Part No. 08162SL (Rev. A)

Service Manual

(Model 30413)

Groundsmaster® 4100–D

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 4100–D (Model 30413).

REFER TO THE OPERATOR'S MANUAL 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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Chapter 1

Safety

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General Safety Instructions

The GROUNDSMASTER 4100-D was 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 vehicle. Become familiar with the controls and know how to stop the vehicle 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 cutting deck is DISENGAGED.

4. Since diesel fuel is highly 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.

   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. Apply the parking brake.

   B. Make sure traction pedal is in neutral 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 linkage is adjusted incorrectly; therefore, shut engine off and adjust linkage 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, muffler or exhaust pipe 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 neutral.

   B. Apply parking brake.

   C. Disengage cutting deck and wait for blades to stop.

   D. Stop engine and remove key from switch.

   E. Toro recommends that anytime the machine is parked (short or long term), the cutting deck should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of the cutting deck unexpectedly lowering to the ground.

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

Maintenance and Service

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Jacking Instructions

CAUTION

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

Jacking the Front End (Fig. 1)

1. Set parking brake and chock both rear tires to prevent the machine from moving.

2. Position jack securely under the frame, just to the inside of the front tire. Jack front wheel off the ground.

3. Once the machine is raised, position suitable jack stand under the frame as close to the wheel as possible to support the machine.

Jacking the Rear End (Fig. 2)

1. Place jack securely under the center of rear axle.

2. Chock both front tires. Jack rear of machine off the ground.

3. Once the machine is raised, use suitable jack stands under the rear axle to support the machine.

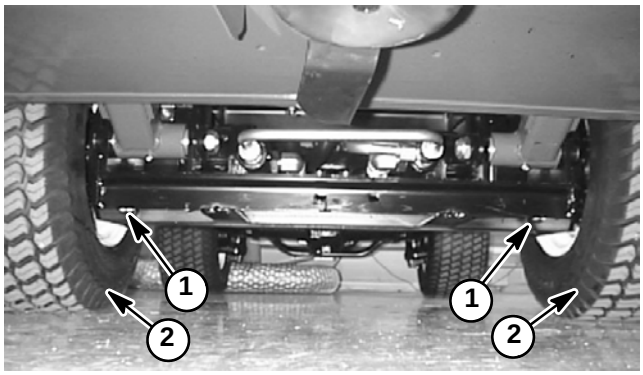

Figure 1

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

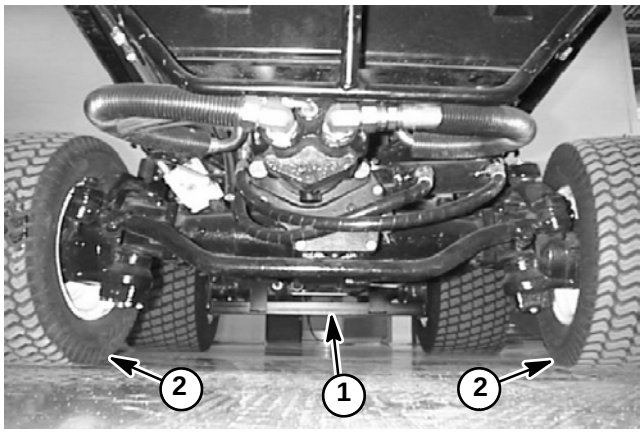

Figure 2

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

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Groundsmaster 4100−D. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog.

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Chapter 2

Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Groundsmaster 4100–D at the end of this chapter. Refer to Operator's Manual for recommended maintenance intervals. Additionally, insert Installation Instructions, Operator's Manuals and Parts Catalogs for any accessories that have been installed on your Groundsmaster at the end of this section.

Maintenance

Maintenance procedures and recommended service intervals for the Groundsmaster 4100–D are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance. Several maintenance procedures have break–in intervals identified in the Operator's Manual. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

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

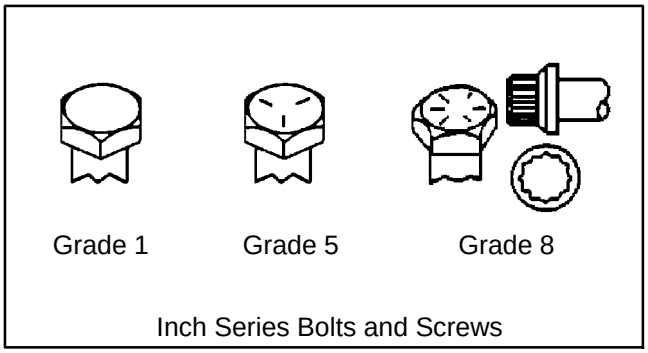

Figure 1

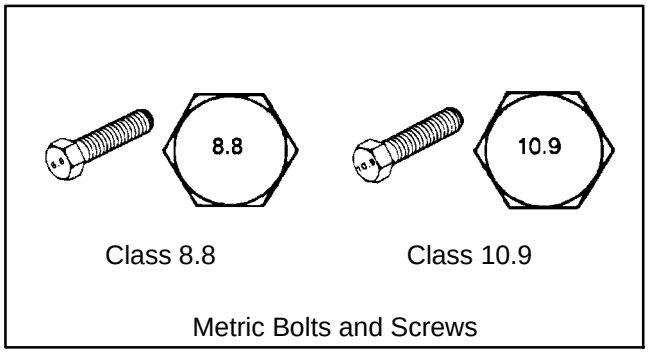

Figure 2

Using a Torque Wrench with an Offset Wrench

Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench calibration due to the effective change of torque wrench length. When using a torque wrench with an offset wrench, multiply the listed torque recommendation by the calculated torque conversion factor (Fig. 3) to determine proper tightening torque. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed torque recommendation.

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

The measured effective length of the torque wrench with the offset wrench installed (distance from the center of the handle to the center of the offset wrench) is 19".

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

If the listed torque recommendation for a fastener is from 76 to 94 ft–lb, the proper torque when using this torque wrench with an offset wrench would be from 72 to 89 ft–lb.

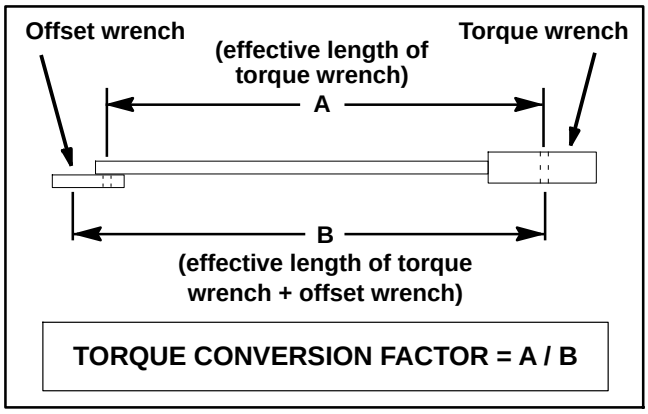

Figure 3

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

Kubota Diesel Engine

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General Information

This Chapter gives information about specifications and repair of the diesel engine used in the Groundsmaster 4100−D.

General maintenance procedures are described in your Operator's Manual. Information on engine troubleshooting, testing, disassembly and reassembly is identified in the Kubota Workshop Manual, Diesel Engine, V2403−M−T−E3B that is included at the end of this section.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual, Diesel Engine, V2403−M−T−E3B. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

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

Operator's Manual

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

Stopping the Engine

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

Specifications

Item	Description
Make / Designation	Kubota Model V2403–M–T–E3B: 4–Cycle, 4 Cylinder, Water Cooled, Turbocharged, Diesel Engine
Bore	3.43” (87.0 mm)
Stroke	4.031” (102.4 mm)
Total Displacement cc (cu. in.)	148.5 in^3 (2434 cc)
Firing Order	1 (closest to gear case end) – 3 – 4 (closest to flywheel end) – 2
Combustion Chamber	Spherical Type (E–TVCS)
Compression Ratio	23.0:1
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Capacity	19.0 U.S. gallons (72 liters)
Fuel Injection Pump	Denso PFR 4M Type Mini Pump
Injection Nozzle	Denso OPD Mini Nozzle
Governor	Centrifugal Mechanical
Low Idle (no load)	1450 $\pm$ 50 RPM
High Idle (no load)	2870 +50/–120 RPM
Engine Oil	API CH–4, CI–4 or higher
Engine Oil Viscosity	See Operator’s Manual
Crankcase Oil Capacity	10.0 U.S. Quarts (9.5 Liters) with Filter
Oil Pump	Trochoid Type
Coolant Capacity	13 U.S. Quarts (12.3 Liters)
Starter	12 VDC, 2.0 kW
Alternator/Regulator Standard Alternator Optional Alternator	12 VDC 40 amp 90 amp
Engine Dry Weight	419 U.S. pounds (190 kg)

Air Filter System

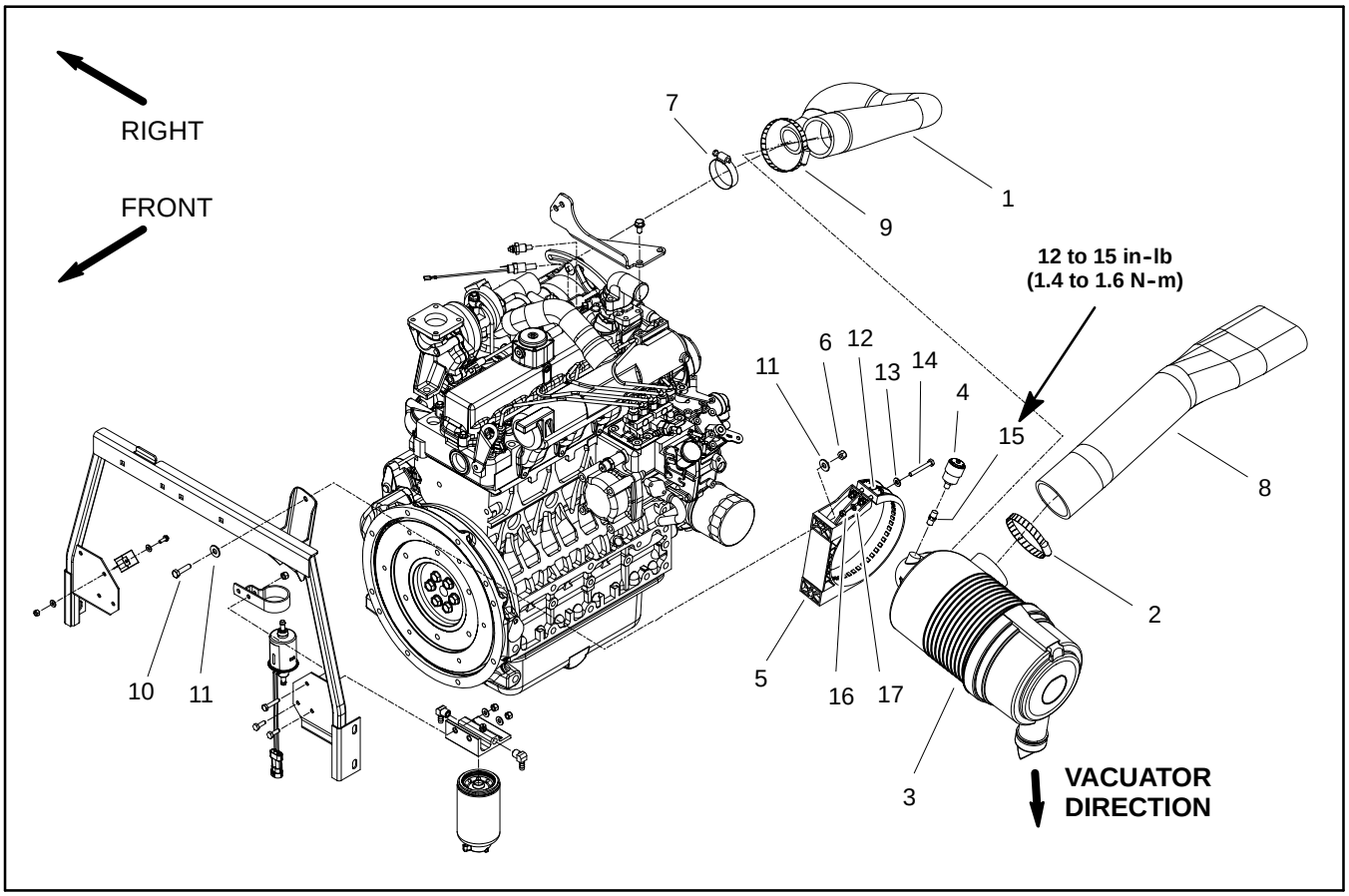

Figure 1

1. **Air cleaner hose**
2. **Hose clamp**
3. **Air cleaner assembly**
4. **Indicator**
5. **Air cleaner strap**
6. **Lock nut (2 used)**
7. **Hose clamp**
8. **Air cleaner hose**
9. **Hose clamp**
10. **Cap screw (2 used)**
11. **Flat washer (4 used)**
12. **Spring (2 used)**
13. **Flat washer (2 used)**
14. **Cap screw (2 used)**
15. **Adapter**
16. **Lock nut (2 used)**
17. **Flat washer (2 used)**

Removal (Fig. 1)

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

2. Raise and support hood.

3. Remove air cleaner components as needed using Figure 1 as a guide.

Installation (Fig. 1)

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 assembly.

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

   A. 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. 3). Torque indicator from **12 to 15 in-lb (1.4 to 1.6 N-m)**.

2. When installing air cleaner hose (8) between air cleaner and turbo-charger (Fig. 4):

   A. Make sure that hose does not contact engine valve cover. To ensure clearance, move and/or rotate air cleaner body in air cleaner strap.

   B. Position hose to allow maximum clearance between air cleaner hose and muffler bracket.

3. Lower and secure hood.

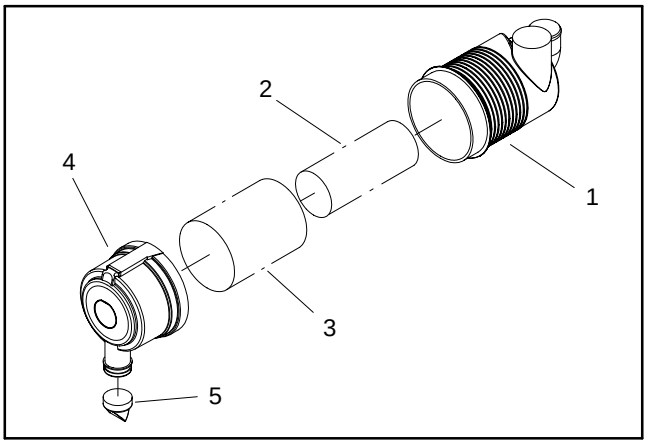

Figure 2

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

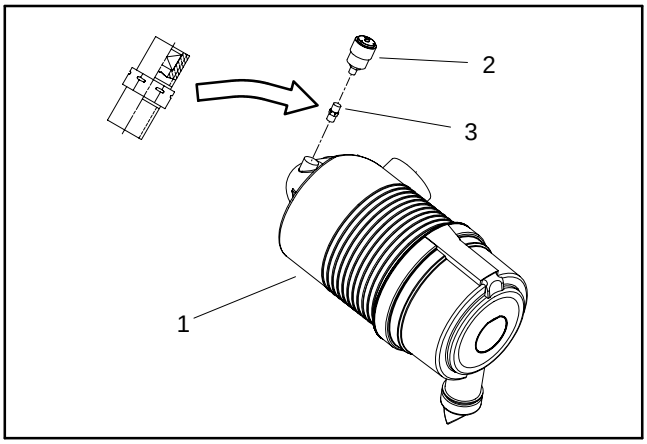

Figure 3

1. **Air cleaner assembly**
2. **Service indicator**
3. **Adapter**

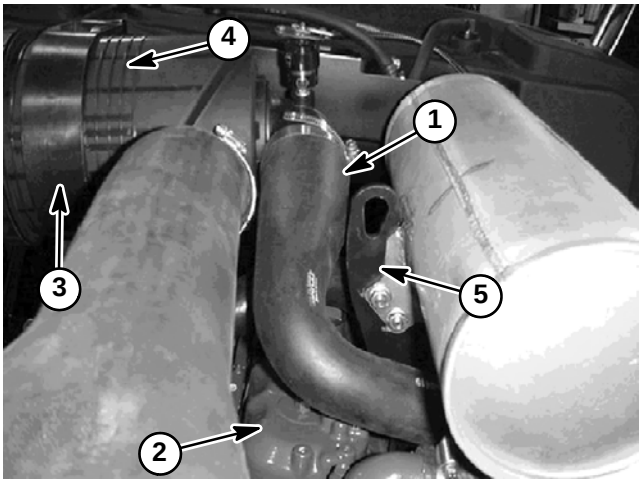

Figure 4

1. **Air cleaner hose**
2. **Engine valve cover**
3. **Air cleaner strap**
4. **Air cleaner slots**
5. **Muffler bracket**

Exhaust System

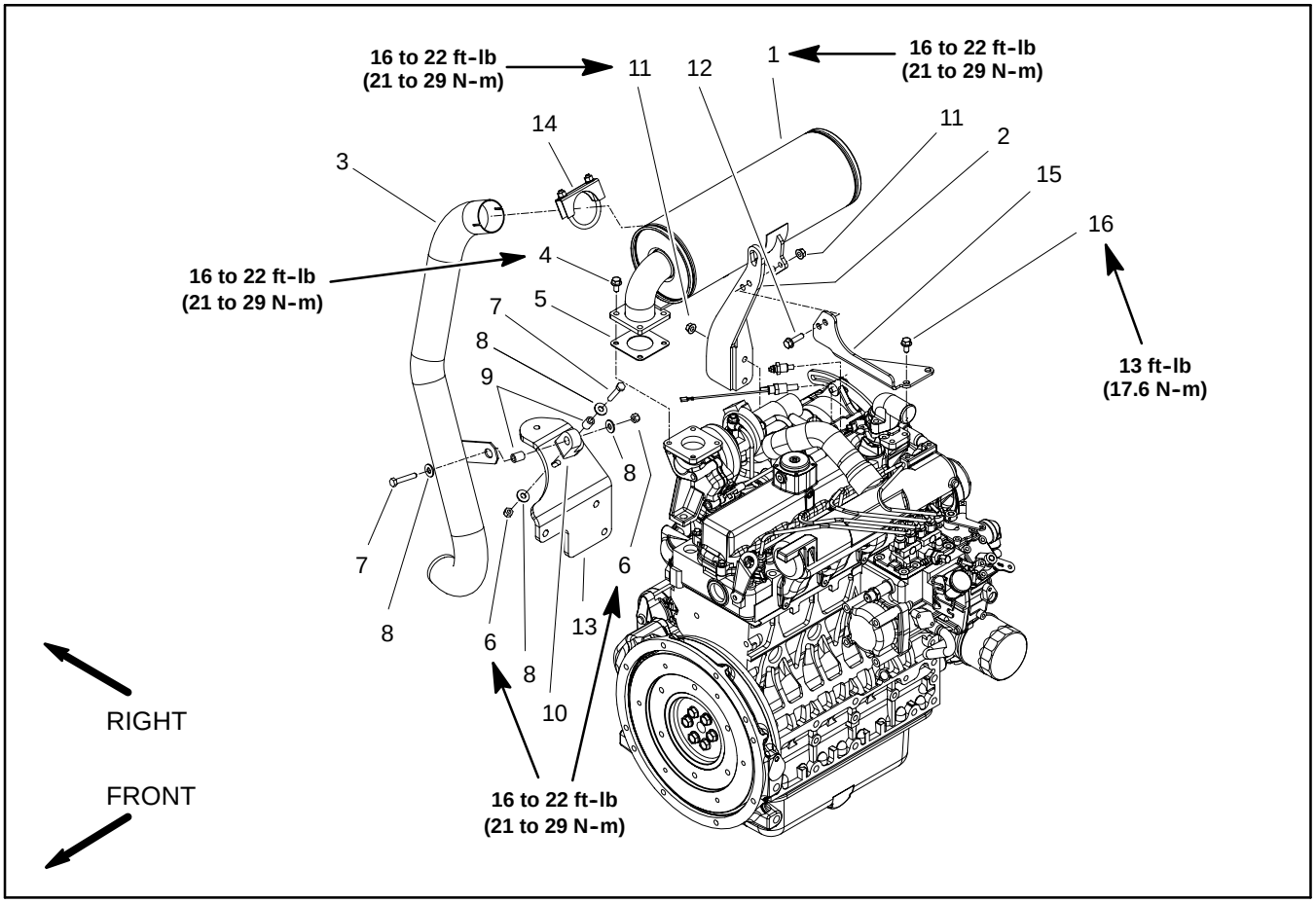

Figure 5

1. **Muffler**
2. **Muffler bracket**
3. **Exhaust pipe**
4. **Flange head screw (4 used)**
5. **Exhaust gasket**
6. **Lock nut (2 used)**
7. **Cap screw (2 used)**
8. **Flat washer (4 used)**
9. **Spacer (2 used)**
10. **Rubber hanger**
11. **Flange nut (4 used)**
12. **Flange head screw (2 used)**
13. **Engine mount**
14. **Muffler clamp**
15. **Exhaust mount**
16. **Flange head screw (2 used)**

Removal (Fig. 5)

CAUTION

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

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

2. Raise and support hood.

3. Remove exhaust system components from the engine as necessary using Figure 5 as a guide.

Installation (Fig. 5)

IMPORTANT: If exhaust studs were removed from engine cylinder head, thoroughly clean threads in head and apply Loctite #277 (or equivalent) to stud threads before installing studs into head.

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** exhaust gasket if original gasket is damaged or torn.

IMPORTANT: Failure to follow the suggested muffler fastener sequence may result in premature muffler failure.

2. Install exhaust system components to the engine using Figure 5 as a guide. Hand tighten exhaust system fasteners and then torque in the sequence shown in Fig. 6 as follows:

A. Torque lock nuts used on rubber hanger cap screws from **16 to 22 ft-lb (21 to 29 N-m)**.

B. Torque flange nuts that secure muffler to muffler bracket from **16 to 22 ft-lb (21 to 29 N-m)**.

C. Torque flange head screws that secure muffler flange to engine from **16 to 22 ft-lb (21 to 29 N-m)**.

D. Torque flange nuts that secure muffler bracket to engine from **16 to 22 ft-lb (21 to 29 N-m)**.

E. Torque flange screws that secure exhaust mount to engine to **13 ft-lb (17.6 N-m)**.

3. Tailpipe should have equal clearance between frame and engine after installation.

4. Lower and secure hood.

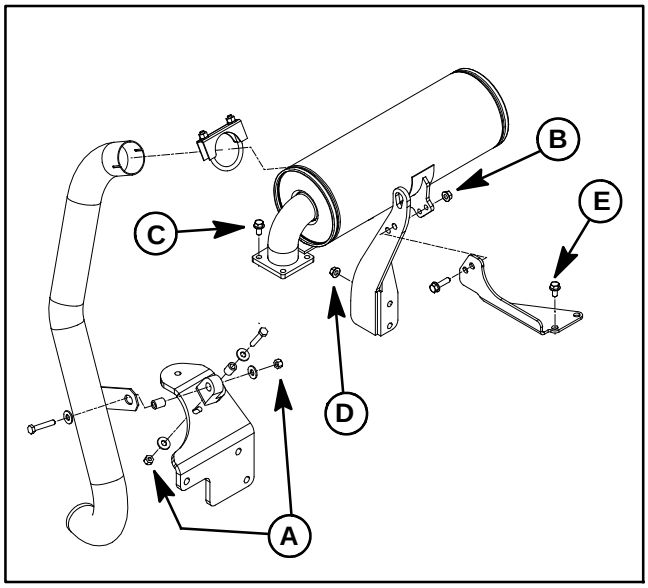

Figure 6

Fuel System

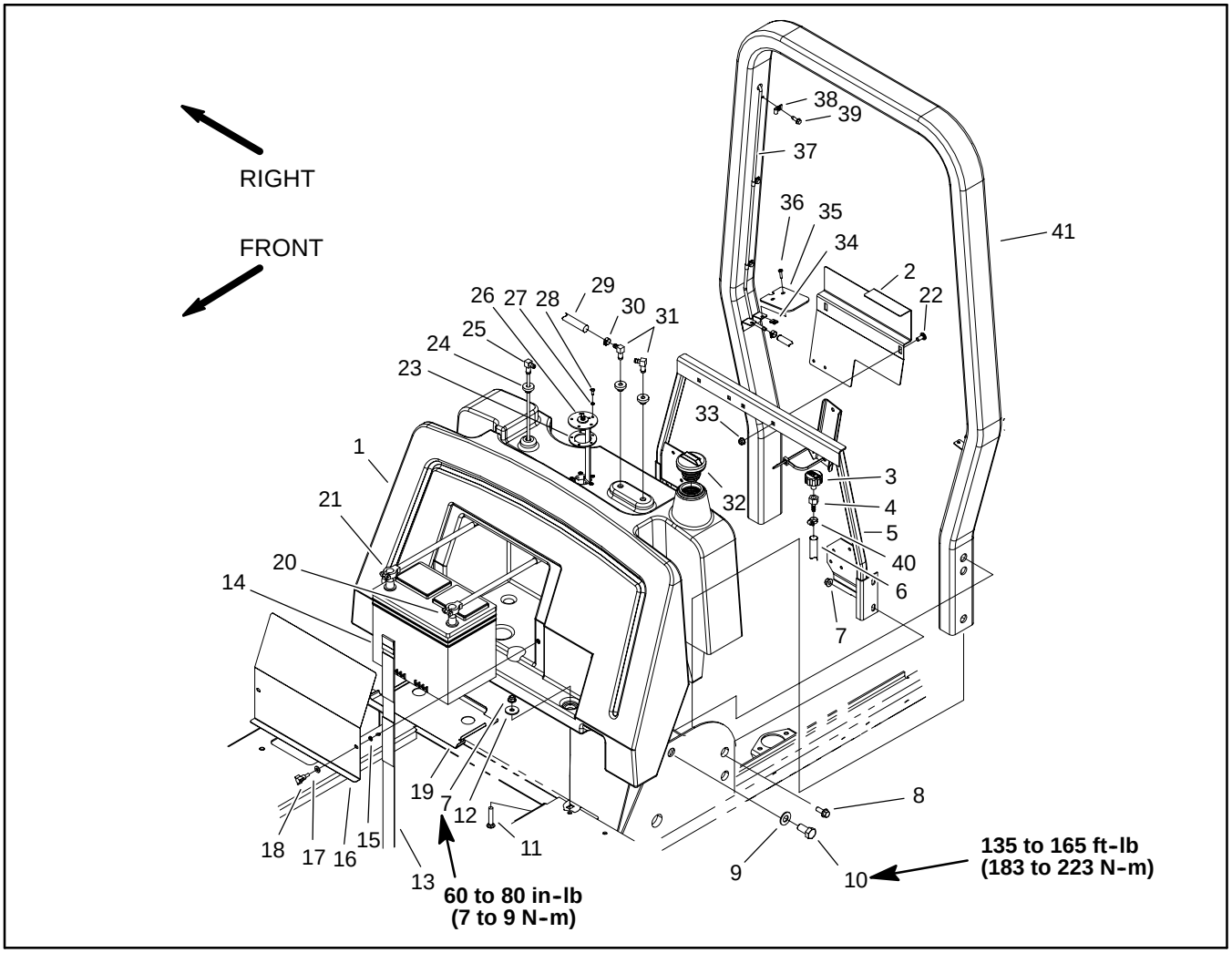

Figure 7

1. **Fuel tank**
2. **Fuel tank bracket**
3. **Air breather**
4. **Female hose barb**
5. **Tank support assembly**
6. **Fuel hose**
7. **Flange nut**
8. **Cap screw (4 used)**
9. **Flat washer**
10. **Cap screw (4 used)**
11. **Carriage screw (2 used)**
12. **Washer**
13. **Battery strap**
14. **Battery**
15. **Retaining ring (2 used)**
16. **Battery cover**
17. **Flat washer (2 used)**
18. **Knob (2 used)**
19. **Battery plate**
20. **Negative battery cable**
21. **Positive battery cable**
22. **Carriage screw (2 used)**
23. **Gasket**
24. **Bushing (3 used)**
25. **Stand pipe**
26. **Fuel sender**
27. **Lock washer (5 used)**
28. **Phillips head screw (5 used)**
29. **Fuel hose**
30. **Hose clamp**
31. **Elbow fitting**
32. **Fuel cap**
33. **Locking flange nut**
34. **Speed nut**
35. **Tank cover (2 used)**
36. **Phillips head screw**
37. **Vent tube**
38. **Insulated clip (3 used)**
39. **Washer head screw (3 used)**
40. **Hose clamp**
41. **ROPS assembly**

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 for the engine 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.

Empty and Clean Fuel Tank

Empty and clean the fuel tank periodically as recommended in the Operator's Manual. Also, empty 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. 7)

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

2. Raise and support seat and hood.

3. Remove battery cover and strap. Disconnect negative battery cable first and then positive battery cable. Remove battery from machine.

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

5. Disconnect electrical wiring from the fuel sender on the fuel tank.

6. Disconnect fuel hose from the standpipe and venting hoses from elbow fittings in top of tank.

7. Remove phillips head screws that secure two (2) tank covers to ROPS assembly. Remove tank covers.

8. Remove fuel tank using Figure 7 as a guide.

Fuel Tank Installation (Fig. 7)

1. Install fuel tank using Figure 7 as a guide.

   A. Torque two (2) flange nuts that secure the fuel tank to the frame from **60 to 80 in-lb (7 to 9 N-m)**.

2. Install two (2) tank covers to ROPS assembly.

3. Connect fuel hose to the standpipe and venting hoses to the elbow fittings.

4. Connect electrical wiring to the fuel sender.

   A. Connect white 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 to the wire terminal connections.

CAUTION

Connecting battery cables to the wrong battery post could result in personal injury and/or damage to the electrical system.

5. Position battery in machine. Connect positive battery cable first and then negative battery cable. Install battery strap and cover.

6. Lower seat and hood.

7. Fill fuel tank.

Radiator

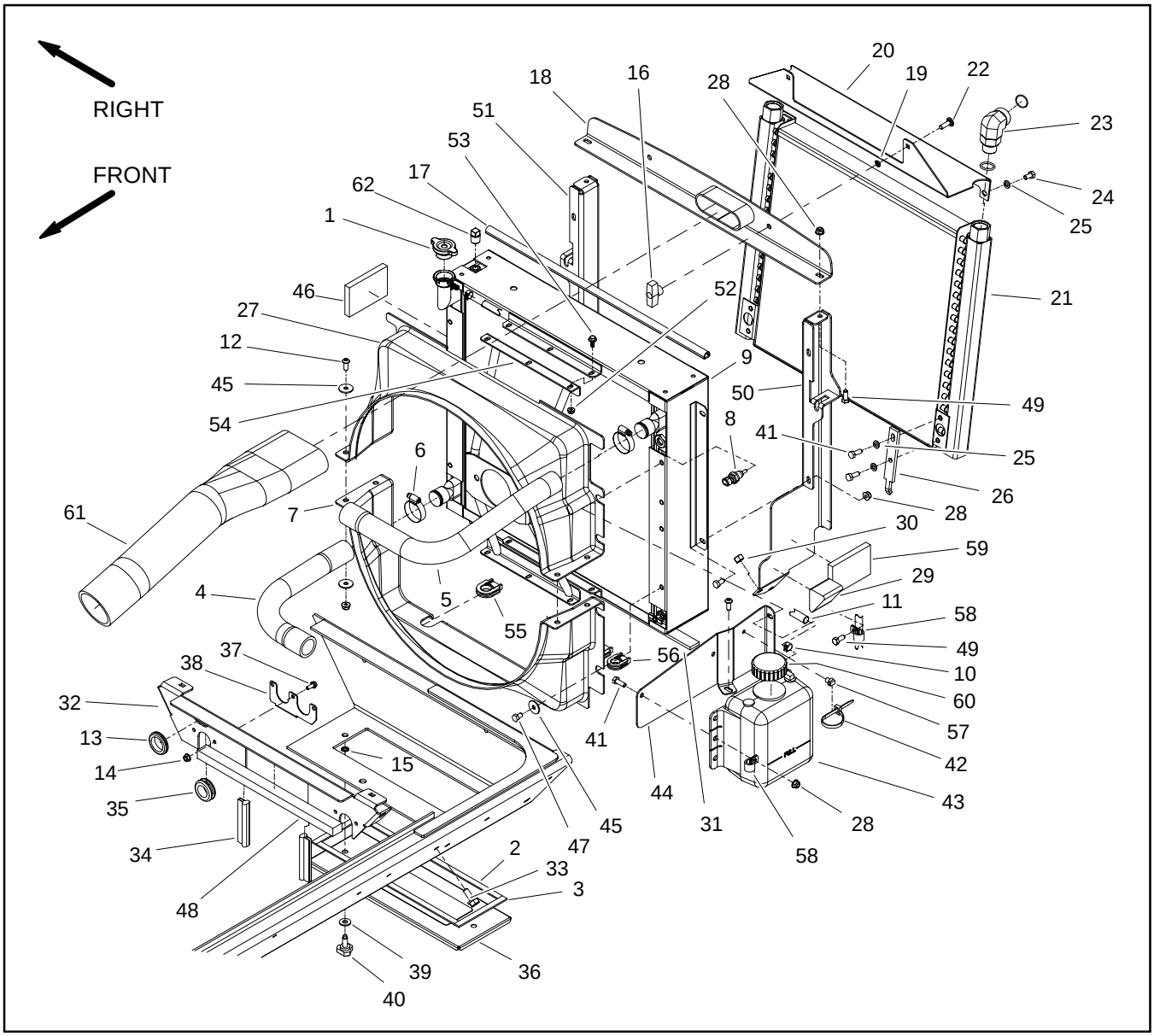

Figure 8

1. Radiator cap
2. Foam strip (2 used)
3. Foam strip (2 used)
4. Lower radiator hose
5. Upper radiator hose
6. Clamp (4 used)
7. Lower radiator shroud
8. Temperature sender
9. Radiator
10. Hose clamp (3 used)
11. Hose (2 used)
12. Screw (4 used)
13. Rubber grommet
14. Flange nut (4 used)
15. Retaining ring (2 used)
16. Knob (2 used)
17. Bulb seal
18. Top radiator support
19. Retaining ring (2 used)
20. Oil cooler bracket
21. Oil cooler
22. Carriage screw (2 used)
23. 90º hydraulic fitting (2 used)
24. Cap screw (6 used)
25. Lock washer (6 used)
26. Oil cooler mount plate (2 used)
27. Upper radiator shroud
28. Flange nut (10 used)
29. Foam plug (2 used)
30. Lock nut (6 used)
31. Foam strip
32. Base bracket
33. Flange head screw (6 used)
34. Bulb seal (2 used)
35. Grommet (2 used)
36. Cover
37. Flange head screw (4 used)
38. Plate (2 used)
39. Flat washer (2 used)
40. Knob (2 used)
41. Cap screw (6 used)
42. Cable tie
43. Coolant reservoir
44. Tank bracket
45. Flat washer (10 used)
46. Foam pad
47. Cap screw (7 used)
48. Foam seal
49. Cap screw (3 used)
50. LH radiator support
51. RH radiator support
52. Flange nut (6 used)
53. Cap screw (6 used)
54. Fan motor bracket
55. Grommet (2 used)
56. Grommet
57. Harness clip
58. R-clamp (2 used)
59. Foam pad
60. Reservoir cap
61. Air cleaner hose
62. Plug

Removal (Fig. 8)

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

2. Open and support hood.

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 radiator into a suitable container using the radiator drain. The radiator drain hose is located near the engine oil filter.

4. Disconnect upper and lower radiator hoses from the radiator.

5. Remove air cleaner hose (item 61).

6. Disconnect reservoir hose from the vent tube near the radiator cap.

7. Detach upper radiator shroud from the radiator and lower radiator shroud. Remove upper shroud from machine.

8. Remove fasteners that secure lower radiator shroud to radiator.

9. Remove six (6) flange head screws and flange nuts that secure fan motor bracket to radiator.

10. Position lower radiator shroud and fan motor bracket assembly away from radiator.

11. Remove cap screws and flange nuts securing the radiator to the support frame. Carefully pull radiator from the machine.

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

Installation (Fig. 8)

1. Remove all plugs placed during the removal procedure.

2. Carefully position radiator to the support frame. Secure radiator to the support frame with cap screws and flange nuts.

3. Position lower radiator shroud and fan motor bracket assembly to the radiator.

4. Secure fan motor bracket to radiator with six (6) flange head screws and flange nuts.

5. Position upper radiator shroud to lower radiator shroud to radiator. Secure shrouds with removed fasteners.

6. Attach radiator shroud assembly to the radiator with cap screws and flat washers. Make sure that clearance between shroud and cooling fan is at least 0.180” (4.6 mm) at all points.

7. Connect reservoir hose to the vent tube near the radiator cap.

8. Connect upper and lower radiator hoses to the radiator.

9. Reinstall air cleaner hose (item 61).

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

11. Close and secure hood.

Engine

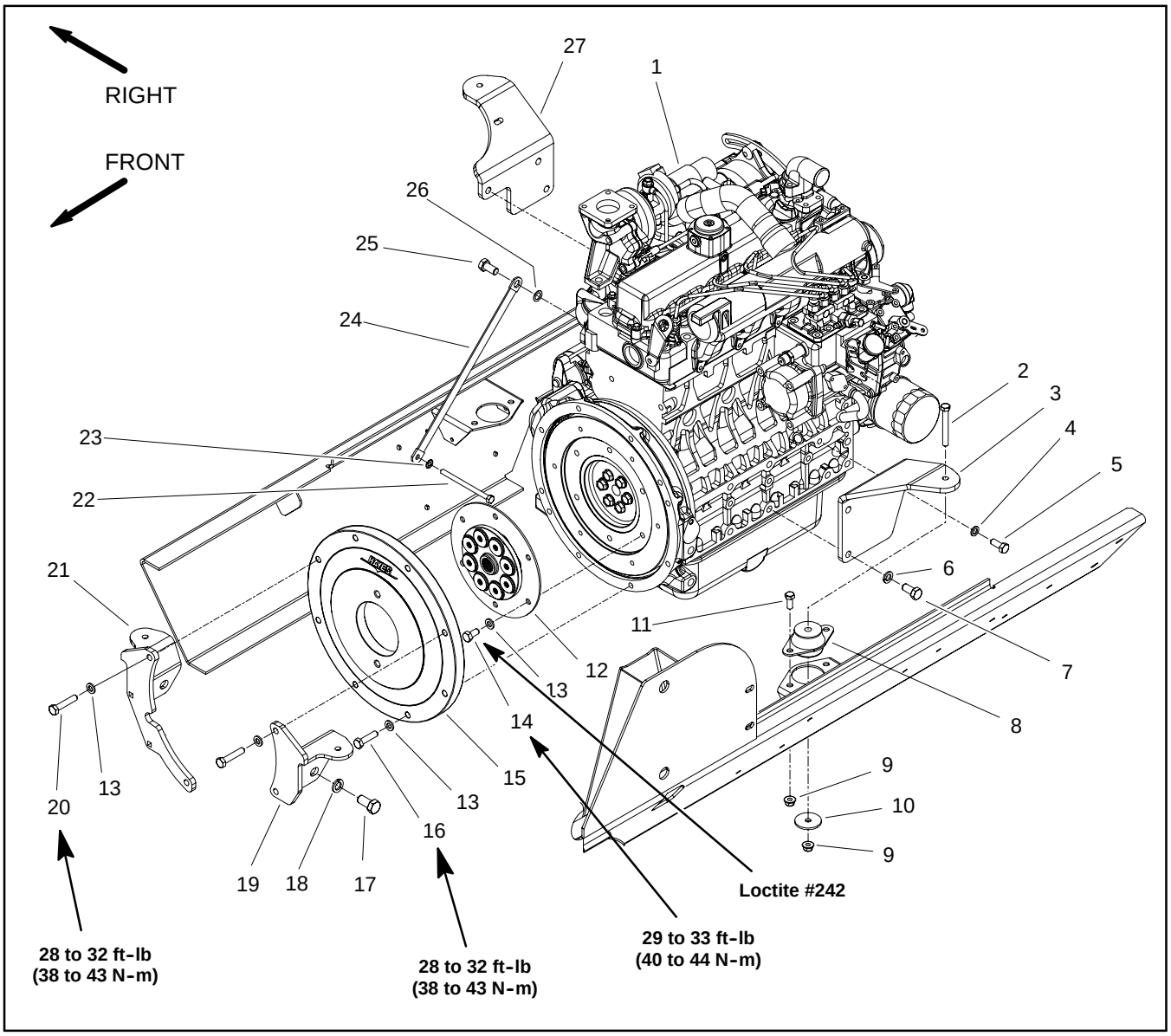

Figure 9

1. **Engine**
2. **Cap screw (4 used)**
3. **LH engine mount**
4. **Lock washer**
5. **Cap screw**
6. **Lock washer (5 used)**
7. **Cap screw (5 used)**
8. **Engine support (4 used)**
9. **Flange nut (12 used)**
10. **Rebound washer (4 used)**
11. **Cap screw (8 used)**
12. **Spring coupler**
13. **Washer (14 used)**
14. **Cap screw (6 used)**
15. **Flywheel plate**
16. **Cap screw (4 used)**
17. **Cap screw (2 used)**
18. **Lock washer (2 used)**
19. **LH engine mount**
20. **Cap screw (4 used)**
21. **RH engine mount**
22. **Cap screw (PTO manifold)**
23. **Lock washer**
24. **Ground cable**
25. **Cap screw**
26. **Lock washer**
27. **RH engine mount**

Engine Removal (Fig. 9)

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

2. Remove battery cover and strap. Disconnect negative battery cable first and then positive battery cable. Remove battery from machine.

3. Open and support hood.

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.

4. Drain coolant from the radiator into a suitable container (see Radiator Removal in this section). Disconnect upper and lower 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.

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

6. Remove air cleaner system from engine (see Air Filter System Removal in this section).

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

A. The dual temperature switch, temperature sender and alternator (Fig 10).

B. The glow plug lead (Fig. 11).

C. The engine run solenoid (Fig. 12).

D. Battery, frame and wire harness ground at the engine block.

E. The electric starter and low oil pressure switch (on RH side of engine).

8. Disconnect fuel supply hose from injection pump (Fig. 13).

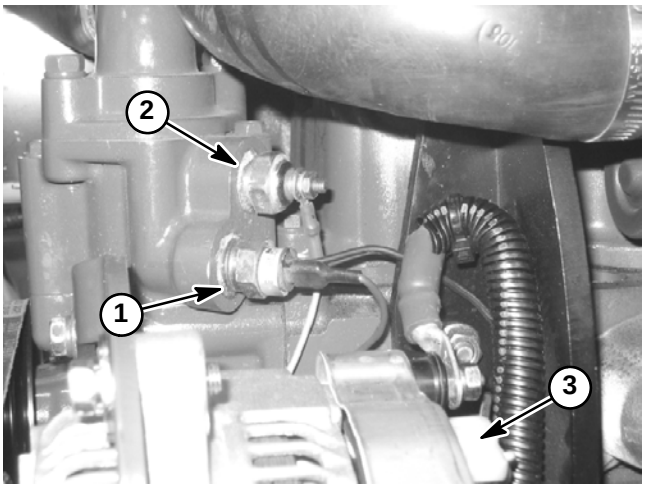

Figure 10

1. **Dual temperature switch**
2. **Temperature sender**
3. **Alternator**

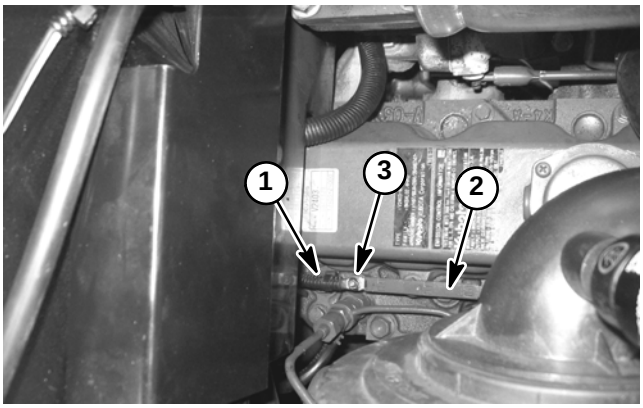

Figure 11

1. **Glow plug wire**
2. **Glow plug lead**
3. **Cylinder #4 glow plug**

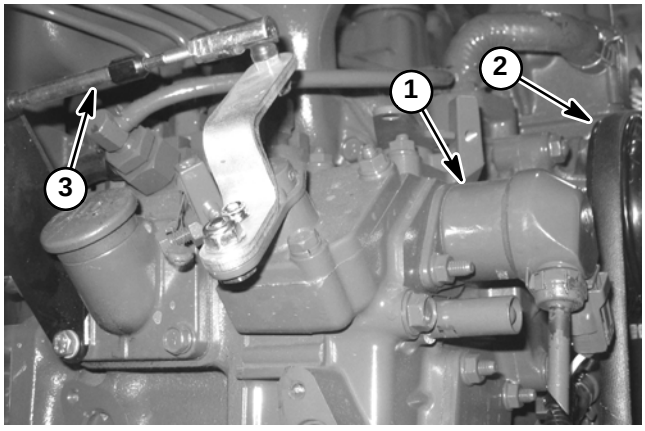

Figure 12

1. **Engine run solenoid**
2. **Alternator belt**
3. **Throttle cable**

9. Disconnect throttle cable from the speed control lever by removing the flat washer and lock nut (Fig. 14). Loosen jam nut and separate cable from cable support. Position cable away from engine.

10. Remove fasteners that secure the upper radiator shroud to the lower shroud and radiator (see Radiator Removal in this section). Position coolant reservoir and bracket away from the radiator. Remove upper radiator shroud from machine.

11. Remove fan hub and fan from hydraulic fan motor (Fig. 15).

A. Remove hex nut (item 9) and washer (item 8) that secure fan hub and fan assembly to fan motor.

NOTE: The fan motor shaft is tapered.

B. Use suitable puller to remove fan hub (with fan attached) from fan motor shaft taking care to not damage fan. Remove fan hub and fan from machine.

IMPORTANT: The hydraulic pump assembly can remain in machine during engine removal. To prevent pump from shifting or falling, make sure to support pump assembly before mounting fasteners are removed.

12. Support hydraulic pump assembly. Remove fasteners that secure pump assembly to engine (see Pump Assembly Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

13. Make sure all cable ties securing the wiring harness, fuel lines or hydraulic hoses to the engine are removed.

14. Connect hoist or lift to the lift tabs on engine.

15. Remove flange nuts, rebound washers and cap screws securing the engine mounts to the engine supports.

CAUTION

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

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

16. Slowly remove engine assembly from the machine.

17. If necessary, remove engine mounts from the engine using Figure 9 as a guide.

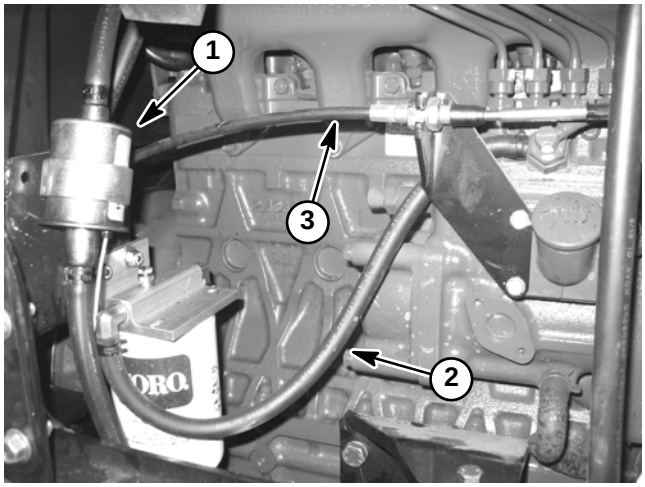

Figure 13

1. **Fuel pump**
2. **Fuel supply hose**
3. **Throttle cable**

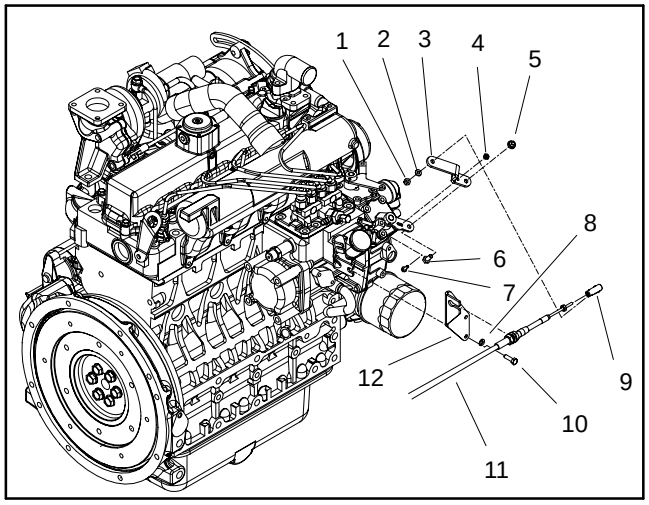

Figure 14

1. **Lock nut**
2. **Flat washer**
3. **Throttle lever**
4. **Lock nut**
5. **Flange head screw**
6. **Cap screw**
7. **Flange head screw**
8. **Spring washer (2 used)**
9. **Ball joint**
10. **Cap screw (2 used)**
11. **Throttle cable**
12. **Cable support**

Engine Installation (Fig. 9)

1. If removed, install engine mounts to the engine using Figure 9 as a guide.

2. Connect hoist or lift to the engine lift tabs.

CAUTION

One person should operate lift or hoist while another 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.

3. Slowly lower engine into the machine.

4. Align engine to the engine supports and hydraulic pump input shaft. Secure engine to engine supports with cap screws, rebound washers and flange nuts.

5. Secure hydraulic pump assembly to engine (see Pump Assembly Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Thoroughly clean tapered surfaces of fan motor shaft and fan hub. Position fan hub (with fan attached) onto motor shaft and secure with washer and hex nut (Fig. 15). Torque nut from **27 to 33 ft-lb (37 to 44 N-m)**.

7. Position upper radiator shroud and coolant reservoir with bracket to the radiator. Secure shroud and reservoir bracket to the radiator and lower radiator bracket with removed fasteners (see Radiator Installation in this section). Make sure that clearance between shroud and fan is at least 0.180" (4.6 mm) at all points.

8. Connect throttle cable to the speed control lever with washer and lock nut (Fig. 14). Secure cable to cable support. Adjust throttle cable.

9. Connect fuel line to the injection pump.

10. Connect wires and/or electrical connections to the following electrical components:

A. The dual temperature switch, temperature sender and alternator (Fig 10).

B. The engine run solenoid and fuel pump (Fig. 13).

C. The glow plug (Fig. 11).

D. Battery, frame and wire harness ground to the engine block.

E. The starter and low oil pressure switch (near starter).

11. Install air cleaner assembly to the engine (see Air Filter System Installation in this section).

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

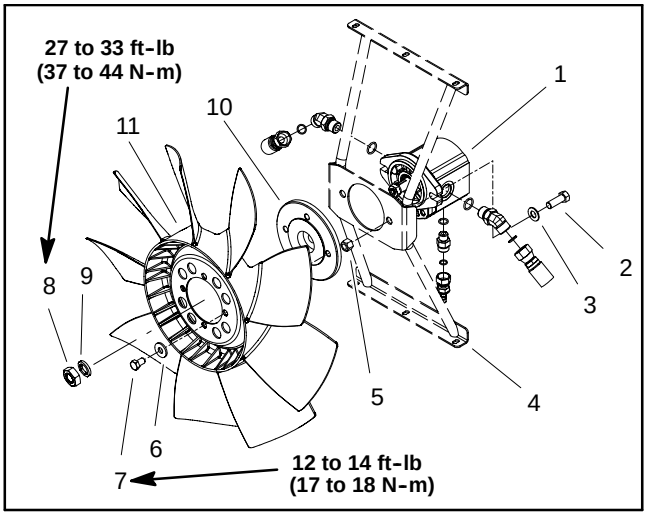

Figure 15

1. **Fan motor**
2. **Cap screw (2 used)**
3. **Flat washer (2 used)**
4. **Fan motor bracket**
5. **Lock nut (2 used)**
6. **Washer (4 used)**
7. **Cap screw (4 used)**
8. **Hex nut**
9. **Washer**
10. **Fan hub**
11. **Fan**

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

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

15. Position battery to machine. Connect positive battery cable first and then negative battery cable. Secure battery to machine with strap and cover.

16. Check and adjust engine oil as needed.

17. Check and adjust hydraulic oil as needed.

18. Bleed fuel system.

19. Start engine and operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in Chapter 4 – Hydraulic System).

20. Close and secure hood.

Spring Coupler

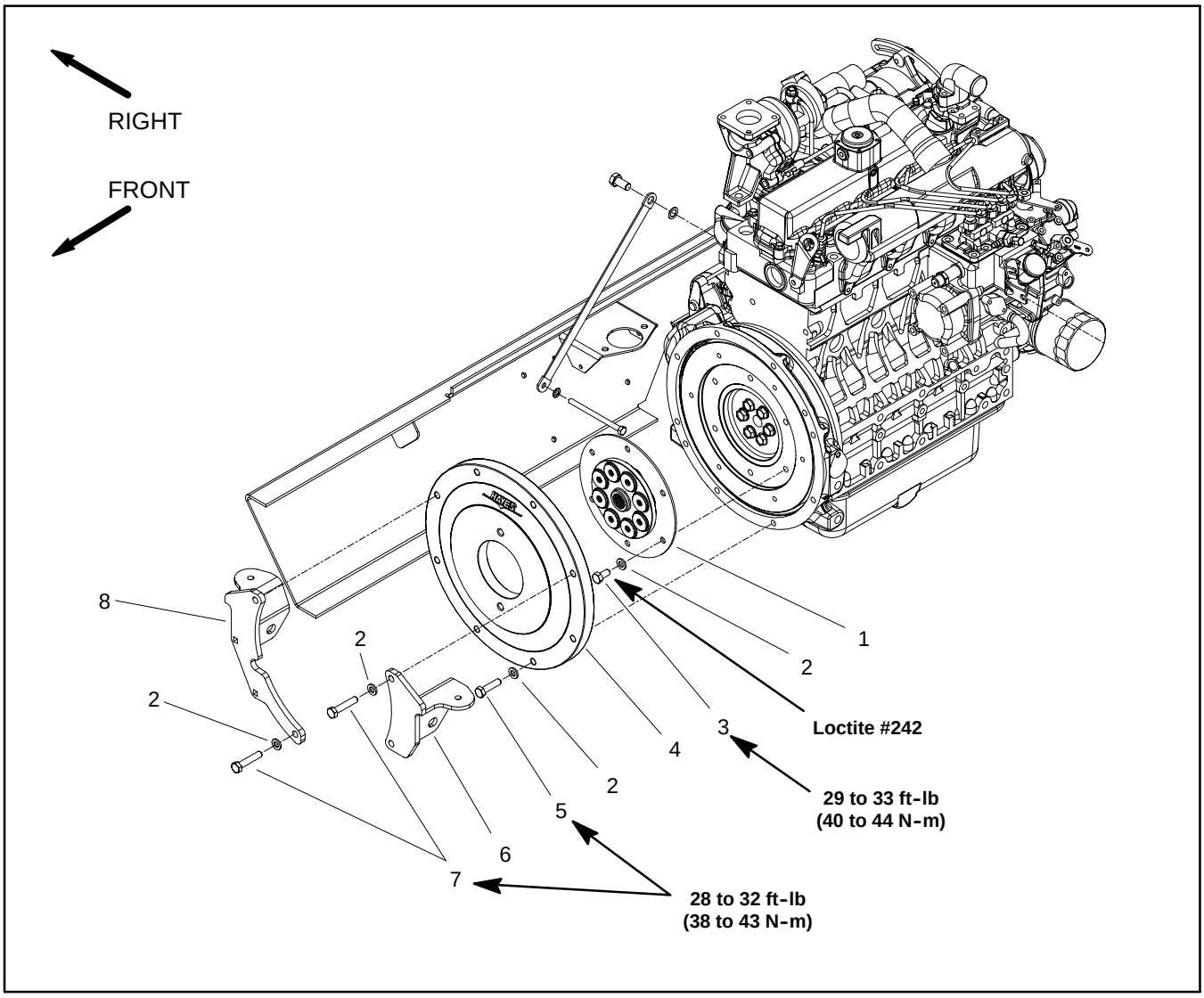

Figure 16

1. **Spring coupler**
2. **Washer (14 used)**
3. **Cap screw (6 used)**
4. **Flywheel plate**
5. **Cap screw (4 used)**
6. **LH engine mount**
7. **Cap screw (2 used)**
8. **RH engine mount**

Coupler Removal (Fig. 16)

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

1. If engine is in machine, support engine from below to prevent it from shifting while removing hydraulic pump assembly (see Piston (Traction) Pump Removal in the Service and Repairs section of Chapter 4 – Hydraulic System), transport cylinder assembly, flywheel plate, engine mounts and spring coupler.

2. Remove flywheel plate and spring coupler from engine using Figure 16 as a guide.

Coupler Installation (Fig. 16)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupler hub is away from engine flywheel (Fig. 17).

2. Apply Loctite #242 (or equivalent) to threads of cap screws (item 3). Secure coupler to flywheel with six (6) cap screws and washers. Torque cap screws in a crossing pattern from **29 to 33 ft-lb (40 to 44 N-m)**.

3. Position flywheel plate to engine and engine mounts. Secure flywheel plate and mounts with cap screws (items 5 and 7) and washers using a crossing pattern tightening procedure. Torque cap screws in a crossing pattern from **28 to 32 ft-lb (38 to 43 N-m)**.

4. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

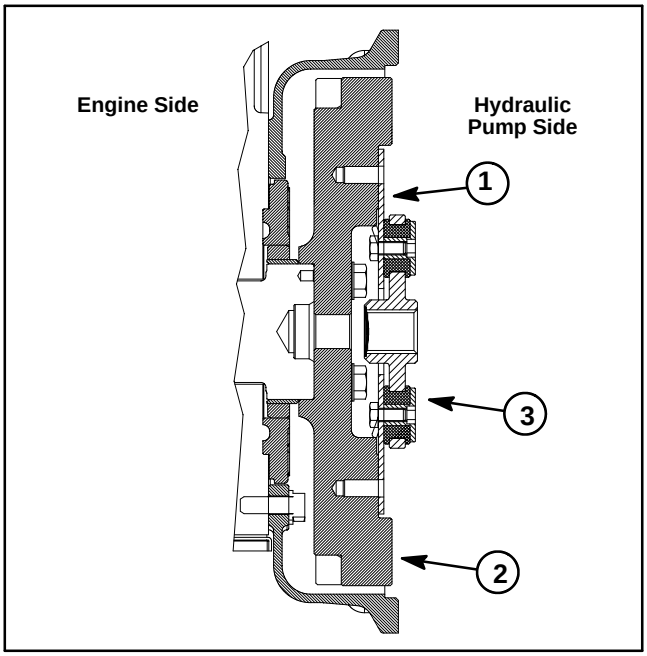

Figure 17

1. **Spring coupler**
2. **Engine flywheel**
3. **Coupler hub**

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Chapter 4

Hydraulic System

Table of Contents

Specifications

Item	Description
Piston (Traction) Pump System Relief Pressure: Forward System Relief Pressure: Reverse Charge Pressure	Eaton Variable Displacement Piston Pump (Model 72400) 4000 PSI (274 bar) 5000 PSI (343 bar) 250 PSI (17 bar)
Front Wheel Motors	Eaton Fixed Displacement Piston Motors (Model 74328)
Rear Axle Motor	Eaton Fixed Displacement Piston Motor (Model 74315)
Gear Pump Section P1/P2 Displacement (per revolution) Section P3/P4 Displacement (per revolution)	Casappa 4 section, positive displacement gear type pump 1.37 Cubic Inches (22.46 cc) 0.56 Cubic Inches (9.16 cc)
Steering Control Valve	Eaton Steering Unit, Series 5
Steering Relief Pressure	1350 PSI (93 bar)
Lift/Lower Relief Pressure	2525 PSI (174 bar)
Cutting Deck Motors	Sauer Danfoss Gear Motor
Cutting Deck Circuit Relief Pressure Center and Left Side Right Side	 3000 PSI (207 bar) 2000 PSI (137 bar)
Engine Cooling Fan Motor Displacement (per revolution)	Casappa Gear Motor 0.50 Cubic Inches (8.3 cc)
Engine Cooling Fan Circuit Relief Pressure	3000 PSI (207 bar)
Hydraulic Filters In–line Suction Strainer	Spin–on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir	8 U.S. Gallons (30.3 Liters)
Hydraulic Oil	See Operator’s Manual

General Information

Operator's Manual

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

Towing Traction Unit

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

If it becomes necessary to tow (or push) the machine, tow (or push) in a **forward direction only** and at a speed **below 3 mph**. The piston (traction) pump is equipped with a by−pass valve that needs to be turned 90º for towing. See Operator's Manual for Towing Procedures.

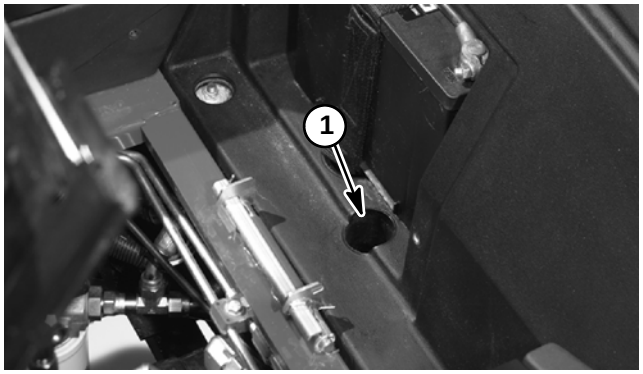


Figure 1

1. **By−pass valve location**

Check Hydraulic Fluid

The Groundsmaster 4100−D hydraulic system is designed to operate on anti−wear hydraulic fluid. The reservoir holds approximately 8 gallons (30.3 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

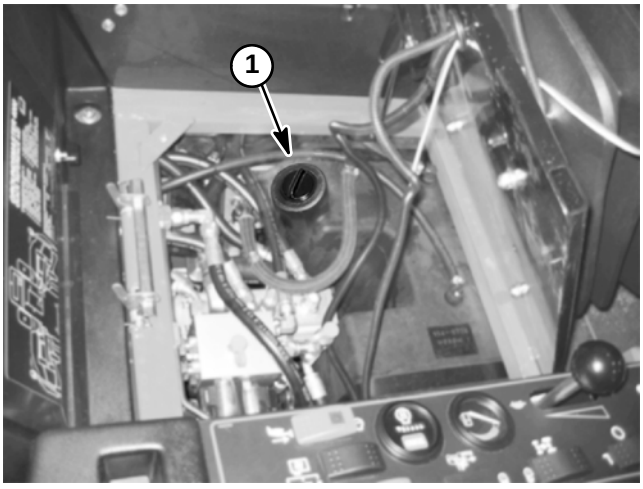


Figure 2

1. **Hydraulic reservoir cap**

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 5. 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

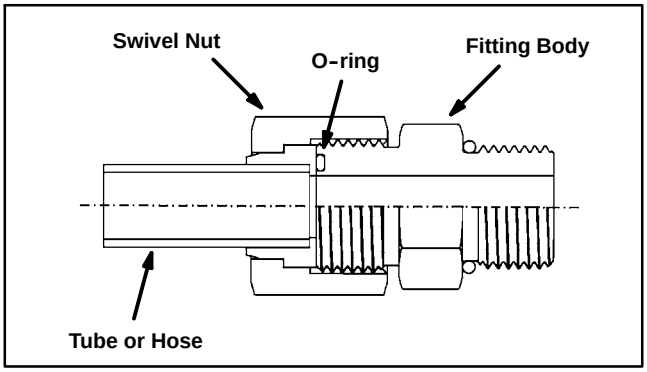


Figure 3

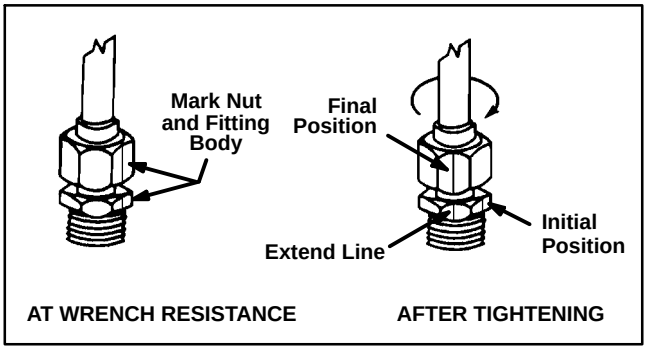


Figure 4

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 5

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

Non-Adjustable Fitting (Fig. 6)

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 7.

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

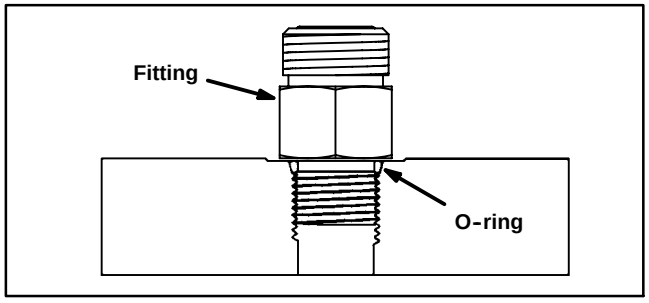


Figure 6

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 7

Adjustable Fitting (Fig. 8)

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 9).

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 7. 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

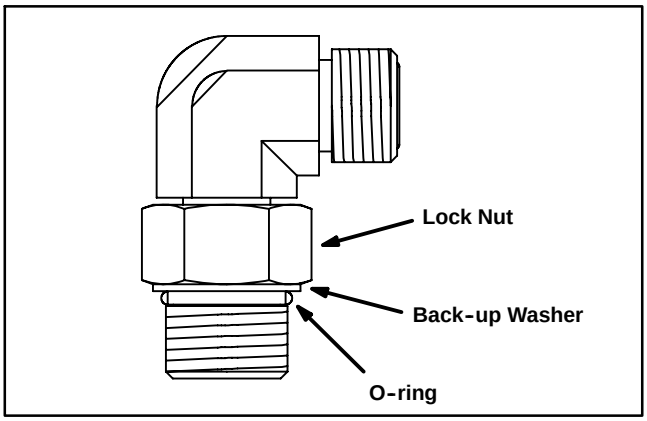


Figure 8

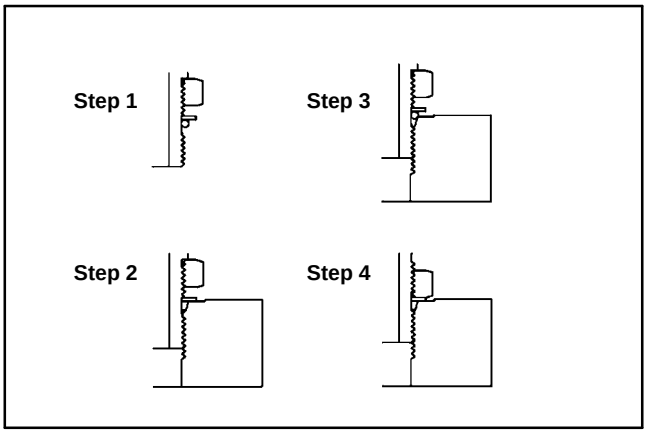
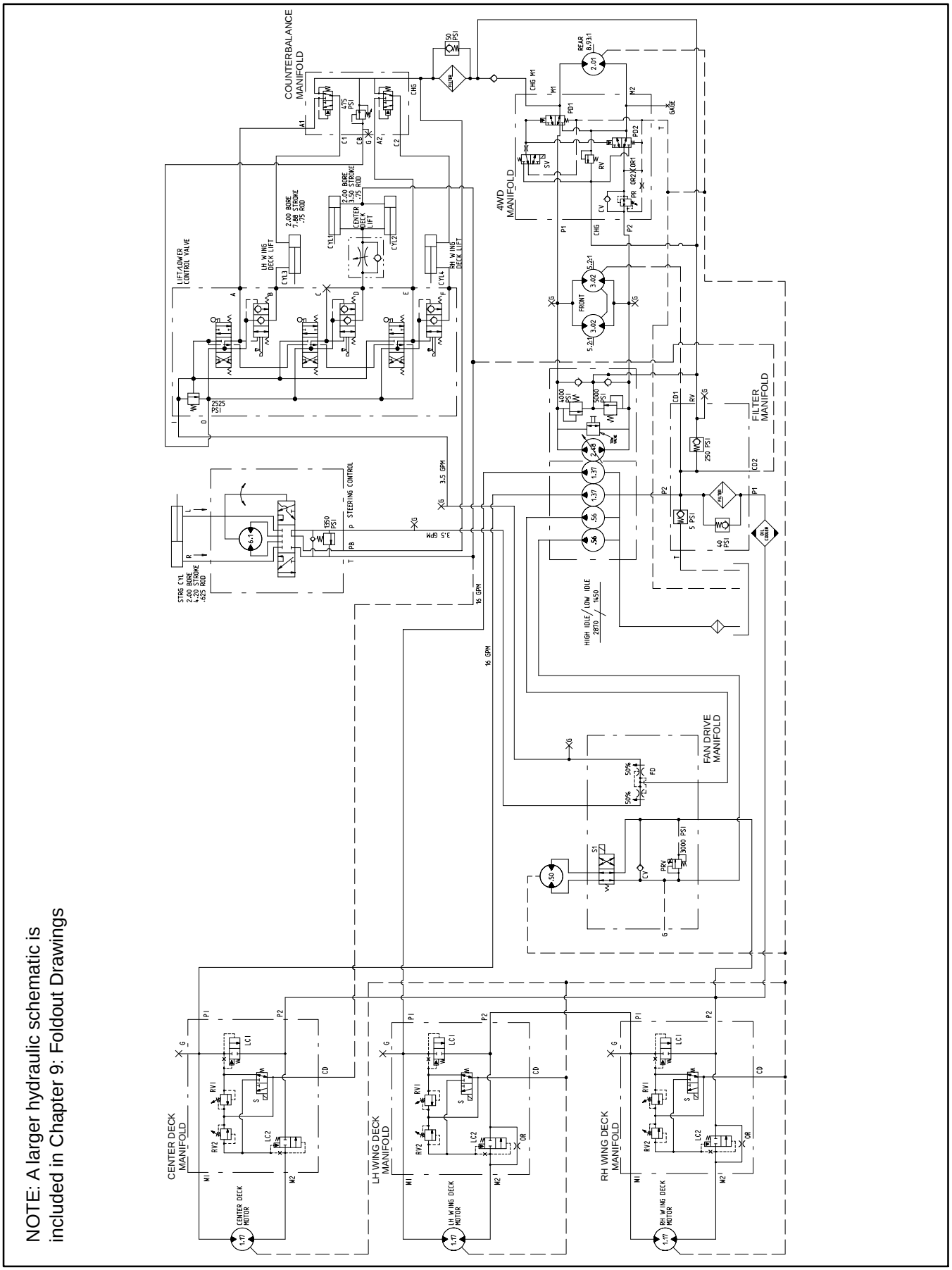


Figure 9

Hydraulic Schematic



NOTE: A larger hydraulic schematic is included in Chapter 9: Foldout Drawings

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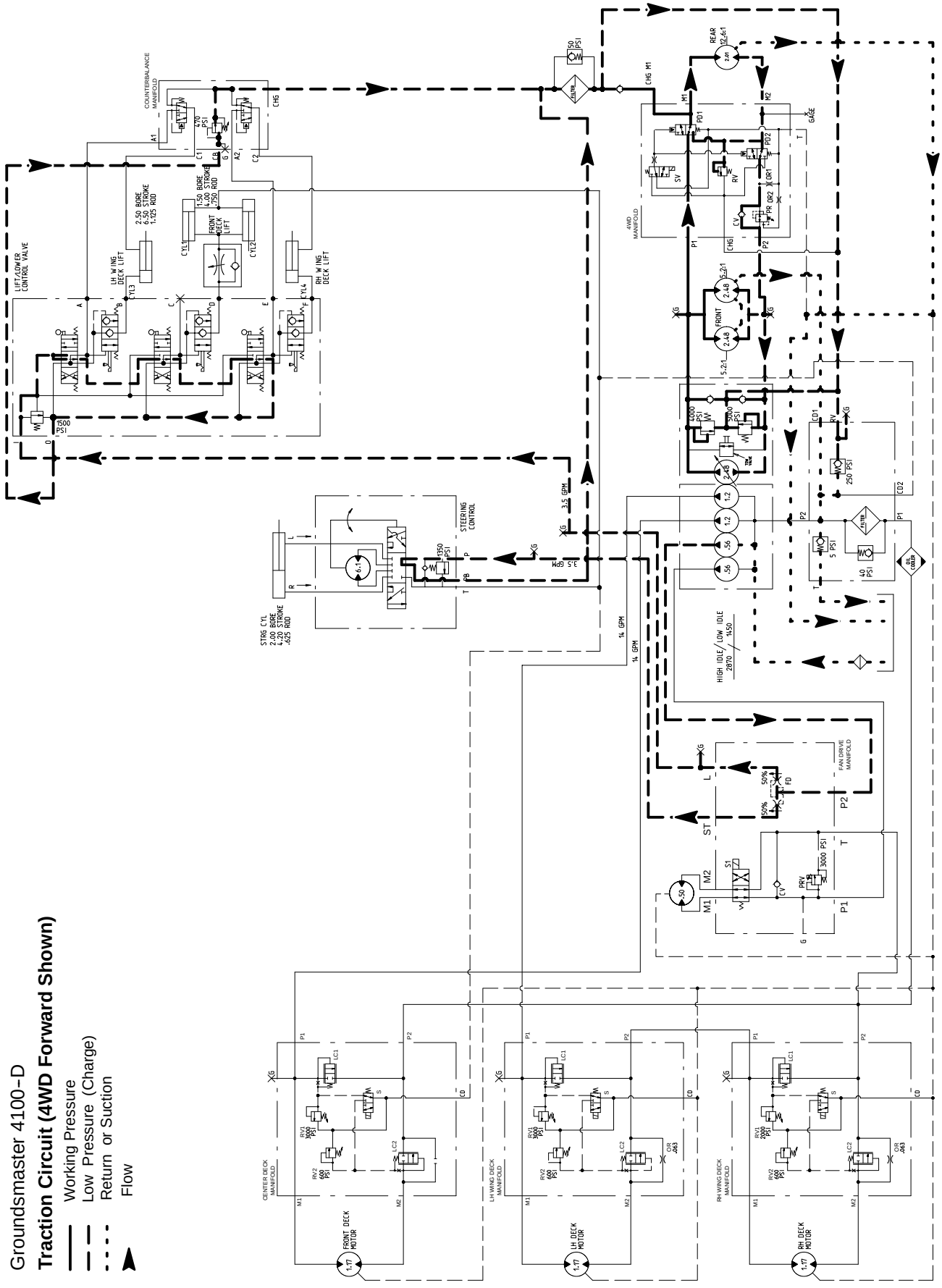
Hydraulic Flow Diagrams



Traction Circuit: 4WD (Mow)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. This oil is directed to the front wheel and rear axle motors. Operating pressure on the high pressure side of the closed traction circuit loop is determined by the amount of load developed at the fixed displacement wheel and axle motors. As the load increases, circuit pressure can increase to relief valve settings: 4000 PSI (274 bar) in forward and 5000 PSI (343 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. The traction circuit provides operation in either 4WD (mow) or transport (2WD).

Traction circuit pressure (forward and reverse) can be measured at test ports on the sides of the machine.

The traction circuit pump and motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the 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 that supplies oil to the steering and lift/lower circuits also provides oil for the charge circuit. This gear pump is driven directly off the traction pump. It provides a constant supply of charge oil to make up for oil that is lost due to internal leakage in the traction pump and motors.

Pump flow for the charge circuit is directed through the oil filter and to the low pressure side of the closed loop traction circuit. A filter bypass valve allows charge oil flow to the closed loop if the filter becomes plugged. Charge pressure is limited to 250 PSI (17 bar) by a relief valve located in the oil filter manifold. Charge pressure can be measured at the charge circuit pressure test port on the oil filter manifold.

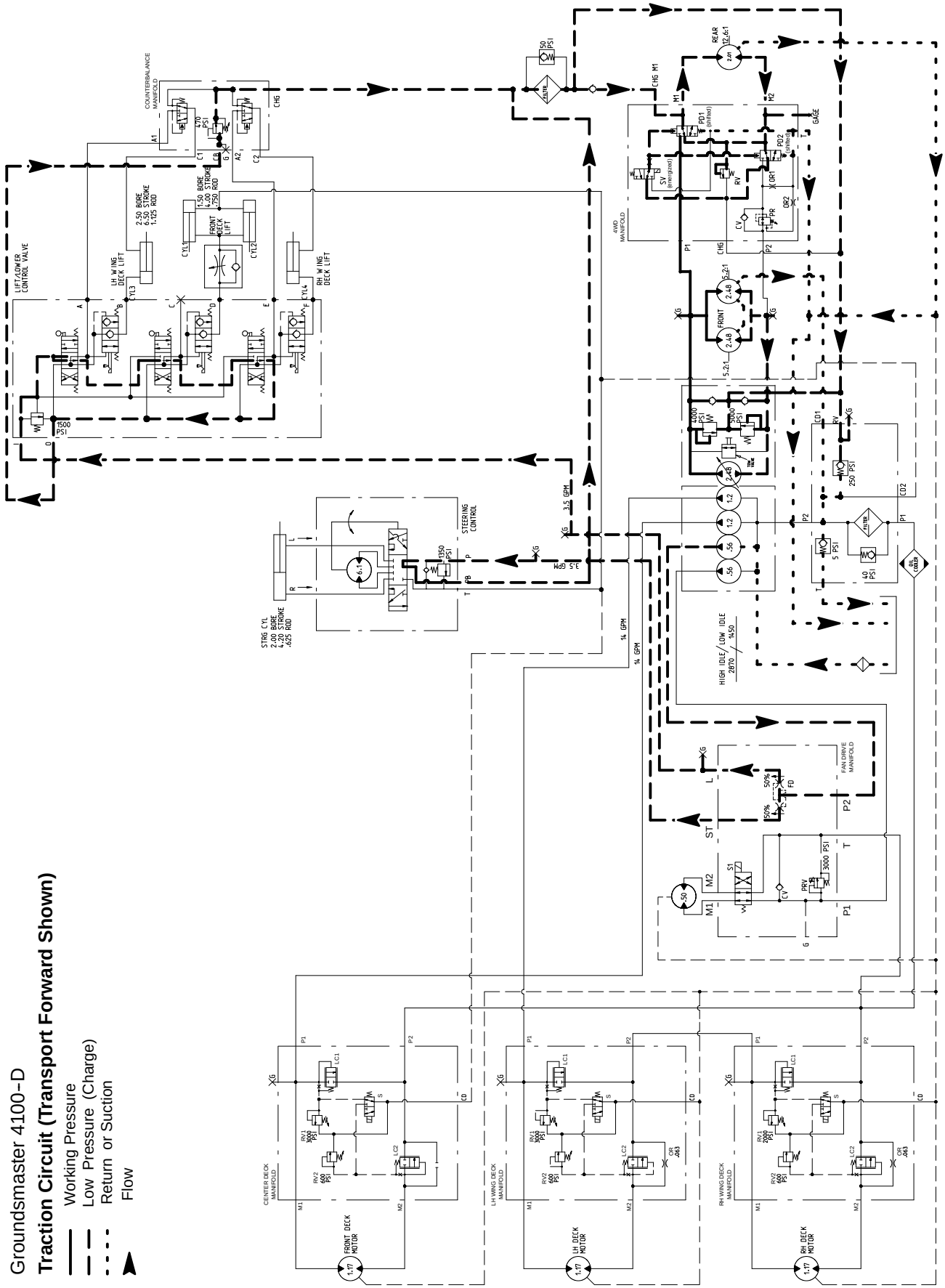
Forward Direction

When the transport/4WD switch is in the 4WD (mow) position and the traction pedal is pushed in the forward direction, oil from the piston pump is directed to the front wheel motors and 4WD manifold. Oil flow to the front wheel motors drives the motors in the forward direction and then returns to the hydrostat. Oil flow to the 4WD manifold enters the P1 port and then is directed to the PD1 cartridge and out of the manifold M1 port to drive the rear axle motor in the forward direction. Oil returning from the rear motor re−enters the 4WD manifold at the M2 port. Flow passes through the PD2 cartridge, through the CV check valve, out manifold port P2 and back to the hydrostat.

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

Reverse Direction

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


Groundsmaster 4100-D
Traction Circuit (Transport Forward Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
COUNTERBALANCE MANIFOLD
FRONT DECK LIFT
LH W ING DECK LIFT
RH W ING DECK LIFT
STEERING CONTROL
STBG CYL
4WD MANIFOLD
FAN DRIVE MANIFOLD
CENTER DECK MANIFOLD
LH W ING DECK MANIFOLD
RH W ING DECK MANIFOLD
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR
HIGH IDLE / LOW IDLE
2870 / 1450
14 GPM
3.5 GPM

Traction Circuit: Transport (2WD)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. This oil is directed to the front wheel and rear axle motors. Operating pressure on the high pressure side of the closed traction circuit loop is determined by the amount of load developed at the fixed displacement wheel and axle motors. As the load increases, circuit pressure can increase to relief valve settings: 4000 PSI (274 bar) in forward and 5000 PSI (343 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. The traction circuit provides operation in either 4WD (mow) or transport (2WD).

Traction circuit pressure (forward and reverse) can be measured at test ports on the sides of the machine.

The traction circuit pump and motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the 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 that supplies oil to the steering and lift/lower circuits also provides charge oil for the traction circuit. This 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 due to internal leakage in the traction pump and motors.

Charge pump flow is directed through the oil filter and to the low pressure side of the closed loop traction circuit. A filter bypass valve allows charge oil flow to the closed loop if the filter becomes plugged. Charge pressure is limited to 250 PSI (17 bar) by a relief valve located in the oil filter manifold. Charge pressure can be measured at the charge circuit pressure test port on the oil filter manifold.

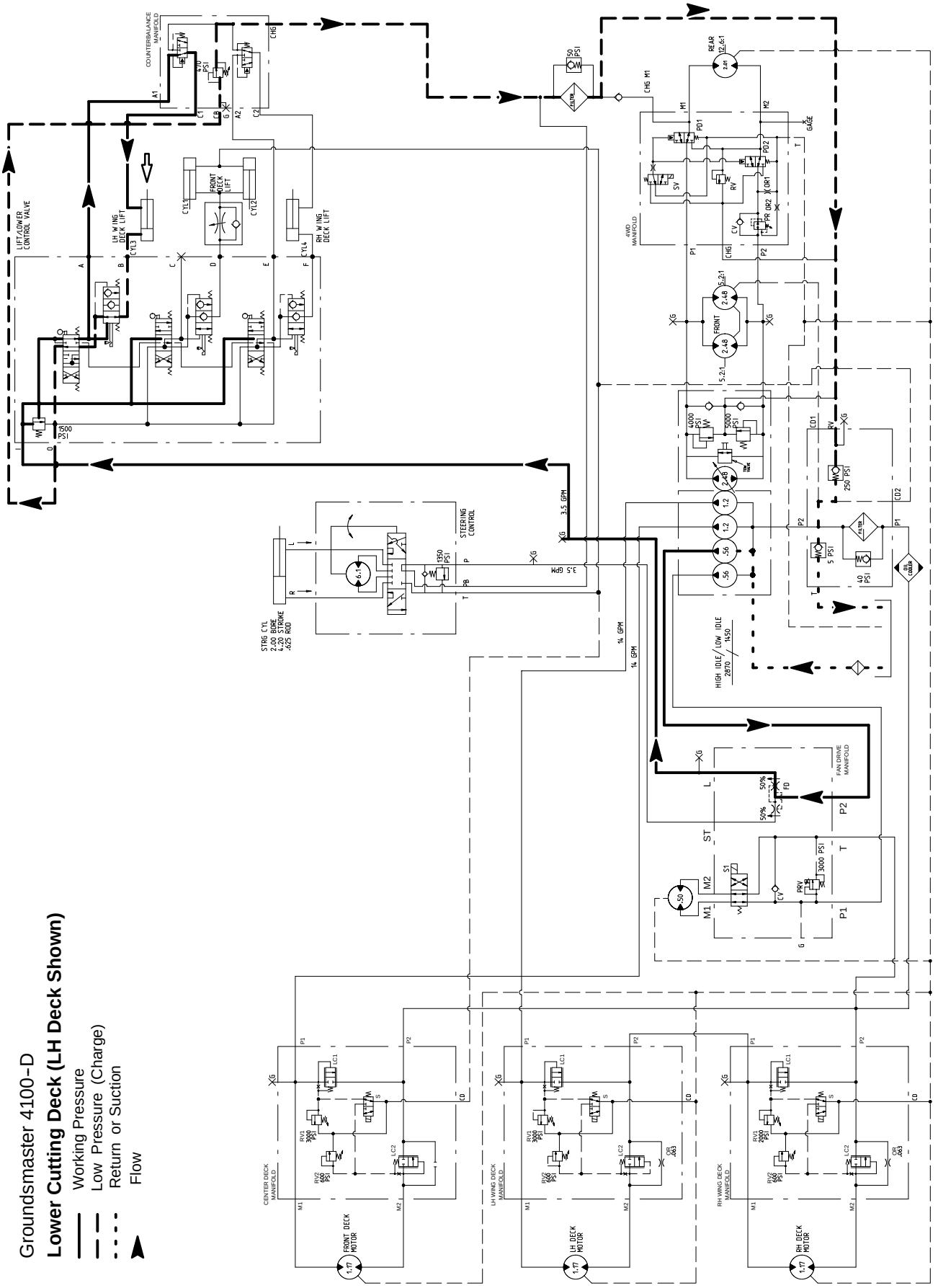
Forward Direction

With the transport/4WD switch in the transport position, solenoid valve (SV) 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 piston pump to the rear axle motor. With flow blocked to the rear axle motor, all pump flow is directed to the front wheel motors to allow a higher transport speed in the forward direction.

Without flow to the rear axle motor, the rotating rear wheels drive the axle motor so it acts like a pump. Inlet oil to the axle motor is provided by a check valve that allows charge oil into the rear axle motor circuit. Oil leaving the axle motor enters the 4WD control manifold at port M2 and is directed back to the axle motor through the shifted 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 PD1 and PD2 cartridges that returns to the reservoir.

Reverse Direction

The traction circuit operates essentially the same in reverse transport (2WD) as it does in the forward direction. However, the flow through the circuit is reversed. The shifted solenoid valve (SV) and directional valves PD1 and PD2 in the 4WD manifold prevent oil flow from the rear axle motor. Oil flow from the hydrostat is therefore directed to only the front wheel motors. This oil drives the front wheel motors in the reverse direction and then returns to the hydrostat. Oil circulation through the rear axle motor loop is the same as in the transport (2WD) forward direction.


Groundsmaster 4100-D
Lower Cutting Deck (LH Deck Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
COUNTERBALANCE MANIFOLD
LIFT/LOWER CONTROL VALVE
FRONT DECK LIFT
LH WING DECK LIFT
RH WING DECK LIFT
STEERING CONTROL
STRG CYL 2.00 BORE 4.20 STROKE .625 ROD
4WD MANIFOLD
FAN DRIVE MANIFOLD
HIGH IDLE/LOW IDLE 2870/1450
CENTER DECK MANIFOLD
LH WING DECK MANIFOLD
RH WING DECK MANIFOLD
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR

Lower Cutting Deck

A four section gear pump is coupled to the piston (traction) pump. The third gear pump section supplies hydraulic flow to both the lift/lower control valve and the steering control valve. Hydraulic flow from this pump section is delivered to the steering and lift/lower circuits through a proportional flow divider that is located in the fan drive manifold. This pump section takes its suction from the hydraulic reservoir.

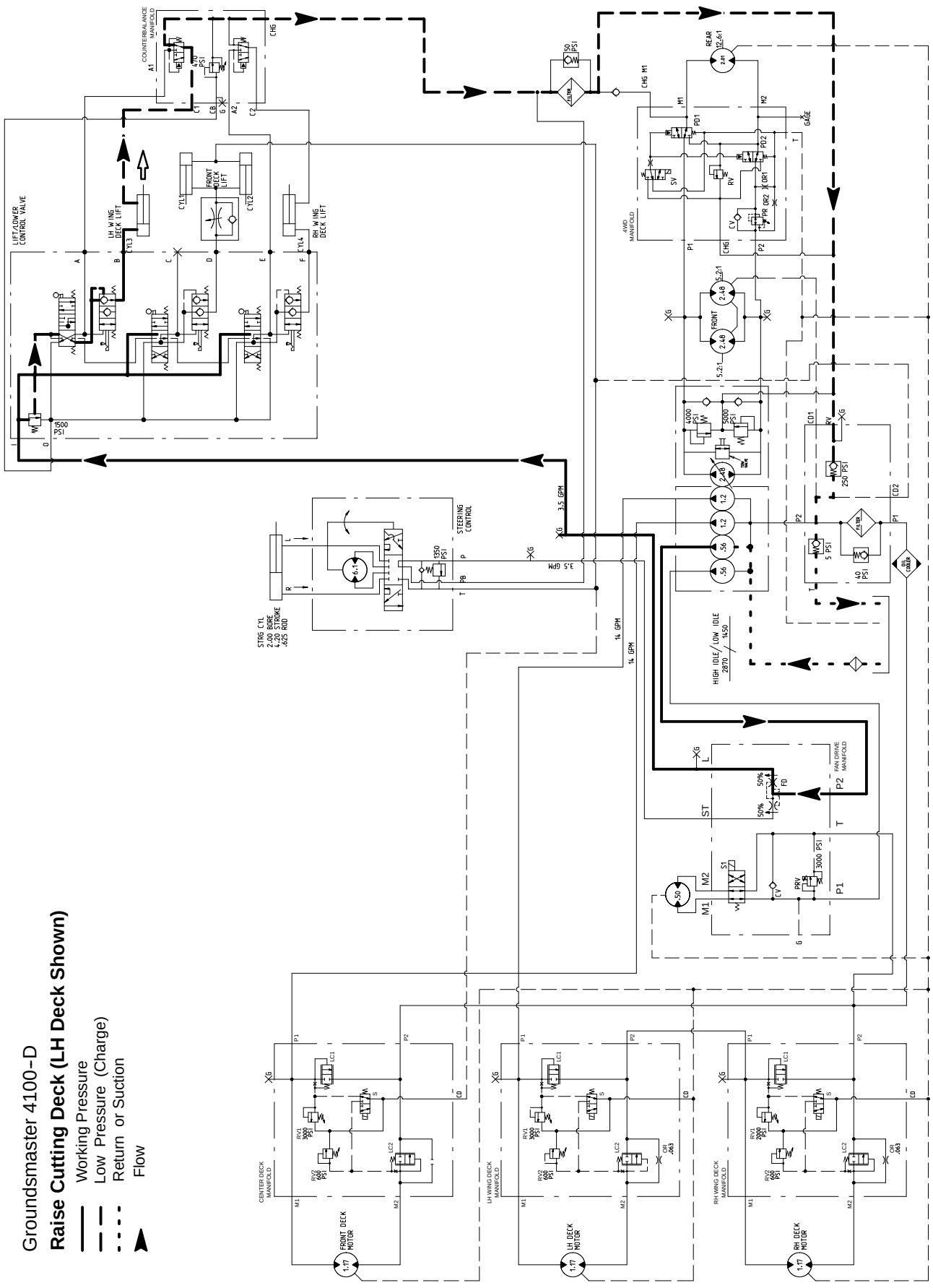
When the cutting deck is in a stationary position, flow from the gear pump is by–passed through the lift/lower control valve, counterbalance manifold, oil filter and traction charge circuit.

To lower the cutting deck, the center lift lever on the lift/lower control valve is pushed to allow valve shift in the lift/lower control. This valve change allows a passage for oil flow from the rod end of the front deck lift cylinders. The weight of the cutting deck causes the lift cylinders to extend, and lower the cutting deck. Oil from the rod end of the cylinders is allowed to return to the traction charge circuit. When the lift lever is released, the lift cylinders and cutting deck is held in position.

The drop speed of the front cutting deck is regulated by an adjustable flow control valve that is located in the hydraulic lines between the lift/lower control valve and the deck lift cylinders.

To lower a wing deck, the appropriate lift lever on the lift/lower control valve is pushed to allow valve shift in the lift/lower control valve. This valve change causes a valve shift in the counterbalance manifold and oil flow to the barrel end of the lift cylinder. Higher hydraulic pressure against the barrel end of the cylinder causes the cylinder shaft to extend, and lower the wing deck. Oil from the piston end of the cylinder returns to the traction charge circuit. When the lift lever is released, the lift cylinder and wing deck is held in position.

An adjustable counterbalance valve (CB) in the counterbalance 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 located in the lift/lower control valve limits lift/lower circuit pressure to 1500 PSI (103 bar). Excess circuit flow is routed to the oil filter and then to the traction charge circuit.


Groundsmaster 4100-D
Raise Cutting Deck (LH Deck Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
COUNTERBALANCE MANIFOLD
LIFT/LOWER CONTROL VALVE
LH WING DECK LIFT
FRONT DECK LIFT
RH WING DECK LIFT
STEERING CONTROL
STRG CYL 2.00 BORE 1.25 STROKE .625 ROD
HIGH IDLE/LOW IDLE 2870/1450
4WD MANIFOLD
REAR
FRONT
FAN DRIVE MANIFOLD
CENTER DECK MANIFOLD
LH WING DECK MANIFOLD
RH WING DECK MANIFOLD
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR

Raise Cutting Deck

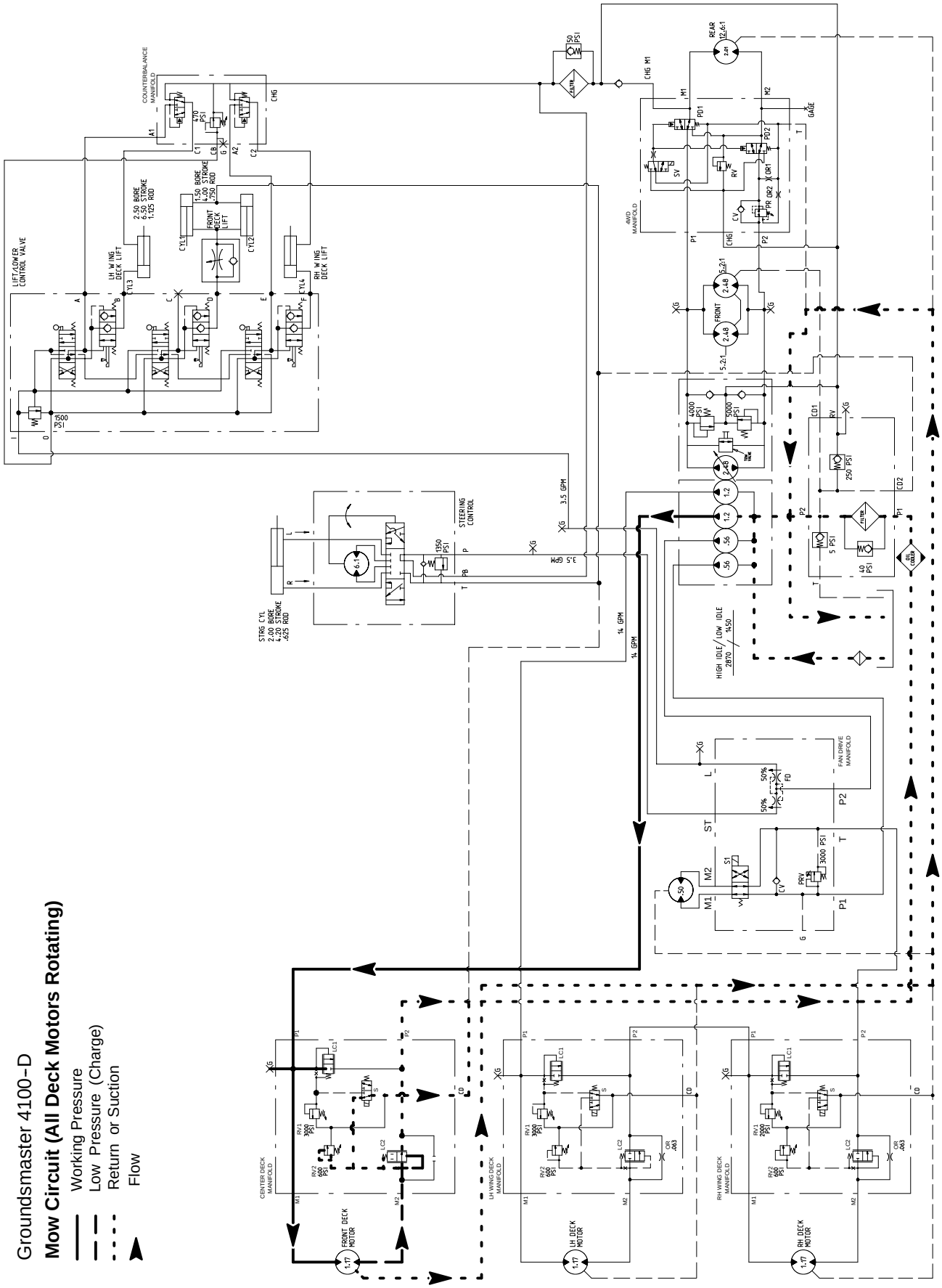
A four section gear pump is coupled to the piston (traction) pump. The third gear pump section supplies hydraulic flow to the lift/lower control valve and the steering control valve. Hydraulic flow from this pump section is delivered to the two circuits through a proportional flow divider. The gear pump takes its suction from the hydraulic reservoir.

When the cutting deck is in a stationary position, flow from the gear pump is by−passed through the lift/lower control valve, counterbalance manifold, oil filter and traction charge circuit.

To raise the cutting deck, the center lift lever on the lift/lower control valve is pulled to allow valve shift in the lift/lower control valve. This valve change allows hydraulic pressure to the rod end of the front deck lift cylinders, causing the cylinders to retract. As the cylinders retract, the cutting deck raises. Oil from the piston end of the cylinders returns to the hydraulic reservoir. When the lift lever is released, the lift cylinders and cutting deck is held in position.

To raise a wing deck, the appropriate lift lever on the lift/lower control valve is pulled to allow valve shift in the lift/lower control valve. This valve change allows hydraulic pressure to the piston end of the wing deck lift cylinder and causes the cylinder shaft to retract, raising the wing deck. Oil from the rod end of the cylinder flows to the traction charge circuit. When the lift lever is released, the lift cylinder and wing deck is held in position.

An adjustable counterbalance valve (CB) in the counterbalance 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 located in the lift/lower control valve limits lift/lower circuit pressure to 1500 PSI (103 bar). Excess circuit flow is routed to the oil filter and then to the traction charge circuit.


Groundsmaster 4100-D
Mow Circuit (All Deck Motors Rotating)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
COUNTERBALANCE MANIFOLD
FRONT DECK LIFT
LH W ING DECK LIFT
RH W ING DECK LIFT
STEERING CONTROL
CHG M1
REAR
FRONT
AWD MANIFOLD
FAN DRIVE MANIFOLD
HIGH IDLE / LOW IDLE
CENTER DECK MANIFOLD
LH W ING DECK MANIFOLD
RH W ING DECK MANIFOLD
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR

Mow Circuit

Hydraulic flow for the mow circuit is supplied by two sections of the gear pump. The gear pump section closest to the piston (traction) pump supplies hydraulic flow to the wing decks, while the next gear pump section supplies the center deck.

