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TORO

Count on it.

Service Manual

Multi Pro® 5800

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2011	Initial Issue.
A	2012	Incorporated Ultra Sonic Boom System.
B	02/2018	Added revision history.
C	05/2018	Added VA02 series planetary information.

Reader Comments

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

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NOTES

Service Manual

Multi Pro® 5800

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 Multi Pro 5800.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manual and Parts Catalog for your machine. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

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

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

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

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

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Chapter 1

Safety

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Safety Instructions

The Multi Pro 5800 Turf Sprayer is designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially 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. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

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

3. Assure interlock switches are adjusted correctly so engine cannot be started unless traction pedal is in the NEUTRAL position.

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

   A. Store fuel in containers specifically designed for this purpose.

   B. Do not remove machine 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 the fuel tank.

   E. Wipe up any spilled fuel.

While Operating

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

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure traction pedal is in the NEUTRAL position and the pump switch is OFF.

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

4. Do not touch engine, radiator, 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 the NEUTRAL position.

   B. Set parking brake.

   C. Turn pump switch OFF.

   D. Stop engine and remove key from ignition switch.

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

6. Follow spray chemical manufacturer's recommendations for handling precautions, protective equipment and mixing proportions.

Maintenance and Service

1. Before servicing or making adjustments, turn spray pump off, put traction pedal in neutral, stop engine, set parking brake and remove key from the switch.

2. Prior to servicing sprayer components, determine what chemical(s) have been used in the sprayer. Follow precautions and recommendations printed on chemical container labels or Material Safety Data Sheets when servicing sprayer components. Use appropriate protective equipment: protective clothing, chemical resistant gloves and eye protection.

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

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

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

6. 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.

7. Before disconnecting or performing any work on the hydraulic system, all pressure in hydraulic system must be relieved. To relieve system pressure, rotate steering wheel in both directions after the key switch has been turned off.

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

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

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

11. Do not overspeed the engine. To assure safety and accuracy, check maximum engine speed.

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

13. Disconnect battery before servicing the machine. Disconnect negative (–) battery 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.

14. 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.

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

16. To assure optimum performance and continued safety of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in nonconformance with safety standards and the warranty may be voided.

17. When changing attachments, tires or performing other service, use correct supports, hoists and jacks. Make sure machine is parked on a solid level floor 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 appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury (see Jacking Instructions in this section).

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

Jacking the Front End

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

2. Position jack securely under the front axle, directly beneath the leaf springs (Fig. 1).

3. Jack front of machine off the ground.

4. Position jack stands under the front axle as close to the wheel as possible to support the machine.

Jacking the Rear End

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

2. Place jack securely under the rear most frame supports between the angle welds (Fig. 2).

3. Jack rear of machine off the ground.

4. Position jack stands under the frame to support the machine.

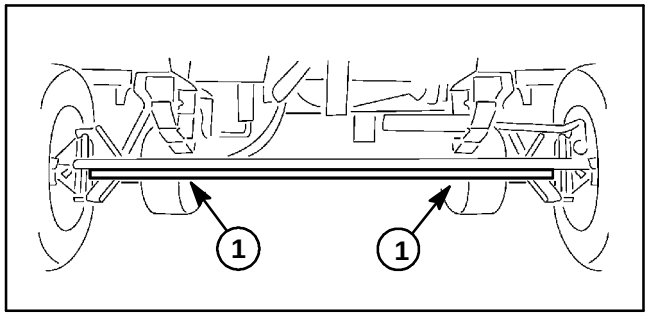

Figure 1

1. Front jacking points

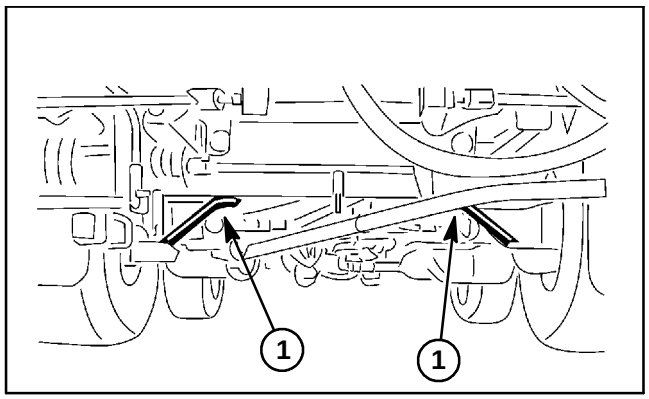

Figure 2

1. Rear jacking points

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Multi Pro 5800. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

Chapter 2

Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Multi Pro 5800 at the end of this chapter. Additionally, if any optional equipment has been installed to your sprayer, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for the Multi Pro 5800 are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance. Several maintenance procedures have break–in intervals identified in the Operator's Manual. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

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

U.S.to Metric Conversions

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

Torque Specifications

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

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

As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on the aluminum or brass material strength, fastener size, length of thread engagement, etc.

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

Fastener Identification

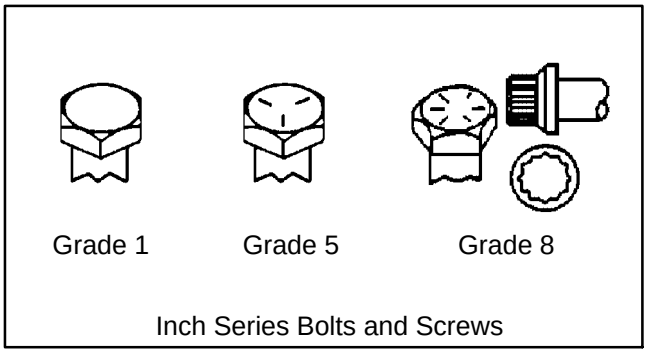

Figure 1

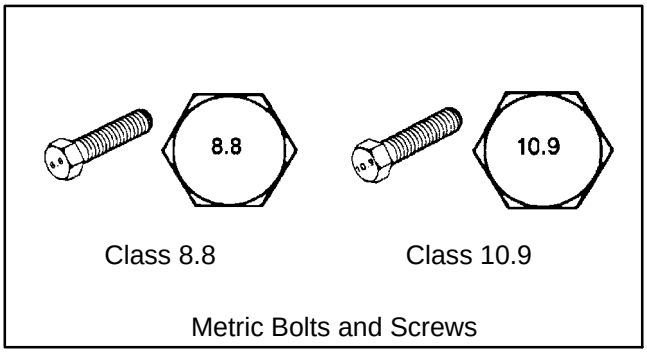

Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

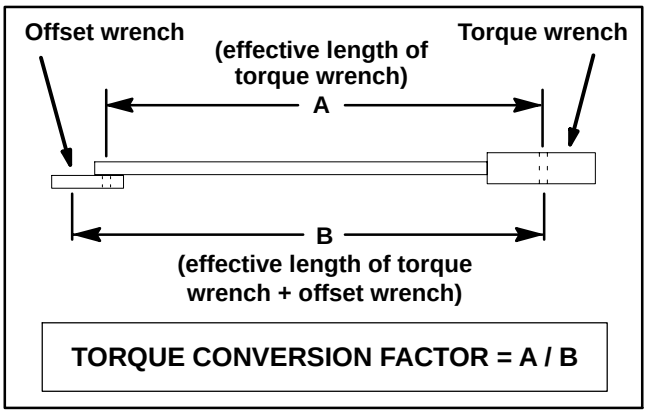

Figure 3

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

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 (e.g. 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 Fasteners)

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 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 (e.g. 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 & finish must be considered when determining specific torque values. All torque values are based on non–lubricated fasteners.

Conversion Factors

in–lb X 11.2985 = N–cm
ft–lb X 1.3558 = N–m

N–cm X 0.08851 = in–lb
N–m X 0.7376 = ft–lb

Chapter 3

Kubota Diesel Engine

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General Information

This Chapter gives information about specifications, adjustments and repair of the Kubota Diesel engine that powers the Multi Pro 5800.

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 (05–E3B Series) that is included at the end of this chapter.

Most engine repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual (05–E3B Series). 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.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the Kubota diesel engine that powers your Multi Pro machine. Refer to that publication for additional information when servicing the machine.

Specifications

Item	Description
Make / Designation	V1505–E3B–TORO, Kubota, 4–Cycle, 4 Cylinder, Water Cooled, Diesel Engine
Bore x Stroke	3.07 in x 3.09 in (78 mm x 78.4 mm)
Total Displacement	91.4 in^3 (1498 cc)
Compression Ratio	23:1
Firing Order	1 (fan end) – 3 – 4 (flywheel end) – 2
Fuel	No. 2–D Diesel Fuel (ASTM D975)
Fuel Injection Pump	Bosch MD Type Mini Pump
Injection Nozzles	Mini Nozzle (DNOPD)
Fuel Tank Capacity	10.6 U.S. gallons (40 liters)
Governor	Centrifugal Mechanical
Low Idle (no load)	1200 to 1300 RPM
High Idle (no load)	3050 to 3150 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Engine Oil	API Classification CH–4, CI–4 or Higher (see Operator's Manual for viscosity recommendations)
Oil Pump	Trochoid Type
Crankcase Oil Capacity (approximate)	4.9 U.S. quarts (4.7 liters) with Filter
Cooling System Capacity (approximate) (including reserve tank)	8 U.S. quarts (7.6 liters)
Starter	12 VDC, 1 KW
Alternator/Regulator	12 VDC 40 AMP
Engine Dry Weight (approximate)	242 lbs (110 kg)

Adjustments

Adjust Throttle Cable

Proper throttle operation is dependent upon proper adjustment of throttle cable.

NOTE: The throttle cable swivel should be positioned in the lowest hole in the speed control lever.

1. Move throttle control lever on control console to **FAST** position.

2. Check position of the engine speed control lever on fuel injection pump. The speed control lever should be contacting the high speed screw when the throttle control lever is in the **FAST** position.

3. If necessary, throttle cable can be adjusted by loosening cable clamp screw and repositioning cable until speed control lever contacts high speed screw when the throttle control lever is in the **FAST** position. Tighten cable clamp screw after adjustment has been completed.

4. After securing cable clamp, make sure that cable adjustment is still correct.

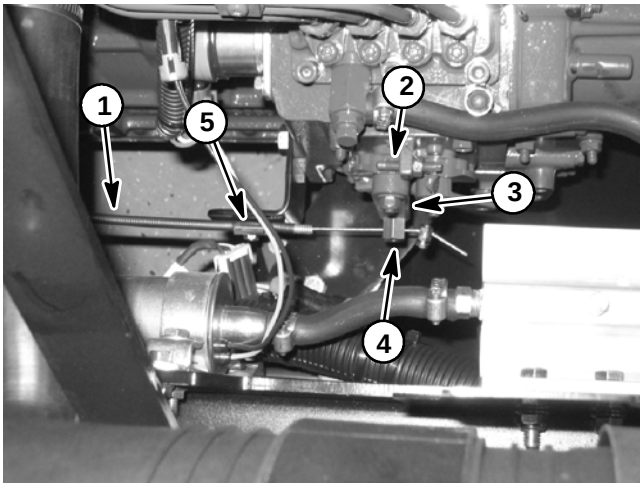

Figure 1

1. **Throttle cable**
2. **High speed screw**
3. **Speed control lever**
4. **Throttle swivel**
5. **Cable clamp**

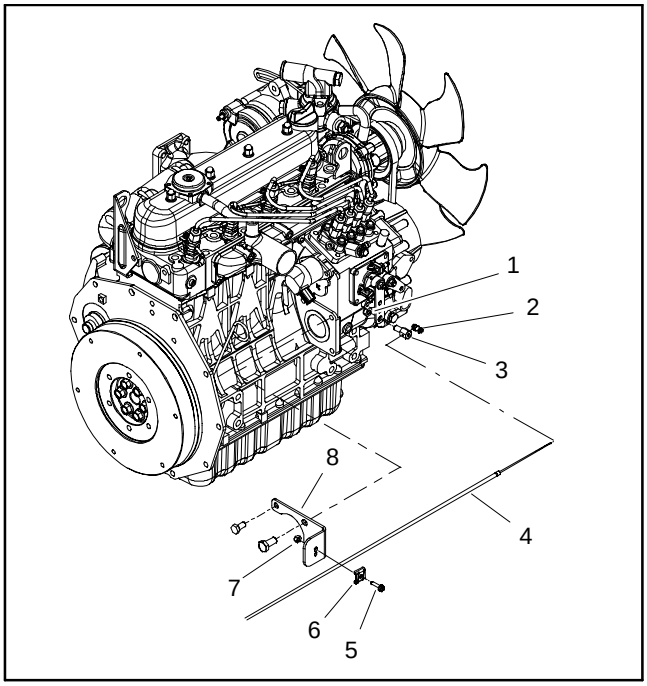

Figure 2

1. **Lock nut**
2. **Cable stop**
3. **Throttle swivel**
4. **Throttle cable**
5. **Washer head screw**
6. **Cable clamp**
7. **Lock nut**
8. **Cable bracket**

Fuel System

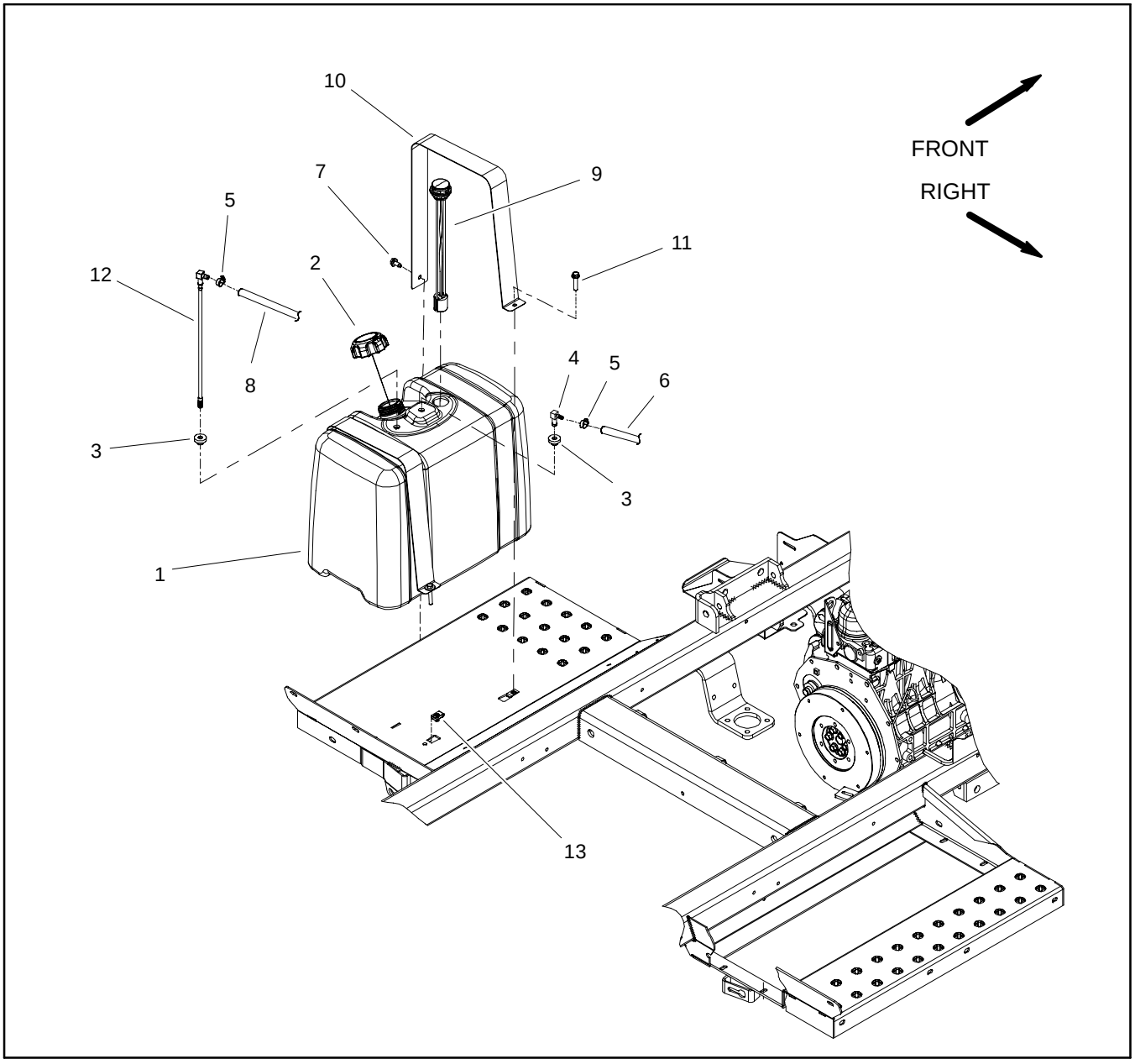

Figure 3

1. **Fuel tank**
2. **Fuel cap**
3. **Bushing (2 used)**
4. **Elbow fitting**
5. **Hose clamp (2 used)**
6. **Fuel return hose**
7. **Washer head screw (2 used)**
8. **Fuel supply hose**
9. **Fuel gauge**
10. **Fuel tank strap (2 used)**
11. **Flange head screw (2 used)**
12. **Standpipe (fuel supply)**
13. **U-nut (2 used)**

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 fuel before starting the engine. Store fuel in a clean, safety-approved container and keep cap in place. Use diesel fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

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

Empty and Clean Fuel Tank

Empty and clean the fuel tank 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 solvent. Make sure tank is free of contaminates and debris.

Fuel Tank Removal (Fig. 3)

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

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

3. Loosen hose clamps that secure supply and return hoses to tank. Remove hoses from tank.

4. Remove fuel tank from machine using Figure 3 as a guide.

5. If necessary, remove fuel hoses from machine. Note fuel hose routing for assembly purposes (Fig. 4).

Fuel Tank Installation (Fig. 3)

1. Install fuel tank to machine using Figure 3 as a guide.

2. If fuel hoses were removed, route fuel hoses through R-clamps on frame and connect to proper engine and fuel tank fittings. Secure hoses with hose clamps. Make sure that clearance exists between fuel hoses and machine components along full length of hoses.

3. Fill fuel tank.

4. Start engine and check fuel line connections for any leakage.

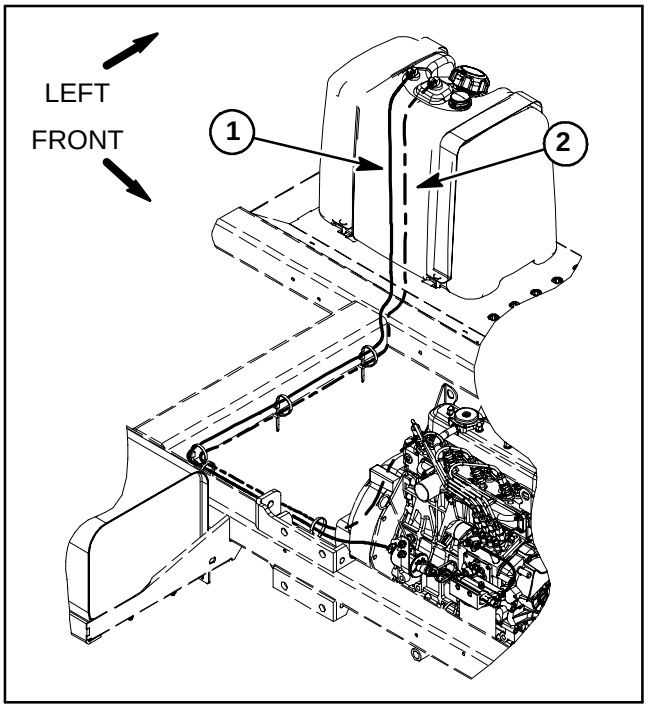

Figure 4

1. Fuel supply hose **2. Fuel return hose**

Air Cleaner

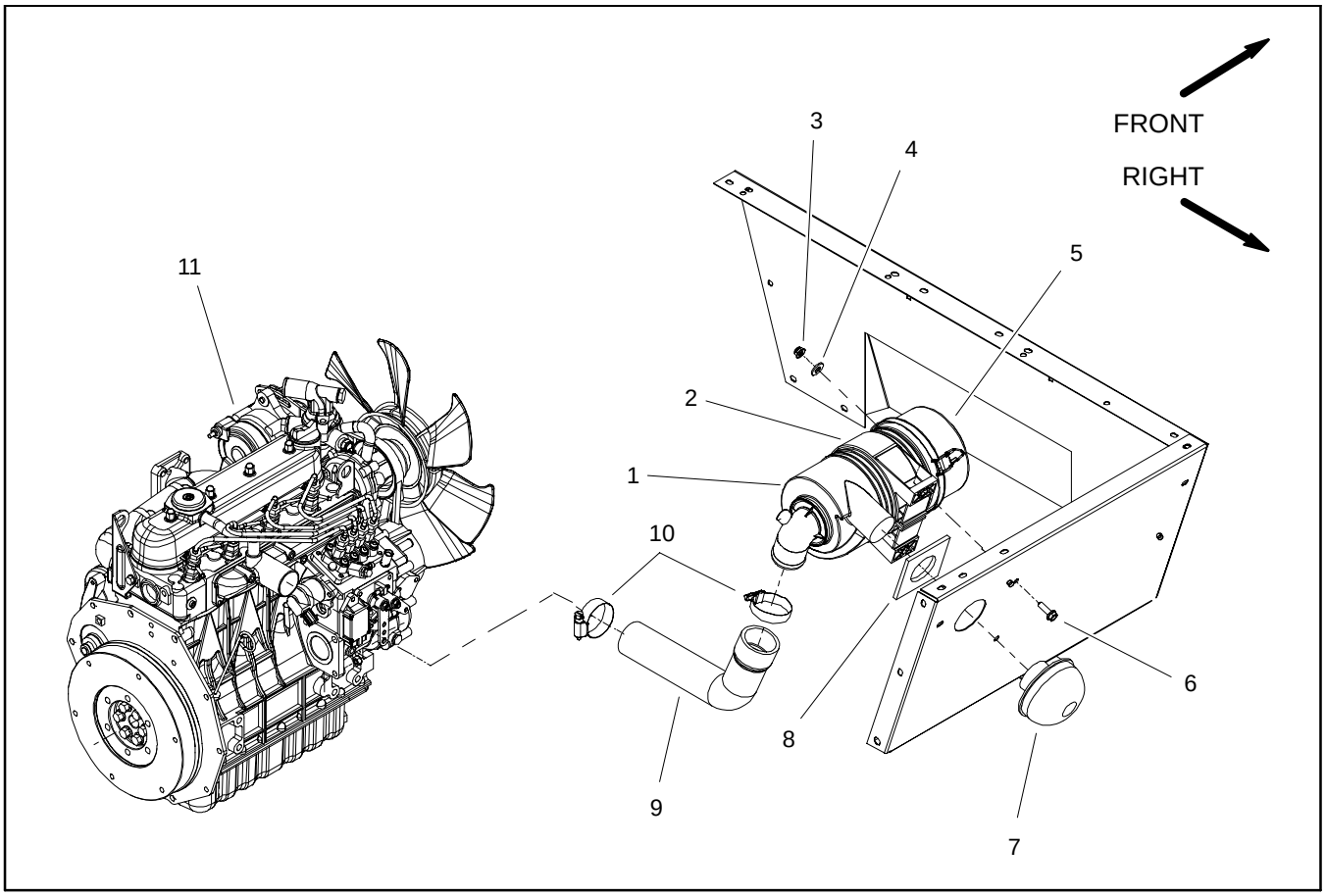

Figure 5

1. **Air cleaner housing**
2. **Mounting band**
3. **Flange nut (2 used)**
4. **Flat washer (2 used)**
5. **Air cleaner cover**
6. **Flange head screw (2 used)**
7. **Air cleaner cap**
8. **Foam seal**
9. **Air cleaner hose**
10. **Hose clamp**
11. **Engine assembly**

Removal (Fig. 5)

NOTE: For air cleaner maintenance information, refer to the Operator's Manual.

1. Raise passenger seat to access air cleaner assembly.

2. Remove air cleaner components as needed using Figure 5 as a guide.

Installation (Fig. 5)

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

1. Assemble air cleaner system using Figure 5 as a guide. Make sure that vacuator valve on air cleaner cover points downward after assembly (Fig. 6).

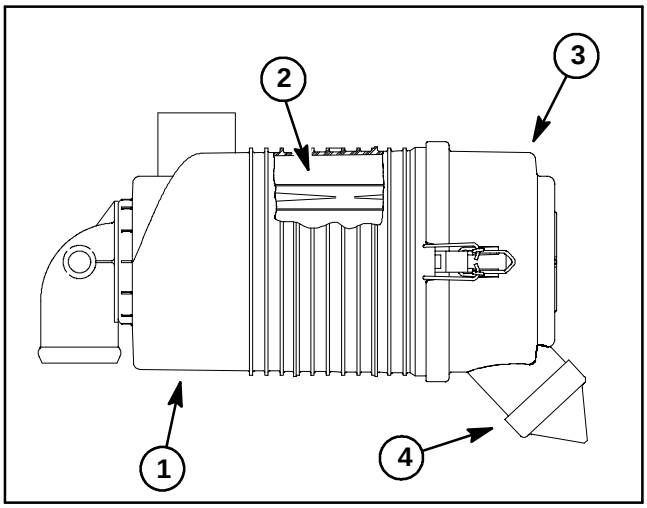

Figure 6

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

Exhaust System

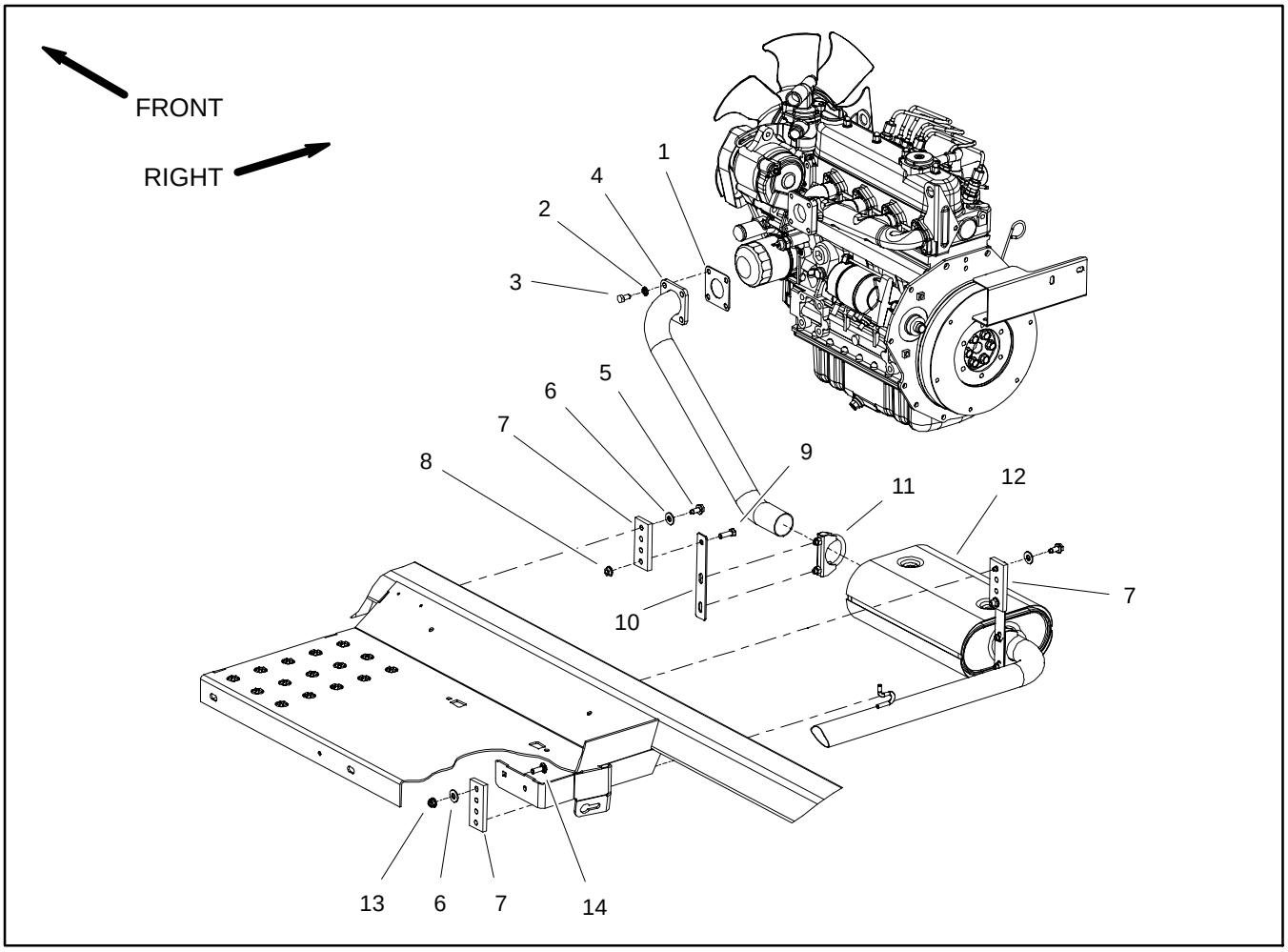

Figure 7

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

Removal (Fig. 7)

CAUTION

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

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

2. Support muffler from below to prevent it from falling.

3. Remove exhaust system components as required using Fig. 7 as a guide. During removal, note location of fasteners in rubber exhaust system hangers so hangers are properly assembled.

4. Locate and retrieve muffler gasket if exhaust pipe was removed.

5. Remove hangers and brackets from exhaust components as needed.

Installation (Fig. 7)

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.

1. Install all removed hangers and brackets to exhaust components.

2. Make sure that gasket surfaces on engine exhaust manifold and exhaust pipe are clean.

3. Install all removed exhaust system components using Fig. 7 as a guide.

   A. During exhaust installation, finger tighten all exhaust system components before fully tightening any of the fasteners.

   B. Install rubber exhaust system hangers as noted during exhaust system removal.

   C. Make sure that tailpipe outlet is parallel to the ground.

   D. Tighten muffler clamps last to secure exhaust components.

Radiator

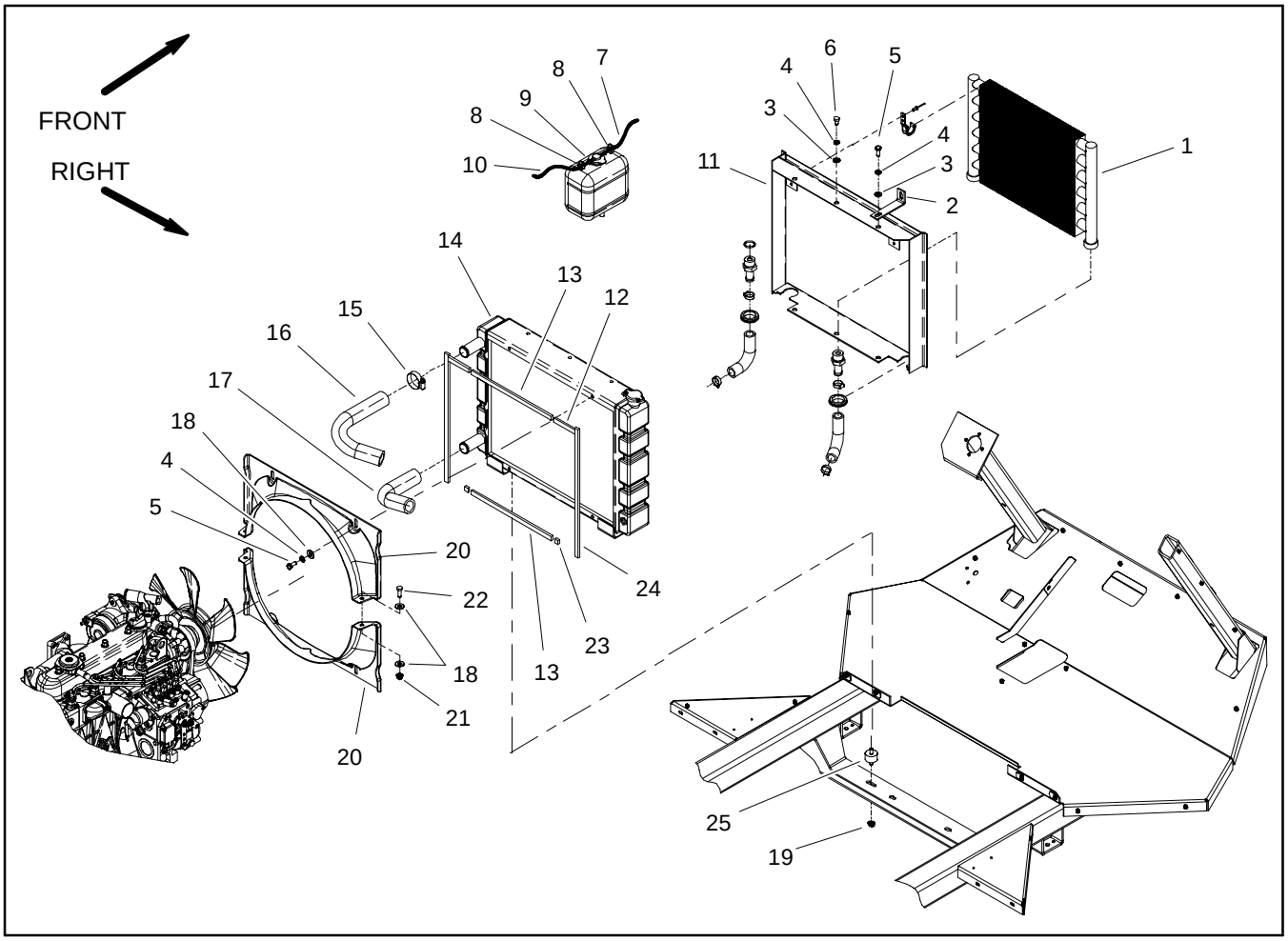

Figure 8

1. **Oil cooler**
2. **Radiator brace (2 used)**
3. **Flat washer**
4. **Lock washer**
5. **Cap screw (6 used)**
6. **Cap screw (4 used)**
7. **Overflow hose**
8. **Hose clamp**
9. **Overflow bottle**
10. **Hose**
11. **Radiator shroud**
12. **Foam seal (2 used)**
13. **Foam seal**
14. **Radiator**
15. **Hose clamp**
16. **Upper radiator hose**
17. **Lower radiator hose**
18. **Flat washer**
19. **Flange nut (2 used)**
20. **Fan shroud**
21. **Flange nut**
22. **Cap screw (2 used)**
23. **Foam seal (2 used)**
24. **Foam seal (4 used)**
25. **Isomount (2 used)**

Removal (Fig. 8)

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. Raise seats of machine to allow access to engine compartment.

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.

2. Drain radiator into a suitable container using the radiator drain.

3. Loosen hose clamps that secure upper and lower radiator hoses to radiator. Disconnect hoses from the radiator.

4. Loosen hose clamp that secures overflow hose to radiator flange. Slide overflow hose from radiator flange and position hose away from radiator.

5. Remove six (6) cap screws (items 5 and 6), lock washers and flat washers that secure radiator shroud (item 11) to radiator.

6. Remove carriage screws and flange nuts that secure seat belt bracket assemblies to seat box (Fig. 9). Remove both bracket assemblies from seat box.

7. Remove fasteners that secure console assembly to seat box assembly (Fig. 9). Carefully pivot console assembly rearward to allow radiator access. Take care to not damage the wire harness or throttle cable. Support console to prevent it from shifting or falling.

8. Remove four (4) cap screws (item 5), lock washers and flat washers that secure fan shroud assembly to radiator.

9. Remove two (2) cap screws (item 22), flat washers and flange nuts that attach fan shrouds.

10. Carefully lift upper fan shroud from machine.

11. Remove two (2) flange nuts (item 19) that secure the isomounts on the bottom of the radiator to the machine frame.

12. Carefully lift radiator up from machine.

Installation (Fig. 8)

1. Replace any foam seal pieces that are damaged or deteriorated.

2. Make sure that lower fan shroud is positioned below fan.

3. Carefully lower radiator to the machine frame. Secure isomounts on the bottom of the radiator to the machine frame with two (2) flange nuts.

4. Position upper fan shroud to radiator. Secure upper shroud to lower shroud with cap screws (item 22), flat washers and flange nuts.

5. Secure fan shroud assembly to radiator with four (4) cap screws (item 5), lock washers and flat washers. Make sure that clearance exists between fan shrouds and fan at all points before tightening fasteners.

6. Connect lower and upper hoses to the radiator. Secure hoses with hose clamps.

7. Carefully pivot console assembly back in position taking care to not damage wire harness or throttle cable. Install fasteners to secure console assembly to seat box assembly.

8. Secure both seat belt bracket assemblies to seat box with carriage screws and flange nuts (Fig. 9).

9. Secure radiator shroud (item 11) to radiator with six (6) cap screws (items 5 and 6), lock washers and flat washers.

10. Place overflow hose to radiator flange and secure with hose clamp.

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

12. Check position of electrical wires, hydraulic hoses and control cables for proper clearance with rotating, high temperature and moving components.

13. Start engine and check for proper operation. Check all coolant hose connections for leaks.

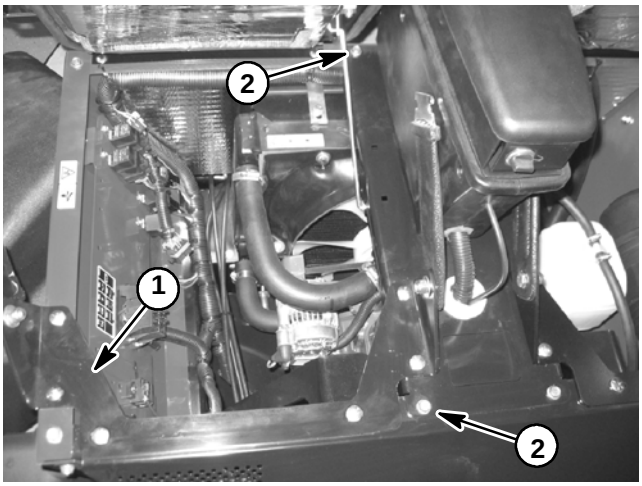

Figure 9

1. Seat belt bracket **2. Console fastener**

Engine

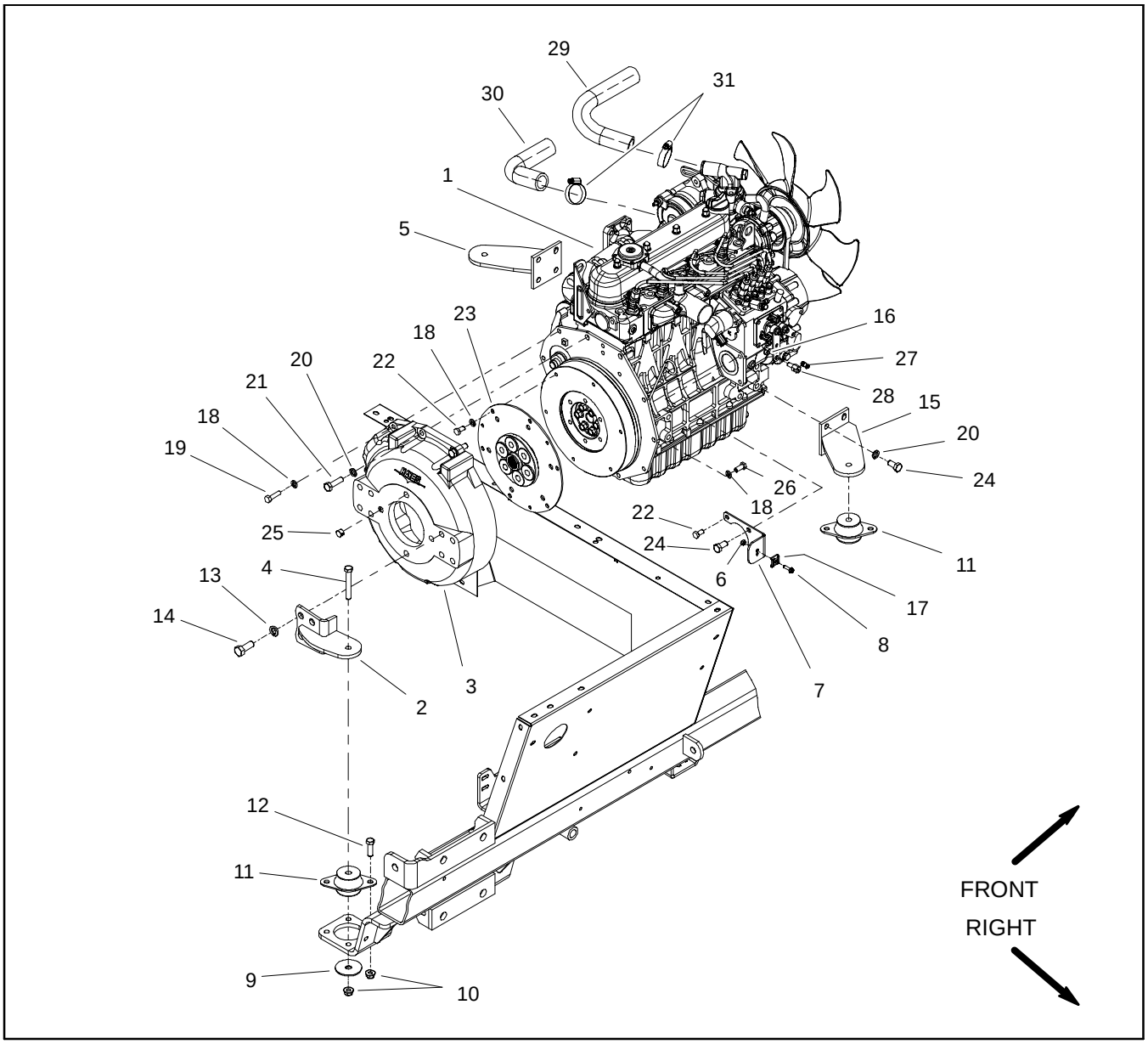

Figure 10

1. **Engine assembly**
2. **Rear engine bracket (2 used)**
3. **Flywheel housing**
4. **Cap screw (4 used)**
5. **LH front engine bracket**
6. **Lock nut**
7. **Throttle cable bracket**
8. **Washer head screw**
9. **Snubbing washer (4 used)**
10. **Flange nut (3 used per mount)**
11. **Engine mount (4 used)**
12. **Cap screw (2 used per mount)**
13. **Lock washer (4 used per bracket)**
14. **Cap screw (4 used per bracket)**
15. **RH front engine bracket**
16. **Lock nut**
17. **Cable clamp**
18. **Lock washer (14 used)**
19. **Cap screw (6 used)**
20. **Lock washer (10 used)**
21. **Cap screw (2 used)**
22. **Cap screw (7 used)**
23. **Flywheel coupler**
24. **Cap screw (9 used)**
25. **Plastic plug (2 used)**
26. **Cap screw (2 used)**
27. **Throttle cable stop**
28. **Throttle cable swivel**
29. **Upper radiator hose**
30. **Lower radiator hose**
31. **Hose clamp**

Engine Removal (Fig. 10)

1. Park machine on a level surface, stop engine and remove key from the ignition switch. Raise machine to allow engine to be lowered from frame.

2. Disconnect negative (–) and then positive (+) battery cables from the battery.

3. Loosen hose clamps that secure air cleaner hose to engine air intake and air cleaner assembly (see Air Cleaner Removal in this section). Remove air cleaner hose.

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.

5. Remove upper and lower radiator hoses from engine.

CAUTION

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

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

7. Disconnect wire harness connectors from engine electrical components. Position harness away from engine.

NOTE: Label all wire harness connectors for assembly purposes.

A. Remove positive battery cable, cable to accessory solenoid and fusible link connector from electric starter motor solenoid stud (Fig. 11). Remove cable tie that secures fusible link connector to starter.

B. Disconnect wire harness white wire and blue wire connectors from starter motor.

C. Remove cap screw and lock washer that secure negative battery cable and wire harness ground wire to engine (Fig. 11).

D. Remove wire harness orange wire from glow plug terminal (Fig. 12).

E. Disconnect wire harness blue wire from temperature sender (Fig. 12).

F. Remove cable from alternator stud and disconnect wire harness connector from alternator (Fig. 13).

G. Disconnect wire harness brown wire from oil pressure switch.

H. Disconnect wire harness connector from fuel stop solenoid (Fig. 14).

8. Clamp fuel supply hose after the fuel/water separator to prevent leakage (Fig. 14). Disconnect fuel supply hose from the fuel injector pump on engine. Position disconnected fuel hose away from engine.

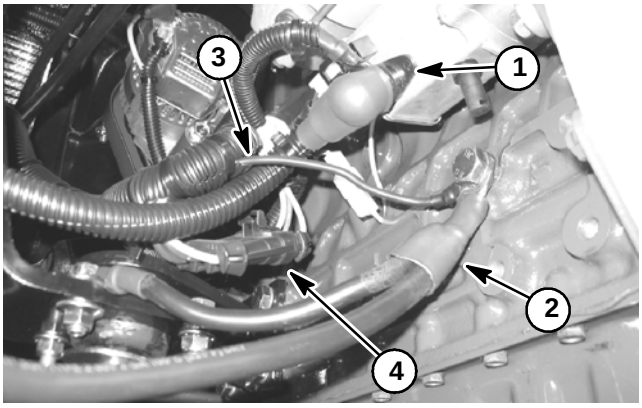

Figure 11

1. **Starter motor stud**
2. **Negative battery cable**
3. **Harness ground wire**
4. **Fusible link connector**

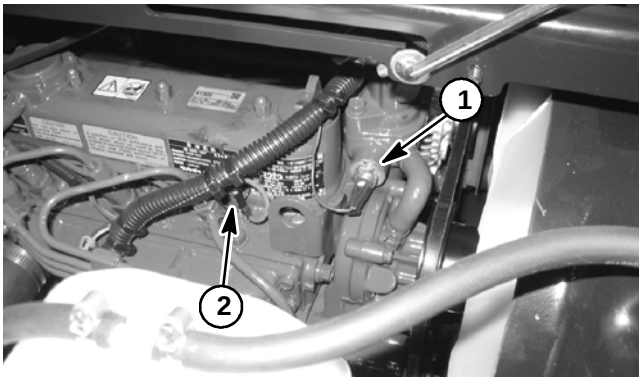

Figure 12

1. **Temperature sender**
2. **Glow plug terminal**

IMPORTANT: During hydraulic pump removal, support pump assembly to prevent it from falling and being damaged.

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

10. Remove throttle cable from injector pump (Fig. 15):

A. Loosen screw that secures cable stop on throttle cable. Slide cable stop from cable.

B. Loosen cable clamp and remove throttle cable from under clamp.

C. Slide cable end out of swivel and position throttle cable away from the engine.

11. Note location of any cable ties used to secure the wiring harness, fuel lines or hydraulic hoses to the engine assembly. Remove cable ties attached to engine assembly.

IMPORTANT: During engine removal, support engine assembly to prevent it from falling and being damaged.

12. Remove flange nuts, snubbing washers and cap screws securing the engine brackets to the machine frame.

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine assembly weighs approximately 275 pounds (125 kg).

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

13. Using a hoist or lift, carefully lower engine from the machine.

14. If necessary, remove engine brackets from the engine and engine mounts from frame.

Engine Installation (Fig. 10)

1. Locate machine on a level surface with key removed from the ignition switch. Raise machine to allow engine to be raised into frame.

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

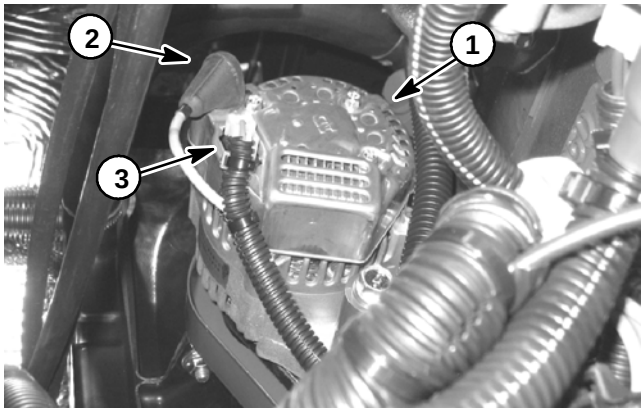

Figure 13

1. Alternator
2. Alternator stud
3. Harness connector

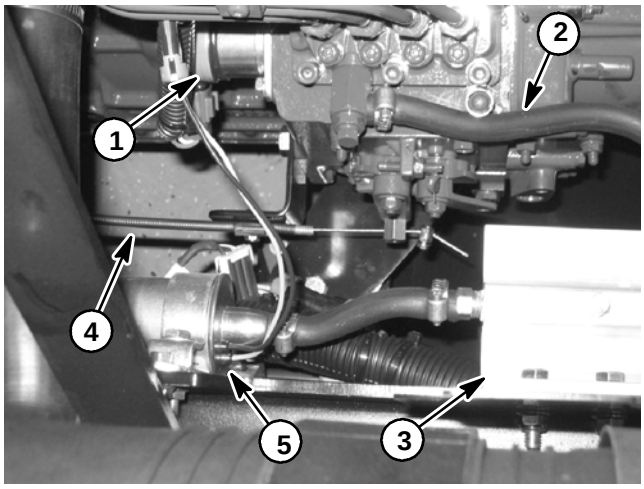

Figure 14

1. Fuel stop solenoid
2. Fuel supply hose
3. Water/fuel filter
4. Throttle cable
5. Fuel pump

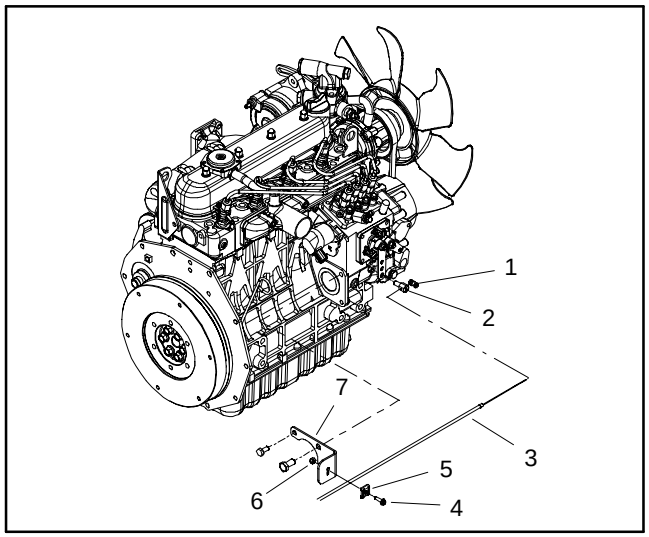

Figure 15

1. Cable stop
2. Throttle swivel
3. Throttle cable
4. Washer head screw
5. Cable clamp
6. Lock nut
7. Cable bracket

3. If engine brackets were removed from engine, secure brackets to engine with cap screws and lock washers.

4. If engine mounts were removed from frame, secure mounts to frame with cap screws and flange nuts.

IMPORTANT: During engine installation, make sure to support engine to prevent it from falling and being damaged.

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

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine assembly weighs approximately 275 pounds (125 kg).

5. Using a hoist or lift, carefully raise engine assembly from under machine and position to frame. Insert cap screws through engine brackets and motor mounts from above. Install flange nuts on cap screws and tighten nuts.

6. Using labels placed during engine removal, connect machine wire harness to engine electrical components (see step 7 in removal procedure).

7. Connect fuel supply hose to the fuel injector pump on engine (Fig. 14). Remove clamp from fuel hose that was placed to prevent leakage during engine removal.

8. Connect throttle cable to injector pump (Fig. 15):

   A. Position throttle cable to engine.

   B. Insert the throttle cable end into the swivel in speed control lever. Slide cable stop onto cable end and secure with screw.

   C. Position throttle cable under cable clamp.

   D. Adjust throttle control cable (see Adjust Throttle Control Cable in the Adjustments section of this chapter).

9. Install upper and lower radiator hoses to engine. Secure hoses with hose clamps.

IMPORTANT: During hydraulic pump installation, support pump to prevent it from falling and being damaged.

10. Install hydraulic pump assembly to engine (see Piston (Traction) Pump Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

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

11. Install air cleaner hose to engine and air cleaner assembly (see Air Cleaner Installation in this section). Make sure that hose clamps are properly tightened.

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

13. Install cable ties to secure the wiring harness, fuel lines and hydraulic hoses to the engine assembly using notes taken during engine removal.

14. Properly fill the radiator with coolant.

15. Check engine oil level and adjust if necessary.

16. Connect positive (+) and then negative (–) battery cables to the battery.

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

18. Start engine and check for proper operation. Check all hose connections for leaks. Check engine speed.

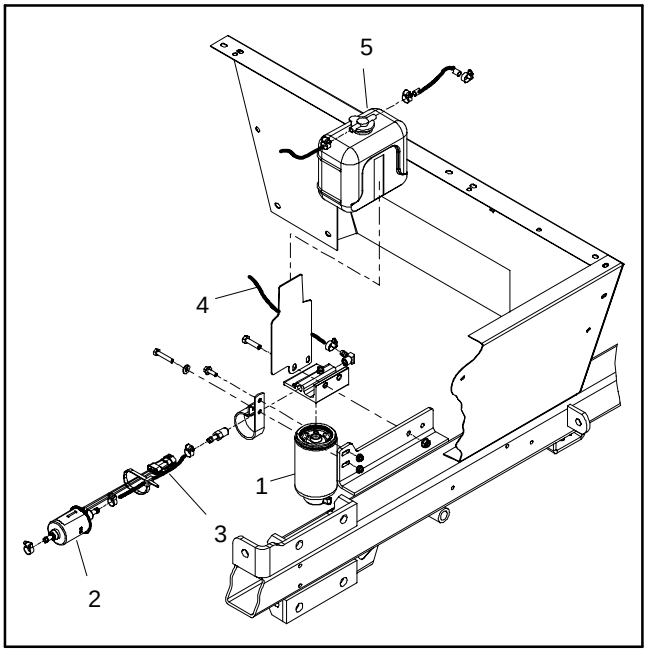

Figure 16

1. **Fuel/water separator**
2. **Fuel pump**
3. **Fuel supply hose**
4. **Fuel supply hose**
5. **Coolant overflow bottle**

Flywheel Coupler

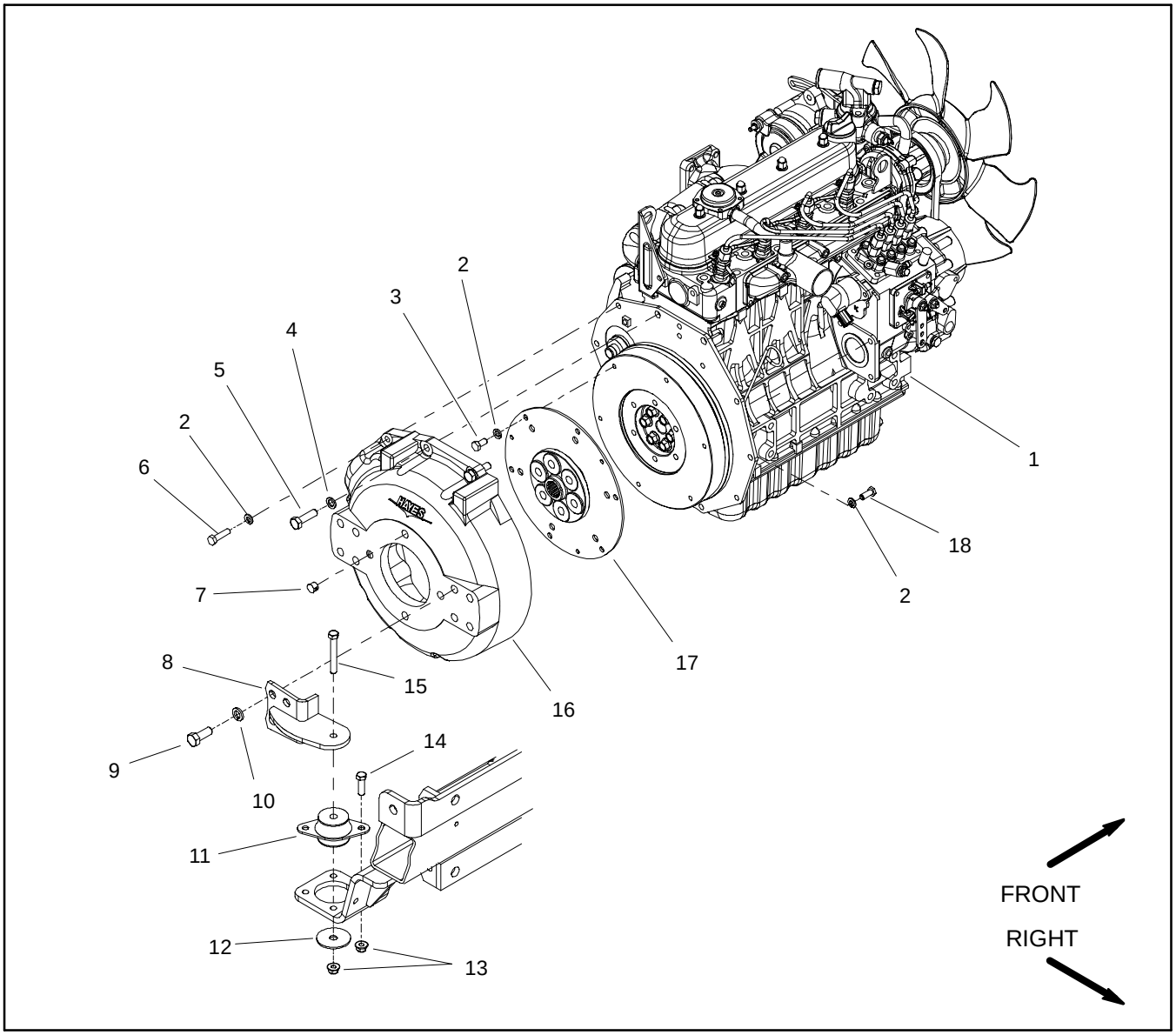

Figure 17

1. **Engine**
2. **Lock washer (14 used)**
3. **Cap screw (6 used)**
4. **Lock washer (2 used)**
5. **Cap screw (2 used)**
6. **Cap screw (6 used)**
7. **Plastic plug (2 used)**
8. **Rear mount bracket (2 used)**
9. **Cap screw (4 used per bracket)**
10. **Lock washer (4 used per bracket)**
11. **Engine mount**
12. **Snubbing washer**
13. **Flange nut (3 used per mount)**
14. **Cap screw (2 used per mount)**
15. **Cap screw**
16. **Flywheel housing**
17. **Coupling**
18. **Cap screw (2 used)**

Coupler Removal (Fig. 17)

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

1. If engine is in machine, support engine from below to prevent it from shifting.

   A. Remove hydraulic pump assembly (see Piston (Traction) Pump Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

   B. Remove flange nuts, snubbing washers and cap screws securing the rear engine mount brackets to engine mounts.

2. Remove flywheel housing and spring coupler from engine using Figure 17 as a guide.

3. If necessary, remove rear mount brackets (item 8) from flywheel housing.

Coupler Installation (Fig. 17)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupler hub is away from engine flywheel (Fig. 18).

2. Secure coupler to flywheel with six (6) cap screws (item 3) and lock washers. Tighten cap screws in a crossing pattern.

3. If rear mount brackets (item 8) were removed from flywheel housing, secure brackets to housing with removed fasteners.

4. Position flywheel housing to engine. Secure flywheel housing with cap screws (items 5, 7 and 18) and lock washers. Tighten cap screws in a crossing pattern.

5. Secure rear mount brackets to engine mounts (item 11) with cap screw and flange nut.

6. If engine is in machine:

   A. Install hydraulic pump assembly (see Piston (Traction) Pump Installation in the Service and Repairs section of Chapter 4 – Hydraulic System)

   B. Secure rear engine mount brackets to engine mounts with flange nuts, snubbing washers and cap screws.

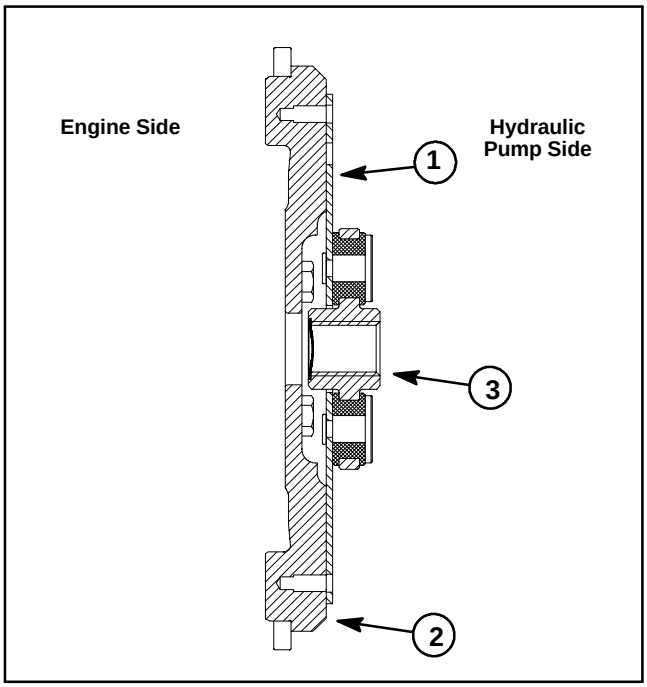

Figure 18

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

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Chapter 4

Hydraulic System

Table of Contents

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Specifications

Item	Description
Piston (Traction) Pump Maximum Displacement (per revolution) System Relief Pressure: Forward System Relief Pressure: Reverse	Variable displacement piston pump (Eaton model 72400) 2.48 in^3 (40.6 cc) 4000 PSI (276 bar) 4000 PSI (276 bar)
Charge Pump Displacement (per revolution) Charge Pressure	Positive displacement gear type pump (integral in piston (traction) pump) 0.42 in^3 (6.9 cc) 250 to 300 PSI (17 to 21 bar)
Gear Pump Front section (spray pump drive) displacement (per revolution) Rear section (steering/boom lift) displacement (per revolution)	2 section, positive displacement gear type pump 0.95 in^3 (15.6 cc) 0.34 in^3 (5.6 cc)
Rear Wheel Motors Displacement (per revolution)	Fixed displacement piston motor (Eaton model 74318) 2.48 in^3 (40.6 cc)
Spray Pump Motor Displacement (per revolution)	Orbital rotor motor (Parker series TE) 6.0 in^3 (100 cc)
Spray Pump Circuit Relief Pressure	2000 PSI (138 bar)
Steering Control Valve Displacement (per revolution)	Rotary valve steering unit with power beyond (Sauer Danfoss series OSPM) 4.27 in^3 (70 cc)
Steering/Boom Lift Circuit Relief Pressure	1015 PSI (69 bar)
Hydraulic Filter In−line Suction Strainer	Spin−on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir Capacity	14 U.S. gal (53 l)
Hydraulic Oil	See Operator's Manual

General Information

Operator's Manual

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

Check Hydraulic Fluid

Your Multi Pro 5800 hydraulic system is designed to operate on anti−wear hydraulic fluid. The reservoir holds approximately 14 U.S. gallons (53 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

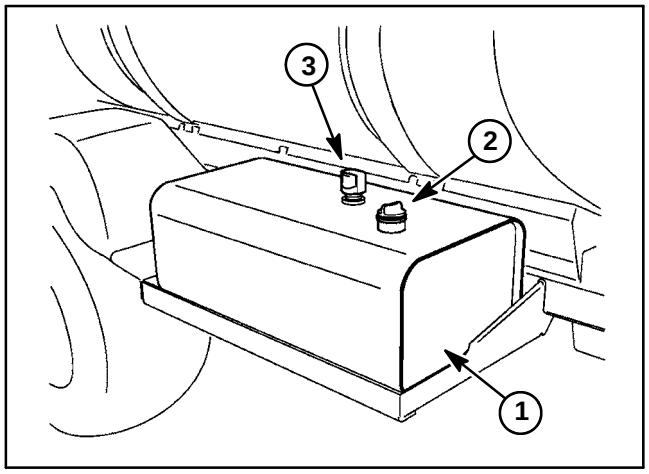


Figure 1

1. **Hydraulic reservoir**
2. **Reservoir cap**
3. **Reservoir vent**

Towing Sprayer

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

If it becomes necessary to tow (or push) the machine, tow (or push) at a speed **below 3 mph (4.8 kph)**. The piston (traction) pump is equipped with a by−pass valve that needs to be turned 90^{o} for towing (or pushing). See Operator's Manual for Towing Procedures.

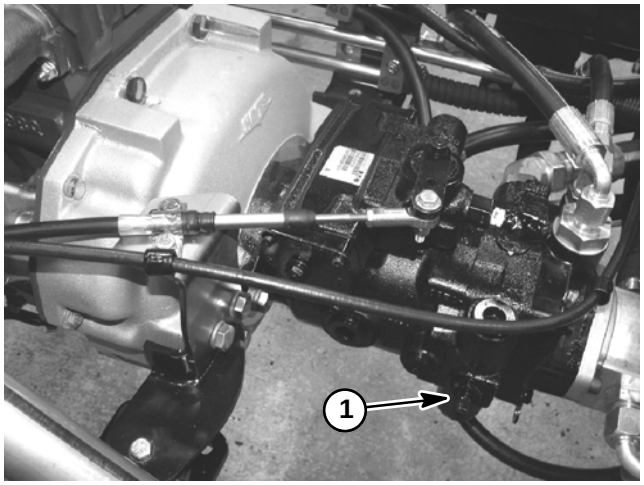


Figure 2

1. **By−pass valve location**

Traction Circuit Component Failure

The traction circuit on Multi Pro 5800 machines is a closed loop system that includes the piston (traction) pump and two (2) rear wheel motors. If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

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

Once the Toro high flow hydraulic filter kit has been placed in the circuit, raise and support the machine with all wheels off the ground. Then, operate the traction circuit to allow oil flow throughout the circuit. The filter will remove contamination from the traction circuit during operation. Because the Toro high flow filter is bi−directional, the traction circuit can be operated in both the forward and reverse direction. The filter should be removed from the machine after contamination has been removed from the traction circuit. See Filtering Closed−Loop Traction Circuit in the Service and Repairs section of this chapter for additional information on using the Toro high flow hydraulic filter.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all components, tubes and hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failure.

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 5. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 – Product Records and Maintenance).

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

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

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

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

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

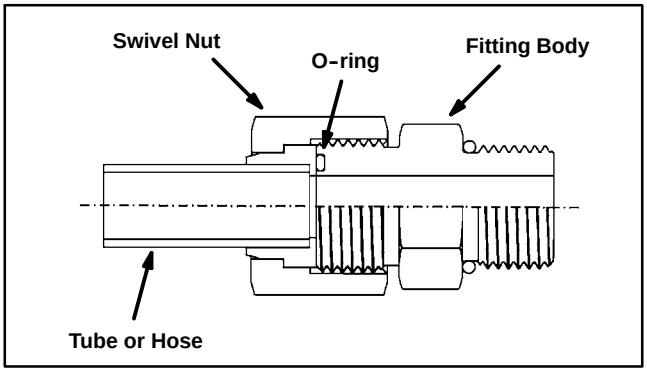


Figure 3

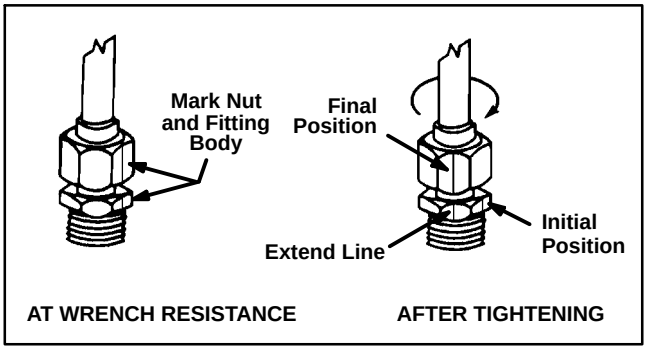


Figure 4

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

Figure 5

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

Non-Adjustable Fitting (Fig. 6)

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

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

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

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

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 7.

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

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

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

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

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

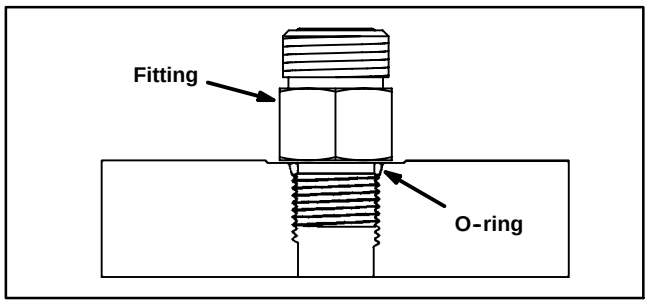


Figure 6

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

Figure 7

Adjustable Fitting (Fig. 8)

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

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

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

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 9).

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

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2 in Figure 9). Make sure that the fitting does not bottom in the port during installation.

6. To put the fitting in the desired position, unscrew it by the required amount to align fitting with incoming hose or tube, but no more than one full turn (Step 3 in Figure 9).

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

8. If a torque wrench is not available or if space at the port prevents use of a torque wrench, an alternate method of assembly is the Flats From Finger Tight (F.F.F.T.) method. Hold the fitting in the desired position with a wrench and, if port material is steel, tighten the lock nut with a second wrench to the listed F.F.F.T. (Step 4 in Figure 9). If port material is aluminum, tighten fitting to 60% of listed F.F.F.T.

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

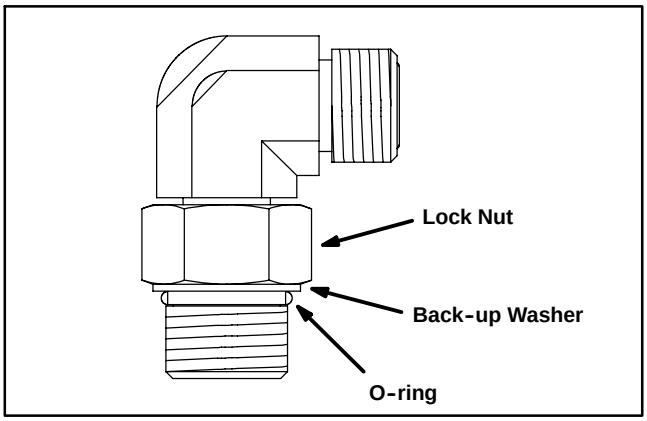


Figure 8

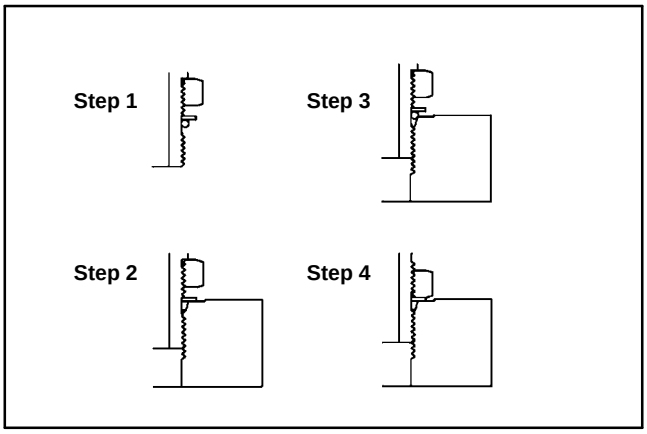
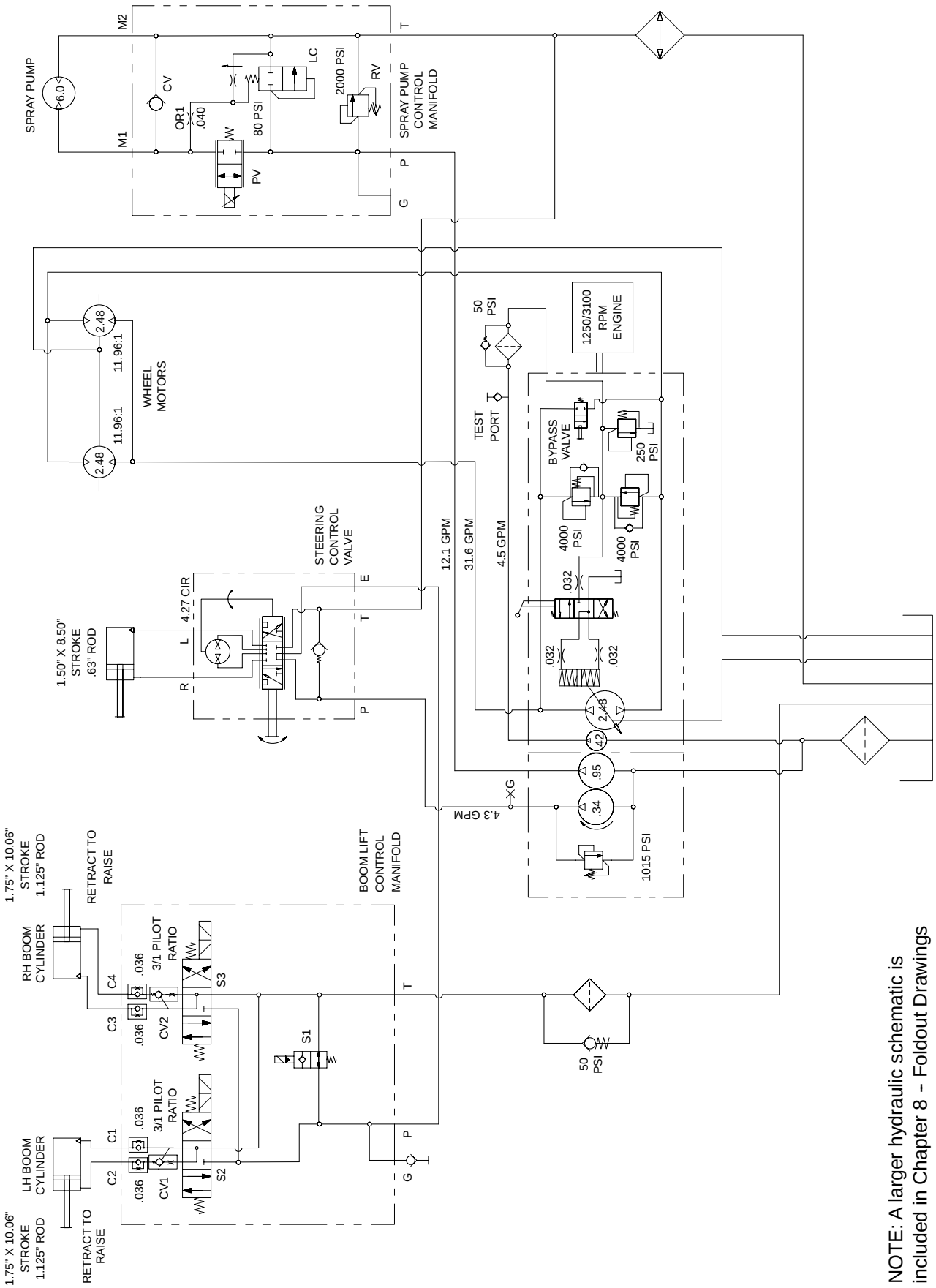


Figure 9

Hydraulic Schematic



NOTE: A larger hydraulic schematic is included in Chapter 8 – Foldout Drawings

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Hydraulic Flow Circuits

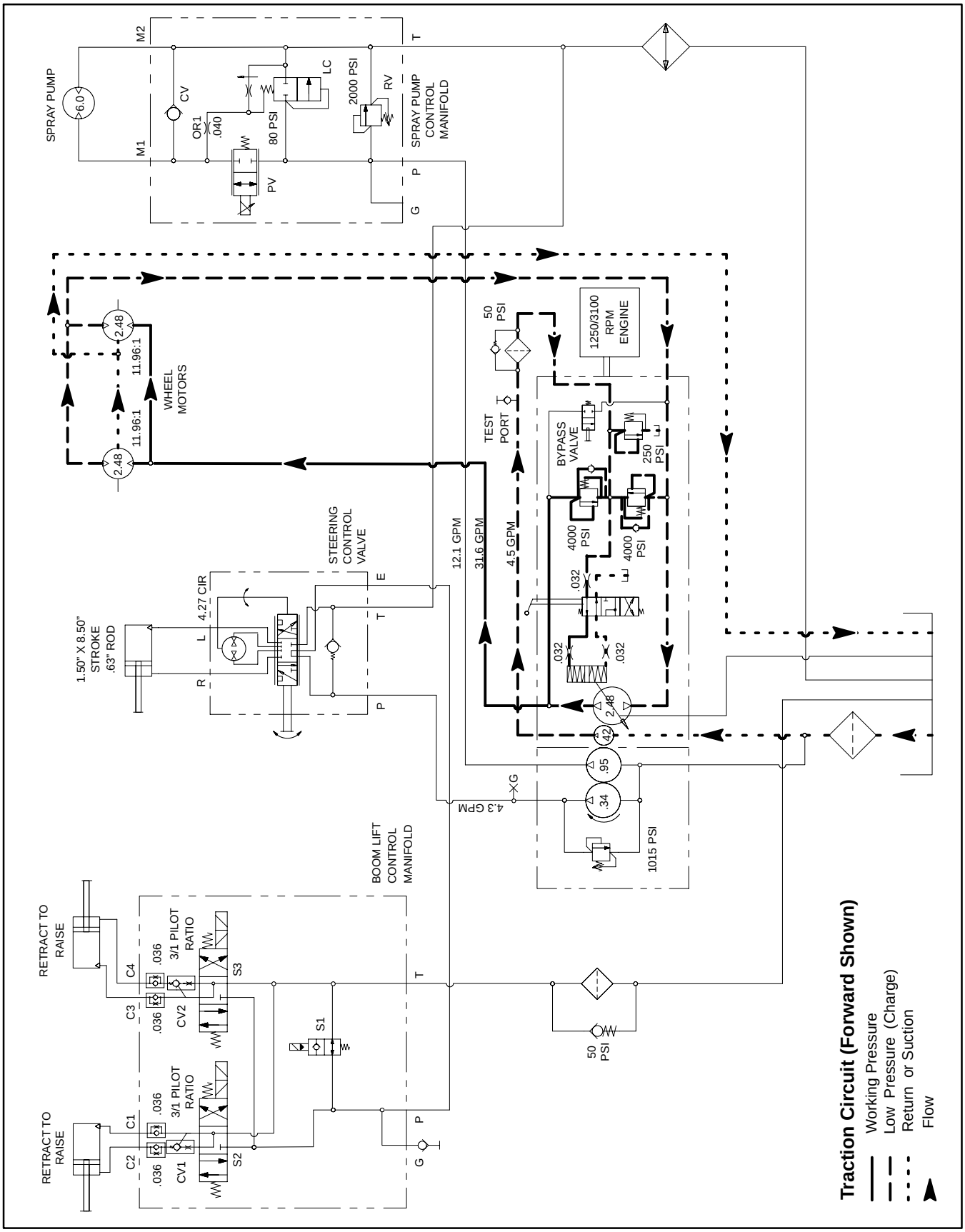


Figure 10

Traction Circuit

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. Pushing the top of the traction pedal rotates the pump swash plate to create a flow of oil for forward machine movement. Pushing the bottom of the traction pedal rotates the pump swash plate to cause oil flow for reverse machine movement. This oil flow is directed to drive the rear wheel 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 motors. As the load increases, circuit pressure can increase to relief valve settings: 4000 PSI (276 bar) in either forward or reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit.

Traction circuit pressure (forward or reverse) can be measured by installing a tee fitting and gauge into the traction system hydraulic lines.

The piston (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 piston (traction) pump assembly includes a charge pump that provides make–up oil for the traction circuit. This gerotor gear pump is driven by the piston pump drive shaft. 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 piston pump and wheel motors.

Charge pump flow is directed through the oil filter and then to the low pressure side of the closed loop traction circuit. Pressure in the charge circuit is limited by a relief valve located in the charge plate adapter on the rear of the piston pump. Charge circuit pressure (250 to 300 PSI (17 to 21 bar)) can be measured at the test port located on the tee fitting at the charge filter.

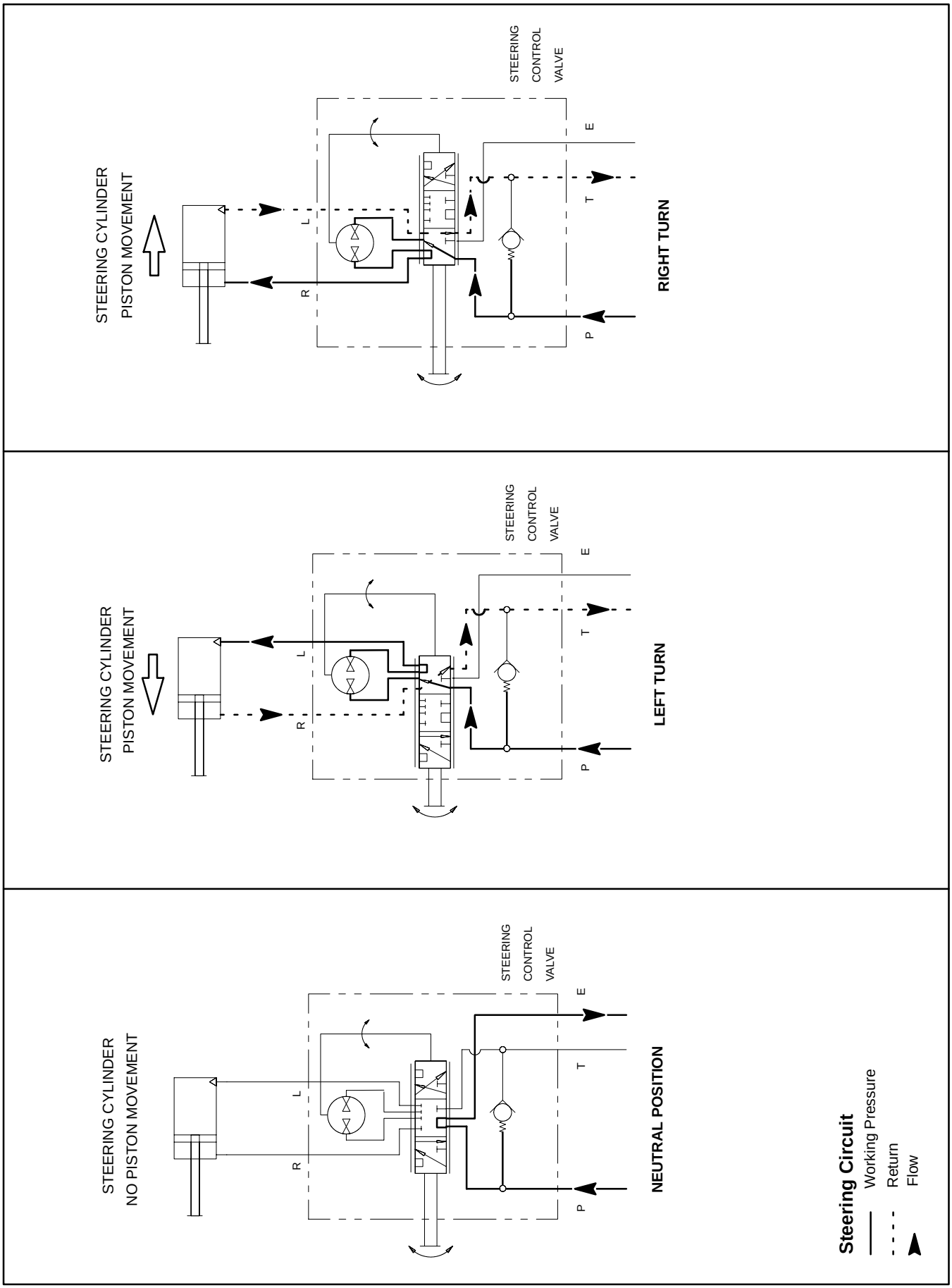

STEERING CYLINDER
PISTON MOVEMENT
STEERING
CONTROL
VALVE
L
R
E
T
P
RIGHT TURN
STEERING CYLINDER
PISTON MOVEMENT
STEERING
CONTROL
VALVE
L
R
E
T
P
LEFT TURN
STEERING CYLINDER
NO PISTON MOVEMENT
STEERING
CONTROL
VALVE
L
R
E
T
P
NEUTRAL POSITION
Steering Circuit
Working Pressure
Return
Flow

Figure 11

Steering Circuit

A two (2) section gear pump is coupled to the piston (traction) pump. The front gear pump section (closest to the piston pump) supplies hydraulic flow to the spray pump drive circuit. The rear gear pump section supplies hydraulic flow to both the steering and spray boom lift/lower circuits. Hydraulic pump flow from the rear pump section is routed to the steering control valve first so the steering circuit has priority. The gear pump takes its suction from the hydraulic reservoir. Steering and boom lift/lower circuit pressure is limited to 1015 PSI (69 bar) by a relief valve located in the gear pump.

The steering control valve includes a check valve that allows steering operation when the engine is not running. Steering wheel rotation with the engine off causes oil flow from the steering control gerotor. The check valve opens in this situation to allow oil flow from the steering control to the steering cylinder in a closed loop.

Steering circuit pressure can be measured by installing a pressure gauge to the test port fitting at the gear pump outlet. Hydraulic flow for the steering circuit can be monitored at the outlet of the rear gear pump section.

With the steering wheel in the neutral position and the engine running, gear pump flow enters the steering control valve (port P) and goes through the steering control spool valve, by–passing the rotary meter and steering cylinder. Flow leaves the control valve (port E) and is routed to the boom lift valve, oil filter and finally returns to the hydraulic oil reservoir.

Left Turn (Fig. 11)

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 bottom of the spool. Flow entering the steering control valve from the gear pump goes through the spool and is routed through the rotary meter (V1) and out the L port. Pressure extends the steering cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, then to the oil cooler and returns to the reservoir.

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

Right Turn (Fig. 11)

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 top of the spool. Flow entering the steering control valve from the gear pump goes through the spool and is routed through rotary meter (V1) and goes out port R. Pressure retracts the steering cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve, then to the oil cooler and returns to the reservoir.

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

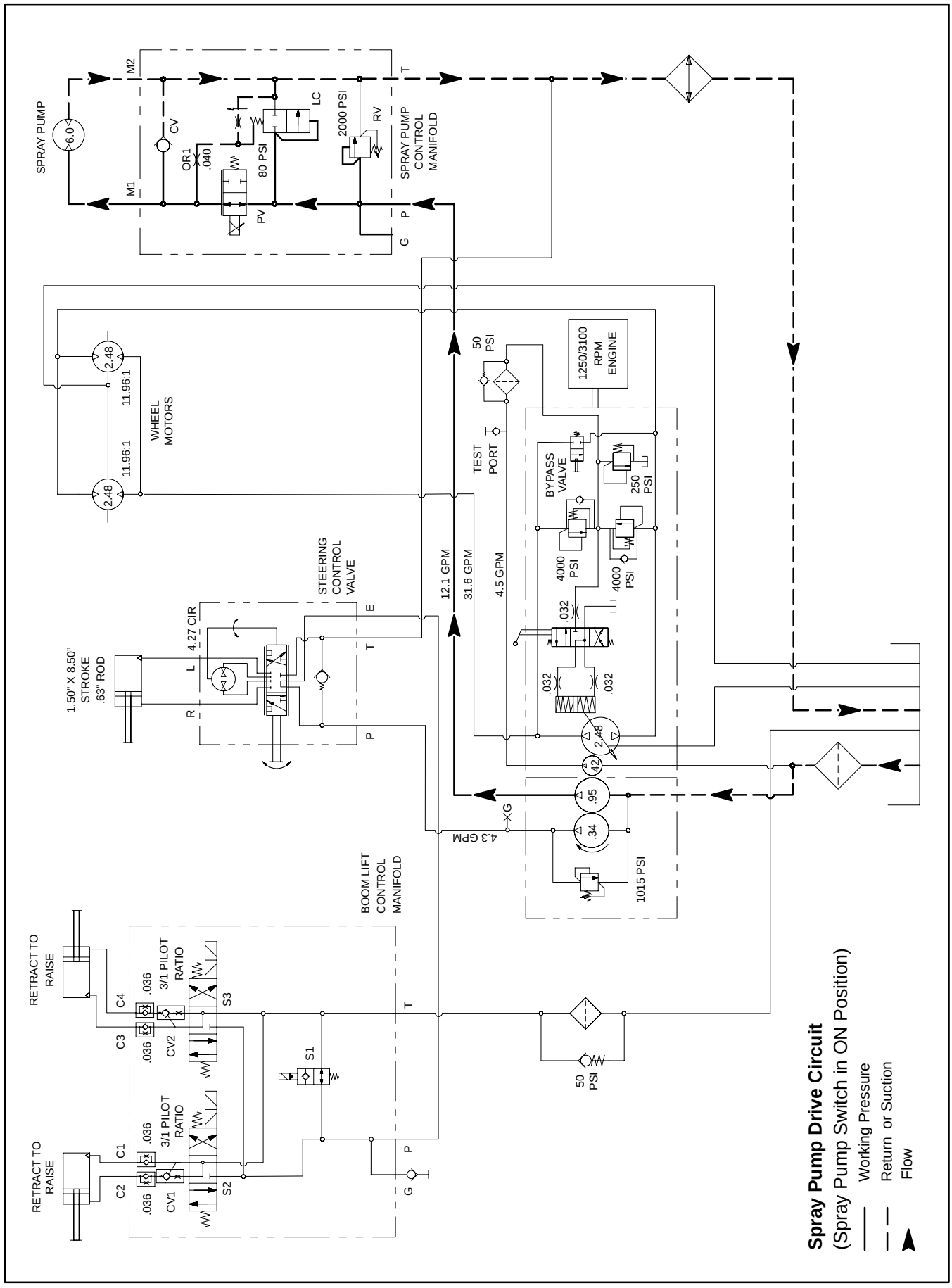

SPRAY PUMP
6.0
M2
M1
CV
OR1
.040
80 PSI
PV
LC
2000 PSI
RV
SPRAY PUMP CONTROL MANIFOLD
T
G
P
WHEEL MOTORS
2.48
11.96:1
11.96:1
2.48
50 PSI
1250/3100 RPM ENGINE
TEST PORT
BYPASS VALVE
250 PSI
4000 PSI
4000 PSI
.032
.032
.032
12.1 GPM
31.6 GPM
4.5 GPM
STEERING CONTROL VALVE
4.27 CIR
L
R
E
T
P
1.50" X 8.50" STROKE .63" ROD
2.48
42
.95
.34
4.3 GPM
G
1015 PSI
BOOM LIFT CONTROL MANIFOLD
RETRACT TO RAISE
C4
.036
3/1 PILOT RATIO
S3
C3
.036
CV2
S1
50 PSI
RETRACT TO RAISE
C1
.036
3/1 PILOT RATIO
C2
.036
CV1
S2
T
P
G
Spray Pump Drive Circuit
(Spray Pump Switch in ON Position)
Working Pressure
Return or Suction
Flow

Figure 12

Spray Pump Drive Circuit

A two (2) section gear pump is coupled to the piston (traction) pump. The front gear pump section (closest to the piston pump) supplies hydraulic flow to the spray pump drive circuit. The rear gear pump section supplies hydraulic flow to both the steering and spray boom lift/lower circuits. The gear pump takes its suction from the hydraulic reservoir. Spray pump circuit pressure is limited to 2000 PSI (138 bar) by a relief valve located in the spray pump control manifold.

Spray pump drive circuit hydraulic flow can be monitored at the outlet of the front gear pump section. Circuit pressure can be measured at a diagnostic fitting in port G on the spray pump control manifold.

Hydraulic flow control for the spray pump drive motor is completed by the spray pump control manifold. The pump control manifold includes a solenoid controlled proportional control valve (PV) that allows the operator to adjust hydraulic flow to the spray pump motor. The spray pump on/off and application rate (increase/decrease) switches are used to adjust electrical current to the control manifold solenoid.

