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TORO®

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Service Manual

Groundsmaster® 4100-D

(Model 30411)

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2003	Initial Issue.
A	2004	Updated Engine chapter.
B	2005	Updated Electrical chapter.
C	2007	Updated Engine chapter.
D	2007	Updated Hydraulic chapter.
E	2012	Updated Electrical chapter.
F	2012	Updated Hydraulic chapter.
G	03/2018	Added revision history.

Reader Comments

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

or Mail to:

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NOTES

Service Manual

(Model 30411)

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.

REFER TO THE OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Replacement Operator's Manuals and Parts Catalogs 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. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. A replacement Operator's Manual is available on the Internet at www.Toro.com or by sending the complete model and serial number to:

   The Toro Company
   Attn. Technical Publications
   8111 Lyndale Avenue South
   Bloomington, Minnesota 55420−1196

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 unit 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. Engage 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. Set parking brake.

   C. Disengage cutting unit 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 unit should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of the cutting unit accidentally 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, set 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 the cutting unit 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 units 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 jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions).

Jacking Instructions

CAUTION

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 machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or 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.

3. Position jack stands or hardwood blocks under the frame as close to the wheels 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. Use jack stands or blocks under the rear axle to support the machine.

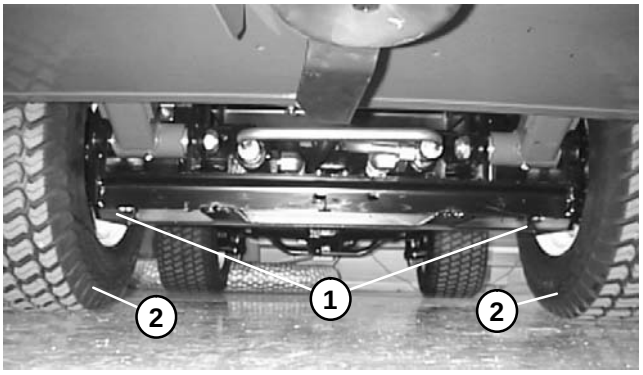

Figure 1

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

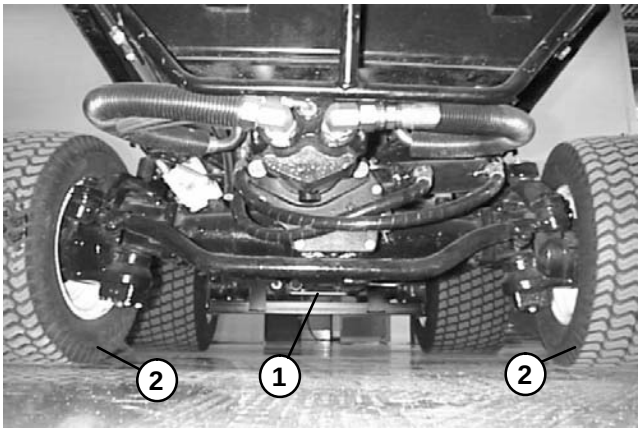

Figure 2

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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Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Groundsmaster 4100 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.

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	0.9375	— 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

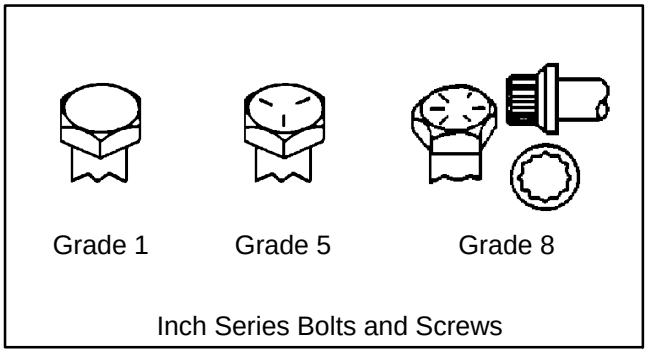
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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, 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.

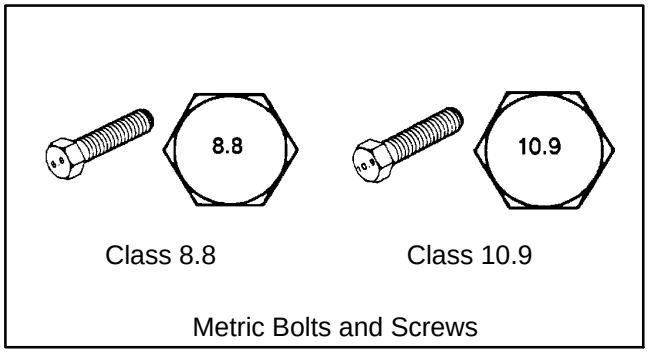
The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws

Figure 1



Metric Bolts and Screws

Figure 2

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

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in−lb	**in−lb**	**N−cm**	**in−lb**	**N−cm**	**in−lb**	**N−cm**
# 6 − 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 − 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 − 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 − 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 − 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 − 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 − 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 − 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 − 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 − 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	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 ± 4	58 ± 5
3/8 − 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
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 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 − 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 − 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 − 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 − 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 − 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 − 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
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 ± 45	644 ± 61	660 ± 60	895 ± 81

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 oil, graphite, 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)

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 ± 5 in−lb	640 ± 60 N−cm	78 ± 7 in−lb	885 ± 80 N−cm
M6 X 1.0	96 ± 9 in−lb	1018 ± 100 N−cm	133 ± 13 in−lb	1500 ± 150 N−cm
M8 X 1.25	19 ± 2 ft−lb	26 ± 3 N−m	27 ± 2 ft−lb	36 ± 3 N−m
M10 X 1.5	38 ± 4 ft−lb	52 ± 5 N−m	53 ± 5 ft−lb	72 ± 7 N−m
M12 X 1.75	66 ± 7 ft−lb	90 ± 10 N−m	92 ± 9 ft−lb	125 ± 12 N−m
M16 X 2.0	166 ± 15 ft−lb	225 ± 20 N−m	229 ± 22 ft−lb	310 ± 30 N−m
M20 X 2.5	325 ± 33 ft−lb	440 ± 45 N−m	450 ± 37 ft−lb	610 ± 50 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 oil, graphite, 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 0.0885 = in−lb
N−m X 0.7376 = ft−lb

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.

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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, V2003−T 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, V2003−T. 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.

Stopping the Engine

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

Specifications

Item	Description
Make / Designation	Kubota, 4−Cycle, 4 Cylinder, Water Cooled, Turbocharged, Diesel Engine
Horse Power	58 HP (43.3 kW) @ 2600 RPM
Bore mm (in.)	83.0 (3.27)
Stroke mm (in.)	92.4 (3.64)
Total Displacement cc (cu. in.)	1999 (121.99)
Firing Order	1−3−4−2
Combustion Chamber	Spherical Type
Fuel	No. 2 Diesel Fuel (ASTM D975)
Fuel Capacity liters (U.S. gallons)	72 (19.0)
Fuel Injection Pump	Bosch Type Mini Pump (PFR)
Governor	Centrifugal Mechanical
Low Idle (no load)	1375 ± 50 RPM
High Idle (no load)	2730 ± 30 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Compression Ratio	22.0:1
Injection Nozzle	Bosch Throttle Type
Engine Oil	SAE 10W30 or 10W40 Detergent (API CD, or higher)
Oil Pump	Trochoid Type
Crankcase Oil Capacity liters (U.S. quarts)	7.6 (8.0) with Filter
Starter	12 VDC, 1.4 kW
Alternator/Regulator	12 VDC, 40 AMP
Coolant Capacity liters (U.S. quarts)	10.4 (11) with 0.9 (1.0) Reservoir
Engine Dry Weight kilograms (U.S. pounds)	184 (406)

Adjustments

Run Solenoid

1. When ignition switch is in the RUN position, the run solenoid should energize and position the fuel stop lever to within 1/16” (1.6 mm) of stop on the injection pump.

2. If adjustment is needed, loosen lock nut and rotate the threaded end of the swivel until the lever is properly positioned.

3. Tighten lock nut. Recheck adjustment.

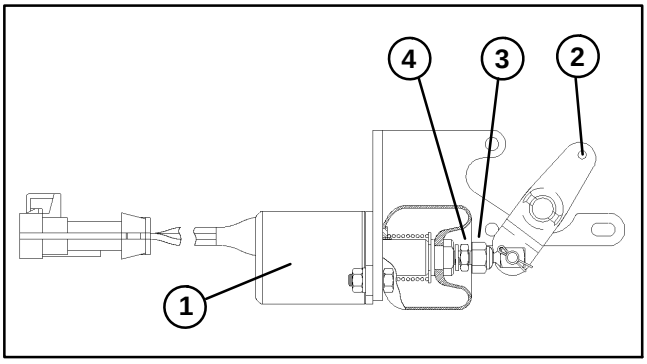

Figure 1

1. **Run solenoid**
2. **Fuel stop lever (run)**
3. **Swivel**
4. **Lock nut**

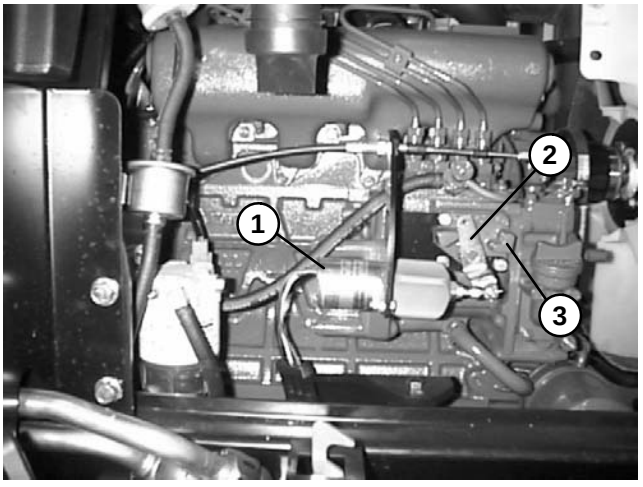

Figure 2

1. **Run solenoid**
2. **Fuel stop lever (off)**
3. **Injection pump stop**

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Air Filter System

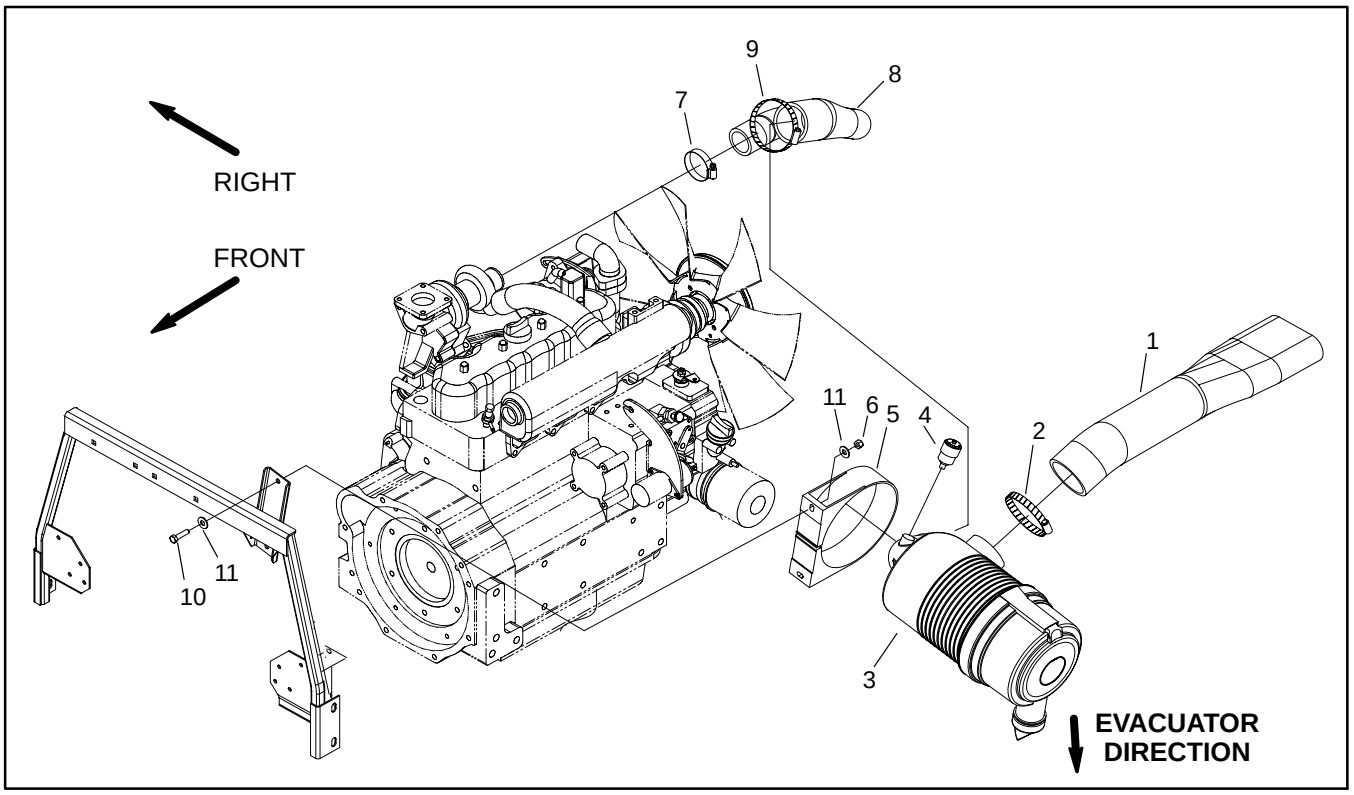

Figure 3

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)**

Removal

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

Installation

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

1. Reassemble air cleaner system using Figure 3 as a guide.

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 modify clearance, move and/or rotate air cleaner body in air cleaner strap. Verify that tabs in strap mesh fully with slots in air cleaner body.

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

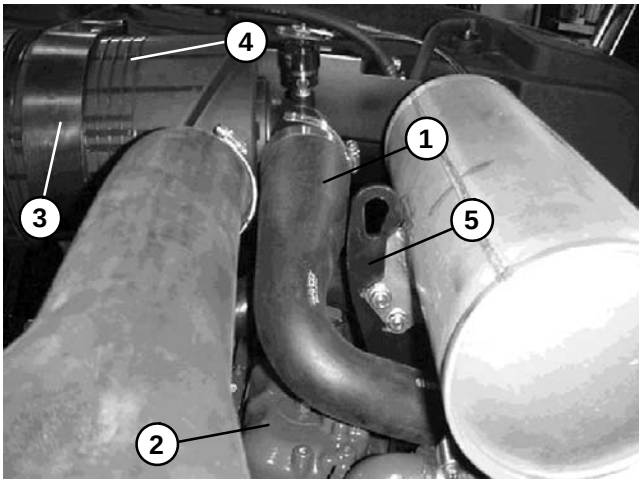

Figure 4

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

Exhaust System

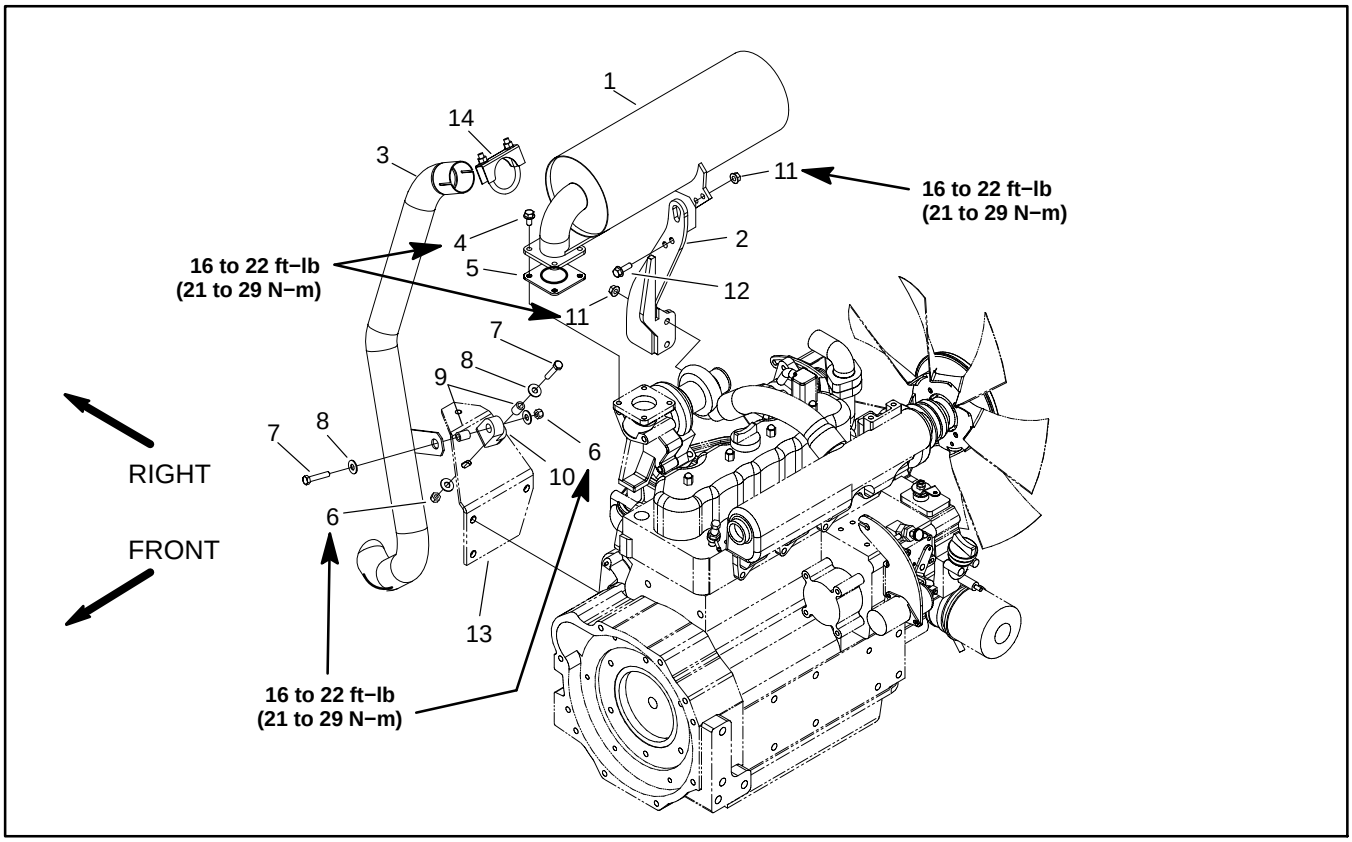

Figure 5

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

Removal

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 unit, stop engine, engage parking brake, and remove key from the ignition switch.

2. Remove muffler and/or muffler bracket from the engine as necessary using Figure 5 as a guide.

Installation

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 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 muffler and/or muffler bracket to the engine using Figure 5 as a guide. Hand tighten and then torque the following fasteners from 16 to 22 ft−lb (21 to 29 N−m) in the sequence listed (Fig. 6):

A. Locknuts used on rubber hanger cap screws.

B. Flange nuts that secure muffler to muffler bracket.

C. Flange head screws that secure muffler flange to engine.

D. Flange nuts that secure muffler bracket to engine.

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

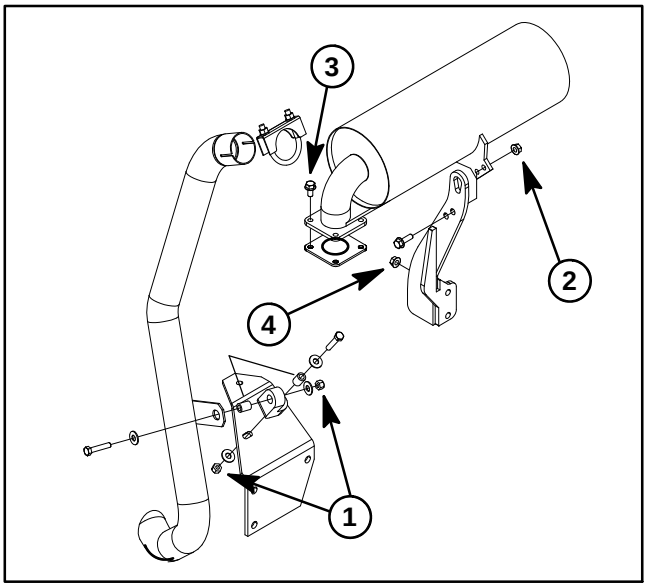

Figure 6

Fuel System

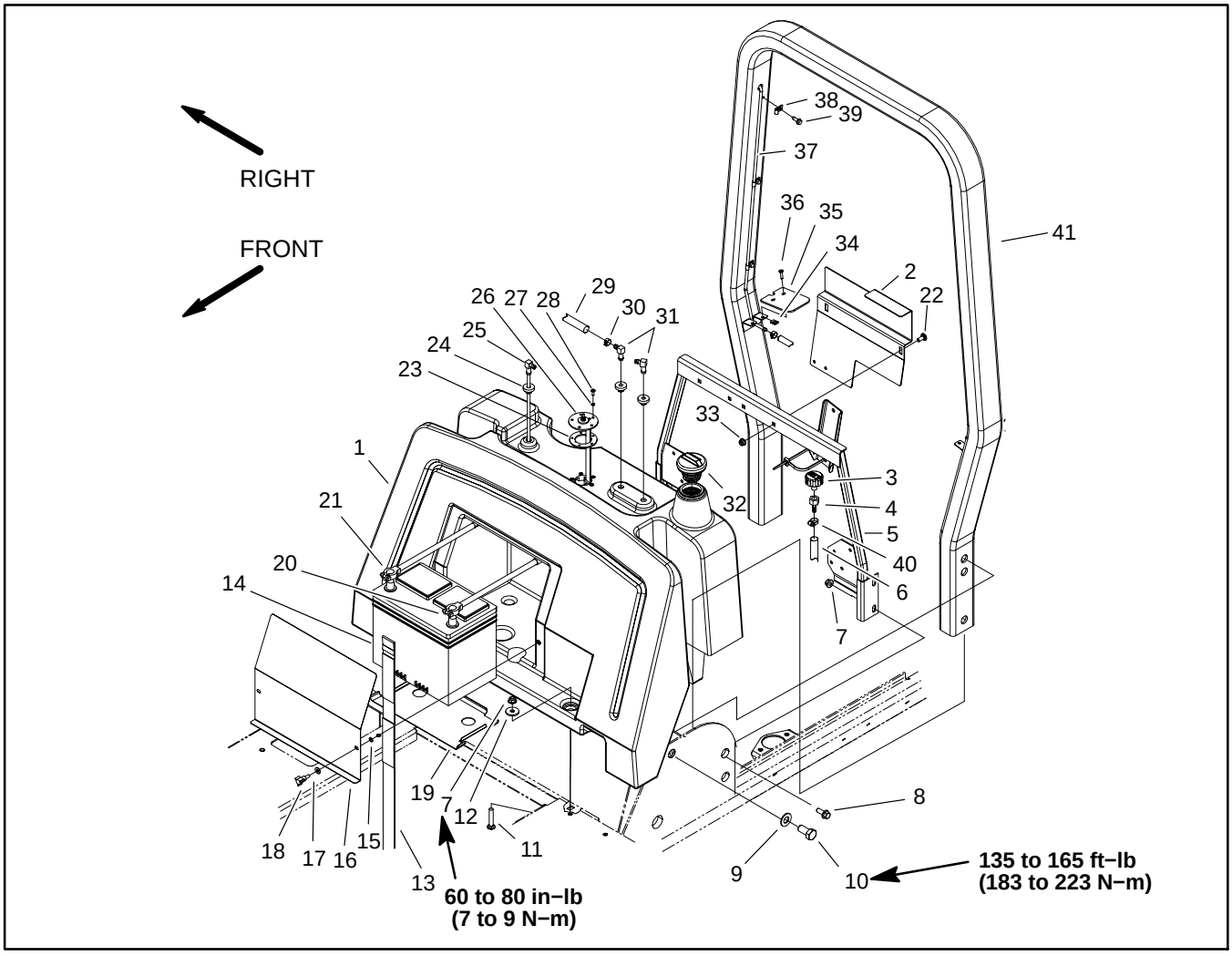

Figure 7

1. Fuel tank
2. Fuel tank bracket
3. Air breather
4. Female hose barb
5. Tank support assembly
6. Fuel hose
7. Locking 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.

Drain and Clean Fuel Tank

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

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

Fuel Tank Removal (Fig. 7)

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

2. Raise 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

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

   A. Torque two locking 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 (see Operator's Manual).

Radiator

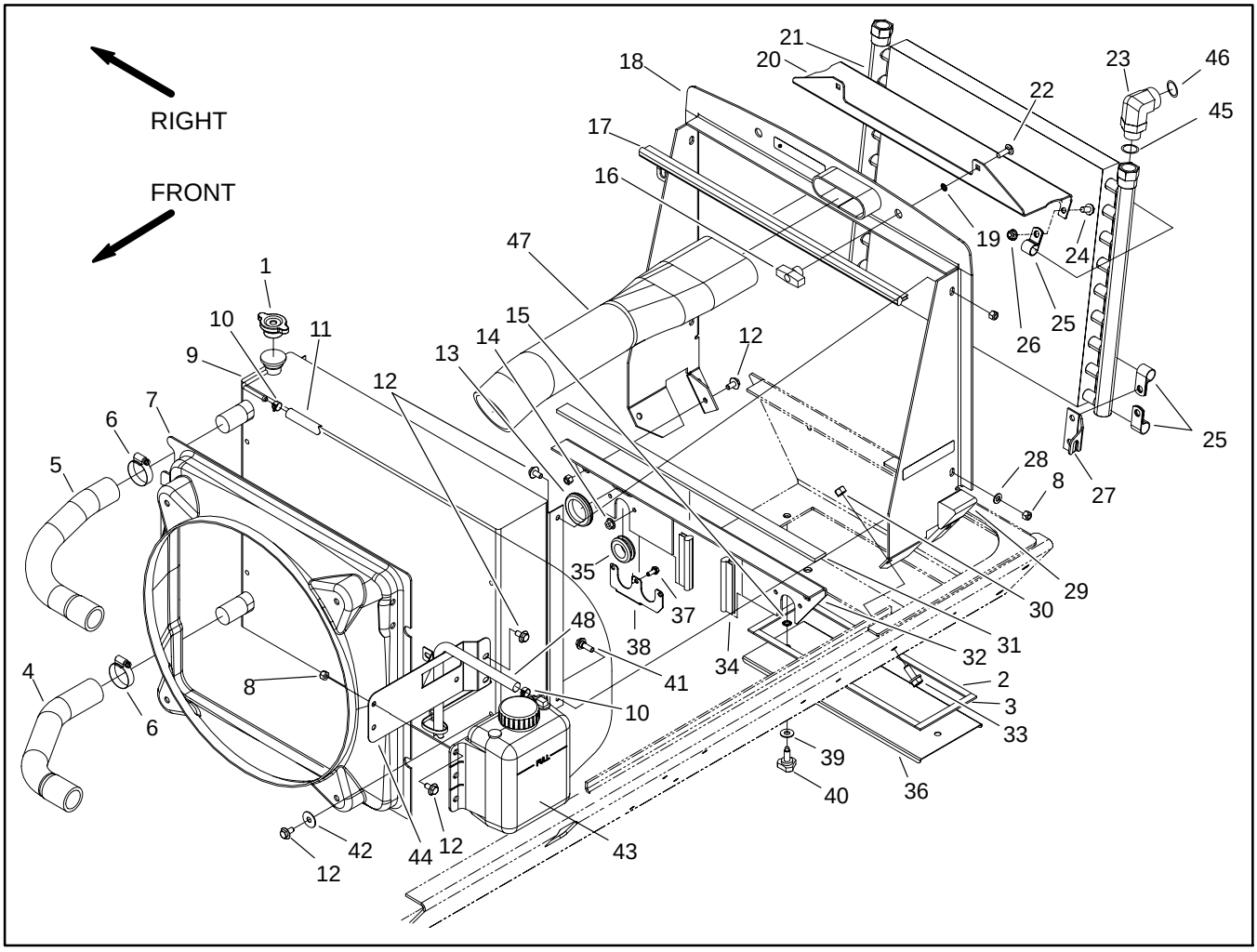

Figure 8

1. **Radiator cap**
2. **Foam strip**
3. **Foam strip**
4. **Lower radiator hose**
5. **Upper radiator hose**
6. **Hose clamp**
7. **Radiator shroud**
8. **Lock nut**
9. **Radiator**
10. **Hose clamp**
11. **Reservoir hose**
12. **Flange head screw**
13. **Grommet**
14. **Flange nut**
15. **Retaining ring**
16. **Knob (2 used)**
17. **Bulb seal**
18. **Radiator support assembly**
19. **Retaining ring**
20. **Oil cooler bracket**
21. **Oil cooler**
22. **Carriage screw**
23. **Oil cooler hydraulic fitting (2 used)**
24. **Flange head screw**
25. **Clamp (6 used)**
26. **Flange nut**
27. **Oil cooler bracket (RH shown)**
28. **Flat washer**
29. **Foam plug**
30. **Lock nut**
31. **Foam strip**
32. **Lower radiator support**
33. **Flange head screw (4 used)**
34. **Bulb seal**
35. **Grommet (2 used)**
36. **Frame cover**
37. **Flange head screw**
38. **Plate**
39. **Flat washer**
40. **Knob**
41. **Shoulder bolt (2 used)**
42. **Flat washer**
43. **Coolant reservoir**
44. **Coolant reservoir bracket**
45. **O−ring**
46. **O−ring**
47. **Air cleaner hose**
48. **Reservoir hose**

Removal

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

2. Open engine hood on the machine.

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 is located near the left hand wing deck manifold (Fig. 9).

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

5. Remove air cleaner hose (item 47).

6. Disconnect reservoir hose (item 11) from the radiator vent tube.

7. Detach radiator shroud from the radiator by removing four flange head screws and flat washers. Position shroud away from radiator.

8. Remove flange head screws, flat washers, and lock nuts that secure the radiator to the support frame. Pull radiator from the machine.

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

Installation

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

2. Position radiator to the support frame. Secure radiator to the support frame with lock nuts, flat washers, and flange head screws.

3. Attach radiator shroud to the radiator with flange screws and flat washers. Make sure that clearance between shroud and fan is at least .180” (4.6 mm) at all points.

4. Connect reservoir hose (item 11) to the radiator vent tube.

5. Connect hoses (upper and lower) to the radiator.

6. Reinstall air cleaner hose (item 47).

7. Make sure radiator drain is closed. Fill radiator with coolant (see Operator’s Manual).

8. Close and secure engine hood on the machine.

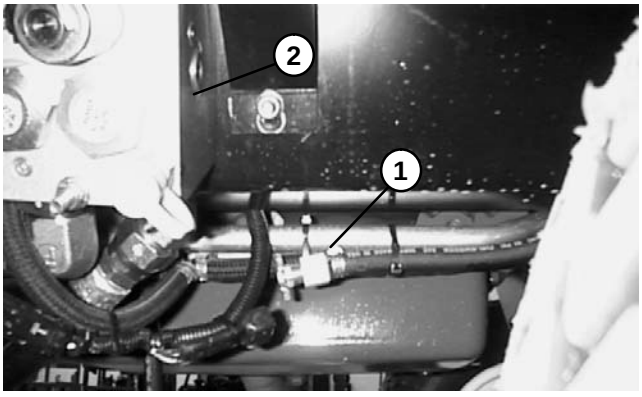

Figure 9

1. **Radiator drain**
2. **LH wing deck manifold**

Engine

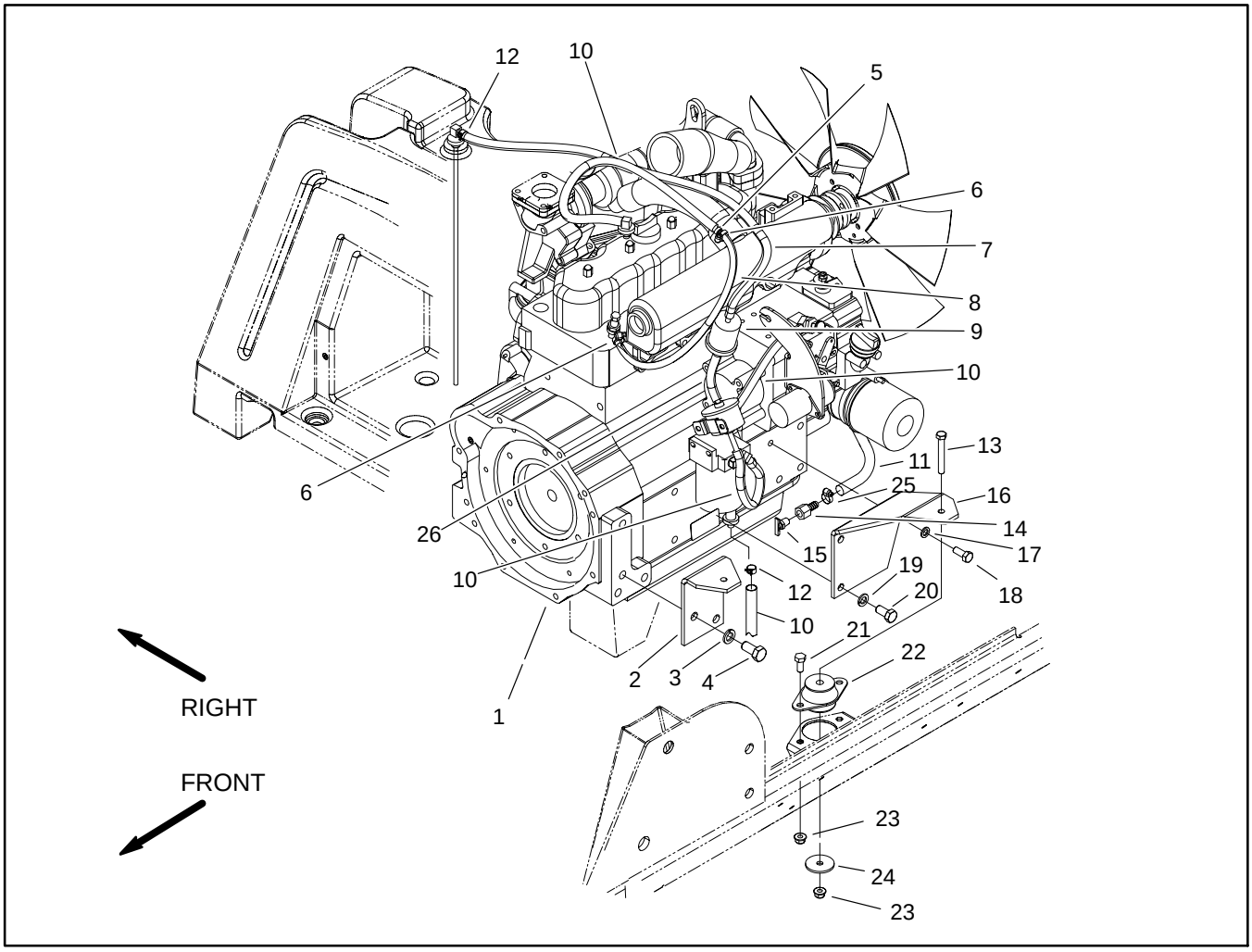

Figure 10

1. **Engine**
2. **Engine mount bracket (RH shown)**
3. **Lock washer**
4. **Cap screw**
5. **Barb fitting**
6. **Hose clamp**
7. **Hose**
8. **Fuel line**
9. **Fuel filter**
10. **Fuel line**
11. **Coolant drain hose**
12. **Hose clamp**
13. **Cap screw (4 used)**
14. **Barb fitting (female)**
15. **Coolant drain cock fitting**
16. **Engine mount bracket (RH shown)**
17. **Lock washer**
18. **Cap screw**
19. **Lock washer**
20. **Cap screw**
21. **Cap screw (8 used)**
22. **Rubber engine mount (4 used)**
23. **Flange head locking nut**
24. **Rebound washer**
25. **Hose clamp**
26. **Fuel line**

Engine Removal

1. Park machine on a level surface, lower cutting unit, stop engine, engage 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 engine 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). Disconnect coolant hoses from the radiator.

CAUTION

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

5. Remove exhaust system from engine (see Muffler Removal).

6. Remove air cleaner system from engine (see Air Cleaner Removal).

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

A. The temperature sender and alternator (Fig 11). Note: red wire attached to alternator with washer, nut, and boot does not have to be removed.

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

C. The high temperature shutdown switch and glow plug (Fig. 14).

D. Battery, frame, and wire harness ground at the engine block (Fig. 15).

E. The electric starter (Fig. 15) and low oil pressure switch (near electric starter).

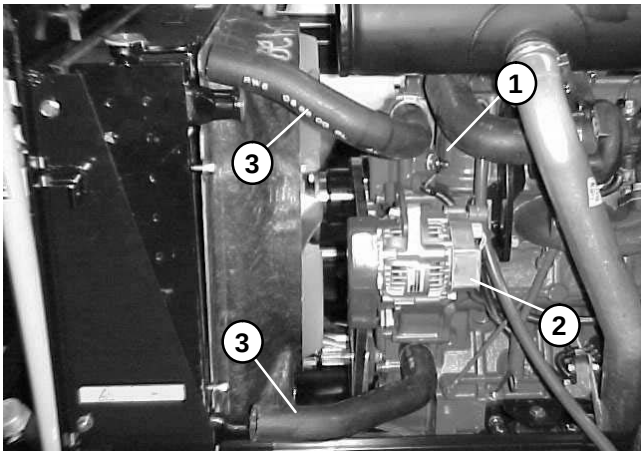

Figure 11

1. Temperature sender
2. Alternator
3. Coolant hose

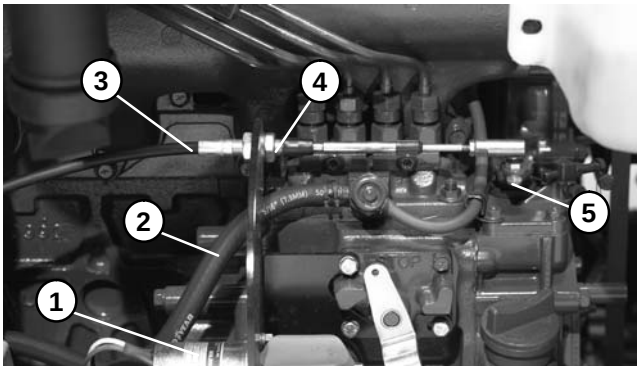

Figure 12

1. Run solenoid
2. Fuel line
3. Throttle cable
4. Cable jam nut
5. Cable washer/lock nut

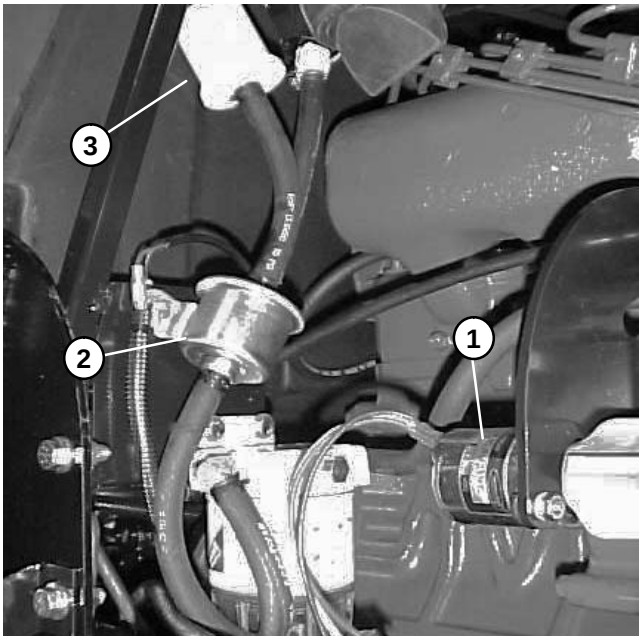

Figure 13

1. Run solenoid
2. Fuel pump
3. Fuel filter

8. Disconnect fuel line from injection pump (Fig. 12). Cap fuel line and injector pump fuel inlet to prevent contamination.

9. Disconnect throttle cable from the speed control lever by removing the washer and lock nut. Loosen jam nut and take cable from mounting bracket (Fig. 12).

10. Remove coolant reservoir and bracket from fan shroud.

11. Remove four flange head screws and flat washers securing the fan shroud to the radiator.

12. Disconnect two wires from neutral switch on hydraulic traction pump.

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

13. Remove hydraulic pump assembly from engine (see Pump Assembly in Chapter 4 − Hydraulic Systems).

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

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

16. Remove flange head locking nuts, rebound washers, and cap screws securing the engine brackets to the engine mounts.

CAUTION

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

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

17. Slowly remove engine from the machine.

18. If necessary, remove engine mount brackets from the engine using Figure 10 as a guide. Note cap screw length and position during removal.

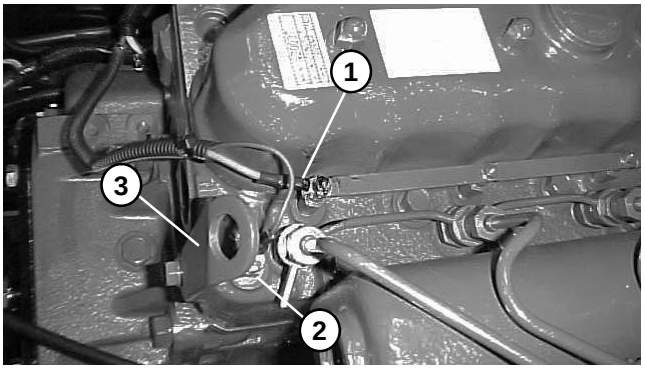

Figure 14

1. **Glow plug wire**
2. **High temp shutdown**
3. **Rear engine lift tab**

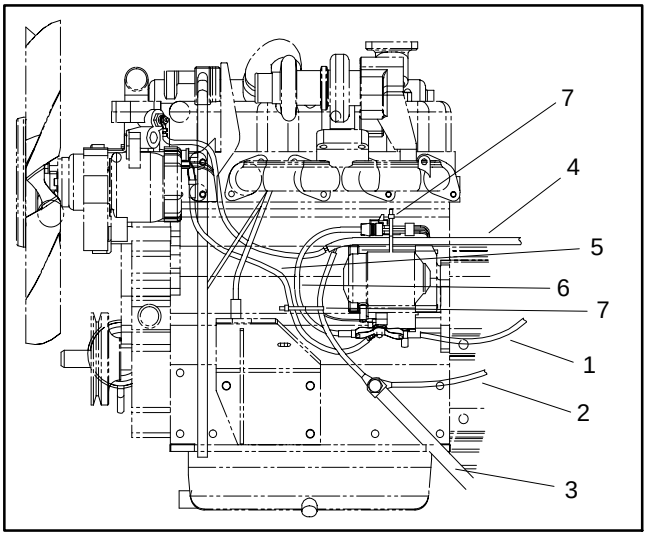

Figure 15

1. **Battery cable (+)**
2. **Battery cable (−)**
3. **Engine to frame ground**
4. **Engine wire harness**
5. **Alternator wire**
6. **Fusible link harness**
7. **Cable tie**

Engine Installation

1. If removed, install engine mount brackets to the engine using Figure 10 as a guide.

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

3. Position fan shroud around the engine fan.

CAUTION

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

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

4. Slowly lower engine into the machine.

5. Align engine to the rubber engine mounts and secure with cap screws, rebound washers, and flange head locking nuts.

6. Secure fan shroud to the radiator with four cap screws, flat washers, and locknuts. Make sure that clearance between shroud and fan is at least .180" (4.6 mm) at all points.

7. Install coolant reservoir bracket and reservoir to fan shroud.

8. Connect throttle cable to the speed control lever with washer and lock nut. Install cable to mounting bracket (Fig. 12). Adjust throttle cable (see Operator's Manual).

9. Connect fuel line to the injection pump fitting (Fig. 12).

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

10. Install hydraulic pump assembly to engine (see Pump Assembly in Chapter 4 − Hydraulic Systems).

11. Connect two wires to neutral switch on traction pump.

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

A. The temperature sender and alternator (Fig 11).

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

C. The high temperature shutdown switch and glow plug (Fig. 14).

D. Battery, frame, and wire harness ground to the engine block (Fig. 15).

E. The starter (Fig. 15) and low oil pressure switch (near starter).

13. Install air cleaner assembly to the engine (see Air Cleaner Installation).

14. Install exhaust system to machine (see Muffler Installation).

15. Connect coolant hoses to the radiator. Make sure radiator drain is shut. Fill radiator and reservoir with coolant (see Operator's Manual).

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

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

18. Check and adjust engine oil as needed (see Operator's Manual).

19. Check and adjust hydraulic oil as needed (see Operator's Manual).

20. Bleed fuel system (see Operator's Manual).

21. Operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in Chapter 4 − Hydraulic Systems).

Pump Adapter Plate

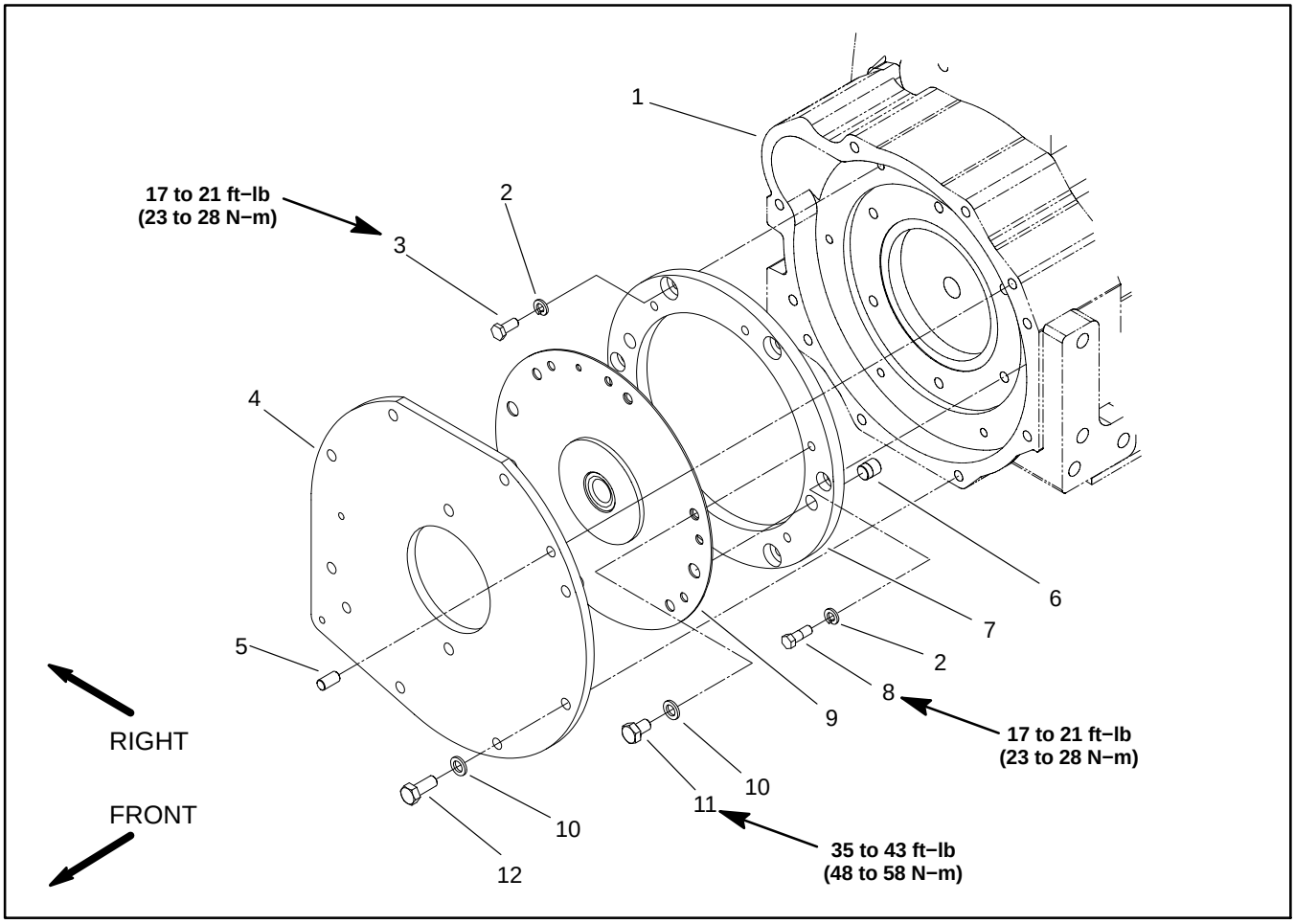

Figure 16

1. **Engine**
2. **Lock washer**
3. **Cap screw (4 used)**
4. **Pump adapter plate**
5. **Plate pin (2 used)**
6. **Dowel (2 used)**
7. **Coupling spacer**
8. **Shoulder bolt (2 used)**
9. **Spring center coupling**
10. **Lock washer**
11. **Cap screw (6 used)**
12. **Cap screw (8 used)**

Disassembly

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

2. Remove pump adapter plate, spring center coupling, and coupling spacer from engine using Figure 16 as a guide.

Assembly

1. Position coupling spacer to engine and align mounting holes. Use two shoulder bolts and lockwashers in the positions shown in Figure 17 to secure the spacer to the half threaded holes in engine flywheel. Torque shoulder bolts from 17 to 21 ft−lb (23 to 28 N−m).

2. Install four cap screws and lockwashers to coupling spacer and flywheel. Torque cap screws from 17 to 21 ft−lb (23 to 28 N−m).

3. Place dowels in locating holes of coupling spacer (Fig. 17).

4. Position spring center coupling (coil springs toward engine (Fig. 18)) over dowels. Secure coupling to coupling spacer with cap screws and lockwashers. Torque cap screws from 35 to 43 ft−lb (48 to 58 N−m).

5. Install plate pins into engine casting. Position pump adapter plate to engine using plate pins as alignment points. Secure adaptor plate with cap screws and lock washers using a star pattern tightening procedure.

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

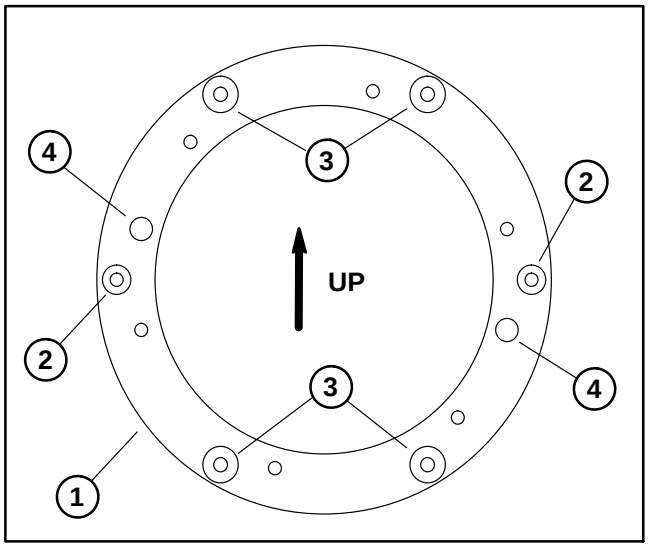

Figure 17

1. Coupling spacer
2. Shoulder bolt position
3. Cap screw position
4. Dowel position

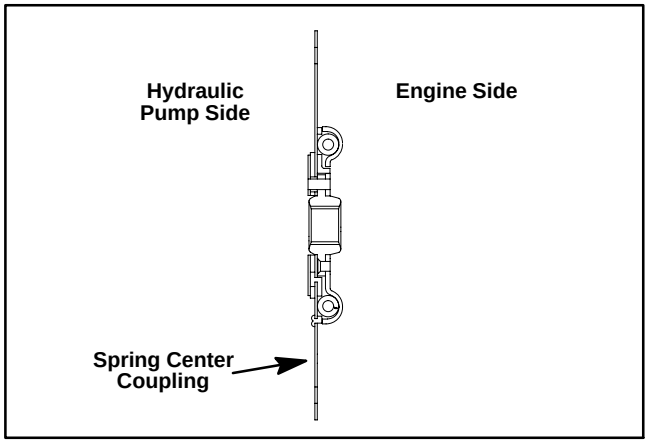

Figure 18

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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	Variable displacement piston pump 4000 PSI (274 bar) 5000 PSI (343 bar) 250 PSI (17 bar)
Gear Pump Steering Relief Pressure Lift/Lower Relief Pressure	3 section, positive displacement gear type pump 1350 PSI (93 bar) 2525 PSI (174 bar)
Front Wheel Motors	Fixed displacement piston motors
Rear Axle Motor	Fixed displacement piston motor
Cutting Deck Motors Relief Pressure (front and left side) Relief Pressure (right side)	Gear motor 3000 PSI (207 bar) 2000 PSI (137 bar)
Hydraulic Filters In-line Suction Strainer	10 Micron spin-on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir	8 gal. (30.3 l)
Hydraulic Oil	See Operator's Manual

General Information

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 or maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

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 on the hose. Use two wrenches; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. Stop engine; lower or support box and/or other attachment(s).

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 Fitting Installation

O-Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Make sure the O-ring is installed and properly seated in the groove. It is recommended that the O-ring be replaced any time the connection is opened.

3. Lubricate the O-ring with a light coating of oil.

4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.

5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct Flats From Finger Tight (F.F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	0.75 ± 0.25
6 (3/8 in.)	0.75 ± 0.25
8 (1/2 in.)	0.75 ± 0.25
10 (5/8 in.)	1.00 ± 0.25
12 (3/4 in.)	0.75 ± 0.25
16 (1 in.)	0.75 ± 0.25

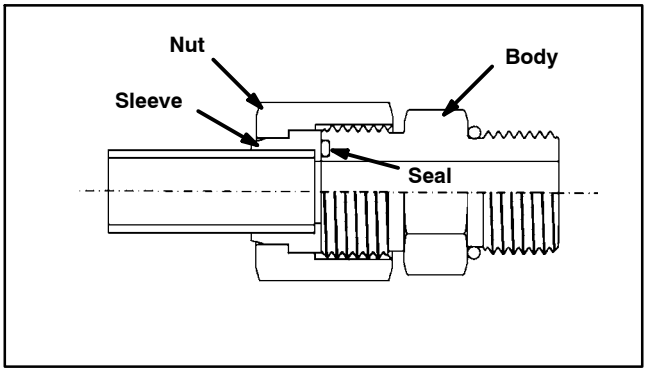

Figure 1

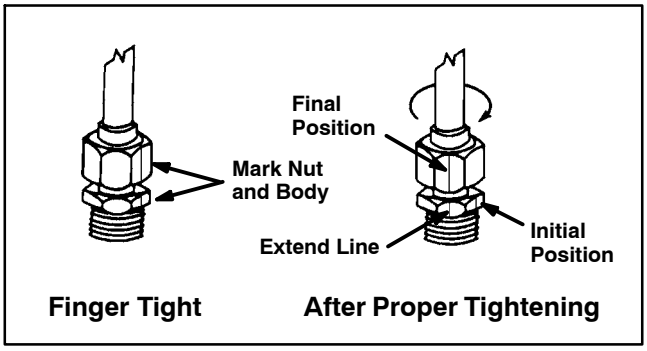

Figure 2

SAE Straight Thread O-Ring Port - Non-adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O-ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O-ring with a light coating of oil.

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

5. Tighten the fitting to the correct Flats From Finger Tight (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

NOTE: Installation torque values for non-adjustable fittings are listed in Figure 4. These torque values should **only** be used when a fitting can be accessed with a socket. Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench accuracy and should not be used.

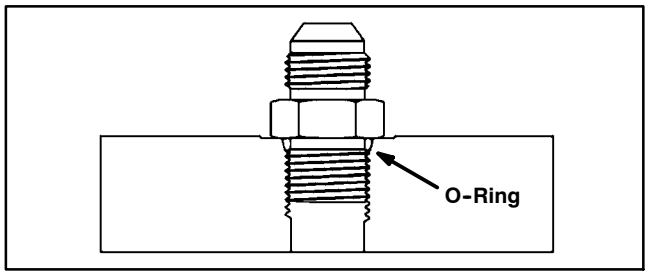

Figure 3

Fitting Size	Installation Torque
4	9-10 ft-lb (12-13 N-m)
6	20-21 ft-lb (27-28 N-m)
8	35-37 ft-lb (47-50 N-m)
10	60-66 ft-lb (81-89 N-m)
12	81-87 ft-lb (110-117 N-m)
16	121-131 ft-lb (164-177 N-m)

Figure 4

SAE Straight Thread O-Ring Port - Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O-ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O-ring with a light coating of oil.

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

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 turn the jam nut with another wrench to the correct Flats From Finger Tight (F.F.F.T.) (Step 4).

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

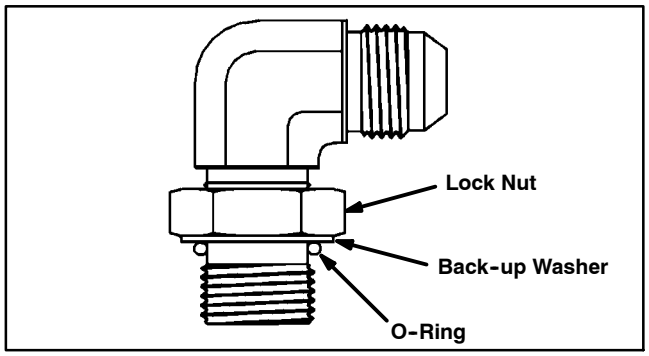

Figure 5

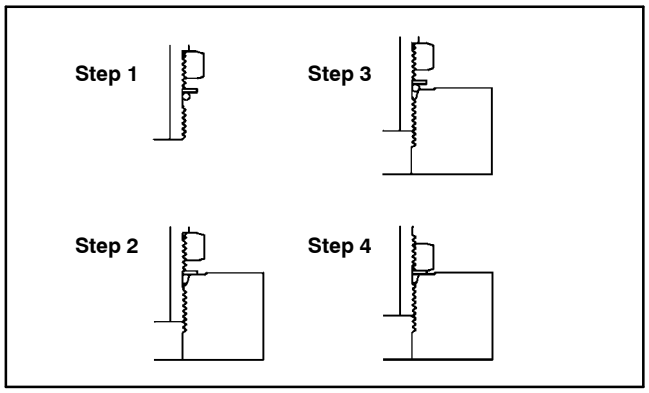

Figure 6

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.

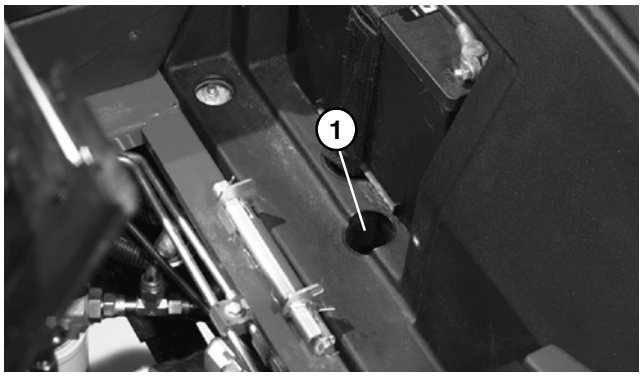

Figure 7

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.

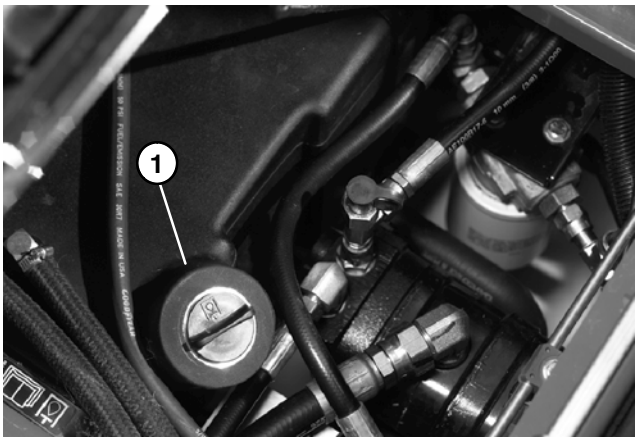

Figure 8

1. **Hydraulic reservoir cap**

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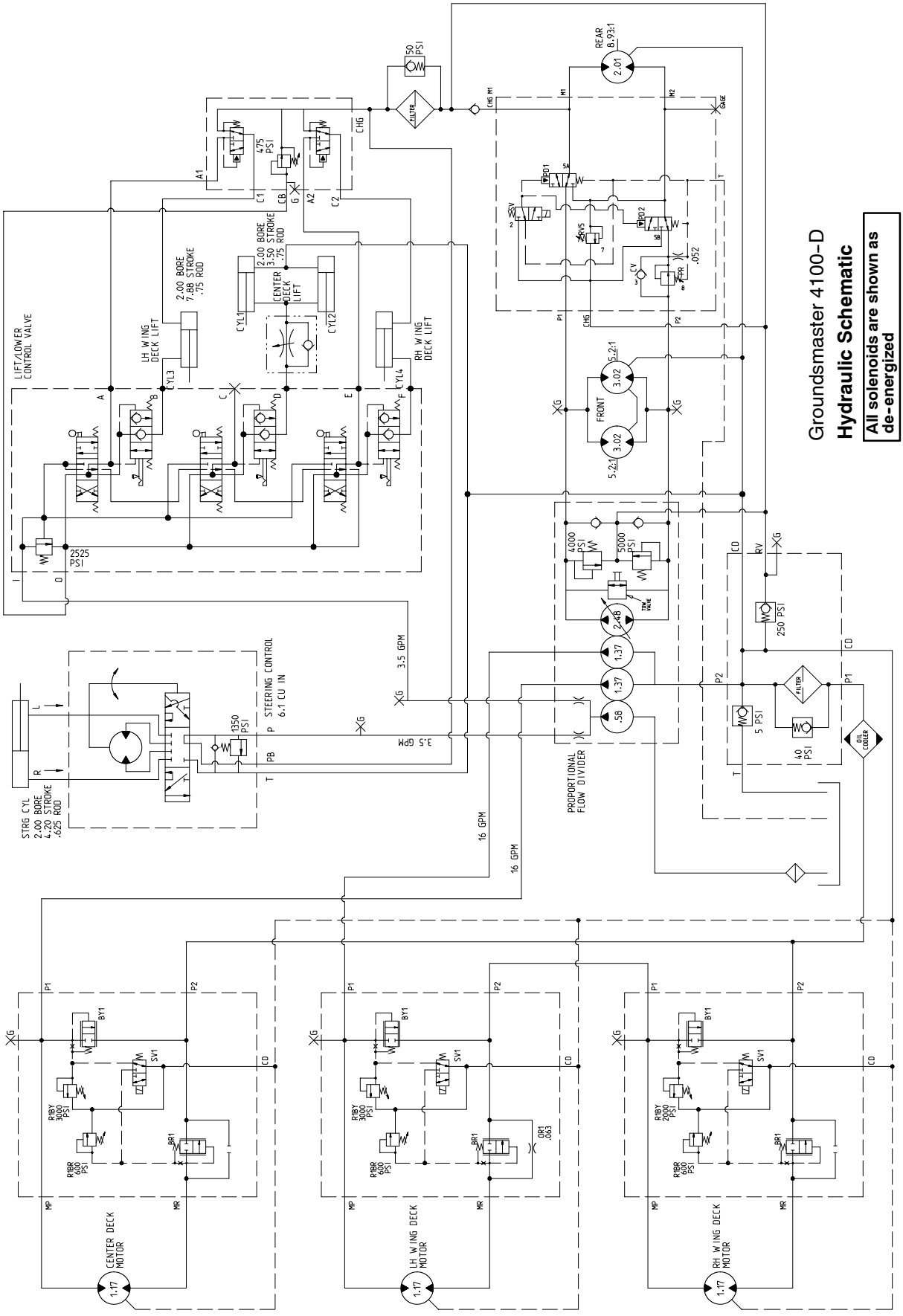
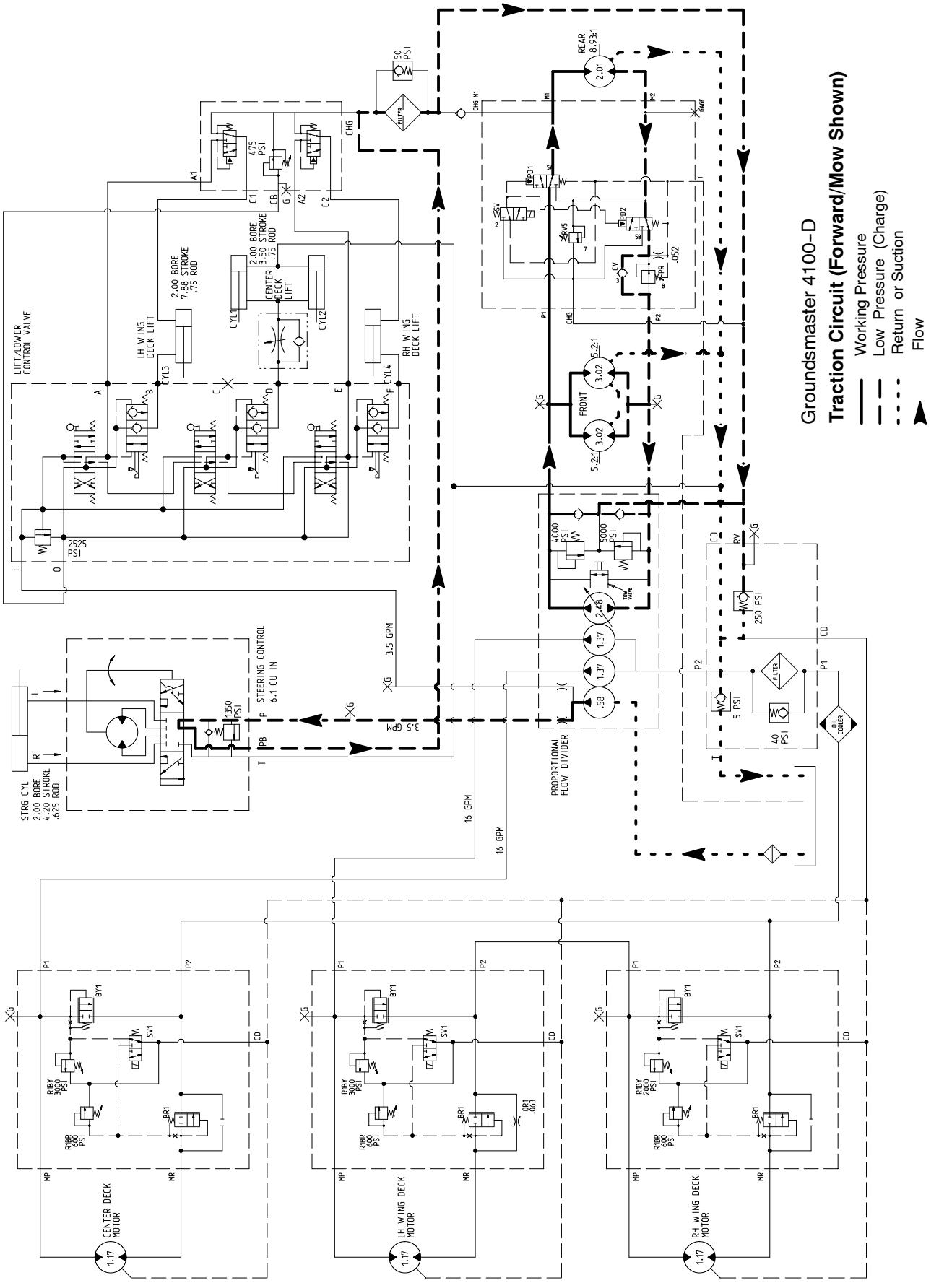
Hydraulic Schematic



Hydraulic Flow Diagrams



Traction Circuit

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the top of 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 in forward and 5000 PSI in reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop circuit. The traction circuit provides operation in either four wheel drive (mow) or two wheel drive (transport).

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

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

The gear pump 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 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.

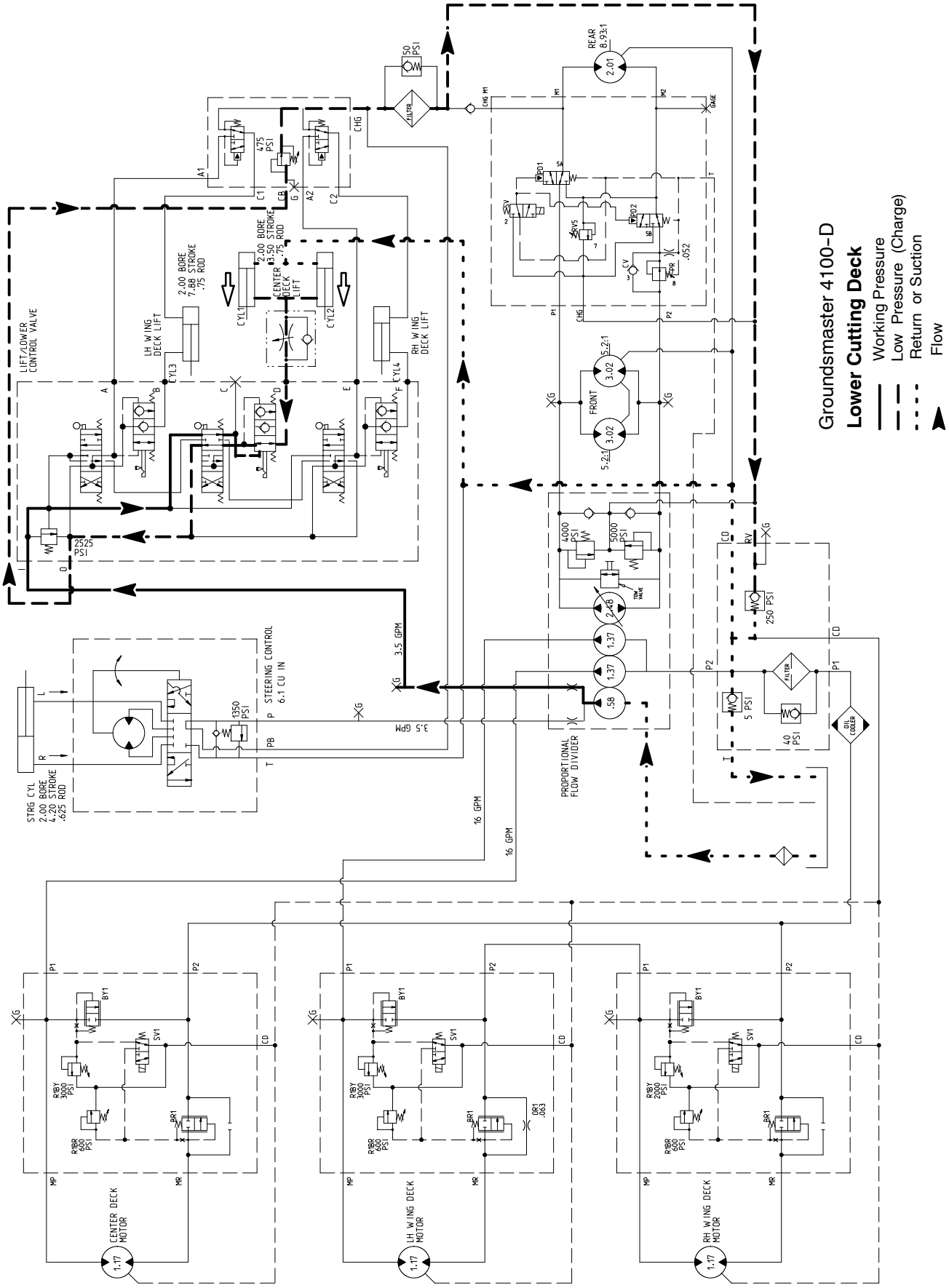
The 4WD/2WD control manifold provides hydraulic flow management in a variety of situations. Pressure testing of this control manifold can be performed at a test port on the manifold.

1. Four wheel drive (mow) and two wheel drive (transport) operation is controlled by a solenoid valve (SV) located in the 4WD/2WD control manifold. When in transport (2WD), the solenoid valve (SV) is energized and directs charge pressure to shift the control valves (PD1 and PD2). These shifted valves block hydraulic flow to the rear axle motor in both forward and reverse directions when in transport (2WD).

2. A pressure reducing valve (PR) in the 4WD/2WD control manifold lowers pressure to the rear axle motor when the machine is operated in reverse. The lower pressure prevents rear tire scuffing and provides added pressure to the front wheels during reverse operation.

3. An adjustable relief valve (RV5) in the 4WD/2WD control manifold reduces rear axle motor pressure created in down−hill, dynamic braking conditions.

To enhance traction control, the lift/lower circuit is equipped with a counterbalance system. An adjustable counterbalance valve located in the counterbalance control manifold (in CB port) transfers cutting deck weight to the machine to improve traction.


Groundsmaster 4100-D
Lower Cutting Deck
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
LH W ING DECK LIFT
RH W ING DECK LIFT
CENTER DECK LIFT
2.00 BORE 7.88 STROKE .75 ROD
2.00 BORE 3.50 STROKE .75 ROD
STEERING CONTROL 6.1 CU IN
STRG CYL 2.00 BORE 4.20 STROKE .625 ROD
PROPORTIONAL FLOW DIVIDER
REAR 8.93:1
FRONT 5.2:1
OIL COOLER
CENTER DECK MOTOR
LH W ING DECK MOTOR
RH W ING DECK MOTOR
3.5 GPM
16 GPM
16 GPM

Lower Cutting Deck

A three section gear pump is coupled to the piston (traction) pump. The gear pump section farthest from the piston pump 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 circuits through a proportional flow divider. This pump section takes its suction from the hydraulic reservoir.

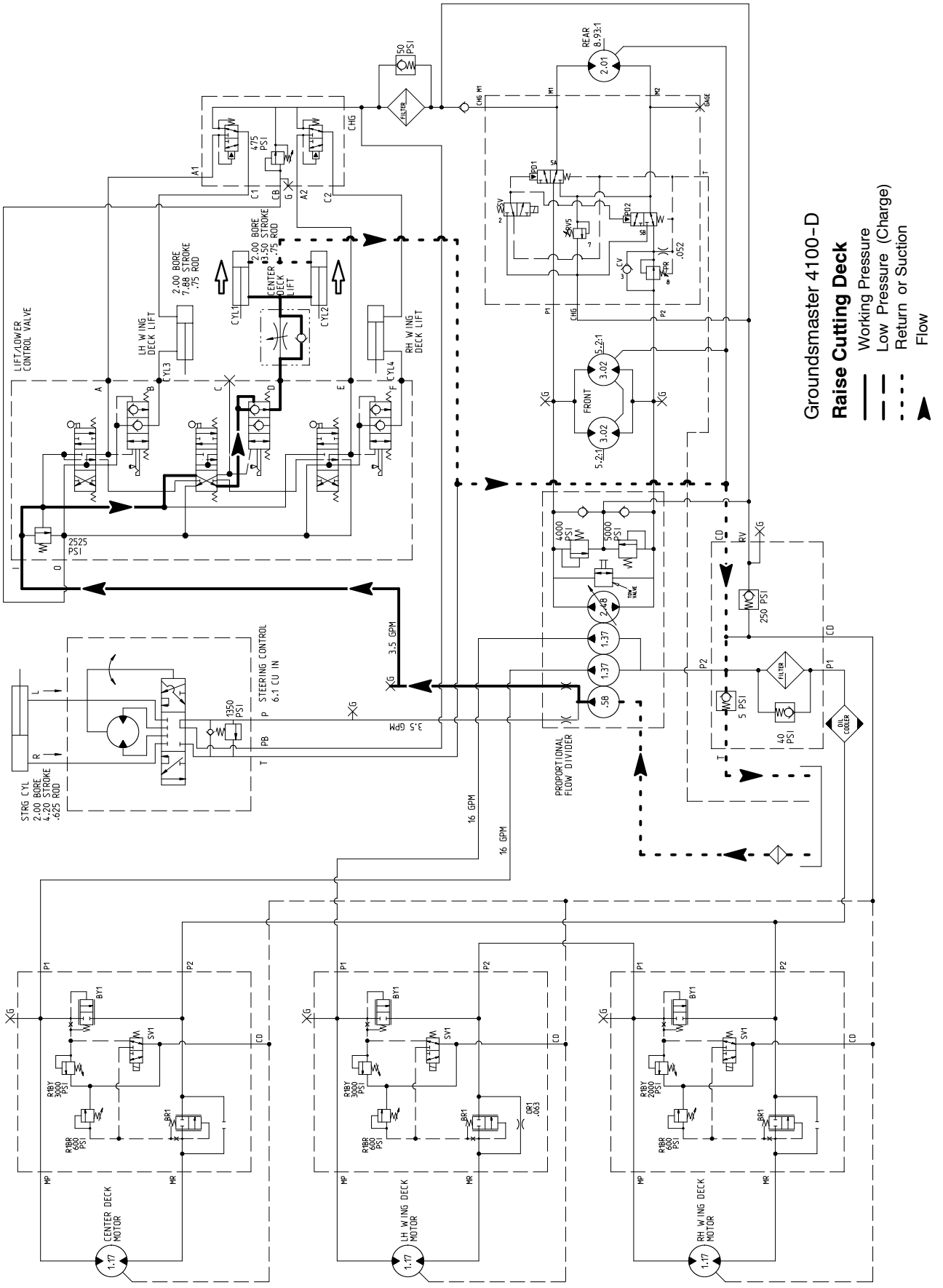
When the cutting deck is in a stationary position, flow from the gear pump is by–passed through the lift/lower control valve, counterbalance manifold, oil filter, and traction charge circuit.

