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Service Manual

Multi Pro[®] 1750

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NOTES



Service Manual

Multi Pro[®] 1750

Preface

The purpose of this publication is to provide the service technician with service information for troubleshooting, testing and repair of major systems and components on the Multi Pro 1750 sprayer.

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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Safety

Product Records
and Maintenance

Kohler
Gasoline Engine

Hydraulic
System

Electrical
System

Spray
System

Drive
Train

Chassis

Ultra Sonic
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Safety Instructions

The Multi Pro 1750 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.



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 range selector is in NEUTRAL.
4. Since gasoline is highly 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 operator seat when starting and operating the machine.
2. Before starting the engine:
 - A. Engage the parking brake.
 - B. Make sure range selector is in NEUTRAL 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, muffler, exhaust pipe or drive system components while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.
5. Before getting off the operator seat:
 - A. Ensure that range selector is in NEUTRAL.
 - B. Engage the 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 chemical manufacturer's recommendations for handling precautions, necessary protective equipment, mixing proportions and clean up procedures.

Maintenance and Service

1. Before servicing or making adjustments, turn spray pump off, put range selector in NEUTRAL, stop engine, apply parking brake and remove key from the ignition 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 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 the system must be relieved. To relieve system pressure, park machine on a level surface, engage parking brake and fully raise the spray booms so they are resting in the boom cradles. Shut engine off. Turn ignition key to the RUN position (do not start engine) and press both boom lift switches to the raise and lower positions to relieve hydraulic pressure in the boom lift circuits. Then, turn ignition key to the STOP position and rotate steering wheel in both directions to relieve hydraulic pressure in the steering circuit.
 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 hands, feet, clothing and other parts of the body away from moving parts. Keep bystanders away.
 11. Do not overspeed the engine by changing governor setting. 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.
- IMPORTANT: Before performing welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC and disconnect the terminal connector from the engine alternator. These steps will prevent damage to the machine electrical system when welding.**
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 non-conformance with the safety standards and the warranty may be voided.
 17. When changing attachments, tires or performing other service, use correct jacks, hoists and jack stands. Make sure machine is parked on a solid level surface such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury (see Jacking Instructions in this chapter).
 18. Make sure to dispose of potentially harmful waste (e.g. fuel, oil, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.

Jacking Instructions



CAUTION

When changing attachments, tires or performing other service, use appropriate 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 appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

IMPORTANT: Before raising the sprayer, it is recommended to empty the spray tank. If the spray tank is not emptied, consider the extra weight of spray tank contents when choosing appropriate jacks, hoists and jack stands for raising and supporting the machine.

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 frame crossbar (Fig. 1).
3. Jack front of machine off the ground.
4. Position suitable jack stands under the frame 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 on the rear frame support, behind the rear tie downs (Fig. 2).
3. Jack rear of machine off the ground.
4. Position jack stands under the frame to support the machine.

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Multi Pro 1750. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

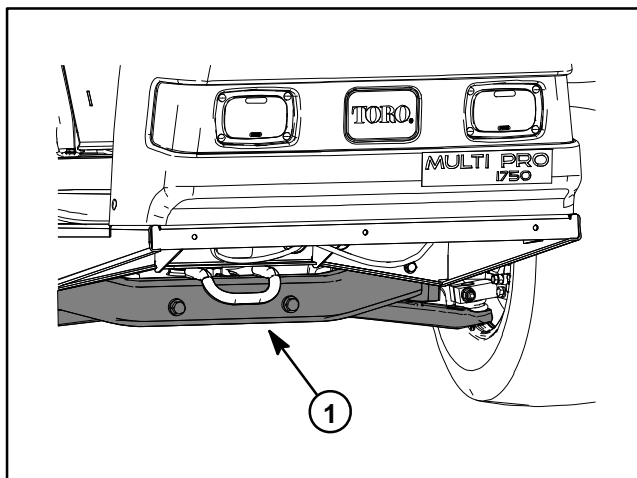


Figure 1

1. Front crossbar

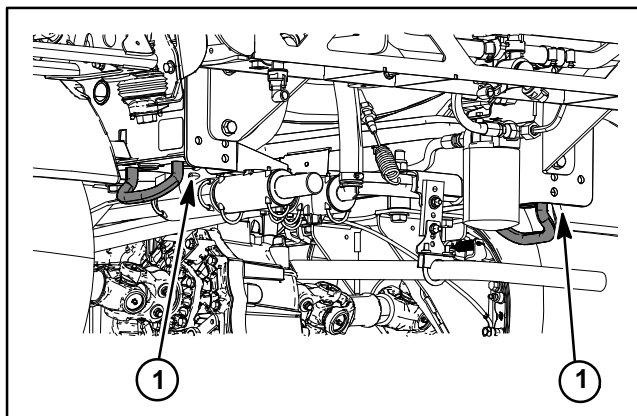


Figure 2

1. Rear jacking points



Product Records and Maintenance

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Product Records

Insert Operator’s Manual and Parts Catalog for your Multi Pro 1750 at the end of this chapter. Refer to Operator’s Manual for recommended maintenance intervals. Additionally, insert Installation Instructions, Operator’s Manuals and Parts Catalogs for any accessories that have been installed on your Multi Pro at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for the Multi Pro 1750 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	
	1/32	0.03125	—	0.794	
	3/64	0.046875	—	1.191	
1/16	—	0.0625	—	1.588	
	5/64	0.078125	—	1.984	
	3/32	0.09375	—	2.381	
	7/64	0.109275	—	2.778	
1/8	—	0.1250	—	3.175	
	9/64	0.140625	—	3.572	
	5/32	0.15625	—	3.969	
	11/64	0.171875	—	4.366	
3/16	—	0.1875	—	4.762	
	13/64	0.203125	—	5.159	
	7/32	0.21875	—	5.556	
	15/64	0.234375	—	5.953	
1/4	—	0.2500	—	6.350	
	17/64	0.265625	—	6.747	
	9/32	0.28125	—	7.144	
	19/64	0.296875	—	7.541	
5/16	—	0.3125	—	7.938	
	21/64	0.328125	—	8.334	
	11/32	0.34375	—	8.731	
	23/64	0.359375	—	9.128	
3/8	—	0.3750	—	9.525	
	25/64	0.390625	—	9.922	
	13/32	0.40625	—	10.319	
	27/64	0.421875	—	10.716	
7/16	—	0.4375	—	11.112	
	29/64	0.453125	—	11.509	
	15/32	0.46875	—	11.906	
	31/64	0.484375	—	12.303	
1/2	—	0.5000	—	12.700	
	1 mm = 0.03937 in.			0.001 in. = 0.0254 mm	
				33/64	0.515625
				17/32	0.53125
				35/64	0.546875
			9/16	—	0.5625
				37/64	0.578125
				19/32	0.59375
				39/64	0.609375
			5/8	—	0.6250
				41/64	0.640625
				21/32	0.65625
				43/64	0.671875
			11/16	—	0.6875
				45/64	0.703125
				23/32	0.71875
				47/64	0.734375
			3/4	—	0.7500
				49/64	0.765625
				25/32	0.78125
				51/64	0.796875
			13/16	—	0.8125
				53/64	0.828125
				27/32	0.84375
				55/64	0.859375
			7/8	—	0.8750
				57/64	0.890625
				29/32	0.90625
				59/64	0.921875
			15/16	—	0.9375
				61/64	0.953125
				31/32	0.96875
				63/64	0.984375
			1	—	1.000

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. Subtract 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

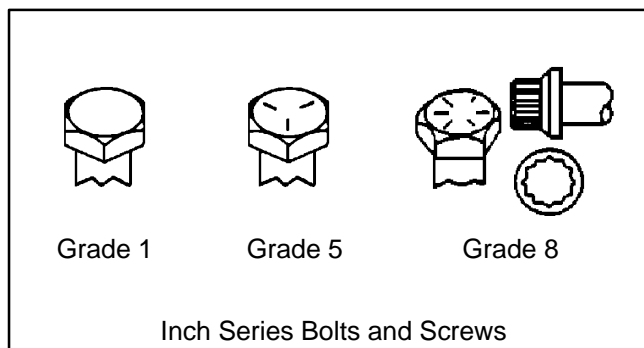


Figure 1

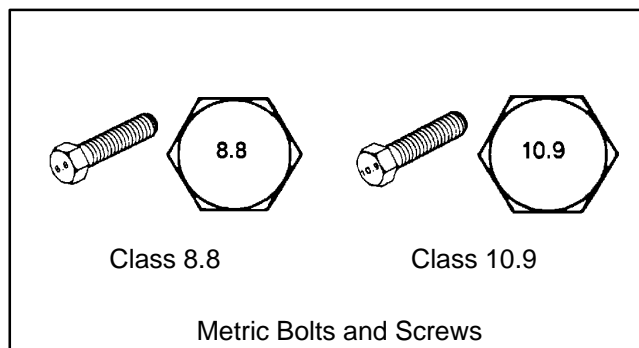


Figure 2

Using a Torque Wrench with an Offset Wrench

Use of an offset wrench (e.g. crowfoot wrench) will affect torque wrench reading 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. When using a torque wrench with an offset wrench, the calculated torque will be lower than the listed torque recommendation.

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

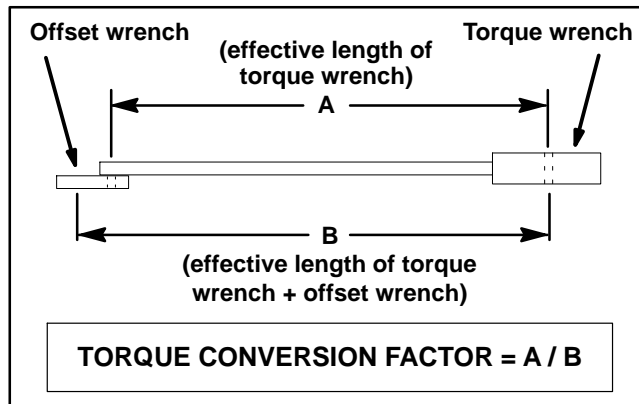


Figure 3

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 such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

NOTE: The nominal torque values listed above for Grade 5 and 8 fasteners are based on 75% of the minimum proof load specified in SAE J429. The tolerance is approximately ± 10% of the nominal torque value. Thin height nuts include jam nuts.

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

Product Records and Maintenance

NOTE: Reduce torque values listed in the table above by 25% for lubricated fasteners. Lubricated fasteners are defined as threads coated with a lubricant such as oil, graphite or thread sealant such as Loctite.

NOTE: Torque values may have to be reduced when installing fasteners into threaded aluminum or brass. The specific torque value should be determined based

on the fastener size, the aluminum or base material strength, length of thread engagement, etc.

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

$$\begin{aligned} \text{in-lb} \times 11.2985 &= \text{N-cm} \\ \text{ft-lb} \times 1.3558 &= \text{N-m} \end{aligned}$$

$$\begin{aligned} \text{N-cm} \times 0.08851 &= \text{in-lb} \\ \text{N-m} \times 0.7376 &= \text{ft-lb} \end{aligned}$$



Kohler Gasoline Engine

Kohler
Gasoline Engine

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KOHLER ENGINE SERVICE MANUAL	

Specifications

Item	Description
Make / Designation	Kohler, CH740, 4–stroke, V–Twin Air Cooled, OHV
Number of Cylinders	2
Bore x Stroke	3.27 in x 2.64 in (83 mm x 67 mm)
Total Displacement	44 in ³ (725 cc)
Compression Ratio	9.0:1
Fuel	Unleaded, Regular Gasoline (Minimum 87 Octane)
Fuel Tank Capacity	5 U.S. gal (18.9 liters)
Governor	Mechanical
Low Idle Speed (no load)	1350 to 1450 RPM
High Idle Speed (no load)	3350 to 3450 RPM
Engine Oil	API SJ, SK, SL or higher (see Operator's Manual for viscosity)
Oil Pump	Gear driven trochoid type
Crankcase Oil Capacity	2.1 U.S. qt (2.0 liters) with filter
Starter	12 VDC
Alternator/Regulator	12 VDC 25 AMP
Dry Weight (approximate)	94 lb (43 kg)

General Information

This chapter gives information about specifications and repair of the Kohler engine used in the Multi Pro 1750.

General maintenance procedures are described in your Operator's Manual. Information on engine troubleshooting, testing, disassembly and reassembly is identified in the Kohler Engine Service Manual that is included at the end of this section.

Most repairs and adjustments require tools which are commonly available in many service shops. Special

tools are described in the Kohler Engine Service Manual. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kohler engines are supplied through your Toro Distributor or a local Kohler Dealer.

Operator's Manual

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

Special Tools

Order special tools from your Toro Distributor.

Clutch Alignment Tool

Use clutch alignment tool to align clutch friction disk to engine flywheel before tightening pressure plate cap screws.

Toro Part Number: **TOR6002**



Figure 1

Troubleshooting

Clutch

Problem	Possible Causes
Clutch slips.	Clutch pedal out of adjustment. Excessive wear of clutch disc facing. Hardening of clutch disc facing, or adhesion of oil. Weak or broken clutch diaphragm spring. Damaged pressure plate or flywheel.
Clutch operation erratic or rough.	Improper installation of clutch cover assembly. Damaged clutch disc. Excessive wear of clutch disc facing. Weak or broken clutch torsion spring. Damaged or broken clutch pressure plate. Bent or broken clutch diaphragm spring tip. Dirty or improperly lubricated clutch disk spline. Damaged or distorted flywheel. Damaged release bearing.
Clutch noisy.	Improper installation of clutch cover assembly. Excessive wear of clutch disc facing. Worn clutch disc spline. Weak or broken clutch torsion spring. Damaged pilot bushing. Damaged release bearing.

Clutch (Continued)

Problem	Possible Causes
Clutch drags or does not release.	Control cable loose or out of adjustment. Bent or broken clutch diaphragm spring tip. Damaged or distorted clutch disc. Worn or rusted clutch disc spline. Damaged pressure plate or flywheel. Damaged release bearing.
Clutch chatters.	Worn or damaged clutch disc facing. Oil adhered to clutch disc facing. Uneven height of diaphragm spring. Weak or damaged clutch torsion spring. Damaged pressure plate or flywheel. Damaged clutch release bearing. Loose or worn front wheel bearings.

Adjustments

Adjust Engine Speed

1. Allow engine to reach operating temperature before checking or adjusting engine speed. Park machine on a level surface, place range selector in neutral and engage parking brake.
2. Raise the Operator's seat and remove the engine cover to access the engine.
3. With engine running, move accelerator pedal to **FAST** position.
4. Using a phototach (non-contact tachometer), check that engine is operating from **3350 to 3450 RPM**.
5. If high idle speed is incorrect, adjust high speed screw on control bracket (Fig. 2).
 - A. Loosen jam nut on high speed screw.
 - B. Adjust high speed screw to obtain **3350 to 3450 RPM**.
 - C. Tighten lock nut. Recheck high speed.
6. Allow accelerator pedal to return to **SLOW** position.
7. Using a phototach, check that engine is operating at **1350 to 1450 RPM**.
8. If low idle speed is incorrect, adjust low speed screw (Fig. 2).
 - A. Loosen jam nut on low speed screw.
 - B. Adjust low speed screw to obtain **1350 to 1450 RPM**.
 - C. Tighten jam nut. Recheck low idle speed.
9. Make sure the accelerator pedal contacts the throttle home switch and comes to rest against the hard pedal stop when released.

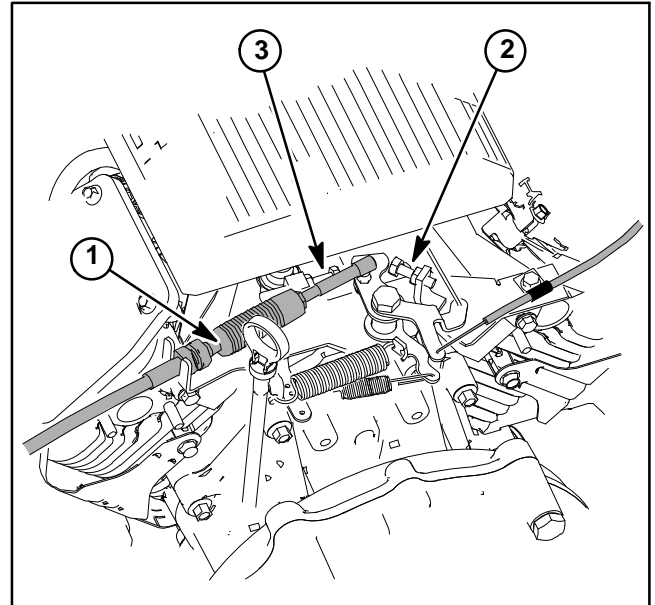


Figure 2

1. Accelerator cable
2. High speed screw
3. Low speed screw

Adjust Choke Cable

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.
2. Release the latch on the back of the seat and lift the seat forward to access the engine.
3. Remove air cleaner cover and air filter from engine.
4. Move choke control on control panel while watching choke plate in carburetor.
 - A. Choke plate should be fully open when choke control is pushed in.
 - B. Choke plate should be fully closed when choke control is pulled out.
5. If choke cable adjustment is needed, loosen cap screw and nut that secure choke cable clamp. Reposition cable to allow correct choke operation. Secure choke cable clamp.
6. Verify choke operation and assemble air cleaner.

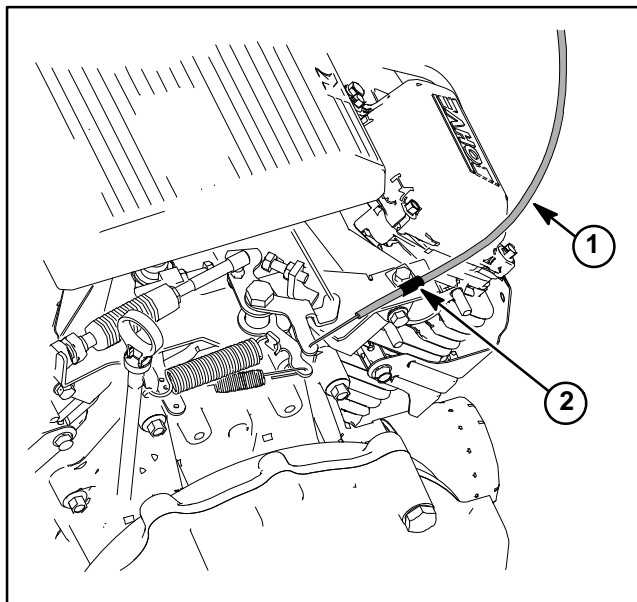


Figure 3

1. Choke cable

2. Cable clamp

Adjust Clutch Cable

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

2. Release the latch on the back of the seat and lift the seat forward to access the engine.

3. Disconnect clutch return spring (Fig. 4).

4. Apply 4 lbs (kg) force against clutch pedal and adjust cable nuts (Fig. 4) until bottom edge of clutch pedal is **2.4 to 2.6 in (60 to 66 mm)** from floor plate (Fig. 5).

5. Connect clutch return spring.

6. Make sure pedal actuates clutch switch and rests against the hard pedal stop (switch mount) when in the return position (Fig. 5).

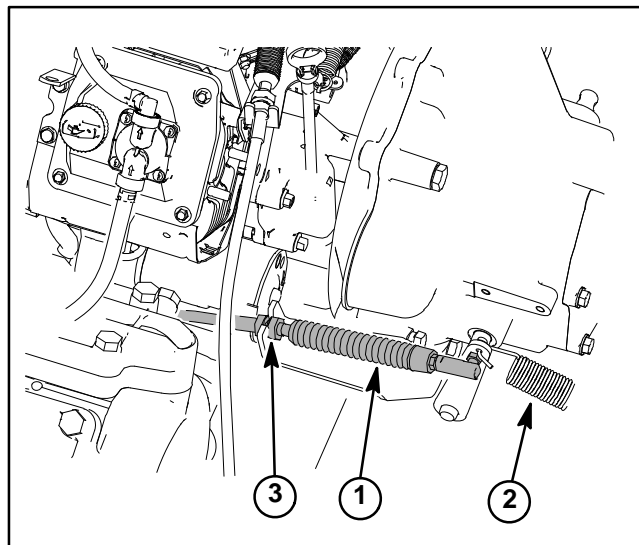


Figure 4

- 1. Clutch cable
- 2. Return spring
- 3. Bulkhead nuts (2)

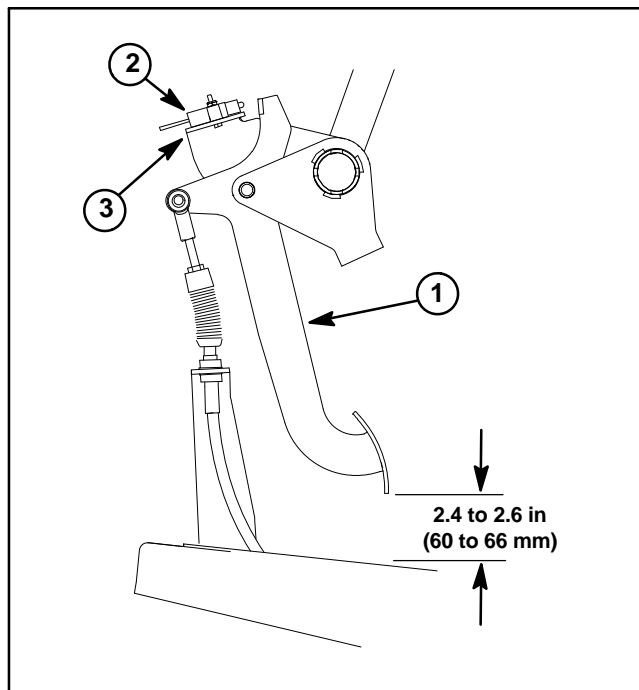


Figure 5

- 1. Clutch pedal
- 2. Switch
- 3. Pedal stop/switch mount

Service and Repairs

Cooling System

To ensure proper engine cooling, make sure the debris screen, cooling fins and other external surfaces of the engine are kept clean at all times.

NOTE: Perform this maintenance procedure at the interval specified in the Operator's Manual.

IMPORTANT: The engine that powers the Multi Pro is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked debris screen or a dirty or plugged blower housing will result in engine overheating and engine damage.

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

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

2. Clean cooling fins on both cylinder heads.

3. Clean debris screen and blower housing of dirt and debris (Fig. 6). Remove screen and housing if necessary.

IMPORTANT: Never operate engine without the blower housing installed. Engine overheating and damage will result.

4. Make sure debris screen and blower housing are re-installed to the engine if removed.

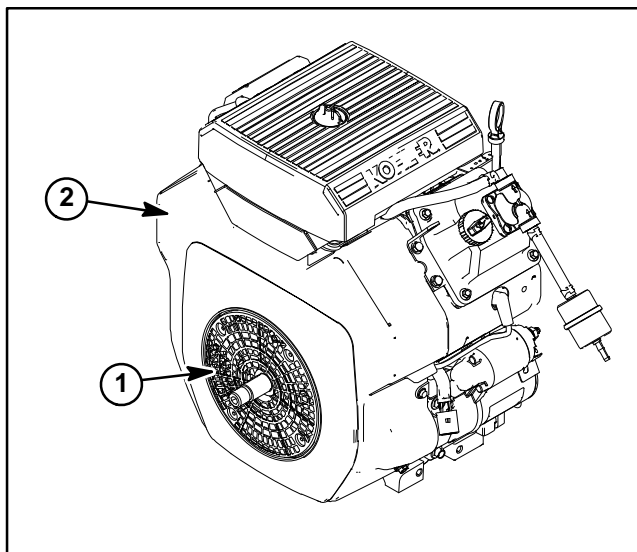


Figure 6

1. Debris screen

2. Blower housing

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Fuel System

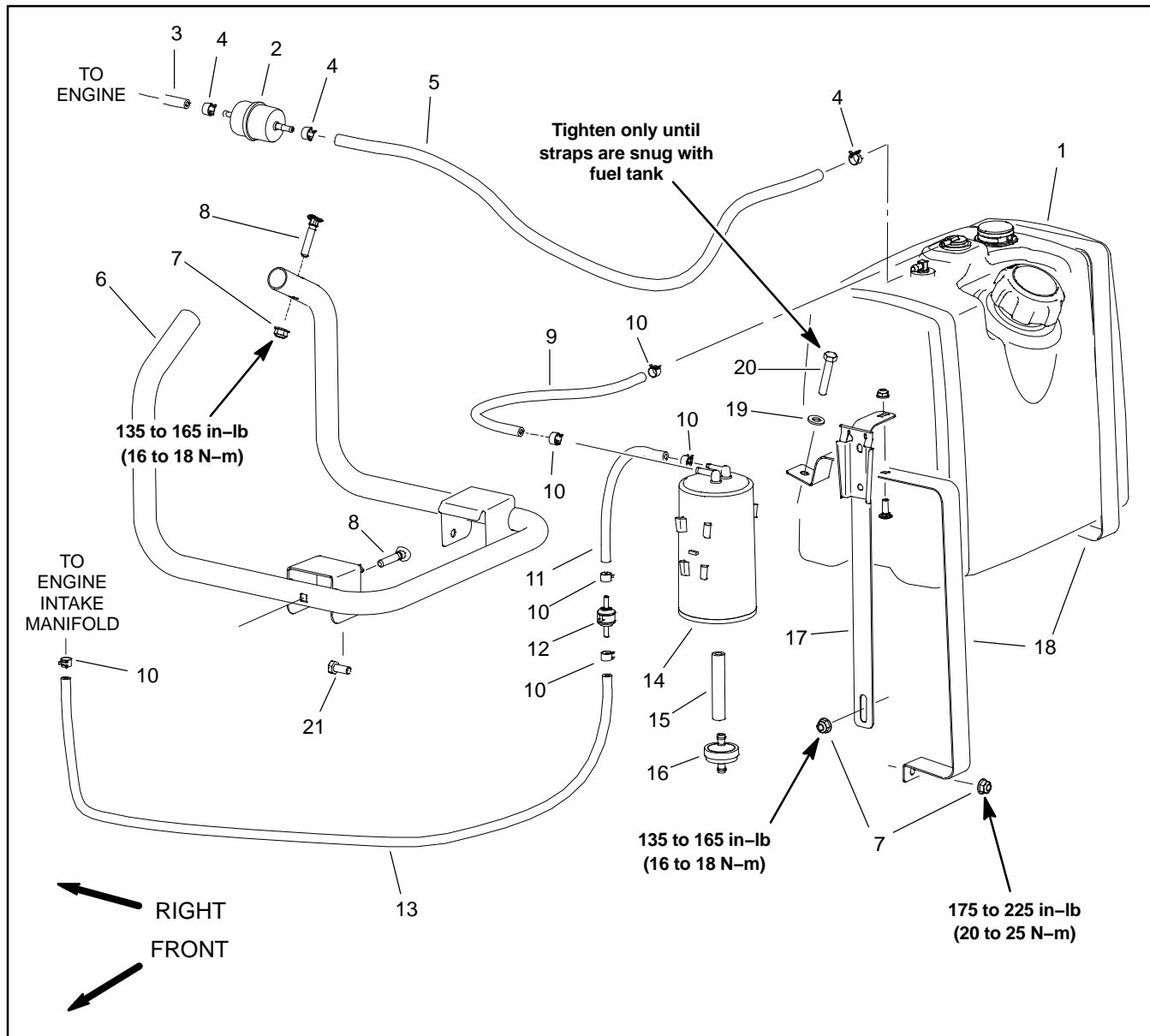


Figure 7

- | | | |
|---------------------------------|--|---------------------------|
| 1. Fuel tank assembly | 8. Handle bolt (3) | 15. Fresh air hose |
| 2. Fuel filter | 9. Vapor hose (tank to canister) | 16. Fresh air filter |
| 3. Fuel hose (filter to engine) | 10. Hose clamp (6) | 17. Carbon canister mount |
| 4. Hose clamp (3) | 11. Vapor hose (canister to check valve) | 18. Fuel tank strap (2) |
| 5. Fuel hose (tank to filter) | 12. Vacuum check valve | 19. Flat washer (2) |
| 6. Fuel tank mount | 13. Vapor hose (check valve to engine) | 20. Cap screw (2) |
| 7. Flange nut (5) | 14. Carbon canister | 21. Cap screw (2) |



DANGER

Because gasoline 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 gasoline for the engine only; not for any other purpose.

Check Fuel Lines and Connections

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

Drain and Clean Fuel Tank

Drain and clean the fuel tank 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 contaminants and debris.

Fuel Tank Removal (Fig. 7)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Use a fuel transfer pump to remove fuel from the fuel tank and into a suitable container.
3. Note routing of fuel hoses for installation purposes. Disconnect fuel hoses from fuel standpipe and rollover valve. Plug fuel hoses to prevent leakage or contaminant entry.
4. Remove fuel tank from machine.
5. Remove components from fuel tank as needed (Fig. 8).

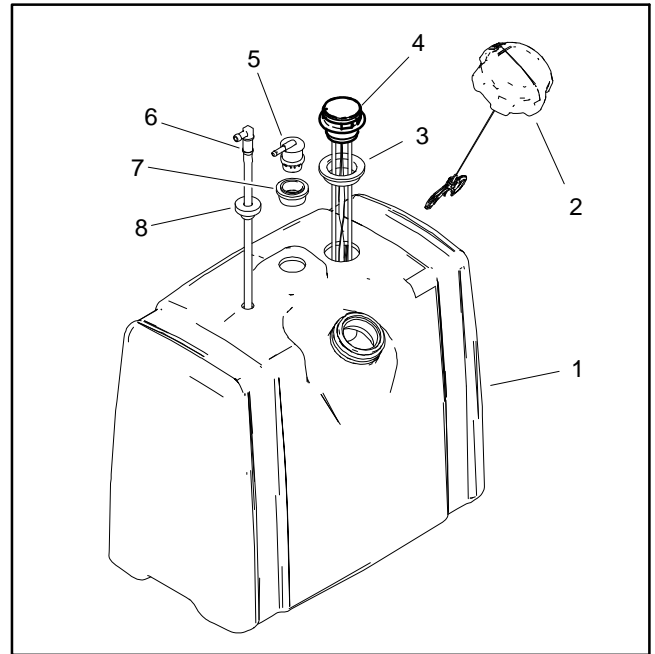


Figure 8

- | | |
|------------------|-------------------|
| 1. Fuel tank | 5. Rollover valve |
| 2. Fuel tank cap | 6. Standpipe |
| 3. Grommet | 7. Grommet |
| 4. Fuel gauge | 8. Bushing |

Fuel Tank Installation (Fig. 7)

1. Install all removed components to fuel tank (Fig. 8).
2. Install fuel tank to machine. Tighten fasteners to specified torque.
3. Remove plugs placed in fuel hoses during fuel tank removal. Connect fuel hoses to fuel standpipe and rollover valve. Secure fuel hoses with hose clamps.
4. Fill fuel tank with fresh gasoline.

Carbon Canister

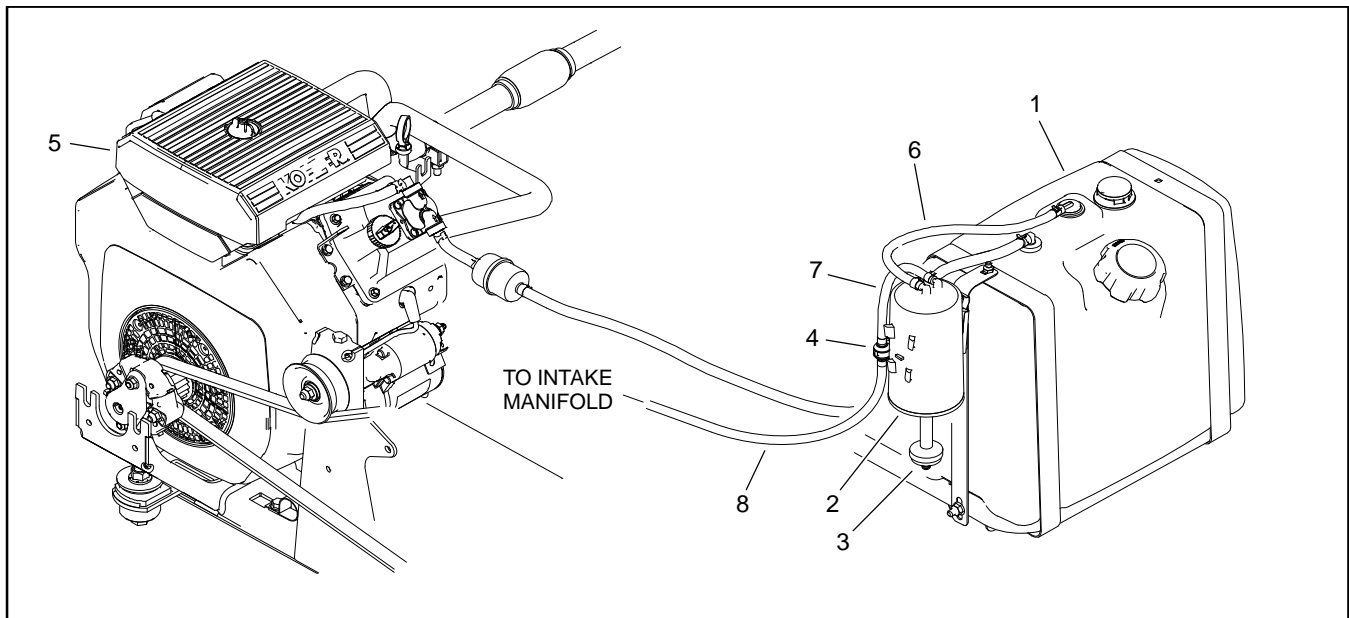


Figure 9

- | | | |
|-----------------------|----------------------------------|---|
| 1. Fuel tank assembly | 4. Vacuum check valve | 7. Vapor hose (canister to check valve) |
| 2. Carbon canister | 5. Engine | 8. Vapor hose (check valve to engine) |
| 3. Fresh air filter | 6. Vapor hose (tank to canister) | |


The function of the fuel evaporative control system is to collect and store evaporative emissions from the fuel tank and engine. The evaporative control system used on Multi Pro 1750 machines uses a carbon canister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister when the engine is not running. When the engine is running, vapors from the canister are consumed by the engine.

The fuel tank on Multi Pro 1750 machines uses a non-vented fuel cap. To connect the tank to the evaporative control system, a rollover valve is positioned in the top of the tank that allows the tank to vent to the carbon canister.

The carbon canister is mounted next to the fuel tank. The engine draws fuel vapor from the carbon canister through an in-line check valve and a hose connected to the engine intake manifold. The check valve is marked with an arrow indicating the direction of flow (to the engine intake manifold) to assure proper installation.

NOTE: If there is restriction in the fresh air filter, the carbon canister or the fuel vent valve, the fuel tank may distort due to venting issues. If the fuel tank returns to its normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

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



DANGER

Gasoline is 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 or 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 the cap in place. Use gasoline for the engine only; not for any other purpose.

2. Inspect carbon cannister and attached hoses for damage or obvious leaks. A damaged or leaking cannister should be replaced.

3. Replace fuel evaporative control system components as needed (Fig. 7 and 9). Note hose routing and location of clamps and cable ties.

4. Make sure that fuel hoses are secured with hose clamps, anchor clamps or cable ties as noted. Check hose connections at carbon canister for correct system operation.

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Exhaust System

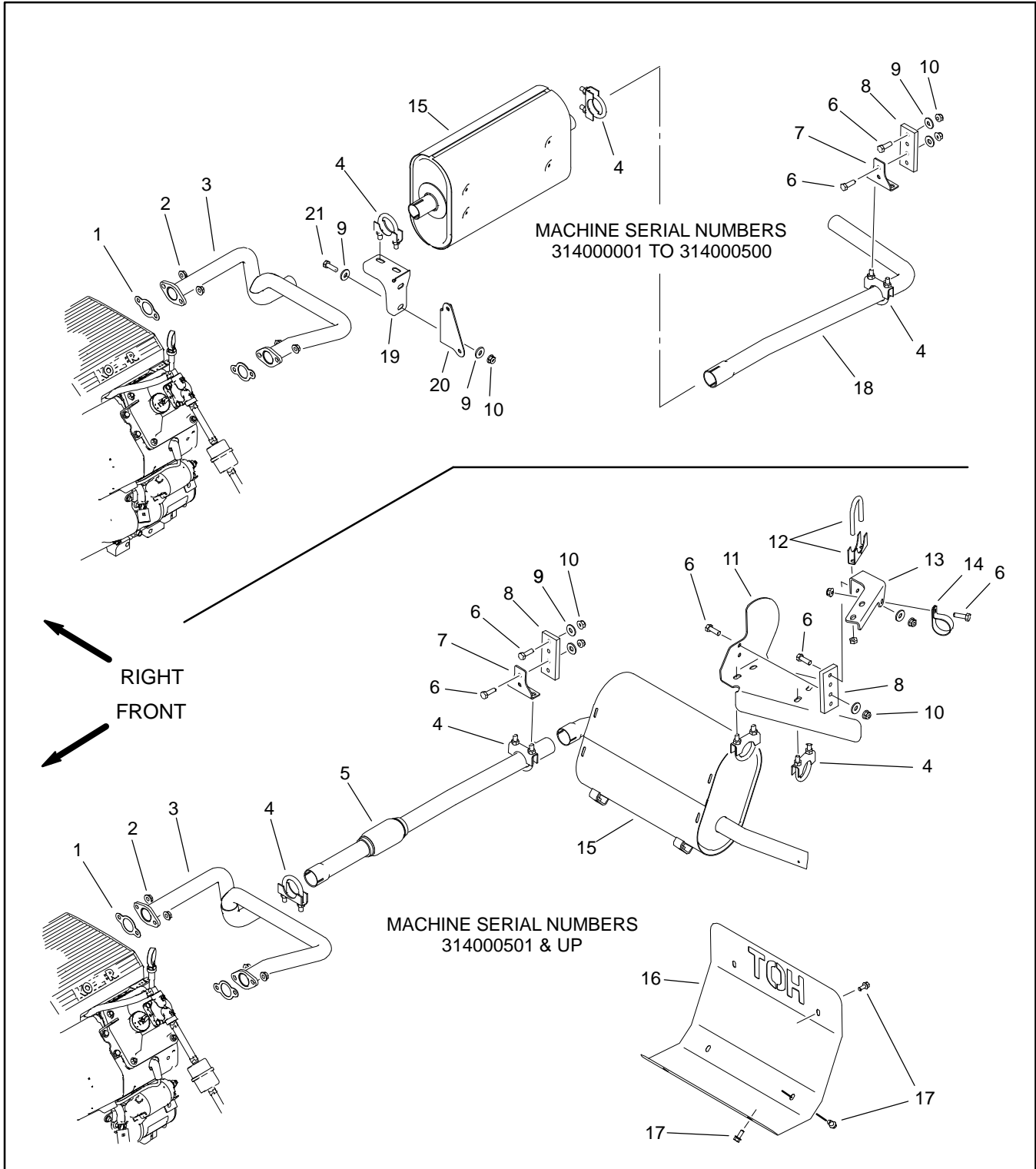


Figure 10

- | | | |
|-----------------------|-----------------------|-----------------------------|
| 1. Exhaust gasket (2) | 8. Muffler hanger (2) | 15. Muffler |
| 2. Flange nut (4) | 9. Flat washer (7) | 16. Heat shield |
| 3. Exhaust manifold | 10. Flange nut (8) | 17. Flange head screw (6) |
| 4. Muffler clamp (4) | 11. Muffler mount | 18. Tailpipe |
| 5. Exhaust pipe | 12. Muffler Clamp | 19. Muffler bracket |
| 6. Hex head screw (8) | 13. Muffler mount | 20. Exhaust support bracket |
| 7. Hanger bracket | 14. R-Clamp | 21. Hex head screw |

Removal (Fig. 10)



Removing the spray tank is not necessary but will make removing the exhaust system easier (see Spray Tank Removal in Chapter 6 – Spray System in this manual).

1. Park machine on a level surface, stop engine and engage parking brake. Remove key from ignition switch and allow engine and exhaust system to cool.
2. Remove the muffler from below the machine:
 - A. Loosen or remove muffler clamp (item 4) that secures muffler to exhaust pipe and hanger bracket (item 7).
 - B. Support muffler to prevent it from unexpectedly shifting.
 - C. Remove fasteners that secure two (2) muffler clamps (item 4) to muffler mount (item 11).
 - D. Slide muffler from exhaust pipe (item 5) and remove from machine.
 - E. If necessary, remove remaining muffler mounting components from machine.
3. Remove muffler clamp (item 4) that secures exhaust pipe to exhaust manifold (item 3).
4. Slide exhaust pipe from exhaust manifold and remove from machine.
5. Remove four (4) flange nuts from the exhaust studs on engine. Remove exhaust manifold from the engine.
6. Remove and discard exhaust gaskets from engine.

