Part No. 08159SL

Service Manual

Groundsmaster® 5900 & 5910

Preface

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

REFER TO THE OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manual and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

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

This safety symbol means DANGER, WARNING, or CAUTION, PERSONAL SAFETY INSTRUCTION. When you see this symbol, carefully read the instructions that follow. Failure to obey the instructions may result in personal injury.

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

IMPORTANT: The IMPORTANT notice will give important instructions which must be followed to prevent damage to systems or components on the machine.



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Safety

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General Safety Instructions

The Groundsmaster 5900 and 5910 are tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

To reduce the potential for injury or death, comply with the following safety instructions.

Before Operating

1. Review and understand the contents of the Operator's Manual and Operator's DVD before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

3. Assure interlock switches are adjusted correctly so engine cannot be started unless traction pedal is in NEUTRAL and PTO switch is OFF (disengaged).

4. Since diesel fuel is flammable, handle it carefully:

   A. Use an approved fuel container.

   B. Do not remove fuel tank cap while engine is hot or running.

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill fuel tank.

   E. Wipe up any spilled fuel.

While Operating

1. Sit on the seat when starting and operating the machine.

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure the traction pedal is in the neutral position and the PTO switch is OFF (disengaged).

   C. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the traction pedal is adjusted incorrectly; therefore, shut engine off and adjust traction system until machine does not move when traction pedal is released.

3. Do not run engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could possibly be deadly.

4. Do not touch engine, radiator or exhaust system while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Ensure that traction pedal is in the neutral position.

   B. Apply parking brake.

   C. Lower the cutting decks fully to the ground. This relieves pressure from the lift circuit and eliminates the risk of the cutting decks accidentally lowering to the ground.

   D. Disengage cutting decks and wait for cutting blades to stop completely.

   E. Allow engine to run at low idle speed for at least five (5) minutes after full load operation to allow the turbocharger to cool.

   F. Stop engine and remove key from switch. Wait for all machine movement to stop.

6. Do not park machine on slopes unless wheels are chocked or blocked.

Maintenance and Service

1. Before servicing or making machine adjustments, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Make sure machine is in safe operating condition by keeping all nuts, bolts and screws tight.

3. Shut engine off before checking or adding oil to the engine crankcase.

4. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt. Clean protective screen on machine frequently.

5. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

6. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.

7. Disconnect batteries before servicing the machine. Disconnect negative battery cables first and positive cables last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the batteries. Reconnect positive battery cables first and negative cables last.

8. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

9. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

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

11. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the system.

12. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

13. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping engine and lowering the cutting decks to the ground.

14. Make sure all engine fuel system connectors and components are correctly installed, and all fuel hoses are in good condition before starting engine.

15. Keep body and hands away from leaks in engine fuel injection lines. Use cardboard or paper to find high pressure fuel leaks if they may exist. Leaking fuel under pressure can penetrate skin and cause injury.

16. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing and other parts of the body away from cutting decks and other moving parts. Keep bystanders away.

17. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards, and the warranty may be voided.

18. When welding on machine, disconnect all battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Disconnect and remove engine electronic control module (ECM) from engine before welding on the machine. Also, attach welder ground cable no more than two (2) feet (0.61 meters) from the welding location.

19. If major repairs are ever needed or assistance is desired, contact an Authorized Toro Distributor.

Jacking Instructions

CAUTION

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

Jacking the Front End (Fig. 1)

1. Chock both rear tires to prevent the machine from moving.

2. Position jack securely under the frame, just to the inside of the front tire. Make sure that jack does not contact hydraulic lift cylinder.

3. Position appropriate jack stands under the frame as close to the front wheel as possible to support the machine.

Jacking the Rear End (Fig. 2)

1. Apply parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely under the center of rear axle. Jack rear of machine off the ground.

3. Use appropriate jack stands under the rear axle to support the machine.

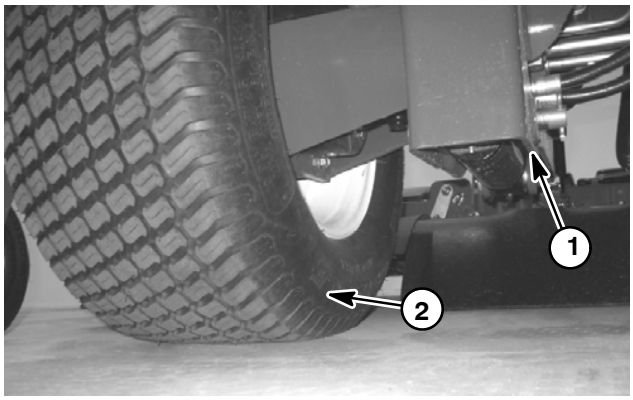


Figure 1

1. Frame jacking point **2. Front tire**

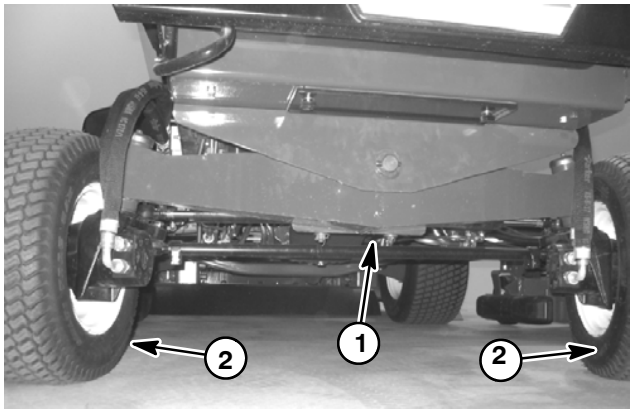


Figure 2

1. Rear axle jacking point **2. Rear tire**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to your Groundsmaster. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog.

Chapter 2

Product Records and Maintenance

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Product Records

Insert Operator's Manuals and Parts Catalogs for your Groundsmaster at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for your Groundsmaster are covered in the Operator's Manuals. Refer to this publication when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

1 mm = 0.03937 in. **0.001 in. = 0.0254 mm**

U.S.to Metric Conversions

	To Convert	Into	Multiply By
Linear Measurement	Miles	Kilometers	1.609
	Yards	Meters	0.9144
	Feet	Meters	0.3048
	Feet	Centimeters	30.48
	Inches	Meters	0.0254
	Inches	Centimeters	2.54
	Inches	Millimeters	25.4
Area	Square Miles	Square Kilometers	2.59
	Square Feet	Square Meters	0.0929
	Square Inches	Square Centimeters	6.452
	Acre	Hectare	0.4047
Volume	Cubic Yards	Cubic Meters	0.7646
	Cubic Feet	Cubic Meters	0.02832
	Cubic Inches	Cubic Centimeters	16.39
Weight	Tons (Short)	Metric Tons	0.9078
	Pounds	Kilograms	0.4536
	Ounces (Avdp.)	Grams	28.3495
Pressure	Pounds/Sq. In.	Kilopascal	6.895
	Pounds/Sq. In.	Bar	0.069
Work	Foot-pounds	Newton-Meters	1.356
	Foot-pounds	Kilogram-Meters	0.1383
	Inch-pounds	Kilogram-Centimeters	1.152144
Liquid Volume	Quarts	Liters	0.9463
	Gallons	Liters	3.785
Liquid Flow	Gallons/Minute	Liters/Minute	3.785
Temperature	Fahrenheit	Celsius	1. Subract 32° 2. Multiply by 5/9

Torque Specifications

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 fasteners shall apply to all fasteners which do not have a specific requirement identified in this Service Manual. The following factors shall be considered when applying 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 fastener's head or similar condition which affects the installation.

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into 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 verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification

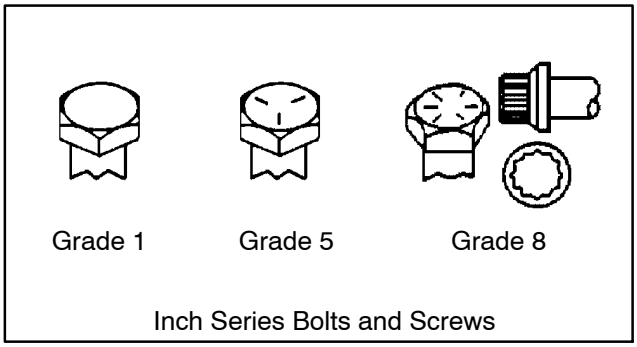


Figure 1

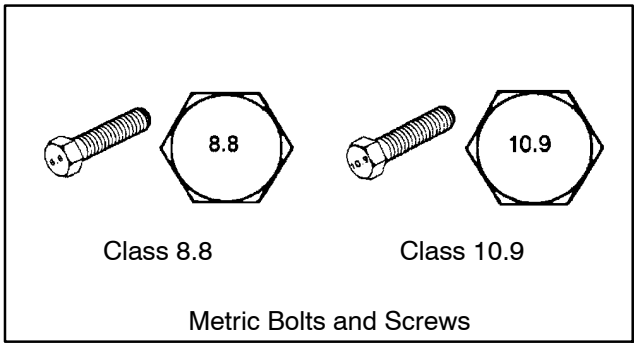


Figure 2

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

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	**in-lb**	**N-cm**	**in-lb**	**N-cm**	**in-lb**	**N-cm**
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 - 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 56	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 - 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 - 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 - 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 - 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	ft-lb	**ft-lb**	**N-m**	**ft-lb**	**N-m**	**ft-lb**	**N-m**
3/8 - 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 5	58 ± 7
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
7/16 - 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 - 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 - 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 - 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 - 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 - 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 - 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 - 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
7/8 - 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 - 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 48	644 ± 65	667 ± 66	904 ± 89

NOTE: Reduce 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 thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, 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. Thin height nuts include jam nuts.

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

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

NOTE: Reduce 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 thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

* Hole size, material strength, material thickness and finish must be considered when determining specific torque values. All torque values are based on 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

Chapter 3

Diesel Engine

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General Information

This Chapter gives information about specifications of the Cummins B3.3 diesel engine used in the Groundsmaster 5900 and 5910. Additionally, some engine repair procedures are described in this manual. Described adjustments and repairs require tools which are commonly available in many service shops.

Some service and repair parts for the engine in your Groundsmaster are supplied through your Authorized Toro Distributor. Be prepared to provide your distributor with the Toro model and serial number of your machine to obtain parts.

Detailed information on engine troubleshooting, testing, disassembly and reassembly is identified in the Cummins Service Manual that is available from Cummins. The use of some specialized tools and test equipment is explained in the Cummins Service Manual. However, the specialized nature of some engine repairs may dictate that the work be done at an engine repair facility.

Operator's Manual

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

Engine Identification

The engine dataplate located near the starter motor includes the engine serial number and control parts list number. The fuel injection dataplate is located on the fuel injection pump. The ECM dataplate is on the electronic control module attached to the flywheel end of the engine. These engine identification tags will assist in identifying the correct parts and service information for the Cummins engine in your Groundsmaster.

Engine Electronic Control Module (ECM)

The Cummins engine that is used in the Groundsmaster 5900 and 5910 uses an electronic control module (ECM) for engine management and also to communicate with the TEC controllers and the operator Info Center on the machine. All engine ECM electrical connectors should be plugged into the controller before the machine ignition switch is moved from the OFF position to either the ON or START position. If the engine ECM is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the ECM. Also, to prevent possible module damage when welding on the machine, disconnect and remove the engine ECM from the engine before welding.

Stopping the Engine

IMPORTANT: Before stopping the engine after mowing or full load operation, allow the engine to run at low idle speed for five (5) minutes. This will allow the turbocharger and internal engine components to adequately cool down. Failure to allow this cool down period may lead to premature turbocharger and engine failure.

Fuel Injection System

The engine fuel injection system operates at high pressures during engine operation. Do not loosen any fuel system components, fittings or hoses while the engine is running.

Keep body and hands away from leaks in engine fuel injection lines. Use cardboard or paper to find high pressure fuel leaks if they may exist. Leaking fuel under pressure can penetrate skin and cause injury.

Engine Specifications

Item	Description
Make / Designation	Cummins, 4-Cycle, 4 Cylinder, Liquid Cooled, Turbocharged, Diesel Engine
Bore	3.74 in (95.0 mm)
Stroke	4.53 in (115 mm)
Total Displacement	201 in^3 (3300 cc)
Firing Order	1 (Closest to Engine Pulley) - 2 - 4 - 3
Direction of Rotation	Clockwise (Viewed from Engine Pulley)
Compression Ratio	17:1
Valve Clearance Intake Exhaust	 0.014" (0.35 mm) 0.020" (0.50 mm)
Fuel	Diesel or Biodiesel (up to B20) with Low/Ultra Low Sulfur Content
Fuel Tank Capacity	35 U.S. gallons (132 liters)
Fuel Injection Pump	Zexel Rotary Type VE Pump
Injection Nozzle	Closed Nozzle, Hole Type
Governor	Electronic
Low Idle (no load)	1350 RPM
High Idle (no load)	2750 RPM
Oil Pump	Geroter Type
Engine Oil	API CH-4 or CI-4 (see Operator's Manual for Viscosity)
Crankcase Oil Capacity	8.5 U.S. quarts (8.0 liters) with Filter
Starter	12 VDC, 2.2 kW
Alternator/Regulator	12 VDC, 120 AMP
Coolant Capacity GM 5900 (without cab) GM 5910 (with cab)	 13.5 U.S. quarts (12.8 liters) 18 U.S. quarts (17 liters)
Engine Dry Weight	606 U.S. pounds (275 kg)

Engine Fastener Torque Specifications

Item	Description
Alternator Adjusting Cap Screw	23 ft-lb (31 N-m)
Alternator Mounting Bracket Cap Screw (2 used)	23 ft-lb (31 N-m)
Alternator Mounting Cap Screw	49 ft-lb (66 N-m)
Crankshaft Pulley Bolt	274 ft-lb (372 N-m)
Exhaust Manifold Flange Head Screw (8 used)	33 ft-lb (45 N-m)
Front Cover Flange Head Screw (16 used)	14 ft-lb (19 N-m)
Oil Drain Plug	38 ft-lb (51 N-m)
Oil Pan Flange Head Screw (24 used)	24 to 38 ft-lb (32 to 51 N-m)
Oil Suction Tube Flange Head Screw (2 used)	14 ft-lb (19 N-m)
Starter Mounting Flange Head Screw (2 used)	32 ft-lb (43 N-m)
Thermostat Housing Flange Head Screw (2 used)	14 ft-lb (19 N-m)
Turbocharger Mounting Nut (4 used)	22 ft-lb (30 N-m)
Turbocharger Oil Drain Line Cap Screw (2 used)	18 ft-lb (24 N-m)
Turbocharger Oil Supply Line Banjo Bolt	18 ft-lb (24 N-m)
Valve Adjustment Nut (rocker arm)	29 to 36 ft-lb (39 to 49 N-m)
Valve Cover Nut (3 used)	80 in-lb (9 N-m)
Water Pump Pulley Flange Head Screw (4 used)	23 ft-lb (31 N-m)

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Adjustments

Valve Clearance

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

2. Raise and support hood.

3. Remove valve cover from engine (see Valve Cover Removal in the Service and Repairs section of this chapter).

4. Position engine crankshaft so cylinder #1 is at top dead center (TDC) at the end of the compression stroke:

   A. While watching the movement of the cylinder #4 intake valve, rotate engine crankshaft in normal rotation direction (clockwise). When the cylinder #4 intake valve starts to open, cylinder #1 is approaching TDC at the end of the compression stroke.

   B. Continue rotating the crankshaft in the normal rotation direction (clockwise) until the cutout in the tone wheel attached to the back of the crankshaft pulley aligns with "1.4 TOP" cast in engine front cover (Fig. 1).

5. In this crankshaft position, adjust valve clearance for intake valves for cylinders #1 and #3 and exhaust valves for cylinders #1 and #2 (Fig. 2 and 3).

   A. Loosen the lock nut on the rocker arm adjustment screw.

   B. Insert correct feeler gauge between the valve stem and the rocker arm. Intake valve clearance specification is 0.014" (0.35 mm). Exhaust valve clearance specification is 0.020" (0.50 mm).

   C. Adjust screw until a slight drag is felt on the feeler gauge.

   D. Hold adjustment screw in position and tighten lock nut to secure valve clearance adjustment. Torque lock nut from **29 to 36 ft-lb (39 to 49 N-m)**.

   E. After tightening lock nut, re-check valve clearance.

6. Rotate crankshaft in the normal rotation direction (clockwise) one complete revolution. The tone wheel cutout should again be aligned with "1.4 TOP".

7. In this crankshaft position, adjust valve clearance for intake valves for cylinders #2 and #4 and exhaust valves for cylinders #3 and #4. Follow procedure under step 5 above.

8. Install valve cover to engine (see Valve Cover Installation in the Service and Repairs section of this chapter).

9. Lower and secure hood.

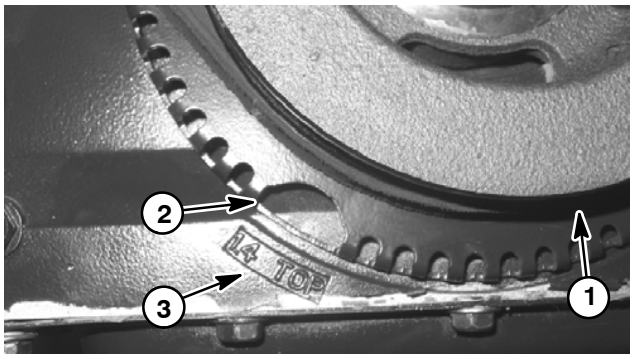


Figure 1

1. **Crankshaft pulley**
2. **Tone wheel cutout**
3. **TDC indicator**

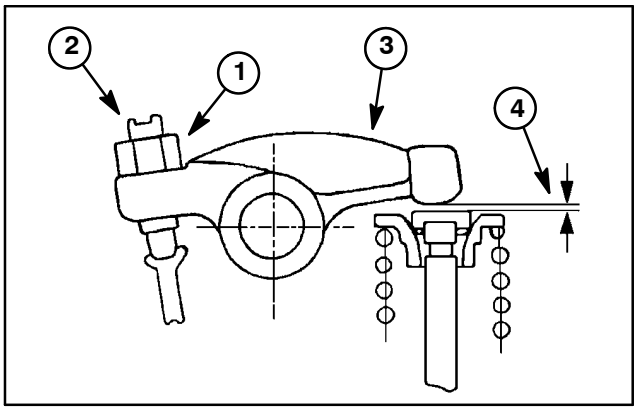


Figure 2

1. **Lock nut**
2. **Adjustment screw**
3. **Rocker arm**
4. **Valve clearance**

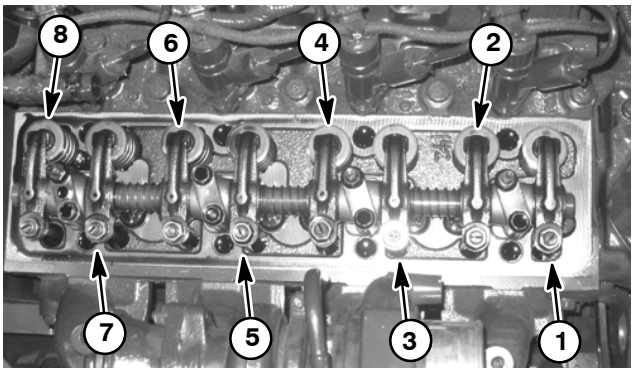


Figure 3

1. **#1 intake**
2. **#1 exhaust**
3. **#2 intake**
4. **#2 exhaust**
5. **#3 intake**
6. **#3 exhaust**
7. **#4 intake**
8. **#4 exhaust**

Air Filter System

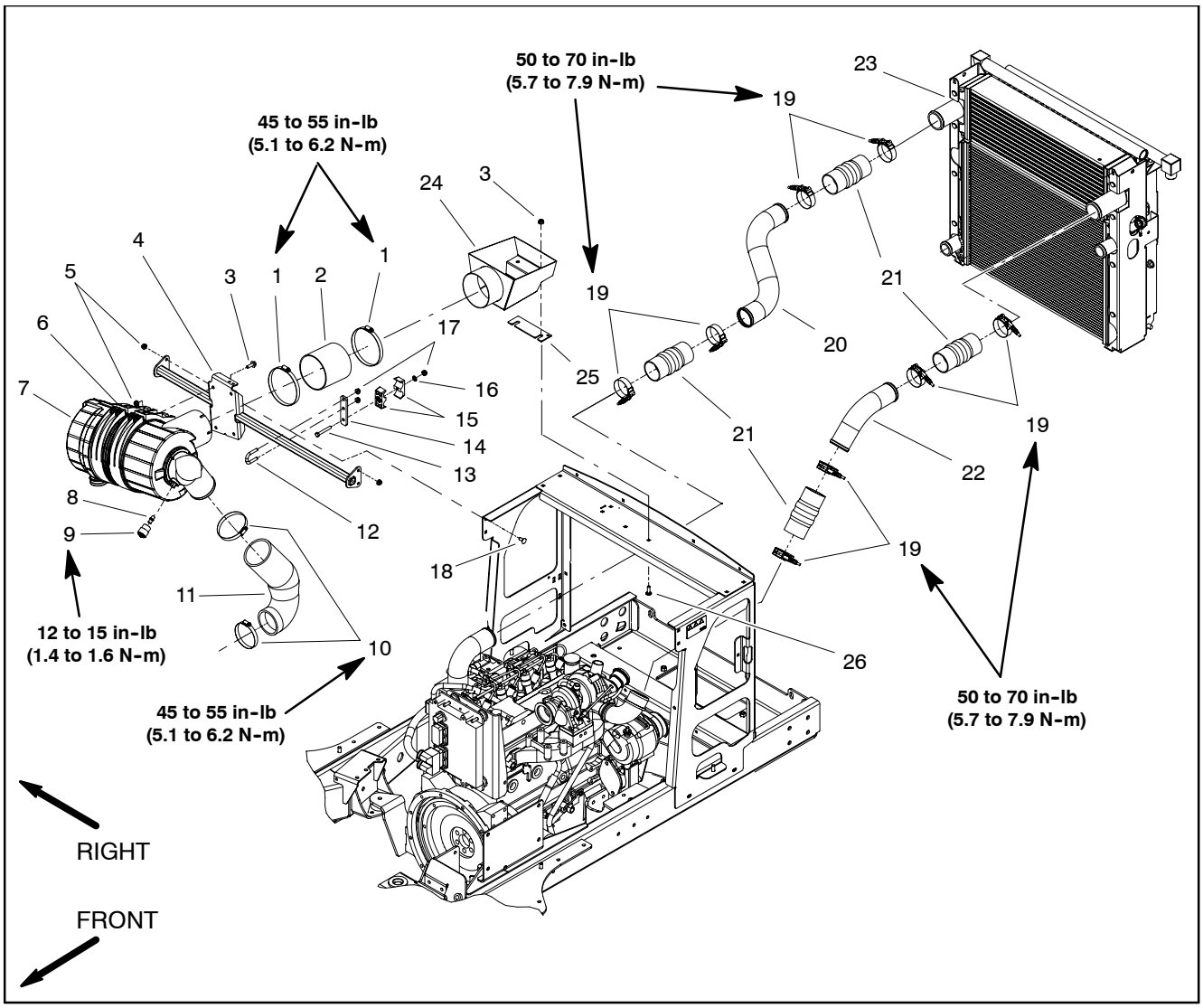


Figure 4

1. Clamp
2. Air hose
3. Flange head screw (6 used)
4. Air cleaner mount
5. Flange nut (8 used)
6. Air cleaner mounting band (2 used)
7. Air cleaner assembly
8. Adapter
9. Service indicator
10. Worm clamp
11. Intake tube
12. U-bolt
13. Cap screw
14. Mount plate
15. Tube clamp
16. Flat washer
17. Flange nut (3 used)
18. Carriage screw (4 used)
19. Hose clamp (8 used)
20. Tube
21. Air intake tube (4 used)
22. Tube
23. Radiator assembly
24. Airbox
25. Spacer plate (as needed)
26. Carriage screw (2 used)

Removal (Fig. 4)

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

2. Raise and support hood to allow access to engine.

3. Remove air cleaner components as needed using Figure 4 as a guide.

4. Inspect all tubes and clamps for evidence of wear or damage. Replace components as needed.

NOTE: If charge air cooler in radiator assembly needs to be serviced (Fig. 5), refer to Radiator Removal and Installation in this section.

Installation (Fig. 4)

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

1. Assemble air cleaner system using Figure 4 as a guide.

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

   B. Position hose clamps (item 1) so that there is no interference with hood foam when hood is closed.

   C. Torque hose clamps (items 1 and 10) from **45 to 55 in-lb (5.1 to 6.2 N-m)**.

   D. Torque hose clamps (item 19) from **50 to 70 in-lb (5.7 to 7.9 N-m)**.

   E. Make sure that air cleaner vacuator valve is pointed down after assembly (Fig. 6).

   F. If service indicator (item 8) and adapter (item 9) were removed from air cleaner housing, apply thread sealant to adapter threads before installing adapter and indicator to housing. Install adapter so that grooves in adapter hex and adapter filter element are installed toward service indicator (Fig. 7). Torque indicator from **12 to 15 in-lb (1.4 to 1.6 N-m)**.

2. Apply chalk on airbox lip, lower hood and check that hood makes a continuous seal around airbox (item 24). If necessary, use shim(s) (item 25) to adjust location of airbox for proper sealing with hood.

3. Lower and secure hood.

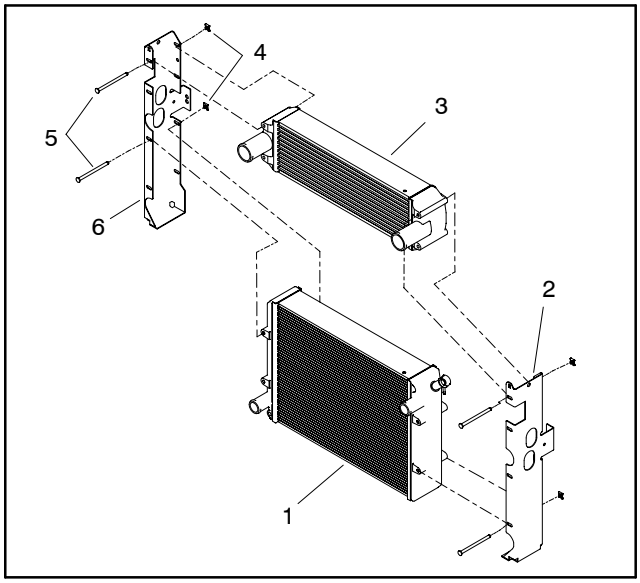


Figure 5

1. **Radiator**
2. **LH cooler bracket**
3. **Charge air cooler**
4. **Pin clip (8 used)**
5. **Pin (8 used)**
6. **RH cooler bracket**

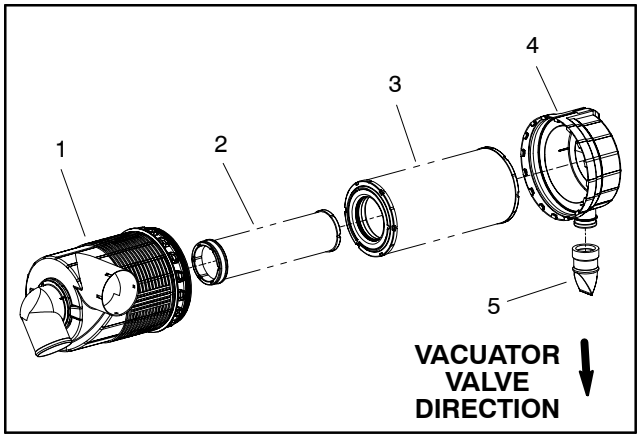


Figure 6

1. **Air cleaner housing**
2. **Safety filter**
3. **Filter element**
4. **Cover**
5. **Vacuator valve**

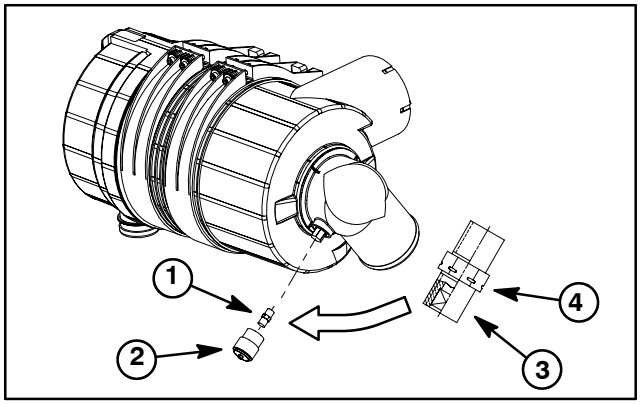


Figure 7

1. **Adapter**
2. **Service indicator**
3. **Adapter filter element**
4. **Adapter grooves**

Exhaust System

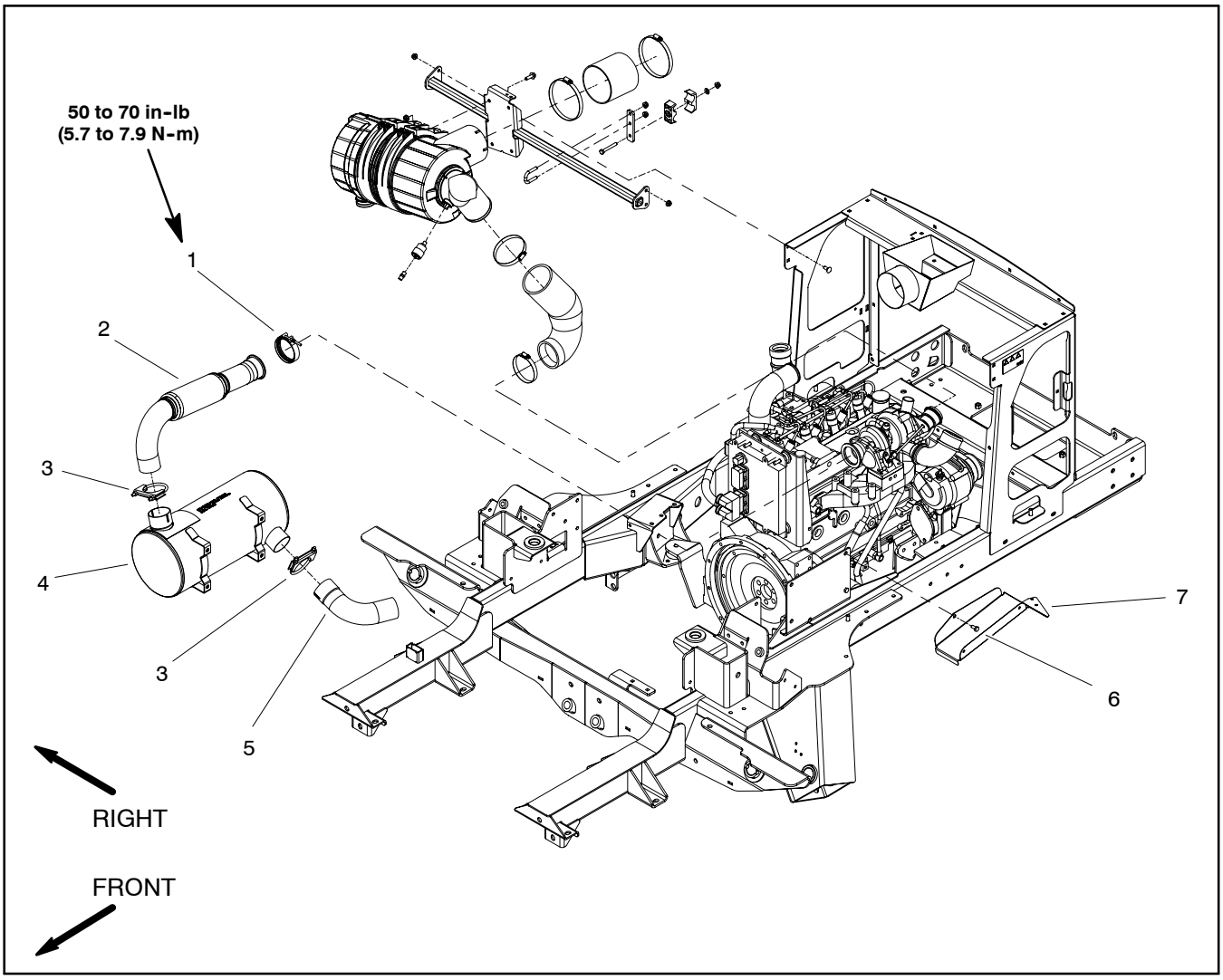


Figure 8

1. **Exhaust clamp**
2. **Exhaust tube**
3. **Muffler clamp (2 used)**
4. **Muffler**
5. **Tailpipe**
6. **Flange head screw (4 used)**
7. **Heat shield**

Removal (Fig. 8)

CAUTION

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

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

2. Raise and support hood to allow access to exhaust system.

3. Remove side panel from right side of frame to allow easier access to exhaust system components.

4. Remove muffler and/or exhaust tube from the engine as necessary using Figure 8 as a guide.

5. If necessary, remove exhaust manifold from engine (Fig. 9):

   A. Remove turbocharger from exhaust manifold (see Turbocharger Removal in this section).

   B. Support exhaust manifold to prevent it from falling.

   C. Remove eight (8) flange head screws that secure exhaust manifold to cylinder head. Remove manifold from engine.

   D. Remove and discard manifold gasket. Clean mating surfaces of cylinder head and manifold.

6. If exhaust openings are to be left open for any length of time, cover openings to prevent any material from falling into openings.

Installation (Fig. 8)

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

1. Remove all covers and plugs that were placed during removal to prevent contamination entry.

2. Install exhaust manifold to engine if removed (Fig. 9):

   A. Apply antiseize lubricant to threads of flange head screws used to secure exhaust manifold.

   B. Position new manifold gasket and exhaust manifold to cylinder head and secure with eight (8) flange head screws. Tighten the screws in the sequence shown in Figure 10. Torque screws **33 ft-lb (45 N-m)**.

   C. Secure turbocharger to exhaust manifold (see Turbocharger Installation in this section).

3. Install muffler and/or exhaust tube to the engine using Figure 8 as a guide. Torque exhaust clamp (item 1) from **50 to 70 in-lb (5.7 to 7.9 N-m)**.

4. After exhaust system assembly, check that tailpipe is approximately parallel to the ground. Loosen clamp and adjust tailpipe if necessary.

5. Install and secure side panel to right side of frame.

6. Lower and secure hood.

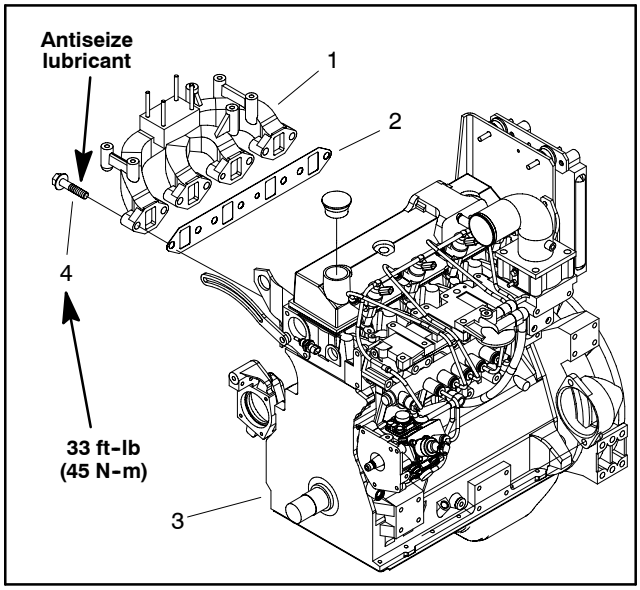


Figure 9

1. Exhaust manifold
2. Manifold gasket
3. Engine
4. Flange screw (8 used)

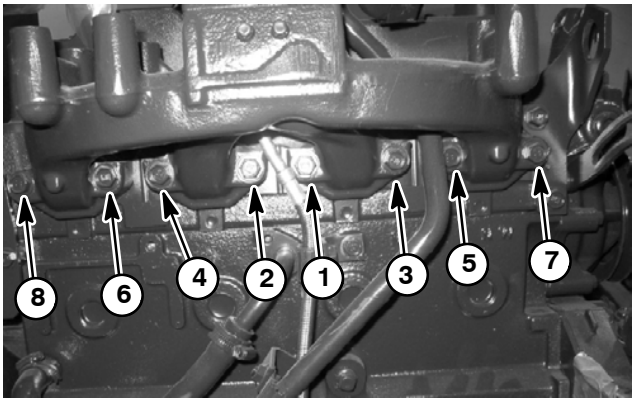


Figure 10

Turbocharger

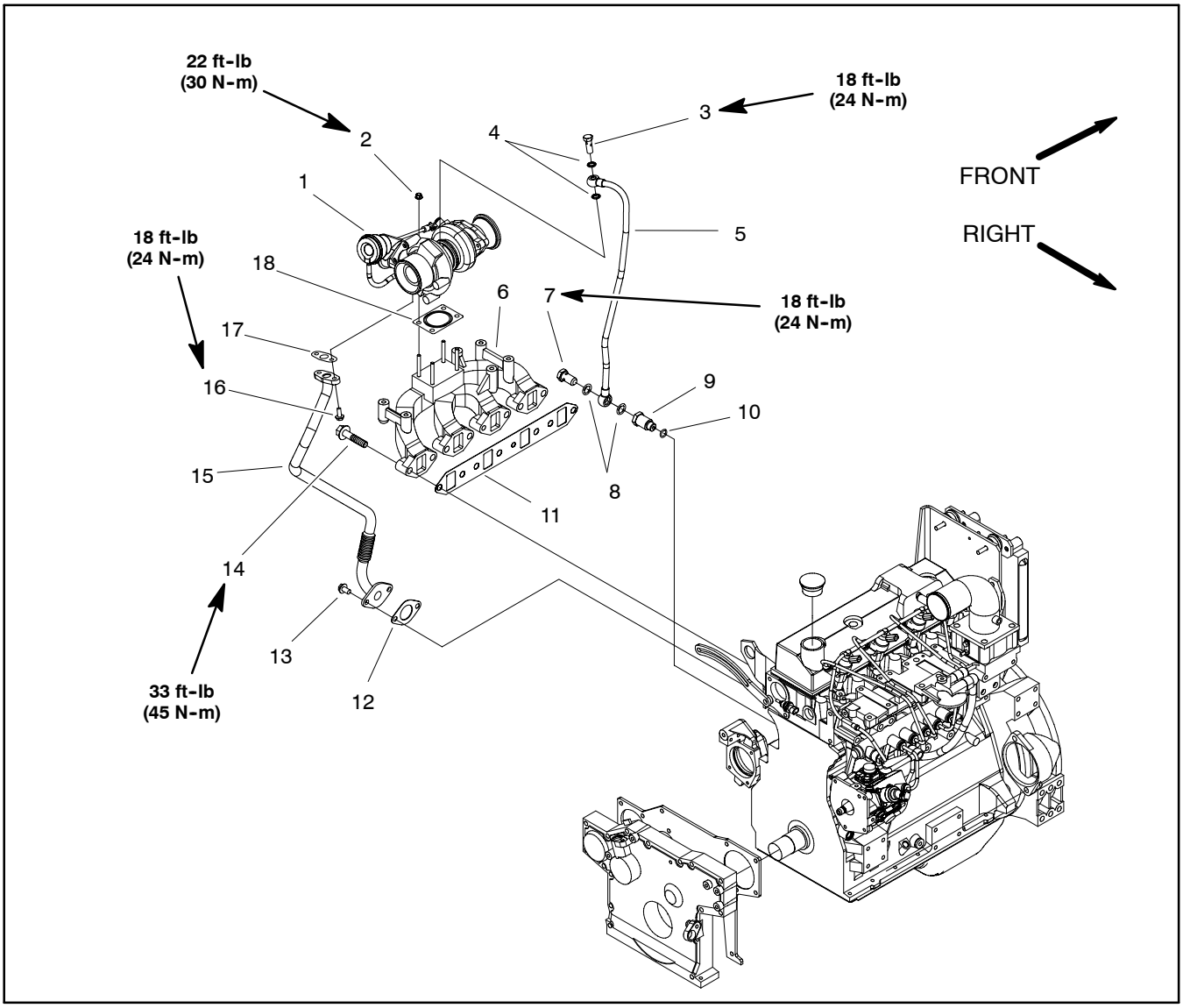


Figure 11

1. **Turbocharger assembly**
2. **Flange nut (4 used)**
3. **Banjo bolt**
4. **Sealing washer**
5. **Oil supply tube**
6. **Exhaust manifold**
7. **Banjo bolt**
8. **Sealing washer**
9. **Coupling**
10. **O-ring**
11. **Exhaust manifold gasket**
12. **Gasket**
13. **Flange head screw (2 used)**
14. **Flange head screw (8 used)**
15. **Oil drain tube**
16. **Flange head screw (2 used)**
17. **Gasket**
18. **Turbocharger gasket**

Removal (Fig. 11)

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 turbocharger.

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

2. Raise and support hood to allow access to engine.

3. Thoroughly clean turbocharger area to prevent contaminants from entering engine.

4. Loosen clamps that secure exhaust tube to turbocharger outlet and muffler inlet. Remove exhaust tube.

5. Loosen clamps that secure air intake tube to turbocharger inlet and air cleaner outlet. Remove air intake tube.

6. Remove two (2) cap screws that secure oil drain line to turbocharger. Separate oil drain line from turbocharger.

7. Remove banjo bolt that secures oil supply line to turbocharger. Separate oil supply line from turbocharger.

8. Remove four (4) nuts that secure turbocharger to exhaust manifold.

9. Carefully lift turbocharger from exhaust manifold.

10. Cover engine, air cleaner and turbocharger openings to prevent any material from falling into openings. Also, plug openings in oil supply and drain lines.

Installation (Fig. 11)

NOTE: Make sure muffler flange and exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Install new gaskets if original gasket was damaged.

2. Remove all covers and plugs that were placed to prevent contamination entry.

3. Position turbocharger to exhaust manifold and secure with four (4) nuts. Torque nuts **22 ft-lb (30 N-m)**.

4. Position oil drain line to turbocharger and secure with two (2) cap screws. Torque screws **18 ft-lb (24 N-m)**.

5. Pour clean engine oil into oil supply line port to ensure turbocharger lubrication on start-up.

6. Position oil supply line to turbocharger and secure with banjo bolt. Torque banjo bolt **18 ft-lb (24 N-m)**.

7. Fit air intake tube to turbocharger inlet and air cleaner outlet. Secure intake tube with clamps.

8. Fit exhaust tube to turbocharger outlet and muffler inlet. Secure exhaust tube with clamps.

9. Lower and secure hood.

Fuel Tank

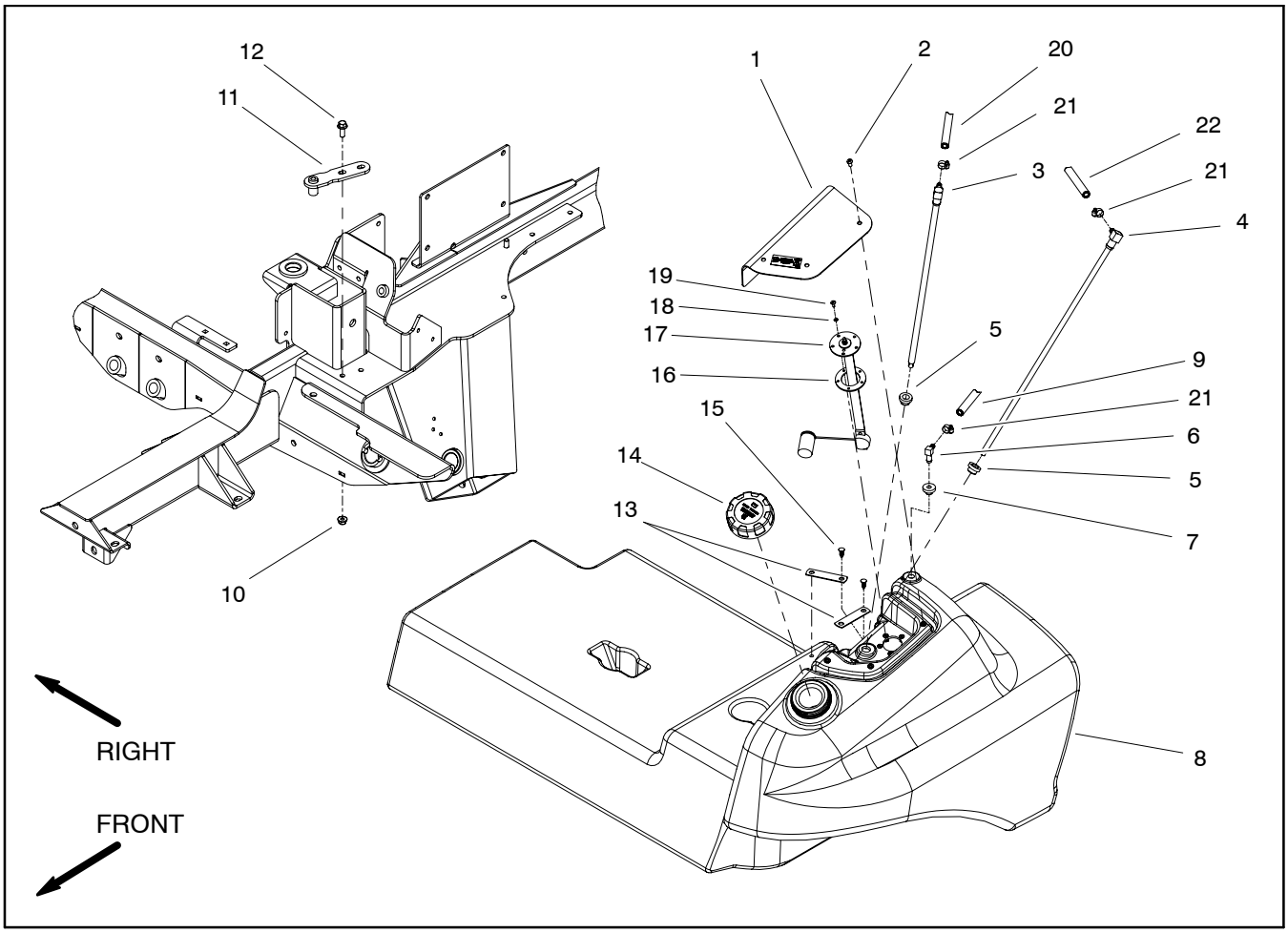


Figure 12

1. Fitting cover
2. Screw (3 used)
3. Fuel supply standpipe
4. Fuel return standpipe
5. Bushing (2 used)
6. Elbow fitting
7. Bushing
8. Fuel tank
9. Fuel hose (2 used)
10. Flange nut (2 used)
11. Tank hold down
12. Flange head screw (2 used)
13. Clamp (2 used)
14. Cap
15. Plug (4 used)
16. Gasket
17. Fuel sender
18. Lock washer (5 used)
19. Screw (5 used)
20. Fuel hose
21. Worm clamp (3 used)
22. Fuel hose

DANGER

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

Check Fuel Lines and Connections

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

Drain and Clean Fuel Tank

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

To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of contaminates and debris.

Fuel Tank Removal (Fig. 12)

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

2. Chock rear wheels and jack up front of machine. Support machine on jack stands. Remove front, left wheel to allow fuel tank removal.

3. Use a fuel transfer pump to remove fuel from the fuel tank and into a suitable container.

4. Remove three (3) socket head screws that secure fitting cover (item 1) to fuel tank. Remove fitting cover.

5. Disconnect power (blue/red) and ground (black) wires from the fuel sender on the fuel tank (Fig. 13).

6. Label fuel hoses to assure proper assembly. Disconnect fuel hoses from the fuel supply standpipe (item 3), the return standpipe (item 4) and the vent elbow fitting (item 6) in top of tank (Fig. 13).

7. Route fuel lines from under clamps (item 13) that route fuel lines from standpipes. If necessary, remove plugs and clamps from top of tank.

8. Remove two (2) flange head screws and lock nuts that secure tank hold down (item 11) to frame. Remove tank hold down.

9. Slide fuel tank from left side of machine to remove tank.

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

Fuel Tank Installation (Fig. 12)

1. If removed, install standpipes, elbow bushings and fuel sender into fuel tank.

2. Install fuel tank from left side of machine.

3. Position tank hold down (item 11) to fuel tank and machine frame. Secure hold down with two (2) flange head screws and lock nuts.

4. Route fuel supply and return hoses under clamps in top of tank.

5. Using labels placed during tank removal, correctly connect fuel hoses to the fuel supply standpipe, the return standpipe and the vent elbow fitting. Secure hoses with hose clamps.

6. Connect electrical wiring to the fuel sender.

   A. Connect blue/red wire to the center terminal and black wire to any of the screws that secure the fuel sender to the fuel tank.

   B. Apply skin-over grease (Toro Part No. 505-165) to the wire terminal connections.

7. Position fitting cover to fuel tank and secure with three (3) socket head screws.

WARNING

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

8. Install front, left wheel assembly.

9. Lower machine to ground. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

10. Fill fuel tank.

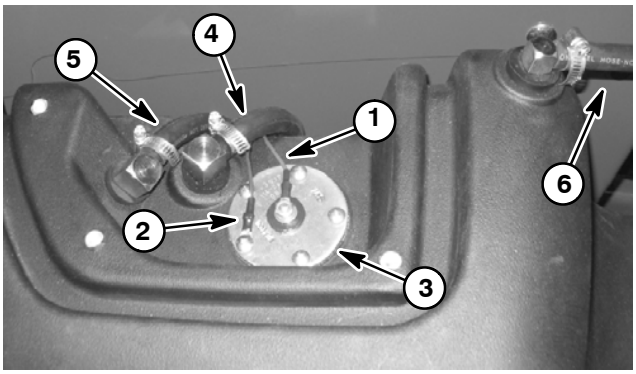


Figure 13

1. **Sender power wire**
2. **Sender ground wire**
3. **Fuel sender**
4. **Fuel supply hose**
5. **Return fuel hose**
6. **Vent hose**

Radiator

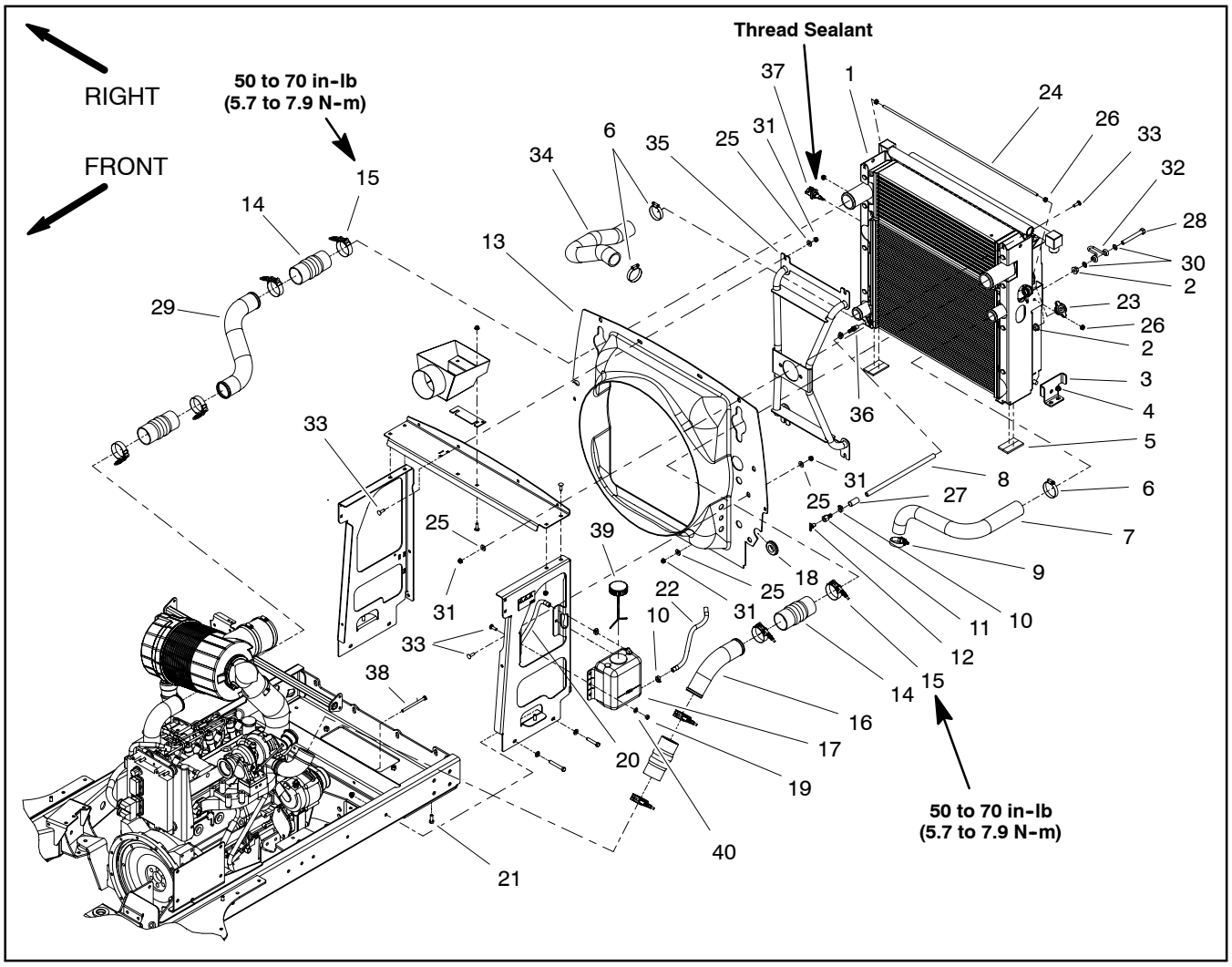


Figure 14

1. Radiator assembly
2. Flange nut (4 used)
3. Support plate (2 used)
4. Flange nut (4 used)
5. Rubber pad (4 used)
6. Hose clamp (3 used)
7. Upper radiator hose
8. Overflow hose
9. Hose clamp
10. Worm clamp (5 used)
11. Barb fitting
12. Drain cock fitting
13. Fan shroud
14. Air intake tube (4 used)
15. Hose clamp (8 used)
16. Tube
17. Coolant reservoir
18. Grommet (2 used)
19. Lock nut (2 used)
20. Hose
21. Cap screw (4 used)
22. Hose
23. Radiator cap
24. Support rod
25. Flat washer (10 used)
26. Flange nut (4 used)
27. Hose sleeve
28. Cap screw (2 used)
29. Tube
30. Washer (4 used)
31. Flange nut (14 used)
32. Clamp (2 used)
33. Carriage screw (14 used)
34. Lower radiator hose
35. Fan motor bracket
36. Fitting
37. Coolant level sensor
38. Cap screw (2 used)
39. Reservoir cap
40. Flat washer (2 used)

Removal (Fig. 14)

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

2. Raise and support hood to allow access to radiator.

3. Rotate clamps that secure oil cooler to radiator frame. Tilt oil cooler toward rear of machine.

4. Loosen hose clamps and disconnect air intake tubes (item14) from the charge air cooler.

5. Disconnect wire harness connector from coolant level sensor on right side of radiator.

CAUTION

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

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

6. Drain radiator into a suitable container using the radiator drain. The radiator drain is located near the hydraulic 4WD manifold (Fig. 15).

7. Loosen hose clamps and disconnect upper and lower coolant hoses (item 6) from the radiator.

8. Loosen hose clamp that secures coolant drain hose to fitting (item 36) on bottom of radiator. Remove coolant drain hose assembly from radiator.

9. Disconnect reservoir hose (item 22) from the radiator vent tube.

10. Detach radiator from the fan shroud and support by removing two (2) carriage screws (item 33), flat washers and flange nuts.

11. Tilt radiator and charge air cooler assembly toward rear of machine and carefully lift assembly from the machine.

12. Plug all radiator and hose openings to prevent contamination.

13. Inspect rubber pads (item 5) at bottom of radiator. Replace pads if worn or damaged.

14. Disassemble radiator and charge air cooler assembly as needed using Figure 16 as a guide.

Installation (Fig. 14)

1. Assemble radiator and charge air cooler assembly as needed using Figure 14 as a guide. Apply thread sealant to coolant level sensor if it was removed.

2. Remove plugs from radiator and hoses placed during the removal procedure.

3. Carefully lower radiator and charge air cooler assembly into the machine.

4. Attach radiator to the fan shroud and support with two (2) carriage screws, flat washers and flange nuts.

5. Connect upper and lower coolant hoses (item 6) to the radiator. Secure hoses with hose clamps.

6. Connect air intake tubes (item14) to the charge air cooler and secure with hose clamps. Torque clamps from **50 to 70 in-lb (5.7 to 7.9 N-m)**.

7. Connect wire harness connector to coolant level sensor on right side of radiator.

8. Install coolant drain hose assembly to radiator fitting and secure with hose clamp.

9. Connect reservoir hose (item 22) to the radiator vent tube and secure with hose clamp.

10. Make sure radiator drain is closed. Fill radiator with coolant.

11. Secure oil cooler to radiator frame.

12. Run engine and check for any coolant leaks.

13. Lower and secure hood.

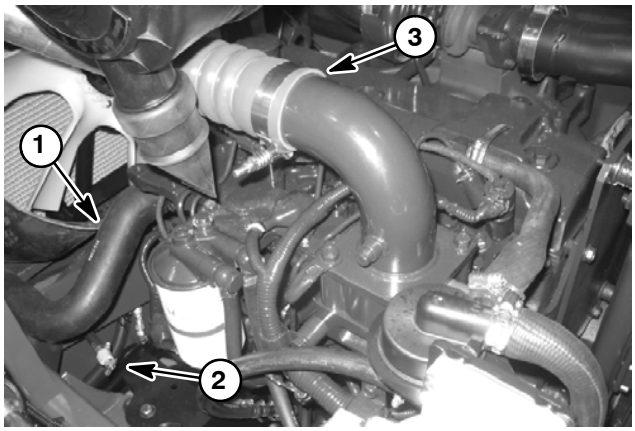


Figure 15

1. **Radiator hose**
2. **Radiator drain**
3. **Air intake tube**

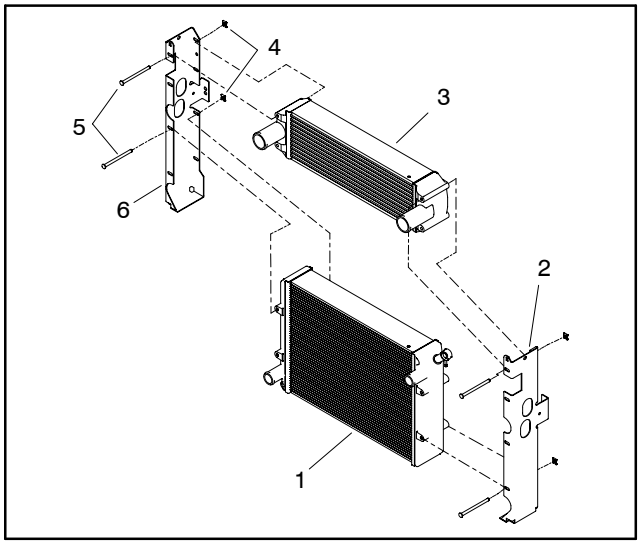


Figure 16

1. **Radiator**
2. **LH cooler bracket**
3. **Charge air cooler**
4. **Pin clip (8 used)**
5. **Pin (8 used)**
6. **RH cooler bracket**

Alternator

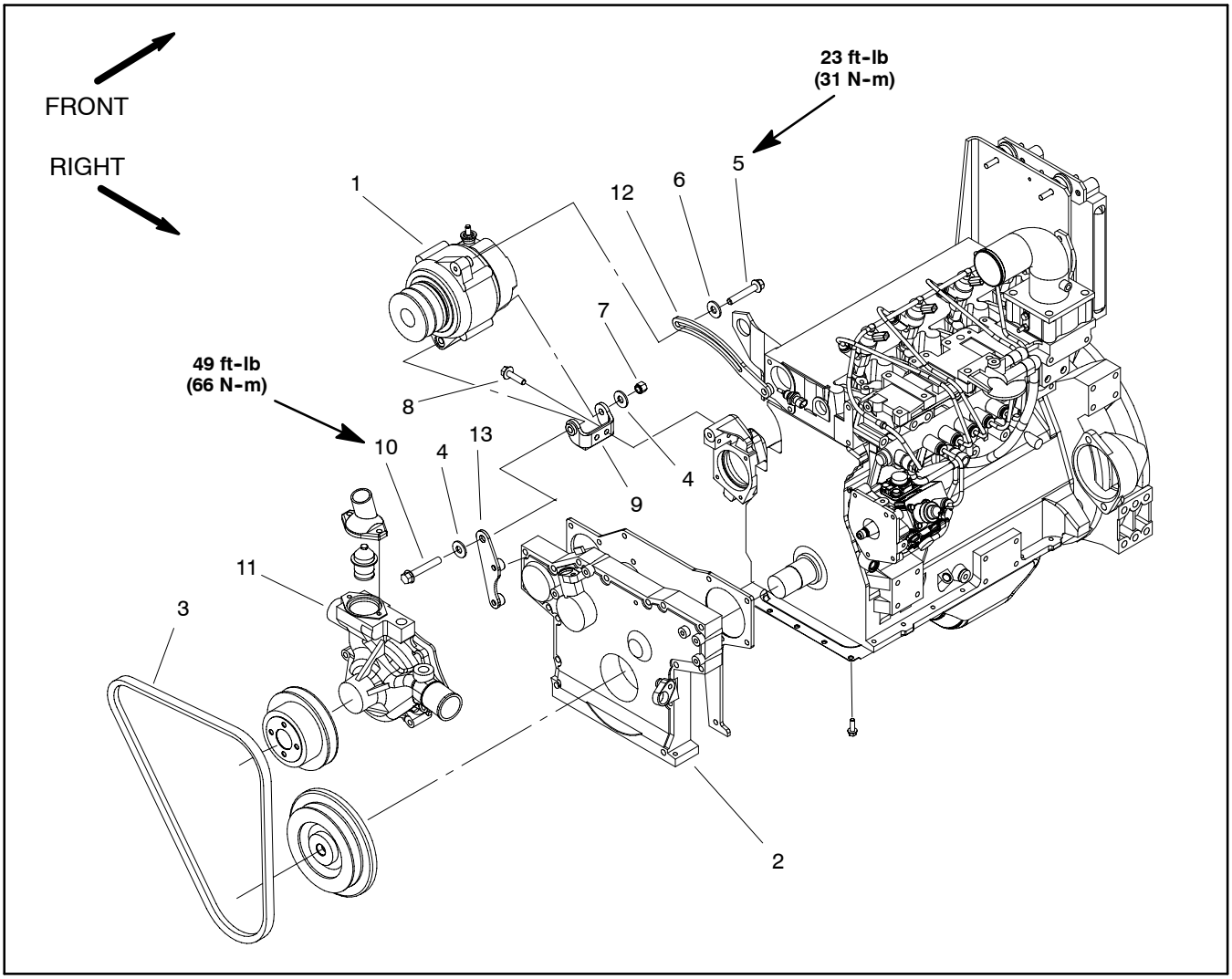


Figure 17

1. **Alternator**
2. **Front cover**
3. **Belt**
4. **Bevel washer (2 used)**
5. **Flange head screw**
6. **Flat washer**
7. **Hex nut**
8. **Flange head screw (2 used)**
9. **Alternator bracket**
10. **Cap screw**
11. **Water pump**
12. **Adjusting bracket**
13. **Alternator bracket**

Removal (Fig. 17)

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

2. Raise and support hood to allow access to engine.

3. Remove battery access panel. Disconnect negative battery cable first and then positive battery cable (see Battery Removal in the Service and Repairs section of Chapter 5 – Electrical System).

4. Loosen flange head screw (item 5) that secures alternator to adjusting bracket. Rotate alternator toward engine to loosen drive belt. Remove belt from alternator pulley.

5. Inspect drive belt for glazing or damage. Replace belt if necessary.

6. For assembly purposes, label all wires that connect to alternator. Disconnect wires from alternator terminals and position wires away from alternator.

7. Support alternator to prevent it from shifting or falling.

8. Remove flange head screw and flat washer that secure alternator to adjusting bracket (item 12). Remove cap screw, two (2) bevel washers and hex nut that secure alternator to mounting brackets (items 9 and 13).

9. Carefully remove alternator from engine and machine.

Installation (Fig. 17)

1. Position alternator to engine brackets.

2. Secure alternator to mounting brackets and adjusting bracket with removed fasteners and washers. Do not fully tighten fasteners.

3. Place drive belt on alternator pulley. Rotate alternator away from engine to properly tension drive belt.

4. Tighten screws to secure alternator. Torque cap screw at mounting bracket (item 10) to **49 ft-lb (66 N-m)**. Torque flange head screw at adjusting bracket (item 5) to **23 ft-lb (31 N-m)**.

5. Using labels placed during alternator removal, correctly connect all wires to alternator terminals.

6. Connect positive battery cable to positive battery terminal. Then, connect negative battery cable to negative battery terminal (see Battery Installation in the Service and Repairs section of Chapter 5 – Electrical System). Install battery access panel.

7. Lower and secure hood.

Starter Motor

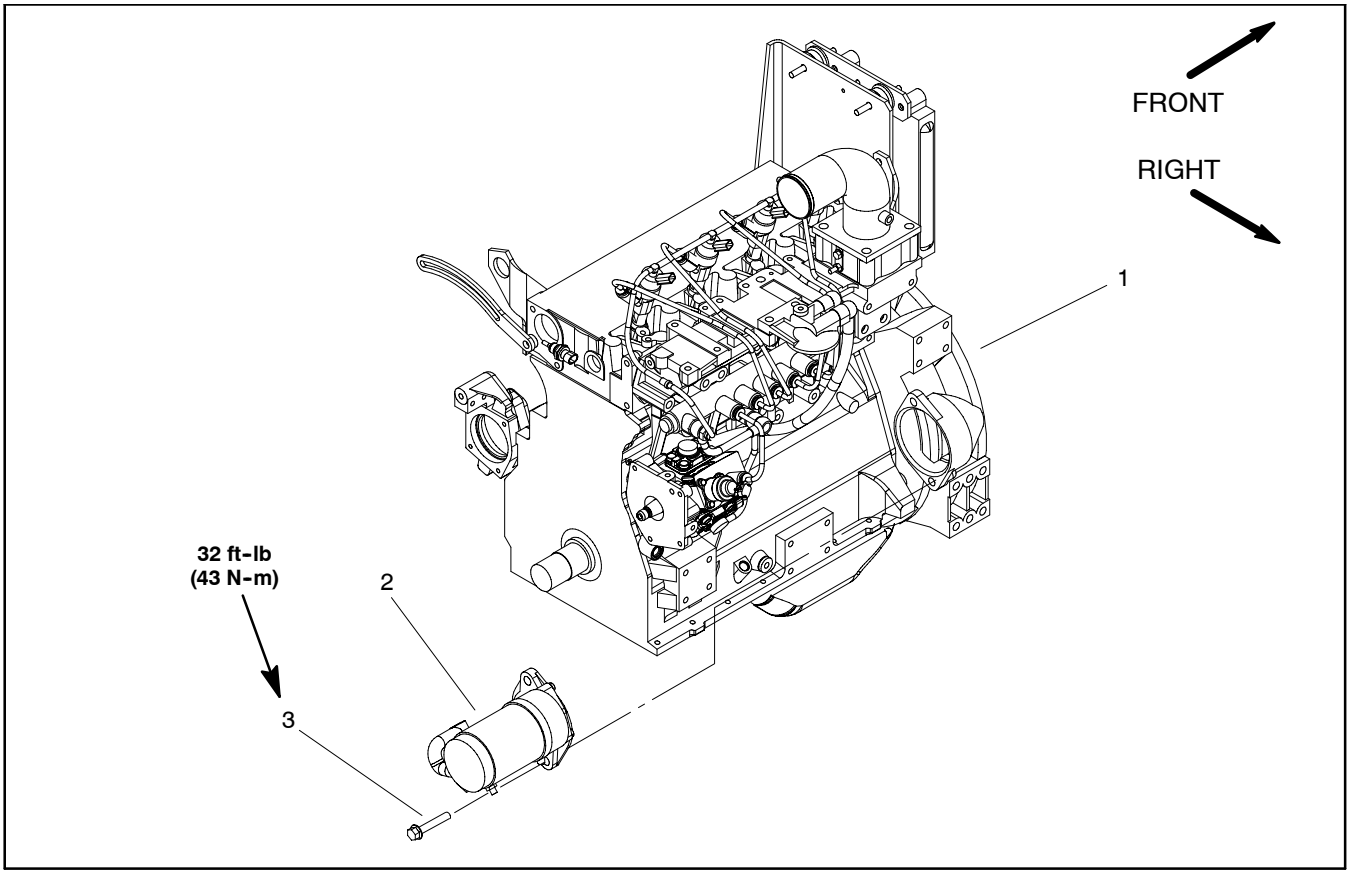


Figure 18

1. **Engine**
2. **Starter motor**
3. **Flange head screw (2 used)**

Removal (Fig. 18)

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

2. Raise and support hood to allow access to engine.

3. Remove battery access panel. Disconnect negative battery cable first and then positive battery cable (see Battery Removal in the Service and Repairs section of Chapter 5 – Electrical System).

4. Label all wires that connect to starter for assembly purposes. Disconnect wires from starter terminals. and position away from starter (Fig. 19).

   A. Remove nut and lock washer that secure cable to starter stud. Remove cable from starter stud.

   B. Loosen screw used to secure harness blue wire to starter solenoid. Unplug wire from starter.

5. Support starter to prevent it from shifting or falling.

6. Remove two (2) flange head screws that secure starter to engine.

7. Carefully remove starter from engine and machine.

Installation (Fig. 18)

1. Position starter to engine housing.

2. Secure starter to engine with two (2) flange head screws. Torque screws **32 ft-lb (43 N-m)**.

3. Using labels placed during removal, correctly connect and secure removed wires to starter terminals.

4. Connect positive battery cable to positive battery terminal. Then, connect negative battery cable to negative battery terminal (see Battery Installation in the Service and Repairs section of Chapter 5 – Electrical System). Install battery access panel.

5. Lower and secure hood.

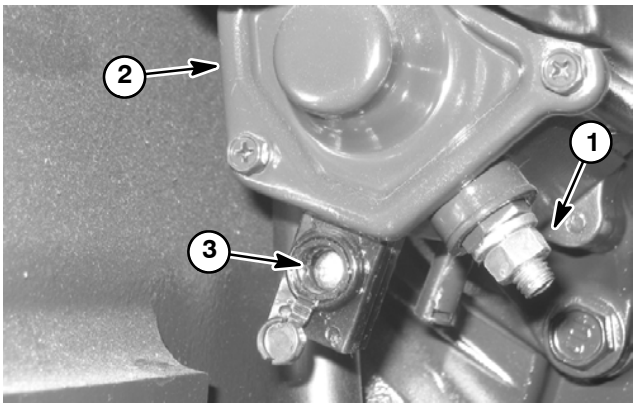


Figure 19

1. **Starter stud**
2. **Starter solenoid**
3. **Screw**

Valve Cover

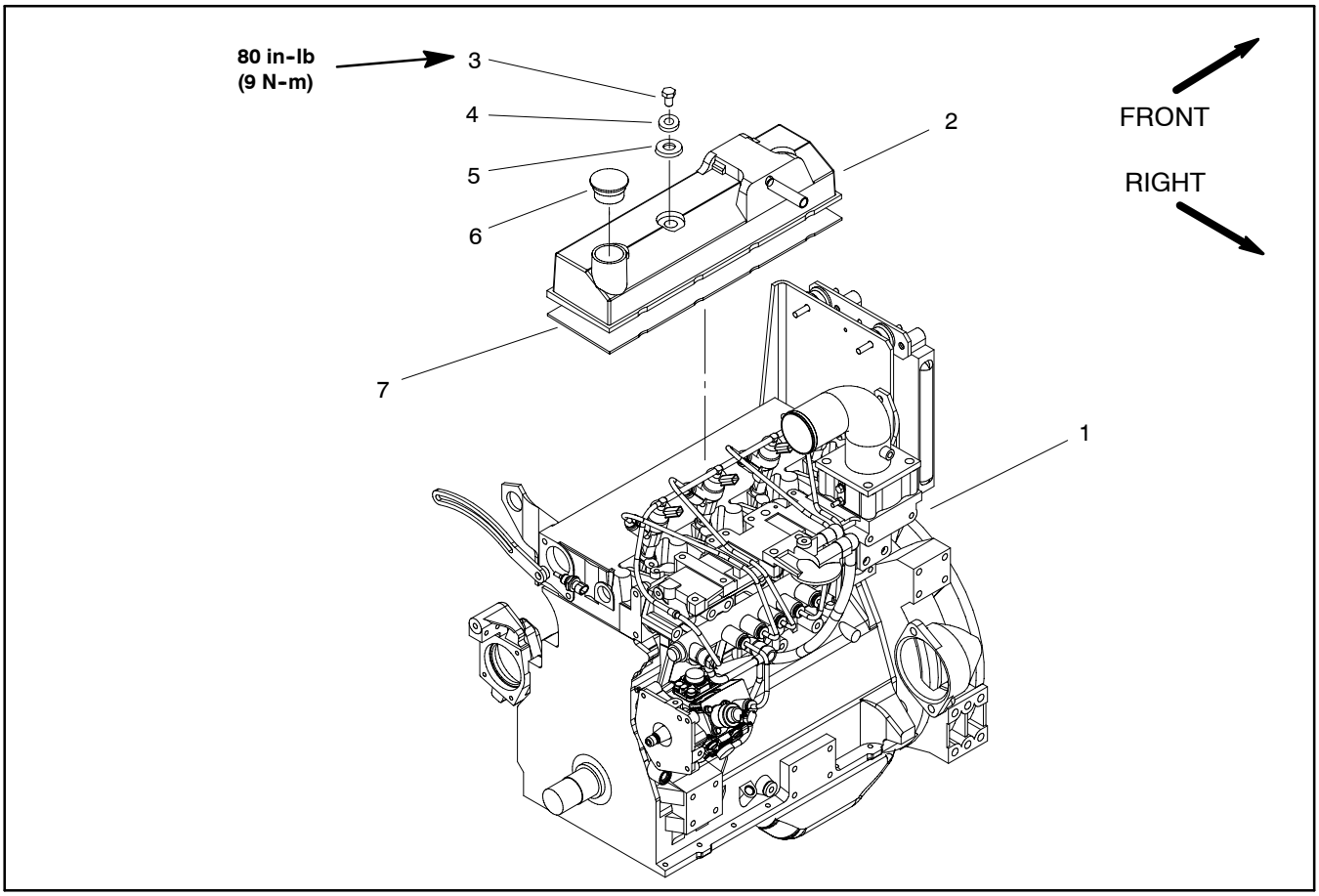


Figure 20

1. **Engine**
2. **Valve cover**
3. **Lock nut (3 used)**
4. **Flat washer (3 used)**
5. **Isolation washer (3 used)**
6. **Oil fill cap**
7. **Valve cover gasket**

Removal (Fig. 20)

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

2. Raise and support hood to allow access to engine.

3. Thoroughly clean valve cover and cylinder head to prevent contaminant entry into engine.

4. Remove crankcase breather tube from valve cover (see Engine Breather Removal in this section).

5. Remove three (3) lock nuts, flat washers and isolator washers.

6. Remove valve cover from cylinder head. Remove and discard valve cover gasket.

Installation (Fig. 20)

1. Position new gasket and valve cover to cylinder head.

2. Secure valve cover to cylinder head with three (3) isolator washers, flat washers and lock nuts. Torque lock nuts **80 in-lb (9 N-m)**.

3. Connect crankcase breather tube to valve cover and secure with hose clamp (see Engine Breather Installation in this section).

4. Check engine oil level and add oil if necessary.

5. Lower and secure hood.

Engine Breather System

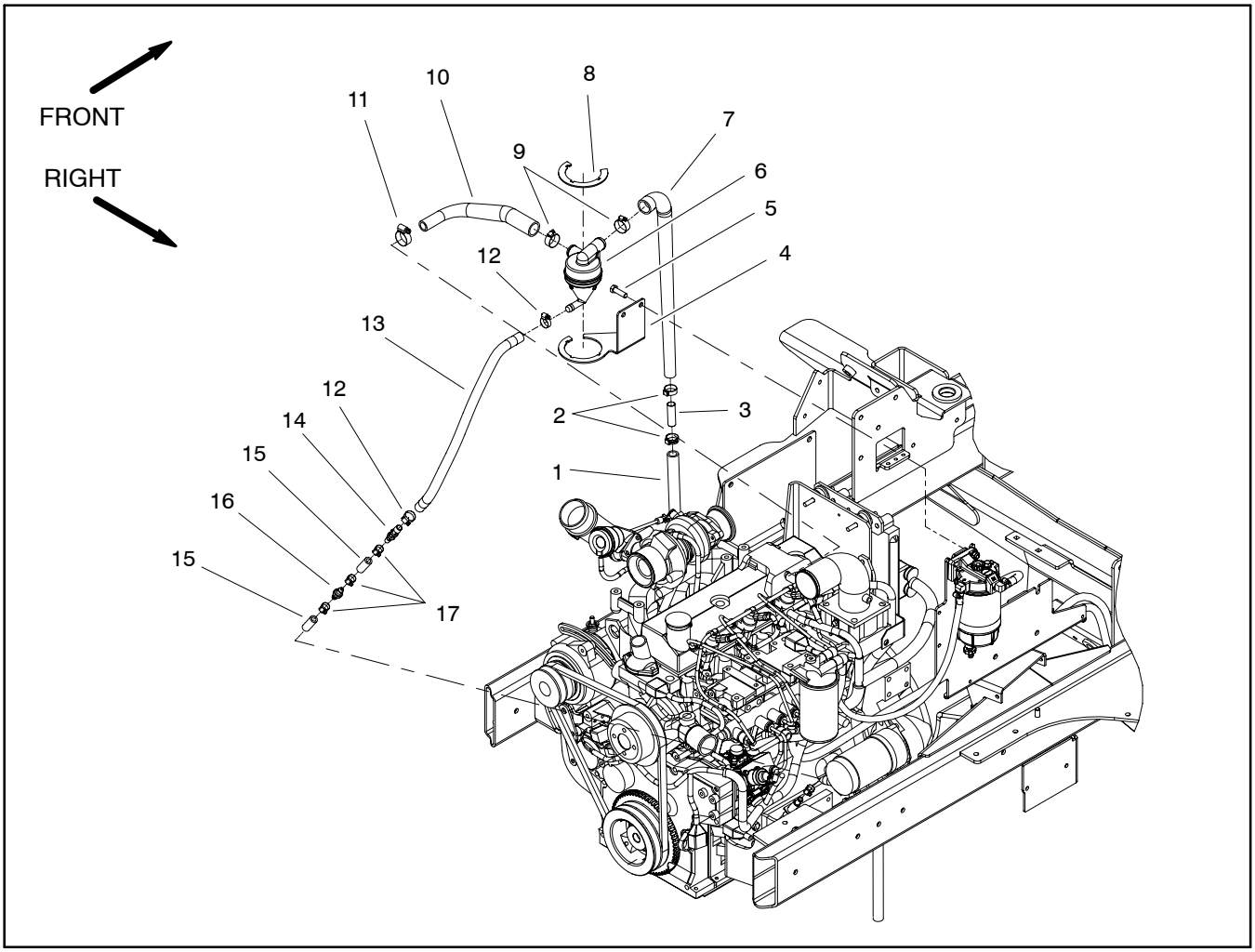


Figure 21

1. **Hose**
2. **Hose clamp**
3. **Spacer**
4. **Breather mount plate**
5. **Cap screw (2 used)**
6. **Breather**
7. **Breather outlet hose**
8. **Latch plate**
9. **Hose clamp**
10. **Breather inlet hose**
11. **Hose clamp**
12. **Hose clamp**
13. **Breather hose**
14. **Hose barb**
15. **Hose**
16. **Check valve**
17. **Worm clamp**

Removal (Fig. 21)

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

2. Raise and support hood to allow access to engine.

3. Clean breather components before removal to prevent contaminant entry into breather system.

4. Remove breather components as necessary using Figure 21 as a guide.

Installation (Fig. 21)

1. Install removed breather components using Figure 21 as a guide. If removed, make sure that check valve (item 16) is installed with black side toward the engine oil pan (Fig. 22).

2. Lower and secure hood.

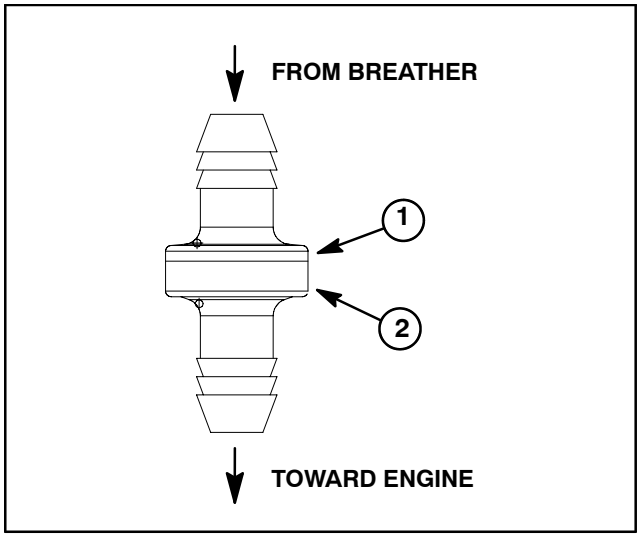


Figure 22

1. **Base (gray)**
2. **Cover (black)**

Thermostat

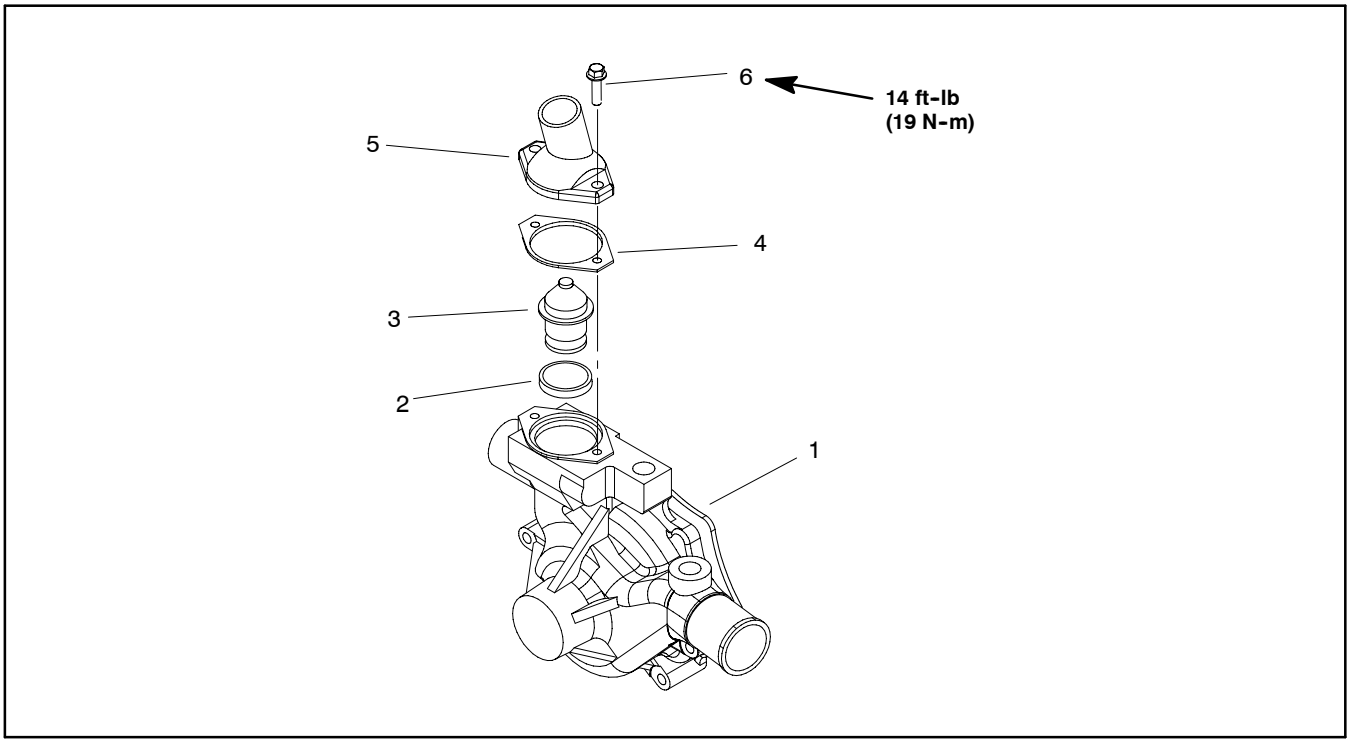


Figure 23

1. **Water pump**
2. **Seal**
3. **Thermostat**
4. **Gasket**
5. **Thermostat housing**
6. **Flange head screw (2 used)**

Removal (Fig. 23)

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

2. Raise and support hood to allow access to engine.

CAUTION

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

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

3. Drain coolant from radiator and engine (see Radiator Removal in this section).

4. Remove upper coolant hose from thermostat housing.

5. Remove two (2) flange head screws that secure thermostat housing to water pump. Remove thermostat housing.

6. Remove thermostat and seal from water pump housing.

7. Clean gasket surfaces of pump and thermostat housing.

8. Inspect thermostat sealing areas in pump housing. Thoroughly clean sealing surfaces if any corrosion or debris buildup is evident.

Thermostat Testing

1. Remove the thermostat (see Water Pump, Hose, Pipe and Thermostat Removal and Installation).

2. Suspend the thermostat and a thermometer in a container of water (Fig. 24). For accurate test results, do not allow the thermostat or thermometer to contact the container.

3. Slowly heat the water and stir water to allow uniform water temperature. Note and record the temperature for the following:

A. The thermostat should start to open at 180°F (82°C).

B. The thermostat should be fully open (0.315" (8 mm) lift) at 203°F (95°C).

4. If the thermostat fails to open, only partially opens or sticks, it should be replaced.

Installation (Fig. 23)

1. Install seal and thermostat into water pump housing.

2. Position thermostat gasket and housing to water pump housing. Secure thermostat housing with two (2) flange head screws. Torque screws **14 ft-lb (19 N-m)**.

3. Install upper coolant hose to thermostat housing and secure with hose clamp.

4. Fill cooling system with coolant.

5. Run engine and check for any coolant leaks.

6. Lower and secure hood.

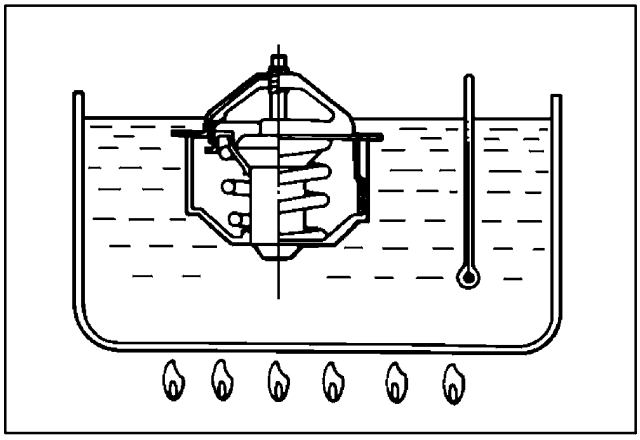


Figure 24

Water Pump

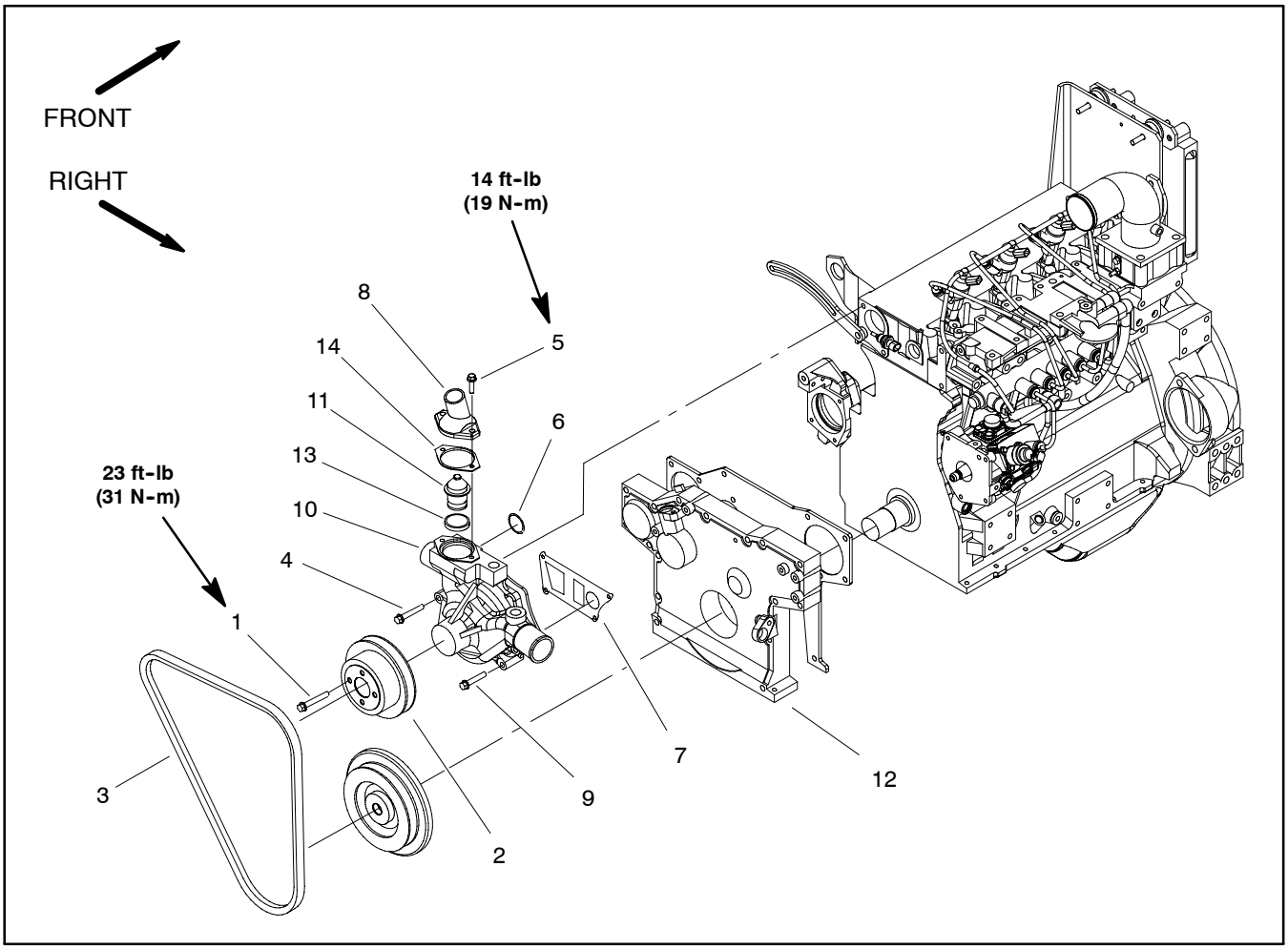


Figure 25

1. Flange head screw (4 used)
2. Water pump pulley
3. Belt
4. Flange head screw
5. Flange head screw (2 used)
6. O-ring
7. Gasket
8. Thermostat housing
9. Flange head screw (3 used)
10. Water pump
11. Thermostat
12. Front cover
13. Seal
14. Gasket

Removal (Fig. 25)

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

2. Raise and support hood to allow access to engine.

CAUTION

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

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

3. Drain coolant from radiator and engine (see Radiator Removal in this section).

4. Disconnect wire harness connector from temperature sensor on water pump housing (Fig. 26).

5. Remove upper and lower radiator hoses from water pump.

6. On Groundsmaster 5910 machines:

   A. Remove cab heater hoses from water pump.

   B. Remove A/C compressor drive belt.

7. Remove alternator and drive belt from engine (see Alternator Removal in this section).

8. Remove four (4) cap screws that secure water pump to engine.

9. Carefully remove water pump from engine.

10. Remove and discard O-ring and gasket from between water pump and engine.

11. If necessary, remove thermostat from water pump (see Thermostat Removal in this section). Make sure that gasket surfaces on water pump and thermostat housing are thoroughly cleaned.

12. If necessary, remove pulley from water pump.

   A. Remove four (4) cap screws that secure pulley to pump shaft.

   B. Pull pulley from pump shaft.

Installation (Fig. 25)

1. Make sure that gasket surfaces on engine, water pump and thermostat housing are thoroughly cleaned.

2. Position new O-ring and gasket to water pump housing.

3. Secure water pump to engine with four (4) cap screws.

4. If pulley was removed from water pump shaft, secure pulley with four (4) cap screws. Torque cap screws **23 ft-lb (31 N-m)**.

5. If thermostat was removed from water pump, install thermostat to water pump (see Thermostat Installation in this section).

6. Install upper and lower radiator hoses to water pump. Secure hoses with hose clamps.

7. On Groundsmaster 5910 machines:

   A. Install and secure cab heater hoses to water pump.

   B. Install and adjust A/C compressor drive belt.

8. Connect wire harness connector to temperature sensor on water pump (Fig. 26).

9. Install alternator and drive belt to engine (see Alternator Installation in this section). Adjust drive belt.

10. Fill cooling system with coolant.

11. Run engine and check for any coolant leaks.

12. Lower and secure hood.

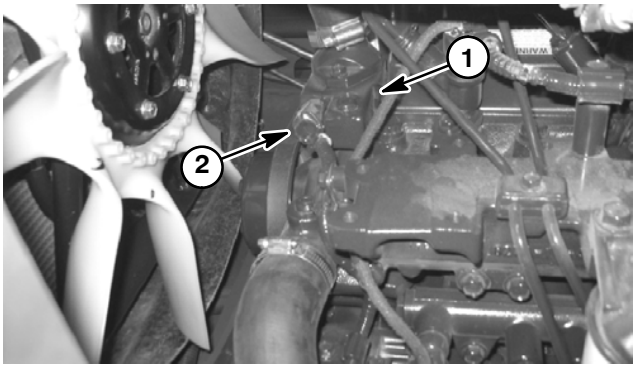


Figure 26

1. **Water pump**
2. **Temperature sensor**

Front Cover

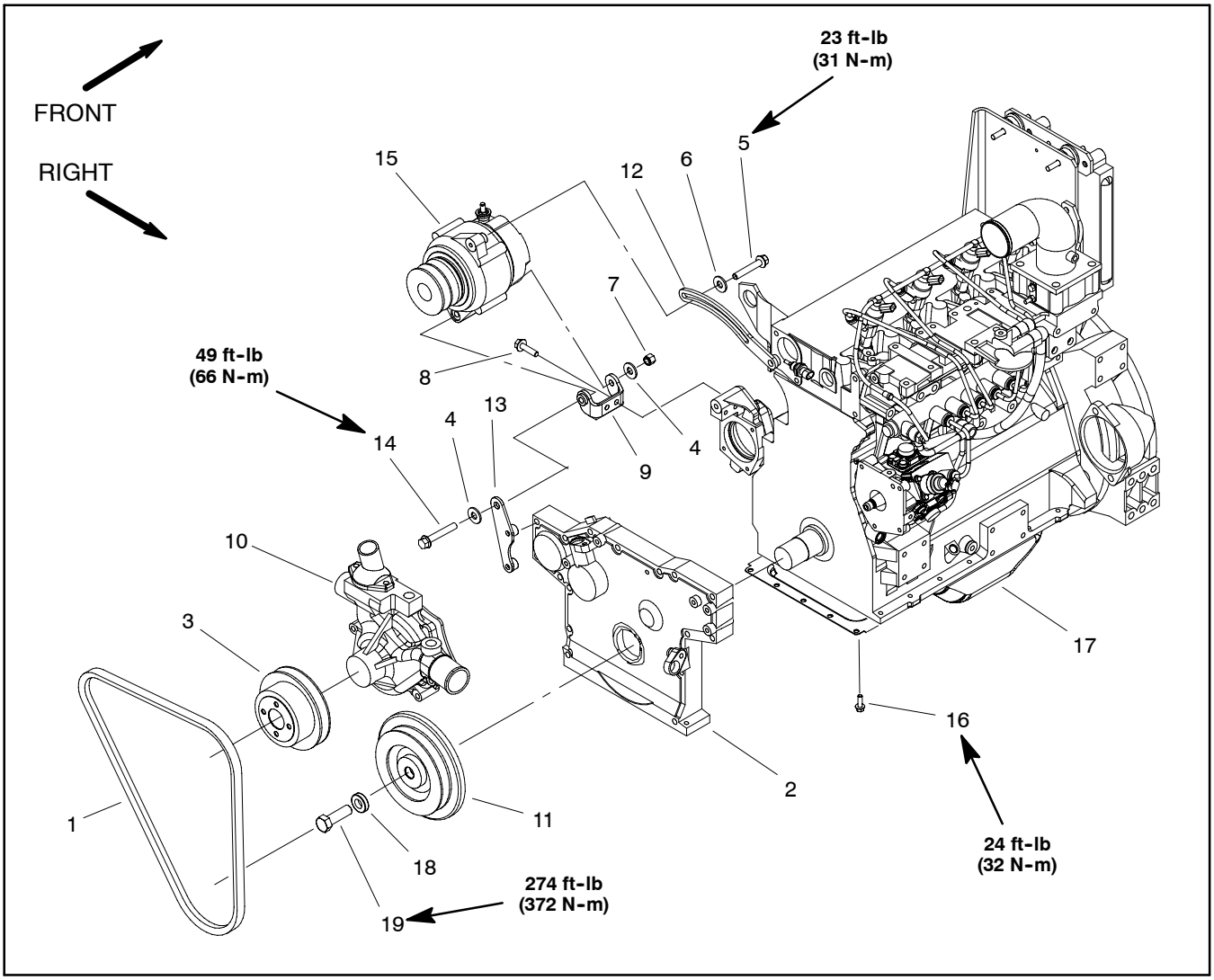


Figure 27

1. Belt
2. Front cover
3. Water pump pulley
4. Bevel washer (2 used)
5. Flange head screw
6. Flat washer
7. Hex nut
8. Flange head screw (2 used)
9. Alternator bracket
10. Water pump assembly
11. Crankshaft pulley with tone wheel
12. Adjusting bracket
13. Alternator bracket
14. Cap screw
15. Alternator
16. Flange head screw
17. Oil pan
18. Mounting plate
19. Cap screw

Removal (Fig. 27)

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

2. Raise and support hood to allow access to engine.

3. Loosen screws that secure alternator to mounting brackets and rotate alternator toward engine to loosen drive belt. Remove belt from machine.

4. On Groundsmaster 5910 machines, remove A/C compressor drive belt.

5. Remove electrical components from front cover (Fig. 28):

   A. Remove screws that secure electrical harness clamps to front cover.

   B. Remove screws that secure crankshaft and camshaft position sensors to front cover.

   C. Carefully pull two (2) sensors from front cover. Inspect O−rings on sensors and replace if necessary.

   D. Position wire harness and sensors away from front cover.

6. Remove five (5) flange head screws that secure oil pan to front cover (see Oil Pan Removal in this section).

7. Remove lock nut and thrust washer that secure rear axle pivot shaft to frame. Slide pivot shaft toward rear of machine to allow clearance for engine pulley bolt to be removed (see Rear Axle Removal in the Service and Repairs section of Chapter 6− Axles, Planetaries and Brakes).

8. Remove crankshaft pulley (Fig. 28):

IMPORTANT: When removing crankshaft pulley, take care to not damage tone wheel that is secured to back of pulley.

   A. Use appropriate holding tool to prevent the pulley and engine crankshaft from rotating.

   B. Loosen and remove cap screw and mounting plate that secure pulley to crankshaft.

   C. Slide pulley from crankshaft. Locate and retrieve woodruff key from crankshaft.

IMPORTANT: Three (3) different lengths of flange head screws are used to secure the front cover. To assist with assembly, note location of screws as they are removed.

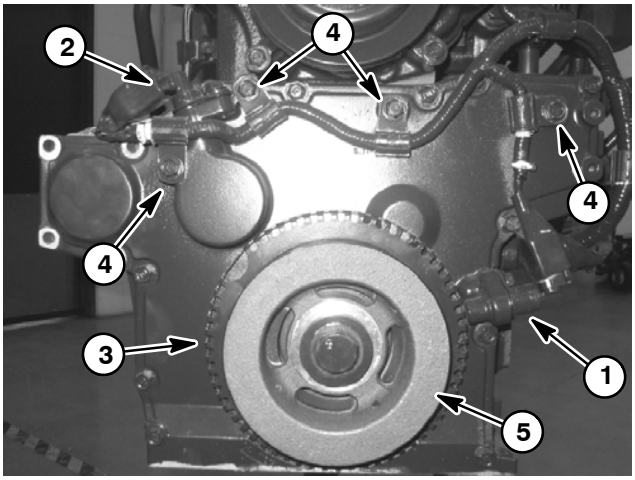


Figure 28

1. Crankshaft sensor
2. Camshaft sensor
3. Tone wheel
4. Harness clamp
5. Crankshaft pulley

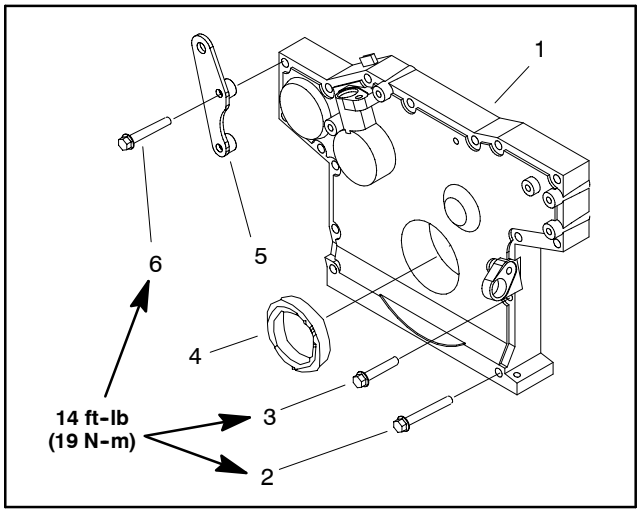


Figure 29

1. Front cover
2. Flange head screw
3. Flange head screw
4. Oil seal
5. Alternator bracket
6. Flange head screw

9. Remove sixteen (16) flange head screws that secure front cover to engine (Fig. 29). Rotate alternator bracket away from front cover.

10. Carefully remove front cover from engine.

11. Remove seal from front cover taking care to not damage seal bore in cover.

12. Thoroughly clean all removed components. Make sure that all sealant is removed from front cover sealing surfaces.

13. Inspect crankshaft surface in oil seal area for any evidence of wear or damage. Repair or replace crankshaft if necessary.

Installation (Fig. 27)

1. Make sure that mounting surfaces on engine, front cover and oil pan are thoroughly cleaned.

2. Fill 50% of the seal lip space with grease. Use Cummins seal installer tool #3164900 (or equivalent) to install new oil seal into front cover.

3. Apply Cummins sealant #3164067 (or equivalent), to the front cover mounting surfaces. Make sure to apply sealant to all engine and oil pan mating surfaces.

4. Carefully install front cover to engine taking care to not damage the oil seal during assembly.

5. Rotate alternator bracket to front cover.

6. Using notes taken during front cover removal to identify correct screw location, secure front cover to engine with sixteen (16) flange head screws. Torque screws **14 ft-lb (19 N-m)**.

7. Secure oil pan to front cover with five (5) flange head screws. Torque screws **14 ft-lb (19 N-m)**.

8. Install crankshaft pulley:

IMPORTANT: When installing crankshaft pulley, take care to not damage tone wheel that is secured to back of pulley.

A. Place woodruff key into crankshaft slot.

B. Carefully slide pulley onto crankshaft making sure to not damage oil seal in front cover. Also, make sure to align keyslot in pulley with woodruff key in crankshaft.

C. Install mounting plate (item 18) and cap screw (item 19) to pulley and crankshaft.

D. Using an appropriate holding tool to prevent the pulley and engine crankshaft from rotating, torque cap screw **274 ft-lb (372 N-m)**.

9. Secure electrical components to front cover (Fig. 28):

A. Position wire harness and sensors to front cover.

B. Apply a light film of clean oil to crankshaft and camshaft position sensors O-rings. Carefully install sensors into front cover and secure with screws.

C. Secure electrical harness clamps to front cover.

10. Secure rear axle pivot shaft to frame (see Rear Axle Removal in the Service and Repairs section of Chapter 6- Axles, Planetaries and Brakes).

A. Slide axle pivot shaft toward front of machine. Make sure that that roll pin on pivot shaft is positioned in frame reliefs.

B. Install thrust washer and lock nut onto pivot shaft.

C. Tighten lock nut to eliminate any axial movement of rear axle. Make sure that axle can still pivot freely after lock nut is tightened.

11. Position drive belt to crankshaft, water pump and alternator pulleys. Tension belt and tighten alternator mounting screws (see Alternator Installation in this section).

12. On Groundsmaster 5910 machines, install and adjust A/C compressor drive belt.

13. Check engine oil level and adjust if necessary.

14. Start engine and check for any oil leakage.

15. Lower and secure hood.

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Oil Pan

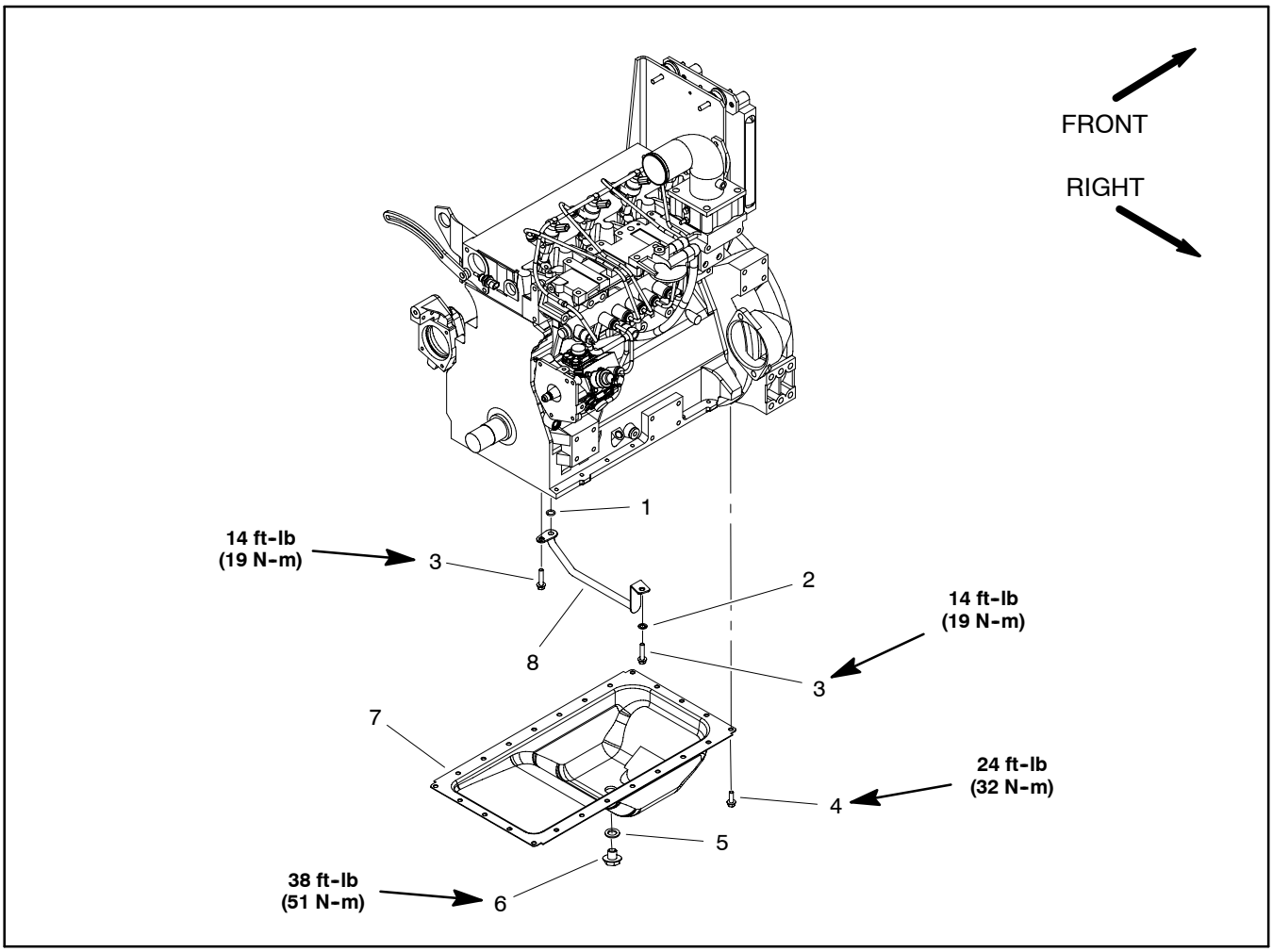


Figure 30

1. O-ring
2. Flat washer
3. Flange head screw (2 used)
4. Flange head screw (24 used)
5. Sealing washer
6. Drain plug
7. Oil pan
8. Oil suction tube

Removal (Fig. 30)

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

2. Raise and support hood to allow access to engine.

3. Drain oil from engine.

4. Remove twenty four (24) flange head screws that secure oil pan to engine.

5. Carefully, remove oil pan from engine taking care to not damage the oil pan or the sealing surface. Remove oil pan from engine.

6. If necessary, remove two (2) flange head screws that secure oil suction tube to engine. Remove oil suction tube.

7. Thoroughly clean sealing surfaces of removed components. Inspect parts for cracks or other damage.

Installation (Fig. 30)

1. If oil suction tube was removed, place O−ring on tube and position tube to engine. Secure with two (2) flange head screws. Torque screws **14 ft−lb (19 N−m)**.

2. Using Cummins sealant #3164067 (or equivalent), apply a 0.039" (1 mm) sealant bead around all oil pan mounting screw holes. Then, apply a 0.118" (3 mm) sealant bead to the oil pan mounting surface.

3. Carefully raise oil pan to cleaned engine mounting surface and secure oil pan to engine with twenty four (24) flange head screws. Torque screws **24 ft−lb (32 N−m)**.

4. Make sure that drain plug (item 6) is installed into oil pan. Torque drain plug **38 ft−lb (51 N−m)**.

5. Add oil to engine to the proper level.

6. Start engine and check for any oil leakage.

7. Lower and secure hood.

Engine

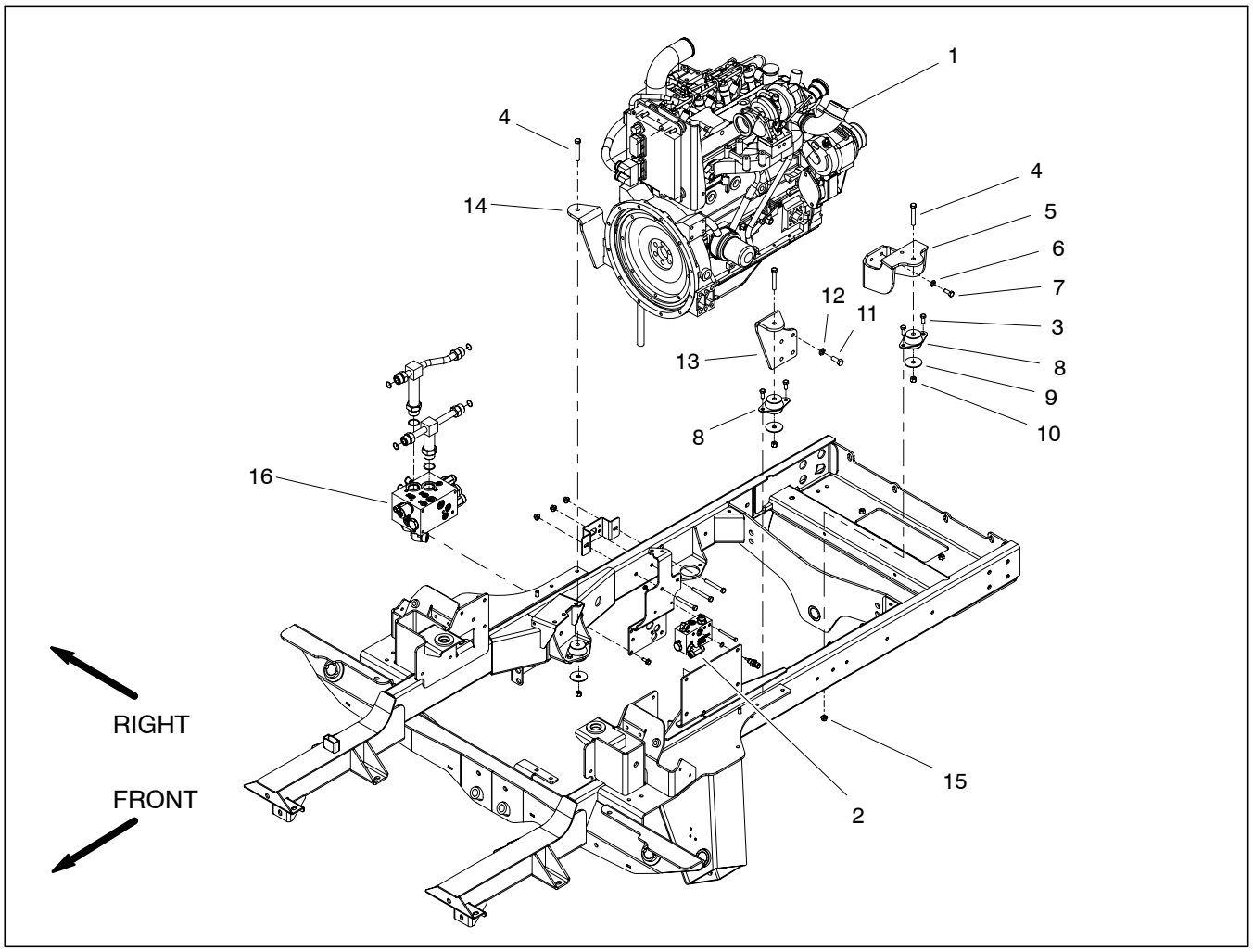


Figure 31

1. **Engine assembly**
2. **Traction flush manifold**
3. **Cap screw (8 used)**
4. **Cap screw (4 used)**
5. **Rear engine mount (2 used)**
6. **Lock washer (4 used per mount)**
7. **Cap screw (4 used per mount)**
8. **Engine isolator mount (4 used)**
9. **Snubbing washer (4 used)**
10. **Lock nut (4 used)**
11. **Cap screw (4 used per mount)**
12. **Lock washer (4 used per mount)**
13. **Front LH engine mount**
14. **Front RH engine mount**
15. **Flange nut (8 used)**
16. **4WD control manifold**

Engine Removal (Fig. 31)

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

2. If engine is to be disassembled, drain oil from engine.

3. Remove hood (see Hood Removal in the Service and Repairs section of Chapter 7 – Chassis).

4. Remove battery access panel. Disconnect negative battery cable first and then positive battery cable (see Battery Removal in the Service and Repairs section of Chapter 5 – Electrical System).

CAUTION

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

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

5. Drain coolant from the radiator into a suitable container (see Radiator Removal in this section). Disconnect coolant hoses from the radiator.

CAUTION

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

6. Remove exhaust system from engine (see Exhaust System Removal in this section).

7. Remove air cleaner system from engine (see Air Cleaner Removal in this section). Also, remove intake hoses from charge air cooler.

8. Note location of cable ties used to secure electrical wires. Disconnect wires and/or electrical connections from the following electrical components:

A. The alternator (Fig 32).

B. The temperature sensor on water pump housing (Fig. 33).

C. Battery, frame and wire harness ground at the engine block (Fig. 34).

D. The engine electronic control module.

E. The electric starter motor.

F. The air intake heater.

G. The air conditioning compressor (Groundsmaster 5910 machines) (Fig. 35).

9. Disconnect fuel hose from water separator outlet (Fig. 36). Cap fuel hose and water separator outlet to prevent contamination.

IMPORTANT: Support hydraulic pump assembly to prevent it from falling and being damaged.

10. Remove hydraulic pump assembly from engine (see Pump Assembly Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

11. On Groundsmaster 5910 machines, remove air conditioning compressor from brackets (see Air Conditioning Compressor Removal in the Service and Repairs section of Chapter 10 – Operator Cab). Position compressor away from engine taking care to not damage compressor or hoses. Support compressor to make sure it will not fall during engine removal.

12. Make sure that all cable ties securing the wiring harness, fuel lines and hydraulic hoses to the engine are removed.

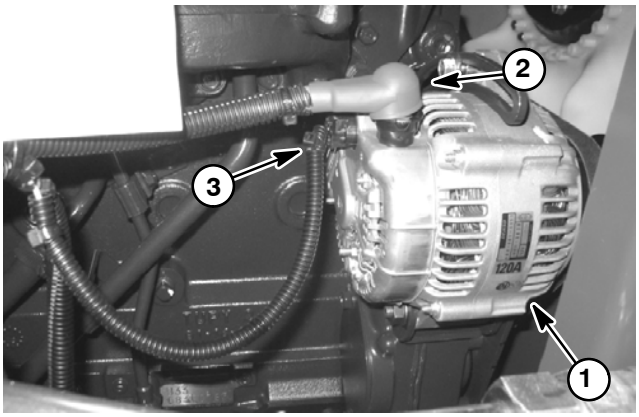


Figure 32

1. **Alternator**
2. **Cable**
3. **Harness connector**

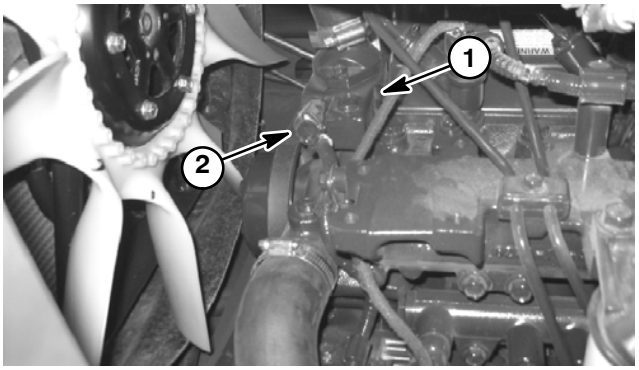


Figure 33

1. **Water pump**
2. **Temperature sensor**

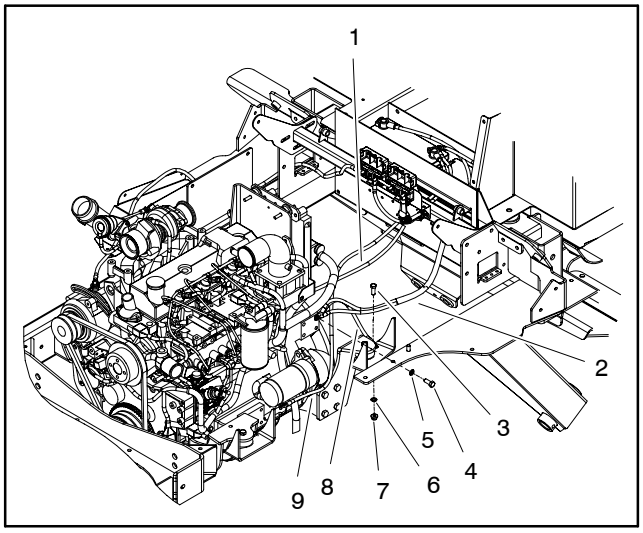


Figure 34

1. **Positive battery cable**
2. **Negative battery cable**
3. **Cap screw**
4. **Cap screw**
5. **Internal lock washer**
6. **Internal lock washer**
7. **Flange nut**
8. **Negative battery cable**
9. **Positive battery cable**

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine weighs approximately 606 pounds (275 kg).

13.Connect suitable hoist or lift to the front and rear lift tabs on engine.

14.Remove lock nuts, snubbing washers and cap screws securing the engine brackets to the engine isolator mounts.

CAUTION

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

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

15.Carefully raise engine from the machine.

16.If necessary, remove engine mount brackets from the engine.

17.If necessary, remove engine isolator mounts (item 8) from frame. Note that one of the fasteners for the RH front motor mount also secures the frame ground cable.

18.Cover or plug all engine openings to prevent contaminants from entering engine.

Engine Installation (Fig. 31)

1. If removed, install engine mount brackets to engine and isolator mounts to frame.

2. Make sure that all parts removed from the engine during maintenance or rebuilding are correctly installed to the engine.

3. Remove all covers and plugs from engine openings that were placed during engine removal.

CAUTION

Make sure that hoist or lift used to install engine can properly support engine. Engine weighs approximately 606 pounds (275 kg).

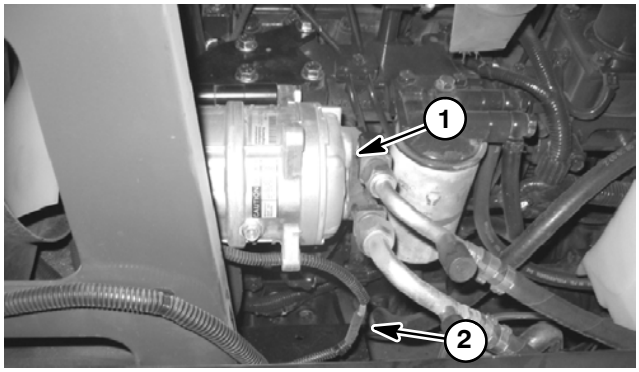


Figure 35

1. **AC compressor**
2. **Connector**

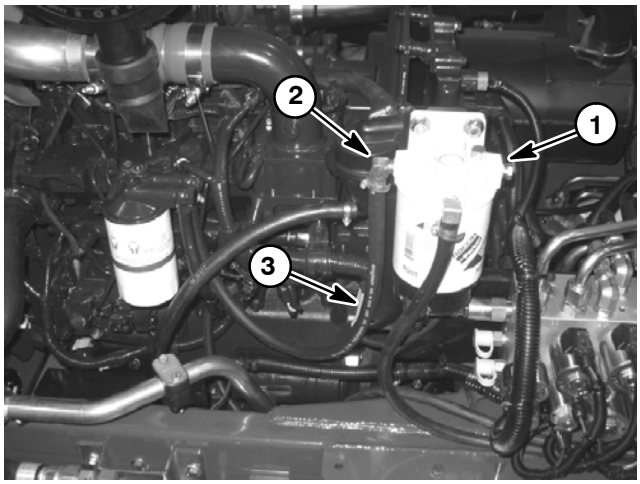


Figure 36

1. **Water separator**
2. **Outlet**
3. **Fuel hose**

4. Connect suitable hoist or lift to the front and rear lift tabs on engine.

CAUTION

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

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

5. Slowly lower engine into the machine.

6. Align engine mount brackets to the engine isolator mounts and secure with cap screws, snubbing washers and lock nuts.

7. Connect fuel hose to water separator outlet (Fig. 36).

8. Install hydraulic pump assembly to engine (see Pump Assembly Installation in the Service and Repairs section of Chapter 4 – Hydraulic Systems).

9. On Groundsmaster 5910 machines, install air conditioning compressor to brackets (see Air Conditioning Compressor Installation in the Service and Repairs section of Chapter 10 – Operator Cab). Make sure that drive belt is properly tensioned.

10. Using notes taken during engine removal, connect wires and/or electrical connections to the following electrical components:

A. The alternator (Fig 32).

B. The temperature sensor on water pump housing (Fig. 33).

C. Battery, frame and wire harness ground at the engine block (Fig. 34).

IMPORTANT: When connecting wire harness to engine electronic control module, make sure that harness connector tab is aligned with corresponding slot in control module.

D. The engine electronic control module.

E. The electric starter motor.

F. The air intake heater.

G. The air conditioning compressor (Groundsmaster 5910 machines) (Fig. 35).

11. Install air cleaner assembly to the engine and intake hoses to charge air cooler (see Air Cleaner Installation in this section). Make sure to torque hose clamps that secure intake system hoses from **45 to 55 in-lb (5.1 to 6.2 N-m)**.

12. Install exhaust system to machine (see Exhaust System Installation in this section).

13. Connect coolant hoses to the radiator. Make sure radiator drain is shut. Fill radiator and reservoir with coolant.

14. Check position of electrical harnesses, fuel lines and hydraulic hoses for proper clearance with rotating, high temperature and moving components.

15. Connect positive battery cable first and then negative battery cable (see Battery Installation in the Service and Repairs section of Chapter 5 – Electrical System). Secure batteries to machine with straps. Install access panel.