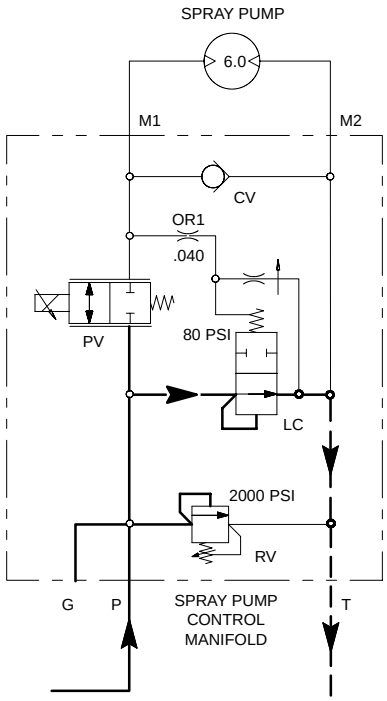
Spray Pump Switch OFF (Fig. 13)

With the engine running and the spray pump switch in the OFF position, the solenoid valve in the spray pump control manifold is not energized. All gear pump flow to the manifold is routed through the pressure compensator valve (LC) in the manifold, directed out the T port of the manifold, to the oil cooler and returns to the hydraulic oil reservoir. The spray pump hydraulic motor receives no hydraulic flow so the spray system pump is not rotated and no spray system flow is available.

Spray Pump Switch ON (Fig. 12)

With the engine running and the spray pump switch in the ON position, the solenoid valve in the spray pump control manifold is energized. Based on available current (mA) from the spray pump application rate (increase/decrease) switch, the spool in the proportional control valve directs some gear pump flow out the M1 port to the spray pump hydraulic motor. This hydraulic flow causes the motor to rotate the spray system pump for spray system operation. The manifold pressure compensator valve (LC) maintains a pressure differential of 80 PSI (5.5 bar) across the proportional control valve (PV). Any excess flow above what the proportional control valve is electrically adjusted for, is by–passed to the reservoir through the compensator valve. Hydraulic flow returns out the manifold T port, to the oil cooler and then to the hydraulic oil reservoir.

The spray pump application rate (increase/decrease) switch allows the operator to adjust electrical current to the proportional control valve (PV) solenoid. Higher current (rate increase) to the proportional control valve solenoid increases hydraulic flow to the spray pump motor and results in a higher spray pump speed with more spray system output/pressure. Lower current (rate decrease) to the proportional control valve solenoid decreases hydraulic flow to the spray pump motor and results in a lower spray pump speed with less spray system output/pressure.



Spray Pump Switch in OFF Position (Spray Pump Motor NOT Rotating)

Figure 13

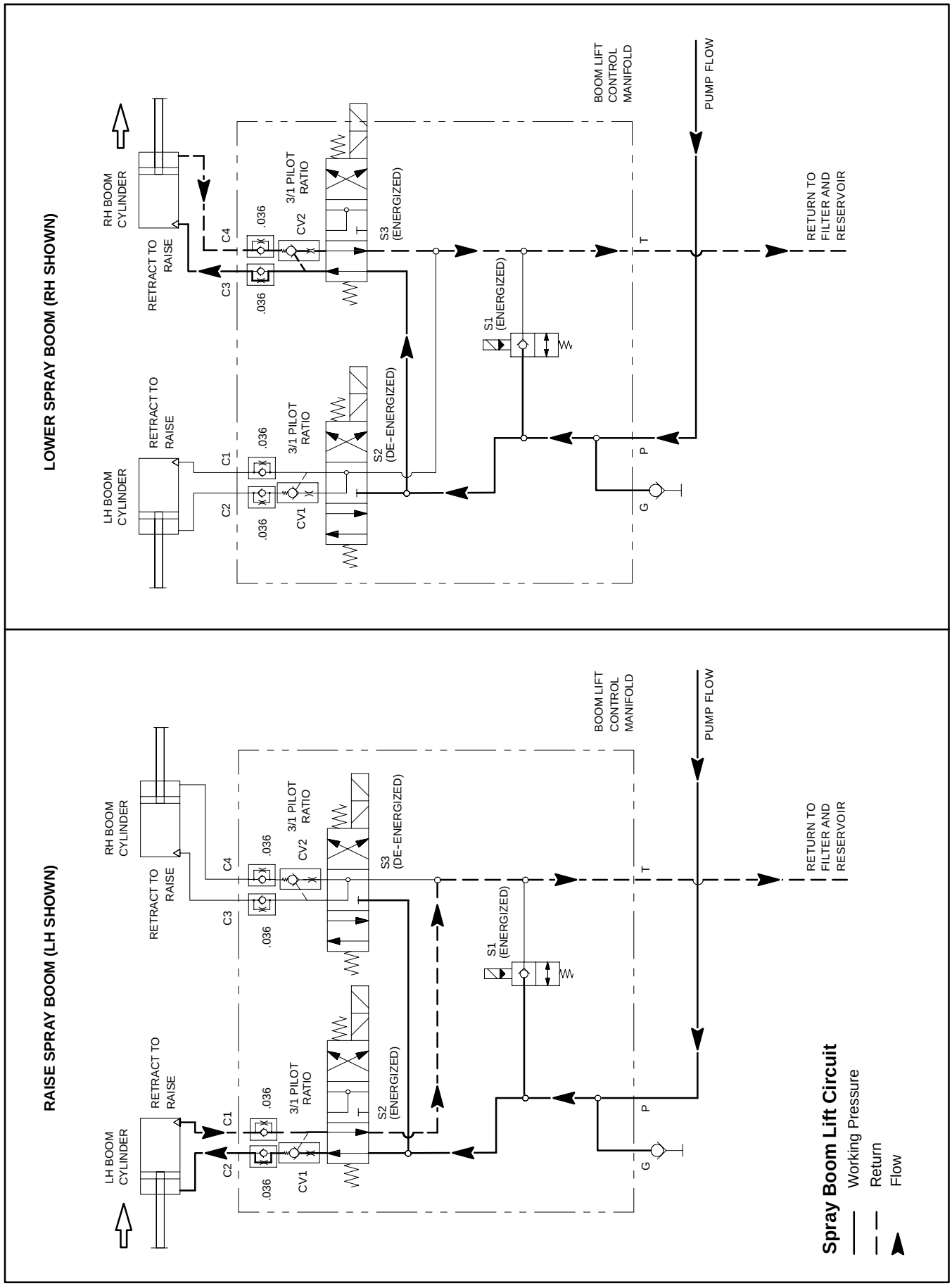

LOWER SPRAY BOOM (RH SHOWN)
RAISE SPRAY BOOM (LH SHOWN)
RH BOOM CYLINDER
LH BOOM CYLINDER
RETRACT TO RAISE
C1
C2
C3
C4
.036
CV1
CV2
3/1 PILOT RATIO
S1 (ENERGIZED)
S2 (DE-ENERGIZED)
S3 (ENERGIZED)
S2 (ENERGIZED)
S3 (DE-ENERGIZED)
BOOM LIFT CONTROL MANIFOLD
PUMP FLOW
RETURN TO FILTER AND RESERVOIR
P
T
G
Spray Boom Lift Circuit
Working Pressure
Return
Flow

Figure 14

Spray Boom Lift Circuit

A two (2) section gear pump is coupled to the piston (traction) pump. The front gear pump section (closest to the piston pump) supplies hydraulic flow to the spray pump drive circuit. The rear gear pump section supplies hydraulic flow to both the steering and spray boom lift/lower circuits. Hydraulic pump flow from the rear pump section is routed to the steering control valve first so the steering circuit has priority. The gear pump takes its suction from the hydraulic reservoir. Steering and boom lift/lower circuit pressure is limited to 1015 PSI (69 bar) by a relief valve located in the gear pump.

Spray boom lift circuit hydraulic flow can be monitored at the outlet of the rear gear pump section. Circuit pressure can be measured at a diagnostic fitting in port G on the boom lift control manifold.

The boom lift control manifold includes three (3) electrically operated valves. Solenoid valve (S1) is used to direct oil flow toward the boom lift cylinders when energized or allow circuit flow to bypass the cylinders when de-energized. Solenoid valve (S2) controls hydraulic flow to raise or lower the left side boom lift cylinder. Solenoid valve (S3) controls hydraulic flow to raise or lower the right side boom lift cylinder.

While operating the machine during conditions of not raising or lowering a spray boom (boom lift switches in the neutral (center) position), all of the boom lift control manifold valves (S1, S2 and S3) are de-energized. The de-energized valve (S1) allows hydraulic flow to return to tank through the boom lift control manifold. Flow returns to the oil filter and then to the hydraulic reservoir.

Raise Spray Boom (Fig. 14)

When a boom lift switch is depressed to the raise position, manifold solenoid valves (S1) and the raise coil for either (S2) (LH cylinder) or (S3) (RH cylinder) are energized. The energized (S1) directs oil flow toward the boom lift cylinders. The other energized valve (S2 or S3) shifts to allow pump flow to be directed toward the rod end of the lift cylinder through a manifold check valve and orifice that controls lift speed. The lift cylinder retracts to raise the boom section.

Displaced oil from the barrel end of the lift cylinder returns to the manifold, bypasses an orifice, is routed through the shifted valve (S2 or S3), exits the control manifold through port T, is routed to the oil filter and then returns to the hydraulic reservoir.

When the lift switch is returned to the neutral (center) position, the manifold solenoid valves are both de-energized. The de-energized valve (S1) allows hydraulic flow to return to tank through the manifold. The boom lift cylinder is held in the raised position by de-energized valve (S2) (LH cylinder) or (S3) (RH cylinder).

Lower Spray Boom (Fig. 14)

When a boom lift switch is depressed to the lower position, manifold solenoid valves (S1) and the lower coil for either (S2) (LH cylinder) or (S3) (RH cylinder) are energized. The energized (S1) directs oil flow toward the boom lift cylinders. The other energized valve (S2 or S3) shifts to allow pump flow to be directed toward the barrel end of the lift cylinder through an orifice that controls lowering speed. The lift cylinder extends to lower the boom section.

As circuit pressure increases, a manifold sensing line shifts the check valve (CV1 for the LH cylinder or CV2 for the RH cylinder) to allow a return path for oil from the rod end of the lift cylinder. Displaced oil from the rod end of the lift cylinder returns to the manifold, bypasses an orifice, flows through the shifted check valve, is routed through the shifted valve (S2 or S3), exits the control manifold through port T, is routed to the oil filter and then returns to the hydraulic reservoir.

When the lift switch is returned to the neutral (center) position, the manifold solenoid valves are both de-energized. The de-energized valve (S1) allows hydraulic flow to return to tank through the manifold. The boom lift cylinder is held in the raised position by de-energized valve (S2) (LH cylinder) or (S3) (RH cylinder).

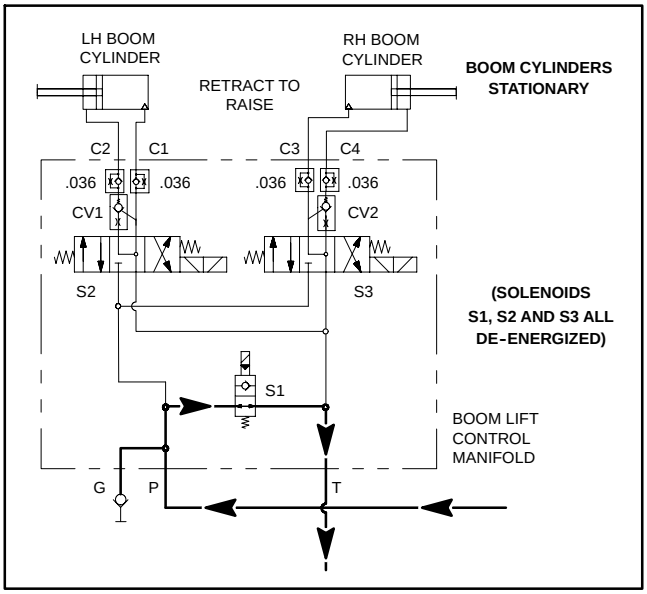


Figure 15

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

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

Toro Part Number: **TOR47009**

Figure 16

15 GPM Hydraulic Tester Kit (Pressure and Flow)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

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

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

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

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

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

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

Toro Part Number: **TOR214678**

Figure 17

40 GPM Hydraulic Tester (Pressure and Flow)

Use to test hydraulic circuits and components for flow and pressure capacities as recommended in the Testing section of this chapter. This tester includes the following:

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

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

3. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 4 to 40 GPM (20 to 150 LPM).

Toro Part Number: **AT40002**

NOTE: This tester does not include hydraulic hoses (see Hydraulic Hose Kit TOR6007 below).

Figure 18

Hydraulic Hose Kit

This kit includes hydraulic fittings and hoses needed to connect 40 GPM hydraulic tester (AT40002) or high flow hydraulic filter kit (TOR6011) to machine hydraulic traction system components.

Toro Part Number: **TOR6007**

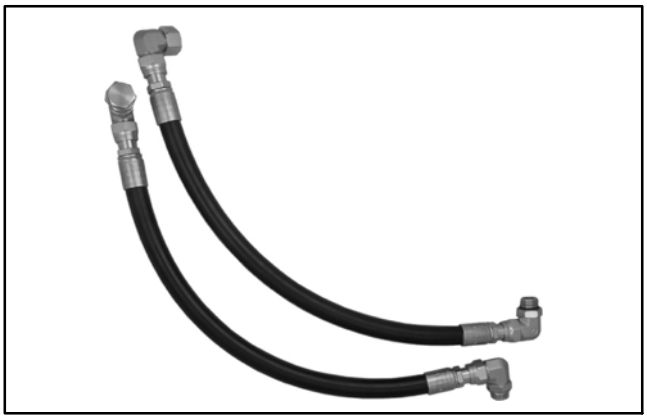


Figure 19

High Flow Hydraulic Filter Kit

The high flow hydraulic filter kit is designed with large flow (40 GPM/150 LPM) and high pressure (5000 PSI/345 bar) capabilities. This kit provides for bi−directional filtration which prevents filtered debris from being allowed back into the circuit regardless of flow direction.

If a component failure occurs in the closed loop traction circuit, contamination from the failed part will remain in the circuit until removed. When connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. hydrostat or wheel motor), the high flow hydraulic filter can be installed in the traction circuit. The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Toro Part Number: **TOR6011**

NOTE: This kit does not include hydraulic hoses (see Hydraulic Hose Kit TOR6007 above).

NOTE: Replacement filter element is Toro part number TOR6012. Filter element cannister tightening torque is **25 ft−lb (34 N−m)**.

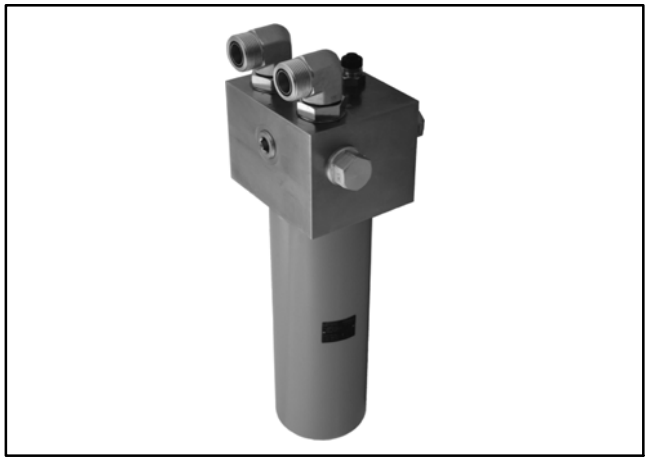


Figure 20

O−Ring Kit

The kit includes O−rings in a variety of sizes for face seal and port seal hydraulic connections. It is recommended that O−rings be replaced whenever a hydraulic connection is loosened.

Toro Part Number: **117−2727**

Figure 21

Hydraulic Test Fitting Kit

This kit includes a variety of O−ring Face Seal fittings to enable connection of test gauges to the hydraulic system.

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

Toro Part Number: **TOR4079**

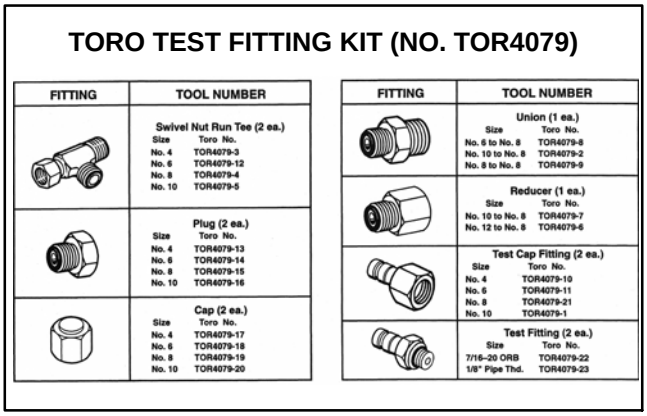


Figure 22

Troubleshooting

The cause of an improperly functioning hydraulic system is best diagnosed with the use of proper testing equipment and a thorough understanding of the complete hydraulic system.

A hydraulic system with an excessive increase in heat or noise has a potential for failure. Should either of these conditions be noticed, immediately stop the machine, turn off the engine, locate the cause of the trouble and correct it before allowing the machine to be used again.

Continued use of an improperly functioning hydraulic system could lead to extensive internal component damage.

The chart that follows contains 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 oil leaks.	Hydraulic fitting(s) or hose(s) are loose or damaged. O−ring(s) or seal(s) are missing or damaged.
Foaming hydraulic fluid.	Oil level in reservoir is incorrect. Hydraulic system has wrong kind of oil. Piston and/or gear pump suction line has an air leak. Water has contaminated the hydraulic system.
Hydraulic system operates hot.	Oil level in reservoir is incorrect. Hydraulic hose is kinked. Oil is contaminated or incorrect viscosity. Brakes are engaged or sticking. Piston pump by−pass valve is open or damaged. Hydraulic oil cooling system is not operating properly. Charge pressure is low. Traction circuit pressure is incorrect. Wheel motor(s) or spray pump motor is/are worn or damaged. Gear pump or piston (traction) pump is worn or damaged.
Machine operates in one direction only.	Traction control linkage is faulty. System charge check valve and/or system relief valve is defective.
Traction pedal is sluggish.	Traction control linkage is stuck or binding. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged. Piston pump manual servo control assembly is damaged. Piston pump or wheel motor(s) is worn or damaged.

Machine travels too far before stopping when the traction pedal is released.	Traction linkage is binding or out of adjustment. Traction pedal does not return to neutral position when pedal is released. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged. Piston pump manual servo control assembly is damaged.
Traction power is lost or machine will not operate in either direction.	Brakes are engaged or sticking. Traction control linkage is damaged or disconnected. Oil level in reservoir is low. Piston pump by–pass valve is open or damaged. Charge pressure is low. Traction circuit pressure is low. Rear wheel motor couplers are damaged.
Steering is inoperative or sluggish.	Engine speed is too low. Steering cylinder is binding. Oil level in reservoir is low. Check valve in steering control valve is sticking, worn or damaged. Relief valve in gear pump is faulty. Steering control valve is worn or damaged. Steering cylinder leaks internally. Rear gear pump section is worn or damaged (boom lift circuit affected as well).
Rotating the steering wheel turns machine in the wrong direction.	Hoses to the steering cylinder are reversed. Steering cylinder has internal leak.
Spray pump hydraulic motor does not rotate.	Pump switch is not in engaged position. Pump control manifold solenoid coil (PV) or circuit wiring has electrical problem (see Chapter 5 – Electrical System). Pump control manifold solenoid valve (PV) is sticking or damaged. Spray pump hydraulic motor is worn or damaged. Front gear pump section is worn or damaged.

One of the spray booms does not raise or lower.	Affected spray boom pivot is worn, binding or damaged. Boom lift control manifold solenoid coil (S2 or S3) or circuit wiring for affected boom has electrical problem (see Chapter 5 – Electrical System). Boom lift control manifold solenoid valve for affected boom (S2 or S3) is sticking or damaged. Boom lift control manifold check valve for affected boom (CV1 or CV2) is sticking or damaged. Boom lift control manifold orifice for affected boom is plugged or damaged. Lift cylinder is worn or damaged.
Neither of the spray booms will raise or lower.	Oil level in reservoir is low. Boom lift control manifold solenoid coil S1 or circuit wiring has electrical problem (see Chapter 5 – Electrical System). Boom lift control manifold solenoid valve S1 is sticking or damaged. Check valve in steering control valve is sticking, worn or damaged. Relief valve in gear pump is faulty. Rear gear pump section is worn or damaged (steering circuit affected as well).
One of the spray booms will not remain in the raised position. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. A spray boom may eventually lower during storage.	Boom lift control manifold check valve for affected boom (CV1 or CV2) is sticking or damaged. Cartridge valve seals are leaking in boom lift control manifold. Lift cylinder for affected boom leaks internally. Hydraulic hoses to lift cylinder for affected boom are incorrectly installed.

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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 hydraulic circuits during various operational checks (see the Special Tools section in this Chapter).

Before Performing Hydraulic Tests

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

WARNING

Before performing any work on the hydraulic system, system pressure must be relieved and all rotating machine parts must come to a stop. Turn ignition switch OFF and remove key from switch. When engine has stopped rotating, operate all hydraulic controls to relieve hydraulic system pressure.

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.

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.

CAUTION

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

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic system components. 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 after removal of components.

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

4. The inlet and the outlet hoses for tester with pressure and flow capabilities must be properly connected. If hoses are reversed, damage to the hydraulic tester or components can occur.

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

6. Install tester 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 reservoir is full.

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

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

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

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

Which Hydraulic Tests Are Appropriate

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, spray pump drive circuit, steering circuit or spray boom lift circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Charge Pressure, Traction Circuit Relief Pressure, Wheel Motor Efficiency, Charge Pump Flow and/or Piston (Traction) Pump Flow Tests.

IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.

2. If a steering circuit problem exists, consider performing one or more of the following tests: Steering Circuit Relief Pressure, Steering Cylinder Internal Leakage and/or Steering and Lift/Lower Gear Pump Flow Tests.

3. If a spray pump drive circuit problem exists, consider performing one or more of the following tests: Cutting Deck Circuit Pressure, PTO Relief Pressure, Cutting Deck Motor Case Drain Leakage and/or Cutting Deck Gear Pump Flow Tests.

4. If a spray boom lift/lower circuit problem exists, consider performing one or more of the following tests: Lift/Lower Circuit Relief Pressure and/or Steering and Lift/Lower Gear Pump Flow Tests.

Traction Circuit Charge Pressure Test (Using Pressure Gauge)

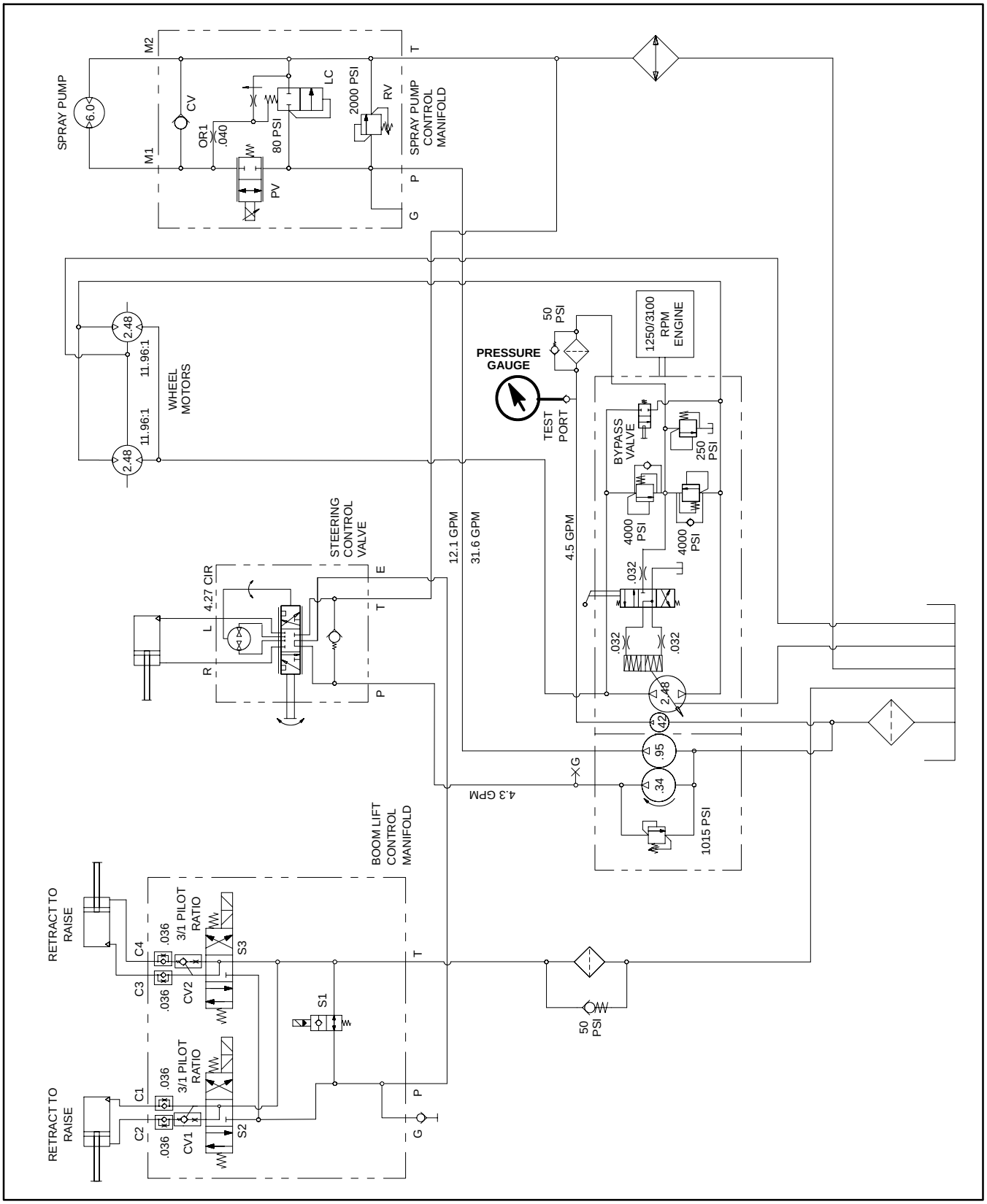

Figure 23

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

Procedure for Traction Circuit Charge Pressure Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Thoroughly clean test port on tee fitting at front of charge circuit oil filter under the hydraulic reservoir. Install 1000 PSI (70 bar) pressure gauge to test port fitting.

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

5. Operate the engine at high idle engine speed **(3050 to 3150 RPM)** with no load on the traction circuit (traction pedal in the neutral position).

GAUGE READING TO BE 250 to 300 PSI (17 to 21 bar)

6. Stop engine and record test results.

7. If there is no pressure or pressure is low, check for restriction in pump suction line. Also, inspect charge relief valve located in charge pump adapter on piston pump (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter). If necessary, check for internal damage or worn parts in charge pump.

8. Next, with the pressure gauge still connected to the test fitting on oil filter, take a pressure reading while operating the machine in forward and reverse. Start the engine and put throttle at high idle engine speed **(3050 to 3150 RPM)**. Apply the brakes and push the traction pedal forward while monitoring the pressure gauge. Repeat for reverse direction.

GAUGE READING TO BE 250 to 300 PSI (17 to 21 bar)

9. Stop engine and record test results.

10. If charge pressure is good under no load (step 5 above), but consistently drops more than 15% when under traction load, the piston (traction) pump and/or rear wheel motor(s) should be suspected of wear and inefficiency. When the piston pump and/or wheel motor(s) are worn or damaged, the charge pump is not able to keep up with internal leakage in traction circuit components.

11. After testing is completed, disconnect pressure gauge from piston pump and reinstall plug to auxiliary test port.

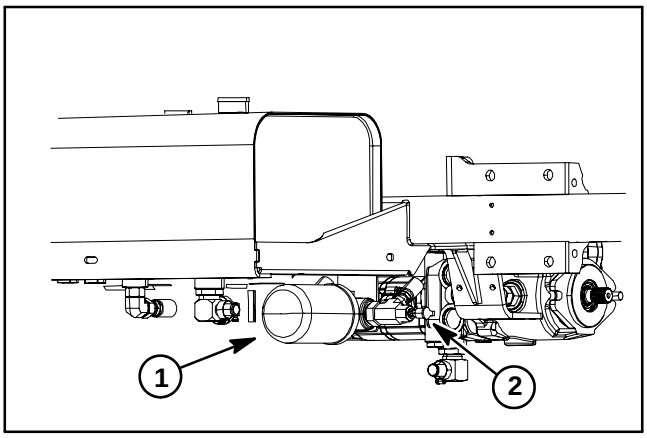

Figure 24

1. Charge circuit oil filter **2. Test port**

Traction Circuit Relief Pressure Test (Using Pressure Gauge)

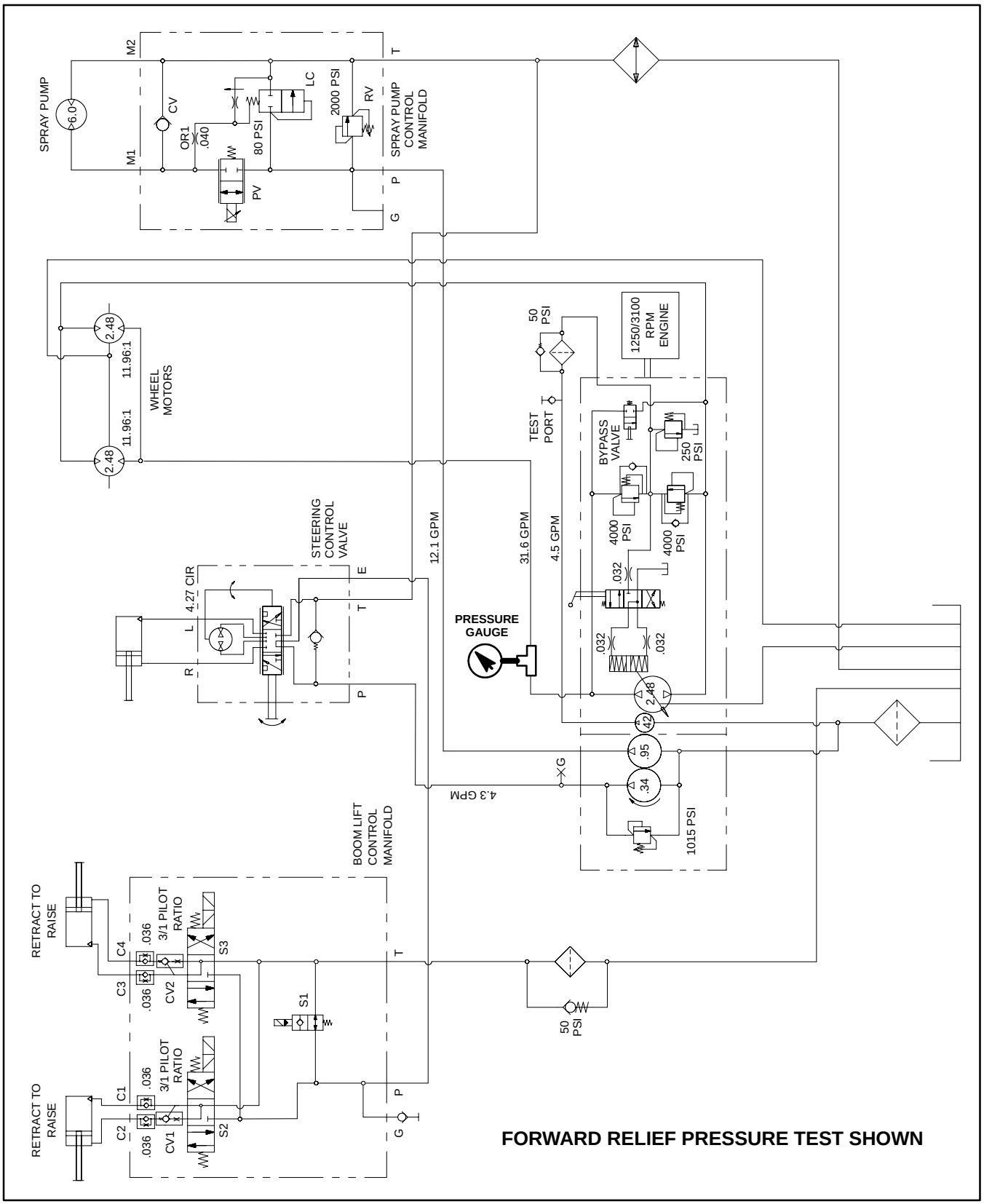

Figure 25

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

Procedure for Traction Circuit Relief Pressure Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Clean and disconnect hydraulic pressure hose from piston pump fitting on right side of pump for function to be checked (Fig. 26):

   Forward pressure hose is upper hose
   Reverse pressure hose is lower hose

4. Install T−connector with 10000 PSI (700 bar) pressure gauge between the piston pump fitting and the disconnected hose.

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

6. Increase engine speed to high idle **(3050 to 3150 RPM)**.

CAUTION

When testing traction circuit relief pressure, move machine to an open area, away from people and obstructions.

7. Drive machine to an open area.

8. With seat occupied, apply brakes fully and slowly depress the traction pedal in the appropriate direction (forward or reverse). While pushing traction pedal, look at pressure reading on gauge.

   GAUGE READING TO BE:
   Forward: **maximum of 4000 PSI (276 bar)**
   Reverse: **maximum of 4000 PSI (276 bar)**

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

10. If traction pressure is too low, inspect traction pump relief valves (Fig. 27) (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter). 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 rear wheel motors should be suspected of wear and inefficiency.

11. After testing is completed, disconnect pressure gauge from machine and connect hydraulic hose to pump fitting.

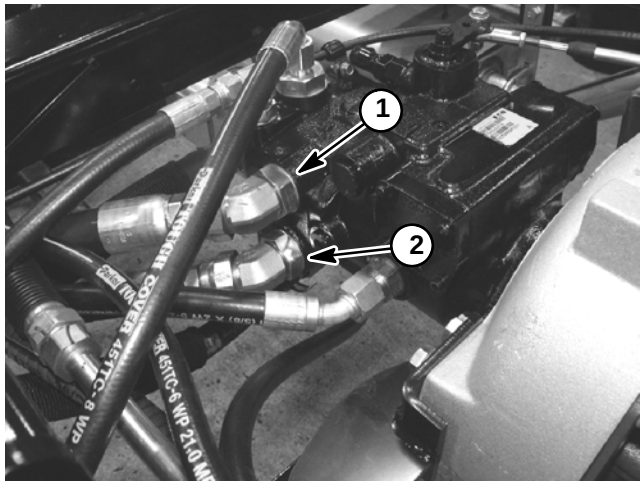

Figure 26

1. Forward fitting (upper) **2. Reverse fitting (lower)**

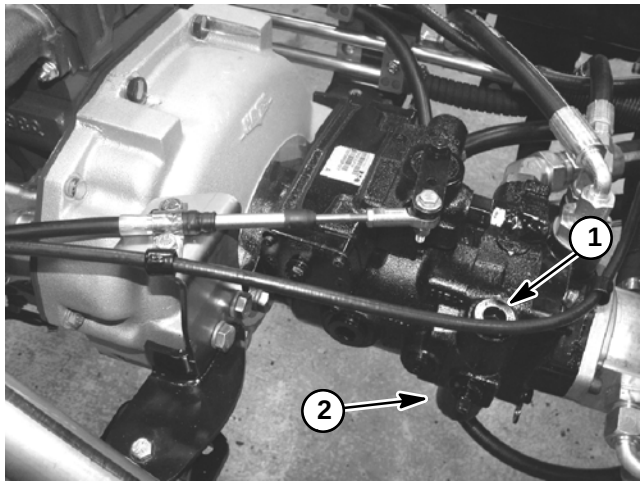

Figure 27

1. Forward relief valve **2. Reverse relief valve**

Wheel Motor Efficiency (Using Tester with Flow Meter and Pressure Gauge)

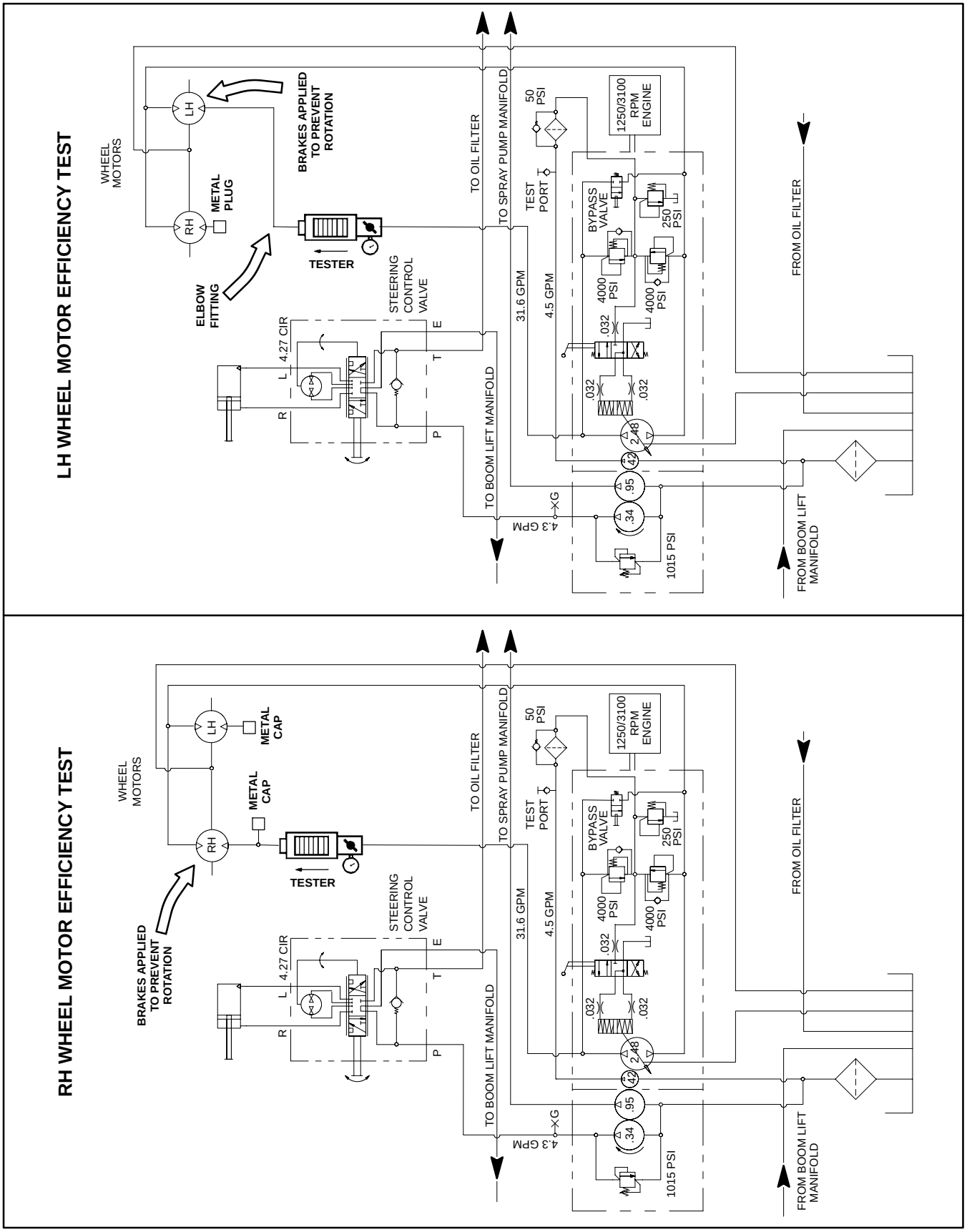

Figure 28

NOTE: Over a period of time, a wheel 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 wheel motor to stall under heavy load 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 overall machine performance.

IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.

Procedure for Wheel Motor Efficiency Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Make sure that traction pedal is adjusted to the neutral position (see Adjust Traction Pedal for Neutral in the Adjustments section of this Chapter).

4. Attach a heavy chain to the rear of the machine frame and an immovable object to prevent the machine from moving during testing.

5. Chock rear wheel being tested to prevent rotation of the wheel. Make sure parking brake is engaged.

6. To test right side (RH) wheel motor efficiency (Fig. 29):

A. Thoroughly clean fittings and hydraulic lines at both wheel motors.

B. Remove hydraulic tube (item 7 in Fig. 29) from between the tee fitting on RH wheel motor and the straight fitting on LH wheel motor.

C. Install metal cap on opening of both the tee fitting (RH side) and straight fitting (LH side).

D. Disconnect hydraulic hose from tee fitting on RH wheel motor.

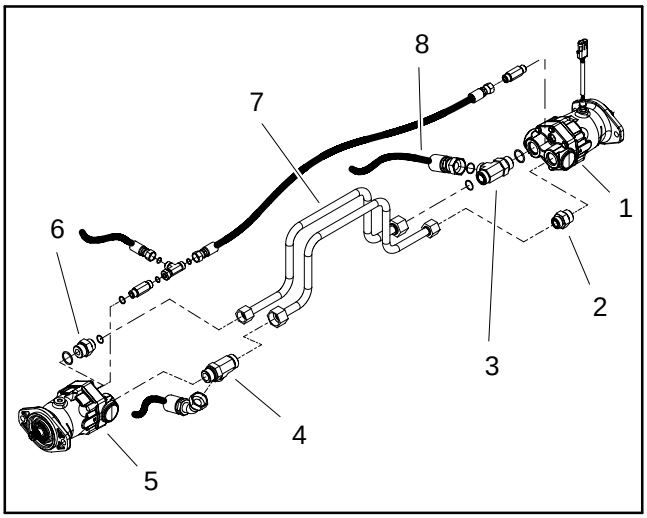

Figure 29

1. **RH wheel motor**
2. **RH straight fitting**
3. **RH tee fitting**
4. **LH tee fitting**
5. **LH wheel motor**
6. **LH straight fitting**
7. **Front hydraulic tube**
8. **Hydraulic hose**

IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump, through the tester and into the tee fitting in the RH wheel motor.

E. Install tester with pressure gauge and flow meter in series with the disconnected hose and the tee fitting in the RH wheel motor. **Make sure the tester flow control valve is fully open.**

7. To test left side (LH) wheel motor efficiency (Fig. 29):

A. Thoroughly clean tee fitting and hydraulic lines at RH wheel motor.

B. Disconnect hydraulic hose and hydraulic tube from tee fitting on RH wheel motor. Remove tee fitting from RH wheel motor.

C. Install 90º hydraulic fitting (Toro part number 340−129) in open end of hydraulic tube. Install metal plug in open port of RH wheel motor.

IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump, through the tester and into the 90º fitting in the hydraulic tube.

D. Install tester with pressure gauge and flow meter in series with the disconnected hose and the 90º hydraulic fitting. **Make sure the tester flow control valve is fully open.**

8. Start engine and run at low idle speed. Check for any hydraulic leakage from tester and hydraulic line connections. Correct any leaks before proceeding.

9. Move throttle so engine is running at high idle speed **(3050 to 3150 RPM)**.

IMPORTANT: Monitor flow meter carefully during test. Do not allow system flow to exceed 8 GPM (30 LPM).

10. Sit on seat, apply brakes fully and slowly depress the traction pedal in the **forward** direction until **1000 PSI (69 bar)** is displayed on the tester pressure gauge.

11. Internal leakage for the tested wheel motor will be shown on flow meter in GPM. Flow should be **less than 2 GPM (7.6 LPM)** for the tested wheel motor.

12. If specifications are not met, the tested wheel motor needs to be inspected and repaired as necessary (see Wheel Motors and Wheel Motor Service in the Service and Repairs section of this chapter).

13. If second wheel motor requires testing, perform test procedure for the remaining motor.

14. When testing is complete, disconnect tester from machine. Remove caps, plugs and/or fittings used during testing. Connect hydraulic fittings and lines to rear wheel motor(s).

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Charge Pump Flow Test

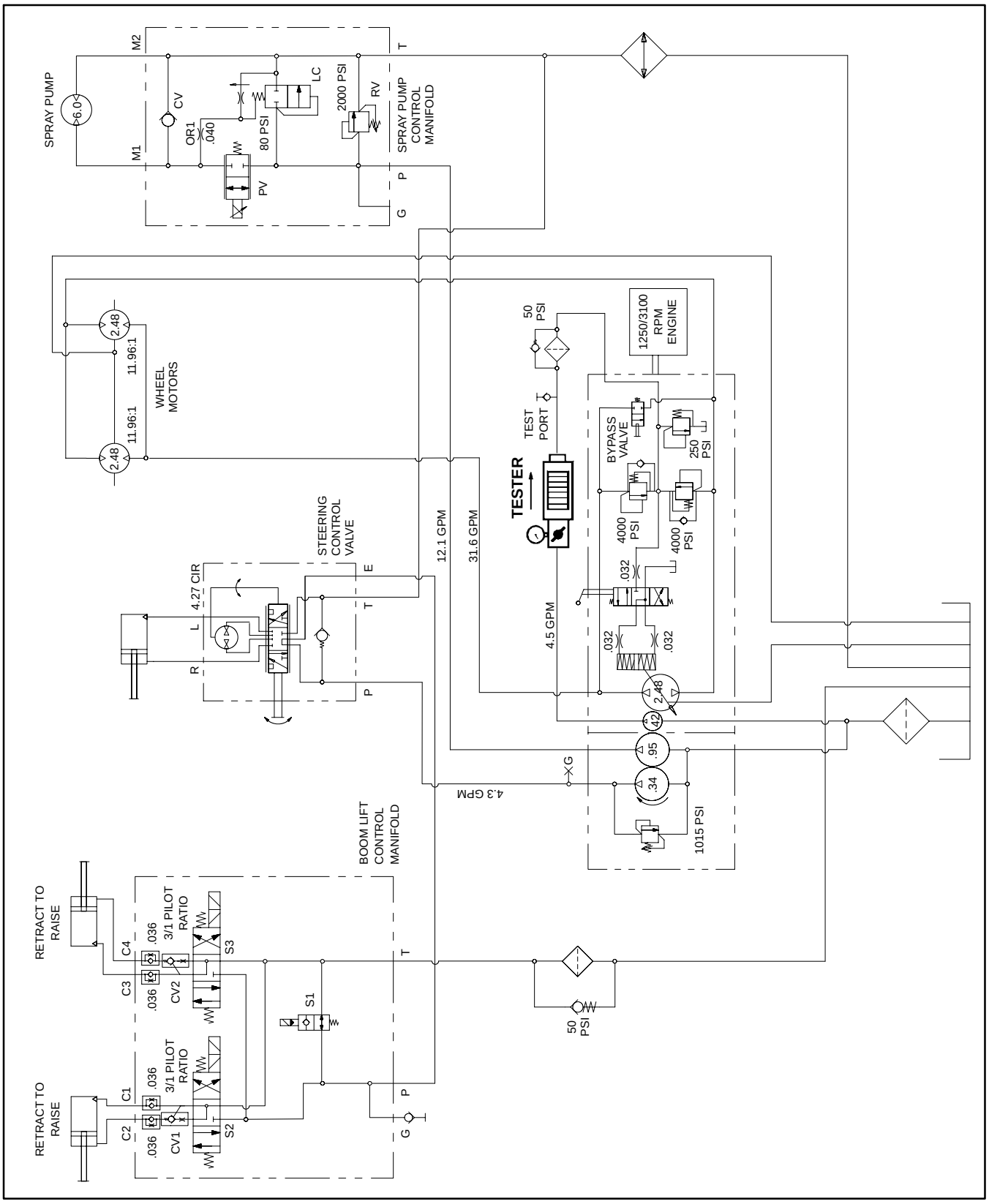

Figure 30

The charge pump flow test should be performed to make sure that the traction charge circuit has adequate hydraulic flow.

Procedure for Charge Pump Flow Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Thoroughly clean tee fitting and hydraulic hose at front of charge circuit oil filter under the hydraulic reservoir.

IMPORTANT: Make sure that the oil flow indicator arrow on the flow meter is showing that the oil will flow from the pump (disconnected hose), through the tester and into the oil filter (tee fitting).

4. Install tester with pressure gauge and flow meter in series with the tee fitting and the disconnected hose. **Make sure the tester flow control valve is fully open.**

5. Start engine and run at low idle speed. Check for any hydraulic leakage from tester and hose connection. Correct any leaks before proceeding.

6. Move throttle so engine is running at high idle speed **(3050 to 3150 RPM)**.

7. Have second person carefully watch pressure gauge on tester while slowly closing the flow control valve until **400 PSI (28 bar)** is obtained. Verify with a phototac that the **engine speed** is still **3050 to 3150 RPM**.

NOTE: If engine speed drops below 3050 RPM, pump flow will decrease.

8. Observe flow gauge. Flow indication should be approximately **4.5 GPM (17 LPM)**.

9. Release traction pedal to the neutral position, open flow control valve on tester and shut off engine. Record test results.

10. If flow is less than **4 GPM (15 LPM)**, check for restriction in pump suction line. If suction line is not restricted, the charge pump in the piston (traction) pump assembly needs to be repaired or replaced as necessary (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter).

11. When testing is complete, disconnect tester from tee fitting and machine hydraulic hose. Reconnect machine hydraulic hose to tee fitting.

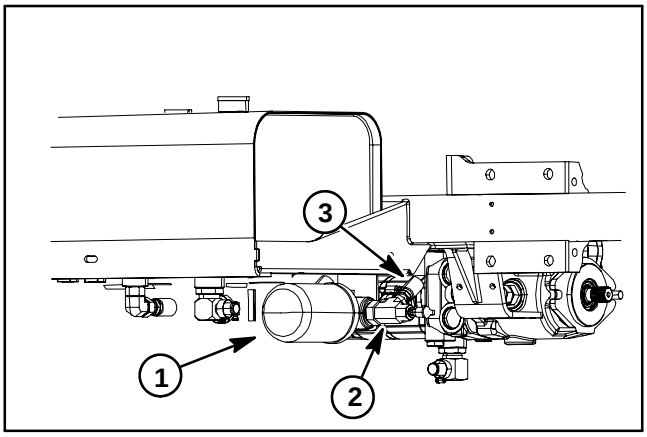

Figure 31

1. **Charge circuit oil filter**
2. **Tee fitting**
3. **Hydraulic hose**

Piston (Traction) Pump Flow Test (Using Tester with Flow Meter and Pressure Gauge)

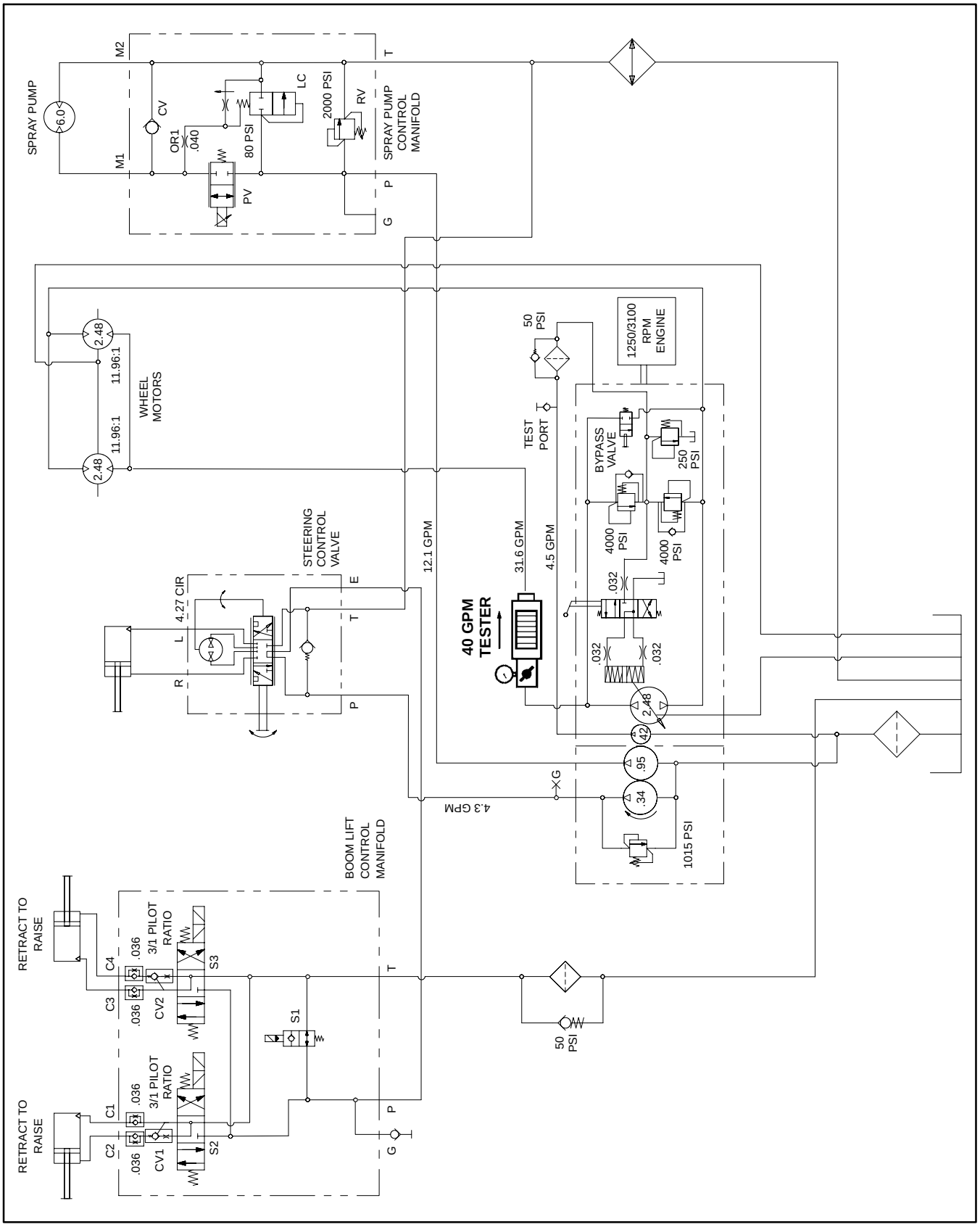

Figure 32

This test measures piston (traction) pump output (flow). During this test, pump load is created at the flow meter using the adjustable load valve on the tester.

IMPORTANT: Traction circuit flow for the Multi Pro 5800 is approximately 30 GPM (113.5 LPM). Use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) for this test (see Special Tools in this chapter).

IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.

Procedure for Piston (Traction) Pump Flow Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Make sure that traction pedal is adjusted to the neutral position. Also, ensure that traction pump is at full stroke when pedal is pushed to fully forward position.

4. Raise and support machine so rear wheels are off the ground (see Jacking Instructions in Chapter 1 – Safety).

5. Thoroughly clean and disconnect upper hydraulic pressure hose from piston pump fitting on right side of pump (Fig. 33).

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

6. Install 40 GPM Hydraulic Tester #AT40002 (pressure and flow) in series between piston pump fitting and disconnected hose to allow flow from piston pump to tester. Use hydraulic hose kit (see Special Tools in this chapter) to connect tester to machine. Make sure that fitting and hose connections are properly tightened. Also, make sure the flow control valve on tester is fully open.

CAUTION

The rear wheels will be off the ground and rotating during this test. Make sure machine is supported so it will not move and accidentally fall to prevent injuring anyone near the machine.

7. Start engine and run at low idle speed. Check for any hydraulic leakage from tester and hose connections. Correct any leaks before proceeding.

8. Move throttle so engine is running at high idle speed **(3050 to 3150 RPM)**.

9. Slowly push traction pedal to fully forward position. Keep pedal fully depressed in the forward position.

10. Have second person carefully watch pressure gauge on tester while slowly closing the flow control valve until **1000 PSI (69 bar)** is obtained. Verify with a phototac that the **engine speed** is still **3050 to 3150 RPM**.

NOTE: If engine speed drops below 3050 RPM, pump flow will decrease.

11. Observe flow gauge. Flow indication should be approximately **31 GPM (118 LPM)**.

12. Release traction pedal to neutral, open flow control valve on tester and shut off engine. Record test results.

13. If flow is less than **28 GPM (106 LPM)**, make sure that piston pump swash plate is being fully rotated. If swash plate is being fully rotated, the piston pump should be inspected and repaired (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter).

14. Make necessary repairs before performing any additional traction circuit tests.

15. When testing is complete, disconnect tester and hose kit from pump fitting and machine hydraulic hose. Reconnect machine hydraulic hose to pump fitting. Lower machine to ground.

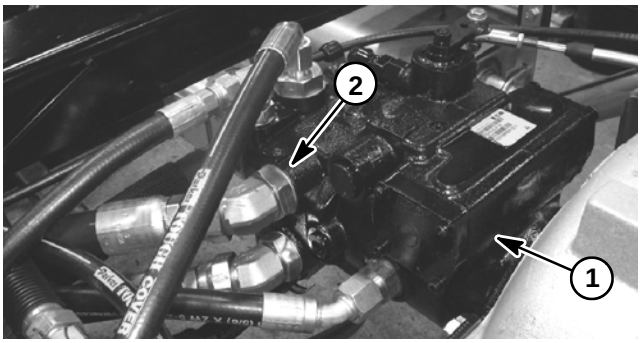

Figure 33

1. Piston (traction) pump
2. Upper fitting

Steering/Boom Lift Circuits Relief Pressure Test (Using Pressure Gauge)

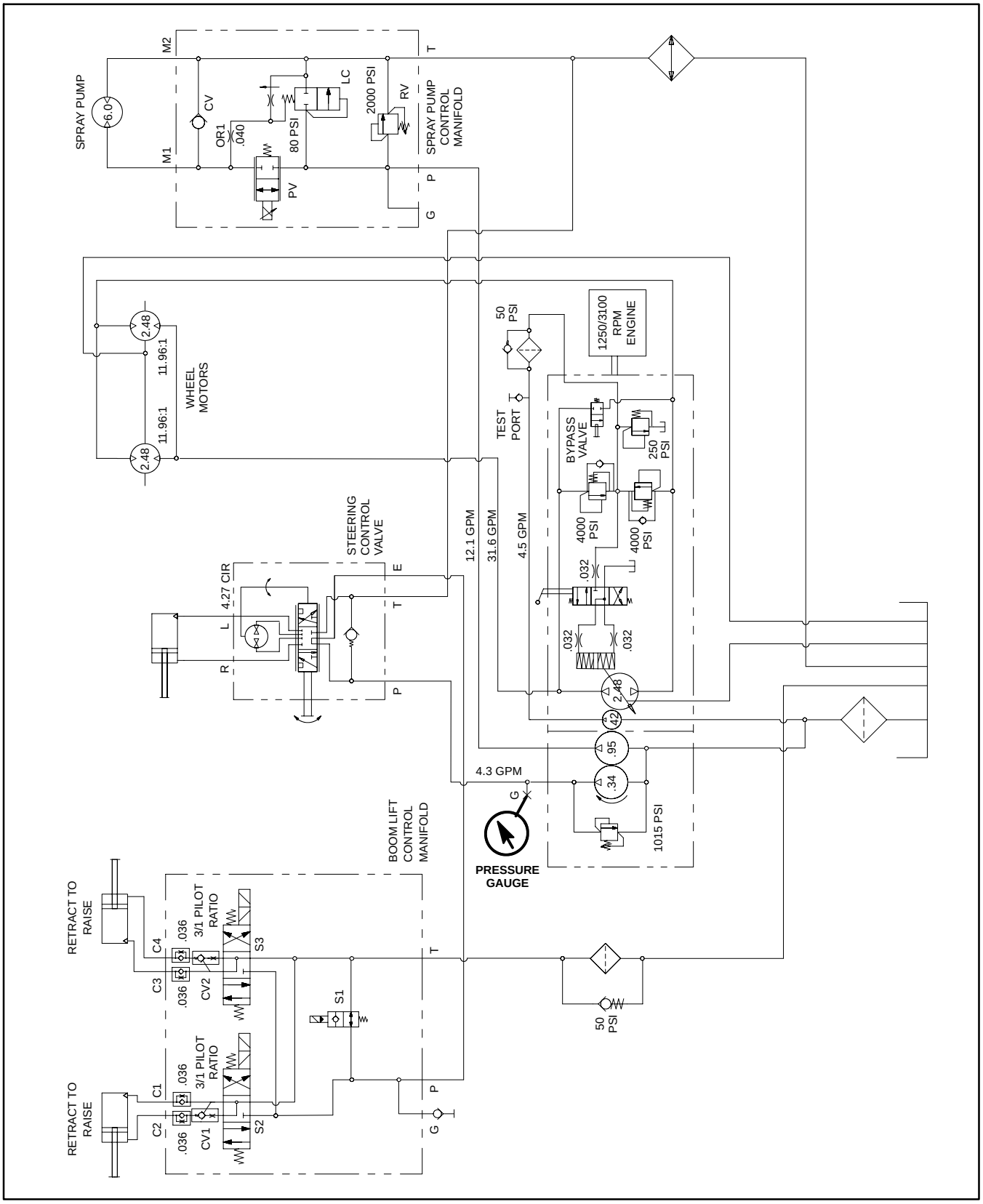

Figure 34

The steering and boom lift circuits relief pressure test should be performed to make sure that the relief pressure for the steering and boom lift circuits is correct.

Procedure for <u>Steering/Boom Lift Circuits Relief Pressure</u> Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. Thoroughly clean test port on tee fitting on left side of rear gear pump section (Fig. 35). Install 5000 PSI (350 bar) pressure gauge to test port fitting.

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

5. Adjust engine speed to high idle **(3050 to 3150 RPM)**.

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

6. Watch pressure gauge carefully while turning the steering wheel completely in one direction (full steering lock) and holding momentarily.

7. System pressure should be approximately **1000 PSI (69 bar)** as the relief valve lifts. Return steering wheel to the neutral position.

8. Slow engine speed and shut off engine. Record test results.

9. If relief pressure is incorrect, inspect for worn, stuck or damaged relief valve in gear pump (see Gear Pump Service in the Service and Repairs section of this chapter). After servicing the valve, retest relief valve pressure.

10. After testing is completed, disconnect pressure gauge from test port.

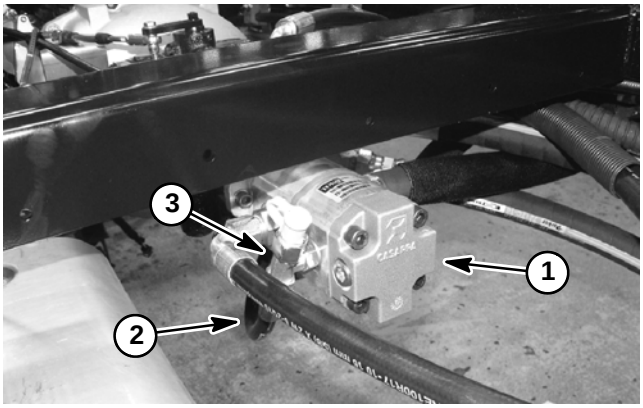

Figure 35

1. **Gear pump**
2. **Steering/boom lift circuit pressure hose**
3. **Tee fitting**

Steering/Boom Lift Circuits Gear Pump Flow Test (Using Tester with Flow Meter and Pressure Gauge)

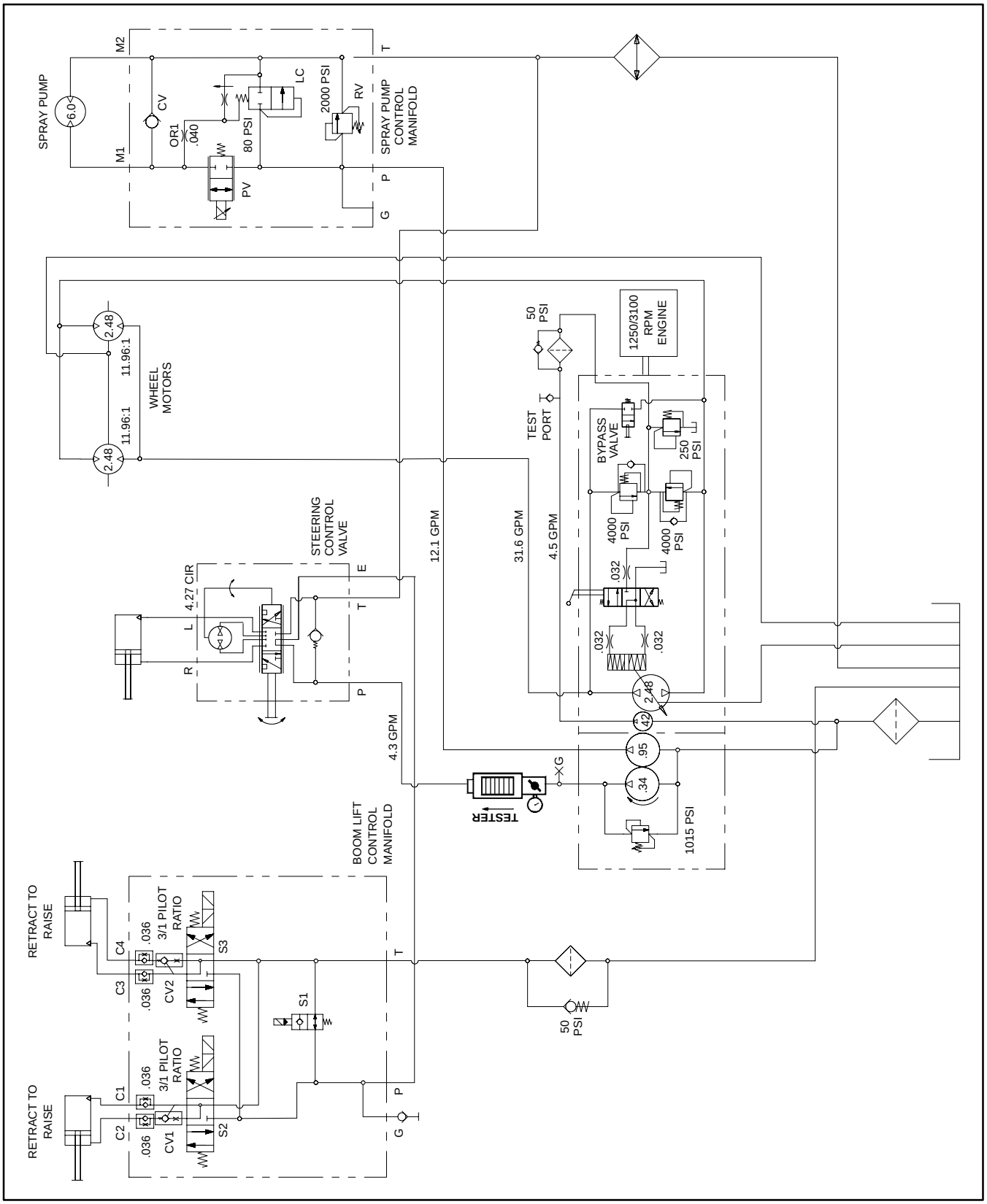

Figure 36

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 can by-pass to cause circuit performance problems. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

Procedure for Steering/Boom Lift Circuits Gear Pump Flow Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. With the engine off, clean tee fitting and hydraulic hose on left side of rear gear pump section (Fig. 37). Disconnect hydraulic hose from the tee fitting.

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

4. Install tester with pressure gauge and flow meter in series between the tee fitting and the disconnected hose. **Make sure the tester flow control valve is open**.

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

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

6. Operate the engine at high idle speed **(3050 to 3150 RPM)**. Verify engine speed with a phototac.

7. Carefully watch pressure gauge on tester while slowly closing the flow control valve until **800 PSI (56 bar)** is obtained. Verify with a phototac that the **engine speed** is still **3050 to 3150 RPM**.

NOTE: If engine speed drops below 3050 RPM, pump flow will decrease.

8. Observe flow gauge. Flow indication should be approximately **4.3 GPM (16 LPM)**.

9. Open tester flow control valve and stop engine. Record test results.

10. If the flow is less than **3.8 GPM (14 LPM)** or a pressure of **800 PSI (56 bar)** could not be obtained, check for restriction in gear pump suction line. If suction line is not restricted, remove gear pump, inspect pump and repair pump as necessary (see Gear Pump and Gear Pump Service in the Service and Repairs section of this chapter).

11. After testing is completed, remove tester and reinstall disconnected hose.

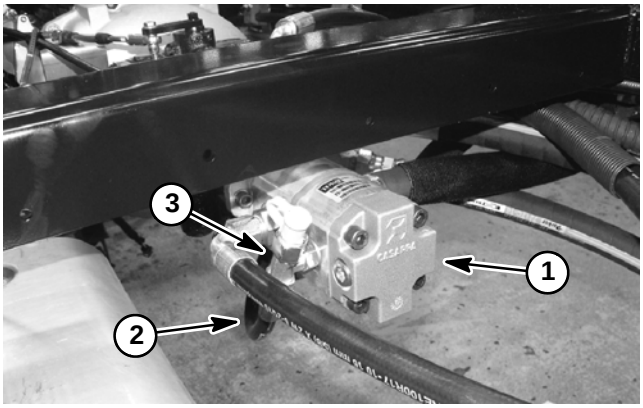

Figure 37

1. **Gear pump**
2. **Steering/boom lift circuit pressure hose**
3. **Tee fitting (rear gear pump fitting)**

Steering Cylinder Internal Leakage Test

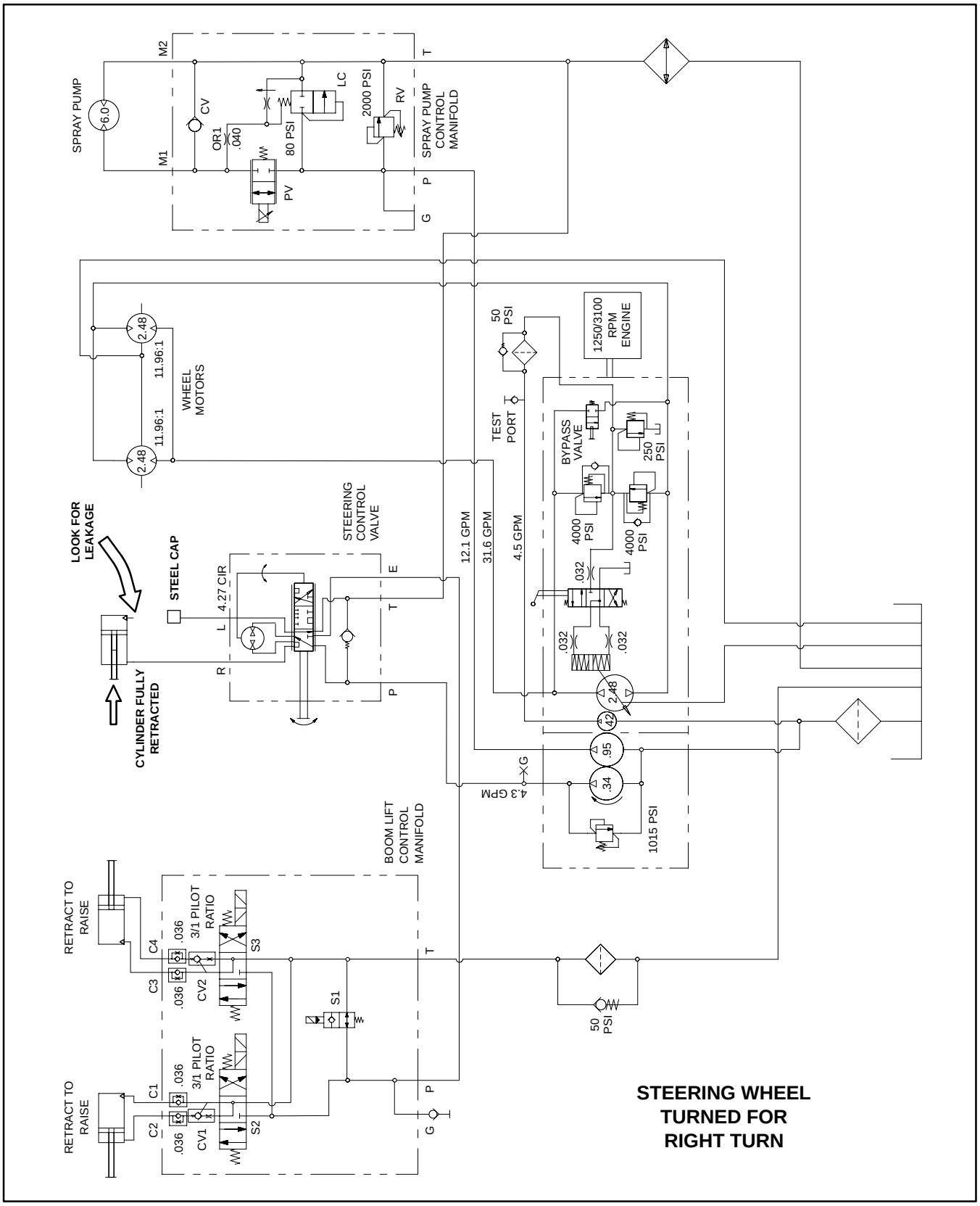

Figure 38

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

NOTE: Steering cylinder operation will be affected by incorrect tire pressure, binding of the hydraulic steering cylinder, excessive weight on the vehicle and/or binding of the steering assembly (e.g. wheel spindles, tie rods). Make sure that these items are checked before proceeding with any hydraulic testing procedure.

Procedure for <u>Steering Cylinder Internal Leakage</u> Test:

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

2. Perform the Steering/Boom Lift Circuits Relief Pressure and Steering/Boom Lift Circuits Gear Pump Flow tests to make sure that relief valve and gear pump are functioning correctly.

3. Park machine on a level surface with the spray system turned off.

4. With the engine running, turn the steering wheel to the right (clockwise) until the steering cylinder rod is fully retracted.

5. Turn engine off and engage the parking brake.

6. Read Precautions for Hydraulic Testing at the beginning of this section.

7. Place a drain pan under the steering cylinder. Clean and remove hydraulic hose from the fitting on the barrel end of the steering cylinder. Plug the end of the disconnected hose with a steel plug.

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

WARNING

Keep body and hands away from disconnected hoses and fittings that might 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: Do not turn steering wheel to the left (counterclockwise) as system damage may occur.

9. With the engine off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully retracted. Observe the open fitting on the steering cylinder as the steering wheel is turned. If oil comes out of the open fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and should be inspected and repaired as necessary (see Steering Cylinder and Steering Cylinder Service in the Service and Repairs section of this chapter). Check drain pan for any evidence of oil that would indicate cylinder leakage.

10. After testing is complete, remove plug from the disconnected hydraulic hose. Reconnect hose to the steering cylinder.

11. If steering problem exists and the steering cylinder, steering/boom lift circuits relief valve pressure and steering/boom lift circuits gear pump flow tested acceptably, the steering control valve requires service (see Steering Control Valve and Steering Control Valve Service in the Service and Repairs section of this chapter).

Boom Lift Cylinder Internal Leakage Test

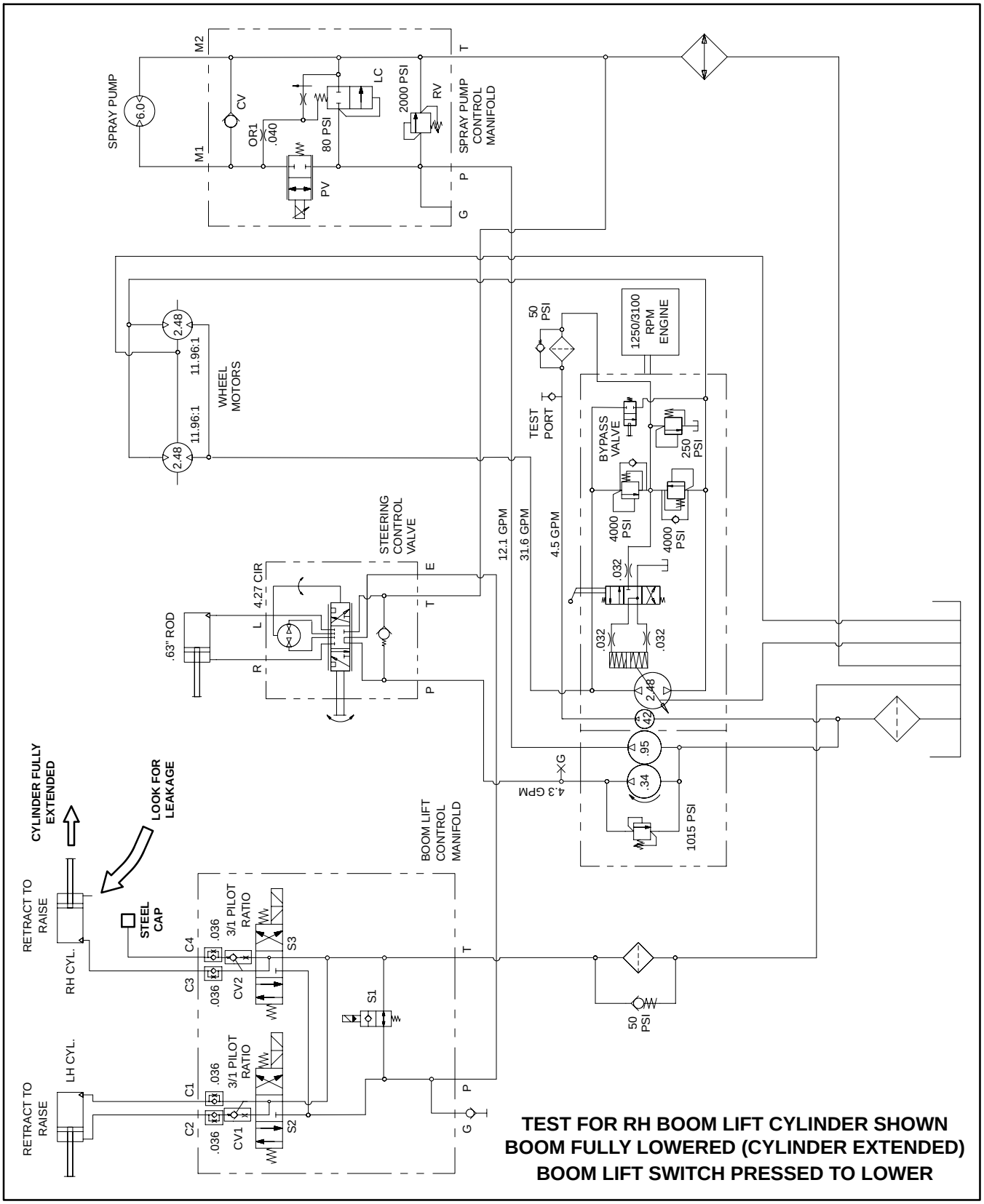

Figure 39

The boom lift cylinder internal leakage test should be performed if a spray boom raise and lower problem is identified. This test will determine if a boom lift cylinder is faulty.

NOTE: Boom lift raise/lower circuit operation will be affected by boom lift cylinder binding, extra weight on the spray booms and/or binding of lift components. Make sure that these items are checked before proceeding with boom lift cylinder internal leakage test.

Procedure for <u>Boom Lift Cylinder Internal Leakage</u> Test:

NOTE: When performing the lift cylinder internal leakage test, the lift cylinder should be attached to the spray boom.

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

2. Perform the Steering/Boom Lift Circuits Relief Pressure and Steering/Boom Lift Circuits Gear Pump Flow tests to make sure that relief valve and gear pump are functioning correctly.

3. Park machine on a level surface with the spray system turned off.

4. With the engine running, use the boom lift switch to fully lower the spray boom (lift cylinder rod is fully extended).

5. Turn engine off and engage the parking brake.

6. Read Precautions for Hydraulic Testing at the beginning of this section.

7. Place a drain pan under the lift cylinder. Clean and remove hydraulic hose from the fitting on the rod end of the lift cylinder. Plug the end of the disconnected hose with a steel plug.

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

WARNING

Keep body and hands away from disconnected hoses and fittings that might 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: While performing test, do not press boom lift switch to raise as system damage may occur.

9. Start engine and run at low idle speed. Have a second person observe the open fitting on the lift cylinder. With the lift cylinder fully extended, momentarily press the boom lift switch to lower. If oil comes out of the open fitting when the lift switch is pressed to lower, the lift cylinder has internal leakage and should be inspected and repaired as necessary (see Lift Cylinder and Lift Cylinder Service in the Service and Repairs section of this chapter). Check drain pan for any evidence of oil that would indicate lift cylinder leakage.

10. After testing is complete, remove plug from the disconnected hydraulic hose. Reconnect hose to the lift cylinder.

11. If boom lift problem exists and the boom lift cylinder, steering/boom lift circuits relief valve pressure and steering/boom lift circuits gear pump flow tested acceptably, the boom lift control manifold requires service (see Boom Lift Control Manifold and Boom Lift Control Manifold Service in the Service and Repairs section of this chapter).

Spray Pump Circuit Gear Pump Flow Test (Using Tester with Flow Meter and Pressure Gauge)

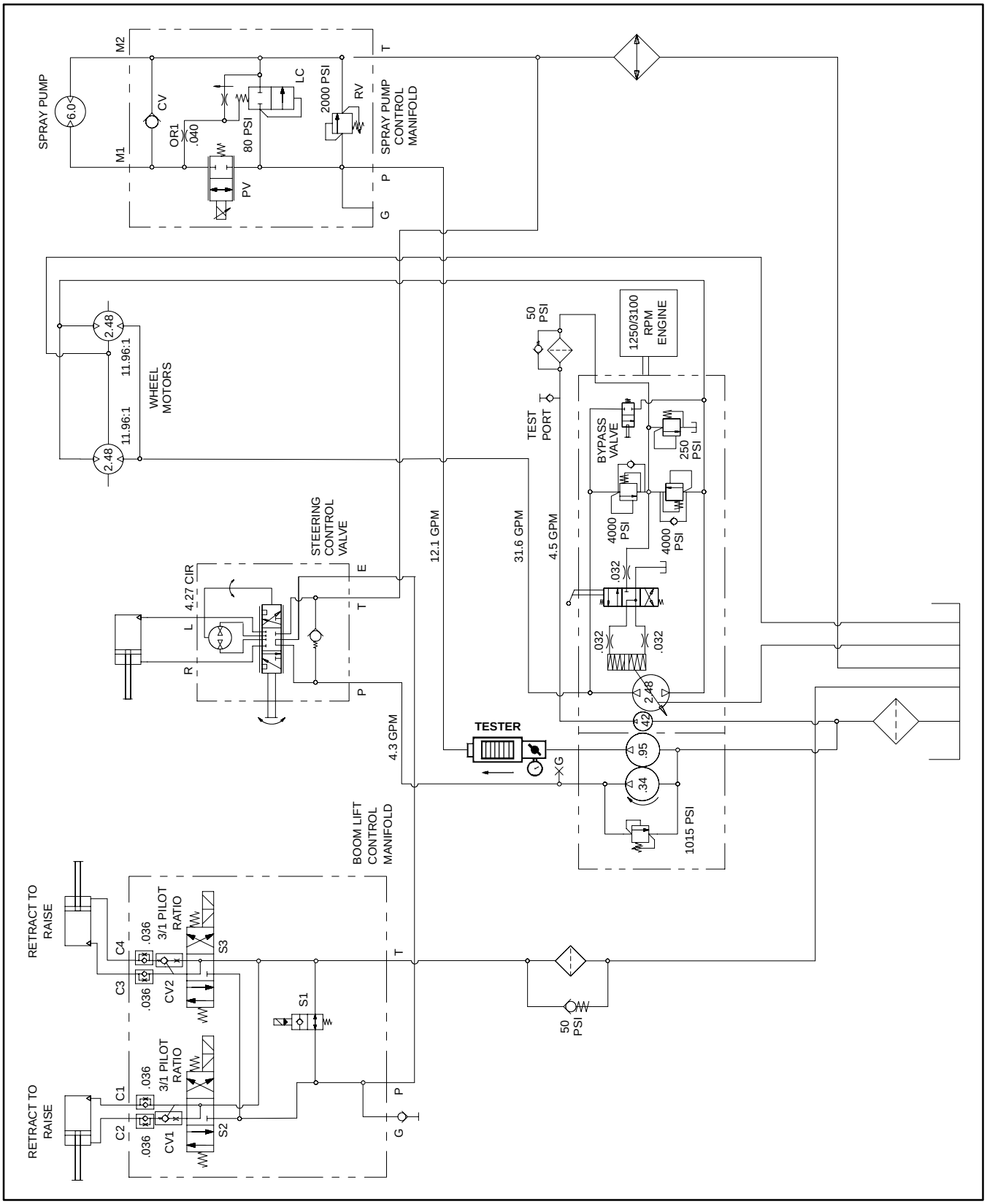

Figure 40

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 can by-pass to cause circuit performance problems. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

Procedure for Spray Pump Circuit Gear Pump Flow Test:

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

2. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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. With the engine off, clean fitting and hydraulic hose on left side of front gear pump section (Fig. 37). Disconnect hydraulic hose from the fitting.

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

4. Install tester with pressure gauge and flow meter in series between the fitting and the disconnected hose. **Make sure the tester flow control valve is open**.

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

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

6. Operate the engine at high idle speed **(3050 to 3150 RPM)**. Verify engine speed with a phototac.

7. Carefully watch pressure gauge on tester while slowly closing the flow control valve until **800 PSI (56 bar)** is obtained. Verify with a phototac that the **engine speed** is still **3050 to 3150 RPM**.

NOTE: If engine speed drops below 3050 RPM, pump flow will decrease.

8. Observe flow gauge. Flow indication should be approximately **12 GPM (46 LPM)**.

9. Open tester flow control valve and stop engine. Record test results.

10. If the flow is less than **10.8 GPM (41 LPM)** or a pressure of **800 PSI (56 bar)** could not be obtained, check for restriction in gear pump suction line. If suction line is not restricted, remove gear pump, inspect pump and repair pump as necessary (see Gear Pump and Gear Pump Service in the Service and Repairs section of this chapter).

11. After testing is completed, remove tester and reinstall disconnected hose.

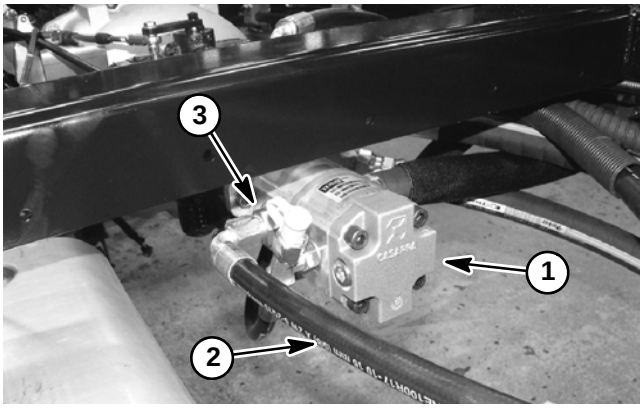

Figure 41

1. **Gear pump**
2. **Spray pump circuit pressure hose**
3. **Fitting (front gear pump section)**

Adjust Traction Pedal for Neutral

The piston (traction) pump control lever should return to the neutral position when the traction pedal is released. If the machine creeps when in neutral, adjust the traction pedal neutral assembly (Fig. 42).

1. Loosen jam nut on spring shaft.
2. Adjust spring shaft until neutral operation is correct.
3. Tighten jam nut to secure adjustment.

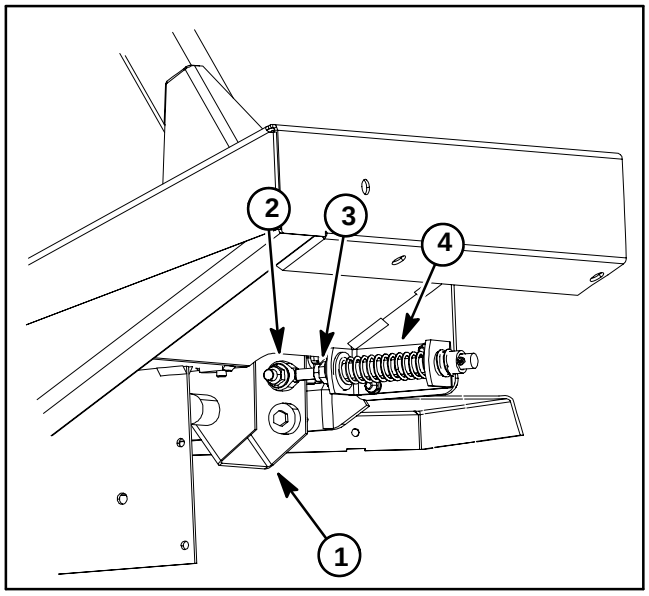

Figure 42

1. **Traction pedal**
2. **Rod end**
3. **Jam nut**
4. **Spring shaft**

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 and stop engine. Remove key from the ignition switch.

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

3. After turning engine off, operate all hydraulic controls to relieve hydraulic system pressure.

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

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

6. 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 lines.

After Repair or Replacement of Components

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

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

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

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

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

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

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

Check Hydraulic Lines and Hoses

WARNING

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

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

Flush Hydraulic System

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

1. Make sure hydraulic oil is warm by operating the machine for several minutes. Park machine on a level surface. Stop engine, apply parking brake and remove key from ignition switch.

2. Clean area around hydraulic filter mounting area and remove filter. Drain filter into a suitable container. Properly dispose removed filter.

3. Drain hydraulic reservoir into a suitable container.

4. Drain hydraulic system. Drain all hoses and components while the system is warm.

5. Make sure filter mounting surface is clean. Apply clean hydraulic oil to gasket on new filter. Screw filter onto filter head until gasket contacts mounting surface, then tighten filter 3/4 turn further.

6. Reinstall all hoses and hydraulic components.

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

7. Fill hydraulic oil reservoir.

8. Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

9. Make sure traction pedal is in neutral. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pumps. Wait fifteen (15) seconds to allow the starter motor to cool and then repeat cranking procedure again.

10. Connect wire harness electrical connector to fuel stop solenoid to allow engine to start.

11. Start engine and run at low idle speed (1200 to 1300 RPM) for a minimum of two (2) minutes.

12. Increase engine speed to high idle (3050 to 3150 RPM) for minimum of one (1) minute under no load.

13. Turn steering wheel in both directions several times.

14. Raise and lower spray booms several times.

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

16. Operate the machine for two (2) hours under normal operating conditions.

17. Check condition of hydraulic oil. If the fluid shows any signs of contamination, repeat system flushing procedure again.

18. When no signs of contamination are evident, resume normal operation and follow recommended maintenance intervals.

Filtering Closed-Loop Traction Circuit

Filtering of a closed−loop hydraulic system after a major component failure (e.g. traction (piston) pump or front wheel motor) is a requirement to prevent debris from transmitting throughout the system. If a closed−loop hydraulic system filtering tool is not used to ensure system cleanliness, repeat failures, as well as subsequent damage to other hydraulic components in the affected system, will occur. To effectively remove contamination from closed−loop traction circuit, use of the Toro high flow hydraulic filter and hydraulic hose kits are recommended (see Special Tools in this chapter).

1. Park machine on a level surface with engine stopped and key removed from ignition switch.

2. Raise and support machine so rear wheels are off the ground (see Jacking Instructions in Chapter 1 − Safety). Chock front wheels.

NOTE: If rear wheel motor was replaced, install high flow filter to the inlet of new motor instead of to the traction pump fitting. This will prevent system contamination from entering and damaging the new motor.

3. Thoroughly clean junction of hydraulic hose and **lower** fitting on right side of traction pump (Fig. 43). Disconnect hose from lower right side pump fitting.

4. Connect Toro high flow hydraulic filter in series between traction pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect filter to machine. Make sure that hose connections are properly tightened.

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required.

6. Start engine and run at idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.

CAUTION

The rear wheels will be off the ground and rotating during this procedure. Make sure machine is well supported so it will not move and accidentally fall to prevent injuring anyone around machine.

IMPORTANT: While engaging the traction circuit, monitor the indicator on the high flow hydraulic filter. If the indicator should show red, either reduce pressure on the traction pedal or reduce engine speed to decrease hydraulic flow through the filter.

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

8. With engine running at high idle speed and traction pedal moved to the forward direction, periodically apply brakes to increase pressure in traction circuit. While monitoring filter indicator, continue this process for an additional five (5) minutes.

IMPORTANT: If using a filter that is not the bi−directional Toro high flow filter, do not press the traction pedal in the reverse direction. If flow is reversed when using a filter that is not bi−directional, debris from the filter will re−enter the traction circuit.