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 deck lift cylinders. The weight of the cutting deck causes the lift cylinder shafts to extend, and lowers the 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, are held in position.

The drop speed of the 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 (right side or left side) 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 piston end of the lift cylinder. Higher hydraulic pressure against the piston end of the cylinder causes the shaft to extend, and lowers the wing deck. Oil from the rod 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 maintains back pressure on the deck lift cylinders. A relief valve located in the lift/lower control valve limits circuit pressure. Excess circuit flow is routed to the oil filter and then to the traction charge circuit.


Groundsmaster 4100-D
Raise Cutting Deck
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
REAR
8.93:1
2.01
50 PSI
FILTER
CHG
CHG M1
M1
M2
GAGE
A1
C1
CB
G
A2
C2
475 PSI
PD1
SR
PD2
SB
SV
SVS
CV
FPR
.052
T
P1
P2
2.00 BORE
7.88 STROKE
.75 ROD
CENTER
DECK
LIFT
CYL1
CYL2
2.00 BORE
3.75 STROKE
.75 ROD
LH WING
DECK LIFT
CYL3
RH WING
DECK LIFT
CYL4
LIFT/LOWER
CONTROL VALVE
A
B
C
D
E
F
2525
PSI
5.2:1
3.02
FRONT
4000
PSI
5000
PSI
TDM
VALVE
2.48
1.37
1.37
.58
PROPORTIONAL
FLOW DIVIDER
CD
RV
250 PSI
FILTER
5 PSI
40
PSI
OIL
COOLER
3.5 GPM
STEERING CONTROL
6.1 CU IN
P
PB
1350
PSI
3.5 GPM
STRG CYL
2.00 BORE
4.20 STROKE
.625 ROD
L
R
16 GPM
16 GPM
BY1
SV1
RBY
3000
PSI
RBR
600
PSI
BR1
OR1
.063
MP
MR
CENTER DECK
MOTOR
LH WING DECK
MOTOR
RH WING DECK
MOTOR
1.17

Raise Cutting Deck

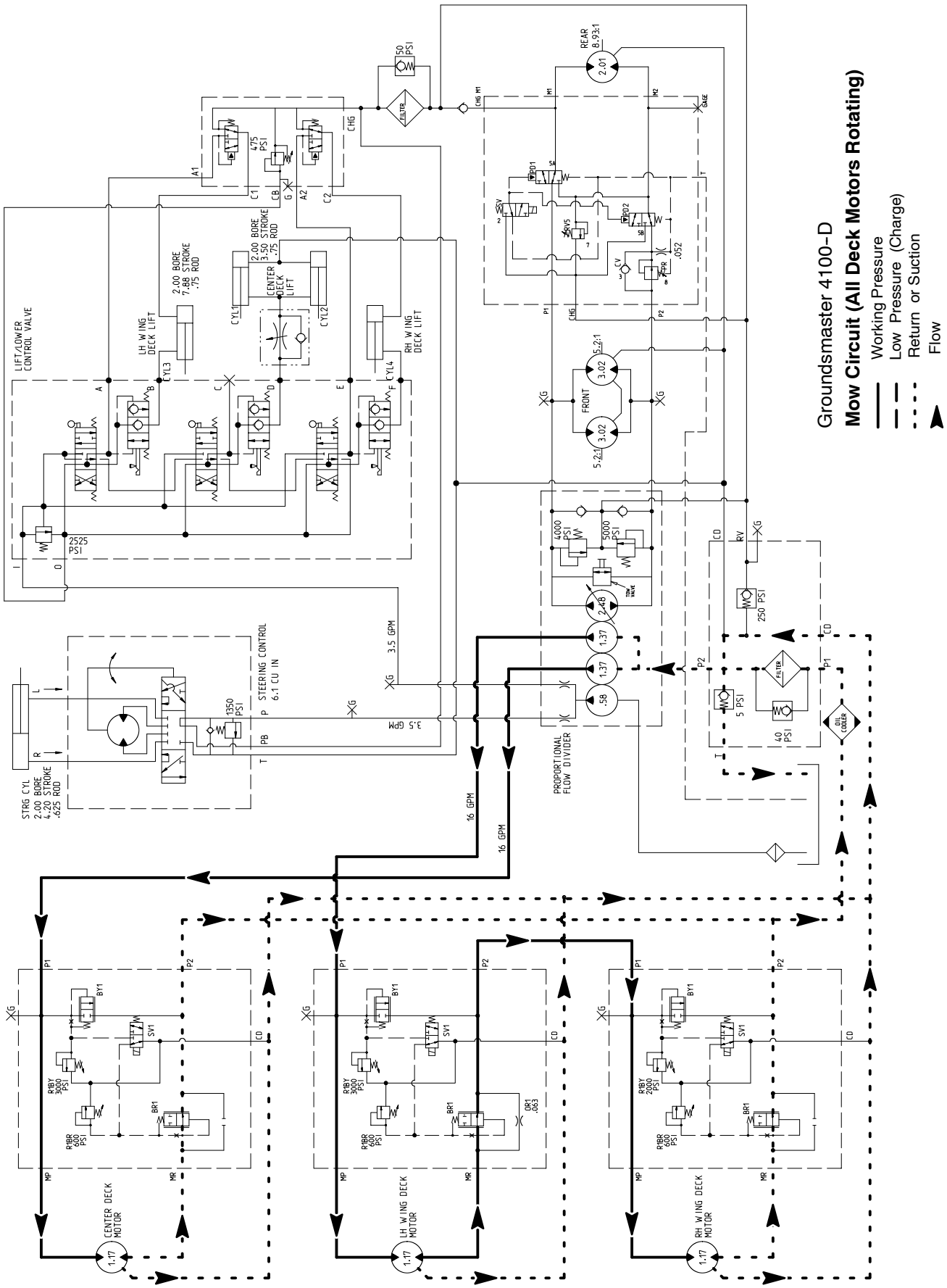
A three section gear pump is coupled to the piston (traction) pump. The gear pump section farthest from the piston pump supplies hydraulic flow to the lift/lower control valve and the steering control valve. Hydraulic flow from this pump section is delivered to the two circuits through a proportional 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. This valve change allows hydraulic pressure to the rod end of the 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, are held in position.

To raise a wing deck, the appropriate lift lever (right side or left side) on the lift/lower control valve is pulled to allow valve shift in the lift/lower control. This valve change allows hydraulic pressure to the piston end of the lift cylinder and causes the 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 maintains back pressure on the lift cylinders. A relief valve located in the lift/lower control valve limits circuit pressure. 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
LH W ING DECK LIFT
RH W ING DECK LIFT
CENTER DECK LIFT
2.00 BORE 7.88 STROKE .75 ROD
2.00 BORE 3.50 STROKE .75 ROD
2525 PSI
STEERING CONTROL 6.1 CU IN
STRG CYL 2.00 BORE 4.25 STROKE .625 ROD
3.5 GPM
16 GPM
16 GPM
PROPORTIONAL FLOW DIVIDER
REAR 8.93:1
FRONT 5.42:1
CENTER DECK MOTOR
LH W ING DECK MOTOR
RH W ING 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 (SV1), bypass cartridge (BY1), brake cartridge (BR1), and relief cartridge (R1BR). When the the deck solenoid valve (SV1) is not energized (PTO switch OFF), hydraulic flow bypasses the deck motor through the bypass cartridge (BY1). When the PTO switch is turned ON, the solenoid valve (SV1) energizes, causing a shift of the by–pass cartridge (BY1) and allowing hydraulic flow to the deck motor. Brake cartridge (BR1) and relief cartridge (R1BR) 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 (SV1) 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 (R1BY) in the hydraulic manifold. The center and left wing deck relief valves are set at 3000 PSI and the right wing deck relief valve is set at 2000 PSI.

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

Cutting Deck Blade Braking

When the operator turns the cutting deck OFF, solenoid valve (SV1) is de–energized causing logic cartridge (BY1) to shift (Fig. 9). This shifted valve allows oil return to the oil cooler and gear pump. Hydraulic pressure is reduced to the cutting deck motor which begins to slow the cutting blades and also causes logic cartridge (BR1) to shift (Fig. 10).

The inertia of the rotating cutting blades increases pressure of the oil return to the deck control manifold. This pressure increase, along with the shifted logic cartridge (BR1), causes relief valve (R1BR) to shift, which bleeds the residual pressure in the circuit and allows the blades to stop in a controlled manner (Fig. 11).

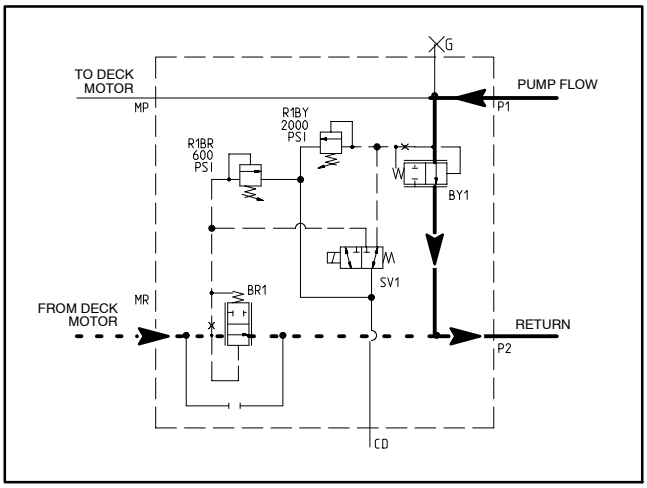


Figure 9

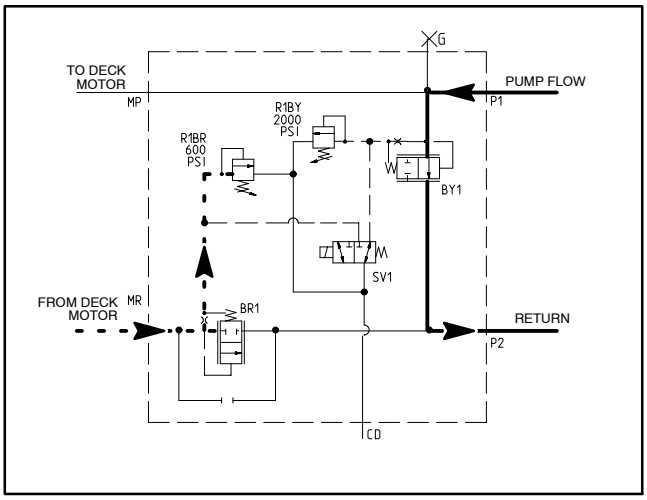


Figure 10

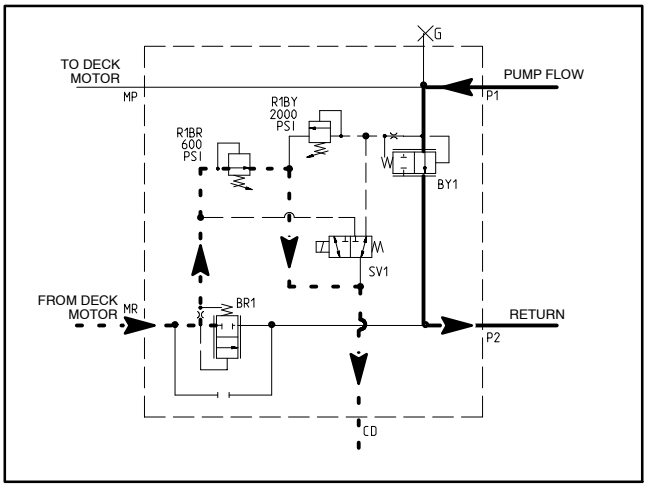
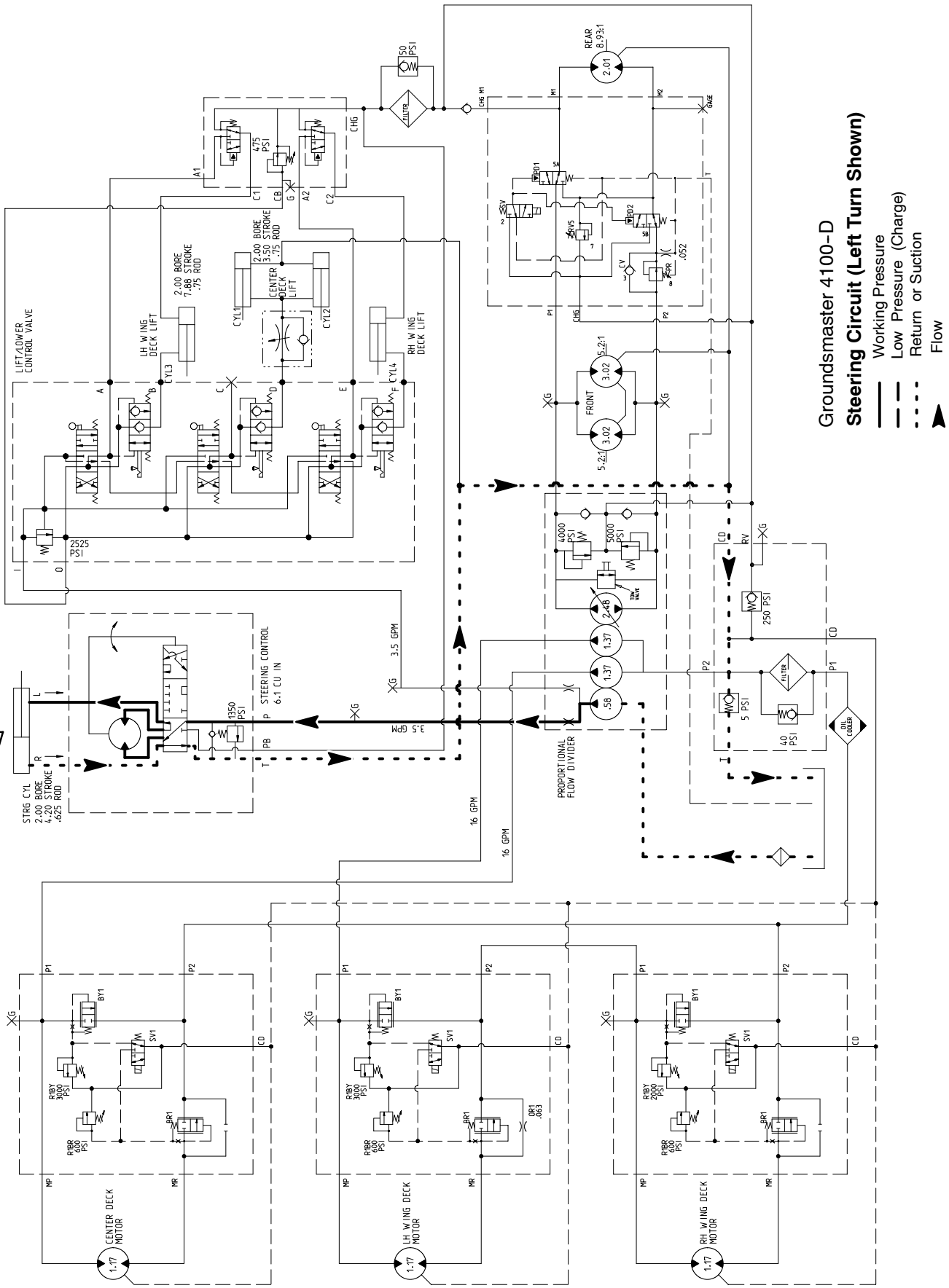


Figure 11


Groundsmaster 4100-D
Steering Circuit (Left Turn Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT/LOWER CONTROL VALVE
LH WING DECK LIFT
RH WING DECK LIFT
CENTER DECK LIFT
2.00 BORE 7.88 STROKE .75 ROD
2.00 BORE 3.50 STROKE .75 ROD
2525 PSI
STEERING CONTROL 6.1 CU IN
1350 PSI
3.5 GPM
STRG CYL 2.00 BORE 4.20 STROKE .625 ROD
PROPORTIONAL FLOW DIVIDER
16 GPM
4000 PSI
5000 PSI
250 PSI
5 PSI
40 PSI
OIL COOLER
FRONT
REAR
CENTER DECK MOTOR
LH WING DECK MOTOR
RH WING DECK MOTOR

Steering Circuit

A three section gear pump is coupled to the piston (traction) pump. The gear pump section farthest from the piston pump 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. The gear pump takes its suction from the hydraulic reservoir. Steering circuit pressure is limited by a relief valve located in the steering control valve.

With the steering wheel in the neutral position (rear wheels positioned straight ahead) and the engine running, flow enters the steering control valve at the P port and goes through the steering control spool valve, bypassing 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 passes through the rotary meter (V1) and is directed out the L port. Pressure contracts the 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 wheel and steering control valve return to the neutral position when turning is completed.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port passes through rotary meter (V1) is directed out port R. Pressure extends the 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 wheel and steering control valve return to the neutral position when turning is completed.

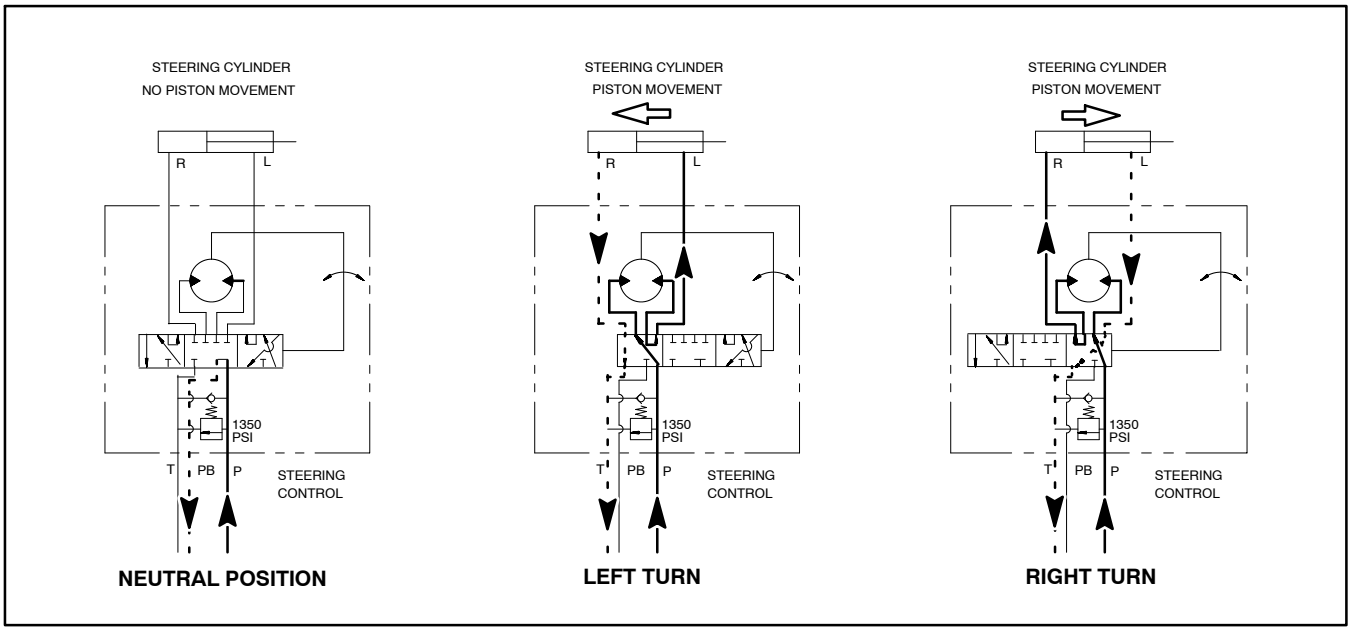


Figure 12

Special Tools

Order these tools from your Toro Distributor.

Hydraulic Pressure Test Kit – TOR47009

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.

Figure 13

Hydraulic Tester (Pressure and Flow) – TOR214678

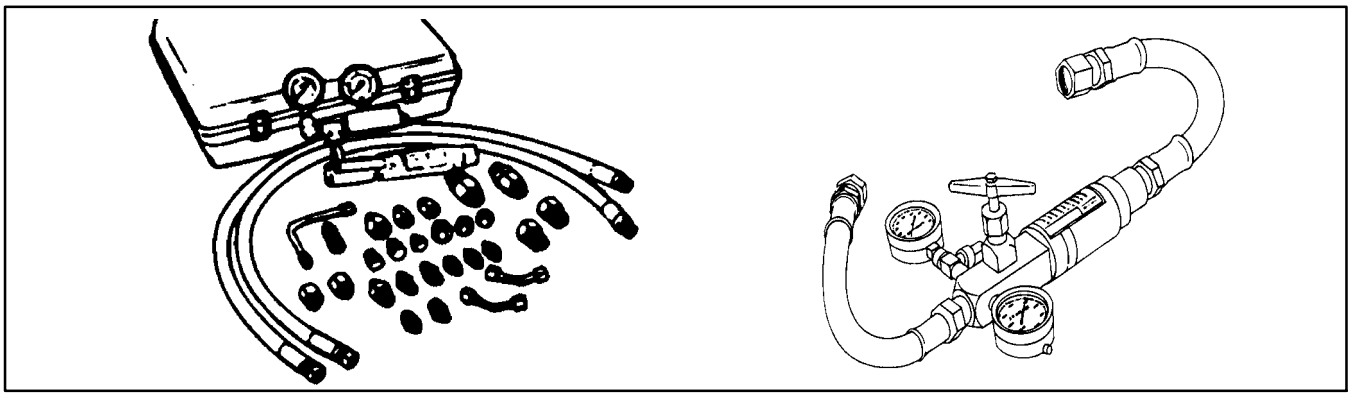


Figure 14

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

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

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

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

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

4. HIGH PRESSURE GAUGE: High range gauge which accommodates pressures beyond the capacity of the low pressure gauge: 0 to 5,000 PSI.

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

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

Hydraulic Test Fitting Kit – TOR4079

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 TEST FITTING KIT (NO. TOR4079)

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

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

Figure 15

Measuring Container – TOR4077

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 17 provides gallons per minute (GPM) conversion for measured milliliter or ounce motor case drain leakage.

Figure 16

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 17

Troubleshooting

The charts that follow contain information 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.

Problem	Possible Cause
Hydraulic system operates hot.	Engine RPM is too low. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Brakes are engaged or sticking. Piston pump by–pass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking in suction line.
Machine operates in one direction only.	Traction control linkage is faulty. System charge check valve and/or system relief valve is defective. Pilot direction valve in 4WD manifold is damaged or sticking.
Traction pedal is sluggish.	Traction control linkage is stuck or binding. Piston pump servo control valve is damaged. Charge pressure is low.
Machine travels too far before stopping when the traction pedal is released.	Traction linkage is binding or out of adjustment. Piston pump servo control valve is damaged. Traction pedal does not return to neutral.
Traction power is lost or unit will not operate in either direction.	Brakes are engaged or sticking. Traction control linkage is damaged or disconnected. 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.

Problem	Possible Causes
Four wheel drive will not engage.	Electrical problem exists (see Chapter 5 – Electrical System). Solenoid valve on 4WD hydraulic manifold is faulty. Cartridge valve in 4WD manifold is damaged or sticking. Rear axle motor is damaged.
Four wheel drive will not disengage.	Electrical problem exists (see Chapter 5 – Electrical System). Solenoid valve on 4WD hydraulic manifold is faulty. Cartridge valve in 4WD manifold is damaged or sticking.
Cutting decks will not operate.	Electrical problem exists (see Chapter 5 – Electrical System). Gear pump or it's coupler is damaged.
One cutting deck motor will not operate.	Electrical problem exists (see Chapter 5 – Electrical System). System pressure to the affected motor is low. Key on affected deck motor is damaged (motor rotates but deck blades don't rotate). Solenoid valve in deck manifold is faulty. Cartridge valve in deck manifold is damaged or sticking. Deck motor or gear pump section is damaged.
All cutting deck motors operate slowly.	Engine RPM is low. Deck motor or gear pump section is 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.
Cutting deck will not raise.	Engine RPM is too low. Hydraulic oil level in reservoir is low. Lift arm pivots are binding. Lift cylinder is damaged. Relief valve in lift/lower control valve is stuck. Pilot valve in lift/lower manifold is damaged or sticking. Proportional flow divider in gear pump is faulty. Gear pump section for lift/lower control valve is inefficient.
Cutting deck raises, but will not stay up.	Lift circuit lines or fittings are leaking. Lift cylinder is damaged. Detents in lift/lower control valve are worn.

Problem	Possible Causes
Cutting decks drop too fast or too slow.	Flow control valve is not adjusted properly.
Cutting deck will not lower.	Lift arm pivots are binding. Lift cylinder is damaged. Counterbalance pressure is excessive. Lift/lower control valve is worn or damaged. Pilot valve in lift/lower manifold is damaged or sticking.

Testing

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

Before Performing Hydraulic Tests

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

Precautions for Hydraulic Testing

CAUTION

Failure to use gauges with recommended pressure (PSI) 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.

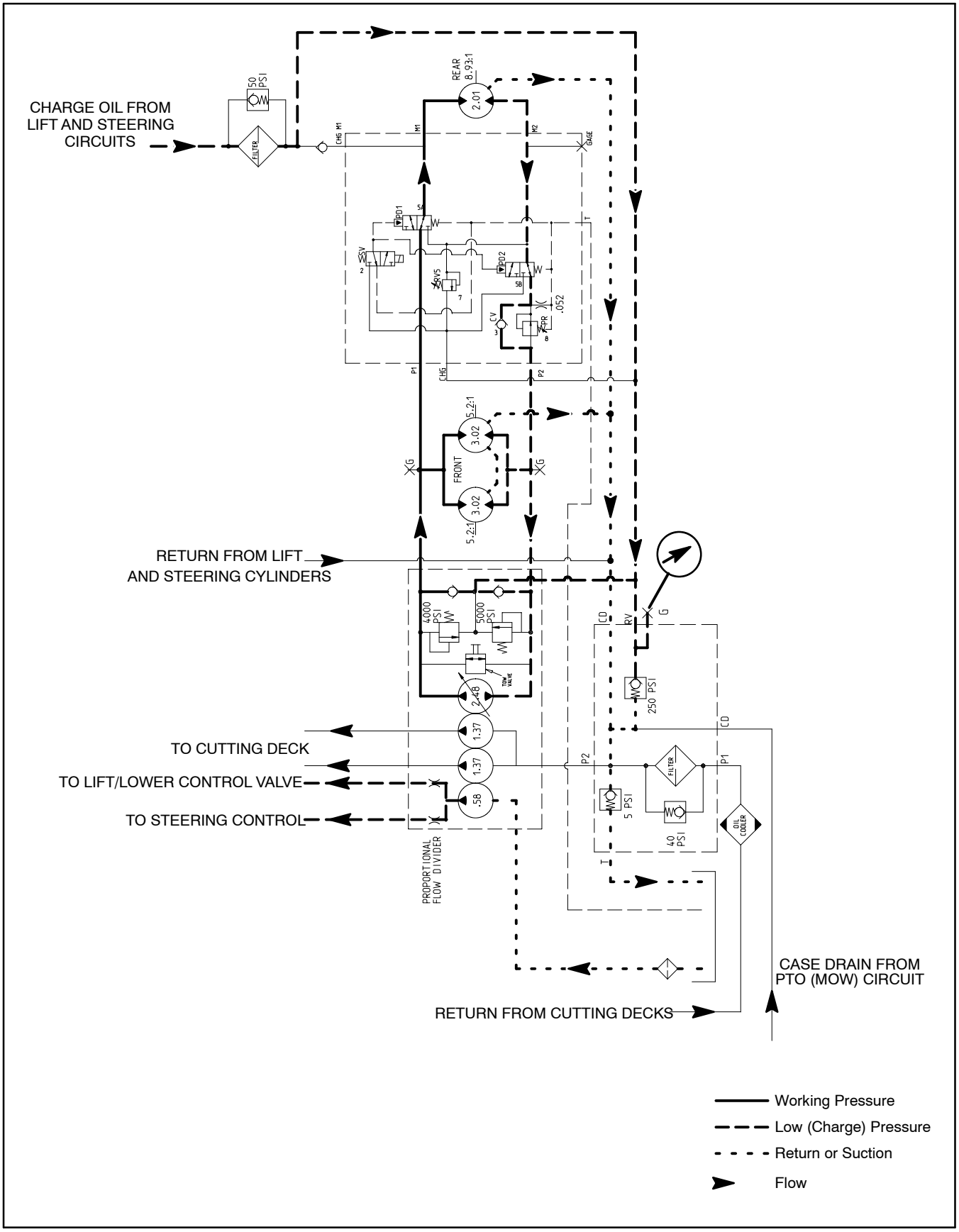
9. Check control linkages for improper adjustment, binding, or broken parts.

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.

TEST NO. 1: 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 decks 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 gauge onto charge pressure test port (Fig. 18) 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 **(2730 ± 30 RPM)** with no load on the hydraulic system.

GAUGE READING TO BE 200 to 300 PSI.

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 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 **(2730 ± 30 RPM)**. Apply the brakes and push the traction pedal forward, then reverse.

GAUGE READING TO BE 200 to 300 PSI.

9. If charge pressure is good under no load, but 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. Disconnect pressure gauge from test port.

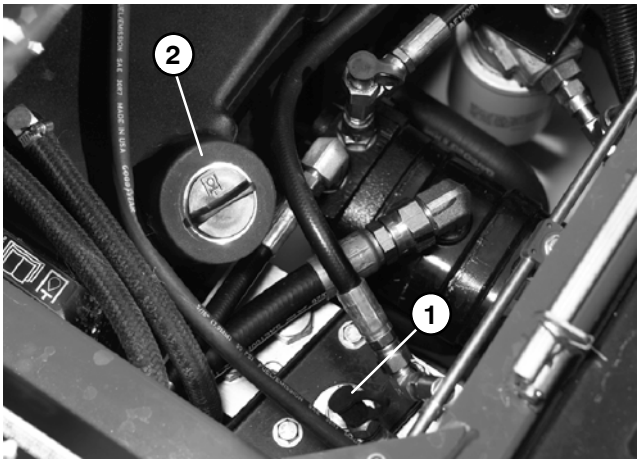
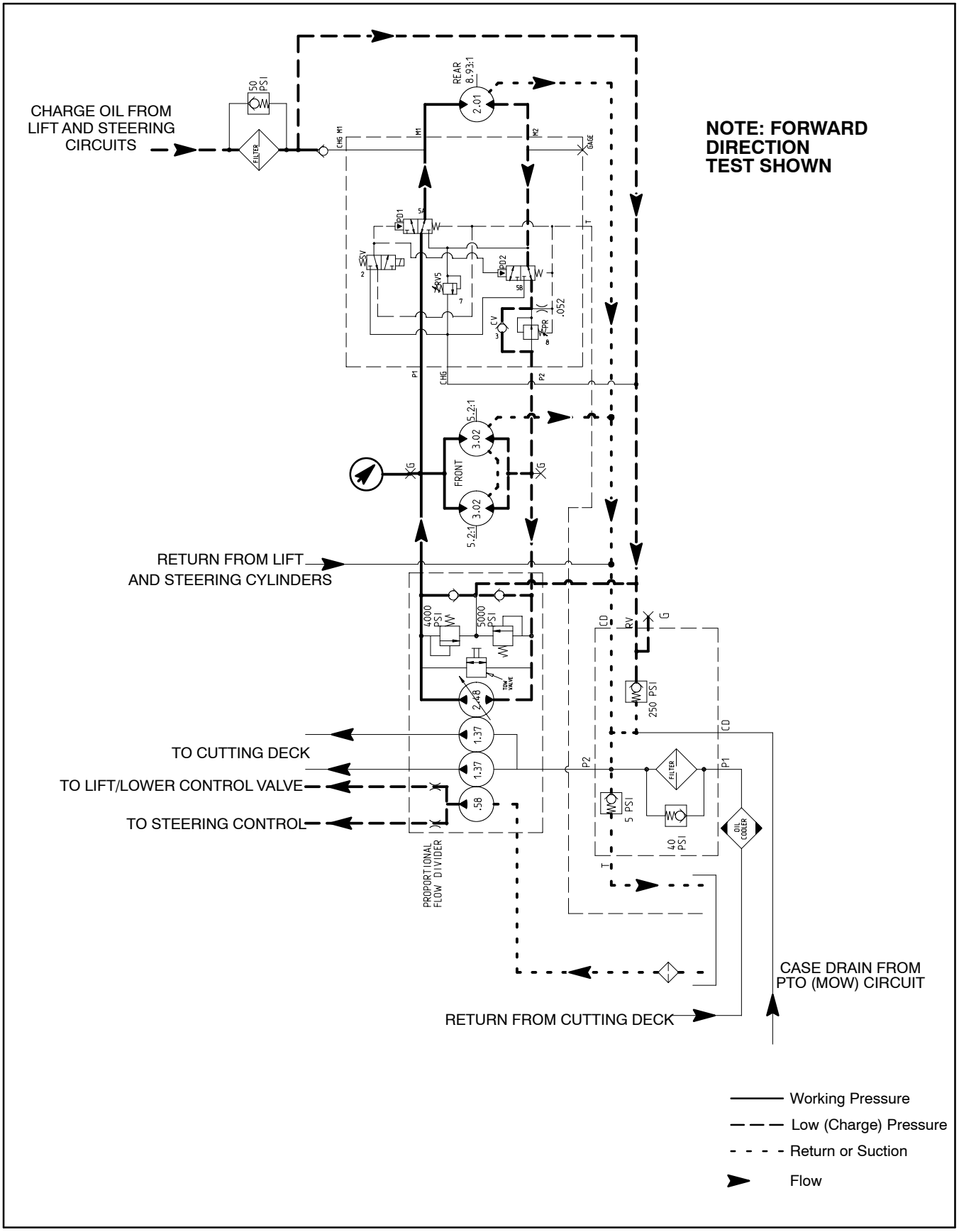


Figure 18

1. **Charge pressure port** 2. **Hydraulic reservoir cap**

TEST NO. 2: Traction Circuit Relief Pressure (Using Pressure Gauge)



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 decks, 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 gauge to traction circuit test port for function to be checked (Forward or Reverse: Fig. 19 or 20).

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 **(2730 ± 30 RPM)**.

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: **maximum of 4000 PSI**
Reverse: **maximum of 5000 PSI**

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

8. If traction pressure is too low, inspect traction pump relief valves (Fig. 21). Clean or replace valves as necessary. These cartridge type valves are factory set, and are not adjustable. If relief valves are in good condition, traction pump or wheel motors should be suspected of wear and inefficiency.

9. Disconnect pressure gauge from test port.

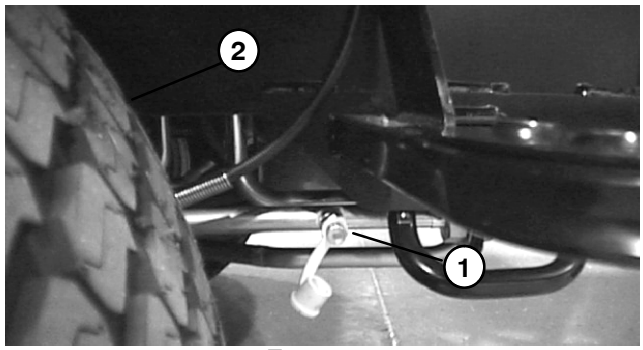


Figure 19

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

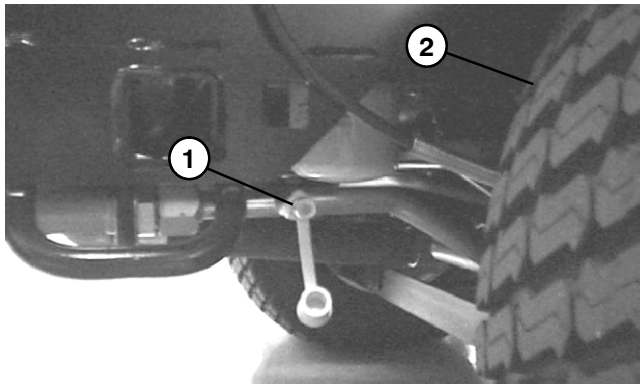


Figure 20

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

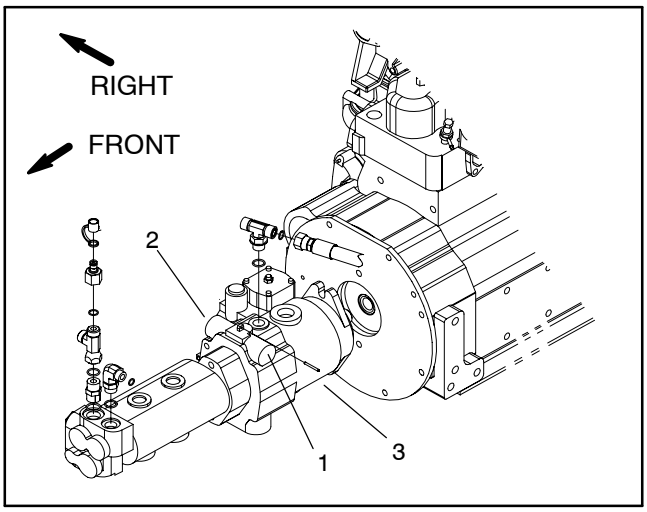
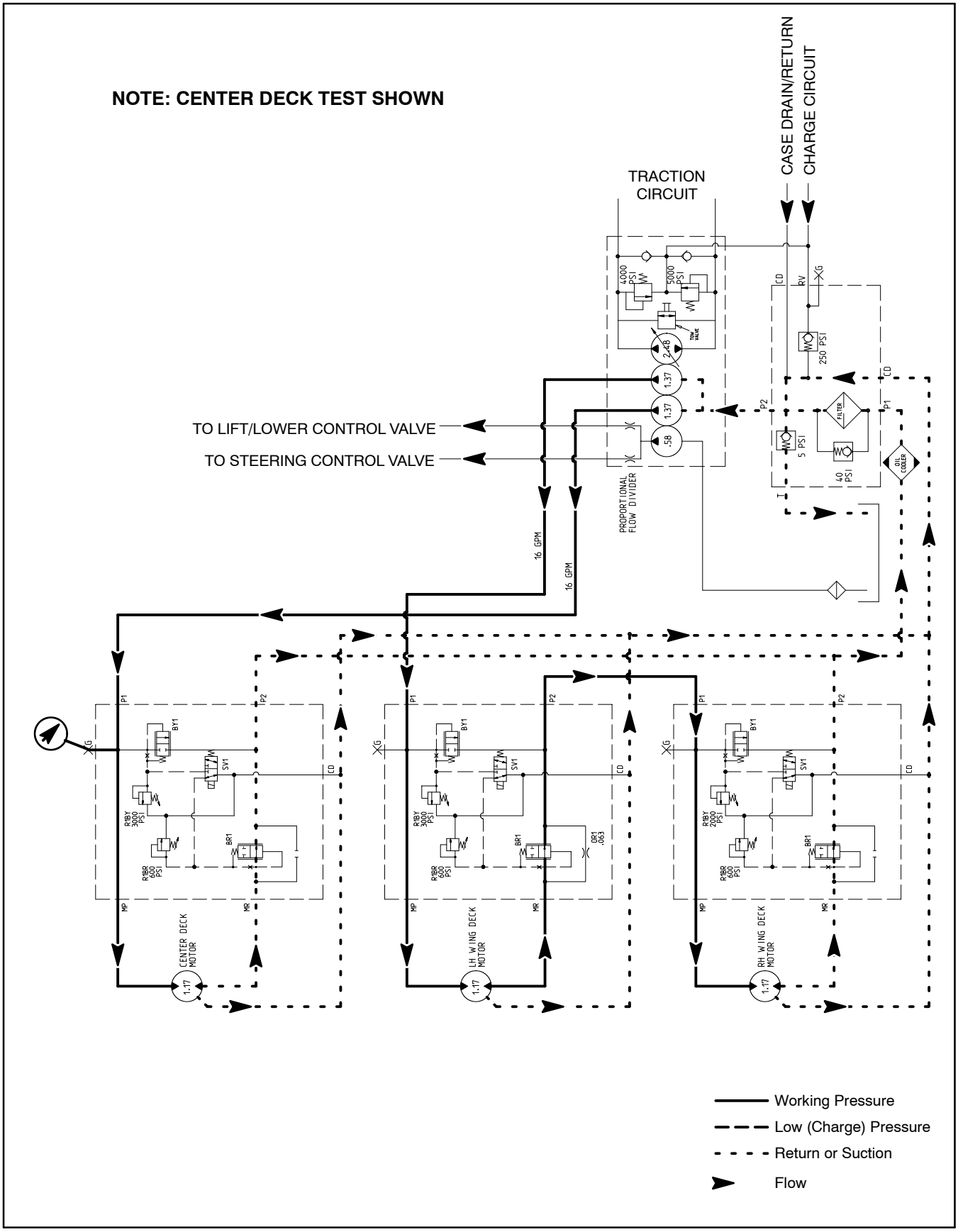


Figure 21

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

TEST NO. 3: 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 decks 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 test pressure gauge with hydraulic hose attached to deck manifold test port for the deck to be tested (Fig. 22, 23, and 24).

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

5. Operate engine at full speed **(2730 ± 30 RPM)**. Engage the cutting decks.

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

7. Cutting deck circuit pressure should be from **1000 to 3000 PSI (1000 to 2000 PSI for RH wing deck)** and will vary depending on mowing conditions.

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

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

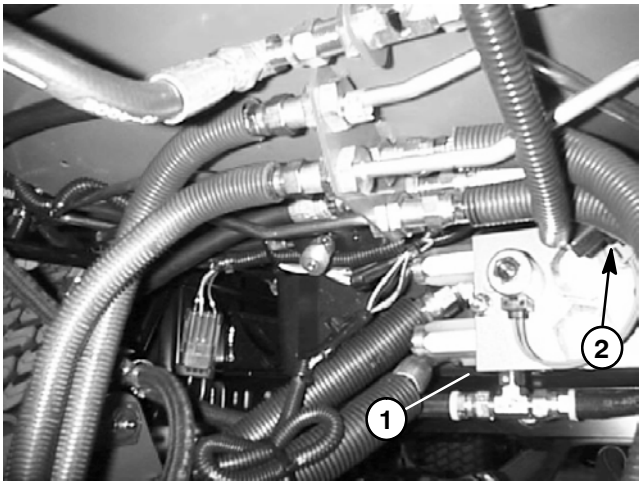


Figure 22

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

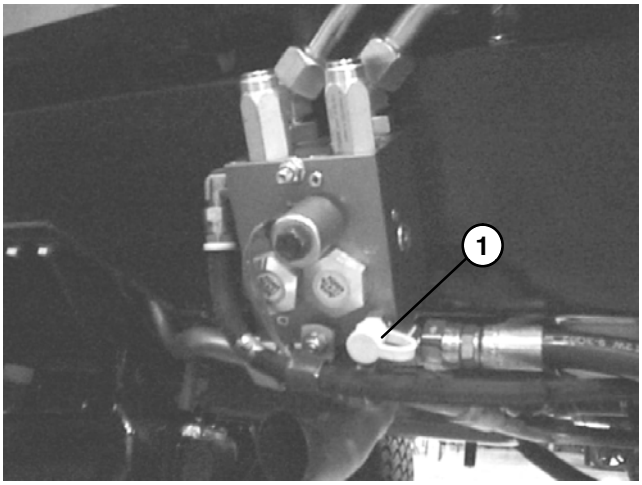


Figure 23

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

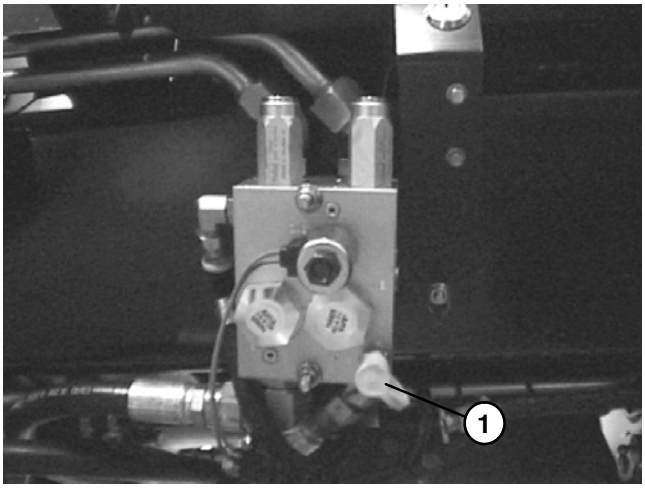
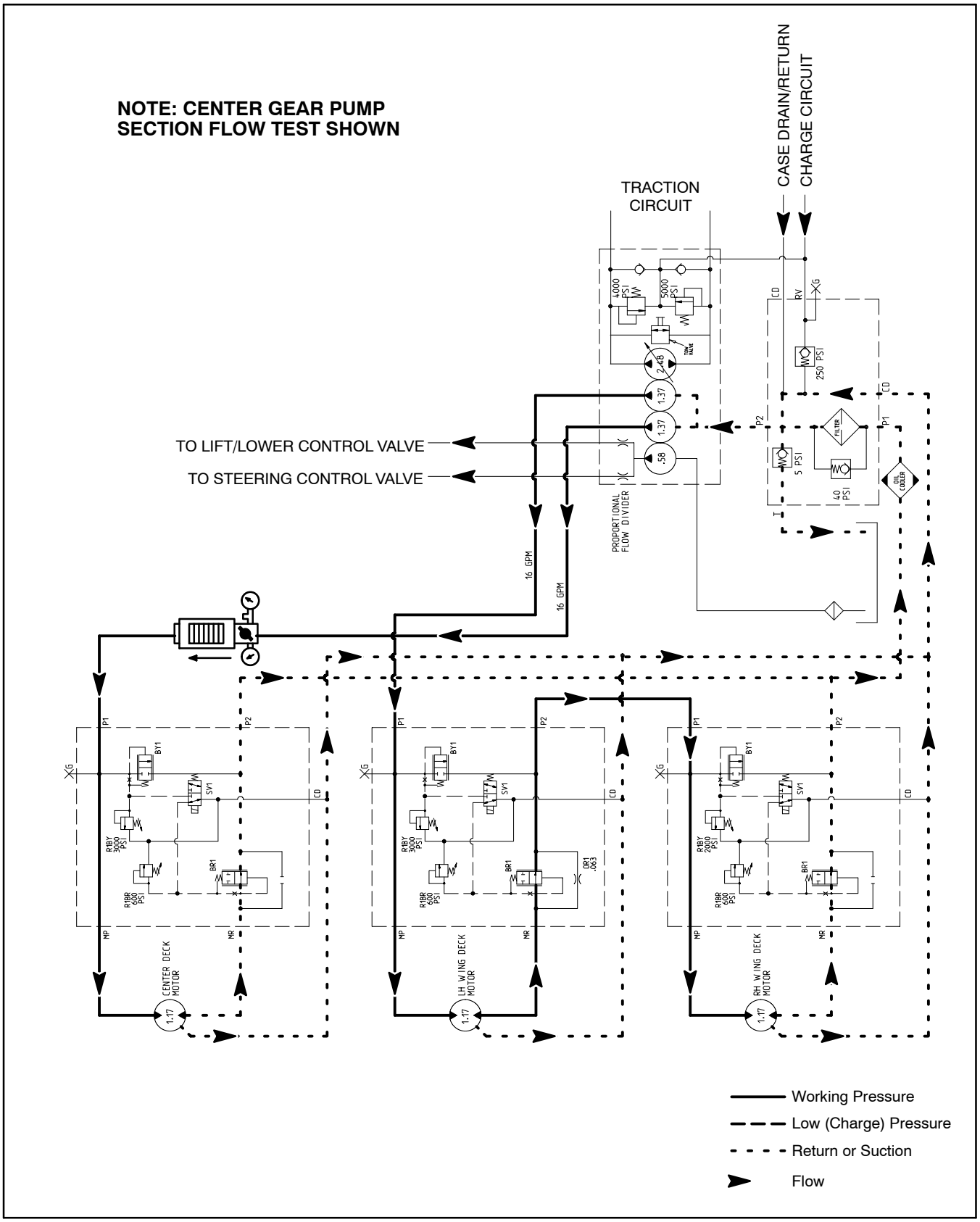


Figure 24

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

TEST NO. 4: 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 decks 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. 25).

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 decks**.

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.

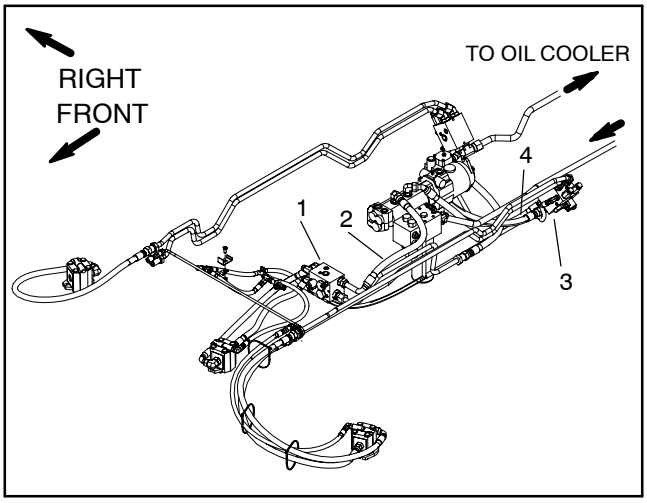
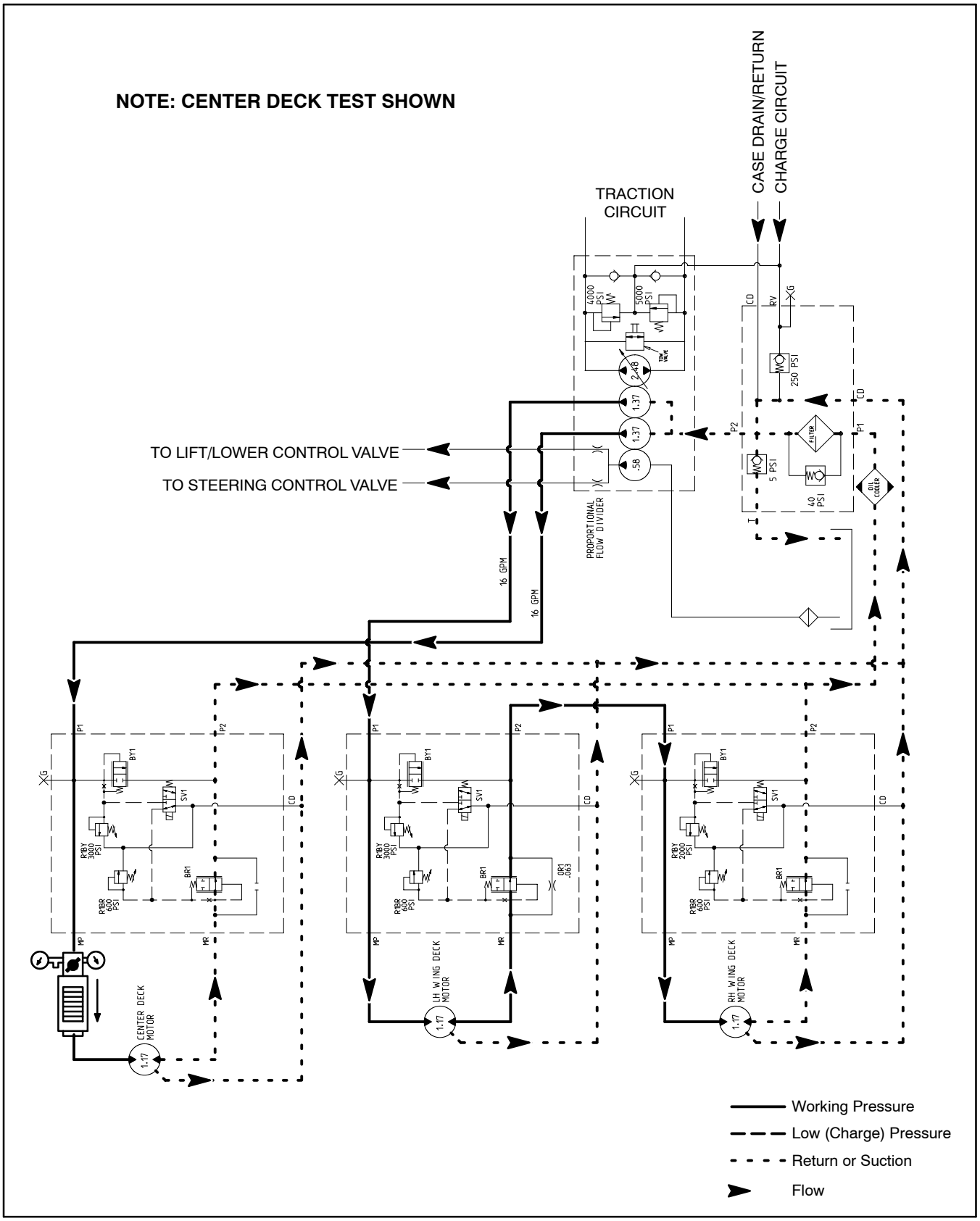


Figure 25

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

TEST NO. 5: Cutting Deck Manifold 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 decks 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. 26). Disconnect hydraulic hose at deck manifold port (MP).

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

4. Install tester with pressure gauges and flow meter in series with the the disconnected hose and hydraulic manifold port (MP) (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 decks during test to prevent personal injury from the cutting blades.

7. Operate engine at full speed **(2730 ± 30 RPM)**. Engage the cutting decks.

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:

3000 PSI for the center deck and left wing deck
2000 PSI for the right wing deck

10. Disengage cutting decks. Shut off engine. Record test results.

11. If specification is **not** met, adjust or clean relief valve in deck manifold port (R1BY). 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. Reinstall 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.

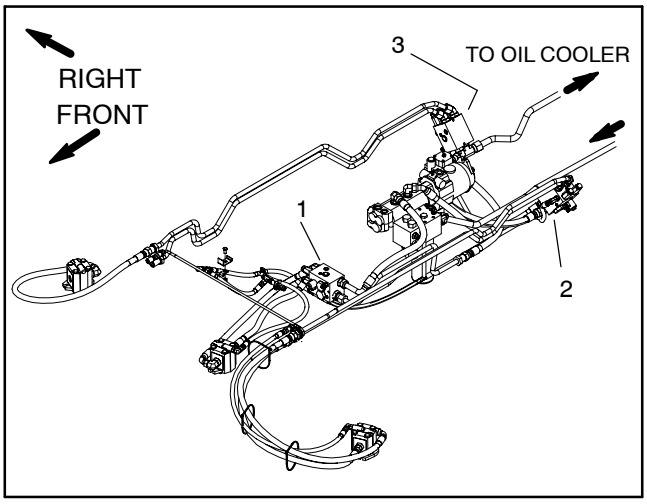


Figure 26

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

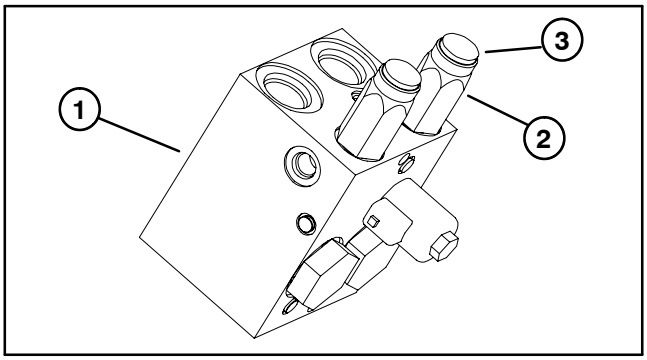
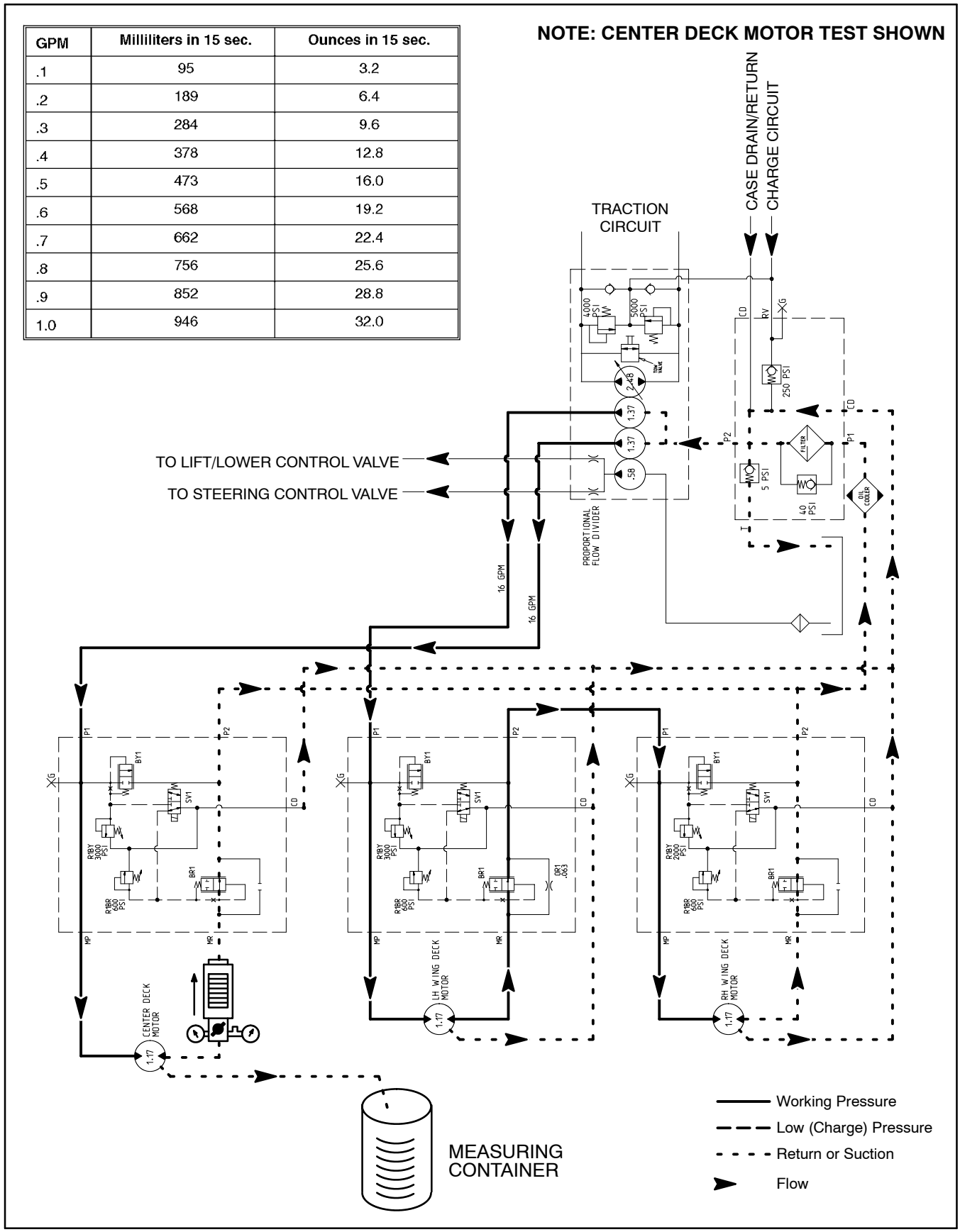


Figure 27

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

TEST NO. 6: Cutting Deck Motor Case Drain Leakage (Using Tester with Pressure Gauges and Flow Meter)

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 decks 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. 28). 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. 29).

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 decks 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 **(2730 ± 30 RPM)**. Move PTO switch to ON.

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

NOTE: Use a graduated container, special tool TOR4077, to measure case drain leakage (Fig. 29).

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 **0.7 GPM** (less than 22.4 ounces (662 ml) of hydraulic fluid in 15 seconds).

9. If flow is more than **0.7 GPM**, the motor is worn or damaged and should be repaired or replaced.

10. 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.

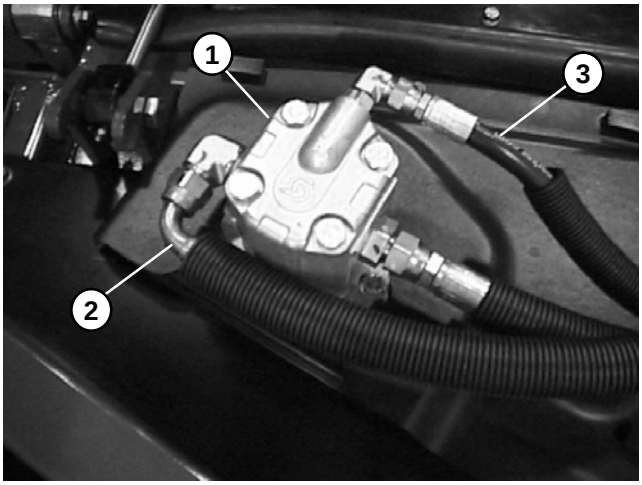
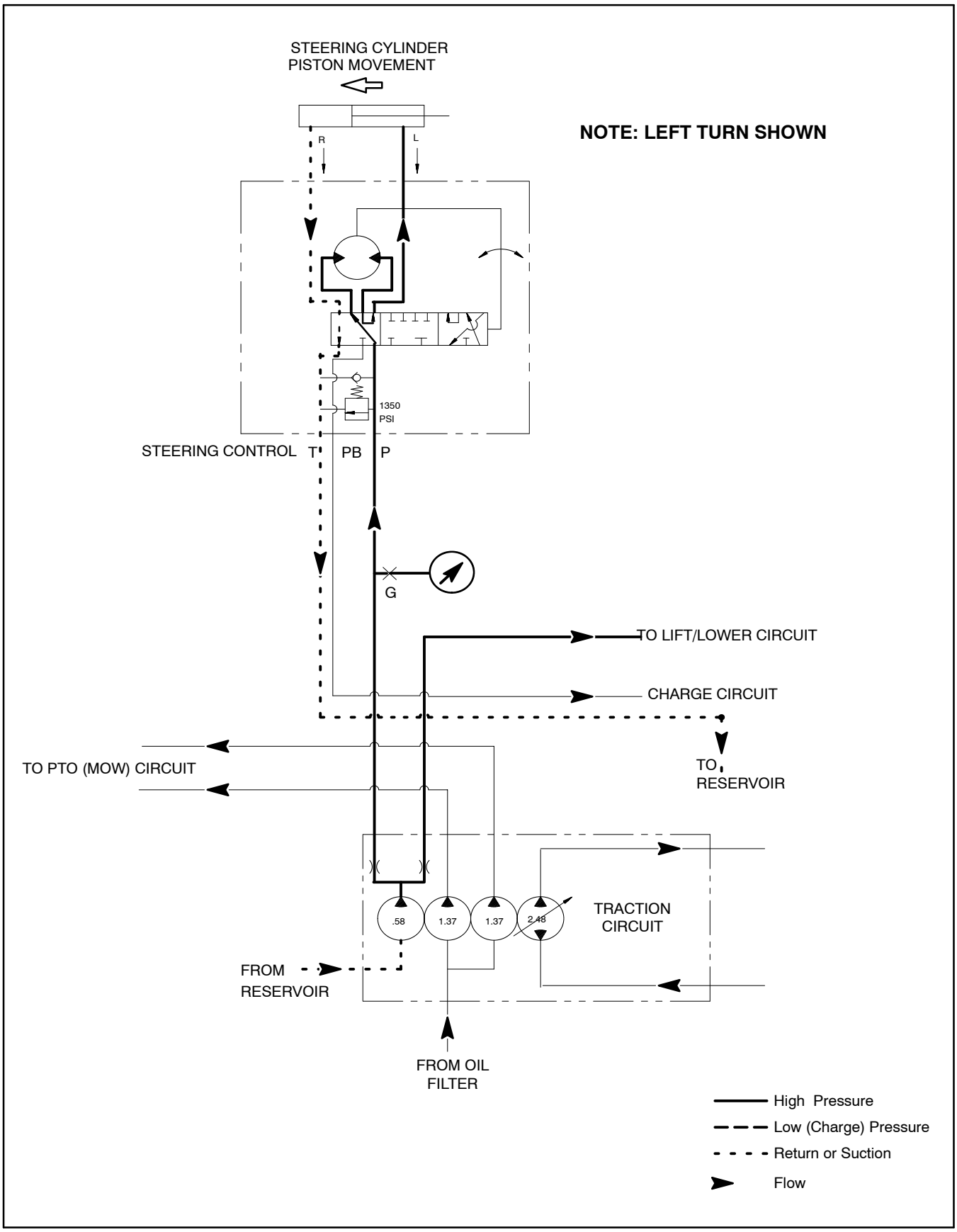


Figure 28

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

Figure 29

TEST NO. 7: 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 decks 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 gauge onto steering circuit pressure test port (Fig. 30).

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 **(2730 ± 30 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 1350 ± 50 PSI.

7. Stop the engine. Record test results.

8. If pressure is incorrect, inspect steering relief valve (Fig. 31). 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. Disconnect pressure gauge from test port.

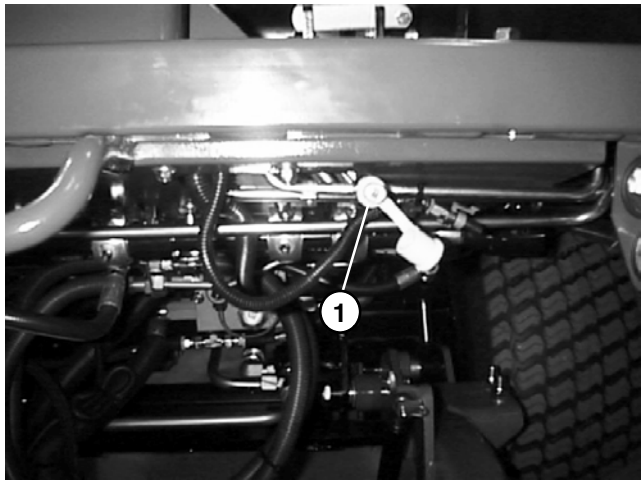


Figure 30

1. Steering circuit pressure test port

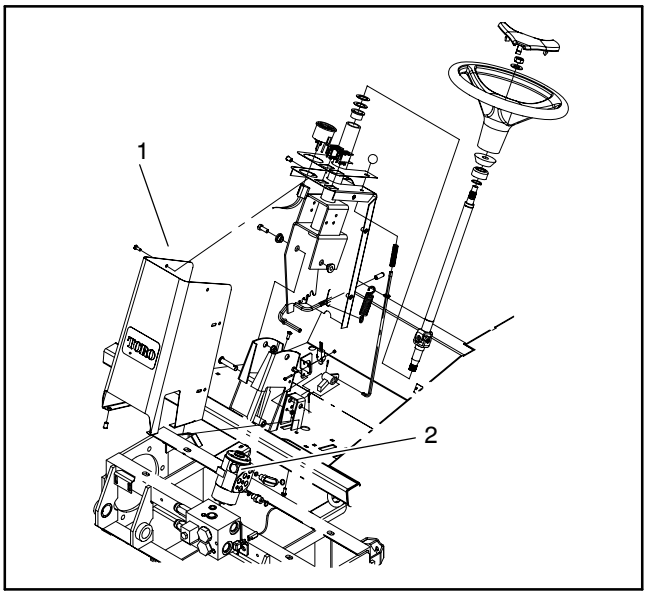
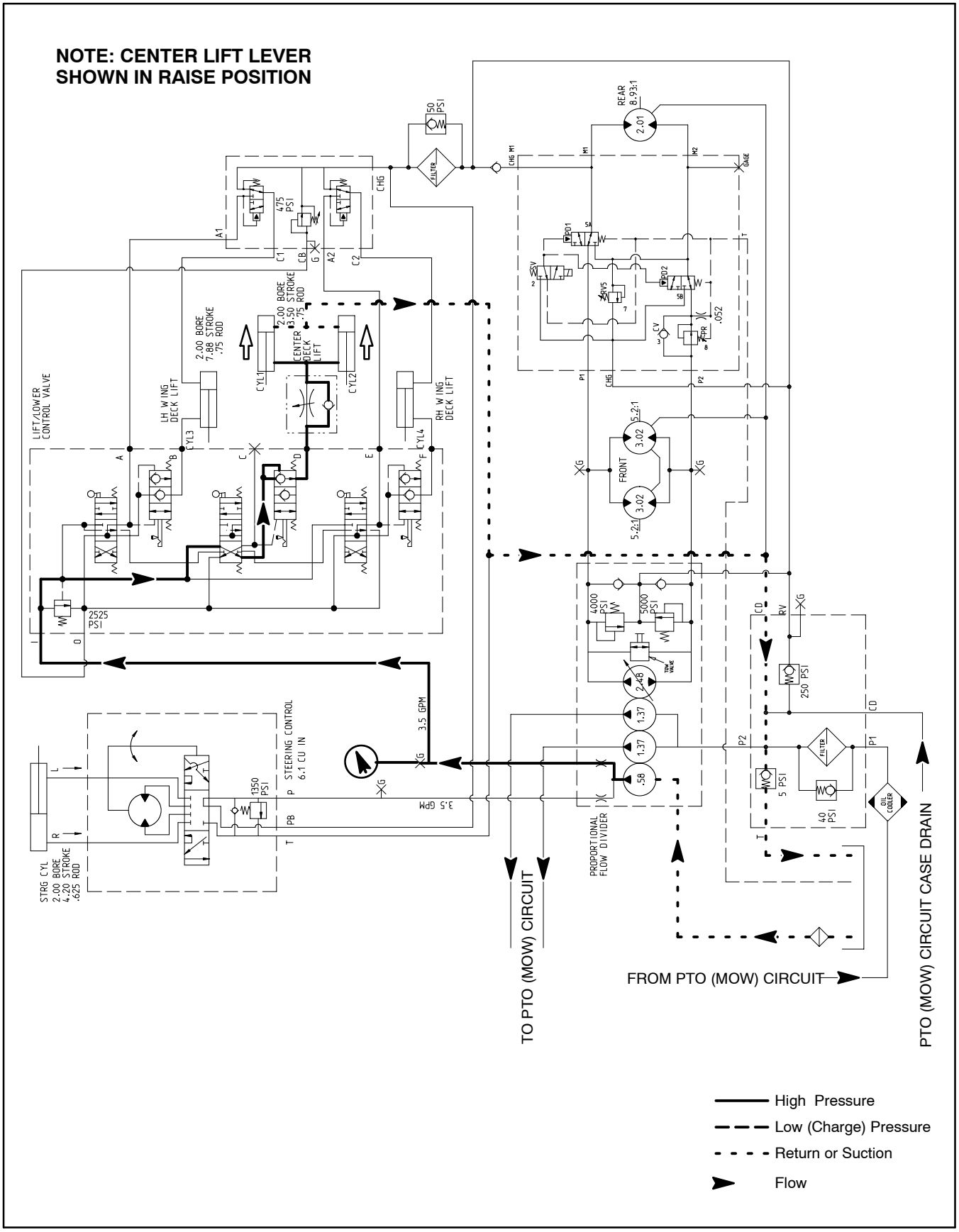


Figure 31

1. Steering tower
2. Steering relief valve

TEST NO. 8: 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 decks 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.

3. Raise seat to gain access to hydraulic test fitting. Connect a 5,000 PSI gauge to lift circuit test port (Fig. 32). 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 **(2730 ± 30 RPM)**.

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

GAUGE READING TO BE 2500 to 2550 PSI.

7. Record test results.

8. Stop the engine. If pressure is too high, adjust relief valve in lift control valve by rotating counterclockwise (Figure 33). 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. Disconnect pressure gauge from test port.

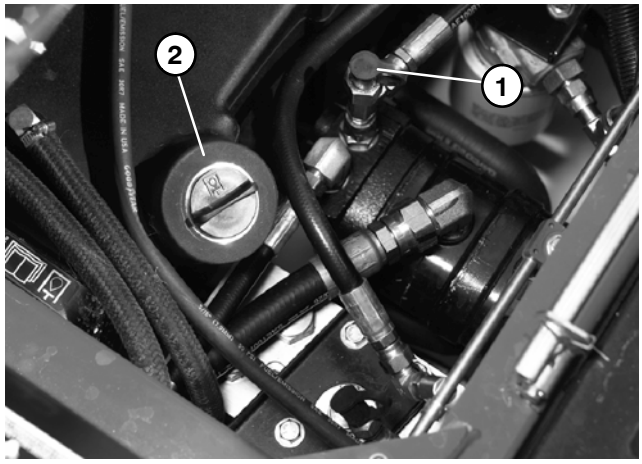


Figure 32

1. **Lift circuit port**
2. **Hydraulic reservoir cap**

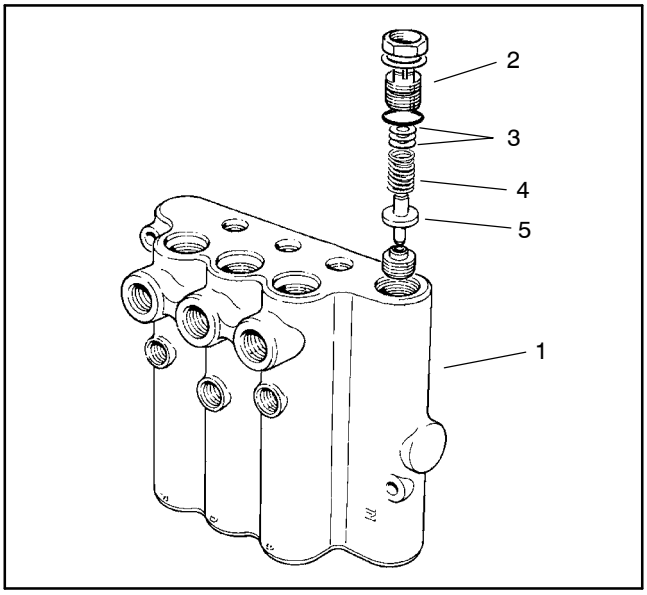
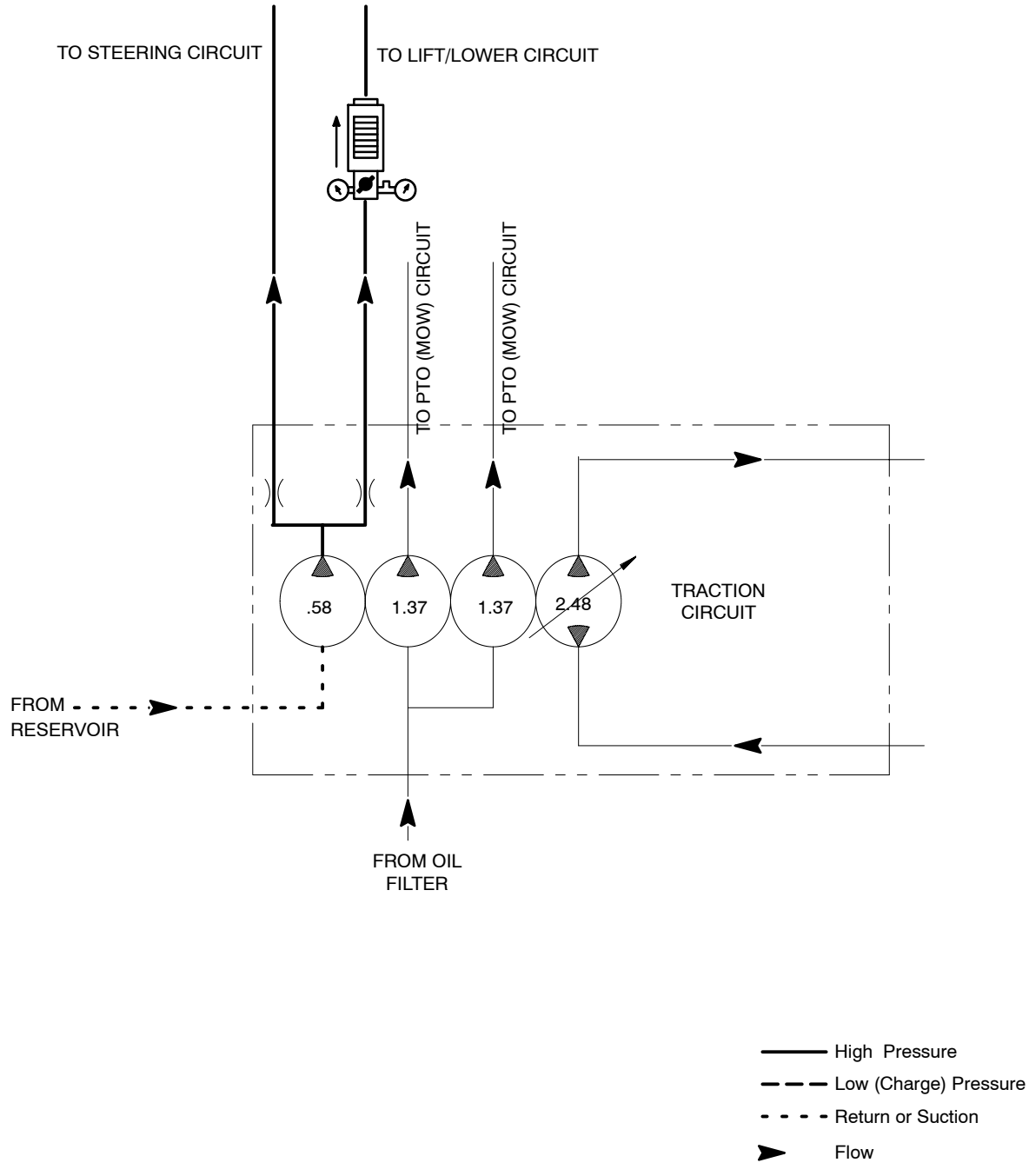


Figure 33

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

TEST NO. 9: Steering and Lift/Lower Gear Pump Flow (Using Tester with Pressure Gauges and Flow Meter)

NOTE: LIFT/LOWER CIRCUIT FLOW TEST SHOWN



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 decks 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, through the tester, and into the hydraulic hose.