16. Check and adjust engine oil as needed.

17. Check and adjust hydraulic oil as needed.

18. Bleed fuel system.

19. Run engine and check for any leaks.

20. Operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in the Service and Repairs section of Chapter 4 – Hydraulic System).

21. Install hood to machine (see Hood Installation in the Service and Repairs section of Chapter 7 – Chassis).

Flywheel Coupling Assembly

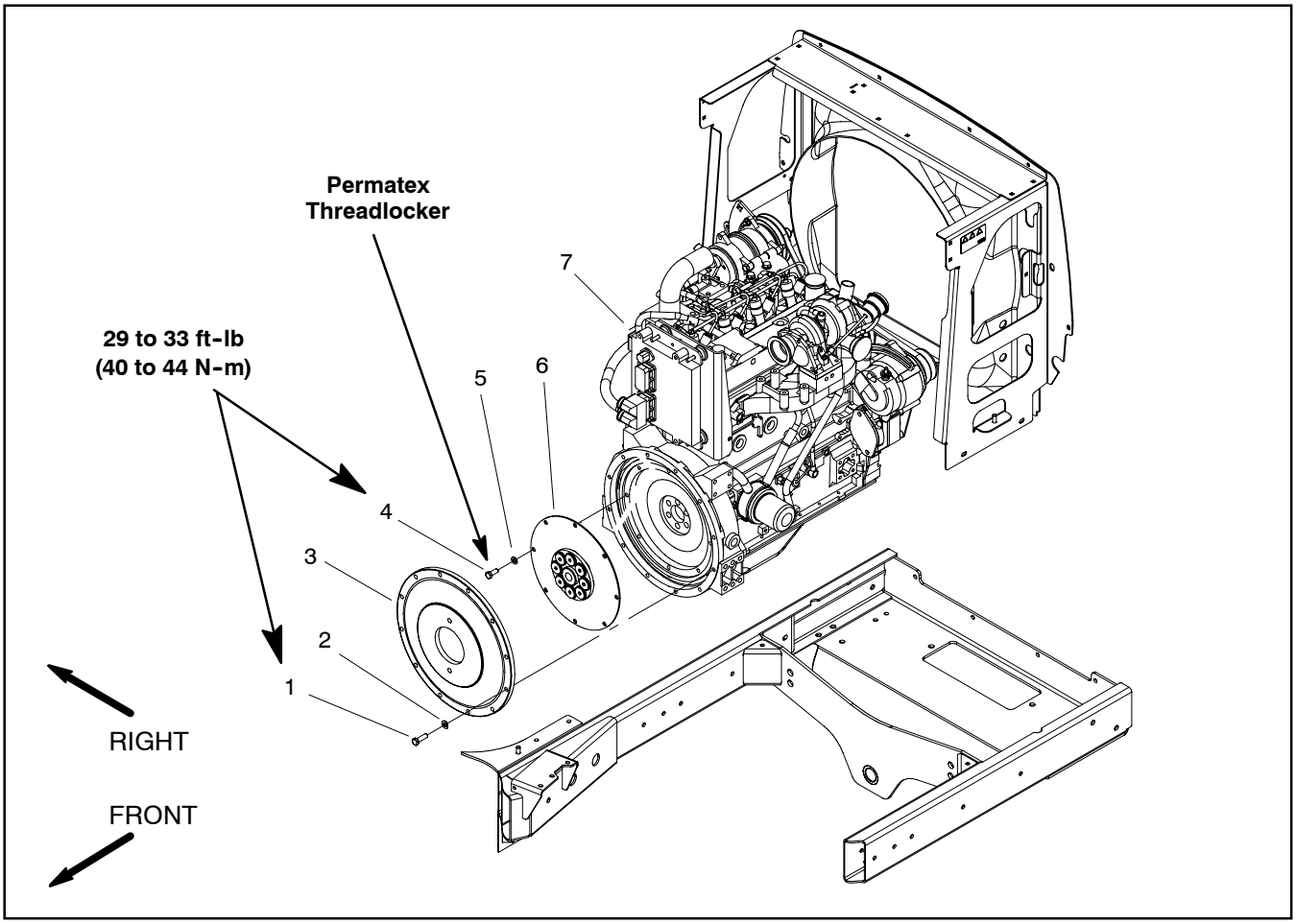


Figure 37

1. Cap screw (12 used)
2. Washer (12 used)
3. Coupling housing
4. Cap screw (8 used)
5. Washer (8 used)
6. Flywheel coupling
7. Engine assembly

Disassembly (Fig. 37)

1. If engine is in machine, hydraulic pump assembly needs to be removed from engine before coupling can be serviced (see Pump Assembly in Chapter 4 – Hydraulic Systems).

2. Remove coupling housing and flywheel coupling from engine using Figure 37 as a guide.

Assembly (Fig. 37)

1. Position flywheel coupling to engine flywheel. Make sure that coupling hub is away from engine flywheel (Fig. 38).

2. Apply Permatex Blue Gel medium strength threadlocker (or equivalent) to threads of cap screws (item 4). Secure coupling to engine flywheel with eight (8) cap screws and washers. Torque cap screws from **29 to 33 ft-lb (40 to 44 N-m)**.

3. Position coupling housing to engine. Secure housing with twelve (12) cap screws and washers using a crossing pattern tightening procedure. Torque screws from **29 to 33 ft-lb (40 to 44 N-m)**.

4. If engine is in machine, install hydraulic pump assembly (see Pump Assembly in Chapter 4 – Hydraulic Systems).

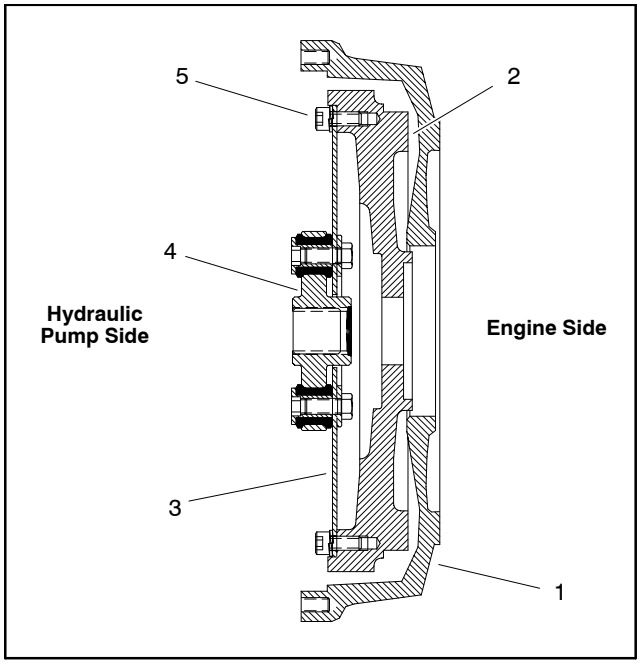


Figure 38

1. **Flywheel housing**
2. **Engine flywheel**
3. **Flywheel coupling**
4. **Coupling hub**
5. **Cap screw (8 used)**

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Chapter 4

Hydraulic System

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REXROTH VARIABLE PUMP A10VG REPAIR MANUAL
EATON REPAIR INFORMATION: MODEL 74318 and 74348 PISTON MOTORS
PARKER TORQMOTOR™ SERVICE PROCEDURE (TC, TB, TE, TJ, TF, TG, TH AND TL SERIES)
EATON PARTS AND REPAIR INFORMATION: 5 SERIES STEERING CONTROL UNITS

Specifications

Item	Description
Piston (Traction) Pump Maximum Pump Displacement (per revolution)	Rexroth Bosch, Variable Displacement Piston Pump 3.84 Cubic Inches (63 cc)
Traction Relief Pressure Forward Reverse	 4330 PSI (299 bar) 5330 PSI (368 bar)
Charge Circuit Relief Pressure	330 PSI (22.8 bar)
Front Wheel Motors Displacement (per revolution)	Eaton Fixed Displacement Piston Motor 1.80 Cubic Inches (29.5 cc)
Rear Wheel Motors Displacement (per revolution)	Parker Orbital Rotor Motor, TG Series 14.5 Cubic Inches (238 cc)
Gear Pump Section P1 Displacement (per revolution) Section P2 Displacement (per revolution) Section P3 Displacement (per revolution)	Sauer-Danfoss 3 Section Gear Pump, D Series 1.94 Cubic Inches (31.8 cc) 1.94 Cubic Inches (31.8 cc) 1.25 Cubic Inches (20.5 cc)
Cutting Deck Motors Displacement (per revolution) Relief Pressure (front and left decks) Relief Pressure (right deck)	Casappa Gear Motor 1.61 Cubic Inches (26.4 cc) 3000 PSI (207 bar) 2000 PSI (138 bar)
Steering Valve	Eaton Steering Unit, Series 5
Steering Circuit Relief Pressure	2100 PSI (145 bar)
Lift/Lower Circuit Relief Pressure	1350 PSI (93 bar)
Engine Cooling Fan Motor Displacement (per revolution)	Casappa Gear Motor 1.03 Cubic Inches (16.9 cc)
Hydraulic Filters (2 used)	Spin-on Cartridge Type 40 PSI (2.8 bar) Bypass in Filter Manifold Filter Manifold Includes Filter Restriction Indicator
Hydraulic Reservoir Capacity	19 U.S. Gallons (71.9 Liters)
Hydraulic Reservoir In-line Suction Strainer	100 Mesh (in Reservoir)
Hydraulic Oil	See Operator's Manual

General Information

Traction Unit Operator's Manual

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

Check Hydraulic Fluid

The hydraulic system on your Groundsmaster is designed to operate on anti−wear hydraulic fluid. The reservoir holds approximately 19 gallons (71.9 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

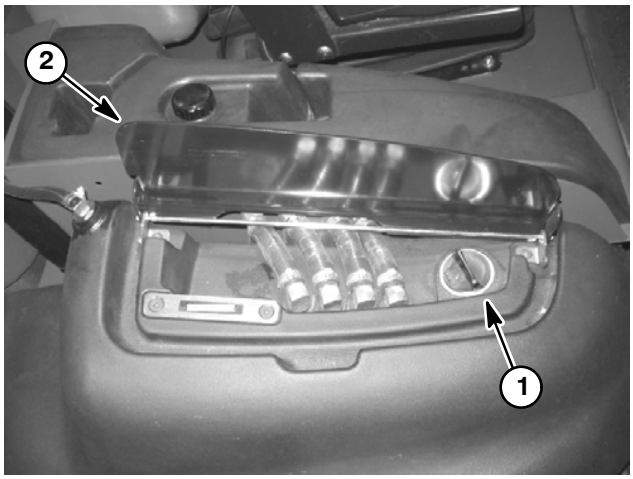


Figure 1

1. **Hydraulic oil cap**
2. **Tank cover**

Relieving Hydraulic System Pressure

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

System pressure in mow circuit is relieved when the cutting decks are disengaged. To relieve hydraulic pressure in steering circuit, rotate steering wheel in both directions.

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

Towing Traction Unit

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

If it becomes necessary to tow or push the machine, move machine in a forward direction at a speed below 2 mph (3.2 kph), and for a very short distance. If the machine needs to be moved more than 1/4 mile (0.4 km), machine should be transported on a trailer. The piston (traction) pump is equipped with two (2) bypass valves that must be opened for towing or pushing (Fig. 2).

IMPORTANT: If the machine must be pushed or towed in a reverse direction, the check valve in the 4WD control manifold must be bypassed. To bypass this check valve, connect a hydraulic hose between the traction pump reverse pressure test port (MA) and the 4WD control manifold test port (G2) (Fig. 3). Toro part numbers 95-8843 (hydraulic hose), 95-0985 (coupler fitting) (2 required) and 340-77 (hydraulic fitting) (2 required) are needed for this connection.

If towing the machine is necessary, use the following procedure:

1. Locate bypass valves on the traction pump (Fig. 2).

2. Open both bypass valves in traction pump:

   A. Loosen the jam nut on bypass valve stem.

   B. Thread bypass valve stem in six (6) turns.

   C. Tighten the jam nut.

3. Tow or push machine in a forward direction as required. Make sure to not exceed speed or distance listed above.

IMPORTANT: Using the tow option bypasses the high pressure relief valves. Catastrophic component damage can occur if hydraulic traction circuit empties or overheats.

4. After moving machine, close both bypass valves:

   A. Loosen the jam nut on bypass valve stem.

   B. Thread bypass valve stem all the way out. Do not exceed **8 ft-lb (11 N-m)** torque to close bypass valve.

   C. Tighten jam nut to secure bypass valve.

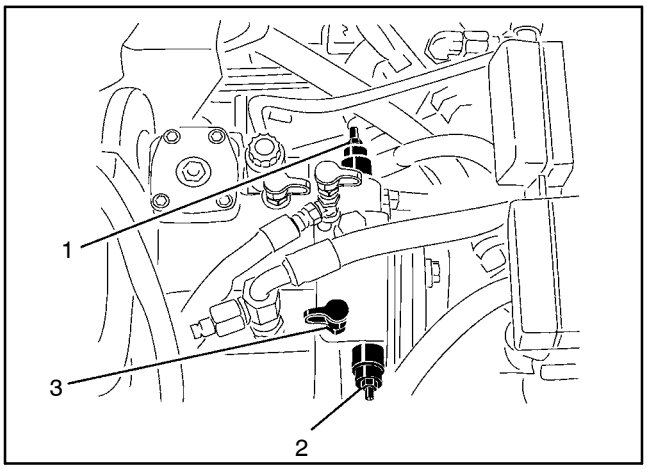


Figure 2

1. **Forward bypass valve**
2. **Reverse bypass valve**
3. **Reverse test port (MA)**

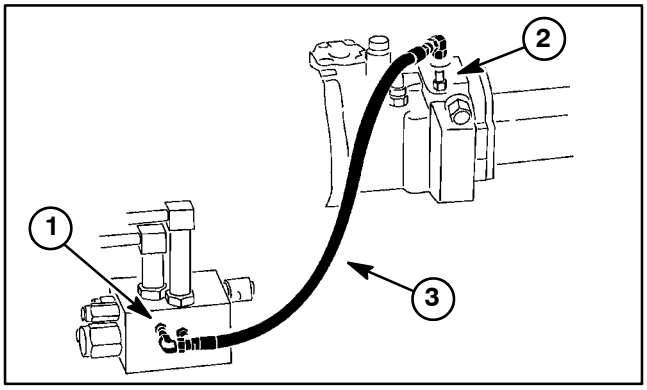


Figure 3

1. **4WD manifold reverse test port (G2)**
2. **Traction pump reverse test port (MA)**
3. **Hydraulic hose**

Traction Circuit Component Failure

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

If a component failure occurs in the traction circuit, it is recommended that the entire traction circuit be disassembled, drained and thoroughly cleaned to ensure that all contamination is removed from the circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional component failure.

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

Once the filter has been placed in the circuit, operate the traction circuit to allow oil flow through the circuit. The filter will remove contamination from the traction circuit during circuit operation. The filter can be removed from the machine after contamination has been removed from the traction circuit.

IMPORTANT: When operating the traction system with the high pressure filter installed, make sure that flow is always directed through the filter before entering a replaced component (e.g. do not press the traction pedal in the reverse direction if the filter is placed for forward direction flow). If flow is reversed, debris from the filter will re−enter the traction circuit.

Hydraulic Hoses

Hydraulic hoses are subject to extreme conditions such as pressure differentials during operation and exposure to weather, sun, chemicals, very warm storage conditions or mishandling during operation and maintenance. These conditions can cause hose damage and deterioration. Some hoses are more susceptible to these conditions than others. Inspect all machine hydraulic hoses frequently for signs of deterioration or damage:

Hard, cracked, cut, abraded, charred, leaking or otherwise damaged hose.

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two wrenches; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the other wrench (See Hydraulic Hose and Tube Installation in this section). If the hose has an elbow at one end, tighten the swivel nut on that end before tightening the nut on the straight end of the hose.

For additional hydraulic hose information, refer to Toro Service Training Book, Hydraulic Hose Servicing (Part Number 94813SL).

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system (see Relieving Hydraulic System Pressure in this section).

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

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

1. Make sure threads and sealing surfaces of the hose/tube and the fitting are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the face seal O-ring be replaced any time the connection is opened. Make sure the O-ring is installed and properly seated in the fitting groove. Lightly lubricate the O-ring with clean hydraulic oil.

3. Place the hose/tube against the fitting body so that the flat face of the hose/tube sleeve fully contacts the O-ring in the fitting.

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 6. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance).

5. If a torque wrench is not available or if space at the swivel nut prevents use of a torque wrench, an alternate method of assembly is the Flats From Wrench Resistance (F.F.W.R.) method (Fig. 2).

A. Using a wrench, tighten the swivel nut onto the fitting until light wrench resistance is reached (approximately 30 in-lb).

B. Mark the swivel nut and fitting body. Hold the hose/tube with a wrench to prevent it from turning.

C. Use a second wrench to tighten the nut to the correct Flats From Wrench Resistance (F.F.W.R.). The markings on the nut and fitting body will verify that the connection has been properly tightened.

Size	F.F.W.R.
4 (1/4 in. nominal hose or tubing)	1/2 to 3/4
6 (3/8 in.)	1/2 to 3/4
8 (1/2 in.)	1/2 to 3/4
10 (5/8 in.)	1/2 to 3/4
12 (3/4 in.)	1/3 to 1/2
16 (1 in.)	1/3 to 1/2

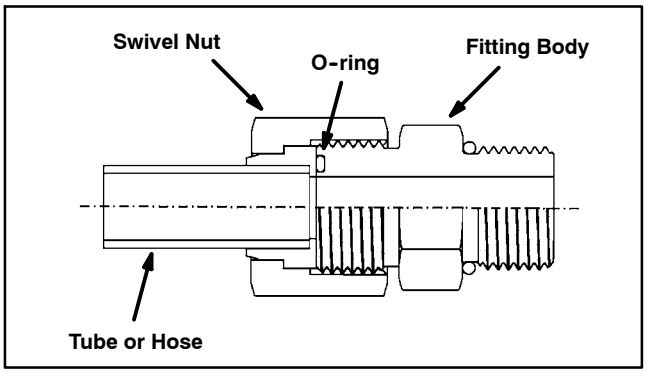


Figure 4

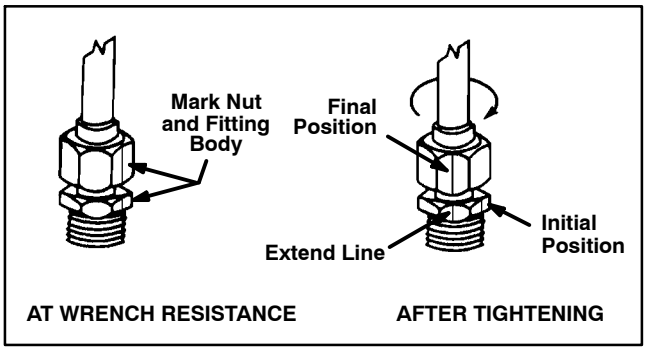


Figure 5

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

Figure 6

Hydraulic Fitting Installation (SAE Straight Thread O-Ring Fitting into Component Port)

Non-Adjustable Fitting (Fig. 7)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O-ring be replaced any time the connection is opened.

3. Lightly lubricate the O-ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 8.

NOTE: Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be less than the recommended installation torque. See Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance to determine necessary conversion information.

5. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method.

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

B. If port material is steel, tighten the fitting to the listed F.F.F.T. If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

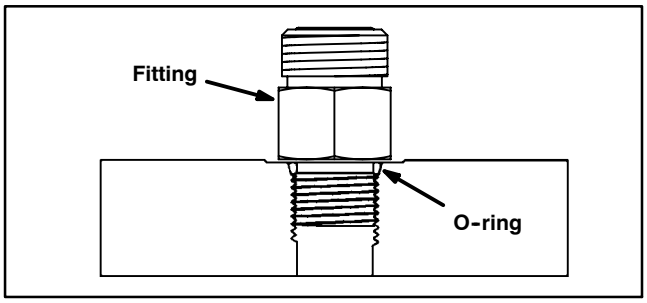


Figure 7

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

Figure 8

Adjustable Fitting (Fig. 9)

1. Make sure all threads and sealing surfaces of fitting and component port are free of burrs, nicks, scratches or any foreign material.

2. As a preventative measure against leakage, it is recommended that the O-ring be replaced any time the connection is opened.

3. Lightly lubricate the O-ring with clean hydraulic oil. Fitting threads should be clean with no lubricant applied.

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 10).

IMPORTANT: Before installing fitting into port, determine port material. If fitting is to be installed into an aluminum port, installation torque is reduced.

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the fitting to the recommended installation torque shown in Figure 8. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance).

8. If a torque wrench is not available, or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method. Hold the fitting in the desired position with a wrench and, if port material is steel, tighten the lock nut with a second wrench to the listed F.F.F.T (Step 4). If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	1.00 ± 0.25
6 (3/8 in.)	1.50 ± 0.25
8 (1/2 in.)	1.50 ± 0.25
10 (5/8 in.)	1.50 ± 0.25
12 (3/4 in.)	1.50 ± 0.25
16 (1 in.)	1.50 ± 0.25

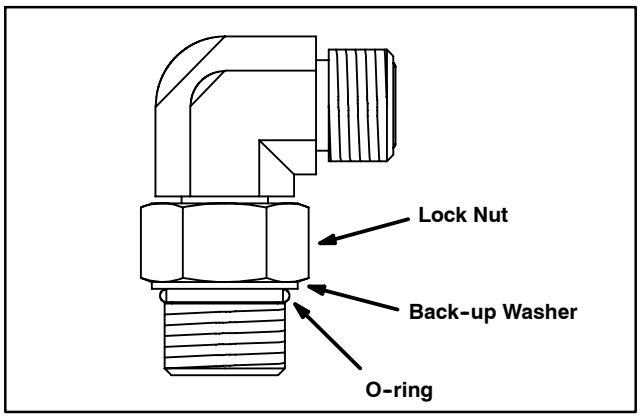


Figure 9

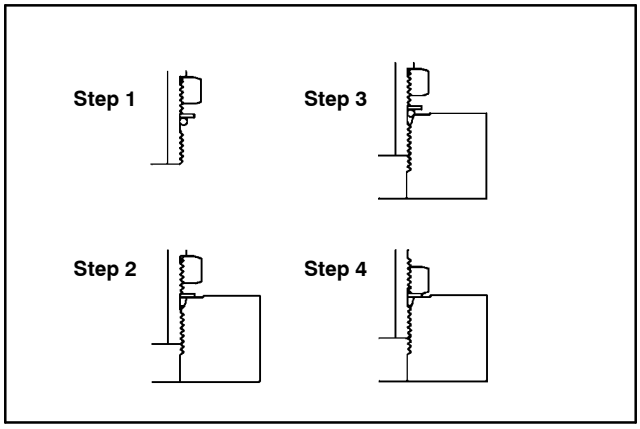


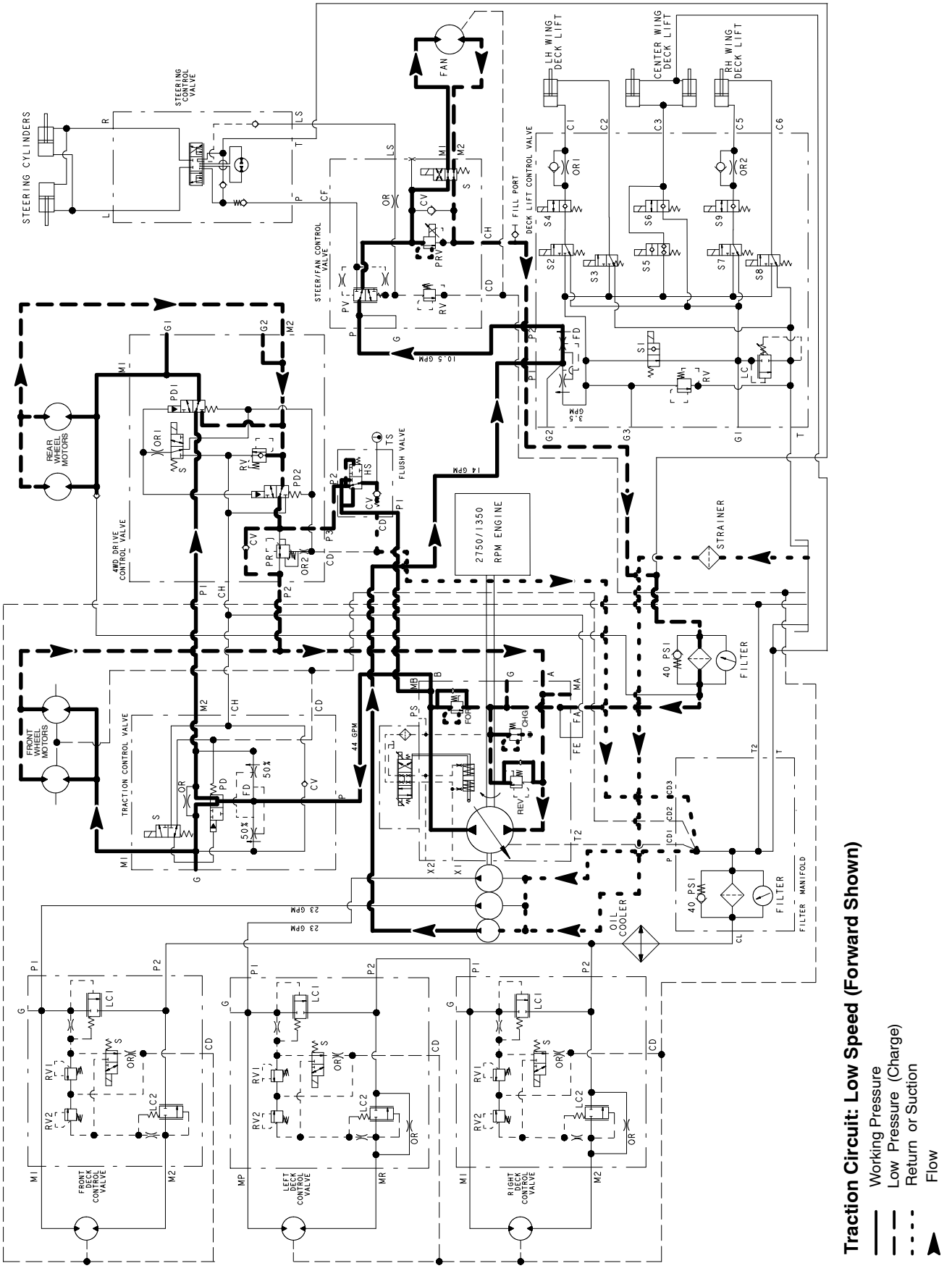
Figure 10

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Hydraulic Schematic

The hydraulic schematic for Groundsmaster 5900 and 5910 machines is located in Chapter 10 – Foldout Drawings.

Hydraulic Flow Diagrams



Traction Circuit: Low Speed

A variable displacement, bi–directional piston pump is directly coupled to the engine flywheel to provide hydraulic flow for the traction circuit. The piston pump swash plate movement is controlled by an electronic proportional servo assembly. Pushing the traction pedal rotates a potentiometer that sends a signal to the machine TEC–5002 controller. The controller in turn sends a corresponding PWM (Pulse Width Modulation) output signal to the hydrostat electronic control to rotate the pump swash plate accordingly to control the pump's output. The oil from the hydrostat is directed to the front and rear wheel motors through the traction, 4WD and traction flush control manifolds.

Operating pressure on the high pressure side of the closed loop traction circuit is determined by the amount of load developed at the fixed displacement wheel motors. As the load increases, circuit pressure can increase to relief valve settings: 4330 PSI (299 bar) in the forward direction and 5330 PSI (368 bar) in reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit.

Traction circuit pressure (forward and reverse) can be measured at test ports located on the hydrostat.

The traction circuit provides operation in either low speed (four wheel assist) or high speed (two wheel drive).

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

The gear pump section (P3) that supplies oil to the steering, lift and cooling fan circuits, also provides charge oil for the traction circuit. The gear pump is driven directly off the traction pump. It provides a constant supply of charge oil to the traction circuit to make up for oil that is lost to internal leakage in the traction pump and wheel motors. Charge pump flow is directed through the charge oil filter before entering the hydrostat. This filter has a bypass valve that allows charge oil flow to the closed traction loop if the filter becomes plugged.

The charge pressure is limited to 330 PSI (22.8 bar) by a relief valve located in the hydrostat. Charge pressure can be measured at the charge pressure test port (G) on the hydrostat.

Forward Direction

With the low speed range selected and the traction pedal pushed in the forward direction, oil from the hydrostat port MB passes through the traction control valve (see Traction Circuit: Traction Control in this section). Oil flow from traction control valve port M1 drives the front wheel motors in the forward direction and then returns to the hydrostat. Oil flow from traction control valve port M2 is routed to the P1 port of the 4WD control valve where it is directed to the PD1 cartridge and out of the manifold to drive the rear wheel motors in the forward direction. Oil returning from the rear motors re–enters the 4WD control valve at the M2 port. Flow passes through the PD2 cartridge, through the CV check valve, out valve port P2 and back to the hydrostat.

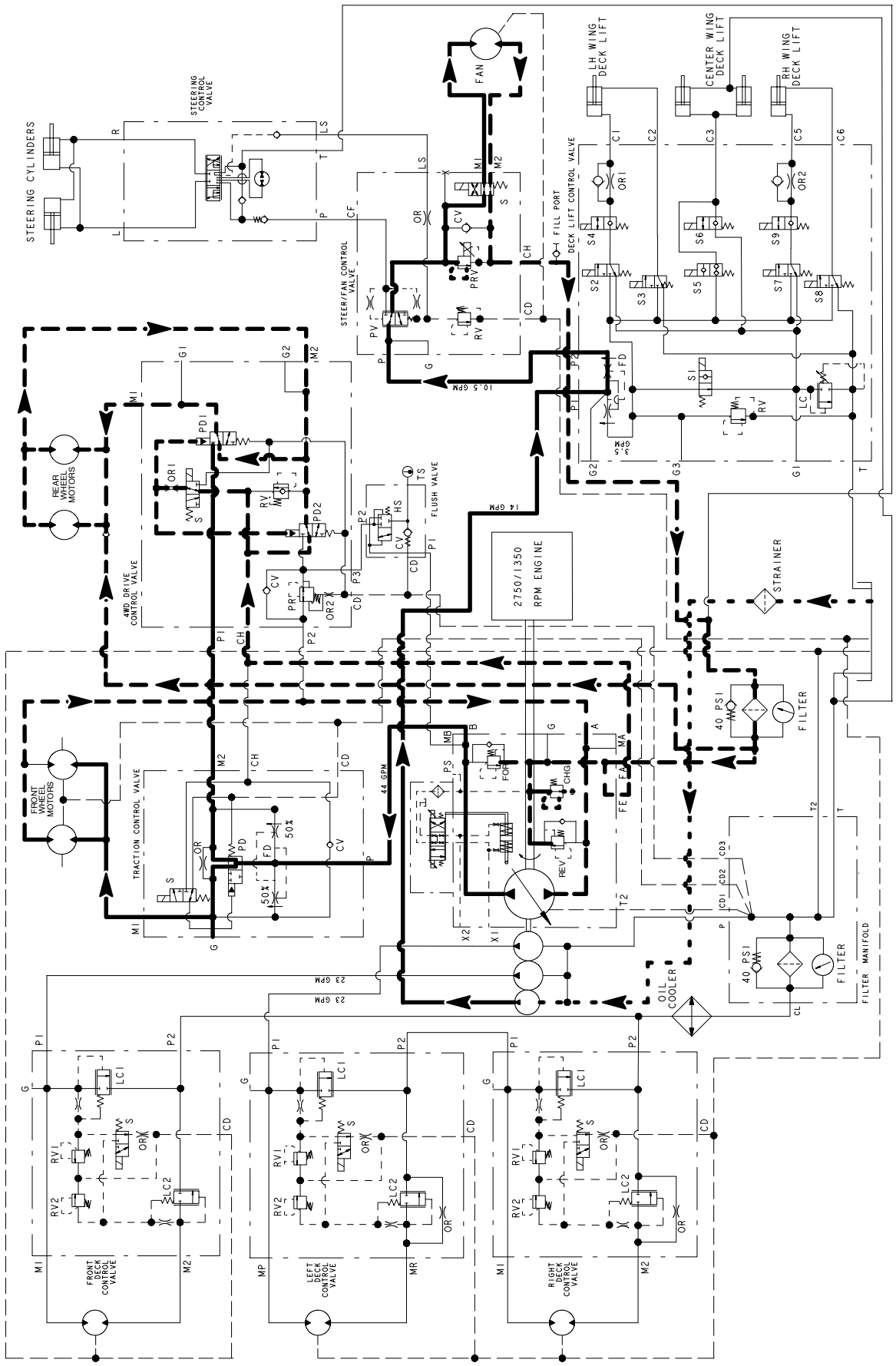
To keep the traction circuit oil properly cooled, a flush valve is incorporated into the traction circuit. When in the forward direction, the flush valve spool is shifted by forward pressure and allows a small amount of hydraulic fluid to bleed off for cooling of the closed loop traction circuit. The charge system replenishes oil that is bled from the traction circuit due to the flushing valve operation.

When going down a hill, the tractor becomes an overrunning load that drives the wheel motors. In this condition, the rear wheel motors could lock up as the oil pumped from the motors increases pressure as it returns to the hydrostat. To prevent wheel lock up, an adjustable relief valve (RV) in the 4WD control valve reduces rear motor pressure created in down hill, dynamic braking conditions.

Reverse Direction

The traction circuit operates essentially the same in reverse low speed as it does in the forward direction. However, the flow through the circuit is reversed. Oil flow from the hydrostat port MA is directed to the front wheel motors and to 4WD control valve port P2. Oil to the front wheel motors drives them in the reverse direction and then returns to the hydrostat through the traction control valve. Oil flow to the 4WD control valve flows through the PR pressure reducing valve which limits the down stream pressure to the rear wheel motors to 650 PSI (45 bar) so the rear wheels will not scuff the turf. This reduced pressure flow passes through the PD2 cartridge and out port M2 to the rear wheel motors. Return oil from the rear motors re–enters the 4WD control valve at port M1, flows through the PD1 cartridge, exits the manifold at port P1 and returns to the hydrostat through the traction control manifold.

When in the reverse direction, the flush valve spool remains in the unshifted position to prevent any traction circuit fluid loss.


Traction Circuit: High Speed (Forward Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
FILL PORT
DECK LIFT CONTROL VALVE
STEER/FAN CONTROL VALVE
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
2750/1350 RPM ENGINE
STRAINER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
40 PSI
FILTER
OIL COOLER
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE
10.5 GPM
14 GPM
44 GPM
23 GPM

Traction Circuit: High Speed

A variable displacement, bi−directional piston pump is directly coupled to the engine flywheel to provide hydraulic flow for the traction circuit. The piston pump swash plate movement is controlled by an electronic proportional servo assembly. Pushing the traction pedal rotates a potentiometer that sends a signal to the machine TEC−5002 controller. The controller in turn sends a corresponding PWM (Pulse Width Modulation) output signal to the hydrostat electronic control to rotate the pump swash plate accordingly to control the pump's output. The oil from the hydrostat is directed to the front and rear wheel motors through the traction, 4WD and traction flush control manifolds.

Operating pressure on the high pressure side of the closed loop traction circuit is determined by the amount of load developed at the fixed displacement wheel motors. As the load increases, circuit pressure can increase to relief valve settings: 4330 PSI (299 bar) in the forward direction and 5330 PSI (368 bar) in reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit.

Traction circuit pressure (forward and reverse) can be measured at test ports located on the hydrostat.

The traction circuit provides operation in either low speed (four wheel assist) or high speed (two wheel drive).

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

The gear pump section (P3) that supplies oil to the steering, lift and cooling fan circuits, also provides charge oil for the traction circuit. The gear pump is driven directly off the traction pump. It provides a constant supply of charge oil to the traction circuit to make up for oil that is lost to internal leakage in the traction pump and wheel motors. Charge pump flow is directed through the charge oil filter before entering the hydrostat. This filter has a bypass valve that allows charge oil flow to the closed traction loop if the filter becomes plugged.

The charge pressure is limited to 330 PSI (22.8 bar) by a relief valve located in the hydrostat. Charge pressure can be measured at the charge pressure test port on the hydrostat.

Forward Direction

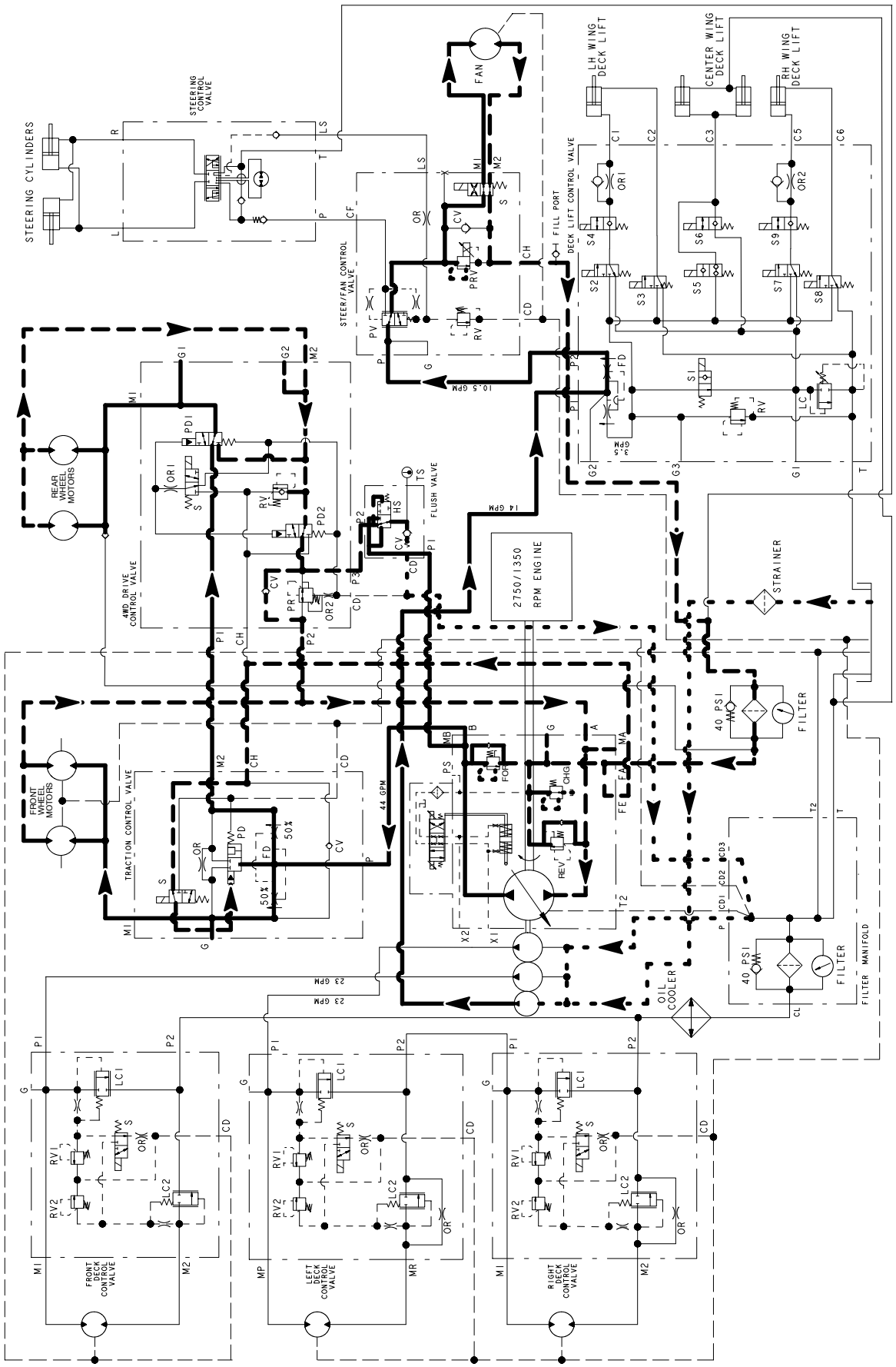
With the Hi−Lo speed switch in the high range position, solenoid valve (S) in the 4WD control manifold is energized. The solenoid valve spool shifts to direct charge pressure that shifts the PD1 and PD2 control valve spools. The shifted PD1 valve prevents hydraulic flow from the hydrostat to the rear wheel motors. With flow blocked to the rear wheel motors, all hydrostat flow is directed to the front wheel motors to allow a higher, transport speed in the forward direction.

Without flow to the rear wheel motors, the rotating rear wheels drive the rear wheel motors so they act like a pump. Inlet oil to the rear wheel motors is provided by a check valve that allows charge oil into the rear wheel motor circuit. Oil leaving the rear wheel motors enters the 4WD control manifold at port M2 and is directed back to the rear wheel motors through the PD1 cartridge and manifold port M1. To allow for rear wheel loop cooling when in forward Transport operation, a small amount of oil exits through the shifted PD2 cartridge and returns to the charge circuit.

Reverse Direction

With the Hi−Lo speed switch in the high range position, solenoid valve (S) in the 4WD control manifold is energized. The solenoid valve spool shifts to direct charge pressure that shifts the PD1 and PD2 control valve spools. Oil flow from the hydrostat port MA enters the 4WD control manifold at port P2, flows through the PR pressure reducing valve and is stopped at the shifted PD2 valve. With flow blocked to the rear wheel motors, all hydrostat flow is directed to the front wheel motors to allow a higher, transport speed in the reverse direction.

Without flow to the rear wheel motors, the rotating rear wheels drive the rear wheel motors so they act like a pump. Inlet oil to the rear wheel motors is provided by a check valve at the 4WD control manifold CH port that allows charge oil into the rear wheel motor circuit. This charge oil is routed through the shifted PD2 cartridge and out manifold port M2 to the rear wheel motors. Return flow from the rear wheel motors enters the 4WD control manifold at port M1, through the shifted PD1 cartridge and and is then directed back to the rear wheel motors as they turn in the reverse direction.


Traction Circuit: Traction Control (Traction Assist Switch Depressed in Low Speed)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
STEER/FAN CONTROL VALVE
FILL PORT
DECK LIFT CONTROL VALVE
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
2750/1350 RPM ENGINE
STRAINER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
44 GPM
40 PSI
FILTER
FILTER MANIFOLD
OIL COOLER
23 GPM
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE

Traction Circuit: Traction Control

A flow divider is incorporated into the traction circuit to provide a proportioned flow to the front and rear wheel motors for a true four−wheel drive system. When the Hi−Lo speed switch is in the Low position and the traction pedal is pressed for the forward direction, the operator can engage the traction flow divider when low traction situations could lead to wheel spin. The engaged flow divider splits traction pump flow equally between the front and rear wheel motors to reduce the chance that excessive flow goes to a spinning wheel.

The TEC−5001 controller does not allow Traction Assist to be activated while the tractor is in the high speed range in either forward or reverse. The controller also prevents Traction Assist in the reverse direction when in low speed range.

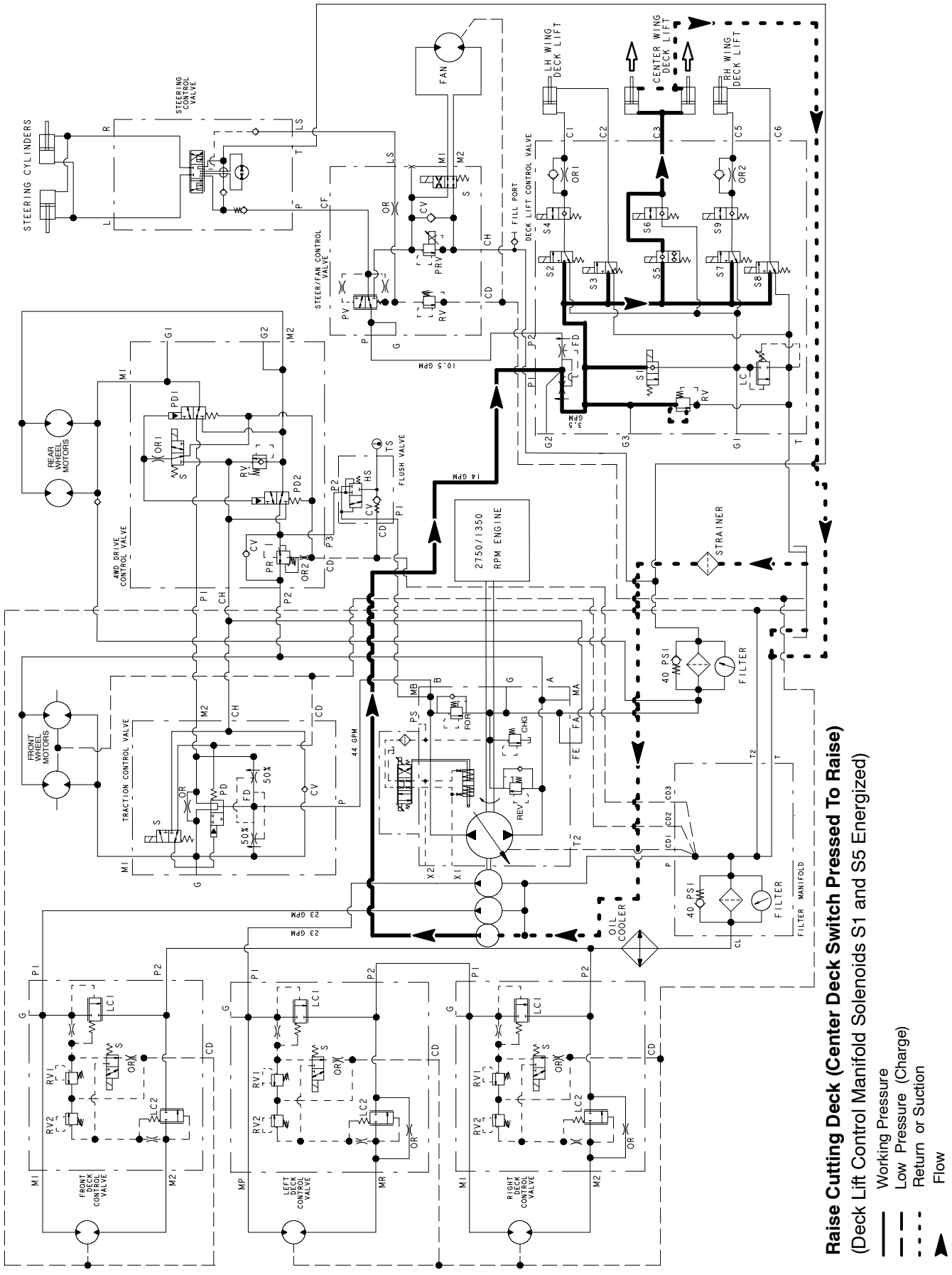
To further enhance traction control, the lift/lower circuit is equipped with a counterbalance system. Counterbalance is achieved by applying a constant pressure to the base end of the lift cylinders to lift the cutting decks slightly. This action causes some of the cutting deck weight to be transferred to the traction unit to improve traction. An adjustable counterbalance valve (LC) located in the deck lift control manifold controls the amount of counterbalance pressure in the lift circuit.

Traction Assist Switch in OFF Position

In low speed range with the Traction Assist switch in the OFF position, solenoid valve (S) in the traction control manifold is de−energized allowing the PD cartridge spool to be in the neutral position. With the traction pedal in the forward direction, hydraulic oil from the hydrostat port MB enters the traction control manifold at port P, flows through the FD cartridge and enters the PD cartridge. Flow at the PD cartridge splits into two circuits depending on downstream pressure. The flow leaving the PD cartridge splits between the M1 manifold port for the front wheel motors and the M2 manifold port for the rear wheel motors.

Traction Assist Switch in ON Position

In low speed range with the traction pedal in the forward direction and the momentary Traction Assist switch depressed and held in the ON position, solenoid valve (S) in the traction control manifold is energized allowing charge pressure to shift the PD cartridge spool. The shifted PD cartridge blocks oil flow from the hydrostat, thereby forcing hydrostat oil flow through the FD proportional flow control valve. The flow from the hydrostat is split approximately equally between the front and rear wheel motors as long as the Traction Assist switch is depressed.


Raise Cutting Deck (Center Deck Switch Pressed To Raise)
(Deck Lift Control Manifold Solenoids S1 and S5 Energized)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
DECK LIFT CONTROL VALVE
FILL PORT
STEER/FAN CONTROL VALVE
10.5 GPM
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
14 GPM
2750/1350 RPM ENGINE
STRAINER
40 PSI
FILTER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
44 GPM
23 GPM
OIL COOLER
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE

Raise Cutting Deck

A three section gear pump is coupled to the piston (traction) pump. The gear pump section (P3) farthest from the piston pump supplies hydraulic flow to the lift control manifold, the steering/cooling fan control manifold and the traction charge circuit. Hydraulic flow from pump section (P3) is split between the lift/lower circuit and the steering/cooling fan/charge circuit by a proportional flow divider located in the lift control manifold. This flow divider splits pump flow approximately 25% for the lift/lower circuit (4 GPM/15.1 LPM) and 75% for the steering/cooling fan/charge circuit (10 GPM/37.9 LPM).

An adjustable counterbalance valve (LC) in the lift control manifold maintains back pressure on the deck lift cylinders to allow some of the cutting deck weight to be transferred to the traction unit to improve traction. A relief valve (RV) located in the lift control manifold limits lift/lower circuit pressure to 1350 PSI (93 bar).

Each of the cutting decks (center, right and left) can be raised independently with the use of three switches on the armrest console (Fig. 11). Pressing the rear of a switch provides an input for the TEC−5001 controller to raise a cutting deck. The controller provides electrical outputs to solenoids in the lift control manifold to allow appropriate valve shift to cause a deck to raise.

When the cutting decks are in a stationary position, all solenoids in the lift control manifold are de−energized. In this position, the flow from the gear pump that is proportioned for the lift/lower circuit is by−passed through the solenoid valve S1, the counterbalance logic cartridge LC and returns to the hydraulic reservoir.

NOTE: The operator must be in the operator seat to raise a cutting deck.

Center Cutting Deck Raise

To raise the center cutting deck, the rear of the center console switch is depressed. The switch signal is an input to the TEC−5001 controller which provides an electrical output to solenoid valves S1 and S5 in the lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the barrel end of the center deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the reservoir. Shifted S5 allows an oil path to the barrel end of the lift cylinder to extend the lift cylinder and raise the center cutting deck. Oil from the extending cylinder returns to the hydraulic reservoir.

When the deck switch is released, the lift/lower control solenoids are de−energized and the center deck lift cylinders and center cutting deck are held in position.

Right Cutting Deck Raise

To raise the right wing deck, the rear of the right console switch is pushed as an input to the TEC−5001 controller. The controller provides an electrical output to solenoid valves S1 and S7 in the lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the rod end of the right deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the reservoir. Shifted S7 allows an oil path through the check valve at S9 (de−energized), the check valve at OR2 and to the barrel end of the lift cylinder to extend the lift cylinder and raise the right cutting deck. Oil from the extending cylinder is directed through S9 (de−energized) and returns to the hydraulic reservoir.

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

Left Cutting Deck Raise

To raise the left wing deck, the rear of the left console switch is pushed as an input to the TEC−5001 controller. The controller provides an electrical output to solenoid valves S1 and S2 in the lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the barrel end of the left deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the reservoir. Shifted S2 allows an oil path through the check valve at S4 (de−energized), the check valve at OR1 and to the barrel end of the lift cylinder to extend the lift cylinder and raise the left cutting deck. Oil from the extending cylinder is directed through S3 (de−energized) and returns to the hydraulic reservoir.

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

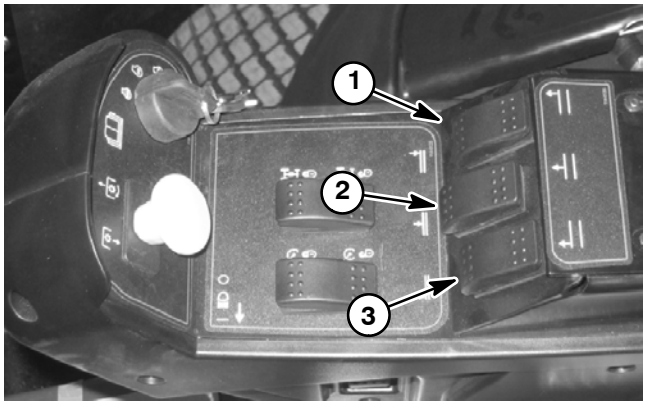
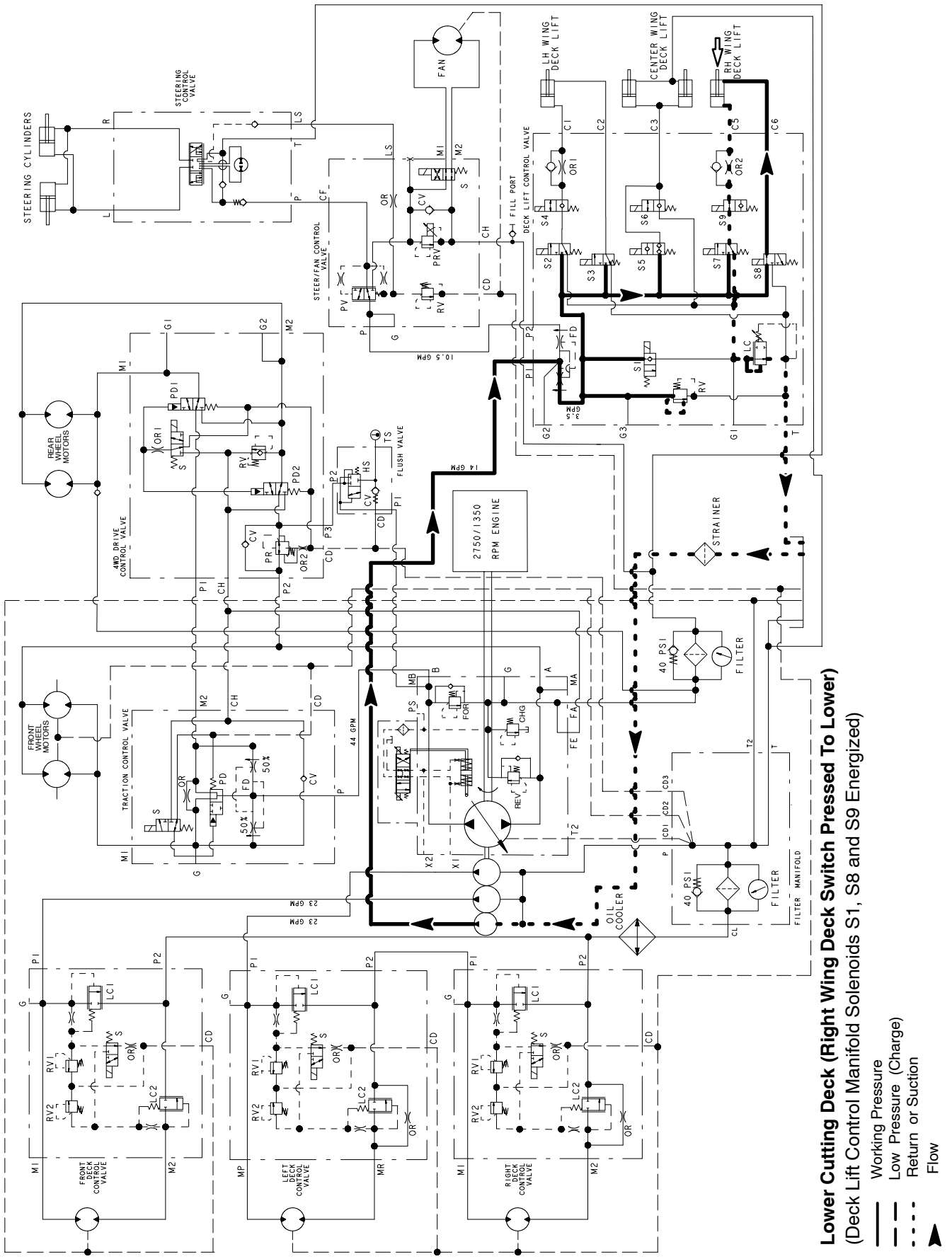


Figure 11

1. Right deck switch
2. Center deck switch
3. Left deck switch


STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
DECK LIFT CONTROL VALVE
FILL PORT
STEER/FAN CONTROL VALVE
10.5 GPM
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
14 GPM
2750/1350 RPM ENGINE
STRAINER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
44 GPM
40 PSI
FILTER
23 GPM
OIL COOLER
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE
Lower Cutting Deck (Right Wing Deck Switch Pressed To Lower)
(Deck Lift Control Manifold Solenoids S1, S8 and S9 Energized)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow

Lower Cutting Deck

A three section gear pump is coupled to the piston (traction) pump. The gear pump section (P3) farthest from the piston pump supplies hydraulic flow to the lift control manifold, the steering/cooling fan control manifold and the traction charge circuit. Hydraulic flow from pump section (P3) is split between the lift/lower circuit and the steering/cooling fan/charge circuit by a proportional flow divider located in the lift control manifold. This flow divider splits pump flow approximately 25% for the lift/lower circuit and 75% for the steering/cooling fan/charge circuit.

An adjustable counterbalance valve (LC) in the lift control manifold maintains back pressure on the deck lift cylinders to allow some of the cutting deck weight to be transferred to the traction unit to improve traction. A relief valve (RV) located in the lift control manifold limits lift/lower circuit pressure to 1350 PSI (93 bar).

Each of the cutting decks (center, right and left) can be lowered independently with the use of three (3) switches on the armrest console (Fig. 11). Pressing the front of a switch provides an input for the TEC–5001 controller to lower a cutting deck. The controller provides electrical outputs to solenoids in the lift control manifold to allow appropriate valve shift to cause a deck to lower.

When the cutting decks are in a stationary position, all solenoids in the lift control manifold are de–energized. In this position, the flow from the gear pump that is proportioned for the lift/lower circuit is by–passed through the solenoid valve S1, the counterbalance logic cartridge LC and returns to the hydraulic reservoir.

NOTE: The operator must be in the operator seat in order to lower a cutting deck.

Center Cutting Deck Lower

To lower the center cutting deck, the front of the center console switch is depressed. The switch signal is an input to the TEC–5001 controller which provides an electrical output to solenoid valve S6 in the lift control manifold. Energized solenoid valve S6 shifts to allow a passage for oil flow from the rod end of the center deck lift cylinders. The weight of the cutting deck causes the center deck lift cylinders to retract and lower the center cutting deck.

When the deck switch is released, the lift/lower control solenoid is de–energized and the lift cylinders and center cutting deck are held in position.

Right Cutting Deck Lower

To lower the right wing deck, the front of the right console switch is pushed as an input to the TEC–5001 controller. The controller provides an electrical output to solenoid valves S1, S8 and S9 in the lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the rod end of the right deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the reservoir. Shifted S8 allows an oil path to the shaft end of the lift cylinder to retract the lift cylinder and lower the right cutting deck. Oil from the retracting cylinder flows through orifice OR2 to control the drop speed of the cutting deck. Flow is then directed through the shifted S9, counterbalance valve (LC) and returns to the hydraulic reservoir.

When the deck switch is released, the lift/lower control solenoids are de–energized and the lift cylinder and right cutting deck are held in position.

Left Cutting Deck Lower

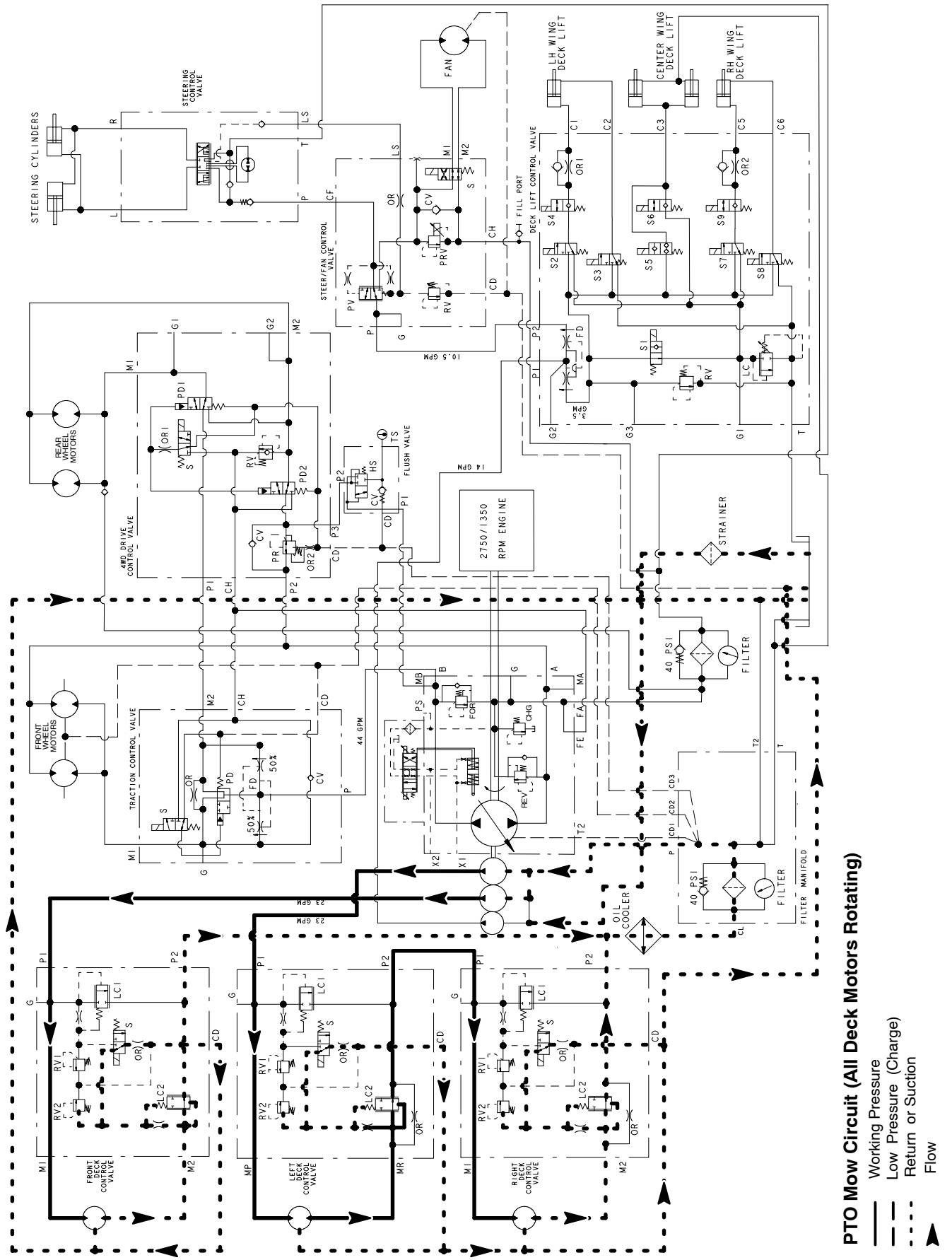
To lower the left wing deck, the front of the left console switch is pushed as an input to the TEC–5001 controller. The controller provides an electrical output to solenoid valves S1, S3 and S4 in the lift control manifold. The energized solenoid valves shift to allow a passage for circuit oil flow to the rod end of the left deck lift cylinder. Shifted S1 prevents oil flow from returning directly to the reservoir. Shifted S3 allows an oil path to the shaft end of the lift cylinder to retract the lift cylinder and lower the left cutting deck. Oil from the retracting cylinder flows through orifice OR1 to control the drop speed of the cutting deck. Flow is then directed through the shifted S3, counterbalance valve (LC) and returns to the hydraulic reservoir.

When the deck switch is released, the lift/lower control solenoids are de–energized and the lift cylinder and left cutting deck are held in position.

Cutting Deck Float

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

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


PTO Mow Circuit (All Deck Motors Rotating)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
DECK LIFT CONTROL VALVE
FILL PORT
STEER/FAN CONTROL VALVE
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
2750/1350 RPM ENGINE
STRAINER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
40 PSI
FILTER
OIL COOLER
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE
10.5 GPM
14 GPM
44 GPM
23 GPM

PTO Mow Circuit

A three section gear pump is coupled to the piston (traction) pump. Hydraulic flow for the PTO mow circuit is supplied by two (2) sections of the gear pump. The gear pump section (P1) closest to the piston pump supplies hydraulic flow in series to the right and left decks, while the next gear pump section (P2) supplies the center deck. Each of the three (3) cutting decks is controlled by a hydraulic control manifold equipped with a solenoid control valve (S), logic cartridges (LC1) and (LC2), a brake relief cartridge (RV2) and a circuit relief cartridge (RV1).

PTO Not Engaged

When the PTO switch is OFF or if the deck is raised with the PTO switch ON, the PTO manifold solenoid valve (S) is not energized and the solenoid spool is in the neutral position. The solenoid valve spool in neutral allows a small amount of hydraulic flow to return to tank through a manifold sensing line which causes a pressure increase that shifts logic cartridge LC1. The pump flow is routed through shifted LC1 and out manifold port P2. Logic cartridge LC2 remains in the unshifted position to prevent any return flow from the deck motor to keep the motor from rotating.

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

PTO Engaged

When the PTO switch is turned ON and the decks are lowered, the PTO control manifold solenoid valve (S) is energized by the TEC–5002 controller. The shifted solenoid valve spool prevents any sense line flow through the spool which causes the logic cartridge LC1 to be in its neutral position. Gear pump flow entering the manifold is routed out manifold port M1 and to the cutting deck motor. The return flow from the deck motor re–enters manifold port M2. The shifted solenoid valve spool allows a small amount of hydraulic flow to return to tank through a manifold sensing line which causes a pressure increase that shifts logic cartridge LC2. Hydraulic flow is routed through shifted LC2, out manifold port P2, through the oil cooler and filter and then is routed to the gear pump input. The deck motor continues to rotate as long as solenoid valve (S) is energized.

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

PTO Circuit Relief

Maximum mow circuit pressure is limited for each deck by a relief valve (RV1) in the hydraulic control manifold. The center and left deck relief valves are set at 3000 PSI (207 bar) and the right deck relief valve is set at 2000 PSI (138 bar).

Relief valve (RV1) and logic cartridge (LC1) work together as a two stage relief. When increased circuit resistance is met or if a cutting blade should strike an object, the pressure increase is felt at the relief valve. If the pressure should exceed the relief valve setting, the relief valve will open, creating a small amount of hydraulic flow to return to tank through a manifold sensing line. This flow causes a pressure increase that shifts logic cartridge LC1 and diverts circuit flow away from the deck motor to manifold port P2 (Fig. 12). When circuit pressure lowers, relief valve (RV1) closes which returns logic cartridge LC1 back to its neutral position allowing flow to return to the deck motor.

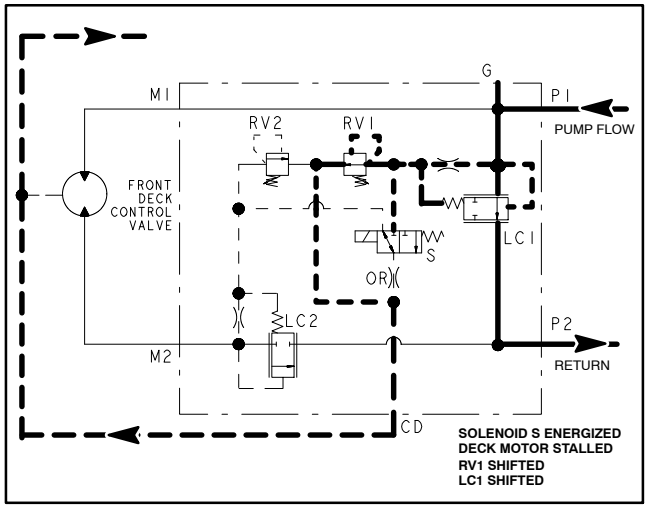


Figure 12

PTO Mow Circuit Cutting Deck Blade Braking

When the operator turns the PTO switch OFF or if a deck is raised with the PTO switch ON, PTO control manifold solenoid valve (S) is de−energized causing logic cartridge (LC1) to shift (refer to information in PTO Mow Circuit in this section). This shifted cartridge allows oil return out manifold port P2. At the same time, solenoid valve (S) in its neutral position prevents any sense line flow through the spool which causes the logic cartridge LC2 to shift to its neutral position blocking return flow from the deck motor and slowing the cutting blades (Fig. 13).

The inertia of the rotating cutting blades, however, effectively turns the deck motor into a pump causing an increase in pressure as the flow from the motor comes up against the closed logic cartridge (LC2). When this pressure builds to approximately 600 PSI (41 bar), relief valve (RV2) opens which allows a small amount of hydraulic flow to return to tank through a manifold sensing line (Fig. 14). This flow causes a pressure increase that shifts logic cartridge LC2 to once again allow oil flow from the motor (Fig. 15). When return pressure drops below 600 PSI (41 bar), relief valve (RV2) reseats and causes LC2 to close again blocking return flow from the deck motor to further slow the cutting blades. This action of the brake relief valve opening and the logic cartridge shifting occurs several times in a very short time frame as the blades finally come to a stop. Once the blades have stopped, logic cartridge LC2 remains in the neutral position to keep the deck motor from rotating.

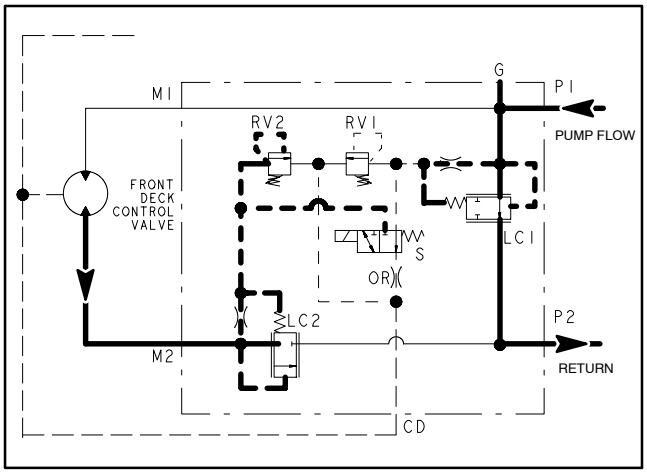


Figure 13

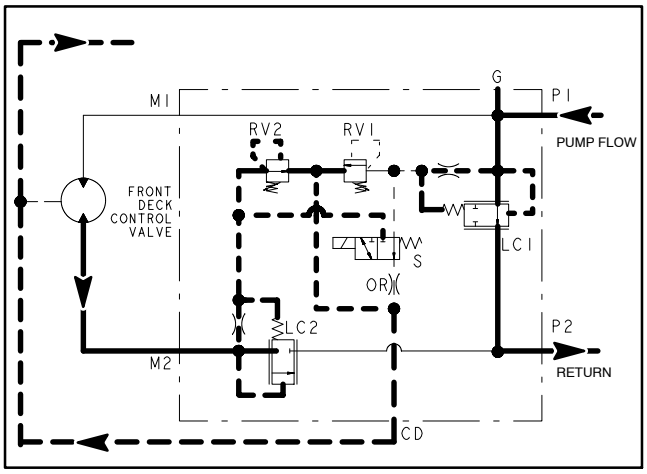


Figure 14

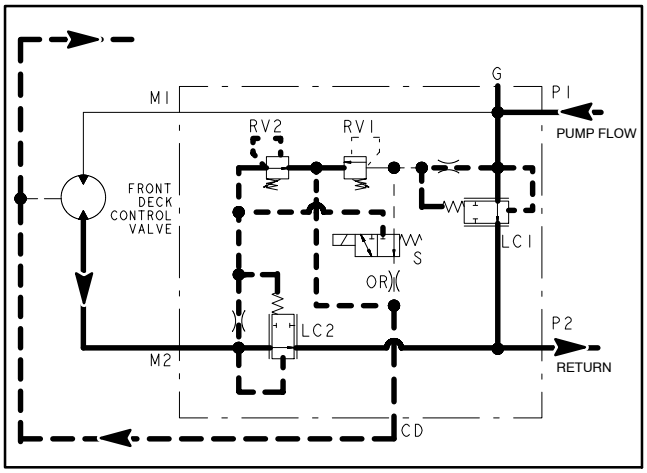
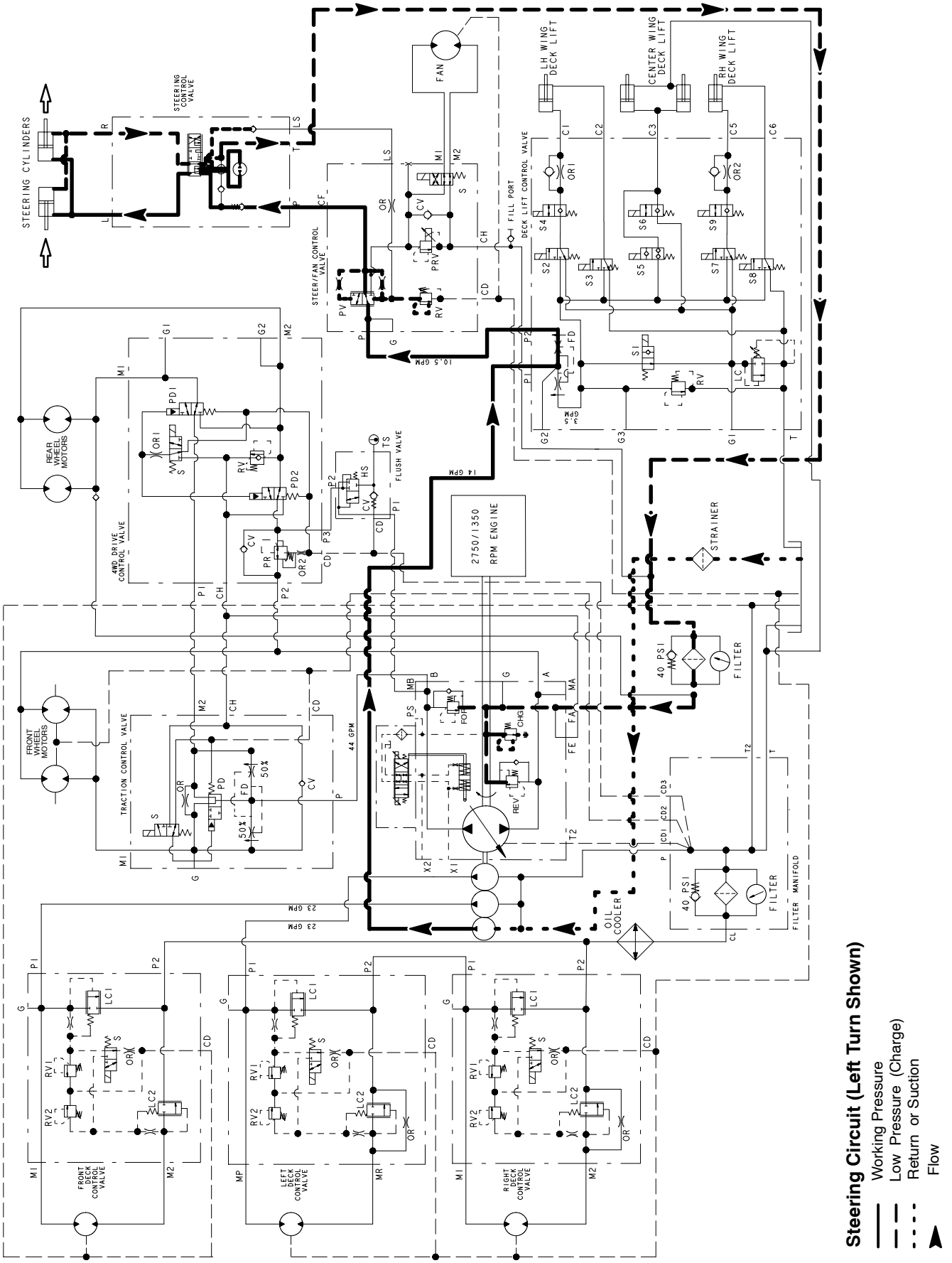


Figure 15

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Steering Circuit (Left Turn Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
DECK LIFT CONTROL VALVE
FILL PORT
STEER/FAN CONTROL VALVE
10.5 GPM
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
14 GPM
2750/1350 RPM ENGINE
STRAINER
40 PSI
FILTER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
44 GPM
OIL COOLER
23 GPM
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE

Steering Circuit

A three section gear pump is coupled to the piston (traction) pump. The gear pump section (P3) farthest from the piston pump supplies hydraulic flow to the steering/cooling fan control manifold, the lift control manifold and the traction charge circuit. Hydraulic flow from pump section (P3) is split between the steering/cooling fan/charge circuit and the lift/lower circuit by a proportional flow divider located in the lift control manifold. This flow divider splits pump flow approximately 75% for the steering/cooling fan/charge circuit (10.5 GPM/39.7 LPM) and 25% for the lift/lower circuit (3.5 GPM/13.2 LPM).

The steering/cooling fan control manifold controls the operation of the steering control valve and the gear motor that drives the engine cooling fan. Priority valve (PV) in the manifold controls the oil flow to the steering control valve which is a closed center, load sensing valve. The steering control valve senses the oil flow that is needed for steering and the priority valve (PV) will supply the correct amount. Oil not used by steering is provided to the cooling fan motor.

With the steering wheel in the neutral, at rest position and the engine running, hydraulic oil from the lift control manifold flow divider enters the steering/cooling fan control manifold port P, flows through the priority valve (PV) and to the steering control valve where it dead heads at the spool. Oil is also sent to both ends of the (PV) spool. On one end of the spool, oil is directed to the steering relief valve (RV) and also is directed through the OR orifice and out the LS manifold port to the steering control valve. This flow provides steering load sense pressure and is directed through a small passage in the steering control valve spool and sleeve before returning to the charge circuit. While this load sense pressure is returning to the charge circuit, the priority valve (PV) spool shifts to direct pump flow to the engine fan motor circuit. Without steering input, no oil is flowing through the steering control valve.

Left Turn

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

The steering wheel and steering control valve return to the neutral position when turning is completed.

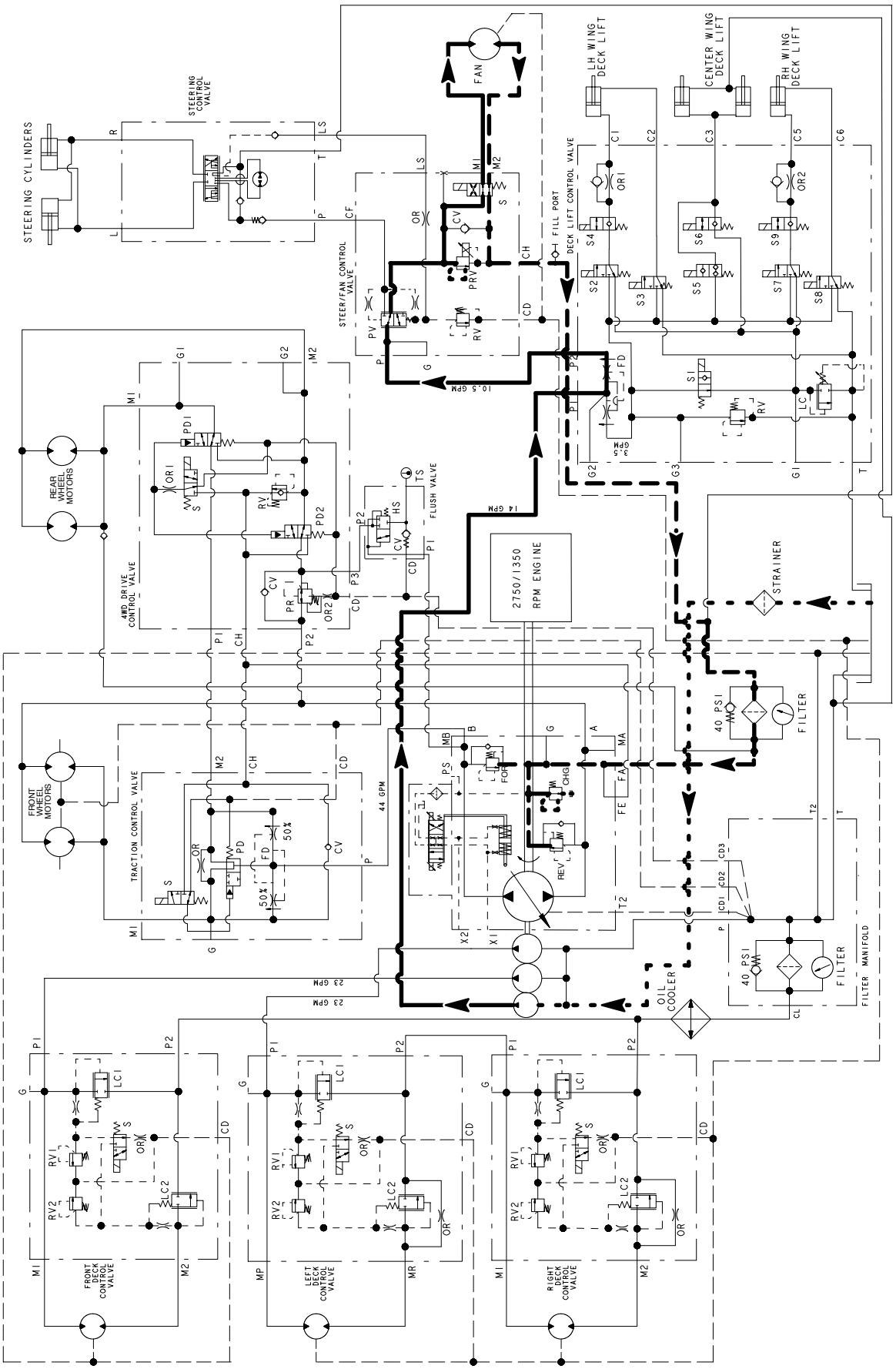
Right Turn

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

The steering wheel and steering control valve return to the neutral position when turning is completed.

Steering Relief Operation

When the steering cylinders reach the end of their stroke or if a rear wheel should encounter an obstruction (e.g. a curb) while steering, the pressure in the steering circuit will rise. Relief valve (RV) in the steering/cooling fan control manifold senses this pressure increase. When this pressure builds to approximately 2100 PSI (145 bar), relief valve (RV) opens and allows hydraulic flow to return to tank. This action causes flow across the relief valve side orifice of priority valve (PV) which shifts the spool in (PV) to send oil away from the steering circuit to the fan motor circuit. Relief valve (RV) controls the action of priority valve (PV) and allows the priority valve to divert only enough oil flow to the steering circuit to maintain relief pressure.


Engine Cooling Fan Circuit (Forward Direction Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
STEERING CYLINDERS
STEERING CONTROL VALVE
FAN
LH WING DECK LIFT
CENTER WING DECK LIFT
RH WING DECK LIFT
FILL PORT
DECK LIFT CONTROL VALVE
STEER/FAN CONTROL VALVE
10.5 GPM
REAR WHEEL MOTORS
4WD DRIVE CONTROL VALVE
FLUSH VALVE
2750/1350 RPM ENGINE
STRAINER
40 PSI
FILTER
FRONT WHEEL MOTORS
TRACTION CONTROL VALVE
44 GPM
23 GPM
OIL COOLER
FILTER MANIFOLD
FRONT DECK CONTROL VALVE
LEFT DECK CONTROL VALVE
RIGHT DECK CONTROL VALVE

Engine Cooling Fan Circuit

A three section gear pump is coupled to the piston (traction) pump. The gear pump section (P3) farthest from the piston pump supplies hydraulic flow to the steering/cooling fan control manifold, the lift control manifold and the traction charge circuit. Hydraulic flow from pump section (P3) is split between the steering/cooling fan/charge circuit and the lift/lower circuit by a proportional flow divider located in the lift control manifold. This flow divider splits pump flow approximately 75% for the steering/cooling fan/charge circuit (10.5 GPM/39.7 LPM) and 25% for the lift/lower circuit (3.5 GPM/13.2 LPM).

The steering/cooling fan control manifold controls the operation of the steering control valve and the gear motor that drives the engine cooling fan. Priority valve (PV) in the manifold controls the oil flow to the steering control valve which is a closed center, load sensing valve. The steering control valve senses the oil flow that is needed for steering and the priority valve (PV) will supply the correct amount. Oil not used by steering is provided to the fan motor. The steering/cooling fan control manifold controls the speed and direction of the fan motor based on electrical output from the TEC–5002 controller.

With the steering wheel in the neutral, at rest position and the engine running, hydraulic oil from the lift control manifold flow divider enters the steering/cooling fan control manifold port P, flows through the priority valve (PV) and to the steering control valve where it dead heads at the spool. Oil is also sent to both ends of the (PV) spool. On one end of the spool, oil is directed to the steering relief valve (RV) and also is directed through the OR orifice and out the LS manifold port to the steering control valve. This flow provides steering load sense pressure and is directed through a small passage in the steering control valve spool and sleeve before returning to the charge circuit. While this load sense pressure is returning to the charge circuit, the priority valve (PV) spool shifts to direct pump flow to the cooling fan motor circuit. Without steering input, no oil is flowing through the steering control valve so all circuit oil is available for the cooling fan motor.

Oil flow from the priority valve (PV) to the cooling fan is controlled by the proportional relief valve (PRV). The (PRV) adjusts fan circuit pressure and flow based on a PWM (Pulse Width Modulation) signal from the TEC–5002 controller. The controller uses engine coolant and hydraulic oil temperatures to determine the proper PWM signal for the (PRV) valve. The fan circuit flow determines the speed of the cooling fan.

If the fan motor is stalled for any reason, the priority valve (PRV) has a secondary function as a circuit relief to limit fan motor pressure to 3300 PSI (228 bar).

When the engine is shut off, the over–running inertia load of the fan blades keeps driving the fan motor and turns it into a pump. The check valve (CV) in the steering/cooling fan control manifold will open to keep the motor circuit full of oil so the fan motor will not cavitate.

Forward Direction Fan Operation

Oil flow from the priority valve (PV) is sent through the de–energized solenoid valve (S), out manifold port M1 and then to rotate the cooling fan motor. Return flow from the motor enters the manifold at port M2, through the de–energized solenoid valve (S), out manifold port CH and is then used for traction circuit charge oil.

Reverse Direction Fan Operation

The TEC–5002 controller can reverse the cooling fan to clean debris from the radiator, oil cooler and rear intake screen. If hydraulic oil and/or engine coolant temperatures increase to an unsuitable level, the PWM signal to the (PRV) valve is sent to slow the cooling fan. The controller then energizes solenoid valve (S) in the steering/cooling fan control manifold to reverse cooling fan motor oil flow so that it runs in the reverse direction. The controller determines the length of time that the fan should be run in reverse before fan rotation is returned to the forward direction.

Special Tools

Order special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Contains one each: 1000 PSI (70 Bar), 5000 PSI (350 Bar) and 10000 PSI (700 Bar) gauges. Use gauges as recommended in Testing section of this chapter.

Toro Part Number: **TOR47009**



Figure 16

Hydraulic Tester (Pressure and Flow)

This tester requires O−ring Face Seal (ORFS) adapter fittings for use on this machine (see Hydraulic Test Fitting Kit − TOR4079 in this section).

1. INLET HOSE: Hose connected from the system circuit to the inlet side of the hydraulic tester.

2. LOAD VALVE: A simulated working load is created in the circuit by turning the valve to restrict flow.

3. LOW PRESSURE GAUGE: Low range gauge (0 to 1000 PSI) to provide accurate reading at low pressure.

   A protector valve cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. HIGH PRESSURE GAUGE: High range gauge (0 to 5000 PSI) which accommodates pressures beyond the capacity of the low pressure gauge.

5. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated at 15 GPM.

6. OUTLET HOSE: A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Toro Part Number: **TOR214678**



Figure 17

Hydraulic Test Fitting Kit

This kit includes a variety of O−ring Face Seal fittings to enable you to connect test gauges into the system.

The kit includes: tee's, unions, reducers, plugs, caps and male test fittings.

Toro Part Number: **TOR4079**

TORO TEST FITTING KIT (NO. TOR4079)

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

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

Figure 18

Measuring Container

Use this container for doing hydraulic motor efficiency testing (motors with case drain lines only). Measure efficiency of a hydraulic motor by restricting the outlet flow from the motor and measuring leakage from the case drain line while the motor is pressurized by the hydraulic system.

The table in Figure 20 provides gallons per minute (GPM) conversion for measured milliliter or ounce motor case drain leakage.

Toro Part Number: **TOR4077**



Figure 19

GPM	Milliliters in 15 sec.	Ounces in 15 sec.
.1	95	3.2
.2	189	6.4
.3	284	9.6
.4	378	12.8
.5	473	16.0
.6	568	19.2
.7	662	22.4
.8	756	25.6
.9	852	28.8
1.0	946	32.0

Figure 20

Rear Wheel Hub Puller

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

Toro Part Number: **TOR6100**

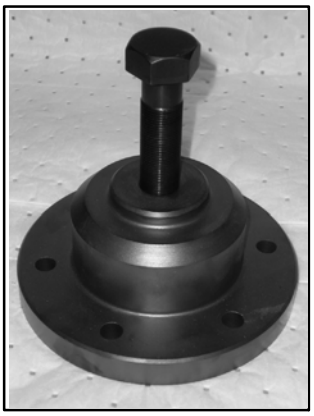


Figure 21

Troubleshooting

The charts that follow contain information to assist in troubleshooting hydraulic circuit problems. There may possibly be more than one cause for a machine malfunction.

Refer to the Testing section of this Chapter for precautions and specific hydraulic test procedures.

General Hydraulic Problems

Problem	Possible Causes
Hydraulic system operates hot.	Engine RPM is too low. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Brakes are applied or sticking. Piston pump by–pass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking in suction line.
Hydraulic oil leak(s).	Fitting(s), hose or tube loose or damaged. Missing or damaged O-ring.

Traction Problems

Problem	Possible Causes
Machine operates in one direction only.	System charge check valve and/or system relief valve is defective. Pilot direction valve in 4WD control manifold is damaged or sticking. Traction control potentiometer is faulty.
Traction pedal is sluggish.	Traction control pedal assembly is stuck or binding. Charge pressure is low. Piston pump servo control valve is damaged.
Machine travels too far before stopping when the traction pedal is released.	Traction control pedal assembly is binding or out of adjustment. Piston pump servo control valve is damaged. Traction pedal does not return to neutral.
Traction power is lost or unit will not operate in either direction.	Hydraulic reservoir oil level is low. Brakes are applied or sticking. Charge pressure is low. Piston pump bypass valve is open or damaged. Traction control potentiometer is damaged or disconnected.
Four wheel drive will not engage.	An electrical problem exists (see Chapter 5 – Electrical System). Solenoid valve on 4WD control manifold is faulty. Cartridge valve in 4WD control manifold is damaged or sticking.
Four wheel drive will not disengage.	An electrical problem exists (see Chapter 5 – Electrical System). Solenoid valve on 4WD control manifold is faulty. Cartridge valve in 4WD control manifold is damaged or sticking.

PTO Problems

Problem	Possible Causes
Cutting decks do not operate. **NOTE:** Decks have to be fully lowered and traction speed needs to be in MOW for decks to operate.	An electrical problem exists (see Chapter 5 – Electrical System). Gear pump is worn or damaged.
One cutting deck motor will not operate.	An electrical problem exists (see Chapter 5 – Electrical System). Cutting deck problem exists (see Chapter 8 – Cutting Decks). System pressure to the affected deck motor is low. Woodruff key on affected deck motor is damaged (motor rotates but deck belt and blades don't rotate). Solenoid valve in deck PTO control manifold is faulty. Cartridge valve in deck PTO control manifold is damaged or sticking. Deck motor or gear pump section is damaged.
All cutting deck motors operate slowly.	Engine RPM is low. Cutting deck problem exists (see Chapter 8 – Cutting Decks). Deck motor or gear pump section is damaged.
Cutting deck stops under load.	Relief valve in deck PTO control manifold is by–passing. Cutting deck problem exists (see Chapter 8 – Cutting Decks). Deck motor has internal leakage (by–passing oil). Cutting deck gear pump section is inefficient.

Steering Circuit Problems

Problem	Possible Cause
Steering inoperative or sluggish.	Steering components (e.g. tie rods, steering cylinder ends) are worn or binding. Steering cylinder is binding. Oil level in hydraulic reservoir is low (other hydraulic systems affected as well). Steering relief valve (RV) in steering/cooling fan control valve is stuck or damaged. Flow divider (FD) in deck lift control valve is faulty. Proportional valve (PV) in steering/cooling fan control valve is faulty. Steering cylinder leaks internally. Steering control valve is worn or damaged. Gear pump section (P3) is worn or damaged (NOTE: A worn or damaged gear pump section (P3) will also affect the traction (charge) and lift circuits).

Lift/Lower Problems

Problem	Possible Causes
Cutting deck will not raise.	Engine RPM is too low. Hydraulic oil level in reservoir is low. Lift arm pivots are binding. Lift cylinder is damaged. Relief valve in lift control manifold is stuck. Pilot valve in lift control manifold is damaged or sticking. Proportional flow divider in lift control manifold is faulty. Gear pump section for lift control manifold is worn or damaged.
Cutting deck raises, but will not stay up. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. The lift arms will eventually lower if left in the raised position during storage.	Lift circuit lines or fittings are leaking. Lift cylinder is damaged.
Side cutting deck drop too fast.	Orifice in lift control valve is missing or damaged. Check valve in lift control valve is faulty.
Side cutting deck drop too slow.	Orifice in lift control valve is plugged or faulty. Lift arm pivots are binding. Lift cylinder is damaged.
Cutting deck will not lower.	Lift arm pivots are binding. Lift cylinder is damaged. Counterbalance pressure is excessive. Lift control valve is worn or damaged. Pilot valve in lift control manifold is damaged or sticking.

Testing

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

Before Performing Hydraulic Tests

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

Precautions for Hydraulic Testing

CAUTION

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

CAUTION

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

CAUTION

Before opening the hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

WARNING

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

WARNING

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

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Contamination will cause excessive wear of hydraulic components.

2. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or removal of components.

3. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings.

4. The inlet and the outlet hoses for tester with pressure and flow capabilities must be properly connected and not reversed to prevent damage to the hydraulic tester or components.

5. When using hydraulic tester with pressure and flow capabilities, open tester load valve completely before starting the engine to minimize the possibility of damaging components.

6. Install fittings finger tight and far enough to make sure that they are not cross-threaded before tightening them with a wrench.

7. Position tester hoses to prevent rotating machine parts from contacting and damaging the hoses or tester.

8. Check oil level in the hydraulic reservoir. After connecting test equipment, make sure tank is full.

9. Check control linkages for improper adjustment, binding or broken parts.

10. After installing test gauges, run engine at low speed and check for any hydraulic oil leaks.

11. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

12. Before returning machine to use, make sure that hydraulic reservoir has correct fluid level. Also, check for hydraulic leaks after test equipment has been removed from hydraulic system.

Which Hydraulic Tests Are Necessary?

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

1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Charge Pressure, Traction Circuit Relief Pressure, Rear Traction Circuit (RV) Relief Pressure, Traction Circuit Reducing Valve (PR) Pressure and/or Counterbalance Pressure Tests.

2. If a PTO (mow) circuit problem exists, consider performing one or more of the following tests: Cutting Deck Circuit Pressure.

3. If a lift circuit problem exists, consider performing one or more of the following tests: Lift/Lower Circuit Relief Pressure, Counterbalance Pressure and/or Gear Pump (P3) Flow Tests.

4. If a steering/engine cooling fan circuit problem exists, consider performing one or more of the following tests: Steering Circuit Relief Pressure, Steering Cylinder Internal Leakage and/or Gear Pump (P3) Flow Tests.

Traction Circuit Charge Pressure Test (Using Pressure Gauge)

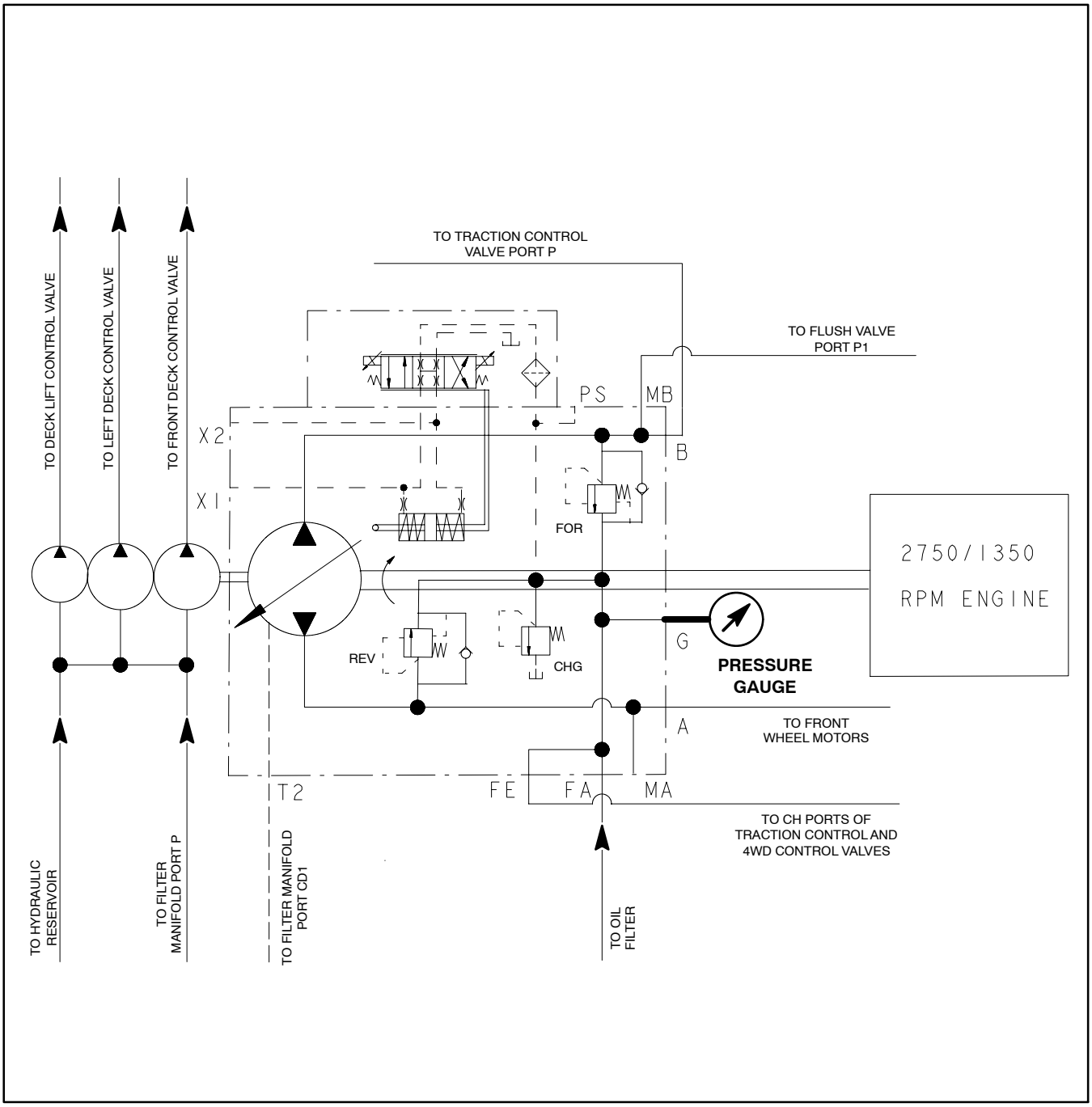


Figure 22

The traction circuit charge pressure test should be performed to make sure that the traction charge circuit is functioning correctly.

Procedure for Traction Circuit Charge Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 1000 PSI (70 Bar) pressure gauge onto charge pressure test port fitting on hydrostat (Fig. 23).

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

5. Operate the engine at full engine speed **(2750 RPM)** with no load on the hydraulic system.

GAUGE READING TO BE 315 to 345 PSI (21.8 to 23.7 bar).

6. Stop engine and record test results.

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

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

B. Inspect charge pressure relief valve located in the hydrostat (Fig. 23). The charge pressure relief valve is adjusted with shims. If charge pressure is low, shim(s) can be added between relief valve cap and spring. If charge pressure is high, shim(s) can be removed from between relief valve cap and spring.

C. Consider a leaking check/relief valve in the hydrostat.

D. Leakage in the traction control manifold, the mow/transport manifold and/or the steering/cooling fan manifold will affect charge circuit pressure. Consider that damaged cartridge seals in these manifolds will cause low charge circuit pressure.

E. If necessary, check for internal damage or worn parts in gear pump (P3). A worn or damaged gear pump (P3) will also affect deck lift/lower, steering and engine cooling fan operation.

8. Also, with the pressure gauge still connected to the charge pressure test port, take a gauge reading while operating the machine in forward and reverse. Start the engine, release parking brake and put throttle at full engine speed **(2750 RPM)**. Push the traction pedal forward, then reverse.

GAUGE READING TO BE 315 to 345 PSI (21.8 to 23.7 bar).

9. If charge pressure is good under no load (step 5), but drops below specification when under traction load (step 8), the piston (traction) pump and/or wheel motor(s) should be suspected of wear and inefficiency. When the pump and/or traction motor(s) are worn or damaged, the charge pump is not able to keep up with internal leakage in traction circuit components.

10. Disconnect pressure gauge from test port.

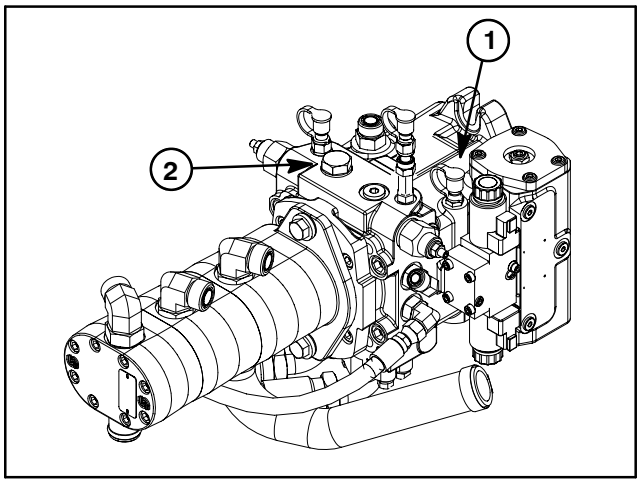


Figure 23

1. **Hydrostat port G**
2. **Charge relief valve**

Traction Circuit Relief Pressure Test (Using Pressure Gauge)

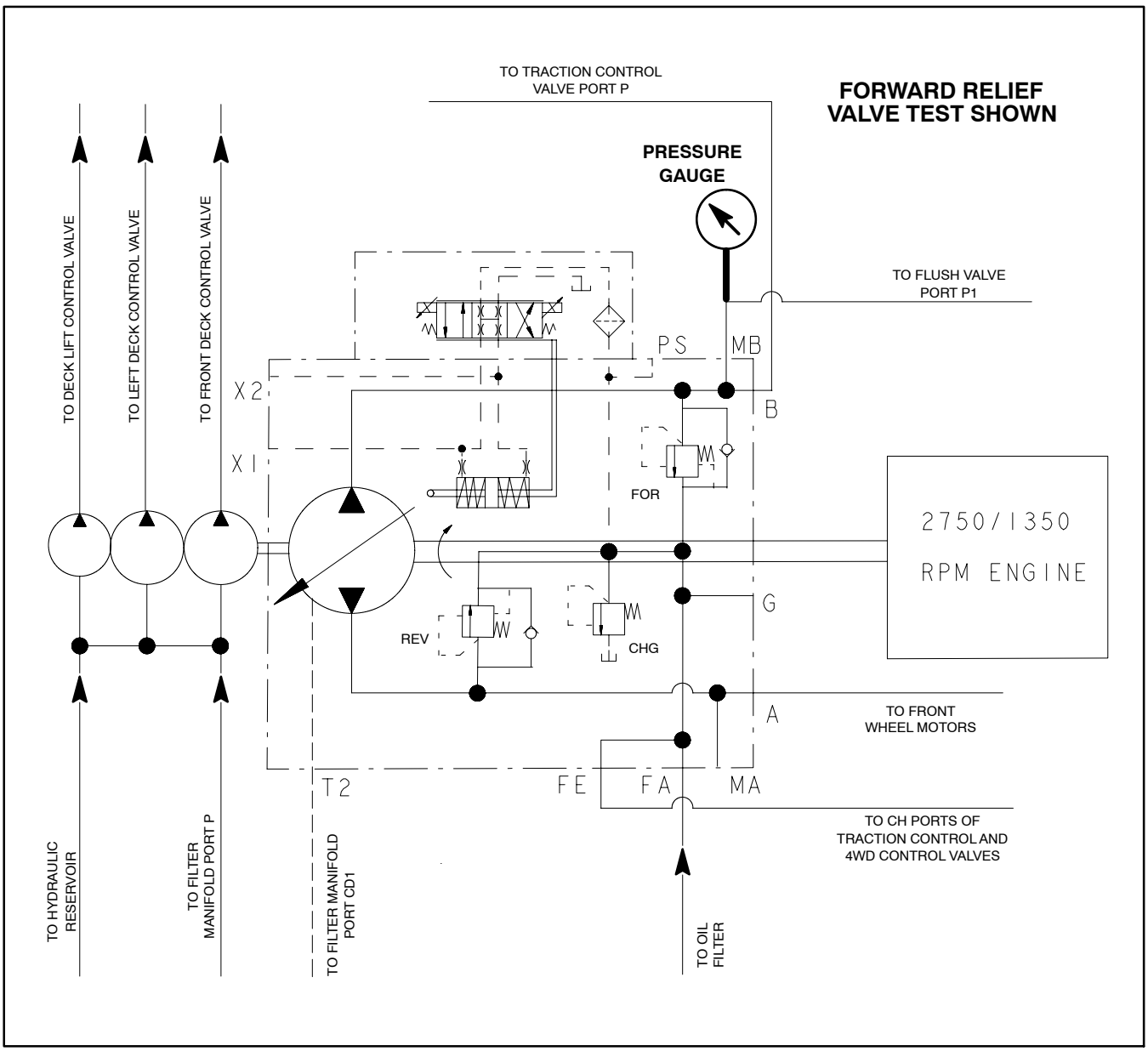


Figure 24

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

Procedure for Traction Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

CAUTION

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

2. Drive machine to an open area, lower cutting decks, turn the engine off and apply the parking brake.

CAUTION

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

3. Connect a 10,000 PSI (700 Bar) pressure gauge to traction circuit test port for function to be checked (Fig. 25).

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

5. Sit on seat and operate the engine at full speed **(2750 RPM)**. Release parking brake.

6. Apply service brakes fully and slowly depress the traction pedal in the appropriate direction (forward or reverse). While pushing traction pedal, look at pressure reading on gauge:

GAUGE READING TO BE:
4230 to 4430 PSI (292 to 305 bar) in forward
5230 to 5430 PSI (361 to 374 bar) in reverse

7. Release traction pedal and stop engine. Record test results.

8. If traction pressure is low, inspect traction pump relief valves (Fig. 25). Clean or replace valves as necessary. These cartridge type valves are factory set and are not adjustable. If relief valves are in good condition, traction pump or wheel motors should be suspected of wear and inefficiency.

9. Disconnect pressure gauge from test port.

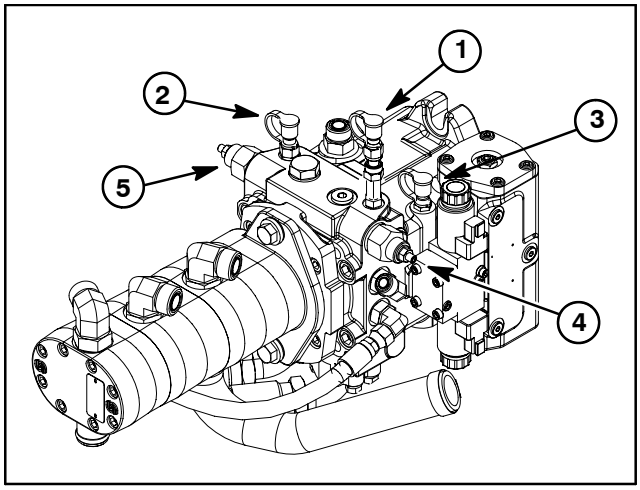


Figure 25

1. **Forward test port**
2. **Reverse test port**
3. **Charge pressure port**
4. **Forward relief valve**
5. **Reverse relief valve**

Rear Traction Circuit (RV) Relief Pressure Test (Using Pressure Gauge)

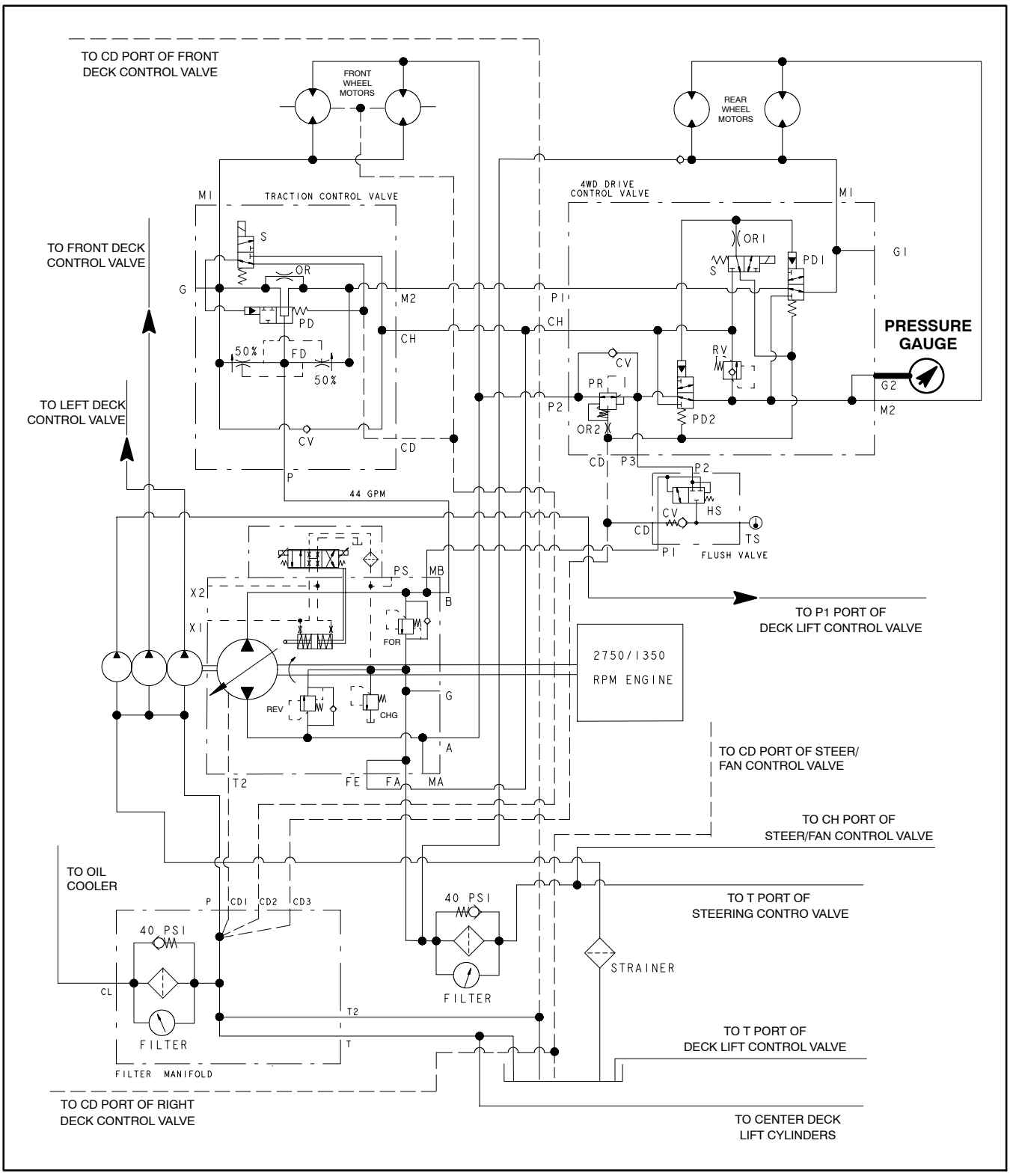


Figure 26

Procedure for Rear Traction Circuit (RV) Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 5000 PSI (350 Bar) gauge to test port G2 on 4WD control manifold on right side of machine (Fig. 27).

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

5. Operate the engine at full engine speed **(2750 RPM)**.

6. Operate the machine in 4WD with the cutting decks lowered. Drive down a slope in a forward direction, decrease pressure on the traction pedal and monitor the pressure gauge. Pressure should increase until the relief valve (RV) lifts. Record test results.

GAUGE READING TO BE:
1200 PSI (83 bar) (approximate).

7. If necessary, adjust the relief valve (RV) so that pressure is correct (see Adjustable Pressure Valve in the Adjustments section of this chapter). Relief valve (RV) is located on the rear side of the 4WD control manifold (Fig. 27).

8. Disconnect pressure gauge from manifold test port.

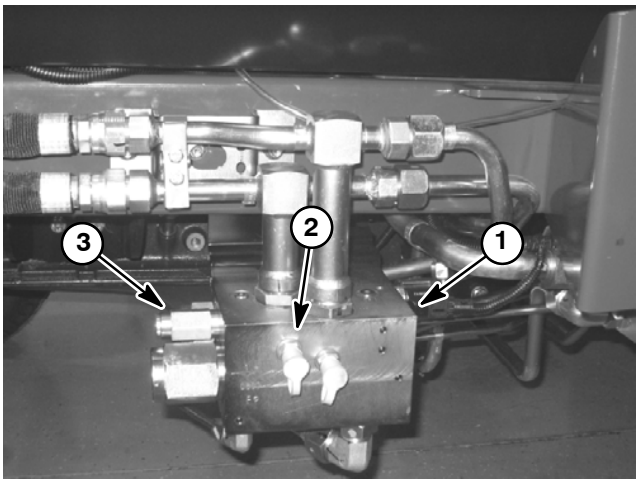


Figure 27

1. **4WD control manifold**
2. **Test port G2**
3. **Relief valve RV**

Traction Circuit Reducing Valve (PR) Pressure Test (Using Pressure Gauge)

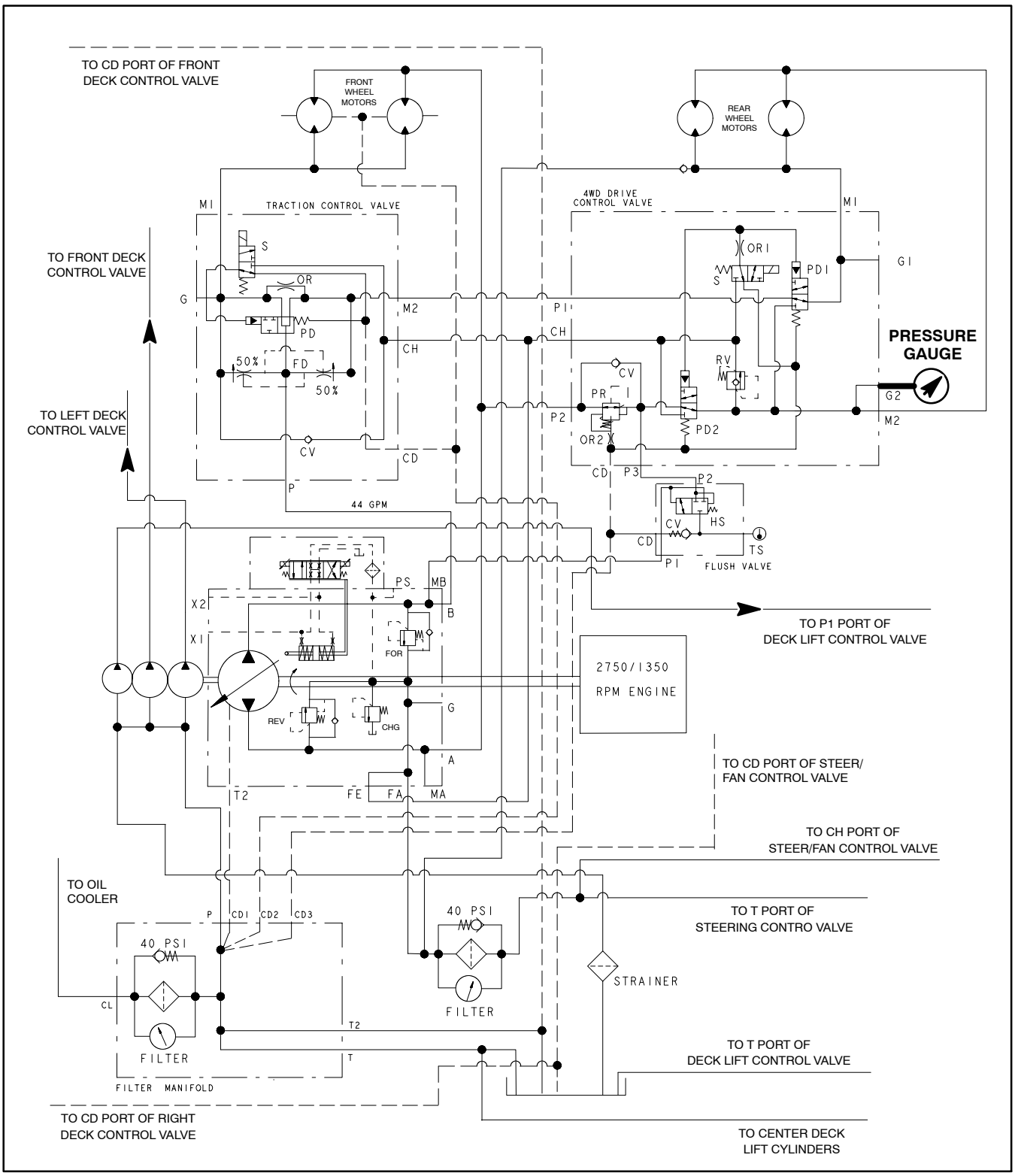


Figure 28

Procedure for Traction Circuit Reducing Valve (PR) Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 1000 PSI (70 Bar) pressure gauge to test port G2 on 4WD control manifold on right side of machine (Fig. 29).

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

5. Operate the engine at full engine speed **(2750 RPM)**.

6. Sit on seat and release parking brake. Apply service brakes fully and slowly depress the traction pedal in the **reverse** direction. While pushing traction pedal, look at pressure reading on gauge:

GAUGE READING TO BE:
650 PSI (45 bar) (approximate).

7. Stop engine and record test results.

8. If necessary, adjust the pressure reducing valve (PR) so that pressure is correct (see Adjustable Pressure Valve in the Adjustments section of this chapter). The pressure reducing valve (PR) is located on the lower, rear side of the 4WD control manifold (Fig. 29).

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

9. Disconnect pressure gauge from test port.

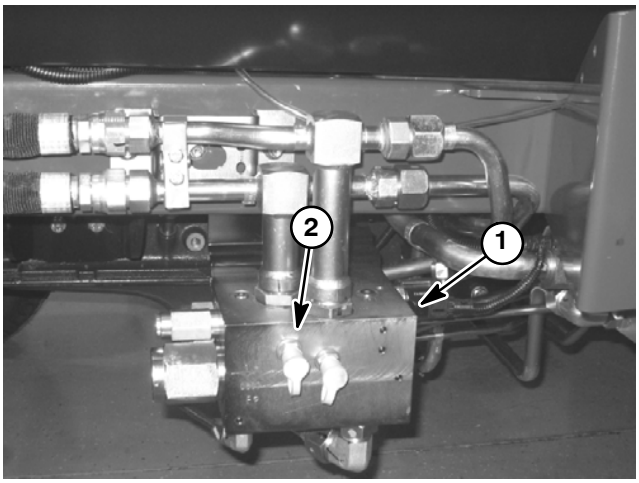


Figure 29

1. 4WD manifold
2. Test port G2

Counterbalance Pressure Test (Using Pressure Gauge)

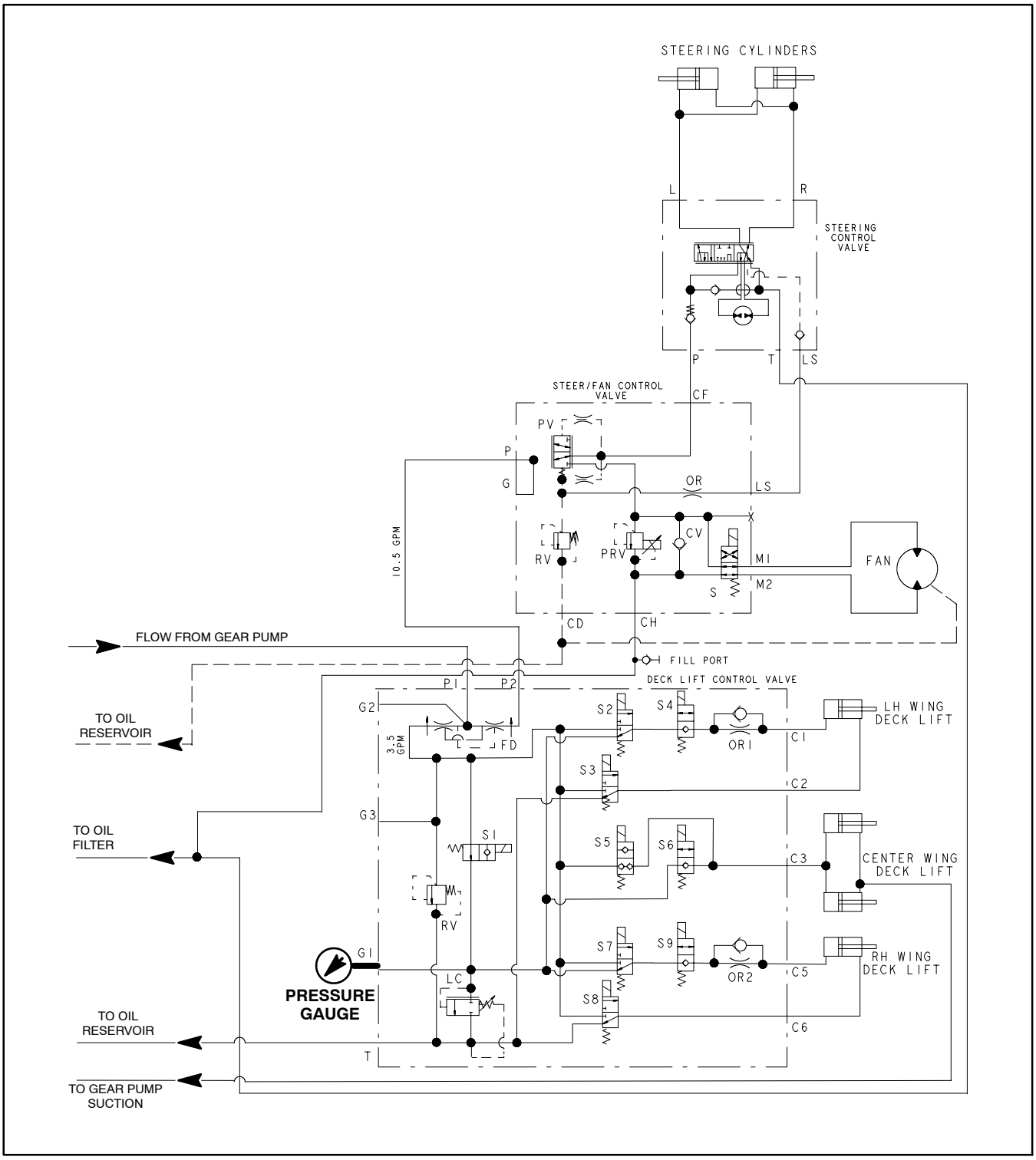


Figure 30

Procedure for Counterbalance Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 1000 PSI (70 Bar) pressure gauge to test port G1 on lift control manifold (Fig. 31).

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

5. Operate the engine at full engine speed **(2750 RPM)** with no load on the system. **Do not engage the cutting decks**.

GAUGE READING TO BE:
360 to 380 PSI (24.9 to 26.2 bar).

6. Stop engine and record test results.

7. If necessary, adjust the counterbalance valve so that pressure is correct (see Adjustable Pressure Valve in the Adjustments section of this chapter). The counterbalance valve is located on the rear side of the lift control manifold (Fig. 31).