Each cutting deck is controlled by a hydraulic manifold equipped with a solenoid control valve (S), bypass cartridge (LC1), brake cartridge (LC2) and relief cartridge (RV1). When the the deck solenoid valve (S) is not energized (PTO switch OFF), hydraulic flow by−passes the deck motor through the bypass cartridge (LC1). When the PTO switch is turned ON, the solenoid valve (S) energizes, causing a shift of the by−pass cartridge (LC1) and allowing hydraulic flow to the deck motor. Brake cartridge (LC2) and relief cartridge (RV2) control the stopping rate of the blade when the solenoid control valve is de−energized as the PTO switch is turned OFF.

The solenoid valve (S) for each wing deck is de−energized any time the wing deck is raised.

Return oil from the deck motors is directed to the oil cooler and oil filter. Deck motor case drain leakage returns to the hydraulic reservoir.

Maximum mow circuit pressure is limited at each deck by a relief valve (RV1) in the hydraulic manifold. The front and left deck relief valves are set at 3000 PSI (207 bar) and the right deck relief valve is set at 2000 PSI (137 bar).

Circuit pressure can be measured at port (G) of the hydraulic manifold for each cutting deck.

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, deck 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. 10).

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. 11). This flow causes a pressure increase that shifts logic cartridge LC2 to once again allow oil flow from the motor (Fig. 12). When motor 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.

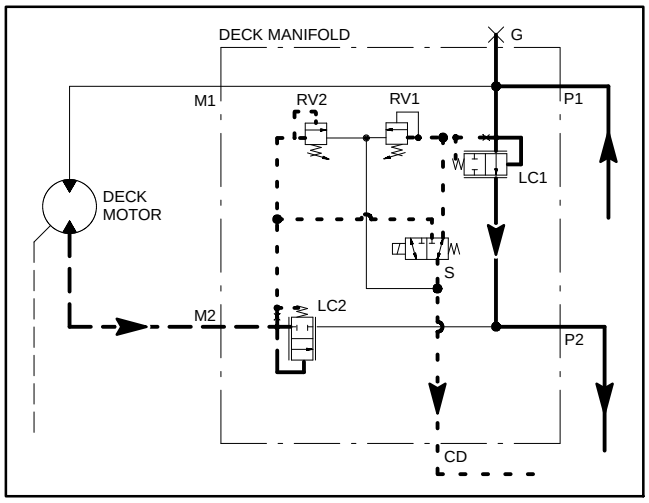


Figure 10

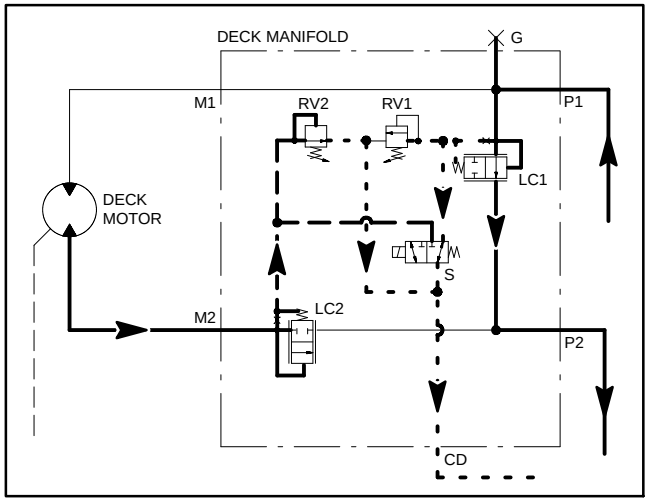


Figure 11

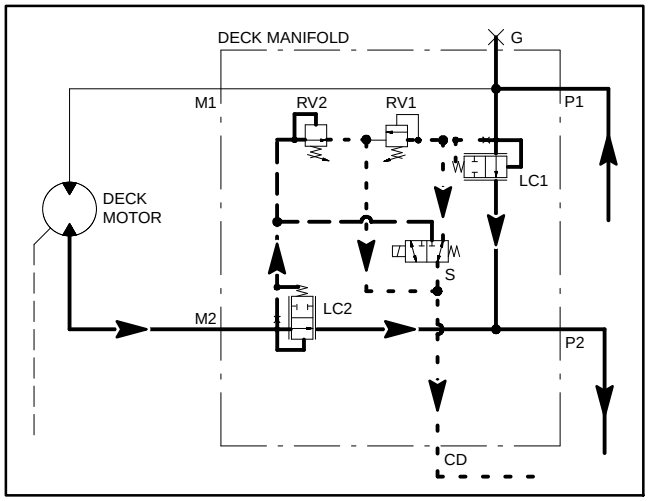


Figure 12

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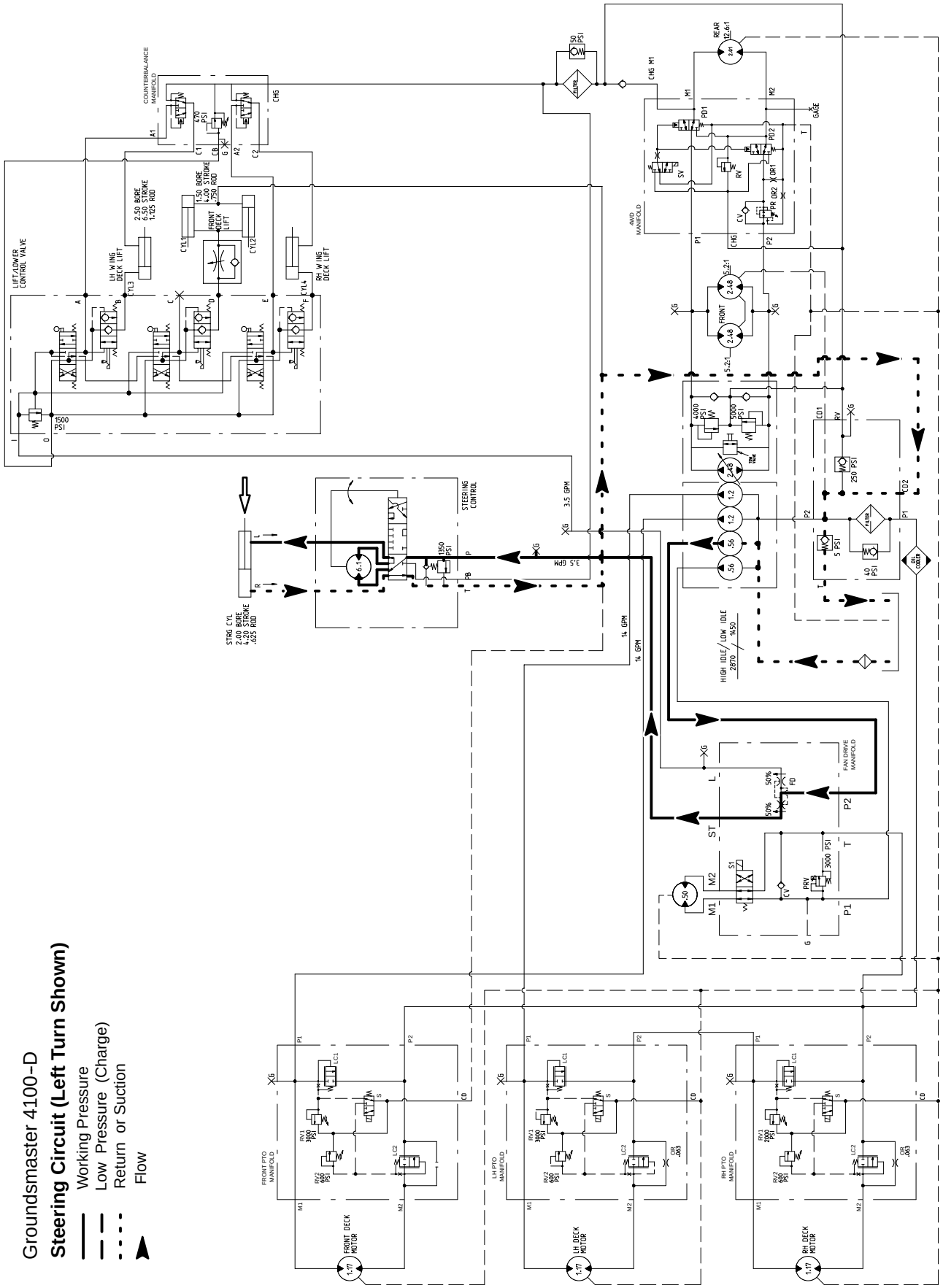

Groundsmaster 4100-D
Steering Circuit (Left Turn Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
COUNTERBALANCE MANIFOLD
FRONT DECK LIFT
LH W ING DECK LIFT
RH W ING DECK LIFT
STEERING CONTROL
STRG CYL
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR
FRONT PTO MANIFOLD
LH PTO MANIFOLD
RH PTO MANIFOLD
FAN DRIVE MANIFOLD
AWD MANIFOLD
CHG M1
REAR
FRONT
GAGE
HIGH IDLE / LOW IDLE
3.5 GPM
14 GPM

Steering Circuit

A four section gear pump is coupled to the piston (traction) pump. The third gear pump section supplies hydraulic flow to the steering control valve and the lift/lower control valve. Pump hydraulic flow is delivered to the two circuits through a proportional flow divider located in the fan drive manifold. The gear pump takes its suction from the hydraulic reservoir. Steering circuit pressure is limited to 1350 PSI (93 bar) by a relief valve located in the steering control.

With the steering wheel in the neutral position and the engine running, flow enters the steering control valve at the P port and goes through the steering control spool valve, by–passing the rotary meter (V1) and steering cylinder. Flow leaves the control valve through the PB port to the oil filter and traction charge circuit.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. First, most of the flow through the valve is by–passed out the PB port back to the oil filter and traction charge circuit. Second, the remainder of the flow is drawn through the rotary meter (V1) and out the L port. Pressure contracts the steering cylinder piston for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the T port and to the hydraulic reservoir.

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

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. As in a left turn, most of the flow through the valve is by–passed out the PB port back to the oil filter and traction charge circuit. Also like a left turn, the remainder of the flow is drawn through rotary meter (V1) but goes out port R. Pressure extends the steering cylinder piston for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the T port and to the hydraulic reservoir.

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

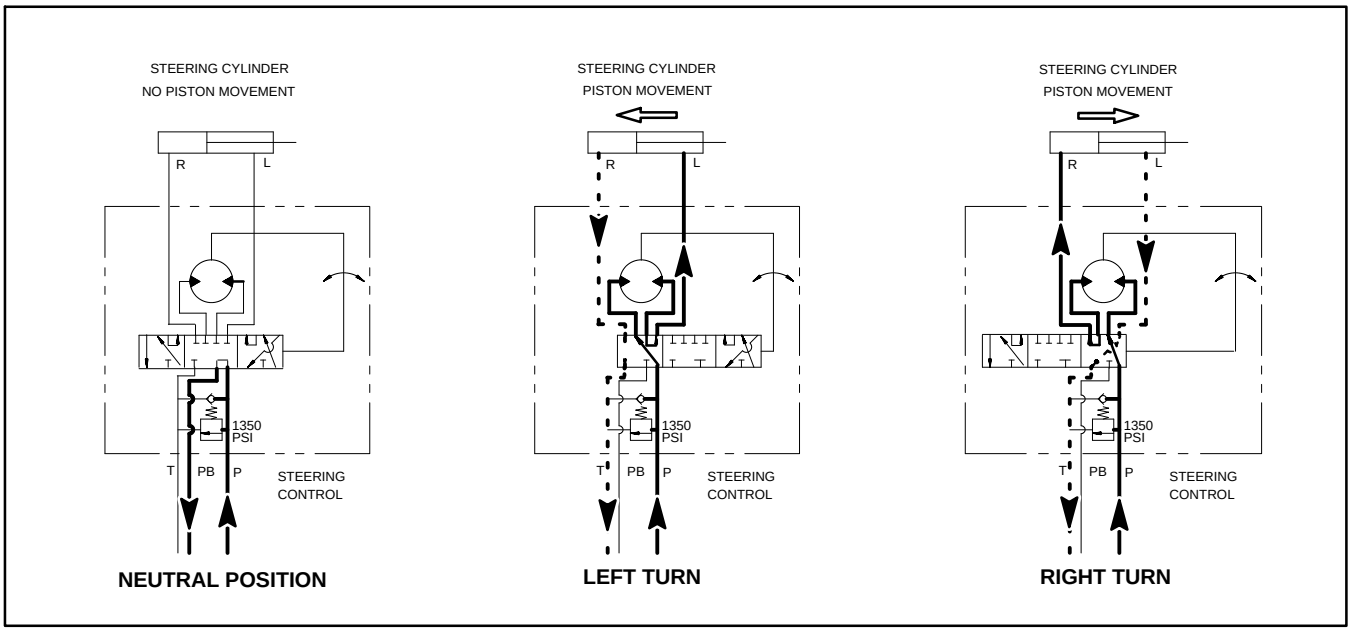
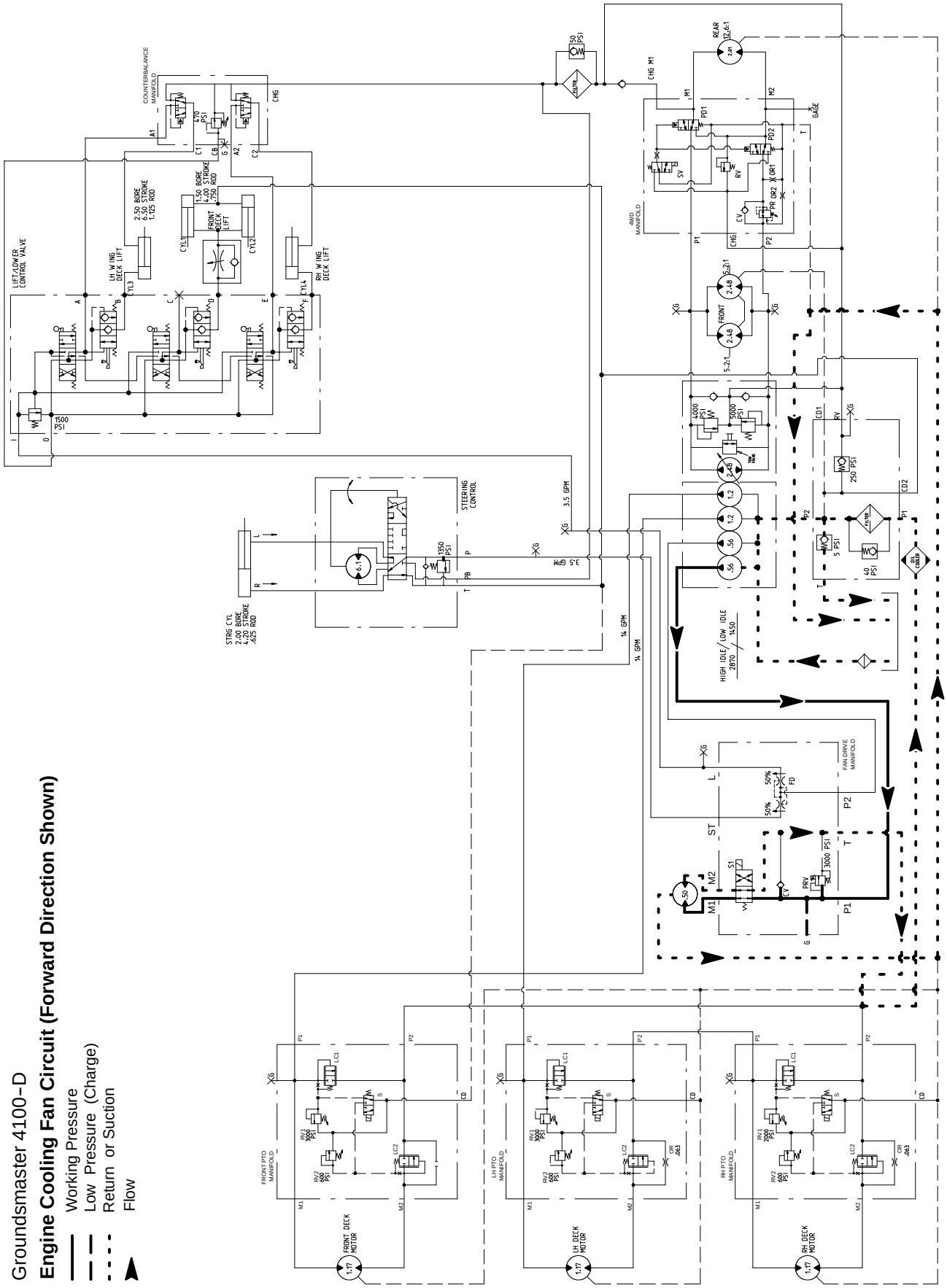


Figure 13


Groundsmaster 4100-D
Engine Cooling Fan Circuit (Forward Direction Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
COUNTERBALANCE MANIFOLD
LH W ING DECK LIFT
RH W ING DECK LIFT
FRONT DECK LIFT
STEERING CONTROL
STRG CYL
FRONT DECK MOTOR
LH DECK MOTOR
RH DECK MOTOR
FRONT PTO MANIFOLD
LH PTO MANIFOLD
RH PTO MANIFOLD
FAN DRIVE MANIFOLD
AWD MANIFOLD
CHG M1
REAR
FRONT
GAGE
HIGH IDLE / LOW IDLE
2870 / 1450
14 GPM
3.5 GPM

Engine Cooling Fan Circuit

A four section gear pump is coupled to the piston (traction) pump. The gear pump section farthest from the piston pump supplies hydraulic flow for the fan drive manifold and hydraulic engine cooling fan motor (Fig. 14).

The fan drive manifold controls the operation of the hydraulic motor that drives the engine cooling fan in addition to including the flow divider for the steering and lift circuits. The electronically controlled proportional relief valve (PRV) in the manifold controls the oil flow to the fan motor. The fan drive manifold controls the speed and direction of the fan motor based on electrical output from the TEC−5002 controller.

Oil flow from the gear pump to the cooling fan motor is controlled by the proportional relief valve (PRV) in the fan drive manifold. This valve 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 as inputs to determine the proper PWM signal for the (PRV) valve. The fan circuit flow determines the speed of the cooling fan motor and thus, the speed of the cooling fan.

If the fan motor is stalled for any reason, the manifold proportional relief valve (PRV) has a secondary function as a circuit relief to limit fan motor pressure to 3000 PSI (207 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 fan drive 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 gear pump is sent through the de−energized solenoid valve (S1) to rotate the cooling fan motor. Return flow from the motor re−enters the manifold (port M2), through the de−energized solenoid valve (S1), out of the manifold (port T) and then is routed through the oil cooler and oil filter.

Reverse Direction Fan Operation (Fig. 15)

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, a high PWM signal is sent to the (PRV) valve to slow the cooling fan and direct pump oil flow to the reservoir. The controller then energizes solenoid valve (S1) in the fan drive manifold to reverse cooling fan motor oil flow so that the motor runs in the reverse direction. A lower PWM signal is sent to the PRV valve allowing oil flow to return to the fan motor but in the reverse direction causing the motor and cooling fan to run in reverse. The controller determines the length of time that the fan should be run in reverse before fan rotation is returned to the forward direction.

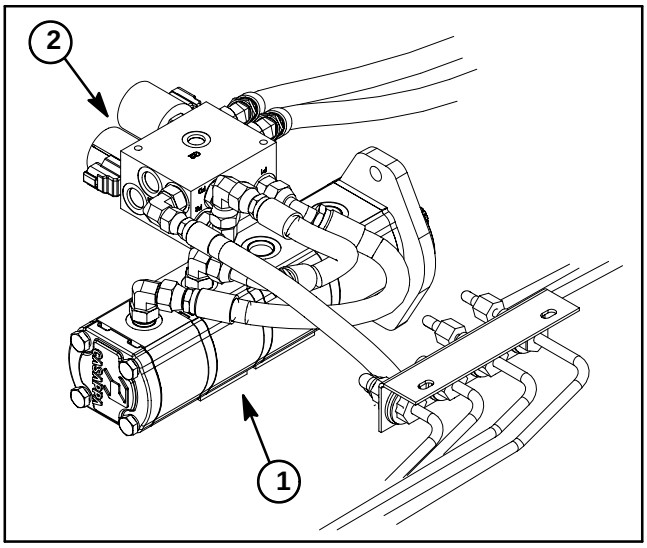


Figure 14

1. **Gear pump**
2. **Fan drive manifold**

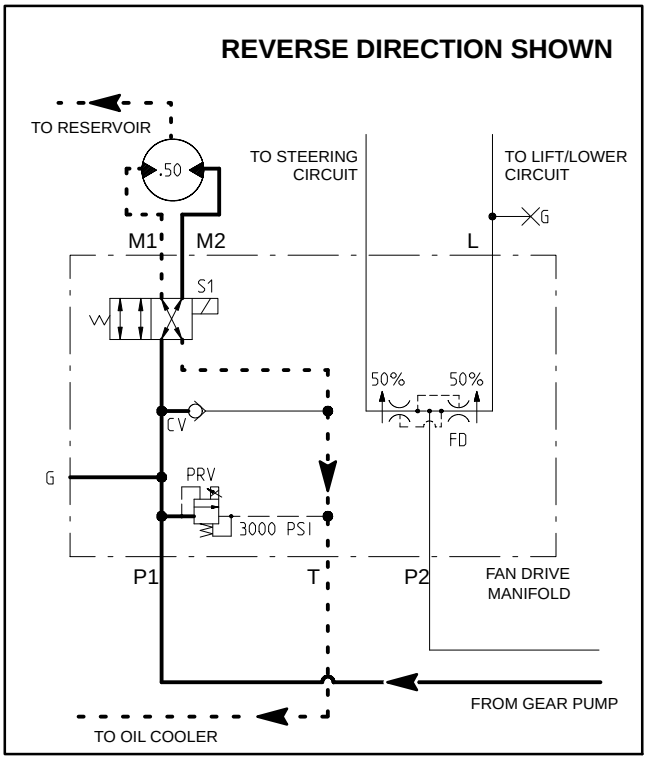


Figure 15

Special Tools

Order these 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. PRESSURE GAUGE: Glycerine filled 0 to 5000 PSI gauge to provide operating circuit pressure.

4. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 1 to 15 GPM (5 to 55 LPM).

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

6. FITTINGS: An assortment of hydraulic fittings are included with this kit.

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. 6 — TOR4079-6 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

Troubleshooting

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

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

NOTE: When troubleshooting traction problems on the Groundsmaster 4100–D, if a problem exists in both 4WD and transport speeds, consider a faulty component that affects the entire traction circuit (e.g. charge circuit, relief valves, piston pump, front wheel motors). If the problem exists in 4WD but not in transport, consider a problem in the 4WD traction system (e.g. rear axle motor, 4WD manifold).

Problem	Possible Cause
Hydraulic system operates hot. **NOTE:** An indication that the hydraulic system is operating at excessive temperatures would be frequent reversing of the cooling fan and a normal engine coolant temperature.	Engine RPM is too low. Brakes are applied or sticking. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Piston pump by–pass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking into a pump suction line.
Machine operates in one direction only.	Traction control linkage is faulty. Traction relief valve is defective.
Traction pedal is sluggish.	Traction control linkage is stuck or binding. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged. 4WD manifold PD1 and PD2 pilot directional valves seals are leaking or damaged.
Machine travels too far before stopping when the traction pedal is released.	Traction linkage is out of adjustment. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged. Traction pedal does not return to neutral.

Problem	Possible Causes
Traction power is lost or unit will not operate in either direction.	Hydraulic reservoir oil level is low. Piston pump by−pass valve is open or damaged. Charge pressure is low. Traction circuit pressure is low. Front wheel motor couplers are damaged.
Four wheel drive will not engage.	Electrical problem exists (see Chapter 5 − Electrical System). Solenoid valve (SV) in 4WD hydraulic manifold is faulty. Cartridge valve(s) in 4WD manifold is faulty. Drive gear on rear axle motor or driven gear for rear axle is loose or damaged. Rear axle motor is damaged.
Four wheel drive will not disengage.	Electrical problem exists (see Chapter 5 − Electrical System). Solenoid valve (SV) in 4WD hydraulic manifold is faulty. Cartridge valve in 4WD manifold is damaged or sticking.
No cutting decks will operate.	Electrical problem exists (see Chapter 5 − Electrical System). Gear pump or its coupler is damaged (Note: other hydraulic circuits impacted as well).
One cutting deck will not operate.	Electrical problem exists (see Chapter 5 − Electrical System). System pressure to the affected deck is low. Woodruff key on affected deck motor is damaged. Solenoid valve (S) in deck manifold is faulty. Cartridge valve in deck manifold is damaged or sticking. Deck motor or gear pump section is damaged.
All cutting decks operate slowly.	Engine RPM is low. Deck motor or gear pump sections are damaged.
Cutting deck stops under load.	Relief valve in deck manifold is by−passing. Deck motor has internal leakage (by−passing oil). Cutting deck gear pump section is inefficient.

Problem	Possible Causes
Cutting deck (or wing decks) will not raise.	Engine RPM is too low. Hydraulic oil level in reservoir is low. Lift arm pivots are binding. Relief valve in lift/lower control valve is stuck. Pilot valve in lift/lower control valve is damaged or sticking. Lift cylinder(s) is (are) damaged. Gear pump section for lift/lower control valve is inefficient.
Cutting deck (or wing decks) raise, but will not stay up. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. The cutting deck will eventually lower if left in the raised position during storage.	Lift circuit lines or fittings are leaking. Lift cylinder is damaged. Detents in lift/lower control valve are worn.
Front cutting deck drops too fast or too slow.	Flow control valve is not adjusted properly.
Cutting deck (or wing decks) will not lower.	Lift arm pivots are binding. Counterbalance pressure is excessive. Pilot valve in lift/lower control valve is damaged or sticking. Lift cylinder is damaged. Lift/lower control valve is worn or damaged.

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) 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

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

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. Check actual speed of the pump when performing flow testing.

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 load valve completely in the tester 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.

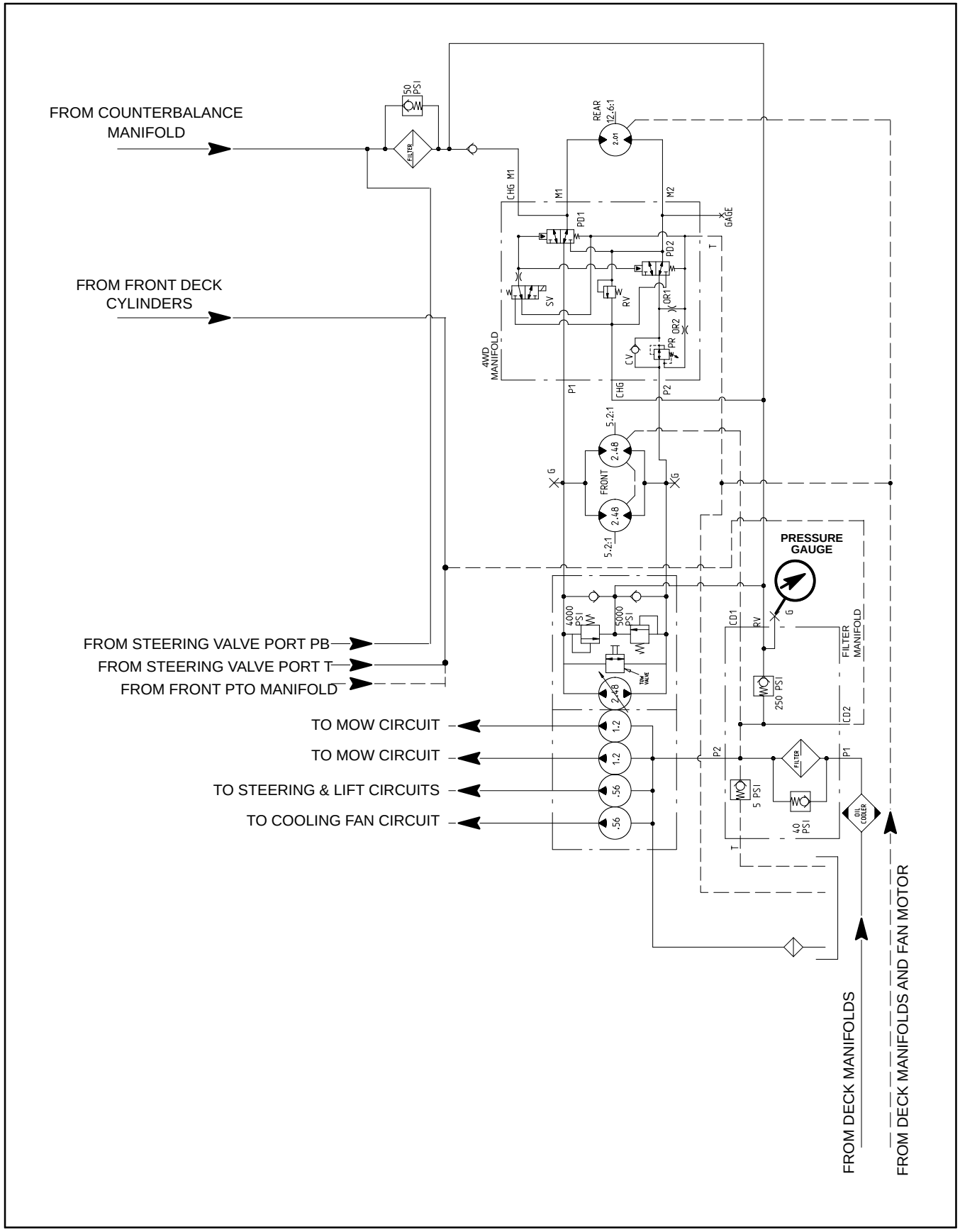
9. Check control linkages for improper adjustment, binding or broken parts.

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.

Traction Circuit Charge Pressure (Using Pressure Gauge)



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 deck lowered and off. Make sure engine is off and the parking brake is engaged. Raise and support operator seat.

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) gauge onto charge pressure test port (Fig. 21) under operator seat.

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 **(2870 RPM)** with no load on the hydraulic system.

GAUGE READING TO BE 200 to 300 PSI (13.8 to 20.6 bar).

6. Stop engine and record test results.

7. If there is no pressure, or pressure is low, check for restriction in pump intake line. Also, inspect charge relief valve located in filter manifold (see Hydraulic Manifold Service: Filter Manifold in the Service and Repairs section of this chapter). If necessary, check for internal damage or worn parts in gear pump.

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 and put throttle at full engine speed **(2870 RPM)**. Apply the brakes and push the traction pedal forward, then reverse.

GAUGE READING TO BE 200 to 300 PSI (13.8 to 20.6 bar).

9. If charge pressure is good under no load, but consistently drops below specification when under traction load, the piston (traction) pump and/or traction 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. When testing is completed, disconnect pressure gauge from test port.

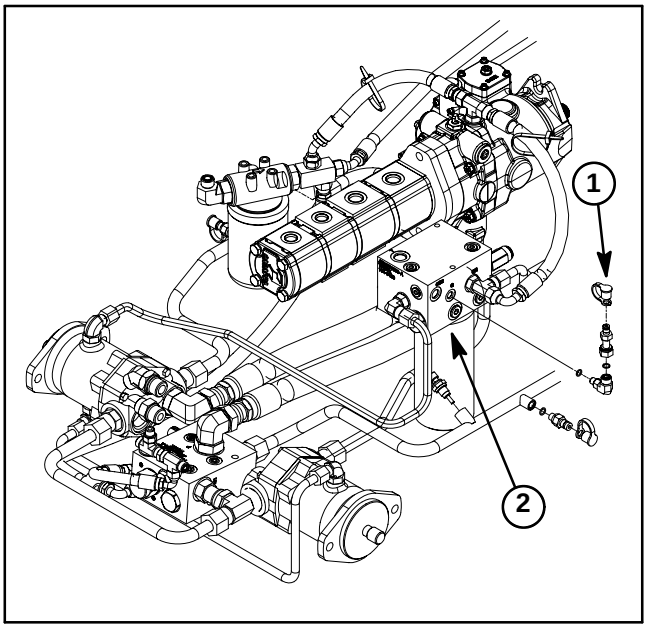
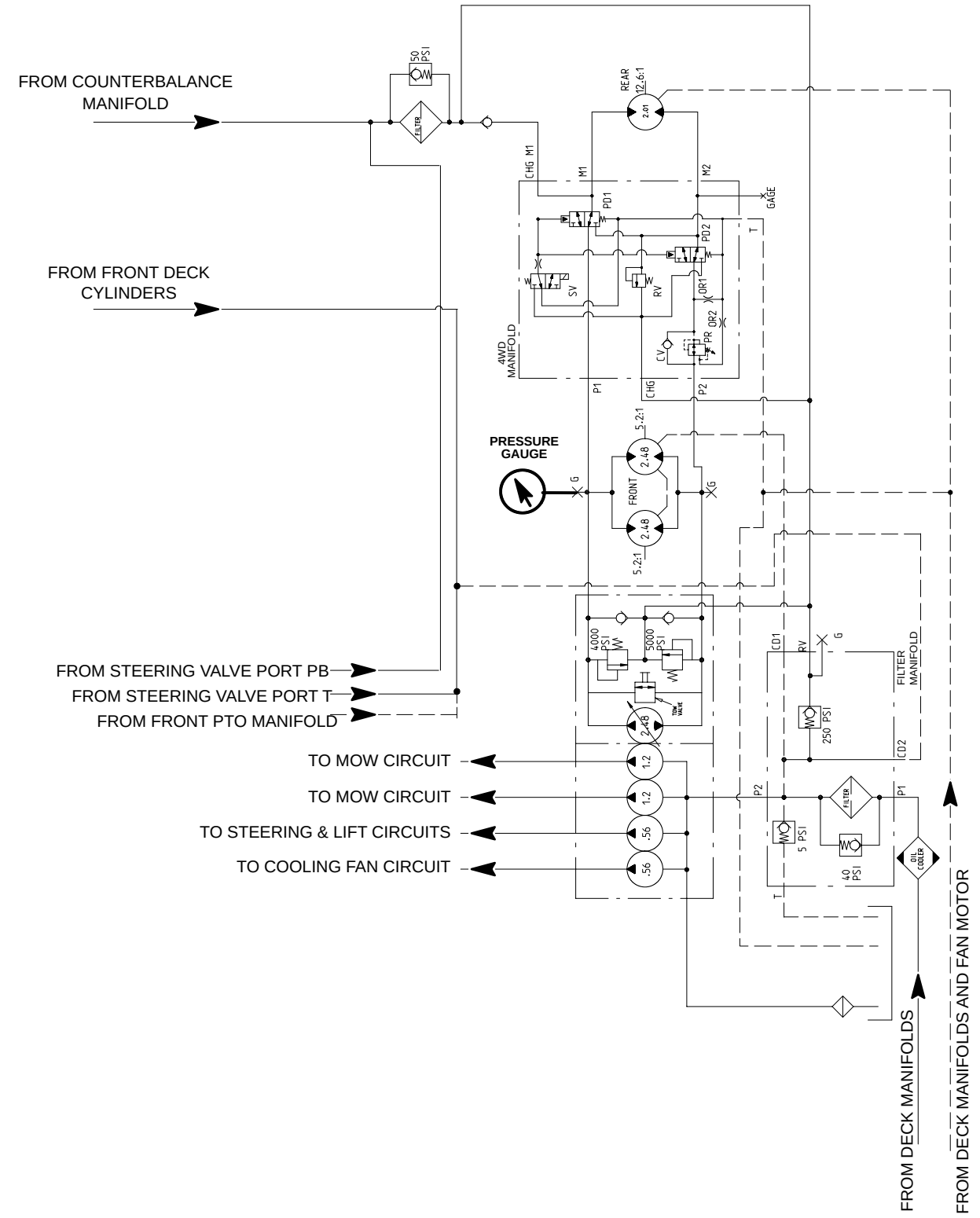


Figure 21

1. Charge pressure port **2. Filter manifold**

Traction Circuit Relief Pressure (Using Pressure Gauge)

FORWARD TRACTION CIRCUIT RELIEF PRESSURE TEST SHOWN



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

Move machine to an open area, away from people and obstructions.

2. Drive machine to an open area, lower cutting deck, turn the engine off and engage 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) gauge to traction circuit test port for function to be checked (Forward or Reverse: Fig. 22 or 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 speed **(2870 RPM)**. Make sure that transport/4WD switch is in the transport position.

6. Sit on seat, apply brakes fully and slowly depress the traction pedal in the appropriate direction. While pushing traction pedal, look at pressure reading on gauge:

GAUGE READING TO BE:
Forward: **3750 to 4250 PSI (259 to 293 bar)**
Reverse: **4750 to 5250 PSI (328 to 362 bar)**

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

8. If traction pressure is too low, inspect traction pump relief valves (Fig. 24). 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.

NOTE: Seal leakage across pilot directional valves PD1 and PD2 in 4WD manifold can also cause low forward traction pressure with reverse pressure meeting specifications.

9. When testing is completed, disconnect pressure gauge from test port.

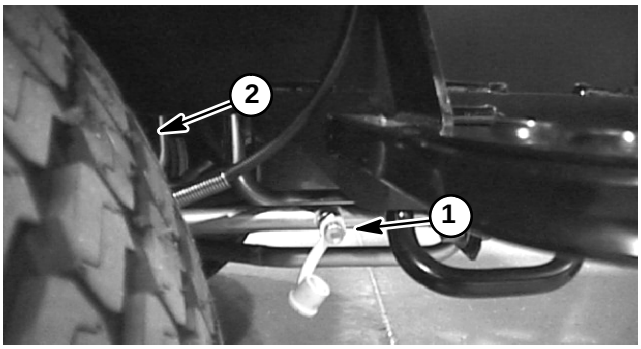


Figure 22

1. **Forward traction port**
2. **LH front tire**

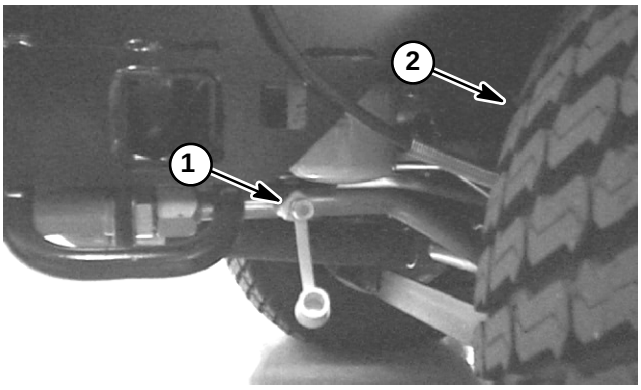


Figure 23

1. **Reverse traction port**
2. **RH front tire**

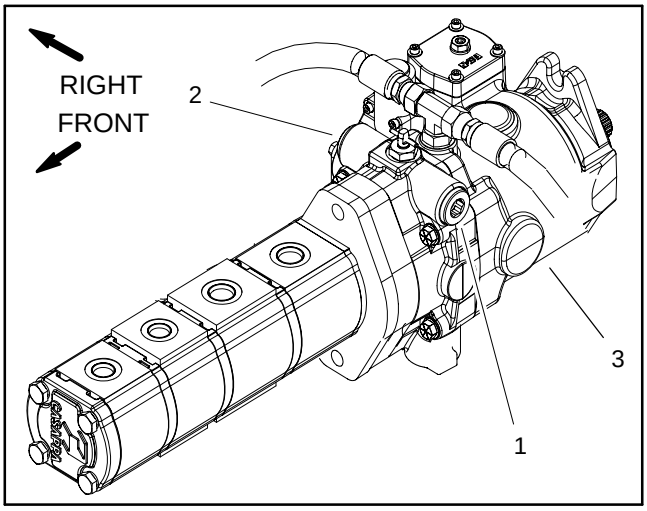
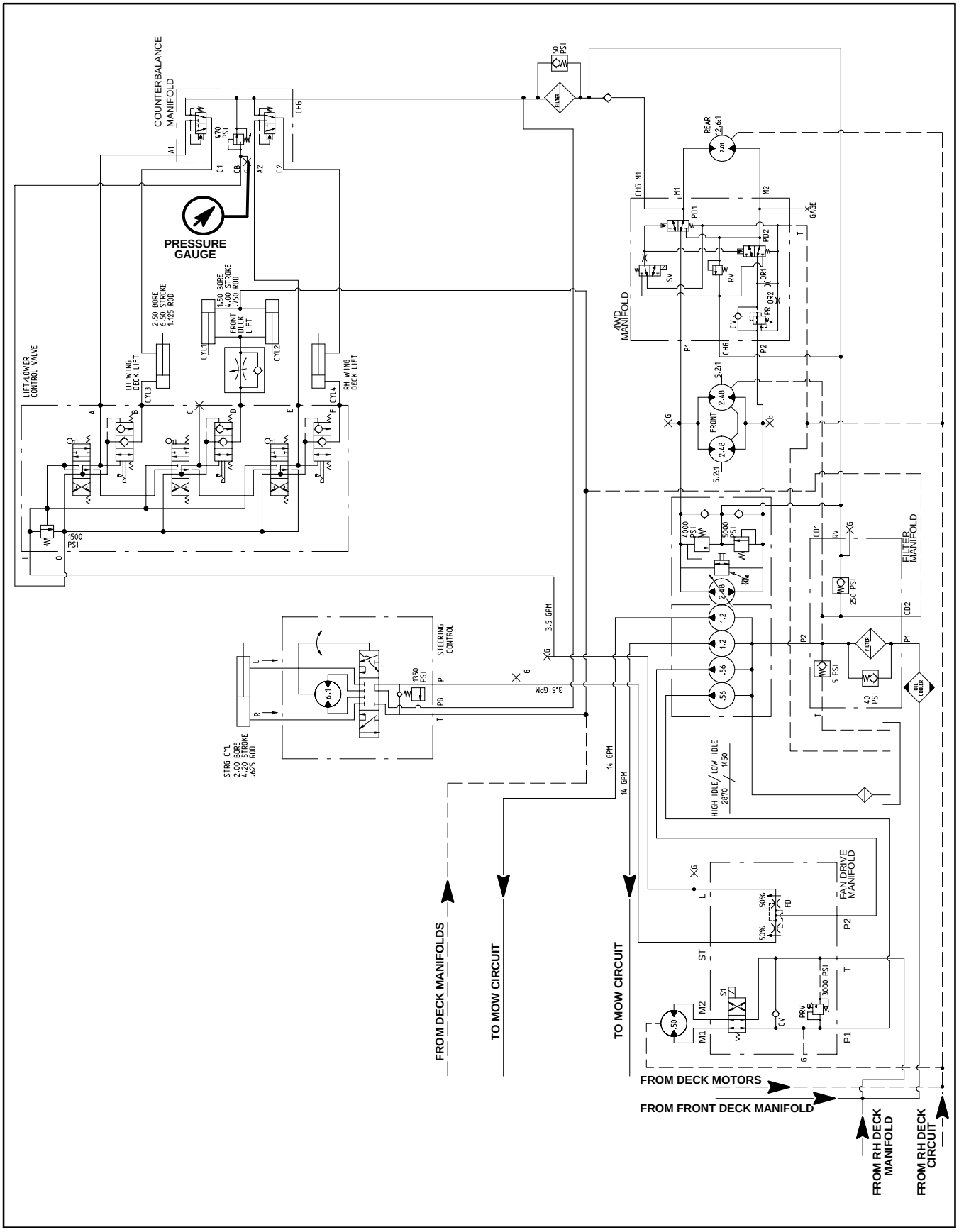


Figure 24

1. **Forward relief valve**
2. **Reverse relief valve**
3. **Traction pump**

Counterbalance Pressure (Using Pressure Gauge)



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 deck lowered and off. Make sure engine is off and the parking brake is engaged. Remove console cover.

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. Determine system charge pressure (see Traction Circuit Charge Pressure in this chapter).

4. Connect a 1000 PSI (70 bar) gauge to counterbalance test port on manifold under console (Fig. 25).

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

6. Operate the engine at full engine speed **(2870 RPM)** with no load on the system. **Do not engage the cutting deck**.

GAUGE READING TO BE 225 PSI (15.5 bar) over system charge pressure (e.g. if charge pressure is 250 PSI (17.2 bar), counterbalance pressure should be 475 PSI (32.7 bar))**.**

7. Stop the engine and record test results.

8. Adjustment of the counterbalance valve can be performed as follows:

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

A. Loosen locknut on counterbalance valve (Fig. 25).

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

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

D. Tighten locknut to secure adjustment. After adjustment, recheck counterbalance pressure. Readjust as needed.

9. When testing is completed, disconnect pressure gauge from test port.

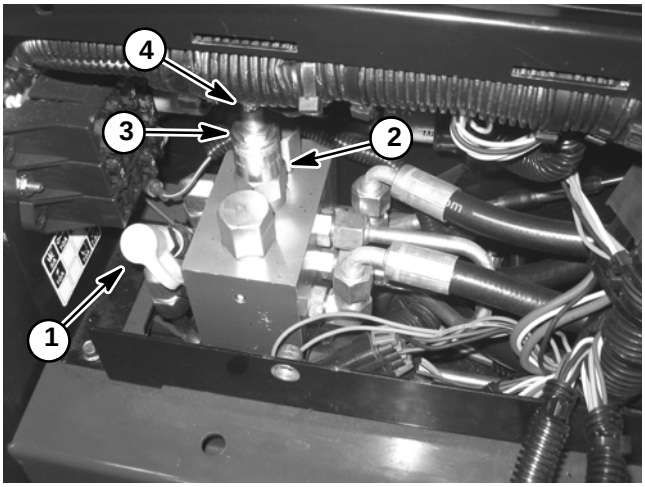
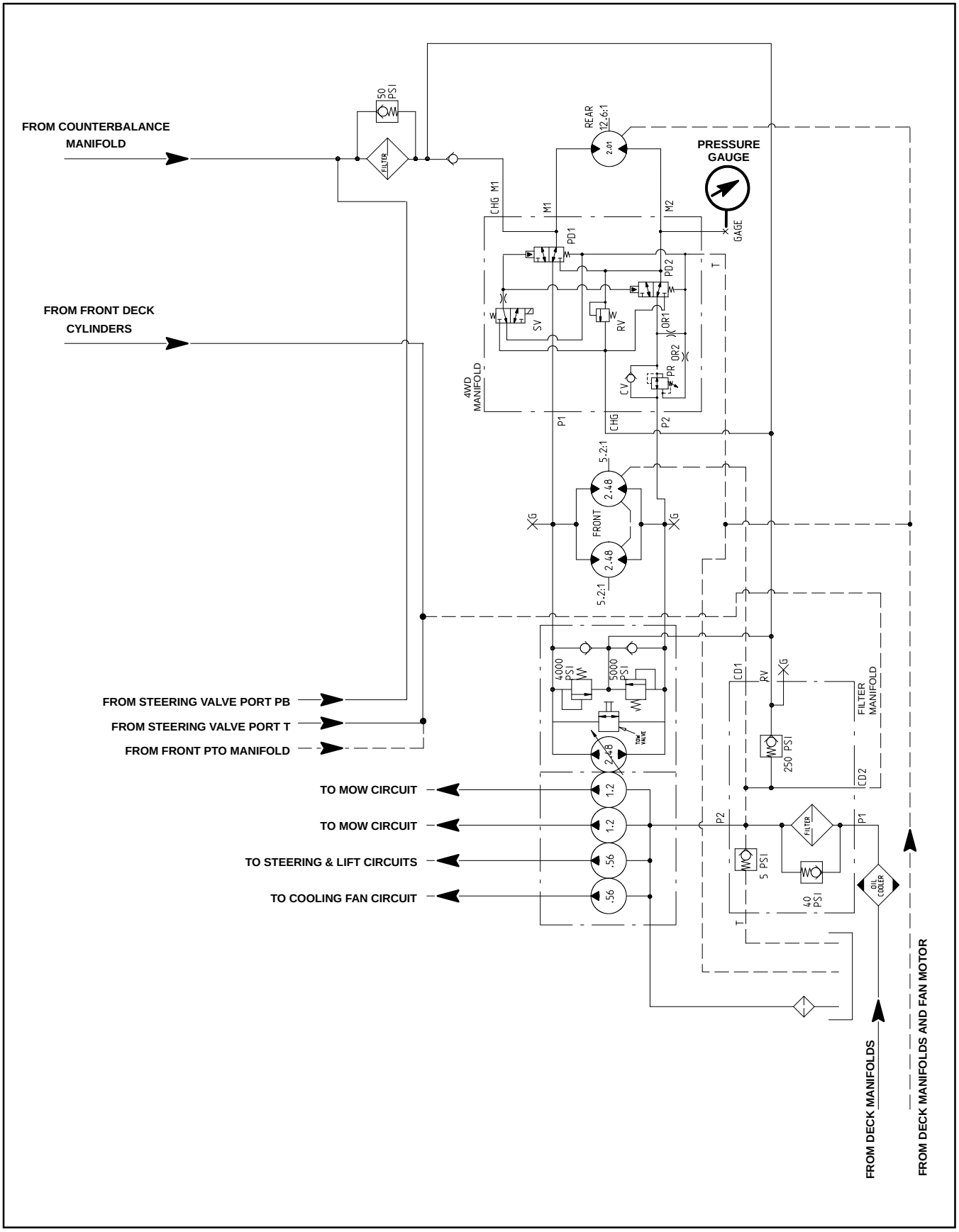


Figure 25

1. **Counterbalance test port**
2. **Counterbalance valve**
3. **Locknut**
4. **Adjusting screw**

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



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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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) gauge to test port on 4WD control manifold under radiator (Fig. 26).

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 **(2870 RPM)**.

6. Operate the machine in 4WD (not transport speed) with the cutting deck 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 750 PSI (52 bar) (approximate).

7. Relief valve (RV) is located on the lower, front side of the 4WD control manifold (Fig. 27). Adjustment of the relief valve can be performed as follows:

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

A. To **increase** relief pressure setting, remove cap on relief valve and turn the adjustment socket on the relief valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure (Fig. 28).

B. To **decrease** pressure setting, remove cap on relief valve and turn the adjustment socket on the relief valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure (Fig. 28).

C. Recheck relief pressure and readjust as needed.

8. When testing is completed, disconnect pressure gauge from test port.

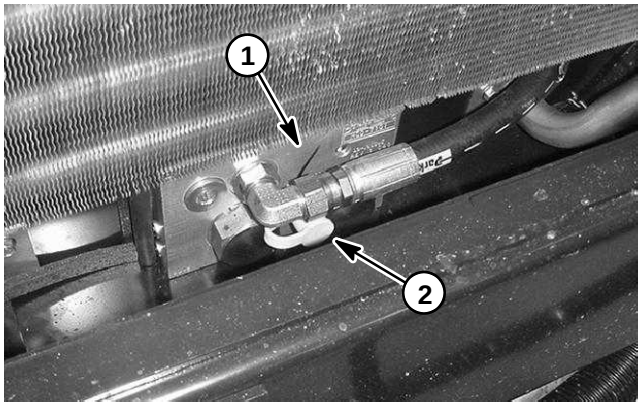


Figure 26

1. **4WD control manifold**
2. **Relief valve test port**

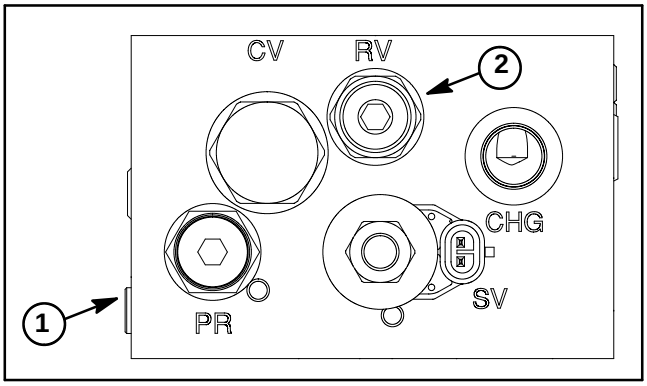


Figure 27

1. **Manifold: lower side**
2. **Relief valve (RV)**

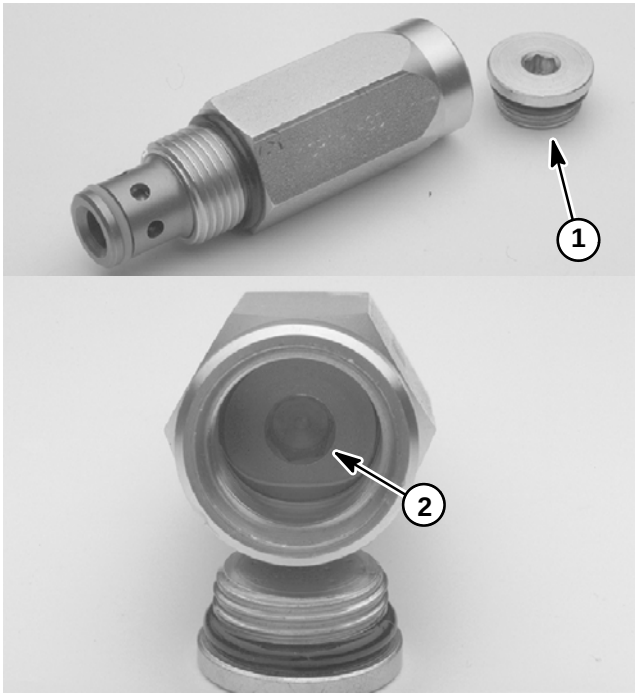
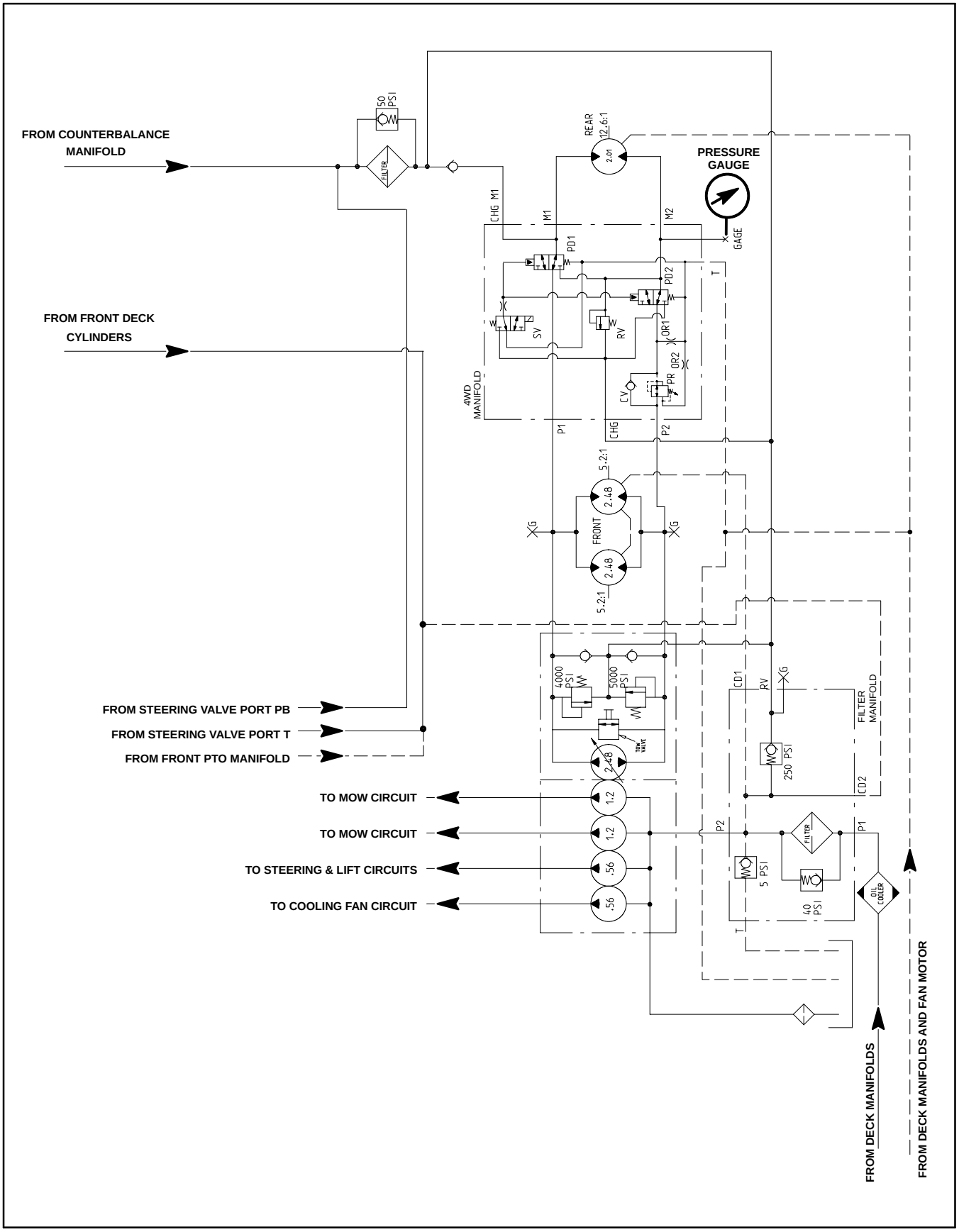


Figure 28

1. **Relief valve cap**
2. **Adjustment socket**

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



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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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) gauge to test port on 4WD control manifold under radiator (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 **(2870 RPM)**. Make sure that transport/4WD switch is in the 4WD position.

6. Sit on seat, apply 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. Pressure reducing valve (PR) is located on the front side of the 4WD control manifold (Fig. 30). Adjustment of this valve can be performed as follows:

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

   A. To **increase** pressure setting, remove cap on reducing valve and 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 setting.

   B. To **decrease** pressure setting, remove cap on reducing valve and 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 setting.

   C. Recheck reducing valve (PR) pressure setting and readjust as needed.

9. Disconnect pressure gauge from test port.

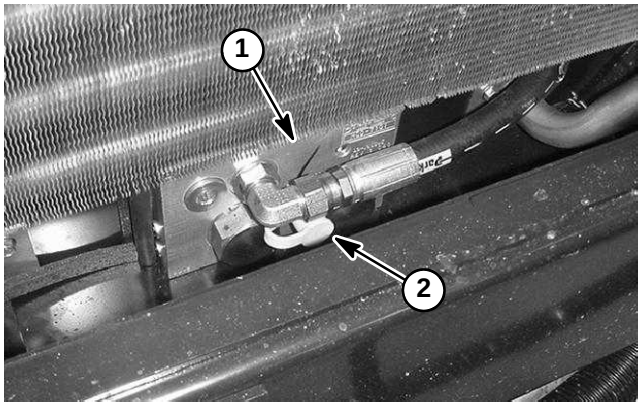


Figure 29

1. **4WD control manifold**
2. **Pressure test port**

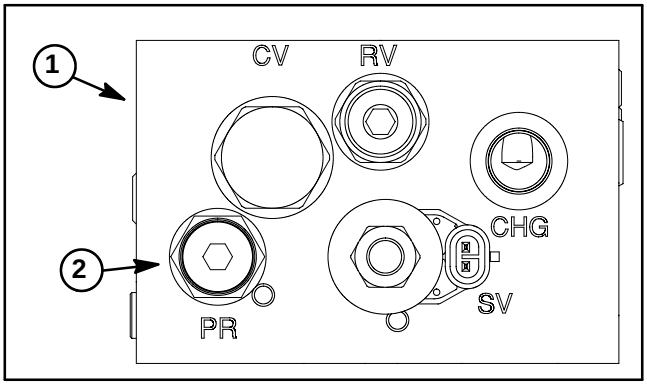
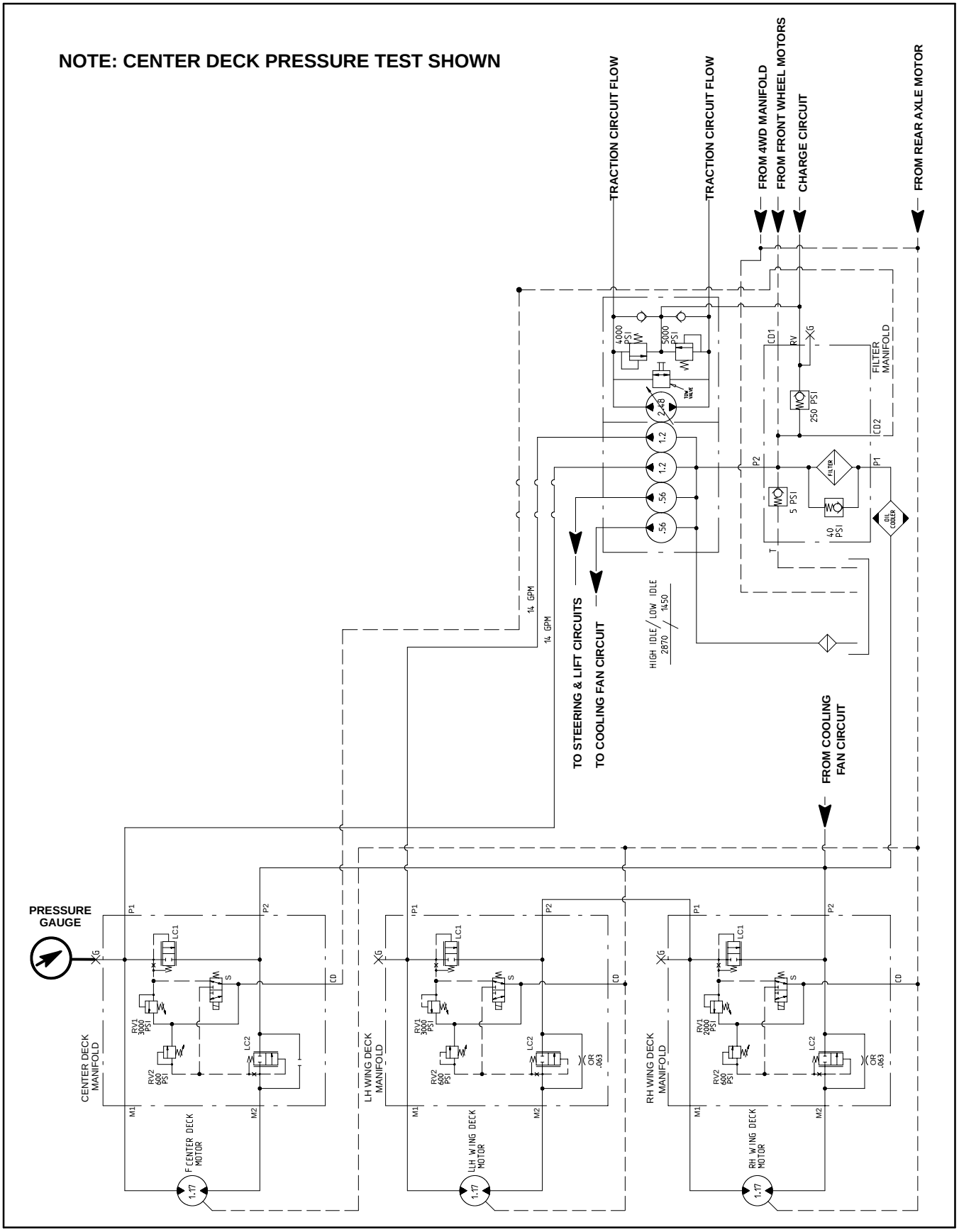


Figure 30

1. **Manifold: front side**
2. **Reducing valve (PR)**

Cutting Deck Circuit Pressure (Using Pressure Gauge)



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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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 for the deck to be tested (Fig. 31, 32 and 33).

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 deck during test to prevent personal injury from the cutting blades.

5. Operate engine at full speed **(2870 RPM)**. Engage the cutting deck.

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

7. Cutting deck circuit pressure should be as follows and will vary depending on mowing conditions:

LH Wing Deck: 1000 to 3000 PSI (69 to 207 bar)
Center Deck: 1000 to 3000 PSI (69 to 207 bar)
RH Wing Deck: 1000 to 2000 PSI (69 to 137 bar)

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

9. When testing is completed, disconnect test gauge with hose from manifold test port.

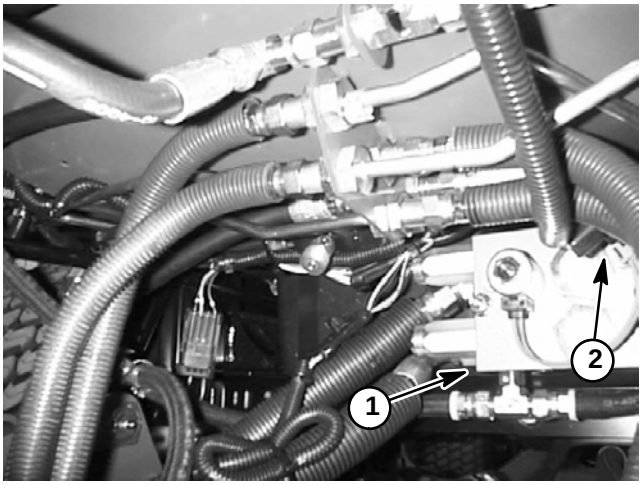


Figure 31

1. **Center deck hydraulic manifold**
2. **Center deck circuit pressure test port**

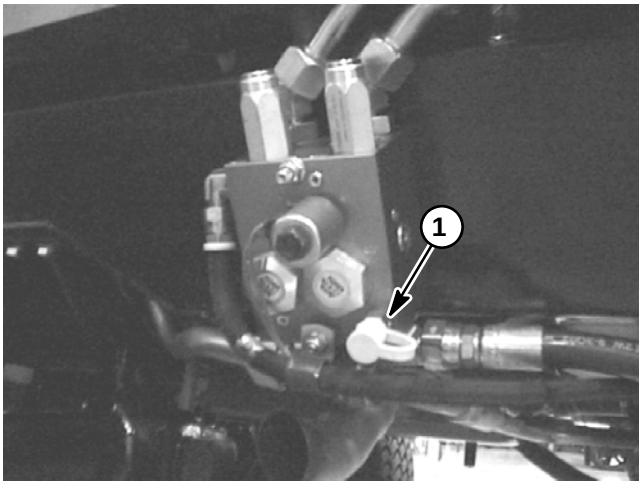


Figure 32

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

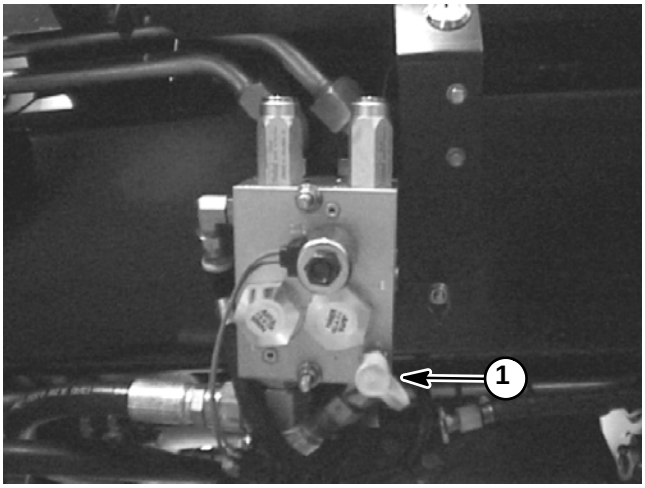
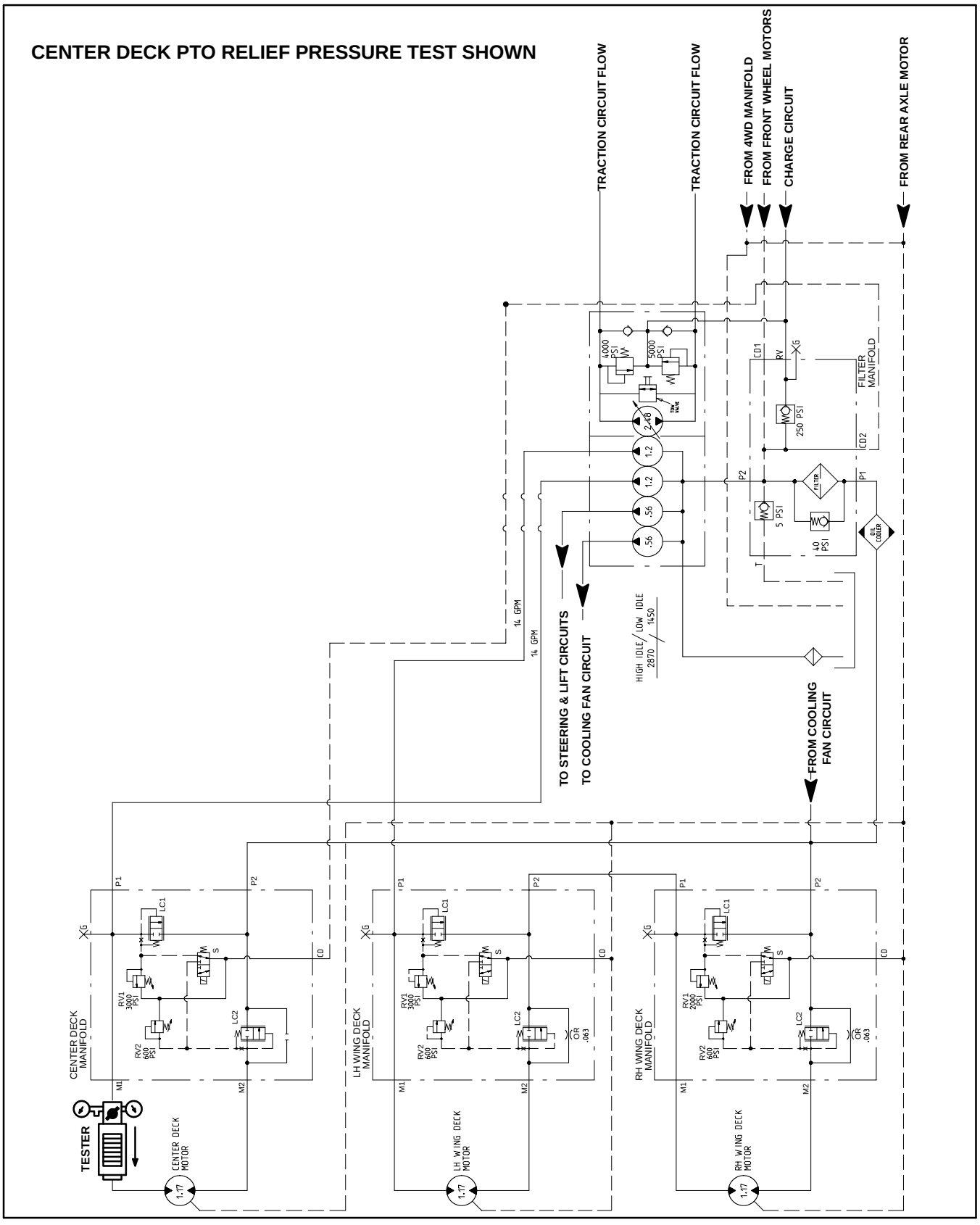


Figure 33

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

PTO Relief Pressure (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Cutting Deck Manifold 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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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. Locate deck manifold to be tested (Fig. 34). Disconnect hydraulic hose at deck manifold port (M1).

NOTE: An alternative to using manifold port (M1) would be to disconnect the inlet hydraulic hose at deck motor.

4. Install tester with pressure gauges and flow meter in series with the the disconnected hose and hydraulic manifold port (M1) (or motor inlet if hose was disconnected at deck motor).

5. **Make sure the flow control valve on tester is fully open.**

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

CAUTION

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

7. Operate engine at full speed **(2870 RPM)**. Engage the cutting deck.

8. Watch pressure gauge carefully while slowly closing the flow control valve to fully closed.

9. As the relief valve lifts, system pressure should be approximately:

2900 to 3100 PSI (200 to 213 bar) for the center deck and LH wing deck
1900 to 2100 PSI (131 to 144 bar) for the RH wing deck

10. Disengage cutting deck. Shut off engine and record test results.

11. If specification is **not** met, adjust or clean relief valve in deck manifold port (RV1). Adjust relief valve as follows:

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

A. Remove cap on relief valve with an allen wrench.

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

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

D. Install and tighten cap to secure adjustment. Recheck relief pressure and readjust as needed.

12. Disconnect tester from manifold and hose. Reconnect hydraulic hose that was disconnected for test procedure.

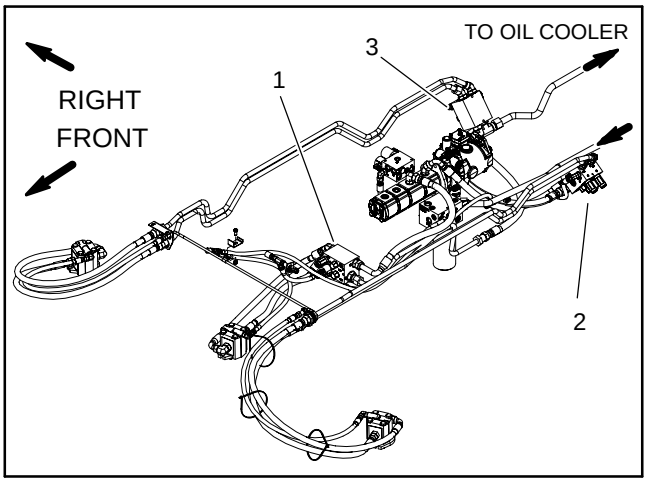


Figure 34

1. **Center deck manifold**
2. **LH wing deck manifold**
3. **RH wing deck manifold**

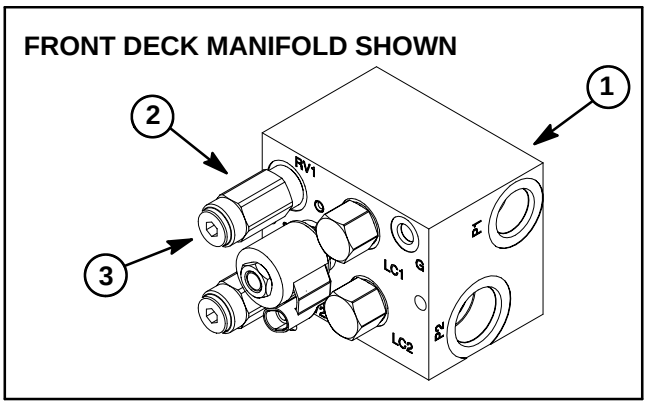
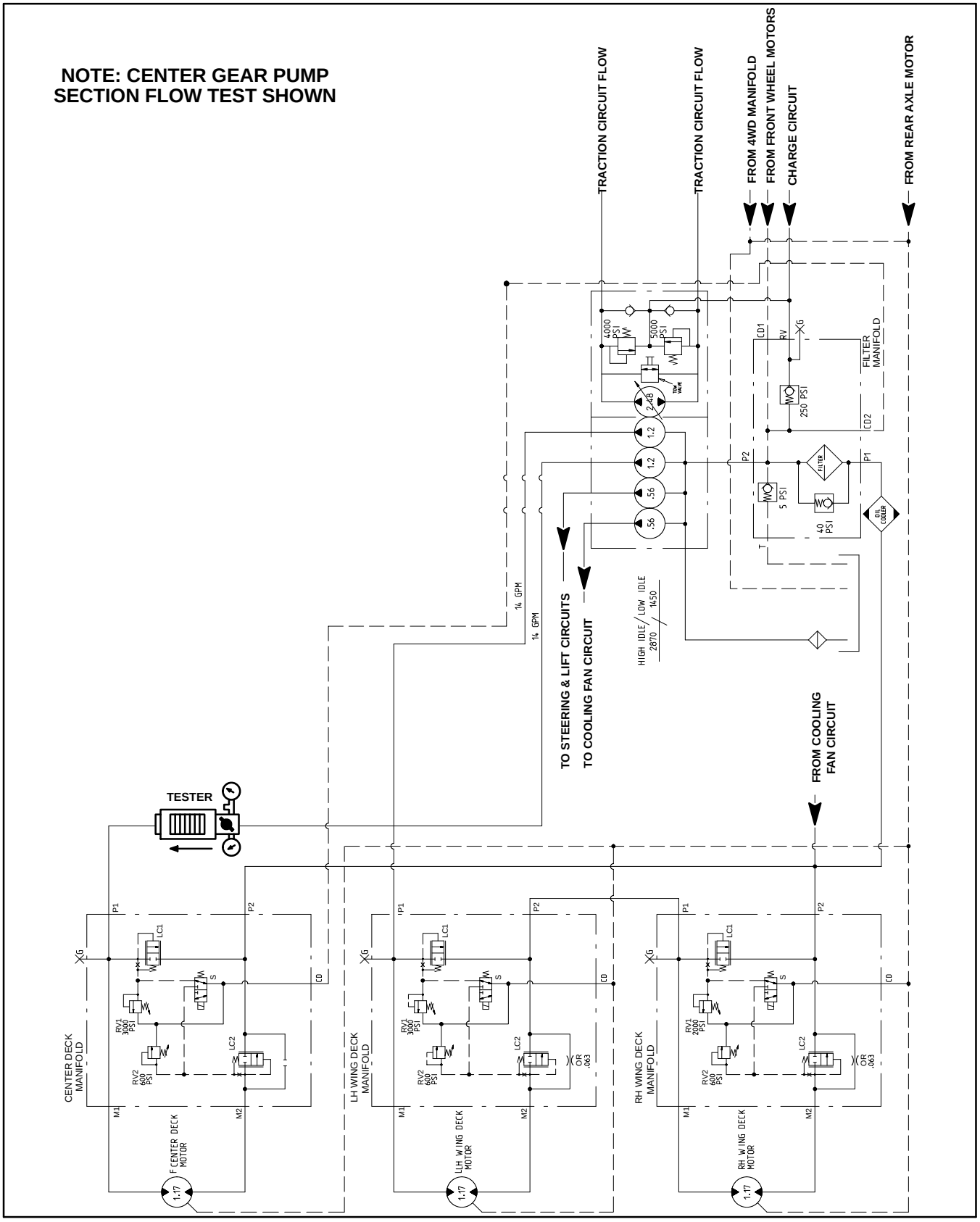


Figure 35

1. **Deck manifold**
2. **Relief valve**
3. **Relief valve cap**

Cutting Deck Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Cutting Deck Gear Pump Flow Test

NOTE: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by−pass oil and make the pump less efficient. Eventually, enough oil loss will occur to cause the cutting deck motors to stall under heavy cutting conditions. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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. Locate deck manifold for gear pump section to be tested. Disconnect hydraulic hose at deck manifold port (P1) (Fig. 36).

4. Install tester with pressure gauges and flow meter in series with the the disconnected hose and hydraulic manifold port (P1).

5. **Make sure the flow control valve on the tester is fully open.**

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

IMPORTANT: Do not run engine at full speed during testing. At full engine speed, cutting deck gear pump output can exceed 15 GPM and cause tester damage.

7. Using a phototac, adjust engine speed to **2400 RPM**. **Do not engage the cutting deck**.

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

8. Watch pressure gauge carefully while slowly closing the flow control valve until **2000 PSI** is obtained. Verify with a phototac that the **engine speed** is **2400 RPM**.

9. For a normal pump, gear pump flow should be approximately **14 GPM**. Shut off engine. Record test results.

10. If measured flow is **less than 12 GPM** or if a pressure of **2000 PSI** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove gear pump and repair or replace as necessary.

11. Disconnect flow tester from hydraulic hose and manifold port. Reconnect hose to the manifold.

12. Repeat test for second pump section if required.

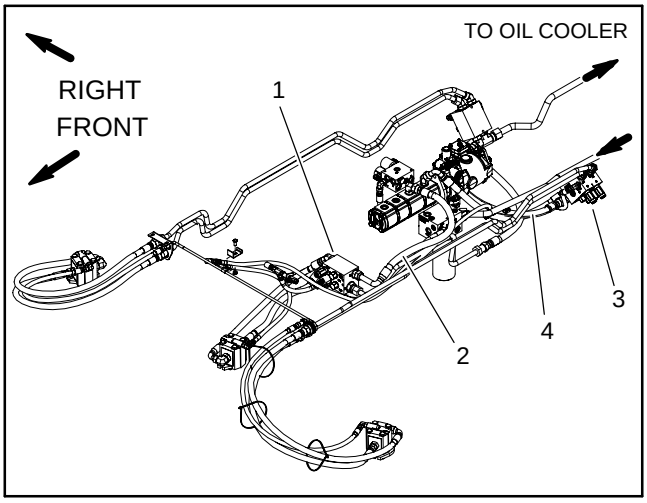


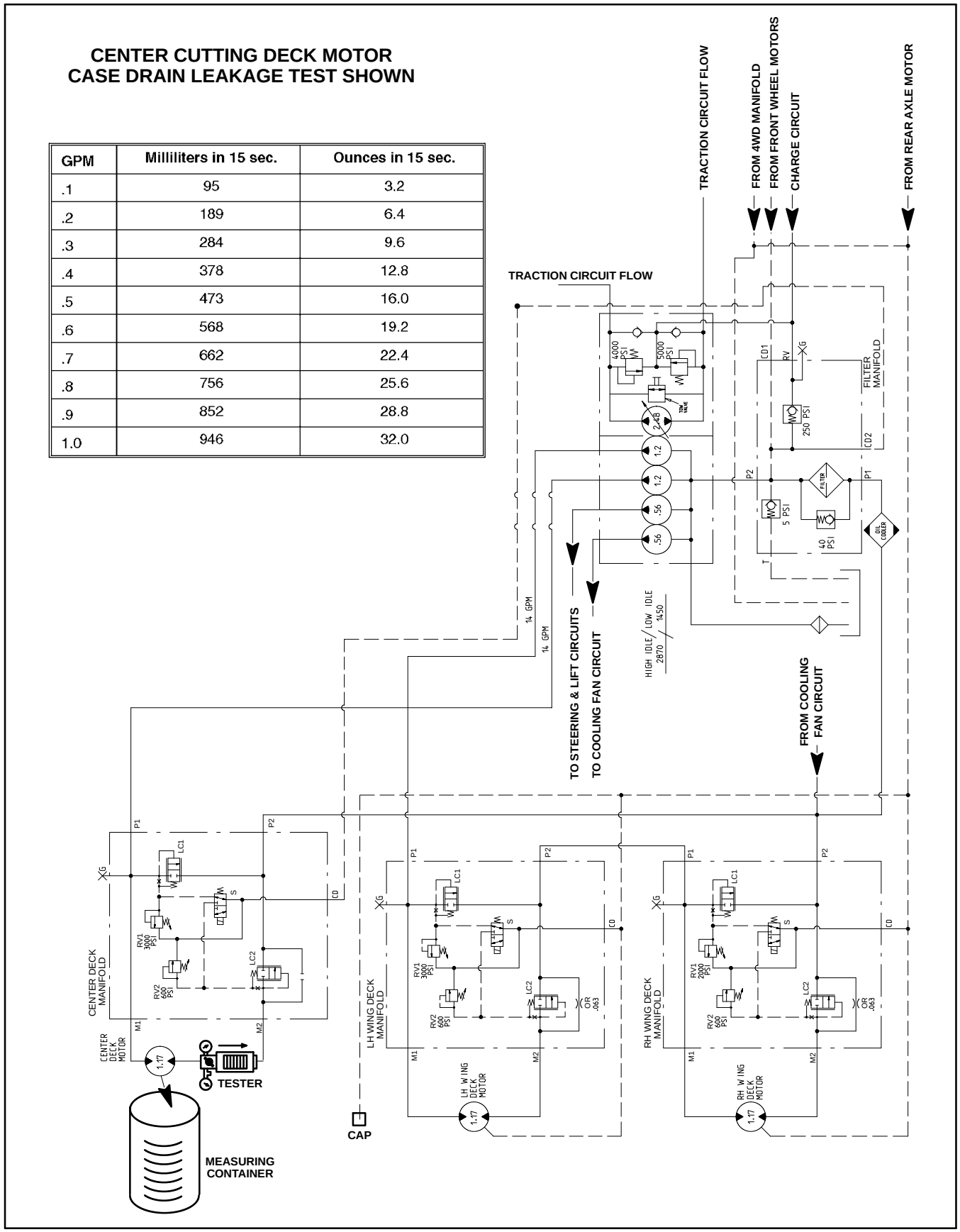
Figure 36

1. **Center deck manifold**
2. **Hyd. hose to front P1**
3. **LH wing deck manifold**
4. **Hyd. hose to side P1**

Cutting Deck Motor Case Drain Leakage (Using Tester with Pressure Gauges and Flow Meter)

CENTER CUTTING DECK MOTOR
CASE DRAIN LEAKAGE TEST SHOWN

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



Procedure for Cutting Deck Motor Case Drain Leakage Test

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

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

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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

CAUTION

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

NOTE: The wing deck motors are connected in series. To isolate a faulty motor, both motors in the circuit may have to be tested by starting with the left side motor first.

3. Disconnect return hose from the motor to be tested (Fig. 37). Install flow tester in series with the motor and the disconnected return hose. **Make sure the flow control valve on tester is fully open**.

4. Disconnect the motor case drain hose (small diameter hose) where it connects to the machine (not at the motor). Put a steel cap on the fitting; leave the case drain hose open (Fig. 38).

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

CAUTION

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

6. Sit on seat and operate the engine at full speed **(2870 RPM)**. Move PTO switch to ON.

7. While watching pressure gauge, slowly close flow control valve on tester until a pressure of **1200 PSI (83 bar)** is obtained.

NOTE: Use a graduated container, special tool TOR4077, to measure case drain leakage (Fig. 38).

8. Have another person measure flow from the case drain line for **15 seconds**, then move the PTO switch to OFF. Open the tester flow control valve and stop the engine. Record test results.

TEST RESULTS: Flow less than **22.2 ounces (662 ml)**.

9. If flow is more than **22.2 ounces (662 ml)**, the motor is worn or damaged and should be repaired or replaced.

10. After testing is completed, disconnect tester from motor and hose. Reconnect hose to the deck motor. Remove cap from machine fitting and reconnect case drain hose.

11. If required, repeat test procedure for other deck motors.

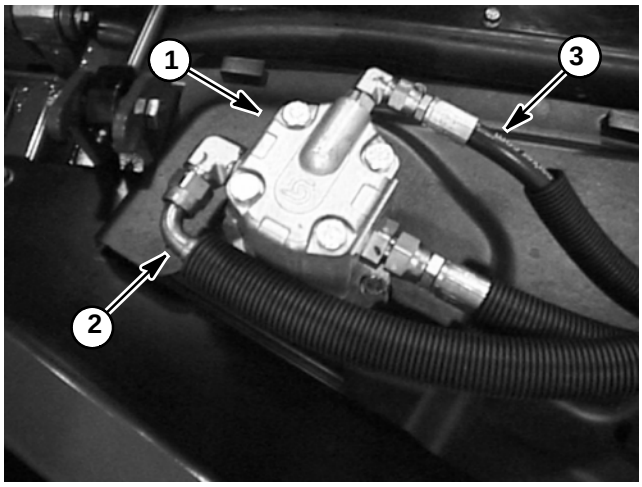


Figure 37

1. **Deck motor (RH shown)**
2. **Return hose**
3. **Case drain hose**

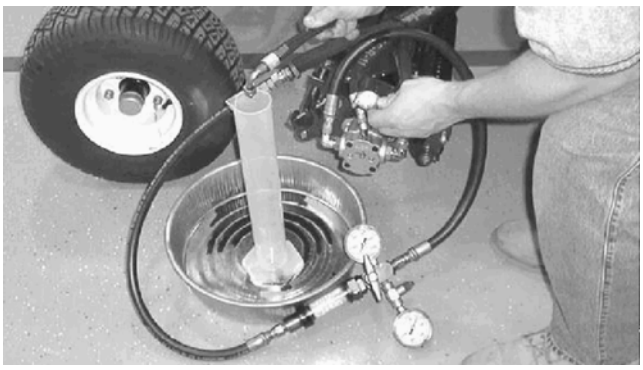
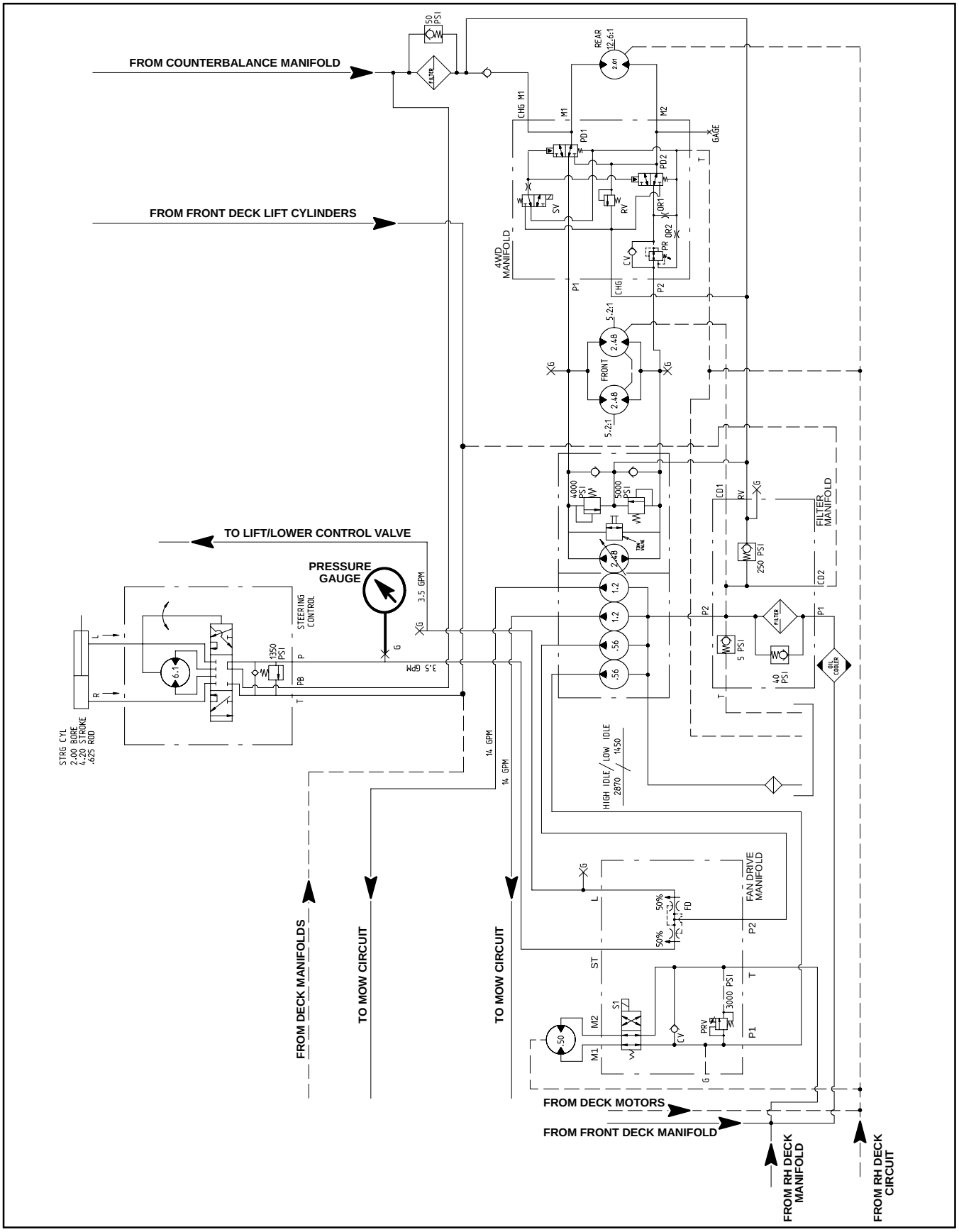


Figure 38

Steering Circuit Relief Pressure (Using Pressure Gauge)



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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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 onto steering circuit pressure test port (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 **(2870 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 will damage the steering motor.

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

   GAUGE READING TO BE 1300 to 1400 PSI (90 to 96 bar).

7. Stop the engine and record test results.

8. If pressure is incorrect, inspect steering relief valve in control valve (Fig. 40). If steering relief valve is operating properly and if lift/lower problems also exist, gear pump should be suspected of wear and inefficiency. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), steering cylinder or steering valve should be suspected of wear or damage.

9. When testing is completed, disconnect pressure gauge from test port.

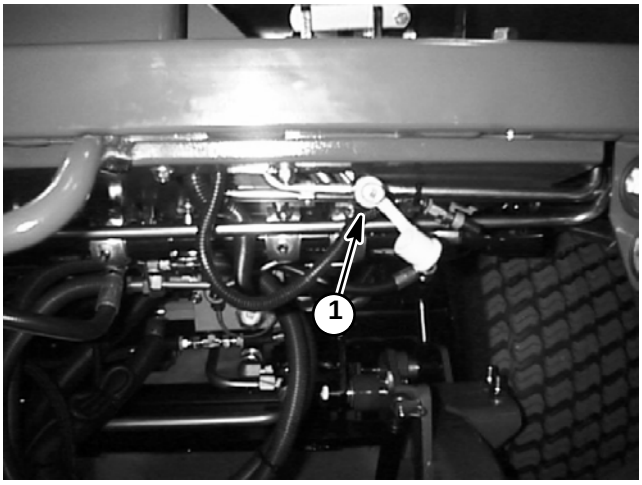


Figure 39

1. **Steering circuit pressure test port**

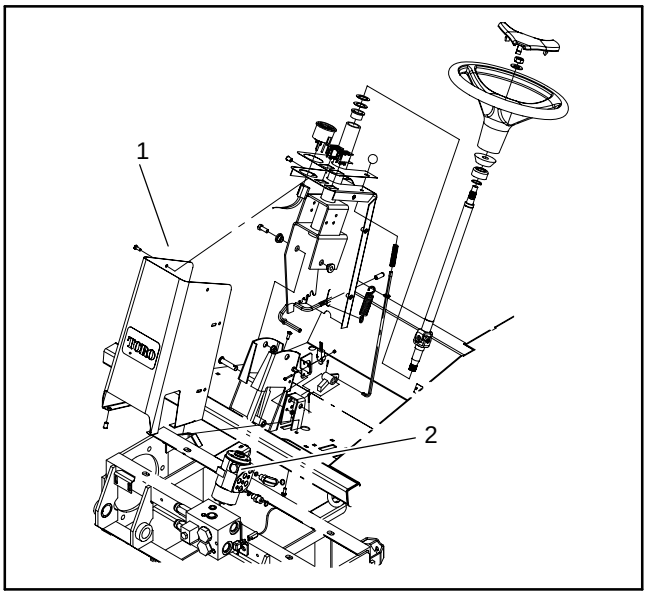
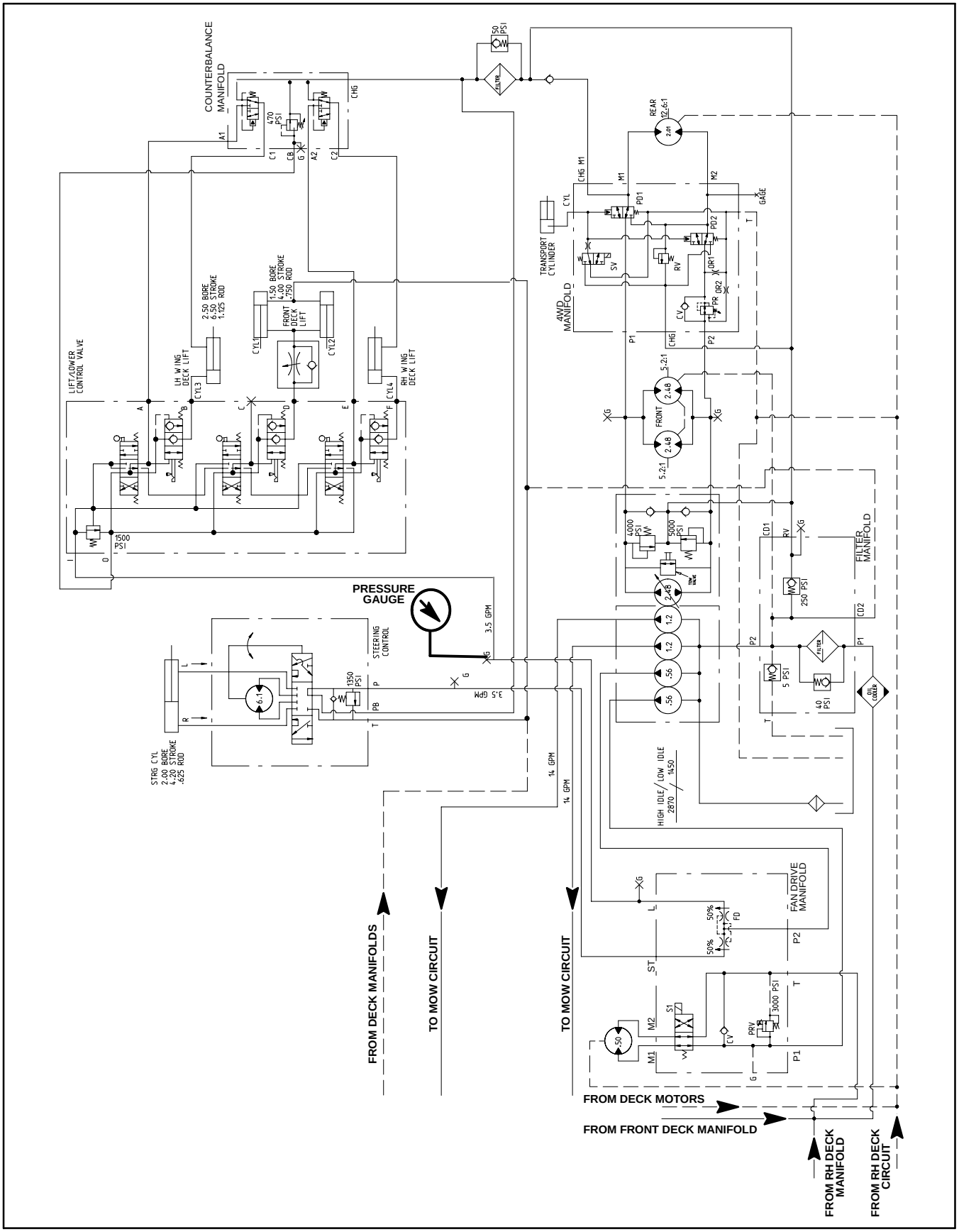


Figure 40

1. **Steering tower**
2. **Steering relief valve**

Lift/Lower Circuit Relief Pressure (Using Pressure Gauge)



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 deck lowered and off. Make sure engine is off and the parking brake is engaged.

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. Raise seat to gain access to hydraulic test fitting. Connect a 5,000 PSI (345 bar) gauge to lift circuit test port (Fig. 41). Route gauge hose to allow seat to be safely lowered.

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 **(2870 RPM)**.

6. While sitting on the seat, pull lift lever back to raise the cutting deck. Momentarily hold the lever with the lift cylinder fully retracted (deck fully raised) while looking at the gauge.

GAUGE READING TO BE 2500 to 2550 PSI (173 to 175 bar).

7. Stop the engine and record test results.

8. If pressure is too high, adjust relief valve in lift control valve by rotating counterclockwise (Figure 42). If pressure is too low, check for restriction in pump intake line. Check the lift cylinder for internal leakage. If cylinder is not leaking, adjust the relief valve by rotating clockwise. If pressure is still too low, pump or lift cylinder(s) should be suspected of wear, damage or inefficiency.