3. With the engine off and cutting decks lowered, install tester with pressure gauges and flow meter in series between the last gear pump section and one of the circuit hoses (Fig. 34). **Make sure the tester flow control valve is open**.

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

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

5. Operate the engine at full speed **(2730 ± 30 RPM)**. **DO NOT** engage the cutting decks.

6. While watching tester pressure gauges, slowly close flow control valve on the tester until **1000 PSI** is obtained on gauge. Verify engine speed continues to be correct **(2730 ± 30 RPM)**. Record test results.

GAUGE READING TO BE: Flow approximately **3.5 GPM** at **1000 PSI**.

7. Open tester flow control valve and stop engine. Remove tester and reinstall disconnected hose. Complete steps 3 through 6 for other circuit hose.

8. If the **total** of the two flows is lower than **7 GPM** or a pressure of **1000 PSI** could not be obtained, check for restriction in pump intake line. If intake line is not restricted, remove gear pump and repair or replace as necessary.

If the **total** of the two flows is **7 GPM** but individual circuit flow is less than **3.5 GPM** (e.g. steering circuit has 2 GPM and lift circuit has 5 GPM), suspect a problem with the proportional valve in the gear pump.

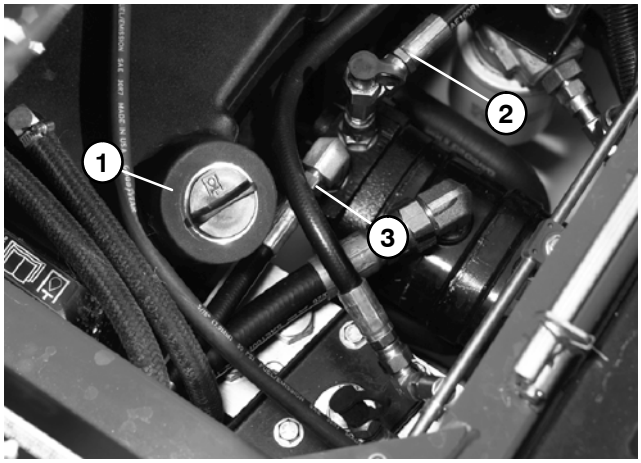


Figure 34

1. Hydraulic tank cap
2. Lift circuit hose
3. Steering circuit hose

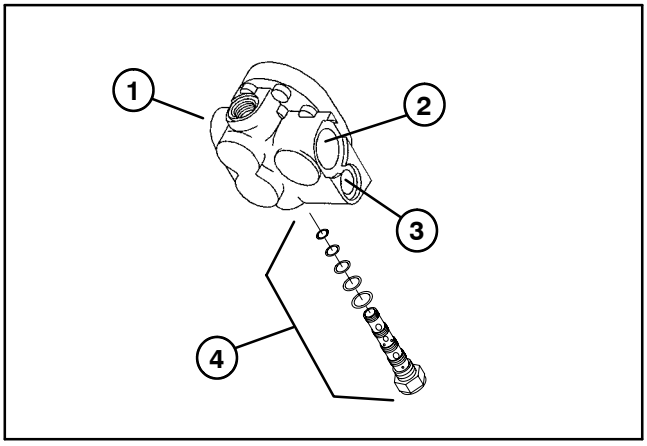
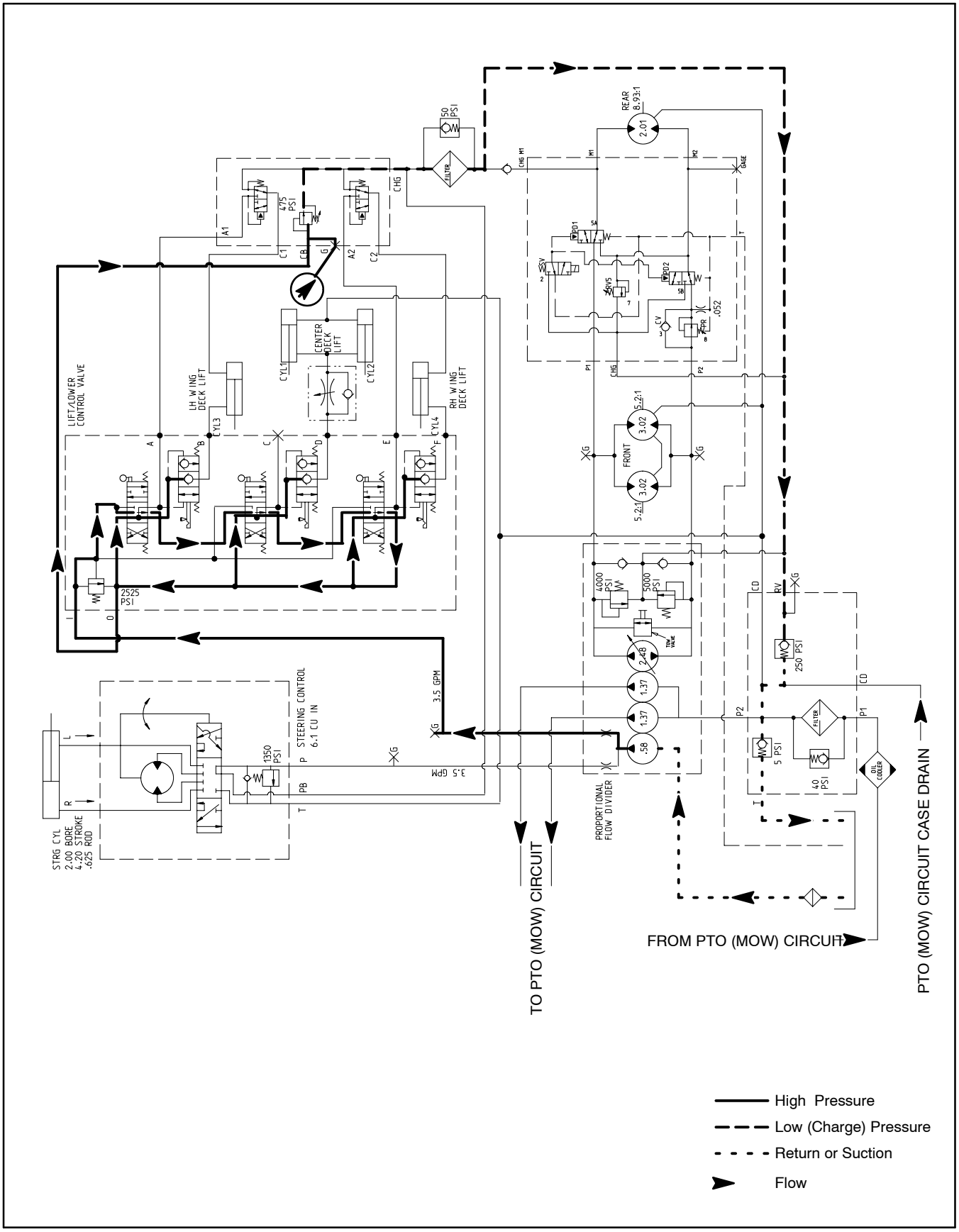


Figure 35

1. Gear pump backplate
2. Lift circuit
3. Steering circuit
4. Proportional valve

TEST NO. 10: 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 decks 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 TEST NO. 1: Traction Circuit Charge Pressure in this chapter).

4. Connect a 1000 PSI gauge to counterbalance test port on manifold under console (Fig. 36).

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 **(2730 ± 30 RPM)** with no load on the system. **Do not engage the cutting decks**.

GAUGE READING TO BE 225 PSI (17.3 bar) over system charge pressure (e.g. if charge pressure is 250 PSI, counterbalance pressure should be 475 PSI)**.**

7. Stop the engine. Record test results.

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

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

A. Loosen locknut on counterbalance valve (Fig. 36).

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. Disconnect pressure gauge from test port.

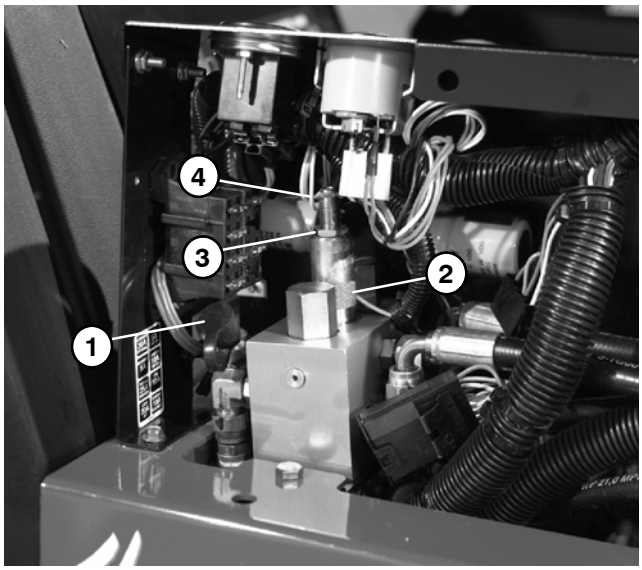
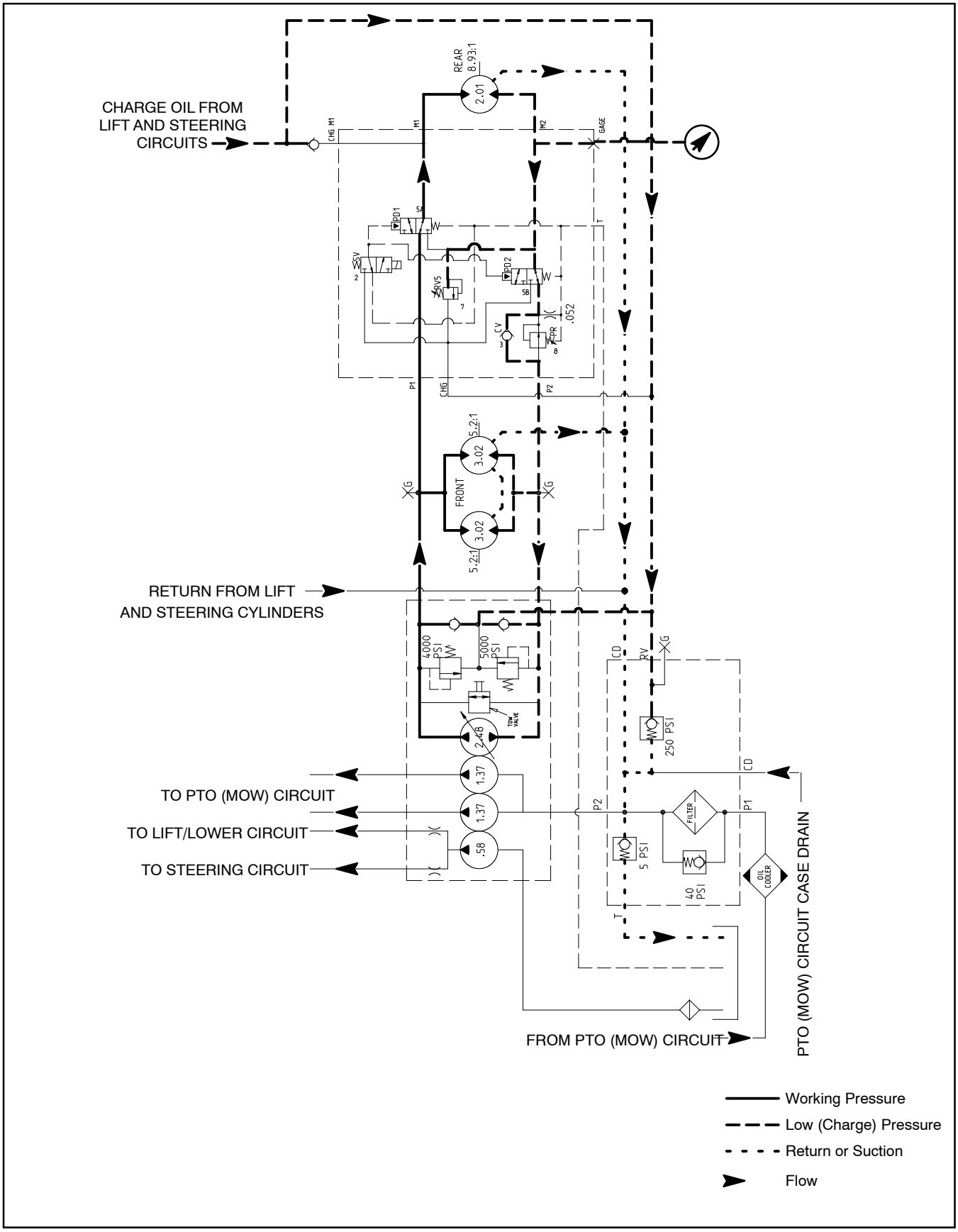


Figure 36

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

TEST NO. 11: Rear Traction Circuit (RV5) Relief Pressure (Using Pressure Gauge)



Procedure for Rear Traction Circuit (RV5) Relief Pressure Test

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

2. Park machine on a level surface with the cutting decks lowered and off. Make sure engine is off and the parking brake is 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 gauge to test port on 2WD/4WD control manifold under radiator (Fig. 37).

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 **(2730 ± 30 RPM)**.

6. Operate the machine in 4WD with the cutting decks lowered. Drive down a slope in a forward direction, decrease pressure on the traction pedal, and monitor the pressure gauge. Pressure should increase until the relief valve (RV5) lifts. Record test results.

GAUGE READING TO BE 750 PSI (approximate).

7. Relief valve (RV5) is located on the lower, front side of the 2WD/4WD control manifold (Fig. 38). 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. 39).

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. 39).

C. Recheck relief pressure and readjust as needed.

8. Disconnect pressure gauge from test port.

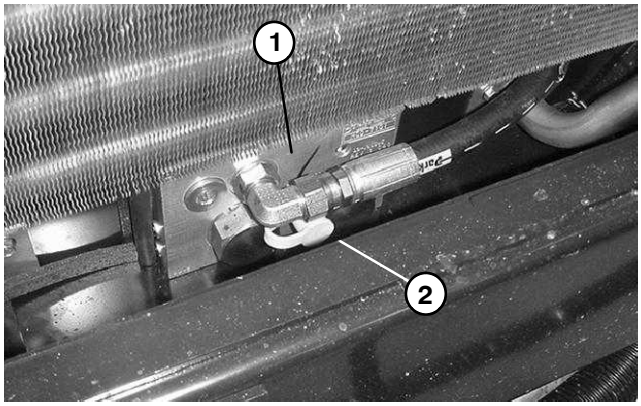


Figure 37

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

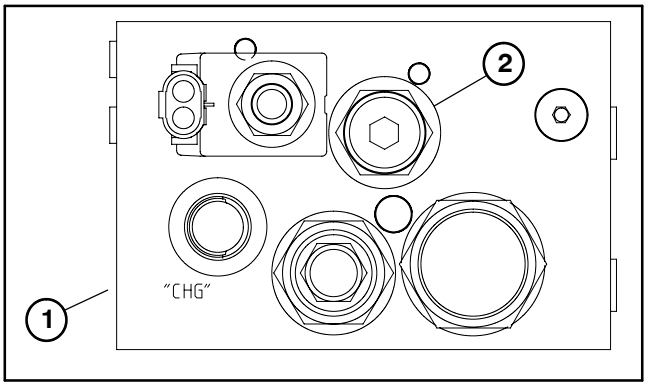


Figure 38

1. **Manifold: lower side**
2. **Relief valve (RV5)**

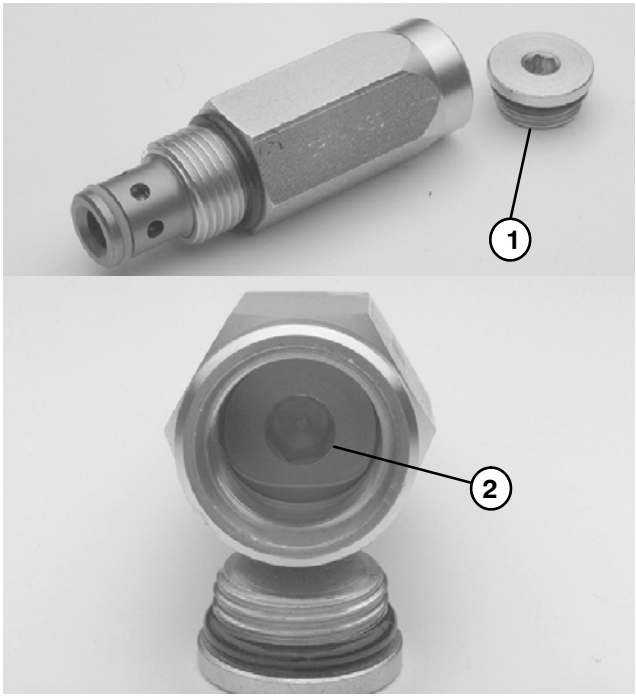
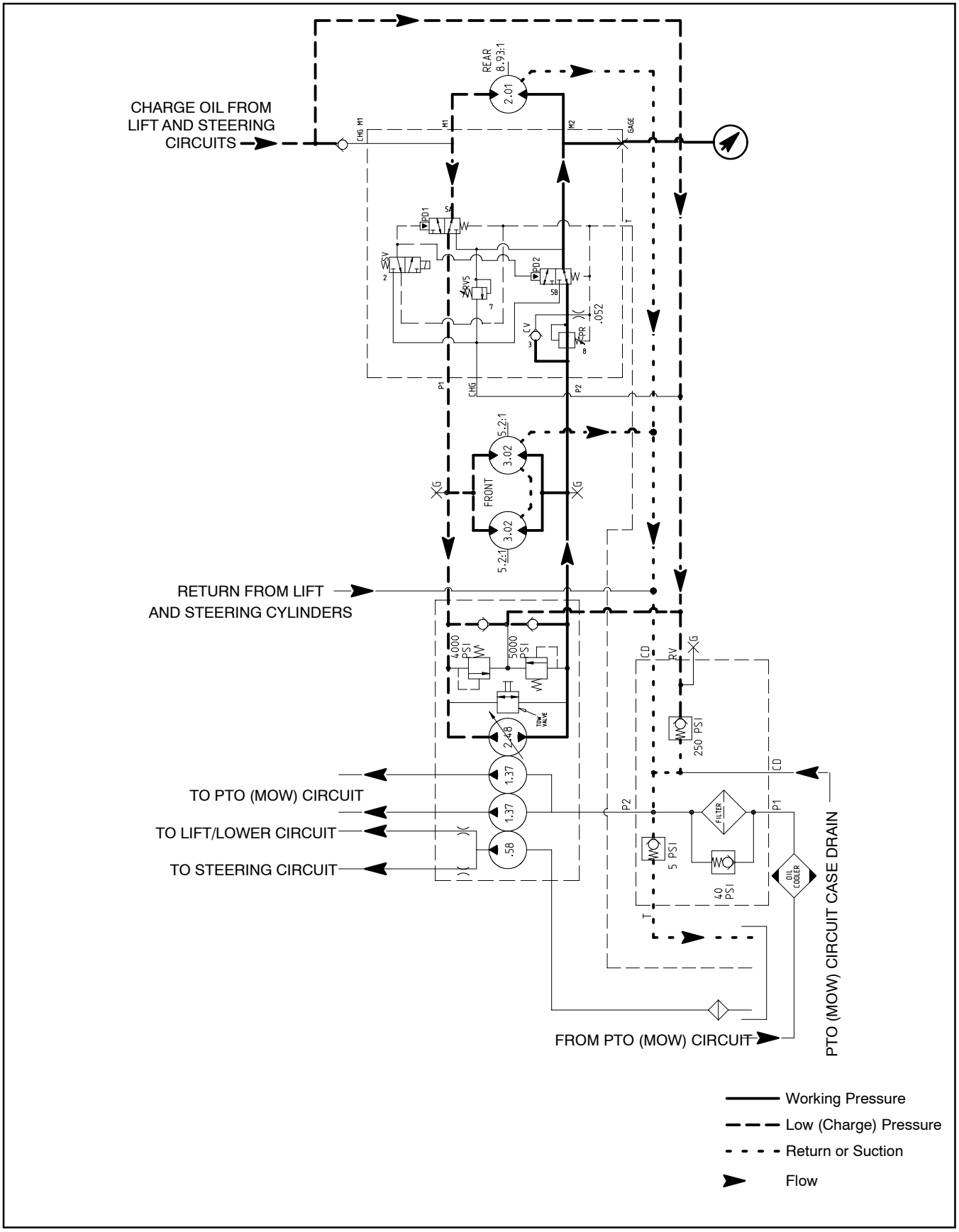


Figure 39

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

TEST NO. 12: 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 decks 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 gauge to test port on 2WD/4WD control manifold under radiator (Fig. 40).

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 **(2730 ± 30 RPM)**.

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 (approximate).

7. Stop engine and record test results.

8. Pressure reducing valve (PR) is located on the lower, front side of the 2WD/4WD control manifold (Fig. 41). Adjustment of this valve can be performed as follows:

NOTE: Do not remove the 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.

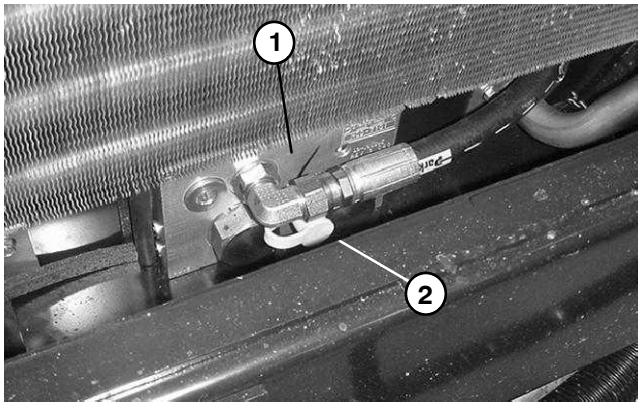


Figure 40

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

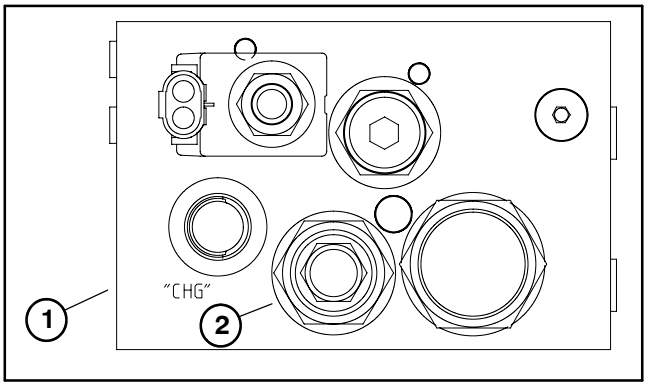


Figure 41

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

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 decks lower. 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 decks to the ground.

2. Locate valve under front of machine (Fig. 42).

3. Loosen setscrew on valve and rotate valve clockwise to slow down drop rate of cutting decks.

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

5. After desired drop rate is attained, tighten setscrew on valve to lock adjustment.

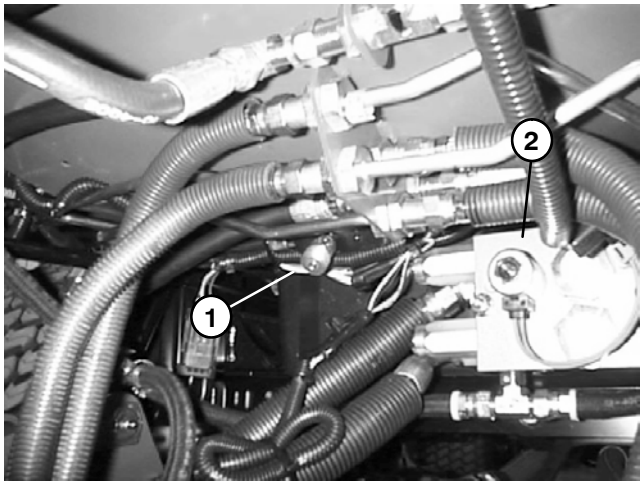


Figure 42

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 decks or attachments, and stop engine. Remove key from the ignition switch.

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

CAUTION

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

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).

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).

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, weather deterioration, or chemical 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).

IMPORTANT: Flush hydraulic system when changing from petroleum base hydraulic fluid to a biodegradable fluid such as Mobil EAL 224H. Operate machine under normal operating conditions for at least four (4) hours before draining.

1. Park machine on a level surface. Lower cutting decks, 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. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

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

2. Drain hydraulic reservoir (see Operator's Manual).

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

4. Change and replace both hydraulic oil filters (see Operator's Manual).

5. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir Inspection in the Service and Repairs section of this chapter).

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

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

7. Fill hydraulic reservoir with **new** hydraulic fluid (see Operator's Manual).

8. Disconnect electrical connector from engine run solenoid.

9. Turn ignition key switch; engage starter for 15 seconds to prime hydraulic pumps. Wait 15 seconds to allow the starter to cool and then repeat this step again.

10. Connect electrical connector to engine run solenoid.

11. Start engine and let it run at low idle **(1375 ± 50 RPM)** for a minimum of 2 minutes. Increase engine speed to high idle **(2730 ± 30 RPM)** for a minimum of 1 minute under no load.

12. Raise and lower cutting decks 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. If changing to biodegradable fluid, repeat steps 1 through 14 again at least once and until the 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 decks, 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 the Service and Repairs section of this chapter).

4. Make sure hydraulic reservoir is full. Add correct hydraulic oil if necessary (see Operator's Manual).

5. Disconnect engine run solenoid lead to prevent the engine from starting.

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

7. Make sure traction pedal and lift control lever are in the neutral position. Turn ignition key switch; engage starter for fifteen (15) seconds to prime the traction and gear pumps.

8. Reconnect engine run solenoid lead.

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 **(1375 ± 50 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 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, remove lines from bottom of piston (traction) pump, and reverse the connections.

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

14. Adjust traction pedal to the neutral position (see Operator's Manual).

15. Check operation of the traction interlock switch (see Operator's Manual).

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.

Gear Pump

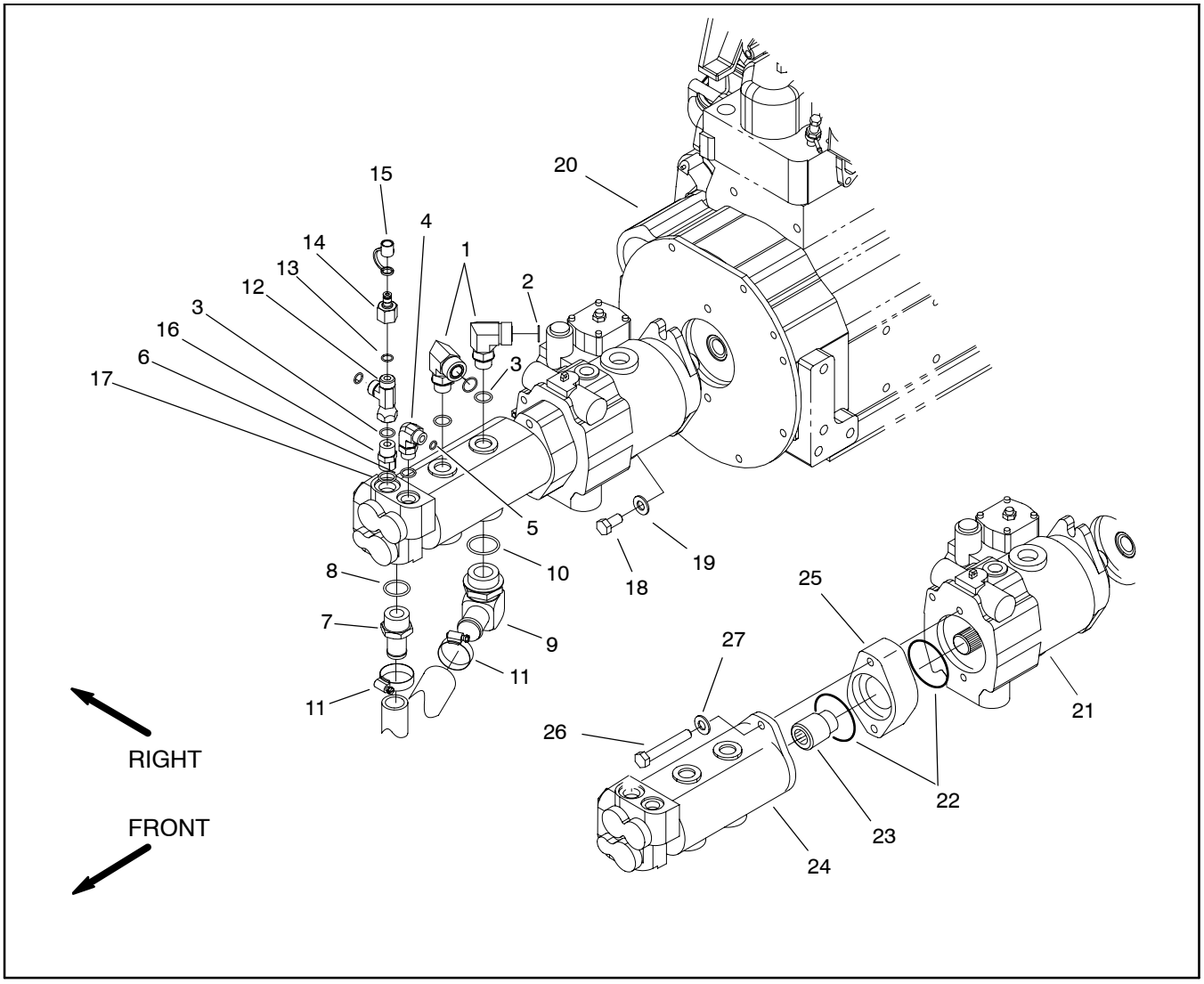


Figure 43

1. **90º hydraulic fitting**
2. **O-ring**
3. **O-ring**
4. **90º hydraulic fitting**
5. **O-ring**
6. **O-ring**
7. **Hydraulic fitting**
8. **O-ring**
9. **Hydraulic fitting**
10. **O-ring**
11. **Clamp**
12. **Hydraulic T fitting**
13. **O-ring**
14. **Hydraulic fitting**
15. **Fitting cap**
16. **Hydraulic fitting**
17. **O-ring**
18. **Cap screw (2 used)**
19. **Flat washer (2 used)**
20. **Engine**
21. **Piston pump**
22. **O-ring**
23. **Coupler**
24. **Gear pump**
25. **Spacer**
26. **Cap screw (2 used)**
27. **Washer (2 used)**

Removal (Fig 43)

1. Park machine on a level surface, lower cutting decks, 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 (see Operator's Manual).

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 the Service and Repairs section of this chapter.

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

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 43)

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.

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 15 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 the Service and Repairs section of this chapter).

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

Gear Pump Service

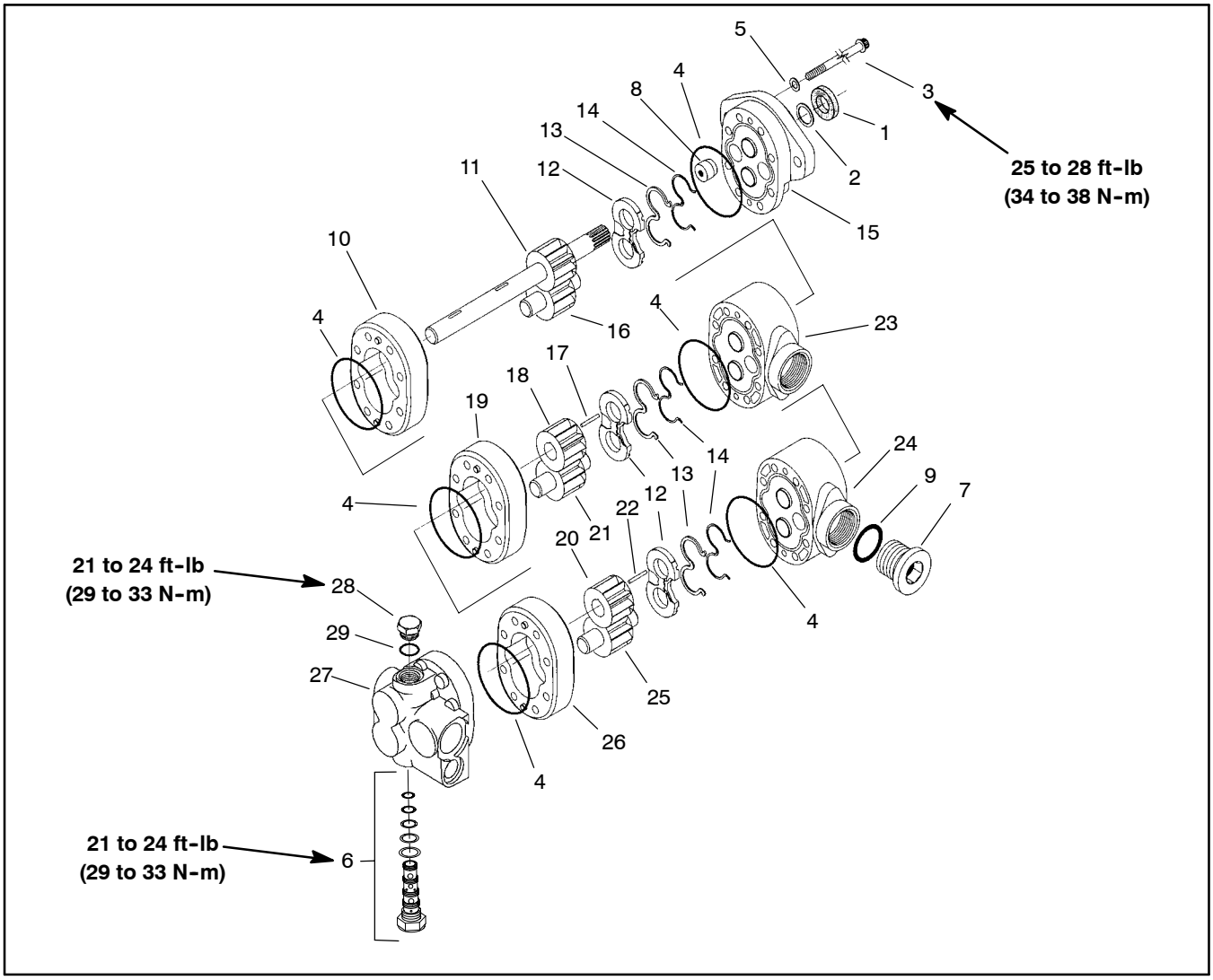


Figure 44

1. Shaft seal
2. Washer
3. Cap screw (8 used)
4. O-ring
5. Washer (8 used)
6. Proportional valve
7. Plug
8. Plug
9. O-ring
10. Front body
11. Drive gear assembly
12. Wear plate
13. Pressure seal
14. Backup gasket
15. Front plate assembly
16. Idler gear
17. Key
18. Drive gear
19. Middle body
20. Drive gear
21. Idler gear
22. Key
23. Front adapter plate
24. Rear adapter plate
25. Idler gear
26. Rear body
27. Backplate assembly
28. Plug
29. O-ring

Disassembly (Fig. 44)

Work in a clean area as cleanliness is extremely important when repairing hydraulic pumps. Thoroughly clean the outside of pump. After cleaning, remove port plugs and drain oil from pump.

1. Scribe a line, at an angle, across front plate (15), bodies (10, 19, 26), adapter plates (23, 24) and backplate (27). This will assure proper reassembly.

NOTE: To maintain maximum pump efficiency, keep body, gears and wear plates for each section together. **DO NOT** mix parts between different sections.

IMPORTANT: Avoid using excessive clamping pressure on the pump housing to prevent distorting the housing.

2. Clamp pump in vise, shaft end up and remove the eight cap screws (3).

3. Remove pump from vise, hold pump in hands and bump shaft against wooden block to separate front pump sections. Front body (10) will remain with either front plate (15) or front adapter plate (23).

4. Place front idler gear (16) into gear pocket and tap with soft face hammer until the front body separates. Remove idler gear from front plate or adapter plate.

5. Remove plug (8) from front plate (15).

6. Remove front adapter plate (23) from front body (10) by tapping on the adapter plate with a soft face hammer.

7. Remove idler gear (21), slip fit gear (18), and key (17).

8. Remove backplate (27) from rear body (26) by tapping on backplate with soft face hammer.

9. Remove rear idler gear (25), slip fit gear (20) and key (22).

10. Remove drive gear assembly (11) from rear adapter plate (24).

11. Place rear idler gear assembly (25) back into gear pocket and tap protruding end with soft face hammer to remove rear body (26) from the backplate assembly (27) or the rear adapter plate (24).

IMPORTANT: Note position of the open and closed side of the wear plates before removing.

12. Remove the wear plates (12) and o–rings (4) from front plate (15), front adapter plate (23), and rear adapter plate (24).

13. Remove backup gaskets (14) and pressure seals (13) from wear plates (15) by carefully prying out with a sharp tool.

IMPORTANT: Do not damage the seal bore in the front plate during seal removal.

14. Remove shaft seal (1) and washer (2) from front plate (15).

15. Remove plug (7) and washer (9) from rear adapter plate (24).

16. Remove proportional valve (6) from backplate assembly (27).

Inspection

1. Clean and dry all pump components. Remove nicks and burrs from all parts with emery cloth.

2. Check spline drive shaft for damaged teeth. Also check for damaged keyway, on drive shaft, that drives the slip fit gears of the pump.

3. Inspect both the drive gear and idler gear shafts at bushing points and seal area for rough surfaces and excessive wear.

4. Replace gear assembly if shaft measures less than .873" (22.17mm) in bushing area. (One gear assembly may be replaced separately; shafts and gears are available as assemblies only. The slip fit gear is available separately).

5. Inspect gear faces for scoring or excessive wear.

6. Replace gear assembly if gear width is below 1.181 inch (30.00 mm).

7. Assure that snap rings are in grooves on either side of drive and idler gears.

8. If any edge of gear teeth is sharp, break edge with emery cloth.

9. Oil groove in bushings in front plate, backplate and adapter plates should be in line with dowel pin holes and 180^{o} apart. This positions the oil grooves closest to respective dowel pin holes.

10. Replace the backplate, front plate or adapter plates if I.D. of bushings exceed .879" (22.33mm) (Bushings are not available as separate items).

11. Bushings in front plate and backup gasket side of adapter plates should be flush with face of plate.

12. Check for scoring on face of backplate and adapter plates. Replace if wear exceeds .0015" (.038mm).

13. Check bodies inside gear pockets for excessive scoring or wear.

14. Replace bodies if I.D. of gear pockets exceeds 2.100 inch (53.34mm).

Reassembly (Fig. 44)

It is important that the relationship of the backplate, adapter plates, bodies, wear plates and front plate is correct. The two half moon cavities in the bodies must face away from the front plate or adapter plate. The smaller half moon port cavity must be on the pressure side of the pump. The side of the wear plate with mid section cut out must be on suction side of pump. Suction side of backplate or adapter plate is always the side with larger port boss.

1. Replace the wear plates, pressure seals, backup gaskets, shaft seal and o-rings as new parts. During reassembly, check the scribe mark on each part to make sure the parts are properly aligned.

2. Install o-rings (4) in groove of front plate (15), adapter plates (23, 24), and backplate (27) with a small amount of petroleum jelly to hold in place.

3. Install new pressure seals (13) and backup gaskets (14) into new wear plates (12). The flat section in the middle of the backup gasket must face away from the wear plate inside the seal.

4. Place plug (8) into pocket of front plate (15).

5. Apply a thin coat of petroleum jelly to both milled gear pockets of front body (10). Position body onto front plate (15) with half moon port cavities in body facing away from front plate.

NOTE: The small half moon port cavity must be on the pressure side of pump.

6. Place wear plate (12) into the gear pocket with the pressure seal and backup gasket against the front plate. The side with the mid section cut away must be on suction side of pump.

7. Dip drive gear assembly (11) and idler gear assembly (16) into clean hydraulic oil. Slip both gear assemblies into gear pocket of front body (10) and into front plate bushings.

8. Install front adapter plate (23) in place on front body (10). Check positioning marks for correct orientation.

9. Install middle body (19) onto front adapter plate (23). Place wear plate (12) into the gear pocket with the pressure seal and backup gasket against the front adapter plate.

10. Install key (17) in slot of drive gear shaft. Dip slip fit gear (18) in clean hydraulic oil and slide on shaft and into gear pocket of middle body (19). Check key for proper alignment.

11. Dip idler gear (21) in clean hydraulic oil and install in gear pocket of middle body.

12. Install rear adapter plate (24) in place on middle body (19). Check positioning mark on all sections of pump.

13. Position rear body (26) onto rear adapter plate (24). Place wear plate (12) into the gear pocket with the pressure seal and backup gasket against the rear adapter plate.

14. Install key (22) in slot of drive gear shaft. Dip slip fit gear (20) in clean hydraulic oil and slide on shaft and into gear pocket of rear body (26). Check key for proper alignment.

15. Dip rear idler gear (25) in clean hydraulic oil and install in gear pocket of rear body.

16. Position backplate (27) over shafts until dowel pins in body are engaged.

17. Secure pump components with cap screws (3). Torque cap screws evenly in a crisscross pattern from 25 to 28 ft-lb (34 to 38 N-m).

18. Place washer (2) over drive shaft into housing. Liberally oil shaft seal (1) and install over drive shaft carefully so that rubber sealing lips are not cut.

19. Place 1-3/8" O.D. sleeve over shaft and press in shaft seal .200 in. (5.08mm) below surface of front plate.

20. Install plug (7) and washer (9) into rear adapter plate.

21. If removed, install plug (28) with o-ring into backplate and torque from 21 to 24 ft-lb (29 to 33 N-m).

22. Install proportional valve (6) into backplate. Torque plug from 21 to 24 ft-lb (29 to 33 N-m).

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Piston (Traction) Pump

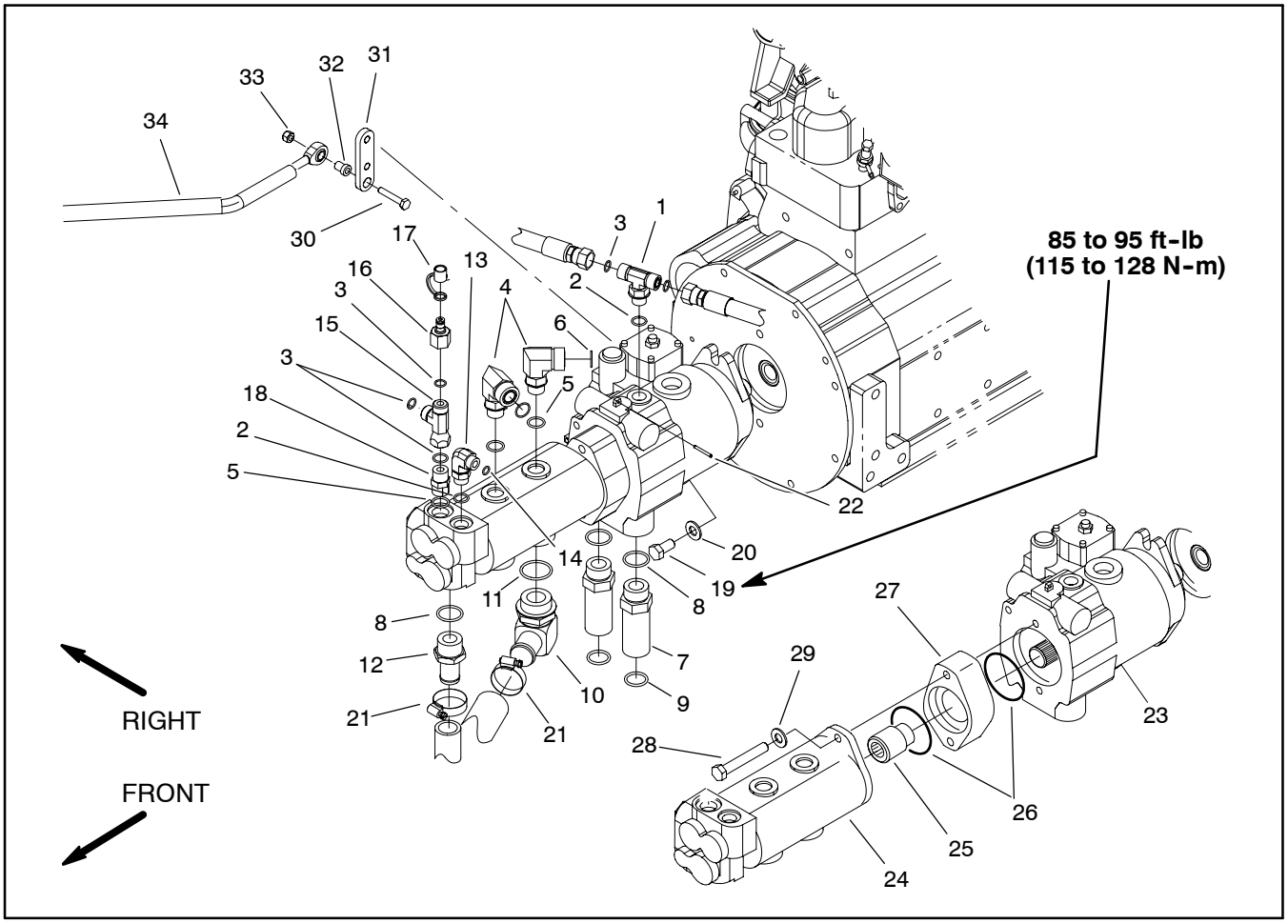

Figure 45

1. Hydraulic T fitting
2. O-ring
3. O-ring
4. 90º hydraulic fitting
5. O-ring
6. O-ring
7. Hydraulic fitting (2 used)
8. O-ring
9. O-ring
10. Hydraulic fitting
11. O-ring
12. Hose connector
13. 90º hydraulic fitting
14. O-ring
15. Hydraulic T fitting
16. Hydraulic fitting
17. Fitting cap
18. Hydraulic fitting
19. Cap screw (2 used)
20. Flat washer (2 used)
21. Clamp
22. Roll pin
23. Piston pump
24. Gear pump
25. Coupler
26. O-ring
27. Spacer
28. Cap screw (2 used)
29. Washer (2 used)
30. Cap screw
31. Control arm (on piston pump)
32. Spacer
33. Lock nut
34. Traction rod

Removal (Fig. 45)

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

2. To prevent contamination of hydraulic system during pump 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.

4. Disconnect two wires from neutral switch on traction 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. 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.

7. Remove gear pump from machine (see Gear Pump Removal). Note: If fuel tank is loosened and raised approximately 4" (102 mm) from the machine, the gear pump and piston pump can be removed as a complete assembly.

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

Installation (Fig. 45)

1. Carefully lower piston pump into the machine and position it to the engine adapter plate. Support pump to prevent it from falling while installing two (2) cap screws and washers securing piston pump to engine adapter plate. Torque screws from 85 to 95 ft–lb (115 to 128 N–m).

2. Install gear pump to piston pump (see Gear Pump Installation in the Service and Repairs section of this chapter).

3. Position traction rod to control arm on piston pump by installing cap screw, spacer, and lock nut.

4. Connect two wires to neutral switch on traction pump.

5. 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.

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

7. Disconnect engine run solenoid electrical connector to prevent engine from starting. Prime hydraulic pumps by turning ignition key switch to start and crank engine for 15 seconds. Wait 15 seconds and repeat cranking procedure again.

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

9. Properly fill hydraulic system (see Charge Hydraulic System in the Service and Repairs section of this chapter).

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

Piston (Traction) Pump Service

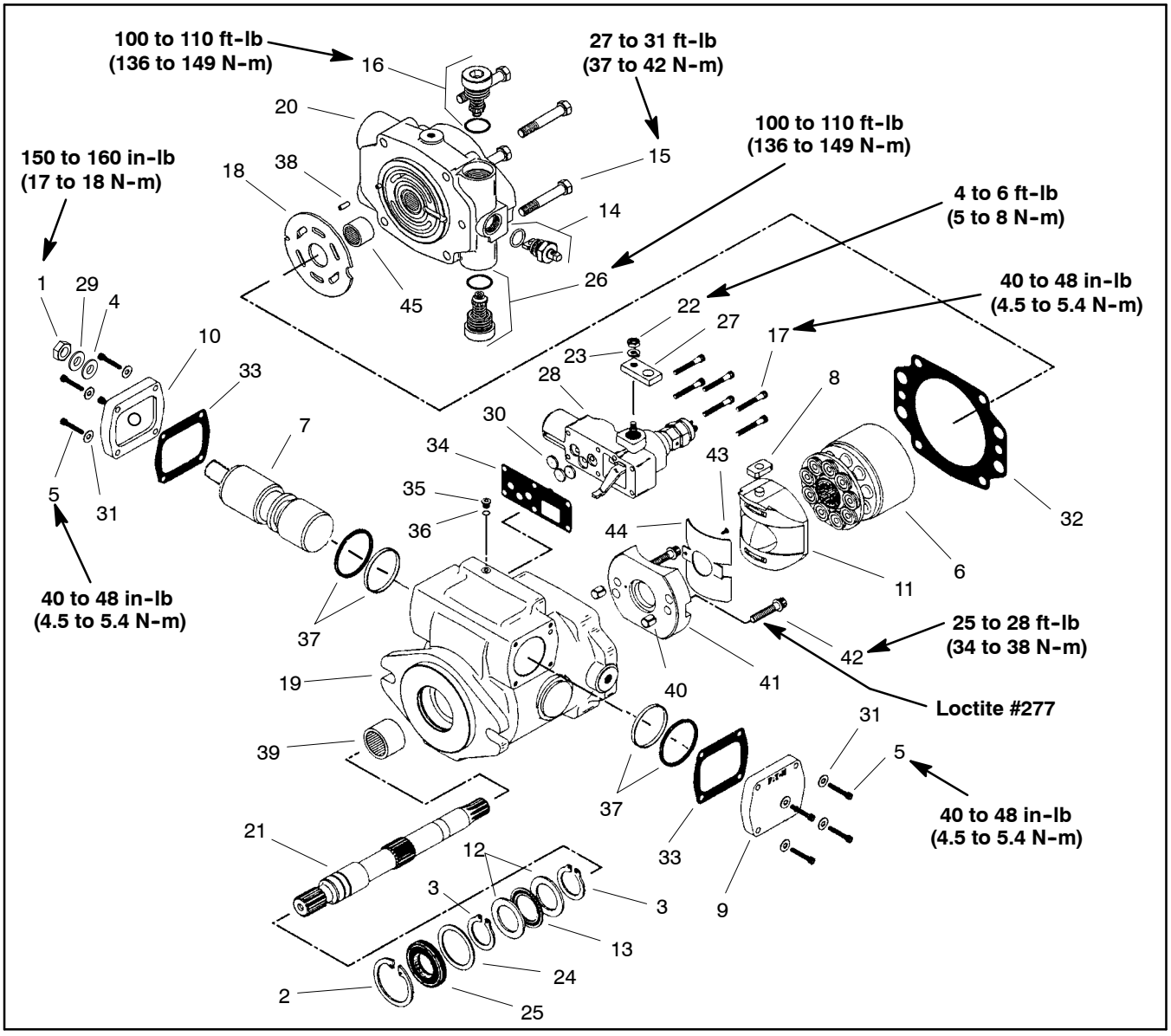

Figure 46

1. Jam nut
2. Retaining ring
3. Retaining ring
4. Seal washer
5. Socket head screw (4 used per cover)
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 (4 used)
16. Relief valve (Reverse)
17. Socket head screw (6 used)
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 (2 used)
41. Cradle sub-assembly
42. Cap screw (2 used)
43. Button head cap screw
44. Bushing
45. Bearing

Disassembly (Fig. 46)

1. Position the pump into a protected jaw vise, clamping onto the outer portion of the flange, with the cap screws up. Mark the relationship of the working ports (for reassembly identification) to the servo control assembly with a scribe. Remove the four cap screws (15) retaining backplate (20).

2. Lift backplate (20) straight up off drive shaft (21) and housing (19). Remove valve plate (18) from backplate (20) or from rotating kit assembly (6), still in housing (19).

3. From backplate (20), remove bypass valve (14), forward relief valve (26), and reverse relief valve (16). Note: Mark the valves in relationship to the cavity it was removed, for reassembly purposes.

4. Remove housing gasket (32) from housing (19) or backplate (20).

5. With pump still in vise, remove the six socket head screws (17) retaining the servo control assembly (28). Remove the control assembly and control housing gasket (34) from the housing. Remove orifice plates (30), noting location for reassembly. Remove nut (22), lock washer (23), and control arm (27) from servo control input shaft. Note position of control arm for reassembly.

6. To remove rotating kit assembly (6) from housing, first remove pump from vise holding the rotating kit assembly in position. Lower pump so that the shaft end (flange end) is up. Set the rear of housing onto table with housing flat and rotating kit assembly at rest on table. (Hole in table, for protruding shaft, is required.) Lift and remove the housing (19) and drive shaft (21) from rotating kit assembly (6) and camplate assembly(11).

7. Remove camplate (11) from rotating kit assembly (6) and servo piston follower (8) from camplate (11).

8. Remove the four socket head screws (5) and washers (31) retaining each cover plate (9 & 10).

9. Remove jam nut (1), washer (29), and seal washer (4). Hold the servo piston bolt with hex key and unscrew cover plate (10) from bolt.

10. Remove servo piston assembly (7) and seal sub–assemblies (two sets) (37) from housing. Note: Disassembly of servo piston assembly is not required.

11. Remove retaining ring (2) from the front of pump housing (19). Press the drive shaft (21), shaft seal (25), and washer (24) from housing. Remove retaining ring (3), thrust race (12), thrust bearing (13), second thrust race (12), and second retaining ring (3) from drive shaft (21).

12. Remove the two cap screws (42) that secure cradle sub–assembly inside housing. Move the cradle sub–assembly back–and–forth to release dowel bushings (40) and remove cradle sub–assembly from housing.

13. Remove button head cap screw (43) to remove bushing (44) from cradle.

14. Remove remaining plugs from housing.

15. Discard the shaft seal (25), gaskets (32, 33, 34), and o–rings from all assemblies. Replace with new seals upon reassembly.

Inspection

1. Inspect backplate assembly:

   A. Check the bearing (45) (press fit) in backplate (20). If needles remain in cage, move freely, and setting is at the dimension shown in Figure 47, bearing removal is not required.

   B. Check roll pin (38) in backplate (20). If tight and set to the dimension shown in Figure 47, removal not required.

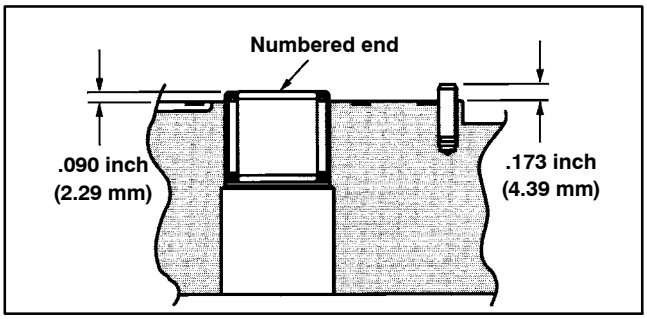

Figure 47

2. Check the bearing (39) (press fit) in pump housing (19). If needles remain in cage, move freely, and setting at the dimension shown in Figure 48, bearing removal is not required.

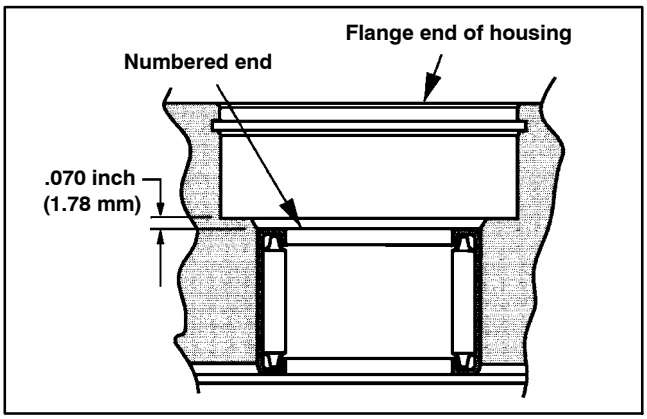

Figure 48

3. Inspect camplate assembly:

A. The finish on the piston shoe surfaces of the camplate (11) should show no signs of scoring.

B. Inspect camplate (11) bushing surface for wear. Also inspect surface for coating transfer from bushing.

4. Inspect bushing (44) for contamination embedment within coating of bushing surface coming in contact with camplate (11).

5. Inspect rotating kit (Fig. 49):

A. The pistons should move freely in the rotating kit piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.

B. Examine the O.D. of the pistons for finish condition. They should not show wear or deep scratches. Inspect the shoes for a snug fit on the ball end of the pistons and a flat smooth surface that comes in contact with the camplate. **Do not lap piston shoes.**

C. Examine the spider for wear in the pivot area.

D. Examine the spider pivot to insure smoothness and no signs of wear.

Reassembly (Fig. 46)

1. All parts should be cleaned and internal pump parts lubricated with clean hydraulic oil before reassembly.

2. If necessary, press new bearing into pump housing to dimension shown in Figure 48 with the numbered end of bearing outward.

3. Install the two new seal sub-assemblies (37) into the servo piston cavity of pump housing (19).

4. Screw the cover plate (10) onto the servo piston assembly (7). Install new cover plate gasket (33) in place on pump housing. Install servo piston assembly (7) and cover plate (10) into servo piston bore in right side of housing (Fig. 50). Retain cover plate with four washers (31) and socket head screws (5). Torque screws from 40 to 48 in-lb (4.5 to 5.4 N-m). To obtain neutral, centering the servo piston assembly is required. Measure in from the left side and set servo piston .500 in. (12.7 mm) from surface of servo housing bore as shown in Figure 50.

NOTE: Re-adjustment may be required for neutral at machine start-up.

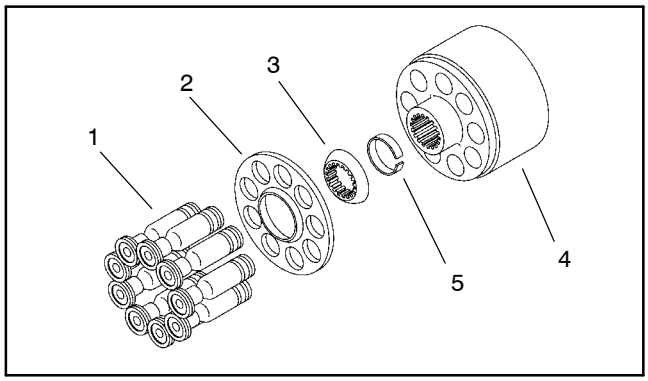

Figure 49

1. **Piston assemblies**
2. **Spider**
3. **Spider pivot**
4. **Piston block**
5. **Retainer**

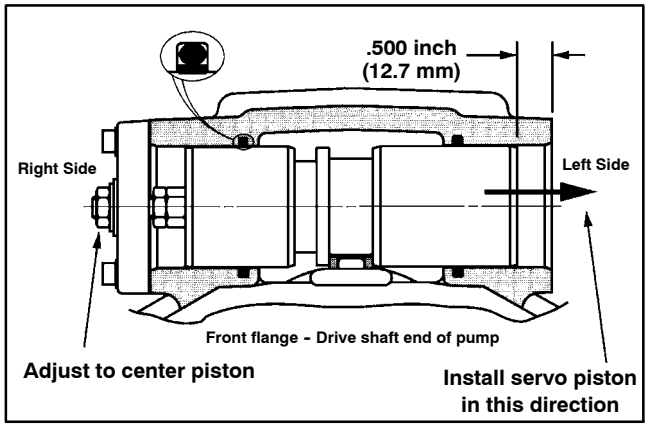

Figure 50

5. Install new seal washer (4), washer (29), and jam nut (1) to servo piston bolt. Holding servo piston bolt with hex key wrench, torque jam nut from 150 to 160 in-lb (17 to 18 N-m). Check the centering of servo piston assembly (7). Install new cover plate gasket (33) and cover plate (9) to open side of servo piston and retain with four washers (31) and socket head screws (5). Torque screws from 40 to 48 in-lb (4.5 to 5.4 N-m).

6. Press dowel bushings (40) into cradle and secure bushing (44) onto cradle with button head cap screw (43). Torque button head cap screw from 14 to 16 in-lb (1.6 to 1.8 N-m).

7. Place cradle sub-assembly (41) into housing (19) making sure dowel bushings (40) and cradle (41) are completely seated into housing. Retain cradle sub-assembly with two cap screws (42) after applying Loctite #277 (or equivalent) to the end of threads. Torque cap screws from 25 to 28 ft-lb (34 to 38 N-m).

8. Place exterior retaining ring (3), thrust race (12), thrust bearing (13), second thrust race (12), and second retaining ring (3) onto drive shaft (21). Position washer (24) and shaft seal (25) onto shaft.

9. Install shaft assembly into front of housing. Seat seal (25) into position with seal driver and retain with interior retaining ring (2).

10. Install servo piston follower (8) onto camplate dowel pin. Install camplate (11) carefully onto bushing (44) (coat bushing surface with hydraulic oil), aligning servo piston follower (8) with slot in servo piston assembly (7).

11. Position housing in a horizontal position. Holding camplate (11) in position with screw driver through controller linkage passageway at the top of housing, place rotating kit assembly (6) over shaft and into housing until pistons are against camplate (11). Make sure all parts are in housing completely and are properly positioned. Return the pump to the vise with open end of housing up, clamping housing on the outer portion of the flange.

12. Install gasket (32) onto housing.

13. If necessary, press new bearing (45) and roll pin (38) in backplate (20) to dimension shown in Figure 47. Note: Bearing should be installed with the numbered end outward. Roll pin should be installed with split oriented away from bearing.

14. Install new o-ring on relief valves (16 & 26). Install relief valve in the cavity in backplate that it was removed and torque from 100 to 110 ft-lb (136 to 149 N-m).

15. Install new o-ring on bypass valve (14). Install bypass valve (14) into backplate (20). Note: Make sure paddle of bypass valve is perpendicular to relief valve axis prior to installing or damage could result.

16. Apply a small amount of petroleum jelly to the steel side of valve plate (18) to hold in place for installation. Aligning the index pin, place the valve plate (18) in position onto the backplate (20), with steel side against backplate.

17. Install backplate assembly (20) onto housing assembly (19). Make sure ports are positioned correctly, and that valve plate (18) and gasket (32) stay in place.

18. Retain backplate (20) with four cap screws (15). Torque cap screws from 27 to 31 ft-lb (37 to 42 N-m).

19. Install control housing gasket (34) onto housing. Install orifices (30) into servo control assembly (28) and retain in position with petroleum jelly. Position the feedback link at 90 degrees from control housing. Install manual servo control assembly (28) onto housing making sure feedback link entered small groove in servo piston assembly (7).

20. Secure control assembly with six socket head screws (17). Torque screws from 40 to 48 in-lb (4.5 to 5.4 N-m).

21. Install control arm (27) onto control assembly input shaft. Retain with lock washer (23) and nut (22). Torque nut from 4 to 6 ft-lb (5 to 8 N-m).

22. Install remaining plugs that were removed from pump. Torque 3/4 in. plug from 21 to 24 ft-lb (28 to 32 N-m). Torque 1-1/4 in. plug from 40 to 45 ft-lb (54 to 61 N-m).

Piston Pump Control Assembly

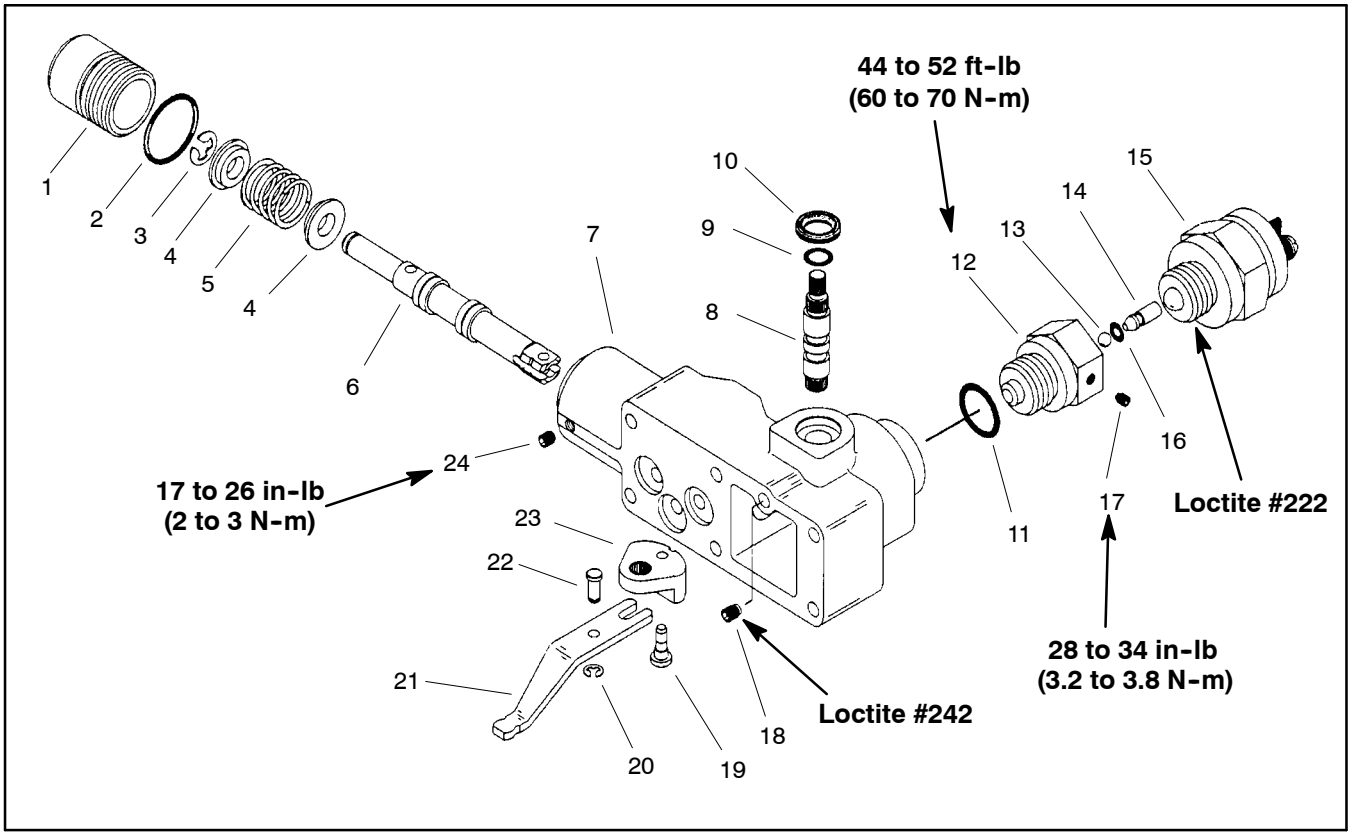

Figure 51

1. Plug
2. O-ring
3. Retaining ring
4. Spring retainer
5. Spring
6. Spool valve
7. Control housing
8. Input shaft
9. O-ring
10. Wiper seal
11. O-ring
12. Adaptor
13. Ball
14. Pin
15. Neutral switch
16. O-ring
17. Set screw
18. Set screw
19. Pin
20. Retaining ring
21. Feedback link
22. Dowel pin
23. Bell crank
24. Set screw

Disassembly - Manual Servo Control Assembly

1. Remove wiper seal with screw driver. Remove set screw (18) that retains input shaft and remove input shaft from control housing. Remove o-ring from shaft.

2. Remove set screw (24) from plug that retains valve spool. Remove plug from control housing and o-ring from plug.

3. Remove retaining ring (20) from pin that retains feedback link and spool valve. Remove pin, feedback link, spool valve, and bell crank from control housing.

4. Compress spring and remove retaining ring (3). Remove spring retainer, spring, and second spring retainer from spool valve.

5. Clean all parts and lubricate in clean hydraulic oil for reassembly.

Reassembly - Manual Servo Control Assembly

1. Install spring retainer, spring, and second spring retainer onto spool valve. Compress spring to allow retaining ring (3) to be installed onto spool valve.

2. Install spool valve into control housing making sure that metering notches on spool valve can be seen in the metering ports.

3. Position bell crank in housing. Slide feedback link into position between clevis on valve spool, aligning holes, and install dowel pin and retaining ring (20).

4. Install new o-ring (9) onto input shaft. Hold bell crank in position with feedback link slot and align splined hole of bell crank with input shaft cavity. Install input shaft into control housing and bell crank.

5. Apply Loctite #242 or equivalent to set screw (18) and install into control housing. Adjust set screw until it bottoms out on input shaft and back out one-quarter turn.

6. Install wiper seal on input shaft.

7. Install new o-ring (2) onto plug and install plug. Adjust plug until there is no end play in the valve spool with input shaft held stationary. Secure plug in place with set screw (24). Torque set screw from 17 to 26 in-lb (2 to 3 N-m).

Disassembly - Neutral Switch

1. Loosen set screw (17) in adapter and remove neutral switch from adapter.

2. Remove adapter from control housing.

3. Remove pin, ball, and o-rings (11 & 16) from adapter.

Reassembly - Neutral Switch

1. Install new o-ring (11) onto adapter and new o-ring (16) onto pin.

2. Install ball and pin into adapter. Lubricate with petroleum jelly to hold in place during installation.

3. Install adapter into control housing. Torque from 44 to 52 ft-lb (60 to 70 N-m).

4. Apply Loctite #222 or equivalent to threads of neutral switch and install switch into adapter. The adjustment procedure for the switch are as follows.

A. Install switch, while moving link back and forth, until "detent" action is detected. Back out the switch until the "detent" action is very slight.

B. Attach the leads from a test light to the switch terminals. **Note:** A multimeter could be used instead of a test light.

C. Move the link out of the detent position. The test light will go on (continuity). Screw in the switch until the light goes off (no continuity). Mark this as position "A" (Fig. 52). Move the link to the detent position and the test light should come back on.

D. Leaving the link in the detent position, the light will remain on. Screw in the switch until the light goes off. Mark this position "B".

E. Unscrew the switch one third of the distance between "B" and "A". Install and tighten the set screw (17) in one of the upper quadrants of the hex of the switch adapter (Fig. 52). Torque set screw from 28 to 34 in-lb (3.2 to 3.8 N-m).

5. Test the switch by moving the control arm to the detent position, the light should be on. Move the control arm out of detent, the light should go off.

6. Remove test light and put servo control assembly into operation.

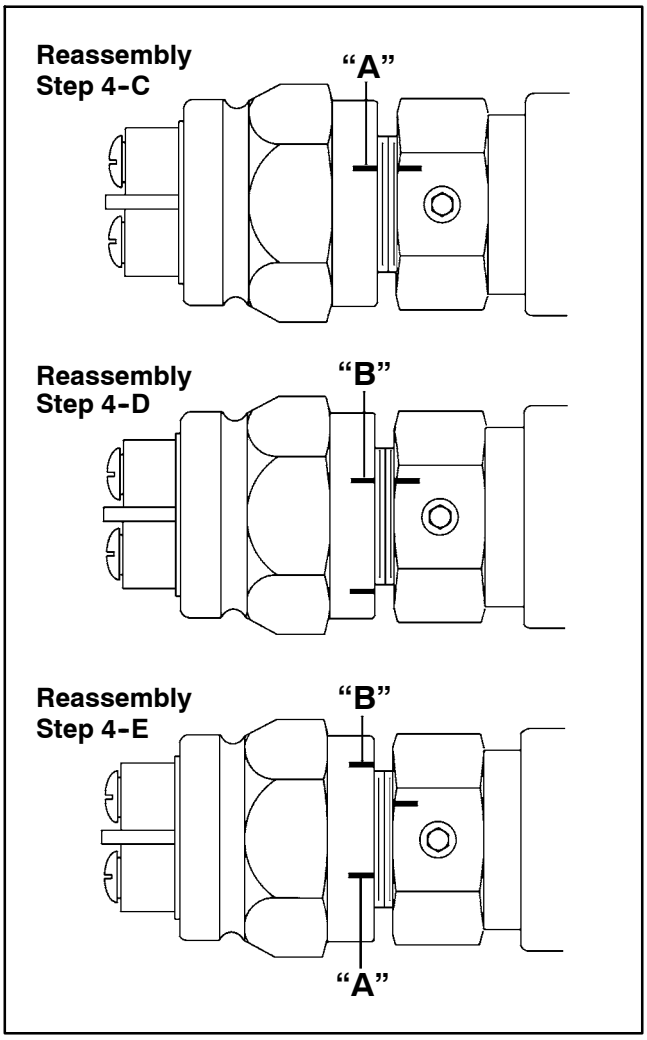

Figure 52

Hydraulic Control Manifold: 4 Wheel Drive

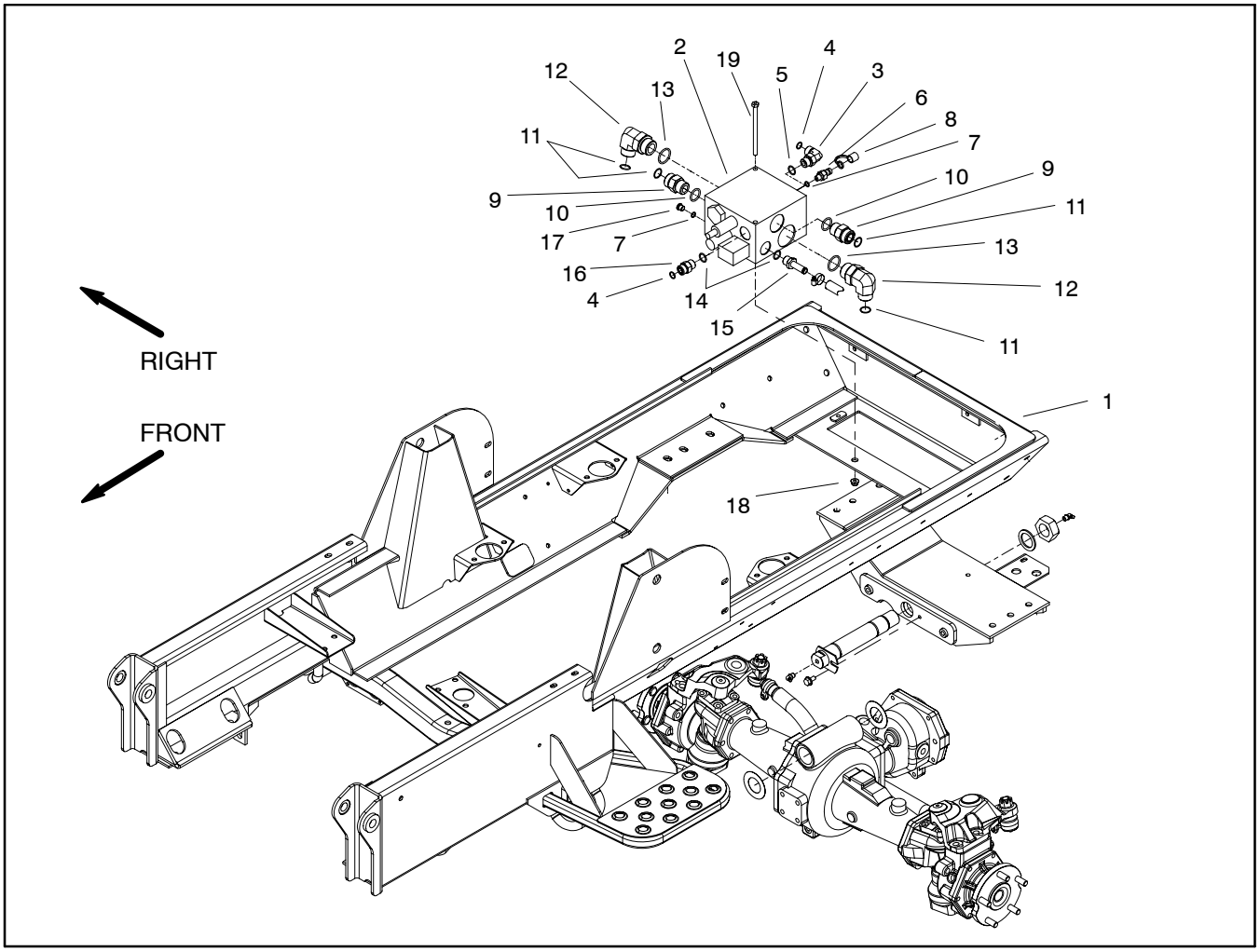

Figure 53

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

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is a piston pump connection port and 2 is the location for the solenoid valve (See Hydraulic Schematic 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 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 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 reassembly.