9. With engine running at high idle speed, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.

10. Shut engine off and remove key from ignition switch.

11. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect disconnected hydraulic hose to traction pump fitting. Make sure to properly tighten hose (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

12. Lower machine to ground.

13. Check oil level in hydraulic reservoir and add correct oil if necessary.

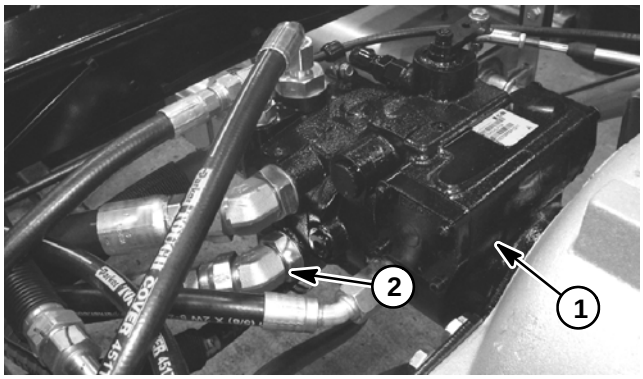

Figure 43

1. Piston (traction) pump
2. Lower fitting

Charge Hydraulic System

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

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

1. Position machine on a level surface, engage parking brake and remove key from the ignition switch.

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

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

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

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

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

6. Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

7. Make sure traction pedal is in neutral. Turn ignition key switch to start; engage starter for ten (10) seconds to prime hydraulic pumps. Wait fifteen (15) seconds to allow the starter motor to cool and then repeat cranking procedure again.

8. Connect wire harness electrical connector to fuel stop solenoid to allow engine to start.

WARNING

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

9. Raise rear wheels off the ground and place jack stands under the frame. Chock front wheels to prevent movement of the machine.

10. Start engine and run it at low idle (1200 to 1300 RPM). The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

11. After the hydraulic system starts to show signs of fill, rotate steering wheel until the steering cylinder rod moves in and out several times. If the cylinder rod does not move after fifteen (15) seconds or the gear pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for 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 fifteen (15) seconds, proceed to step 13.

13. Operate the traction pedal in the forward and reverse directions. The rear wheels should rotate in the proper direction.

    A. If the wheels rotate in the wrong direction, stop engine and check for proper hose connections at piston (traction) pump and wheel motors. Correct as needed.

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

14. Adjust traction pedal to the neutral position (see Adjust Traction Pedal for Neutral in the Adjustments section of this chapter).

15. Check operation of the traction neutral switch.

16. Remove jack stands from frame and lower machine to the ground. Remove chocks from front wheels.

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

18. Operate machine by gradually increasing its work load to full over a ten (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

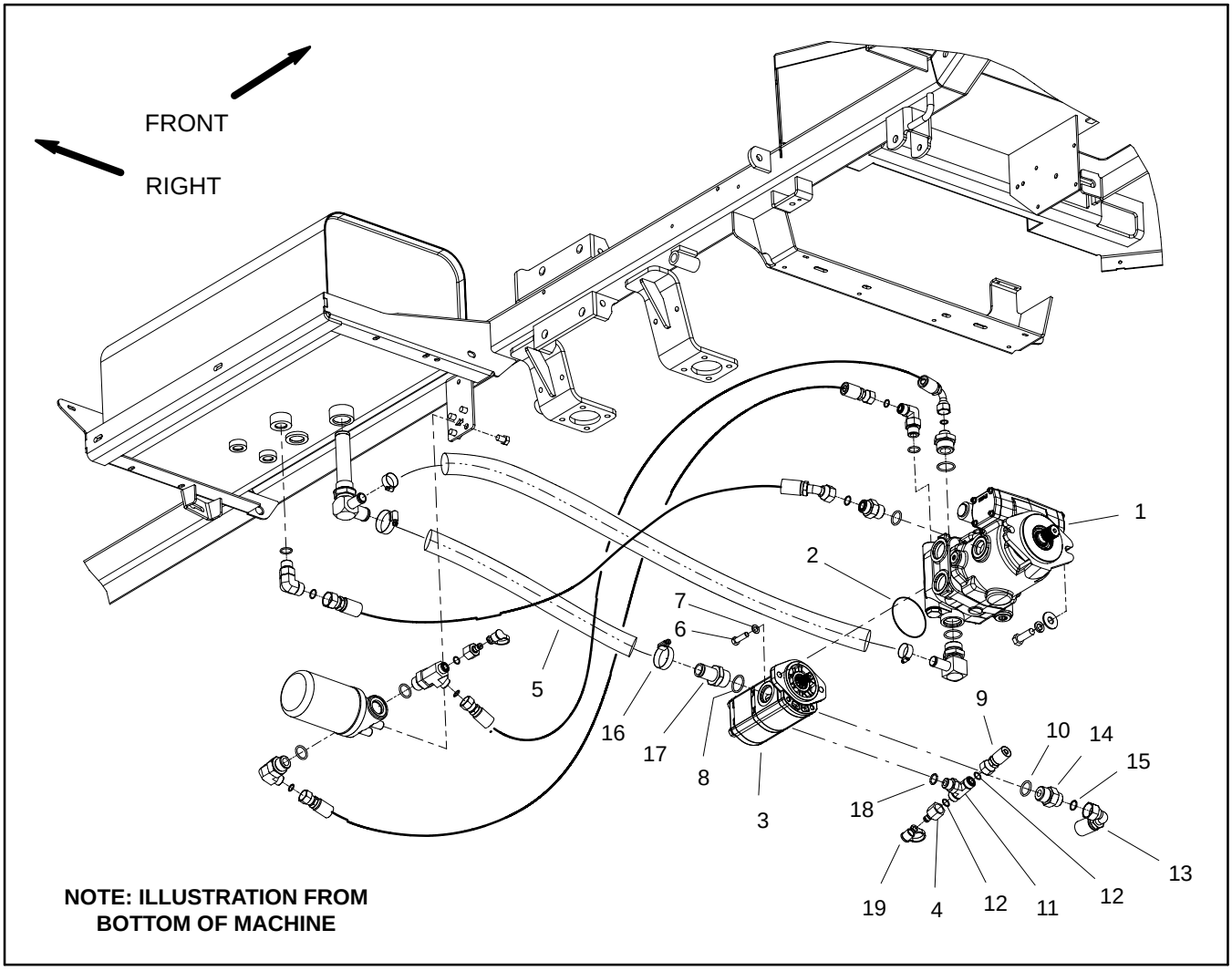

Figure 44

1. **Piston (traction) pump**
2. **O-ring**
3. **Gear pump**
4. **Test fitting**
5. **Hydraulic hose (with cover)**
6. **Cap screw (2 used)**
7. **Flat washer (2 used)**
8. **O-ring**
9. **Hydraulic hose (to steering control)**
10. **O-ring**
11. **Hydraulic tee fitting**
12. **O-ring**
13. **Hydraulic hose (to pump manifold)**
14. **Straight fitting**
15. **O-ring**
16. **Hose clamp**
17. **Hydraulic fitting**
18. **O-ring**
19. **Dust cap**

Removal (Fig. 44)

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

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

3. Operate all hydraulic controls to relieve hydraulic system pressure.

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

5. For assembly purposes, label hydraulic hoses to show their correct position on the gear pump.

6. Put drain pan below the gear pump. Remove hydraulic hoses connected to gear pump. Put plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the system.

7. Support the gear pump to prevent it from falling (Fig. 45). Remove two (2) cap screws and flat washers retaining gear pump to piston pump.

8. Carefully pull gear pump from piston pump and lower it out of the machine. Locate and retrieve O−ring (item 2) from between pumps.

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

Installation (Fig. 44)

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

2. Lubricate new O−ring (item 2) and position it to gear pump. Carefully raise gear pump and position it to the piston pump.

3. Align spline teeth and slide gear pump input shaft into piston pump coupling. Support gear pump to prevent it from shifting. Secure gear pump to piston pump with two (2) cap screws and flat washers.

4. Remove plugs or caps from disconnected hydraulic hoses of the gear pump. Lubricate new O−rings and install hoses to correct location on gear pump.

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

5. Check and adjust oil level in hydraulic reservoir.

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

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

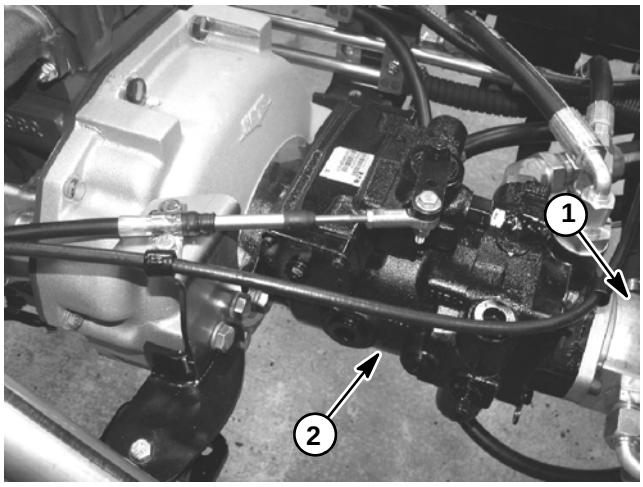

Figure 45

1. Gear pump
2. Piston pump

Gear Pump Service

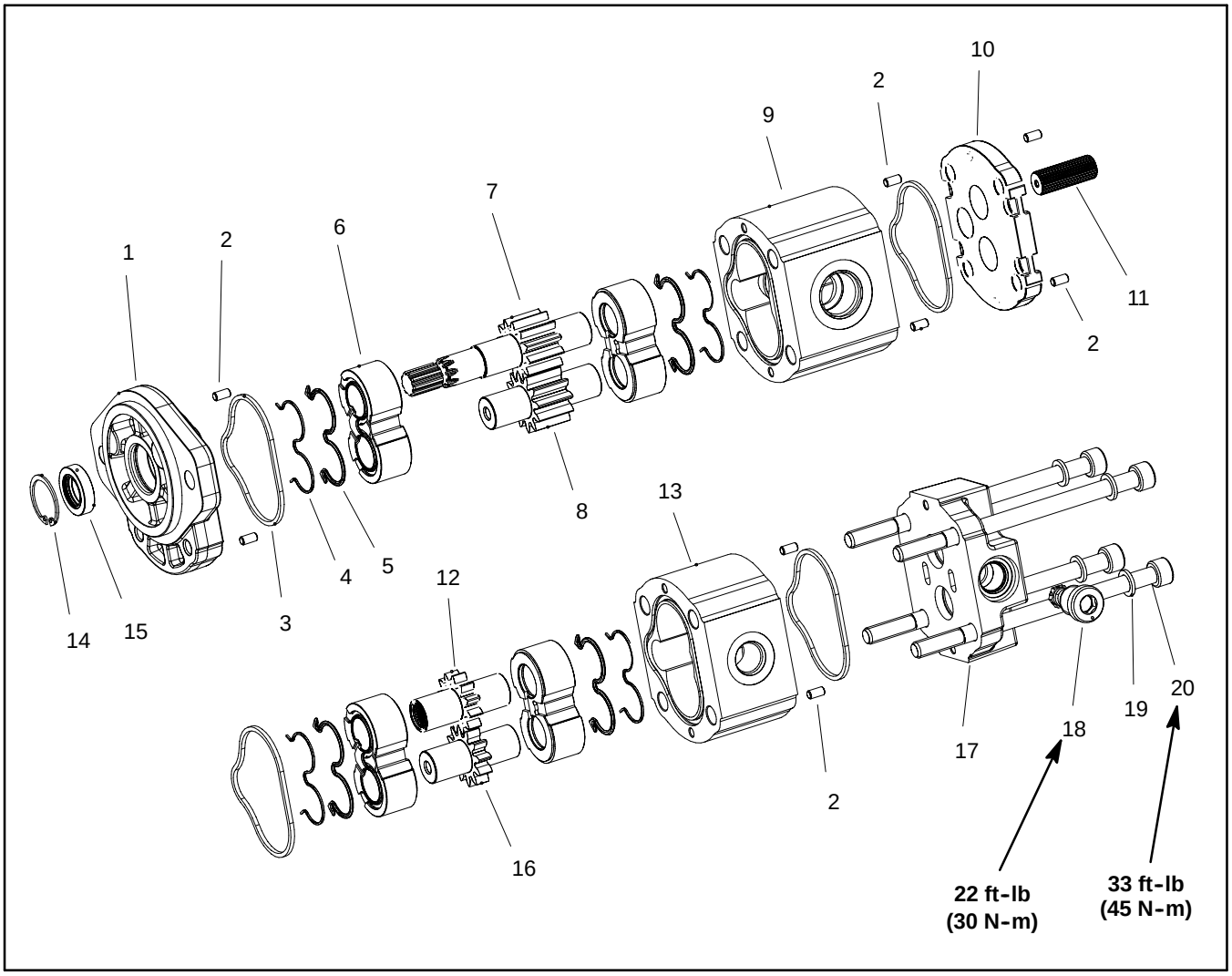

Figure 46

1. **Front cover**
2. **Dowel pin (8 used)**
3. **Square section seal (4 used)**
4. **Back-up ring (4 used)**
5. **Pressure seal (4 used)**
6. **Thrust plate (4 used)**
7. **Drive shaft**
8. **Driven gear**
9. **Body (P1 section)**
10. **Flange**
11. **Splined connecting shaft**
12. **Drive gear**
13. **Body (P2 section)**
14. **Retaining ring**
15. **Front seal**
16. **Driven gear**
17. **Rear cover**
18. **Relief valve (steering/boom lift)**
19. **Washer (4 used)**
20. **Bolt (4 used)**

Disassembly (Fig. 46)

NOTE: Disassemble gear pump for cleaning, inspection and seal replacement only. If internal components of pump are worn or damaged, the gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately.

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

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

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 47).

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

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

4. Loosen, but do not remove, the four (4) screws that secure pump assembly.

5. Remove pump from vise and remove fasteners.

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

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

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

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

9. Replace the entire pump assembly if pump componets are excessively worn, scored or damaged.

Disassembly (Fig. 46)

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

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

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

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

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

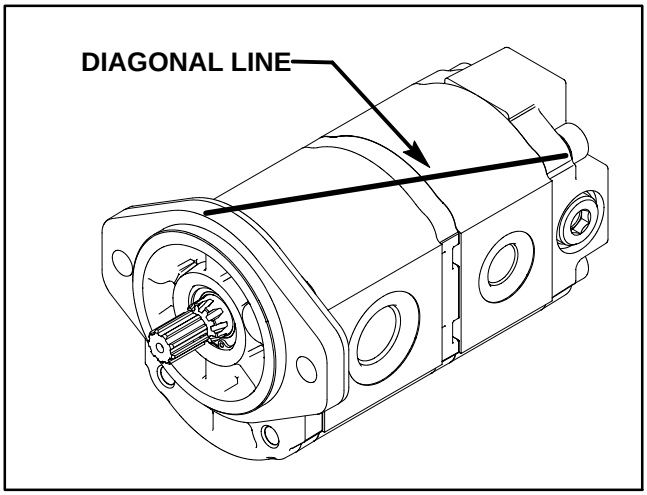

Figure 47

Piston (Traction) Pump

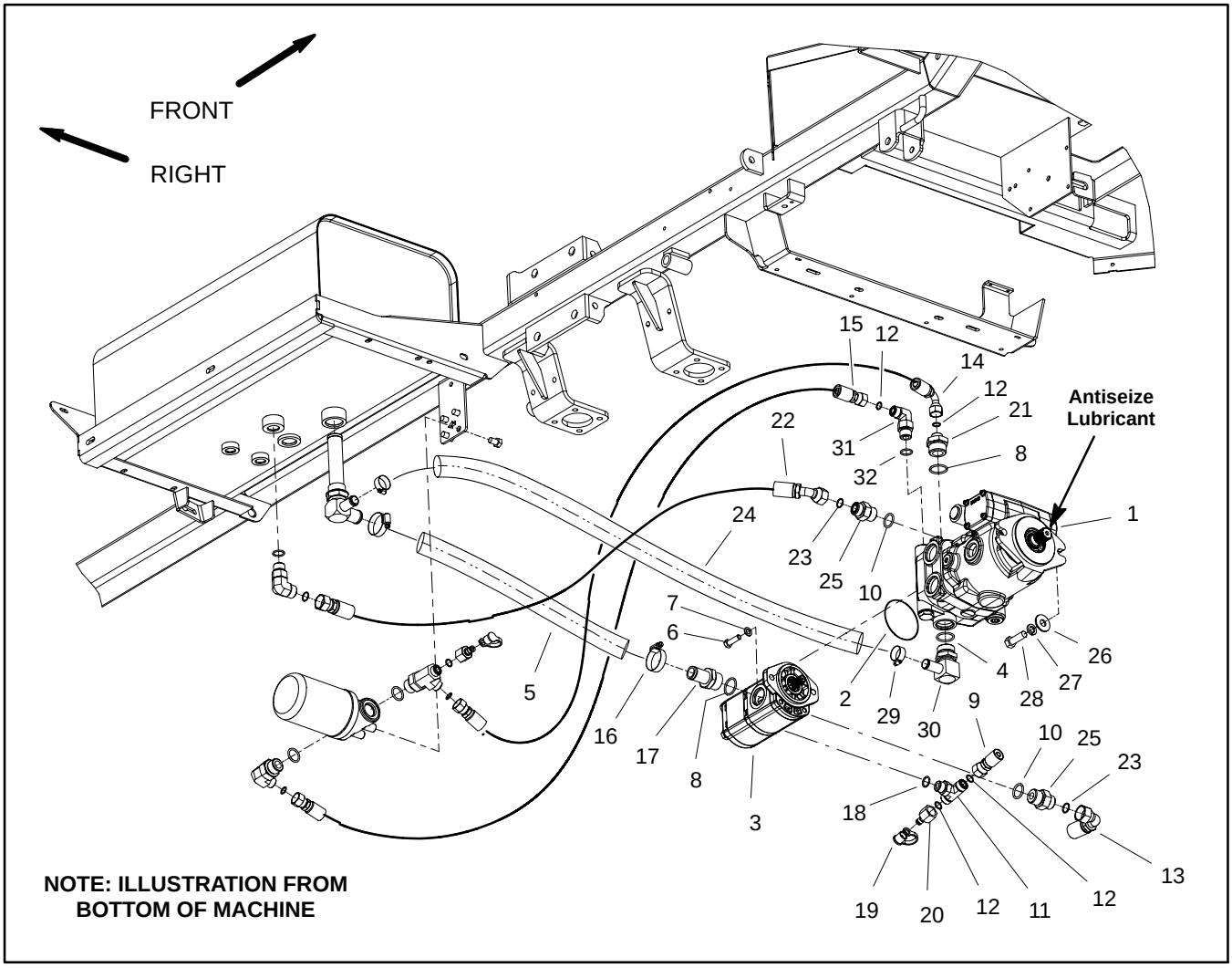

Figure 48

1. Piston (traction) pump
2. O-ring
3. Gear pump
4. O-ring
5. Hydraulic hose (with cover)
6. Cap screw (2 used)
7. Flat washer (2 used)
8. O-ring
9. Hydraulic hose (to steering control)
10. O-ring
11. Hydraulic tee fitting
12. O-ring
13. Hydraulic hose (to pump manifold)
14. Hydraulic hose
15. Hydraulic hose
16. Hose clamp
17. Hydraulic fitting
18. O-ring
19. Dust cap
20. Test fitting
21. Straight fitting
22. Hydraulic hose
23. O-ring
24. Hydraulic hose (with cover)
25. Straight fitting
26. Flat washer (2 used)
27. Lock washer (2 used)
28. Cap screw (2 used)
29. Hose clamp
30. 90º hydraulic fitting
31. 90º hydraulic fitting
32. O-ring

Removal (Fig. 48)

1. Park machine on a level surface, 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.

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

3. Operate all hydraulic controls to relieve hydraulic system pressure.

4. Remove traction cable ball joint from control plate on piston pump by removing lock nut, cap screw and three (3) flat washers from control plate (Fig. 49).

5. Disconnect wire harness connector from neutral switch on piston pump (Fig. 50).

6. Remove flange head screw and flange nut that secures R−clamp and right side brake cable to pump assembly (Fig. 50).

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

8. For assembly purposes, label hydraulic hoses to show their correct position on the pump assembly.

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

CAUTION

Pump assembly weighs approximately 72 pounds (33 kg). Make sure that pump assembly is well supported during removal.

10. Support the pump assembly to prevent it from falling. Remove two (2) cap screws, lock washers and flat washers that secure pump assembly to engine bell housing.

11. Carefully separate pump assembly from engine and lower it out of the machine.

12. If needed, separate gear pump from piston pump (see Gear Pump Removal in this section).

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

Installation (Fig. 48)

1. If gear pump was removed from piston pump, install gear pump to piston pump (see Gear Pump Installation in this section).

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

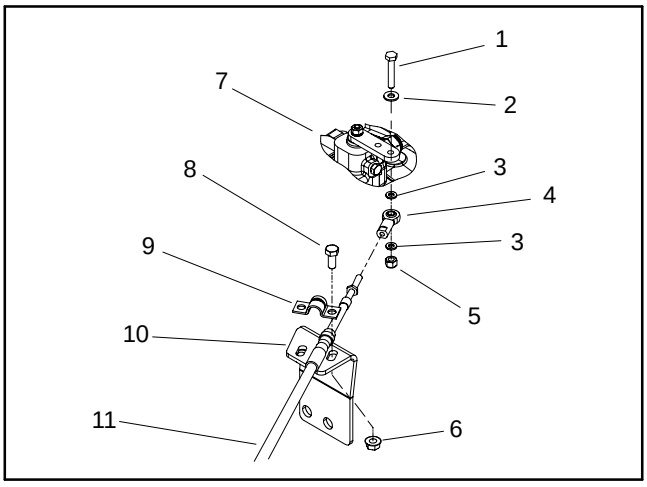

Figure 49

1. Cap screw
2. Flat washer
3. Flat washer (2 used)
4. Ball joint
5. Lock nut
6. Flange nut (2 used)
7. Piston pump
8. Cap screw (2 used)
9. Cable clamp
10. Cable bracket
11. Traction cable

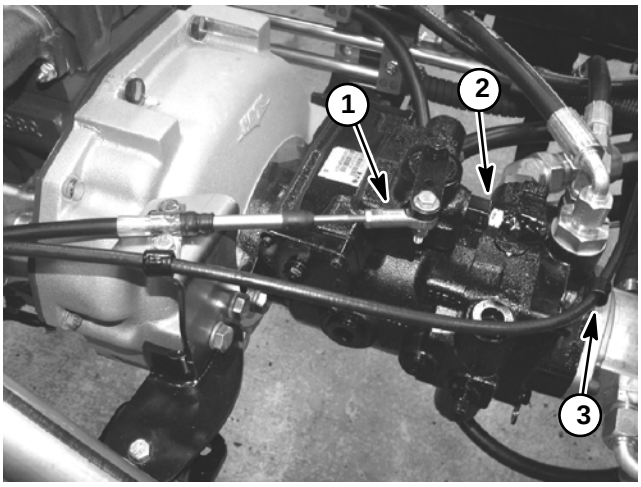

Figure 50

1. Traction cable ball joint
2. Neutral switch
3. R−clamp/brake cable

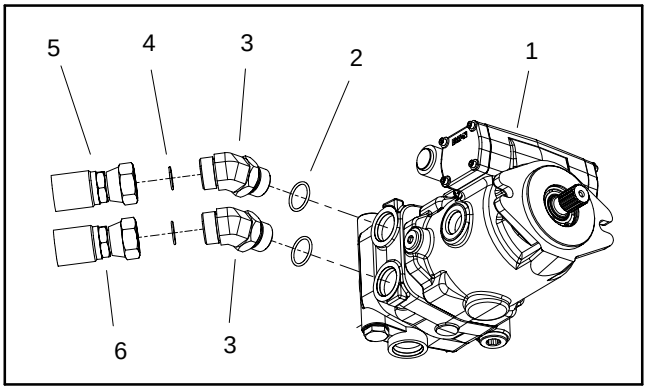

Figure 51

1. Traction (piston) pump
2. O−ring
3. 45º hydraulic fitting
4. O−ring
5. Hose (forward pressure)
6. Hose (reverse pressure)

3. Apply antiseize lubricant to piston pump shaft splines.

CAUTION

Pump assembly weighs approximately 72 pounds (33 kg). Make sure that pump assembly is well supported during installation.

4. Carefully raise pump assembly and position it to the engine.

5. Align spline teeth and slide piston pump input shaft into engine coupling. Support pump to prevent it from shifting while installing two (2) cap screws, lock washers and flat washers to secure pump to engine bell housing.

6. Secure traction cable to control plate with cap screw, three (3) washers and lock nut (Fig. 49).

7. Connect wire harness connector to neutral switch on piston pump (Fig. 50).

8. Remove plugs or caps from disconnected hydraulic hoses and fittings on pumps. Lubricate new O−rings and install hydraulic hoses to correct location on gear and piston pumps (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Secure R−clamp and right side brake cable to pump assembly with flange head screw and flange nut (Fig. 50).

IMPORTANT: Use only hydraulic fluids specified in Operator's Manual. Other fluids could cause system damage.

10. Check and adjust oil level in hydraulic reservoir.

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

12. Adjust traction pedal to the neutral position (see Adjust Traction Pedal for Neutral in the Adjustments section of this chapter).

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

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Piston (Traction) Pump Service

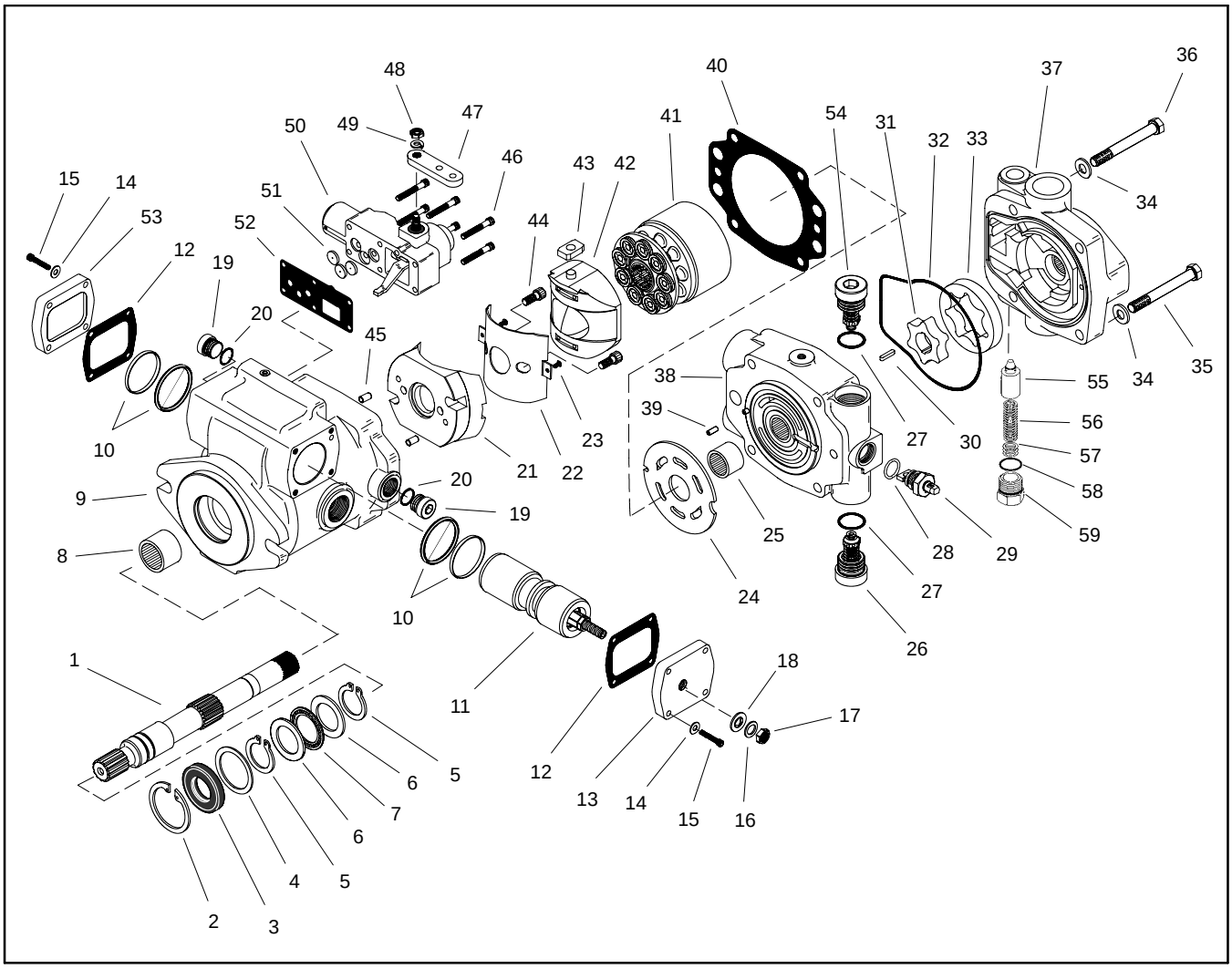

Figure 52

1. **Drive shaft**
2. **Retaining ring**
3. **Shaft seal**
4. **Washer**
5. **Retaining ring**
6. **Thrust bearing race**
7. **Thrust bearing**
8. **Bearing**
9. **Housing**
10. **Seal set**
11. **Servo piston**
12. **Gasket**
13. **Cover plate**
14. **Flat washer (4 used per cover)**
15. **Socket head screw (4 used per cover)**
16. **Washer**
17. **Jam nut**
18. **Seal washer**
19. **Plug**
20. **O-ring**
21. **Cradle**
22. **Bushing**
23. **Screw (2 used)**
24. **Valve plate**
25. **Bearing**
26. **Reverse relief valve**
27. **O-ring**
28. **O-ring**
29. **Bypass valve**
30. **Key**
31. **Geroter (inner)**
32. **O-ring**
33. **Geroter (outer)**
34. **Flat washer (4 used)**
35. **Cap screw (3 1/2" long: 2 used)**
36. **Cap screw (4" long: 2 used)**
37. **Charge pump adapter**
38. **Backplate**
39. **Roll pin**
40. **Housing gasket**
41. **Rotating kit**
42. **Camplate**
43. **Servo piston follower**
44. **Cap screw (2 used)**
45. **Bushing dowel (2 used)**
46. **Socket head screw (6 used)**
47. **Control arm**
48. **Hex nut**
49. **Lock washer**
50. **Manual servo control assembly**
51. **Control orifice (3 used)**
52. **Housing gasket**
53. **Cover plate**
54. **Forward relief valve**
55. **Charge relief valve poppet**
56. **Charge relief valve spring**
57. **Charge relief valve shims**
58. **O-ring**
59. **Plug**

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

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Wheel Motors

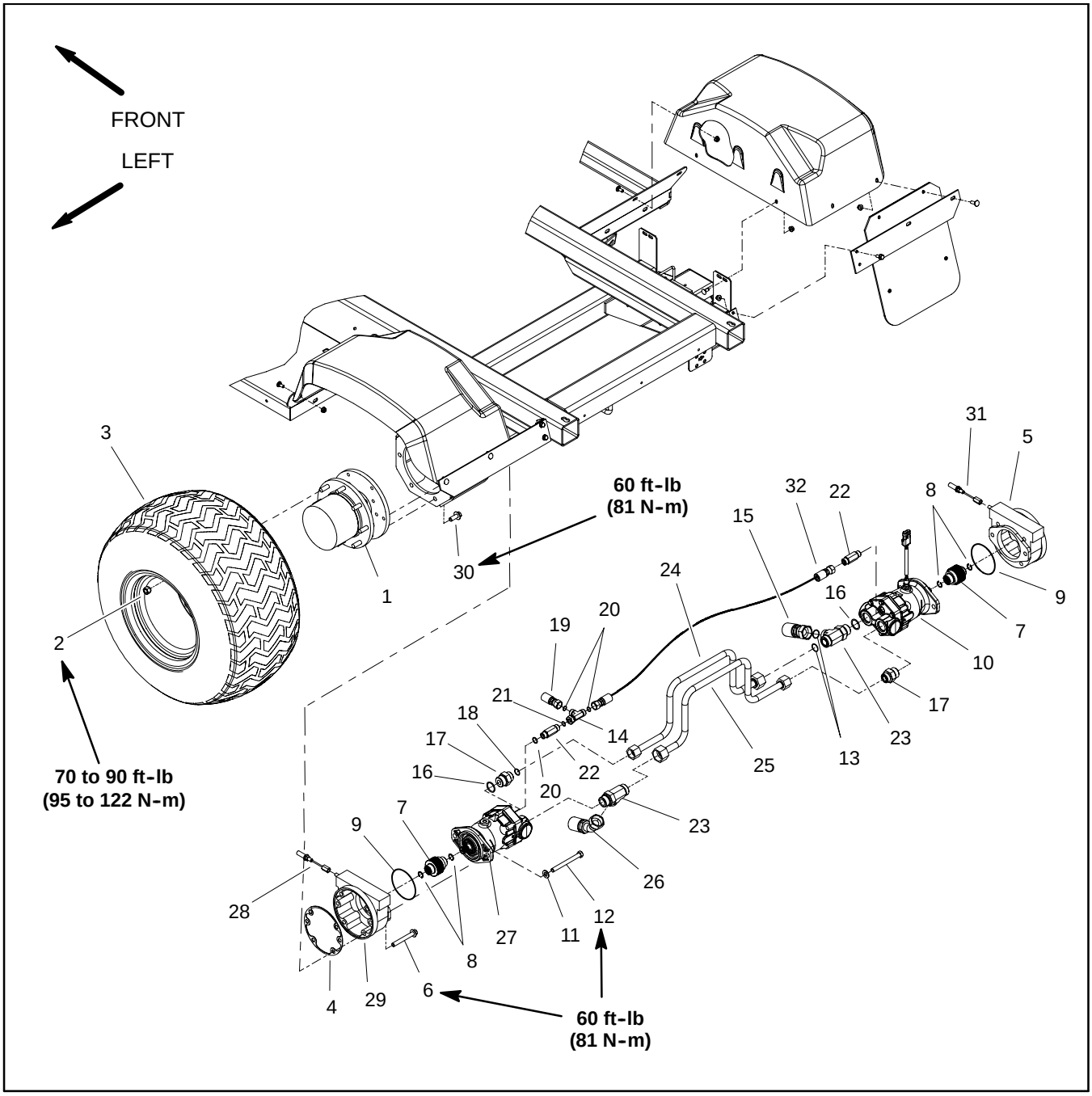

Figure 53

1. **Planetary assembly**
2. **Lug nut (8 used per wheel)**
3. **Tire and wheel assembly**
4. **Gasket**
5. **RH brake assembly**
6. **Flange head screw (4 used per brake)**
7. **Splined brake shaft**
8. **Retaining ring**
9. **O-ring**
10. **RH wheel motor**
11. **Flat washer (2 used per motor)**
12. **Cap screw (2 used per motor)**
13. **O-ring**
14. **Hydraulic tee fitting**
15. **Hyd. hose (to upper pump fitting)**
16. **O-ring**
17. **Hydraulic adapter**
18. **O-ring**
19. **Hydraulic hose (to reservoir)**
20. **O-ring**
21. **O-ring**
22. **Straight hydraulic fitting**
23. **Hydraulic tee fitting (2 used)**
24. **Hydraulic tube**
25. **Hydraulic tube**
26. **Hyd. hose (to lower pump fitting)**
27. **LH wheel motor**
28. **LH brake cable**
29. **LH brake assembly**
30. **Flange head screw (6 used per side)**
31. **RH brake cable**
32. **Hydraulic hose**

Removal (Fig. 53)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

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

5. For assembly purposes, label the hydraulic lines to show their correct position on the wheel motor.

6. Disconnect hydraulic lines from fittings on wheel motor. Put caps or plugs on hydraulic lines and fittings to prevent contamination.

7. If right side wheel motor is being removed, unplug speed sensor connector from machine wire harness.

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

8. Support the motor assembly to prevent it from falling. Remove two (2) cap screws and flat washers that secure wheel motor to brake and planetary assemblies. Remove wheel motor from machine.

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

Installation (Fig. 53)

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

2. If splined brake shaft was removed from brake assembly, make sure that the stepped end of the shaft is aligned toward the hydraulic wheel motor (Fig. 54). Also, make sure that splines engage rotating discs in brake assembly.

3. Install O−ring (item 9) onto motor. Position wheel motor to brake assembly.

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

5. Secure motor to brake and planetary assemblies with cap screws and flat washers. Torque cap screws **60 ft−lb (81 N−m)**.

6. Remove plugs from hydraulic lines, fittings and ports. Lubricate new O−rings and attach hydraulic lines to wheel motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. If right side wheel motor was removed, plug speed sensor connector into machine wire harness.

8. Check fluid level in hydraulic oil reservoir and adjust as required.

9. Operate machine and inspect for leaks.

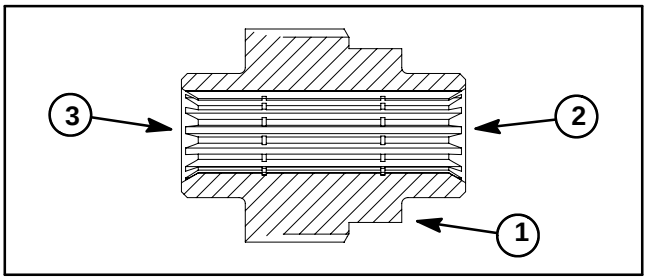

Figure 54

1. Splined brake shaft step
2. Hydraulic motor end
3. Planetary assembly end

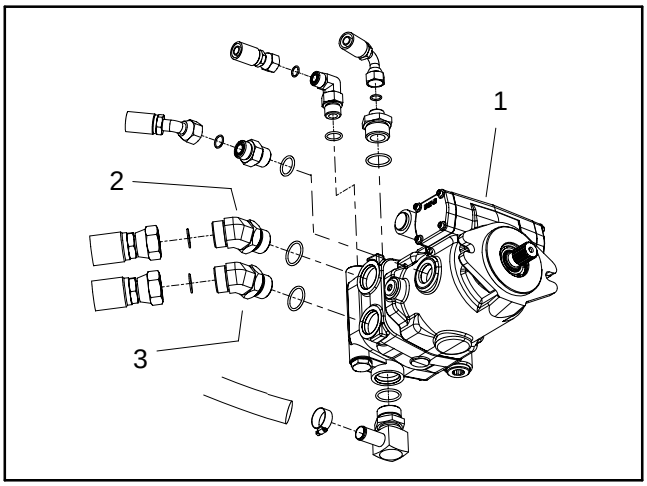

Figure 55

1. Piston (traction) pump
2. Upper pump fitting
3. Lower pump fitting

Wheel Motor Service

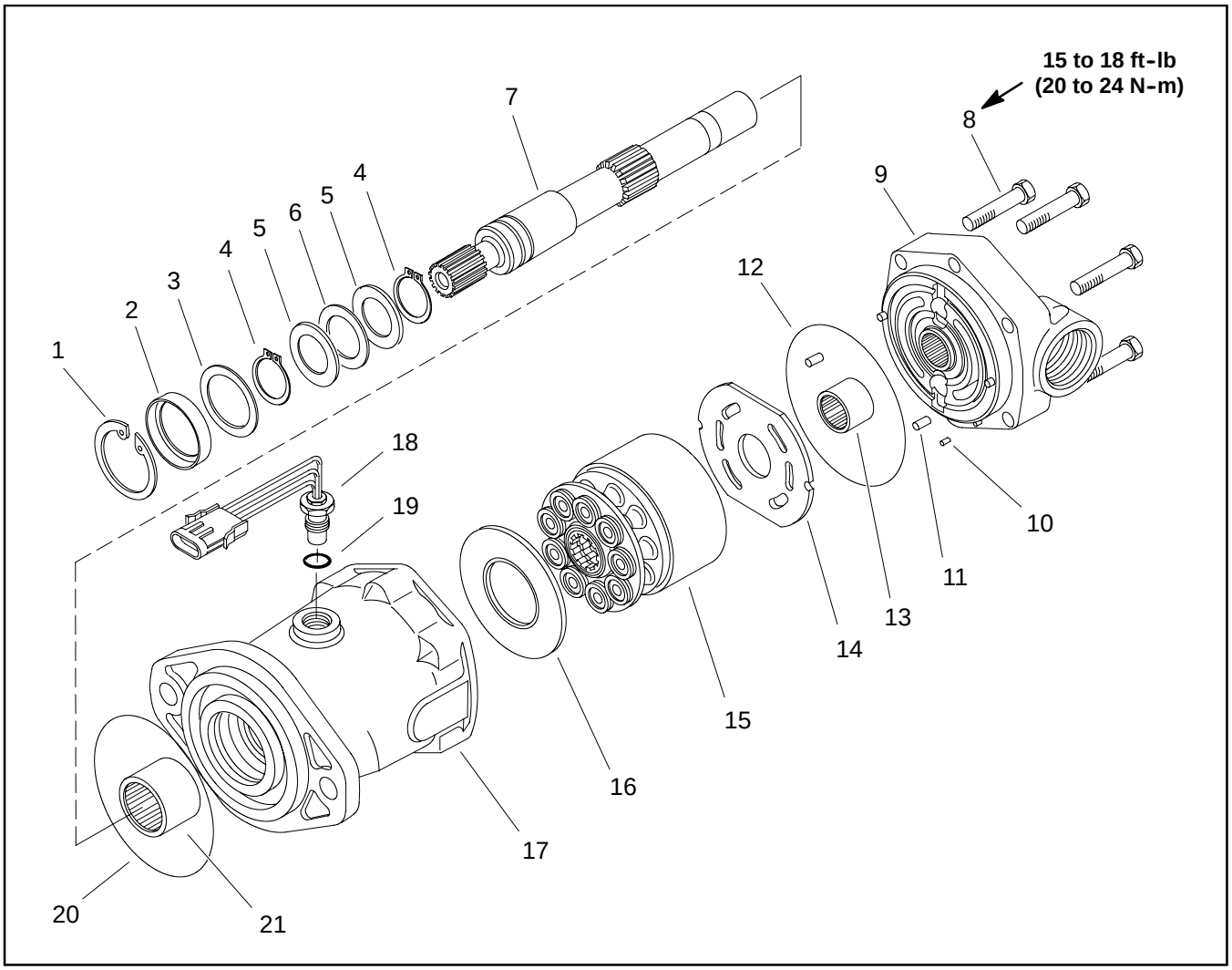

Figure 56

1. **Retaining ring**
2. **Shaft seal**
3. **Washer**
4. **Retaining ring**
5. **Thrust bearing race**
6. **Thrust bearing**
7. **Drive shaft**
8. **Cap screw (6 used)**
9. **Back plate**
10. **Dowel pin**
11. **Dowel pin (3 used)**
12. **O-ring**
13. **Needle bearing**
14. **Valve plate**
15. **Rotating kit**
16. **Cam plate insert**
17. **Housing**
18. **Speed sensor (RH wheel)**
19. **O-ring**
20. **O-ring**
21. **Needle bearing**

NOTE: The wheel motors used on the Multi Pro 5800 are very similar. The major difference is the speed sensor installed in the right side wheel motor. Service of the left and right motors requires the same procedure.

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

NOTE: For information on speed sensor installation, see Traction Speed Sensor in the Service and Repairs section of Chapter 5 – Electrical System.

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Spray Pump Drive Motor

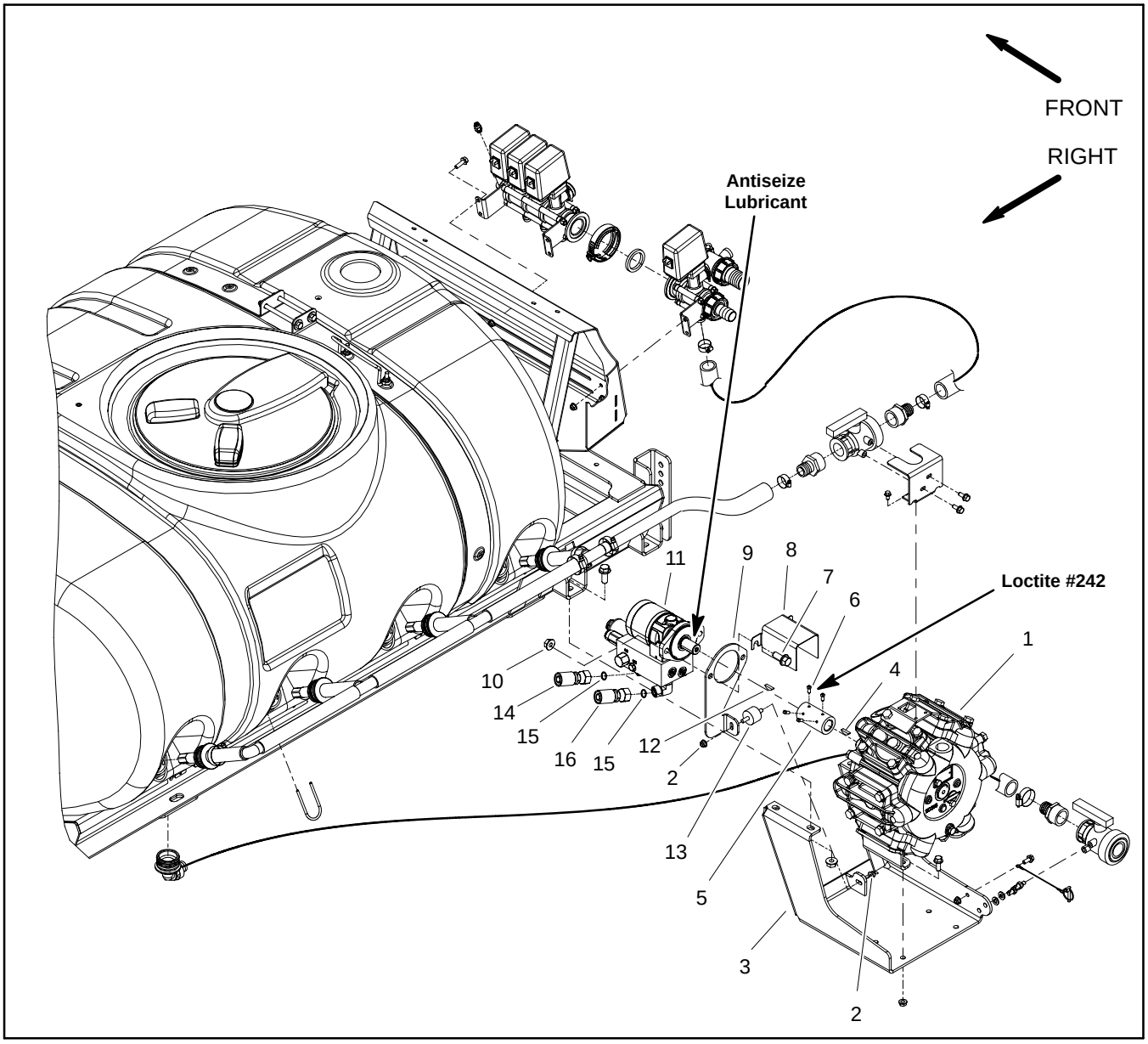

Figure 57

1. Spray pump
2. Flange nut (2 used)
3. Pump bracket
4. Woodruff key
5. Coupler
6. Set screw (4 used)
7. Flange head screw (2 used)
8. Guard
9. Motor mount plate
10. Flange nut (2 used)
11. Control manifold/motor assembly
12. Woodruff key
13. Vibration mount
14. Hydraulic hose (from gear pump)
15. O–ring
16. Hydraulic hose (to oil cooler)

Removal (Fig. 57)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Thoroughly clean hydraulic hose ends that connect to pump control manifold.

5. Label all pump control manifold electrical and hydraulic connections for assembly purposes.

6. Disconnect wire harness electrical connector from solenoid valve coil on pump control manifold.

7. Disconnect hydraulic hoses connected to the pump control manifold. Allow hoses to drain into a suitable container. Cap or plug openings of control manifold and hoses to prevent contamination.

8. Loosen, but do not remove, flange nuts (item 10) that secure spray pump motor to motor mount plate so that guard (item 8) can be lifted from machine. Remove guard.

9. Loosen two (2) set screws (item 6) that secure coupler (item 5) to hydraulic motor shaft. Do not loosen two (2) set screws that secure coupler to spray pump shaft so that coupler will remain on the pump shaft during motor removal.

10. Remove flange nut (item 2) that secures motor mount plate (item 9) to vibration mount (item 13).

11. While supporting the mount plate, control manifold and motor assembly, rotate the motor mount plate to free it from the vibration mount stud. Slide motor shaft from coupler and remove mount plate, control manifold and motor assembly from machine.

12. Locate and remove woodruff key (item 12) from motor shaft.

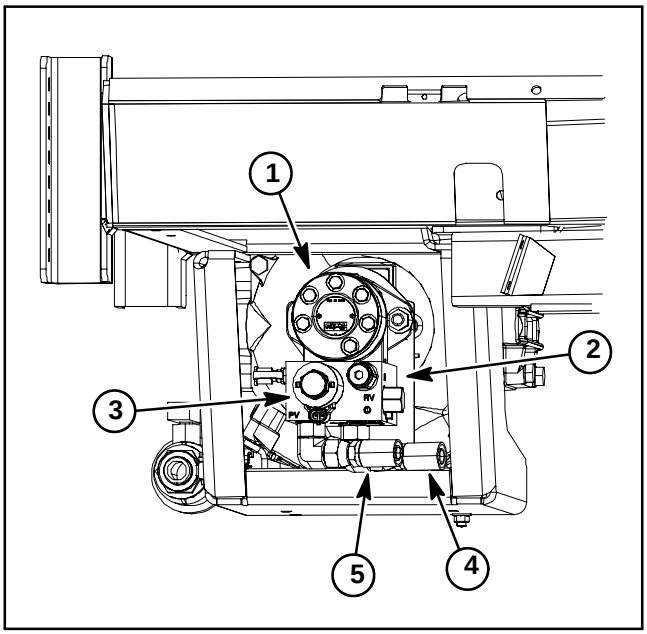

Figure 58

1. Spray pump motor
2. Pump control manifold
3. Manifold solenoid coil
4. Hyd hose (to cooler)
5. Hyd hose (from pump)

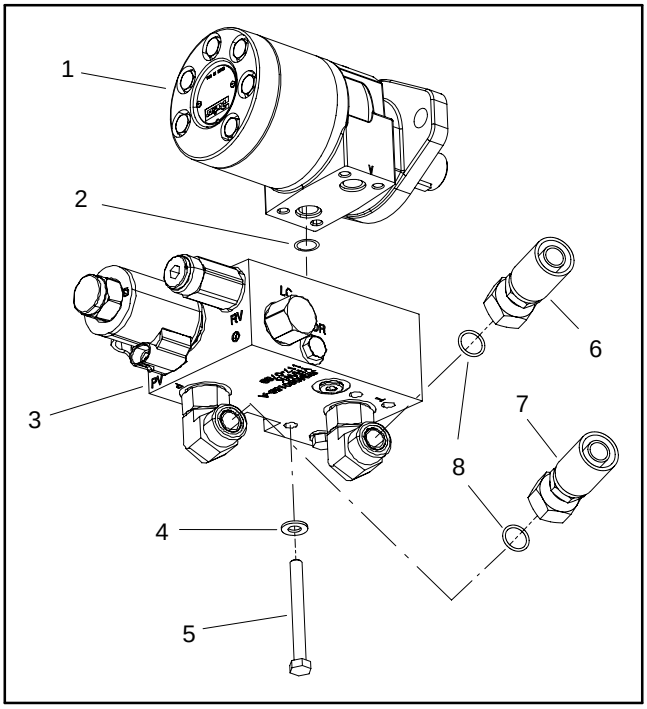

Figure 59

1. Hydraulic motor
2. O-ring (2 used)
3. Pump control manifold
4. Flat washer (4 used)
5. Cap screw (4 used)
6. Hyd hose (to cooler)
7. Hyd hose (from pump)
8. O-ring

13. Remove two (2) flange head screws and flange nuts that secure hydraulic motor to motor mount plate. Remove mount plate from control manifold and motor assembly.

14. Remove four (4) cap screws and flat washers that secure control manifold to motor (Fig. 59). Separate control manifold from motor. Locate and discard two (2) O−rings from motor ports.

15. Remove set screws (item 6) that were loosened in coupler. Clean threads of set screws and coupler.

Installation (Fig. 57)

1. Secure control manifold to motor:

   A. Lubricate two (2) new O−rings and place O−rings in motor ports.

   B. Position control manifold to motor making sure that O−rings remain in position.

   C. Install and tighten four (4) cap screws and flat washers to secure assembly.

2. Position motor mount plate to motor and install two (2) flange head screws and flange nuts to motor and mounting bracket. Leave fasteners loose.

3. Apply antiseize lubricant to motor shaft. Install woodruff key in shaft.

4. Position mount plate, control manifold and motor assembly to machine and slide motor shaft into coupler on spray pump shaft.

5. Rotate motor mount plate to insert the vibration mount stud into the plate hole. Secure plate to mount with flange nut (item 2).

6. Apply Loctite #242 (or equivalent) to threads of set screws (item 6). Install and tighten set screws into coupler to secure coupler to motor shaft.

7. Position guard (item 8) to motor mount plate making sure that guard fits around screws used to attach motor to mount plate. Tighten flange head screws and flange nuts to secure assembly.

8. Using labels placed during removal, lubricate new O−rings and install hydraulic hoses to correct hydraulic fittings on control manifold (Fig. 59) (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Connect wire harness electrical connector to solenoid valve coil on pump control manifold.

10. Check fluid level in hydraulic oil reservoir and adjust as required.

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

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

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Spray Pump Drive Motor Service

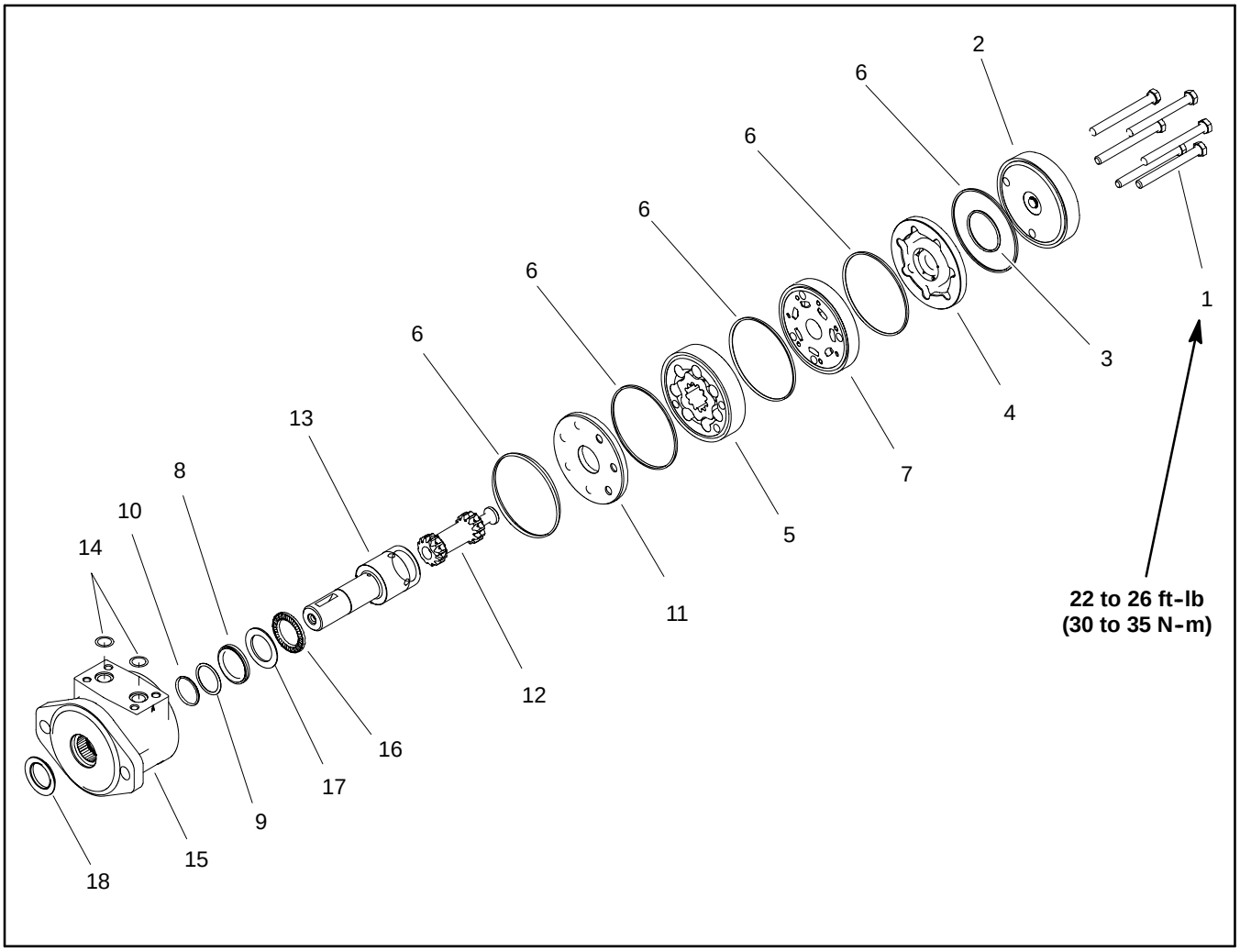

Figure 60

1. **Cap screw (6 used)**
2. **End cover**
3. **Commutator seal**
4. **Commutator assembly**
5. **Rotor assembly**
6. **Seal ring**
7. **Manifold**
8. **Inner seal**
9. **Backup washer**
10. **Backup ring**
11. **Wear plate**
12. **Drive link**
13. **Shaft**
14. **O-ring (2 used)**
15. **Housing**
16. **Thrust bearing**
17. **Thrust washer**
18. **Seal**

NOTE: For service of the spray pump drive motor, see the Parker Torqlink™ Service Procedure at the end of this chapter.

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Spray Pump Control Manifold

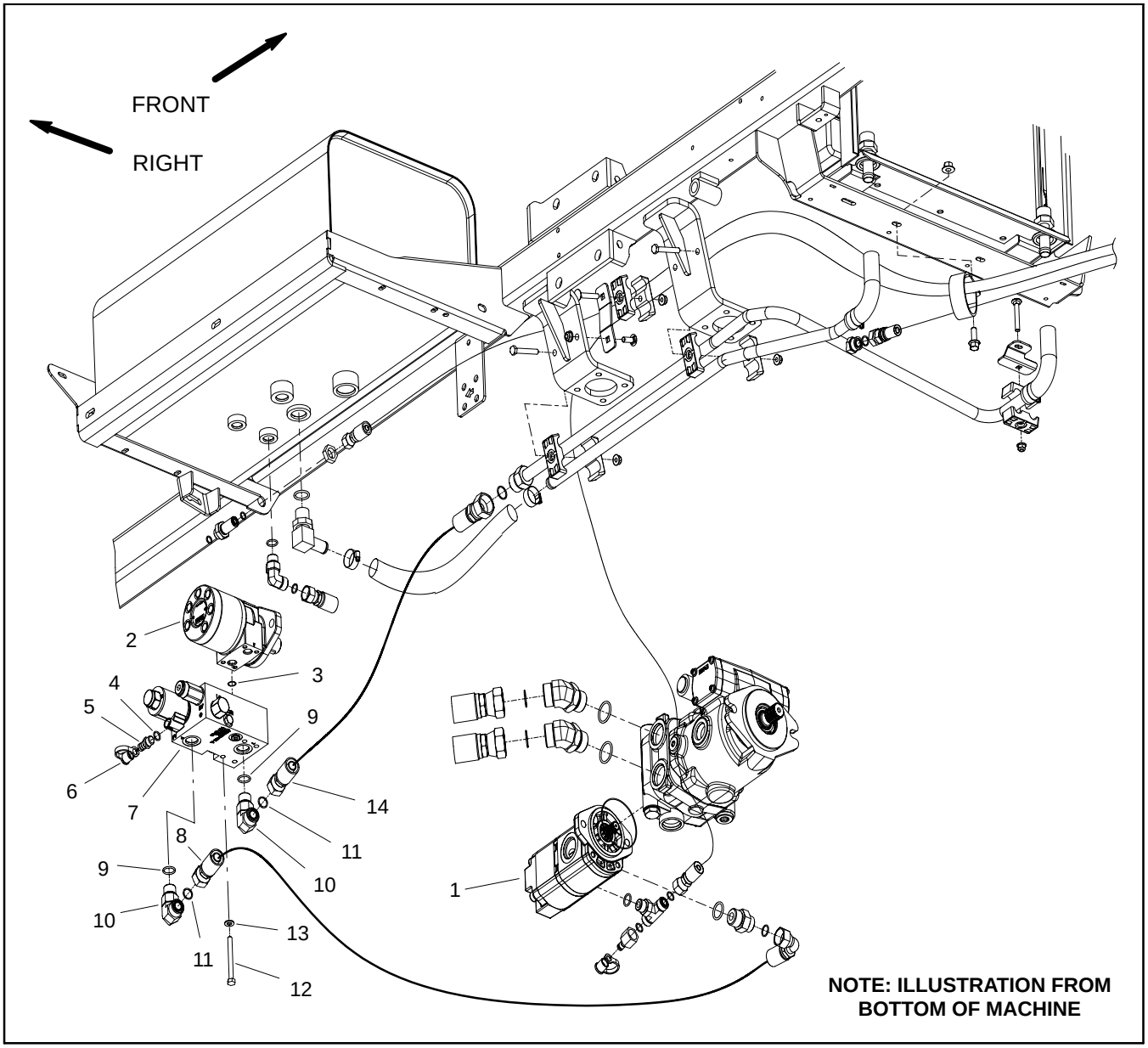

Figure 61

1. **Gear pump**
2. **Spray pump motor**
3. **O-ring (2 used)**
4. **O-ring**
5. **Test fitting**
6. **Dust cap**
7. **Spray pump control manifold**
8. **Hydraulic hose**
9. **O-ring**
10. **90º hydraulic fitting**
11. **O-ring**
12. **Cap screw (4 used)**
13. **Flat washer (4 used)**
14. **Hydraulic hose**

The spray pump control manifold is used on the Multi Pro 5800 to control gear pump flow to the spray pump drive motor. Electrical current to the manifold valve solenoid coil affects the internal spool setting of the manifold flow control valve and thus the hydraulic flow to the spray pump drive motor.

NOTE: For information on manifold valve solenoid coil testing, see Hydraulic Valve Solenoid Coils in the Component Testing section of Chapter 5 – Electrical System.

Removal (Fig. 61)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Remove the spray pump drive motor and pump control manifold assembly from machine and then separate pump control manifold from motor (see Spray Pump Drive Motor Removal in this section).

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

Installation (Fig. 61)

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

2. Assemble and secure spray pump drive motor to pump control manifold and then install the motor and manifold assembly to machine (see Spray Pump Drive Motor Installation in this section).

3. Check fluid level in hydraulic oil reservoir and adjust as required.

4. Operate machine and inspect for leaks.

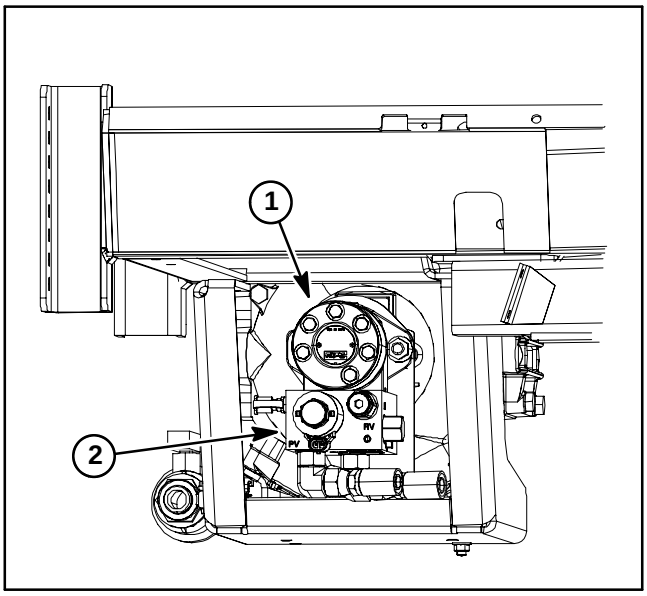

Figure 62

1. Spray pump drive motor **2. Pump control manifold**

Spray Pump Control Manifold Service

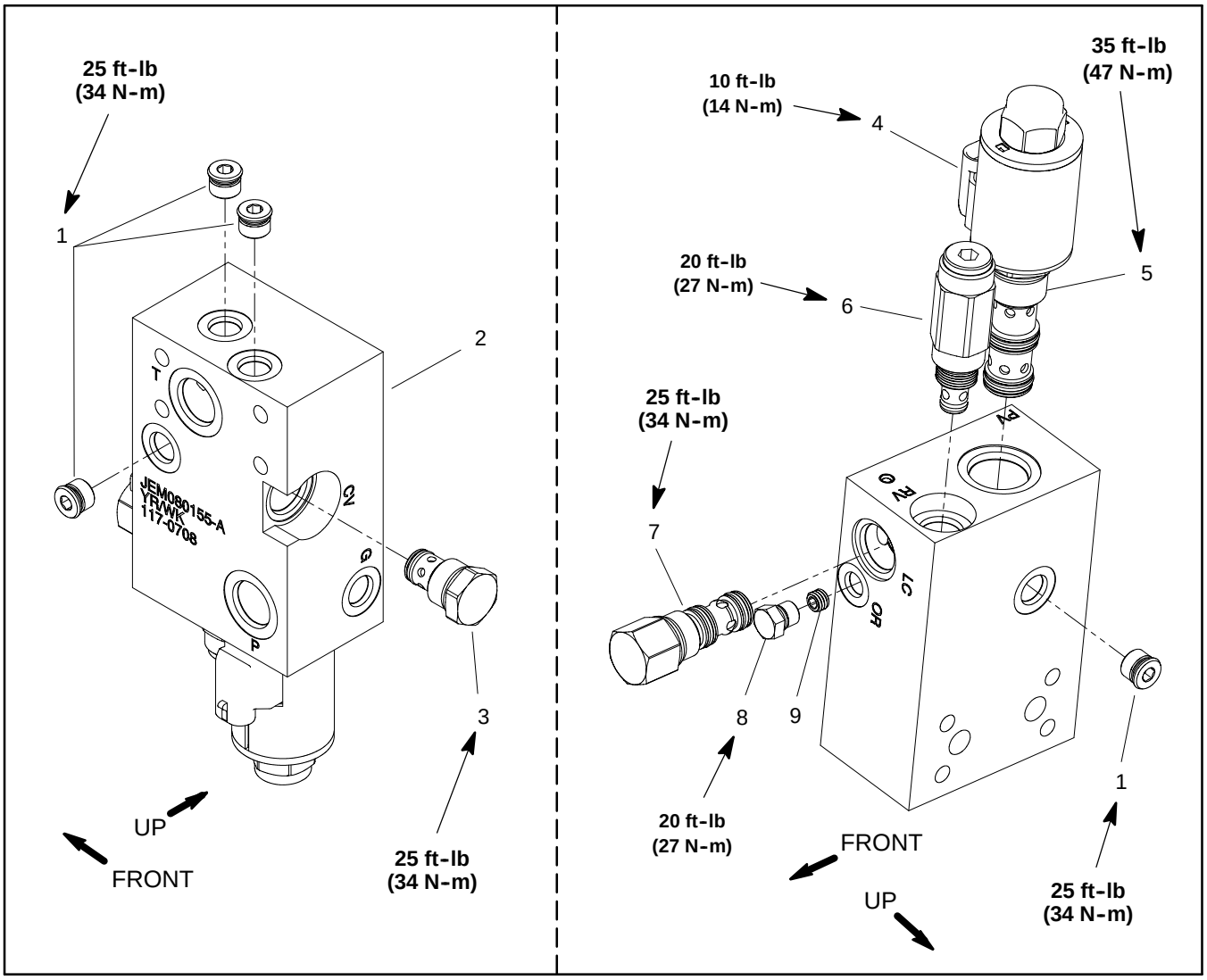

Figure 63

1. #6 zero leak plug with O-ring
2. Spray pump control manifold
3. Check valve (port CV)
4. Solenoid coil
5. Proportional control valve (port PV)
6. Relief valve (port RV)
7. Pressure compensator (port LC)
8. #4 zero leak plug with O-ring
9. Orifice (0.040)

NOTE: The ports on the manifold are marked for easy identification of components. Example: P is the gear pump connection port and CV is the location for the check valve (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port).

NOTE: The spray pump control 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.

Spray Pump Control Manifold Service (Fig. 63)

1. Make sure the manifold is clean before removing a cartridge 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 removing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

3. Remove cartridge valve with a deep well socket. Note correct location for O−rings, sealing rings and backup rings on valve. Remove and discard seal kit.

4. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads or contamination.

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

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

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

7. The pump control manifold includes an orifice that is positioned in the OR port. This orifice (item 9) threads into the manifold under the #4 zero leak plug (item 8).

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

B. Lubricate threads of cartridge valve with clean hydraulic oil. Thread cartridge valve carefully into manifold port. The valve should go in easily without binding.

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

D. If cartridge is solenoid operated, carefully install solenoid coil to the cartridge valve. Torque nut to value identified in manifold illustration. Do not over−tighten nut.

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

Steering Control Valve

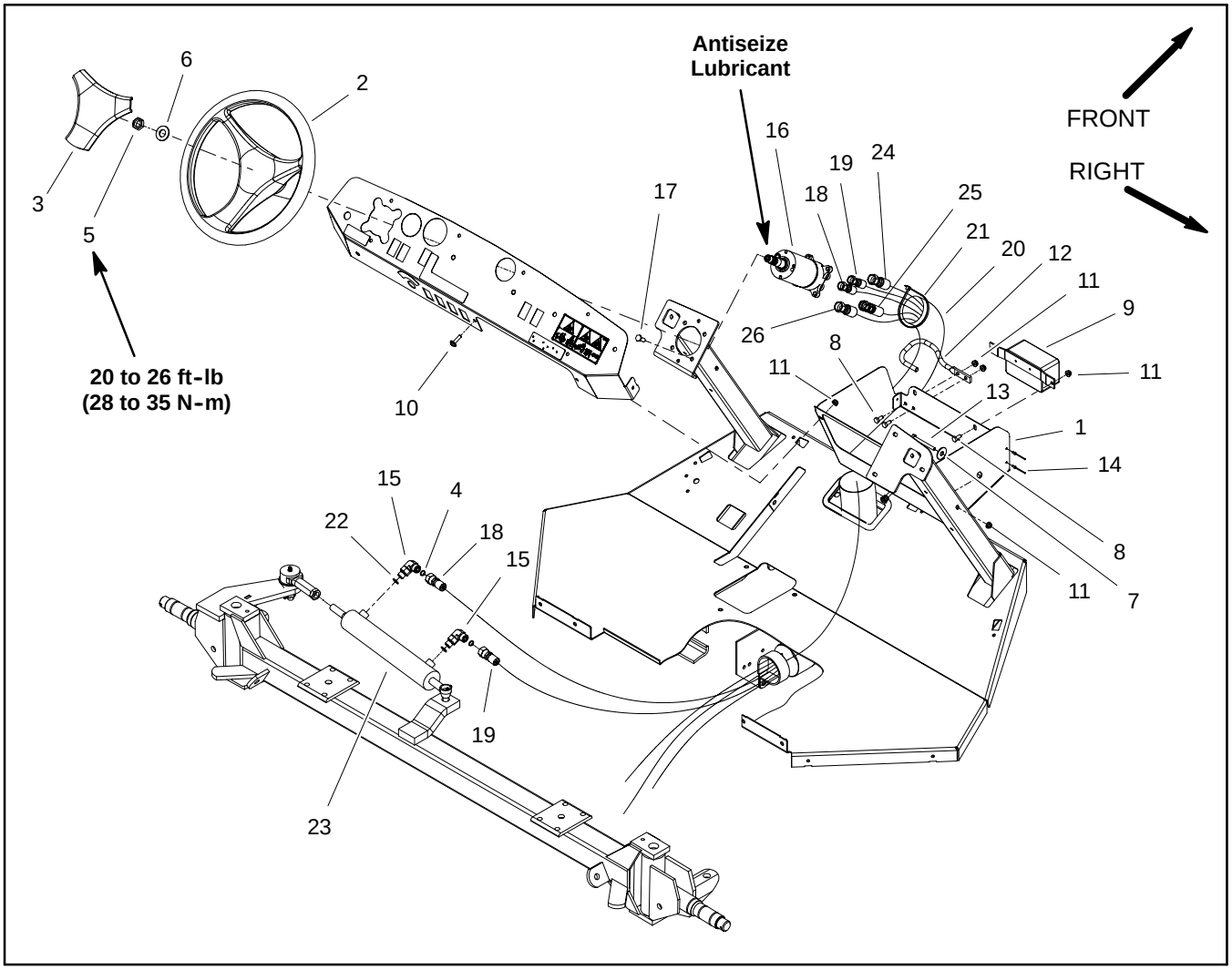

Figure 64

1. Storage compartment
2. Steering wheel
3. Steering wheel cover
4. O-ring
5. Nut
6. Flat washer
7. Washer
8. Cap screw (4 used)
9. Manual interface module
10. Screw (2 used)
11. Flange nut (7 used)
12. Hose guide
13. Cap screw
14. Rivet (3 used)
15. 90º hydraulic fitting (2 used)
16. Steering control valve
17. Cap screw (4 used)
18. Hydraulic hose
19. Hydraulic hose
20. Cover
21. Cable tie (7 used)
22. O-ring
23. Steering cylinder
24. Hydraulic hose
25. Hydraulic hose
26. Hydraulic hose

Removal (Fig. 64)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

3. Remove steering wheel from steering control valve:

   A. Remove steering wheel cover from steering wheel by carefully prying up on one of the cover spokes.

   B. Remove nut and flat washer that secure steering wheel to steering control valve shaft.

   C. Use a suitable puller to remove steering wheel from steering control valve.

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

5. Loosen and remove four (4) cap screws that secure steering control valve to machine frame.

6. Lower steering control valve (with hydraulic hoses attached) out of frame opening.

7. Label all hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends.

8. Disconnect hydraulic hoses connected to the steering control valve (Fig. 65). Allow hoses to drain into a suitable container. Cap or plug openings of control valve and hoses to prevent contamination.

9. Remove control valve from machine.

Installation (Fig. 64)

1. Remove caps and plugs from disconnected hoses and control valve fittings.

2. Using labels placed during control valve removal, lubricate new O−rings and connect hydraulic hoses to steering control valve (Fig. 65). Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

3. Slide steering control valve (with hydraulic hoses attached) into frame opening. Secure control valve to frame with four (4) cap screws.

4. Install steering wheel to steering control valve:

   A. Apply antiseize lubricant to splines of steering control valve shaft taking care to keep antiseize lubricant from tapered surface of shaft. Slide steering wheel onto steering valve.

   B. Secure steering wheel to steering control valve shaft with flat washer and nut. Torque nut from **20 to 26 ft−lb (28 to 35 N−m)**.

   C. Install steering wheel cover to steering wheel.

5. Check fluid level in hydraulic oil reservoir and adjust as required.

6. After assembly is completed, rotate steering wheel in both directions to verify that hydraulic hoses and fittings are not contacted by anything and that there are no leaks from hydraulic connections.

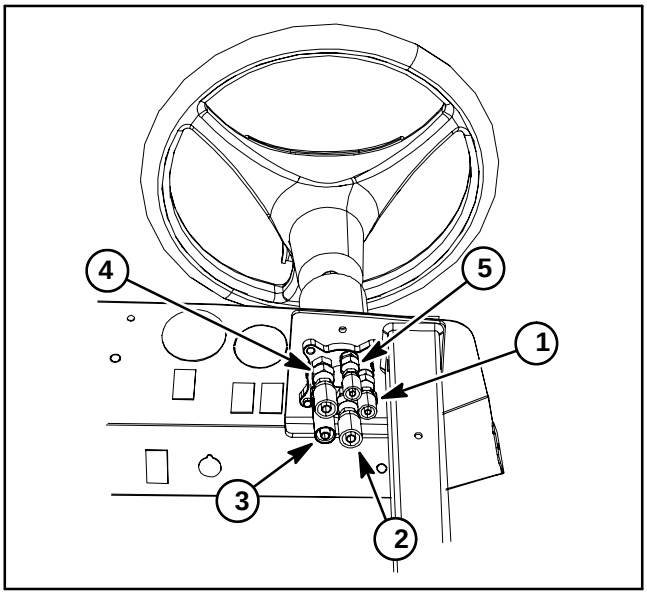

Figure 65

1. R port
2. E port
3. T port
4. P port
5. L port

Steering Control Valve Service

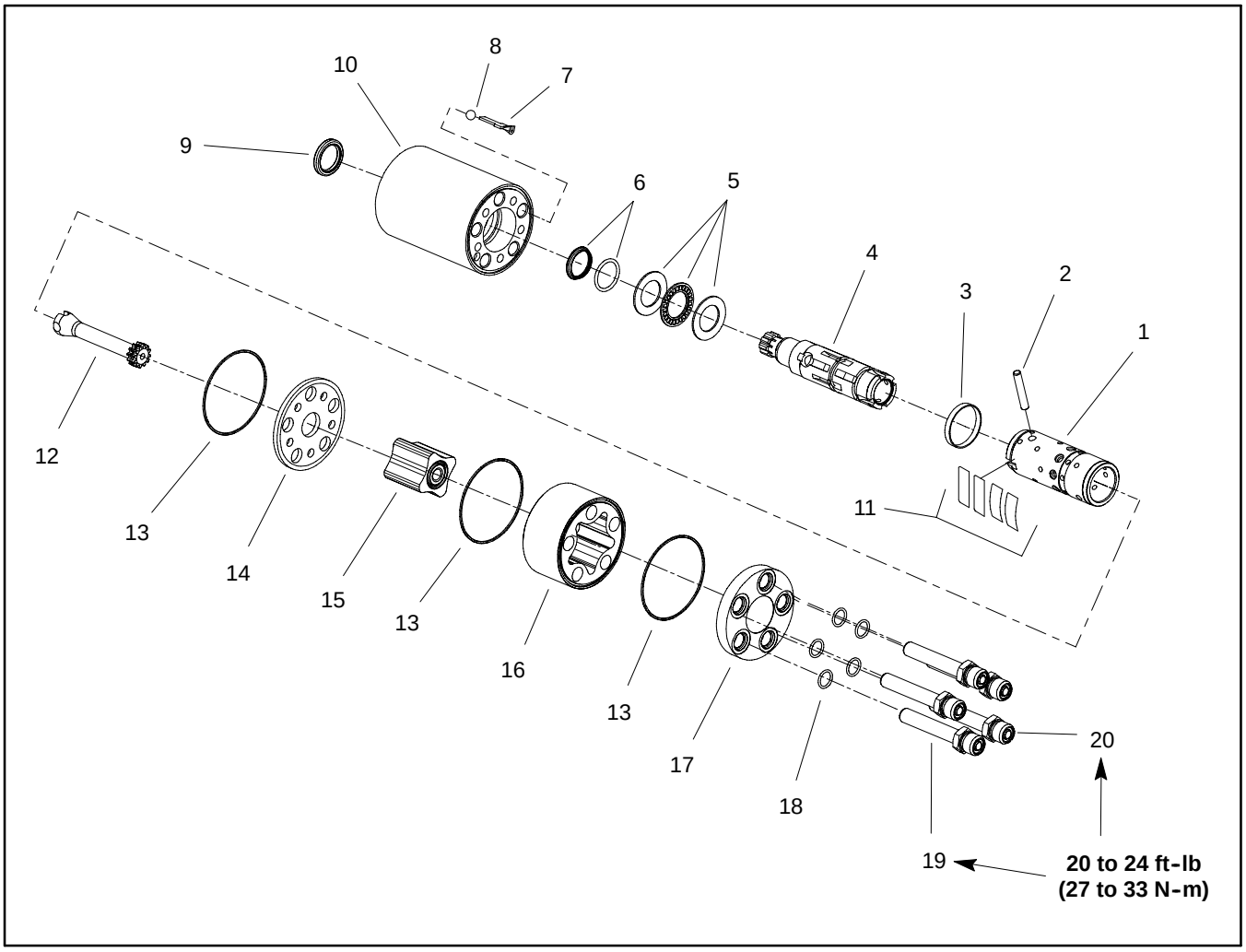

Figure 66

1. **Sleeve**
2. **Cross pin**
3. **Ring**
4. **Spool**
5. **Bearing assembly**
6. **Shaft seal**
7. **Ball stop**
8. **Ball**
9. **Dust seal ring**
10. **Housing**
11. **Spring set**
12. **Cardan shaft**
13. **O-ring**
14. **Distribution plate**
15. **Inner gearwheel**
16. **Outer gearwheel**
17. **End cover**
18. **O-ring (5 used)**
19. **Screw/fitting (ports L, R)**
20. **Screw/fitting (ports P, T and E)**

NOTE: For service of the steering control valve, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

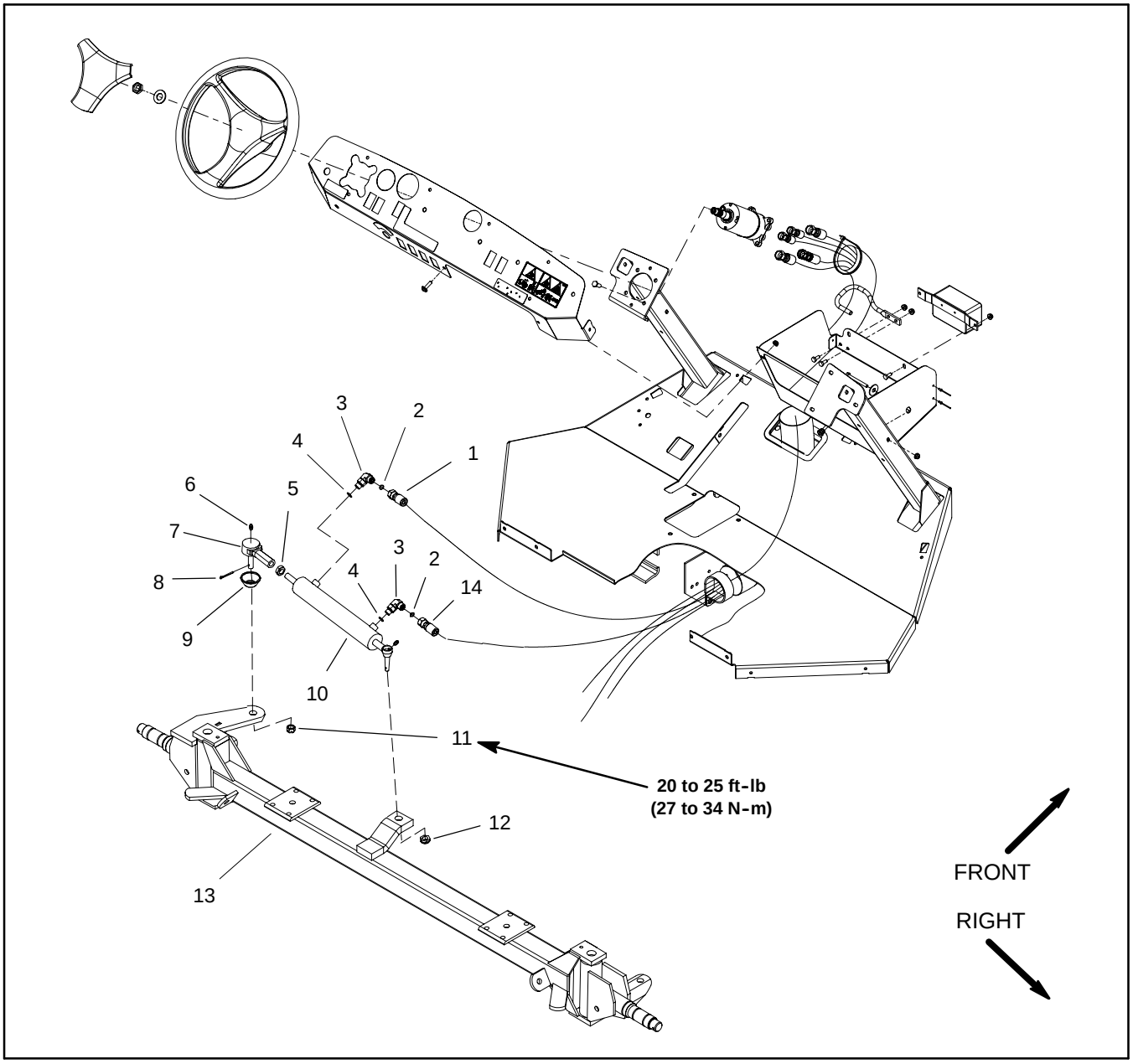

Figure 67

1. **Hydraulic hose**
2. **O-ring**
3. **90º hydraulic fitting (2 used)**
4. **O-ring**
5. **Jam nut**
6. **Grease fitting**
7. **Ball joint**
8. **Cotter pin**
9. **Rod end seal**
10. **Steering cylinder**
11. **Slotted hex nut**
12. **Lock nut**
13. **Front axle**
14. **Hydraulic hose**

Removal (Fig. 67)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Label hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from steering cylinder.

5. Disconnect hydraulic hoses from steering cylinder (Fig. 68). Allow hoses to drain into a suitable container.

6. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

7. Remove lock nut that secures the barrel end of the steering cylinder to the front axle.

8. Remove cotter pin and slotted hex nut that secure the shaft end of the steering cylinder to the left side front axle spindle.

9. Separate cylinder ball joints from axle assembly. Remove steering cylinder from machine.

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

11. If ball joint requires removal from cylinder shaft, count number of revolutions it takes to remove from shaft so ball joint can be re−installed without affecting steering.

Installation (Fig. 67)

1. If ball joint was removed from cylinder shaft, install ball joint onto shaft the same number of revolutions needed to remove ball joint. Secure ball joint with jam nut. After ball joint installation, the distance between ball joint centers should be from 18.620 to 18.740 in (473.0 to 475.9 mm) with the cylinder shaft fully retracted (Fig. 69).

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

3. Thoroughly clean tapered surfaces of cylinder ball joints and axle bores.

4. Place rod end seal on cylinder shaft ball joint. Insert rod ends of cylinder down into attachment points on the axle assembly.

5. Secure shaft end of cylinder to the front axle spindle with slotted hex nut. Torque hex nut from **20 to 25 ft−lb (27 to 34 N−m)** and if necessary, continue tightening the nut until hex nut groove aligns with cotter pin hole in ball joint. Install cotter pin.

6. Secure barrel end of cylinder to the front axle with lock nut.

7. Remove caps and plugs from disconnected hoses and fittings.

8. Lubricate new O−rings and connect hydraulic hoses to steering cylinder (Fig. 68). Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Check fluid level in hydraulic oil reservoir and adjust as required.

10. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything and that there are no leaks. Also, make sure that a clockwise rotation of the steering wheel makes a right turn.

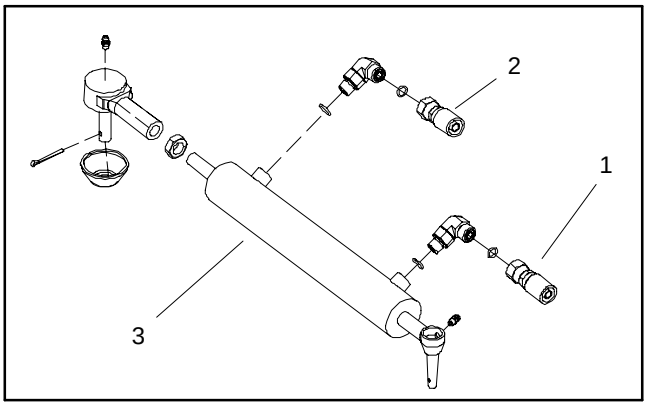

Figure 68

1. **Hose from steering control R port**
2. **Hose from steering control L port**
3. **Steering cylinder**

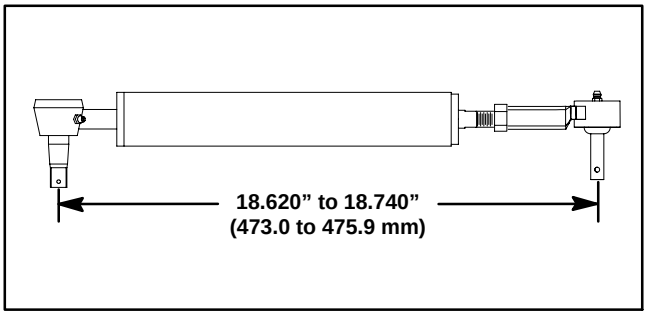

Figure 69

Steering Cylinder Service

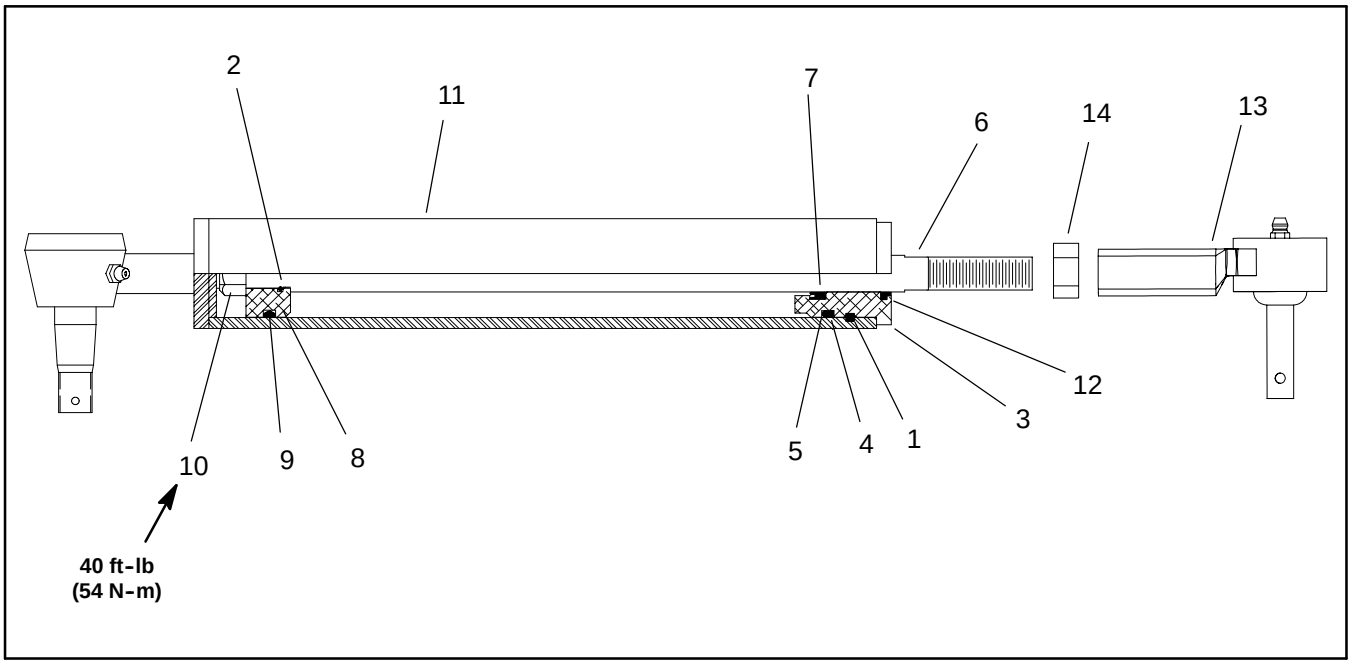

Figure 70

1. **Retaining ring**
2. **O-ring**
3. **Head**
4. **Backup ring**
5. **O-ring**
6. **Shaft**
7. **Rod seal**
8. **Piston**
9. **Uni-ring**
10. **Lock nut**
11. **Barrel**
12. **Dust seal**
13. **Ball joint**
14. **Jam nut**

Disassembly (Fig. 70)

1. Remove oil from the steering 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 hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

2. Mount end of steering cylinder in a vise. Remove retaining ring that secures head into barrel.

3. Remove plugs from ports. Extract shaft, 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.

4. Mount shaft securely in a vise by clamping on the end of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

5. Remove Uni−ring and O−ring from the piston.

6. Remove O−ring, back−up ring, rod seal and dust seal from the head.

Assembly (Fig. 70)

1. Make sure all parts are clean before reassembly.

2. Coat new O−rings, Uni−ring, rod seal and back−up ring with clean hydraulic oil.

   A. Install Uni−ring and O−ring to the piston.

   B. Install O−ring, back−up ring, rod seal 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 end of the shaft.

   A. Coat shaft with a light coating of clean hydraulic oil.

   B. Slide head assembly onto the shaft. Install piston and lock nut onto the shaft. Torque lock nut **40 ft−lb (54 N−m)** to secure assembly.