8. Disconnect pressure gauge from test port.

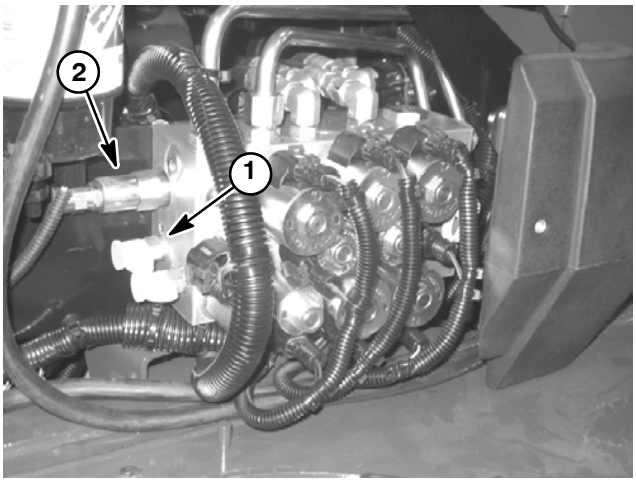


Figure 31

1. Counterbalance test port **2. Counterbalance valve**

Cutting Deck Circuit Pressure Test (Using Pressure Gauge)

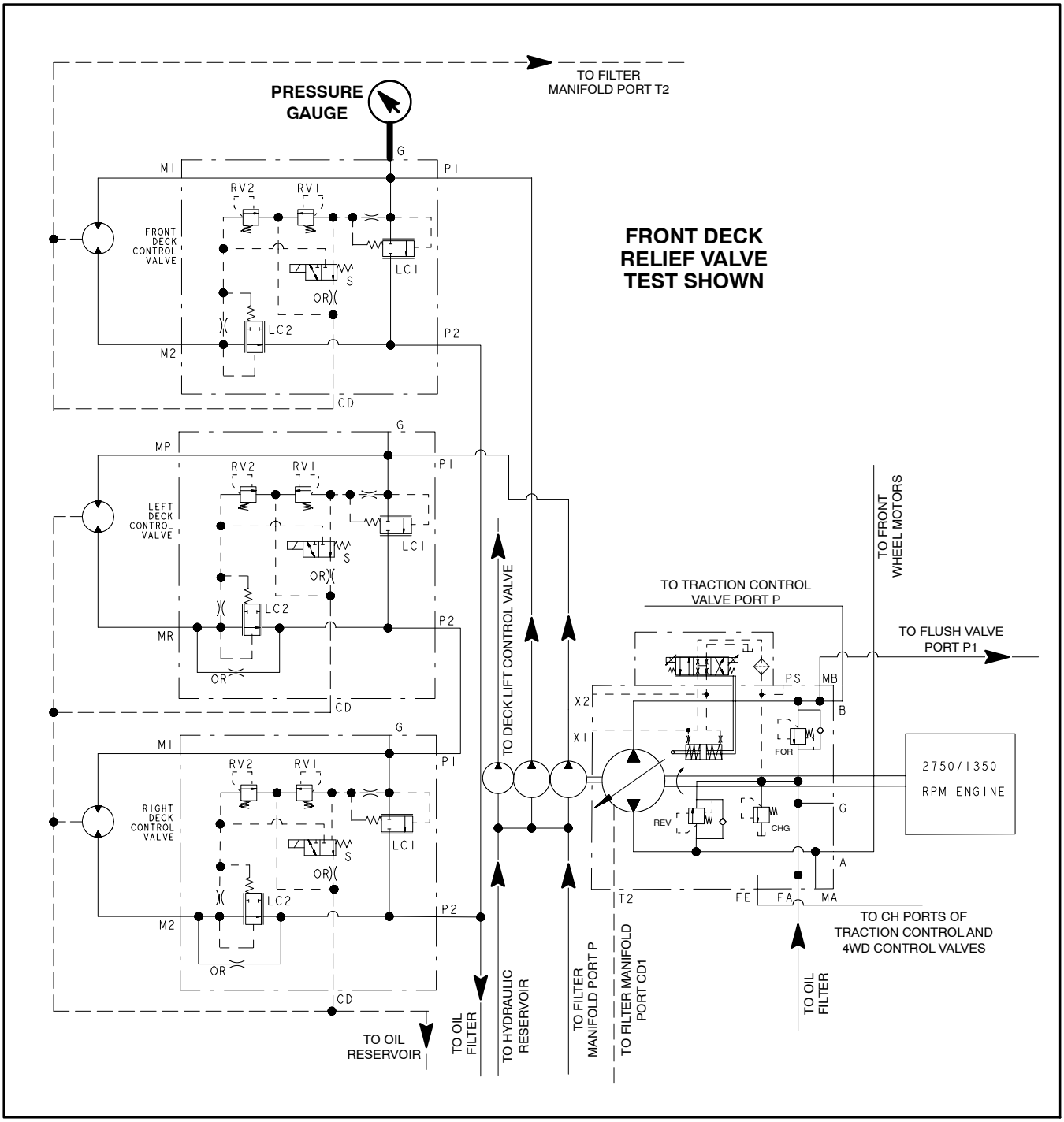


Figure 32

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

Procedure for Cutting Deck Circuit Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Install 5000 PSI (350 Bar) pressure gauge with hydraulic hose attached to deck manifold test port G for the deck to be tested (Fig. 33, 34 and 35).

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

CAUTION

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

5. Sit on seat and operate the engine at full speed **(2750 RPM)**. Release parking brake and engage the cutting decks.

6. Watch pressure gauge carefully while mowing with the machine.

7. Cutting deck circuit pressure should be from **1000 to 3200 PSI (69 to 220 bar) (1000 to 2100 PSI (69 to 144 bar) for RH wing deck)** and will vary depending on mowing conditions.

8. Disengage cutting decks and shut off engine. Record test results.

9. Disconnect pressure gauge with hose from manifold test port.

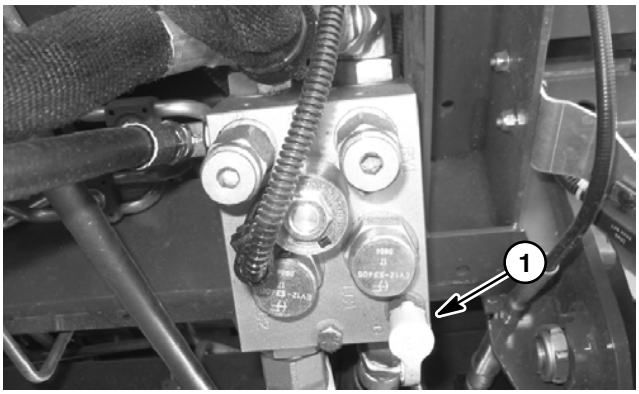


Figure 33

1. **Center deck circuit pressure test port G**

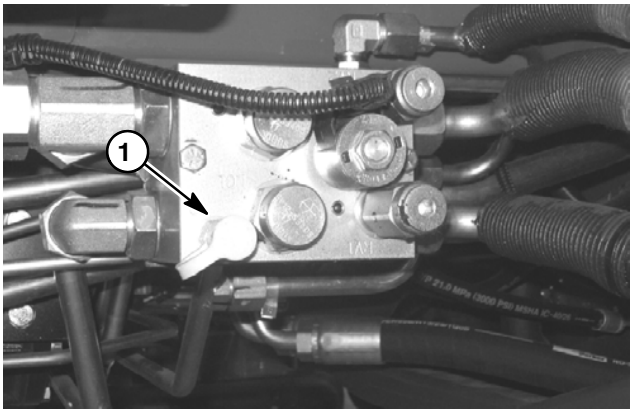


Figure 34

1. **Right wing deck circuit pressure test port G**

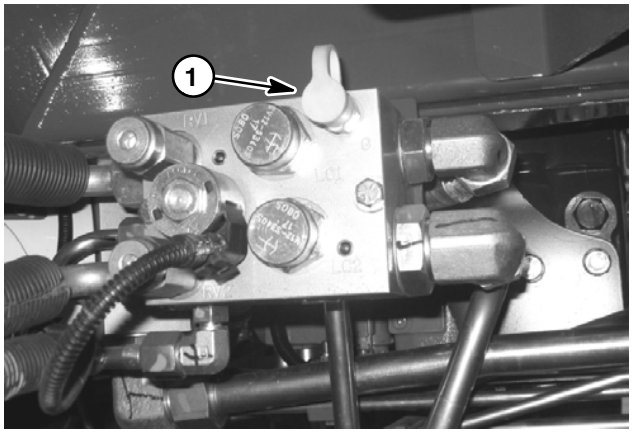


Figure 35

1. **Left wing deck circuit pressure test port G**

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

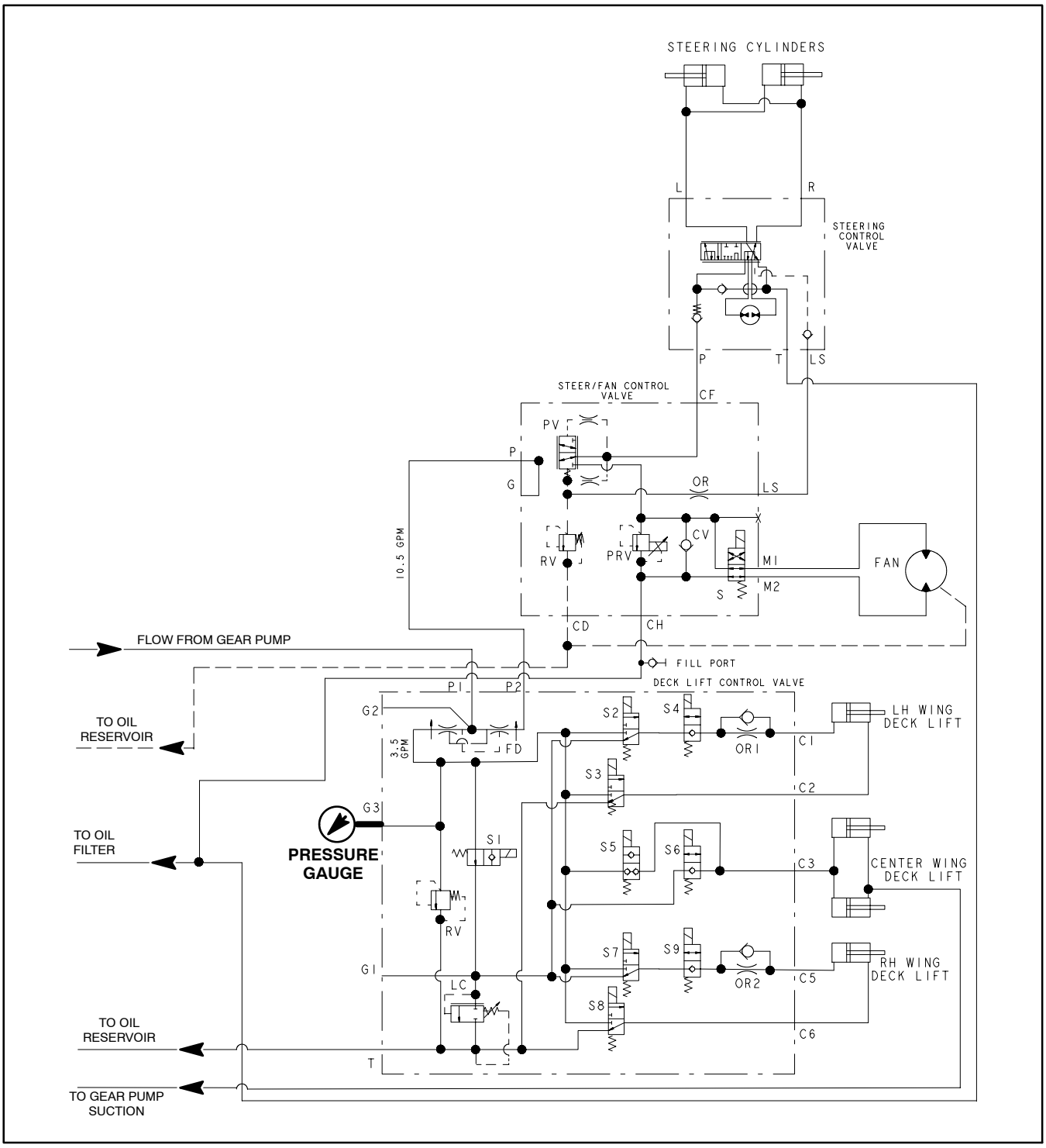


Figure 36

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

Procedure for Lift/Lower Circuit Relief Pressure Test

NOTE: Before attempting to check or adjust lift pressure, make sure that counterbalance pressure is correctly adjusted.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 5000 PSI (350 Bar) pressure gauge to test port G3 on lift control manifold (Fig. 37). Route gauge hose to allow operator to view the gauge.

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

5. Sit on the seat and operate the engine at full speed **(2750 RPM)**.

6. While sitting on the seat, press and hold one of the deck lift switches to fully raise a cutting deck. Momentarily hold the switch with the deck fully raised while looking at the gauge.

GAUGE READING TO BE:
1350 PSI (93 bar) (approximate).

7. Stop engine and record test results.

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

8. If relief pressure is too high, remove cap on relief valve (RV) in lift control manifold (Fig. 37). Adjust valve by rotating adjustment socket counterclockwise to decrease relief pressure (see Adjustable Pressure Valve in the Adjustments section of this chapter). A 1/8 turn on the socket will make a measurable change in relief pressure. Recheck relief pressure and readjust as needed. Install and tighten cap on relief valve after adjustment.

9. If relief pressure is too low, check for restriction in gear pump intake line or reservoir strainer. Check the lift cylinder for internal leakage. If cylinder is not leaking, remove cap on relief valve (RV) in lift control manifold (Fig. 37) and adjust valve by rotating adjustment socket clockwise to increase relief pressure (see Adjustable Pressure Valve in the Adjustments section of this chapter). A 1/8 turn on the socket will make a measurable change in relief pressure. Recheck relief pressure and readjust as needed. If pressure is still too low, gear pump (P3) or lift cylinder(s) should be suspected of wear, damage or inefficiency. Install and tighten cap on relief valve after adjustment.

10. Disconnect pressure gauge from test port.

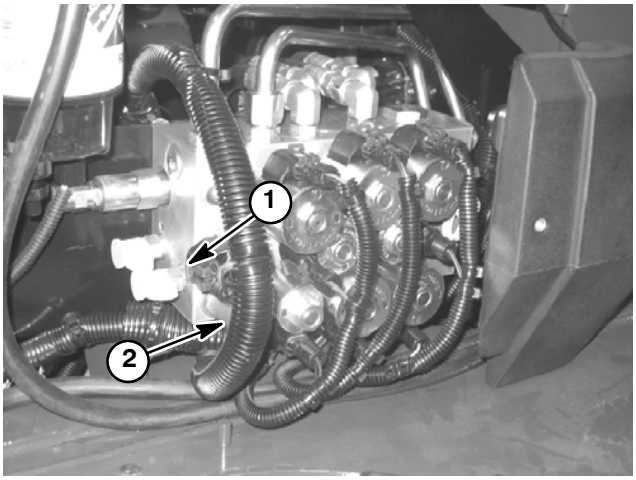


Figure 37

1. **Lift circuit test port G3** 2. **Relief valve RV**

Steering Circuit Relief Pressure Test (Using Pressure Gauge)

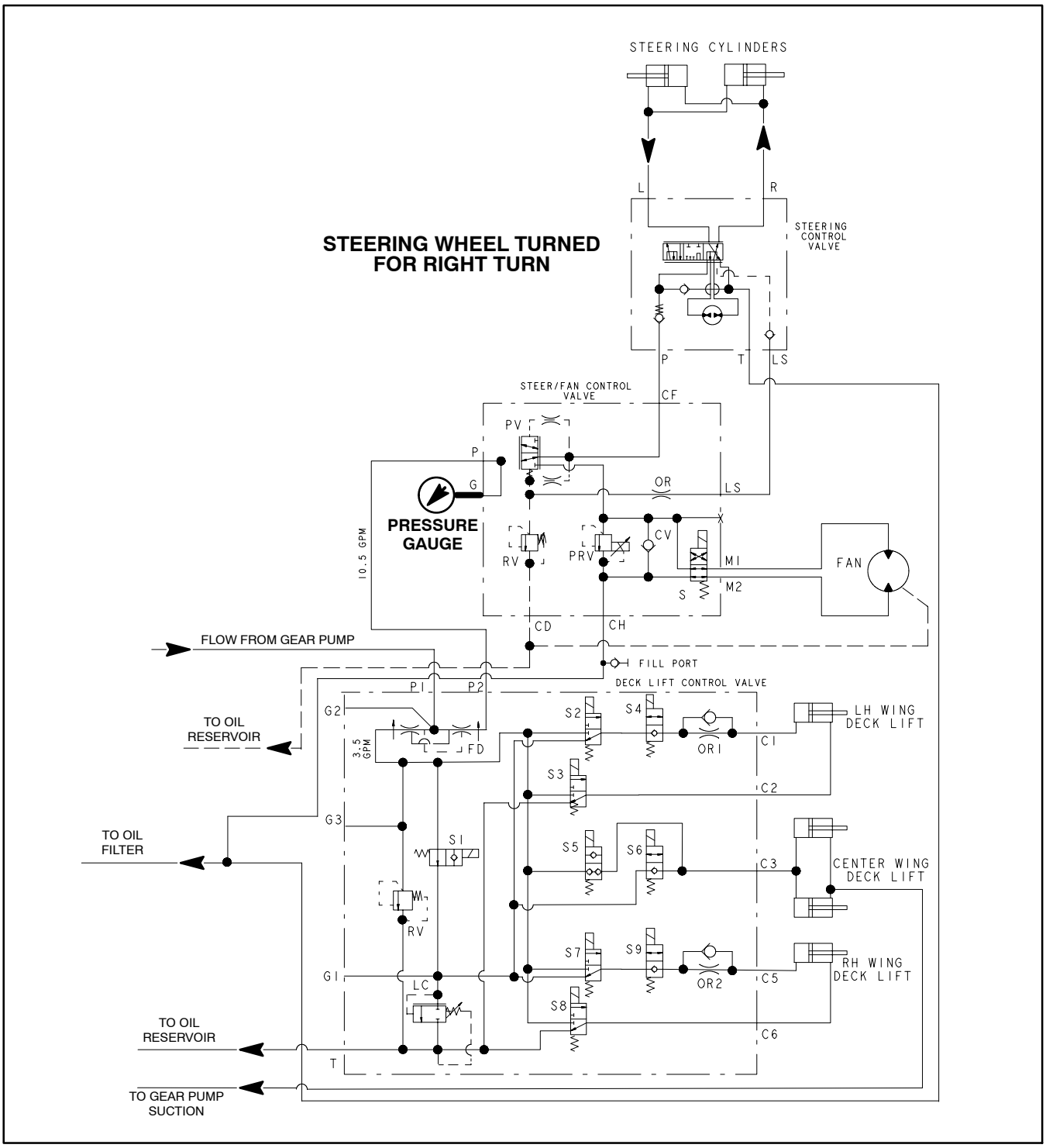


Figure 38

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

Procedure for Steering Circuit Relief Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Connect a 5000 PSI (350 Bar) pressure gauge onto steering circuit pressure test port G on the steering/cooling fan control manifold (Fig. 39).

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

5. Operate the engine at full engine speed **(2750 RPM)**.

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

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

GAUGE READING TO BE:
2000 to 2200 PSI (138 to 151 bar).

7. Stop engine and record test results.

NOTE: If steering relief pressure is incorrect and lift/lower problems also exist, gear pump (P3) should be suspected of wear and inefficiency. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), the steering cylinder or steering control valve should be suspected of wear or damage.

8. If relief pressure specification is **not** met, adjust relief valve (RV) in steering/cooling fan control manifold (Fig. 40) so that pressure is correct (see Adjustable Pressure Valve in the Adjustments section of this chapter).

9. Disconnect pressure gauge from manifold test port.

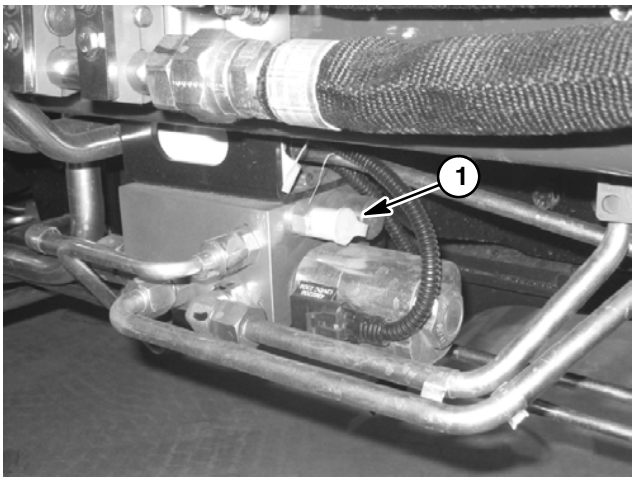


Figure 39

1. Steering circuit pressure test port

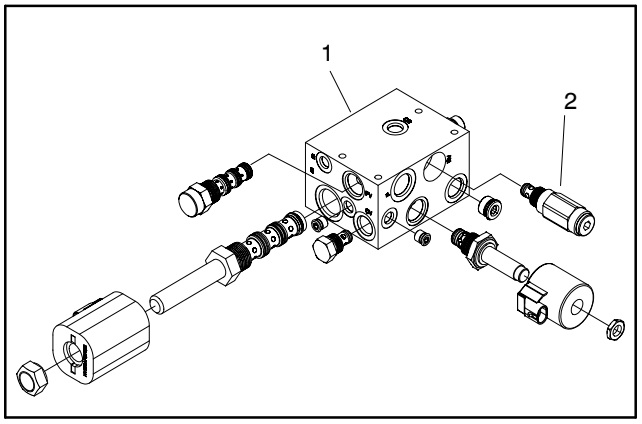


Figure 40

1. Steering/fan manifold **2. Steering relief valve**

Steering Cylinder Internal Leakage Test

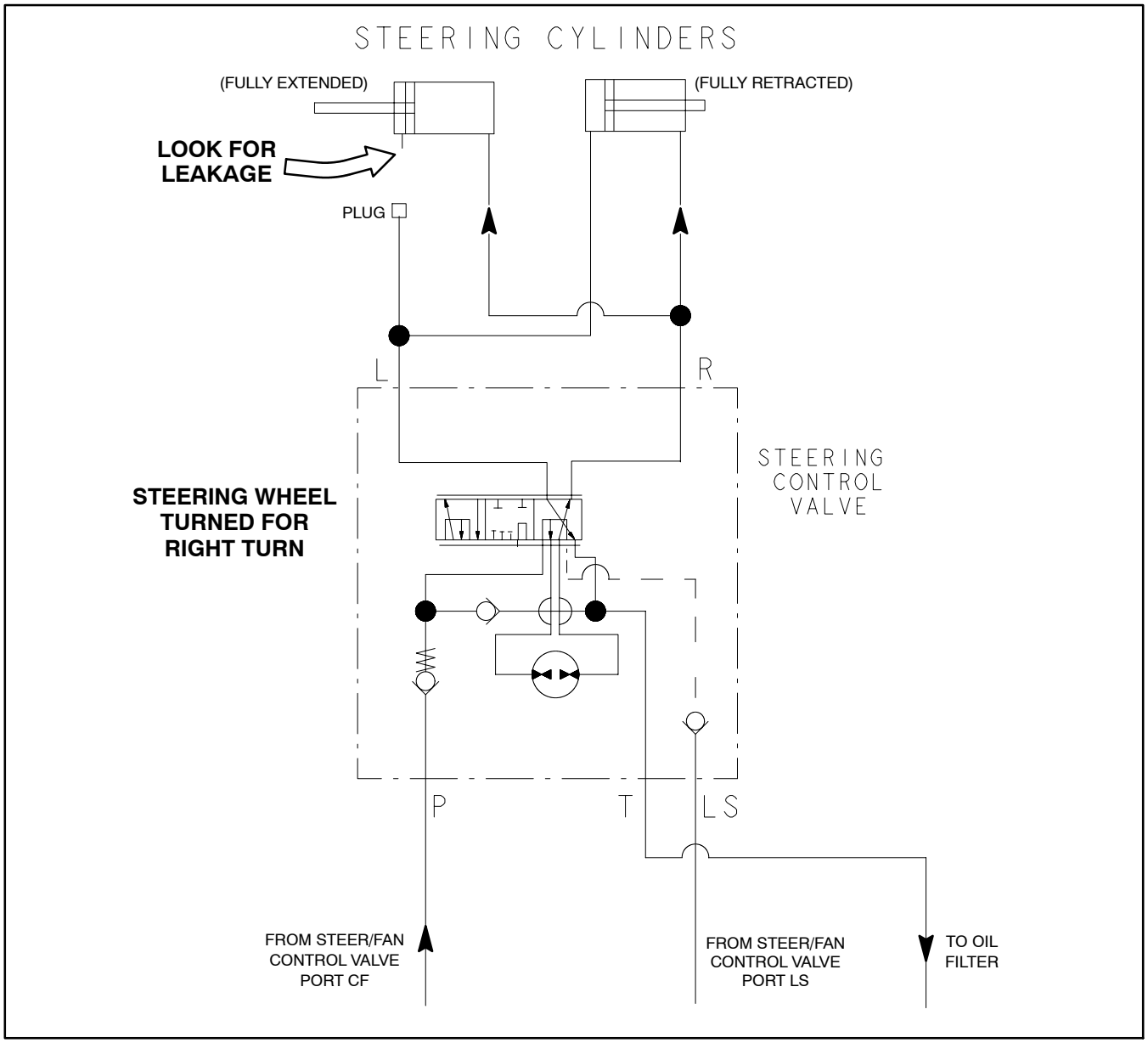


Figure 41

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

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

Procedure for Steering Cylinder Internal Leakage Test

1. Make sure hydraulic oil is at normal operating temperature.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied.

CAUTION

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

3. Turn the steering wheel so the steering cylinder rod of the cylinder to be tested is fully extended.

4. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder to be tested.

5. Place a drain pan under the steering cylinder. Remove hydraulic hose from the fitting on the rod end of the steering cylinder to be tested. Install a steel plug in the disconnected hose.

6. Remove all hydraulic oil from drain pan. Make sure that empty drain pan remains under the open fitting of the steering cylinder.

7. With the engine off, turn the steering wheel in the same direction needed to extend the cylinder. Observe the open fitting on the extended steering cylinder as the steering wheel is turned. If oil comes out of the fitting while turning the steering wheel, the steering cylinder has internal leakage and must be repaired or replaced (see Steering Cylinder and Steering Cylinder Service in the Service and Repairs section of this chapter). Check drain pan for any evidence of oil that would indicate cylinder leakage.

8. After testing is completed, remove plug from the hydraulic hose. Connect hose to the steering cylinder fitting.

9. If a steering problem exists and the steering cylinder tested acceptably, the steering control valve requires service (see Steering Control Valve and Steering Control Valve Service in the Service and Repairs section of this chapter).

10. Check oil level in hydraulic reservoir and adjust if needed.

Gear Pump (P3) (Steering, Cooling Fan, Lift/Lower and Traction Charge) Flow Test (Using Tester with Pressure Gauges and Flow Meter)

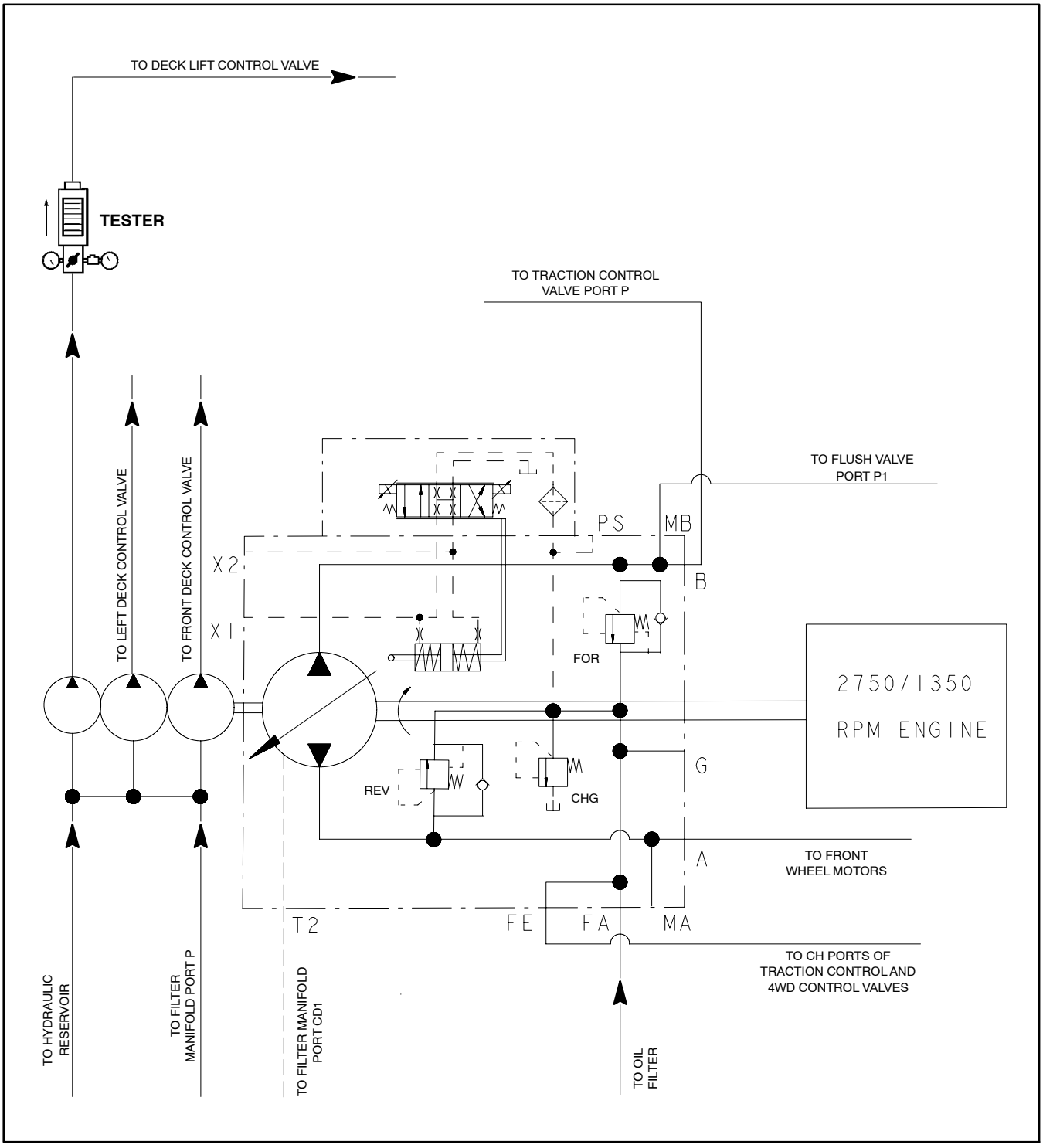


Figure 42

The gear pump (P3) flow test should be performed to make sure that the traction charge circuit, lift/lower circuit and steering/engine cooling fan circuit have adequate hydraulic flow.

Procedure for Gear Pump (P3) Flow Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately 10 minutes. Make sure the hydraulic tank is full.

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is applied. Raise hood.

CAUTION

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

3. Disconnect outlet hose from gear pump section (P3) (Fig. 43).

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

4. Install tester with pressure gauges and flow meter in series between the gear pump section (P3) and the disconnected hose. **Make sure the tester flow control valve is open**.

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

IMPORTANT: The pump is a positive displacement type. If pump flow is completely restricted or stopped, damage to the pump, tester or other components could occur.

6. Operate the engine at full speed **(2750 RPM)**. **DO NOT** engage the cutting decks.

7. While watching tester pressure gauges, slowly close flow control valve on the tester until **1000 PSI (69 bar)** is obtained on gauge. Verify that engine speed continues to be correct **(2750 RPM)**. Record test results.

GAUGE READING TO BE:
A pump in good condition should have a flow of approximately **14 GPM (53 LPM)** at **1000 PSI (69 bar)**.

8. Open tester flow control valve and stop engine.

9. If the measured pump flow is lower than **12.5 GPM (47.3 LPM)** or a pressure of **1000 PSI (69 bar)** could not be obtained, check for restriction in gear pump intake line. If intake line is not restricted, remove gear pump and repair or replace pump (P3) as necessary.

10. Remove tester from machine. Connect hydraulic hose to gear pump (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

11. Check oil level in hydraulic reservoir and adjust if needed.

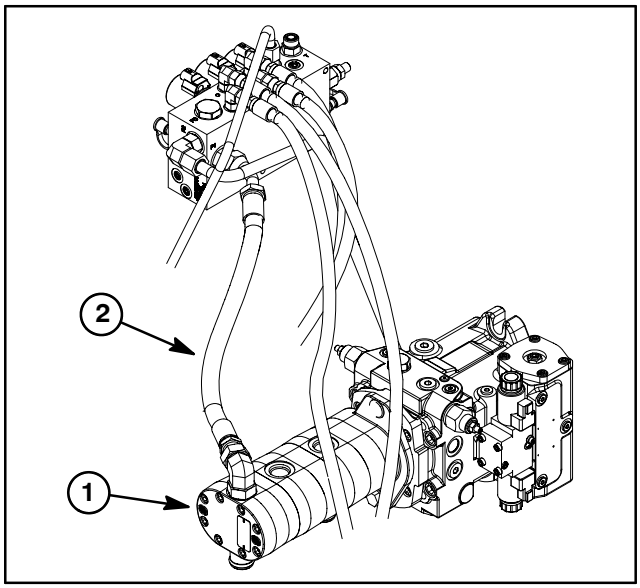


Figure 43

1. **Pump section (P3)**
2. **Outlet hose**

Adjustments

Adjustable Pressure Valve

The mow/transport and lift control manifolds include adjustable pressure valves. An adjustment may be required to these valves if testing determines that the circuit pressure setting is incorrect (see TESTING in this chapter). Use the following process if an adjustment is required:

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

IMPORTANT: Do not remove cap from valve or make valve adjustment when engine is running. Hydraulic oil under pressure may be ejected from valve without cap in place.

1. Make sure that engine is not running. Remove cap from hydraulic valve with an allen wrench.

2. To **increase** pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.

3. To **decrease** pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in pressure.

4. Install cap on valve.

5. Recheck valve pressure using correct test procedure and readjust if needed.

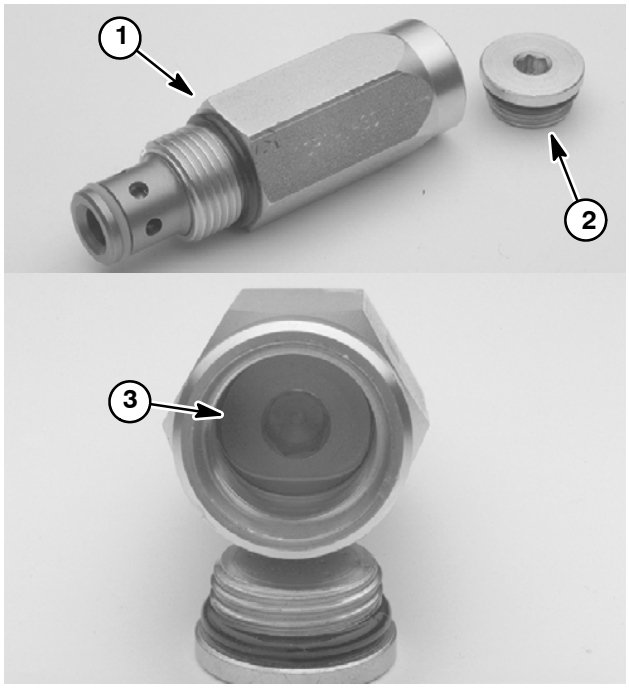


Figure 44

1. **Hydraulic valve**
2. **Valve cap**
3. **Adjustment socket**

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, apply parking brake, lower cutting decks or attachments and stop engine. Remove key from the ignition switch.

2. Clean machine before disconnecting, removing or disassembling any hydraulic components. Make sure hydraulic components, hoses connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.

CAUTION

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

3. Put caps or plugs on any hydraulic lines, hydraulic fittings or components left open or exposed to prevent hydraulic system contamination.

4. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.

5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repair or Replacement of Components

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

2. Lubricate O−rings and seals with clean hydraulic oil before installing hydraulic components.

3. Make sure all caps or plugs are removed from hydraulic tubes, hydraulic fittings and components before reconnecting.

4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Hose and Tube Installation and Hydraulic Fitting Installation in the General Information section of this chapter).

5. After repairs, check control linkages or cables for proper adjustment, binding or broken parts.

6. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Charge Hydraulic System in this section).

7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

Check Hydraulic Lines and Hoses

WARNING

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

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

Flush Hydraulic System

IMPORTANT: Flush the hydraulic system any time there is a severe component failure or the system is contaminated (oil appears milky, black or contains metal particles).

1. Park machine on a level surface. Lower cutting decks, stop engine and apply parking brake. Remove key from the ignition switch.

CAUTION

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

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disconnected for draining.

2. Drain hydraulic reservoir.

3. Drain complete hydraulic system. Drain all hoses, tubes and components while the system is warm.

4. Remove and replace both hydraulic oil filters.

5. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir Inspection in this section).

6. Reconnect all hydraulic hoses, tubes and components that were disconnected while draining system.

NOTE: Use only hydraulic fluids specified in the Operator's Manual. Other fluids may cause system damage.

7. Fill hydraulic reservoir with **new** hydraulic fluid.

IMPORTANT: Before unplugging the wire harness power connector from the engine ECM, make sure that the ignition switch is in the OFF position and the key is removed from the switch. If the power connector is removed from the engine ECM while electrical power is on, the ECM may be damaged.

8. Make sure that the ignition switch is OFF and the key is removed from the switch. Unplug the wire harness power connector from the engine ECM to prevent the engine fuel solenoid from being energized (Fig. 45). This will keep the engine from starting while cranking the engine.

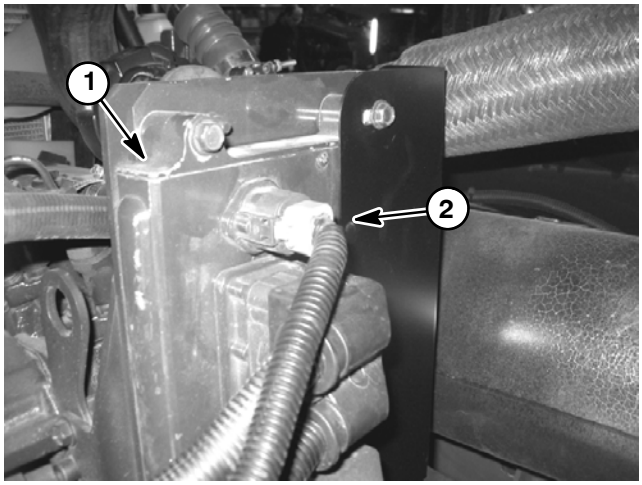


Figure 45

1. **Engine ECM**
2. **Power connector**

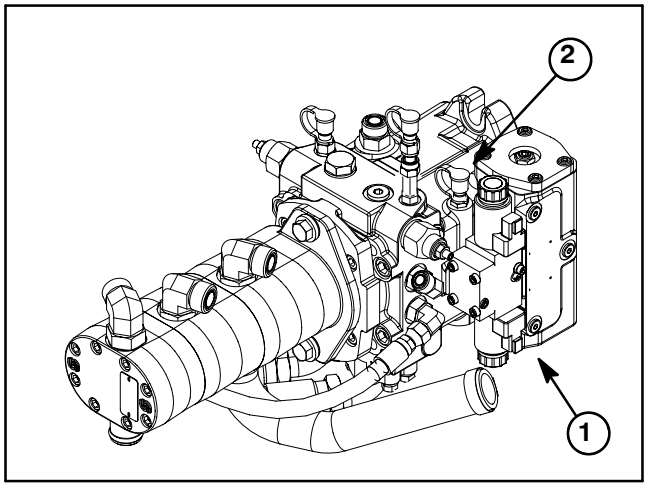


Figure 46

1. **Hydrostat**
2. **Charge test port**

9. Connect a 1000 PSI (70 Bar) pressure gauge onto charge pressure test port fitting on hydrostat (Fig. 46).

10. Turn ignition key switch to START and engage starter for thirty (30) seconds to prime the traction and gear pumps. Wait two (2) minutes to allow the starter to cool and then repeat this step again.

11. Repeat step 10 until the pressure gauge attached to charge pressure test port indicates that pressure in the charge circuit is increasing.

12. Make sure that the ignition switch is OFF and the key is removed from the switch.

IMPORTANT: Before plugging the wire harness power connector to the engine ECM, make sure that the ignition switch is in the OFF position and the key is removed from the switch. If the harness power connector is plugged into the engine ECM while electrical power is on, the ECM will be damaged.

13. Connect the wire harness power connector to the engine ECM (Fig. 45).

14. Disconnect pressure gauge from charge pressure test port (Fig. 46).

15. Start engine and let it run at low idle **(1350 RPM)** for a minimum of 2 minutes. Increase engine speed to high idle **(2750 RPM)** for a minimum of 1 minute under no load.

16. Raise and lower cutting decks several times. Turn steering wheel fully left and right several times.

17. Shut off engine and check entire machine for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct amount of oil if necessary.

18. Operate machine for 2 hours under normal operating conditions.

19. Check condition of hydraulic oil. If the new fluid shows any signs of contamination, repeat steps 1 through 14 again until oil is clean.

20. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

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

IMPORTANT: Change hydraulic oil filter whenever hydraulic components are repaired or replaced.

1. Position machine on a level surface. Remove key from the ignition switch.

2. Make sure all hydraulic connections, lines and components are tight.

3. If component failure was severe or the system is contaminated, flush and refill hydraulic system and reservoir (see Flush Hydraulic System in this section).

4. Make sure hydraulic reservoir is full. Add correct hydraulic oil if necessary.

IMPORTANT: Before unplugging the wire harness power connector from the engine ECM, make sure that the ignition switch is in the OFF position and the key is removed from the switch. If the harness power connector is removed from the engine ECM while electrical power is on, the ECM may be damaged.

5. Make sure that the ignition switch is OFF and the key is removed from the switch. Unplug the wire harness power connector from the engine ECM to prevent the engine fuel solenoid from being energized (Fig. 47). This will keep the engine from starting while cranking the engine.

6. Connect a 1000 PSI (70 Bar) pressure gauge onto charge pressure test port fitting on hydrostat (Fig. 48).

7. Make sure traction pedal is in the neutral position. Turn ignition key switch to START and engage starter for thirty (30) seconds to prime the traction and gear pumps. Wait two (2) minutes to allow the starter to cool and then repeat this step again.

8. Repeat step 7 until the pressure gauge attached to charge pressure test port indicates that pressure in the charge circuit is increasing.

9. Make sure that the ignition switch is OFF and the key is removed from the switch.

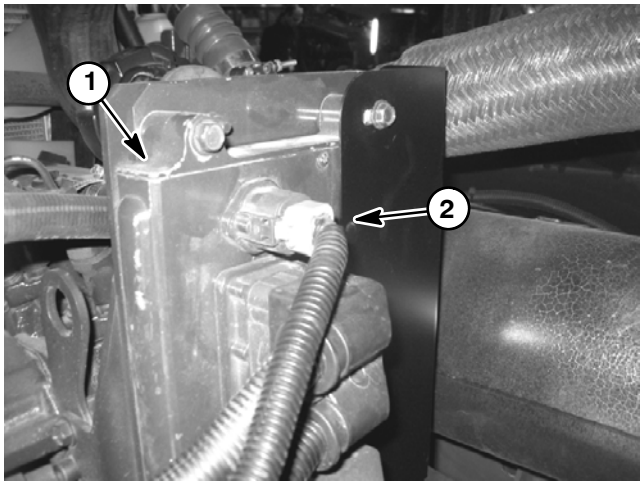


Figure 47

1. **Engine ECM**
2. **Power connector**

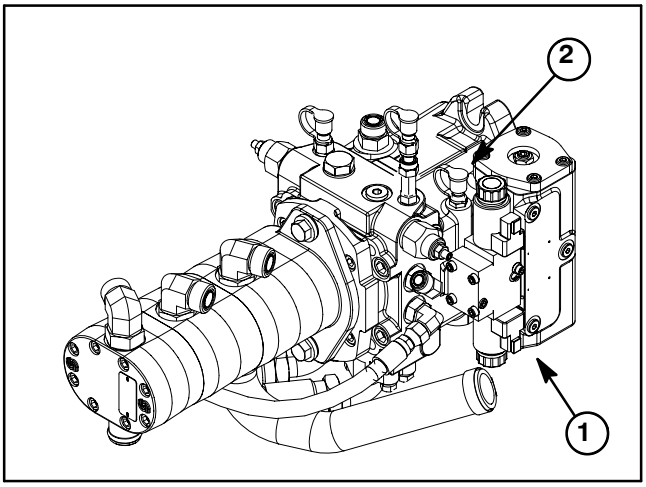


Figure 48

1. **Hydrostat**
2. **Charge test port**

IMPORTANT: Before connecting the wire harness power connector to the engine ECM, make sure that the ignition switch is in the OFF position and the key is removed from the switch. If the harness power connector is plugged into the engine ECM while electrical power is on, the ECM may be be damaged.

10. Connect the wire harness power connector to the engine ECM (Fig. 47).

11. Disconnect pressure gauge from charge pressure test port (Fig. 48).

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

12. Raise one front and one rear wheel off the ground and place appropriate jackstands under the frame to support the machine. Chock remaining wheels to prevent movement of the machine.

13. Make sure traction pedal is in the neutral position. Start engine and run it at low idle speed **(1350 RPM)**. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

14. After the hydraulic system starts to show signs of fill, actuate lift control switches until the lift cylinders extend and retract several times. If the cylinders do not move after fifteen (15) seconds or the gear pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for loose filter or suction lines, blocked suction line, faulty charge relief valve or faulty gear pump.

15. If lift cylinders do move in fifteen (15) seconds, proceed to step 16.

16. Operate the traction pedal in the forward and reverse directions. The wheels off the ground should rotate in the proper direction.

A. If the wheels rotate in the wrong direction, stop engine and inspect hydraulic line placement at piston (traction) pump and wheel motors. Correct hydraulic line installation before proceeding.

B. If the wheels rotate in the proper direction, stop engine.

17. Use Info Center to check for traction neutral position and interlock switch operation.

18. Remove jackstands from frame and lower machine to the ground. Remove chocks from remaining wheels.

19. If the piston (traction) pump or a wheel motor was replaced or rebuilt, run the machine so all wheels turn slowly for ten (10) minutes.

20. Operate machine by gradually increasing it's work load to full over a ten (10) minute period.

21. Stop the machine. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

Hydraulic Reservoir

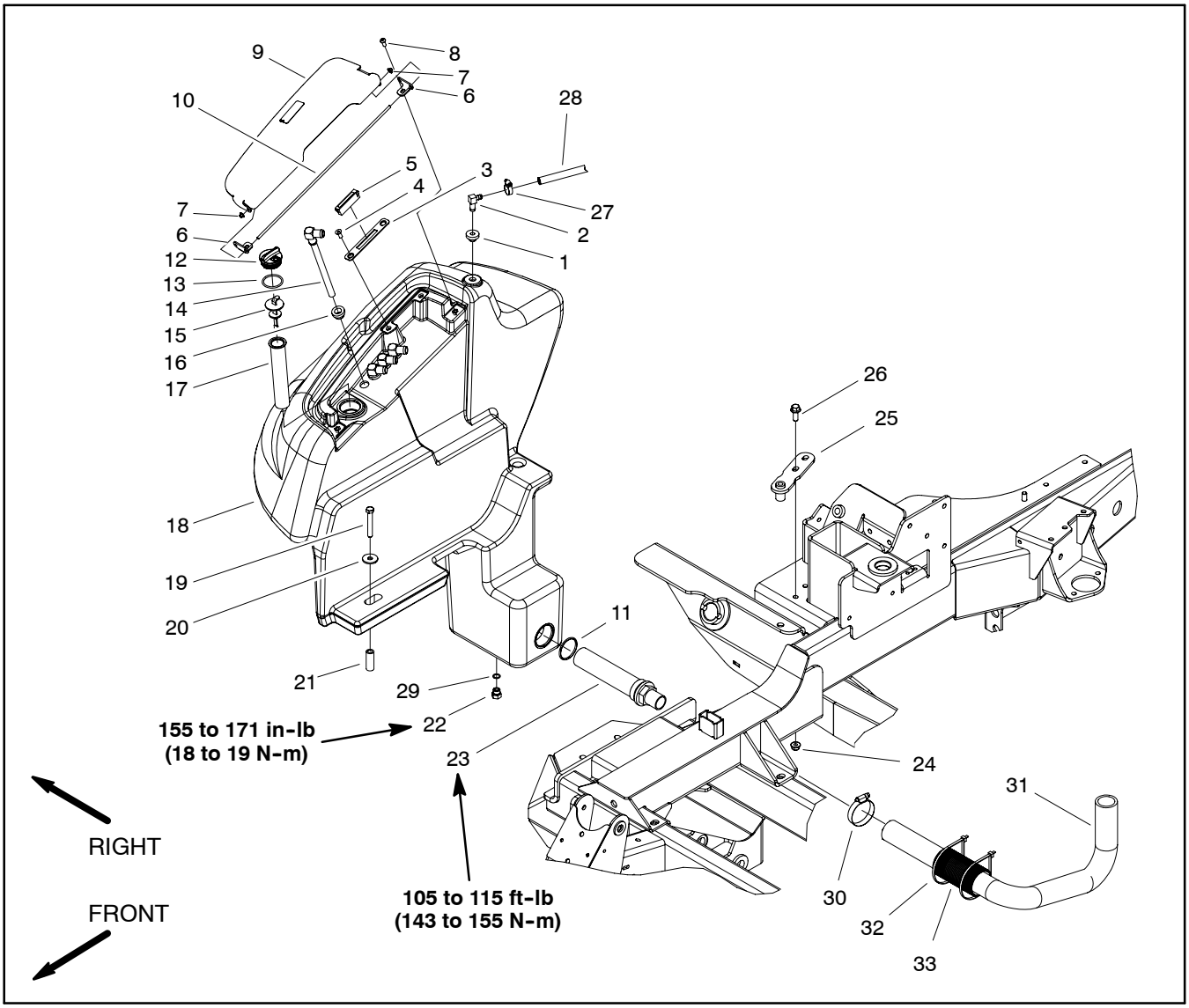


Figure 49

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

Removal (Fig. 49)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during hydraulic reservoir removal, thoroughly clean exterior of reservoir, fittings and hoses.

4. Remove drain plug and empty reservoir into a suitable container.

5. To allow access to reservoir fasteners, loosen fuel tank and slide it toward left side of machine (see Fuel Tank Removal in the Service and Repairs section of Chapter 3 - Diesel Engine).

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

NOTE: Original production clamps used to secure hoses to stand pipes and hydraulic tubes are crimped and will need to be cut in order to remove hoses (Fig. 50). Replacement clamps are traditional worm clamps.

7. Disconnect hydraulic hoses from reservoir fittings. Put caps or plugs on fittings and hoses to prevent contamination.

8. Remove hydraulic reservoir using Figure 49 as a guide.

Inspection

1. Clean hydraulic reservoir and tank strainer with solvent.

2. Inspect reservoir for leaks, cracks or other damage.

Installation (Fig. 49)

1. Install reservoir using Figure 49 as a guide.

   A. Torque drain plug (item 22) from **155 to 171 in-lb (18 to 19 N-m)**.

   B. Torque tank strainer (item 23) from **105 to 115 ft-lb (143 to 155 N-m)**.

2. Remove caps or plugs placed during removal to prevent contamination.

3. Using tags placed during reservoir removal, properly connect hydraulic hoses to reservoir fittings and secure with hose clamps.

4. If hose guard (item 33) was removed, install guard with split orientated up and secure with two (2) cable ties.

5. Slide fuel tank to proper location on machine and secure in place (see Fuel Tank Installation in the Service and Repairs section of Chapter 3 - Diesel Engine).

6. Fill reservoir with new hydraulic fluid.

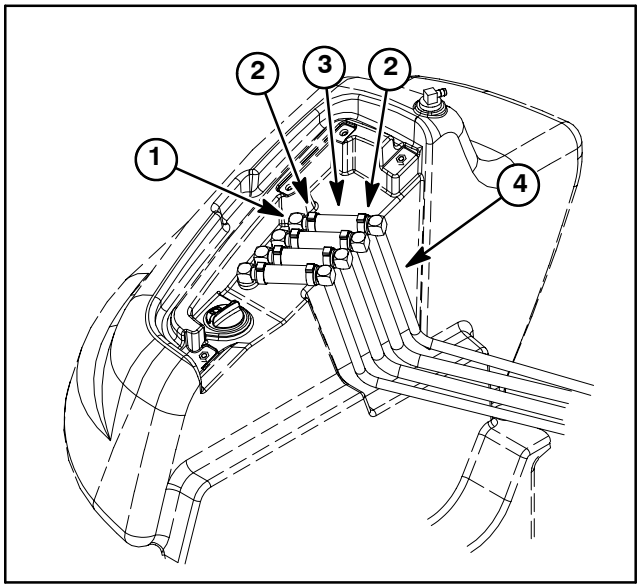


Figure 50

1. **Stand pipe**
2. **Hose clamp**
3. **Hose**
4. **Hydraulic tube**

Gear Pump

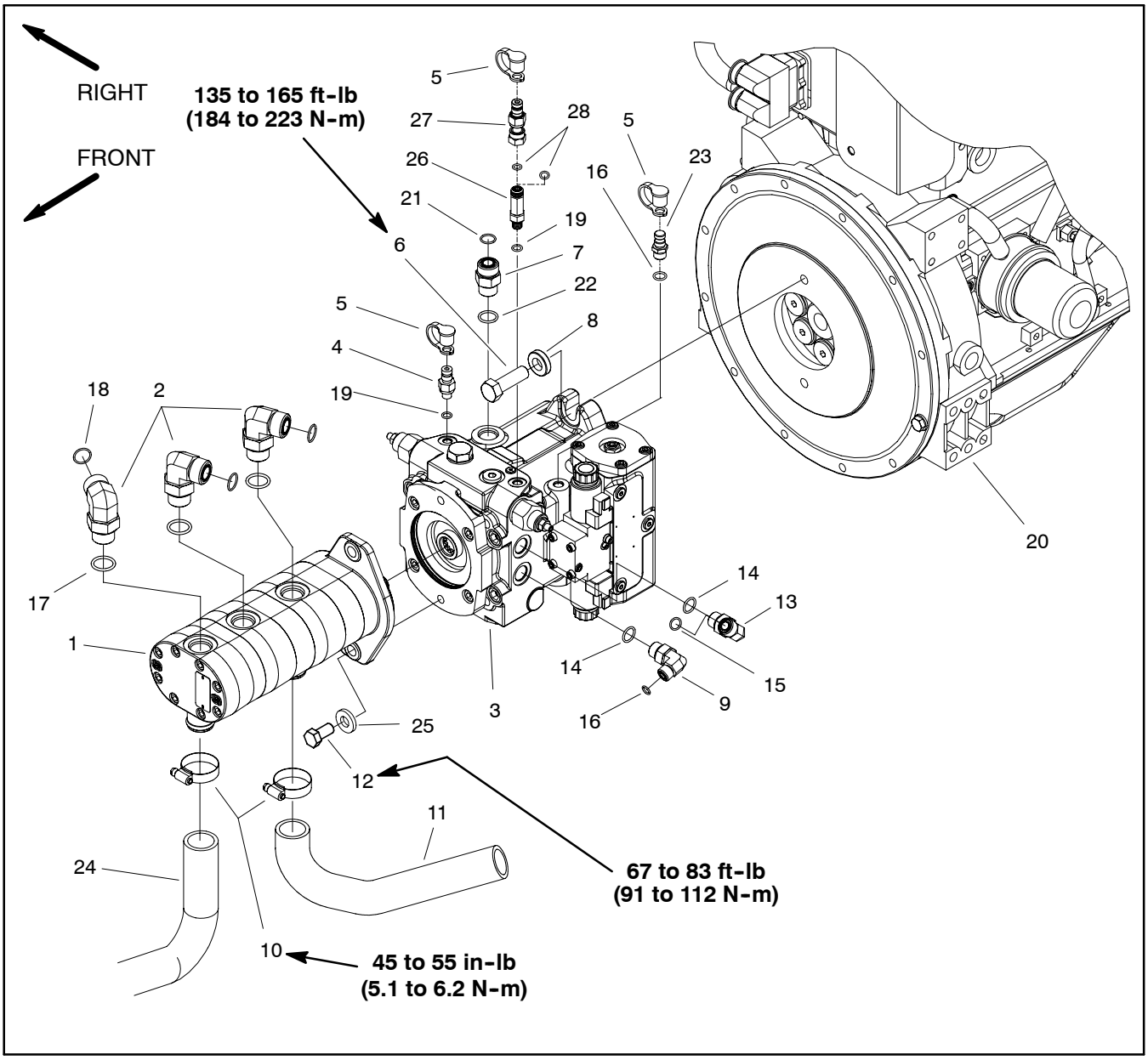


Figure 51

1. Gear pump
2. 90º hydraulic fitting
3. Piston pump
4. Quick fitting
5. Dust cap
6. Cap screw (2 used)
7. Hydraulic adapter
8. Flat washer (2 used)
9. 90º hydraulic fitting
10. Clamp
11. Hose (from filter)
12. Cap screw (2 used)
13. 90º hydraulic fitting
14. O-ring
15. O-ring
16. O-ring
17. O-ring
18. O-ring
19. O-ring
20. Engine
21. O-ring
22. O-ring
23. Diagnostic fitting
24. Hose (from hydraulic tank)
25. Washer (2 used)
26. Tee fitting
27. Test fitting
28. O-ring

Removal (Fig 51)

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

2. Remove hood to gain access to gear pump (see Hood Removal in the Service and Repairs section of Chapter 7 - Chassis).

3. Drain the hydraulic reservoir.

4. To prevent contamination of hydraulic system during pump removal, thoroughly clean exterior of pump and fittings.

5. Label all hydraulic hose connections for assembly purposes.

6. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

7. Disconnect all hydraulic lines from gear pump and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper reassembly.

CAUTION

Make sure gear pump is properly supported before removing the pump mounting screws. Gear pump assembly weighs approximately 42 pounds (19 kg).

8. Support gear pump assembly to prevent it from falling.

9. Remove two (2) cap screws that secure gear pump to piston pump. Remove gear pump from machine.

10. If hydraulic fittings are to be removed from gear pump, mark fitting orientation to allow correct assembly. Remove fittings from pump and discard O-rings.

Installation (Fig 51)

1. If fittings were removed from gear pump, lubricate and place new O-rings onto fittings. Install fittings into pump openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position gear pump to piston pump. Align gear pump input shaft splines with piston pump coupler and slide gear pump input shaft into piston pump coupler. Secure gear pump to piston pump with two (2) cap screws. Torque screws from **67 to 83 ft-lb (91 to 112 N-m)**.

3. Remove caps or plugs from hydraulic lines and fittings. Install hydraulic lines to gear pump (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Remove and replace hydraulic filters.

5. Fill hydraulic reservoir with new hydraulic oil.

6. Properly fill hydraulic system (see Charge Hydraulic System in this section).

7. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

8. Install hood (see Hood Installation in the Service and Repairs section of Chapter 7 - Chassis).

Gear Pump Service

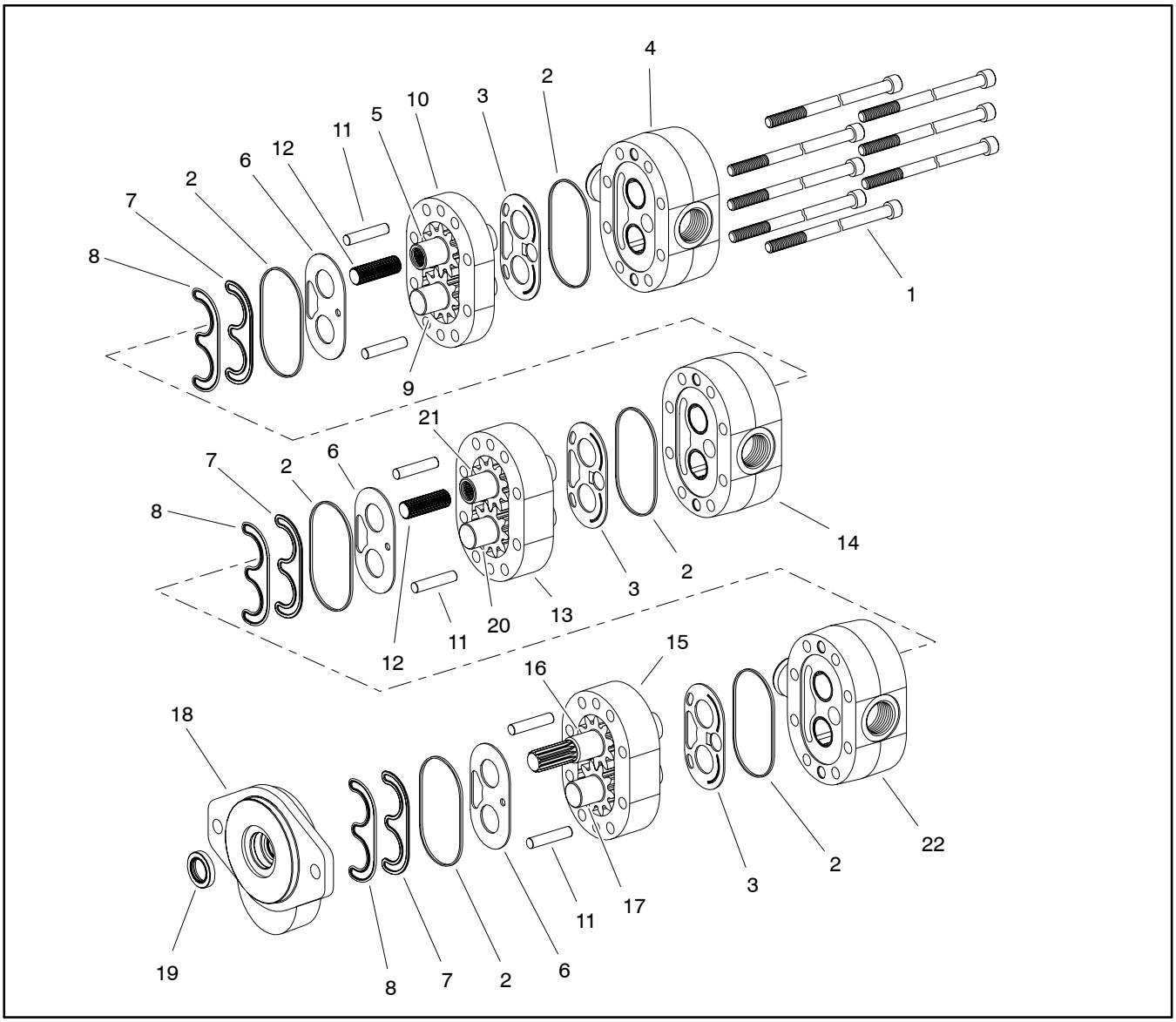


Figure 52

1. **Socket head screw (8 used)**
2. **Seal ring**
3. **Deflecting plate**
4. **Rear cover**
5. **Drive gear**
6. **Deflecting plate**
7. **Load seal**
8. **Pre-load seal**
9. **Idler gear**
10. **Gear housing**
11. **Dowel pin (6 used)**
12. **Drive coupler**
13. **Gear housing**
14. **Bearing plate**
15. **Gear housing**
16. **Drive gear**
17. **Idler gear**
18. **Mounting flange**
19. **Seal**
20. **Idler gear**
21. **Drive gear**
22. **Bearing plate**

NOTE: For gear pump repair procedures, see the Sauer Danfoss D Series Gear Pump Seal Kit Service Instruction Bulletin at the end of this chapter.

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Traction Circuit

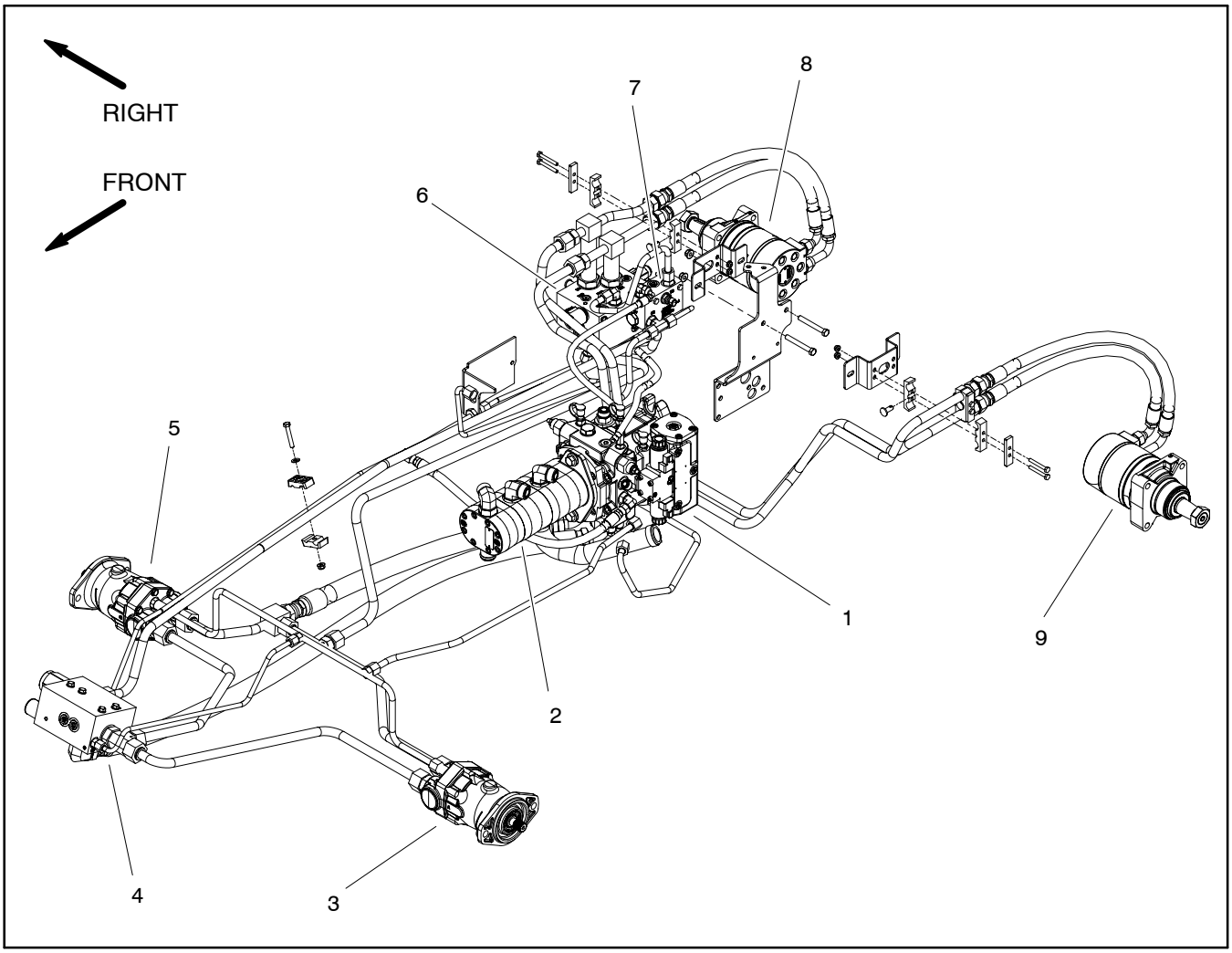


Figure 53

1. **Piston (traction) pump**
2. **Gear pump**
3. **LH front wheel motor**
4. **Traction control manifold**
5. **RH front wheel motor**
6. **4WD control manifold**
7. **Traction flush manifold**
8. **RH rear wheel motor**
9. **LH rear wheel motor**

Figure 53 illustrates the components that are used in the Groundsmaster traction circuit. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this section.

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Piston (Traction) Pump

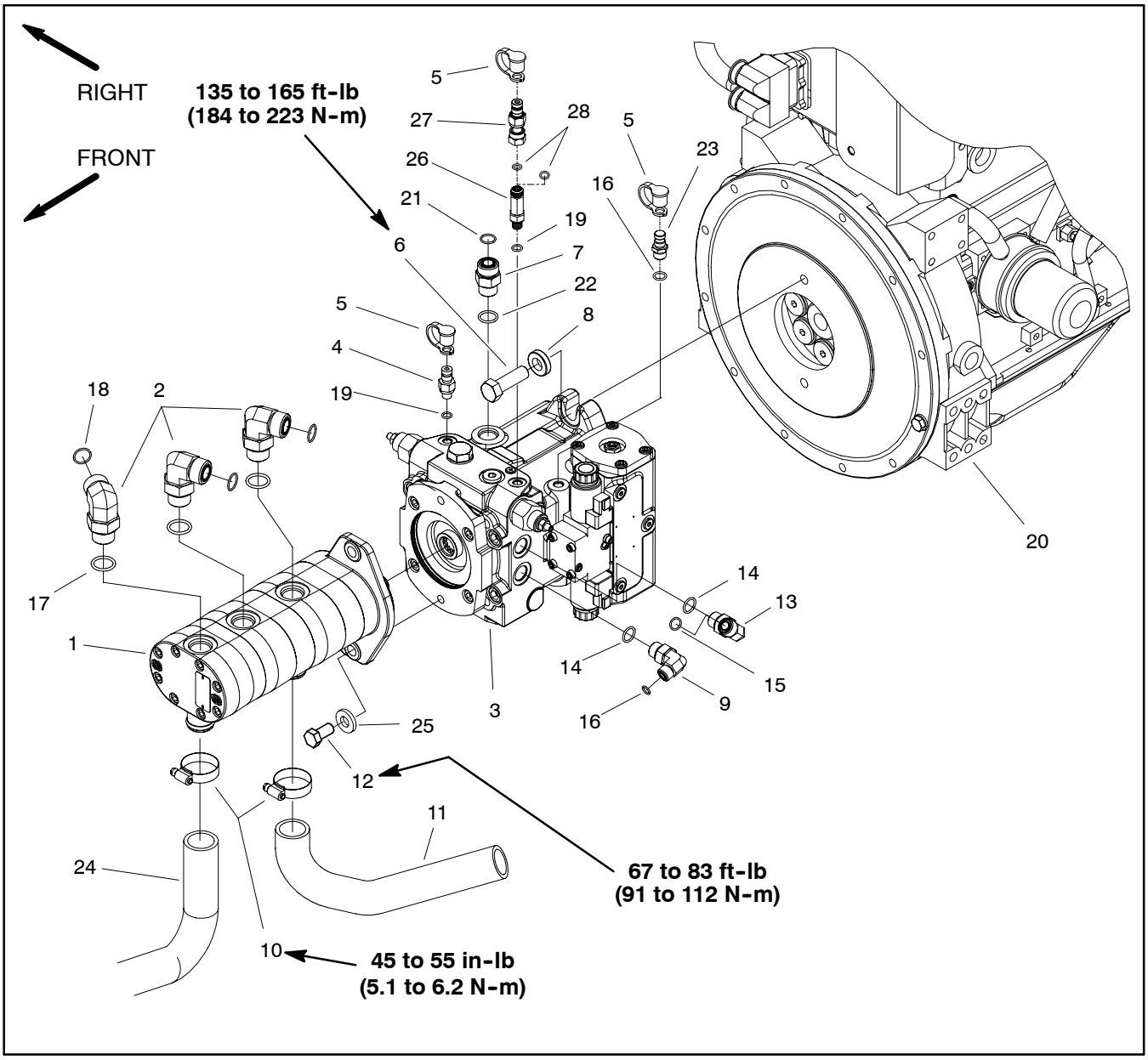


Figure 54

1. Gear pump
2. 90º hydraulic fitting
3. Piston pump
4. Quick fitting
5. Dust cap
6. Cap screw (2 used)
7. Hydraulic adapter
8. Flat washer (2 used)
9. 90º hydraulic fitting
10. Clamp
11. Hose (from filter)
12. Cap screw (2 used)
13. 90º hydraulic fitting
14. O-ring
15. O-ring
16. O-ring
17. O-ring
18. O-ring
19. O-ring
20. Engine
21. O-ring
22. O-ring
23. Diagnostic fitting
24. Hose (from hydraulic tank)
25. Washer (2 used)
26. Tee fitting
27. Test fitting
28. O-ring

Removal (Fig. 54)

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

2. Remove hood to gain access to hydraulic pumps (see Hood Removal in the Service and Repairs section of Chapter 7 - Chassis).

3. Drain the hydraulic reservoir.

4. To prevent contamination of hydraulic system during pump removal, thoroughly clean exterior of pump assembly including hydraulic hoses.

5. For assembly purposes, label wire harness leads for traction pump solenoids. Disconnect wire harness connectors from two (2) solenoids on pump.

6. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

7. Label all hydraulic hose connections for assembly purposes.

8. Put a drain pan below the pump assembly. Remove all hydraulic hoses connected to piston and gear pumps. Put plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the system.

9. Remove gear pump from machine (see Gear Pump Removal in this section).

CAUTION

Make sure piston pump is properly supported before removing the pump mounting screws. Piston pump assembly weighs approximately 86 pounds (39 kg).

10. Attach hoist to piston pump to support pump and also to allow safe removal of pump from machine.

11. Remove two (2) cap screws and washers that retain pump assembly to flywheel coupling housing on engine.

12. Carefully slide pump assembly from housing on engine and raise pump out of the machine.

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

Installation (Fig. 54)

1. If fittings were removed from piston pump, lubricate and place new O-rings onto fittings. Install fittings into pump openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Attach hoist to piston pump to support pump and also to allow safe installation of pump into machine.

3. Carefully lower piston pump into the machine and position it to the flywheel coupling housing on engine. Support pump to make sure that side loads are not applied to flywheel coupling and that pump pilot is aligned with coupling housing on engine. Support pump to prevent it from shifting or falling while installing two (2) cap screws and washers securing piston pump to engine housing. Torque screws from **135 to 165 ft-lb (184 to 223 N-m)**.

4. Install gear pump to piston pump (see Gear Pump Installation in this section).

5. Using labels placed during removal, correctly connect two (2) wire harness connectors to solenoids on traction pump.

6. Remove plugs or caps from disconnected hydraulic hoses. Install hoses to correct location on gear and piston pumps (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Remove and replace hydraulic filters.

8. Fill hydraulic reservoir with correct oil.

9. Properly fill hydraulic system (see Charge Hydraulic System in this section).

10. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

11. Install hood (see Hood Installation in the Service and Repairs section of Chapter 7 - Chassis).

Piston (Traction) Pump Service

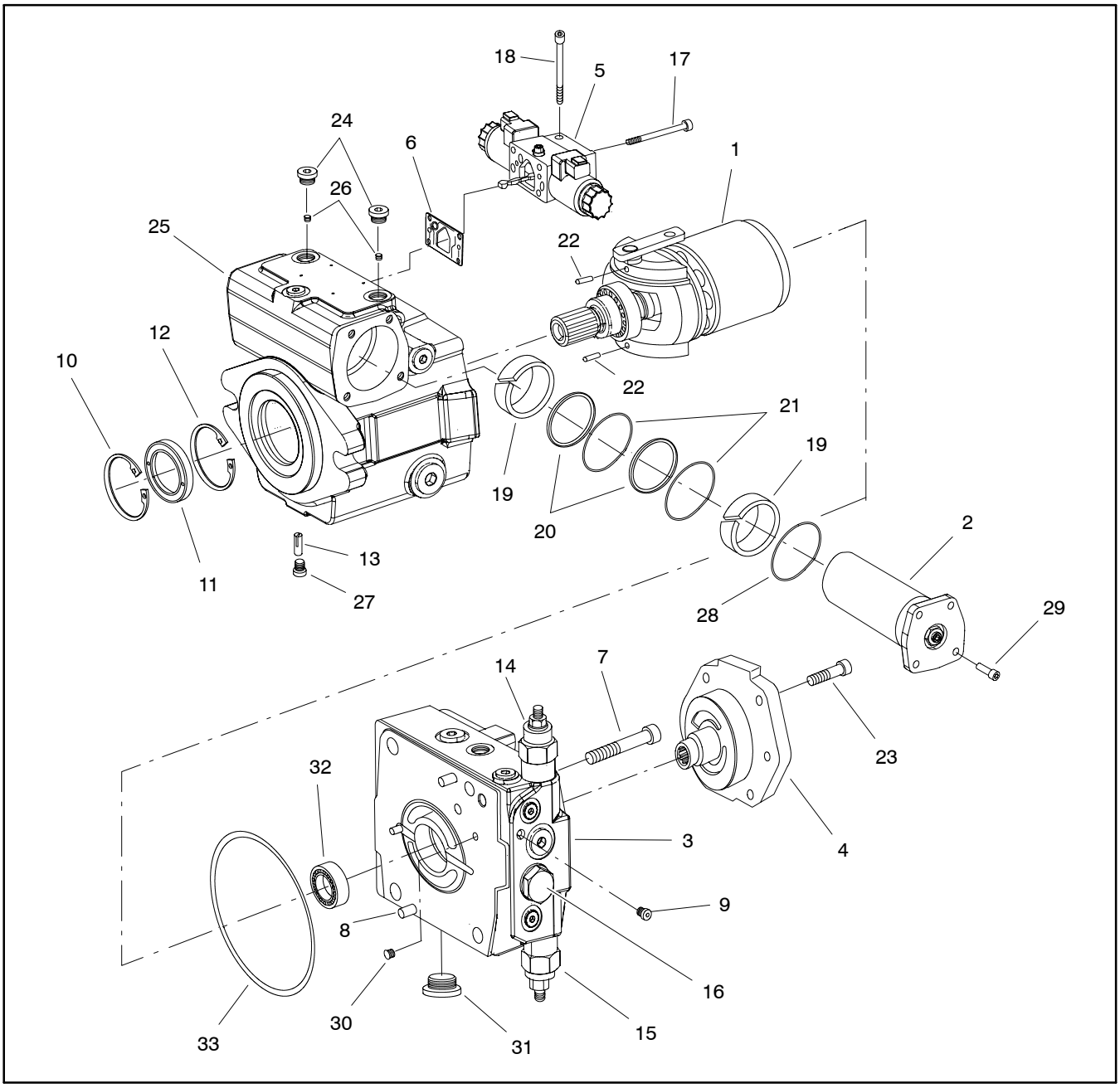


Figure 55

1. Rotary group
2. Stroking piston assembly
3. Port plate assembly
4. Pump support plate assembly
5. EP control assembly
6. Gasket
7. Socket head screw (4 used)
8. Dowel pin (2 used)
9. Plug
10. Retaining ring
11. Shaft seal
12. Retaining ring
13. Joint pin
14. Forward traction relief valve
15. Reverse traction relief valve
16. Charge relief valve
17. Socket head screw (4 used)
18. Socket head screw
19. Guide ring
20. Rod seal
21. O-ring
22. Dowel pin (2 used)
23. Socket head screw (4 used)
24. Plug
25. Pump housing
26. Orifice
27. Plug
28. O-ring
29. Socket head screw (4 used)
30. Clamping pin
31. Plug
32. Bearing
33. O-ring

NOTE: For piston (traction) pump repair procedures, see the Rexroth Variable Pump A10VG Repair Instructions and Repair Manual at the end of this chapter.

IMPORTANT: If a piston (traction) pump failure occurred, refer to Traction Circuit Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

Front Wheel Motors

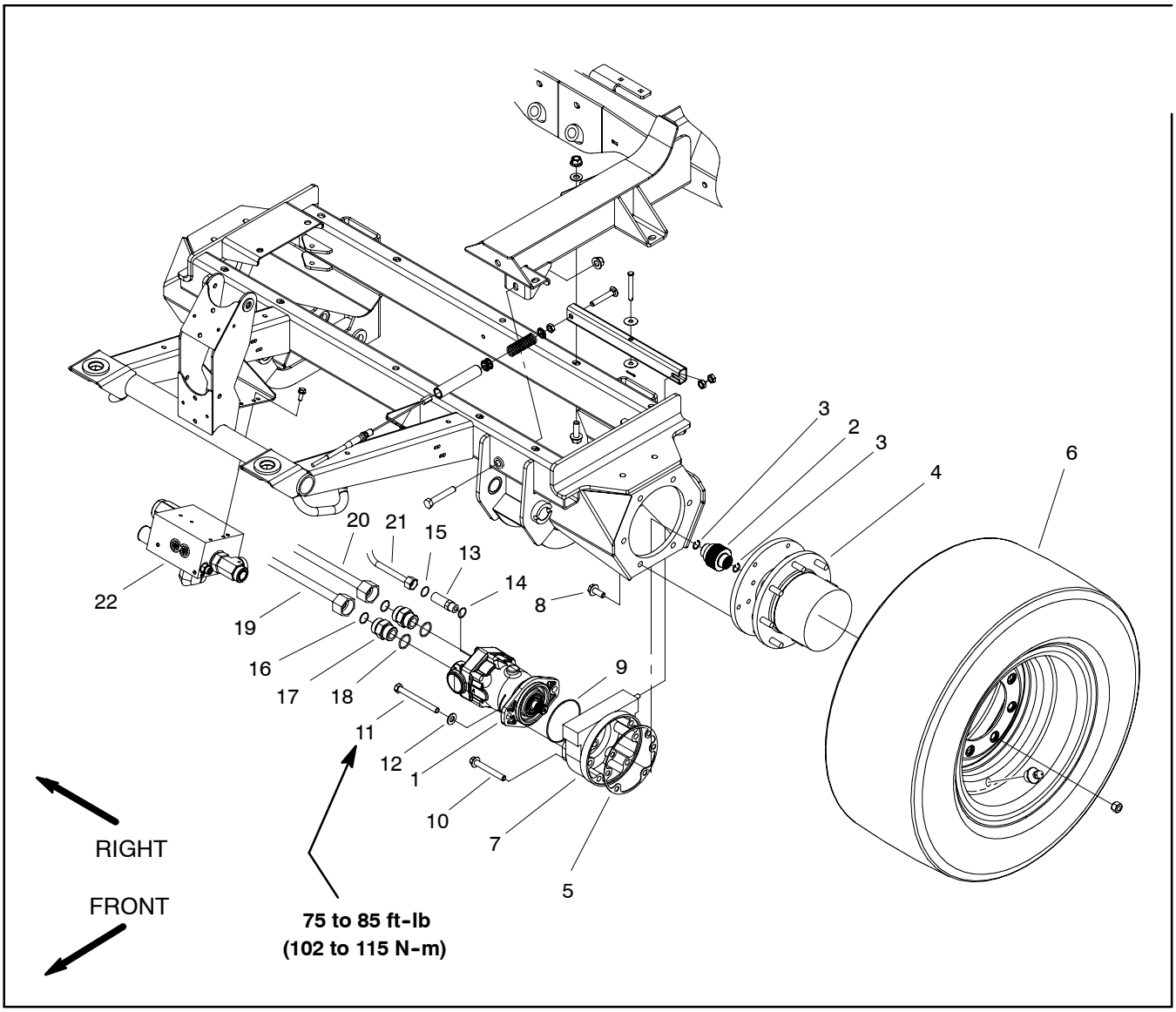


Figure 56

1. Front wheel motor
2. Splined brake shaft
3. Internal retaining ring
4. Planetary assembly
5. Gasket
6. Front wheel assembly
7. Brake assembly (LH shown)
8. Flange head screw (6 per planetary)
9. O-ring
10. Flange head screw (4 per brake)
11. Cap screw (2 used per motor)
12. Flat washer (2 used per motor)
13. Hydraulic fitting
14. O-ring
15. O-ring
16. O-ring
17. Hydraulic fitting (2 used per motor)
18. O-ring
19. Hydraulic tube
20. Hydraulic tube
21. Hydraulic tube
22. Traction control manifold

Removal (Fig. 56)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during motor removal, thoroughly clean exterior of motor, hydraulic tubes and fittings.

4. To allow easier access to hydraulic tube fittings at wheel motor, remove pin that secures lift cylinder to front deck lift arm and lower front of lift cylinder (see Front Deck Lift Cylinder Removal in this section).

5. Disconnect hydraulic tubes from wheel motor. Also, loosen fittings that are at other end of tubes to allow tubes to be shifted for wheel motor removal.

6. Put caps or plugs on disconnected hydraulic lines and fittings to prevent contamination.

IMPORTANT: Before loosening fasteners, support wheel motor to prevent motor from falling during removal.

7. Remove two (2) cap screws and flat washers that secure front wheel motor to brake and planetary assemblies.

8. Slide front wheel motor from brake assembly and remove from machine.

9. Remove and discard O−ring from between wheel motor and brake assembly.

10. If necessary, remove fittings from wheel motor and discard fitting O−rings.

Installation (Fig. 56)

1. If fittings were removed from wheel motor, lubricate and place new O−rings onto fittings. Install fittings into motor ports and tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Lightly oil new O−ring (item 9) and place on wheel motor flange.

3. Position wheel motor to brake assembly making sure that case drain port is above supply line ports (Fig. 57).

4. Align splines on motor shaft and splined brake shaft in brake assembly. Slide motor into brake assembly.

5. Secure motor to brake and planetary assemblies with two (2) cap screws and flat washers. Torque cap screws from **75 to 85 ft−lb (102 to 115 N−m)**.

6. Remove plugs from hydraulic lines and fittings. Attach hydraulic tubes to wheel motor and then tighten all tube fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill reservoir with new hydraulic fluid as required.

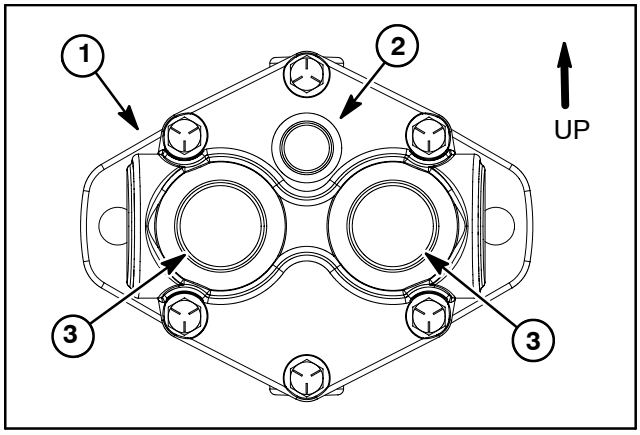


Figure 57

1. **Wheel motor backplate**
2. **Case drain port**
3. **Supply line port**

Front Wheel Motor Service

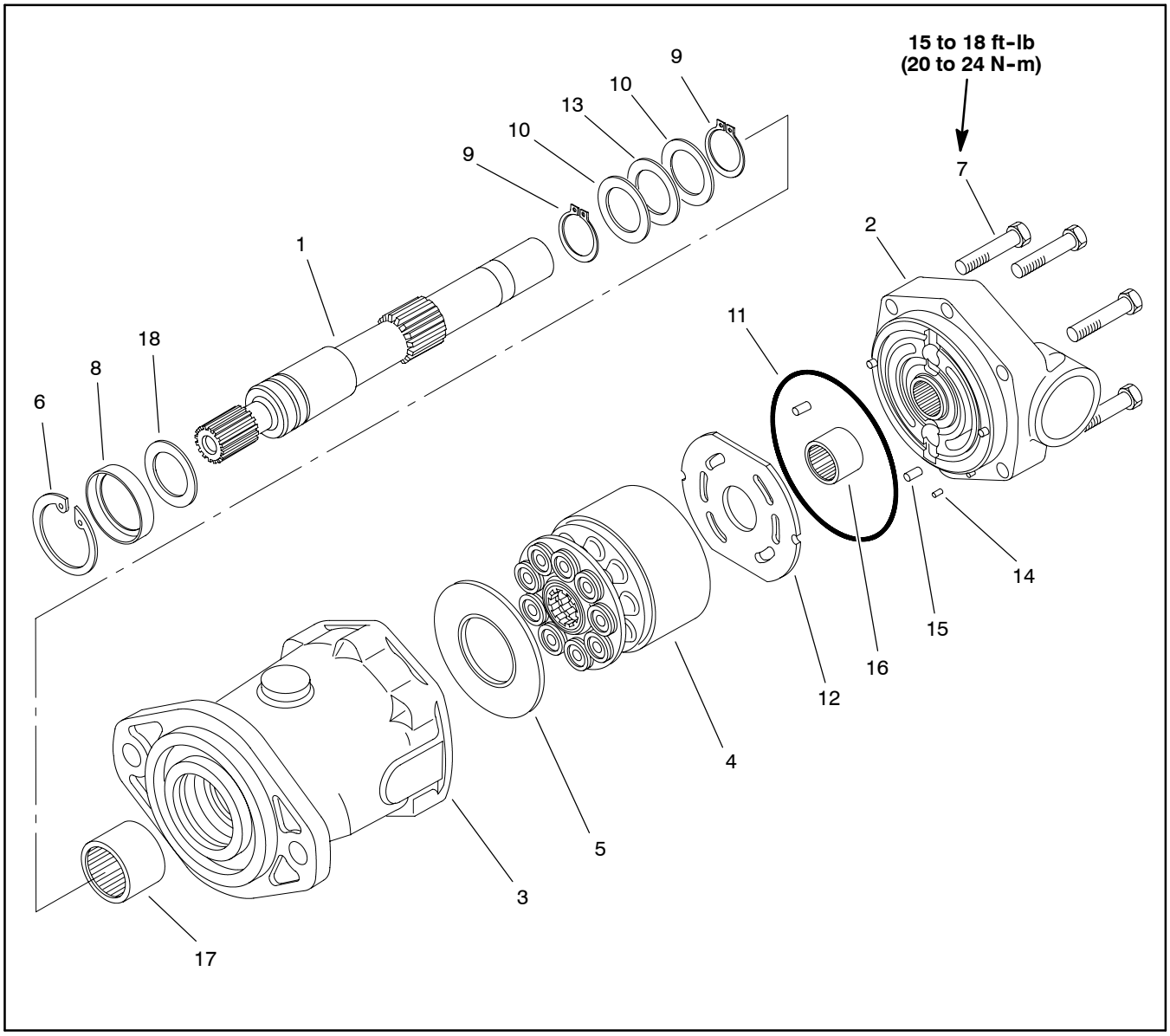


Figure 58

1. **Drive shaft**
2. **Backplate**
3. **Housing assembly**
4. **Rotating assembly**
5. **Cam plate insert**
6. **Retaining ring**
7. **Cap screw (6 used)**
8. **Shaft seal**
9. **Retaining ring**
10. **Thrust race**
11. **O-ring**
12. **Valve plate**
13. **Thrust bearing**
14. **Roll pin**
15. **Roll pin**
16. **Bearing**
17. **Bearing**
18. **Washer**

NOTE: The front wheel motors on Groundsmaster 5900 and 5910 machines are Eaton Model 74348 motors. The front wheel motors are identical. For wheel motor repair procedures, see the Eaton Repair Information: Model 74318 and 74348 Piston Motors at the end of this chapter.

IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

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Rear Wheel Motors

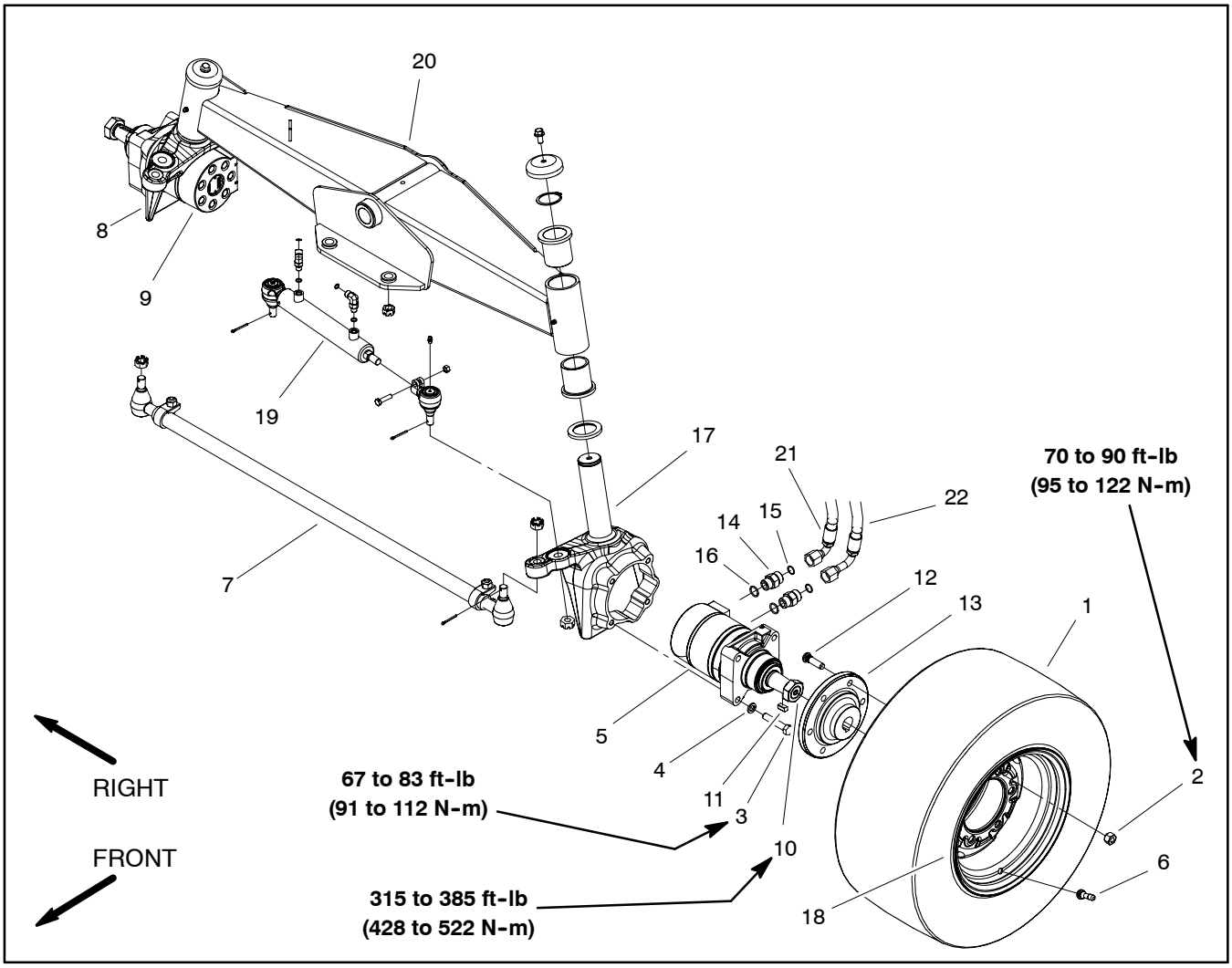


Figure 59

1. Rear tire
2. Lug nut (6 used per wheel)
3. Cap screw (4 used per motor)
4. Lock washer (4 used per motor)
5. LH wheel motor
6. Valve stem
7. Tie rod assembly
8. RH steering spindle
9. RH wheel motor
10. Hex nut
11. Square key
12. Wheel stud (6 used per wheel)
13. Wheel hub
14. Hydraulic fitting
15. O-ring
16. O-ring
17. LH steering spindle
18. Wheel rim
19. Steering cylinder (2 used)
20. Rear axle
21. Hydraulic hose
22. Hydraulic hose

Removal (Fig. 59)

WARNING

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

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

2. Chock front wheels to prevent machine from shifting.

3. Loosen, but do not remove, six (6) wheel lug nuts and hex nut (item 10) that secures wheel hub to wheel motor.

WARNING

Before jacking up the machine, review and follow Jacking Instructions in Chapter 1 - Safety.

4. Jack up machine enough to allow the removal of the rear wheel. Support machine with jack stands.

5. Remove rear wheel assembly from the machine (see Rear Wheel Removal in the Service and Repairs section of Chapter 6 – Chassis).

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

6. Make sure that hex nut (item 10) that secures wheel hub to wheel motor is loosened at least two (2) turns. Use hub puller (see Special Tools) to loosen wheel hub from wheel motor.

7. Remove loosened hex nut and wheel hub from motor shaft. Locate and retrieve square key from wheel motor shaft.

8. Thoroughly clean hydraulic hose ends and fittings on rear wheel motor to prevent hydraulic system contamination.

9. Label all hydraulic hoses for assembly purposes. Remove hydraulic hoses from fittings on wheel motor. Allow hoses to drain into a suitable container.

10. Remove hydraulic fittings from wheel motor. Remove and discard O–rings from fittings.

11. Put clean plugs in disconnected hydraulic hoses and wheel motor ports to prevent system contamination.

12. Support the wheel motor to prevent it from falling during removal.

13. Remove four (4) cap screws and lock washers that secure wheel motor to the steering spindle.

14. Remove wheel motor from frame.

Installation (Fig. 59)

IMPORTANT: Because of internal differences in rear wheel motors, DO NOT interchange rear wheel motors on machine (i.e. do not put right side motor on left side of machine). The left side wheel motor has a yellow identification mark on the motor housing. If necessary, use parts catalog and part number on wheel motor to identify RH and LH motors.

1. Position rear wheel motor to steering spindle. Make sure that ports in wheel motor are facing toward the rear of the machine.

2. Secure wheel motor to spindle with four (4) cap screws and lock washers. Torque screws from **67 to 83 ft–lb (91 to 112 N–m)**.

3. Remove plugs from disconnected hydraulic hoses and wheel motor ports.

4. Lubricate and install new O–rings to hydraulic fittings. Install fittings into wheel motor ports (see Hydraulic Fitting Installation in the General Information section of this chapter).

5. Remove caps or plugs placed during removal to prevent contamination.

6. Using labels placed during the removal process, properly connect hydraulic hoses to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Make sure that tapers of wheel motor shaft and wheel hub are thoroughly clean.

8. Position square key to keyslot in wheel motor shaft.

IMPORTANT: Do not reuse hex nut that secures wheel hub to wheel motor after it has been removed.

9. Place wheel hub on motor shaft and secure with new hex nut (item 10).

10. Install wheel assembly to the machine and secure with six (6) lug nuts.

11. Lower the machine to the ground.

WARNING

Failure to properly tighten nut that secures wheel hub or wheel lug nuts could result in failure or loss of wheel and may result in personal injury.

12. Torque hex nut (item 10) from **315 to 385 ft–lb (428 to 522 N–m)**.

13. Torque wheel lug nuts from **70 to 90 ft–lb (95 to 122 N–m)**.

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

15. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything through full range of axle motion. Also, check for any hydraulic leaks.

Rear Wheel Motor Service

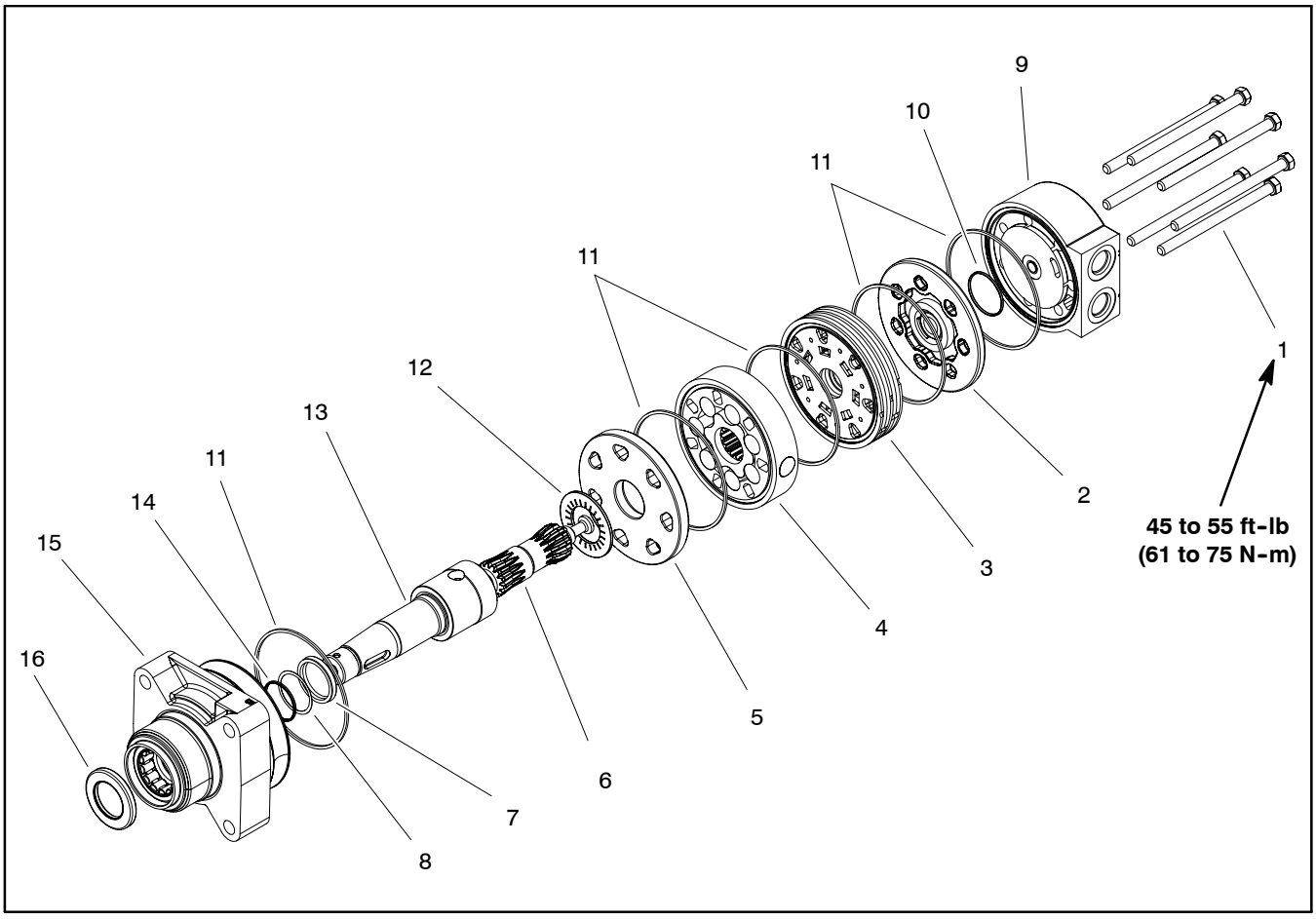


Figure 60

1. **Cap screw (7 used)**
2. **Commutator assembly**
3. **Manifold**
4. **Stator assembly**
5. **Wear plate**
6. **Drive link**
7. **Shaft seal**
8. **Back-up washer**
9. **End cover**
10. **Commutator ring**
11. **Body seal (5 used)**
12. **Thrust bearing**
13. **Coupling shaft**
14. **Back-up ring**
15. **Housing**
16. **Dirt and water seal**

NOTE: The rear wheel motors on Groundsmaster 5900 and 5910 machines are Parker Torqmotor™ TG Series. Right and left motors are the same basic design but the right side motor has a reverse timed manifold to allow correct rotation direction for forward and reverse. The left side wheel motor has a yellow identification mark on the motor housing.

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

IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

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Traction Control Manifold

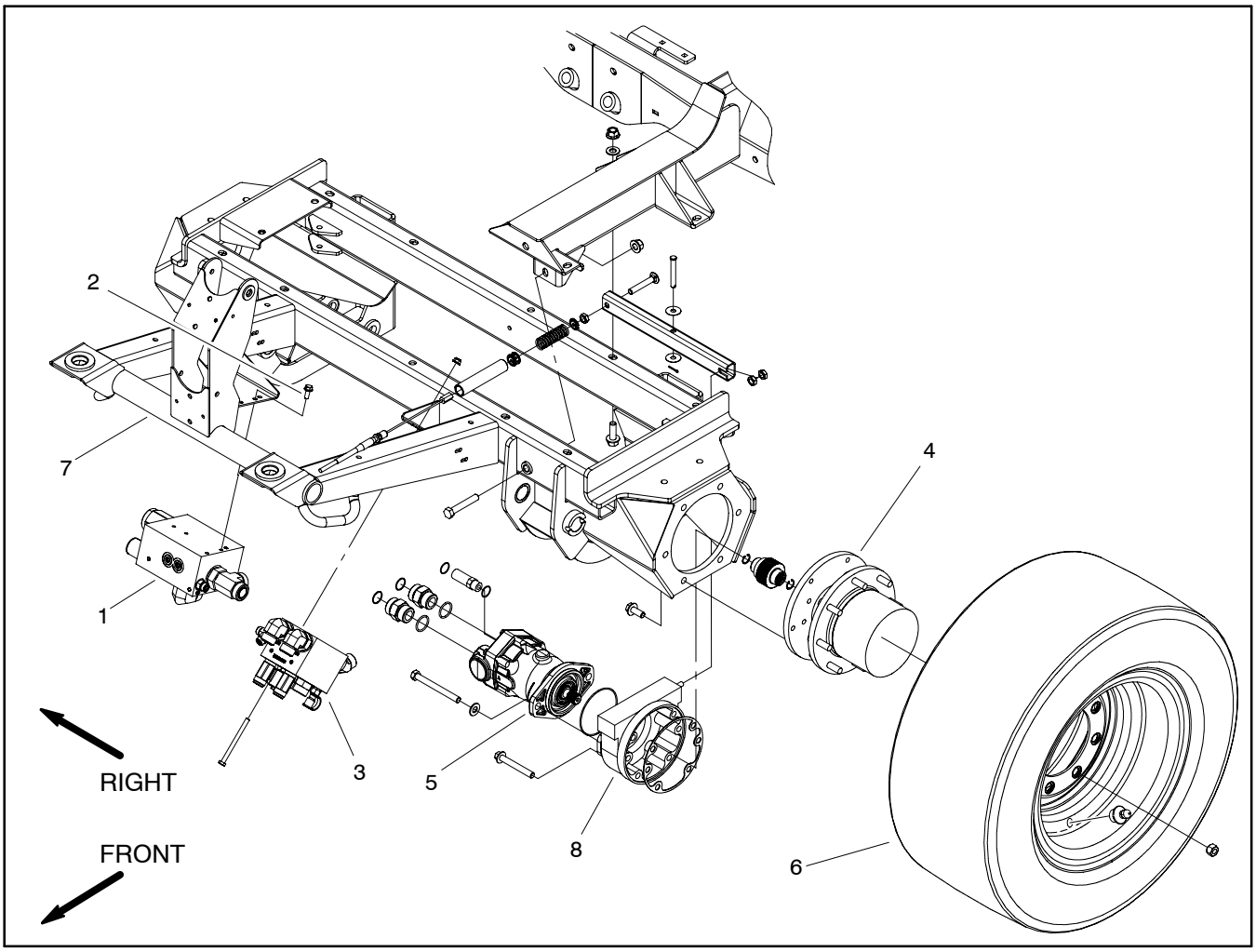


Figure 61

1. **Traction control manifold**
2. **Flange head screw (4 used)**
3. **Front PTO control manifold**
4. **Planetary assembly**
5. **LH front wheel motor**
6. **Front wheel assembly**
7. **Frame assembly**
8. **Brake assembly**

NOTE: The ports on the traction control manifold are marked for easy identification of components. Example: P is the piston pump connection port and S is the location for the solenoid valve (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 61)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect wire harness connector from the solenoid valve.

4. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label disconnected hydraulic lines for proper assembly.

5. Remove hydraulic manifold from the frame using Figure 61 as guide.

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

Installation (Fig. 61)

1. If fittings were removed from manifold, lubricate and place new O-rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Refer to Figure 62 for straight fitting installation torque. For information on tightening procedures for other manifold fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Install traction control manifold to the frame using Figure 61 as guide.

3. Remove caps and plugs from fittings and hoses. Using labels placed during removal, properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness connector to the solenoid valve.

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

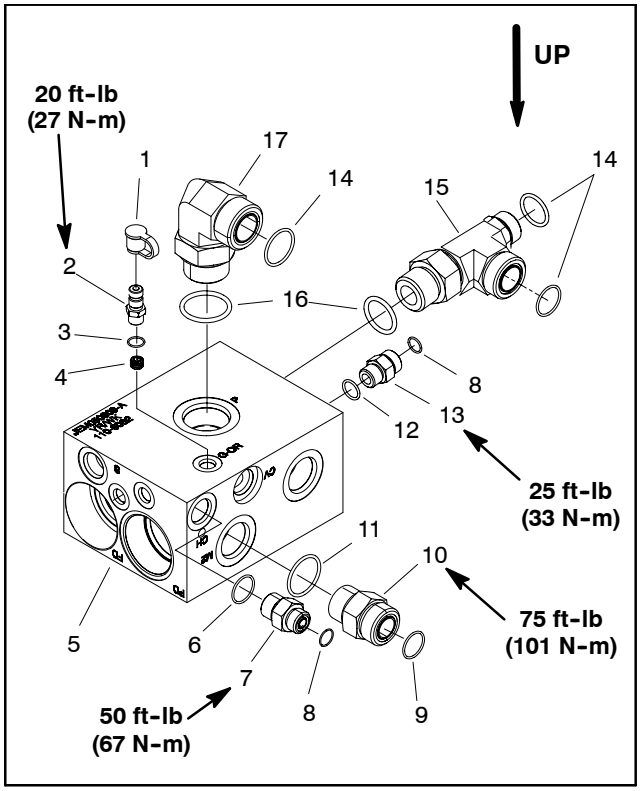


Figure 62

1. Dust cap
2. Quick fitting (G-OR)
3. O-ring
4. Orifice (G-OR)
5. Manifold
6. O-ring
7. Straight fitting (CH)
8. O-ring
9. O-ring
10. Straight fitting (M2)
11. O-ring
12. O-ring
13. Straight fitting (CD)
14. O-ring
15. Tee fitting (M1)
16. O-ring
17. 90° fitting (P)

Traction Control Manifold Service

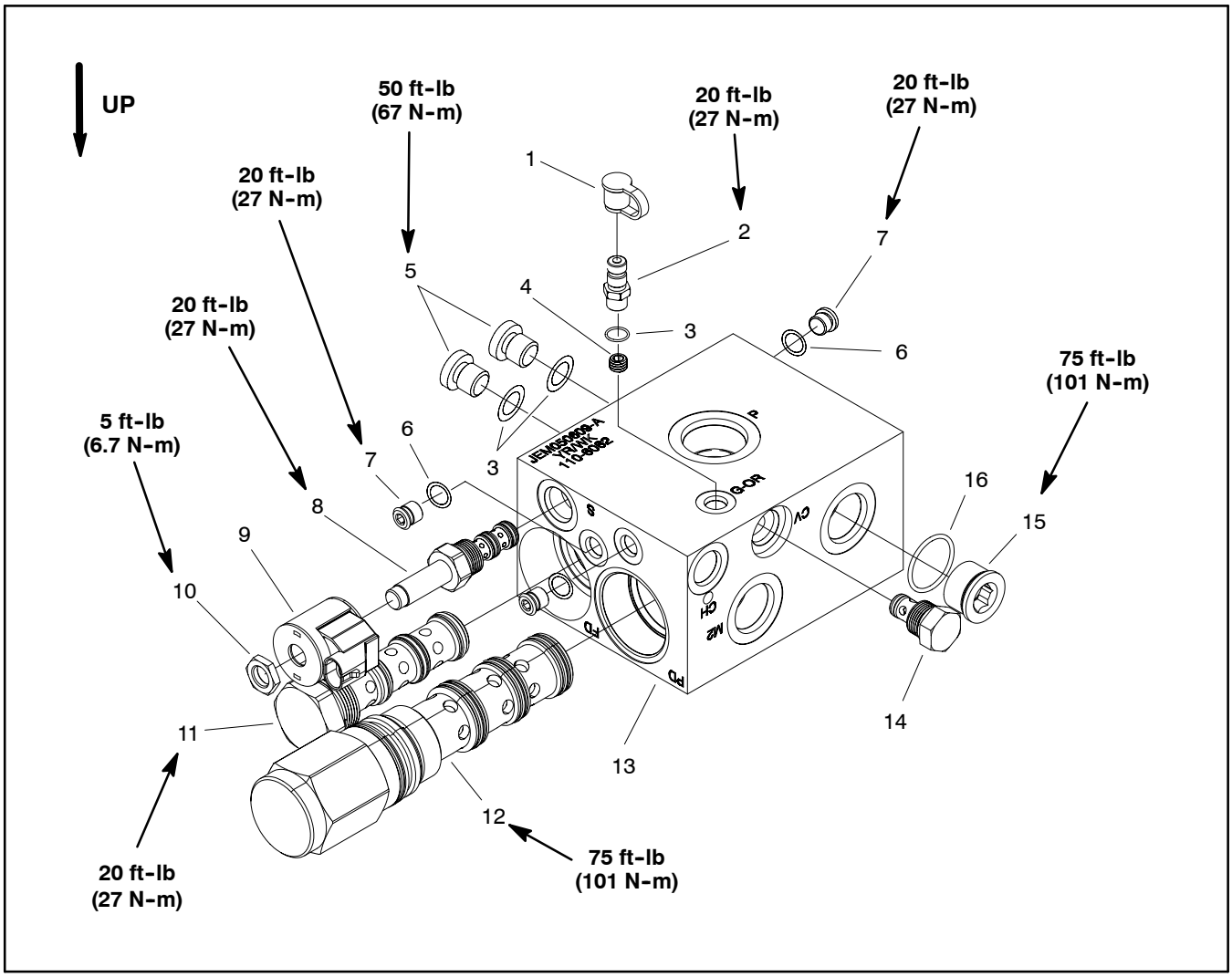


Figure 63

1. Dust cap
2. Quick fitting (G-OR)
3. O-ring
4. Orifice (G-OR)
5. #8 NWD plug
6. O-ring
7. #4 NWD plug (3 used)
8. Solenoid valve (S)
9. Solenoid coil
10. Nut
11. Flow divider (FD)
12. Pilot directional valve (PD)
13. Manifold body
14. Check valve (CV)
15. #12 NWD plug
16. O-ring

NOTE: The ports on the traction control manifold are marked for easy identification of components. Example: P is the piston pump connection port and S is the location for the solenoid valve (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The traction control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O-ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to Figure 63 for plug installation torque.

Valve Cartridge Service

1. Make sure the entire outer surface of the manifold is clean before removing the valve.

2. If cartridge is solenoid operated, remove nut securing solenoid coil to the cartridge valve. Carefully slide solenoid coil off the valve.

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

3. Remove cartridge valve with a deep socket wrench. Note correct location for O−rings, sealing rings and backup rings. Remove and discard seal kit.

4. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads and contamination. Also, inspect cartridge valve for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

5. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful to not damage cartridge. Use compressed air for cleaning.

6. Reinstall the cartridge valve:

A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The O−rings, sealing rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

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

B. Thread cartridge valve carefully into manifold port. The valve should go in easily without binding.

C. Torque cartridge valve using a deep socket to value identified in manifold illustration.

D. If cartridge is solenoid operated, carefully install solenoid coil to the cartridge valve. Torque nut to value identified in manifold illustration. Over−tightening may damage the solenoid or cause the valve to malfunction.

7. If problems still exist, remove valve and clean again or replace valve.

4WD Control Manifold

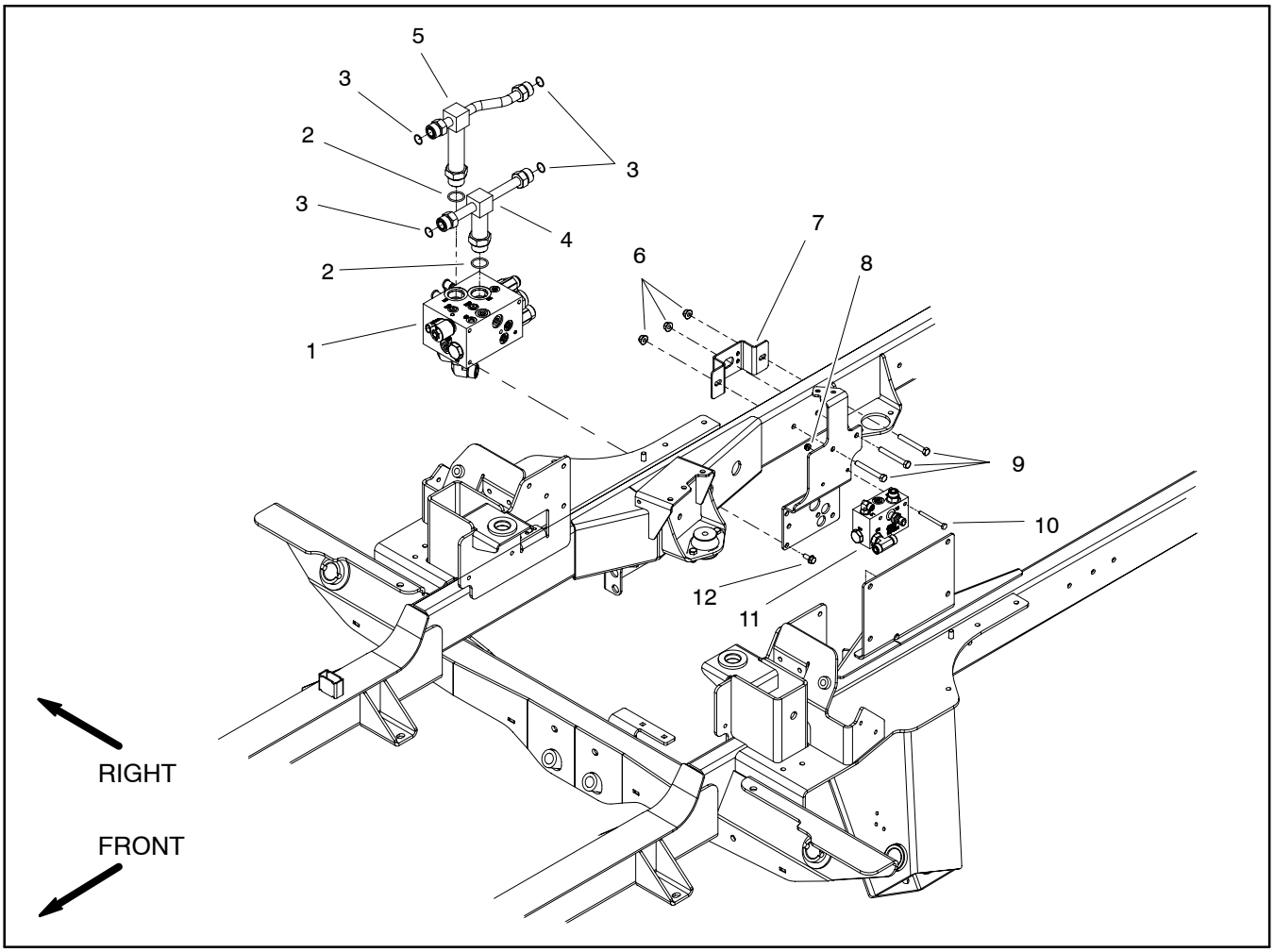


Figure 64

1. **4WD control manifold**
2. **O-ring**
3. **O-ring**
4. **Hydraulic tee fitting**
5. **Hydraulic tee fitting**
6. **Flange nut**
7. **Bulkhead mount plate**
8. **Flange nut (2 used)**
9. **Cap screw**
10. **Cap screw (2 used)**
11. **Flush manifold**
12. **Flange screw (4 used)**

NOTE: The ports on the 4WD control manifold are marked for easy identification of components. Example: P1 is the pump supply port for the forward direction and S is the location for the solenoid valve (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 64)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect wire harness connector from the solenoid valve.

4. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Support manifold to prevent it from falling.

6. Remove four (4) flange screws that secure 4WD control manifold to frame. Remove manifold from frame.

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

Installation (Fig. 64)

1. If fittings were removed from manifold:

   A. Lubricate new O−rings with clean hydraulic oil. Install lubricated O−rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Refer to Figure 65 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Position 4WD control manifold to the frame and secure with four (4) flange screws.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness connector to the solenoid valve.

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

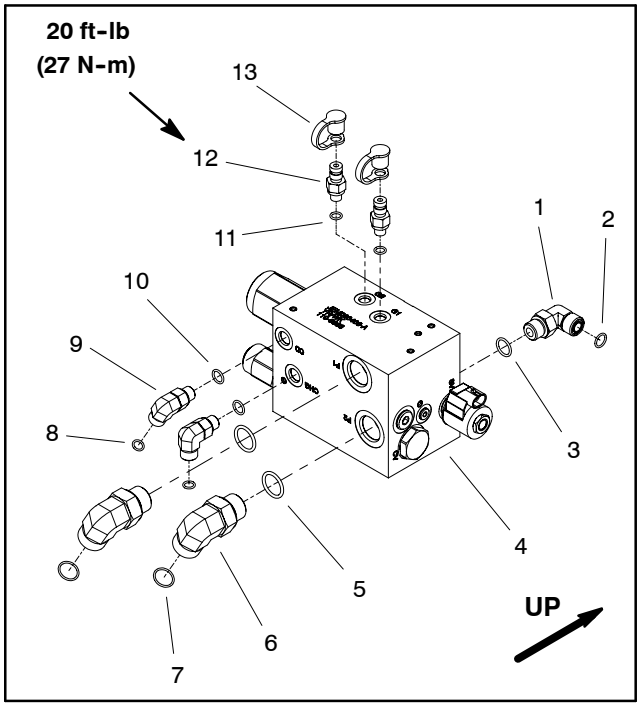


Figure 65

1. 90º fitting (P3)
2. O−ring
3. O−ring
4. 4WD manifold
5. O−ring
6. 90º fitting (P1 & P2)
7. O−ring
8. O−ring
9. 90º fitting (CHG & CD)
10. O−ring
11. O−ring
12. Quick fitting (G1 & G2)
13. Dust cap

4WD Control Manifold Service

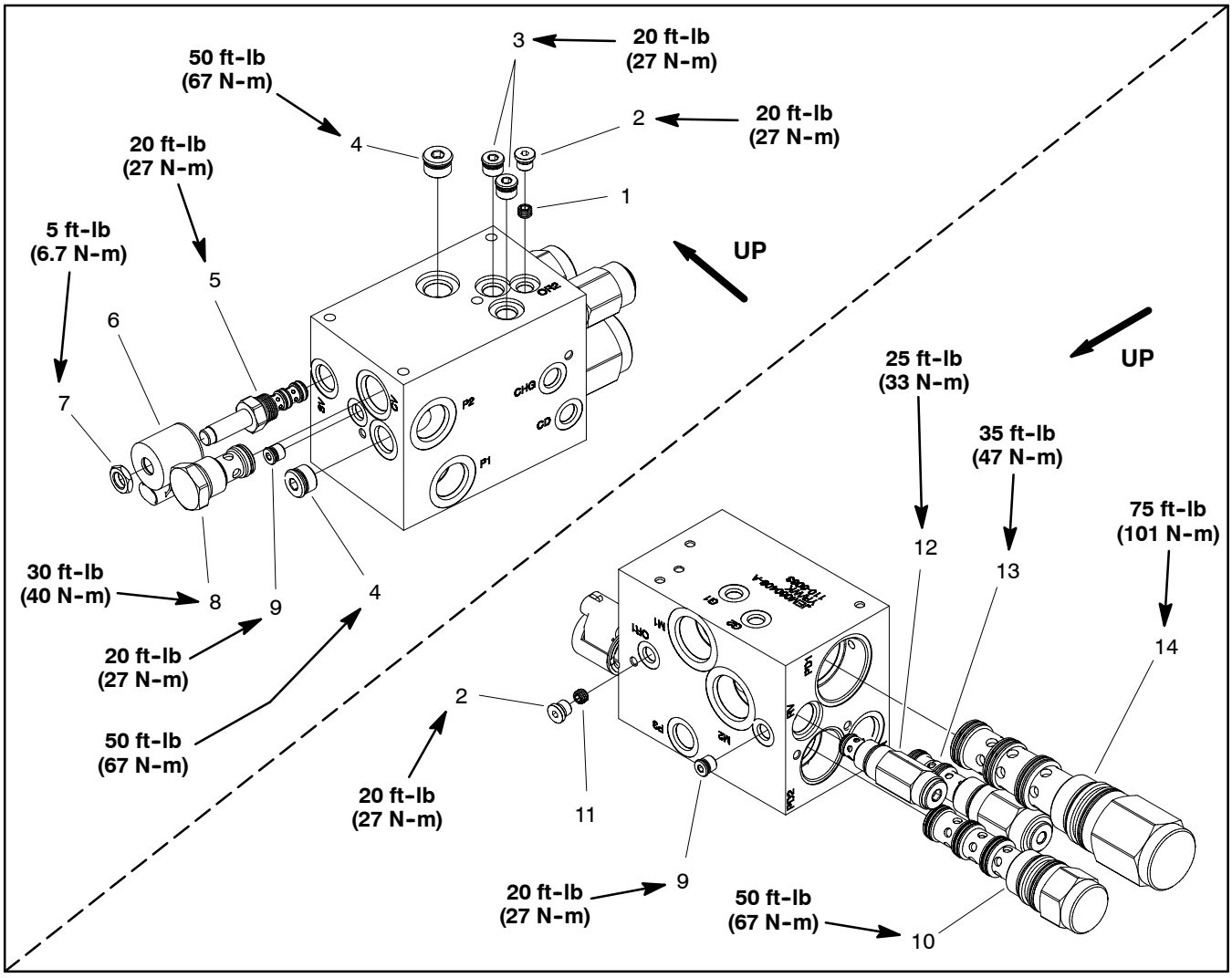


Figure 66

1. Orifice (0.040) (OR2)
2. Plug with O-ring
3. NWD #6 plug with O-ring
4. NWD #8 plug with O-ring
5. Solenoid valve (SV)
6. Solenoid coil
7. Nut
8. Check valve (CV)
9. NWD #4 plug with O-ring
10. Directional pilot valve (PD2)
11. Orifice (0.030) (OR1)
12. Relief valve (RV)
13. Pressure valve (PR)
14. Directional pilot valve (PD1)

NOTE: The ports on the 4WD control manifold are marked for easy identification of components. Example: P1 is the pump supply port for the forward direction and RV is the location for the relief valve (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Valve Cartridge Service (Fig. 66)

For solenoid and control valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figure 66 for 4WD control manifold cartridge valve and plug installation torque.