9. When testing is completed, disconnect pressure gauge from test port.

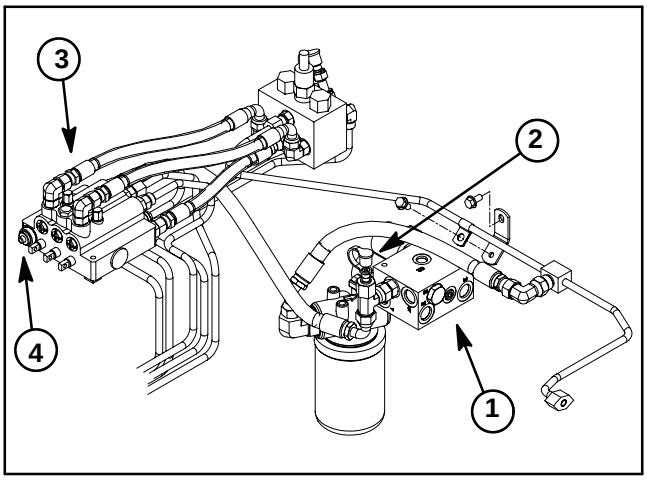


Figure 41

1. **Fan drive manifold**
2. **Lift circuit test port**
3. **Lift control valve**
4. **Relief valve**

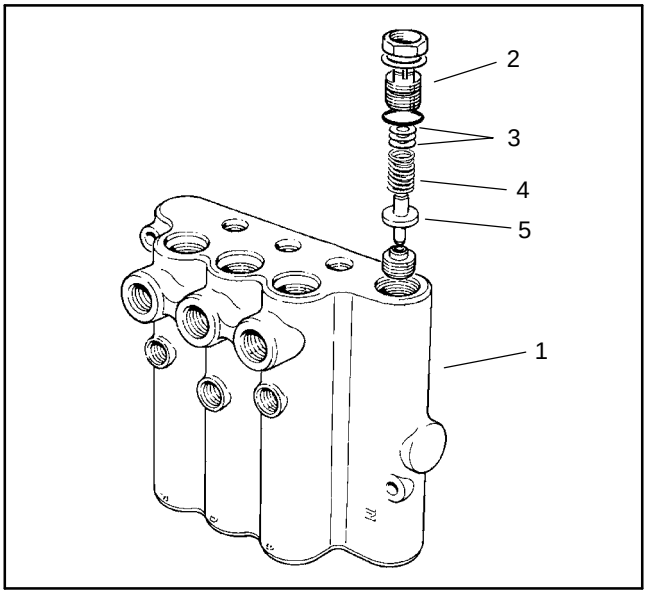
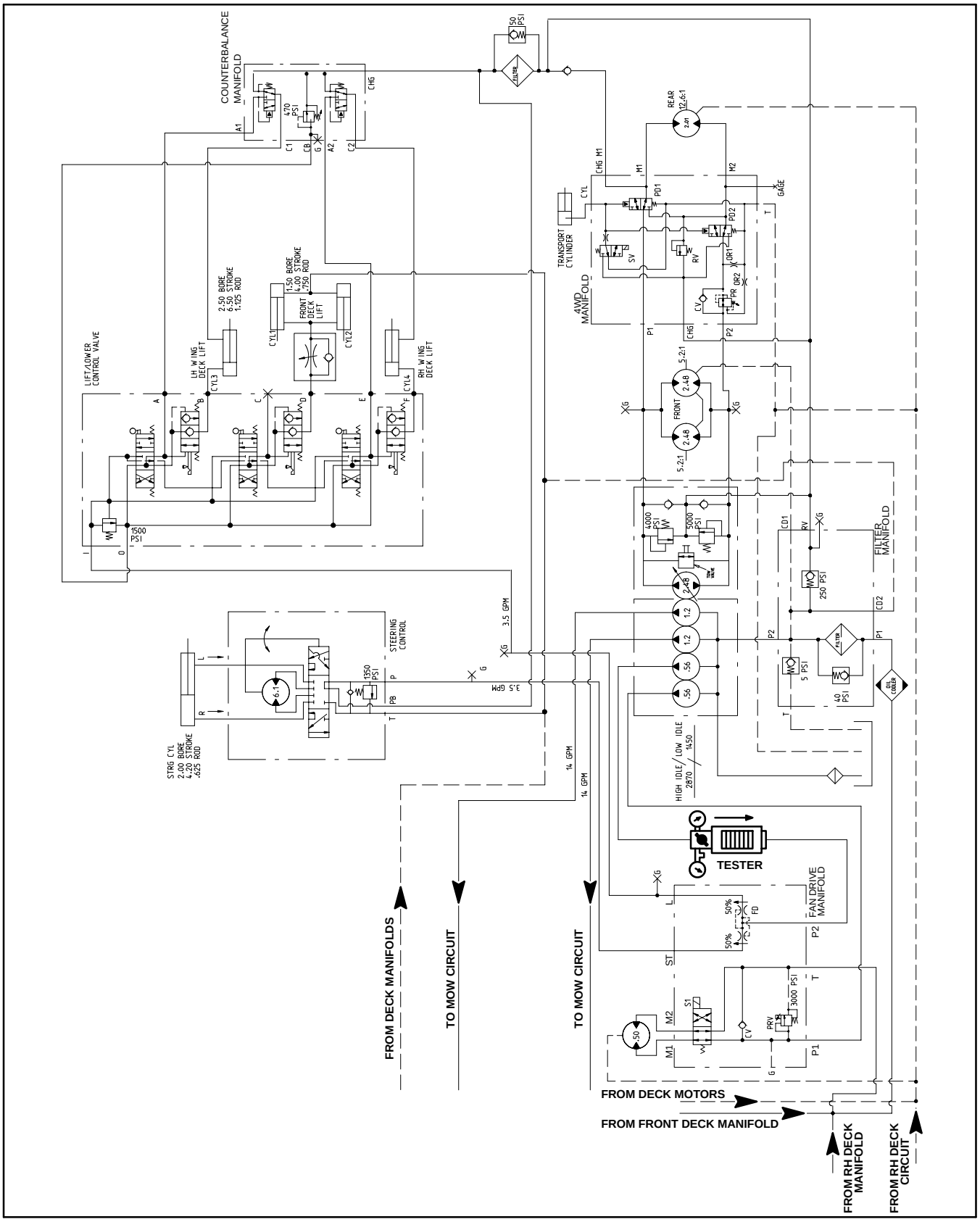


Figure 42

1. **Control valve assembly**
2. **Relief valve assembly**
3. **Washers**
4. **Spring**
5. **Poppet**

Steering and Lift/Lower Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Steering and Lift/Lower Gear Pump Flow Test

Output from the steering and lift/lower gear pump section is equally divided by a proportional valve to provide flow to the steering circuit and the lift circuit. To test gear pump flow, testing of both steering and lift/lower circuits is required. Total gear pump flow is the combined flow from the two circuits.

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 deck lowered and off. Make sure engine is off and the parking brake is engaged. Raise seat.

CAUTION

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

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

3. With the engine off and cutting deck lowered, disconnect the hydraulic hose from the 90º fitting in the third gear pump section which supplies the steering and lift/lower circuits (Fig. 43).

4. Install tester in series between the fitting and the disconnected hose. Make sure the tester flow control valve is OPEN.

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.

5. Start the engine and move throttle to full speed **(2870 RPM)**. DO NOT engage the cutting deck.

6. While watching pressure gauges, slowly close flow control valve until **1000 PSI (69 bar)** is obtained on gauge. Verify engine speed continues to be **2870 RPM**.

GAUGE READING TO BE: Flow approximately **7 GPM (26.3 LPM)** at **1000 PSI (69 bar)**.

7. Stop engine and record test results.

8. If a pressure of **1000 PSI (69 bar)** could not be obtained or flow is lower than **6 GPM (22.3 LPM)** (85% of expected flow), check for restriction in pump intake line. If intake line is not restricted, consider that gear pump is worn or damaged.

9. When testing is complete, remove tester and reconnect hose to pump fitting.

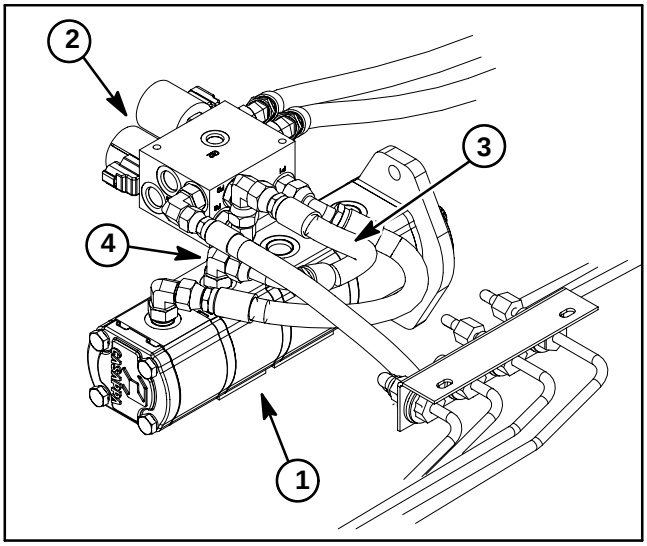
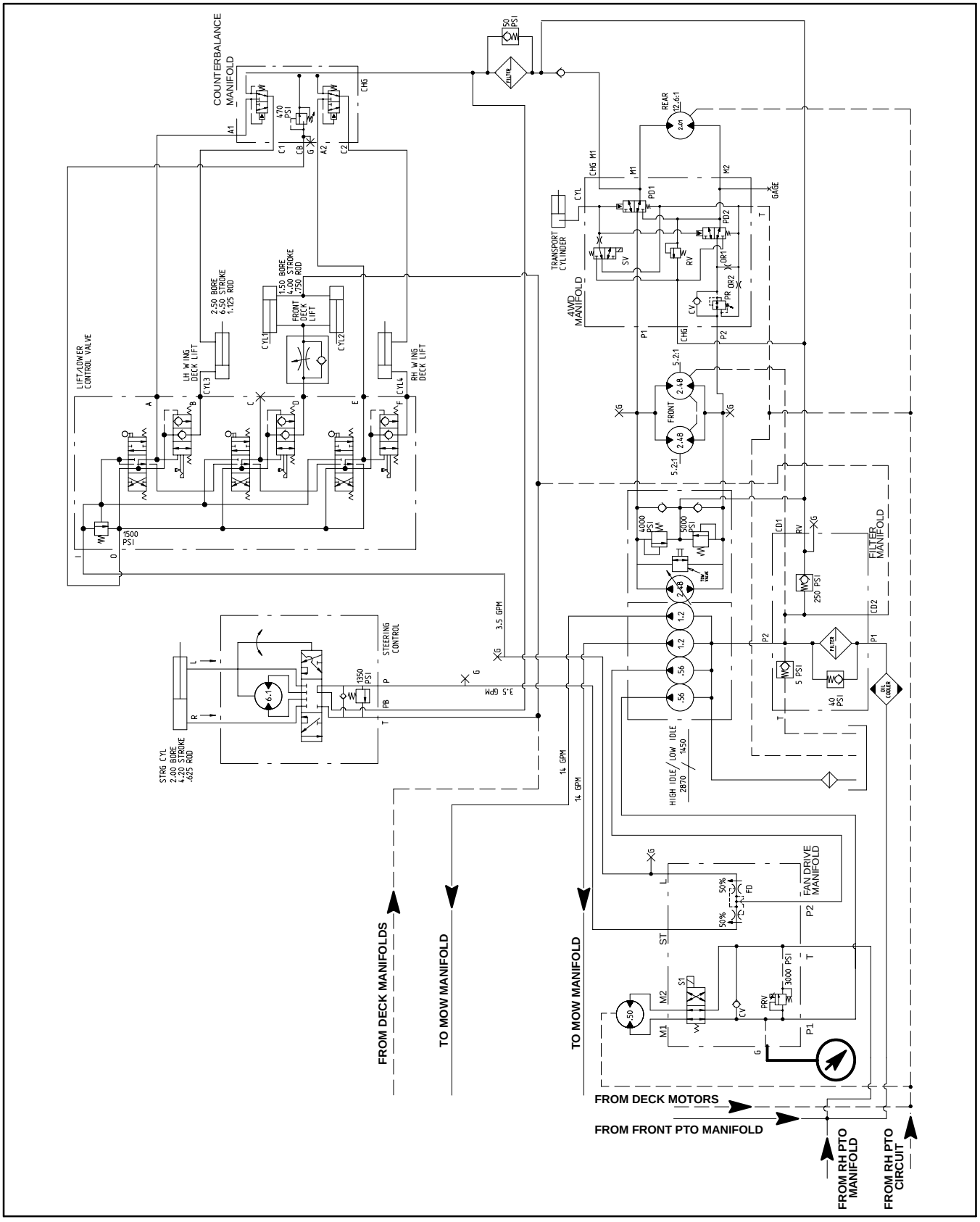


Figure 43

1. **Gear pump**
2. **Fan drive manifold**
3. **Steering/lift hose**
4. **90º fitting**

Engine Cooling Fan Circuit (Using Pressure Gauge and Phototac)



Procedure for Engine Cooling Fan Circuit 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 and support 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. Raise seat to gain access to cooling fan circuit test port at the fan drive manifold (Fig. 44). Connect a 5,000 PSI (345 bar) gauge with hydraulic hose attached to test port on top of manifold.

4. Start the engine. Move throttle to full speed **(2870 RPM)**.

5. While monitoring the pressure gauge and using a phototac to identify the cooling fan speed, disconnect the wire harness connector (white/green and black wires) from the PRV solenoid on fan drive manifold. Both fan speed and pressure should increase and stabilize after the solenoid is disconnected.

   PRESSURE GAUGE READING TO BE approximately **3000 PSI (207 bar)**.

   PHOTOTAC READING TO BE: fan speed approximately **2800 RPM**.

6. Stop engine and record test results.

7. If pressure rises to approximately **3000 PSI (207 bar)** but fan speed is low, consider that the fan motor is worn or damaged. If pressure and fan speed are both low, consider that the gear pump is worn or damaged (see Engine Cooling Circuit Gear Pump Flow Test).

NOTE: If pressure and fan speed are both low and gear pump flow proves to be correct, suspect that seals in fan drive manifold are leaking or faulty (see Fan Drive Manifold Service in the Service and Repairs section of this chapter).

8. When testing is complete, remove pressure gauge and reconnect wire harness to PRV solenoid.

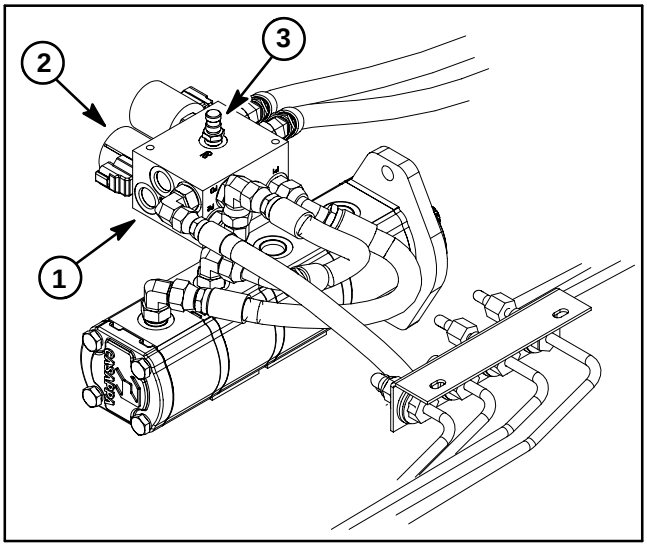
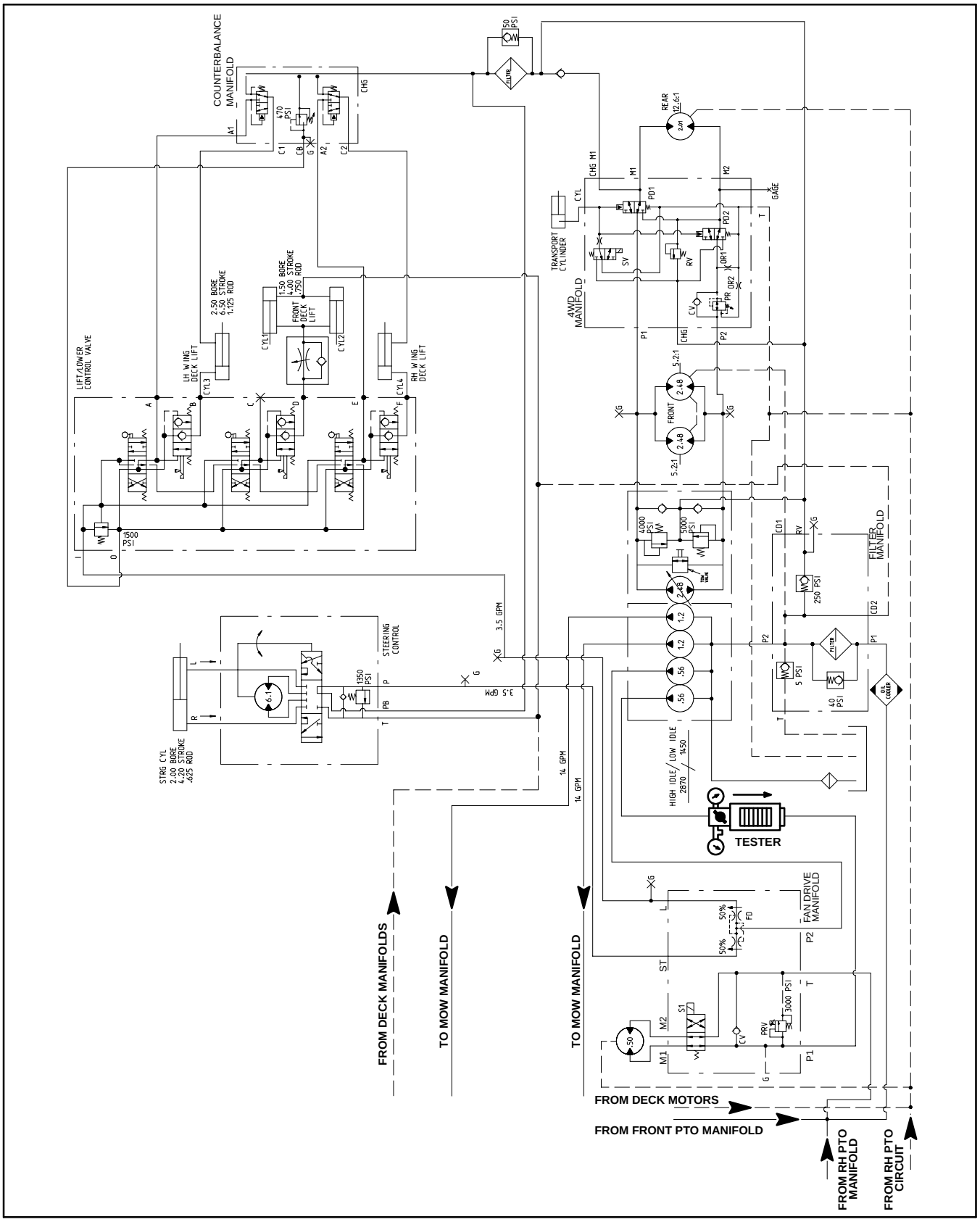


Figure 44

1. **Fan drive manifold**
2. **PRV solenoid**
3. **Test port**

Engine Cooling Fan Circuit Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Engine Cooling Fan Circuit Gear Pump 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 deck 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.

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

3. With the engine off and cutting deck lowered, disconnect the hydraulic hose from the 90º fitting in the last gear pump section which supplies the engine cooling circuit (Fig. 43).

4. Install tester in series between the fitting and the disconnected hose. Make sure the tester flow control valve is OPEN.

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.

5. Start the engine and move throttle to full speed **(2870 RPM)**. DO NOT engage the cutting deck.

6. While watching tester pressure gauges, slowly close flow control valve until **1000 PSI (69 bar)** is obtained on pressure gauge. Verify engine speed continues to be **2870 RPM**.

GAUGE READING TO BE: Flow approximately **7 GPM (26.3 LPM)** at **1000 PSI (69 bar)**.

7. Stop engine and record test results.

8. If a pressure of **1000 PSI (69 bar)** could not be obtained or flow is lower than **6 GPM (22.3 LPM)** (85% of expected flow), check for restriction in pump intake line. If intake line is not restricted, consider that gear pump is worn or damaged.

9. When testing is complete, remove tester and reconnect hose to pump fitting.

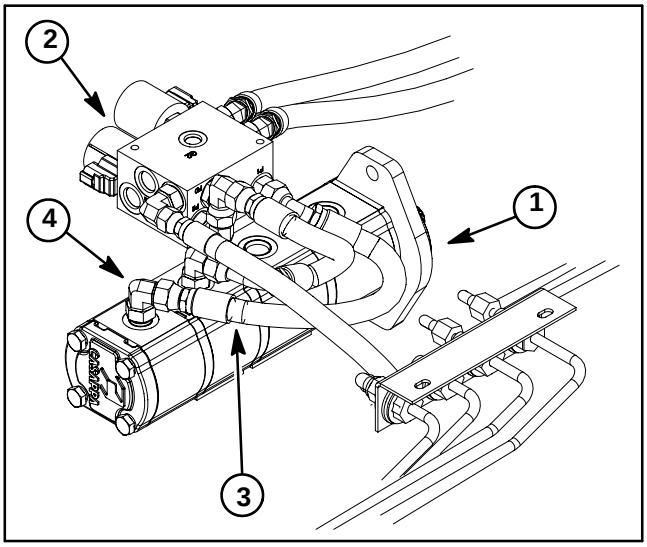


Figure 45

1. **Gear pump**
2. **Fan drive manifold**
3. **Engine cooling hose**
4. **90º fitting**

Adjust Cutting Deck Flow Control Valve

The cutting deck lift circuit is equipped with an adjustable flow control valve used to adjust the rate at which the cutting deck lowers. The control valve is located under the front platform.

Adjust flow control valve as follows:

1. Run machine to get hydraulic oil at operating temperatures. Park machine on a level surface, shut engine off and lower cutting deck to the ground.

2. Locate valve under front of machine (Fig. 46).

3. Loosen set screw on valve and rotate valve clockwise to slow drop rate of cutting deck.

4. Verify adjustment by raising and lowering cutting deck several times. Readjust as required.

5. After desired drop rate is attained, tighten set screw on flow control valve to secure adjustment.

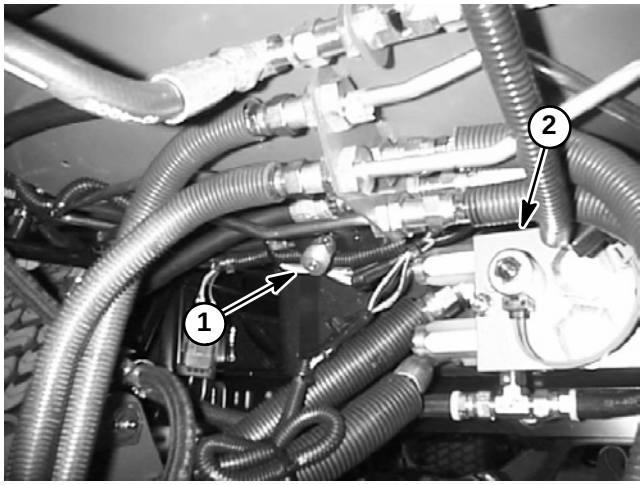


Figure 46

1. **Cutting deck lift flow control valve**
2. **Front deck hydraulic manifold**

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, engage parking brake, lower cutting deck 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 when pressure has been relieved. Remove key from the ignition switch.

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

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 deck to the ground, stop engine and engage parking brake. Remove key from the ignition switch.

CAUTION

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

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

2. Drain hydraulic reservoir.

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

4. Change and replace both hydraulic oil filters.

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

6. Connect 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.

8. Disconnect wire harness connector from engine run solenoid.

9. Turn ignition key switch and engage starter for ten (10) seconds to prime hydraulic pumps. Repeat this step again.

10. Connect wire harness connector to engine run solenoid.

11. Start engine and let it run at low idle **(1450 RPM)** for a minimum of 2 minutes. Increase engine speed to high idle **(2870 RPM)** for a minimum of 1 minute under no load.

12. Raise and lower cutting deck several times. Turn steering wheel fully left and right several times.

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

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

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

16. 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. Park machine on a level surface. Lower cutting deck to the ground, stop engine and engage parking brake. 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.

5. Check control rod to the piston (traction) pump for proper adjustment, binding or broken parts.

6. Disconnect wire harness connector from engine run solenoid to prevent the engine from starting.

7. Make sure traction pedal and lift control lever are in the neutral position. Turn ignition key switch and engage starter for ten (10) seconds to prime the traction and gear pumps. Repeat this step again.

8. Connect wire harness connector to engine run solenoid.

WARNING

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

9. Raise one front and one rear wheel off the ground and place support blocks under the frame. Chock remaining wheels to prevent movement of the machine.

10. Make sure traction pedal and lift control lever are in neutral. Start engine and run it at low idle **(1400 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.

11. After the hydraulic system starts to show signs of fill, actuate lift control lever until the lift cylinder rod moves in and out several times. If the cylinder rod does not move after fifteen (15) seconds or the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:

    A. Loose filter or suction lines.

    B. Blocked suction line.

    C. Faulty charge relief valve.

    D. Faulty gear pump.

12. If cylinder does move in 15 seconds, proceed to step 13.

13. 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 check for proper hose connections at traction pump and motors. Correct as needed.

    B. If the wheels rotate in the proper direction, stop engine.

14. Adjust traction pedal to the neutral position.

15. Check operation of the traction interlock switch.

16. Remove blocks from frame and lower machine to the ground. Remove chocks from remaining wheels.

17. If the piston (traction) pump or a wheel or axle motor was replaced or rebuilt, run the machine so all wheels turn slowly for 10 minutes.

18. Operate machine by gradually increasing it's work load to full over a 10 minute period.

19. Stop the machine. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

Hydraulic Reservoir

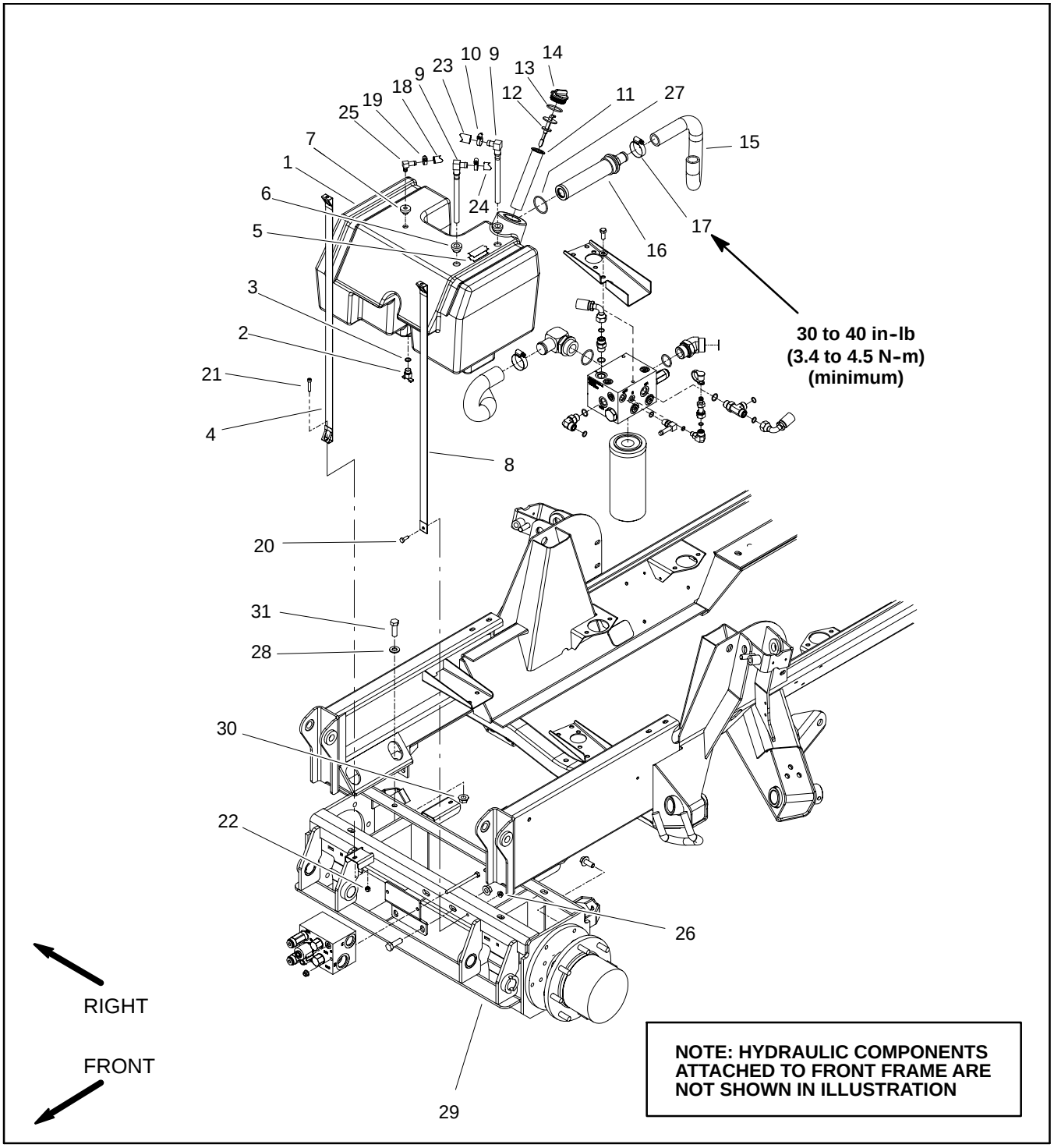


Figure 47

1. Hydraulic reservoir
2. Petcock
3. O-ring
4. Strap
5. Felt strap (2 used)
6. Bushing (2 used)
7. Bushing
8. Strap
9. Stand pipe (2 used)
10. Hose clamp (2 used)
11. Screen filter
12. Dipstick
13. O-ring
14. Reservoir cap
15. Suction hose
16. Tank strainer
17. Hose clamp
18. Hose
19. Hose clamp
20. Cap screw
21. Socket head screw (3 used)
22. Lock nut (3 used)
23. Hose
24. Hose
25. Elbow fitting
26. Flange nut
27. O-ring
28. Flat washer (4 used)
29. Front frame
30. Flange nut (4 used)
31. Cap screw (4 used)

NOTE: The front frame needs to be lowered from the main frame to allow clearance to remove the hydraulic reservoir from the machine.

Removal (Fig. 47)

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

2. Remove front cutting deck (see Cutting Deck Removal in the Service and Repairs section of Chapter 8 – Cutting Deck).

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. Drain reservoir into a suitable container.

5. Disconnect hydraulic hoses from reservoir. Label disconnected hydraulic lines for proper installation.

6. Remove straps (items 4 and 8) that secure reservoir to front frame. Remove felt straps (item 3) from between straps and reservoir.

7. To allow front frame to be lowered for reservoir removal, remove hydraulic tubes that connect hydraulic components on front frame (wheel motors and front deck PTO manifold) to components on main frame. Put caps or plugs on open hydraulic lines and fittings.

8. Chock rear wheels to prevent the machine from moving. Use jack or hoist to raise front of machine and support machine with jackstands.

9. Support front frame to prevent it from moving.

10. Remove cap screws (item 31), flat washers (item 28) and flange nuts (item 30) that secure front frame to main frame.

11. Carefully lower front frame assembly to allow clearance for reservoir removal. Once lowered, support front frame to prevent it from shifting.

12. Carefully remove hydraulic reservoir from machine.

Inspection

1. Clean hydraulic reservoir and suction strainer with solvent.

2. Inspect for leaks, cracks or other damage.

Installation (Fig. 47)

1. Using a wrench, turn tank strainer into port at least 1–1/2 to 2 full turns beyond finger tight.

2. Position reservoir to machine.

3. Carefully raise front frame assembly to main frame. Align frame mounting holes and support front frame to prevent it from moving.

4. Secure front frame to main frame with cap screws (item 31), flat washers (item 28) and flange nuts (item 30).

5. Lower machine to ground.

6. Position felt straps (item 3) between straps and reservoir. Secure reservoir to front frame with straps (items 4 and 8).

7. Remove caps and plugs from hydraulic lines and fittings that were placed during the removal process. Using labels placed during removal, connect hydraulic hoses and tubes to fittings on reservoir, wheel motors and hydraulic manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

8. Install front cutting deck (see Cutting Deck Installation in the Service and Repairs section of Chapter 8 – Cutting Deck).

9. Fill reservoir with new hydraulic fluid to proper level.

10. Properly fill hydraulic system (see Charge Hydraulic System in this section).

11. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

Hydraulic Oil Cooler

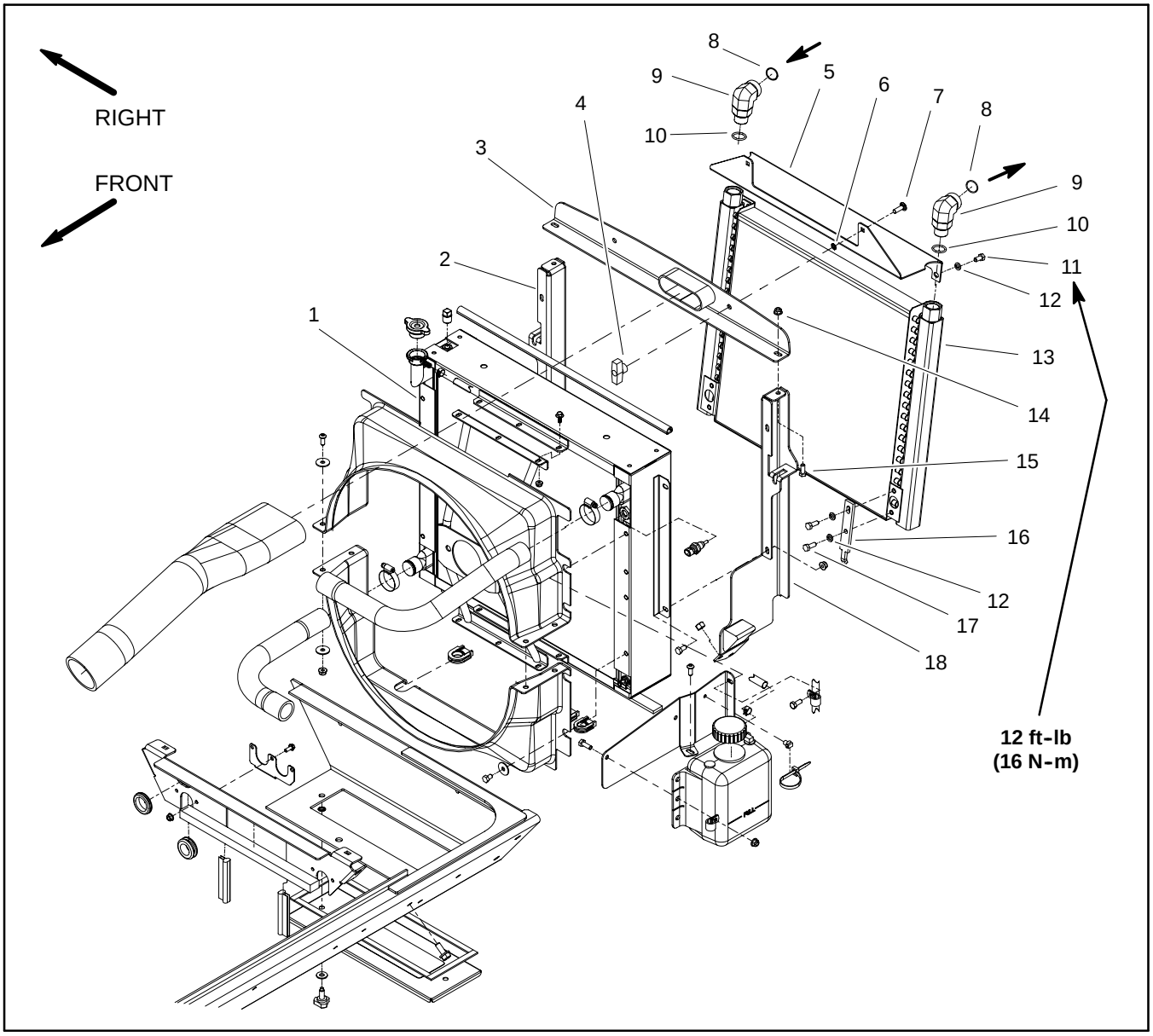


Figure 48

1. **Radiator**
2. **RH radiator support**
3. **Top radiator support**
4. **Knob (2 used)**
5. **Oil cooler bracket**
6. **Retaining ring (2 used)**
7. **Carriage screw (2 used)**
8. **O-ring**
9. **90º hydraulic fitting (2 used)**
10. **O-ring**
11. **Cap screw (2 used)**
12. **Lock washer (6 used)**
13. **Oil cooler**
14. **Flange nut (2 used)**
15. **Cap screw(2 used)**
16. **Oil cooler mount plate (2 used)**
17. **Cap screw (4 used)**
18. **LH radiator support**

Removal (Fig. 48)

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 deck, 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 oil cooler using Figures 48 as a guide.

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 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. 48)

1. Install oil cooler using Figures 48 as a guide.

2. Fill reservoir with hydraulic fluid as required.

Gear Pump

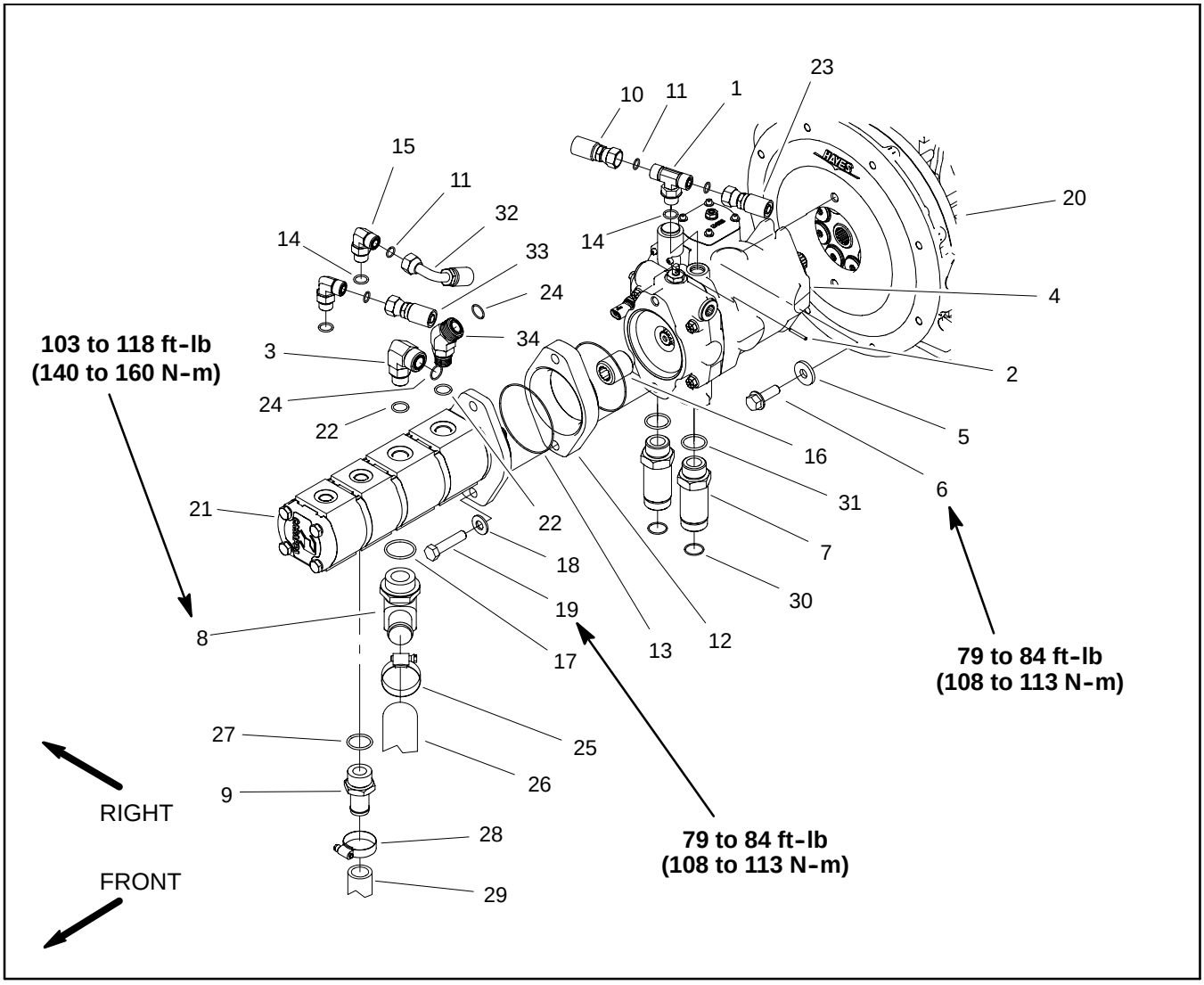


Figure 49

1. Hydraulic tee fitting
2. Roll pin
3. 90° hydraulic fitting
4. Piston pump
5. Flat washer (2 used)
6. Cap screw (2 used)
7. Hydraulic fitting (2 used)
8. 90° hydraulic fitting
9. Hydraulic fitting
10. Hydraulic hose
11. O-ring
12. Pump spacer
13. O-ring (2 used)
14. O-ring
15. 90° hydraulic fitting (2 used)
16. Pump coupler
17. O-ring
18. Flat washer (2 used)
19. Cap screw (2 used)
20. Engine
21. Gear pump
22. O-ring
23. Hydraulic hose
24. O-ring
25. Hose clamp
26. Hydraulic hose
27. O-ring
28. Hose clamp
29. Hydraulic hose
30. O-ring
31. O-ring
32. Hydraulic hose
33. Hydraulic hose
34. Hydraulic fitting

Removal (Fig 49)

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

2. Raise seat and secure it with prop rod to gain access to gear pump.

3. Drain the hydraulic reservoir.

4. To prevent contamination of hydraulic system during pump removal, thoroughly clean exterior of pump and fittings.

5. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this section.

6. Disconnect hydraulic lines from gear pump and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper installation.

7. Support gear pump assembly to prevent it from falling.

8. Remove two (2) cap screws and washers that secure gear pump to piston pump. Remove gear pump, coupler, spacer and O−rings from machine through the seat opening.

Installation (Fig 49)

1. Lubricate new O−rings with clean hydraulic oil and position on pump.

2. Slide coupler onto the piston pump output shaft.

3. Position O−rings and spacer to gear pump. Align gear teeth and slide gear pump input shaft into coupler. Secure gear pump to piston pump with two (2) cap screws and washers. Torque cap screws from **79 to 84 ft−lb (108 to 113 N−m)**.

4. Remove caps or plugs from hydraulic lines and fittings. Install hydraulic lines to gear pump.

5. Replace hydraulic filter and fill hydraulic reservoir with new hydraulic oil.

6. Disconnect engine run solenoid electrical connector to prevent engine from starting. Prime the hydraulic pump by turning the ignition key switch to start and crank the engine for ten (10) seconds. Wait 15 seconds and repeat cranking procedure again.

7. Connect engine run solenoid electrical connector, start the engine and check for proper operation.

8. Properly fill hydraulic system (see Charge Hydraulic System in this section).

9. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

Gear Pump Service

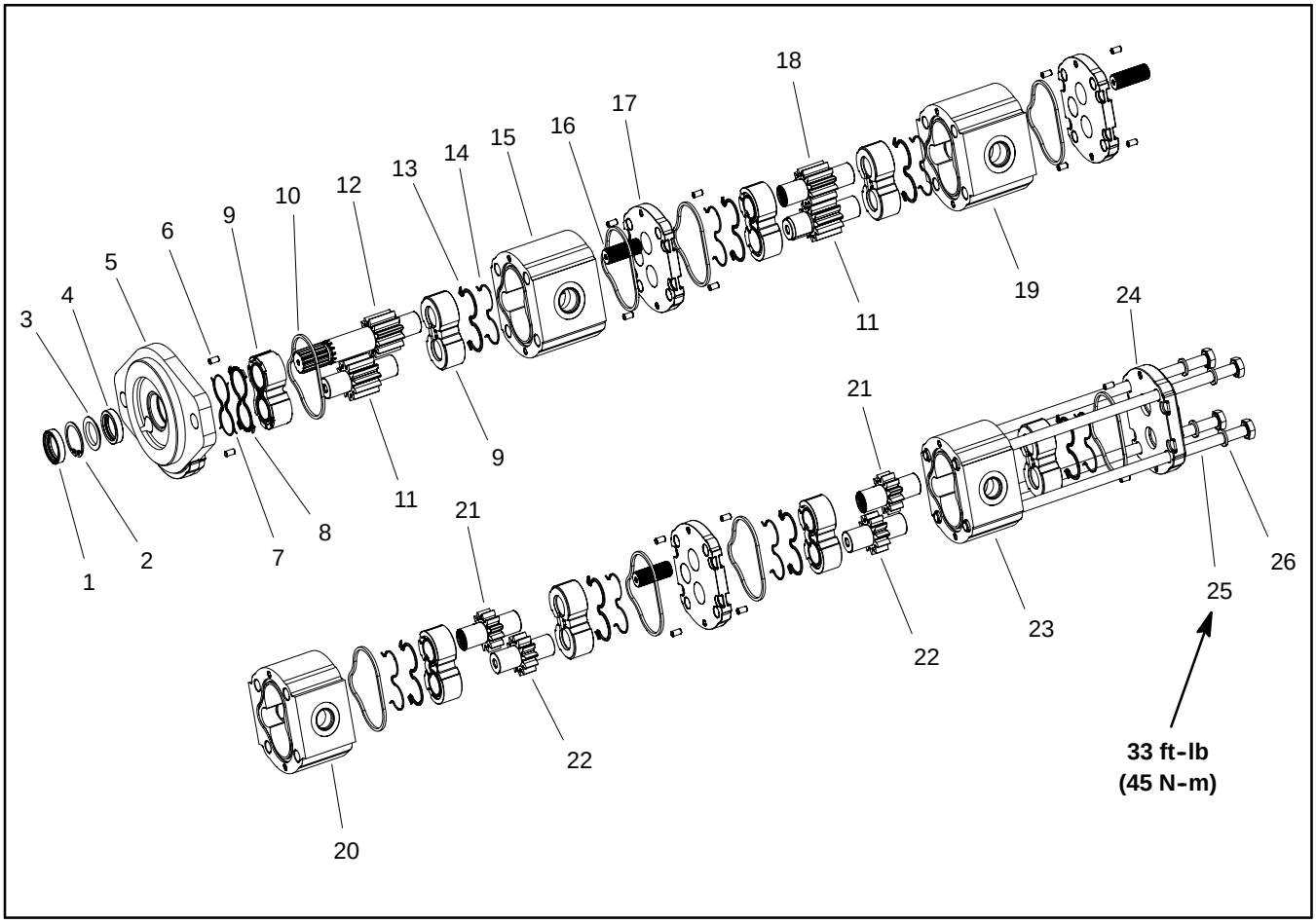


Figure 50

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Front cover**
6. **Dowel pin (16 used)**
7. **Pressure seal**
8. **Back-up gasket**
9. **Thrust plate (8 used)**
10. **Seal (8 used)**
11. **Idler gear**
12. **Drive shaft**
13. **Back-up gasket**
14. **Pressure seal**
15. **Front body**
16. **Splined connecting shaft (3 used)**
17. **Flange**
18. **Drive gear**
19. **Body**
20. **Body**
21. **Drive gear**
22. **Idler gear**
23. **Rear body**
24. **Rear cover**
25. **Cap screw (4 used)**
26. **Washer (4 used)**

Disassembly (Fig. 50)

NOTE: The gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

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

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

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 51).

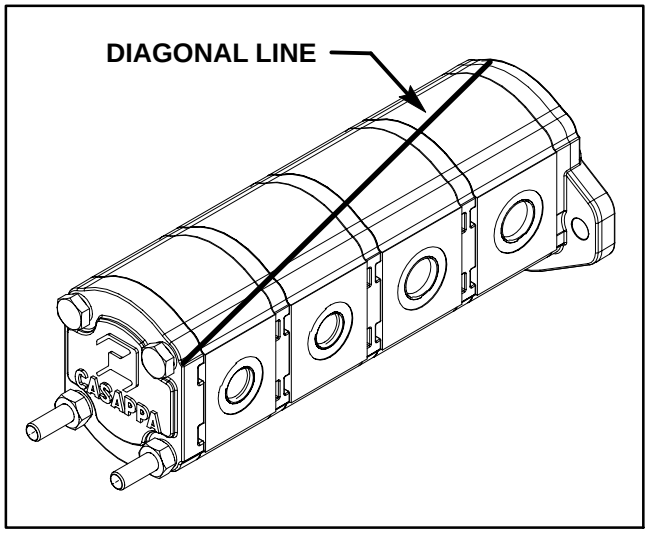


Figure 51

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

3. Secure the front cover of the pump in a vise with the drive shaft pointing down.

4. Loosen the four (4) cap screws that secure pump assembly.

5. Remove pump from vise and remove fasteners.

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

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

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

8. Clean all parts. Check all components for burrs, scoring, nicks and other damage.

9. Replace the entire pump assembly if parts are excessively worn or scored.

Assembly (Fig. 50)

1. Apply clean hydraulic oil to all parts before assembling.

NOTE: Pressure seals and back-up gaskets fit in grooves machined into thrust plates. Body seals fit in grooves machined in body faces.

2. Assemble pump sections starting at front cover end. Apply grease or petroleum jelly to new section seals to hold them in position during gear pump assembly.

3. After pump has been assembled, tighten cap screws and nuts by hand. Rotate the drive shaft to check for binding. Protect the shaft if using a pliers to rotate shaft.

4. Tighten the four (4) cap screws evenly in a crossing pattern to a torque of **33 ft-lb (45 N-m)**.

Traction Circuit

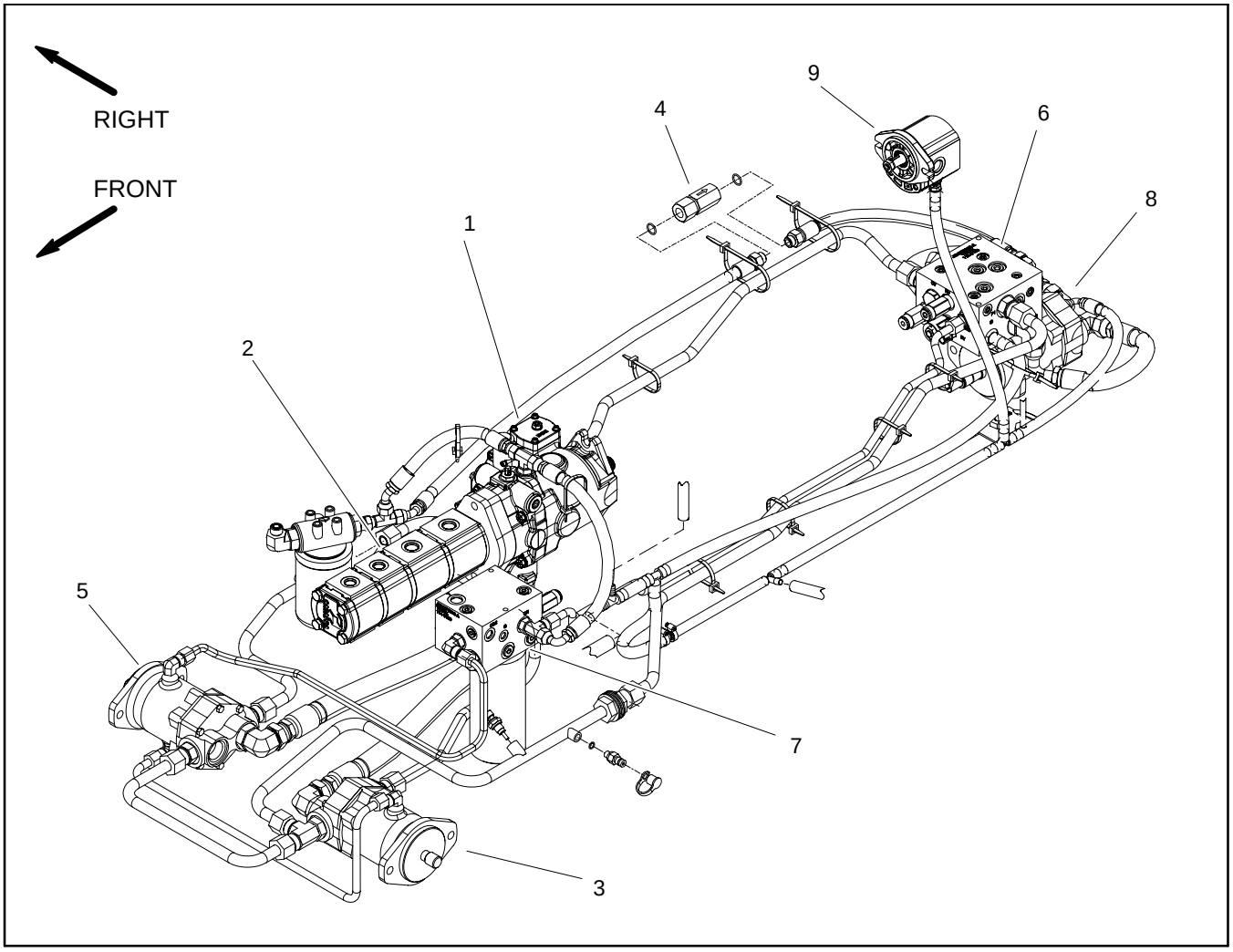


Figure 52

1. **Piston (traction) pump**
2. **Gear pump**
3. **LH front wheel motor**
4. **Check valve**
5. **RH front wheel motor**
6. **4WD manifold**
7. **Filter manifold**
8. **Rear axle motor**
9. **Cooling fan motor**

Figure 52 illustrates the components that are used in the Groundsmaster 4100−D 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

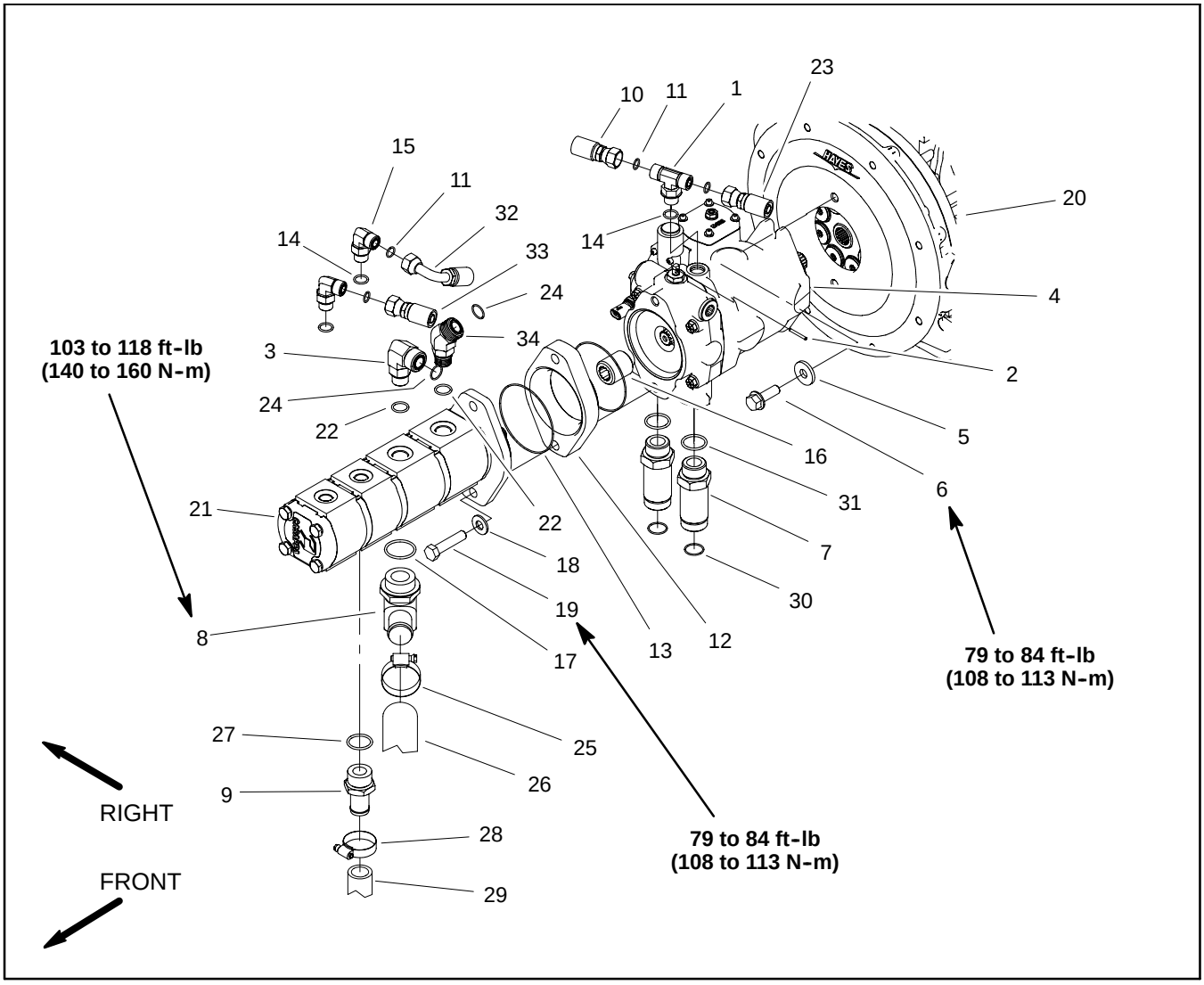

Figure 53

1. Hydraulic T fitting
2. Roll pin
3. 90° hydraulic fitting
4. Piston pump
5. Flat washer (2 used)
6. Cap screw (2 used)
7. Hydraulic fitting (2 used)
8. 90° hydraulic fitting
9. Hydraulic fitting
10. Hydraulic hose
11. O-ring
12. Pump spacer
13. O-ring (2 used)
14. O-ring
15. 90° hydraulic fitting (2 used)
16. Pump coupler
17. O-ring
18. Flat washer (2 used)
19. Cap screw (2 used)
20. Engine
21. Gear pump
22. O-ring
23. Hydraulic hose
24. O-ring
25. Hose clamp
26. Hydraulic hose
27. O-ring
28. Hose clamp
29. Hydraulic hose
30. O-ring
31. O-ring
32. Hydraulic hose
33. Hydraulic hose
34. Hydraulic fitting

Removal (Fig. 53)

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

2. To prevent contamination of hydraulic system during removal, thoroughly clean exterior of pump assembly.

3. Remove traction rod from control arm on piston pump by removing lock nut, spacer and cap screw (Fig. 54).

4. Disconnect wire harness connector from neutral switch on piston pump.

5. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

6. For installation purposes, label all hydraulic lines that connect to gear pump and piston pump.

7. Put a drain pan below the pump assembly. Remove hydraulic hoses and fittings connected to piston and gear pumps. Put plugs or caps on disconnected hydraulic hoses to prevent contamination of the system. Put plugs in open ports of pumps.

NOTE: If fuel tank is loosened and raised from the machine, the gear pump and piston pump can be removed as a complete assembly.

8. Remove gear pump from machine (see Gear Pump Removal in this section).

9. Support the piston pump to prevent it from falling while removing two (2) cap screws and washers retaining pump assembly to engine flywheel plate. Carefully pull pump assembly from flywheel plate and raise it out of the machine.

Installation (Fig. 53)

1. Carefully lower piston pump into the machine, align pump input shaft to spring coupler on engine and position it to the engine flywheel plate. Support pump to prevent it from producing any side load into coupler and also to align pilot diameter of pump to flywheel plate bore.

2. While maintaining pump alignment with spring coupler and flywheel plate, install two (2) cap screws and washers to secure piston pump to engine flywheel plate. Torque screws from **79 to 84 ft-lb (108 to 113 N-m)**.

3. Install gear pump to piston pump (see Gear Pump Installation).

4. Position traction rod to control arm on piston pump by installing cap screw, spacer and lock nut (Fig. 54).

5. Connect wire harness connector to neutral switch on traction pump.

6. Remove plugs or caps from disconnected hydraulic hoses and open ports of the pump assembly. Install fittings and hoses to correct location on gear and piston pumps.

7. Install new filter and fill hydraulic reservoir with correct oil.

8. Disconnect engine run solenoid electrical connector to prevent engine from starting. Prime pumps by turning ignition key switch to crank engine for 10 seconds. Repeat cranking procedure again.

9. Connect engine run solenoid electrical connector, start the engine and check for proper operation.

10. Properly fill hydraulic system (see Charge Hydraulic System in this section).

11. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

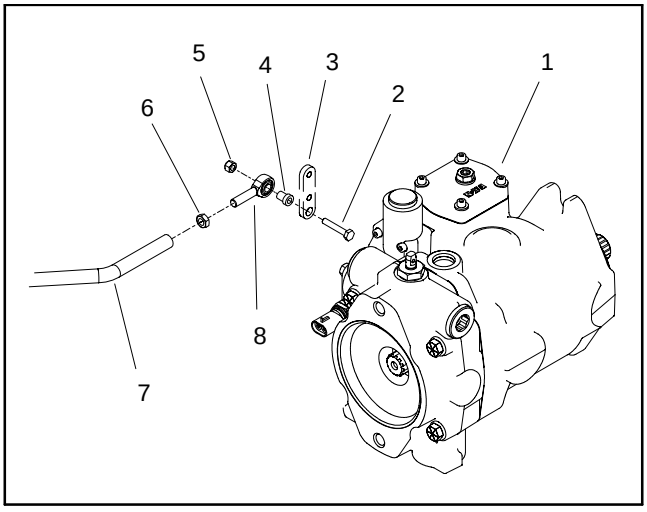

Figure 54

1. **Piston pump**
2. **Cap screw**
3. **Pump control arm**
4. **Spacer**
5. **Lock nut**
6. **Jam nut**
7. **Traction rod**
8. **Rod end**

Piston (Traction) Pump Service

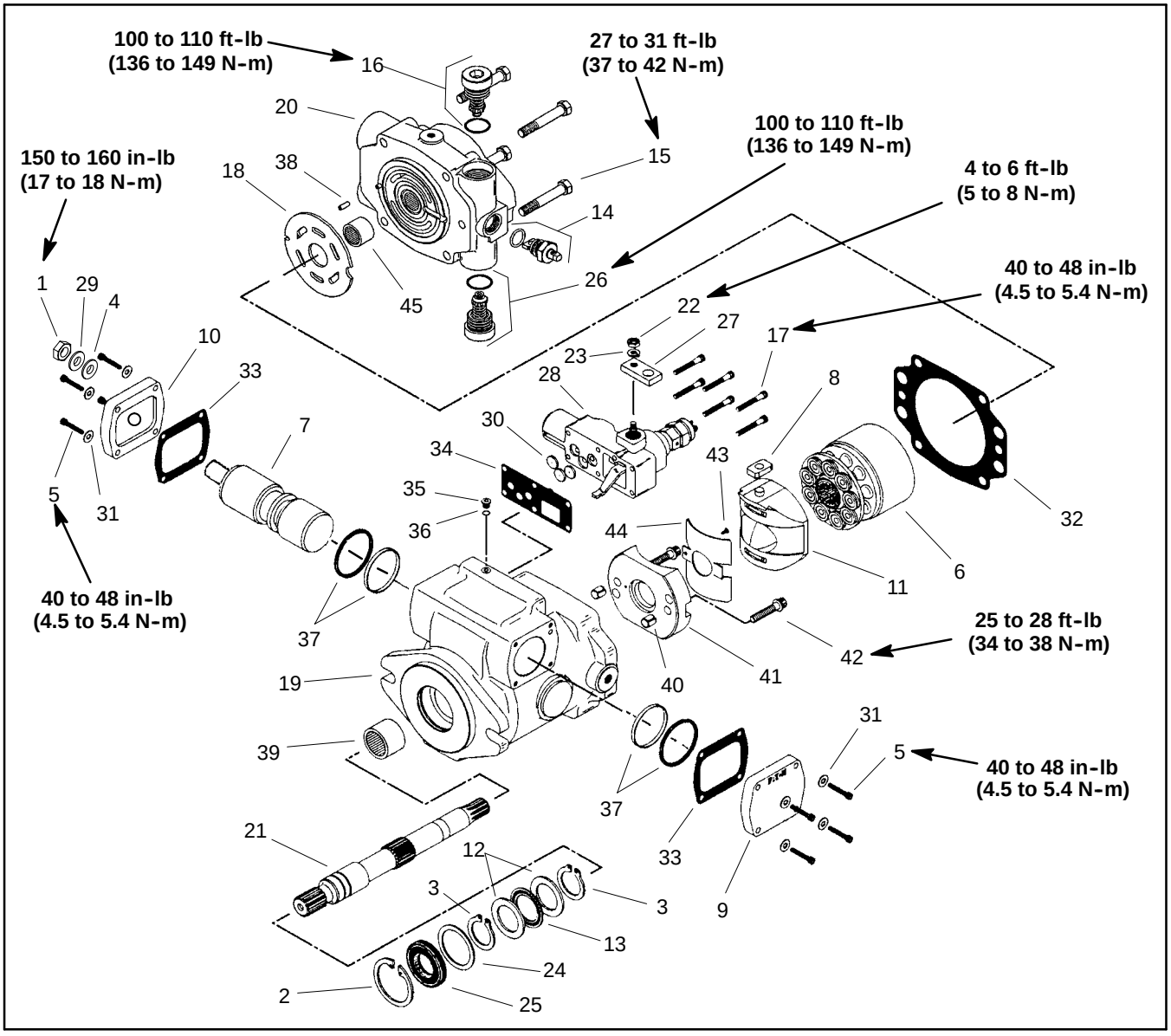

Figure 55

1. Jam nut
2. Retaining ring
3. Retaining ring
4. Seal washer
5. Socket head screw
6. Rotating kit assembly
7. Servo piston assembly
8. Piston follower
9. Cover plate
10. Cover plate
11. Camplate assembly
12. Thrust race
13. Thrust bearing
14. Bypass valve
15. Cap screw
16. Relief valve (Reverse)
17. Socket head screw
18. Valve plate
19. Pump housing
20. Backplate assembly
21. Drive shaft
22. Nut
23. Lock washer
24. Washer
25. Shaft seal
26. Relief valve (Forward)
27. Control arm
28. Servo control assembly
29. Washer
30. Orifice plate (3 used)
31. Flat washer
32. Housing gasket
33. Cover plate gasket
34. Control assembly gasket
35. Plug
36. O-ring
37. Seal sub-assembly
38. Roll pin
39. Bearing
40. Dowel bushing
41. Cradle sub-assembly
42. Cap screw
43. Button head cap screw
44. Bushing
45. Bearing

NOTE: For service of the piston (traction) pump (including the servo control (item 28), see the Eaton Model 72400 Servo Controlled Piston Pump Repair Information at the end of this chapter.

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Rear Axle Motor

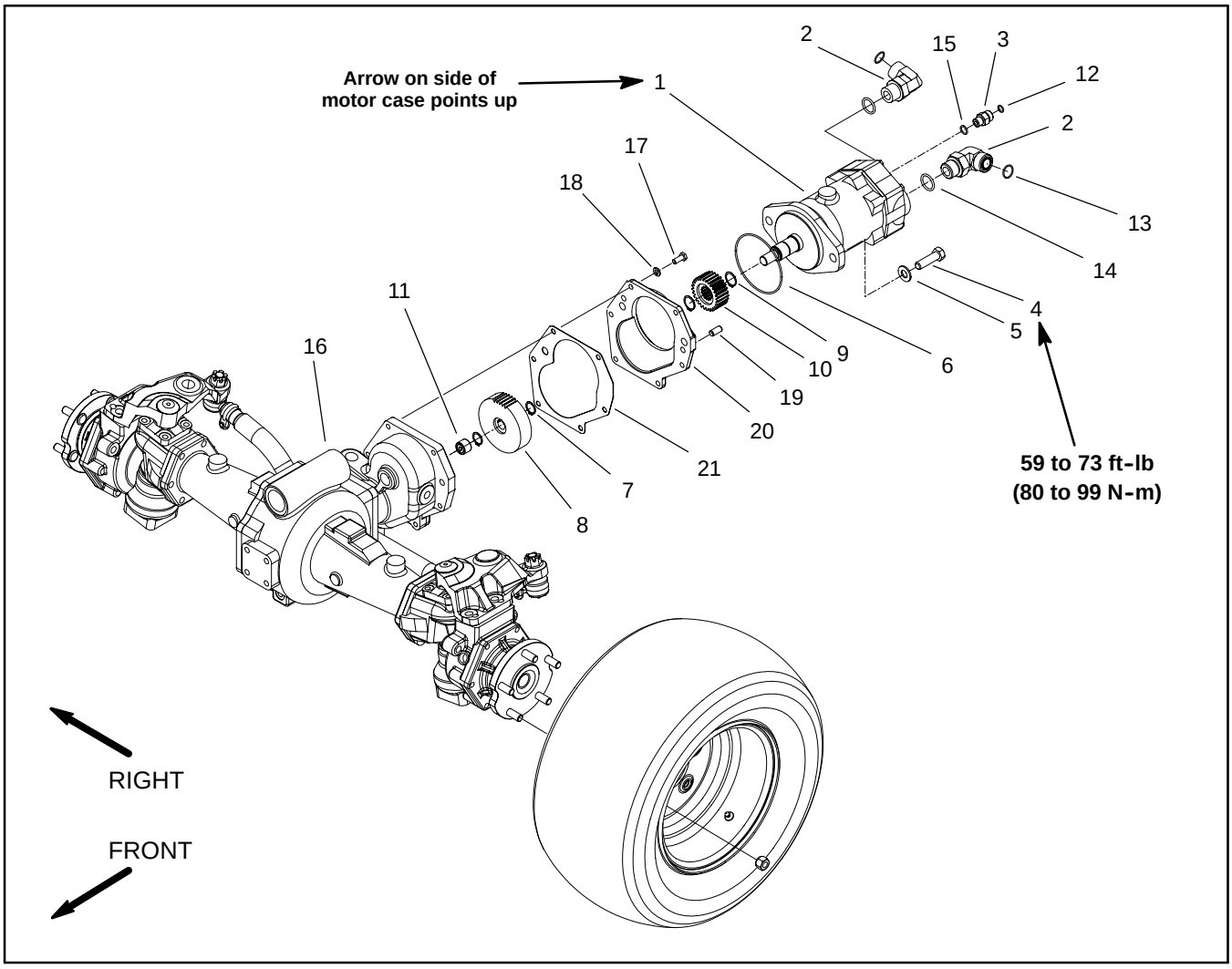

Figure 56

1. Axle motor
2. 90º hydraulic fitting (2 used)
3. Hydraulic fitting
4. Cap screw (2 used)
5. Flat washer (2 used)
6. O-ring
7. External snap ring (2 used)
8. Pinion gear
9. External snap ring (2 used)
10. Gear
11. Needle bearing
12. O-ring
13. O-ring
14. O-ring
15. O-ring
16. Drive axle assembly
17. Cap screw (6 used)
18. Lock washer (6 used)
19. Dowel pin (2 used)
20. Cover plate
21. Gasket

Removal (Fig. 56)

1. Park machine on a level surface, lower cutting deck, 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.

NOTE: To ease installation, tag the hydraulic hoses to show their correct position on the axle motor.

3. Disconnect hydraulic hoses from motor. Put caps or plugs on motor ports and hose openings to prevent contamination.

IMPORTANT: Support axle motor to prevent motor from falling during removal.

4. Remove motor from rear axle using Figure 56 as a guide.

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

Installation (Fig. 56)

1. If fittings were removed from motor, lubricate and place new O−rings onto fittings. Install fittings into port 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. If removed, install pinion gear to axle motor.

3. Install O−ring onto motor. Position motor to rear axle assembly making sure that arrows on the side of motor case point upward. Align gear teeth and slide motor into place.

4. Secure motor to axle with cap screws and flat washers. Torque screws from **59 to 73 ft−lb (80 to 99 N−m)**.

5. Remove plugs from motor ports and hose openings. Attach hydraulic hoses to axle motor.

6. Fill reservoir with hydraulic fluid as required.

7. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything.

Front Wheel Motors

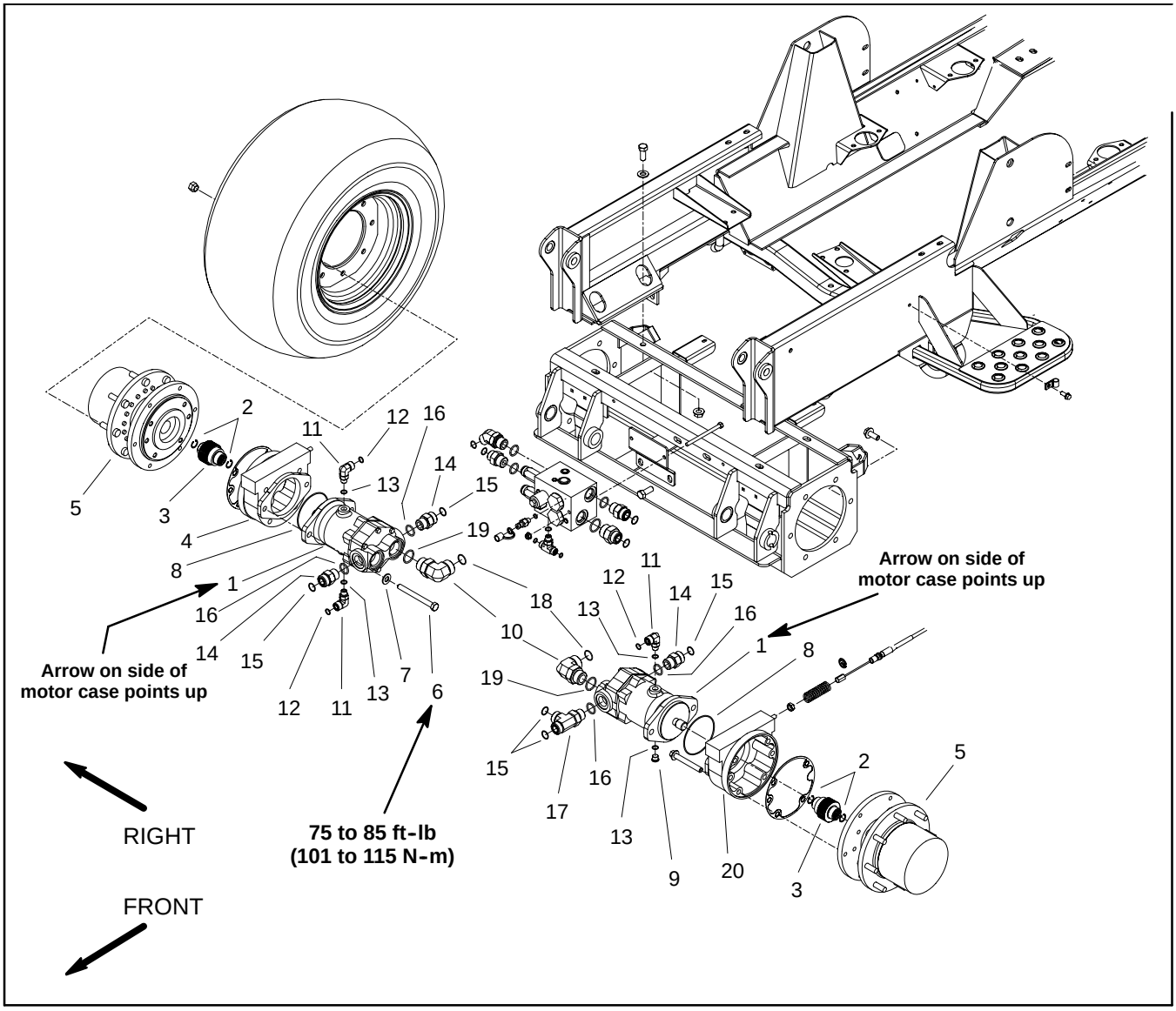

Figure 57

1. Front wheel motor
2. Internal retaining ring
3. Splined brake shaft
4. RH brake assembly
5. Planetary assembly
6. Cap screw (2 used per motor)
7. Flat washer (2 used per motor)
8. O-ring
9. Hex head plug
10. 90º hydraulic fitting
11. 90º hydraulic fitting
12. O-ring
13. O-ring
14. Hydraulic fitting
15. O-ring
16. O-ring
17. Hydraulic tee fitting
18. O-ring
19. O-ring
20. LH brake assembly

Removal (Fig. 57)

1. Park machine on a level surface, lower cutting deck, 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.

NOTE: To ease installation, tag the hydraulic hoses to show their correct position on the wheel motor.

3. Disconnect hydraulic hoses and tubes from wheel motor. Put caps or plugs on motor ports and hose openings to prevent contamination.

IMPORTANT: Before loosening fasteners, support wheel motor to prevent motor from falling during removal.

4. Remove wheel motor using Figure 57 as a guide.

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

Installation (Fig. 57)

1. If fittings were removed from motor, lubricate and place new O−rings onto fittings. Install fittings into port 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 wheel motor to brake assembly making sure that arrows on the side of motor case point upward.

3. Align splines on motor shaft and splined brake shaft. Slide motor into brake assembly.

4. Secure motor to brake assembly with cap screws and flat washers. Tighten cap screws from **75 to 85 ft−lb (101 to 115 N−m)**.

5. Remove plugs from wheel motor ports and hose openings. Attach hydraulic hoses and tubes to wheel motor.

6. Fill reservoir with hydraulic fluid as required.

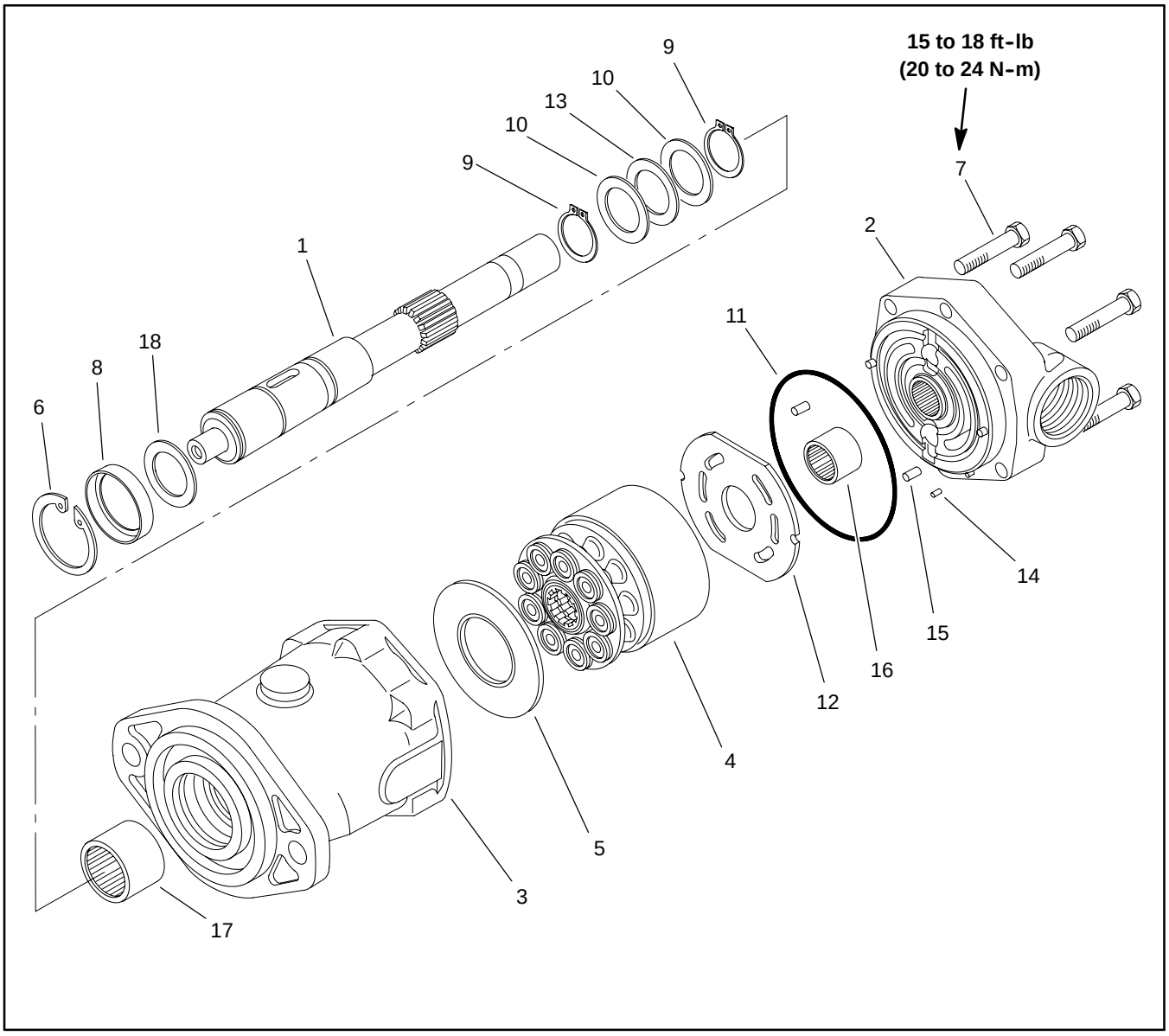

Figure 58

1. **Drive shaft**
2. **Backplate (front motor shown)**
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 (3 used)**
15. **Roll pin**
16. **Bearing**
17. **Bearing**
18. **Washer**

NOTE: The front wheel motors are identical. The rear axle motor has some differences from the front motors. Service of the front and rear motors requires the same procedures.

NOTE: For service of the wheel motors, see the Eaton Model 74318 and 74348 Piston Motors: Fixed Displacement, Valve Plate Design Repair Information at the end of this chapter.

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4WD Manifold

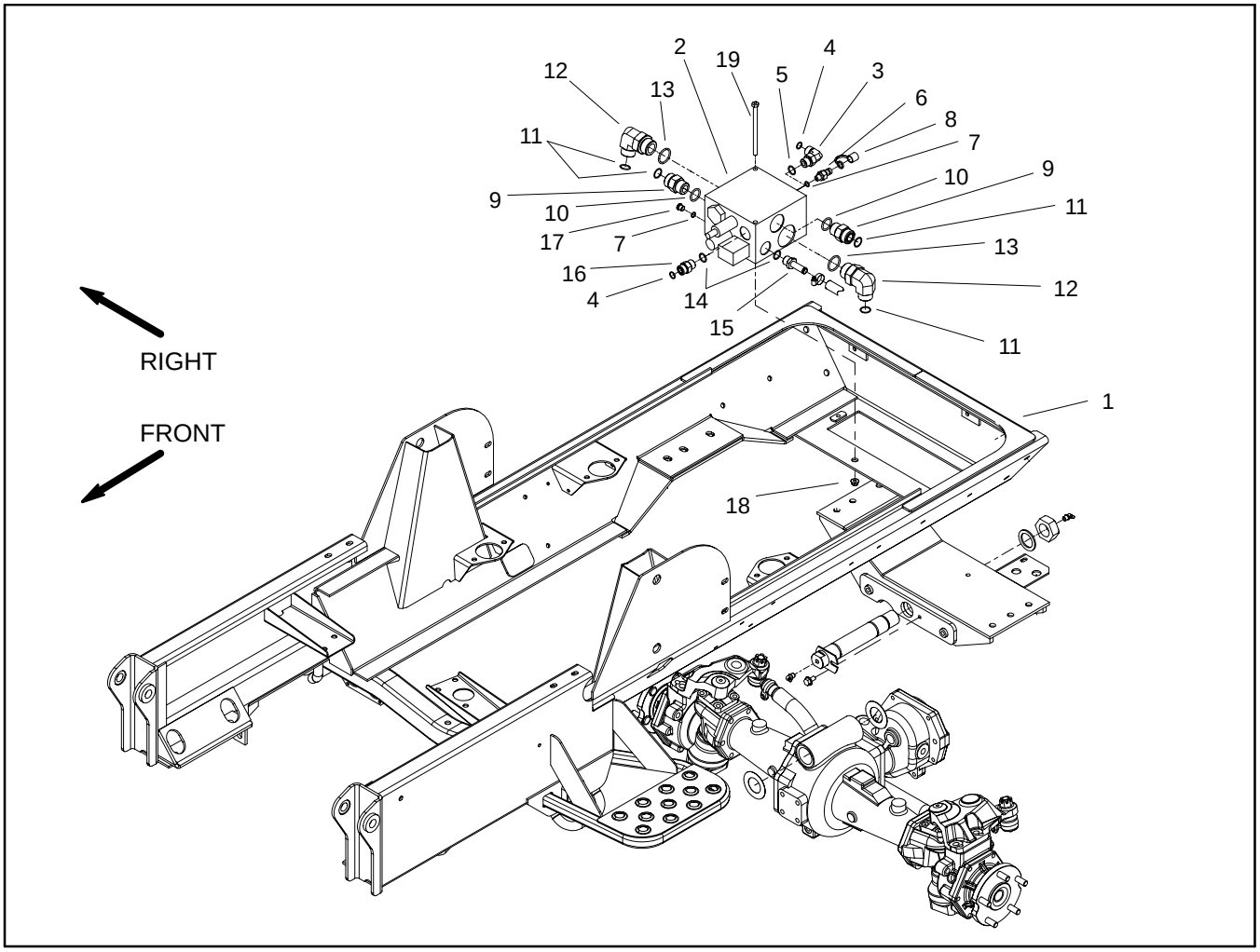

Figure 59

1. **Frame assembly**
2. **4 wheel drive manifold**
3. **90º hydraulic fitting**
4. **O-ring**
5. **O-ring**
6. **Quick fitting**
7. **O-ring**
8. **Fitting cap**
9. **Hydraulic fitting**
10. **O-ring**
11. **O-ring**
12. **90º hydraulic fitting**
13. **O-ring**
14. **O-ring**
15. **Hydraulic fitting**
16. **Adapter**
17. **Plug (SAE #4)**
18. **Flange nut (2 used)**
19. **Cap screw (2 used)**

Removal (Fig. 59)

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is a piston pump connection port and SV is the location for the solenoid valve (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this section.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect electrical connector from the 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 installation.

5. Remove hydraulic manifold from the frame using Figure 59 as guide.

Installation (Fig. 59)

1. Install hydraulic manifold to the frame using Figure 59 as guide.

2. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold.

3. Connect electrical connector to the solenoid valve.

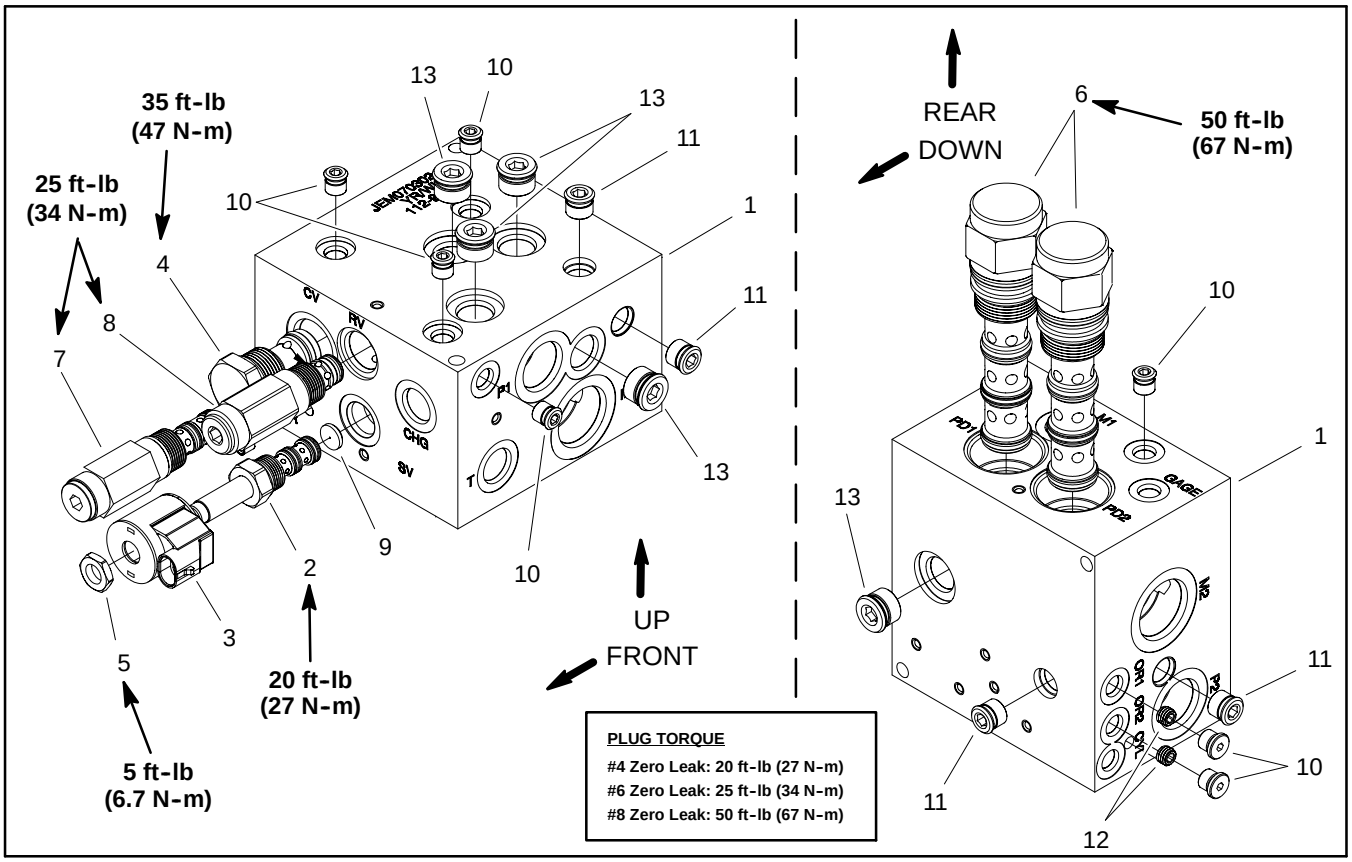

Figure 60

1. Manifold body
2. Solenoid valve (port SV)
3. Solenoid coil
4. Check valve (port CV)
5. Nut
6. Directional valve (ports PD1 & PD2)
7. Pressure reducing valve (port PR)
8. Relief valve (port RV)
9. Orifice (0.030) (port SV)
10. #4 zero leak plug with O-ring
11. #6 zero leak plug with O-ring
12. Orifice (0.050) (ports OR1 and OR2)
13. #8 zero leak plug with O-ring

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is a piston pump connection port and SV is the location for the solenoid valve (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

4WD Manifold Service (Fig. 60)

1. Make sure the manifold is clean before removing the valve.

2. If cartridge is solenoid operated, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid 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 or contamination.

5. Visually inspect cartridge valve for damaged sealing surfaces and contamination.

A. Contamination may cause valves to stick or hang up. Contamination can become lodged in small valve orifices or seal areas causing malfunction.

B. If valve sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. The 4WD control manifold includes three (3) orifice fittings (items 9 and 13). The 0.030 orifice (item 9) is positioned in the SV port under the solenoid cartridge valve. The 0.050 orifices (item 13) thread into the manifold in ports OR1 and OR2. Before removing or installing the orifice in OR1, removal of the #6 plug in the bottom of the manifold is necessary.

8. 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.

9. If problems still exist, remove valve and clean again or replace valve.

Filter Manifold

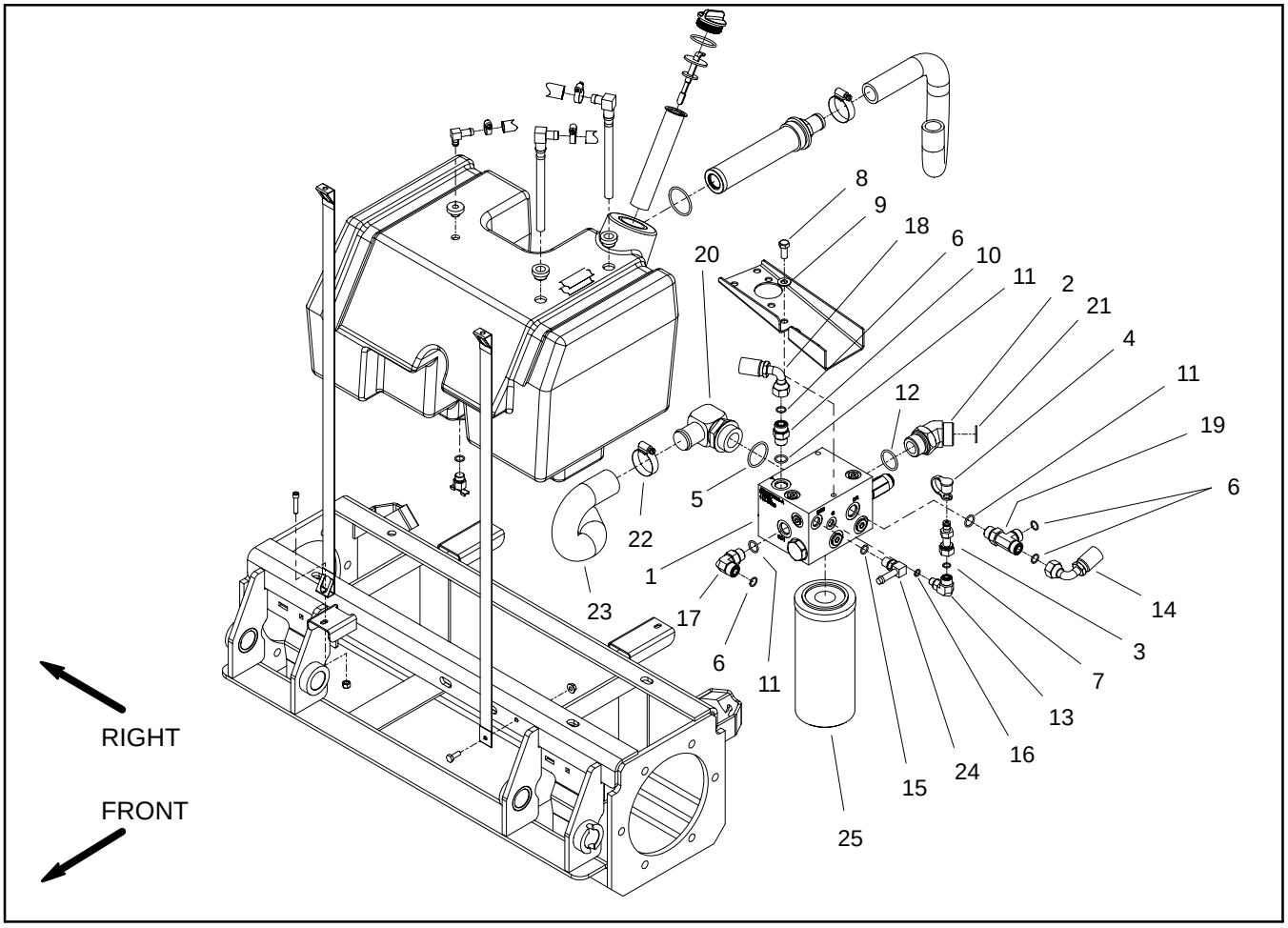

Figure 61

1. **Filter manifold**
2. **45º hydraulic fitting**
3. **Test nipple**
4. **Dust cap**
5. **O-ring**
6. **O-ring**
7. **O-ring**
8. **Cap screw (3 used)**
9. **Flat washer (3 used)**
10. **Hydraulic fitting**
11. **O-ring**
12. **O-ring**
13. **90º hydraulic fitting**
14. **Hydraulic hose**
15. **O-ring**
16. **O-ring**
17. **90º hydraulic fitting**
18. **Hydraulic hose**
19. **Hydraulic tee fitting**
20. **90º hydraulic fitting**
21. **O-ring**
22. **Hose clamp**
23. **Filter hose**
24. **Barb fitting**
25. **Oil filter**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P2 is the gear pump connection port and T is the connection for the hydraulic reservoir return port (See Hydraulic Schematic in Chapter 9 – 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 hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper reassembly.

4. Remove filter manifold from the frame using Figure 61 as guide.

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

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. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Install filter manifold to the frame using Figure 61 as guide.

3. Remove caps and plugs from fittings and hoses. Using labels placed during manifold removal, properly connect hydraulic lines to manifold.

Filter Manifold Service

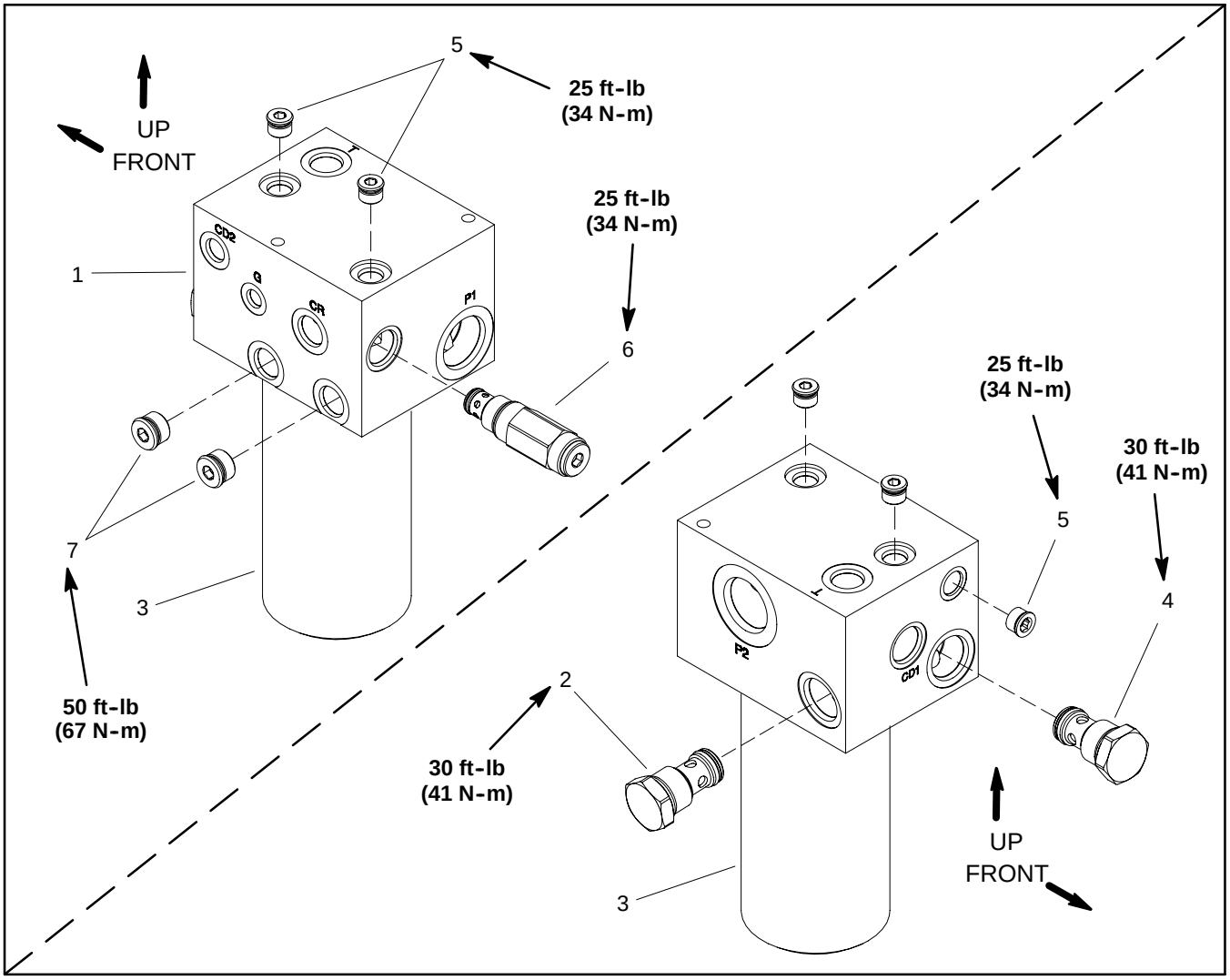

Figure 62

1. **Filter manifold**
2. **Check valve (reservoir return)**
3. **Oil filter element**
4. **Check valve (filter bypass)**
5. **Plug (Zero Leak #6)**
6. **Charge relief valve**
7. **Plug (Zero Leak #8)**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P2 is the gear pump connection port and T is the connection for the hydraulic reservoir return port (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Filter Manifold Service (Fig. 62)

For cartridge valve service procedures, see 4WD Manifold Service in this section. Refer to Figure 62 for filter manifold cartridge valve and plug installation torque.