   C. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

4. Mount end of the barrel in a vise.

5. Coat all internal parts with a light coating of clean hydraulic oil. Slide piston, shaft and head assembly into the barrel being careful to not damage the seals.

6. Secure head into the barrel with retaining ring.

Boom Lift Control Manifold

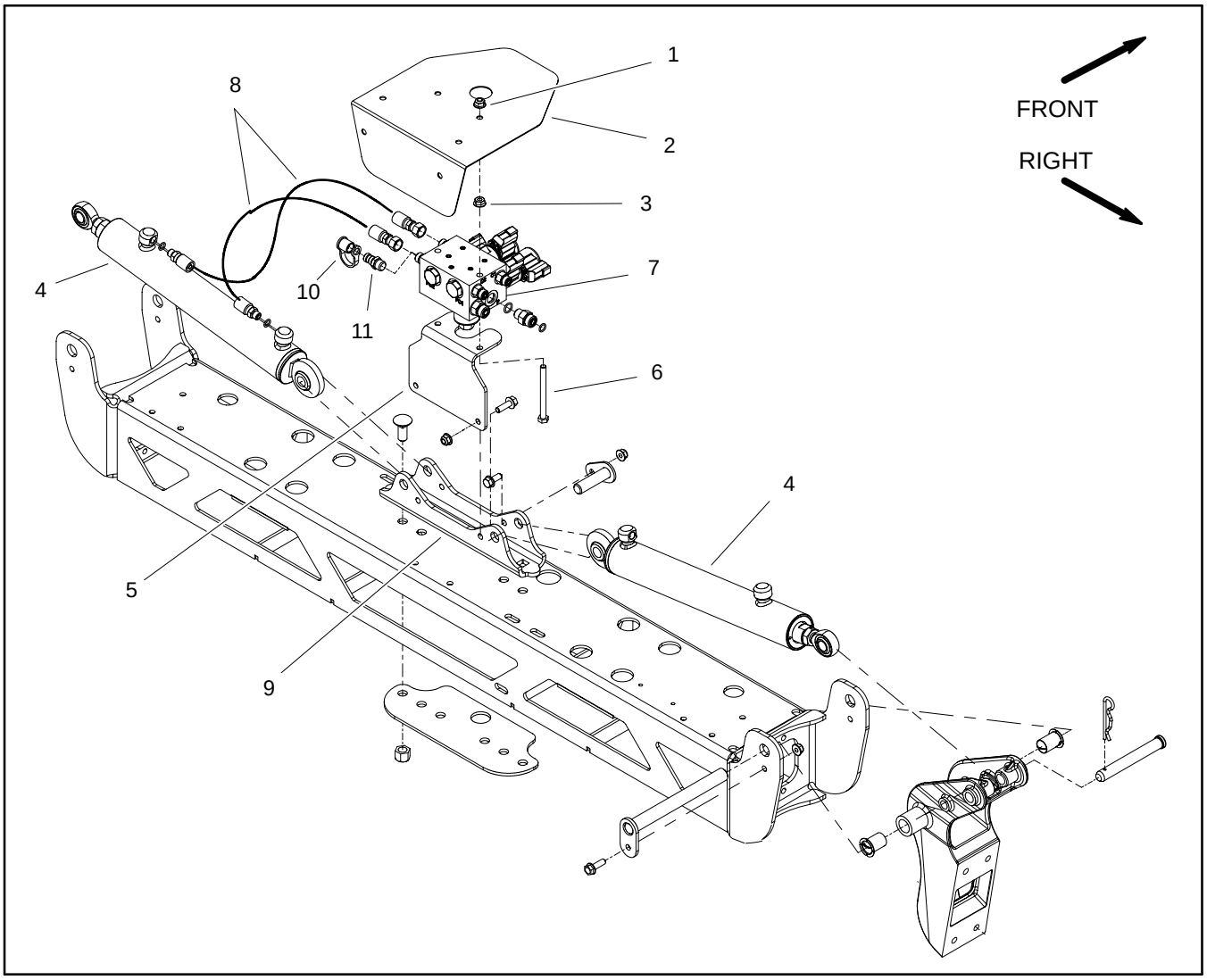

Figure 71

1. **Flange nut (2 used)**
2. **Cover plate**
3. **Flange nut (2 used)**
4. **Boom lift cylinder (2 used)**
5. **Boom valve mount plate**
6. **Cap screw (2 used)**
7. **Boom lift control manifold**
8. **Hydraulic hose (4 used)**
9. **Cylinder mount plate**
10. **Dust cap**
11. **Test fitting**

Removal (Fig. 71)

1. Park the machine on a level surface, fully lower the spray booms, engage the parking brake and stop the engine. Remove the key from the ignition switch.

WARNING

Make sure that spray booms are fully lowered before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If booms are not fully lowered as manifold components are loosened, booms may drop unexpectedly.

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from boom lift control manifold.

NOTE: The ports on the control manifold are marked to identify hydraulic hose connections. Example: P is the pump connection port (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port location).

5. Label all control manifold electrical and hydraulic connections for assembly purposes.

6. Disconnect wire harness electrical connectors from solenoid valve coils on lift control manifold.

7. Disconnect hydraulic hoses from fittings in lift control manifold. Allow hoses to drain into a suitable container.

8. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

9. Remove two (2) flange nuts that secure cover plate (item 2) to top of lift control manifold. Remove cover plate.

10. Remove two (2) flange nuts and cap screws that secure lift control manifold to mount plate. Remove manifold from machine.

IMPORTANT: A flow control orifice (0.036) is placed beneath the hydraulic fittings in control manifold ports C1, C2, C3 and C4. If any of these fittings is removed from the manifold, make sure to remove orifice and label its position for assembly purposes. Also note location of slot in orifice for assembly purposes.

11. If necessary, remove fittings and flow control orifices from control manifold and discard O–rings (Fig. 72).

Installation (Fig. 71)

IMPORTANT: If fitting and flow control orifice were removed from manifold ports C1, C2, C3 or C4, place orifice with slot toward the bottom of the port making sure that the orifice is flat in the base of the port before installing fitting. Manifold damage is possible if the orifice is cocked in the port.

1. If fittings were removed from control manifold, lubricate and place new O–rings onto fittings. Install fittings into control manifold port openings. Refer to Figure 72 for for fitting torque specifications.

2. Position boom lift control manifold to mount plate. Secure manifold to plate with two (2) cap screws and flange nuts.

3. Remove caps and plugs from disconnected hoses and fittings.

4. Lubricate new O–rings and install on fittings. Using labels placed during removal, correctly connect hydraulic hoses to lift control manifold fittings. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Using labels placed during removal, correctly connect wire harness connectors to manifold solenoid valve coils.

6. Install cover plate (item 2) and secure to top of lift control manifold with two (2) flange nuts.

7. Check fluid level in hydraulic oil reservoir and adjust as required.

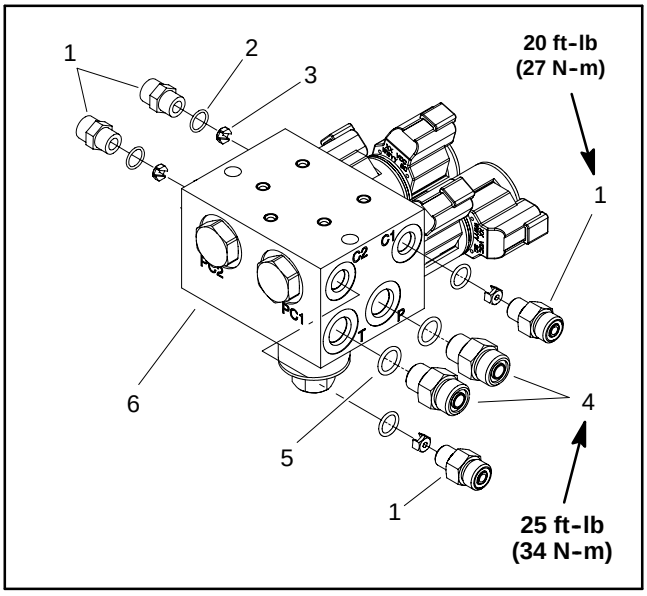

Figure 72

1. **Straight fitting (4 used)**
2. **O–ring**
3. **Orifice (0.036) (4 used)**
4. **Straight fitting (2 used)**
5. **O–ring**
6. **Lift control manifold**

Boom Lift Control Manifold Service

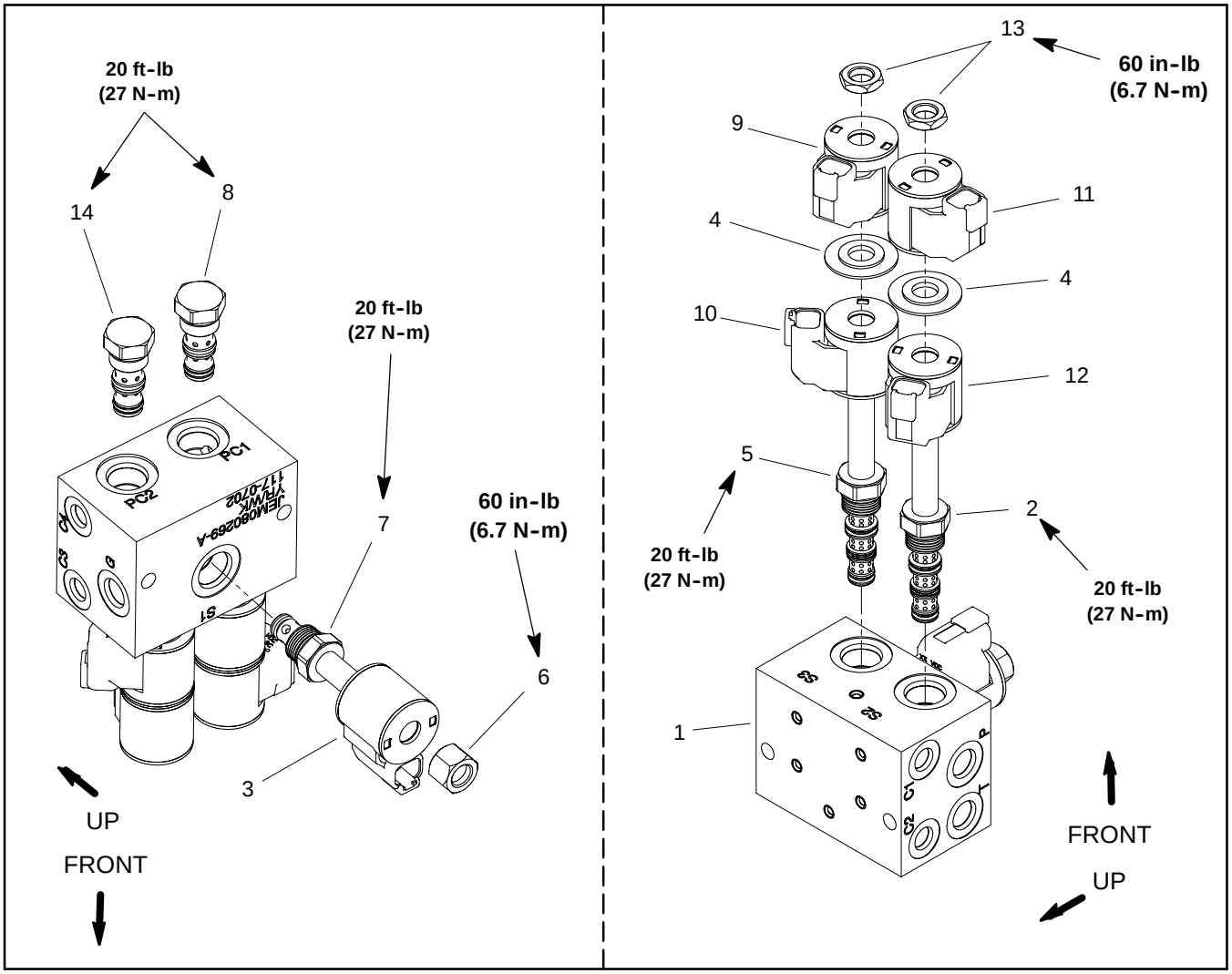

Figure 73

1. **Manifold**
2. **Solenoid valve (S2) (RH boom)**
3. **Solenoid coil (S1)**
4. **Coil spacer (2 used)**
5. **Solenoid valve (S3) (LH boom)**
6. **Nut**
7. **Solenoid valve (S1)**
8. **Check valve CV1 (PC1 port)**
9. **Solenoid coil (S3) (LH boom raise)**
10. **Solenoid coil (S3) (LH boom lower)**
11. **Solenoid coil (S2) (RH boom raise)**
12. **Solenoid coil (S2) (RH boom lower)**
13. **Nut (2 used)**
14. **Check valve CV2 (PC2 port)**

NOTE: The ports on the boom lift control manifold are marked for easy identification of components. Example: P is the gear pump connection port and S1 is the location for solenoid valve S1 (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port).

NOTE: If sprayer is equipped with optional Sonic Boom System, the boom lift control manifold will be different than the manifold shown in Figure 73. Service of the Sonic Boom System boom lift control manifold is similar to the standard manifold.

NOTE: The boom lift control 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.

Boom Lift Control Manifold Service (Fig. 73)

For boom lift manifold cartridge valve service procedures, see Spray Pump Control Manifold Service in this section. Refer to Figure 73 for manifold cartridge valve and plug installation torque.

NOTE: The five (5) solenoid valve coils on the boom lift control manifold are identical. To assist in troubleshooting, identical coils can be exchanged. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. a hydraulic problem exists).

Boom Lift Cylinder

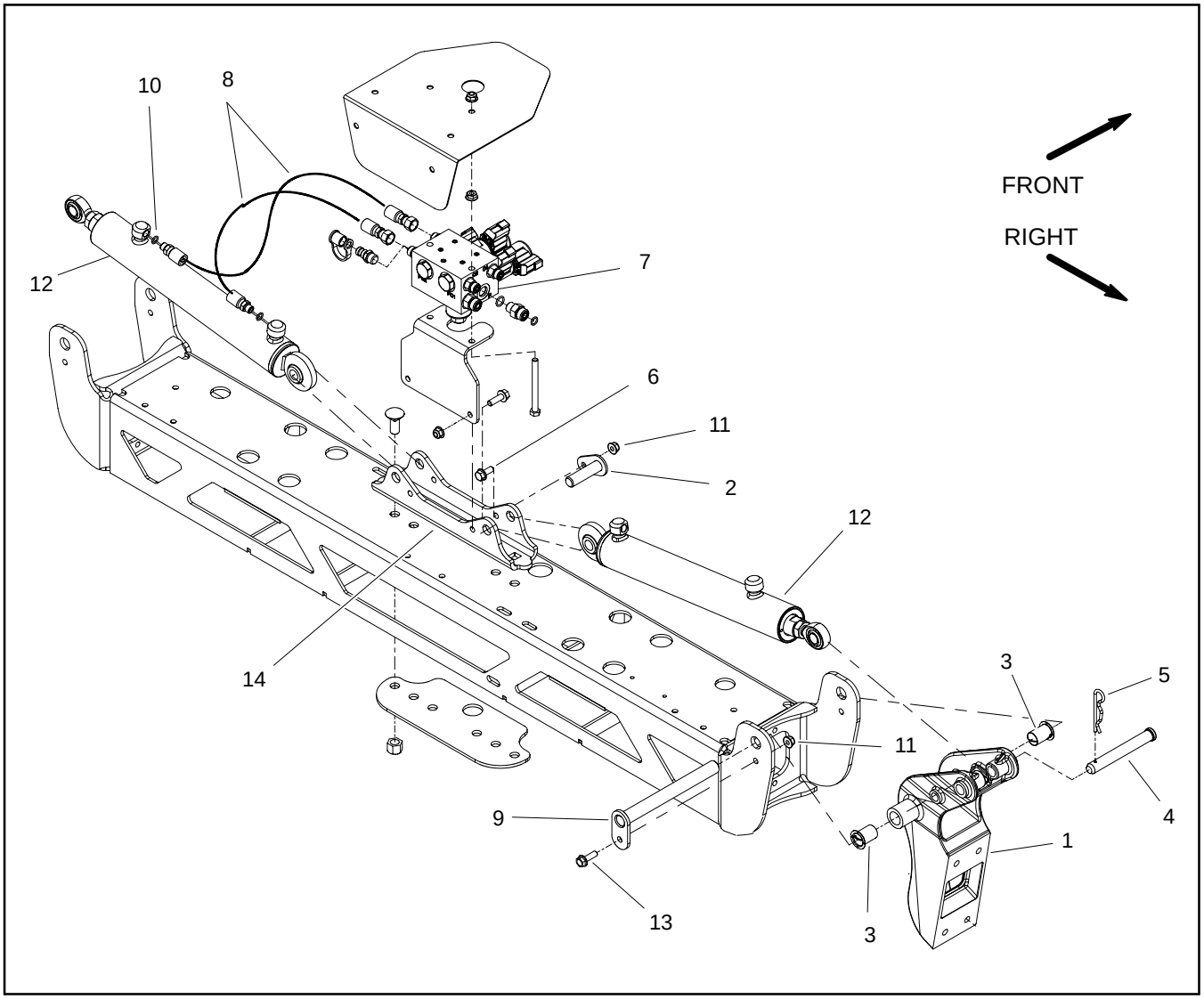

Figure 74

1. **Boom pivot bracket (2 used)**
2. **Pivot pin (2 used)**
3. **Bushing (4 used)**
4. **Clevis pin (2 used)**
5. **Hitch pin (2 used)**
6. **Flange head screw (2 used)**
7. **Boom lift manifold**
8. **Hydraulic hose (4 used)**
9. **Pivot pin (2 used)**
10. **O-ring**
11. **Flange nut**
12. **Boom lift cylinder (2 used)**
13. **Flange head screw (2 used)**
14. **Cylinder mount plate**

Removal (Fig. 74)

1. Park the machine on a level surface, fully lower the spray booms, engage the parking brake and stop the engine. Remove the key from the ignition switch.

WARNING

Make sure that spray booms are fully lowered before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If booms are not fully lowered as manifold components are loosened, booms may drop unexpectedly.

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Label hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from boom lift cylinder.

5. Disconnect hydraulic hoses from boom lift cylinder. Allow hoses to drain into a suitable container.

6. Put caps or plugs on disconnected hoses and cylinder ports to prevent contamination.

7. Remove hitch pin (item 5) and clevis pin (item 4) that secure lift cylinder shaft rod end to boom pivot bracket.

8. Remove flange head screw (item 6) and flange nut (item 11) that secure pivot pin (item 2) to cylinder mount plate. Slide pivot pin from mount plate and lift cylinder.

9. Remove lift cylinder from machine.

Installation (Fig. 74)

1. Position lift cylinder to cylinder mount plate and boom pivot bracket.

2. Slide pivot pin (item 2) through cylinder mount plate and lift cylinder. Secure pivot pin to mount plate with flange head screw (item 6) and flange nut (item 11).

3. Secure lift cylinder shaft rod end to boom pivot bracket with clevis pin (item 4) and hitch pin (item 5).

4. Remove caps and plugs from disconnected hoses and cylinder ports.

5. Lubricate new O−rings and connect hydraulic hoses to boom lift cylinder. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Check fluid level in hydraulic oil reservoir and adjust as required.

7. After assembly is completed, operate boom lift cylinder to verify that hydraulic hoses and cylinder are not contacted by anything and that there are no leaks.

Boom Lift Cylinder Service

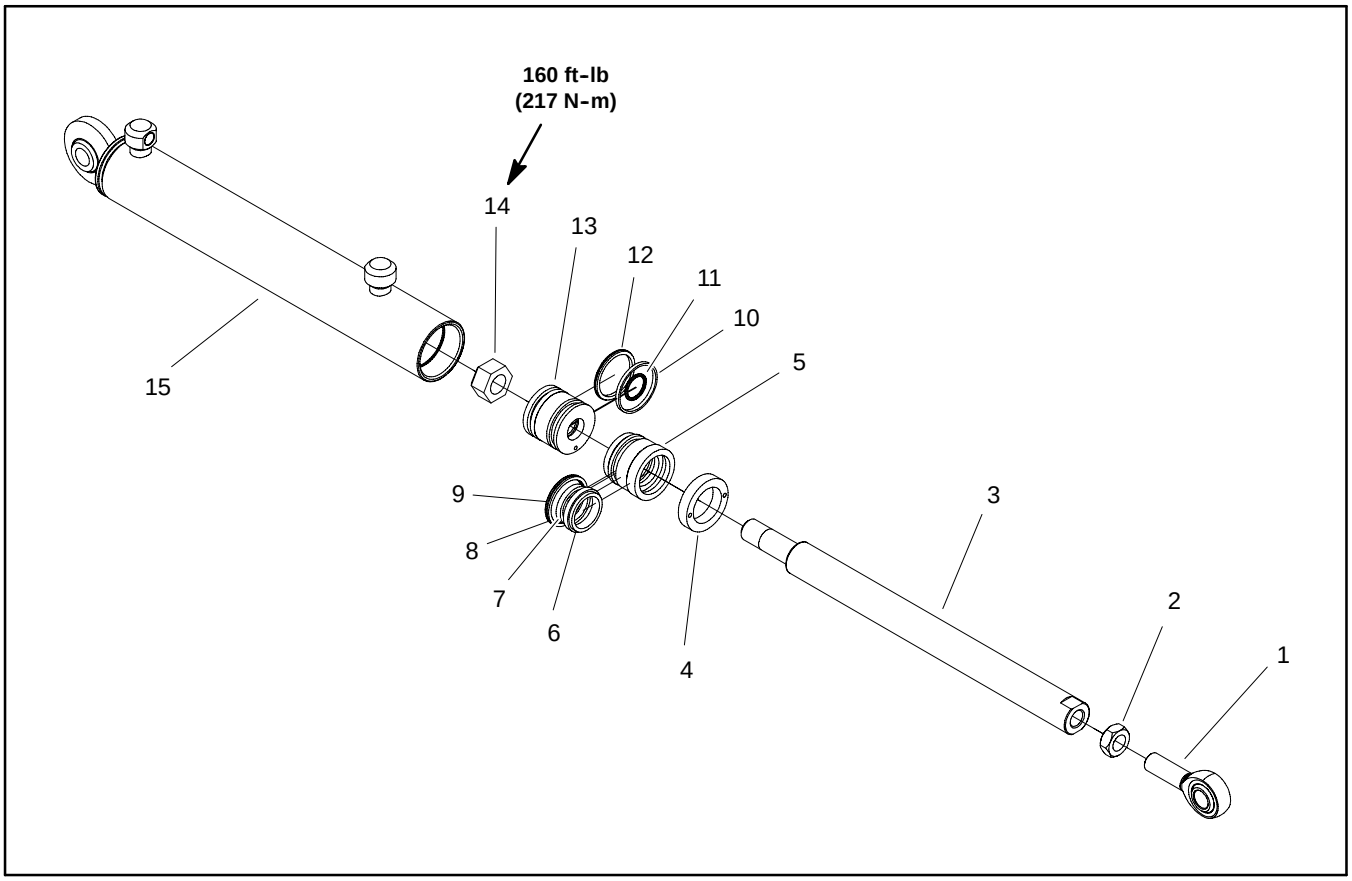

Figure 75

1. **Rod end**
2. **Jam nut**
3. **Shaft**
4. **Internal collar**
5. **Head**
6. **Dust seal**
7. **Shaft seal**
8. **Back-up ring**
9. **O-ring**
10. **Steel ring**
11. **O-ring**
12. **Seal**
13. **Piston**
14. **Lock nut**
15. **Barrel**

Disassembly (Fig. 75)

1. Remove oil from the boom 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 hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

2. Mount barrel end of lift cylinder in a vise.

3. Remove internal collar (item 4) with a spanner wrench.

4. Remove plugs from ports. Extract shaft, 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 end of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

6. Remove seal kit components from the piston and head. Discard removed seals, back-up ring and O-rings.

Assembly (Fig. 75)

1. Make sure all cylinder parts are clean before assembly.

2. Coat all seat kit components with clean hydraulic oil.

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

   B. Install O-ring, back-up ring, shaft seal 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 end of the shaft.

   A. Coat shaft with a light coating of clean hydraulic oil.

   B. Slide head assembly onto the shaft. Install piston and lock nut onto the shaft. Torque lock nut **160 ft-lb (217 N-m)** to secure assembly.

   C. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise. Do not close vise enough to distort the barrel.

4. Mount end of the barrel in a vise.

5. Coat all internal parts with a light coating of clean hydraulic oil. Slide piston, shaft and head assembly into the barrel being careful to not damage the seals.

6. Install internal collar (item 4) with a spanner wrench to secure head into the barrel.

Oil Cooler

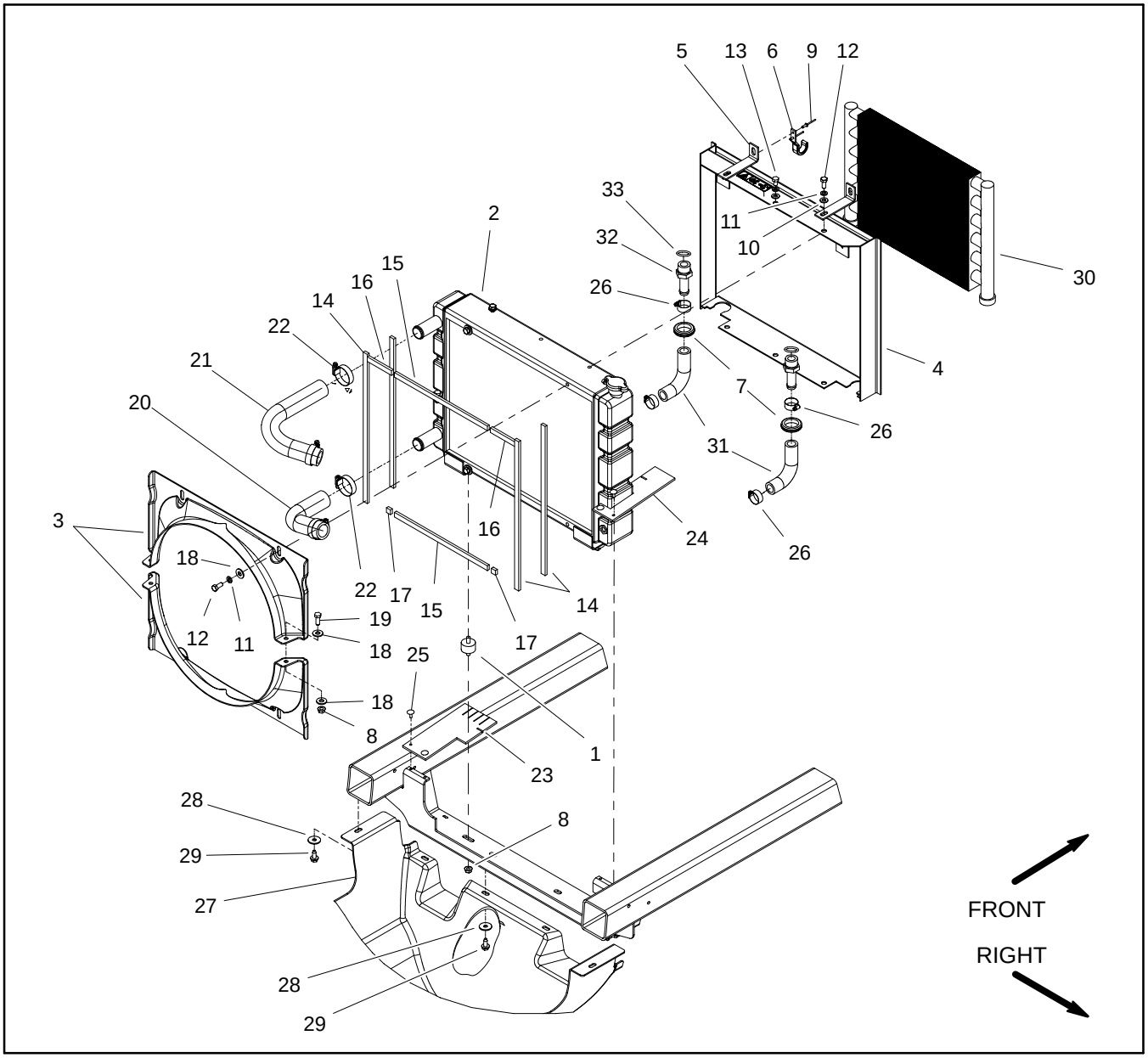

Figure 76

1. **Isolator seat (2 used)**
2. **Radiator**
3. **Fan shroud (2 used)**
4. **Radiator shroud**
5. **Radiator brace (2 used)**
6. **Oil cooler mount hook (2 used)**
7. **Rubber grommet (2 used)**
8. **Flange nut (4 used)**
9. **Rivet (4 used)**
10. **Flat washer (6 used)**
11. **Lock washer (10 used)**
12. **Cap screw (6 used)**
13. **Cap screw (4 used)**
14. **Foam seal (4 used)**
15. **Foam seal (2 used)**
16. **Foam seal (2 used)**
17. **Foam seal (2 used)**
18. **Flat washer (8 used)**
19. **Cap screw (2 used)**
20. **Lower radiator hose**
21. **Upper radiator hose**
22. **Hose clamp (4 used)**
23. **LH heat baffle**
24. **RH heat baffle**
25. **Rivet (4 used)**
26. **Clamp (4 used)**
27. **Front heat shield**
28. **Flat washer (6 used)**
29. **Washer head screw (6 used)**
30. **Oil cooler**
31. **Oil cooler hose (2 used)**
32. **Hydraulic fitting (2 used)**
33. **O-ring (2 used)**

Removal (Fig. 76)

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

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

2. Operate all hydraulic controls to relieve hydraulic system pressure.

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

4. Label all hydraulic connections for reassembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from oil cooler.

5. From under front of machine, disconnect hydraulic hoses from oil cooler. Allow hoses to drain into a suitable container.

6. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

7. Lift oil cooler from hooks and remove from machine.

8. If necessary, remove fittings from oil cooler. Discard O−rings.

9. Clean oil cooler with solvent. Inspect for damage.

Installation (Fig. 76)

1. If fittings were removed from oil cooler, lubricate and place new O−rings onto fittings. Install fittings into oil cooler port openings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Place oil cooler onto hooks.

3. Remove caps and plugs from disconnected hoses and fittings.

4. Connect hydraulic hoses to oil cooler fittings. Tighten hose clamps.

5. Check fluid level in hydraulic oil reservoir and adjust as required.

6. After assembly is completed, operate machine to verify that hydraulic hoses and fittings are not contacted by anything and that there are no hydraulic leaks.

Hydraulic Reservoir

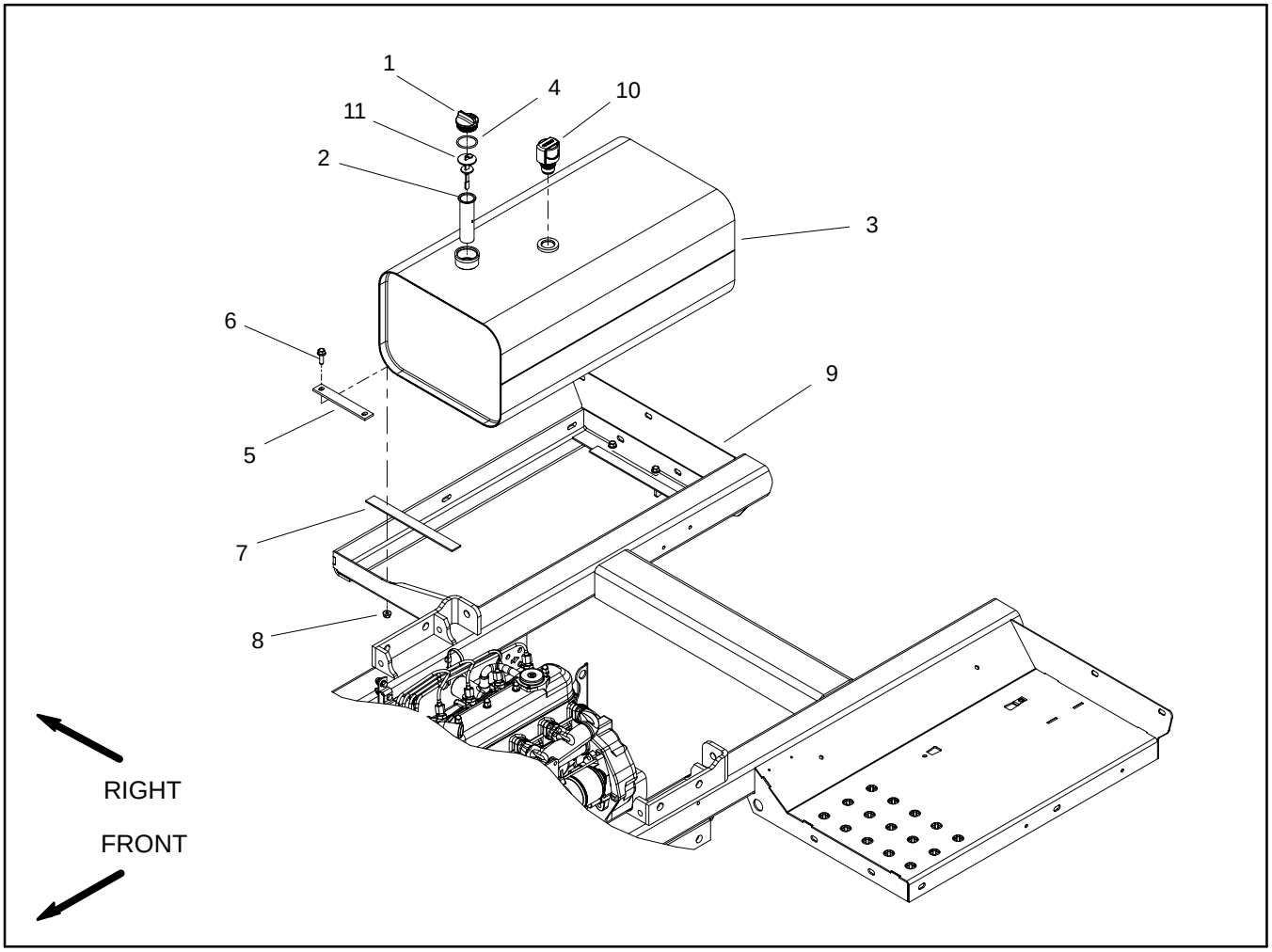

Figure 77

1. **Hydraulic reservoir cap**
2. **Strainer**
3. **Hydraulic reservoir**
4. **O-ring**
5. **Hold down strap (2 used)**
6. **Flange head screw (4 used)**
7. **Cushion (2 used)**
8. **Flange nut (4 used)**
9. **Frame**
10. **Breather**
11. **Dipstick**

Removal (Fig. 77)

1. Park the machine on a level surface, engage the parking brake and stop the engine. Remove the 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. Label all hydraulic hoses for assembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from reservoir.

4. Disconnect one hydraulic hose from the bottom of the hydraulic reservoir to drain reservoir.

5. Disconnect remaining hydraulic hoses from reservoir.

6. Remove hydraulic reservoir from machine using Figure 77 as a guide.

7. Put caps or plugs on hydraulic lines and fittings to prevent contamination.

8. If hydraulic fittings are to be removed from reservoir, mark fitting orientation to allow correct assembly (Fig. 78). Remove fittings from reservoir and discard O−rings.

Inspection

1. Clean hydraulic reservoir with solvent.

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

Installation (Fig. 77)

1. If fittings were removed from reservoir, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings (Fig. 78). Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

1. Install hydraulic reservoir to machine using Figure 77 as a guide.

2. Lubricate new O−rings and reconnect hydraulic hoses to reservoir fittings (Fig. 78) (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

3. Fill reservoir with hydraulic fluid.

4. Operate machine and inspect for leaks.

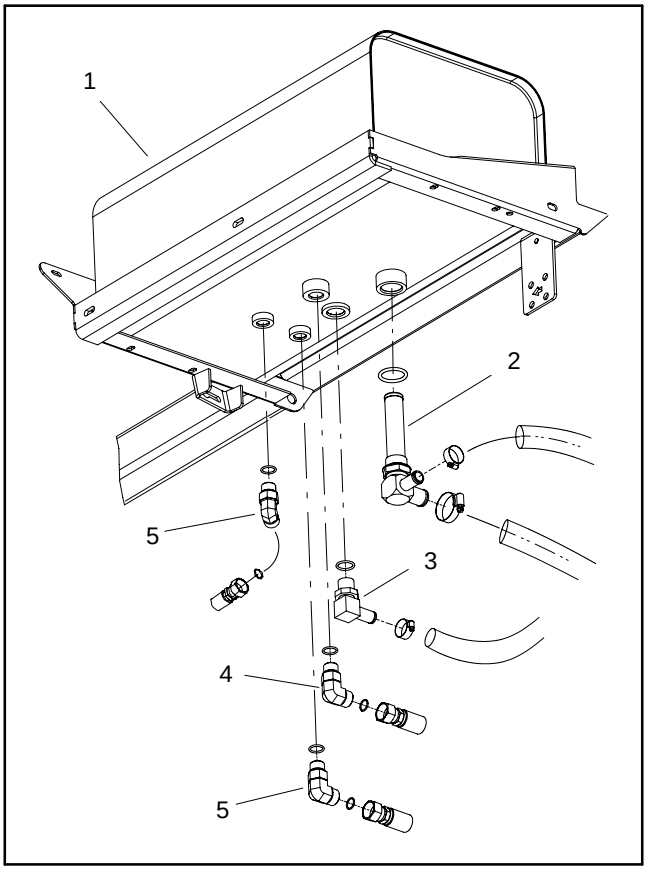

Figure 78

1. **Hydraulic tank**
2. **Tee strainer**
3. **90º hydraulic fitting**
4. **90º hydraulic fitting**
5. **90º hydraulic fitting**

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Chapter 5

Electrical System

Table of Contents

General Information

Electrical Drawings

The electrical schematic, electrical circuit drawings and wire harness drawings for the Multi Pro 5800 are located in Chapter 8 – Foldout Drawings.

Operator's Manual

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

Special Tools

Order these special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The multimeter can test electrical components and circuits for current, resistance or voltage. Obtain this tool locally.

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.

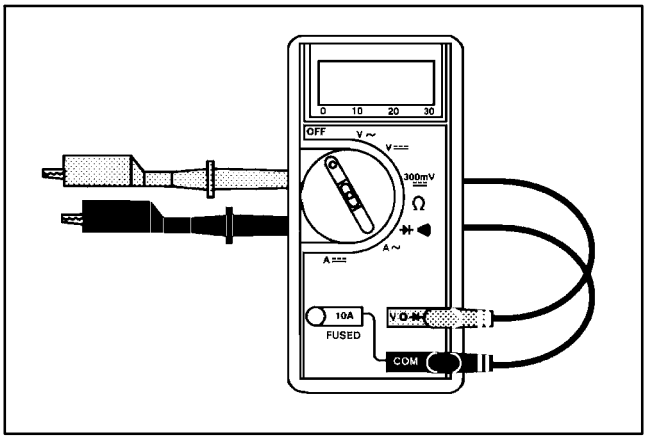

Figure 1

Battery Terminal Protector

Battery terminal protector is an aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after battery cable has been secured to battery terminal.

Toro Part Number: **107-0392**

Figure 2

Battery Hydrometer

Use the battery hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.

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 Electrical Schematics in Chapter 8 – Foldout Drawings).

If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables are loose or corroded. Battery ground cable to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid operation. Starter is faulty.
Nothing happens when start attempt is made.	Battery cables are loose or corroded. Battery ground cable to frame is loose or corroded. Battery is discharged or faulty. Main fuse (15 amp) is open. Wiring to start circuit components is loose, corroded or damaged (see Chapter 8 – Foldout Drawings). Neutral switch is out of adjustment or faulty. Ignition switch is faulty. Fuse block is faulty. Starter solenoid is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Fuse (15 amp) is open. Main relay is faulty. Fusible link to fuel stop solenoid pull coil is faulty. Ignition switch is faulty. The engine glow plug circuit does not operate properly. Engine is malfunctioning (see Chapter 3 – Kubota Diesel Engine). Fuel system is malfunctioning (see Chapter 3 – Kubota Diesel Engine). Engine may be too cold.
The glow plug circuit does not operate properly.	Wiring in the engine glow circuit (see Chapter 8 – Foldout Diagrams) is loose, corroded or damaged. Fuse (15 amp) is faulty. Main relay is faulty. Engine glow plug(s) is (are) faulty. The glow relay or glow plug controller is faulty. Fusible link harness at the engine starter motor is faulty.
Engine cranks (but should not) with the traction pedal out of the neutral position.	Neutral switch is out of adjustment or faulty. Neutral switch wiring is faulty (see Chapter 8 – Foldout Drawings).

General Run Problems

Problem	Possible Causes
Battery does not charge.	Wiring to the charging circuit components is loose, corroded or damaged (see Chapter 8 – Foldout Drawings). Alternator belt is slipping or damaged. Alternator is faulty. Battery is faulty.
Engine stops during operation.	Ignition switch is faulty. Fuel stop solenoid is faulty. Engine is malfunctioning (see Chapter 3 – Kubota Diesel Engine).

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60º to 100º F (16º to 38º C). The ignition key should be in the OFF position and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

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

Voltage Measured	Battery Charge Level
12.68 v (or higher)	Fully charged (100%)
12.45 v	75% charged
12.24 v	50% charged
12.06 v	25% charged
11.89 v	0% charged

Charging System Test

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

Use a multimeter set to the DC volts setting. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

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

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle (3050 to 3150 RPM). Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

Test results should be (example):

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.80 v
Difference	= +0.50 v

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of your Multi Pro glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive Ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to RUN and record the multimeter results.

The Multi Pro 5800 glow plug system should have a reading of approximately 36 amps total (9 amps per glow plug). If low current reading is observed, one (or more) glow plugs is faulty.

Neutral Switch Operation

CAUTION

Do not disconnect neutral interlock switch. It is for the operator's protection. Check the operation of the switch daily for proper operation. Replace malfunctioning neutral interlock switch before operating the machine.

Neutral switch operation is described in the Multi Pro 5800 Operator's Manual. Testing of the neutral switch is included in the Component Testing section of this Chapter.

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. disconnect the ignition switch connector before doing a continuity check on the ignition switch).

NOTE: See the Kubota Workshop Manual (05–E3B Series) for engine component testing information.

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 dash mounted ignition (key) switch has three (3) positions (OFF, ON/PREHEAT and START).

Testing

1. Make sure ignition switch is off. Disconnect wire harness electrical connector from the ignition switch.

2. 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 switch position. The ignition switch terminals are marked as shown in Figure 5. The circuitry of this switch is shown in the chart below. Verify continuity between switch terminals.

POSITION	CIRCUIT
OFF	NONE
ON/PREHEAT	B + C + F, D + E
START	A + B + C

3. Replace ignition switch if necessary.

4. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Chapter 8 – Foldout Drawings).

5. When testing is complete, connect wire harness electrical connector to the ignition switch.

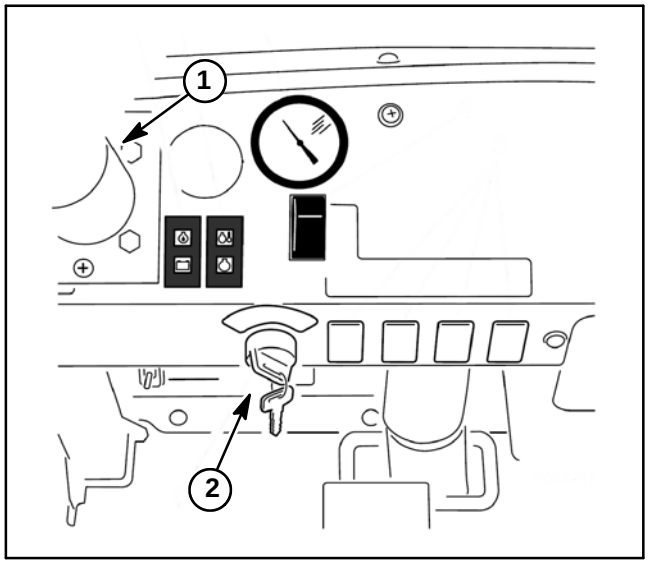

Figure 4

1. **Steering column**
2. **Ignition switch**

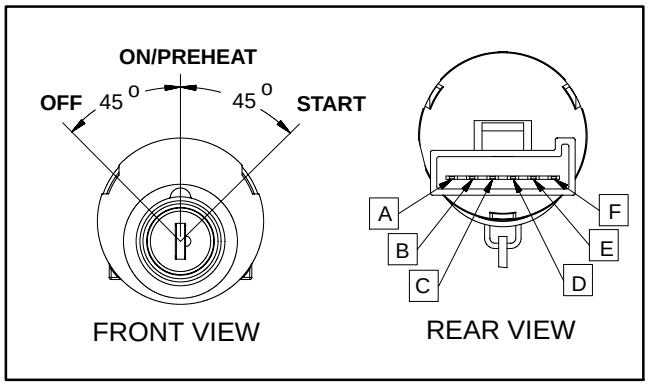

Figure 5

Indicator Lights

High Temperature Warning Light

If the engine coolant temperature rises to approximately 220º F (104º C), the high temperature light should come on when the normally open temperature sender closes.

To test the high temperature warning light and circuit wiring, ground the blue wire attached to temperature sender located on water pump housing (see Temperature Sender in this section). Turn ignition switch to the ON position; the high temperature warning light should illuminate.

Glow Plug Indicator Light

The glow plug light should come on when the ignition switch is placed in the ON position prior to placing the ignition switch in START. The light should stay lit for approximately six (6) seconds while the ignition switch is left in the ON position.

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 4.3 PSI (0.3 kg/cm^2).

To test the oil pressure light and circuit wiring, ground the brown wire attached to oil pressure switch located on the front side of engine near the oil dipstick. Turn ignition switch to the ON position; the oil pressure light should come on indicating correct operation of the electrical wiring to the oil pressure switch.

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the ON position with the engine not running or with an improperly operating charging circuit while the engine is running.

Testing Indicator Lights

1. Apply 12 VDC to terminals 1A and 2A (Fig. 7).
2. Ground terminals 1B and 2B (Fig. 7).
3. Both indicator lights should illuminate.

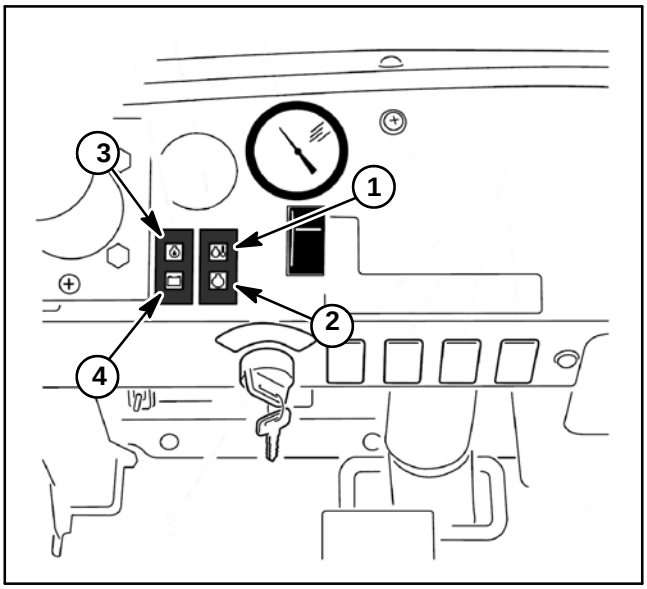

Figure 6

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

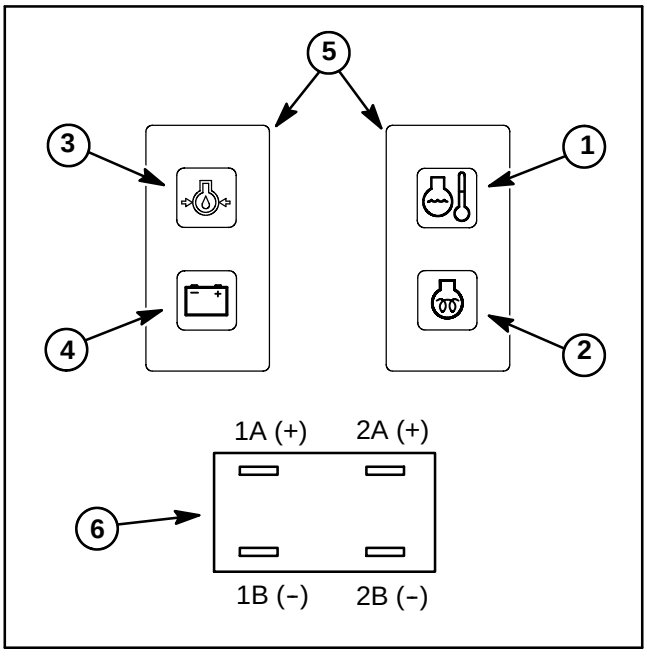

Figure 7

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

Hour Meter

The hour meter is located on the right side of the console assembly (Fig. 8).

Testing

1. Remove RH console cover to gain access to hour meter (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the terminals on the hour meter.

3. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

4. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

5. The hour meter should move 1/10 of an hour in six (6) minutes.

6. Disconnect voltage source from the hour meter.

7. When testing is complete, connect wire harness to the meter terminals.

8. Secure RH console cover to machine (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

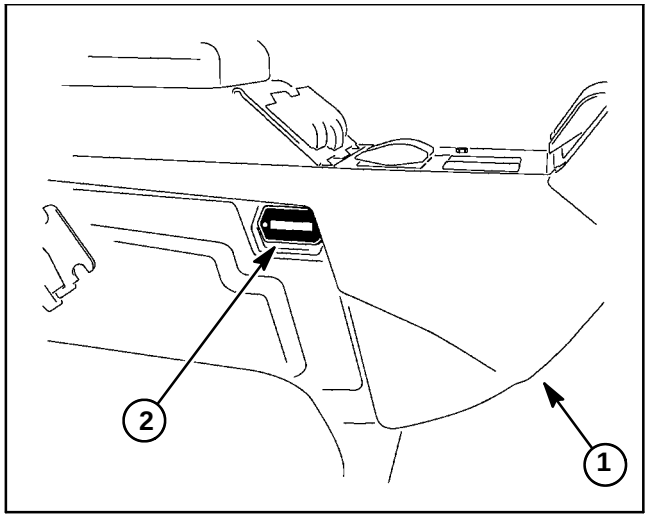

Figure 8

1. Console assembly **2. Hour meter**

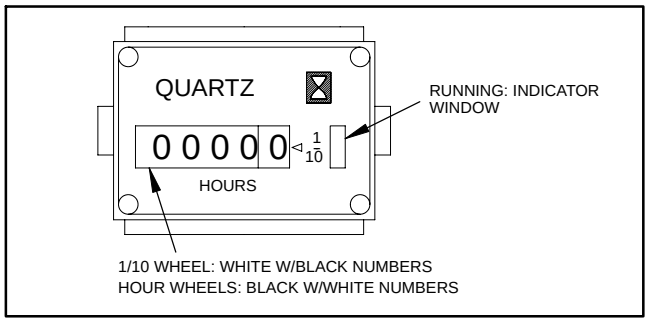

Figure 9

Headlight Switch

The headlight switch is located on the left side of the console assembly (Fig. 10) and is used to turn the headlights on and off.

Testing

1. Remove LH console cover to gain access to headlight switch (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the headlight switch.

3. 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. The switch terminals are marked as shown in Figure 11. The circuitry of the headlight switch is shown in the chart below. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
ON	2 + 3	5 + 6
OFF	2 + 1	5 + 4

4. Replace switch if necessary.

5. Connect the wire harness connector to the switch after testing is complete.

6. Secure LH console cover to machine (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

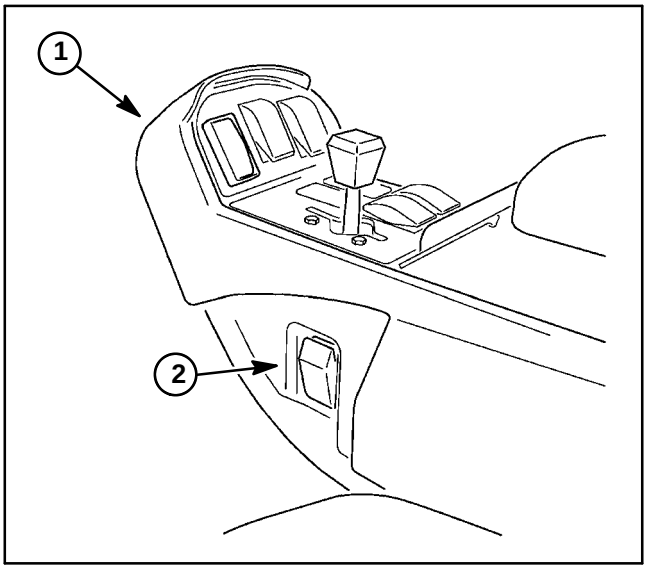

Figure 10

1. Console assembly **2. Headlight switch**

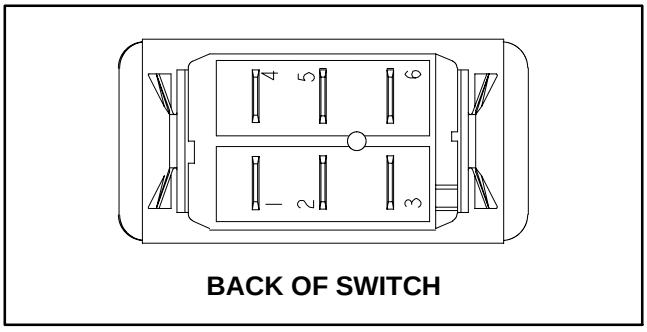

Figure 11

NOTE: Headlight switch terminals 1, 4, 5 and 6 are not used on Multi Pro 5800 machines.

Speed Lock Switch

The speed lock switch is located on the console assembly (Fig. 12). This switch energizes the speed lock coil to allow the operator to maintain a constant ground speed. The switch includes a light that should be illuminated when the switch is in the ON position.

Testing

1. Remove LH console cover to gain access to speed lock switch (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the speed lock switch.

3. The switch terminals are marked as shown in Figure 13. In the ON position, continuity should exist between terminals 2 and 3. In the momentary SET position, continuity should exist between terminals 5 and 6. In the OFF position, there should be no continuity between any switch terminals.

4. Terminals 7 (–) and 8 (+) are used for the indicator light in the switch. The light should be illuminated when the switch is in the ON position.

5. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (–). The light should illuminate.

6. Replace switch if necessary.

7. Connect the wire harness connector to the switch after testing is complete.

8. Secure LH console cover to machine (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

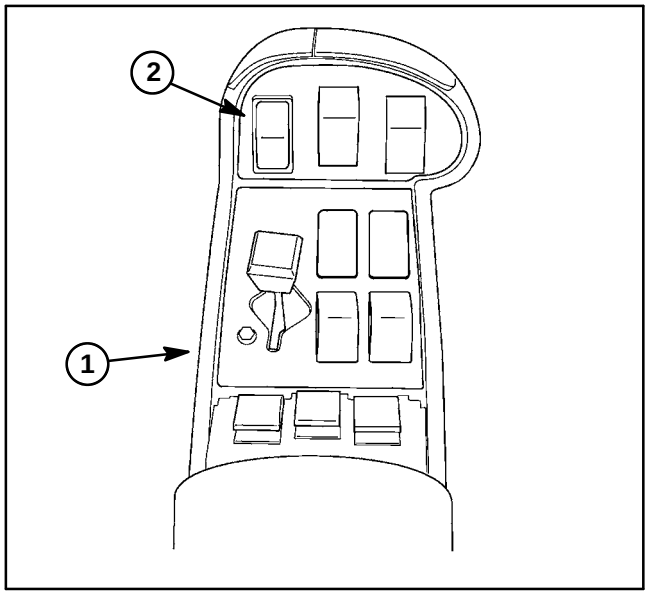

Figure 12

1. Console assembly **2. Speed lock switch**

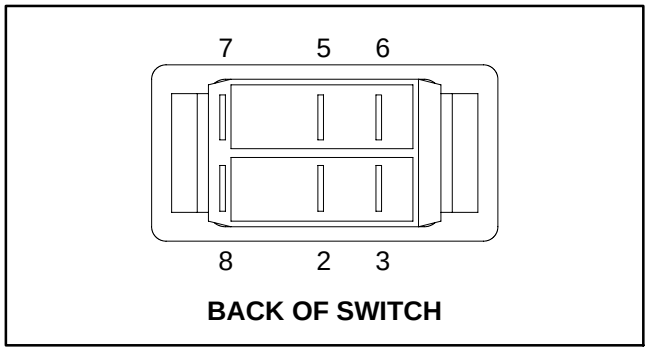

Figure 13

Pressure Rate Switch

The pressure rate (increase/decrease) switch is located on the dash (Fig. 14). This switch along with the Manual Interface Module (or Pro Control, if equipped) changes the applied current to the hydraulic manifold compensator valve solenoid coil which controls hydraulic flow to the motor that drives the spray pump. Pressing the switch to the increase position allows additional current to the compensator valve coil which increases flow to the hydraulic motor. The spray pump increases speed to allow additional flow and pressure from the spray pump. Moving the switch to the decrease position reduces current to the compensator valve coil and results in less flow and pressure from the spray pump.

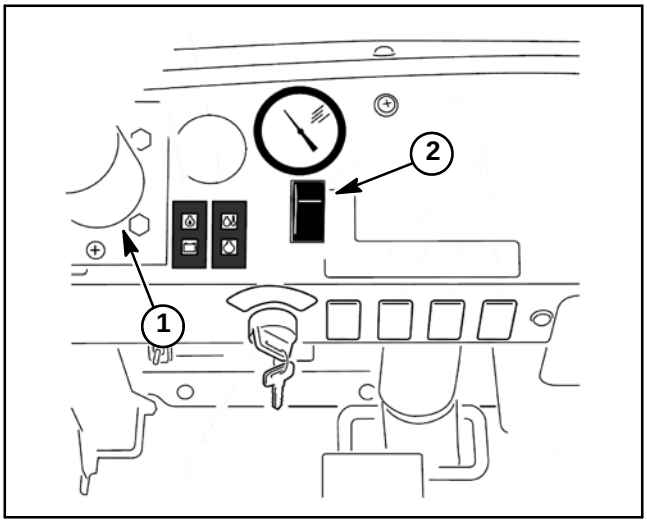

Figure 14

1. Steering column **2. Pressure rate switch**

Testing

1. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the switch.

2. The switch terminals are marked as shown in Figure 17. In the INCREASE position, continuity should exist between terminals 2 and 3 and also between terminals 5 and 6. In the neutral, center position, there should be no continuity between any switch terminals. In the DECREASE position, continuity should exist between terminals 2 and 1 and also between terminals 5 and 4.

3. Replace switch if necessary.

4. Connect the wire harness connector to the switch after testing is complete.

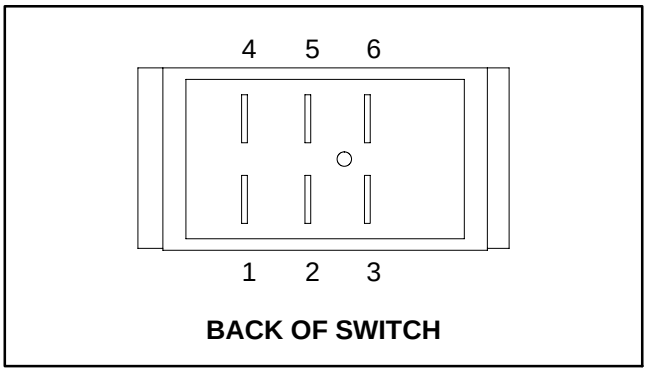

Figure 15

Boom Lift Switches

The two (2) boom lift switches are used to raise or lower the spray booms. When a boom switch is pressed, necessary boom lift manifold solenoid valve coils are energized to allow hydraulic flow to the boom lift cylinder. These switches are located on the console assembly (Fig. 16).

Testing

1. Remove console covers to gain access to switch that is to be tested (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the switch.

3. The switch terminals are marked as shown in Figure 17. In the boom raise position, continuity should exist between terminals 2 and 1 and also between terminals 5 and 4. In the neutral, center position, there should be no continuity between any switch terminals. In the boom lower position, continuity should exist between terminals 2 and 3 and also between terminals 5 and 6.

4. Replace switch if necessary.

5. Connect the wire harness connector to the switch after testing is complete.

6. Secure console covers to machine (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

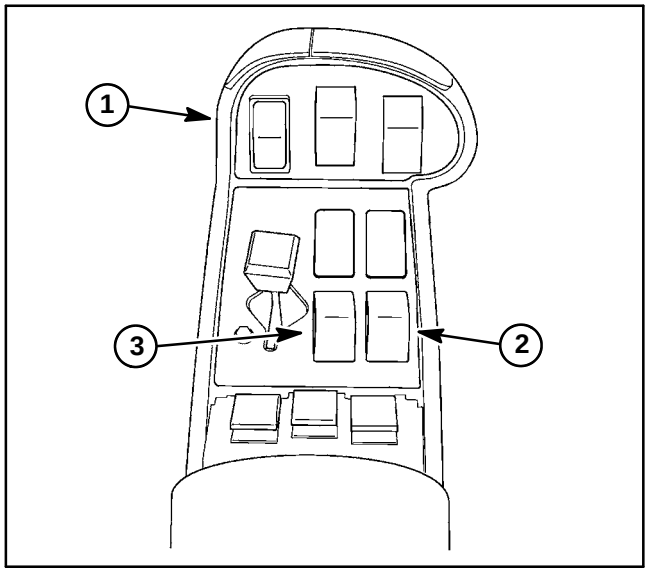

Figure 16

1. **Console assembly**
2. **RH boom lift switch**
3. **LH boom lift switch**

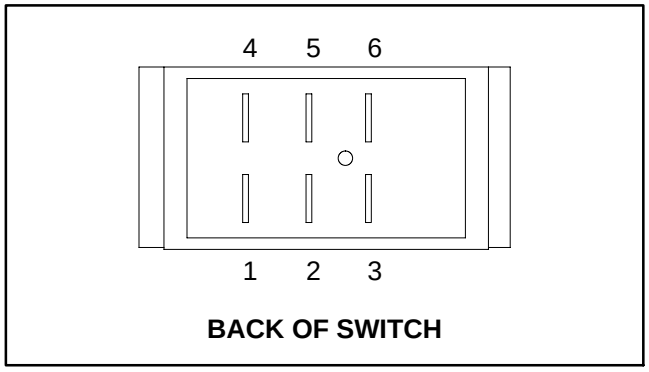

Figure 17

NOTE: Boom lift switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Spray Pump, Agitation and Boom Control Switches

The spray pump (on/off), agitation (on/off) and boom control (on/off) switches are located on the spray control console (Fig. 18). The switch includes a light that should be illuminated when the switch is in the ON position.

Testing

1. Remove console covers to gain access to switch that is to be tested (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

2. Make sure ignition switch is off. Disconnect the wire harness electrical connector from the switch.

3. The switch terminals are marked as shown in Figure 19. In the ON position, continuity should exist between terminals 2 and 3 and also between terminals 5 and 6. In the OFF position, continuity should exist between terminals 1 and 2 and also between terminals 4 and 5.

4. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (–). The light should illuminate.

5. Replace switch if necessary.

6. Connect the wire harness connector to the switch after testing.

7. Secure console covers to machine (see Console Assembly in the Service and Repairs section of Chapter 7 – Chassis).

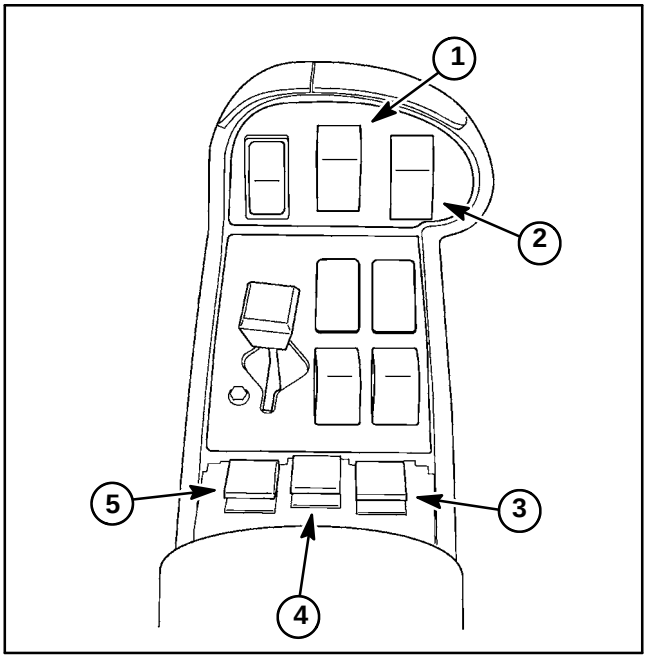

Figure 18

1. **Agitation switch**
2. **Pump switch**
3. **RH boom switch**
4. **Center boom switch**
5. **LH boom switch**

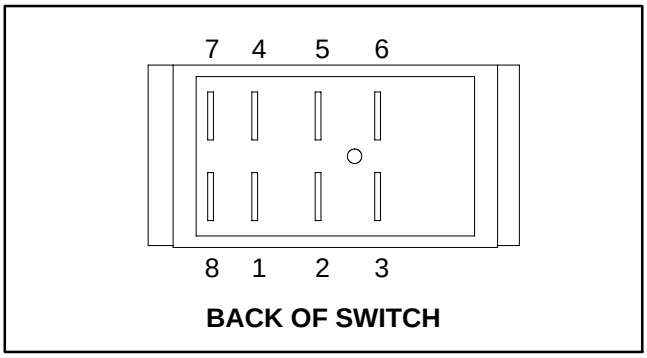

Figure 19

Master Boom (Foot) Switch

The master boom switch is located on the floorboard of the machine (Fig. 20). This switch allows the machine operator to control the operation of all boom sections using one switch.

Testing

1. Locate switch and unplug wire harness connector from switch.

2. The switch terminals are shown in Figure 21. Continuity should exist between the common terminal and only one of the side terminals. When the switch is depressed, continuity should exist between the common terminal and the other side terminal. Regardless of switch position, there should never be continuity between the two side terminals.

3. Reconnect the wire harness connector to the switch after testing is completed.

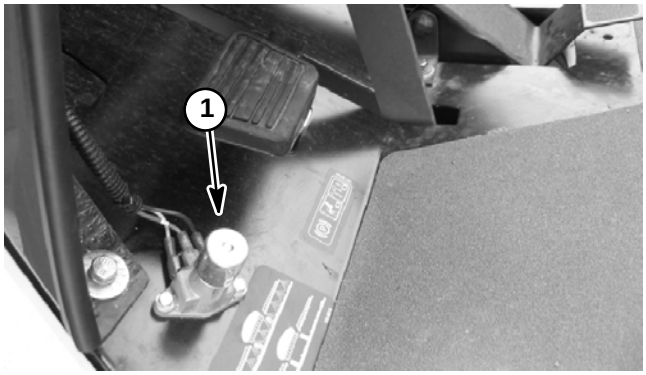

Figure 20

1. Master boom switch

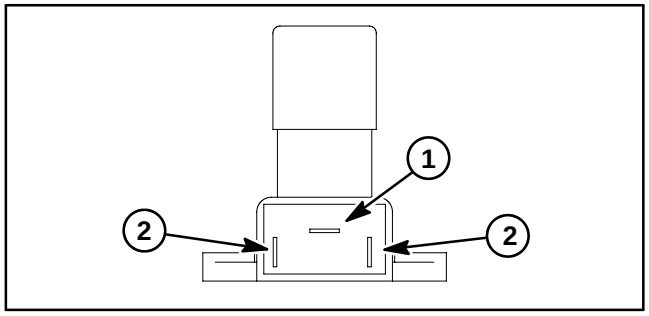

Figure 21

1. Common terminal **2. Side terminal**

Speed Lock Coil

The speed lock coil is energized by the speed lock switch on the console. The energized coil becomes a magnet to hold the traction pedal in position and maintains ground speed for accurate sprayer operation.

Testing

1. Make sure ignition switch is off. Locate speed lock coil next to traction pedal under the floorboard (Fig. 22). Unplug coil connector from machine wire harness.

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

2. Using a multimeter (ohms setting), verify control coil resistance between the terminals of the connector and the frame of the coil. Resistance should be from 3.6 to 4.0 ohms.

3. If coil does not engage when voltage is applied or coil resistance is incorrect, replace control coil.

4. After coil testing is complete, connect the coil connector to the machine harness.

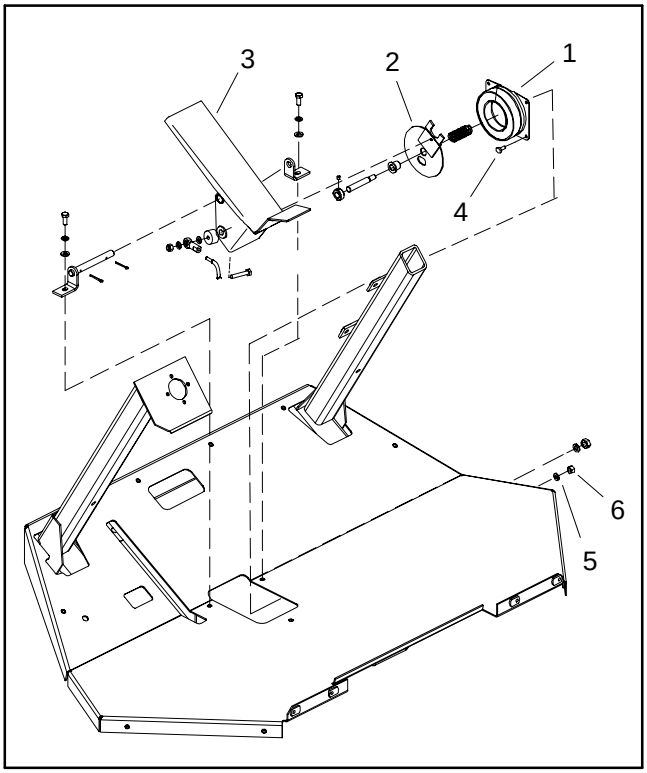

Figure 22

1. **Speed lock coil**
2. **Plate**
3. **Traction pedal**
4. **Cap screw (4 used)**
5. **Lock washer (4 used)**
6. **Hex nut (4 used)**

Brake Pedal Switch

The brake pedal switch is mounted on the frame under the floorboard (Fig. 23). The brake pedal switch prevents the cruise control coil from being energized when the brake pedal is applied.

Testing

1. Make sure ignition switch is off. Locate switch and unplug wire harness connector from switch.

2. When the switch plunger is pressed (brake pedal released), there **should be** continuity between the switch terminals. When the switch plunger is extended (brake pedal depressed), there **should not be** continuity between the switch terminals.

3. Replace switch if necessary.

4. Connect the wire harness connector to the switch after testing is complete.

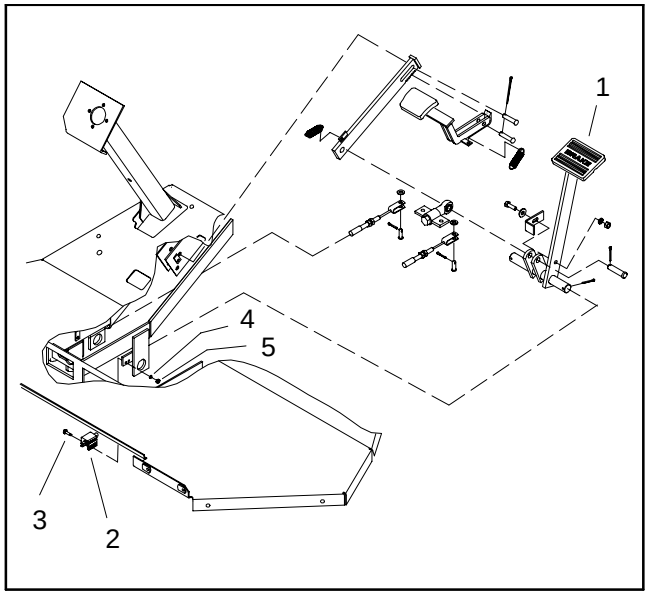

Figure 23

1. **Brake pedal**
2. **Brake pedal switch**
3. **Screw (2 used)**
4. **Lock washer (2 used)**
5. **Hex nut (2 used)**

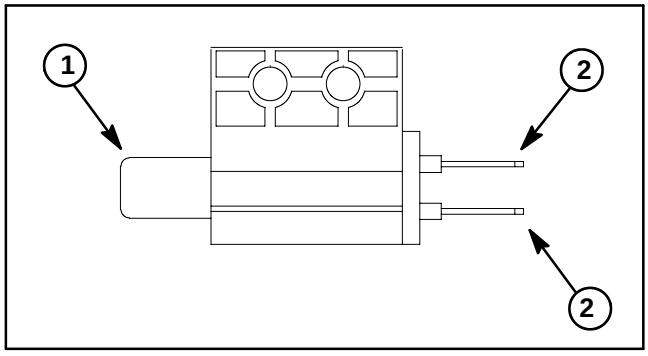

Figure 24

1. **Switch plunger**
2. **Switch terminal**

Spray System Relays

The Multi Pro 5800 uses two (2) relays in the spray system in conjunction with the master boom (foot) switch to turn the spray booms on and off. These relays are attached to the electric panel under the operator seat and can be identified by a tag on the wire harness. The spray system relays have five (5) terminals.

NOTE: If optional kits are installed on machine, additional relays may be present on electric panel.

Relay Testing

1. Raise operator seat to allow access to engine compartment. Locate relay to be tested and unplug wire harness connector from relay. Remove relay from electrical panel for easier testing.

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

2. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be from 70 to 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 break and make continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.

6. Replace relay if necessary.

7. Disconnect voltage and multimeter leads from the relay terminals when testing is completed.

8. Secure relay to electric panel and connect the wire harness connector to the relay.

9. Lower and secure operator seat.

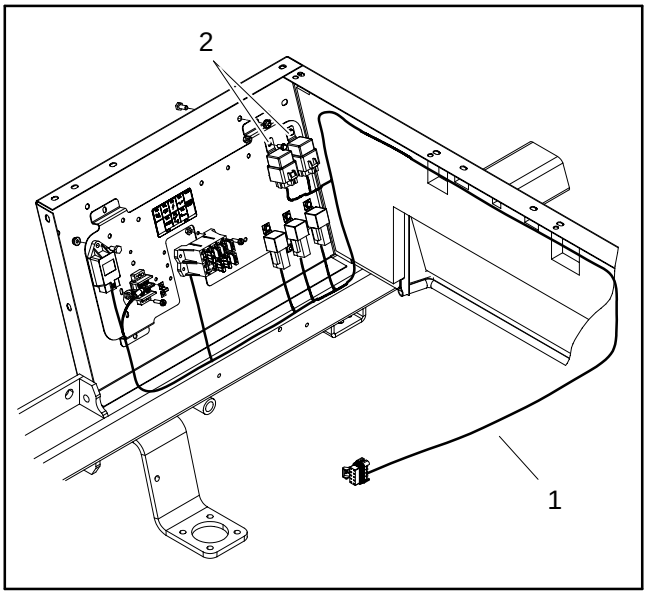

Figure 25

1. Front wire harness **2. Spray system relay**

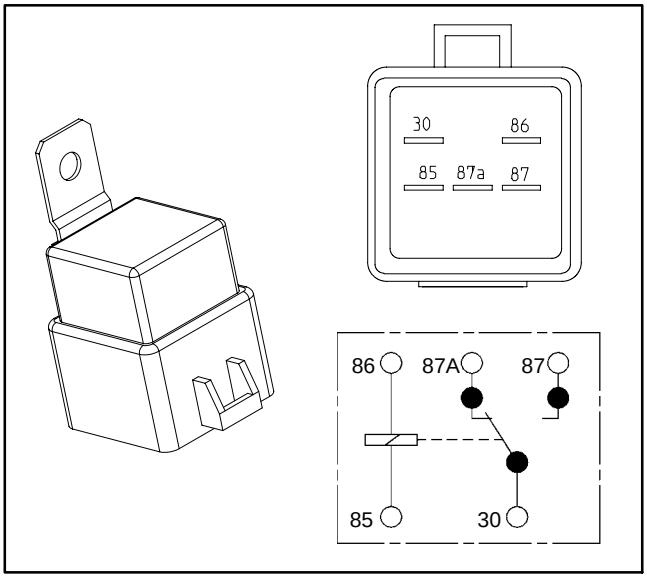

Figure 26

Main, Glow and Speed Lock Relays

The main, glow and speed lock relays are attached to the electric panel under the operator seat (Fig. 27). Relays can be identified by a tag on the wire harness. The main, glow and speed lock relays have four (4) terminals.

The main relay is energized and provides electrical current to most fuses when the ignition switch is in either the ON or START position.

When energized, the glow relay allows electrical current to the engine glow plugs.

The speed lock relay is used to engage the speed lock coil when energized.

NOTE: If optional kits are installed on machine, additional relays may be present on electric panel.

Relay Testing

1. Raise operator seat to allow access to engine compartment. Locate relay to be tested and unplug wire harness connector from relay. Remove relay from electrical panel for easier testing.

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

1. Verify coil resistance between terminals 85 and 86 with a multimeter (ohms setting). Resistance should be approximately 72 ohms.

2. 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.

3. Replace relay if necessary.

4. Disconnect voltage and multimeter leads from the relay terminals when testing is completed.

5. Secure relay to electric panel and connect the wire harness connector to the relay.

6. Lower and secure operator seat.

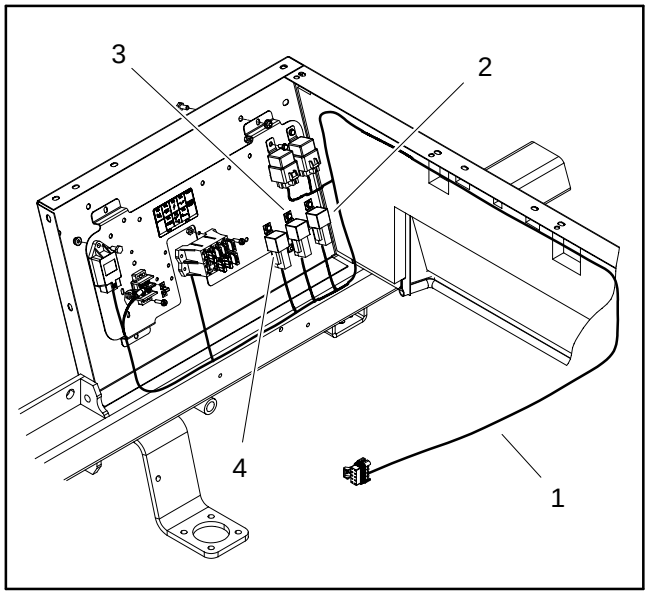

Figure 27

1. **Front wire harness**
2. **Glow relay**
3. **Main relay**
4. **Speed lock relay**

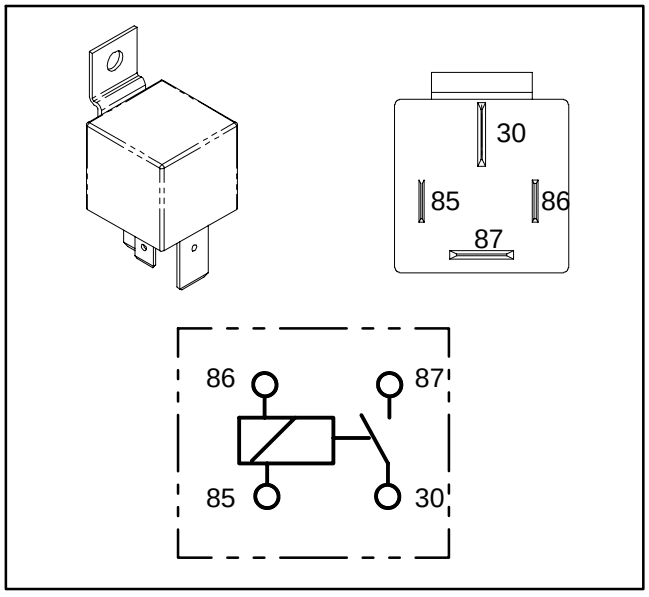

Figure 28

Traction Speed Sensor

The traction speed sensor is attached to the right side rear wheel motor (Fig. 29). The sensor provides ground speed information for two (2) options: the Pro Control Electronics and the speedometer kit. It uses a magnetically based, Hall Effect integrated circuit. As the piston group in the wheel motor turns, the sensor accurately senses the movement of the pistons passing the sensor. The sensor red connector wire (connector terminal A) is the positive lead, the black wire (terminal C) is the ground lead and the white wire (terminal B) is the signal output.

Testing

1. Make sure ignition switch is off. Remove speed sensor from machine (see Traction Speed Sensor Removal in the Service and Repairs Section of this Chapter).

IMPORTANT: Incorrect jumper wire connections during testing can damage the sensor.

2. Using a +12 VDC battery, a multimeter, a 1K ohm resistor and appropriate jumper wires, connect the battery and multimeter to the speed sensor using Figure 30 as a guide.

3. Set multimeter to DC volts setting.

4. The multimeter should display very low voltage when a metal object is held near the sensor tip. The multimeter should display battery voltage when the metal object is moved away from the sensor tip.

5. After sensor testing is complete, remove jumper wires, resistor and multimeter leads from sensor connector.

IMPORTANT: When replacing the sensor, see Traction Speed Sensor Installation in the Service and Repairs Section of this chapter.

6. Reinstall speed sensor into wheel motor (see Traction Speed Sensor Installation in the Service and Repairs Section of this Chapter). Reconnect speed sensor to machine wire harness.

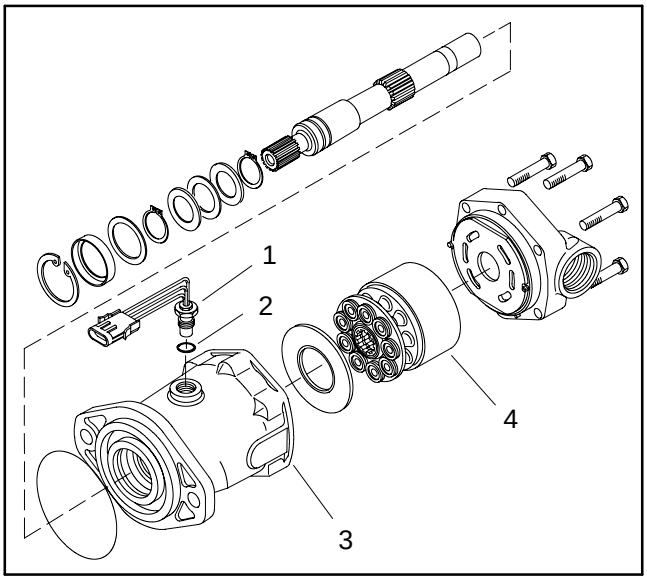

Figure 29

1. **Speed sensor**
2. **O-ring**
3. **RH wheel motor housing**
4. **Motor piston group**

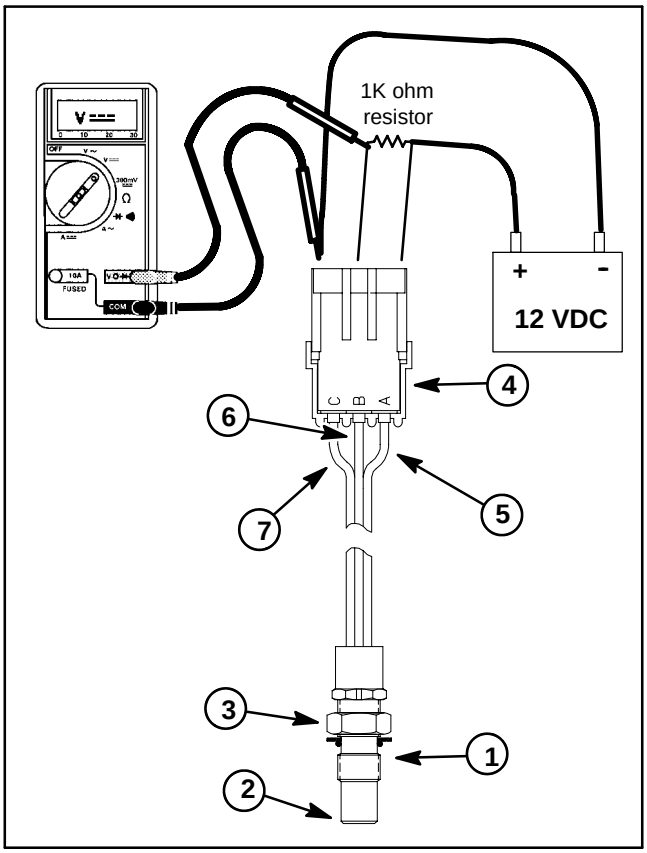

Figure 30

1. **Speed sensor**
2. **Sensor tip**
3. **Lock nut**
4. **Sensor connector**
5. **Red wire**
6. **White wire**
7. **Black wire**

Hydraulic Valve Solenoid Coils

The Multi Pro 5800 hydraulic system uses several hydraulic solenoid valve coils for system control. The spray pump control manifold includes one (1) solenoid valve (Fig. 31) and the boom lift control manifold includes five (5) solenoid valves (Fig. 32). When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic flow. Testing of the coils can be done with the coil installed on the hydraulic valve.

Testing

1. Make sure ignition switch is off. Locate solenoid valve coil to be tested and disconnect wire harness connector from coil.

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

NOTE: Solenoid coil resistance should be measured with solenoid at approximately 68^{o}F (20^{o}C). Resistance may be slightly different than listed at different temperatures. Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

2. Using a multimeter (ohms setting), measure resistance between the two connector terminals on the solenoid valve coil. The resistance for the solenoid coils is identified below:

   A. The resistance of the solenoid coil on the spray pump manifold should be 4.5 ohms.

   B. The five (5) solenoid coils on the boom lift manifold are identical. Resistance of these coils should be 8.8 ohms.

3. If solenoid coil resistance is incorrect, replace coil (see Spray Pump Control Manifold Service or Boom Lift Control Manifold Service in the Service and Repairs section of Chapter 4 – Hydraulic System).

NOTE: Because the five (5) solenoid valve coils on the boom lift control manifold are identical, they can be exchanged to assist in troubleshooting. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. switch, circuit wiring, hydraulic problem).

4. After testing is completed, connect wire harness electrical connector to the solenoid valve coil.

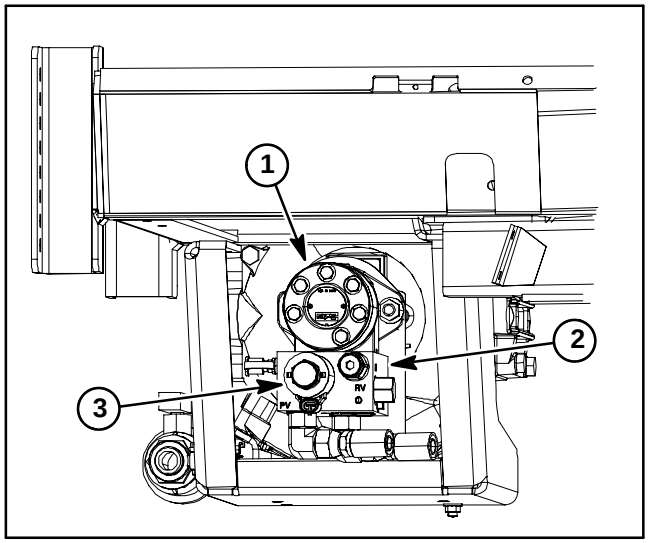

Figure 31

1. **Spray pump drive motor**
2. **Spray pump manifold**
3. **Solenoid coil (PV)**

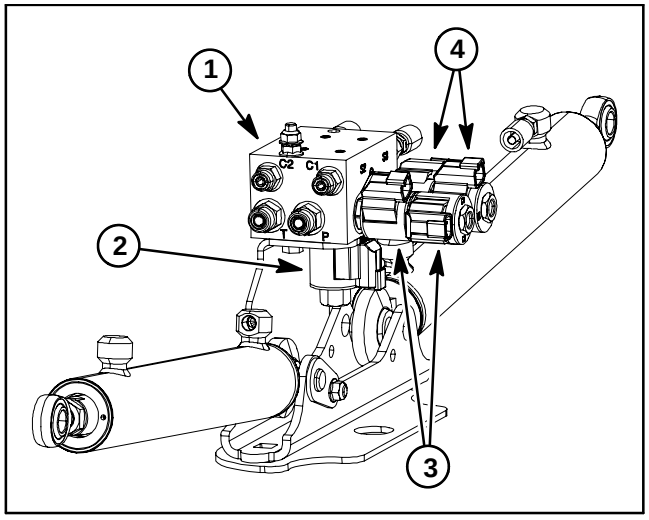

Figure 32

1. **Boom lift manifold**
2. **Solenoid coil (S1)**
3. **Solenoid coil (S2)**
4. **Solenoid coil (S3)**

Manual Interface Module

The manual interface module is used in conjunction with the increase/decrease switch to adjust current flow to the hydraulic pump control manifold compensator valve and to maintain pump rate settings when the booms are turned off and on again using the master boom (foot) switch. The module is located behind the hood and in front of the glove box (Fig. 33). The manual interface module is automatically disabled if a Pro Control is installed in the spray system.

Once the operator has set the spray application rate, whenever the master boom switch is turned off, the module stores the current (mA) setting available to the compensator valve solenoid coil. When the master boom switch is pressed to begin spraying again, the module ensures that the spray application rate is unchanged. Because of the module, the operator does not have to reset spray rates when the master boom switch is used to turn the spray booms on and off.

The interface module is a solid state device and there is no reliable means of bench testing the module. If spray rates have to be reset after turning the booms off and on with the master boom switch, the manual interface module should be suspect.

Testing of the interface module, circuit wiring and increase/decrease switch can be performed as follows:

1. Make sure ignition switch is off. Disconnect wire harness connector from the hydraulic pump control manifold compensator valve solenoid coil.

IMPORTANT: When connecting multimeter test leads to wire harness connector, do not push meter test leads into wire harness connector. Connector damage can occur if meter leads are forced into connector.

2. Connect one multimeter test lead to one of the wire harness connector leads and the other meter test lead to the second harness connector lead (Fig. 34). Set multimeter to DC Volts setting.

3. Turn ignition switch to the ON position.

4. While monitoring the multimeter display, use the increase/decrease switch to adjust spray rate:

   A. Pressing the increase/decrease switch to increase should result in an increased voltage displayed on the multimeter.

   B. Pressing the increase/decrease switch to decrease should result in a decreased voltage displayed on the multimeter.

5. If voltage change to the compensator valve solenoid coil is correct, the interface module, circuit wiring and increase/decrease switch are functioning correctly. If voltage change is incorrect, test the increase/decrease switch and then circuit wiring. Replace manual interface module only after other components have tested acceptably.

6. Remove multimeter and secure wire harness connector to the solenoid coil.

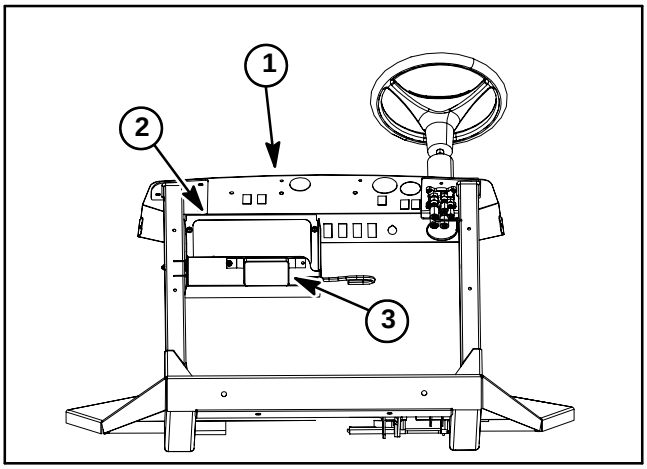

Figure 33

1. **Dash panel (from front)**
2. **Glove box**
3. **Interface module**

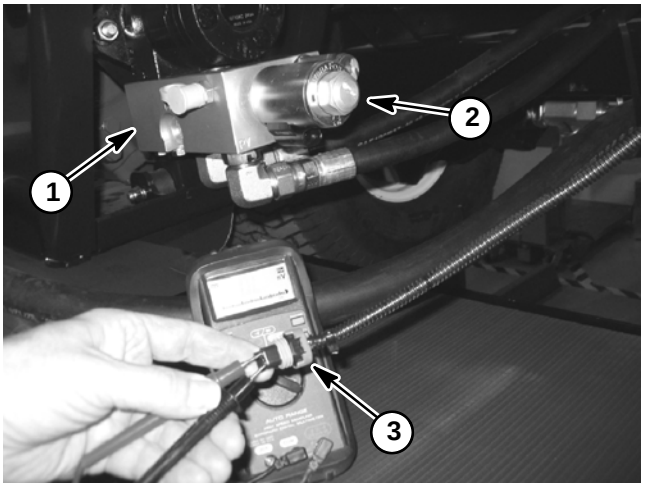

Figure 34

1. **Pump control manifold**
2. **Compensator valve coil**
3. **Harness connector**

Neutral Switch

The neutral switch is located on the top side of the piston (traction) pump (Fig. 35). The switch is closed when the traction pedal is in the neutral position and opens when the pedal is depressed in either direction (forward or reverse).