NOTE: The 4WD control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to Figure 66 for plug installation torque.

IMPORTANT: An orifice is placed beneath the plugs in the control manifold OR1 and OR2 ports. If one of these plugs is removed, make sure to remove orifice and label its position for assembly purposes.

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Traction Flush Manifold

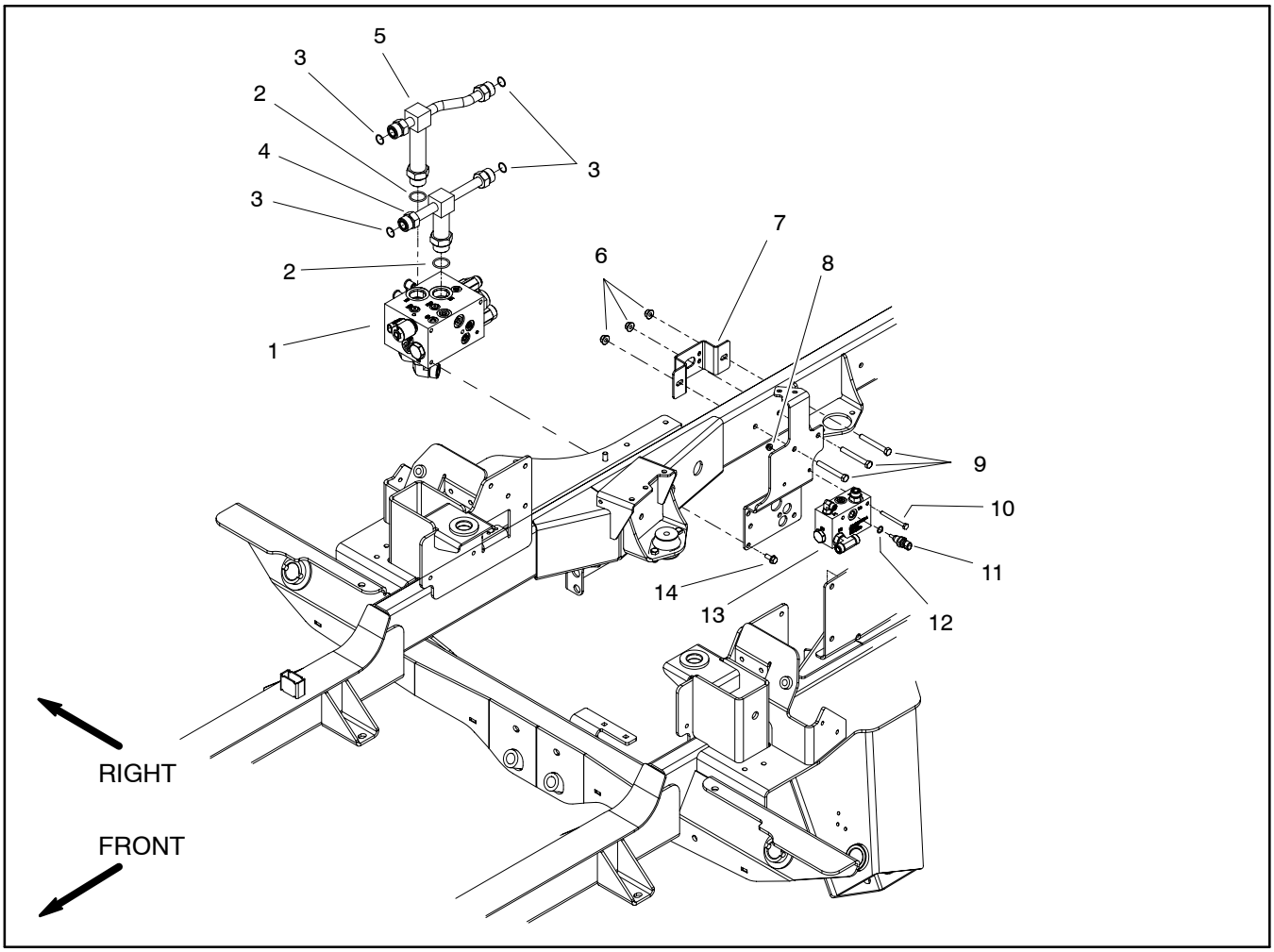


Figure 67

1. **4WD control manifold**
2. **O-ring**
3. **O-ring**
4. **Hydraulic tee fitting**
5. **Hydraulic tee fitting**
6. **Flange nut**
7. **Bulkhead mount plate**
8. **Flange nut (2 used)**
9. **Cap screw**
10. **Cap screw (2 used)**
11. **Hydraulic oil temp sender**
12. **O-ring**
13. **Flush manifold assembly**
14. **Flange screw (4 used)**

NOTE: The ports on the traction flush manifold are marked for easy identification of components. Example: CV is the check valve port and TS is the temperature sender port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The traction flush manifold includes a zero leak NWD plug. This plug has a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plug also has an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plug, refer to Figure 68 for plug installation torque.

Removal (Fig. 67)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect hydraulic lines from flush manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

4. Support flush manifold to prevent it from falling. Remove two (2) cap screws and flange nuts that secure manifold to frame (Fig. 67). Remove flush manifold from the machine.

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

Installation (Fig. 67)

1. If fittings were removed from manifold:

   A. Lubricate new o−rings with clean hydraulic oil. Install lubricated o−rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Refer to Figure 68 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Refer to Figure 68 for check valve, shuttle valve and plug installation torque.

3. Position flush manifold to the frame and secure with two (2) cap screws and flange nuts.

4. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

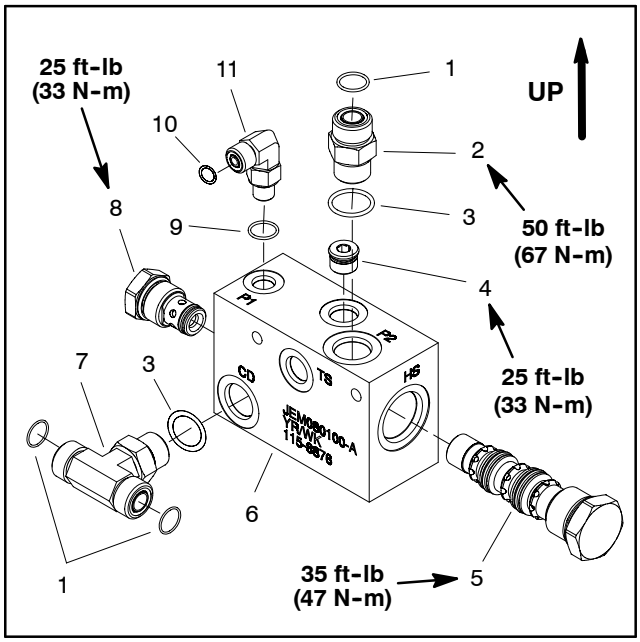


Figure 68

1. O-ring
2. Straight fitting (P2)
3. O-ring
4. #6 NWD plug/O-ring
5. Shuttle valve (HS)
6. Flush manifold
7. Tee fitting (CD)
8. Check valve (CV)
9. O-ring
10. O-ring
11. 90° fitting (P1)

PTO Circuit

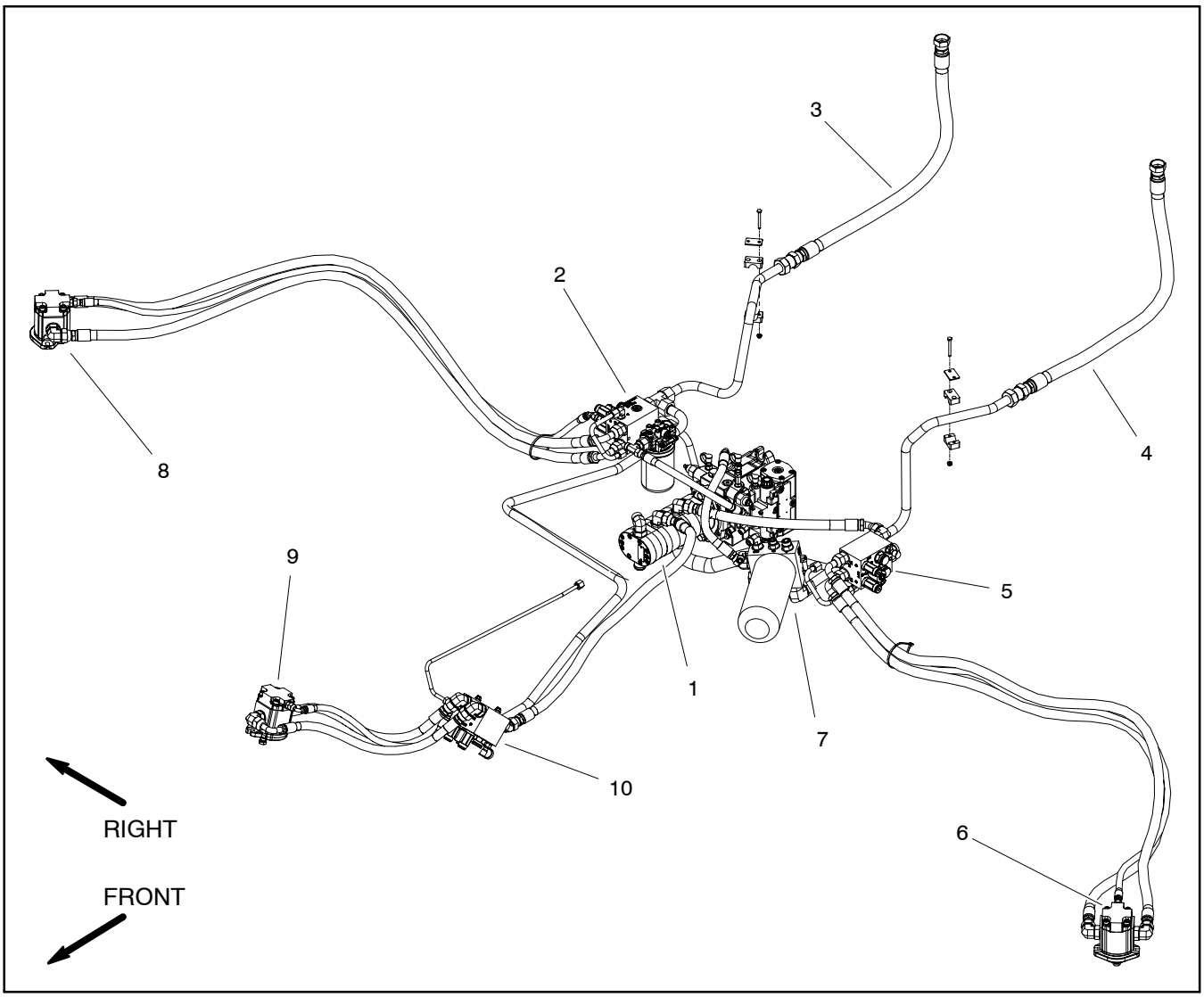


Figure 69

1. **Gear pump**
2. **RH PTO control manifold**
3. **Hydraulic hose to oil cooler**
4. **Hydraulic hose from oil cooler**
5. **LH PTO control manifold**
6. **LH cutting deck motor**
7. **Filter manifold**
8. **RH cutting deck motor**
9. **Front cutting deck motor**
10. **Front PTO control manifold**

Figure 69 illustrates the components that are used in the Groundsmaster PTO circuit. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this section.

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Cutting Deck Motor

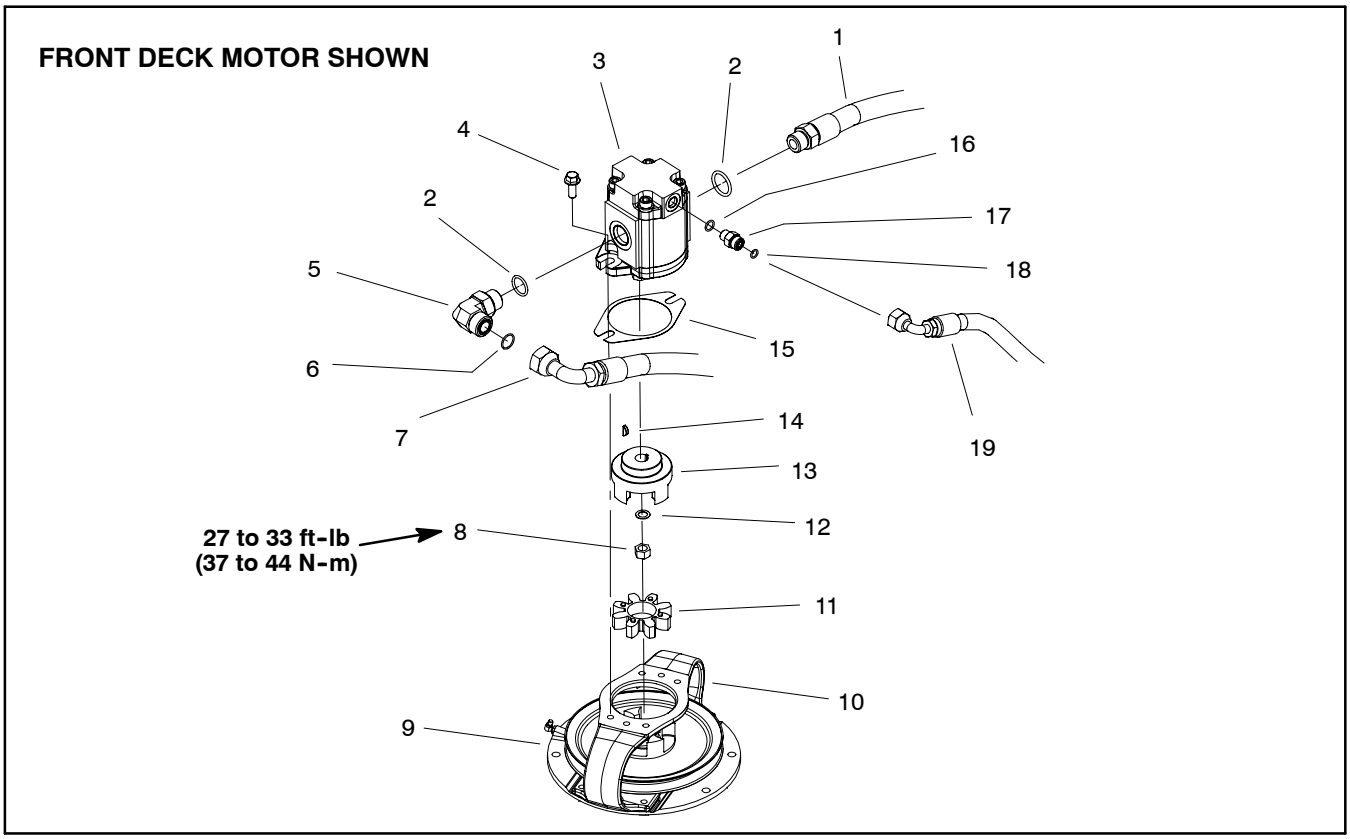


Figure 70

1. **Hydraulic hose**
2. **O-ring**
3. **Cutting deck motor**
4. **Flange head screw (2 used)**
5. **90º hydraulic fitting**
6. **O-ring**
7. **Hydraulic hose**
8. **Hex nut**
9. **Spindle assembly**
10. **Motor mount**
11. **Spider**
12. **Washer**
13. **Spider hub**
14. **Woodruff key**
15. **Mounting shim (if equipped)**
16. **O-ring**
17. **Hydraulic fitting**
18. **O-ring**
19. **Hydraulic hose**

Removal (Fig. 70)

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

2. Remove cutting deck cover to gain access to cutting deck motor.

3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

4. Label hydraulic lines for proper assembly. Disconnect hydraulic hoses from deck motor. Put caps or plugs on fittings and hoses to prevent contamination.

5. Remove two (2) flange head screws that secure hydraulic motor to motor mount.

6. Carefully remove hydraulic motor from cutting deck taking care not to damage spider hub attached to motor. Locate and remove spider and mounting shim(s) (if present) from the deck.

7. If hydraulic fittings are to be removed from deck motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O-rings.

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

Installation (Fig. 70)

1. If fittings were removed from deck motor, lubricate and place new O-rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

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

3. Check for proper clearance between spider hub and spindle pulley. Install motor to cutting deck without placing the spider in the spindle pulley. The clearance between hub and pulley valleys should be from 0.830" to 0.930" (21.1 to 23.6 mm). If required, use mounting shim(s) between motor and motor mount to adjust clearance.

4. Position spider in spindle pulley. Place mounting shim(s) (if required) on deck. Carefully install hydraulic motor to the cutting deck taking care to not damage spider hub attached to motor.

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

IMPORTANT: For proper hydraulic hose routing, make sure cutting decks are fully lowered before installing hoses to deck motor.

6. Remove caps or plugs from fittings and hoses. Connect hydraulic hoses to deck motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. After assembly is completed, verify that hydraulic hoses and fittings are not contacted by moving components through full range of deck movement.

8. Install cutting deck cover.

9. Fill reservoir with new hydraulic fluid as required.

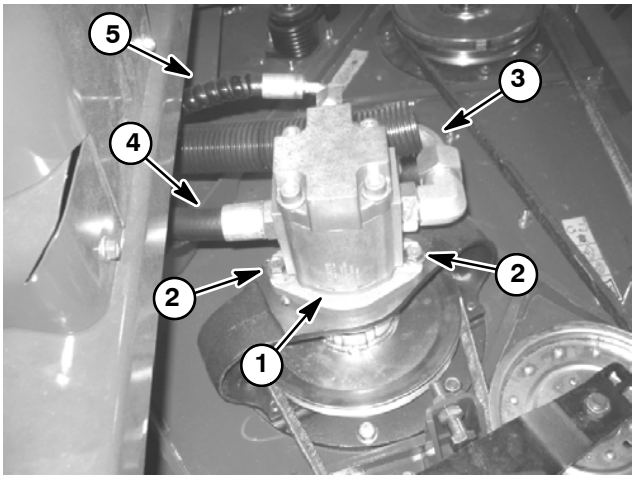


Figure 71

1. **Deck motor (front)**
2. **Flange head screw**
3. **Inlet hose**
4. **Return hose**
5. **Case drain hose**

Cutting Deck Motor Service

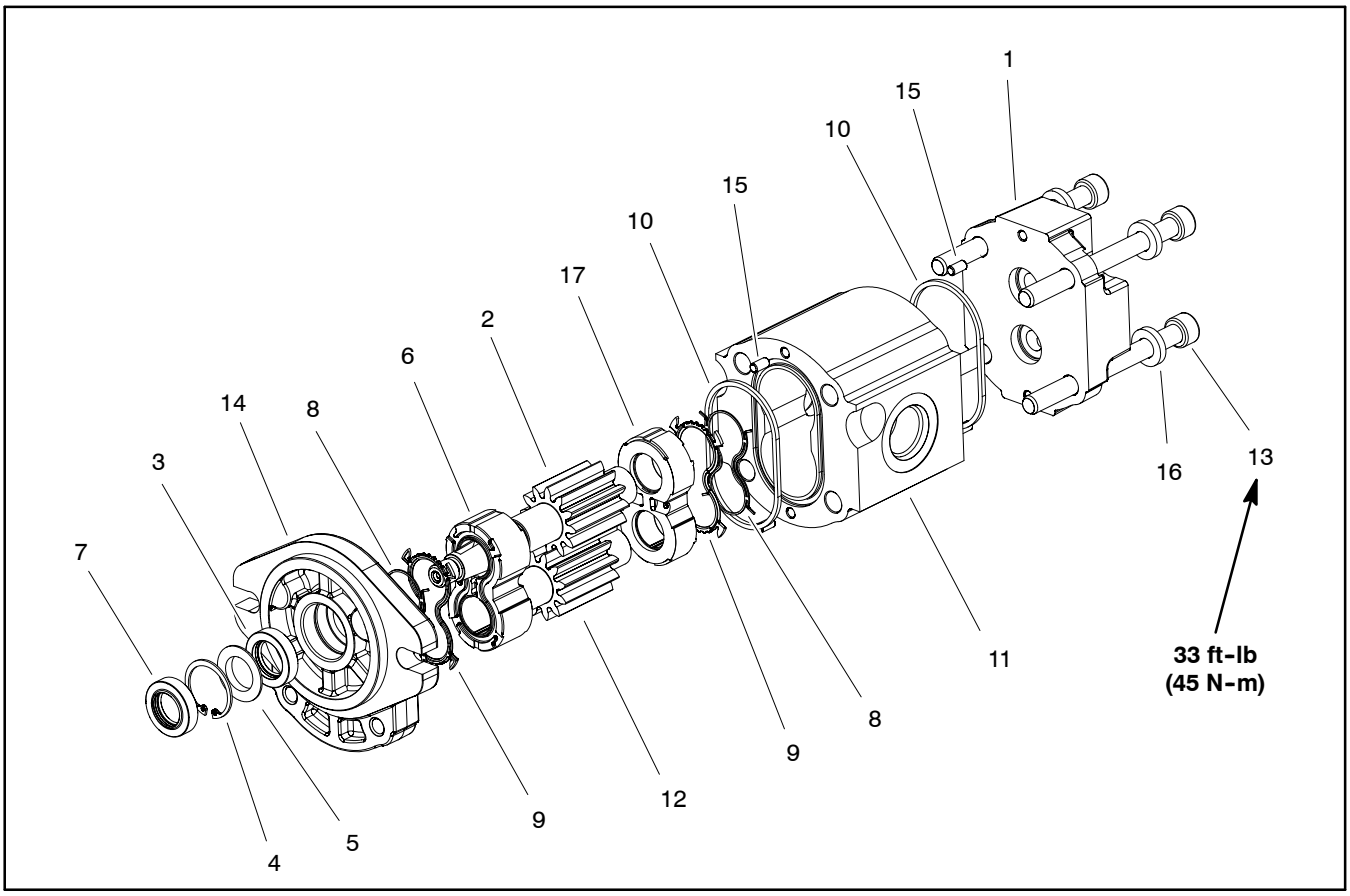


Figure 72

1. Rear cover
2. Drive gear
3. Shaft seal
4. Retaining ring
5. Flange washer
6. Front wear plate
7. Dust seal
8. Pressure seal
9. Back-up gasket
10. O-ring
11. Body
12. Idler gear
13. Cap screw (4 used)
14. Front flange
15. Dowel pin (4 used)
16. Washer (4 used)
17. Rear wear plate

Disassembly (Fig. 72)

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

2. Remove nut and washer that secure spider hub to motor shaft (Fig. 73). Use suitable puller to remove hub from shaft. Remove woodruff key.

3. Use a marker to make a **diagonal** line across the front flange, body and rear cover for assembly purposes (Fig. 74).

IMPORTANT: To prevent distorting the motor housing during disassembly, do not clamp housing in a vise.

4. Clamp front flange of motor in a vise with soft jaws with the shaft end down.

5. Loosen cap screws from the rear cover.

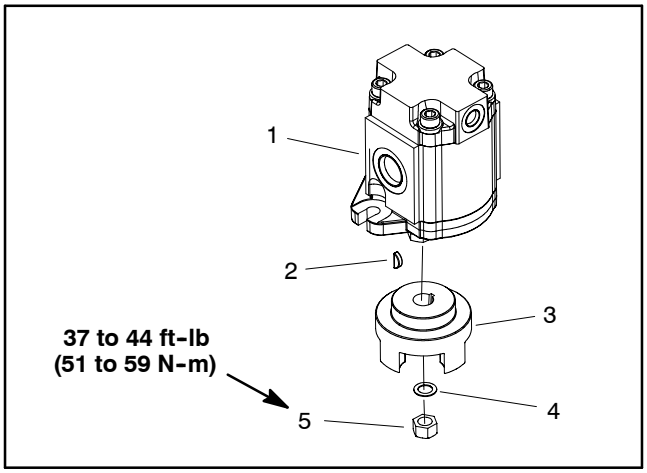


Figure 73

1. Deck motor
2. Woodruff key
3. Spider hub
4. Washer
5. Nut

6. Remove motor from the vise and remove cap screws.

7. Remove rear cover from the body.

8. Carefully remove body. Lift body straight up to remove. Make sure the rear wear plate remains on the drive and idler gear shafts. Remove and discard O-rings from the body. Locate and retrieve dowel pins.

IMPORTANT: Note position of the open and closed side of the wear plates before removing. Also, identify wear plates (front and rear) with a marker for proper assembly.

9. Carefully remove rear wear plate, idler gear, drive gear and front wear plate from the front flange.

10. Remove and discard back-up gaskets and pressure seals from wear plates.

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

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

12. Carefully remove dust seal, retaining ring, flange washer and shaft seal from the front flange (Fig. 76). Discard seals.

Inspection

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive gears and idler gears for the following (Fig. 75):

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into wear plates and, thus, must be replaced.

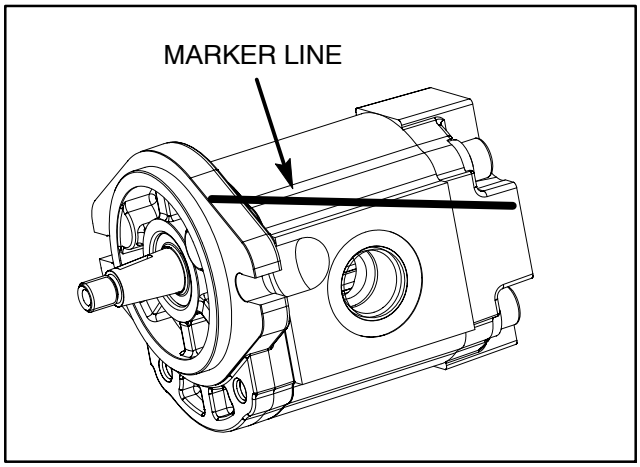


Figure 74

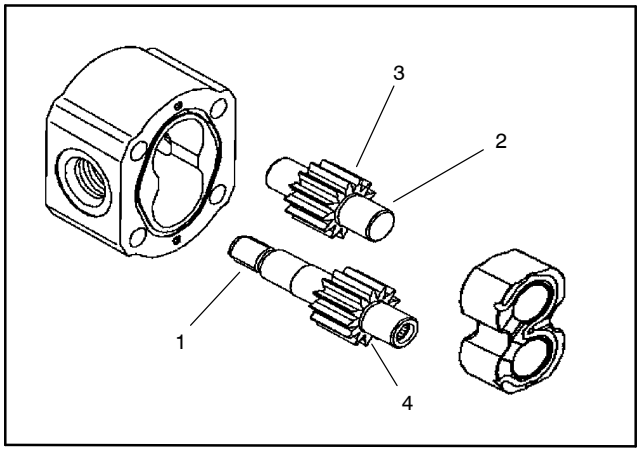


Figure 75

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

4. Inspect wear plates for the following:

A. Bearing areas should not have excessive wear or scoring.

B. Face of wear plates that are in contact with gears should be free of wear, roughness or scoring.

C. Thickness of wear plates should be equal.

5. Inspect front flange and rear cover for damage or wear.

Assembly (Fig. 72)

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

1. Lubricate O-rings, pressure seals, back-up gaskets and wear plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new seals into front flange (Fig. 76):

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

   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.

   C. Install new dust seal into front flange.

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

4. Install the pressure seals, flat side outward, into the grooves in the wear plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the wear plate.

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

6. Lubricate the drive gear shaft with clean hydraulic oil. Insert the drive end of the drive shaft through the wear plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange.

7. Lubricate the idler gear shaft with clean hydraulic oil. Install idler gear shaft into the remaining position in the front wear plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear wear plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

9. Apply a light coating of petroleum jelly to new O-rings and O-ring grooves in the body. Install new O-rings to the body.

10. Install locating dowels in body. Align marker line on the body and front flange.

IMPORTANT: Do not dislodge seals during installation.

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowels.

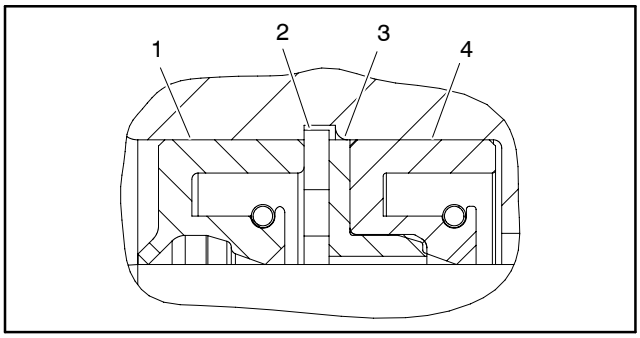


Figure 76

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**

12. Check to make sure that the surface of the rear wear plate is slightly below the face of the body. If the wear plate is not below the body, check assembly for a shifted pressure seal, backup gasket or O-ring. Correct before proceeding.

13. Apply a light coating of petroleum jelly to the exposed side of the rear cover.

14. Place rear cover on assembly using marker line for proper location. Firm hand pressure should be sufficient to engage the dowels.

15. Install the four (4) cap screws with washers and hand tighten.

IMPORTANT: Avoid using excessive clamping pressure on the motor housing to prevent distorting the housing.

16. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws **33 ft-lb (45 N-m)**.

17. Remove motor from vise.

18. Place a small amount of clean hydraulic oil in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

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PTO Control Manifolds

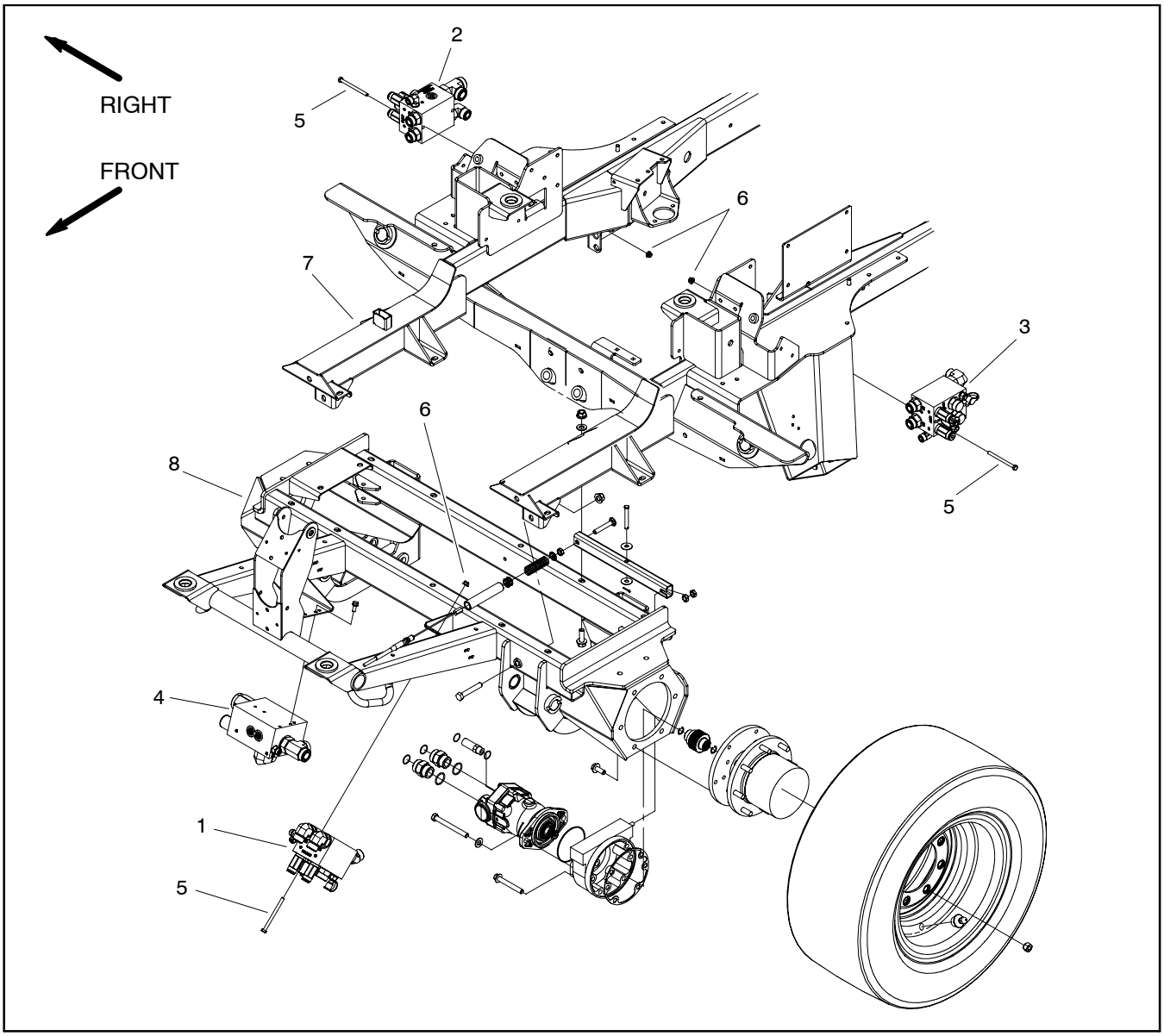


Figure 77

1. **Front PTO control manifold**
2. **RH PTO control manifold**
3. **LH PTO control manifold**
4. **Traction control manifold**
5. **Cap screw (2 used per manifold)**
6. **Flange nut (2 used per manifold)**
7. **Main frame**
8. **Front axle frame**

The control manifolds for the three cutting deck sections are very similar. **Note:** When servicing the PTO control manifolds, **DO NOT** interchange parts from one control manifold to another.

NOTE: The ports on the PTO control manifolds are marked for easy identification of components. Example: S is the solenoid valve and M2 is the return from the deck motor (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 77)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect wire harness connector from the manifold solenoid valve.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Support PTO control manifold to prevent it from falling.

6. Remove two (2) cap screws and flange nuts that secure manifold to frame. Remove PTO control manifold from the frame.

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O-rings.

Installation (Fig. 77)

1. If fittings were removed from manifold:

   A. Lubricate new O-rings with clean hydraulic oil. Install lubricated O-rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Refer to Figures 78, 79 and 80 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Position PTO control manifold to the frame and secure with two (2) cap screws and flange nuts.

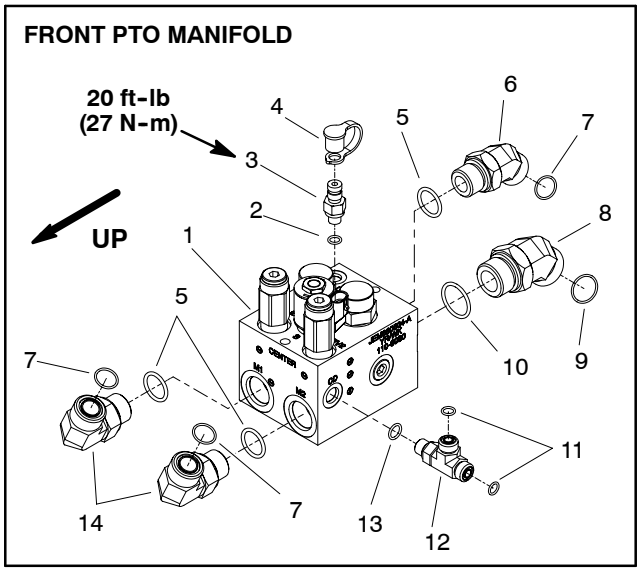


Figure 78

1. **Front PTO manifold**
2. **O-ring**
3. **Quick fitting**
4. **Dust cap**
5. **O-ring**
6. **Hydraulic 45º fitting**
7. **O-ring**
8. **Hydraulic 45º fitting**
9. **O-ring**
10. **O-ring**
11. **O-ring**
12. **Hydraulic tee fitting**
13. **O-ring**
14. **Hydraulic 90º fitting**

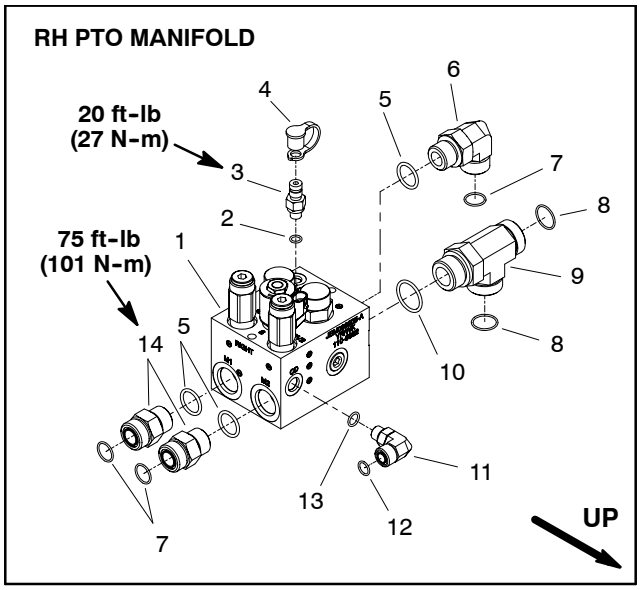


Figure 79

1. **RH PTO manifold**
2. **O-ring**
3. **Quick fitting**
4. **Dust cap**
5. **O-ring**
6. **Hydraulic 90º fitting**
7. **O-ring**
8. **O-ring**
9. **Hydraulic tee fitting**
10. **O-ring**
11. **Hydraulic 90º fitting**
12. **O-ring**
13. **O-ring**
14. **Straight fitting**

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness connector to the solenoid valve.

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

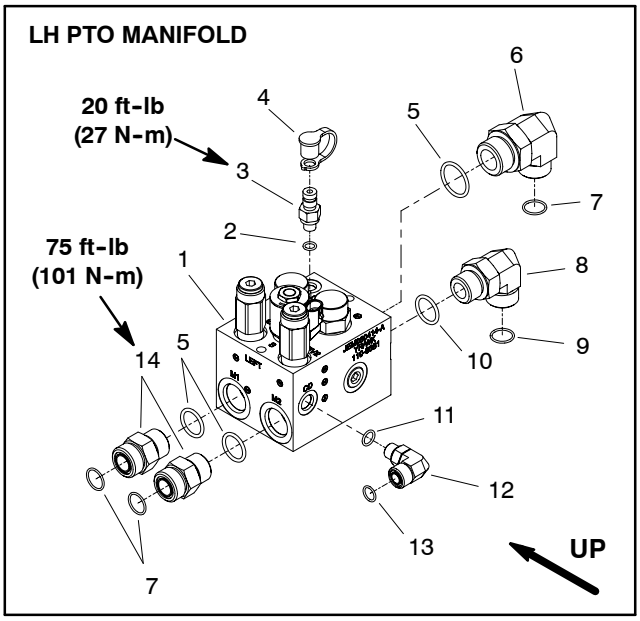


Figure 80

1. LH PTO manifold
2. O-ring
3. Quick fitting
4. Dust cap
5. O-ring
6. Hydraulic 90º fitting
7. O-ring
8. Hydraulic 90º fitting
9. O-ring
10. O-ring
11. O-ring
12. Hydraulic 90º fitting
13. O-ring
14. Straight fitting

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PTO Control Manifold Service

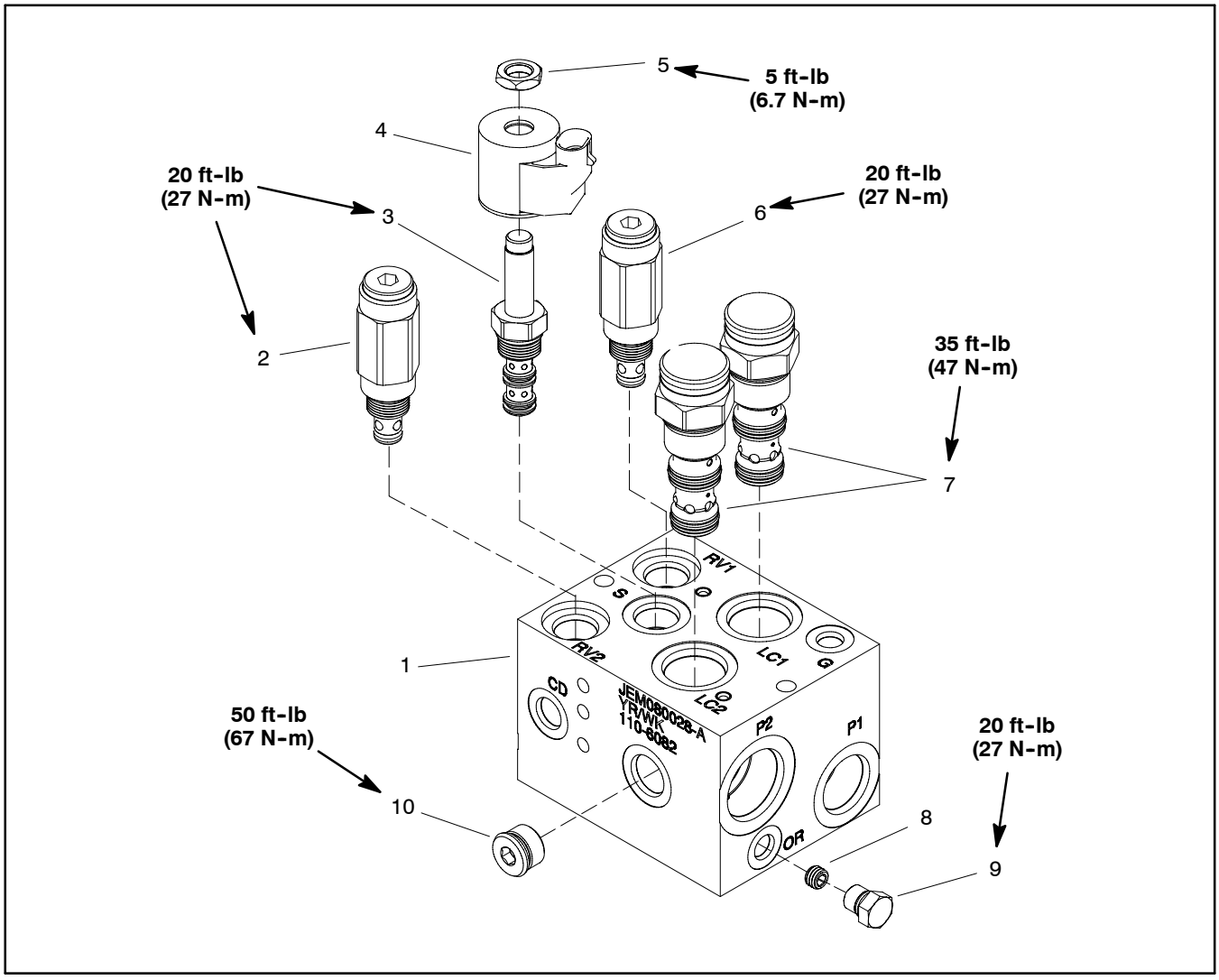


Figure 81

1. Manifold body
2. Relief valve (RV2)
3. Solenoid valve (S)
4. Solenoid coil
5. Nut
6. Relief valve (RV1)
7. Spool logic element (LC1 & LC2)
8. Orifice (OR) (RH and LH only)
9. NWD #4 plug with O-ring
10. NWD #8 plug with O-ring

NOTE: The ports on the PTO control manifolds are marked for easy identification of components. Example: S is the solenoid valve and M2 is the return from the deck motor (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The PTO control manifolds include several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O-ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using a wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug. When installing plugs, refer to manifold illustration in Figure 81 for plug installation torque.

Valve Cartridge Service (Fig. 81)

The control manifolds for the three cutting deck sections are very similar. The manifold for the right and left side decks include an orifice (item 8) that is not used on the front deck manifold. Also, relief valve (RV1) on the right side manifold is set to a lower pressure (2000 PSI/138 bar) than the relief valve (RV1) pressure on the front and left side manifold (3000 PSI/207 bar). **Note:** When servicing the deck control manifolds, **DO NOT** interchange parts from one control manifold to another.

For solenoid and control valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figure 81 for PTO control manifold cartridge valve and plug installation torque.

Filter Manifold

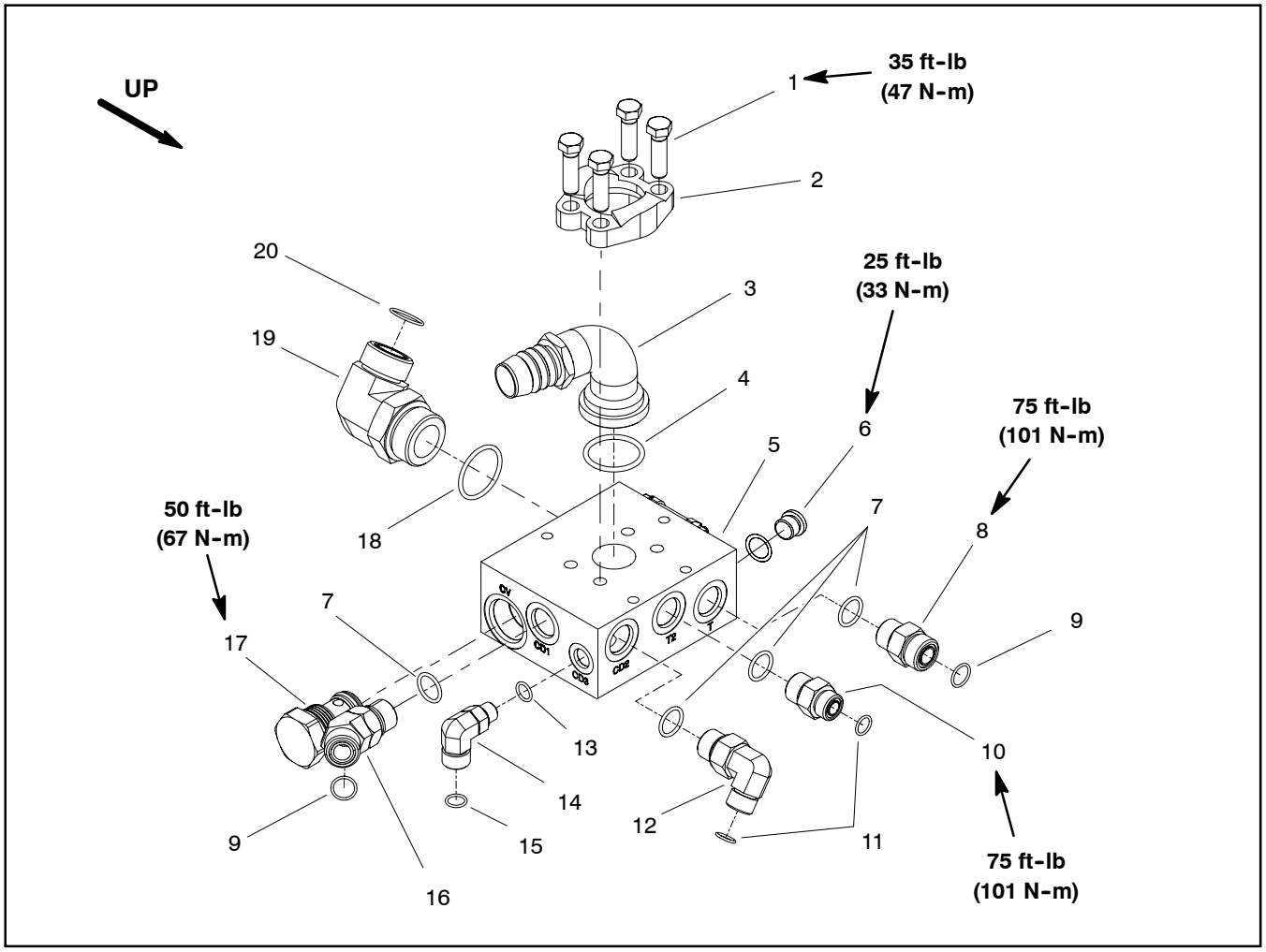


Figure 82

1. Cap screw & lock washer (4 used)
2. Split flange
3. Fitting
4. O-ring
5. Filter manifold
6. NWD #6 plug with O-ring
7. O-ring
8. Straight fitting (T)
9. O-ring
10. Straight fitting (T2)
11. O-ring
12. 90º hydraulic fitting (CD2)
13. O-ring
14. 90º hydraulic fitting (CD3)
15. O-ring
16. 45º hydraulic fitting (CD1)
17. Check valve (CV)
18. O-ring
19. 90º hydraulic fitting (CL)
20. O-ring

NOTE: The ports on the filter manifold are marked for easy identification of components. Example: CL is the connection port for the return from the oil cooler and CV is the check valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Figs. 82 and 83)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood to gain access to filter manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. Disconnect hydraulic lines from filter manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Support filter manifold to prevent it from falling. Remove four (4) flange head screws that secure manifold to frame (Fig. 83). Remove filter manifold from the machine.

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

Installation (Figs. 82 and 83)

1. If fittings were removed from manifold:

   A. Lubricate new o−rings with clean hydraulic oil. Install lubricated o−rings on fittings.

   B. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   C. Refer to Figure 82 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Refer to Figure 82 for check valve and plug installation torque.

3. Position filter manifold to the frame and secure with four (4) flange head screws (Fig. 83). Torque screws from **106 to 159 in−lb (12.0 to 17.9 N−m)**.

4. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

6. Lower and secure hood.

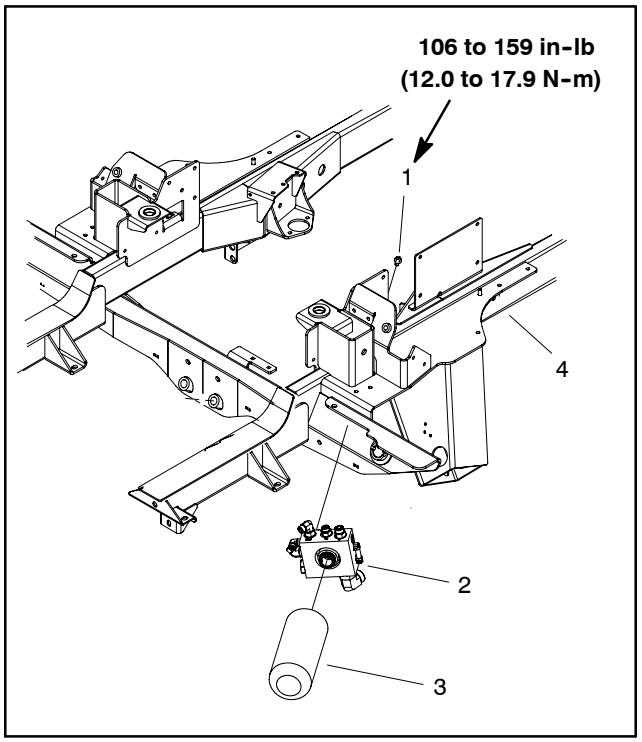


Figure 83

1. **Flange screw (4 used)**
2. **Filter manifold**
3. **Oil filter**
4. **Main frame**

Hydraulic Oil Cooler

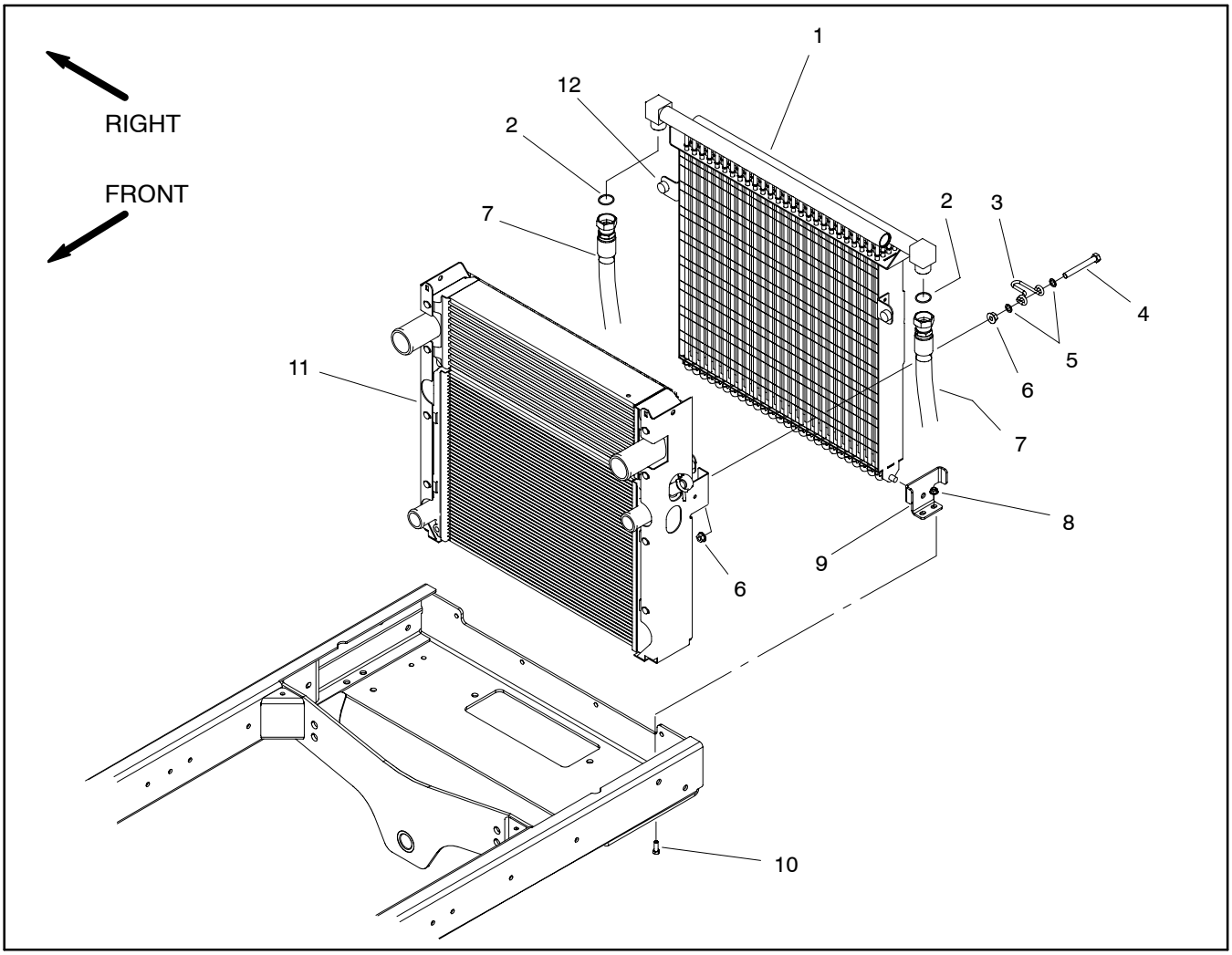


Figure 84

1. **Oil cooler**
2. **O-ring**
3. **Clamp (2 used)**
4. **Cap screw (2 used)**
5. **Washer (4 used)**
6. **Flange nut (4 used)**
7. **Hydraulic hose (2 used)**
8. **Flange nut (4 used)**
9. **Support plate (2 used)**
10. **Cap screw (4 used)**
11. **Radiator assembly**
12. **Bumper (2 used)**

Removal (Fig. 84)

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

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

2. Raise hood to gain access to oil cooler.

3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

4. To prevent contamination of hydraulic system during oil cooler removal, thoroughly clean exterior of oil cooler and hydraulic hoses.

5. Remove oil cooler using Figure 84 as a guide. Use backup wrench on oil cooler fittings when removing hydraulic hoses from fittings. Put caps or plugs on oil cooler and hydraulic hose openings to prevent contamination.

Inspection

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Plug both ends of oil cooler. Clean exterior of cooler. Make sure all fins are clear of dirt and debris.

4. The oil cooler should be free of corrosion, cracked tubes and excessive pitting of tubes.

Installation (Fig. 84)

1. Remove caps or plugs placed during removal to prevent contamination. Install oil cooler using Figure 84 as a guide. Use backup wrench on oil cooler fittings when installing hydraulic hoses to fittings.

2. Fill reservoir with new hydraulic fluid as required.

3. Lower and support hood.

Cutting Deck Raise/Lower Circuit

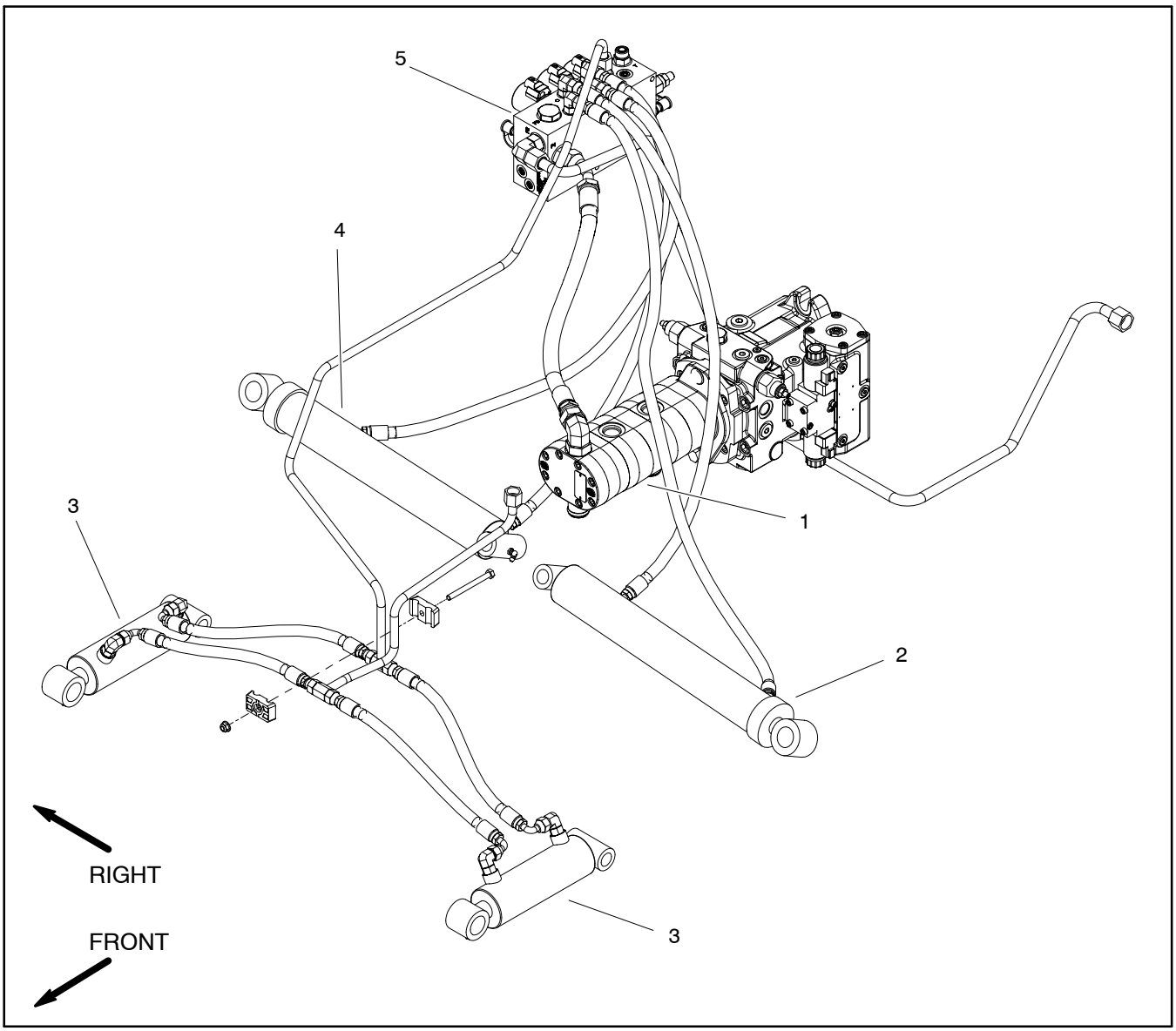


Figure 85

1. **Gear pump**
2. **LH cutting deck lift cylinder**
3. **Front cutting deck lift cylinder**
4. **RH cutting deck lift cylinder**
5. **Lift control manifold**

Figure 85 illustrates the components that are used in the Groundsmaster cutting deck raise/lower circuits. Procedures for removal, installation and disassembly/assembly of these components are provided in the following pages of this section.

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Front Deck Lift Cylinder

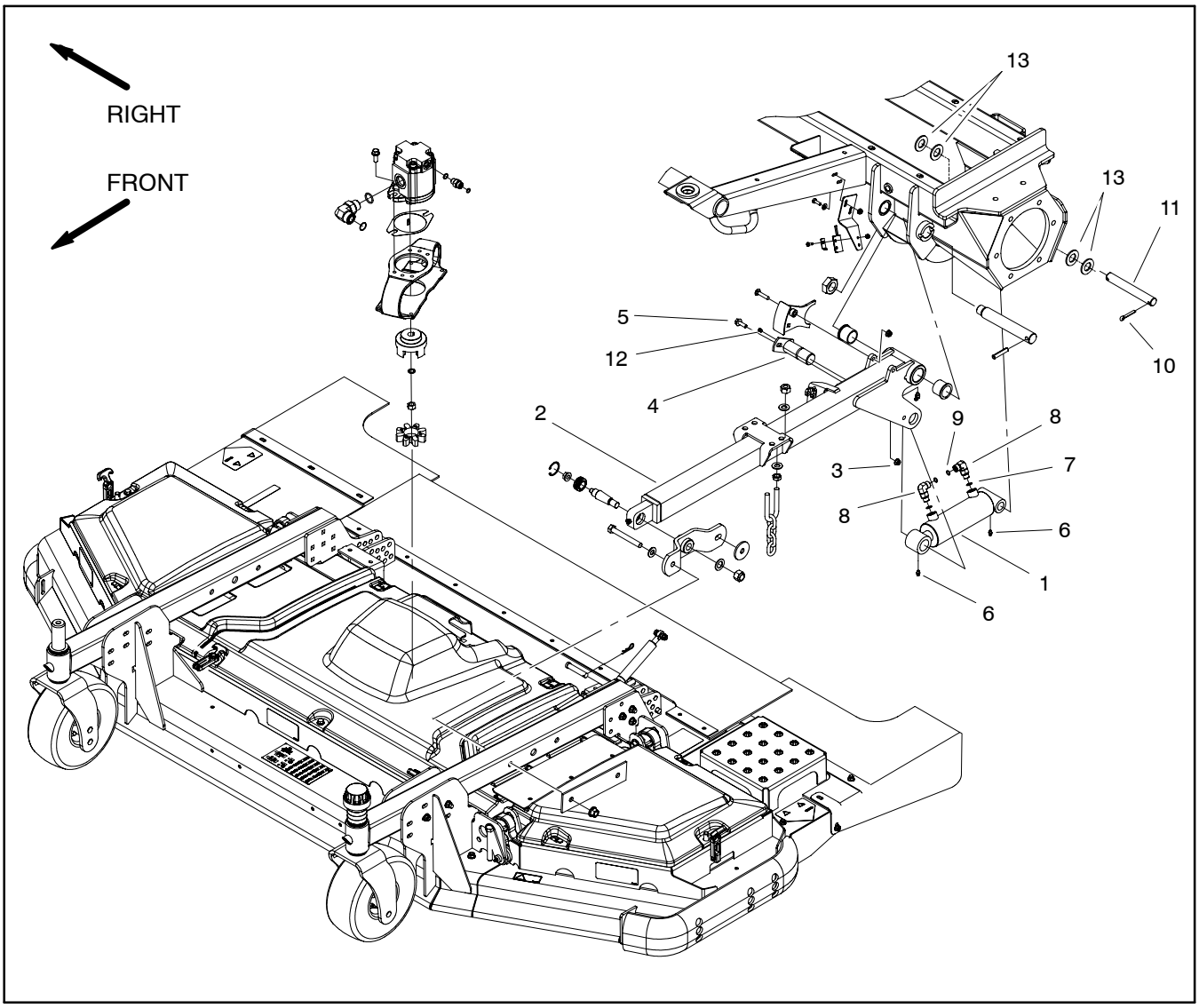


Figure 86

1. **Lift cylinder**
2. **Lift arm (LH shown)**
3. **Flange nut**
4. **Pin**
5. **Flange head screw**
6. **Grease fitting**
7. **O-ring**
8. **90º hydraulic fitting**
9. **O-ring**
10. **Cotter pin (2 used per pin)**
11. **Clevis pin**
12. **Plug**
13. **Flat washer (4 used per pin)**

Removal (Fig. 86)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT: Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove flange head screw (item 5) and flange nut (item 3) that secure the pin (item 4) to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.

6. Remove cotter pin (item 10) and two (2) flat washers (item 13) from one end of the clevis pin (item 11). Pull clevis pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Installation (Fig. 86)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Make sure that cotter pin (item 10) and two (2) flat washers (item 13) are installed on one end of clevis pin (item 11).

3. Position cylinder barrel clevis to frame and insert clevis pin (item 11) into frame and cylinder clevis. Secure lift pin with two (2) flat washers (item 13) and cotter pin (item 10).

4. Insert pin (item 4) through lift arm and cylinder shaft clevis. Secure pin to lift arm with flange head screw (item 5) and flange nut (item 3).

5. Remove caps or plugs placed during removal to prevent contamination.

6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill reservoir with new hydraulic fluid as required.

8. Lubricate lift cylinder grease fittings.

9. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by any machine components.

Front Deck Lift Cylinder Service

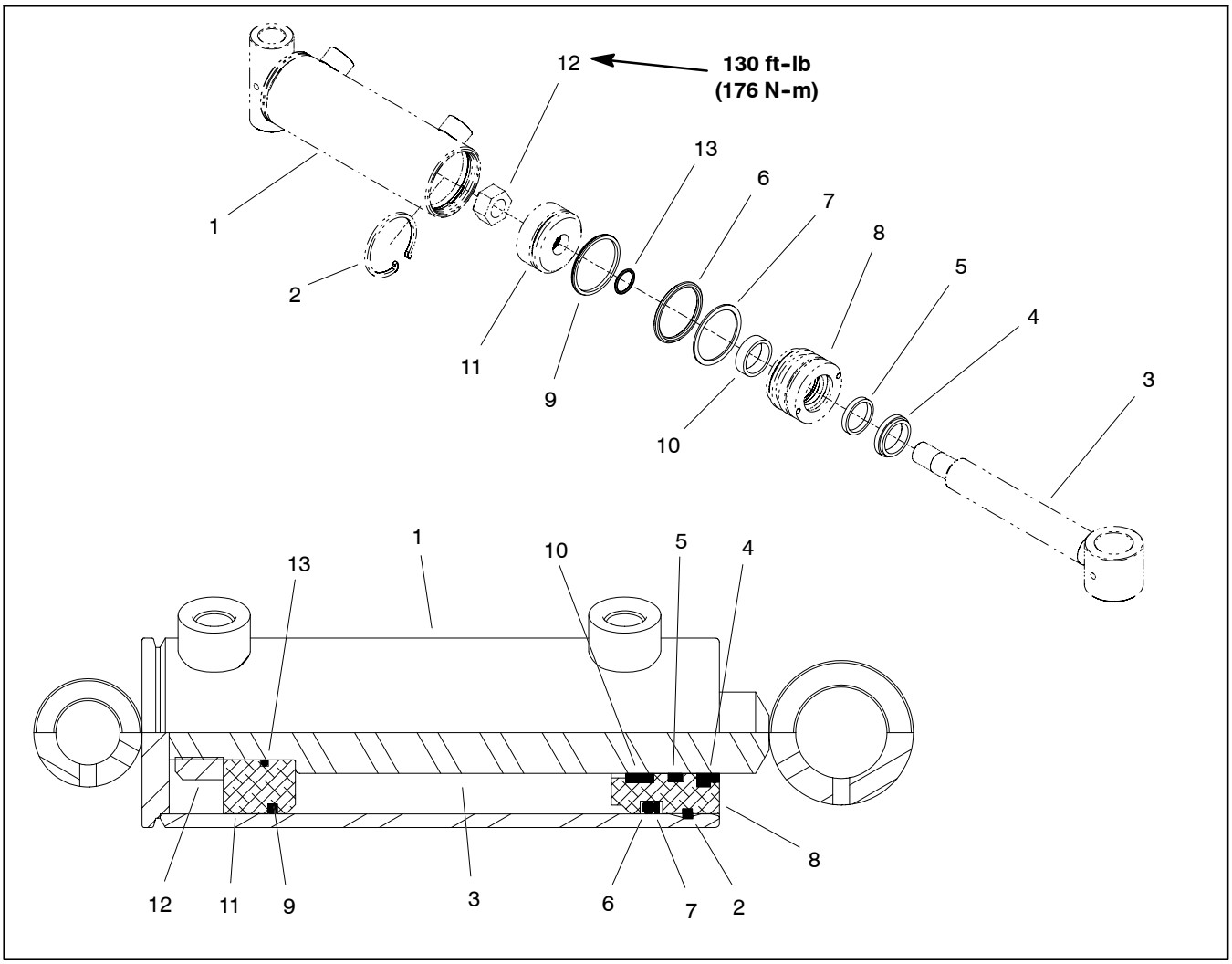


Figure 87

1. **Barrel with clevis**
2. **Retaining ring**
3. **Shaft with clevis**
4. **Dust seal**
5. **Shaft seal**
6. **O-ring**
7. **Back-up ring**
8. **Head**
9. **Piston seal**
10. **Wear ring**
11. **Piston**
12. **Lock nut**
13. **O-ring**

Disassembly (Fig. 87)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

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

3. Remove retaining ring that secures head in barrel.

   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening.

   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening.

   C. Rotate the head counter-clockwise to remove retaining ring from barrel and head.

4. Extract shaft with head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head from the shaft.

6. Remove piston seal and O-ring from the piston. Remove O-ring, back-up ring, wear ring, dust seal and shaft seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in the hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 87)

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, piston seal, wear ring, shaft seal, back-up ring and dust seal with clean hydraulic oil.

   A. Install piston seal and O-ring to the piston.

   B. Install back-up ring, O-ring, wear ring, shaft seal and dust seal to the head.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.

   A. Coat shaft with clean hydraulic oil.

   B. Slide head and piston onto the shaft.

   C. Secure piston to shaft with lock nut. Torque lock nut to **130 ft-lb (176 N-m)**.

4. Lubricate head and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise on barrel.

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

6. Secure head in barrel with retaining ring.

   A. Align retaining ring hole in the head with the access slot in the barrel.

   B. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Wing Deck Lift Cylinder

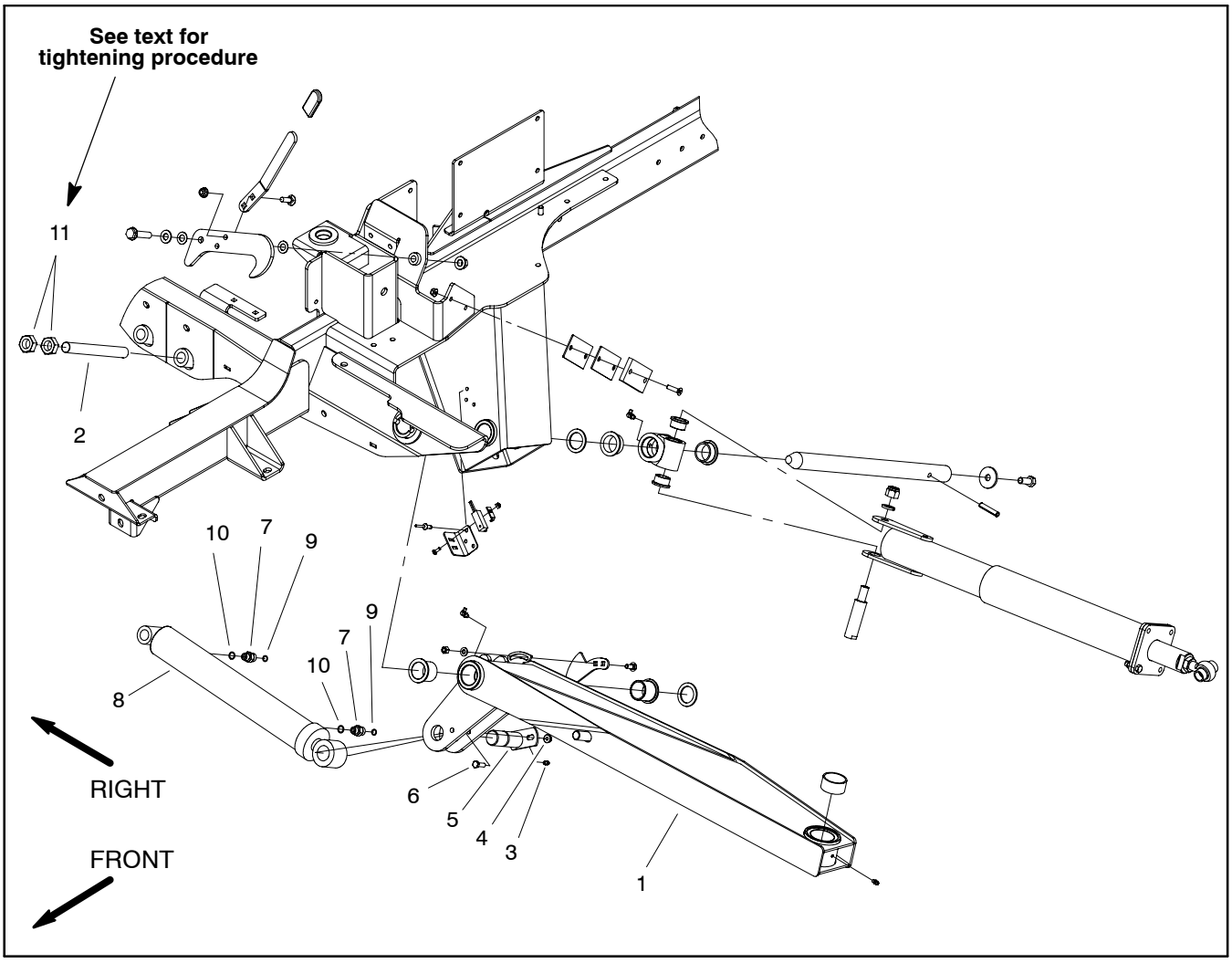


Figure 88

1. Wing deck lift arm (LH shown)
2. Pin
3. Grease fitting
4. Flange nut
5. Pin
6. Cap screw
7. Hydraulic fitting (2 used per cylinder)
8. Wing deck lift cylinder (LH shown)
9. O-ring
10. O-ring
11. Jam nut (4 used per pin)

Removal (Fig. 88)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

IMPORTANT: Make sure to relieve lift system pressure before removing lift cylinder. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove cap screw (item 6) and flange nut (item 4) that secure the pin (item 5) to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.

6. Remove two (2) jam nuts (item 11) from one end of the pin (item 2). Pull pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

8. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

Installation (Fig. 88)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Make sure that two (2) jam nuts (item 11) are installed on one end of pin (item 2). Hold inner jam nut with wrench and torque outer jam nut from **60 to 70 ft−lb (82 to 94 N−m)**.

3. Position cylinder barrel clevis to frame.

4. Insert pin (item 2) through frame and cylinder clevis. Secure lift pin with two (2) jam nuts (item 11). Hand tighten first jam nut to take up as much free play as possible. While holding first jam nut with wrench, torque second jam nut from **60 to 70 ft−lb (82 to 94 N−m)**.

5. Insert pin (item 5) through lift arm and cylinder shaft clevis. Secure pin to lift arm with cap screw (item 6) and flange nut (item 4).

6. Remove caps or plugs placed during removal to prevent contamination.

7. Using tags placed during cylinder removal, correctly attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

8. Fill reservoir with new hydraulic fluid as required.

9. Lubricate lift cylinder grease fittings.

10. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Wing Deck Lift Cylinder Service

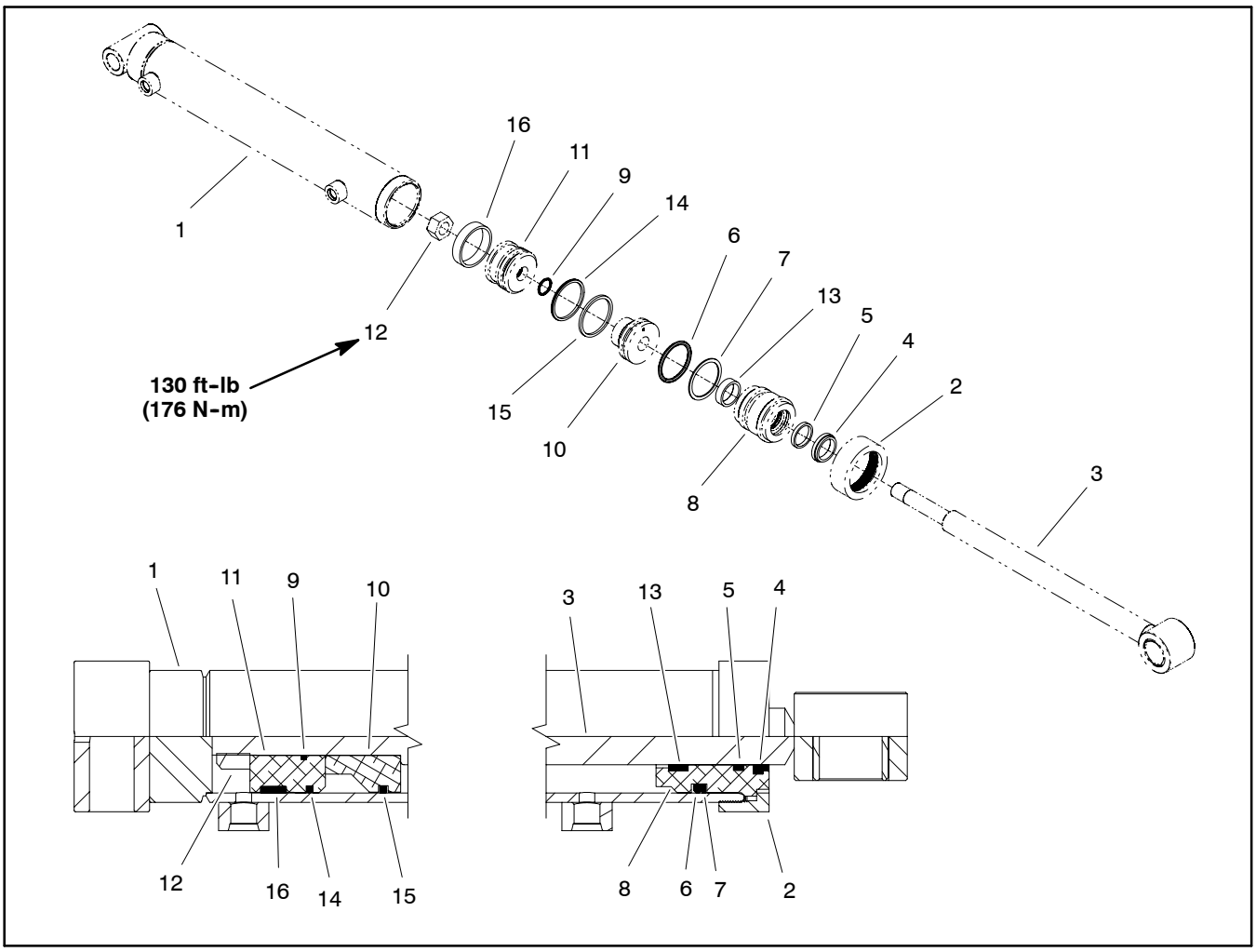


Figure 89

1. Barrel with clevis
2. External collar
3. Shaft with clevis
4. Dust seal
5. Shaft seal
6. O-ring
7. Back-up ring
8. Head
9. O-ring
10. Cushion
11. Piston
12. Lock nut
13. Wear ring
14. Piston seal
15. Steel ring
16. Wear ring

Disassembly (Fig. 89)

1. Remove oil from lift cylinder by slowly pumping the cylinder shaft. After removing oil from cylinder, plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

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

3. Use a spanner wrench to loosen and remove collar from barrel.

4. Extract shaft with head, cushion and piston by carefully twisting and pulling on the shaft.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut from the shaft. Slide shaft, cushion and head off the shaft.

6. Remove piston seal, wear ring and O-ring from the piston. Remove O-ring, back-up ring, dust seal, wear ring and shaft seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect shaft and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 89)

1. Make sure all parts are clean before assembly.

2. Coat new O-rings, piston seal, rod seal, back-up ring, wear rings and dust seal with clean hydraulic oil.

   A. Install piston seal, wear ring and O-ring to the piston.

   B. Install back-up ring, O-ring, shaft seal, wear ring and dust seal to the head.

IMPORTANT: When securing shaft in vise, clamp on shaft clevis only. Do not clamp vise jaws against the shaft surface.

3. Mount shaft securely in a vise equipped with soft jaws by clamping on the shaft clevis.

   A. Coat shaft with clean hydraulic oil.

   B. Slide external collar, head, cushion and piston onto the shaft.

   C. Secure piston to shaft with lock nut. Torque lock nut to **130 ft-lb (176 N-m)**.

4. Lubricate head, cushion and piston with clean hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the barrel clevis only. Do not close vise on barrel.

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

6. Use a spanner wrench to tighten collar onto barrel.

Lift Control Manifold

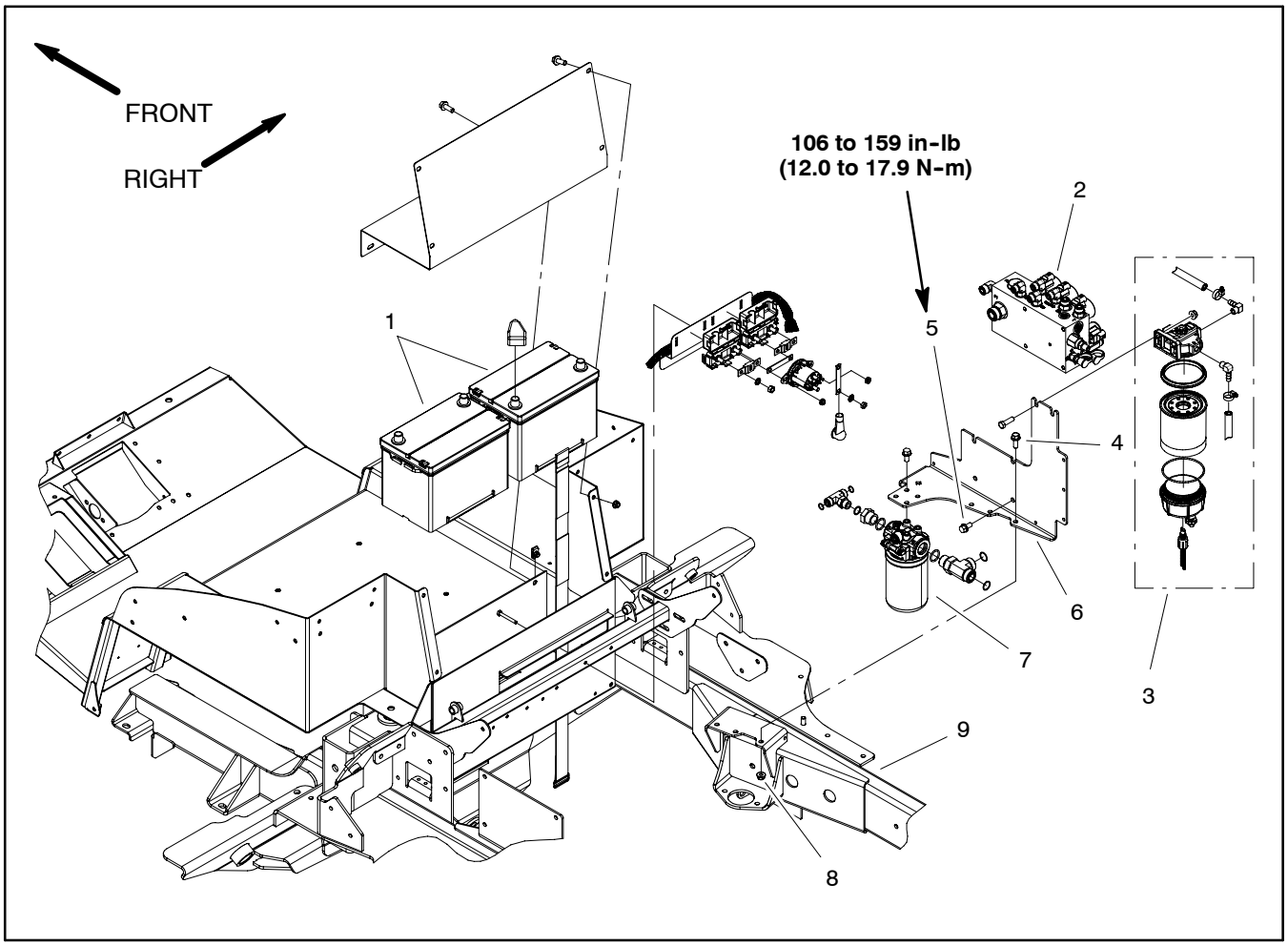


Figure 90

1. **Battery**
2. **Lift control manifold**
3. **Water separator assembly**
4. **Flange head screw (3 used)**
5. **Flange head screw (4 used)**
6. **Mounting plate**
7. **Hydraulic filter**
8. **Flange nut (3 used)**
9. **Frame**

NOTE: The ports on the lift control manifold are marked for easy identification of components. Example: P1 is the supply port from the gear pump and FD is the flow divider cartridge location (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 90)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood and remove RH side panel to gain access to lift control manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. For assembly purposes, label wire harness leads for manifold solenoids. Disconnect wire harness connectors from solenoids on manifold.

5. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

6. Remove hydraulic manifold from the frame using Figure 90 as guide.

IMPORTANT: An orifice is placed beneath the 90º hydraulic fittings in the control manifold C1-OR1 and C5-OR2 ports. If either of these fittings is removed from manifold, make sure to remove orifice and label its position for assembly purposes.

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O-rings.

Installation (Fig. 90)

1. If fittings were removed from manifold:

   A. Lubricate new O-rings with clean hydraulic oil. Install lubricated O-rings on fittings.

   IMPORTANT: When installing the orifice in manifold port C1-OR1 or C5-OR2, make sure that orifice is flat in the base of the port cavity. Manifold damage is possible if the orifice is cocked in the cavity.

   B. If fitting was removed from manifold port C1-OR1 or C5-OR2, place orifice in port before installing fitting.

   C. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   D. Refer to Figure 91 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Install lift control manifold to the frame using Figure 90 as guide. Torque the four (4) flange head screws that secure manifold to frame from **106 to 159 in-lb (12.0 to 17.9 N-m)**.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Using labels placed during removal, correctly connect wire harness connectors to solenoids on lift control manifold.

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

6. Secure RH side panel to machine. Lower and secure hood.

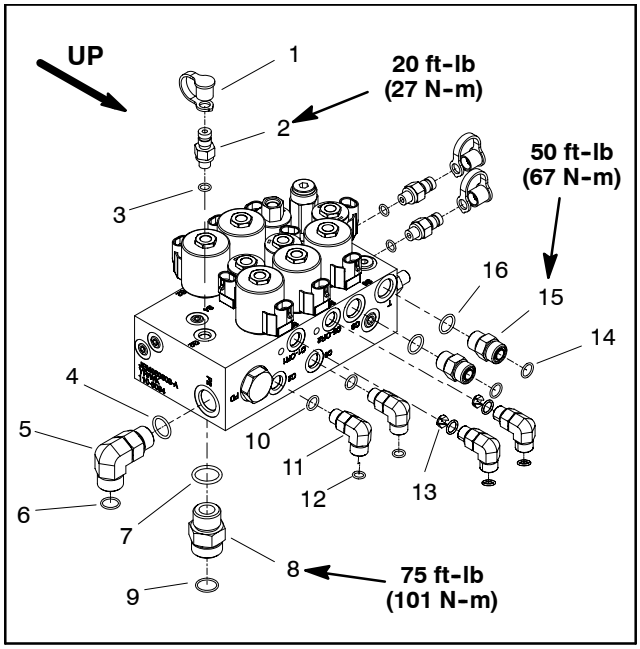


Figure 91

1. Dust cap
2. Quick fitting (3 used)
3. O-ring
4. O-ring
5. 90° fitting
6. O-ring
7. O-ring
8. Straight fitting
9. O-ring
10. O-ring
11. 90° fitting (4 used)
12. O-ring
13. Orifice disc (2 used)
14. O-ring
15. Straight fitting (2 used)
16. O-ring

Lift Control Manifold Service

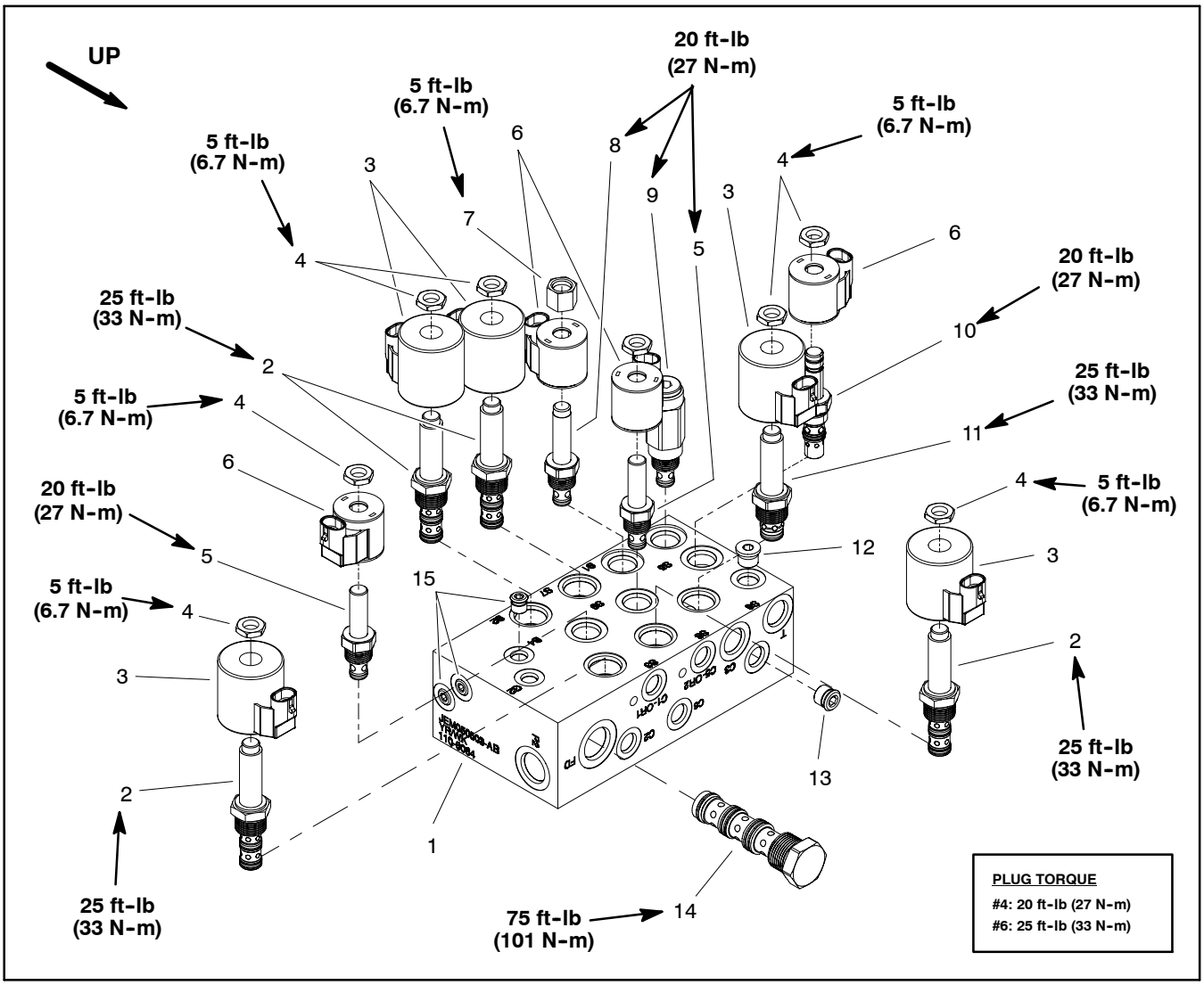


Figure 92

1. Lift manifold
2. Solenoid valve (S2, S3, S7 and S8)
3. Solenoid coil (5 used)
4. Solenoid nut
5. Solenoid valve (S4 and S9)
6. Solenoid coil (4 used)
7. Solenoid nut
8. Solenoid valve (S1)
9. Relief valve (RV)
10. Solenoid valve (S5)
11. Solenoid valve (S6)
12. SAE #6 plug with O-ring
13. NWD #6 plug with O-ring
14. Flow divider (FD)
15. SAE #4 plug with O-ring (7 used)

NOTE: The ports on the lift control manifold are marked for easy identification and assembly of components. Example: P1 is the supply port from the gear pump and FD is the flow divider cartridge location (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The lift control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to manifold illustration for plug installation torque.

Valve Cartridge Service (Figs. 92 and 93)

For cartridge valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figures 92 and 93 for lift control manifold cartridge valve and plug installation torque.

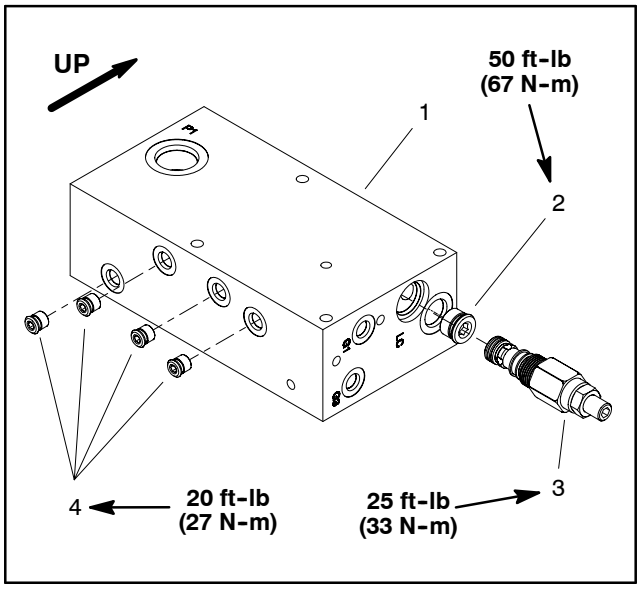


Figure 93

1. **Lift manifold**
2. **NWD #8 plug/O-ring**
3. **Logic valve (LC)**
4. **SAE #4 plug/O-ring**

Steering and Engine Cooling Fan Circuit

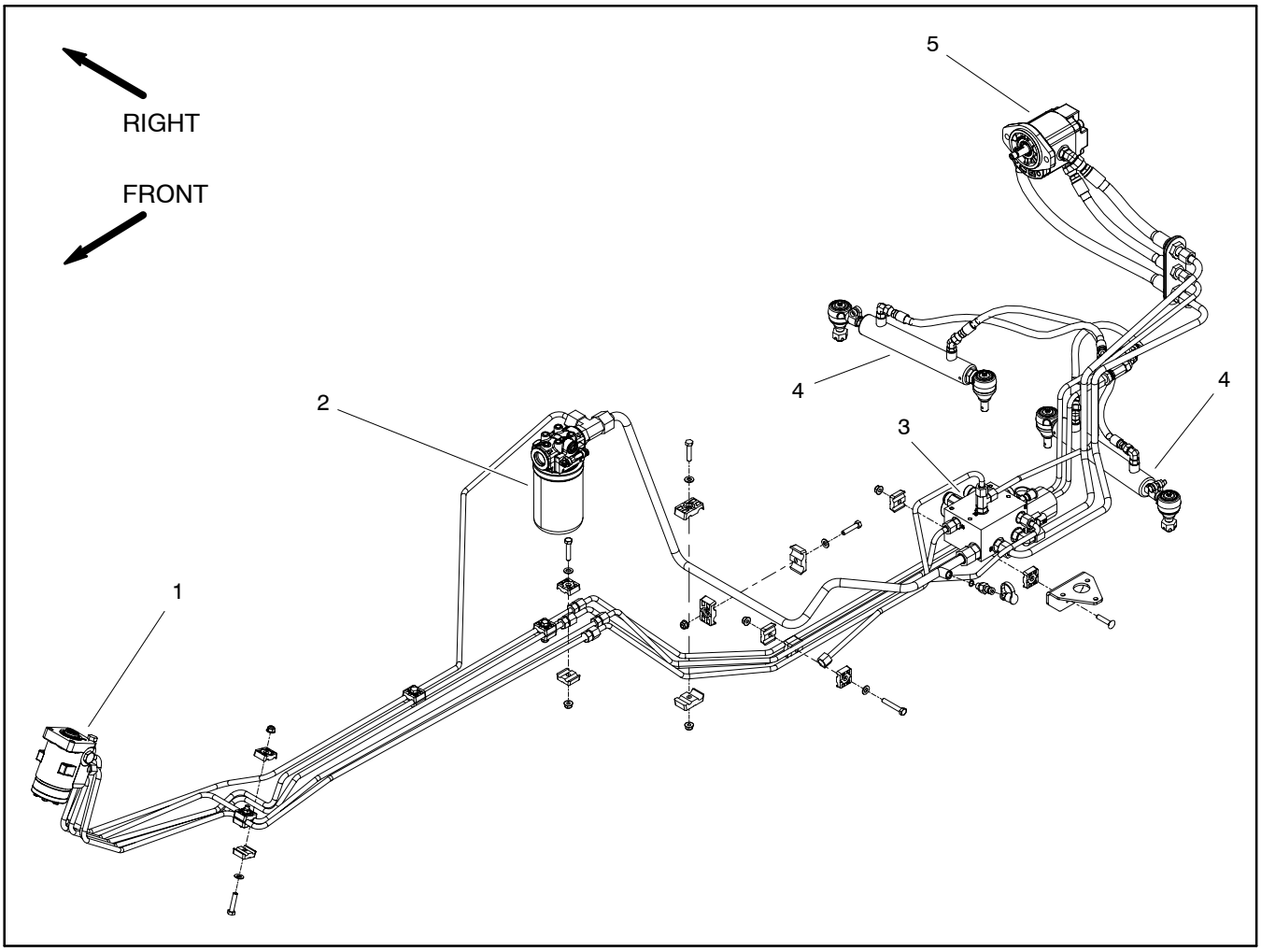


Figure 94

1. **Steering control valve**
2. **Oil filter**
3. **Steering/cooling fan control manifold**
4. **Steering cylinder (2 used)**
5. **Engine cooling fan motor**

Figure 94 illustrates the components that are used in the Groundsmaster steering and engine cooling fan circuit. Procedures for removal, installation and disassembly/ assembly of these components are provided in the following pages of this section.

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Steering Control Valve

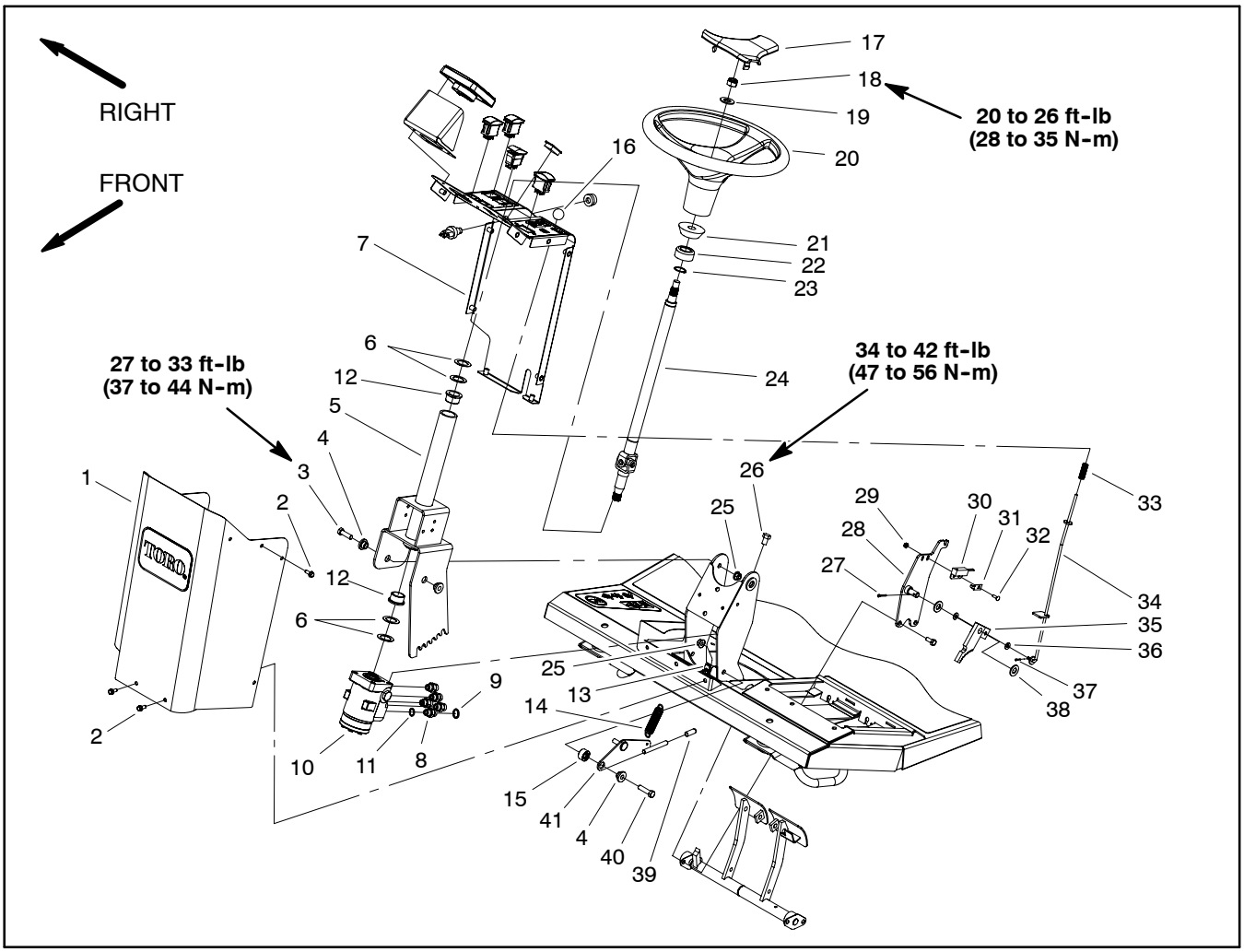


Figure 95

1. Steering tower cover
2. Flange head screw
3. Cap screw (2 used)
4. Pivot hub (3 used)
5. Steering column assembly
6. Thrust washer (4 used)
7. Steering tower
8. Hydraulic fitting (5 used)
9. O-ring
10. Steering control valve
11. O-ring
12. Flange bushing (2 used)
13. Clip (2 used)
14. Spring
15. Spacer
16. Knob
17. Steering wheel cover
18. Hex nut
19. Flat washer
20. Steering wheel
21. Foam collar
22. Steering seal
23. External snap ring (2 used)
24. Steering shaft assembly
25. Flange nut (3 used)
26. Cap screw (4 used)
27. Cotter pin
28. Parking brake pivot
29. Lock nut
30. Proximity switch
31. Switch plate
32. Carriage bolt
33. Compression spring
34. Parking brake rod
35. Parking brake rack
36. Flat washer (2 used)
37. Cotter pin
38. Flat washer (2 used)
39. Cap
40. Cap screw
41. Tilt lever

Removal (Fig. 95)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. Remove steering tower cover (item 1).

4. To prevent contamination of hydraulic system during steering valve removal, thoroughly clean exterior of steering valve, hydraulic tubes and fittings.

5. Disconnect hydraulic tubes from steering control valve. Put caps or plugs on fittings and tubes to prevent contamination. Tag hydraulic lines for proper assembly.

6. Support steering control valve to prevent it from falling.

7. Remove four (4) cap screws that secure steering control valve to machine. Slide steering control valve from lower end of steering shaft and remove from machine.

8. If necessary, remove fittings from control valve and discard fitting O−rings.

Installation (Fig. 95)

1. If fittings were removed from steering control valve, lubricate and place new O−rings onto fittings. Install fittings into control valve and tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Slide steering control valve onto lower end of steering shaft. Secure control valve to machine with four (4) cap screws. Torque screws from **34 to 42 ft−lb (47 to 56 N−m)**.

3. Remove caps or plugs placed during removal to prevent contamination.

4. Connect hydraulic tubes to fittings on steering valve using tags placed during control valve removal to identify correct tube placement (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Install steering tower cover (item 1).

6. Fill reservoir with new hydraulic fluid as required.

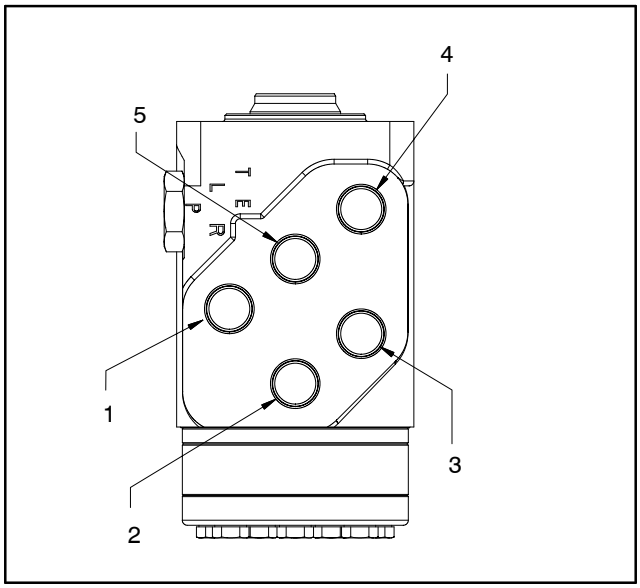


Figure 96

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

Steering Control Valve Service

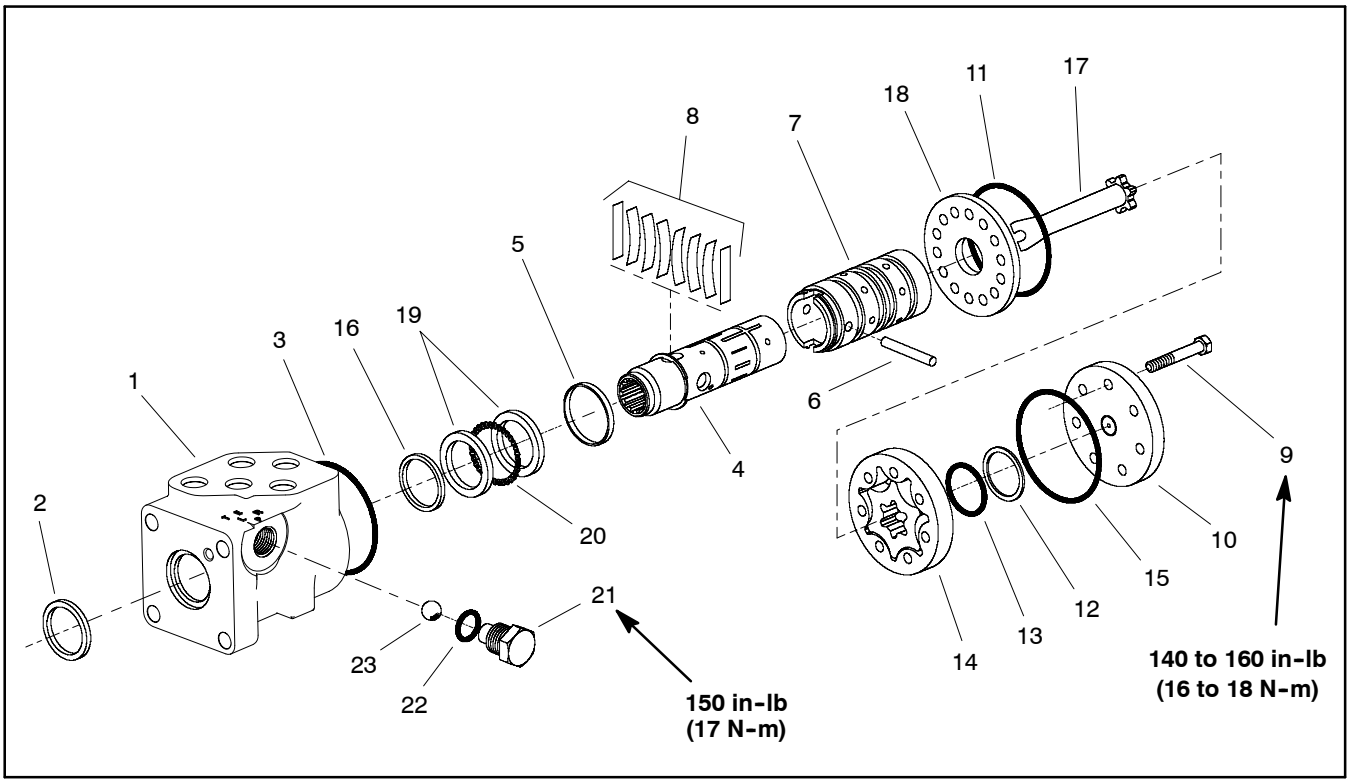


Figure 97

1. **Steering valve housing**
2. **Dust seal**
3. **O-ring**
4. **Spool**
5. **Spring retaining ring**
6. **Pin**
7. **Sleeve**
8. **Centering springs/spacers**
9. **Cap screw (7 used)**
10. **End cap**
11. **O-ring**
12. **Seal ring**
13. **O-ring**
14. **Geroter**
15. **O-ring**
16. **Quad seal**
17. **Geroter drive**
18. **Wear plate**
19. **Bearing race**
20. **Thrust bearing**
21. **Plug**
22. **O-ring**
23. **Check ball**

NOTE: For steering control valve repair procedures, see the Eaton Parts and Repair Information: 5 Series Steering Control Units at the end of this chapter.

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Steering Cylinders

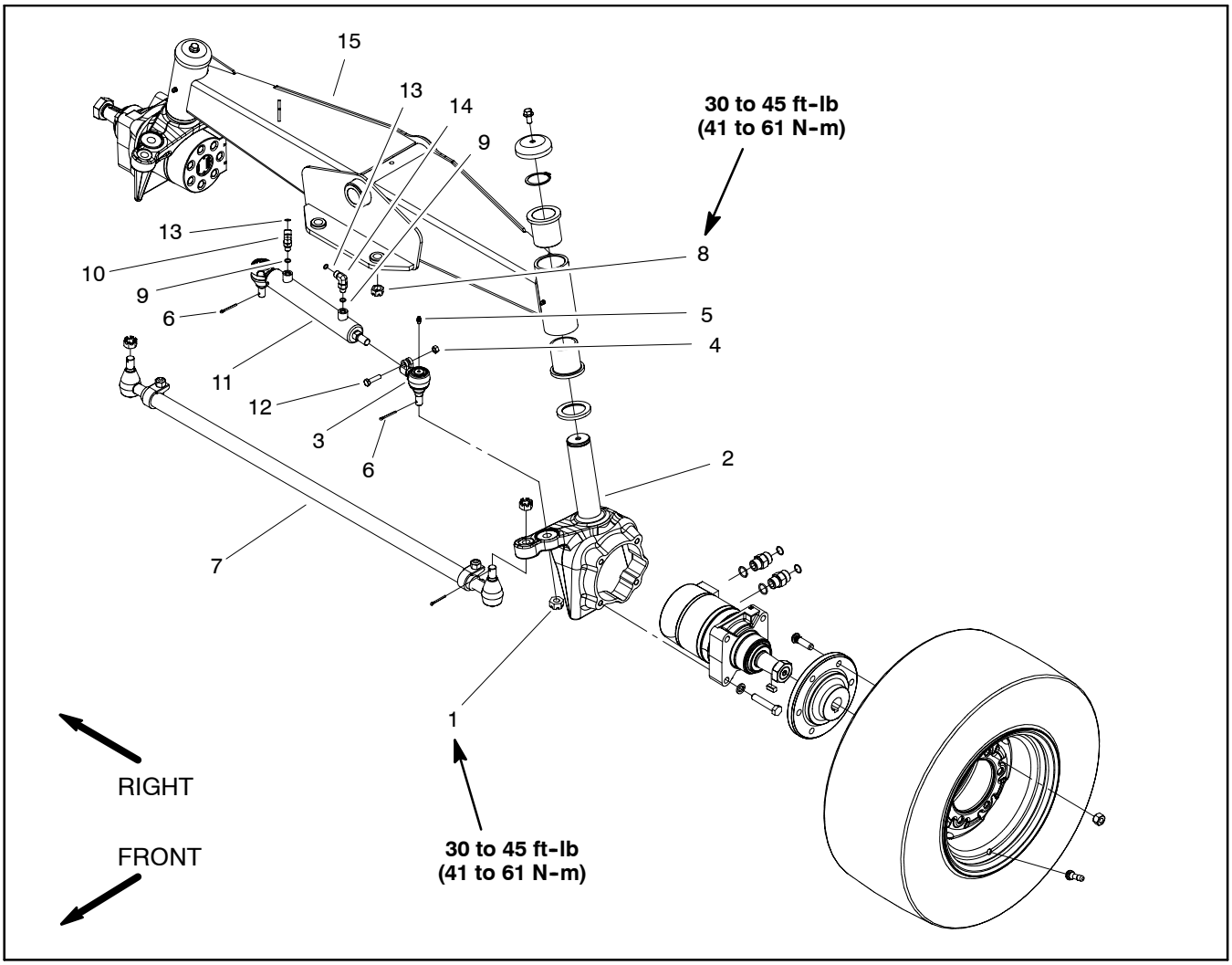


Figure 98

1. **Slotted hex nut**
2. **LH steering spindle**
3. **Ball joint**
4. **Hex nut**
5. **Grease fitting**
6. **Cotter pin**
7. **Tie rod assembly**
8. **Slotted hex nut**
9. **O-ring**
10. **45º hydraulic fitting**
11. **Steering cylinder**
12. **Cap screw**
13. **O-ring**
14. **90º hydraulic fitting**
15. **Rear axle**

Removal (Fig. 98)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during steering cylinder removal, thoroughly clean exterior of cylinder, fittings and hoses.

NOTE: To ease assembly, label all hydraulic hoses to identify their correct position on the steering cylinder.

4. Disconnect hydraulic hoses from steering cylinder fittings. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

5. Remove cotter pins and slotted hex nuts (items 1 and 8) that secure the cylinder ball joints to rear axle and steering spindle.

6. Separate ball joints from rear axle and steering spindle. Remove steering cylinder from machine.

7. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove fittings from steering cylinder and discard O-rings from fittings.

Installation (Fig. 98)

1. If fittings were removed from steering cylinder, lubricate and place new O-rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Thoroughly clean tapers on steering cylinder ball joints. Also, clean ball joint bores of rear axle assembly and steering spindle.

3. Position steering cylinder to machine.

4. Secure steering cylinder to rear axle and steering spindle with slotted hex nuts (items 1 and 8). Torque slotted hex nuts from **30 to 45 ft-lbs (41 to 61 N-m)** while aligning ball joint hole with slot in nut. Insert cotter pins.

5. Remove caps or plugs placed during removal to prevent contamination.

6. Using tags placed during cylinder removal, correctly attach hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Fill reservoir with new hydraulic fluid as required.

8. Lubricate cylinder ball joint grease fittings.

9. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings do not contact any machine components.

Steering Cylinder Service

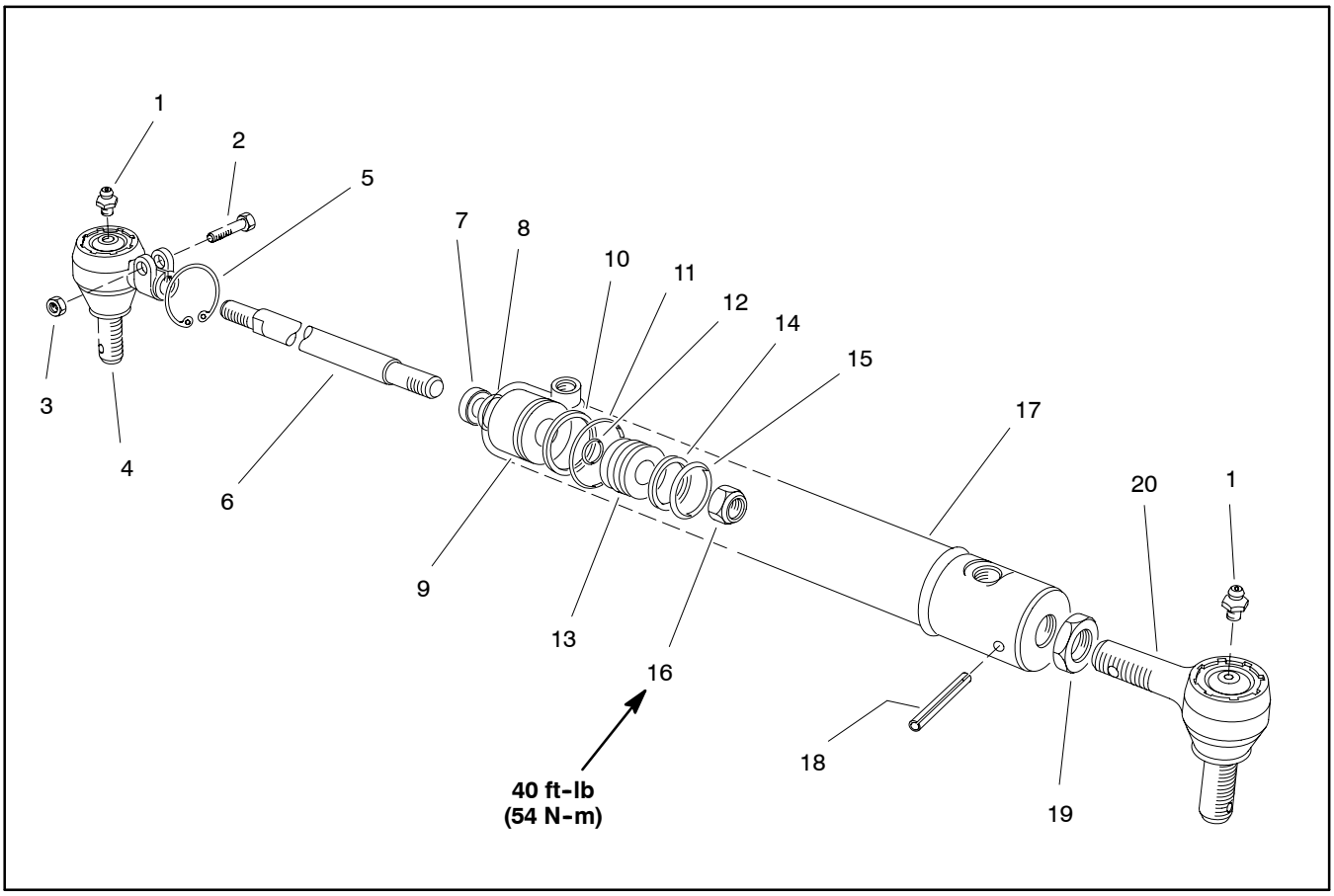


Figure 99

1. **Grease fitting**
2. **Cap screw**
3. **Lock nut**
4. **Ball joint**
5. **Snap ring**
6. **Piston rod**
7. **Rod wiper**
8. **Rod seal**
9. **Head**
10. **Back-up ring**
11. **O-ring**
12. **O-ring**
13. **Piston**
14. **Slipper seal**
15. **O-ring**
16. **Lock nut**
17. **Barrel**
18. **Roll pin**
19. **Jam nut**
20. **Ball joint**

Disassembly (Fig. 99)

1. Remove oil from steering cylinder by slowly pumping the piston rod. After removing oil from cylinder, plug both ports and thoroughly clean the outside of the cylinder.

2. Remove snap ring (item 5) that secures head in barrel.

3. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod and head from cylinder barrel.

4. Using a wrench on the piston rod flats to prevent the rod from turning, remove lock nut (item 16) from rod. Remove piston and head from rod.

5. Remove all seals and O-rings from head and piston.

6. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

7. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

8. If piston rod ball joint (item 4) removal is necessary, loosen cap screw (item 2) and lock nut (item 3) and then unscrew ball joint from piston rod.

9. If necessary, remove barrel end ball joint (item 20) from barrel as follows:

   A. Loosen jam nut (item 19).

   B. Drive roll pin (item 18) from barrel.

   C. Unscrew ball joint from barrel.

Assembly (Fig. 99)

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of clean hydraulic oil on all new seals and O-rings.

2. Install new O-rings and slipper seal to the piston and new O-ring, back-up ring, rod seal and rod wiper to head.

3. Lubricate shaft with clean hydraulic oil. Slide head and piston onto piston rod.

4. Using a wrench on the piston rod flats to prevent the rod from turning, install and tighten lock nut (item 16). Torque lock nut to **40 ft-lb (54 N-m)**.

5. Put a coating of clean hydraulic oil on all cylinder parts to ease assembly.

6. Carefully slide piston rod assembly into cylinder barrel taking care to not damage seals or O-rings.

7. Secure head in barrel with snap ring. Make sure that snap ring is fully seated in groove in barrel.

8. If barrel end ball joint (item 20) was removed, install ball joint to barrel as follows:

   A. Thread ball joint into barrel so that roll pin hole in joint aligns with hole in barrel.

   B. Drive roll pin into aligned holes in barrel and ball joint.

   C. Tighten jam nut.

9. If piston rod end ball joint (item 4) was removed, fully retract piston rod and thread ball joint onto rod so that center to center length is from 14.270" to 14.330" (362.5 to 363.9 mm) (Fig. 100). Tighten cap screw (item 2) and lock nut (item 3).

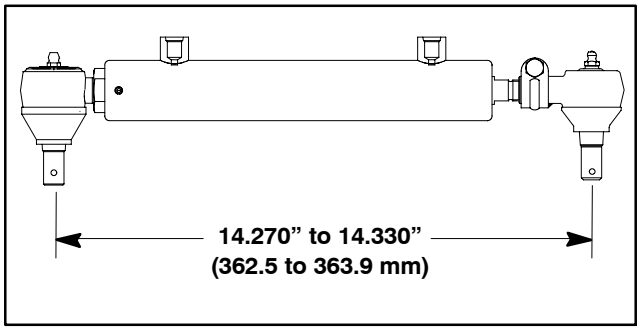


Figure 100

Engine Cooling Fan Motor

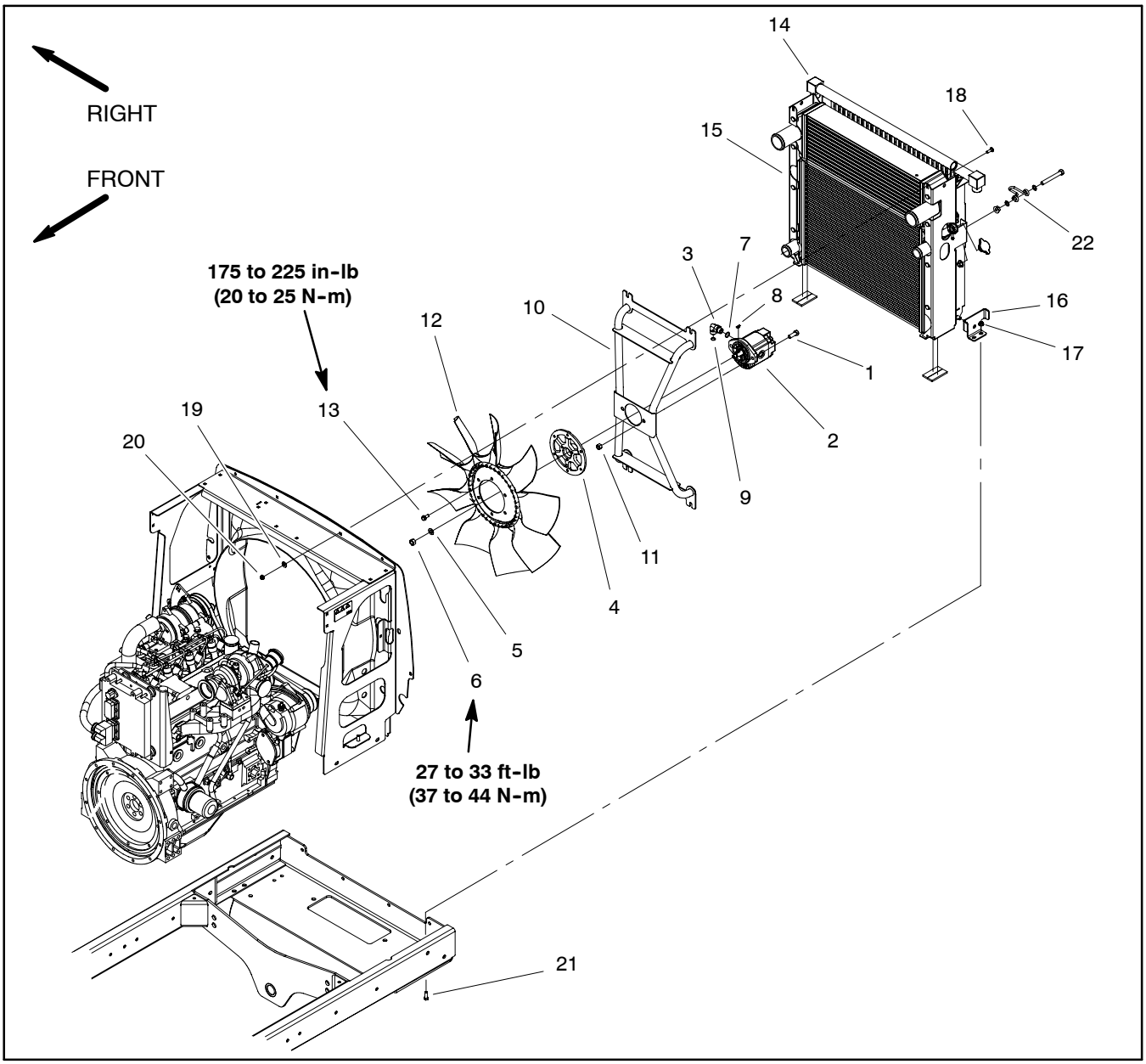


Figure 101

1. Socket head screw (2 used)
2. Cooling fan motor
3. 90º hydraulic fitting
4. Fan hub
5. Flat washer
6. Hex nut
7. O-ring
8. Woodruff key
9. O-ring
10. Fan motor bracket
11. Lock nut (2 used)
12. Cooling fan
13. Flange head screw (6 used)
14. Oil cooler
15. Radiator assembly
16. Oil cooler support plate (2 used)
17. Flange nut (4 used)
18. Carriage screw (2 used)
19. Flat washer (2 used)
20. Flange nut (2 used)
21. Cap screw (4 used)
22. Clamp (2 used)

Removal (Fig. 101)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. Unlatch and raise hood.