Installation (Fig. 10)

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

IMPORTANT: Finger tighten all exhaust system fasteners before fully tightening so there is no preload on exhaust components.

1. Place new exhaust gaskets on the exhaust studs on engine. Position exhaust manifold to the engine and install four (4) flange nuts finger tight.
2. Install exhaust pipe and muffler clamp (item 4) that secures exhaust pipe to exhaust manifold.
3. Install the muffler:
 - A. Install all removed muffler mounting components to machine.
 - B. Slide muffler inlet onto exhaust pipe.
 - C. Secure two (2) muffler clamps to muffler mount (item 11) with removed fasteners.
 - D. Install muffler clamp to hanger bracket (item 7).
4. Tighten exhaust system fasteners starting at the engine and continuing toward the muffler outlet as follows:
 - A. Four (4) flange nuts that secure exhaust manifold to engine.
 - B. Fasteners to secure muffler hangers (item 7) to machine frame. Muffler hangers should be perpendicular to frame after tightening.
 - C. Muffler clamp (item 4) fasteners at hanger.
 - D. Fasteners at two (2) muffler clamps that secure muffler to muffler mount (item 11).
5. Install the spray tank assembly if previously removed (see Spray Tank in Chapter 6 – Spray Tank in this manual).

Engine and Pump Mounting Plate Assembly

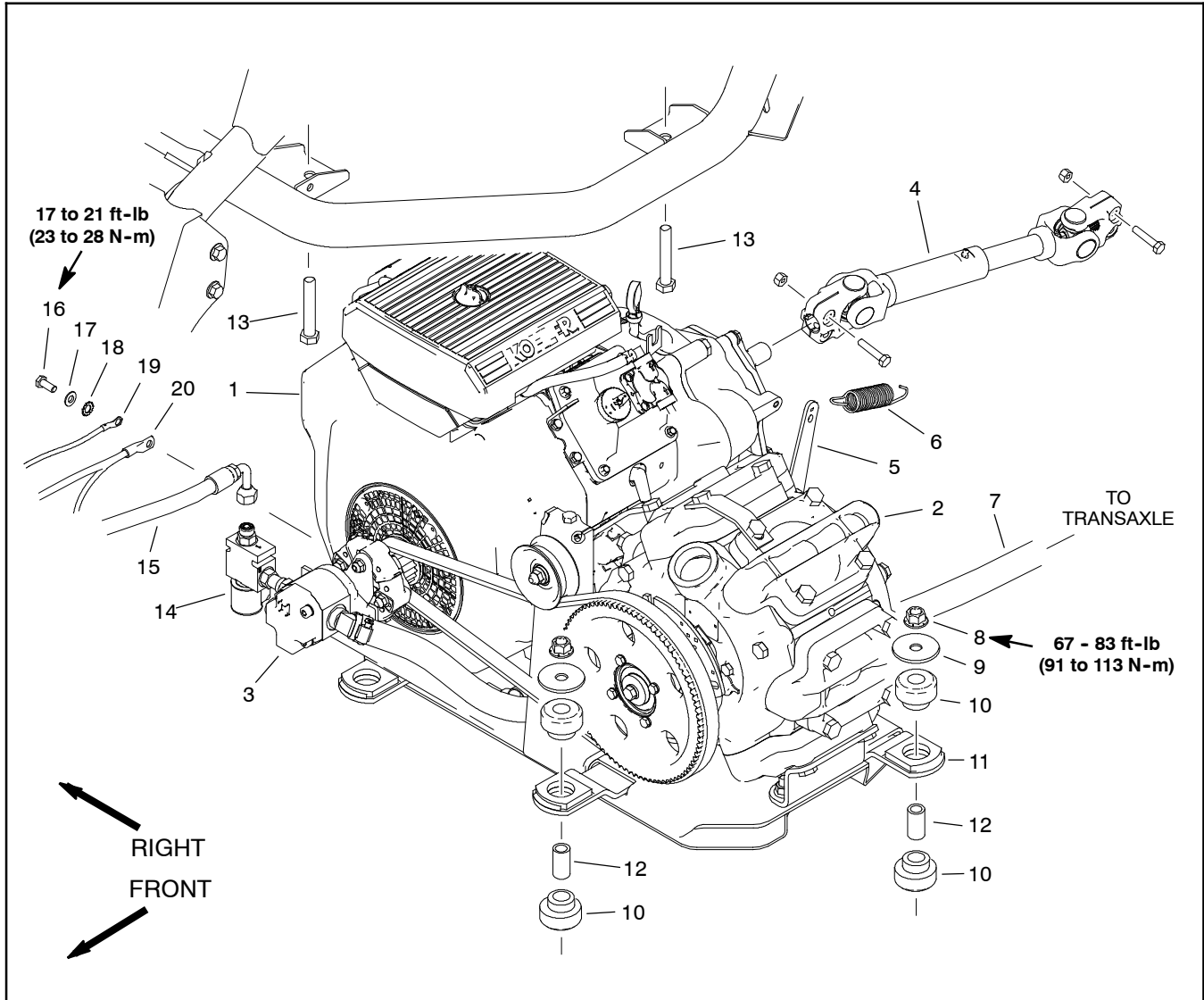


Figure 11

- | | | |
|---------------------------|------------------------------------|--------------------------------|
| 1. Engine | 8. Flange nut (4) | 15. Hydraulic hose |
| 2. Spray pump | 9. Washer (4) | 16. Hex head screw |
| 3. Hydraulic pump | 10. Engine mount - cushion (8) | 17. Flat washer |
| 4. Transaxle drive shaft | 11. Engine and pump mounting plate | 18. External tooth lock washer |
| 5. Clutch throwout lever | 12. Engine mount - tube (4) | 19. Main wire harness ground |
| 6. Return spring | 13. Hex head screw (4) | 20. Battery negative (-) cable |
| 7. Hydraulic suction hose | 14. Hydraulics enable valve | |

NOTE: The engine can be removed from the machine without removing the engine and pump mounting plate if the spray pump has been removed (see Spray Pump in Chapter 6 - Spray Pump in this manual and Engine in this chapter).

Removal (Fig. 11)

Engine removal is accomplished by first removing the engine and pump mounting plate as an assembly out from underneath the machine. Removing the spray tank is not necessary but will make removing the engine and pump mounting plate assembly easier (see Spray Tank Removal in Chapter 6 – Spray System in this manual).

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Safely raise the machine about 14 in. (35 cm) off the ground (see Jacking Instructions in Chapter 1 – Safety in this manual).



CAUTION

The engine, exhaust system and drive components may be hot. To avoid possible burns, allow all components to cool before removing the engine mounting plate assembly.

3. Tilt operator seat forward and remove engine cover.
4. Disconnect negative (–) and then positive (+) battery cables at the battery.
5. Remove accelerator cable from engine (Fig. 12).
 - A. Slide the sleeve back on the cable ball joint and lift accelerator cable from the ball stud.
 - B. Loosen one of the two cable jam nuts that secures accelerator cable to control bracket.
 - C. Remove accelerator cable from the engine speed control bracket and position away from the engine.
6. Remove choke cable clamp and choke cable from the engine speed control bracket (Fig. 12).
7. Remove exhaust system (see Exhaust System in this chapter).
8. Disconnect fuel hose from fuel pump on engine. Disconnect evaporative system vapor hose at engine intake manifold (left side of engine).

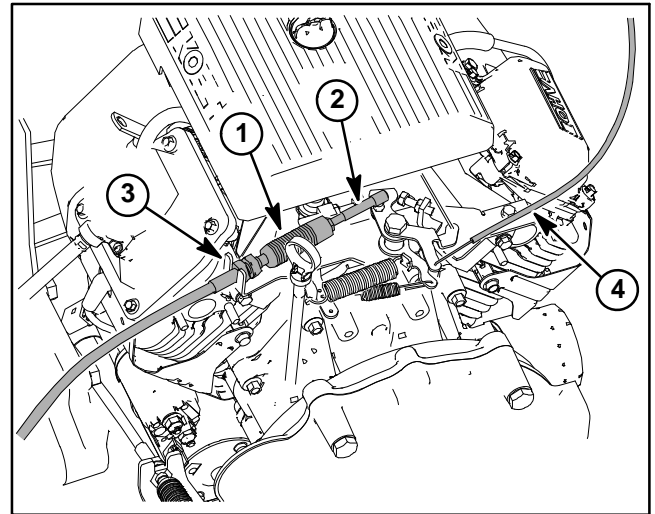


Figure 12

- | | |
|----------------------|------------------|
| 1. Accelerator cable | 3. Cable jam nut |
| 2. Cable ball joint | 4. Choke cable |

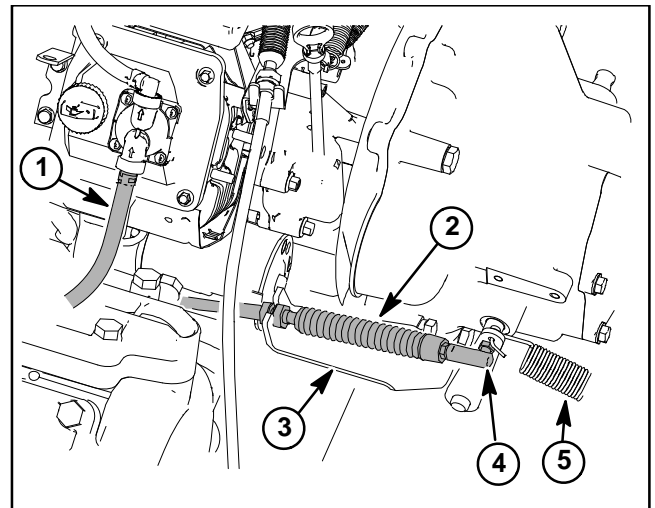


Figure 13

- | | |
|-----------------|------------------|
| 1. Fuel line | 4. Ball Joint |
| 2. Clutch cable | 5. Return spring |
| 3. Bracket | |

9. Disconnect the following engine electrical connections and position disconnected wires away from engine:
 - A. Unplug engine wire harness from machine wire harness (near starter).
 - B. Remove the blue starter signal wire from the starter solenoid.
 - C. Remove the fusible link and positive (+) battery cable ring terminals from the starter solenoid (stud).
 - D. Disconnect battery negative (–) cable and machine wire harness ground at engine base (Fig. 11).
 - E. Disconnect wire harness connector at spray pump electric clutch.

10. Remove transaxle drive shaft from engine (see Transaxle Drive Shaft in Chapter 7 – Drive Train in this manual).


11. Remove clutch cable from bracket on clutch housing (Fig. 13). Remove ball joint lock nut and ball joint from throwout lever, loosen cable bulkhead nuts, and remove clutch cable from bracket. Remove the return spring.

	CAUTION
Rotate steering wheel to relieve hydraulic system pressure and avoid injury from pressurized hydraulic oil.	

12. Clean hydraulic hose ends prior to disconnecting the hoses. Remove hydraulic hose from hydraulics enable valve. Disconnect hydraulic suction hose at transaxle. Cap or plug openings of valve, transaxle, and hoses to prevent system contamination.

13. Make sure spray tank is empty and disconnect top suction hose and main supply hose from spray pump. Cover pump ports to prevent pump contamination.

14. Remove and record the locations of cable ties and clamps used to secure disconnected wiring, fuel lines, hydraulic lines, etc.

	CAUTION
The engine and pump mounting plate assembly weighs approximately 350 lbs (158 kg). Use an appropriate lifting device to safely lift the engine and pump mounting plate assembly.	

15. Remove engine mounting plate assembly from machine:

A. Support the engine mounting plate assembly from below to prevent it from falling.

B. Remove four (4) cap screws, washers and flange nuts that secure the engine and pump mounting plate to the frame.

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

C. Carefully remove the engine and pump mounting plate assembly from the machine.

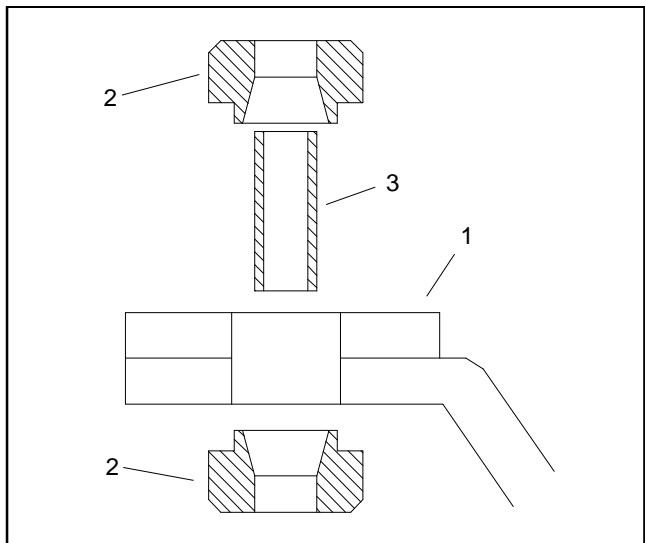


Figure 14

- 1. Engine support strap
- 2. Engine mount cushion
- 3. Engine mount tube

Installation (Fig. 11)

1. Place machine on a level surface with key removed from the ignition switch. Safely raise the machine about 14 in. (35 cm) off the ground (see Jacking Instructions in Chapter 1 – Safety in this manual).

2. Reinstall engine mounting plate assembly to machine:

A. Make sure that engine mounts are correctly assembled (Fig. 14). Position engine mounting plate assembly under machine.

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

B. Carefully raise engine mounting plate assembly to machine frame.

C. Secure engine mounting plate assembly to frame with four (4) cap screws, washers and flange nuts. Tighten flange nuts from **67 to 83 ft-lbs (91 to 113 N-m)**.

3. Uncover pump ports and connect top suction hose and main supply hose to spray pump.

4. Remove caps and plugs and install hydraulic hoses to hydraulic enable valve and transaxle.

5. Install clutch cable to bracket on clutch housing (Fig. 13). Set bulkhead nuts so an equal amount of cable housing thread appears on each side of the cable bracket and tighten bulkhead nuts. Install ball joint to throwout lever with lock nut and tighten. Install return spring. Adjust clutch cable (see Clutch Cable Adjustment in this chapter).
 6. Install transaxle drive shaft to engine (see Transaxle Drive Shaft in Chapter 7 – Drive Train in this manual).
 7. Route wires away from moving and hot components and connect the following engine electrical connections:
 - A. Connect engine wire harness to machine wire harness (near starter).
 - B. Connect the blue starter signal wire to the starter solenoid.
 - C. Install the fusible link and positive (+) battery cable ring terminals to the starter solenoid (stud).
- Note:** Make sure that the engine and frame ground surfaces are free from corrosion, oil and paint.
- D. Connect battery negative (-) cable and machine wire harness ground to engine base (Fig. 11).
 - E. Torque the engine ground bolt to **17 to 21 ft-lbs (23 to 28 N-m)** and apply a coat of terminal protector.
 - F. Torque the frame ground bolt to **175 to 225 in-lbs (19.7 to 25.4 N-m)** and apply a coat of terminal protector.
 - G. Connect wire harness connector at spray pump electric clutch.
8. Connect fuel line to the fuel pump on engine. Connect evaporative system vapor hose to engine intake manifold (left side of engine).
 9. Install exhaust system (see Exhaust System in this chapter).
 10. Install choke cable to engine (Figs. 12). Check choke cable adjustment (see Adjust Choke Cable in this chapter).
 11. Reconnect accelerator cable to engine (Figs. 12).
 - A. Fit accelerator cable to the engine speed control bracket.
 - B. Slide the sleeve back on the cable ball joint and place cable ball joint on ball stud. Release the sleeve so it slides over the stud to secure cable.
 - C. Tighten cable jam nuts that secure accelerator cable to control bracket.
 12. Check engine oil level and transaxle/hydraulic fluid level (see Operator's Manual).
 13. Connect positive (+) and then negative (-) battery cables to the battery.
 14. Check engine speed (see Adjust Engine Speed in the Adjustments Section of this chapter).

Engine

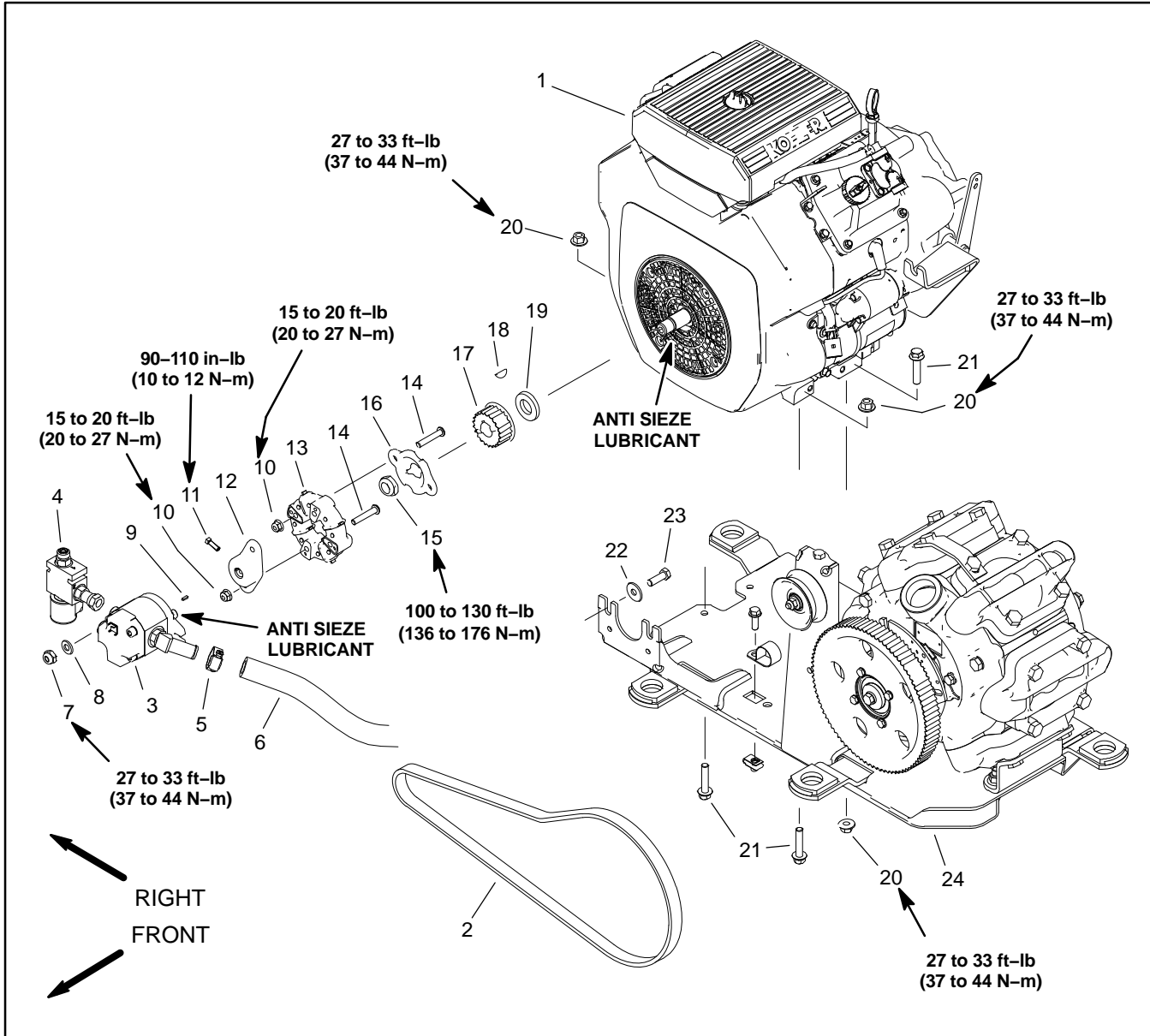


Figure 15

- | | | |
|----------------------------|---------------------------|------------------------------------|
| 1. Engine | 9. Square key | 17. Belt sprocket |
| 2. Spray pump drive belt | 10. Flange nut (4) | 18. Woodruff key |
| 3. Hydraulic pump assembly | 11. Set screw (2) | 19. Spacer |
| 4. Hydraulic enable valve | 12. Pump hub | 20. Flange nut (4) |
| 5. Hose clamp | 13. Rubber coupler | 21. Flange head screw (4) |
| 6. Suction hose | 14. Button head screw (4) | 22. Flat washer (2) |
| 7. Lock nut (2) | 15. Lock nut | 23. Hex head screw (2) |
| 8. Flat washer (2) | 16. Sprocket adaptor | 24. Engine and pump mounting plate |

Removal (Fig. 15)

Engine removal is accomplished by first removing the engine and pump mounting plate as an assembly from the machine (see Engine and Pump Mounting Plate Assembly in this chapter).

1. Loosen two (2) set screws on pump hub (item 12).
2. Remove fasteners securing hydraulic pump assembly (item 3) to engine and pump mounting plate. Slide pump assembly from pump hub and set aside. See Chapter 4 – Hydraulic System in this manual for additional hydraulic pump service information.
3. Loosen idler pulley flange nut and turn adjusting screw counterclockwise to relieve drive belt tension (Fig. 16). Remove spray pump drive belt.
4. Loosen and remove four (4) flange head screws and flange nuts that secure engine to engine and pump mounting plate.

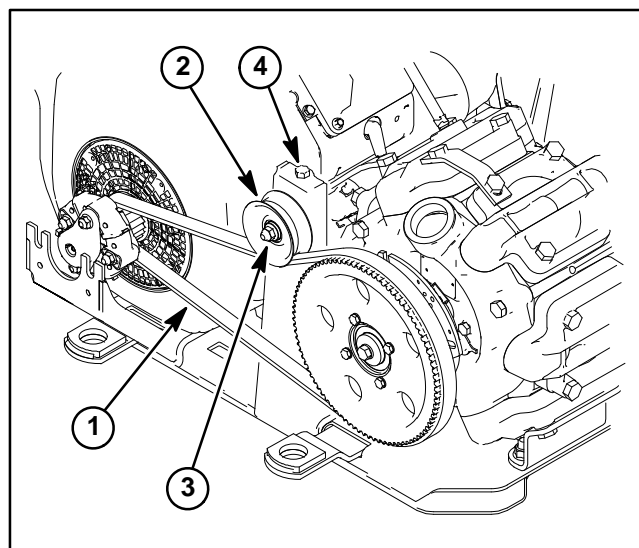


Figure 16

- | | |
|--------------------------|--------------------|
| 1. Spray pump drive belt | 3. Flange nut |
| 2. Idler pulley | 4. Adjusting screw |



CAUTION

Engine and clutch assembly weighs approximately 125 lbs (57 kg). Use an appropriate lifting device to safely lift the engine assembly.

5. Carefully lift engine from mounting plate.
6. Remove hydraulic pump hub, rubber coupling, and drive sprocket components from engine crankshaft if necessary. Locate and retrieve hydraulic pump key and drive pulley key.
7. Remove throttle bracket assembly if necessary (Fig. 17).
8. Remove engine clutch assembly if necessary (see Clutch in this chapter).

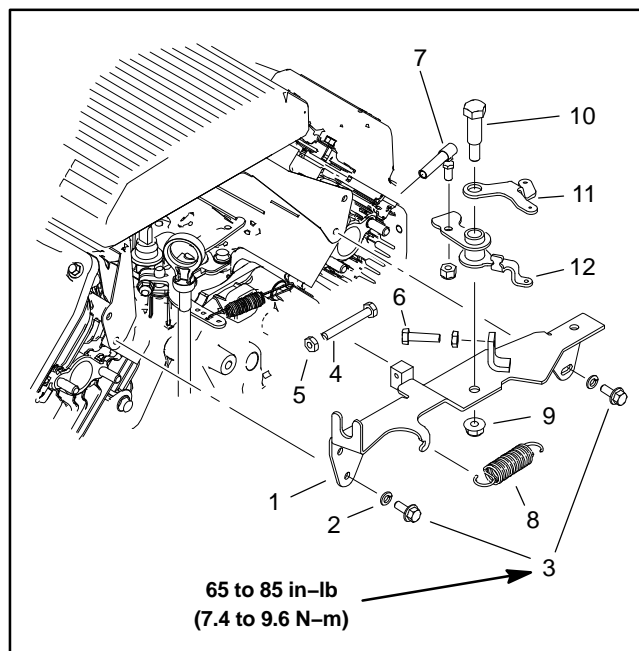


Figure 17

- | | |
|----------------------------|------------------------------|
| 1. Throttle bracket | 7. Throttle cable ball joint |
| 2. Lock washer(4) | 8. Spring |
| 3. Flange head screw (4) | 9. Flange nut |
| 4. Screw – high speed stop | 10. Shoulder screw |
| 5. Jam nut (2) | 11. Choke lever |
| 6. Screw – low speed stop | 12. Throttle lever |

Installation (Fig. 15)

1. Make sure that all parts removed from the engine during maintenance or rebuilding are correctly reinstalled to the engine.
2. Install engine clutch assembly if removed (see Clutch in this chapter).
3. Install throttle bracket assembly if removed (Fig. 17). Tighten mounting screws from **65 to 85 in-lb (7.4 to 9.6 N-m)**.

4. If removed, install drive sprocket components, rubber coupling, and hydraulic pump hub as follows:

A. Install sprocket spacer on engine shaft.

B. Position woodruff key on engine shaft. Apply anti seize lubricant to shaft and key, then fit drive sprocket on engine shaft.

C. Place two (2) button head screws (item 14) in position in sprocket adapter (item 16). Install sprocket adapter and lock nut on engine shaft. Make sure sprocket adapter is fully engaged with sprocket and tighten lock nut from **100 to 130 ft-lb (136 to 176 N-m)**.

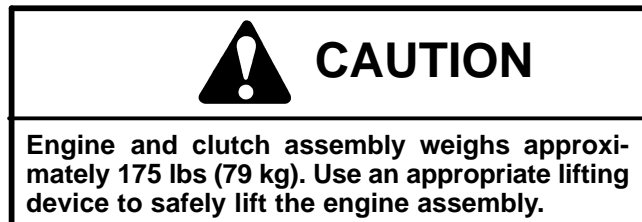
D. Place two (2) button head screws (item 14) in rubber coupler (item 13). Position rubber coupler over screws in sprocket adapter and install flange nuts. Tighten flange nuts from **15 to 20 ft-lb (20 to 27 N-m)**.

E. Place pump hub over screws in rubber coupler and install flange nuts. Tighten flange nuts from **15 to 20 ft-lb (20 to 27 N-m)**

6. Install drive belt over sprockets and under idler pulley. Adjust drive belt tension (see Adjust Spray Pump Drive Belt in Chapter 6 – Spray System in this manual).

7. Position key into hydraulic pump shaft and apply anti-seize lubricant to pump shaft and key. Align pump shaft with hub and install pump to mounting plate with fasteners shown. Tighten pump mounting fasteners from **27 to 33 ft-lb (37 to 44 N-m)**. Tighten two (2) pump hub set screws from **90 to 110 in-lb (10 to 12 N-m)**.

8. Install engine and pump mounting plate assembly to machine (see Engine and Pump Mounting Plate Assembly in this chapter).



5. Carefully lift engine onto the engine and pump mounting plate and secure with four (4) flange head screws and flange nuts. Tighten fasteners from **27 to 33 ft-lb (37 to 44 N-m)**.

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Clutch

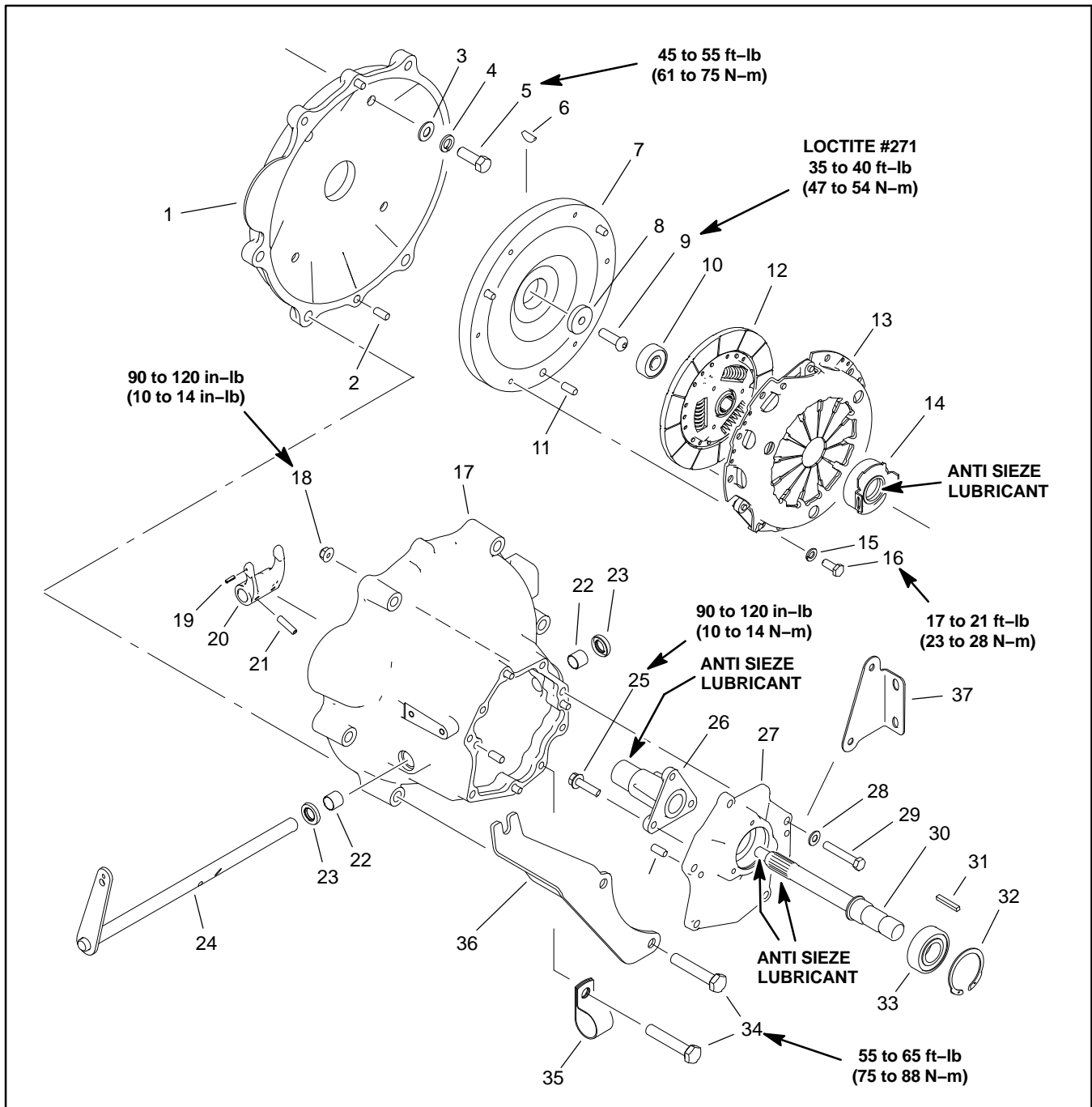



Figure 18

- | | | |
|-----------------------------|---------------------------|---|
| 1. Adapter plate | 14. Release bearing | 27. Bearing support |
| 2. Alignment pin (4) | 15. Lock washer (6) | 28. Lock washer (6) |
| 3. Flat washer (4) | 16. Hex head screw (6) | 29. Hex head screw (6) |
| 4. Lock washer (4) | 17. Bell housing | 30. Output shaft |
| 5. Hex head screw (4) | 18. Flange nut (6) | 31. Square key |
| 6. Woodruff key | 19. Roll pin | 32. Retaining ring |
| 7. Flywheel | 20. Release fork | 33. Bearing |
| 8. Washer | 21. Roll pin (2) | 34. Hex head screw (6) |
| 9. Button head screw | 22. Bushing (2) | 35. R-clamp |
| 10. Pilot bearing | 23. Seal (2) | 36. Clutch cable bracket |
| 11. Alignment pin (3) | 24. Release shaft | 37. Exhaust support bracket
(machine serial no 314000001 thru
31400500) |
| 12. Clutch disc | 25. Flange head screw (3) | |
| 13. Pressure plate assembly | 26. Release guide | |

Removal (Fig. 18)

The clutch can be removed with the engine in the machine or after the engine has been removed from the machine.

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

	CAUTION
The engine, exhaust system and drive components may be hot. To avoid possible burns, allow all components to cool before removing the engine mounting plate assembly.	

2. Remove exhaust system (see Exhaust System in this chapter).

3. Remove transaxle drive shaft from engine (see Transaxle Drive Shaft in Chapter 7 – Drive Train in this manual).

4. Remove clutch cable from bracket on clutch housing (Fig. 19). Remove ball joint lock nut and ball joint from throwout lever, loosen cable bulkhead nuts, and remove clutch cable from bracket. Remove the return spring.

5. Remove six (6) hex head screws (item) and clutch cable bracket securing bell housing assembly to adapter plate (item 1).

6. Support bell housing assembly and slide assembly rearward until output shaft (item 30) is free from clutch. Remove bell housing assembly from machine.

7. Remove six (6) hex head screws and lock washers securing pressure plate assembly (item 13) to flywheel and remove pressure plate assembly and clutch disc from engine.

8. Remove pilot bearing (item 10) from flywheel and discard bearing.

9. If necessary, disassemble clutch release mechanism (see Clutch Release Disassembly in this chapter).

10. If necessary, remove button head screw and washer, and pull flywheel from engine shaft. Locate and retrieve flywheel key.

11. If necessary, remove four (4) hex head screws, lock washers, and flat washers, and remove adapter plate (item 1) from engine.

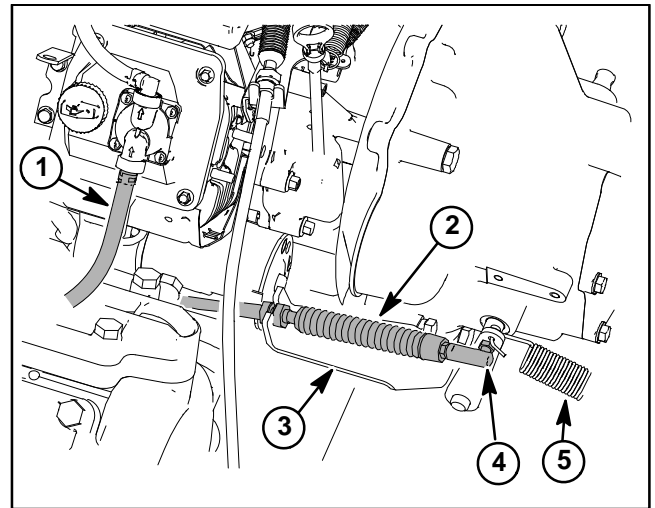


Figure 19

- | | |
|-----------------|------------------|
| 1. Fuel line | 4. Ball Joint |
| 2. Clutch cable | 5. Return spring |
| 3. Bracket | |

Inspection

1. Inspect diaphragm spring end of pressure plate for wear and uneven height. Replace if wear is evident or if height difference exceeds 0.020 in. (0.5 mm).
2. Check pressure plate surface for wear, cracks or color change.
3. Check strap plate rivets for looseness. Replace pressure plate if rivets are loose.
4. Check clutch disk facing for loose rivets, uneven contact, deterioration due to seizure and lubricant contamination. Replace clutch disk if damaged.
5. Measure rivet sink and replace clutch disk if out of specification (Fig. 20).

Clutch disk thickness	0.307 to 0.339 in. (7.8 to 8.6 mm)
Clutch disk rivet sink	0.012 in. (0.3 mm) minimum

6. Check for torsion spring play or damage. Replace clutch disk if necessary.
7. Install clutch disc on output shaft. Make sure clutch slides freely on splines of shaft. Check clutch and output shaft splines for excessive play in rotating direction.
8. Inspect flywheel surface for stepped wear, streaking or seizure. Replace if necessary. Clean any oil or rust from flywheel surface with light abrasive. Check flywheel runout and replace if runout exceeds 0.005 in. (0.13 mm).

Installation (Fig. 18)

1. If previously removed, secure adapter plate (item 1) to engine with four (4) hex head screws, lock washers, and flat washers. Tighten screws from **45 to 55 ft-lbs (61 to 75 N-m)**.
2. If previously removed, clean engine shaft, woodruff key, and flywheel bore thoroughly with solvent and fit key and flywheel on engine shaft. Apply heavy duty thread locking compound (ie. loctite 271) to button head screw (item 9) and install washer and button head screw. Tighten screw from **35 to 40 ft-lbs (47 to 54 N-m)**.
3. Install new pilot bearing (item 10) in flywheel.
4. Thoroughly clean clutch contact surface of flywheel and pressure plate with solvent.

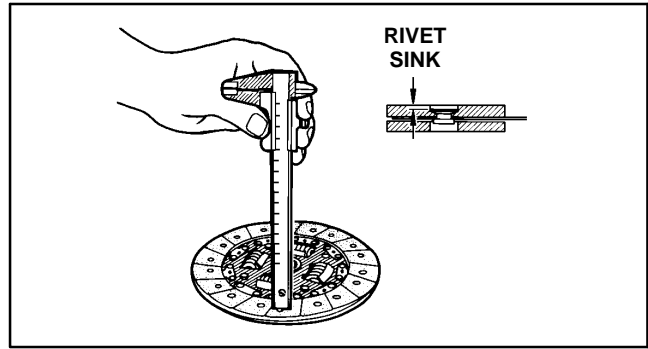


Figure 20

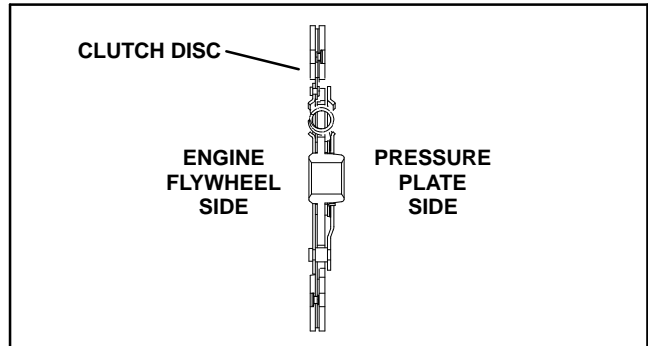


Figure 21

5. Position clutch disc with flat side against flywheel (Fig. 21). Position pressure plate assembly over alignment pins in flywheel. Use clutch alignment tool (see Special Tools in this chapter) and center clutch disc over pilot bearing. Secure pressure plate assembly to flywheel with six (6) hex head screws and lock washers. Tighten screws from **17 to 21 ft-lbs (23 to 28 N-m)** and remove clutch alignment tool.
6. Align output shaft with splines in clutch disc and install bell housing assembly over alignment pins in adapter plate (item 2). Fit the clutch cable bracket and R-clamp under the mounting screws and secure bell housing to adapter plate with six (6) hex head screws. Tighten screws from **55 to 65 ft-lbs (75 to 88 N-m)**.
7. Install clutch cable to bracket on clutch housing (Fig. 19). Set bulkhead nuts so an equal amount of cable housing thread appears on each side of the cable bracket and tighten bulkhead nuts. Install ball joint to throwout lever with lock nut and tighten. Install return spring. Adjust clutch cable (see Clutch Cable Adjustment in this chapter).
8. Install transaxle drive shaft to engine (see Transaxle Drive Shaft in Chapter 7 – Drive Train in this manual).
9. Install exhaust system (see Exhaust System in this chapter).

Clutch Release Disassembly (Fig. 18)

1. Remove five (5) hex head screws, flat washers, and flange nuts securing bearing support (item 27) to bell housing. Remove bearing support assembly from bell housing.
2. Remove clutch release bearing (item 14) from release fork.
3. Remove three (3) flange head screws securing release guide (item 26) to bearing support and remove release guide.
4. Remove retaining ring (item 32) and press output shaft and bearing (item 33) from bearing support. Press bearing from output shaft and discard bearing.
5. If necessary, remove two (2) roll pins from clutch release fork (item 20) and pull clutch release shaft (item 24) and fork from bell housing.

If necessary, remove and discard roll pin from release fork and remove and discard release shaft seals and bushings from bell housing.