Test the switch by disconnecting the wire harness connector from the switch and connecting a continuity tester across the two (2) 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 (Traction) Pump Service in the Service and Repairs section of Chapter 4 – Hydraulic Systems for disassembly, assembly and adjustment procedures for the neutral switch.

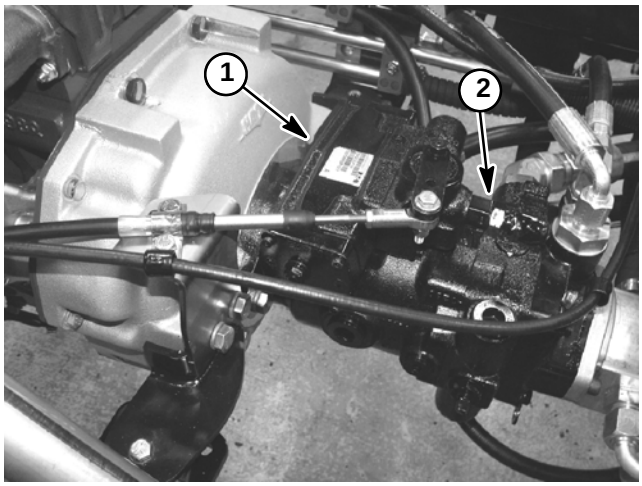

Figure 35

1. **Piston (traction) pump**
2. **Neutral switch**

Fuel Stop Solenoid

The fuel stop solenoid must be energized for the engine to run. It is mounted to the injection pump on the engine (Fig. 36).

In Place Testing

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

1. Disconnect wire harness connector from solenoid.

2. Using a digital multimeter, touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 37). The resistance of the pull coil should be less than 1 ohm (but not zero).

3. Using a digital multimeter, touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 37). The resistance of the hold coil should be approximately 15 ohms.

4. Connect harness wire connector to the solenoid.

Live Testing

1. Disconnect wire harness connector from 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 plunger moves freely and is free of dirt, debris and corrosion.

3. Connect a positive (+) test lead from a 12 VDC source to the pull coil and hold coil terminals.

4. Touch a negative (–) test lead from the 12 VDC source to the fuel stop solenoid frame (ground) (Fig. 37). The solenoid should engage, making an audible “click,” and the plunger should retract.

5. Remove positive (+) voltage from the pull coil terminal. The solenoid should stay engaged.

6. Remove positive (+) voltage from the hold coil terminal. The solenoid should release.

7. When testing is complete, reconnect harness wire connector to the solenoid.

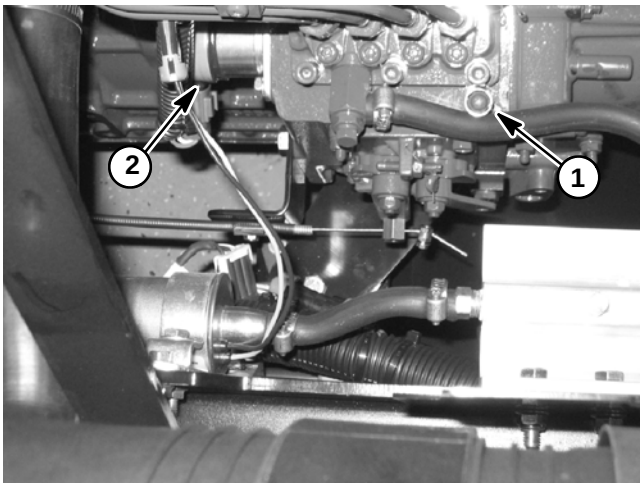

Figure 36

1. **Injection pump**
2. **Fuel stop solenoid**

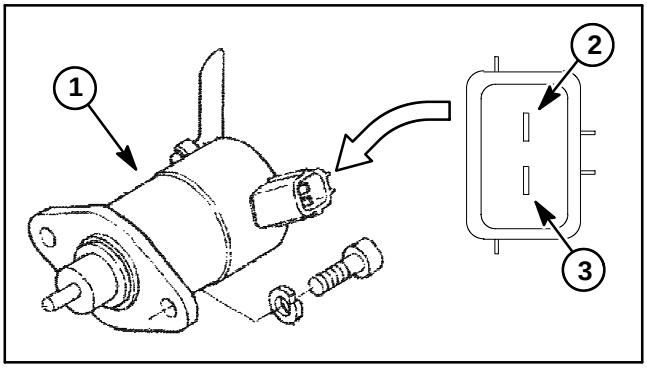

Figure 37

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

Glow Plug Controller

The glow plug controller is attached to the electric panel under the operator seat.

NOTE: Refer to see Chapter 8 – Foldout Drawings when troubleshooting the glow plug controller.

Controller Operation

1. When the ignition switch is placed in the ON position, the controller energizes the glow plugs and illuminates the glow plug indicator light for approximately six (6) seconds.

2. When the ignition switch is held in the START position, the glow plugs will energize while the switch is held in START and the glow plug 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 plug indicator light will remain off.

Controller Checks

1. Make sure there is power from the battery.

2. Disconnect wire harness connector from the fuel stop solenoid to prevent the engine from starting.

3. Place ignition switch in the ON position. Verify the following while the ignition switch is in the ON position:

   A. Glow plug indicator light is on.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow plug indicator light goes out and glow plugs de–energize after approximately six (6) seconds.

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

   A. Glow plug indicator light is out.

   B. Glow relay is energized.

   C. Glow plugs are energized.

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

NOTE: If there is no power 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 8 – Foldout Drawings).

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 8 – Foldout Drawings).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow plug indicator light, glow relay and ground (see Chapter 8 – Foldout Drawings).

   C. Repair or replace components as necessary.

6. When testing is complete, connect wire harness connector to the fuel stop solenoid.

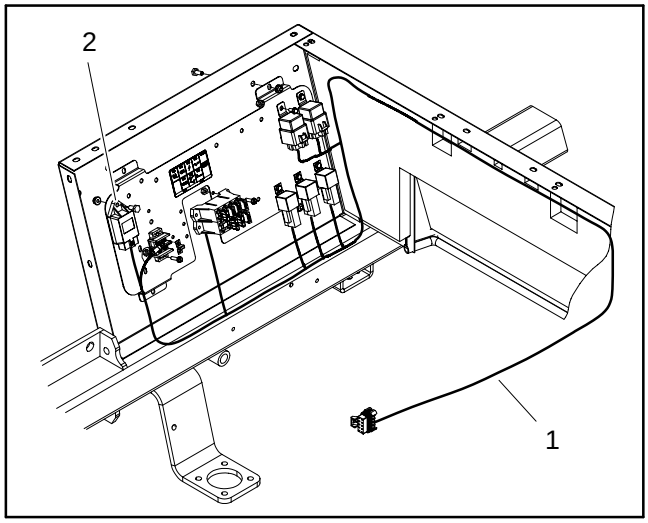

Figure 38

1. Front wire harness **2. Glow plug controller**

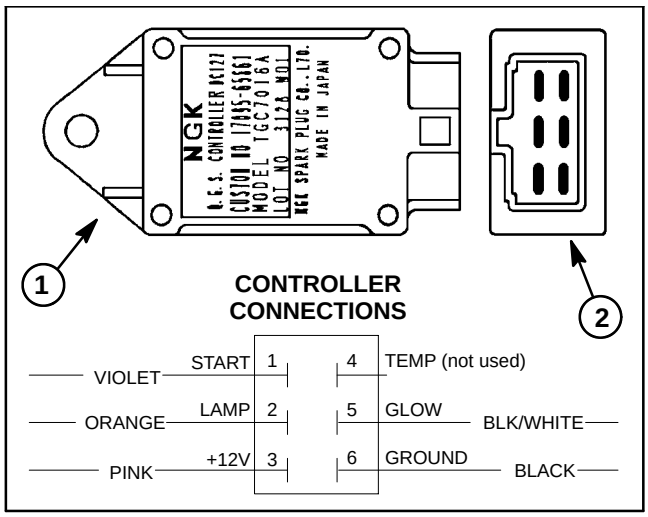

Figure 39

1. Glow controller top view **2. Controller end view**

Fuel Pump

The fuel pump is attached to the frame just outboard of the fuel injection pump (Fig. 40).

DANGER

Because diesel fuel is highly flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Make sure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.

Operational Test

1. Disconnect wire harness electrical connector from the fuel stop solenoid to prevent the engine from starting (see Fuel Stop Solenoid in this section).

2. Disconnect fuel pump discharge hose from the fuel filter.

3. Make sure fuel hoses attached to the fuel pump are free of obstructions.

4. Place fuel pump discharge hose into a large, graduated cylinder sufficient enough to collect 1 quart (950 ml).

IMPORTANT: When testing the fuel pump, DO NOT turn ignition switch to START.

5. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for fifteen (15) seconds, then return switch to OFF.

6. The amount of fuel collected in the graduated cylinder should be approximately **16 fl oz (475 ml) after fifteen (15) seconds**.

7. Replace fuel pump as necessary. Install disconnected fuel hose to the fuel filter.

8. Wipe up any spilled fuel.

9. Reconnect wire harness electrical connector to the fuel stop solenoid.

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

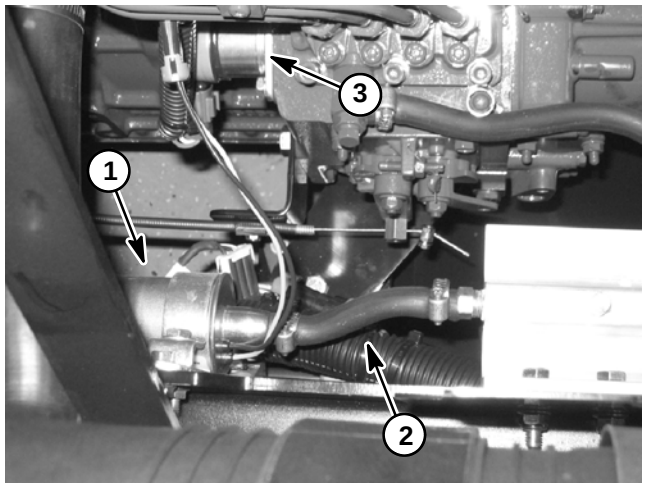

Figure 40

1. **Fuel pump**
2. **Pump discharge hose**
3. **Fuel stop solenoid**

Fuel Pump Specifications

Fuel pump specifications are as follows:

Pump Capacity	64 fl oz/min (1.9 liters/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Temperature Sender

The temperature sender is located near the alternator on the water flange attached to the engine cylinder head (Fig. 41). There is a blue wire attached to the terminal of the sender.

Testing

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

2. Put sender in a container of oil with a thermometer and slowly heat the oil (Fig. 42).

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 temperature sender you are testing.

3. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases. The temperature sender is normally open and should close between 216° to 226° F (102° to 108° C).

4. Allow oil to cool while observing temperature. The temperature sender should open at approximately 208° F (98° C).

5. Replace sender if specifications are not met.

6. After testing, install temperature sender to the water flange.

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

   B. Tighten sender into the water flange.

   C. Reconnect blue wire to sender.

7. Fill engine cooling system.

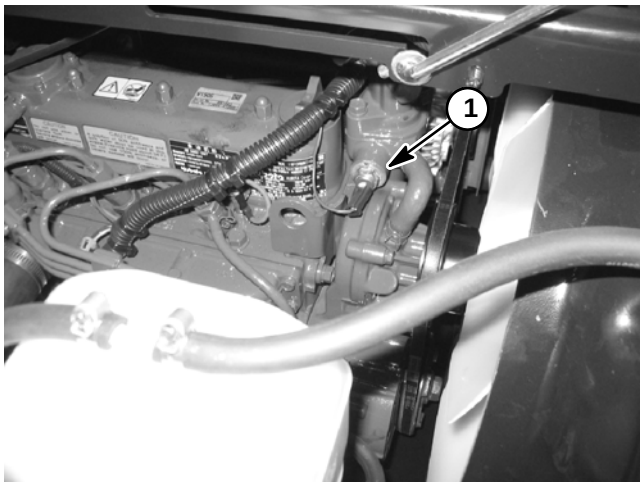

Figure 41

1. Temperature sender

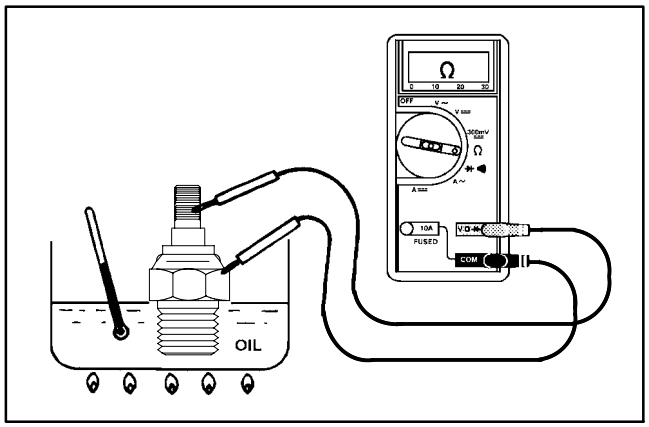

Figure 42

Fusible Links

The Multi Pro 5800 uses four (4) fusible links for circuit protection. Three (3) of these fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Fig. 43). The remaining fusible link is included in the wire harness and connects the starter terminal G to the engine fuel stop solenoid pull coil (Fig. 43). If any of these links should fail, current to the protected circuit will cease. Refer to wire harness drawings in Chapter 8 – Foldout Drawings for additional fusible link information.

Testing

1. Make sure that ignition switch is OFF.

2. Disconnect negative (–) battery cable from battery terminal and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter).

3. For fusible link harness (Fig. 44):

   A. Locate and unplug fusible link connector from machine wire harness.

   B. Use a multimeter to make sure that continuity exists between the fusible link terminal on the starter B+ terminal (terminal J1 on fusible link harness) and each of the terminals in the link harness connector P1 (Fig. 44). If any of the fusible links are open, replace the fusible link harness.

4. For fusible link in wire harness (Fig. 43):

   A. Locate and unplug machine wire harness connector from starter connector (white wire).

   B. Use a multimeter to make sure that continuity exists between the wire harness connector at the starter and the engine fuel stop solenoid connector for the solenoid pull coil (white wire).

   C. If this fusible link should fail, make sure that the wire harness is repaired with the correct fusible link. Do not replace a failed harness fusible link with a section of wire.

5. When testing is completed, make sure to connect all disconnected wire harness components. Connect positive (+) battery cable and then negative (–) cable (see Battery Service in the Service and Repairs section of this chapter).

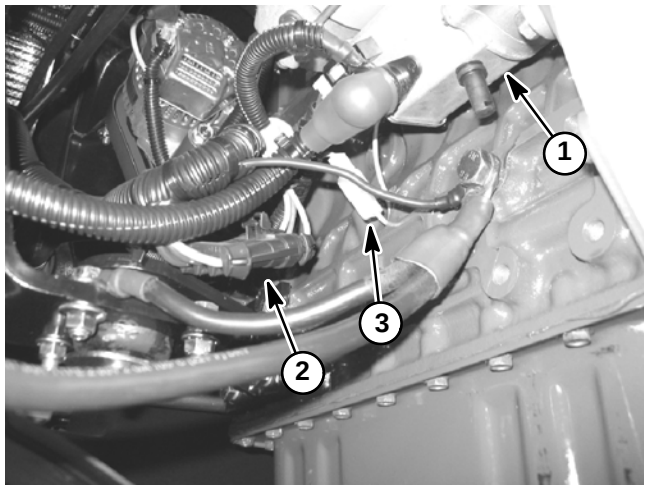

Figure 43

1. **Starter motor**
2. **Fusible link harness**
3. **Harness fusible link**

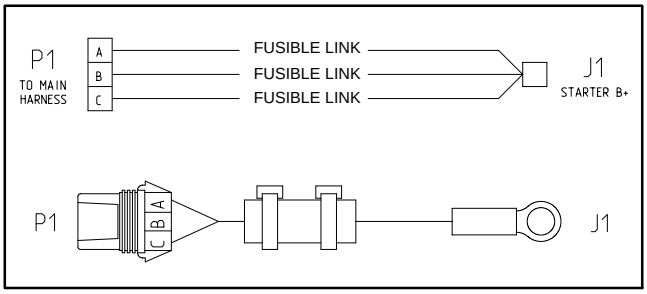

Figure 44

Diode Assemblies

The Multi Pro 5800 wiring harness includes several diode assemblies (Fig. 45). The diode assemblies plug into the vehicle wire harness at various locations (see wire harness drawings in Chapter 8 – Foldout Drawings).

The engine start circuit includes a diode for circuit protection from voltage spikes that occur when the starter solenoid is de–energized.

The speed lock circuit includes two (2) diodes. One of the diodes is used to provide a latching circuit for the speed lock relay. The second diode is used for circuit protection from voltage spikes that occur when the speed lock coil is de–energized.

The spray boom lift circuit includes four (4) diodes for circuit logic.

NOTE: If optional kits are installed on machine, additional diodes may exist in wire harness.

Testing

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

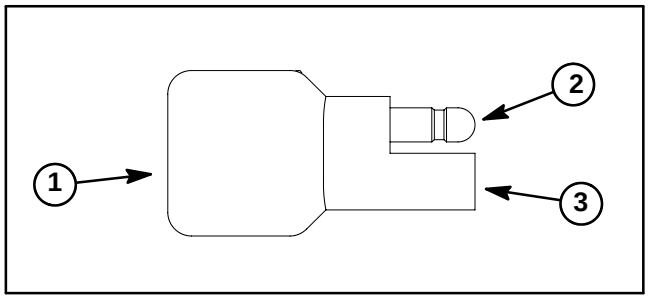

Figure 45

1. **Diode assembly**
2. **Male terminal**
3. **Female terminal**

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Service and Repairs

NOTE: See the Kubota Workshop Manual (05−E3B Series) for engine electrical component repair information.

Headlights

CAUTION

The headlights use a halogen bulb that becomes extremely hot when in operation. Handling a hot headlight bulb can cause severe burns and personal injury. Allow enough time for bulb to cool before handling.

CAUTION

Any surface contamination can damage the headlight bulb and lead to its failure. Headlight bulbs should be handled without touching the clear bulb surface. Handle the bulb by holding onto the base.

Headlight Disassembly (Fig. 46)

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

2. Gain access to headlight assembly under dash panel on rear of hood.

3. Unplug wire harness connector from headlight bulb.

4. If bulb removal is necessary, loosen the bulb from the headlight by rotating it 1/4 turn counter−clockwise. Then, grasp bulb base and remove bulb from the headlight.

5. If necessary, remove headlight from machine.

   A. Remove three (3) clips that secure headlight to headlight brackets on rear of hood.

   B. Remove headlight from machine.

Headlight Assembly (Fig. 46)

1. If headlight was removed, secure headlight to machine:

   A. Insert headlight into hood opening. Make sure that SPEAKER logo on headlight lens is at bottom.

   B. Secure headlight to headlight brackets on rear of hood with three (3) clips.

2. If bulb was removed from headlight, align tabs on bulb with notches in headlight opening. Insert bulb into back of headlight without touching the clear bulb surface. Secure bulb to headlight by rotating it 1/4 turn clockwise.

3. After repairs are completed, attach wire harness connector to headlight bulb.

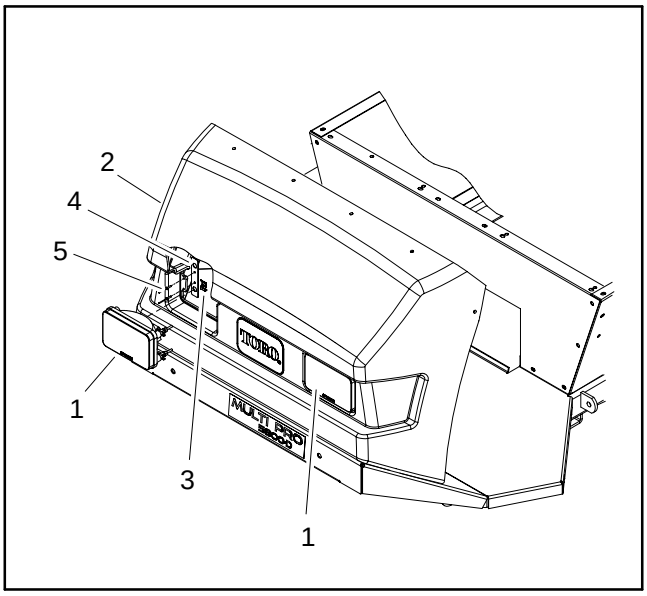

Figure 46

1. **Headlight assembly**
2. **Hood**
3. **Clip (3 used)**
4. **Headlight bracket**
5. **Pop rivet (2 per bracket)**

Traction Speed Sensor

Removal (Fig. 47)

1. Locate speed sensor on right side wheel motor. Disconnect speed sensor from machine wire harness.

2. Loosen lock nut and remove speed sensor from wheel motor.

Installation (Fig. 47)

1. Thread lock nut fully onto speed sensor threads.

2. Center a wheel motor piston in the center of the sensor port (see Sensor Port View in Fig. 48). Use a suitable tool to feel when a motor piston is in the center of the sensor port.

3. Lubricate O-ring and install onto sensor threads.

4. Thread sensor into port until sensor contacts piston. Rotate motor output shaft one complete revolution to make sure it rotates freely.

5. Turn sensor out (counter-clockwise) until angle between sensor orientation grooves and motor centerline is between 90º and 93º, then back out sensor one (1) full turn. Hold sensor at this position and torque lock nut from **75 to 125 in-lb (8.5 to 14.1 N-m)**.

6. Plug speed sensor connector into machine wire harness.

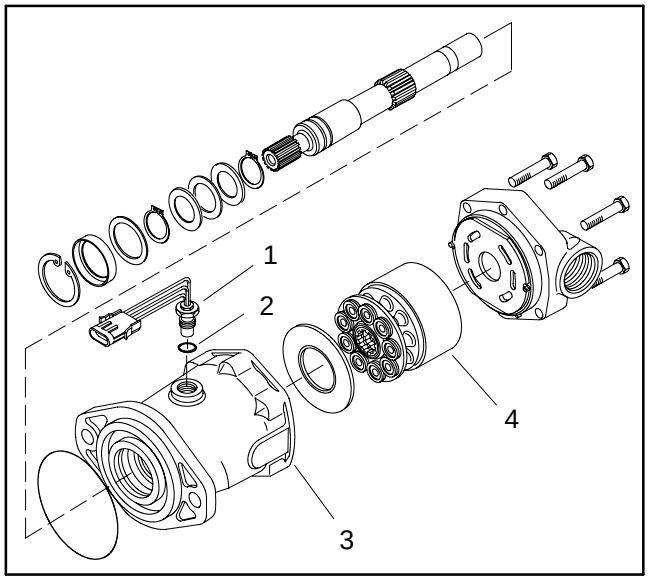

Figure 47

1. **Speed sensor**
2. **O-ring**
3. **RH wheel motor housing**
4. **Motor piston group**

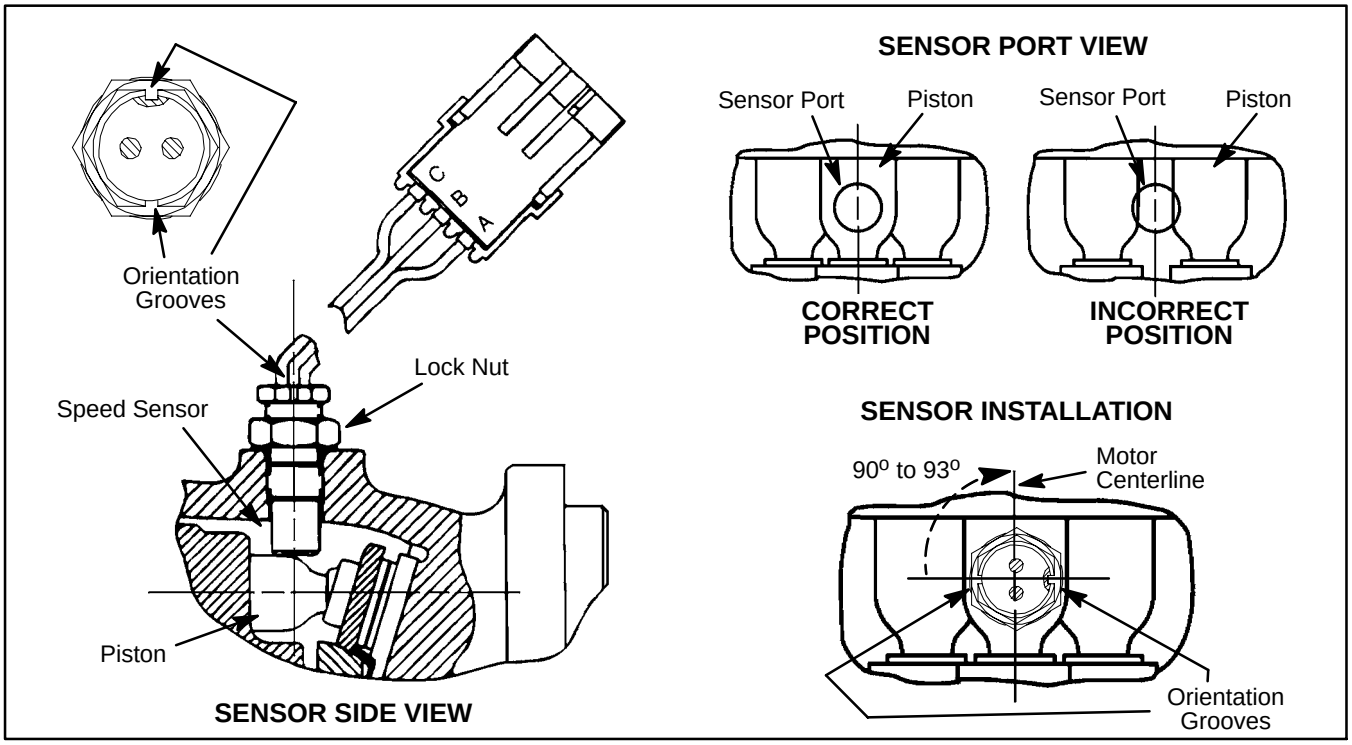

Figure 48

Speed Lock Coil

Removal (Fig. 50)

1. Set parking brake, turn ignition off and remove key.

2. Remove hex nut and lock washer that secure shaft to machine frame. Remove shaft with collar, flange bushing, plate and compression spring.

3. Unplug speed lock coil connector from machine wire harness. Remove four (4) cap screws, lock washers and hex nuts that secure coil to frame. Remove speed lock coil.

Installation (Fig. 50)

1. Attach speed lock coil to frame using four (4) cap screws, lock washers and hex nuts.

2. Position compression spring, plate and flange bushing to machine making sure to align plate slot with post on traction pedal. Apply anti−seize lubricant to shaft and insert shaft with collar. Secure shaft to frame with hex nut and lock washer.

3. Plug speed lock coil connector into machine wire harness.

4. Check that gap between speed lock coil and plate is approximately 3/32" (2.4 mm). If gap is incorrect, loosen set screw in collar and slide collar on shaft to allow proper gap. Tighten set screw to secure collar on shaft.

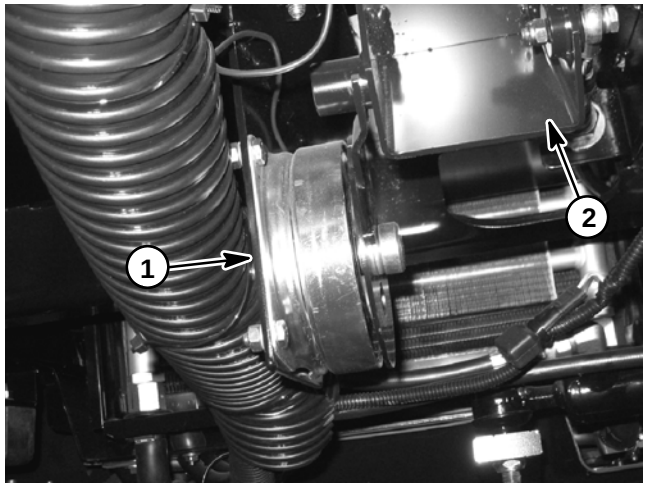

Figure 49

1. Speed lock coil **2. Traction pedal**

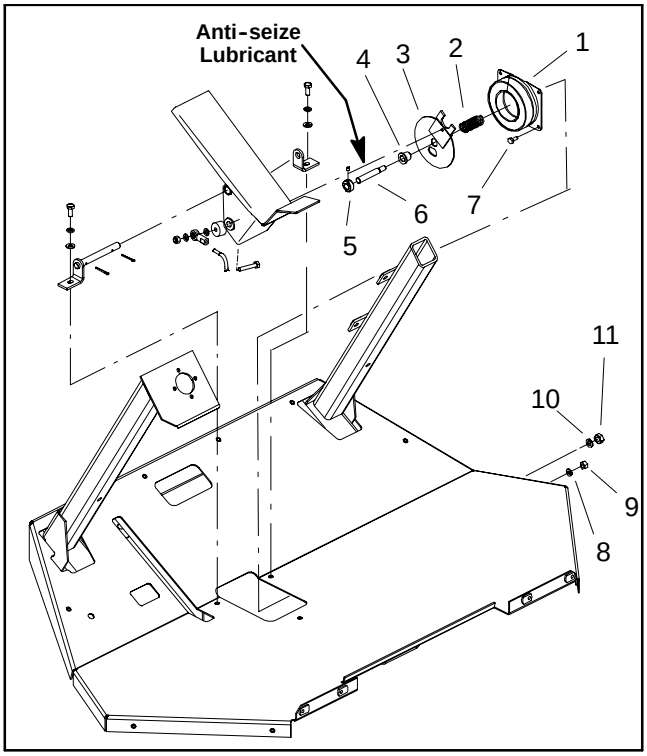

Figure 50

1. Speed lock coil
2. Compression spring
3. Plate
4. Flange bushing
5. Collar w/set screw
6. Shaft
7. Cap screw (4 used)
8. Lock washer (4 used)
9. Hex nut (4 used)
10. Shaft lock washer
11. Shaft hex nut

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 battery fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

   B. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107−0392) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

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

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (−) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107−0392) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours and every 30 days if machine is in storage.

6. Maintain cell electrolyte 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.

Battery Specifications

BCI Group 34 Battery
690 Amp Cranking Performance at 0º F (–18º C)
100 minute Reserve Capacity at 80º F (27º C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal (Fig. 51)

IMPORTANT: Be careful not to damage battery terminal posts or cable connectors when removing the battery cables.

1. Make sure ignition and all accessories are **OFF**.

2. Loosen strap and remove battery box cover from machine.

3. Using two (2) wrenches, loosen cap screw and nut on ground (–) cable connector first and then remove ground (–) cable from battery. This should prevent short circuiting the battery, other components or the operator's hands.

4. Loosen cap screw and nut on positive (+) cable connector using two (2) wrenches. Remove positive (+) cable from battery.

5. Make sure battery vent caps are on tightly.

6. Remove battery from the battery box and machine.

Battery Installation (Fig. 51)

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

1. Make sure ignition and all accessories are **OFF**.

2. Make sure that battery box is clean and that battery cables and connections are in good condition.

3. Place battery into battery box and make sure battery is level and flat.

4. Connect positive (+) cable connector onto positive battery post. Tighten cap screw and nut using two (2) wrenches.

5. Connect a digital multimeter (set to amps) between the negative battery post and the 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.

6. Connect ground (–) cable connector to the negative battery post. Tighten cap screw and lock nut using two (2) wrenches.

7. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

8. Install battery cover and secure with strap.

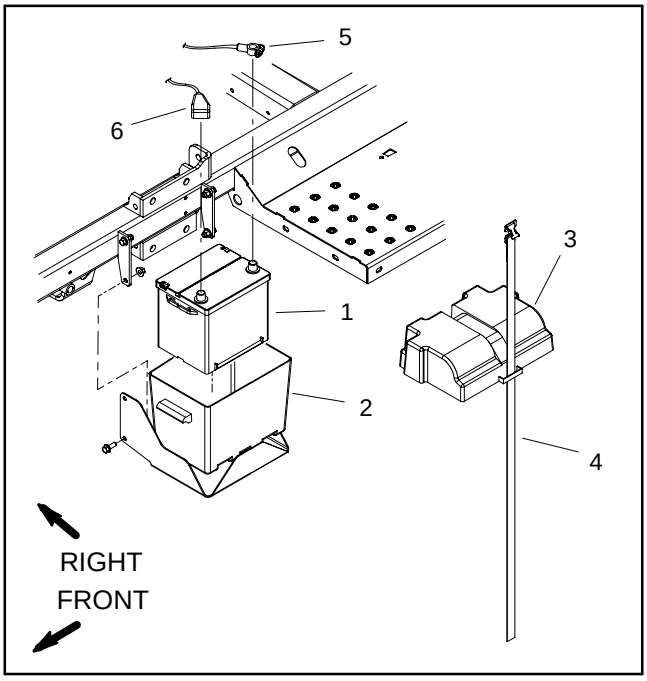

Figure 51

1. **Battery**
2. **Battery box**
3. **Cover**
4. **Strap**
5. **Negative cable**
6. **Positive cable**

Battery Inspection and Maintenance

1. Replace battery if cracked or leaking.

2. Check battery terminal posts and cables for corrosion. Use wire brush to clean corrosion from posts and cables.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

3. 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.

4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

5. 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 fifteen (15) minutes to allow sufficient mixing of the electrolyte (see battery charging in this section).

Battery Testing

1. 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.

2. 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 battery load tester manufacturer's instructions when using a battery load tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, charge the battery (see battery charging in this section).

B. If the battery has been charged, apply a 150 amp load for fifteen (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 battery tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 345 amps (one half the cranking performance rating of the battery) for fifteen (15) seconds.

G. Take a voltage reading after fifteen (15) seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70° F (and up)	21.1° C (and up)
9.5	60° F	15.6° C
9.4	50° F	10.0° C
9.3	40° F	4.4° C
9.1	30° F	-1.1° C
8.9	20° F	-6.7° C
8.7	10° F	-12.2° C
8.5	0° F	-17.8° C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	**3.8 hrs @ 3 amps**	**7.5 hrs @ 3 amps**	**11.3 hrs @ 3 amps**	**15 hrs @ 3 amps**
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60° F (15.5° C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125° F (52° C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

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Chapter 6

Spray System

Table of Contents

Specifications

Item	Description
Spray Pump	Diaphragm Pump, 40 GPM (151 LPM) @ 200 PSI
Spray Pressure Relief Valve	Poppet Style, 220 PSI (1500 kPa) Maximum
Sprayer Tank	300 U.S. Gallon (1136 Liter), Polyethylene
Suction Strainer	50 Mesh (Blue), Stainless Steel, Tank Mounted (30 Mesh (Red) and 80 Mesh (Green) Optional)

General Information

Operator's Manual

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

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil or other property. To eliminate environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Stop the vehicle and set the parking brake.

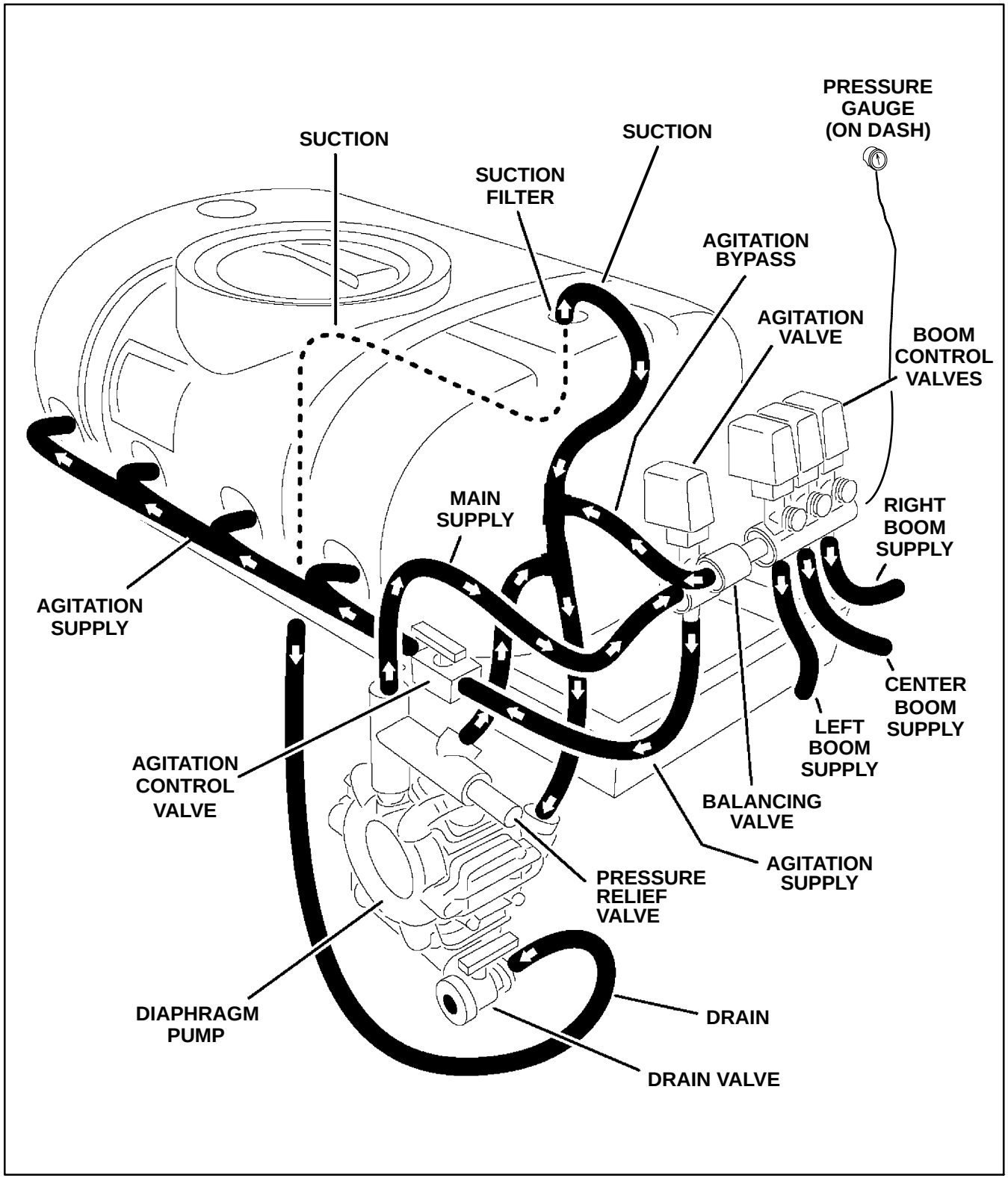
2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure line pressure is relieved before loosening any system component.

Spray System Flow Diagram



Spray System Operation

The Multi Pro 5800 spray system uses a positive displacement six (6) diaphragm pump to move spray solution from the spray tank to the boom nozzles. The spray pump is self−priming and has a dry crankcase.

The downward stroke of the pump's connecting rods and diaphragms creates suction to allow fluid to be drawn from the spray tank to the pump via the suction tube, suction strainer, hoses and connectors. Suction valves positioned in the pump valve chamber prevent fluid from being pumped back into the suction line. Leaks in the suction line will cause system problems and often will be indicated by erratic suction line jumping and excessive pump noise.

Once to the pump, the fluid is pushed by the upward stroke of the pump's connecting rods and diaphragms to the pressure side of the spray system through hoses, connectors, control valves and spray nozzles. Pressure valves positioned in the pump head prevent fluid from being drawn back into the pump. Maximum pressure in the system is limited by a pressure relief valve located near the pump. A pressure gauge on the dash panel indicates spray system pressure.

Battery current for spray system fuses, switches, valve motors and other electrical components is provided by the main relay when the machine ignition switch is in the RUN position. For spray system electrical component information, see Chapter 5 – Electrical System.

The machine operator controls the spray system on the Multi Pro 5800 with electrical switches located on the dash and spray console. Switches include a spray pump on/off switch, an application rate (increase/decrease) switch, an agitation control switch, three (3) boom control switches and two (2) boom lift switches. These switches control the agitation control valve, three (3) boom control valves, the hydraulic manifold pressure compensator valve solenoid coil and the hydraulic boom lift solenoid coils. Additionally, a master (foot) boom valve switch allows the operator to turn off/on all three (3) boom sections.

The spray pump is directly coupled to and driven by a hydraulic motor. Flow from the hydraulic gear pump to the motor is controlled by the hydraulic pump control manifold. Based on available current (mA) from the application rate (increase/decrease) switch, the manifold pressure compensator valve controls gear pump flow to the spray pump hydraulic motor. This hydraulic flow causes the motor to rotate the spray system pump for spray system operation.

When the spray pump is ON, the switch light is illuminated and the application rate (increase/decrease) switch allows the operator to adjust electrical current to the manifold pressure compensator valve solenoid coil. Higher current (rate increase) to the solenoid coil increases hydraulic flow to the spray pump motor and results in a higher spray pump speed with more output/pressure. Lower current (rate decrease) to the solenoid coil decreases hydraulic flow to the spray pump motor and results in a lower spray pump speed with less output/pressure. Desired spray pump pressure should be based on boom nozzle selection and ground speed. See the Nozzle Selection Guide (Toro Form No. 3351−389) for information regarding boom nozzle selection.

When the agitation switch is ON, the switch light is illuminated and the agitation control valve is opened. This open valve directs system flow to four (4) agitation nozzles in the spray tank. When the agitation switch is OFF, the agitation control valve is closed so no flow is directed to the tank agitation nozzles.

When a boom control switch (left, center or right) is ON, the switch light is illuminated and the boom control valve for that boom is opened. This open valve directs system flow to the spray nozzles located on the boom section. When a boom control switch is OFF, the boom control valve is closed so no flow is available to that spray boom.

If the Multi Pro is equipped with the manual interface control, a manually adjustable boom bypass valve is incorporated in each of the boom control valves. Proper adjustment of the boom bypass valves prevents system pressure changes when a boom section is shut off. Flow from the boom bypass valves is directed back to the spray tank (boom bypass).

An optional Pro Control XP Spray System is available for the Multi Pro 5800. This system includes a dash mounted computer and an inline flowmeter to control the spray system. The flowmeter is positioned in the pressure side of the spray system directly before the boom control valves. The flowmeter measures spray boom flow. The Pro Control computer determines system application rate based on operator programming and inputs from the flowmeter and the ground speed sensor located in the right rear wheel motor. Additional Pro Control information can be found in the Pro Control XP Spray System Operator's Manual.

Troubleshooting

Problem	Possible Cause
Spray system leaks fluid.	Fitting(s), hose(s) or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged. Spray tank drain valve not seating.
Fluid leaking from bottom of spray pump.	Faulty diaphragm(s) exist in spray pump. Pump casting is cracked.
Fluid leaking from spray pump valve cover.	Valve cover bolts are loose. O–ring at inlet or outlet valve is faulty. Diaphragm is not seating against pump casting and valve cover. Valve cover is damaged.
Excessive suction hose vibration.	Suction screen in tank is plugged. Spray pump suction line has an air leak. Suction tube in spray tank has an air leak. Suction line is restricted.
Spray pressure decreases while operating sprayer.	Suction line is restricted. Low fluid level exists in spray tank. Suction screen in tank is plugged. Spray pump suction line has an air leak. Agitation nozzle(s) in tank are loose or damaged (only occurs if agitation switch is on). Spray nozzles are worn or damaged. Pressure line or component is restricted or damaged. Engine speed is low. Pressure relief valve is stuck. Spray pump is damaged.
Nozzles on spray boom section leak when boom is switched off.	Diaphragm in turret body is leaking or damaged. Boom valve motor for affected boom is not seating.

Spray pump does not rotate.	Spray pump switch is off or damaged. Pressure increase/decrease switch is not adjusted properly. Key on spray pump or hydraulic motor shaft is sheared or missing. Spray pump coupler assembly is loose or damaged. Pump drive hydraulic motor is not engaged or is damaged (see Chapter 4 – Hydraulic System). Pro Control XP Spray System (if equipped) is not set up correctly.
Spray operation from booms is erratic.	Suction screen in tank is plugged. Spray nozzle(s) are clogged or damaged. Spray nozzles are different sizes. Console boom switch(es) are dirty, corroded or damaged. Boom valve motor is worn or damaged. Boom bypass is not adjusted correctly (sprayer equipped with manual interface module).
No spray output from one spray boom.	Hoses on boom are pinched or kinked. Boom valve motor for affected boom is not opening. Fuse for affected boom valve motor is faulty. Console boom switch for affected boom valve is dirty, corroded or damaged. NOTE: Check for 12 volts at affected boom valve motor in both directions (on and off).
Low spray rate from one boom nozzle.	Nozzle is clogged or damaged. Spray nozzles are different sizes on boom. Boom valve motor for affected boom is not seating.

Spray Pump

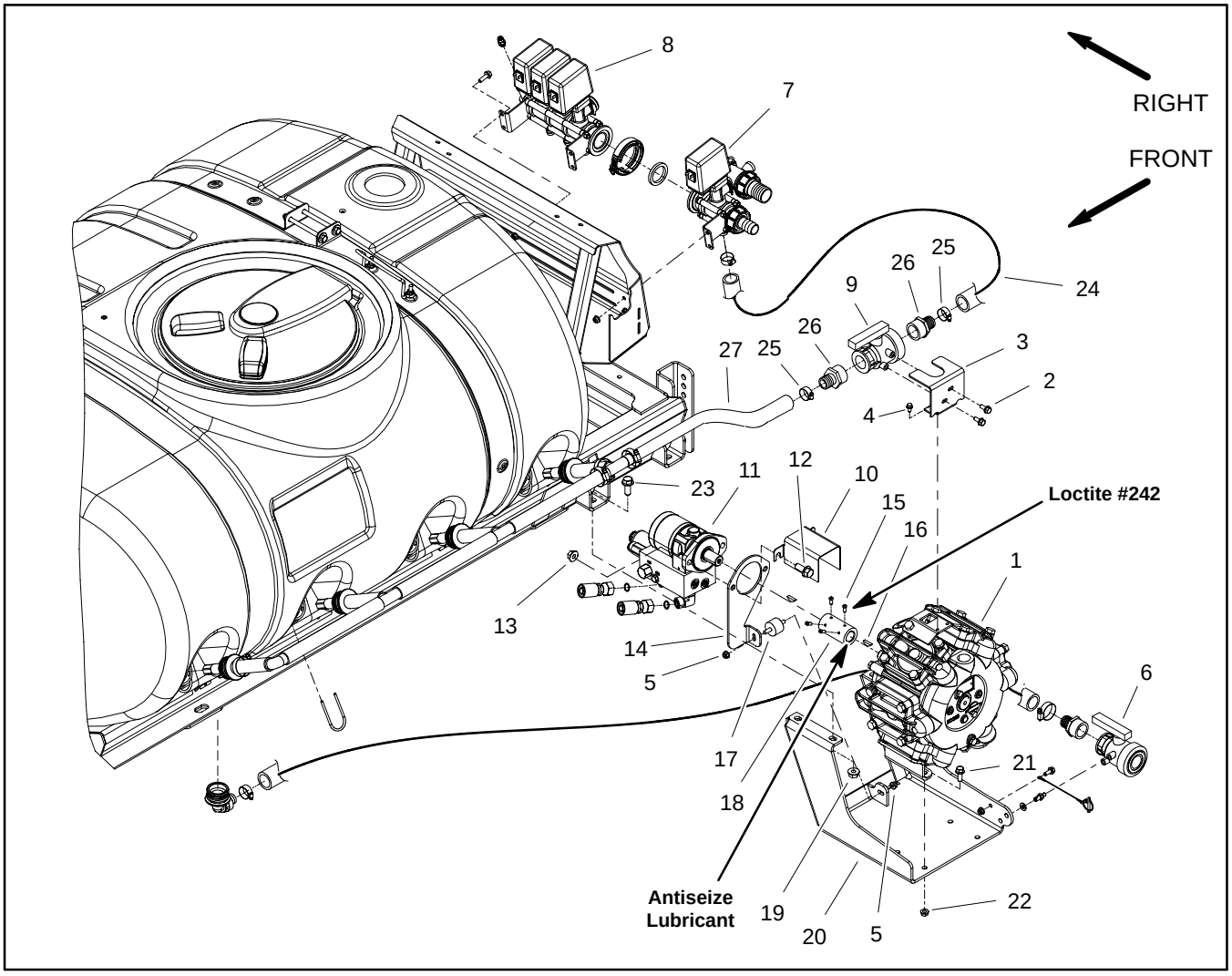


Figure 1

1. Spray pump assembly
2. Flange head screw (2 used)
3. Valve bracket
4. Flange head screw (2 used)
5. Flange nut (2 used)
6. Ball valve (drain)
7. Agitation valve assembly
8. Boom manifold valve assembly
9. Ball valve (agitation)
10. Pump shaft guard
11. Control manifold/motor assembly
12. Flange head screw (2 used)
13. Flange nut (2 used)
14. Motor mount plate
15. Set screw (4 used)
16. Woodruff key
17. Vibration mount
18. Coupler
19. Flange nut (4 used)
20. Pump bracket
21. Flange head screw (4 used)
22. Flange nut (4 used)
23. Flange head screw (4 used)
24. Hose (agitation supply)
25. Hose clamp
26. Barbed fitting
27. Hose (agitation supply)

Removal (Fig. 1)

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

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

2. Loosen hose clamps that secure hoses to fittings in agitation ball valve (item 9). Disconnect hoses from ball valve and position hoses away from pump.

3. To allow removal of the pump shaft guard (item 10), loosen, but do not remove, two (2) flange head screws (item 12) and flange nuts (item 13) that secure control manifold/motor assembly to motor mount plate. Remove guard from machine.

4. Disconnect hoses as follows (Fig. 2):

   A. Remove fork (item 3 in Fig. 2) from supply pump fitting (item 7 in Fig. 2). Lift connector (item 5 in Fig. 2) from supply pump fitting.

   B. Remove fork (item 2 in Fig. 2) that secures upper end of suction hose (item 9 in Fig. 2) to tee fitting (item 13 in Fig. 2). Carefully pull upper end of suction hose from tee fitting.

5. Remove two (2) set screws (item 15) that secure coupler to pump shaft.

6. Remove four (4) flange head screws (item 21) and flange nuts (item 22) that secure spray pump to pump bracket.

7. Slide pump until shaft is removed from coupler. Locate and retrieve woodruff key (item 16) from pump shaft.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is removed from the machine. Pump assembly weighs approximately 121 pounds (55 kg).

8. Remove pump assembly (Fig. 3) from machine.

9. If needed, remove pump fitting (supply) from pump outlet (Fig. 2).

10. If needed, remove suction hose and pump fitting (suction) from pump inlet (Fig. 2).

11. If needed, remove ball valve (agitation) from pump bracket.

12. Remove and discard O−rings at all disconnected fittings.

13. Clean threads of set screws (item 15) and coupler that is still attached to pump motor shaft.

Installation (Fig. 1)

NOTE: Coat all spray system O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. If pump fitting (supply) and/or pump fitting (suction) were removed from pump, apply thread sealant to fitting threads and install fitting(s) into correct pump port (Fig. 4).

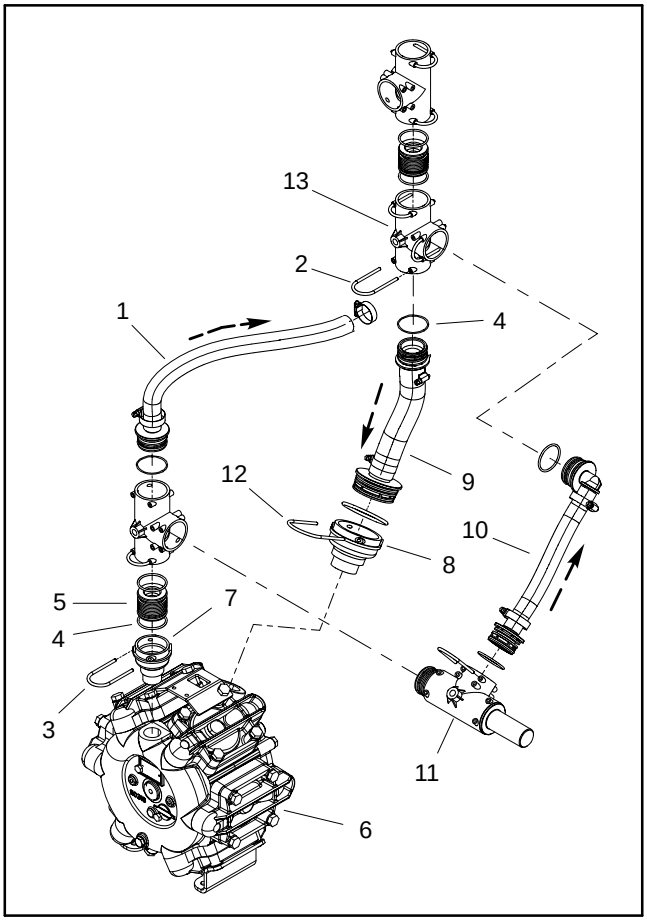


Figure 2

1. **Hose (supply)**
2. **Fork**
3. **Fork**
4. **O−ring**
5. **Connector**
6. **Spray pump**
7. **Pump fitting (supply)**
8. **Pump fitting (suction)**
9. **Hose (suction)**
10. **Hose (pressure relief)**
11. **Pressure relief valve**
12. **Fork**
13. **Tee fitting**

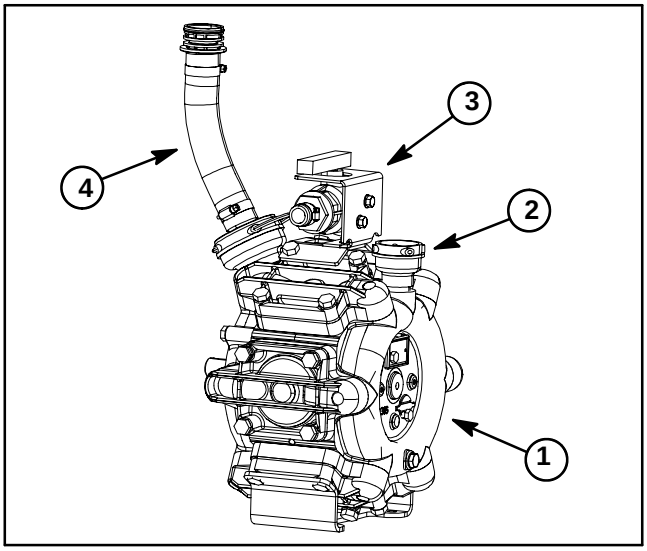


Figure 3

1. **Spray pump**
2. **Pump fitting (supply)**
3. **Ball valve (agitation)**
4. **Hose (suction)**

NOTE: To reduce the chance of leakage at suction fittings, secure the suction hose assembly to the pump before the pump is installed to the machine.

2. If suction hose was removed from pump fitting (suction), lubricate and install new O−ring to fitting. Install suction hose assembly and secure assembly to pump fitting with fork (Fig. 2).

3. If ball valve (agitation) was removed from pump bracket, secure ball valve to bracket with removed fasteners.

4. Apply antiseize lubricant to pump shaft. Install woodruff key into shaft.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is installed to the machine. Pump assembly weighs approximately 121 pounds (55 kg).

5. Place pump assembly (Fig. 3) onto pump bracket. Align woodruff key in pump shaft with slot in coupler and slide pump shaft into coupler.

6. Install and finger tighten four (4) flange head screws (item 21) and flange nuts (item 22) to attach motor assembly to mount bracket. Do not fully tighten fasteners at this time.

7. Turn spray pump shaft by hand and position pump on pump bracket to best align the pump shaft and the hydraulic motor shaft.

8. Secure pump to pump bracket by tightening flange head screws and flange nuts.

9. Apply Loctite #242 (or equivalent) to threads of coupler set screws (item 15). Install and tighten set screws into coupler to secure coupler to pump shaft.

10. Position pump shaft guard to motor mount plate. Make sure that flange head screws are in the slots of the guard. Tighten flange head screws and flange nuts to secure control manifold/motor assembly to motor mount plate.

11. Connect hoses as follows (Fig. 2):

    A. Lubricate and install new O−ring onto connector (item 5 in Fig. 2). Carefully insert connector into supply pump fitting (item 7 in Fig. 2) taking care to not damage O−ring. Install fork (item 3 in Fig. 2) to retain connection.

    B. Lubricate and install new O−ring onto upper fitting of suction hose (item 9 in Fig. 2). Carefully insert suction hose fitting into tee fitting (item 13 in Fig. 2) taking care to not damage O−ring. Install fork (item 2 in Fig. 2) to retain connection.

12. Connect agitation hoses to ball valve (item 9) and secure hoses with hose clamps.

13. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

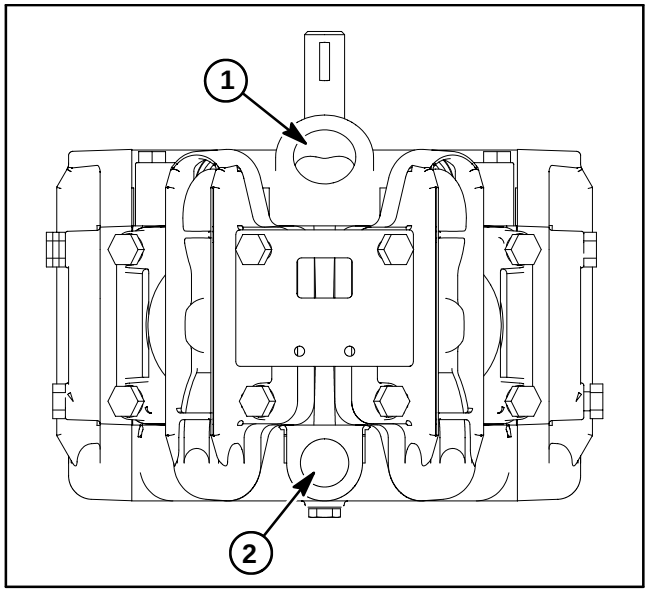


Figure 4

1. **Suction port**
2. **Supply port**

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Spray Pump Service

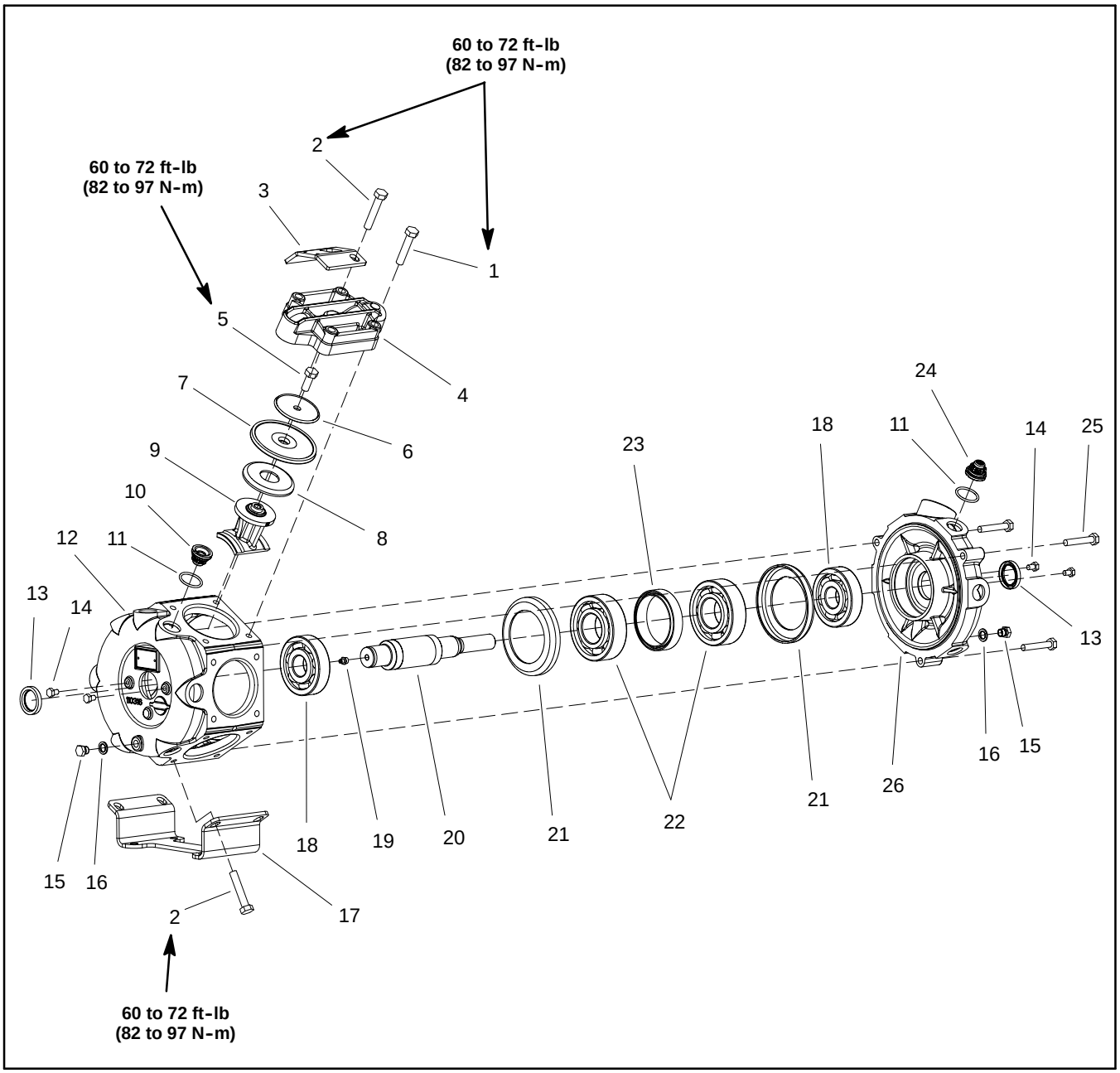

Figure 5

1. **Hex bolt (60 mm long) (18 used)**
2. **Hex bolt (65 mm long) (6 used)**
3. **Pump bracket**
4. **Valve cover (6 used)**
5. **Hex bolt (6 used)**
6. **Diaphragm disc (6 used)**
7. **Diaphragm (6 used)**
8. **Diaphragm backing disc (6 used)**
9. **Connecting rod (6 used)**
10. **Pump valve (10 used)**
11. **O-ring (12 used)**
12. **Pump casting**
13. **Oil seal (2 used)**
14. **Hex bolt (4 used)**
15. **Plug (2 used)**
16. **Seal (2 used)**
17. **Pump foot**
18. **Ball bearing (2 used)**
19. **Grease fitting**
20. **Crankshaft**
21. **Connecting rod spacer (2 used)**
22. **Ball bearing (2 used)**
23. **Bearing spacer**
24. **Pump valve (2 used)**
25. **Hex bolt (3 used)**
26. **Pump casting (suction)**

NOTE: Many pump components can be easily reversed. During disassembly, make note of component position (e.g. valve cover, pump valve, diaphragm) to assure correct assembly.

Disassembly (Fig. 5)

IMPORTANT: Make sure to remove and neutralize chemicals from pump before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during pump repair.

1. Remove plugs (item 15) and seals (item 16) from pump to allow all fluid to be drained from pump. Install seals and plugs after draining is complete.

2. Thoroughly clean exterior of pump.

3. For assembly purposes, use marker to identify location of all valve covers on pump housing.

NOTE: Pump bracket (item 3) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot (item 17) is secured to pump with four (4) longer bolts on lower valve covers.

4. Remove hex bolts that retain valve covers (item 4) to pump. Separate and remove valve covers from pump.

NOTE: The two (2) pump inlet valves in the upper pump positions (either side of pump suction port) are different than the rest of the valves used in the pump (Fig. 6). These two (2) valves are white.

5. Remove and discard all valves (inlet and outlet) and valve O−rings from pump. During valve removal, note location and orientation of valves.

6. Remove hex bolt, diaphragm disc, diaphragm and diaphragm backing disc from each connecting rod. Discard all diaphragms.

IMPORTANT: If pump sealing surfaces are not thoroughly cleaned, leakage can occur that will adversely affect pump operation.

7. Thoroughly clean valve, diaphragm and O−ring seats in the valve covers and pump valve chambers.

8. Check the crankshaft for sufficient grease. Also, visually inspect crankshaft assembly for any signs of excessive wear or damage. Check that crankshaft turns freely. If crankshaft bearings are loose, rough or worn, crankshaft bearings should be replaced.

Crankshaft Bearing Service (Fig. 5)

1. For assembly purposes, use marker to identify location of all connecting rods.

2. Remove three (3) hex bolts that secure pump casting halves together.

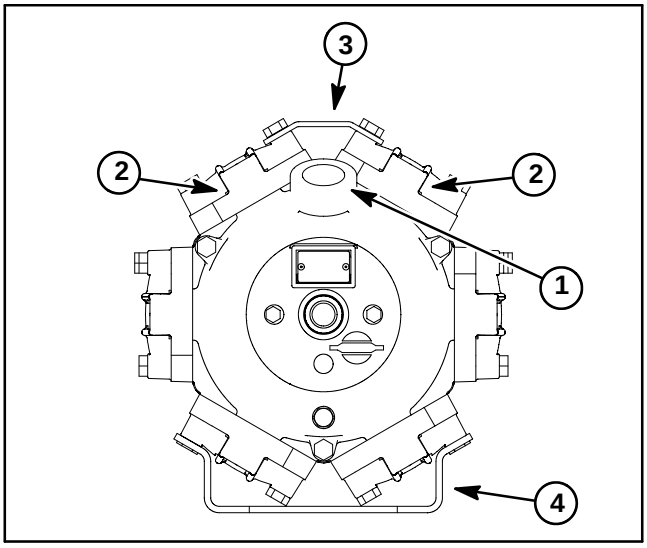

Figure 6

1. Pump suction port
2. White check valve
3. Pump bracket
4. Pump foot

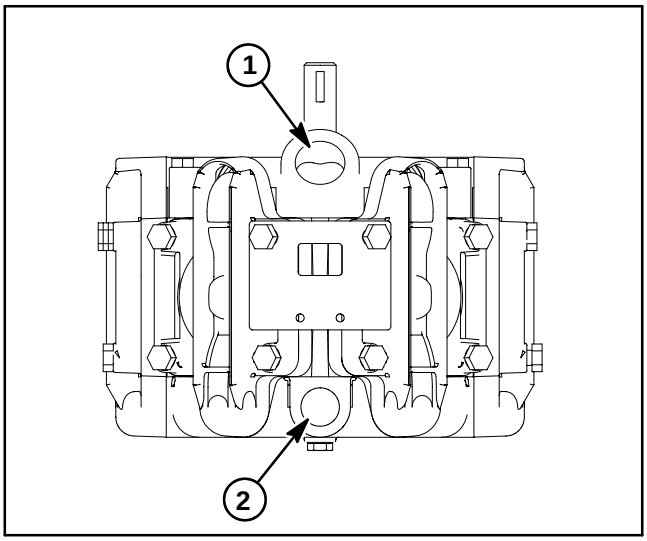

Figure 7

1. Suction port
2. Supply port

3. To separate the pump castings:

   A. On crankshaft end with grease fitting, place spacer or socket on crankshaft.

   B. Using deadblow hammer, tap the spacer to separate the pump castings.

   C. Once a gap is created between the castings, carefully pry pump castings apart.

4. Remove connecting rods and inspect the rod bearing surfaces which should be clean and smooth. Replace any of the connecting rods that have evidence of scoring, wear or damage.

5. Remove crankshaft with bearings and spacers (items 21 and 23) from pump casting.

6. Press ball bearings from crankshaft and pump castings.

7. Remove seals from pump castings.

8. Clean crankshaft and internal surfaces of pump castings.

9. Pack new bearings with #2 general purpose lithium base grease.

10. Press new bearings into pump castings.

11. Install connecting rod bearings on crankshaft:

    A. Pressing on bearing inner race, install first connecting rod bearing onto crankshaft.

    B. Place bearing spacer (item 23) onto crankshaft and then press second bearing onto crankshaft.

12. Install seals into pump castings. Seal face should be flush with casting.

13. Position the pump casting with the seal end down.

14. Place connecting rod spacer (item 21) and then crankshaft assembly into pump casting. Make sure that grease fitting end of crankshaft is inserted into the casting.

15. Using marks made during disassembly to identify connecting rod locations, install connecting rods to crankshaft. Makes sure that rod flange fits under connecting rod spacer.

16. Place second connecting rod spacer onto crankshaft and connecting rods and then install pump casting. Make sure that pump suction and supply ports are aligned during assembly of the pump castings (Fig. 7).

17. Secure pump castings with three (3) hex bolts. Torque bolts from **60 to 72 ft-lb (82 to 97 N-m)**. After assembly, check that crankshaft turns freely.

Assembly (Fig. 5)

1. Install diaphragms to connecting rods:

    A. Place diaphragm back disc (item 8), new diaphragm (item 7) and diaphragm disc (item 6) on connecting rod. Make sure that the diaphragm disc lip faces away from the diaphragm.

    B. Thread hex bolt (item 5) into connecting rod.

    C. Rotate crankshaft so the diaphragm is in the up position and then torque the hex bolt from **60 to 72 ft-lb (82 to 97 N-m)**.

    D. Repeat for remaining diaphragms.

IMPORTANT: The two (2) pump inlet valves in the upper pump positions (either side of pump suction port) are different than the rest of the valves used in the pump (Fig. 6). These two (2) valves are white.

NOTE: Pump bracket (item 3) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot (item 17) is secured to pump with four (4) longer bolts on lower valve covers.

2. Install valves and valve covers:

    A. Position new valves (inlet and outlet) and O-rings to pump castings. Inlet valves should be installed with the spring up. Outlet valves should be installed with the spring down into the pump casting.

    B. Place valve cover over valves noting orientation of cover inlet and outlet. Make sure that diaphragm lip, valves and O-rings fit into recesses in cover.

    C. Secure valve cover to pump using hex bolts (4 per cover). Torque bolts from **60 to 72 ft-lb (82 to 97 N-m)**.

    D. Repeat for remaining valve covers.

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Agitation Supply

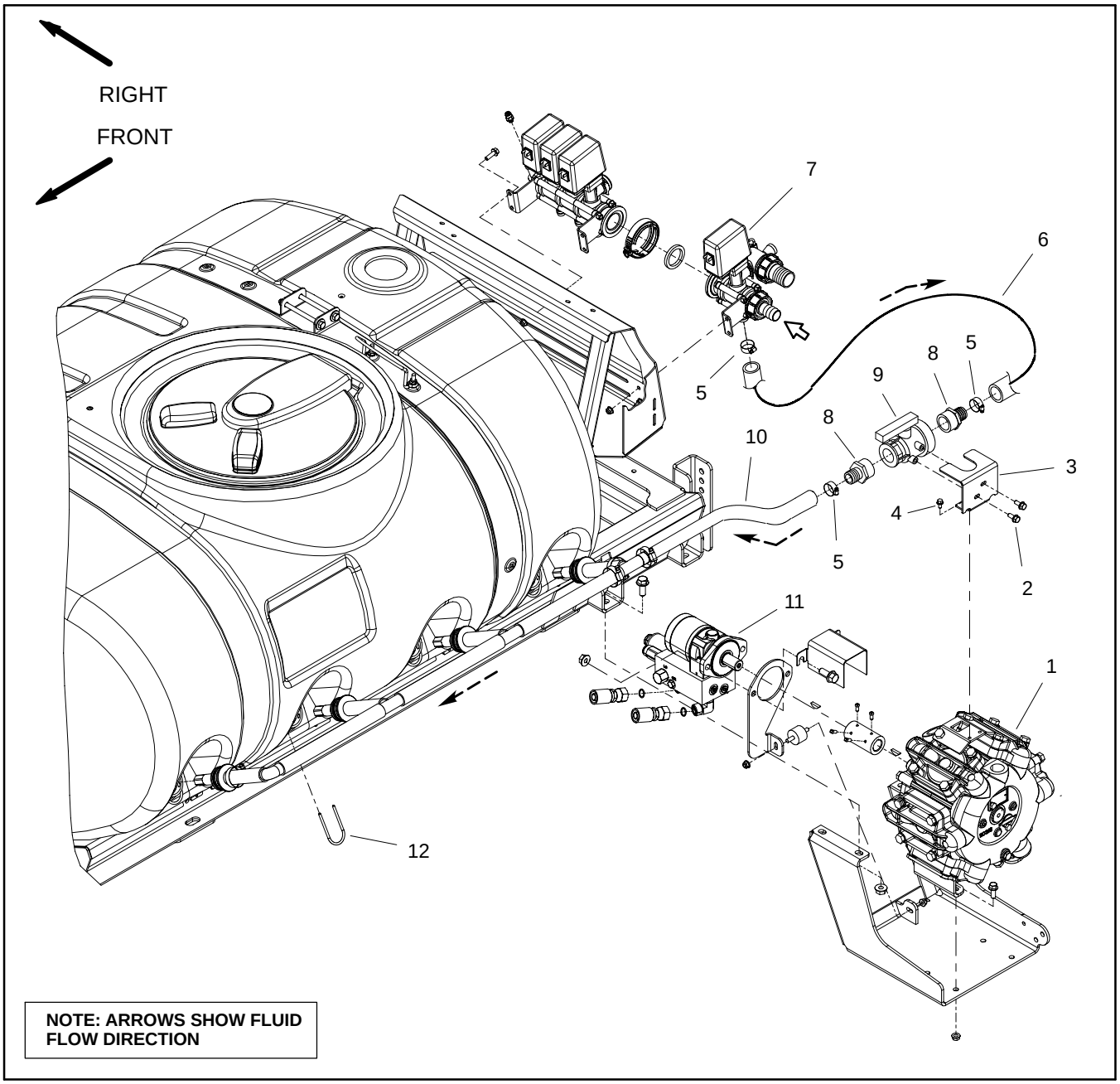

Figure 8

1. **Spray pump**
2. **Flange head screw (2 used)**
3. **Valve bracket**
4. **Flange head screw (2 used)**
5. **Hose clamp (3 used)**
6. **Agitation supply hose**
7. **Agitation valve assembly**
8. **Barbed fitting (2 used)**
9. **Ball valve**
10. **Agitation supply assembly**
11. **Control manifold/motor assembly**
12. **Fork**

Disassembly (Fig. 8)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Drain spray tank so that spray tank fluid level is below agitation nozzle location.

3. Label hoses that are to be disconnected for assembly purposes.

4. Remove agitation supply components as required using Figures 8, 9 and 10 as guides. Discard all removed O−rings and gaskets.

Assembly (Fig. 8)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install all removed agitation supply components using Figures 8, 9 and 10 as guides. Replace all removed O−rings and gaskets.

2. Using labels placed during disassembly, install disconnected hoses and secure with hose clamps.

3. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

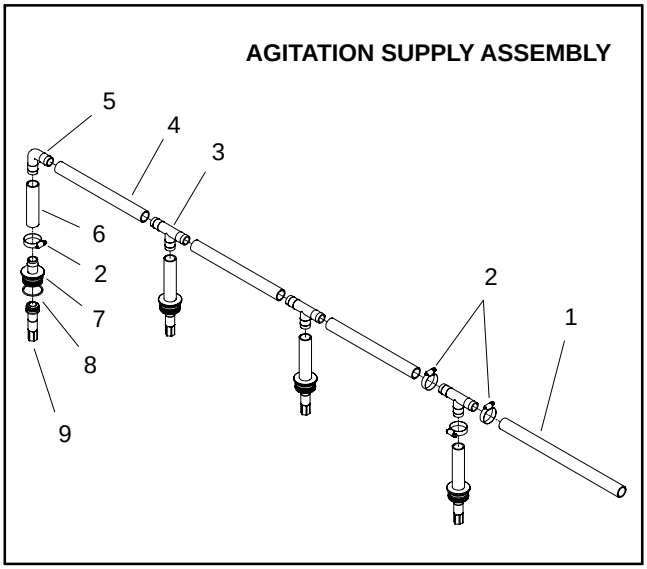

Figure 9

1. **Hose**
2. **Hose clamp (15 used)**
3. **Tee hosebarb (3 used)**
4. **Hose (3 used)**
5. **Elbow hosebarb**
6. **Hose (4 used)**
7. **Hosebarb (4 used)**
8. **O−ring (4 used)**
9. **Nozzle (4 used)**

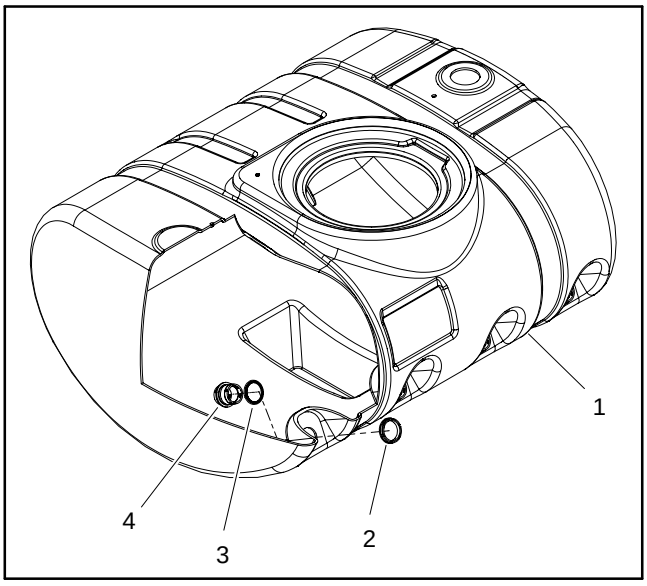

Figure 10

1. **Spray tank**
2. **Bulkhead nut (4 used)**
3. **Gasket (4 used)**
4. **Bulkhead fitting (4 used)**

Pressure Relief Valve

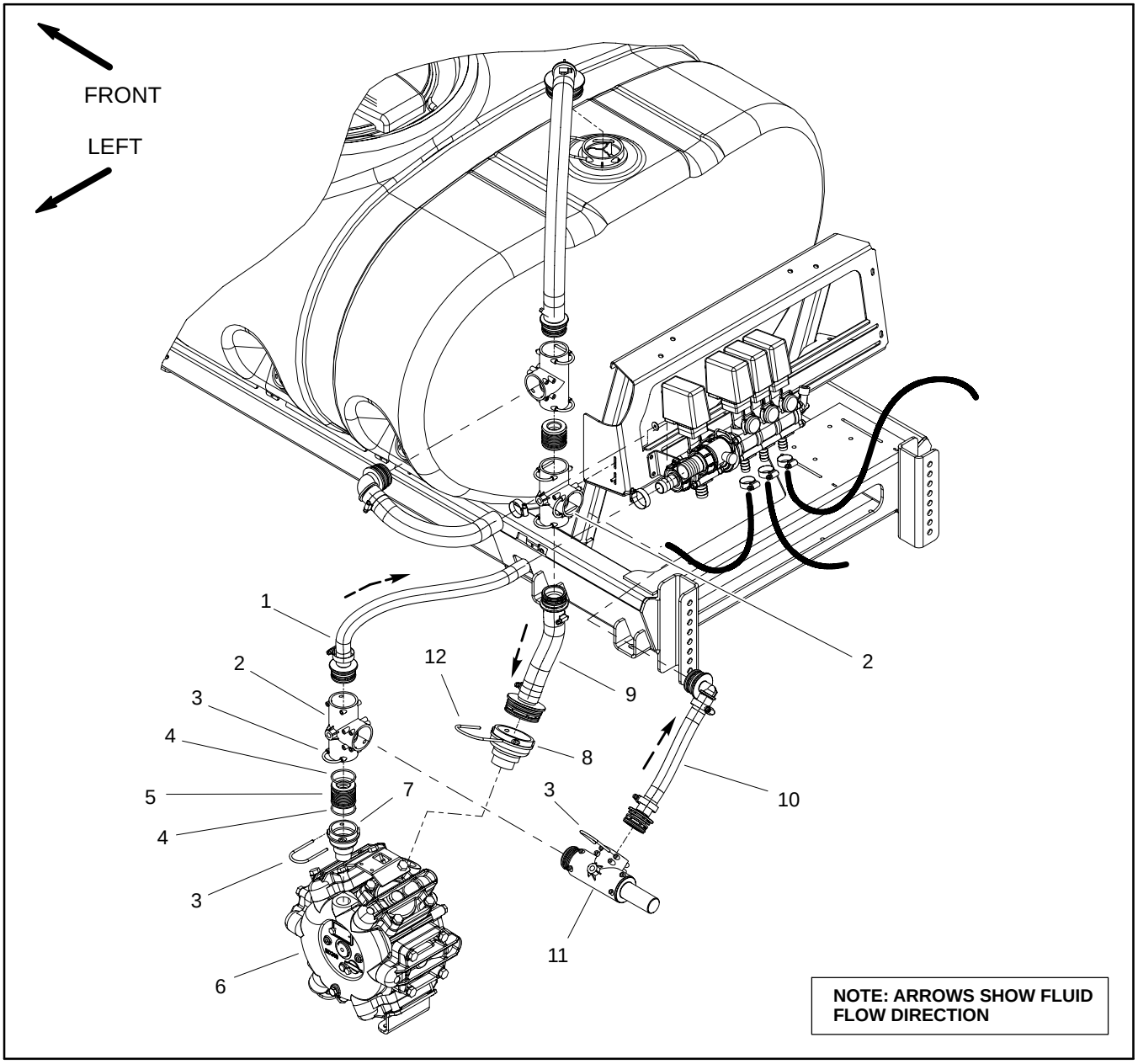

Figure 11

1. **Supply hose assembly**
2. **Tee fitting**
3. **Fork**
4. **O-ring**
5. **Connector**
6. **Spray pump**
7. **Pump fitting (pressure)**
8. **Pump fitting (suction)**
9. **Lower suction hose assembly**
10. **Pressure relief hose assembly**
11. **Relief valve assembly**
12. **Fork**

Removal (Fig. 11)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Drain spray tank.

3. Label disconnected hoses for proper installation after repairs are completed.

4. Remove pressure relief valve from spray tank using Figures 11, 12 and 13 as guides. Discard all removed O−rings and gaskets.

Installation (Fig. 11)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install pressure relief valve using Figures 11, 12 and 13 as guides. Replace all removed O−rings and gaskets.

2. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Pressure Relief Valve Testing

To test the operation of the pressure relief valve, follow the following steps:

A. Have machine on a level surface with engine off and parking brake engaged. Make sure that traction pedal is in the neutral position. Close the agitation supply ball valve.

B. Have a person in the operator seat to control the spray system and a second person near the pressure relief valve.

C. Have operator start the engine, turn spray pump switch ON and turn agitation switch ON.

D. While second person listens for pressure relief valve to open, have the operator slowly increase the application rate while watching the pressure gauge. Pressure gauge should open when system pressure reaches approximately 220 PSI (1500 kPa).

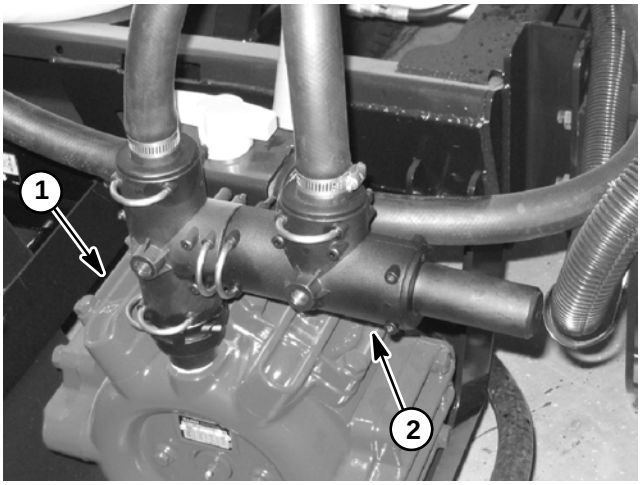

Figure 12

1. **Spray pump**
2. **Pressure relief valve**

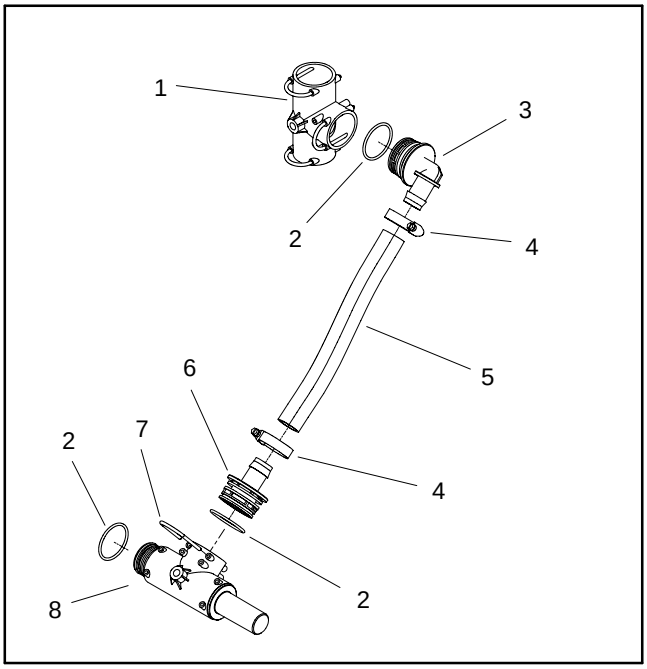

Figure 13

1. **Tee fitting**
2. **O−ring**
3. **Elbow hosebarb**
4. **Hose clamp**
5. **Pressure relief hose**
6. **Straight hosebarb**
7. **Fork**
8. **Pressure relief valve**

Spray Control Assembly

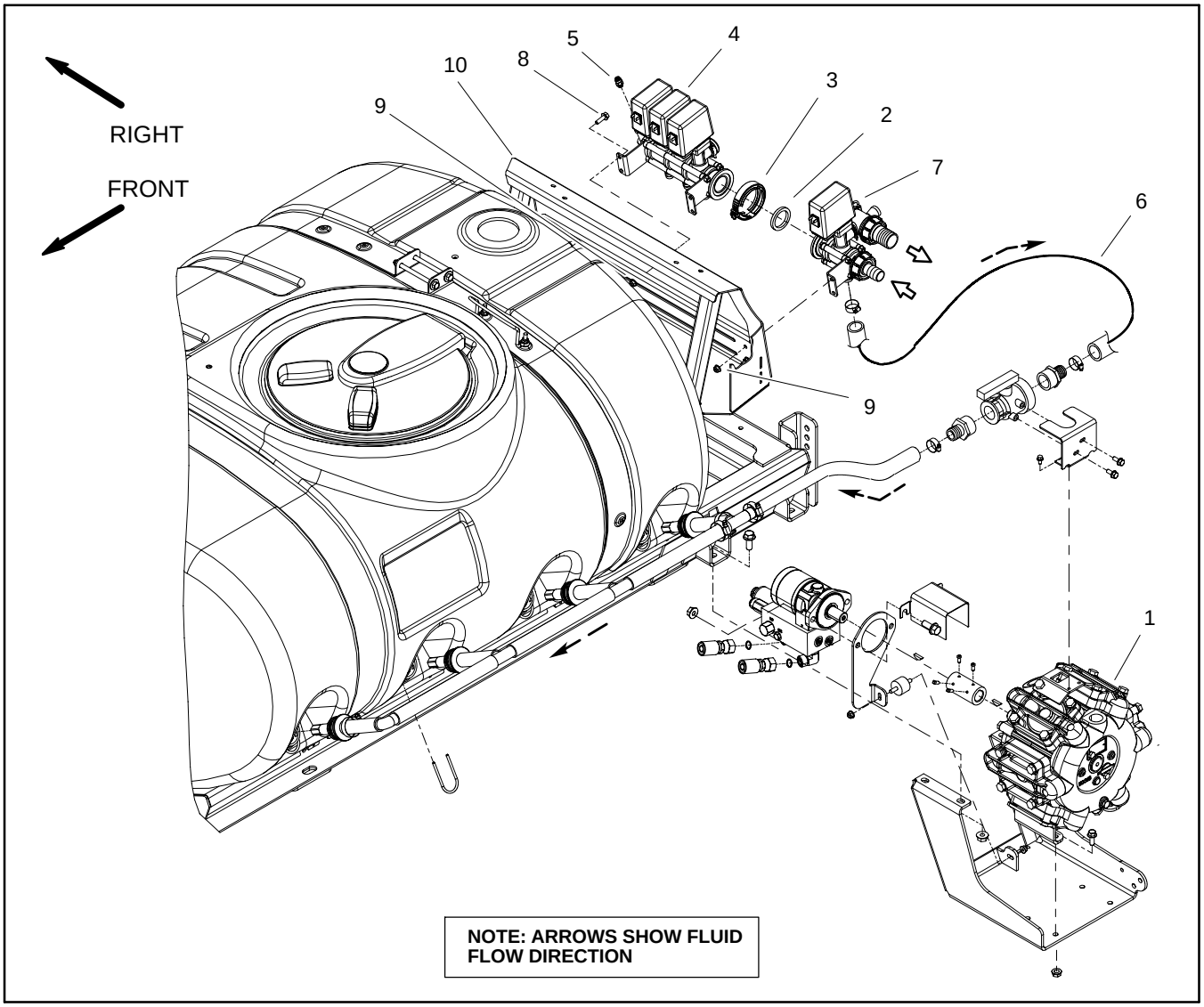

Figure 14

1. **Spray pump**
2. **Gasket**
3. **Screw clamp**
4. **Boom manifold valve assembly**
5. **Tube coupler**
6. **Agitation supply hose**
7. **Agitation valve assembly**
8. **Flange head screw (6 used)**
9. **Flange nut (6 used)**
10. **Mounting bracket**

The spray control assembly includes the agitation valve and boom manifold valves. If the machine is equipped with a Pro Control XP Spray System, the spray control assembly will include a flowmeter between the agitation valve and boom manifold valves (Fig. 15). Additional valves may be attached to the spray control if the machine has any optional kits installed (e.g. foam marker, eductor).

Removal (Fig. 14)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Label hoses for proper installation after repairs are completed (Fig. 16). Loosen hose clamps and disconnect hoses from spray control assembly as needed.

3. Loosen screw clamp (item 3) that secures components of spray control assembly.

4. If boom manifold valve assembly is to be removed:

   A. Label wire harness connectors at boom manifold valve assembly for proper installation after repairs are completed. Unplug harness connectors from boom valve motors.

   B. Remove pressure gauge tube from boom manifold assembly.

   C. Support boom manifold valve assembly to prevent it from falling. Remove fasteners that secure boom manifold valve assembly to mount bracket.

   D. Remove boom manifold valve assembly from machine. Locate and retrieve gasket (item 2).

5. If agitation valve assembly is to be removed:

   A. Unplug machine wire harness connector from agitation valve motor.

   B. Support agitation valve assembly to prevent it from falling. Remove fasteners that secure agitation valve assembly to mount bracket.

   C. Remove agitation valve assembly from machine. Locate and discard gasket (item 2).

6. Remove additional spray control components as required using Figure 14 as a guide. Discard all removed O−rings and gaskets.

Assembly (Fig. 14)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Install spray control components using Figure 14 as a guide. Replace all removed O−rings and gaskets.