5. Remove hydraulic manifold from the frame using Figure 53 as guide.

Installation

1. Install hydraulic manifold to the frame using Figure 53 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.

Hydraulic Control Manifold Service: 4 Wheel Drive

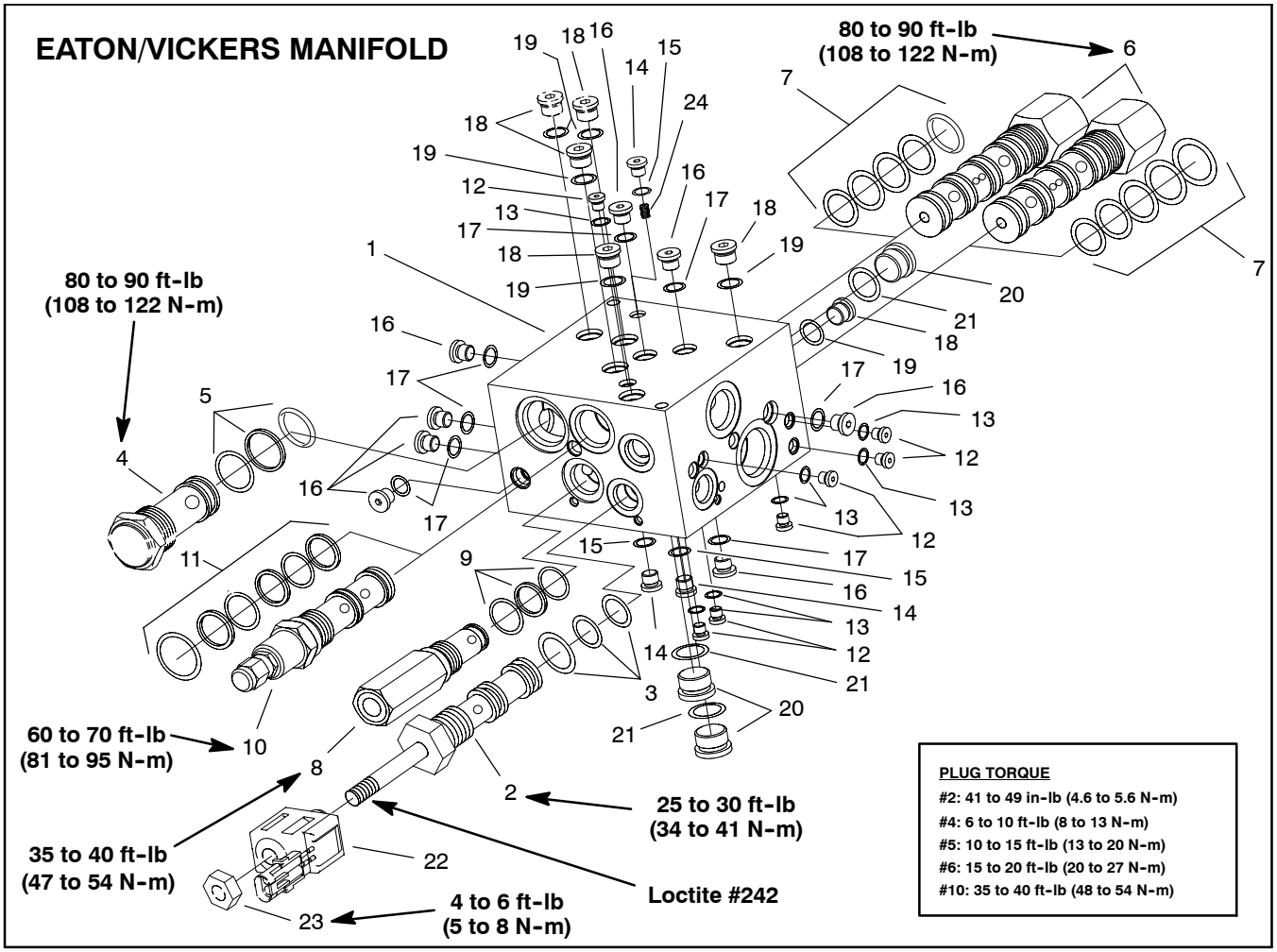

Figure 54

1. Manifold body (4WD)
2. Solenoid valve (port 2)
3. Seal kit
4. Check valve (port 3)
5. Seal kit
6. Control valve (ports 5A & 5B)
7. Seal kit
8. Relief valve (port 7)
9. Seal kit
10. Reducing valve (port 8)
11. Seal kit
12. Zero leak plug (#2)
13. O-ring
14. Zero leak plug (#4)
15. O-ring
16. Zero leak plug (#5)
17. O-ring
18. Zero leak plug (#6)
19. O-ring
20. Zero leak plug (#10)
21. O-ring
22. Solenoid coil
23. Nut
24. Orifice plug

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is a piston pump connection port and 2 is the location for the solenoid valve (See Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each port).

NOTE: The Groundsmaster 4100-D four wheel drive manifold uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an o-ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug. When installing plugs, refer to manifold illustration for plug installation torque.

NOTE: 4WD manifolds used on Groundsmaster 4000-D machines are either Eaton/Vickers (Fig. 54) or JEM (Fig. 55).

Valve Cartridge Service

1. Make sure the entire outer surface of the manifold is clean before removing the valve.

2. If cartridge is solenoid operated, remove nut securing solenoid 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, and contamination. Also, inspect cartridge valve for damaged sealing surfaces and contamination.

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

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

6. Reinstall the cartridge valve:

A. Lubricate new seal kit components with clean hydraulic oil and install on valve. The o-rings, sealing rings, and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction.

B. Thread cartridge valve carefully into manifold port. The valve should go in easily without binding.

C. Torque cartridge valve using a deep socket to value identified in manifold illustration.

D. If cartridge is solenoid operated, carefully install solenoid coil to the cartridge valve. Apply Loctite #242 or equivalent to the threads of the valve. Torque nut to value identified in manifold illustration. Over-tightening may damage the solenoid or cause the valve to malfunction.

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

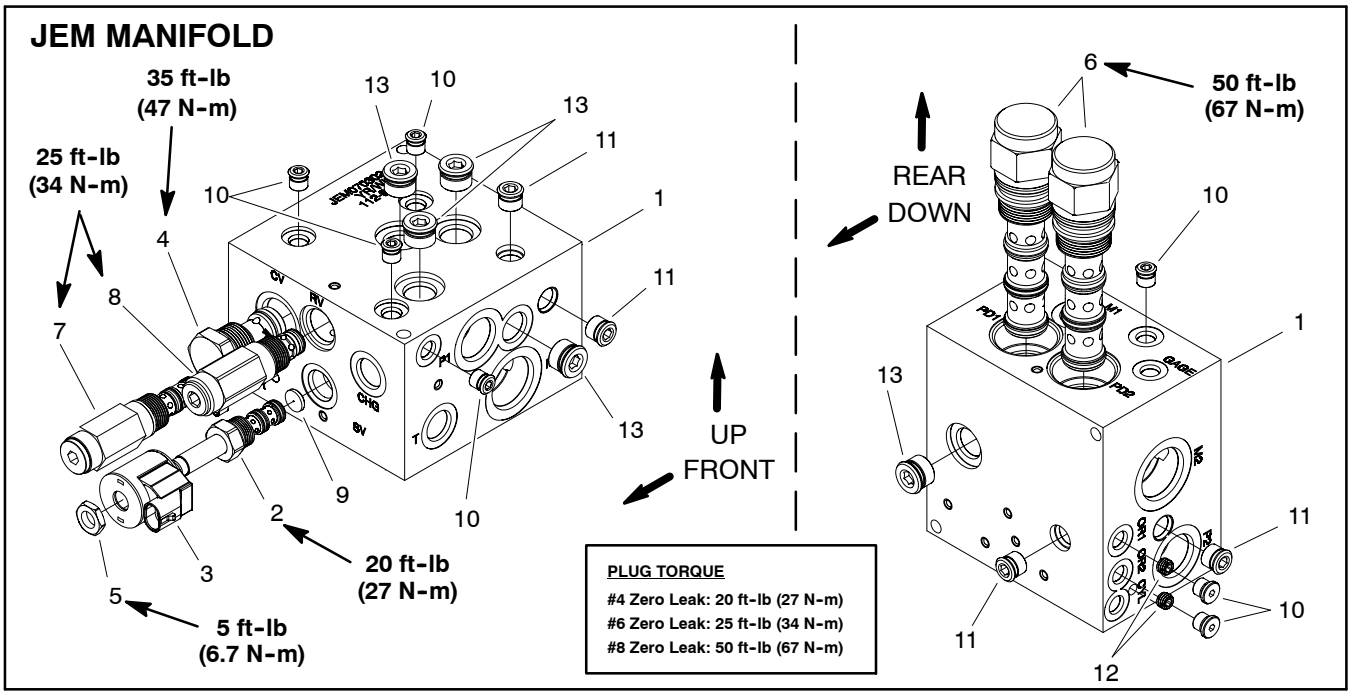

Figure 55

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 (.030)
10. #4 zero leak plug with O-ring
11. #6 zero leak plug with O-ring
12. Orifice (.050)
13. #8 zero leak plug with O-ring

Hydraulic Control Manifold: Deck Drive

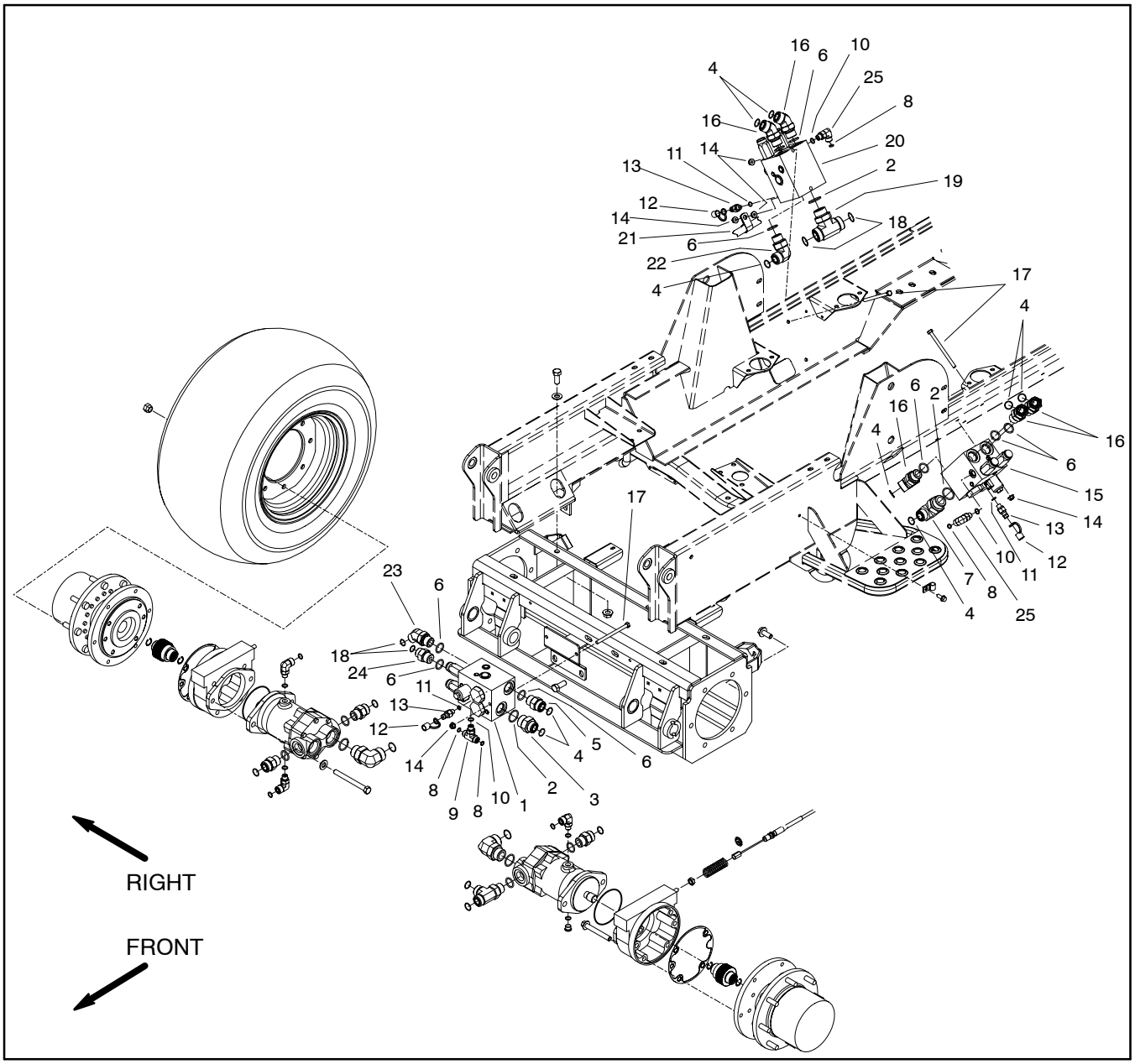

Figure 56

1. **Hydraulic manifold (center deck)**
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. **Hydraulic manifold (LH wing deck)**
16. **45º hydraulic fitting**
17. **Cap screw (2 used per manifold)**
18. **O-ring**
19. **Hydraulic tee fitting**
20. **Hydraulic manifold (RH wing deck)**
21. **Hose**
22. **90º hydraulic fitting**
23. **Hydraulic fitting**
24. **Hydraulic adapter**
25. **90º hydraulic fitting**

Removal

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 to identify the function of the hydraulic lines and cartridge valves at each port).

The control manifolds for the three cutting deck sections are very similar. **Note:** 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 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 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 reassembly.

5. Remove hydraulic manifold from the frame using Figure 56 as guide.

Installation

1. Install hydraulic manifold to the frame using Figure 56 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.

Hydraulic Control Manifold Service: Deck Drive

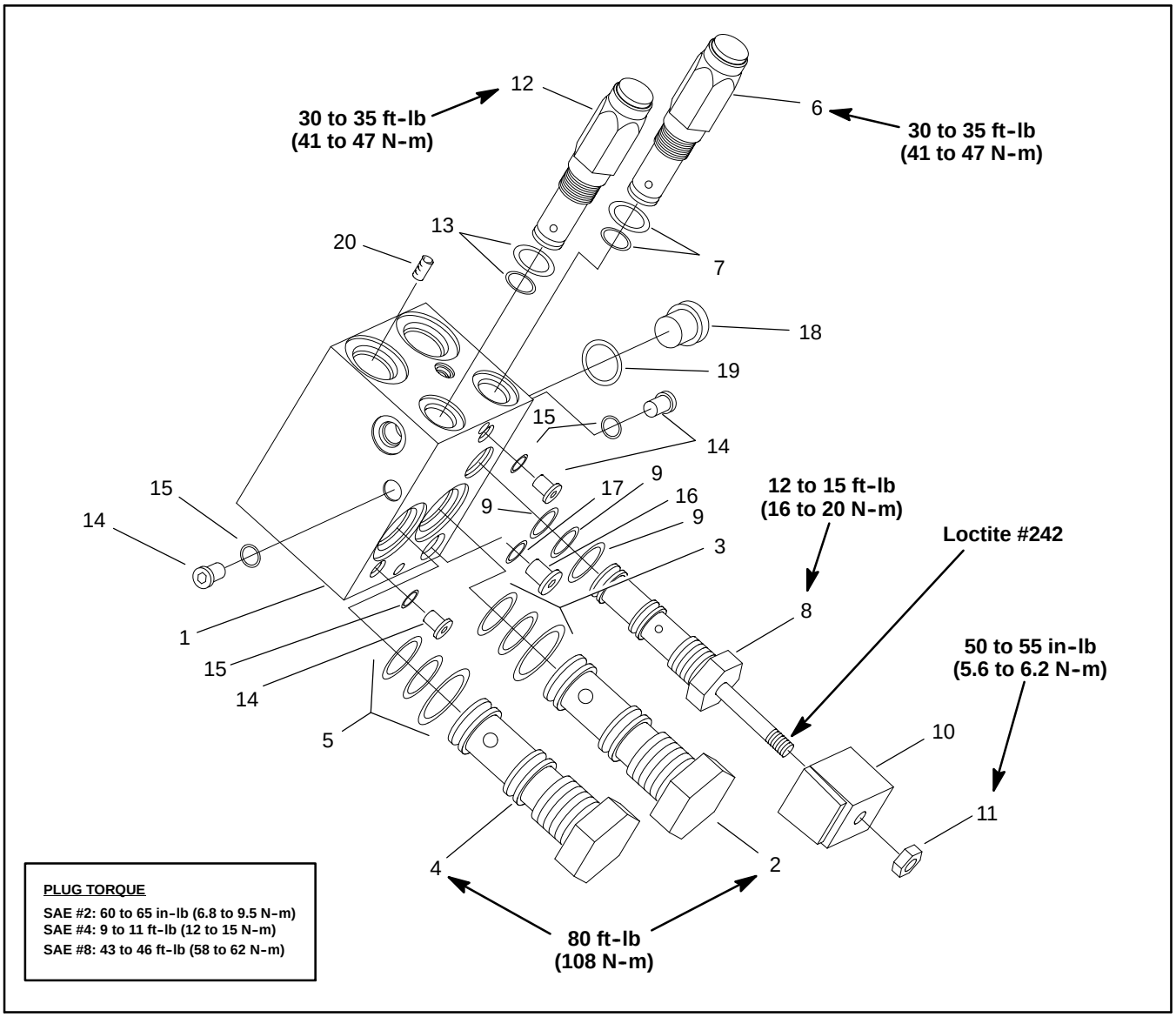

Figure 57

1. **Manifold body**
2. **Spool logic cartridge (port BY1)**
3. **Seal kit**
4. **Spool logic cartridge (port BR1)**
5. **Seal kit**
6. **Relief valve (port R1BY)**
7. **Seal kit**
8. **Solenoid valve (port SV1)**
9. **Seal kit**
10. **Solenoid coil**
11. **Nut**
12. **Relief pilot cartridge (port R1BR)**
13. **Seal kit**
14. **Plug (SAE #2)**
15. **O-ring**
16. **Plug (SAE #4)**
17. **O-ring**
18. **Plug (SAE #8)**
19. **O-ring**
20. **Orifice plug (port MR)**

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

The control manifolds for the three cutting deck sections are very similar. **Note:** When servicing the deck control manifolds, **DO NOT** interchange parts from one control manifold to another.

For solenoid and control valve service procedures, see Hydraulic Control Manifold Service: 4 Wheel Drive in this section. Refer to Figure 57 for cartridge valve and plug installation torque.

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Hydraulic Control Manifold: Cutting Deck Lift/Lower

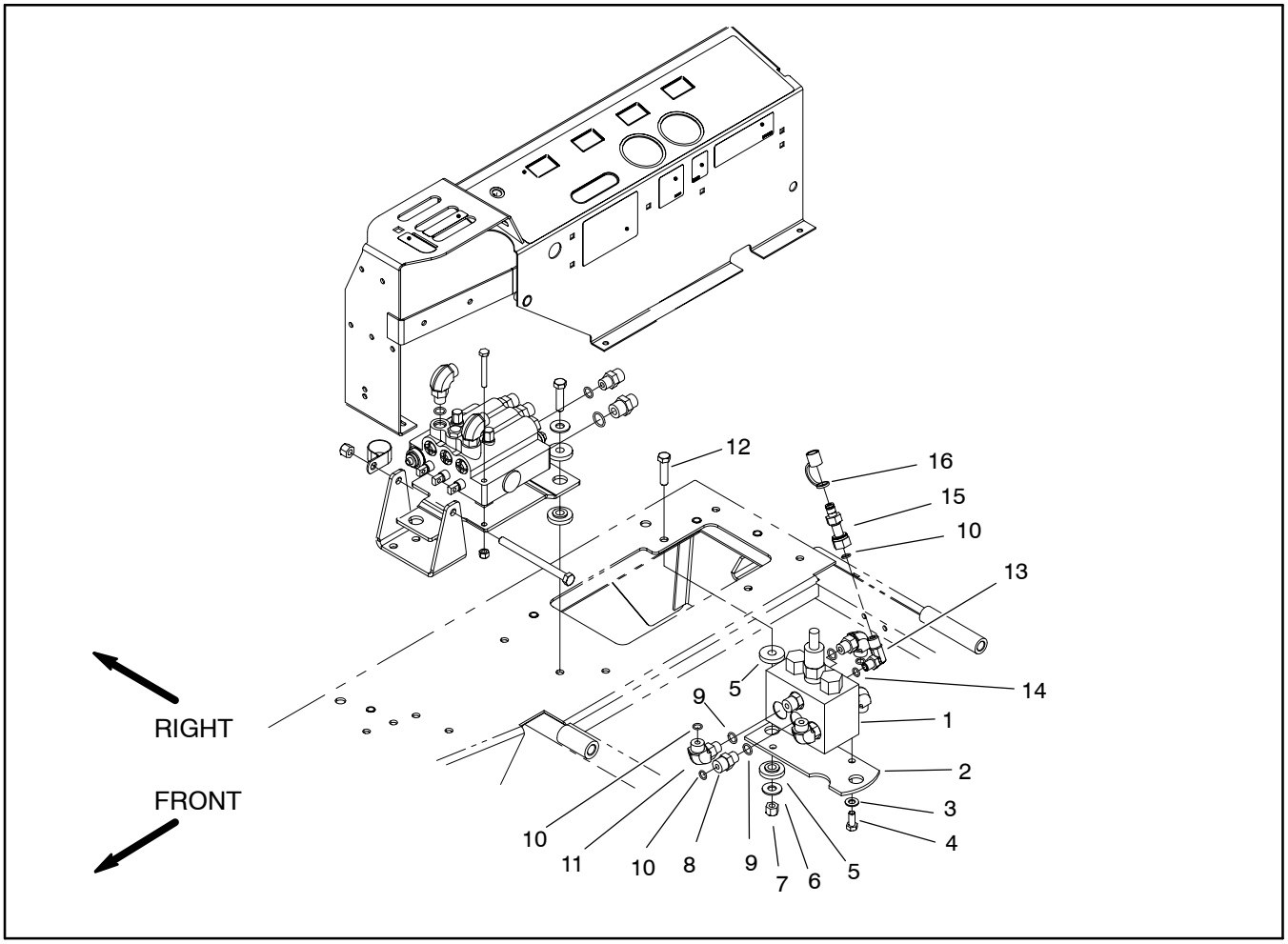

Figure 58

1. **Lift/lower hydraulic manifold**
2. **Valve plate**
3. **Flat washer (2 used)**
4. **Cap screw (2 used)**
5. **Grommet (4 used)**
6. **Flat washer (2 used)**
7. **Lock nut**
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. **Fitting cap**

Removal

NOTE: The ports on the manifold are marked for easy identification of components. Example: C1 is the connection port from the LH wing deck lift cylinder and CHG is the charge circuit connection (See Hydraulic Schematic 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 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 58 as guide.

Installation

1. Install hydraulic manifold to the frame using Figure 58 as guide.

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

Hydraulic Control Manifold Service: Cutting Deck Lift/Lower

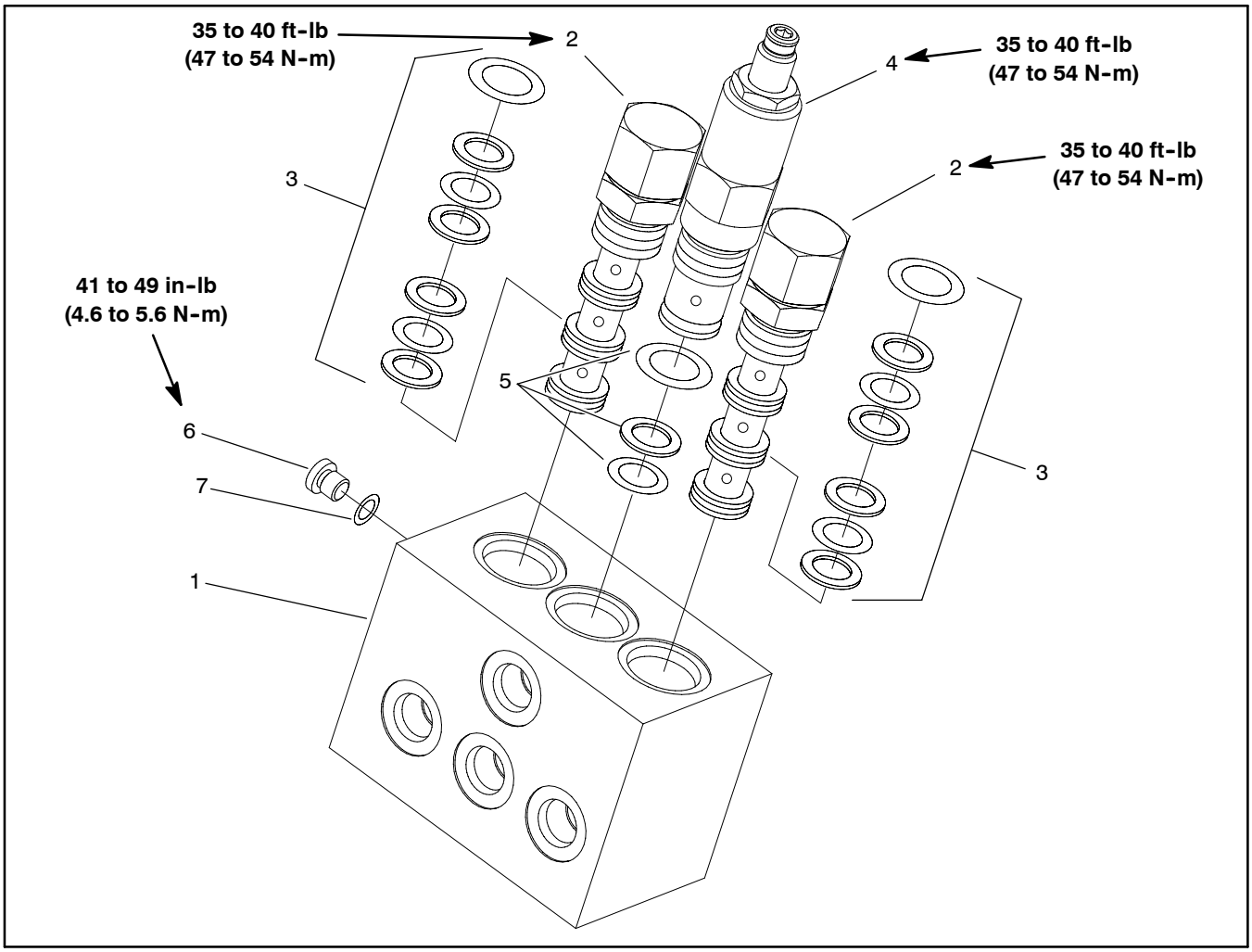

Figure 59

1. **Manifold body**
2. **Pilot valve**
3. **Seal kit**
4. **Relief valve (Counterbalance)**
5. **Seal kit**
6. **Plug (SAE #2)**
7. **O-ring**

NOTE: The ports on the manifold are marked for easy identification of components. Example: C1 is the connection port from the LH wing deck lift cylinder and CHG is the charge circuit connection (See Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each port).

For cartridge valve service procedures, see Hydraulic Control Manifold Service: 4 Wheel Drive in this section. Refer to Figure 59 for cartridge valve and plug installation torque.

Hydraulic Control Manifold: Filter Manifold

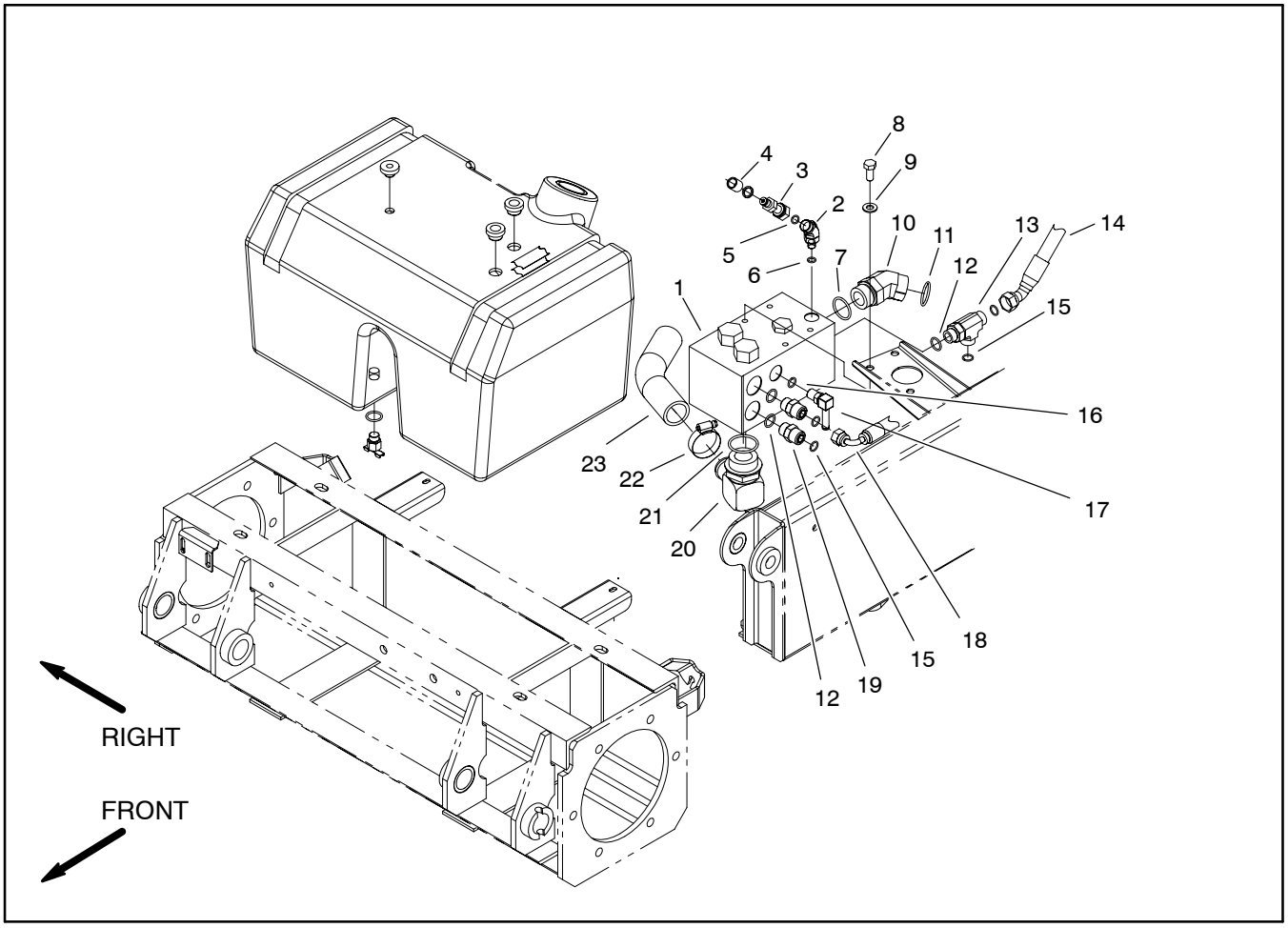

Figure 60

1. **Filter manifold**
2. **45º hydraulic elbow**
3. **Test nipple**
4. **Fitting 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. **Hydraulic fitting**
14. **Hydraulic hose**
15. **O-ring**
16. **O-ring**
17. **90º hydraulic elbow**
18. **Hydraulic hose**
19. **Hydraulic fitting (2 used)**
20. **90º hydraulic fitting**
21. **O-ring**
22. **Hose clamp**
23. **Filter hose**

Removal

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 reservoir return (See Hydraulic Schematic 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 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 60 as guide.

Installation

1. Install hydraulic manifold to the frame using Figure 60 as guide.

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

Hydraulic Control Manifold Service: Filter Manifold

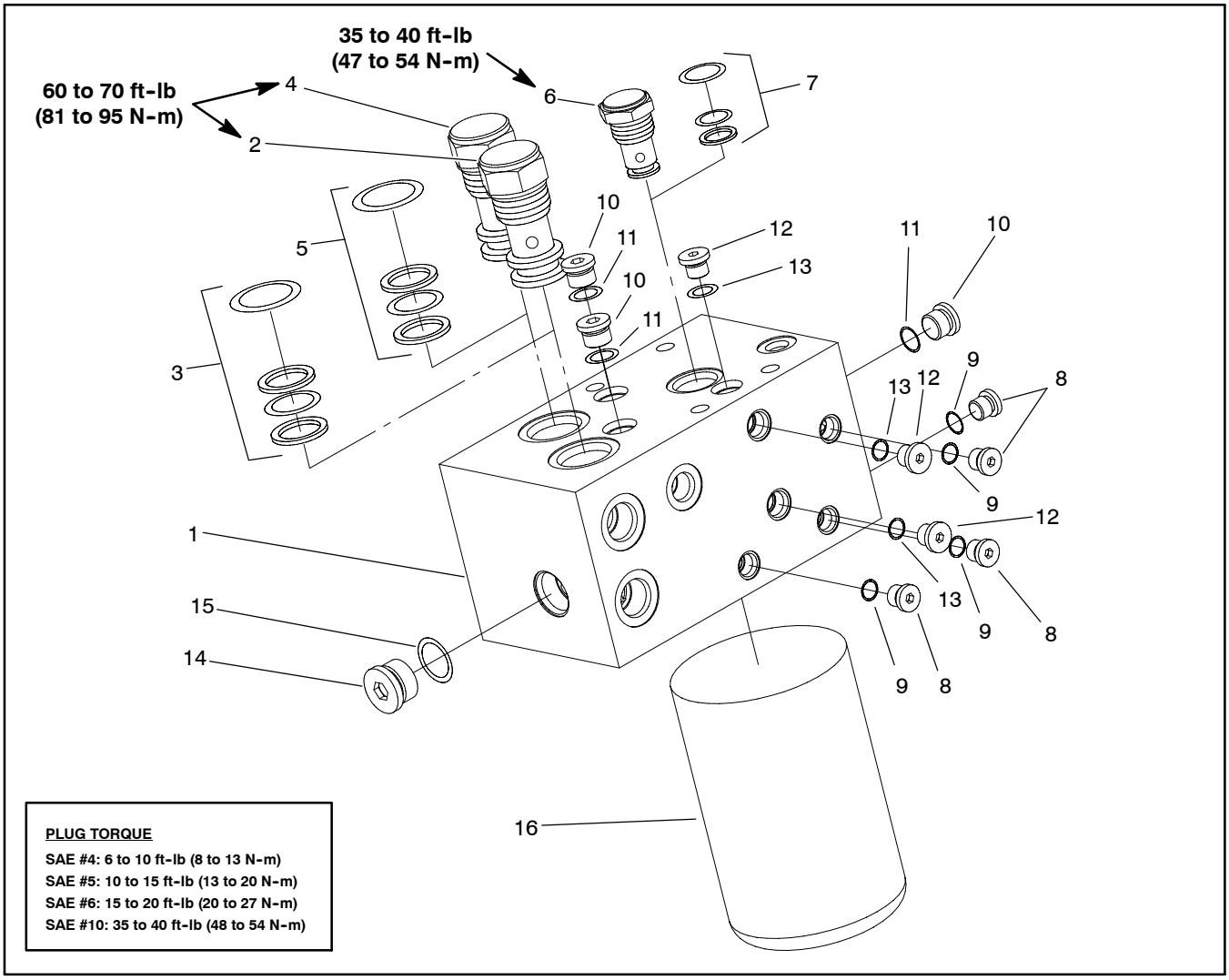

Figure 61

1. **Filter manifold assembly**
2. **Check valve (Reservoir return)**
3. **Seal kit**
4. **Check valve (Filter bypass)**
5. **Seal kit**
6. **Check valve (Charge pressure)**
7. **Seal kit**
8. **Plug (SAE #4)**
9. **O-ring**
10. **Plug (SAE #6)**
11. **O-ring**
12. **Plug (SAE #5)**
13. **O-ring**
14. **Plug (SAE #10)**
15. **O-ring**
16. **Oil filter element**

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 reservoir return (See Hydraulic Schematic to identify the function of the hydraulic lines and cartridge valves at each port).

For cartridge valve service procedures, see Hydraulic Control Manifold Service: 4 Wheel Drive in this section. Refer to Figure 61 for cartridge valve and plug installation torque.

Rear Axle Motor

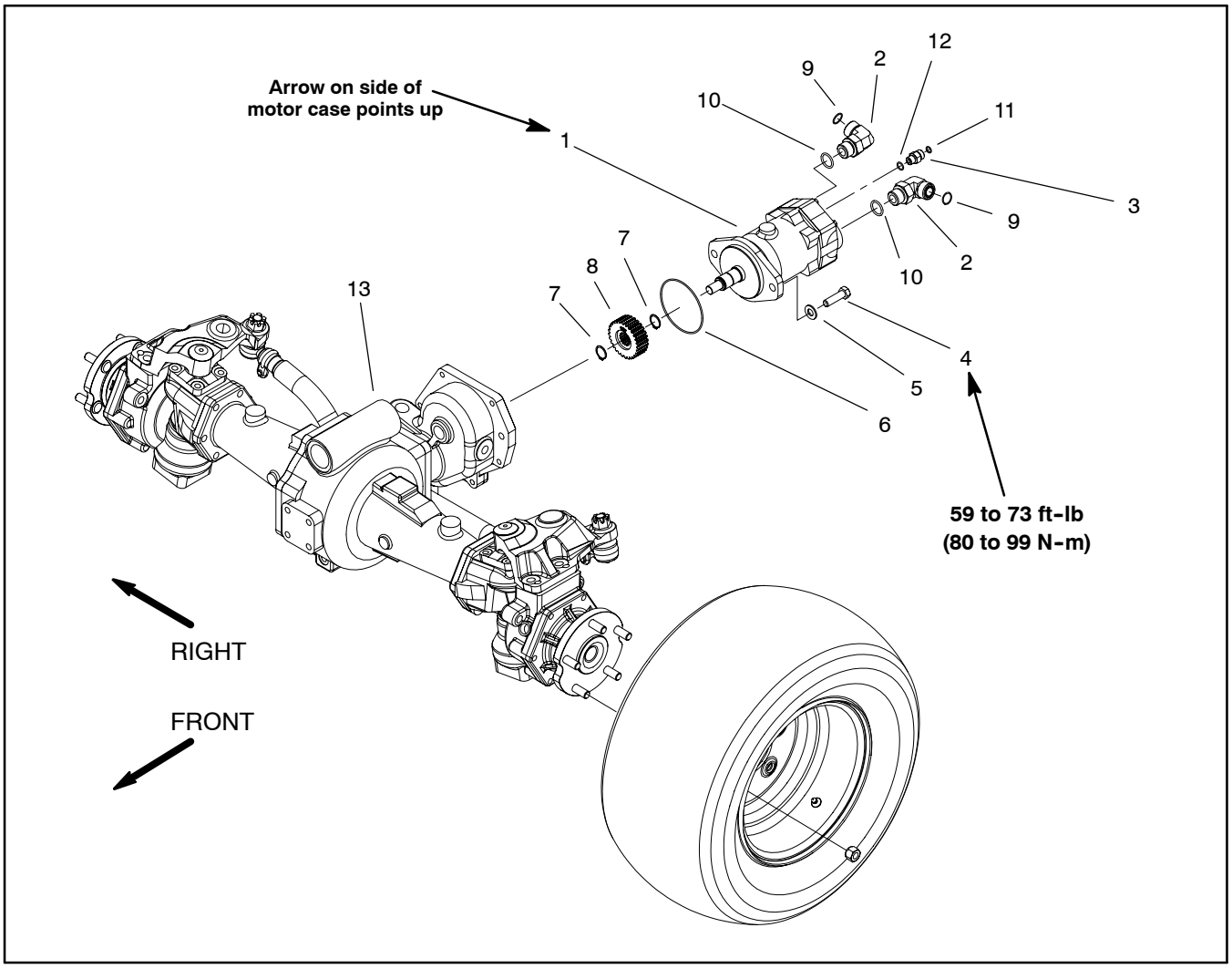

Figure 62

1. Rear axle motor
2. 90º hydraulic fitting
3. Hydraulic fitting
4. Cap screw (2 used)
5. Flat washer (2 used)
6. O-ring
7. External snap ring
8. Pinion gear
9. O-ring
10. O-ring
11. O-ring
12. O-ring
13. Drive axle assembly

Removal

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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

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

4. Disconnect hydraulic hoses from rear axle motor. Put caps or plugs on open hydraulic lines, fittings, and ports to prevent contamination.

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

5. Remove motor using Figure 62 as a guide.

Installation

1. If removed, install pinion gear to axle motor.

2. 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.

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

4. Remove plugs from hydraulic lines, fittings, and ports. Attach hydraulic hoses to axle motor.

5. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

6. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything through full range of axle pivot motion. Also, check for any leaks.

Front Wheel Motors

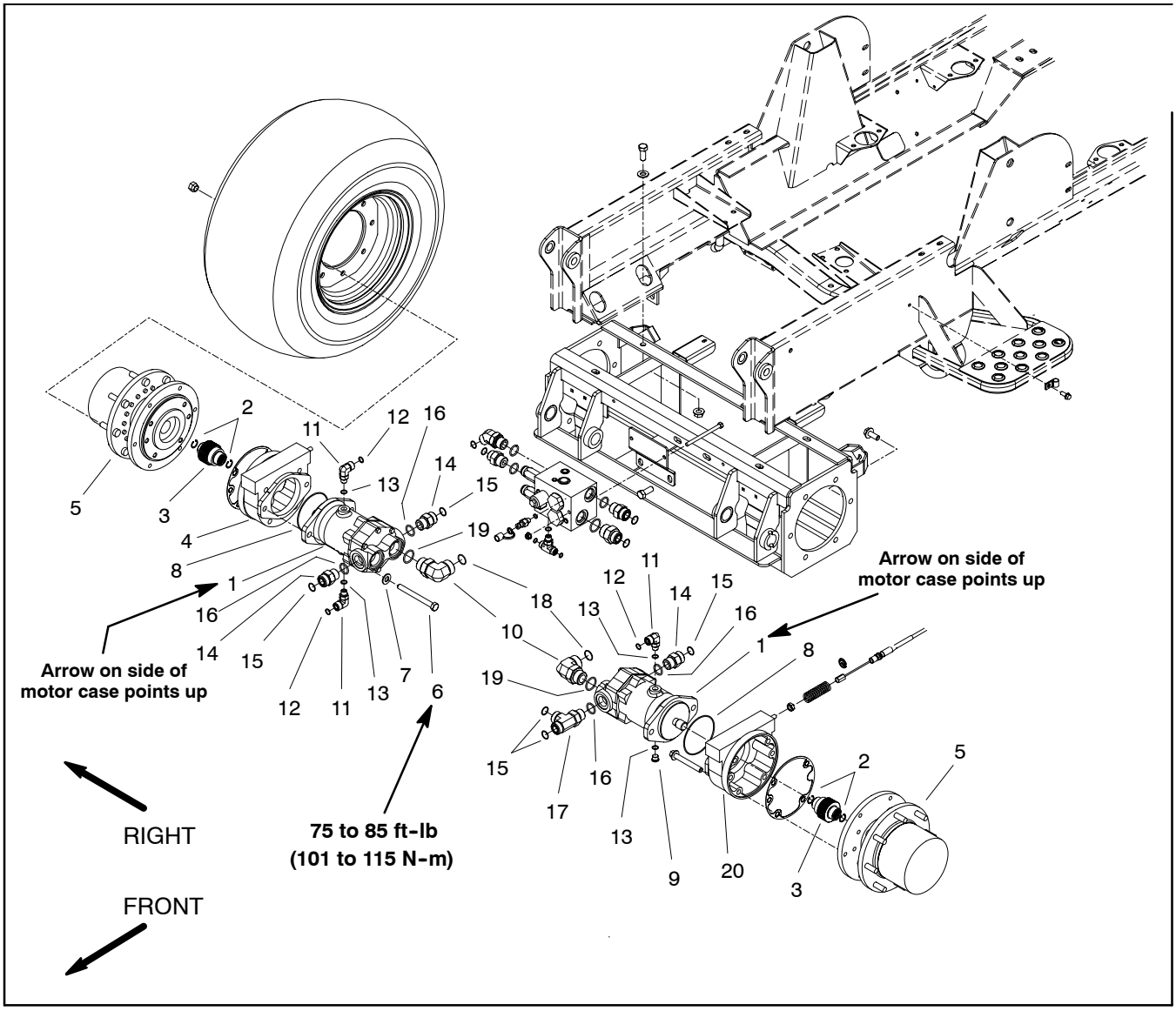

Figure 63

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

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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

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

4. Disconnect hydraulic hoses and tubes from wheel motor. Put caps or plugs on hydraulic lines, fittings, and ports to prevent contamination.

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

5. Remove wheel motor using Figure 63 as a guide.

Installation

1. Position wheel motor to brake assembly making sure that arrows on the side of motor case point upward.

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

3. 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).

4. Remove plugs from hydraulic lines, fittings, and ports. Attach hydraulic hoses and tubes to wheel motor.

5. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

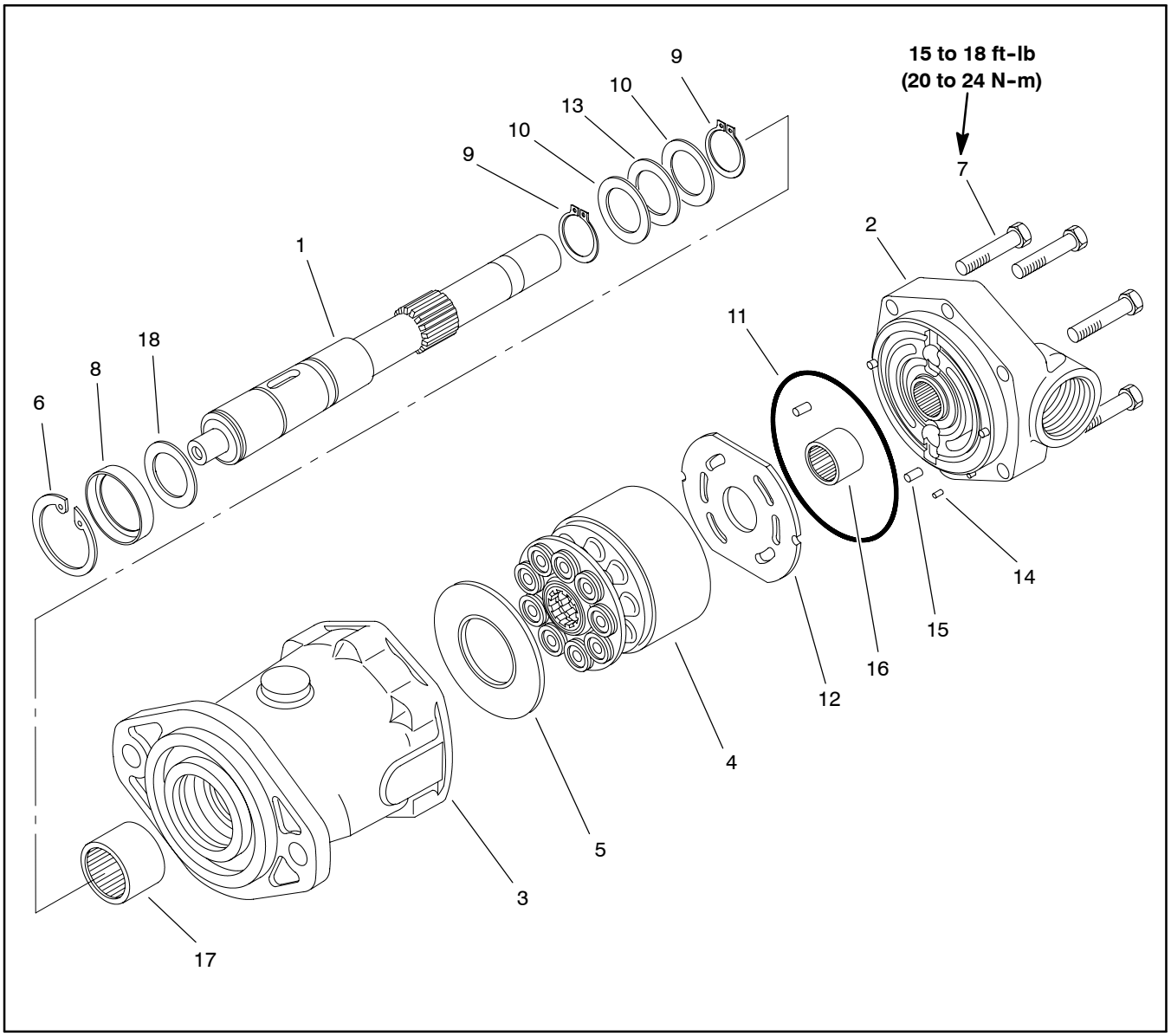

Figure 64

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
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.

Cleanliness is extremely important when repairing these motors. Work in a clean area. Before disconnecting the lines, clean port area of motor. Thoroughly clean the outside of the motor. After cleaning, remove port plugs and drain oil.

Disassembly (Fig. 64)

1. Clamp the drive shaft end of the piston motor in a protected jaw vise with the cap screws up. Remove the six cap screws (7) from the motor assembly.

2. Use a soft face hammer and tap the backplate (2) to loosen and remove from housing.

3. Remove valve plate (12) and O-ring (11) from backplate. It is not necessary to remove roll pins (14, 15) in backplate.

4. Remove motor from vise and remove rotating assembly (4) from motor housing.

5. Remove the camplate insert (5) from housing. Use caution not to mar the finish that makes contact with pistons.

6. Remove retaining ring (6) from housing. Press shaft from housing and remove shaft seal (8) and washer (18).

7. Remove retaining rings (9) from shaft and remove thrust races (10) and thrust bearing (13).

8. Discard the shaft seal and o-ring, and replace with new items upon reassembly.

Inspection

1. Check the condition of the needle bearing (16) in backplate (2) and replace if necessary.

2. Inspect valve plate (12) on the bronze side next to the piston block for wear. A smooth surface is required. **Do not lap valve plate bronze surface.** Replace valve plate if any wear exists.

3. Inspect the piston block surface that makes contact with valve plate. This surface should be smooth and free of deep scratches. **Do not lap piston block.**

4. The pistons should move freely in the piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.

5. Examine the O.D. of the pistons for finish condition. They should not show wear or deep scratches. Inspect the shoes for a snug fit on the ball end of the pistons and a flat smooth surface that comes in contact with the camplate. **Do not lap piston shoes.**

6. Examine the spider for wear in the pivot area.

7. Examine the spider pivot to insure smoothness and no signs of wear.

8. The polished finish on the shoe surface of the camplate insert (5) should show no signs of scoring.

9. Inspect the shaft for wear in the seal, bearing and spline areas.

10. Inspect thrust bearing (13) and races (10) for wear.

11. Check the condition of the needle bearing (17) in housing and replace if necessary.

Reassembly (Fig. 64)

1. Clean all parts in suitable solvent and lubricate all internal parts with clean hydraulic oil before reassembly.

2. If necessary, install new needle bearing (17) in housing (3) with numbered end of the bearing outward.

3. Install retaining ring (9) on shaft. Install thrust race (10), thrust bearing (13), and second thrust race (10). Secure with second retaining ring (9).

4. Install shaft in housing. Install washer (18), new shaft seal (8), and retaining ring (6).

5. Install camplate insert (5) with the lettering side of insert to the front of the housing. Use petroleum jelly to hold in place during assembly.

6. Install rotating assembly (4) into housing. Make sure that piston shoes make contact with the camplate insert.

7. Clamp motor assembly in a protected jaw vise with the open end of the housing up.

8. If roll pins were removed, install to dimension shown in Figure 65 and with opening of roll pin oriented away from bearing within 5 degrees of bearing center line.

9. To replace bearing (16) in backplate (2). Press bearing down to the dimension shown (Fig. 65) protruding from backplate with numbered end of bearing facing up next to valve plate.

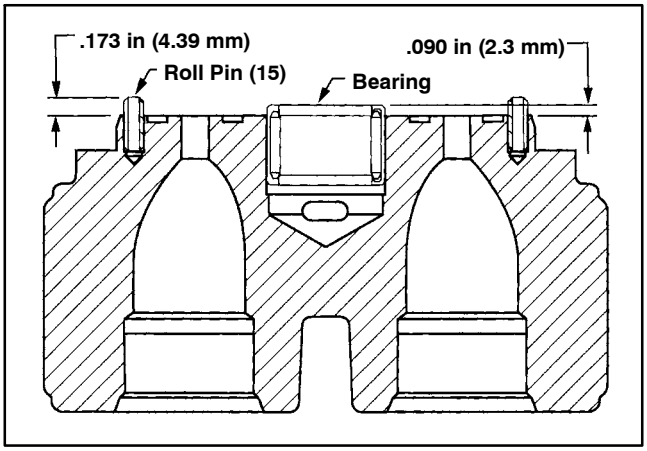

Figure 65

10. Apply small amount of petroleum jelly to the steel side of valve plate (12) to hold in place for installation. Place the valve plate in position onto the backplate (2), with steel side against backplate, bronze colored side against piston block.

11. Placing new o-ring (11) onto backplate, install backplate assembly (2) onto housing assembly. Make sure valve plate stays in position.

12. Insert cap screws and torque from 15 to 18 ft-lb (20 to 24 N-m) in a criss-cross pattern.

13. Fill case half full of new hydraulic oil.

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Cutting Deck Motor

Removal

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

3. Disconnect hydraulic lines from deck motor. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper reassembly.

4. Remove two flange head screws that secure hydraulic motor to motor mount (Fig. 66).

5. 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.

6. If required, remove spider hub from motor shaft. Straighten tab washer and remove nut and spider.

Installation

1. If removed, 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 .830" to .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 flange head screws (Fig. 66).

IMPORTANT: For proper hydraulic hose routing, make sure cutting decks are 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.

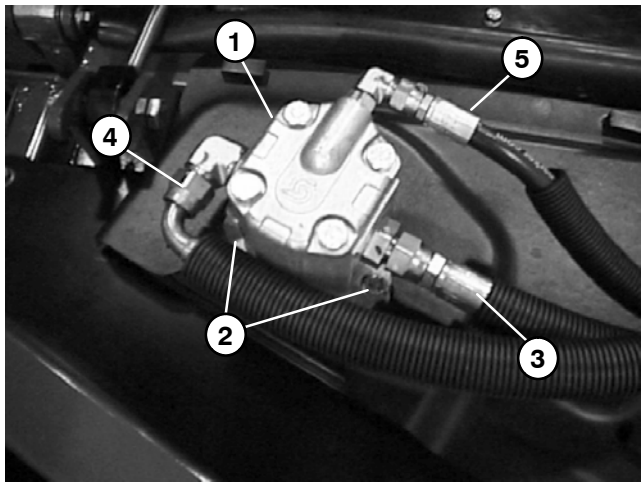

Figure 66

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

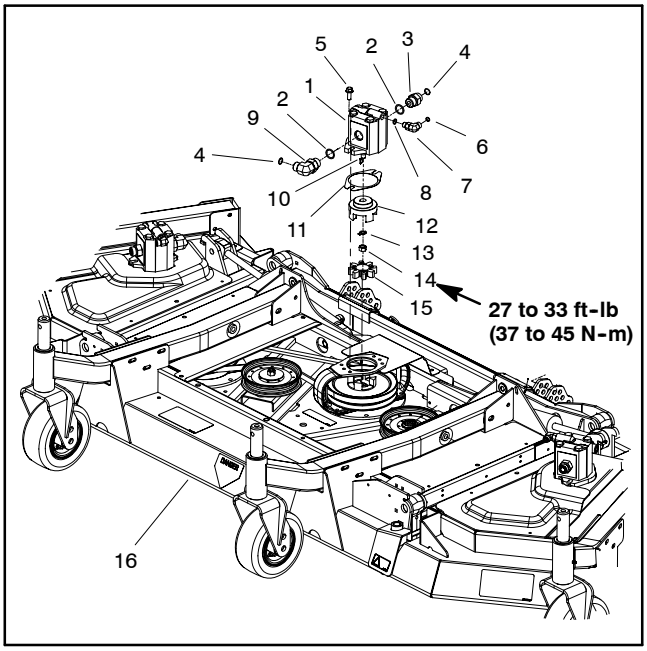

Figure 67

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

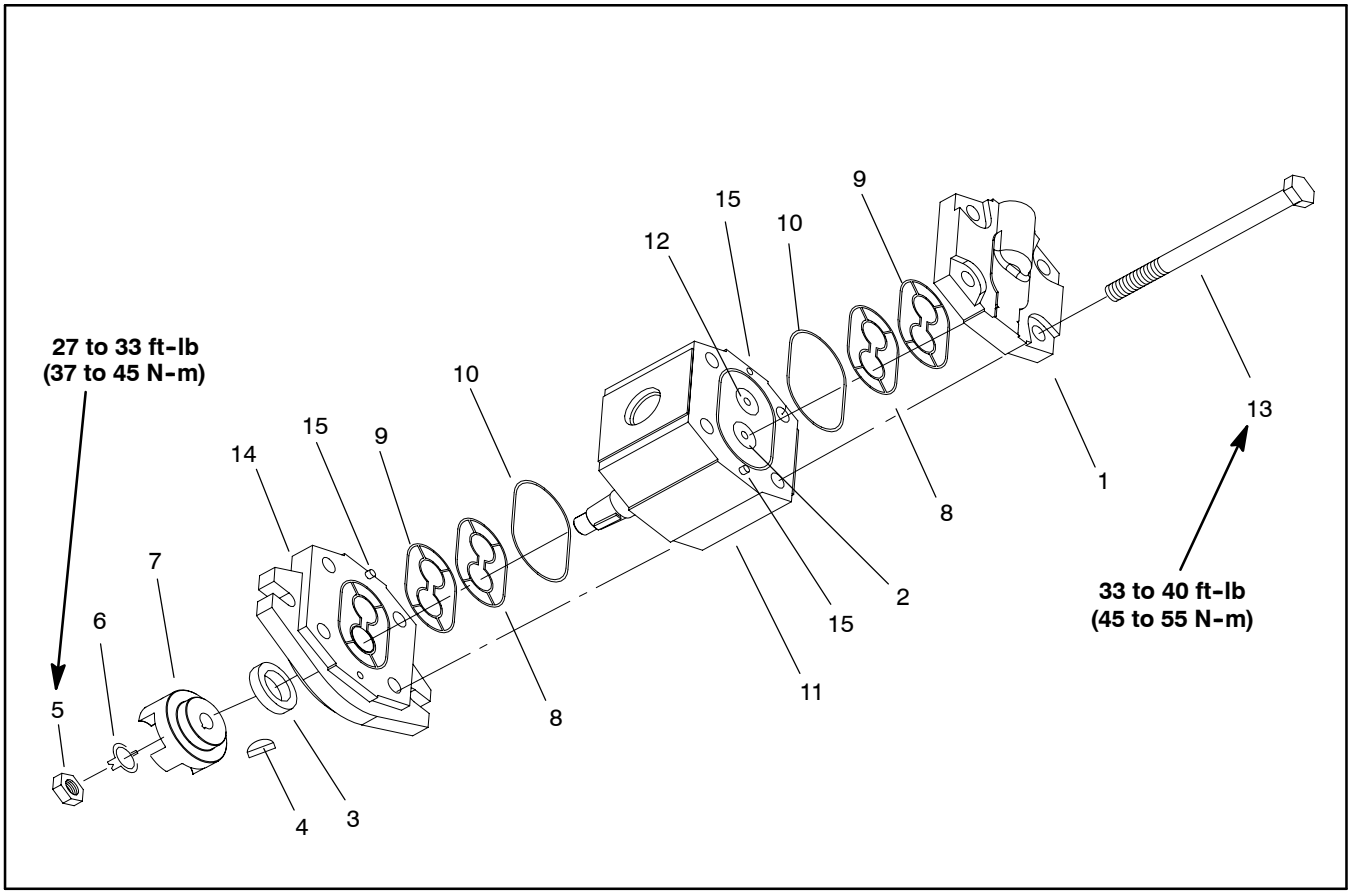

Figure 68

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. 68)

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 or scribe to make a **diagonal** mark across the front flange, body, and rear cover for reassembly purposes (Fig. 69).

IMPORTANT: Avoid using excessive clamping pressure on the motor flange to prevent distorting the casting.

4. Clamp mounting flange of motor in a vise 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.

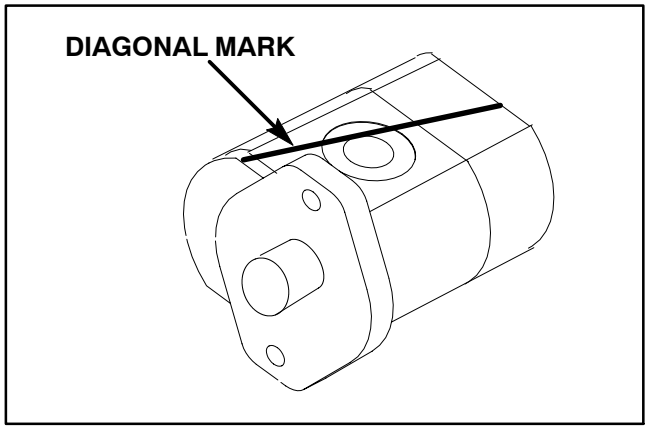

Figure 69

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. 70).

9. Carefully remove and discard o-rings, pressure seals, and back-up rings (Fig. 71) 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. 72) 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.

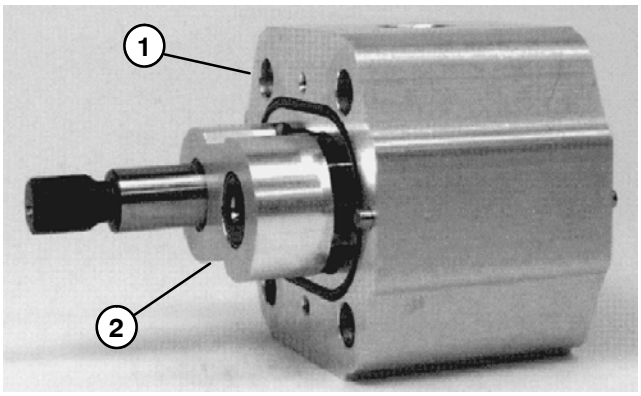

Figure 70

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

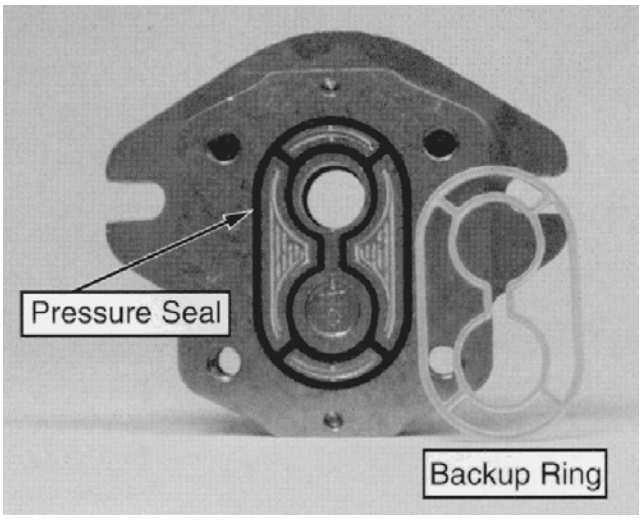

Figure 71

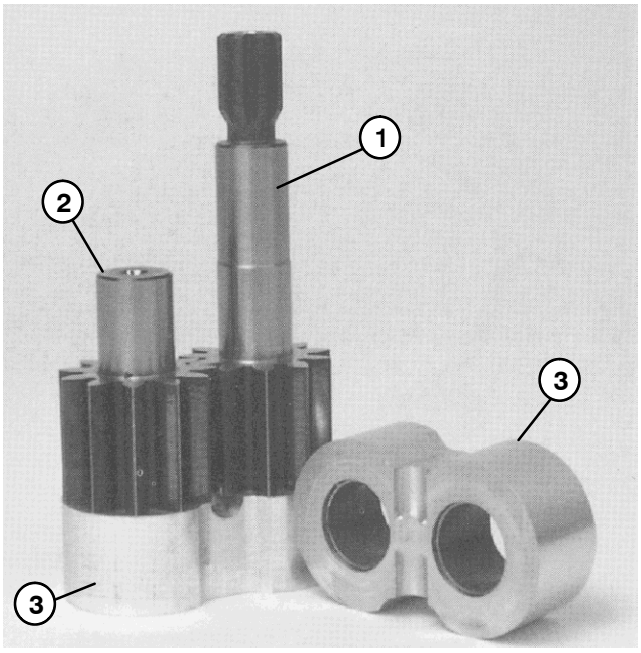

Figure 72

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

Reassembly (Fig. 68)

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

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. 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 or scribe mark for proper location.

11. Install the four cap screws and hand tighten.

IMPORTANT: Avoid using excessive clamping pressure on the motor housing to prevent distorting the housing.

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. 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).

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

16. Remove motor from vise.

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Lift/Lower Control Valve

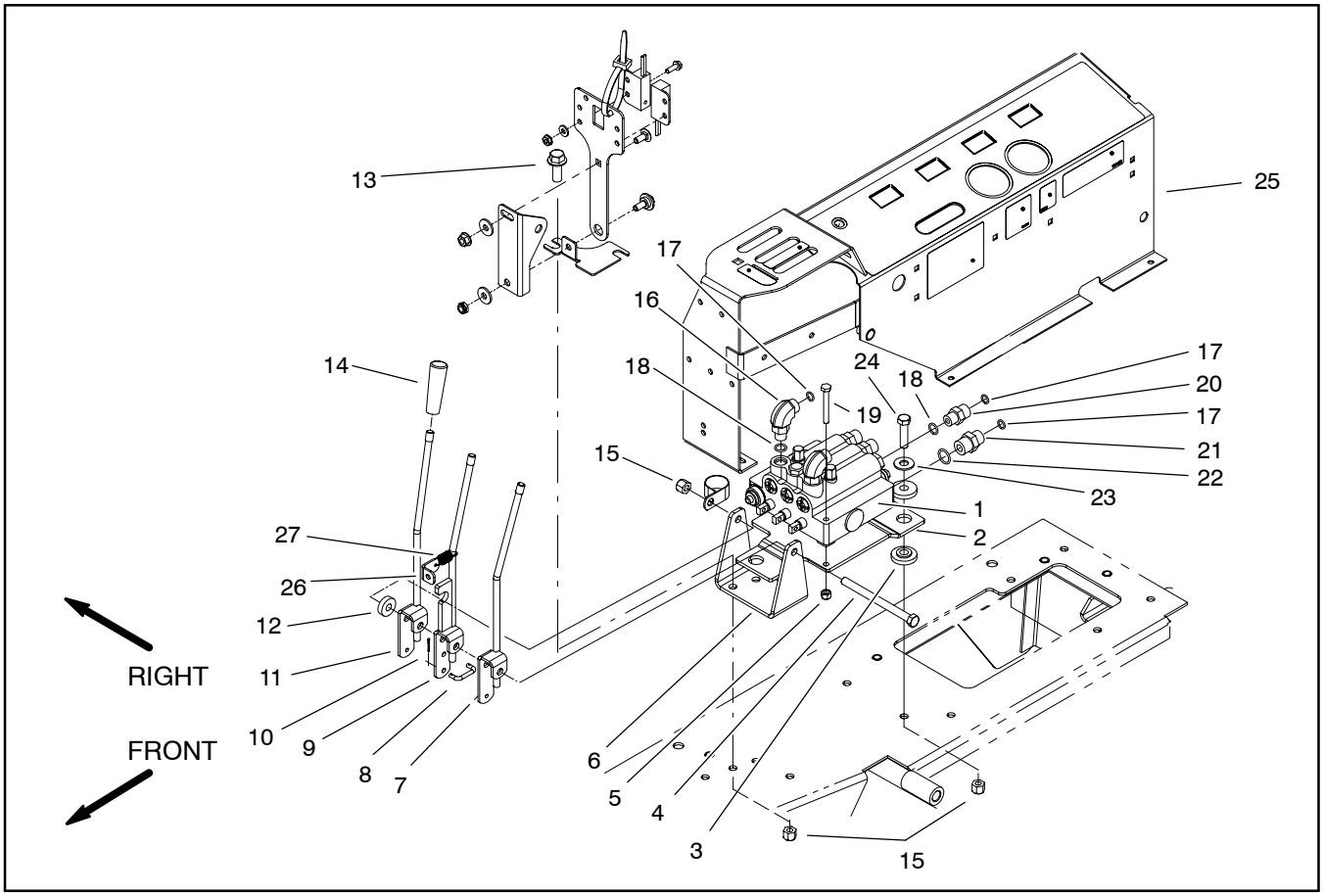

Figure 73

1. Control valve assembly
2. Valve bracket
3. Grommet
4. Cap screw
5. Lock nut
6. Pivot bracket
7. LH lever assembly
8. Lever link (3 used)
9. Center lever assembly
10. Cotter pin (3 used)
11. RH lever assembly
12. Spacer
13. Flange head screw (2 used)
14. Knob (3 used)
15. Lock nut
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

Removal

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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 73 as a guide.

Installation

1. Install lift/lower control valve using Figure 73 as a guide.

2. After reassembly, check operation of cutting deck raise and lower switches (see Operator's Manual).

3. Make sure hydraulic tank is full. Add correct oil if necessary before returning machine to service (see Operator's Manual).

Lift/Lower Control Valve Service

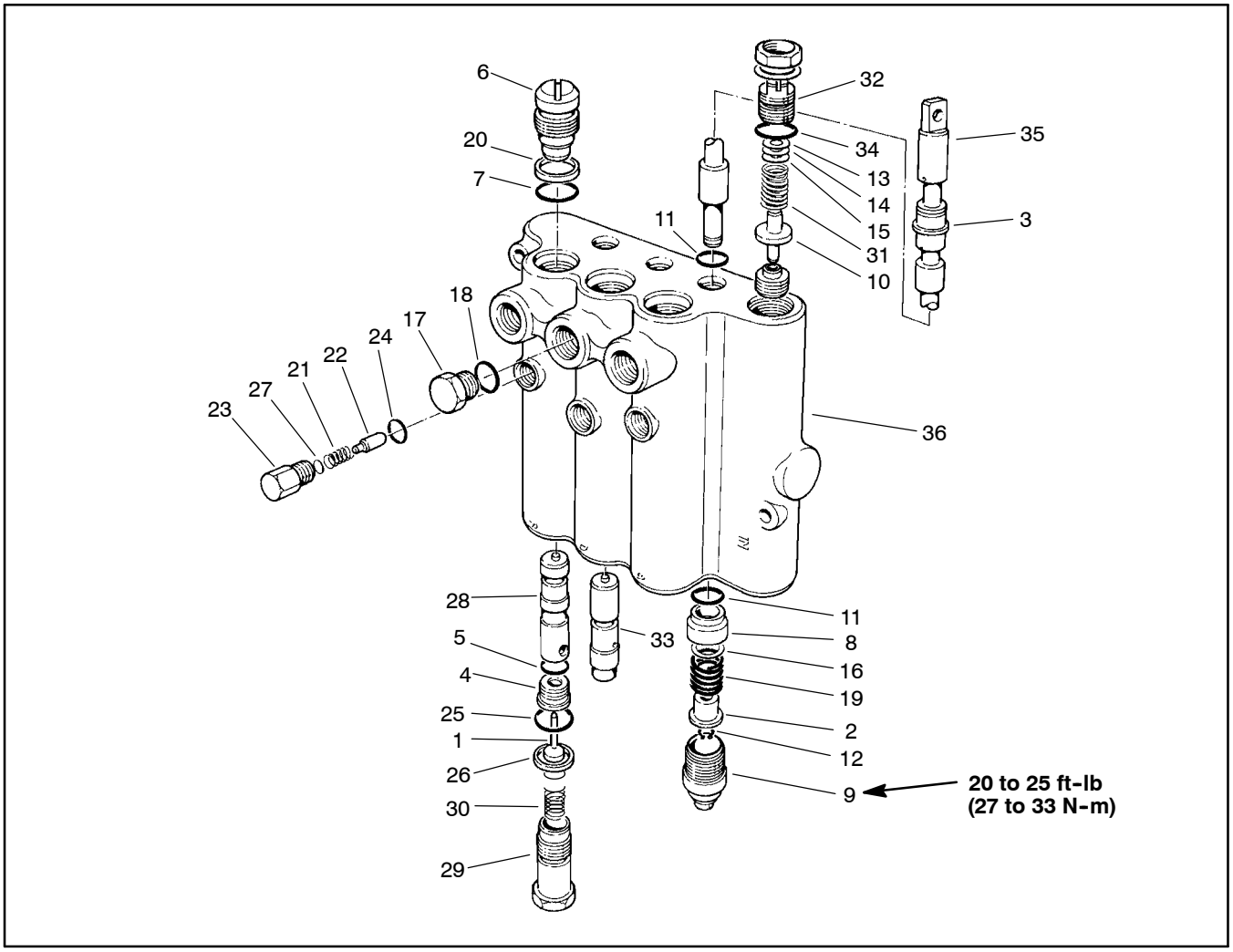

Figure 74

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. 74)

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

2. Remove spool caps (9). Do not remove retaining rings (12) from spools unless spool spring (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 (35) from valve body (36).

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

5. Remove plugs (6).

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

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

7. Remove plug (17).

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

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

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

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

4. If spools (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 (10) for breakage or wear.

Assembly (Fig. 74)

1. Thoroughly clean and dry all parts. Apply a light coating of clean hydraulic oil to 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 (11) in proper grooves in spool bores.

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

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

5. Install plungers (33 and 28).

IMPORTANT: Check location and positioning of plungers during installation.

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

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

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

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

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

11. Slide bushings (8) over spools. Slide new O-rings (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 (9) and tighten from 20 to 25 ft-lb (27 to 33 N-m).