Steering and Cooling Fan Circuits

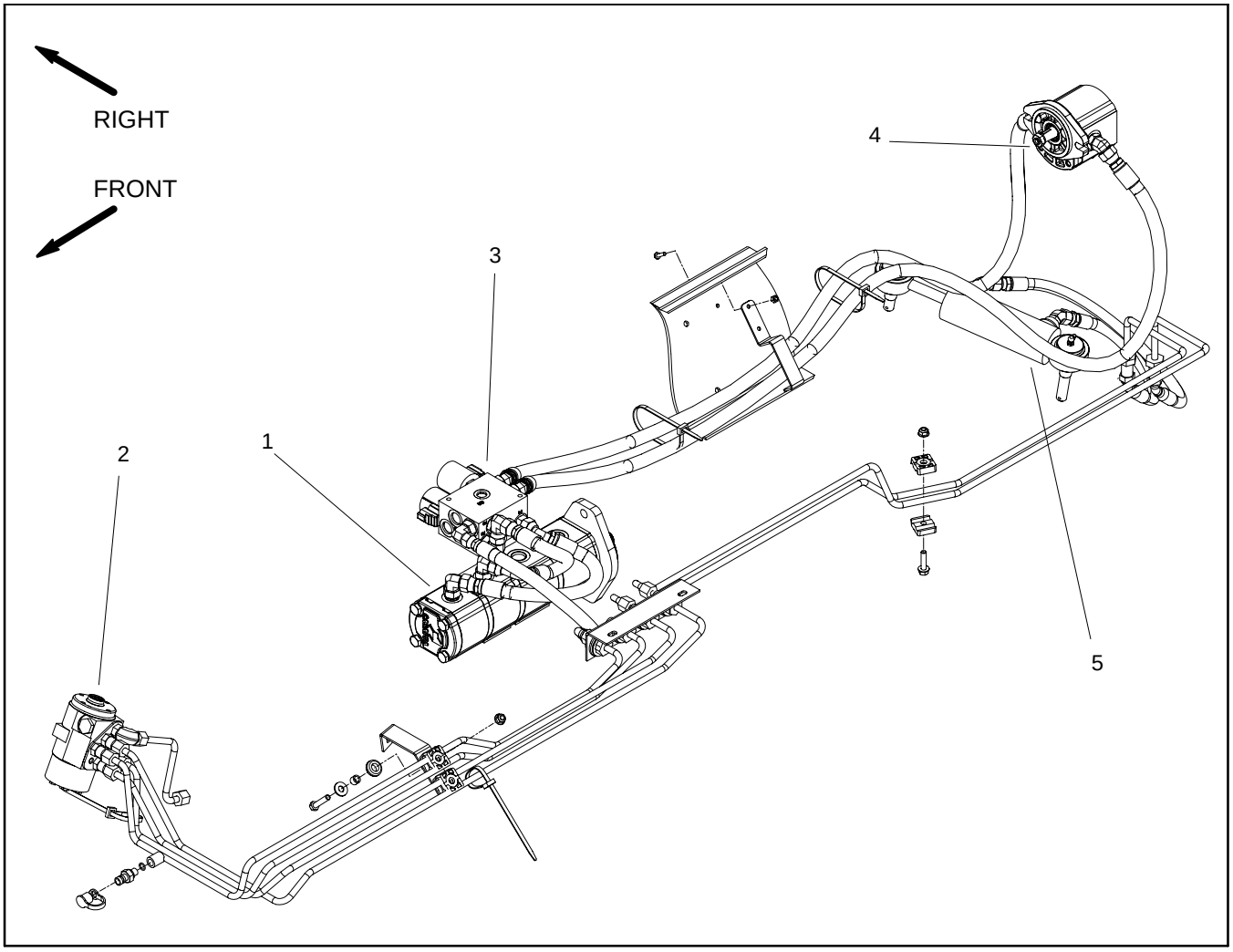

Figure 63

1. **Gear pump**
2. **Steering control valve**
3. **Fan drive manifold**
4. **Fan motor**
5. **Steering cylinder**

Figure 63 illustrates the components that are used in the Groundsmaster 4100−D steering and cooling fan circuit. Procedures for removal, installation and disassembly/ assembly of these components are provided on the following pages of this section.

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Steering Valve

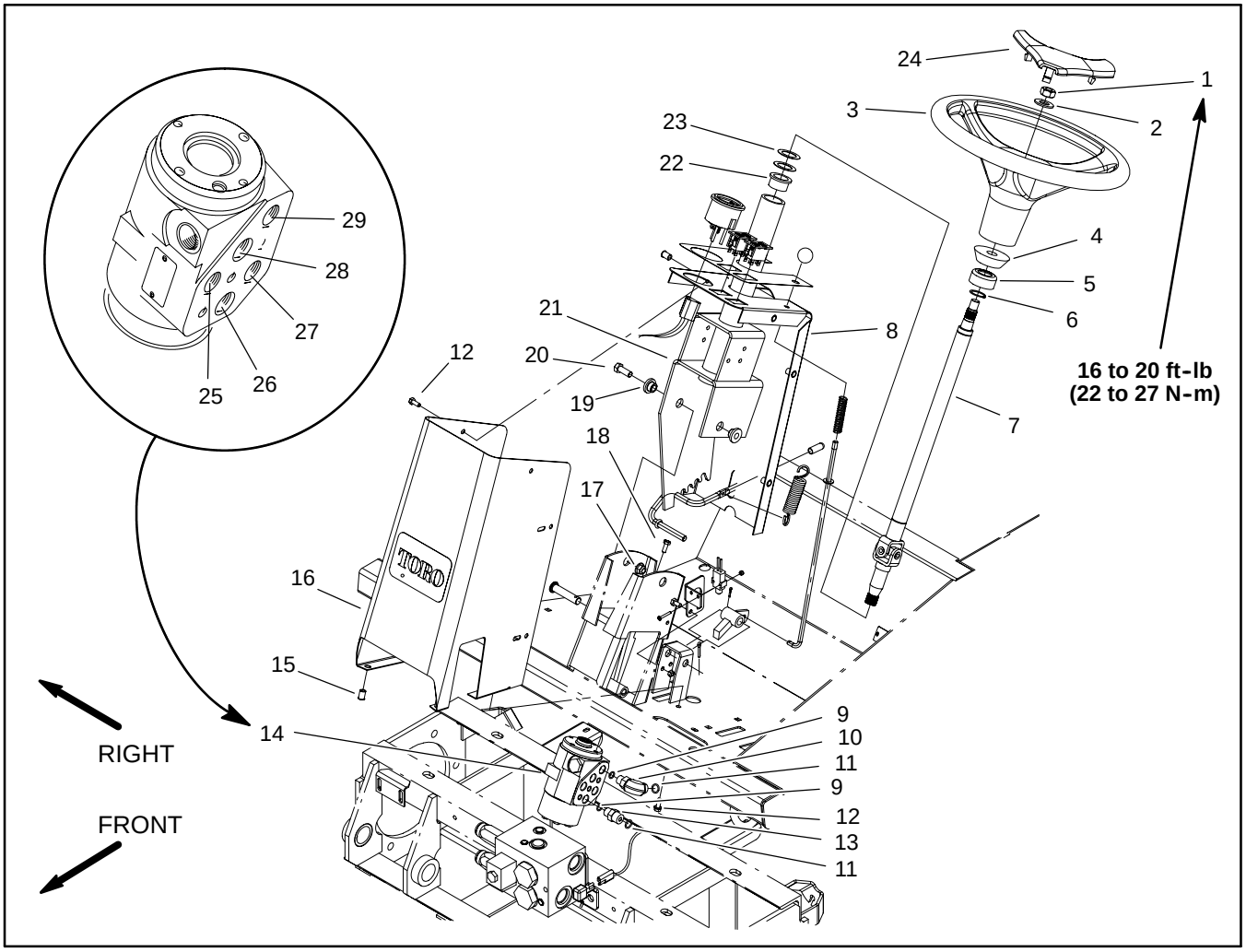

Figure 64

1. Hex nut
2. Flat washer
3. Steering wheel
4. Foam collar
5. Steering seal
6. External snap ring
7. Steering shaft assembly
8. Steering tower cover
9. O-ring
10. 90º hydraulic fitting
11. O-ring
12. Flange head screw
13. Hydraulic adapter (4 used)
14. Steering valve assembly
15. Nut insert
16. Steering tower
17. Flange locking nut (2 used)
18. Flange head screw (4 used)
19. Pivot hub (2 used)
20. Cap screw (2 used)
21. Steering column assembly
22. Flange bushing
23. Thrust washer
24. Steering wheel cover
25. In port (P)
26. Right turn port (R)
27. Load sensing port (PB)
28. Left turn port (L)
29. Out port (T)

Removal (Fig. 64)

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. To prevent contamination of hydraulic system during steering valve removal, thoroughly clean exterior of steering valve and fittings.

4. Remove steering valve from machine using Figure 64 as a guide.

5. If hydraulic fittings are to be removed from steering valve, mark fitting orientation to allow correct assembly. Remove fittings from valve and discard O−rings.

Installation (Fig. 64)

1. If fittings were removed from steering valve, lubricate and place new O−rings onto fittings. Install fittings into port 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. Install steering valve using Figure 64 as a guide.

3. Make sure hydraulic tank is full. Add correct oil if necessary before returning machine to service.

Steering Valve Service

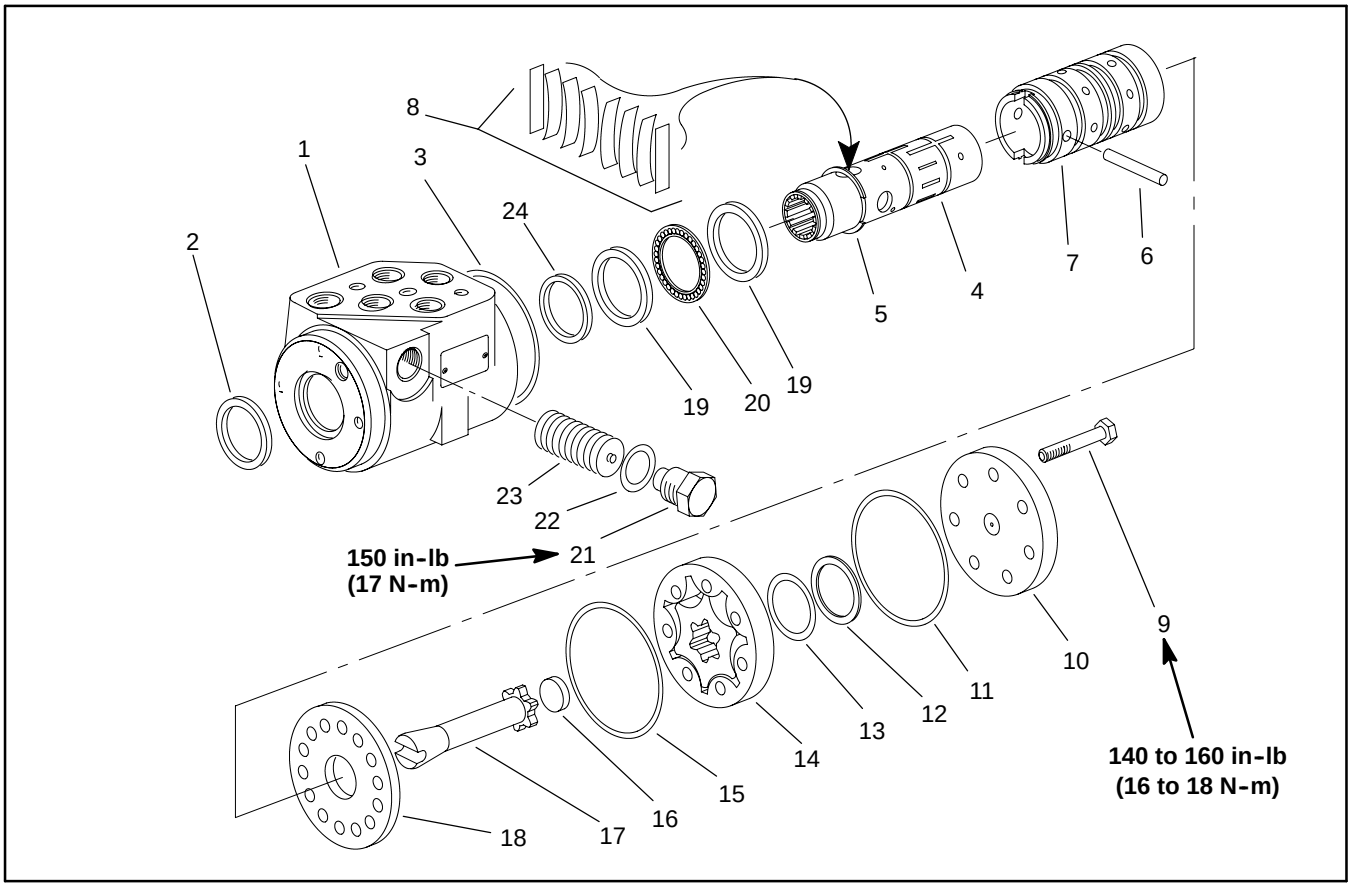

Figure 65

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. **Spacer**
17. **Geroter drive**
18. **Wear plate**
19. **Bearing race**
20. **Thrust bearing**
21. **Plug**
22. **O-ring**
23. **Relief valve**
24. **Quad seal**

Disassembly (Fig. 65)

NOTE: Cleanliness is extremely important when repairing steering control units. Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the steering valve assembly. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior. During repairs, always protect machined surfaces.

1. Remove the seven (7) cap screws from the steering valve assembly.

2. Remove end cap, geroter, spacer, geroter drive, wear plate, seal ring and O-rings from housing.

3. Remove the plug and relief valve.

4. Slide the spool and sleeve assembly from the housing.

5. Remove the thrust bearing and bearing races (2).

6. Remove the quad seal.

7. Use a small blade screwdriver to carefully pry the dust seal from the housing. Be careful to not damage the dust seal seat in the housing.

8. Remove the pin that holds the spool and sleeve together.

9. Carefully slide the spool out of the sleeve. The centering springs and spring retaining ring will stay with the spool as it is removed.

CAUTION

The centering springs are under tension. Remove the retaining ring carefully.

10. Remove the spring retaining ring and centering springs from the spool.

Reassembly (Fig. 65)

Check all mating surfaces. Replace any parts with scratches or burrs that could cause leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth as lint in a hydraulic system will cause damage.

NOTE: Always use new seals and O−rings when assembling the steering valve.

IMPORTANT: During assembly, lubricate the new seals with petroleum jelly. Also, lubricate machined surfaces and bearings with clean hydraulic fluid.

1. Install the quad seal (Fig. 66):

   A. Put one of the bearing races and sleeve into the housing.

   B. Together, the housing and bearing race create a groove into which the quad seal will be installed.

   C. Hold the bearing race tightly against the input end of the housing by pushing on the gerotor end of the sleeve.

   D. Fit the quad seal into its seat through the input end of the housing. Be sure the seal is not twisted.

   E. Remove the sleeve and bearing race.

2. Lubricate and install the dust seal.

3. Install the centering springs in the spool. It is best to install the two flat pieces first. Next, install the curved pieces, three at a time.

4. Fit the retaining ring over the centering springs.

5. Apply a light coating of clean hydraulic fluid to the spool and slide it into the sleeve. Be sure the centering springs fit into the notches in the sleeve.

6. Install the pin.

7. Apply a light coating of petroleum jelly to the inner edge of the dust and quad seals.

8. Put the thrust bearing and races into the housing. The thrust bearing goes between the two races (Fig. 66).

IMPORTANT: Do not damage the dust or quad seals when installing the spool and sleeve assembly.

9. Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly and carefully slide the assembly into the housing.

10. Clamp the housing in a vise. Use only enough clamping force to hold the housing securely.

11. Lubricate and install a new O-ring seal in the groove in the housing.

12. Install the wear plate and align screw holes in the wear plate with threaded holes in the housing.

NOTE: The holes in the wear plate are symmetrical.

13. Install the geroter drive, making sure the slot in the drive engages the pin.

14. Lubricate and install new O-ring in wear plate groove.

15. Install the gerotor and align the screw holes.

16. Lubricate and install new O-ring in gerotor ring groove.

17. Lubricate and install new O-ring and seal ring in gerotor star groove.

18. Install the spacer.

19. Install the end cap and seven (7) cap screws. Tighten the cap screws, in a crossing pattern, from **140 to 160 in-lb (16 to 18 N−m)**.

20. Remove the steering valve from the vise.

21. Install the relief valve and plug. Tighten the plug to **150 in-lb (17 N−m)**.

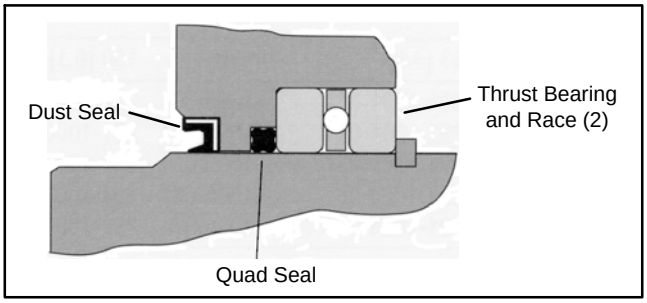

Figure 66

Steering Cylinder

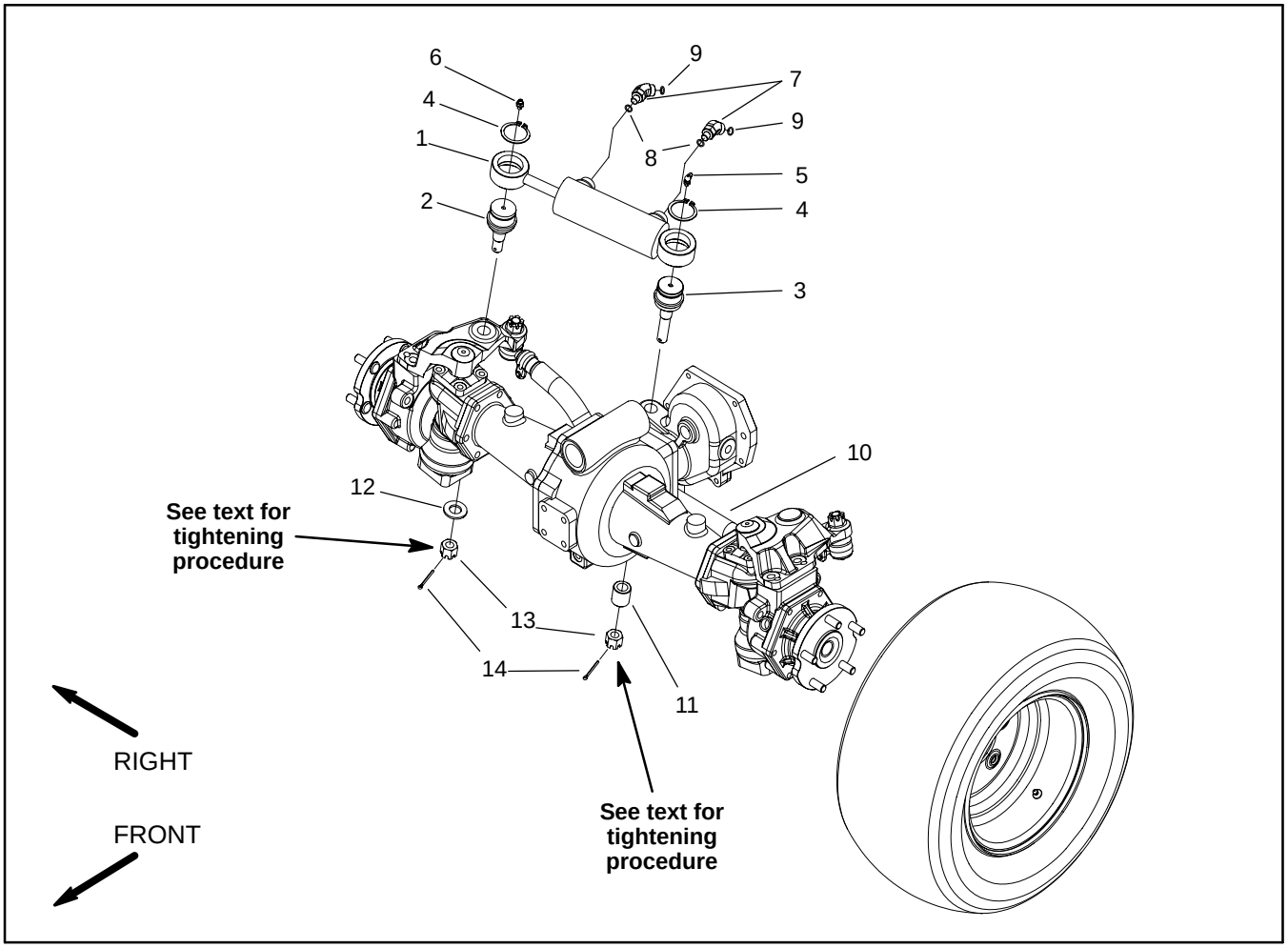

Figure 67

1. **Steering cylinder**
2. **Ball joint**
3. **Ball joint**
4. **Retaining ring**
5. **Grease fitting**
6. **Grease fitting**
7. **90º hydraulic fitting**
8. **O−ring**
9. **O−ring**
10. **Drive axle assembly**
11. **Ball joint spacer**
12. **Axle washer**
13. **Hex slotted nut**
14. **Cotter pin**

Removal (Fig. 67)

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. To prevent contamination of hydraulic system during steering cylinder removal, thoroughly clean exterior of cylinder and fittings.

NOTE: To ease installation, label the hydraulic hoses to show their correct position on the steering cylinder.

4. Remove hydraulic hoses from steering cylinder.

5. Remove cotter pins, hex slotted nuts, axle washer and ball joint spacer from the threaded ends of ball joints (Fig. 67). Remove steering cylinder with ball joints from machine.

6. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O−rings.

7. If needed, remove ball joints from steering cylinder.

Installation (Fig. 67)

1. If removed, install ball joints into steering cylinder.

2. If fittings were removed from steering cylinder, lubricate and place new O−rings onto fittings. Install fittings into port 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).

3. Slide ram end ball joint through hole on steering arm. Secure with axle washer and hex slotted nut. Slide fixed end of cylinder through hole on axle. Secure with slotted hex nut. Torque slotted hex nuts to **100 ft−lbs (135 N−m)** and then continue tightening the nut until hex nut groove aligns with cotter pin hole in ball joint. Install cotter pin to nut and ball joint.

4. Install hydraulic hoses to steering cylinder.

5. Fill reservoir with hydraulic fluid as required.

6. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Steering Cylinder Service

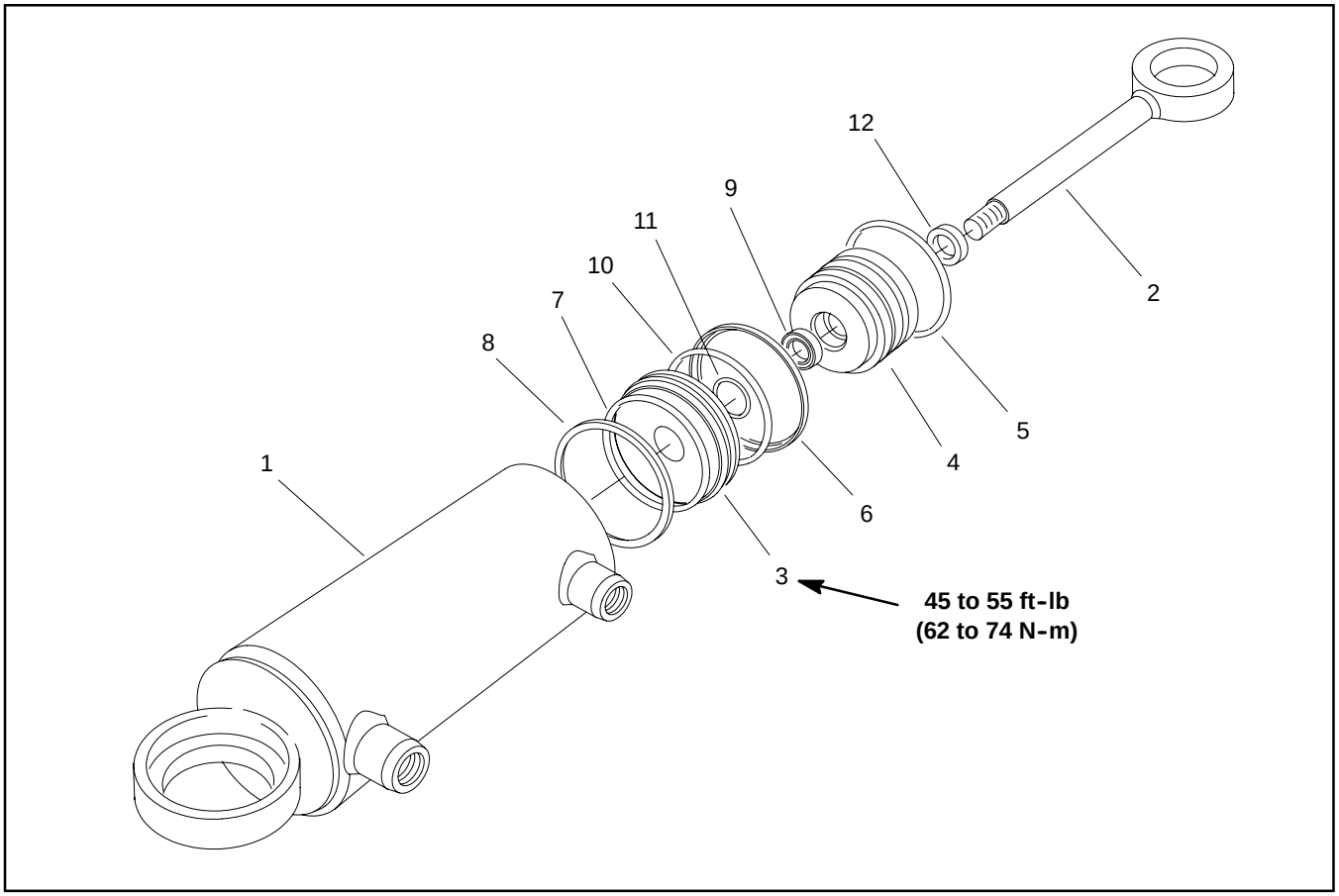

Figure 68

1. **Tube assembly**
2. **Rod**
3. **Piston assembly**
4. **Head**
5. **Retaining ring**
6. **Backup ring**
7. **O-ring**
8. **Cap seal**
9. **Rod seal**
10. **O-ring**
11. **O-ring**
12. **Wiper**

Disassembly (Fig. 68)

1. Pump oil out of cylinder into a drain pan by SLOWLY moving rod and piston in and out of cylinder bore. Plug ports and clean outside of cylinder.

IMPORTANT: To prevent damage when clamping cylinder in a vise, clamp only on pivotal ends. Use of a vise with soft jaws is recommended.

2. Mount cylinder in a vise so rod end of cylinder is tilted up slightly. Do not close vise so firmly that cylinder tube could become distorted.

3. Loosen head from tube:

   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the tube 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 tube and head.

4. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod and head from cylinder tube.

IMPORTANT: Do not clamp vise jaws against piston rod surface; the piston rod will become damaged.

5. Securely mount piston, piston rod and head into vise and remove piston. Remove head from rod.

6. Remove and discard all seals and O−rings from head and piston.

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 rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 68)

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 seals to the piston and head.

3. Lubricate shaft with clean hydraulic oil. Slide head onto shaft. Install and tighten head. Torque head from **45 to 55 ft−lb (62 to 74 N−m)**.

4. Put a coating of clean hydraulic oil on all cylinder parts to ease assembly.

5. Slide rod assembly into cylinder tube.

6. Mount steering cylinder in a vise with soft jaws. Secure head in barrel:

   A. Align retaining ring hole in the head with the access slot in the tube.

   B. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the tube and the ring ends are covered.

   C. Apply silicone sealer to tube access slot.

Engine Cooling Fan Motor

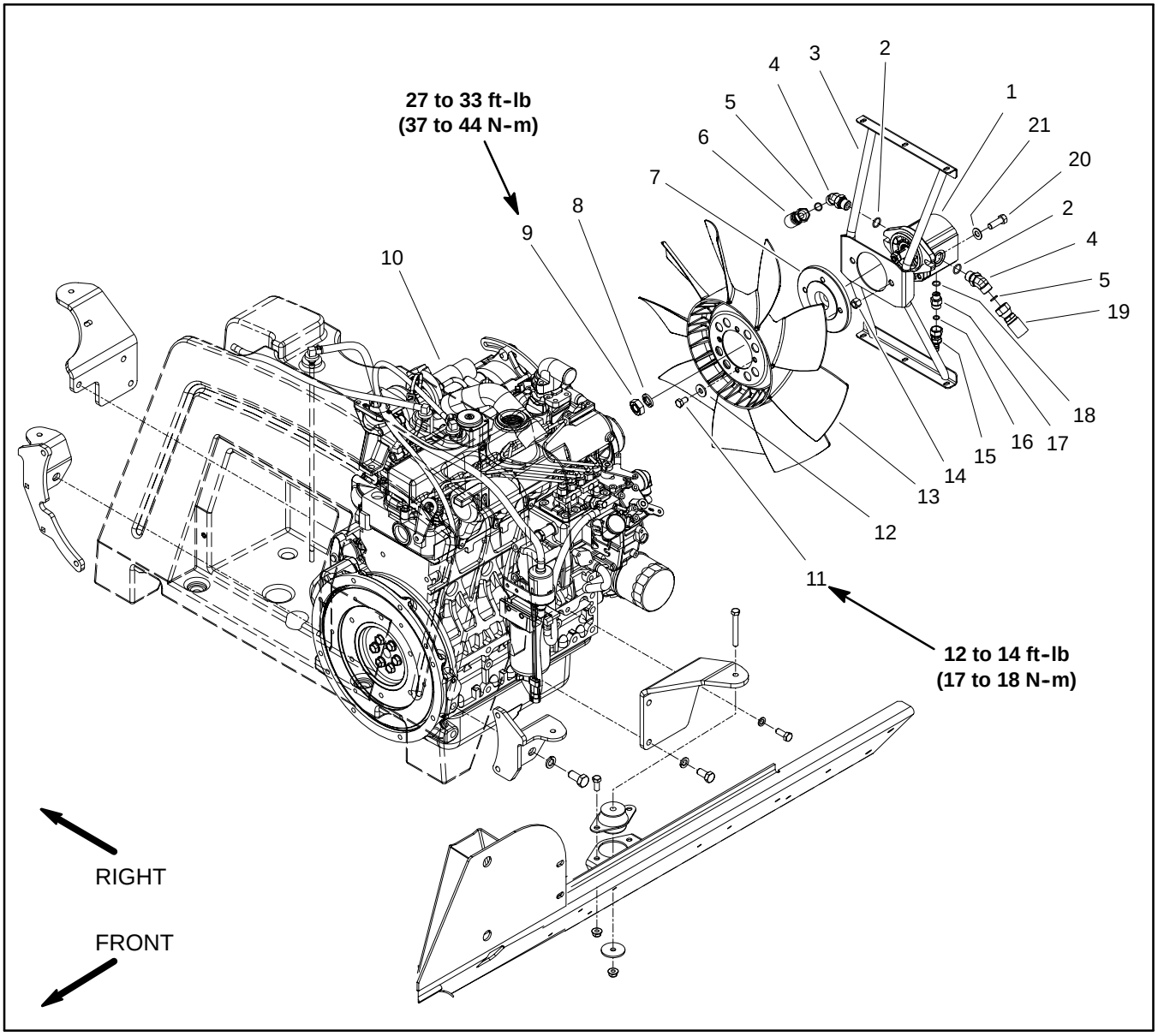

Figure 69

1. **Hydraulic fan motor**
2. **O-ring**
3. **Bracket**
4. **45º hydraulic fitting**
5. **O-ring**
6. **Hydraulic hose**
7. **Fan hub**
8. **Washer**
9. **Hex nut**
10. **Engine**
11. **Cap screw (4 used)**
12. **Washer (4 used)**
13. **Fan**
14. **Lock nut (2 used)**
15. **Hydraulic hose**
16. **O-ring**
17. **Hydraulic fitting**
18. **O-ring**
19. **Hydraulic hose**
20. **Cap screw (2 used)**
21. **Flat washer (2 used)**

Removal (Fig. 69)

1. Park machine on a level surface, lower cutting deck, 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.

4. Remove air cleaner hose and upper radiator shroud to allow easier access to hydraulic fan motor (Fig. 70).

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before removing fan motor.

IMPORTANT: Make sure to not damage the radiator, fan or other machine components while loosening and removing the fan motor.

5. Remove hex nut (item 9) and washer (item 8) 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. To prevent contamination of hydraulic system during fan motor removal, thoroughly clean exterior of motor and fittings.

8. Disconnect hydraulic hoses from cooling fan motor. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper assembly.

9. Support fan motor to prevent it from falling. Remove two (2) cap screws (item 20), flat washers (item 21) and lock nuts (item 14) that secure fan motor to fan motor bracket.

10. Carefully lower fan motor and remove from machine.

11. 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. 69)

1. If fittings were removed from fan motor, lubricate and place new O−rings onto fittings. Install fittings into port 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).

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 cap screws (item 20), flat washers (item 21) and lock nuts (item 14).

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 fasteners 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 washer (item 8) and hex nut (item 9). Torque nut from **27 to 33 ft−lb (37 to 44 N−m)**.

6. Install upper radiator shroud and air cleaner hose (Fig. 70). Make sure that clearance between shroud and cooling fan is at least 0.180” (4.6 mm) at all points.

7. Lower and secure hood.

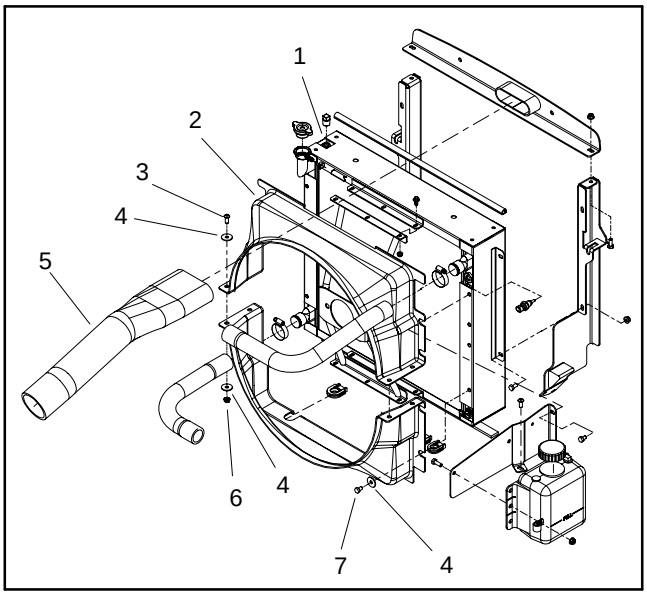

Figure 70

1. **Radiator**
2. **Upper radiator shroud**
3. **Screw (4 used)**
4. **Flat washer**
5. **Air cleaner hose**
6. **Flange nut (4 used)**
7. **Cap screw**

Engine Cooling Fan Motor Service

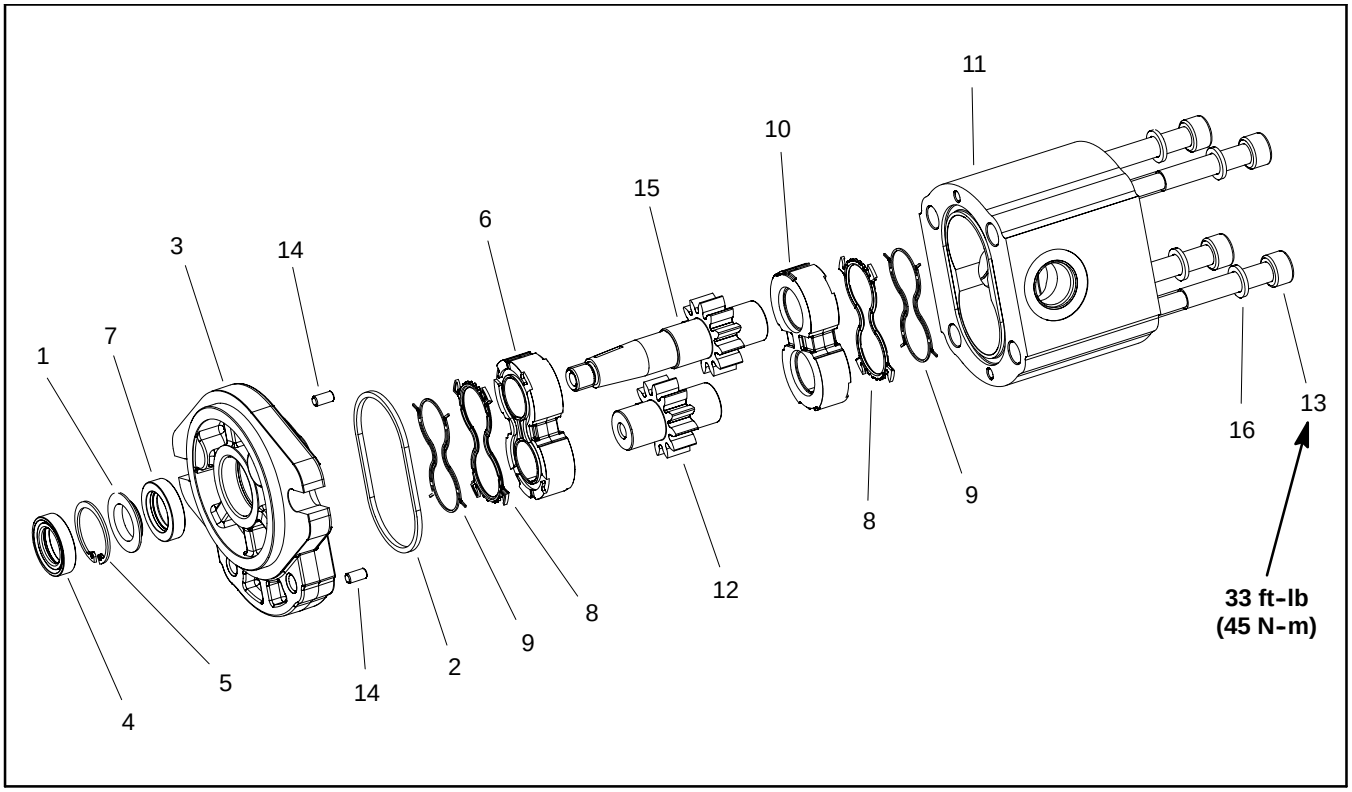

Figure 71

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

Disassembly (Fig. 71)

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. Use a marker to make a **diagonal** line across the front flange and body for assembly purposes (Fig. 72).

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

3. Clamp front flange of motor in a vise with soft jaws with the shaft end down.

4. Loosen cap screws from the rear cover.

5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.

6. 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.

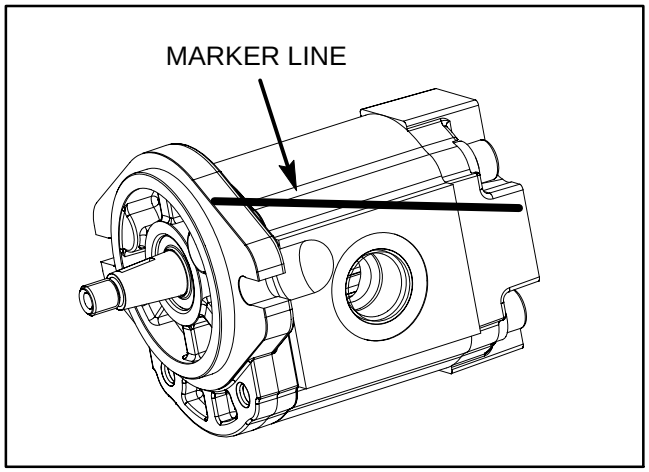

Figure 72

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.

7. Carefully remove rear wear plate, idler gear, drive gear and front wear plate from the front flange.

8. Remove and discard back−up gaskets and pressure seals from wear plates.

9. 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.

10.Carefully remove dust seal, retaining ring, flange washer and shaft seal from the front flange (Fig. 74). 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. 73):

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.

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.

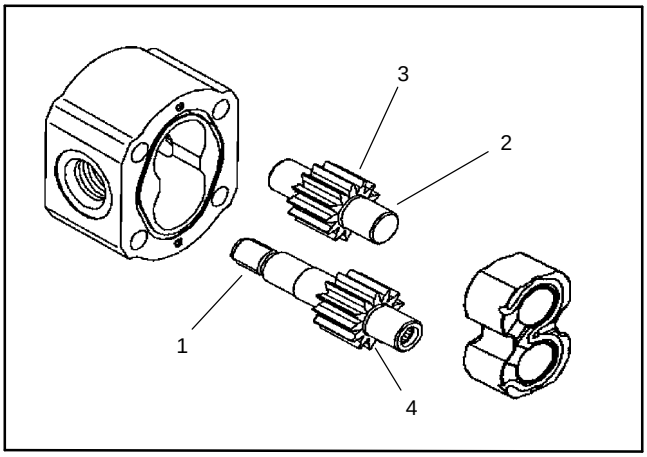

Figure 73

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

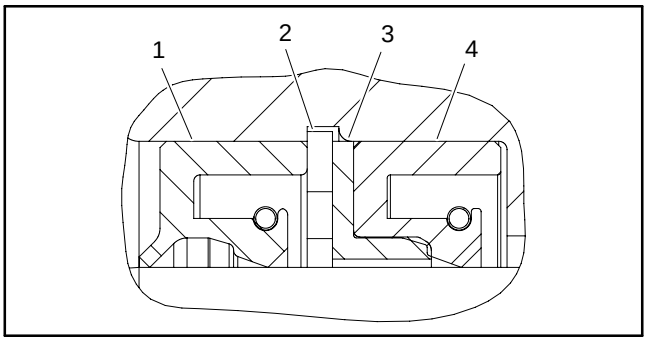

Figure 74

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**

Assembly (Fig. 71)

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. 74):

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.

12. Install the four (4) cap screws with washers and hand tighten.

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

13. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws **33 ft-lb (45 N-m)**.

14. Remove motor from vise.

15. 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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Fan Drive Manifold

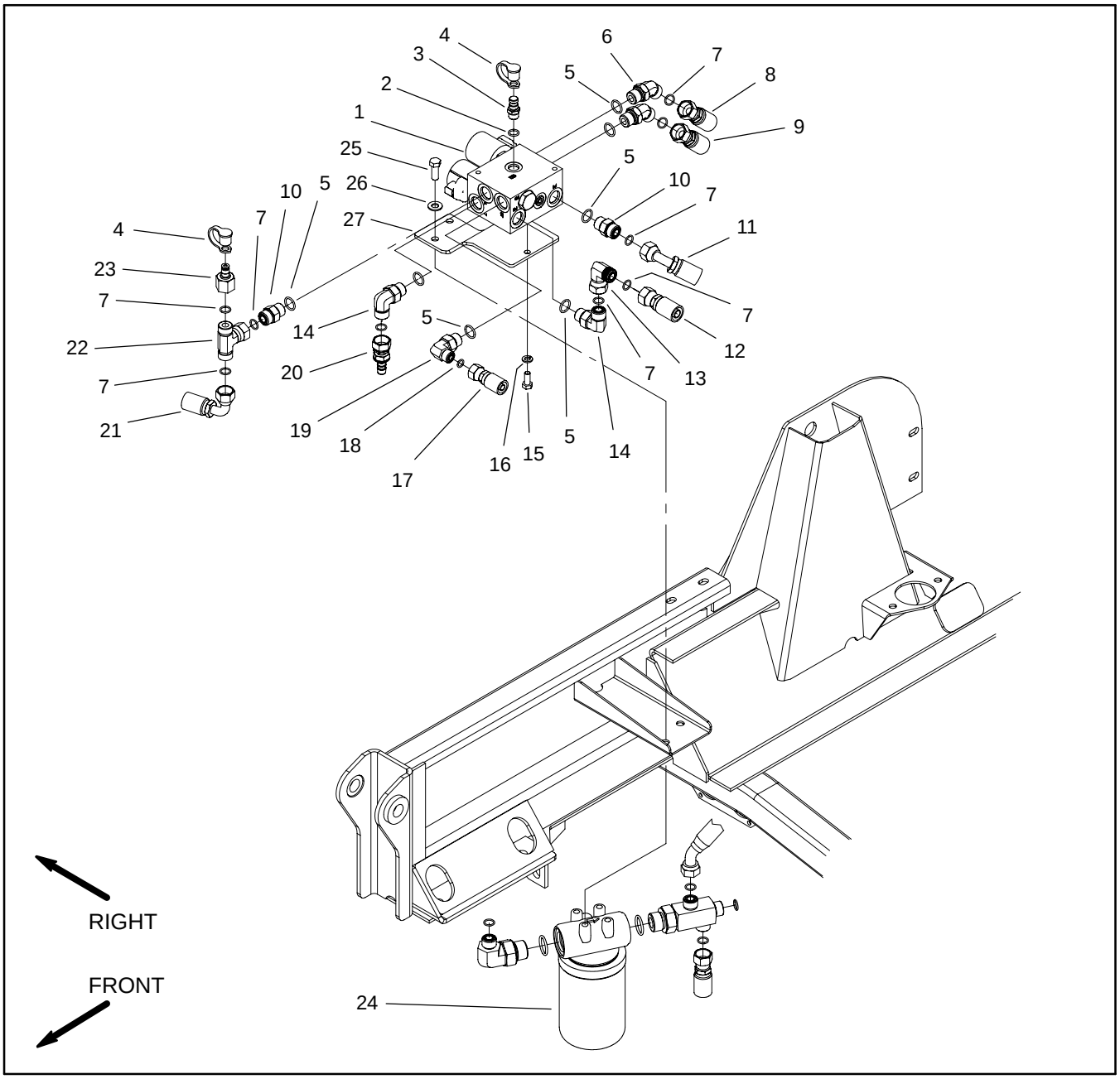

Figure 75

1. **Fan drive manifold**
2. **O-ring**
3. **Test fitting**
4. **Dust cap (2 used)**
5. **O-ring**
6. **45º hydraulic fitting (2 used)**
7. **O-ring**
8. **Hydraulic hose**
9. **Hydraulic hose**
10. **Hydraulic fitting**
11. **Hydraulic hose**
12. **Hydraulic hose**
13. **90º hydraulic fitting**
14. **90º hydraulic fitting (2 used)**
15. **Cap screw (2 used)**
16. **Lock washer (2 used)**
17. **Hydraulic hose**
18. **O-ring**
19. **90º hydraulic fitting**
20. **Hydraulic hose**
21. **Hydraulic hose**
22. **Hydraulic tee fitting**
23. **Hydraulic test fitting**
24. **Oil filter assembly**
25. **Cap screw (2 used)**
26. **Flat washer (2 used)**
27. **Manifold mount**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 and P2 are gear pump connection ports and S1 is the solenoid valve port (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 75)

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 connectors from the solenoid valve coils.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper reassembly.

5. Remove hydraulic manifold from the frame using Figure 75 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. 75)

1. If fittings were removed from manifold, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Install hydraulic manifold to the frame using Figure 75 as guide.

3. Remove caps and plugs from fittings and hoses. Using labels placed during manifold removal, properly connect hydraulic lines to manifold.

4. Connect wire harness connectors to the solenoid valve coils.

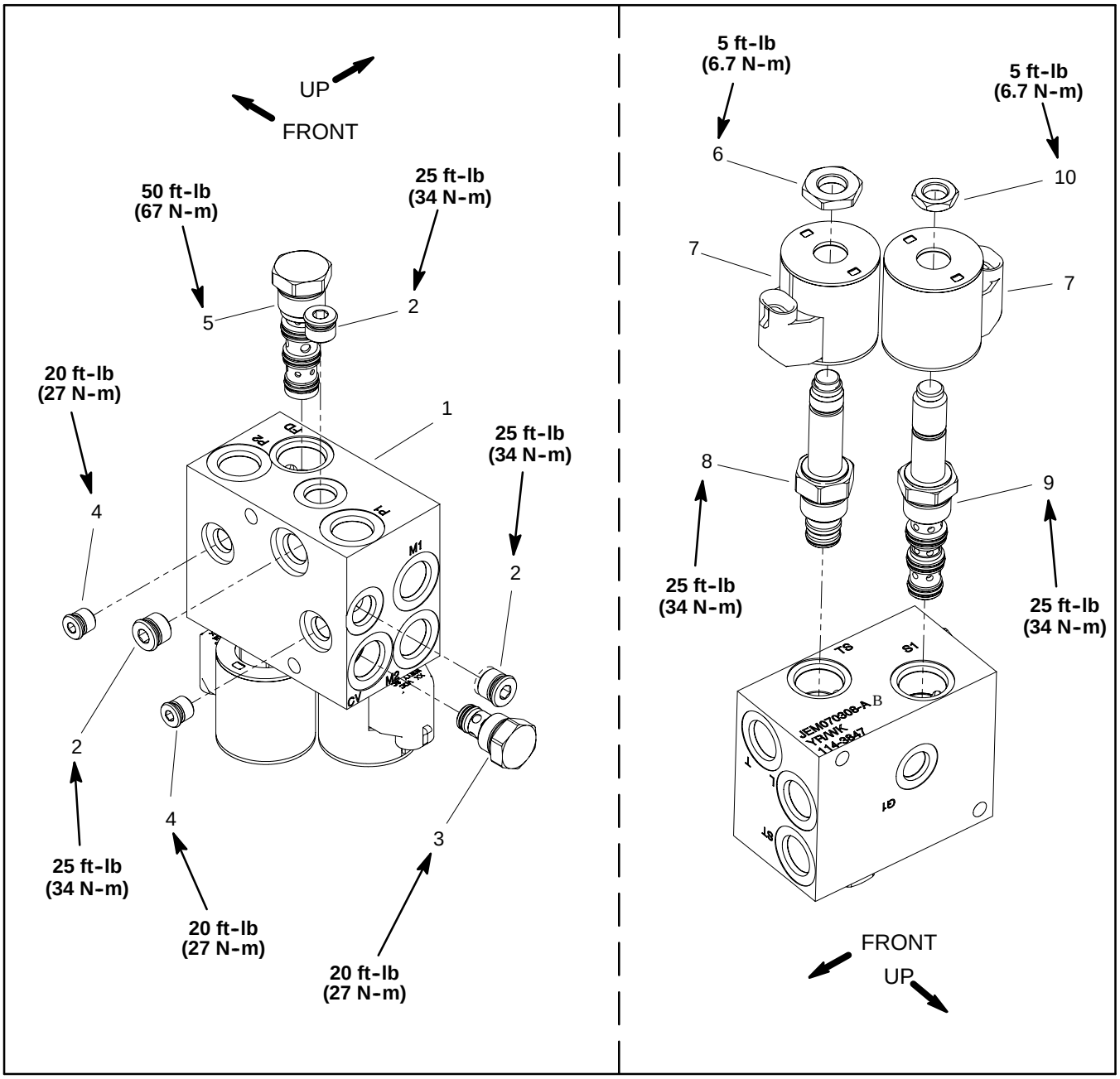

Figure 76

1. **Fan drive manifold**
2. **#4 zero leak plug (3 used)**
3. **Check valve**
4. **#6 zero leak plug (2 used)**
5. **Flow divider valve**
6. **Nut**
7. **Solenoid coil (2 used)**
8. **Proportional relief valve**
9. **Solenoid valve**
10. **Nut**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 and P2 are gear pump connection ports and S1 is the solenoid valve port (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Fan Drive Manifold Service (Fig. 76)

For cartridge valve service procedures, see 4WD Manifold Service in this section. Refer to Figure 76 for fan drive manifold cartridge valve and plug installation torque.

Mow Circuit

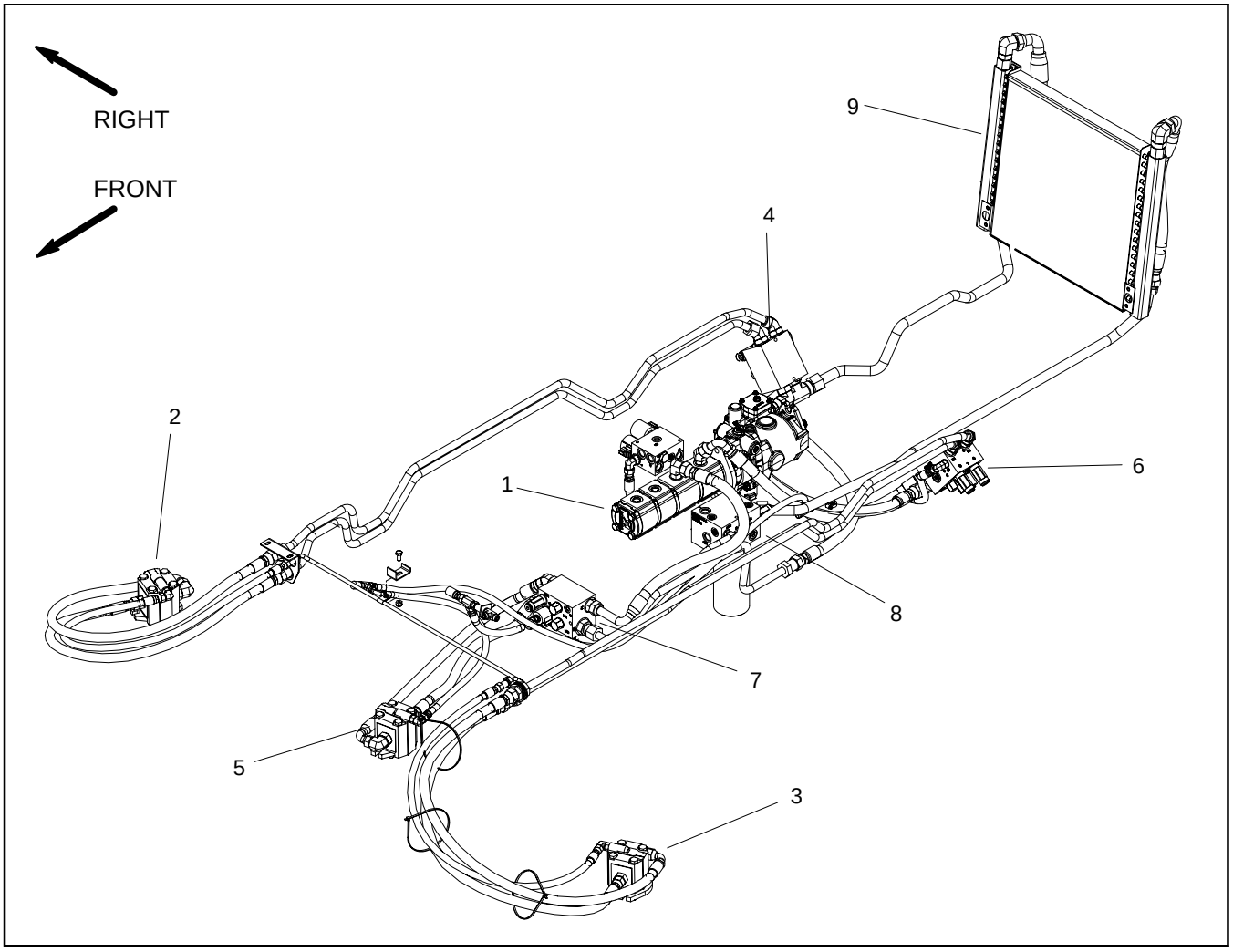

Figure 77

1. **Gear pump**
2. **RH wing deck motor**
3. **LH wing deck motor**
4. **RH Wing Deck manifold**
5. **Front cutting deck motor**
6. **LH Wing Deck manifold**
7. **Front Deck manifold**
8. **Filter manifold**
9. **Oil cooler**

Figure 77 illustrates the components that are used in the Groundsmaster 4100−D mow circuits. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this section.

Cutting Deck Motor

Removal

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. To prevent contamination of hydraulic system during motor removal, thoroughly clean exterior of motor and fittings.

4. Disconnect hydraulic lines from deck motor. Put caps or plugs on fittings and hoses to prevent contamination. Label hydraulic lines for proper installation.

5. Remove two (2) flange head screws that secure hydraulic motor to motor mount (Fig. 78).

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 required, remove spider hub from motor shaft. Straighten tab washer and remove nut, spider and woodruff key.

Installation

1. If spider hub was removed from motor shaft, thoroughly clean tapered surfaces of hub and shaft. Install spider hub to motor shaft with tab washer and nut. Torque nut from **27 to 33 ft-lb (37 to 45 N-m)**. Bend small tab of washer into keyway and large tab against nut.

2. 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 shims between motor and motor mount to adjust clearance.

3. Position spider in spindle pulley. Place mounting shim(s) (if required) on deck. Carefully install hydraulic motor to the cutting deck taking care not to damage spider hub attached to motor.

4. Secure motor to cutting deck with two (2) flange head screws (Fig. 78).

IMPORTANT: For proper hydraulic hose routing, make sure cutting deck is fully lowered before installing hoses to deck motor.

5. Remove caps or plugs from fittings and hoses. Connect hydraulic hoses to deck motor.

6. After assembly is completed, verify that hydraulic hoses and fittings are not contacted by moving components through full range of deck movement.

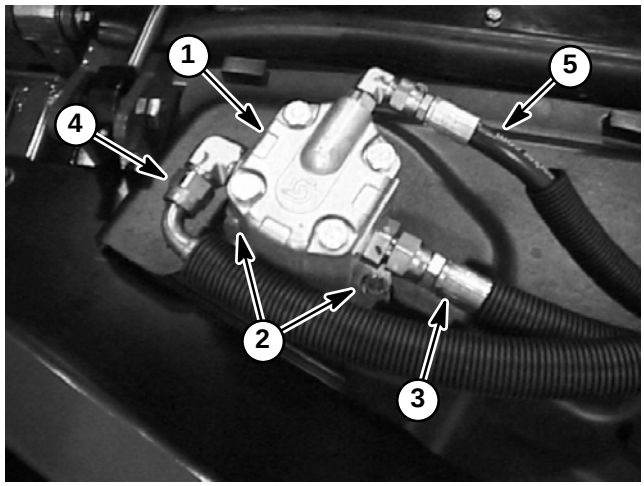

Figure 78

1. **Cutting deck motor**
2. **Flange head screw**
3. **Inlet hose**
4. **Return hose**
5. **Case drain hose**

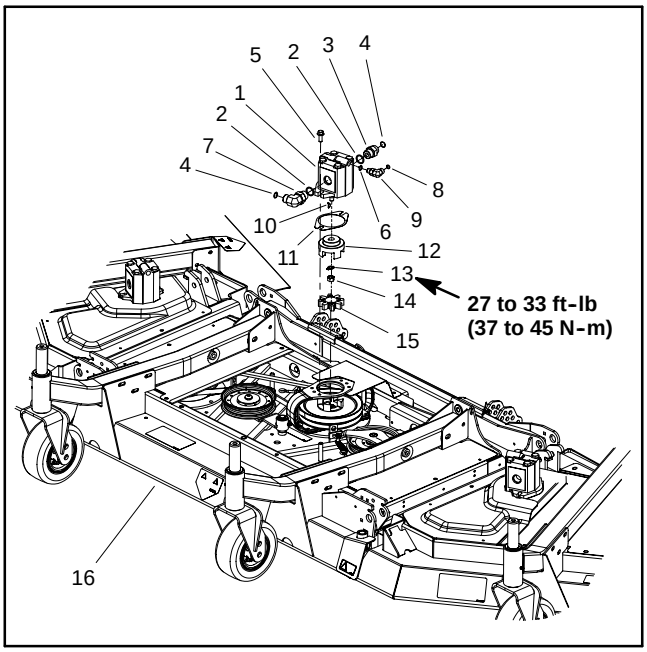

Figure 79

1. **Cutting deck motor**
2. **O-ring**
3. **Hydraulic adapter**
4. **O-ring**
5. **Flange head screw (2)**
6. **O-ring**
7. **90º hydraulic fitting**
8. **O-ring**
9. **90º hydraulic fitting**
10. **Woodruff key**
11. **Shim (if required)**
12. **Spider hub**
13. **Tab washer**
14. **Nut**
15. **Spider**
16. **Cutting deck**

Cutting Deck Motor Service

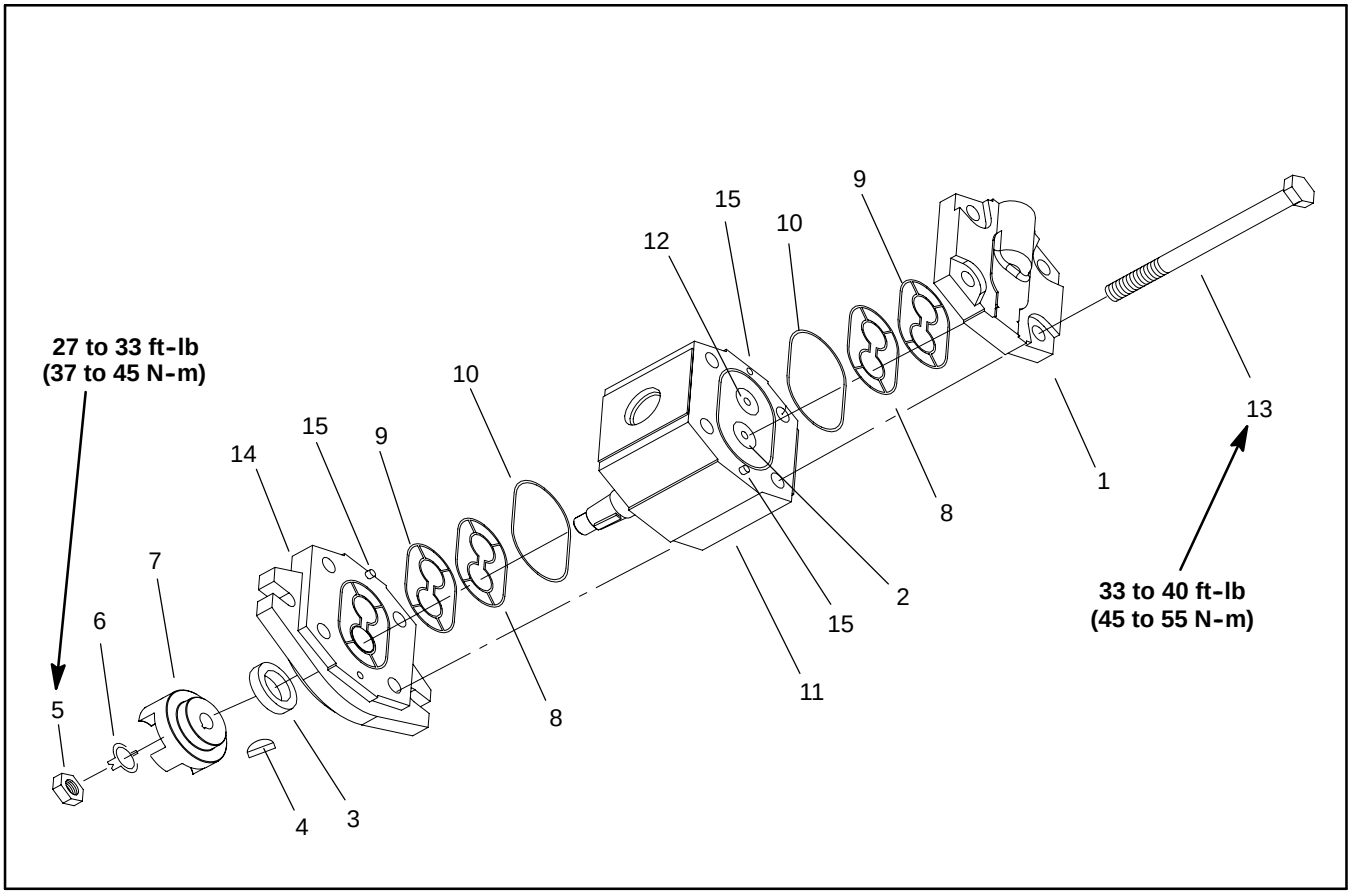

Figure 80

1. **Rear cover**
2. **Drive gear**
3. **Seal**
4. **Woodruff key**
5. **Nut**
6. **Tab washer**
7. **Spider hub**
8. **Pressure seal**
9. **Back-up ring**
10. **O-ring**
11. **Body**
12. **Idler gear**
13. **Cap screw (4 used)**
14. **Front flange**
15. **Dowel pin**

Disassembly (Fig. 80)

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. Straighten tabs on tab washer to allow removal of nut from motor shaft. Remove tab washer, spider hub and woodruff key from motor.

3. Use a marker to make a **diagonal** mark across the front flange, body and rear cover for assembly purposes (Fig. 81).

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

4. Clamp front flange of motor in a vise equipped with soft jaws with the shaft end down.

5. Loosen cap screws that secure the rear cover.

6. Take motor from the vise and remove cap screws.

7. Remove front flange from the body, then remove rear cover. Locate and remove dowel pins from body.

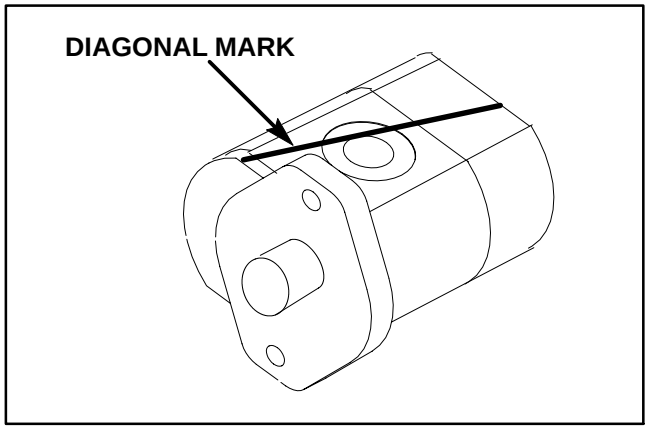

Figure 81

IMPORTANT: Mark the relative positions of the gear teeth and the bearing blocks so they can be re-assembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

8. Place the motor on its side and push on the rear bearing block to remove the bearing block and gear set (Fig. 82).

9. Carefully remove and discard O−rings, pressure seals and back−up rings (Fig. 83) from motor. Do not cause any damage to the machined grooves during the removal process.

IMPORTANT: Make sure not to damage the counter bore when removing the shaft seal from the front plate.

10. Position front flange with seal side up. Remove shaft seal.

Inspection

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive gear, idler gear and bearing blocks (Fig. 84) for the following:

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 bearing blocks and, thus, must be replaced.

D. Bearing areas of bearing blocks should not have excessive wear or scoring.

E. Face of bearing blocks that are in contact with gears should be free of wear, roughness or scoring.

4. Inspect front flange and rear cover for damage or wear.

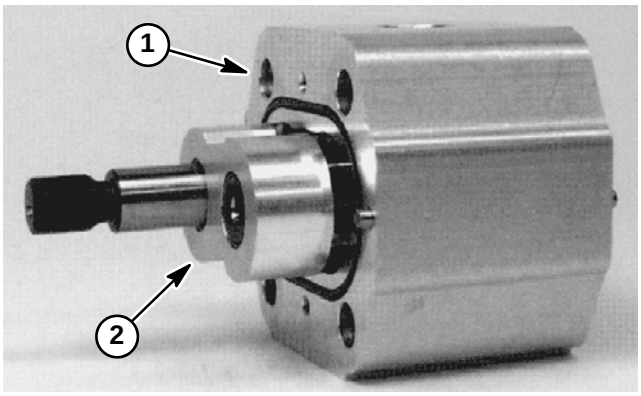

Figure 82

1. **Motor body**
2. **Bearing block & gear set**

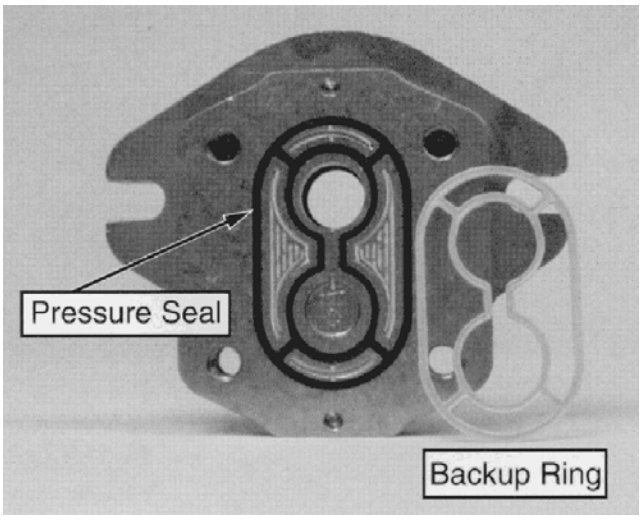

Figure 83

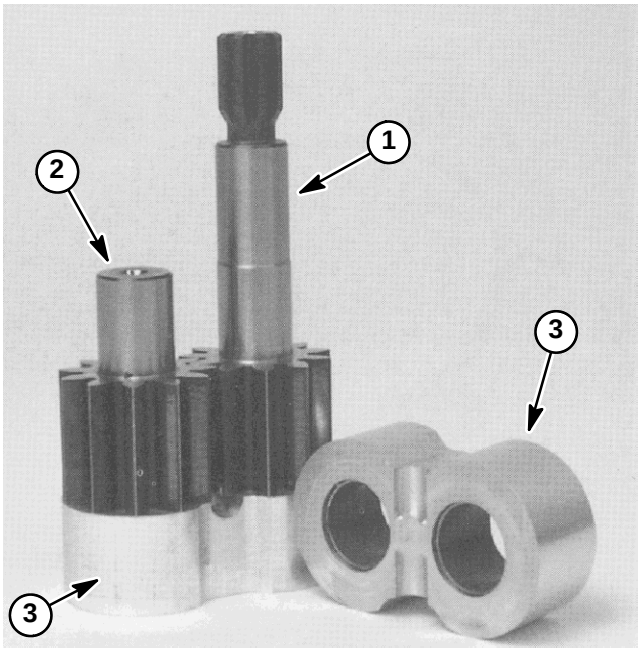

Figure 84

1. **Drive gear**
2. **Idler gear**
3. **Bearing block**

Assembly (Fig. 80)

NOTE: When assembling the motor, check the identification marks made during disassembly to make sure the parts are properly aligned during assembly.

1. Lubricate O−rings, pressure seals, back−up gaskets and seal grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new shaft seal into front flange.

3. Install lubricated pressure seals into the grooves in the front flange and rear cover. Follow by carefully placing the back−up rings into the grooves.

4. Install new O−rings to the body.

5. Lubricate gear faces and bearing surfaces of drive gear, idler gear and bearing blocks with clean hydraulic oil. Carefully assemble bearing blocks and gears noting identification marks made during disassembly.

6. Position the motor body on its side. Carefully slide bearing block and gear assembly into the body cavity using identification marks made during disassembly.

7. Remove any excess lubrication from mating surfaces of body, rear cover and front flange. Make sure that these surfaces are clean and dry.

8. Install dowel pins in body.

IMPORTANT: Do not dislodge O−rings, pressure seals or back−up rings during final assembly.

9. Gently slide the rear cover onto the assembly using marker or scribe mark for proper location. Firm hand pressure should be sufficient to engage the dowel pins.

10. Position the motor with rear cover downwards. Carefully slide the front flange onto the assembly using marker line for proper location.

11. Install the four (4) cap screws and hand tighten.

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

12. Place motor front flange in a vise and alternately torque the screws from **33 to 40 ft−lb (45 to 55 N−m)**.

13. Put a small amount of hydraulic oil in port on motor and rotate driveshaft one revolution. Protect the shaft if using a pliers. If drive shaft binds, disassemble motor and repeat assembly process.

14. Make sure that tapered surface of motor shaft and spider hub are thoroughly clean.

15. Place woodruff key in motor shaft slot. Install spider hub and tab washer on shaft. Secure spider hub to shaft with nut. Torque nut from **27 to 33 ft−lb (37 to 45 N−m)**.

16. Secure nut to motor shaft by bending small tab of tab washer into keyway and large tab against nut.

17. Remove motor from vise.

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Deck Manifolds

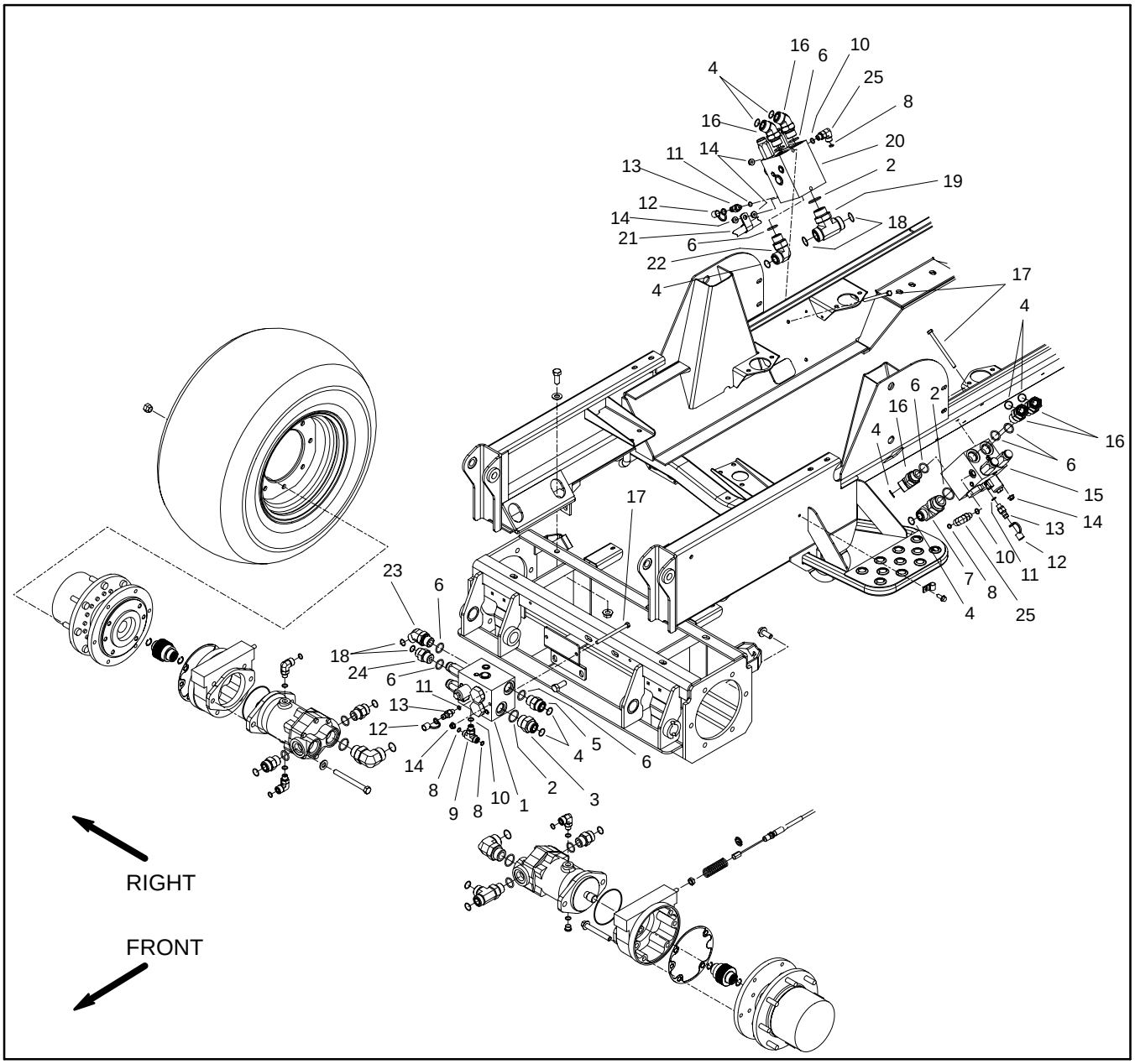

Figure 85

1. **Center deck manifold**
2. **O-ring**
3. **Hydraulic adapter**
4. **O-ring**
5. **Straight hydraulic fitting**
6. **O-ring**
7. **90º hydraulic fitting**
8. **O-ring**
9. **Hydraulic tee fitting**
10. **O-ring**
11. **O-ring**
12. **Dust cap**
13. **Quick fitting**
14. **Flange nut**
15. **LH wing deck manifold**
16. **45º hydraulic fitting**
17. **Cap screw (2 used per manifold)**
18. **O-ring**
19. **Hydraulic tee fitting**
20. **RH wing deck manifold**
21. **Hose**
22. **90º hydraulic fitting**
23. **Hydraulic fitting**
24. **Hydraulic adapter**
25. **90º hydraulic fitting**

Removal (Fig. 85)

NOTE: The ports on the manifold are marked for easy identification of components. Example: SV1 is the deck solenoid valve and P1 is a gear pump connection port. (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

The control manifolds for the three (3) cutting deck sections are very similar.

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

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this section.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold and fittings.

3. Disconnect electrical connector from the 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 installation.

5. Remove hydraulic manifold from the frame using Figure 85 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. 85)

1. If fittings were removed from manifold, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Install hydraulic manifold to the frame using Figure 85 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold.

4. Connect electrical connector to the solenoid valve.

Deck Manifold Service

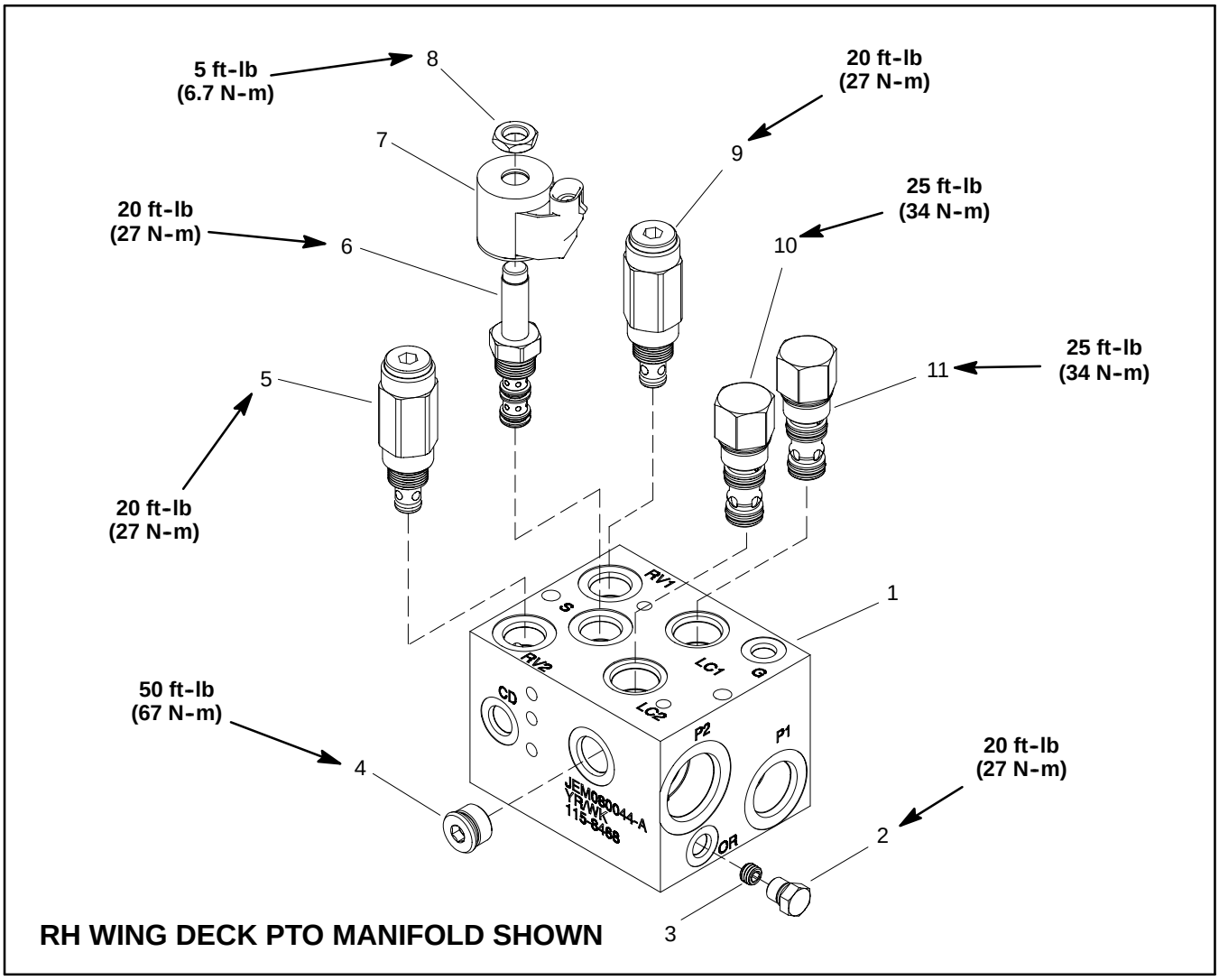

Figure 86

1. Manifold body
2. NWD SAE #4 plug with O-ring
3. Orifice (0.063) (port OR)
4. #8 zero leak plug with O-ring
5. Relief valve (port RV2)
6. Solenoid valve (port S)
7. Solenoid coil
8. Nut
9. Relief valve (port RV1)
10. Spool logic cartridge (port LC2)
11. Spool logic cartridge (port LC1)

NOTE: The ports on the manifold are marked for easy identification of components. Example: S is the deck solenoid valve and P1 is the gear pump connection port. (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location).

The control manifolds for the three (3) cutting deck sections are very similar. The front deck control manifold does not include an orifice (item 3).

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

PTO Manifold Service (Fig. 86)

For solenoid and control valve service procedures, see 4WD Manifold Service in this section. Refer to Figure 86 for PTO manifold cartridge valve and plug installation torque.

Lift/Lower Circuit

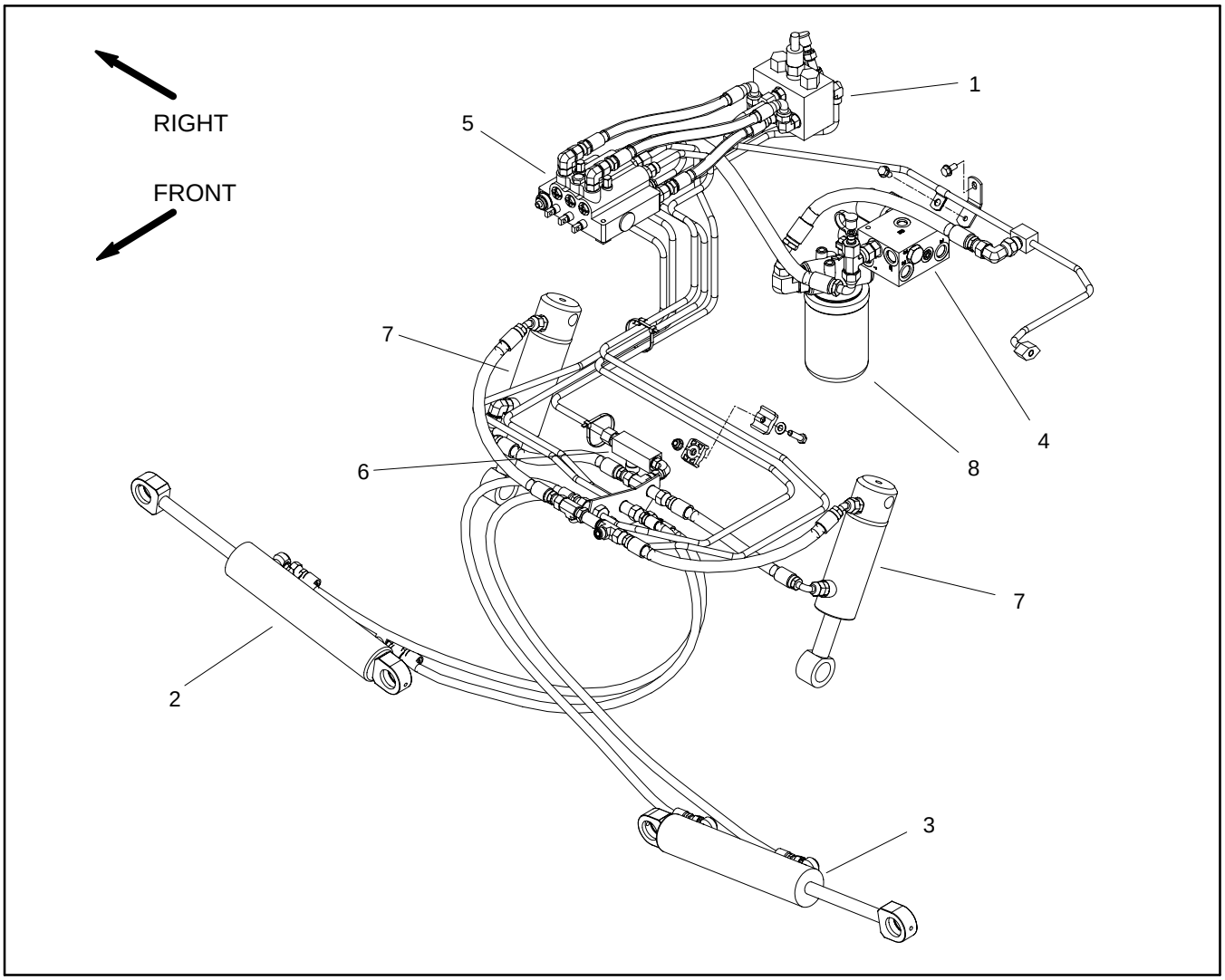

Figure 87

1. **Counterbalance manifold**
2. **RH wing deck lift cylinder**
3. **LH wing deck lift cylinder**
4. **Fan drive manifold**
5. **Lift control valve**
6. **Front deck flow control valve**
7. **Front lift cylinder**
8. **Oil filter**

Figure 87 illustrates the components that are used in the Groundsmaster 4100−D cutting deck lift and lower circuits. Procedures for removal, installation and disassembly/assembly of these components are provided on the following pages of this section.

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Lift/Lower Control Valve

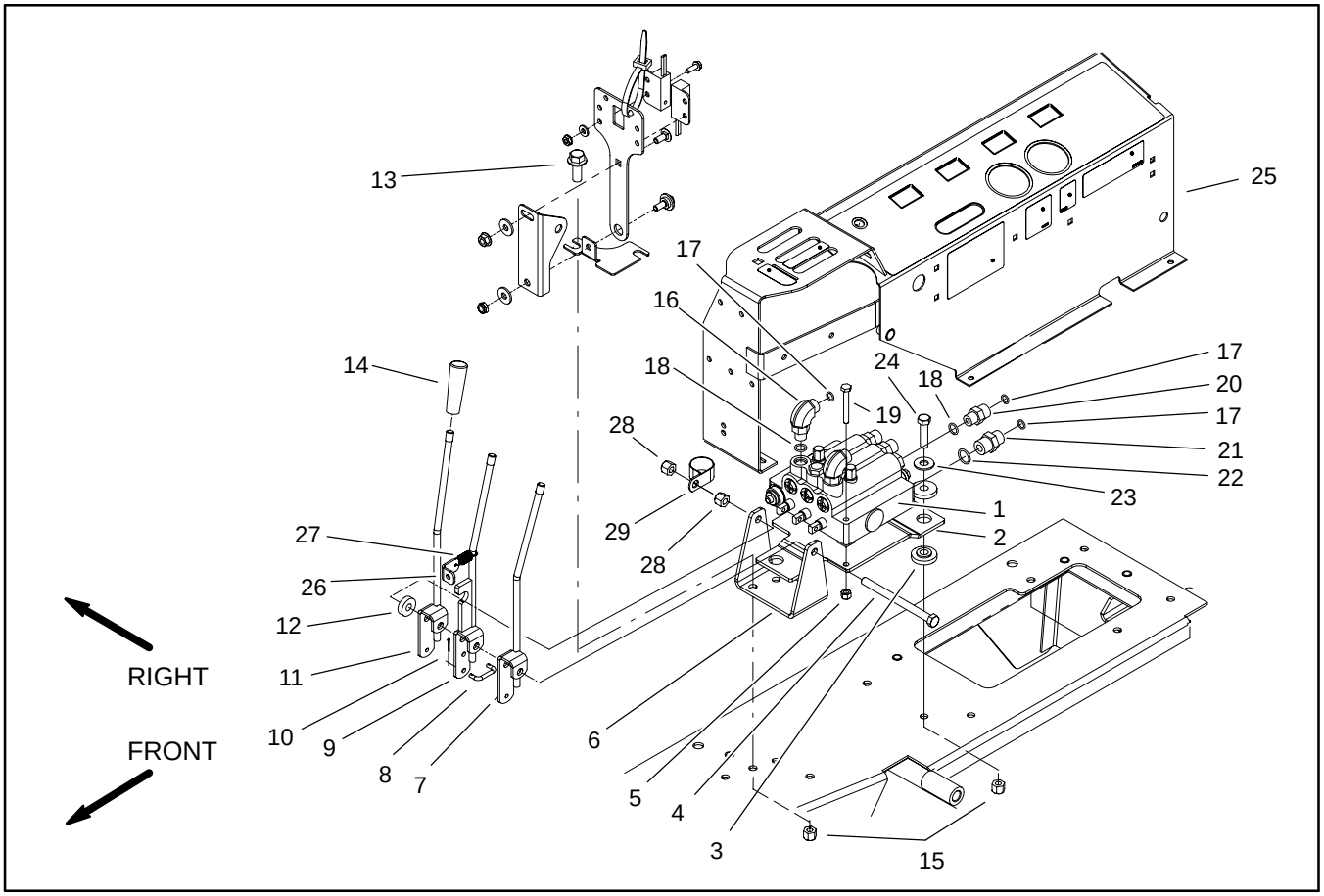


Figure 88

1. Control valve assembly
2. Valve bracket
3. Isolator (6 used)
4. Cap screw
5. Lock nut (2 used)
6. Pivot bracket
7. LH lever assembly
8. Lever link (3 used)
9. Center lever assembly
10. Cotter pin (6 used)
11. RH lever assembly
12. Spacer
13. Flange head screw (2 used)
14. Knob (3 used)
15. Lock nut (4 used)
16. 90º hydraulic fitting (2 used)
17. O-ring
18. O-ring
19. Cap screw (2 used)
20. Hydraulic fitting (3 used)
21. Hydraulic fitting
22. O-ring
23. Flat washer (3 used)
24. Cap screw (3 used)
25. Control panel
26. Spring bracket
27. Extension spring
28. Lock nut (2 used)
29. R-clamp

Removal (Fig. 88)

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. To prevent contamination of hydraulic system during control valve removal, thoroughly clean exterior of control valve and fittings.

4. Remove lift/lower control valve using Figure 88 as a guide.

5. If hydraulic fittings are to be removed from control valve, mark fitting orientation to allow correct assembly. Remove fittings from valve and discard O−rings.

Installation (Fig. 88)

1. If fittings were removed from control valve, lubricate and place new O−rings onto fittings. Install fittings into port 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. Install lift/lower control valve using Figure 88 as a guide.

   A. If valve bracket (item 2) was removed, tighten cap screw (item 24) only until the washer (item 23) begins to seat against the isolator (item 3). The isolator should not be deformed.

3. After installation, check operation of cutting deck raise and lower switches (see Cutting Deck Raise and Lower Switches in the Adjustment section of Chapter 5 − Electrical System).

4. Make sure hydraulic tank is full. Add correct oil if necessary before returning machine to service.

Lift/Lower Control Valve Service

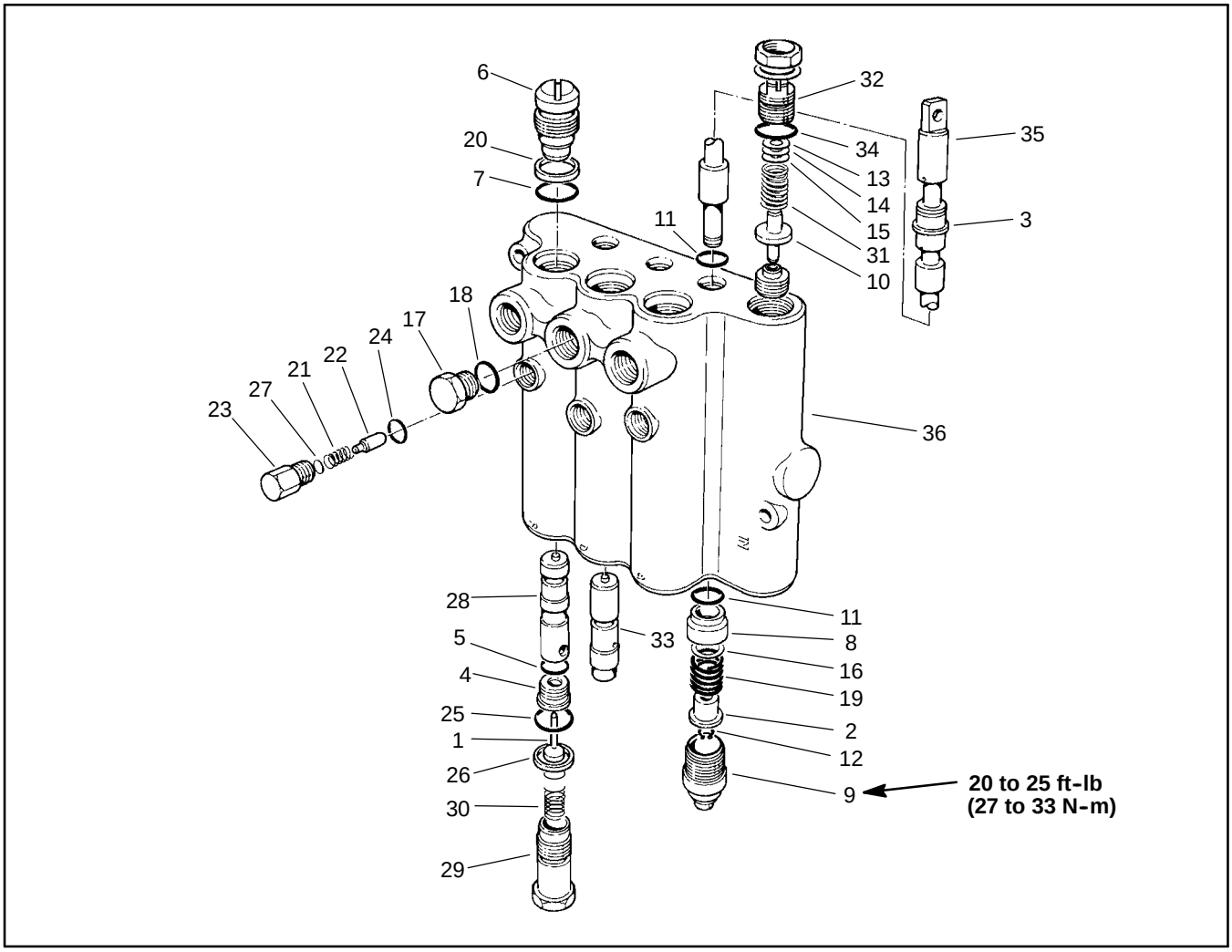


Figure 89

1. Poppet
2. Spacer
3. Wiper seal
4. Seat
5. O-ring
6. Plug (3 used)
7. O-ring
8. Bushing
9. Spool cap (3 used)
10. Relief valve poppet
11. O-ring
12. Retaining ring
13. Washer
14. Washer
15. Washer
16. Washer
17. Plug
18. O-ring
19. Spool spring
20. Backup washer
21. Detent spring
22. Detent plunger
23. Detent plug (3 used)
24. O-ring
25. O-ring
26. Backup washer
27. Disc
28. Plunger (2 used)
29. Plug assembly (3 used)
30. Lockout spring
31. Relief valve spring
32. Relief plug assembly
33. Plunger
34. O-ring
35. Spool
36. Control valve body

Disassembly (Fig. 89)

1. Plug all ports and clean outside of valve thoroughly.

2. Remove spool caps (item 9). Do not remove retaining rings (item 12) from spools unless spool spring (item 19) is broken.

NOTE: Spools and spool bores are matched sets. Be sure each spool is identified with the correct valve body spool bore.

3. Remove spools (item 35) from valve body (item 36).

4. Remove bushings (item 8) and O−rings (item 11) from spools.

5. Remove plugs (item 6).

IMPORTANT: Check location and positioning of plungers when removing from body to assure proper assembly.

6. Remove plugs (item 29), lockout springs (item 30), poppets (item 1), seats (item 4) and plungers (items 28 and 33).

7. Remove plug (item 17).

8. Remove detent plug (item 23), disc (item 27), detent spring (item 21) and detent plunger (item 22).

9. Remove relief plug assembly (item 32), washers (items 13, 14 and 15), relief valve spring (item 31) and relief valve poppet (item 10).

10. Remove all O−rings and back−up rings from all plugs and seats.

11. Discard all removed O−rings, back−up washers, wiper seals and nylon poppets.

Inspection

1. Remove all nicks and burns from parts and inspect for excessive wear.

2. Inspect all plungers and poppet seats for burrs or roughness.

3. Inspect spool springs (item 19), relief valve spring (item 31), lockout springs (item 30) and detent spring (item 21) for breakage.

4. If spools (item 35) have excessive wear, the control valve becomes non−serviceable as the spools and spool bores are matched. Damaged spools cannot be replaced individually.

5. Inspect relief valve poppet (item 10) for breakage or wear.

Assembly (Fig. 89)

1. Thoroughly clean and dry all parts. Apply a light coating of clean hydraulic oil to all control valve parts prior to assembly.

NOTE: All O−rings, back−up washers, wiper seals and nylon poppets should be replaced as new items.

2. Install new O−rings (item 11) in proper grooves in spool bores.

3. Install relief valve components (items 13, 14, 15, 31 and 10) with new O−ring (item 34) on plug assembly (item 32).

4. Install plugs (item 6) with new back−up washers (item 20) and new O−rings (item 7).

5. Install plungers (items 33 and 28).

IMPORTANT: Check location and positioning of plungers during installation.

6. Install new O−rings (item 5) on seats (item 4). Install new back−up washers (item 26) and O−rings (item 25) on plugs (item 29).

7. Install seats (item 4), new poppets (item 1) and plugs (item 29).

8. Install plug (item 17) with new O−ring (item 18).

9. Install detent plunger (item 22), spring (item 21), disc (item 27) and plug (item 23) with new O−ring (item 24).

10. If retaining ring (item 12) has been removed to replace spool spring (item 19), install washer (item 16), spring (item 19) and spacer (item 2) on spool. Secure with retaining ring (item 12).

11. Slide bushings (item 8) over spools. Slide new O−rings (item 11) over spools and position next to bushings. Dip spools in clean hydraulic oil and install spool assemblies into proper location of valve body.