Clutch Release Assembly (Fig. 18)

1. Press new bearing onto output shaft (item 30) until fully seated. Press bearing and output shaft assembly into bearing support and install retaining ring (item 32).
2. Attach release guide (item 26) to bearing plate with three (3) flange head screws. Tighten screws from **90 to 120 in-lbs (10 to 12 N-m)**. Apply anti seize lubricant to shoulder of release guide, output shaft splines, and output shaft pilot bearing surface.

3. If previously removed, press new roll pin (item 19) into arm of release fork.

4. If previously removed, press new release shaft bushings and seals (items 22 and 23) into bell housing. Position release shaft lever and release fork arms upward and slide release shaft (item 24) through bell housing and release fork. Press two (2) roll pins through release fork and shaft.

5. Apply anti seize lubricant to inside groove and bore of release bearing (item 33) and hang bearing on release fork.

6. Slide release bearing over release guide and fit bearing support over alignment pins in bell housing. Make sure release bearing remains fit over roll pin (item 19) in release fork. Install bearing support assembly with five (5) hex head screws, flat washers, and flange nuts. Tighten flange nuts from **90 to 120 in-lbs (10 to 12 N-m)**.

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Hydraulic System

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Hydraulic System

Specifications

Item	Description
Gear Pump Displacement (per revolution)	Positive displacement, gear type pump 0.26 in ³ (4.27 cc)
Steering/Boom Lift Circuit Relief Pressure	1000 PSI (69 bar)
Steering Control Valve Displacement (per revolution)	Rotary valve steering unit with power beyond (Sauer Danfoss series OSPM) 4.3 in ³ (70 cc)
Hydraulic Filter	Spin-on cartridge type
Hydraulic Reservoir	In transaxle
Hydraulic Oil	Dexron III ATF (See Operator's Manual)

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General Information

For Ultra Sonic Boom Leveling Kit hydraulic system and component information, see Chapter 9 – Ultra Sonic Boom Kit in this manual.

Operator's Manual

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

Relieving the Hydraulic System Pressure

Before disconnecting or performing any work on the hydraulic system, all pressure in the hydraulic system must be relieved. To relieve system pressure:

1. Park machine on a level surface, engage parking brake and fully raise the spray booms so they are resting in the boom cradles. Shut engine off.
2. Turn ignition key to the RUN position (do not start engine) and press both boom lift switches to the raise and lower positions to relieve hydraulic pressure in the boom lift circuits.
3. Turn ignition key to the STOP position and rotate steering wheel in both directions to relieve hydraulic pressure in the steering circuit.

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two (2) 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 components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in the General Information section of this chapter).

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.

Installing Hydraulic Hoses and Tubes (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 Dexron III ATF.

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 3. 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

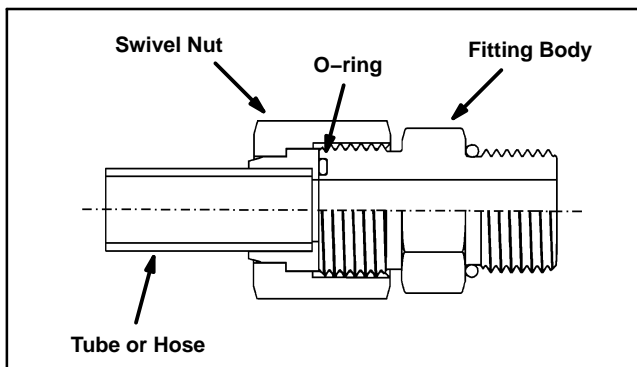


Figure 1

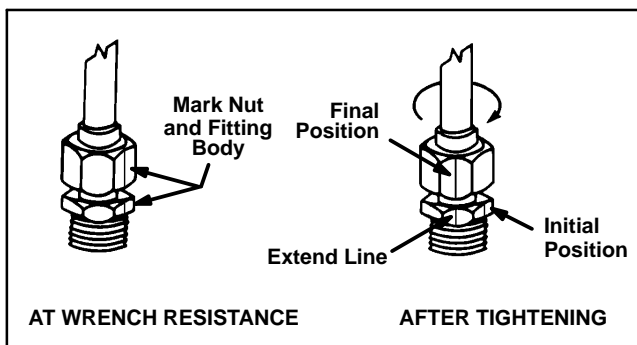


Figure 2

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 3

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

Installing Non-Adjustable Fittings (Fig. 4)

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 Dexron III ATF. 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 5.

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

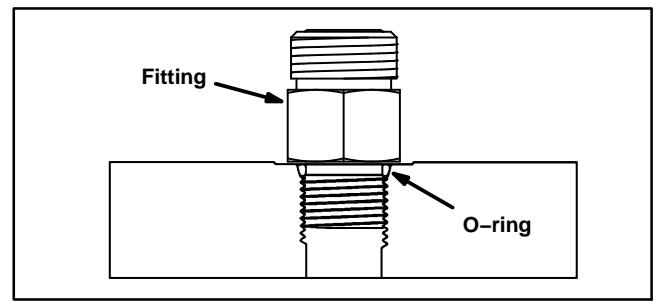


Figure 4

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 5

Hydraulic System

Installing Adjustable Fittings (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 Dexron III ATF. 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 7).

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 7). 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 7).

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 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).

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

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

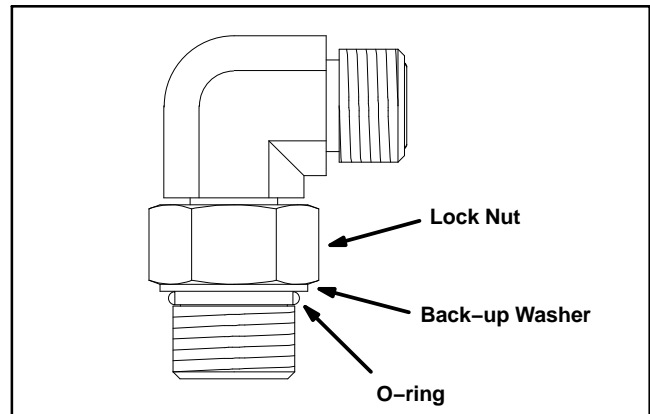


Figure 6

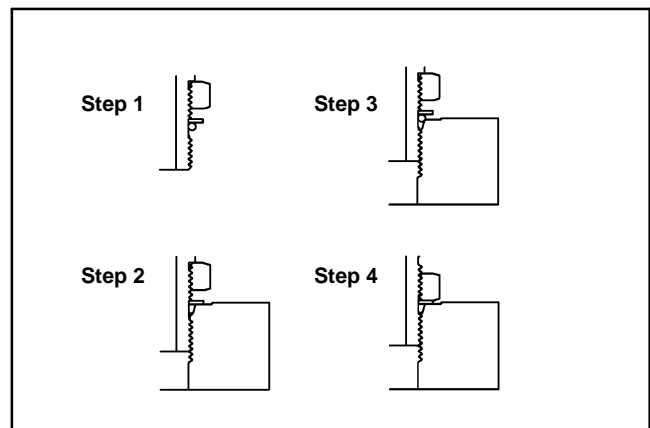
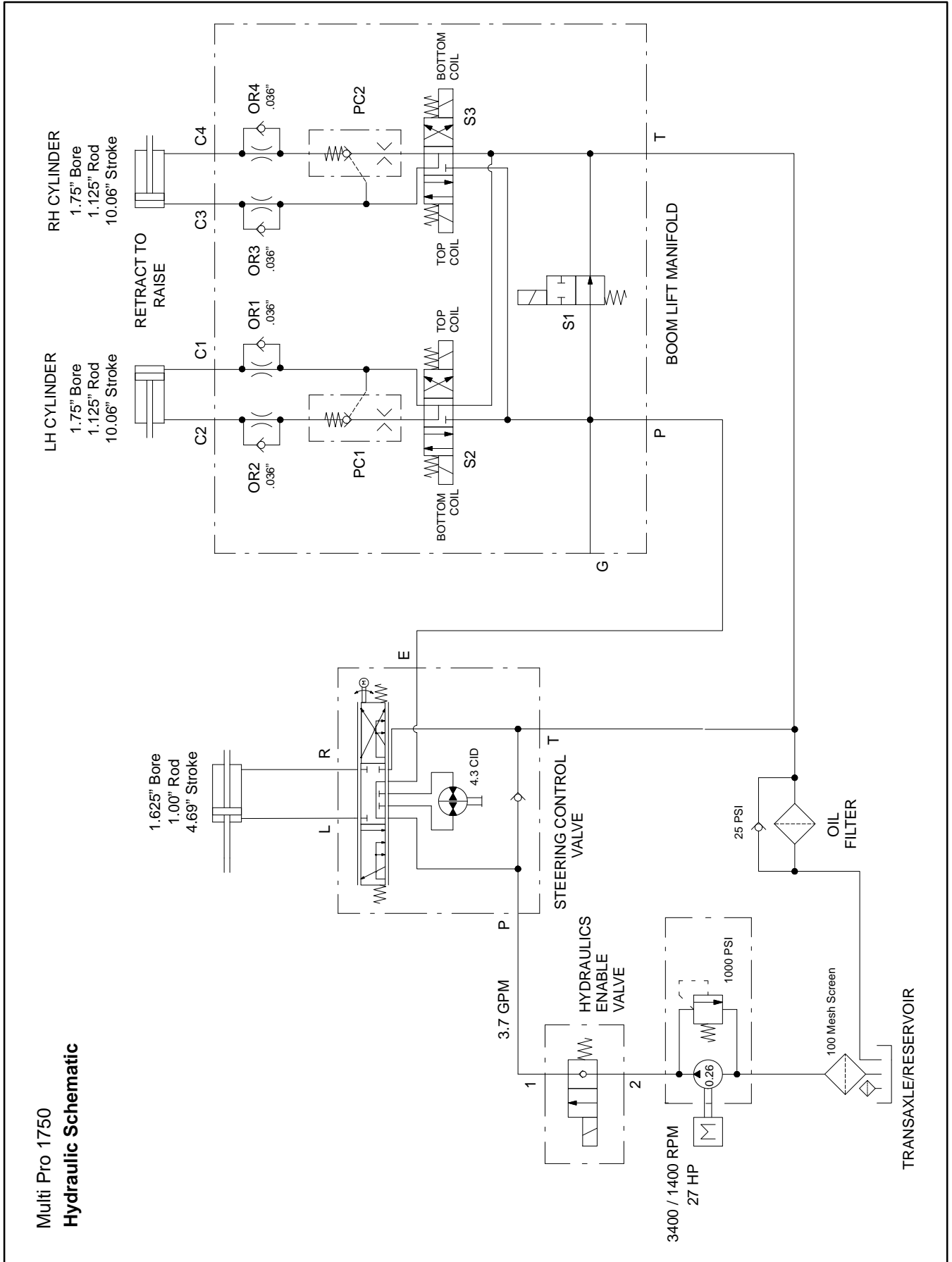


Figure 7

Hydraulic Schematic



Hydraulic System

Hydraulic Flow Diagrams

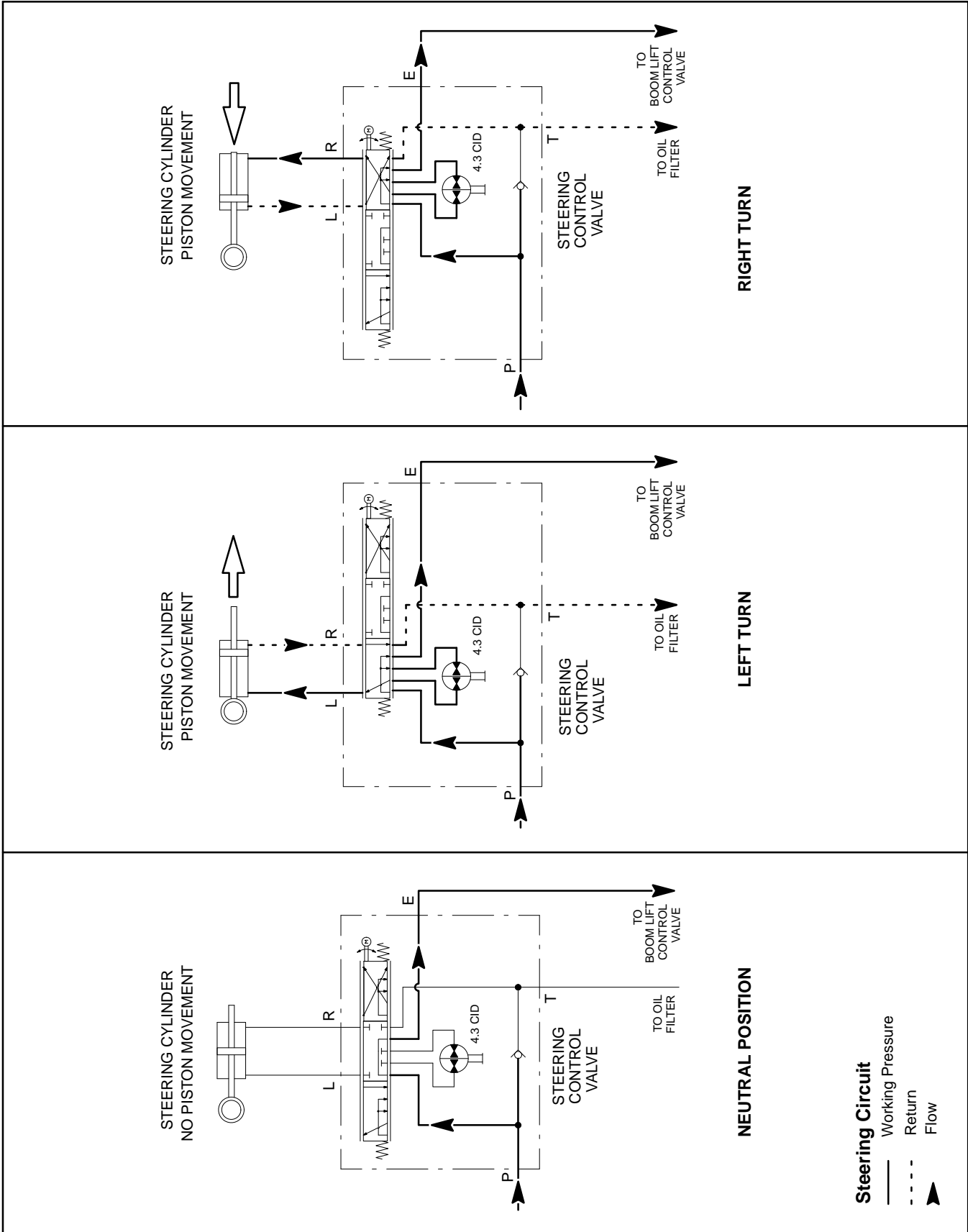


Figure 8

Steering Circuit

A single section gear pump supplies hydraulic flow to the steering control valve, steering cylinder and spray boom lift cylinders. The gear pump is directly coupled to the engine and takes its suction from the transaxle. When the ignition is switched to the ON position, the hydraulics enable valve is energized, allowing hydraulic fluid flow from the gear pump to the remainder of the hydraulic system. When the ignition is switched to the OFF position, the hydraulics enable valve closes and decreases the time required for the engine and gear pump to stop turning.

Hydraulic circuit pressure is limited to 1000 PSI (69 bar) by a relief valve located in the gear pump. Hydraulic flow and pressure to the steering control valve can be monitored at the outlet of the gear pump.

With the steering wheel in the neutral position and the engine running, gear pump flow enters the steering control valve and goes through the steering control spool valve, by-passing the control valve rotary meter and steering cylinder. Flow leaves the control valve and is routed to the spray boom lift control manifold, to the oil filter and returns to the transaxle.

Making a Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve from the gear pump goes through the rotary meter and out the L port. Pressure extends the steering cylinder trunnion 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 steering control spool valve, then to the oil filter and returns to the transaxle.

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

Making a Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve from the gear pump goes through the rotary meter and out the R port. Pressure retracts the steering cylinder trunnion 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 steering control spool valve, then to the oil filter and returns to the transaxle.

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

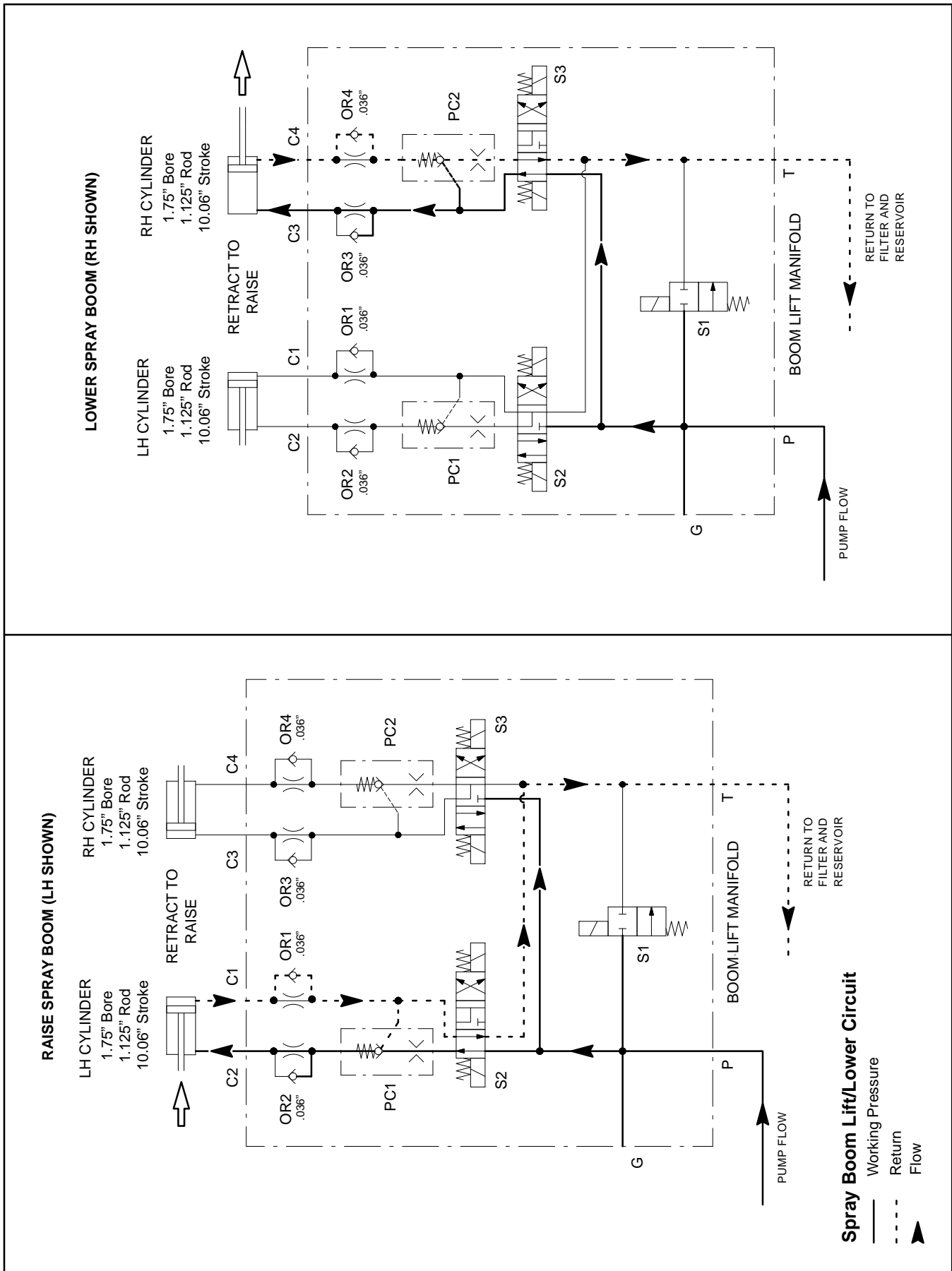


Figure 9

Spray Boom Lift/Lower Circuit

A single section gear pump supplies hydraulic flow to the steering control valve, steering cylinder and spray boom lift cylinders. The gear pump is directly coupled to the engine and takes its suction from the transaxle. When the ignition is switched to the ON position, the hydraulics enable valve is energized, allowing hydraulic fluid flow from the gear pump to the remainder of the hydraulic system. When the ignition is switched to the OFF position, the hydraulics enable valve closes and decreases the time required for the engine and gear pump to stop turning.

Hydraulic circuit pressure is limited to 1000 PSI (69 bar) by a relief valve located in the gear pump. Hydraulic flow and pressure supplied by the gear pump can be monitored at the outlet of the pump. Spray boom lift/lower 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. 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 (Fig. 10). The de-energized valve (S1) allows hydraulic flow to return to tank through the boom lift control manifold.

Raising the Spray Boom (Fig. 9)

When a boom lift switch is depressed to the raise position, manifold solenoid valves (S1) and the top 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/transaxle.

When the lift switch is returned to the neutral (center) position, the manifold solenoid valves are 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 check valve (PC1 – LH cylinder) or (PC2 – RH cylinder).

Lowering the Spray Boom (Fig. 9)

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.

As circuit pressure increases, a manifold sensing line shifts the check valve (PC1 for the LH cylinder or PC2 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 valve (S2 or S3), exits the control manifold through port T, is routed to the oil filter and then returns to the hydraulic reservoir/transaxle.

When the lift switch is returned to the neutral (center) position, the manifold solenoid valves are 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 check valve (PC1 – LH cylinder) or (PC2 – RH cylinder).

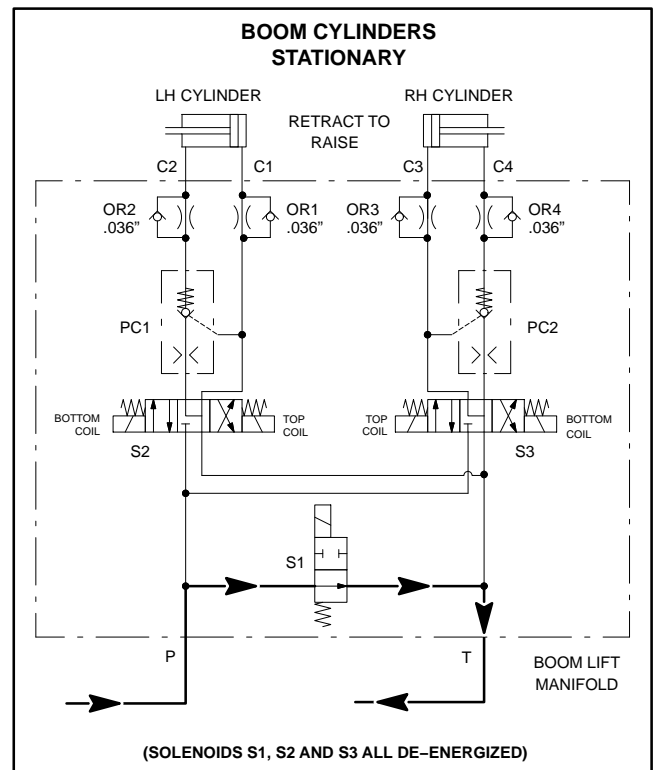


Figure 10

Special Tools

Order the following 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 11

Hydraulic Tester (Pressure and Flow)

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

1. **INLET HOSE:** A 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:** 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 at 15 GPM.
5. **OUTLET HOSE:** A hose from the outlet side of the hydraulic tester connects to the hydraulic system circuit.

Toro Part Number: **TOR214678**



Figure 12

O-Ring Kit

The O-ring 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 13

Hydraulic Test Fitting Kit

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

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

Toro Part Number: **TOR4079**








TORO TEST FITTING KIT (TOR4079)			
FITTING	TOOL NUMBER	FITTING	TOOL NUMBER
	Swivel Nut Run Tee (2 ea.) Size Toro No. No. 4 TOR4079-3 No. 6 TOR4079-12 No. 8 TOR4079-4 No. 10 TOR4079-5		Union (1 ea.) Size Toro No. No. 4 to No. 8 TOR4079-3 No. 10 to No. 8 TOR4079-2 No. 8 to No. 8 TOR4079-9
	Plug (2 ea.) Toro No. Size No. 4 TOR4079-13 No. 6 TOR4079-14 No. 8 TOR4079-15 No. 10 TOR4079-16		Reducer (1 ea.) Size Toro No. No. 10 to No. 8 TOR4079-7 No. 12 to No. 8 TOR4079-6
	Cap (2 ea.) Toro No. Size No. 4 TOR4079-17 No. 6 TOR4079-18 No. 8 TOR4079-19 No. 10 TOR4079-20		Test Cap Fitting (2 ea.) Toro No. Size No. 4 TOR4079-10 No. 6 TOR4079-11 No. 8 TOR4079-21 No. 10 TOR4079-1
			Test Fitting (2 ea.) Toro No. Size 7/16-20 ORB TOR4079-22 1/8" Pipe Thd. TOR4079-23

Figure 14

Hydraulic System

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	Fitting(s), hose(s) or tube(s) are loose or damaged. O-ring(s) or seal(s) are missing or damaged.
Foaming hydraulic fluid	Oil level in transaxle is incorrect. Hydraulic system has wrong kind of oil. Hydraulic oil is contaminated. The hydraulic pump suction line has an air leak.
Hydraulic system operates hot (above 200F (93C)).	Oil level in transaxle is incorrect. Hydraulic hose is kinked. Hydraulic oil is contaminated or is wrong kind of oil. Suction screen in transaxle is loose or clogged. Oil constantly forced over relief. Hydraulic pump is worn or damaged (boom lift affected as well). Transaxle or drive train problem (see Drive Train – Chapter 7 in this manual).
Steering and spray booms inoperative	Hydraulics enable valve solenoid coil or circuit wiring has electrical problem (see Chapter 5 – Electrical System in this manual). Hydraulic pump is worn or damaged

Problem	Possible Cause
Steering inoperative or sluggish	<p>Engine speed is too low.</p> <p>Oil level in transaxle is incorrect.</p> <p>Steering pitman arm pivot is not greased and binding.</p> <p>Steering cylinder is binding.</p> <p>Steering relief valve is stuck open.</p> <p>Steering control valve is worn or damaged.</p> <p>Pulley key (either on engine or gear pump) is sheared.</p> <p>Steering cylinder leaks internally.</p> <p>Hydraulic pump is worn or damaged (boom lift affected as well).</p>
One of the spray booms does not raise or lower.	<p>Affected spray boom pivot is worn, binding or damaged.</p> <p>Boom lift control manifold solenoid coil (S2 or S3) or circuit wiring for affected boom has electrical problem (see Chapter 5 – Electrical System in this manual).</p> <p>Boom lift control manifold solenoid valve for affected boom (S2 or S3) is sticking or damaged.</p> <p>Boom lift control manifold check valve for affected boom (PC1 or PC2) is sticking or damaged.</p> <p>Boom lift control manifold orifice for affected boom is plugged or damaged.</p> <p>Affected lift cylinder is worn or damaged.</p>

Problem	Possible Cause
<p>Neither of the spray booms will raise or lower.</p>	<p>Oil level in transaxle is incorrect.</p> <p>Boom lift control manifold solenoid coil S1 or circuit wiring has electrical problem (see Chapter 5 – Electrical System in this manual).</p> <p>Boom lift control manifold solenoid valve S1 is sticking or damaged.</p> <p>Check valve in steering control valve is sticking, worn or damaged.</p> <p>Relief valve in hydraulic pump is faulty.</p> <p>Hydraulic pump is worn or damaged (steering circuit affected as well).</p>
<p>One of the spray booms will not remain in the raised position.</p> <p>NOTE: Lift cylinders cannot provide an absolutely perfect seal. A spray boom may eventually lower during storage.</p>	<p>Boom lift control manifold check valve for affected boom (PC1 or PC2) is sticking or damaged.</p> <p>Cartridge valve seals are leaking in boom lift control manifold.</p> <p>Lift cylinder for affected boom leaks internally.</p> <p>Hydraulic hoses to lift control cylinder for affected boom are incorrectly installed.</p>

Testing

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


Remember that pressure specifications that appear on hydraulic schematics are the design specifications for the specific component. Actual system pressure will vary depending on oil temperature, the location of the test port, and the specific components used in the hydraulic circuit.

IMPORTANT: The hydraulic test procedures listed in this manual represent actual performance for this machine. To correctly measure product or component performance, be sure to follow the test procedures provided.


Before Performing Hydraulic Tests

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


Precautions For Hydraulic Testing

**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**

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 hydraulic fluid.

**CAUTION**

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

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. Hydraulic fluid contamination will cause excessive wear of components.
2. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or while hydraulic components are removed.

**WARNING**

Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.

3. The engine must be in good operating condition. Use a phototach (non-contact tachometer) when performing a hydraulic test. Engine speed can affect the accuracy of the test readings. Monitor engine RPM during hydraulic testing. Use the information below when performing hydraulic system tests. If engine RPM is above or below the specified speed during a test, you will need to adjust the expected hydraulic performance parameters (approx. 3% per 100 engine rpm at full throttle)

IMPORTANT: Hydraulic component output volume relates directly to engine RPM. For every 100 engine rpm the following component output volumes will change by the volume listed.

Hydraulic Pump: 100 engine RPM = **0.11 GPM or 14.4 oz. (426 cc)** of hydraulic fluid displaced per minute.

4. The inlet and the outlet hoses must be properly connected and not reversed (hydraulic tester with pressure and flow capabilities) to prevent damage to the hydraulic tester or components.
5. When using a hydraulic tester with pressure and flow capabilities, open load valve completely in the hydraulic tester to minimize the possibility of damaging components.

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

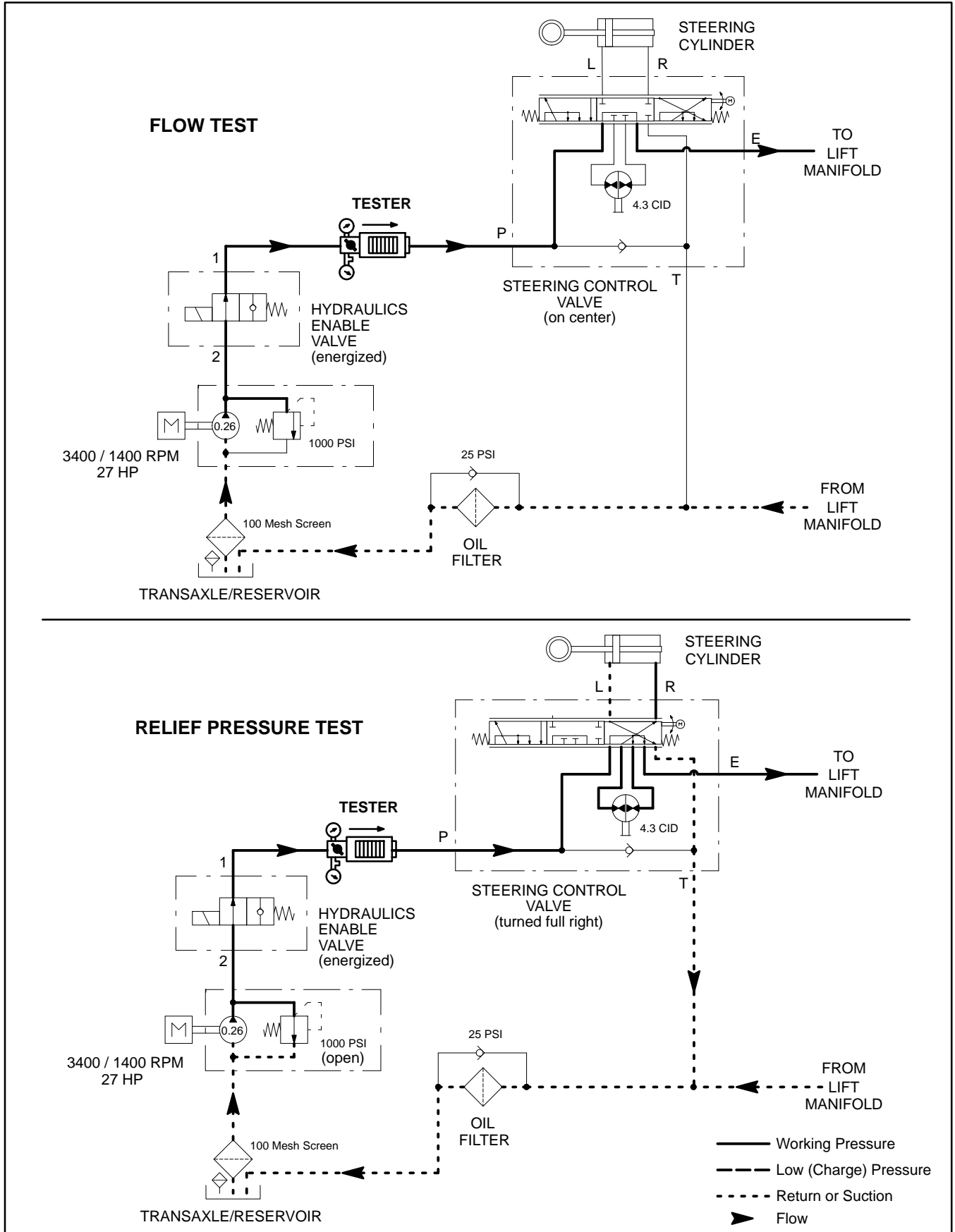
7. Position hydraulic tester hoses to prevent moving machine parts from contacting and damaging the hoses or tester.

8. Check fluid level in the hydraulic reservoir/transaxle. After connecting test equipment, make sure reservoir/transaxle is full.

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

10. All hydraulic tests should be made with the hydraulic fluid at normal operating temperature.

Hydraulic Pump Flow and Relief Pressure Test




Hydraulic System

Figure 15

Testing Steering Pump Flow and Relief Pressure

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.
2. Park machine on a level surface with the spray system off. Apply parking brake and make sure range selector is in the neutral position. Tilt operator seat forward.
3. Read Precautions For Hydraulic Testing in this chapter.

**CAUTION**

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

4. Clean hose fitting and disconnect pressure hose from the top of the hydraulics enable valve (Fig. 16).

IMPORTANT: Make sure oil flow indicator arrow on the flow gauge is showing that the oil will flow from the hydraulics enable valve through the tester and into the machine hydraulic system.

5. Install flow tester with pressure gauges in series with the enable valve and the disconnected hose. Make sure flow control valve on tester is fully open.

6. To test steering pump flow:

A. Start engine and set accelerator pedal to full speed.

B. Verify with a phototach that the engine/pump speed is approximately **3400 RPM**. Adjust engine speed if necessary (see Adjust Engine Speed in Chapter 3 – Kohler Gasoline Engine in this manual).

C. Close flow control valve on tester until pressure gauge reads **800 PSI (55 bar)**. Observe flow gauge.

TESTER READING: Flow approximately **3.5 GPM**.

D. Release accelerator pedal and turn off machine. Record test result.

7. If pump flow specification is not met:

A. Check pump suction line for restrictions.

B. Test hydraulic pump relief valve (procedure follows).

C. Hydraulic pump needs to be repaired or replaced.

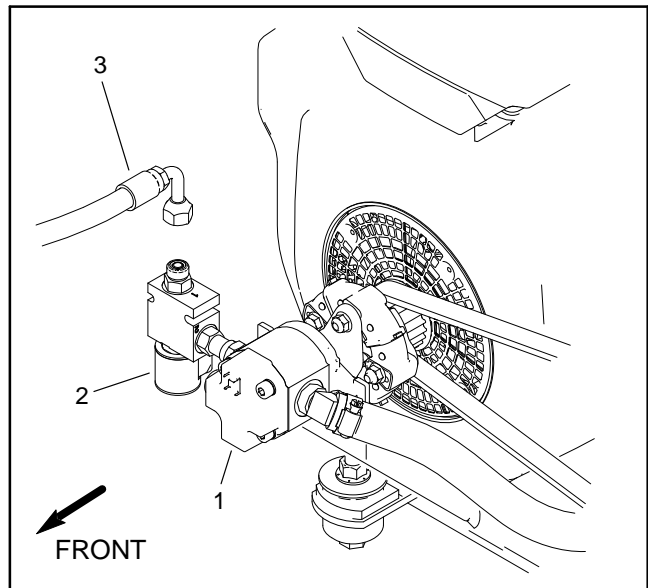


Figure 16

1. Hydraulic pump
2. Hydraulics enable valve
3. Pressure hose

8. To test hydraulic pump relief pressure:

A. Make sure flow control valve on tester is fully open.

B. Start engine and set accelerator pedal to full speed.

C. Verify with a phototach that the engine/pump speed is approximately **3400 RPM**. Adjust engine speed if necessary (see Adjust Engine Speed in Chapter 3 – Kohler Gasoline Engine in this manual).

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 the steering control valve.

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

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

F. Release accelerator pedal and turn off machine. Record test results.

9. If relief pressure is incorrect, repair or replace relief valve in hydraulic pump.

10. After testing is completed, disconnect tester from steering pump and hose. Reconnect hose to the pump. Check and adjust hydraulic oil level.

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Steering Control Valve and Steering Cylinder Test

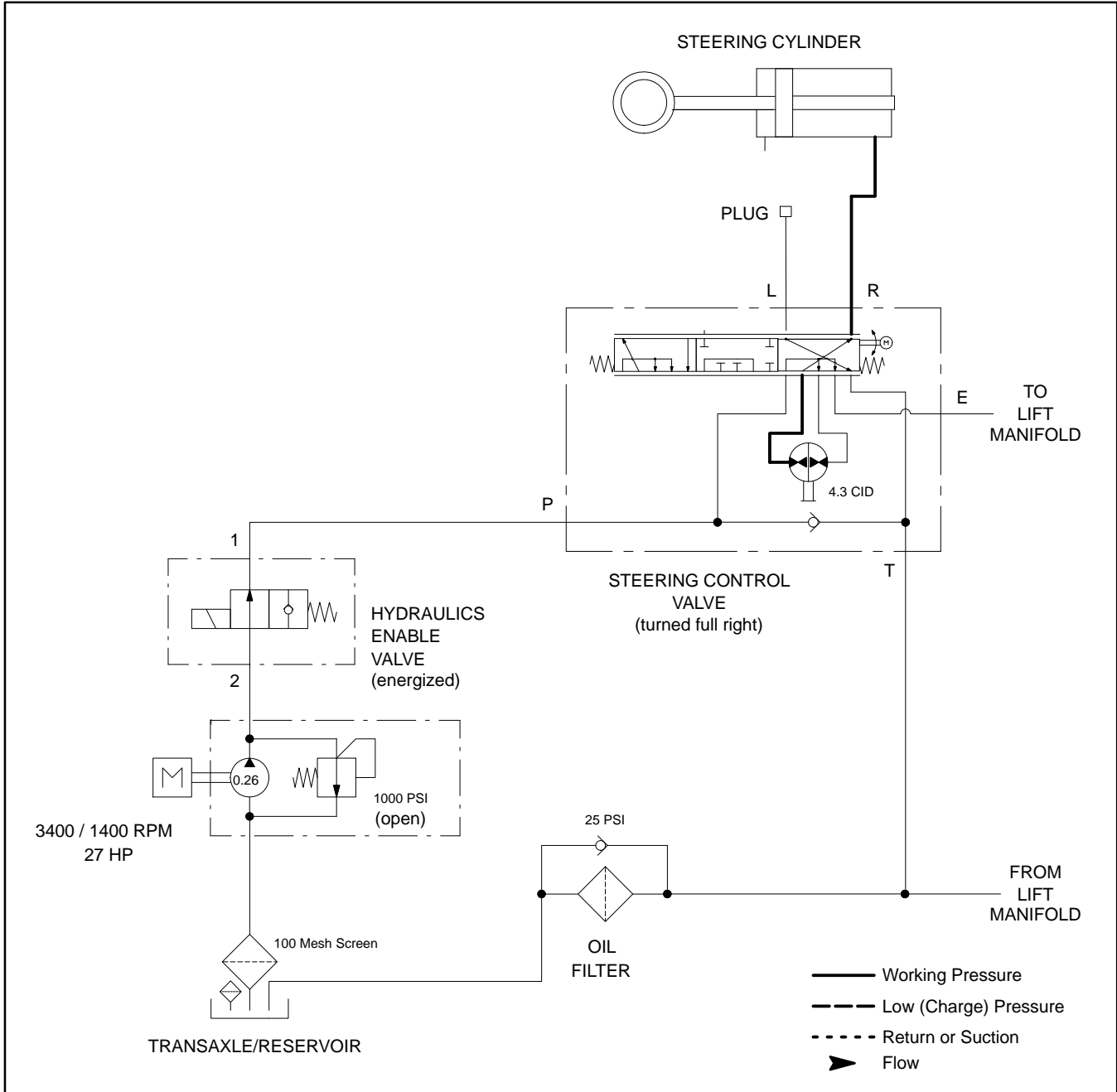


Figure 17

Testing Steering Control Valve and Steering Cylinder

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

2. Perform the Hydraulic Pump Flow and Relief Pressure tests to make sure that pump and relief valve are functioning correctly.