13. Install new wiper seals (3).

Steering Valve

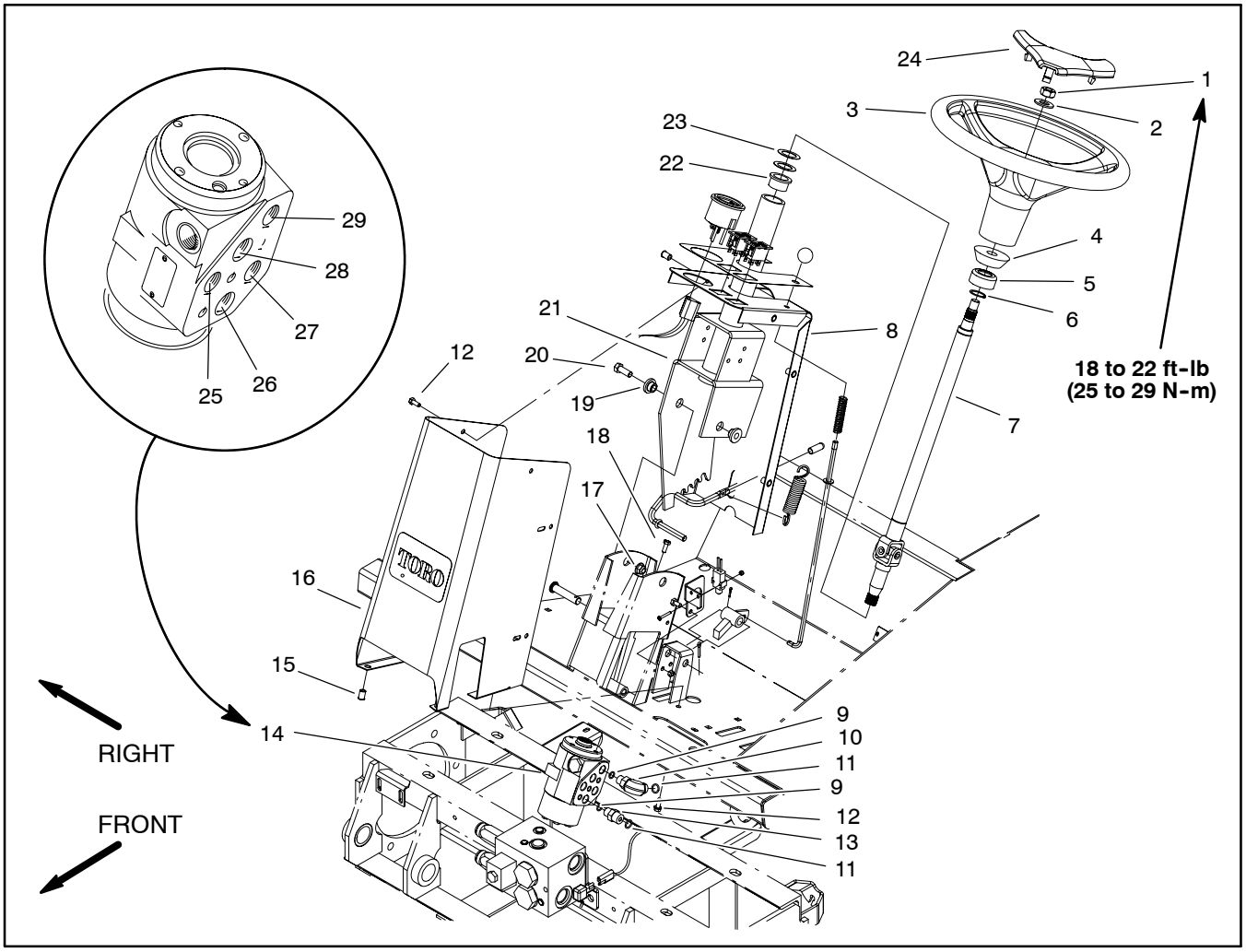

Figure 75

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

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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 75 as a guide.

Installation

1. Install steering valve using Figure 75 as a guide.

2. Make sure hydraulic tank is full. Add correct oil if necessary before returning machine to service (see Operator's Manual).

Steering Valve Service

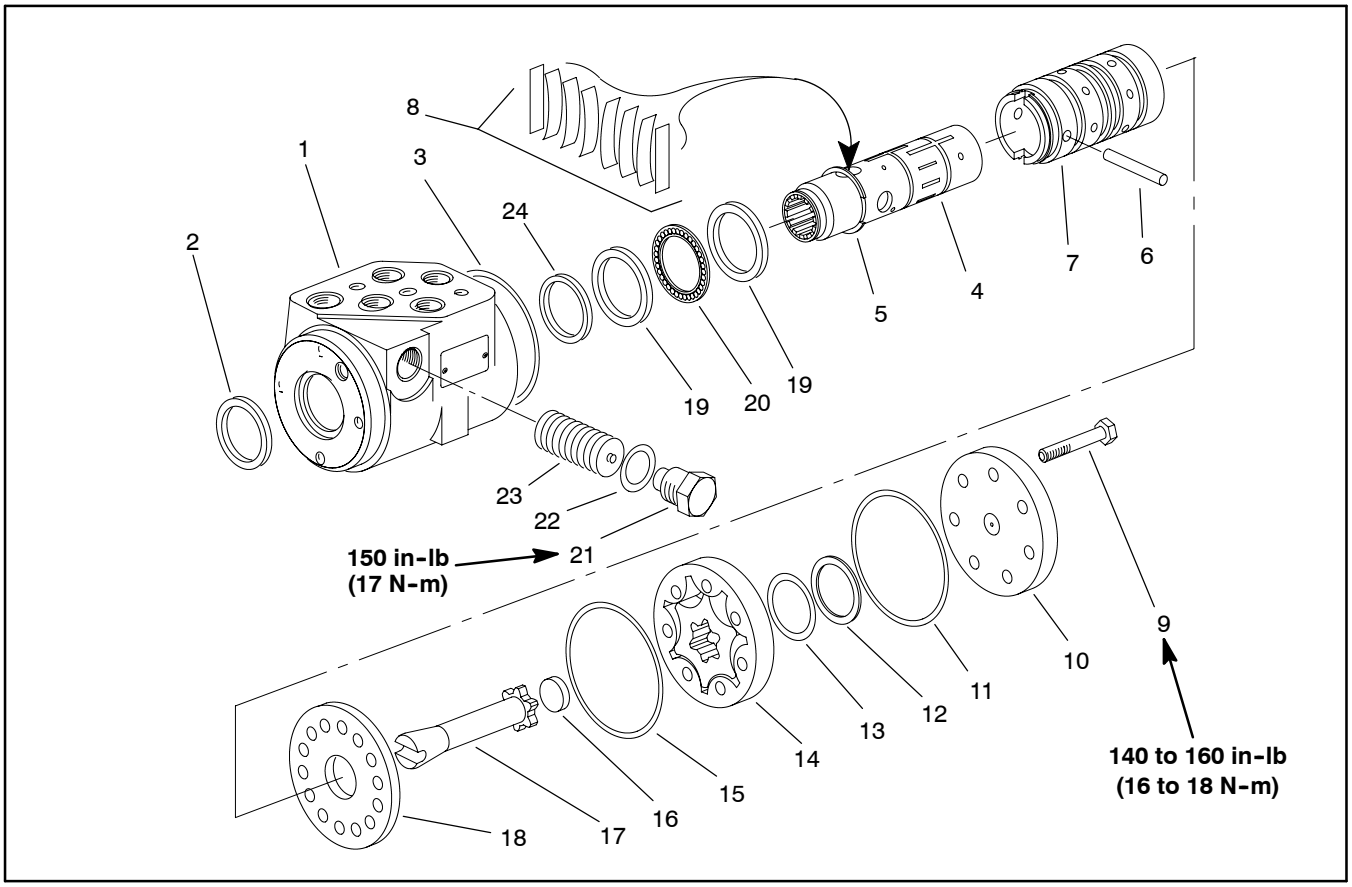

Figure 76

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. 76)

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 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. 76)

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 reassembling the steering valve.

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

1. Install the quad seal (Fig. 77):

   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. 77).

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 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).

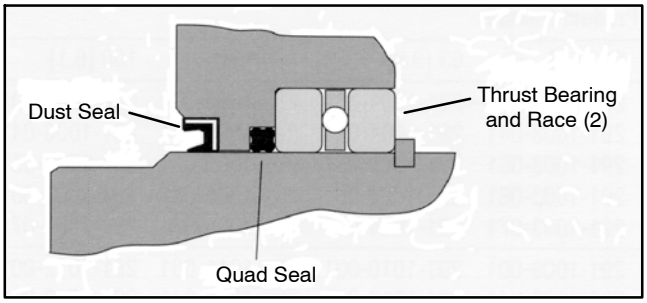

Figure 77

Front Deck Lift Cylinder

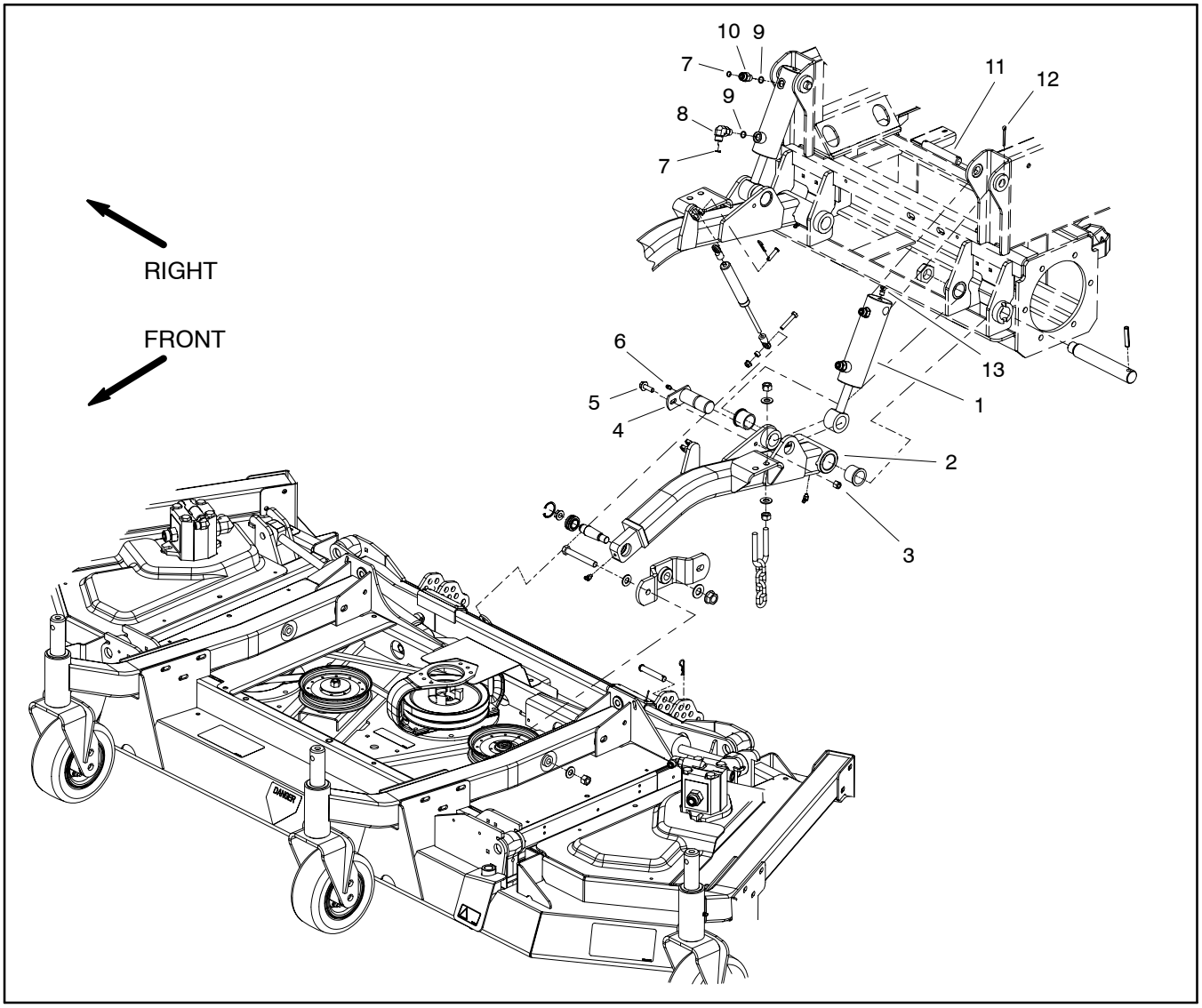

Figure 78

1. **Lift cylinder**
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. 78)

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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

NOTE: To ease reassembly, tag 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.

Installation (Fig. 78)

1. Position cylinder barrel clevis to frame and insert upper lift pin into frame and clevis. Secure lift pin with cotter pin.

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

3. Attach hydraulic hoses to lift cylinder.

4. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

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

Front Deck Lift Cylinder Service

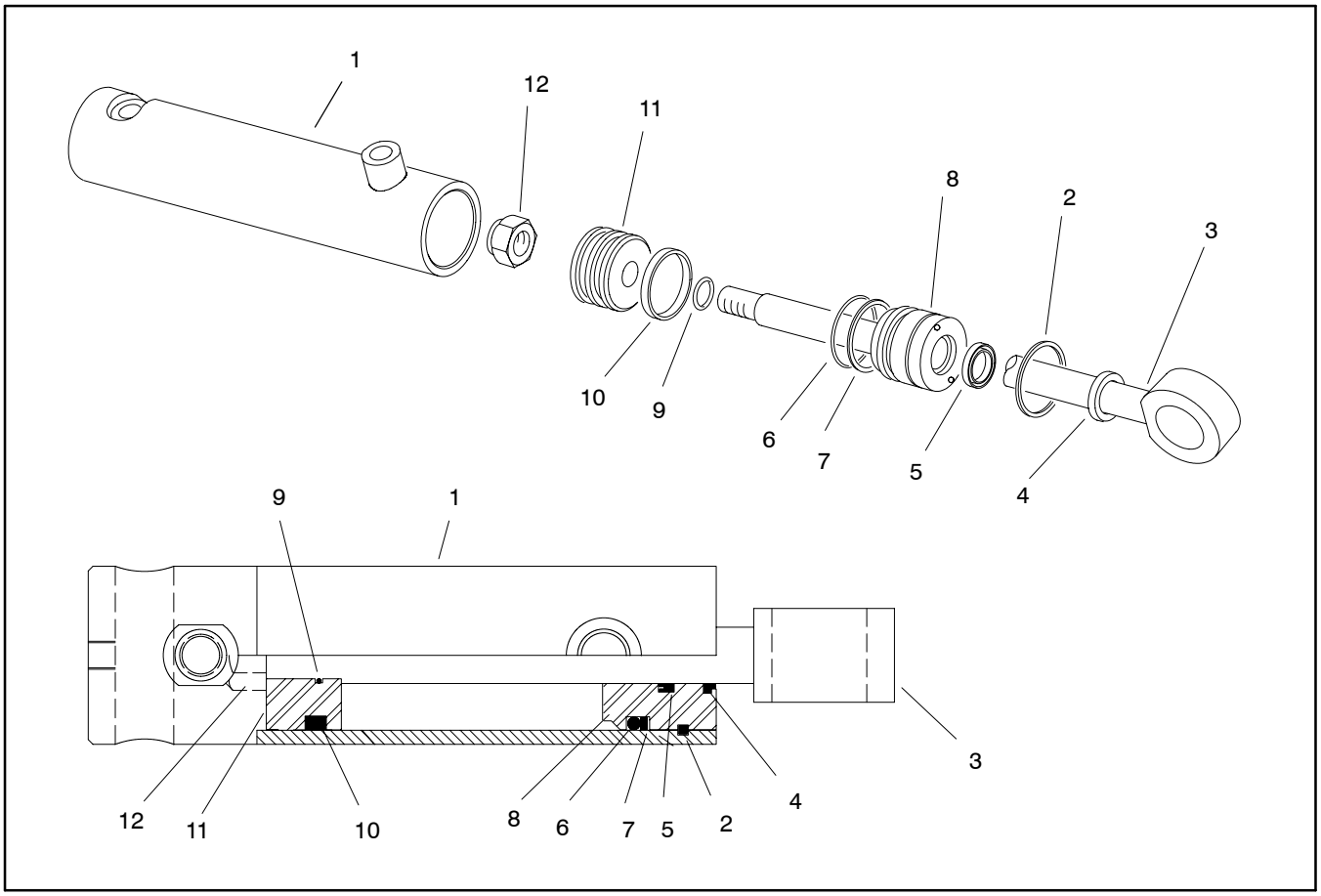

Figure 79

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. **T-seal**
11. **Piston**
12. **Locking nut**

Disassembly (Fig. 79)

1. Remove oil from lift cylinder into a drain pan by slowly pumping the cylinder shaft. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder into a vise. Use of a vise with soft jaws is recommended.

3. Remove retaining ring that secures head in barrel.

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

   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening.

   C. Rotate the head counter-clockwise to remove retaining ring from barrel and head.

4. Extract shaft with head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: 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 T-seal, o-ring, and wear ring from the piston. Remove O-ring, back-up ring, rod seal, and dust seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting, or wear. Replace any damaged parts.

Assembly (Fig. 79)

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, T-seal, wear ring, rod seal, back-up ring, and dust seal with clean hydraulic oil.

   A. Install T-seal, wear ring, and O-ring to the piston.

   B. Install dust seal, O-ring, back-up ring, and dust seal 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. Slide head and piston onto the shaft. Secure piston to shaft with locknut.

4. Lubricate head and piston with hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

5. Mount lift cylinder into a vise. Secure head in barrel with retaining ring.

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

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

Wing Deck Lift Cylinder

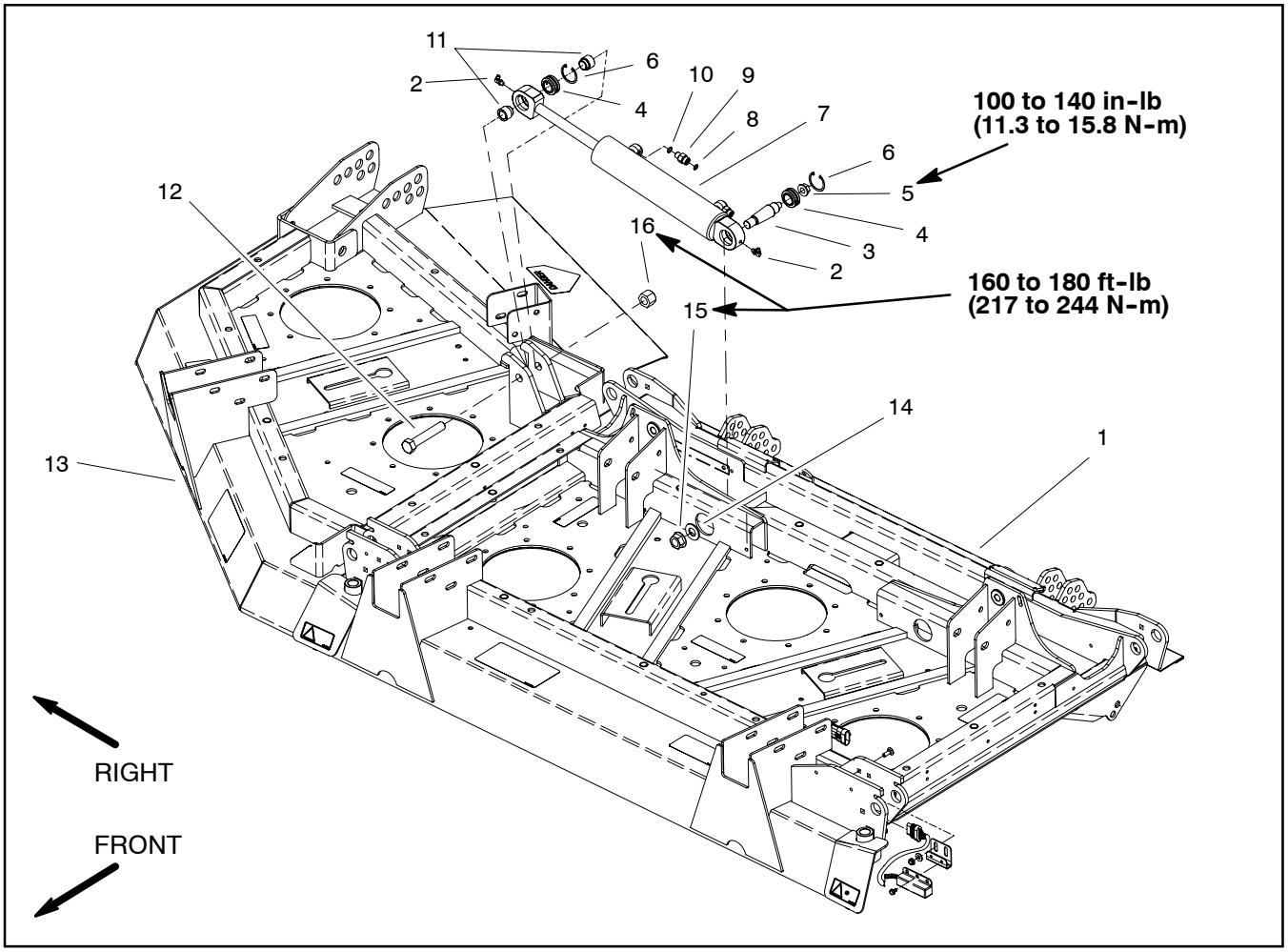

Figure 80

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

Removal (Fig. 80)

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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 reassembly, tag 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 flange 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. 80)

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 100 to 140 in–lb (11.3 to 15.8 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 flange 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 (see Operator's Manual).

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

Wing Deck Lift Cylinder Service

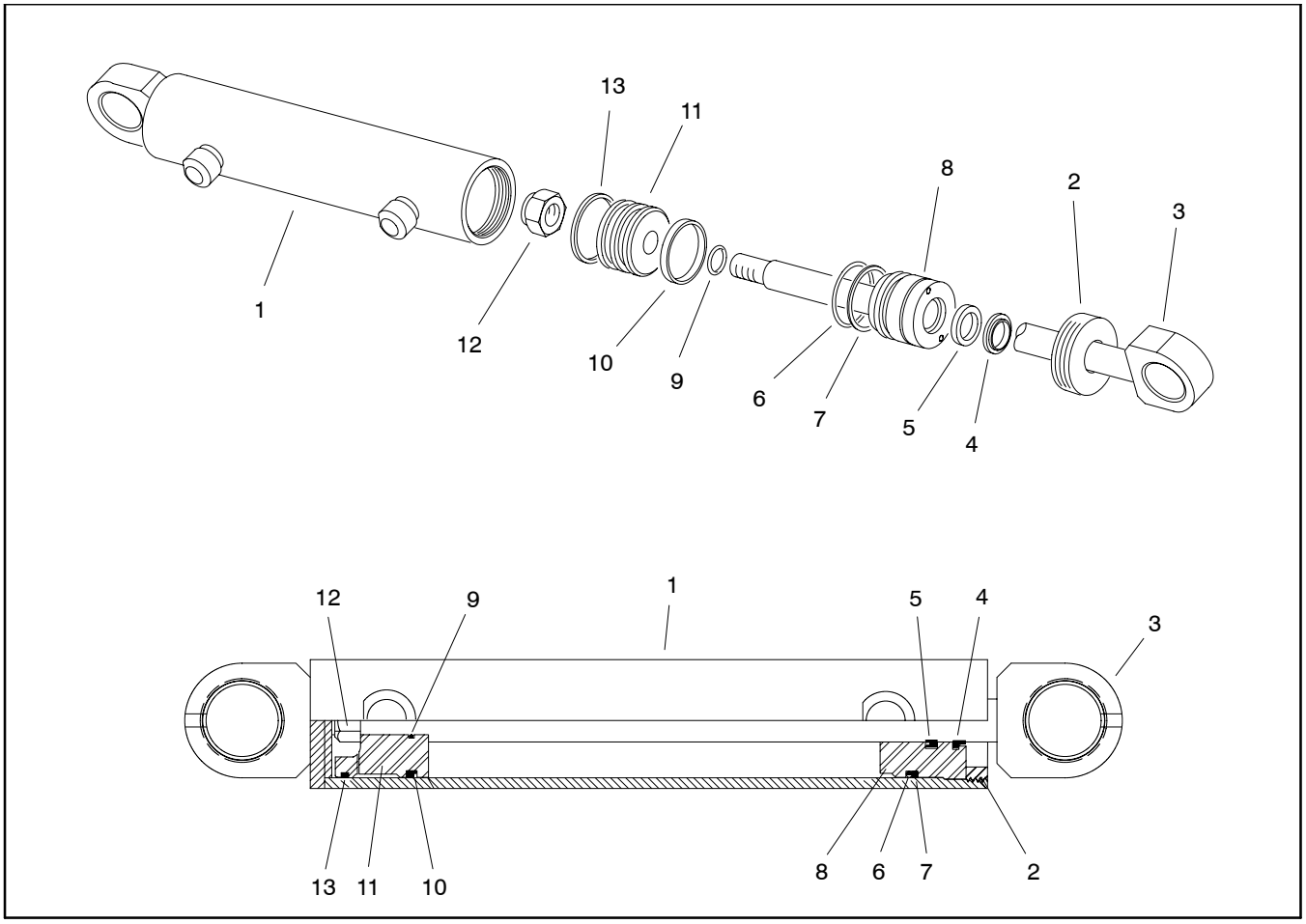

Figure 81

1. **Barrel with clevis**
2. **Internal collar**
3. **Shaft with clevis**
4. **Dust seal**
5. **Rod seal**
6. **O-ring**
7. **Back-up ring**
8. **Head**
9. **O-ring**
10. **T-seal**
11. **Piston**
12. **Locking nut**
13. **Steel ring**

Disassembly (Fig. 81)

1. Remove oil from lift cylinder by slowly pumping the cylinder shaft. After removing oil from cylinder, plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder into a vise. Use of a vise with soft jaws is recommended. Remove internal collar with a spanner wrench.

3. Loosen head from barrel:

   A. On cylinders with a collar in the barrel (Fig. 81), use a spanner wrench to loosen and remove collar from barrel.

   B. On cylinders with a retaining ring (Fig. 82), use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. 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 T-seal and O-ring from the piston. Remove O-ring, back-up ring, rod seal, and dust seal from the head.

7. Wash parts in clean solvent. Dry parts with compressed air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting, or wear. Replace any damaged parts.

Assembly (Fig. 81)

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, T-seal, rod seal, back-up ring, and dust seal with clean hydraulic oil.

   A. Install T-seal and O-ring to the piston.

   B. Install dust seal, O-ring, back-up ring, and dust seal 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. If removed, install internal collar onto shaft.

   C. Slide head and piston onto the shaft. Secure piston to shaft with locknut.

4. Lubricate head and piston with hydraulic oil. Slide shaft assembly carefully into cylinder barrel.

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

5. Mount lift cylinder in a vise with soft jaws. Secure head in barrel:

   A. On cylinders with a collar in the barrel (Fig. 81), use a spanner wrench to tighten collar into barrel.

   B. On cylinders with a retaining ring (Fig. 82), align retaining ring hole in the head with the access slot in the barrel. 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.

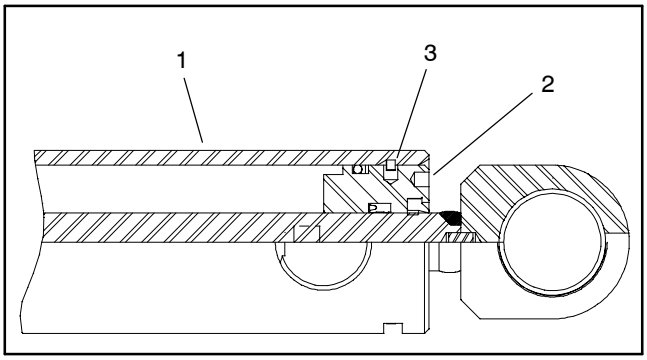

Figure 82

1. **Barrel**
2. **Head**
3. **Retaining ring**

Steering Cylinder

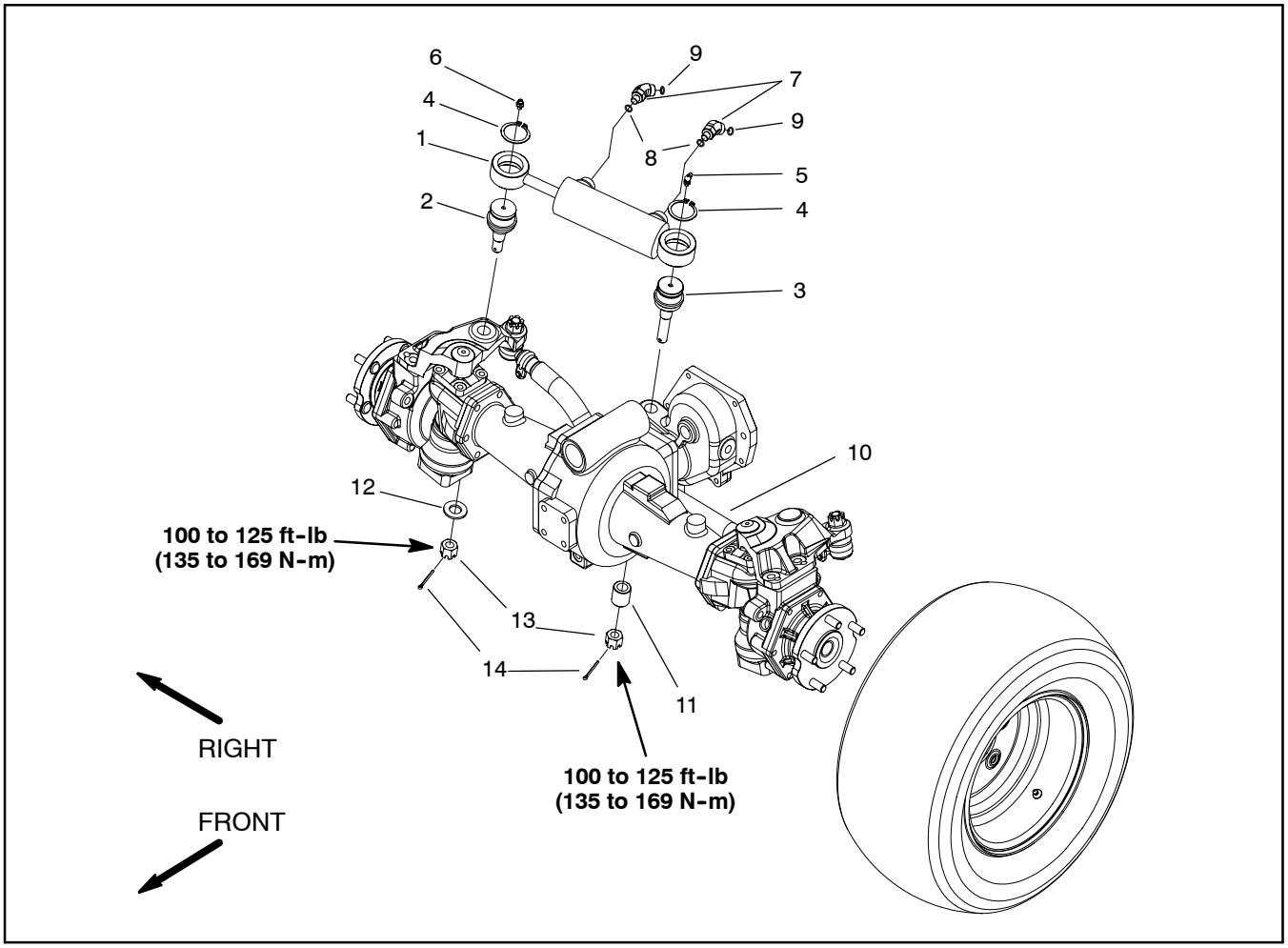

Figure 83

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. 83)

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

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

NOTE: To ease reassembly, tag 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. 83). Remove steering cylinder with ball joints from machine.

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

Installation (Fig. 83)

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

2. 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. Install spacer onto ball joint and secure with hex slotted nut. Torque slotted nuts from 100 to 125 ft–lbs (135 to 169 N–m) prior to inserting cotter pins.

3. Install hydraulic hoses to steering cylinder.

4. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

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

Steering Cylinder Service

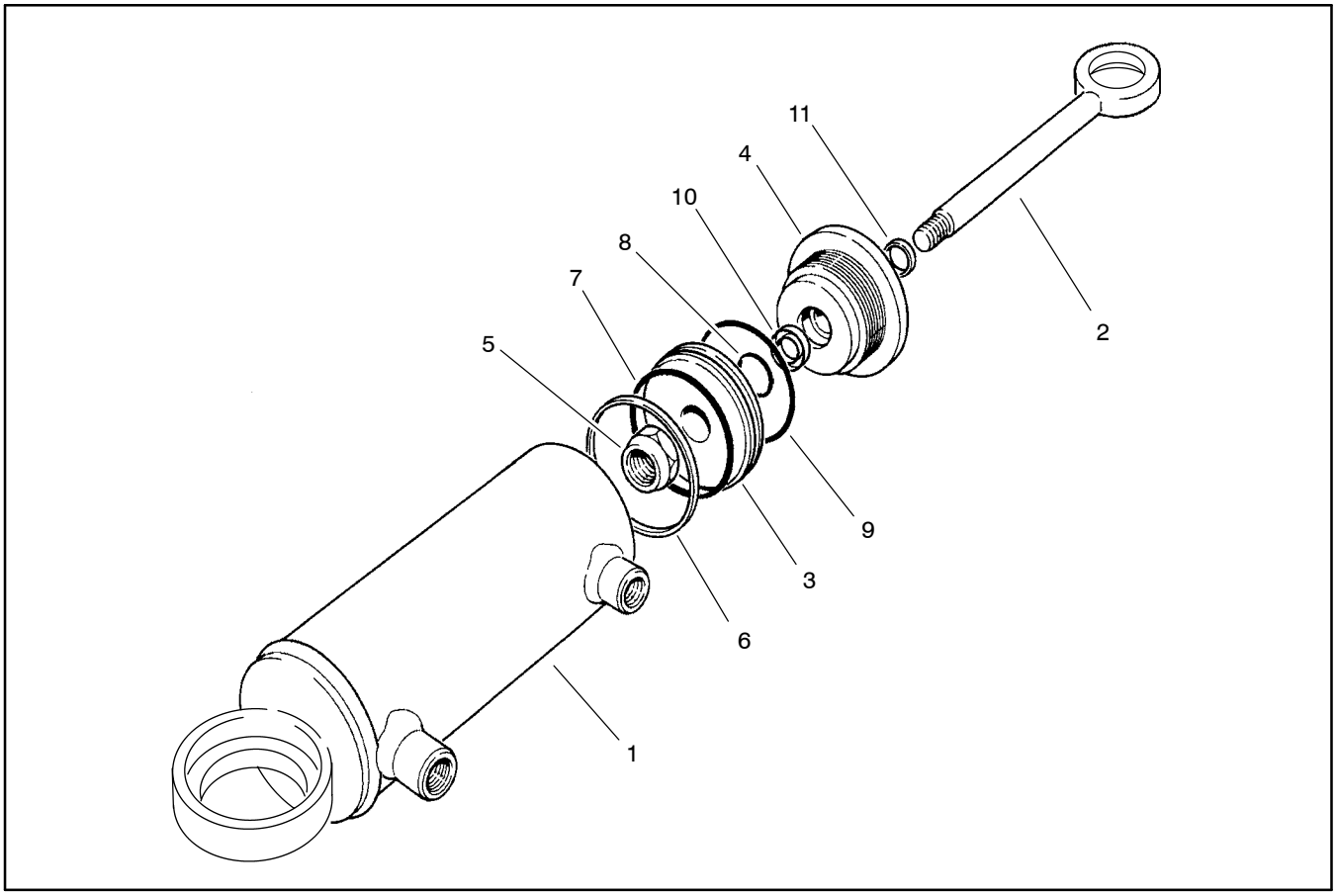

Figure 84

1. **Butt and tube assembly**
2. **Shaft**
3. **Piston rod assembly**
4. **Gland**
5. **Locking nut**
6. **O-ring**
7. **PTFE seal**
8. **O-ring**
9. **O-ring**
10. **U-cup**
11. **Wiper**

Disassembly (Fig. 84)

1. Remove oil from lift cylinder by slowly pumping the cylinder shaft. After removing oil from cylinder, plug both ports and clean the outside of the cylinder.

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

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

3. Loosen gland (head) from barrel:

   A. On cylinders without a retaining ring slot in the barrel (Fig. 84), use a spanner wrench to loosen and remove gland from barrel.

   B. On cylinders with a retaining ring (Fig. 85), use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter−clockwise to remove retaining ring from barrel and head.

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

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

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

6. Remove all seals and O−rings.

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 (Fig. 84)

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 PTFE seal to the piston rod and new O−ring, U−cup, and wiper to gland.

3. Lubricate shaft with clean hydraulic oil. Slide gland and piston onto shaft. Install and tighten locking nut.

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

5. Slide piston rod assembly into cylinder tube.

6. Mount lift cylinder in a vise with soft jaws. Secure gland (head) in barrel:

   A. On cylinders without a retaining ring slot in the barrel (Fig. 84), use a spanner wrench to tighten gland into barrel.

   B. On cylinders with a retaining ring (Fig. 85), align retaining ring hole in the head with the access slot in the barrel. 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.

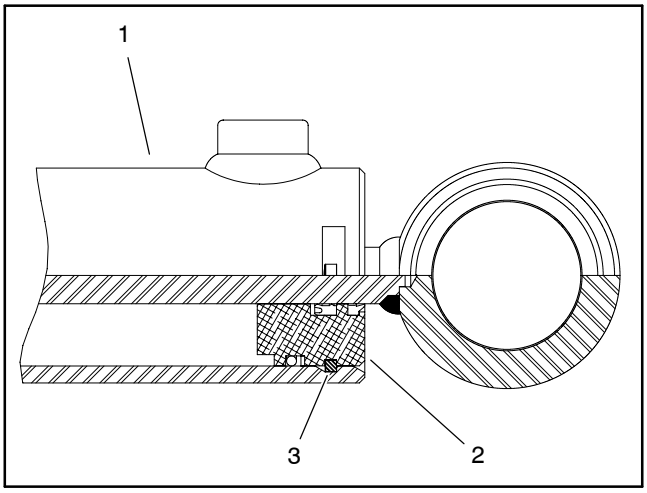

Figure 85

1. **Barrel**
2. **Gland (head)**
3. **Retaining ring**

Hydraulic Reservoir

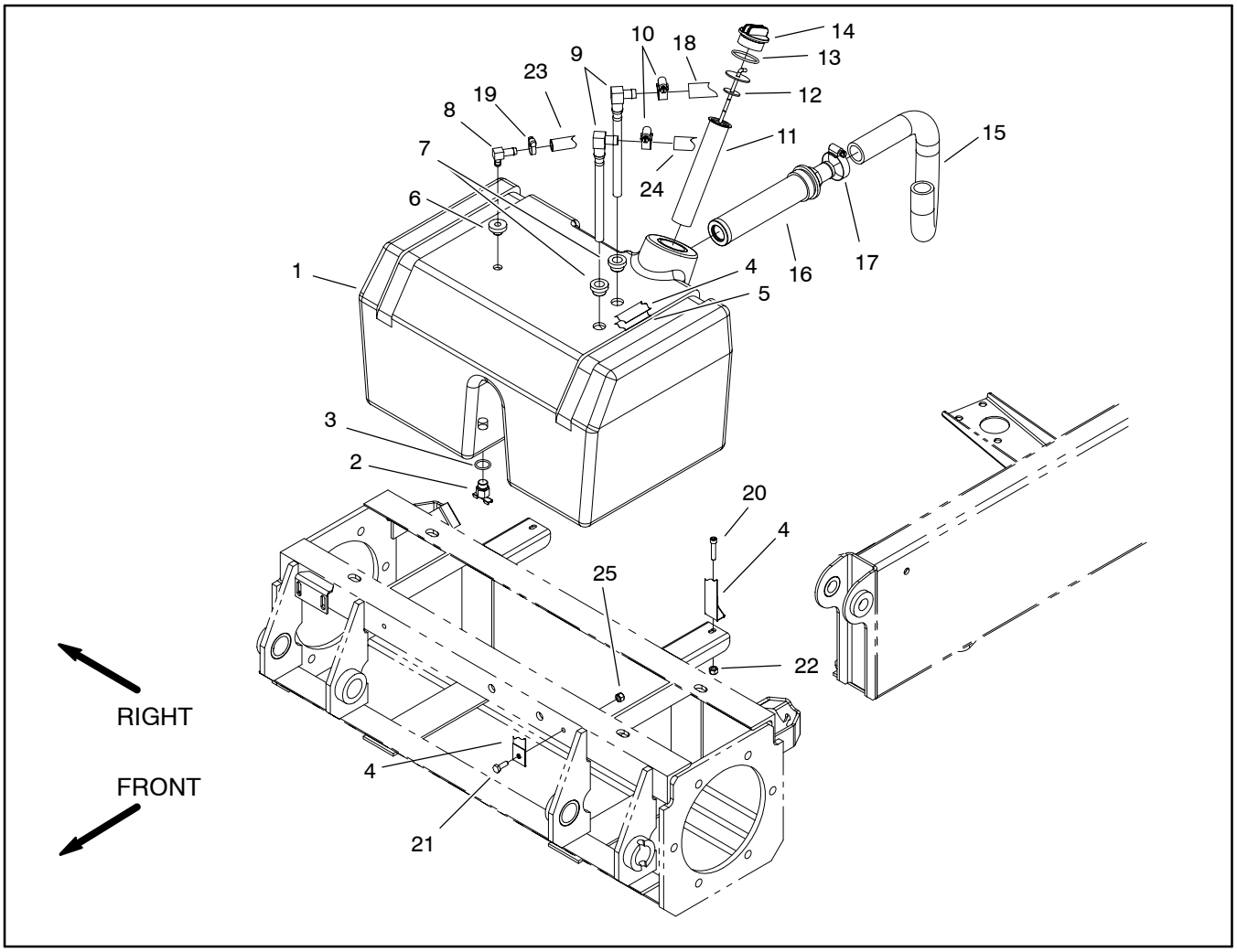

Figure 86

1. **Hydraulic reservoir**
2. **Petcock**
3. **O-ring**
4. **Strap (2 used)**
5. **Felt strap (2 used)**
6. **Bushing**
7. **Bushing**
8. **Hydraulic fitting**
9. **Stand pipe**
10. **Hose clamp**
11. **Screen filter**
12. **Dipstick**
13. **O-ring**
14. **Reservoir cap**
15. **Suction hose**
16. **Tank strainer w/o-ring**
17. **Hose clamp**
18. **Hose**
19. **Hose clamp**
20. **Cap screw (2 used)**
21. **Cap screw (2 used)**
22. **Lock nut (2 used)**
23. **Hose**
24. **Hose**
25. **Hex flange nut (2 used)**

Removal

1. Park machine on a level surface, lower cutting decks, 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 the Service and Repairs section of this chapter.

3. Drain reservoir into a suitable container (see Operator's Manual).

4. Disconnect hydraulic hoses from reservoir.

5. Remove hydraulic reservoir using Figure 86 as a guide.

Inspection

1. Clean hydraulic reservoir and suction strainer with solvent.

2. Inspect for leaks, cracks, or other damage.

Installation

1. Install reservoir using Figure 86 as a guide.

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

3. Reconnect hydraulic hoses.

4. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

Hydraulic Oil Cooler

Removal

CAUTION

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

1. Park machine on a level surface, lower cutting decks, stop engine, 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 the Service and Repairs section of this chapter.

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

4. Remove oil cooler using Figures 87 and 88 as guides.

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

1. Install oil cooler using Figures 87 and 88 as guides.

2. Fill reservoir with hydraulic fluid as required (see Operator's Manual).

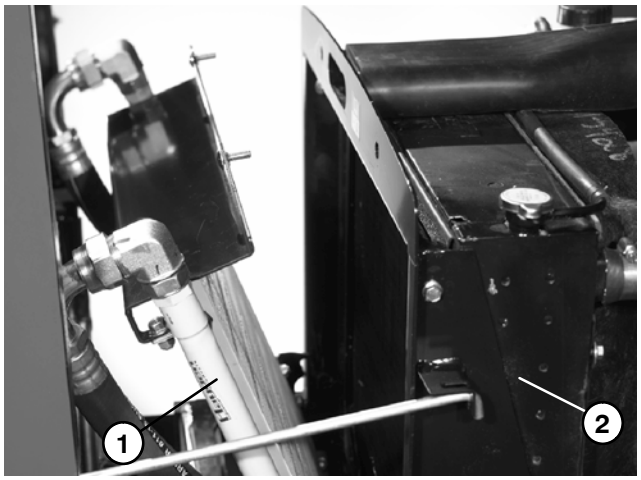

Figure 87

1. **Oil cooler**
2. **Radiator assembly**

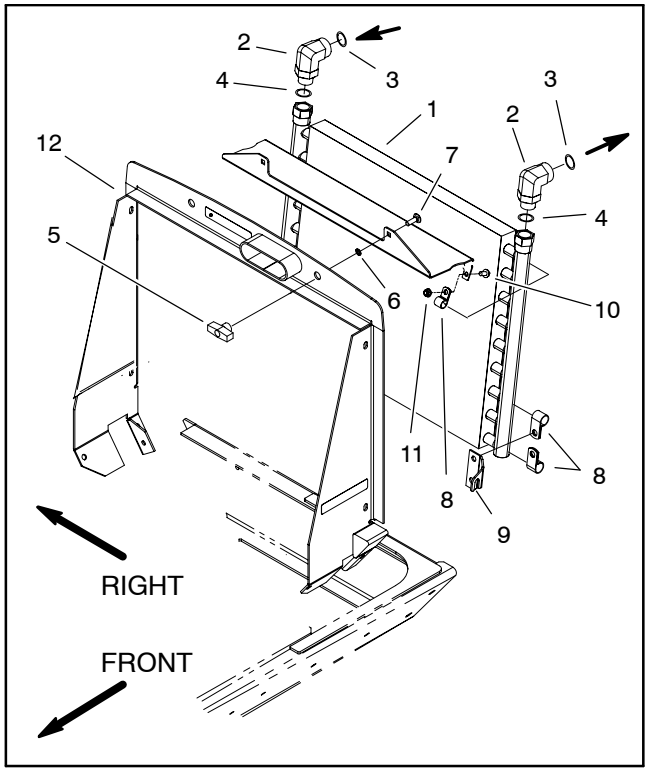

Figure 88

1. **Oil cooler**
2. **90º hydraulic fitting**
3. **O-ring**
4. **O-ring**
5. **Knob (2 used)**
6. **Retaining ring (2 used)**
7. **Carriage screw (2 used)**
8. **Clamp**
9. **Oil cooler bracket (RH)**
10. **Flange screw**
11. **Flange locking nut**
12. **Radiator support**

Chapter 5

Electrical System

Table of Contents

Electrical Schematic, Circuit Diagrams, and Wire Harness Drawings

The electrical schematic, circuit diagrams, and wire harness drawings for the Groundsmaster 4100−D are located in Chapter 9 − Electrical Diagrams.

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.

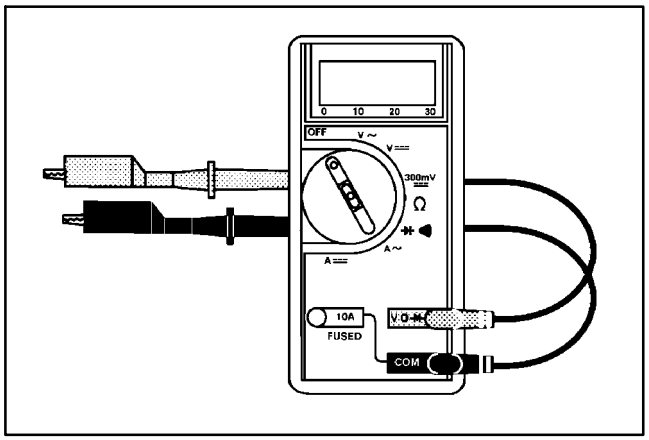

Figure 1

Skin−Over Grease

Special non−conductive grease (Toro Part No. 505−165) which forms a light protective skin which helps waterproof electrical switches and contacts.

Figure 2

Deck Proximity Switch Adjustment Tool

The Deck Proximity Switch Adjustment Tool (TOR4095) is designed to assist in the adjustment of the cutting deck position switches for cutting blade shutdown during deck lift.

Figure 3

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 9 − Electrical Diagrams).

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

Starting Problems

Problem	Possible Causes
All electrical power is dead, including gauges.	The battery charge is low. The 10 amp fuse to the ignition switch is open. Bad ground connection on machine. The ignition 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 wiring.	Low battery charge. Loose or corroded battery cables. Loose or corroded ground. Faulty wiring at the starter. Faulty starter solenoid. Faulty starter.
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 or the neutral switch or circuit wiring is faulty. Faulty ignition switch or circuit wiring. Start relay or circuit wiring is faulty. Starter solenoid or starter is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	Engine run solenoid is out of adjustment or circuit wiring is faulty. High temperature shutdown switch or circuit wiring is faulty.

Problem	Possible Causes
Engine cranks, but does not start.	Engine is not cranking fast enough. Engine run solenoid, circuit wiring, or fuel pump is faulty. The problem is not electrical (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 open. 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 sensor or circuit wiring is faulty. 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. Engine run solenoid is out of adjustment or circuit wiring 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 switch. 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. Faulty alternator or dead battery. Charge indicator lamp is faulty or burned out. Charge indicator lamp wiring loose, corroded, or damaged.

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 decks run, but should not, when raised. Decks shut off with PTO switch.	The deck position switch or circuit wiring is faulty.
Cutting decks run, but should not, when raised. Units do 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 decks run, but should not, when lowered with PTO switch in the OFF (disengage) position.	The PTO switch or circuit wiring is faulty.
Cutting deck(s) do not operate.	The operator is lifting off the seat switch. 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 decks 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 60ºF to 100ºF (16ºC to 38ºC). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (−) meter lead to the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

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

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. 4).

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. 5).

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.

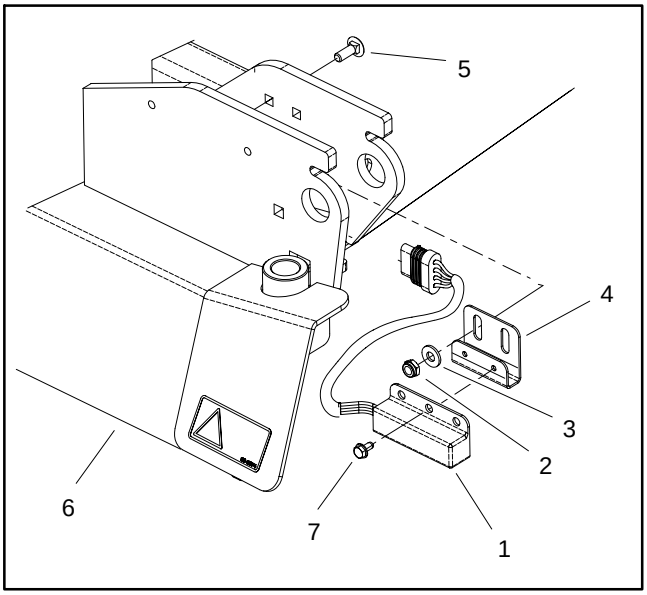

Figure 4

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)**

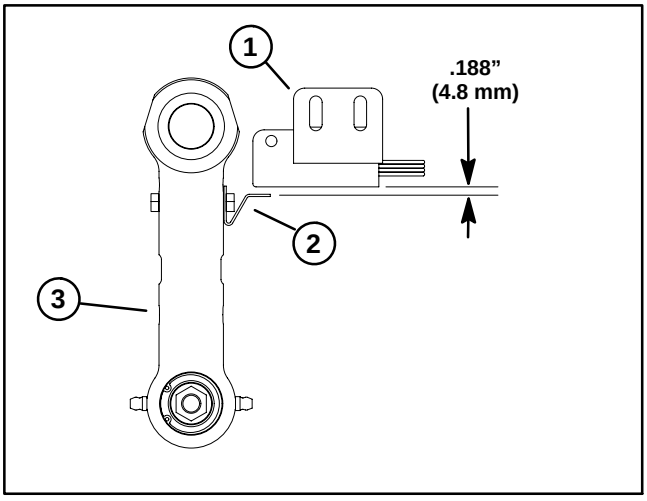

Figure 5

1. **Position switch**
2. **Actuator tab**
3. **Wing deck link**

Cutting Deck Raise and Lower Switches

Adjustment (Fig. 6)

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 approximately .625” (15.9 mm) (Fig. 7).

   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.

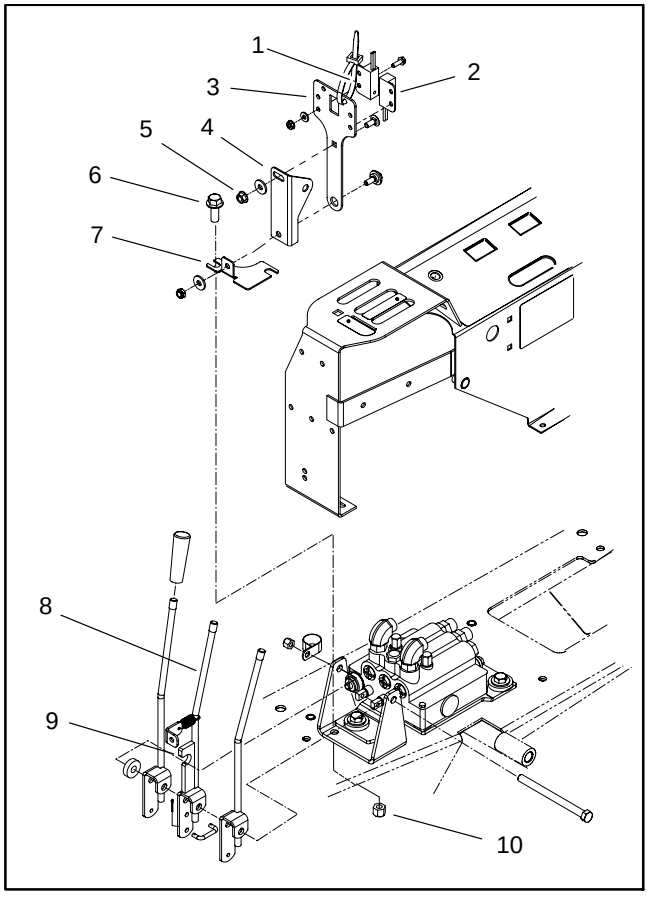

Figure 6

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**

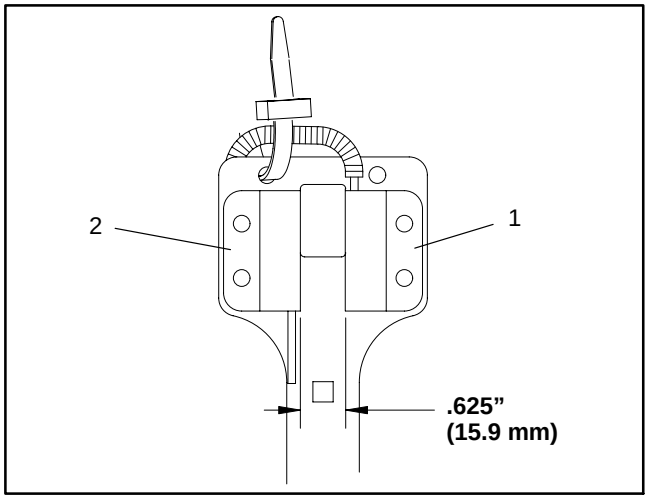

Figure 7

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, V2003−T 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). The terminals are marked as shown. 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

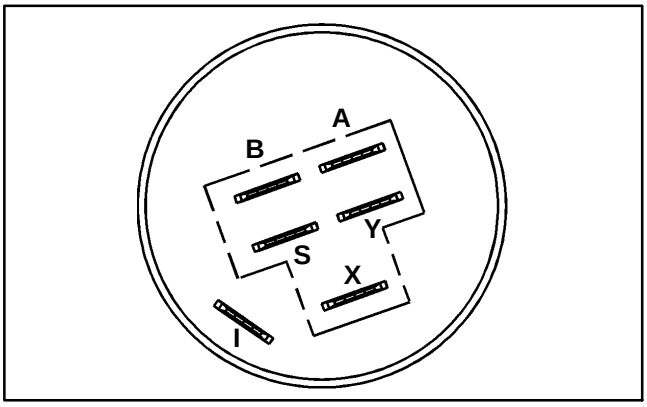

Figure 8

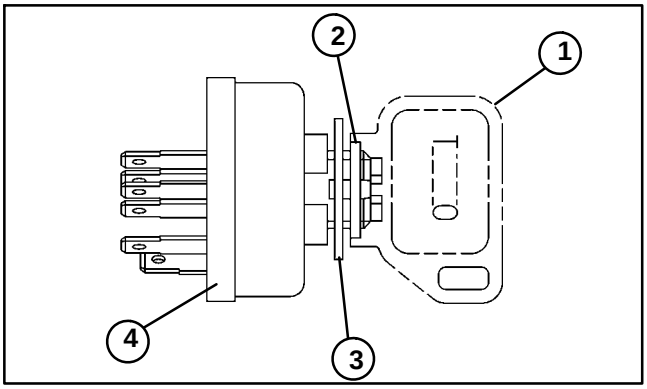

Figure 9

1. **Key**
2. **Hex nut**
3. **Lock washer**
4. **Ignition switch**

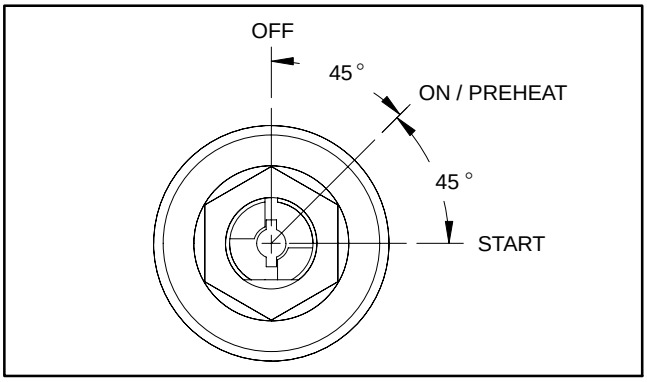

Figure 10

Fuses

The fuse blocks are located under the operator's control console.

Identification, Function, and Wiring

The fuses are held in two fuse blocks. Use Figure 11 to identify each individual fuse and its correct amperage. Each fuse holder has the following functions and wires connected to it.

Fuse A1 (5 amp)

A. Supplies power to the seat switch.

B. Has green wire and red wire (battery).

Fuse A2 (10 amp)

A. Supplies power to ignition switch terminal B.

B. Has pink wire and red wire (battery).

Fuse A3 (10 amp)

A. Supplies power to the PTO switch.

B. Has yellow wire and red wire (battery).

Fuse A4 (10 amp)

A. Supplies power to the starter solenoid.

B. Has orange wire and red wire (battery).

Fuse B1 (10 amp)

A. Supplies power to the power point outlet.

B. Has white wire and red wire (battery).

Fuse B4 (when optional lighting is installed)

A. Supplies power for optional light kit.

B. Has two red wires.

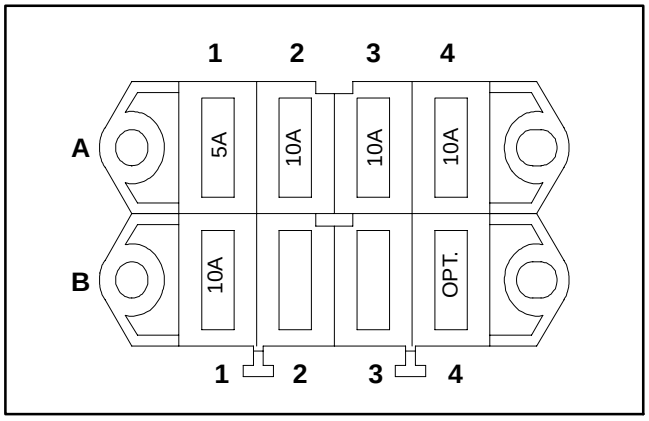

Figure 11

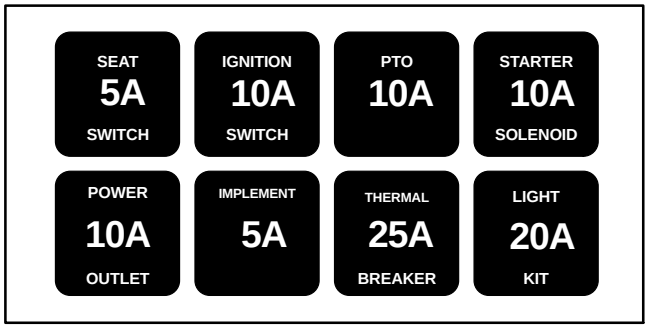

Figure 12

Warning Lights

Testing Warning Lights

1. Apply 12 VDC to terminals 1A and 2A.

2. Ground terminals 1B and 2B.

3. Both indicator lights should light.

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 Shutdown Light

If the coolant temperature rises to approximately 230ºF (110ºC), the high temperature light should come on as the high temperature shutdown switch stops the engine.

1. Disconnect and ground the blue wire attached to temperature switch on flywheel end of engine. The warning light should illuminate and the engine should stop running.

2. Depress high temperature override switch and hold. Engine should start and run.

3. Reconnect blue wire to temperature switch.

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 7 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.

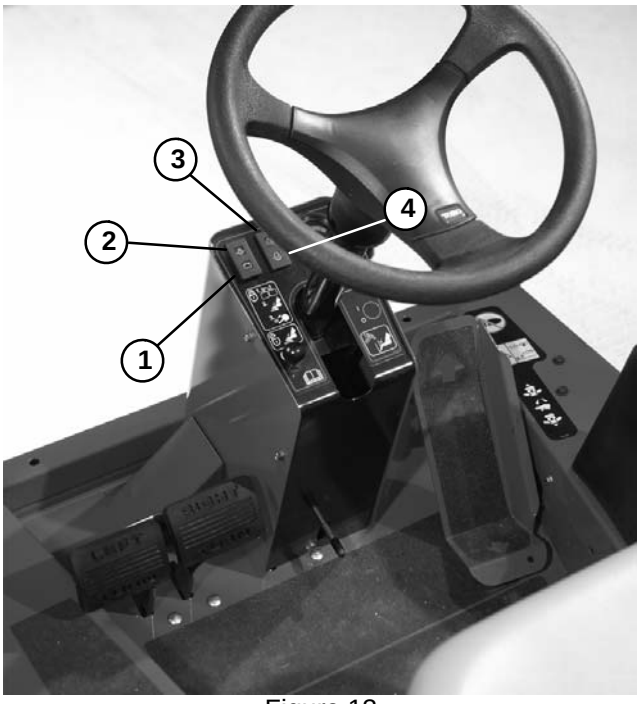

Figure 13

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temp shutdown**
4. **Glow plug indicator**

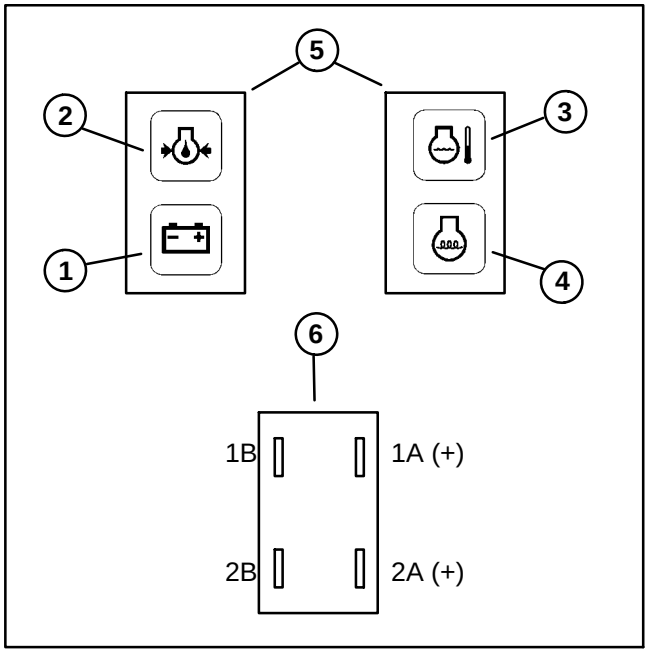

Figure 14

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temp shutdown**
4. **Glow plug indicator**
5. **Warning light front**
6. **Warning light back**

PTO Switch

The PTO switch is attached to the control console next to the operator seat (Fig. 15).

The switch terminals are marked as shown in Figure 16. 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

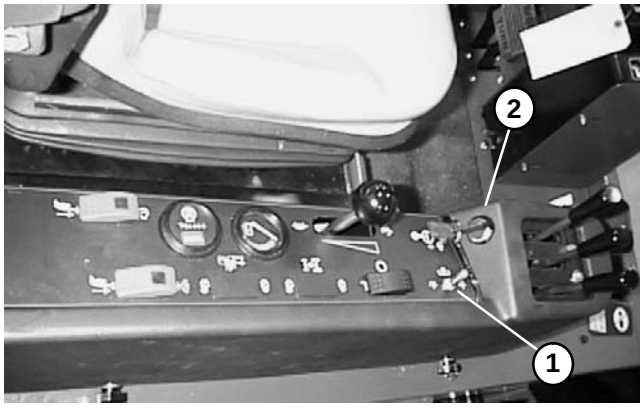

Figure 15

1. **PTO switch**
2. **Control console**

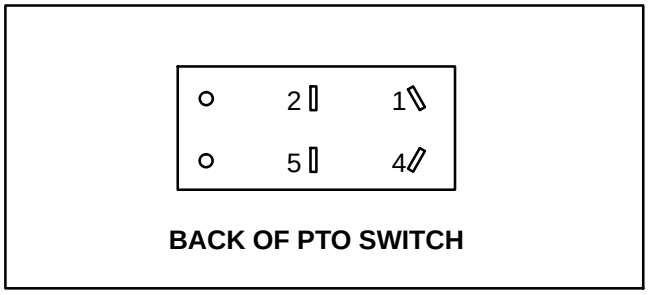

Figure 16

Audio Alarm

The audio alarm for low engine oil pressure is attached to the control console next to the operator seat.

IMPORTANT: Make sure to observe polarity on the alarm terminals when testing. Damage to the alarm may result from an improper connection.

1. Isolate alarm from the circuit. Correctly connect 12VDC source to the terminals (Fig. 17).

2. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit.

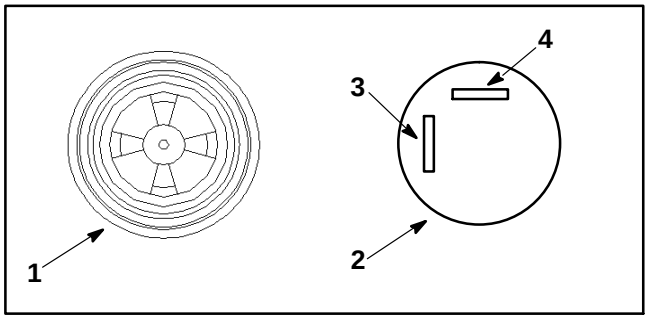

Figure 17

1. **Alarm top view**
2. **Alarm bottom view**
3. **Positive (+) terminal**
4. **Negative (−) terminal**

Transport, Alarm Silence, and Temperature Override Switches

The transport, alarm silence, and temperature override rocker switches are located on the control console (Fig. 18). These switches have common switching logic.

The switch terminals are marked as shown in Figure 19 and Figure 20. The circuitry of these 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.

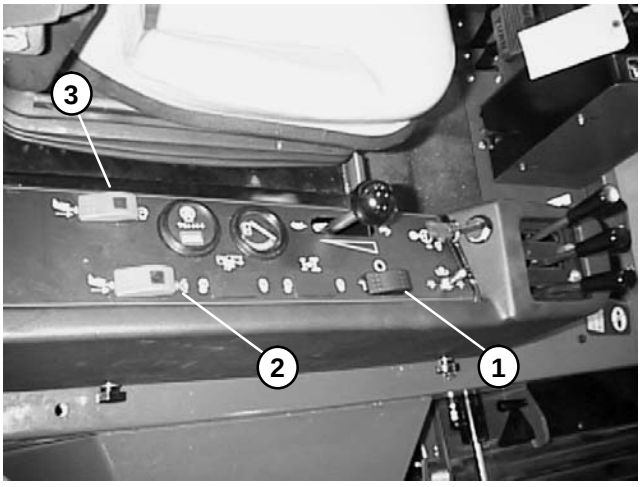

Figure 18

1. **Transport switch**
2. **Alarm silence switch**
3. **Temp. override switch**

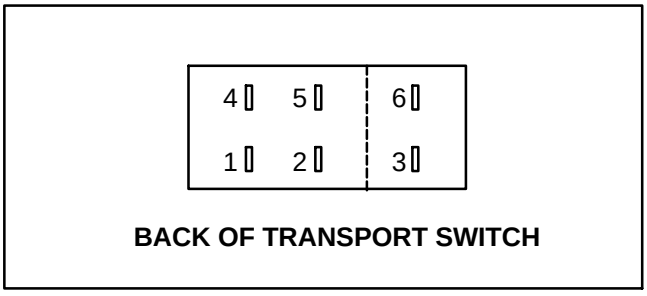

Figure 19

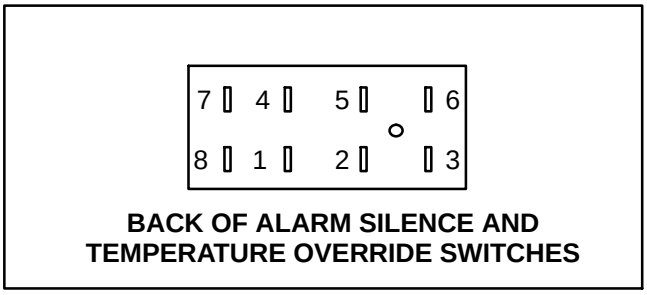

Figure 20

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine will stop. The seat switch and its electrical connector are located directly under the seat (Fig. 21). Testing of the switch can be done without seat removal by disconnecting the seat wire from the machine wiring harness.

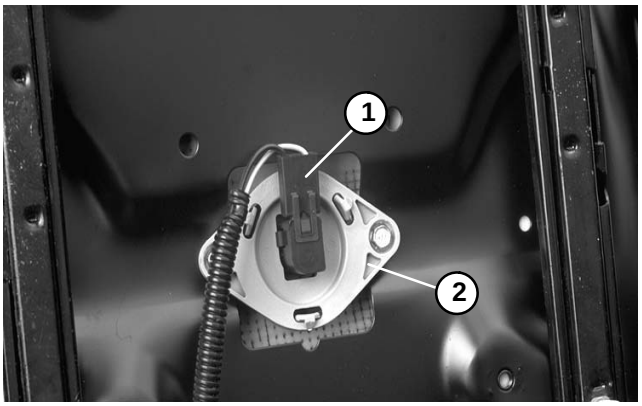

Figure 21

1. **Electrical connector**
2. **Seat switch**

Testing

1. Make sure the engine is off.

2. Disconnect 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. Reconnect switch connector.

Parking Brake Switch

The switch used for the parking brake is a normally closed switch. The parking brake switch is located under the steering tower cover (Fig. 22) and opens when the parking brake lever is engaged.

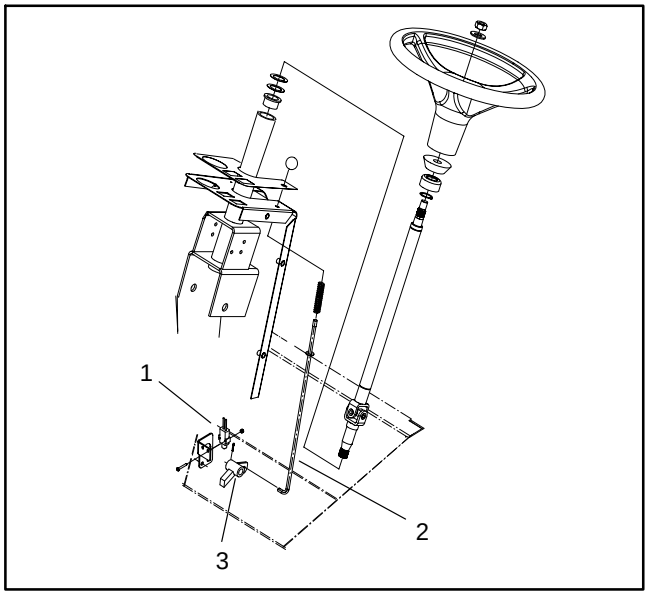

Figure 22

1. **Parking brake switch**
2. **Parking brake rod**
3. **Parking brake pawl**

Testing

1. Make sure the engine is off. Locate brake switch for testing.

2. Disconnect electrical 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 be continuity between the switch terminals.

5. When the switch plunger is depressed, there should be no continuity between the switch terminals.

6. Reconnect switch connector.

Hour Meter

The hour meter is located on the control console next to the operator seat.

1. Disconnect 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 minutes.

5. Disconnect voltage source from the hour meter. Reconnect harness connector to hour meter.

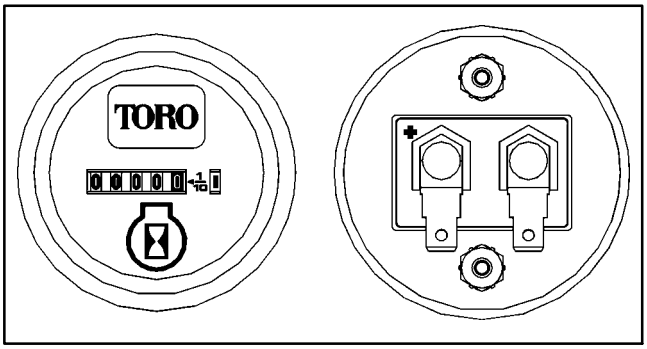

Figure 23

Glow Relay

The glow relay is attached to the the right side of the fuel tank support under the hood (Fig. 24).

Testing

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value for the tested component.

1. Disconnect the harness connector from the glow relay.

2. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 25). Resistance should be between 70 and 100 ohms.

3. Verify infinite resistance (no continuity) between terminals 30 and 87.

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 make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

5. Disconnect meter leads and jumper wires from the relay terminals. Reconnect glow relay to machine wire harness.

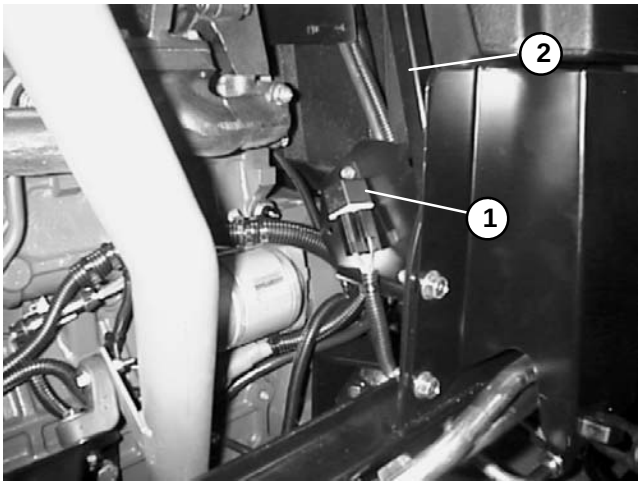

Figure 24

1. Glow relay **2. Fuel tank support**

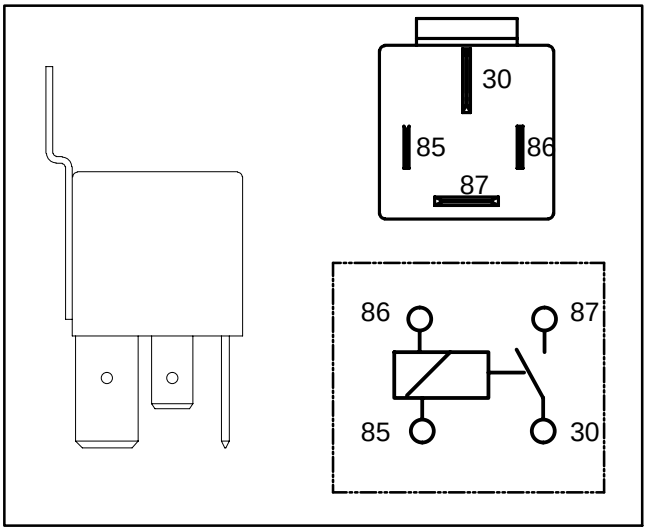

Figure 25

Start, Engine Shutdown, Seat, PTO, Alarm, Down Latching, and Over Temperature Relays

These seven relays are located under the console housing cover. The wiring harness is tagged to identify each relay.

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. Disconnect the harness connector from the relay that is to be tested.

2. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 26). Resistance should be between 70 and 90 ohms.

3. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

4. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.

5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.

6. Disconnect voltage and multimeter leads from the relay terminals. Reconnect relay to machine wire harness.

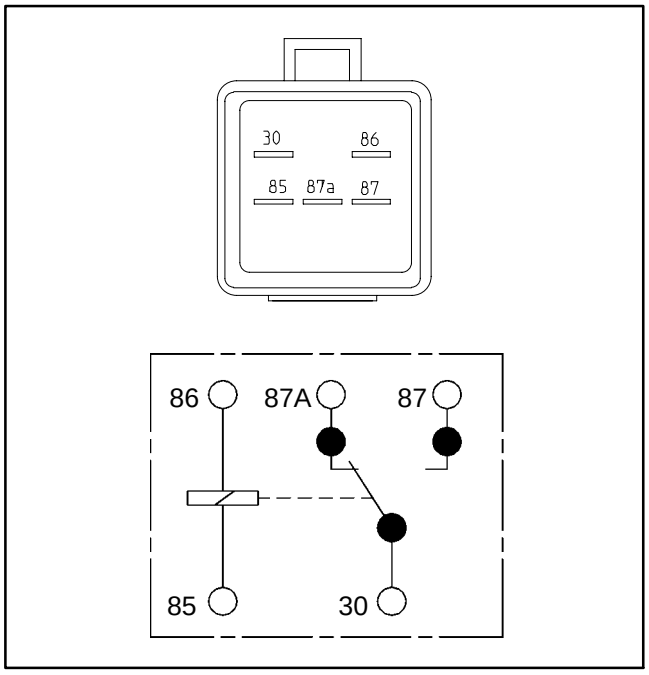

Figure 26

Hydraulic Valve Solenoids

There are four hydraulic valve solenoids on the Groundsmaster 4100−D (Fig. 28). 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 hydraulic valve solenoid electrical connector (Fig. 27).