12. Install spool caps (item 9) and tighten from **20 to 25 ft−lb (27 to 33 N−m)**.

13. Install new wiper seals (item 3).

Front Deck Lift Cylinder

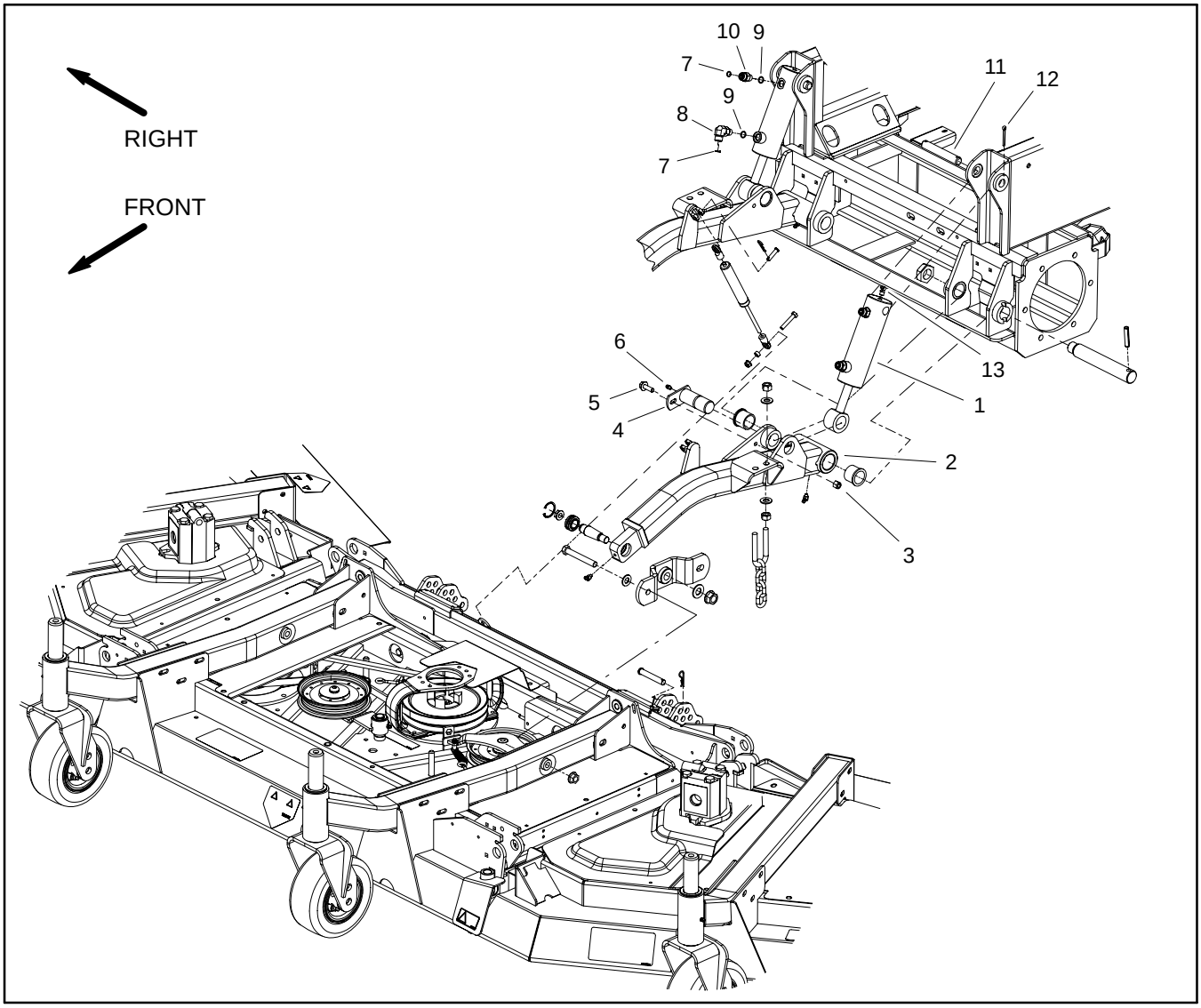


Figure 90

1. **Lift cylinder (2 used)**
2. **Lift arm (LH shown)**
3. **Lock nut**
4. **Pin**
5. **Flange head screw**
6. **Grease fitting**
7. **O−ring**
8. **90º hydraulic fitting**
9. **O−ring**
10. **Hydraulic fitting**
11. **Pivot pin**
12. **Cotter pin**
13. **Grease fitting**

Removal (Fig. 90)

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

NOTE: To ease installation, label the hydraulic hoses to show their correct position on the lift cylinder.

4. Disconnect hydraulic hoses from lift cylinder.

5. Remove flange head screw and lock nut that secure the pin to the lift arm. Remove pin from lift arm and cylinder shaft clevis which will free lift cylinder from lift arm.

6. Remove one cotter pin from upper lift pin. Pull upper lift 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. 90)

1. If fittings were removed from lift cylinder, lubricate and place new O−rings onto fittings. Install fittings into port 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 cylinder barrel clevis to frame and insert upper lift pin into frame and clevis. Secure lift pin with cotter pin.

3. Insert pin through lift arm and cylinder shaft clevis. Secure pin to lift arm with flange head screw and lock nut.

4. Attach hydraulic hoses to lift cylinder.

5. Fill reservoir with hydraulic fluid as required.

6. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Wing Deck Lift Cylinder

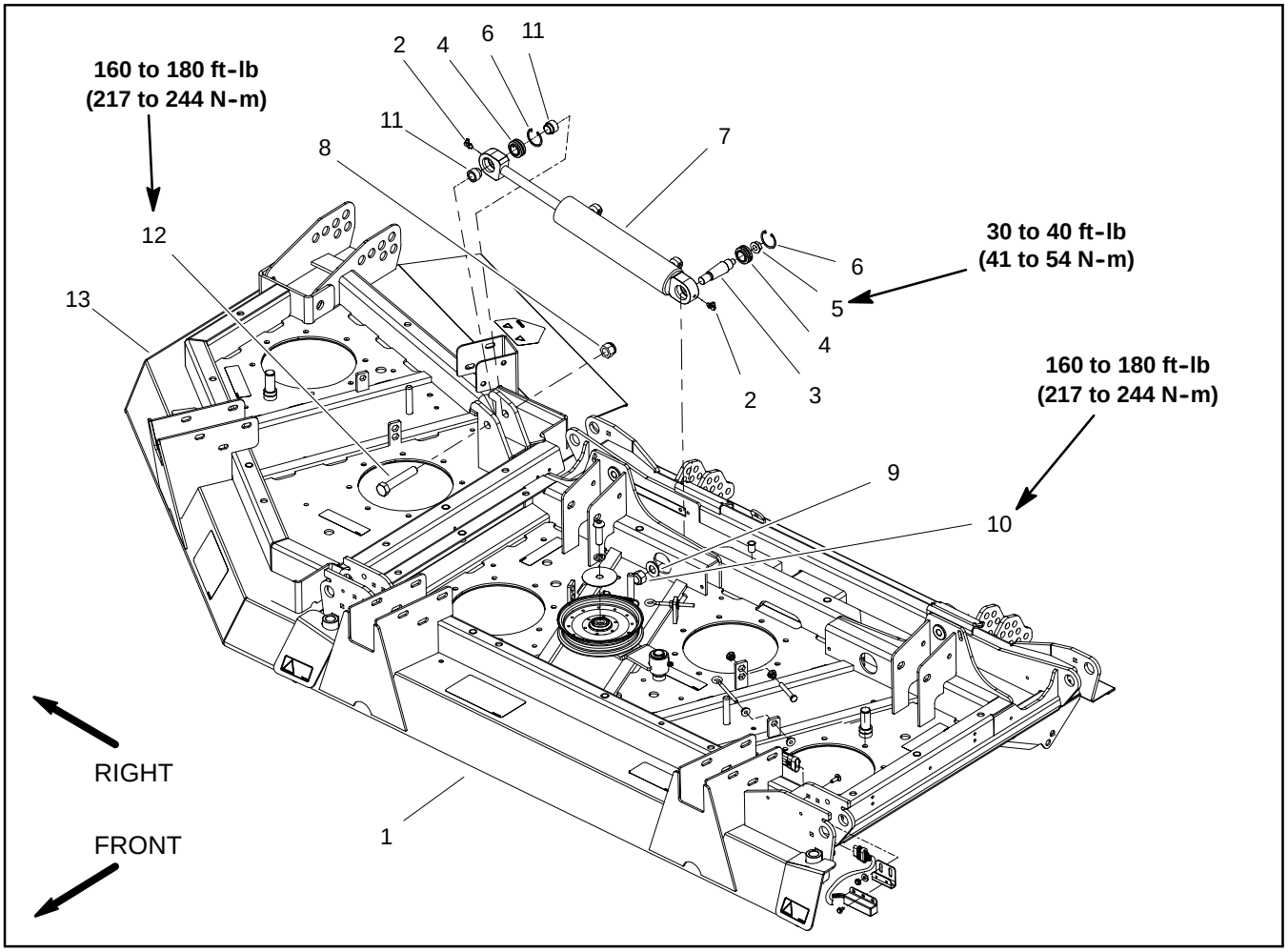


Figure 91

1. Center deck
2. Grease fitting
3. Tapered stud
4. Spherical bearing
5. Flange nut
6. Retaining ring
7. Wing deck lift cylinder
8. Lock nut
9. Flat washer
10. Lock nut
11. Pilot spacer
12. Cap screw
13. Wing deck (RH shown)

Removal (Fig. 91)

1. Park machine on a level surface, lower cutting deck, stop engine, engage 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 this section.

3. Remove deck covers as needed to allow access to lift cylinder hoses and fasteners.

4. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of cylinder and fittings.

NOTE: To ease installation, label the hydraulic hoses to show their correct position on the lift cylinder.

5. Disconnect hydraulic hoses from lift cylinder.

6. Remove cap screw and lock nut that secure the lift cylinder clevis to the wing deck.

7. Remove lock nut and flat washer from the tapered stud on the barrel end of the lift cylinder.

8. Remove lift cylinder from deck assembly.

9. Remove spherical bearings from lift cylinder clevis ends, if required.

   A. On shaft clevis, remove retaining ring and then press spherical bearing from clevis.

   B. On barrel clevis, remove retaining ring and then press tapered stud with spherical bearing and flange nut from clevis. Remove flange nut and then spherical bearing from stud.

Installation (Fig. 91)

1. If removed, install spherical bearings into lift cylinder clevis ends.

   A. On shaft clevis, press spherical bearing into clevis and secure with retaining ring.

   B. On barrel clevis, install spherical bearing on tapered stud and secure with flange nut. Torque flange nut from **30 to 40 in-lb (41 to 54 N-m)**. Install stud with spherical bearing into clevis and secure with retaining ring.

2. Thoroughly clean tapered surfaces of lift cylinder stud and mounting boss on deck.

3. Position lift cylinder to cutting deck. Insert tapered stud into deck mounting boss. Secure stud with flat washer and lock nut. Torque flange nut from **160 to 180 ft-lb (217 to 244 N-m)**.

4. Insert cap screw from the front of the deck through the deck brackets and cylinder shaft clevis. Secure cap screw with lock nut. Torque lock nut from **160 to 180 ft-lb (217 to 244 N-m)**.

5. Attach hydraulic hoses to lift cylinder.

6. Install any removed deck covers.

7. Fill reservoir with hydraulic fluid as required.

8. After assembly is completed, operate lift cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Deck Lift Cylinder Service

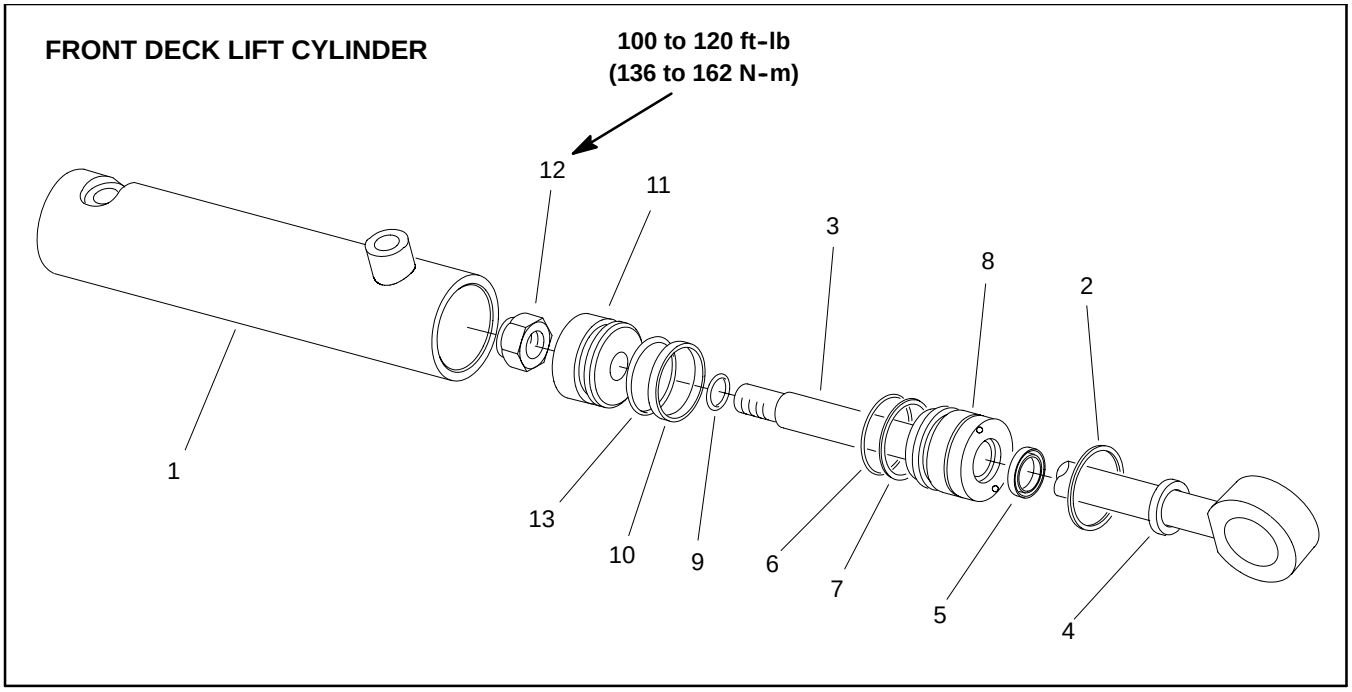


Figure 92

1. **Barrel with clevis**
2. **Retaining ring**
3. **Shaft with clevis**
4. **Dust seal**
5. **Rod seal**
6. **O-ring**
7. **Back-up ring**
8. **Head**
9. **O-ring**
10. **Wear ring**
11. **Piston**
12. **Locking nut**
13. **Seal with loader**

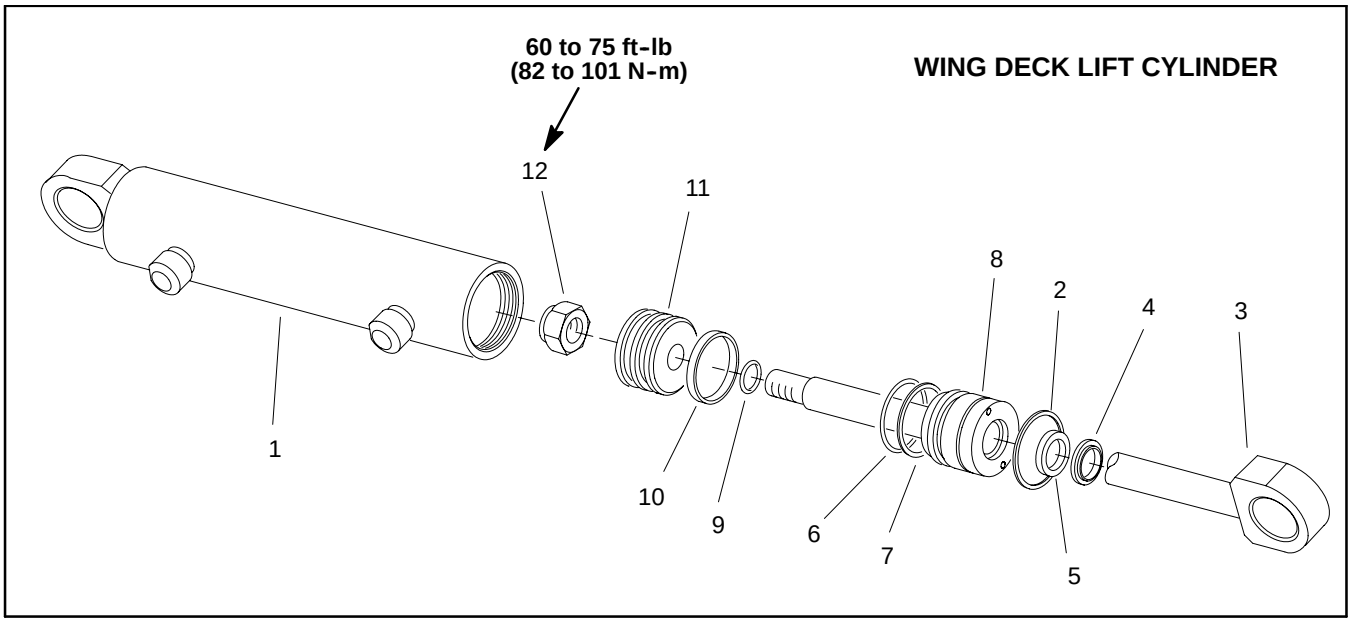


Figure 93

1. **Barrel with clevis**
2. **Retaining ring**
3. **Shaft with clevis**
4. **Dust seal**
5. **Rod seal**
6. **O-ring**
7. **Back-up ring**
8. **Head**
9. **O-ring**
10. **Seal with O-ring**
11. **Piston**
12. **Lock nut**

Disassembly (Figs. 92 and 93)

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 in a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Loosen head from 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: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

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 off the shaft.

6. Remove and discard all seals and O−rings from the piston and 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 piston rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Figs. 92 and 93)

1. Make sure all cylinder components are clean before assembly.

2. Coat new seal kit components with clean hydraulic oil.

   A. Install new seals and O−rings to the piston.

   B. Install new seals, O−ring and back−up ring to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

3. Mount shaft securely in a vise by clamping on the clevis of the shaft.

   A. Coat shaft with clean hydraulic oil.

   B. Carefully slide head and piston onto the shaft. Secure piston to shaft with lock nut.

   C. Torque lock nut to specification in Figure 92 (front deck cylinder) or Figure 93 (wing cylinder).

4. Lubricate head and piston with hydraulic oil. Carefully slide shaft assembly into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

5. Mount lift cylinder in a vise with soft jaws. Secure head in barrel:

   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.

   C. Apply silicone sealer to barrel access slot.

Counterbalance Manifold

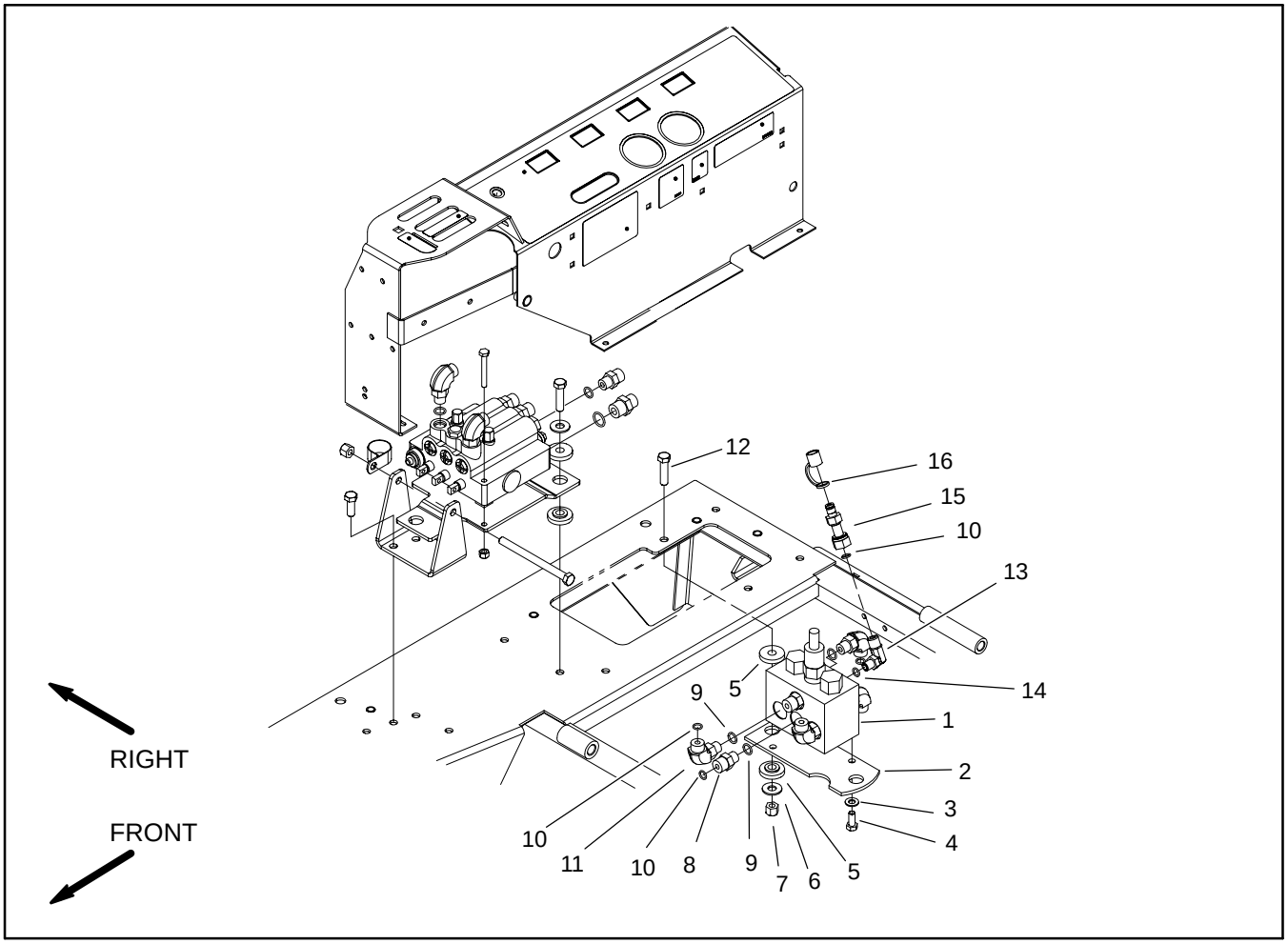


Figure 94

1. **Counterbalance hydraulic manifold**
2. **Valve plate**
3. **Flat washer (2 used)**
4. **Cap screw (2 used)**
5. **Isolator (4 used)**
6. **Flat washer (2 used)**
7. **Lock nut (2 used)**
8. **Hydraulic fitting (2 used)**
9. **O−ring**
10. **O−ring**
11. **90º hydraulic fitting (4 used)**
12. **Cap screw (2 used)**
13. **90º hydraulic fitting**
14. **O−ring**
15. **Test nipple**
16. **Dust cap**

NOTE: The ports on the manifold are marked for easy identification of components. Example: C1 is the connection port from the LH deck lift cylinder and CHG is the charge circuit connection (See Hydraulic Schematic in Chapter 9 − Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 94)

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 manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper reassembly.

4. Remove hydraulic manifold from the frame using Figure 94 as guide.

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

Installation (Fig. 94)

1. If fittings were removed from manifold, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Install hydraulic manifold to the frame using Figure 94 as guide.

   A. If valve plate (item 2) was removed, tighten lock nut (item 7) until washer begins to seat in isolator (item 5). Do not cause isolator to be deformed during valve plate installation.

3. Remove caps and plugs from fittings and hoses. Using labels placed during manifold removal, properly connect hydraulic lines to manifold.

Counterbalance Manifold Service

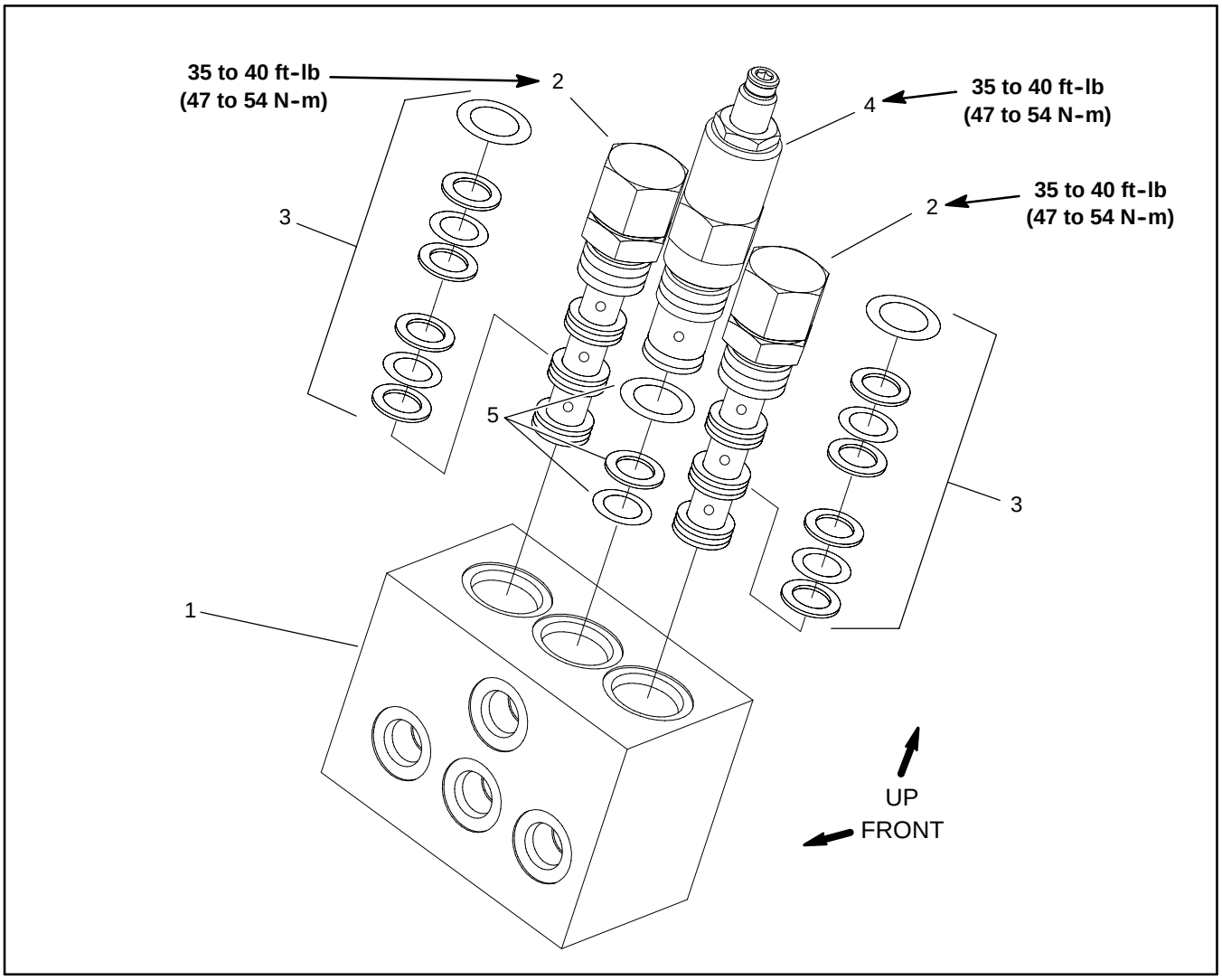


Figure 95

1. **Manifold body**
2. **Pilot valve**
3. **Seal kit**
4. **Relief valve (counterbalance)**
5. **Seal kit**

NOTE: The ports on the manifold are marked for easy identification of components. Example: C1 is the connection port from the LH deck lift cylinder and CHG is the charge circuit connection (See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Counterbalance Manifold Service (Fig. 95)

For cartridge valve service procedures, see 4WD Manifold Service in this section. Refer to Figure 95 for counterbalance manifold cartridge valve installation torque.

Chapter 5

Electrical System

Table of Contents

General Information

Operator's Manual

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

Electrical Drawings

The electrical schematic, circuit diagrams and wire harness drawings for the Groundsmaster 4100–D are located in Chapter 9 – 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.

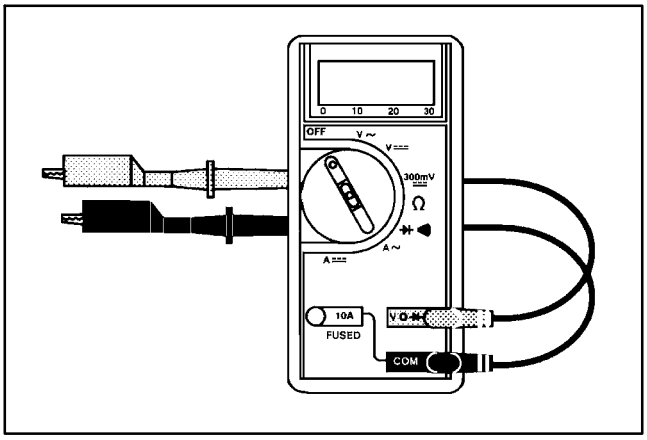


Figure 1

Skin–Over Grease

Special non–conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: **505–165**

Figure 2

Deck Proximity Switch Adjustment Tool

The Deck Proximity Switch Adjustment Tool is designed to assist in the adjustment of the cutting deck position switches for cutting blade shutdown during deck lift.

Toro Part Number: **TOR4095**

Figure 3

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 4

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 5

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.

Figure 6

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, there must be a good understanding of the electrical circuits and components used on this machine (see electrical schematic and circuit diagrams in Chapter 9 – Foldout Drawings).

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

Starting Problems

Problem	Possible Causes
All electrical power is dead, including gauges.	The traction pedal is not in the neutral position. The battery is discharged. Fuse F2 (10 amp) to the ignition switch is faulty. A bad ground connection exists on machine. The ignition switch or circuit wiring is faulty. The neutral switch or circuit wiring is faulty. The fusible link from the battery is faulty.
Starter solenoid clicks, but starter will not crank. **NOTE:** If the solenoid clicks, the problem is not in the interlock circuit.	The battery is discharged. The battery cables are loose or corroded. A ground wire or cable is loose or corroded. Wiring at the starter motor is faulty. The starter solenoid is faulty. The starter is faulty.
Nothing happens when start attempt is made. Control panel lights and gauges operate with the ignition switch in ON.	The traction pedal is not in neutral position. The traction neutral switch or circuit wiring is faulty. The ignition switch or circuit wiring is faulty. The start relay or circuit wiring is faulty. The starter solenoid is faulty. The starter is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	The engine run solenoid is out of adjustment or circuit wiring is faulty. The high temperature shutdown switch or circuit wiring is faulty.

Problem	Possible Causes
Engine cranks, but does not start.	Engine is not cranking fast enough. The engine run solenoid or circuit wiring is faulty. The fuel pump is faulty. An engine problem exists (see Chapter 3 – Kubota Engine).
Starter cranks, but should not when the traction pedal is depressed.	The traction neutral switch is out of adjustment. The traction neutral switch or circuit wiring is faulty.

General Run and Transport Problems

Engine continues to run, but should not, when the ignition switch is turned off.	The engine run solenoid is stuck or is faulty. The ignition switch or circuit wiring is faulty.
Engine continues to run, but should not, when the traction pedal is engaged with no operator in the seat.	The seat switch or circuit wiring is faulty. The traction neutral switch or circuit wiring is faulty.
The engine stops during operation, but is able to restart.	The operator is lifting off the seat switch. The seat switch or circuit wiring is faulty. The engine shutdown delay is faulty. The ignition switch or circuit wiring is faulty.
The engine kills when the traction pedal is depressed.	The operator is lifting off the seat as the pedal is depressed. The seat switch or circuit wiring is faulty.
Battery does not charge.	Loose, corroded or broken wire(s). The fusible link to the battery is faulty. The charge indicator lamp is faulty or burned out. The charge indicator lamp wiring is loose, corroded or damaged. The battery is faulty. The alternator is faulty.

Cutting Deck Operating Problems

The cutting deck remains engaged, but should not, with no operator in the seat.	The seat switch or circuit wiring is faulty.
Cutting deck runs, but should not, when raised. Deck shuts off with PTO switch.	The deck position switch or circuit wiring is faulty.
Cutting deck runs, but should not, when raised. Deck does not shut off with the PTO switch.	The deck position switch or circuit wiring and PTO switch or circuit wiring are faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 – Hydraulic System).
Cutting deck runs, but should not, when lowered with PTO switch in the OFF (disengage) position.	The PTO switch or circuit wiring is faulty.
Cutting deck does not operate.	The operator is lifting off the seat switch. Traction circuit is in transport mode. The seat switch, relay or circuit wiring is faulty. The PTO switch, relay or circuit wiring is faulty. The deck position switch or circuit wiring is faulty. Center lift lever position switch is out of adjustment or faulty. The transport/4WD switch or circuit wiring is faulty. Hydraulic valve solenoid(s) or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 – Hydraulic System).
Cutting deck shut off when PTO switch is released from the engage position.	Diode circuit board or circuit wiring is faulty.
PTO fuse blows when engaging cutting deck.	Hydraulic valve solenoid coil is shorted. Deck position switch is faulty.

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 60°F to 100°F (16°C to 38°C). 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.

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 **(2870 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. Testing of interlock switches and relays is included in the Component Testing section of this Chapter.

Wing Deck Position Switches

Adjustment

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

2. Remove switch cover from deck to allow access to position switch that requires adjustment.

NOTE: Use Deck Proximity Switch Adjustment Tool (TOR4095) to assist with switch adjustment (see Special Tools).

3. Loosen two (2) lock nuts that secure switch bracket to center cutting deck (Fig. 7).

4. When adjusting switch location, the target surface of position switch should be approximately 0.188" (4.8 mm) from actuator tab on wing deck link (Fig. 8).

5. When wing deck position switch is properly adjusted, hydraulic motor on wing deck should turn off when wing deck is raised and wing deck latch opens.

6. For switch testing information, see Wing Deck Position Switches in the Component Testing section of this chapter.

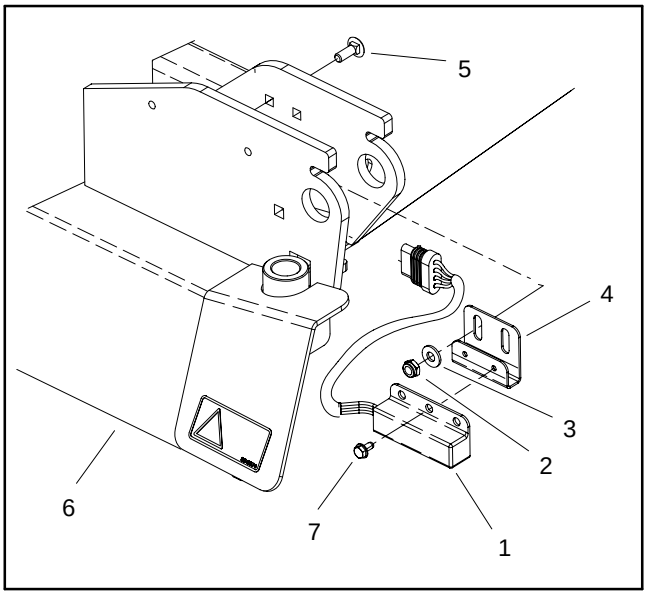


Figure 7

1. **Position switch**
2. **Lock nut (2 used)**
3. **Flat washer (2 used)**
4. **Switch bracket**
5. **Carriage screw (2 used)**
6. **Center cutting deck**
7. **Screw (2 used)**

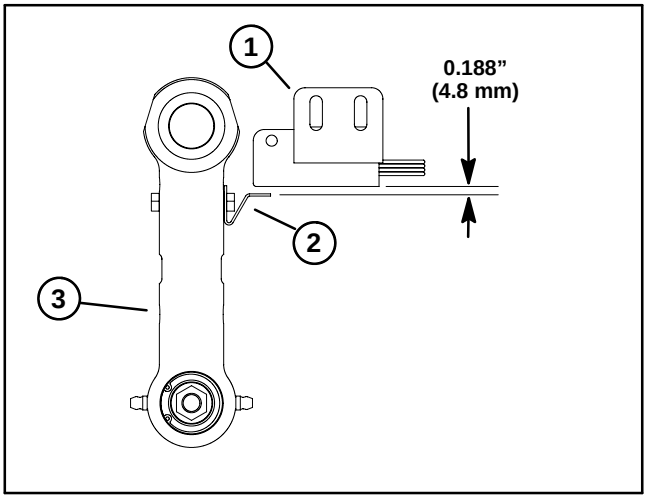


Figure 8

1. **Position switch**
2. **Actuator tab**
3. **Wing deck link**

Cutting Deck Raise and Lower Switches

Adjustment (Fig. 9)

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

2. The cutting deck raise and lower switches can be adjusted for correct operation by repositioning the switch(es).

   A. The distance between switches should be from 0.595" to 0.655" (15.2 to 16.6 mm) (Fig. 10).

   B. The lever bracket (item 4) should be parallel with the center deck lift/lower lever. If lever bracket adjustment is needed, loosen flange bolts (item 6) and reposition lever bracket.

   C. Switch surfaces need to be parallel to each other and also to the switch actuator on center lift/lower lever (item 9). If necessary, switch plate (item 3) can be rotated after loosening flange nut (item 5).

3. After any switch adjustment, unplug switch connector from machine harness and check for correct switch operation using a multimeter:

   A. The raise switch should be closed (continuity) when the center deck lift/lower lever is in the neutral position. As the lift/lower lever is slowly pulled back, the raise switch should open (no continuity) after the lever has removed all free play (with no spool movement in lift/lower control valve) but before the deck is lifted.

   B. The lower switch should be open (no continuity) when the center deck lift/lower lever is in the neutral position. As the lift/lower lever is slowly pushed forward, the lower switch should close (continuity) before the lever reaches full forward travel.

4. If switch operation is too sensitive, increase distance between switches by repositioning one or both switches. If switch operation is not sensitive enough, decrease distance between switches by repositioning one or both switches. Recheck operation of switches after repositioning.

5. If switches cannot be adjusted for correct operation, exchange position of switches. Recheck operation of switches.

NOTE: If correct switch operation cannot be achieved, replace one or both switches. Recheck switch operation after replacement.

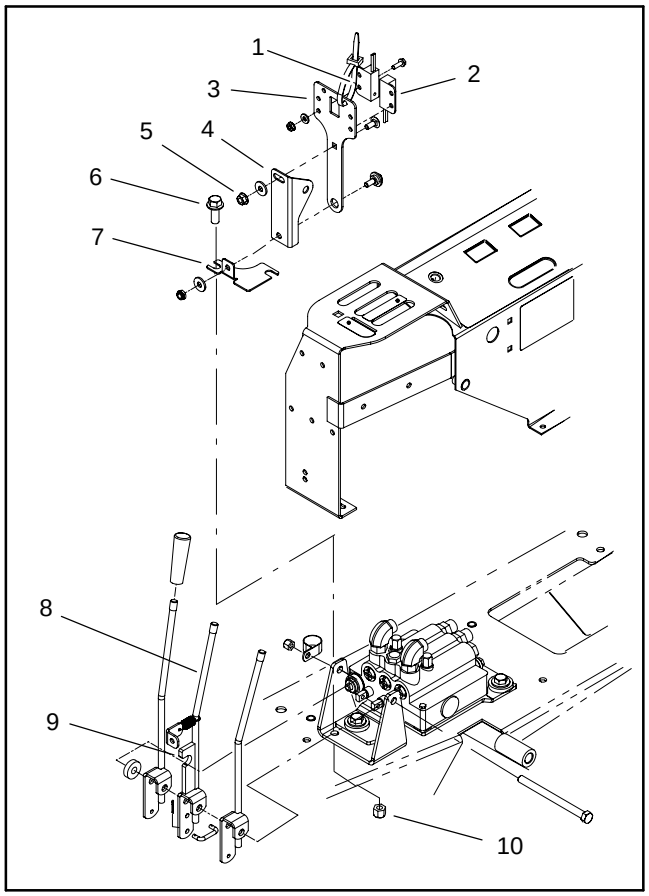


Figure 9

1. **Deck lower switch**
2. **Deck raise switch**
3. **Switch plate**
4. **Lever bracket**
5. **Flange nut**
6. **Flange bolt (2 used)**
7. **Tab plate**
8. **Deck lift/lower lever**
9. **Switch actuator**
10. **Lock nut (2 used)**

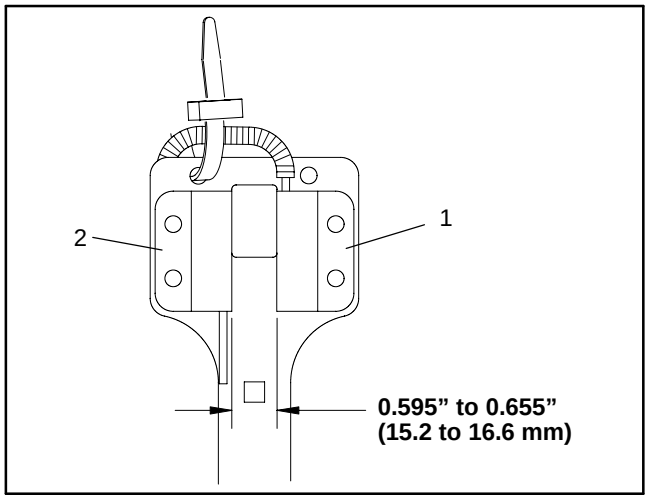


Figure 10

1. **Deck lower switch**
2. **Deck raise switch**

Component Testing

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

NOTE: For engine component testing information, see the Kubota Workshop Manual, Diesel Engine, V2403–M–T–E3B Series at the end of Chapter 3 – Kubota Diesel Engine.

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, ON/PREHEAT and START (Fig. 11). The terminals are marked as shown in Figure 12. The circuit wiring of the ignition switch is shown in the chart. 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.

POSITION	CIRCUIT
OFF	NONE
ON / PREHEAT	B + I + A, X + Y
START	B + I + S

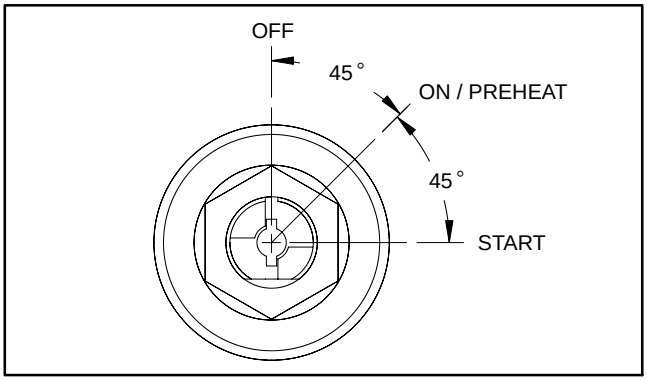


Figure 11

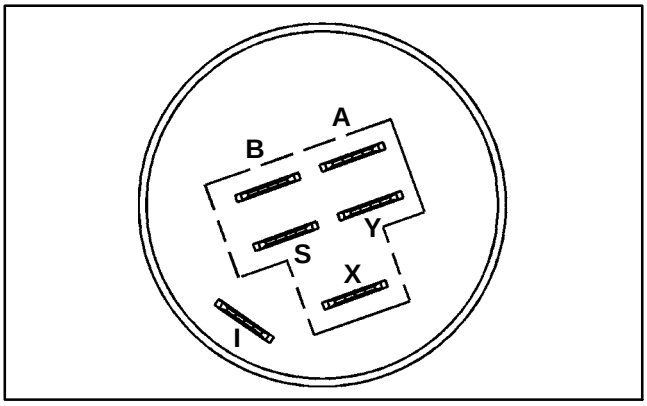


Figure 12

Fuses

The fuse blocks are located under the operator's control console.

Identification, Function and Wiring

The fuses are held in three (3) fuse blocks. Use Figures 13 and 14 to identify each individual fuse and its correct amperage. Each fuse holder has the following functions and wire connected to it.

Fuse F1 (5 amp) (fuseblock location A1): Supplies power to the seat switch and seat relay.

Fuse F2 (10 amp) (fuseblock location A2): Supplies power to ignition switch terminal B.

Fuse F3 (10 amp) (fuseblock location A3): Supplies power to the PTO switch.

Fuse F4 (10 amp) (fuseblock location A4): Supplies power to the starter solenoid.

Fuse F5 (when optional lighting is installed) (15 amp) (fuseblock location B4): Supplies power for optional light kit.

Fuse F8 (10 amp) (fuseblock location B1): Supplies power to the power point outlet.

Fuse F9 (7.5 amp) (fuseblock location C4): Supplies power for engine cooling fan operation (TEC−5002 controller).

Fuse F10 (10 amp) (fuseblock location C3): Supplies power for seat operation.

In addition to the fuses in the fuse blocks, a 2 amp fuse is included in the wire harness to protect the logic power circuit for the TEC−5002 controller. This fuse resides in a fuse holder near the battery.

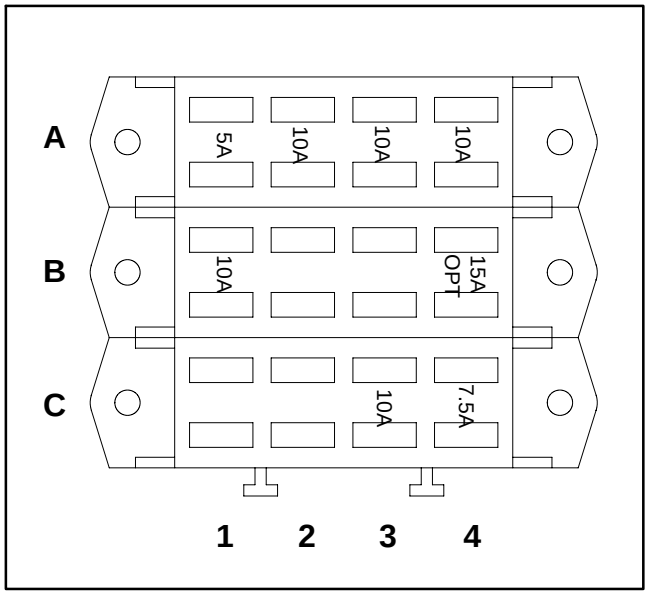


Figure 13

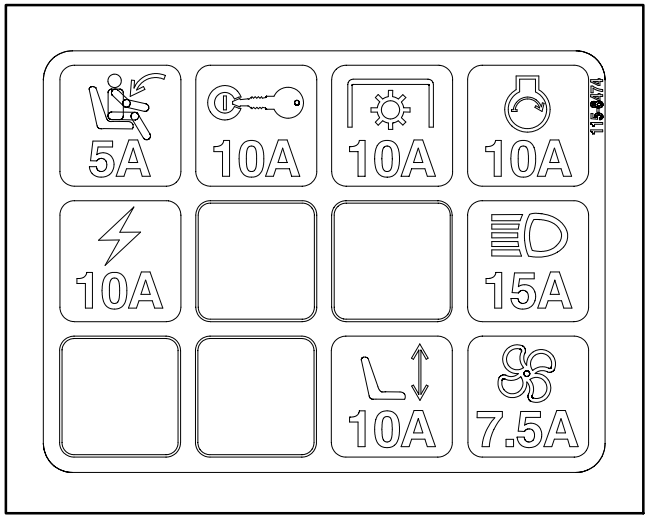


Figure 14

Warning Lights

Engine Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running if the engine oil pressure drops below 7 PSI (0.5 kg/cm^2).

1. Disconnect green wire from the oil pressure switch on the engine (located near the starter motor).

2. Ground green wire to the engine block.

3. Turn ignition switch to ON; the oil pressure light should come on indicating correct operation of the electrical wiring to the oil pressure switch.

4. Turn ignition switch to OFF. Reconnect green wire to the oil pressure switch. Apply skin–over grease (Toro Part No. 505–165) to switch terminal.

High Temperature Warning Light

If the coolant temperature rises to approximately 220^{o}F (105^{o}C), the high temperature warning light should illuminate as the dual temperature switch terminal closes.

NOTE: If the PTO is engaged when the dual temperature switch terminal closes, the PTO will disengage.

To test the high temperature warning light and its circuit wiring, ground the blue wire attached to dual temperature switch on engine water flange. The high temperature warning light should illuminate.

Glow Plug Indicator Light

The glow plug indicator light should come on when the ignition switch is placed in ON prior to placing the ignition switch in START. The light should stay lit for approximately 10 seconds while the ignition switch is left in ON.

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in ON with the engine not running or with an improperly operating charging circuit while the engine is running.

Testing Warning Lights

1. Apply 12 VDC to terminals 1A and 2A.

2. Ground terminals 1B and 2B.

3. Both indicator lights should light.

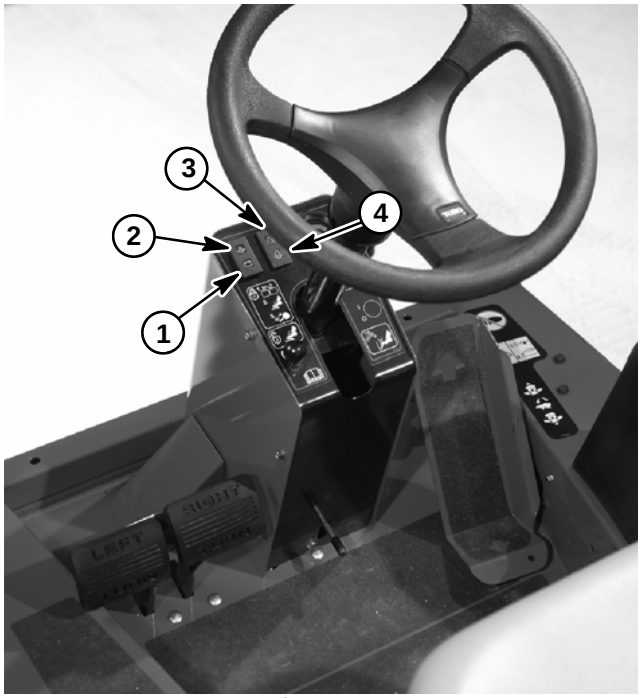


Figure 15

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temp warning**
4. **Glow plug indicator**

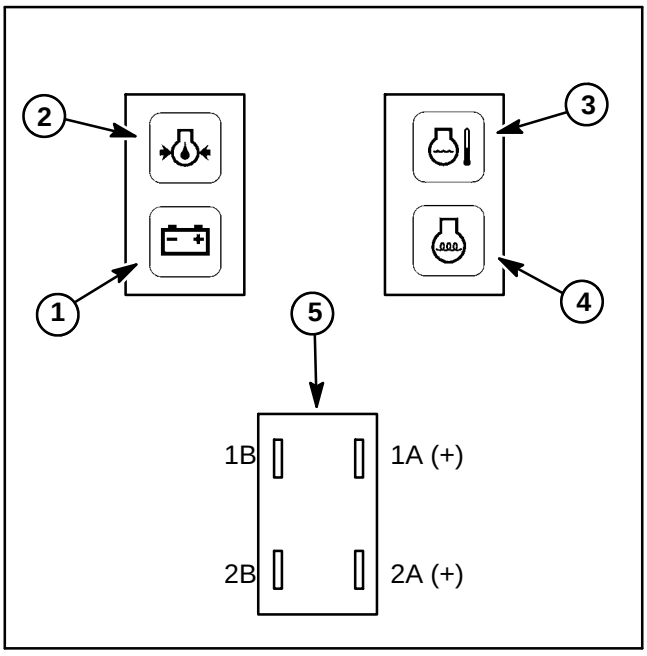


Figure 16

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temp shutdown**
4. **Glow plug indicator**
5. **Warning light back**

PTO Switch

The PTO switch is used to engage or disengage the cutting deck. The PTO switch is attached to the control console next to the operator seat (Fig. 17).

The switch terminals are marked as shown in Figure 18. The circuitry of the PTO switch is shown in the chart below. 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.

NOTE: The PTO ENGAGE position requires lifting and pushing the lever toward the switch keyway. The PTO OFF position occurs when the lever is pushed opposite the keyway.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
PTO ENGAGE	1 + 2	4 + 5
CENTER (ON)	1 + 2	NONE
PTO OFF	NONE	NONE

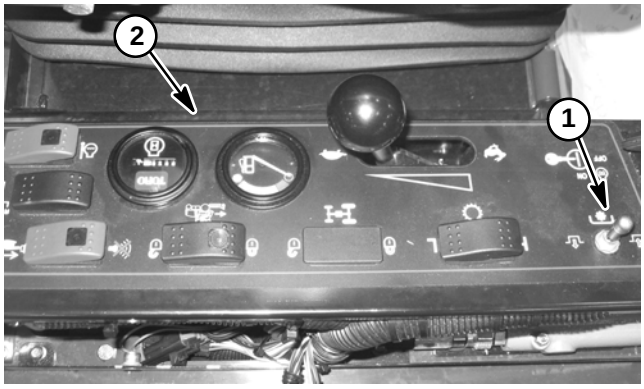
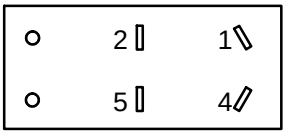


Figure 17

1. **PTO switch**
2. **Control console**



BACK OF PTO SWITCH

Figure 18

Alarm Silence and Temperature Override Switches

The alarm silence and temperature override rocker switches are located on the control console next to the operator seat (Fig. 19). These switches are identical.

Testing

The switch terminals are shown in Figure 20. The circuitry of the switches is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
ON	2 + 3	5 + 6
OFF	1 + 2	4 + 5

NOTE: Terminals 7 (–) and 8 (+) on alarm silence and temperature override switches are for the switch light.

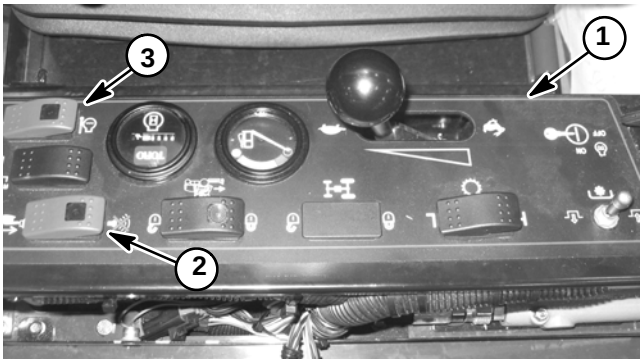
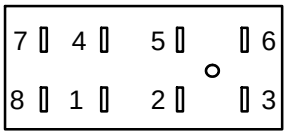


Figure 19

1. **Control console**
2. **Alarm silence switch**
3. **Temp. override switch**



BACK OF ALARM SILENCE AND TEMPERATURE OVERRIDE SWITCHES

Figure 20

Transport / 4WD Switch

The transport/4WD switch is used to set the machine traction speed for transport or mow. The transport/4WD rocker switch is located on the control console next to the operator seat (Fig. 21).

Testing

The switch terminals are shown in Figure 22. The circuitry of the switches is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
TRANSPORT	2 + 3	5 + 6
MOW	1 + 2	4 + 5

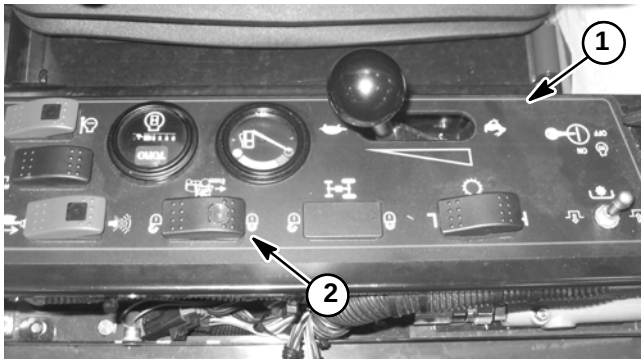


Figure 21

1. **Control console**
2. **Transport/4WD switch**

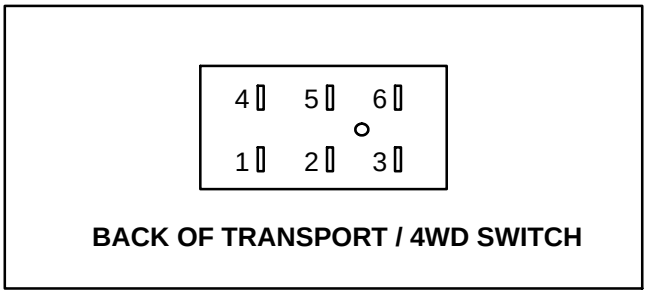


Figure 22

Cooling Fan Switch

The cooling fan switch is used to control the operation of the hydraulic cooling fan and is located on the control console (Fig. 23). This switch has three (3) positions: Reverse, Auto and Forward.

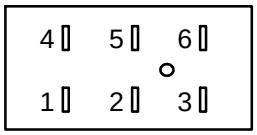
When the cooling fan switch is in the normal Auto position, cooling fan operation is controlled by the TEC−5002 controller. In this switch position, if either engine coolant or hydraulic oil temperature is excessive, the fan will stop and then reverse direction to allow automatic debris cleaning of the radiator, oil cooler and rear intake screen. The controller determines the length of time that the fan should be run in reverse before fan rotation is returned to the forward direction.

If the operator depresses the cooling fan switch to the Reverse position, a fan reverse cycle that is controlled by the TEC−5002 controller is initiated. The switch automatically returns to the Auto position and fan operation returns to the forward direction after the reverse cycle is completed.

If the cooling fan switch is placed in the Forward position, the engine cooling fan will run only in the forward direction.

Figure 23

1. **Control console**
2. **Cooling fan switch**



BACK OF COOLING FAN SWITCH

Figure 24

Testing

The switch terminals are shown in Figure 24. The circuitry of the switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
NORMAL	2 + 3	NONE
REVERSE	2 + 3	5 + 6
FORWARD	NONE	NONE

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch and its electrical connector are located in the seat assembly. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine will stop. Testing of the switch can be done without seat removal by disconnecting the seat wire from the machine wiring harness (Fig. 25).

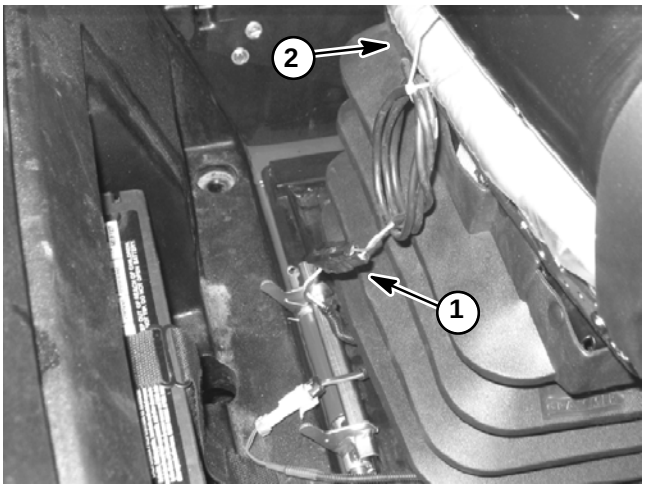


Figure 25

1. **Seat switch electrical connector**
2. **Operator seat**

Testing

1. Make sure the engine is off.

2. Disconnect wire harness electrical connector for the seat switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. With no pressure on the seat, there should be no continuity between the seat switch terminals.

5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

6. 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).

7. Connect seat switch to harness connector after testing is complete.

Parking Brake Switch

The switch used for the parking brake is a normally open switch that is located under the steering tower cover (Fig. 26). When the parking brake **is not** applied, the parking brake pawl depresses the switch plunger to close the switch. When the parking brake **is** applied, the parking brake pawl is positioned away from the switch plunger so the switch is in its normal, open state.

Testing

1. Make sure the engine is off. Locate parking brake switch for testing.

2. Disconnect wire harness connector from the switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. When the switch plunger is extended there **should not be** continuity between the switch terminals.

5. When the switch plunger is depressed, there **should be** continuity between the switch terminals.

6. After testing, connect switch connector to wire harness.

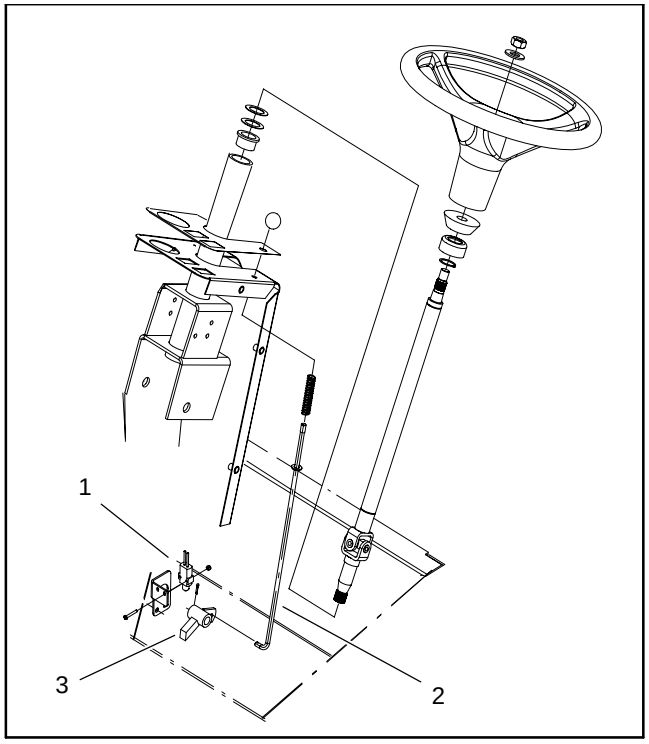


Figure 26

1. **Parking brake switch**
2. **Parking brake rod**
3. **Parking brake pawl**

Hour Meter

The hour meter is located on the control console next to the operator seat.

Testing

1. Disconnect wire harness connector from hour meter.

2. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

3. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

4. The hour meter should move a 1/10 of an hour in six (6) minutes.

5. Disconnect voltage source from the hour meter. Reconnect harness connector to hour meter.

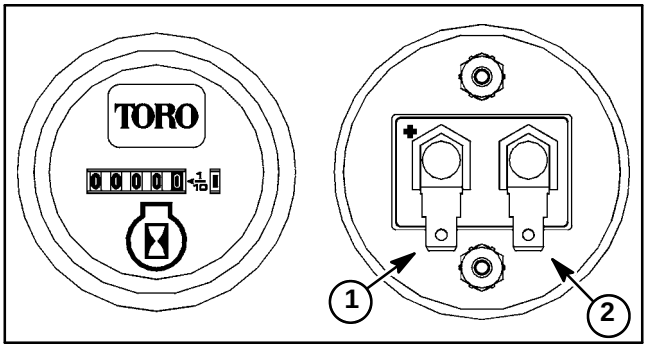


Figure 27

1. **Positive (+) terminal**
2. **Negative (-) terminal**

Audio Alarm

The audio alarm for low engine oil pressure or high engine coolant temperature is attached to the control console next to the operator seat.

Testing

1. Disconnect wire harness connector from alarm.

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

2. Correctly connect 12VDC source to the alarm terminals (Fig. 28).

3. Alarm should sound. Remove voltage source from the alarm.

4. Reconnect harness connector to alarm.

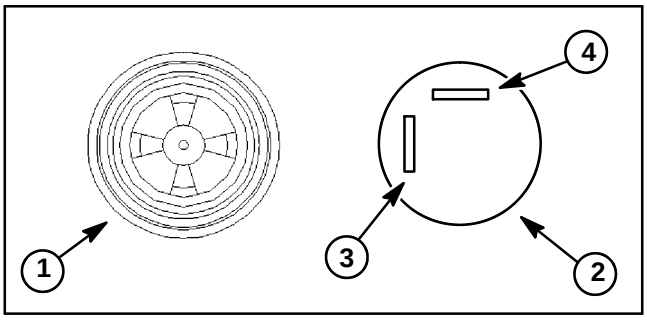


Figure 28

1. **Top view**
2. **Bottom view**
3. **Positive (+) terminal**
4. **Negative (-) terminal**

Glow and Power Relays

The Groundsmaster 4100−D uses two (2) identical relays to control electrical power circuits. The glow relay is attached to the the right side of the fuel tank support under the hood. The power relay is attached to the control panel under the console housing.

The glow relay supplies electrical power for the engine glow plugs when energized. The start relay is energized by the glow plug controller.

The power relay supplies electrical power for fuses F9 (TEC−5002 outputs), F10, F11 and F12. The main power relay is energized when the ignition switch is in the START or RUN position.

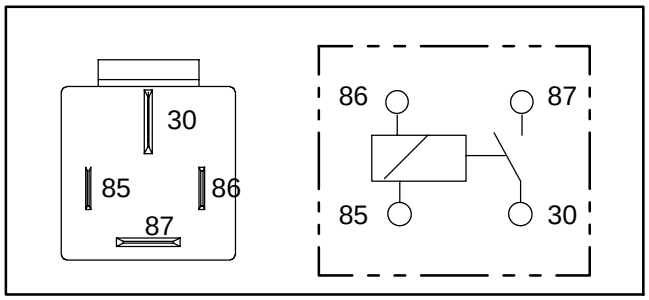


Figure 29

Testing

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

2. Open hood to gain access to relay.

3. Locate relay and disconnect the machine wire harness connector from the relay. Remove relay from machine 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 from the measured value of the component you are testing.

4. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting) (Fig. 29). Resistance should be approximately 72 ohms.

5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should 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.

6. After testing is complete, install relay to frame and connect wire harness to relay.

7. Close and secure hood.

Start, Engine Shutdown, Seat, Alarm, PTO, PTO Overtemp, Down Latching and Over Temperature Relays

These eight (8) relays are located under the console housing cover (Fig. 30). The wiring harness is tagged to identify each relay.

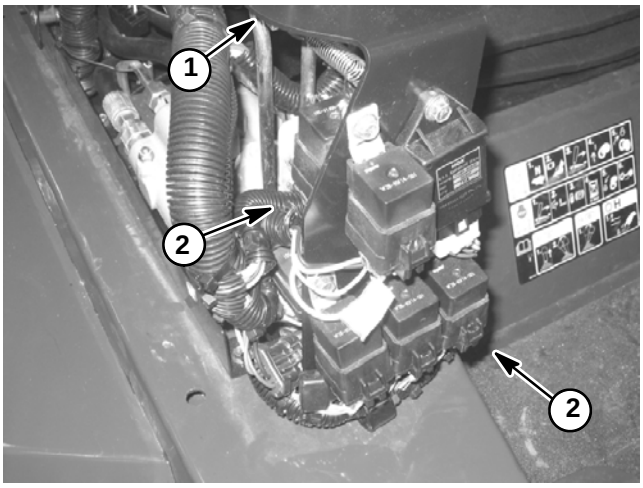


Figure 30

1. Control panel **2. Relay location**

Testing

1. Make sure that ignition switch is OFF.

2. Locate relay and disconnect the machine wire harness connector from the relay. Remove relay from machine if necessary.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the component you are testing.

3. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 31). 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.

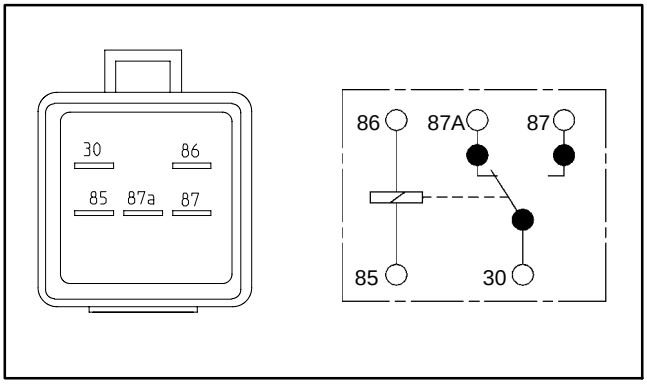


Figure 31

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 if removed. Connect machine wire harness connector to relay.

Hydraulic Valve Solenoids

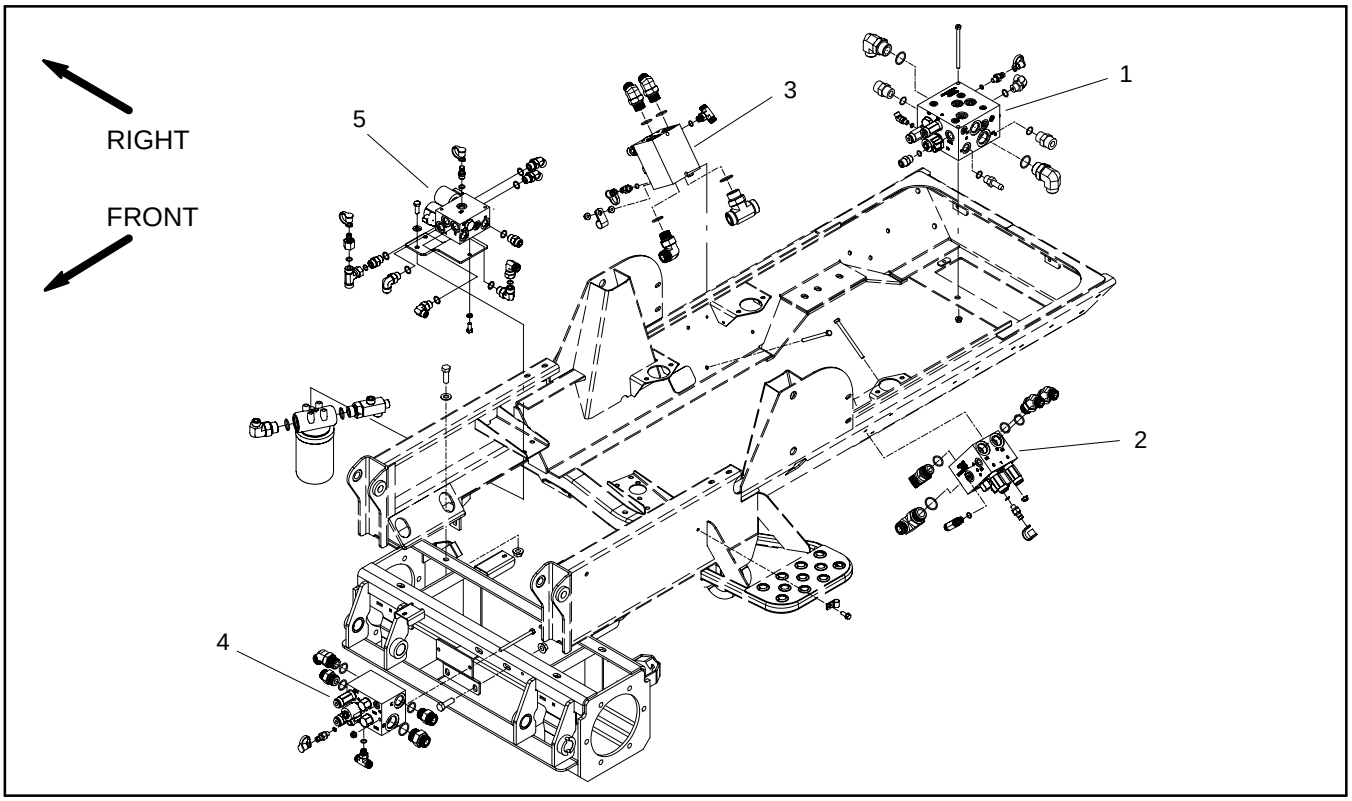


Figure 32

1. **4WD manifold**
2. **LH deck manifold**
3. **RH deck manifold**
4. **Front deck manifold**
5. **Fan drive manifold**

There are several hydraulic valve solenoids on the Groundsmaster 4100−D (Fig. 32). Testing of these solenoids can be done with the solenoid on the hydraulic valve.

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 from the measured value of the component you are testing.

1. Make sure engine is off. Disconnect wire harness connector from the solenoid (Fig. 33).

2. Measure resistance between the two (2) solenoid connector terminals. The resistance for any solenoid coil used on the Groundsmaster 4100−D should be approximately 8.7 ohms.

3. Install new solenoid if necessary. Torque solenoid nut to **5 ft−lb (6.7 N−m)**. Over−tightening may damage the solenoid or cause the cartridge valve to malfunction.

4. When testing is complete, connect wire harness connector to the solenoid.

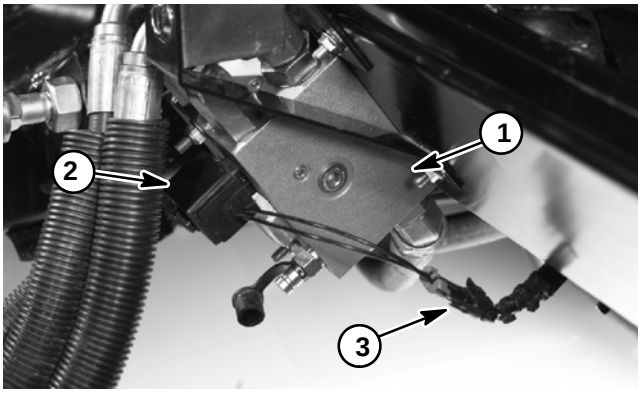


Figure 33

1. **Manifold (RH deck manifold shown)**
2. **Valve solenoid**
3. **Solenoid connector**

TEC−5002 Controller

Groundsmaster 4100−D machines use a Toro Electronic Controller (TEC) to control the operation of the hydraulic cooling fan. The controller is attached to the operator platform under the console housing cover (Fig. 34).

Logic power is provided to the controller as long as the battery cables are connected to the battery. A 2 amp fuse in a fuse holder near the battery provides circuit protection for this logic power to the controller.

The TEC−5002 controller monitors the states of the following components as inputs: ignition switch, hydraulic temperature sender, engine coolant temperature sender and cooling fan switch.

The TEC−5002 controller controls electrical output to the engine cooling fan hydraulic valve solenoid coils (speed and direction). Circuit protection for TEC−5002 outputs is provided by fuse F9 (7.5 amp).

Because of the solid state circuitry built into the TEC, there is no method to test the controller directly. The controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

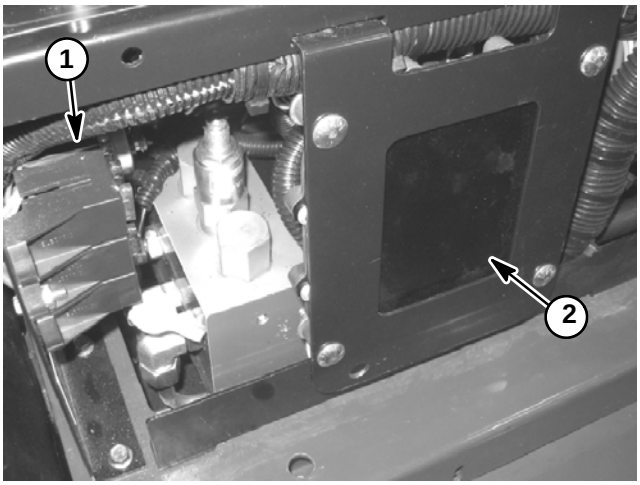


Figure 34

1. **Fuses**
2. **TEC location**

Fuel Sender

The fuel sender is located on top of the fuel tank.

Testing

1. Remove white wire and black ground wire from the sender.

CAUTION

If testing circuit wiring and fuel gauge, make sure wire connections are secure before turning ignition switch ON to prevent an explosion or fire from sparks.

2. To test the circuit wiring and fuel gauge, connect white and black wires and turn ignition switch to ON. Fuel gauge needle should point to the right edge of the green area (full). 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. 35).

   A. Resistance with the float in the full position should be 27.5 to 39.5 ohms.

   B. Resistance with the float in the empty position should be 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.

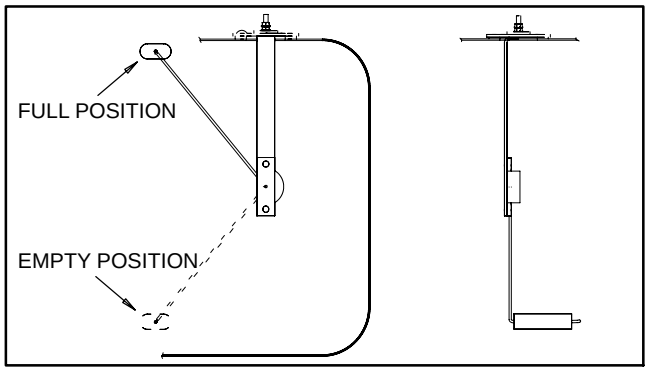


Figure 35

Fuel Gauge

The fuel gauge can be tested using a new gauge as a substitute or with the use of a DC voltage source and a variable resistance box (see Fuel Sender Testing in this section for additional information).

Testing

CAUTION

Make sure the voltage source is turned OFF before connecting it to the electrical circuit to avoid electrical shock and prevent damaging the gauge.

1. Connect fuel gauge to the variable resistance and DC voltage source (Fig. 36).

NOTE: When reading the gauge test point, there are two white dots on the gauge face below the edge of the glass cover for each test point. For each variable resistance setting, the needle must be pointed between the two white dots.

2. Take test point readings (Fig. 37).

IMPORTANT: Allow circuit to warm up for at least 5 minutes before taking test readings.

A. Set variable resistance to 240 ohms. Apply a 14 ± 0.01 VDC to the circuit. The needle should point to the left edge of the red area (empty).

B. Set variable resistance to 33 ohms. The needle should point to the right edge of the green area (full).

3. Turn off the voltage source. Disconnect voltage source, gauge and variable resistance.

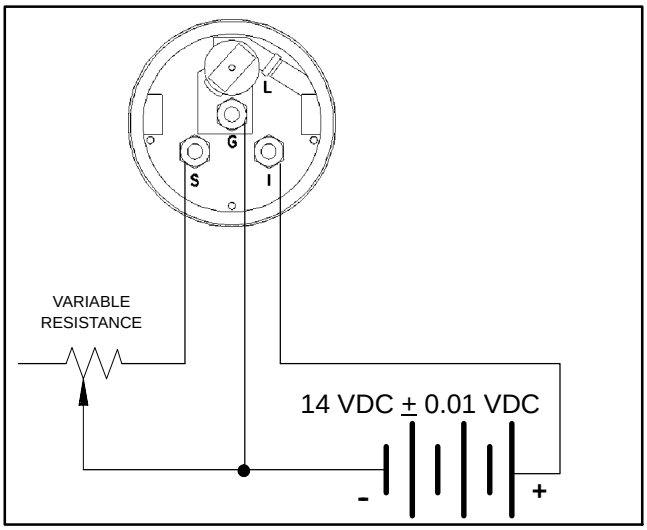


Figure 36

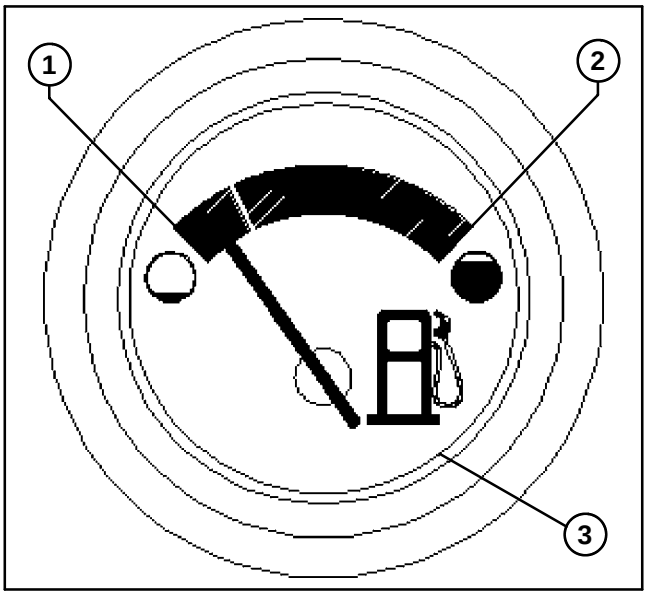


Figure 37

1. **Empty position**
2. **Full position**
3. **Glass face edge**

Fuel Pump

The fuel pump is attached to the frame above the fuel water separator (Fig. 38).

Operational Test

1. Park machine on a level surface, lower cutting deck, stop engine and apply parking brake.

2. Disconnect wire harness electrical connector from the fuel stop solenoid to prevent the engine from firing.

3. Disconnect fuel hose (pump discharge) from the fuel water separator.

4. Make sure fuel hoses attached to the fuel pump are free of obstructions.

5. Place fuel hose (pump discharge) into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

6. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for 15 seconds, then turn switch to OFF.

7. The amount of fuel collected in the graduated cylinder should be approximately 16 fl oz (475 ml) after 15 seconds.

8. Replace fuel pump as necessary. Install fuel hose to the water separator.

9. Connect wire harness electrical connector to the fuel stop solenoid.

10. Prime fuel system.

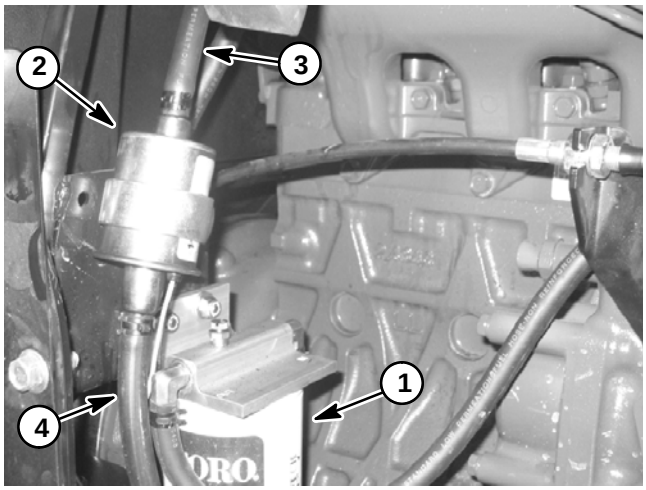


Figure 38

1. **Fuel water separator**
2. **Fuel pump**
3. **Pump inlet hose**
4. **Pump discharge hose**

Fuel Pump Specifications

Pump Capacity	64 fl oz/min (1.9 l/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Glow Controller

The glow controller is located under the console cover (Fig. 39).

NOTE: Refer to electrical schematic and circuit drawings in Chapter 9 – Foldout Drawings when troubleshooting the glow controller.

Glow Controller Operation

1. When the ignition switch is placed in the ON position, the controller energizes the glow plugs and lights up the glow lamp for approximately 10 seconds.

2. When the ignition switch is held in the START position, the glow plugs will energize and the glow lamp will **not** light.

3. When the ignition switch is released from START to ON, the glow plugs will deenergize and the glow lamp will remain off.

Glow Controller Checks

1. Make sure there is power from the battery.

2. Disconnect electrical connector to the engine run solenoid to prevent the engine from starting.

3. Place ignition switch in the ON position. Verify the following while in the ON position:

   A. Glow indicator lamp is illuminated.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow indicator lamp goes out and glow plugs de–energize after approximately 10 seconds.

4. Place ignition switch in the START position. Verify the following while in the START position:

   A. Glow indicator lamp is not illuminated.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Power exists at terminal 1 of the glow controller.

NOTE: If there is no power at terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform step 4 again (see electrical schematic in Chapter 9 – Foldout Drawings).

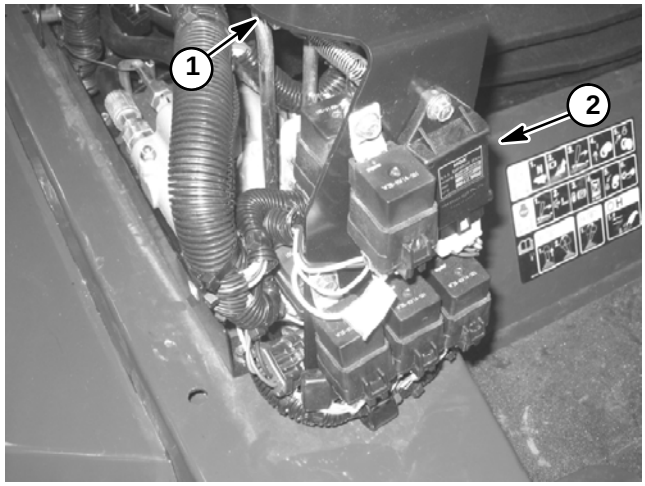


Figure 39

1. Control panel **2. Controller location**

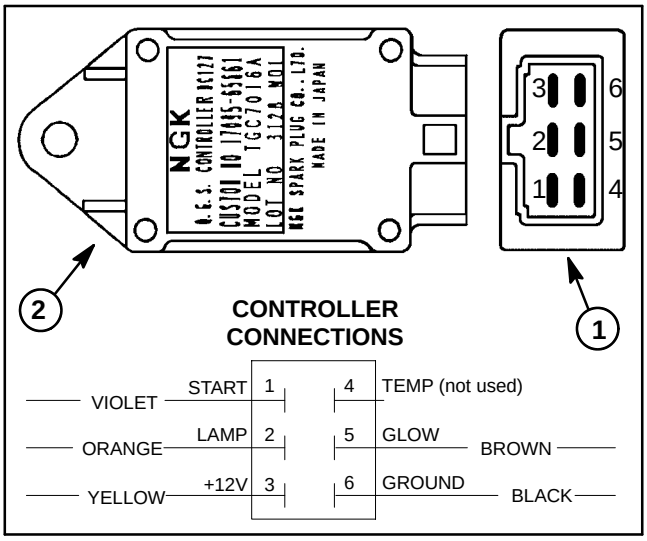


Figure 40

1. Glow controller end view **2. Controller side view**

5. If any of the conditions in step 3 are not met or power to terminal 1 exists and any of the other conditions in step 4 are not met:

   A. Verify continuity of the circuitry from the battery to the glow relay and glow plugs (see electrical schematic in Chapter 9 – Foldout Drawings).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow lamp, glow relay and ground (see electrical schematic in Chapter 9 – Foldout Drawings).

   C. Replace parts as necessary.

6. Connect electrical connector to the run solenoid.

Temperature Sender

The temperature sender is located near the alternator on the water flange attached to the engine cylinder head (Fig. 41). The resistance of the temperature sender reduces as the engine coolant temperature increases. There is a gray harness wire attached to the terminal of the switch.

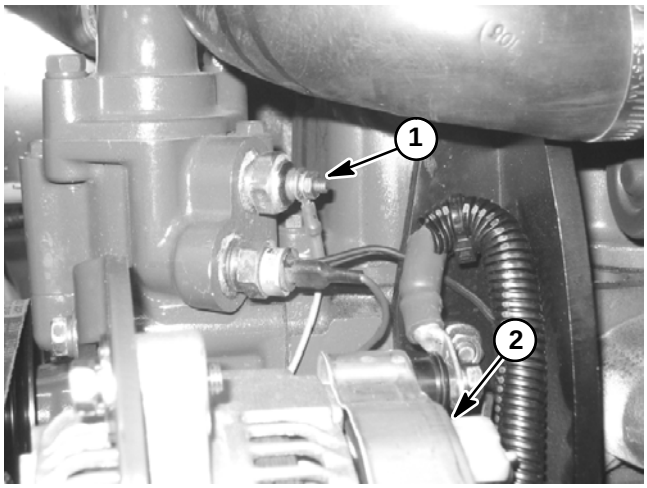


Figure 41

1. **Temperature sender** 2. **Alternator**

Testing

1. Lower coolant level in the engine and remove the temperature sender from water flange.

2. Suspend sender in a container of oil with a thermometer and slowly heat the oil (Fig. 42).

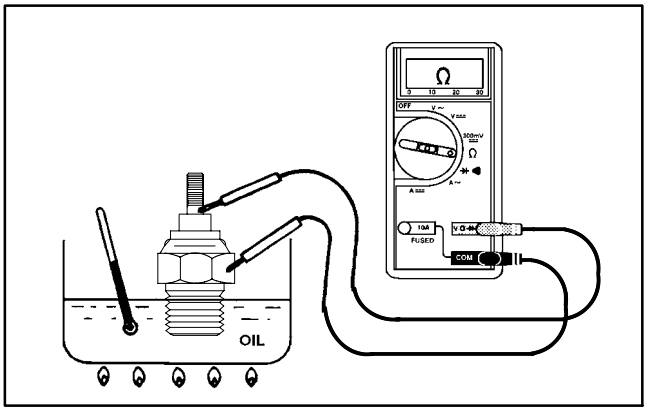


Figure 42

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

NOTE: Prior to taking resistance readings with a digital multi meter, 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.

3. Check resistance of the sender with a multimeter (ohms setting) as the temperature increases. Replace sender if specifications are not met.

COOLANT TEMP	TEMP SENDER RESISTANCE
100ºF (38ºC)	460 ohms (approximate)
160ºF (71ºC)	140 ohms (approximate)
200ºF (93ºC)	54 to 78 ohms
221ºF (105ºC)	50 ohms (approximate)

4. After testing is complete, install sender to the water flange.

   A. Thoroughly clean threads of water flange and sender. Apply thread sealant to the threads of the sender.

   B. Screw sender into the water flange. Torque sender from **16 to 20 ft-lb (22 to 27 N-m)**.

   C. Reconnect gray harness wire to sender. Apply skin-over grease (Toro Part No. 505-165) to sender terminal.

5. Fill engine cooling system.

Dual Temperature Switch

The dual temperature switch is attached to the engine near the alternator on the water flange attached to the engine cylinder head (Fig. 43). Two (2) electrical harness wires (a blue wire and a yellow wire) are attached to the switch.

The terminal on the switch is used to activate the engine over temperature warning. The warning illuminates the overtemp warning light and also causes the PTO to disengage. The wire harness blue wire attaches to the switch terminal.

The wire lead on the switch is used to shutdown the engine. The wire harness yellow wire attaches to the switch lead.

Testing

CAUTION

Make sure engine is cool before removing the temperature switch.

1. Lower coolant level in the engine and remove the dual temperature switch from the engine water flange.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 45).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check continuity of the switch with a multimeter (ohms setting). Both circuits of the temperature switch are normally open and should close at the following temperatures:

   A. The warning terminal should close from 214º to 226º F (101 to 108º C).

   B. The shutdown wire lead should close from 234º to 246º F (112 to 119º C).

4. Replace switch if necessary.

5. Install switch to the water flange.

   A. Clean threads of cylinder head and switch thoroughly. Apply thread sealant to the threads of the switch.

   B. Screw switch into the cylinder head and torque switch from **22 to 28 ft-lb (29.4 to 39.2 N-m)**.

   C. Connect harness wires to switch.

6. Fill engine cooling system.

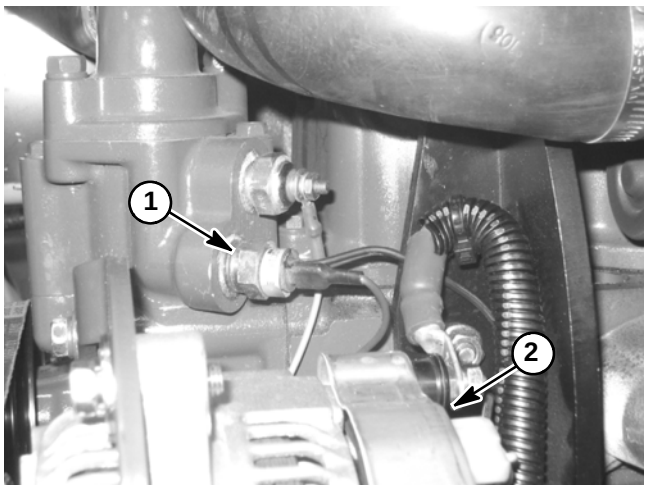


Figure 43

1. Dual temp switch **2. Alternator**

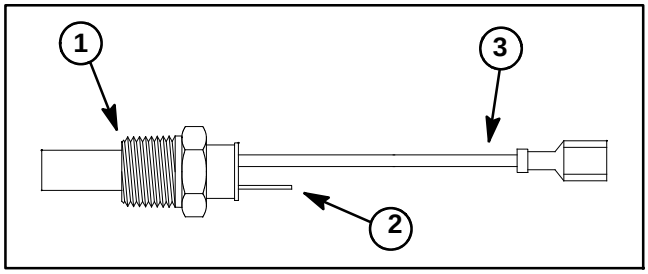


Figure 44

1. Dual temperature switch **3. Wire lead (shutdown)**
2. Terminal (warning)

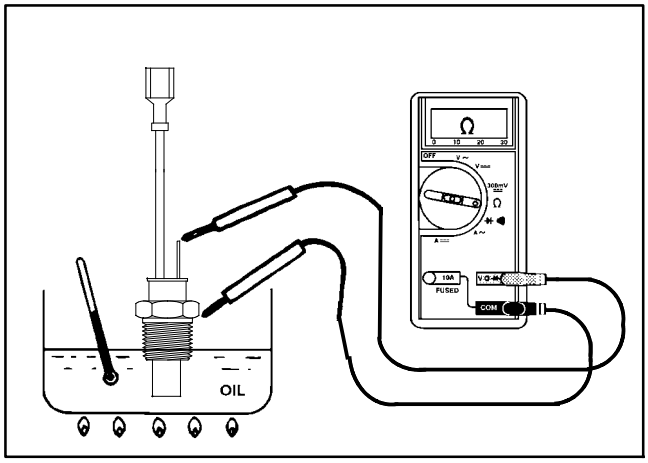


Figure 45

Temperature Gauge

The temperature gauge can be tested using a new gauge as a substitute or with the use of a DC voltage source and a variable resistance box.

Testing

CAUTION

Make sure the voltage source is turned OFF before connecting variable resistance to the electrical circuit to avoid electrical shock and to prevent damaging the gauge.

1. Connect temperature gauge to the variable resistance and DC voltage source (Fig. 46).

NOTE: When reading the gauge test point, there are two white dots on the gauge face below the edge of the glass cover for each test point. For each variable resistance setting, the needle must be pointed between the two white dots.

2. Take test point readings (Fig. 47).

IMPORTANT: Allow circuit to warm up for at least 5 minutes before taking test readings.

A. Set variable resistance to 71 ohms. Apply a 14 ± 0.01 VDC to the circuit. The needle should point to the middle of the green area (80°C).

B. Set variable resistance to 38 ohms. The needle should point between the green and red area (105°C).

3. Turn off the voltage source. Disconnect voltage source, gauge and variable resistance.

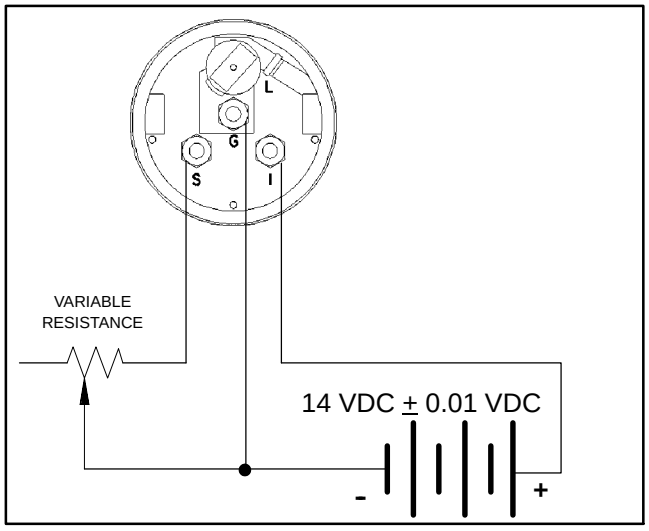


Figure 46

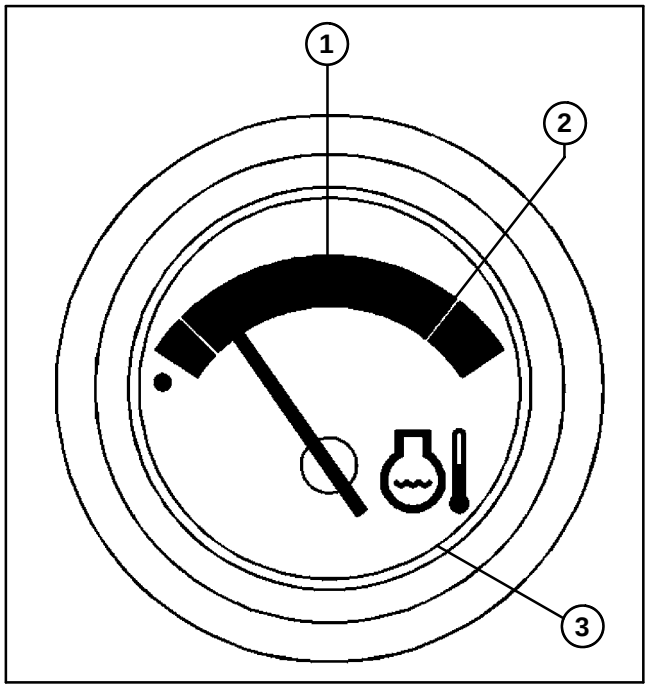


Figure 47

1. **Middle position**
2. **High temp. position**
3. **Edge of glass cover**

Traction Neutral Switch

The traction neutral switch is closed when the traction pedal is in the neutral position and opens when the pedal is depressed in either direction. The switch is located on the right side of the piston (traction) pump (Fig. 48).

Testing

Test the switch by disconnecting the wires from the switch terminals and connecting a continuity tester across the two switch terminals. With the engine turned off, slowly push the traction pedal in a forward or reverse direction while watching the continuity tester. There should be indications that the traction neutral switch is opening and closing. Allow the traction pedal to return to the neutral position. There should be continuity across the switch terminals when the traction pedal is in the neutral position.

See the Eaton Model 72400 Servo Controlled Piston Pump Repair Information at the end of Chapter 4 – Hydraulic System for disassembly and assembly procedures for the neutral switch.

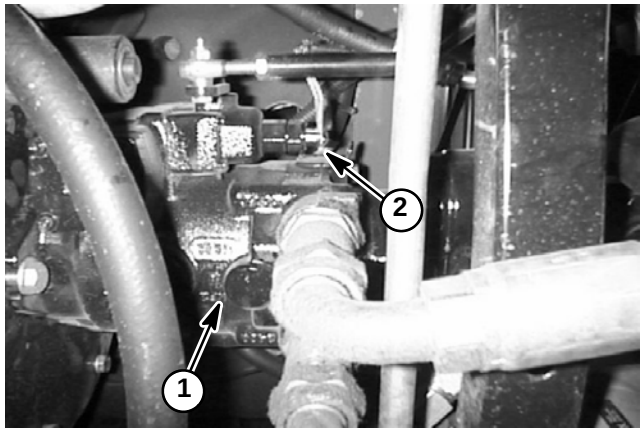


Figure 48

1. Piston pump (bottom)
2. Neutral switch

Diode Assemblies

The Groundsmaster 4100–D electrical system includes several diode assemblies (Fig. 49) that are used for circuit protection and circuit logic control. The diodes plug into the wiring harness at various locations on the machine.

The diodes D2, D4, D5 and D6 are used for circuit protection from inductive voltage spikes that occur when a hydraulic valve solenoid is de–energized. Diode D2 is in the Transport/Mow circuit, D4 is in the left cutting deck circuit, D5 is in the front cutting deck circuit and D6 is in the right cutting deck circuit.

Diode D9 provides logic for the high temperature warning system.

Diode D3 provides a latching circuit for the cutting deck when in the lowered position.

If the machine is equipped with the optional cruise control kit, two (2) additional diodes are used. Diode D7 in this kit is used for circuit protection that occur when a hydraulic valve solenoid is de–energized. Diode D8 provides a latching circuit to keep the cruise relay energized.

Testing

The diodes can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

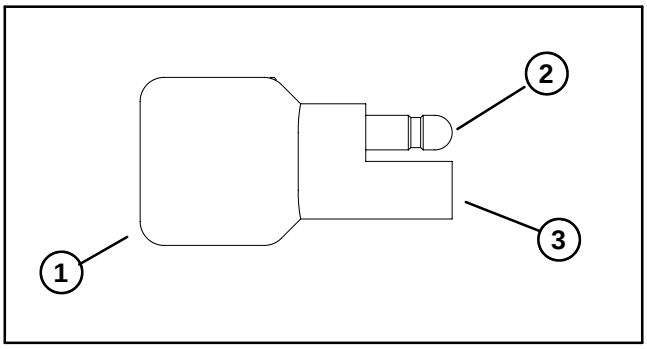


Figure 49

1. Diode
2. Male terminal
3. Female terminal

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Diode Circuit Board

The diode circuit board (Fig. 50) contains four (4) diodes and is located under the console housing. Diode D1–A provides logic for the interlock system. Diodes D1–B (right wing deck), D1–C (front deck) and D1–D (left wing deck) provide latching circuits for the PTO relay.

Testing

The diodes can be individually tested using a digital multimeter (ohms setting) and the table to the right. If any of the diodes are damaged, the diode circuit board must be replaced.

Apply dielectric grease (Toro part number 107–0342) to circuit board contacts whenever the circuit board is installed into the wire harness.