2. Position removed motor assembly to mount bracket. Install and finger tighten fasteners to attach motor assembly to mount bracket.

3. Make sure that screw clamp (item 3) is positioned on spray control assembly.

4. Position new gasket (item 2) between removed components.

5. Fit screw clamp to flanges of manifolds. Tighten screw clamp to secure assembly.

6. Tighten fasteners to secure spray control to mount bracket.

7. Using labels placed during disassembly, install hoses to correct locations on spray control assembly (Fig. 16). Secure hoses with hose clamps.

8. If removed, install pressure gauge tube to boom valve motor assembly.

9. Plug machine wire harness connectors to valve motor(s).

10. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

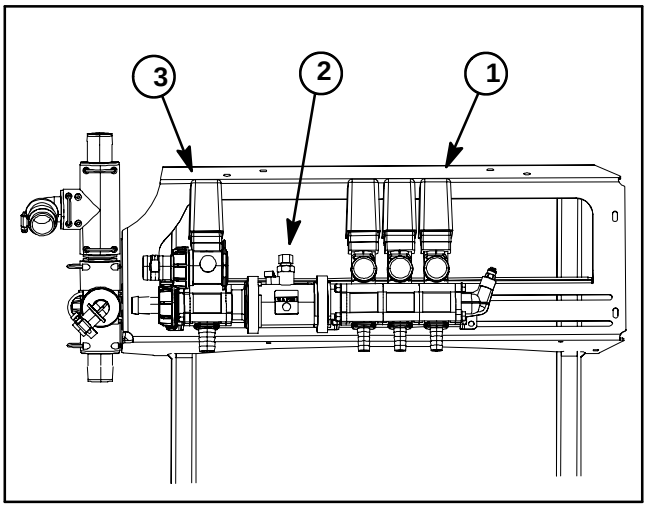

Figure 15

1. **Boom manifold valves**
2. **Flowmeter**
3. **Agitation valve**

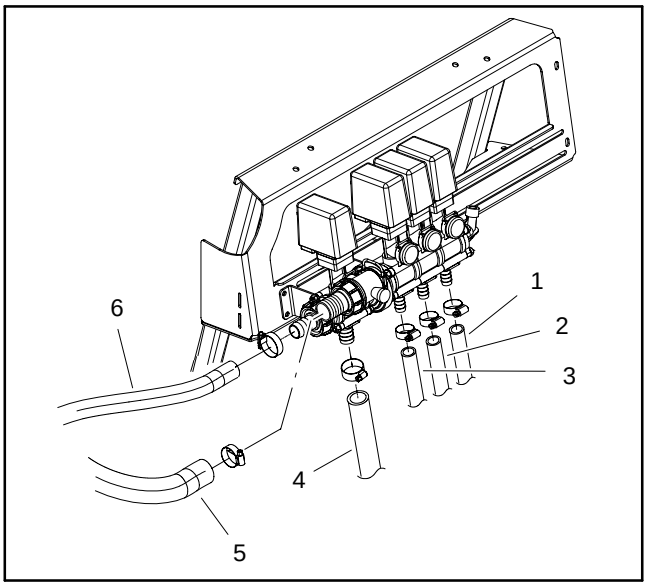

Figure 16

1. **RH boom hose**
2. **Center boom hose**
3. **LH boom hose**
4. **Agitation supply hose**
5. **Agitation bypass hose**
6. **Main supply hose**

Boom Manifold Valve Assembly

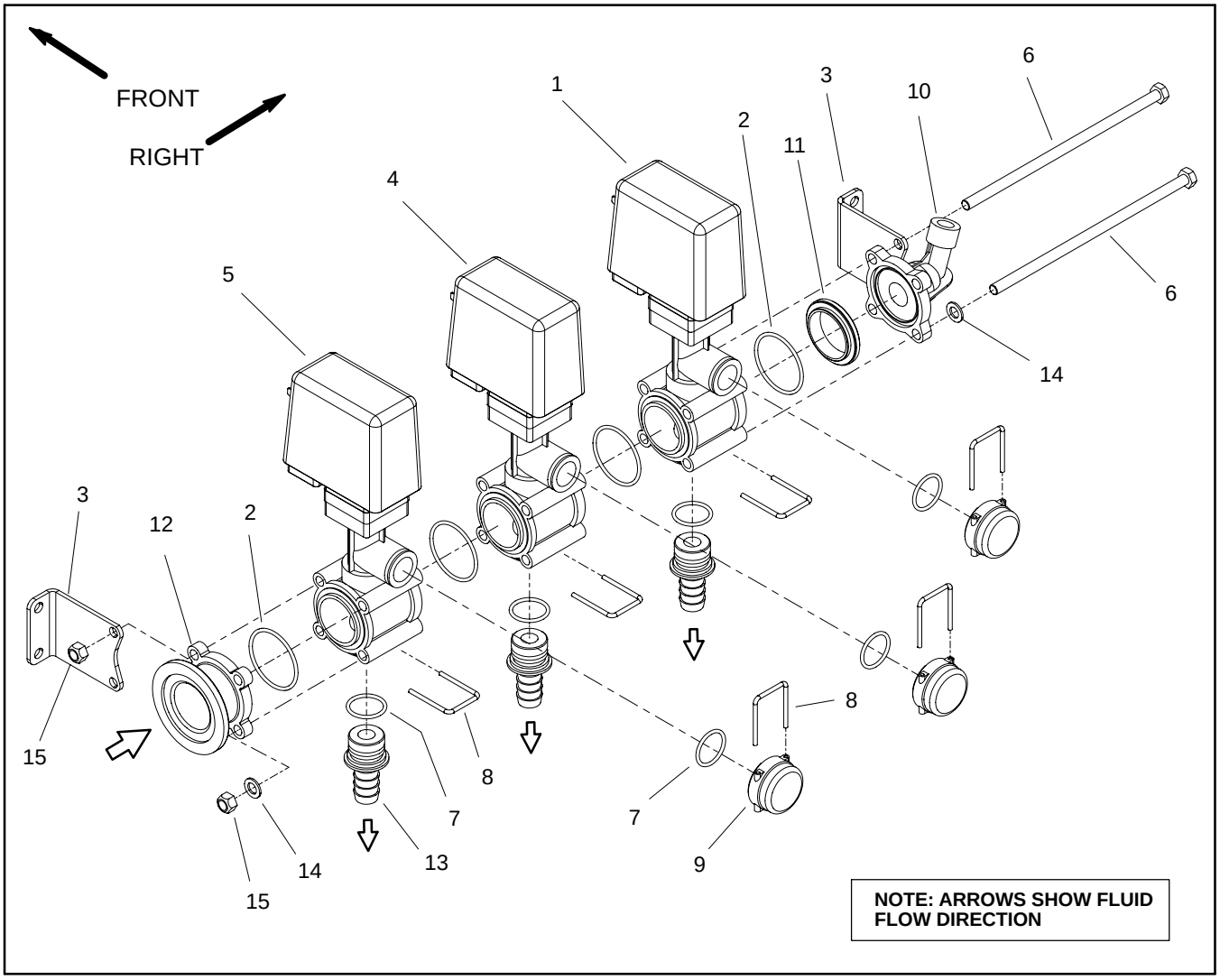

Figure 17

1. **RH boom valve motor**
2. **O-ring**
3. **Mounting bracket (2 used)**
4. **Center boom valve motor**
5. **LH boom valve motor**
6. **Cap screw (4 used)**
7. **O-ring (6 used)**
8. **Fork (6 used)**
9. **Valve cap (3 used)**
10. **Pressure gauge port**
11. **Adapter**
12. **Flange**
13. **Hosebarb (3 used)**
14. **Washer (4 used)**
15. **Lock nut (4 used)**

IMPORTANT: Boom valve motors have a fuse for circuit protection. Make sure that correct fuse is installed in the in-line fuse holder located in the boom valve motor harness.

The boom control switches on the operator spray console are used to energize the boom valve motors and open the boom valves. The open boom valves allow system flow to reach the appropriate boom section (right, center or left).

NOTE: If your Multi Pro is equipped with the manual interface control, a manually adjustable boom bypass valve must be incorporated in each of the boom control valves (Fig. 19). The balancing valve assembly should not be used on vehicles with a Pro Control XP Spray System.

Disassembly (Fig. 17)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Remove boom manifold valve assembly from machine (see Spray Control Assembly in this section).

3. Separate boom valve motors as needed using Figure 17 as a guide. Discard all removed O−rings and gaskets.

4. See Boom and Agitation Valve Motor Service in this section for disassembly and assembly information of boom valve motor.

Assembly (Fig. 17)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble boom manifold valve assembly using Figure 17 as a guide. Replace all removed O−rings.

2. Install boom manifold valve assembly on machine (see Spray Control Assembly in this section).

3. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

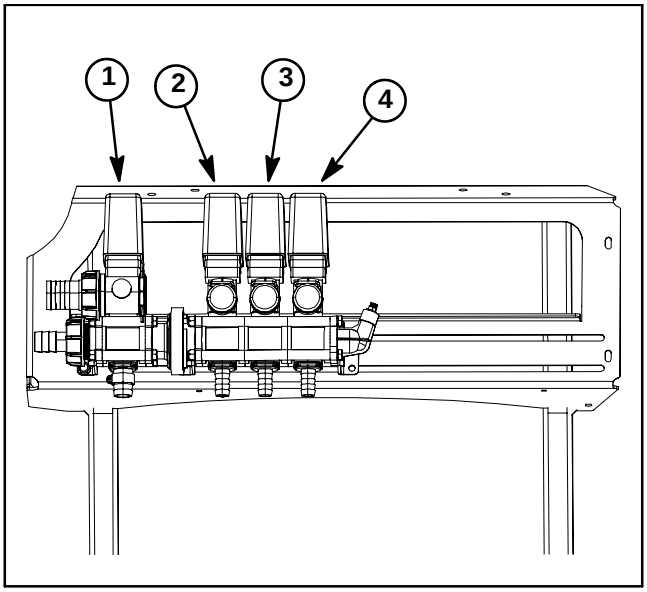

Figure 18

1. **Agitation valve motor**
2. **LH boom motor**
3. **Center boom motor**
4. **RH boom motor**

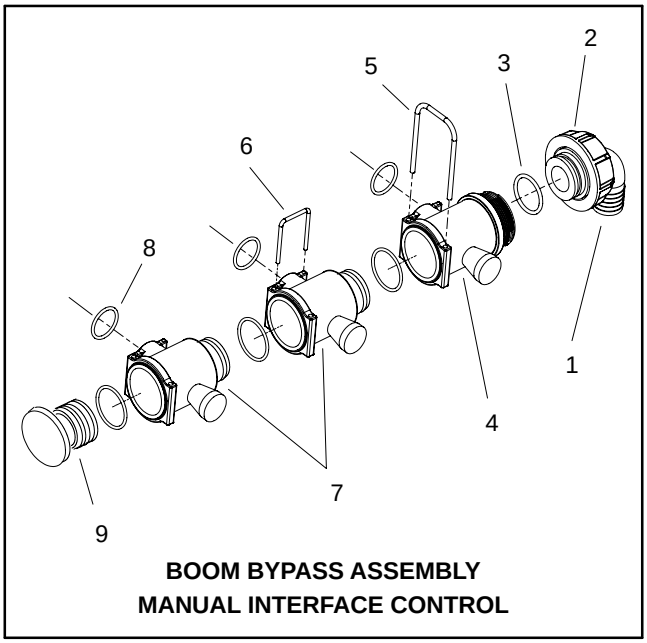

Figure 19

1. **Elbow fitting**
2. **Fly nut**
3. **O−ring (4 used)**
4. **Balancing valve assy**
5. **Fork (3 used)**
6. **Fork (3 used)**
7. **Balancing valve assy**
8. **O−ring (3 used)**
9. **Plug**

Agitation Valve Assembly

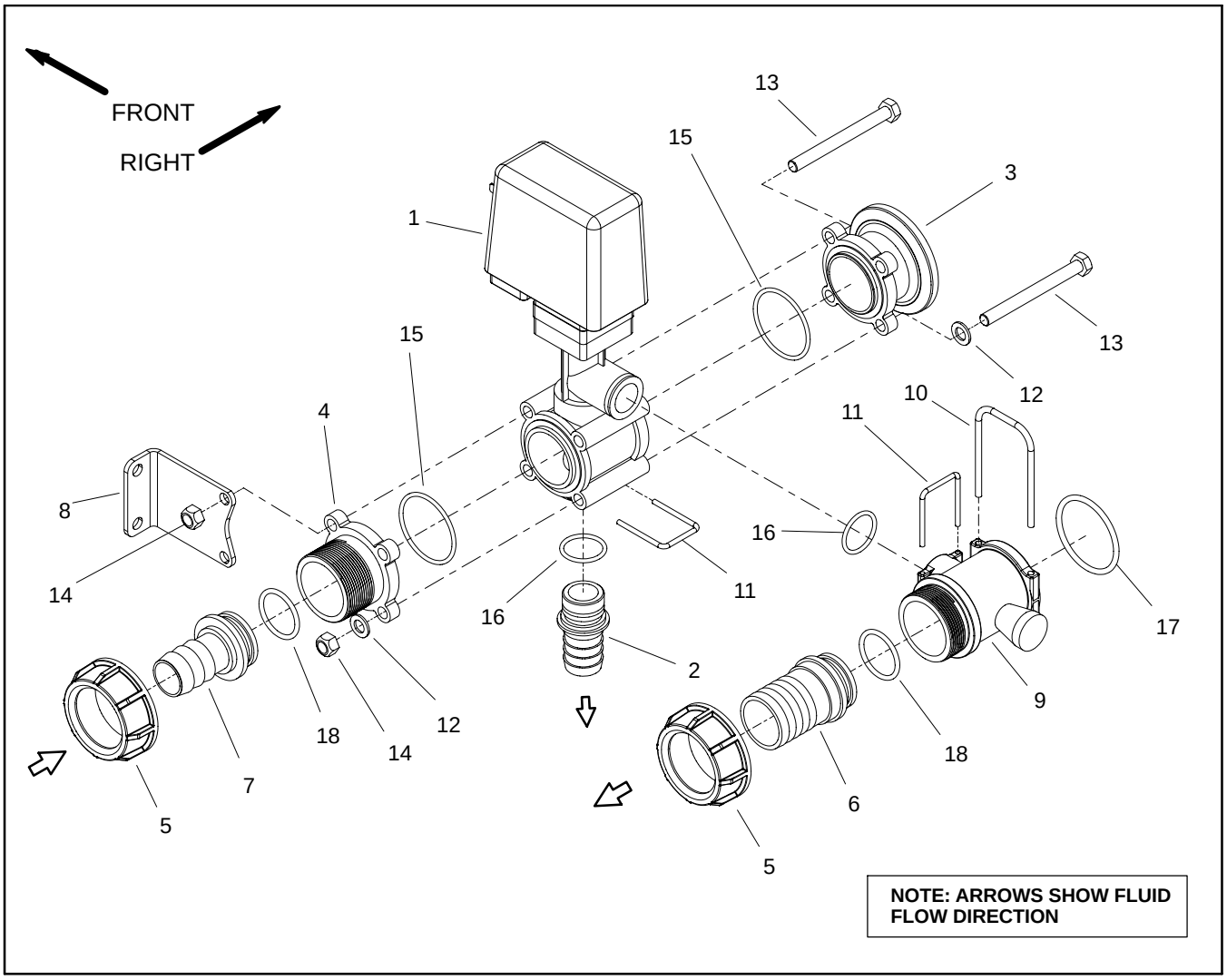

Figure 20

1. **Agitation valve motor**
2. **Hosebarb**
3. **Flange**
4. **Adapter**
5. **Flynut (2 used)**
6. **Hosebarb**
7. **Hosebarb**
8. **Mounting bracket**
9. **Balancing valve assembly**
10. **Fork**
11. **Fork (2 used)**
12. **Washer (4 used)**
13. **Cap screw (4 used)**
14. **Lock nut (4 used)**
15. **O-ring (2 used)**
16. **O-ring (2 used)**
17. **O-ring**
18. **O-ring (2 used)**

IMPORTANT: The agitation valve motor has a fuse for circuit protection. Make sure that correct fuse is installed in the in-line fuse holder located in the boom valve motor harness.

The agitation switch on the operator spray console is used to energize the agitation valve motor and open the valve. The open agitation valve allows system flow to reach the four (4) agitation nozzles located in the spray tank.

Disassembly (Fig. 20)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Remove agitation valve assembly from machine (see Spray Control Assembly in this section).

3. Disassemble agitation valve assembly as needed using Figure 20 as a guide. Discard all removed O−rings and gaskets.

4. See Boom and Agitation Valve Motor Service in this section for disassembly and assembly information of the agitation valve motor.

Assembly (Fig. 20)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble agitation valve assembly using Figure 20 as a guide. Replace all removed O−rings.

2. Install agitation valve assembly on machine (see Spray Control Assembly in this section).

3. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

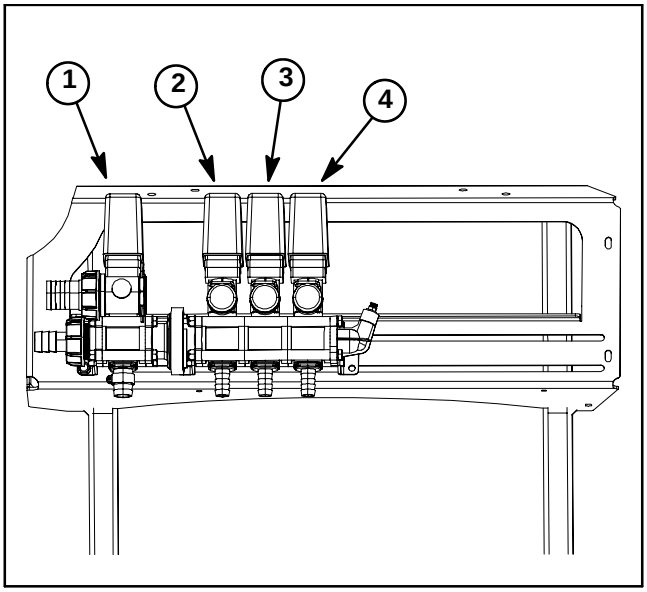

Figure 21

1. **Agitation valve motor**
2. **LH boom motor**
3. **Center boom motor**
4. **RH boom motor**

Boom and Agitation Valve Motor Service

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before valve motor disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

NOTE: There are limited replacement parts available for boom and agitation valve motor assemblies. Check your parts catalog for parts that are available.

Valve Motor Cover Removal (Fig. 22)

1. Loosen three (3) screws that secure valve motor cover to valve motor assembly.

2. Carefully lift and rotate cover from valve motor.

3. Unplug wire connections and remove cover.

4. Make sure that all screws that secure valve motor are tight (Fig. 22).

Valve Motor Cover Installation (Fig. 22)

1. Connect cover wires to motor wires. Make sure that cover wire color is the same as the motor wire color when connecting wires.

2. Carefully rotate cover onto valve motor taking care to not damage wires.

3. Tighten screws to secure cover to valve motor.

Piston Valve Service (Fig. 23)

1. Remove hosebarb from bottom of valve motor to allow access to piston valve.

2. Make sure that valve is closed. If valve is not closed, spring above piston valve will be under compression and may damage valve motor or piston valve during disassembly. End of piston valve will extend into bottom of valve motor housing when valve is closed. If necessary, reconnect motor to machine wire harness and close valve before removing piston valve.

3. Use 3mm allen wrench to loosen and remove piston valve assembly from valve motor. Locate and retrieve spring from above piston valve.

4. Inspect seals on piston valve assembly. O−ring in top groove of piston valve assembly is available separately. If lower two (2) seals in piston valve are worn or damaged, replace piston valve assembly. The piston valve is not designed to be disassembled.

5. Apply silicone grease to seals on piston valve assembly.

6. Position spring into valve motor housing. Use 3mm allen wrench to secure piston valve assembly to valve motor.

7. Secure hosebarb to bottom of valve motor.

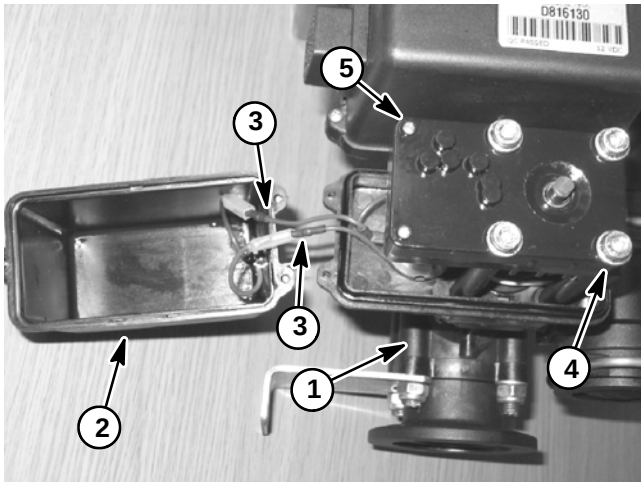

Figure 22

1. **Valve motor assembly**
2. **Valve motor cover**
3. **Wire connector**
4. **Socket screw (4 used)**
5. **Phillips screw (2 used)**

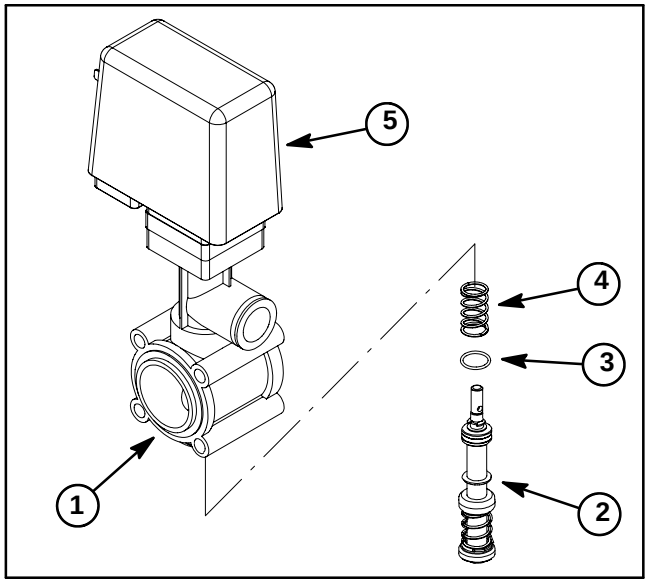

Figure 23

1. **Valve motor assembly**
2. **Piston valve assembly**
3. **Valve seal**
4. **Spring**
5. **Valve motor cover**

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Tank Suction

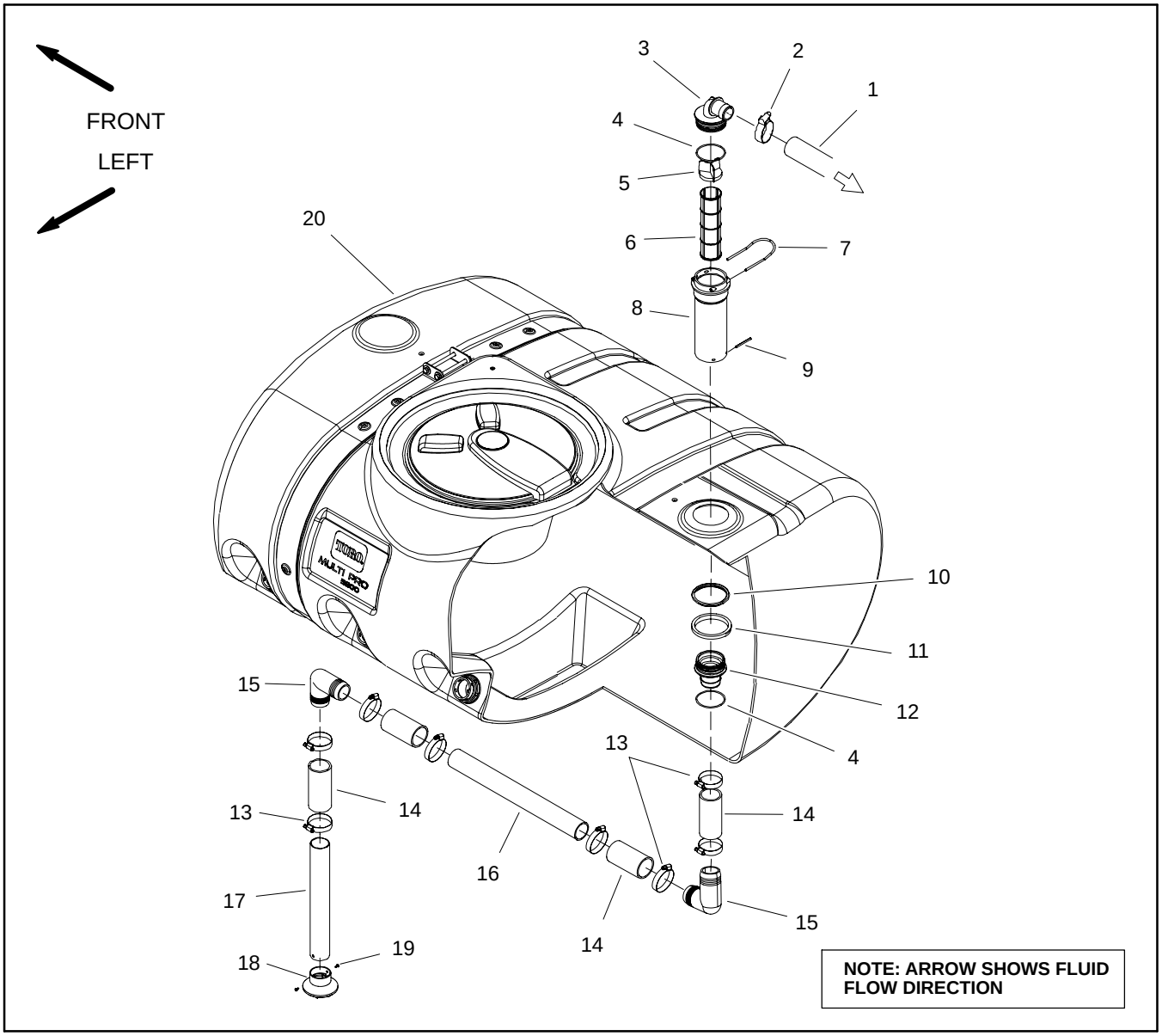


Figure 24

1. **Suction hose (1 1/2”)**
2. **Hose clamp**
3. **Hosebarb**
4. **O-ring**
5. **Suction screen vane**
6. **Suction screen**
7. **Fork**
8. **Filter housing**
9. **Expansion pin (2 used)**
10. **Gasket**
11. **Bulkhead nut**
12. **Hosebarb**
13. **Hose clamp (8 used)**
14. **Suction hose**
15. **Elbow**
16. **Suction tube**
17. **Suction tube**
18. **Suction tube foot**
19. **Screw (2 used)**
20. **Spray tank**

NOTE: If suction tube in tank develops an air leak, spray performance will diminish when tank level reaches the leak.

Removal (Fig. 24)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Remove suction strainer from spray tank.

3. Raise tank lid and remove strainer basket to gain access to suction tube inside spray tank.

4. Remove suction tube assembly from spray tank and disassemble tube using Figure 8 as a guide. Discard all removed O−rings and gaskets.

Assembly (Fig. 24)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble and install suction tube assembly using Figure 24 as a guide. Replace all removed O−rings and gaskets. Make sure that clearance exists between suction tube foot and bottom of tank after assembly.

2. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

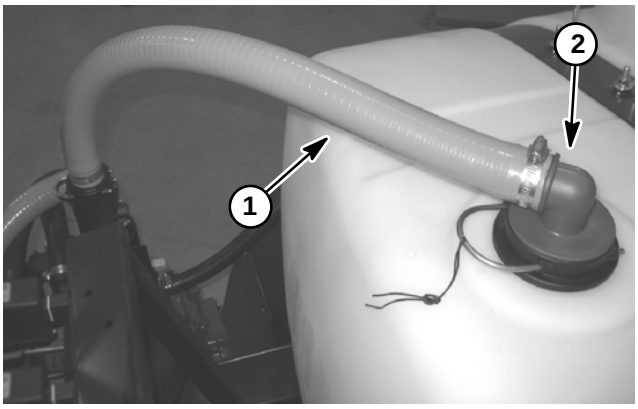


Figure 25

1. **Suction hose**
2. **Strainer location**

Tank Drain Valve

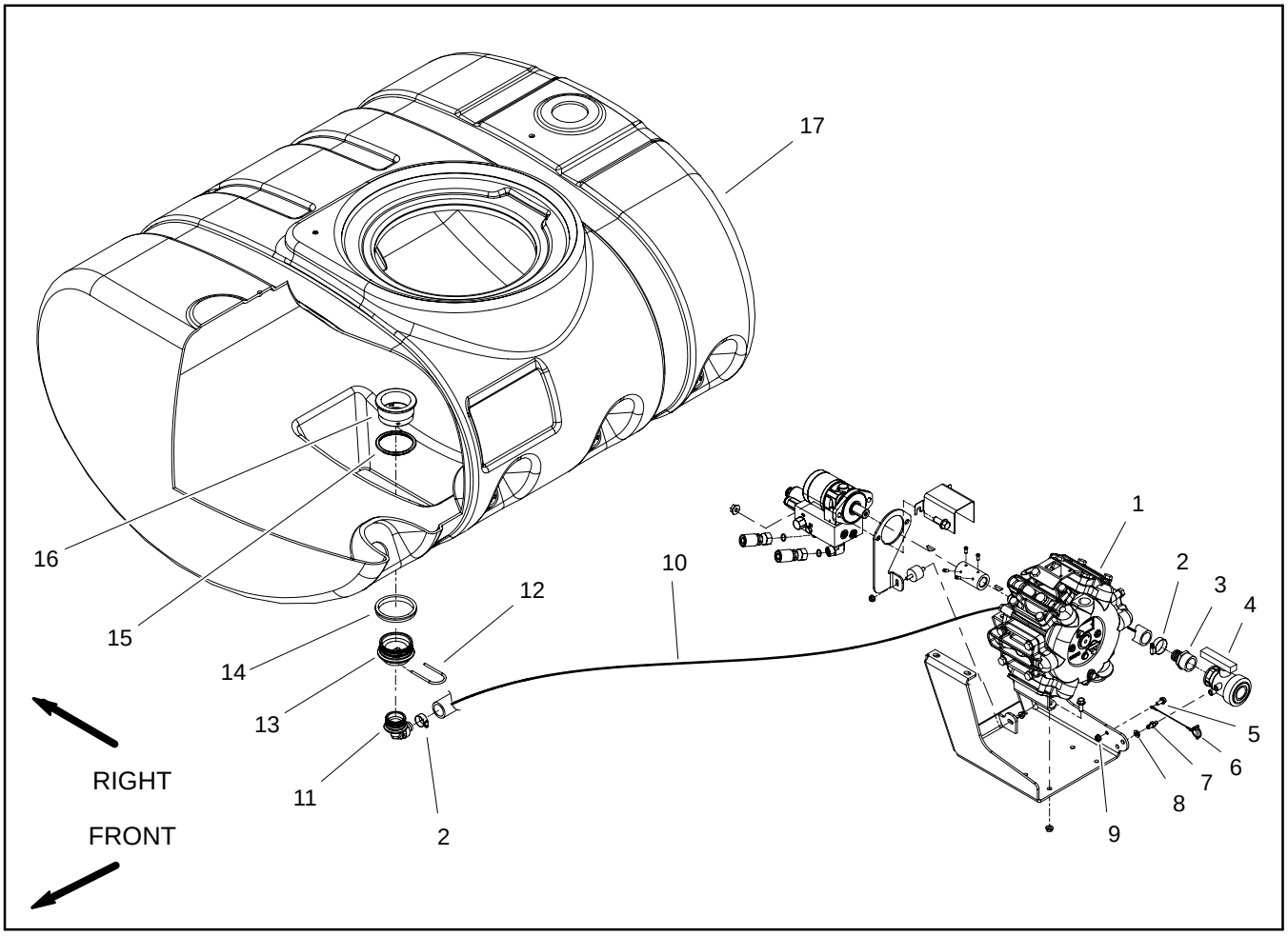


Figure 26

1. **Spray pump**
2. **Hose clamp (2 used)**
3. **Barbed fitting**
4. **Drain valve**
5. **Flange head screw**
6. **Lynch pin**
7. **Peg mount (2 used)**
8. **Rubber washer (2 used)**
9. **Flange nut**
10. **Drain hose**
11. **Elbow hosebarb**
12. **Fork**
13. **Adapter**
14. **Bulkhead nut**
15. **Gasket**
16. **Bulkhead fitting**
17. **Spray tank**

Disassembly (Fig. 26)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Drain spray tank.

3. Label hoses to allow proper installation after repairs are completed. Loosen hose clamps and remove hoses from hosebarbs that are to be disassembled.

4. Disassemble drain assembly using Figure 26 as a guide. Discard all removed O−rings and gaskets.

Assembly (Fig. 26)

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble drain assembly using Figure 26 as a guide. Replace all removed O−rings and gaskets.

2. Using labels placed during disassembly, install hoses to hosebarbs and secure with hose clamps.

3. Make sure that drain valve is closed and secured to sprayer with lynch pin.

4. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

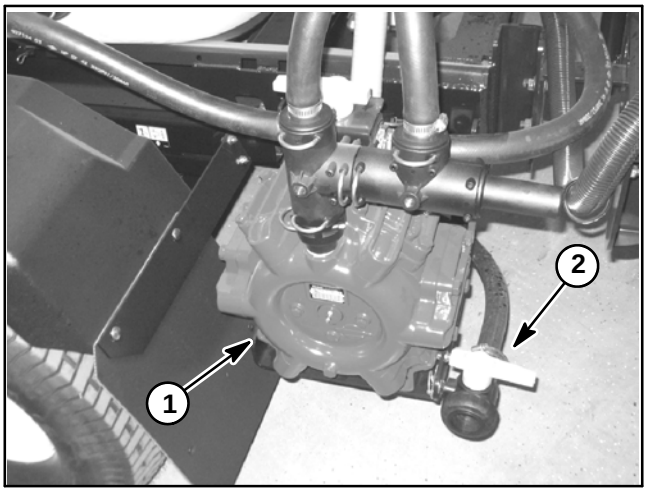


Figure 27

1. Spray pump
2. Drain valve

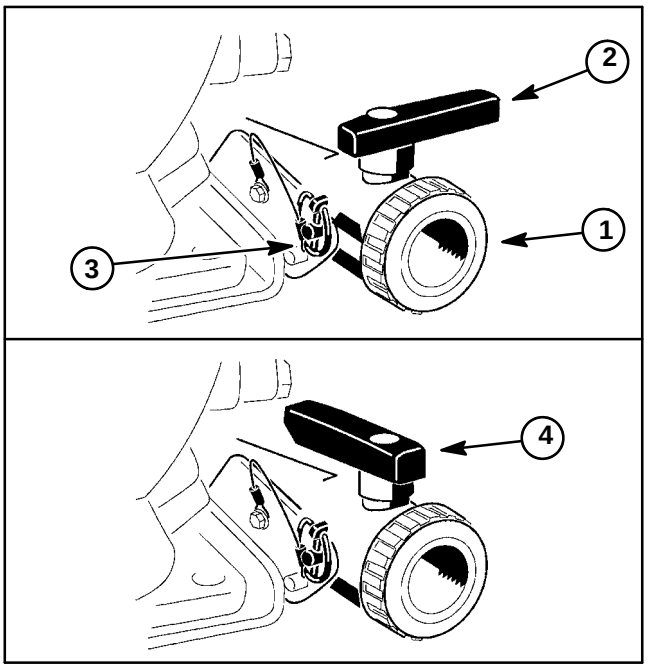


Figure 28

1. Drain valve
2. Valve closed
3. Lynch pin
4. Valve open

Turret Bodies

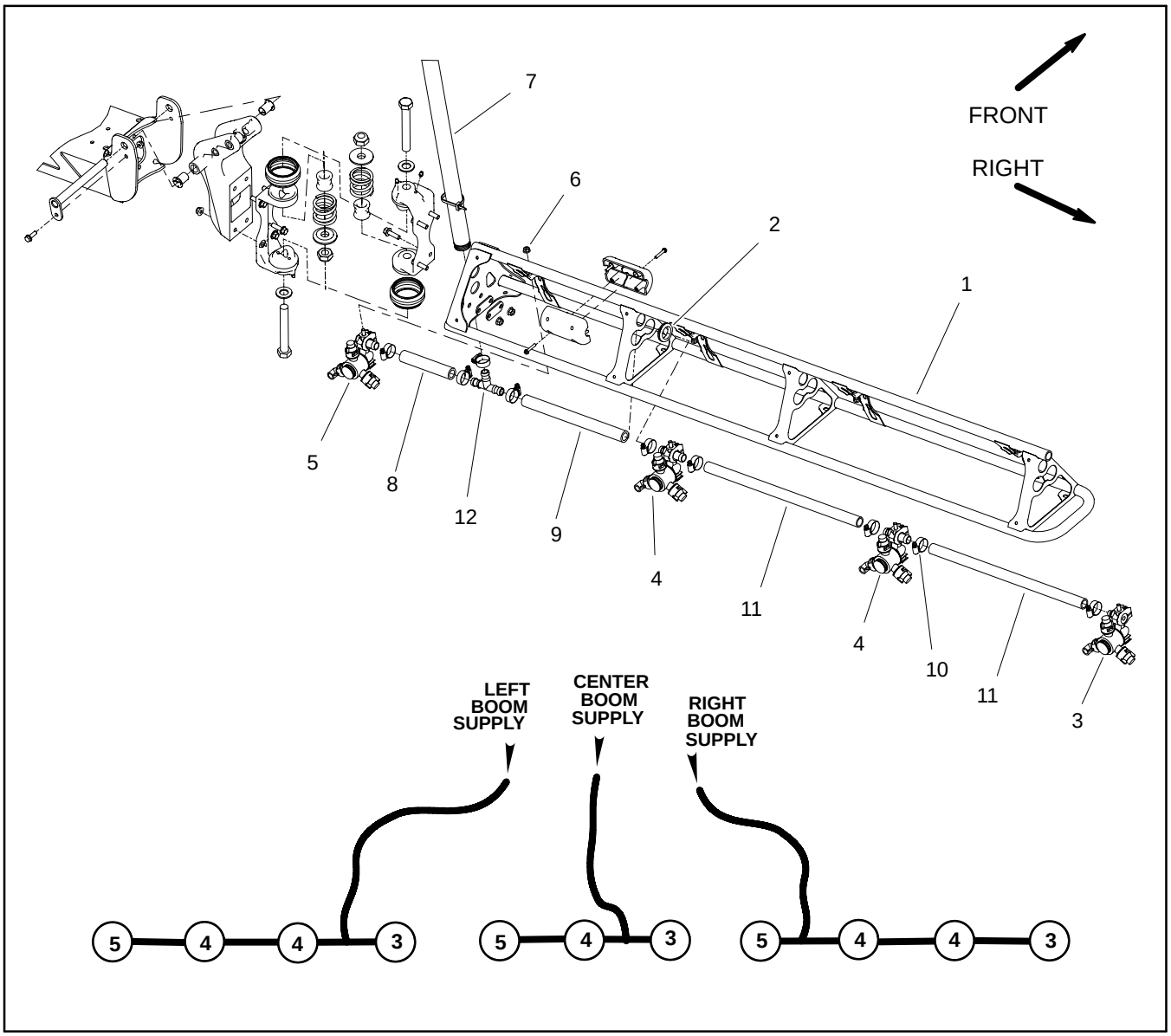


Figure 29

1. **Spray boom (RH shown)**
2. **Grommet**
3. **Turret body (w/single LH hose barb)**
4. **Turret body (w/double hose barb)**
5. **Turret body (w/single RH hose barb)**
6. **Flange nut (1 used per turret)**
7. **Supply hose**
8. **Boom hose**
9. **Boom hose**
10. **Hose clamp**
11. **Boom hose**
12. **Tee fitting**

Removal (Fig. 29)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Loosen hose clamps and remove supply hose(s) from turret body.

3. Remove flange nut (item 6) that secures turret body to spray boom. Remove turret body from machine.

Installation (Fig. 29)

NOTE: The type of hose barb on turret body determines turret location on spray boom. Refer to Figure 29 for turret position on booms.

1. Position turret body to bracket on spray boom. Make sure that spray nozzle and nozzle fan slot are parallel to ground. Install and tighten flange nut to secure turret body.

2. Install supply hose(s) to turret body and secure with hose clamp(s).

Turret Body Service

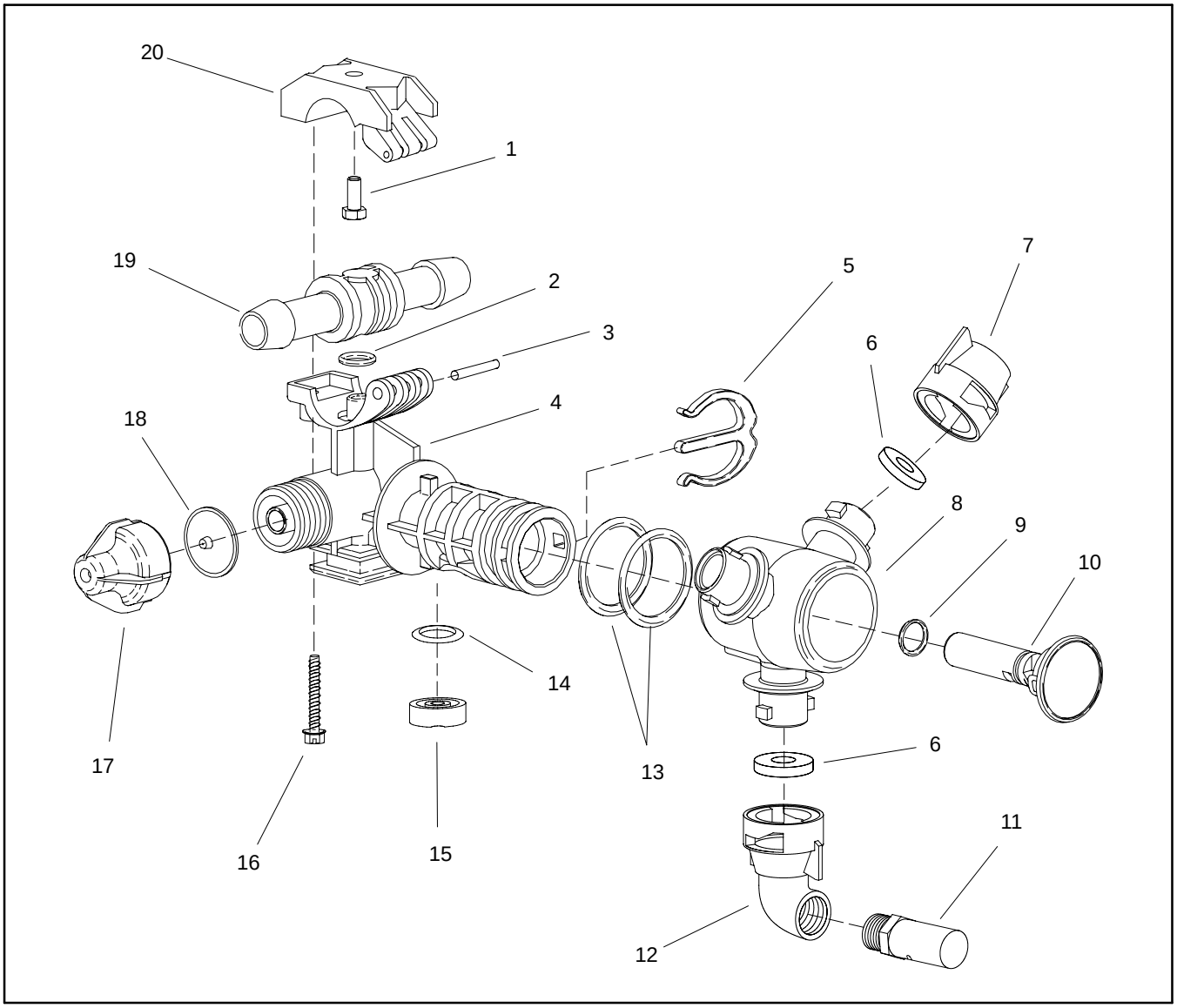


Figure 30

1. **Cap screw**
2. **O-ring**
3. **Pivot pin**
4. **Body**
5. **E-clip**
6. **Gasket**
7. **Dust cap (2 used)**
8. **Turret**
9. **O-ring**
10. **Plug**
11. **Nozzle**
12. **Nozzle cap**
13. **O-ring (2 used)**
14. **O-ring**
15. **Seal**
16. **Screw**
17. **Diaphragm cap**
18. **Diaphragm**
19. **Hose barb (double barb shown)**
20. **Upper clamp**

Disassembly (Fig. 30)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

1. Pull e−clip from body and slide plug with O−ring from body.

2. Disassemble turret body using Figure 30 as a guide.

3. Discard all removed seals, gaskets, O−rings and diaphragms.

Assembly (Fig. 30)

NOTE: Seal kits for turret body service are available. Seal kit part number 108−3266 includes an O−ring (item 14) and seal (item 15). Seal kit part number 108−3267 includes a diaphragm (item 18) and four (4) O−rings (items 2, 9 and 13).

NOTE: Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Replace all removed seals, gaskets, O−rings and diaphragms.

2. Assemble turret body using Figure 30 as a guide.

   A. The turret (item 8) end with slightly larger bore and detent grooves needs to be orientated toward detent posts on body (item 4) (Fig. 31).

   B. Make sure to align notch on plug (item 10) with groove in body (item 4) as plug is installed.

   C. Install e−clip (item 5) into body to secure assembly.

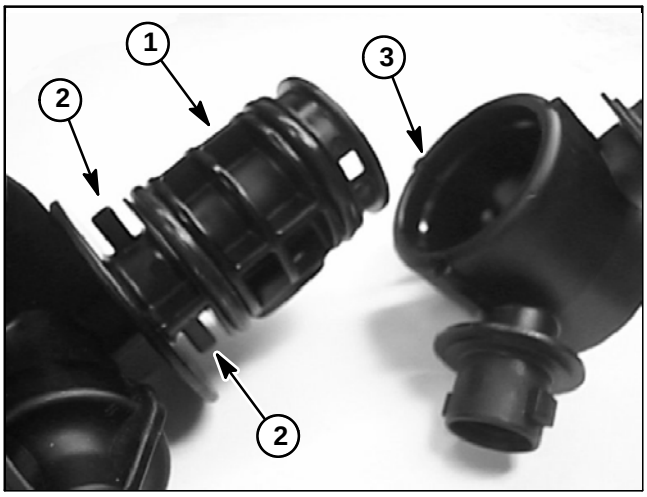


Figure 31

1. **Body**
2. **Detent post**
3. **Detent groove**

Boom Hinge

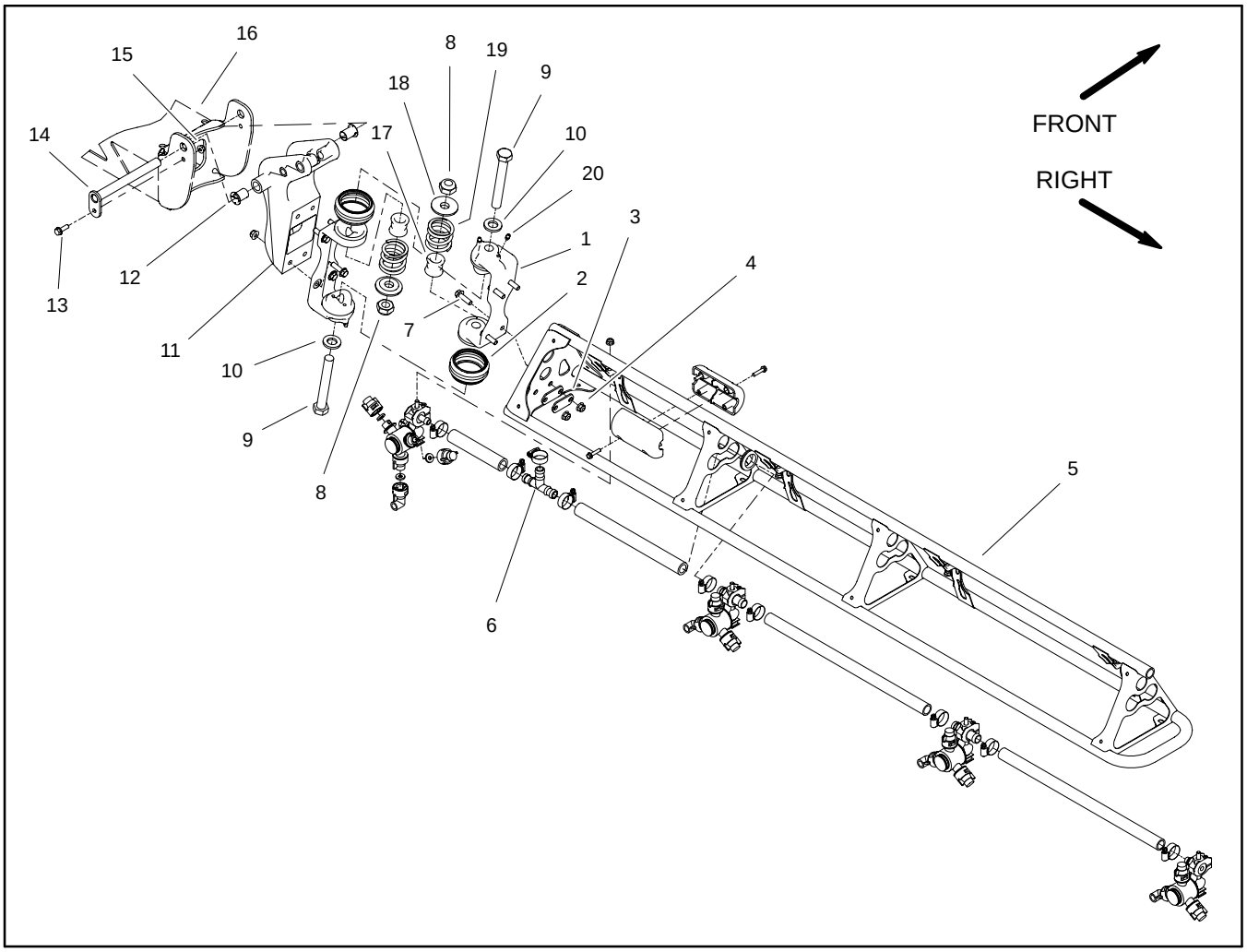


Figure 32

1. **Hinge (2 used per boom)**
2. **Rubber boot (2 used per hinge)**
3. **Backing plate (4 used per hinge)**
4. **Flange nut (4 used per hinge)**
5. **Boom (RH shown)**
6. **Tee fitting**
7. **Flange hd screw (4 used per hinge)**
8. **Lock nut**
9. **Cap screw**
10. **Flat washer**
11. **Pivot bracket**
12. **Bushing (2 used per pivot bracket)**
13. **Flange head screw**
14. **Pivot pin**
15. **Flange nut**
16. **Boom frame**
17. **Tube (2 used per boom)**
18. **Spring retainer (2 used per boom)**
19. **Breakaway spring (2 used per boom)**
20. **Grease fitting (2 used per hinge)**

Disassembly (Fig. 32)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Loosen hose clamp and remove supply hose from tee fitting (item 6) on spray boom.

3. Support spray boom to prevent it from falling.

4. Loosen two (2) cap screws (item 9) and lock nuts (item 8) to allow breakaway springs (item 19) to fully extend.

5. Complete disassembly boom hinge as required using Figure 32 as a guide. If pivot bracket (item 11) is to be removed from machine, disconnect boom lift cylinder (not shown) from pivot bracket (see Boom Lift Cylinder Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

6. Clean all removed components. If pivot bracket was removed, inspect bushings and pivot pin for damage or wear. Replace bushings and/or pivot pin if required.

Assembly (Fig. 32)

1. If pivot bracket (item 11) was removed from machine, lightly lubricate bushings (item 12) with motor oil before assembly. Connect boom lift cylinder (not shown) to pivot bracket (see Boom Lift Cylinder Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

2. Make sure that hinges (item 1) are securely fastened to pivot bracket (item 11) and boom (item 5). The boom hinge uses four (4) backing plates between the boom and flange nuts.

3. Position boom hinge to pivot bracket hinge. Make sure that rubber boots (item 2) are placed at hinge junctions and that rib on boots is toward the top of the boom (Fig. 33).

4. Insert two (2) cap screws (item 9) through flat washers (item 10) and hinges. Place tube (item 17), breakaway spring (item 19), spring retainer (item 18) and lock nut (item 8) on each cap screw. Make sure that shoulder on spring retainer fits into breakaway spring.

5. Tighten lock nuts so there is 1.560” (39.6 mm) between the face of the spring retainer and the hinge casting (Fig. 34).

6. Connect supply hose to tee fitting on spray boom and secure with hose clamp.

7. Lubricate grease fittings on boom hinge.

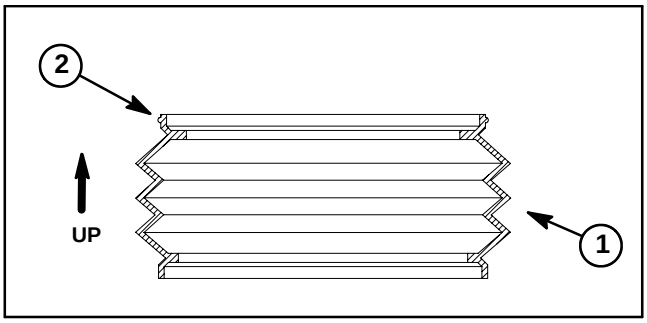


Figure 33

1. Rubber boot **2. Rib**

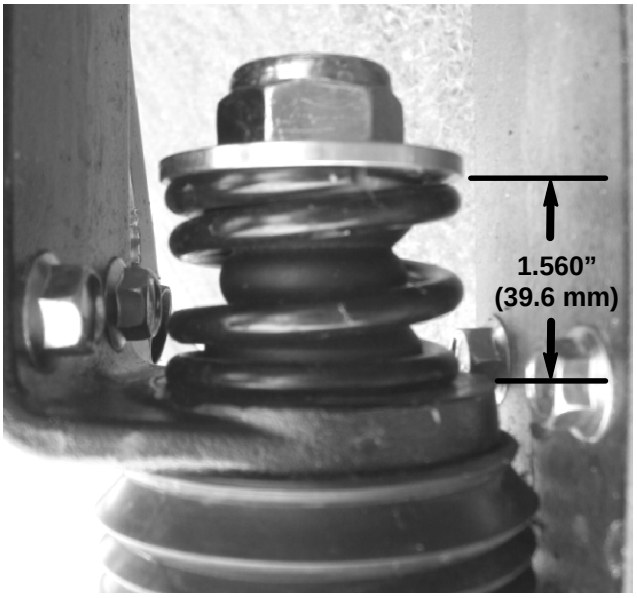


Figure 34

Pro Control XP Spray System (Optional)

The Multi Pro 5800 has an optional Pro Control XP Spray System available. This system includes a computer and flowmeter and is designed to automatically control spray application at varying vehicle speeds. The Operator's Manual for the Pro Control XP Spray System includes information regarding installation, operation, programming and maintenance. Refer to your Operator's Manual for information on the Pro Control XP Spray System.

NOTE: When a vehicle is equipped with the optional Pro Control XP Spray System, the boom valve motors must have caps installed onto valve motor openings. There should not be balancing valves on boom valve motors if vehicle is equipped with a Pro Control.

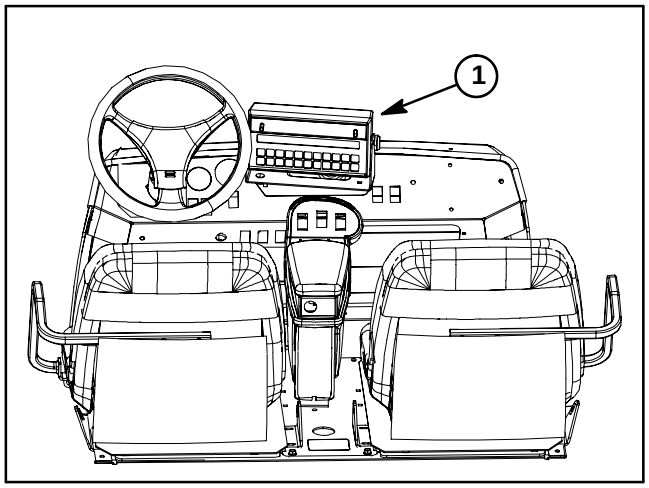


Figure 35

1. **Pro Control computer**

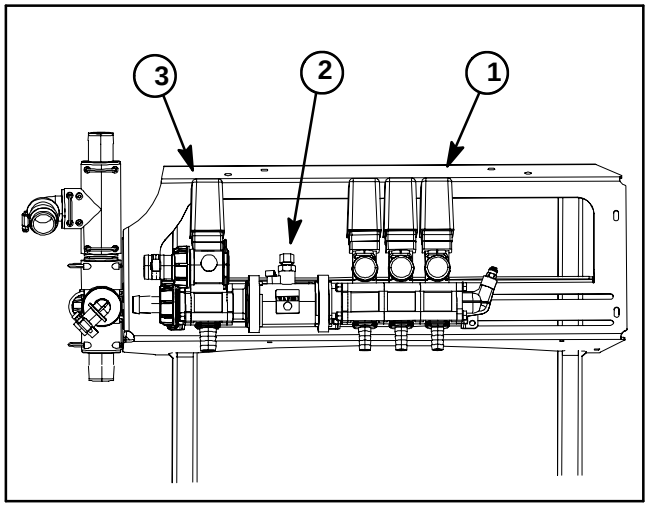


Figure 36

1. **Boom control valves**
2. **Flowmeter**
3. **Agitation valve**

Chapter 7

Chassis

Table of Contents

Specifications

Item	Description
Front Tire Pressure (23 x 10.5 – 12, 4 ply, tubeless)	18 PSI (124 kPa)
Rear Tire Pressure (26.5 x 14 – 12, 4 ply, tubeless)	18 PSI (124 kPa)
Front Wheel Lug Nut Torque	55 to 75 ft–lb (75 to 102 N–m)
Rear Wheel Lug Nut Torque	85 to 100 ft–lb (115 to 135 N–m)
Planetary, Brake Assembly and Wheel Motor Mounting Screw Torque OPH–2 series planetary VA02 series planetary	 60 ft–lb (81 N–m) 75 to 85 ft–lb (101 to 115 N–m)
Front Wheel Toe–In	1/8 to 1/4 inch (3.2 to 6.4 mm)
Planetary Drive Lubricant Capacity (each wheel)	SAE 85W–140 wt. Gear Lube 16 to 20 fl oz (0.47 to 0.59 L)

General Information

Operator's Manual

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

Planetary Drive Assembly Endplay (OPH−2 series planetary drives)

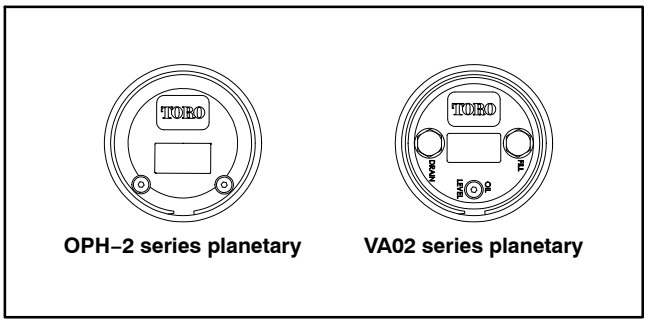
A front planetary drive assembly that is properly operating should have no endplay. Any endplay in a planetary assembly indicates that there are potential problems with the planetary. Check planetary endplay at intervals specified in your Operator's Manual.

Endplay Checking Procedure

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

CAUTION

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



OPH−2 series planetary **VA02 series planetary**

Figure 1

2. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 − Safety). Support machine with jack stands.

3. Grasp rear wheel and check for endplay in the planetary assembly as indicated by axial wheel movement. Make sure that there is no endplay in assembly.

4. If any endplay is detected, the planetary should be disassembled, inspected and serviced as necessary (see Planetary Drive Assembly in the Service and Repairs section of this chapter).

5. After planetary endplay checking is completed, lower machine to ground.

Tie Rod Ends

Removal (Fig. 2)

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

2. Loosen jam nut on tie rod end. **Note:** Left side tie rod end has left hand threads.

3. Remove cotter pin and castle nut that secure tie rod end to spindle.

4. Use a suitable puller to separate tie rod end from spindle.

5. When removing tie rod end from tie rod, count the number of revolutions it takes to remove so new tie rod end can be installed with minimal change to front wheel toe−in.

Installation (Fig. 2)

1. Install dust boot on new tie rod end.

2. Thread tie rod end into tie rod the same number of revolutions as the old tie rod end took to remove.

3. Install grease fitting into tie rod end.

4. Insert tie rod end shaft into spindle and secure with castle nut. Torque castle nut from **20 to 25 ft−lb (27 to 33 N−m)**. If necessary, nut can be tightened slightly further to align cotter pin position in spindle and nut. Install cotter pin.

5. Grease tie rod end.

6. Check front wheel toe−in and adjust if needed. Front wheel toe−in should be from 1/8 to 1/4 inch (3.2 to 6.4 mm).

7. Adjust steering stop bolt on each spindle so that at full turn, there is a gap from 1/16" to 1/8" (1.6 to 3.2 mm) between the head of the stop bolt and the axle stop lug.

8. Verify that there is at least a 1/16" (1.6 mm) gap between the tie rod and front axle when turning full right to left.

9. After assembly is complete, make sure that steering components do not contact hoses and/or electrical harness wires.

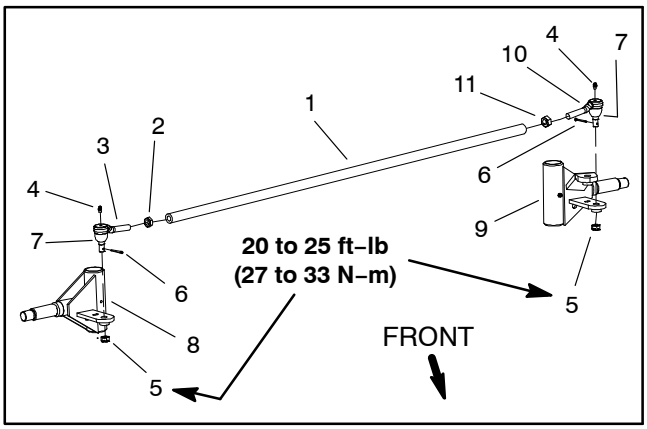


Figure 2

1. **Tie rod**
2. **Jam nut (RH thread)**
3. **RH tie rod end**
4. **Grease fitting**
5. **Castle nut**
6. **Cotter pin**
7. **Dust boot**
8. **RH spindle**
9. **LH spindle**
10. **LH tie rod end**
11. **Jam nut (LH thread)**

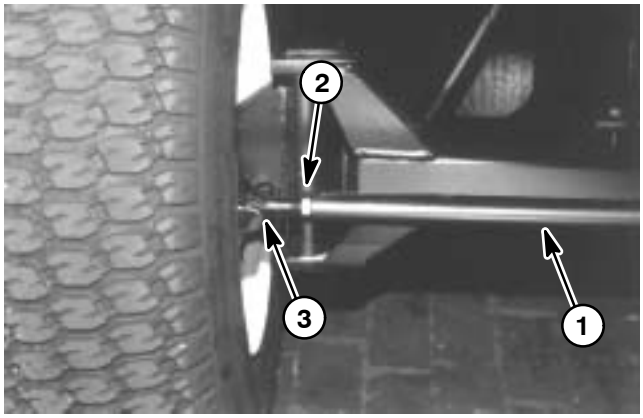


Figure 3

1. **Tie rod**
2. **Jam nut**
3. **Tie rod end**

Front Wheels and Hubs

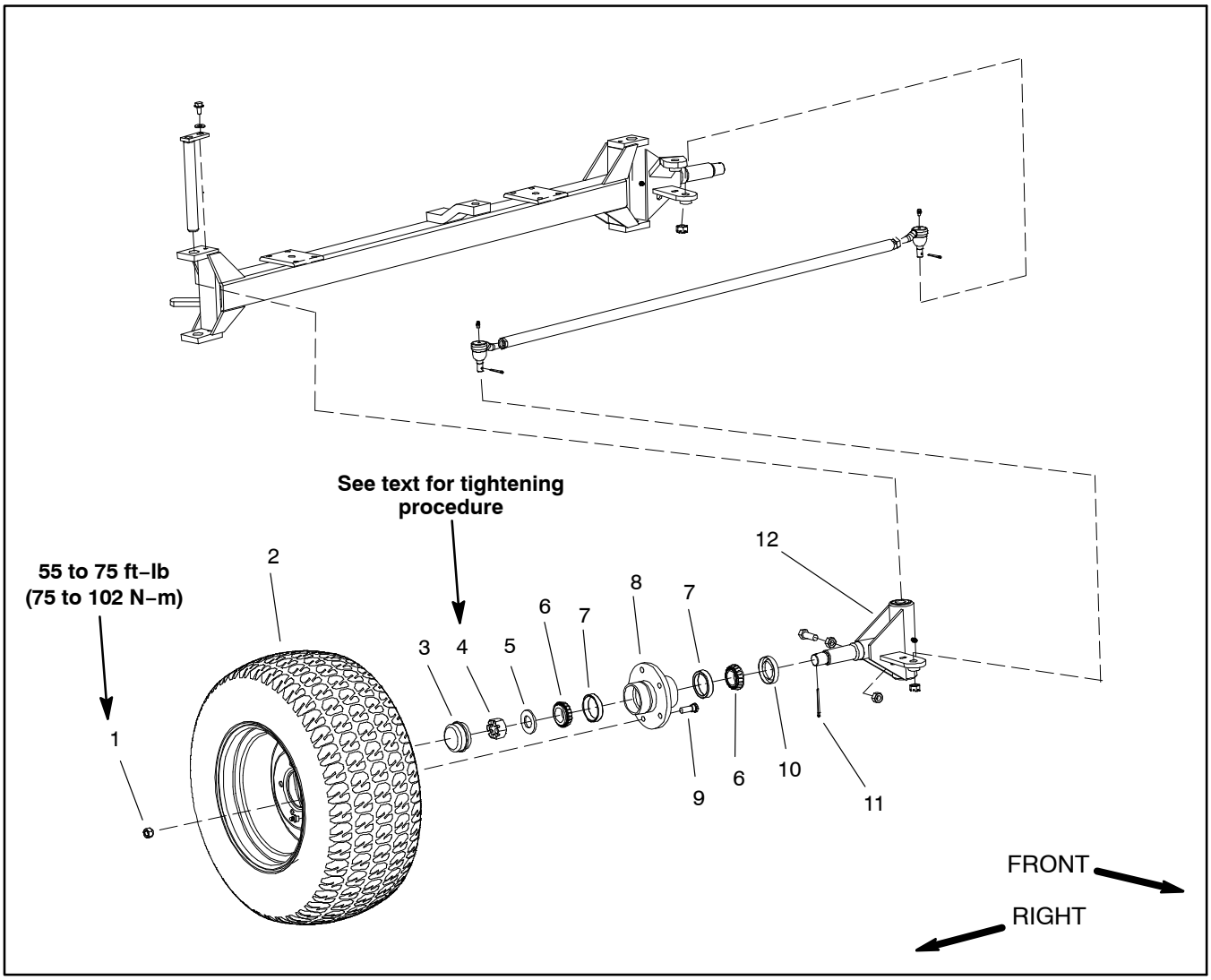


Figure 4

1. Lug nut (5 used per wheel)
2. Wheel and tire assembly
3. Dust cap
4. Slotted hex nut
5. Washer
6. Wheel bearing cone
7. Wheel bearing cup
8. Wheel hub
9. Wheel stud (5 used per wheel)
10. Seal
11. Cotter pin
12. Front spindle (RH shown)

Removal (Fig. 4)

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

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front wheel off the ground (see Jacking Instructions in Operator's Manual). Chock front and rear of other wheels. Support raised machine with jack stands.

3. Remove lug nuts and front wheel assembly.

4. Carefully pry dust cap from wheel hub.

5. Remove cotter pin from front spindle.

6. Remove slotted hex nut and washer that secures wheel hub to spindle. Slide wheel hub with bearings from spindle.

7. If required, disassemble wheel hub:

   A. Pull seal out of the wheel hub.

   B. Remove bearings from both sides of wheel hub. Clean bearings in solvent. Clean inside of the hub.

   C. Inspect wheel bearings. Check the bearings and cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

   D. If necessary, press wheel studs from hub.

Installation (Fig. 4)

1. Clean all parts thoroughly before reassembly.

2. If wheel bearings were removed from wheel hub, assemble wheel hub:

   A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

   B. Pack both bearings with grease. Install greased inner bearing into the cup on inboard side of the wheel hub.

   C. Fill hub approximately 50% full of grease.

   IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must face the bearing.

   D. Lubricate the inside of the new lip seal and press it into the wheel hub.

   E. If wheel studs were removed from hub, press studs fully into hub. Make sure that stud flange is pressed fully to hub surface.

3. Install the wheel hub onto the spindle shaft taking care to not damage seal.

4. Install greased outer bearing cone, washer and slotted hex nut onto spindle shaft.

5. Rotate the wheel hub by hand and torque the slotted hex nut from **75 to 180 in-lb (8.5 to 20.3 N–m)** to seat bearings. Loosen nut until it is away from washer and hub has end play. Finally, tighten slotted hex nut from **15 to 20 in–lbs (1.7 to 2.2 N–m)** while rotating hub.

6. Install cotter pin through spindle shaft hole. Install dust cap to hub.

WARNING

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

7. Install wheel assembly with valve stem facing out and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from **55 to 75 ft–lb (75 to 102 N–m)**.

8. Lower machine to ground.

Spindles

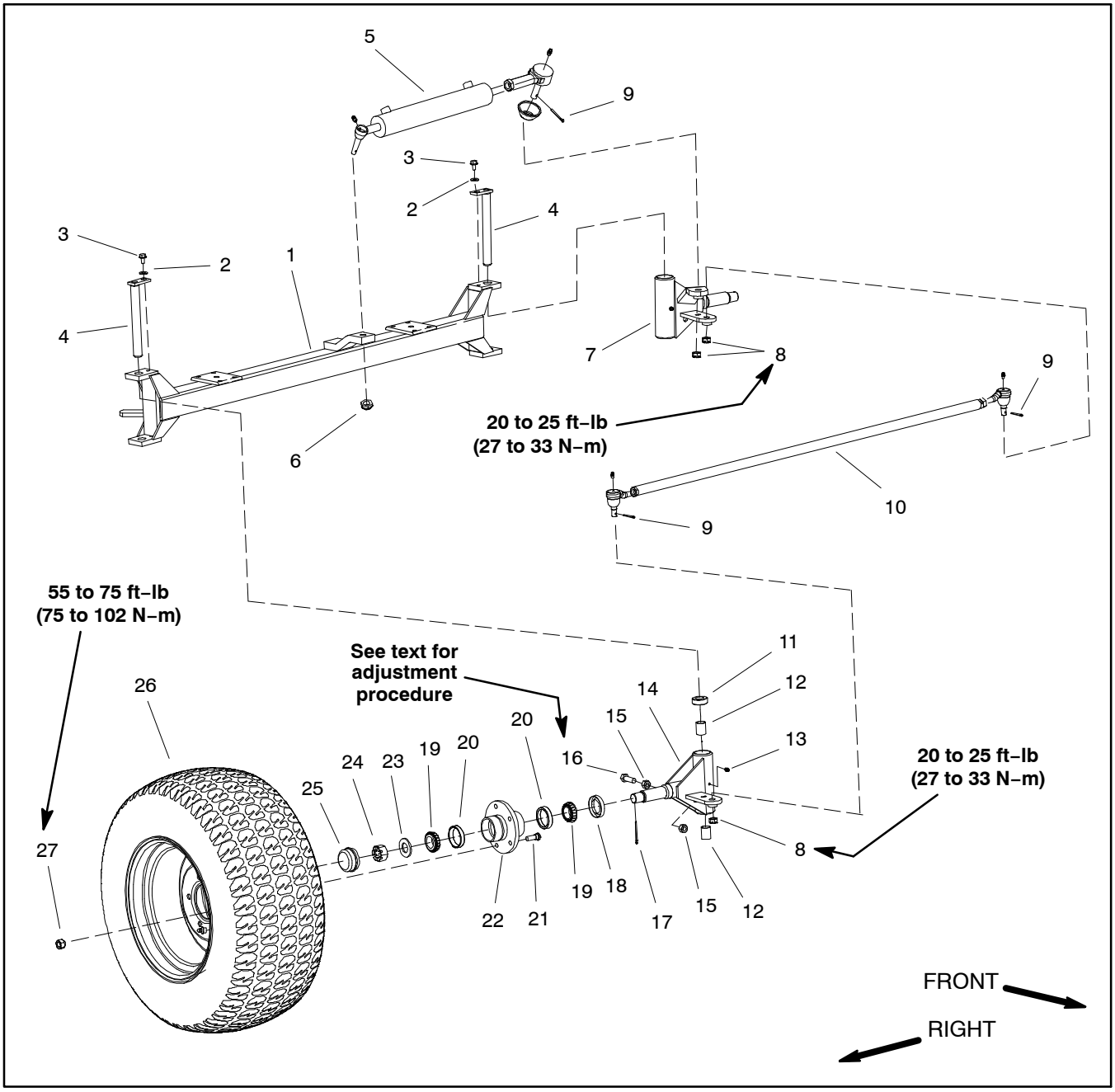


Figure 5

1. **Front axle**
2. **Flat washer**
3. **Washer head screw**
4. **King pin**
5. **Hydraulic steering cylinder**
6. **Lock nut**
7. **LH spindle assembly**
8. **Castle nut**
9. **Cotter pin**
10. **Tie rod assembly**
11. **Thrust bearing**
12. **Bushing**
13. **Grease fitting**
14. **RH spindle**
15. **Hex nut**
16. **Steering stop bolt**
17. **Cotter pin**
18. **Oil seal**
19. **Bearing cone**
20. **Bearing cup**
21. **Wheel stud (5 used per wheel)**
22. **Wheel hub**
23. **Flat washer**
24. **Slotted hex nut**
25. **Dust cap**
26. **Wheel assembly**
27. **Lug nut (5 used per wheel)**

Disassembly (Fig. 5)

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

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety).

3. Remove front wheel assembly and wheel hub from machine (see Front Wheels and Hubs in this section).

4. Remove tie rod end from spindle (see Tie Rod Ends in this section).

5. If left side spindle is being removed, separate hydraulic steering cylinder from spindle (see Steering Cylinder in Service and Repairs Section of Chapter 4 – Hydraulic System).

6. Remove washer head screw and flat washer that secure king pin to front axle.

7. Support spindle assembly to prevent it from falling during disassembly. Slide king pin from front axle and spindle. Remove spindle from front axle.

8. Remove thrust bearing from top of spindle.

9. If needed, remove bushings and steering stop bolt from spindle.

Assembly (Fig. 5)

1. If removed, install bushings and steering stop bolt into spindle.

2. Place thrust bearing in top of spindle. Top of bearing is identified on bearing case.

3. Position spindle to front axle. Slide king pin into front axle and spindle.

4. Install washer head screw and flat washer to secure king pin to front axle.

5. If left side spindle was removed, attach hydraulic steering cylinder to spindle (see Steering Cylinder in Service and Repairs Section of Chapter 4 – Hydraulic System).

6. Secure tie rod end to spindle (see Tie Rod End in this section).

WARNING

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

7. Install wheel with valve stem facing out and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from **55 to 75 ft–lb (75 to 102 N–m)**.

8. Lubricate grease fittings on front axle assembly.

9. Lower machine to ground.

10. Check and adjust front wheel toe–in. Front wheel toe–in should be from 1/8" to 1/4" (3.2 to 6.4 mm).

11. Adjust steering stop bolt on each spindle so that at full turn, there is a gap from 1/16" to 1/8" (1.6 to 3.2 mm) between the head of the stop bolt and the axle stop lug.

12. Verify that there is at least a 1/16" (1.6 mm) gap between the tie rod and front axle when turning full right to left.

13. After assembly is complete, make sure that steering components do not contact hoses and/or electrical harness wires.

Front Suspension

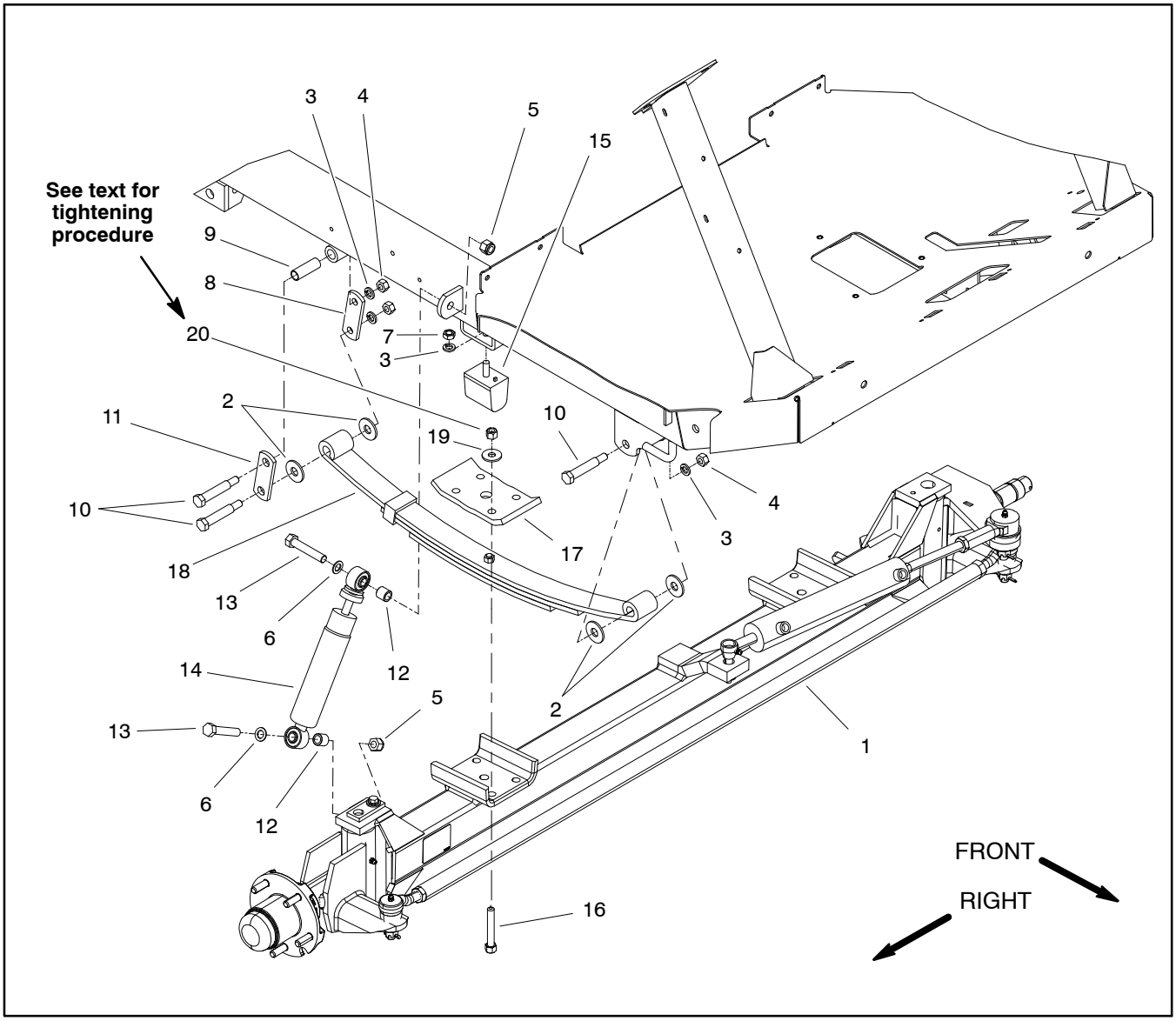


Figure 6

1. **Front axle assembly**
2. **Flat washer (4 used per side)**
3. **Lock washer (4 used per side)**
4. **Hex nut (3 used per side)**
5. **Hex nut (2 used per shock)**
6. **Washer (2 used per shock)**
7. **Hex nut**
8. **Inside shackle**
9. **Shackle bushing**
10. **Shoulder bolt (3 used per side)**
11. **Outside shackle**
12. **Spacer (2 used per shock)**
13. **Cap screw (2 used per shock)**
14. **Shock absorber**
15. **Axle bumper**
16. **Cap screw (4 used per spring)**
17. **Spring plate**
18. **Leaf spring (2 used)**
19. **Hardened washer (4 used per spring)**
20. **Lock nut (4 used per spring)**

Disassembly (Fig. 6)

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

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety). Support machine to allow front suspension to hang freely from machine.

3. Remove front wheels (see Front Wheels and Hubs).

4. Support axle to prevent it from shifting or falling.

5. To remove leaf springs:

   A. Loosen fasteners that secure springs to frame attachment points.

   B. Loosen and remove cap screws and lock nuts that secure spring plate (item 17).

   C. Remove shackles, bushings, shoulder bolts, lock washers and hex nuts from spring and frame.

   D. Remove leaf springs from machine.

IMPORTANT: If leaf spring replacement is needed, always replace both springs for proper vehicle performance.

6. If front axle removal is required, remove steering cylinder (see Steering Cylinder Removal in the Service and Repair Section of Chapter 4 – Hydraulic System) and shock absorbers from axle.

Assembly (Fig. 6)

1. If axle was removed from vehicle, position and support axle under frame.

2. To install leaf springs:

NOTE: When installing leaf springs, make sure front axle and spring plate are centered on the screw head and nut that attach spring leaves.

   A. Loosely attach springs to frame with shackles, bushings, shoulder bolts, lock washers and hex nuts. Do not fully tighten fasteners.

   B. Install spring plate (item 17) to top of spring assembly with curved edge toward spring.

   C. Install and tighten cap screws (item 16), hardened washers (item 19) and lock nuts (item 20) in a crossing pattern until spring plate, leaf spring and axle are in contact.

   D. Fully tighten fasteners that secure springs to frame.

   E. Using a crossing pattern, torque lock nuts (item 20) that secure spring plate **34 ft–lb (46 N–m)**. Again using a crossing pattern, torque lock nuts from **69 to 85 ft–lb (94 to 115 N–m)**. Finally, use a crossing pattern to check that lock nuts are all torqued from **69 to 85 ft–lb (94 to 115 N–m)**.

3. If shock absorbers were removed, install shocks to vehicle. Make sure that spacer is positioned between shock and frame attachment point during shock installation.

4. If steering cylinder was removed, install steering cylinder (see Steering Cylinder Installation in the Service and Repair Section of Chapter 4 – Hydraulic System)

WARNING

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

5. Install wheel with valve stem facing out and secure with lug nuts. Torque lug nuts evenly in a crossing pattern from **55 to 75 ft–lb (75 to 102 N–m)**.

6. Lower vehicle to ground.

7. Check front suspension and steering operation. Make sure that components do not contact hoses and/or wires.

Brake Assembly

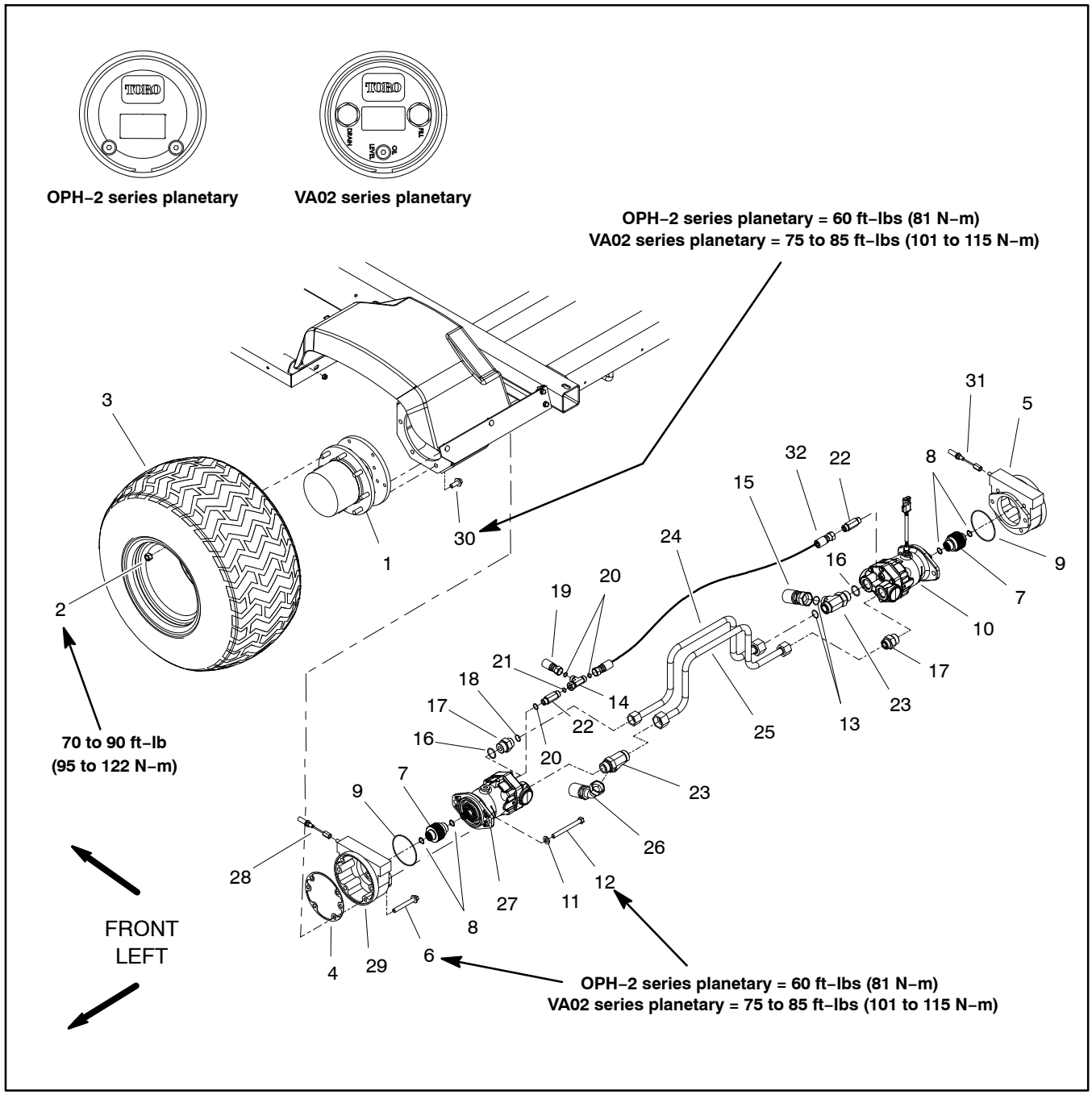


Figure 7

1. Planetary assembly (2 used)
2. Lug nut (8 used per wheel)
3. Tire and wheel assembly
4. Gasket
5. RH brake assembly
6. Flange head screw (4 used per brake)
   OPH−2 planetary = 90 mm lg
   VA02 planetary = 80 mm lg
7. Splined brake shaft
8. Retaining ring
9. O−ring
10. RH wheel motor
11. Flat washer (2 used per motor)
12. Cap screw (2 used per motor)
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
13. O−ring
14. Hydraulic tee fitting
15. Hyd. hose (to upper pump fitting)
16. O−ring
17. Hydraulic adapter
18. O−ring
19. Hydraulic hose (to reservoir)
20. O−ring
21. O−ring
22. Straight hydraulic fitting
23. Hydraulic tee fitting (2 used)
24. Hydraulic tube
25. Hydraulic tube
26. Hyd. hose (to lower pump fitting)
27. LH wheel motor
28. LH brake cable
29. LH brake assembly
30. Flange head screw (6 used per side)
31. RH brake cable
32. Hydraulic hose

Removal (Fig. 7)

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

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands.

4. Remove rear wheel assembly.

5. Remove hydraulic wheel motor (see Rear Wheel Motors in Service and Repairs section of Chapter 4 – Hydraulic System).

6. Disconnect brake cable from pull rod on brake (Fig. 9).

NOTE: Be careful to not drop splined brake shaft as brake assembly is removed.

7. Support brake assembly and remove four (4) flange head screws that secure brake assembly to planetary assembly. Remove brake assembly from machine.

8. Locate and remove splined brake shaft (item 7).

9. Remove and discard gasket (item 4). Make sure that all gasket material and sealant is removed from both the brake and the planetary assembly.

10. Complete brake inspection and repair.

Installation (Fig. 7)

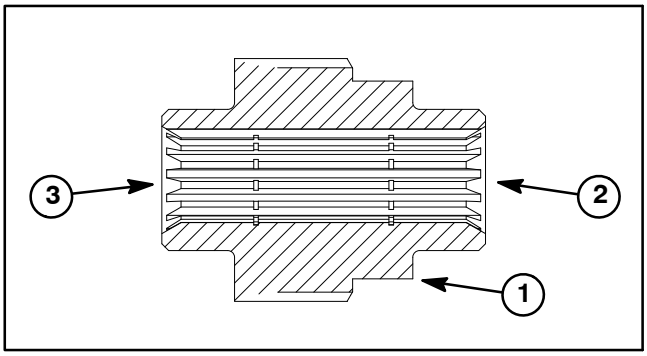


Figure 8

1. **Splined brake shaft step**
2. **Hydraulic motor end**
3. **Planetary assembly end**

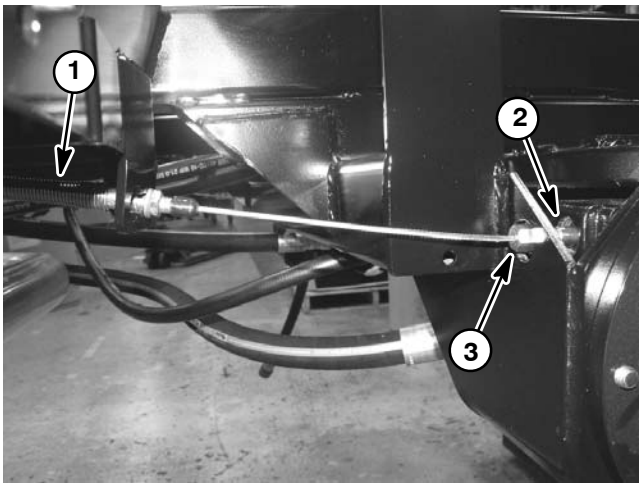


Figure 9

1. **Brake cable**
2. **Brake pull rod**
3. **Brake cable end**

NOTE: The stepped end of the splined brake shaft must be aligned toward the hydraulic wheel motor (Fig. 8).

1. Install splined brake shaft into brake assembly. Make sure that splines engage rotating discs in brake assembly.

2. Apply gasket sealant (Loctite #2 or equivalent) to sealing surfaces of new gasket (item 4). Align gasket and secure brake assembly to planetary.

   For OPH–2 series planetary drives: tighten screws from **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

3. Install brake cable to pull rod on brake assembly (Fig. 9). Brake cable end should be completely threaded onto pull rod.