NOTE: This steering test procedure 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, steering pivot). Make sure that these items are checked before proceeding with any hydraulic testing procedure.

3. Drive machine slowly in a figure eight on a flat level surface.

A. There should be no shaking or vibration in the steering wheel or front wheels.

B. Steering wheel movements should be followed immediately by a corresponding front wheel movement without the steering wheel continuing to turn.

4. Stop machine with the engine running. Turn steering wheel with small quick movements in both directions. Let go of the steering wheel after each movement.

A. The steering must immediately return to the neutral position.

B. The steering wheel or front wheels should not continue to turn.

5. If either of these performance tests indicate a steering problem, determine if the steering cylinder is faulty using the following procedure:

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

B. Turn the steering wheel all the way to the right (clockwise) so the steering cylinder trunnion is fully extended.

C. Turn the engine off and engage the parking brake.

D. Read and follow the Precautions for Hydraulic Testing in this chapter.

E. Clean the hose fitting and disconnect the hydraulic hose from the fitting on the trunnion end of the steering cylinder (Fig. 18). Plug the end of the hose.

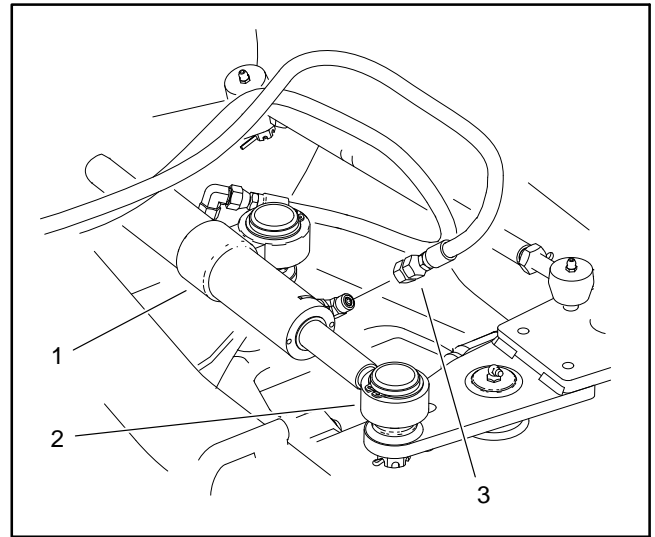


Figure 18

1. Steering cylinder
2. Trunnion end

3. Hydraulic hose



WARNING

Keep body and hands away from disconnected hose and fitting 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.

F. With the engine off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If oil comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and should be repaired or replaced.

G. Remove plug from the hydraulic hose. Reconnect hose to the steering cylinder.

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

7. After testing is completed, reconnect hose to the steering cylinder. Check and adjust hydraulic oil level.

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repairing or Replacing Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, stop spray pump, 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 hydraulic components, hose connections and fittings are cleaned thoroughly. Always keep in mind the need for cleanliness when working on hydraulic equipment.



CAUTION

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

3. Put caps or plugs on any hydraulic lines, hydraulic fittings and components left open or exposed to prevent contamination.
4. Put labels on disconnected hydraulic lines and hoses for proper installation after repairs are completed.
5. Note the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic hoses and tubes.

After Repairing or Replacing Components

1. Check oil level in the transaxle and add correct oil if necessary. Drain and refill transaxle 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 Dexron III ATF before installing hydraulic components.
3. Make sure caps or plugs are removed from the hydraulic tubes, hydraulic fittings and components before reconnecting.
4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation and Hydraulic Hose and Tube Installation in the General Information section of this chapter).
5. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system.
6. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in transaxle and add correct oil if necessary.

Checking 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 or deterioration. Make all necessary repairs before operating machine.

Flushing the 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. Park machine on a level surface and stop spray pump. Stop engine, apply parking brake and remove key from ignition switch.

2. Clean area around hydraulic filter mounting area (Fig. 19). Remove filter and drain filter into a suitable container. Discard filter.

3. Remove drain plug from transaxle (Fig. 20) and drain transaxle 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 Dexron III ATF to gasket on new filter. Screw filter on until gasket contacts mounting plate, then tighten filter 1/2 turn further.

6. Install all hydraulic hoses and components.

IMPORTANT: Use only hydraulic system fluid specified in Operator's Manual (Dexron III ATF). Other fluid could cause system damage.

7. Fill transaxle with new fluid (Dexron III ATF).

8. Disconnect and ground spark plug wires to prevent engine from starting.

9. Turn ignition key switch to START; engage starter for ten (10) seconds to prime hydraulic pump. Allow starter to cool and then repeat this step again.

10. Connect spark plug wires.

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

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

13. Turn steering wheel in both directions several times. Operate spray boom lift cylinders several times.

14. Shut off engine and check for oil leaks. Check oil level in transaxle and add correct oil if necessary.

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

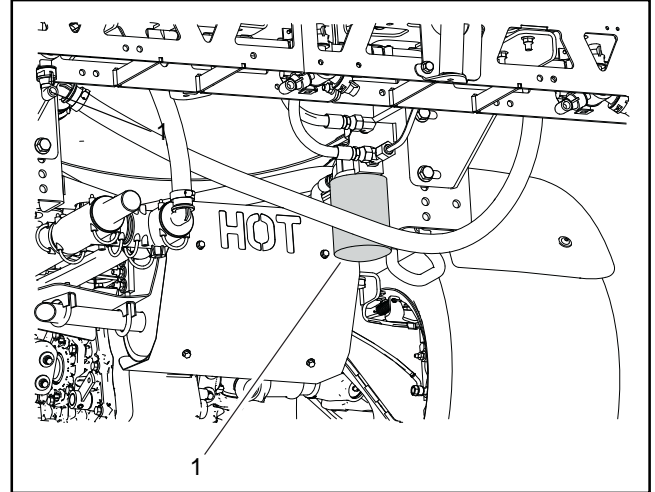


Figure 19

1. Hydraulic filter

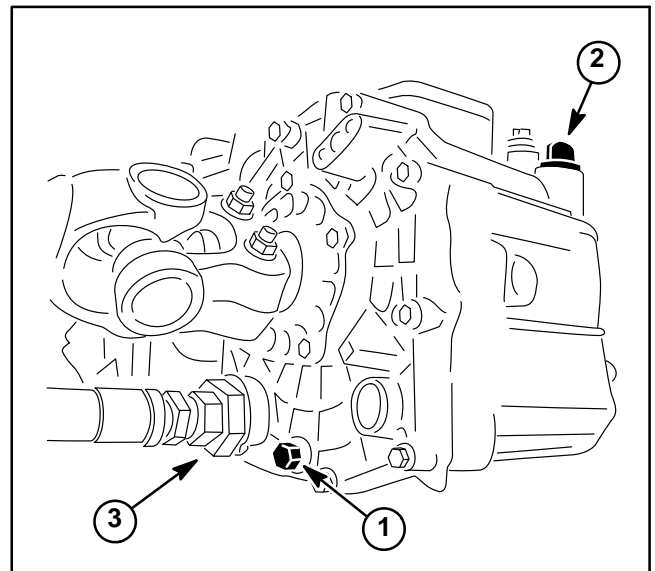


Figure 20

1. Transaxle drain plug 3. Strainer
2. Dipstick/filler

16. Check condition of hydraulic oil. If the fluid shows any signs of contamination repeat steps 1 through 15 again.

17. Resume normal operation and follow recommended maintenance intervals.

Hydraulic Pump

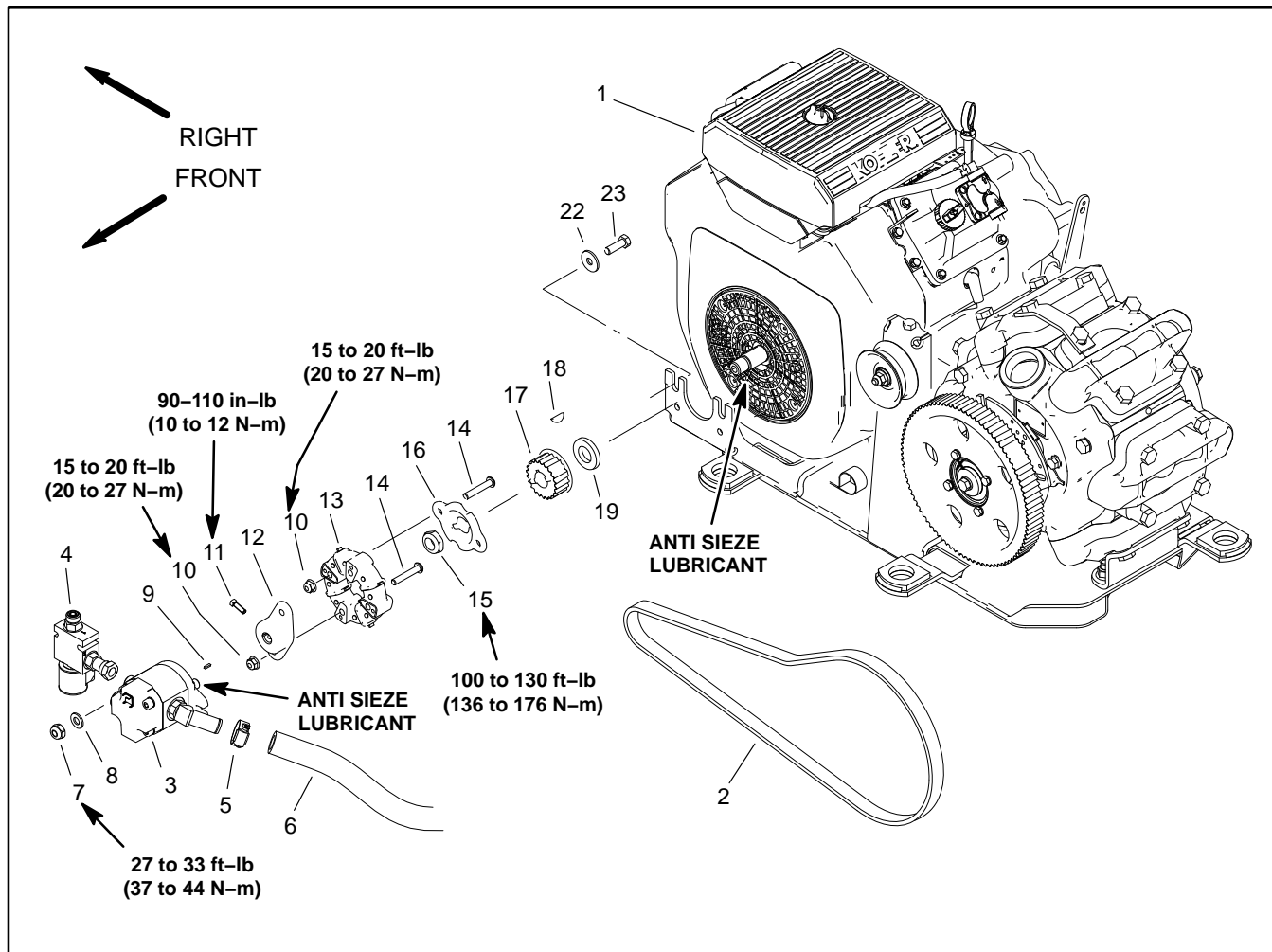


Figure 21

- | | | |
|----------------------------|---------------------------|------------------------|
| 1. Engine | 8. Flat washer (2) | 15. Lock nut |
| 2. Spray pump drive belt | 9. Square key | 16. Sprocket adaptor |
| 3. Hydraulic pump assembly | 10. Flange nut (4) | 17. Belt sprocket |
| 4. Hydraulic enable valve | 11. Set screw (2) | 18. Woodruff key |
| 5. Hose clamp | 12. Pump hub | 19. Spacer |
| 6. Suction hose | 13. Rubber coupler | 20. Flat washer (2) |
| 7. Lock nut (2) | 14. Button head screw (4) | 21. Hex head screw (2) |

Removing the Hydraulic Pump (Fig. 21)

1. Park the machine on a level surface, stop spray pump, engage parking brake and stop engine. Remove key from the ignition switch and tilt operator's seat forward.



CAUTION

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in the General Information section of this chapter).

2. Label all hydraulic connections at gear pump for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses.

3. Disconnect suction hose from gear pump fitting. Allow hose and transaxle/reservoir to drain into a suitable container.

4. Disconnect hydraulic enable valve from pump. Loosen swivel connector at fitting in gear pump (Fig. 22).

5. Cap or plug openings of gear pump, enable valve, and suction line to prevent contamination, and position hydraulics enable valve assembly away from gear pump.

6. Loosen two (2) square head set screws that secure pump hub (item 12) to gear pump shaft.

7. Support gear pump to prevent it from falling.

8. Remove two (2) cap screws, flat washers and lock nuts that secure gear pump to frame bracket.

9. Slide gear pump shaft from the pump hub and remove pump from the machine.

10. Locate and retrieve square key (item 9) from gear pump shaft.

11. 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.

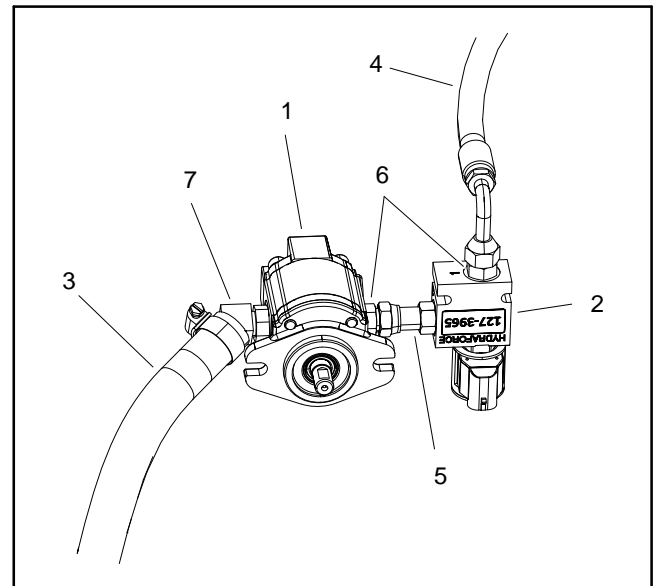


Figure 22

- | | |
|-----------------------------|----------------------|
| 1. Hydraulic pump | 5. Swivel connector |
| 2. Hydraulics enable valve | 6. Hydraulic fitting |
| 3. Suction hose | 7. Hydraulic fitting |
| 4. Hose (to steering valve) | |

Installing the Hydraulic Pump (Fig. 21)

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

2. Position key into hydraulic pump shaft and apply anti-seize lubricant to pump shaft and key.

3. Align key in hydraulic pump shaft with the slot in the pump hub (item 12) and slide gear pump shaft into the pump hub.

4. Position hydraulic pump to the frame bracket and secure pump with two (2) cap screws, flat washers and lock nuts. Tighten lock nuts from **27 to 33 ft-lb (37 to 44 N-m)**.

5. Secure pump hub to gear pump shaft with two (2) square head screws (item 11). Torque square head screws from **90 to 110 in-lb (10.2 to 12.4 N-m)**.

6. Remove plugs and caps from hydraulic pump and hydraulic lines that were installed during disassembly. Connect suction hose and swivel connector at hydraulics enable valve to gear pump fittings (see Hydraulic Hose and Tube Installation in this chapter).

7. Check fluid level in transaxle and adjust as required.

Hydraulic Pump Service

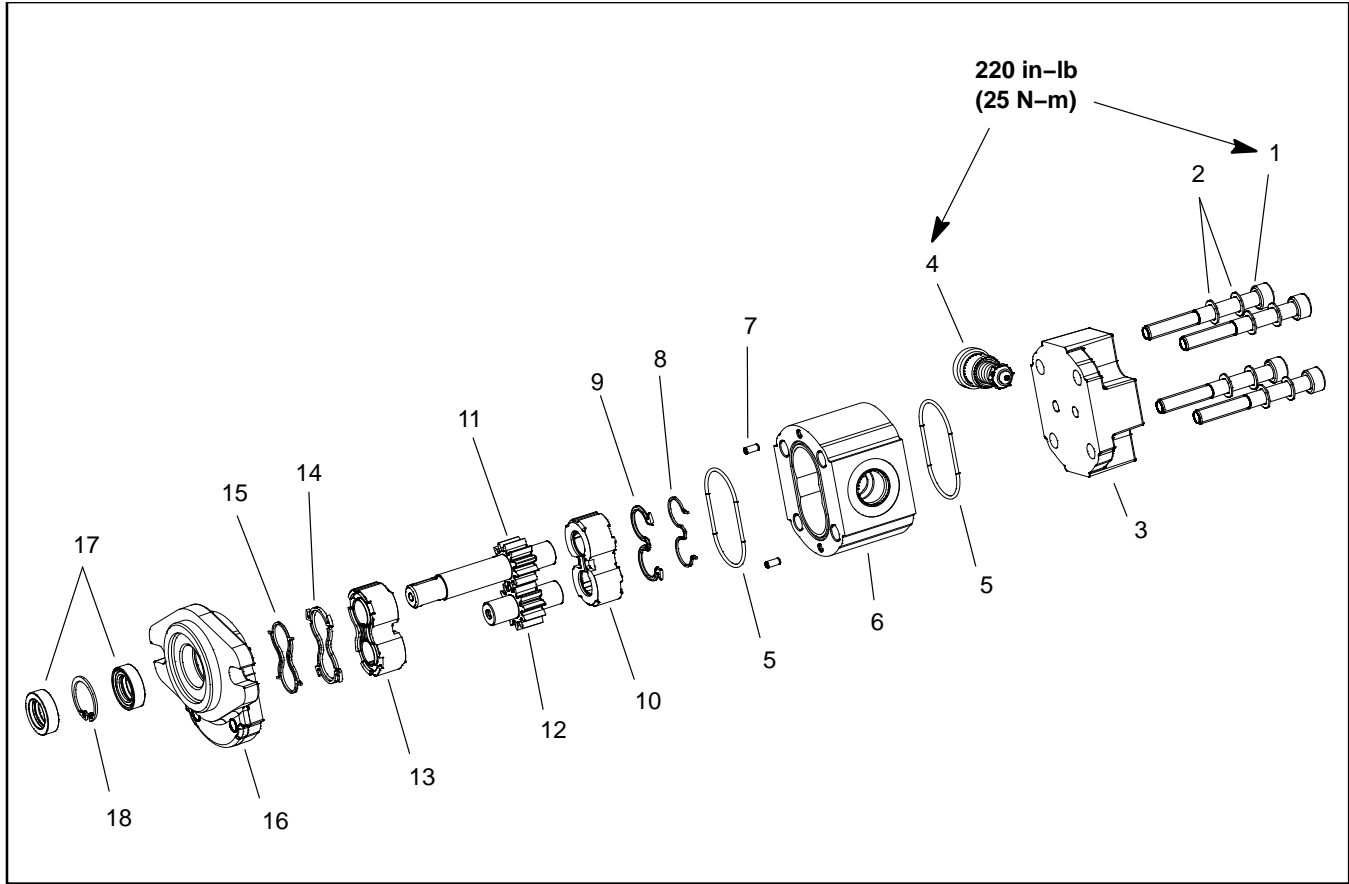


Figure 23

- | | | |
|--------------------------|-----------------------|------------------------|
| 1. Socket head screw (4) | 7. Dowel pin (2) | 13. Front thrust plate |
| 2. Washer (8) | 8. Backup seal | 14. Pressure seal |
| 3. Rear cover | 9. Pressure seal | 15. Backup seal |
| 4. Relief valve | 10. Rear thrust plate | 16. Front cover |
| 5. O-ring (2) | 11. Drive shaft | 17. Shaft seal (2) |
| 6. Body | 12. Driven gear | 18. Retaining ring |

Disassembling the Hydraulic Pump (Fig. 23)

1. Install clean plugs in pump ports and clean the outside of the pump thoroughly. After cleaning, remove plugs and drain any oil out of the pump.

2. Use a marker to make a "V" across the front cover, body and rear cover for assembly purposes (Fig. 24).

IMPORTANT: When clamping the pump in a vise, clamp only on mounting flange. DO NOT clamp pump body in a vise.

3. Clamp mounting flange of pump in a vise with the shaft end down.

4. Loosen four (4) socket head screws that secure the rear cover.

5. Remove pump from the vise. Remove socket head screws and washers.

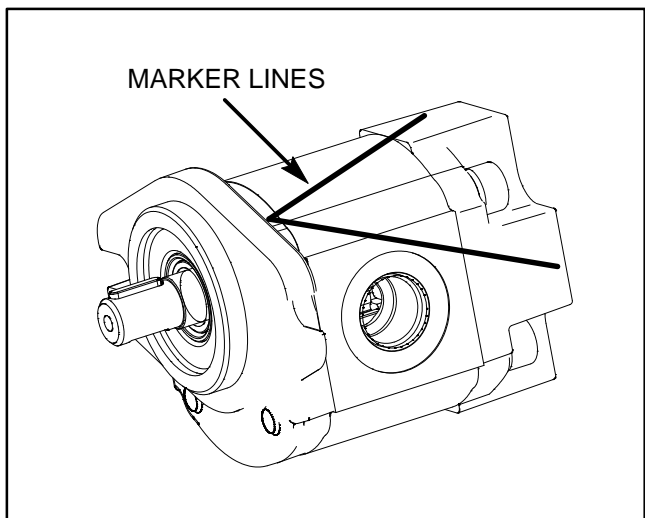


Figure 24

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

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

7. Place pump on its side and carefully push on the rear thrust plate to remove thrust plates and gear set from the pump body.

NOTE: Pressure seals and back-up seals fit in grooves machined into thrust plates. O-rings fit in grooves machined in the pump body.

8. Carefully remove and discard O-rings, pressure seals and back-up seals from pump body and thrust plates. Do not cause any damage to the machined grooves during the removal process.

IMPORTANT: Make sure to not damage the counter bore when removing the shaft seals and retaining ring from the front cover.

9. Carefully remove shaft seals and retaining ring from the front cover (Fig. 25). Note orientation of seal lips during removal. Discard removed seals.

10. If necessary, remove implement relief valve from rear cover. Remove and discard sealing washers from relief valve.

Inspecting the Hydraulic Pump (Fig. 26)

	CAUTION
<p>Use eye protection such as goggles when using compressed air.</p>	

1. Clean all pump parts with solvent. Dry all parts with compressed air.

2. Inspect drive shaft, driven gear and thrust plates for the following. If damage is found, pump replacement is necessary.

A. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas. Scoring, rough surfaces or wear on gear shafts indicates need for replacement.

B. Gear teeth should be free of excessive scoring and wear. Any broken or nicked gear teeth must be replaced.

C. Inspect gear face edge for sharpness. Sharp edges of gears will mill into thrust plates and, thus, must be replaced.

D. Bearing areas of thrust plates should not have excessive wear or scoring.

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

3. Inspect front and rear covers for damage or wear. Replace pump if covers are damaged or worn.

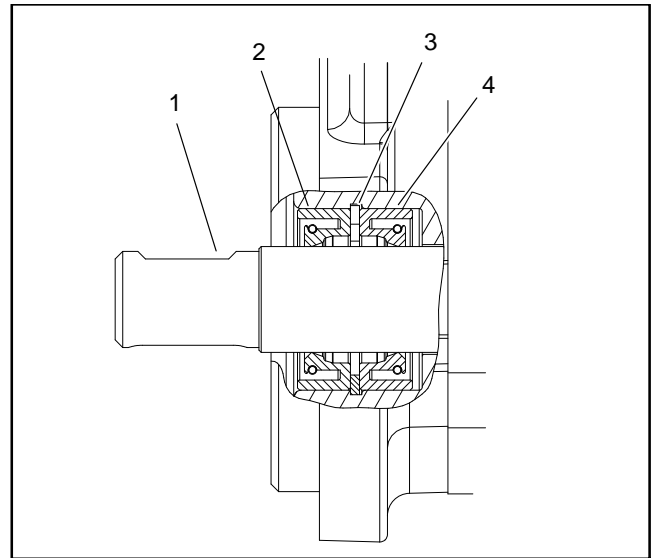


Figure 25

- | | |
|---------------------|---------------------|
| 1. Drive gear shaft | 3. Retaining ring |
| 2. Outer shaft seal | 4. Inner shaft seal |

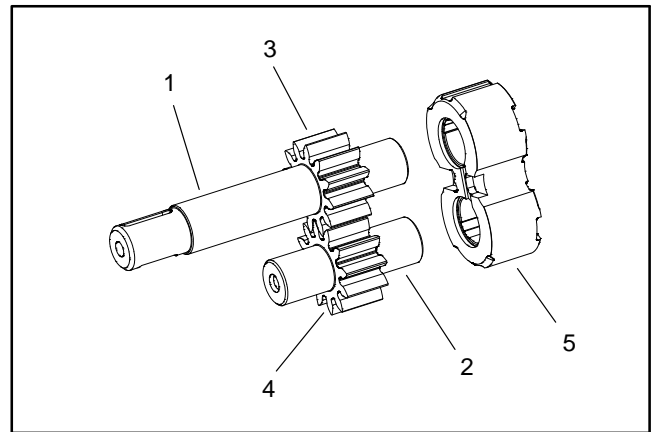


Figure 26

- | | |
|----------------|-------------------|
| 1. Drive shaft | 4. Gear face edge |
| 2. Gear shaft | 5. Thrust plate |
| 3. Gear teeth | |

Assembling the Hydraulic Pump (Fig. 23)

NOTE: When assembling the pump, check the V-shaped marker line made before disassembly to make sure components are properly aligned.

1. Lubricate new O-rings, pressure seals and back-up seals with a thin coat of petroleum jelly. Lubricate all internal pump parts freely with clean Dexron III ATF.
2. Install new retaining ring and shaft seals into front cover. Note orientation of seal lips during installation (Fig. 25). Seals should be pressed into place until they reach the retaining ring.
3. Install lubricated O-rings to the body.
4. Install lubricated pressure seals into the machined grooves of the thrust plates and follow by carefully placing the back-up seals into the grooves.
5. Lubricate gear faces and bearing surfaces of drive gear, idler gear and thrust plates with clean Dexron III ATF. Carefully assemble thrust plates and gears noting identification marks made during disassembly.
6. Position the pump body on its side. Carefully slide thrust plate and gear assembly into the body cavity using identification marks made during disassembly.
7. Remove any excess lubrication from mating surfaces of body, rear cover and front cover. Make sure that these surfaces are clean and dry.
8. Install dowel pins in body.

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

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

10. Place thin sleeve or tape on pump shaft to prevent seal damage.

11. Position the pump with rear cover downwards. Carefully slide the front cover onto the assembly using marker lines for proper location. Take care to not damage the seals during front cover installation. Remove sleeve or tape from pump shaft after front cover is installed.

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

IMPORTANT: When clamping the pump in a vise, clamp only on mounting flange. DO NOT clamp pump body in a vise.

13. Clamp mounting flange of pump in a vise with the shaft end down.

14. Alternately torque the socket head screws **220 in-lb (25 N-m)**.

15. If implement relief valve was removed from back plate, install relief valve. Tighten relief valve to a torque of **220 in-lb (25 N-m)**.

16. Put a small amount of Dexron III ATF in inlet port of pump and rotate input shaft one revolution. Place coupler on input shaft and use pliers on coupler to rotate pump shaft. If input shaft binds, disassemble pump and repeat assembly process.

17. Remove pump from vise.

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Steering Control Valve

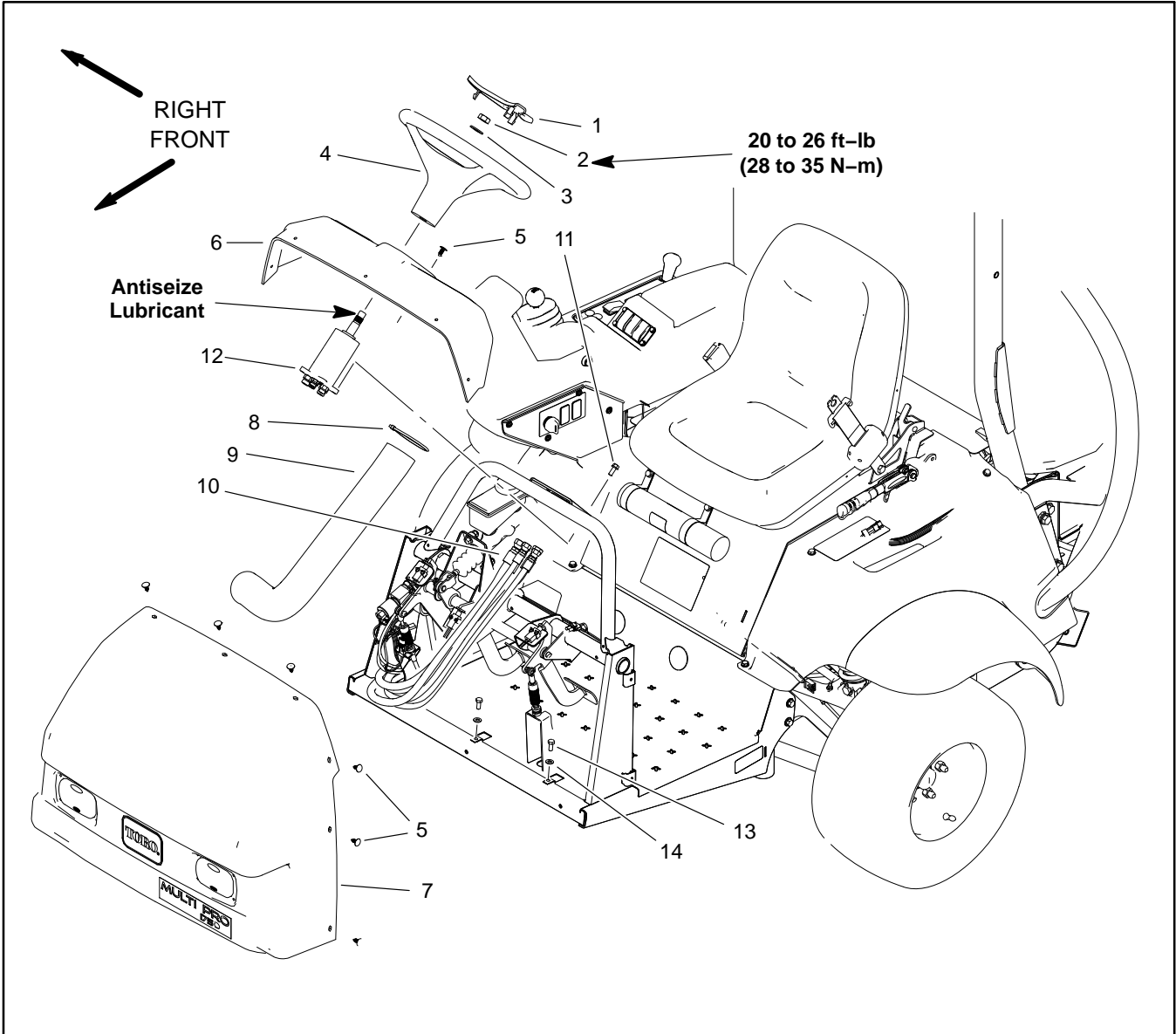


Figure 27

- | | | |
|-------------------------|-------------------------|----------------------------|
| 1. Steering wheel cover | 6. Dash | 11. Cap screw (4) |
| 2. Hex nut | 7. Hood | 12. Steering control valve |
| 3. Flat washer | 8. Cable tie (4) | 13. Cap screw (3) |
| 4. Steering wheel | 9. Dust cover | 14. Flat washer (3) |
| 5. Panel fastener (10) | 10. Hydraulic hoses (5) | |

Removing the Steering Control Valve (Fig. 27)

1. Park the machine on a level surface, stop spray pump, engage parking brake and stop engine. Remove key from the ignition switch.
2. Remove cover (item 1) from steering wheel by carefully prying up on one of the cover spokes.
3. Remove lock nut and flat washer that secure steering wheel to steering column.
4. Remove steering wheel from steering column shaft. Use a suitable puller if necessary.
5. Remove three (3) screws and flat washers (item 13 & 14) that secure hood to floor plate.
6. Remove ten (10) panel fasteners securing hood to dash (item 6), machine frame, and center of dash to support tube. Remove hood and dash. If necessary, disconnect headlight wire harness connectors.
7. Remove cable ties and dust cover (item 9).



CAUTION

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

8. Label all hydraulic hoses for assembly purposes (Fig. 28). Clean hydraulic hose ends prior to disconnecting the hoses from the steering control valve.
9. Disconnect hydraulic hoses connected to the steering control valve. Allow hoses to drain into a suitable container. Cap or plug openings of control valve and hoses to prevent contamination.
10. Support steering control valve to prevent it from falling during removal. Loosen and remove four (4) cap screws (item 11) that secure steering column and steering control valve and remove steering control valve from machine.

Installing the Steering Control Valve (Fig. 27)

1. Position steering control valve to frame. Secure steering column and control valve to frame with four (4) cap screws (item 11).
2. Remove caps and plugs from disconnected hoses and fittings. Using labels placed during removal, connect hydraulic hoses to steering control valve (Fig. 28). Tighten hose connections (see Hydraulic Hose and Tube Installation in this chapter).

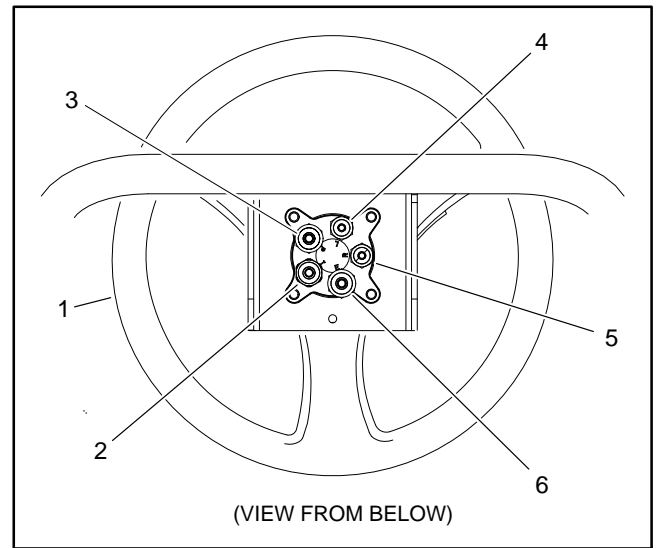


Figure 28

1. Steering wheel
2. T port (hose to oil filter)
3. P port (hose from hydraulic enable valve)
4. L port (hose to trunnion end of steering cylinder)
5. R port (hose to barrel end of steering cylinder)
6. E port (hose to boom lift control manifold)

3. Install dust cover (item 9) over hydraulic hoses and secure with four (4) cable ties.
4. Position dash over steering control valve and secure to support tube with one (1) panel fastener (item 5).
5. Connect headlight wire harness connectors and install hood to dash and machine frame with nine (9) panel fasteners.
6. Install three (3) screws and flat washers (item 13 & 14) securing hood to floor plate.
7. Thoroughly clean tapered surfaces of steering wheel and steering column.
8. Apply a thin coating of antiseize lubricant to splines of steering column taking care to keep antiseize lubricant from column taper. Slide steering wheel onto steering column.
9. Secure steering wheel to steering column with flat washer and lock nut. Tighten lock nut from **20 to 26 ft-lb (28 to 35 N-m)**.
10. Install steering wheel cover to steering wheel.
11. Check fluid level in transaxle and adjust as required (see Operator's Manual).
12. Test for proper steering operation before returning machine to service.

Steering Control Valve Service

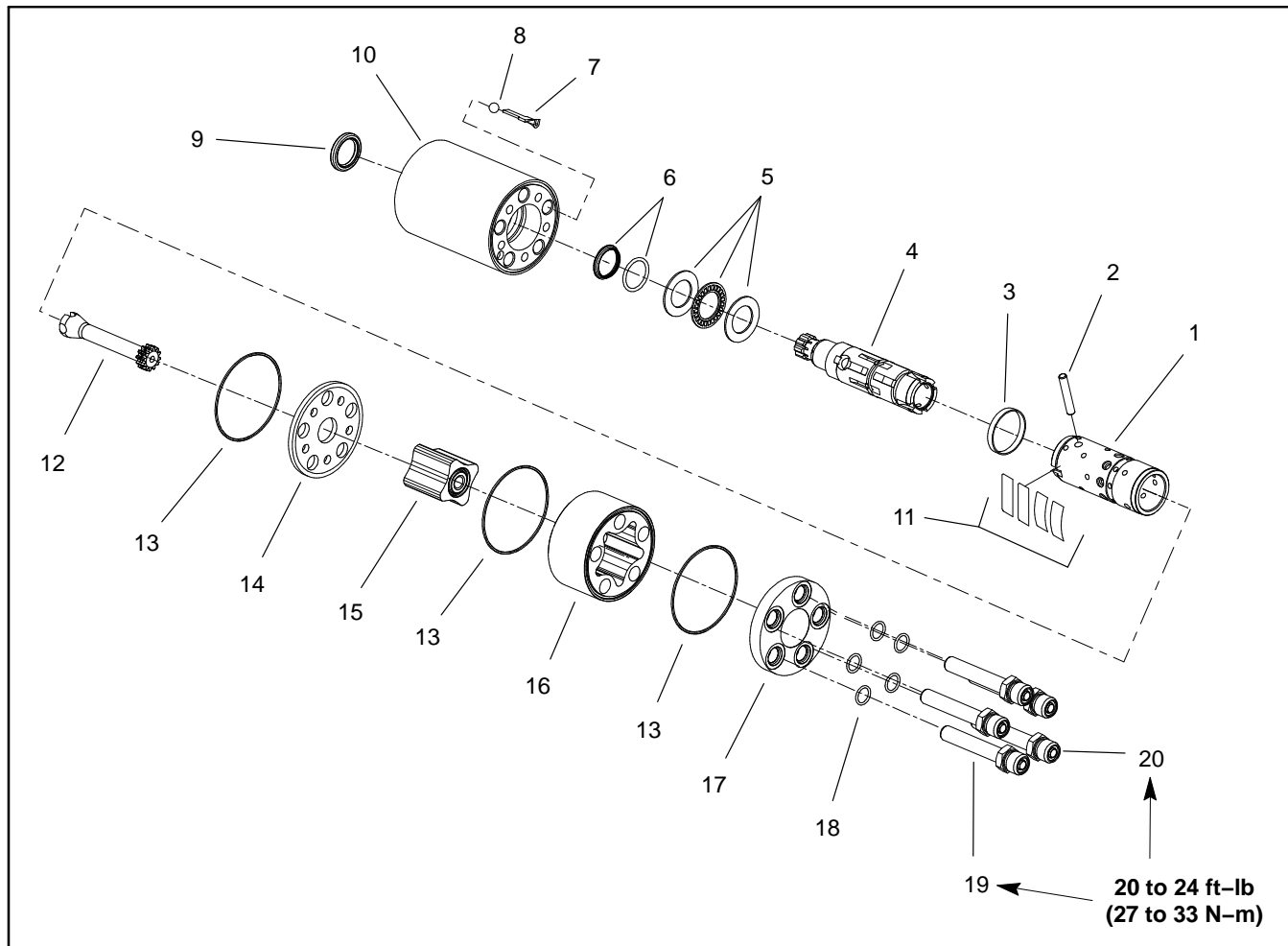


Figure 29

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

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

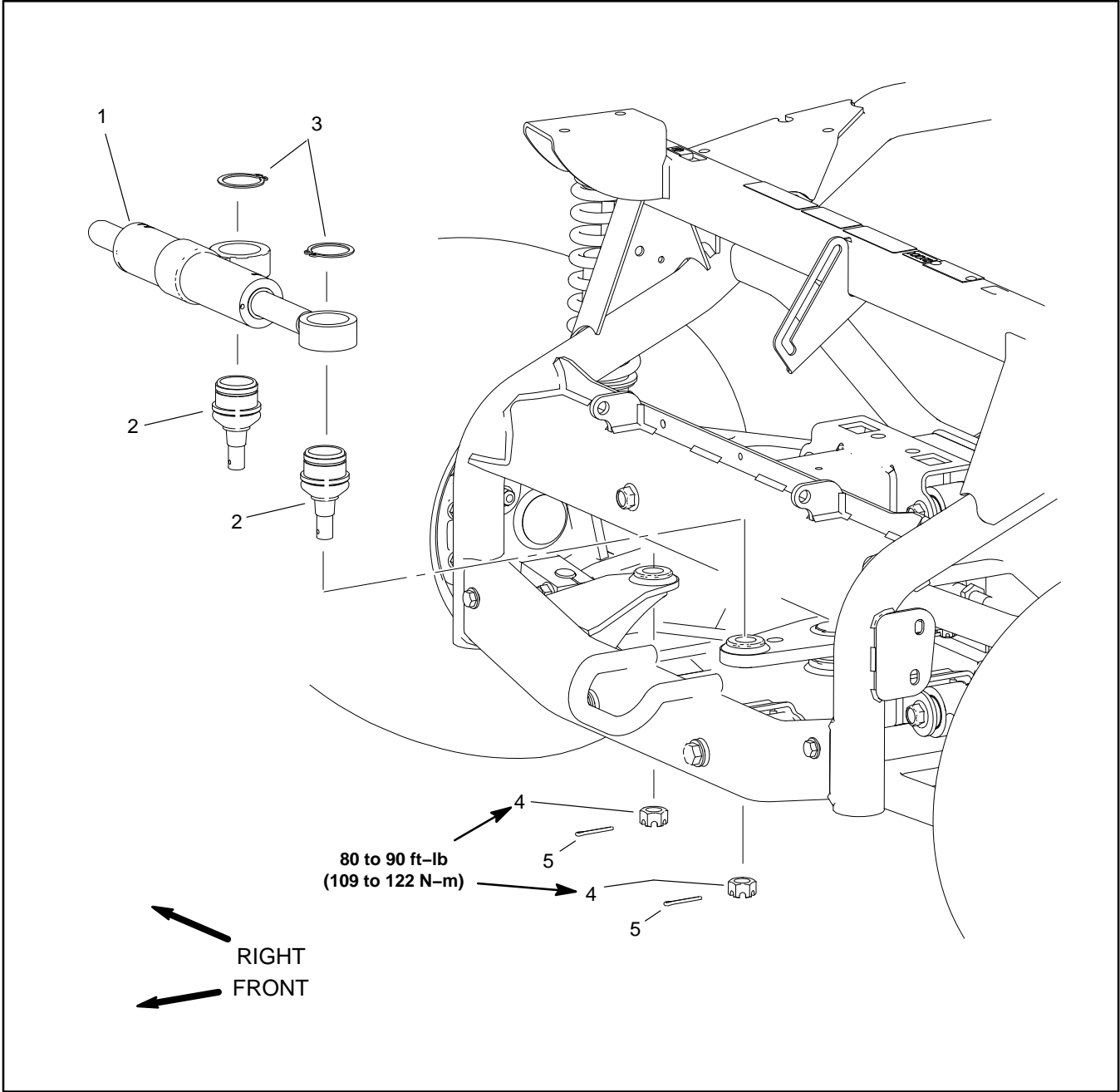


Figure 30


1. Steering cylinder
2. Ball joint (2)

3. Retaining ring (2)
4. Slotted hex nut (2)

5. Cotter pin (2)

Removing the Steering Cylinder (Fig. 30)

1. Park the machine on a level surface, stop spray pump, engage the parking brake and stop the engine. Remove key from the ignition switch.
2. Label all hydraulic connections for assembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from steering cylinder.