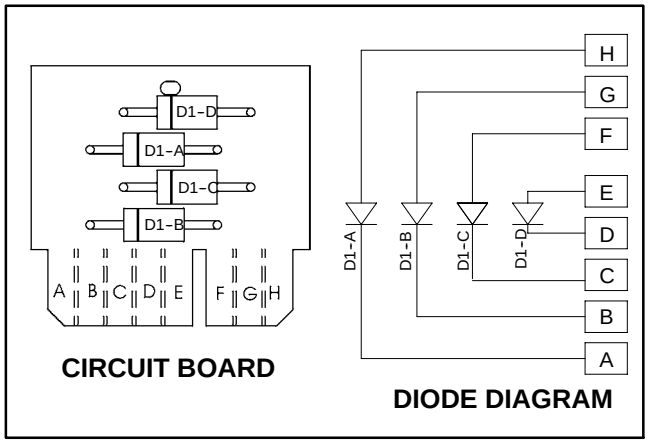


Figure 50

Red Lead (+) on Terminal	Black Lead (-) on Terminal	Continuity
H	A	YES
A	H	NO
G	B	YES
B	G	NO
F	C	YES
C	F	NO
E	D	YES
D	E	NO

Fusible Links

The Groundsmaster 4100−D uses five (5) fusible links for circuit protection. Three (3) of these fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Fig. 51). An additional fusible link is used that connects the starter B+ terminal to the alternator B+ terminal (Fig. 52). The remaining fusible link is included in the wire harness and connects the starter terminal to the engine run solenoid pull coil. If any of these links should fail, current to the protected circuit will cease. Refer to the Electrical Schematic and Circuit Diagrams in Chapter 9 − Foldout Diagrams for additional circuit information.

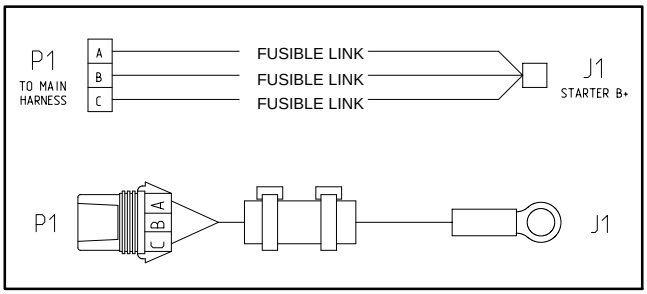


Figure 51

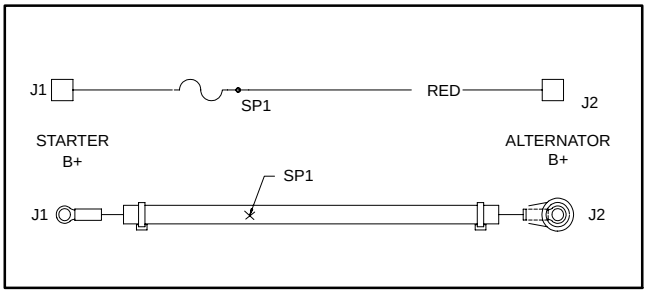


Figure 52

Testing

Make sure that ignition switch is OFF. Disconnect negative battery cable from battery terminal and then disconnect positive cable from battery (see Battery Service in the Service and Repairs section of this chapter). Locate and unplug fusible link connector. Use a multimeter to make sure that continuity exists between the fusible link terminals. If a fusible link is open, replace the link.

After testing is complete, make sure that fusible link is securely attached to engine component and wire harness. Connect positive battery cable to battery terminal first and then connect negative cable to battery.

Wing Deck Position Switches

The wing deck position switches on the Groundsmaster 4100–D are attached to the center deck housing (Fig. 53) and are normally open. The wing deck position switch is a powered proximity switch that incorporates an internal reed switch and relay (see schematic in Figure 54). The actuator for the position switch is bolted to the wing deck link (Fig. 55).

When a wing deck is lowered, the actuator tab on the wing deck link is positioned close to the position switch causing the switch to close. The closed switch allows current flow to the wing deck hydraulic valve solenoid and allows that wing deck to operate.

When a wing deck is raised, the actuator tab is moved away from the position switch and the switch opens. The open switch prevents current flow to the wing deck hydraulic valve solenoid and keeps that wing deck from operating.

Testing

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

2. Remove switch cover from deck to allow access to switch that requires testing. Disconnect switch from wiring harness.

NOTE: Deck Proximity Switch Adjustment Tool (TOR4095) can be used for switch testing and adjustment.

3. Ground switch connector terminal for black wire and apply 12 VDC to switch connector terminal for red wire.

4. Using a multimeter, verify that switch connector terminal for blue wire has 12 VDC and terminal for white wire has 0 VDC.

5. Place a metal object near sensing area of switch (opposite end from wires). Ground switch connector terminal for black wire and apply 12 VDC to switch connector terminal for red wire.

6. Using a multimeter, verify that switch connector terminal for blue wire has 0 VDC and terminal for white wire has 12 VDC.

7. Replace switch as needed. For switch adjustment procedure, see Wing Deck Position Switches in the Adjustments section of this chapter.

8. Install switch cover to deck.

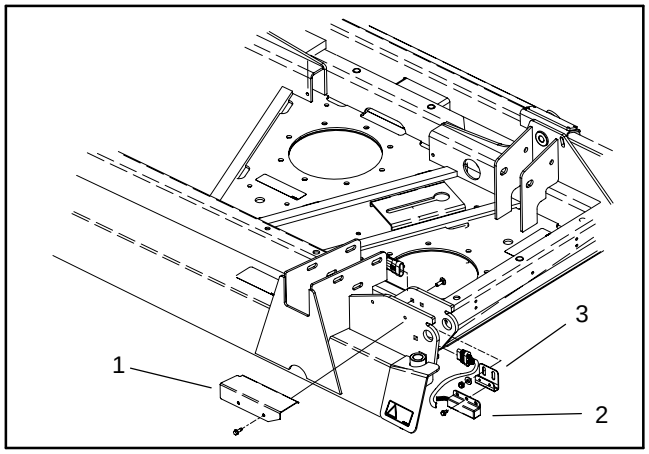


Figure 53

1. **Switch cover**
2. **Position switch**
3. **Switch bracket**

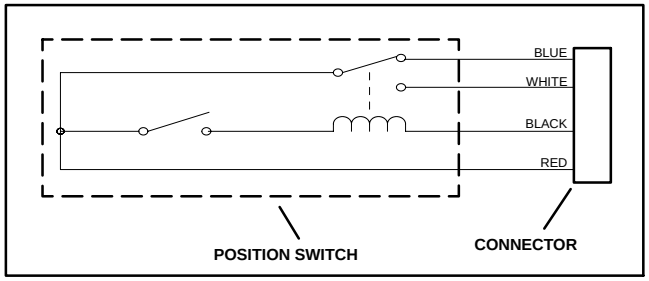


Figure 54

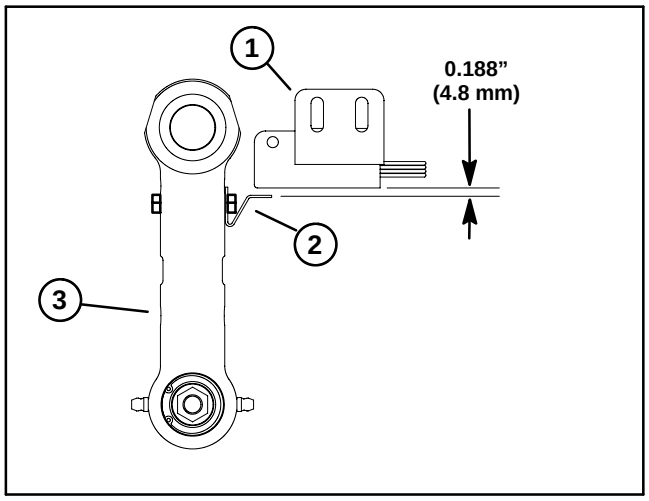


Figure 55

1. **Position switch**
2. **Actuator tab**
3. **Wing deck link**

Cutting Deck Raise and Lower Switches

The deck raise and lower switches are normally open proximity switches that are located under the console housing (Fig. 56). These identical switches are mounted in opposite directions so their circuit logic differs. The actuator for the switches is on the center deck lift/lower lever. The raise and lower switches are used in conjunction with the down latching relay to provide current to the PTO switch.

The deck raise switch is closed when the center deck lift/lower lever is either in the neutral (center) position or pushed to the lower (forward) position. If the center deck lift/lower lever is pulled to the raise (rear) position, the deck raise switch opens.

The deck lower switch is closed when the center deck lift/lower lever is pushed to the lower (forward) position. If the center deck lift/lower lever is in either the neutral (center) position or the raise (rear) position, the deck lower switch remains open.

Once the down latching relay is energized by lowering the cutting deck, the cutting deck raise switch and diode D3 provide a latching circuit to keep the relay energized.

Testing

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

2. Remove console cover and locate cutting deck raise or lower switch to be tested. Disconnect switch connector from machine wiring harness.

3. Check switch continuity by connecting a multimeter (ohms setting) across the switch connector terminals.

4. The raise switch should be closed (continuity) when the center deck lift/lower lever is in the neutral position. As the lift/lower lever is slowly pulled back, the raise switch should open (no continuity) after the lever has removed all free play (with no spool movement in lift/lower control valve) but before the deck is lifted.

5. The lower switch should be open (no continuity) when the center deck lift/lower lever is in the neutral position. As the lift/lower lever is slowly pushed forward, the lower switch should close (continuity) before the lever reaches full forward travel.

6. For switch adjustment procedure, see Cutting Deck Raise and Lower Switches in the Adjustments section of this chapter.

7. Connect switch to wiring harness. Install console cover to machine.

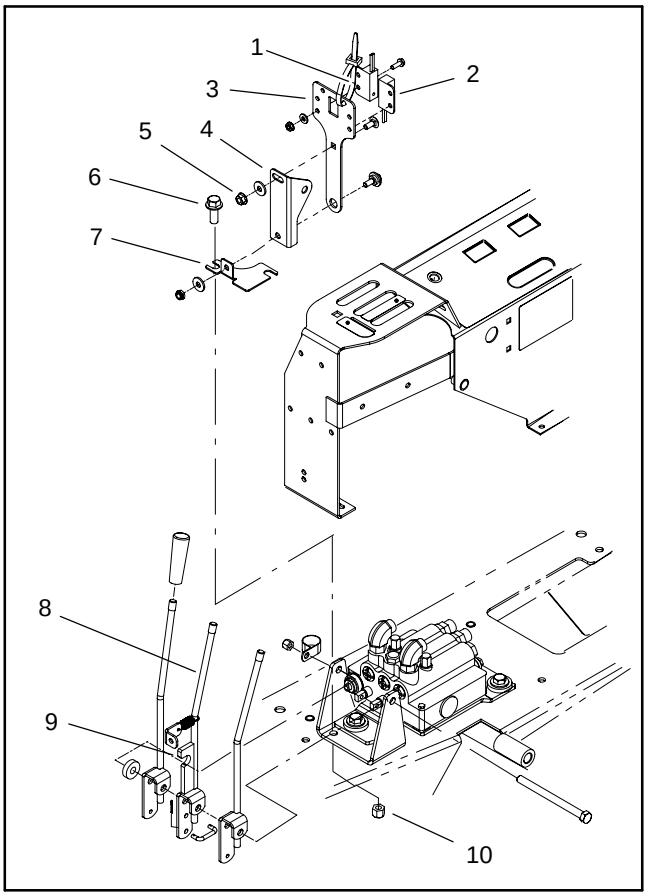


Figure 56

1. **Deck lower switch**
2. **Deck raise switch**
3. **Switch plate**
4. **Lever bracket**
5. **Flange nut**
6. **Flange bolt (2 used)**
7. **Tab plate**
8. **Deck lift/lower lever**
9. **Switch actuator**
10. **Lock nut (2 used)**

Engine Coolant and Hydraulic Oil Temperature Senders

The Groundsmaster 4100−D uses two (2) temperature senders as inputs for the TEC−5002 to identify if either the engine coolant or hydraulic oil temperature has reached an excessive level. These senders are identical. The coolant temperature sender threads into the radiator (Fig. 57). The hydraulic oil temperature sender is attached to the hydraulic hydraulic tube on the left side of the machine (Fig. 58).

Testing

1. Locate temperature sender that is to be tested. Disconnect wire harness connector from sender.

2. Thoroughly clean area around temperature sender and remove sender.

3. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Fig. 59).

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 kilo ohms at 68ºF (20ºC).

   B. The meter should indicate from 2.3 to 2.5 kilo ohms at 140ºF (60ºC).

   C. The meter should indicate from 605 to 669 ohms at 212 ºF (100ºC).

   D. Replace sender if specifications are not met.

5. After allowing the sender to cool, install sender:

   A. Install new O−ring on sender.

   B. Install sender into port and torque from **9 to 11 ft−lb (12.3 to 14.9 N−m)**.

   C. Reconnect harness wire to sender.

6. Check and fill system (coolant or hydraulic) to proper level.

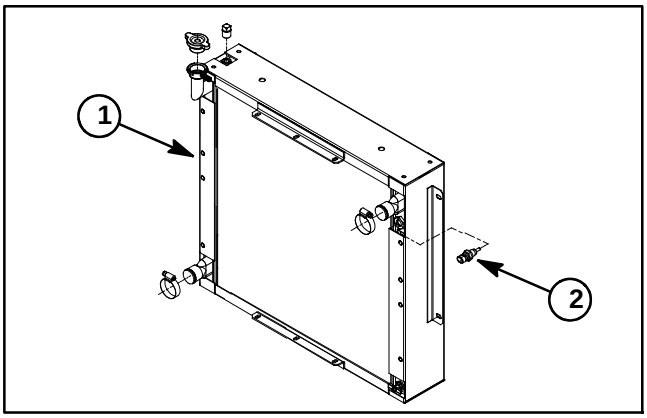


Figure 57

1. Radiator **2. Coolant temp sender**

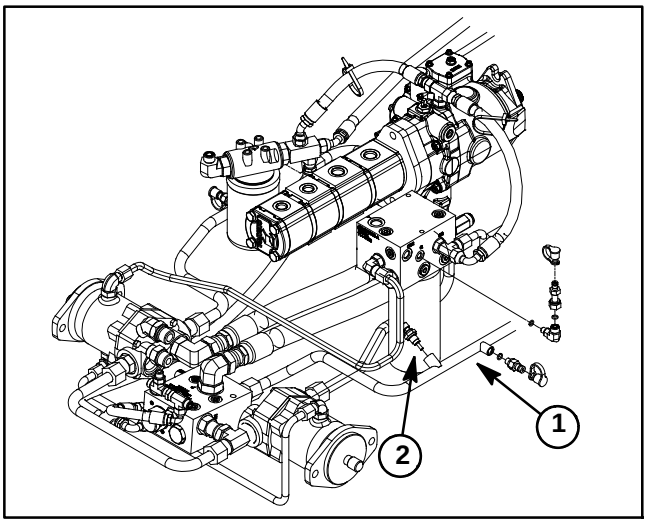


Figure 58

1. Hydraulic tube **2. Oil temp sender**

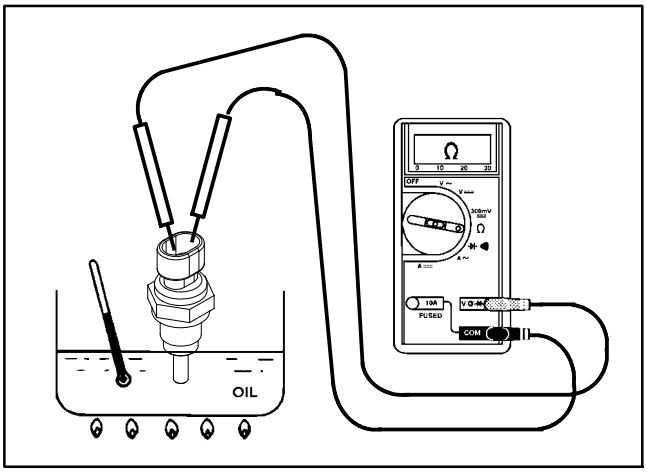


Figure 59

Service and Repairs

NOTE: For engine component repair information, see the Kubota Workshop Manual, Diesel Engine, V2403−M−T−E3B Series at the end of Chapter 3 − Kubota Diesel Engine.

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the battery and charge it fully (see Battery Service in this section).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service in this section).

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 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 post could result in personal injury and/or damage to the electrical system.

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (−) cable first. Clean clamps and terminals separately. Connect cables with positive (+) cable first. Coat battery posts and cable connectors with 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 water. Do not fill cells above the fill line.

Battery Service

The battery is 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.

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80ºF (26.7ºC)
Discharged: less than 1.240

Battery Specifications
BCI Group Size 24
650 CCA at 0º F (–17.8º C)
Reserve Capacity of 110 minutes at 80ºF (26.7ºC)

Dimensions (including terminal posts and caps)

Length	10.2 inches (259 mm)
Width	6.6 inches (167 mm)
Height	9.0 inches (228 mm)

Battery Removal and Installation (Fig. 60)

1. Raise and support operator seat. Remove battery access panel.

2. Loosen and remove negative cable from battery. After negative cable is removed, loosen and remove positive cable.

3. Loosen battery strap that secures battery to machine.

4. Carefully remove battery from machine.

5. Install battery in reverse order making sure to connect and tighten positive cable to battery before connecting negative cable.

NOTE: Before connecting the negative (ground) cable to the battery, connect a digital multimeter (set to DC Amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 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 battery with battery strap. Install battery access panel. Lower and secure operator seat.

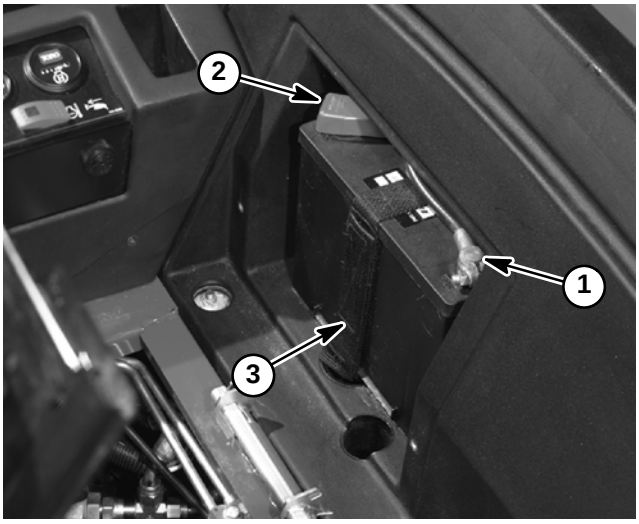


Figure 60

1. **Negative (-) cable**
2. **Positive (+) cable**
3. **Battery strap**

Battery Inspection, Maintenance and Testing

1. Perform following inspections and maintenance:

   A. Check 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 away. Replace the battery if the seal is broken or leaking.

   E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all 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 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100°F
Cell Gravity	1.245
100°F minus 80°F equals 20°F	
(37.7°C minus 26.7°C equals 11.0°C)	
20°F multiply by 0.004/10°F equals 0.008	
(11°C multiply by 0.004/5.5°C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80°F (26.7°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 **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 manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, charge the battery before continuing with load testing procedure.

B. If the battery has recently 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 temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 325 amps (one half the battery cold cranking amp rating) for 15 seconds.

G. Take a battery voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

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, 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 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 locally.

CAUTION

Follow the 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 (15.5° 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 (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three 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.

Chapter 6

Axles, Planetaries and Brakes

Table of Contents

Specifications

Item	Specification
Tire pressure (front and rear)	25 to 30 PSI (172 to 207 kPa)
Rear wheel toe–in	0.125 in (3.18 mm)
Planetary gear drive oil System gear lube capacity (each wheel)	SAE 85W–140 wt. gear lube 16 fl. oz. (0.47 liters)
Rear axle lubricant System gear lube capacity	SAE 85W–140 wt. gear lube 80 fl. oz. (2.37 liters)
Rear axle gear box lubricant System gear lube capacity	SAE 85W–140 wt. gear lube 16 fl. oz. (0.47 liters)
Wheel lug nut torque	85 to 100 ft–lb (115 to 135 N–m), front and rear
Steering cylinder bolt torque	100 to 125 ft–lb (139 to 169 N–m)
Planetary, brake housing and front wheel motor mounting screw torque	75 to 85 ft–lb (101 to 115 N–m)

General Information

Operator's Manual

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

Brake Assembly

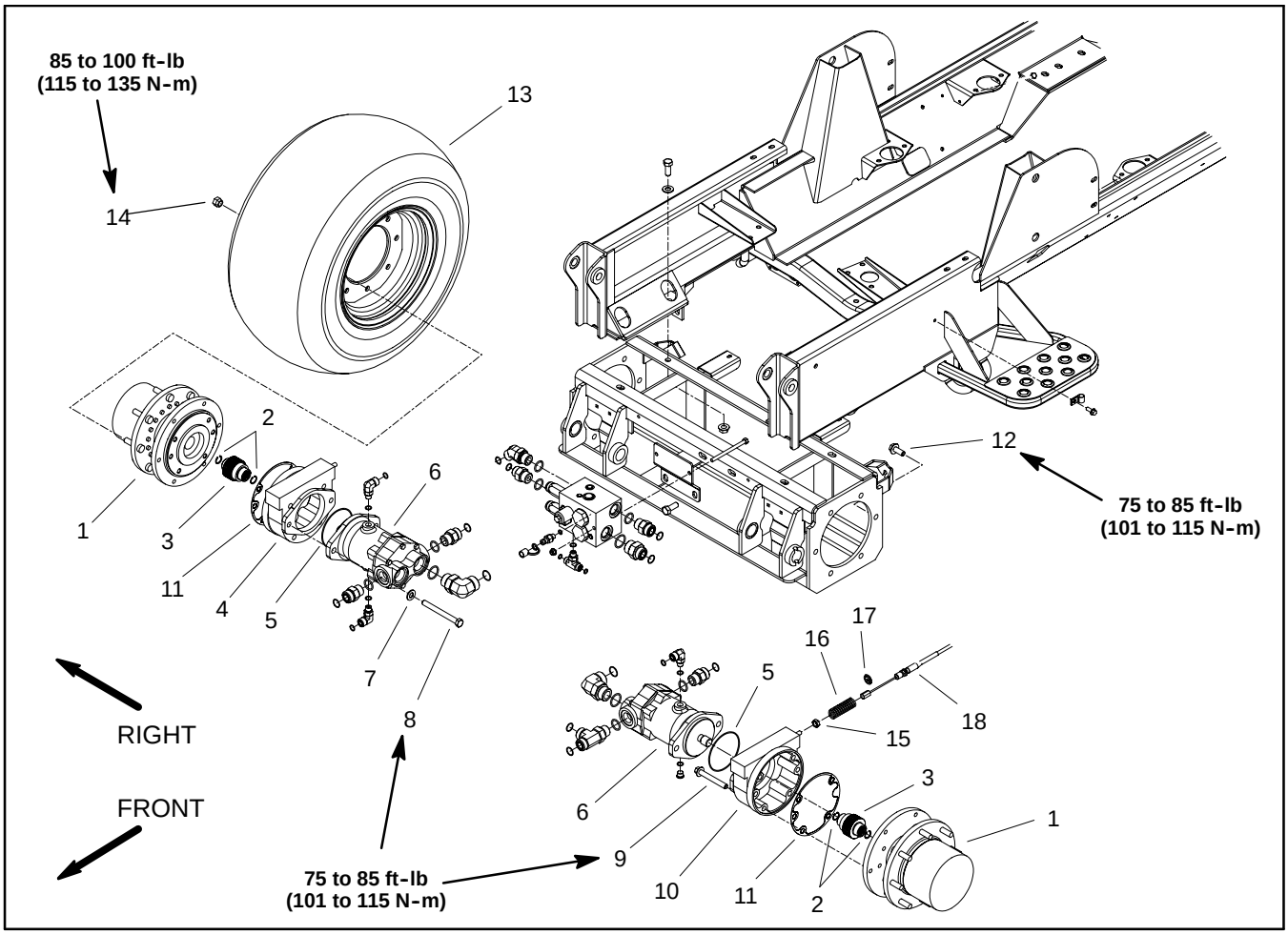


Figure 1

1. Planetary assembly
2. Retaining ring
3. Splined brake coupler
4. Brake assembly (RH)
5. O-ring
6. Hydraulic wheel motor
7. Flat washer
8. Cap screw (2 used per side)
9. Flange head screw (4 used per side)
10. Brake assembly (LH)
11. Gasket
12. Flange head screw (6 used per side)
13. Tire and wheel assembly
14. Lug nut (8 used per wheel)
15. Jam nut
16. Compression spring
17. Spring plate
18. Brake cable

Removal (Fig. 1)

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

2. Drain oil from planetary wheel drive/brake assembly.

CAUTION

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

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with suitable jack stands.

4. Remove front wheel assembly.

5. Remove hydraulic wheel motor (see Front Wheel Motors in Service and Repairs section of Chapter 4 – Hydraulic System).

6. Disconnect brake cable from pull rod on brake assembly.

7. Support brake assembly to prevent it from falling.

8. Remove four (4) flange head screws (item 9) securing brake assembly to machine. Remove brake assembly taking care to not drop splined brake coupler as brake assembly is removed.

9. Remove splined brake coupler.

10. Complete brake inspection and repair (see Brake Inspection and Repair in this section).

Installation (Fig. 1)

1. Slide splined brake coupler into brake assembly. **NOTE:** The stepped end of the coupler must be installed toward the hydraulic wheel motor (Fig. 2).

2. Position brake assembly to frame, aligning splined brake coupler with input shaft on planetary wheel drive.

3. 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)**.

4. Install brake cable to pull rod on brake assembly. Brake cable end should be completely threaded onto pull rod.

5. 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)**.

6. Install wheel assembly.

WARNING

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

7. Lower machine to ground. Torque lug nuts from **85 to 100 ft-lb (115 to 135 N-m)**.

8. Make sure drain plug is installed in bottom of brake assembly (Fig. 3). Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube. Capacity is approximately 16 fl. oz. (0.47 liters) per wheel.

9. Check and adjust brake cables for proper brake operation. If necessary, adjust brake cable jam nuts at frame bracket so that pull rod jam nut is positioned from 0.470" to 0.530" (12.0 to 13.4 mm) from brake casting surface when brakes are disengaged (Fig. 4).

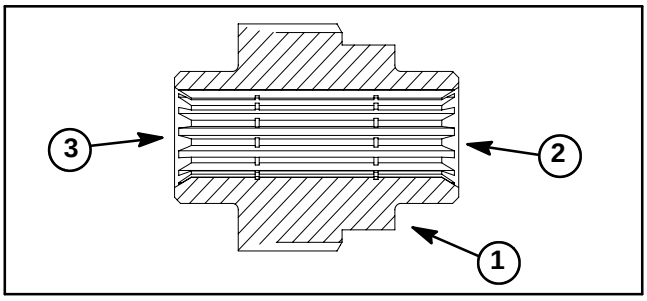


Figure 2

1. **Brake coupler step**
2. **Hydraulic motor end**
3. **Planetary assembly end**

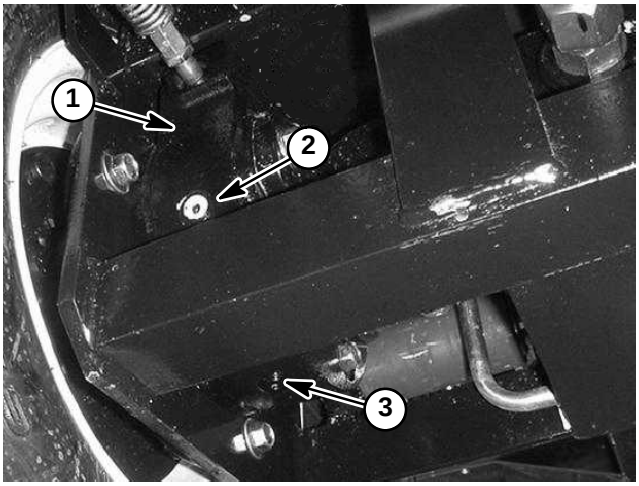


Figure 3

1. **Brake housing**
2. **Check plug**
3. **Drain plug**

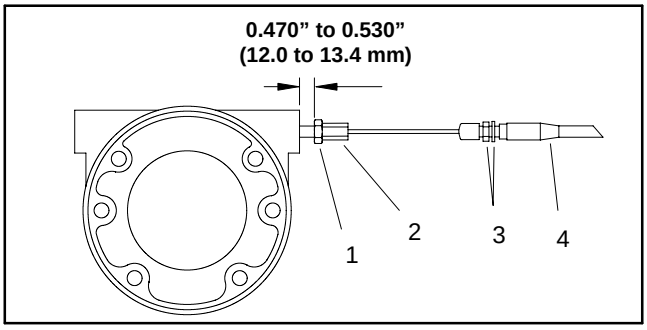


Figure 4

1. **Pull rod jam nut**
2. **Brake cable end**
3. **Cable jam nut**
4. **Brake cable**

Brake Service

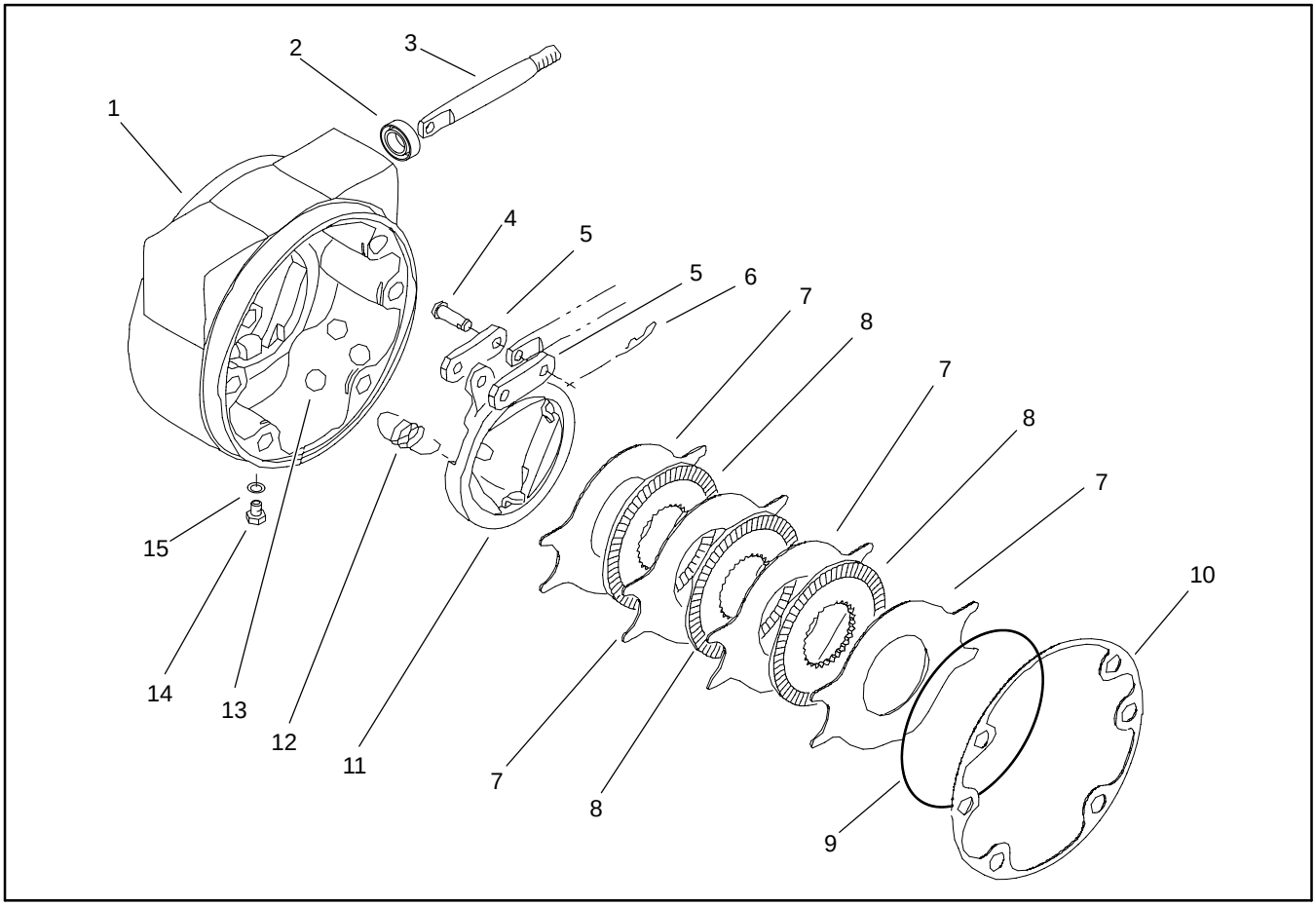


Figure 5

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin (2 used)**
5. **Link**
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 Inspection and Repair (Fig. 5)

1. Scrape gasket material (item 10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (item 9).

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.

7. Wash parts in cleaning solvent. Inspect components for wear or damage.

   A. The stack of four (4) stationary and three (3) rotating discs should have a minimum thickness of 0.440" (11.2 mm).

8. Reverse steps 2 – 6 to assemble brakes, installing new parts as necessary. Install a new seal (item 2).

9. Use a new gasket (item 10) when installing brake assembly to machine.

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Planetary Wheel Drive Assembly

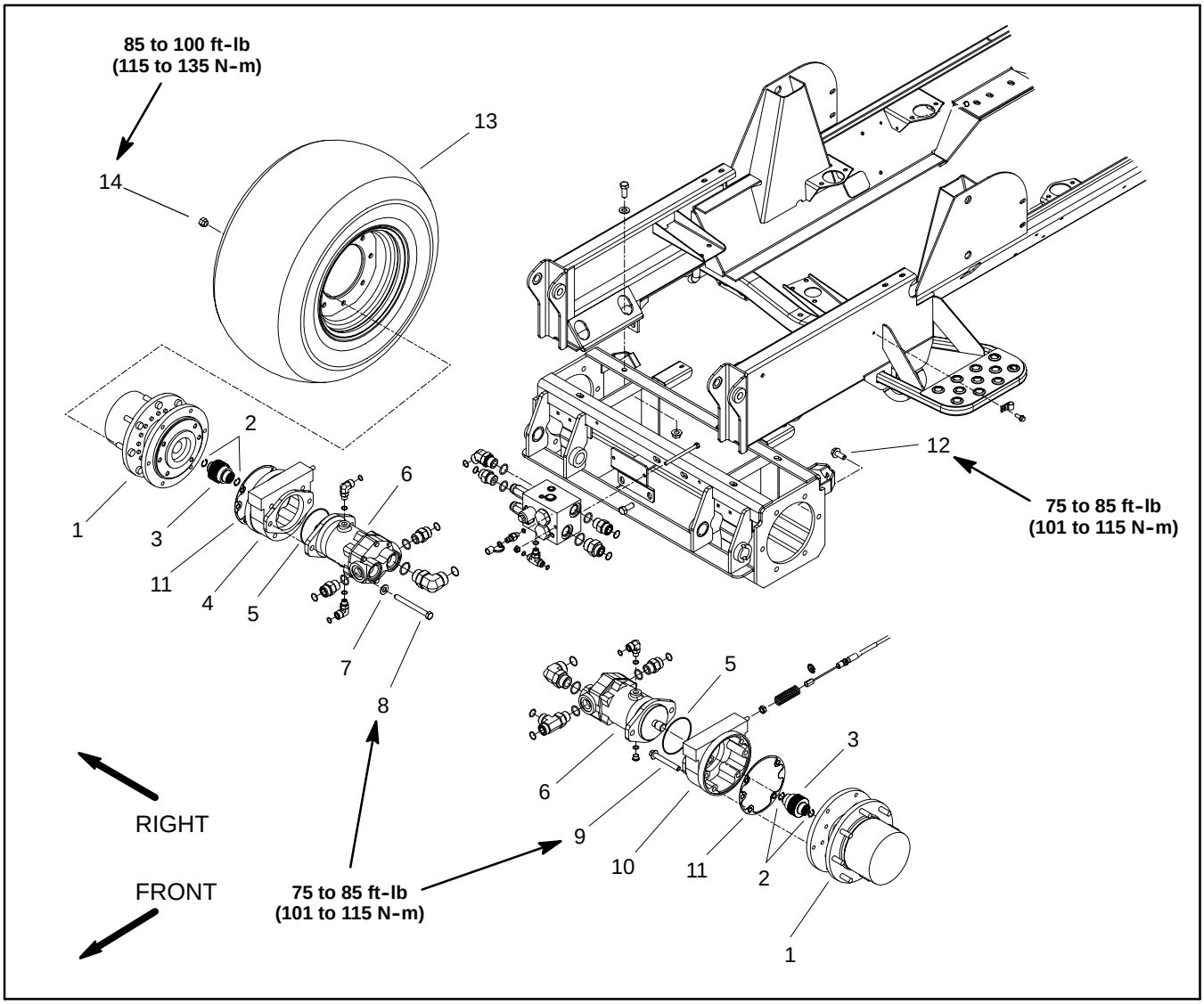

Figure 6

1. **Planetary assembly**
2. **Retaining ring**
3. **Splined brake coupler**
4. **Brake assembly (RH)**
5. **O-ring**
6. **Hydraulic wheel motor**
7. **Flat washer**
8. **Cap screw (2 used per side)**
9. **Flange head screw (4 used per side)**
10. **Brake assembly (LH)**
11. **Gasket**
12. **Flange head screw (6 used per side)**
13. **Tire and wheel assembly**
14. **Lug nut (8 used per wheel)**

Removal (Fig. 6)

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

2. Drain oil from planetary wheel drive/brake assembly.

CAUTION

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

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with suitable jack stands.

4. Remove front wheel assembly.

5. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly Removal in this Chapter).

6. Support hydraulic wheel motor to prevent it from falling. Remove two (2) cap screws that secure wheel motor to planetary assembly.

7. Support planetary assembly to prevent it from falling. Loosen and remove flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

Installation (Fig. 6)

1. Inspect gasket between brake and planetary assemblies. Replace as needed.

2. Position planetary assembly to machine. Install flange head screws that secure planetary assembly to frame. Torque screws from **75 to 85 ft-lb (101 to 115 N-m)**.

3. Secure brake assembly to planetary assembly with four (4) flange head screws (see Brake Assembly Installation in this Chapter). Torque screws from **75 to 85 ft-lb (101 to 115 N-m)**.

4. Secure hydraulic wheel motor to planetary assembly with two (2) cap screws. Torque screws from **75 to 85 ft-lb (101 to 115 N-m)**.

5. Install wheel assembly.

WARNING

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

6. Lower machine from jack stands. Torque lug nuts from **85 to 100 ft-lb (115 to 135 N-m)**.

7. Make sure drain plug is installed in bottom of brake assembly (Fig. 7). Fill planetary wheel drive/brake assembly with SAE 85W-140 gear lube. Capacity is approximately 16 fl. oz. (0.47 l) per wheel.

8. Check for proper brake operation.

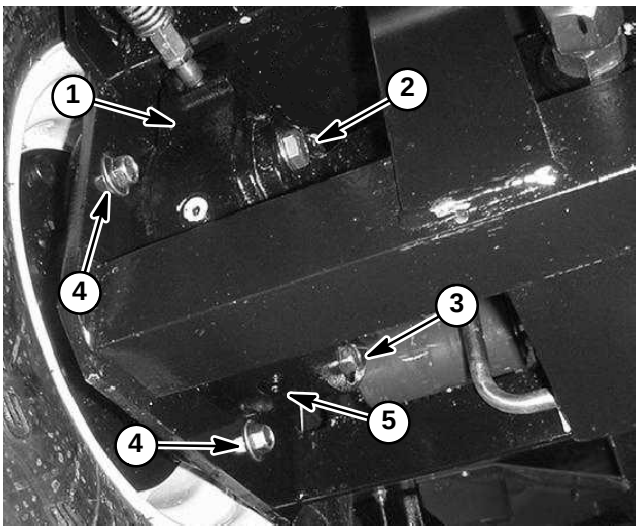

Figure 7

1. **Brake housing**
2. **Wheel motor cap screw**
3. **Brake flange screw**
4. **Planetary flange screw**
5. **Brake drain plug**

Planetary Wheel Drive Service

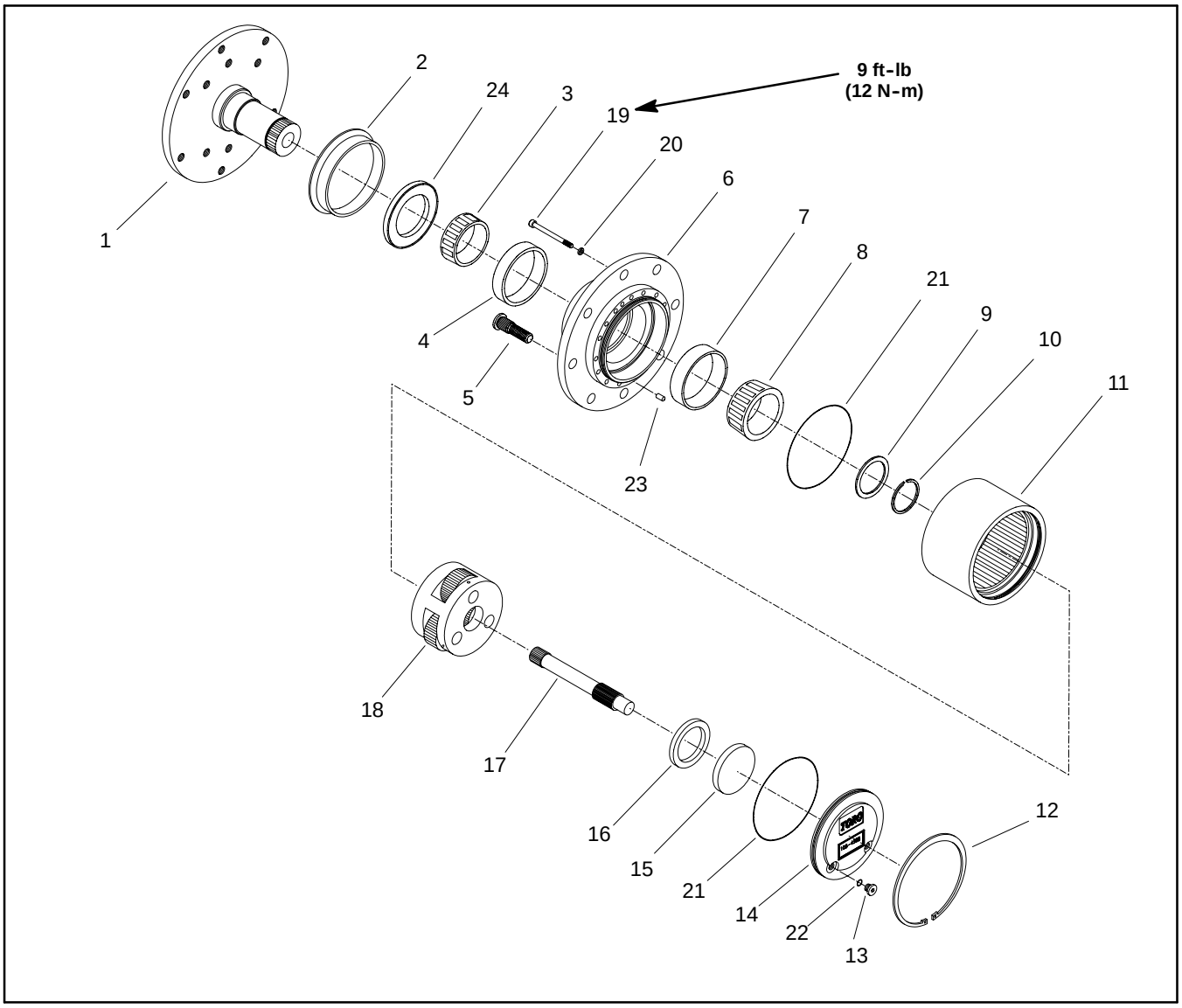

Figure 8

1. Spindle
2. Boot seal
3. Bearing cone
4. Bearing cup
5. Wheel stud (8 used)
6. Housing
7. Bearing cup
8. Bearing cone
9. Thrust washer
10. Retaining ring (external)
11. Ring gear
12. Retaining ring (internal)
13. Plug (2 used)
14. End cap
15. Thrust plug
16. Thrust washer
17. Drive shaft
18. Carrier assembly
19. Socket head screw (16 used)
20. Lock washer (16 used)
21. O-ring
22. O-ring
23. Dowel pin (2 used)
24. Seal

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 Removal in this section.

Disassembly (Figs. 8 and 9)

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 12).

3. Remove end cap (item 14). Thrust plug (item 15) and thrust washer (item 16) usually remain in end cap bore and should be removed for cleaning and inspection.

4. Remove drive shaft assembly (items 17).

5. Remove carrier assembly (item 18).

6. If wheel stud (item 5) removal is necessary, use press to extract stud(s) from housing.

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.

7. Remove retaining ring (item 10) and thrust washer (item 9). Discard retaining ring.

8. Remove housing (item 6) from spindle (item 1). Remove outer bearing cone (item 8).

9. Remove and discard all seals and O–rings (items 2, 21 and 24).

10. If bearings will be replaced, remove inner bearing cone (item 3) from housing. Remove bearing cups (items 4 and 7) from housing.

11. If necessary, remove socket head screws (item 19) with lock washers (item 20) that secure ring gear (item 11) to housing. Remove ring gear and two (2) dowel pins (item 23) from housing.

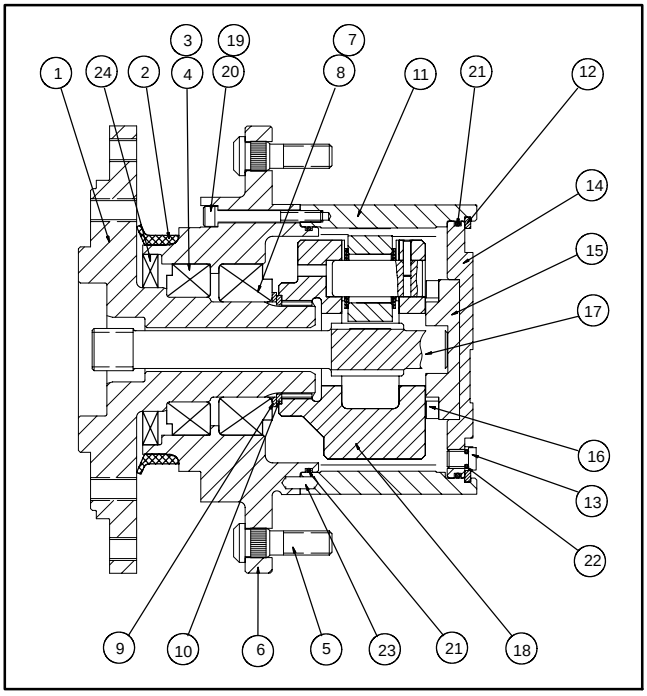

Figure 9

Assembly (Figs. 8 and 9)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

NOTE: Use new seal and shim kits when assembling planetary wheel drive.

2. If spindle and housing were separated:

   A. Press bearing cups (items 4 and 7) into housing. Cups should be pressed fully to shoulder of the housing bore.

   B. Set inner bearing cone (item 3) into bearing cup (item 4) that is installed in housing.

   C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 24) 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 23) in housing. Secure ring gear to housing with lock washers (item 20) and socket head screws (item 19). Torque socket head screws to **9 ft–lb (12 N–m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing onto spindle (item 1) taking care to not damage seal or spindle. Make sure that bearing in housing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 8) 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 9) 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 and retaining ring. Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 10) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 10) 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. After correct assembly, 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 21) to housing.

3. Install carrier assembly (item 18) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

4. Install drive shaft (item 17) making sure that drive shaft spline aligns with carrier gears.

5. Install thrust plug (item 15) and thrust washer (item 16) into end cap (item 14). Make sure that thrust plug and thrust washer are captive on inside of end cap.

6. Install new O−ring (item 21) to end cap (item 14) and then install end cap. Secure cap with retaining ring (item 12).

7. 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.

8. If planetary wheel drive assembly is installed on machine:

A. Install 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 lug nuts from **85 to 100 ft−lb (115 to 135 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. Capacity is approximately 16 fl. oz. (0.47 liters) per wheel.

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Rear Axle Assembly

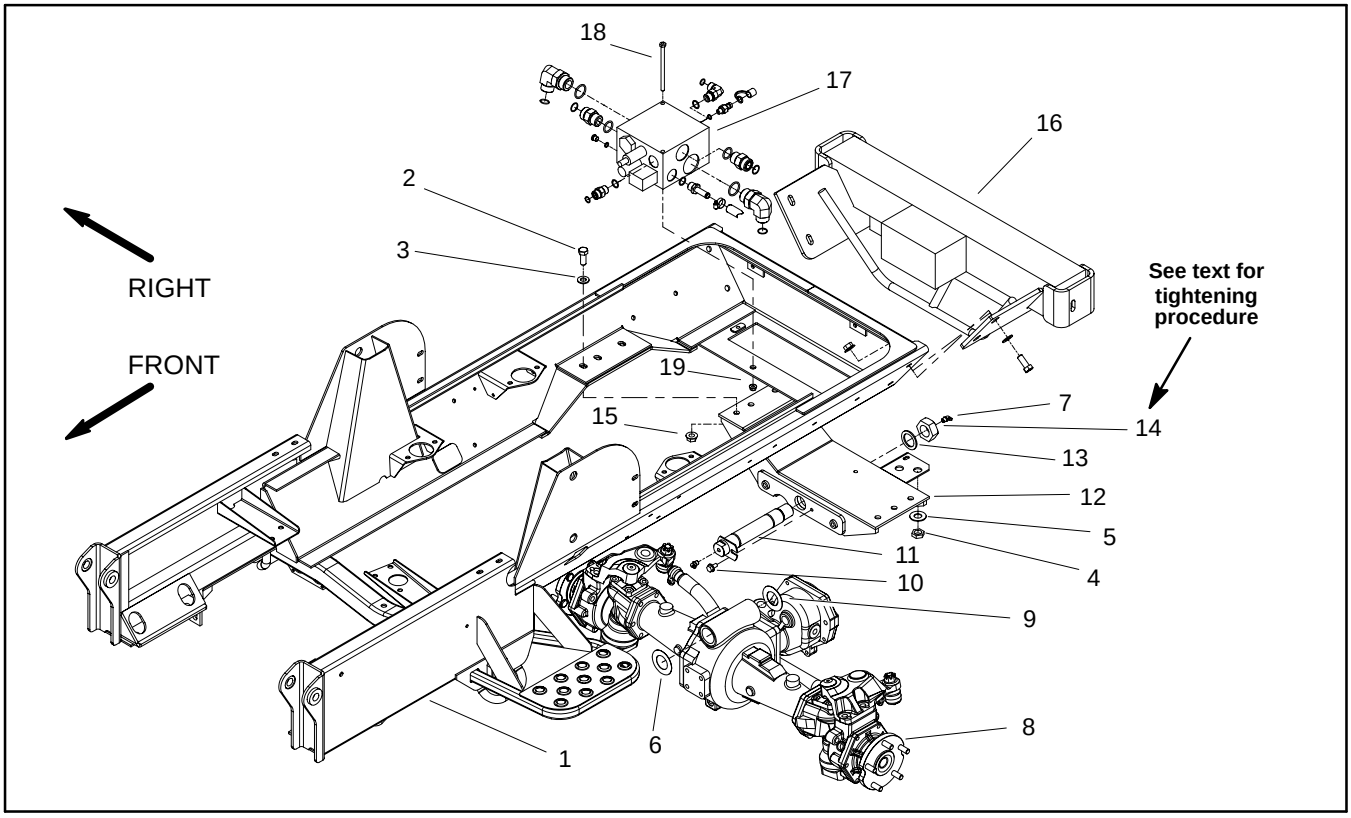

Figure 10

1. **Frame**
2. **Cap screw (6 used)**
3. **Flat washer**
4. **Bulkhead lock nut (2 used)**
5. **Washer**
6. **Thrust washer (thick)**
7. **Grease fitting (2 used)**
8. **Rear axle assembly**
9. **Thrust washer (thin)**
10. **Washer head screw**
11. **Pivot pin**
12. **Rear frame mount**
13. **Washer**
14. **Lock nut**
15. **Flange nut**
16. **Rear bumper**
17. **Hydraulic manifold (4WD)**
18. **Cap screw (2 used)**
19. **Flange nut (2 used)**

Removal (Fig. 10)

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

CAUTION

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

2. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with suitable jack stands.

3. Drain oil from rear axle and axle gearbox.

4. Remove both wheels from rear axle.

5. Remove hydraulic motor from rear axle assembly (see Rear Axle Motor in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Remove steering cylinder from rear axle (see Steering Cylinder in the Service and Repairs section of Chapter 4 – Hydraulic System).

7. Disconnect both steering cylinder hydraulic hoses from hydraulic tubes at rear frame mount (Fig. 11). Remove bulkhead locknuts and washers that secure steering cylinder hydraulic tubes to rear frame mount. Separate tubes from frame mount.

8. Remove cap screw and flange nut that secures front corner of 4WD hydraulic manifold to rear frame mount.

9. If required, remove tie rod ends from steering arms on rear axle (Fig. 12). Remove the cotter pins and castle nuts from the tie rod ball joints. Use a ball joint fork and remove the tie rod ends from the axle steering arms.

10. Support rear axle to prevent it from falling. Remove six (6) cap screws, flat washers and flange nuts that secure rear frame mount to equipment frame. Lower rear axle and rear frame mount from machine.

11. Remove lock nut and washer from pivot pin that attaches rear axle to rear frame mount. Remove washer head screw that secures flange of pivot pin to frame mount (Fig. 13).

12. Remove pivot pin. Separate rear frame mount from rear axle. Note location of thrust washers on both ends of axle mounting boss.

Installation (Fig. 10)

1. Position rear frame mount to axle. Install thrust washers between axle boss and frame mount. The thinner thrust washer should be installed on the hydraulic motor end of the axle (toward the rear of the machine). With washers installed, there should be from 0.002" to 0.020" (0.05 mm to 0.51 mm) clearance between rear frame mount and axle mounting boss. Add thrust washers if needed to adjust clearance.

2. Install axle pivot pin to secure axle to rear frame mount. Tighten lock nut and then loosen it slightly to allow the axle pin to pivot freely. Secure pivot pin to frame mount with washer head screw (Fig. 13).

3. If removed, install the tie rod to rear axle (Fig. 12). Tighten ball joint castle nuts and install new cotter pins.

4. Position axle and rear mount under machine with a jack. Raise assembly to machine frame and align mounting holes of rear mount and machine frame.

5. Secure rear mount to frame with six (6) cap screws, flat washers and flange nuts.

6. Install cap screw and flange nut that secures front corner of 4WD hydraulic manifold to rear frame mount.

7. Attach steering cylinder hydraulic tubes to rear frame mount with washers and bulkhead lock nuts (Fig. 11). Install steering cylinder hoses to hydraulic tubes.

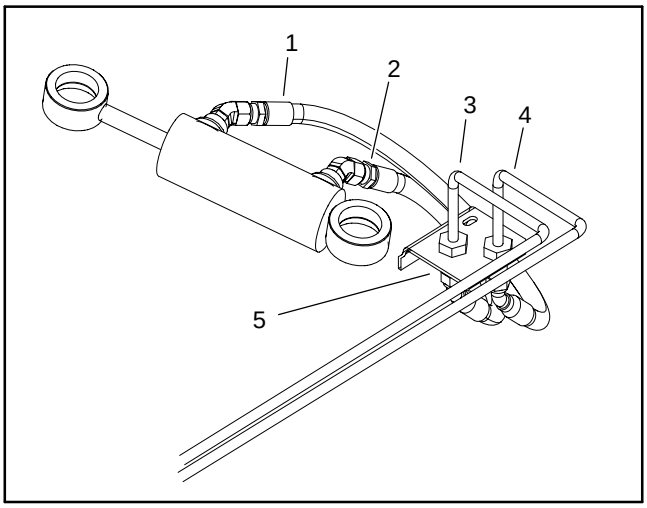

Figure 11

1. **Hydraulic hose**
2. **Hydraulic hose**
3. **Hydraulic tube**
4. **Hydraulic tube**
5. **Rear frame mount**

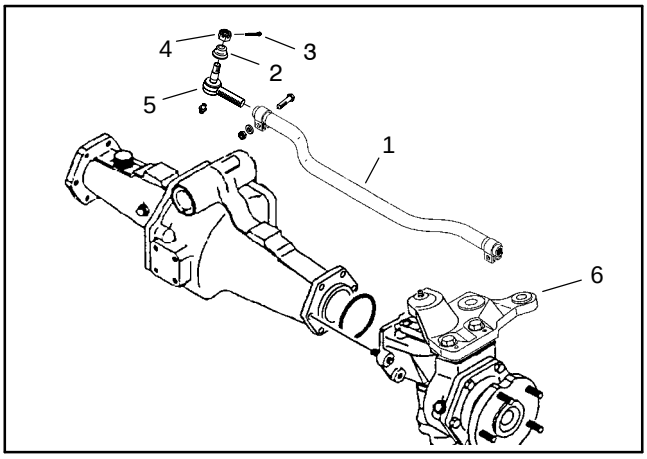

Figure 12

1. **Tie rod**
2. **Dust cover**
3. **Cotter pin**
4. **Castle nut**
5. **Tie rod end**
6. **Steering arm (LH)**

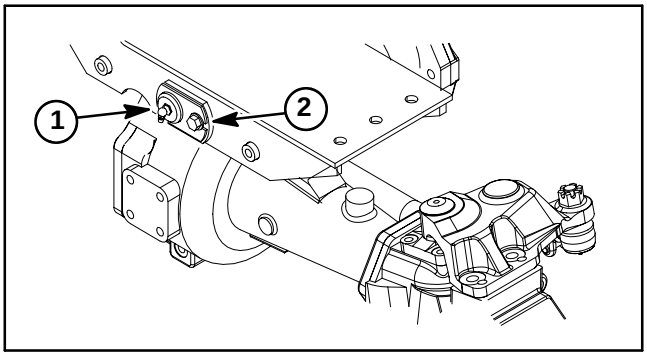

Figure 13

1. **Pivot pin**
2. **Washer head screw**

8. Install steering cylinder to axle assembly (see Steering Cylinder Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

9. Install hydraulic motor to axle assembly (see Rear Axle Motor Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

10. Install wheels to axle.

WARNING

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

11. Lower machine to ground. Torque wheel lug nuts from **85 to 100 ft-lb (115 to 135 N-m)**.

12. Fill axle and input gearbox with SAE 85W-140 weight gear lube. Lubricant capacity is approximately 80 fl. oz. (2.37 liters) for the axle and 16 fl. oz. (0.47 liters) for the gearbox.

13. Check rear wheel toe-in and adjust if necessary.

14. Check steering stop bolt adjustment. When the steering cylinder is fully extended (right turn), a gap of 1/16" (1.6 mm) should exist between bevel gear case casting and stop bolt on left axle case. Figure 14 shows stop bolt location.

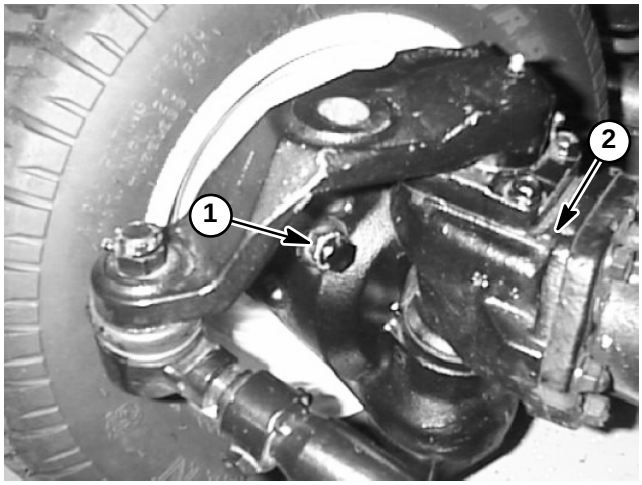

Figure 14

1. **Steering stop bolt**
2. **Bevel gear case (LH)**

Bevel Gear Case and Axle Case

The following procedures assume the rear axle assembly has been removed from the machine (see Rear Axle Assembly Removal in this section).

Bevel Gear Case and Axle Case Removal

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 15).

2. Mark both right and left bevel gear case/axle case assemblies.

IMPORTANT: Do not interchange right and left bevel gear case/axle case assemblies.

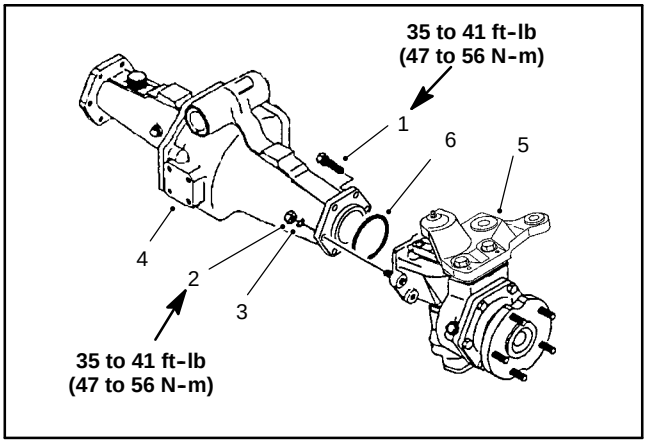

Figure 15

1. Cap screw (4 used)
2. Lock nut (2 used)
3. Lock washer (2 used)
4. Axle support
5. Bevel gear case/axle case assembly
6. O-ring

3. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 16).

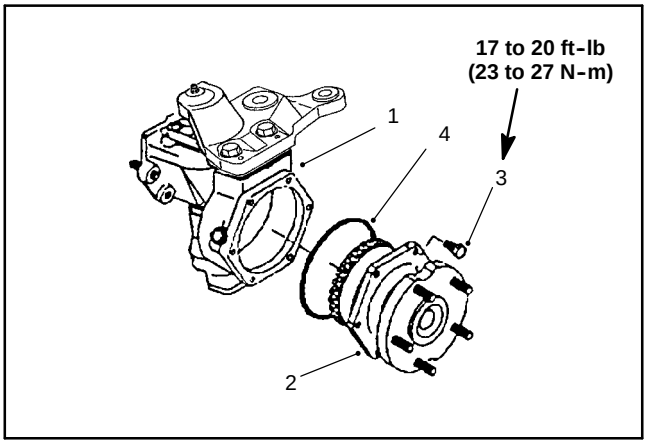

Figure 16

1. Axle case
2. Axle cover assembly
3. Mounting screw (6 used)
4. O-ring

4. Remove the axle case support mounting screws, the axle case support and the support shims (Fig. 17).

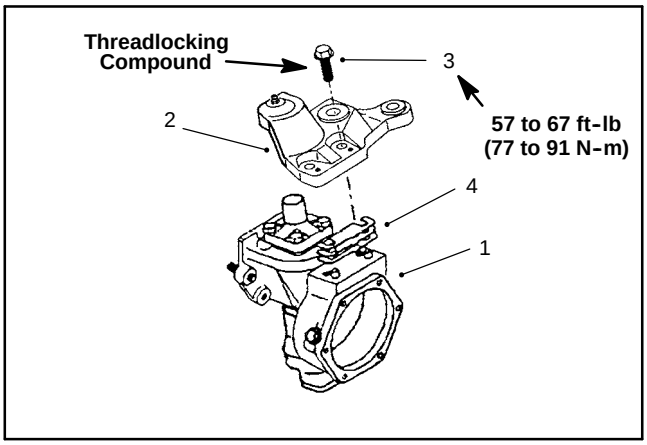

Figure 17

1. Axle case
2. Axle case support
3. Mounting screw (2 used)
4. Support shim

5. Remove the knuckle pin mounting screws and the knuckle pin. Remove the gasket and any remaining gasket material from either mating surface (Fig. 18).

6. While holding the bevel gear case, tap the upper end of the bevel gear shaft out of the upper bearing and upper bevel gear.

7. Pull the bevel gear case from the axle case and remove the upper bevel gear and collar from the gear case.

8. Remove the axle case cover screws, cover and the O-ring from the axle case.

9. Remove the plug and sealing washer from the center of the axle case cover. While holding the axle case cover, lightly tap the lower end of the bevel gear shaft out of the lower bearing and lower bevel gear.

10. Remove and discard bevel gear shaft seal from axle case (Fig. 18).

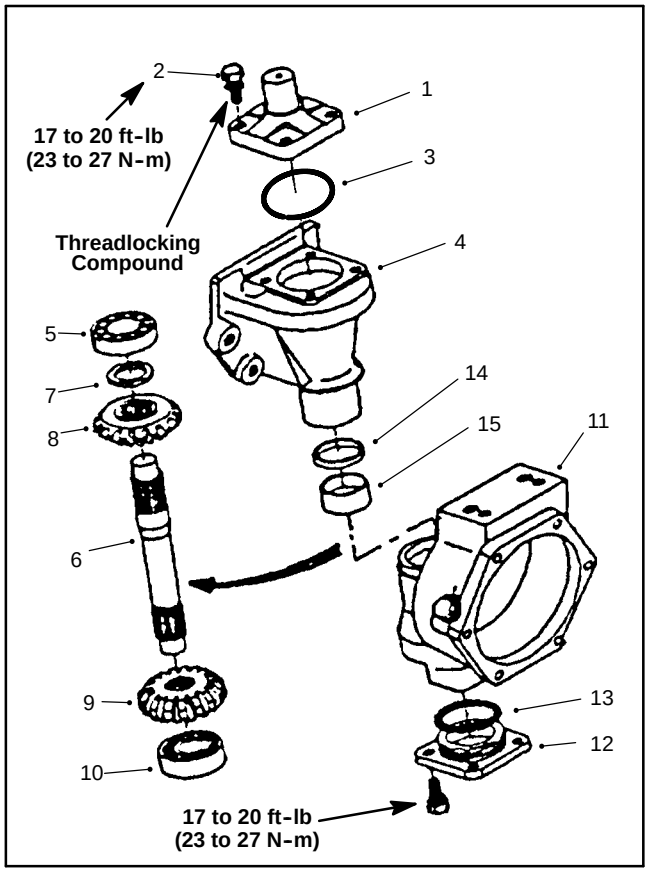

Figure 18

1. Knuckle pin
2. Mounting screw (4 used)
3. O-ring
4. Bevel gear case
5. Upper bearing
6. Bevel gear shaft
7. Collar
8. Upper bevel gear
9. Lower bevel gear
10. Lower bearing
11. Axle case
12. Axle case cover
13. O-ring
14. Shaft seal
15. Bushing

Bevel Gear Case and Axle Case Inspection

1. Measure the knuckle pin O.D. and the axle case support bushing I.D. to determine the bushing to pin clearance (Fig. 19). Replace components as necessary.

BUSHING TO PIN CLEARANCE:
0.002 to 0.016 in. (0.05 to 0.40 mm)

KNUCKLE PIN O.D. (Factory Spec.):
0.982 to 0.983 in. (24.95 to 24.98 mm)

AXLE CASE SUPPORT BUSHING I.D.
(Factory Spec.):
0.984 to 0.987 in. (25.00 to 25.08 mm)

2. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

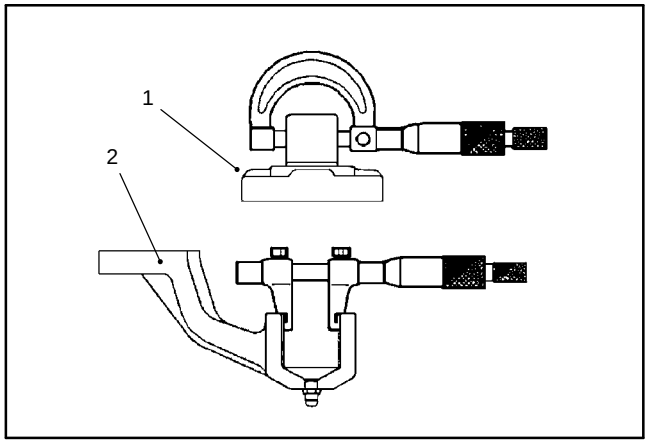

Figure 19

1. Knuckle pin
2. Axle case support

Bevel Gear Case and Axle Case Installation

1. Coat new shaft seal with grease and install in axle case as shown (Fig. 20).

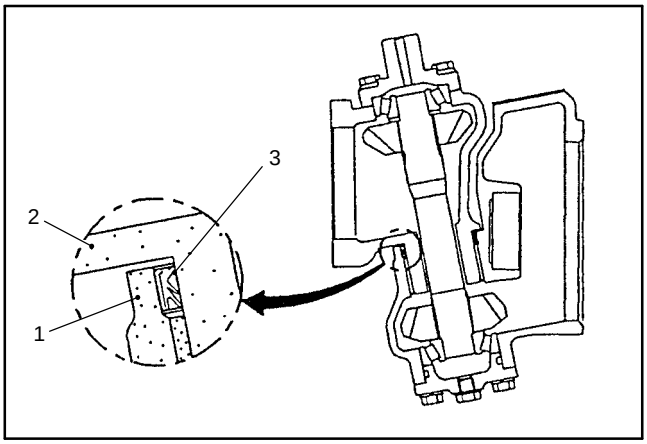

Figure 20

1. **Axle case**
2. **Bevel gear case**
3. **Shaft seal**

2. Install the lower bevel gear and bevel gear shaft in the axle case cover. Coat a new O-ring with grease and install the axle case cover (Fig. 21). Tighten cover screws from **17 to 20 ft-lb (23 to 27 N-m)**.

3. Slide the bevel gear case over the bevel gear shaft and install the bevel gear and collar. Make sure the bevel gear shaft is completely seated in the upper and lower bearings (Fig. 21).

4. Install the knuckle pin. Use medium strength Loctite thread locker and tighten the knuckle pin mounting screws from **17 to 20 ft-lb (23 to 27 N-m)**.

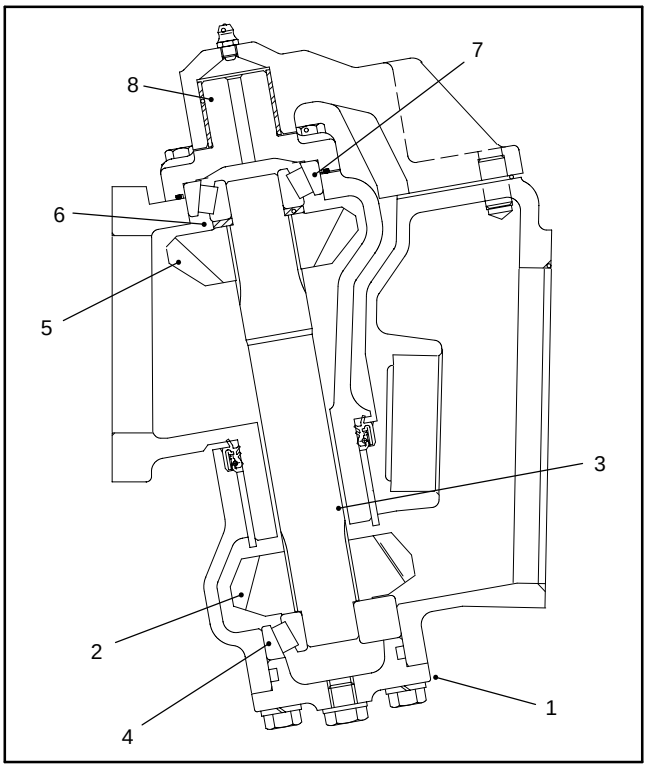

Figure 21

1. **Axle case cover**
2. **Lower bevel gear**
3. **Bevel gear shaft**
4. **Lower bearing**
5. **Upper bevel gear**
6. **Collar**
7. **Upper bearing**
8. **Knuckle pin**

5. Determine necessary quantity of support shims.

A. Lubricate the axle case support bushing with a thin coat of grease and slide axle case support onto knuckle pin.

B. Position support shims that were removed during disassembly between axle case support and axle case. Install mounting screws into axle case. Slowly tighten screws while frequently checking for clearance (vertical endplay) between axle case support and knuckle pin. If binding of components is noted before screws are fully tightened, add additional support shims. Torque screws from **57 to 67 ft-lb (77 to 91 N-m)**.

C. Use dial indicator to measure vertical endplay of axle case (Fig. 22).

AXLE CASE ASSEMBLY ENDPLAY:
0.001 to 0.008 in. (0.02 to 0.20 mm)

D. Adjust endplay by increasing or reducing number of axle case support shims.

NOTE: Axle case support shims are available in 0.004 in. (0.1 mm), 0.008 in. (0.2 mm) and 0.016 in. (0.4 mm) thickness.

6. After correct support shims have been determined, remove mounting screws, apply heavy strength thread-locking compound to screw threads, reinstall screws and torque from **57 to 67 ft-lb (77 to 91 N-m)**.

IMPORTANT: Correct engagement between bevel gears is critical to axle performance and durability.

7. Temporarily install the bevel gear case/axle case assembly on the axle support. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the upper bevel gear to differential shaft gear backlash (Fig. 23).

UPPER BEVEL GEAR BACKLASH:
0.004 to 0.016 in. (0.10 to 0.40 mm)

8. Adjust backlash by increasing or reducing axle bearing shim thickness (see Differential Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.004 in. (0.1 mm), 0.008 in. (0.2 mm) and 0.020 in. (0.5 mm) thickness.

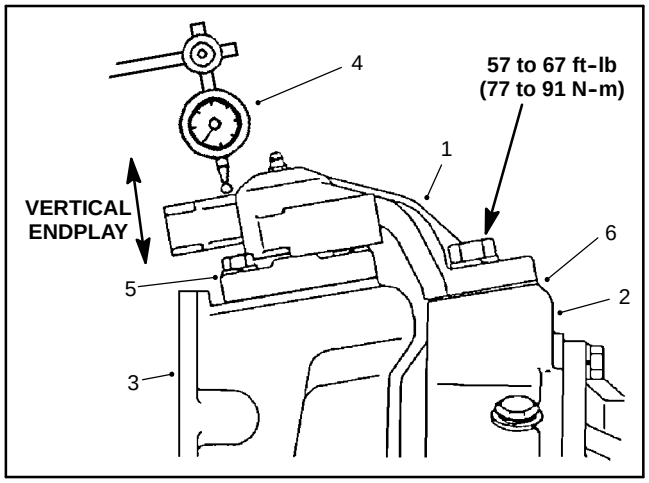

Figure 22

1. **Axle case support**
2. **Axle case**
3. **Bevel gearcase**
4. **Dial indicator**
5. **Knuckle pin**
6. **Support shim location**

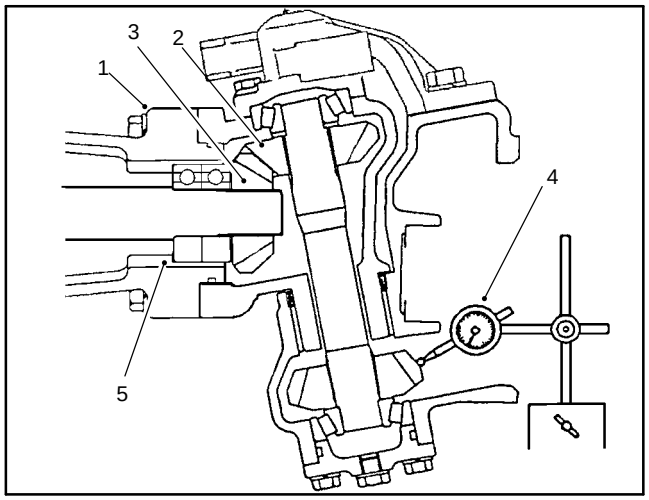

Figure 23

1. **Axle support**
2. **Upper bevel gear**
3. **Differential shaft gear**
4. **Dial indicator**
5. **Axle bearing shims**

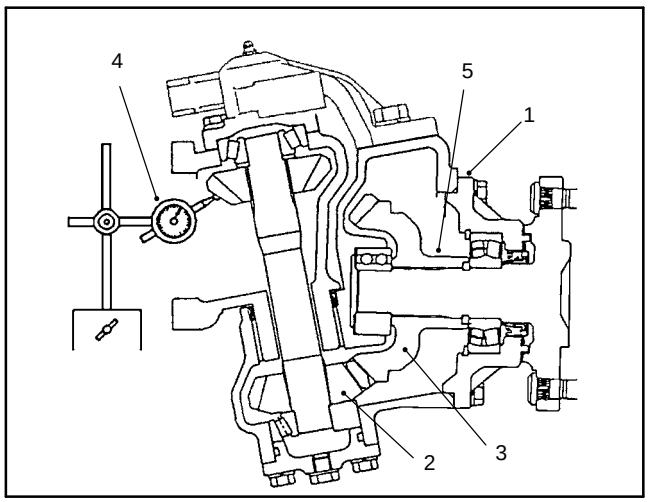

Figure 24

1. **Axle cover assembly**
2. **Lower bevel gear**
3. **Axle gear**
4. **Dial indicator**
5. **Axle bearing shims**

9. Remove the bevel gear case/axle case assembly from the axle support. Coat a new O-ring with grease and temporarily install the axle cover assembly. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the lower bevel gear to axle gear backlash (Fig. 24).

LOWER BEVEL GEAR BACKLASH:
0.004 to 0.016 in. (0.10 to 0.40 mm)

10. Adjust backlash by increasing or reducing axle bearing shim thickness (see Axle Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.008 in. (0.2 mm), 0.012 in. (0.3 mm) and 0.020 in. (0.5 mm) thickness.

11. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N-m)**.

12. Coat a new O-ring with grease and install the bevel gear case/axle case assembly on the axle support. Tighten mounting screws and nuts from **35 to 41 ft-lb (47 to 56 N-m)** (Fig. 15).

Differential Shafts

The following procedures assume the rear axle assembly has been removed from the machine (see Rear Axle Assembly Removal in this section).

Differential Shaft Removal

IMPORTANT: Do not interchange right and left differential shaft assemblies.

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 25).

2. Mark and pull the differential shaft assembly from the axle support.

3. Remove the retaining ring and bevel gear (Fig 26).

4. Drive the differential shaft out of the bearings. Remove the bearings and bearing shims.

5. Inspect all gears, shafts, bearings and cases for damage and wear. Replace components as necessary.

Differential Shaft Installation

1. Press bearings onto differential shaft. Place correct combination of bearing shims in axle support and drive differential shaft and bearing assembly into axle support.

2. Install bevel gear and retaining ring.

3. Coat new O-ring with grease. Align differential shaft splines with differential gear assembly and slide differential shaft assembly onto axle support.

4. Install bevel gear case/axle case assembly (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

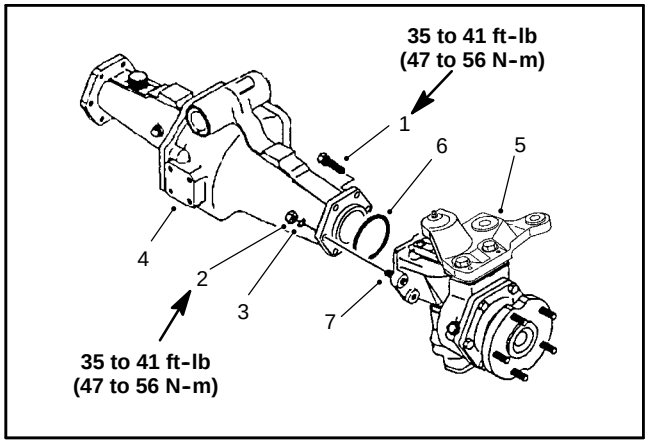

Figure 25

1. Cap screw (4 used)
2. Lock nut (2 used)
3. Lock washer (2 used)
4. Axle support
5. Bevel gear/axle case assembly
6. O-ring
7. Stud (2 used)

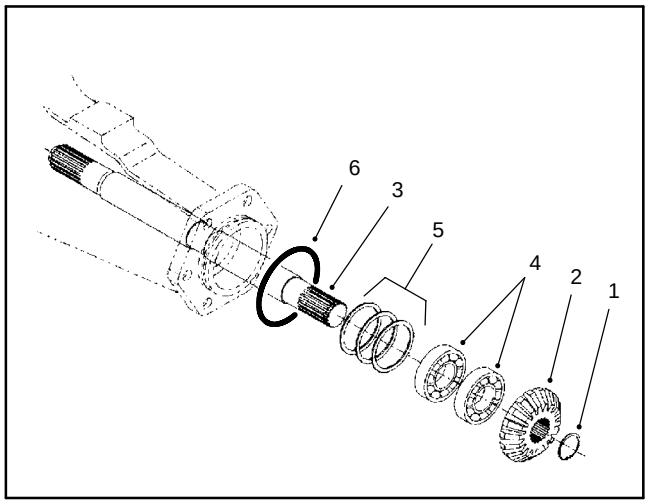

Figure 26

1. Retaining ring
2. Bevel gear
3. Differential shaft
4. Bearing
5. Bearing shims
6. O-ring

Axle Shafts

The following procedures assume the rear axle assembly has been removed from the machine (see Rear Axle Assembly Removal in this section).

Axle Shaft Removal

1. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 27).

2. Use a bearing puller to remove the bearing and bevel gear as shown (Fig. 28).

3. Remove the shims, spacer and retaining ring. Drive the axle out of the bearing and cover. Remove and discard the axle shaft seal.

4. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

Axle Shaft Installation

1. Coat new axle shaft seal with grease and install in axle cover as shown (Fig. 29).

2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Fig. 29).

3. Install retaining ring, spacer and correct combination of bearing shims. Install bevel gear and bearing.

4. Coat a new O-ring with grease and install the axle cover assembly. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N-m)**.

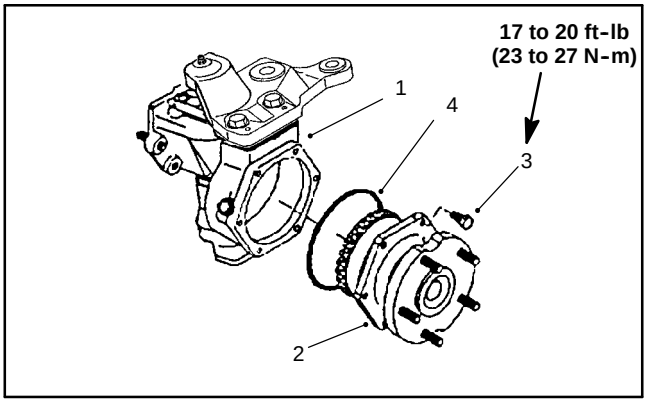

Figure 27

1. **Axle case**
2. **Axle cover assembly**
3. **Mounting screw (6 used)**
4. **O-ring**

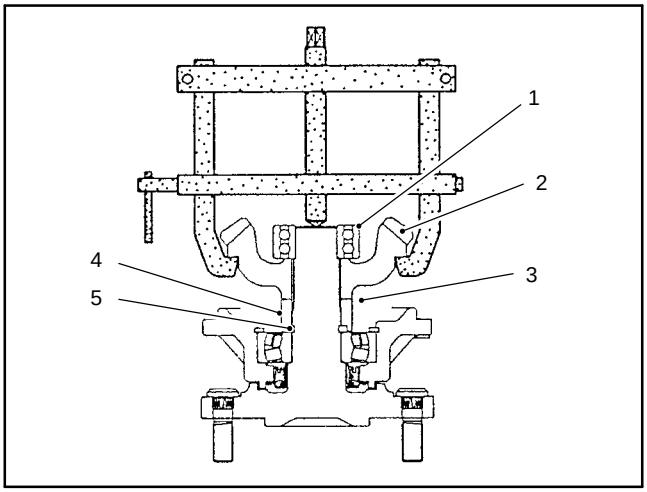

Figure 28

1. **Bearing**
2. **Bevel gear**
3. **Bearing shims**
4. **Spacer**
5. **Retaining ring**

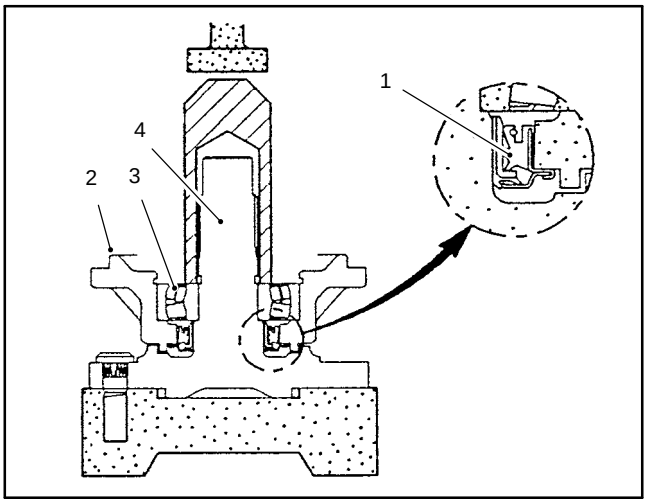

Figure 29

1. **Axle shaft seal**
2. **Axle cover**
3. **Bearing**
4. **Axle shaft**

Input Shaft/Pinion Gear

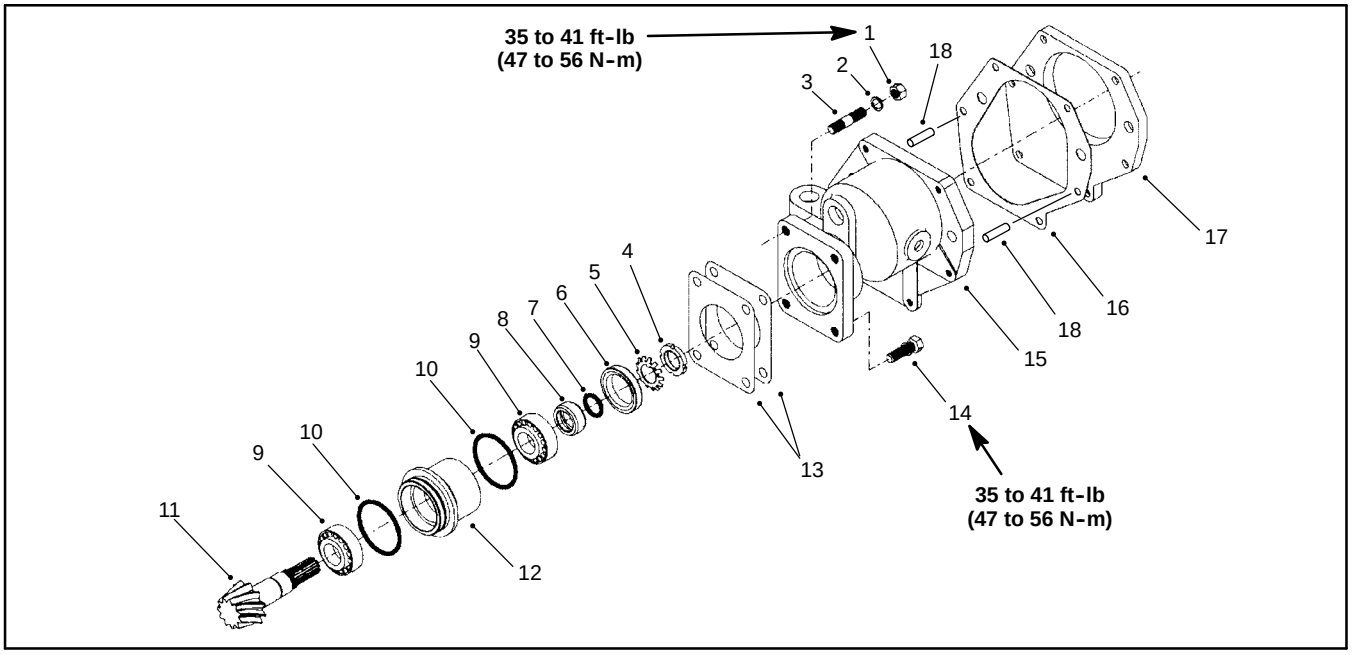

Figure 30

1. **Nut (2 used)**
2. **Lockwasher (2 used)**
3. **Stud (2 used)**
4. **Locknut**
5. **Stake washer**
6. **Oil seal**
7. **O-ring**
8. **Seal collar**
9. **Bearing**
10. **O-ring**
11. **Input shaft/pinion gear**
12. **Bearing case**
13. **Shim**
14. **Screw (2 used)**
15. **Gear case**
16. **Gasket**
17. **Cover plate**
18. **Dowel pin**

The following procedures assume the rear axle assembly has been removed from the machine (see Rear Axle Assembly Removal in this section).

Removal (Fig. 30)

1. Remove the cover plate, gasket and gear case assembly from the axle assembly. Remove the gasket and any remaining gasket material.

2. Remove the retaining rings and the driven gear from the input shaft/pinion gear.

3. Remove input shaft/pinion gear assembly from the gear case. Remove the shims and bearing case O-rings.

4. Release the stake washer and remove the locknut. Remove and discard the stake washer.

5. Drive the input shaft/pinion gear out from the outer bearing cone and bearing case. Remove and discard the oil seal and O-ring.

6. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

NOTE: Replacement input shaft/pinion gears are only available in matched ring and pinion sets.

Installation (Fig. 30)

NOTE: When installing new bearing cones, press only on the inner race of the bearing cone.

1. If the inner bearing cone was removed, press a new bearing cone all the way onto the input shaft/pinion gear.

2. Place the shaft and bearing assembly in the bearing case and install the outer bearing cone.

NOTE: The bearings must be completely seated. There should be no input shaft/pinion gear end play.

3. Coat a new oil seal with grease and install as shown (Fig. 31). The seal should be installed with the garter spring towards the hydraulic motor.

4. Coat new O-ring with grease. Install O-ring in the oil seal collar and install the collar.

5. Install a new stake washer. Install the lock nut finger tight.

6. Set the bearing preload by securing the bearing case in a vise. Thread a M12 x 1.5 hex head cap screw into the splined end of the input shaft/pinion gear and slowly tighten the locknut until **4 to 6 in-lb (0.4 to 0.7 N-m)** of force is required to rotate the input shaft/pinion gear in the bearing case.

7. Secure the lock nut with the stake washer.

8. Use a depth gauge to measure the distance from the end face of the input shaft/pinion gear to the mating surface of the bearing case. Subtract the “Design Cone Center Distance” from this distance to determine initial shim thickness (Fig. 32).

DESIGN CONE CENTER DISTANCE (distance from mating surface of axle support to end face of pinion gear):
1.870 ± 0.002 in. (47.5 ± 0.05 mm)

NOTE: Bearing case shims are available in 0.004 in. (0.1 mm) and 0.008 in. (0.2 mm) thickness.

9. Coat new O-rings with grease and install the bearing case in the gear case. Place shims on the gear case and temporarily install gear case assembly into axle case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N-m)**.

10. Insert a screwdriver through the drain plug hole to hold ring gear and measure the pinion gear to ring gear backlash (Fig. 33).

PINION GEAR TO RING GEAR BACKLASH:
0.004 to 0.016 in. (0.10 to 0.40 mm)

11. Adjust backlash by increasing or reducing gear case shim thickness.

12. Check pinion gear to ring gear engagement (see Pinion Gear to Ring Gear Engagement in this section of this manual).

13. Place the correct combination of shims on the gear case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N-m)**.

14. Install retaining rings and driven gear on input shaft/pinion gear.

15. If the drive gear (on drive motor shaft) was removed, install the retaining rings and drive gear on the motor shaft.

16. Use a new gasket and install the cover plate.

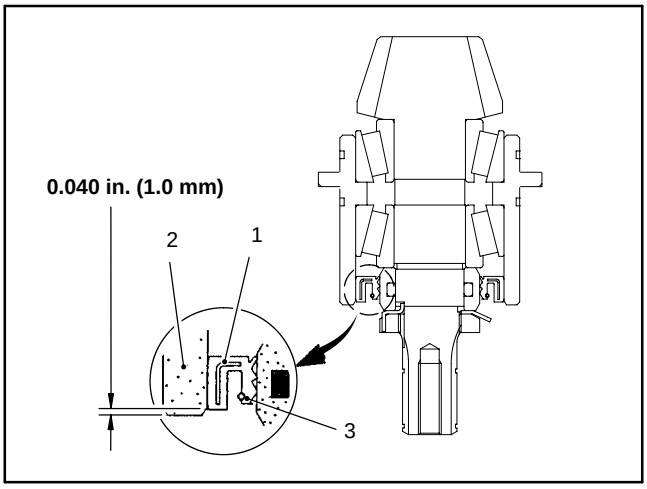

Figure 31

1. Oil seal
2. Bearing case
3. Seal garter spring

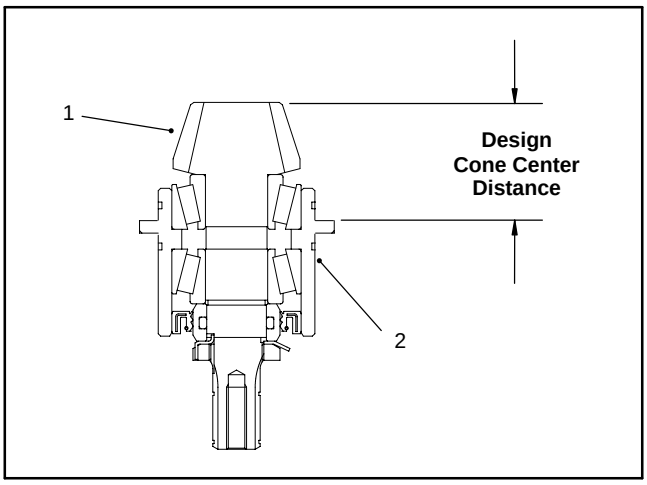

Figure 32

1. Input shaft/pinion gear
2. Bearing case

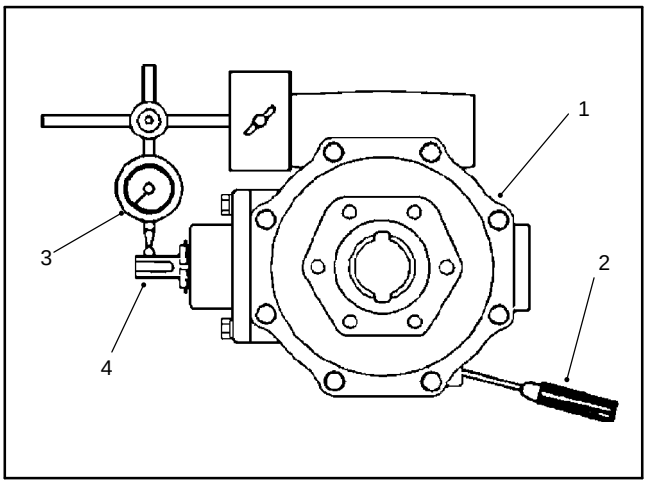

Figure 33

1. Axle case
2. Screwdriver
3. Dial indicator
4. Input shaft/pinion gear

Differential Gear

The following procedures assume the rear axle assembly has been removed from the machine (see Rear Axle Assembly Removal in this section).

Differential Gear Removal

1. Remove bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

IMPORTANT: Do not interchange right and left differential shafts assemblies.

2. Mark and pull the differential shaft assemblies from the axle support.

3. Remove input shaft/pinion gear assembly, shims and O-ring from the axle support (Fig. 34).

4. Remove the axle support case screws. Separate the axle support halves and remove the O-ring.

5. Remove the differential gear assembly, bearings and adjusting shims from the axle case.

6. Drive the spring pin from the differential case with a punch and hammer. Discard the spring pin (Fig. 35).

NOTE: Mark and arrange all components so they can be reassembled in their original position.

7. Remove the differential pinion shaft, pinion gears and pinion washers. Remove the differential side gears and side gear shims. Remove the ring gear only if it will be replaced (Fig. 36).

NOTE: Replacement ring gears are only available in matched ring and pinion sets.

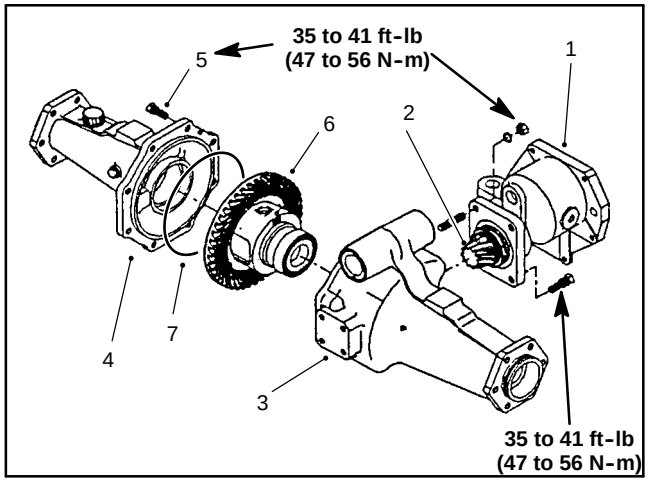

Figure 34

1. Gear Case
2. Pinion Gear
3. Axle support (left)
4. Axle support (right)
5. Case screw (8 used)
6. Differential gear
7. O-ring

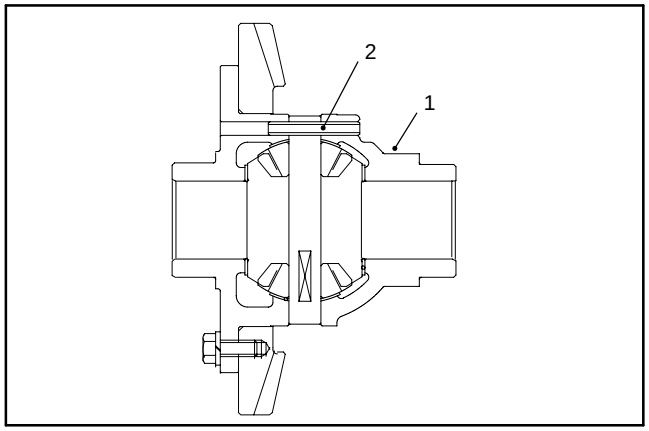

Figure 35

1. Differential case
2. Spring pin

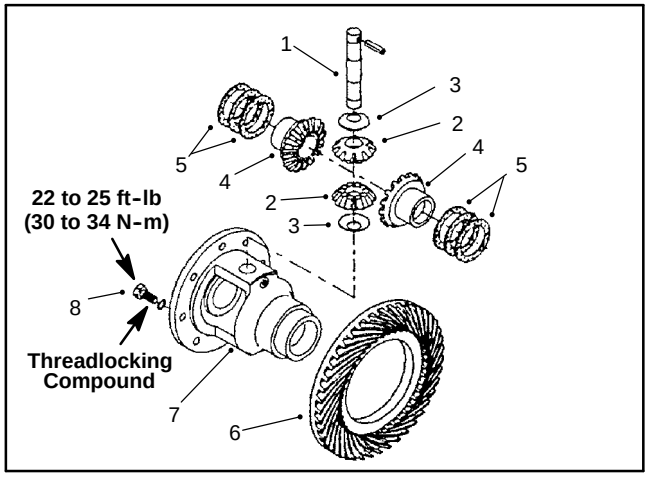

Figure 36

1. Differential pinion shaft
2. Pinion gear
3. Pinion washer
4. Side gear
5. Side gear shims
6. Ring gear
7. Differential case
8. Bolt/washer (8 used)

Differential Gear Inspection

1. Measure the differential side gear O.D. and the differential case I.D. to determine the side gear to case clearance (Fig. 37). Replace components as necessary.

SIDE GEAR TO CASE CLEARANCE:
0.002 to 0.012 in. (0.05 to 0.30 mm)

SIDE GEAR O.D. (Factory Spec.):
1.335 to 1.337 in. (33.91 to 33.95 mm)

DIFFERENTIAL CASE I.D. (Factory Spec.):
1.339 to 1.341 in. (34.00 to 34.06 mm)

2. Measure the differential pinion shaft O.D. and the pinion gear I.D. to determine the pinion shaft to pinion gear clearance (Fig. 38). Replace components as necessary.