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

IMPORTANT: Make sure to not damage the radiator, oil cooler or other machine components while loosening and removing the fan motor.

4. Remove air intake box from top of radiator assembly (see Air Cleaner Removal in the Service and Repairs section of Chapter 3 – Engine).

5. Remove hex nut (item 6) and flat washer (item 5) that secure fan hub and fan assembly to fan motor.

6. Use suitable puller to remove fan hub (with fan attached) from fan motor shaft taking care to not damage fan. Position fan assembly away from fan motor.

7. Disconnect hydraulic hoses from cooling fan motor. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

8. Support fan motor to prevent it from falling. Remove two (2) socket head screws (item 1) and lock nuts (item 11) that secure fan motor to fan motor bracket.

9. Carefully lower fan motor and remove from machine.

10. If hydraulic fittings are to be removed from fan motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O–rings.

Installation (Fig. 101)

1. If fittings were removed from fan motor, lubricate and place new O–rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

IMPORTANT: Make sure to not damage the radiator, oil cooler or other machine components while installing the fan motor.

2. Carefully position fan motor to fan motor bracket. Loosely attach motor to bracket with socket head screws (item 1) and lock nuts (item 11).

3. Remove caps or plugs placed during removal to prevent contamination. Connect hydraulic hoses to cooling fan motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Tighten socket head screws (item 1) and lock nuts (item 11) to secure fan motor to bracket.

5. Thoroughly clean tapered surfaces of fan motor shaft and fan hub. Position fan hub (with fan attached) onto motor shaft and secure with flat washer (item 5) and hex nut (item 6). Torque nut from **27 to 33 ft-lb (37 to 44 N-m)**.

6. Install air intake box to top of radiator assembly (see Air Cleaner Installation in the Service and Repairs section of Chapter 3 – Engine).

7. Lower and secure hood.

8. Fill reservoir with new hydraulic fluid as required.

Engine Cooling Fan Motor Service

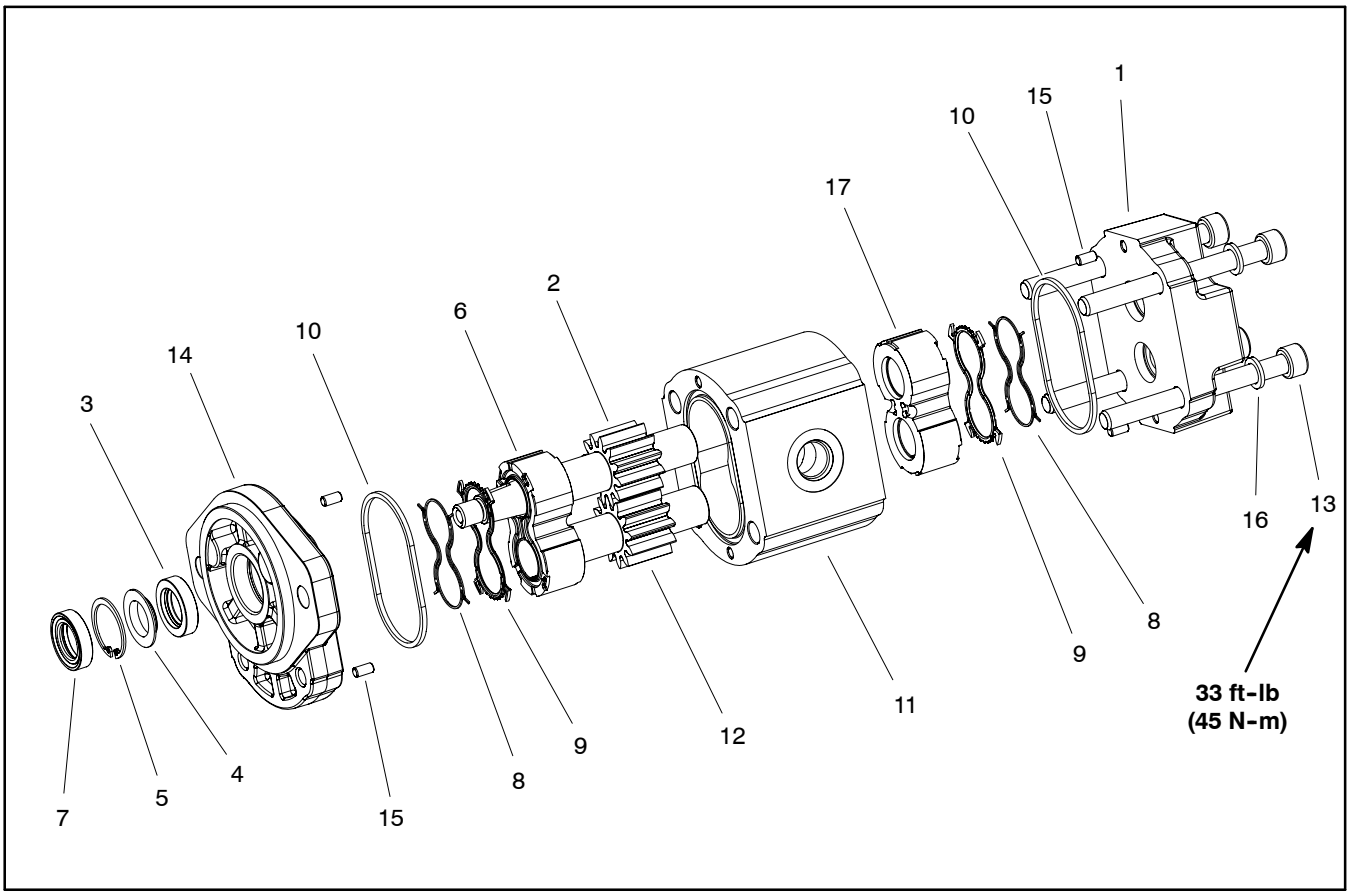


Figure 102

1. **Rear cover**
2. **Drive gear**
3. **Shaft seal**
4. **Flange washer**
5. **Retaining ring**
6. **Front wear plate**
7. **Dust seal**
8. **Pressure seal**
9. **Back-up gasket**
10. **O-ring**
11. **Body**
12. **Idler gear**
13. **Cap screw (4 used)**
14. **Front flange**
15. **Dowel pin (4 used)**
16. **Washer (4 used)**
17. **Rear wear plate**

For disassembly, inspection and assembly procedures of the cooling fan motor, see Cutting Deck Motor Service in this section.

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Steering/Engine Cooling Fan Control Manifold

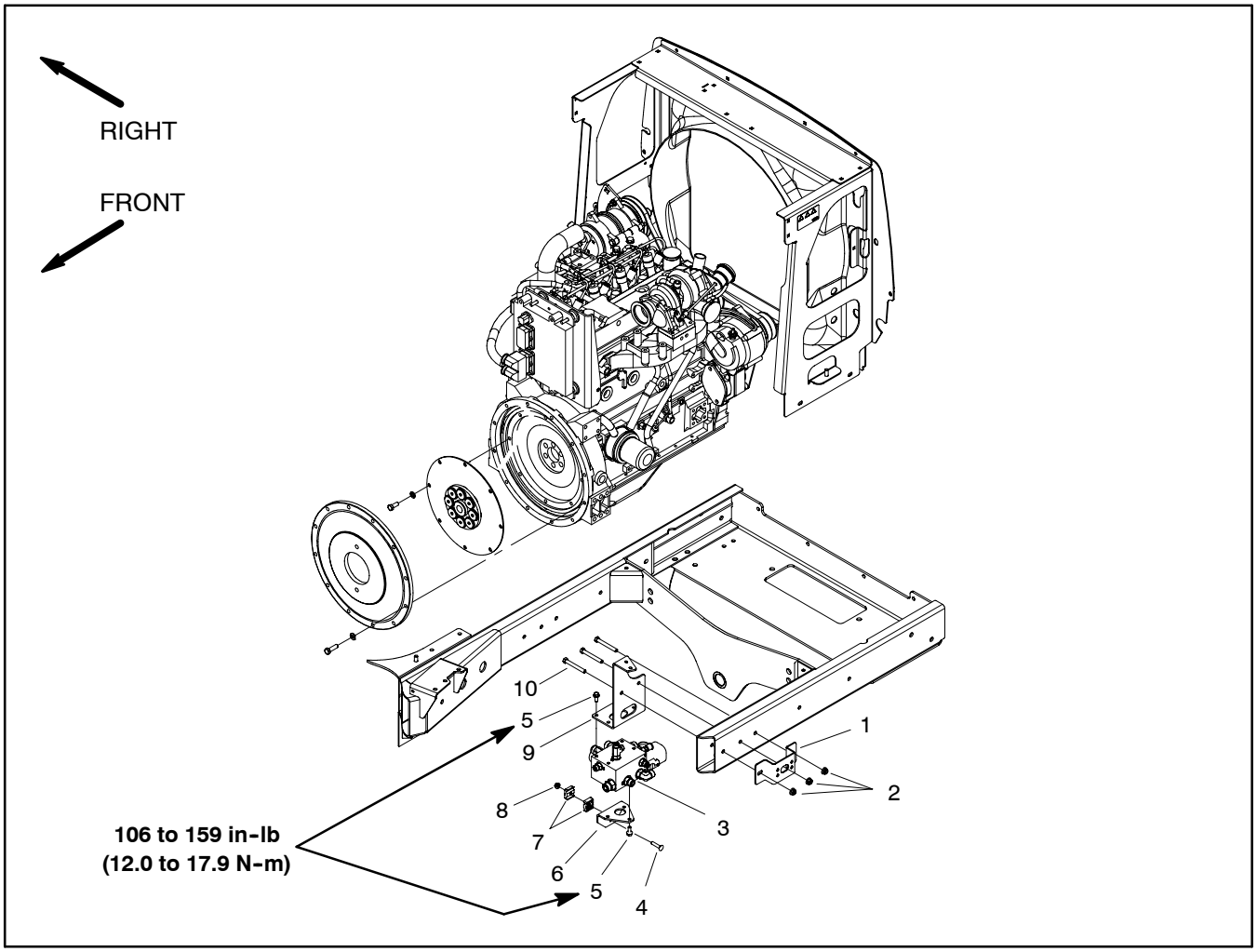


Figure 103

1. **Bulkhead mount plate**
2. **Flange nut (3 used)**
3. **Steering/cooling fan manifold**
4. **Carriage bolt**
5. **Flange head screw (7 used)**
6. **Tube mount plate**
7. **Tube clamp**
8. **Flange nut**
9. **Manifold mount plate**
10. **Cap screw (3 used)**

NOTE: The ports on the steering/cooling fan manifold are marked for easy identification of components. Example: P is the connection port for the supply from the lift control valve and RV is the relief cartridge valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 103)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

2. Raise hood to gain access to steering/cooling fan control manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

4. For assembly purposes, label wire harness leads for manifold solenoids. Disconnect wire harness connectors from solenoids on manifold.

5. Disconnect all hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

6. Remove steering/cooling fan manifold from the frame using Figure 103 as guide.

IMPORTANT: An orifice is placed beneath the hydraulic fitting in the control manifold LS port. If this fitting is removed from manifold, make sure to remove orifice and label its position for assembly purposes.

7. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O-rings.

Installation (Fig. 103)

1. If fittings were removed from manifold:

   A. Lubricate new O-rings with clean hydraulic oil. Install lubricated O-rings on fittings.

   IMPORTANT: When installing the orifice in manifold port LS, make sure that orifice is flat in the base of the port cavity. Manifold damage is possible if the orifice is cocked in the cavity.

   B. If fitting was removed from manifold port LS, install orifice in port.

   C. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings.

   D. Refer to Figure 104 for straight fitting installation torque. For information on tightening procedures for adjustable fittings, see Hydraulic Fitting Installation in the General Information section of this chapter.

2. Install steering/cooling fan manifold to the frame using Figure 103 as guide. Torque the flange head screws that secure manifold to mount plates from **106 to 159 in-lb (12.0 to 17.9 N-m)**.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Using labels placed during removal, correctly connect wire harness connectors to solenoids on manifold.

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

6. Lower and secure hood.

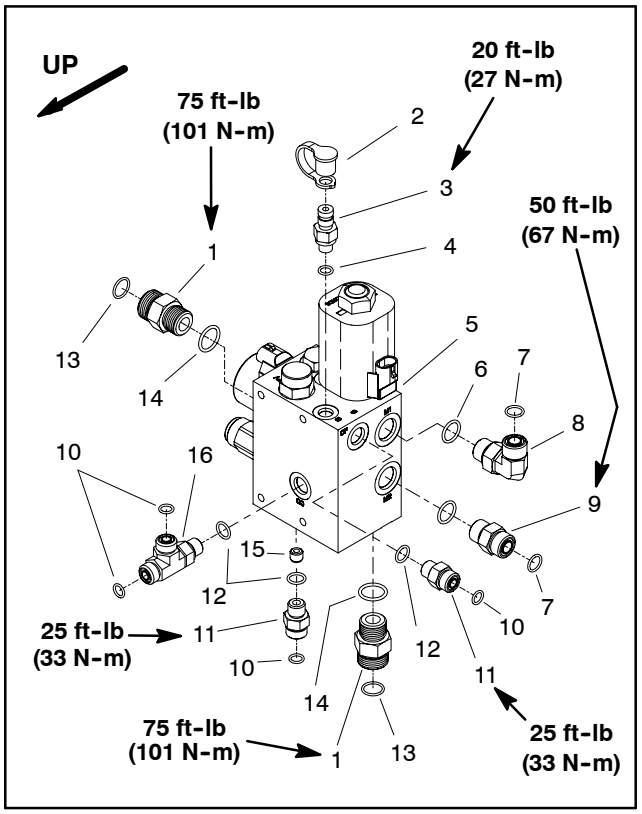


Figure 104

1. **Straight fitting (P & CH)**
2. **Dust cap**
3. **Quick fitting (G)**
4. **O-ring**
5. **Manifold assembly**
6. **O-ring**
7. **O-ring**
8. **90º fitting (M1)**
9. **Straight fitting (M2)**
10. **O-ring**
11. **Straight fitting (CF & LS)**
12. **O-ring**
13. **O-ring**
14. **O-ring**
15. **Orifice (LS)**
16. **Tee fitting (CD)**

Steering/Engine Cooling Fan Control Manifold Service

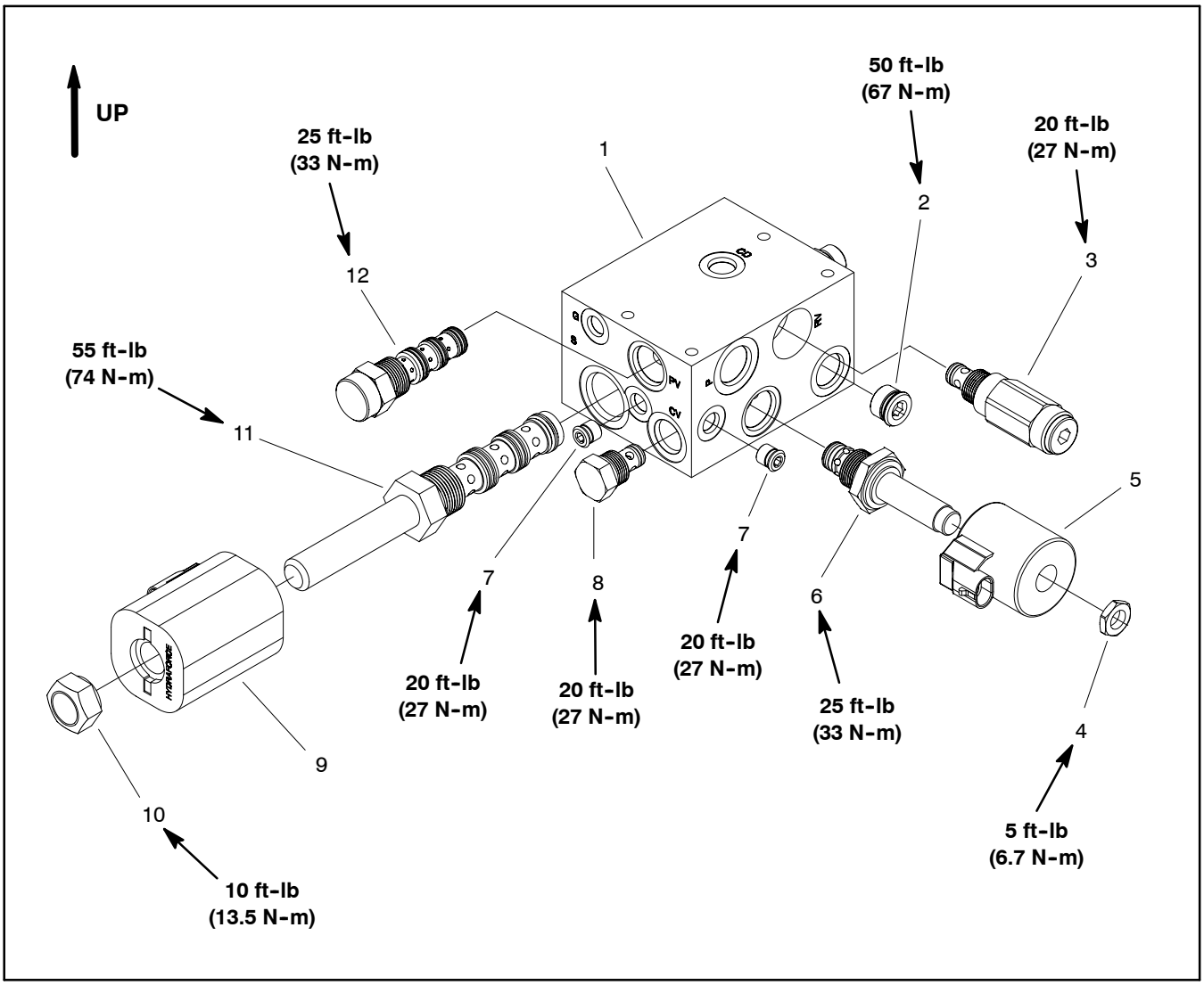


Figure 105

1. Steering/cooling fan manifold
2. NWD #8 plug with O-ring
3. Relief valve (RV)
4. Solenoid nut
5. Solenoid coil
6. Proportional relief valve (PRV)
7. NWD #4 plug with O-ring (2 used)
8. Check valve (CV)
9. Solenoid coil
10. Solenoid nut
11. Solenoid valve (S)
12. Compensator valve (PV)

NOTE: The ports on the steering/cooling fan manifold are marked for easy identification and assembly of components. Example: P is the connection port for the supply from the lift control valve and RV is the relief cartridge valve port (see Hydraulic Schematic in Chapter 10 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Valve Cartridge Service (Fig. 105)

For cartridge valve service procedures, see Hydraulic Traction Control Manifold Service in this section. Refer to Figure 105 for steering/cooling fan manifold cartridge valve and plug installation torque.

NOTE: The steering/cooling fan control manifold includes several zero leak NWD plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to Figure 105 for plug installation torque.

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Chapter 5

Electrical System

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General Information

Operator's Manual

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

Toro Electronic Controllers (TEC)

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC) to manage machine electrical functions. The controllers are microprocessor controlled that sense the condition of various switches (inputs) and direct electrical power to control appropriate machine functions (outputs) based on the inputs. Communication between the two Toro controllers, the Cummins engine controller and the Info Center Display is provided with a CAN bus system. The status of inputs to the controllers as well as outputs from the controllers can be monitored with the Info Center Display.

The controllers appear identical but they are different in terms of the connectors and internal hardware. They are arranged in "master / slave" configuration and therefore cannot be interchanged. The TEC−5002 master controller is responsible for powering up both the TEC−5001 slave controller and the Cummins engine controller. The TEC−5002 also controls the engine start circuit.

IMPORTANT: Before performing any welding on the machine, disconnect the battery cables from the batteries, disconnect the wire harness connectors from both Toro Electronic Controllers, disconnect the wire harness connectors from the engine controller and disconnect the terminal connector from the alternator to prevent damage to the machine electrical system.

Cummins Engine Electronic Control Module (ECM)

The Cummins engine that is used in the Groundsmaster 5900 and 5910 uses an electronic control module (ECM) for engine management and also to communicate with the TEC controllers and the Info Center Display on the machine. All engine ECM electrical connectors should be plugged into the controller before the machine ignition switch is moved from the OFF position to either the RUN or START position. If the engine ECM is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the engine ECM.

CAN-bus Communications

The two (2) TEC controllers (TEC−5001 and TEC−5002), the Cummins Engine Controller and the Info Center Display used on the Groundsmaster 5900 and 5910 communicate with each other on a CAN bus system. Using this system allows the traction unit to fully integrate all the different electrical components of the tractor and bring them together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of electrical functions also allows the Info Center Display to assist with electrical system diagnostics.

CAN identifies the Controller Area Network that is used between the controllers on the Groundsmaster. Two (2) specially designed, twisted cables form the bus. These wires provide the data pathways between the controllers (TEC−5001, TEC−5002 and the Cummins controller) and the Info Center Display used on the machine. The engineering term for these cables are CAN High and CAN Low. At the ends of the twisted pair of bus cables are 120 ohm termination resistors.

Each of the components that is controlled by the CAN bus link only needs four (4) wires to operate and communicate to the system: CAN High, CAN Low, B+ (power) and ground.

Electrical Drawings

The electrical schematic and wire harness drawings for the Groundsmaster 5900 and 5910 are located in Chapter 10 − Foldout Drawings.

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

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

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm-Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

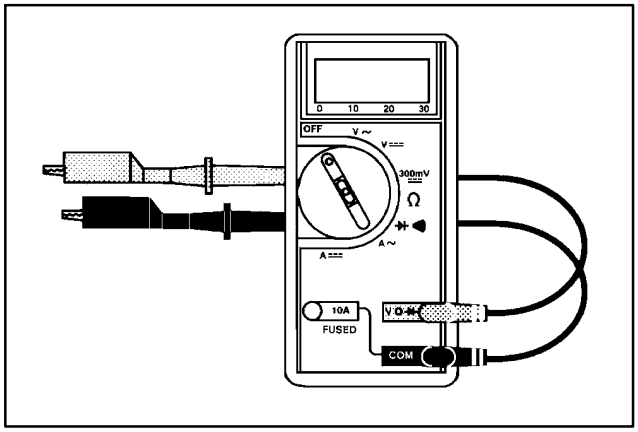


Figure 1

Skin-Over Grease

Special non-conductive grease which forms a light protective skin which helps waterproof electrical switches and contacts.

Toro Part Number: **505-165**



Figure 2

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Toro Part Number: **107-0342**



Figure 3

Battery Terminal Protector

Aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after the battery cable has been secured to the battery terminal.

Toro Part Number: **107-0392**



Figure 4

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.



Figure 5

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 10 – Foldout Drawings).

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

NOTE: Use the Info Center Display when troubleshooting a Groundsmaster 5900 or 5910 electrical problem.

Starting Problems

Problem	Possible Causes
All electrical power is dead, including Info Center Display.	Batteries are discharged. Battery cables are loose or corroded. Fuse 1F1 (5 amp) to the ignition switch is faulty. Ignition switch or circuit wiring is faulty.
Starter solenoid clicks, but starter will not crank. **NOTE:** If the starter solenoid clicks, the problem is not in the interlock circuit.	Batteries are discharged. Battery cables are loose or corroded. Ground cable is loose or corroded. Wiring at the starter motor is faulty. Starter solenoid or starter motor is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	Engine or fuel system is malfunctioning (see Chapter 3 - Cummins Diesel Engine).
Engine cranks, but does not start.	Engine and/or fuel may be too cold. Fuel tank is empty. Engine or fuel system is malfunctioning (see Chapter 3 - Cummins Diesel Engine). Hydraulic load is slowing engine cranking speed.
Engine cranks, but should not, when the traction pedal is depressed.	Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty.

Starting Problems (Continued)

Problem	Possible Causes
Nothing happens when start attempt is made. Info Center Display operates with the ignition switch in RUN. **NOTE:** Use Info Center Display to assist with identifying problem.	Traction pedal is not in neutral position. Operator seat is unoccupied OR the parking brake is not applied. PTO switch is engaged. Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty. Seat switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Start relay or circuit wiring is faulty. TEC–5002 fuses (3F1, 3F2, 3F3, 3F4) are faulty. Maxi Fuse #1 is faulty Controller power relay is faulty. Wiring to start circuit components is loose, corroded or damaged (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Electrical Drawings). Engine coolant sensor or circuit wiring is faulty. Hydraulic temperature sender or circuit wiring is faulty. Starter solenoid or starter motor is faulty. Engine or fuel system is malfunctioning (see Chapter 3 - Diesel Engine). TEC–5002 controller is faulty.

General Run and Transport Problems

Problem	Possible Causes
Engine continues to run, but should not, when the ignition switch is turned off.	Ignition switch or circuit wiring is faulty. Engine or engine controller is malfunctioning (see Chapter 3 - Diesel Engine). TEC−5002 controller is faulty.
Engine continues to run, but should not, when the traction pedal is engaged with no operator in the seat.	Seat switch or circuit wiring is faulty. Traction pedal potentiometer is out of adjustment. Traction pedal potentiometer or circuit wiring is faulty. TEC−5002 controller is faulty.
The engine stops during operation, but is able to restart. **NOTE:** If excessive coolant temperature causes engine shutdown, the operator can restart the engine to allow the machine to be moved a short distance. After a restart in this condition, the engine will run for approximately 10 seconds before the engine shuts down again.	Parking brake is engaged. Operator is raising from the seat (seat switch not fully depressed). Seat switch or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Machine is being operated on a slope with a low fuel level. The parking brake switch or circuit wiring is faulty.
The engine kills when the traction pedal is depressed.	Parking brake is engaged. Operator is not fully depressing the seat switch. Seat switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. TEC−5002 controller is faulty.
Batteries do not charge.	Wiring to charging circuit components is loose, corroded or damaged (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings). Alternator belt is loose or damaged. Battery cables are loose or corroded. 125A Mega fuse is faulty. Alternator is faulty. Battery is faulty.

Cutting Deck (PTO) Operating Problems

Problem	Possible Causes
The PTO remains engaged, but should not, with no operator in the seat.	Seat switch or circuit wiring is faulty. TEC–5002 controller is faulty.
Cutting decks run, but should not, when raised. Cutting decks shut off with PTO switch.	Up limit switch or circuit wiring is faulty. TEC–5002 controller is faulty.
Cutting decks run, but should not, when raised. Cutting decks do not shut off with PTO switch.	Both the up limit switch (or circuit wiring) and PTO switch (or circuit wiring) are faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
One cutting deck does not operate when lowered with the PTO engaged.	Up limit switch for affected deck is out of adjustment. Up limit switch or circuit wiring for affected deck is faulty. Control manifold solenoid coil S or circuit wiring for affected deck is faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
None of the cutting decks operate. Cutting decks are able to raise and lower.	PTO switch is in the OFF position. High temperature of engine coolant or hydraulic oil has disabled the cutting decks. Seat switch or circuit wiring is faulty. PTO switch or circuit wiring is faulty. Cutting deck up limit switch or circuit wiring is faulty. Mow/transport switch or circuit wiring is faulty. Hydraulic temperature sender or circuit wiring is faulty. Coolant temperature sender or circuit wiring is faulty. A hydraulic problem in the PTO circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5002 controller is faulty.
Cutting decks run, but should not, when lowered with PTO switch in the disengaged (OFF) position.	The PTO switch or circuit wiring is faulty. TEC–5002 controller is faulty.

Cutting Deck Lift/Lower Problems

Problem	Possible Causes
None of the cutting decks will lower.	Mow/transport switch is in the transport position. Operator is not fully depressing the seat switch. TEC–5001 fuses (4F1, 4F2, 4F3, 4F4) are faulty. Seat switch or circuit wiring is faulty. Mow/transport switch or circuit wiring is faulty. Lift control manifold solenoid coil S1 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
None of the cutting units will raise.	Lift control manifold solenoid coil S1 or circuit wiring is faulty. A hydraulic problem in the lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
Front cutting deck **will not** raise or lower, but both wing cutting decks **will** raise and lower.	Front deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S5 or S6 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
RH wing cutting deck **will not** raise or lower, but the front and LH wing cutting decks **will** raise and lower.	RH deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S7, S8 or S9 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.
LH wing cutting deck **will not** raise or lower, but the front and RH wing cutting decks **will** raise and lower.	LH deck lift switch or circuit wiring is faulty. Lift control manifold solenoid coils S2, S3 or S4 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System). TEC–5001 controller is faulty.

Info Center Display

The Groundsmaster Info Center Display is a LCD device that is located on the steering tower. The Info Center provides information for the machine operator during machine operation, provides electrical system diagnostic assistance for technicians and allows inputs for adjustable machine settings.

Power for the Info Center is available when the main power relay is energized (ignition switch is in the START or RUN position). Fuse 1F3 protects the Info Center power circuit. A CAN bus system involving the TEC−5001 controller, the TEC−5002 controller, the Cummins ECM and the Info Center is used to provide necessary machine communication for the Info Center.

NOTE: The TEC controllers and the Info Center Display used on the Groundsmaster 5900 and 5910 are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

Operator Information

The Info Center replaces traditional gauges by displaying engine and machine status. This information is displayed on two (2) screens that can be selected by the operator.

Info Center Screen 1 (Fig. 6) is the default screen that is displayed when the ignition switch is in either the RUN or START position. Screen 1 displays engine coolant temperature, fuel level, machine hours and whether the traction speed is in LO or HI speed range. Indicator icons will also appear on this screen when the PTO is engaged, when the parking brake is applied, when the engine cooling fan reverses direction, when the cruise control is engaged, when the air intake heater is energized and when traction assist is engaged.

The Info Center navigation menu (Fig. 7) can be accessed by pressing and releasing any of the left four (4) buttons on the display. The navigation menu will automatically close after a short display time or it can be closed by pressing the button under the opened door.

Info Center Screen 2 (Fig. 8) can be viewed by accessing the Info Center navigation menu and pressing the button below SCREEN TWO. Screen 2 displays engine RPM, hydraulic oil temperature, battery voltage and operating time until the next service.

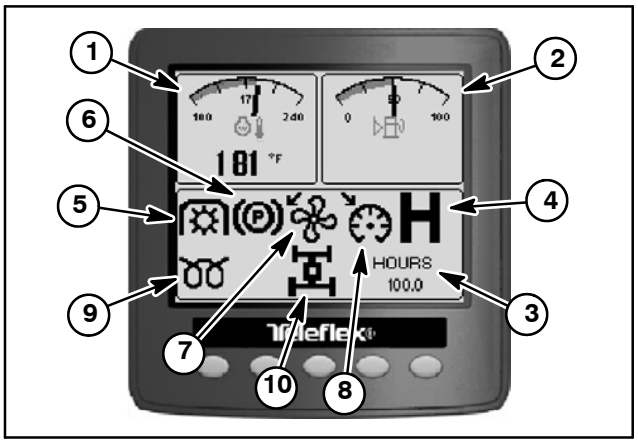


Figure 6

1. **Coolant temperature**
2. **Fuel level**
3. **Machine hours**
4. **Traction speed**
5. **PTO icon**
6. **Parking brake icon**
7. **Cooling fan icon**
8. **Cruise icon**
9. **Intake heater icon**
10. **Traction assist icon**

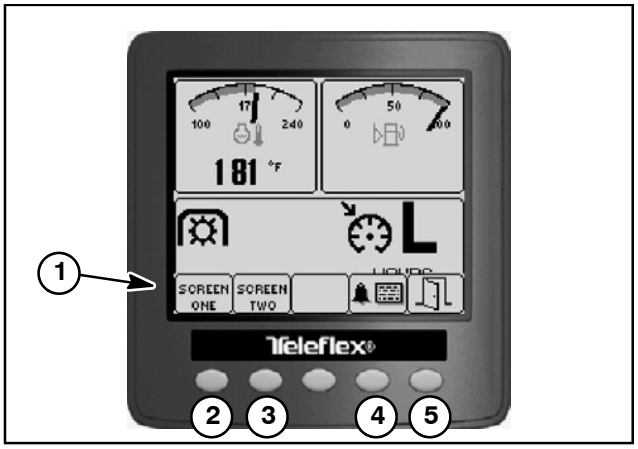


Figure 7

1. **Navigation menu**
2. **Screen 1 access button**
3. **Screen 2 access button**
4. **Fault access button**
5. **Exit menu button**

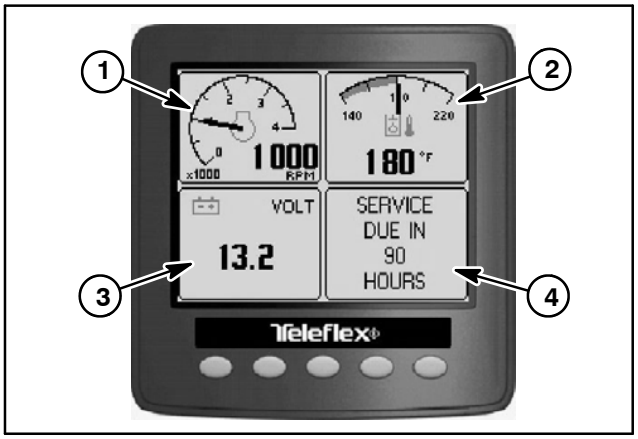


Figure 8

1. **Engine RPM**
2. **Hydraulic oil temperature**
3. **Battery voltage**
4. **Time until next service**

Info Center controls for brightness and contrast can be accessed by pressing and releasing the right button on the Info Center (Fig. 9). Use the display buttons to change the screen image and to exit the control screen.

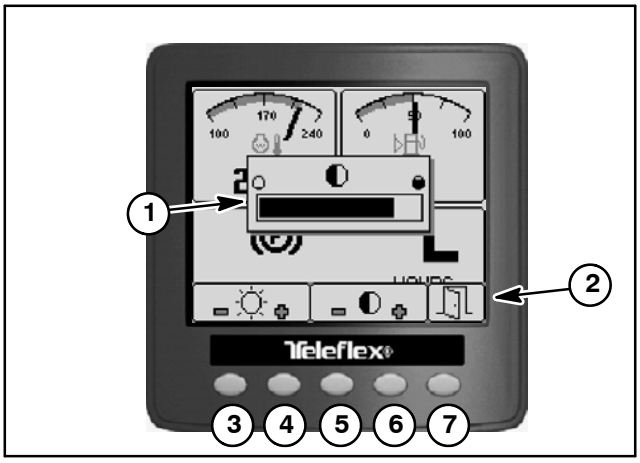


Figure 9

1. **Indicator bar**
2. **Menu**
3. **Brightness - button**
4. **Brightness + button**
5. **Contrast - button**
6. **Contrast + button**
7. **Exit button**

Operator Advisories

Operator advisories are automatically displayed by the Info Center when a machine function requires additional action. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the Info Center Display that the traction pedal needs to be in neutral. An advisory will not be logged into any fault log.

Displayed advisories can be cleared from the display by pressing any of the Info Center buttons.

Advisories are available for the following functions:

1. The TO START advisory identifies that the engine starter will not engage after the ignition switch is turned to START (Fig. 10):

   A. ENGINE RUNNING. Engine is already running.

   B. WAIT. Engine signalling wait due to air intake heater being energized.

   C. RESET TEACH PLUG. Traction pedal teach wires are connected.

   D. DISENGAGE PTO. The PTO switch is pulled out (engaged) and must be disengaged before starter will operate.

   E. MOVE TP TO NEUTRAL. The traction pedal is not in the neutral position.

   F. SEAT OPERATOR OR SET PARKING BRAKE. Operator needs to be in seat or parking brake needs to be applied to engage starter.

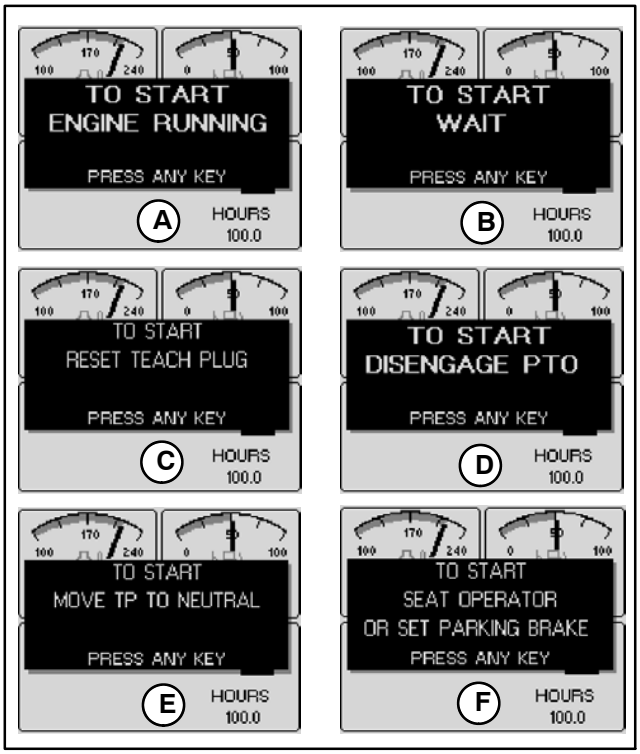


Figure 10

2. The TO LOWER DECK advisory identifies that the cutting deck will not lower when a lower deck switch is pressed (Fig. 11):

A. SET LOW RANGE. Machine is set to high speed range and needs to be in low speed before decks will lower.

B. SEAT OPERATOR. Operator needs to be in seat to lower cutting decks.

C. SET PARKING BRAKE. Parking brake needs to be applied to lower cutting deck.

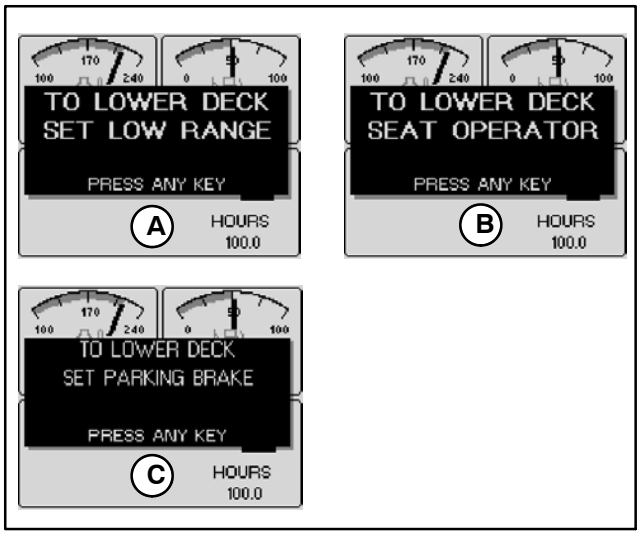


Figure 11

3. The FOR TRACTION advisory identifies that the traction drive will not engage when the traction pedal is pressed (Fig. 12):

A. SEAT OPERATOR. Operator needs to be in seat to engage traction.

B. MOVE TP TO NEUTRAL. The traction pedal is not in the neutral position.

C. RELEASE PARKING BRAKE. Parking brake is applied and needs to be released before traction drive will engage.

D. FIX CRITICAL SENSOR ERROR. Critical traction pedal sensor error exists.

E. FIX CRITICAL VOLTAGE ERROR. Critical traction pedal voltage error exists.

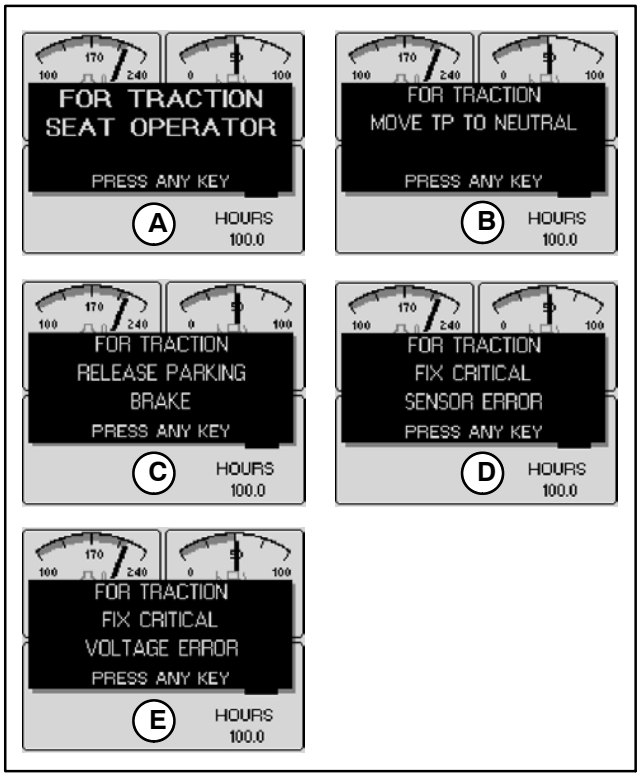


Figure 12

4. The FUEL LEVEL advisory identifies that the fuel remaining in the tank is low (Fig. 13).

A. LOW FUEL LEVEL. Less than 5 gallons of fuel remain in the fuel tank.

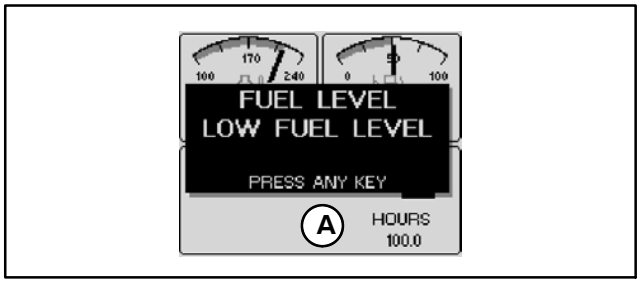


Figure 13

5. The FOR TRACTION ASSIST advisory identifies that the the traction assist system will not engage when the traction assist switch is pressed (Fig. 14).

A. SEAT OPERATOR. Operator needs to be in seat to engage traction assist.

B. MUST BE IN LOW RANGE. Machine is set to high speed range and needs to be in low speed to engage traction assist.

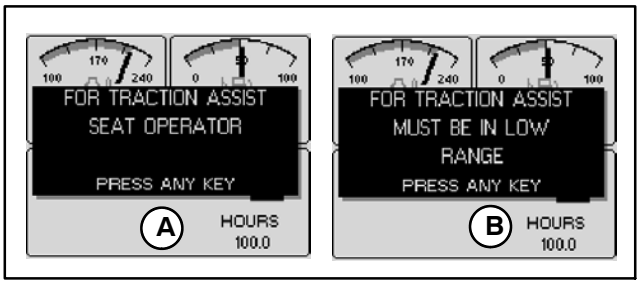


Figure 14

6. The TO ENGAGE PTO advisory identifies that the PTO will not engage when the PTO switch is pulled out (Fig. 15):

A. SEAT OPERATOR. Operator needs to be in seat to engage PTO.

B. MUST BE IN LOW RANGE. Machine is set to high speed range and needs to be in low speed before PTO will engage.

C. LET ENGINE WARM. Engine needs to reach operating temperature before PTO will engage.

D. LOWER DECKS. No cutting decks are lowered. At least one deck must be fully lowered before the PTO will engage.

E. SOLVE ENGINE TORQUE LIMIT. Engine torque is limited.

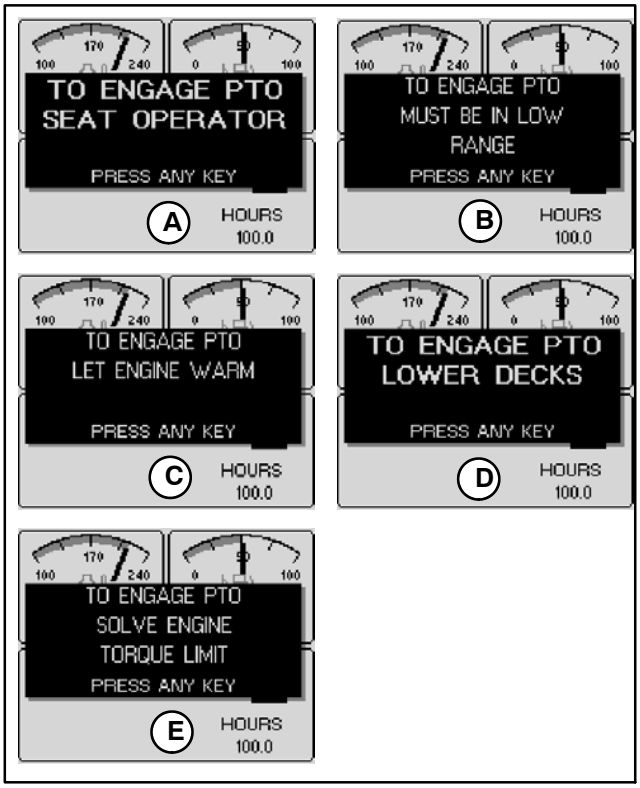


Figure 15

7. The TO SET CRUISE CONTROL advisory identifies that the cruise control will not engage when the cruise control switch is pressed (Fig. 16):

A. INCREASE TRACTION. Forward ground speed is too low to engage cruise control.

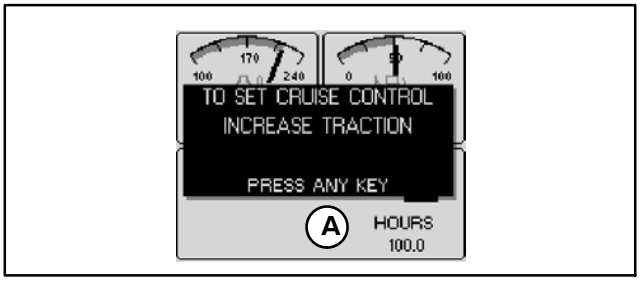


Figure 16

8. The TO FLOAT DECK advisory identifies that the cutting decks are not in float mode (Fig. 17):

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

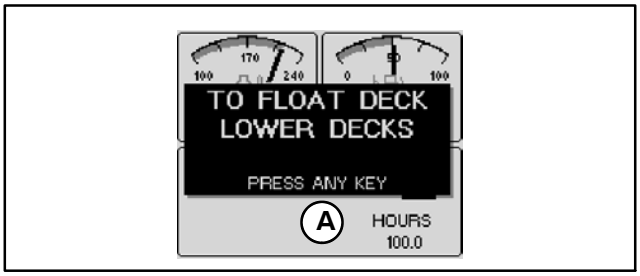


Figure 17

9. The TO SET RANGE LOW advisory identifies that low speed range will not engage when the Hi-Lo speed switch is pressed (Fig. 18).

A. REDUCE GROUND SPEED. Ground speed needs to be less than 2 MPH in order to engage low speed range.

B. DISENGAGE CRUISE. Cruise control is engaged and needs to be disengaged in order to engage low speed range.

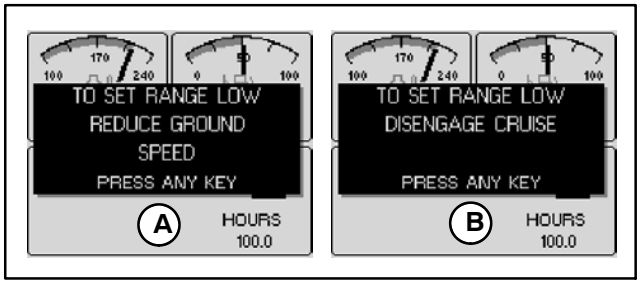


Figure 18

10. The FAN REVERSED BECAUSE advisory identifies that the engine cooling fan reversed direction (Fig. 19).

A. HIGH HYDRAULIC OIL TEMP. Hydraulic oil temperature above 203º F (95º C) is causing the cooling fan motor to reverse.

B. HIGH ENG COOLANT TEMP. Engine coolant temperature above 199º F (93º C) is causing the cooling fan motor to reverse.

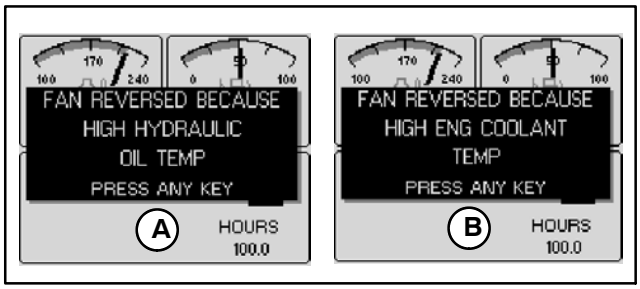


Figure 19

11. The FOR TEACH advisory identifies that the traction pedal teach function is not accessible.

A. TURN KEY SWITCH OFF THEN ON. To access the traction pedal teach function, cycle the ignition switch OFF and then to RUN.

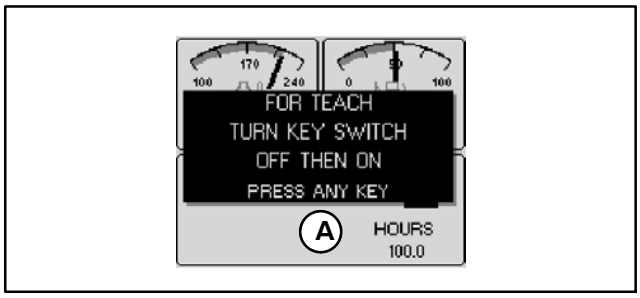


Figure 20

12. The TO SET RANGE HIGH advisory identifies that high speed range will not engage when the Hi-Lo speed switch is pressed (Fig. 21).

A. LIFT LEFT DECK. Left cutting deck is lowered and needs to be raised before high speed range can be engaged.

B. LIFT LEFT DECK FULLY. Left cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

C. LIFT CENTER DECK. Center (front) cutting deck is lowered and needs to be raised before high speed range can be engaged.

D. LIFT CENTER DECK FULLY. Center (front) cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

E. LIFT RIGHT DECK. Right cutting deck is lowered and needs to be raised before high speed range can be engaged.

F. LIFT RIGHT DECK FULLY. Right cutting deck is lowered below the up limit switch and needs to be raised before high speed range can be engaged.

G. DISENGAGE PTO. PTO is engaged and must be shut off before high speed range can be engaged.

H. DISENGAGE CRUISE. Cruise control is engaged and must be shut off before high speed range can be engaged.

I. REDUCE GROUND SPEED. Ground speed needs to be less than 2 MPH in order to engage high speed range.

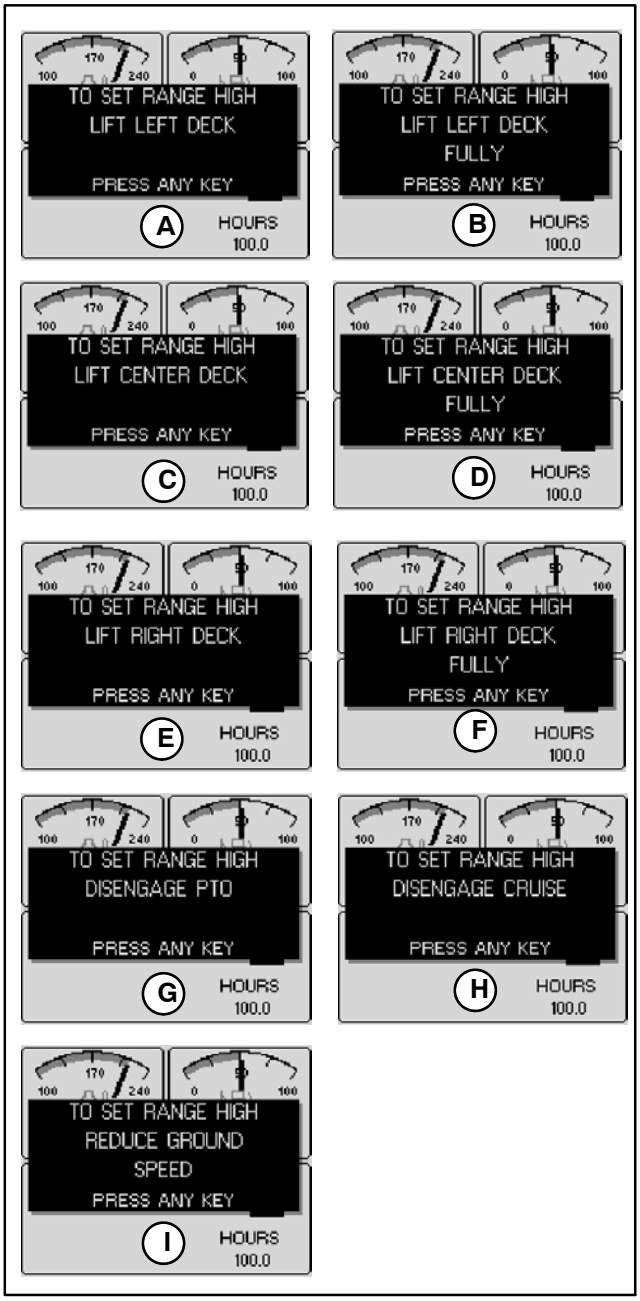


Figure 21

Engine Faults

The Info Center monitors critical engine electrical functions (e.g. engine oil pressure, engine operating temperature) and alerts the operator if potential issues arise. If an engine electrical fault is identified by the Cummins controller, the Info Center will alternately display a warning icon and information about the fault (Fig. 22).

If a STOP fault is displayed on the Info Center, the operator should cease operation of the machine and the engine as quickly and as safely as possible to reduce damage to the engine.

If a CHECK ENGINE fault is displayed on the Info Center, the operator should take the machine to a service center as soon as possible.

In order to clear the displayed fault, the engine problem has to be resolved.

NOTE: All engine electrical faults are stored in the Cummins controller and can be accessed by using the Cummins diagnostic software.

To access additional information regarding the displayed fault:

1. Access the Info Center navigation menu by pressing and holding any of the buttons on the display (Fig. 23).

2. Press the button under the fault access icon.

3. The fault description will be displayed on the Info Center (Fig. 24). If there are multiple faults, they can be reviewed using the navigation arrows.

4. To exit the fault description screen, press the button under the alarm icon.

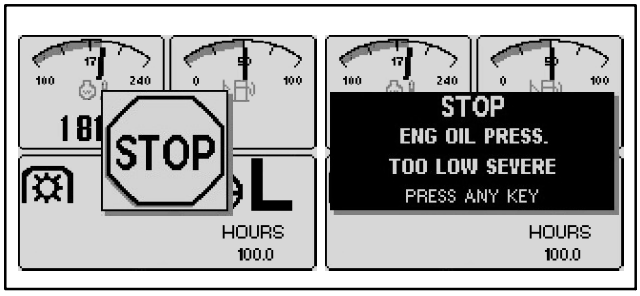


Figure 22

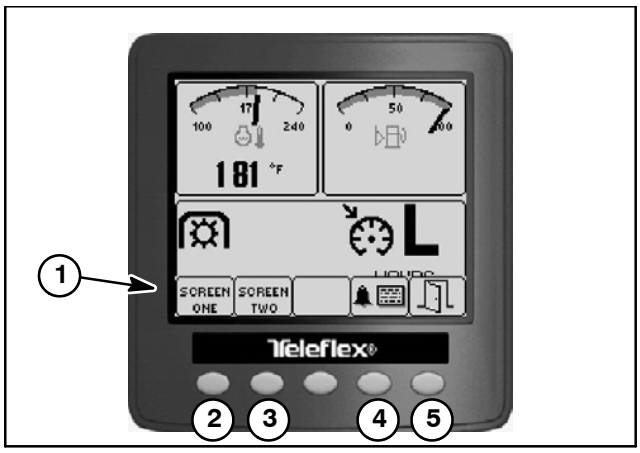


Figure 23

1. **Navigation menu**
2. **Screen 1 access button**
3. **Screen 2 access button**
4. **Fault access button**
5. **Exit menu button**

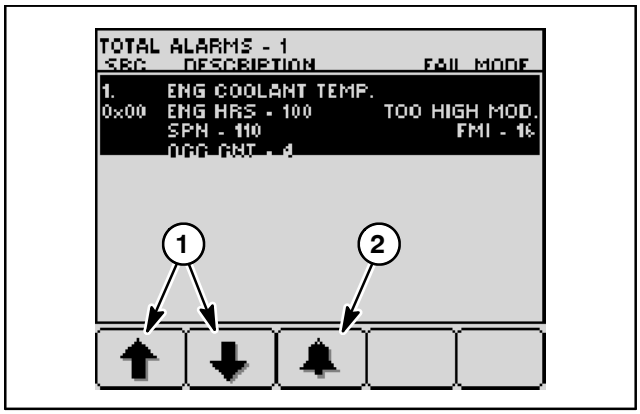


Figure 24

1. **Navigation arrows**
2. **Alarm icon**

Diagnostics

The Info Center DIAGNOSTICS screens allow TEC controller electrical inputs and outputs to be tested. No separate code reader or computer is needed to access the information. Use of the DIAGNOSTICS screens can be used to identify and troubleshoot machine electrical functions.

To access the DIAGNOSTICS screen (Fig. 25):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose DIAGNOSTICS.
- Use navigation arrows to choose TORO DIAG.
- Use navigation arrows to choose machine function that is to be evaluated.

Each DIAGNOSTICS screen is separated into three (3) areas of information (Fig. 26). The top section identifies the controller inputs that are necessary for the function that is being evaluated. The middle section identifies additional inputs that are involved with the chosen function. The bottom section identifies the TEC outputs.

For troubleshooting purposes, the DIAGNOSTICS screens can be used to identify whether a switch and it's circuit wiring are functioning correctly. As an example, if the ENGINE RUN diagnostic screen is displayed and the key switch is in the RUN position (ON), the PTO switch can be engaged and disengaged while the screen is viewed. The PTO ENABLED item should indicate the change in status of the PTO switch. If there is no change on the screen when the switch changes state, a switch or circuit wiring problem should be investigated.

When the correct inputs are received by the TEC controllers, the outputs identified on the DIAGNOSTICS screen should show as ON. If the inputs are properly positioned and the output remains OFF, a problem with TEC controller power (circuit wiring or fuse) or the controller itself should be suspected.

It should be noted that a faulty output component may not be identified by the DIAGNOSTICS screen. As an example, if the starter solenoid is faulty, the ENGINE RUN screen could show that all inputs and outputs are correct for the function selected. The controller output occurs but the faulty solenoid will prevent the engine from starting.

DIAGNOSTICS screens are available for the functions listed on the following pages.

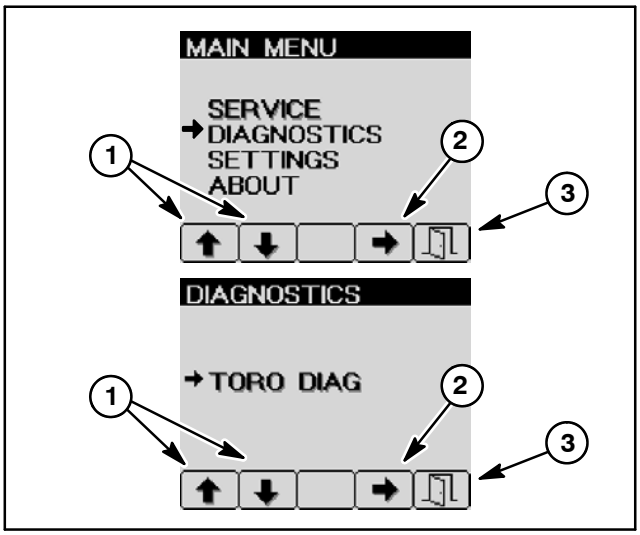


Figure 25

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

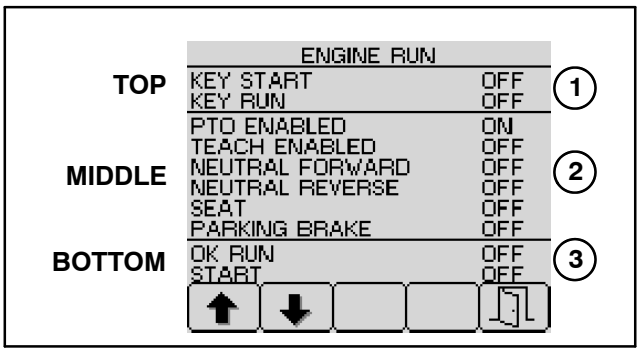


Figure 26

1. **Function inputs**
2. **Additional inputs**
3. **Outputs**

1. LEFT DECK and RIGHT DECK controls (Fig. 27)

   NOTE: The cutting decks will not lower when the high speed range is selected. Also, the decks will not raise or lower if the operator is not in the seat while the engine is running.

   To **lower** the left or right cutting deck, the following inputs have to be initiated:
   - Left or right lift/lower switch pressed to lower (DECK LOWER ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
   - Seat needs to be occupied (SEAT ON)

   If the proper inputs exist, the following outputs should occur:
   - Left or right deck lower (MASTER LIFT SOLENOID ON and DECK LOWER ON)

   Once the deck is fully lowered, the following outputs should occur:
   - Left or right deck in float mode (DECK FLOAT ON)

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

   To **raise** a left or right cutting deck, the following inputs have to be initiated:
   - Left or right deck lift/lower switch pressed to raise (DECK RAISE ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
   - Seat needs to be occupied (SEAT ON)

   If the proper inputs exist, the following outputs should occur:
   - Left or right deck raise (MASTER LIFT SOLENOID ON and DECK RAISE ON)

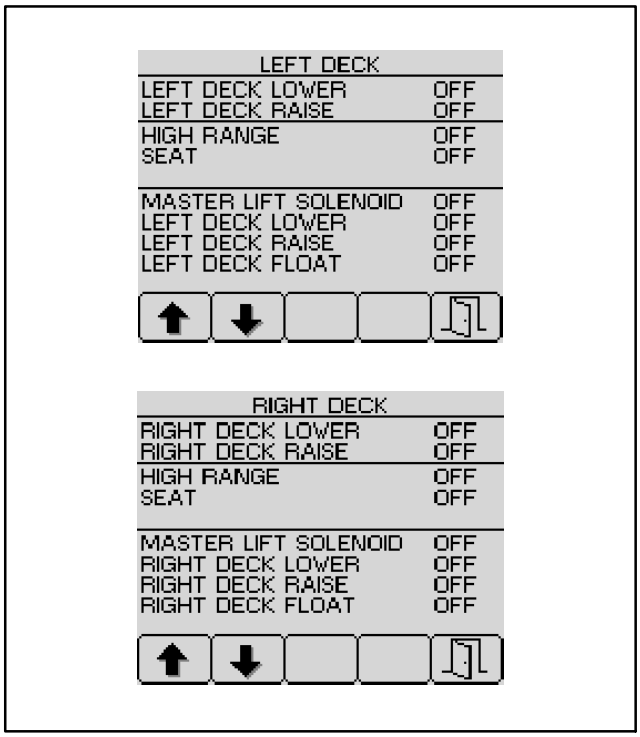


Figure 27

2. CENTER DECK controls (Fig. 28)

NOTE: The cutting decks will not lower when the high speed range is selected. Also, the decks will not raise or lower if the operator is not in the seat while the engine is running.

To **lower** the center (front) cutting deck, the following inputs have to be initiated:

- Center deck lift/lower switch pressed to lower (CENTER DECK LOWER ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
- Seat needs to be occupied (SEAT ON)

If the proper inputs exist, the following outputs should occur:

- Center deck lower (CENTER DECK LOWER/FLO ON)

To **raise** the center (front) cutting deck, the following inputs have to be initiated:

- Center deck lift/lower switch pressed to raise (CENTER DECK RAISE ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)
- Seat needs to be occupied (SEAT ON)

If the proper inputs exist, the following outputs should occur:

- Center deck raise (MASTER LIFT SOLENOID ON and CENTER DECK RAISE ON)

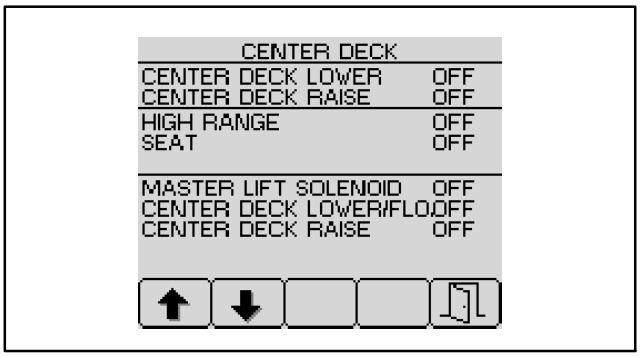


Figure 28

3. TRACTION PEDAL sensor function (Fig. 29)

The traction pedal DIAGNOSTIC screen identifies the state of the traction pedal potentiometer

- An indicator bar shows the relative location of the traction pedal range
- The voltages for the neutral position state change
- The present state of the forward and reverse neutral switches

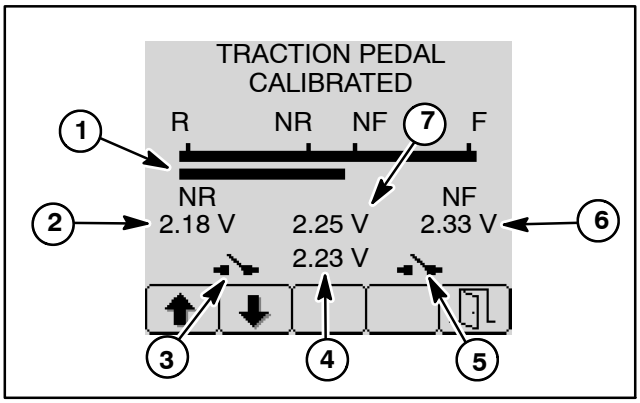


Figure 29

1. **Indicator bar**
2. **Neutral close/open voltage (reverse)**
3. **Neutral switch state change voltage (reverse)**
4. **Voltage for pedal in present position**
5. **Neutral switch state change voltage (forward)**
6. **Neutral close/open voltage (forward)**
7. **Neutral center target voltage**

4. TRACTION (Fig. 30)

   To engage forward traction, the following inputs have to be initiated:
   - Traction pedal pushed to forward (FWD NEUTRAL ON and REV NEUTRAL OFF)
   - Seat needs to be occupied (SEAT ON)
   - Parking brake not applied (PARKING BRAKE OFF)

   If the listed inputs exist, the following output should occur:
   - Forward traction engaged (HYDROSTAT FORWARD ON)

   The reverse traction diagnostic inputs and outputs are similar to the forward direction.

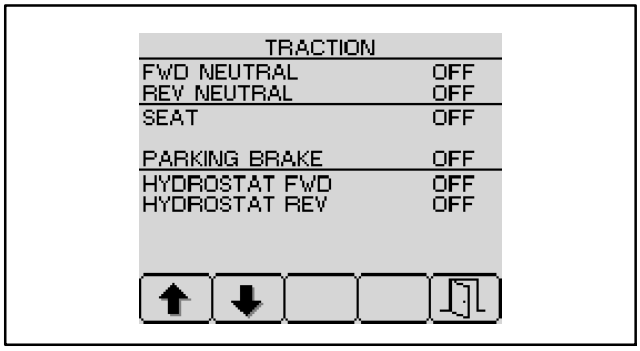


Figure 30

5. HIGH/LOW RANGE (Fig. 31)

   To engage traction high range speed, the following inputs have to be initiated:
   - PTO needs to be OFF (PTO SWITCH OFF)
   - All cutting decks need to be raised (All DECK DOWN OFF and all DECK FLOAT OFF)
   - Hi-Lo speed switch pressed to HI (HIGH RANGE REQUEST ON)

   If the listed inputs exist, the following outputs should occur:
   - High range speed engaged (HIGH RANGE ACTIVE ON)

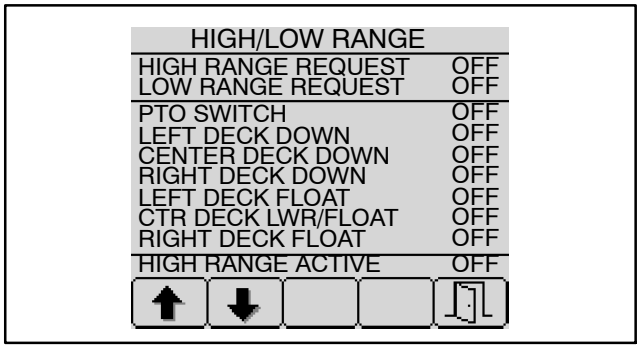


Figure 31

6. PTO (Fig. 32)

   To engage the PTO, the following inputs have to be initiated:
   - PTO switch pulled out (PTO ON)
   - Seat needs to be occupied (SEAT ON)
   - Cutting deck(s) need to be fully lowered into float position (LEFT, CENTER and/or RIGHT DECK FLOAT ON)
   - Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)

   If the proper inputs exist, the following outputs should occur:
   - Left deck engaged (LEFT PTO ON)
   - Center deck engaged (CENTER PTO ON)
   - Right deck engaged (RIGHT PTO ON)

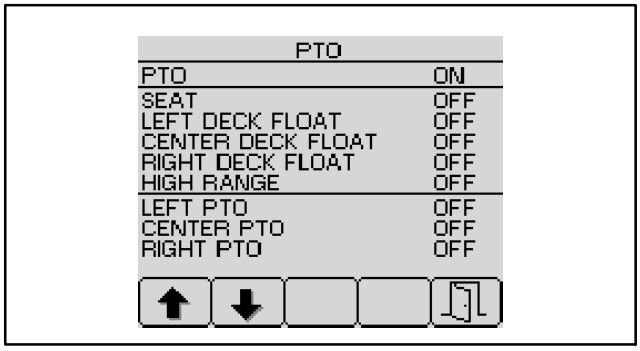


Figure 32

7. TRACTION ASSIST (Fig. 33)

NOTE: Traction assist only engages when low speed range is selected and the traction pedal is pressed in the forward direction.

To engage forward traction assist, the following inputs have to be initiated:

- Traction assist switch depressed to engage traction assist (TRACTION ASSIST INPUT ON)
- Seat needs to be occupied (SEAT ON)
- Hi-Lo speed switch needs to be in LO (HIGH RANGE OFF)

If the listed inputs exist, the following output should occur:

- Traction assist will be engaged (TRACTION ASSIST OUTPUT ON)

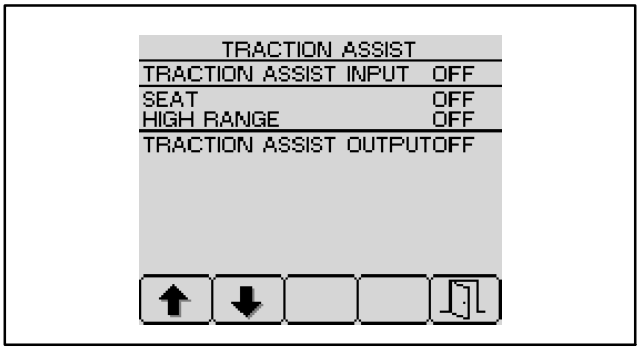


Figure 33

8. CRUISE CONTROL (Fig. 34)

To engage cruise control, the following inputs have to be initiated:

- Cruise control switch in the ON position (CRUISE ON/OFF ON)
- Cruise control switch depressed to engage cruise control (CRUISE ENGAGE ON)

If the listed inputs exist, the following output should occur:

- Cruise control will be engaged (CRUISE ACTIVE ON)

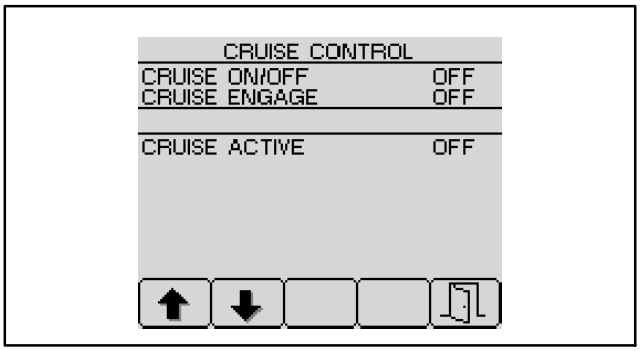


Figure 34

9. ENGINE RUN (Fig. 35)

When the ignition switch is in the ON position, the ENGINE RUN Diagnostic screen should show:

- KEY RUN input ON
- OK RUN output ON

To allow the engine to start, the following inputs have to be initiated:

- Ignition switch needs to be turned to START (KEY START and KEY RUN both ON)
- PTO disengaged (PTO ENABLED OFF)
- Traction pedal not in TEACH mode (TEACH ENABLED OFF)
- Traction pedal in neutral (NEUTRAL FORWARD and NEUTRAL REVERSE both OFF)
- Seat occupied or parking brake applied (either SEAT ON or PARKING BRAKE ON)

If the listed inputs exist, the following outputs should occur:

- The engine starter motor should engage (OK RUN and START both ON)

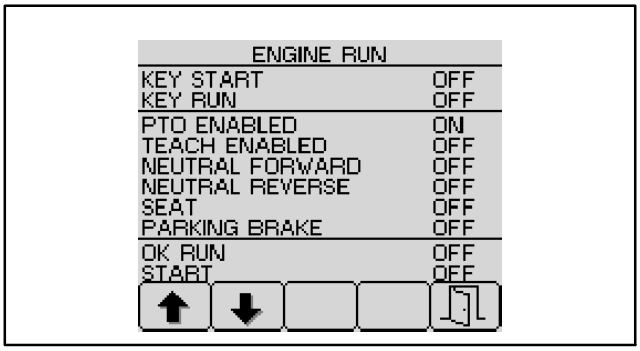


Figure 35

10. LIGHT KIT operation (Fig. 36)

To have the left hazard and turn signals operate, the following inputs have to be initiated:

- Headlight switch depressed to turn lights on (LIGHTS ON)
- Left turn signal switch depressed (LEFT TURN SIGNAL ON)

If the listed inputs exist, the following outputs should occur:

- Left turn signal and hazard lights will be on (LEFT HAZARD SIGNAL and LEFT TURN SIGNAL ON)

The right hazard and right turn signal diagnostic inputs and outputs are similar to the left direction.

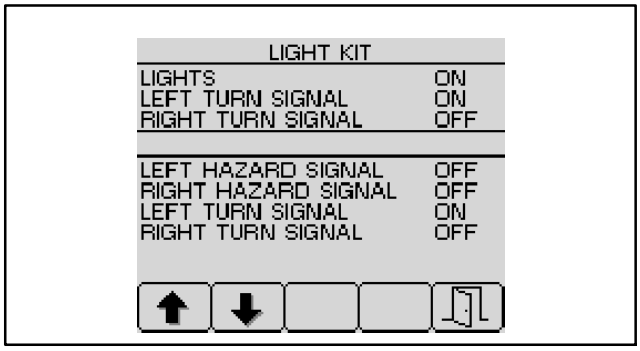


Figure 36

Administration Settings

The administration SETTINGS screens provide display choices for the Info Center Display.

To access the administration SETTINGS screen (Fig. 37):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose SETTINGS.
- Use navigation arrows to choose which of the SETTINGS menu items is to be viewed or changed.

SETTINGS choices are available for the following items:

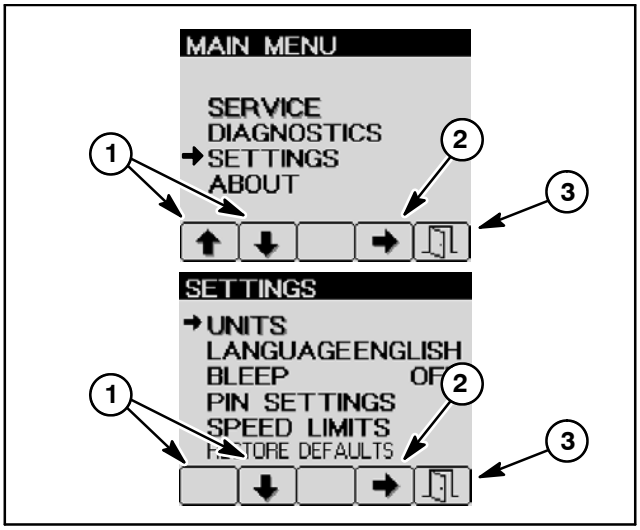


Figure 37

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

1. UNITS (Fig. 38)

   The UNITS settings allow the display to show speed, distance, pressure, volume and temperature in U.S. or Metric units.

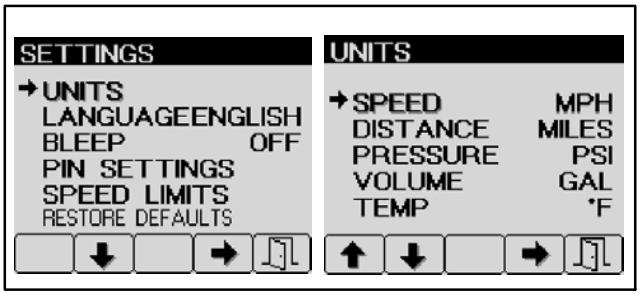


Figure 38

2. LANGUAGE options (Fig. 39)

   The LANGUAGE settings allows the Info Center Display language to be chosen. Use the navigation arrows to choose a language and use the enter arrow to accept the chosen language.

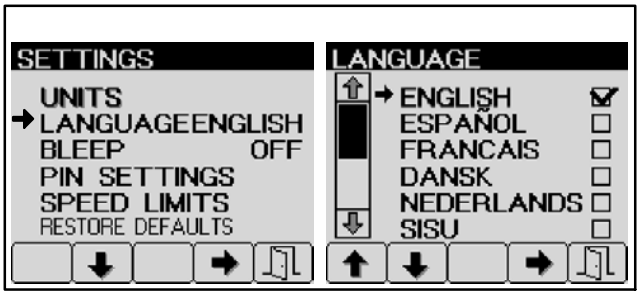


Figure 39

3. BLEEP (Fig. 40)

   When BLEEP is ON, a tone from the Info Center will sound whenever a button on the Info Center is pressed. When BLEEP is OFF, no tone will sound.

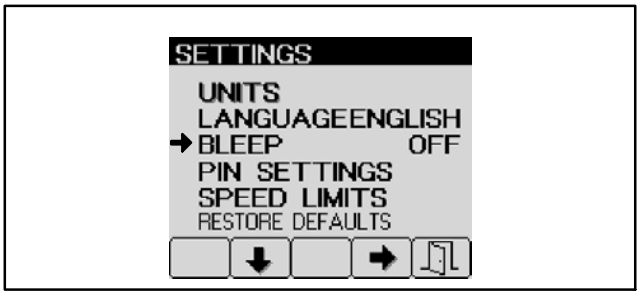


Figure 40

4. PIN SETTINGS (Fig. 41)

   Use of a PIN allows the ability to password protect access to Info Center SETTINGS screens.

   If a PIN is desired for Info Center access, use the navigation buttons to change the PIN ENTRY to ON.

   To enter PIN, use navigation buttons to accept PIN CHANGE. Use the Info Center Display buttons to enter the desired four (4) digit PIN and accept the PIN.

   NOTE: If PIN use is chosen (PIN ENTRY ON), make sure to record PIN so future Info Center Display access is available. If PIN reset is necessary (e.g. PIN has been forgotten), contact your Toro Distributor.

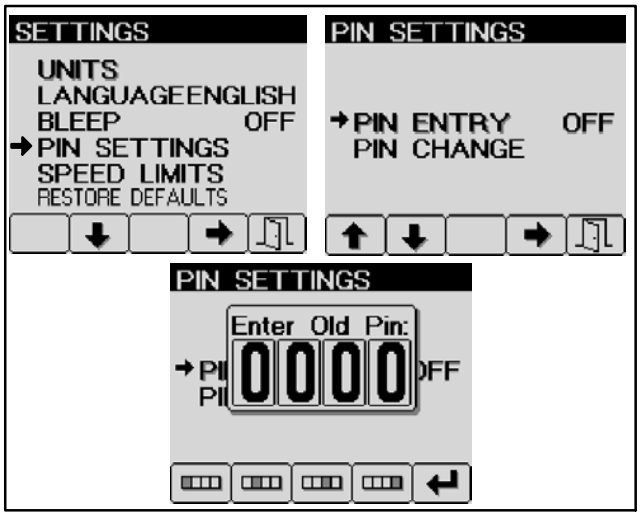


Figure 41

5. SPEED LIMITS (Fig. 42)

   Use the SPEED LIMITS settings to adjust the maximum ground speed for the machine. Speed adjustments are available for forward and reverse in both high and low speed range settings.

   After using the navigation buttons to choose the speed to be adjusted, the current speed limit will be identified with an indicator mark. Press the Info Center button under the + or – to change the speed limits. Exit the screen after ground speed adjustments are complete.

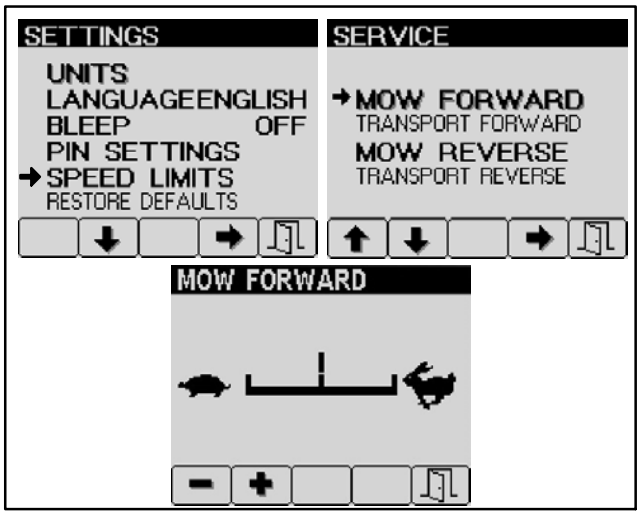


Figure 42

6. RESTORE DEFAULTS (Fig. 43)

   Use the RESTORE DEFAULTS settings to accept the Info Center defaults.

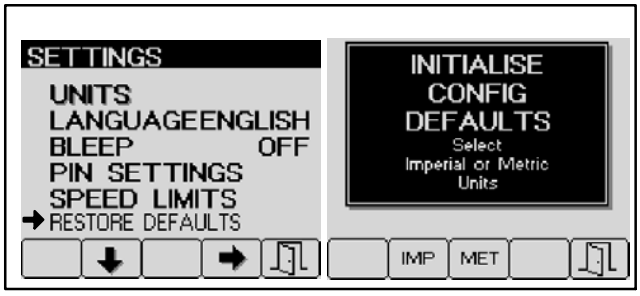


Figure 43

Administration Service

To access the administration SERVICE screens (Fig. 44):
Access the MAIN MENU screen by pressing and holding the right button on the Info Center.
Use the buttons under the navigation arrows to choose SERVICE
Select SERVICE by pressing the button under enter (right arrow)

To access the administration SERVICE screen (Fig. 44):
- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose SERVICE.
- Use navigation arrows to choose which of the SERVICE items is to be viewed or changed.

SERVICE choices are available for the following items:

1. Hours (Fig. 45)

The hours screen identifies the time that the machine has been operated in different functions.

2. Traction Pedal (Fig. 46)

The traction pedal screen lists the calibration values stored in the TEC–5002 controller for different pedal positions. This screen also identifies that the traction pedal calibration has been completed.

3. Fan Override (Fig. 47)

The fan override screen allows the direction and speed of the cooling fan motor to be tested if necessary. The engine must be running to allow the fan override option to be available.

NOTE: The parking brake needs to be applied for the fan override to be operational.

4. Fan Test (Fig. 48)

The fan test screen gives the opportunity to put the cooling fan motor through a demonstration mode. The fan motor will change speed and direction when the FAN DEMO is ON. The engine must be running to allow the fan test option to be available.

NOTE: The parking brake needs to be applied for the fan test to be operational.

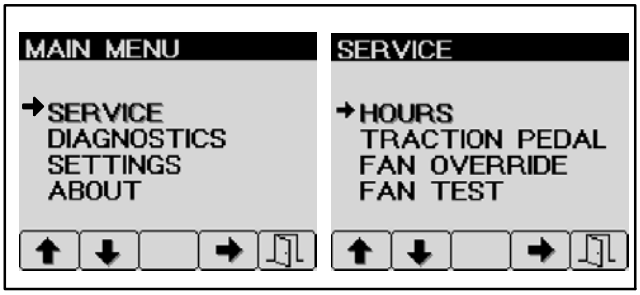


Figure 44

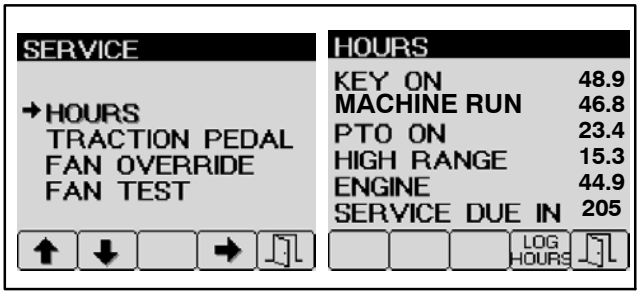


Figure 45

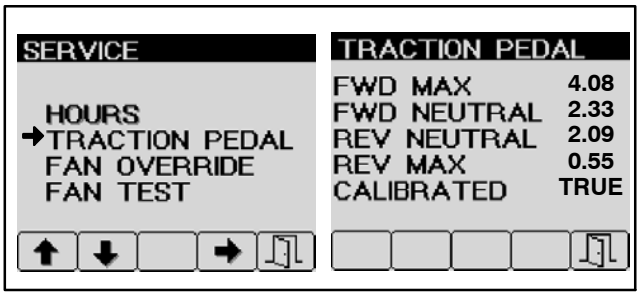


Figure 46

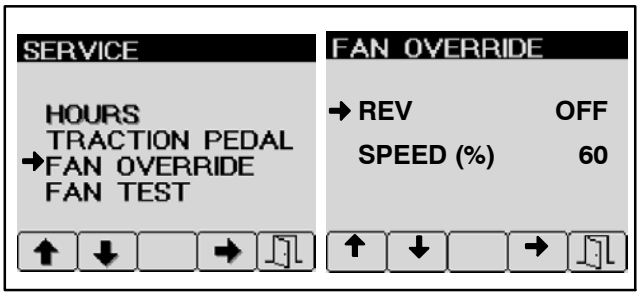


Figure 47

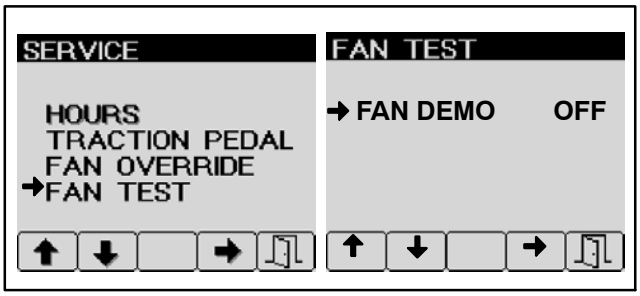


Figure 48

Administration About

The Administration ABOUT screens provide information about the machine, the Info Center Display, the two (2) Toro controllers and the Cummins engine controller.

To access the administration ABOUT screen (Fig. 49):

- Go to MAIN MENU screen by pressing and holding the right button on the Info Center.
- Use navigation arrows to choose ABOUT.
- Information about the Machine (model and serial number), Info Center, TEC−5001, TEC−5002 and Cummins engine controller can be chosen and viewed on the different ABOUT screens (Fig. 50). Use navigation arrows to move between the screens.

NOTE: The TEC controllers and the Info Center Display are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

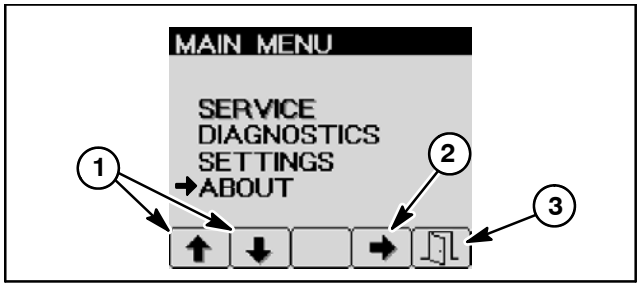


Figure 49

1. **Navigation arrows**
2. **Enter (accept)**
3. **Exit from menu**

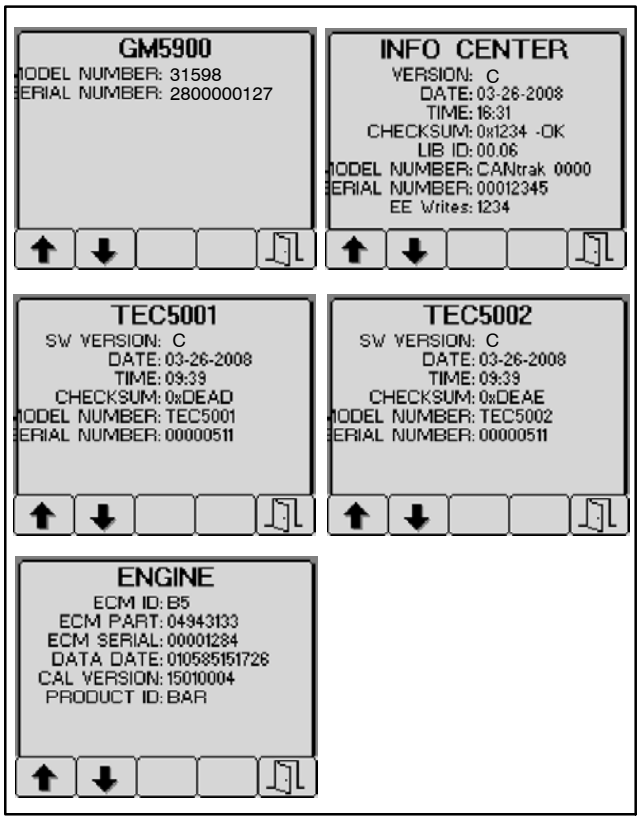


Figure 50

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60ºF to 100ºF (16ºC to 38ºC). The ignition key should be OFF and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service in the Service and Repairs section of this chapter).

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

Charging System Test

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

Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

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

NOTE: Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Start the engine and run at high idle **(3450 RPM)**. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

After running the engine for at least 3 minutes, battery voltage should be at least 0.50 volt higher than initial battery voltage.

An example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 v
Difference	= +0.55 v

Check Operation of Interlock Switches

CAUTION

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

Interlock switch operation is described in the Operator's Manual. Your Groundsmaster is equipped with two (2) Toro Electronic Controllers (TEC) which monitor interlock switch operation. Information on the TEC is described in the Operator's Manual and in the Component Testing section of this Chapter.

The interlock system used on your Groundsmaster includes the seat switch, the traction pedal potentiometer, the parking brake switch, the cutting deck position switches, the mow/transport switch and the PTO switch. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

NOTE: Use the Info Center Display to test Toro Electronic Controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

Traction Pedal Calibration

IMPORTANT: A properly installed and calibrated traction pedal potentiometer is critical to accurate traction system response and for reliable sensor life. Use care when removing, installing and calibrating the traction pedal potentiometer.

1. Park machine on a level surface, lower cutting decks, stop engine and apply parking brake.

2. Make sure that wire harness connector is plugged into traction pedal potentiometer.

3. Turn ignition switch to ON but do not start engine. Use the Info Center Display Diagnostic menu (see Info Center Display in the Service and Repairs section) to obtain the Traction Pedal Calibrated screen on the display (Fig. 51).

4. On the bar graph in the screen, the indicator bar should be between the NR and the NF. Also, the two (2) switch icons on the screen should both be open. To change the indicator bar location:

   A. Remove traction pedal cover and spring cover from front platform (see Traction Pedal Disassembly in the Service and Repairs section of Chapter 6 – Chassis).

   B. Loosen hex nut that secures neutral spring adjustment (Fig. 52).

   C. Slowly rotate the spring shaft while watching the switch icons (Fig. 52). When one of the switch icons close, stop rotating and mark the shaft position. Then slowly rotate the shaft in the opposite direction until the second switch icon closes and mark the shaft position.

   D. Rotate the spring shaft to the mid–point of the two shaft positions. Tighten the hex nut to secure the adjustment. At this setting, the indicator bar should be between the NR and the NF. Also, the neutral voltage value should be within 0.02 V of the midpoint voltage.

   NOTE: When adjusting traction pedal, voltage values should be similar to values shown in Figure 51. If spring shaft is rotated too quickly during adjustment, voltage values could be considerably different than the values shown.

5. Test traction system operation.

6. Install traction pedal cover and spring cover to front platform (see Traction Pedal Assembly in the Service and Repairs section of Chapter 6 – Chassis).

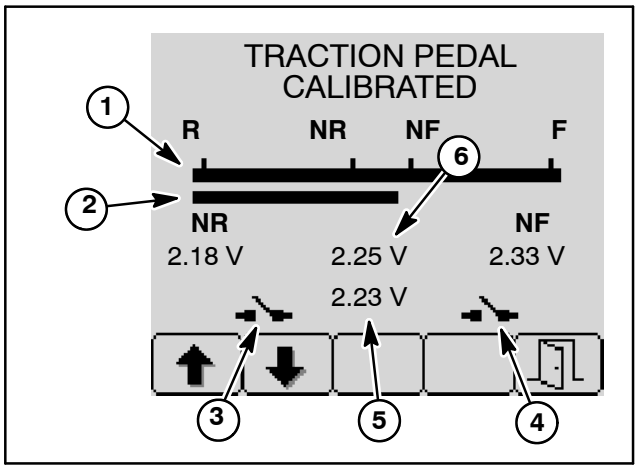


Figure 51

1. **Bar graph**
2. **Indicator bar**
3. **Reverse switch icon**
4. **Forward switch icon**
5. **Neutral voltage**
6. **Midpoint voltage**

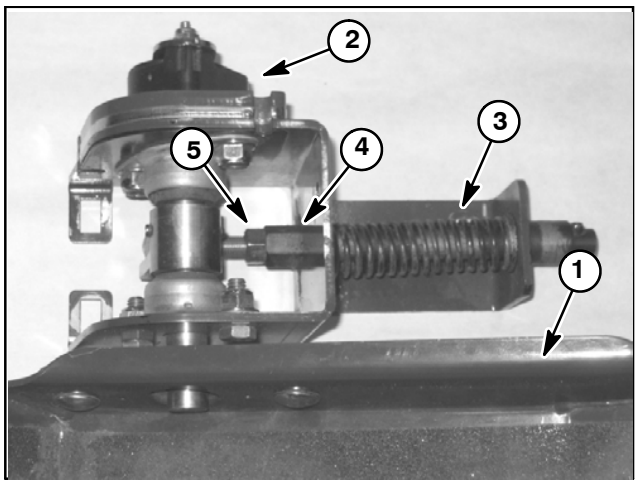


Figure 52

1. **Traction pedal**
2. **Pedal potentiometer**
3. **Compression spring**
4. **Spring shaft**
5. **Hex nut**

Traction Pedal Teach

1. Remove the power center console located to the right of the operator seat.

2. Locate wire harness termination cap that connects the two (2) traction pedal Teach wires (Fig. 53).

3. Remove termination cap and connect the two (2) Teach wires together (Fig. 54).

4. Turn ignition switch to ON but do not start engine. The Info Center Display will be in the “Teach Mode.” Follow the screen prompts to calibrate the traction potentiometer valves to the TEC−5002 controller.

5. After calibration is complete, turn ignition switch to OFF. Separate the two (2) Teach wires and connect the wire harness termination cap to the wires.

6. Install and secure power center console.

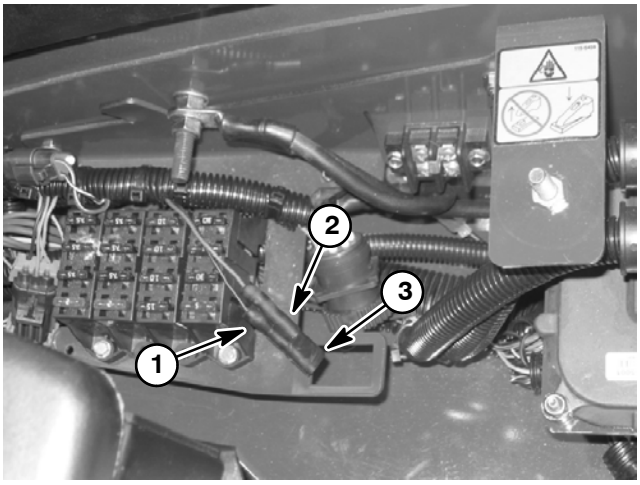


Figure 53

1. **Male teach wire**
2. **Female teach wire**
3. **Termination cap**

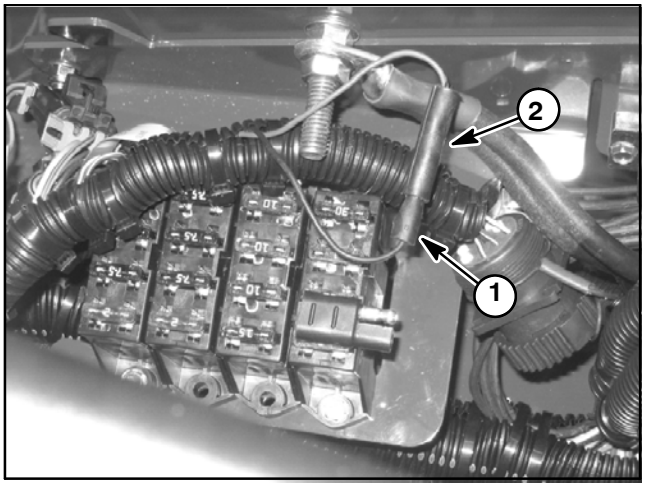


Figure 54

1. **Male teach wire**
2. **Female teach wire**

Component Testing

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

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN and START). The ignition switch is located on the console arm (Fig. 55).

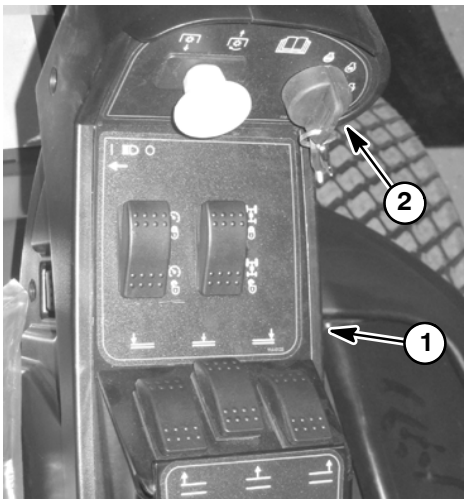


Figure 55

1. **Console arm**
2. **Ignition switch**

Testing

1. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that ignition switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that ignition switch and circuit wiring **are not** functioning correctly, test ignition switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to ignition switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 56. The circuit logic of the ignition switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

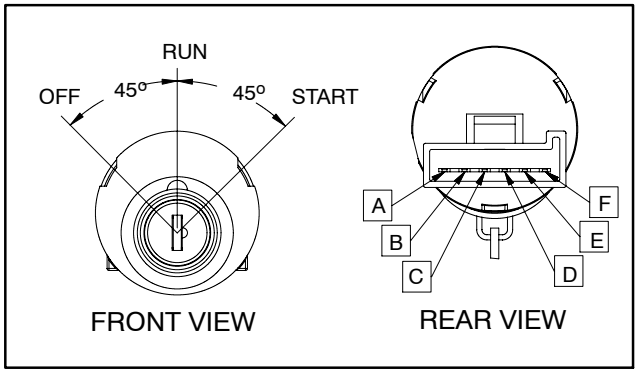


Figure 56

POSITION	CIRCUIT
OFF	NONE
RUN	B + C + F, D + E
START	A + B + C

7. Connect the wire harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Fuses

The fuse blocks are located to the right of the operator seat under the power center console.

Identification and Function (Figs. 57 and 58)

Fuse 1F1 (5 Amp) supplies power to ignition switch terminal B.

Fuse 1F2 (30 Amp) supplies power to the starter solenoid circuit.

Fuse 1F3 (1 Amp) supplies power to the Info Center Display.

Fuse 1F4 (30 Amp) supplies power to the Cummins Engine Controller.

Fuse 2F1 (15 Amp) supplies power to the road and brake light circuits.

Fuse 2F2 (10 Amp) supplies power to the air ride seat suspension seat compressor.

Fuse 2F3 (10 Amp) supplies power to the power point.

Fuse 2F4 (10 Amp) supplies power to the horn circuit.

Fuse 3F1 (2 Amp) supplies logic power for the TEC−5002 Master Controller.

Fuse 3F2 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 3F3 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 3F4 (7.5 Amp) supplies power to the TEC−5002 Master Controller.

Fuse 4F1 (2 Amp) supplies logic power for the TEC−5001 Slave Controller.

Fuse 4F2 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse 4F3 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse 4F4 (7.5 Amp) supplies power to the TEC−5001 Slave Controller.

Fuse Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Remove power center cover from operator platform to access fuses.

3. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.

4. After fuse testing is completed, install and secure power center cover.

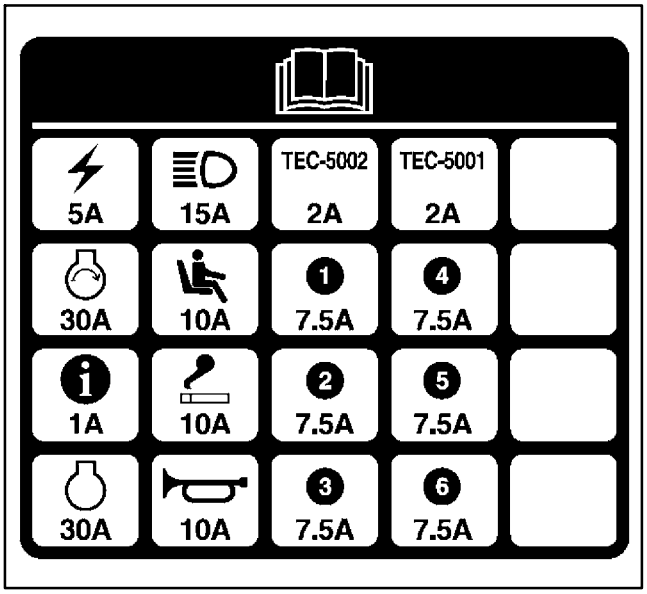


Figure 57

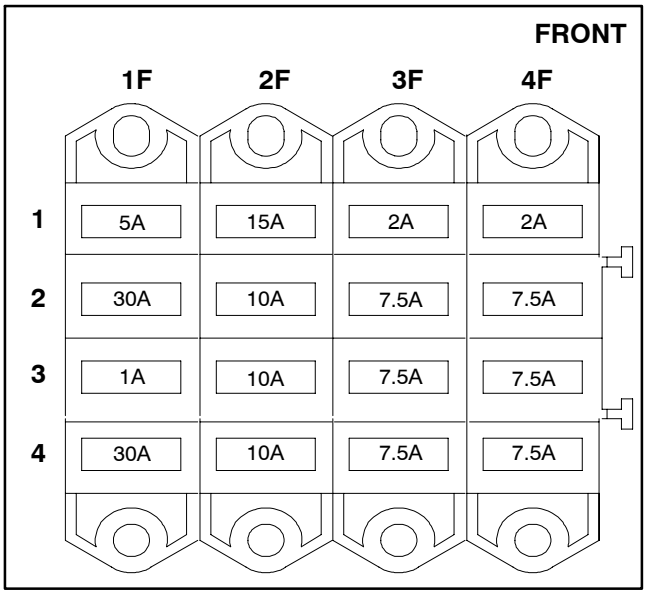


Figure 58

Maxi Fuses

Three (3) 60 amp maxi fuses are used on the Groundsmaster for protection of main electrical circuits. The maxi fuse block is located to the right of the operator seat under the power center console (Fig. 59).

Identification and Function (Fig. 60)

Maxi Fuse #1 protects the controller power circuit.

Maxi Fuse #2 protects the main power circuit.

Maxi Fuse #3 protects the cab power circuit.

Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Remove power center cover from operator platform to access maxi fuses.

3. Remove fuse from fuse block for testing. Fuses should have continuity across the terminals.

4. After fuse testing is completed, install and secure power center cover.

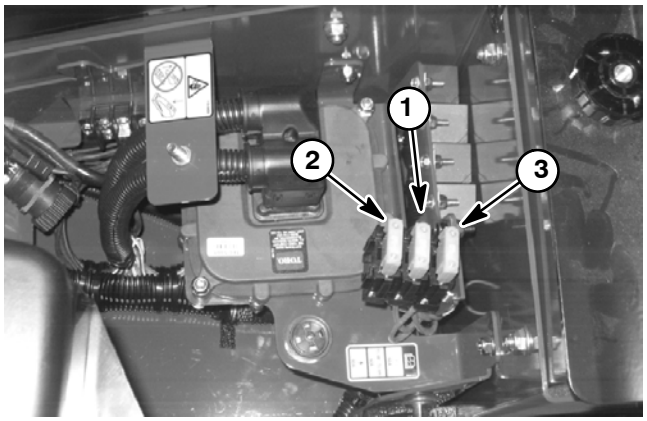


Figure 59

1. **Maxi fuse #1**
2. **Maxi fuse #2**
3. **Maxi fuse #3**

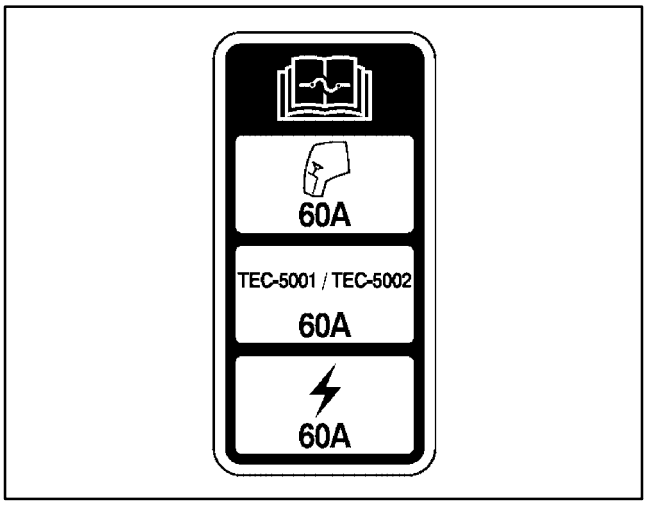


Figure 60

Mega Fuses

Two (2) mega fuses are used on the Groundsmaster for protection of high amperage circuits. One of the mega fuses is a 125 amp fuse and protects the alternator circuit. The other mega fuse is a 300 amp fuse that is a component in the intake air heater circuit. The mega fuse blocks are attached to a hood support frame behind the batteries (Fig. 61).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Disconnect battery cables from battery terminals (see Battery Service in the Service and Repairs section of this chapter).

3. Raise hood to gain access to fuse holders.

4. Press latch that retains fuse holder cover and raise cover.

5. Remove flange nuts and lock washers that secure fuse to holder (Fig. 62). Remove fuse for testing.

6. Fuse should have continuity across the terminals.

7. After testing, slide fuse onto fuse holder studs. Place removed cables and jumper straps onto studs.

8. Secure fuse and conductors with lock washers and flange nuts. Torque nuts from **9 to 13 ft-lb (12.3 to 17.6 N-m)**.

9. Close and secure fuse holder cover.

10. Lower and secure hood.

11. Connect battery cables to battery terminals (see Battery Service in the Service and Repairs section of this chapter).

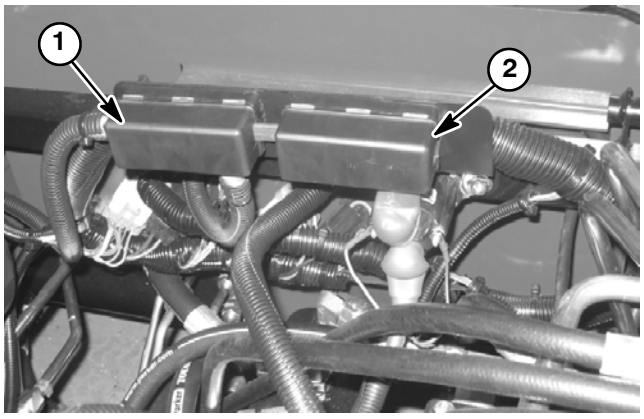


Figure 61

1. **Alternator mega fuse**
2. **Intake heater mega fuse**

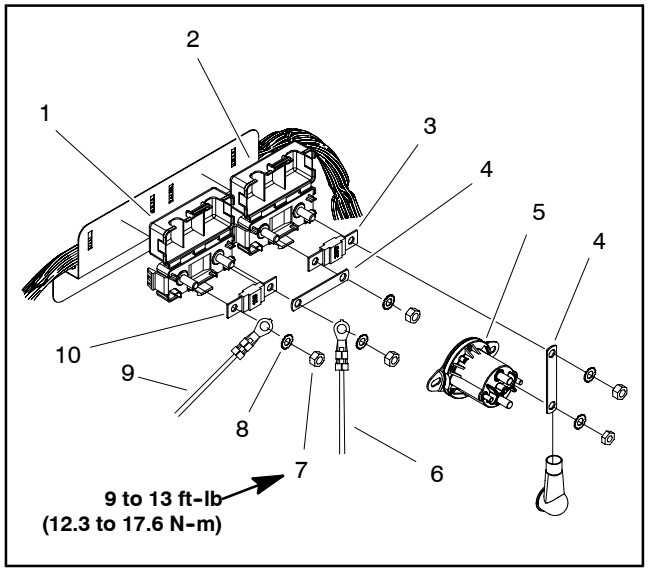


Figure 62

1. **Alternator fuse holder**
2. **Heater fuse holder**
3. **300 amp mega fuse**
4. **Jumper strap**
5. **Contactor**
6. **Battery cable**
7. **Flange nut**
8. **Lock washer**
9. **Alternator cable**
10. **125 amp mega fuse**

Cab Fuses (Groundsmaster 5910)

The cab fuse blocks are located in the cab headliner.

Identification and Function (Figs. 63 and 64)

Fuse 1F1 (15 Amp) supplies power to the windshield wiper.

Fuse 1F2 (15 Amp) supplies power to the heater circuit.

Fuse 1F3 (25 Amp) supplies power to the air conditioner circuit.

Fuse 2F1 (15 Amp) supplies power to the optional cab work lights.

Fuse 2F2 (15 Amp) supplies power to the cab dome light.

Fuses 1F4, 2F3 and 2F4 are available for optional equipment.

Testing

Make sure that ignition switch is OFF and key is removed from switch. Remove fuse from fuse block for testing. Fuse should have continuity across the fuse terminals.

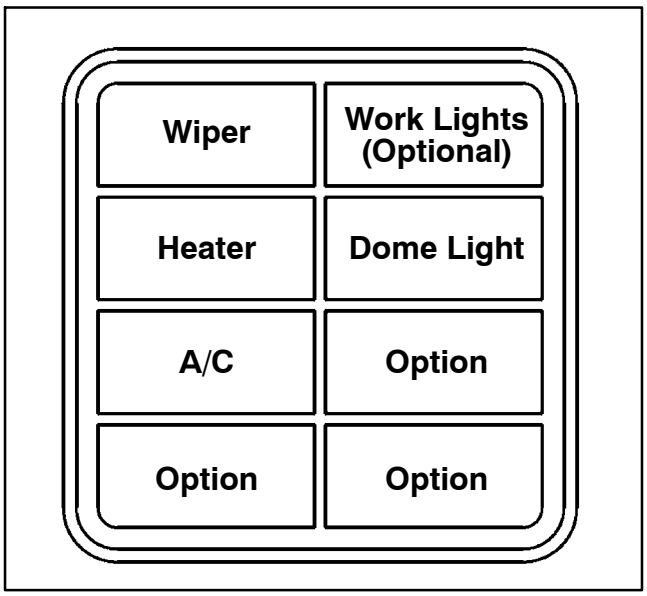


Figure 63

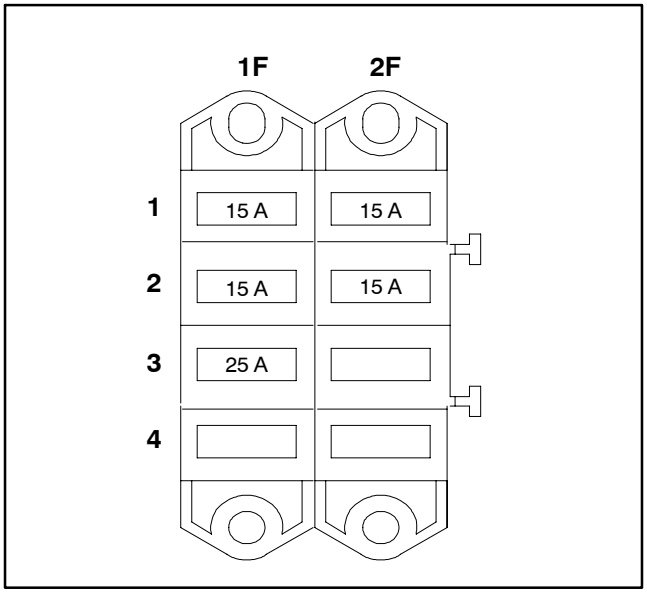


Figure 64

PTO Switch

The PTO switch is located on the console arm (Fig. 65). The PTO switch is pulled up to engage the PTO (cutting decks or implement).

The TEC−5002 controller monitors the position of the PTO switch (up or down). Using inputs from the PTO switch and other switches in the interlock system, the TEC controller controls the energizing of the hydraulic solenoid valves used to drive the cutting deck motors.

IMPORTANT: During machine operation, if the PTO shuts down and the Info Center indicates excessive engine coolant temperature, avoid shutting off the engine. Under this condition, the operator should disengage the PTO, slowly drive to a safe flat area, lower the engine speed to the SLOW position and engage the parking brake. The engine should be allowed to idle for several minutes while it cools to a safe level. Then, the cooling system should be checked before returning the machine to service.

Testing

1. Before disconnecting the PTO switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the PTO switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the PTO switch and circuit wiring **are not** functioning correctly, test PTO switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to PTO switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 − Chassis).

6. The switch terminals are marked as shown in Figure 66. The circuit logic of the PTO switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the wire harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Wiring Schematic and Circuit Drawings in Chapter 10 − Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 − Chassis).

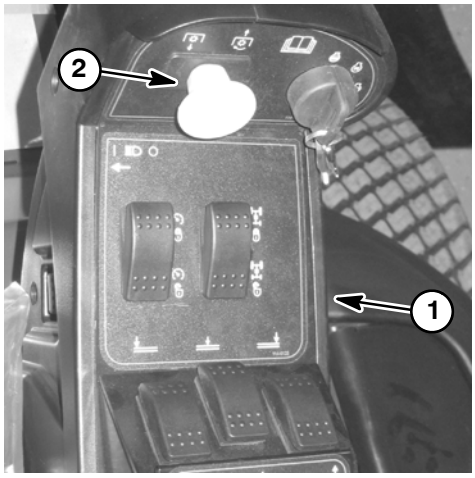


Figure 65

1. **Console arm**
2. **PTO switch**

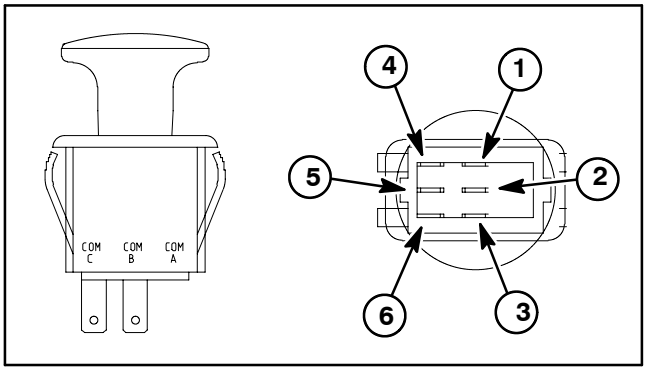


Figure 66

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

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

Cutting Deck Lift Switches

The cutting deck lift switches are used as inputs for the TEC−5001 controller to raise or lower the cutting decks. When the front of a lift switch is depressed and held, the controlled deck (left, front or right) will lower. When the rear of a lift switch is depressed and held, the controlled deck will raise. The deck will remain in position when the switch is released. The lift switches are located on the console arm (Fig. 67).

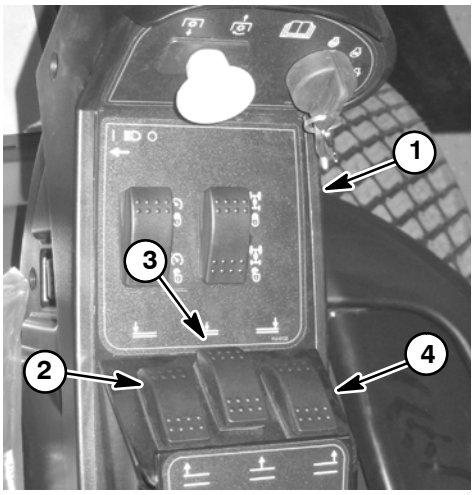


Figure 67

1. **Console arm**
2. **LH lift switch**
3. **Front lift switch**
4. **RH lift switch**

Testing

1. Before disconnecting a cutting deck lift switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the lift switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the lift switch and circuit wiring **are not** functioning correctly, test lift switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to cutting deck lift switches (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 68. The circuit logic of the lift switches is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

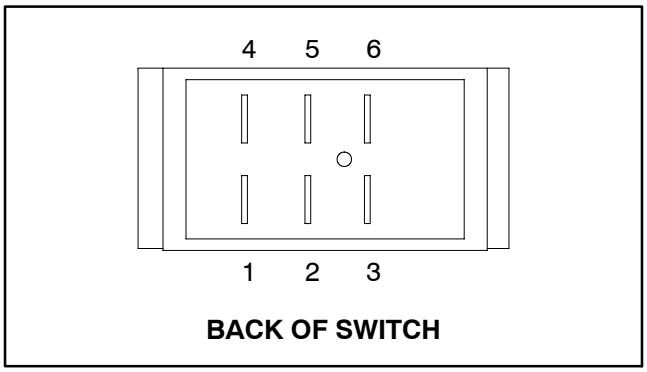


Figure 68

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
DECK RAISE	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
DECK LOWER	2 + 1 5 + 4	2 + 3 5 + 6

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Traction Assist Switch

The traction assist switch is used as an input for the TEC–5001 controller to energize the solenoid valve in the traction control manifold. When the traction assist switch is depressed, hydraulic flow is split equally between front and rear wheels for enhanced traction. The traction assist switch only functions when the machine is in low speed range and in the forward direction. The traction assist switch is located on the console arm (Fig. 69).

Testing

1. Before disconnecting the traction assist switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the traction assist switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the traction assist switch and circuit wiring **are not** functioning correctly, test traction assist switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to traction assist switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 70. The circuit logic of the traction assist switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

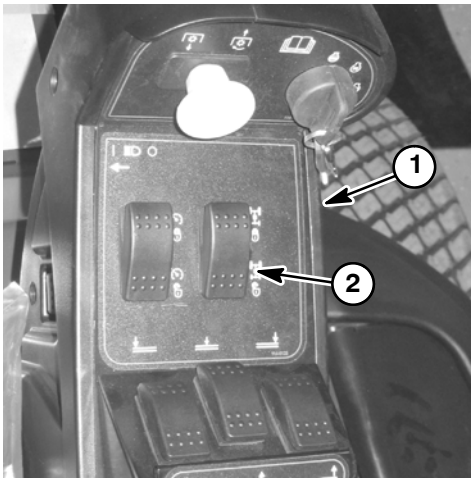


Figure 69

1. **Console arm**
2. **Traction assist switch**

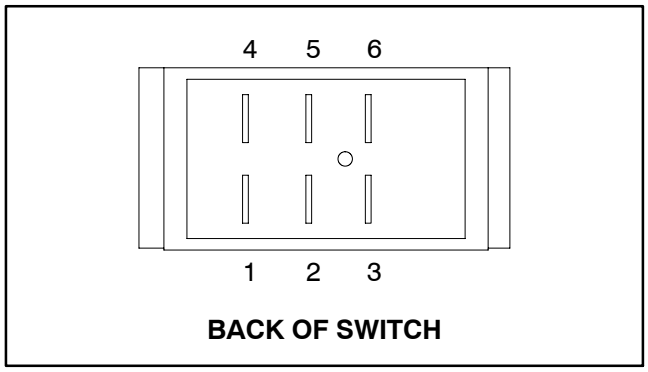


Figure 70

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
NORMAL	2 + 3 5 + 6	2 + 1 5 + 4
TRACTION ASSIST	2 + 1 5 + 4	2 + 3 5 + 6

Cruise Control Switch

The cruise control switch is used as an input for the TEC−5002 controller to maintain ground speed. The cruise control function is engaged (set) when the front of the cruise control switch is depressed. The cruise control function is disengaged when the rear of the cruise control switch is depressed. The cruise control switch is located on the console arm (Fig. 71).

NOTE: The cruise function is also disengaged if the brake pedal is applied or if the traction pedal is pressed to the reverse direction.

Testing

1. Before disconnecting the cruise control switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the cruise control switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the cruise control switch and circuit wiring **are not** functioning correctly, test cruise control switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disassemble console arm to gain access to cruise control switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. The switch terminals are marked as shown in Figure 72. The circuit logic of the cruise control switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Assemble console arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

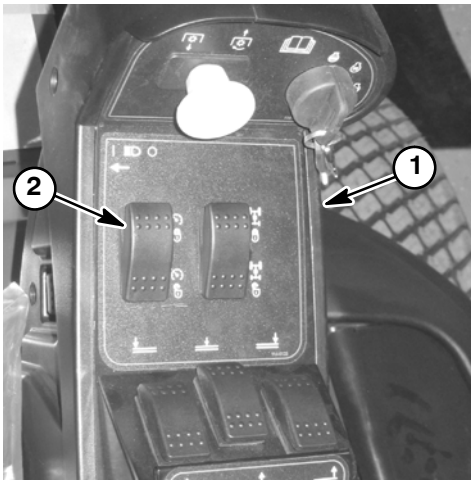


Figure 71

1. **Console arm**
2. **Cruise control switch**

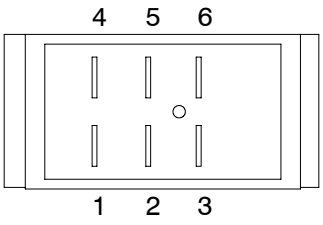


Figure 72

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
NORMAL	2 + 3	5 + 6
CRUISE ENGAGE	2 + 3 5 + 6	NONE
CRUISE DISENGAGE	NONE	ALL

Throttle Control Switch

The throttle control switch is used as an input for the engine control module to adjust the engine speed to one of three (3) RPM settings: low idle (1350 RPM), mid idle (2400 RPM) or high idle (2750 RPM). The throttle control switch is located on the steering tower (Fig. 73).