2. Apply 12VDC source directly to the solenoid. Listen for solenoid to switch on.

3. Remove 12VDC source from the solenoid. Listen for solenoid to switch off.

4. Measure resistance between the two connector terminals. The resistance for the solenoid coil should be approximately 7.2 ohms.

5. Reconnect electrical connector to the solenoid.

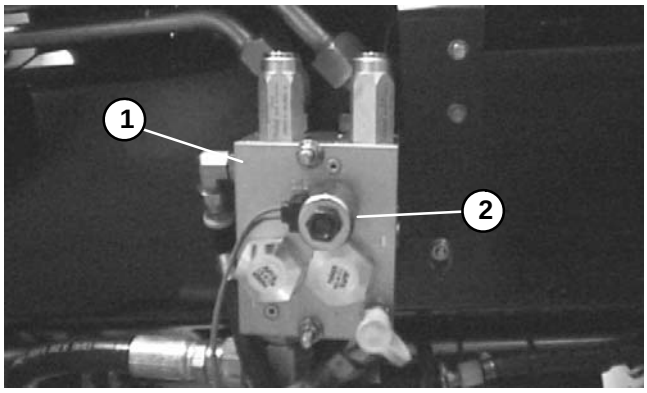

Figure 27

1. **Manifold (LH deck shown)**
2. **Valve solenoid**

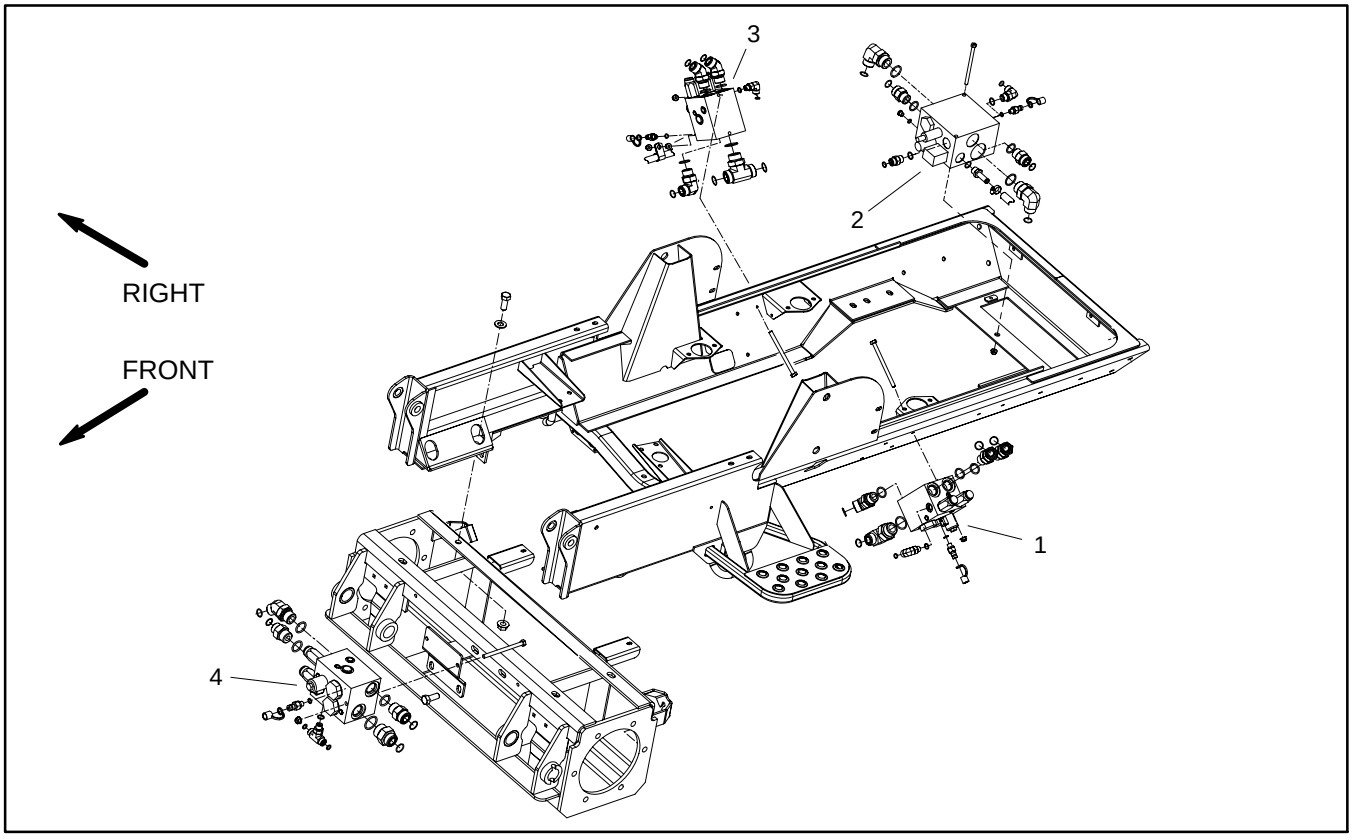

Figure 28

1. **LH wing deck solenoid**
2. **2WD/4WD manifold solenoid**
3. **RH wing deck solenoid**
4. **Center deck solenoid**

Engine Run Solenoid

The engine run solenoid must be energized for the engine to run. It is mounted on the engine block near the injection pump (Fig. 29).

In Place 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. Disconnect the connector from the engine run solenoid.

2. Using a digital multimeter, touch one lead to the pin of the black wire and the other lead to the pin of the white wire. The resistance of the pull coil should be approximately 0.26 ohms.

3. Using a digital multimeter, touch one lead to the pin of the black wire and the other lead to the pin of the red wire. The resistance of the hold coil should be approximately 10.9 ohms.

4. Reconnect solenoid to the wiring harness.

Live Testing

1. Disconnect connector from the engine run solenoid.

NOTE: The solenoid may be removed from the engine or tested in place.

2. If the solenoid is removed from the engine, make sure that the solenoid linkage moves freely and is free of dirt, debris, and corrosion.

3. Connect a positive (+) test lead from a 12 VDC source to the pins of the red and white wires.

4. Touch a negative (−) test lead from the 12 VDC source to the pin of the black wire. The solenoid should engage making an audible “click”.

5. Remove positive (+) voltage from the pin of the white wire. The solenoid should stay engaged.

6. Remove positive (+) voltage from the pin of the red wire. The solenoid should release.

7. Reinstall solenoid if removed from engine.

8. Reconnect the harness wire connector to the solenoid.

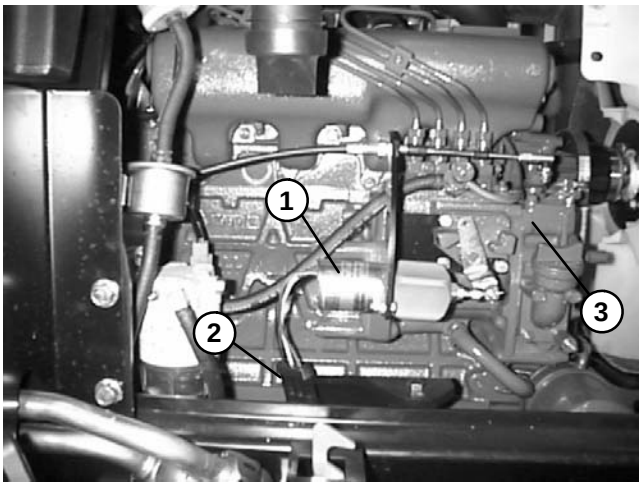

Figure 29

1. **Engine run solenoid**
2. **Solenoid connector**
3. **Injection pump**

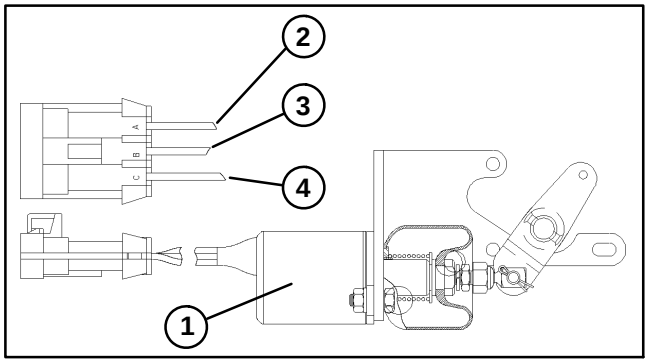

Figure 30

1. **Engine run solenoid**
2. **Red wire (hold coil)**
3. **White wire (pull coil)**
4. **Black wire (common)**

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. 31).

   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.

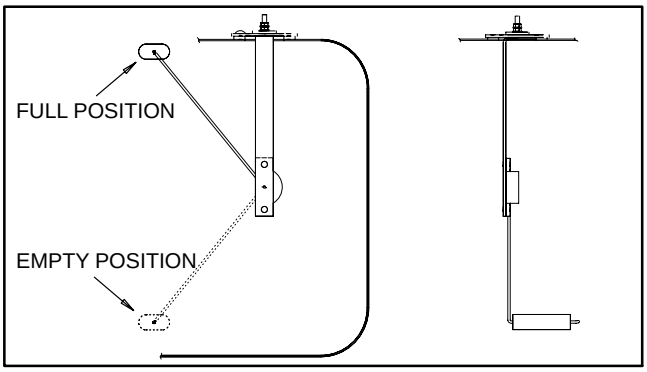

Figure 31

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. 32).

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. 33).

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.

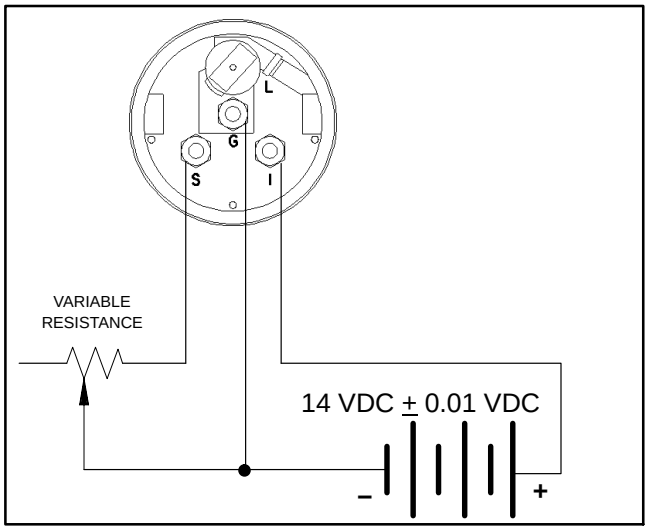

Figure 32

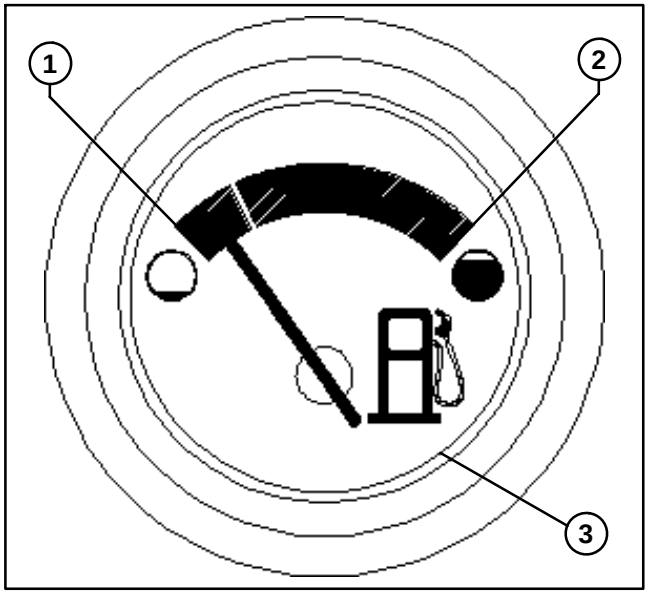

Figure 33

1. **Empty position**
2. **Full position**
3. **Glass face edge**

Fuel Pump

The fuel pump is attached to the fuel tank support above the fuel/water separator (Fig. 34).

IMPORTANT: When testing fuel pump, make sure that pump is not operated dry.

Operational Test

1. Park machine on a level surface, lower cutting units, stop engine, and engage parking brake.

2. Disconnect electrical connector from the fuel stop solenoid to prevent the engine from firing.

DANGER

Because diesel fuel is highly flammable, use caution when testing. Do not smoke while testing the fuel pump. Do not perform this test while engine is running, hot, or when machine is in an enclosed area. Always wipe up any spilled diesel fuel before starting the engine.

3. Disconnect fuel hose (pump discharge) from the 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 and holding it in the START position. Allow pump to run for 30 seconds, then release switch to OFF.

7. The amount of fuel collected in the graduated cylinder should be approximately 11.75 fl oz (350 ml) after 30 seconds.

8. Replace fuel pump as necessary. Reconnect fuel hoses.

9. Reconnect electrical connector to the fuel stop solenoid.

10. Bleed the fuel system (see Operator's Manual).

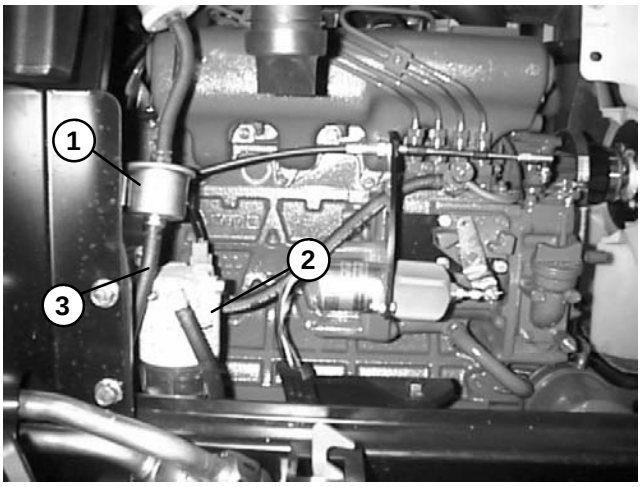

Figure 34

1. **Fuel pump**
2. **Fuel/water separator**
3. **Pump discharge hose**

Fuel Pump Specifications

Pump Capacity	23.5 fl oz/min (695 ml/min)
Pressure	3.3 psi (22.8 kPa)
Maximum Current Draw	0.9 amp

Glow Controller

The glow controller is located under the console cover.

NOTE: Refer to Chapter 9 − Electrical Schematics and Diagrams when troubleshooting the controller.

Controller Operation

1. When the ignition switch is placed in the ON position, the controller energizes the glow plugs and illuminates the glow indicator light for approximately 7 seconds.

2. When the ignition switch is held in the START position, the glow plugs will energize and the glow indicator light will **not** light.

3. When the ignition switch is released from START to ON, the glow plugs will de−energize and the glow indicator light will remain off.

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 light is on.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow indicator light goes out and glow plugs de−energize after 7 seconds.

4. Place ignition switch in the START position. Verify the following while in the START position:

   A. Glow indicator light is out.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Power exists to terminal 1 of the glow controller.

NOTE: If there is no power to terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform step 4 again (see Chapter 9 − Electrical Schematics and Diagrams).

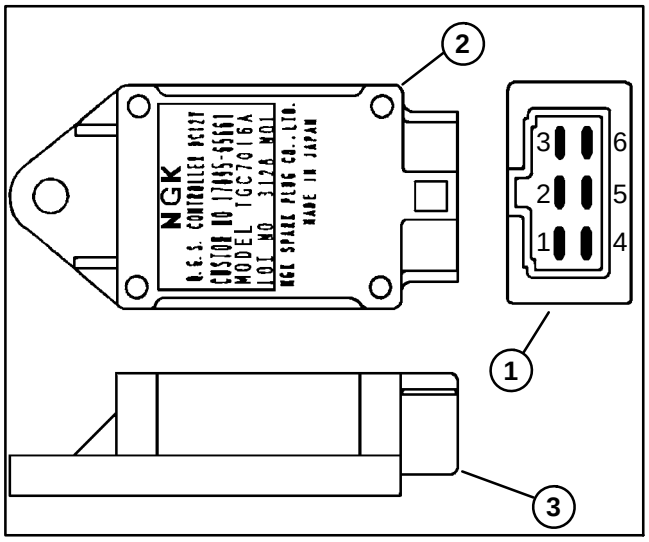

Figure 35

1. **Glow controller end view**
2. **Controller top view**
3. **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 Chapter 9 − Electrical Schematics and Diagrams).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow indicator light, glow relay, and ground (see Chapter 9 − Electrical Schematics and Diagrams).

   C. Replace components as necessary.

6. Reconnect 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. 36). There is a gray wire attached to the terminal of the switch.

Testing

1. Lower coolant level in the engine and remove the temperature sender from water flange.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 37).

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.

3. Check resistance of the sender with a multimeter (ohms setting) as the temperature increases.

   A. The meter should indicate more than 600 ohms at 70°F (21°C).

   B. The meter should indicate approximately 460 ohms at 100°F (38°C).

   C. The meter should indicate from 54 to 78 ohms at 200°F (93°C).

   D. Replace sender if specifications are not met.

4. Install sender to the water flange.

   A. Clean threads of water flange and sender thoroughly. Apply thread sealant to the threads of the sender.

   B. Screw sender into the water flange. Torque sender from 16 to 20 ft−lb (21.7 to 27.1 N−m).

   C. Reconnect gray wire to sender. Apply skin−over grease (Toro Part No. 505−165) to sender terminal.

5. Fill engine cooling system (see Operator's Manual).

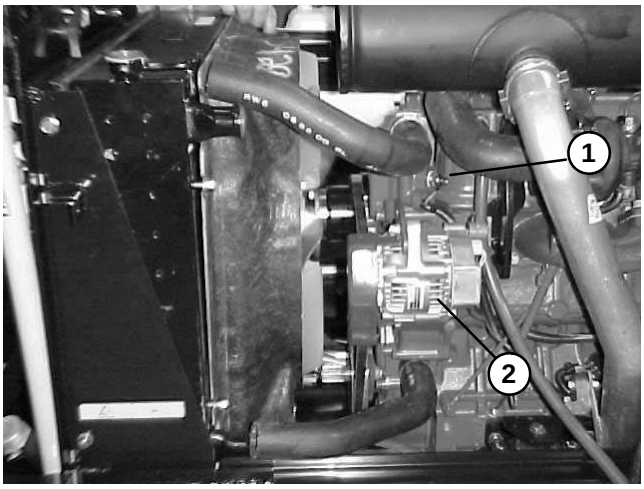

Figure 36

1. Temperature sender **2. Alternator**

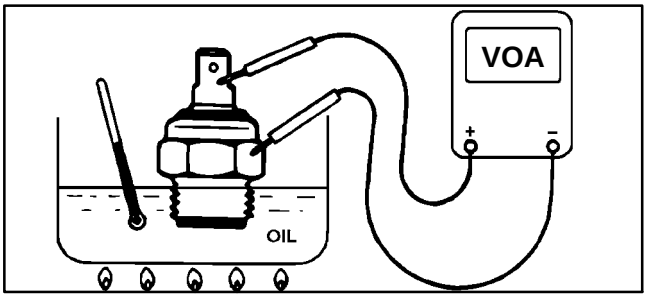

Figure 37

High Temperature Shutdown Switch

The high temperature shutdown switch is located near the glow plug connection on the engine cylinder head (Fig. 38). There is a blue wire attached to the switch.

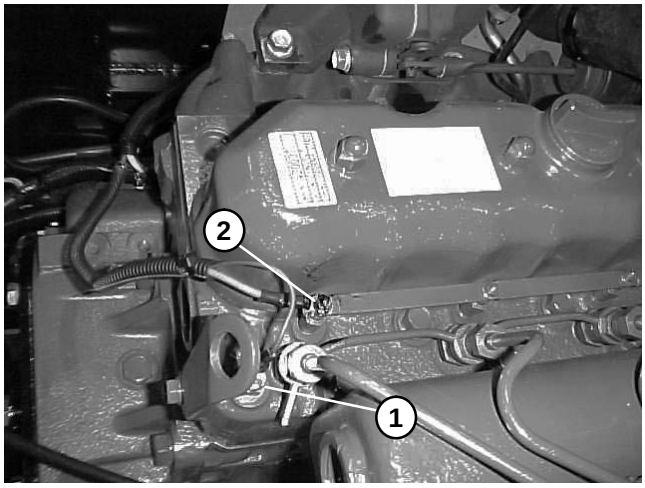

Figure 38

1. Temp. shutdown switch 2. Glow plug connection

Testing

CAUTION

Make sure engine is cool before removing the temperature switch.

1. Lower coolant level in the engine and remove the temperature shutdown switch.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 39).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

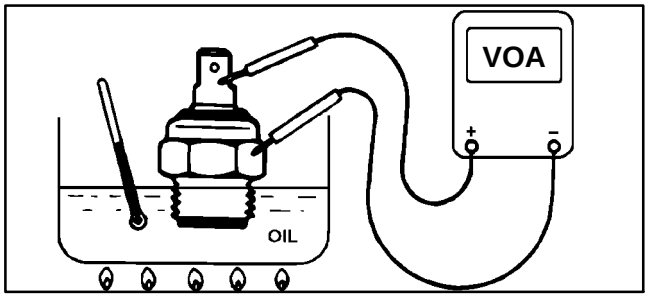

Figure 39

3. Check continuity of the switch with a multimeter (ohms setting). The temperature switch is normally open and should close between 225º to 235ºF (107º to 113ºC).

4. Allow oil to cool while observing temperature. The temperature switch should open at about 219ºF (104ºC).

5. Replace switch if necessary.

6. 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 tighten.

   C. Connect blue wire to switch.

7. Fill engine cooling system (see Operator's Manual).

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. 40).

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. 41).

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 (80ºC).

B. Set variable resistance to 38 ohms. The needle should point between the green and red area (105ºC).

3. Turn off the voltage source. Disconnect voltage source, gauge, and variable resistance.

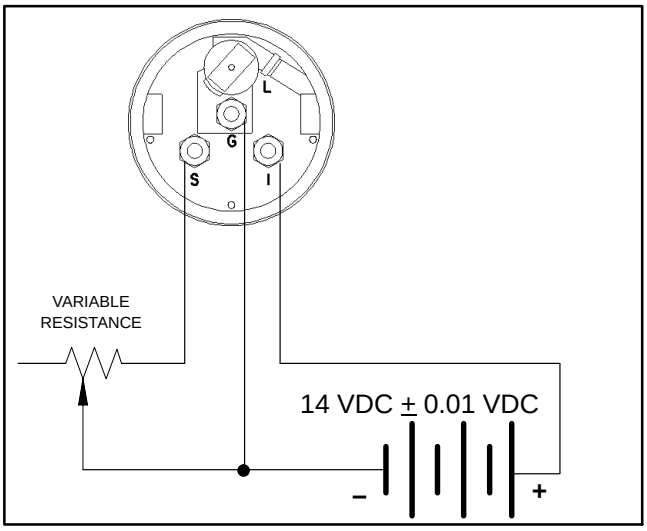

Figure 40

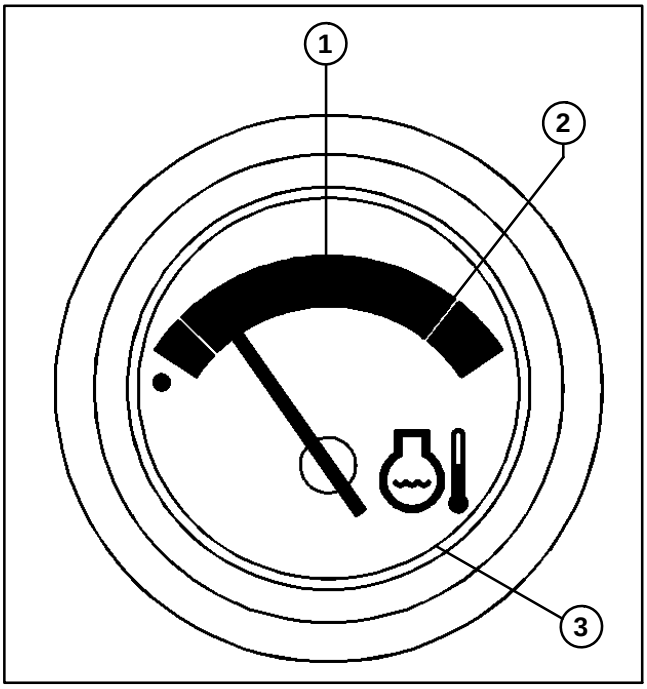

Figure 41

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. 42).

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 Piston Pump Control Assembly in Chapter 4 − Hydraulic Systems for disassembly and reassembly procedures for the neutral switch.

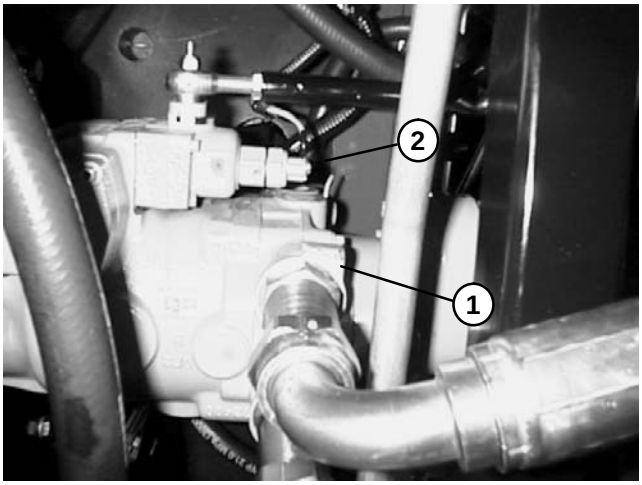

Figure 42

1. Piston pump (bottom)
2. Neutral switch

Diode Assemblies (Fig. 43)

Diodes D2, D4, D5, and D6 are used for circuit protection from 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 wing deck circuit, D5 is in the front deck circuit, and D6 is in the right wing deck circuit.

Diode D3 provides logic for the cutting deck lift/lower switches and down latching relay.

The optional cruise control kit includes diodes D7 and D8. Diode D7 is used for circuit protection from voltage spikes that occur when the cruise coil is de−energized and D8 provides a latching circuit for the cruise relay.

These diodes plug into the machine wiring harness at various locations (see wire harness drawings in Chapter 9 − Electrical Diagrams).

Testing

The diodes can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

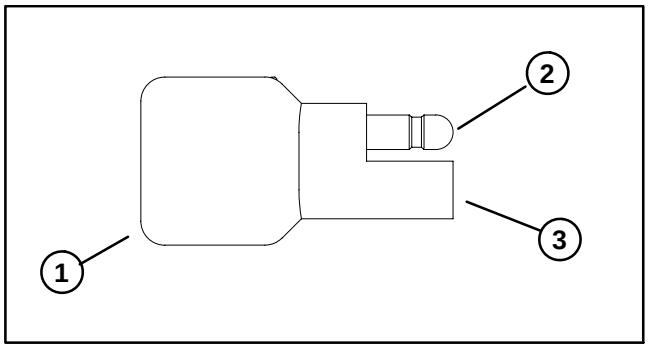

Figure 43

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 (Fig. 44)

The diode circuit board contains four 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 to circuit board contacts whenever the circuit board is installed into the wire harness.

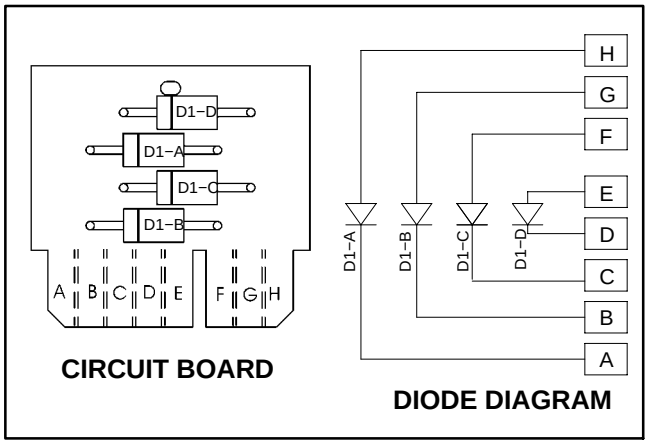

Figure 44

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

Wing Deck Position Switches

The wing deck position switches on the Groundsmaster 4100−D are attached to the center deck housing (Fig. 45) 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 46). The actuator for the position switch is bolted to the wing deck link (Fig. 47).

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. Reinstall switch cover to deck.

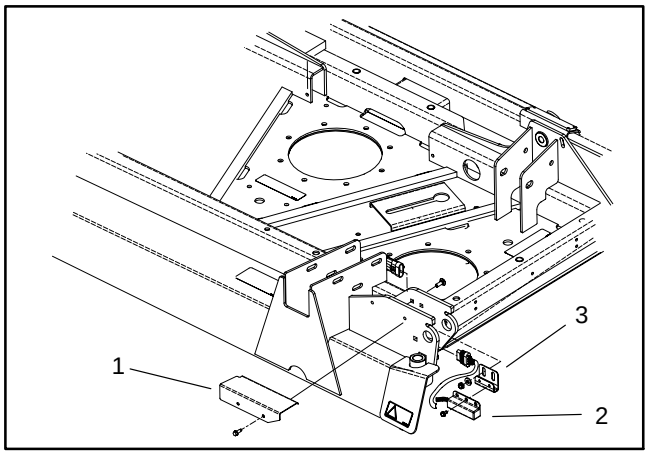

Figure 45

1. **Switch cover**
2. **Position switch**
3. **Switch bracket**

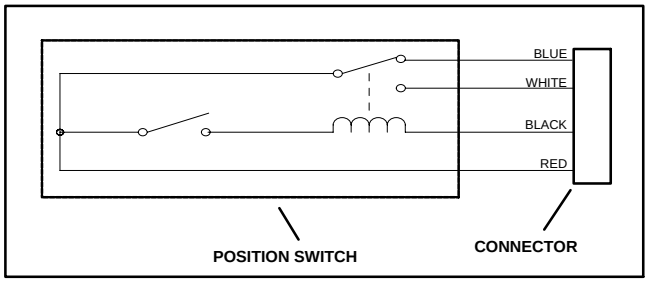

Figure 46

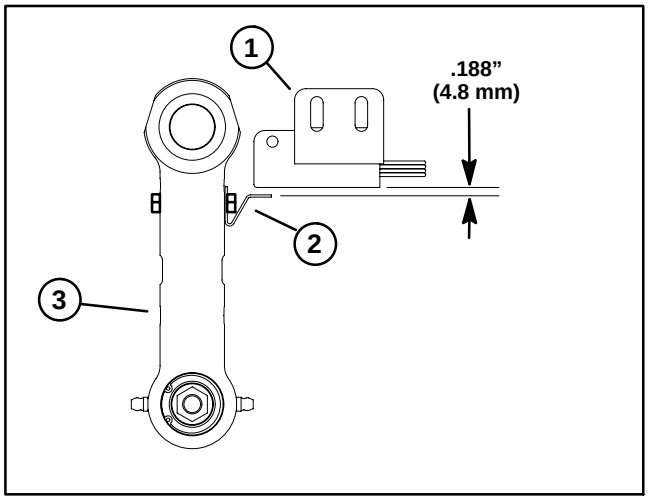

Figure 47

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. 48). 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. Reconnect switch to wiring harness. Install console cover to machine.

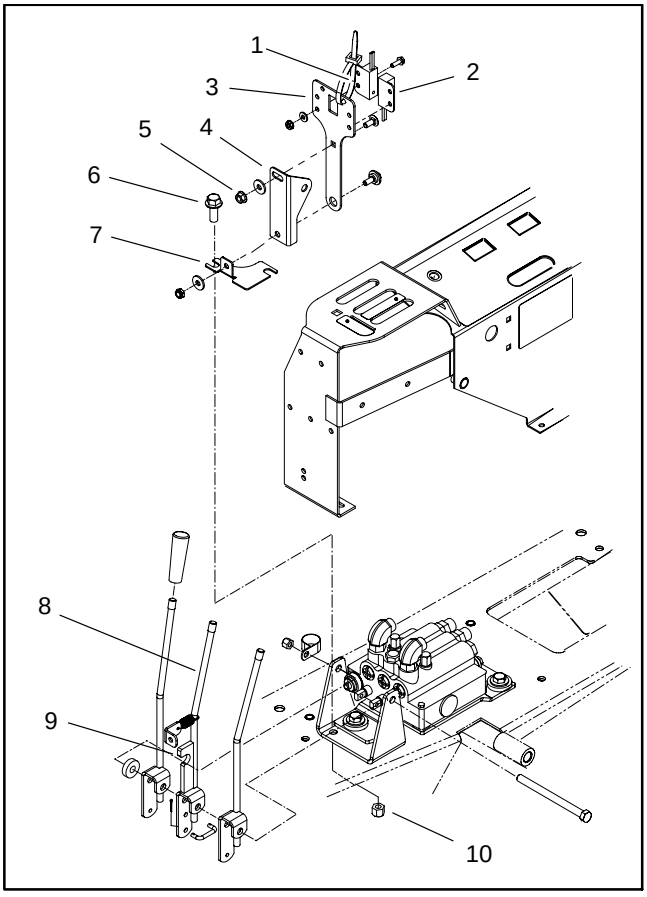

Figure 48

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**

Service and Repairs

NOTE: For more component repair information, see the Kubota Workshop Manual, Diesel Engine, V2003−T Series at the end of Chapter 3 − Kubota Diesel Engine.

Hydraulic Valve Solenoids

The hydraulic valve solenoids can be replaced without opening the hydraulic system.

1. Make sure ignition switch is off. Disconnect hydraulic valve solenoid electrical connector from wiring harness (Fig. 49).

2. Remove nut that secures solenoid coil to valve. Carefully slide coil from valve stem.

3. Install new solenoid to valve.

   A. Apply Loctite 242 or equivalent to threads on end of valve stem before installing nut.

   B. Torque solenoid nut to specification identified in Figure 50. Over−tightening may damage the solenoid or cause the valve to malfunction.

4. Reconnect electrical connector to the solenoid.

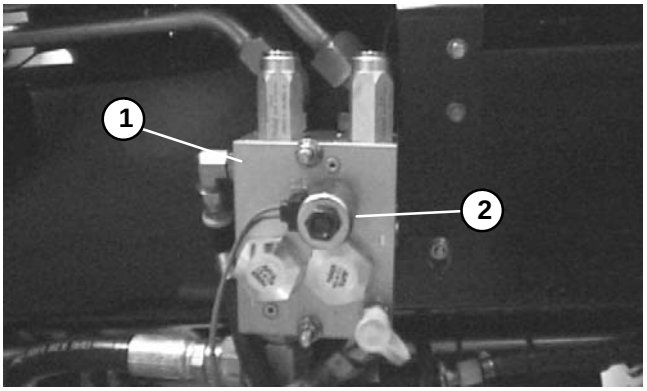

Figure 49

1. **Manifold (LH deck shown)**
2. **Valve solenoid**

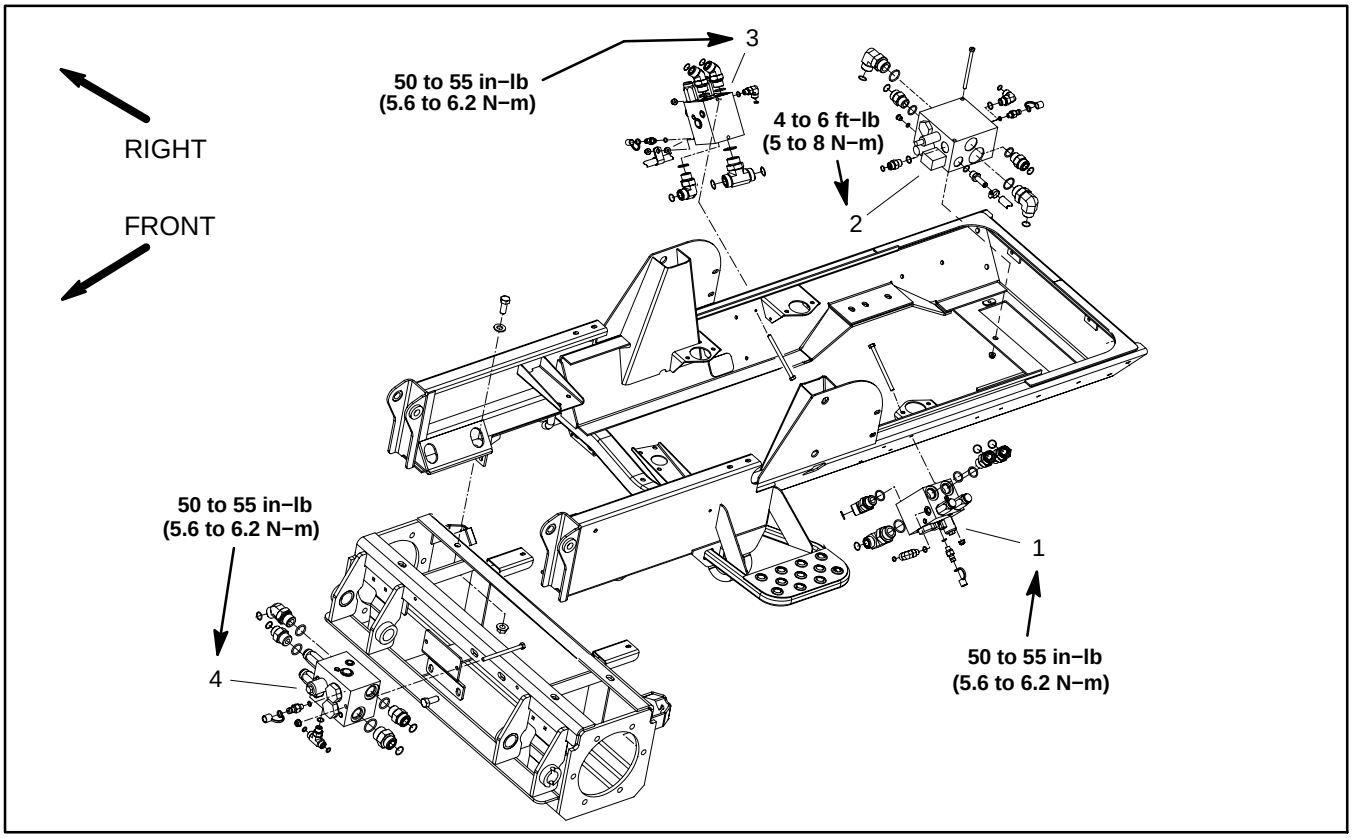

Figure 50

1. **LH wing deck solenoid**
2. **2WD/4WD manifold solenoid**
3. **RH wing deck solenoid**
4. **Center deck solenoid**

Battery Storage

If the machine will be stored for more than 30 days:

1. Remove the battery and charge it fully (see Battery Service).

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).

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 skin−over grease (Toro Part No. 505-165) 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. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with skin−over grease (Toro Part No. 505-165) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The 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 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications
BCI Group Size 24
650 CCA at 0° F (−17.8° C)
Reserve Capacity of 110 minutes at 80°F (26.7°C)

Dimensions (including terminal posts and caps)

Length	10.2 inches (25.9 cm)
Width	6.64 inches (16.9 cm)
Height	8.99 inches (22.8 cm)

Removal and Installation (Fig. 51)

See Operator's Manual for battery removal and installation information.

NOTE: Before connecting the negative (ground) cable, connect a digital multimeter (set to 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 unit's electrical system should be tested and repaired.

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.

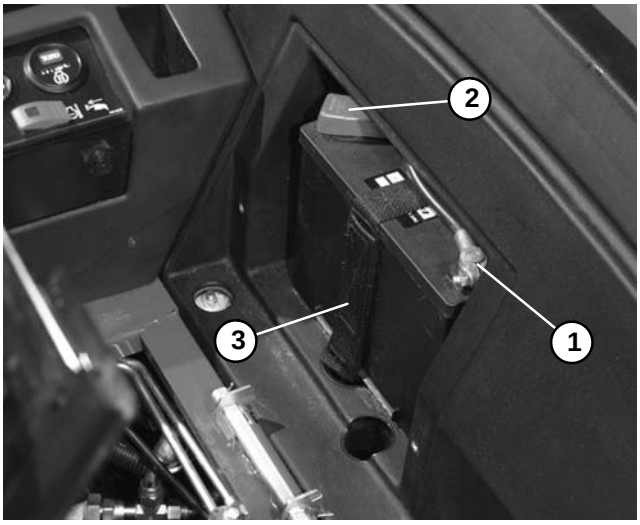

Figure 51

1. **Negative (−) cable**
2. **Positive (+) cable**
3. **Battery retainer**

   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, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the 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 one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a 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.

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 available in most shops.

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 manufacturer's battery charger 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 manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the 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.

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Chapter 6

Axles, Planetaries, and Brakes

Table of Contents

Specifications

Item	Specification
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)
Rear wheel toe−in	.125 in (3.18 mm)
Tire pressure	25 to 30 psi (1.7 to 2.1 bar), front and rear
Planetary, brake housing, and front wheel motor mounting screw torque	75 to 85 ft−lb (101 to 115 N−m)
Planetary gear drive oil System gear lube capacity (each wheel)	SAE 85W−140 wt. gear lube 16 fl oz (.47 l)
Rear axle lubricant System gear lube capacity	SAE 85W−140 wt. gear lube 80 fl oz (2.37 l)
Rear axle gear box lubricant System gear lube capacity	SAE 85W−140 wt. gear lube 16 fl oz (.47 l)

Adjustments

See Operator's Manual for adjustment procedures for Groundsmaster 4100−D axles, planetaries, and brakes.

Brake Assembly

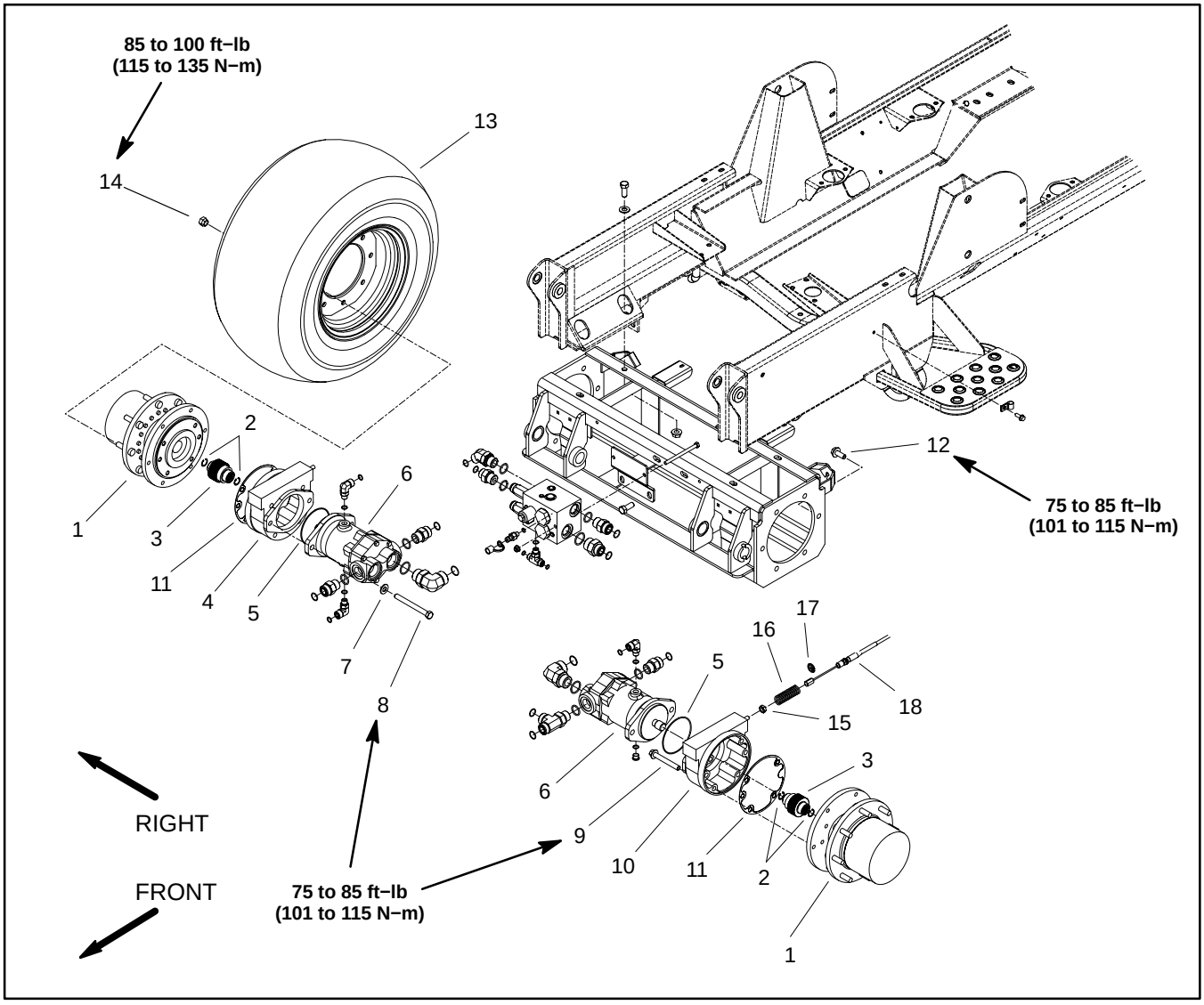

Figure 1

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**

Remove Brake Assembly (Fig. 1)

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

2. Drain oil from planetary wheel drive/brake assembly (see Operator's Manual).

CAUTION

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 machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or 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 jack stands or solid wood blocks.

4. Remove 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. Remove four (4) flange head screws (9) securing brake assembly to machine. Remove brake assembly taking care not to drop splined brake coupler as brake assembly is removed.

8. Remove splined brake coupler.

9. Complete brake inspection and repair.

Install Brake Assembly (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).

WARNING

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

6. Install wheel assembly. Torque lug nuts from 85 to 100 ft−lb (115 to 135 N−m).

7. Lower machine to ground.

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 (see Operator's Manual). Capacity is approximately 16 oz. (.47 l) per wheel.

9. Check and adjust brake cable for proper brake operation (see Operator's Manual).

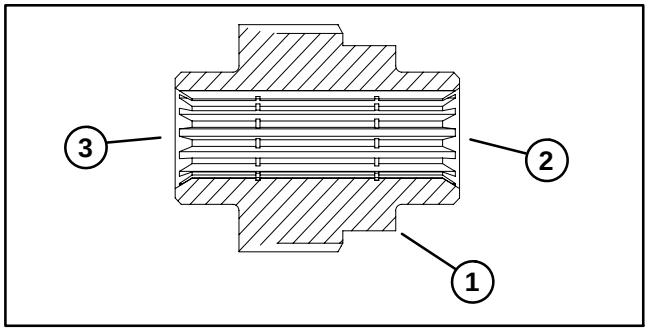

Figure 2

1. **Brake coupler step**
2. **Hydraulic motor end**
3. **Planetary assembly end**

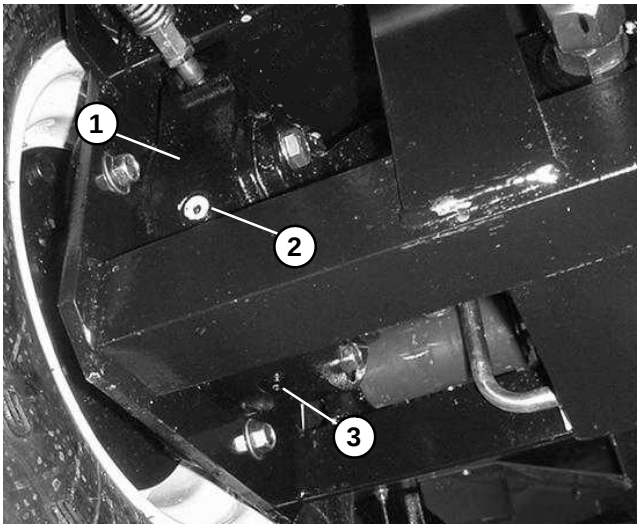

Figure 3

1. **Brake housing**
2. **Check plug**
3. **Drain plug**

Brake Inspection and Repair

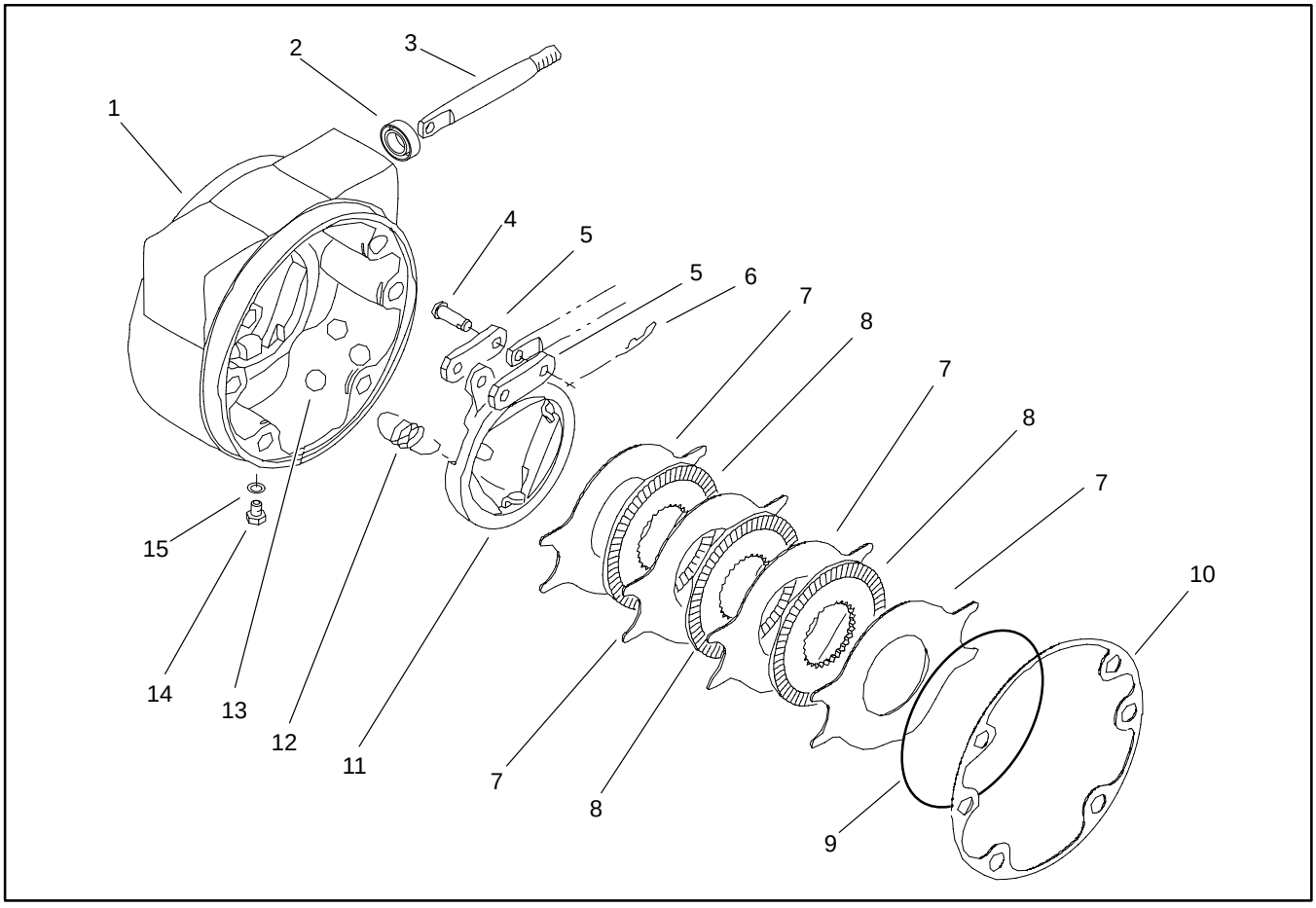

Figure 4

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**
8. **Rotating disc**
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. 4)

1. Scrape gasket material (10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (9).

3. Remove four stationary discs (7) and three rotating discs (8).

4. Remove three extension springs (12).

5. Remove actuator assembly (11, 6, 5, 4, 3) and balls (13).

6. Remove seal (2) from brake housing.

7. Wash parts in cleaning solvent. Inspect components for wear or damage.

   A. The stack of four stationary and three rotating discs should have a minimum thickness of .440” (11.2 mm).

8. Reverse steps 2 − 6 to assemble brakes, installing new parts as necessary. Install a new seal (2).

9. Use a new gasket (10) when installing brake assembly to machine.

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Planetary Wheel Drive Assembly

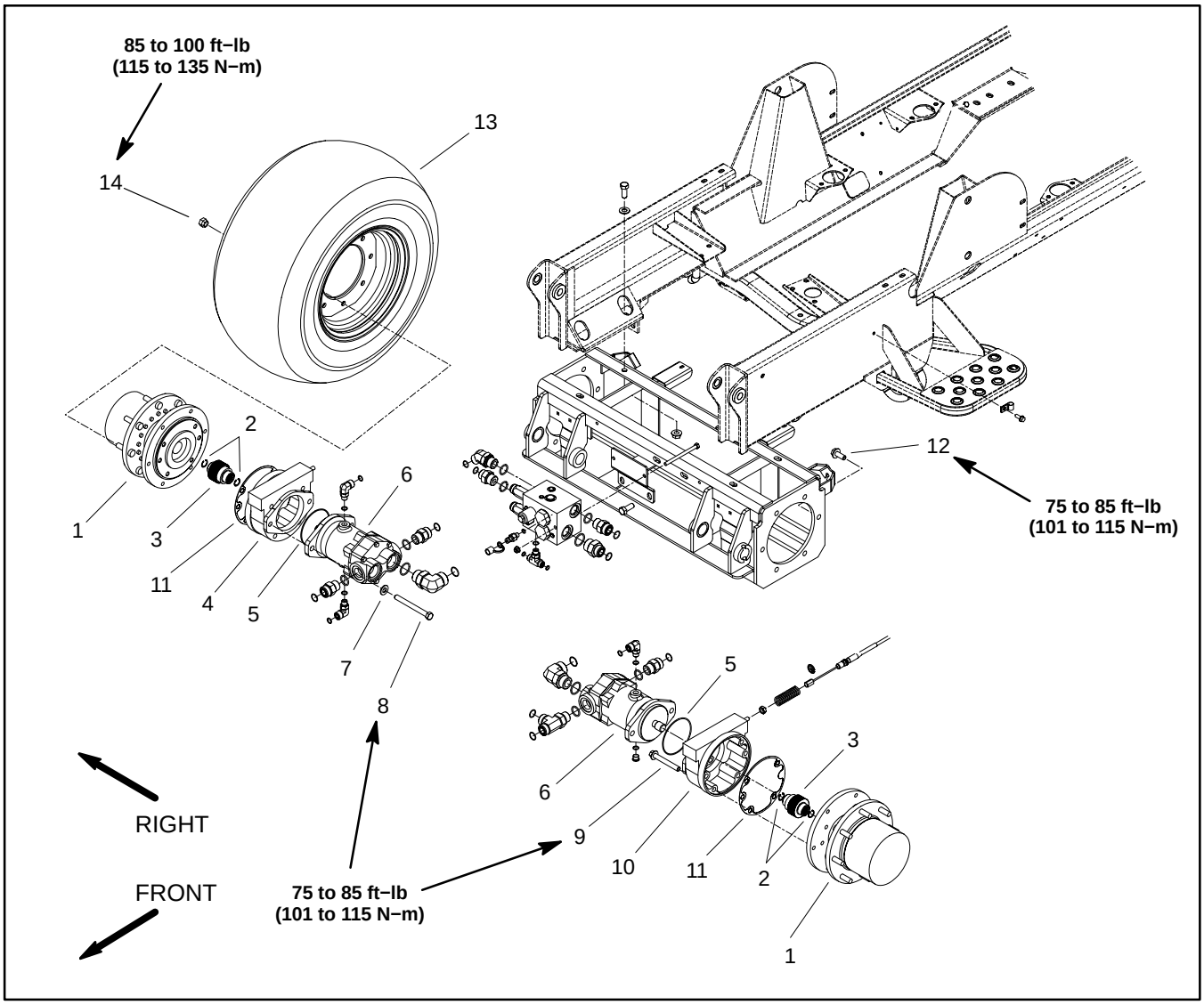

Figure 5

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)

Planetary Wheel Drive Removal (Fig. 5)

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

2. Drain oil from planetary wheel drive/brake assembly (see Operator's Manual).

CAUTION

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 machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or 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 jack stands or solid wood blocks.

4. Remove front wheel assembly.

5. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly 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.

Planetary Wheel Drive Installation (Fig. 5)

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 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).

WARNING

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

5. Install wheel assembly. Torque lug nuts from 85 to 100 ft−lb (115 to 135 N−m).

6. Lower machine from jack stands.

7. Make sure drain plug is installed in bottom of brake assembly (Fig. 6). Fill planetary wheel drive/brake assembly with SAE 85W−140 gear lube (see Operator's Manual). Capacity is approximately 16 oz. (.47 l) per wheel.

8. Check for proper brake operation (see Operator's Manual).

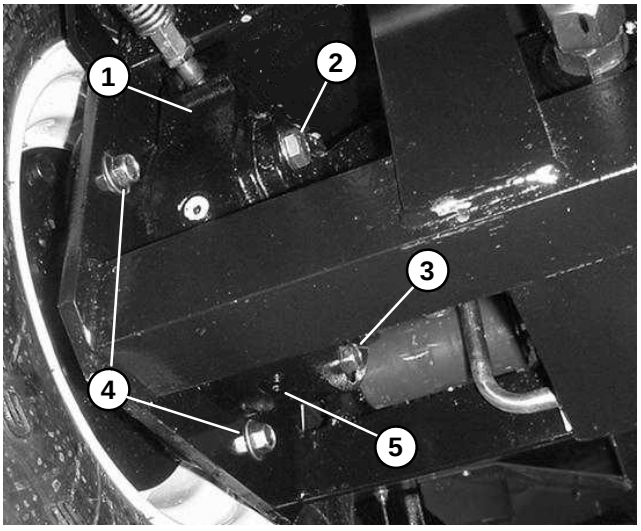

Figure 6

1. **Brake housing**
2. **Wheel motor cap screw**
3. **Brake flange screw**
4. **Planetary flange screw**
5. **Brake drain plug**

Planetary Wheel Drive Service

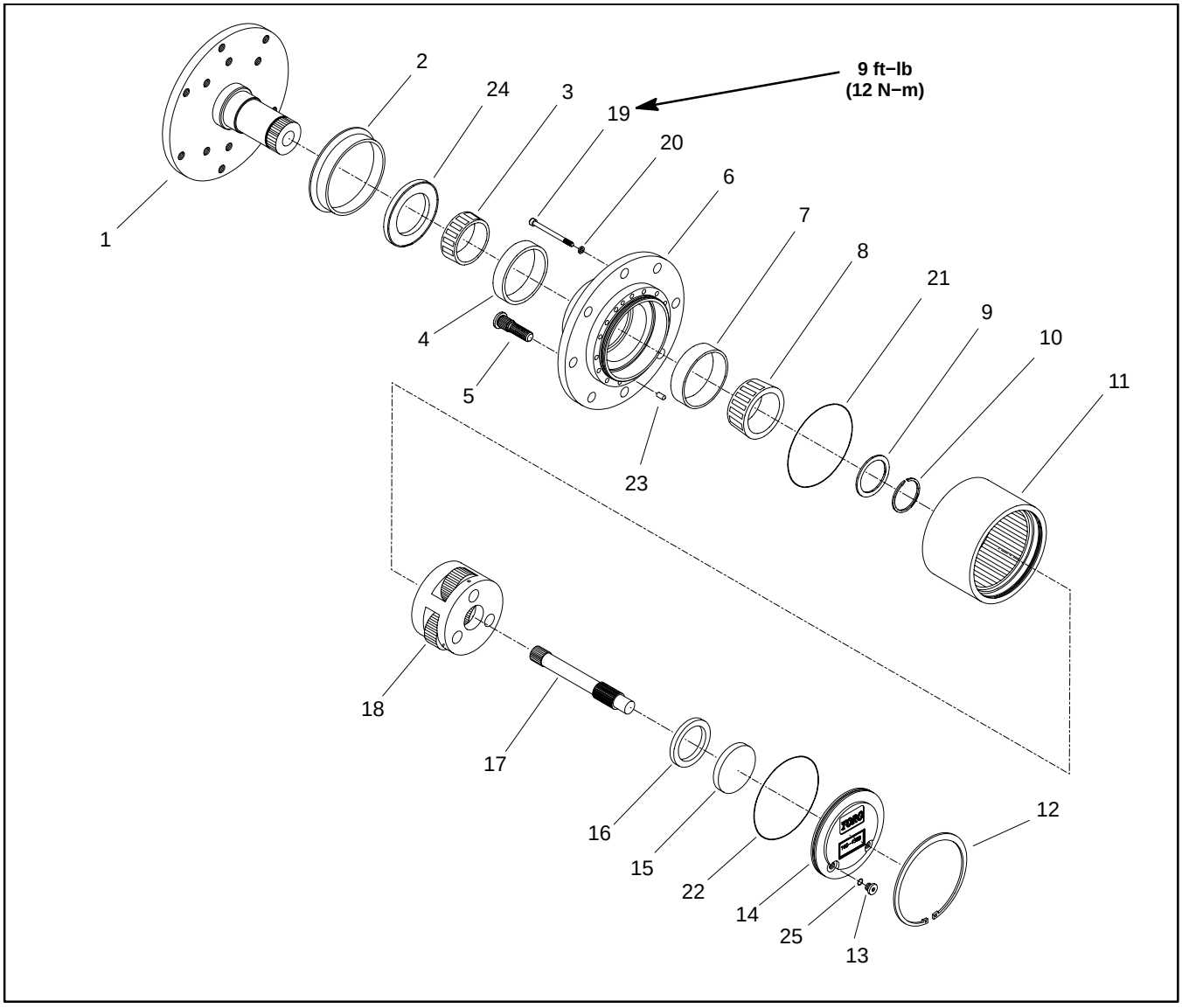

Figure 7

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**
25. **O−ring**

Planetary Wheel Drive Disassembly (Figure 7)

1. Remove retaining ring (12).

2. Remove end cap (14). Thrust plug (15) and thrust washer (16) are captive on inside of end cap.

3. Remove drive shaft (17).

4. Remove carrier assembly (18).

NOTE: Steps 6 −10 are necessary only if inspecting or replacing bearings and/or seals.

5. Remove socket head screws (19) with lock washers (20) and remove ring gear (11).

6. Remove retaining ring (10) and thrust washer (9).

7. Remove spindle (1) from housing (6). Remove bearing cone (8).

8. Remove and discard all seals.

9. If bearings will be replaced, remove bearing cone (3) from spindle. Remove bearing cups (4 and 7) from housing (6).

Planetary Wheel Drive Assembly (Figure 7)

NOTE: Use new seal kit when assembling planetary wheel drive.

1. Clean parts in solvent. Inspect parts for damage or excessive wear and replace as necessary.

2. If spindle and housing were separated:

   A. Install boot seal (2) to spindle (1).

   B. Press bearing cups (4 and 7) into housing (6).

   C. Install bearing cone (3) onto spindle (1).

   D. Install seal (24) to housing (6). Assemble housing (6) to spindle (1).

   E. Install bearing cone (8) onto spindle and secure with thrust washer (9) and retaining ring (10).

   F. After retaining ring is installed, make sure that there is minimal endplay in assembly. If required, thrust washer options are identified in the parts manual.

   G. Install o−ring (21) and then assemble ring gear (11) to housing (6) with lock washers (20) and socket head screws (19). Torque socket head screws to 9 ft−lb (12 N−m).

3. Install carrier assembly (18).

4. Install drive shaft (17).

5. Install thrust washer (16) and thrust plug (15).

6. Make sure that thrust plug (15) and thrust washer (16) are captive on inside of end cap. Install o−ring (22) to end cap and then install end cap (14). Secure cap with retaining ring (12).

7. Check operation of planetary wheel drive before installing assembly on the machine. 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.

Rear Axle Assembly

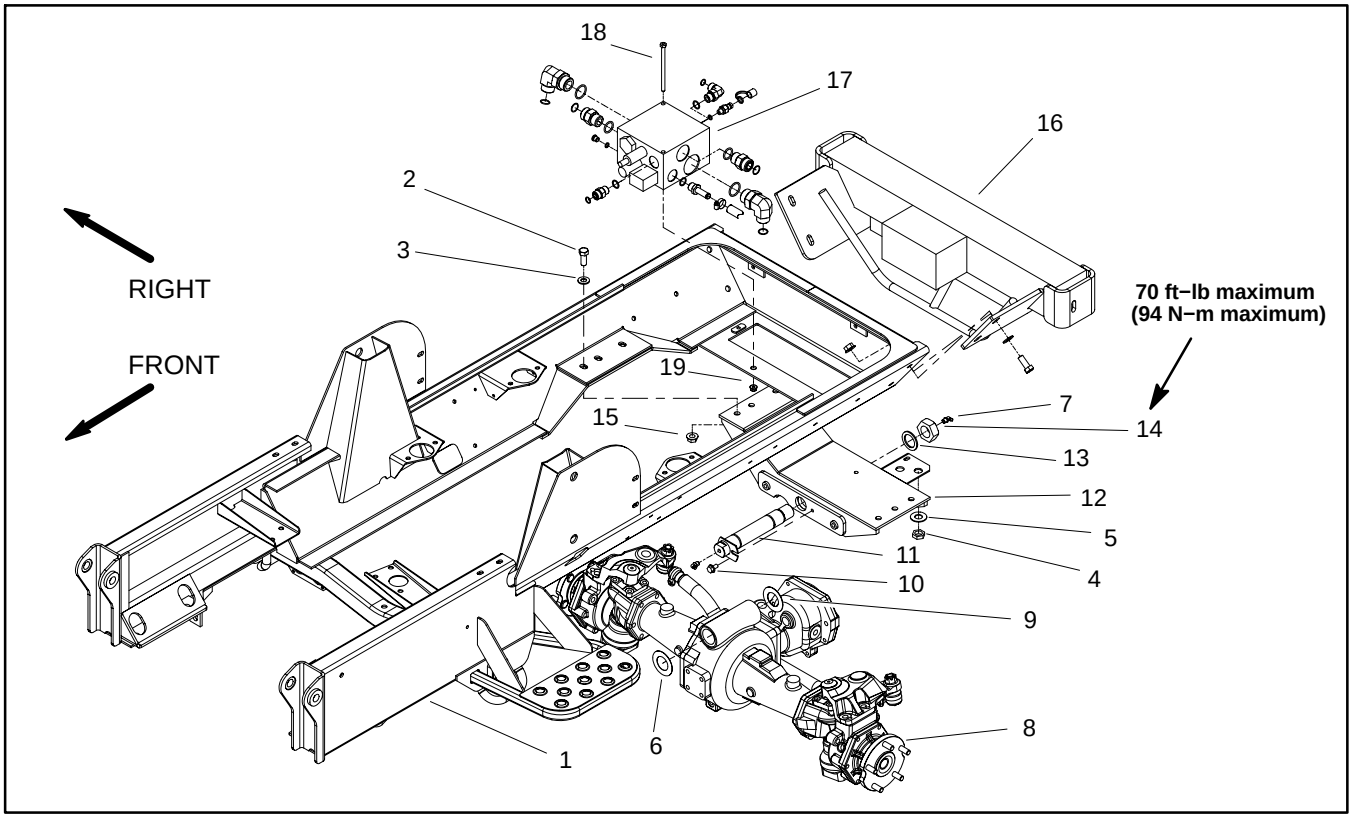

Figure 8

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**

Remove Rear Axle

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

CAUTION

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 machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or 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 jack stands or solid wood blocks.

3. Drain oil from rear axle and axle gearbox (see Operator's Manual).

4. Remove wheels from rear axle.

5. Remove hydraulic motor from rear axle assembly (see Rear Axle Motor in Service and Repairs section of Chapter 4 − Hydraulic System).

6. Remove steering cylinder from rear axle (see Steering Cylinder in Service and Repairs section of Chapter 4 − Hydraulic System).

7. Disconnect both steering cylinder hydraulic hoses from hydraulic tubes at rear frame mount (Fig. 9). 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. 10). 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 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. 11).

12. Remove pivot pin. Separate rear frame mount from rear axle. Note location of thrust washers on both ends of axle mounting boss.

Install Rear Axle

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 .002" to .020" (.05 mm to .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. Install washer and lock nut onto pivot pin. Lock nut should be tightened enough to allow pivot pin to rotate (70 ft−lb (94 N−m) maximum). Secure pivot pin to frame mount with washer head screw (Fig. 11).

3. If removed, install the tie rod to rear axle (Fig. 10). 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 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. If removed, install the tie rod to rear axle. Tighten ball joint castle nuts and install new cotter pins.

8. Attach steering cylinder hydraulic tubes to rear frame mount with washers and bulkhead locknuts (Fig. 9). Install steering cylinder hoses to hydraulic tubes.

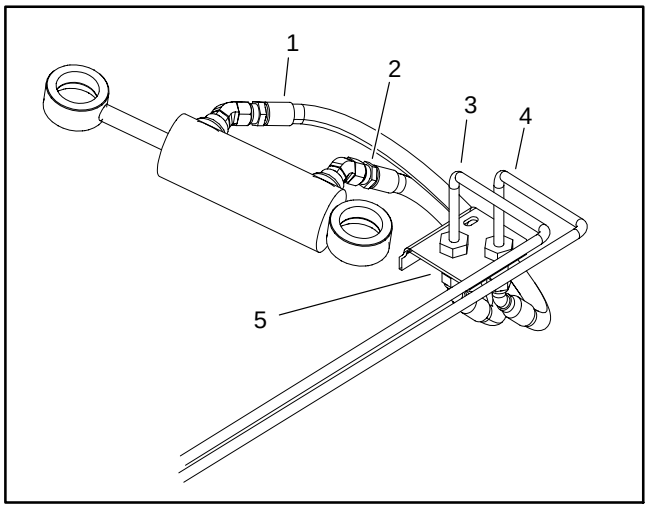

Figure 9

1. **Hydraulic hose**
2. **Hydraulic hose**
3. **Hydraulic tube**
4. **Hydraulic tube**
5. **Rear frame mount**

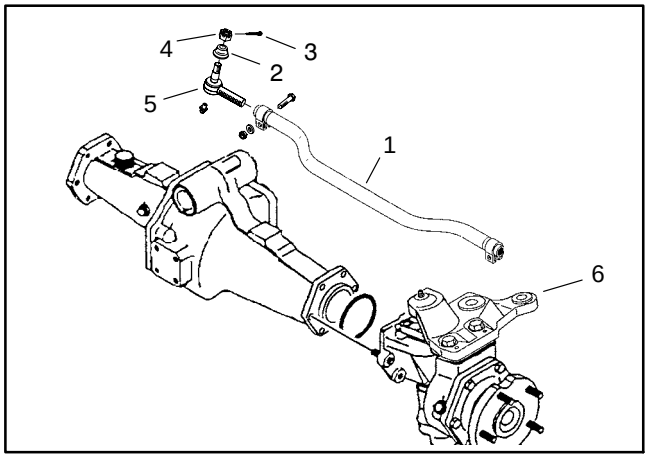

Figure 10

1. **Tie rod**
2. **Dust cover**
3. **Cotter pin**
4. **Castle nut**
5. **Tie rod end**
6. **Steering arm (LH)**

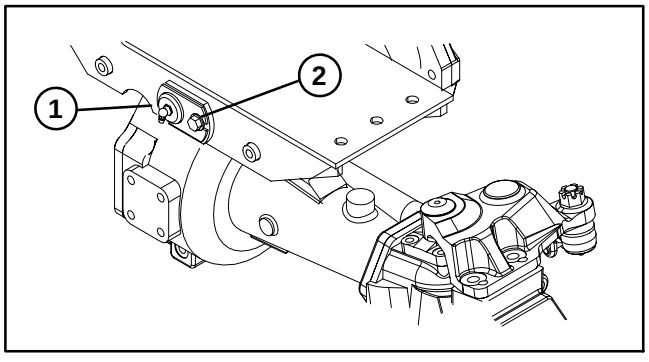

Figure 11

1. **Pivot pin**
2. **Washer head screw**

9. Install steering cylinder to axle assembly (see Steering Cylinder in Service and Repairs section of Chapter 4 − Hydraulic System).

10. Install hydraulic motor to axle assembly (see Rear Axle Motor in Service and Repairs section of Chapter 4 − Hydraulic System).

WARNING

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

11. Install wheels to axle. Torque wheel lug nuts from 85 to 100 ft−lb (115 to 135 N−m).

12. Lower machine to ground.

13. Fill axle and input gearbox with SAE 85W−140 weight gear lube (see Operator's Manual). Lubricant capacity is approximately 80 fl oz (2.37 l) for the axle and 16 fl oz (.47 l) for the gearbox.

14. Check rear wheel toe−in and adjust if necessary (see Operator's Manual).

15. 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 12 shows stop bolt location.

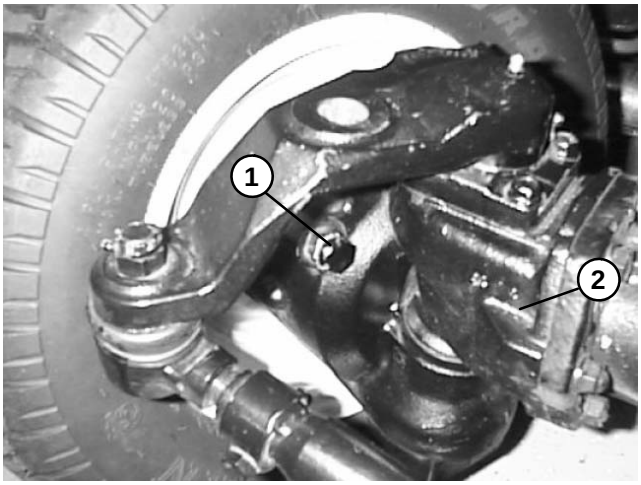

Figure 12

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.

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. 13).

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.

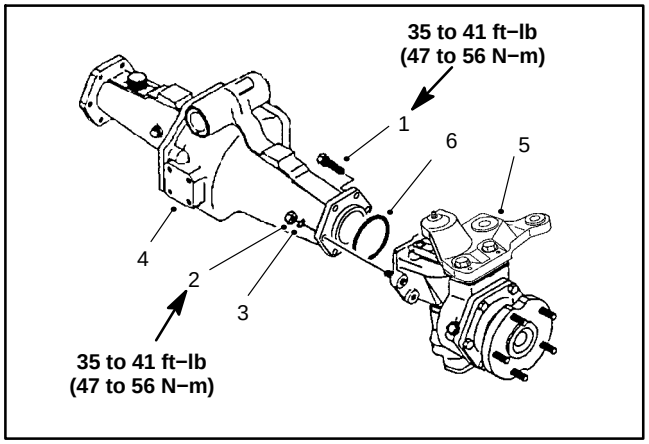

Figure 13

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. 14).

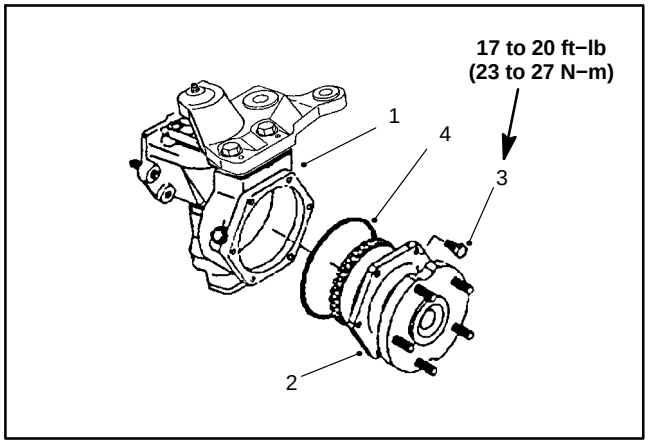

Figure 14

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. 15).