**CAUTION**

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

3. Disconnect hydraulic hoses from steering cylinder. Allow hoses to drain into a suitable container. Put caps or plugs on disconnected hoses and fittings to prevent contamination.
4. Remove cotter pins and castle nuts from cylinder ball joints. Carefully pry cylinder with ball joints from frame and pitman arm with a ball joint "pickle" fork and remove steering cylinder from machine.
5. 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 (Fig. 31).
6. Remove retaining rings and press ball joints from cylinder trunnions if necessary.

Installing the Steering Cylinder (Fig. 30)

1. If ball joints were removed from cylinder, press ball joints into cylinder trunnions and install retaining rings.
2. If fittings were removed from steering cylinder, lubricate and place new O-rings onto fittings. Install fittings into cylinder openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

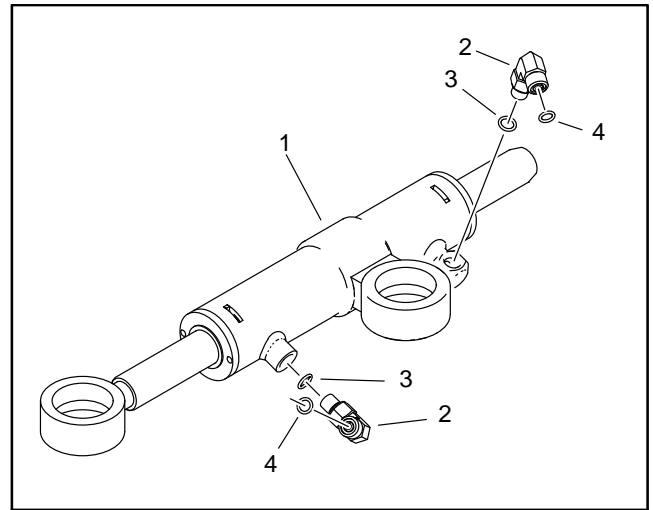


Figure 31

- | | |
|----------------------|---------------|
| 1. Steering cylinder | 3. O-ring (2) |
| 2. Elbow fitting (2) | 4. O-ring (2) |

3. Position cylinder ball joints in frame and pitman arm and install castle nuts. Tighten nuts from **80 to 90 ft-lbs (109 to 122 N-m)** and install cotter pins.
4. Remove caps and plugs from disconnected hoses and fittings.
5. Connect hydraulic hoses to steering cylinder (Fig. 31). Tighten hose connections (see Hydraulic Hose and Tube Installation in this chapter).
6. Check fluid level in transaxle and adjust as required (see Operator's Manual).
7. Test for proper steering operation before returning machine to service.

Steering Cylinder Service

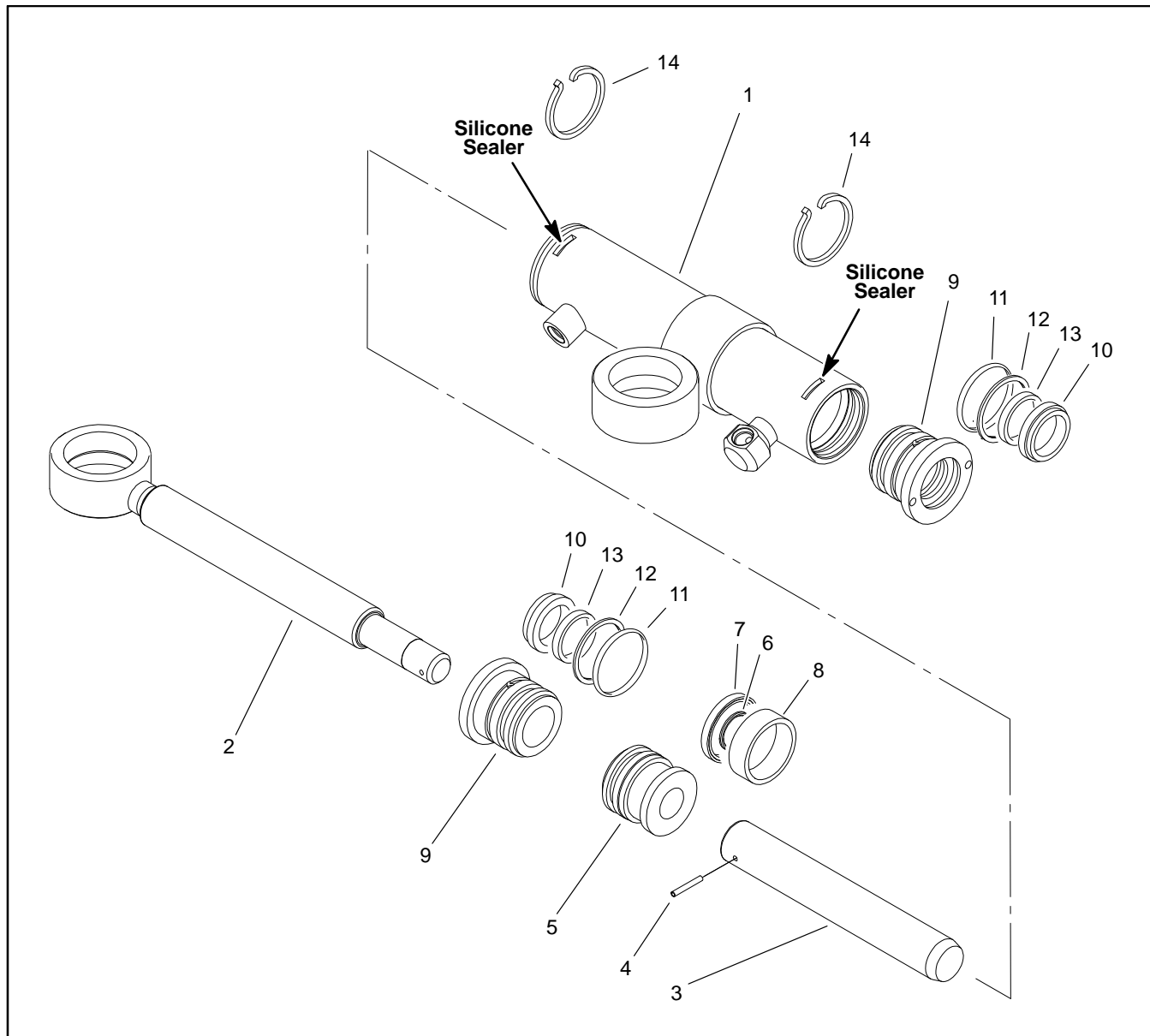


Figure 32

- 1. Barrel
- 2. Shaft – trunnion
- 3. Shaft – front
- 4. Roll pin
- 5. Piston

- 6. O–ring
- 7. Seal
- 8. Wear ring
- 9. Head (2)
- 10. Dust seal (2)

- 11. O–ring (2)
- 12. Backup ring (2)
- 13. Seal (2)
- 14. Retaining ring (2)

Disassembling the Steering Cylinder (Fig. 32)

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 with soft jaws. Remove retaining ring.

A. Use a spanner wrench to rotate head (item 9) clockwise until the edge of the retaining ring appears in the barrel opening.

B. Insert a screwdriver under the beveled edge of the retaining ring (item 14) to start the retaining ring through the opening.

C. Rotate the head counter-clockwise to remove retaining ring through slot in barrel.

D. Repeat steps A. thru C. for remaining head.

3. Use a twisting and pulling motion to carefully extract the head assembly from the front shaft and barrel.

4. Grasp the end of the trunnion shaft and use a twisting and pulling motion to carefully extract the trunnion shaft, trunnion head, piston and front shaft assembly from the barrel.

5. Remove cylinder from vise.

IMPORTANT: When removing roll pin from front and trunnion shafts, make sure that shaft surfaces are not damaged.

6. Remove roll pin (item 4) that secures front shaft to trunnion shaft, then remove front shaft, piston and rear head from trunnion shaft. Retain the 1/8" x 7/8" roll pin for reassembly.

7. Remove and discard seals, O-rings and wear ring from piston and heads.

Inspecting the Steering Cylinder

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

2. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.).

3. Inspect shaft and piston for evidence of excessive scoring, pitting or wear.

4. Replace steering cylinder if internal components are found to be worn or damaged.

Assembling the Steering Cylinder (Fig. 32)

1. Use a new seal kit to replace all seals, O-rings and wear ring to piston and heads. Apply clean Dexron III ATF to all seal kit components before installing.

2. Install trunnion head with new seals onto trunnion shaft.

IMPORTANT: Make sure to not damage O-ring as piston is installed over roll pin hole in trunnion shaft.

3. Install piston with new seals and back-ups onto trunnion shaft.

IMPORTANT: When installing roll pin into front and trunnion shafts, make sure that shaft surfaces are not damaged.

4. Slide front shaft onto trunnion shaft and align roll pin holes in shafts. Install the 1/8" x 7/8" roll pin to secure shafts.

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

5. Mount steering cylinder in a vise equipped with soft jaws by clamping on the barrel clevis.

6. Coat all cylinder components with clean Dexron III ATF. Slide shaft assembly into barrel, being careful to not damage seals during installation.

7. Insert front head assembly into the barrel being careful to not damage head seals during installation.

8. Secure front and trunnion heads in barrel with retaining rings.

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

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

C. Apply silicone sealer to tube access slot.

Hydraulics Enable Valve

A hydraulic solenoid valve assembly is used on this machine. When energized, this solenoid valve allows hydraulic flow to the steering and boom lift circuits. The hydraulics enable valve assembly is located near the gear pump (Fig. 33).

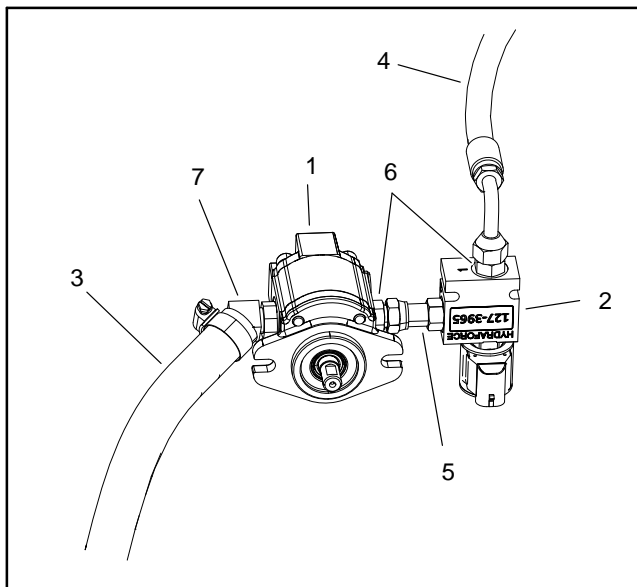


Figure 33

- | | |
|-----------------------------|----------------------|
| 1. Gear pump | 5. Swivel connector |
| 2. Hydraulics enable valve | 6. Hydraulic fitting |
| 3. Suction hose | 7. Hydraulic fitting |
| 4. Hose (to steering valve) | |

Hydraulics Enable Valve Service



CAUTION

Read and follow to the General Precautions for Removing and Installing Hydraulic System Components in this section.

See Cartridge Valve Service in this chapter. Tighten cartridge valve and solenoid coil nut to specified torque (Fig. 34).

See Hydraulic Solenoid Valve Coils in Chapter 5 – Electrical System for information on testing the solenoid coil.

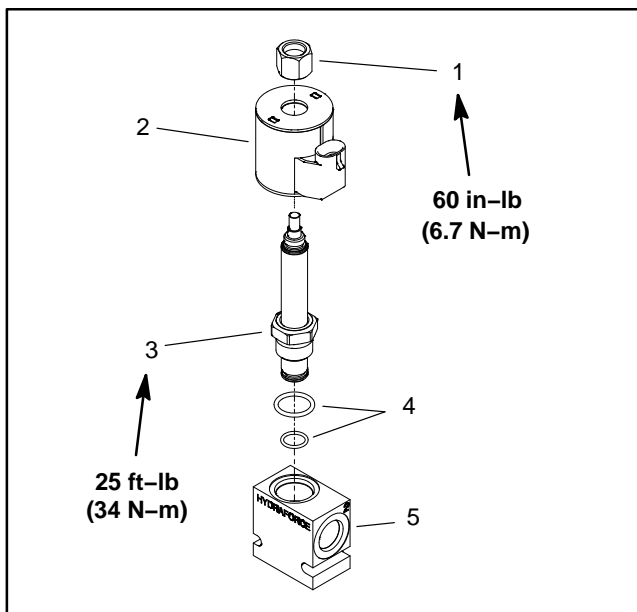


Figure 34

- | | |
|--------------------|-------------|
| 1. Nut | 4. Seal kit |
| 2. Solenoid coil | 5. Manifold |
| 3. Cartridge valve | |

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Boom Lift Control Manifold

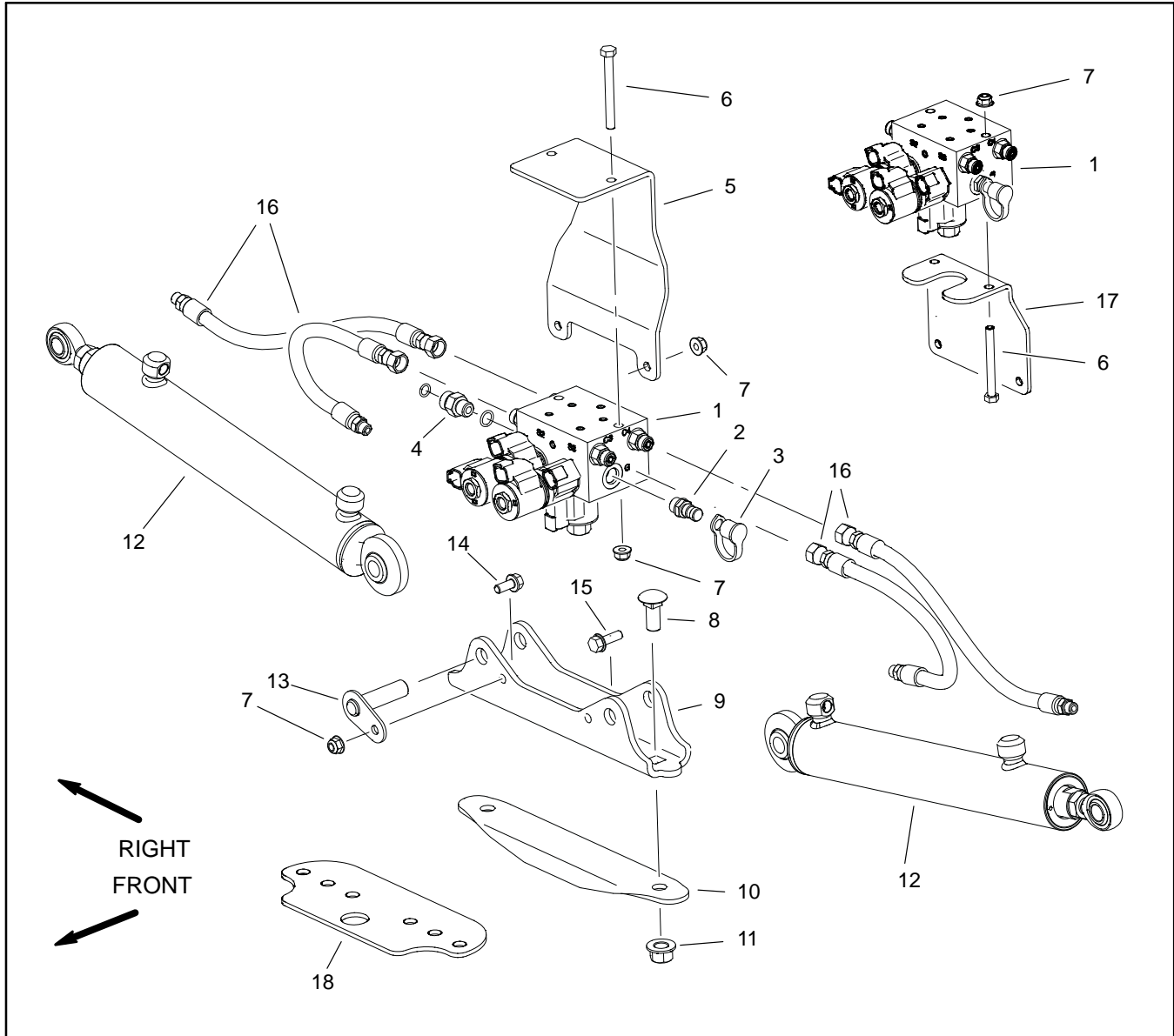



Figure 35


- | | | |
|---|---|---|
| 1. Boom control manifold | 8. Carriage screw (2) | 15. Flange head screw (2) |
| 2. Diagnostic fitting | 9. Cylinder mount plate | 16. Hydraulic hose (4) |
| 3. Dust cap | 10. Stiffener plate
(machine serial no 315000001 & up) | 17. Manifold mount plate
(machine serial no 314000001 thru
314000999) |
| 4. Straight fitting (2) | 11. Lock nut (2) | 18. Stiffener plate
(machine serial no 314000001 thru
314000999) |
| 5. Manifold mount plate
(machine serial no 315000001 & up) | 12. Lift cylinder (2) | |
| 6. Cap screw (2) | 13. Pivot pin (2) | |
| 7. Flange nut (6) | 14. Flange head screw (2) | |

Removing the Boom Control Manifold (Fig. 35)

1. Park the machine on a level surface, stop spray pump, fully raise 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 raised and resting in the boom cradles before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If booms are not fully raised as manifold components are loosened, booms may drop unexpectedly.

 **CAUTION**

Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

2. 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 this chapter to identify the function of the hydraulic lines and cartridge valves at each manifold port location).

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

4. Disconnect wire harness electrical connectors from solenoid valve coils on lift control manifold.

5. Disconnect hydraulic hoses from fittings in lift control manifold. Allow hoses to drain into a suitable container. Put caps or plugs on disconnected hoses and fittings to prevent contamination.

6. Remove two (2) flange nuts and cap screws that secure boom lift control manifold to the manifold mount plate. Remove control 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 the orifice to prevent damage or loss.

7. If necessary, remove fittings and flow control orifices from control manifold and discard O-rings (Fig. 36).

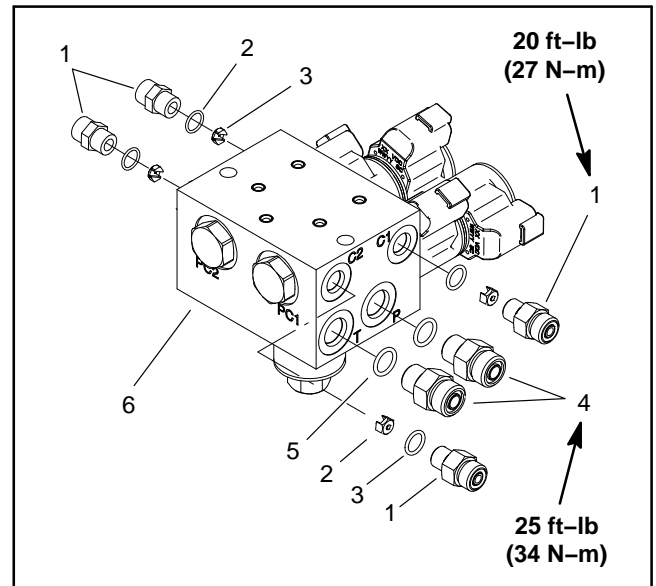


Figure 36

- | | |
|-------------------------|--------------------------|
| 1. Straight fitting (4) | 4. Straight fitting (2) |
| 2. O-ring | 5. O-ring |
| 3. Orifice - 0.036" (4) | 6. Lift control manifold |

Installing the Boom Control Manifold (Fig. 35)

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 (Fig. 36).

2. Position boom lift control manifold to manifold mount plate. Secure manifold to plate with two (2) cap screws and flange nuts.

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

NOTE: Hydraulic hoses from lift cylinder rod ends should be connected to manifold ports C2 and C4. Hoses from lift cylinder cap end should be connected to manifold ports C1 and C3.

4. Lubricate new O-rings and install on hose fittings. Install hydraulic hoses (see Hydraulic Hose and Tube Installation in this chapter).

5. Using labels placed during removal, connect wire harness connectors to manifold solenoid valve coils.

6. Check fluid level in transaxle and adjust as required (see Operator's Manual).

Boom Lift Control Manifold Service

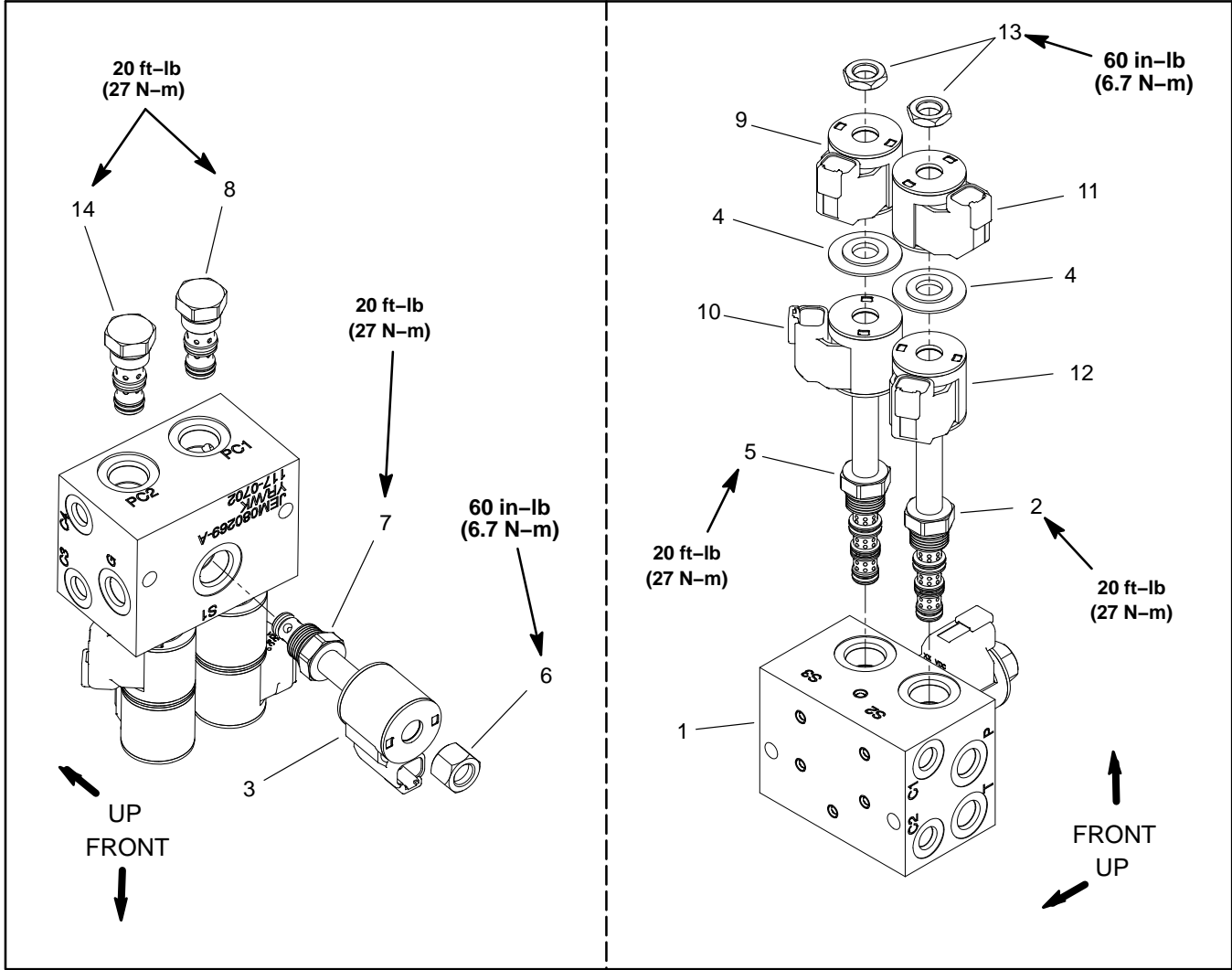



Figure 37

- 1. Manifold
- 2. Solenoid valve – S2 (RH boom)
- 3. Solenoid coil – S1
- 4. Coil spacer (2)
- 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)
- 14. Check valve – CV2 (PC2 port)

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

	WARNING
<p>Make sure that spray booms are fully raised and resting in the boom cradles before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If booms are not fully raised as manifold components are loosened, booms may drop unexpectedly.</p>	

See Cartridge Valve Service in this chapter. Tighten cartridge valve and solenoid coil nut to specified torque (Fig. 37).

See Hydraulic Solenoid Valve Coils in Chapter 5 – Electrical System for information on testing the solenoid coil.

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).

Cartridge Valve Service

Removing a Cartridge Valve

1. Make sure the control manifold is clean before removing the cartridge valve from the control manifold.
2. If cartridge valve is solenoid operated, remove nut securing solenoid coil to the cartridge valve. Carefully slide coil off the valve.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. When removing cartridge valve from manifold, make sure that deep well socket fully engages the valve base.

3. Remove cartridge valve from manifold using a deep socket wrench. Note correct location for O-rings, sealing rings and backup rings. Remove seal kit from cartridge valve and discard removed seals.

Inspecting and Cleaning a Cartridge Valve

1. Visually inspect the port in the manifold for damage to the sealing surfaces, damaged threads and contamination.
2. 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.

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

Installing a Cartridge Valve

1. Install the cartridge valve into the manifold:
 - A. Lubricate new seal kit components with clean Dexron III ATF 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.
 - B. Dip assembled cartridge into clean Dexron III ATF.

IMPORTANT: Use care when handling the valve cartridge. Slight bending or distortion of the stem tube can cause binding and malfunction. When installing cartridge valve into manifold, make sure that deep well socket fully engages the valve base.

 - C. Thread cartridge valve carefully into manifold port by hand until the top O-ring is met. The valve should go into manifold port easily without binding.
 - D. Torque cartridge valve using a deep socket wrench to value identified in control manifold illustration.

2. If cartridge valve is solenoid operated, carefully install solenoid coil to the cartridge valve. Secure coil to valve with nut and torque nut to **60 in-lb (6.8 N-m)**.
3. If problems still exist after assembly, remove valve and clean again or replace valve.

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Boom Lift Cylinders

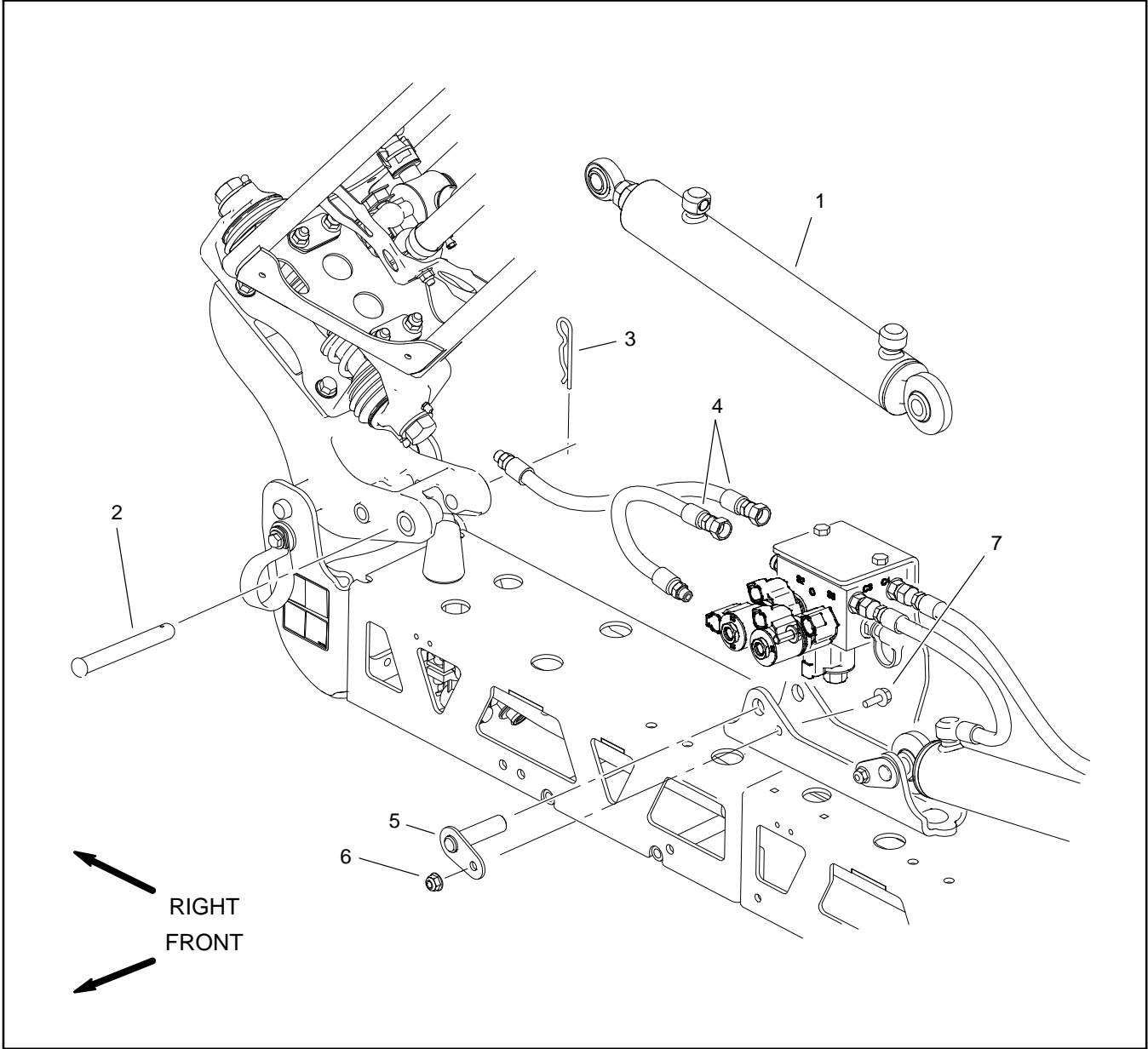




Figure 38

- 1. Hydraulic boom lift cylinder (2)
- 2. Clevis pin (2)
- 3. Cotter pin (2)
- 4. Hydraulic hoses
- 5. Pivot pin (2)
- 6. Flange nut (2)
- 7. Flange head screw (2)

Removing the Boom Lift Cylinders (Fig. 38)

1. Park the machine on a level surface, stop the spray pump, fully raise 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 raised and resting in the boom cradles before loosening hydraulic lines, cartridge valves or plugs from lift control manifold. If booms are not fully raised as manifold components are loosened, booms may drop unexpectedly.

 CAUTION
Before disconnecting components or performing any work on hydraulic system, all pressure in the system must be relieved (see Relieving Hydraulic System Pressure in this chapter).

2. Label hydraulic hoses for assembly purposes. Thoroughly clean hydraulic hose ends prior to disconnecting the hoses from boom lift cylinder.
3. Disconnect hydraulic hoses from boom lift cylinder. Allow hoses to drain into a suitable container.
4. Put caps or plugs on disconnected hoses and cylinder ports to prevent contamination.

5. Remove cotter pin (item 3) and clevis pin (item 2) that secure lift cylinder rod end to boom pivot bracket.

6. Remove flange head screw (item 7) and flange nut (item 6) that secure pivot pin (item 5) to cylinder mount plate. Slide pivot pin from mount plate and remove lift cylinder.

Installing the Boom Lift Cylinders (Fig. 38)

1. Position lift cylinder to cylinder mount plate and boom pivot bracket.

2. Slide pivot pin (item 5) through cylinder mount plate and lift cylinder. Secure pivot pin to mount plate with flange head screw (item 7) and flange nut (item 6).

3. Secure lift cylinder shaft rod end to boom pivot bracket with clevis pin (item 2) and cotter pin (item 3).

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 this chapter).

6. Check fluid level in transaxle and adjust as required (see Operator's Manual).

7. Operate boom lift cylinder before returning machine to service. Nothing should contact the hydraulic hoses or cylinder at any time during operation, and there should be no fluid leaks.

Boom Lift Cylinder Service

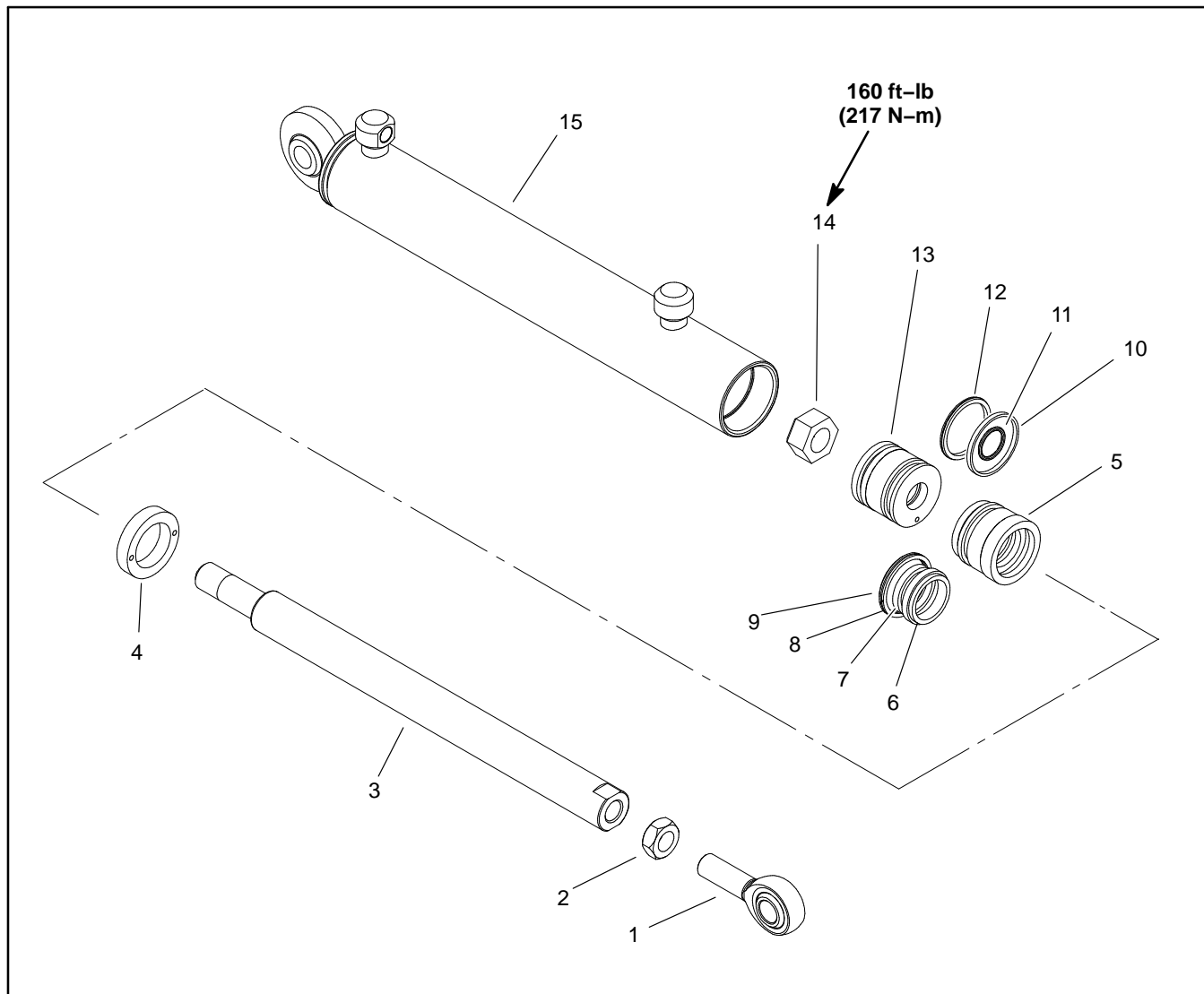


Figure 39

- | | | |
|--------------------|-----------------|--------------|
| 1. Rod end | 6. Dust seal | 11. O-ring |
| 2. Jam nut | 7. Shaft seal | 12. Seal |
| 3. Shaft | 8. Back-up ring | 13. Piston |
| 4. Internal collar | 9. O-ring | 14. Lock nut |
| 5. Head | 10. Steel ring | 15. Barrel |

Disassembling a Boom Lift Cylinder (Fig. 39)

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.

Assembling a Boom Lift Cylinder (Fig. 39)

1. Make sure all cylinder parts are clean before assembly.
2. Coat all seal kit components with clean Dexron III ATF.
 - 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 Dexron III ATF.
 - 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 Dexron III ATF. 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.

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Electrical System

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General Information

For engine electrical system and component information, see the Kohler Engine Service Manual.

For Ultra Sonic Boom Leveling Kit electrical system and component information, see Chapter 9 – Ultra Sonic Boom Kit in this manual.

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Multi Pro 1750 machine. Refer to that publication for additional information when servicing the machine.

Electrical Drawings

The electrical schematics and wire harness drawings for the Multi Pro 1750 are located in Chapter 10 – Electrical Drawings.

Toro Electronic Controller (TEC)

Multi Pro 1750 machines use a single Toro Electronic Controller (TEC) to manage machine electrical functions. The TEC is attached to the control console.

The TEC is a microcontroller that monitors the condition of various machine switches and sensors (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter Display.