Testing

1. Before disconnecting the throttle control switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the throttle control switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the throttle control switch and circuit wiring **are not** functioning correctly, test throttle control switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis). Locate throttle control switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 74. The circuit logic of the throttle control switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

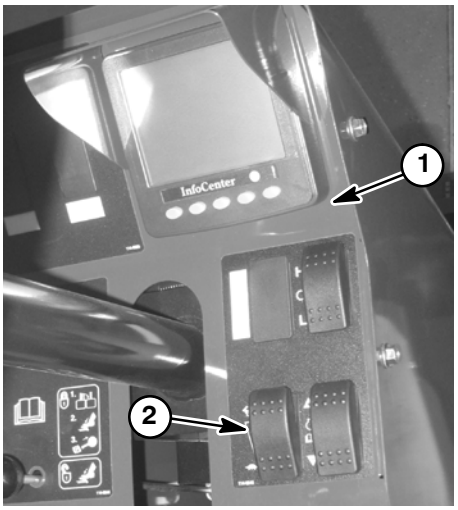


Figure 73

1. Steering tower
2. Throttle control switch

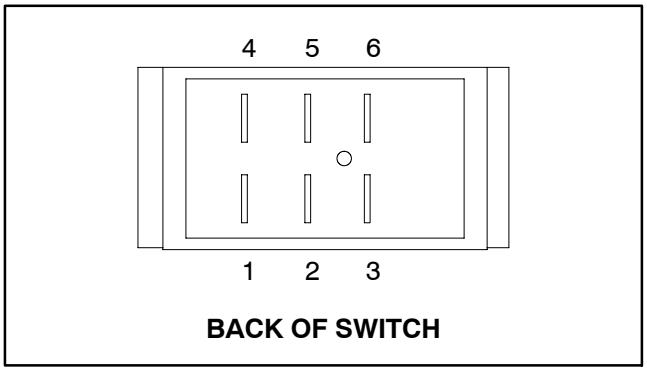


Figure 74

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
LOW IDLE	2 + 1 5 + 4	2 + 3 5 + 6
MID IDLE	2 + 3 5 + 4	2 + 1 5 + 6
HIGH IDLE	2 + 3 5 + 6	2 + 1 5 + 4

Increment/Decrement Switch

The increment/decrement switch is used as an input for the engine control module to raise or lower the engine speed in small amounts. When the switch is depressed and held in the forward position, the engine speed will increase. Conversely, when the rear of the switch is depressed, engine speed will decrease. The increment/decrement switch is located on the steering tower (Fig. 75).

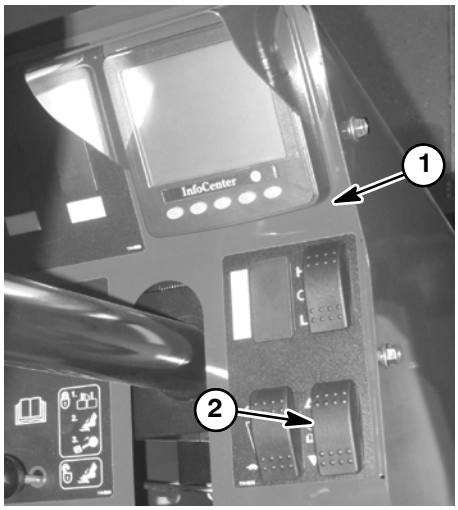


Figure 75

1. **Steering tower**
2. **Increment/decrement switch**

Testing

1. Before disconnecting the increment/decrement switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the increment/decrement switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the increment/decrement switch and circuit wiring **are not** functioning correctly, test increment/decrement switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis). Locate increment/decrement switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 76. The circuit logic of the increment/decrement switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

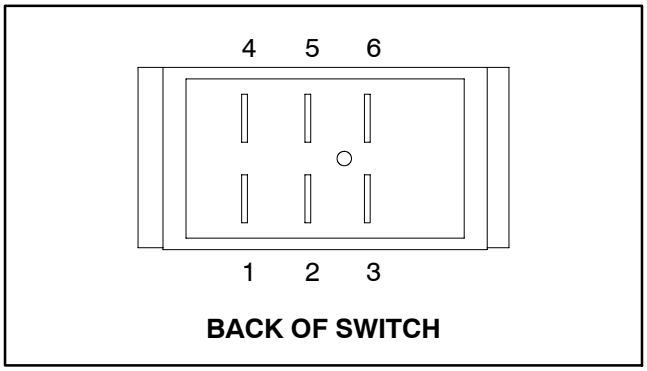


Figure 76

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
SPEED INCREASE	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
SPEED DECREASE	2 + 1 5 + 4	2 + 3 5 + 6

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Hi-Lo Speed Switch

The hi-lo speed switch is used as an input for the TEC-5001 controller to set the machine traction speed for high speed range (transport) or low speed range (mow). To change speed range settings with the speed switch, the machine must be stopped or moving very slowly. The hi-lo speed switch is located on the steering tower (Fig. 77).

Testing

1. Before disconnecting the mow/transport switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the mow/transport switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the mow/transport switch and circuit wiring **are not** functioning correctly, test mow/transport switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 - Chassis). Locate mow/transport switch and unplug wire harness connector from switch.

6. The switch terminals are marked as shown in Figure 78. The circuit logic of the mow/transport switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

7. Connect the harness connector to the switch after testing.

8. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 - Foldout Drawings).

9. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 - Chassis).

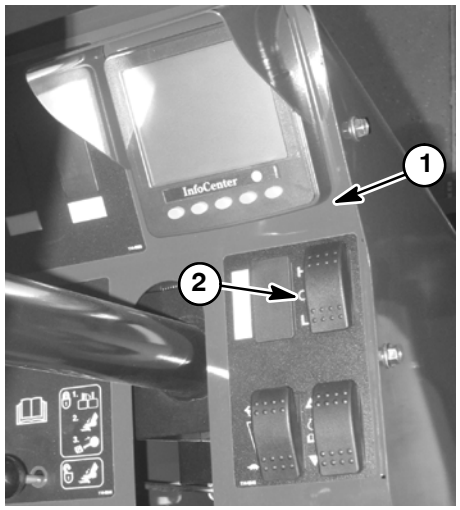


Figure 77

1. **Steering tower**
2. **Hi-Lo speed switch**

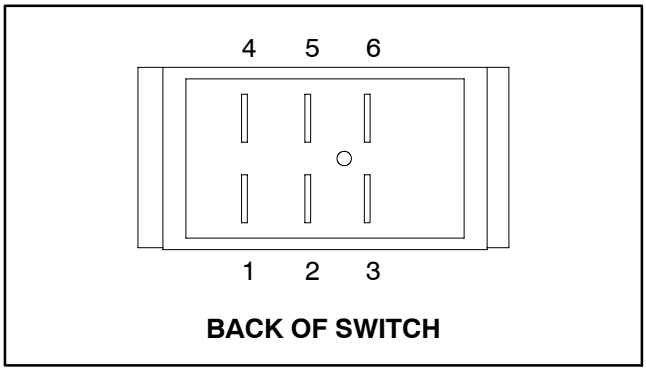


Figure 78

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
MOW SPEED	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
TRANSPORT SPEED	2 + 1 5 + 4	2 + 3 5 + 6

Headlight Switch

The headlight switch is used as an input for the TEC–5002 controller to provide power for the headlights and taillights. The headlight switch is located on the operator side of the control console.

Testing

1. Before disconnecting the headlight switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the headlight switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the headlight switch and circuit wiring **are not** functioning correctly, test headlight switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove inside control arm cover to gain access to headlight switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate headlight switch and unplug wire harness connector from switch.

7. The switch terminals are marked as shown in Figure 80. The circuit logic of the headlight switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

8. Connect the harness connector to the switch after testing.

9. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

10. Install inside control arm cover (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

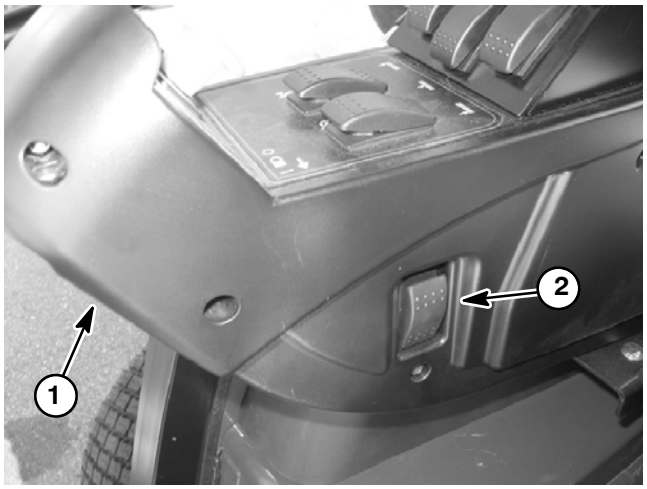


Figure 79

1. Console arm **2. Headlight switch**

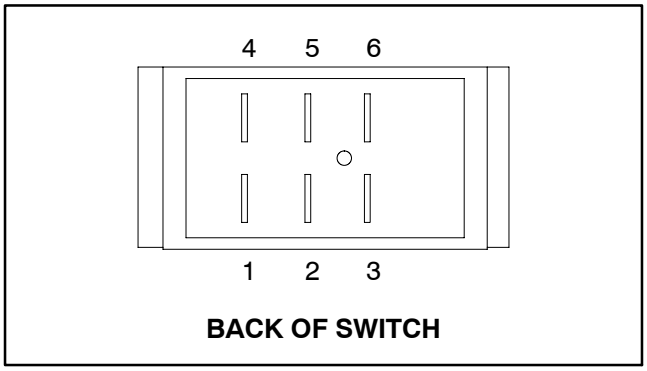


Figure 80

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 3	5 + 6
ON	2 + 1	5 + 4

Turn Signal Switch

The turn signal switch is used as an input for the TEC–5002 controller to provide power for the turn signals. The switch is located on the steering tower (Fig. 81).

Testing

1. Before disconnecting the turn signal switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the turn signal switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the turn signal switch and circuit wiring **are not** functioning correctly, test turn signal switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate turn signal switch and unplug wire harness connector from switch.

7. The switch terminals are marked as shown in Figure 82. The circuit logic of the turn signal switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

8. Connect the harness connector to the switch after testing.

9. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

10. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

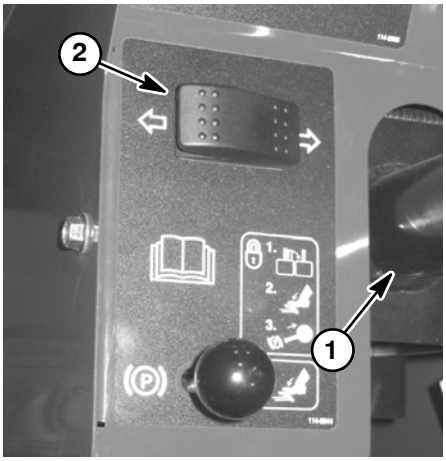


Figure 81

1. Steering column
2. Turn signal switch

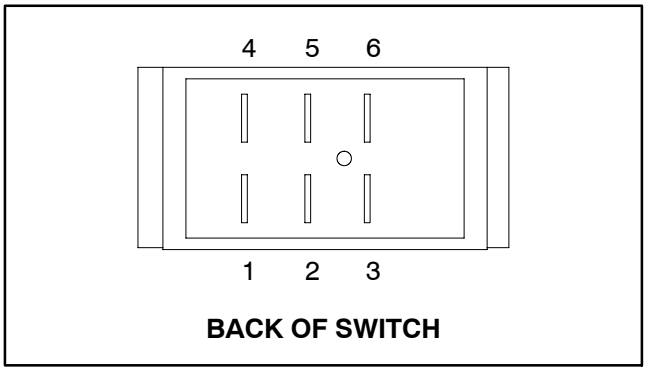


Figure 82

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
RIGHT TURN	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
LEFT TURN	2 + 1 5 + 4	2 + 3 5 + 6

Windshield Wiper/Washer Switch (Groundsmaster 5910)

The windshield wiper/washer switch is used to control operation of the windshield wiper and washer pump. The windshield wiper/washer switch is located in the cab headliner (Fig. 83).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove switch plate from cab headliner.

3. Locate windshield wiper/washer switch and unplug wire harness connector from switch.

4. The switch terminals are marked as shown in Figure 84. The circuit logic of the wiper/washer switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

5. Connect the harness connector to the switch after testing.

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

7. Install switch plate to cab headliner.

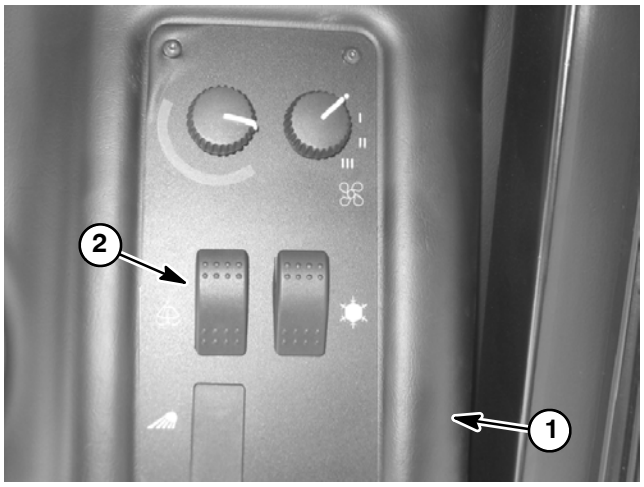


Figure 83

1. Cab headliner **2. Wiper/washer switch**

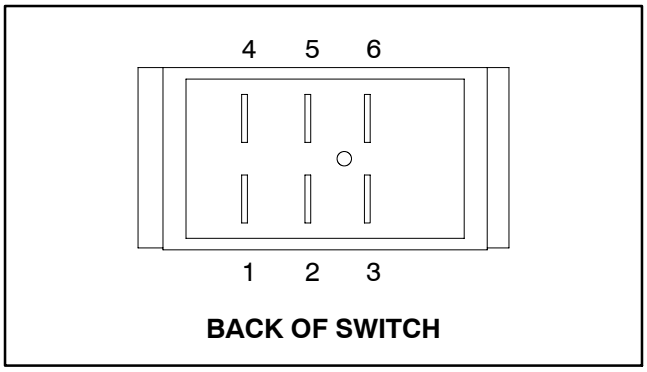


Figure 84

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF	NONE	ALL
WIPER ON	2 + 3	5 + 6
WASHER ON	2 + 3 5 + 6	NONE

Air Conditioning Switch (Groundsmaster 5910)

The air conditioning switch is used to control operation of the air conditioning system. The switch is located in the cab headliner (Fig. 85).

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove switch plate from cab headliner.

3. Locate air conditioning switch and unplug wire harness connector from switch.

4. The switch terminals are marked as shown in Figure 86. The circuit logic of the air conditioning switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

5. Connect the harness connector to the switch after testing.

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).

7. Install switch plate to cab headliner.

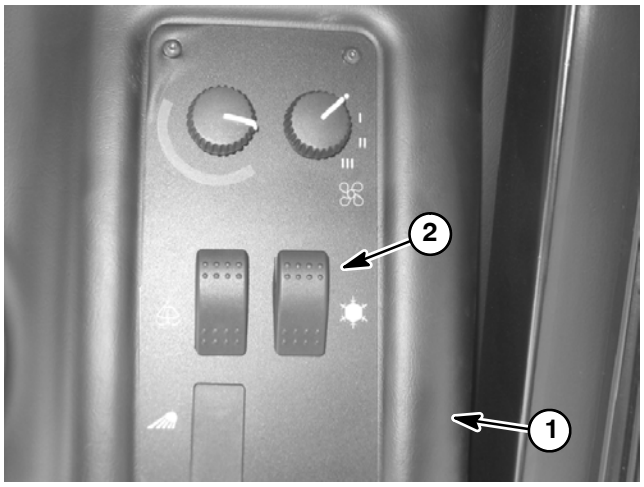


Figure 85

1. **Cab headliner**
2. **Air conditioning switch**

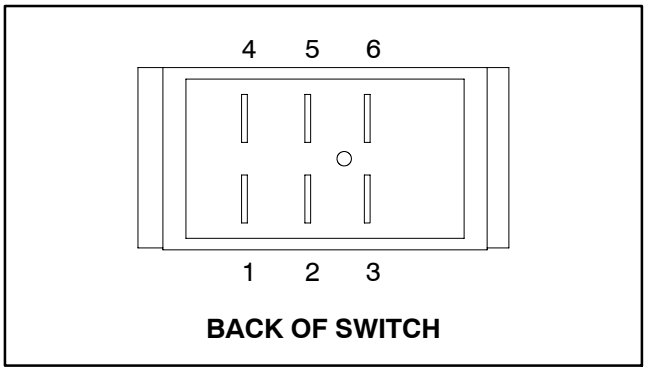


Figure 86

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
AC OFF	2 + 3 5 + 6	2 + 1 5 + 4
AC ON	2 + 1 5 + 4	2 + 3 5 + 6

Intake Air Heater Contactor

The intake air heater contactor is used on the Groundsmaster 5900 and 5910 to provide current for the engine intake air heater. The contactor is attached to a frame bracket behind the batteries (Fig. 87). The contactor is energized by the engine ECM when low temperatures are detected prior to starting the engine.

Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less) that is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

1. Park machine on a level surface, lower cutting decks, stop engine, engage parking brake and remove key from the ignition switch. Raise and support hood to access intake air heater solenoid.

2. Disconnect battery cables from battery terminals (see Battery Service in the Service and Repairs section of this chapter).

3. Locate contactor. Note wire connector locations on contactor for assembly purposes. Disconnect all harness electrical connectors from contactor.

4. Using jumper wires, apply 12 VDC directly across the contactor coil posts (Fig. 88). The contactor should click. With the contactor coil energized, resistance across the contactor main posts should be less than **1 ohm**.

5. Remove voltage from contactor coil posts. The contactor should click. With the contactor coil not energized, resistance across the contactor main posts should be **infinite ohms**.

6. With voltage removed from all contactor posts, measure resistance across the contactor coil posts (Fig. 88). Resistance of the coil should be approximately 13.5 ohms.

7. With voltage removed from all contactor posts, measure resistance across the contactor main posts (Fig. 88). Resistance should be **infinite ohms**.

8. If testing determines that contactor is faulty, replace contactor.

9. After testing, connect harness connectors to contactor.

10. Connect battery cables to battery terminals (see Battery Service in the Service and Repairs section of this chapter).

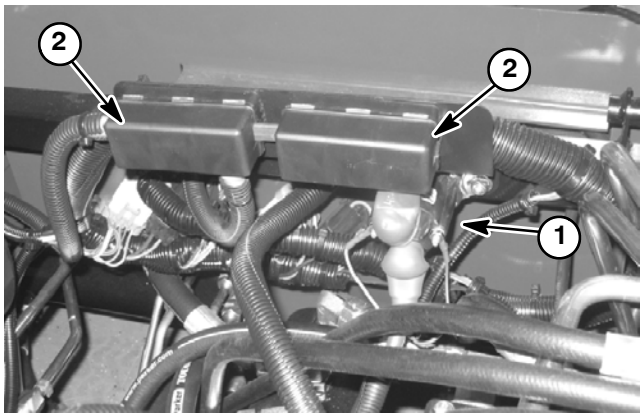


Figure 87

1. **Air heater contactor**
2. **Mega fuse holder**

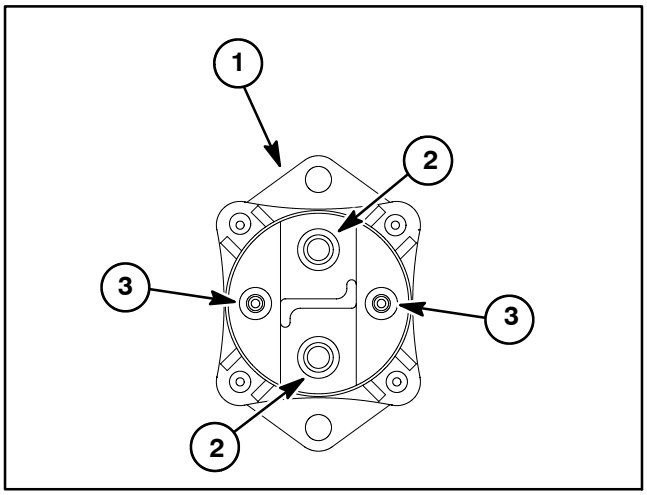


Figure 88

1. **Contactor**
2. **Main post**
3. **Coil posts**

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch is an input for the TEC−5002 controller. If the traction system or PTO switch is engaged when the operator raises out of the seat, the traction system or PTO operation will cease. The seat switch and its electrical connector are located in the seat assembly.

Testing

1. Before disconnecting the seat switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the seat switch and circuit wiring **are not** functioning correctly, test seat switch.

NOTE: Testing of the seat switch can be done without seat removal by disconnecting the seat wire from the machine wiring harness (Fig. 89).

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Disconnect seat switch electrical connector from the machine wire harness.

6. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

7. With no pressure on the seat, there should be **no continuity** (infinite resistance) between the seat switch terminals.

8. Press directly onto the seat switch through the seat cushion. There should be **continuity** (zero resistance) as the seat cushion approaches the bottom of its travel.

9. If testing determines that seat switch is faulty, replace seat switch (see Operator Seat Service in the Service and Repairs section of Chapter 7 − Chassis).

10. Connect switch connector to the machine wire harness.

11. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

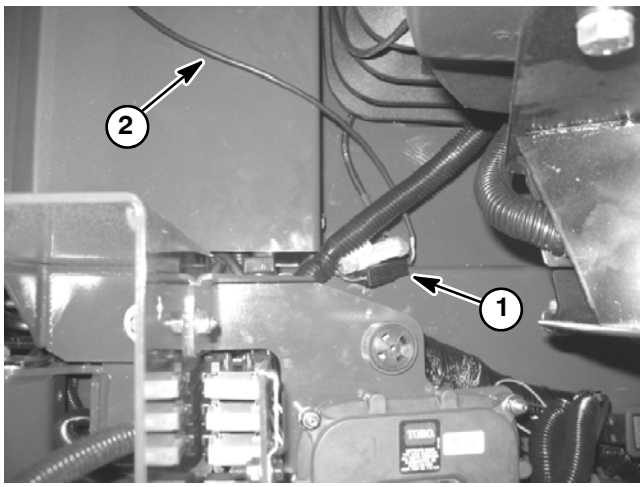


Figure 89

1. **Electrical connector**
2. **Seat switch wire**

Parking Brake Switch

The switch used for the parking brake is a normally open proximity switch that is located under the steering tower cover (Fig. 90). The parking brake switch is an input for the TEC–5002 controller. When the parking brake **is not** applied, a tab on the brake rod is positioned near the switch sense zone which causes the switch to close. When the parking brake **is** applied, the brake rod tab is positioned away from the switch allowing the switch to be in its normal, open position (no continuity).

Testing

1. Before disconnecting the parking brake switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the parking brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the parking brake switch and circuit wiring **are not** functioning correctly, test brake switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch.

5. Remove front steering tower cover (see Steering Tower Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

6. Locate parking brake switch and unplug wire harness connector from switch.

7. Disconnect switch electrical connector from the machine wire harness.

8. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

9. When the parking brake is not applied (brake rod tab away from brake switch), there should be **no continuity** (infinite resistance) between the switch terminals.

10. When the parking brake is applied (brake rod tab close to brake switch), there should be **continuity** (zero resistance) between the switch terminals.

11. Replace switch if necessary.

12. Correctly connect the wire harness connector to the parking brake switch after testing is completed.

13. Install front steering tower cover (see Steering Tower Assembly in the Service and Repairs section of Chapter 7 – Chassis).

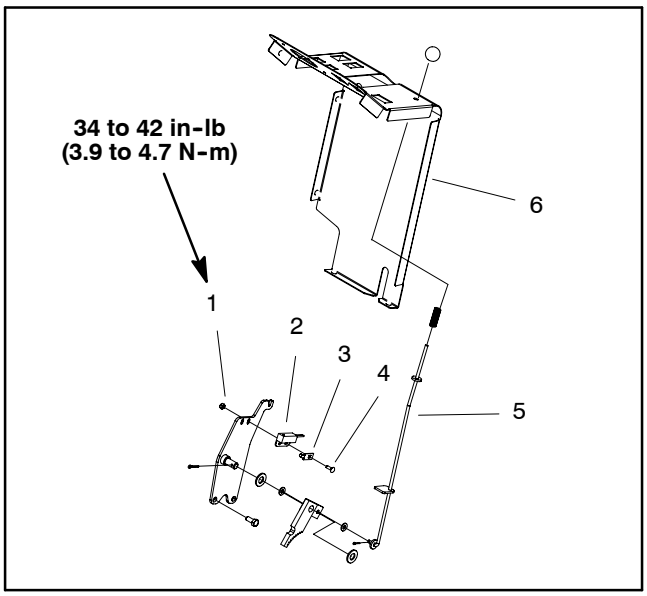


Figure 90

1. **Lock nut**
2. **Parking brake switch**
3. **Switch plate**
4. **Carriage bolt**
5. **Parking brake rod**
6. **Steering tower cover**

Adjustment

With the parking brake not applied (brake rod tab near the switch), there should be a 0.062” (1.6 mm) gap between the switch and the brake rod tab.

Service Brake Switches

The two (2) switches used for the service brakes are normally open switches that are located under the footrest panel (Fig. 90). The service brake switches provide inputs for the TEC−5002 controller. When a brake pedal is not depressed, the brake pedal assembly contacts the switch plunger to close the switch. When a brake is applied, the brake pedal assembly moves away from the switch plunger, allowing the switch plunger to extend and the switch to open.

Testing

1. Before disconnecting a service brake switch for testing, the switch and its circuit wiring should be tested as a TEC controller input with the Info Center Diagnostic Display (see Info Center Display in this section).

2. If the Diagnostic Display verifies that the service brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary.

3. If the Diagnostic Display determines that the service brake switch and circuit wiring **are not** functioning correctly, test seat switch.

4. Make sure ignition switch is OFF. Remove key from ignition switch. Locate service brake switch for testing.

5. Disconnect switch electrical connector from the machine wire harness.

6. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

7. When the service brake is not applied (service brake switch plunger depressed), there should be **continuity** (zero resistance) between the switch terminals.

8. When the service brake is applied (service brake switch plunger extended), there should be **no continuity** (infinite resistance) between the switch terminals.

9. Replace switch if necessary.

10. Reconnect switch electrical connector to the machine wire harness after testing.

Adjustment

Adjust the service brake switch so that the switch plunger always makes full contact with the brake pedal. Tighten fasteners from **13 to 17 in−lb (1.5 to 1.9 N−m)**.

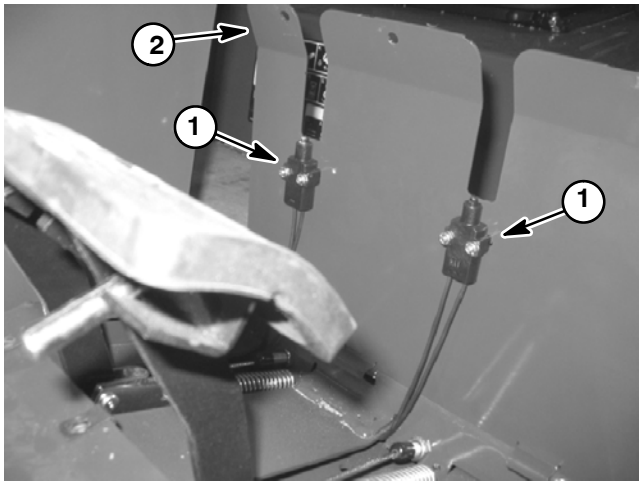


Figure 91

1. **Service brake switch**
2. **Footrest panel**

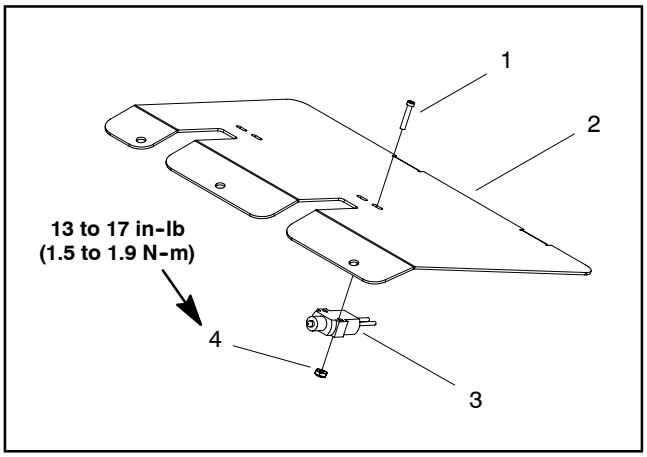


Figure 92

1. **Screw (2 per switch)**
2. **Footrest panel**
3. **Switch (2 used)**
4. **Lock nut (2 per switch)**

Main Power, Controller, Start and Cab (Groundsmaster 5910) Relays

The Groundsmaster 5900 and 5910 use three (3) identical relays to control electrical power circuits. The Groundsmaster 5910 uses an additional relay for the cab electrical components. The relays are attached to the operator platform under the power center cover (Fig. 93).

The main power relay supplies electrical power for the Info Center Display, operator seat, power point receptacle, horn, road lights, brake lights and optional electrical equipment. The main power relay is energized when the ignition switch is in the START or RUN position.

The controller relay supplies electrical input power for the two (2) electrical controllers (TEC−5001 and TEC−5002). The controller relay is energized when the ignition switch is in the START or RUN position.

The start relay supplies electrical power for the engine starter solenoid. The start relay is energized by the TEC−5002 controller when the correct start functions are initiated (ignition switch to RUN, traction pedal in neutral, PTO switch OFF).

The cab relay used on the Groundsmaster 5910 supplies power for cab electrical functions (air conditioning, fan, windshield washer/wiper, cab work lights). This relay is energized when the ignition switch is in the START or RUN position.

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove power center cover from operator platform to access relays.

3. Disconnect the machine wire harness connector from the relay to be tested.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value for the tested component.

4. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 94). Resistance should be between 70 and 100 ohms.

5. Verify infinite resistance (no continuity) between terminals 30 and 87.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

7. Disconnect meter leads and jumper wires from the relay terminals. Reconnect machine wire harness connector to relay.

8. Install and secure power center cover.

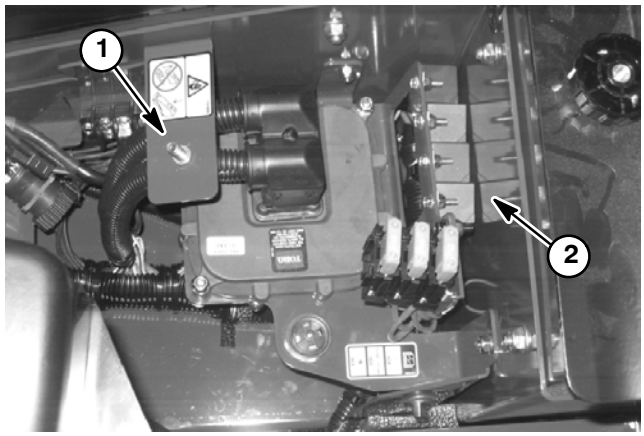


Figure 93

1. **Cover attachment screw** 2. **Relay location**

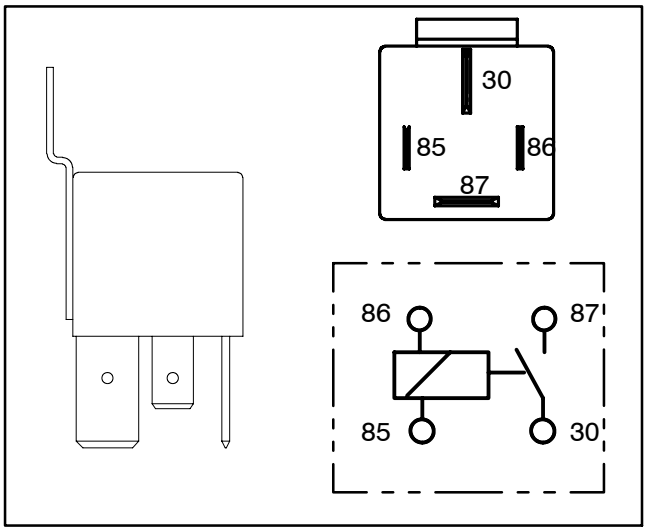


Figure 94

Air Conditioning Relay (Groundsmaster 5910)

A relay is used to control the air conditioning electrical power circuit on the Groundsmaster 5910. When energized by the air conditioning switch, the relay provides current for the air conditioning components. The relay is attached to the cab headliner above the switch panel.

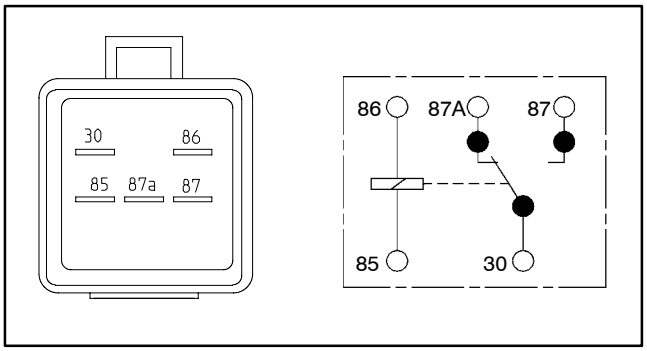


Figure 95

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Remove screws that secure switch panel to headliner in cab. Locate relay and disconnect the machine wire harness connector from the relay. Remove relay for easier testing.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value for the tested component.

3. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 95). Resistance should be between 70 and 90 ohms.

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should have continuity between terminals 30 and 87 as +12 VDC is applied to terminal 85. The relay should not have continuity between terminals 30 and 87 as +12 VDC is removed from terminal 85.

5. Disconnect voltage and multimeter leads from the relay terminals.

6. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should not have continuity between terminals 30 and 87A as +12 VDC is applied to terminal 85. The relay should have continuity between terminals 30 and 87A as +12 VDC is removed from terminal 85.

7. Disconnect voltage and multimeter leads from the relay terminals.

8. Secure relay to machine and connect machine wire harness connector to relay.

Toro Electronic Controller (TEC)

Groundsmaster 5900 and 5910 machines use two (2) Toro Electronic Controllers (TEC). The controllers are attached to the operator platform under the power center cover (Fig. 96). The Info Center Display should be used when checking inputs and outputs of the TEC used on your Groundsmaster (see Troubleshooting in this chapter).

Logic power is provided to both of the controllers as long as the battery cables are connected to the batteries. A 2 amp fuse provides circuit protection for this logic power to each of the controllers.

The TEC−5002 master controller (lower) monitors the states of the following components as inputs: ignition switch, seat switch, parking brake switch, service brake switches, traction pedal potentiometer, hydraulic temperature sender, fuel level sender, PTO switch and cruise control switch.

The TEC−5002 controller controls electrical output to the following components: TEC−5001, traction pump solenoid coils, engine cooling fan hydraulic valve solenoid coils, PTO circuit hydraulic valve solenoid coils, start relay and turn signals. Circuit protection for TEC−5002 outputs is provided by fuses 3F2, 3F3 and 3F4.

The TEC−5001 slave controller (upper) monitors the states of the following components as inputs: ignition switch, cutting deck lift switches, traction assist switch, mow/transport switch and cutting deck position sensors.

The TEC−5001 controller controls electrical output to the following components: lift circuit hydraulic valve solenoid coils, traction assist hydraulic valve solenoid coil, mow/transport hydraulic valve solenoid coil and audio alarm. Circuit protection for TEC−5001 outputs is provided by fuses 4F2, 4F3 and 4F4.

Because of the solid state circuitry built into the TEC, there is no method to test the controllers directly. The controllers may be damaged if an attempt is made to test them with an electrical test device (e.g. digital multimeter).

NOTE: The TEC controllers and the Info Center Display used on the Groundsmaster 5900 and 5910 are matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

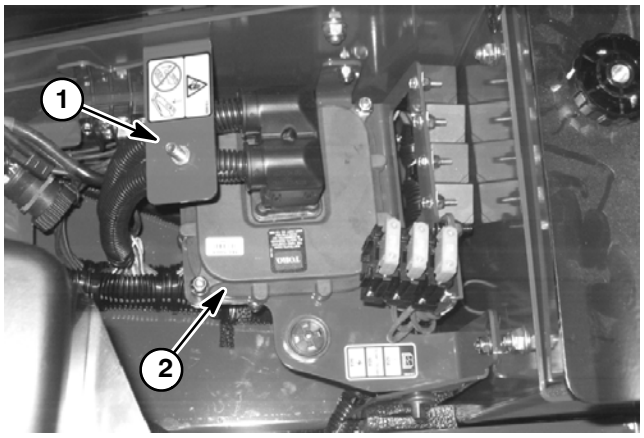


Figure 96

1. **Cover attachment point**
2. **Controller location**

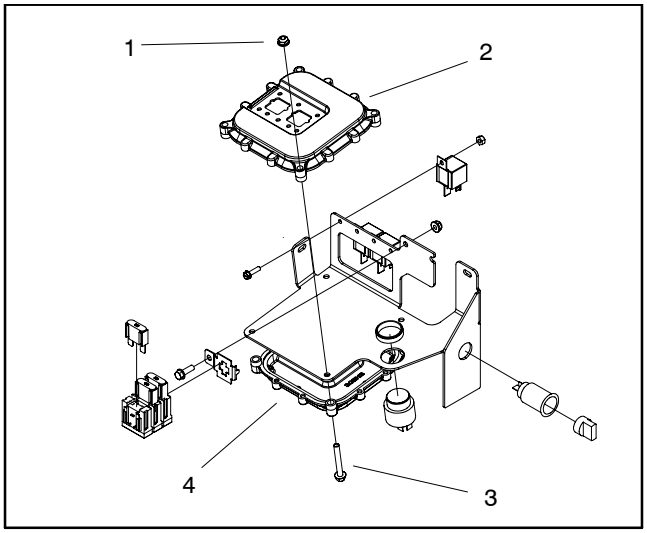


Figure 97

1. **Flange nut (4 used)**
2. **TEC−5001**
3. **Flange screw (4 used)**
4. **TEC−5002**

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Hydraulic Valve Solenoid Coils

There are numerous hydraulic valve solenoid coils on the Groundsmaster hydraulic manifolds. When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic flow. Testing of these solenoid coils can be done with the solenoid coil on the hydraulic valve.

Testing

NOTE: A faulty solenoid coil or solenoid circuit wiring problem will not be identified by the Info Center Display. The Info Center Display can be used to verify that output current from the TEC is available for the solenoid coil but the Display will not verify that the solenoid coil and circuit wiring is functioning correctly.

1. Identify the solenoid coil that is to be tested.

2. Disconnect wire harness electrical connector from hydraulic solenoid valve coil that is to be tested.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter may display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

3. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid coil. The resistance for the solenoid coils is identified below:

A. The solenoid coils at the following control manifold ports are the same. Resistance of these coils should be approximately 8.8 ohms.
PTO manifold port S (Figs. 98, 99 and 100)
Traction manifold port S (Fig. 101)
4WD manifold port SV (Fig. 102)
Lift manifold ports S1, S4, S5 and S9 (Fig. 103)

B. The solenoid coils at the following control manifold ports are the same. Resistance of these coils should be approximately 7.1 ohms.
Lift manifold ports S2, S3, S6, S7 and S8 (Fig. 103)
Steering/cooling fan manifold port PRV (Fig. 104)

C. Resistance of the solenoid coil at steering/cooling fan manifold port S should be approximately 4.6 ohms (Fig. 104).

4. If solenoid coil resistance is incorrect, replace coil (see Hydraulic Valve Solenoid Coil Removal and Installation in the Service and Repairs section of this chapter).

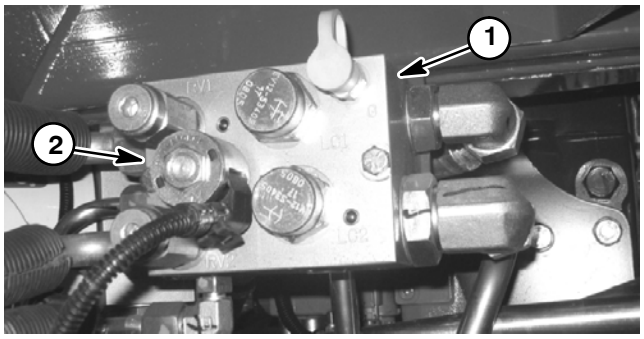


Figure 98

1. **LH PTO manifold** 2. **Solenoid coil (port S)**

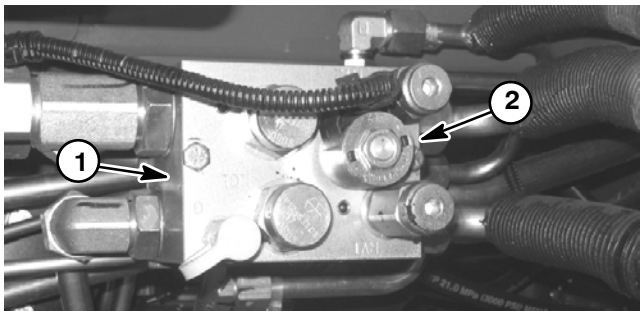


Figure 99

1. **RH PTO manifold** 2. **Solenoid coil (port S)**

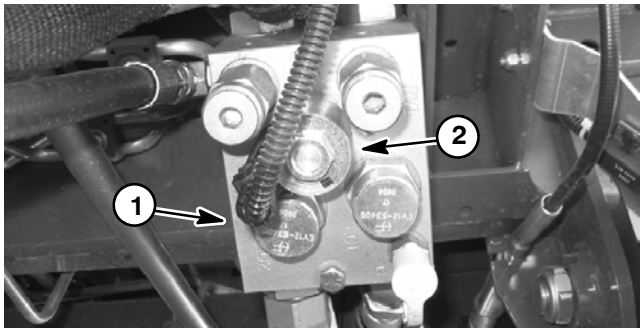


Figure 100

1. **Center PTO manifold** 2. **Solenoid coil (port S)**

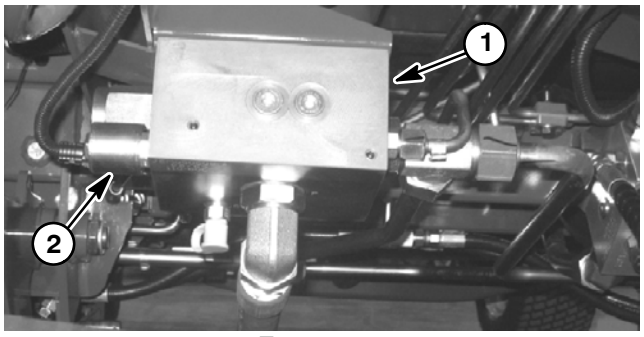


Figure 101

1. **Traction control manifold** 2. **Solenoid coil (port S)**

NOTE: To assist in troubleshooting, identical solenoid coils can be exchanged. If the machine problem follows the exchanged coil, an electrical problem likely exists. If the problem remains unchanged, something other than the solenoid coil is the likely problem source (e.g. switch, circuit wiring, hydraulic problem).

5. After testing is complete, connect wire harness electrical connector to the solenoid coil.

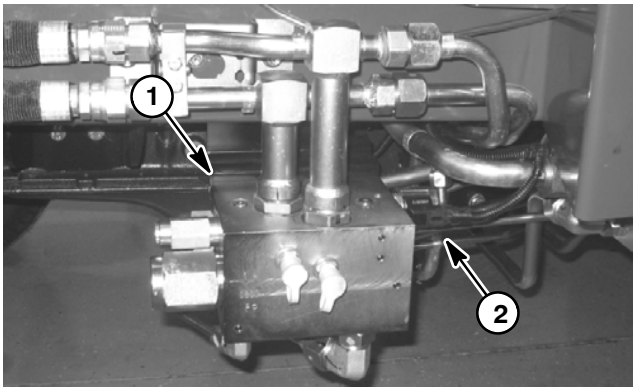


Figure 102

1. **4WD control manifold**
2. **Solenoid coil (port SV)**

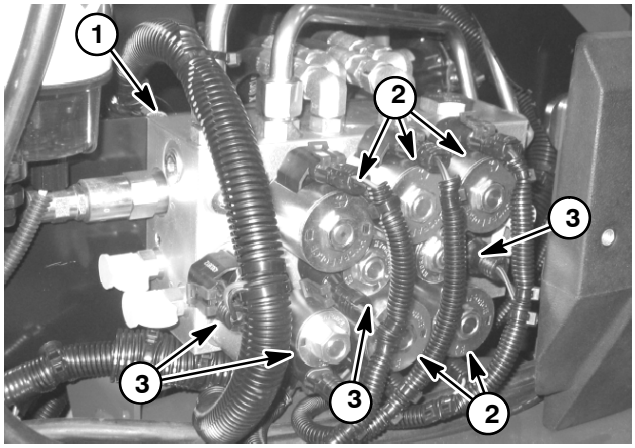


Figure 103

1. **Lift control manifold**
2. **Solenoid coil (ports S2, S3, S6, S7 and S8)**
3. **Solenoid coil (ports S1, S4, S5 and S9)**

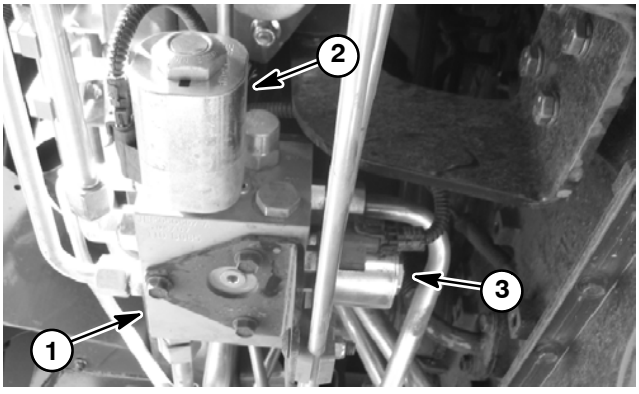


Figure 104

1. **Steering/fan manifold**
2. **Solenoid coil (port S)**
3. **Solenoid coil (port PRV)**

Fuel Sender

The fuel sender is located on top of the fuel tank.

Testing

1. Remove blue/red wire and black ground wire from the fuel sender.

CAUTION

When testing circuit wiring and fuel gauge, make sure wire connections are secure before turning ignition switch RUN to prevent an explosion or fire from sparks.

2. To test the circuit wiring and Info Center Display fuel gauge, connect blue/red and black wires and turn ignition switch to RUN. Fuel gauge should indicate a full fuel tank. Turn ignition switch OFF and continue testing fuel sender if circuit wiring and gauge are acceptable.

3. Remove screws and lock washers that secure the sender to the fuel tank.

4. Remove sender and gasket from the fuel tank. Clean any fuel from the sender.

NOTE: Before taking small resistance readings with a digital multimeter, short meter test leads together. The meter will display a small resistance value. This internal resistance of the meter and test leads should be subtracted from the measured value of the component.

CAUTION

Make sure sending unit is completely dry (no fuel on it) before testing. Perform test away from the tank to prevent an explosion or fire from sparks.

5. Check resistance of the sender with a multimeter (Fig. 105).

   A. Resistance with the float in the full position should be from 27.5 to 39.5 ohms.

   B. Resistance with the float in the empty position should be from 240 to 260 ohms.

6. Replace sender as necessary. Reinstall sender into fuel tank.

7. Reconnect wires to fuel sender. Apply skin–over grease (Toro Part No. 505–165) to sender terminals.

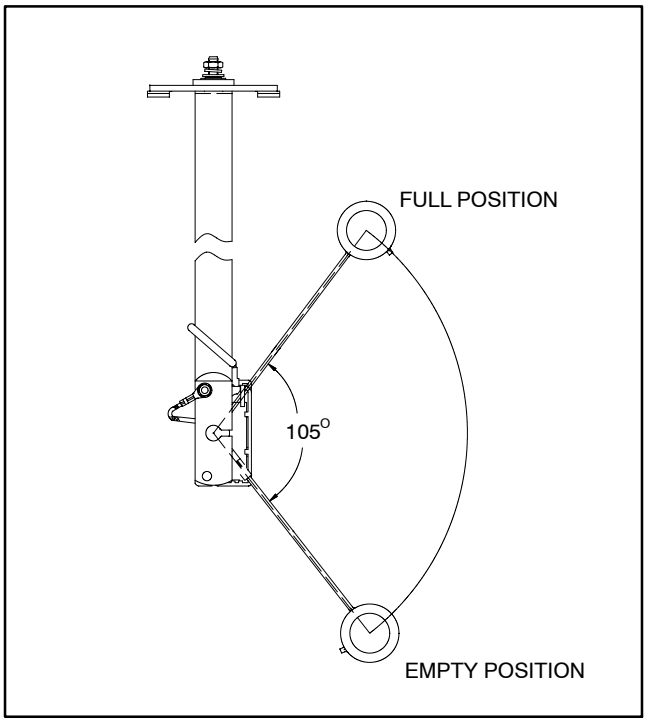


Figure 105

Hydraulic Oil Temperature Sender

The hydraulic oil temperature sender is attached to the hydraulic flush manifold in port TS (Fig. 106).

Testing

1. Locate oil temperature sender on hydraulic flush manifold. Disconnect wire harness connector from temperature sender.

2. Thoroughly clean hydraulic flush manifold around temperature sender. Remove sender from manifold.

3. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Fig. 107).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

NOTE: Prior to taking resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured value of the component you are testing.

4. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.

   A. The meter should indicate from 11.6 to 13.5 ohms at 68º F (20º C).

   B. The meter should indicate from 2.3 to 2.5 ohms at 140º F (60º C).

   C. The meter should indicate from 0.6 to 0.7 ohms at 212 º F (100º C).

   D. Replace sender if specifications are not met.

5. After allowing the sender to cool, install sender to the flush control manifold.

   A. Install new O-ring on sender.

   B. Install sender into the hydraulic flush manifold. Torque sender to **12 ft-lb (16.3 N-m)**.

   C. Reconnect harness wire to sender.

6. Check and fill hydraulic system to proper level.

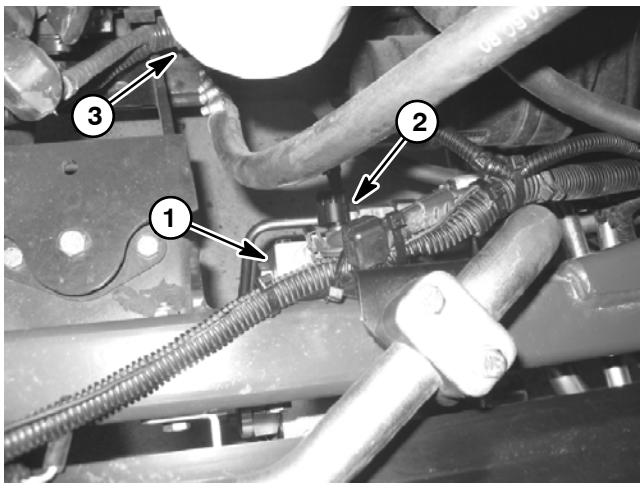


Figure 106

1. **Hydraulic flush manifold**
2. **Oil temperature sender**
3. **Fuel water separator**

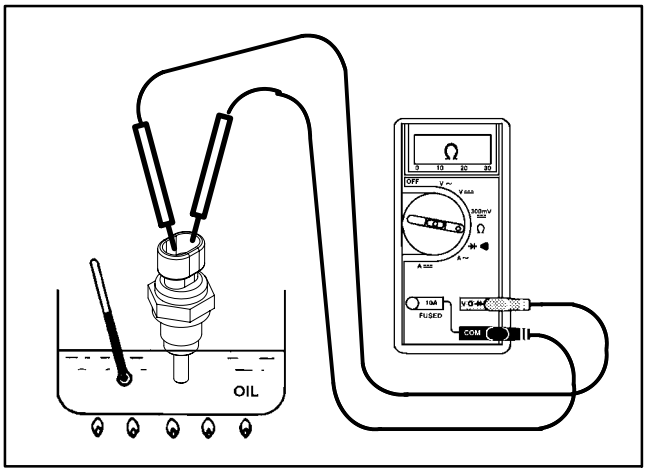


Figure 107

Diode Assembly

A diode assembly is used in the Groundsmaster 5900 wire harness (Fig. 109). The diode is used for circuit protection from voltage spikes that occur when the starter solenoid is de−energized. The diode plugs into the wire harness near the fuel water separator.

Testing

The diode can be tested using a digital multimeter (diode test or ohms setting) and the table below.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

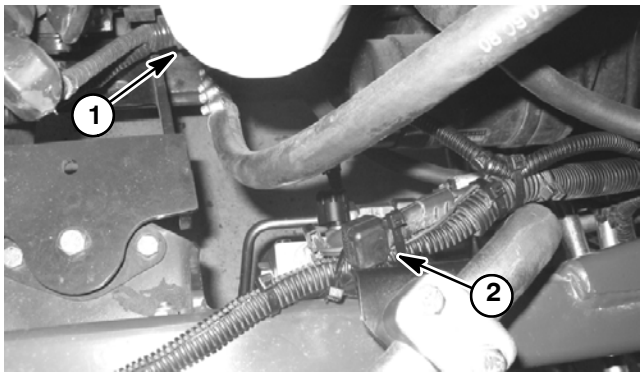


Figure 108

1. Fuel water separator
2. Diode

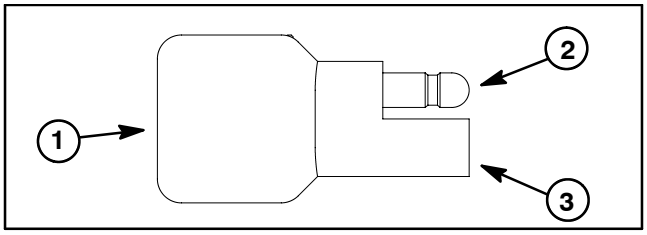


Figure 109

1. Diode
2. Male terminal
3. Female terminal

Audible Alarm

The audible alarm sounds to notify the operator when a machine problem exists. Electrical current for the alarm is provided as an output from the slave Toro Electronic Controller. The audible alarm is located to the right of the operator seat under the power center console (Fig. 110).

Testing

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

1. Make sure ignition switch is OFF. Remove key from ignition switch.

1. Remove power center cover from operator platform to access audible alarm.

2. Isolate alarm from the circuit. Correctly connect 12VDC source to the terminals (Fig. 111).

3. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit.

4. Install and secure power center cover.

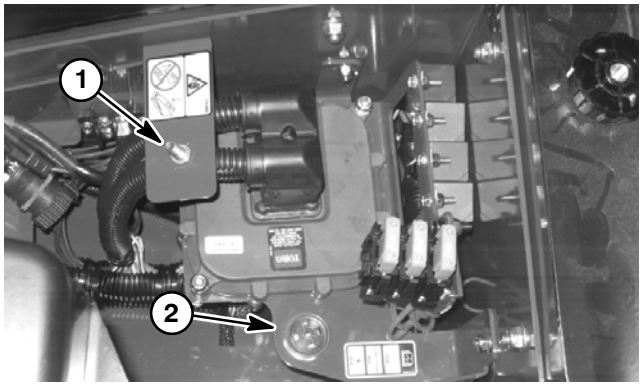


Figure 110

1. Cover attachment screw
2. Audible alarm

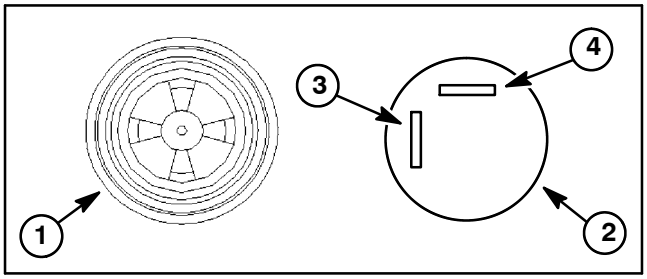


Figure 111

1. Top view
2. Bottom view
3. Positive (+) terminal
4. Negative (-) terminal

Traction Pedal Potentiometer

The traction pedal potentiometer is connected to the traction pedal assembly (Fig. 112). This potentiometer determines the neutral band for the traction pedal, the direction of travel desired by the operator and the traction speed. The potentiometer is a single analog, dual digital signal electronic device. The potentiometer portion is a variable resistor that provides an analog signal for the TEC−5002 controller to determine the desired ground speed based on how far the traction pedal is moved. The traction pedal potentiometer also houses two (2) switches that are used to determine the neutral position (deadband) and the indicated direction of travel (forward or reverse). As the traction pedal is depressed, the internal wiper of the potentiometer moves and sends the analog signal to the TEC−5002 controller to determine machine direction and speed.

The traction pedal potentiometer must be calibrated with the TEC−5002 controller to determine the neutral and full speed set points for both the forward and reverse directions.

A properly installed and calibrated traction pedal potentiometer is critical to accurate traction response and potentiometer life. Use care when installing and calibrating the potentiometer.

Before suspecting a faulty potentiometer, follow calibration procedures for the traction pedal potentiometer found in the Adjustments section of this chapter. If potentiometer replacement is necessary, see Traction Pedal in the Service and Repairs section of Chapter 6 − Chassis.

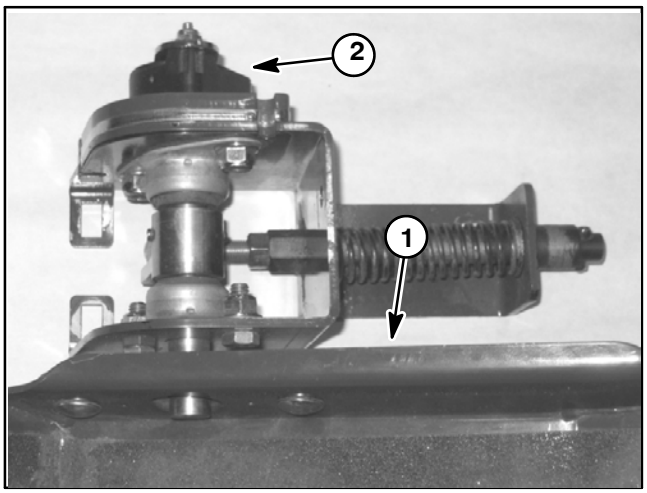


Figure 112

1. **Traction pedal**
2. **Traction potentiometer**

Up Limit Switches

The cutting deck up limit switches are normally open proximity switches that are attached to brackets located on the traction unit frame (Fig. 113). The sensing plates used for the switches are located on the cutting deck lift arms.

When a cutting deck is in the lowered position, the sensing plate will be near the up limit switch and the switch will be closed. This closed switch is used as an input for the controller to provide current flow to the cutting deck hydraulic solenoid valve when the PTO is engaged, allowing the cutting deck to operate.

When a cutting deck is raised, the sensing plate is moved away from the up limit switch and the switch opens. This open switch is used as an input for the controller to prevent current flow to the cutting deck hydraulic solenoid valve, preventing the cutting deck from operating.

Switch Testing

NOTE: Operation of a up limit switch and its circuit wiring should be monitored with the Info Center before disconnecting the switch for testing (see Info Center Display in the Troubleshooting section of this chapter). If the Info Center Display verifies that the up limit switch and circuit wiring **are** functioning correctly, switch testing is not necessary.

1. Verify with the Info Center Display that the deck position switch and circuit wiring **are not** functioning correctly.

2. Park machine on a level surface, lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

3. Disconnect up limit switch that requires testing from machine wire harness.

4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

5. With the cutting unit in the lowered position, there should be **continuity (zero resistance)** across the switch terminals.

6. Raise the cutting unit. There should be **no continuity (infinite resistance)** across the switch terminals.

7. Replace switch as needed. Reconnect switch to machine wire harness.

Switch Adjustment

1. Adjust up limit switch to have from 0.070” to 0.130” (1.8 to 3.3 mm) clearance between switch and sensing plate on the lift arm.

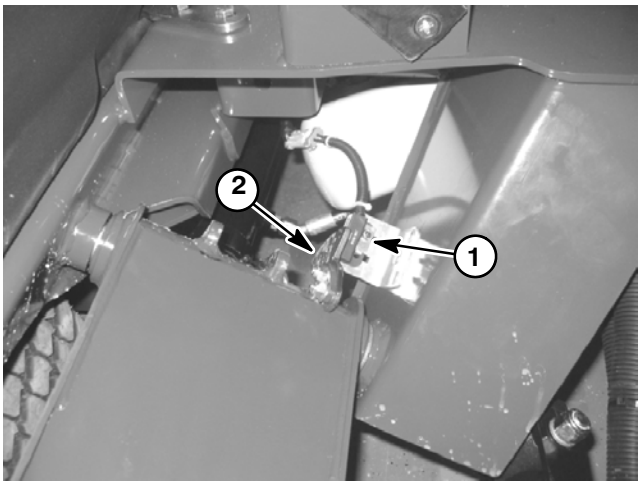


Figure 113

1. **Up limit switch (LH shown)**
2. **Sensing plate**

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the batteries and charge them fully (see Battery Service).

2. Either store batteries on a shelf or on the machine.

3. Leave cables disconnected if the batteries are stored on the machine.

4. Store batteries in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the batteries from freezing, make sure they are fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

IMPORTANT: Do not remove fill caps while cleaning.

2. 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.

A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

B. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107-0392) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

Connecting cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (-) cables first. Clean clamps and terminals separately. Reconnect cables with positive (+) cables first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107-0392) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

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

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Specifications
BCI Group Size 34
690 CCA at 0º F (-17.8º C)
Reserve Capacity of 110 minutes at 80º F (26.7º C)

Battery Dimensions (including terminal posts)

Length	10.2 inches (259 mm)
Width	6.6 inches (168 mm)
Height	8.0 inches (203 mm)

Battery Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80º F (26.7º C)
Discharged: less than 1.240

Battery Removal and Installation (Figs. 114 and 115)

1. Remove fasteners that secure battery panel to machine. Remove panel to access the batteries.

2. Loosen and remove the negative cables from the batteries. After both negative cables are removed, loosen and remove positive cables.

3. Loosen battery straps that secures batteries to machine.

4. Carefully remove batteries from machine.

5. Install batteries in reverse order making sure to connect and tighten both positive cables to batteries before connecting the negative cables.

NOTE: Before connecting the negative (ground) cables to the battery, connect a digital multimeter (set to DC Amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the machine's electrical system should be tested for short circuits or faulty components and repaired.

6. Secure batteries with battery straps.

7. Position battery panel in place and secure with removed fasteners.

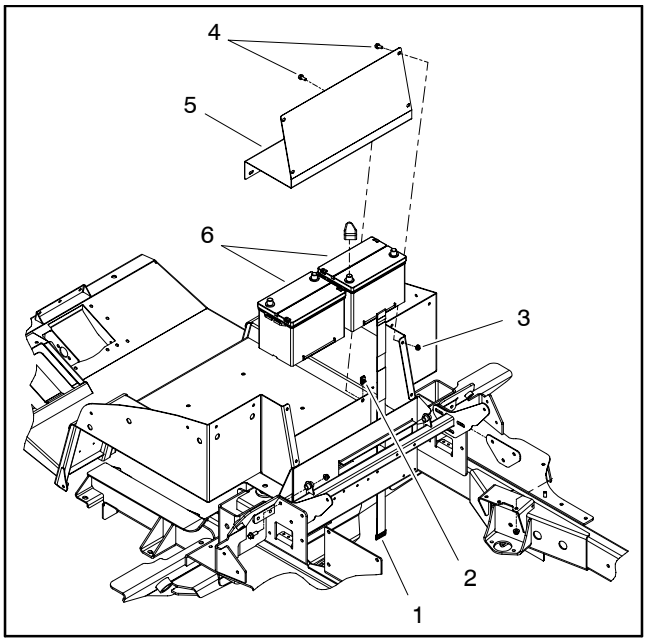


Figure 114

1. **Battery strap (2 used)**
2. **U-nut (2 used)**
3. **Flange nut (4 used)**
4. **Flange screw (6 used)**
5. **Battery panel**
6. **Battery (2 used)**

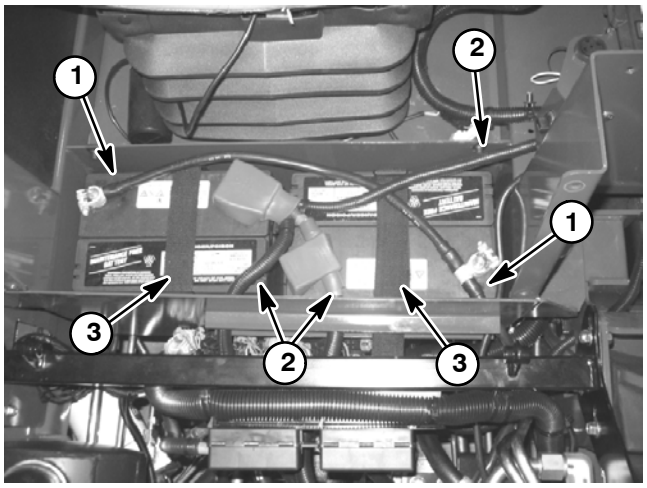


Figure 115

1. **Negative (-) cable**
2. **Positive (+) cable**
3. **Battery strap**

Battery Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Check battery case for cracks. Replace battery if cracked or leaking.

   B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

   IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

   C. Check for 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 battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

   D. Check that the cover seal is not broken. Replace the battery if the seal is broken or leaking.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

   A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to 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 10º F (5.5º C) above 80º F (26.7º C) add 0.004 to the specific gravity reading. For each 10º F (5.5º C) below 80º F (26.7º C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100ºF
Cell Specific Gravity	1.245
100º F minus 80º F equals 20º F	
(37.7º C minus 26.7º C equals 11.0º C)	
20º F multiply by 0.004/10º F equals 0.008	
(11º C multiply by 0.004/5.5º C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80º F (26.7º C)	1.253

   C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Battery Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high–discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold–cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the load tester manufacturer's instructions when using a battery load tester.

   A. Check the voltage across the battery terminals prior to load testing the battery. If the voltage is less than 12.4 VDC, charge the battery.

   B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

   C. Make sure battery terminals are free of corrosion.

   D. Measure the electrolyte temperature of the center battery cell.

   E. Connect a battery load tester to the battery terminals **following the load tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

   F. Apply a test load of 345 amps (one half the Cranking Performance rating of the battery) for 15 seconds.

   G. Take a battery voltage reading at 15 seconds, then remove the test load. This reading is the test voltage.

H. Using the table below, determine the minimum voltage for the electrolyte temperature of the center battery cell:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70° F (and up)	21.1° C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum voltage shown in the chart, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and to allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is readily available.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	**5.3 hrs @ 4 amps**	**10.5 hrs @ 4 amps**	**15.8 hrs @ 4 amps**	**21 hrs @ 4 amps**
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60° F (16° C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125° F (52° C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. 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 three consecutive readings.

Hydraulic Valve Solenoid Coil

A hydraulic valve solenoid coil on a hydraulic control manifold can be replaced without opening the hydraulic system.

Removal (Figs. 116 and 117)

1. Park machine on a level surface, lower cutting decks, stop engine and engage parking brake. Remove key from ignition switch.

2. Locate the solenoid valve coil that is to be replaced.

3. Disconnect the wire harness electrical connector from the solenoid valve coil to be replaced.

4. Remove the nut from the hydraulic valve.

5. Slide the solenoid coil from the valve.

6. Clean any corrosion or dirt from the valve stem.

Installation (Figs. 116 and 117)

1. Slide new coil assembly onto the hydraulic valve.

2. Install the nut onto the valve and torque nut as follows (do not over tighten):

   A. For solenoid valve S on the steering/engine cooling fan control manifold, torque the coil retaining nut to **10 ft-lb (13.5 N-m)**.

   B. For all other solenoid valves on the machine, torque the coil retaining nut to **5 ft-lb (6.7 N-m)**.

3. Connect the machine wire harness connector to the solenoid coil.

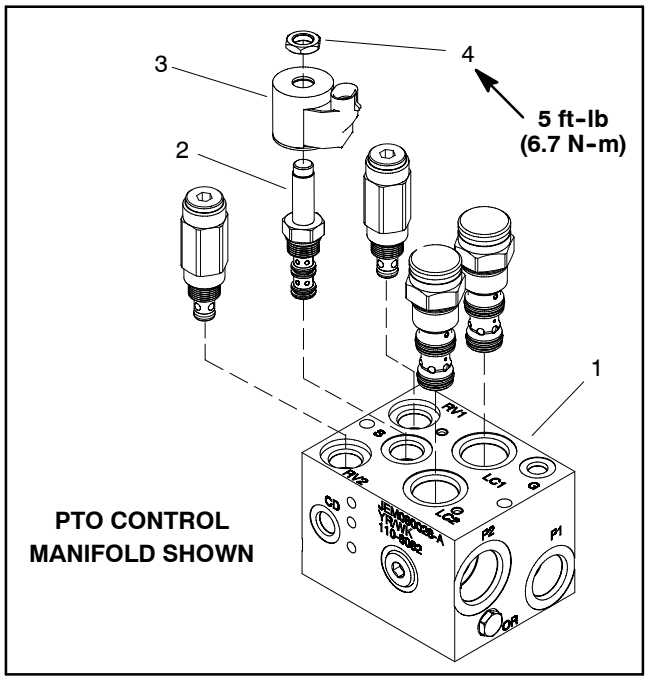


Figure 116

1. **Hydraulic manifold**
2. **Solenoid valve**
3. **Solenoid valve coil**
4. **Nut**

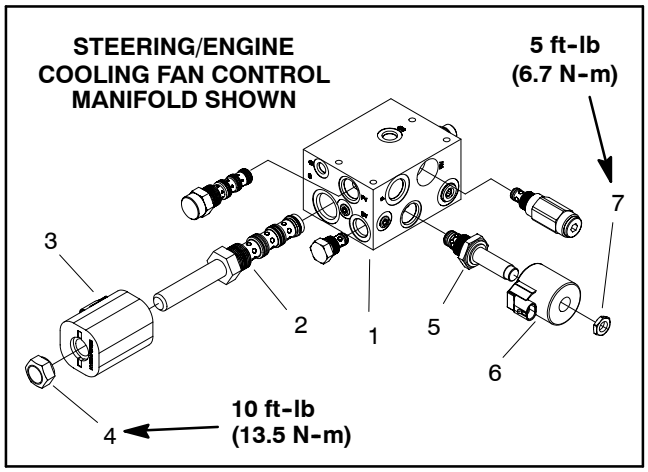


Figure 117

1. **Steering/fan manifold**
2. **Solenoid valve S**
3. **Solenoid valve coil**
4. **Nut**
5. **Solenoid valve PRV**
6. **Solenoid valve coil**
7. **Nut**

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Chapter 6

Axles, Planetaries and Brakes

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Specifications

Item	Specification
Tire pressure Front tire Rear tire	 50 psi (345 kPa) 30 psi (207 kPa)
Rear wheel toe-in	0 to 0.125 in (0 to 3.18 mm)
Planetary gear drive oil Capacity (each planetary)	SAE 85W-140 wt. gear lube 16 fluid ounces (0.47 liters)
Wheel lug nut torque (front and rear)	70 to 90 ft-lb (95 to 122 N-m)
Steering cylinder slotted hex nut torque	30 to 45 ft-lb (41 to 61 N-m)
Steering tie rod slotted hex nut torque	35 to 50 ft-lb (48 to 67 N-m)
Planetary mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Brake housing mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Front wheel motor mounting screw torque	75 to 85 ft-lb (102 to 115 N-m)
Rear wheel motor mounting screw torque	67 to 83 ft-lb (91 to 112 N-m)
Rear wheel hub nut torque	315 to 385 ft-lb (428 to 522 N-m)

General Information

Operator's Manual

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

Wheels

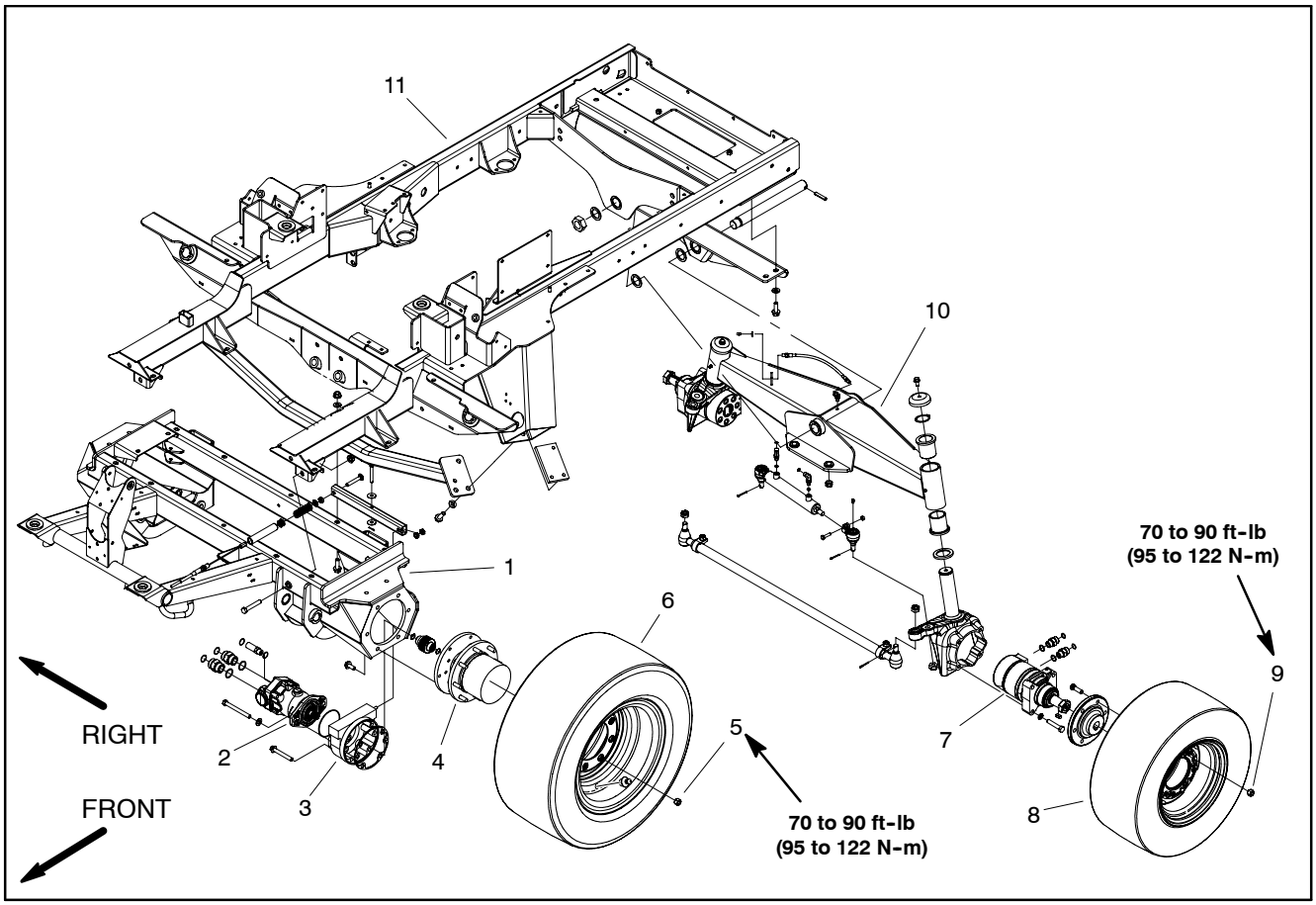


Figure 1

1. **Front axle frame**
2. **Front wheel motor**
3. **Brake assembly**
4. **Planetary assembly**
5. **Lug nut (8 used per front wheel)**
6. **Front wheel assembly**
7. **Rear wheel motor**
8. **Rear wheel assembly**
9. **Lug nut (6 used per rear wheel)**
10. **Rear axle**
11. **Main frame**

Wheel Removal (Fig. 1)

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

2. Chock wheels to prevent machine from shifting.

3. Loosen, but do not remove, lug nuts that secure wheel to machine.

CAUTION

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

4. Using a jack, raise machine so wheel to be removed is off ground (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove lug nuts and then remove wheel from machine.

Wheel Installation (Fig. 1)

NOTE: The front wheels use eight (8) lug nuts. The rear wheels use six (6) lug nuts.

1. Install wheel and secure with lug nuts.

2. Lower machine to ground.

WARNING

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

3. Torque wheel lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

Brake Assembly

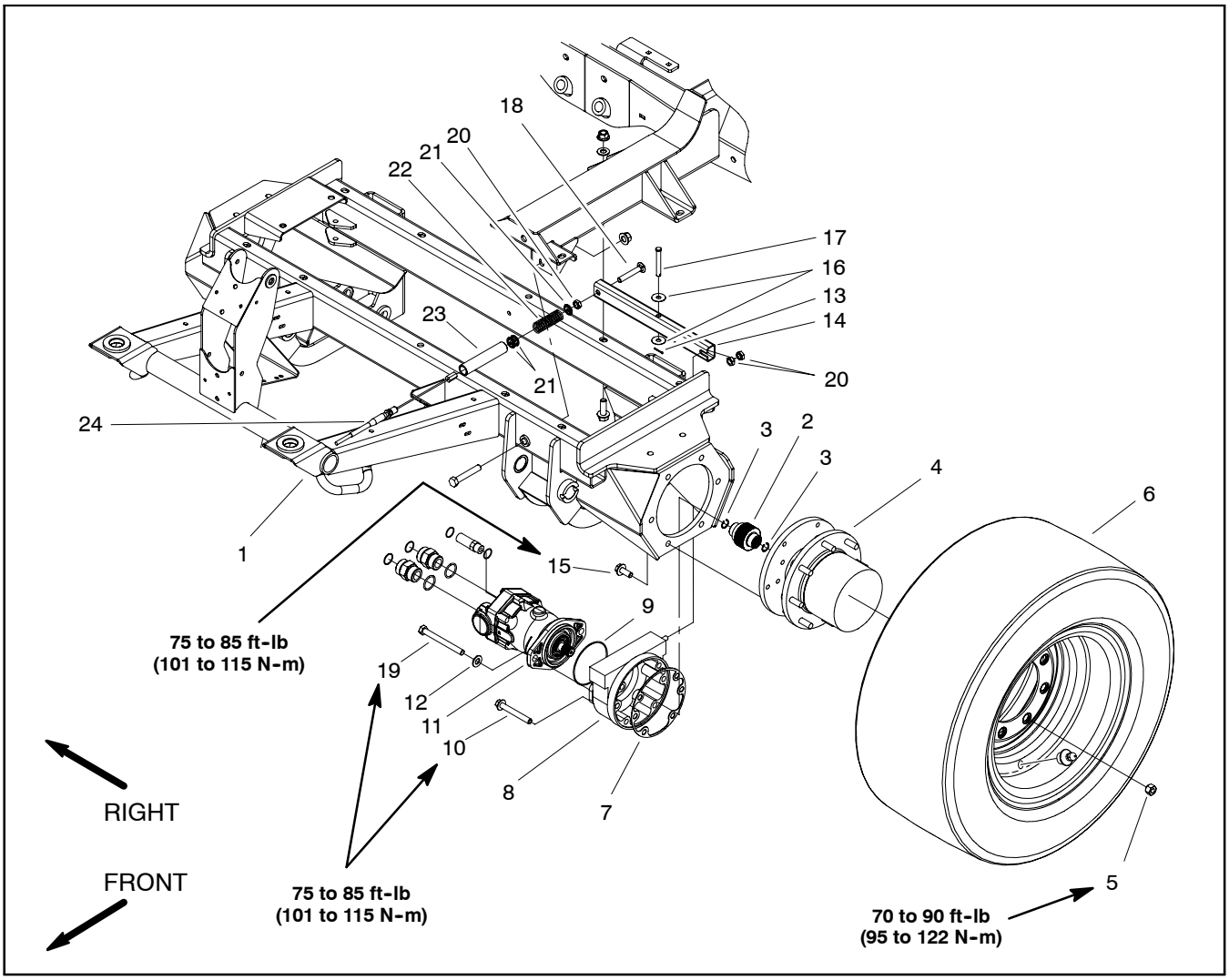


Figure 2

1. Front axle frame
2. Splined brake shaft
3. Retaining ring
4. Planetary assembly (2 used)
5. Lug nut (8 used per wheel)
6. Front wheel assembly
7. Gasket
8. Brake assembly (LH shown)
9. O-ring
10. Flange head screw (4 used per side)
11. Front wheel motor (2 used)
12. Flat washer (2 used per motor)
13. Cotter pin
14. Brake lever (2 used)
15. Flange head screw (6 used per side)
16. Washer
17. Clevis pin
18. Carriage screw
19. Cap screw (2 used per motor)
20. Jam nut
21. Spring plate
22. Compression spring
23. Spacer
24. Brake cable (LH shown)

Remove Brake Assembly (Fig. 2)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch. Do not apply parking brake.

2. Drain oil from planetary/brake assembly.

3. Chock rear wheels to prevent machine from shifting.

CAUTION

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

4. Jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove front wheel assembly.

6. Remove hydraulic wheel motor (see Front Wheel Motor Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

7. Disengage brake lever (item 14) from brake assembly pull rod:

   A. Remove tension on brake cable.

   B. Remove cotter pin (item 13) that secures brake lever to front axle frame.

   C. Slide clevis pin (item 17) from axle frame bracket and brake lever. Remove two (2) washers (item 16) from between brake lever and frame bracket (Fig. 5).

   D. Shift brake lever toward the center of the machine to disengage lever slot from pull rod on brake assembly.

8. Remove four (4) flange head screws (item 9) that secure brake assembly to machine. Remove brake assembly from machine. Take care to not drop splined brake coupler (item 2) as brake assembly is removed.

9. Remove and discard gasket (item 7). Make sure that all gasket material is removed from both brake and planetary assemblies.

10. Remove splined brake coupler (item 2).

11. Complete brake inspection and repair (see Brake Service in this section).

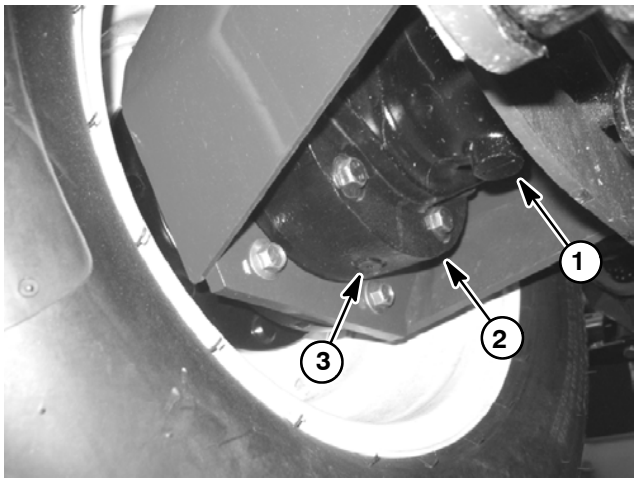


Figure 3

1. Wheel motor
2. Brake assembly
3. Drain plug

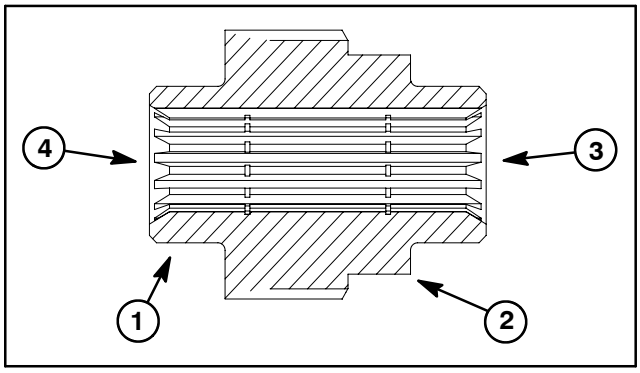


Figure 4

1. Splined brake coupler
2. Brake coupler step
3. Hydraulic motor end
4. Planetary assembly end

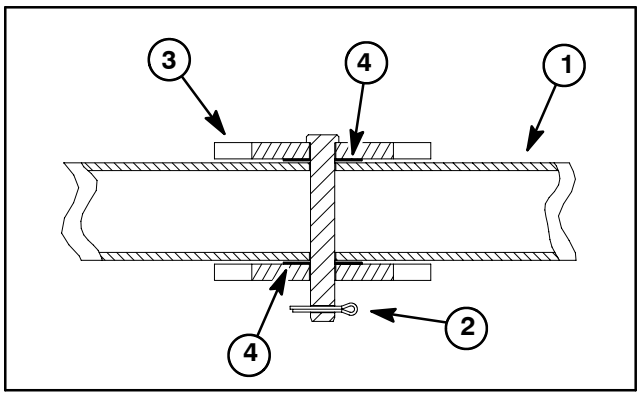


Figure 5

1. Brake lever
2. Cotter pin
3. Frame bracket
4. Washer

Install Brake Assembly (Fig. 2)

1. Make sure that internal retaining rings are fully seated in grooves inside splined brake coupler (item 2). Slide splined brake coupler into brake assembly. **Note:** The stepped end of the coupler must be installed toward the hydraulic wheel motor (Fig. 4).

2. Apply Loctite Gasket Sealant #2 (or equivalent) to sealing surfaces of new gasket (item 7). Apply gasket to brake assembly.

3. Position brake assembly to frame, aligning splined brake coupler with input shaft on planetary wheel drive.

4. Install four (4) flange head screws to secure brake assembly to frame. Torque screws in a crossing pattern from **75 to 85 ft-lb (101 to 115 N-m)**.

5. Secure brake lever (item 14) to brake pull rod:

   A. Position brake lever so that brake lever slot fits around pull rod on brake assembly (Fig. 6).

   B. Place two (2) washers (item 16) between brake lever and frame bracket (Fig. 5).

   C. Slide clevis pin (item 17) through frame bracket, washers and brake lever.

   D. Secure brake lever to front axle frame with cotter pin (item 13).

   E. Make sure that brake lever rotates freely after assembly.

6. Install new o-ring on hydraulic wheel motor. Install wheel motor and torque cap screws from **75 to 85 ft-lb (101 to 115 N-m)** (see Front Wheel Motor Installation in the Service and Repairs section of Chapter 4 - Hydraulic System).

7. Install front wheel assembly.

WARNING

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

8. Lower machine to ground. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

9. Make sure drain plug is installed in bottom of brake assembly. Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube to proper level. Capacity is approximately 16 fl. oz. (0.47 l) per wheel.

10. Check and adjust brake cable for proper brake operation. Brake lever should be from 0.470" to 0.530" (12.0 to 13.4 mm) from brake casting surface when brake is disengaged (Fig. 6).

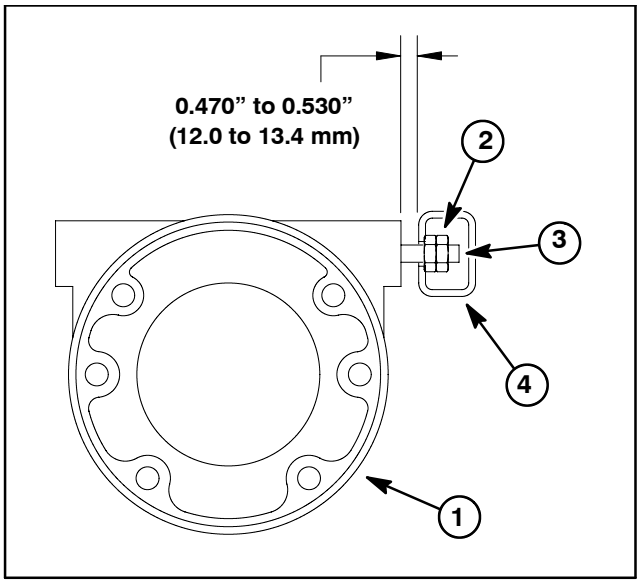


Figure 6

1. **Brake assembly**
2. **Jam nut (2 used)**
3. **Brake pull rod**
4. **Brake lever**

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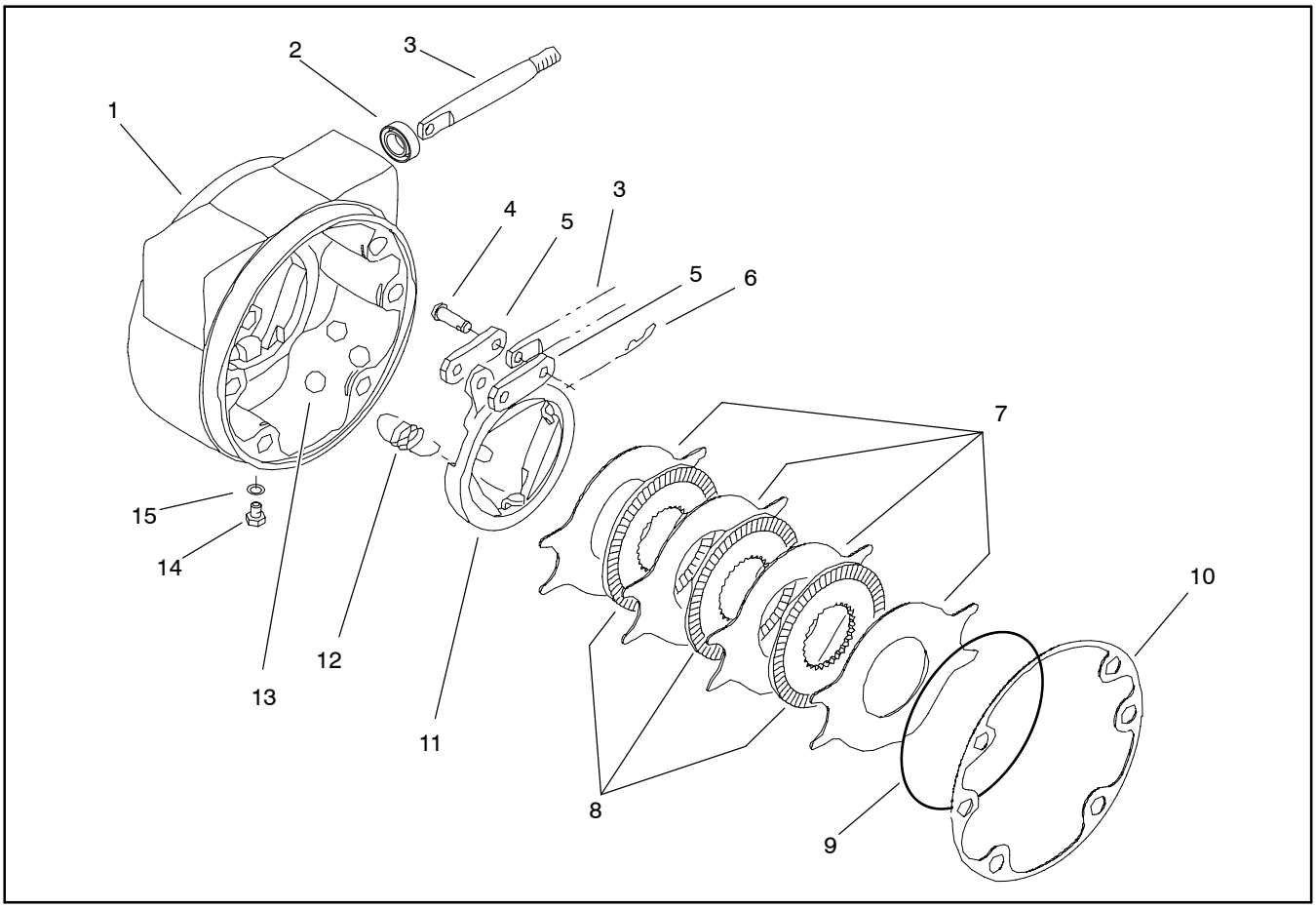


Figure 7

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin (2 used)**
5. **Link (2 used)**
6. **Hitch pin (2 used)**
7. **Stationary disc (4 used)**
8. **Rotating disc (3 used)**
9. **Retaining ring**
10. **Gasket**
11. **Rotating actuator**
12. **Extension spring (3 used)**
13. **Ball (3 used)**
14. **Plug**
15. **O-ring**

Brake Disassembly (Fig. 7)

1. Scrape gasket material (item 10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (item 9) from brake housing.

3. Remove four (4) stationary discs (item 7) and three (3) rotating discs (item 8).

4. Remove three (3) extension springs (item 12).

5. Remove actuator assembly (items 11, 6, 5, 4 and 3) and balls (item 13).

6. Remove seal (item 2) from brake housing. Discard seal.

Brake Inspection

1. Wash parts in cleaning solvent. Inspect components for wear or damage.

2. The stack of four (4) stationary and three (3) rotating discs should have a minimum thickness of 0.440" (11.2 mm).

Brake Assembly (Fig. 7)

1. Reverse steps 2 through 6 to assemble brakes, installing new parts as necessary. Make sure to install a new seal (item 2).

2. When installing jam nuts onto brake pull rod, position inner jam nut so that it is 0.120" (3.0 mm) from step in brake pull rod (Fig. 8). From that point, loosen inner jam nut 3 flats. While holding inner jam nut with a wrench, install and tighten outer jam nut.

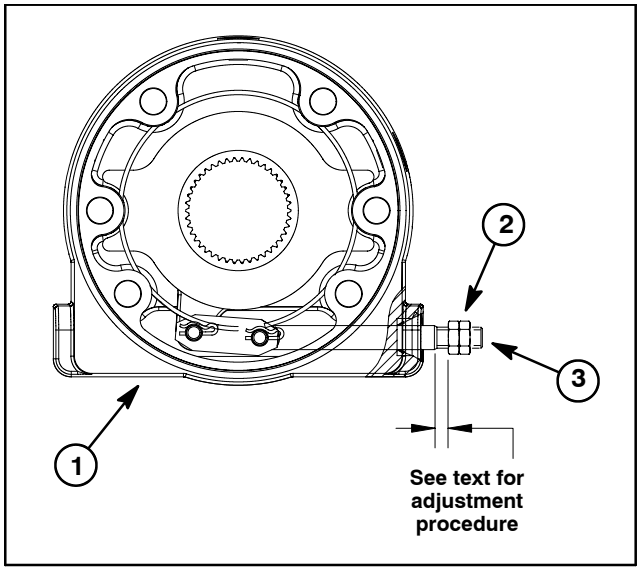


Figure 8

1. **Brake assembly**
2. **Jam nut (2 used)**
3. **Brake pull rod**

Planetary Wheel Drive Assembly

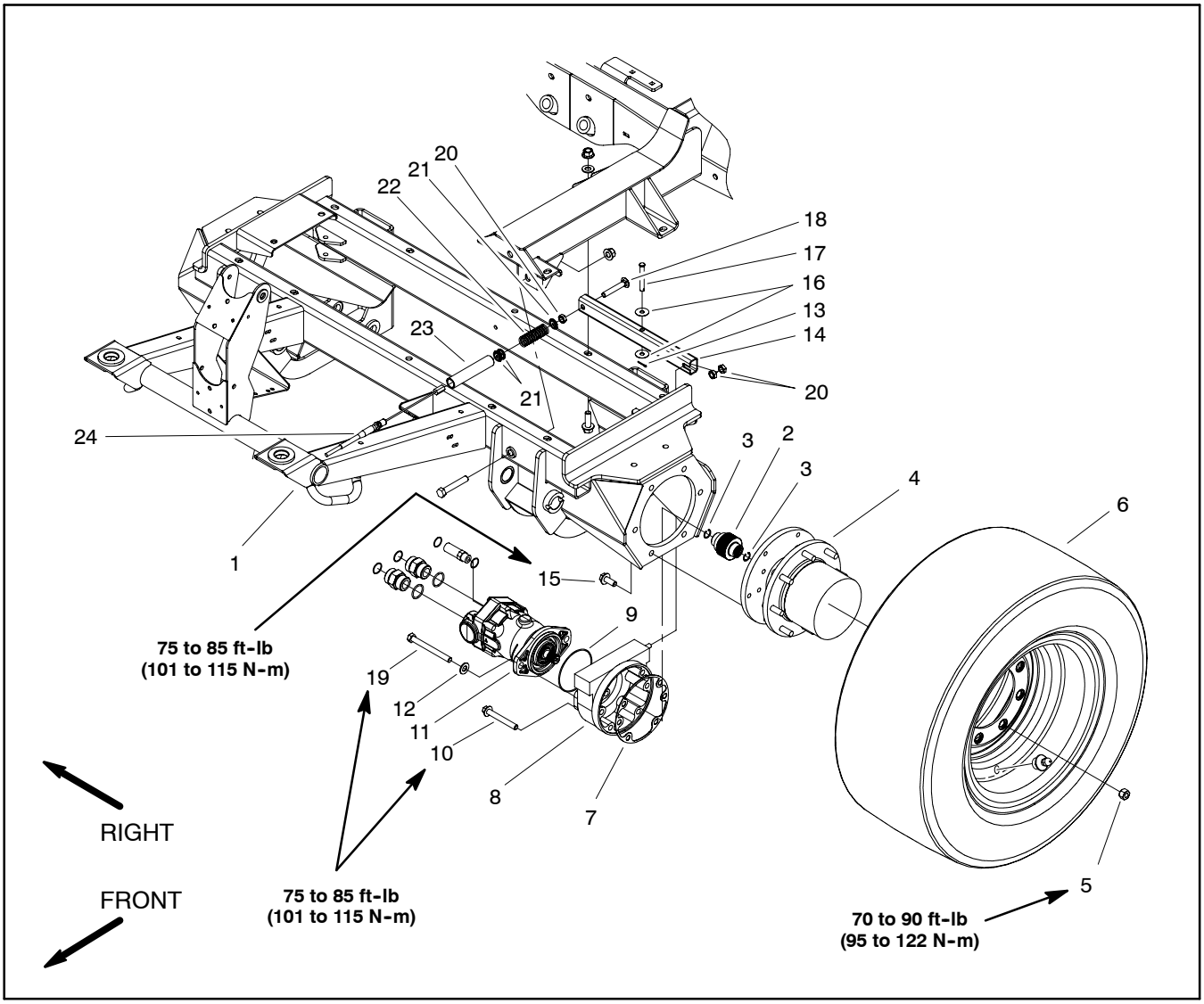


Figure 9

1. Front axle frame
2. Splined brake shaft
3. Retaining ring
4. Planetary assembly (2 used)
5. Lug nut (8 used per wheel)
6. Front wheel assembly
7. Gasket
8. Brake assembly (LH shown)
9. O-ring
10. Flange head screw (4 used per side)
11. Front wheel motor (2 used)
12. Flat washer (2 used per motor)
13. Cotter pin
14. Brake lever (2 used)
15. Flange head screw (6 used per side)
16. Washer
17. Clevis pin
18. Carriage screw
19. Cap screw (2 used per motor)
20. Jam nut
21. Spring plate
22. Compression spring
23. Spacer
24. Brake cable (LH shown)

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine (see Planetary Wheel Drive Service in this section). Use the following procedure to remove and install planetary wheel drive assembly from machine.

Planetary Wheel Drive Removal (Fig. 9)

1. Park machine on a level surface, lower cutting decks, stop engine and remove key from the ignition switch. Do not apply parking brake.

2. Drain oil from planetary wheel drive/brake assembly.

3. Chock rear wheels to prevent machine from shifting.

CAUTION

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

4. Jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

5. Remove front wheel assembly.

6. Remove hydraulic wheel motor (see Front Wheel Motor Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

7. Remove brake assembly (see Brake Assembly Removal in this section).

8. Support planetary assembly to prevent it from falling. Loosen and remove six (6) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

9. Remove and discard gasket (item 7). Make sure that all gasket material is removed from both brake and planetary assemblies.

Planetary Wheel Drive Installation (Fig. 9)

1. Apply Loctite Gasket Sealant #2 (or equivalent) to sealing surfaces of new gasket (item 7). Apply gasket to brake assembly.

2. Position planetary assembly to machine frame. Install six (6) flange head screws that secure planetary assembly to frame. Torque screws in a crossing pattern from **75 to 85 ft-lb (101 to 115 N-m)**.

3. Install brake assembly (see Brake Assembly Installation in this section).

4. Install hydraulic wheel motor (see Front Wheel Motor Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

WARNING

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

5. Install front wheel assembly.

6. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

7. Make sure drain plug is installed in bottom of brake assembly (Fig. 10). Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube to proper level. Capacity is approximately 16 oz. (0.47 l) per wheel.

8. Check for proper brake operation.

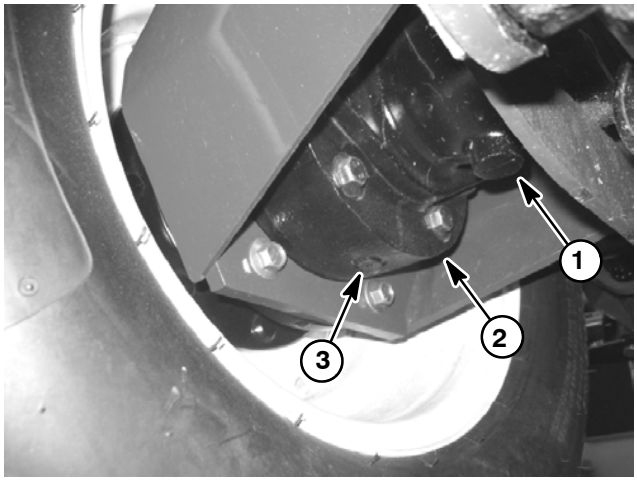


Figure 10

1. **Wheel motor**
2. **Brake assembly**
3. **Drain plug**

Planetary Wheel Drive Service

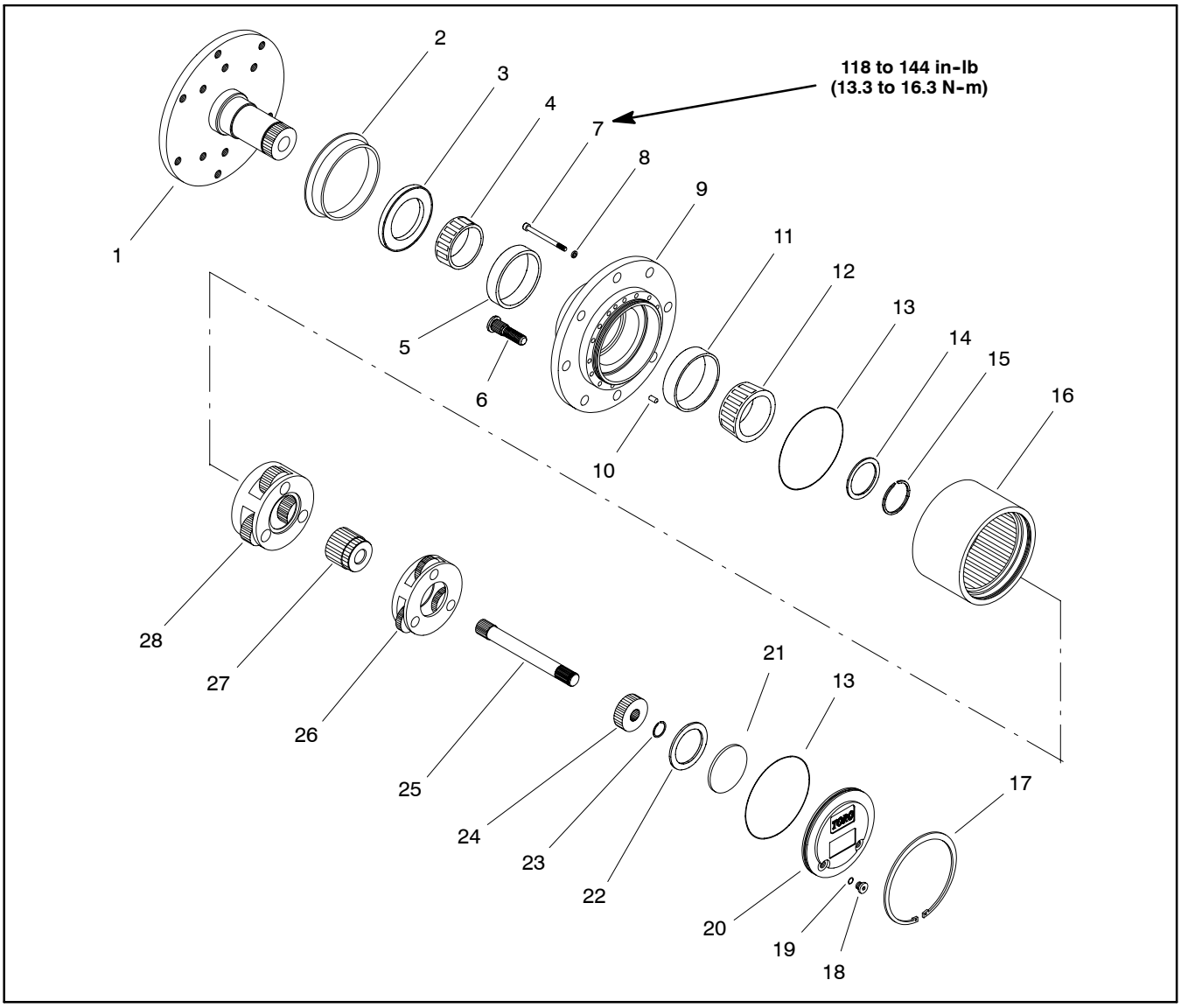


Figure 11

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8 used)
7. Socket head screw (16 used)
8. Lock washer (16 used)
9. Housing
10. Dowel pin (2 used)
11. Outer bearing cup
12. Outer bearing cone
13. O-ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2 used)
19. O-ring (2 used)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assembly
27. Secondary gear
28. Secondary carrier assembly

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed from machine, see Planetary Wheel Drive Assembly in this section.

Disassembly (Figs. 11 and 12)

1. If planetary wheel drive assembly is installed on machine:

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

   B. Drain oil from planetary wheel drive/brake assembly.

   C. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands.

   D. Remove front wheel assembly.

2. Remove retaining ring (item 17).

3. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

4. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

5. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 6 through 10 are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 10) after it has been removed.

6. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

7. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

8. Remove and discard seals (items 2 and 3) and O-rings (item 13) from housing.

9. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

10. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

11. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

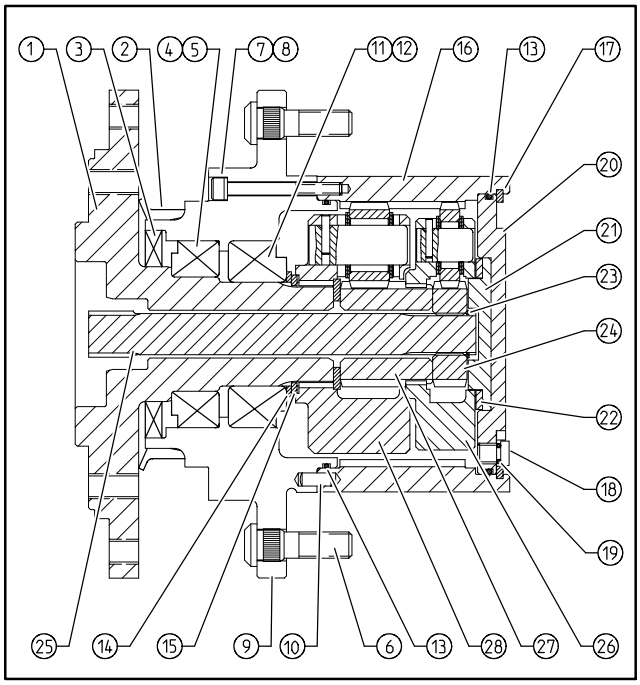


Figure 12

Assembly (Figs. 11 and 12)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary wheel drive.

3. If spindle and housing were separated:

   A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

   B. Set inner bearing cone (item 4) into inner bearing cup.

   C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

   D. Pack boot seal (item 2) with grease and install on housing.

   E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in-lb (13.3 to 16.3 N-m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing in housing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 in. (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated into the spindle groove. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O−ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O−ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

9. Check operation of planetary wheel drive. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

10. If planetary wheel drive assembly is installed on machine:

A. Install front wheel assembly.

WARNING

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

B. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **70 to 90 ft−lb (95 to 122 N−m)**.

C. Make sure drain plug is installed in bottom of brake assembly. Fill planetary wheel drive/brake assembly with SAE 85W−140 gear lube to proper level. Capacity is approximately 16 oz. (0.47 l) per wheel.

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Rear Axle

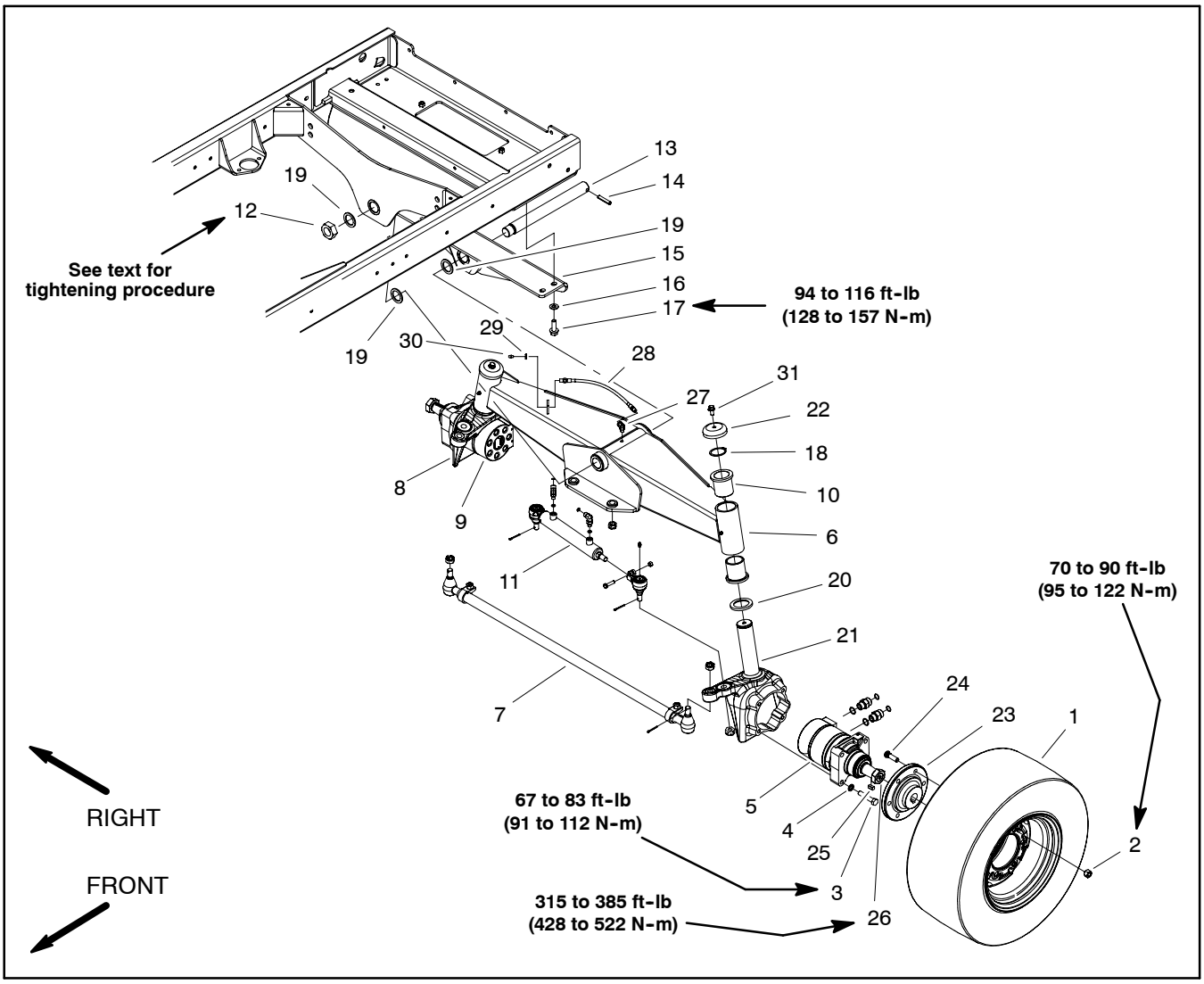


Figure 13

1. Rear wheel assembly
2. Lug nut (6 used per wheel)
3. Cap screw (4 used per motor)
4. Lock washer (4 used per motor)
5. LH wheel motor
6. Rear axle
7. Tie rod
8. RH spindle
9. RH wheel motor
10. Flange bushing (4 used)
11. Steering cylinder (2 used)
12. Lock nut
13. Pivot shaft
14. Roll pin
15. Axle support
16. Flat washer (4 used)
17. Flange head screw (4 used)
18. Retaining ring
19. Thrust washer (3 used)
20. Thrust washer
21. LH spindle
22. Spindle cap
23. Wheel hub
24. Wheel stud (6 used per hub)
25. Square key
26. Hex nut
27. Elbow
28. Hose
29. Nut
30. Grease fitting
31. Flange head screw

Removal (Fig. 13)

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

2. Chock front wheels to prevent machine from shifting.

3. Thoroughly clean hydraulic hose ends and fittings on steering cylinders and rear wheel motors to prevent hydraulic system contamination.

NOTE: To ease assembly, label hydraulic hoses to show their correct position on the steering cylinders and rear wheel motors.

4. Disconnect the hydraulic hoses from the steering cylinders and rear wheel motors. Put caps or plugs on all fittings and hoses to prevent contamination.

5. Remove the lock nut (item 12) and thrust washer (item 19) that secures the axle pivot shaft (item 13) to the frame.

CAUTION

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

6. Jack up the machine (just ahead of the rear wheels) until clearance exists to allow rear axle removal. Support the machine with appropriate jack stands prevent it from falling.

7. Support rear axle to prevent it from falling.

8. Pull the axle pivot shaft from frame and rear axle. This will release the rear axle and two (2) thrust washers (item 19) from the frame. Carefully lower the entire axle assembly and remove it from under the machine.

NOTE: If service to the rear wheel motors or steering cylinders is required, refer to the Service and Repairs section of Chapter 4 – Hydraulic System.

Installation (Fig. 13)

1. Thoroughly clean the rear axle pivot shaft. Inspect the shaft for wear or damage and replace if necessary.

2. Position the rear axle assembly to the frame. Install thrust washer (item 19) between each side of axle and frame. Raise axle assembly to frame and slide pivot shaft through frame, thrust washers and axle. Make sure that roll pin on pivot shaft is positioned in frame reliefs.

3. Install thrust washer (item 19) and lock nut (item 12) onto pivot shaft. Tighten lock nut to eliminate any axial movement of rear axle. Make sure that axle can still pivot freely after lock nut is tightened.

4. Lower the machine to the ground.

5. Correctly install the hydraulic hoses to the steering cylinders and rear wheel motors.

WARNING

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

6. Make sure that wheel lug nuts are properly torqued from **70 to 90 ft-lb (95 to 122 N-m)**.

7. Check oil level in hydraulic reservoir.

8. Lubricate the rear axle pivot bushings through the grease fitting on the rear axle.

9. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.

10. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Readjust if necessary.

Rear Axle Service

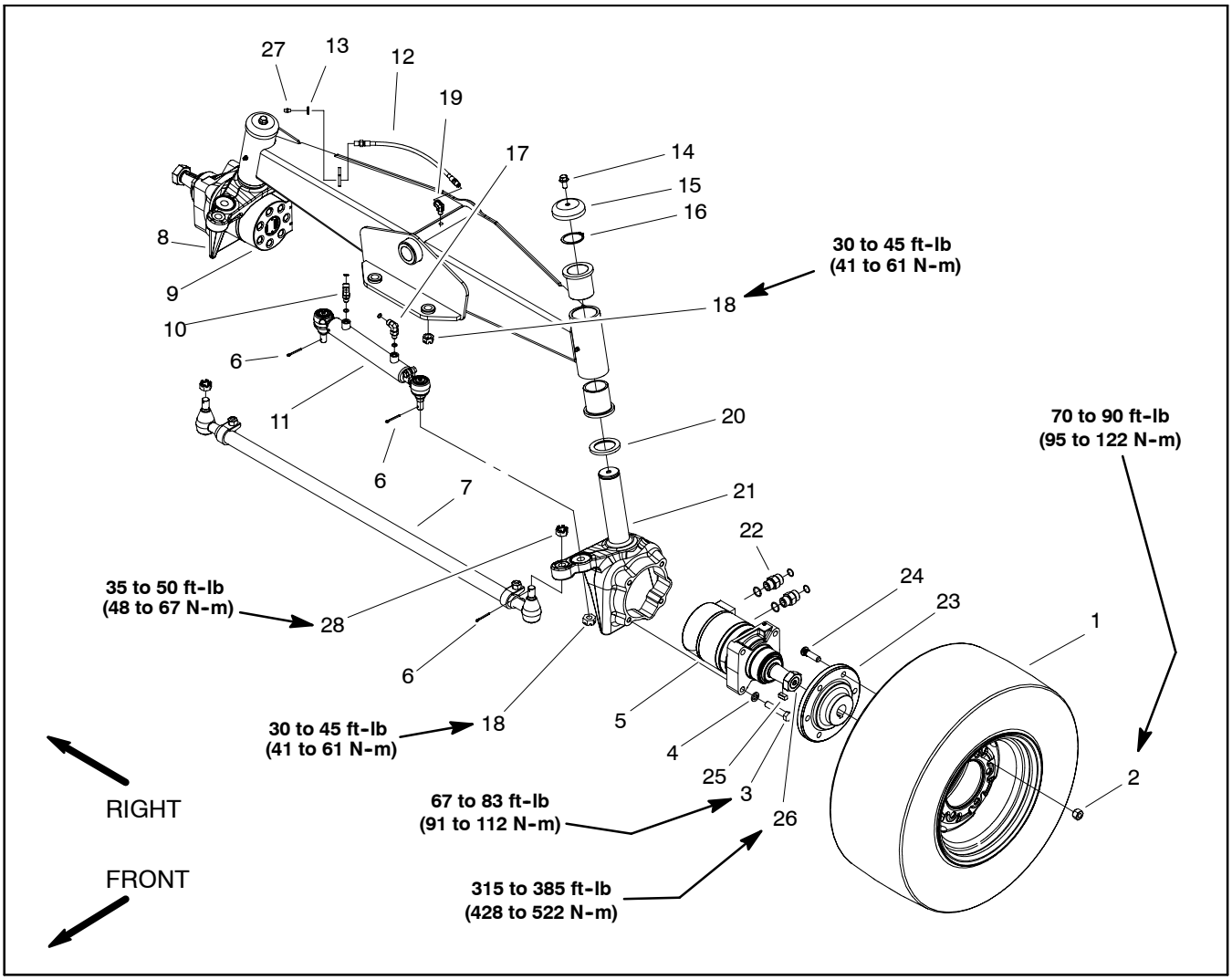


Figure 14

1. **Rear wheel assembly**
2. **Lug nut (6 used per wheel)**
3. **Cap screw (4 used per motor)**
4. **Lock washer (4 used per motor)**
5. **LH wheel motor**
6. **Cotter pin**
7. **Tie rod assembly**
8. **RH spindle**
9. **RH wheel motor**
10. **45º hydraulic fitting**
11. **Steering cylinder (2 used)**
12. **Hose**
13. **Nut**
14. **Flange head screw**
15. **Spindle cap**
16. **Retaining ring**
17. **90º hydraulic fitting**
18. **Slotted hex nut**
19. **Elbow**
20. **Thrust washer**
21. **LH spindle**
22. **Hydraulic fitting (2 used per motor)**
23. **Wheel hub (2 used)**
24. **Wheel stud (6 used per wheel)**
25. **Square key**
26. **Hex nut**
27. **Grease fitting**
28. **Slotted hex nut**

NOTE: If service to the rear wheel motors or steering cylinders is required, refer to the Service and Repairs section of Chapter 4 – Hydraulic System.

Tie Rod Assembly (Figs. 14 and 15)

1. Remove cotter pin and slotted hex nut that secure the tie rod ends to the steering spindles. Separate the tie rod ends from the spindle and remove tie rod from machine.

NOTE: One of the tie rod ball joints has left hand threads.

2. Loosen cap screw and lock nut and then unscrew ball joint from tie rod.

3. Thread ball joints equally into tie rod so that center to center length is from 41.080" to 41.200" (1043.5 to 1046.4 mm) (Fig. 16).

4. Thoroughly clean the tapered surfaces of the tie rod ball joints and steering spindles.

5. Connect the tie rod ends to the steering spindles with slotted hex nuts. Torque nut from **35 to 50 ft-lb (48 to 67 N-m)**. Install cotter pin.

6. Check and adjust rear wheel toe-in. After toe-in is correct, tighten cap screw and lock nut.

7. Lubricate the tie rod ball joints.

8. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Adjust if necessary.

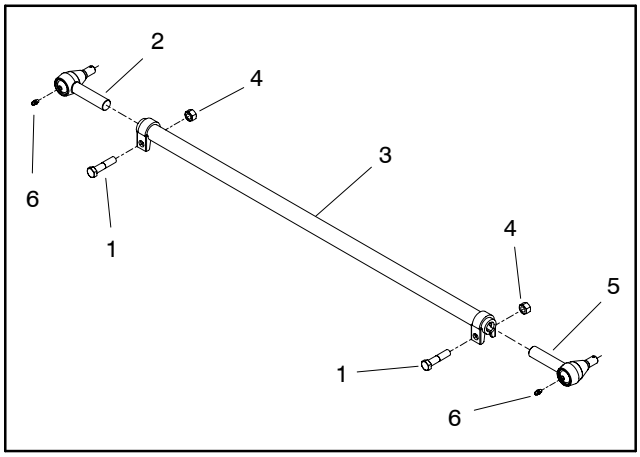


Figure 15

1. **Cap screw**
2. **Tie rod end**
3. **Tie rod tube**
4. **Lock nut**
5. **Tie rod end**
6. **Grease fitting**

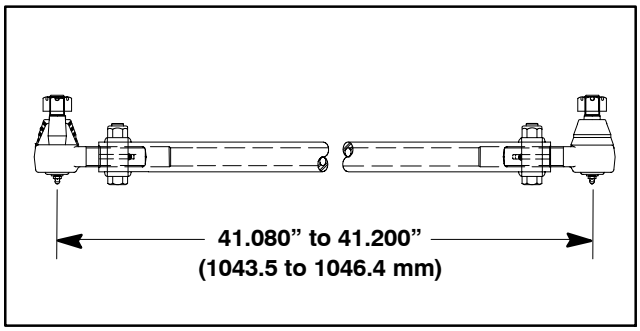


Figure 16

Rear Axle Spindle Bushings (Fig. 14)

The rear wheel spindles must fit snugly in the rear axle. Excessive movement of the spindle in the axle might indicate that the rear axle spindle bushings (Fig. 17) are worn and must be replaced.

1. Loosen, but do not remove, lug nuts that secure rear wheels to axle.

2. Remove rear axle from machine (see Rear Axle Removal in this section).

3. Remove rear wheels from axle.

4. Remove cotter pin and slotted hex nut that secure the tie rod end to the steering spindle. Separate the tie rod end from the spindle.

5. Remove cotter pin and slotted hex nut that secure steering cylinder ball joint to steering spindle. Separate steering cylinder from spindle.

6. If necessary, remove wheel motor from steering spindle (see Rear Wheel Motor Removal in the Service and Repairs section of Chapter 4 - Hydraulic System).

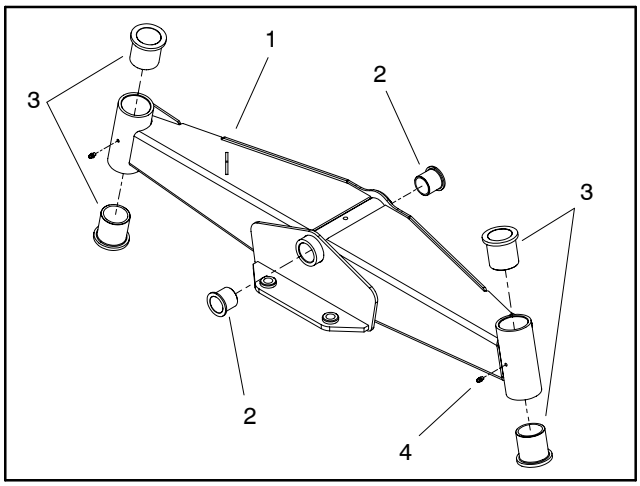


Figure 17

1. **Rear axle**
2. **Pivot bushing**
3. **Spindle bushing**
4. **Grease fitting**

7. Remove the flange head screw, spindle cap and retaining ring that secure the steering spindle into the axle tube. Slide the spindle out of the axle tube to expose the spindle bushings. Locate and retrieve thrust washer (item 20) from steering spindle shaft.

8. Use a bushing removal tool to extract both spindle bushings from the axle tube. Take care to not damage the bore of the axle tube. Clean the inside of the axle tube to remove any dirt or foreign material.