PINION SHAFT TO PINION GEAR CLEARANCE:
0.001 to 0.010 in. (0.03 to 0.25 mm)

PINION SHAFT O.D. (Factory Spec.):
0.550 to 0.551 in. (13.97 to 13.10 mm)

PINION GEAR I.D. (Factory Spec.):
0.551 to 0.552 in. (13.10 to 14.02 mm)

3. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

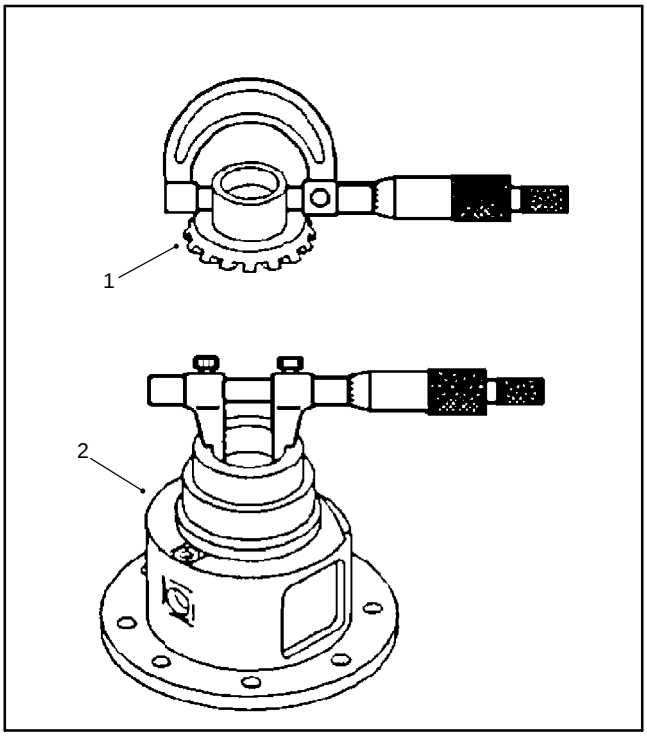

Figure 37

1. Side gear **2. Differential case**

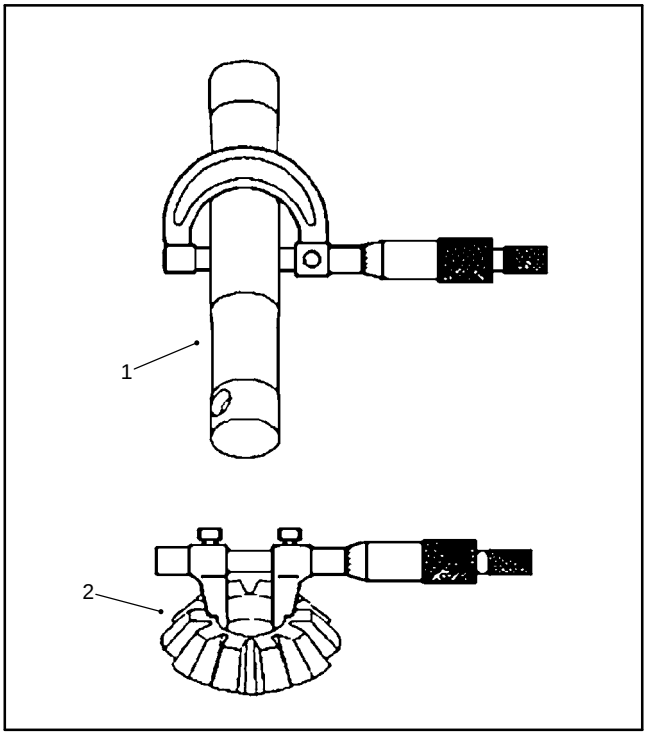

Figure 38

1. Pinion shaft **2. Pinion gear**

Differential Gear Installation

1. If the ring gear was removed, use medium strength thread locking compound and tighten the mounting screws from **22 to 25 ft-lb (30 to 34 N-m)**.

2. Apply molybdenum disulfide grease to the splines and bearing surfaces of the differential pinion gears, pinion washers and side gears.

3. Install the side gear shims and side gears in their original location in the differential case.

4. Place the differential pinion gears and pinion washers in their original location in the differential case. Temporarily install the differential pinion shaft.

5. Secure the differential case in a vise. Position a dial indicator at the tooths center and measure the differential pinion gear to side gear backlash (Fig. 39).

PINION GEAR TO SIDE GEAR BACKLASH:
0.004 to 0.016 in. (0.10 to 0.40 mm)

6. Adjust backlash by increasing or reducing side gear shim thickness.

NOTE: Side gear shims are available in 0.043 in. (1.1 mm), 0.047 in. (1.2 mm) and 0.051 in. (1.3 mm) thickness.

7. Apply gear marking compound, such as DyKem® Steel Blue lightly over several gear teeth.

8. While applying a light load to either side gear, rotate either pinion gear until the side gears have made one complete revolution.

9. Ideal tooth contact should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe (small) end (Fig. 40).

10. Adjust side gear shims if necessary to correct tooth contact. Recheck differential pinion gear to side gear backlash if any changes are made.

11. After backlash and tooth contact have been adjusted, align the hole in the differential pinion shaft with the hole in the differential case and install a new spring pin.

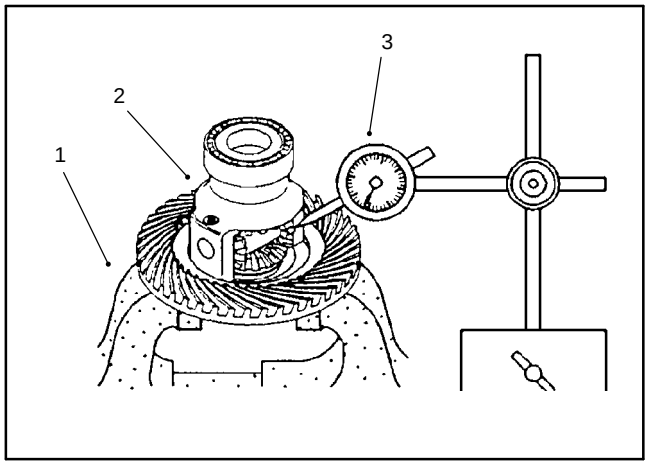

Figure 39

1. **Vise**
2. **Differential gear case**
3. **Dial indicator**

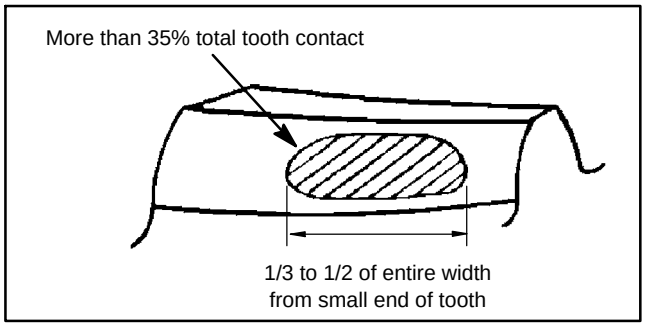

Figure 40

12. Install differential gear assembly in right side axle support half.

13. Coat a new O-ring with grease and install left side axle support half. Tighten axle support case screws from **35 to 41 ft-lb (47 to 56 N-m)**.

14. Install input shaft/pinion gear assembly (see Input shaft/Pinion in this section of this manual).

15. Coat new O-rings with grease, align differential shaft splines with differential gear assembly and slide differential shaft assemblies onto axle support.

16. Install bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

Pinion Gear to Ring Gear Engagement

The final position of the pinion gear is verified by using the gear contact pattern method as described in the following procedure.

GEAR TOOTH DEFINITIONS (Fig. 41):

Toe – the portion of the tooth surface at the end towards the center.

Heel – the portion of the gear tooth at the outer end.

Top Land – top surface of tooth.

1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem® Steel Blue.

2. Install the input shaft/pinion gear assembly into axle case.

3. While applying a light load to the ring gear, rotate the pinion gear in the direction of forward travel until the ring gear has made one complete revolution.

Ideal tooth contact observed on the ring gear should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe end (Fig. 42).

Adjustments to the gear contact position are made by moving the input shaft/pinion gear (bearing case shims) or by moving the differential gear case (differential bearing shims) (Fig. 43).

NOTE: Bearing case shims are available in 0.004 in. (0.10 mm) and 0.008 in. (0.20 mm) thickness.

NOTE: Differential bearing shims are available in 0.004 in. (0.10 mm), 0.008 in. (0.20 mm) and 0.016 in. (0.40 mm) thickness.

Study the different contact patterns (Figs. 44 and 45) and correct gear engagement as necessary.

NOTE: When making changes, note that two variables are involved (see Gear Pattern Movement Summary in this section of this manual).

Example: If the pinion gear to ring gear backlash is set correctly to specifications and the bearing case shim is changed to adjust tooth contact, it may be necessary to readjust backlash to the correct specification before checking the contact pattern.

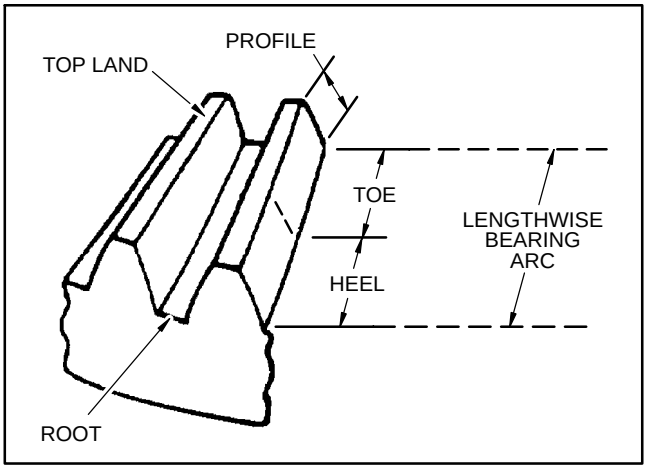

Figure 41

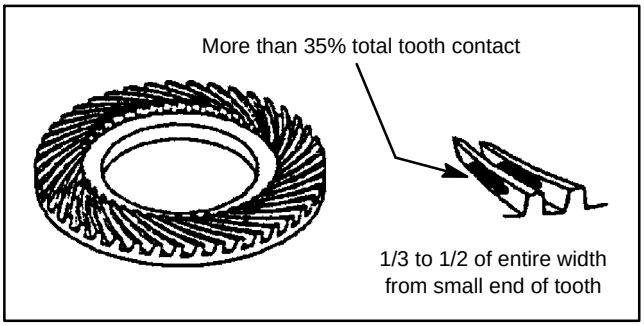

Figure 42

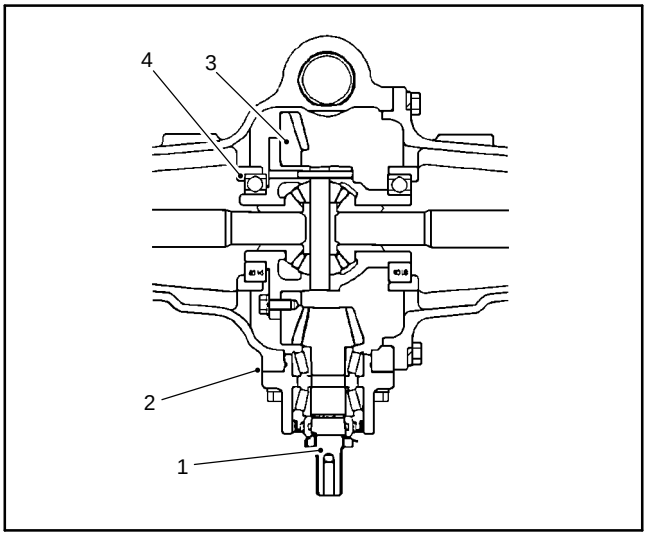

Figure 43

1. **Input shaft/pinion gear**
2. **Bearing case shims**
3. **Differential gear case**
4. **Differential bearing shims**

Gear Pattern Movement Summary

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as gear location is changed.

1. If contact is toward the heel or base of the gear (Fig. 44):

   A. Install thicker or additional bearing case shim(s) to move pinion shaft toward ring gear.

   B. Install thinner or remove differential bearing shim(s) to move ring gear backward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

2. If contact is toward the toe or tip of the gear (Fig. 45):

   A. Install thinner or remove bearing case shim(s) to move pinion shaft away from ring gear.

   B. Install thicker or additional differential bearing shim(s) to move ring gear forward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

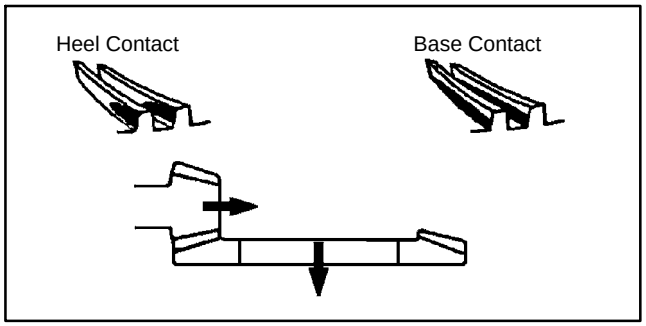

Figure 44

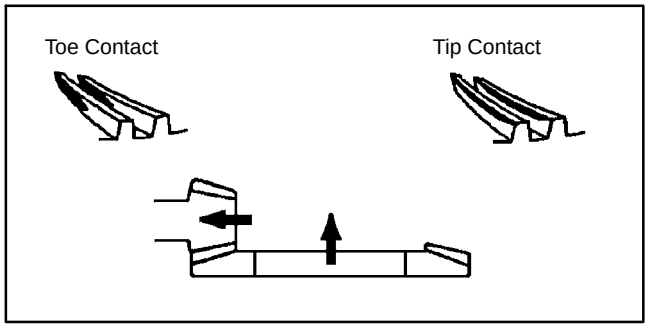

Figure 45

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 that publication for additional information when servicing the machine.

Steering Tower

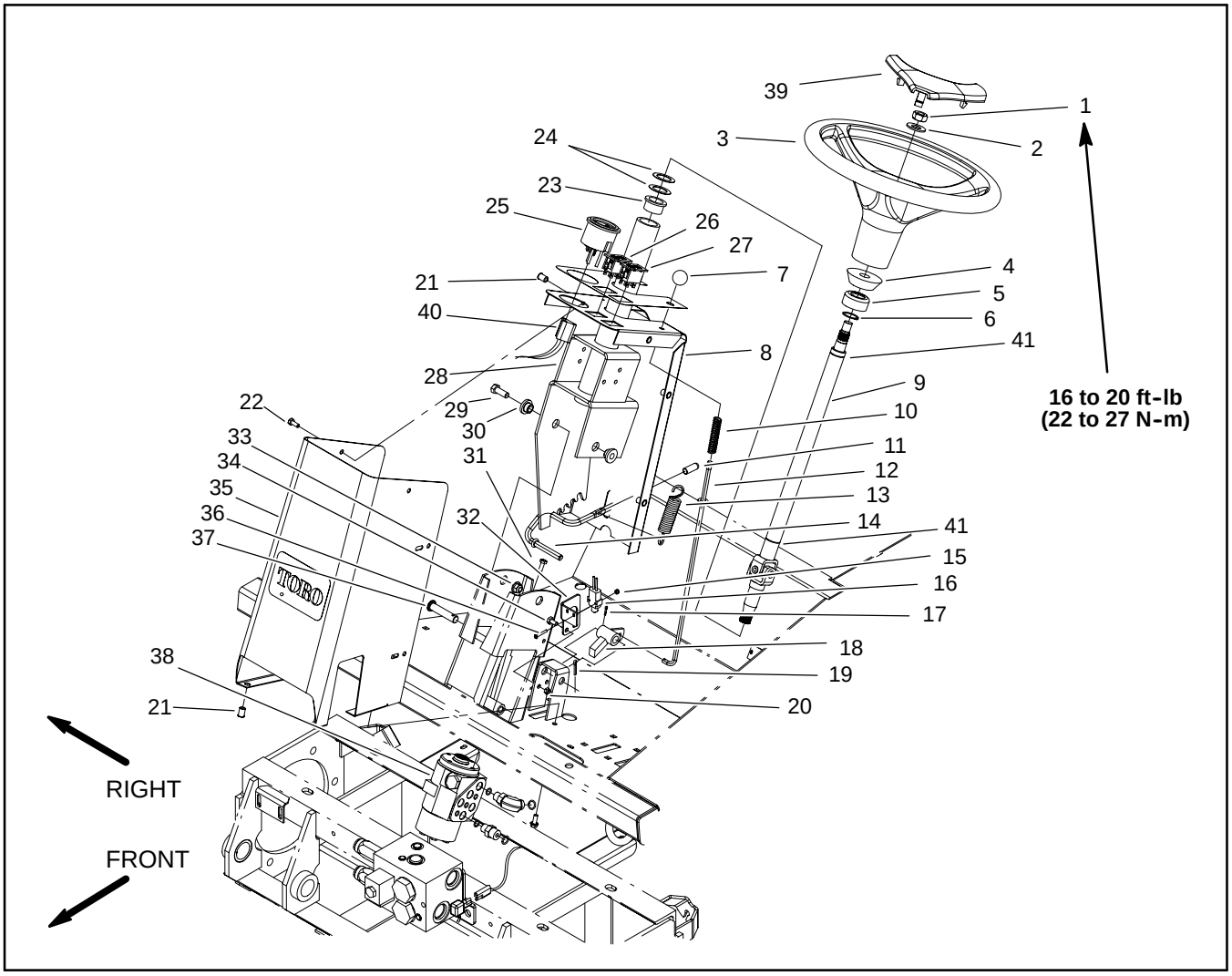

Figure 1

1. Hex nut
2. Flat washer
3. Steering wheel
4. Foam collar
5. Steering seal
6. External snap ring (2 used)
7. Knob
8. Steering tower cover
9. Steering shaft
10. Compression spring
11. Cap
12. Rod assembly
13. Extension spring
14. Tilt rod
15. Lock nut (2 used)
16. Parking brake switch
17. Cotter pin
18. Brake pawl
19. Cotter pin
20. Lock nut (2 used)
21. Nut insert (10 used)
22. Flange head screw (10 used)
23. Flange bushing (2 used)
24. Thrust washer (as needed)
25. Temperature gauge
26. Warning lamp (temp/glow plug)
27. Warning lamp (charge/oil pressure)
28. Steering column
29. Cap screw (2 used)
30. Pivot hub(2 used)
31. Flange head screw (4 used)
32. Switch bracket
33. Flange nut (2 used)
34. Cap screw (2 used)
35. Steering tower
36. Phillips head screw (2 used)
37. Clevis pin
38. Steering valve
39. Steering wheel cover
40. Front wire harness
41. Snap ring location

Disassembly (Fig. 1)

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

2. Disassemble steering tower as needed using Figure 1 as a guide.

Assembly (Fig. 1)

1. Assemble steering tower using Figure 1 as a guide.

   A. Thrust washer(s) (item 24) on steering column are used as needed to remove end play of steering shaft.

   B. If steering wheel was removed, torque hex nut (item 1) from **16 to 20 ft lb (22 to 27 N–m)**.

Cutting Deck Lift Arms

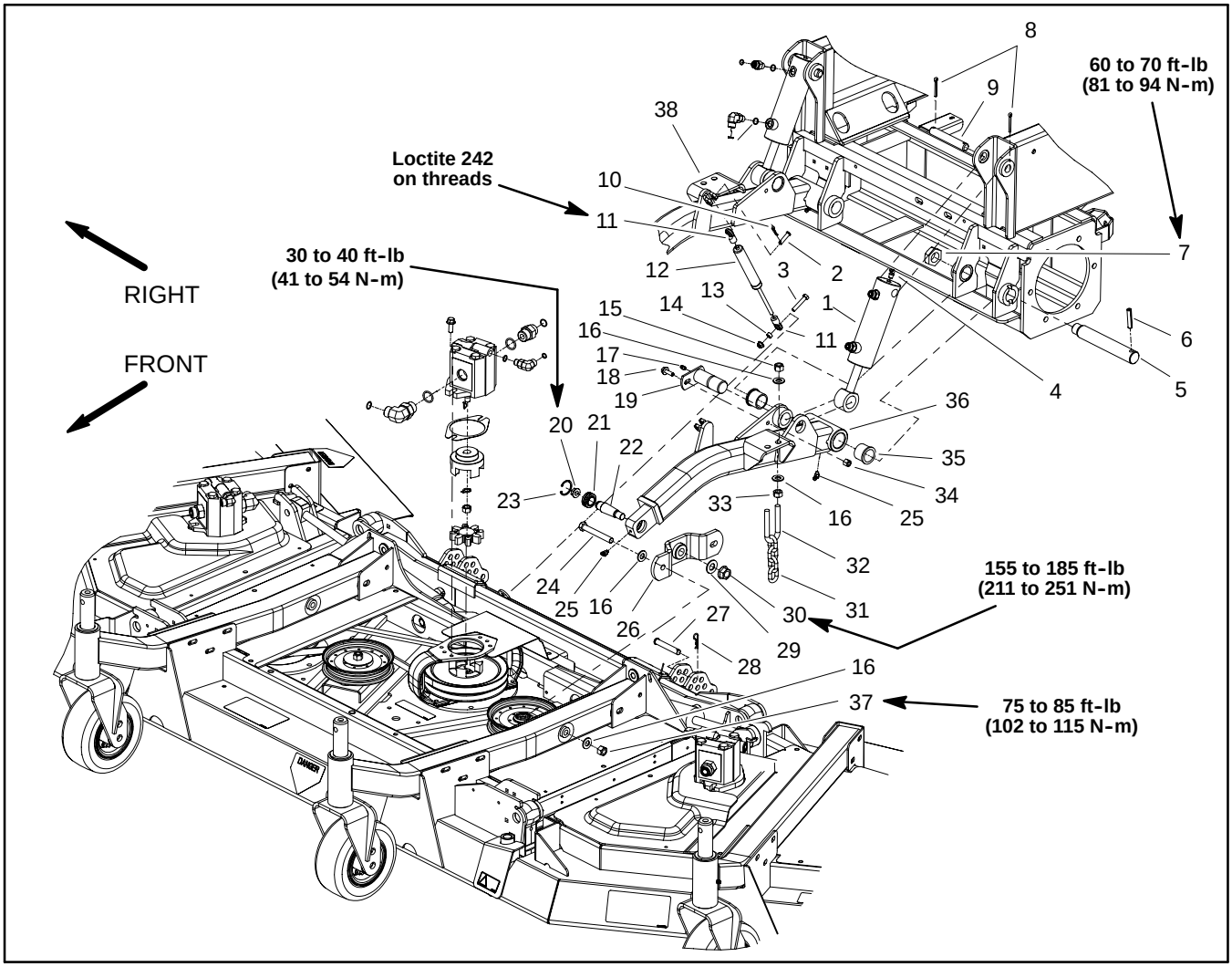

Figure 2

1. **Lift cylinder**
2. **Clevis pin**
3. **Cap screw**
4. **Grease fitting**
5. **Lift arm pin**
6. **Slotted roll pin**
7. **Lock nut**
8. **Cotter pin**
9. **Pivot pin**
10. **Hair pin**
11. **Spherical rod end**
12. **Damper**
13. **Yoke spacer**
14. **Flange nut**
15. **Lock nut**
16. **Flat washer**
17. **Grease fitting**
18. **Flange head screw**
19. **Lift cylinder pin**
20. **Flange nut**
21. **Spherical bearing**
22. **Tapered stud**
23. **Retaining ring**
24. **Cap screw**
25. **Grease fitting**
26. **Support hub**
27. **Clevis pin**
28. **Hair pin**
29. **Flat washer**
30. **Flange nut**
31. **Height-of-cut chain**
32. **U-bolt**
33. **Nut**
34. **Lock nut**
35. **Flange bushing (2 per lift arm)**
36. **Lift arm (LH)**
37. **Lock nut**
38. **Lift arm (RH)**

Removal (Fig. 2)

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

2. Remove front cutting deck (see Cutting Deck Removal in Chapter 8 – Cutting Deck).

CAUTION

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

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.

4. Remove flange head screw and lock nut that secure lift cylinder pin to lift arm. Remove pin and separate lift cylinder from lift arm.

5. Remove lock nut that secures lift arm pin. Support lift arm and slide pin from frame and lift arm. Remove lift arm from frame.

6. As needed, disassemble lift arm:

   A. Remove height−of−cut chain and damper assembly.

   B. Press flange bearings from lift arm.

   C. Remove flange nut, flat washer and support hub from tapered stud. Remove tapered stud with spherical bearing from lift arm after removing retaining ring from lift arm. Remove flange nut and spherical bearing from stud.

Installation (Fig. 2)

1. If removed, install components to lift arm.

   A. Assemble height−of−cut chain u−bolt so that threaded portion of u−bolt extends 0.750” (19.1 mm) above mounting plate on lift arm (Fig. 3).

   B. If rod ends were removed from damper, apply Loctite #242 to threads and install on damper. Install damper assembly to lift arm with damper rod end toward deck (Fig. 4).

   C. Press flange bearings into lift arm.

   D. Install spherical bearing on tapered stud and secure with flange nut. Torque flange nut from **30 to 40 ft−lb (41 to 54 N−m)**. Install stud with spherical bearing into lift arm and secure with retaining ring.

   E. 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 flange nut. Tighten flange nut from **155 to 185 ft−lb (211 to 251 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 (81 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 lock nut.

4. Install front wheel assembly. Lower machine to the ground.

5. Install cutting deck (see Cutting Deck Installation in Chapter 8 − Cutting Deck).

6. Lubricate lift arm grease fittings.

7. After assembly is completed, raise and lower the cutting deck to verify that hydraulic hoses and fittings do not contact anything.

8. Check height−of−cut and deck pitch adjustment.

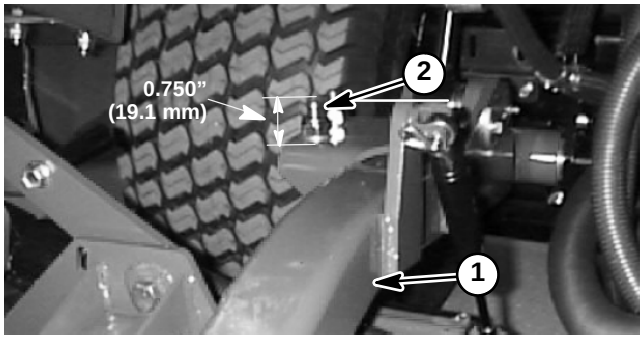

Figure 3

1. Lift arm
2. U−bolt threads

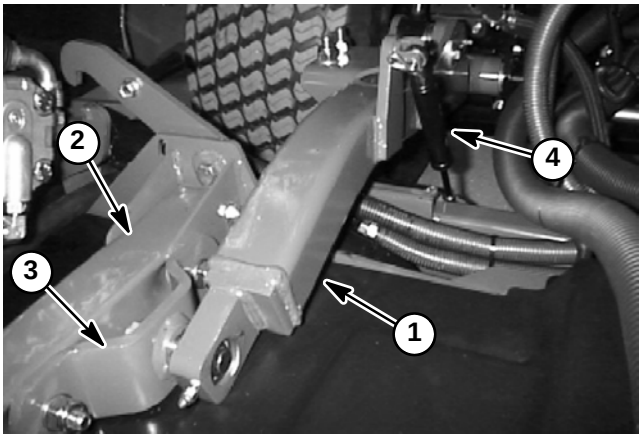

Figure 4

1. Lift arm
2. Deck castor arm
3. Support hub
4. Damper

Operator Seat

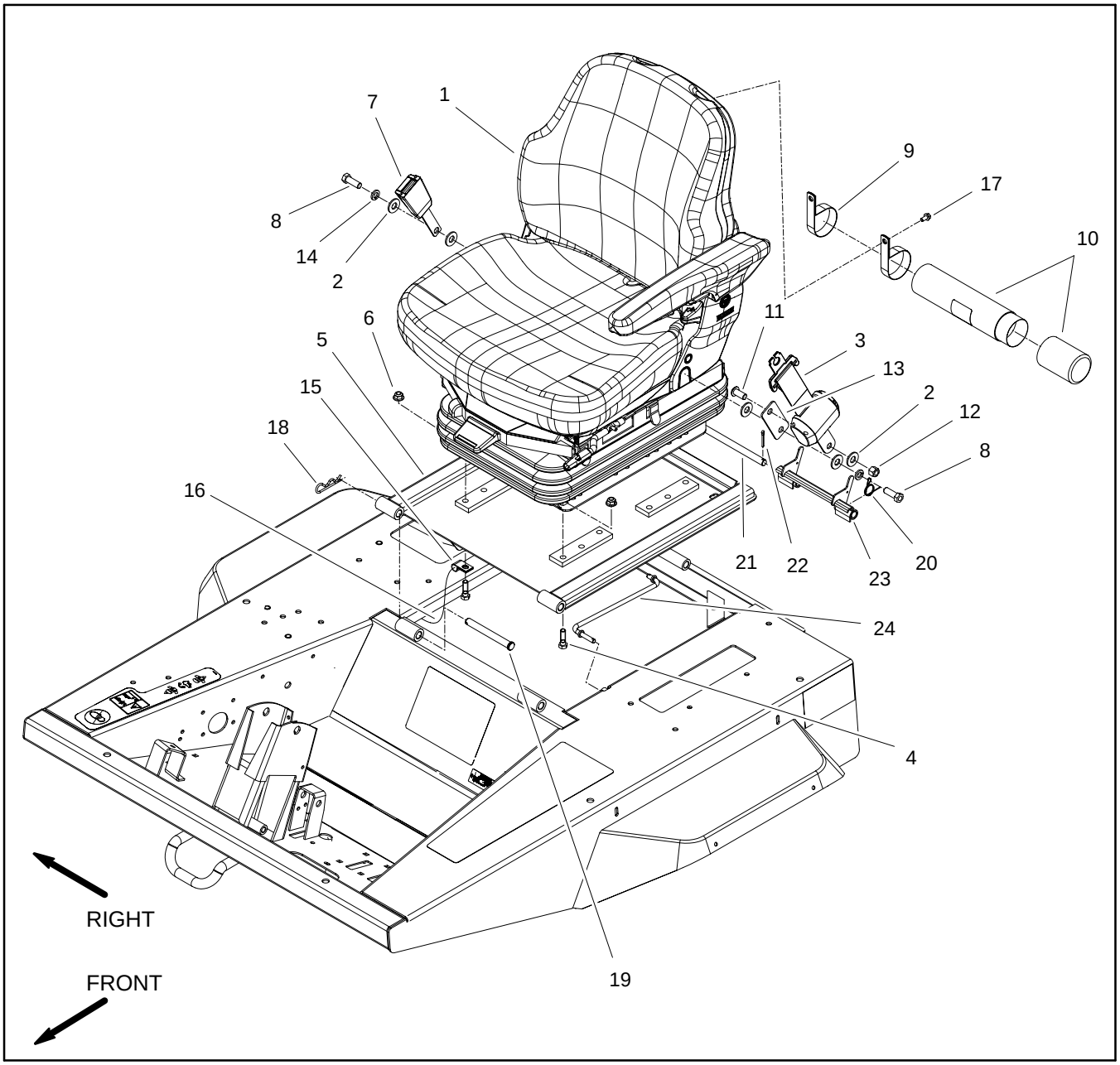

Figure 5

1. **Seat assembly**
2. **Flat washer (5 used)**
3. **Seat belt**
4. **Cap screw (4 used)**
5. **Seat platform**
6. **Flange nut (4 used)**
7. **Seat belt buckle**
8. **Cap screw (2 used)**
9. **R-clamp (2 used)**
10. **Manual tube**
11. **Screw**
12. **Lock nut**
13. **Seat belt mount**
14. **Lock washer (2 used)**
15. **R-clamp (2 used)**
16. **Wire harness seat switch lead**
17. **Screw (2 used)**
18. **Hair pin (2 used)**
19. **Clevis pin (2 used)**
20. **Spring**
21. **Latch shaft**
22. **Cotter pin (2 used)**
23. **Latch**
24. **Prop rod**

Removal (Fig. 5)

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

2. Remove seat from seat suspension:

   A. Disconnect seat electrical connectors from machine wire harness (Fig. 6).

   B. Remove four (4) Torx head screws that secure seat to seat suspension (Fig. 7). Note that the screw near the seat adjustment handle is longer than the other three (3) screws.

   C. Lift seat from seat suspension and remove from machine.

NOTE: Most of the seat suspension components can be serviced with the seat suspension base mounted to the frame platform.

3. If necessary, remove seat suspension from seat platform:

   A. Tilt seat to gain access to mounting fasteners. Support seat suspension to prevent it from falling.

   B. Remove four (4) cap screws and flange nuts that secure seat suspension to seat plate. Note that two (2) r-clamps that retain wire harness are secured with seat suspension fasteners.

   C. Lift seat suspension from machine.

Installation (Fig. 5)

1. If removed, install seat suspension to seat platform:

   A. Position seat suspension onto seat plate.

   B. Secure seat suspension and two (2) wire harness r-clamps to seat platform with four (4) cap screws and flange nuts.

   C. Lower seat plate and suspension.

2. Install seat to seat suspension:

   A. Carefully position seat to seat suspension.

   B. Secure seat to seat suspension with four (4) Torx head screws (Fig. 7). Make sure that longer screw is positioned near the seat adjustment handle.

   C. Torque screws **18 ft-lb (25 N-m)**.

3. Connect seat electrical connectors to machine wire harness (Fig. 6).

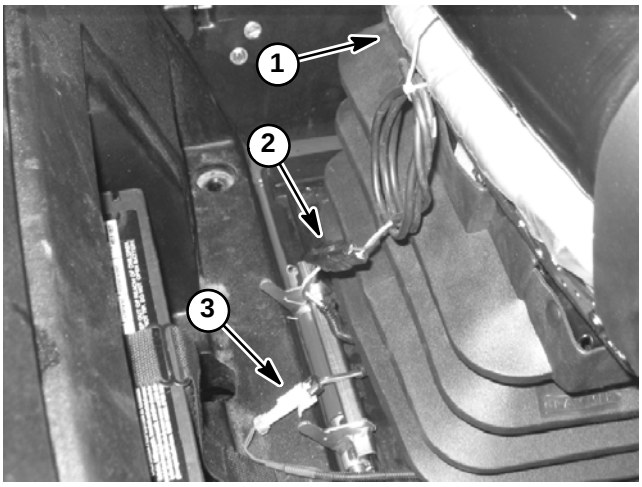

Figure 6

1. Operator seat
2. Seat switch connector
3. Suspension connector

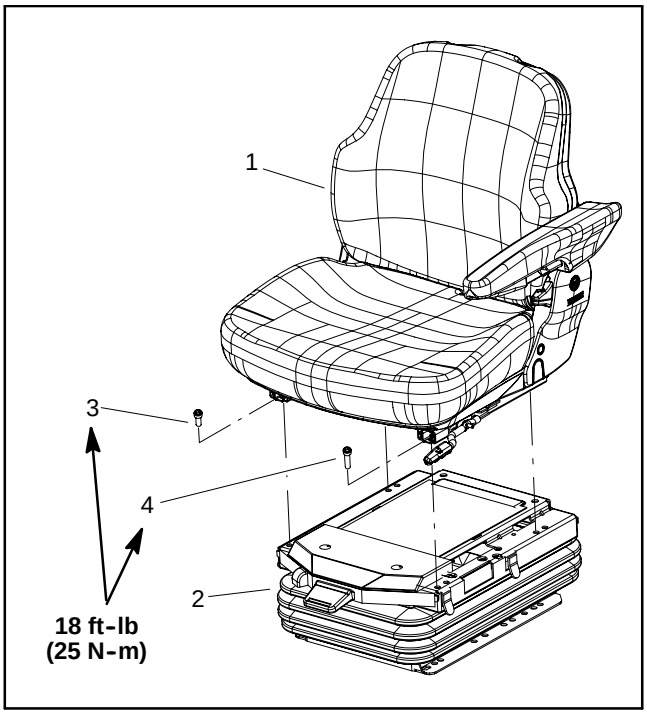

Figure 7

1. Seat
2. Suspension assembly
3. Screw (M8x12) (3 used)
4. Screw (M8x16)

Operator Seat Service

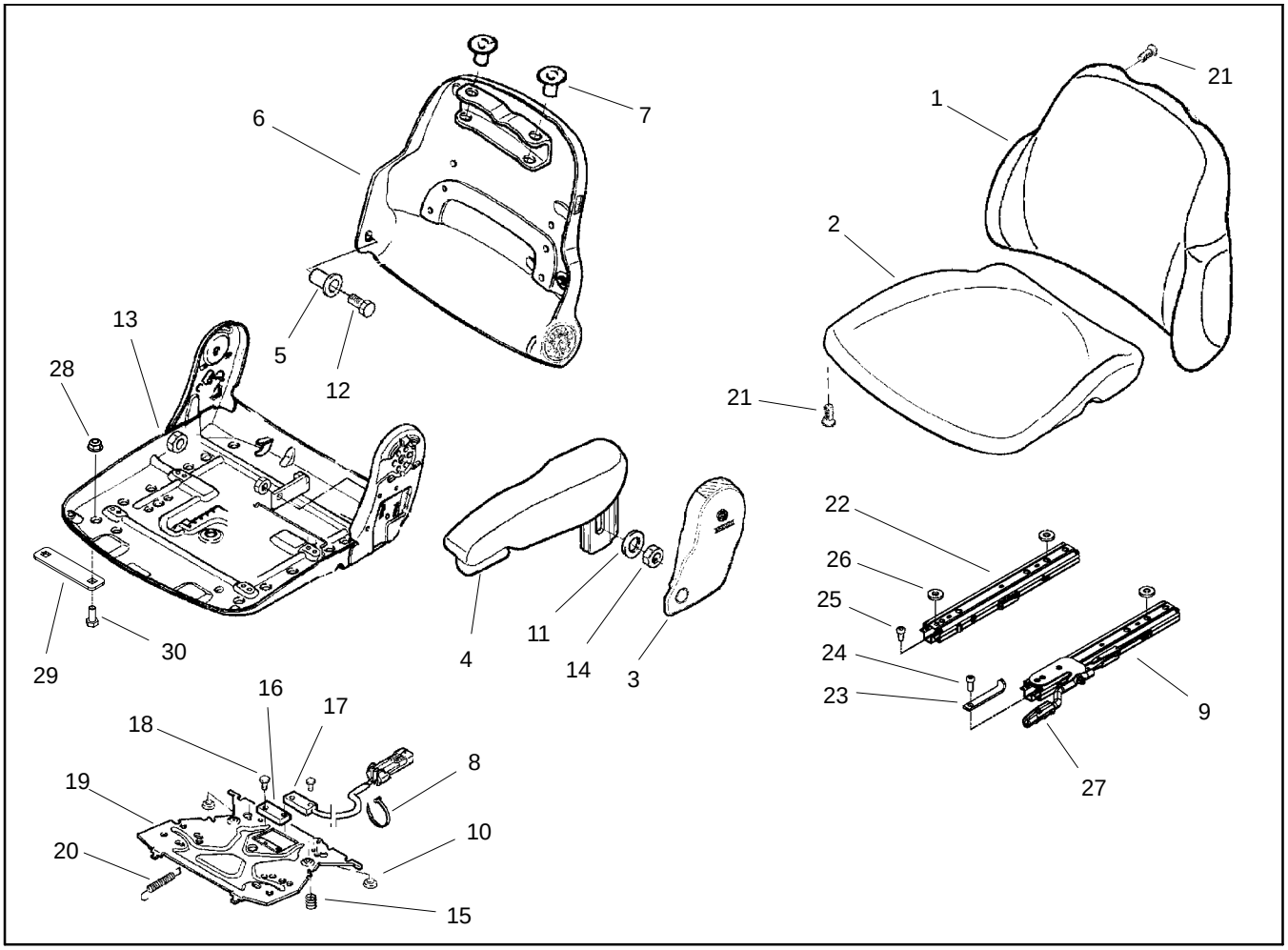

Figure 8

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. 8)

1. Disassemble operator seat as necessary using Figure 8 as a guide.

Assembly (Fig. 8)

1. Assemble operator seat using Figure 8 as a guide.

Operator Seat Suspension

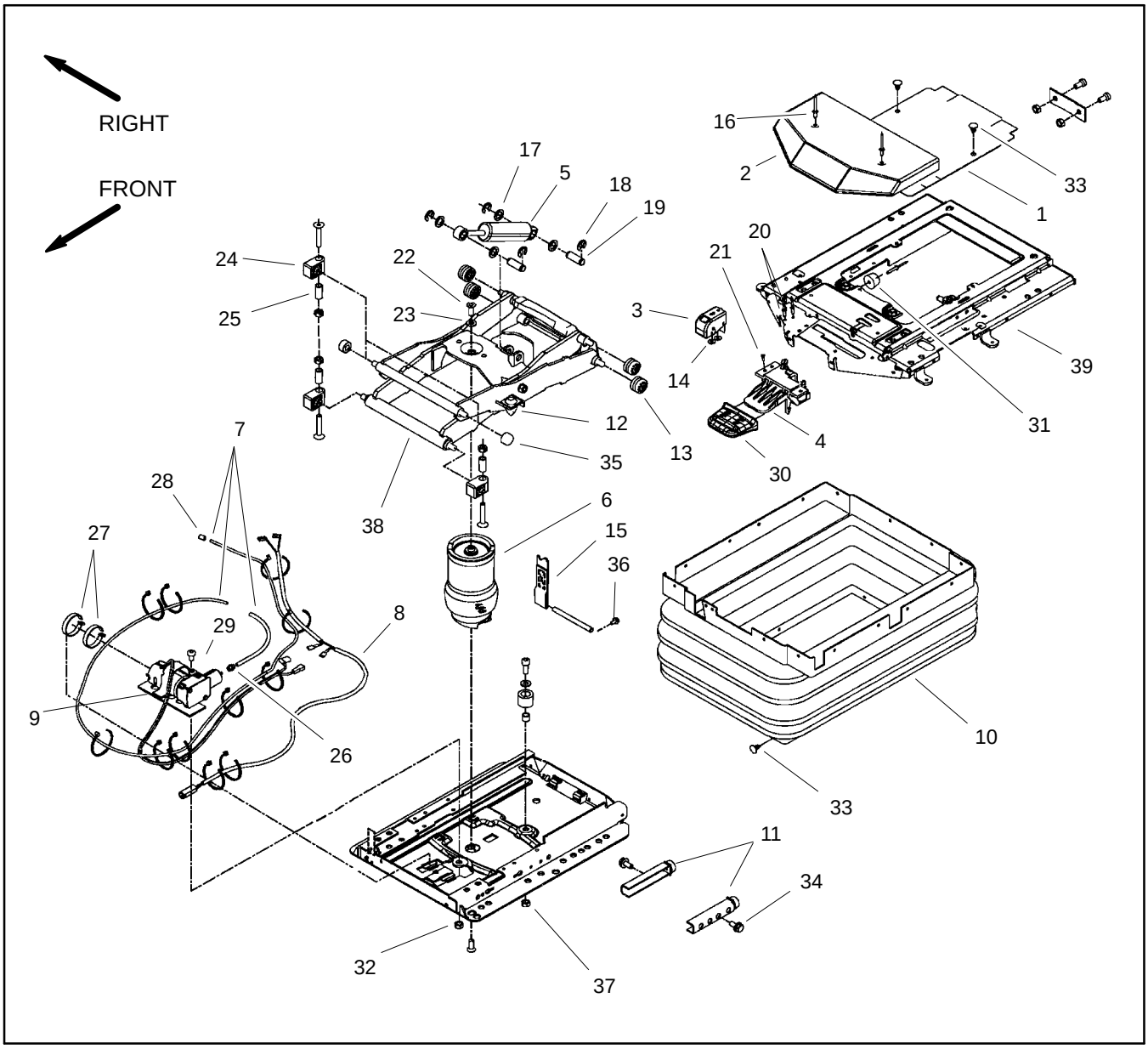

Figure 9

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. 9)

1. Remove operator seat from seat suspension (see Operator Seat Removal in this section).

2. If the air spring assembly (item 6) or base plate (item 37) requires removal, remove seat suspension from seat platform (see Operator Seat Removal in this section).

3. Remove seat suspension components as needed using Figure 9 as a guide.

Assembly (Fig. 9)

1. Install all removed seat suspension components using Figure 9 as a guide.

2. Install seat suspension if it was removed from seat platform (see Operator Seat Installation in this section):

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 (Fig. 10).

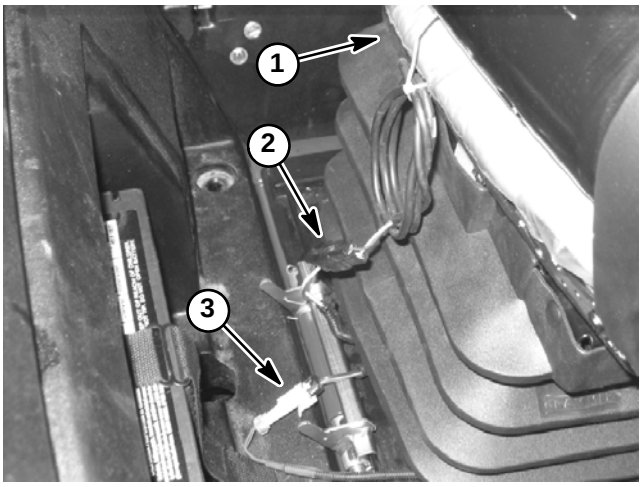

Figure 10

1. **Operator seat**
2. **Seat switch connector**
3. **Suspension connector**

Hood

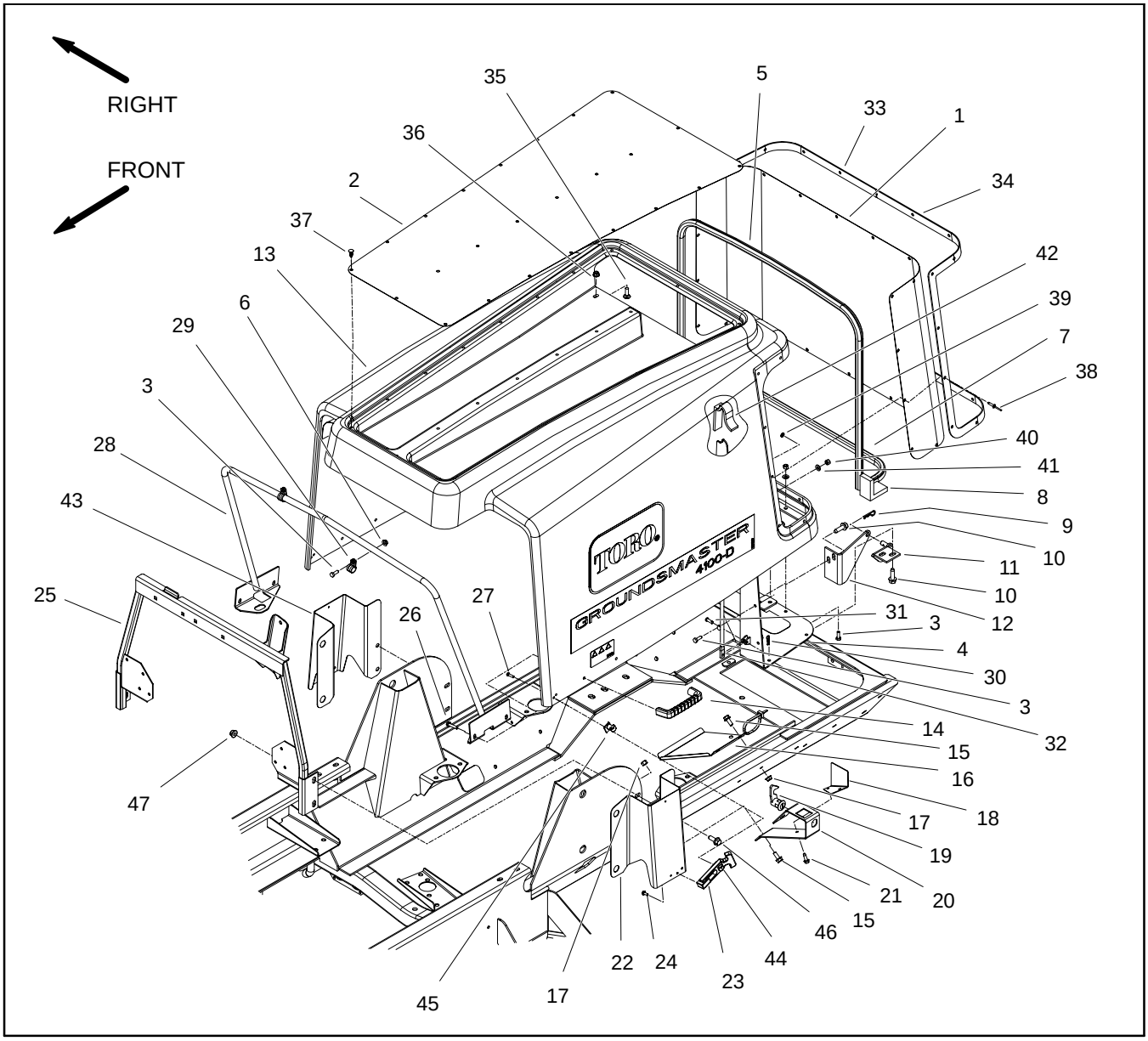

Figure 11

1. **Rear screen**
2. **Top screen**
3. **Cap screw (22 used)**
4. **Screen assembly**
5. **Bulb seal**
6. **Flange nut (2 used)**
7. **Bulb seal**
8. **Screen corner seal (2 used)**
9. **Hair pin (2 used)**
10. **Screw (8 used)**
11. **Hood pivot (2 used)**
12. **Pivot bracket (2 used)**
13. **Hood**
14. **Handle (2 used)**
15. **Flange head screw (4 used)**
16. **Oil filter deflector**
17. **Flange nut (4 used)**
18. **Latch cover**
19. **Latch**
20. **Hood latch bracket**
21. **Washer head screw (2 used)**
22. **LH latch bracket**
23. **Latch bracket (2 used)**
24. **Screw (4 used)**
25. **Fuel tank support**
26. **Screw (4 used)**
27. **Screw (2 used)**
28. **Hood support**
29. **R-clamp (2 used)**
30. **Hair pin (2 used)**
31. **Clevis pin (2 used)**
32. **Hood rod (2 used)**
33. **RH screen mount**
34. **LH screen mount**
35. **Carriage bolt (2 used)**
36. **Flange nut (2 used)**
37. **Plastic plug (24 used)**
38. **Pop rivet (22 used)**
39. **Flat washer (22 used)**
40. **Lock nut (20 used)**
41. **Flat washer (21 used)**
42. **Foam seal (2 used)**
43. **RH latch bracket**
44. **Latch handle (2 used)**
45. **Latch keeper (2 used)**
46. **Flange head screw (4 used)**
47. **Flange nut (4 used)**

Removal

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

2. Remove hood using Figure 11 as a guide.

Installation

1. Install hood using Figure 11 as a guide.

2. Align hood to machine to allow correct operation of hood latches and dust seals:

   A. Place shim that is 3/8" to 7/16" (9.5 to 11.1 mm) thick on top of frame (both RH and LH sides) near the sides of oil cooler (Figs. 12 and 13).

   B. Close hood so that it rests on shims and fasten the hood latches.

   C. Loosen hood pivots at frame to adjust vertical placement of pivots. Re-tighten hood pivot fasteners.

   D. Loosen pivot brackets to allow hood latches to pull hood against radiator support. Re-tighten pivot bracket fasteners.

3. After hood is assembled to machine, check for the following:

   A. Check that bulb seals are equally compressed at all contact points with hood.

   B. Hood should open and close without contacting oil cooler hardware.

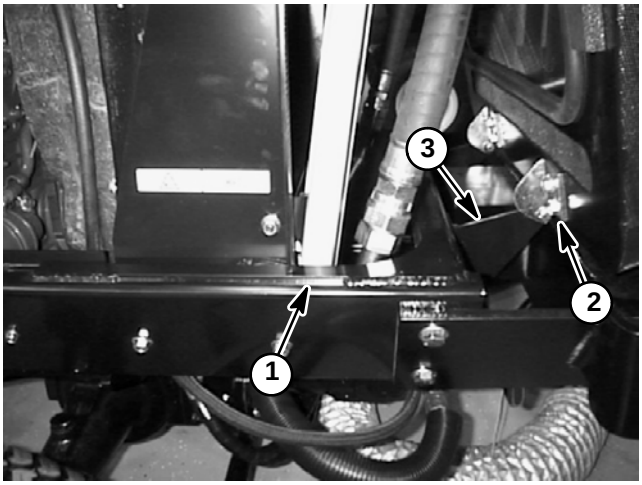

Figure 12

1. **LH shim location**
2. **LH hood pivot**
3. **LH pivot bracket**

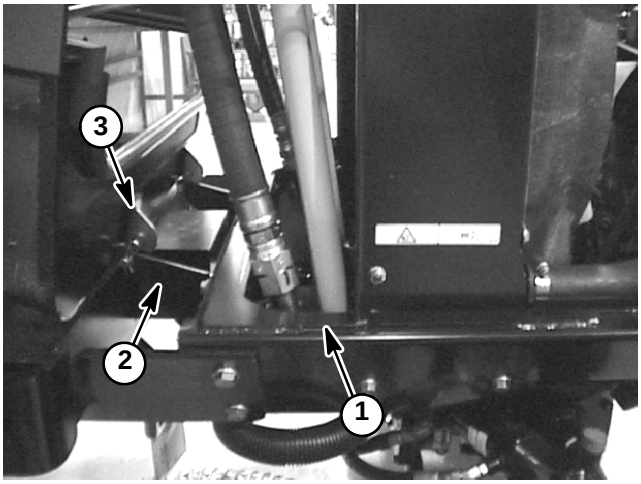

Figure 13

1. **RH shim location**
2. **RH hood pivot**
3. **RH pivot bracket**

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Chapter 8

Cutting Deck

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Specifications

MOUNTING: Cutting deck is supported by lift arms controlled with hydraulic lift levers.

CONSTRUCTION: Deck chamber is welded 12 gauge steel construction reinforced with channels and plates.

HEIGHT-OF-CUT RANGE: 1” to 5” (25.4 mm to 127 mm) adjustable in 1/2” (12.7 mm) increments. Center deck height-of-cut adjustment is achieved by changing spacers on castor wheels and adjusting length of deck support chains. Wing deck adjustment achieved by changing spacers on castor wheels, re-positioning the castor wheel axles in the castor forks and securing the castor wheel bracket to the correct height-of-cut bracket holes.

DECK DRIVE: Closed loop hydraulic system operates hydraulic motor on each cutting deck section. 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 19” (483 mm) long, 2.5” (64 mm) wide and 0.250” (6.4 mm) thick. Anti-scalp cup installed on each cutting blade. Center deck includes three blades and each wing deck includes two blades.

WIDTH OF CUT: Front deck provides 54” (1372 mm) width of cut. Each side deck has 37” (940 mm) width of cut. Total width of cut is 124” (3150 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 six castor wheels, two adjustable skids and five anti-scalp rollers.

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, adjustments and maintenance intervals for your Groundsmaster cutting deck. Refer to that publication 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 (5) seconds after the cutting deck engagement switch is shut down.

NOTE: Make sure the deck is 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 20 feet and watch one of the cutting deck blades. Have the operator shut the cutting deck down and record the time it takes for the blades to come to a complete stop. If this stopping time is excessive, the braking valve(s) (RV2) on the hydraulic deck control manifold(s) may need adjustment.

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 deck 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.	Check maximum governed engine speed. Adjust speed to specifications if necessary (see Chapter 3 − Kubota 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 each tire including 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 linkages for wear, damage or binding. Also, inspect for bent or damaged pivot shafts.
8. Roller and castor wheel condition.	All rollers and caster wheels should rotate freely. Replace bearings if worn or damaged.
9. Grass conditions.	Mow when grass is dry for best cutting results. Also, remove only 1” (25 mm) or 1/3 of the grass blade when cutting.

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Service and Repairs

CAUTION

Never install or work on the cutting deck or lift arms with the engine running. Always stop engine and remove ignition key first.

Cutting Deck

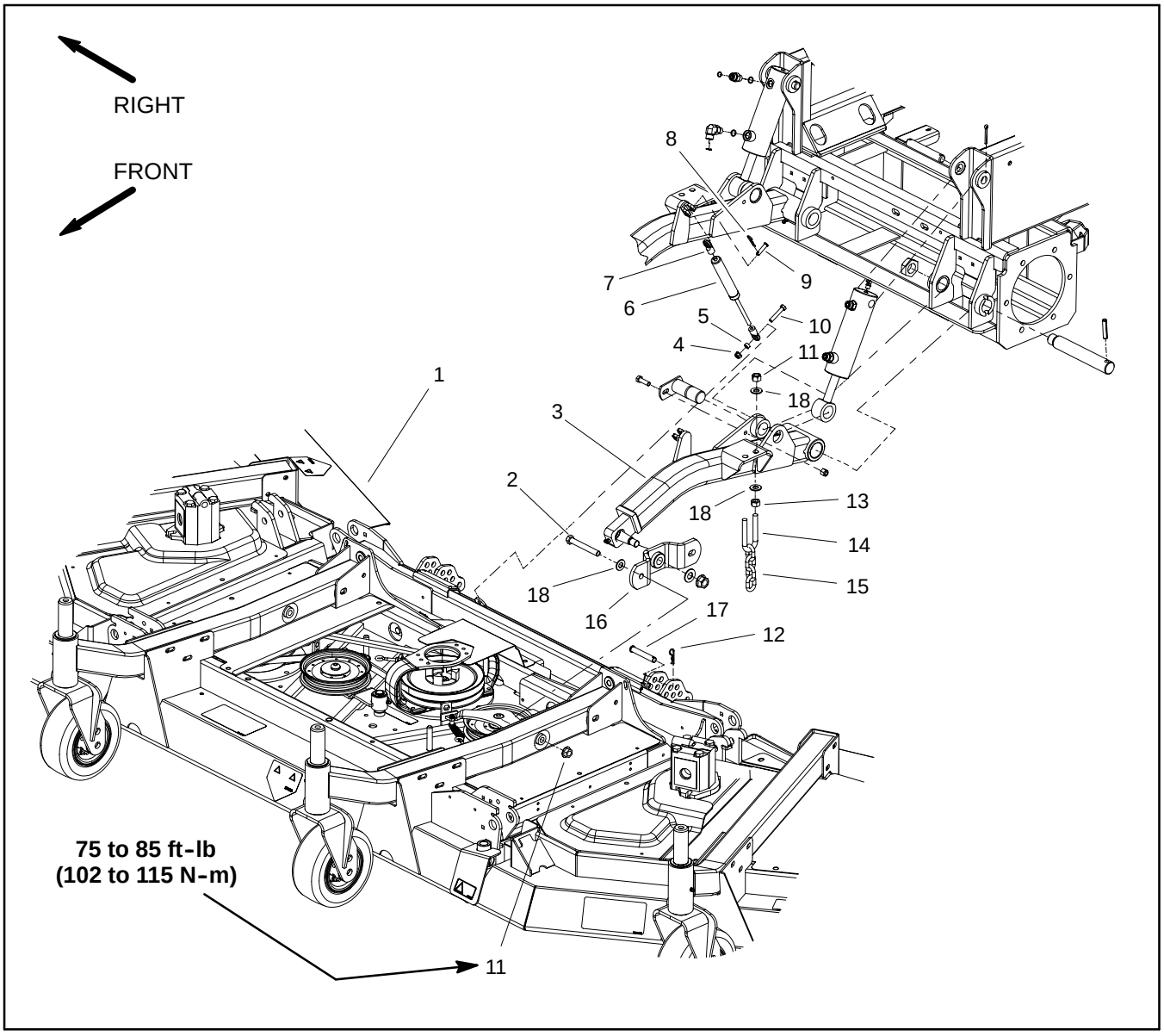

Figure 1

1. **Cutting deck**
2. **Cap screw**
3. **Lift arm (LH shown)**
4. **Flange nut**
5. **Spacer**
6. **Damper**
7. **Damper rod end (2 per damper)**
8. **Hair pin**
9. **Clevis pin**
10. **Cap screw**
11. **Flange nut**
12. **Hair pin**
13. **Hex nut**
14. **U-bolt**
15. **Height of cut chain**
16. **Support hub**
17. **Clevis pin**
18. **Flat washer**

Removal (Fig. 1)

1. Position machine on a clean, level surface. Lower cutting deck, stop engine, engage parking brake and remove key from the ignition switch.

NOTE: Removal of clevis pins from deck and height−of−cut chains is easier if deck is lifted slightly.

2. Remove hairpins and clevis pins that secure the height−of−cut chains to the rear of the cutting deck (Fig. 2).

3. Remove hydraulic motors from cutting deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 − Hydraulic System). Position motors away from cutting deck.

4. Remove hairpins and clevis pins that secure dampers to lift arms (Fig. 3). Rotate dampers and place on cutting deck.

5. Remove hydraulic hoses from wing deck lift cylinders (Fig. 4):

A. Remove deck covers to allow access to wing deck lift cylinders.

B. Thoroughly clean exterior of cylinder and fittings. For assembly purposes, label hydraulic hoses to show their correct position on the lift cylinder.

C. Disconnect hydraulic hoses from wing deck lift cylinders. Cap hoses and fittings to prevent contamination.

6. Disconnect cutting deck wire harness from main machine harness (Fig. 5).

7. Remove cap screws, flat washers and flange nuts that secure support hubs to cutting deck castor arms (Fig. 3).

8. Slide the cutting deck away from the traction unit.

Installation (Fig. 1)

1. Position machine on a clean, level surface. Lower 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 support hub to cutting deck castor arms and secure with cap screws, flat washers and flange nuts (Fig. 3). Torque flange nuts from **75 to 85 ft−lb (102 to 115 N−m)**.

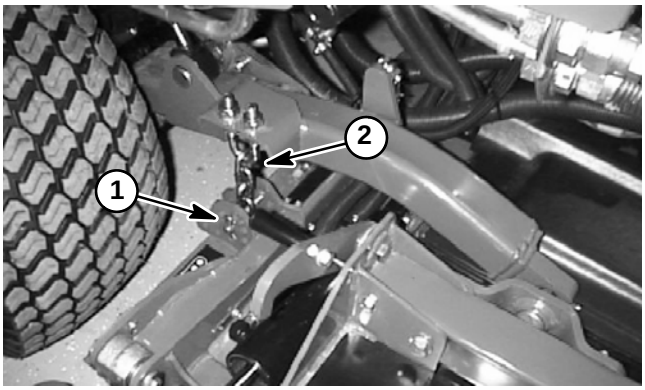

Figure 2

1. **Hairpin and clevis pin**
2. **Height−of−cut chain**

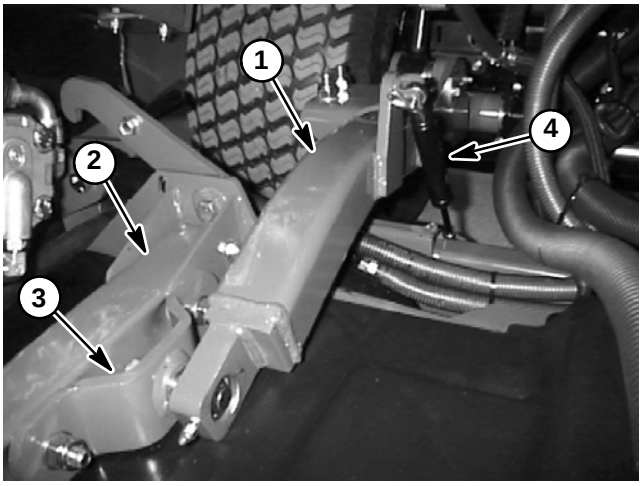

Figure 3

1. **Lift arm**
2. **Castor arm**
3. **Support hub**
4. **Damper**

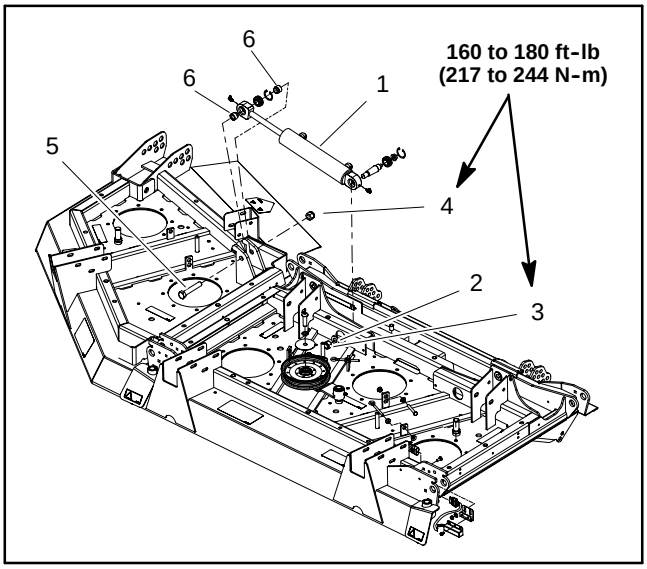

Figure 4

1. **Wing deck lift cylinder**
2. **Flat washer**
3. **Lock nut**
4. **Lock nut**
5. **Cap screw**
6. **Spacer**

NOTE: Installation of clevis pins to deck and height−of−cut chains is easier if deck is lifted slightly.

4. Install clevis pins and hairpins that secure the height−of−cut chains to the rear of the cutting deck (Fig. 2).

5. Remove plugs from hydraulic hoses and fittings on wing deck lift cylinders. Attach hydraulic hoses to lift cylinders.

6. Connect cutting deck wire harness to main machine wire harness (Fig. 5).

7. Position dampers to lift arms. Install clevis pins and hairpins to secure dampers to lift arms (Fig. 3).

8. Install any removed cutting deck covers.

9. Install hydraulic motors to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 − Hydraulic System).

10. Lubricate grease fittings on cutting deck and lift assemblies.

11. Fill reservoir with hydraulic fluid as required.

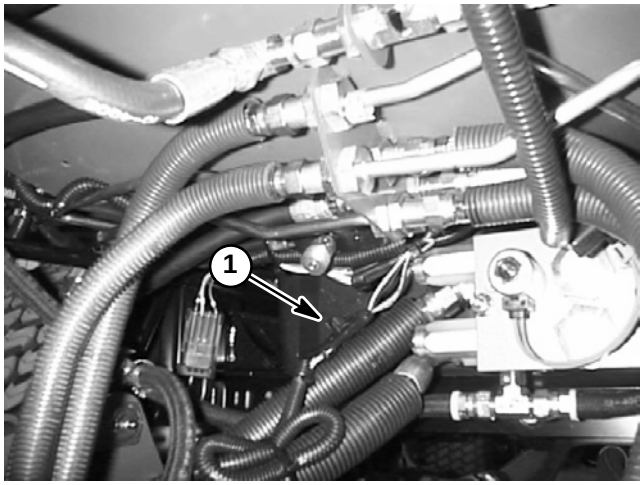

Figure 5

1. Cutting deck wire harness connection

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Wing Deck Service

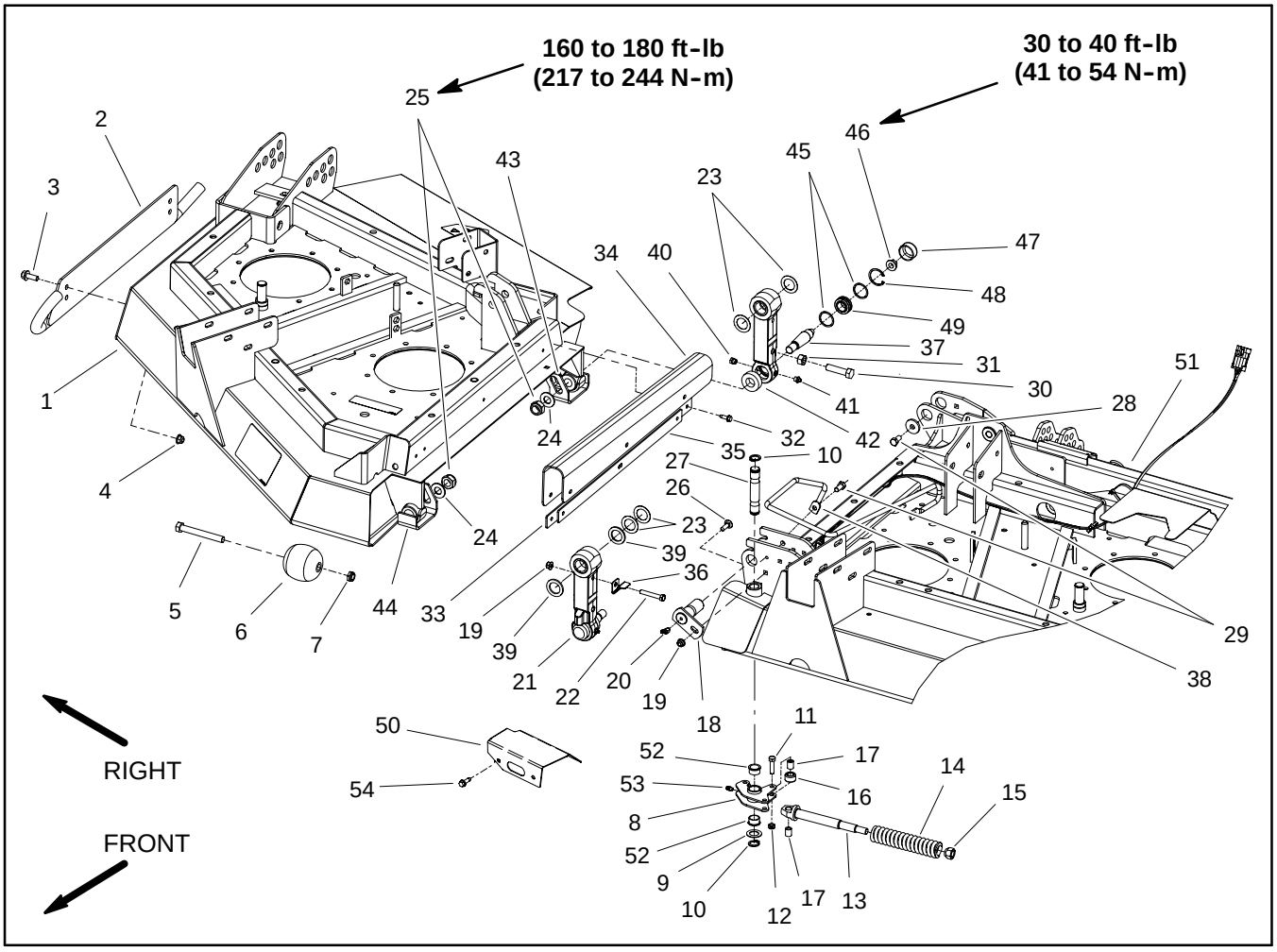

Figure 6

1. Wing deck (RH shown)
2. Skid (RH shown)
3. Flange screw (2 used per skid)
4. Flange nut (2 used per skid)
5. Cap screw
6. Roller (2 used)
7. Lock nut
8. Pivot latch (2 used)
9. Flat washer
10. Retaining ring (2 used per latch)
11. Cap screw (3 used per latch)
12. Lock nut (3 used per latch)
13. Spring support
14. Compression spring
15. Lug nut
16. Lock roller (2 used per latch)
17. Bushing (3 used per latch)
18. Pivot pin (4 used)
19. Flange nut (front links)
20. Grease fitting
21. Link assembly (4 used)
22. Cap screw (front links)
23. Thrust washer (0.030" thick)
24. Flat washer (4 used)
25. Lock nut (4 used)
26. Carriage bolt (4 used)
27. Latch pin
28. Flat washer (2 used)
29. Cap screw (4 used)
30. Cap screw (rear links)
31. Hex jam nut (rear links)
32. Washer head screw (12 used)
33. Wing strap (2 used)
34. Flex shield (2 used)
35. Shield strap (center deck)
36. Switch tab (front links)
37. Tapered stud
38. Hose guide
39. Hardened spacer (0.120" thick)
40. Plug
41. Grease fitting
42. Foam washer (4 used)
43. Link skid (2 used)
44. Link skid (2 used)
45. Flat washer
46. Flange nut
47. Dust cap
48. Retaining ring
49. Spherical bearing
50. Switch shield (RH shown)
51. Center deck
52. Flange bushing
53. Grease fitting
54. Washer head screw (2 per shield)

Removal (Fig. 6)

1. Position machine on a clean, level surface. Lower cutting deck and engage parking brake.

2. Fully raise wing deck, stop engine and remove key from the ignition switch. Remove three (3) washer head screws and shield strap that secure flex shield to wing deck. Lower wing deck.

3. Remove hydraulic motor from wing deck (see Cutting Deck Motor Removal in the Service and Repairs Section of Chapter 4 – Hydraulic System).

4. Remove cap screw and lock nut that secure lift cylinder clevis to the wing deck (Fig. 7).

5. Remove switch shield (item 50) from center deck.

6. Support wing deck to prevent it from falling as links are removed.

7. Remove cap screw (item 29) from pivot pin on upper end of both links. Cap screw on rear link also uses a flat washer (item 28).

NOTE: When removing pivot pins from deck, note location of thrust washers (item 6) and hardened spacers (item 42).

8. Remove flange nut (item 19) from carriage bolt (item 26) and pull pivot pins (item 18) from deck. Locate and retrieve thrust washers (item 6) and hardened spacers (item 42) from between links and deck brackets.

9. Slide the wing deck away from the center deck.

10. If required, remove link(s) from wing deck by removing lock nut and flat washer that secure tapered stud to deck. Press tapered stud from deck to remove link assembly. Remove foam washer (item 42) and link skid.

Installation (Fig. 6)

1. Park machine on a clean, level surface. Stop engine, engage parking brake and remove key from the ignition switch.

2. If links were removed from wing deck, thoroughly clean tapered stud on link and mounting boss of wing deck. Place foam washer on tapered stud and insert stud into deck mounting boss. Position link skid to stud and secure with flat washer and lock nut. Torque lock nut from **160 to 180 ft-lb (217 to 244 N-m)**.

NOTE: Pivot latches (item 8) may need to be manually opened prior to wing deck installation. If necessary, use a pry bar to carefully open latch.

3. Position the wing deck to the center deck.

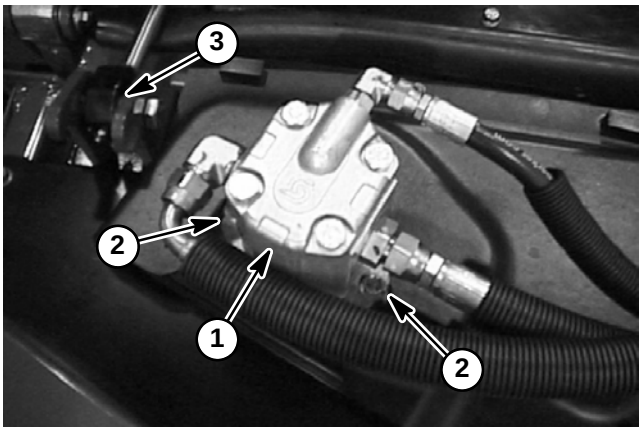

Figure 7

1. **Hydraulic motor**
2. **Flange head screw**
3. **Lift cylinder clevis**

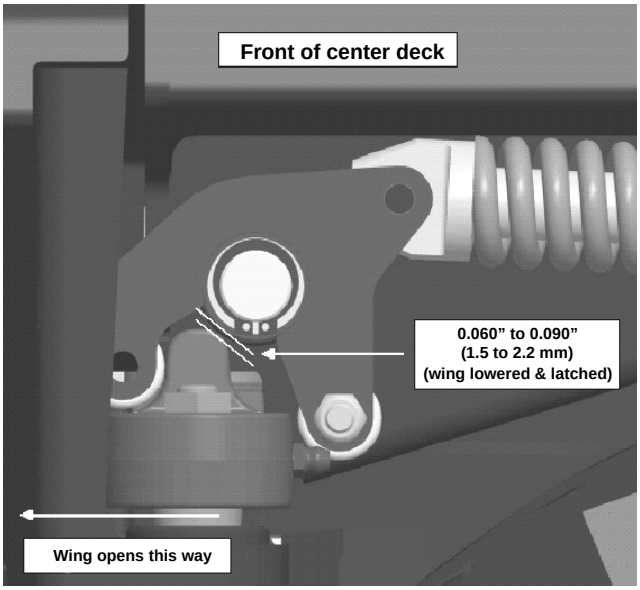

Figure 8

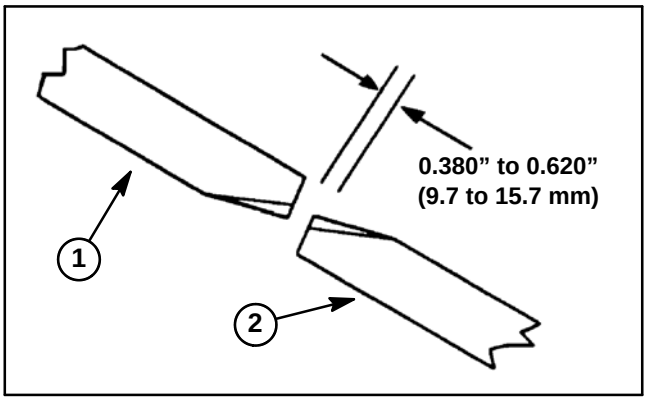

Figure 9

1. **Wing deck blade**
2. **Center deck blade**

4. Position upper end of links to center cutting deck brackets.

5. Align upper end of links with mounting holes in center deck. While installing pivot pins to center deck and links, insert spacers and washers as follows:

A. Place a hardened spacer (item 42) on each side of the front link. Use one or two thrust washers on rear side of assembly so that link is snug between deck brackets.

B. Place a thrust washer (item 6) on each side of rear link.

6. Secure pins with carriage screw and flange head screw.

7. Install cap screw (item 29) to pivot pin on both links. Cap screw on rear link uses a flat washer (item 28). Cap screw on front link also secures hose guide (item 38).

8. Position lift cylinder to the wing deck (Fig. 7). Secure cylinder with cap screw and lock nut.

9. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 – Hydraulic System).

10. Fully raise wing deck, stop engine and remove key from the ignition switch. Secure flex shield to wing deck with shield strap and three (3) washer head screws. Lower wing deck.

11. Lower wing deck and inspect deck latch assembly to insure that front link is locked when the wing deck is in the lowered position. There should be a gap from 0.060" to 0.090" (1.5 to 2.2 mm) between the arm latch actuator and the latch pivot (Fig. 8). If gap is incorrect, adjust link position by repositioning the location of the hardened spacers (item 42) and thrust washers (item 6). At a minimum, there must be a hardened spacer positioned to the rear of the front link.

12. Lubricate grease fittings on cutting deck and lift components.

13. Check distance between inner deck blade on wing deck and outer deck blade on center deck. Distance between blades should be 0.380" to 0.620" (9.7 to 15.7 mm) (Fig. 9). If blade distance is incorrect, loosen hex jam nut (item 32) on rear link assembly and adjust cap screw (item 31). Tighten jam nut when blade distance is correct.

14. Check operation of wing deck position switch. Adjust if necessary (see Wing Deck Position Switches in the Adjustments section of Chapter 5 – Electrical System).

15. Secure switch shield (item 50) to center deck.

Cutting Deck Link Service

Disassembly (Fig. 10)

1. Press bushings from top of link.

2. Remove dust cap and retaining ring from link.

3. Press tapered stud with spherical bearing, flat washers and flange nut from link.

4. Remove flange nut and press spherical bearing from tapered stud.

Assembly (Fig. 10)

1. Install new spherical bearing onto tapered stud. Secure bearing with flange nut. Torque nut from **30 to 40 ft-lb (41 to 54 N-m)**.

2. Position flat washer in both sides of spherical bearing.

3. Press tapered stud with spherical bearing, flat washers and flange nut into link. Secure spherical bearing into link with retaining ring.

4. Press bushings into top bore of link.

5. If cap screw and jam nut were removed from rear link, install cap screw to allow 1.625" (41.3 mm) between the head of the screw and the side of the link (Fig. 11).

6. After link is installed on deck, check distance between center deck blade and wing deck blade. Readjust cap screw and jam nut on rear link if needed (see Wing Deck Service in this Chapter).

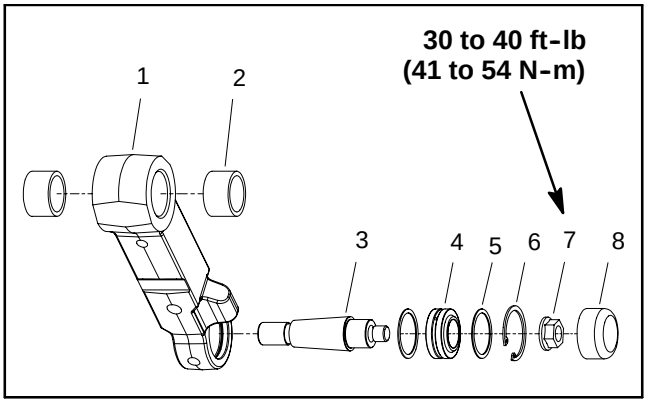

Figure 10

1. **Link**
2. **Bushing (2 used)**
3. **Tapered stud**
4. **Spherical bearing**
5. **Flat washer (2 used)**
6. **Retaining ring**
7. **Flange nut**
8. **Dust cap**

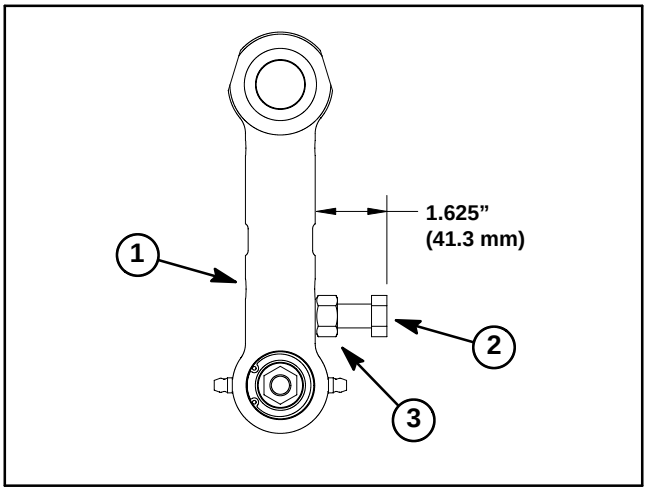

Figure 11

1. **Rear link**
2. **Cap screw**
3. **Hex jam nut**

Wing Deck Latch

Disassembly (Fig. 12)

1. Raise wing deck to transport position. Carefully rotate latch to closed position.

2. Loosen lug nut to release compression spring tension.

3. Remove retaining ring and flat washer from bottom of latch pin. Rotate lug nut enough to allow latch pin to be removed from latch.

4. Remove lug nut from spring support. Remove latch assembly from deck.

5. Disassemble latch (items 1 through 8) using Figure 12 as a guide.

Assembly (Fig. 12)

1. Assemble latch (items 1 through 8) using Figure 12 as a guide.

2. Slide spring onto spring support and insert end of spring support into hole located on underside of center deck. Start lug nut (tapered side towards plate on deck) onto spring support.

3. Tighten lug nut until holes in front of deck align with bushings in latch. Insert latch pin with retaining ring down through deck and latch. Secure latch pin on underside of deck with flat washer and retaining ring.

4. Carefully rotate latch to the open position. Lower wing deck to allow link to engage latch.

5. Lubricate latch grease fitting.

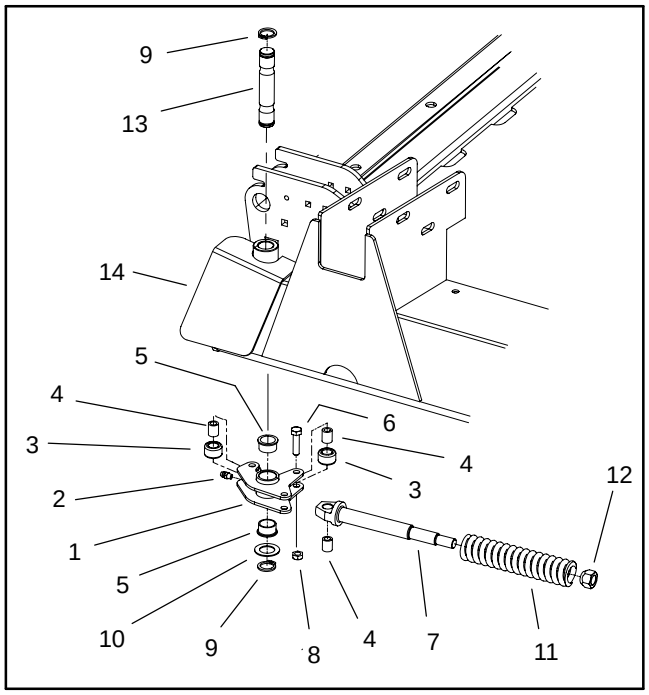

Figure 12

1. **Latch**
2. **Grease fitting**
3. **Lock roller**
4. **Bushing**
5. **Flange bushing**
6. **Cap screw (3 used)**
7. **Spring support**
8. **Lock nut (3 used)**
9. **Retaining ring**
10. **Flat washer**
11. **Compression spring**
12. **Lug nut**
13. **Latch pin**
14. **Center deck**

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Blade Spindle

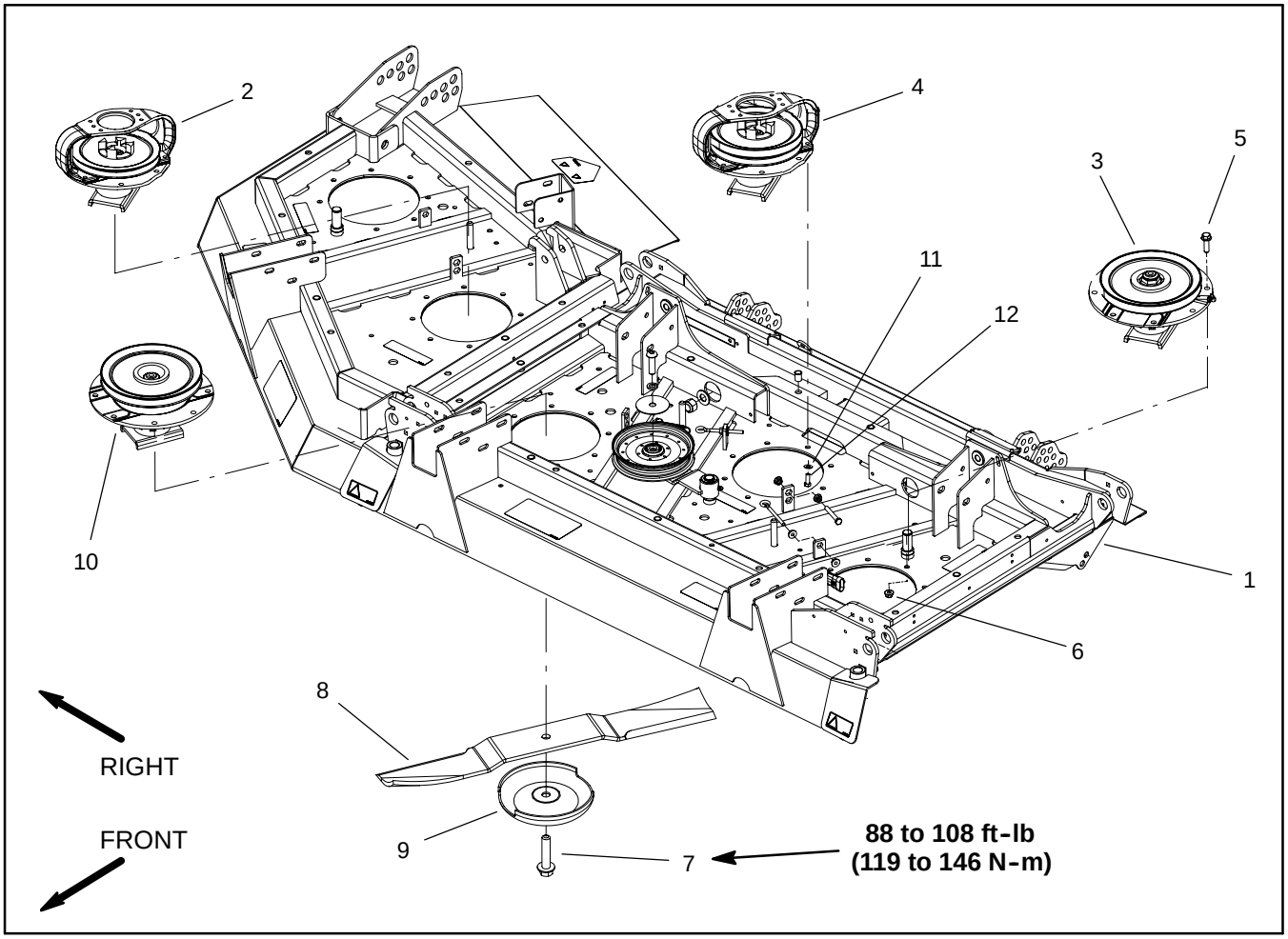

Figure 13

1. **Cutting deck**
2. **Drive spindle: single pulley (2 used)**
3. **Low driven spindle (3 used)**
4. **Drive spindle: double pulley (1 used)**
5. **Flange head screw**
6. **Flange nut**
7. **Blade bolt**
8. **Cutting blade (7 used)**
9. **Anti-scalp cup**
10. **High driven spindle (1 used)**
11. **Flat washer**
12. **Cap screw**

Removal (Fig. 13)

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

2. 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 System). Position motor away from spindle.

3. Remove belt covers from top of cutting deck. Loosen idler pulley to release belt tension (see Idler Assembly Removal in this section). Remove drive belt from spindle to be serviced.

4. 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.

5. Remove cutting blade, anti-scalp cup and blade bolt from spindle to be serviced.

6. 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 flat washers that secure spindle and motor mount to deck.

Installation (Fig. 13)

1. Position spindle on cutting deck noting orientation of grease fitting (Fig. 15). Secure spindle assembly to deck with removed fasteners.

2. Install cutting blade, anti−scalp cup and blade bolt. 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 component(s).

4. Install drive belt and adjust belt tension (see Idler Assembly Installation in this section).

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 System).

6. Install belt covers to cutting deck.

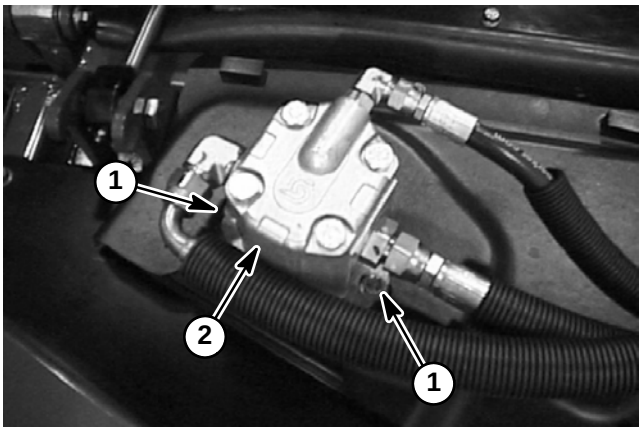

Figure 14

1. Flange head screw **2. Hydraulic motor**

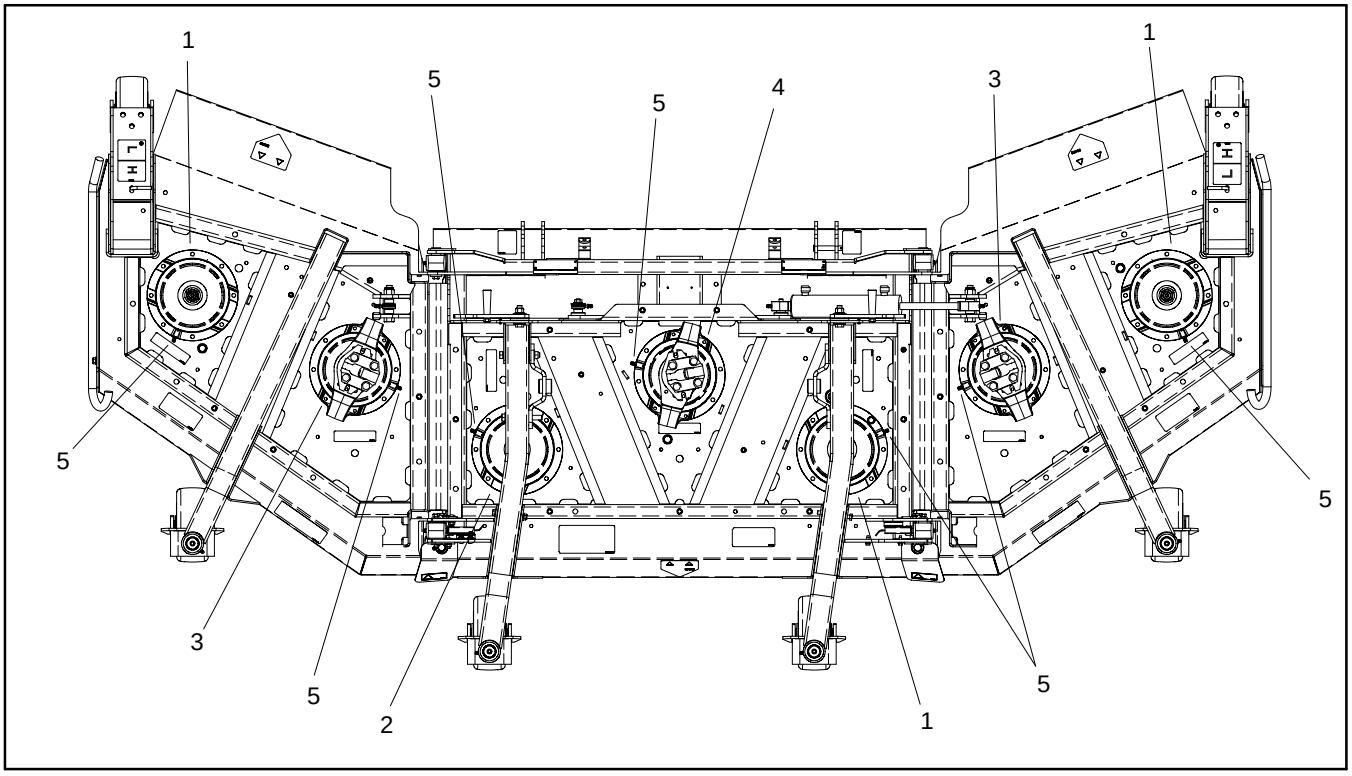

Figure 15

1. Driven spindle
2. Driven spindle (high pulley)
3. Drive spindle (wing deck)
4. Drive spindle (center deck)
5. Spindle grease fitting location

Blade Spindle Service

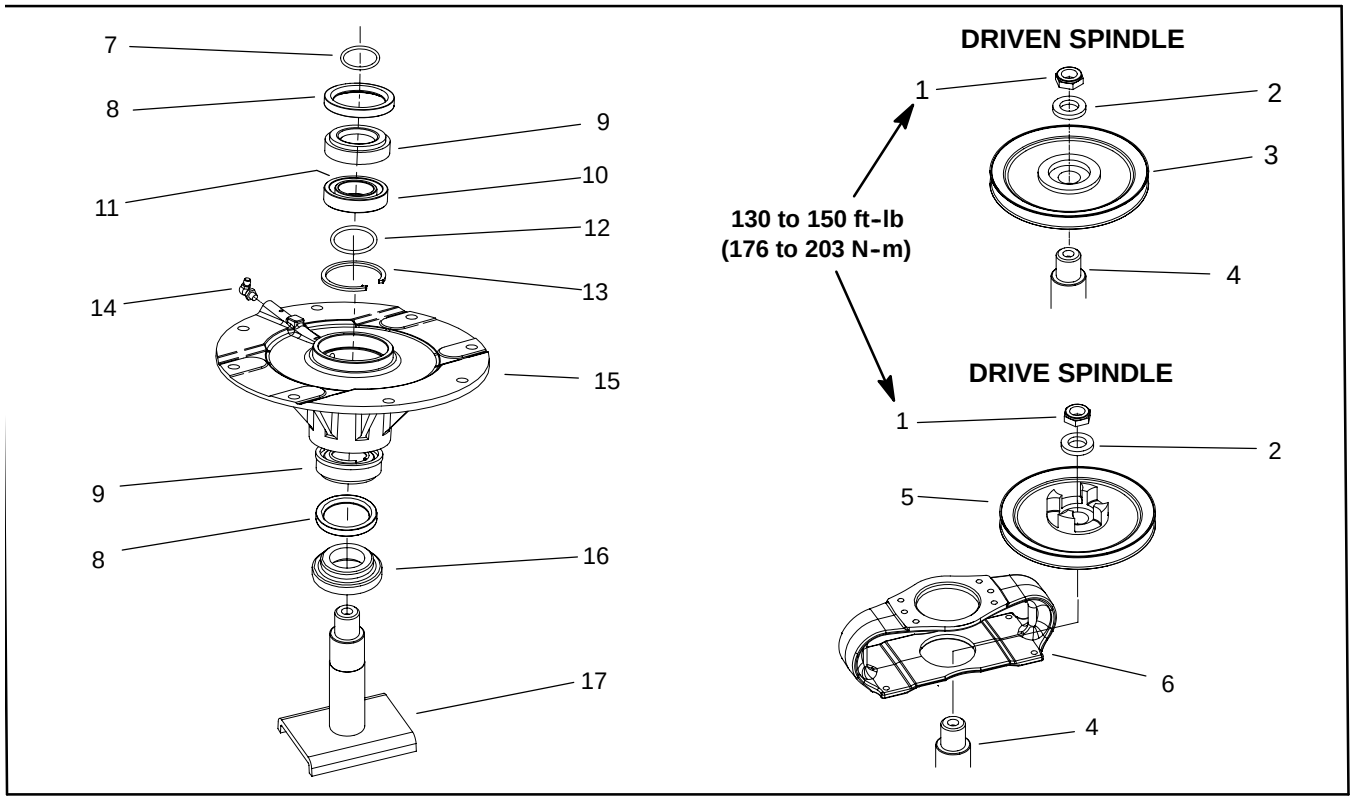

Figure 16

1. Lock nut
2. Flat washer
3. Driven pulley
4. Spindle shaft
5. Drive pulley (single shown)
6. Hydraulic motor mount
7. O-ring
8. Oil seal
9. Bearing cup and cone
10. Outer bearing spacer
11. Inner bearing spacer
12. Spacer ring
13. Snap ring
14. Grease fitting
15. Spindle housing
16. Spindle shaft spacer
17. Spindle shaft

Disassembly (Fig. 16)

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 taking care to not damage seal bore in housing.

4. Allow the bearing cones, inner bearing spacer and spacer ring to drop out of the spindle housing (Fig. 17).

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. 16)

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. 17). 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. 17). 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.

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 18).

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 oil seal into bottom of spindle housing. **Note:** The bottom seal must have the lip facing out (down) (Fig. 19). 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. 17).

6. Slide spacer ring and inner bearing spacer into spindle housing, then install upper bearing cone and oil seal into top of housing. **Note:** The upper seal must have the lip facing in (down) (Fig. 19). Also, upper seal should be flush or up to 0.060" (1.5 mm) recessed into housing.

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 O−ring to top of spindle shaft. For drive spindle, position hydraulic motor mount to top of spindle.

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 air pockets when filling large cavities and therefore, are not recommended to be used for proper 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.