IMPORTANT: Before performing any welding on the machine, disconnect the battery cables from the battery, disconnect the wire harness connector from the Toro Electronic Controller and disconnect the terminal connector from the alternator. These steps will prevent damage to the machine electrical system.

CAN-bus Communications

The Toro Electronic Controller (TEC) communicates with other electrical components on a CAN-bus communication system. Using this system allows the machine to fully integrate all the different electrical components and bring them together as one. The CAN-bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be reduced. The integration of electrical functions also allows the InfoCenter Display to assist with electrical system diagnostics.

CAN identifies the Controller Area Network that is used on the Multi Pro. Two (2) twisted wires form the bus. These wires provide the data pathways between machine components. The engineering term for these two (2) wires are CAN-high and CAN-low. At the ends of the twisted pair of bus wires are 120 ohm termination resistors.

Each of the components that is controlled by the CAN-bus link only needs four (4) wires to operate and communicate to the system: CAN-high, CAN-low, B+ (power) and ground.

IMPORTANT: The termination resistors at the ends of the bus wires are required for proper electrical system operation.

Special Tools

Order 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.

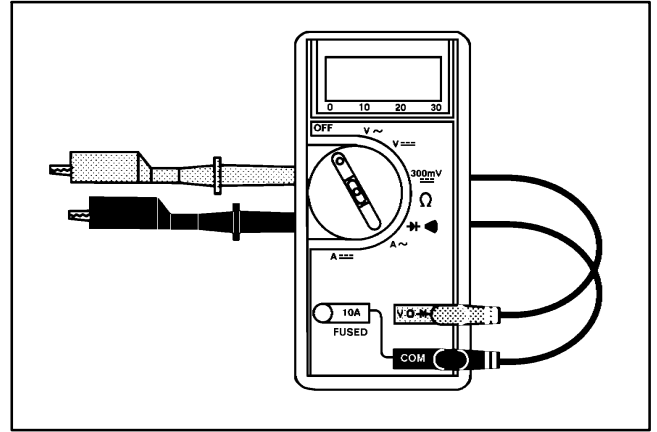


Figure 1

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and then connect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Do not use dielectric gel on sealed connection terminals as the gel can unseat connector seals during assembly.

Toro Part Number: **107-0342**



Figure 2

Terminal Protector

Aerosol spray that should be used on battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply battery terminal protector to the connection after the battery cable, ring terminal, or fork terminal has been secured.

Toro Part Number: **107-0392**



Figure 3

Spark Tester

The spark tester can be used to test magneto ignitions on gasoline engines. The spark tester determines if ignition is present.

Toro Part Number: **TOR4036**



Figure 4

Battery Hydrometer

Use the Battery Hydrometer when measuring specific gravity of battery electrolyte. Obtain this tool locally.



Figure 5

Traction Speed Sensor Test Harness

NOTE: Based on harness length, speed sensor testing can be performed while driving machine in an open area or while the machine is stationary. Stationary testing requires an assistant and using jack stands to get the rear wheels off the ground.

Special Tools Needed

Traction speed sensor test harness (fabricated using the information provided here)

Multimeter with frequency measurement capability (12V square wave)

Instructions

1. Park machine on a level surface, stop engine and engage parking brake. Remove key from ignition switch.
2. Disconnect sensor from wire harness and check wire harness for circuit problems before testing speed sensor (see Traction Speed Sensor in the Component Testing section of this chapter).
3. With sensor installed in transaxle, connect traction speed sensor test harness between sensor and machine harness.
4. Plug blue wire (red test harness connector) into the positive voltage port on the multimeter and black wire (black test harness connector) into ground port on the multimeter.
5. Set multimeter to measure frequency (12V square wave).
6. Start and drive machine while watching the meter. The frequency should increase when vehicle speed increases if the sensor is functioning appropriately.
7. If frequency is not registered, is erratic, or does not increase when increasing speed, remove and replace the speed sensor. See Traction Speed Sensor in the Service and Repairs section of this chapter.

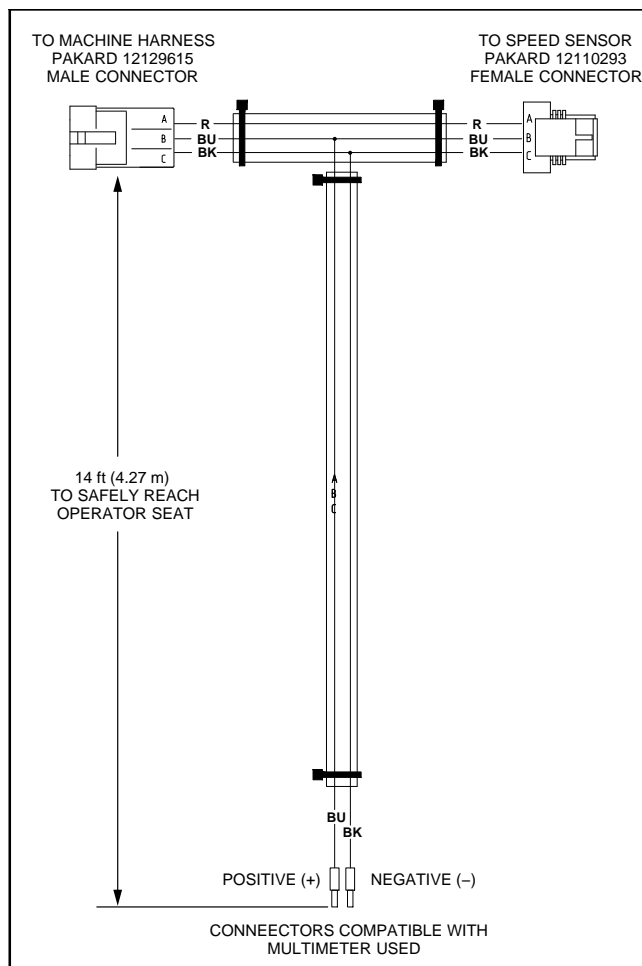


Figure 6
Traction Speed Sensor Test Harness

Flow Meter Sensor Test Harness

Special Tools Needed

Flow meter sensor test harness (fabricated using the information provided here)

Multimeter with frequency measurement capability (12V square wave)

Instructions

1. Park machine on a level surface, stop engine and engage parking brake. Remove key from ignition switch.
2. Disconnect flow meter sensor from wire harness and check wire harness for circuit problems before testing speed sensor (see Flow Meter Sensor in the Component Testing section of this chapter).
3. With sensor installed in flow meter, connect flow meter sensor test harness between sensor and machine wire harness.
4. Plug red wire (from connector pins 3) into the positive voltage port on the multimeter and black wire (from connector pins 1) into ground port on the multimeter.
5. Set multimeter to measure frequency (12V square wave).
6. Watch the meter as an assistant begin spraying (vehicle remains stationary). A frequency reading should appear and remain relatively constant. Making adjustments to the spray system pressure or changing nozzles should increase or decrease the frequency reading accordingly.
7. If frequency is not registered or is erratic, verify orientation of grooves on sensor body. The grooves must be aligned parallel to the flow meter body (see Flow Meter Sensor in the Service and Repairs section of this chapter). If the sensor grooves are not aligned:
 - A. Loosen sensor lock nut.
 - B. Rotate sensor clockwise (sensor turns into the port) until grooves are aligned.
 - C. Tighten the lock nut from **15–20 in-lbs (1.7 to 2.3 N-m)** and re-test.
8. If frequency continues to not register or is erratic, remove and re-install sensor.
 - A. Thread jam nut against sensor hex head.
 - B. Thread sensor into flow meter body until bottom of sensor jam nut is **0.38 in. (9.6 mm)** from flow meter body.

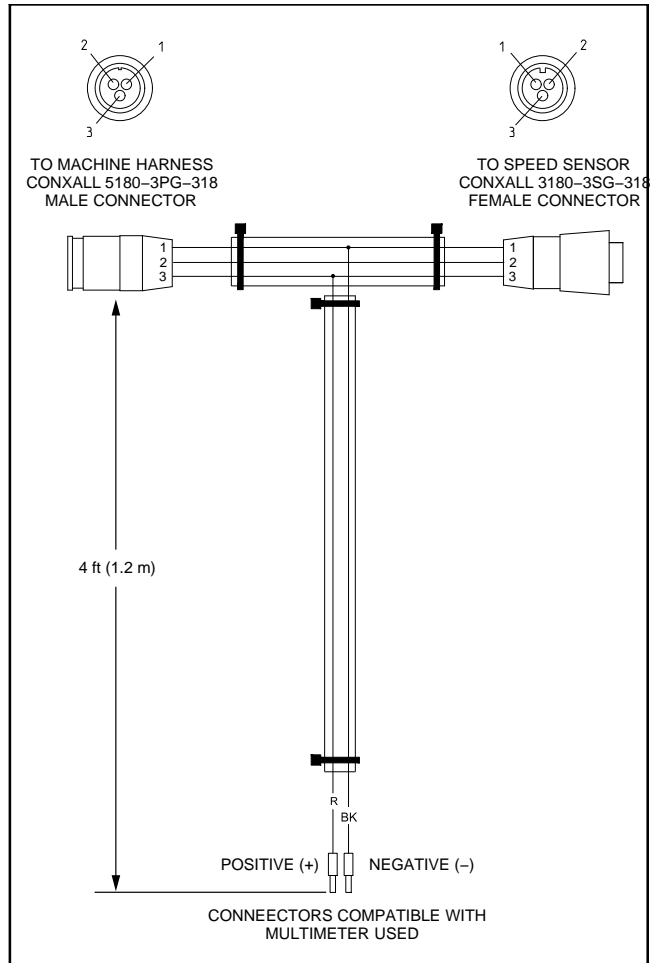


Figure 7
Flow Meter Sensor Test Harness

C. Turn sensor out (counterclockwise) until orientation groove on top of sensor is parallel with flow meter body.

D. Hold sensor in position and turn jam nut down to contact flow meter body. Tighten jam nut from **15 to 20 in-lb (1.7 to 2.3 N-m)**.

9. If frequency measurement does not register, is erratic, or does not change with changes to spray system pressure or nozzle size after verifying alignment of sensor and re-installation, remove and replace the flow meter sensor. See Flow Meter Sensor in the Service and Repairs section of this chapter.

InfoCenter Display

The InfoCenter Display used on your Multi Pro is a LCD device that is located on the console arm (Fig. 8). The InfoCenter provides information for machine Operators, it provides electrical system diagnostic assistance for technicians, and provides access to adjustable machine settings (Fig. 9).

Power for the InfoCenter is available when energized by the main power relay (ignition switch in the RUN or START position). The InfoCenter Display is protected by a 15 amp fuse located in the main fuse block. A CAN-bus system provides communication necessary for machine operation between the Toro Electronic Controller (TEC) and the InfoCenter.

Use the InfoCenter Display to test TEC inputs and qualifiers when troubleshooting an electrical problem on your Multi Pro 1750 (see Using the InfoCenter Display to Test TEC Inputs and Outputs in this chapter).

Your machine is equipped with an Toro Electronic Controller (TEC) which monitors interlock switch (input) operation. If one or more inputs are not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (see Operator Advisory Screen and Operator Advisories in this chapter).

NOTE: Icons used by the InfoCenter display are identified in the machine Operator's Manual.

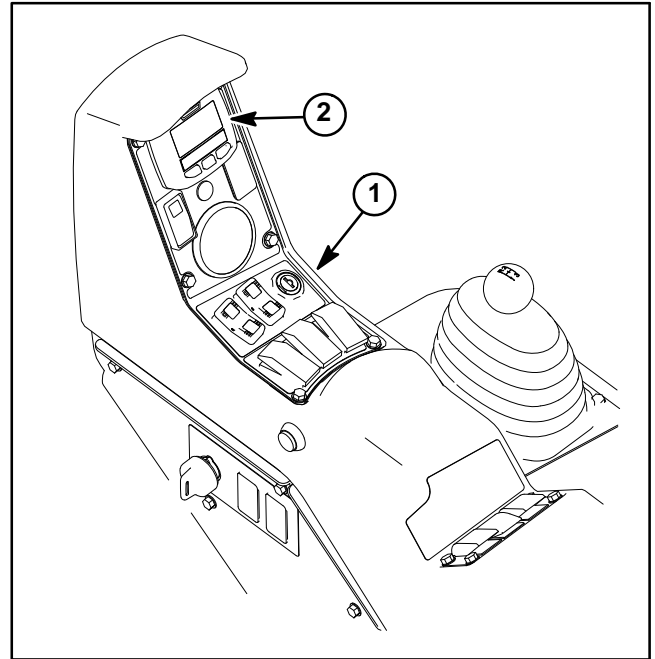


Figure 8

1. Control console

2. InfoCenter Display

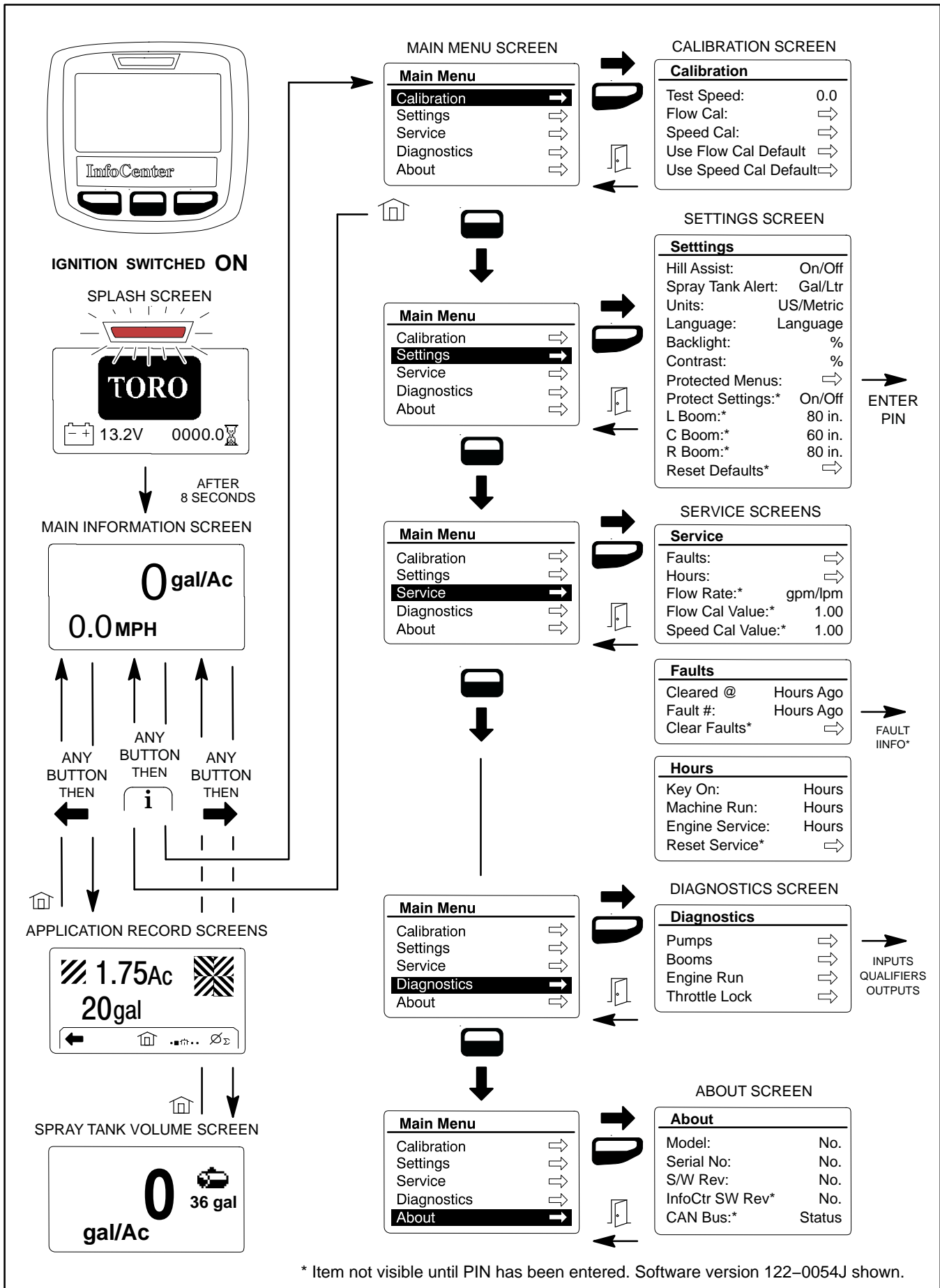


Figure 9 InfoCenter Display Screens

Splash Screen

When the ignition switch is turned from the OFF position to the ON or START position, the fault indicator illuminates for a few seconds to verify indicator operation and the InfoCenter splash screen appears (Fig. 10). The splash screen provides the following information to the operator:

- Voltmeter
- Hourmeter

After the splash screen has been displayed for eight seconds, the main information screen will be appear on the InfoCenter. The only way to return to the splash screen is by switching the key switch OFF then back ON.

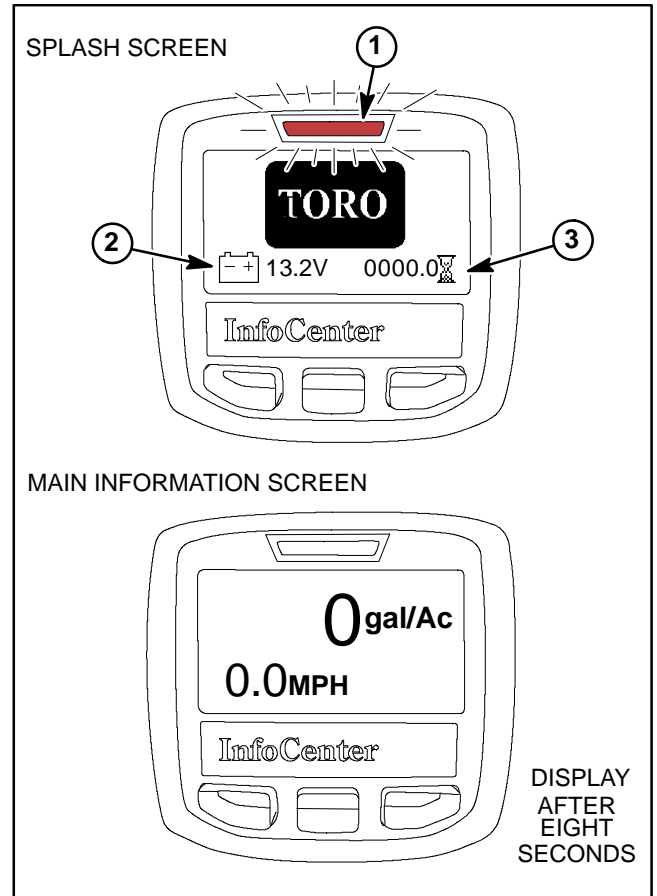


Figure 10

1. Fault indicator
2. Voltmeter
3. Hourmeter

Main Information Screen

The InfoCenter main information screen is displayed about 10 seconds after the ignition switch has been turned from the OFF position to the ON or START position (Fig. 11). The main information screen is the “default” screen as it will be displayed during normal machine operation. The main information screen provides the following information to the operator:

- Vehicle speed
- Spray system application rate
- Spray tank volume
Icon appears when a spray tank volume greater than zero (0) is entered
- Parking brake
Icon appears when parking brake is engaged
- Master boom
Icon (all three booms) appear across the top of the screen when master boom switch is ON
- Boom sections
Icon (boom with spray pattern) appears when master boom switch is ON and one or more spray boom switches are ON
- Hill Assist
Icon appears when hill assist is enabled and engaged
- Throttle Lock
Icon appears when throttle lock is active
- Speed Lock
Icon appears when speed lock is active

Press any button once to expose the navigation pane at the bottom of the screen. The navigation pane will close automatically if another button is not pressed within five (5) seconds. Press the center, left or right buttons when the navigation pane is exposed to access additional screens and menus.

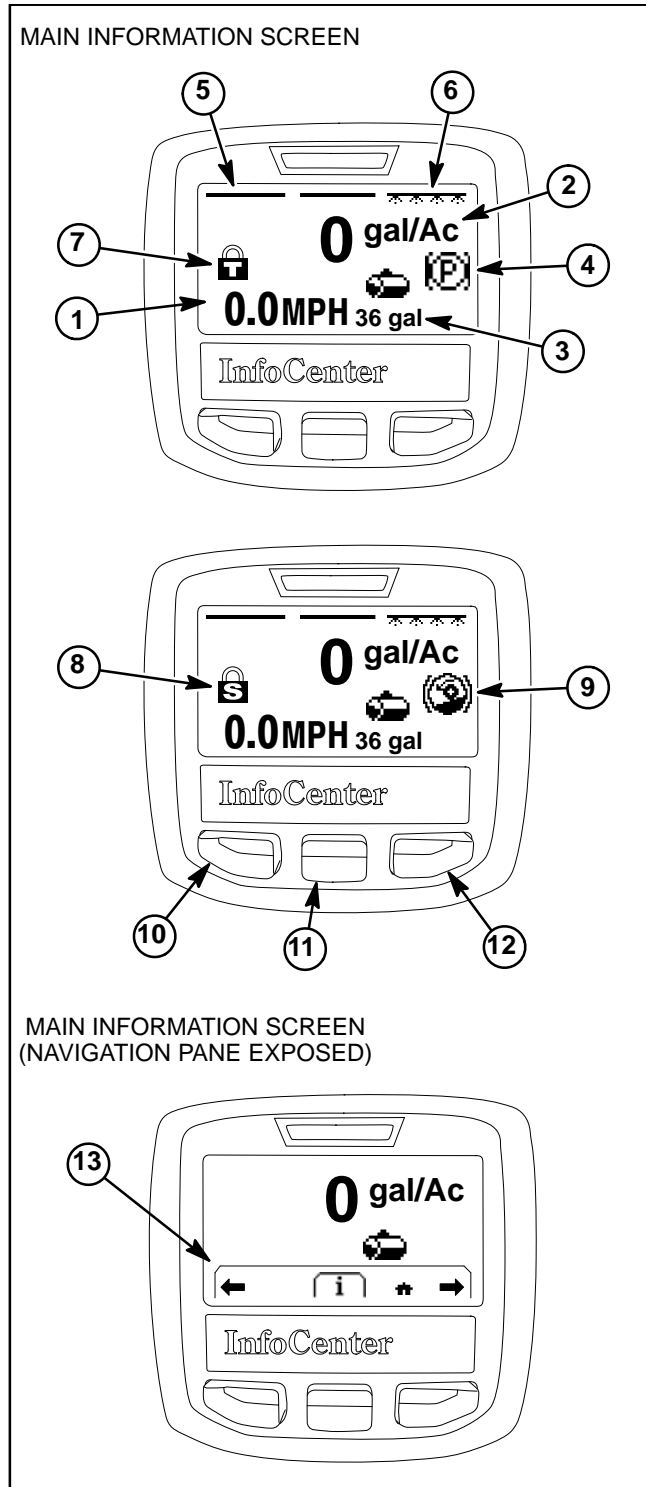


Figure 11

- | | |
|----------------------------|--------------------------|
| 1. Vehicle speed | 8. Speed lock (active) |
| 2. Application rate | 9. Hill assist (active) |
| 3. Spray tank volume | 10. Left/back button |
| 4. Parking brake (applied) | 11. Center/down button |
| 5. Master boom (active) | 12. Right/forward button |
| 6. Spray boom (active) | 13. Navigation pane |
| 7. Throttle lock (active) | |

Application Record Screens

Use the application record screens to view the area and the amount of product sprayed since the screens were cleared (Fig. 12). The first application record screen displays the total area and total amount of product sprayed. The application record total screen is accessed from the InfoCenter main information screen by pressing any button once to expose the navigation pane, then press the left/back button again (as indicated by the ← in the navigation pane).

The second application record screen displays the area and the amount of product sprayed in the first of twenty (20) sub areas. The application record sub area screen is accessed from the application record total screen by pressing the left/back button again (as indicated by the ← in the navigation pane). Press center/down button to display each additional sub area screen (as indicated by the ↵ in the navigation pane).

To clear the application record total (all sub areas), press the right/forward button on the application record total screen (as indicated by the → at the bottom of the screen). To clear an application record sub area, press the right/forward button on the application record sub area screen (as indicated by the → at the bottom of the screen).

To return to the previous screen, press the left/back button (as indicated by the ← at the bottom of the screen).

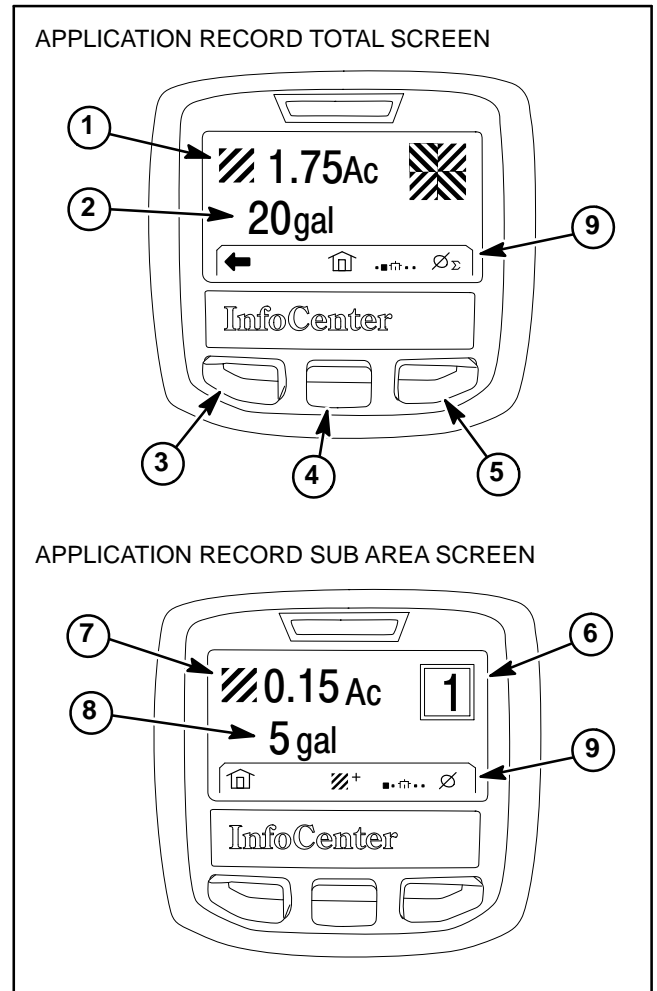


Figure 12

- | | |
|--------------------------|-----------------------------|
| 1. Total area applied | 6. Sub area number |
| 2. Total product applied | 7. Sub area applied |
| 3. Left/back button | 8. Sub area product applied |
| 4. Center/down button | 9. Navigation pane |
| 5. Right/forward button | |

Spray Tank Volume Screen

Use the spray tank volume screen to enter the amount of water filled into the tank before you begin spraying. The spray tank volume screen (Fig. 13) is accessed from the InfoCenter main information screen by pressing any button once to expose the navigation pane, then press the right/forward button again (as indicated by the ➡ in the navigation pane).

Enter the spray tank volume by pressing any button once to expose the navigation pane, then press the right/forward button again (as indicated by the ➡ in the navigation pane). Press the left/back button once (as indicated by the ⏪ in the navigation pane) and adjust the tank volume + or – as necessary. Press the left/back button once to save your changes (as indicated by the 💾 in the navigation pane).

Entering the spray tank volume automatically sets the spray tank alert to 1 gal/ltr. Adjust the spray tank alert after entering the spray tank volume (see Settings Screen – Spray Tank Alert in this chapter).

To return to the previous screen, press the left/back button (as indicated by the ⏪ at the bottom of the screen).

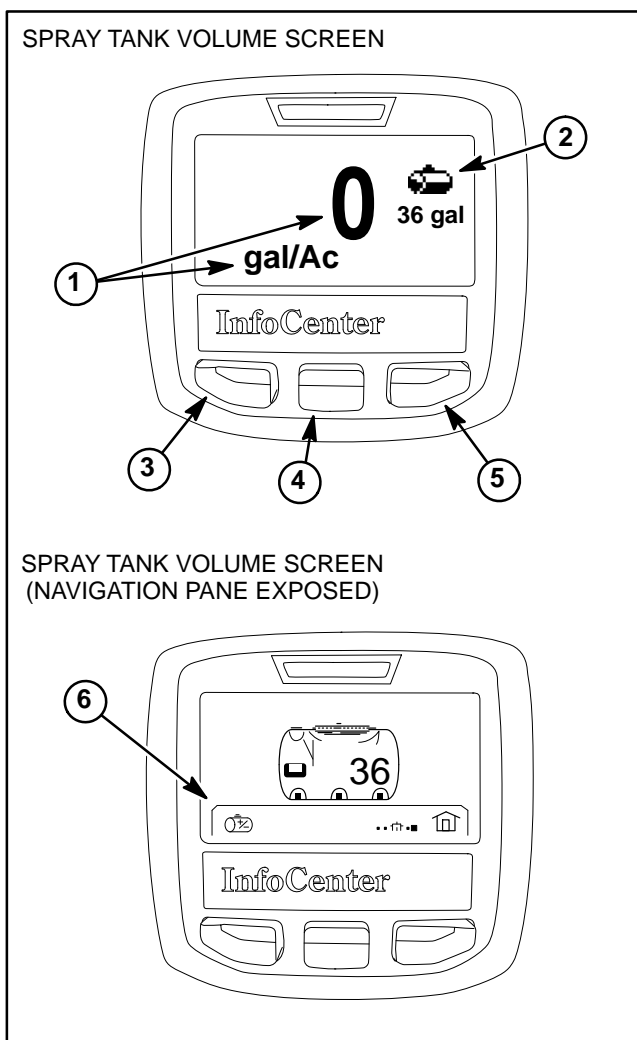





Figure 13


- | | |
|-----------------------------|-------------------------|
| 1. Current application rate | 4. Center/down button |
| 2. Current tank volume | 5. Right/forward button |
| 3. Left/back button | 6. Navigation pane |

Main Menu Screen

The main menu screen (Fig. 14) is accessed from the InfoCenter main information screen. Press any button once to expose the navigation pane, then press the center/down button again (as indicated by the  in the navigation pane). The main menu screen provides access to the following screens:

- Calibration
- Settings
- Service
- Diagnostics
- About

Press the center/down button (as indicated by the  at the bottom of the screen) to highlight the desired menu item, then press the left/forward button (as indicated by the  at the bottom of the screen) to enter the highlighted menu item.

To return to the previous screen, press the left/back button (as indicated by the  at the bottom of the screen).

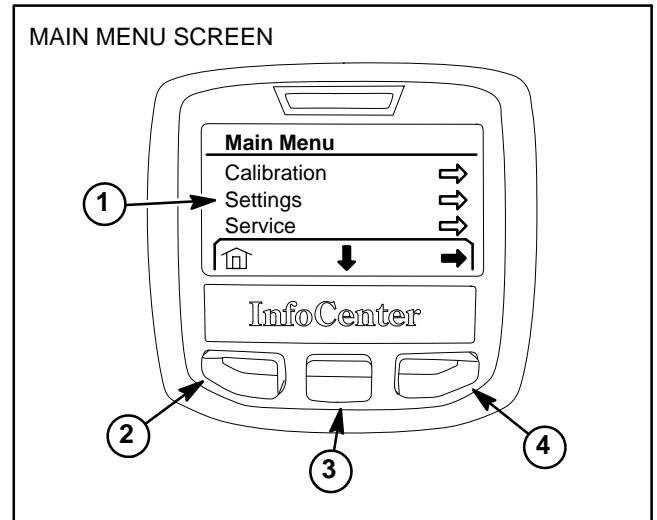






Figure 14


1. Menu screens
2. Left/back button
3. Center/down button
4. Right/forward button


Calibration Screen

Use the calibration screen (Fig. 15) to calibrate the sprayer flow, speed, and boom bypass if you change the nozzles, or as needed (see machine Operator's Manual). Press the center/down button (as indicated by the  at the bottom of the screen) to highlight the desired menu item, then press the left/forward button (as indicated by the  at the bottom of the screen) to enter the highlighted menu item.

To return to the previous screen, press the left/back button (as indicated by the  at the bottom of the screen).

Test Speed: Vehicle speed is an element necessary to calculate and maintain the desired application rate. Use the right/forward button (as indicated by the  at the bottom of the screen) to enter a vehicle speed when static testing the spray system (ie: boom bypass valve adjustment).

Flow Calibration: Product flow/volume is an element necessary to calculate and maintain the desired application rate. Use the right/forward button (as indicated by the  at the bottom of the screen) to begin the process of calibrating the flow meter flow/volume sensor.

Speed Calibration: Vehicle speed is an element necessary to calculate and maintain the desired application rate. Use the right/forward button (as indicated by the  at the bottom of the screen) to begin the process of calibrating the vehicle speed sensor.

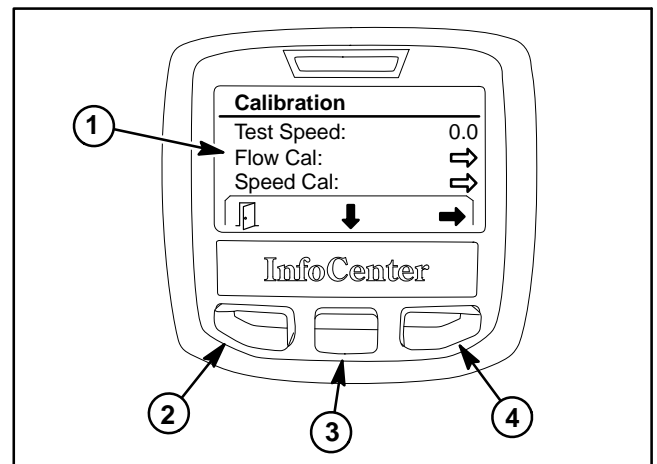




Figure 15

1. Calibration items
2. Left/back button
3. Center/down button
4. Right/forward button

Use Flow Calibration Default: Use the right/forward button (as indicated by the  at the bottom of the screen) to reset the flow calibration to the default calculated average, not the actual volume. The actual volume is the result of the flow calibration process.

Use Speed Calibration Default: Use the right/forward button (as indicated by the  at the bottom of the screen) to reset the speed calibration to the default calculated average, not the actual speed. The actual speed is the result of the speed calibration process.

Settings Screen

The settings screen (Fig 16) allows the operator or technician to modify a variety of machine functions, customize the InfoCenter display, and provides access to unlock various protected menus and settings. To scroll through the list of functions, view its current setting, and select (highlight) the setting to be modified, press the center/down button (as indicated by the ↓ at the bottom of the screen).

To return to the previous screen, press the left/back button (as indicated by the ⏪ at the bottom of the screen).

Hill Assist: Use the right/forward button (as indicated by the → at the bottom of the screen) to enable or disable the hill assist feature. Once enabled, the hill assist feature is activated when the clutch pedal and brake pedal are pressed, the vehicle speed is zero (0) and the required brake pressure has been reached. The brake will remain engaged for a second or two after the operator releases the brake pedal to allow time for engaging the clutch and accelerator.

Spray Tank Alert: Use the right/forward button (as indicated by the → at the bottom of the screen) to enter the desired spray tank alert volume. The indicator light on the InfoCenter Display will illuminate when the spray tank reaches the volume entered. The volume setting for the alert can be adjusted with the center button – or right button +. The spray tank alert volume resets to 1 gal/ltr any time the spray tank volume is entered.

Units: Use the right/forward button (as indicated by the → at the bottom of the screen) to select between English, Turf or SI (metric) units of measure.

Language: Use the right/forward button (as indicated by the → at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for five (5) seconds. The fault indicator will illuminate and an operator advisory #242 (Value Saved) will appear on the InfoCenter display to confirm that the change has been recorded.

Backlight: Press the right/forward button (as indicated by the → at the bottom of the screen) then increase or decrease the InfoCenter Display brightness (as indicated by the – and the + at the bottom of the screen). Allow the desired selection to remain in view for five (5) seconds. The fault indicator will illuminate and an operator advisory #242 (Value Saved) will appear on the InfoCenter display to confirm that the change has been recorded.

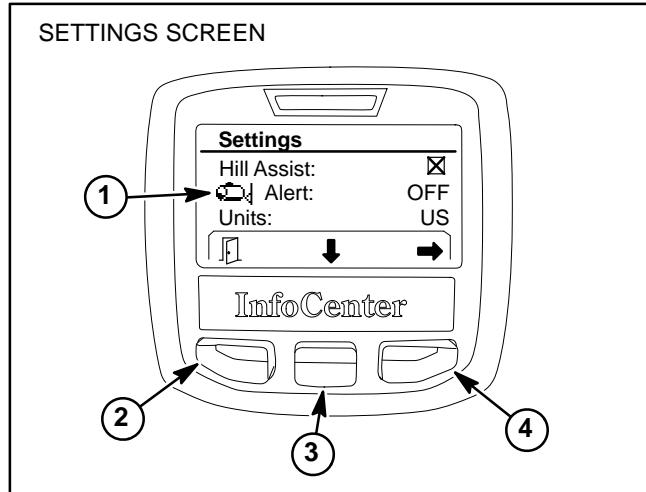


Figure 16

1. Settings items
2. Left/back button
3. Center/down button
4. Right/forward button

Contrast: Press the right/forward button (as indicated by the → at the bottom of the screen) then increase or decrease the InfoCenter Display contrast (as indicated by the – and the + at the bottom of the screen). Allow the desired selection to remain in view for five (5) seconds. The fault indicator will illuminate and an operator advisory #242 (Value Saved) will appear on the InfoCenter display to confirm that the change has been recorded.

Protected Menus: Authorized individuals can enter the four (4) digit Personal Identification Number (PIN) to reveal the following service functions (see Service Screens in this chapter):

- Flow Rate
- Flow Calibration Value
- Speed Calibration Value
- Clear System Faults
- Service Timer Reset

Entering the correct PIN will also reveal and allow adjustment of various machine functions on the settings screen if Protect Settings is enabled (see Settings Screen – Protect Settings).

Use the center/down button and right/forward button (as indicated by the ↓ and the → at the bottom of the screen) to enter the four (4) digit PIN. Once the correct PIN has been entered, press the center/down button (as

indicated by the ✓ at the bottom of the screen). **PIN** will appear in the upper right hand corner of the InfoCenter display. The protected items will be visible as long as the ignition switch remains ON.

To edit the Personal Identification Number (PIN), enter the current PIN as previously described (**PIN** will appear in the upper right hand corner). Select Protected Menus again and use the center/down button and right/forward button (as indicated by the ↓ and the ➡ at the bottom of the screen) to enter a new four (4) digit PIN. Press the center/down button to save the change (as indicated by the ☑ at the bottom of the screen). The fault indicator will illuminate and an operator advisory #242 (Value Saved) will appear on the InfoCenter display to confirm that the change has been recorded.

NOTE: The initial PIN will be either 1234 or 0000. If the PIN has been changed and is forgotten, a temporary PIN can be obtained from your Toro distributor.

The following settings will only be visible if Protect Settings is enabled ☑ and the correct personal identification number (PIN) has been entered, or Protect Settings is disabled ☐:

Protect Settings: Use the right/forward button (as indicated by the ➡ at the bottom of the screen) to enable ☑ or disable ☐ the protected items. When Protect Settings is disabled ☐, the remaining items will be visible and adjustable at all times. When Protect Settings is enabled ☑, the remaining items will be visible and adjustable only after the correct personal identification number (PIN) has been entered (see Settings Screen – Protected Menus).

L Boom: The width of the left boom spray pattern must be entered for accurate application rate calculation and coverage recording. The boom width can be adjusted with the center button – or right button +.

C Boom: The width of the center boom spray pattern must be entered for accurate application rate calculation and coverage recording. The boom width can be adjusted with the center button – or right button +.

R Boom: The width of the right boom spray pattern must be entered for accurate application rate calculation and coverage recording. The boom width can be adjusted with the center button – or right button +.

Reset Defaults: Use this menu item to reset the following settings to the factory defaults:

- Application Recording – sub area 1
- Test Speed – 0.0
- Hill Assist – enabled
- Spray Tank Alert – 1 gal/ltr
- Units – US
- L Boom – 80 in
- C Boom – 60 in
- R Boom – 80 in

Service Screens

The service screen (Fig. 19) contains machine operational information including Faults and Hours. If the correct personal identification number (PIN) has been entered (see Settings Screen – Protected Menus in this chapter) the service screen allows viewing the Flow Rate, Flow Calibration Value and Speed Calibration Value. To scroll through the list of service items and view the current values, press the center/down button (as indicated by the ↓ at the bottom of the screen).