9. Apply grease to the inside and outside of the new bushings. Use a press to install the bushings into the top and bottom of the axle tube. Press bushings into tube until bushing flange shoulder bottoms on tube.

10. Thoroughly clean the steering spindle shaft. Inspect the spindle for wear and replace if worn or damaged.

11. Install thrust washer (item 20) onto the spindle shaft and slide the shaft up through the axle tube. Hold the spindle shaft assembly in place and install the retaining ring (item 16) into the groove in the spindle shaft.

12. Install the spindle cap and flange head screw.

13. Thoroughly clean the tapered surfaces of the tie rod ends, steering cylinder ball joints and steering spindle.

14. Connect the tie rod end to the steering spindle with slotted hex nut and cotter pin. Torque nut from **35 to 50 ft-lb (48 to 67 N-m)**.

15. Secure steering cylinder ball joint to steering spindle with slotted hex nut and cotter pin. Torque nut from **30 to 45 ft-lb (41 to 61 N-m)**.

16. If removed, install rear wheel motor (see Rear Wheel Motor Installation in the Service and Repairs section of Chapter 4 - Hydraulic System).

17. Secure rear wheels to axle with lug nuts (see Wheel Installation in this section).

WARNING

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

18. Install rear axle to machine (see Rear Axle Installation in this section). After lowering machine to ground, torque wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

19. Lubricate the steering spindles through the grease fittings on the rear axle.

20. Check rear wheel toe-in and adjust if necessary.

21. Operate machine and check hydraulic connections at steering cylinders and wheel motors for leaks.

22. After assembly and adjustments have been completed, make sure that no contact is made between any machine components as the rear wheels are moved from steering lock to lock. Adjust if necessary.

Axle Pivot Bushings (Fig. 14)

The rear axle must be held in place snugly by the axle pivot shaft. Excessive movement of the axle, which is often characterized by erratic steering, might indicate worn axle pivot bushings. To correct the problem, replace the rear axle pivot bushings (Fig. 17).

1. Loosen, but do not remove, lug nuts that secure rear wheels to axle.

2. Remove rear axle from machine (see Rear Axle Removal in this section).

3. Remove rear wheels from axle (see Wheel Removal in this section).

4. Use a bushing removal tool to extract both axle pivot bushings from the axle pivot tube. Take care to not damage bore of pivot tube during bushing removal.

5. Clean the inside of the tube to remove all dirt and foreign material.

6. Apply grease to the inside and outside of the new bushings. Use a press to install the bushings into the front and back of the axle pivot tube. Press bushings into tube until bushing flange shoulder bottoms on tube.

7. Secure rear wheels to axle with lug nuts (see Wheel Installation in this section).

WARNING

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

8. Install rear axle to machine (see Rear Axle Installation in this section). After lowering machine to ground, torque wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

Chapter 7

Chassis

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General Information

Operator's Manual

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

Steering Tower

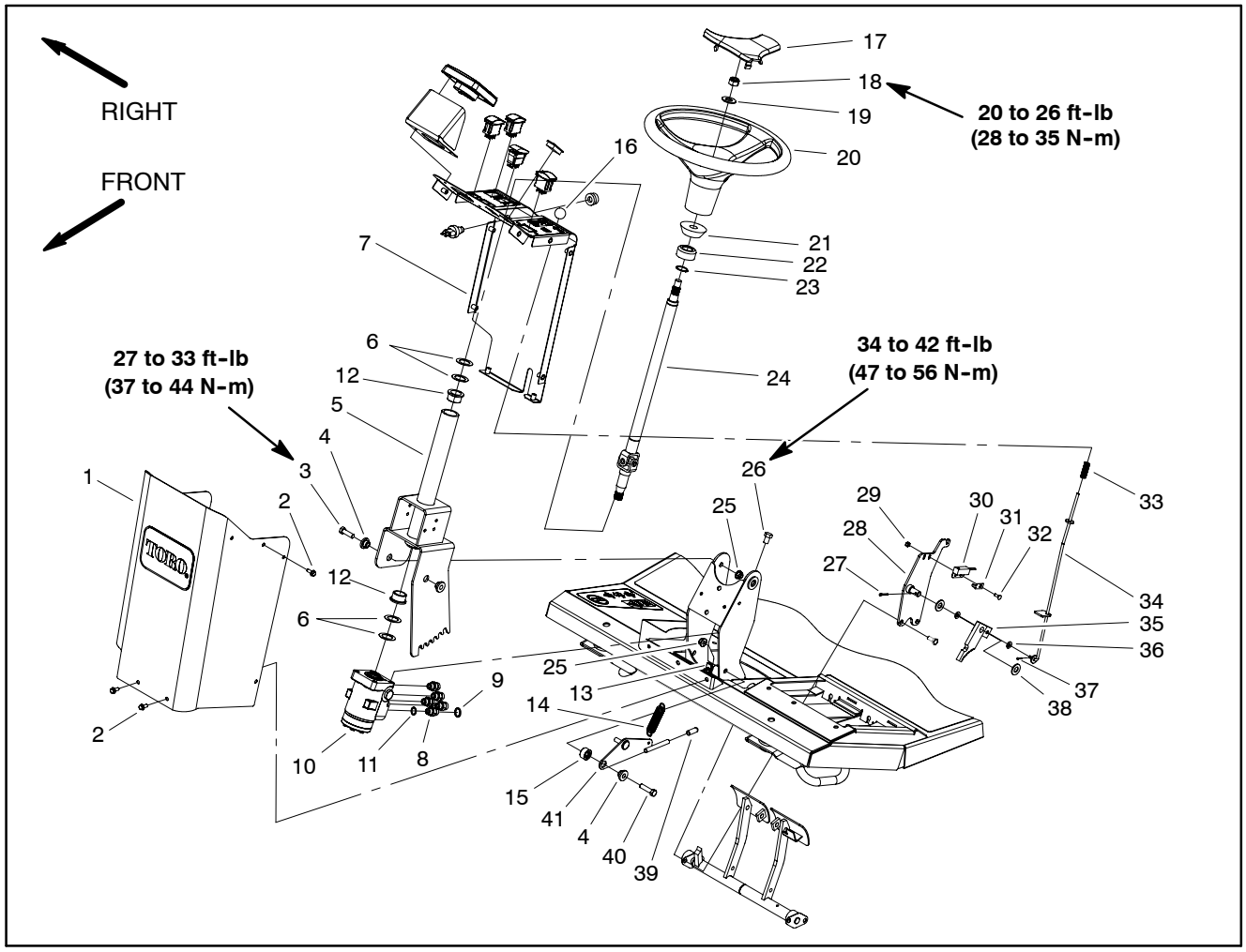


Figure 1

1. Steering tower cover
2. Flange head screw
3. Cap screw (2 used)
4. Pivot hub (3 used)
5. Steering column assembly
6. Thrust washer (4 used)
7. Steering tower
8. Hydraulic fitting (5 used)
9. O-ring
10. Steering control valve
11. O-ring
12. Flange bushing (2 used)
13. Clip (2 used)
14. Spring
15. Spacer
16. Knob
17. Steering wheel cover
18. Hex nut
19. Flat washer
20. Steering wheel
21. Foam collar
22. Steering seal
23. External snap ring (2 used)
24. Steering shaft assembly
25. Flange nut (3 used)
26. Cap screw (4 used)
27. Cotter pin
28. Parking brake pivot
29. Lock nut
30. Proximity switch
31. Switch plate
32. Carriage bolt
33. Compression spring
34. Parking brake rod
35. Parking brake rack
36. Flat washer (2 used)
37. Cotter pin
38. Flat washer (2 used)
39. Cap
40. Cap screw
41. Tilt lever

NOTE: If steering control valve (item 10) is to be removed, see Steering Control Valve in the Service and Repairs section of Chapter 4 – Hydraulic System.

Disassembly

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

2. Disassemble steering tower as needed using Figure 1 as a guide.

Assembly

1. Assemble steering tower using Figure 1 as a guide.

   A. If steering wheel was removed, torque hex nut (item 18) from **20 to 26 ft-lb (28 to 35 N-m)**.

   B. If steering column (item 5) was removed, torque cap screw (item 3) from **27 to 33 ft-lb (37 to 44 N-m)**.

   C. Thrust washers (item 6) on steering column are used as needed to remove end play of steering shaft.

Wing Deck Rear Impact Arm Assembly

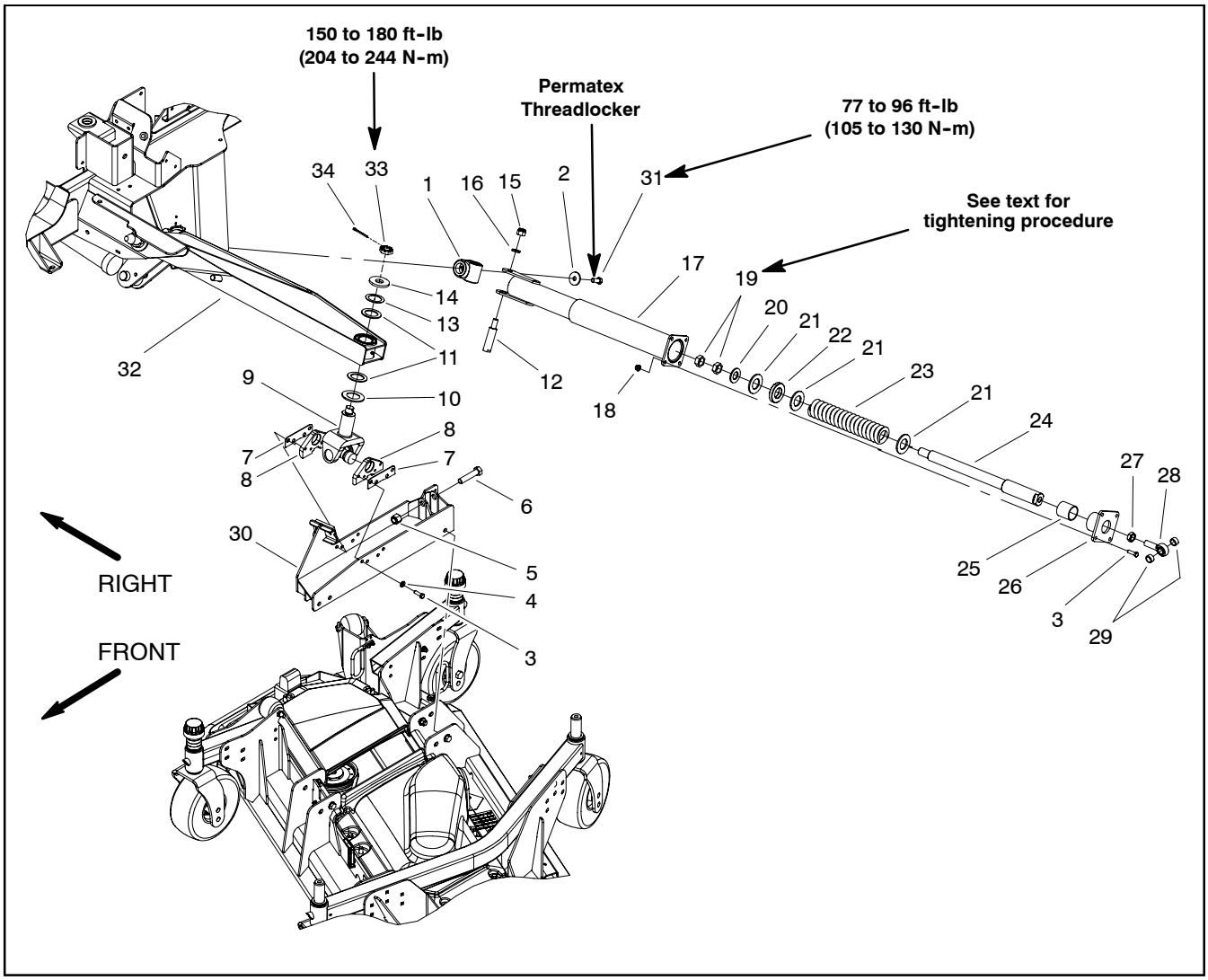


Figure 2

1. Pivot hub
2. Thrust washer
3. Cap screw
4. Flat washer
5. Lock nut
6. Cap screw
7. Shim
8. Base mount
9. Joint yoke
10. Spacer
11. Thrust washer
12. Pivot shaft
13. Thrust washer (as required)
14. Hardened washer
15. Lock nut
16. Lock washer
17. Rear impact arm housing
18. Flange nut (4 used per impact arm)
19. Jam nut
20. Flat washer
21. Plain washer
22. Plastic bearing
23. Compression spring
24. Spring shaft
25. Plain bushing
26. Housing
27. Jam nut
28. Rod end
29. Spacer
30. Deck connection
31. Cap screw
32. Lift arm (LH shown)
33. Slotted hex nut
34. Cotter pin

Removal (Fig. 2)

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

2. Remove cap screw (item 6) and lock nut (item 5) that secures rod end of rear impact arm to cutting deck connection. Locate and remove spacer (item 29) from each side of rod end.

3. Remove lock nut (item 15) and lock washer (item 16) that secures rear impact arm pivot shaft (item 12). Slide pivot shaft from pivot hub and impact arm clevis. Remove rear impact arm assembly from machine.

Disassembly (Fig. 2)

1. Disassemble wing deck rear impact arm assembly using Figure 2 as a guide.

2. Thoroughly clean rear impact arm components and inspect for worn parts. Replace components as needed.

Assembly (Fig. 2)

1. Slide plain washer (item 21), compression spring (item 23), second plain washer (item 21), plastic bearing (item 22), third plain washer (item 21) and then flat washer (item 20) onto spring shaft. Thread one jam nut (item 19) onto shaft and tighten so that spring length is 12.000" (304.8 mm).

2. Slide the housing (item 26) onto rod end of assembled spring shaft.

3. Insert assembly into rear impact arm housing (item 17).

4. Temporarily secure housing (item 26) to rear impact arm housing with two (2) cap screws (item 3) and lock nuts (item 18).

IMPORTANT: All endplay must be removed from spring shaft assembly to allow proper operation and ensure long life.

5. Grasp end of spring shaft. Push inward and pull outward on shaft to determine if endplay exists in spring shaft assembly.

6. If endplay in spring shaft assembly exists, insert a 3/4" socket onto jam nut (item 19) on spring shaft. Access to jam nut can be obtained through the open end of rear impact arm housing. Loosen jam nut until all endplay in shaft is removed.

7. When no endplay exists in spring shaft assembly, remove two (2) cap screws and nuts securing housing (item 26) to rear impact arm housing. Remove spring shaft assembly from housing.

8. Thread second jam nut (item 19) onto end of spring shaft. While holding first jam nut with a wrench to prevent it from turning, torque second jam nut from **135 to 165 ft-lb (184 to 223 N-m)** to secure spring adjustment.

9. Thoroughly pack spring with grease. Apply approximately 40 oz (1.1 kg) of grease to a clean spring.

10. Install spring shaft assembly into rear impact arm housing and secure housing (item 26) with four (4) cap screws (item 3) and lock nuts (item 18).

11. Thread rod end (item 28) with jam nut (item 27) into end of spring shaft so that distance from center of rod end to center of pivot shaft mounting hole is from 34.890" to 35.010" (886.3 to 889.2 mm) (Fig. 3). Do not tighten jam nut until alignment of cutting deck to traction unit is checked (see below).

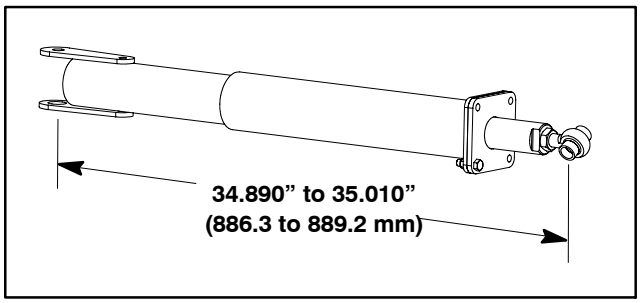


Figure 3

Installation (Fig. 2)

1. Position rear impact arm assembly to cutting deck connection and frame.

2. Slide pivot shaft (item 12) through rear impact arm clevis and hub. Secure pivot shaft with lock washer and lock nut.

3. Position spacers on both sides of rod end of rear impact arm assembly. Secure rod end of rear impact arm to deck connection with cap screw (item 6) and lock nut (item 5).

4. Lubricate rear impact arm grease fittings.

5. After installation is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

NOTE: Due to differences in grass conditions and the counterbalance setting of traction unit, it is advised that grass be cut and appearance checked before formal cutting is started. Refer to Operator's Manual for correcting cutting deck mismatch procedures.

Lift Arm Joint Yoke

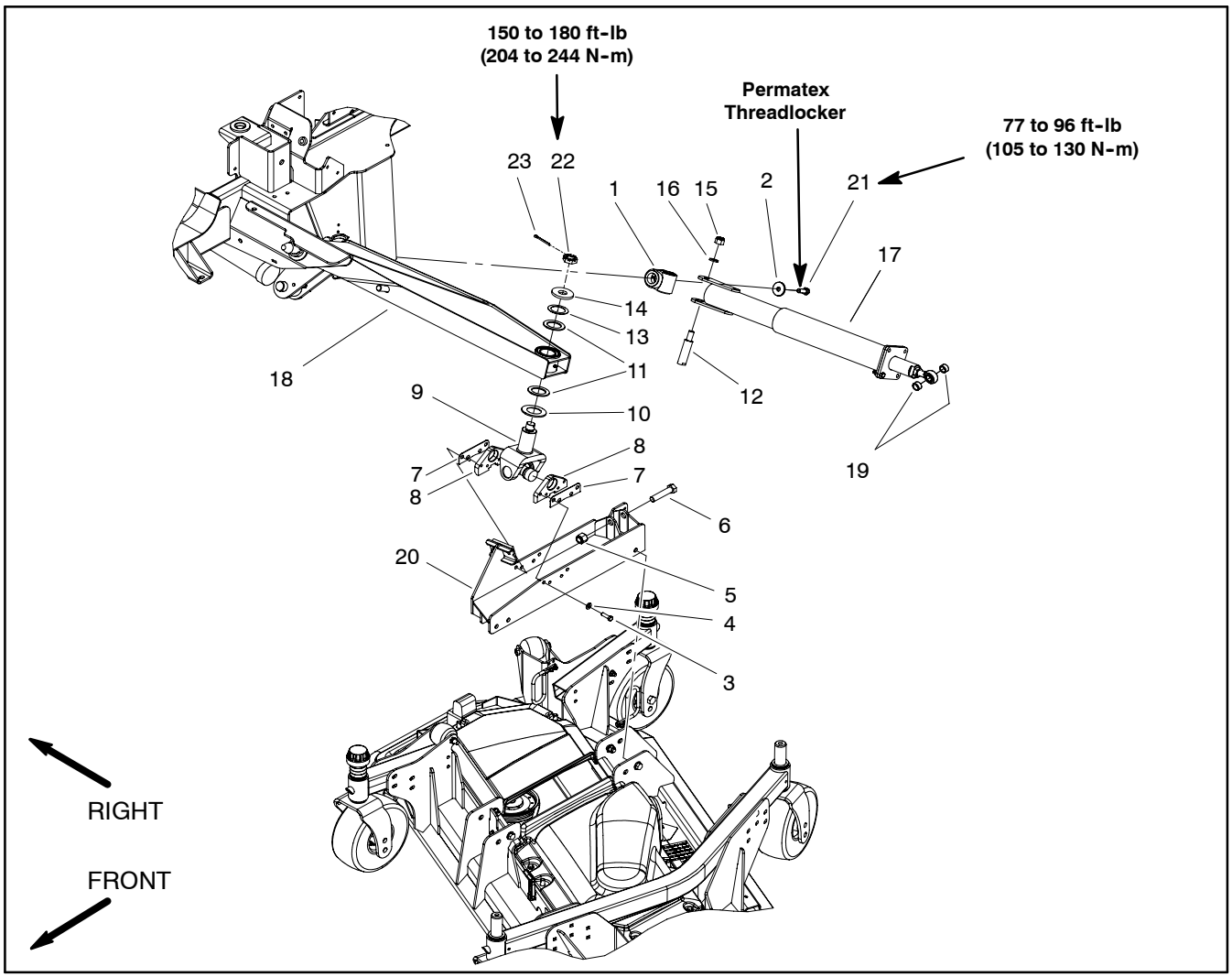


Figure 4

1. **Pivot hub**
2. **Thrust washer**
3. **Cap screw (8 used per yoke)**
4. **Flat washer (8 used per yoke)**
5. **Lock nut**
6. **Cap screw**
7. **Shim**
8. **Base mount**
9. **Joint yoke**
10. **Spacer**
11. **Thrust washer**
12. **Pivot shaft**
13. **Thrust washer (as required)**
14. **Hardened washer**
15. **Lock nut**
16. **Lock washer**
17. **Rear impact arm assembly**
18. **Lift arm (LH shown)**
19. **Spacer**
20. **Deck connection**
21. **Cap screw**
22. **Slotted hex nut**
23. **Cotter pin**

Joint Yoke Removal (Fig. 4)

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

2. Remove cotter pin (item 23) and then slotted hex nut (item 22) from joint yoke shaft. Remove hardened washer (item 14) and thrust washers (items 11 and 13, if equipped) from joint yoke shaft.

3. Remove eight (8) cap screws (item 3) and flat washers (item 4) that secure base mounts (item 8) to cutting deck connection.

4. Raise lift arm enough to free joint yoke from lift arm. Remove thrust washer (item 11) and spacer (item 10) from yoke shaft.

5. Lift joint yoke and base mounts from deck mount. Locate and retrieve shim (item 7) from between each base mount and deck mount.

Joint Yoke Disassembly

1. Remove snap rings from yoke.

IMPORTANT: Support yoke when removing cross and bearings to prevent yoke damage.

2. Press base mounts from joint yoke. Slide bearings from joint yoke.

3. Use a press to remove cross and remaining bearings from yoke:

A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.

B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.

C. Remove yoke from press, grasp partially removed bearing and tap on yoke to completely remove the bearing.

D. Repeat process for remaining bearing.

E. Thoroughly clean and inspect all components.

Joint Yoke Assembly

1. Apply a coating of grease to bearing bores of yoke. Also, apply grease to bearings and seal of bearing assembly.

2. Press one bearing partially into yoke.

IMPORTANT: Take care when installing cross into bearing to avoid damaging bearing seal.

3. Carefully insert cross into bearing and yoke.

4. Hold cross in alignment and press bearing in until it hits the yoke.

5. Carefully place second bearing into yoke bore and onto cross shaft. Press bearing into yoke.

6. Install snap rings to bearings to secure bearings in place.

7. Press base mounts to joint yoke with the angled edge of the mounts assembled away from the joint (Fig. 5). The outside of the yoke bearing cups should be flush with the base mount surfaces.

8. Make sure that assembled joint yoke moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble joint yoke to identify and eliminate source of binding.

Joint Yoke Installation (Fig. 4)

1. Install joint yoke to lift arm:

A. Place spacer (item 10) and then thrust washer (item 11) onto joint yoke shaft.

B. Insert yoke shaft up through lift arm bushings.

C. Place second thrust washer (item 11) onto joint yoke shaft and then place washer(s) (item 13) as needed to remove as much clearance as possible between second thrust washer and hardened washer (item 14) location.

D. Install slotted hex nut to secure joint yoke to lift arm. Torque nut from **150 to 180 ft-lb (204 to 244 N-m)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.

2. Carefully lower lift arm to position base mounts to deck connection.

3. Install shims between deck connection and base mounts. Secure base mounts with eight (8) cap screws and flat washers.

4. Grease joint yoke and lift arm bushing after installation on machine.

5. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

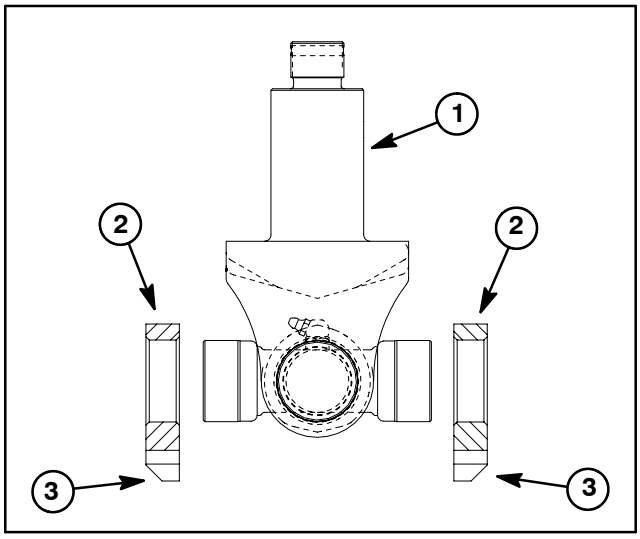


Figure 5

1. **Joint yoke**
2. **Base mount**
3. **Angled edge**

Front Deck Lift Arms

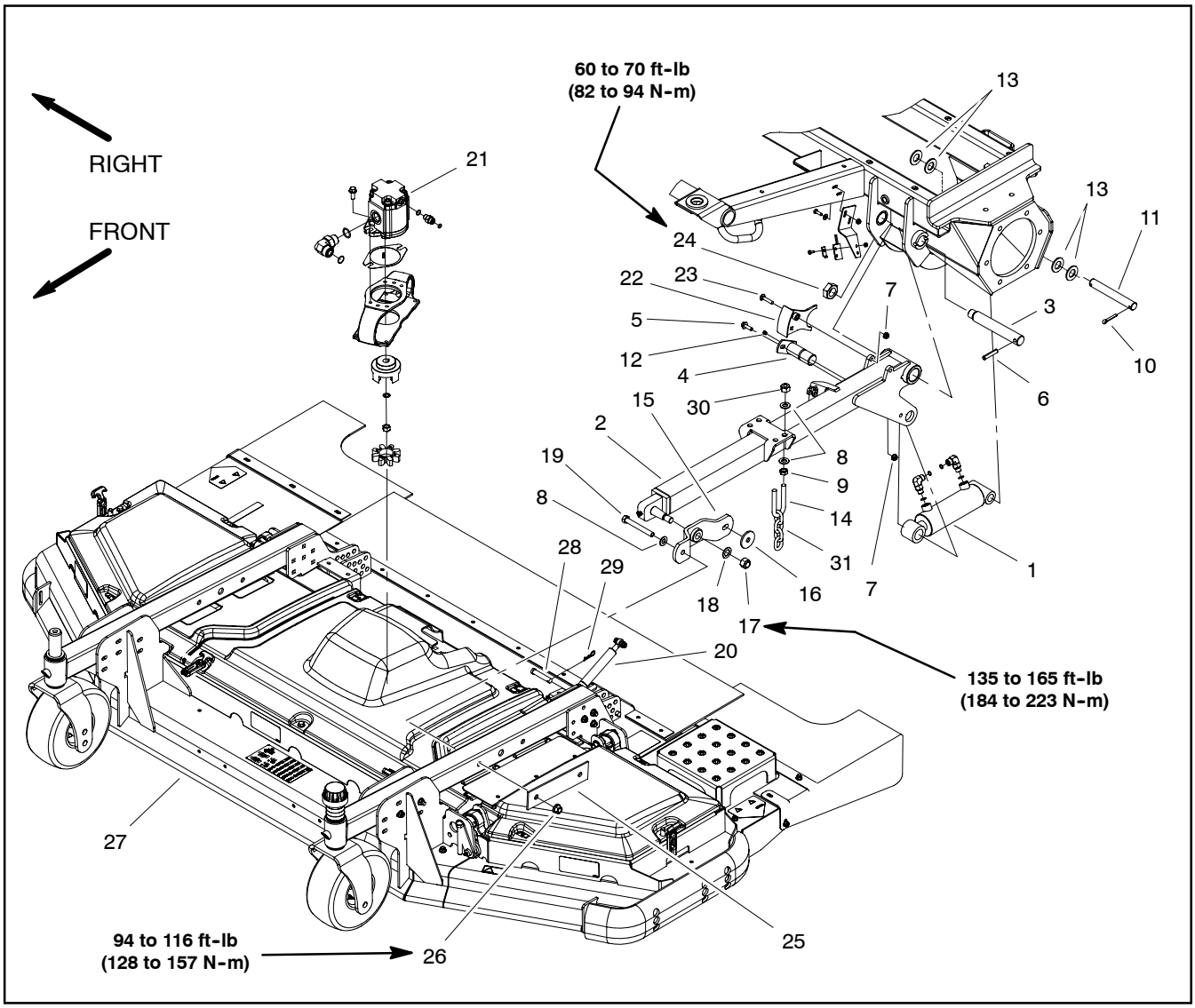


Figure 6

1. Lift cylinder (LH shown)
2. Lift arm (2 used)
3. Lift arm pin
4. Pin
5. Flange head screw
6. Roll pin
7. Flange nut
8. Flat washer
9. Jam nut (2 used per u-bolt)
10. Cotter pin (2 used per clevis pin)
11. Clevis pin
12. Plug
13. Flat washer (4 used per pin)
14. U-bolt (2 used)
15. Support hub (2 used)
16. Thrust washer
17. Lock nut
18. Flat washer
19. Cap screw (2 used per hub)
20. Damper assembly
21. Front deck motor
22. Trigger sensor
23. Carriage screw
24. Lock nut
25. Plate
26. Lock nut
27. Front deck assembly
28. HOC clevis pin (2 used)
29. Hair pin (2 used)
30. Lock nut (2 used per u-bolt)
31. HOC chain

NOTE: If lift cylinder (item 1) is to be removed, see Front Deck Lift Cylinder in the Service and Repairs section of Chapter 4 – Hydraulic System.

Removal (Fig. 6)

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

2. Remove front cutting deck (see Cutting Deck Removal in Chapter 8 – Cutting Units).

CAUTION

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

3. Chock rear wheels and jack up front of machine. Support machine on jack stands. Remove front wheel next to lift arm that is being removed (see Wheel Removal in the Service and Repairs section of Chapter 6 – Axles, Planetaries and Brakes).

4. Remove flange head screw and flange nut that secure lift cylinder pin (item 4) to lift arm. Remove pin and separate lift cylinder from lift arm.

5. Remove lock nut (item 24) that secures lift arm pin (item 3).

6. Support lift arm and slide pin from frame and lift arm. Remove lift arm from frame.

7. As needed, disassemble lift arm (Fig. 7):

   A. Remove height–of–cut chain.

   B. Remove lock nut, flat washer and support hub from tapered stud in lift arm.

   C. Remove retaining ring that secures spherical bearing in lift arm. Remove tapered stud with spherical bearing from lift arm. Separate flange nut and spherical bearing from stud.

   D. Press flange bushings from lift arm. Thoroughly clean lift arm bore.

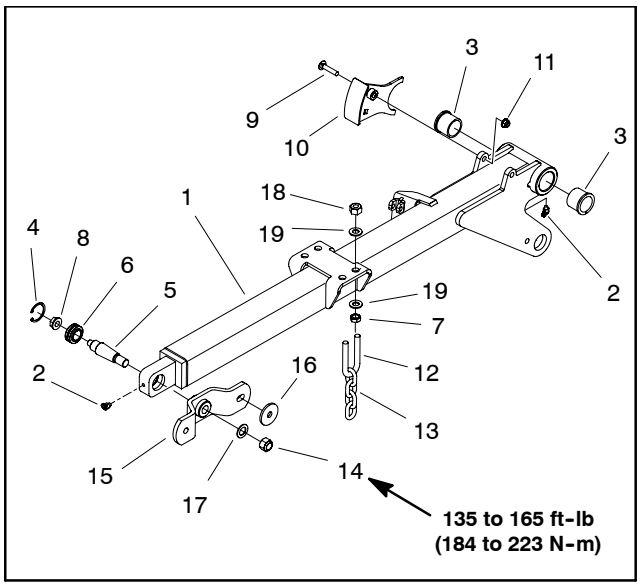


Figure 7

1. Lift arm (LH shown)
2. Grease fitting
3. Flange bushing
4. Retaining ring
5. Tapered stud
6. Spherical bearing
7. Jam nut (2 used)
8. Flange nut
9. Carriage screw
10. Trigger sensor
11. Flange nut
12. U-bolt
13. HOC chain
14. Lock nut
15. Support hub
16. Thrust washer
17. Flat washer
18. Lock nut (2 used)
19. Flat washer (4 used)

Installation (Fig. 6)

1. If removed, install components to lift arm (Fig. 7):

   A. Assemble height–of–cut chain u–bolt so that threaded portion of u–bolt extends 1.200" (30.5 mm) above mounting plate on lift arm.

   B. Lightly lubricate new flange bushings and press bushings into lift arm. Make sure that bushing flange is pressed fully to lift arm surface.

   C. Install spherical bearing on tapered stud and secure with flange nut. Install stud with spherical bearing into lift arm and secure with retaining ring.

   D. Thoroughly clean tapered surfaces of stud and mounting boss of support hub. Secure support hub (position slotted hole in hub toward rear of deck) to tapered stud with flat washer and lock nut. Tighten lock nut from **135 to 165 ft–lb (184 to 223 N–m)**.

2. Position lift arm to frame and insert lift arm pin. Engage roll pin into frame slots and install lock nut on pin. Torque lock nut from **60 to 70 ft–lb (82 to 94 N–m)**.

3. Align lift cylinder with lift arm. Slide lift cylinder pin through lift arm and cylinder end. Secure pin with flange head screw and flange nut.

4. Install front wheel assembly (see Wheel Installation in the Service and Repairs section of Chapter 6 – Axles, Planetaries and Brakes). Lower machine to the ground.

WARNING

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

5. Torque wheel lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to 122 N-m)**.

6. Install cutting deck (see Cutting Deck Installation in Chapter 8 – Cutting Deck).

7. Lubricate lift arm grease fittings.

8. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

9. When lift arms are fully raised, check that gap between lift arms and bumper pads on bottom of operator platform is approximately 0.100" (2.5 mm) (Fig. 8). If necessary, add or remove shim pads so that gap is correct.

10. Verify correct operation of front deck proximity switch.

11. Check height-of-cut and deck pitch adjustment. Adjust if necessary.

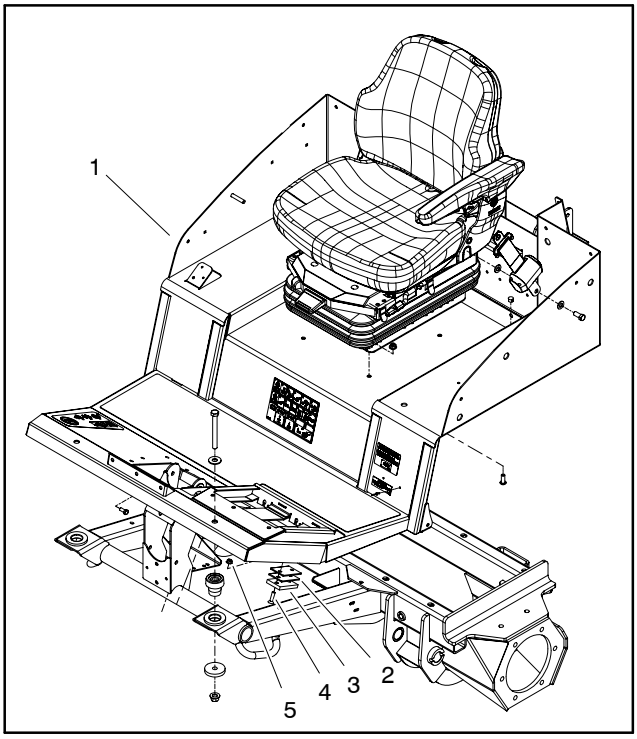


Figure 8

1. **Operator platform**
2. **Shim pad**
3. **Bumper pad**
4. **Flange head screw**
5. **Flange nut**

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Wing Deck Lift Arms

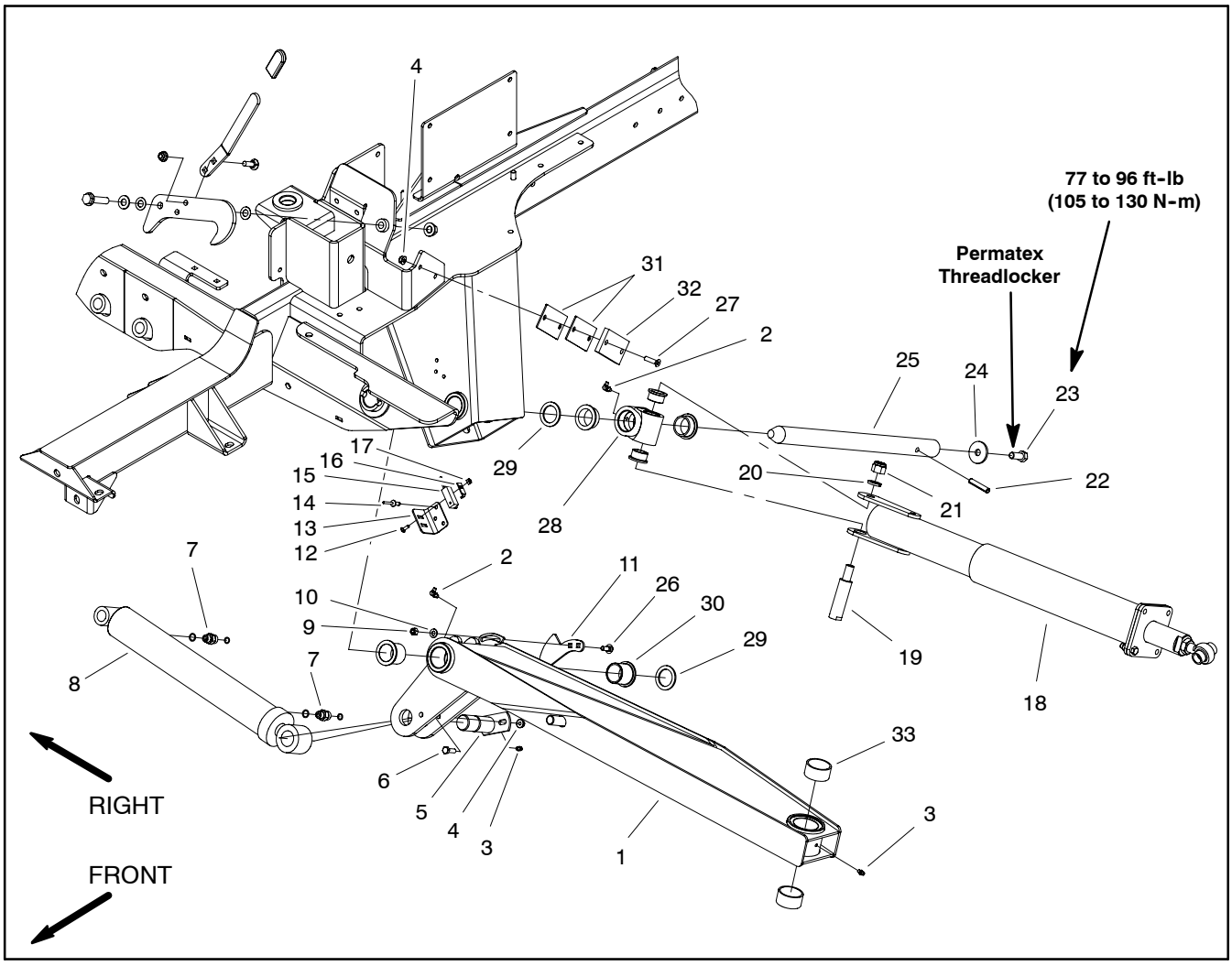


Figure 9

1. Lift arm (LH shown)
2. Grease fitting
3. Grease fitting
4. Flange nut
5. Cylinder pin
6. Cap screw
7. Hydraulic fitting
8. Lift cylinder
9. Lock nut (2 used per plate)
10. Flat washer (2 used per plate)
11. Sensing plate
12. Carriage bolt
13. Aluminum plate
14. Rivet (3 used per plate)
15. Proximity sensor
16. Switch plate
17. Lock nut
18. Impact arm assembly
19. Pivot shaft
20. Lock washer
21. Lock nut
22. Roll pin
23. Cap screw
24. Thrust washer
25. Lift arm pivot shaft
26. Carriage screw (2 used per plate)
27. Screw (2 used per pad)
28. Pivot hub assembly
29. Thrust washer
30. Flange bushing (2 used per arm)
31. Shim pad
32. Bumper pad
33. Straight bushing (2 used per arm)

NOTE: If wing deck lift cylinder (item 8) is to be removed, see Wing Deck Lift Cylinder in the Service and Repairs section of Chapter 4 – Hydraulic System.

Removal (Fig. 9)

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

2. Remove wing deck from lift arm (see Wing Cutting Deck in Chapter 8 – Cutting Decks).

3. Remove wing deck impact arm assembly from pivot hub (see Wing Deck Impact Arm Assembly in this section).

4. Remove joint yoke and cutting deck connection from lift arm (Fig. 12):

   A. Support cutting deck connection to prevent it from falling.

   B. Remove cotter pin, slotted hex nut, hardened washer and thrust washers from joint yoke shaft.

   C. Lower joint yoke, cutting deck connection and wing deck impact arm assembly from lift arm.

5. Remove cap screw and flange nut that secure lift cylinder pin (item 5) to lift arm. Slide cylinder pin from lift cylinder and lift arm. Separate lift cylinder from lift arm.

6. Remove cap screw (item 23) and flat washer (item 24) from lift arm pivot shaft.

7. Slide wing deck impact arm pivot hub and thrust washer (item 29) from lift arm pivot shaft.

8. Drive out roll pin (item 22) that retains lift arm pivot shaft to frame. Discard roll pin.

9. Support lift arm to prevent it from shifting or falling. Pull lift arm pivot shaft from lift arm and frame. Locate and remove thrust washer (item 29) during pivot shaft removal.

NOTE: If pivot shaft is difficult to remove, fabricate a puller as shown in Figure 10. Attach puller to end of pivot shaft with the pictured bolt and flat washer. Drive pivot shaft from lift arm and frame with hammer.

10. Remove lift arm from machine.

11. If necessary, press bushings from lift arm (Fig. 11). Thoroughly clean lift arm bores.

Installation (Fig. 9)

1. If bushings were removed from lift arm, press new bushings into lift arm bores. Make sure that bushings are pressed fully to lift arm surface.

2. Apply anti–seize lubricant to lift arm pivot shaft.

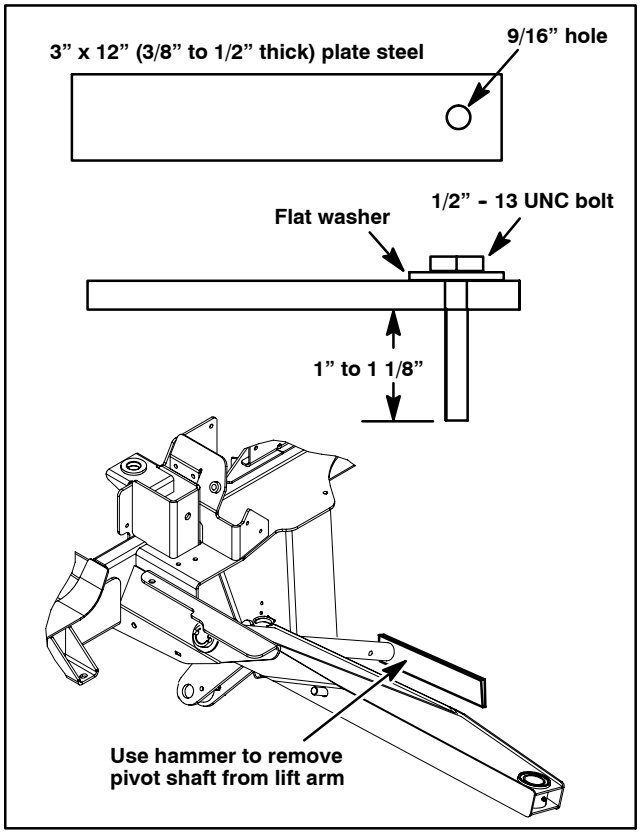


Figure 10

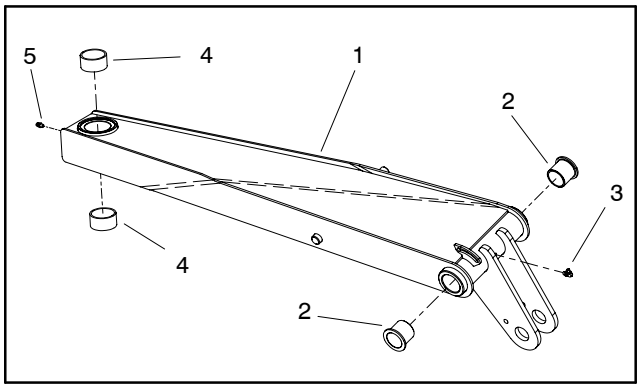


Figure 11

1. Lift arm (LH shown)
2. Flange bushing
3. Grease fitting
4. Straight bushing
5. Grease fitting

3. Position lift arm to frame with thrust washer (item 29) properly placed between rear of lift arm pivot hub and frame. Slide pivot shaft into frame, thrust washer and lift arm until roll pin holes in pivot shaft and frame align.

4. Install new roll pin (item 22) to secure lift arm pivot shaft to frame.

5. Slide thrust washer (item 29) and then wing deck impact arm pivot hub onto pivot shaft. Make sure that thrust washer is between frame and pivot hub.

6. Apply Permatex Blue Gel medium strength threadlocker (or equivalent) to threads of cap screw (item 23). Secure pivot hub to pivot shaft with washer (item 24) and cap screw. Torque cap screw from **77 to 96 ft-lb (105 to 130 N-m)**.

7. Install joint yoke and cutting deck connection to lift arm (Fig. 12):

A. Make sure that spacer and thrust washer are installed on joint yoke.

B. Raise joint yoke, cutting deck connection and wing deck impact arm assembly to lift arm. Slide joint yoke into lift arm bore.

C. Place second thrust washer onto joint yoke shaft and then place washer(s) (item 5 in Figure 12) as needed to remove as much clearance as possible between second thrust washer and hardened washer (item 4) location.

D. Install slotted hex nut to secure joint yoke to lift arm. Torque hex nut from **150 to 180 ft-lb (204 to 244 N-m)**. Make sure that joint yoke rotates in lift arm without binding and that excessive clearance does not exist in yoke assembly.

8. Secure wing deck rear impact arm assembly to pivot hub (see Wing Deck Rear Impact Arm Assembly in this section).

9. Position and install wing cutting deck to machine (see Wing Cutting Unit in Chapter 8 – Cutting Units).

10. Lubricate lift arm grease fittings after assembly is complete.

11. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

12. When lift arm is fully raised, check that gap between lift arm and bumper pad (item 32) is approximately 0.100" (2.5 mm). If necessary, add or remove shim pads (item 31) so that gap is correct.

13. When lift arm is fully raised, the bumper on the stop bracket should be contacted slightly by the lift arm (Fig. 13). There should be less than one (1) bumper shim of interference. If necessary, add or remove bumper shims so that slight contact exists.

14. Verify correct operation of wing deck proximity switch.

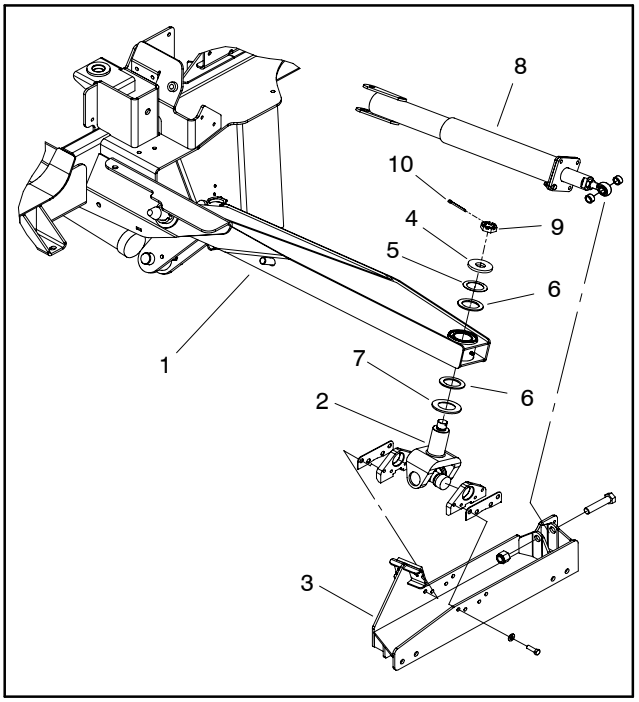


Figure 12

1. **Lift arm (LH shown)**
2. **Joint yoke**
3. **Deck connection**
4. **Hardened washer**
5. **Thrust washer**
6. **Thrust washer**
7. **Spacer**
8. **Rear impact arm**
9. **Slotted hex nut**
10. **Cotter pin**

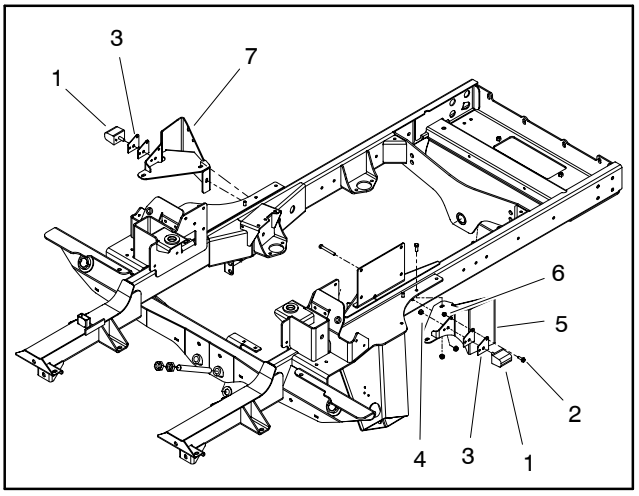


Figure 13

1. **Bumper**
2. **Flange head screw**
3. **Bumper shim**
4. **Lock nut**
5. **LH stop bracket**
6. **Flange nut**
7. **RH stop bracket**

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Console Arm

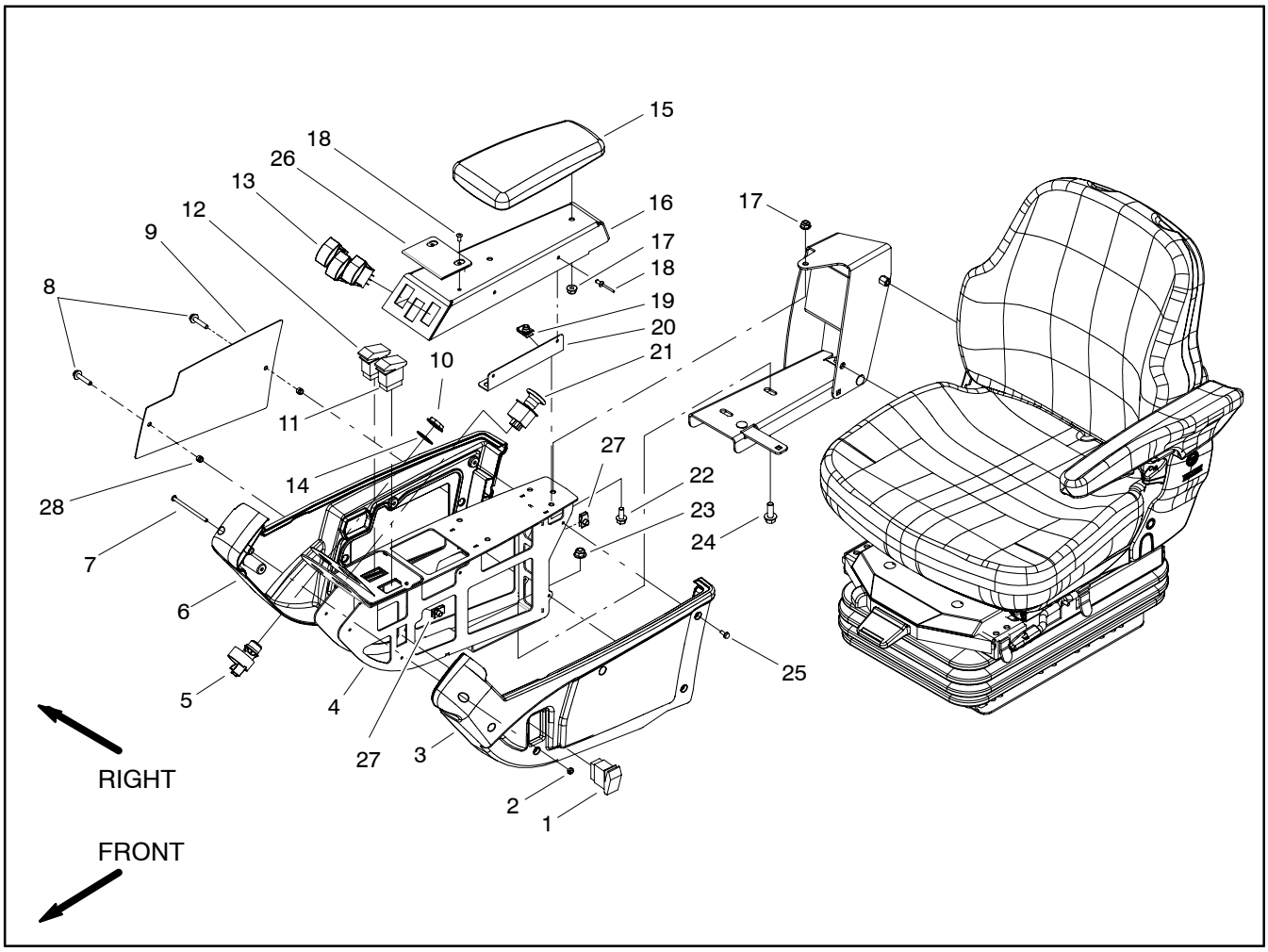


Figure 14

1. Headlight switch
2. Lock nut
3. LH cover
4. Console arm panel
5. Ignition switch
6. RH cover
7. Screw
8. Cap screw (2 used)
9. Cover plate
10. Nut
11. Cruise switch
12. 4WD traction assist switch
13. Lift/lower switch (3 used)
14. Lock washer
15. Arm rest
16. Arm panel
17. Flange nut (3 used)
18. Rivet (4 used)
19. U-nut (4 used)
20. Mounting angle
21. PTO switch
22. Flange head screw (5 used)
23. Flange nut (2 used)
24. Flange head screw (2 used)
25. Washer head screw (10 used)
26. Switch guard
27. Clip (2 used)
28. Flange spacer (2 used)

Disassembly (Fig. 14)

1. Park machine on a level surface, lower cutting units, stop engine and engage parking brake. Remove key from ignition switch.

2. Remove two (2) cap screws (item 8) and then cover plate (item 9) from outside of console arm. Locate and retrieve two (2) flange spacers (item 28).

3. At front of console arm, remove screw (item 7) and lock nut (item 2) that secure console arm covers to each other.

4. Remove five (5) washer head screws (item 25) that secure each cover to console arm panel.

5. Remove console arm covers from machine. As LH cover (item 3) is removed from console arm, unplug wire harness connector from headlight switch.

6. Remove electrical components from console arm as needed using Figure 14 as a guide.

7. If necessary, remove console panel and supports from machine using Figures 14 and 15 as guides.

Assembly (Fig. 14)

1. Install all removed electrical and console arm components using Figure 14 and 15 as guides.

2. Position covers to console arm. As LH cover (item 3) is placed, plug wire harness connector to headlight switch.

3. Secure each cover to console arm with five (5) washer head screws (item 25). Install screw (item 7) and lock nut (item 2) to secure covers at front of console arm.

4. Position cover plate and flange spacers to outside of console arm. Secure with two (2) cap screws.

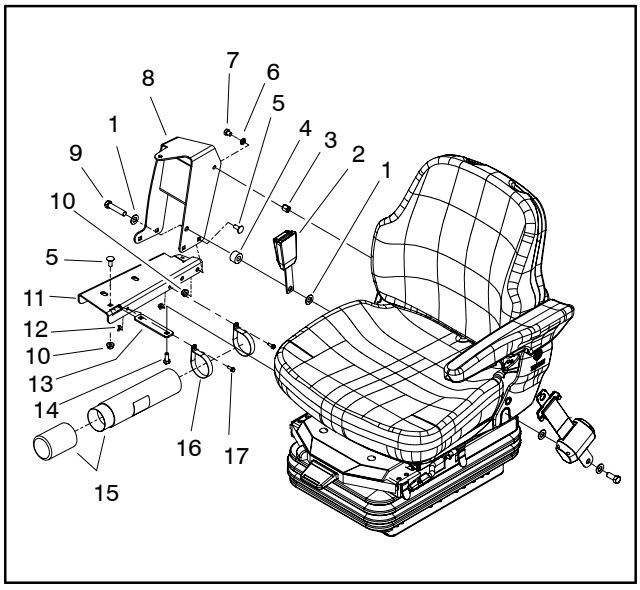


Figure 15

1. **Flat washer**
2. **Seat belt buckle**
3. **Coupling nut**
4. **Spacer**
5. **Carriage screw (5 used)**
6. **Lock washer**
7. **Cap screw**
8. **Arm support**
9. **Cap screw**
10. **Flange nut**
11. **Support channel**
12. **Flange nut (2 used)**
13. **Support bracket**
14. **Cap screw**
15. **Manual tube**
16. **R-clamp (2 used)**
17. **Screw (2 used)**

Traction Pedal

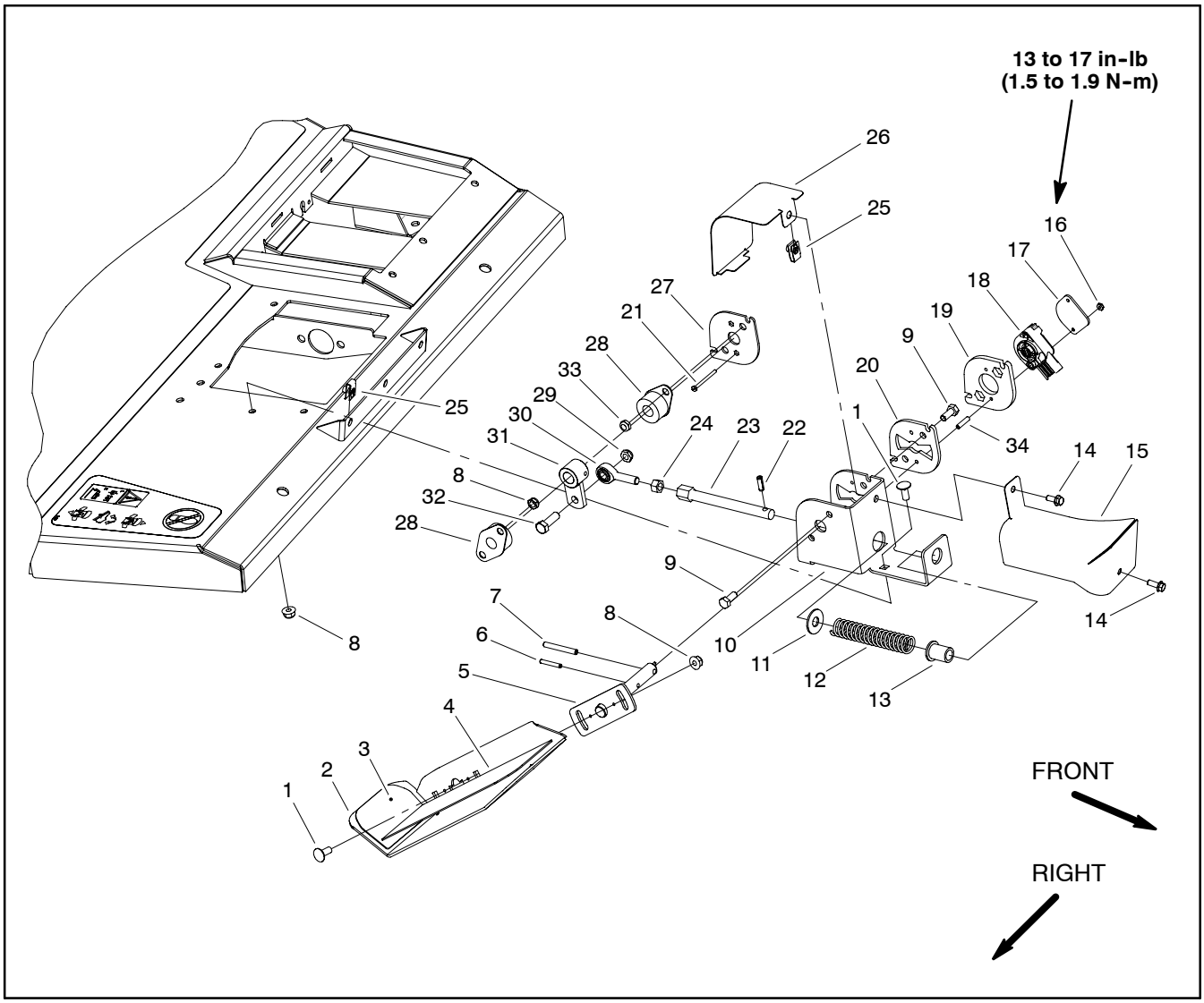


Figure 16

1. Carriage screw (6 used)
2. Traction pedal
3. Pedal abrasive
4. Pedal abrasive
5. Traction pedal shaft
6. Slotted roll pin
7. Roll pin
8. Flange nut (6 used)
9. Cap screw (4 used)
10. Mounting bracket
11. Flat washer
12. Compression spring
13. Spring retainer
14. Flange head screw (2 used)
15. Spring cover
16. Lock nut (2 used)
17. Capture plate
18. Traction pedal potentiometer
19. Mounting plate
20. Shim plate
21. Screw (2 used)
22. Roll pin
23. Spring shaft
24. Hex nut
25. Clip (2 used)
26. Traction pedal cover
27. Cover plate
28. Flange mount bearing (2 used)
29. Lock nut
30. Rod end bearing
31. Traction pedal hub
32. Cap screw
33. Lock nut (4 used)
34. Standoff spacer (2 used)

IMPORTANT: A properly installed and calibrated traction pedal potentiometer is critical to accurate traction system response and for reliable potentiometer life. Use care when removing, installing and calibrating the traction pedal potentiometer.

Disassembly (Fig. 16)

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

2. Disconnect machine wire harness connector from potentiometer (item 18) on traction pedal.

3. If the traction pedal is to be removed from the traction pedal shaft, use a marker or paint pen on pedal and shaft to identify location of pedal for assembly purposes.

4. Disassemble traction pedal as needed using Figures 16 and 17 as guides. When removing roll pins (items 6, 7 and 22), make sure to support shaft to prevent component damage.

Assembly (Fig. 16)

1. Assemble traction pedal using Figures 16 and 17 as guides noting the following items:

   A. Apply antiseize lubricant to spring shaft (item 23) between hex head and roll pin hole.

   B. The bracket of the traction pedal hub (item 31) should be closer to the traction pedal than the slotted roll pin (Fig. 17).

   C. Use a press to install slotted roll pin (item 6) and roll pin (item 7). DO NOT distort roll pins during assembly.

   D. Make sure that roll pin (item 7) is fully inside the groove of the shim plate (item 20). The roll pin should not contact the shim plate throughout the operating range.

   E. To install the traction pedal potentiometer (item 18), press and hold the traction pedal in the reverse direction slightly. Align the slot on the end of the pedal shaft with the slot in the potentiometer. Slide potentiometer onto screws and release pedal. Hold potentiometer in position while installing capture plate (item 17) and lock nuts (item 16).

   F. Torque lock nuts (item 16) from **13 to 17 in-lb (1.5 to 1.9 N-m)**.

   G. Leave the hex nut (item 24) loose so that the potentiometer can be calibrated. Also, do not install spring cover (item 15) and traction pedal cover (item 26) until after calibration of potentiometer.

2. Plug machine wire harness connector into traction pedal potentiometer (item 18).

3. After assembly of the traction pedal, calibrate the traction pedal potentiometer using the Info Center Display (see Traction Pedal Calibration in the Adjustments section of Chapter 5 – Electrical System).

4. Make sure that hex nut (item 24) is tightened after potentiometer adjustment.

5. Install spring cover (item 15) and traction pedal cover (item 26).

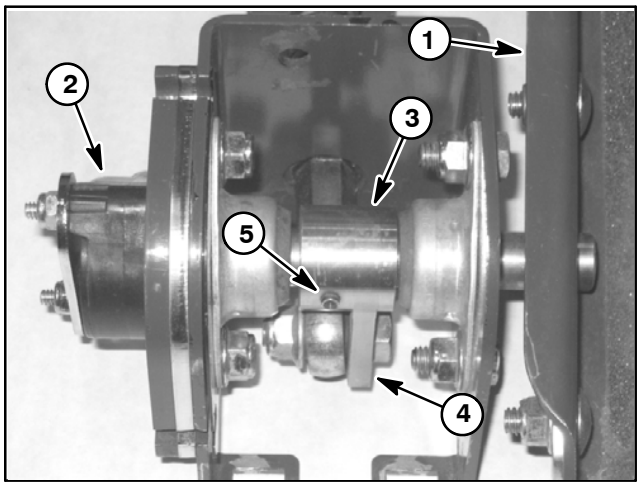


Figure 17

1. **Traction pedal**
2. **Pedal potentiometer**
3. **Traction pedal hub**
4. **Pedal hub bracket**
5. **Slotted roll pin**

Operator Seat

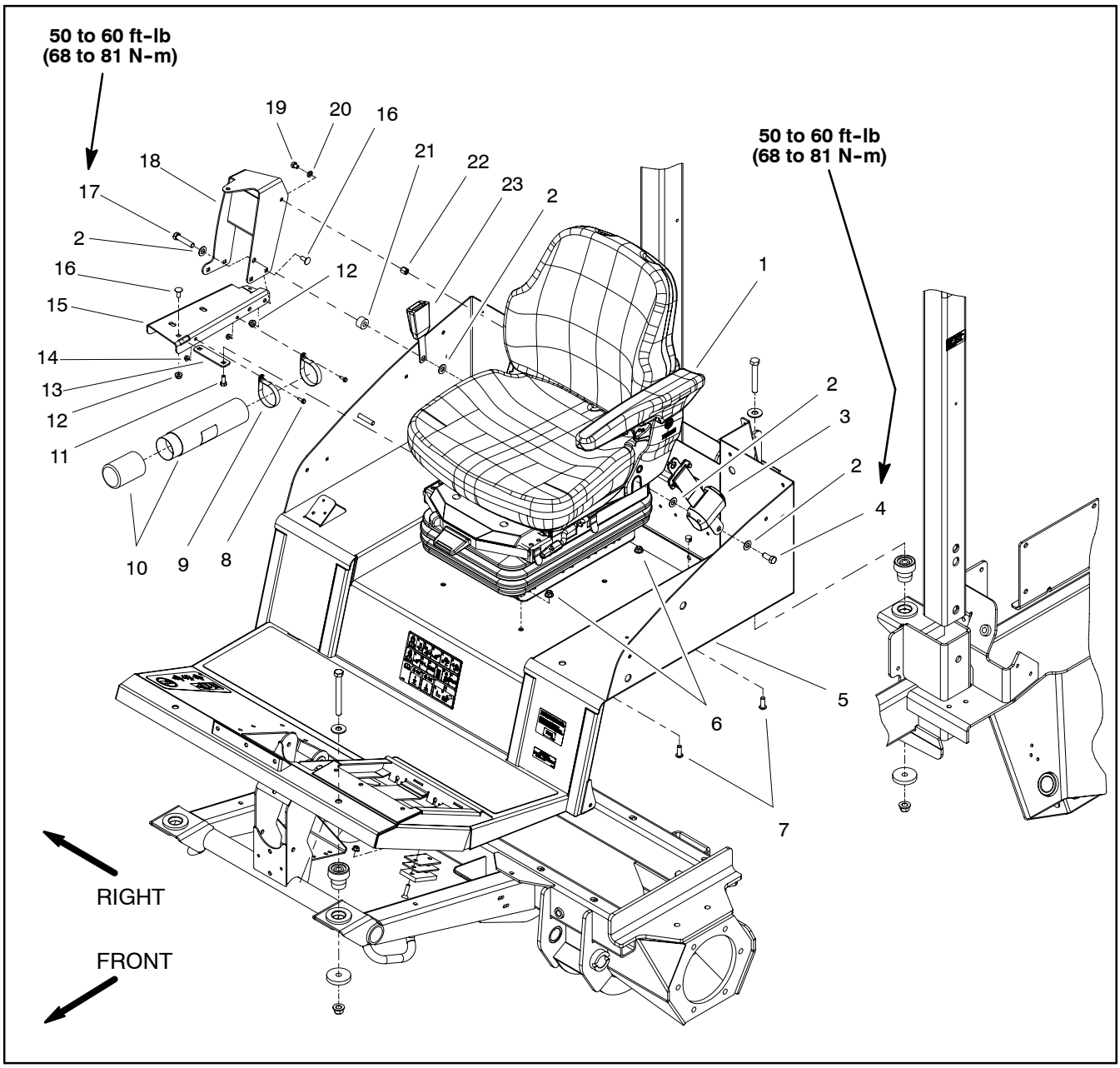


Figure 18

1. **Seat assembly**
2. **Flat washer (4 used)**
3. **Seat belt**
4. **Cap screw**
5. **Seat platform**
6. **Flange nut (4 used)**
7. **Carriage screw (4 used)**
8. **Screw (2 used)**
9. **R-clamp (2 used)**
10. **Manual tube**
11. **Cap screw**
12. **Flange nut**
13. **Support bracket**
14. **Flange nut (2 used)**
15. **Support channel**
16. **Carriage screw (5 used)**
17. **Cap screw**
18. **Arm support**
19. **Cap screw**
20. **Lock washer**
21. **Spacer**
22. **Coupling nut**
23. **Seat belt buckle**

Removal (Fig. 18)

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

2. Disconnect seat electrical connector from machine wire harness.

3. Support control arm assembly to prevent it from shifting.

4. Remove flange nut (item 12) and carriage screw (item 16) that secure support bracket (item 13) to support channel (item 15).

5. Remove cap screw (item 19) and lock washer (item 20) that secure console arm support (item 18) to coupling nut (item 22).

6. Remove cap screw (item 17), two (2) flat washers (item 2), spacer (item 21) and seat belt buckle (item 23) from seat and console arm support (item 18).

7. Carefully move console arm assembly away from seat.

8. Remove four (4) Torx head screws (Fig. 19) that secure seat to seat suspension. Note that the screw near the seat adjustment handle is longer than the other three screws.

9. Lift seat from seat suspension and remove from machine.

Installation (Fig. 18)

1. Carefully position seat to seat suspension.

2. Secure seat to seat suspension with four (4) Torx head screws (Fig. 19). Make sure that longer screw is positioned near the seat adjustment handle. Torque screws **18 ft-lb (25 N-m)**.

3. Position and secure console arm assembly to seat. Install all fasteners before fully tightening them.

   A. Secure support bracket (item 13) and support channel (item 15) with flange nut (item 12) and carriage screw (item 16).

   B. Secure console arm support (item 18) to coupling nut with cap screw (item 19) and lock washer (item 20).

   C. Place flat washer (item 2), seat belt buckle (item 23) and spacer (item 21) between seat and console arm support (item 18) and secure with flat washer (item 2) and cap screw (item 17). Torque cap screw from **50 to 60 ft-lb (68 to 81 N-m)**.

   D. Fully tighten all fasteners to secure console arm assembly to seat.

4. Connect seat electrical connector to machine wire harness.

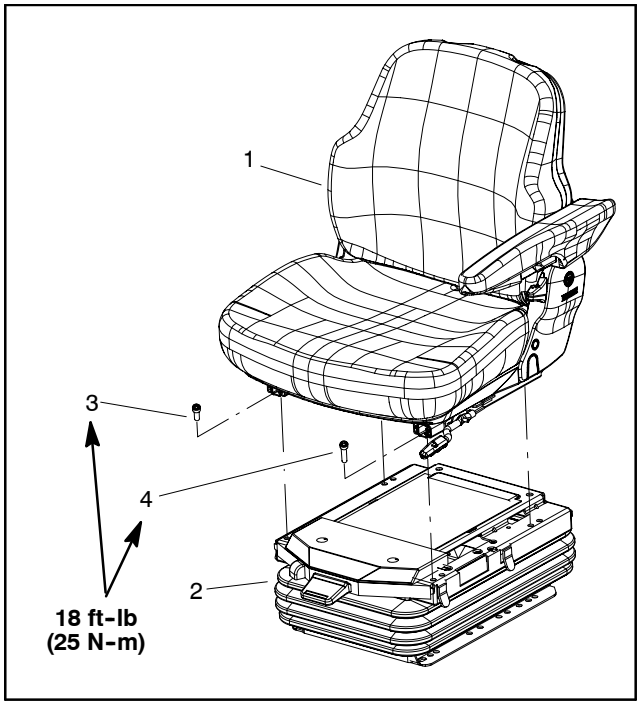


Figure 19

1. **Seat**
2. **Suspension assembly**
3. **Screw (M8x12) (3 used)**
4. **Screw (M8x16)**

Operator Seat Service

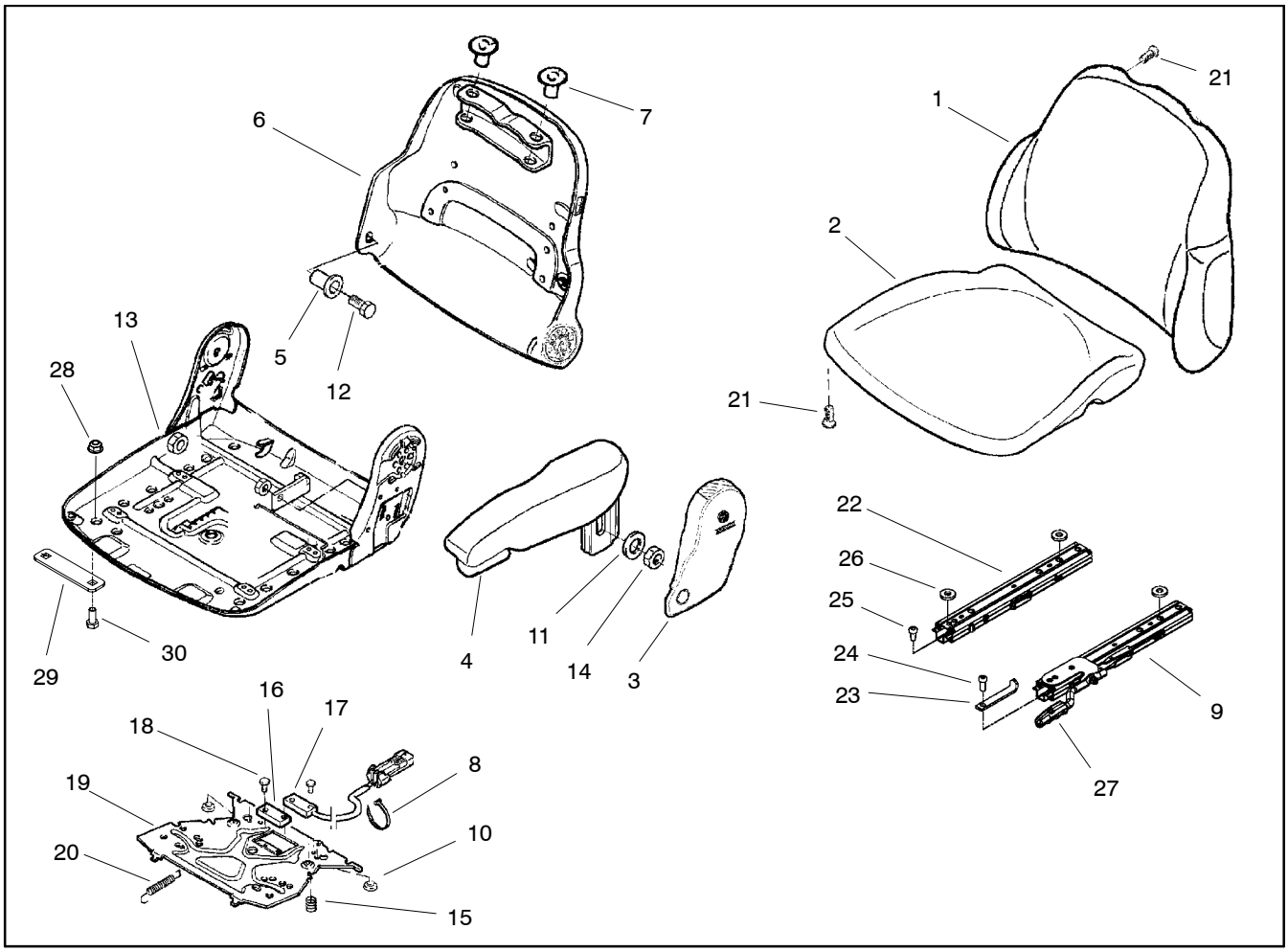


Figure 20

1. **Backrest cushion**
2. **Seat cushion**
3. **Armrest cover**
4. **LH armrest**
5. **Bushing (2 used)**
6. **Backrest**
7. **Plug (2 used)**
8. **Cable tie (3 used)**
9. **LH adjustment rail**
10. **Bumper (2 used)**
11. **Washer**
12. **Cap screw (2 used)**
13. **Seat**
14. **Nut**
15. **Spring (2 used)**
16. **Magnet**
17. **Seat switch**
18. **Rivet (4 used)**
19. **Mounting plate**
20. **Return spring**
21. **Torx screw (5 used)**
22. **RH adjustment rail**
23. **Rail stop**
24. **Torx screw**
25. **Torx screw (3 used)**
26. **Washer (3 used)**
27. **Handle**
28. **Nut**
29. **Support bracket**
30. **Cap screw**

Disassembly (Fig. 20)

1. Remove seat from machine for service (see Operator Seat Removal in this section).

2. Disassemble operator seat as necessary using Figure 20 as a guide.

Assembly (Fig. 20)

1. Assemble operator seat using Figure 20 as a guide.

2. Install seat to machine (see Operator Seat Installation in this section).

Operator Seat Suspension

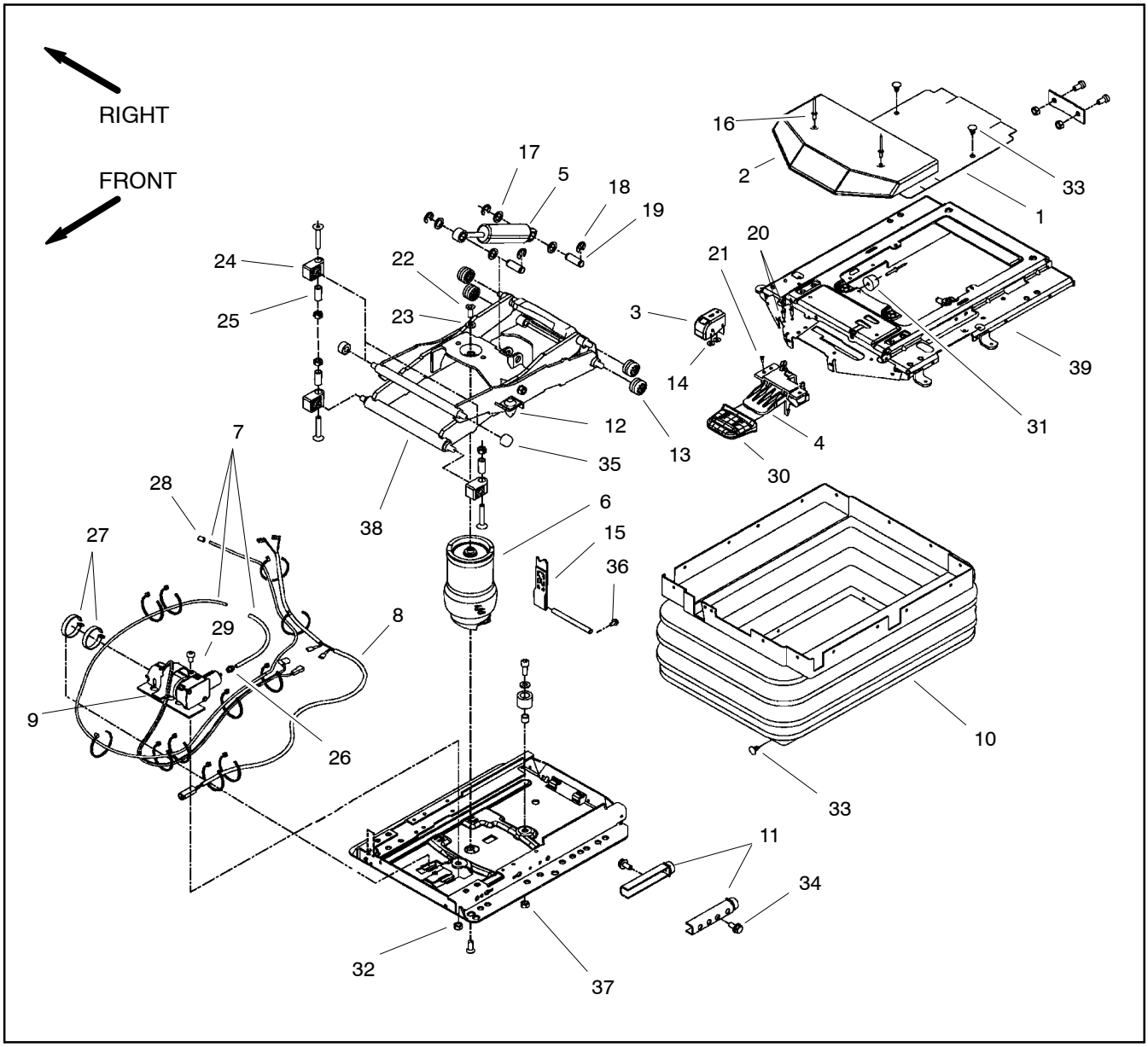


Figure 21

1. Cover
2. Cover
3. Level control
4. Air control valve
5. Shock absorber
6. Air spring
7. Air tube assembly
8. Wire harness
9. Compressor
10. Bellows
11. Stop
12. Bumper set (2 used)
13. Roller (4 used)
14. Washer (2 used)
15. Tether
16. Rivet (2 used)
17. Washer (4 used)
18. C-clip (4used)
19. Pin (2 used)
20. Rivet (2 used)
21. Washer (3 used)
22. Screw (2 used)
23. Washer
24. Housing support (4 used)
25. Spacer (4 used)
26. Hose nipple
27. Clamp (2 used)
28. Hose nipple
29. Screw
30. Handle
31. Bumper
32. Nut
33. Plastic plug (23 used)
34. Screw (2 used)
35. Roller (2 used)
36. Screw (4 used)
37. Base plate
38. Suspension frame
39. Upper plate

NOTE: Most of the seat suspension components can be serviced with the seat suspension base mounted to the frame platform. If the air spring assembly (item 6) requires removal, the seat suspension base will have to be removed from the seat platform.

Disassembly (Fig. 21)

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

2. Remove operator seat from seat suspension (see Operator Seat Removal in this section).

3. Disconnect seat suspension electrical connector from machine wire harness.

4. If the air spring assembly (item 6) or base plate (item 37) requires removal, remove seat suspension from seat platform (Fig. 22):

   A. To gain access to seat suspension mounting screws, slide fuel tank toward left side of machine (see Fuel Tank Removal in the Service and Repairs section of Chapter 3 – Engine). Support tank to prevent it from shifting.

   B. Remove four (4) screws and flange nuts that secure seat suspension to seat platform.

   C. Lift seat suspension from machine.

5. Remove seat suspension components as needed using Figure 21 as a guide.

Assembly (Fig. 21)

1. Install all removed seat suspension components using Figure 21 as a guide.

2. If seat suspension was removed from seat platform (Fig. 22):

   A. Position seat suspension onto seat platform.

   B. Secure seat suspension to seat platform with four (4) screws and flange nuts.

   C. Slide fuel tank toward right side of machine (see Fuel Tank Installation in the Service and Repairs section of Chapter 3 – Engine). Make sure that fuel tank and front wheel are properly secured.

3. Install operator seat to seat suspension (see Operator Seat Installation in this section).

4. Make sure that seat electrical connectors are secured to machine wire harness.

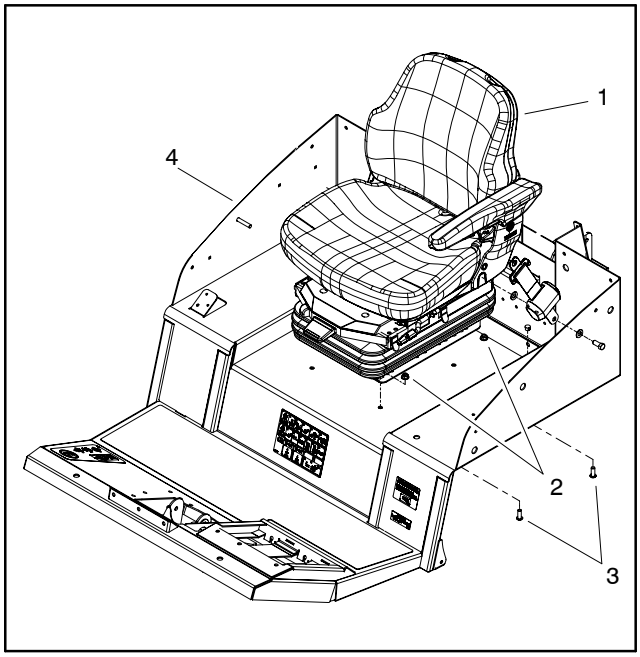


Figure 22

1. **Operator seat assembly**
2. **Flange nut (4 used)**
3. **Screw (4 used)**
4. **Seat platform**

Hood

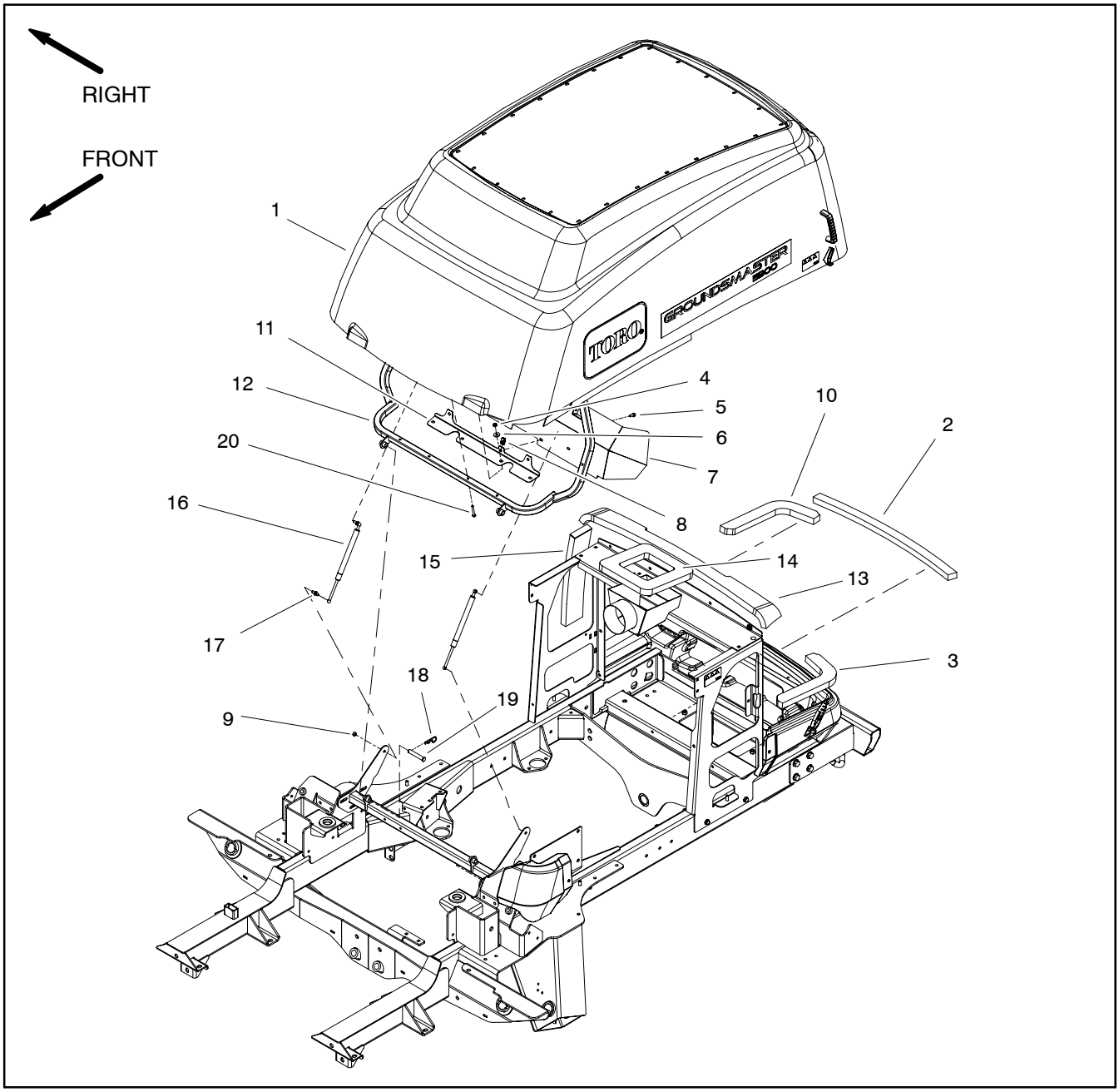


Figure 23

1. **Hood**
2. **Rear hood foam seal**
3. **LH rear foam seal**
4. **Flange nut (8 used)**
5. **Flange head screw (3 used)**
6. **Washer (8 used)**
7. **Heat shield**
8. **Clip (3 used)**
9. **Hex nut (2 used per cylinder)**
10. **RH rear foam seal**
11. **Support plate**
12. **Hood frame**
13. **Top foam seal**
14. **Air box foam seal**
15. **Side foam seal (2 used)**
16. **Gas spring (2 used)**
17. **Ball stud (2 used per cylinder)**
18. **Hair pin (2 used)**
19. **Clevis pin (2 used)**
20. **Cap screw (8 used)**

NOTE: Hood removal and installation requires two people.

Removal (Fig. 23)

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

2. Unlatch and raise hood.

3. Have one person support the rear of the raised hood.

4. Have a second person disengage gas springs from front ball. Lift up on flat clip until ball is released from spring socket.

5. Remove the two (2) hair pins (item 18) that secure the clevis pins to the frame.

6. While supporting hood on both sides, remove two (2) clevis pins (item 19) that secure hood to machine. Lift hood and remove from rear of machine.

7. Inspect all foam seals for damage. Also, make sure that foam seals show evidence of effective sealing with hood. Remove and replace foam seals if necessary.

8. If necessary, remove hood components using Figures 23 and 24 as guides.

Installation (Fig. 23)

1. Replace all removed hood components using Figures 23 and 24 as guides.

2. While supporting hood on both sides, position hood to align clevis pin holes in hood and machine frames. Install two (2) clevis pins to secure hood to machine.

3. Have one person support the rear of the raised hood.

4. Have a second person secure the gas springs to the machine frame. Align ball and socket and press together to engage.

5. Lower hood and check that hood makes a continuous seal around air cleaner system airbox. If necessary, use shim(s) to adjust location of airbox for proper sealing with hood (Fig. 25).

6. Lower and secure hood.

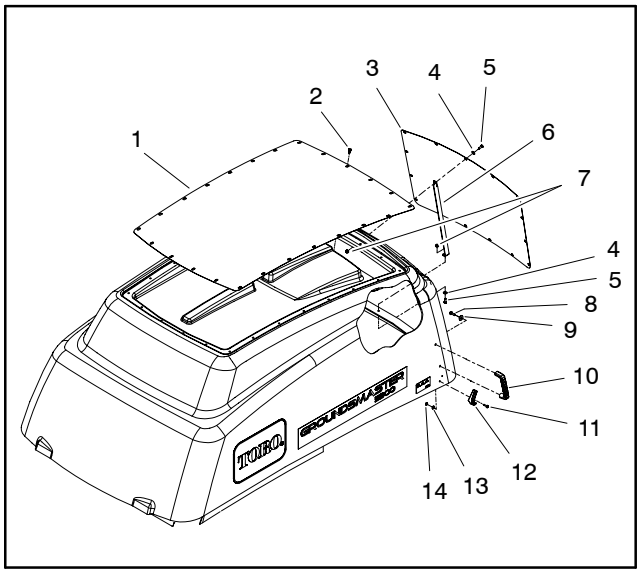


Figure 24

1. **Top screen**
2. **Plug**
3. **Rear screen**
4. **Flat washer (2 used)**
5. **Screw (2 used)**
6. **Hood strap**
7. **Flange nut (2 used)**
8. **Screw (4 used)**
9. **Washer (4 used)**
10. **Handle (2 used)**
11. **Screw (4 used)**
12. **Latch (2 used)**
13. **Flat washer (4 used)**
14. **Lock nut (4 used)**

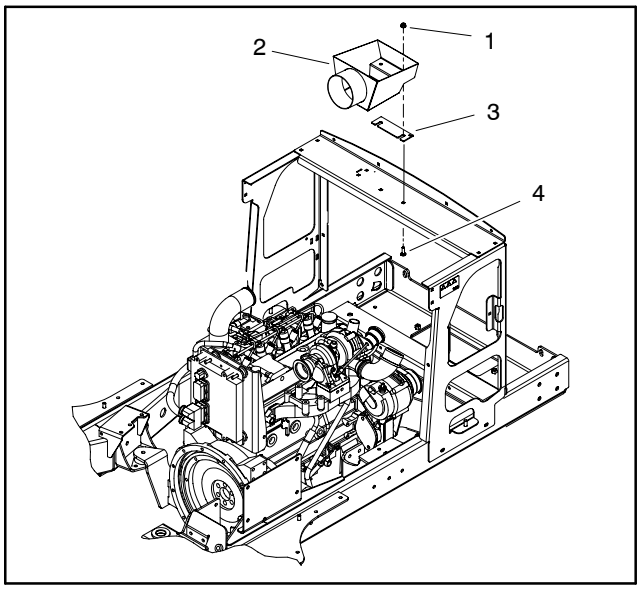


Figure 25

1. **Flange nut (2 used)**
2. **Air box**
3. **Shim (as needed)**
4. **Carriage screw (2 used)**

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Chapter 8

Cutting Decks

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Specifications



MOUNTING: Cutting decks are supported by lift arms controlled with hydraulic lift cylinders.

CONSTRUCTION: Deck chambers are welded steel construction reinforced with channels and plates.

HEIGHT-OF-CUT RANGE: 1" to 6" (25.4 mm to 152 mm) adjustable in 1/2" (12.7 mm) increments. Center deck height-of-cut adjustment is achieved by changing spacers on castor wheels, re-positioning the castor arms in the deck brackets, re-positioning the castor wheel axles in the castor forks and adjusting length of deck support chains. Wing deck adjustment is achieved by changing spacers on castor wheels, re-positioning the castor arms in the deck brackets and re-positioning the castor wheel axles in the castor forks.

DECK DRIVE: Closed loop hydraulic system operates hydraulic motor on each cutting deck. Motor drives one spindle directly with remaining deck section spindle(s) driven by B section kevlar v-belt(s). Blade spindles are 1-1/4" (31.7 mm) shafts supported by greaseable, tapered roller bearings.

CUTTING BLADE: Cutting blade dimensions are 20" (508 mm) long, 2.500" (64 mm) wide and 0.250" (6.4 mm) thick. Anti-scalp cup installed on each cutting blade. Center deck includes five blades and each wing deck includes three blades.

WIDTH OF CUT: Front deck provides 92" (2337 mm) width of cut. Each wing deck has 57" (1448 mm) width of cut. Total width of cut is 192" (4877 mm).

DISCHARGE: Clippings are discharged from the rear of the cutting deck.

SUSPENSION SYSTEM: A fully floating suspension with hydraulic counterbalance. Front deck suspended from lift arms and has two castor wheels, two adjustable skids and three anti-scalp rollers. Wing decks suspended from lift arms and have four castor wheels, two adjustable skids and two anti-scalp rollers.

Troubleshooting

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

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

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
1. Maximum governed engine speed.	Make sure that throttle control is placed in the fast position when mowing. Check maximum governed engine speed (see Chapter 3 − Diesel Engine).
2. Blade speed.	All deck blades should rotate at the same speed. See items in Troubleshooting Section of Chapter 4 − Hydraulic System.
3. Tire pressure.	Check air pressure of all machine tires including cutting deck castor tires. Adjust to pressures specified in Operator’s Manual.
4. Blade condition.	Sharpen blades if their cutting edges are dull or nicked. Inspect blade sail for wear or damage. Replace blade if needed.
5. Mower housing condition.	Make sure that cutting chambers are in good condition. Keep underside of deck clean. Debris buildup will reduce cutting performance.
6. Height−of−cut.	Make sure all deck height−of−cut adjustments are the same. Adjust deck as specified in the Operator’s Manual.
7. Cutting deck alignment and ground following.	Check lift arms and cutting deck pivot pins for wear, damage or binding.
8. Roller and castor wheel condition.	All rollers and caster wheels should rotate freely. Replace bearings if worn or damaged.
9. Grass conditions.	Mow when grass is dry for best cutting results. Also, remove only 1” (25.4 mm) or 1/3 of the grass blade when cutting.

General Information

CAUTION

Never install or work on the cutting deck or lift arms with the engine running. Always stop engine and remove ignition key first.

Operator's Manual

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

Castor Wheel Tire Pressure

Castor tires on the cutting deck should be inflated to 50 PSI (345 kPa).

Blade Stopping Time

The blades of the cutting deck should come to a complete stop in approximately five (5) seconds after the PTO switch is shut off.

NOTE: Make sure the decks are lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify blade stopping stopping time, have a second person stand back from the deck at least twenty (20) feet (6.1 meters) and watch one of the cutting deck blades. Have the operator shut the cutting deck off and record the time it takes for the blades to come to a complete stop. If this stopping time is greater than seven (7) seconds, the braking valve (RV2) on the deck drive hydraulic control manifold may need adjustment.

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Service and Repairs

CAUTION

Never install or work on a cutting deck or lift arm with the engine running. Always stop engine and remove ignition key first.

Front Cutting Deck

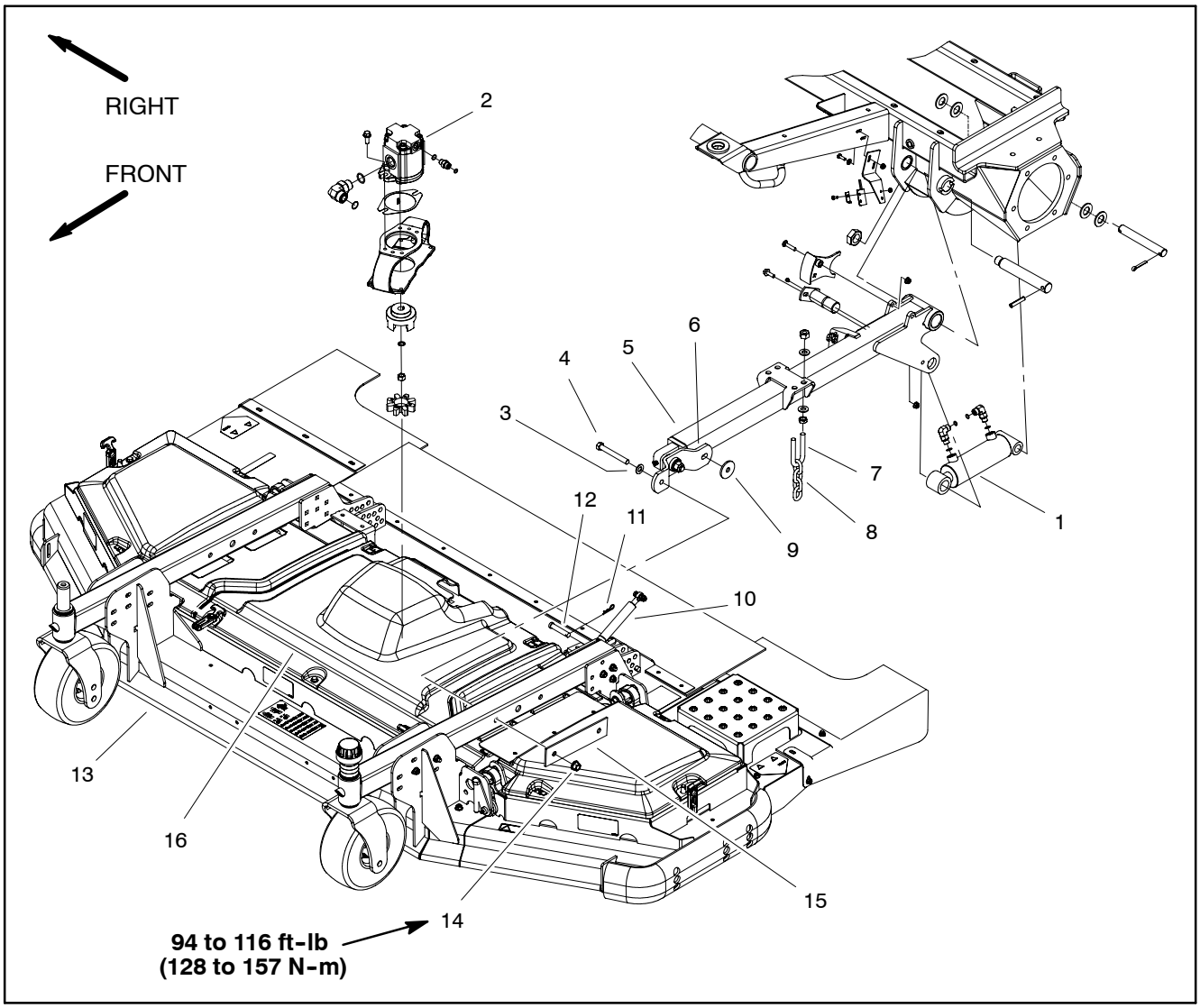


Figure 1

1. Lift cylinder (LH shown)
2. Hydraulic deck motor
3. Flat washer (2 used per lift arm)
4. Cap screw (2 used per lift arm)
5. Lift arm assembly (LH shown)
6. Support hub (1 used per lift arm)
7. U-bolt (1 used per lift arm)
8. HOC chain (1 used per lift arm)
9. Thrust washer (1 used per lift arm)
10. Damper assembly
11. Hairpin (1 used per lift arm)
12. Clevis pin (1 used per lift arm)
13. Front cutting deck
14. Lock nut (2 used per lift arm)
15. Plate (1 used per lift arm)
16. Center deck cover

Removal (Fig. 1)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove center deck cover to access hydraulic deck motor.

3. Remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position and support motor away from cutting deck.

4. Start engine and raise deck slightly. Stop engine and remove key from the ignition switch.

5. Remove hairpins (item 11) and clevis pins (item 12) that secure the height–of–cut chains to the rear of the cutting deck.

6. Remove spring pin and spacer that secure damper to damper mount on deck (Figs. 2 and 3). Position damper away from cutting deck.

7. Start engine and lower deck to ground. Stop engine and remove key from the ignition switch.

8. Remove cap screws (item 4), flat washers (item 3), plate (item 15) and lock nuts (item 14) that secure lift arm support hubs to cutting deck. Remove thrust washer (item 9) from between the lift arm and the rear, slotted hole in the support hub.

9. Slide the cutting deck away from the traction unit.

Installation (Fig. 1)

1. Position machine on a clean, level surface. Lower front lift arms, stop engine, engage parking brake and remove key from the ignition switch.

2. Position the cutting deck to the lift arms.

3. Align lift arm support hub to cutting deck. Make sure that slotted hole in the support hub is toward the rear of the deck.

4. Place thrust washer (item 9) between the lift arm and the rear, slotted hole in the support hub.

5. Secure lift arm support hub to deck with cap screws (item 4), flat washers (item 3), plate (item 15) and lock nuts (item 14). Torque fasteners from **94 to 116 ft-lb (128 to 157 N-m)**.

6. Start engine and raise deck slightly. Stop engine and remove key from the ignition switch.

7. Install clevis pins and hairpins that secure the height–of–cut chains to the rear of the cutting deck.

8. Position damper to mount on cutting deck. Install spacer and spring pin to secure damper to deck (Figs. 2 and 3).

9. Start engine and lower deck to ground. Stop engine and remove key from the ignition switch.

10. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

11. Install all removed cutting deck covers.

12. Lubricate grease fittings on cutting deck and lift arm assemblies (see Operator's Manual).

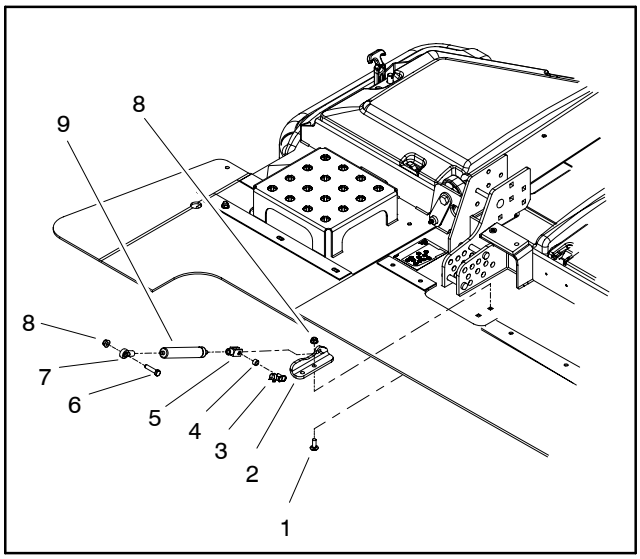


Figure 2

1. **Carriage screw (2 used)**
2. **Damper mount**
3. **Spring pin**
4. **Spacer**
5. **Clevis rod end**
6. **Cap screw**
7. **Bearing rod end**
8. **Flange nut (3 used)**
9. **Damper**

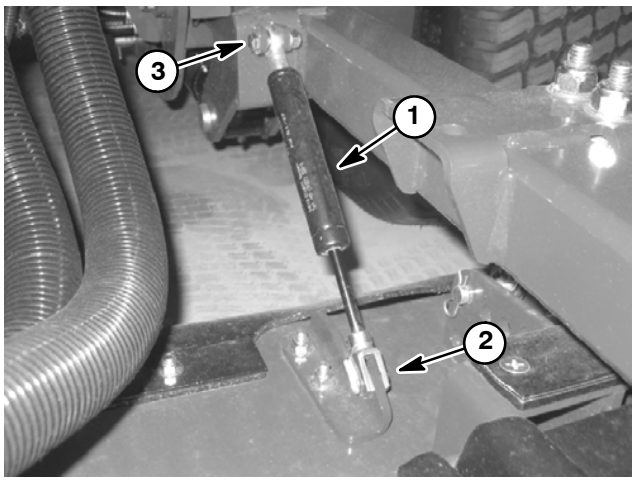


Figure 3

1. **Damper**
2. **Clevis rod end**
3. **Bearing rod end**

Wing Cutting Deck

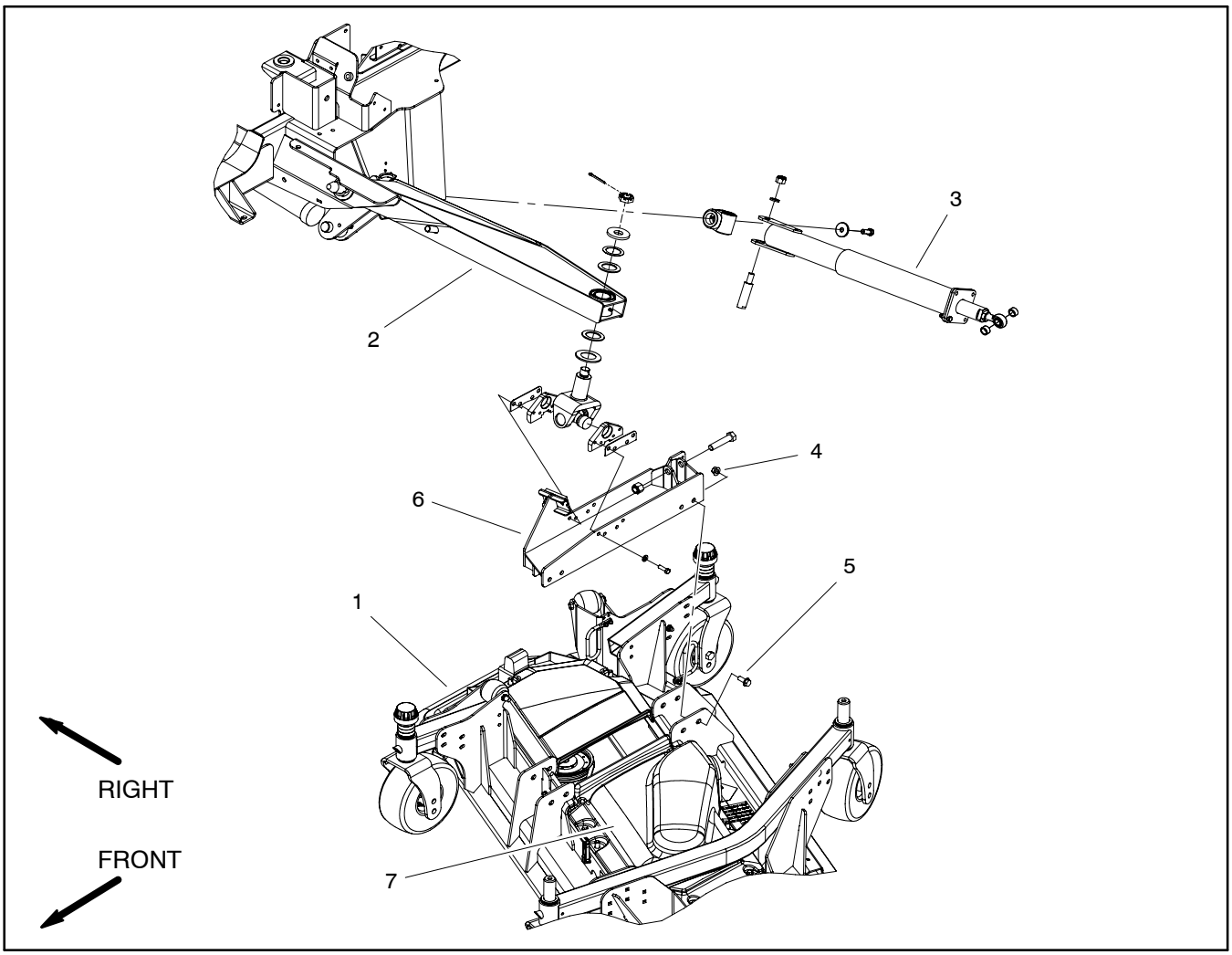


Figure 4

1. **Wing cutting deck (LH shown)**
2. **Lift arm (LH shown)**
3. **Rear impact arm assembly**
4. **Lock nut (8 used)**
5. **Flange head screw (8 used)**
6. **Deck connection (LH shown)**
7. **Deck outer cover**

Removal (Fig. 4)

1. Position machine on a clean, level surface. Lower cutting decks, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove cutting deck outer cover to access hydraulic deck motor.

3. Remove three (3) hose guides from cutting deck (Fig. 5). Leave two (2) loop guides (Fig. 5, item 6) on hydraulic hoses.

4. Remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position and support motor away from cutting deck.

5. Remove eight (8) flange head screws (item 5) and lock nuts (item 4) that secure deck connection (item 6) to cutting deck.

6. Raise lift arm enough to separate deck connection from cutting deck.

7. Slide the cutting deck away from the traction unit.

Installation (Fig. 4)

1. Position machine on a clean, level surface. Lower wing deck lift arm, stop engine, engage parking brake and remove key from the ignition switch.

2. Position the wing cutting deck to the raised lift arm.

3. Lower lift arm while aligning deck connection to cutting deck.

4. Install deck connection to cutting deck with eight (8) flange head screws (item 5) and lock nuts (item 4). Tighten fasteners.

5. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

6. Position and secure three (3) hose guides to cutting deck (Fig. 5).

7. Install all removed cutting deck covers.

8. Lubricate grease fittings on cutting deck and lift arm assemblies (see Operator's Manual).

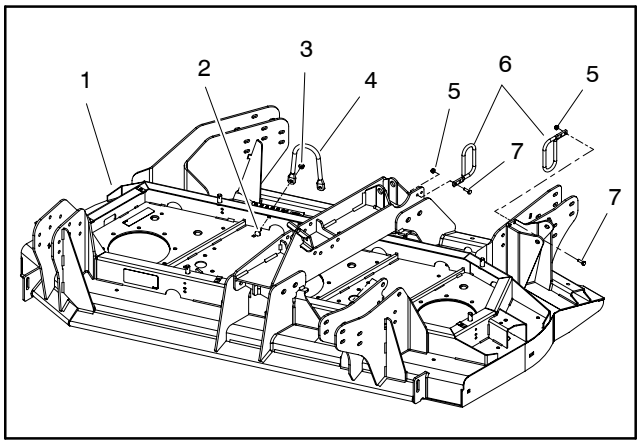


Figure 5

1. **Wing deck (RH shown)**
2. **Carriage screw (2 used)**
3. **Flange nut (2 used)**
4. **Hose guide**
5. **Flange nut (4 used)**
6. **Hose guide**
7. **Cap screw (4 used)**

Idler Assembly

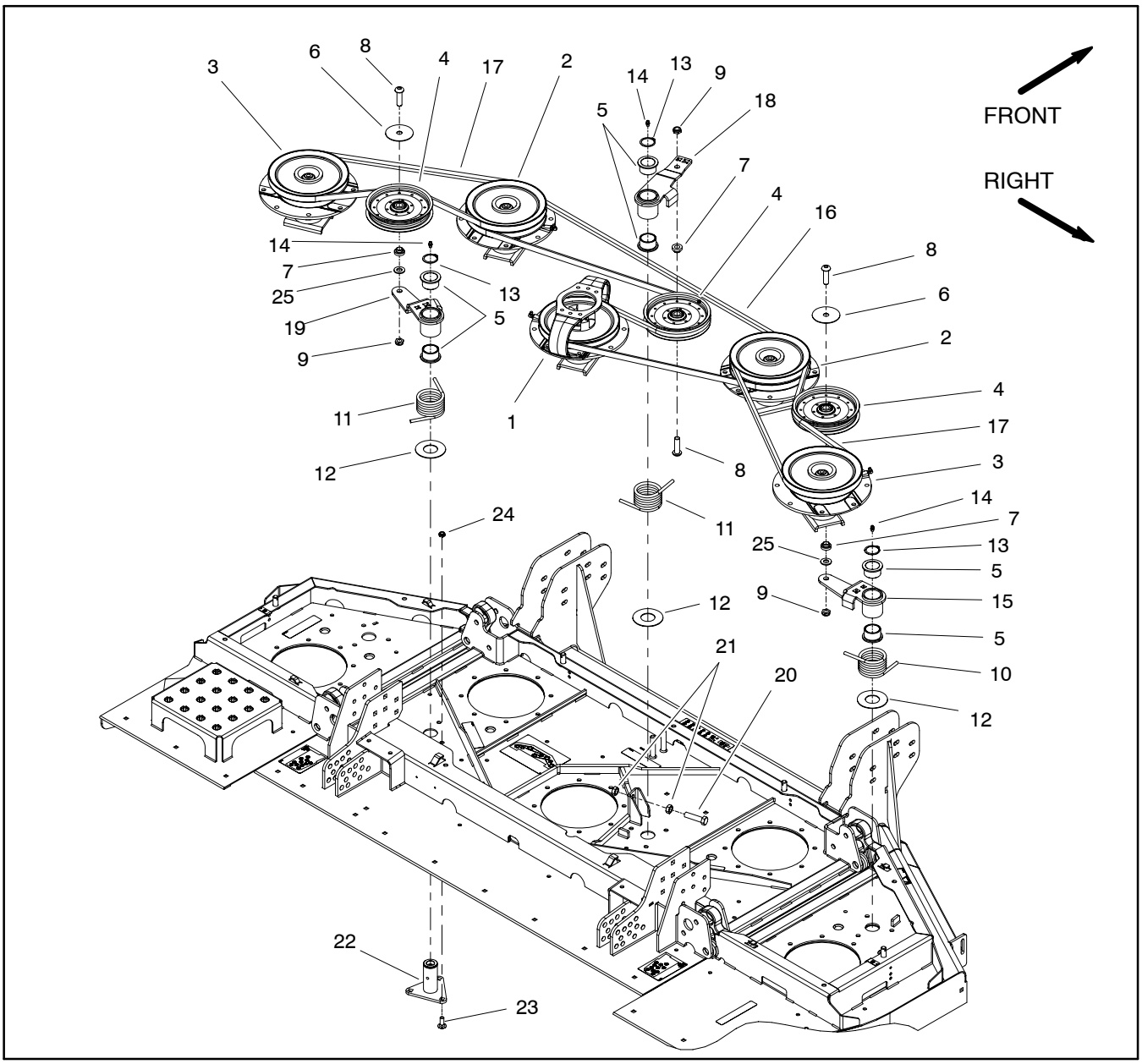


Figure 6

1. **Drive spindle assembly**
2. **Driven spindle assembly (double)**
3. **Driven spindle assembly (single)**
4. **Idler pulley**
5. **Flange bushing**
6. **Flat washer**
7. **Idler spacer**
8. **Screw**
9. **Lock nut**
10. **Torsion spring**
11. **Torsion spring**
12. **Washer**
13. **Snap ring**
14. **Grease fitting**
15. **Low idler arm**
16. **V-belt**
17. **V-belt**
18. **High idler arm**
19. **Low idler arm**
20. **Cap screw**
21. **Jam nut**
22. **Idler pivot post**
23. **Carriage screw (3 used per post)**
24. **Lock nut (3 used per post)**
25. **Flat washer**

NOTE: The front deck is shown in Figure 6. The idler assemblies used on the wing decks are very similar.

Removal (Fig. 6)

1. Park machine on a level surface with cutting deck lowered. Stop engine, engage parking brake and remove key from the ignition switch.

2. Remove deck covers from top of cutting deck.

3. If removing high idler assembly on front deck, loosen jam nuts (item 21) that secure idler stop bolt (item 20) to cutting deck to allow clearance between high idler arm and stop bolt.

4. Using appropriate socket wrench, rotate idler arm away from drive belt to release belt tension. Remove drive belt(s) from deck pulleys.

5. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when removing tension from the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

6. Carefully push the torsion spring end down and away from the idler arm to unhook the spring from the arm.

7. Remove snap ring that retains idler arm assembly to cutting deck.

8. Remove idler components as needed using Figure 6 as a guide. Note location of washer(s), idler spacer, lock nut and screw as idler assemblies are being removed (Figs. 6 and 7).

Installation (Fig. 6)

1. Install removed idler components using Figure 6 as a guide. Secure idler arm assembly to cutting deck with snap ring.

2. Insert nut driver or small piece of pipe onto the end of the torsion spring for the idler arm.

CAUTION

Be careful when applying tension to the idler arm torsion spring. The spring is under heavy load and may cause personal injury.

3. Carefully push down on the torsion spring end to get the spring under the idler arm mounting plate. Then release the spring slowly to lock it into place.

4. Using appropriate socket wrench on idler arm to release drive belt tension, position drive belt(s) to deck pulleys. Make sure that idler pulley tensions the back side of the belt.

5. On front deck, make sure that clearance between high idler arm and stop bolt is from 0.100" to 0.160" (2.5 to 4.0 mm) (Fig. 8). If necessary, adjust jam nut location on stop bolt to allow proper clearance.

6. Install deck covers to cutting deck.

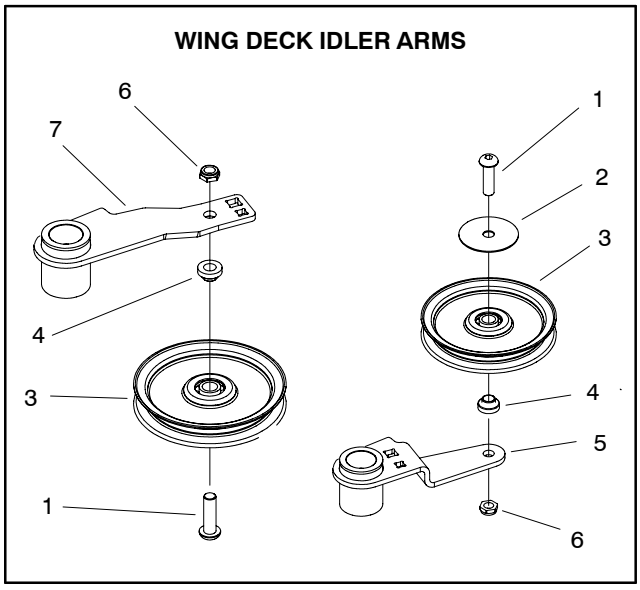


Figure 7

1. **Screw**
2. **Flat washer**
3. **Idler pulley**
4. **Idler spacer**
5. **Low idler arm**
6. **Lock nut**
7. **High idler arm**

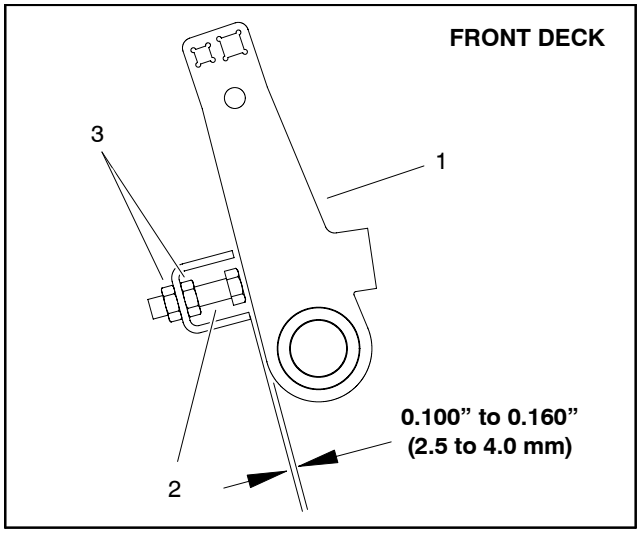


Figure 8

1. **High idler arm**
2. **Stop bolt**
3. **Jam nut**

Front Deck Winglets

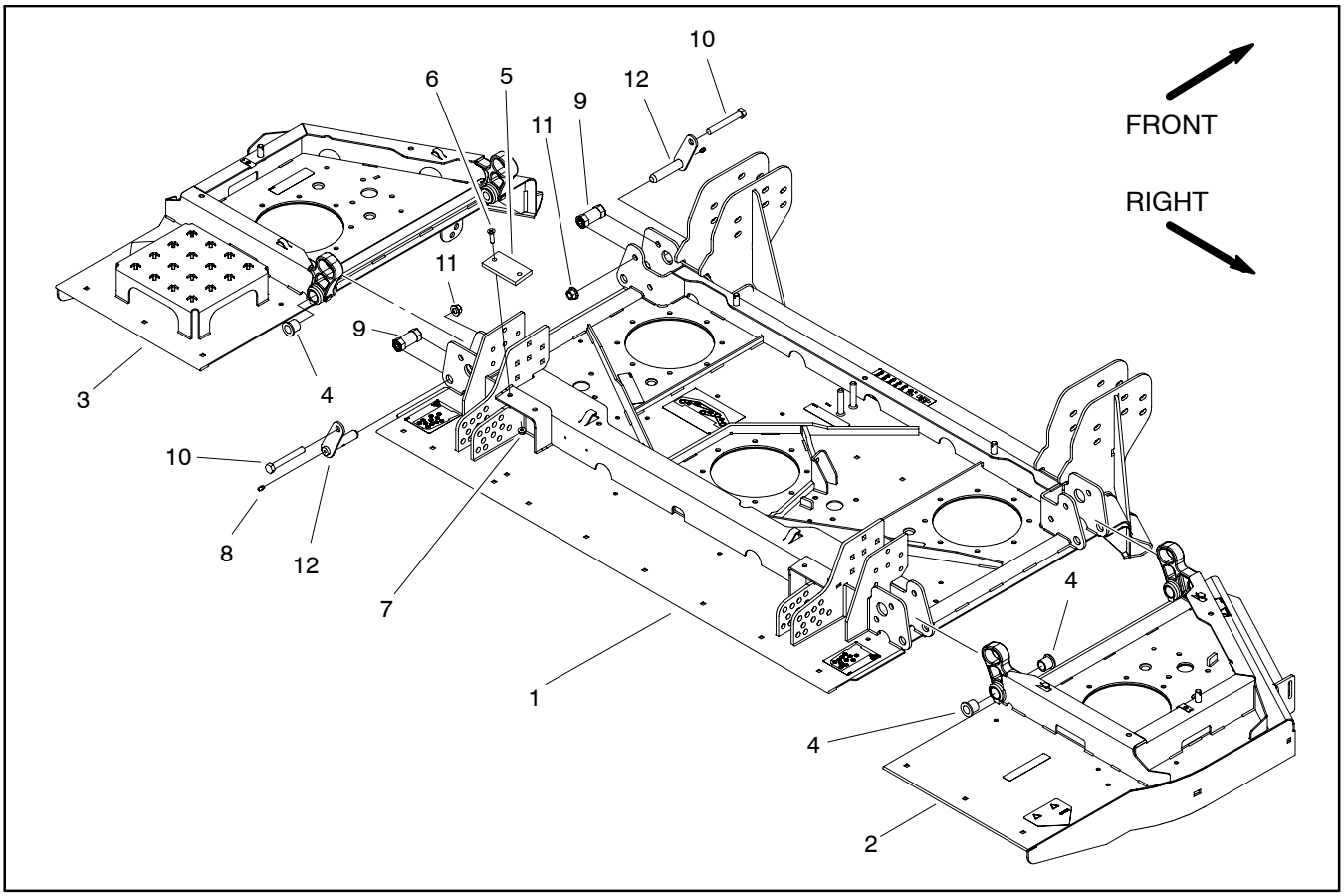


Figure 9

1. **Center deck**
2. **RH deck winglet**
3. **LH deck winglet**
4. **Flange bushing (4 used per winglet)**
5. **Bumper pad (2 used)**
6. **Screw (4 used)**
7. **Flange nut (4 used)**
8. **Grease fitting**
9. **Eccentric (2 used per winglet)**
10. **Cap screw (2 used per winglet)**
11. **Lock nut (2 used per winglet)**
12. **Hinge pin (2 used per winglet)**

Disassembly (Fig. 9)

1. Park machine on a level surface, lower front cutting deck, stop engine, apply parking brake and remove key from the ignition switch.