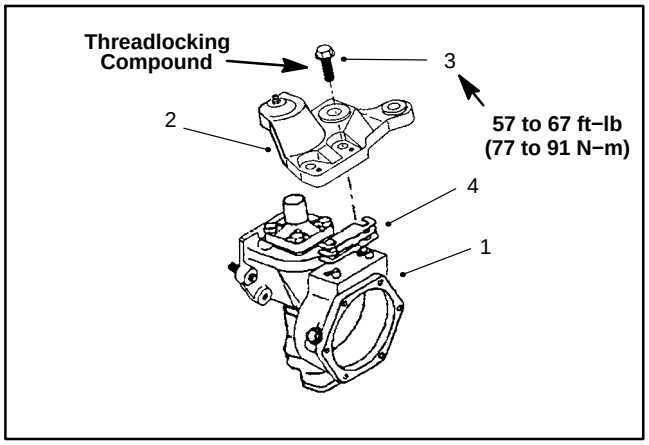

Figure 15

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. 16).

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. 16).

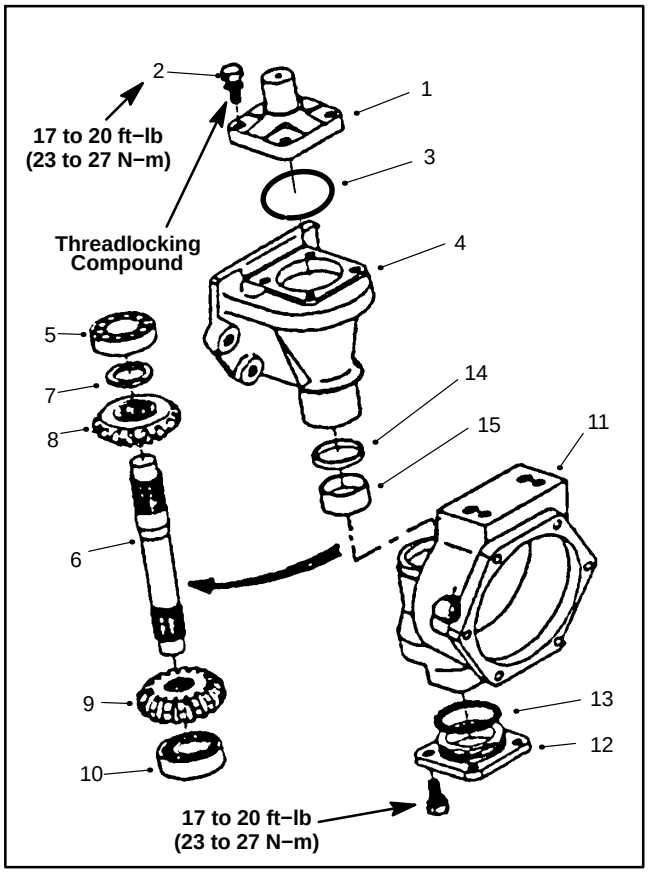

Figure 16

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**

Inspection

1. Measure the knuckle pin O.D. and the axle case support bushing I.D. to determine the bushing to pin clearance (Fig. 17). 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.

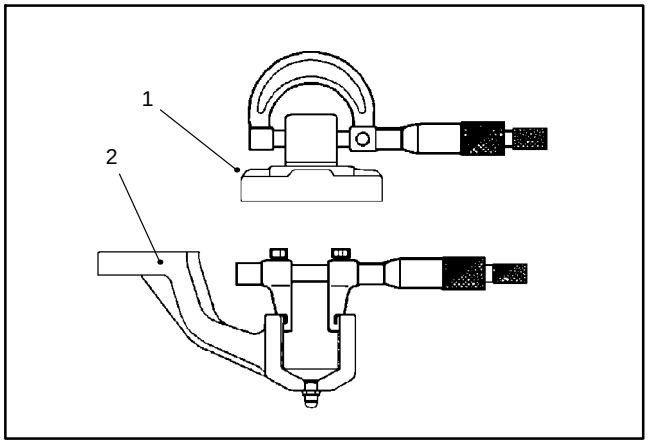

Figure 17

1. **Knuckle pin**
2. **Axle case support**

Installation

1. Coat new shaft seal with grease and install in axle case as shown (Fig. 18).

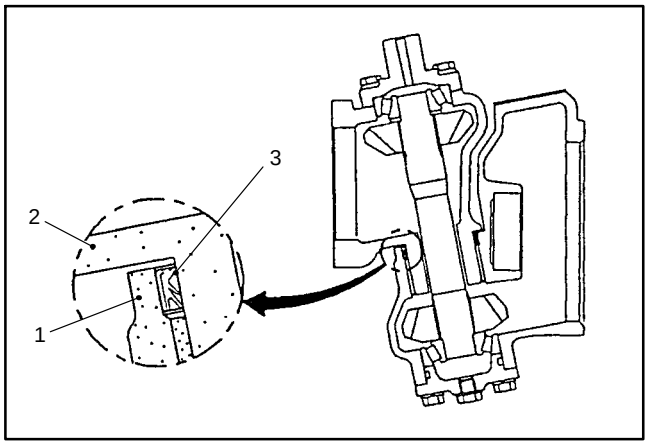

Figure 18

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. 19). 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. 19).

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).

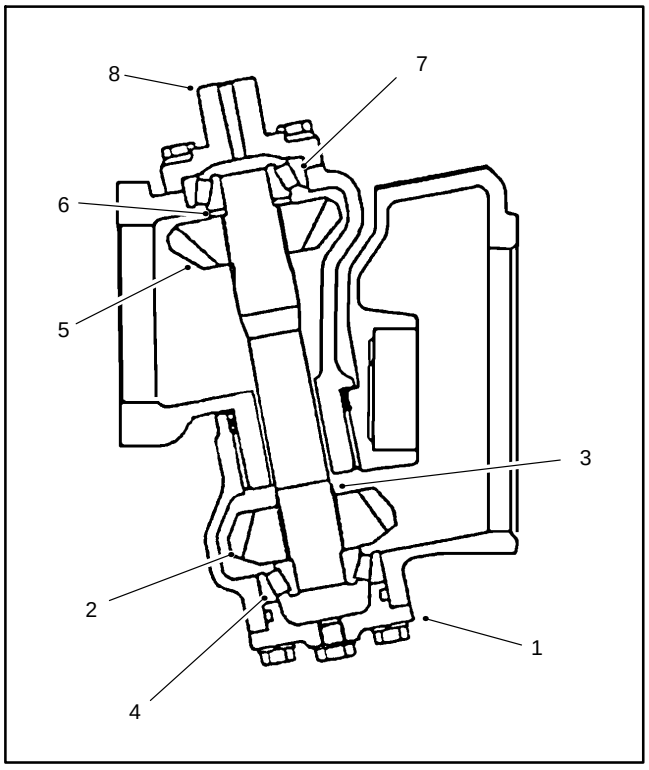

Figure 19

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. 20).

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. 21).

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.

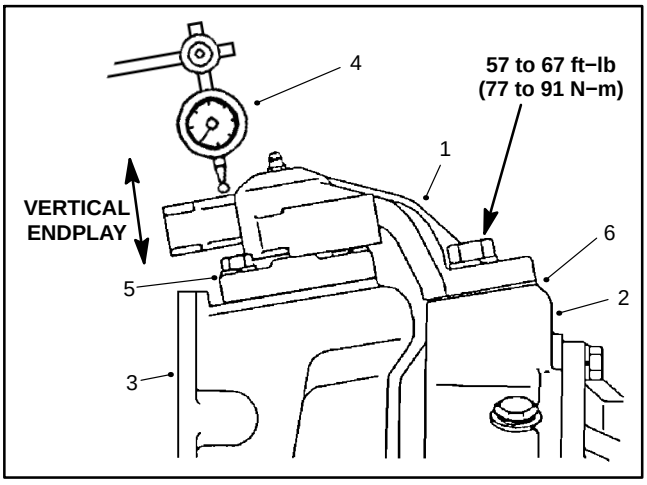

Figure 20

1. **Axle case support**
2. **Axle case**
3. **Bevel gearcase**
4. **Dial indicator**
5. **Knuckle pin**
6. **Support shim location**

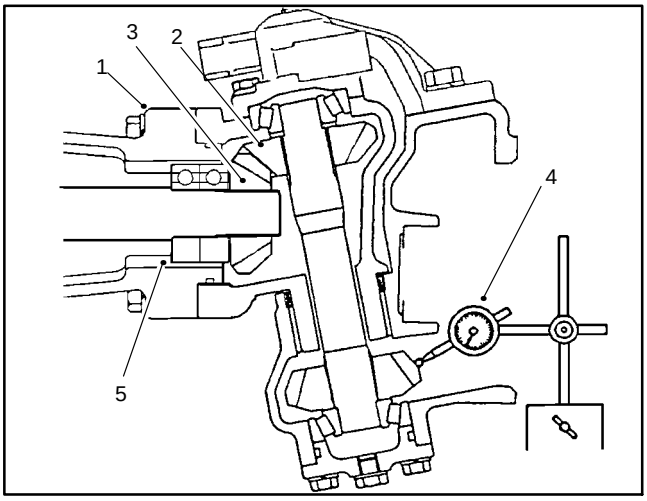

Figure 21

1. **Axle support**
2. **Upper bevel gear**
3. **Differential shaft gear**
4. **Dial indicator**
5. **Axle bearing shims**

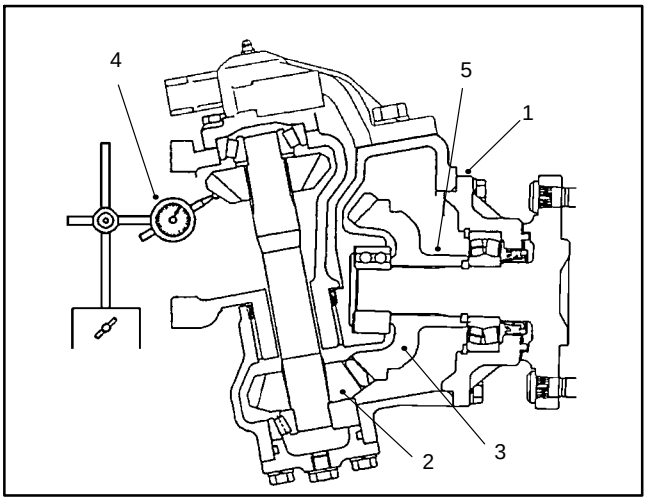

Figure 22

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. 22).

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. 13).

Differential Shafts

The following procedures assume the rear axle assembly has been removed from the machine.

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. 23).

2. Mark and pull the differential shaft assembly from the axle support.

3. Remove the retaining ring and bevel gear (Fig 24).

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.

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).

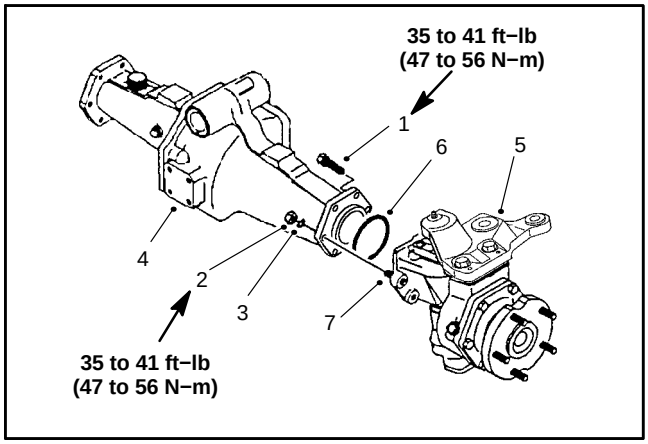

Figure 23

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)**

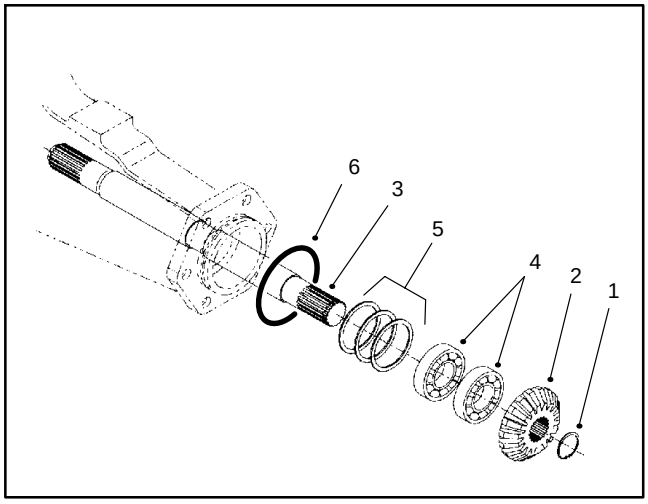

Figure 24

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.

Removal

1. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 25).

2. Use a bearing puller to remove the bearing and bevel gear as shown (Fig. 26).

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.

Installation

1. Coat new axle shaft seal with grease and install in axle cover as shown (Fig. 27).

2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Fig. 27).

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).

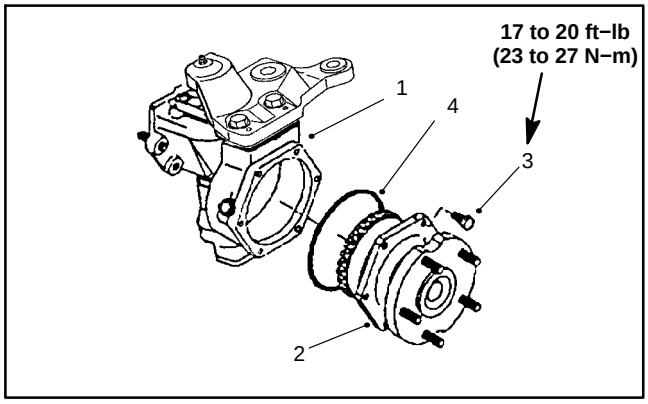

Figure 25

1. **Axle case**
2. **Axle cover assembly**
3. **Mounting screw (6 used)**
4. **O-ring**

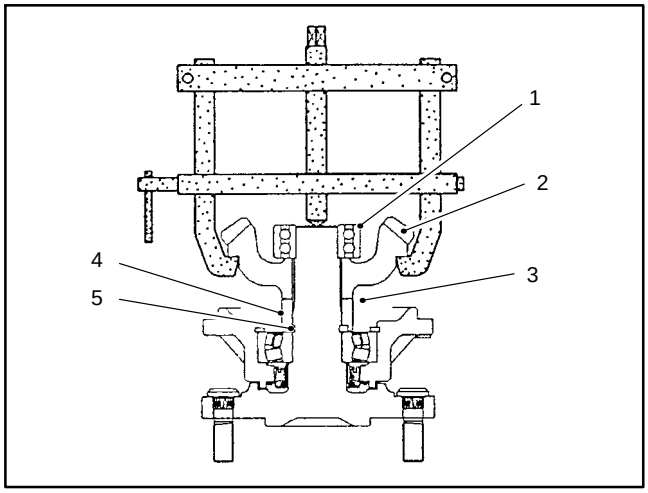

Figure 26

1. **Bearing**
2. **Bevel gear**
3. **Bearing shims**
4. **Spacer**
5. **Retaining ring**

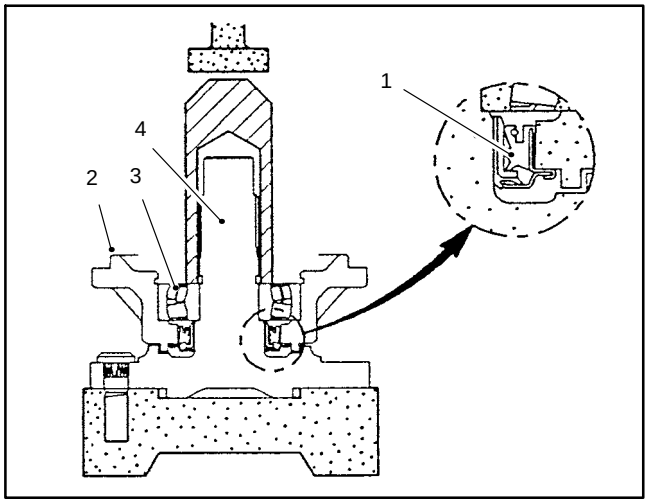

Figure 27

1. **Axle shaft seal**
2. **Axle cover**
3. **Bearing**
4. **Axle shaft**

Input Shaft/Pinion Gear

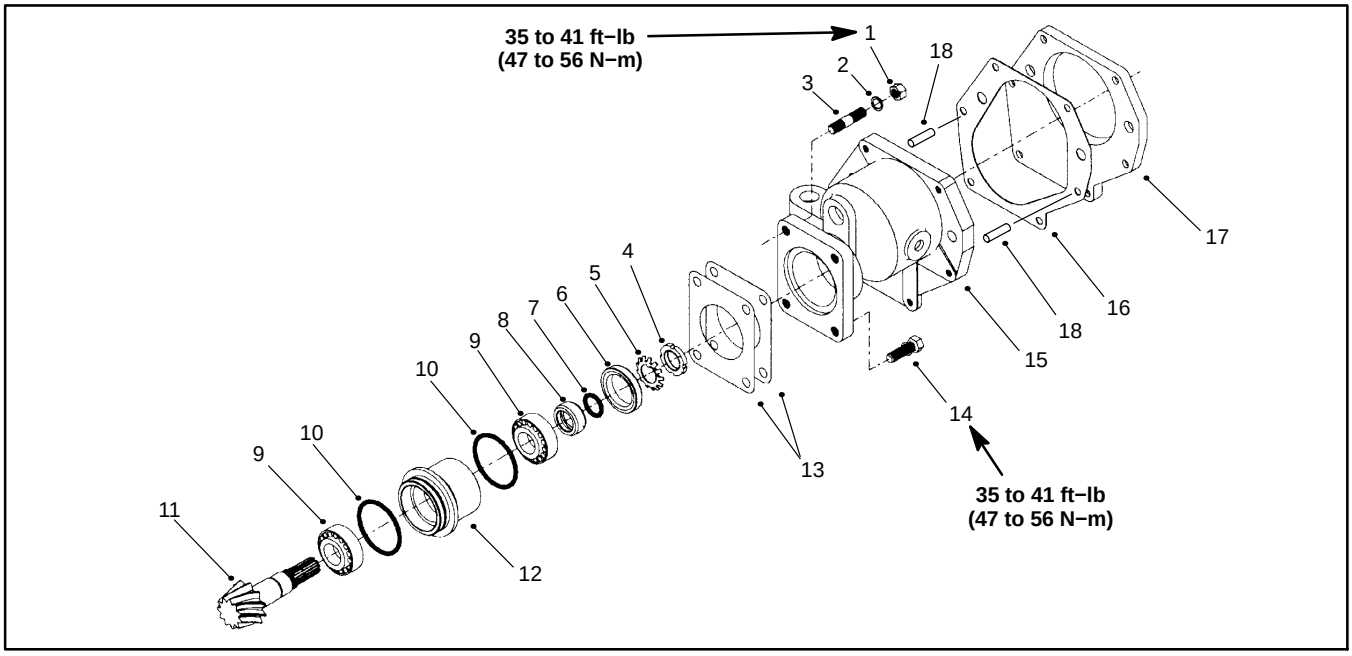

Figure 28

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.

Removal

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

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. 29). 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. 30).

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. 31).

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. Use a new O-ring and install the drive motor.

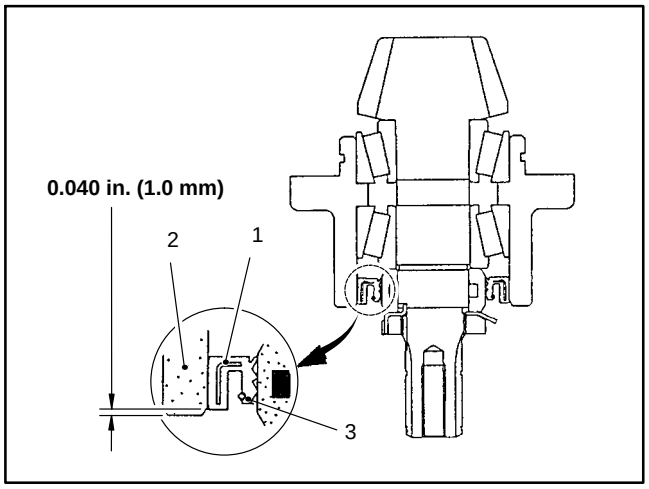

Figure 29

1. Oil seal
2. Bearing case
3. Seal garter spring

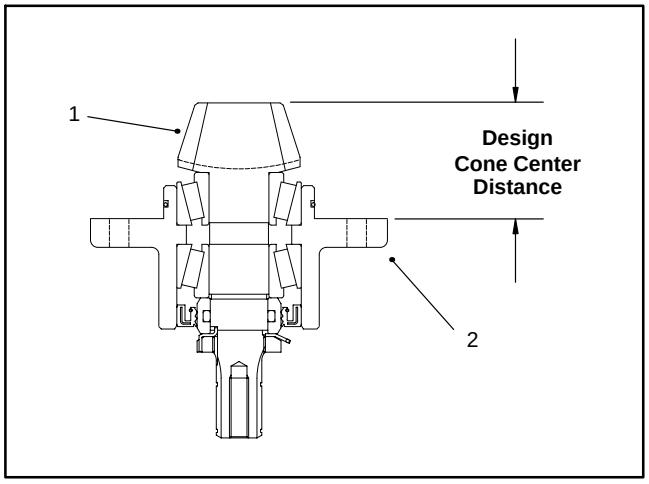

Figure 30

1. Input shaft/pinion gear
2. Bearing case

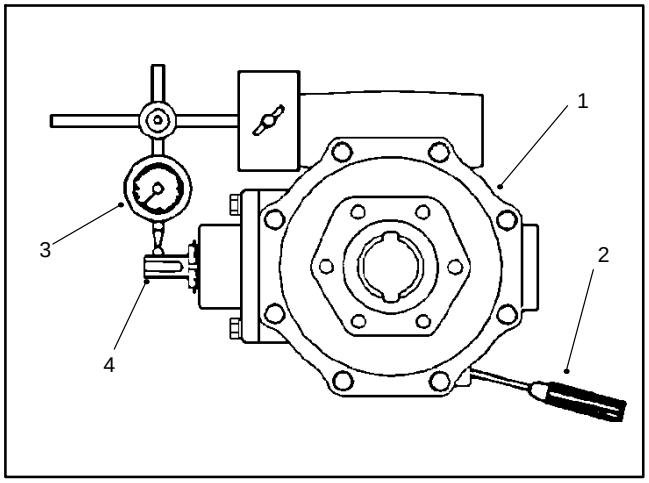

Figure 31

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.

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. 32).

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. 33).

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. 34).

NOTE: Replacement ring gears are only available in matched ring and pinion sets.

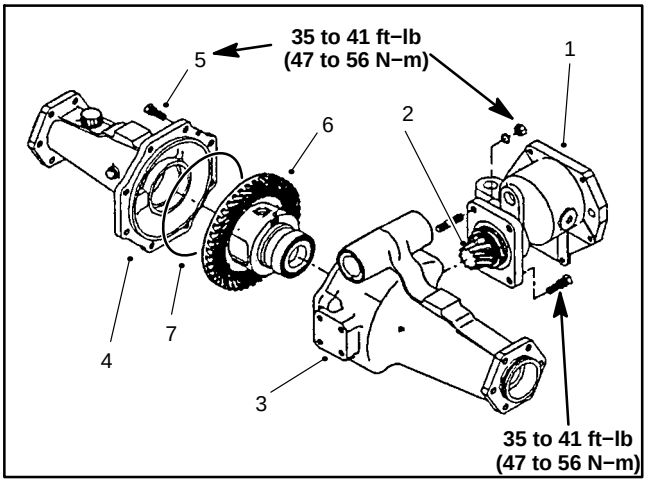

Figure 32

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

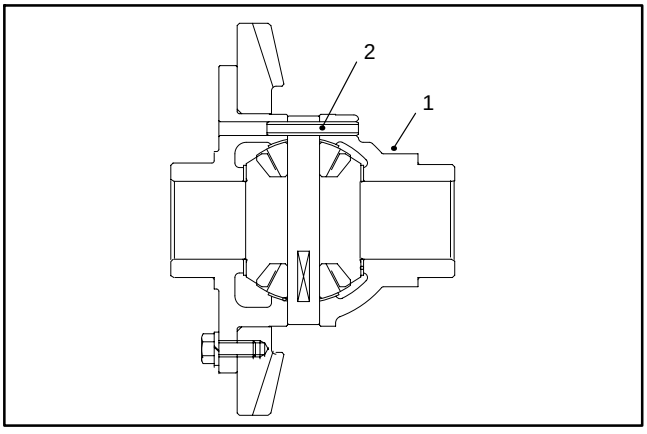

Figure 33

1. Differential case
2. Spring pin

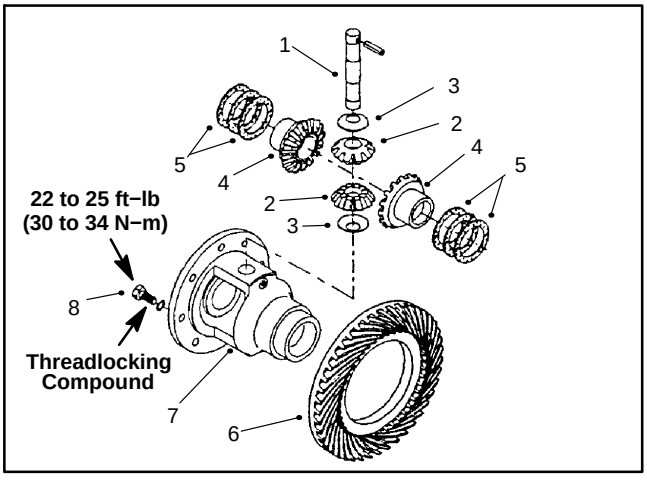

Figure 34

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)

Inspection

1. Measure the differential side gear O.D. and the differential case I.D. to determine the side gear to case clearance (Fig. 35). 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. 36). 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.

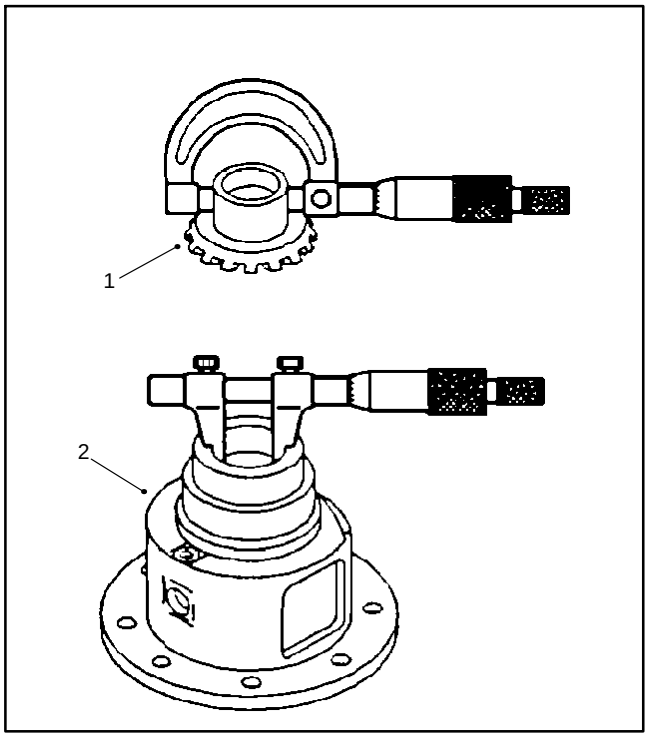

Figure 35

1. Side gear **2. Differential case**

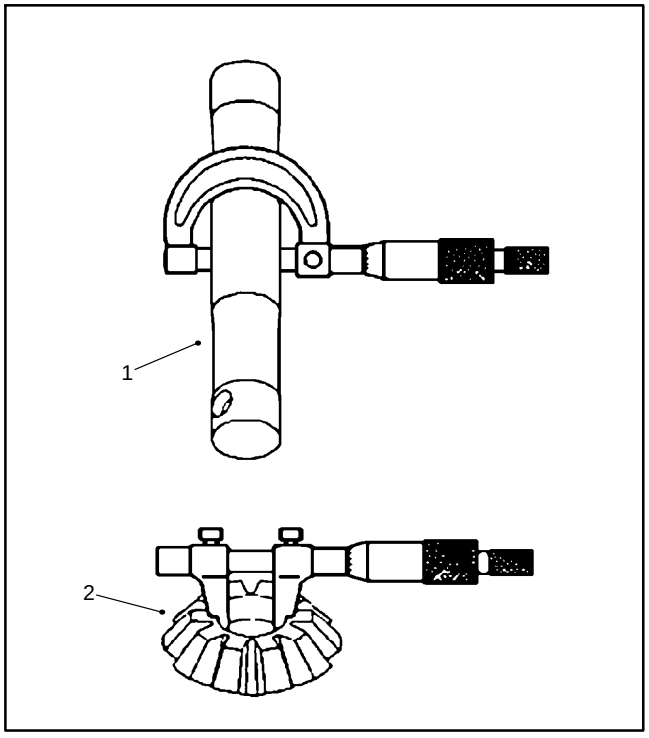

Figure 36

1. Pinion shaft **2. Pinion 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. 37).

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. 38).

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.

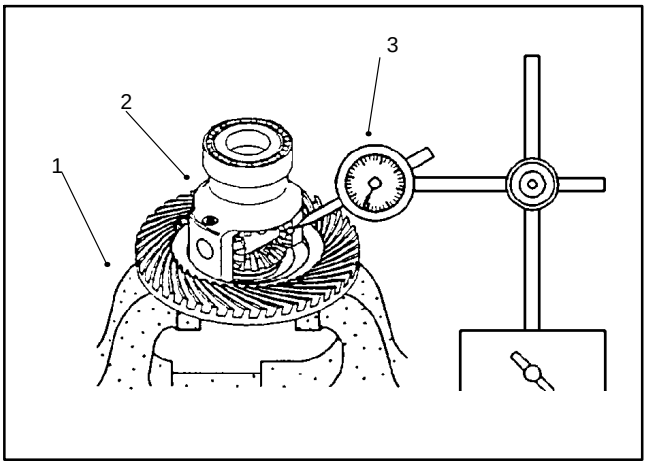

Figure 37

1. **Vise**
2. **Differential gear case**
3. **Dial indicator**

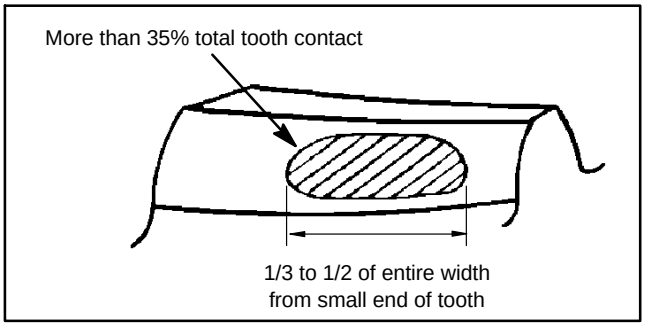

Figure 38

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. 39):

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. 40).

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. 41).

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. 42 and 43) 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.

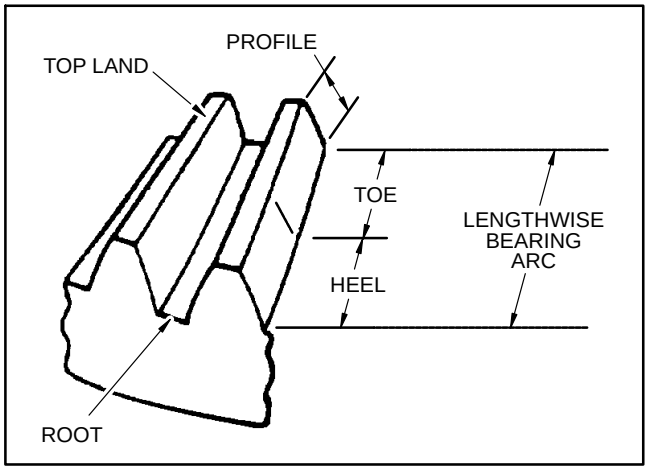

Figure 39

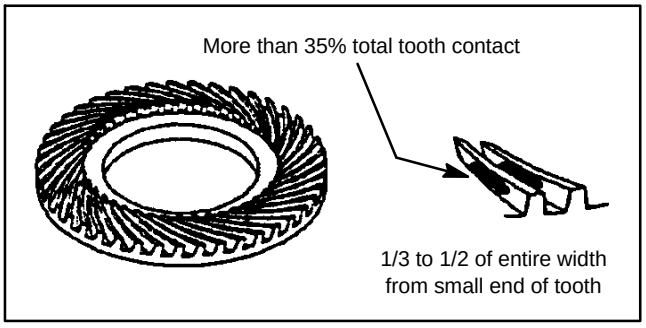

Figure 40

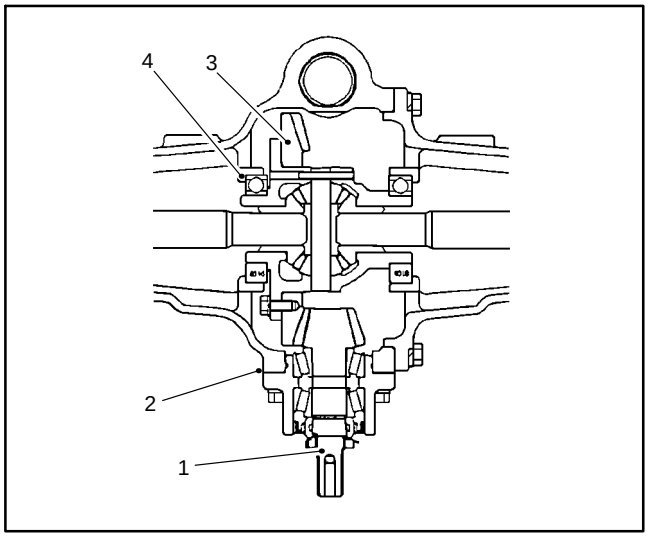

Figure 41

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. 42):

   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. 43):

   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.

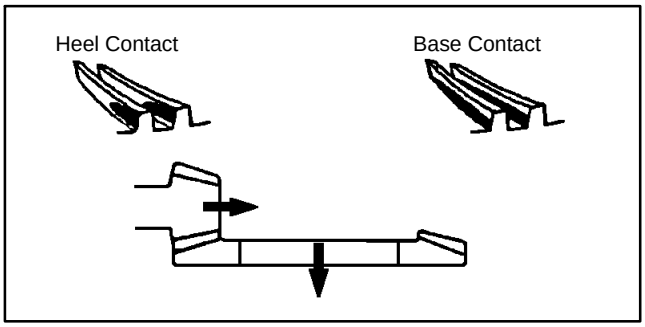

Figure 42

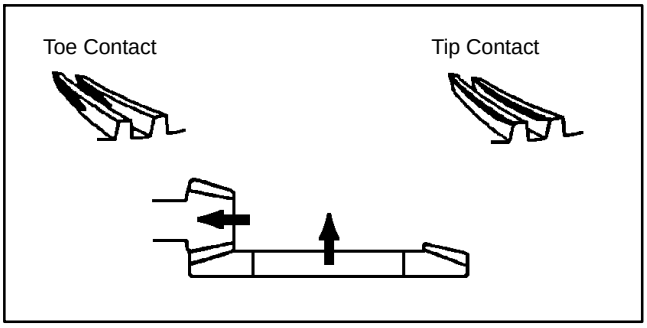

Figure 43

Chapter 7

Chassis

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Steering Tower

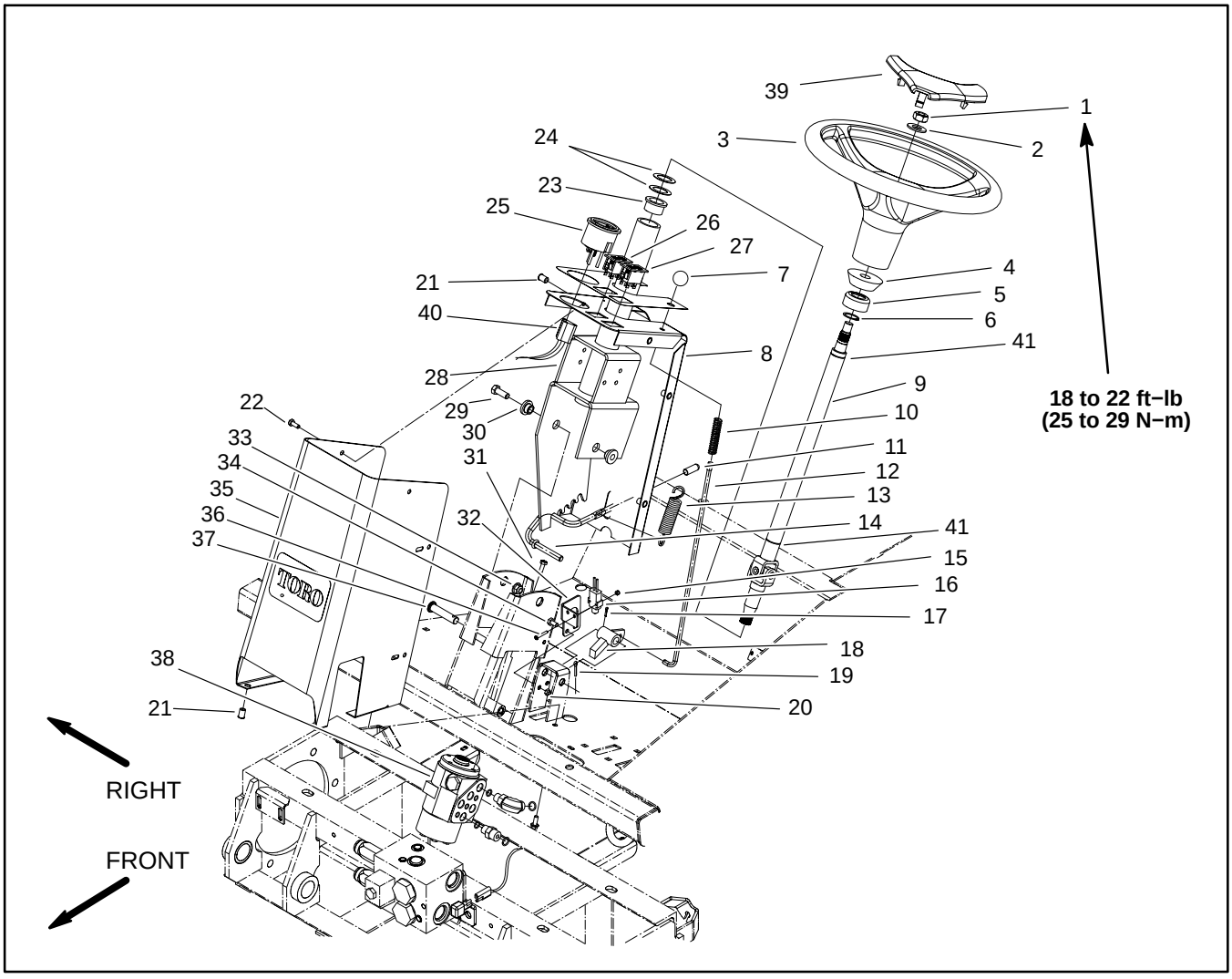

Figure 1

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
16. Parking brake switch
17. Cotter pin
18. Brake pawl
19. Cotter pin
20. Lock nut
21. Nut insert
22. Flange head screw
23. Flange bushing
24. Thrust washer
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
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

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

1. Assemble steering tower using Figure 1 as a guide. **Note:** Thrust washer(s) (24) on steering column are used as needed to remove end play of steering shaft.

Front Deck Lift Arms

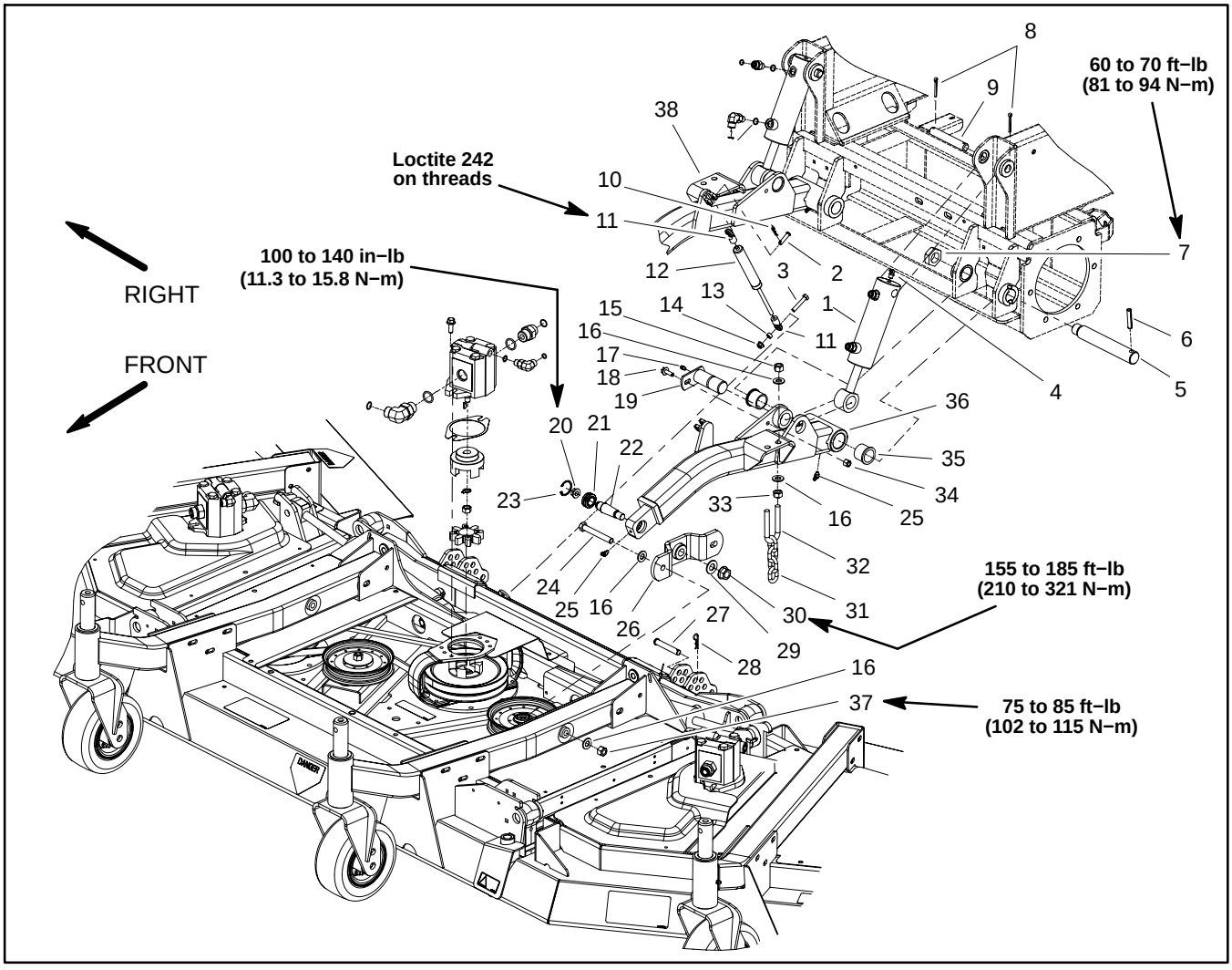

Figure 2

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

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 Units).

CAUTION

When raising machine, use correct blocks, hoists, and jacks. 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 or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or 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

1. If removed, install components to lift arm.

   A. Assemble height−of−cut chain u−bolt so that threaded portion of u−bolt extends .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 100 to 140 in−lb (11.3 to 15.8 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 (210 to 321 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 (see Operator’s Manual).

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 (see Operator’s Manual).

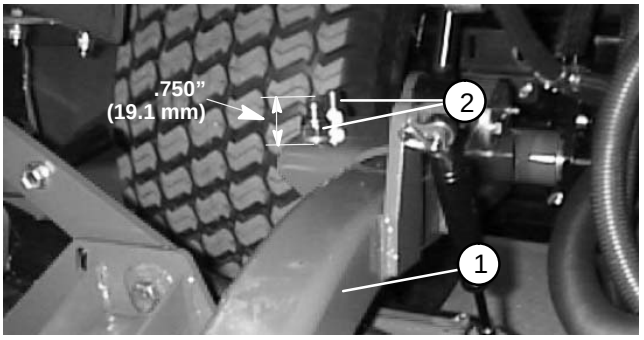

Figure 3

1. Lift arm
2. U−bolt threads

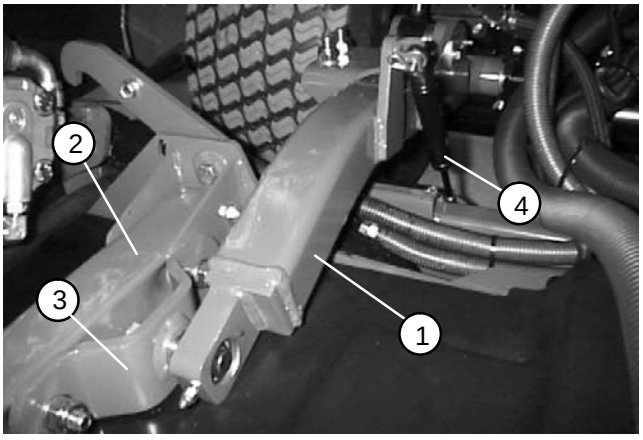

Figure 4

1. Lift arm
2. Deck castor arm
3. Support hub
4. Damper

Hood

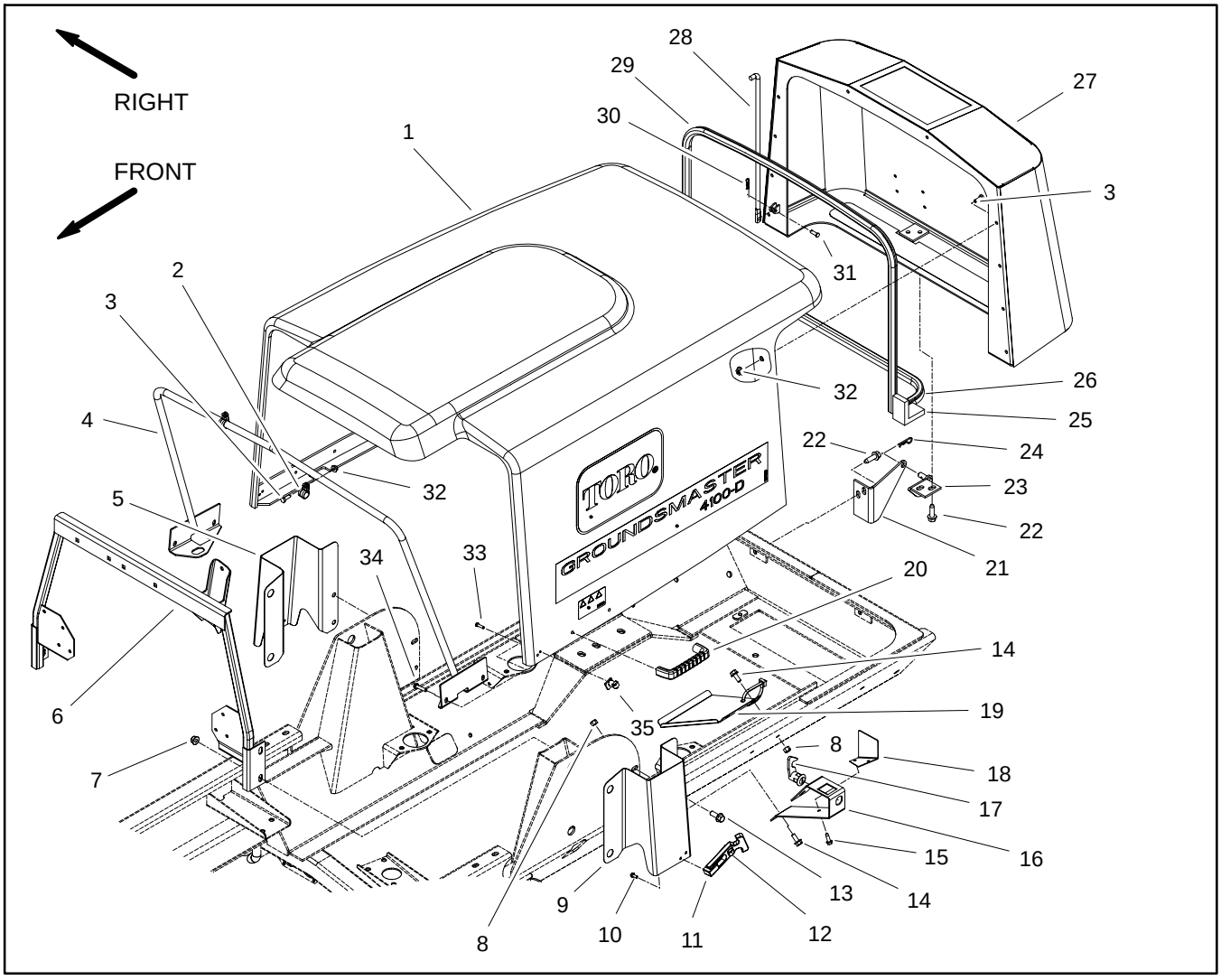

Figure 5

1. **Hood**
2. **R−clamp (2 used)**
3. **Cap screw**
4. **Hood support**
5. **Latch bracket (RH)**
6. **Fuel tank support**
7. **Flange nut**
8. **Lock nut**
9. **Latch bracket (LH)**
10. **Screw (2 used per handle)**
11. **Latch bracket (2 used)**
12. **Latch handle (2 used)**
13. **Flange head screw (4 used)**
14. **Flange head screw (4 used)**
15. **Washer head screw (2 used)**
16. **Hood latch bracket**
17. **Latch**
18. **Latch cover**
19. **Oil filter deflector**
20. **Handle (2 used)**
21. **Hood pivot (2 used)**
22. **Self tapping screw**
23. **Pivot bracket (2 used)**
24. **Hair pin**
25. **Screen corner seal (2 used)**
26. **Bulb seal**
27. **Screen**
28. **Hood rod**
29. **Bulb seal**
30. **Hair pin**
31. **Clevis pin**
32. **Flange nut**
33. **Cap screw (2 used)**
34. **Screw (4 used)**
35. **Latch keeper (2 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 5 as a guide.

Installation

1. Install hood using Figure 5 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. 6 and 7).

   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.

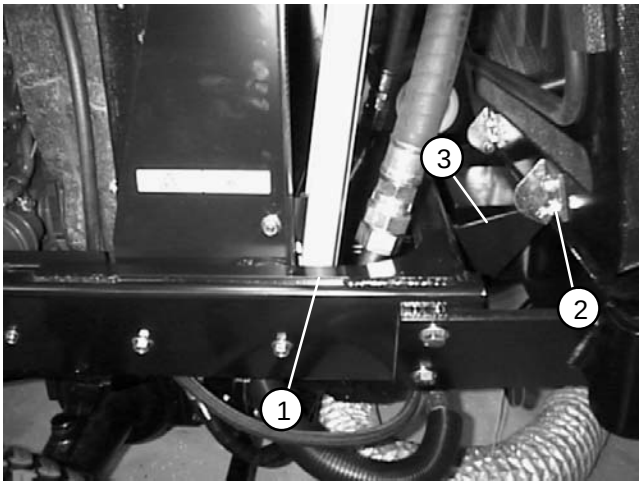

Figure 6

1. **LH shim location**
2. **LH hood pivot**
3. **LH pivot bracket**

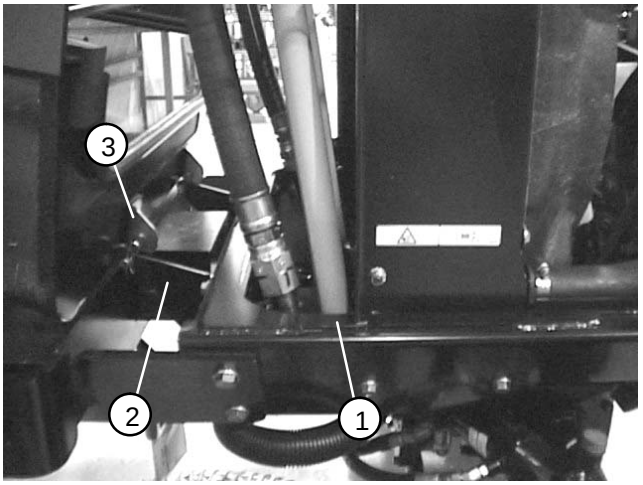

Figure 7

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” (2.54 cm to 12.7 cm) adjustable in 1/2” (1.27 cm) 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” (3.17 cm) shafts supported by greaseable, tapered roller bearings.

CUTTING BLADE: Cutting blade dimensions are 19” (48.3 cm) long, 2.5” (6.4 cm) wide, and .250” (.64 cm) 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” (137.2 cm) width of cut. Each side deck has 37” (94 cm) width of cut. Total width of cut is 124” (315 cm).

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.

Troubleshooting

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

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

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
1. Maximum governed engine speed.	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” (2.5 cm) or 1/3 of the grass blade when cutting.

Adjustments

CAUTION

Never install or work on the cutting deck or lift arms with the engine running. Always stop engine and remove ignition key first.

See Operator's Manual for adjustment procedures for the cutting deck on the Groundsmaster 4100−D.

Castor Wheel Tire Pressure

Castor tires on the cutting deck should be inflated to 50 psi (3.5 bar).

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 decks are lowered onto a clean section of turf or hard surface to avoid dust and debris.

To verify blade stopping stopping time, have a second person stand back from the deck at least 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 greater than 7 seconds, the braking valve(s) (R1BR) on the deck drive hydraulic control manifold(s) need adjustment.

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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

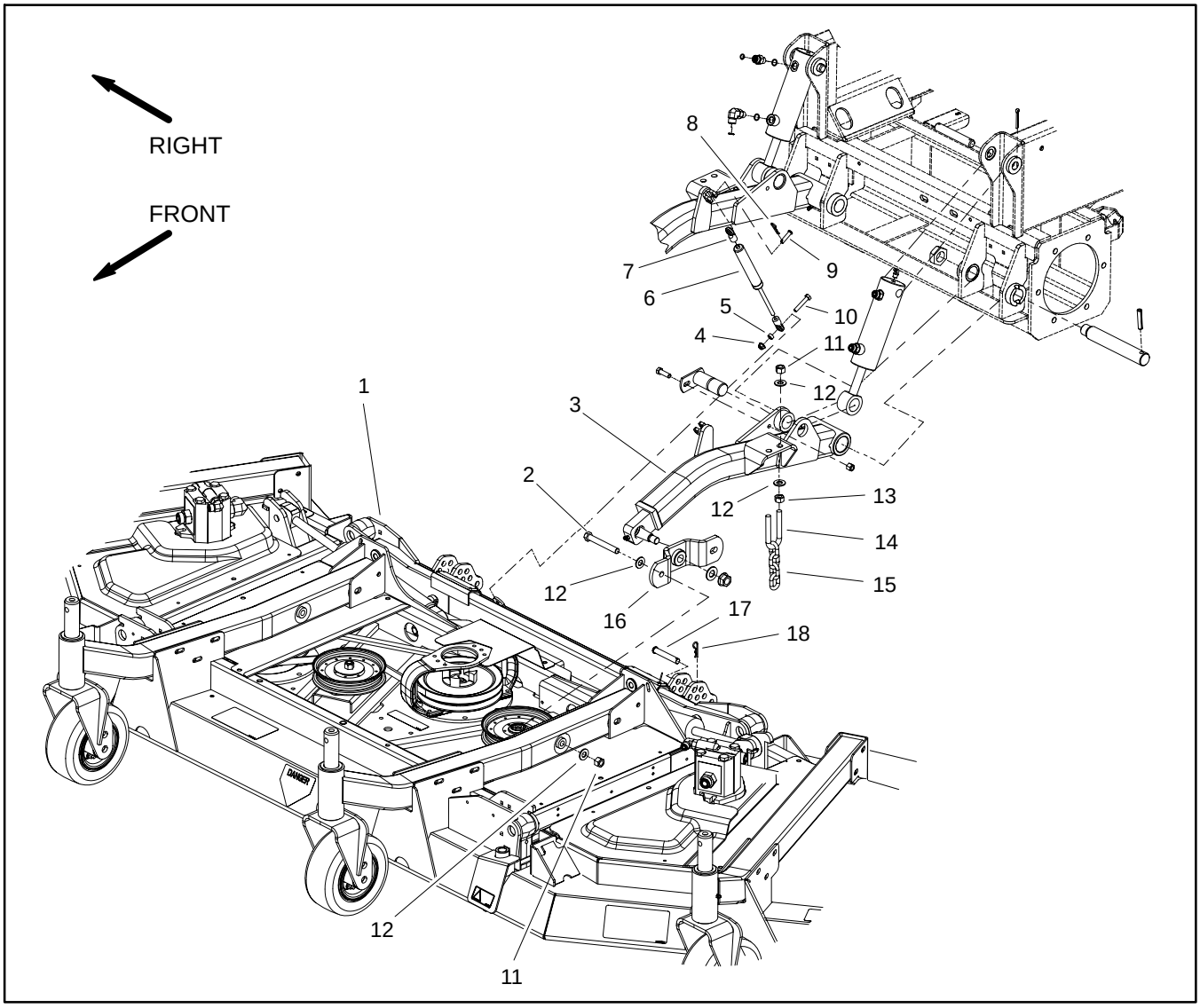

Figure 1

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. **Lock nut**
12. **Flat washer**
13. **Hex nut**
14. **U−bolt**
15. **Height of cut chain**
16. **Support hub**
17. **Clevis pin**
18. **Hair pin**

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 Systems). 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 wing deck lift cylinders from cutting deck (Fig. 4):

A. Remove deck covers as needed to allow access to lift cylinder fasteners.

B. Remove cap screw and lock nut that secure the lift cylinder clevis to the wing deck.

C. Remove flange nut and flat washer from the tapered stud on the barrel end of the lift cylinder.

D. Remove lift cylinder from the deck. Locate and retrieve spacers from each side of the lift cylinder clevis.

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).

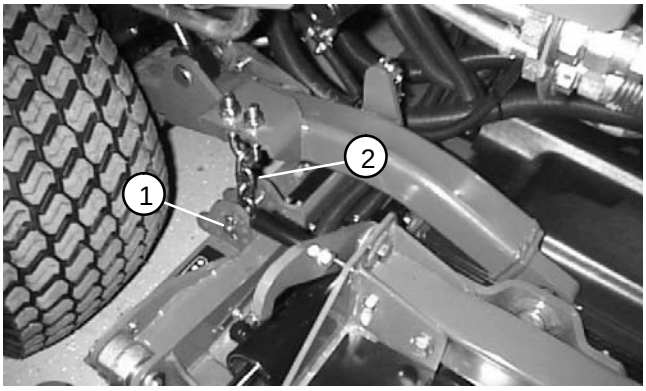

Figure 2

1. **Hairpin and clevis pin**
2. **Height−of−cut chain**

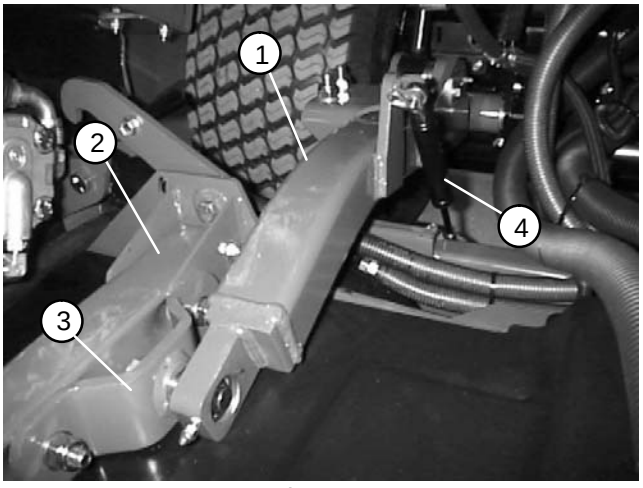

Figure 3

1. **Lift arm**
2. **Castor arm**
3. **Support hub**
4. **Damper**

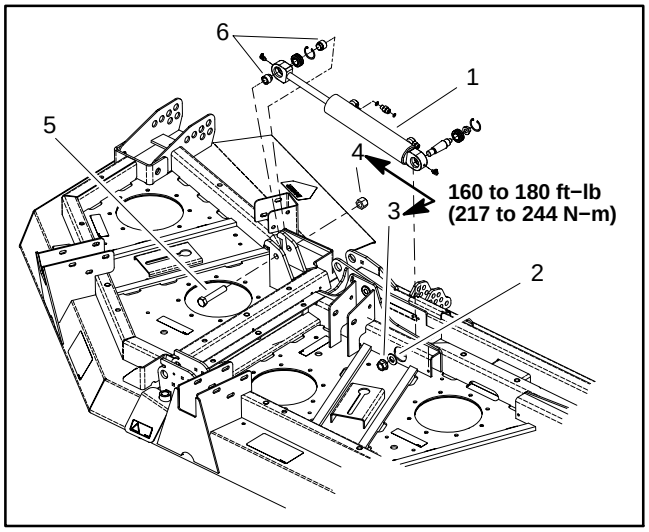

Figure 4

1. **Wing deck lift cylinder**
2. **Flat washer**
3. **Flange 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. Install wing deck lift cylinders to cutting deck (Fig. 4):

   A. Thoroughly clean tapered surfaces of lift cylinder studs and mounting bosses on deck.

   B. Position lift cylinders to the deck.

   C. Secure the barrel end of each lift cylinder to the center deck with flange nut and flat washer. Torque flange nut from 160 to 180 ft−lb (217 to 244 N−m).

   D. Make sure that spacers are positioned on each side of the lift cylinder clevis. Install cap screw from the front side of the deck and secure each lift cylinder clevis to the wing deck with lock nut. Torque lock nut from 160 to 180 ft−lb (217 to 244 N−m).

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 Systems).

10. Lubricate grease fittings on cutting deck and lift assemblies (see Operator's Manual).

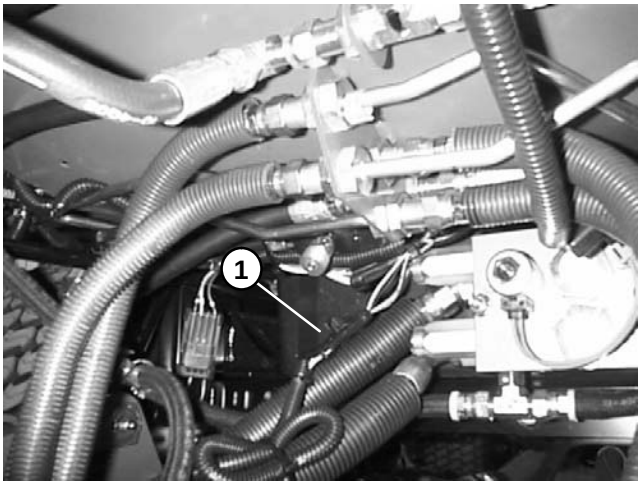

Figure 5

1. Cutting deck wire harness connection

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Wing Deck Service

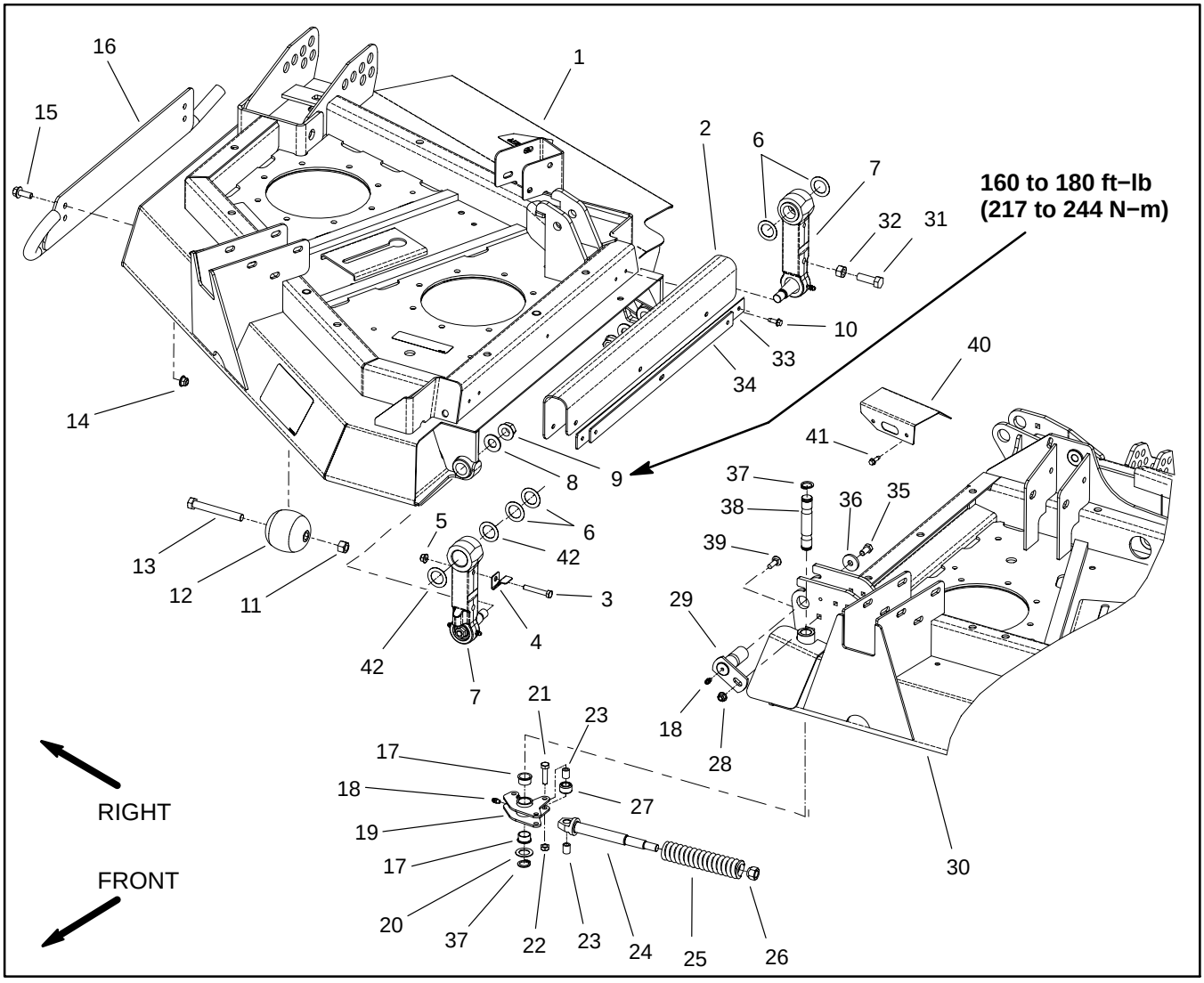

Figure 6

1. Wing deck (RH shown)
2. Flex shield
3. Cap screw
4. Switch actuator
5. Lock nut
6. Thrust washer (.030” thick)
7. Link assembly
8. Flat washer
9. Flange nut
10. Screw (6 used per flex shield)
11. Lock nut
12. Anti−scalp roller
13. Cap screw
14. Flange nut
15. Flange screw (2 used per skid)
16. Skid (RH shown)
17. Flange bushing
18. Grease fitting
19. Latch
20. Flat washer
21. Cap screw (3 used per latch)
22. Lock nut (3 used per latch)
23. Bushing (3 used per latch)
24. Spring support
25. Compression spring
26. Lug nut
27. Lock roller (2 used per latch)
28. Flange nut
29. Pivot pin
30. Center deck
31. Cap screw
32. Hex jam nut
33. Shield strap (wing deck)
34. Shield strap (center deck)
35. Cap screw
36. Washer
37. Retaining ring
38. Latch pin
39. Carriage bolt
40. Switch shield (RH shown)
41. Washer head screw
42. Hardened spacer (.120” thick)

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 Systems).

4. Remove cap screw and lock nut that secure lift cylinder clevis to the wing deck (Fig. 7).

5. Remove switch shield from center deck.

6. Support wing deck to prevent it from falling as links are removed.

7. Remove cap screw and washer from pivot pin on upper end of both links. Remove flange nut from carriage bolt and pull pivot pins from deck. Locate and retrieve two thrust washers (item 6) from upper end of both links and two hardened spacers (item 42) from front link.

8. Slide the wing deck away from the center deck.

9. If required, remove link(s) from wing deck by removing flange nut and flat washer that secure tapered stud to deck. Press tapered stud from deck to remove link assembly.

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. Insert tapered stud into deck mounting boss and secure with flat washer and flange nut. Torque flange nut from 160 to 180 ft−lb (217 to 244 N−m).

3. Position the wing deck to the center deck.

NOTE: If two thrust washers (item 6) cause front link to bind, use only one thrust washer on rear side of front link.

4. Position thrust washers (item 6) to upper end of links. Front link has both thrust washers toward the rear. Rear link has thrust washer on each side. Also, place hardened spacer (item 42) on each side of front link. Align upper end of links with mounting holes in center deck. Install pivot pins.

5. Secure pivot pins to center deck with carriage screw and flange head screw. Install washer and cap screw to pivot pins.

6. Position lift cylinder to the wing deck (Fig. 7). Secure cylinder with cap screw and lock nut.

7. Install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 − Hydraulic Systems).

8. 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.

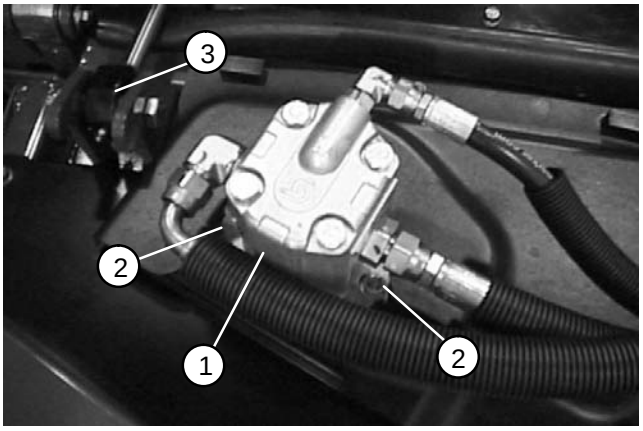

Figure 7

1. **Hydraulic motor**
2. **Flange head screw**
3. **Lift cylinder clevis**

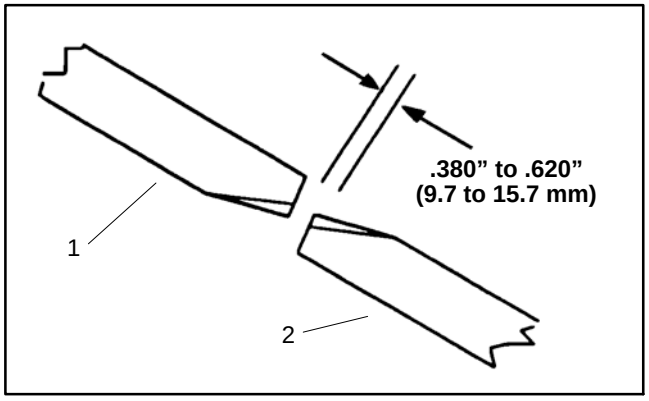

Figure 8

1. **Wing deck blade**
2. **Center deck blade**

9. Lubricate grease fittings on cutting deck and lift components (see Operator's Manual).

10. Check distance between inner deck blade on wing deck and outer deck blade on center deck. Distance between blades should be .380" to .620" (9.7 to 15.7 mm) (Fig. 8). 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.

11. Inspect deck latch assembly to insure that link is locked when wing deck is in the lowered position.

12. Check operation of wing deck position switch. Adjust if necessary (see Wing Deck Position Switches in the Adjustments section of Chapter 5 − Electrical System).

Cutting Deck Link Service

Disassembly (Fig. 9)

1. Press flange bushings from top of link.

2. Remove retaining ring and press tapered stud with spherical bearing and flange nut from link.

3. Remove flange nut and press spherical bearing from tapered stud.

Reassembly (Fig. 9)

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. Press tapered stud with spherical bearing and flange nut into link. Secure spherical bearing into link with retaining ring.

3. Press flange bushings into bore of link.

4. 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. 10).

5. After link is installed on deck, check distance between center deck blade and wing deck blade. Readjust cap screw and jam nut if needed (see Wing Deck Service in this Chapter).

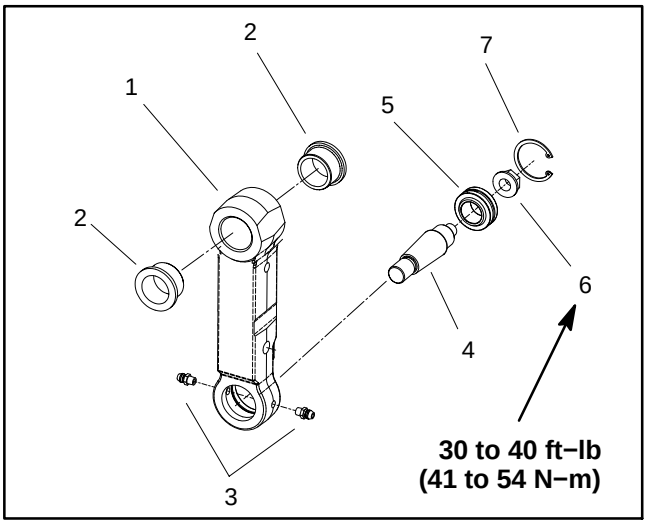

Figure 9

1. **Link**
2. **Flange bushing**
3. **Grease fitting**
4. **Tapered stud**
5. **Spherical bearing**
6. **Flange nut**
7. **Retaining ring**

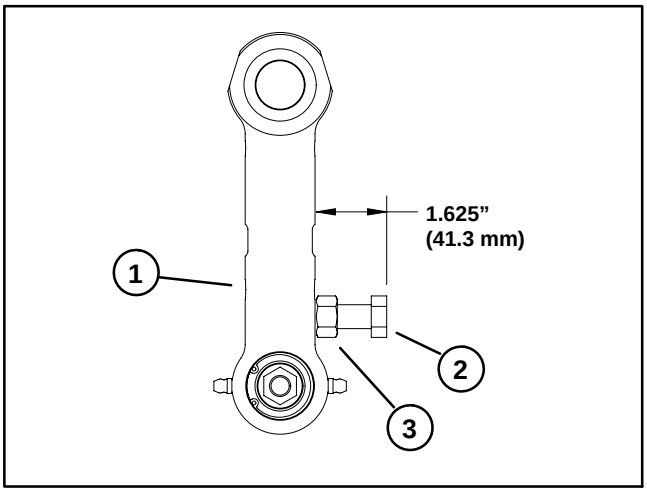

Figure 10

1. **Rear link**
2. **Cap screw**
3. **Hex jam nut**

Wing Deck Latch

Disassembly (Fig. 11)

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 11 as a guide.