Faults: The Faults screen (Fig. 18) will list the last time faults were cleared and all machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by fault number and when the fault occurred. Fault Codes that might occur on the machine are listed in the Troubleshooting section of this chapter. If the correct personal identification number (PIN) has been entered (see Settings Screen – Protected Menus in this chapter) the service screen allows access to additional information about each fault present and provides the ability to clear any of the present faults.

Hours: The Hours screen (Fig. 19) will list the following:

- Key On – Identifies the number of hours that the ignition switch has been in the RUN position.
- Machine Run – Identifies the number of hours that the engine has been running.
- Engine Service – Identifies the number of hours remaining before the next recommended service.

If the correct personal identification number (PIN) has been entered (see Settings Screen – Protected Menus in this chapter) the service screen allows access to reset the engine service timer.

Flow Rate: Displays the current flow rate. The rate displayed here should be consistent with catch test results after flow calibration. If not, flow meter and/or flow meter sensor may not be functioning correctly.

Flow Calibration: Displays the current multiplier used to calculate the difference between the assumed flow and the calibrated flow. The assumed flow multiplier is 1.00. The calibrated flow multiplier can be equal to, higher or lower than the assumed flow.

Speed Calibration: Displays the current multiplier used to calculate the difference between the assumed speed and the calibrated speed. The assumed speed multiplier is 1.00. The calibrated speed multiplier can be equal to, higher or lower than the assumed speed.

To return to the previous screen, press the Menu/Back button (as indicated by the ⏪ at the bottom of the screen).

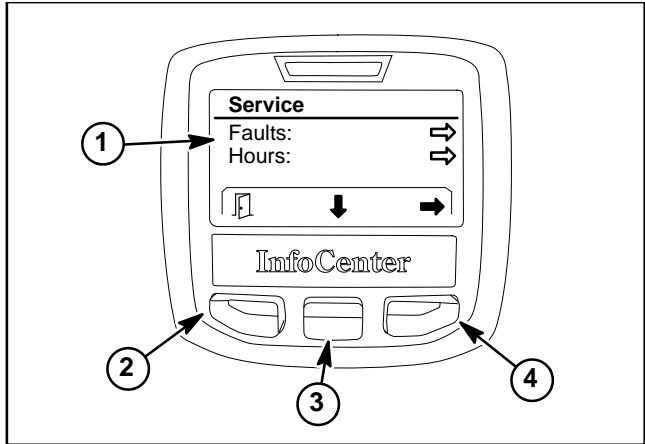


Figure 17

1. Service items
2. Left/back button
3. Center/down button
4. Right/forward button

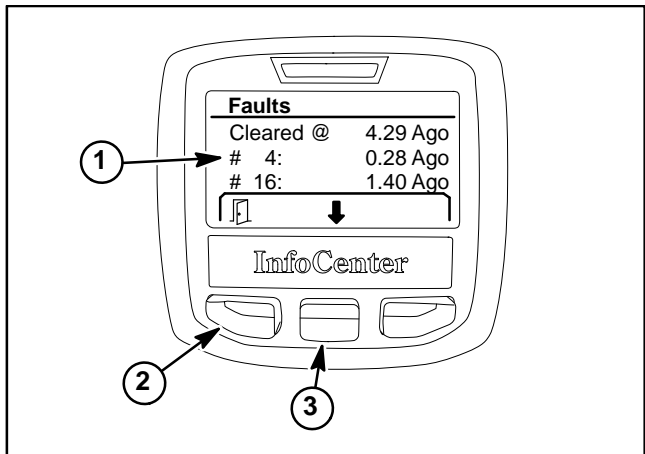


Figure 18

1. Fault items
2. Left/back button
3. Center/down button

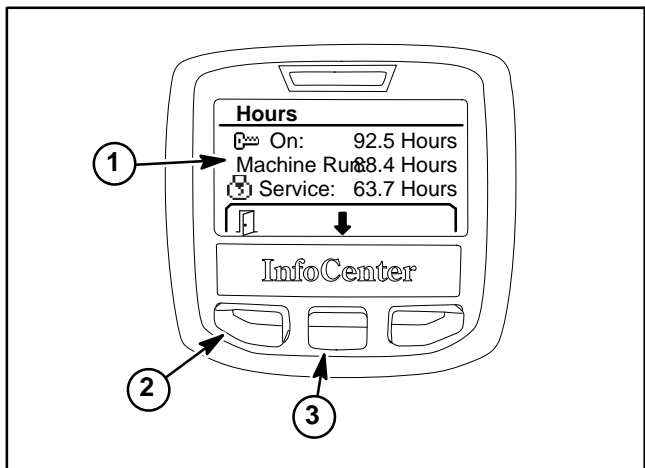


Figure 19

1. Hours items
2. Left/back button
3. Center/down button

Diagnostics Screen

The diagnostics screen (Fig. 20) lists a variety of machine operations and the current state of the Toro Electronic Controller (TEC) inputs, the qualifiers and the outputs required to allow the operation to proceed. The diagnostics screen should be used to troubleshoot machine operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting in this chapter). To scroll through the list of operations and select (highlight) the operation to be viewed, press the Down button (as indicated by the ↓ at the bottom of the screen).

To return to the previous screen, press the Menu/Back button (as indicated by the ⏪ at the bottom of the screen).

Pumps Identifies the requirements necessary to allow the TEC to operate the spray pump and the optional rinse pump.

Inputs	Qualifiers	Outputs
Spray Pump Switch	Throttle Home Switch	Spray Pump Clutch
Momentary Rinse Switch (optional rinse pump kit)	Timer (optional rinse pump kit)	Rinse Pump (optional rinse pump kit)
Timed Rinse Switch (optional rinse pump kit)		

Booms Identifies the requirements necessary to allow the TEC to operate the master boom spray valve.

Inputs	Qualifiers	Outputs
Left Boom Switch	None	Master Boom Spray Valve
Center Boom Switch		
Right Boom Switch		
Master Boom Switch		

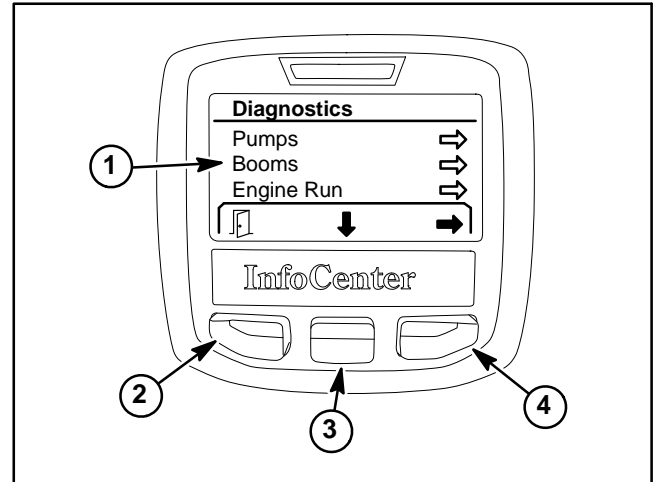


Figure 20

1. Diagnostics items
2. Left/back button
3. Center/down button
4. Right/forward button

Engine Run Identifies the requirements necessary to allow the TEC to start and run the engine.

Inputs	Qualifiers	Outputs
Key Start	Neutral Switch	OK RUN
Key Run	Seat Switch or Parking Brake Switch	Starter Output
	Pump Switch OFF	

Throttle Lock Identifies the requirements necessary to allow the TEC to hold the throttle in its current position.

Inputs	Qualifiers	Outputs
Speed Lock/Throttle Lock Switch	Neutral Switch	Speed Lock/Throttle Lock Solenoid
	Parking Brake Switch	
	Spray Pump Switch	
	Clutch Switch	

About Screen

The about screen (Fig. 21) identifies the machine model number, serial number and software revision for the machine. If the correct personal identification number (PIN) has been entered (see Settings Screen – Protected Menus in this chapter), the InfoCenter software is displayed and the CAN–bus status will be visible. Press the Center/down button to scroll through the screen items (as indicated by the ↓ at the bottom of the screen). The information found in the about screen can be edited only by your Toro Distributor.

To return to the previous screen, press the Menu/Back button (as indicated by the ↶ at the bottom of the screen).

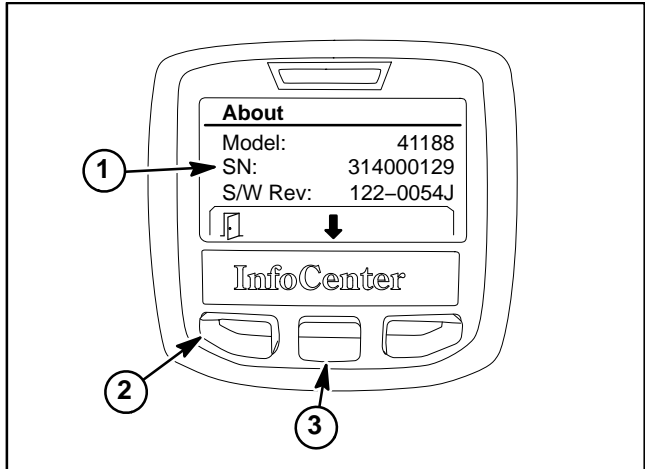



Figure 21

1. About items
2. Left/back button
3. Center/down button

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Troubleshooting

 CAUTION
Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Also, 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 and wire harness drawings in Chapter 10 – Electrical Drawings).

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

NOTE: .Check the InfoCenter Display for possible operator advisories or faults whenever diagnosing machine electrical problems.

Operator Advisory Screen

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (Fig. 22). Each advisory screen has three elements: the advisory number/code, the advisory description, and the advisory qualifier.

An advisory qualifier denotes the condition(s) that triggered the advisory and provides instruction on eliminating the advisory. An operator advisory may involve one or more advisory qualifier. Typically, an advisory can be eliminated by changing the position of the operator control(s) referenced by the advisory qualifier. Once the first qualifier displayed is satisfied, any additional qualifiers that remain to be satisfied will appear in the operator advisory screen individually.

NOTE: If a machine fault occurs during machine operation, the InfoCenter fault indicator will blink to notify the operator (see Faults Screen in this chapter).

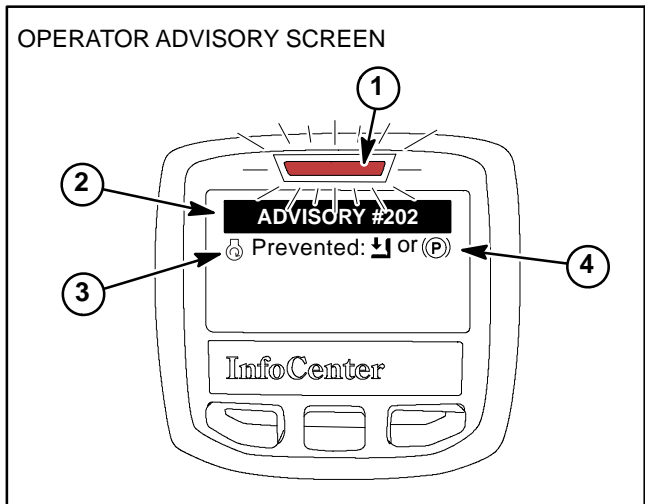


Figure 22

- | | |
|-------------------------|-------------------------|
| 1. Fault indicator | 3. Advisory description |
| 2. Advisory number/code | 4. Advisory qualifier |

Operator Advisories

The list below identifies the operator advisories that are generated by the Toro Electronic Controller (TEC). An advisory will be displayed on the InfoCenter Display. Typically, an advisory can be eliminated with a change in machine controls by the operator.

Advisory	Advisory Description
200	Start Prevented – Pump switch active
201	Start Prevented – Not in neutral
202	Start Prevented – User not in seat
203	Start Prevented – Throttle pedal is not home
204	Start Prevented – Starter engage timeout
205	Parking brake is engaged
206	Pump start prevented – boom active
207	Pump start prevented – engine rpm high
208	Throttle/Speed lock prevented – Pump is not active
209	Throttle lock prevented – parking brake is not engaged
210	Speed lock prevented – Operator not in seat or parking brake is engaged
211	Throttle/Speed lock prevented – Clutch or service brake is engaged
212	Tank low volume alert
213	Rinse pump ON
220	Flow sensor calibration
221	Flow sensor calibration – Fill water in tank and enter volume filled
222	Flow sensor calibration – Turn on the pump
223	Flow sensor calibration – Turn on all the booms
224	Flow sensor calibration – Calibration commenced
225	Flow sensor calibration – Calibration complete
226	Flow sensor calibration – Exiting calibration mode
231	Speed sensor calibration
232	Speed sensor calibration – Fill the fresh water tank, press next
233	Speed sensor calibration – Fill the sprayer half full with water, press next
234	Speed sensor calibration – Enter the calibration distance, press next
235	Speed sensor calibration – Mark and drive the entered distance with booms off
236	Speed sensor calibration – Speed sensor calibration in progress
237	Speed sensor calibration – Speed sensor calibration complete
238	Speed sensor calibration – Turn off the booms
241	Calibrator out of bounds, using default

Using the InfoCenter Display for Troubleshooting

The diagnostics screen of the InfoCenter display can be very helpful when troubleshooting machine operation issues (see Diagnostics Screen in this chapter). The diagnostics screen (Fig. 23) lists a variety of machine operations and the current state of the inputs, the qualifiers and the outputs required to allow the operation to proceed. The electrical components involved in the following machine operations can be evaluated using the diagnostics screen prior to testing each component individually:

Pumps The components necessary to operate the spray pump and the optional rinse pump.

Booms The components necessary to operate the master boom spray valve.

Engine The components necessary to start and run the engine.

Throttle Lock The components necessary to engage the throttle lock/speed lock.

If a machine operation is malfunctioning, the following procedure can help identify the cause of the component or circuit wiring causing the malfunction.

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

2. Set the ignition switch to the ON position and navigate to the InfoCenter Diagnostic Screen.

3. Select (highlight) the malfunctioning machine operation and press the Right/forward button (as indicated by the ➡ at the bottom of the screen). For this example, the Pumps operation has been selected (Fig. 24).

4. Select (highlight) Inputs and press the Right/forward button (as indicated by the ➡ at the bottom of the screen).

5. Manually operate each input item listed (Fig. 25). The input condition on the InfoCenter display should alternate ON and OFF as the input is switched open and closed. If ON and OFF do not alternate during input operation, the input component or its circuit wiring is faulty and should be tested (see Component Testing in this chapter).

In the Pumps operation example, the only input is the Spray Pump Switch (unless the machine has an optional rinse pump kit). If ON and OFF do not alternate when the switch is toggled ON and OFF, the switch or the circuit wiring for the switch is faulty and should be tested as described.

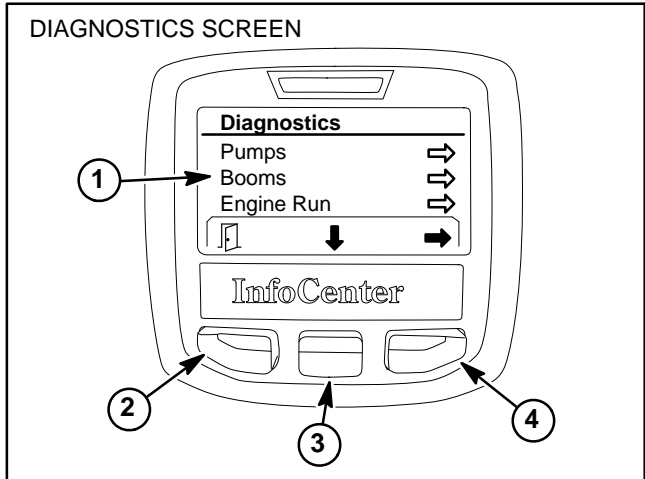


Figure 23

- | | |
|----------------------|-------------------------|
| 1. Diagnostics items | 3. Center/down button |
| 2. Left/back button | 4. Right/forward button |

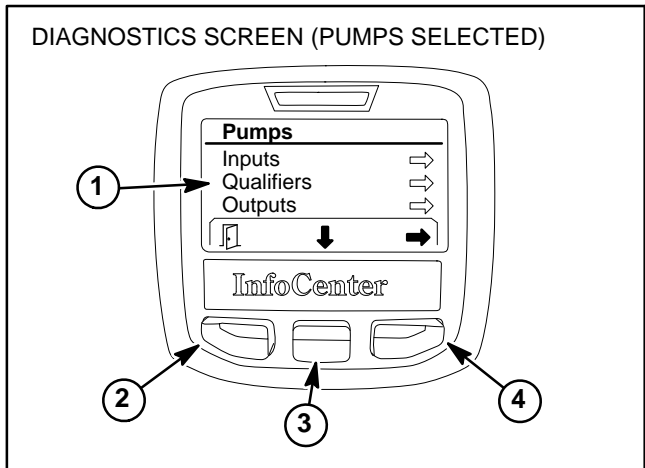


Figure 24

- | | |
|----------------------|-------------------------|
| 1. Diagnostics items | 3. Center/back button |
| 2. Left/back button | 4. Right/forward button |

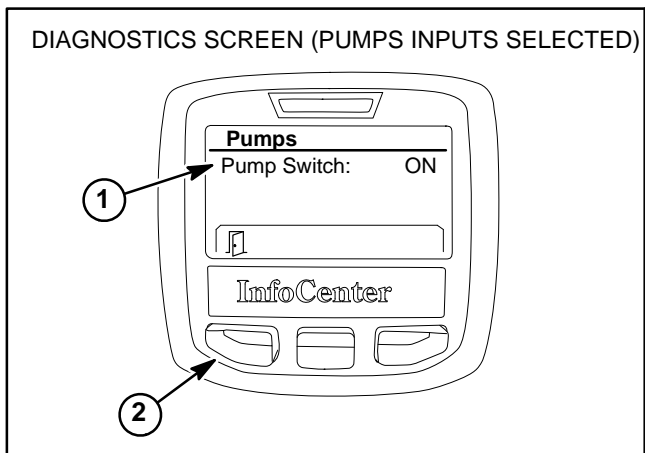




Figure 25

- | | |
|----------------|---------------------|
| 1. Input items | 2. Left/back button |
|----------------|---------------------|

6. Press the Left/back button (as indicated by the  at the bottom of the screen). Select (highlight) Qualifiers and press the Left/forward button (as indicated by the  at the bottom of the screen).



NOTE: All of the qualifiers for the machine operation must be in the desired condition () before the operation Outputs can be energized.

7. Manually operate each qualifier listed (Fig. 26). The qualifier condition on the InfoCenter display should alternate and as the qualifiers condition is changed. If and do not alternate during qualifier operation, the qualifier component or its circuit wiring is faulty and should be tested (see Component Testing in this chapter).


CAUTION

It may be necessary to start and run the engine or otherwise operate the machine during the troubleshooting process. Make sure the machine is in a well ventilated area and keep away from moving parts while troubleshooting to prevent personal injury.

In the Pumps operation example, the only qualifier that must be in the desired condition () before the operation Outputs can be energized is the Throttle Home Switch. An additional Timer qualifier appears when an optional rinse pump kit is installed. If and do not alternate when the qualifier condition is changed, the qualifier or the circuit wiring for the qualifier is faulty and should be tested as described.

8. Press the Left/back button (as indicated by the  at the bottom of the screen. Select (highlight) Outputs and press the Right/forward button (as indicated by the  at the bottom of the screen).

9. If all the Inputs are ON and all the Qualifiers are in their desired condition () the Outputs for the machine operation should be ON. If the outputs remain OFF, the Toro Electronic Controller (TEC) output fuses, the TEC, or the TEC software may be damaged and require reloading or replacement. Contact your Toro Distributor for assistance.

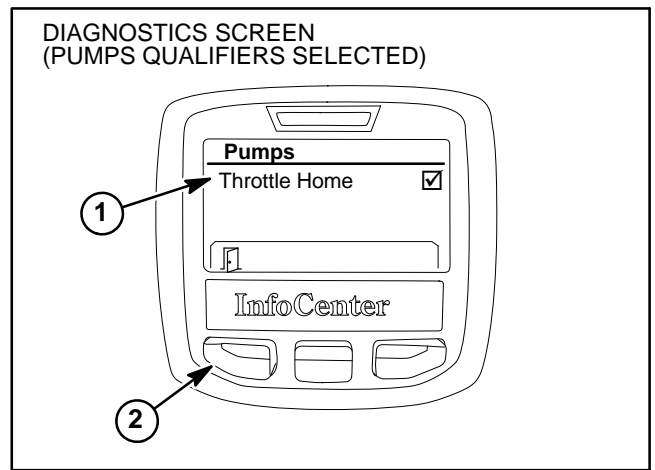


Figure 26

1. Qualifier items 2. Left/back button

10. If the outputs listed on the InfoCenter Display are ON, and the operation is still malfunctioning:

- Test the specific output and output wiring (see Component Testing in this chapter).
- Hydraulic components related to the operation (if applicable) should be tested (see Chapter 5 – Hydraulic System in this manual).

In the Pumps operation example, the output is the spray pump electric clutch. If ON appears next to the spray pump output on the InfoCenter Display and the spray pump fails to engage:

- Make sure the spray pump is free to rotate.
- Test the spray pump clutch (see Pump Drive Electric Clutch in the Testing section of this chapter).

An additional Rinse Pump output appears when an optional rinse pump kit is installed. The rinse pump output is the rinse pump relay. If ON appears next to the rinse pump output on the InfoCenter Display and the rinse pump fails to engage:

- Test the 30A rinse pump fuse.
- Make sure the rinse pump is free to rotate.
- Test the rinse pump motor.
- Test the rinse pump relay (see Relays with 5 Terminals in the Testing section of this chapter).

Fault Codes

The list below identifies the fault codes that are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurred during machine operation. Use the InfoCenter Display for fault retrieval.

NOTE: The following list of fault codes identifies electrical problems that typically will prevent normal machine operation. The InfoCenter Display will identify existing faults if they should occur. For input problems, use the InfoCenter Display to check the different switch positions before removing or replacing the component.

Fault Code	Fault Description
1	TEC is faulty
2	One or more of the TEC output fuses (7.5 Amp) is faulty
3	Main power relay or circuit wiring is faulty
4	Charging system or circuit wiring is faulty
5	Start relay or circuit wiring is faulty
6	Kill relay circuit is faulty
7	Spray pump clutch or circuit wiring is faulty
8	Spray pump indicator light or circuit wiring is faulty
9	Throttle lock or circuit wiring is faulty
10	Throttle lock indicator light or circuit wiring is faulty
11	Master boom valve actuator or circuit wiring is faulty
12	Rinse pump relay, optional rinse pump or circuit wiring is faulty
13	Brake hold solenoid or circuit wiring is faulty
14	InfoCenter software is not recognized by TEC
15	Brake pressure switch or circuit wiring is faulty (circuit is closed even though the brake pedal has been released)
16	Service brake or throttle home sensor, or circuit wiring, is faulty (circuit is open even though the brake or accelerator pedal has been released)
17	Starter timeout (starter has been engaged for more than 30 seconds)

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Starting Problems

Problem	Possible Causes
<p>No electrical power to machine.</p>	<p>The battery is discharged.</p> <p>The battery cables are loose or corroded.</p> <p>Fusible link at starter motor is faulty.</p> <p>Fuse(s) is (are) faulty.</p> <p>A faulty ground connection exists on machine.</p> <p>The ignition switch or circuit wiring is faulty.</p> <p>Main power relay or circuit wiring is faulty.</p>
<p>Nothing happens when start attempt is made. InfoCenter display operates with the ignition switch in the RUN position.</p> <p>NOTE: Use InfoCenter Display to assist with identifying problem.</p>	<p>Range selector is not in the neutral position (Advisory will be displayed on InfoCenter Display).</p> <p>Operator seat is not occupied and parking brake is not engaged (Advisory will be displayed on InfoCenter Display).</p> <p>Accelerator pedal is not released to the HOME position (Advisory will be displayed on InfoCenter Display).</p> <p>Spray pump switch is ON (Advisory will be displayed on InfoCenter Display).</p> <p>Battery cables are loose or corroded.</p> <p>Battery ground cable to frame is loose or corroded.</p> <p>Battery is discharged or faulty.</p> <p>Fuse is faulty.</p> <p>Start relay or circuit wiring is faulty.</p> <p>Wiring to start circuit components is loose, corroded or damaged (see Chapter 10 – Electrical Drawings).</p> <p>Neutral switch or circuit wiring is faulty.</p> <p>Ignition switch or circuit wiring is faulty.</p> <p>Fuse block is faulty.</p> <p>Engine starter solenoid is faulty.</p>

Starting Problems (continued)

Problem	Possible Causes
Engine starter solenoid clicks, but starter motor will not crank (if solenoid clicks, problem is not in safety interlock system).	<p>Battery is discharged.</p> <p>Battery cables are loose or corroded.</p> <p>Battery ground to frame is loose or corroded.</p> <p>Wiring at engine starter motor is faulty.</p> <p>Engine starter solenoid is faulty.</p> <p>Engine starter mounting bolts are loose or not supplying a sufficient ground for solenoid.</p> <p>Engine starter motor is faulty.</p>
Engine cranks, but does not start.	<p>Fuel tank is empty.</p> <p>Ignition switch is faulty.</p> <p>Kill relay or circuit wiring is faulty.</p> <p>Circuit wiring to engine magneto system is grounded (see Chapter 10 – Electrical Drawings).</p> <p>Circuit wiring to carburetor solenoid is loose, corroded or damaged (see Chapter 10 – Electrical Drawings).</p> <p>Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Gasoline Engine).</p> <p>Engine may be too cold.</p>
Engine cranks (but should not) with the range selector out of the neutral position.	Neutral switch or circuit wiring is faulty.

General Run Problems

Problem	Possible Causes
Battery does not charge.	<p>Wiring to the charging circuit components is loose, corroded or damaged (see Chapter 10 – Electrical Drawings).</p> <p>Alternator components are faulty.</p> <p>Battery is faulty.</p>
Engine stops during machine operation.	<p>Ignition switch is faulty.</p> <p>Circuit wiring to engine magneto system is damaged (see Chapter 10 – Electrical Drawings).</p> <p>Circuit wiring to carburetor solenoid is loose, corroded or damaged (see Chapter 10 – Electrical Drawings).</p> <p>Engine or fuel system is malfunctioning (see Chapter 3 – Kohler Gasoline Engine).</p>

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 60° to 100° F (16° to 38° 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.

Tool required: Digital multimeter set to DC volts.

Test instructions: 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 (3350 to 3450 RPM). Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

Test results should be **at least 0.50 volt over initial battery voltage**. Example:

Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.95 v
Difference	= +0.65 v

NOTE: Typical battery voltage while the engine is running during this test should be 13.5 to 14.5 volts.

Check Operation of Interlock System



CAUTION

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

Interlock switch operation is described in the machine Operator's Manual. Your machine is equipped with an Toro Electronic Controller (TEC) which monitors interlock switch (input) operation. If one or more inputs are


not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (see Operator Advisory Screen and Operator Advisories in this chapter). Testing of individual interlock switches is included in the Component Testing section of this Chapter.

NOTE: Use the InfoCenter Display (see InfoCenter Display in this chapter) to test Toro Electronic Controller inputs and outputs before further troubleshooting of an electrical problem on your machine.

To start the engine that powers the Multi Pro 1750, the operator seat must be occupied or the parking brake engaged, the range selector must be in the neutral position, the accelerator pedal must be released to the HOME position and the spray pump switch must be OFF. Neutral switch operation is described in the Multi Pro 1750 Operator's Manual. Testing of this 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. unplug the ignition switch connector before doing a continuity check on the ignition switch).

	CAUTION
When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.	

Fusible Link Harness

The Multi Pro 1750 uses a fusible link for circuit protection. This fusible link connects the main wire harness to the starter B+ terminal and positive battery cable. If the link should fail, current to the machine will cease. Refer to electrical schematic and wire harness drawings in Chapter 10 – Electrical Drawings for additional fusible link information.

Testing

Make sure that ignition switch is OFF and disconnect the negative battery cable from the battery terminal. Then disconnect the positive cable from battery (see Battery Service in this chapter). Locate and unplug fusible link connector from machine wire harness. Use a multimeter to make sure that continuity exists between the disconnected fusible link connector and the link terminal at the starter motor (Fig. 27). If the fusible link is open (no continuity), replace the fusible link harness.

After testing is complete, make sure that fusible link harness connectors are securely attached to starter and machine wire harness. Connect positive battery cable to battery terminal first and then connect negative cable to battery.

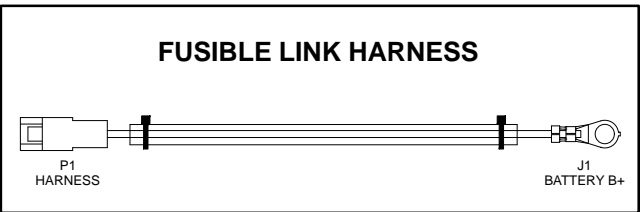


Figure 27

Fuses

The fuse blocks are located under the operator seat next to the battery.

Fuse Identification and Function

Use the fuse decal (Fig. 28) and fuse block shown in Figure 29 to identify each individual fuse and its correct amperage. The fuses have the following functions:

Left column, top fuse (10 amp) protects ignition switch circuits.

Left column, 2nd from top fuse (15 amp) protects spray system power circuits.

Left column, 3rd from top fuse (15 amp) is available for optional foam marker kit.

Left column, bottom fuse (15 amp) protects headlight circuit, InfoCenter power circuit and ground speed sensor circuit.

Middle column, top fuse (7.5 amp) protects TEC output power supply for engine start relay, engine kill relay, engine carburetor solenoid, spray pump electric clutch and spray pump running indicator light. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

Middle column, 2nd from top fuse (7.5 amp) protects TEC output power supply for throttle lock coil, throttle lock indicator light, master spray boom power and optional tank clean rinse kit pump relay. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

Middle column, 3rd from top fuse (7.5 amp) protects TEC output power supply for brake lock and optional brake light. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

Middle column, bottom fuse (2 amp) protects logic power circuit to the TEC.

Right column, top fuse (30 amp) is available for optional tank clean rinse kit.

In-line Fuses (machine serial number 314000001 to 314000999) (5 amp) protect the master spray valve, agitation valve, right spray valve, center spray valve, left spray valve, and rate valve. The fuses are located in the wire harness near each valve actuator wire harness connector.

Testing

Raise and support operator seat to access fuse blocks. Turn ignition switch to the ON position (do not start engine). With the fuse installed in the fuse block, use a multimeter to verify that 12 VDC exists at both of the terminal test points on the fuse. If 12 VDC exists at one of the fuse test points but not at the other, the fuse is faulty.

If necessary, make sure that ignition switch is OFF and key is removed from switch. Remove fuse from fuse block and check that fuse has continuity across the fuse terminals.

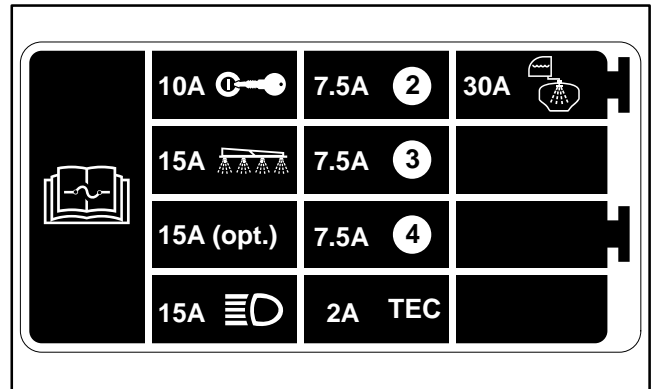


Figure 28

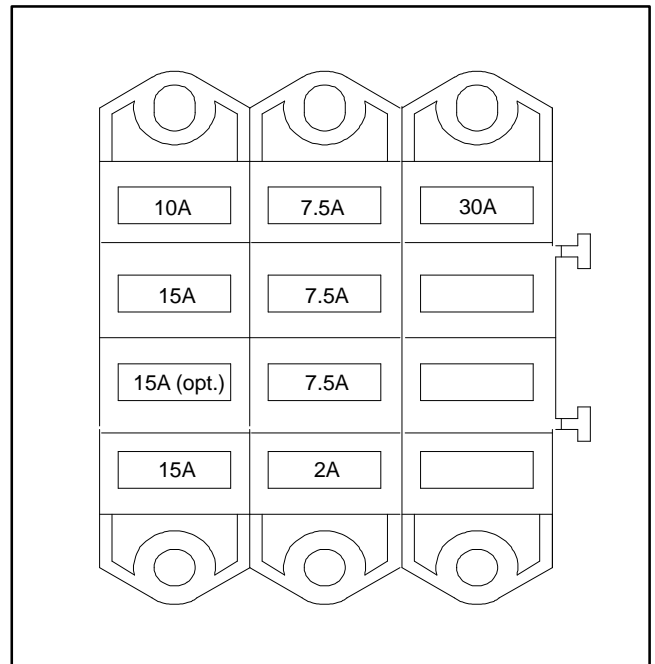


Figure 29

Toro Electronic Controller (TEC)

Multi Pro 1750 machines use a Toro Electronic Controller (TEC-5001) to control electrical system operation. The TEC is a microcontroller that monitors the condition of various switches and sensors (inputs). The controller then directs electrical power to control appropriate machine functions (outputs) based on the state of one or more inputs. The controller is attached to a bracket under the control console (Fig. 30).

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-5001 monitors the states of the following components as inputs: ignition switch, boom switches (master, left, right and center spray), clutch switch, spray pump switch, neutral switch, service brake switch, seat switch, parking brake switch, throttle home switch, transaxle speed sensor, spray system flow meter, brake pressure switch and optional rinse circuit switch (if equipped).

The TEC-5001 controls electrical output to the engine start relay, engine kill relay, engine carburetor solenoid, spray pump clutch, spray pump running indicator light, throttle lock coil, throttle lock indicator light, master boom valve and brake lock system. Outputs from the TEC are also used for the rinse pump relay and brake light (if equipped). Circuit protection for TEC outputs is provided by three (3) 7.5 amp fuses.

The InfoCenter display should be used to check inputs and outputs of the TEC. Information on using the InfoCenter is included in the InfoCenter Display section of this chapter.

The connection terminal functions for the TEC are shown (Fig. 31). Note that electrical power for controller outputs is provided through three (3) connector terminals (PWR 2, PWR 3 and PWR 4) each protected with a 7.5 amp fuse. A fifty (50) pin wire harness connector attaches to the controller. The layout of the wire harness connector that plugs into the TEC is shown (Fig. 32).

IMPORTANT: When testing for wire harness continuity at the connector for the TEC, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair will be necessary for proper machine operation.

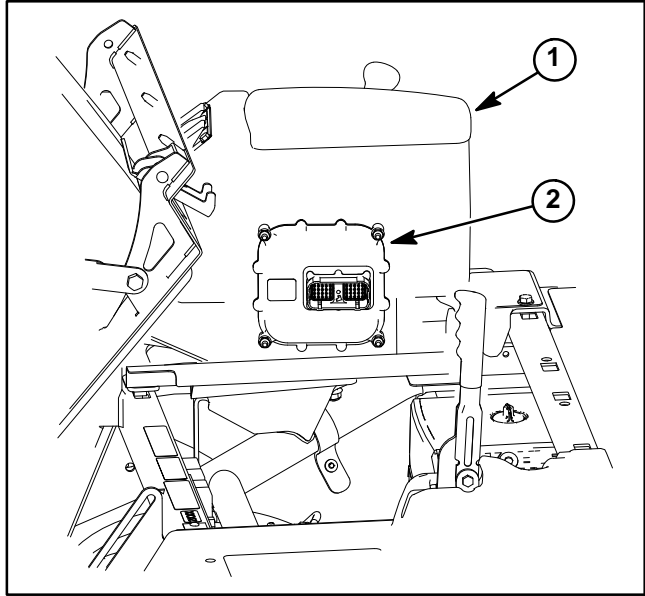


Figure 30

- 1. Control console
- 2. Toro Electronic Controller (TEC)

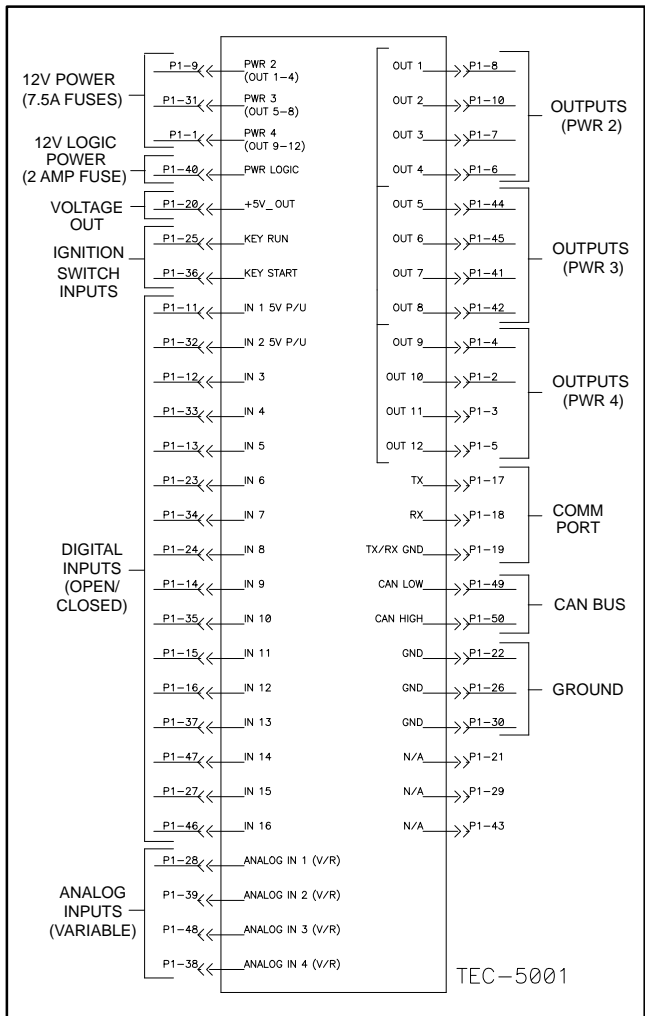


Figure 31

The machine electrical schematic and wire harness drawings in Chapter 10 – Electrical Drawings can be used to identify possible circuit problems between the controller and the input/output devices (e.g. switches and solenoid coils).

Because of the solid state circuitry built into the TEC, there is no method to test the controller directly. The controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

NOTE: The TEC and the InfoCenter used on the Multi Pro 1750 are matched for correct machine operation. If either of these components are replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

IMPORTANT: Before performing welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC and disconnect the terminal connector from the engine alternator. These steps will prevent damage to the machine electrical system when welding.

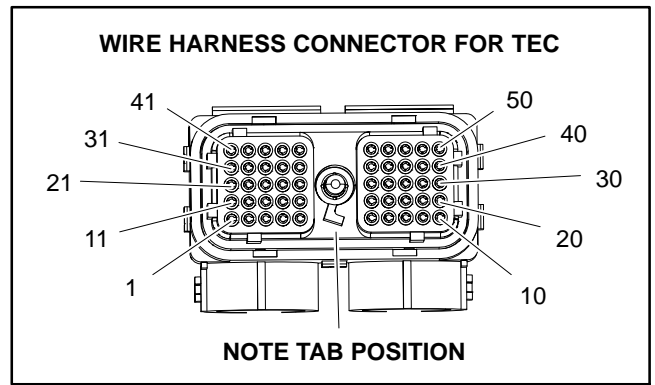


Figure 32

Ignition Switch

The ignition (key) switch is located on the control console and has three (3) positions: STOP, RUN and START (Fig. 33). The ignition switch is an input for the Toro Electronic Controller (TEC).

Testing

The ignition switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing verifies that the ignition switch and circuit wiring are functioning correctly, proceed to step 5. If, however, testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate ignition switch on console and unplug machine wire harness connector from switch.
3. The ignition switch terminals are identified as shown in Figure 33. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.
4. Replace switch if testing identifies that switch is faulty.
5. If ignition switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 – Foldout Drawings).
6. After testing is completed, connect the wire harness connector to the ignition switch.
7. After testing is complete, connect machine wire harness connector to ignition switch. Install console panel to machine.