2. Remove covers from front cutting deck.

3. Using appropriate socket wrench, rotate idler arm away from drive belt to release belt tension. Remove drive belt from deck winglet spindle.

4. For assembly alignment purposes, use a marker or paint pen on eccentric and deck brackets to identify location of eccentric (Fig. 10).

5. Remove lock nut, cap screw, eccentric and hinge pin from front and rear winglet hinges. Use hole in deck bracket to remove eccentric from deck. Slide winglet away from front deck.

6. Inspect hinge pin, eccentric and flange bushings in deck winglet. Replace worn or damaged components.

Assembly (Fig. 9)

1. Position winglet to front deck.

2. Secure deck winglet to center deck with hinge pin.

3. Position eccentrics in center frame brackets and install cap screw and lock nut. Do not fully tighten fasteners.

4. Using appropriate socket wrench on idler arm to release drive belt tension, position drive belt to deck winglet spindle. Make sure that idler pulley tensions the back side of the belt.

5. Use the marker or paint pen line made during disassembly to position the eccentric (Fig. 10). Check front deck blade plane and adjust as needed. Refer to Operator's Manual for additional adjustment information. After blade plane is adjusted correctly, tighten lock nut to secure eccentric in position.

6. Lubricate hinge pin grease fittings.

7. Install and secure all removed covers to front cutting deck.

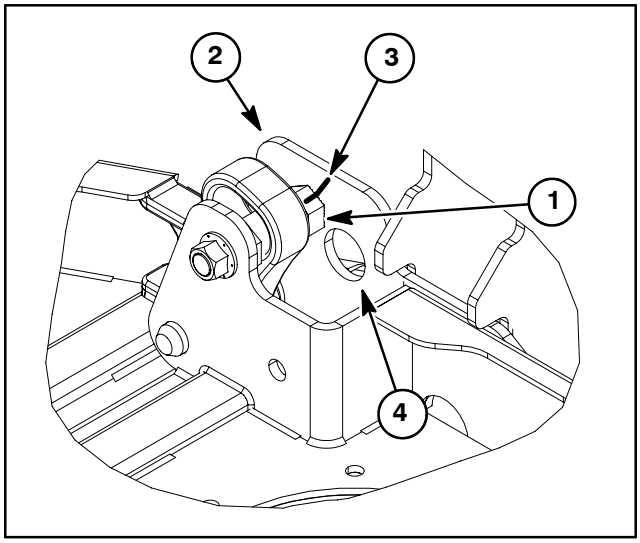


Figure 10

1. **Eccentric**
2. **Deck bracket**
3. **Marker/paint line**
4. **Eccentric removal hole**

Blade Spindle

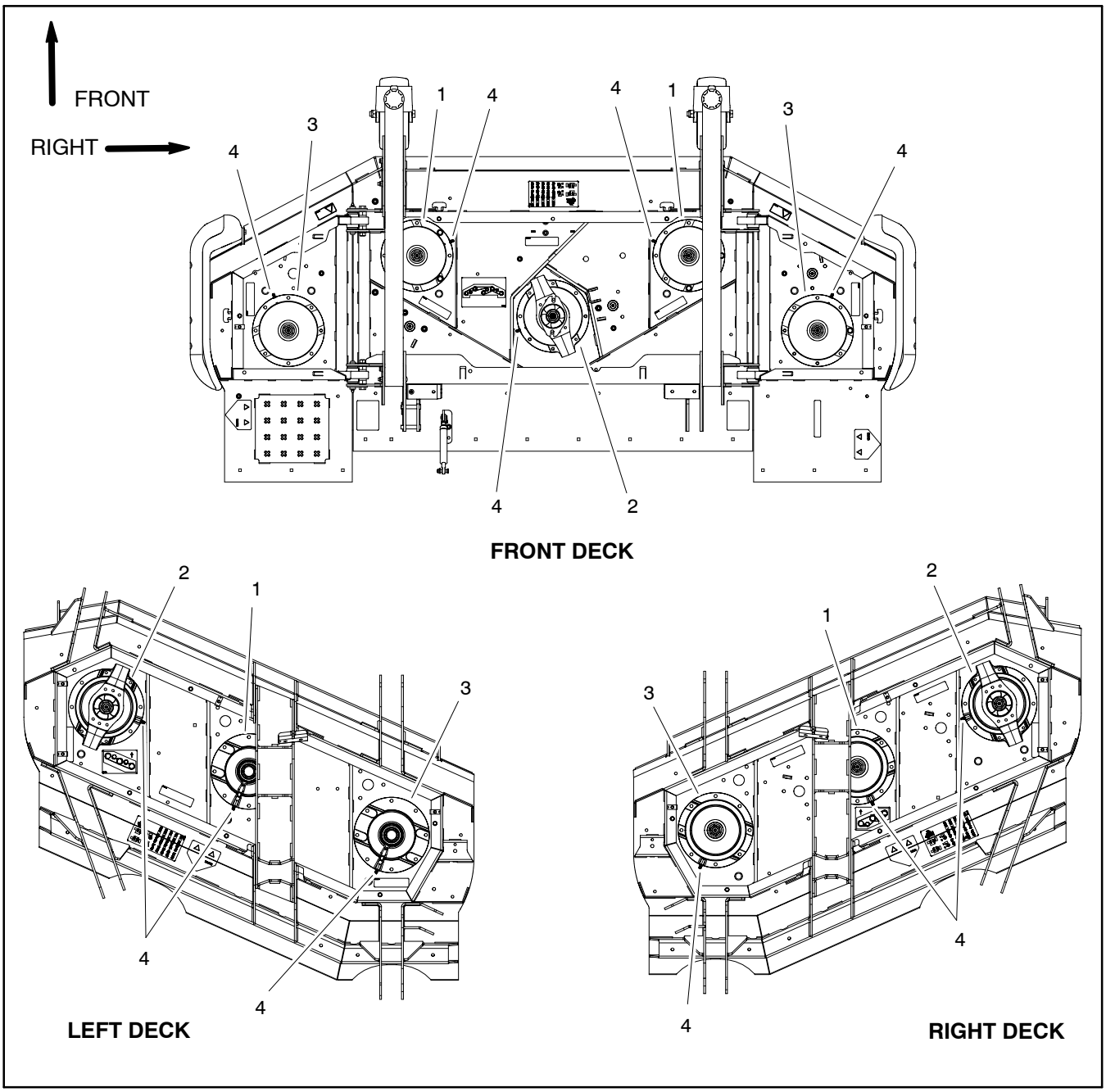


Figure 11

1. **Driven spindle (double pulley)**
2. **Drive spindle**
3. **Driven spindle (high pulley)**
4. **Grease fitting**

Removal (Figs. 11 and 13)

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

2. Remove covers from cutting deck to allow access to blade spindle.

3. If drive spindle is to be serviced, remove hydraulic motor from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic Systems). Position motor away from spindle.

4. Using appropriate socket wrench, loosen idler pulley to release belt tension. Remove drive belt from spindle to be serviced.

5. Start the engine and raise the cutting deck. Stop engine and remove key from the ignition switch. Latch or block up the cutting deck so it cannot fall accidentally.

6. Remove cutting blade, anti-scalp cup and blade bolt from spindle to be serviced.

7. Remove spindle housing assembly from deck.

   A. For driven spindle assemblies, remove eight (8) flange head screws with flange nuts that secure spindle to deck.

   B. For drive spindle assemblies, loosen and remove four (4) flange head screws with flange nuts that secure spindle to deck. Then, remove four (4) cap screws with washers that secure spindle and hydraulic motor mount to deck.

   C. Lift spindle assembly from deck.

Installation (Figs. 11 and 13)

1. Position spindle on cutting deck noting orientation of grease fitting (Fig. 11). Secure spindle assembly to deck with correct fasteners.

2. Install cutting blade, anti-scalp cup and blade bolt to spindle. Tighten blade bolt from **88 to 108 ft-lb (119 to 146 N-m)**.

3. Slowly rotate cutting blades to verify that blades do not contact any deck components.

4. Install drive belt to spindle pulleys and idler pulley(s).

5. If drive spindle was removed, install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic Systems).

6. Install covers to cutting deck.

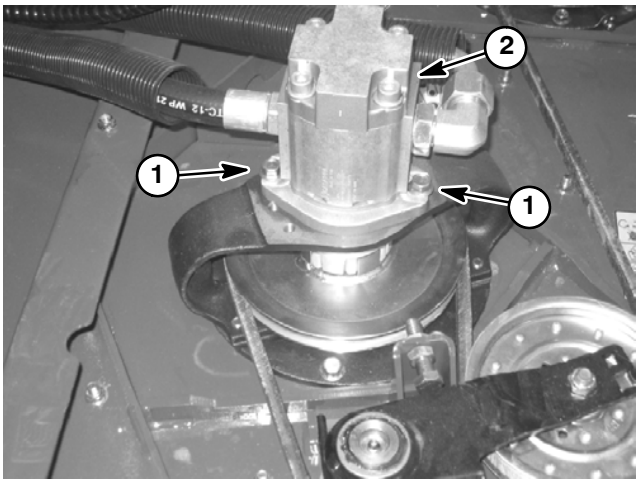


Figure 12

1. **Flange head screw**
2. **Hydraulic motor**

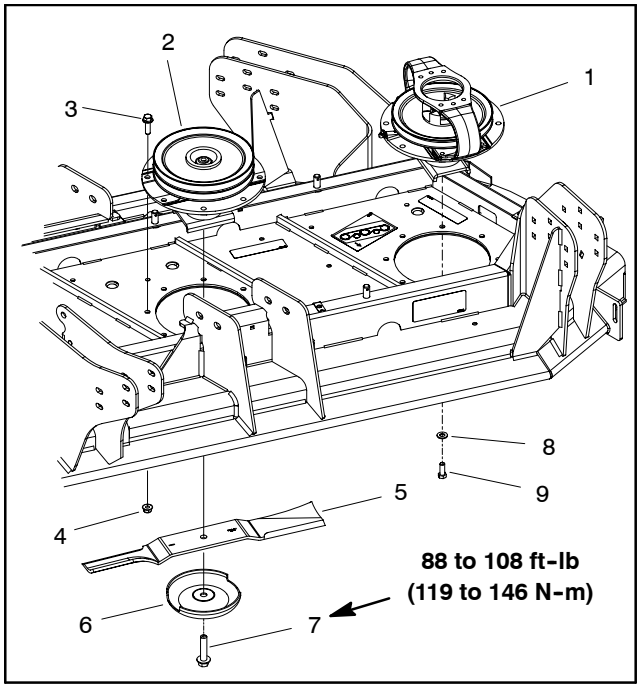


Figure 13

1. **Drive spindle**
2. **Driven spindle**
3. **Flange head screw**
4. **Flange nut**
5. **Cutting blade**
6. **Anti-scalp cup**
7. **Blade bolt**
8. **Flat washer**
9. **Cap screw**

Blade Spindle Service

Disassembly (Fig. 14)

1. Loosen and remove lock nut from top of spindle shaft. Remove hardened washer and pulley from spindle. For drive spindle, remove hydraulic motor mount.

2. Remove the spindle shaft from the spindle housing which may require the use of an arbor press. The spindle shaft spacer should remain on the spindle shaft as the shaft is being removed.

3. Carefully remove oil seals from spindle housing.

4. Allow the bearing cones, inner bearing spacer and spacer ring to drop out of the spindle housing.

5. Using an arbor press, remove both of the bearing cups and the outer bearing spacer from the housing.

6. The large snap ring can remain inside the spindle housing. Removal of this snap ring is very difficult.

Assembly (Fig. 14)

NOTE: A replacement spindle bearing set contains two (2) bearings, a spacer ring and a large snap ring (items 1, 2 and 3 in Fig. 15). These parts cannot be purchased separately. Also, do not mix bearing set components from one deck spindle to another.

NOTE: A replacement bearing spacer set includes the inner spacer and outer spacer (items 4 and 5 in Fig. 15). Do not mix bearing spacers from one deck spindle to another.

IMPORTANT: If new bearings are installed into a used spindle housing, it may not be necessary to replace the original large snap ring. If the original snap ring is in good condition with no evidence of damage (e.g. spun bearing), leave the snap ring in the housing and discard the snap ring that comes with the new bearings. If the large snap ring is found to be damaged, replace the snap ring.

1. If large snap ring was removed from spindle housing, install snap ring into housing groove. Make sure snap ring is fully seated in housing groove.

2. Install outer bearing spacer into top of spindle housing. The spacer should fit against the snap ring.

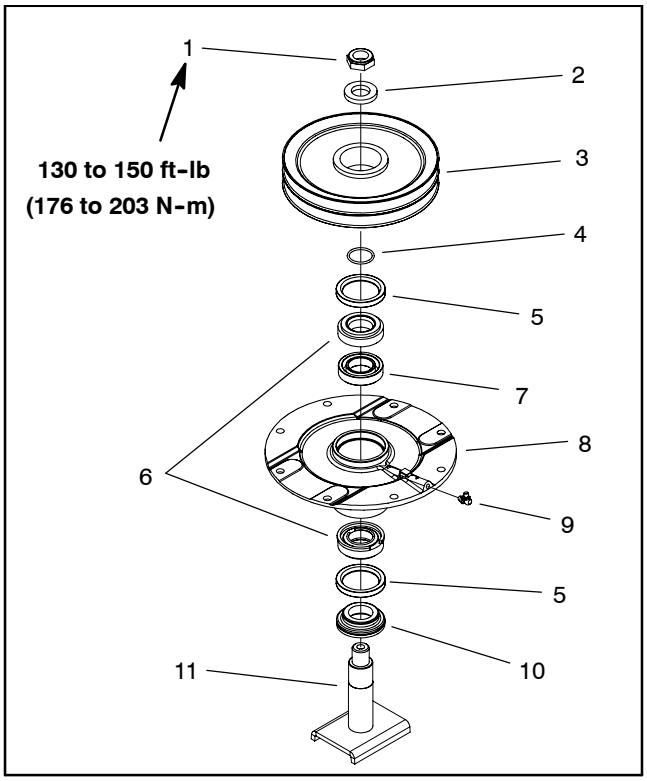


Figure 14

1. **Lock nut**
2. **Hardened washer**
3. **Pulley**
4. **O-ring**
5. **Oil seal**
6. **Bearing set**
7. **Spacer set**
8. **Spindle housing**
9. **Grease fitting**
10. **Shaft spacer**
11. **Spindle shaft**

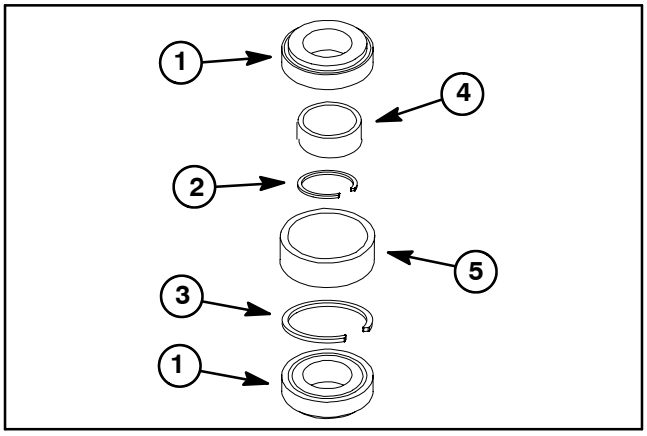


Figure 15

1. **Bearing**
2. **Spacer ring**
3. **Large snap ring**
4. **Inner bearing spacer**
5. **Outer bearing spacer**

3. Using an arbor press, push the bearing cups into the top and bottom of the spindle housing. The top bearing cup must contact the outer bearing spacer previously installed, and the bottom bearing cup must contact the snap ring. Make sure that the assembly is correct by supporting the first bearing cup and pressing the second cup against it (Fig 16).

4. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals and O−ring.

5. Install lower bearing cone and greased oil seal into bottom of spindle housing. **Note:** The bottom seal must have the lip facing out (down) (Fig. 17). This seal installation allows grease to purge from the spindle during the lubrication process.

IMPORTANT: If bearings are being replaced, make sure to use the spacer ring that is included with new bearing set (Fig. 15).

6. Slide spacer ring and inner bearing spacer into spindle housing, then install upper bearing cone and greased oil seal into top of housing. **Note:** The upper seal must have the lip facing in (down) (Fig. 17). Make sure upper seal is flush to 0.060" (1.5 mm) recessed to housing surface.

7. Inspect the spindle shaft and shaft spacer to make sure there are no burrs or nicks that could possibly damage the oil seals. Lubricate the shaft and spacer with grease.

8. Install spindle shaft spacer onto shaft. Place thin sleeve or tape on spindle shaft splines to prevent seal damage during shaft installation.

9. Carefully slide spindle shaft with spacer up through spindle housing. The bottom oil seal and spindle spacer fit together when the spindle is fully installed.

10. Install greased O−ring to top of spindle shaft.

11. Install pulley (hub down), hardened washer and lock nut to spindle shaft. Tighten lock nut from **130 to 150 ft−lb (176 to 203 N−m)**.

IMPORTANT: Pneumatic grease guns can produce high pressure inside spindle housing that can damage spindle seals. Pneumatic grease guns, therefore, are not recommended to be used for greasing of spindle housings.

12. Attach a hand pump grease gun to grease fitting on housing and fill housing cavity with grease until grease starts to come out of lower seal.

13. Rotate spindle shaft to make sure that it turns freely.

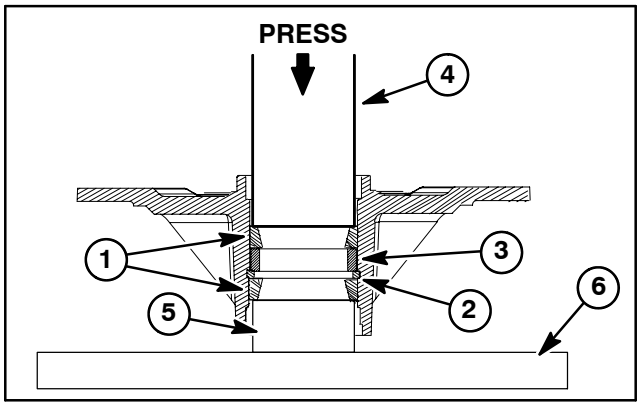


Figure 16

1. **Bearing cups**
2. **Large snap ring**
3. **Large outer spacer**
4. **Arbor press**
5. **Support**
6. **Arbor press base**

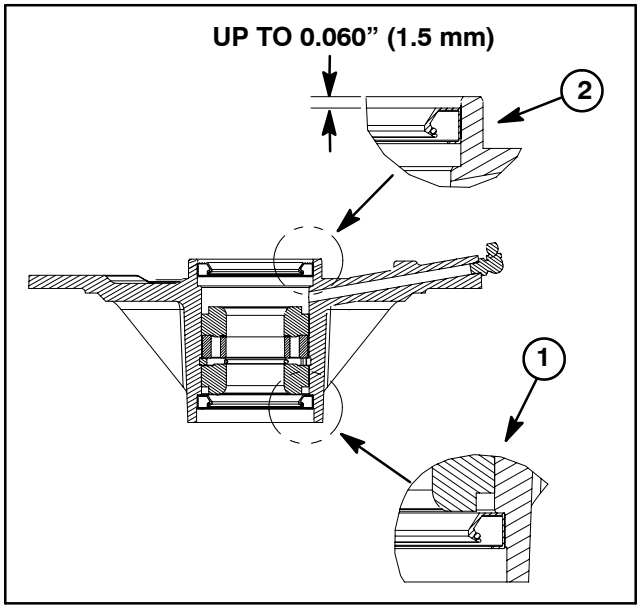


Figure 17

1. **Bottom seal installation**
2. **Upper seal installation**

Castor Forks and Wheels

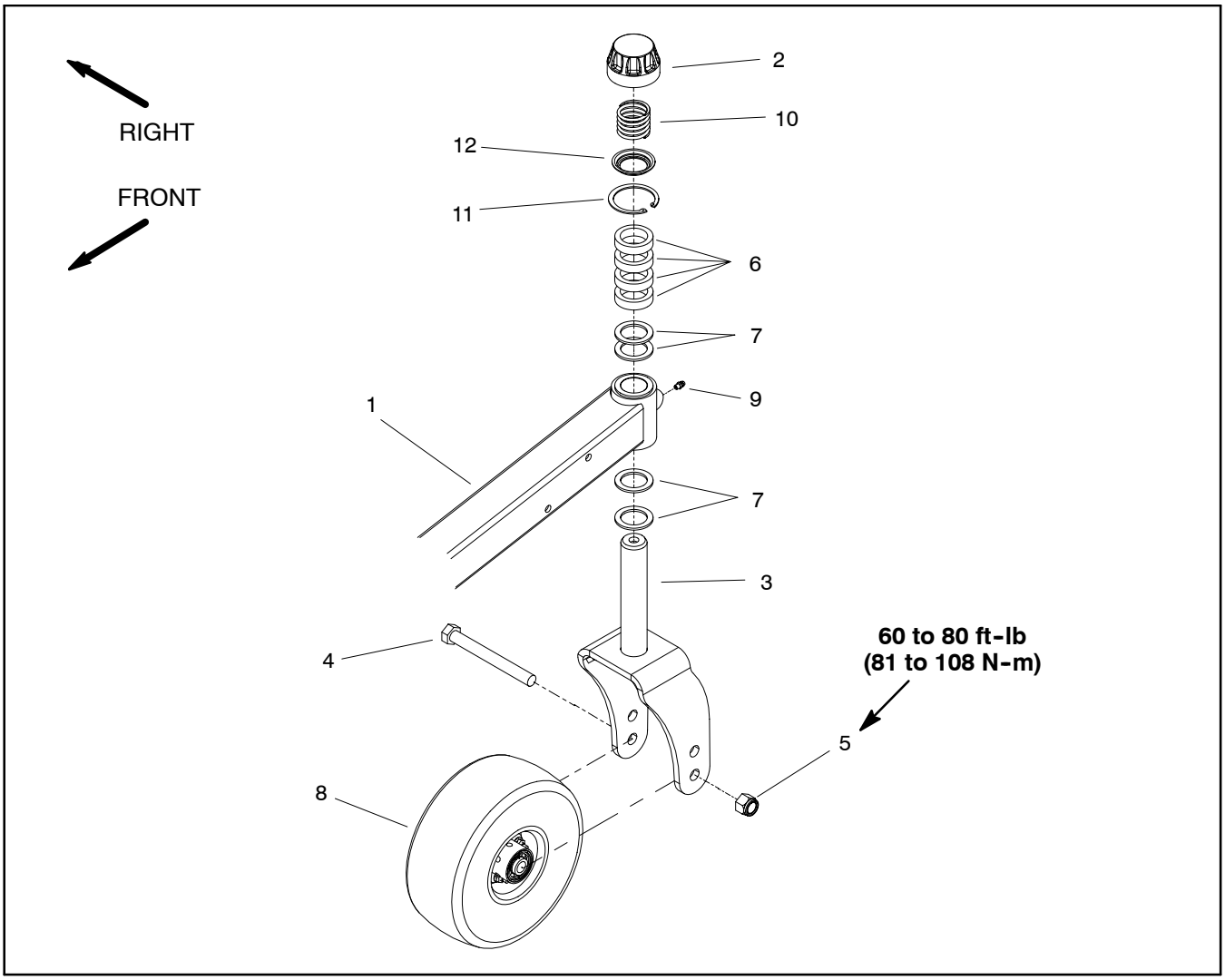


Figure 18

1. **Castor arm (wing deck shown)**
2. **Cap**
3. **Castor fork**
4. **Castor wheel bolt**
5. **Lock nut**
6. **Castor spacer**
7. **Thrust washer**
8. **Castor wheel**
9. **Grease fitting**
10. **Compression spring**
11. **Retaining ring**
12. **Cap washer**

Disassembly

1. Disassemble castor forks and wheels using Figures 18 and 19 as guides.

Assembly

1. Assemble castor forks and wheels using Figures 18 and 19 as guides.

   A. Install castor wheels so that valve stem extends toward left side of machine.

   B. Insert castor wheel bolt (item 4) from the right side of the machine.

   C. Torque castor wheel lock nut from **60 to 80 ft-lb (81 to 108 N-m)**.

2. Lubricate castor fork grease fitting.

3. Check height-of-cut setting and adjust if necessary.

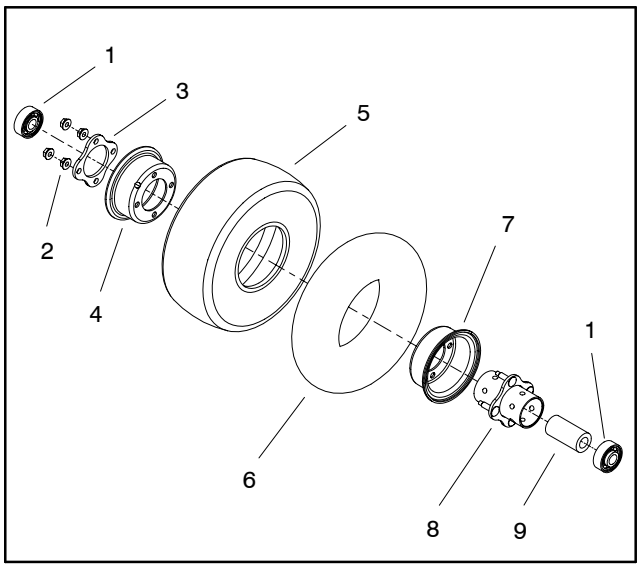


Figure 19

1. **Bearing**
2. **Flange nut (4 used)**
3. **Plate**
4. **Rim half**
5. **Tire**
6. **Inner tube**
7. **Rim half**
8. **Hub**
9. **Bearing spacer**

Deck Skids and Rollers

Removal (Fig. 20 and 21)

1. Remove skids and rollers from deck using Figures 20 and 21 as guides.

Installation (Fig. 20 and 21)

1. Install skids and rollers to deck using Figures 20 and 21 as guides.

   A. Make sure to install skids (item 7) in the same mounting hole height position (lower, middle or upper).

   B. Make sure to install all deck rollers (items 2 and 9) in the same mounting hole height position (lower or upper).

   C. When installing roller (item 2) on the front deck winglets (Fig. 20), install cap screw with the threads orientated toward the centerline of the deck. Install and tighten lock nut so that nylon locking insert in nut is fully engaged by bolt threads and roller rotates freely.

   D. When installing roller (item 2) on a wing deck (Fig. 21), install cap screw with the threads orientated away from the centerline of the machine. Install and tighten lock nut so that nylon locking insert in nut is fully engaged by bolt threads and roller rotates freely.

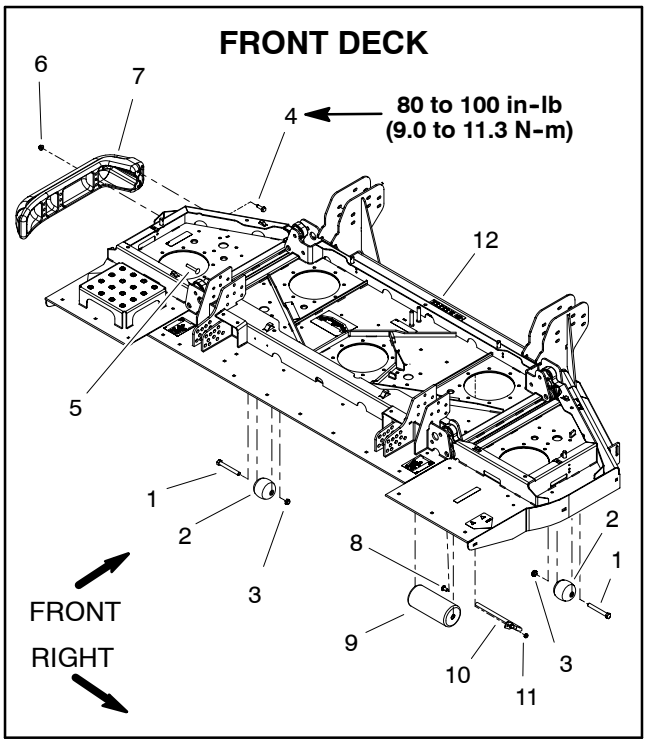


Figure 20

1. Cap screw
2. Roller
3. Lock nut
4. Washer head screw
5. Carriage screw
6. Flange nut
7. Bumper skid (2 used)
8. Carriage screw
9. Roller
10. Roller shaft
11. Flange nut

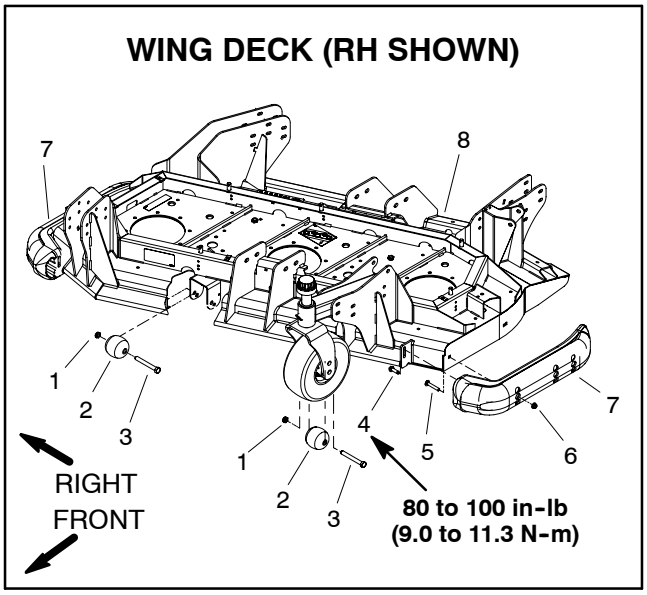


Figure 21

1. Lock nut
2. Roller
3. Cap screw
4. Washer head screw
5. Carriage screw
6. Flange nut
7. Bumper skid

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ICE COMPRESSOR SERVICE MANUAL

General Information

The information in this chapter pertains to the operator cab on the Groundsmaster 5910.

Operator's Manual

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

Electrical Components and Schematic

Information regarding Groundsmaster 5910 electrical cab components (switches and relay) is included in Chapter 5 – Electrical System. The electrical schematic and harness drawings for the operator cab are included in Chapter 10 – Foldout Drawings.

Air Conditioning System

The air conditioning system used on the Groundsmaster 5910 consists of the following components:

1. A compressor mounted on the engine and driven by a v–belt.

2. A condenser and condenser fan located on the top of the cab.

3. A drier–receiver, an expansion valve and an evaporator (combined with the heater core) mounted in the headliner of the cab.

4. The necessary hoses and tubes that connect the system components.

5. A fan motor that provides air movement through the evaporator and into the cab. The fan motor is located in the cab headliner and is also used for the cab heating system.

6. Operator controls to turn the air conditioning on, to adjust the fan speed and to control the cab air temperature.

Cab Heater System

The cab heater system used on the Groundsmaster 5910 consists of the following components:

1. A heater core located in the cab headliner.

2. Hoses to allow a circuit for engine coolant to circulate through the heater core. The heater core (combined with the A/C evaporator) is located in the headliner of the cab.

3. A fan motor that provides air movement through the heater core and into the cab. The fan motor is located in the cab headliner and is also used for the air conditioning system.

4. Operator controls to adjust the fan speed and to control the cab air temperature.

General Precautions for Removing and Installing Air Conditioning System Components

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

WARNING

Always wear safety goggles or a face shield when working with air conditioning system components. Also, do not allow refrigerant contact with your skin or eyes as there would be the possibility of serious injury.

CAUTION

Never use compressed air to leak test or pressure test the air conditioning system. Under certain conditions, pressurized mixtures of refrigerant and air can be combustible.

1. Before servicing any air conditioning system components, park machine on a level surface, apply parking brake, lower cutting decks or attachments and stop engine. Remove key from the ignition switch.

2. Clean machine before disconnecting, removing or disassembling any air conditioning system components. Thorough cleaning will prevent system contamination while performing service procedures.

3. Put caps or plugs on any lines, fittings or components left open or exposed to prevent system contamination.

4. Before loosening or removing any air conditioning system hose or other component, have a certified air conditioning service technician recover the system refrigerant and then evacuate the air conditioning system completely. It is illegal to vent refrigerant to the atmosphere.

5. Put labels on disconnected lines and hoses for proper installation after repairs are completed.

6. If compressor is removed from machine, keep compressor in the same orientation as the installed position. This will prevent compressor oil from filling the compressor cylinders.

7. Note the position of fittings (especially elbow fittings) before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hoses and tubes.

8. Always use a DOT approved tank for storing used and recycled refrigerants.

9. The Groundsmaster 5910 air conditioning system uses R134a refrigerant. DO NOT use other refrigerants in the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

10. Refrigerant containers (either full or empty) are under pressure that will increase if the containers are heated. DO NOT expose refrigerant containers to high heat sources or flame.

11. Be sure the work area is properly ventilated to prevent any accumulation of refrigerant or other fumes.

12. Make sure that caps are always placed on the pressure hose ports. These caps prevent refrigerant leakage from the system.

13. The drier-receiver component is used to collect moisture that will reduce air conditioning performance. If the air conditioning system is opened for component repair or replacement, drier-receiver replacement is recommended.

14. After installing air conditioning components, have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system.

Air Conditioning Compressor

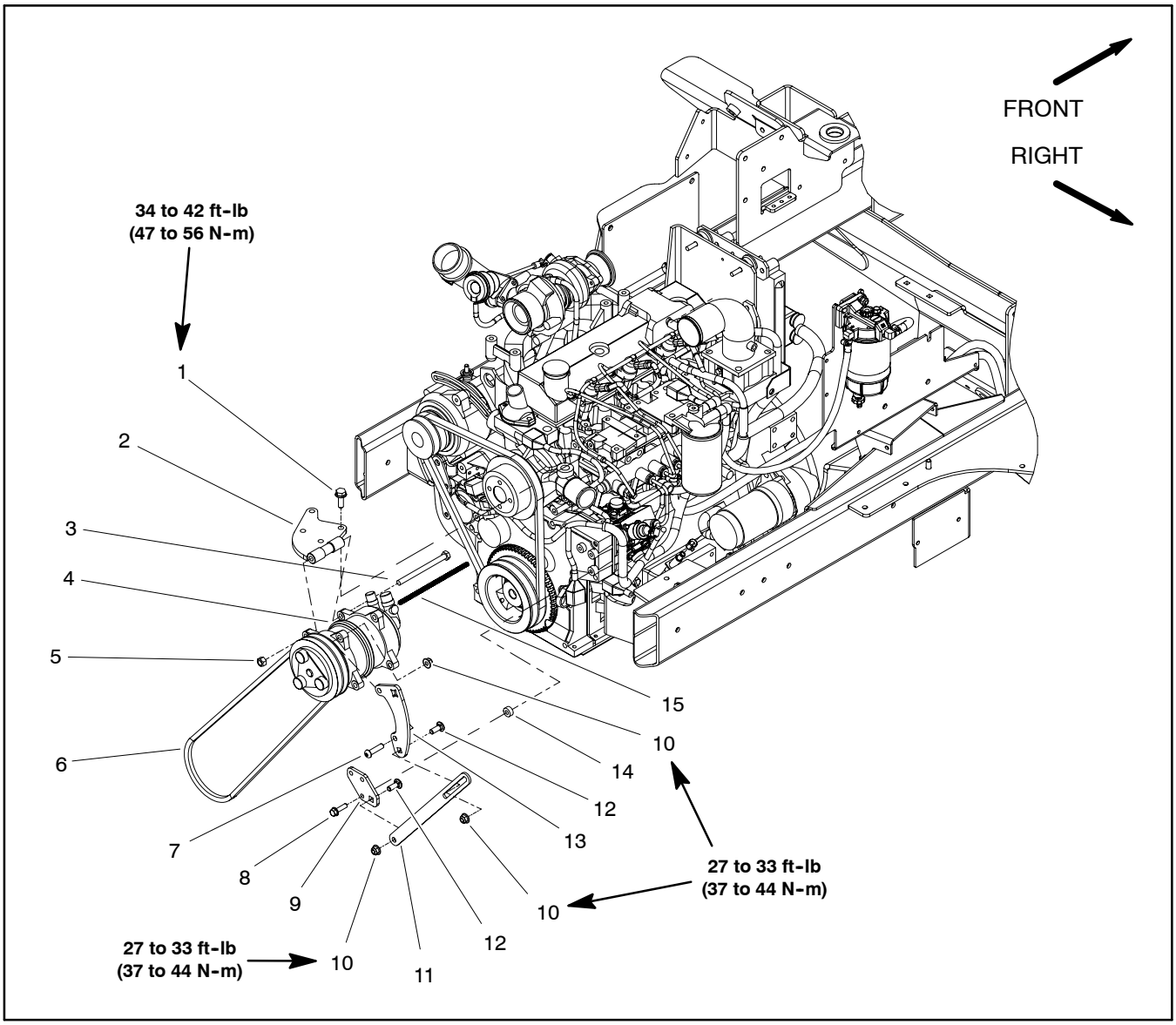


Figure 1

1. Flange head screw (4 used)
2. Pivot plate
3. Cap screw
4. Air conditioning compressor
5. Lock nut
6. Belt
7. Button head screw (2 used)
8. Flange head screw (3 used)
9. Mount plate
10. Flange nut (4 used)
11. Tensioner arm
12. Carriage screw (2 used)
13. Mount plate
14. Spacer (3 used)
15. Conduit

Removal (Fig. 1)

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

2. Raise hood to allow access to engine.

3. Loosen carriage screws and flange nuts that secure A/C compressor and tensioner arm (Fig. 2). Rotate compressor to loosen drive belt. Remove belt from A/C compressor pulley.

4. Inspect compressor drive belt for glazing or damage. Replace belt if necessary.

5. Disconnect compressor electrical connector from machine wire harness.

6. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

7. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

8. Label and remove hoses from compressor. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

9. Support compressor to prevent it from shifting or falling.

NOTE: There may be shims mounted between compressor and pivot plate. When removing compressor, note shim location and quantity for assembly purposes.

10. Remove carriage screw and flange nut that secure compressor to tensioner arm. Remove cap screw and lock nut that secure compressor to pivot plate.

IMPORTANT: To prevent compressor oil from filling the compressor cylinders, keep compressor in the same orientation as the installed position.

11. Carefully remove compressor from engine and machine.

12. If necessary, remove compressor mounting brackets from engine.

NOTE: The replacement of the drier−receiver is recommended whenever A/C compressor is removed from the system (see Heater and Evaporator Assembly in this section).

Installation (Fig. 1)

1. If removed, secure compressor mounting brackets to engine.

2. Position compressor to pivot plate and tensioner arm on engine.

3. The clearance between the compressor mounting flanges and pivot plate must be less than 0.004” (0.10 mm). If necessary, install shims between compressor flanges and pivot plate to adjust clearance. See Parts Catalog for shim kit.

4. Secure compressor to pivot plate and tensioner arm with removed fasteners and nuts. Do not fully tighten fasteners.

IMPORTANT: After the compressor has been installed, make sure to rotate the compressor drive shaft several times to properly distribute oil in the compressor. Compressor damage due to oil slugging can occur if this procedure is not performed.

5. Manually rotate the compressor drive shaft at least ten (10) revolutions to make sure that no compressor oil is in the compressor cylinders.

6. Place drive belt onto compressor pulley.

7. Tension compressor drive belt:

   A. Insert torque wrench in square hole on compressor mount plate (Fig. 2).

   B. Rotate compressor with torque wrench from **27 to 33 ft−lb (37 to 44 N−m)**.

   C. Hold compressor in position and tighten fasteners to secure compressor in place. Torque flange nuts that secure tensioner arm from **27 to 33 ft−lb (37 to 44 N−m)**.

8. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to compressor.

9. Connect compressor electrical connector to machine wire harness.

10. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

11. Lower and secure hood.

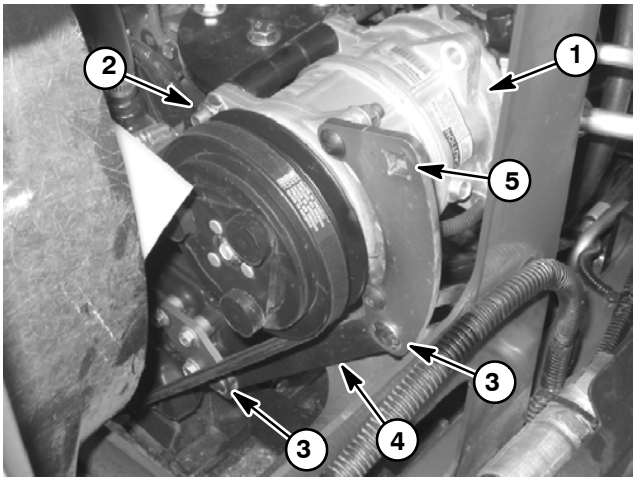


Figure 2

1. **Compressor**
2. **Cap screw & lock nut**
3. **Carriage screw & nut**
4. **Tensioner arm**

Air Conditioning Compressor Service

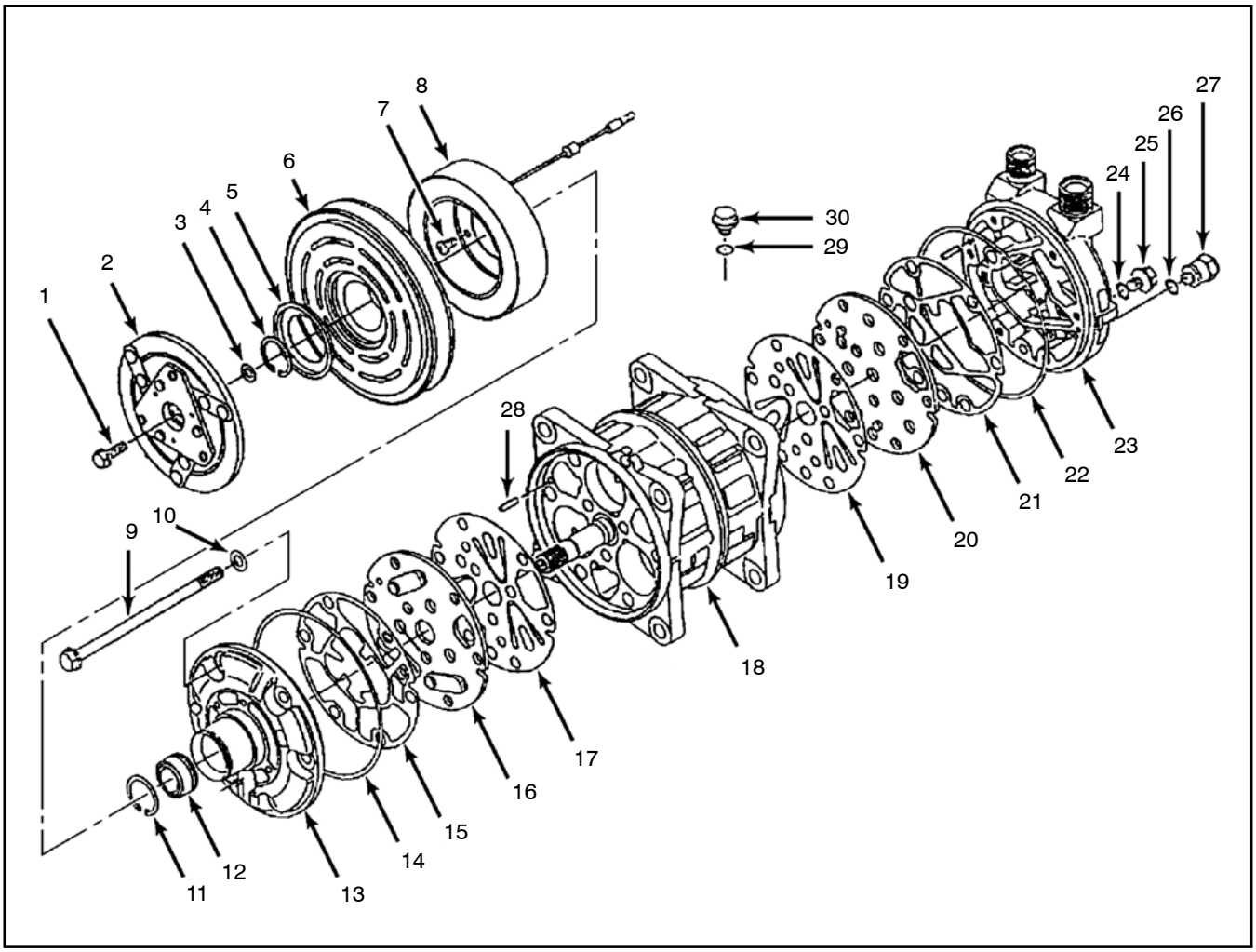


Figure 3

1. **Armature bolt**
2. **Armature plate**
3. **Shim**
4. **Snap ring**
5. **Cover**
6. **Pulley assembly**
7. **Coil screw (3 used)**
8. **Coil**
9. **Body bolt (6 used)**
10. **Washer (6 used)**
11. **Snap ring**
12. **Shaft seal**
13. **Front cylinder head**
14. **Body O-ring**
15. **Front gasket**
16. **Front valve plates**
17. **Front suction valve**
18. **Cylinder shaft assembly**
19. **Rear suction valve**
20. **Rear valve plate**
21. **Rear gasket**
22. **Body O-ring**
23. **Rear cylinder head**
24. **O-ring**
25. **Drain plug**
26. **O-ring**
27. **Pressure relief valve**
28. **Alignment pin**
29. **O-ring**
30. **Oil fill plug**

NOTE: The air conditioning compressor used on the Groundsmaster 5910 is an International Components Engineering (ICE) model TM-16. For air conditioning compressor repair procedures, see the ICE Compressor Service Manual at the end of this chapter.

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Roof Assembly

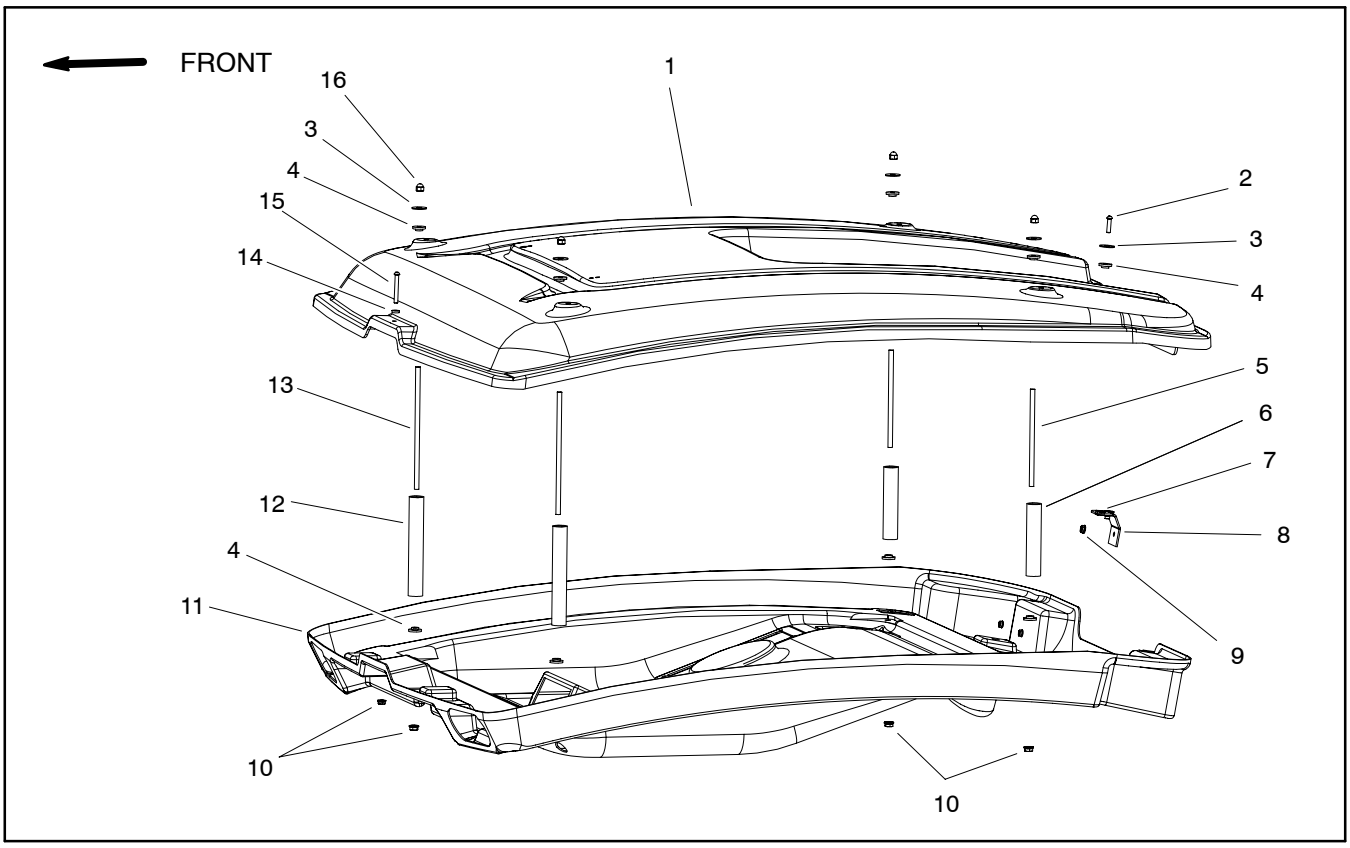


Figure 4

1. **Roof**
2. **Screw (2 used)**
3. **Flat washer (6 used)**
4. **Bushing**
5. **Rear fastener (2 used)**
6. **Rear spacer (2 used)**
7. **Panel nut**
8. **Roof mount**
9. **Flange nut**
10. **Flange nut (4 used)**
11. **Headliner**
12. **Front spacer (2 used)**
13. **Front fastener (2 used)**
14. **Rubber washer**
15. **Cap screw**
16. **Hex nut (4 used)**

To gain access to the heater core and air conditioning components that are located under the cab roof, the roof panel can be loosened, raised and supported.

Removal (Fig. 4)

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

2. Remove two (2) screws (item 2), flat washers (item 3) and bushings (item 4) that secure the rear of the roof to the roof mount.

3. Remove the cap screw (item 15) and rubber washer (item 14) that secure the front of the roof.

4. Remove four (4) hex nuts (item 16), flat washers (item 3) and bushings (item 4) that secure roof to front and rear fasteners.

5. Carefully lift front of roof while leaving rear of roof against headliner. Support front of roof in the raised position to allow access to heater and air conditioning components.

Installation (Fig. 4)

1. Make sure that all components in headliner and roof are installed and secure.

2. Remove support and carefully tilt roof into position.

3. Secure roof to headliner with all removed fasteners.

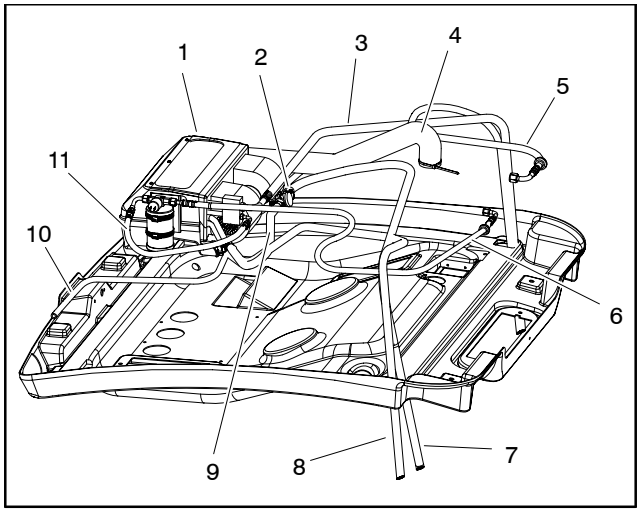


Figure 5

1. **Heater evaporator assembly**
2. **Heater valve**
3. **A/C hose: evaporator to compressor**
4. **Air duct hose**
5. **A/C hose: compressor to condenser**
6. **A/C hose: condenser to drier**
7. **Heater hose: thermostat to heater valve**
8. **Heater hose: heater core to water pump**
9. **Heater hose: heater valve to heater core**
10. **Condensation drain hose (2 used)**
11. **A/C hose: drier to evaporator**

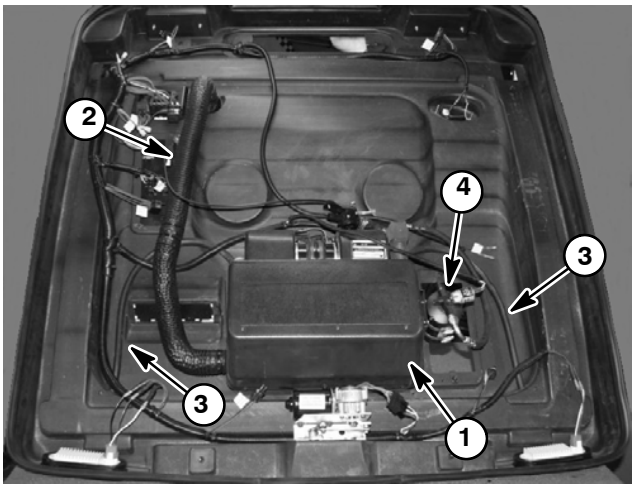


Figure 6

1. **Heater evaporator**
2. **Air duct hose**
3. **Drain hose**
4. **Drier-receiver**

Air Conditioning Condenser Assembly

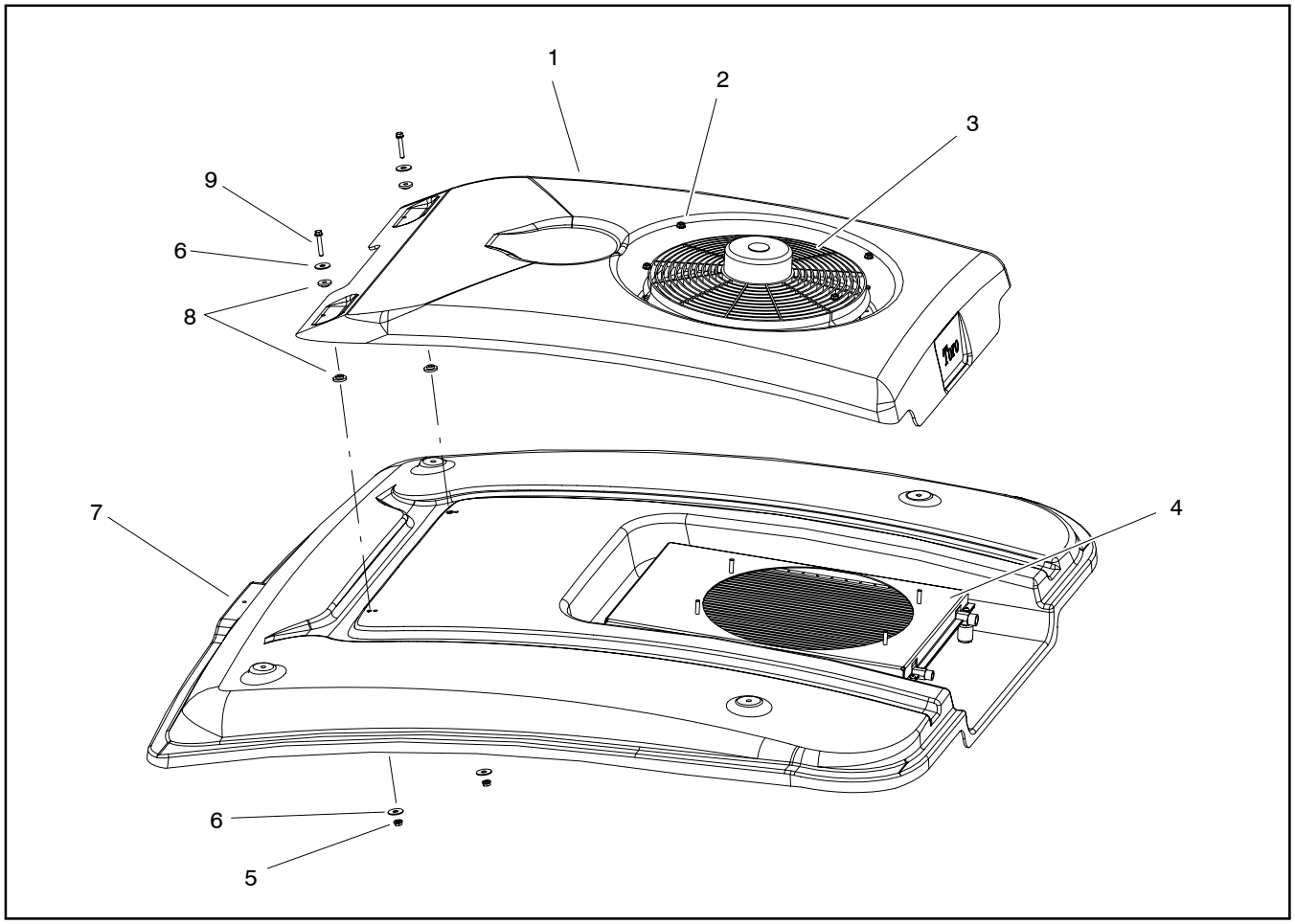


Figure 7

1. **Condenser cover**
2. **Flange nut (4 used)**
3. **Condenser fan**
4. **Condenser coil assembly**
5. **Flange nut (2 used)**
6. **Flat washer (4 used)**
7. **Roof**
8. **Bushing (4 used)**
9. **Flange head screw (2 used)**

Removal (Fig. 7)

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

2. Remove fasteners that secure roof in place. Raise and support roof to allow access to condenser assembly (see Roof Assembly Removal in this section).

3. Disconnect wire harness connector from condenser fan motor.

4. Remove flange nuts (item 2) that secure condenser fan and cover to condenser coil.

5. Remove fasteners (items 5, 6, 8 and 9) that secure condenser cover to roof. Lift cover and condenser fan from roof.

6. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

7. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

8. Label and remove hoses from condenser coil. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

9. Remove condenser coil from roof using Figure 8 as a guide.

NOTE: The replacement of the drier–receiver is recommended whenever the air conditioning system is opened (see Heater and Evaporator Assembly in this section).

Installation (Fig. 7)

1. Install condenser coil to roof using Figure 8 as a guide.

2. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to condenser coil.

3. Position condenser cover and condenser fan to roof. Secure cover and fan with removed fasteners (items 5, 6, 8 and 9).

4. Secure condenser fan to condenser coil with flange nuts (item 2).

5. Connect wire harness connector to condenser fan motor.

6. Make sure that all machine air conditioning components are installed and secure.

7. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

8. Lower and secure roof assembly (see Roof Assembly Installation in this section).

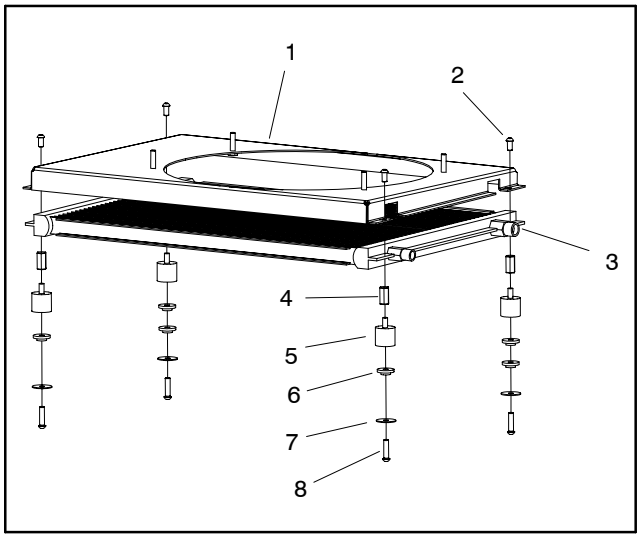


Figure 8

1. **Condenser fan mount**
2. **Screw (4 used)**
3. **Condenser coil**
4. **Coupler nut (4 used)**
5. **Isolator mount (4 used)**
6. **Bushing (6 used)**
7. **Flat washer (4 used)**
8. **Screw (4 used)**

Heater and Evaporator Assembly

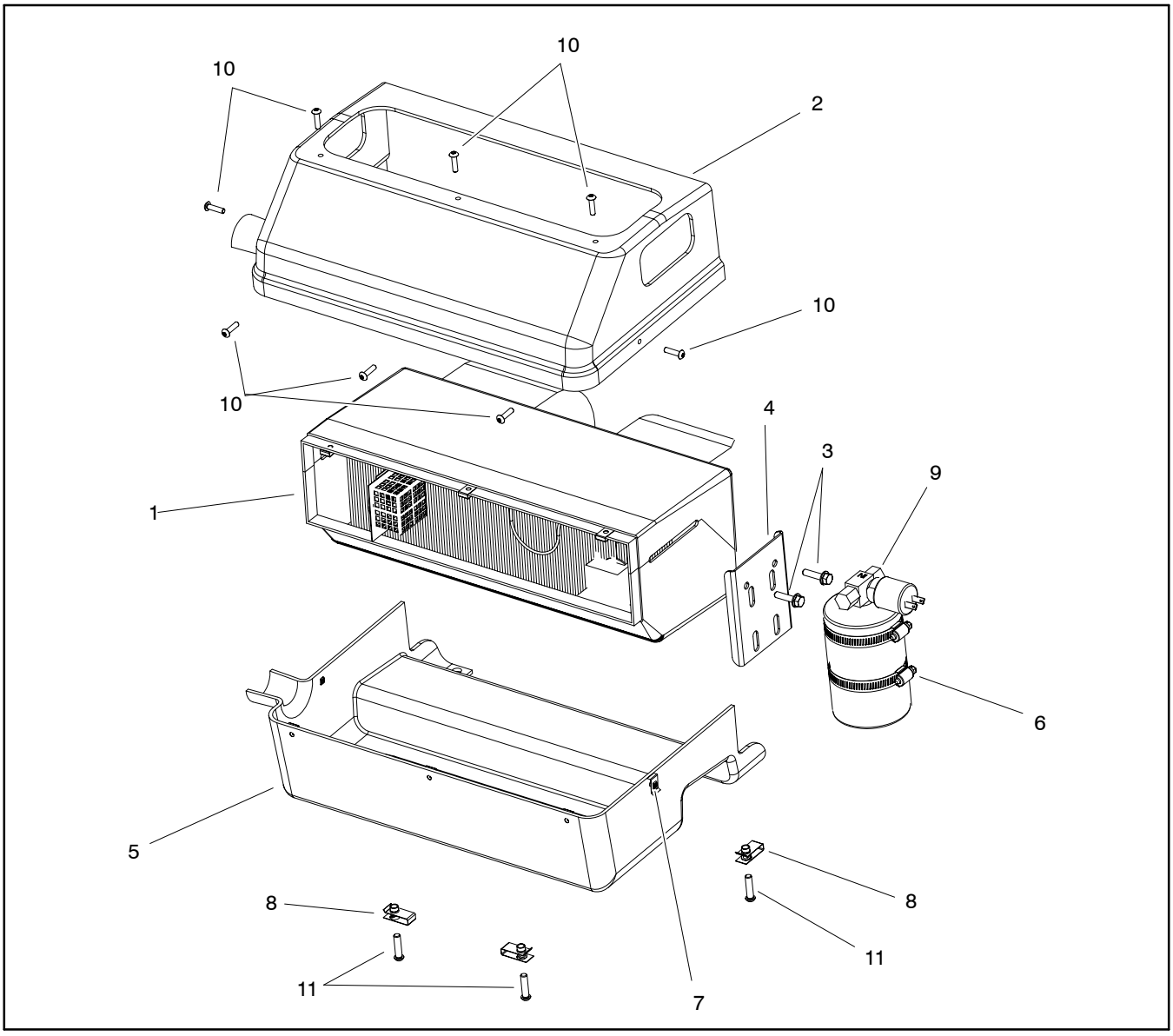


Figure 9

1. **Heater and evaporator assembly**
2. **Top cover**
3. **Flange head screw (2 used)**
4. **Drier-receiver mount**
5. **Bottom cover**
6. **Hose clamp (2 used)**
7. **Speed nut (8 used)**
8. **Panel nut (4 used)**
9. **Drier-receiver**
10. **Screw (8 used)**
11. **Screw (5 used)**

Removal (Fig. 9)

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

2. Remove fasteners that secure roof in place. Raise and support roof to allow access to condenser assembly (see Roof Assembly Removal in this section).

3. Disconnect wire harness connectors from fan motor and binary switch on drier−receiver.

4. Read the General Precautions for Removing and Installing Air Conditioning System Components at the beginning of the Service and Repairs section of this chapter.

CAUTION

The air conditioning system is under high pressure. Do not loosen any system fitting or component until after the system has been completely discharged by a certified A/C service technician.

5. Have refrigerant evacuated from air conditioning system by a certified A/C service technician.

6. Label and remove hoses from heater core, evaporator and drier−receiver. Immediately cap hoses and fittings to prevent moisture and contaminants from entering the system.

7. Loosen hose clamp that secures air duct hose to heater and evaporator assembly covers. Slide hose from covers.

8. Remove screws that secure top cover to bottom cover. Remove top cover to access heater and evaporator assembly.

9. Disassemble heater and evaporator assembly using Fig. 12 as a guide.

NOTE: The replacement of the drier−receiver is recommended whenever the air conditioning system is opened.

Installation (Fig. 9)

1. Assemble heater and evaporator assembly using Fig. 12 as a guide. Make sure that expansion valve is covered with insulating tape to prevent condensation issues.

2. Position heater and evaporator assembly into bottom cover in headliner. Secure top cover to bottom cover with removed screws.

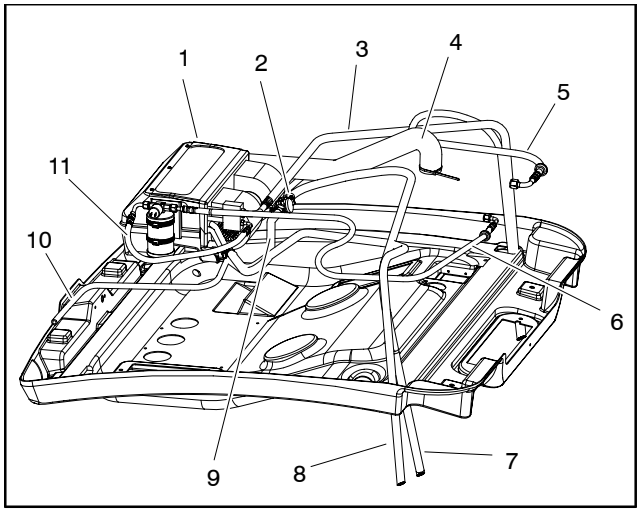


Figure 10

1. **Heater evaporator assembly**
2. **Heater valve**
3. **A/C hose: evaporator to compressor**
4. **Air duct hose**
5. **A/C hose: compressor to condenser**
6. **A/C hose: condenser to drier**
7. **Heater hose: thermostat to heater valve**
8. **Heater hose: heater core to water pump**
9. **Heater hose: heater valve to heater core**
10. **Condensation drain hose (2 used)**
11. **A/C hose: drier to evaporator**

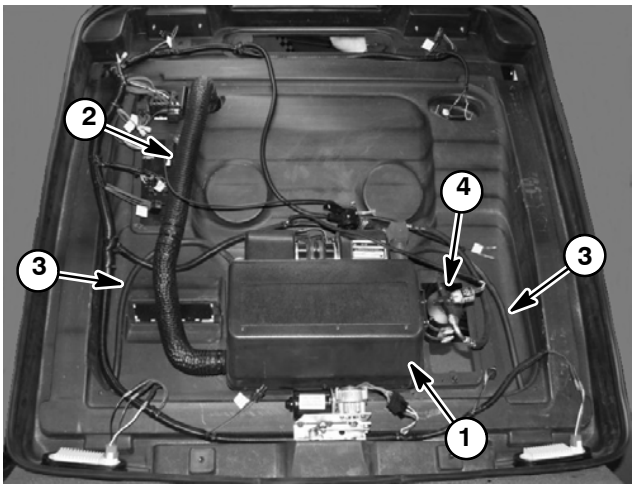


Figure 11

1. **Heater evaporator**
2. **Air duct hose**
3. **Drain hose**
4. **Drier−receiver**

3. Slide air duct hose onto heater and evaporator assembly covers and secure with hose clamp.

4. Remove caps that were placed on hoses and fittings during the removal process. Using labels placed during removal, properly secure hoses to heater core, evaporator and drier−receiver.

5. Make sure that condensation hoses are secured to bottom housing of heater and evaporator assembly and are routed to cab frame for proper draining of condensate.

6. Connect wire harness connectors to fan motor and binary switch on drier−receiver.

7. Make sure that all machine air conditioning components are installed and secure.

8. Have a certified air conditioning service technician evacuate the air conditioning system completely, properly recharge the system with R134a refrigerant and then leak test the system. A/C system capacity is 1.25 pounds of R134a refrigerant.

9. Operate the heater system to make sure that no coolant leaks exist.

10. Lower and secure roof assembly (see Roof Assembly Installation in this section).

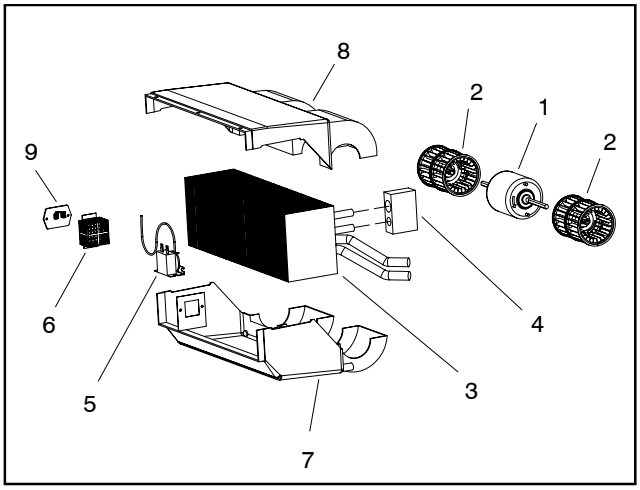


Figure 12

1. **Fan motor**
2. **Blower wheel**
3. **Evaporator/heater core**
4. **Expansion valve**
5. **Freeze switch**
6. **Resistor guard**
7. **Bottom housing**
8. **Top housing**
9. **Resistor**

Chapter 10

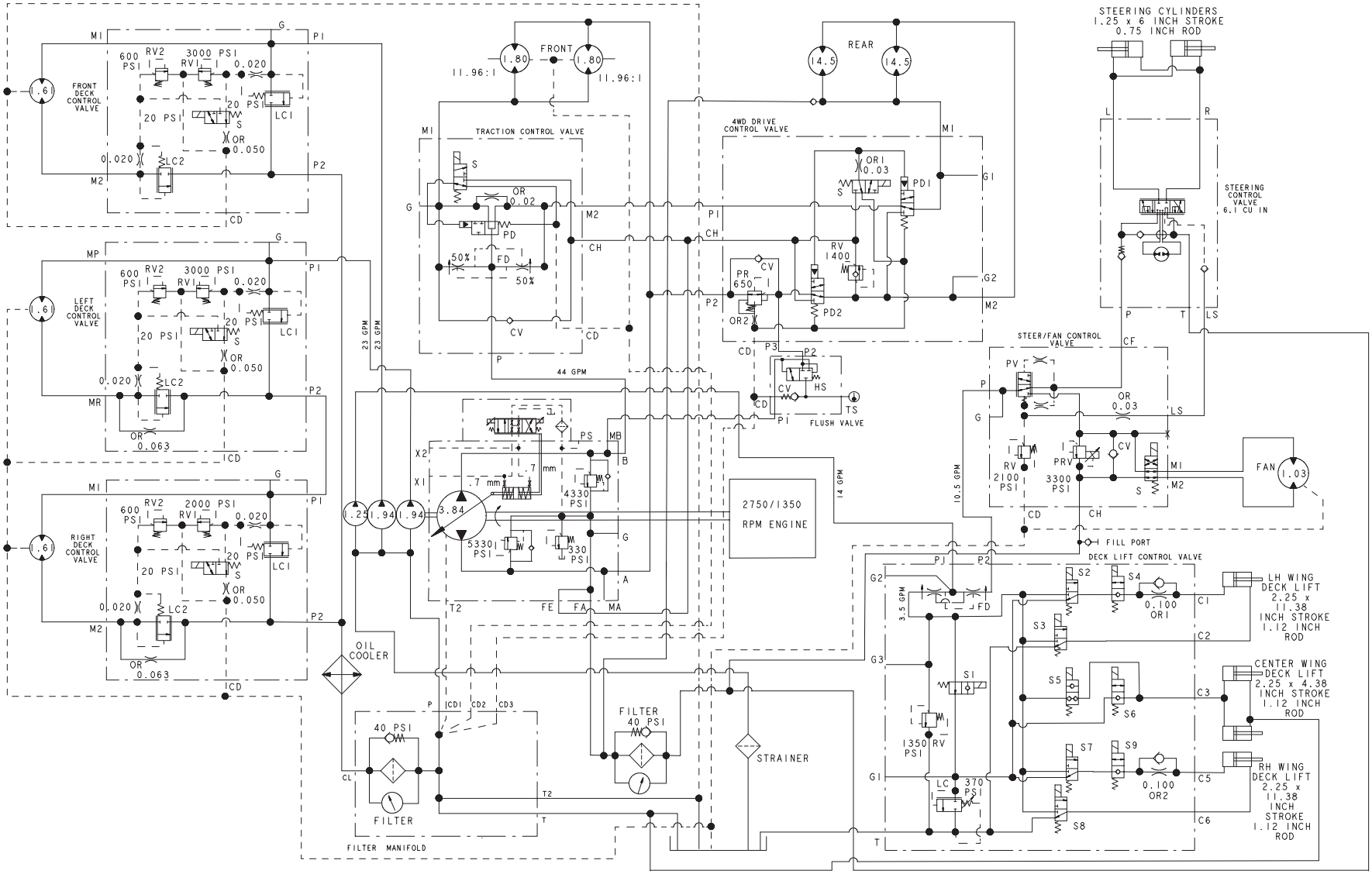
Foldout Drawings

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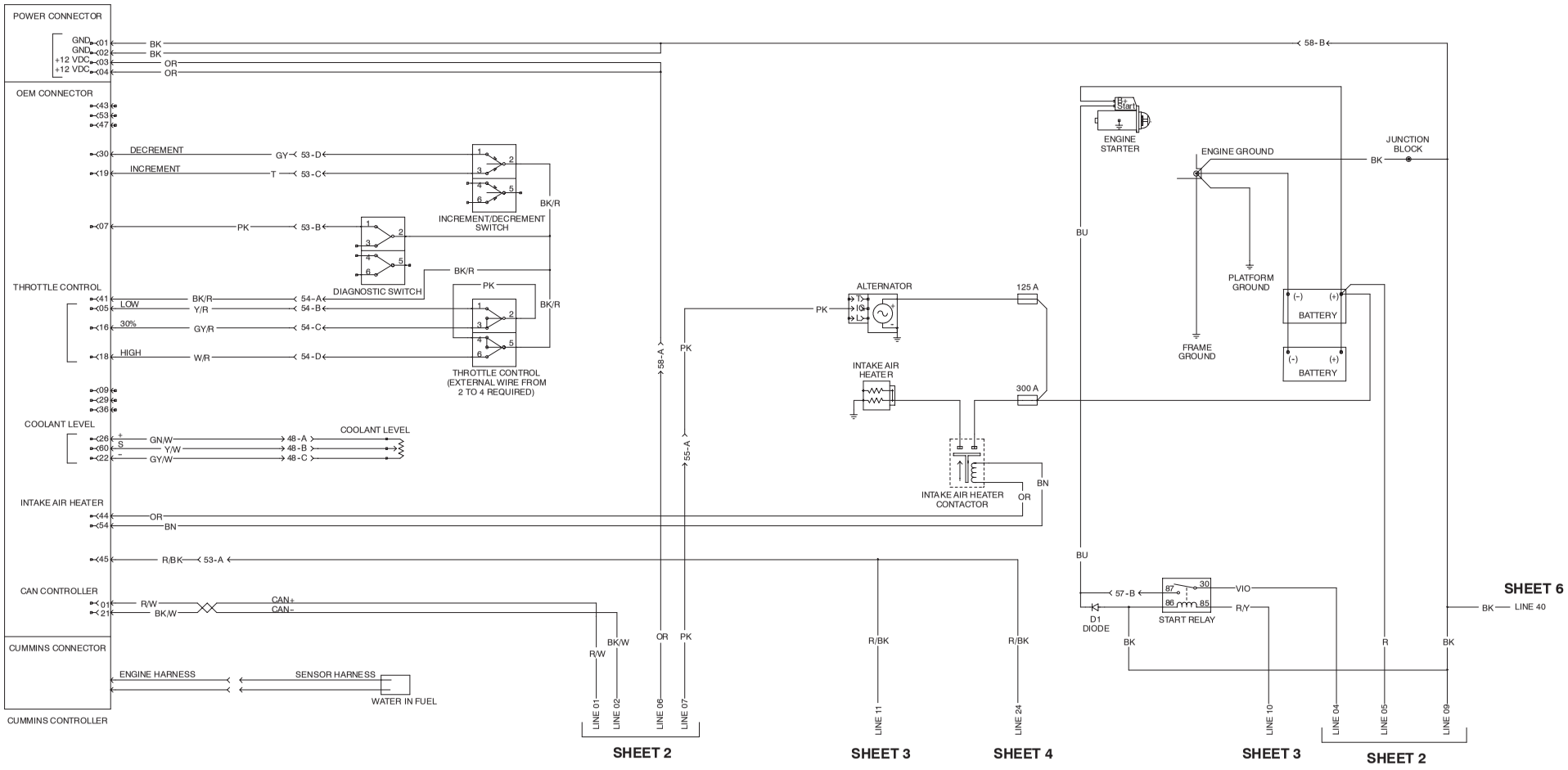
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Groundsmaster 5900/5910
Hydraulic Schematic



Groundsmaster 5900/5910

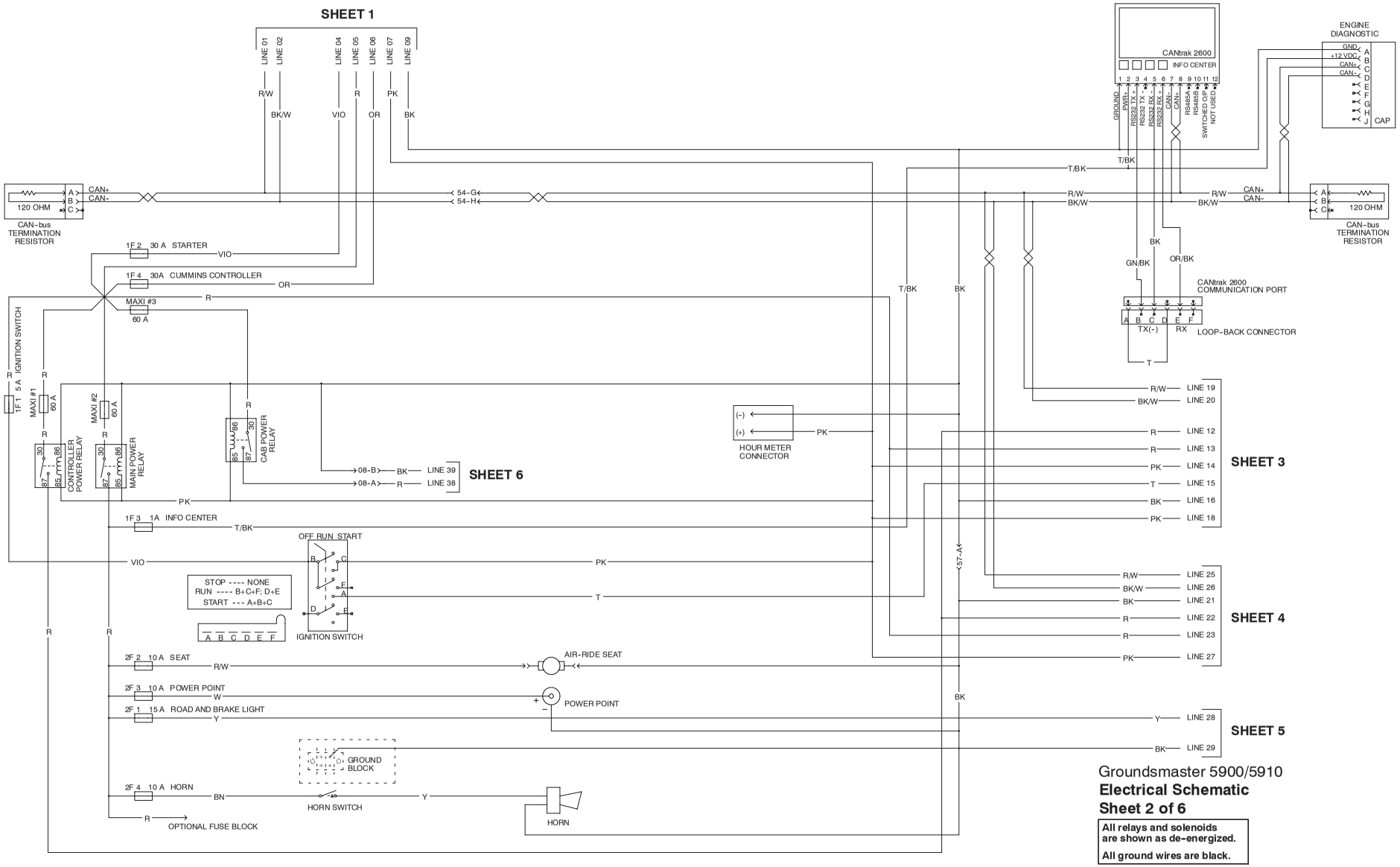
Electrical Schematic

Sheet 1 of 6

All relays and solenoids are shown as de-energized.

All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

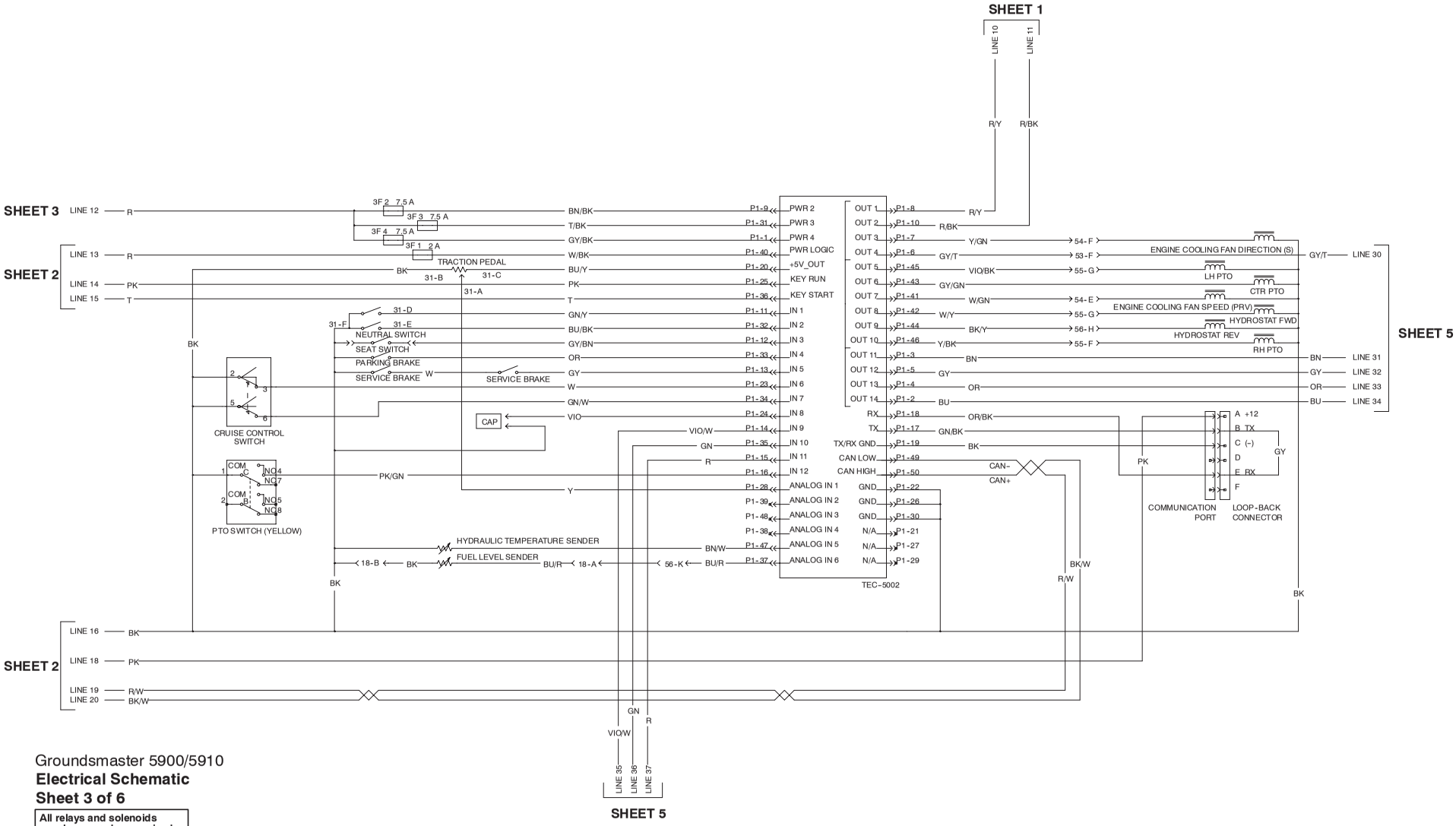
Electrical Schematic

Sheet 2 of 6

All relays and solenoids are shown as de-energized.

All ground wires are black.

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Groundsmaster 5900/5910

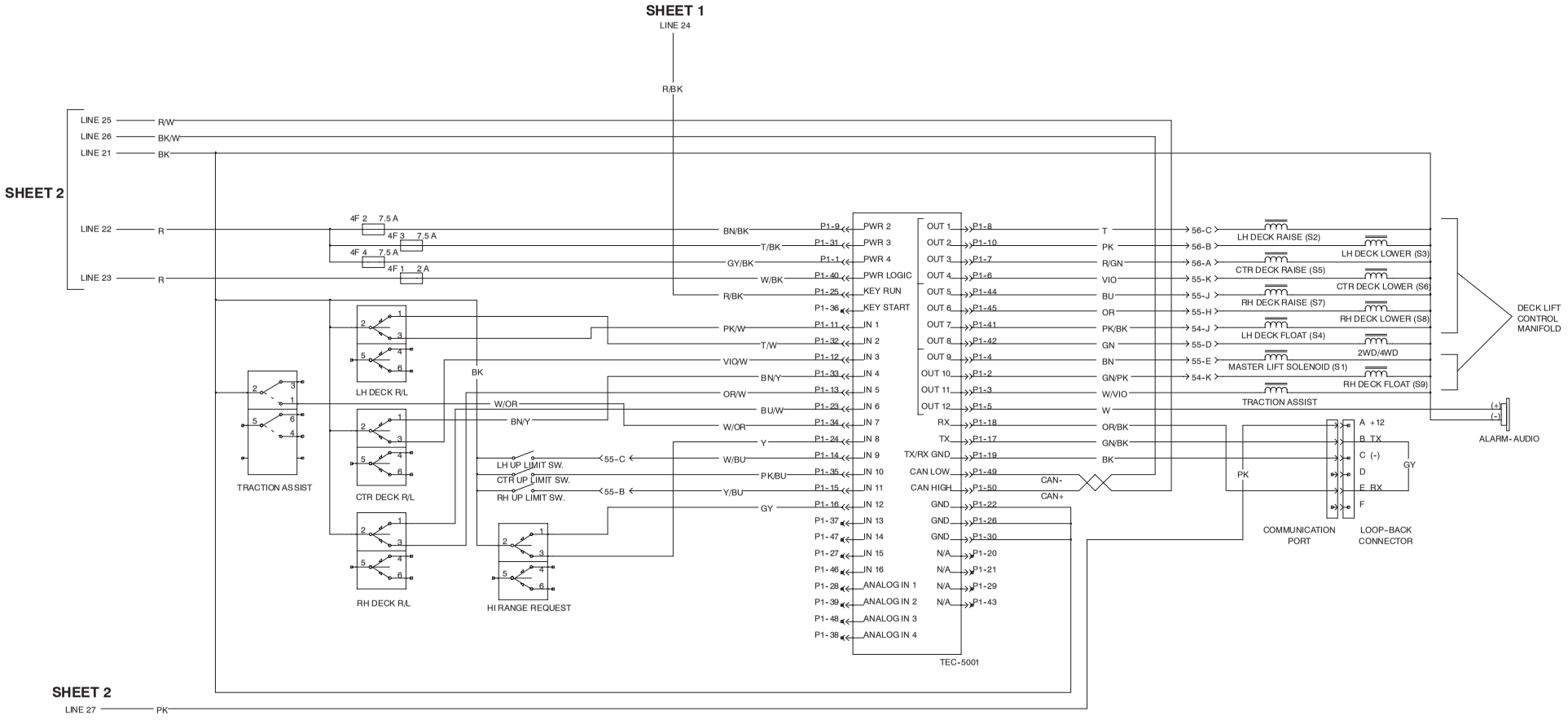
Electrical Schematic

Sheet 3 of 6

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All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

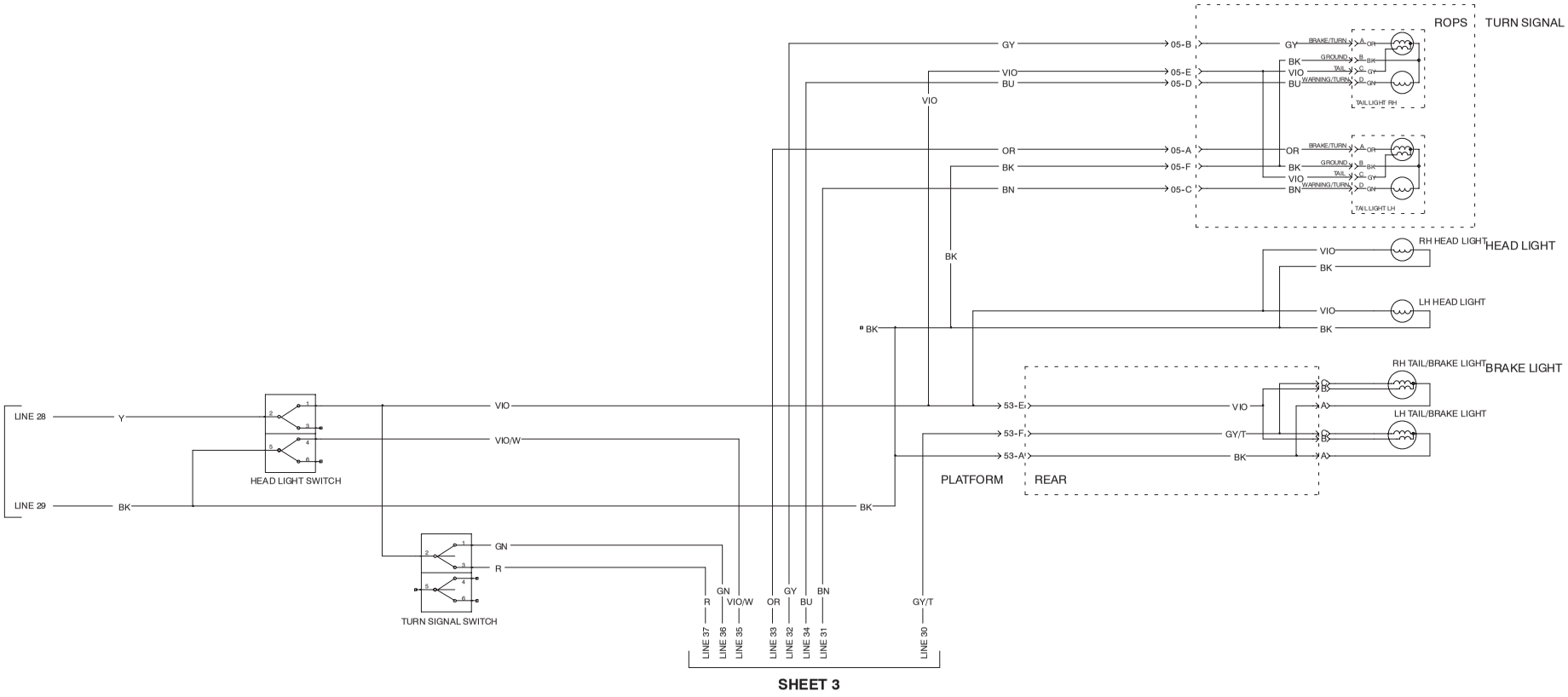
Electrical Schematic

Sheet 4 of 6

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All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



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Groundsmaster 5900/5910

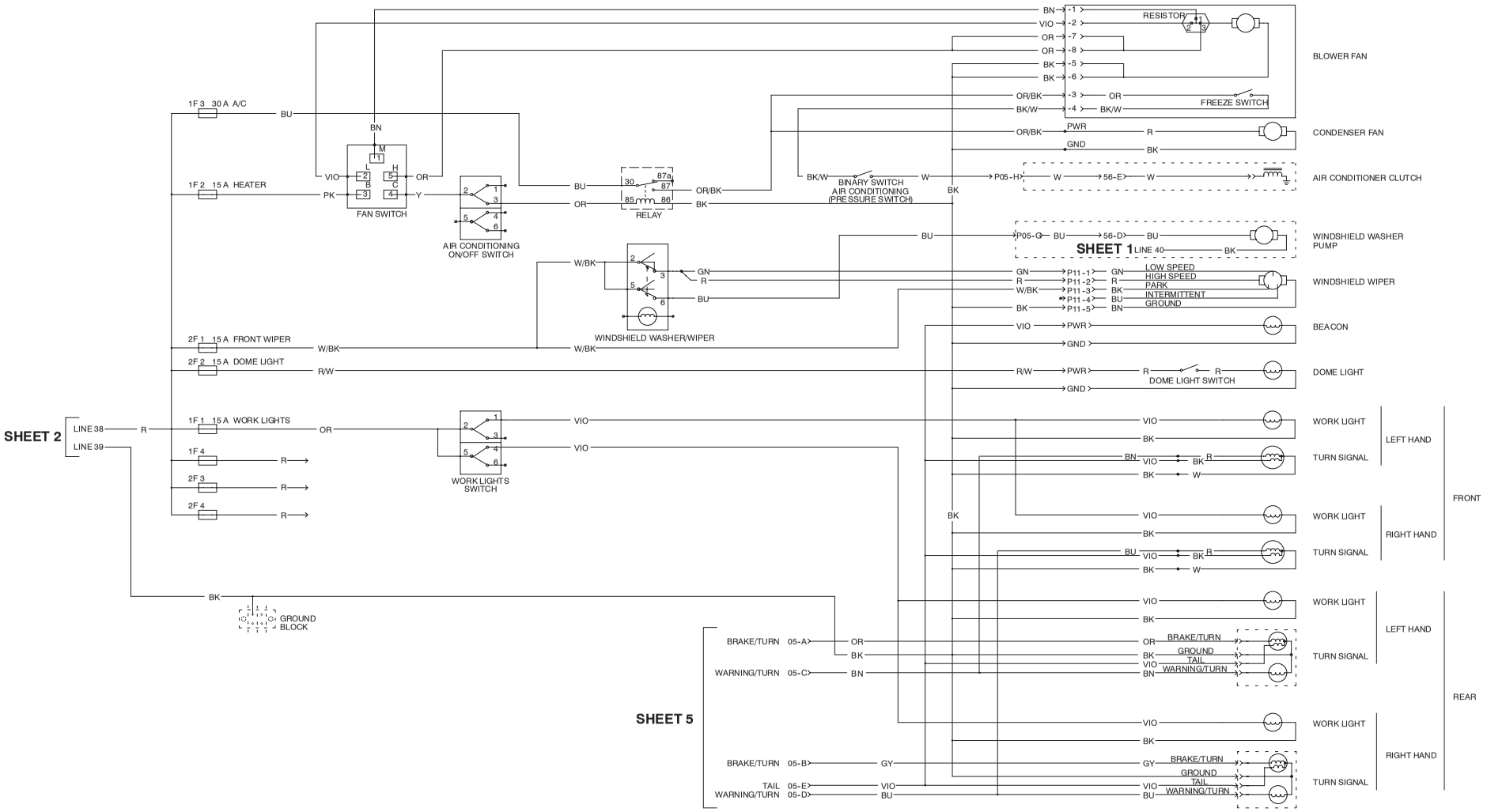
Electrical Schematic

Sheet 5 of 6

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All ground wires are black.

NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

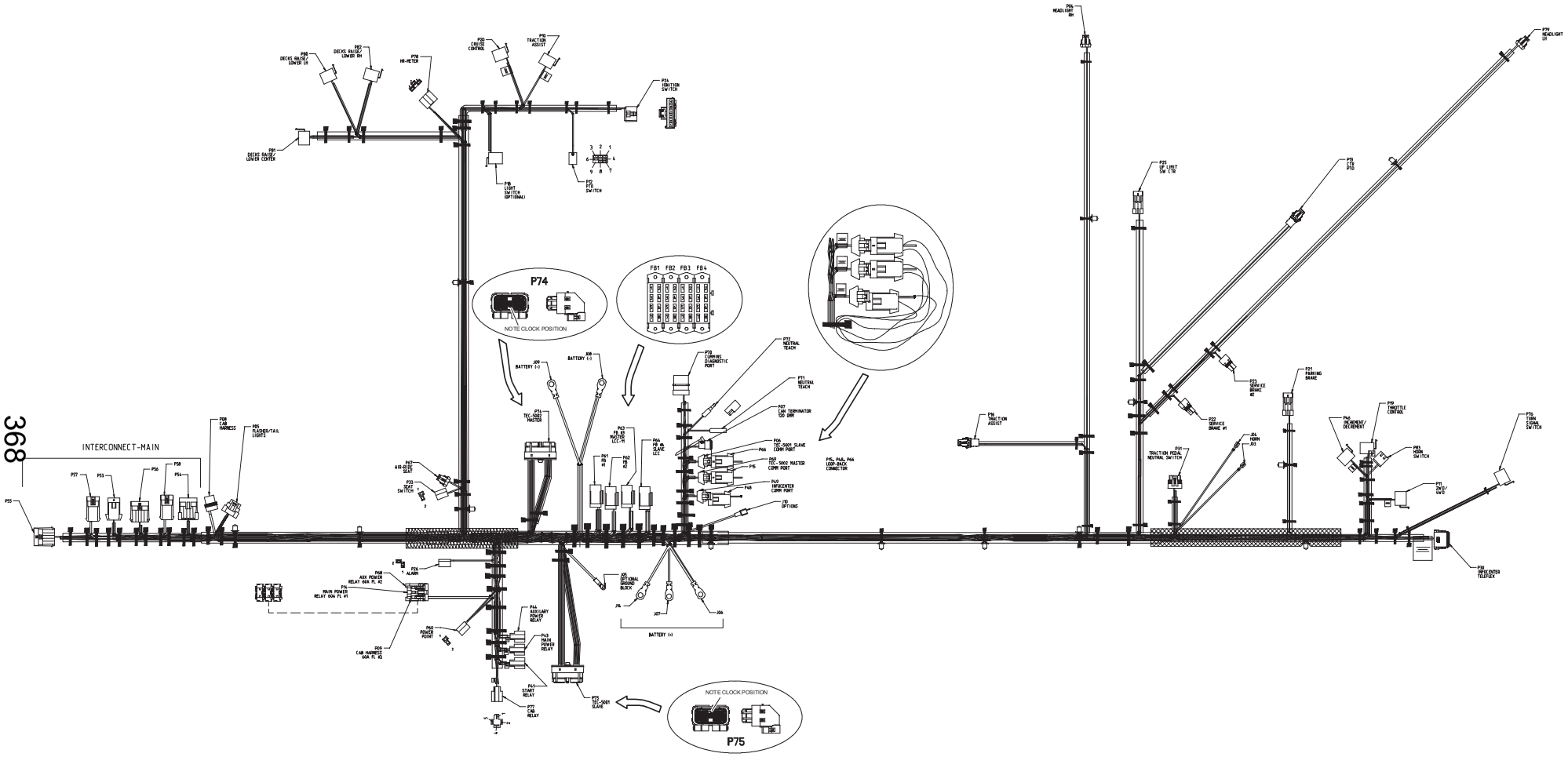
Electrical Schematic

Sheet 6 of 6 (Operator Cab)

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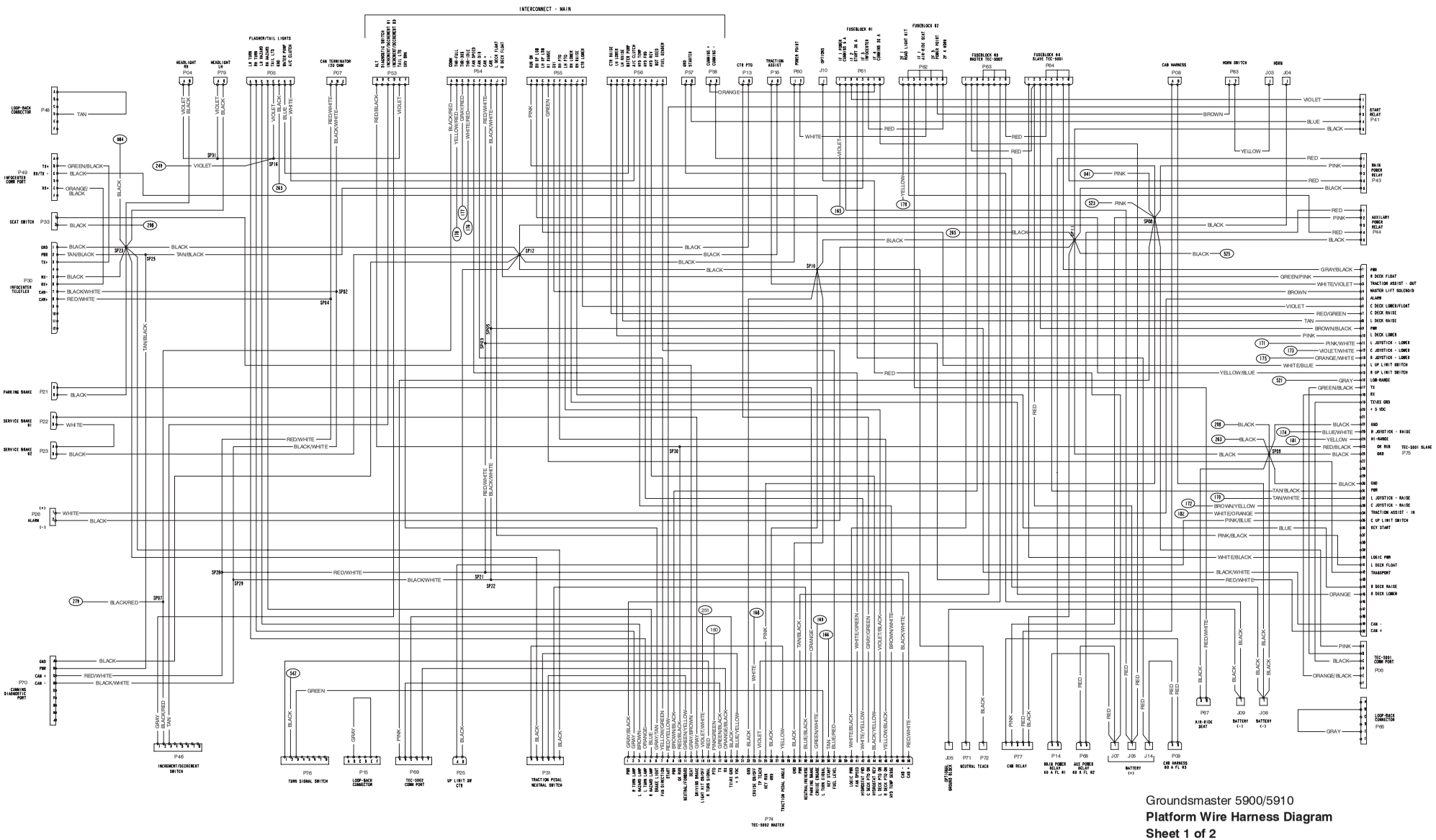
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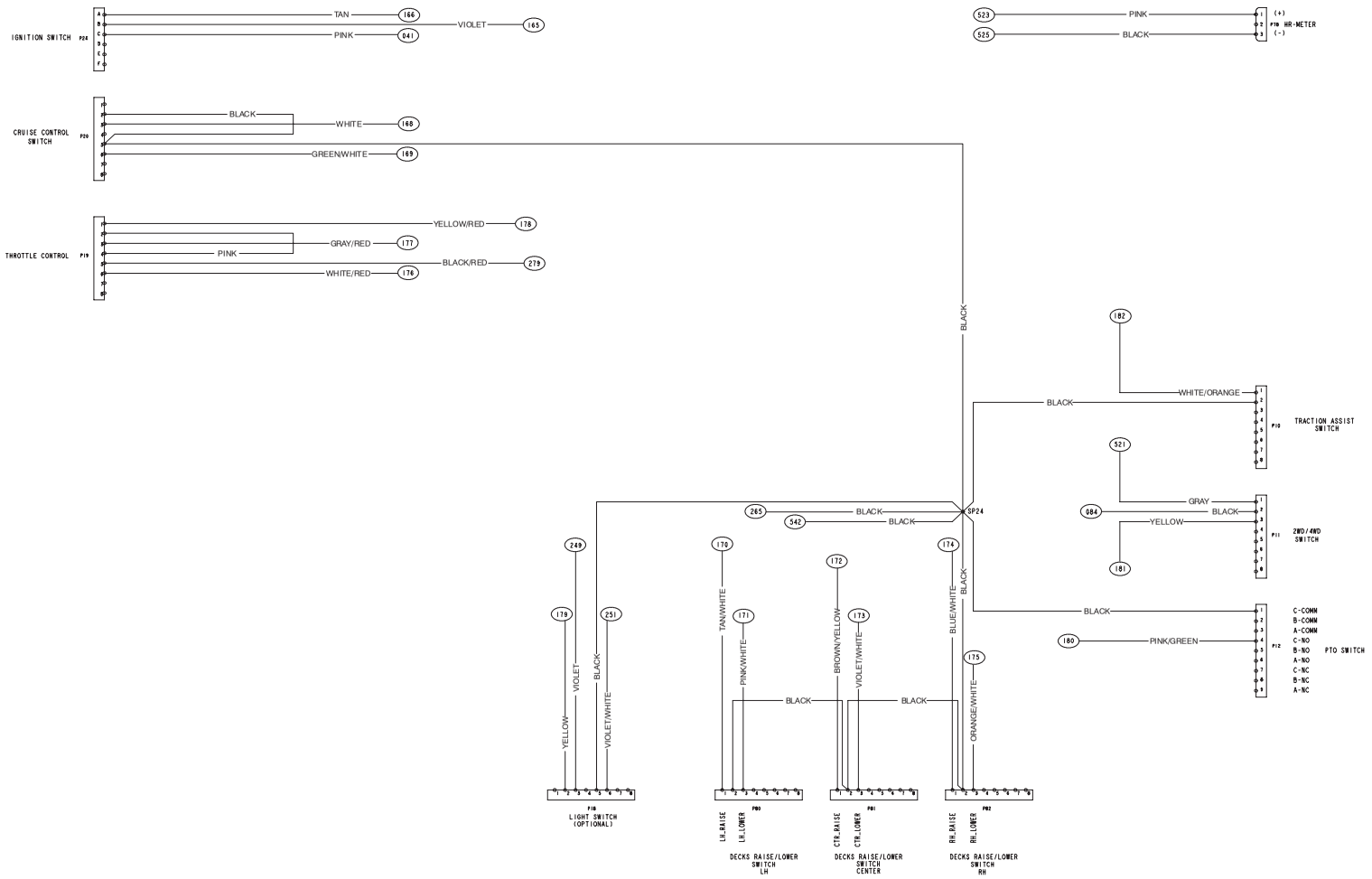
NOTE: THE ELECTRICAL SCHEMATIC IS SHOWN ON SIX (6) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, THE SHEET NUMBER AND A LINE NUMBER WILL BE IDENTIFIED.



Groundsmaster 5900/5910

Platform Wire Harness Drawing


INTERCONNECT - MAIN
Groundsmaster 5900/5910
Platform Wire Harness Diagram
Sheet 1 of 2
NOTE: THE PLATFORM WIRE HARNESS DIAGRAM IS SHOWN ON TWO (2) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, A REFERENCE NUMBER WILL BE IDENTIFIED.



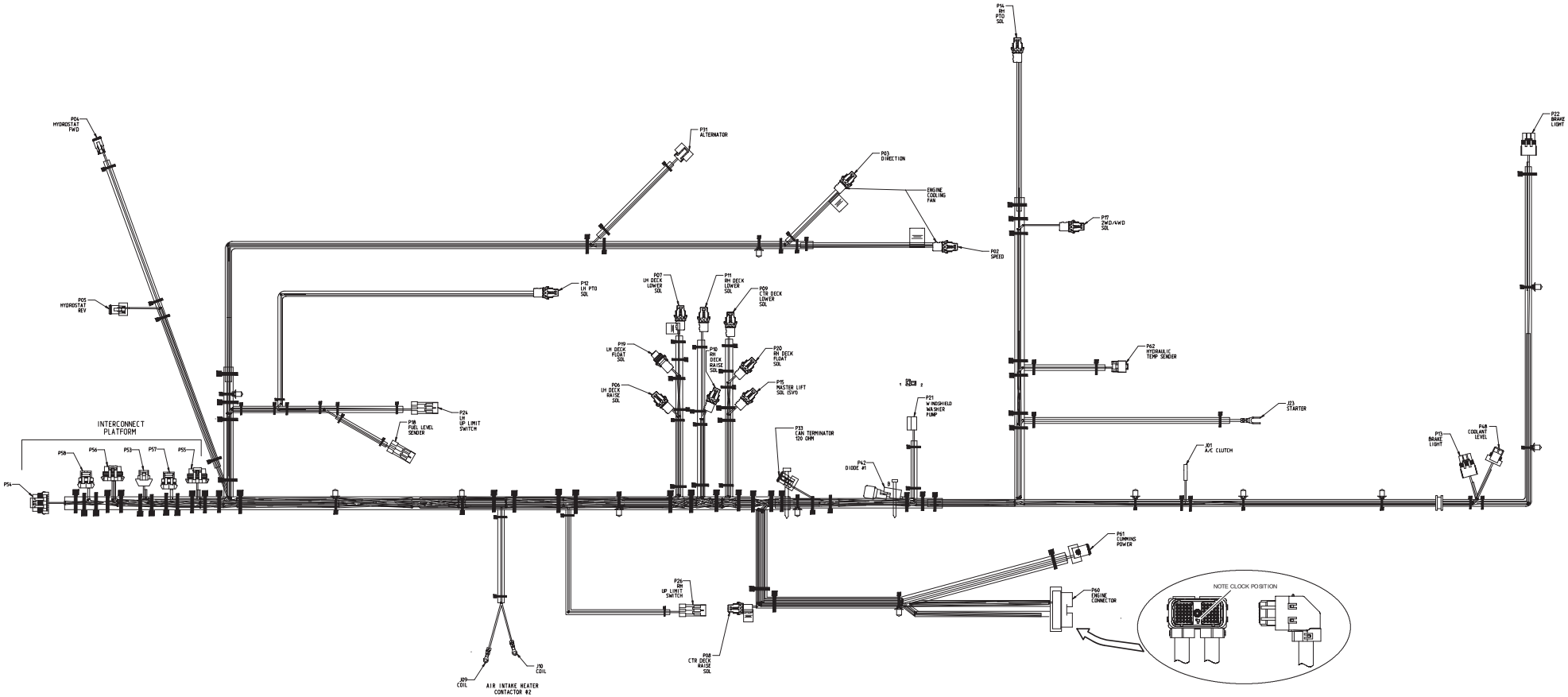
Groundsmaster 5900/5910

Platform Wire Harness Diagram

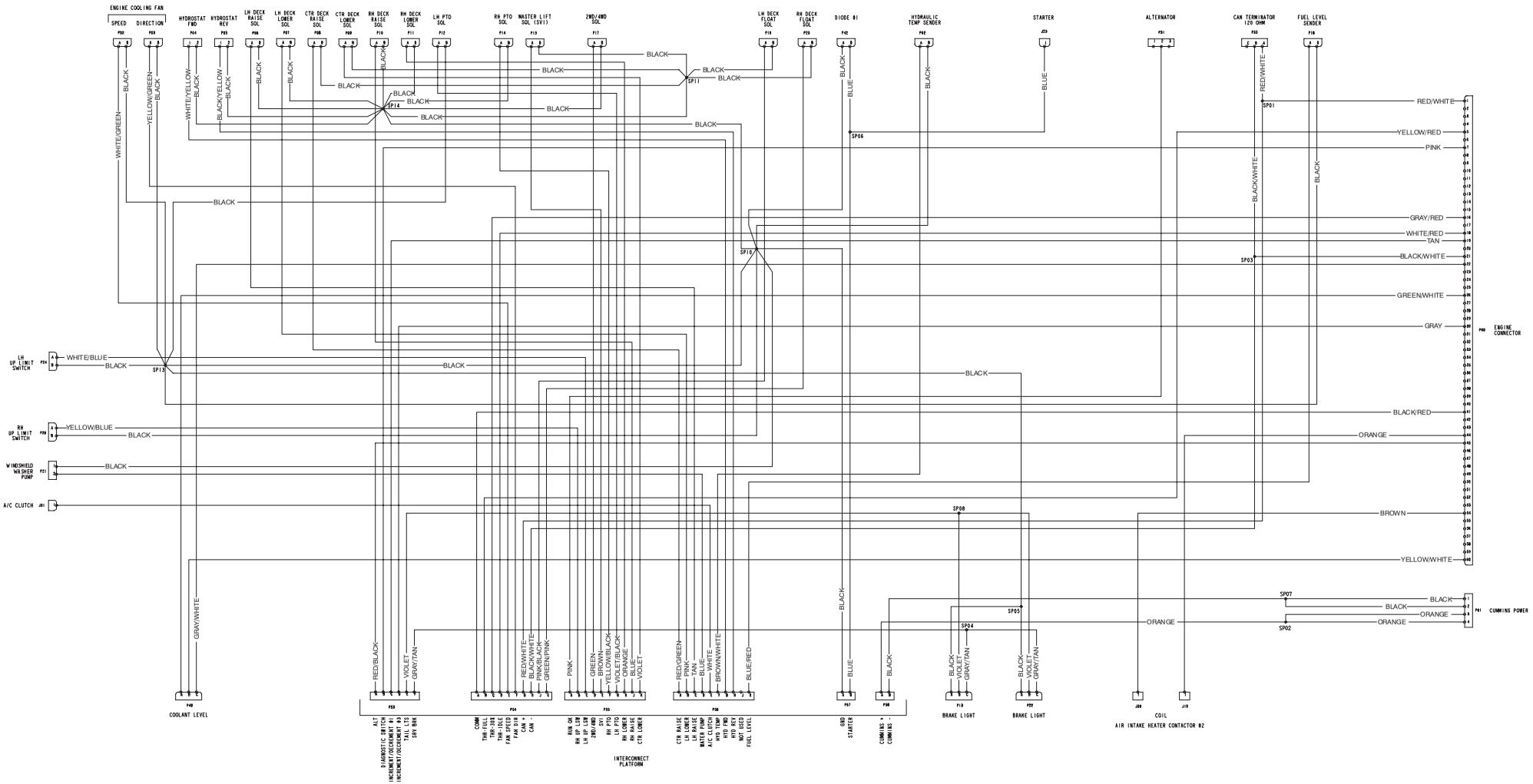
Sheet 2 of 2

NOTE: THE PLATFORM WIRE HARNESS DIAGRAM IS SHOWN ON TWO (2) SHEETS. WHEN A CONDUCTOR CONTINUES ON ANOTHER SHEET, A REFERENCE NUMBER WILL BE IDENTIFIED.

Page 10 – 12

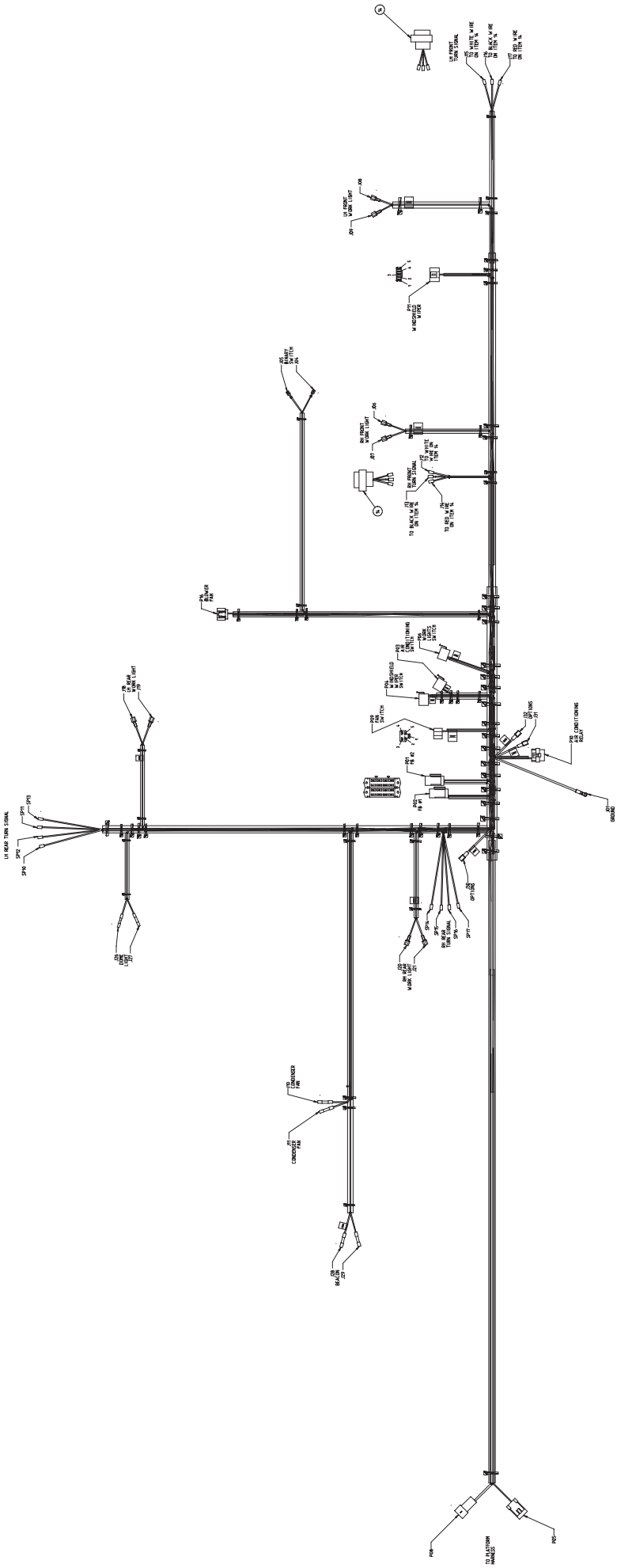


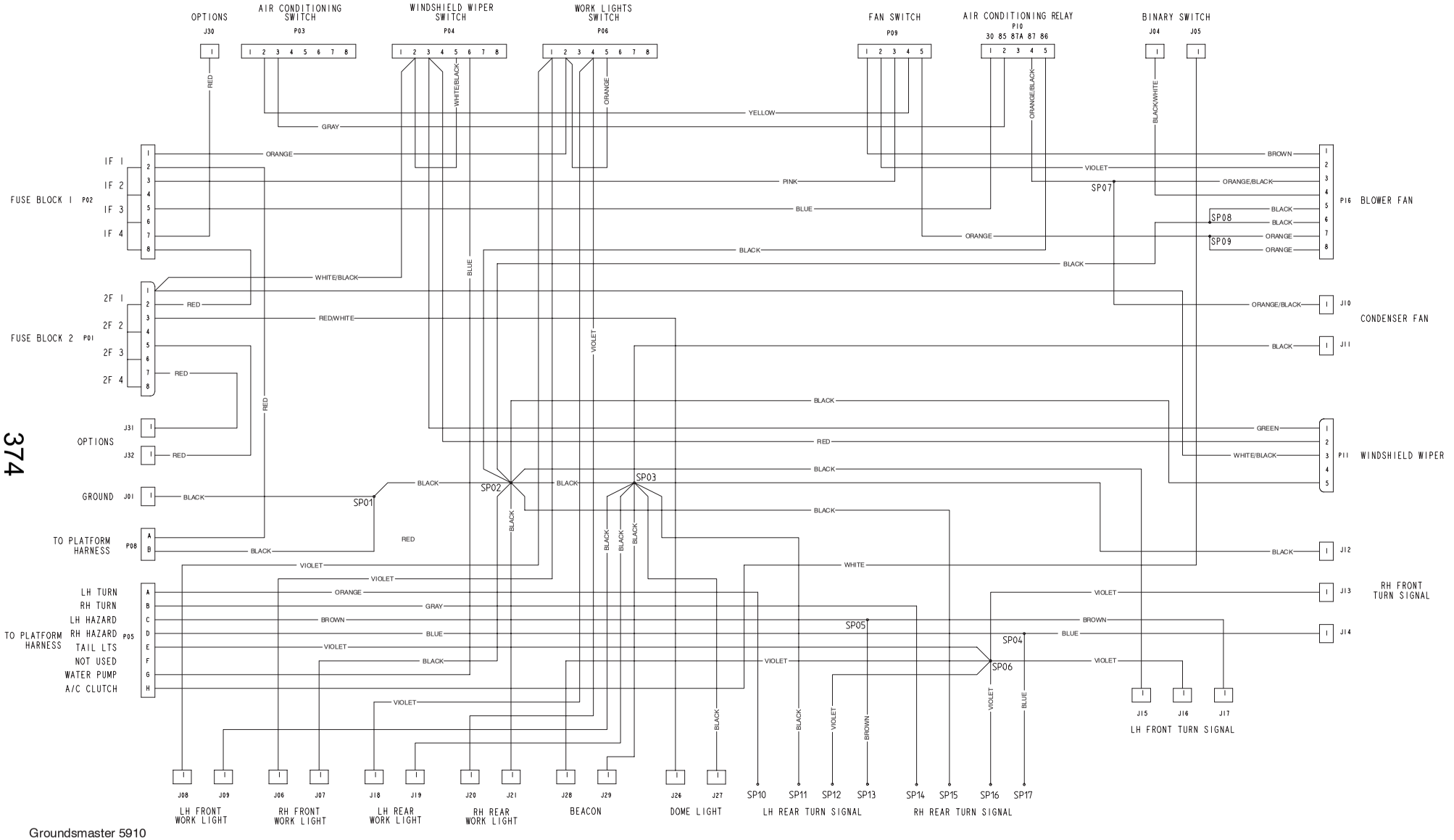
Groundsmaster 5900/5910
Rear Wire Harness Drawing



Groundsmaster 5900/5910

Rear Wire Harness Diagram





Groundsmaster 5910
Cab Wire Harness Diagram