4. Make sure wheel motor O−ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

   For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

5. Install front wheel assembly.

6. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

7. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

WARNING

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

8. Lower machine to ground. Torque wheel lug nuts from **85 to 100 ft−lb (116 to 135 N−m)**.

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Brake Inspection and Repair

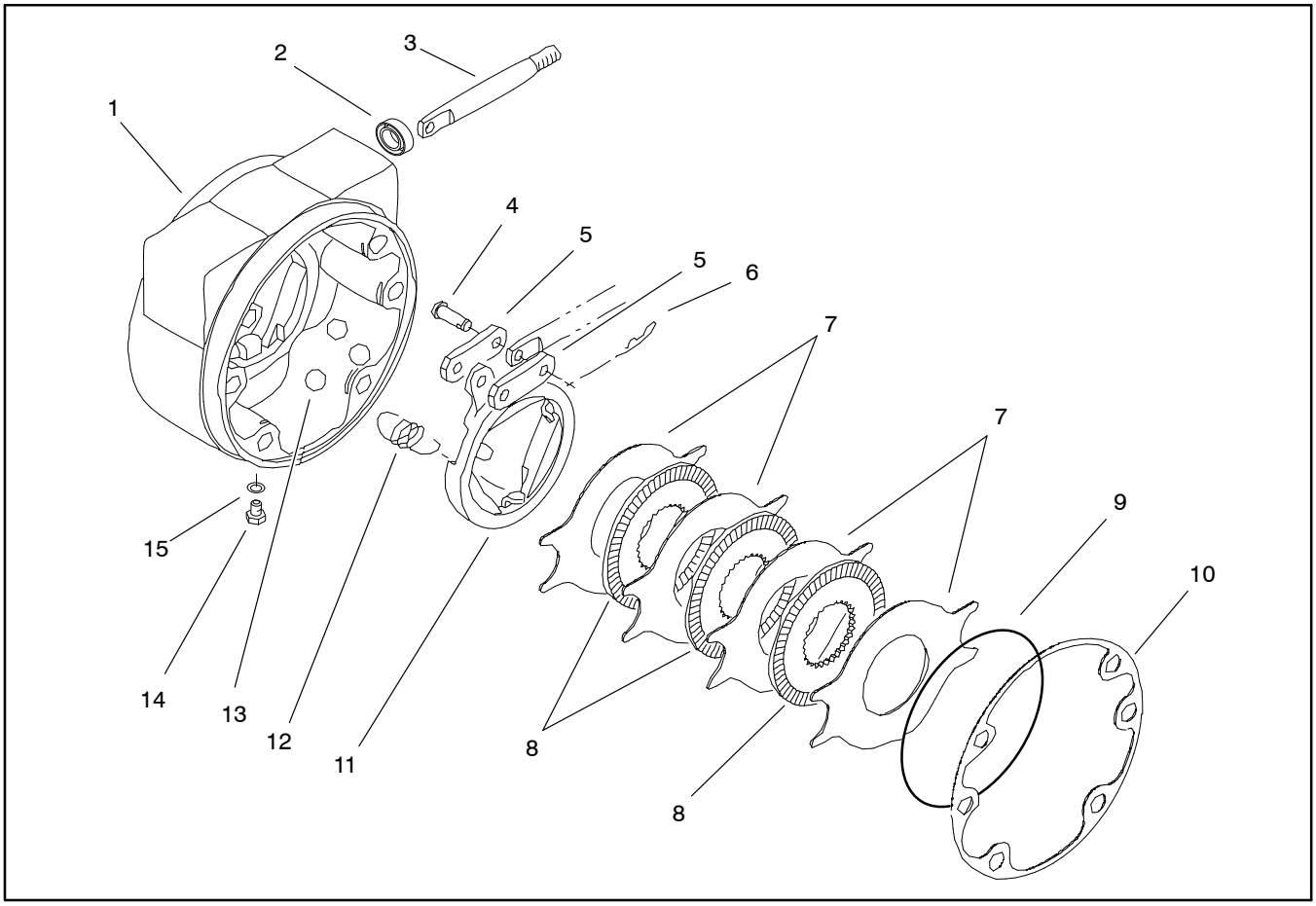

Figure 10

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin**
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 (2 used)**
15. **O−ring**

Brake Inspection and Repair (Fig. 10)

1. Scrape gasket material (item 10) from brake housing and planetary drive mounting surfaces.

2. Remove retaining ring (item 9).

3. Remove four (4) stationary discs (item 7) and three (3) rotating discs (item 8).

4. Remove three (3) extension springs (item 12).

5. Remove actuator assembly (items 3, 4, 5, 6 and 11) and three (3) balls (item 13).

6. Remove seal (item 2) from brake housing.

7. Wash parts in cleaning solvent. Inspect components for wear or damage.

8. Reverse steps 2 through 6 to assemble brakes, installing new parts as necessary. Install a new seal (item 2).

9. Use a new gasket (item 10) when installing the brake assembly to machine.

Brake Cables

Brake Cable Removal

1. Remove brake cable from brake equalizer at front of machine under floorboard (Fig. 11 and 12):

   A. Remove cotter pin, flat washer and clevis pin that secure brake cable to brake equalizer.

   B. Loosen jam nuts that secure cable to cable bracket on frame.

2. Remove brake cable from rear brake (Fig. 13):

   A. Loosen and remove cable end from pull rod on brake assembly.

   B. Loosen jam nut that secures brake cable to cable bracket on frame.

3. Remove R−clamp that secures brake cable:

   A. R−clamp for right side cable is on top of traction pump.

   B. R−clamp for left side cable is inside left frame rail.

4. Note routing of brake cable and remove cable from machine.

Brake Cable Installation

1. Install brake cable to rear brake assembly:

   A. Insert rear end of cable through cable bracket on frame and through hole in rear axle frame.

   B. Connect cable end to brake pull rod on brake assembly. Tighten cable end.

   C. Place cable in cable bracket. Secure with jam nut.

2. Route brake cable to front of machine.

3. Install brake cable to brake equalizer:

   A. Pass cable through cable bracket on frame and position cable to brake equalizer.

   B. Attach cable to equalizer with clevis pin, flat washer and cotter pin.

   C. Position cable to cable bracket and adjust cable free play with jam nuts. There should be no slack in cable and brake equalizer should be perpendicular to vehicle centerline after adjustment.

4. Secure cable to machine with R−clamp.

5. Check operation of brakes before using the machine.

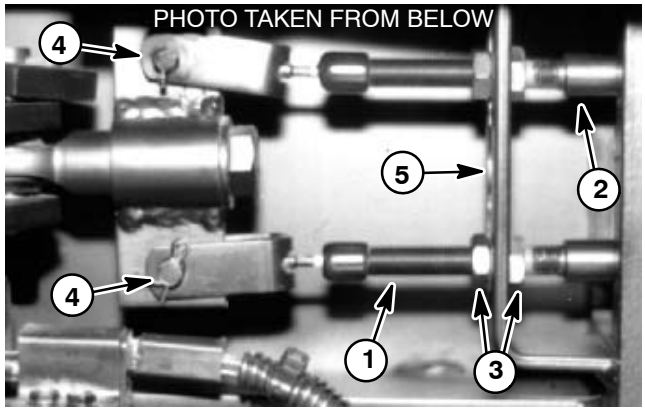

Figure 11

1. RH brake cable
2. LH brake cable
3. Cable jam nut
4. Clevis pin
5. Frame cable bracket

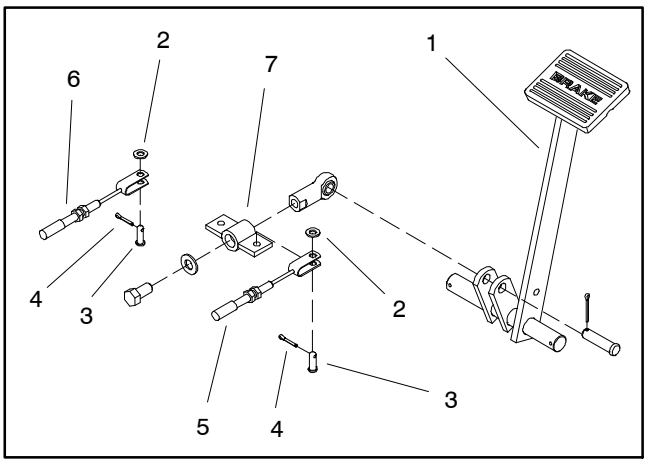

Figure 12

1. Brake pedal
2. Flat washer
3. Clevis pin
4. Cotter pin
5. RH brake cable
6. LH brake cable
7. Brake equalizer

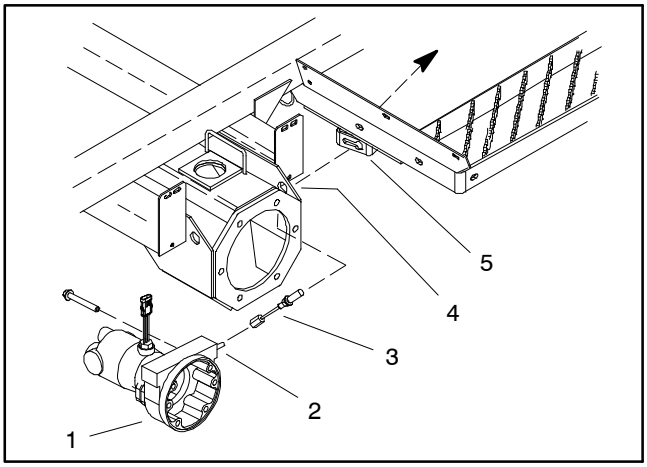

Figure 13

1. Brake (RH shown)
2. Brake pull rod
3. Brake cable (RH shown)
4. Axle frame hole
5. Cable bracket

Planetary Wheel Drive Assembly

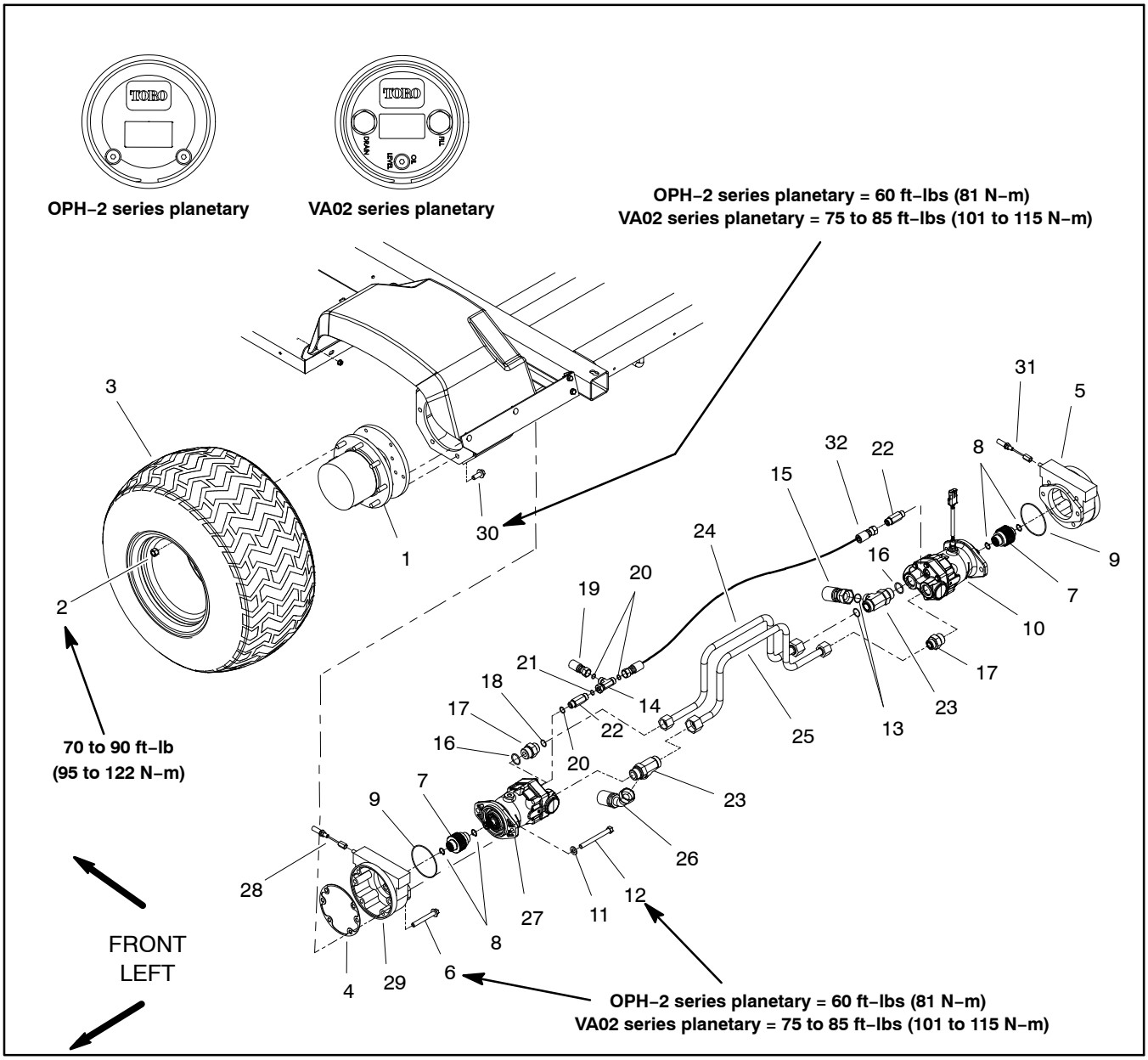

Figure 14

1. Planetary assembly (2 used)
2. Lug nut (8 used per wheel)
3. Tire and wheel assembly
4. Gasket
5. RH brake assembly
6. Flange head screw (4 used per brake)
   OPH−2 planetary = 90 mm lg
   VA02 planetary = 80 mm lg
7. Splined brake shaft
8. Retaining ring
9. O−ring
10. RH wheel motor
11. Flat washer (2 used per motor)
12. Cap screw (2 used per motor)
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
13. O−ring
14. Hydraulic tee fitting
15. Hyd. hose (to upper pump fitting)
16. O−ring
17. Hydraulic adapter
18. O−ring
19. Hydraulic hose (to reservoir)
20. O−ring
21. O−ring
22. Straight hydraulic fitting
23. Hydraulic tee fitting (2 used)
24. Hydraulic tube
25. Hydraulic tube
26. Hyd. hose (to lower pump fitting)
27. LH wheel motor
28. LH brake cable
29. LH brake assembly
30. Flange head screw (6 used per side)
31. RH brake cable
32. Hydraulic hose

NOTE: The planetary drive assembly can be serviced with the planetary installed to machine (see Planetary Wheel Drive Service in this section). Use the following procedure to remove and install planetary drive assembly from machine.

Removal (Fig. 14)

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

2. Drain the oil from the brake assembly and the Planetary drive; refer to the traction unit Operator's Manual.

CAUTION

When changing attachments, tires or performing other service, use correct supports, 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 other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. 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.

4. Remove rear wheel assembly.

5. Support wheel motor and brake assembly to prevent them from shifting during planetary removal.

6. Remove two (2) cap screws and flat washers that secure wheel motor to planetary assembly.

7. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly in this section of this chapter).

8. Support planetary assembly to prevent it from falling. Loosen and remove eight (8) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

9. Remove and discard gasket (item 4). Make sure that all gasket material and sealant is removed from both brake and planetary assemblies.

Installation (Fig. 14)

1. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with eight (8) flange head screws.

   For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

2. Apply gasket sealant (Loctite #2 or equivalent) to sealing surfaces of new gasket (item 4). Align gasket and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

   For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

3. Make sure wheel motor O−ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

   For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

4. Install front wheel assembly.

5. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

6. Check for proper brake operation and adjust brake cables if necessary.

WARNING

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

7. Lower machine to ground. Torque wheel lug nuts from **85 to 100 ft−lb (116 to 135 N−m)**.

OPH−2 Series Planetary Drive Service

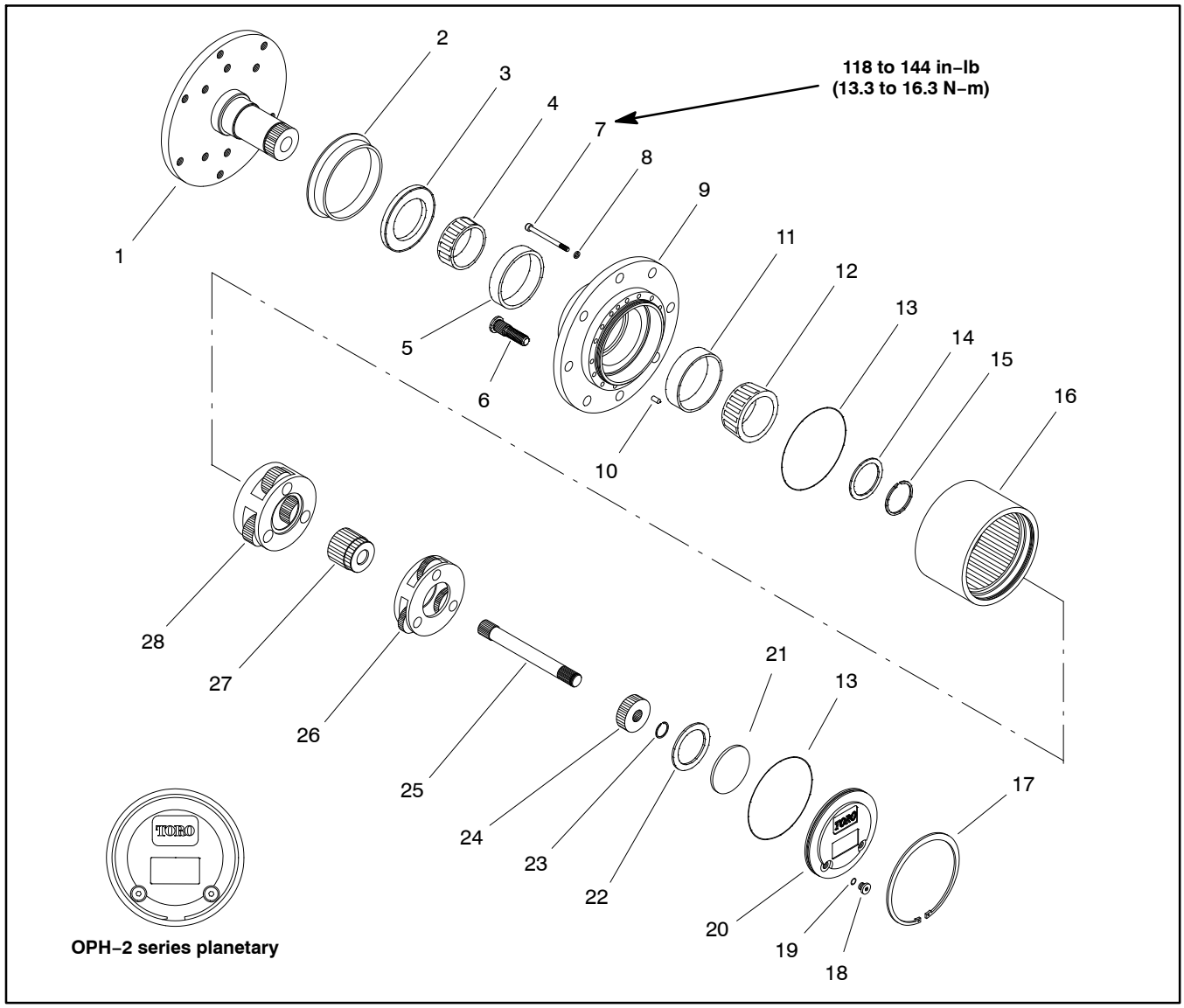

Figure 15

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8 used)
7. Socket head screw (16 used)
8. Lock washer (16 used)
9. Housing
10. Dowel pin (2 used)
11. Outer bearing cup
12. Outer bearing cone
13. O−ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2 used)
19. O−ring (2 used)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assembly
27. Secondary gear
28. Secondary carrier assembly

NOTE: The planetary drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed, see Planetary Wheel Drive Assembly in this section.

Disassembly (Figs. 15 and 16)

1. Park machine on a level surface, stop engine and remove key from the ignition switch.

2. Drain oil from planetary drive/brake assembly; refer to traction unit Operator's Manual.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove rear wheel assembly.

4. Remove retaining ring (item 17).

5. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

6. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

7. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 6 through 10 are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 15) after it has been removed.

8. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

9. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

10. Remove and discard seals (items 2 and 3) and O–rings (item 13) from housing.

11. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

12. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

13. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

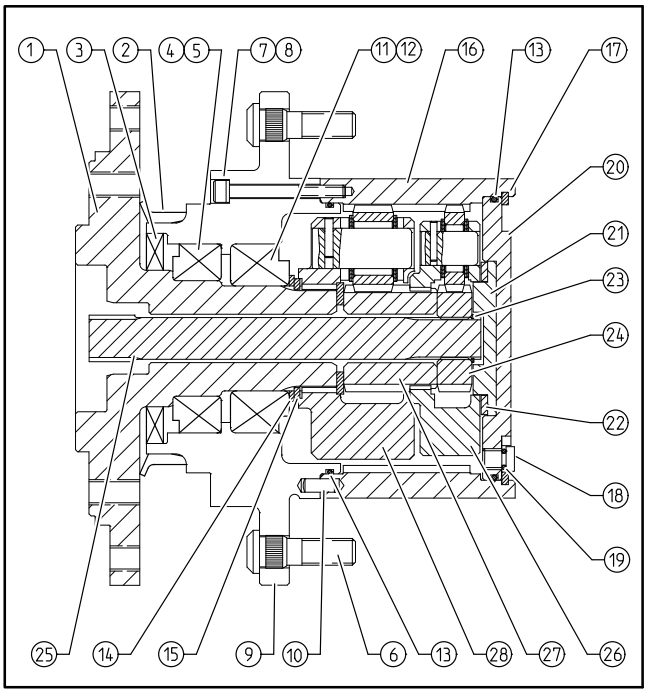

Figure 16

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8)
7. Socket head screw (16)
8. Lock washer (16)
9. Housing
10. Dowel pin (2)
11. Outer bearing cup
12. Outer bearing cone
13. O–ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2)
19. O–ring (2)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assy.
27. Secondary gear
28. Secondary carrier assy.

Assembly (Figs. 15 and 16)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary drive.

3. If spindle and housing were separated:

   A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

   B. Set inner bearing cone (item 4) into inner bearing cup.

C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

D. Pack boot seal (item 2) with grease and install on housing.

E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in−lb (13.3 to 16.3 N−m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing in housing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 in. (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated into the spindle groove. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O−ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O−ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

9. Check operation of planetary drive. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

10. Install rear wheel assembly.

11. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

12. Test planetary drive operation.

WARNING

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

13. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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VA02 Series Planetary Drive Service

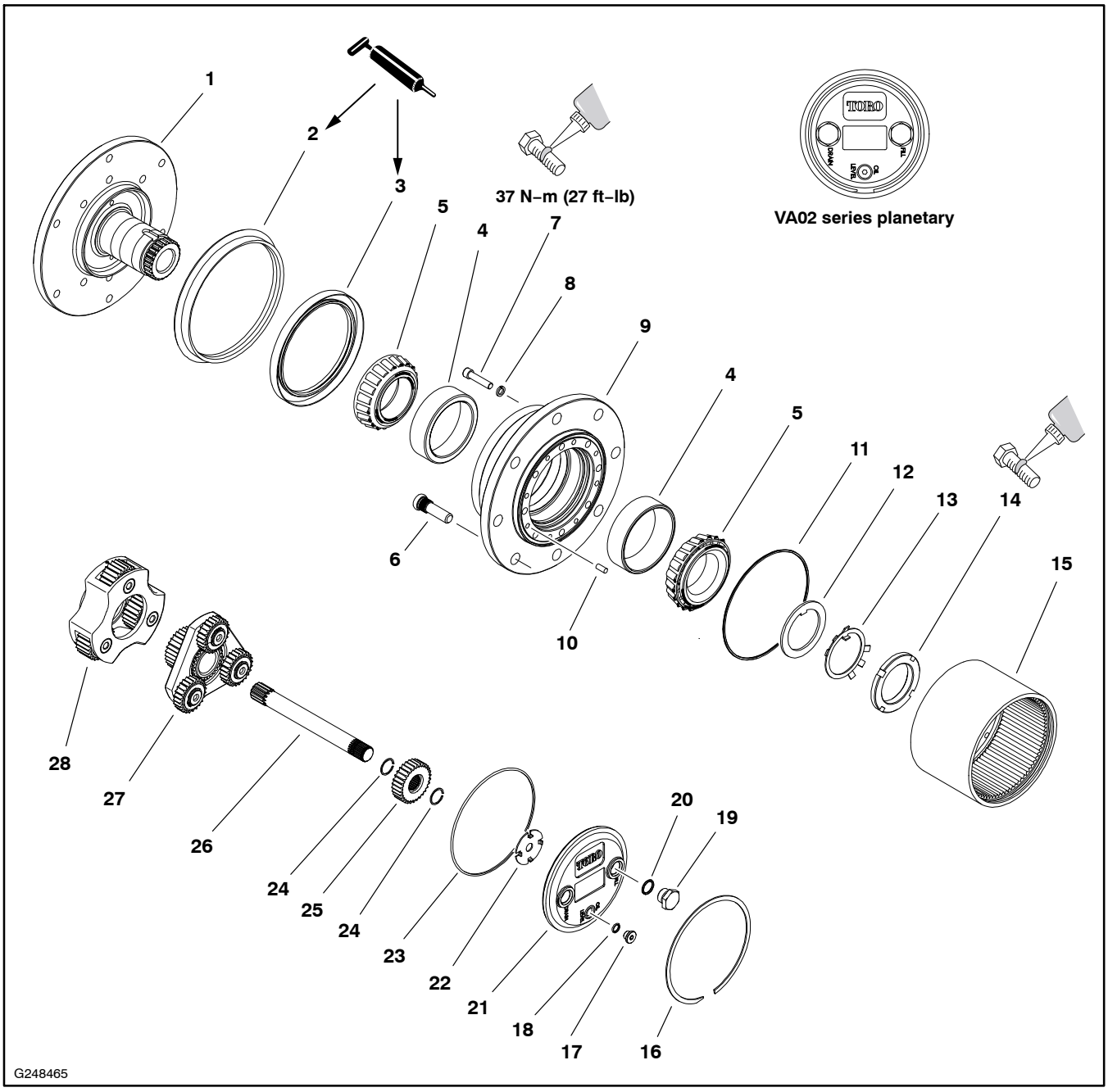

Figure 17

1. Spindle
2. Boot seal
3. Lip seal
4. Inner bearing cup (2)
5. Inner bearing cone (2)
6. Wheel stud (8)
7. Socket head screw (8)
8. Lock washer (8)
9. Housing
10. Dowel pin (4)
11. O−ring
12. Spacer
13. Locking washer
14. Lock nut
15. Ring gear
16. Retaining ring
17. Plug
18. O−ring
19. Plug (2)
20. O−Ring (2)
21. End cap
22. Thrust plate
23. O−Ring
24. Retaining ring (2)
25. Primary gear
26. Drive shaft
27. Primary carrier assembly
28. Secondary carrier assembly

NOTE: The planetary drive assembly is best serviced with the planetary installed to machine or the spindle firmly secured to a fixture or workbench. If the spindle (item 1) needs to be removed from machine, see Planetary Drive Assembly in this chapter.

Disassembly

1. Park machine on a level surface, stop engine and remove key from the ignition switch.

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

3. Chock **rear**/**front** wheels and jack up **front**/**rear** of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove rear wheel assembly.

4. Remove retaining ring (item 16).

5. Remove end cap and thrust plate. Retrieve and discard O–ring from ring gear bore.

6. Remove primary gear and drive shaft assembly (items 24–26).

7. Remove primary carrier and secondary carrier from ring gear.

8. Bend the locking washer tab away from the lock nut. Use a TMFS12 spanner socket to remove the 55 x 1.5 mm lock nut. Remove the locking washer and spacer. Discard the locking washer.

9. Carefully remove housing and bearing cones from spindle.

10. Remove and discard seals from housing.

11. If necessary, remove bearing cups from housing.

12. If wheel stud removal is necessary, use a press to remove the stud(s) from the housing.

13. If necessary, remove the ring gear from the housing:

    NOTE: High strength thread locking compound was used during assembly. It may be necessary to heat the ring gear near the mounting screws to release the screws.

    A. Remove socket head screws (item 7) and lock washers that secure the ring gear to the housing.

    B. Remove the ring gear and retrieve the four (4) dowel pins (item 10) from housing.

    C. Remove the O–ring from the housing bore and discard.

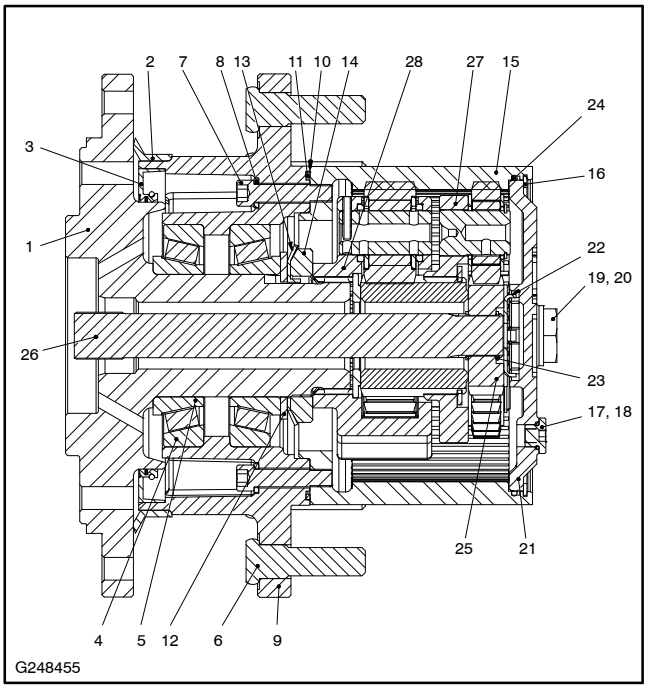

Figure 18

1. **Spindle**
2. **Boot seal**
3. **Lip seal**
4. **Inner bearing cup (2)**
5. **Inner bearing cone (2)**
6. **Wheel stud (8)**
7. **Socket head screw (8)**
8. **Lock washer (8)**
9. **Housing**
10. **Dowel pin (4)**
11. **O–ring**
12. **Spacer**
13. **Locking washer**
14. **Lock nut**
15. **Ring gear**
16. **Retaining ring**
17. **Plug**
18. **O–ring**
19. **Plug (2)**
20. **O–Ring (2)**
21. **End cap**
22. **Thrust plate**
23. **O–Ring**
24. **Retaining ring (2)**
25. **Primary gear**
26. **Drive shaft**
27. **Primary carrier asm**
28. **Secondary carrier asm**

Assembly

NOTE: Use new seals, O–rings and locking washer when assembling the planetary drive.

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

3. If ring gear was removed from housing:

    A. Fit four (4) dowel pins in housing.

    B. Apply a light coat of grease to a new O–ring and install it in the housing bore.

    C. Apply high strength thread locking compound and secure ring gear to housing with lock washers and socket head screws. Tighten screws to **27 ft–lb (37 N–m)**.

4. If previously removed, press bearing cups into housing. Cups should be pressed fully to shoulder of the housing bore.

5. Fit inner bearing cone onto spindle. Make sure inner bearing cone seats fully against spindle shoulder. If inner bearing is not seated fully, lightly tap bearing cone on inner hub until it seats properly.

6. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal is not rubber or does not have a sealant coating, apply a light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face.

7. Install boot seal. Cover surface of lip seal and boot seal with grease.

8. Lightly oil bearing cups then place housing assembly over spindle and inner bearing cone. Take care to not damage seals or spindle during installation.

9. Fit outer bearing cone onto spindle.

10. Align key on spacer and install spacer onto spindle shaft.

11. Align key on locking washer and install locking washer onto spindle shaft.

IMPORTANT: .Perform the following steps without interruption. Once the thread locking compound is applied, you have only a few minutes before the curing process will influence the bearing lock nut torque.

12. Install the bearing lock nut:

A. Apply high strength thread locking compound (Loctite 263 or equivalent) and install the lock nut.

B. Tighten the lock nut to **110 ft−lb (150 N−m)**.

C. Rotate the housing on the spindle a few revolutions to align the bearings.

D. Tighten the lock nut to **150 ft−lb (200 N−m)**.

E. Rotate the housing on the spindle a few revolutions to seat the bearings.

IMPORTANT If installing the bearing nut with the spindle installed on machine, have an assistant hold the housing firmly in position during the following step.

F. Loosen the lock nut completely, then tighten to **90 ft−lb (122 N−m).**

IMPORTANT: Continue to tighten the lock nut until it aligns with one of the locking washer tabs. Do Not loosen the lock nut to align it with the locking washer tabs.

G. Secure the lock nut by bending one of the locking washer tabs into a slot in the lock nut.

13. Install secondary carrier and primary carrier making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

14. If primary gear (item 25) was removed from drive shaft, slide gear onto shaft and secure with retaining rings.

15. Install drive shaft assembly (items 24−26) making sure that drive shaft spline aligns with carrier gears.

16. Cover the outer face of the thrust plate with grease and fit thrust plate onto end cap. Make sure that thrust plate tabs are captive in end cap.

17. Apply a light coat of grease to a new O−ring and install it in the ring gear bore. Avoid pinching or cutting the O−ring and install the end cap. Use a soft mallet to fully seat the end cap.

18. Secure the end cap with the retaining ring. Make sure the retaining ring is fully seated in the ring groove.

19. Check operation of planetary drive by hand. 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.

20. Install rear wheel assembly.

21. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

22. Test planetary drive operation.

WARNING

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

23. Lower machine from jack stands. Torque wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Console Assembly

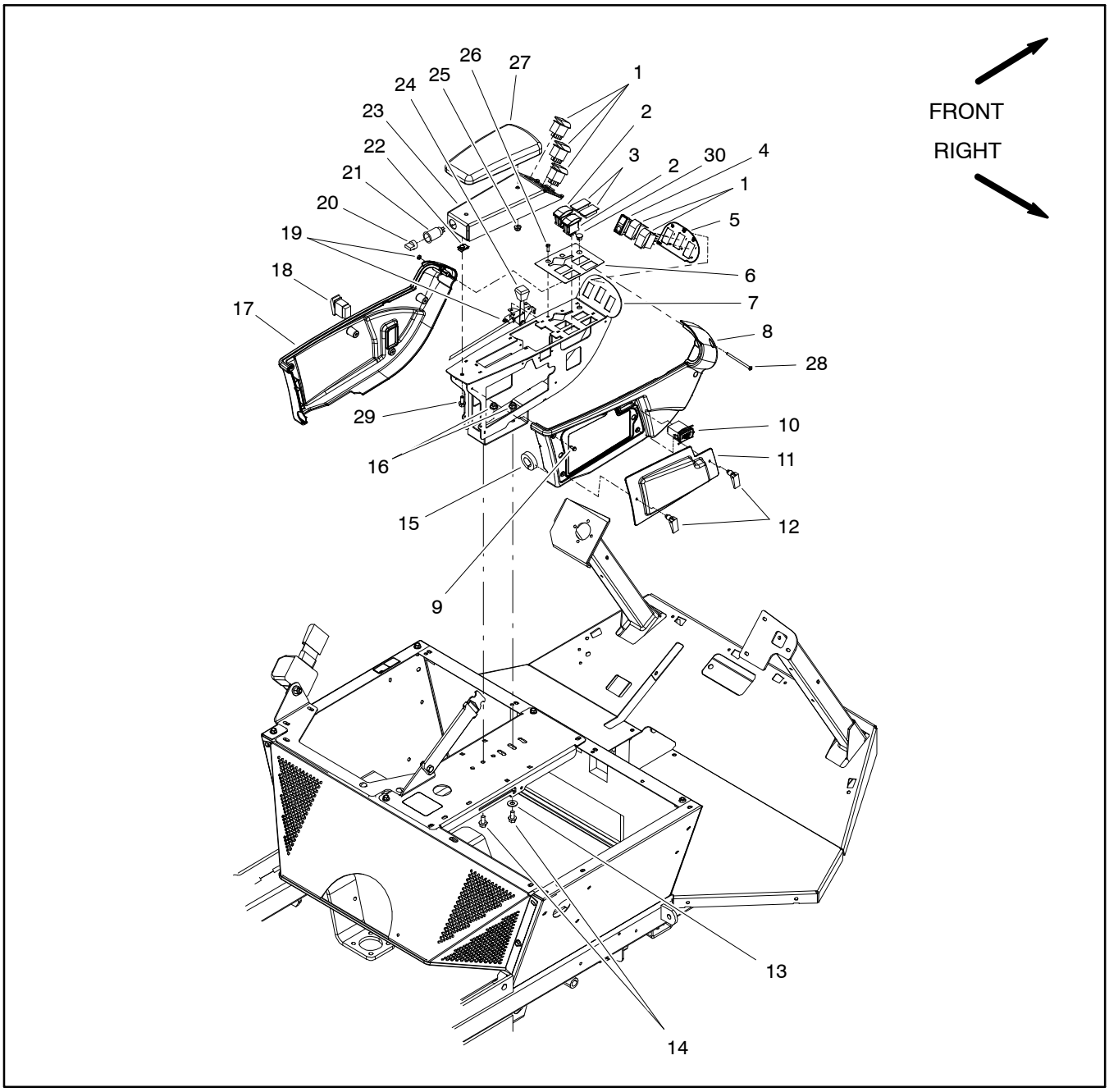

Figure 19

1. Switch (5 used)
2. Switch (2 used)
3. Hole plug (2 used)
4. Switch
5. Upper console decal
6. Lower console decal
7. Arm panel
8. RH cover
9. Washer head screw (10 used)
10. Hour meter
11. Access panel
12. Swell latch (2 used)
13. Flat washer
14. Flange head screw (2 used)
15. Foam seal
16. Flange nut (2 used)
17. LH cover
18. Headlight switch
19. Lock nut (3 used)
20. Cap
21. Power point
22. Tinnerman nut
23. Console arm
24. Throttle control
25. Flange nut (2 used)
26. Washer head screw (2 used)
27. Arm rest
28. Phillips head screw
29. Flange head screw
30. Hole plug

Disassembly (Fig. 19)

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

2. Loosen latches and remove access cover from outside of console assembly.

3. At front of console assembly, remove screw (item 28) and lock nut (item 19) that secure console arm covers to each other.

4. Remove five (5) washer head screws (item 9) that secure each cover to console assembly.

5. Remove console assembly covers from machine. As LH console cover (item 17) is removed from console assembly, unplug wire harness connector from headlight switch.

6. Remove components from console assembly as needed using Figures 19 and 20 as guides.

Assembly (Fig. 19)

1. Install all removed components to console assembly using Figures 19 and 20 as guides.

2. Position covers to console assembly. As LH cover (item 17) is placed, plug wire harness connector to headlight switch. Also, make sure that wire harness and throttle control cable are routed correctly through cover openings.

3. Secure each cover to console assembly with five (5) washer head screws (item 9). Install screw (item 28) and lock nut (item 19) to secure covers at front of console assembly.

4. Install access panel to outside of console assembly.

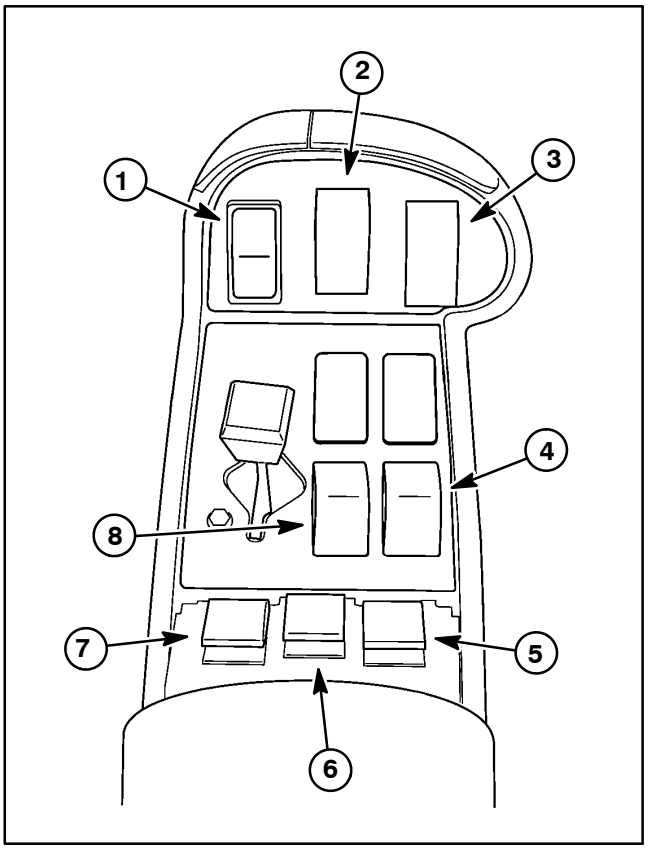

Figure 20

1. **Speed lock switch**
2. **Agitation switch**
3. **Pump switch**
4. **RH boom lift switch**
5. **RH boom switch**
6. **Center boom switch**
7. **LH boom switch**
8. **LH boom lift switch**

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Chapter 7.1

Ultra Sonic Boom System (Optional Kit)

Table of Contents

General Information

Installation Instructions

The Ultra Sonic Boom Kit Installation Instructions provides information regarding the installation, operation and general maintenance for your Ultra Sonic Boom System. Refer to that publication for additional information when servicing the machine.

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil and other property. To eliminate environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (refer to container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Park vehicle on a level surface and apply the parking brake.

2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure spray system pressure is relieved before loosening any system component.

Special Tools

Diagnostic Display

The Diagnostic Display (Fig. 1) can be connected to the Ultra Sonic Boom wire harness communication connector to verify correct electrical functions of the Ultra Sonic Boom System. Toro electronic controller (TEC) inputs and outputs for the Ultra Sonic Boom System can be checked using the Diagnostic Display.

Toro Part Number for Diagnostic Display: **85-4750**

Toro Part Number for Overlay (English)**: 119-9432**

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to wire harness communication connector. Machine will not operate without loopback connector installed on wire harness. Store Diagnostic Display in a dry, secure, indoor location and not on machine.

Figure 1

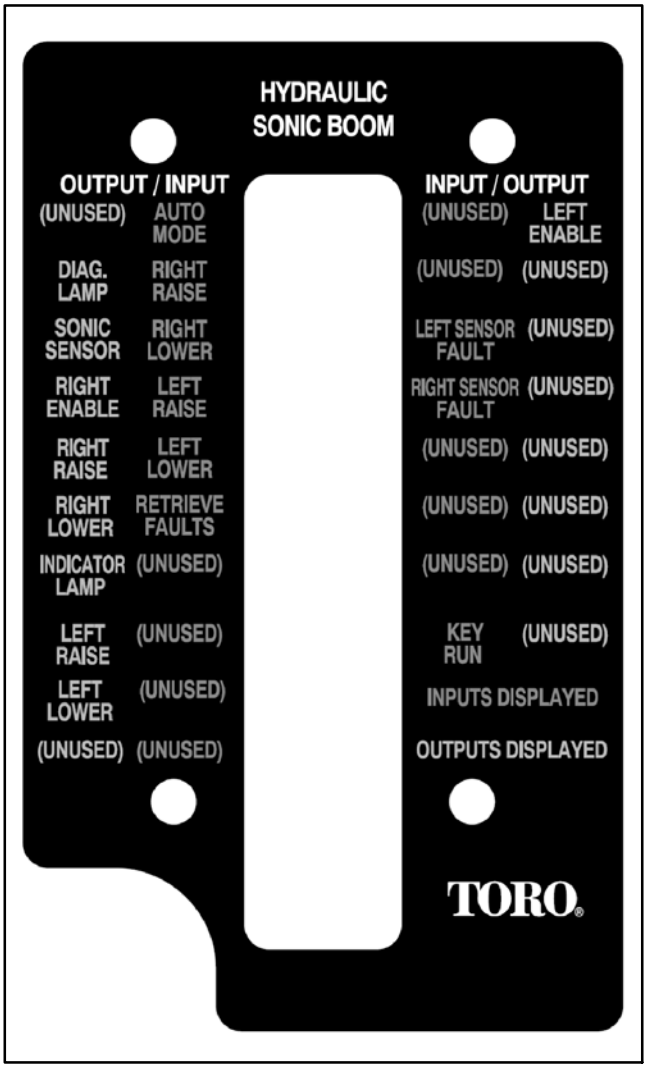
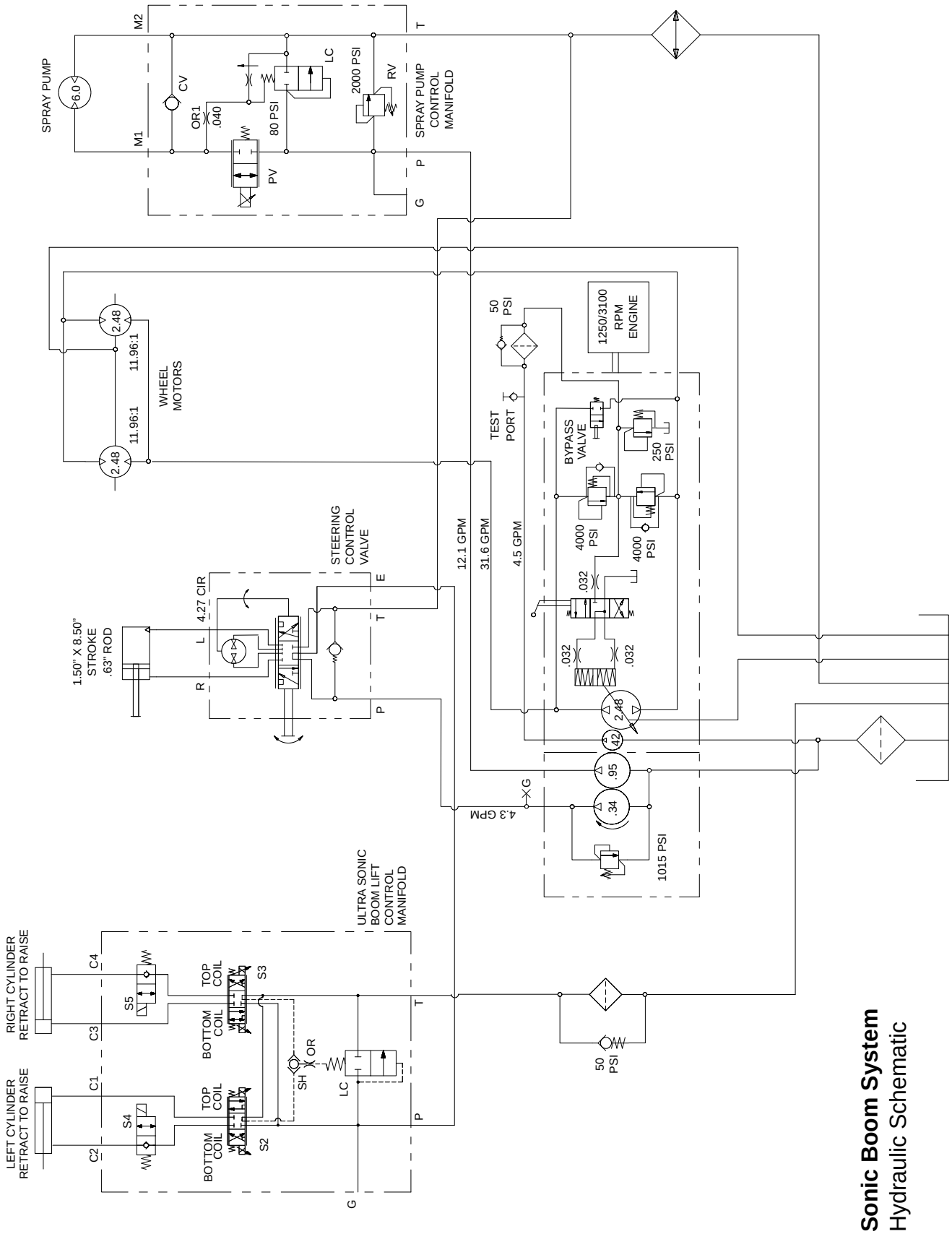


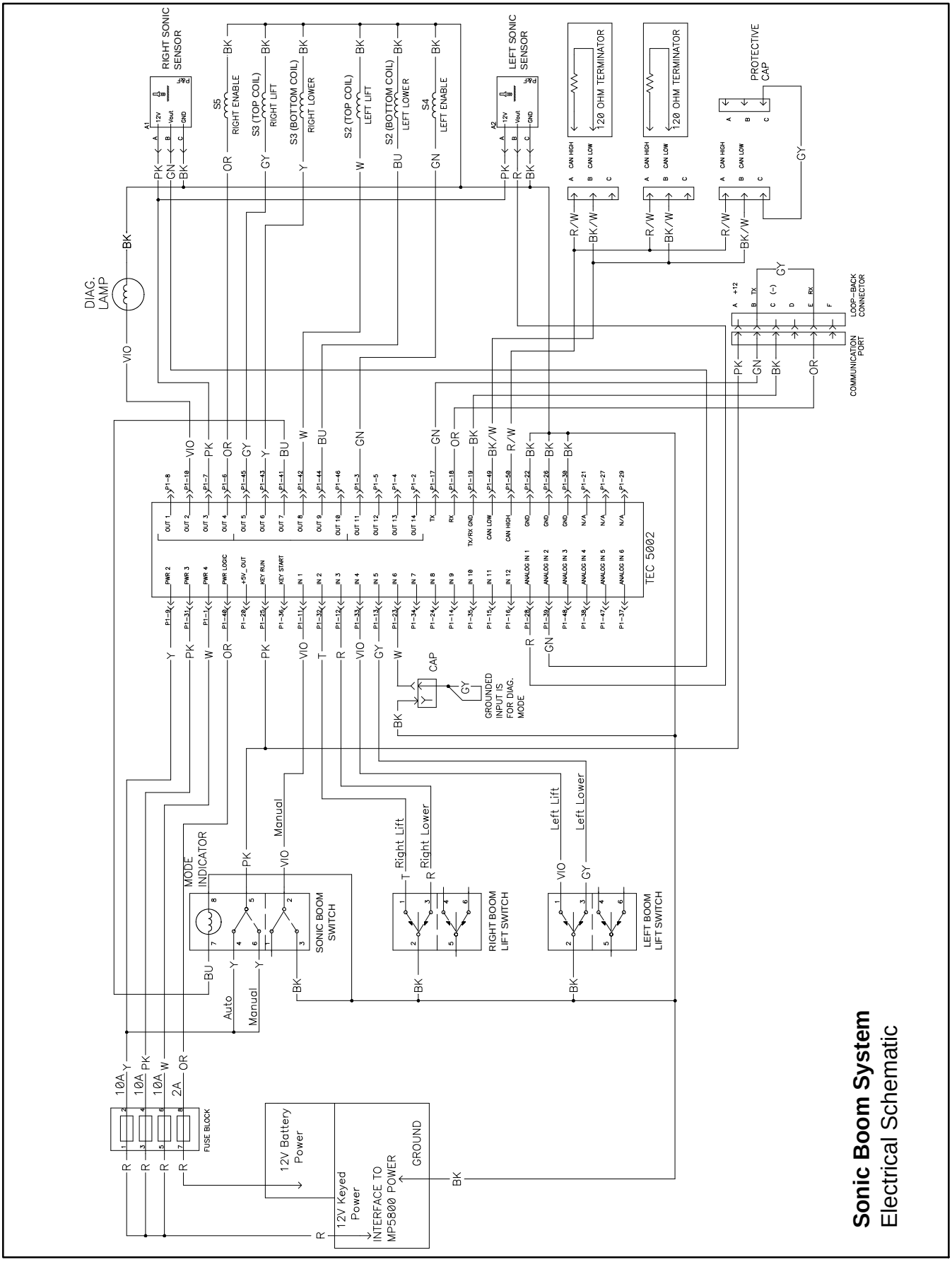
Figure 2

Hydraulic Schematic

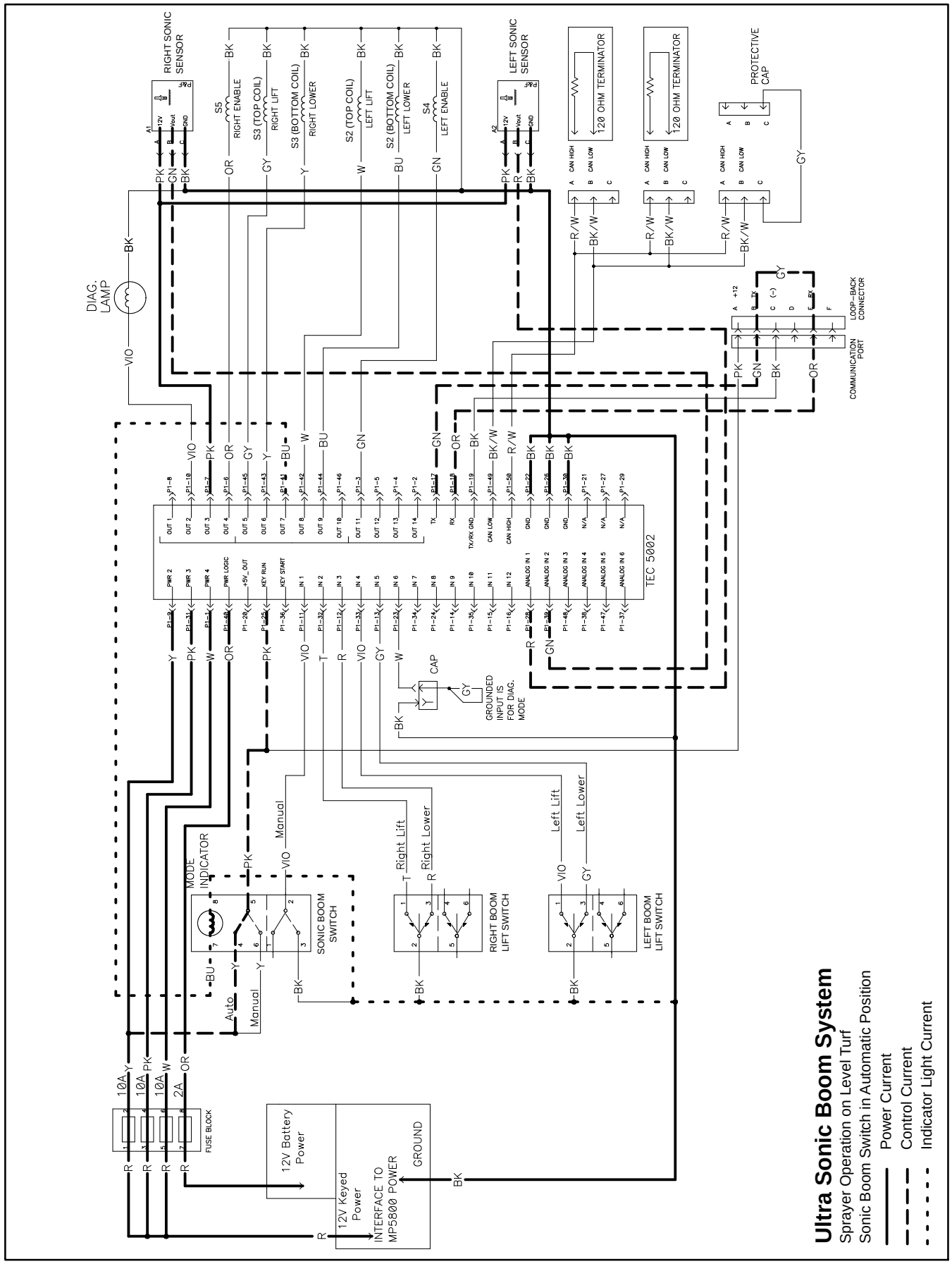


Sonic Boom System
Hydraulic Schematic

Electrical Schematic



Ultra Sonic Boom System Operation



Sprayer Operation on Level Turf

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echoes as the signals bounce off the turf. The Toro electronic controller (TEC) determines the sensor distance from the ground based on the elapsed time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom will remain at a fixed height from the ground for spraying accuracy.

On level turf, the boom sensors continually send signals and receive echoes that determine that the boom sections are at the calibrated height. Thus, there is no need to change boom height. The TEC does not energize lift control manifold solenoid coils so hydraulic flow bypasses the boom lift cylinders (Fig. 3). The boom sections will remain at the correct, level position.

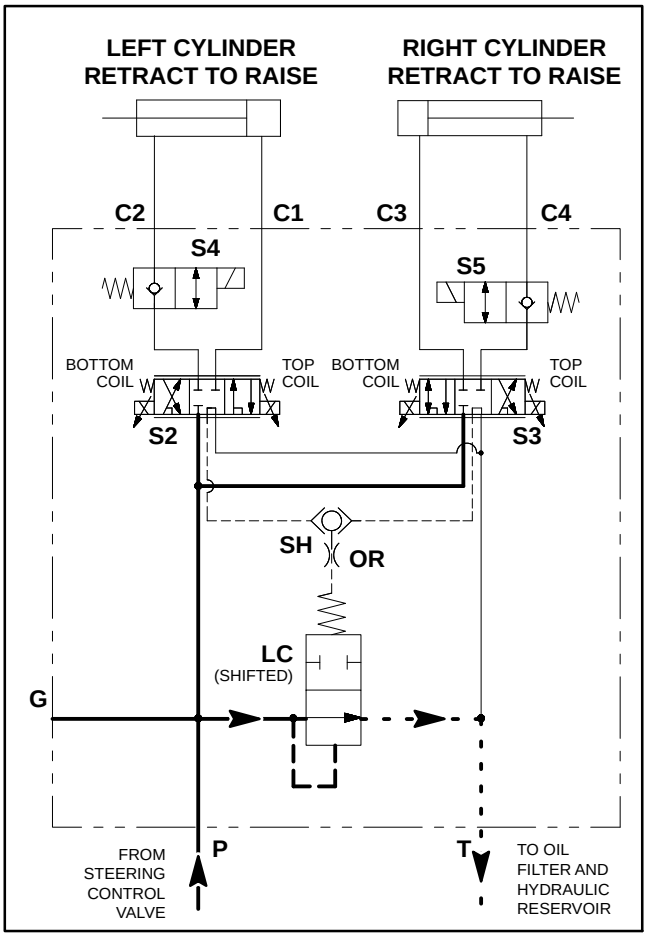


Figure 3

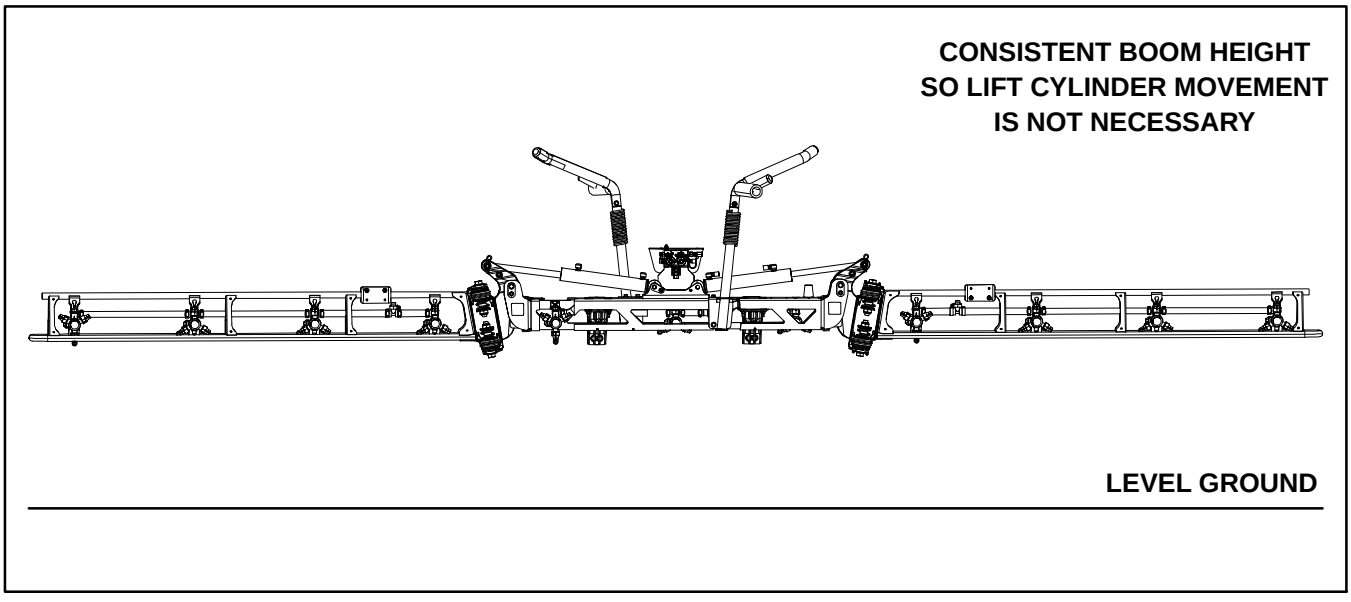
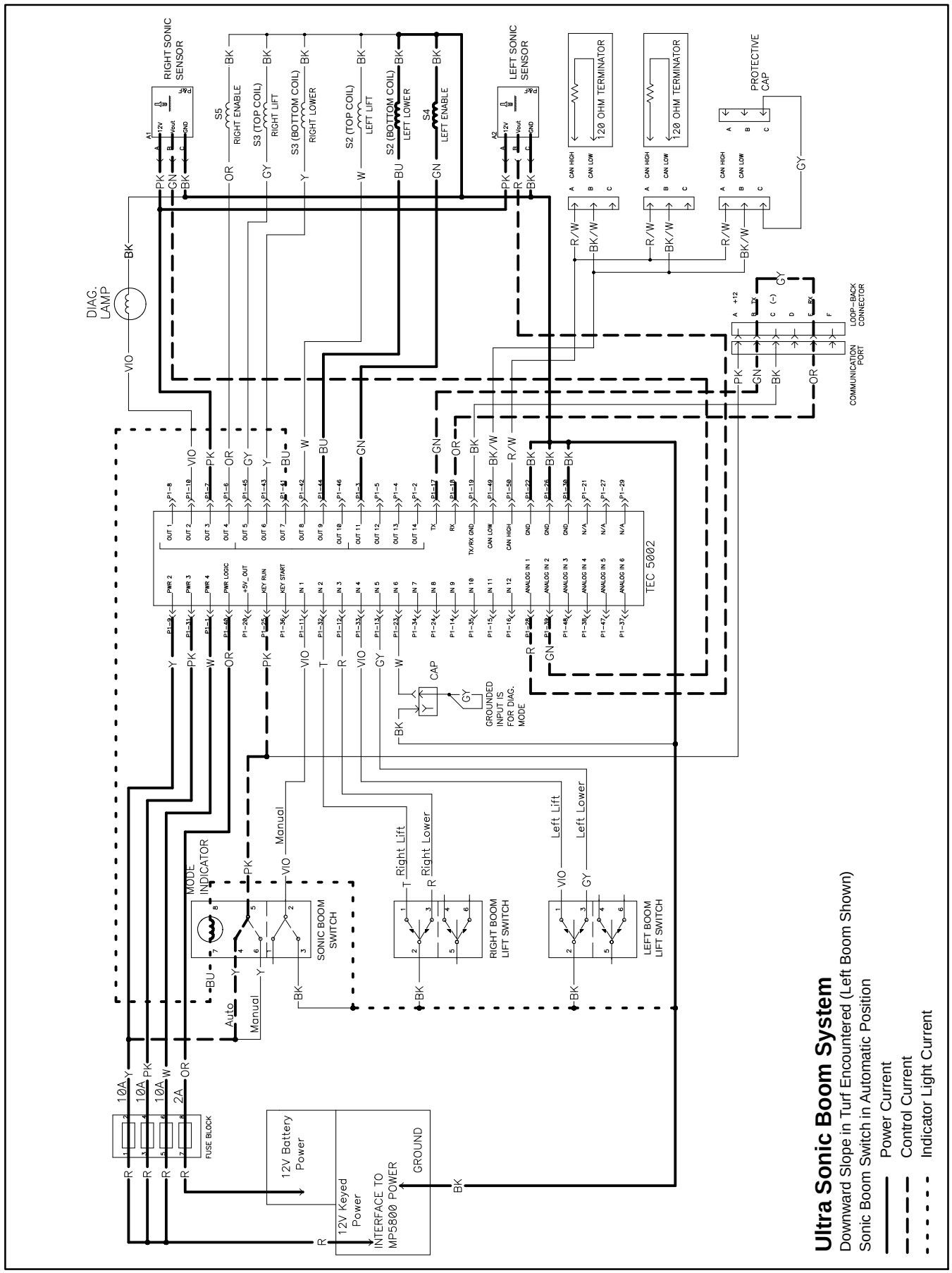


Figure 4


Ultra Sonic Boom System
Downward Slope in Turf Encountered (Left Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
DIAG. LAMP
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
TEC 5002
120 OHM TERMINATOR
PROTECTIVE CAP
LOOP-BACK CONNECTOR
COMMUNICATION PORT
FUSE BLOCK
12V Battery Power
12V Keyed Power
INTERFACE TO MP5800 POWER
GROUND
GROUNDED INPUT IS FOR DIAG. MODE
S5 RIGHT ENABLE
S3 (TOP COIL) RIGHT LIFT
S3 (BOTTOM COIL) RIGHT LOWER
S2 (TOP COIL) LEFT LIFT
S2 (BOTTOM COIL) LEFT LOWER
S4 LEFT ENABLE
Auto
Manual
Right Lift
Right Lower
Left Lift
Left Lower

Downward Slope in Turf Encountered

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echoes as the signals bounce off the turf. The Toro electronic controller (TEC) determines the sensor distance from the ground based on the elapsed time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom section will remain at a fixed distance from the ground for spraying accuracy.

When a spray boom section encounters a downward slope in the turf, the time necessary for the sensor to receive the signal echo is longer than the calibrated timeframe. This change in time causes the TEC to energize the appropriate solenoid valve coils in the hydraulic boom lift control manifold. The energized coils provide hydraulic flow from the gear pump to the barrel end of the boom lift cylinder causing the cylinder to extend and the boom section to lower. Once the boom section is lowered to the calibrated distance, the elapsed time between the sensor signal generation and the received echo returns to the correct timeframe, manifold coils are de–energized and the boom stops lowering. This maintains the boom height at the calibrated distance from the ground.

The boom sensor target distance is initiated during initial sonic boom calibration and is typically set at twenty (20) inches. If the boom target distance changes when in automatic mode, the TEC will energize the appropriate lift control manifold solenoid coil(s). The energized coils will lead to a change in boom lift cylinder length and ultimately a change in boom height.

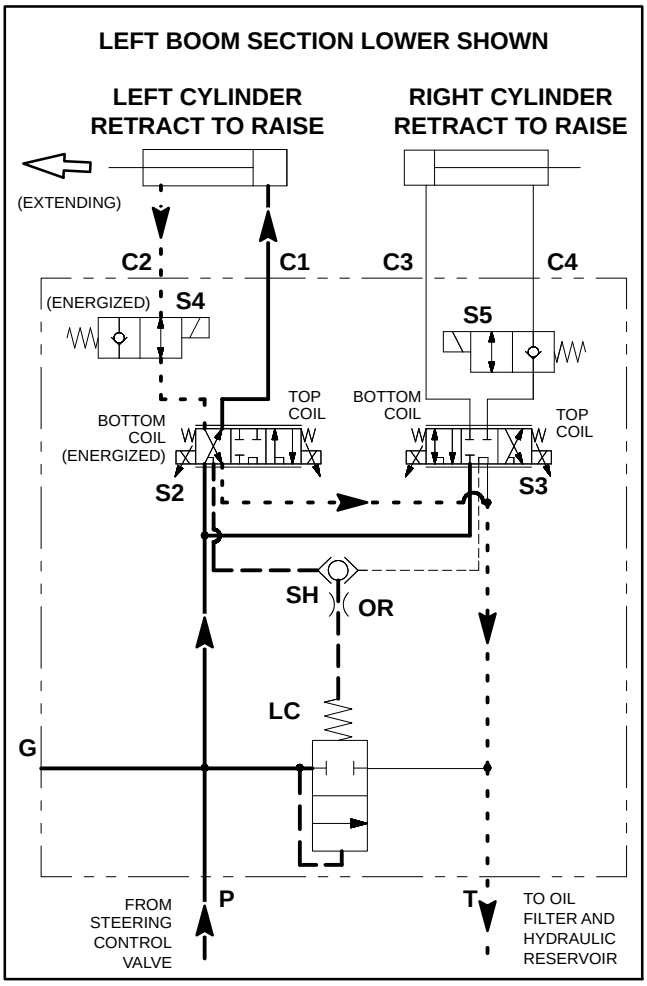


Figure 5

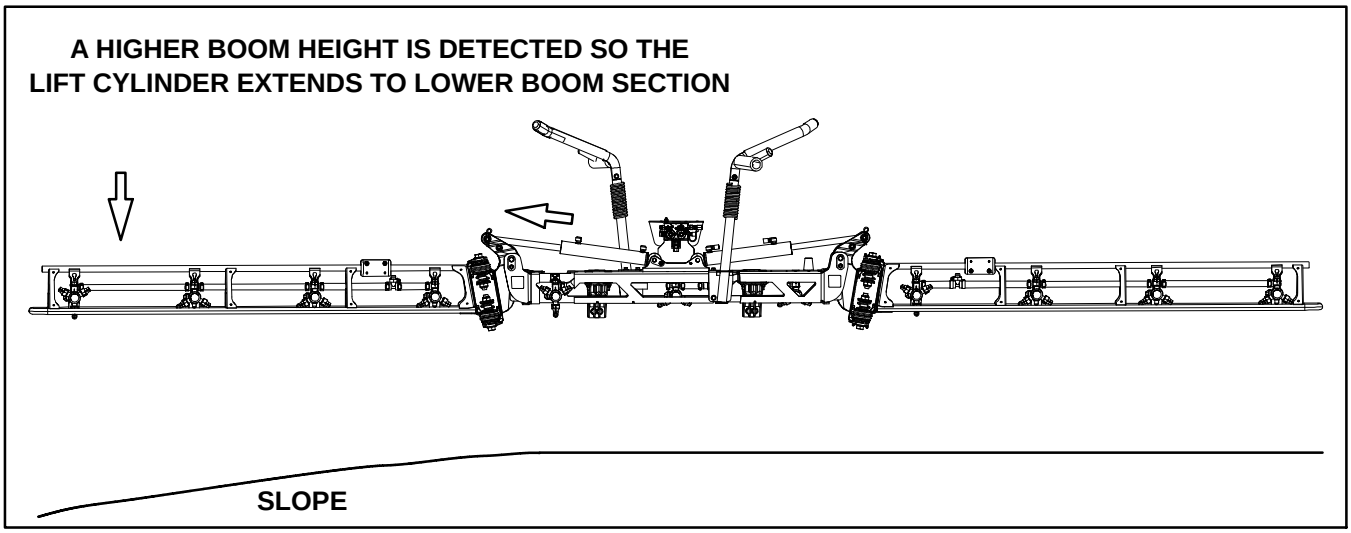
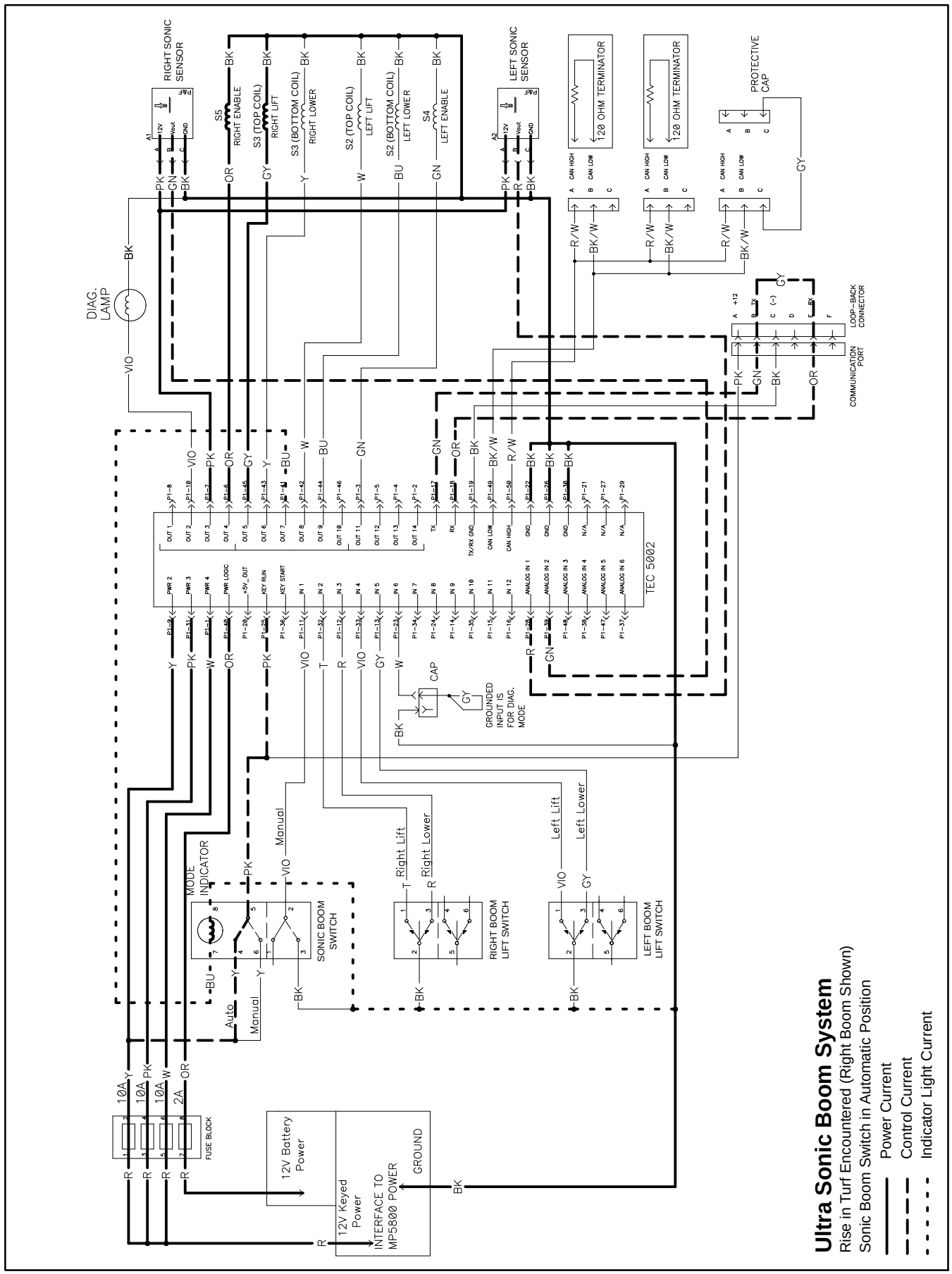


Figure 6


Ultra Sonic Boom System
Rise in Turf Encountered (Right Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
DIAG. LAMP
S5 RIGHT ENABLE
S3 (TOP COIL) RIGHT LIFT
S3 (BOTTOM COIL) RIGHT LOWER
S2 (TOP COIL) LEFT LIFT
S2 (BOTTOM COIL) LEFT LOWER
S4 LEFT ENABLE
120 OHM TERMINATOR
PROTECTIVE CAP
LOOP-BACK CONNECTOR
COMMUNICATION PORT
TEC 5002
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
GROUNDED INPUT IS FOR DIAG. MODE
FUSE BLOCK
10A
10A
10A
2A
12V Battery Power
12V Keyed Power
INTERFACE TO MP5800 POWER
GROUND
Auto
Manual
Right Lift
Right Lower
Left Lift
Left Lower

Rise in Turf Encountered

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echoes as the signals bounce off the turf. The Toro electronic controller (TEC) determines the sensor distance from the ground based on the time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom section will remain at a fixed distance from the ground for spraying accuracy.

When a spray boom section encounters a rise in the turf, the time necessary for the sensor to receive the signal echo is shorter than the calibrated timeframe. This change in time causes the TEC to energize the appropriate lift control manifold solenoid coils. The energized coils provide hydraulic flow from the gear pump to the rod end of the boom lift cylinder causing the cylinder to retract and the boom section to raise. This maintains the boom height at the calibrated distance from the ground. Once the boom section is raised to the calibrated distance, the elapsed time between the sensor signal generation and the received echo returns to the correct timeframe and the boom stops raising.

The boom sensor target distance is initiated during initial sonic boom calibration and is typically set at twenty (20) inches. If the boom target distance changes when in automatic mode, the TEC will energize the appropriate lift control manifold solenoid coil(s). The energized coils will lead to a change in boom lift cylinder length and ultimately a change in boom height.

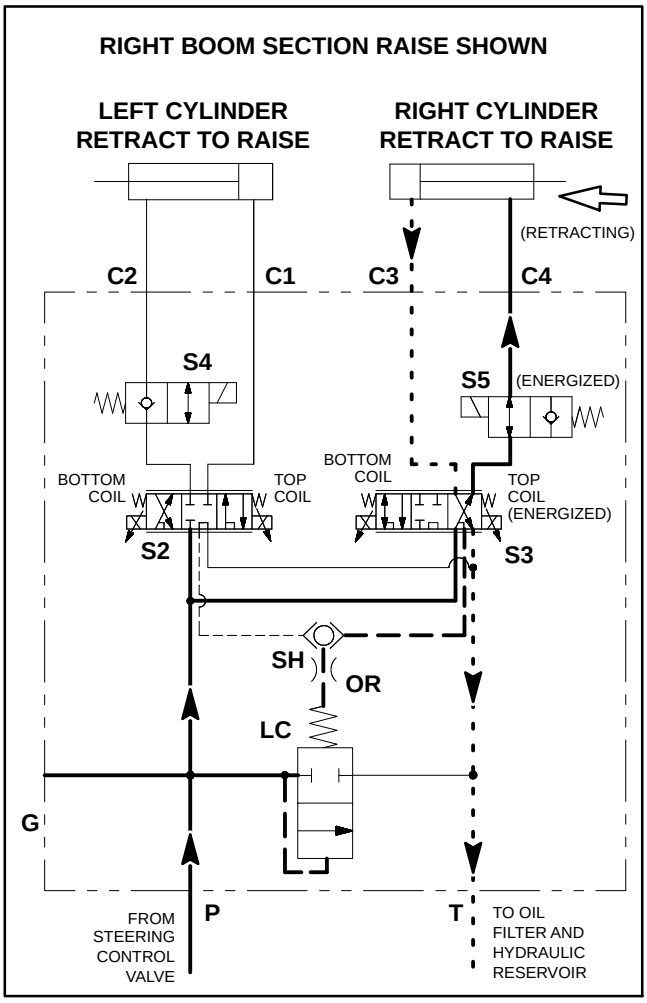


Figure 7

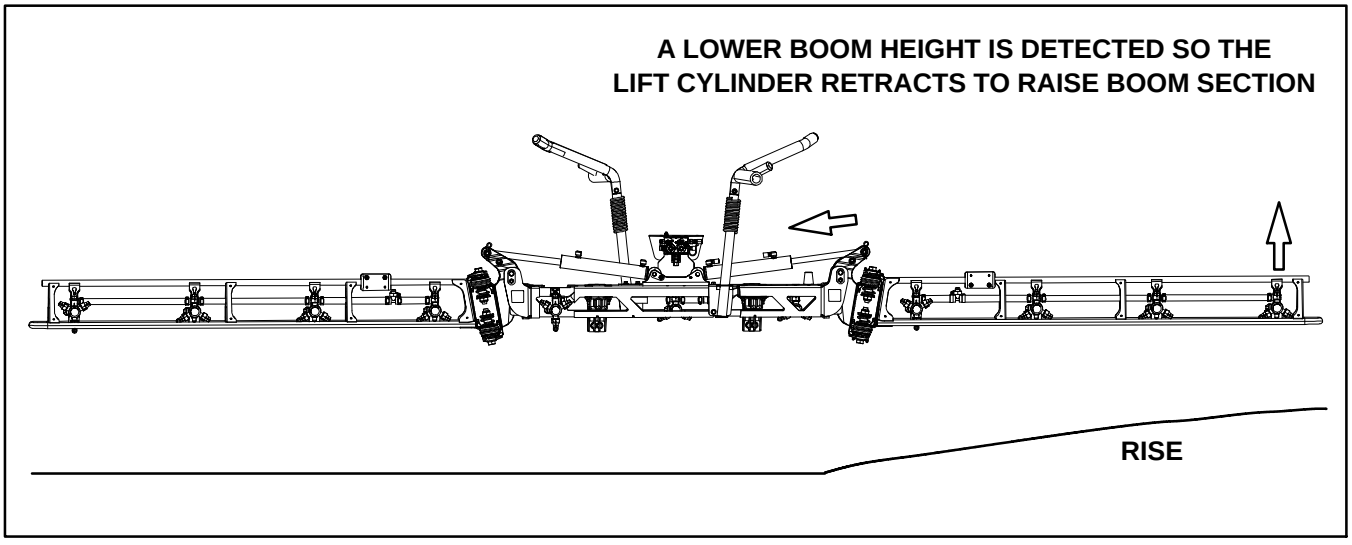
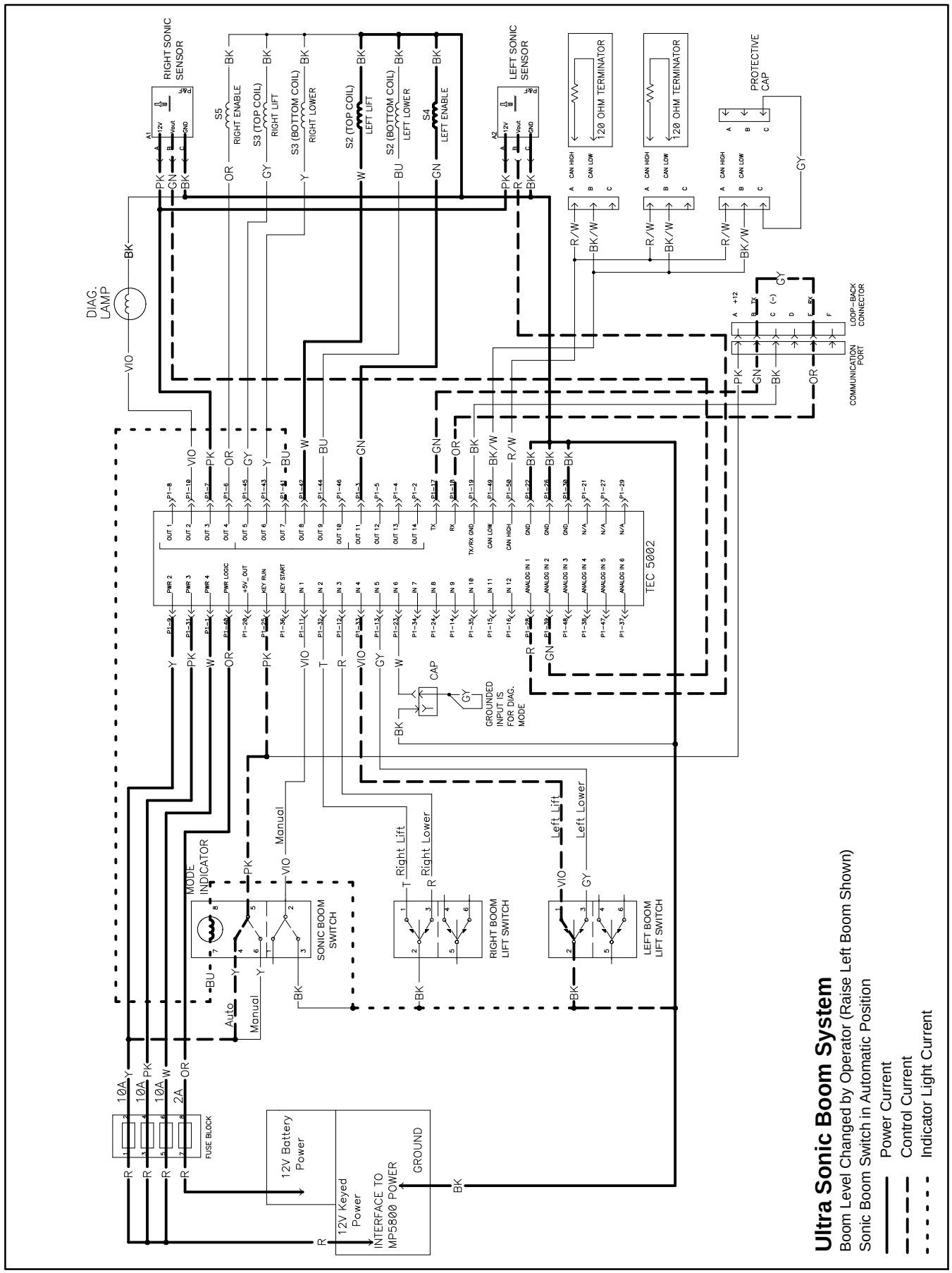


Figure 8


Ultra Sonic Boom System
Boom Level Changed by Operator (Raise Left Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
TEC 5002
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
120 OHM TERMINATOR
PROTECTIVE CAP
DIAG. LAMP
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
FUSE BLOCK
12V Battery Power
12V Keyed Power
GROUND
INTERFACE TO MP5800 POWER
COMMUNICATION PORT
LOOP-BACK CONNECTOR
GROUNDED INPUT IS FOR DIAG. MODE
CAP
Auto
Manual
Right Lift
Right Lower
Left Lift
Left Lower
S5 RIGHT ENABLE
S3 (TOP COIL) RIGHT LIFT
S3 (BOTTOM COIL) RIGHT LOWER
S2 (TOP COIL) LEFT LIFT
S2 (BOTTOM COIL) LEFT LOWER
S4 LEFT ENABLE

Boom Level Changed by Operator During Automatic Operation

During sprayer operation with the sonic boom switch in the automatic position (sonic boom switch light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echoes as the signals bounce off the turf. The Toro electronic controller (TEC) determines the sensor distance from the ground based on the time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom will remain at a fixed distance from the ground for spraying accuracy.

If the sprayer operator should press a boom lift switch while in automatic operation, the TEC energizes the appropriate boom lift control manifold solenoid coils. The energized coils provide hydraulic flow from the gear pump to the boom lift cylinder causing the cylinder to raise or lower the boom section. The solenoids will stay energized as long as the operator keeps the boom lift switch pressed. The sonic boom light will flash while the boom lift switch is being depressed. If one boom is moved by the operator, the other boom continues to function automatically.

If a boom is raised by the operator while the Ultra Sonic Boom System is in automatic operation, that boom will remain in the raised position until the boom lift switch is pressed to lower and released which will re-engage automatic sonic boom operation on that boom section.

If a boom is lowered by the operator while the Ultra Sonic Boom System is in automatic operation, that boom will lower until the boom lift switch is released. The automatic sonic boom operation will be re-engaged as soon as the lift switch is released from lower.

NOTE: To re-engage automatic sonic boom operation, the boom lift switch must be pressed to lower and released. Pressing the boom lift switch to raise will not re-engage automatic operation.

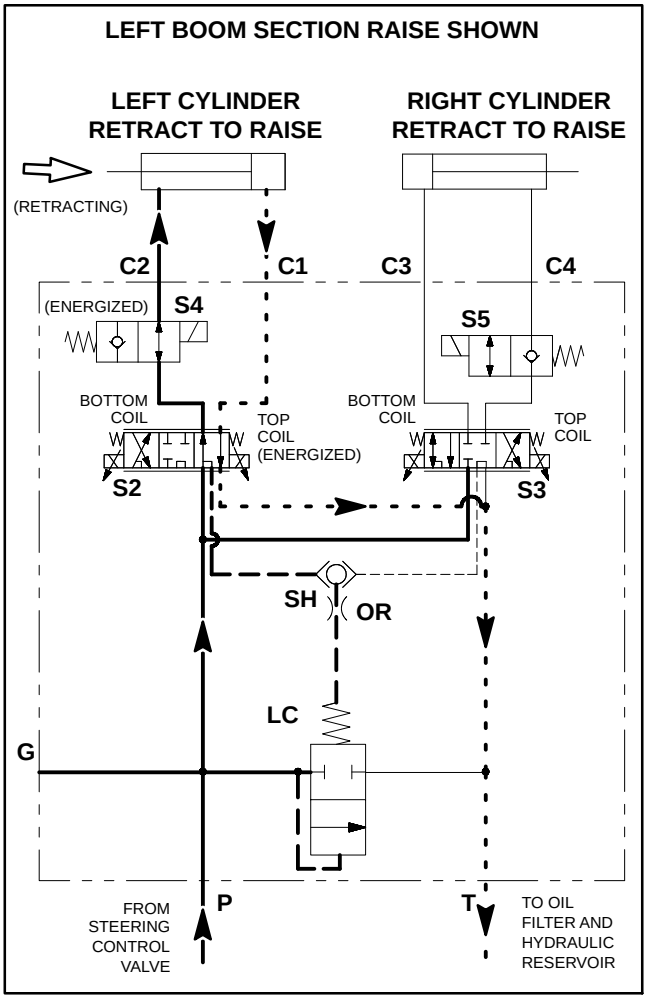
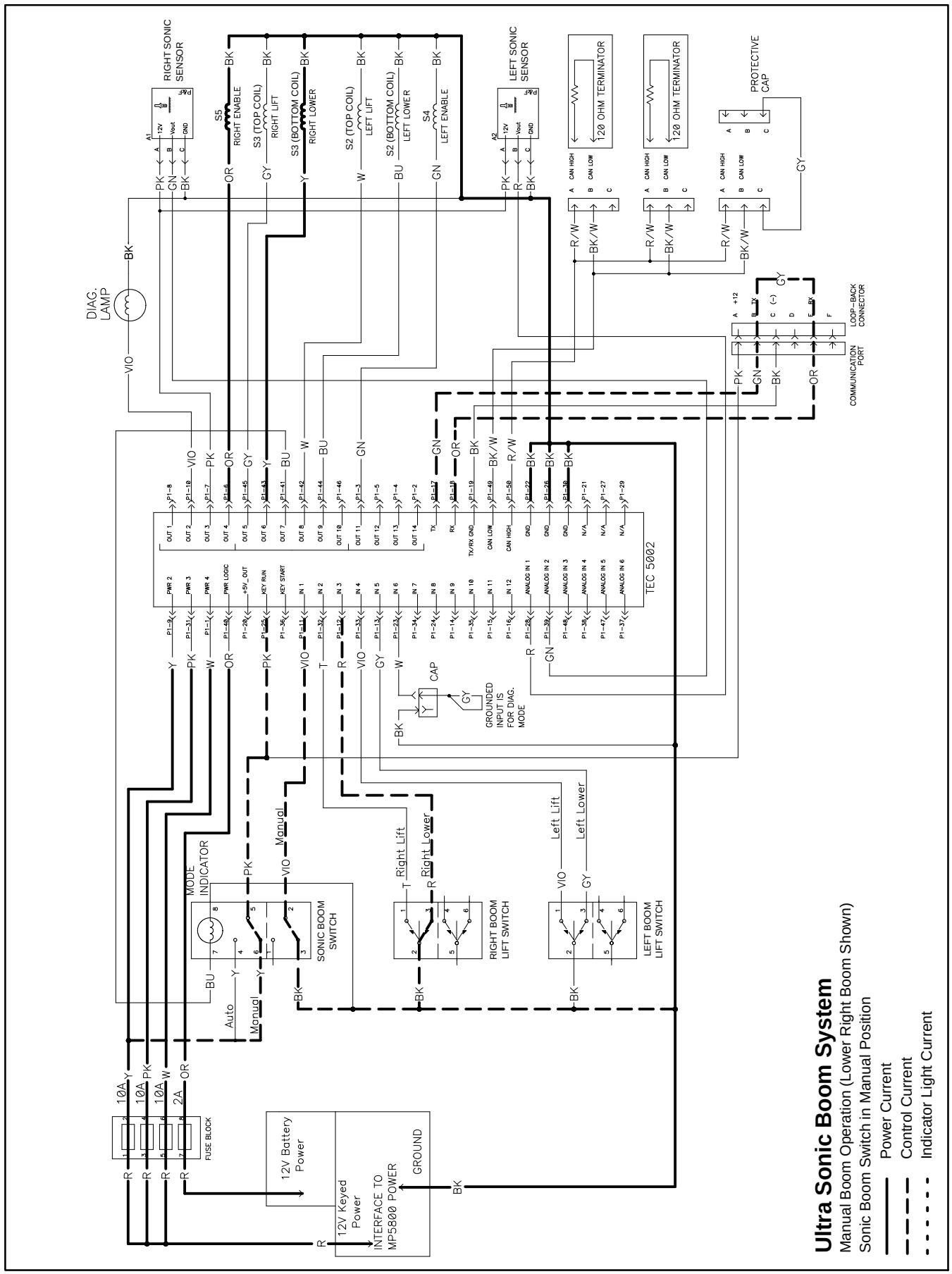


Figure 9


Ultra Sonic Boom System
Manual Boom Operation (Lower Right Boom Shown)
Sonic Boom Switch in Manual Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
DIAG. LAMP
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
TEC 5002
120 OHM TERMINATOR
PROTECTIVE CAP
COMMUNICATION PORT
LOOP-BACK CONNECTOR
FUSE BLOCK
12V Battery Power
12V Keyed Power
GROUND
INTERFACE TO MP5800 POWER
GROUNDED INPUT IS FOR DIAG. MODE
Auto
Manual
Right Lift
Right Lower
Left Lift
Left Lower

Manual Boom Operation

During sprayer operation with the sonic boom switch in the manual position, the spray booms will remain in position unless the operator presses a boom lift switch. The sonic boom light should not be illuminated when in the manual position. The operator will control the boom position with the boom lift switches.