Assembly (Fig. 11)

1. Assemble latch (items 1 through 8) using Figure 11 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.

5. Lubricate latch grease fitting.

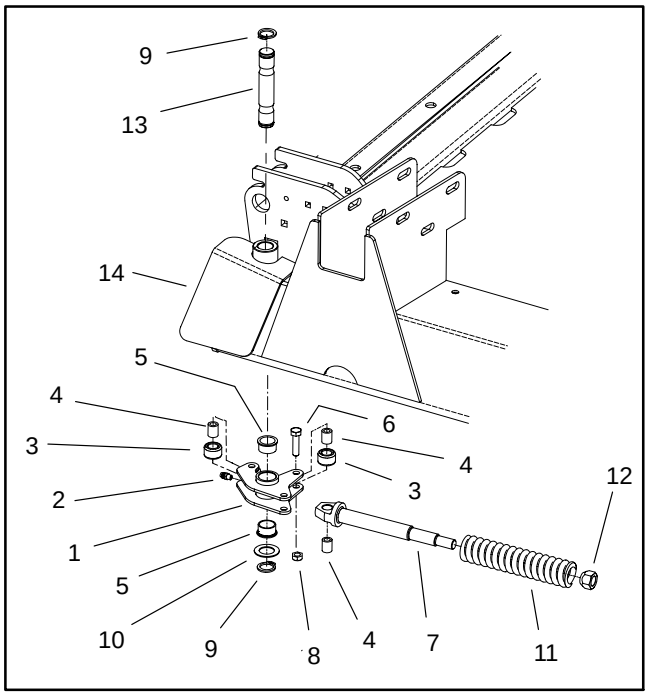

Figure 11

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**

Blade Spindle

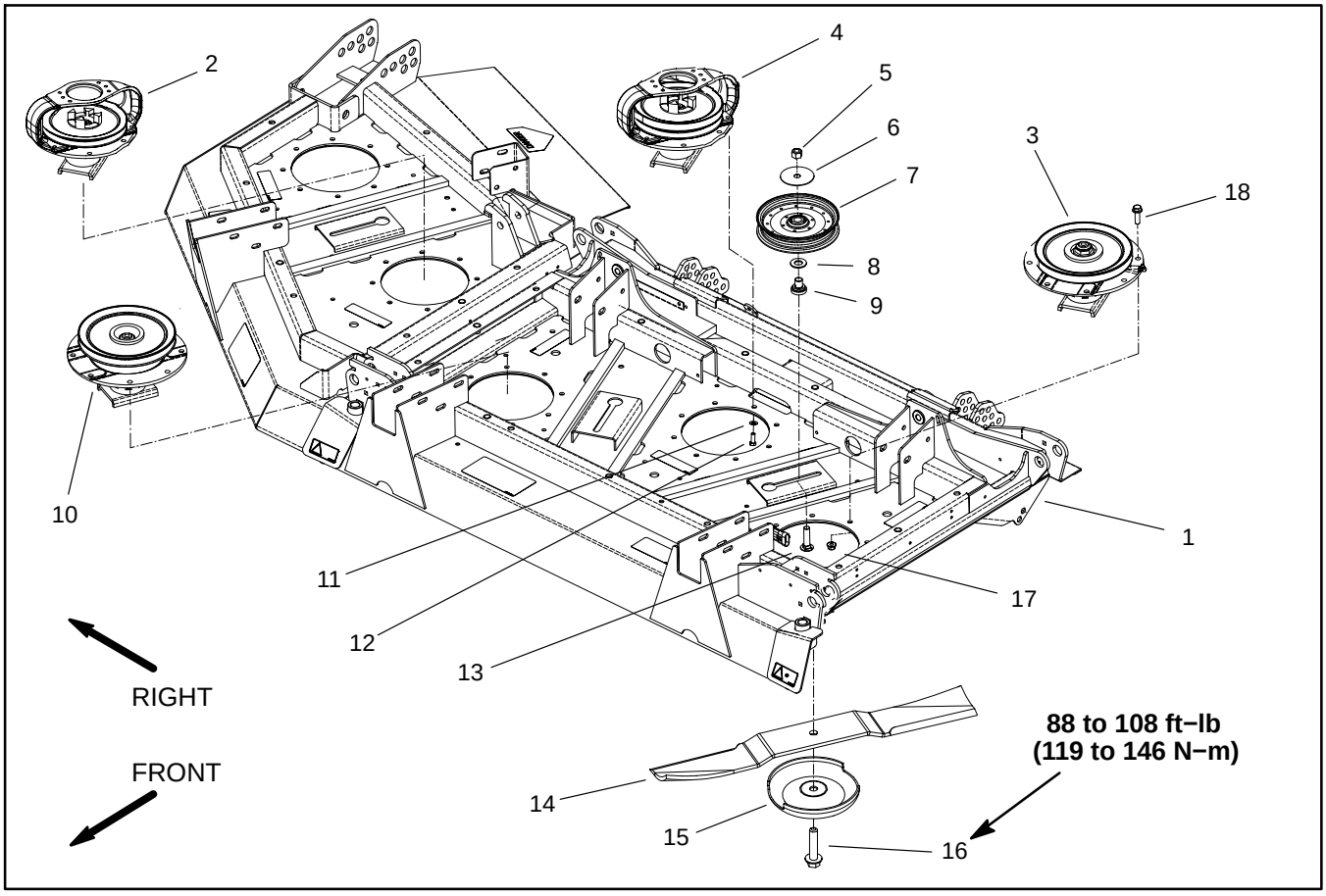

Figure 12

1. **Cutting deck**
2. **Drive spindle: single pulley (2 used)**
3. **Low driven spindle (3 used)**
4. **Drive spindle: double pulley (1 used)**
5. **Lock nut**
6. **Flat washer**
7. **Idler pulley (4 used)**
8. **Flat washer**
9. **Idler spacer**
10. **High driven spindle (1 used)**
11. **Flat washer**
12. **Cap screw**
13. **Carriage screw**
14. **Cutting blade**
15. **Anti−scalp cup**
16. **Blade bolt**
17. **Flange nut**
18. **Flange head screw**

Removal (Fig. 12)

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 Systems). Position motor away from spindle.

3. Remove belt covers from top of cutting deck (see Operator's Manual). Loosen idler pulley to release belt tension. 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 (see Operator's Manual).

6. Remove spindle housing assembly from deck.

   A. For driven spindle assemblies, remove eight (8) flange head screws with lock nuts that secure spindle to deck.

   B. For drive spindle assemblies, loosen and remove four (4) flange head screws with lock nuts that secure spindle to deck. Then, remove four (4) cap screws with washers that secure spindle and motor mount to deck.

Installation (Fig. 12)

1. Position spindle on cutting deck noting orientation of grease fitting (Fig. 14). Secure spindle assembly to deck with correct fasteners.

2. Install cutting blade, anti−scalp cup, and blade bolt (see Operator's Manual). 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 Operator's Manual).

5. If drive spindle was removed, install hydraulic motor to cutting deck (see Cutting Deck Motor Installation in the Service and Repairs Section of Chapter 4 − Hydraulic Systems).

6. Install belt covers to cutting deck (see Operator's Manual).

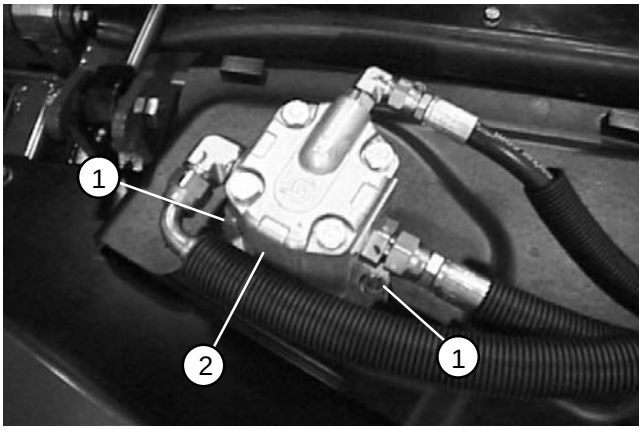

Figure 13

1. **Flange head screw**
2. **Hydraulic motor**

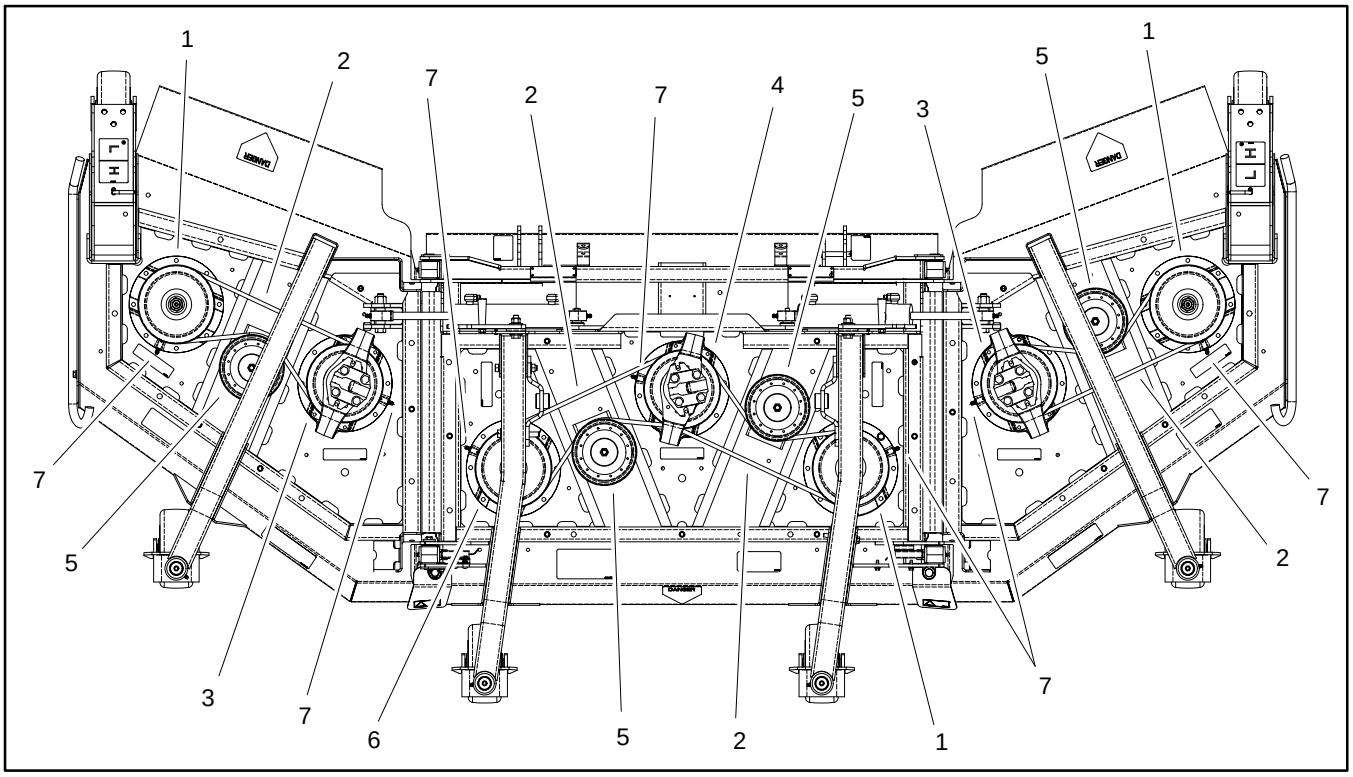

Figure 14

1. **Driven spindle**
2. **Drive belt**
3. **Drive spindle (wing deck)**
4. **Drive spindle (center deck)**
5. **Idler pulley**
6. **Driven spindle (high pulley)**
7. **Spindle grease fitting location**

Blade Spindle Service

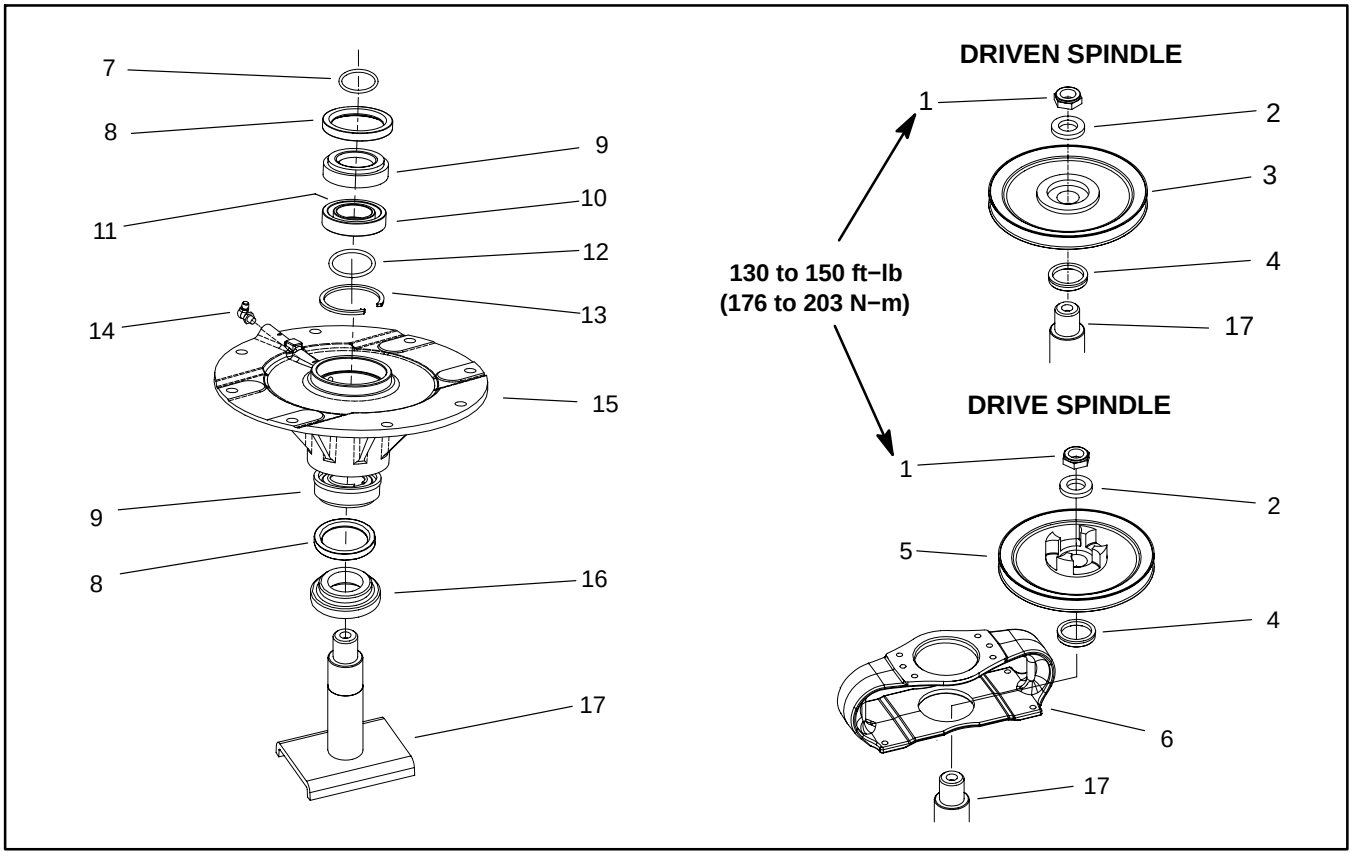

Figure 15

1. **Lock nut**
2. **Flat washer**
3. **Driven pulley**
4. **V−ring seal (if equipped)**
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. 15)

NOTE: Early production spindle assemblies included a v−ring seal (item 4) which has been found to be unnecessary. Discard v−ring seal if found in spindle assembly.

1. Loosen and remove lock nut from top of spindle shaft. Remove flat washer, pulley, and v−ring seal (if equipped) 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. Remove oil seals from spindle housing.

4. Allow the bearing cones, inner bearing spacer, and spacer ring to drop out of the spindle housing.

5. Using a punch and hammer, drive both of the bearing cups out of the spindle housing. Remove 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. 15)

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. Replacement bearings are sold only with a matched spacer ring and large snap ring (Fig. 17). These parts cannot be purchased separately.

1. If large snap ring was removed, install snap ring into spindle housing groove. Make sure snap ring is fully seated in housing groove.

2. Install large 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 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 against it (Fig 16).

4. Pack the bearing cones with grease. Apply a film of grease on lips of oil seals.

5. Install lower bearing cone and oil seal into bottom of spindle housing. **Note:** The lower seal must have the lip facing out (down) (Fig. 18).

IMPORTANT: If bearings are being replaced, make sure to use the spacer ring that is included in bearing set.

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) and be recessed into the spindle housing .095" (2.4 mm) (Fig. 18).

7. Inspect the spindle shaft and shaft spacer to make sure they are free of burrs or nicks that could possibly damage the oil seals. Lubricate the shaft with grease.

8. Install spindle shaft spacer onto shaft. Carefully slide spindle shaft with spacer up through spindle housing. The bottom oil seal and spindle spacer fit together when the spindle is installed fully.

9. Lightly grease o−ring and install to top of spindle shaft.

10. For drive spindle, position motor mount to top of spindle assembly.

NOTE: Early production spindle assemblies included a v−ring seal (item 4) which has been found to be unnecessary. **Do not** install a v−ring seal when assembling the spindle.

11. Install pulley (hub down), flat washer, and lock nut to spindle shaft. Tighten lock nut from 130 to 150 ft−lb (176 to 203 N−m).

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. **Note:** 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.

13. Rotate spindle shaft to make sure that it turns freely.

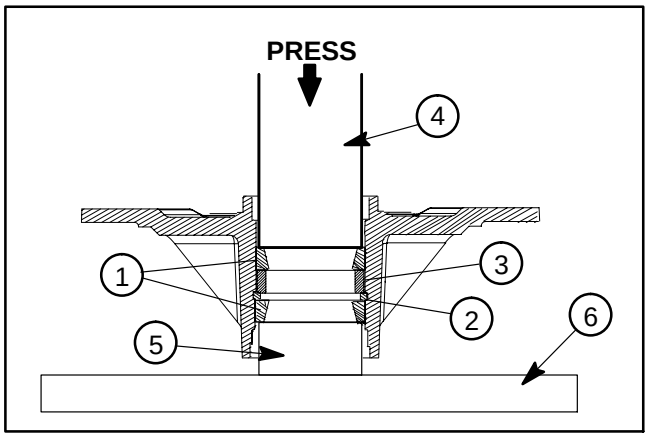

Figure 16

1. **Bearing cups**
2. **Large snap ring**
3. **Large outer spacer**
4. **Arbor press**
5. **Support**
6. **Arbor press base**

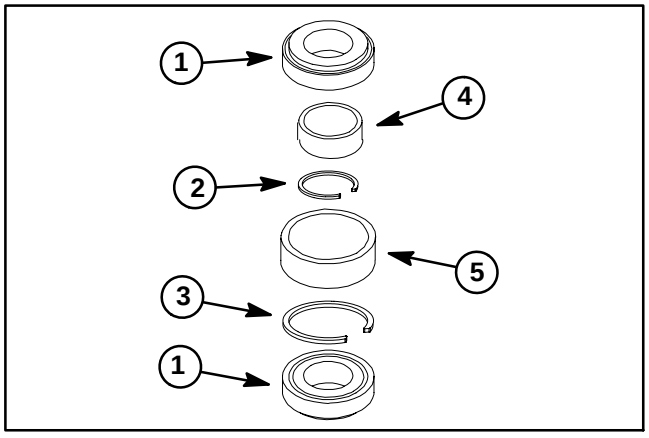

Figure 17

1. **Bearing**
2. **Spacer ring**
3. **Large snap ring**
4. **Inner spacer**
5. **Outer spacer**

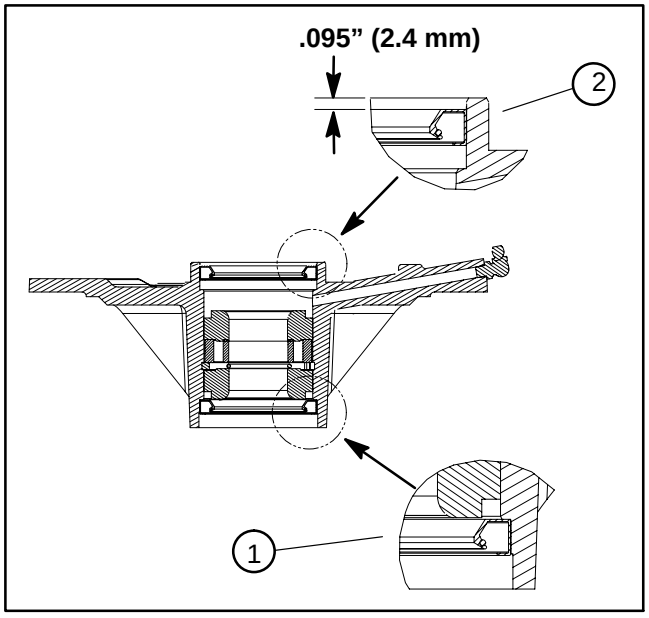

Figure 18

1. **Bottom seal installation**
2. **Upper seal installation**

Castor Forks and Wheels

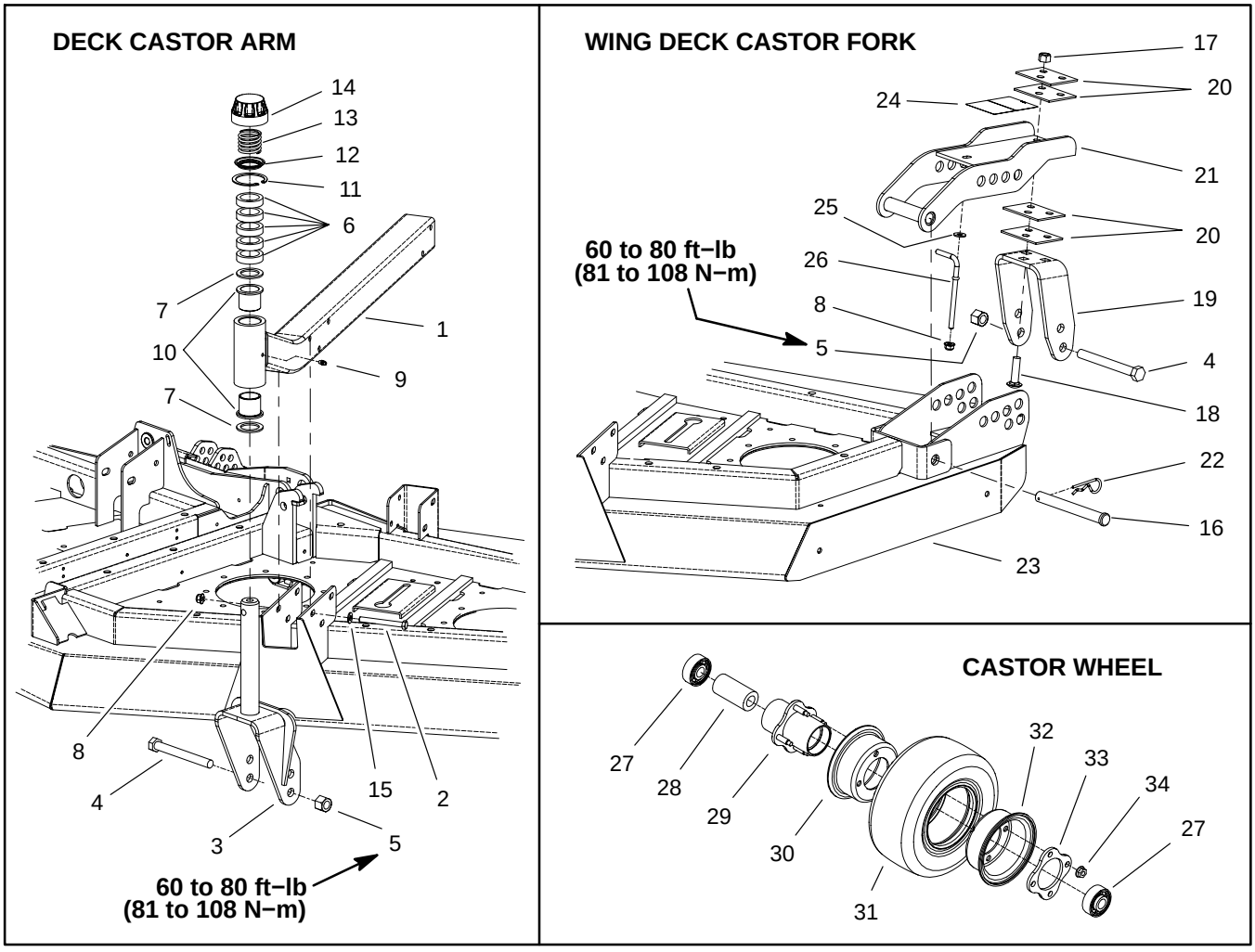

Figure 19

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

1. Disassemble castor forks and wheels using Figure 19 as a guide.

Assembly

1. Assemble castor forks and wheels using Figure 19 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

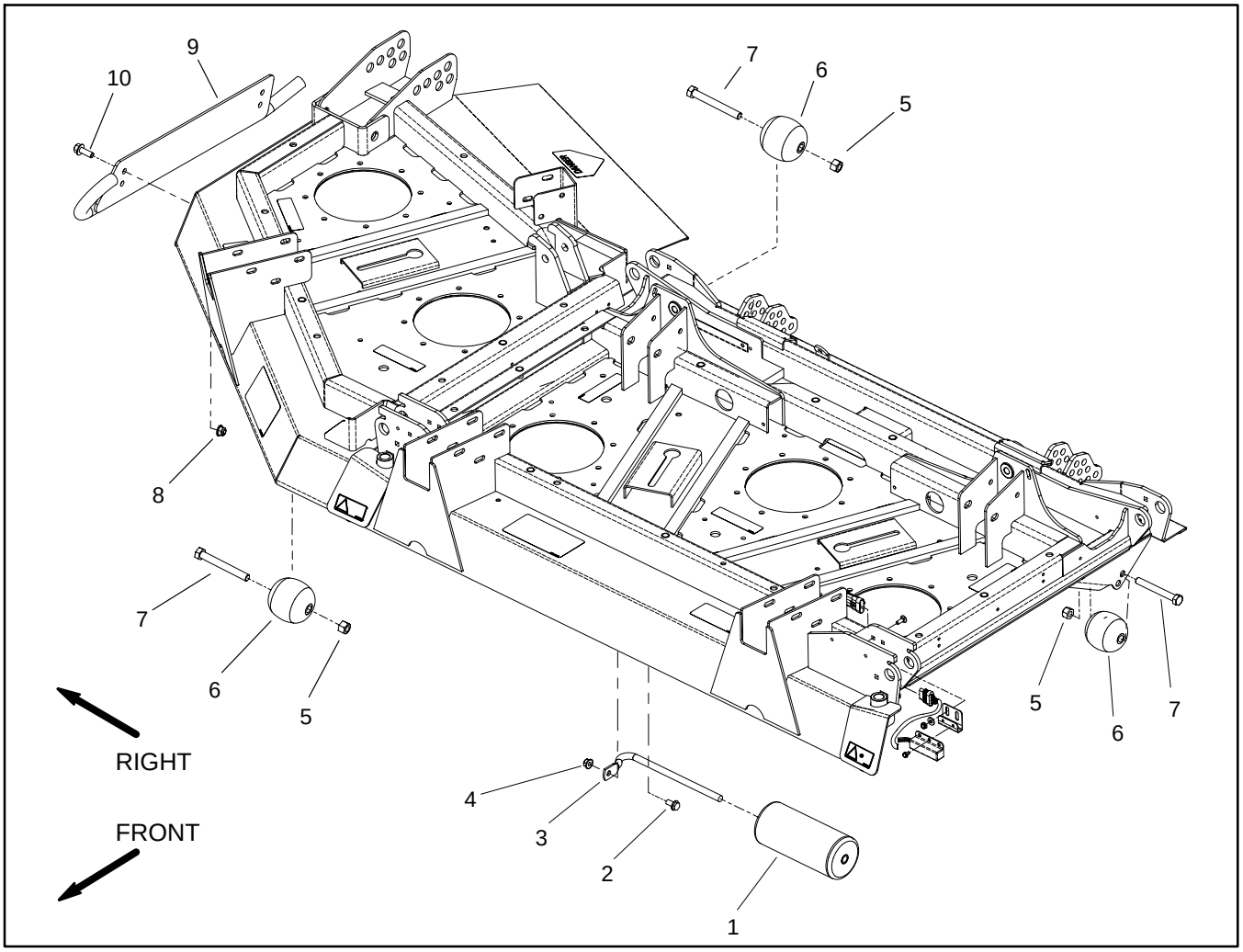

Figure 20

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

1. Remove skids and rollers from deck using Figure 20 as a guide.

Installation

1. Install skids to deck using Figure 20 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).

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Chapter 9

Electrical Diagrams

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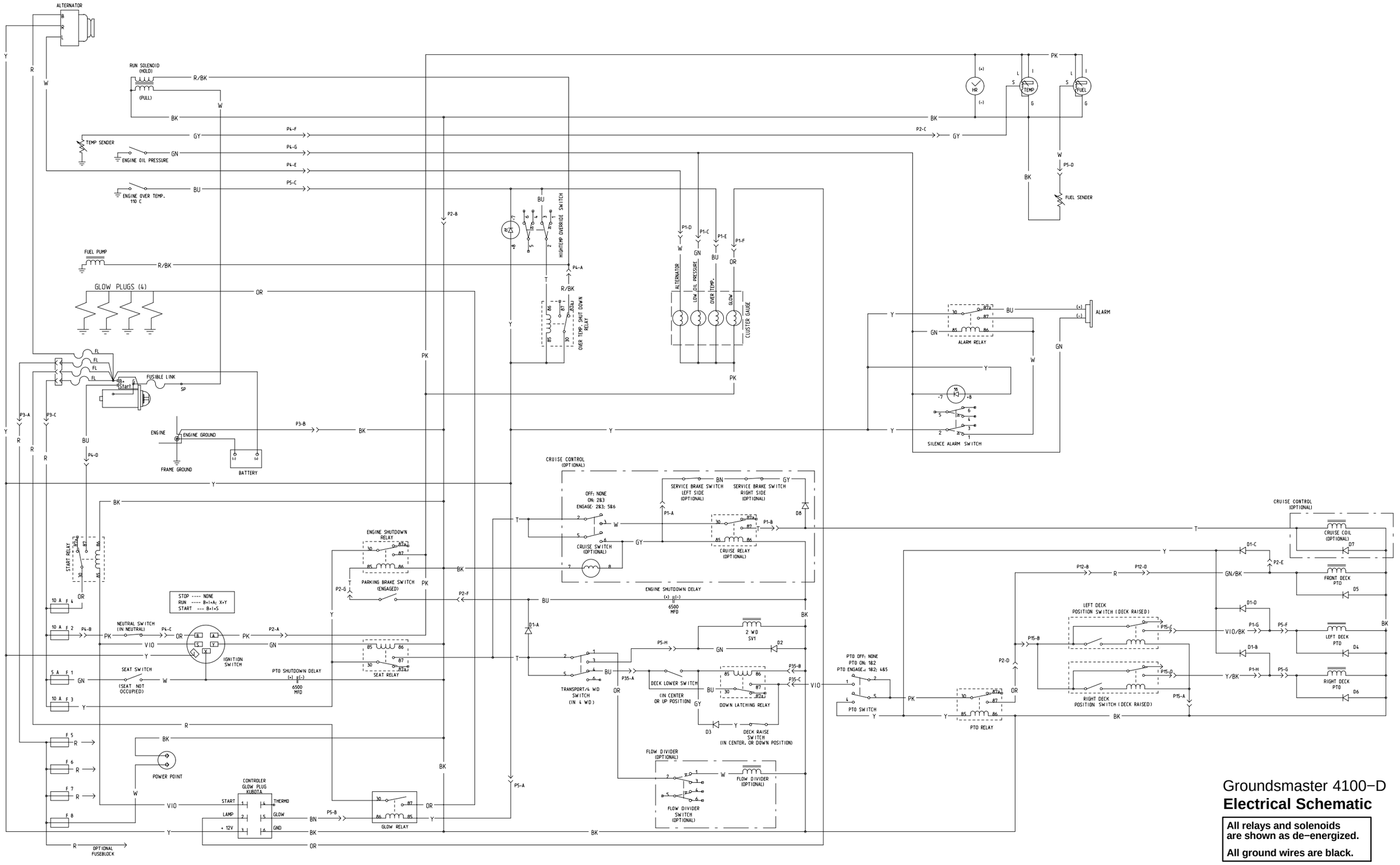
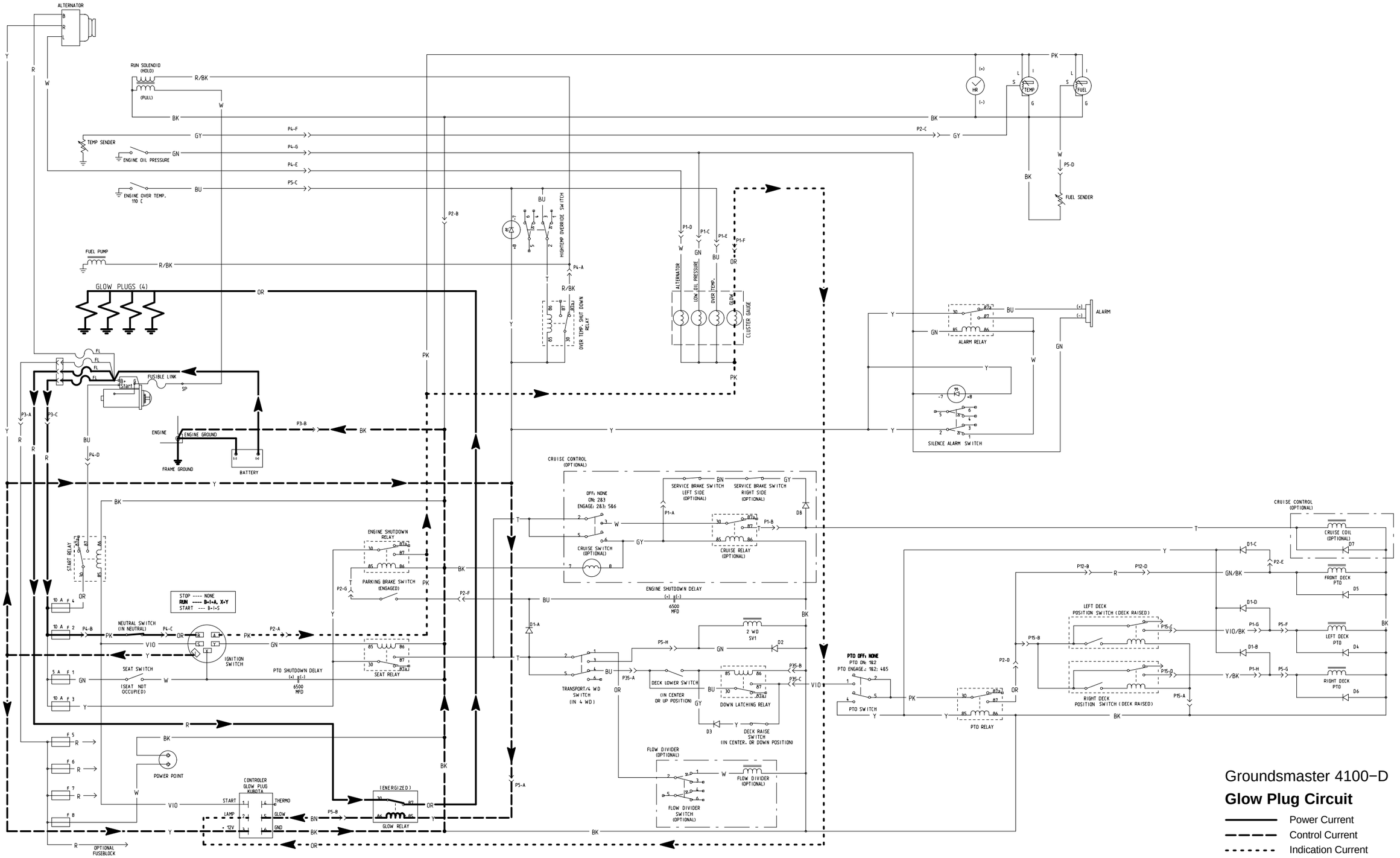


Groundsmaster 4100−D

Electrical Schematic

All relays and solenoids are shown as de−energized.

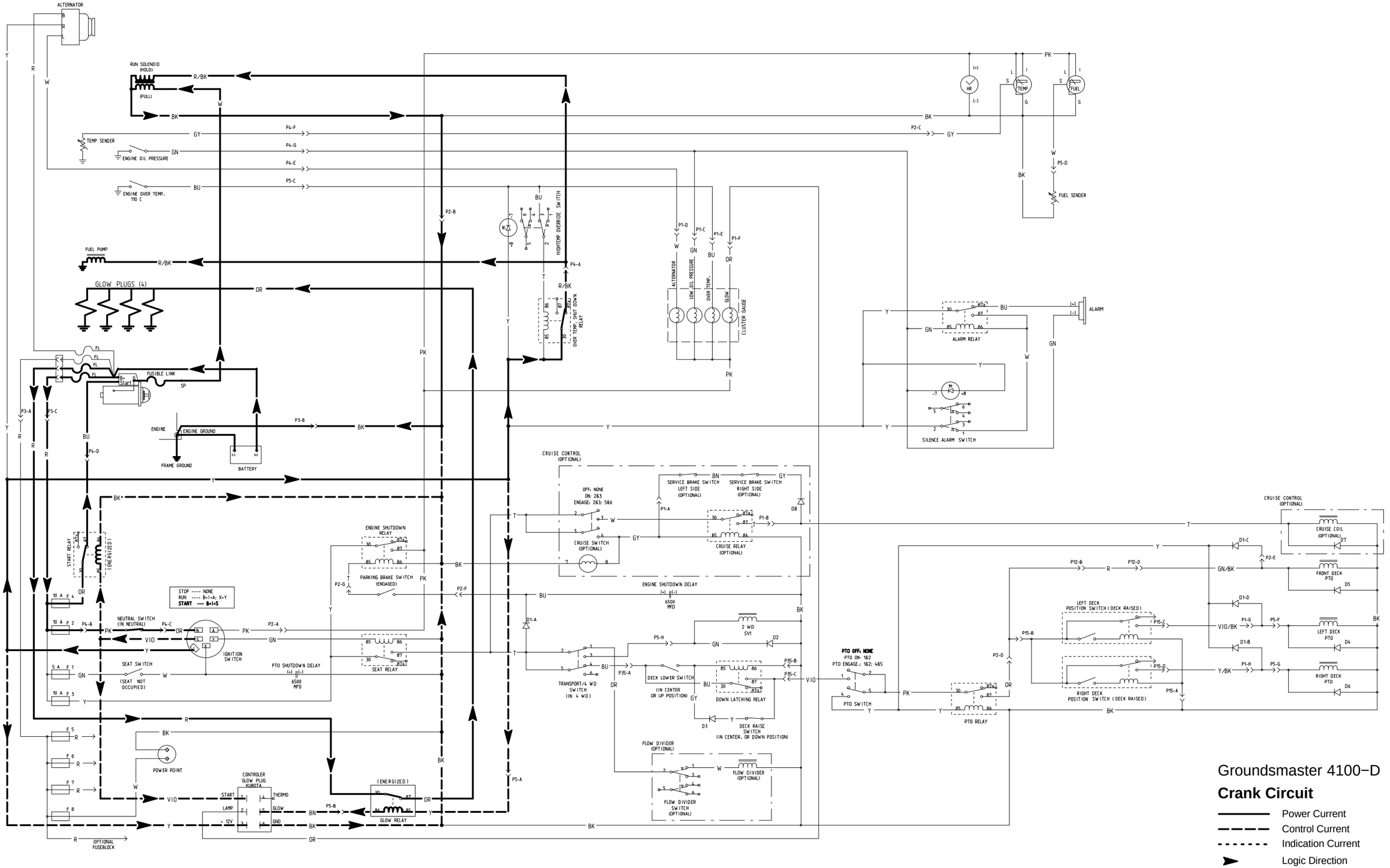
All ground wires are black.



Groundsmaster 4100−D

Glow Plug Circuit

- Power Current
- Control Current
- Indication Current
- Logic Direction



Groundsmaster 4100−D

Crank Circuit

- Power Current
- Control Current
- Indication Current
- Logic Direction

ALTERNATOR
B
R
L
RUN SOLENOID (HOLD)
(PULL)
R/BK
BK
W
GY
TEMP SENDER
GN
ENGINE OIL PRESSURE
ENGINE OVER TEMP. 110 C
BU
P4-F
P4-G
P4-E
P5-C
P2-B
P2-C
PK
HR
TEMP
FUEL
G
P5-D
FUEL SENDER
FUEL PUMP
GLOW PLUGS (4)
OR
HIGH TEMP OVERRIDE SWITCH
P4-A
OVER TEMP. SHUT DOWN RELAY
P1-D
P1-C
P1-E
P1-F
ALTERNATOR
LOW OIL PRESSURE
OVER TEMP.
GLOW
CLUSTER GAUGE
ALARM
ALARM RELAY
SILENCE ALARM SWITCH
FUSIBLE LINK
SP
Start
P3-A
P3-C
P3-B
P4-D
ENGINE
ENGINE GROUND
FRAME GROUND
BATTERY
CRUISE CONTROL (OPTIONAL)
OFF: NONE
ON: 283
ENGAGE: 283; 586
SERVICE BRAKE SWITCH LEFT SIDE (OPTIONAL)
SERVICE BRAKE SWITCH RIGHT SIDE (OPTIONAL)
BN
CRUISE SWITCH (OPTIONAL)
CRUISE RELAY (OPTIONAL)
ENGINE SHUTDOWN RELAY
(ENERGIZED)
ENGINE SHUTDOWN DELAY
(+) ||(-)
6500 MFD
PARKING BRAKE SWITCH (DISENGAGED)
START RELAY
STOP ---- NONE
RUN ---- B+I+A, X+Y
START --- B+I+S
NEUTRAL SWITCH (NOT IN NEUTRAL)
IGNITION SWITCH
SEAT SWITCH (SEAT OCCUPIED)
PTO SHUTDOWN DELAY
SEAT RELAY (ENERGIZED)
TRANSPORT/4 WD SWITCH (IN TRANSPORT)
DECK LOWER SWITCH (IN CENTER OR UP POSITION)
DOWN LATCHING RELAY
DECK RAISE SWITCH (IN CENTER, OR DOWN POSITION)
(ENERGIZED)
2 WD SV1
FLOW DIVIDER (OPTIONAL)
FLOW DIVIDER SWITCH (OPTIONAL)
PTO OFF: NONE
PTO ON: 182
PTO ENGAGE: 182; 485
PTO SWITCH
PTO RELAY
CRUISE CONTROL (OPTIONAL)
CRUISE COIL (OPTIONAL)
FRONT DECK PTO
LEFT DECK PTO
RIGHT DECK PTO
LEFT DECK POSITION SWITCH (DECK RAISED)
RIGHT DECK POSITION SWITCH (DECK RAISED)
CONTROLER GLOW PLUG KUBOTA
START
LAMP
+ 12V
THERMO
GLOW
GND
GLOW RELAY
OPTIONAL FUSEBLOCK
POWER POINT
10 A F 4
10 A F 2
5 A F 1
10 A F 3
F 5
F 6
F 7
F 8

Groundsmaster 4100−D

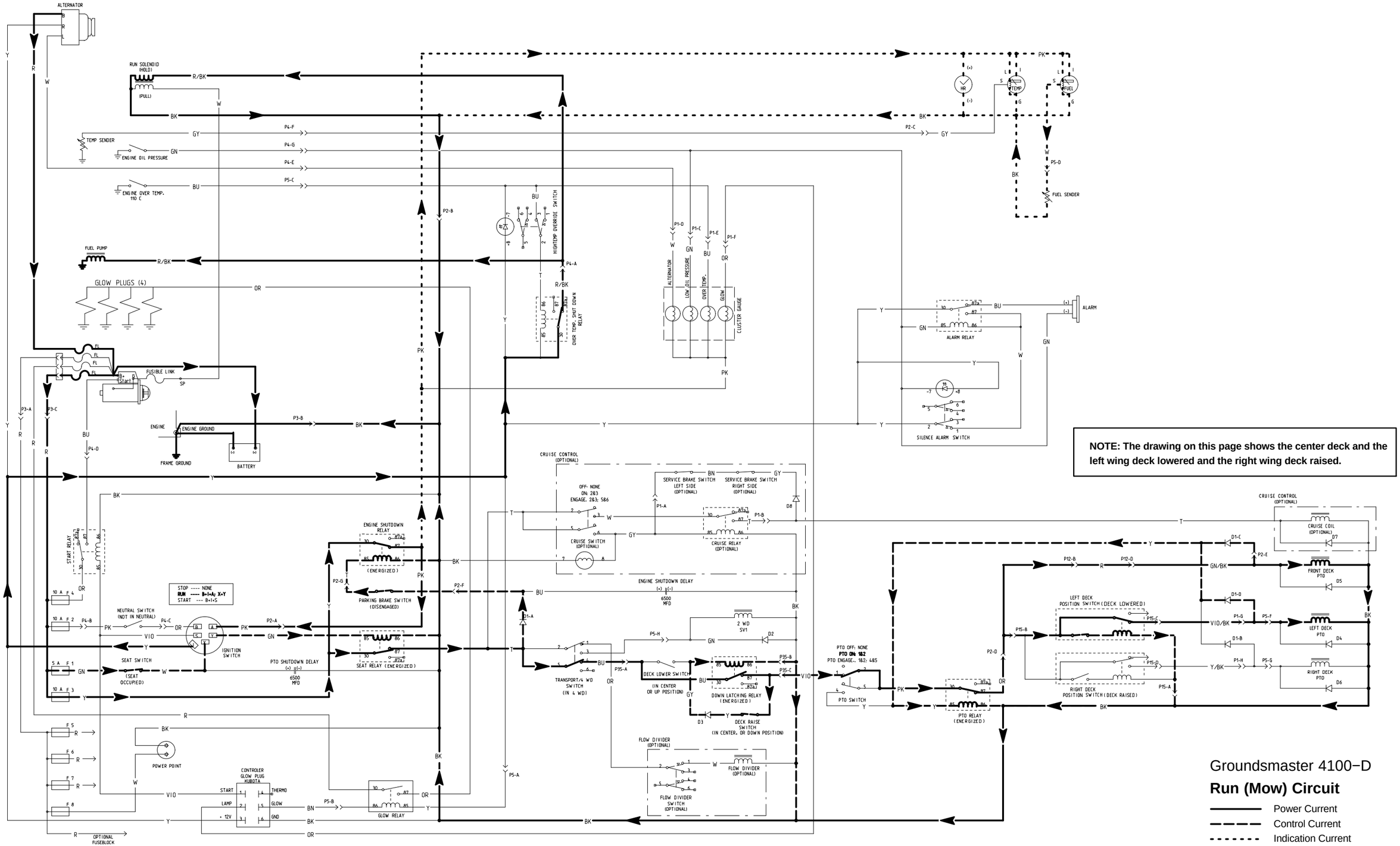
Run (Transport) Circuit

Power Current

Control Current

Indication Current

Logic Direction

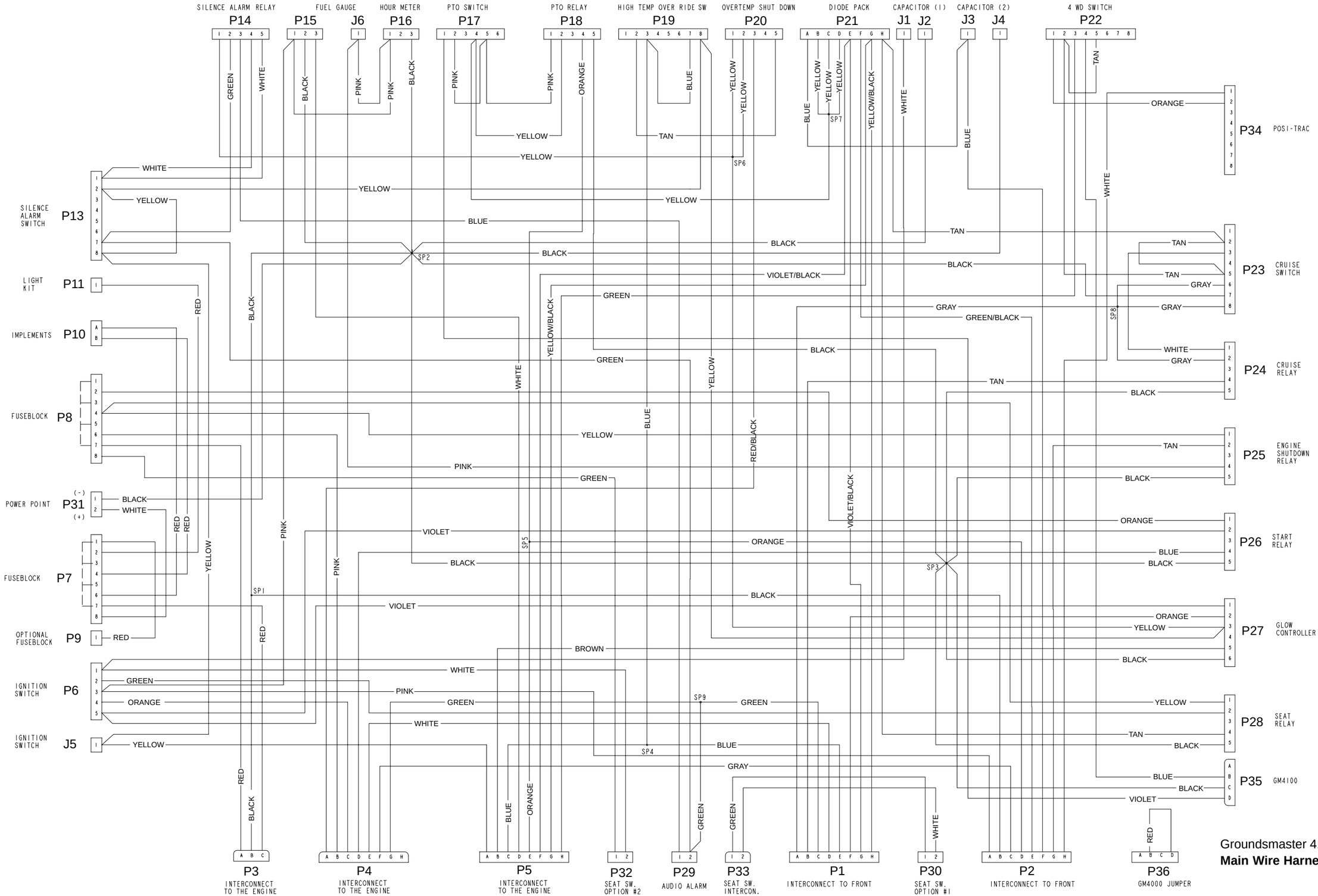


NOTE: The drawing on this page shows the center deck and the left wing deck lowered and the right wing deck raised.

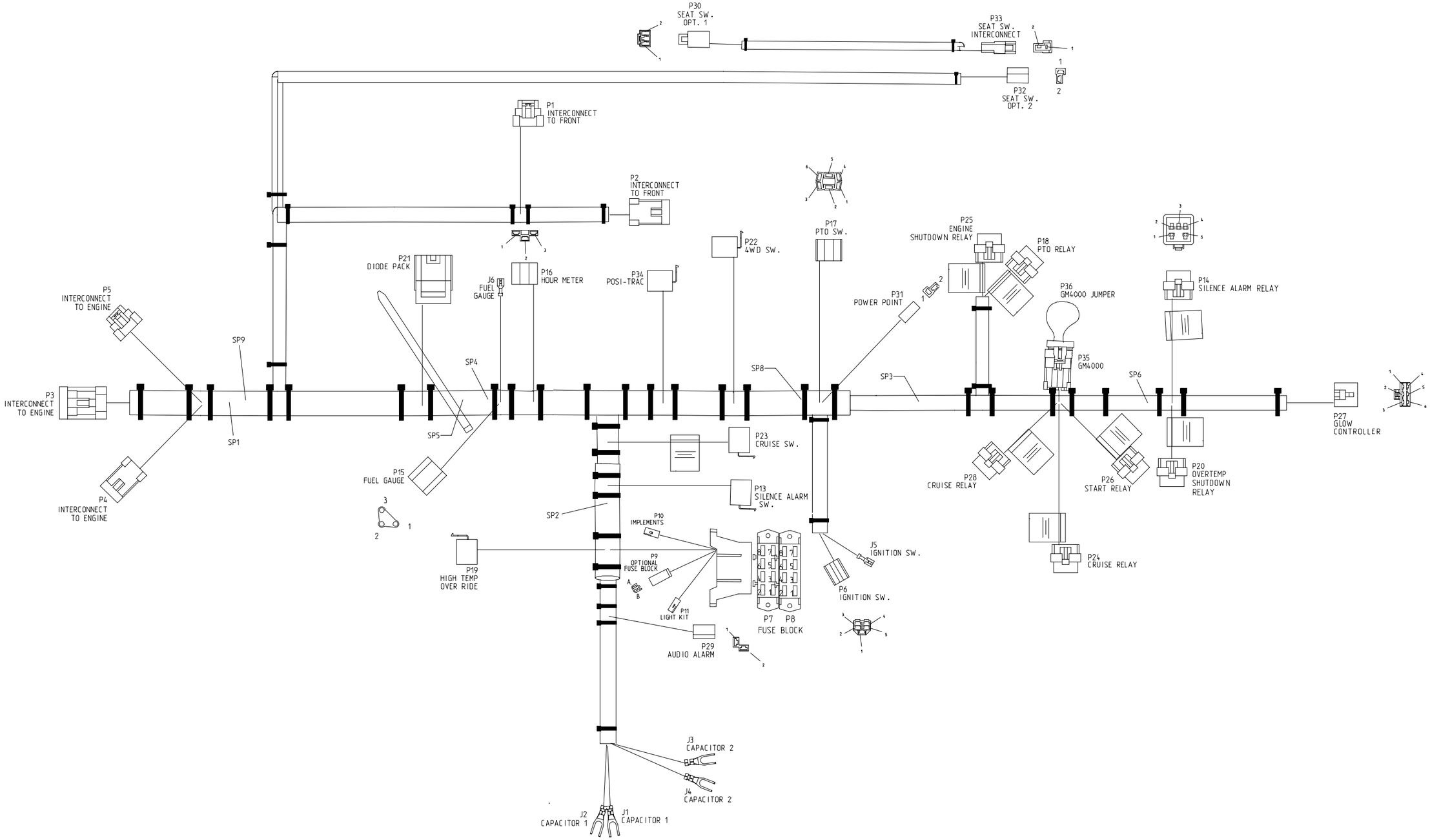
Groundsmaster 4100−D

Run (Mow) Circuit

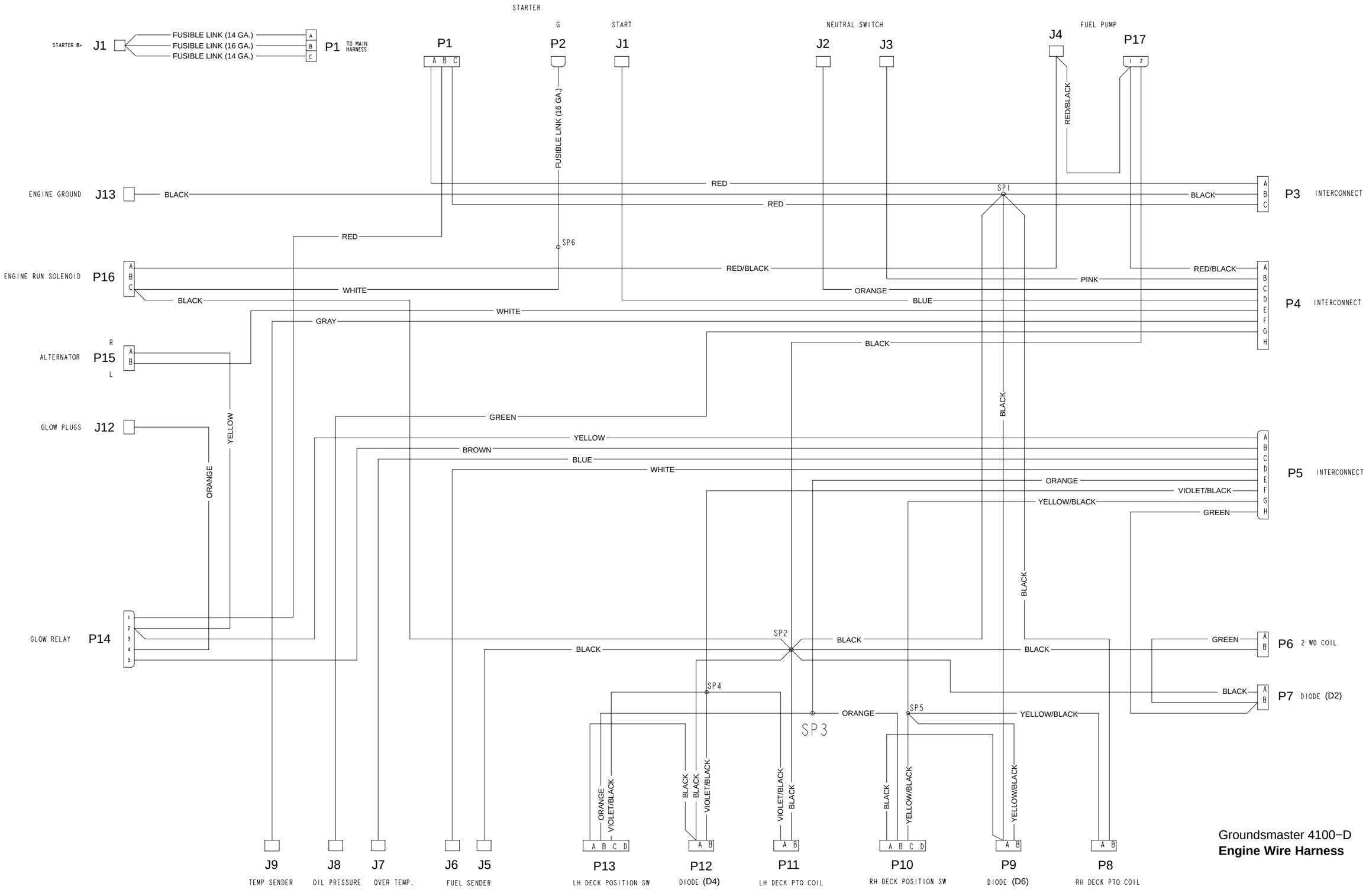
- Power Current
- Control Current
- Indication Current
- Logic Direction



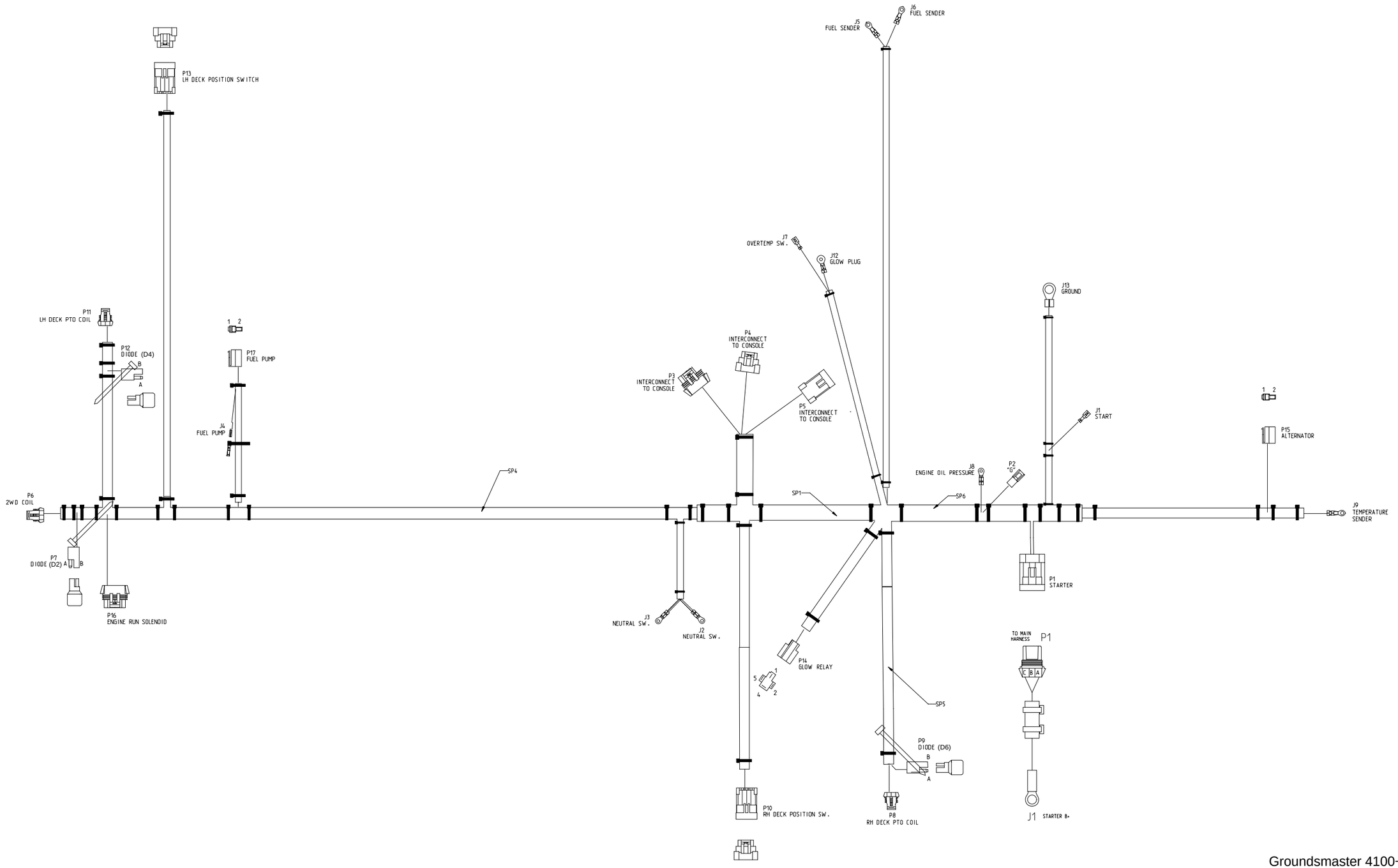
Groundsmaster 4100−D
Main Wire Harness



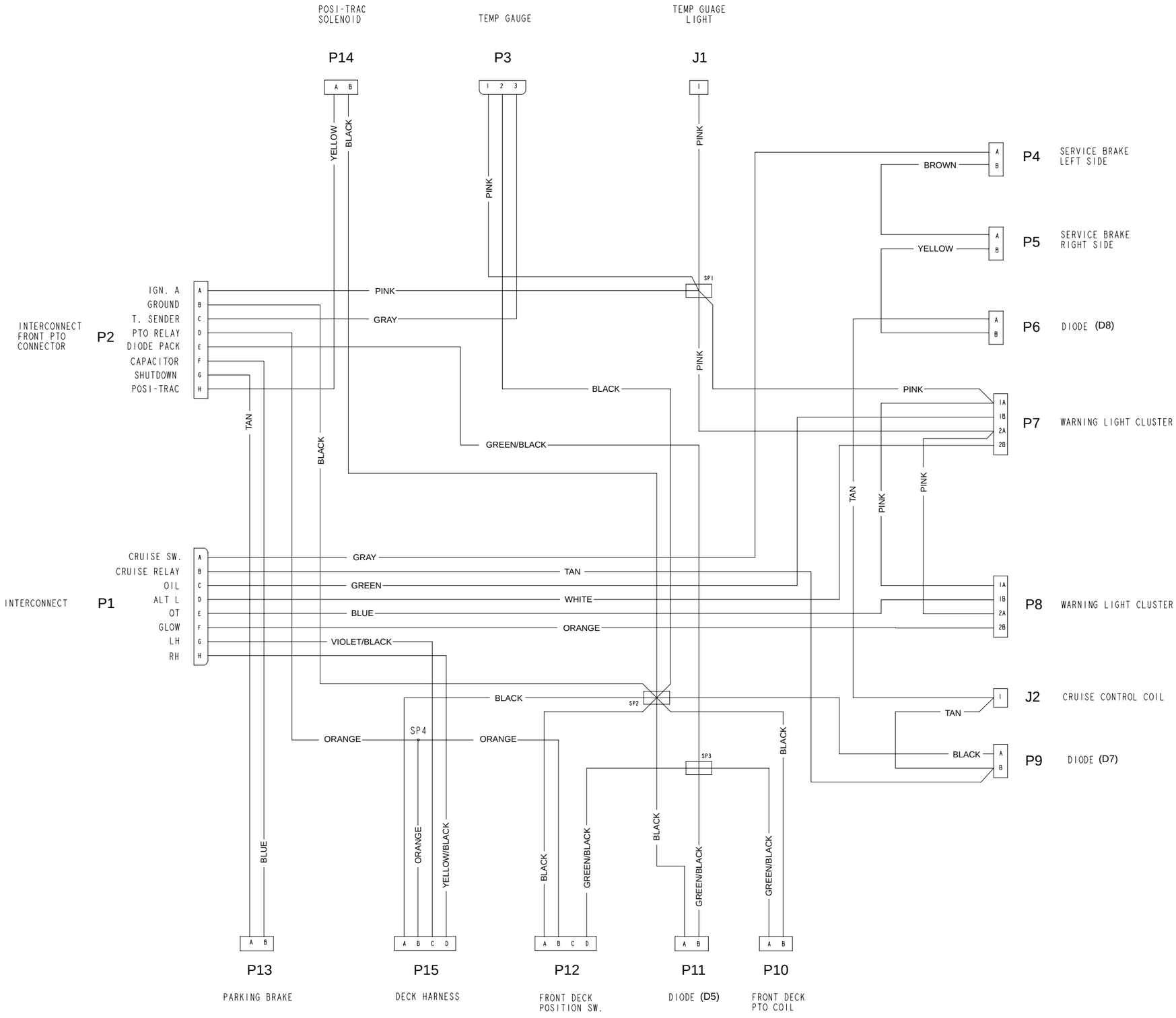
Groundsmaster 4100−D
Main Wire Harness

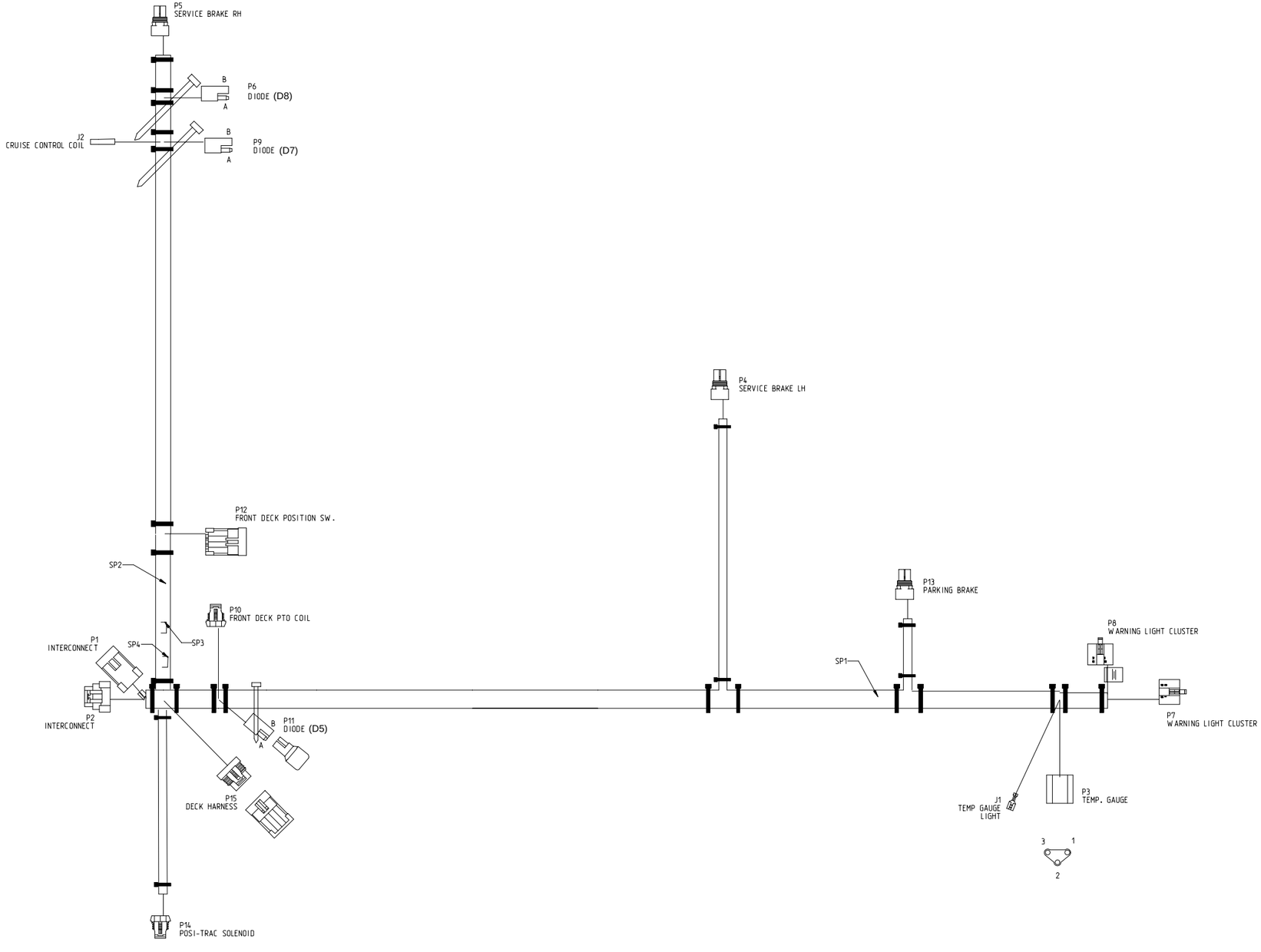


Groundsmaster 4100−D
Engine Wire Harness

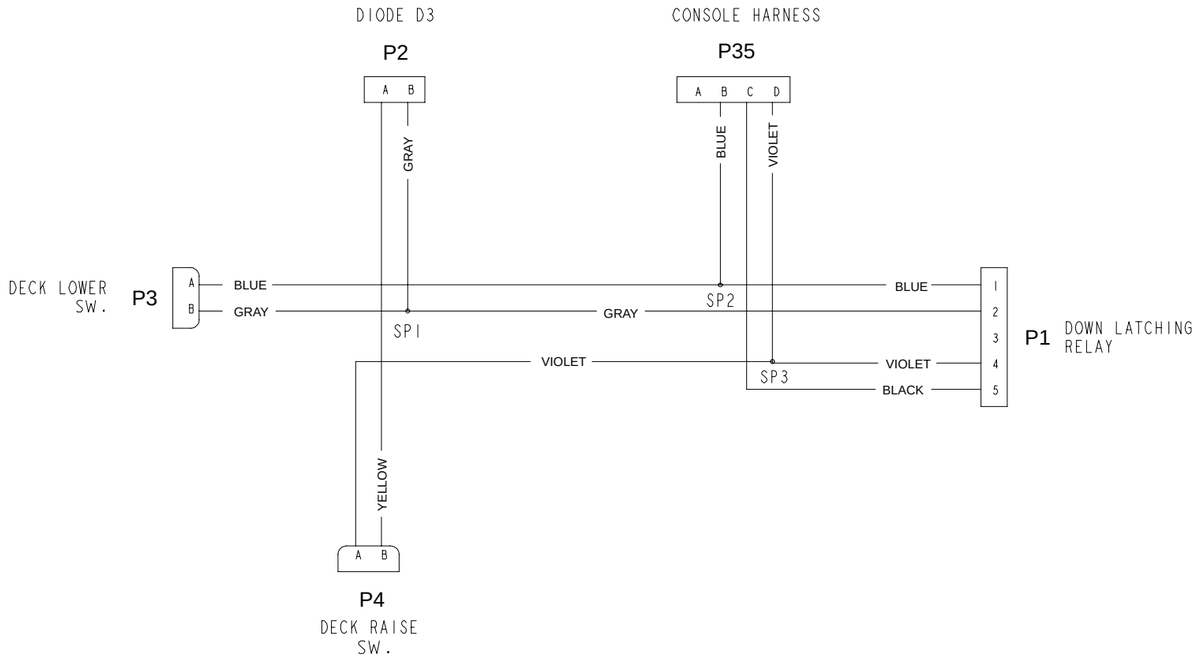


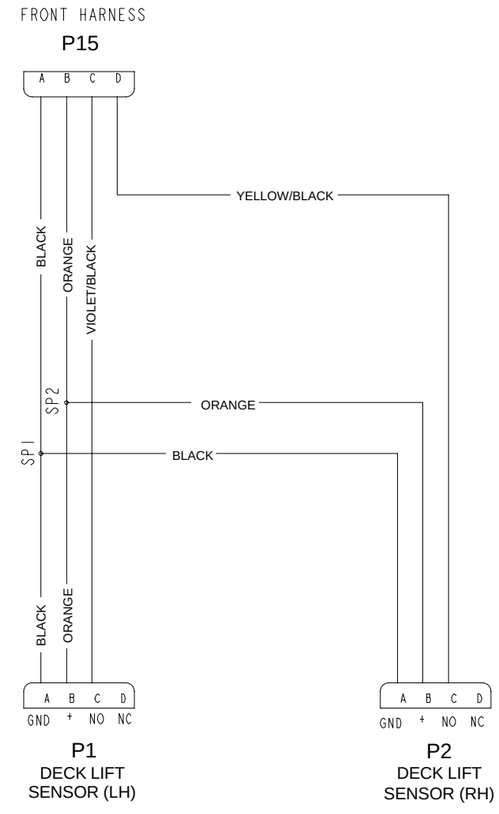
Groundsmaster 4100−D
Engine Wire Harness

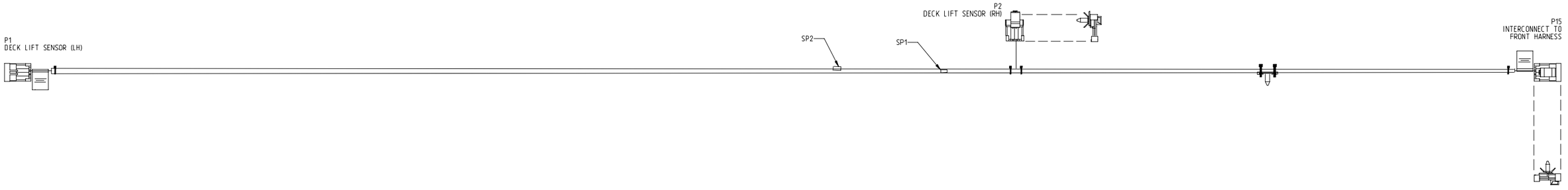

POSI-TRAC SOLENOID
TEMP GAUGE
TEMP GUAGE LIGHT
P14
P3
J1
A B
1 2 3
1
YELLOW
BLACK
PINK
PINK
PINK
P4
SERVICE BRAKE LEFT SIDE
BROWN
P5
SERVICE BRAKE RIGHT SIDE
YELLOW
P6
DIODE (D8)
SP1
INTERCONNECT FRONT PTO CONNECTOR
P2
IGN. A
GROUND
T. SENDER
PTO RELAY
DIODE PACK
CAPACITOR
SHUTDOWN
POSI-TRAC
A
B
C
D
E
F
G
H
PINK
GRAY
BLACK
PINK
GREEN/BLACK
TAN
BLACK
PINK
PINK
P7
WARNING LIGHT CLUSTER
1A
1B
2A
2B
TAN
PINK
PINK
CRUISE SW.
CRUISE RELAY
OIL
ALT L
OT
GLOW
LH
RH
INTERCONNECT
P1
GRAY
TAN
GREEN
WHITE
BLUE
ORANGE
VIOLET/BLACK
P8
WARNING LIGHT CLUSTER
BLACK
SP2
J2
CRUISE CONTROL COIL
TAN
SP4
ORANGE
ORANGE
BLACK
P9
DIODE (D7)
SP3
BLACK
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
PARKING BRAKE
P15
DECK HARNESS
P12
FRONT DECK POSITION SW.
P11
DIODE (D5)
P10
FRONT DECK PTO COIL

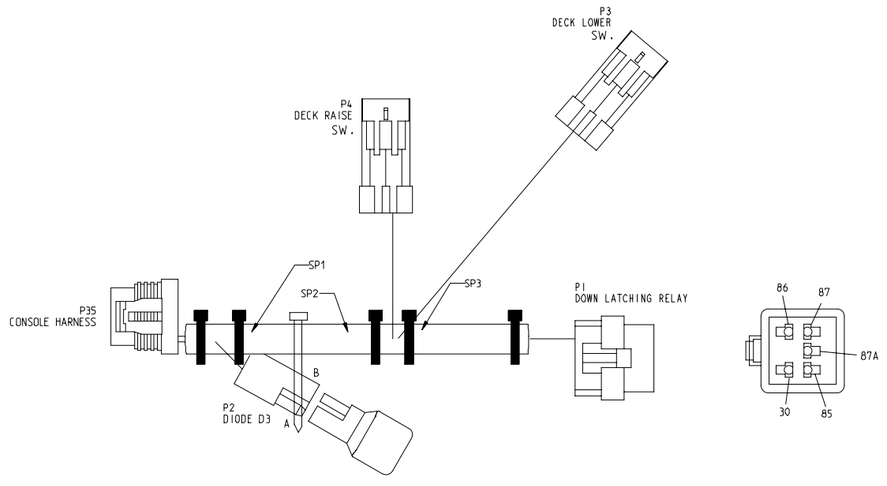


Groundsmaster 4100−D
Front Wire Harness


DIODE D3
P2
A B
GRAY
CONSOLE HARNESS
P35
A B C D
BLUE
VIOLET
DECK LOWER SW.
P3
A
B
BLUE
GRAY
SP1
GRAY
SP2
BLUE
VIOLET
SP3
VIOLET
BLACK
1
2
3
4
5
P1
DOWN LATCHING RELAY
YELLOW
A B
P4
DECK RAISE SW.


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)


P1
DECK LIFT SENSOR (LH)
SP2
SP1
P2
DECK LIFT SENSOR (RH)
P15
INTERCONNECT TO
FRONT HARNESS


P3
DECK LOWER
SW.
P4
DECK RAISE
SW.
SP1
SP2
SP3
P35
CONSOLE HARNESS
B
P2
DIODE D3
A
P1
DOWN LATCHING RELAY
86
87
87A
30
85