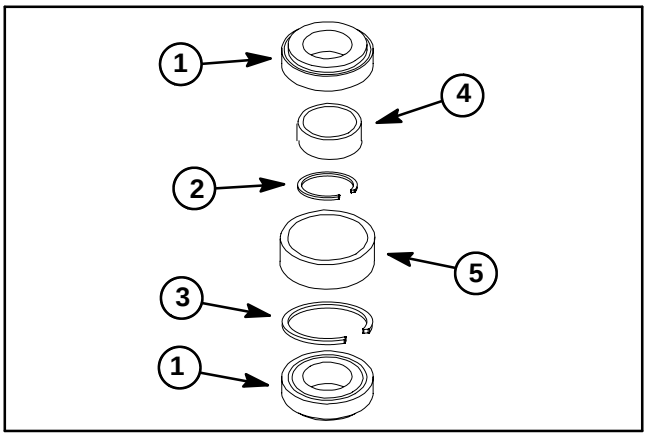

Figure 17

1. **Bearing**
2. **Spacer ring**
3. **Large snap ring**
4. **Inner bearing spacer**
5. **Outer bearing spacer**

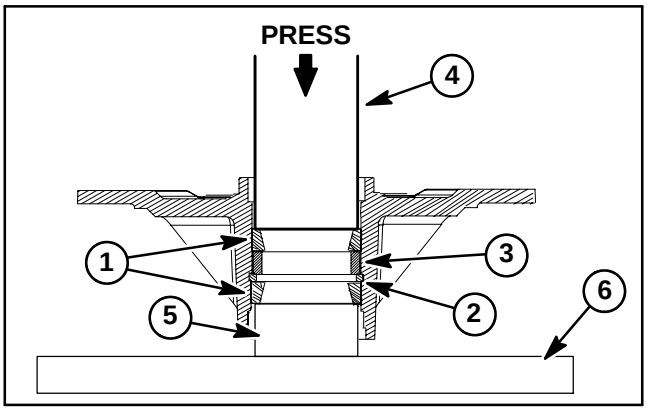

Figure 18

1. **Bearing cups**
2. **Large snap ring**
3. **Large outer spacer**
4. **Arbor press**
5. **Support**
6. **Arbor press base**

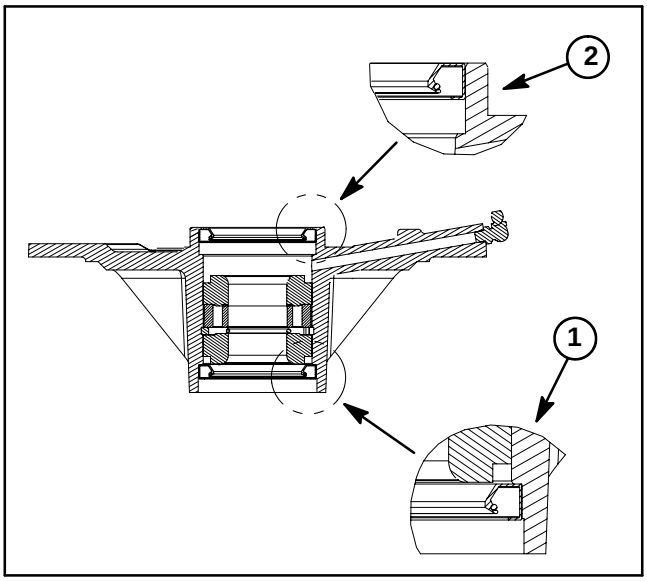

Figure 19

1. **Bottom seal installation**
2. **Upper seal installation**

Idler Assembly

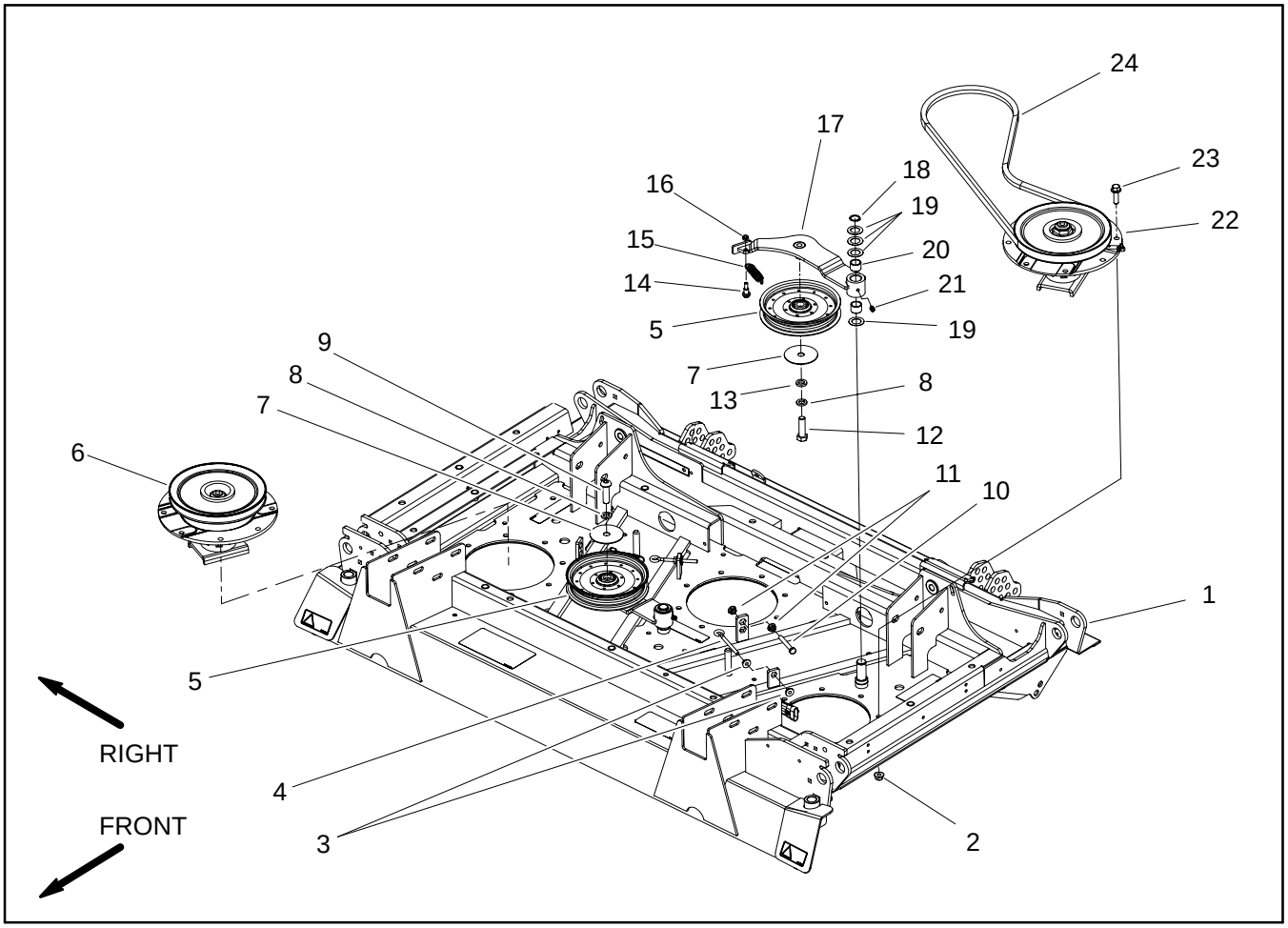

Figure 20

1. **Center deck**
2. **Flange nut**
3. **Flange nut**
4. **Adjusting screw**
5. **Idler pulley**
6. **High driven pulley**
7. **Flat washer**
8. **Lock washer**
9. **Socket head screw**
10. **Stop bolt**
11. **Flange nut**
12. **Cap screw**
13. **Spacer**
14. **Shoulder bolt**
15. **Spring**
16. **Lock nut**
17. **Idler arm**
18. **Retaining ring**
19. **Thrust washer (4 used per idler)**
20. **Bushing (2 used per idler)**
21. **Grease fitting**
22. **Low driven pulley**
23. **Flange head screw**
24. **Drive belt**

NOTE: The center deck is shown in Figure 20. The idler assemblies used on the wing decks use the same idler components.

Removal (Fig. 20)

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

2. Remove deck covers from top of cutting deck.

CAUTION

Be careful when removing idler spring. The spring is under heavy load and may cause personal injury.

3. Use spring hook tool to unhook the idler spring (item 15) from the adjusting screw (item 4).

4. Remove drive belt(s) from deck pulleys.

5. Loosen flange nuts (item 11) that secure idler stop bolt (item 10) to cutting deck to allow clearance between idler arm and stop bolt.

6. Remove idler components as needed using Figure 20 as a guide. Note location of washers, idler spacer and screw as idler assemblies are being removed.

Installation (Fig. 20)

1. Install removed idler components using Figure 20 as a guide.

   A. Make sure that one (1) thrust washer (item 19) is placed below the idler arm and three (3) thrust washers are placed between the idler and retaining ring location.

   B. Secure idler arm assembly to cutting deck with snap ring.

   C. If idler stop bolt (item 10) was removed from deck, make sure that it is installed in the hole that allows the stop bolt head to align with the idler arm.

2. Install drive belt to pulleys.

CAUTION

Be careful when installing the idler spring. The spring is under heavy load and may cause personal injury.

3. Use spring hook tool to attach the idler spring (item 15) onto the adjusting screw (item 4) and shoulder bolt on idler arm. With the idler arm tensioning the drive belt, the spring hook to hook length should be from 3.250" to 3.750" (82.6 to 95.2 mm) (Fig. 21). If necessary, disconnect spring and change position of adjusting screw. When idler spring is the correct length, tighten second flange nut to secure adjustment.

4. Adjust location of idler stop bolt (item 10) so that the clearance between idler arm and idler stop bolt head is from 0.125" to 0.185" (3.2 to 4.6 mm) (Fig. 21).

5. Install deck covers to cutting deck.

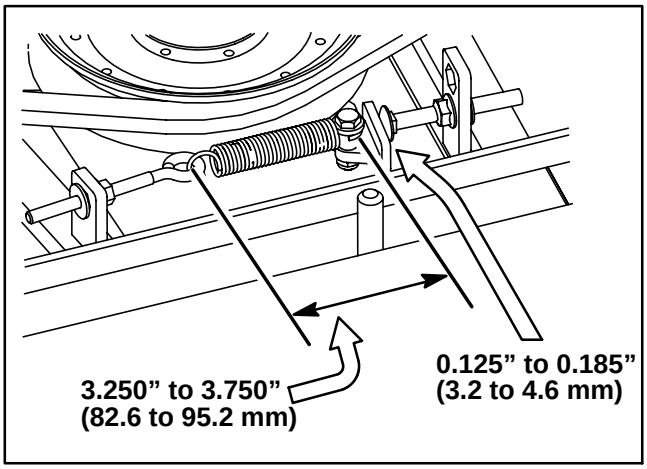

Figure 21

Castor Forks and Wheels

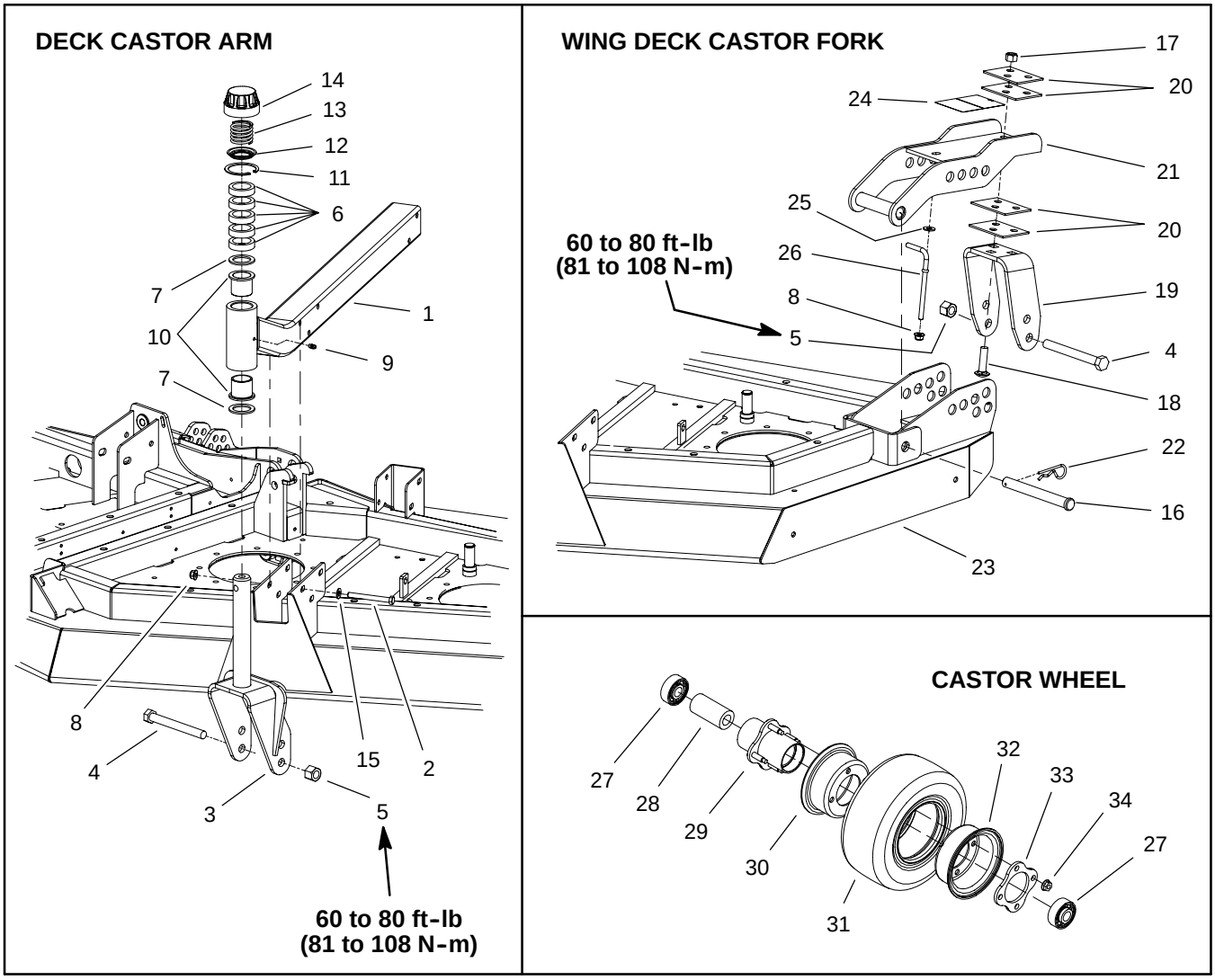

Figure 22

1. Castor arm (wing deck shown)
2. Cap screw (6 per arm)
3. Castor fork
4. Castor wheel bolt
5. Lock nut
6. Castor spacer
7. Thrust washer
8. Flange lock nut
9. Grease fitting
10. Flange bushing
11. Retaining ring
12. Cap washer
13. Compression spring
14. Cap
15. Flat washer (6 per arm)
16. Clevis pin (2 used per fork)
17. Lock nut
18. Carriage screw (3 used per fork)
19. Castor fork bracket
20. Shim
21. Castor fork bracket
22. Hairpin
23. Cutting deck (LH shown)
24. Decal
25. Flat washer
26. Tension rod
27. Bearing
28. Inner bearing spacer
29. Wheel hub
30. Wheel rim half
31. Castor tire
32. Wheel rim half
33. Plate
34. Flange nut (4 used per wheel)

Disassembly (Fig. 22)

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

2. Disassemble castor forks and wheels using Figure 22 as a guide.

Assembly (Fig. 22)

1. Assemble castor forks and wheels using Figure 22 as a guide.

2. Torque castor wheel lock nut from **60 to 80 ft-lb (81 to 108 N-m)**.

3. If castor fork was removed, lubricate grease fitting.

4. See Operator's Manual for castor wheel adjustment.

Deck Rollers and Skids

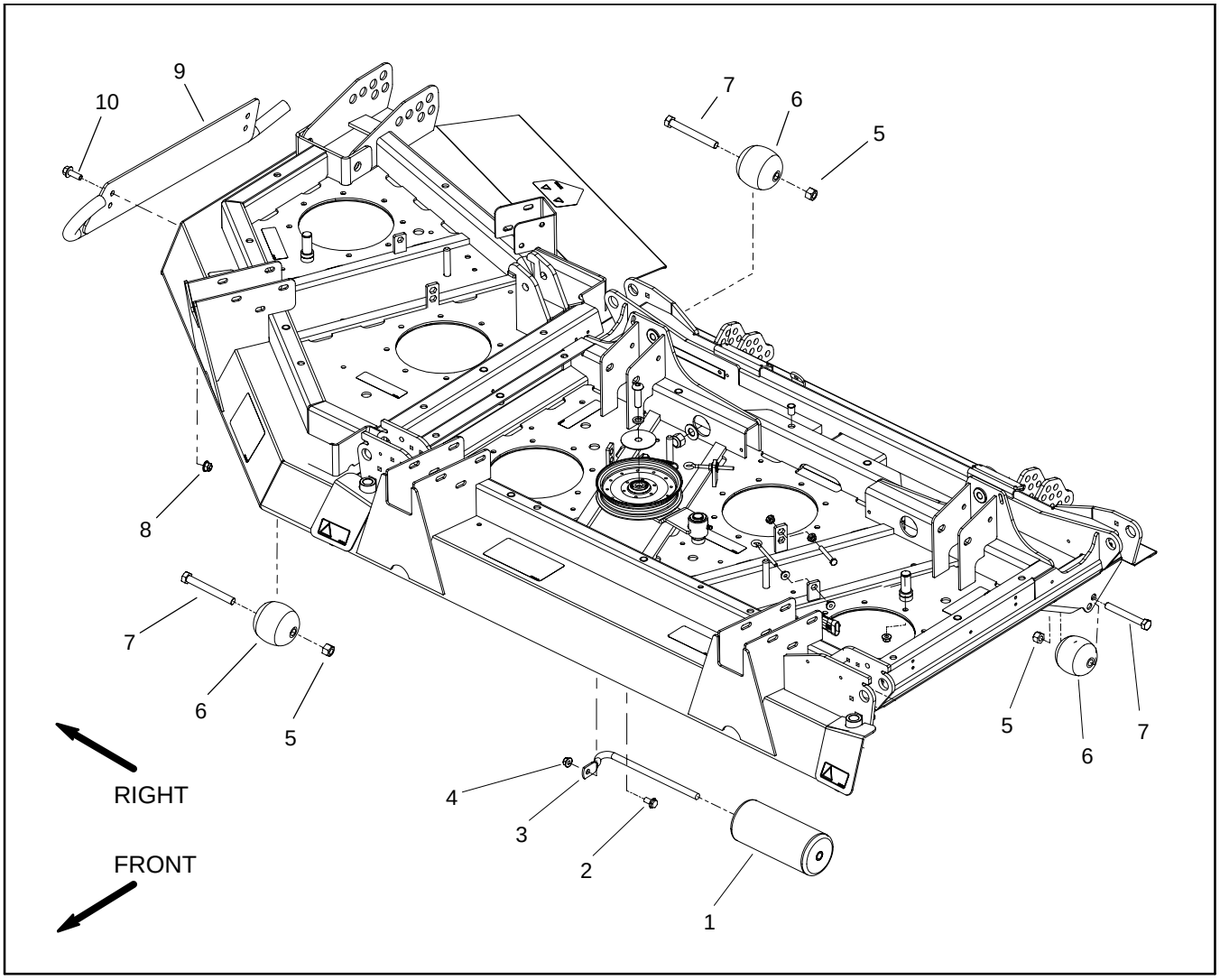

Figure 23

1. **Roller**
2. **Flange head screw**
3. **Roller shaft**
4. **Flange nut**
5. **Lock nut**
6. **Roller**
7. **Cap screw**
8. **Flange nut**
9. **Skid (RH shown)**
10. **Flange head screw**

Removal (Fig. 23)

1. Remove skids and rollers from deck using Figure 23 as a guide.

Installation (Fig. 23)

1. Install skids to deck using Figure 23 as a guide. Make sure to install skids in the same mounting hole height position (lower or upper).

2. When installing roller (item 6), install cap screw with the threads orientated toward the centerline of the deck. Install and tighten lock nut until roller will not rotate, then loosen lock nut only enough to allow roller to rotate freely. Make sure to install all deck rollers in the same mounting hole height position (lower or upper).

Chapter 9

Foldout Drawings

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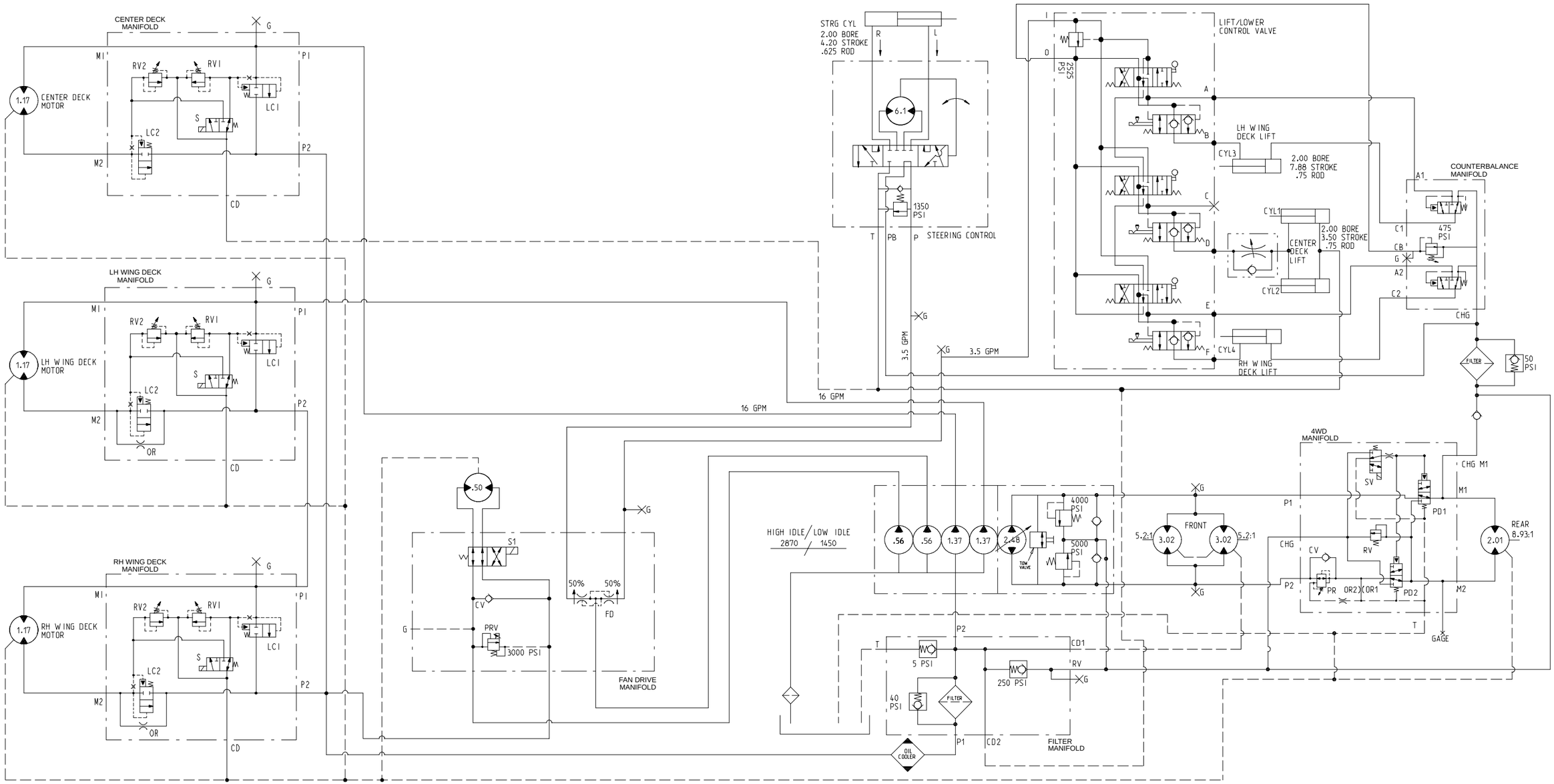
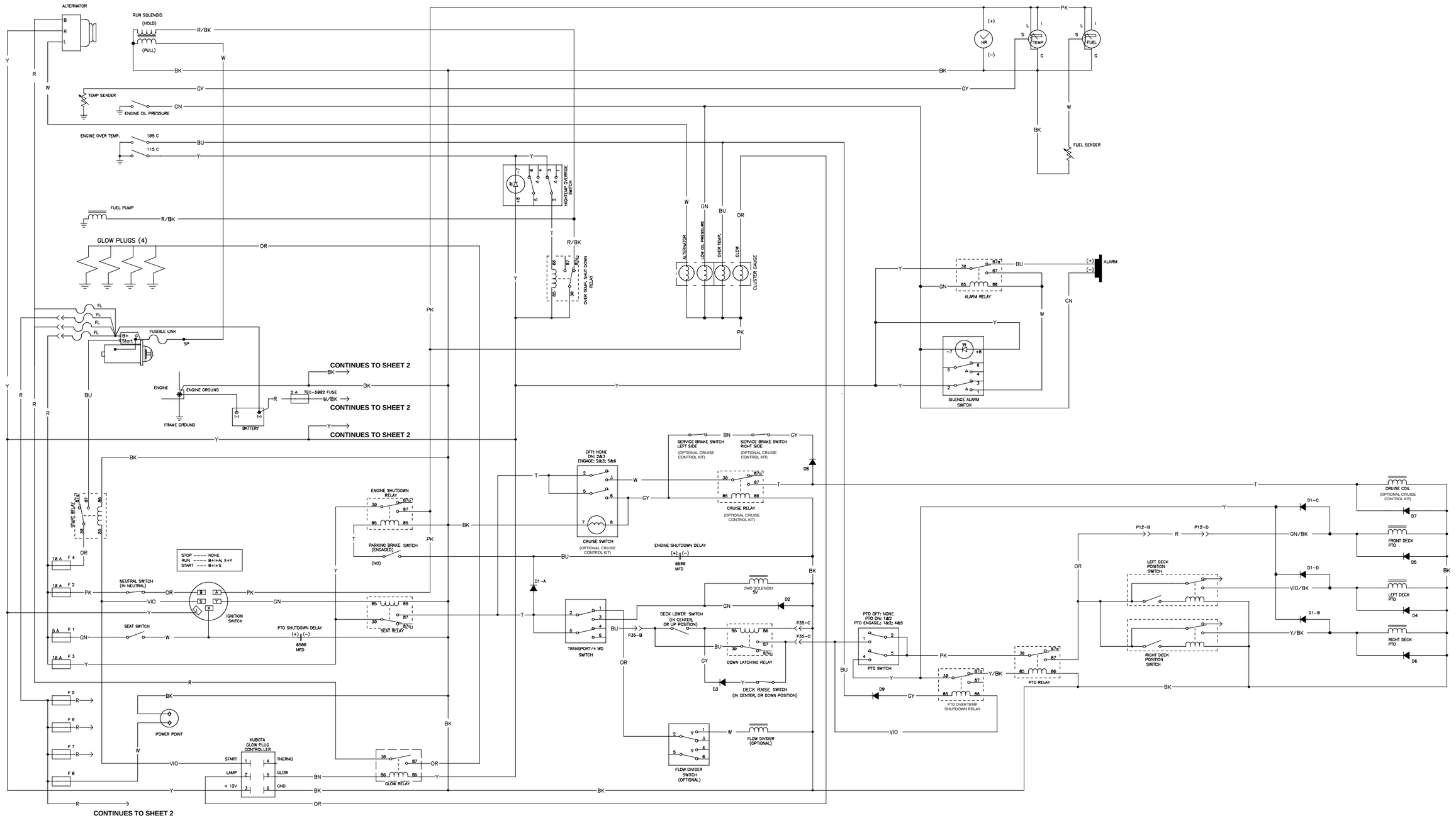

CENTER DECK MANIFOLD
G
M1
P1
RV2
RV1
1.17
CENTER DECK MOTOR
LC1
S
M
LC2
P2
M2
CD
LH WING DECK MANIFOLD
LH WING DECK MOTOR
OR
RH WING DECK MANIFOLD
RH WING DECK MOTOR
STRG CYL
2.00 BORE
4.20 STROKE
.625 ROD
R
L
6.1
1350 PSI
T
PB
P
STEERING CONTROL
3.5 GPM
16 GPM
LIFT/LOWER CONTROL VALVE
I
D
2525 PSI
A
B
C
D
E
F
LH WING DECK LIFT
CYL3
2.00 BORE
7.88 STROKE
.75 ROD
CYL1
CENTER DECK LIFT
2.00 BORE
3.50 STROKE
.75 ROD
CYL2
CYL4
RH WING DECK LIFT
COUNTERBALANCE MANIFOLD
A1
A2
C1
C2
CB
475 PSI
CHG
FILTER
50 PSI
4WD MANIFOLD
SV
CHG M1
M1
PD1
REAR
2.01
8.93:1
FRONT
5.2:1
3.02
CV
RV
PR
OR2
OR1
PD2
M2
GAGE
.50
S1
CV
PRV
3000 PSI
50%
FD
FAN DRIVE MANIFOLD
HIGH IDLE / LOW IDLE
2870 / 1450
.56
1.37
2.48
TOW VALVE
4000 PSI
5000 PSI
CD1
5 PSI
250 PSI
40 PSI
OIL COOLER
CD2
FILTER MANIFOLD



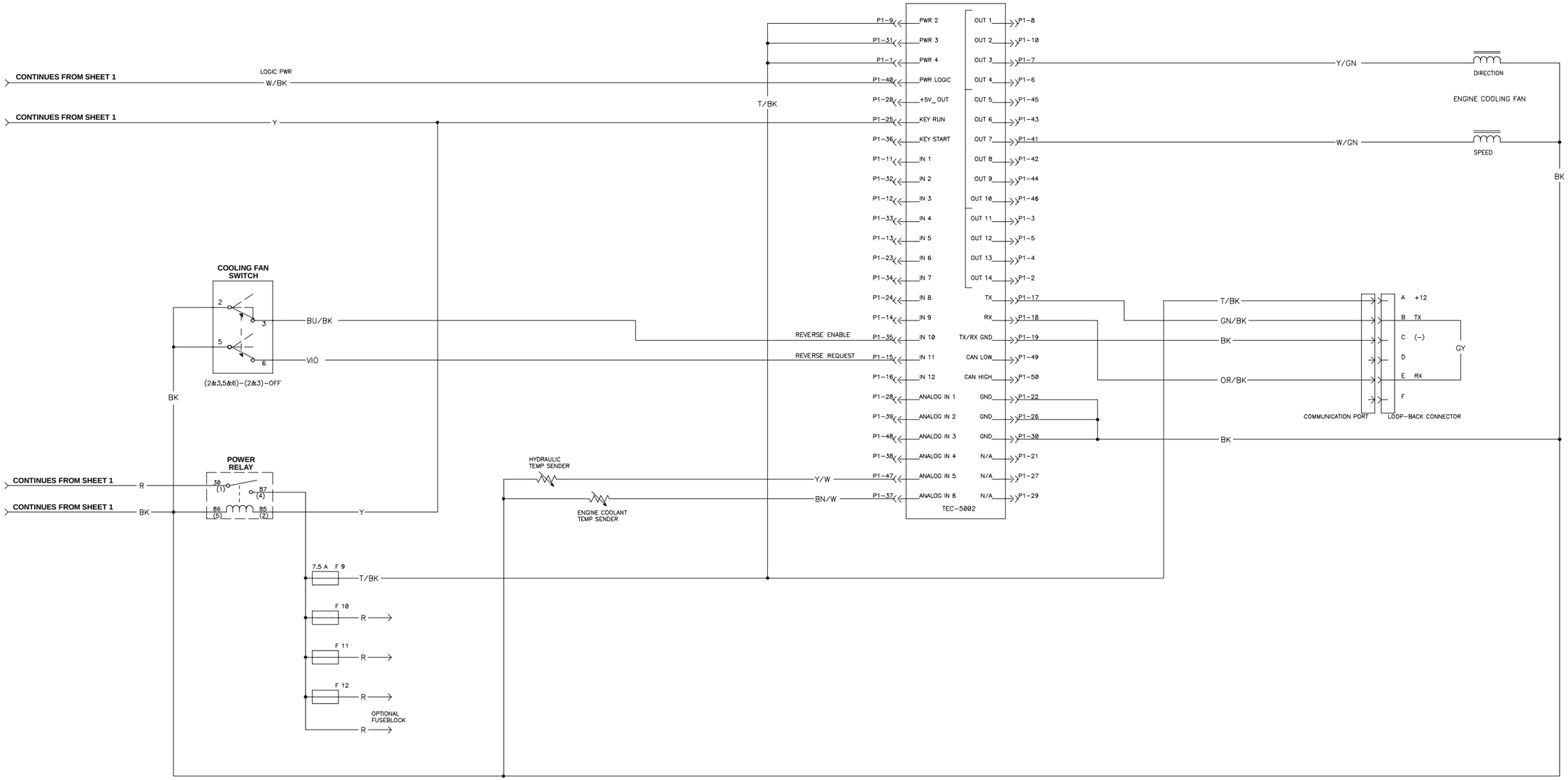
Groundsmaster 4100-D

Electrical Schematic

Sheet 1 of 2

All relays and solenoids are shown as de-energized.

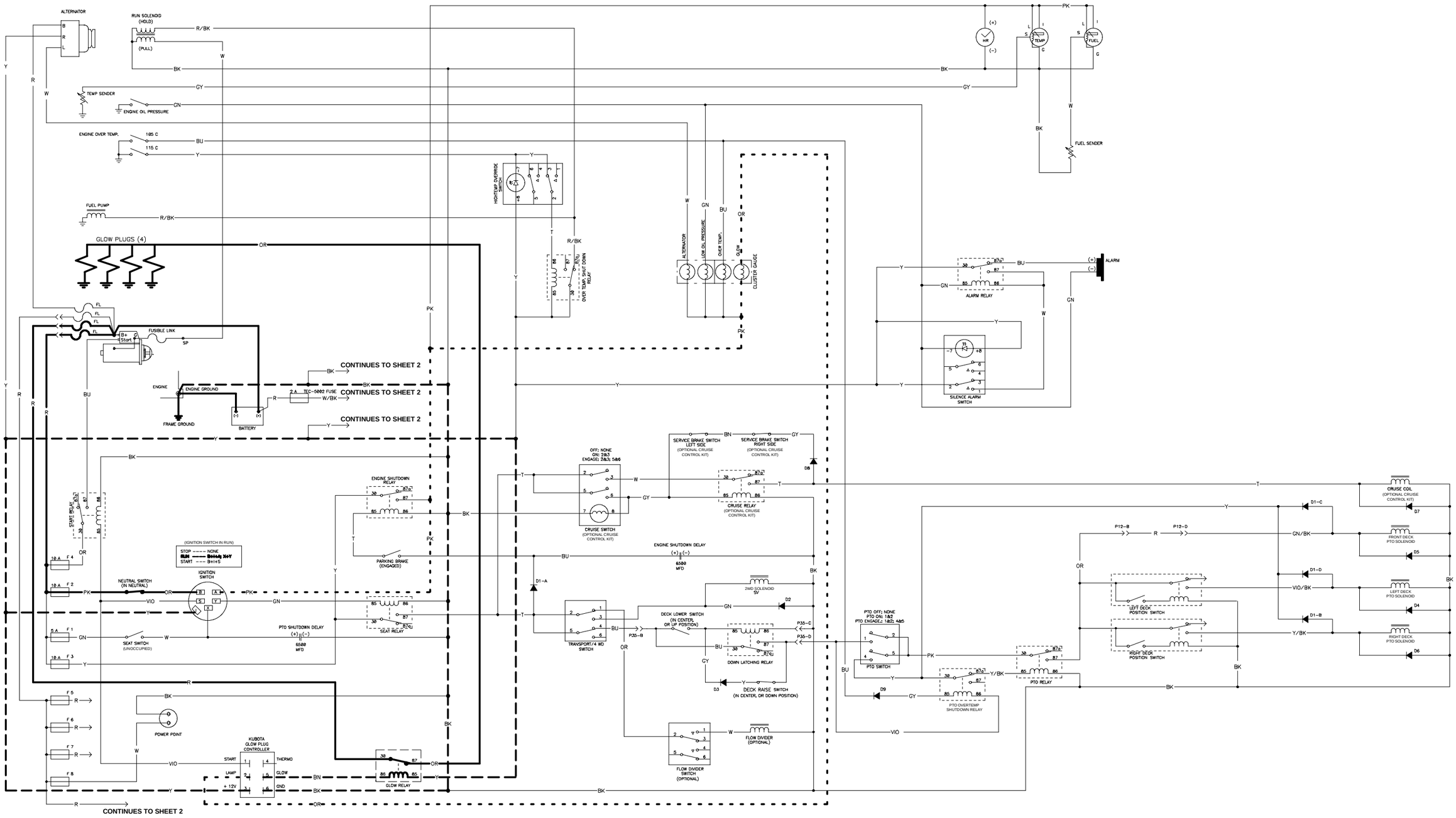
All ground wires are black.



Groundsmaster 4100–D
Electrical Schematic
Sheet 2 of 2

All relays and solenoids are shown as de-energized.

All ground wires are black.



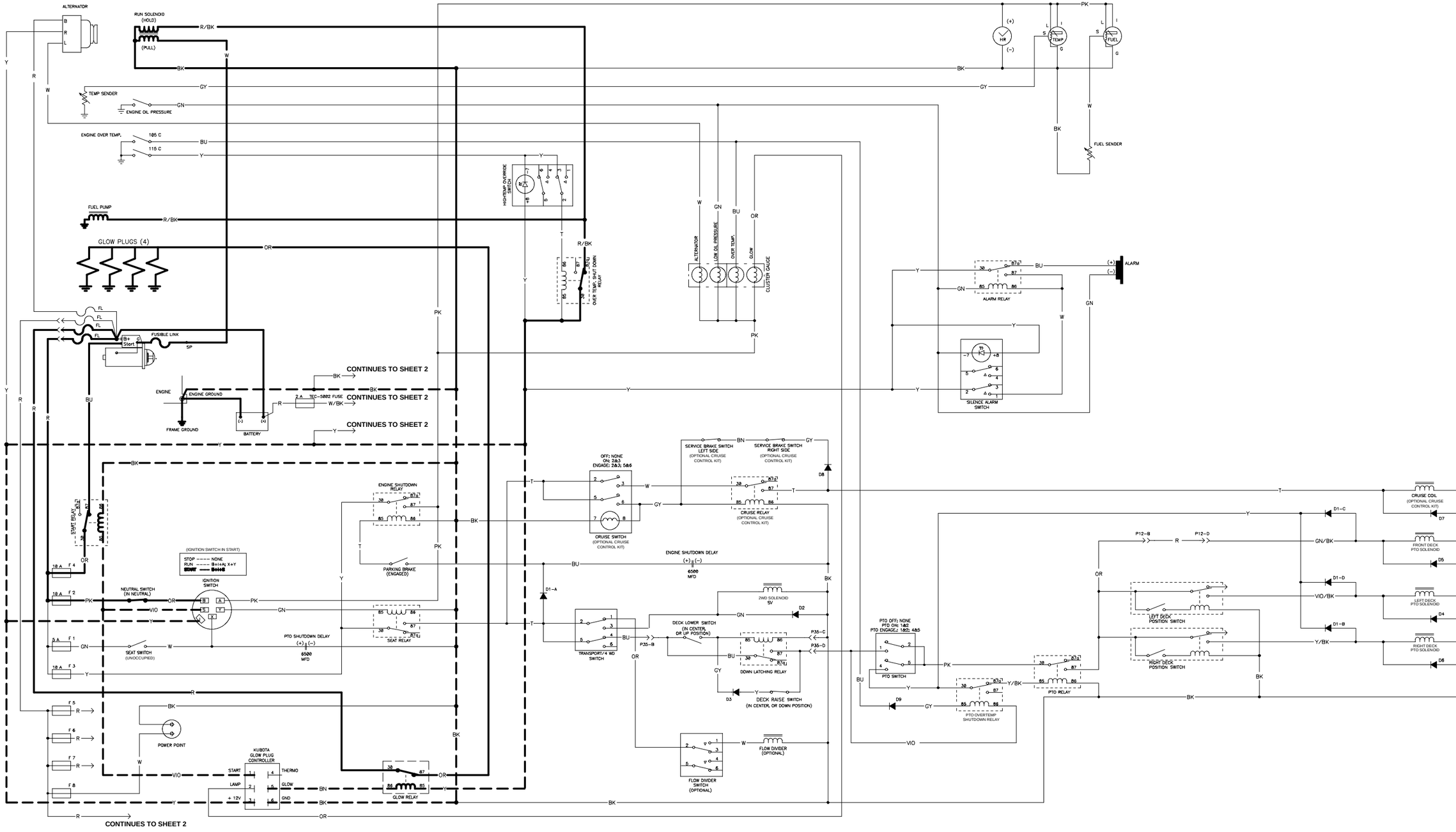
Groundsmaster 4100-D

Glow Plug Circuits

Power Current

Control Current

Indication Current



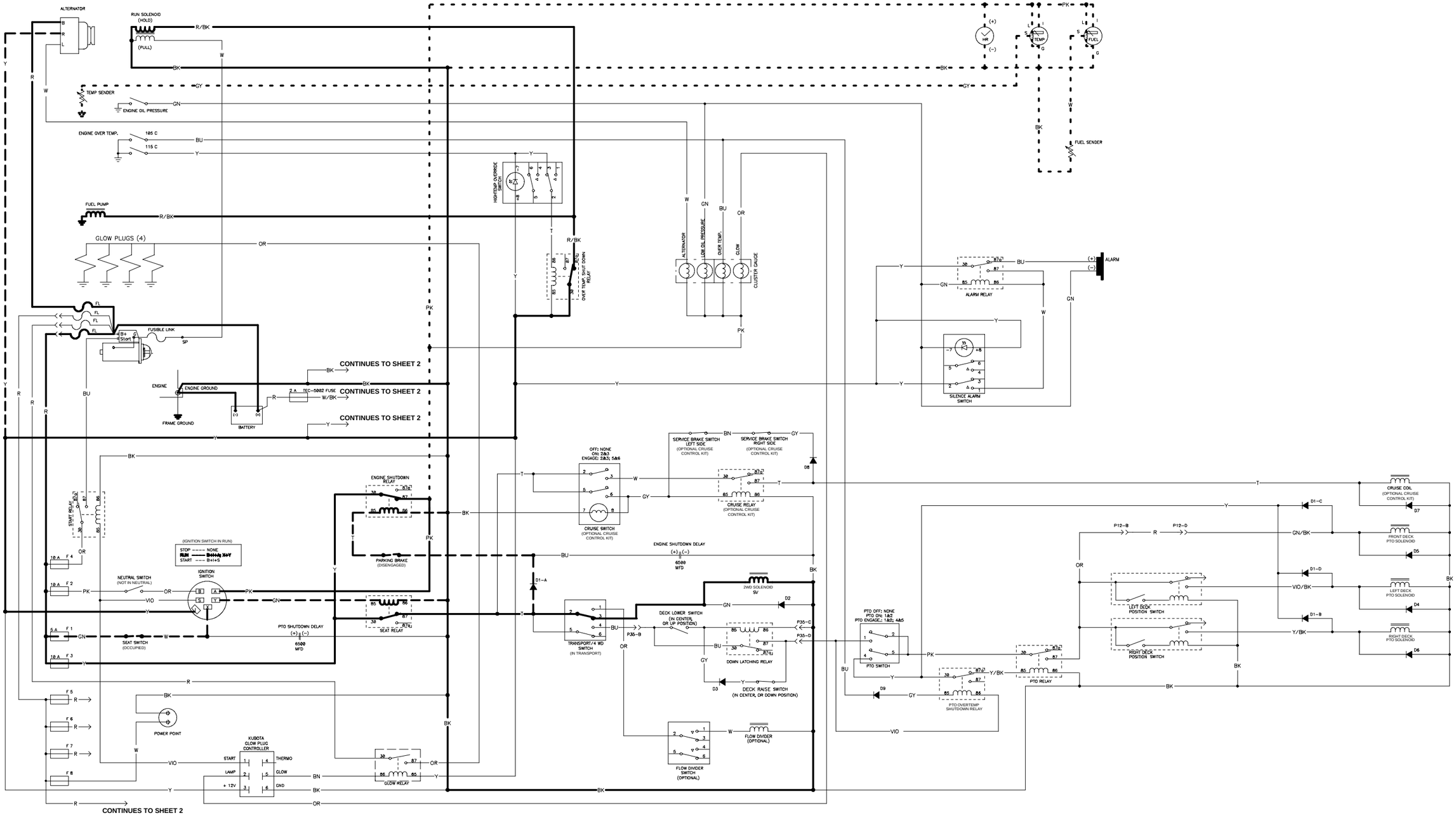
Groundsmaster 4100–D

Crank Circuits

Power Current

Control Current

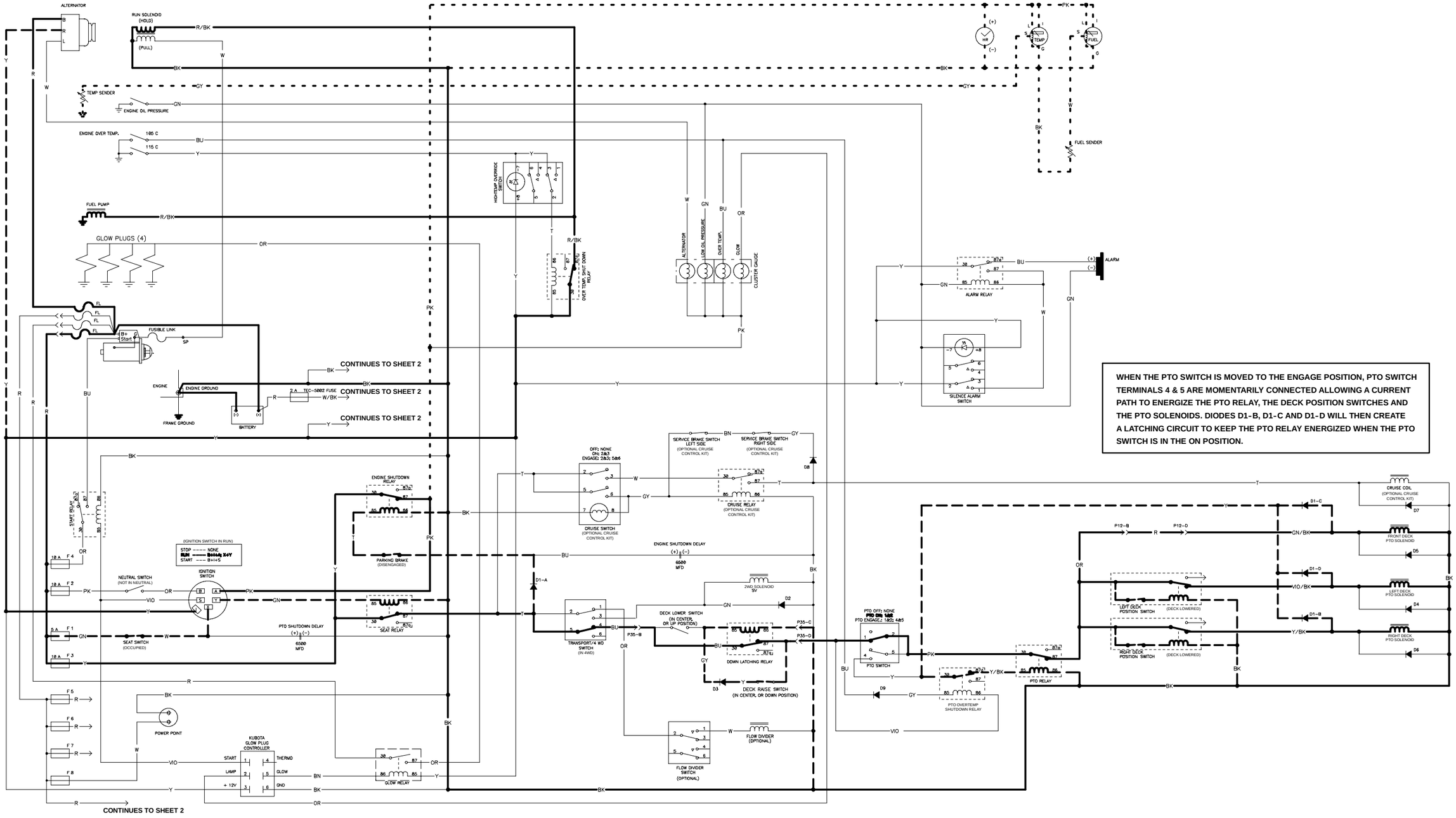
Indication Current



Groundsmaster 4100–D

Run (Transport) Circuits

- Power Current
- Control Current
- Indication Current



WHEN THE PTO SWITCH IS MOVED TO THE ENGAGE POSITION, PTO SWITCH TERMINALS 4 & 5 ARE MOMENTARILY CONNECTED ALLOWING A CURRENT PATH TO ENERGIZE THE PTO RELAY, THE DECK POSITION SWITCHES AND THE PTO SOLENOIDS. DIODES D1-B, D1-C AND D1-D WILL THEN CREATE A LATCHING CIRCUIT TO KEEP THE PTO RELAY ENERGIZED WHEN THE PTO SWITCH IS IN THE ON POSITION.

WHEN THE CUTTING DECK LIFT LEVER IS MOVED TO LOWER THE DECK, THE DECK LOWER SWITCH CLOSES TO ENERGIZE THE DOWN LATCHING RELAY. THIS PROVIDES A CURRENT PATH FOR THE PTO SWITCH. THE DECK RAISE SWITCH AND DIODE D3 CREATE A LATCHING CIRCUIT TO KEEP THE DOWN LATCHING RELAY ENERGIZED. IF THE LIFT LEVER IS MOVED TO RAISE THE DECK, THE DOWN LATCHING RELAY IS DE-ENERGIZED PREVENTING AVAILABLE CURRENT FOR THE PTO CIRCUIT.

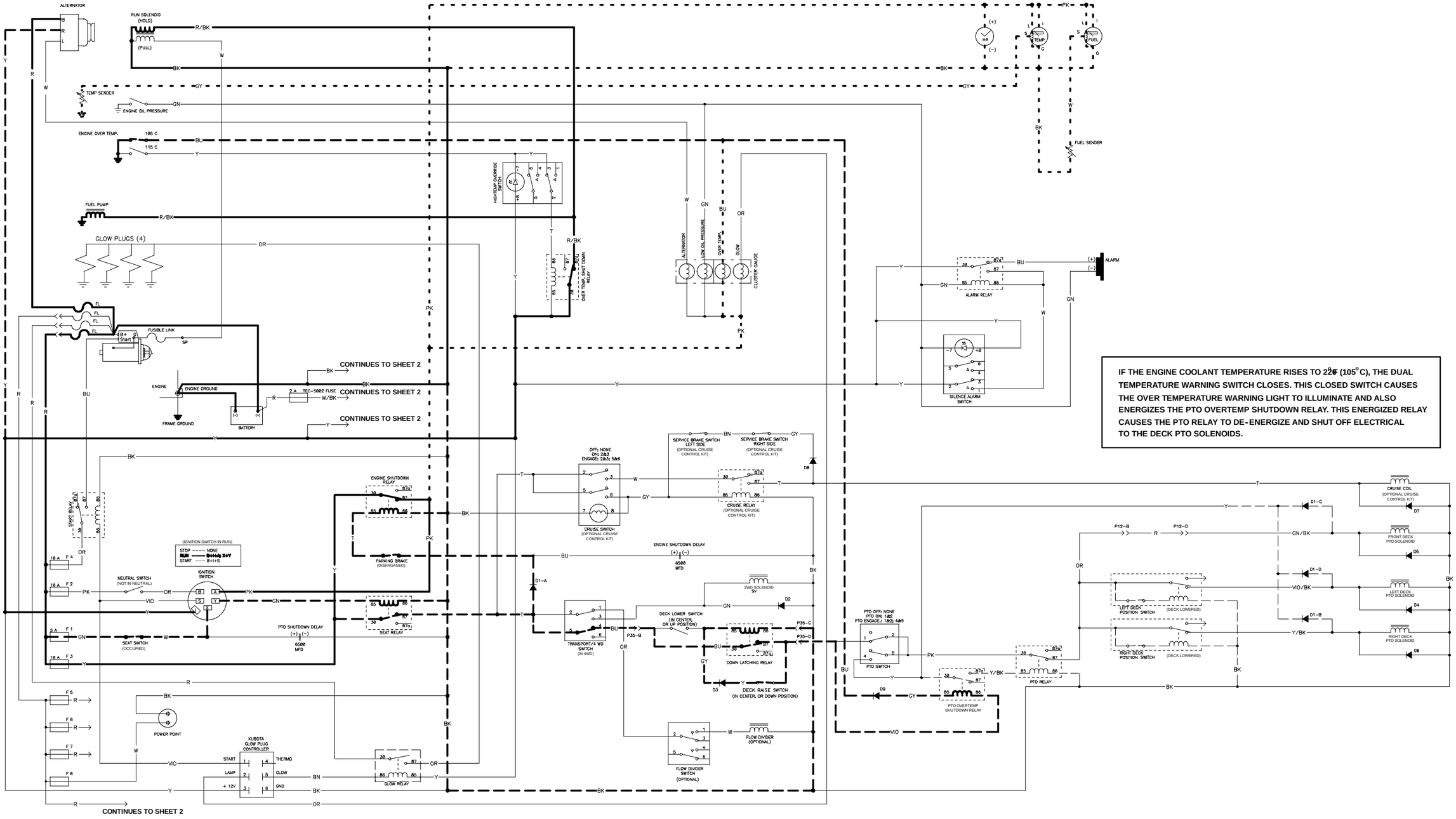
Groundsmaster 4100-D

Run (Mow) Circuits

Power Current

Control Current

Indication Current

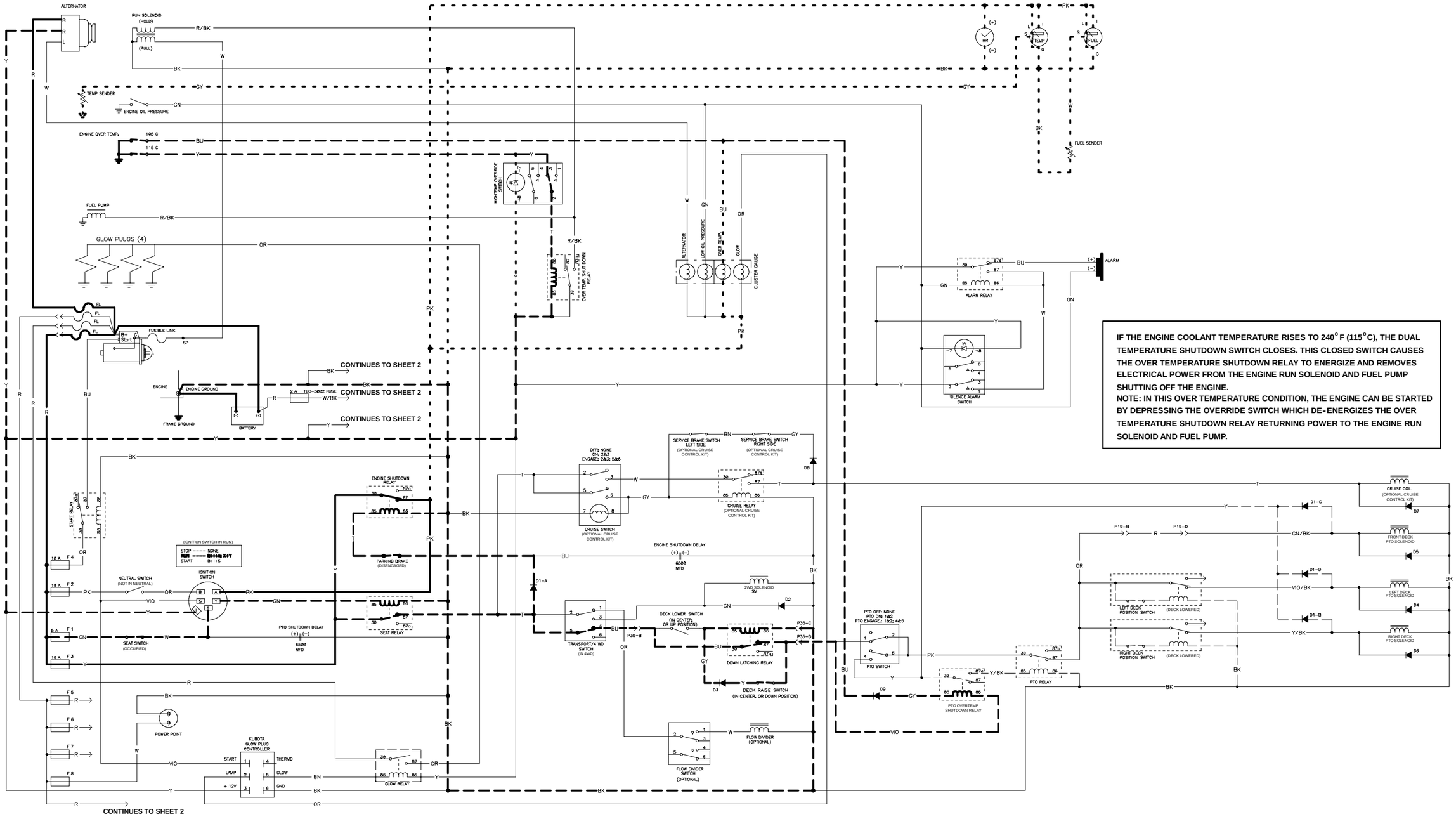


IF THE ENGINE COOLANT TEMPERATURE RISES TO 226°F (105°C), THE DUAL TEMPERATURE WARNING SWITCH CLOSES. THIS CLOSED SWITCH CAUSES THE OVER TEMPERATURE WARNING LIGHT TO ILLUMINATE AND ALSO ENERGIZES THE PTO OVERTEMP SHUTDOWN RELAY. THIS ENERGIZED RELAY CAUSES THE PTO RELAY TO DE-ENERGIZE AND SHUT OFF ELECTRICAL TO THE DECK PTO SOLENOIDS.

Groundsmaster 4100-D

High Temperature Warning Circuits

- Power Current
- Control Current
- Indication Current

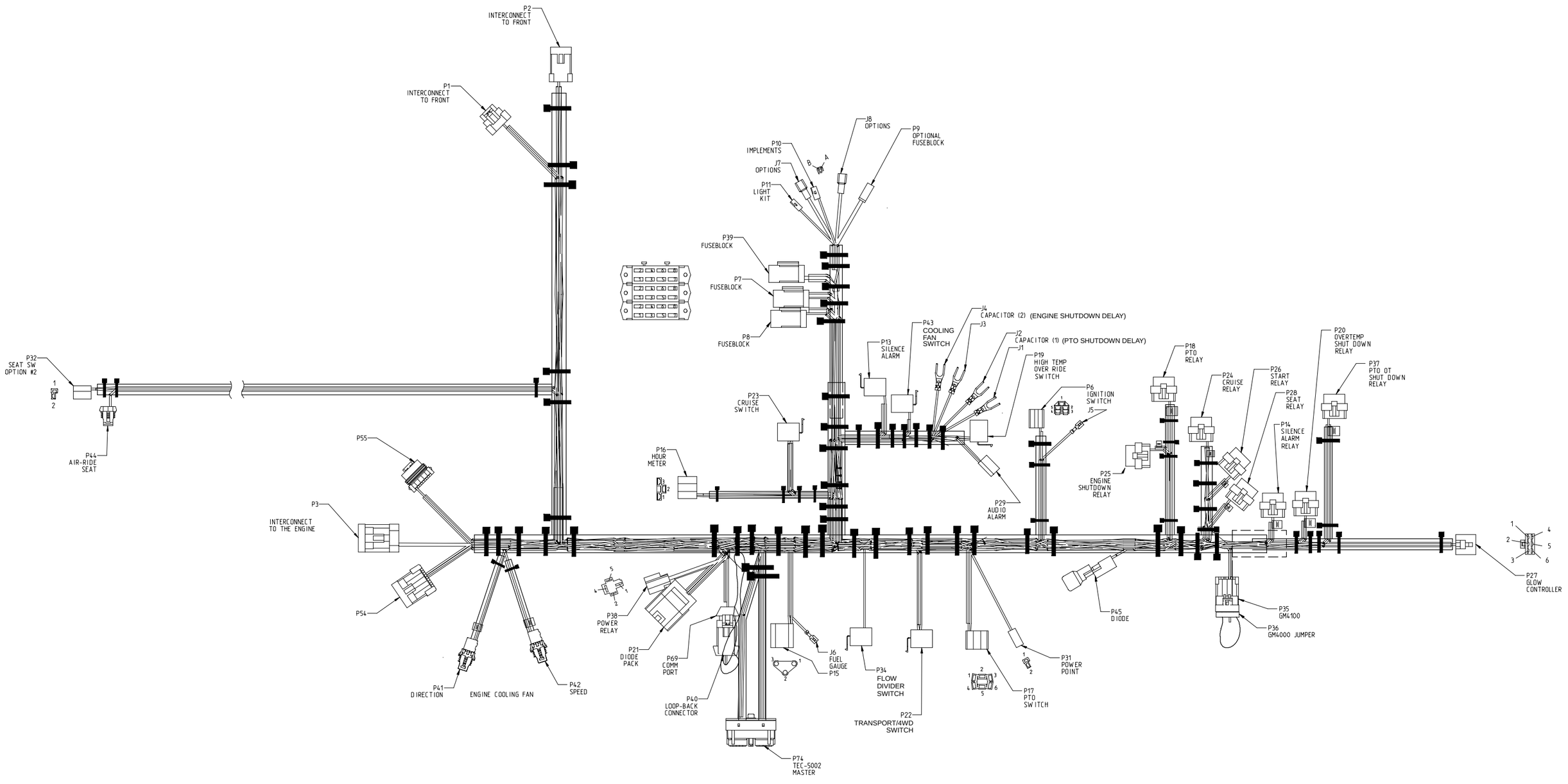


IF THE ENGINE COOLANT TEMPERATURE RISES TO 240° F (115° C), THE DUAL TEMPERATURE SHUTDOWN SWITCH CLOSES. THIS CLOSED SWITCH CAUSES THE OVER TEMPERATURE SHUTDOWN RELAY TO ENERGIZE AND REMOVES ELECTRICAL POWER FROM THE ENGINE RUN SOLENOID AND FUEL PUMP SHUTTING OFF THE ENGINE.
NOTE: IN THIS OVER TEMPERATURE CONDITION, THE ENGINE CAN BE STARTED BY DEPRESSING THE OVERRIDE SWITCH WHICH DE-ENERGIZES THE OVER TEMPERATURE SHUTDOWN RELAY RETURNING POWER TO THE ENGINE RUN SOLENOID AND FUEL PUMP.

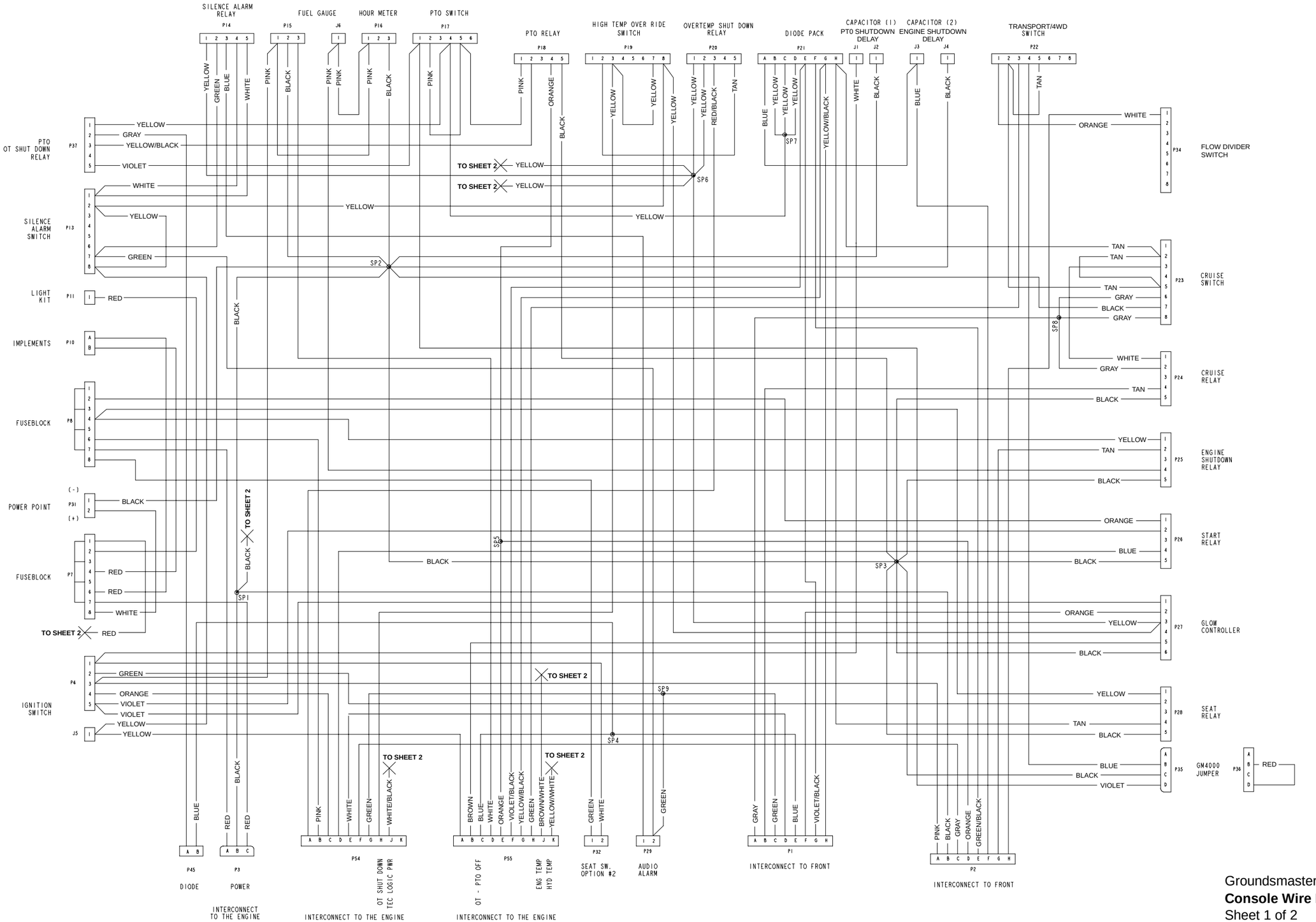
Groundsmaster 4100–D

Over Temperature Shutdown Circuits

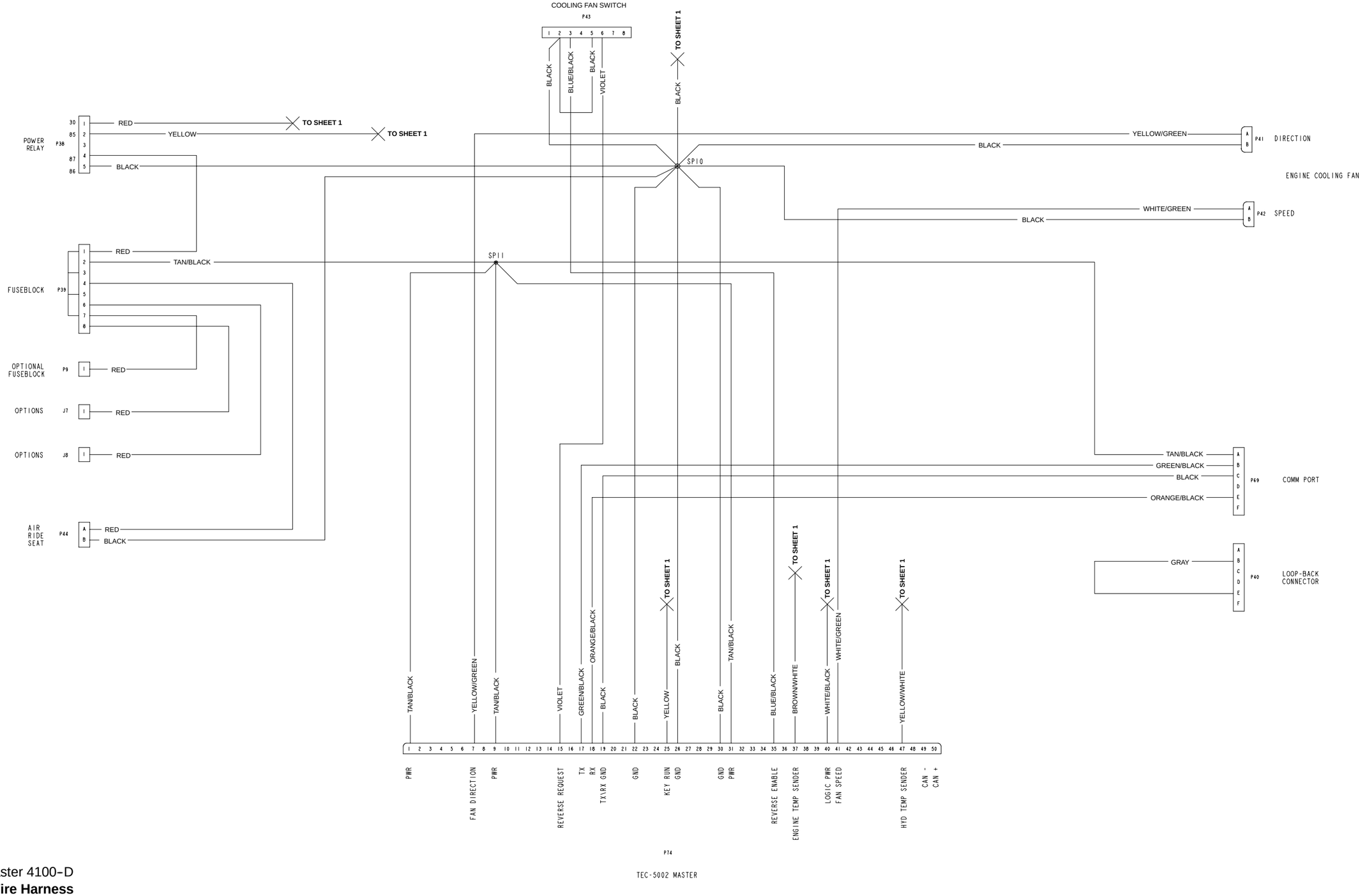
Power Current
Control Current
Indication Current



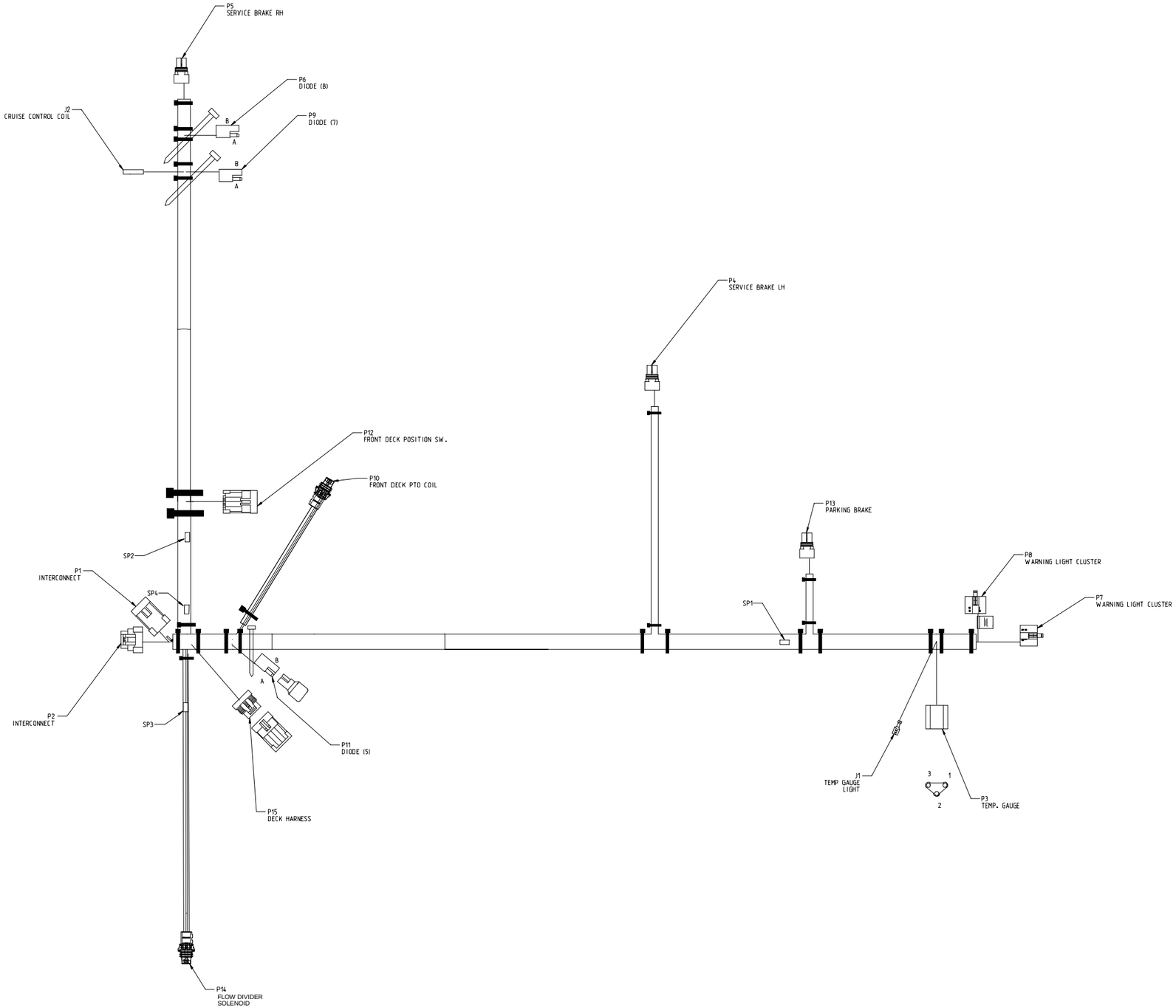
Groundsmaster 4100-D
Console Wire Harness

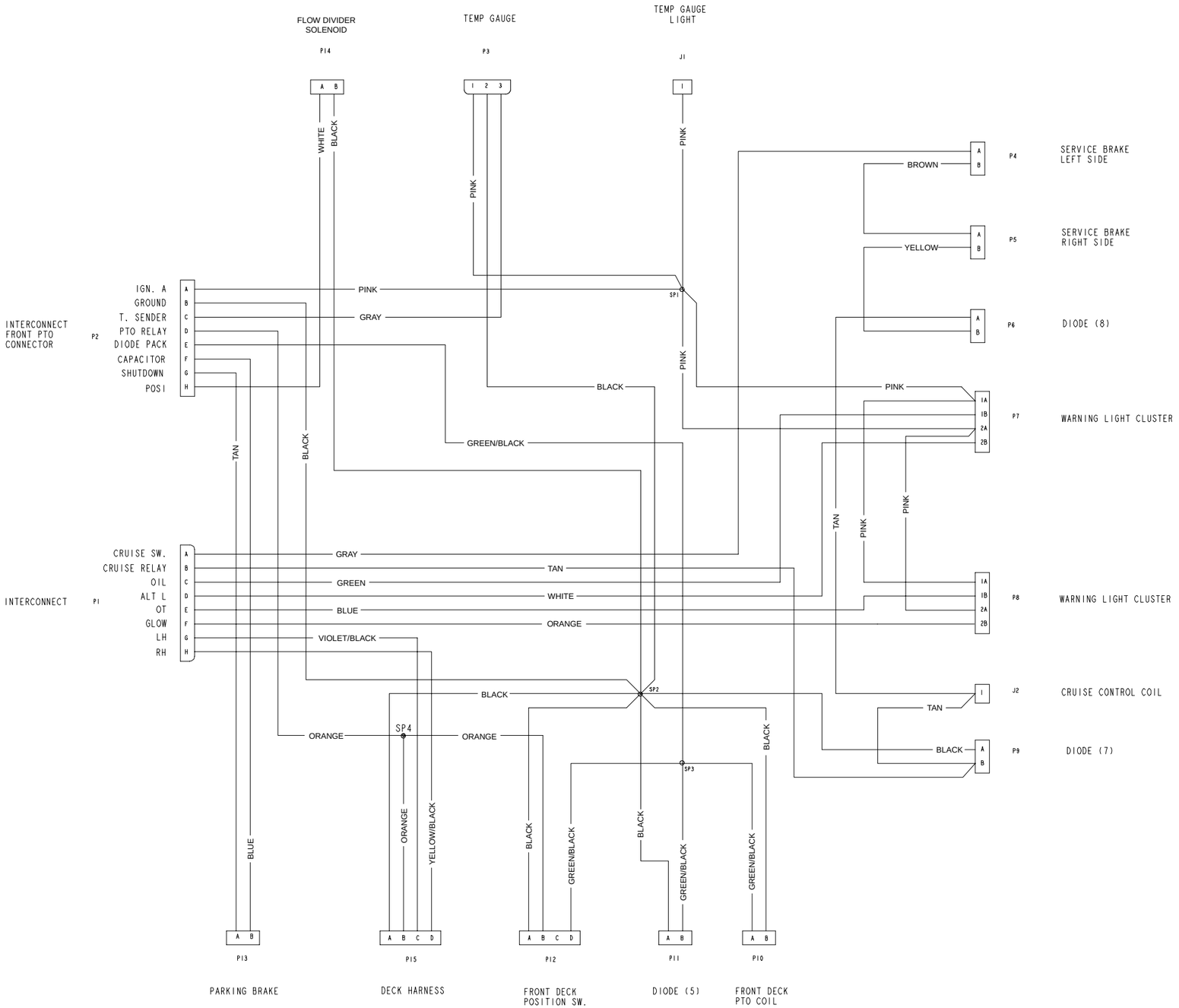


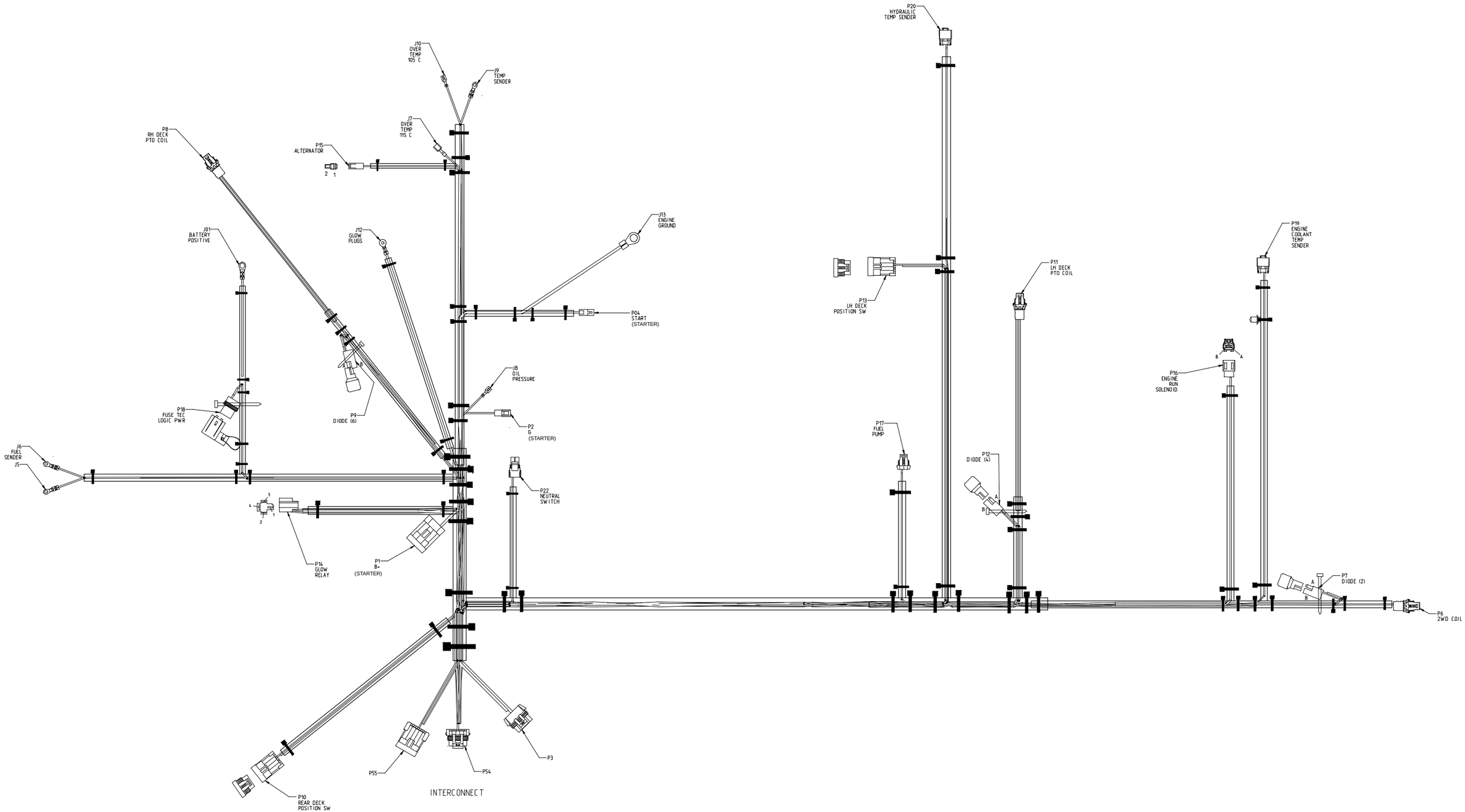
Groundsmaster 4100-D
Console Wire Harness
Sheet 1 of 2

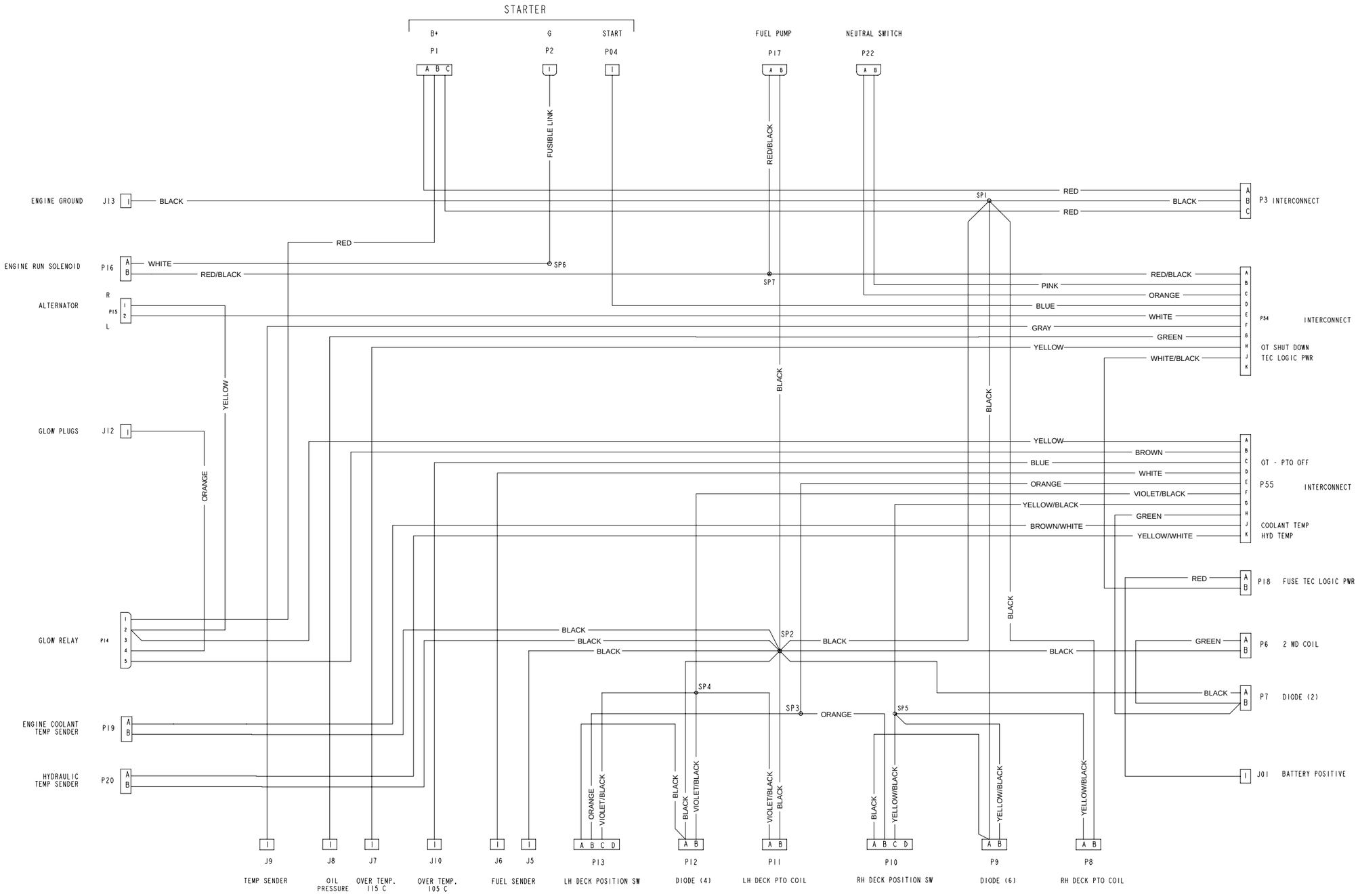


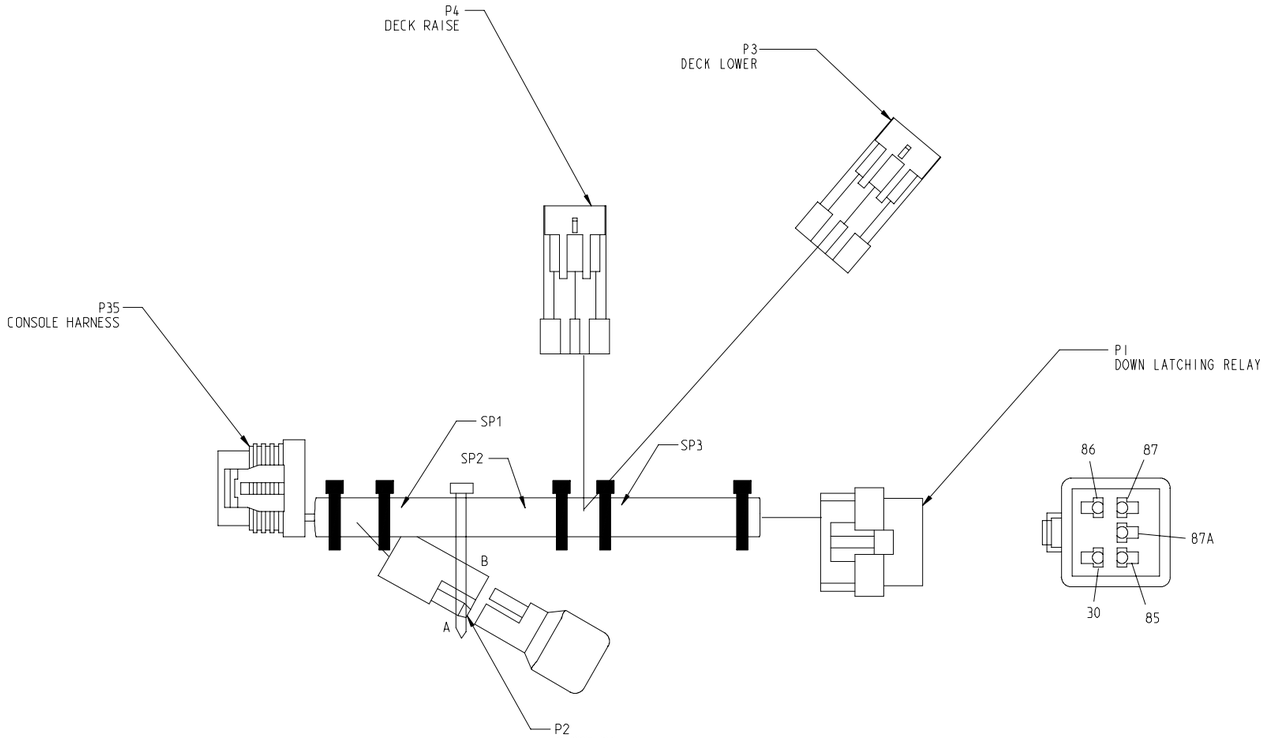
Groundsmaster 4100-D
Console Wire Harness
Sheet 2 of 2

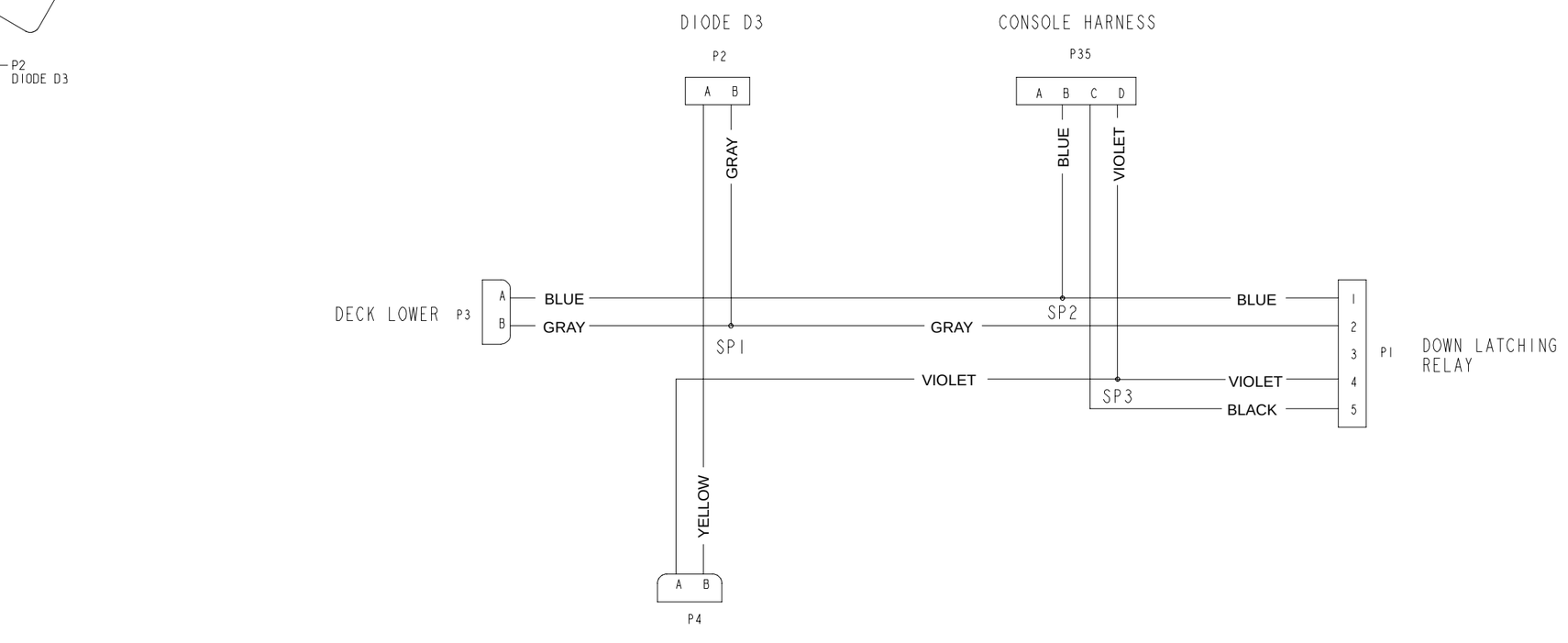

P5
SERVICE BRAKE RH
P6
DIODE (B)
J2
CRUISE CONTROL COIL
P9
DIODE (7)
B
A
B
A
P12
FRONT DECK POSITION SW.
P10
FRONT DECK PTO COIL
SP2
P1
INTERCONNECT
SP4
P2
INTERCONNECT
SP3
B
A
P11
DIODE (5)
P15
DECK HARNESS
P14
FLOW DIVIDER
SOLENOID
P4
SERVICE BRAKE LH
P13
PARKING BRAKE
SP1
P8
WARNING LIGHT CLUSTER
P7
WARNING LIGHT CLUSTER
J1
TEMP GAUGE
LIGHT
3
1
2
P3
TEMP. GAUGE

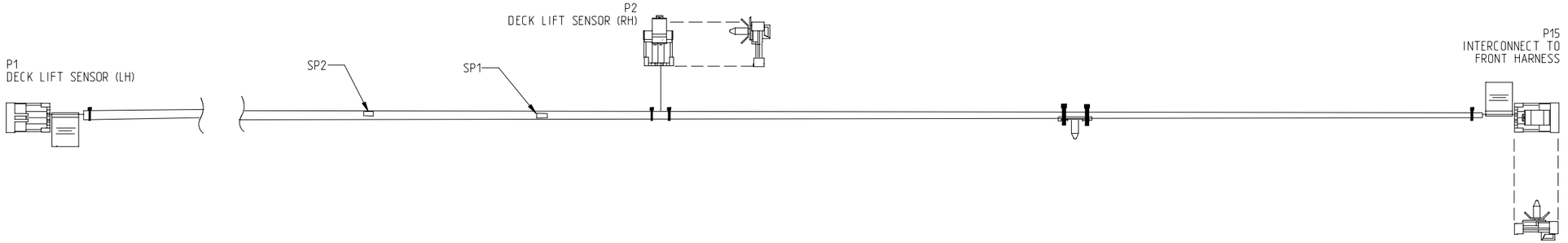

FLOW DIVIDER SOLENOID
P14
A B
WHITE
BLACK
TEMP GAUGE
P3
1 2 3
PINK
TEMP GAUGE LIGHT
J1
1
PINK
INTERCONNECT FRONT PTO CONNECTOR
P2
IGN. A
GROUND
T. SENDER
PTO RELAY
DIODE PACK
CAPACITOR
SHUTDOWN
POSI
A
B
C
D
E
F
G
H
PINK
GRAY
SP1
BLACK
PINK
TAN
BLACK
GREEN/BLACK
BROWN
YELLOW
P4
SERVICE BRAKE LEFT SIDE
P5
SERVICE BRAKE RIGHT SIDE
P6
DIODE (8)
P7
WARNING LIGHT CLUSTER
1A
1B
2A
2B
TAN
PINK
PINK
INTERCONNECT
P1
CRUISE SW.
CRUISE RELAY
OIL
ALT L
OT
GLOW
LH
RH
GRAY
TAN
GREEN
WHITE
BLUE
ORANGE
VIOLET/BLACK
P8
WARNING LIGHT CLUSTER
SP2
BLACK
J2
CRUISE CONTROL COIL
TAN
SP4
ORANGE
ORANGE
BLACK
BLACK
P9
DIODE (7)
SP3
BLUE
ORANGE
YELLOW/BLACK
BLACK
GREEN/BLACK
BLACK
GREEN/BLACK
GREEN/BLACK
A B
A B C D
A B C D
A B
A B
P13
P15
P12
P11
P10
PARKING BRAKE
DECK HARNESS
FRONT DECK POSITION SW.
DIODE (5)
FRONT DECK PTO COIL

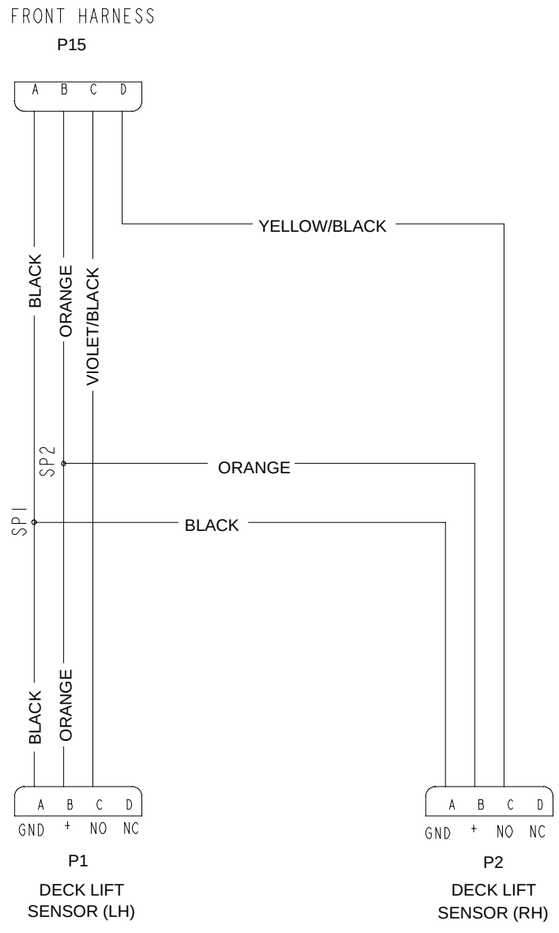

J10
OVER
TEMP
105 C
J9
TEMP
SENDER
J7
OVER
TEMP
115 C
P8
RH DECK
PTO COIL
P15
ALTERNATOR
2 1
J01
BATTERY
POSITIVE
J12
GLOW
PLUGS
J13
ENGINE
GROUND
P04
START
(STARTER)
J8
OIL
PRESSURE
P2
G
(STARTER)
P18
FUSE TEC
LOGIC PWR
P9
DIODE (6)
J6
FUEL
SENDER
J5
P22
NEUTRAL
SWITCH
P14
GLOW
RELAY
P1
B+
(STARTER)
P55
P54
P3
P10
REAR DECK
POSITION SW
INTERCONNECT
P20
HYDRAULIC
TEMP SENDER
P13
LH DECK
POSITION SW
P11
LH DECK
PTO COIL
P17
FUEL
PUMP
P12
DIODE (4)
P19
ENGINE
COOLANT
TEMP
SENDER
P16
ENGINE
RUN
SOLENOID
P7
DIODE (2)
P6
2WD COIL


STARTER
B+
P1
G
P2
START
P04
FUEL PUMP
P17
NEUTRAL SWITCH
P22
FUSIBLE LINK
RED/BLACK
ENGINE GROUND
J13
BLACK
RED
SP1
P3 INTERCONNECT
ENGINE RUN SOLENOID
P16
WHITE
RED/BLACK
SP6
SP7
ALTERNATOR
P15
R
L
YELLOW
BLACK
P54
INTERCONNECT
OT SHUT DOWN
TEC LOGIC PWR
PINK
ORANGE
BLUE
WHITE
GRAY
GREEN
YELLOW
WHITE/BLACK
GLOW PLUGS
J12
ORANGE
P55
INTERCONNECT
OT - PTO OFF
BROWN
VIOLET/BLACK
YELLOW/BLACK
BROWN/WHITE
YELLOW/WHITE
COOLANT TEMP
HYD TEMP
GLOW RELAY
P14
SP2
SP3
SP4
SP5
P18
FUSE TEC LOGIC PWR
P6
2 WD COIL
P7
DIODE (2)
J01
BATTERY POSITIVE
ENGINE COOLANT TEMP SENDER
P19
HYDRAULIC TEMP SENDER
P20
J9
TEMP SENDER
J8
OIL PRESSURE
J7
OVER TEMP. 115 C
J10
OVER TEMP. 105 C
J6
J5
FUEL SENDER
P13
LH DECK POSITION SW
P12
DIODE (4)
P11
LH DECK PTO COIL
P10
RH DECK POSITION SW
P9
DIODE (6)
P8
RH DECK PTO COIL


P4
DECK RAISE
P3
DECK LOWER
P35
CONSOLE HARNESS
P1
DOWN LATCHING RELAY
SP1
SP2
SP3
B
A
P2
86
87
87A
30
85


DIODE D3
P2
A B
GRAY
A B C D
BLUE
VIOLET
DECK LOWER P3
A
B
BLUE
GRAY
SP1
SP2
BLUE
GRAY
VIOLET
SP3
VIOLET
BLACK
1
2
3
4
5
P1
DOWN LATCHING RELAY
YELLOW
A B
P4
DECK RAISE
CONSOLE HARNESS
P35


P1
DECK LIFT SENSOR (LH)
SP2
SP1
P2
DECK LIFT SENSOR (RH)
P15
INTERCONNECT TO
FRONT HARNESS


FRONT HARNESS
P15
A B C D
YELLOW/BLACK
BLACK
ORANGE
VIOLET/BLACK
SP2
ORANGE
SP1
BLACK
BLACK
ORANGE
A B C D
GND + NO NC
P1
DECK LIFT
SENSOR (LH)
A B C D
GND + NO NC
P2
DECK LIFT
SENSOR (RH)