Lower Boom

When a boom lift switch is pressed to lower a boom section, the Toro electronic controller (TEC) energizes the appropriate hydraulic lift control manifold solenoid coils. The energized coils provide hydraulic flow from the gear pump to the barrel end of the boom lift cylinder causing the cylinder to extend and the boom section to lower. The boom will continue to lower until the operator releases the boom actuator switch.

Raise Boom

When a boom lift switch is pressed to raise a boom section, the Toro electronic controller (TEC) energizes the appropriate hydraulic lift control manifold solenoid coils. The energized coils provide hydraulic flow from the gear pump to the rod end of the boom lift cylinder causing the cylinder to retract and the boom section to raise. The boom will continue to rise until the operator releases the boom lift switch.

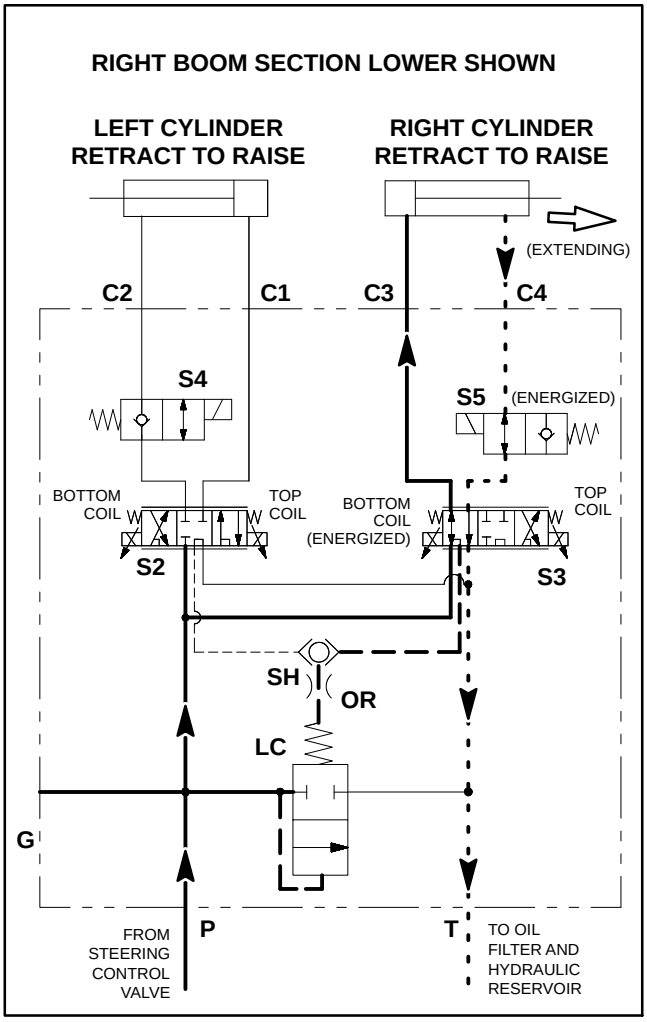


Figure 10

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Troubleshooting

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on the Ultra Sonic Boom System (see Ultra Sonic Boom System Operation in this chapter).

NOTE: When troubleshooting an electrical problem on your Ultra Sonic Boom System, refer to information regarding the sonic boom light and diagnostic lamp in this section. Also, use the Diagnostic Display (see Special Tools in this chapter) to test Toro electronic controller (TEC) inputs and outputs.

Sonic Boom Light

The sonic boom light is included in the sonic boom switch on the dash panel (Fig. 11). This light should be illuminated whenever the vehicle ignition switch is ON and the sonic boom switch is in the automatic position.

The sonic boom light flashing quickly indicates that the Ultra Sonic Boom System is in the calibration mode. This mode allows the spray booms to be adjusted for the desired boom height. The calibration mode lasts for twenty (20) seconds after which the sonic boom light should quit flashing.

NOTE: A sequence of switch movements is necessary to engage the calibration mode. Refer to the Sonic Boom Kit Installation Instructions for this sequence.

The sonic boom light flashes slowly when the sonic boom switch is in the automatic position and a boom lift switch is pressed to manually change the boom height. The flashing light will return to being constantly ON and automatic operation will be re−engaged once the boom switch is manually pressed to the lower position.

A slowly flashing sonic boom light may also indicate that a system fault has been encountered. In the event that there is a fault in the Ultra Sonic Boom System (e.g. there is no signal coming from a boom sensor), the affected boom will raise briefly and then stop. The sonic boom light will begin to flash slowly and the diagnostic lamp on the console will also flash. If this occurs, refer to Diagnostic Lamp, Diagnostic Display and Troubleshooting Chart in this section.

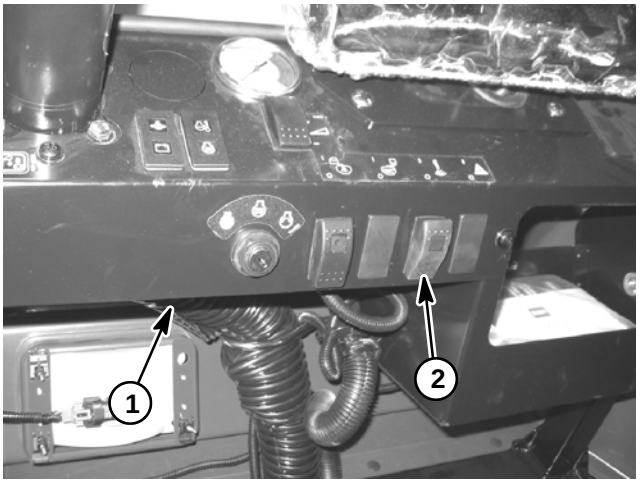

Figure 11

1. Dash panel
2. Sonic boom switch

Ultra Sonic Boom Calibration

The sensor calibration process is critical to the correct operation of the Ultra Sonic Boom System. The calibration process establishes the sensor target distance between the boom and the turf surface. Typically, this distance is approximately twenty (20) inches. Steps needed for proper calibration are identified in the Ultra Sonic Boom Kit Installation Instructions.

While calibrating the Ultra Sonic Boom sensors, it is best to perform the calibration process on turf. A shiny surface (e.g. cement shop floor) can skew sensor signals. Also, ensure the calibration area is free of buildings, trees, underground plumbing and other machines that could interfere with sensor signals.

Diagnostic Lamp

The Ultra Sonic Boom System includes a diagnostic lamp that displays the status of the sonic boom system. The diagnostic lamp is located on the console (Fig. 12).

When the ignition switch is moved to the ON position and the Ultra Sonic Boom System electrical system is functioning properly, the diagnostic lamp will be illuminated for approximately three (3) seconds and then will turn off. The diagnostic lamp should remain off during normal sonic boom operation.

If the sonic boom system TEC controller detects an electrical system malfunction (fault) during operation (e.g. there is no signal coming from a boom sensor), the affected boom will raise briefly and then stop. The sonic boom light (in sonic boom switch) will begin to flash slowly and the diagnostic lamp will flash rapidly. The diagnostic lamp will stop flashing and will automatically reset when the ignition switch is turned to the OFF position. The fault, however, will be retained in controller memory and can be retrieved at a future time (see Retrieving Fault Codes below).

If the diagnostic lamp does not illuminate when the ignition switch is turned to the ON position, possible causes are:

- The loopback connector is not connected to the machine wire harness (Fig. 13). The loopback connector is located under the console.
- The diagnostic lamp (or circuit wiring) is faulty.
- TEC controller fuse(s) are faulty.
- The TEC controller is faulty.

Check electrical connections, controller fuses and the diagnostic lamp to determine malfunction. Make sure that the loopback connector is secured to the wire harness connector.

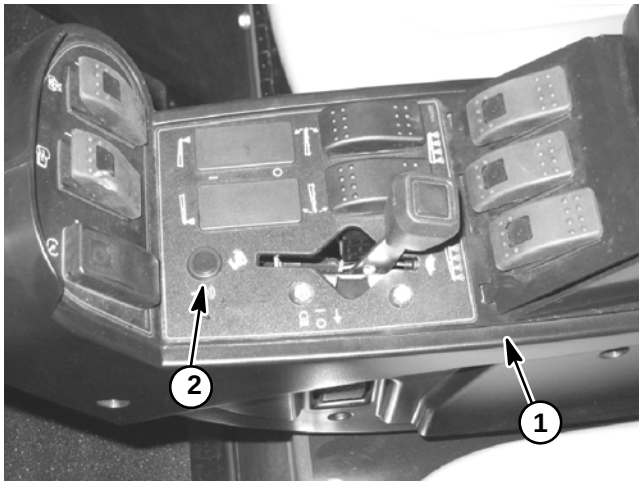

Figure 12

1. Console **2. Diagnostic lamp**

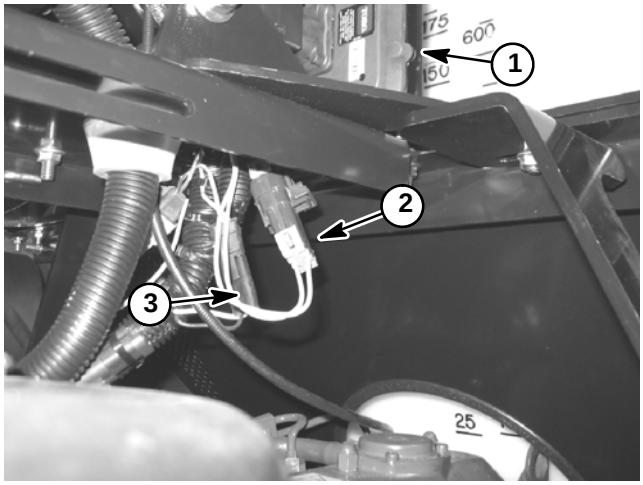

Figure 13

1. TEC controller location
2. Loopback connector
3. Diagnostic shunt wires

Retrieving Fault Codes

All Ultra Sonic Boom System fault codes are retained in the TEC controller memory. The three (3) most recent fault codes that have occurred within the last forty (40) hours of operation can be retrieved using the diagnostic lamp. To retrieve these fault codes from the controller memory, perform the following steps:

1. Make sure that ignition switch is OFF.

2. Raise and support operator seat.

3. Locate diagnostic tether cap that connects the two (2) diagnostic shunt wires located under the console and operator seat (Fig. 13).

4. Remove diagnostic tether cap from diagnostic shunt wires and connect the two (2) shunt wires together.

5. Turn ignition switch to the ON position.

6. Monitor the diagnostic lamp for fault code(s).

Fault codes displayed by the diagnostic lamp are two (2) digit numbers with no digit larger than five (5). Fault codes are listed in the chart below. There will be a one (1) second pause between the first and second digit of a code. Up to three (3) fault codes retained in controller memory will be displayed by the diagnostic lamp in order from the most recent fault to the oldest fault. If there are multiple faults in controller memory, there will be a three (3) second pause between codes. The fault codes will continually repeat after a five (5) second pause until the ignition key is turned OFF.

If there are no faults that have occurred within the last forty (40) hours of operation, the diagnostic lamp will flash continuously after performing the above steps.

If a fault code is not retrieved from the controller memory within forty (40) hours of machine operating time, the fault cannot be retrieved from controller memory using this procedure. If necessary, contact your Toro distributor to retrieve older fault codes.

After necessary service has been performed, disconnect diagnostic shunt wires and insert shunt leads into diagnostic tether cap. Lower operator seat.

Fault Code (Lamp Flashes)	Fault Description
1 – 2	Left sonic boom sensor fault occurred
1 – 3	Right sonic boom sensor fault occurred
1 – 6	TEC inputs are out of range (sonic boom operation will stop)
2 – 1	Fuse A is faulty
2 – 2	Fuse B is faulty
2 – 3	Fuse C is faulty
2 – 4	Main electrical power to sonic boom system was interrupted
3 – 4	Left boom raise function (output) is grounded or faulty
4 – 1	Right boom raise function (output) is grounded or faulty
4 – 2	Right boom lower function (output) is grounded or faulty
4 – 5	Left boom lower function (output) is grounded or faulty

Clearing Fault Codes

After fault codes have been retrieved, clearing of those faults can be completed using the following switch sequence:

1. Place sprayer in fault retrieval mode (see above). The diagnostic lamp should be displaying the fault codes.

2. At the same time, press the left boom switch to lower and the right boom switch to raise.

3. Monitor the diagnostic lamp for continuous flashing indicating that all faults have been cleared from the controller memory.

Diagnostic Display

The Ultra Sonic Boom System is equipped with the Toro electronic controller (TEC) which controls machine sonic boom electrical functions. The TEC monitors various input switches (e.g. sonic boom switch, boom lift switches, sonic boom sensors) and energizes outputs (e.g. hydraulic valve solenoid coils, diagnostic lamp) for appropriate machine functions.

For the TEC to control the machine as desired, each of the inputs (switches and sensors) and outputs (solenoid coils) must be connected and functioning properly.

The Diagnostic Display (see Special Tools in this chapter) is a tool to help the technician verify correct electrical functions of the machine.

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of the Diagnostic Display is completed, disconnect it from the machine and reconnect loopback connector to harness connector. The machine will not operate without the loopback connector installed on the harness. Store the Diagnostic Display in a dry, secure, indoor location and not on machine.

Verify Diagnostic Display Input Functions

1. Park machine on a level surface, stop the engine and apply the parking brake. Raise and support operator seat.

2. Locate Ultra Sonic Boom wire harness communication port and loopback connector under the operator seat (Fig. 14). Carefully unplug loopback connector from harness connector.

3. Connect the Diagnostic Display connector to the wire harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 15).

4. Turn the machine ignition switch to the ON position, but do not start engine.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to input switches and the **green** text refers to TEC outputs.

5. Make sure that the "INPUTS DISPLAYED" LED, on lower right column of the Diagnostic Display, is illuminated. If "OUTPUTS DISPLAYED" LED is illuminated, press the toggle button on the Diagnostic Display to change to "INPUTS DISPLAYED" LED.

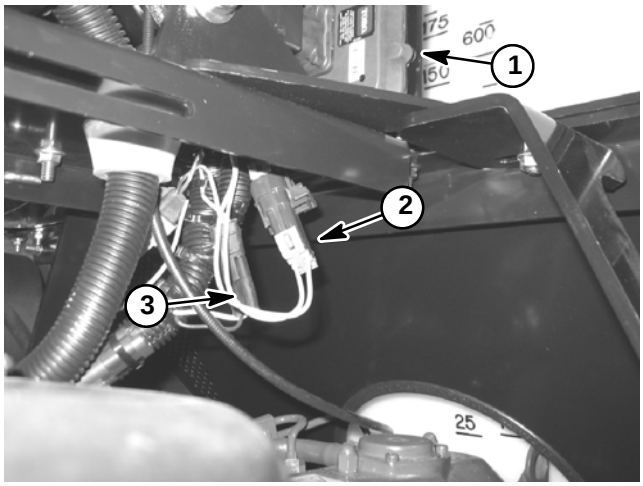

Figure 14

1. **TEC controller location**
2. **Loopback connector**
3. **Diagnostic shunt wires**

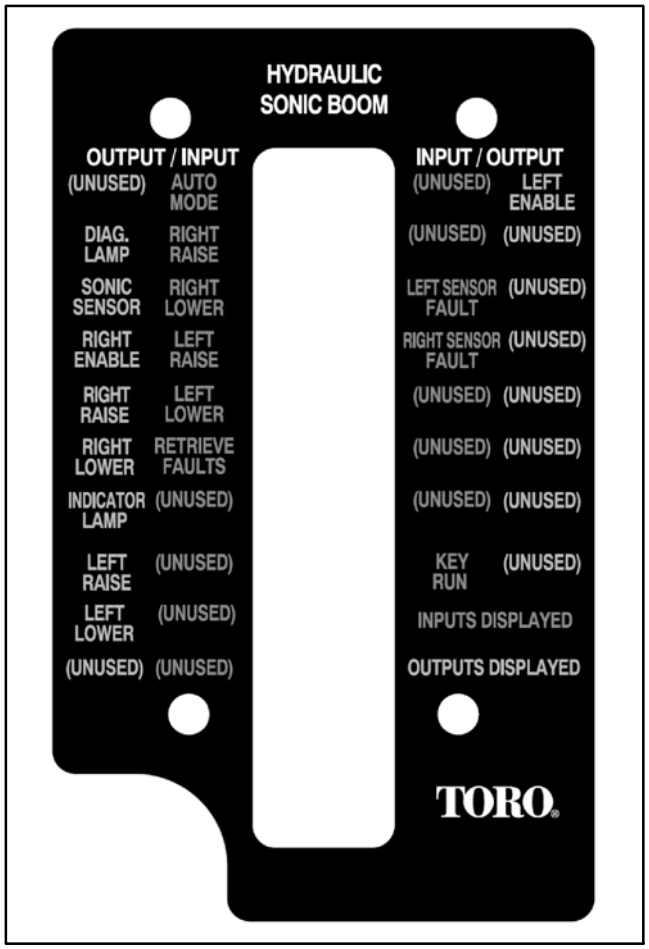

Figure 15

CAUTION

When testing TEC inputs with the Diagnostic Display, boom control manifold solenoid coils may be energized causing the spray booms to move. Be cautious of potential sprayer component movement while verifying inputs with the Diagnostic Display.

6. The Diagnostic Display will illuminate the LED associated with each of the inputs when that input switch is closed. Individually, change each of the switches from open to closed (e.g. toggle sonic boom switch), and note that the appropriate LED on the Diagnostic Display will illuminate when the corresponding switch is closed. Repeat on each switch that is possible to be changed by hand (see Inputs and LED Operation chart below).

7. If appropriate LED does not toggle on and off when switch state is changed, perform test of switch and/or check all wiring and connections to that switch. Replace any defective switches and repair any damaged wiring.

8. After input functions testing is complete, disconnect the Diagnostic Display connector from the harness connector. Plug loopback connector into wire harness and lower operator seat.

Diagnostic Display Inputs	Diagnostic Display LED Operation
AUTO MODE	Sonic boom switch in auto position: LED ON Sonic boom switch not in auto position: LED OFF
RIGHT RAISE	Right boom lift switch in raise position: LED ON Right boom lift switch not in raise position: LED OFF
RIGHT LOWER	Right boom lift switch in lower position: LED ON Right boom lift switch not in lower position: LED OFF
LEFT RAISE	Left boom lift switch in raise position: LED ON Left boom lift switch not in raise position: LED OFF
LEFT LOWER	Left boom lift switch in lower position: LED ON Left boom lift switch not in lower position: LED OFF
RETRIEVE FAULTS	Diagnostic shunt wires are connected for fault retrieval: LED ON Diagnostic shunt wires are not connected: LED OFF
LEFT SENSOR FAULT	The TEC has detected an invalid reading from left sensor: LED ON Left sensor operating normally: LED OFF
RIGHT SENSOR FAULT	The TEC has detected an invalid reading from right sensor: LED ON Right sensor operating normally: LED OFF
KEY RUN	Ignition key is in ON position: LED ON Ignition key is in OFF position: LED OFF

NOTE: When the vehicle ignition switch is in the OFF position, all Diagnostic Display LED's should be OFF.

NOTE: Initial calibration of the Ultra Sonic Boom sensors is required for proper operation of TEC inputs. Refer to your Sonic Boom Kit Installation Instructions for information on initial sensor calibration.

NOTE: Right and left side Ultra Sonic Boom sensors are identical so they can be exchanged to assist in troubleshooting. If a problem follows the exchanged sensor, an electrical problem likely exists with the sensor. If the problem remains unchanged, something other than the sensor is the problem source (e.g. switch, circuit wiring).

Verify Diagnostic Display Output Functions

The Diagnostic Display also has the ability to detect which output solenoid coils or lights (sonic boom or diagnostic) are energized by the Toro electronic controller (TEC). This is a quick way to determine which electrical component is malfunctioning.

NOTE: An open output (e.g. an unplugged connector or a broken wire) cannot be detected with the Diagnostic Display.

1. Park machine on a level surface, stop the engine and engage the parking brake. Raise and support operator seat.

2. Locate Ultra Sonic Boom wire harness communication port and loopback connector under the operator seat. Carefully unplug loopback connector from harness connector.

3. Connect the Diagnostic Display connector to the harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (see Special Tools in this chapter).

4. Turn the ignition switch to the ON position.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to input switches and the **green** text refers to TEC outputs.

5. Make sure that the “OUTPUTS DISPLAYED” LED, on lower right column of the Diagnostic Display, is illuminated. If “INPUTS DISPLAYED” LED is illuminated, press the toggle button on the Diagnostic Display to change the LED to “OUTPUTS DISPLAYED”.

NOTE: It may be necessary to toggle between “INPUTS DISPLAYED” and “OUTPUTS DISPLAYED” several times to perform the following step. To change from inputs to outputs, press toggle button once. This may be done as often as required. **Do not press and hold toggle button**.

CAUTION

When testing TEC inputs with the Diagnostic Display, boom control manifold solenoid coils may be energized causing the spray booms to move. Be cautious of potential sprayer component movement while verifying inputs with the Diagnostic Display.

6. Attempt to operate the desired function of the machine. The appropriate output LED’s should illuminate on the Diagnostic Display to indicate that the TEC is turning on that function (see Outputs and LED Operation chart on next page). The outputs can be checked with the ignition switch in the ON position and the engine not running.

   A. If the correct output LED’s do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur.

   B. If the output LED’s are on as specified, but the booms do not function properly, suspect a failed electrical component, an open in the tested circuit or a non-electrical problem (e.g. binding of the boom hinge). Repair as necessary.

   C. If each input switch is in the correct position and functioning correctly, but the output LED’s are not correctly illuminated, this may indicate a TEC problem. If this occurs, contact your Toro Distributor for assistance.

7. After output functions testing is complete, disconnect the Diagnostic Display connector from the harness connector and plug loopback connector into wire harness. Lower operator seat.

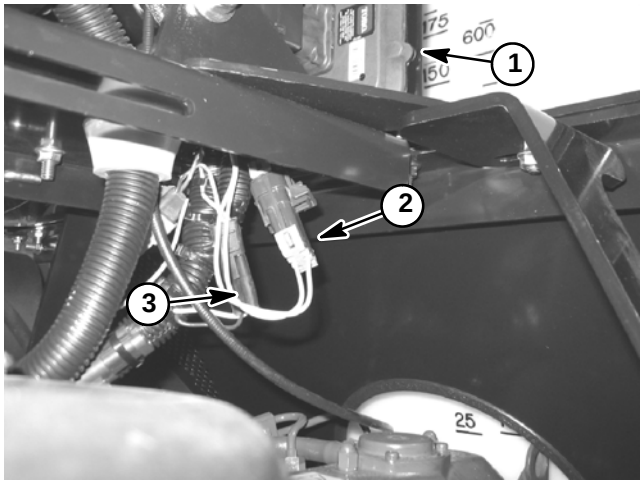

Figure 16

1. **TEC controller location**
2. **Loopback connector**
3. **Diagnostic shunt wires**

Diagnostic Display Outputs	Diagnostic Display LED Operation
DIAG LAMP	Diagnostic lamp is ON or FLASHING: LED ON or FLASHING Diagnostic lamp is not ON or FLASHING: LED OFF
SONIC SENSOR	TEC output exists to sonic sensors: LED ON No TEC output to sonic sensors: LED OFF
RIGHT ENABLE	TEC output exists to energize solenoid coil S5: LED ON No TEC output to solenoid coil S5: LED OFF
RIGHT RAISE	TEC output exists to energize top coil of solenoid S3: LED ON No TEC output to top coil of solenoid S3: LED OFF
RIGHT LOWER	TEC output exists to energize bottom coil of solenoid S3: LED ON No TEC output to bottom coil of solenoid S3: LED OFF
INDICATOR LAMP	Sonic boom switch is in automatic position: LED ON Sonic boom switch is in manual position: LED OFF
LEFT RAISE	TEC output exists to energize top coil of solenoid S2: LED ON No TEC output to top coil of solenoid S2: LED OFF
LEFT LOWER	TEC output exists to energize bottom coil of solenoid S2: LED ON No TEC output to bottom coil of solenoid S2: LED OFF
LEFT ENABLE	TEC output exists to energize solenoid coil S4: LED ON No TEC output to solenoid coil S4: LED OFF

Troubleshooting Chart

The chart that follows contains suggestions that can be used to assist in diagnosing Ultra Sonic Boom System performance issues. These suggestions are not all–inclusive. Also, consider that there may be more than one cause for a machine problem.

NOTE: When troubleshooting an electrical problem on your Ultra Sonic Boom System, refer to information regarding the sonic boom light in this section. Also, use the Diagnostic Display (see Special Tools in this chapter) to test Toro electronic controller (TEC) inputs and outputs.

Problem	Possible Cause
Light in sonic boom switch is not illuminated.	Sonic boom switch is in the MANUAL position. Fuse D (2 amp) in sonic boom fuse block is faulty (all sonic boom functions are affected). Fuse B (10 amp) in sonic boom fuse block is faulty. Loopback connector is unplugged from wire harness connector (all sonic boom functions are affected). Electrical power from vehicle is not available (all sonic boom functions are affected). Sonic boom switch or circuit wiring is faulty.
One of the boom lift cylinders will not extend or retract.	Boom lift switch or circuit wiring for affected lift cylinder is faulty. Boom lift control manifold solenoid coil or circuit wiring for affected lift cylinder is faulty. A hydraulic problem exists with the lift cylinder, boom lift control manifold or other hydraulic component.
Neither of the boom lift cylinders will extend or retract.	Loopback connector is unplugged from wire harness connector (all sonic boom functions are affected). Fuse(s) in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). A hydraulic problem exists with the lift cylinders, boom lift control manifold or other hydraulic component. The Toro electronic controller (TEC) or circuit wiring is faulty.
The LED's on one of the sonic boom sensors are not illuminated.	Sonic boom sensor or circuit wiring is faulty.
The LED's on both of the sonic boom sensors are not illuminated.	Sonic boom switch is in the MANUAL position. Fuse A (10 amp) in sonic boom fuse block is faulty. Sonic boom switch or circuit wiring is faulty.

Problem	Possible Cause
One of the booms does not automatically follow ground irregularities. Boom can be controlled with boom lift switch.	On affected boom, the sonic boom sensor cover is on sensor. On affected boom, calibration of the sonic boom sensors is incorrect. The sonic boom sensor is incorrectly installed. Sonic boom sensor or circuit wiring for affected boom is faulty. The Toro electronic controller (TEC) or circuit wiring is faulty.
Neither boom automatically follows ground irregularities. Booms can be controlled with boom lift switches.	Sonic boom switch is not in the AUTOMATIC position. Sonic boom sensor covers are on both sensors. Calibration of the sonic boom sensors is incorrect. Both sonic boom sensors or circuit wiring are faulty. The Toro electronic controller (TEC) or circuit wiring is faulty.

Sonic Boom Fuses

Fuses for the Ultra Sonic Boom system are includes in the bottom four (4) fuse holders in the fuse block under the operator seat (Fig. 17).

Fuse Identification and Function

Fuses for the Ultra Sonic Boom system have the following function:

Fuse A (10 Amp): Protects power supply for TEC outputs (diagnostic lamp, sonic sensors and hydraulic solenoid coil S5).

Fuse B (10 Amp): Protects power supply for TEC outputs (sonic boom light and hydraulic solenoid coils S2 and S3).

Fuse C (10 Amp): Protects power supply for TEC outputs (hydraulic solenoid coil S4).

Fuse D (2 Amp): Protects power supply for TEC logic.

Fuse Testing

Remove fuses from the fuse block for testing. Fuse should have continuity between fuse terminals.

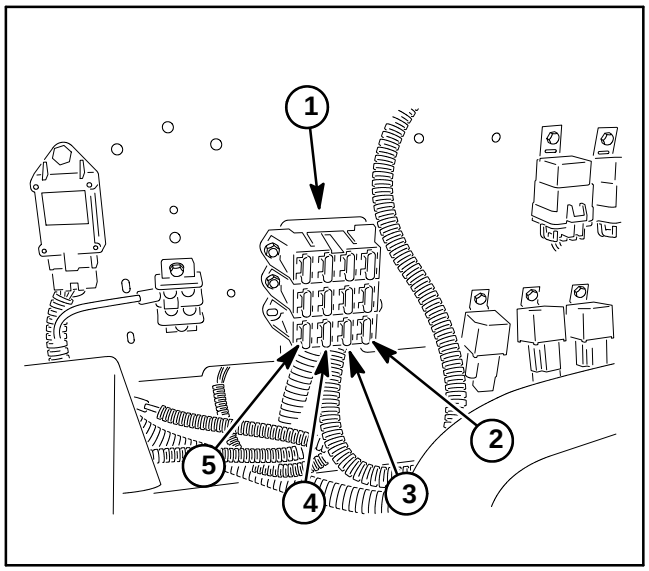

Figure 17

1. **Fuse block**
2. **Sonic boom fuse A**
3. **Sonic boom fuse B**
4. **Sonic boom fuse C**
5. **Sonic boom fuse D**

Sonic Boom Switch

The sonic boom switch is used as an input for the Toro electronic controller (TEC) to activate the Ultra Sonic Boom System. This switch has two (2) positions: automatic and manual. The sonic boom switch is located on the dash panel.

If the sonic boom switch is in the automatic position, the sonic sensors will be activated to allow automatic movement of the booms. The tips of the booms will remain at a constant distance from the ground. The boom lift switches can be used to raise/lower the booms when the sonic boom switch is in the automatic position. The light in the switch should be illuminated when the switch is in the automatic position.

If the sonic boom switch is in the manual position, the sonic sensors are disabled. The boom lift switches are used to raise/lower the booms when the sonic boom switch is in the manual position.

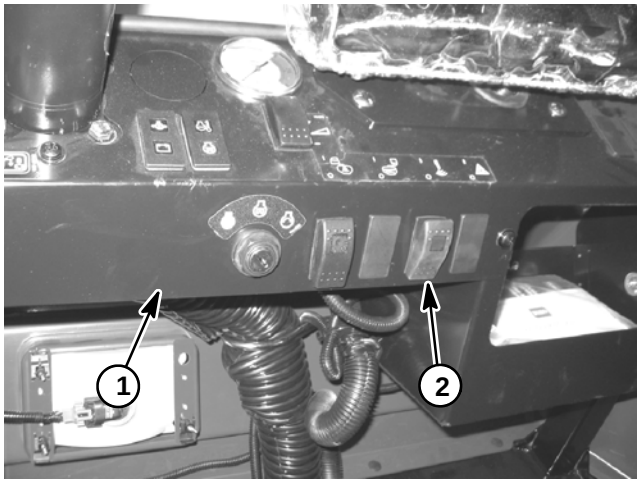

Figure 18

1. Dash panel
2. Sonic boom switch

Testing

1. Before disconnecting the sonic boom switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the sonic boom switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the sonic boom switch and circuit wiring **are not** functioning correctly, proceed with switch test.

2. Park vehicle on a level surface, stop engine, engage parking brake and remove key from ignition switch.

3. Disconnect wire harness electrical connector from the sonic boom switch on the dash.

4. The switch terminals are marked as shown in Figure 19. The circuit logic of the sonic boom switch is shown in the chart to the right. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

5. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (–). The light should illuminate.

6. If the sonic boom switch tests correctly and circuit problem still exists, check wire harness.

7. After testing is completed, connect wire harness connector to the sonic boom switch.

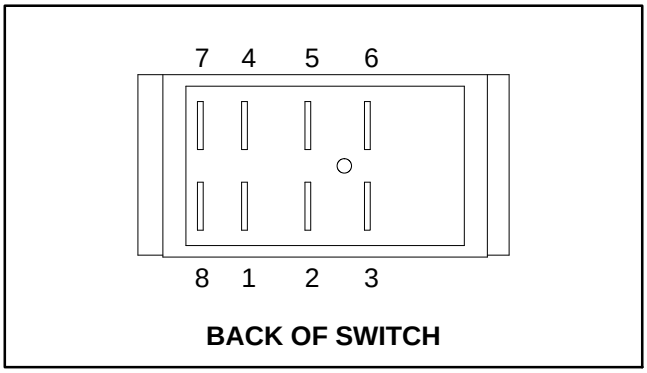

Figure 19

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
MANUAL	2 + 3 5 + 6	2 + 1 5 + 4
AUTOMATIC	2 + 1 5 + 4	2 + 3 5 + 6

Sonic Sensors

Two (2) identical sonic sensors are used in the Ultra Sonic Boom System. The sensors are mounted to the spray booms (Figs. 20, 21 and 22). During sprayer operation with the sonic boom switch in the automatic position, the sonic sensors will provide inputs for the Toro electronic controller (TEC) to keep the booms at a constant distance from the ground.

During sprayer operation, the sonic boom sensor continually sends an impulse signal and then receives an echo as the signal bounces off the turf. The TEC establishes the sensor distance from the ground based on the time between the sensor signal generation and the received echo. The TEC then determines if the boom height is different than the calibrated height and, if necessary, energizes the appropriate solenoid(s) on the hydraulic lift control manifold to change the boom height.

Sensors should be secured to the spray booms correctly for proper sonic sensor operation. Refer to the Ultra Sonic Boom Kit Installation Instructions for sonic sensor installation and setup information.

The sonic sensors and their circuit wiring can be tested as TEC inputs with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). Because of the solid state circuitry built into the sensors, there is no method to test them directly. The sensors may be damaged if an attempt is made to test them with an electrical test device (e.g. digital multimeter or test light)

IMPORTANT: Do not spray water at or on the sensors. Water sprayed under even household pressure can damage the sensor. Always install sensor cap on sensor before washing the sprayer. Also, install cap when sprayer is not in use.

As required, use a damp cloth to clean the sensors. Make sure that the sensor covers and caps are clean and dry before installing them on sensors. When the sprayer is not being used, it is recommended to have the caps installed on the sensors for sensor protection.

Each of the sonic sensor assemblies includes a programming plug for sensor accuracy. If a programming plug is removed from the sensor, make sure that the arrow below the sideways T on the plug is aligned with the notch on the top edge of the sensor (Fig. 23).

NOTE: The two (2) sonic sensors are identical. To assist in troubleshooting, sensors can be exchanged. If the problem follows the exchanged sensor, an electrical problem likely exists with the sensor. If the problem remains unchanged, something other than the sensor is the problem source.

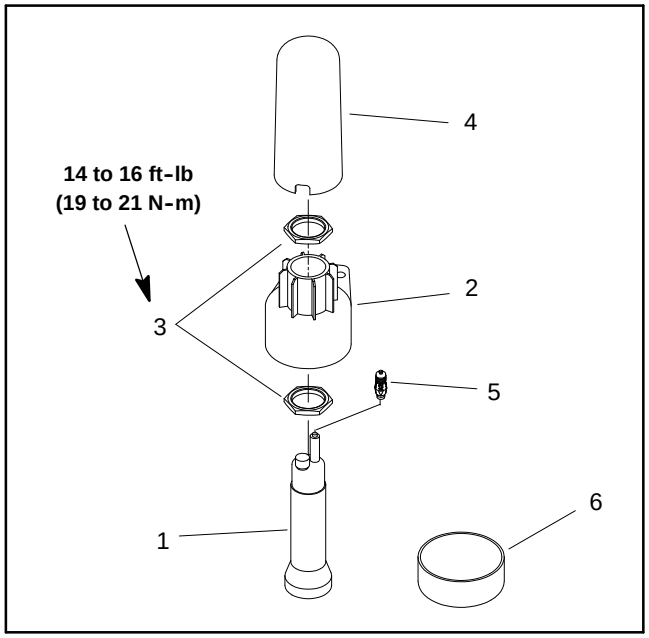

Figure 20

1. **Sonic sensor**
2. **Lower housing**
3. **Nut (2 used)**
4. **Cover**
5. **Programming plug**
6. **Cap**

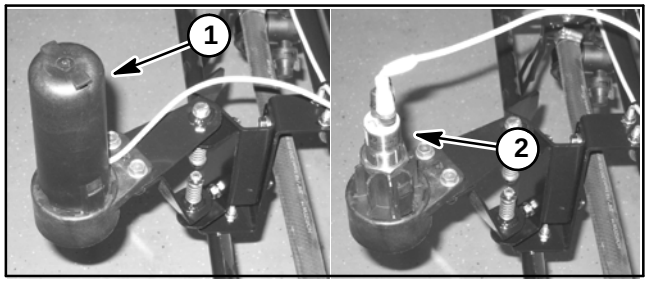

Figure 21

1. **Sensor with cover**
2. **Sensor without cover**

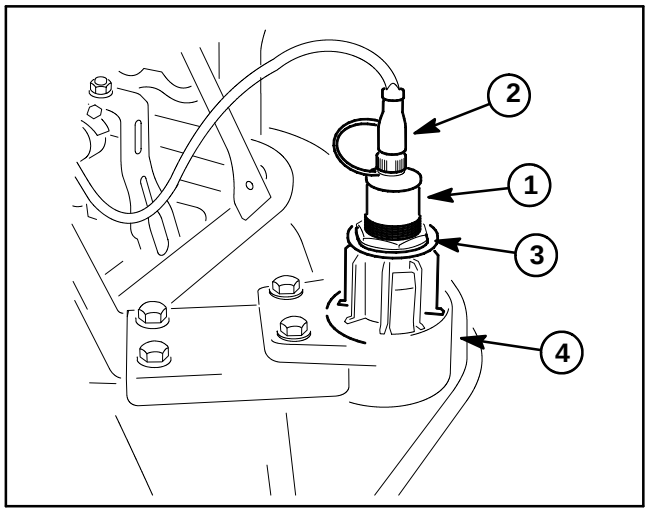

Figure 22

1. **Sonic sensor**
2. **Harness connector**
3. **Nut (2 used)**
4. **Lower housing**

Sonic Sensor LED Window

The sonic sensor includes a LED window that identifies sensor status during sprayer operation during operation of the Ultra Sonic Boom system (Fig. 24). To view the LED window, carefully remove cover from sonic sensor. The LED window includes four (4) LED's.

During normal operation, the green LED and both yellow LED's should be illuminated. The red LED will be off.

If there is some interference with normal sensor operation, the red LED will be flashing. The green LED will be off. The yellow LED's may flash, be illuminated or be off.

If the sensor programming plug is removed or is faulty, the red LED will be illuminated. The green LED will be off. The yellow LED's may flash, be illuminated or be off.

The status of the LED's on the sensors can be used to identify a faulty or unplugged programming plug. The LED's also can be used to identify the presence of interference that can affect Ultra Sonic Boom system operation. If the LED's do not illuminate correctly, a problem may exist with circuit wiring to the sensor or with the sensor itself.

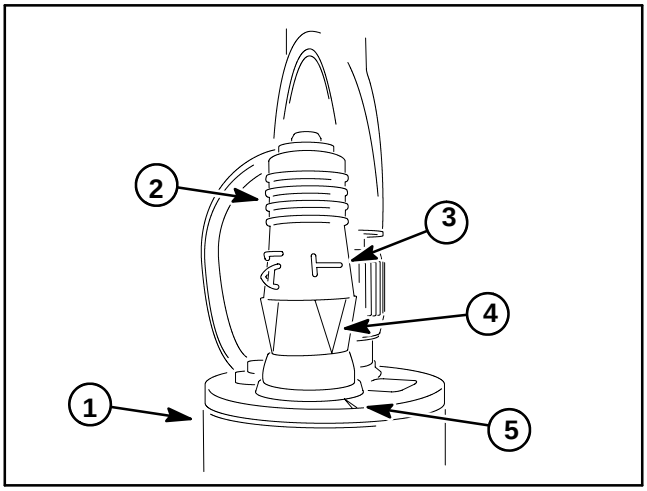

Figure 23

1. **Sonic sensor**
2. **Programming plug**
3. **Letter T**
4. **Plug arrow**
5. **Sensor notch**

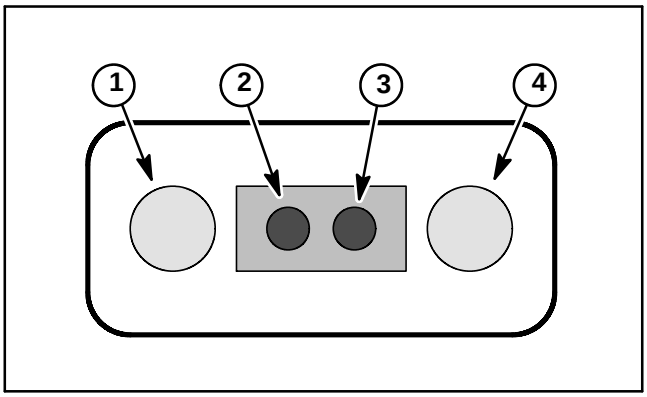

Figure 24

1. **Yellow LED**
2. **Green LED**
3. **Red LED**
4. **Yellow LED**

Toro Electronic Controller (TEC)

The Ultra Sonic Boom System uses the Toro Electronic Controller (TEC) to control electrical system operation. The TEC is attached to a mounting plate between the seats (Fig. 25).

Power is provided to the TEC when the vehicle ignition switch is ON. A 5 amp fuse provides circuit protection for this logic power to the TEC. The fuse is located in the Ultra Sonic Boom System fuse block.

Logic power is provided to the controller as long as the battery cables are connected to the battery. A 2 amp fuse provides circuit protection for this logic power to the controller.

The TEC monitors the states of the following components as inputs: the sonic boom switch, the two (2) boom lift switches, the two (2) sonic boom sensors and the diagnostic shunt wires.

The TEC controls electrical output to the sonic boom light, the diagnostic lamp and the six (6) hydraulic solenoid coils that electrically control the operation of the boom lift cylinders. Circuit protection for the TEC outputs is provided by three (3) 10 amp fuses located in the Ultra Sonic Boom System fuse block.

Testing of the TEC inputs and outputs can be completed with the use of the Diagnostic Display (see the Special Tools and Troubleshooting sections of this chapter).

Because of the solid state circuitry built into the TEC, there is no method to test it directly. The TEC may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

IMPORTANT: Before performing welding on the machine, disconnect both cables from the battery and disconnect wire harness connector from the TEC. These steps will prevent damage to the machine electrical system.

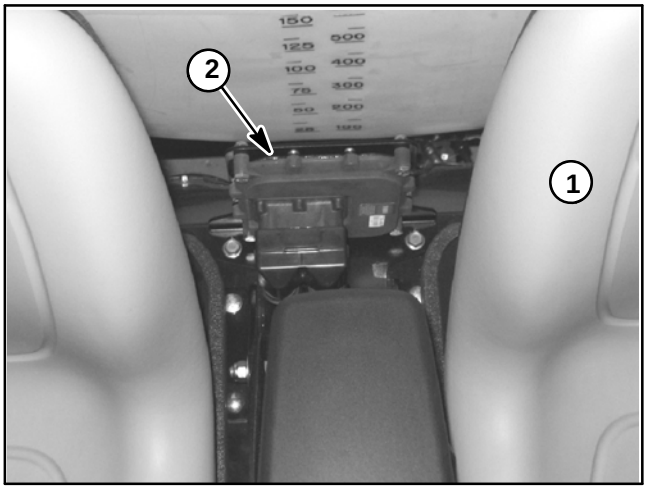

Figure 25

1. **Operator seat**
2. **TEC**

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Boom Lift Control Manifold

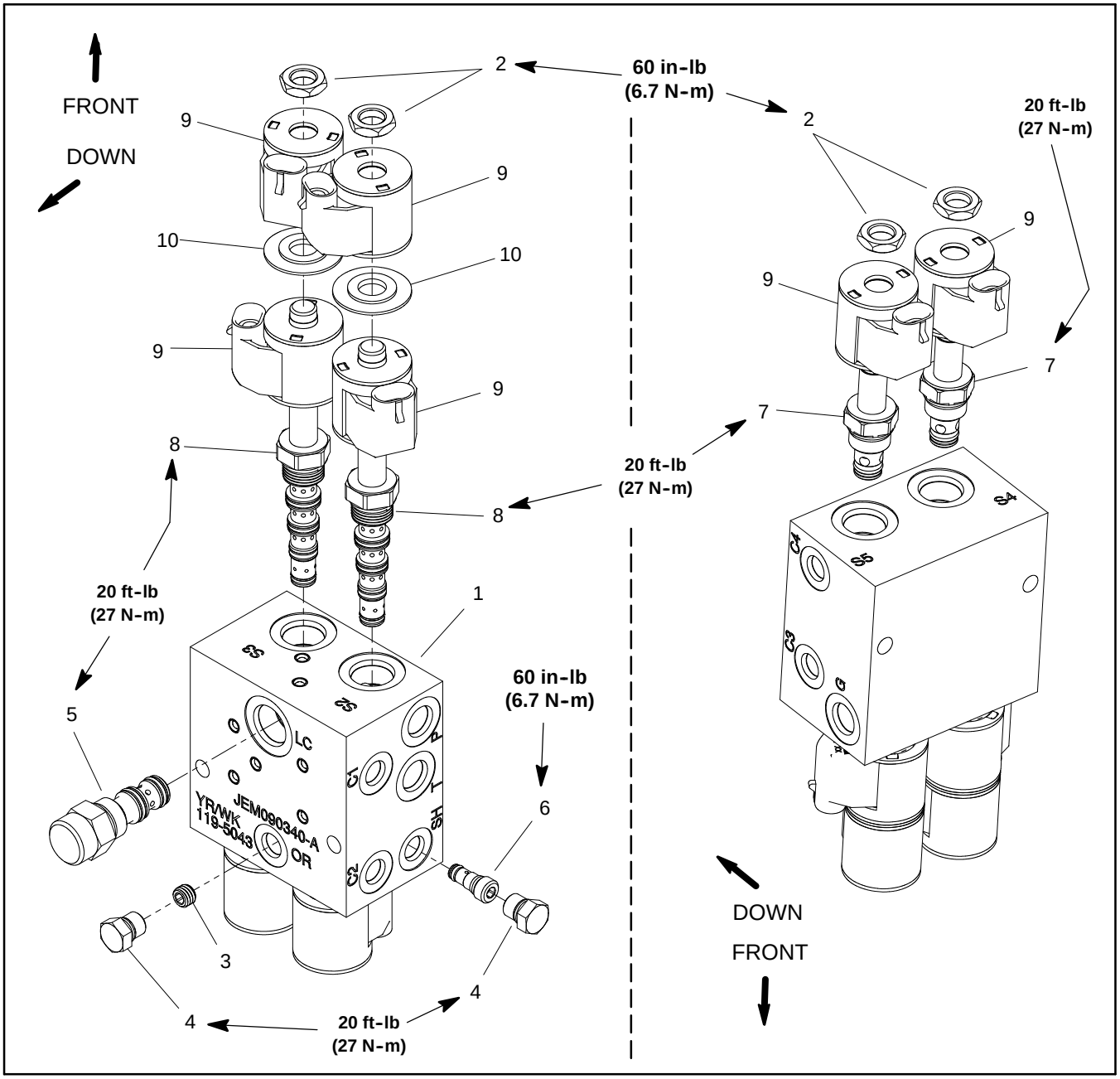

Figure 26

1. **Lift control manifold**
2. **Coil nut (4 used)**
3. **Orifice (0.030) (OR)**
4. **Zero leak plug (2 used)**
5. **Logic element (LC)**
6. **Load shuttle (SH)**
7. **Solenoid valve (2 used) (S4 and S5)**
8. **Solenoid valve (2 used) (S2 and S3)**
9. **Solenoid coil (6 used)**
10. **Coil spacer (2 used)**

NOTE: The ports on the Ultra Sonic Boom System boom lift control manifold are marked for easy identification of components. Example: P is the pump supply connection port and S2 is the location for solenoid valve S2 (see Figure 27 to identify the function of the hydraulic lines and cartridge valves at each manifold port).

NOTE: The boom lift control manifold includes two (2) 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 a wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug.

Boom Lift Control Manifold Service (Fig. 26)

WARNING

Make sure that spray booms are fully lowered before loosening hydraulic lines, cartridge valves or plugs from boom lift control manifold. If booms are not fully lowered as manifold components are loosened, booms may drop unexpectedly.

CAUTION

Rotate steering wheel and depress traction pedal in both forward and reverse to relieve hydraulic system pressure and to avoid injury from pressurized hydraulic oil.

For boom lift manifold cartridge valve service procedures, see Spray Pump Control Manifold Service in the Service and Repairs section of Chapter 4 – Hydraulic System. Refer to Figure 26 for manifold cartridge valve and plug installation torque.

NOTE: The six (6) solenoid valve coils on the boom lift control manifold are identical. To assist in troubleshooting, identical coils can be exchanged. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. a hydraulic problem exists).

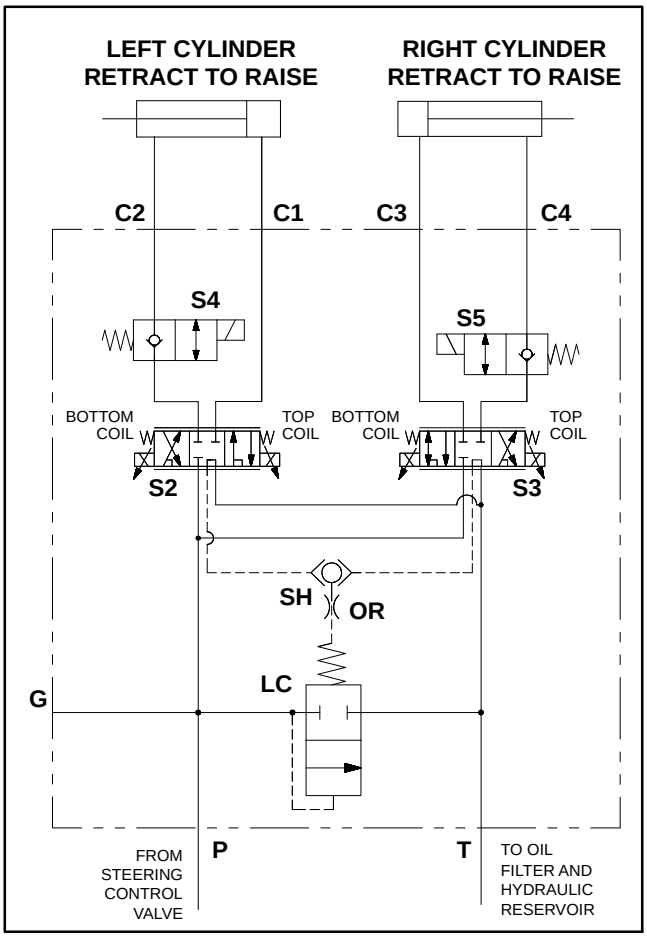

Figure 27

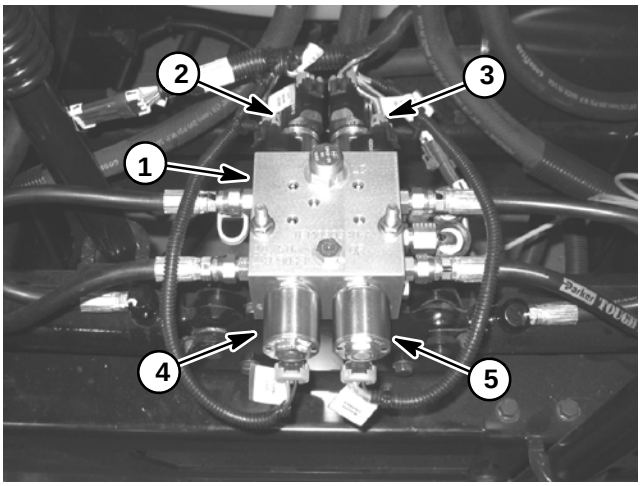

Figure 28

1. **Boom lift manifold**
2. **Solenoid S2**
3. **Solenoid S3**
4. **Solenoid S4**
5. **Solenoid S5**

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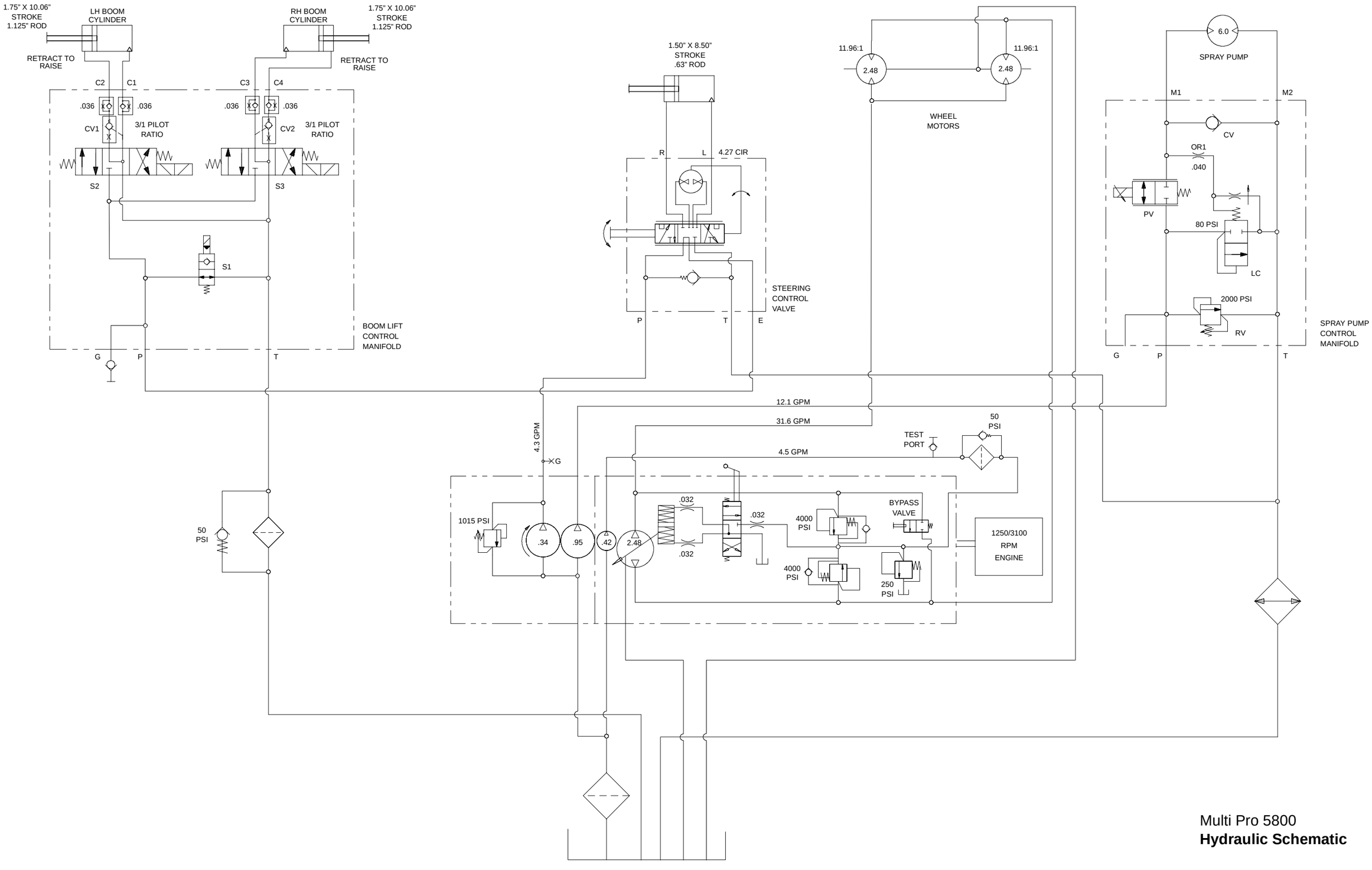
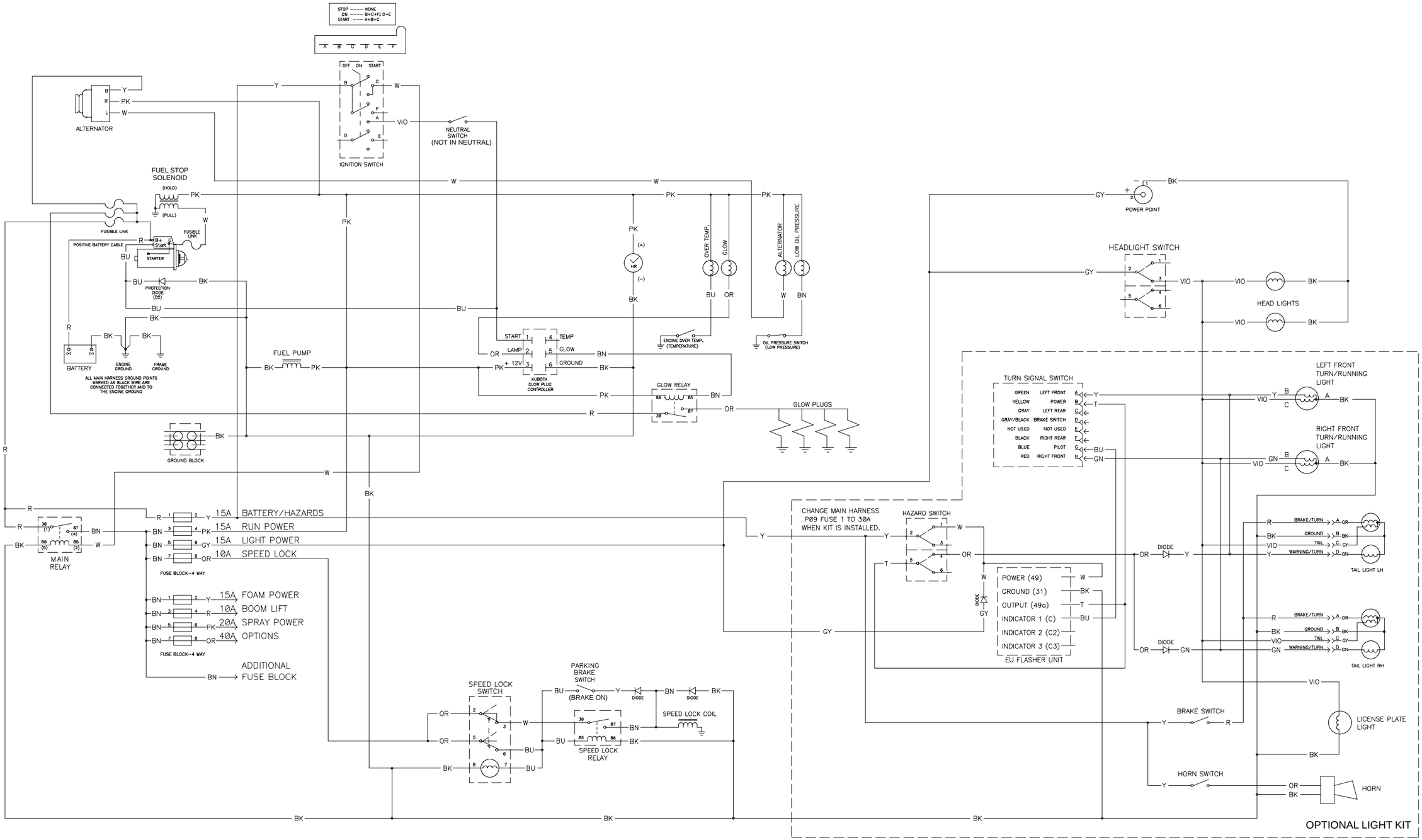


Multi Pro 5800
Hydraulic Schematic

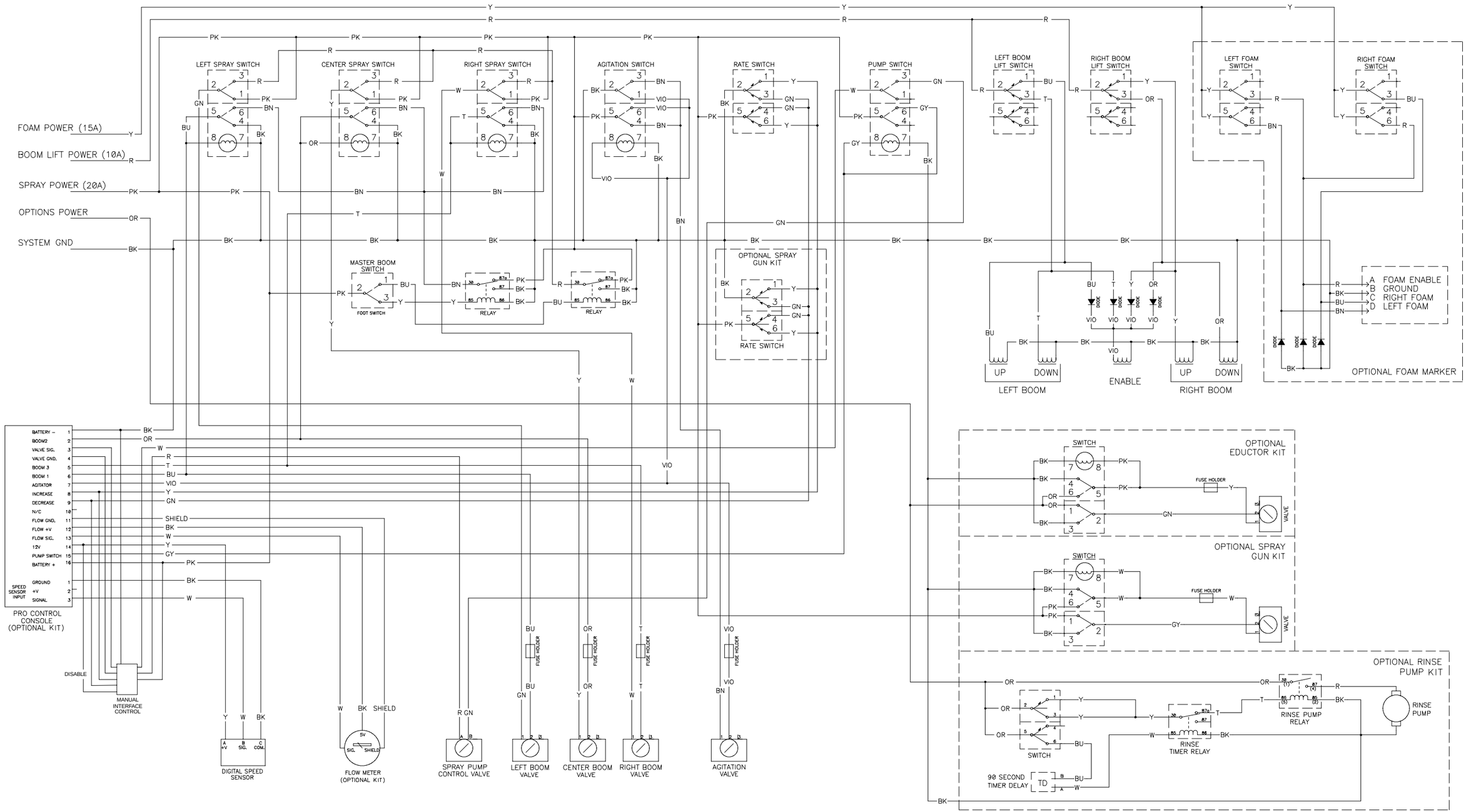


Multi Pro 5800

Vehicle Electrical Schematic

All relays and solenoids are shown as de-energized.

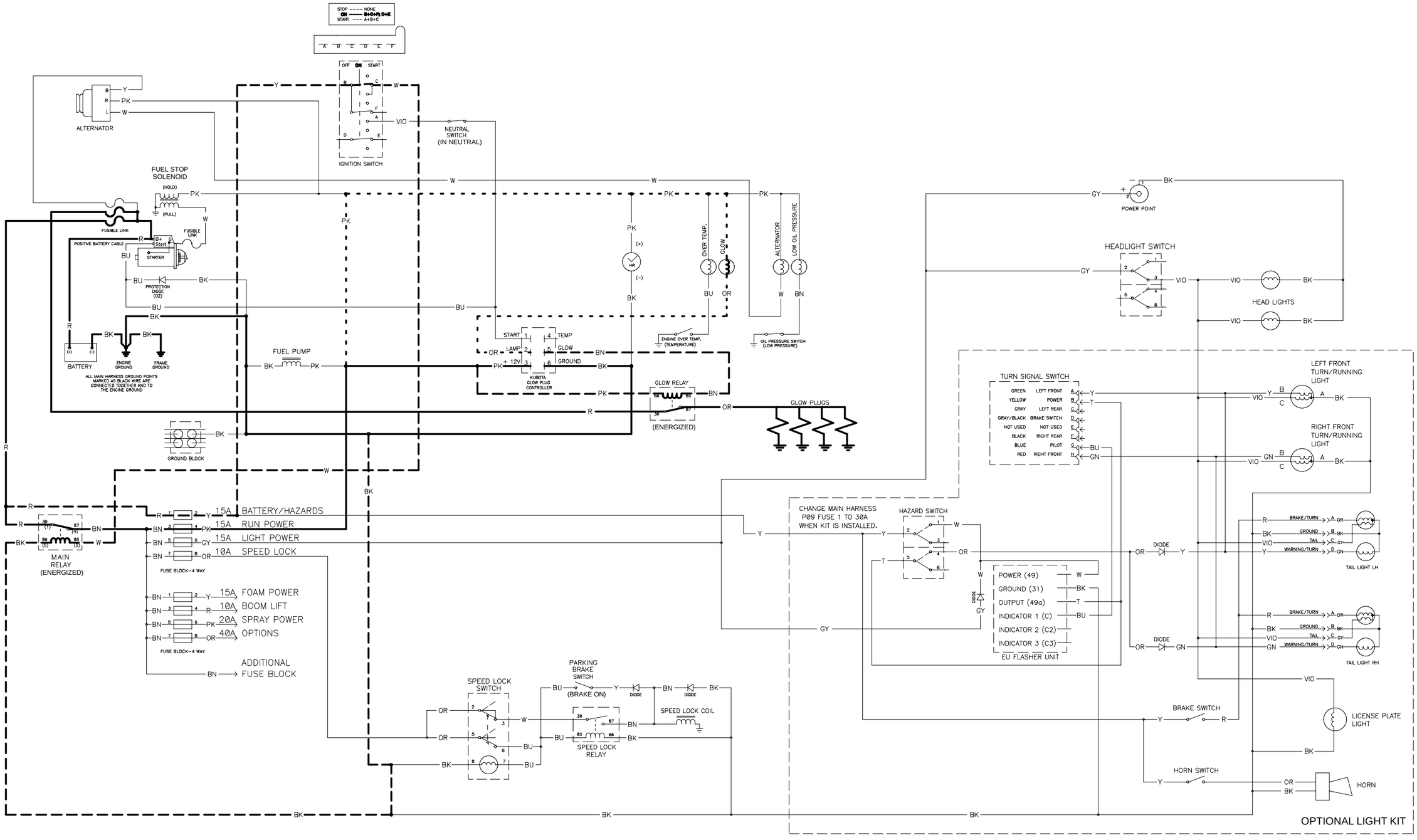
All ground wires are black.



All relays and solenoids are shown as de-energized.

All ground wires are black.

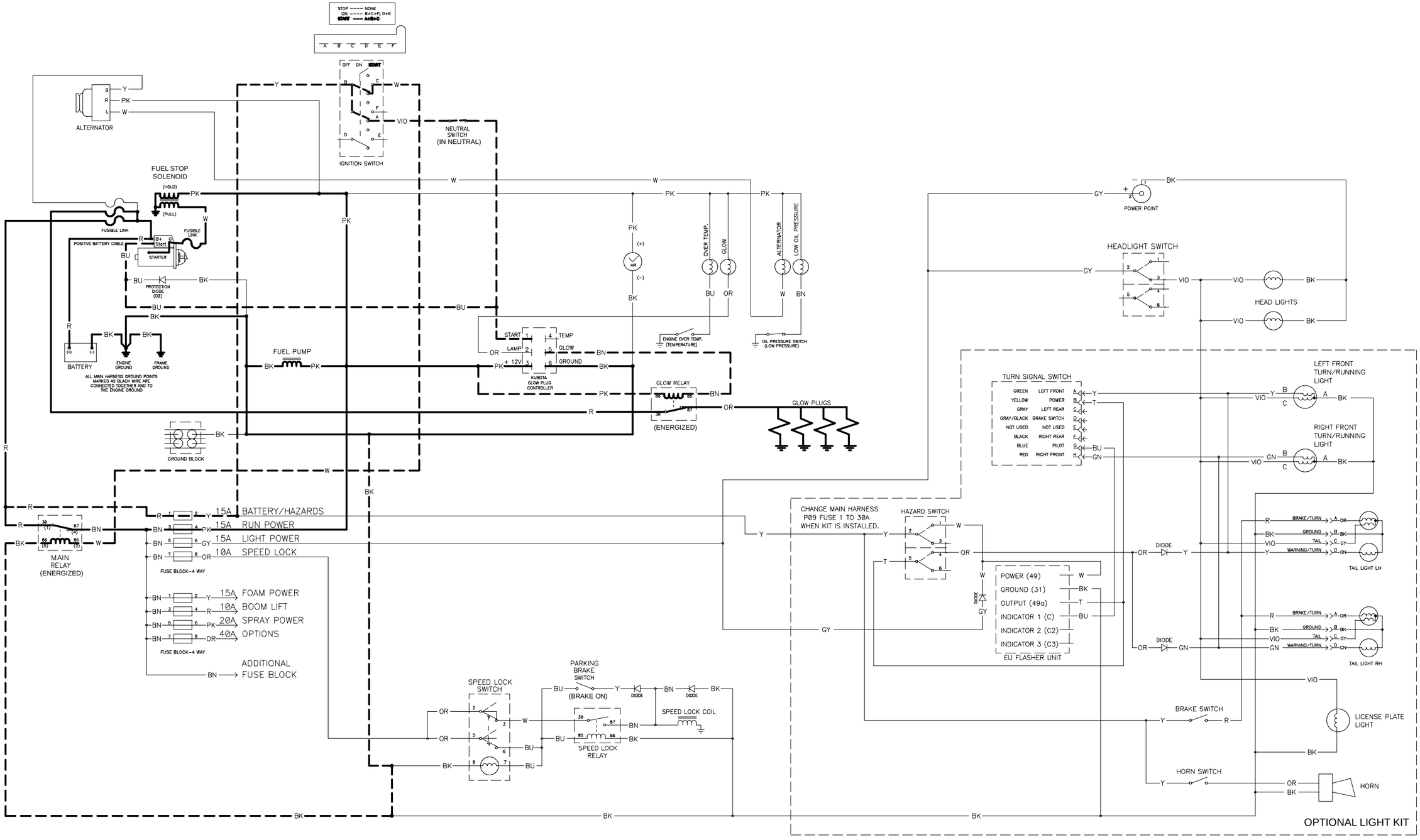
Multi Pro 5800
Spray System Electrical Schematic



Multi Pro 5800

Glow Plug Circuit

- Power Current
- Control Current
- Indicator/Gauge Current



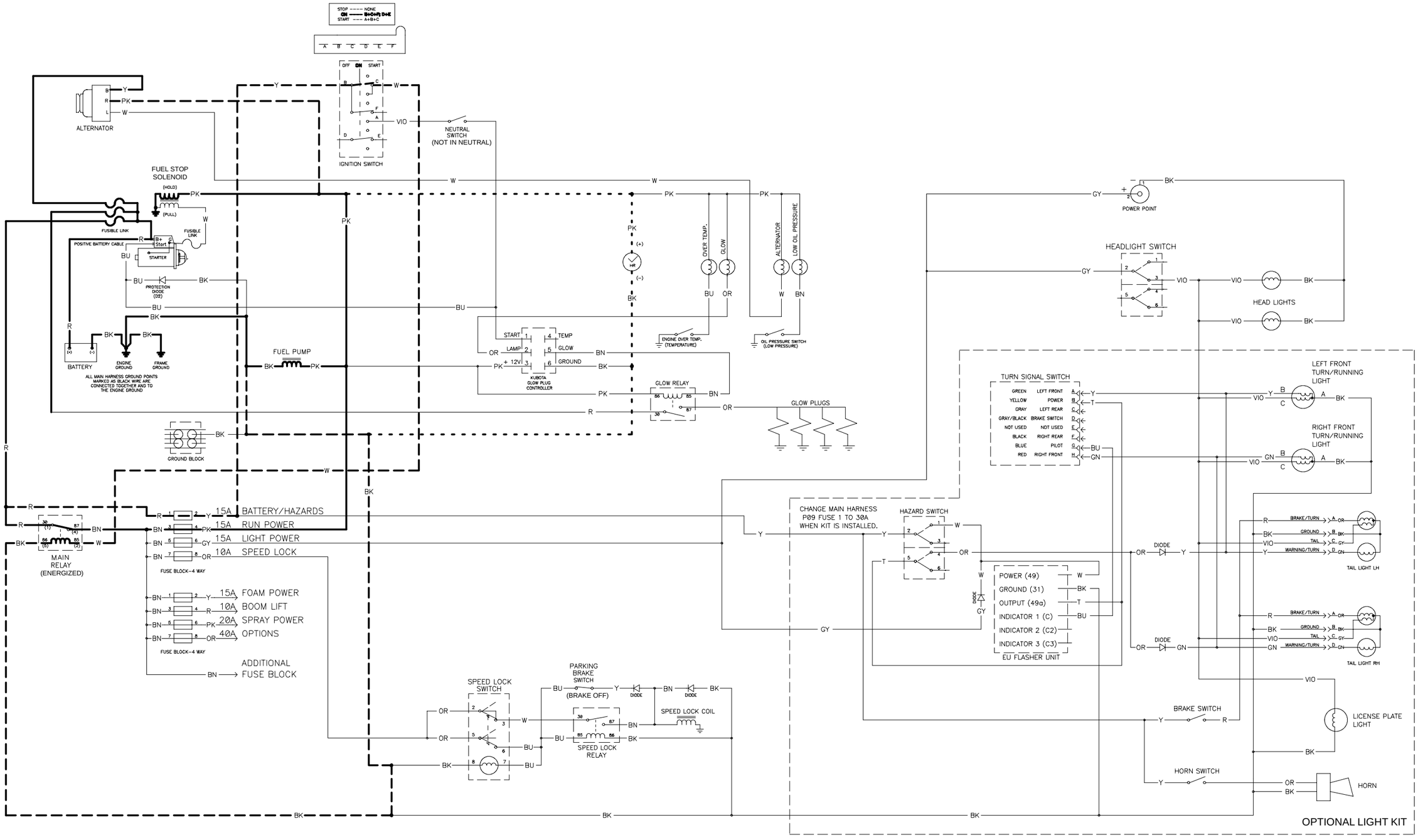
Multi Pro 5800

Start Circuit

Power Current

Control Current

Indicator/Gauge Current



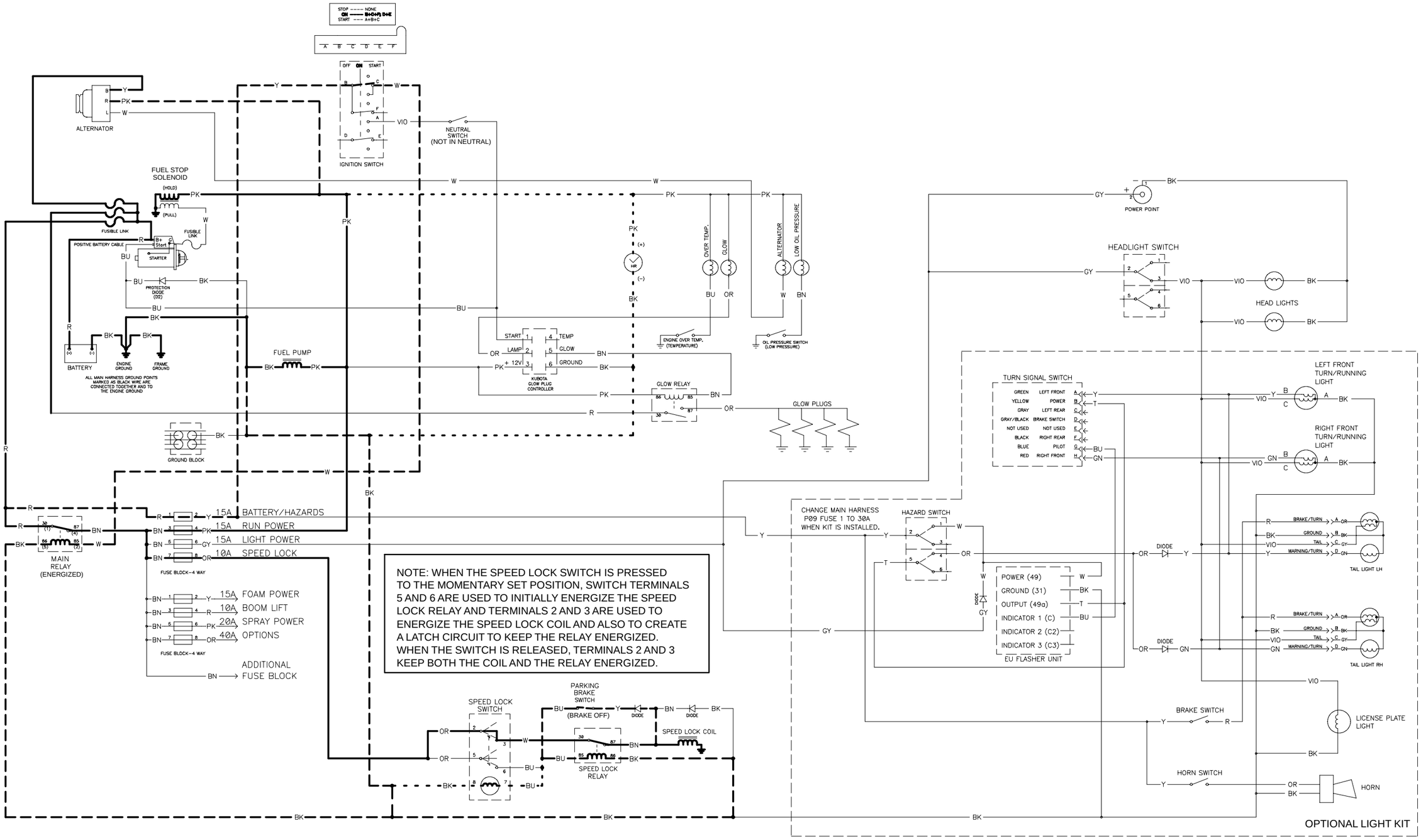
Multi Pro 5800

Run Circuit

Power Current

Control Current

Indicator/Gauge Current



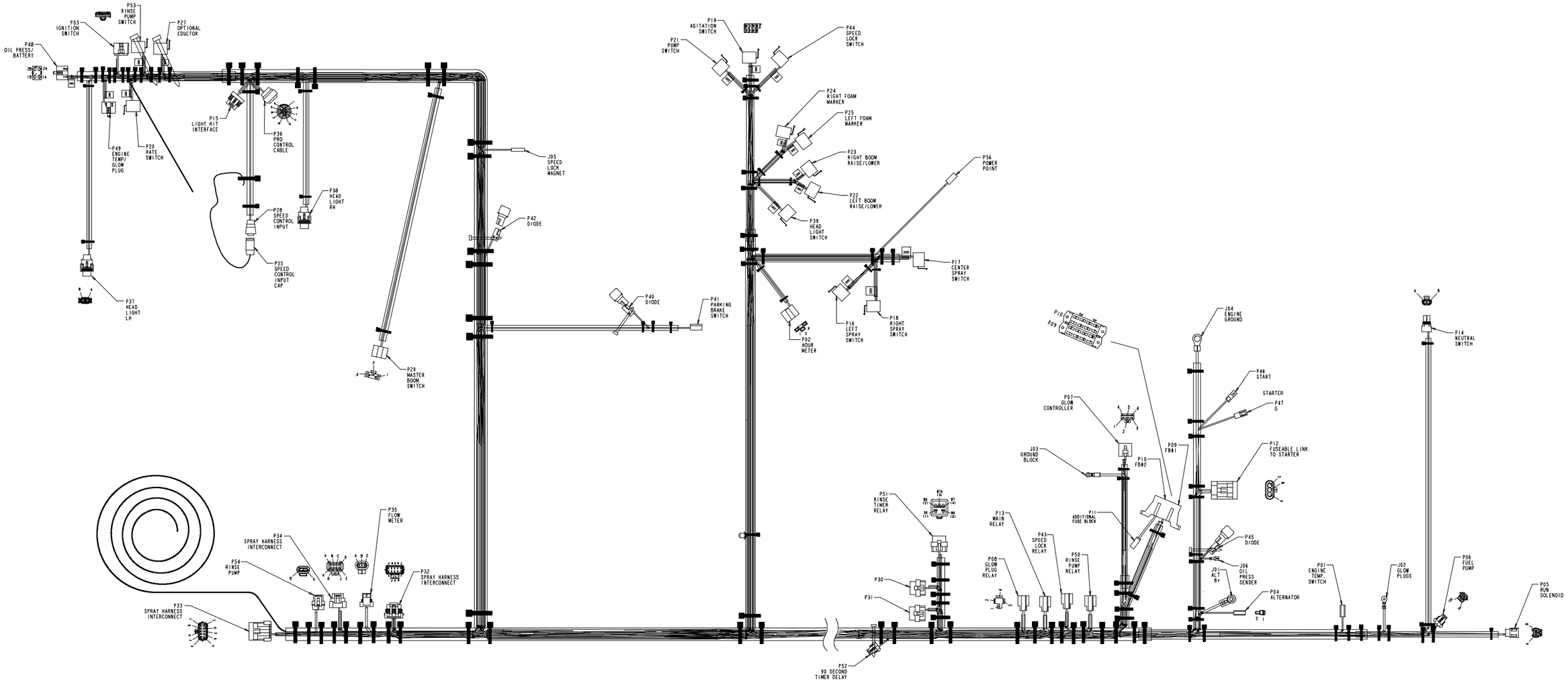
Multi Pro 5800

Speed Lock Circuit

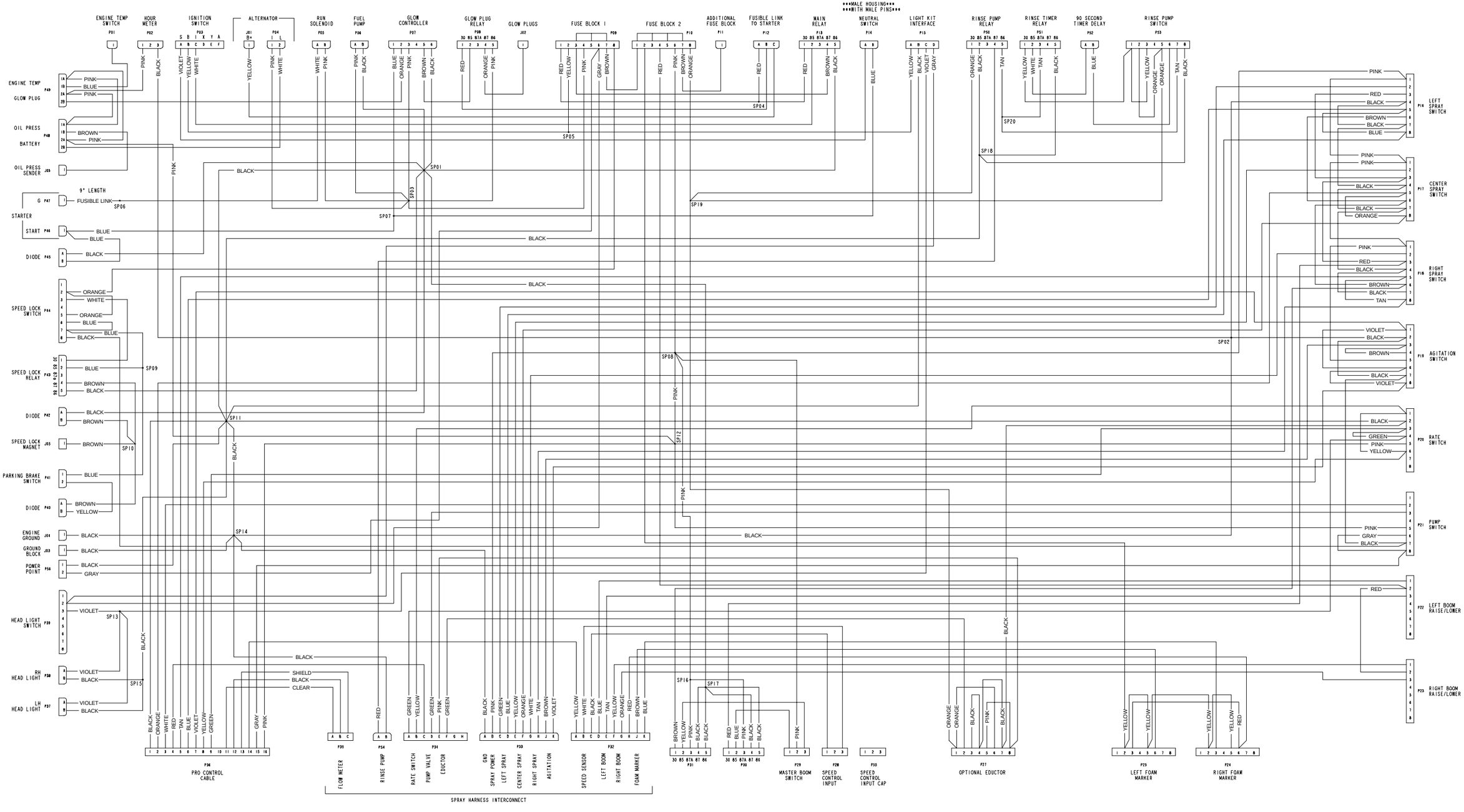
Power Current

Control Current

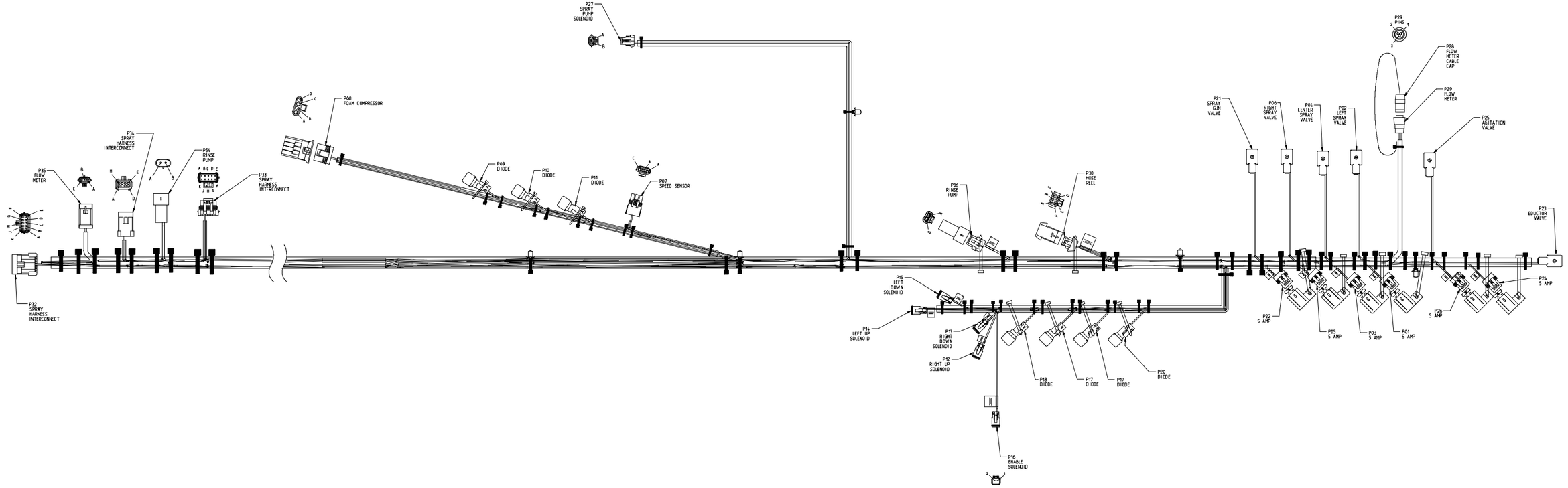
Indicator/Gauge Current



Multi Pro 5800
Front Wire Harness

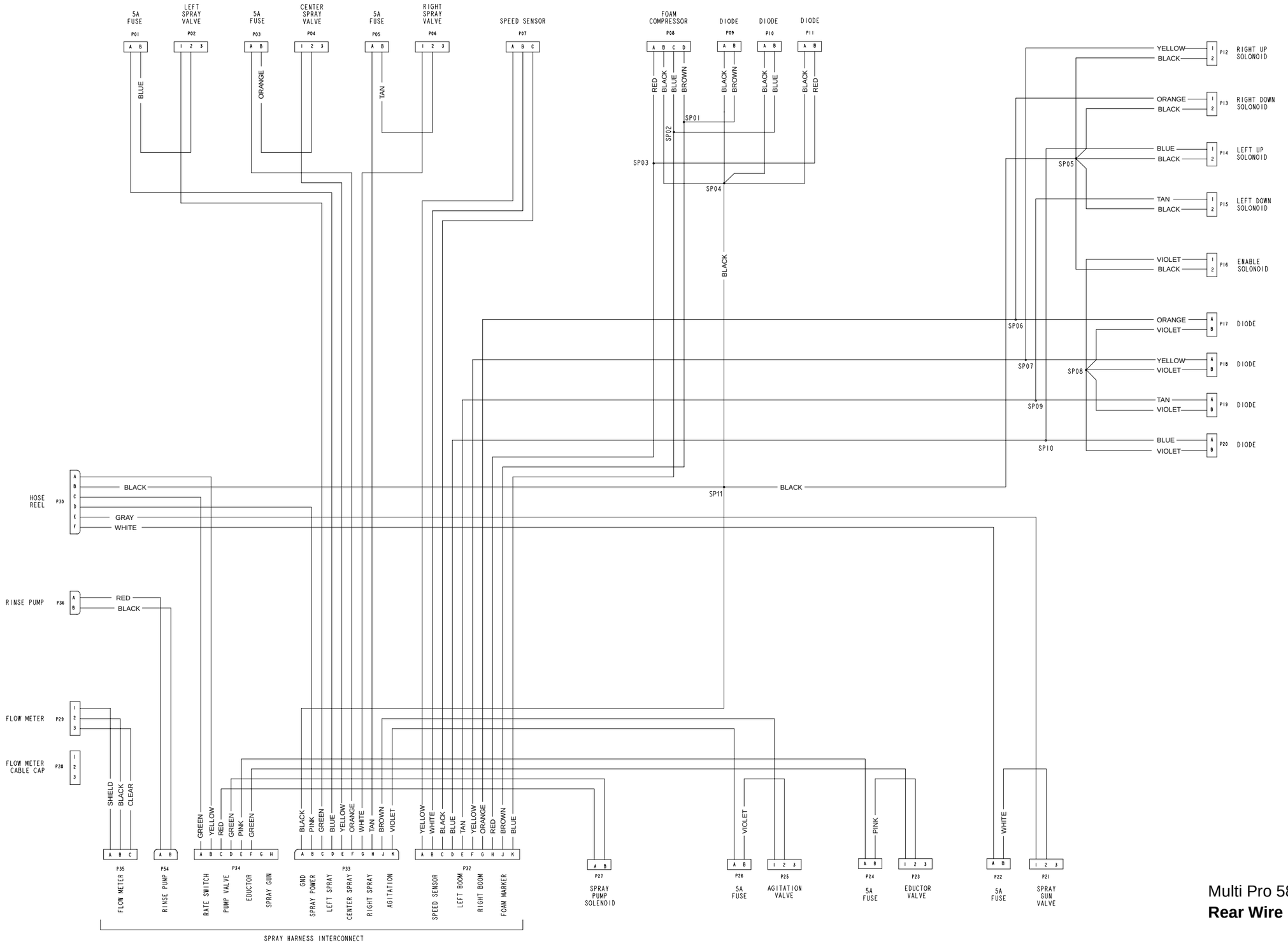


Multi Pro 5800
Front Wire Harness



Multi Pro 5800

Rear Wire Harness



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Rear Wire Harness

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