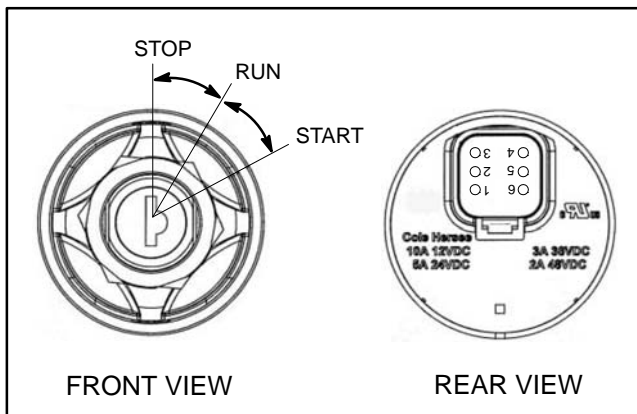


Figure 33

SWITCH POSITION	CIRCUITS
STOP	1 + 6
RUN	1 + 3 + 4 + 5 + 6
START	1 + 2 + 4 + 5 + 6

Figure 34

NOTE: Ignition switch terminals 1 and 6 are connected internally. Terminals 4 and 5 are also connected internally. These terminals should have continuity regardless of switch position.

Operator Seat Switch

The seat switch is normally open and closes when the operator seat is occupied. If the parking brake is not engaged when the operator raises out of the seat, the engine will stop. The seat switch is located directly under the operator seat. The Toro Electronic Controller (TEC) monitors the operation of the seat switch (input).

Testing

The seat switch and its circuit wiring can be tested as a TEC qualifier using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Raise and support operator seat to access seat switch.
3. Disconnect wire harness electrical connector from the seat switch under the operator seat (Fig. 35).
4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.
5. With no pressure on the seat, there should be no continuity (infinite ohms resistance) between the seat switch terminals.
6. Press directly onto the seat switch through the seat cushion. There should be continuity (zero ohms resistance) between the seat switch terminals as the seat cushion approaches the bottom of its travel.
7. If testing determines that seat switch is faulty, replace switch.
8. If the seat switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
9. After seat switch testing is completed, connect wire harness electrical connector to the seat switch. Lower and secure seat.

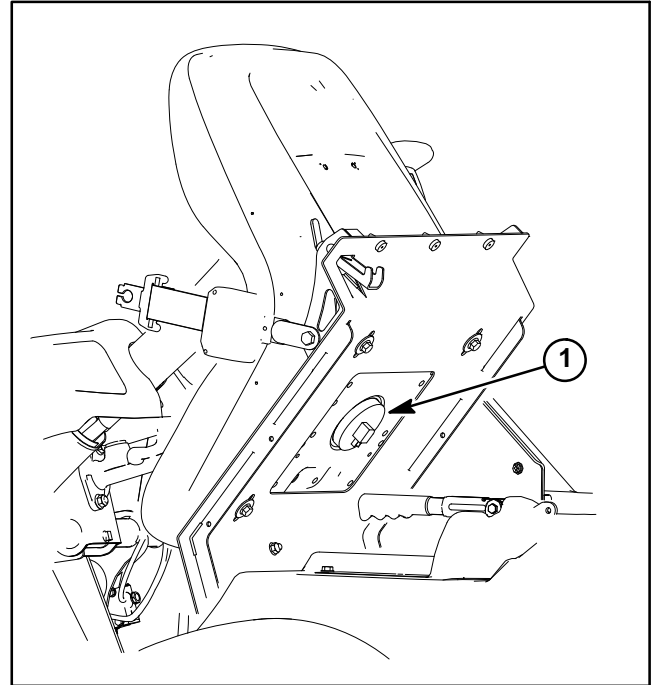


Figure 35

1. Seat switch

Parking Brake Switch

The parking brake switch is a normally open proximity switch attached to the parking brake bracket (Fig. 36). The switch is in its normal open position as long as the parking brake lever is released (disengaged). When the parking brake lever is raised (parking brake engaged), the lever is positioned close to the proximity switch causing the switch to close.

The Toro Electronic Controller (TEC) monitors the operation of the parking brake switch (input). The parking brake switch is used in the engine start and engine run interlock system to make sure that either the parking brake is engaged or the operator is in the seat while the engine is being started or running. The parking brake switch is also involved in the throttle lock feature.

Testing

The parking brake switch and its circuit wiring can be tested as a TEC qualifier using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Raise and support operator seat to access parking brake switch connector.
3. Disconnect the wire harness from the parking brake switch connector. Use a multimeter (ohms setting) to test continuity across the switch terminals. There should be continuity (zero ohms) when the parking brake lever is raised (brake engaged) and there should not be continuity (infinite ohms) when the parking brake lever is released (brake disengaged).

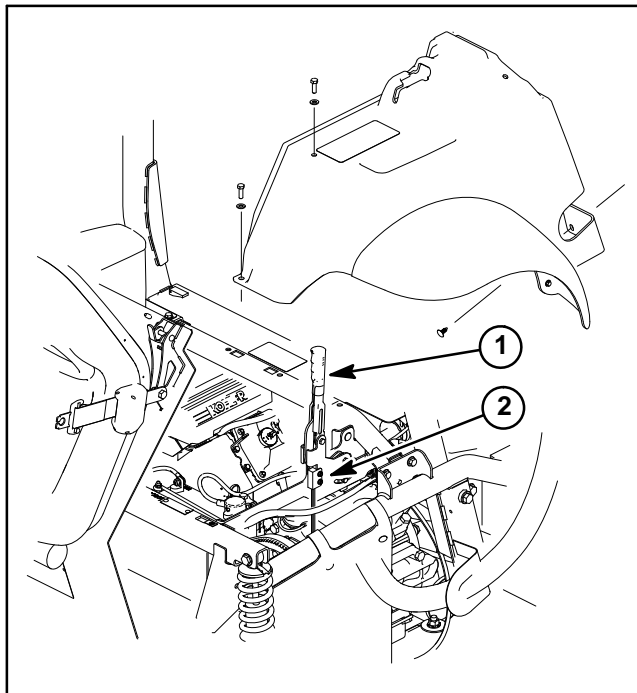


Figure 36

1. Parking brake lever 2. Parking brake switch

4. Replace the parking brake switch if switch proves faulty. To replace the parking brake switch:
 - A. Remove the three (3) hex head screws and flat washers and two (2) panel fasteners securing the left seat base and fender assemble to the machine.
 - B. Lift the left seat base and fender assembly from the machine.
 - C. Remove the two (2) switch mounting screws and replace the switch.
 - D. Reinstall the left seat base and fender assembly.
5. If the parking brake switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After switch testing is completed, connect the wire harness to the switch connector. Lower and secure seat.

Clutch, Throttle Home and Service Brake Switches

The switches used for the clutch, throttle home and service brake are the same, normally open switch. These switches are attached to the platform frame (Fig. 37). When the clutch, throttle home, or service brake pedal is depressed, the switch plunger is extended so the switch is open. The switch closes when the pedal is released.

The Toro Electronic Controller (TEC) monitors the operation of these three (3) switches (inputs).

The clutch switch is used in the engine run interlock system to make sure that the clutch pedal is fully depressed (disengaged) if the neutral switch is out of neutral and the parking brake is engaged, preventing the Operator from driving the machine with the parking brake engaged. The clutch switch position is also used in the throttle lock, speed lock, and hill assist systems.

The throttle home switch is used in the engine start interlock system to make sure that the throttle pedal is fully released (at low idle) while the engine is being started.

The service brake switch position is used in the throttle lock, speed lock, and hill assist systems. The service brake switch is also used to activate the optional brake light.

Testing

The clutch and throttle home switch and their circuit wiring can be tested as TEC qualifiers using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and its circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate switch that is to be tested and disconnect the wire harness connector from the switch.

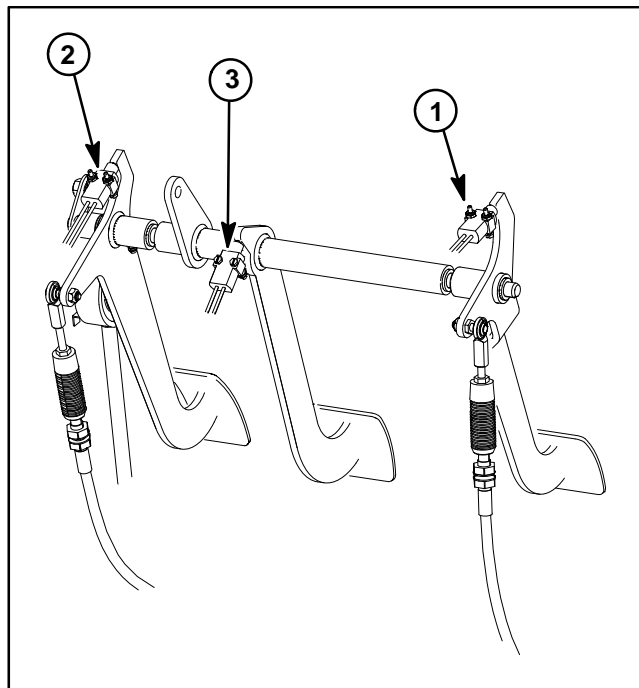


Figure 37

1. Clutch switch
2. Throttle home switch
3. Service brake switch

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. When the switch plunger is extended there should not be continuity (infinite ohms resistance) between the switch terminals.

5. When the switch plunger is depressed, there should be continuity (zero ohms resistance) between the switch terminals.

6. Replace switch if testing determines that it is faulty.

7. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

8. After testing is completed, reconnect wire harness connector to switch.

9. Make sure the pedal contacts the switch and comes to rest against the hard pedal stop when released.

Neutral Switch

The neutral switch is a normally open switch that is closed when the transmission is in the neutral position. The neutral switch is attached to the front of the transmission (Fig. 38).

The Toro Electronic Controller (TEC) monitors the operation of the neutral switch (input).

The neutral switch is used in the engine start interlock system to make sure that the transmission is in neutral before starting the engine.

The neutral switch is used in the engine run interlock system to make sure that the transmission is in neutral if the clutch pedal is fully released (engaged) and the parking brake is engaged, preventing the Operator from driving the machine with the parking brake engaged.

The neutral switch position is used in the throttle lock and speed lock systems.

Testing

The neutral switch and its circuit wiring can be tested as a TEC input or qualifier using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate neutral switch on the front of the transmission. Disconnect the wire harness connector from the switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.
4. With the range selector in the neutral position, the neutral switch should be closed (zero ohms resistance).

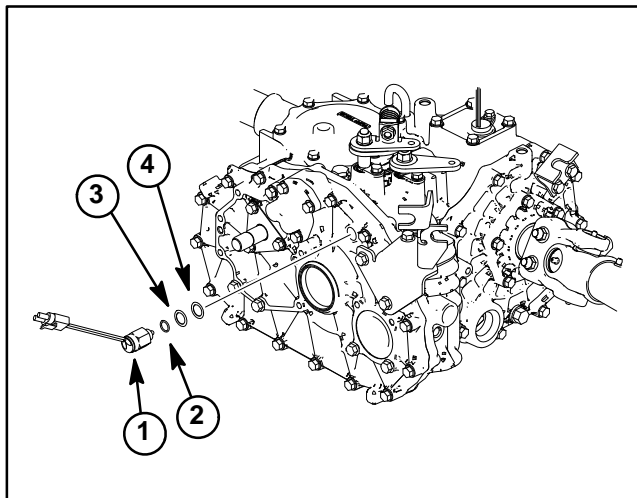


Figure 38

- | | |
|-------------------|---------------------------|
| 1. Neutral switch | 3. Shim (0.012" / 0.3 mm) |
| 2. O-ring | 4. Shim (0.008" / 0.2 mm) |

5. While watching the multimeter, move the range selector out of the neutral position. Continuity of the neutral switch should be broken as the selector is moved out of neutral and the neutral switch opens (infinite ohms resistance).

6. If testing determines that the neutral switch is faulty, replace neutral switch.

7. If the neutral switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

8. When testing is complete, connect the wire harness connector to the neutral switch.

Adjustment (Fig. 38)

Two (2) shim thicknesses are available that allow the neutral switch to be adjusted if necessary (items 4 and 5). Install shims between the switch body and O-ring as needed until neutral switch operation is correct as described in Testing above.

Traction Speed Sensor

The traction speed sensor is attached to the upper transaxle cover (Fig. 39). It uses a magnetically based, Hall Effect integrated circuit. As the differential ring gear in the transaxle turns, the sensor accurately senses the movement of the gear teeth passing by the sensor.

The Toro Electronic Controller (TEC) monitors the operation of the speed sensor (input). Information from the speed sensor is used by the speed lock system and for product application calculations. The speed sensor must be calibrated for accurate speed calculations (see Machine Operator's Manual).

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate traction speed sensor on the transaxle assembly. Disconnect the wire harness connector from the traction speed sensor.
3. Remove cap screw and lock washer securing sensor to transaxle. Remove speed sensor from transaxle.
4. Connect positive multimeter test lead to the sensor connector gray striped wire terminal and the negative multimeter lead to the connector black wire terminal (Fig. 40). Set multimeter to ohms setting.

IMPORTANT: Incorrect jumper wire connections during testing can damage the sensor.

5. Using a +12 VDC battery, a multimeter, a 1K ohm resistor and appropriate jumper wires, connect the battery and multimeter to the speed sensor (Fig. 40).
6. Set multimeter to DC volts setting. 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. Replace speed sensor if necessary.
7. After testing is complete, install speed sensor into transaxle and secure with cap screw and lock washer. Connect speed sensor to wire harness.
8. If the speed sensor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

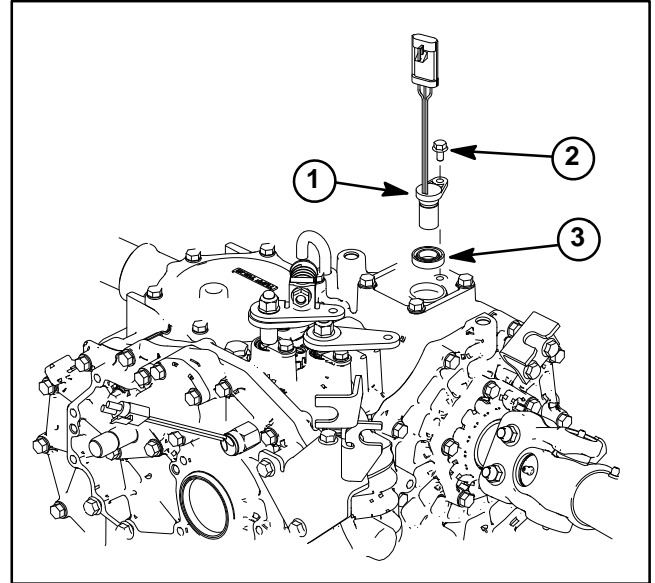


Figure 39

1. Speed sensor
2. Flange head screw
3. Seal

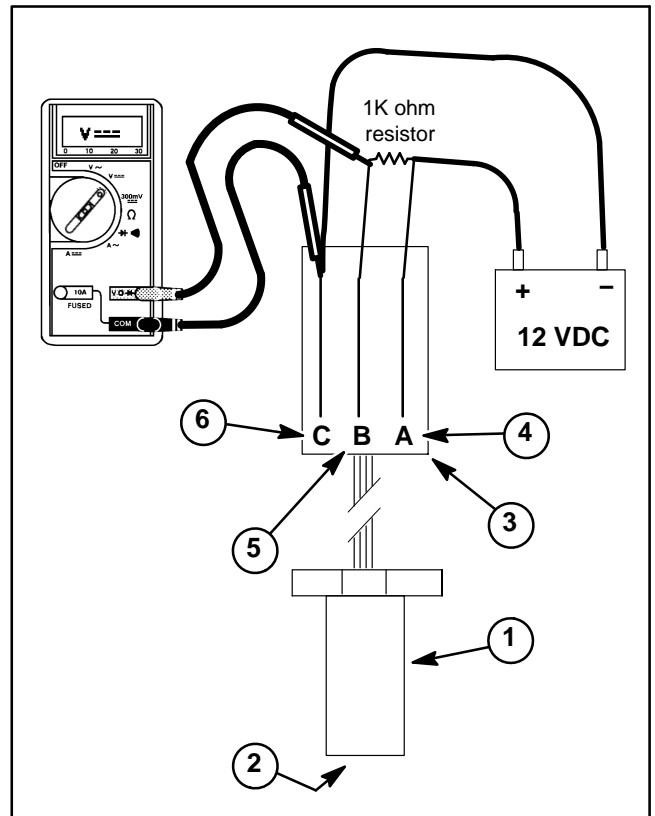


Figure 40

1. Speed sensor
2. Sensor tip
3. Sensor connector
4. Red striped wire (+)
5. Gray striped wire (signal)
6. Black wire (-)

Traction Speed Sensor

The traction speed sensor is attached to the upper transaxle cover (Fig. 41). The sensor uses a magnetically based, Hall Effect integrated circuit. As the differential ring gear in the transaxle turns, the sensor accurately senses the movement of the gear teeth passing by the sensor. The sensor white connector wire (pin A) is the positive lead, the black wire (pin C) is the ground lead and the blue wire (pin B) is the signal output.

The Toro Electronic Controller (TEC) monitors the operation of the speed sensor (input). Information from the speed sensor is used by the speed lock system and for product application calculations. The speed sensor must be calibrated for accurate speed calculations (see Machine Operator's Manual).

Testing

1. Park machine on a level surface, stop engine and engage parking brake.
2. Disconnect machine wire harness from speed sensor.
3. Test the machine wire harness to the speed sensor:
 - A. Set the ignition switch to the RUN/PREHEAT position.
 - B. Connect a jumper wire across the ground (-) pin C and the signal (+) pin B (Fig. 42A). Have an assistant watch the InfoCenter Display as you open and close the connection across the pins multiple times. Vehicle speed readings other than 00.0 should appear on the InfoCenter Display.
 - C. Remove the jumper wire.
 - D. Use a multimeter set to DC voltage and check for 12 VDC across the supply (+) pin A and ground (-) pin C of the machine wire harness (Fig. 42B).
 - E. Turn the ignition switch to OFF.
4. Test the speed sensor:

A sensor test harness is required to quickly check sensor operation without removing the sensor from the wheel motor.

NOTE: Instructions for fabricating and using a traction sensor test harness can be found in the Special Tools section of this chapter or contact your Authorized Toro Distributor for assistance.

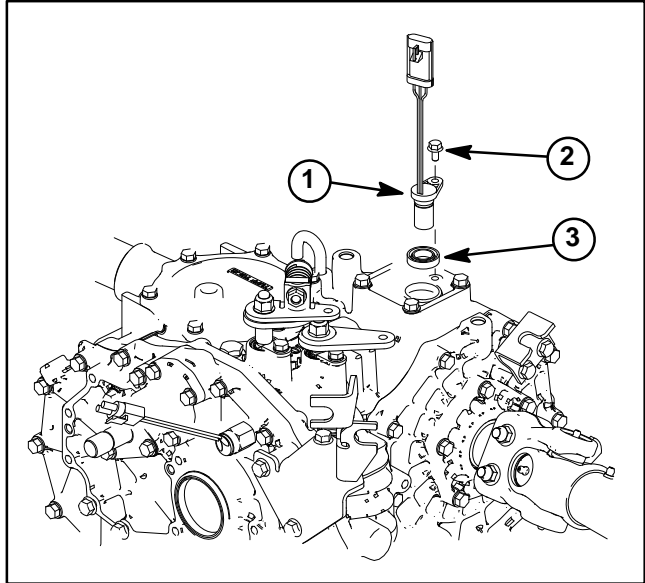


Figure 41

1. Speed sensor
2. Flange head screw
3. Seal

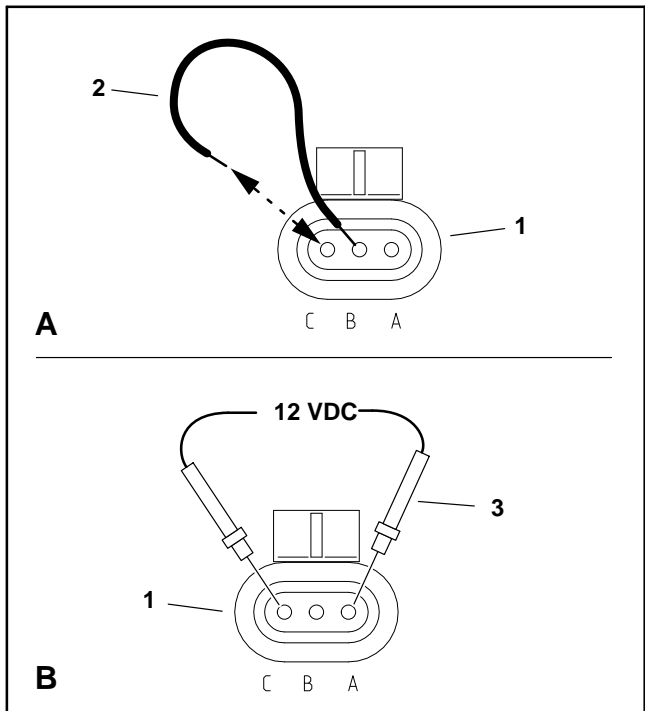


Figure 42

1. Machine wire harness connector
2. Jumper wire
3. Multimeter probe (typ.)

Master Boom (Spray Enable) Switch

The master boom switch is a momentary push button switch used to turn the master boom valve ON and OFF. The master boom switch is located on the side of the control console (Fig. 43).

With the ignition switch in the RUN or START position, a continuous supply of voltage is applied to terminal 1 or A (+) and 2 or B (-) of the master boom valve actuator, closing the master boom valve. The Toro Electronic Controller (TEC) monitors the operation of the master boom switch (input). When the master boom switch is depressed, a momentary ground is created, and if system conditions are met, the TEC energizes the master boom valve output. The output applies voltage to terminal 3 or C (open) of the master boom valve actuator, opening the master boom valve. An icon will appear on the InfoCenter Display when the master boom valve is open (enabled).

NOTE: The master boom (spray enable) switch must be disengaged or the master boom switch engaged but none of the boom spray switches engaged to energize the spray pump clutch.

Testing

The master boom (spray enable switch) and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate master boom switch and unplug wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the master boom switch functions may be tested to determine whether continuity exists across the terminals for each switch position. Continuity (zero ohms resistance) should exist across the switch terminals when the switch is depressed. There should not be continuity (infinite ohms resistance) across the switch terminals when the switch is not depressed.

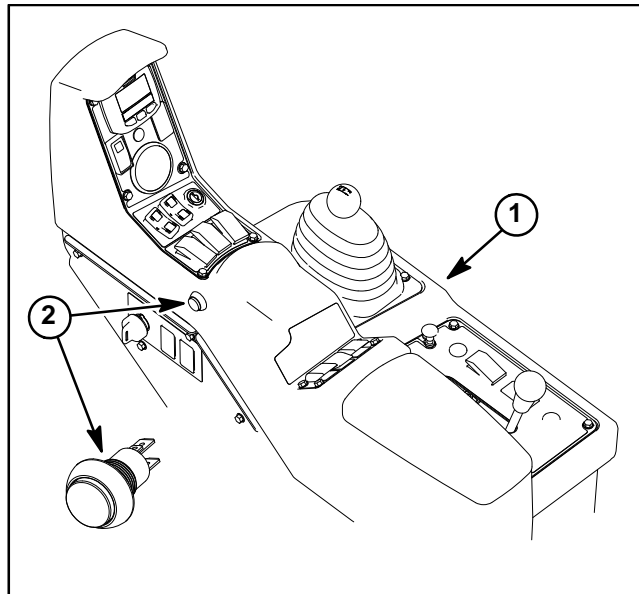


Figure 43

1. Control console
2. Master boom (spray enable) switch

4. Replace master boom switch if testing determines that it is faulty.
5. If the master boom switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. Connect the wire harness connector to the master boom switch after testing. Secure console panel to machine.

Boom Spray Switches (Serial Number Below 31500000)

Three (3) identical boom spray switches are used on the Multi Pro 1750 to turn the spray valve for the individual boom sections ON or OFF. The boom switches are located on the control console (Fig. 44).

With the ignition switch in the START or RUN position, a continuous supply of voltage is applied to the boom spray valve actuators, closing the boom spray valves. When a boom spray switch is set to ON, voltage is supplied to the activator wire of the boom spray valve actuator, opening the boom spray valve. When in the ON position, the light on the switch will illuminate. The Toro Electronic Controller (TEC) monitors the operation of the boom spray switches as inputs. The inputs are used for counter, timer, and spray calculation purposes.

NOTE: If any of the boom spray switches and the master boom (spray enable) switch are engaged, energizing the spray pump clutch will be prohibited.

Testing

The boom spray switches and the circuit wiring can be tested as a TEC inputs using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate boom spray switch and unplug machine wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the boom spray switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 45) and the circuitry of the boom spray switch is shown in the chart (Fig. 46). Verify continuity between switch terminals.
4. Terminals 7 (–) and 8 (+) are used for the indicator light in the boom spray switch. The light should be illuminated when the switch is in the ON position.
5. Replace the boom spray switch if testing determined that it is faulty.

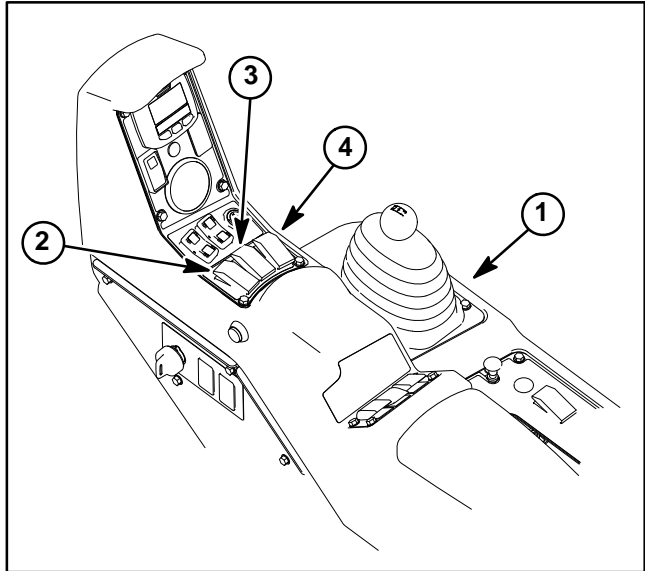


Figure 44

- | | |
|-------------------------|-------------------------|
| 1. Control console | 3. Center boom switch |
| 2. LH spray boom switch | 4. RH spray boom switch |

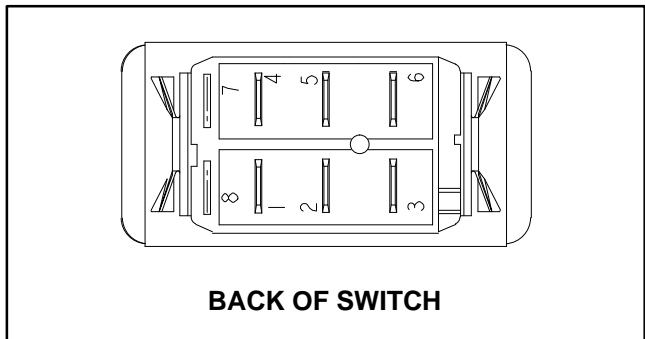


Figure 45

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 46

6. If the boom spray switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
7. Connect the harness connector to the boom spray switch after testing. Install console panel to machine.

Boom Spray Switches (Serial Number Above 31500000)

Three (3) identical boom spray switches are used on the Multi Pro 1750 to turn the spray valve for the individual boom sections ON or OFF. The boom switches are located on the control console (Fig. 44).

With the ignition switch in the START or RUN position, a continuous supply of voltage is applied to the boom spray valve actuators, closing the boom spray valves. When a boom spray switch is set to ON, voltage is supplied to the activator wire of the boom spray valve actuator, opening the boom spray valve. The Toro Electronic Controller (TEC) monitors the operation of the boom spray switches as inputs. The inputs are used for counter, timer, and spray calculation purposes.

NOTE: If any of the boom spray switches and the master boom (spray enable) switch are engaged, energizing the spray pump clutch will be prohibited.

Testing

The boom spray switches and the circuit wiring can be tested as a TEC inputs using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate boom spray switch and unplug machine wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the boom spray switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 48) and the circuitry of the spray boom switch is shown in the chart (Fig. 49). Verify continuity between switch terminals.
4. Replace the boom spray switch if testing determined that it is faulty.
5. If the boom spray switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. Connect the harness connector to the boom spray switch after testing. Install console panel to machine.

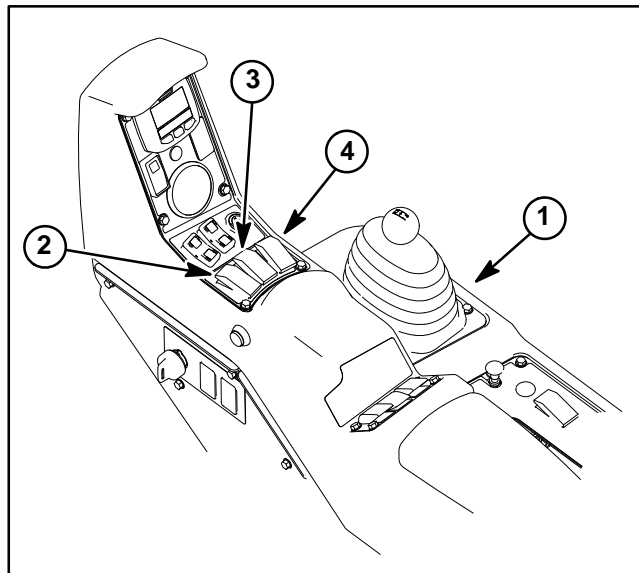
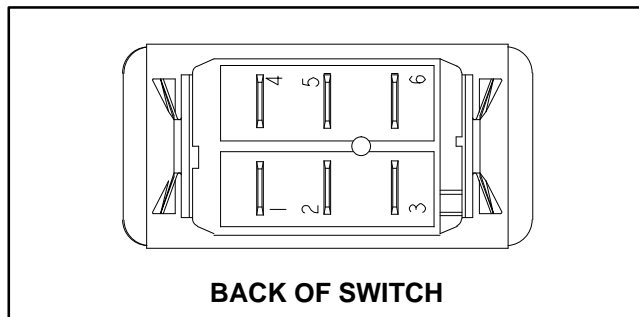


Figure 47

- | | |
|-------------------------|-------------------------|
| 1. Control console | 3. Center boom switch |
| 2. LH spray boom switch | 4. RH spray boom switch |



BACK OF SWITCH

Figure 48

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 49

Spray Pump and Agitation Switches

The spray pump and agitation switches are identical switches and are located on the control console (Fig. 50). These switches include an indicator light to notify the operator when the switches are in the ON position.

The spray pump switch allows the operator to energize or de-energize the spray pump electric clutch. The Toro Electronic Controller (TEC) monitors the operation of the spray pump switch as an input and provides an output to energize the pump electric clutch when appropriate.

NOTE: To avoid damaging the spray pump drive, the spray pump switch will only engage when the engine is at low idle and either the master boom (spray enable) switch is disengaged or the master boom switch is engaged but none of the boom spray switches are engaged.

The agitation switch allows the operator to energize or de-energize the spray system agitation valve for spray tank agitation. On machines with a serial number below 315000000, the switch reverses the polarity of the voltage supplied to the agitation valve actuator (2 wire). On machines with a serial number above 315000000, the switch removes or applies voltage to the activator terminal (C) to control the agitation valve actuator operation.

Testing

The spray pump switch and its circuit wiring can be tested as a TEC input or qualifier using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate switch that is to be tested and unplug machine wire harness connector from 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 switch position. The switch terminals are marked as shown (Fig. 51) and the circuitry of the switch is shown in the chart (Fig. 52). Verify continuity between switch terminals.
4. Replace switch if testing determines that it is faulty.

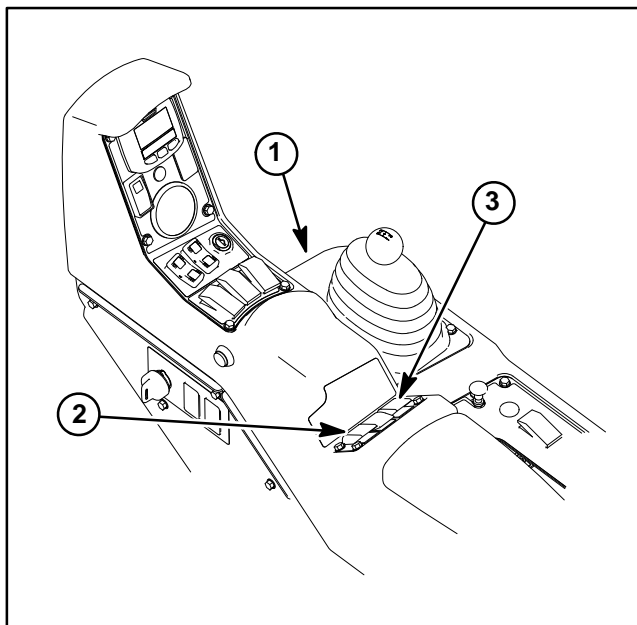
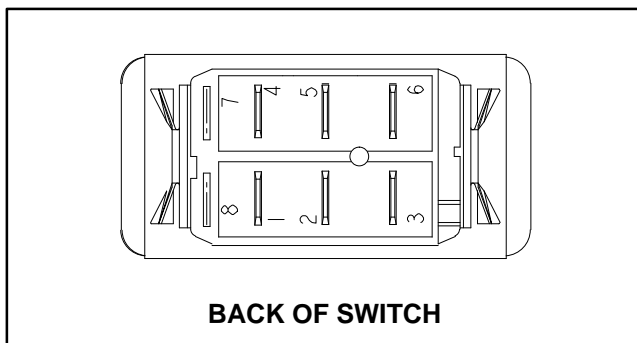


Figure 50

1. Control console
2. Pump switch
3. Agitation switch



BACK OF SWITCH

Figure 51

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 52

5. Switch terminals 7 (-) and 8 (+) are used for the indicator light in the switch.
6. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
7. After testing is completed, connect the harness connector to the switch. Install console panel to machine.

Application Rate (Spray Pressure) Switch

The application rate switch is a three (3) position rocker switch used to increase or decrease the application rate (spray system pressure). When the application rate switch is pressed, the spray system rate valve is adjusted. The application rate switch is located on the control console (Fig. 53).

NOTE: When the supervisor switch is in the OFF (locked) position, the application rate switch is disabled.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate the application rate switch on console and unplug machine wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the application rate switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 54) and the circuitry of the application rate switch is shown in the chart (Fig. 55). Verify continuity between switch terminals.
4. Replace application rate switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After testing is completed, connect the harness connector to the application rate switch. Install console panel to machine.

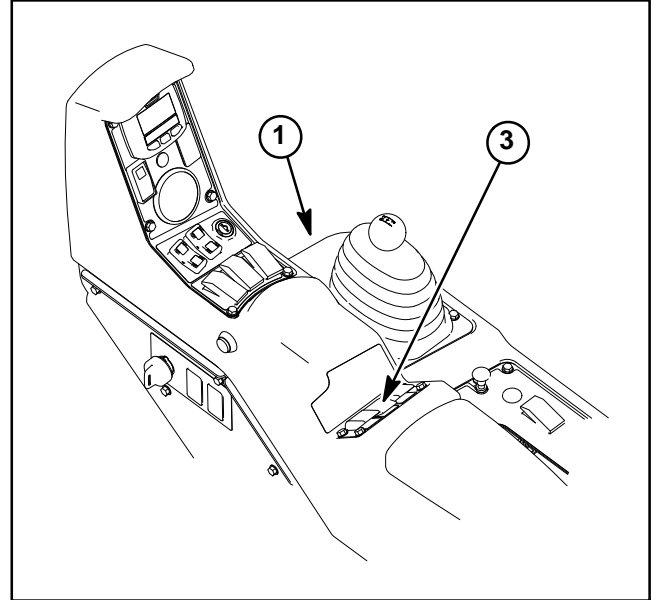
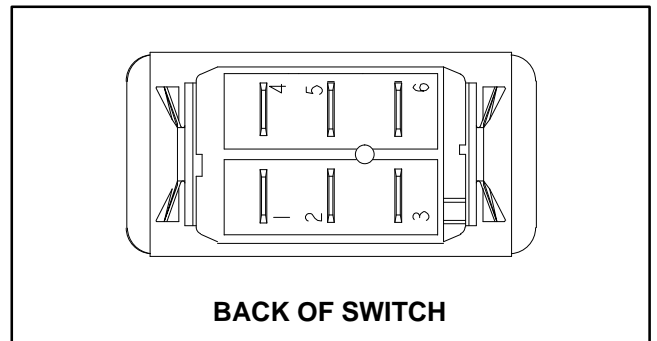


Figure 53

1. Control console
2. Application rate (spray pressure) switch



BACK OF SWITCH

Figure 54

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 55

Supervisor Key Switch

The supervisor key switch on the Multi Pro 1750 sprayer is located on the control console to the right of the operator seat (Fig. 56). When the supervisor switch is in the OFF (locked) position, the spray system pressure switch is disabled, preventing spray system pressure (application rate) adjustment.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate supervisor key switch and remove wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the key switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 57). The circuitry of the supervisor key switch is shown in the chart (Fig. 58). Verify continuity between switch terminals.

NOTE: Only key switch terminals A and D are used on Multi Pro 1750 machines.

4. Replace supervisor key switch if testing determines the switch is faulty.
5. If the supervisor key switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After testing is completed, connect the harness connector to the supervisor switch and install console panel to machine.

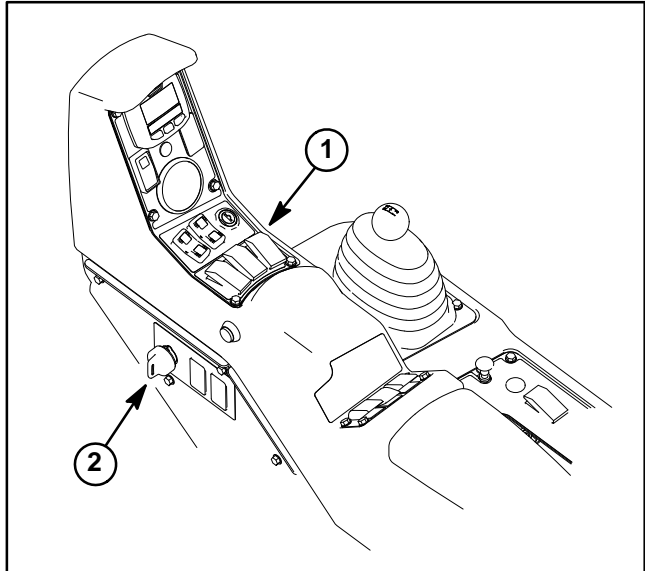


Figure 56

1. Control console 2. Supervisor key switch

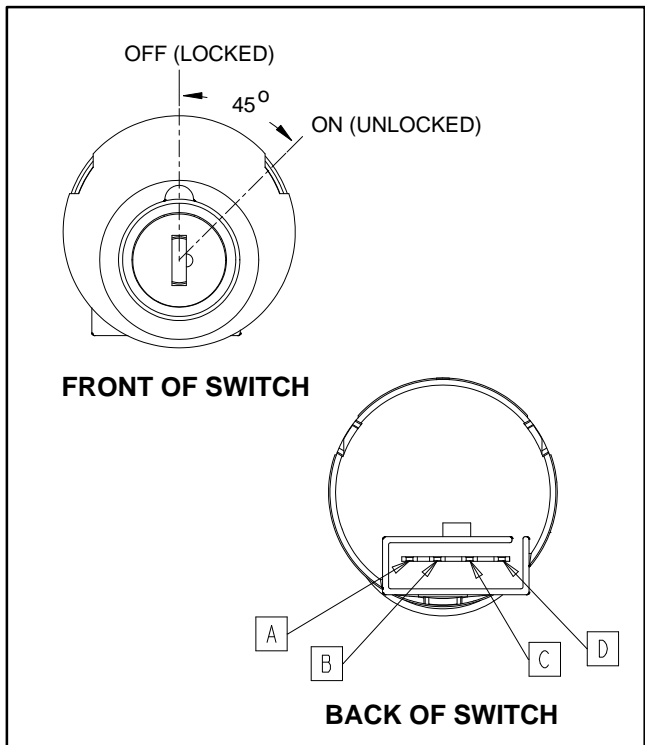


Figure 57

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF (LOCKED)	NONE	B + C
ON (UNLOCKED)	A + D	B + C

Figure 58

Boom Lift Switches

The right and left boom lift switches are identical switches and are located on the control console (Fig. 59). Pressing the front of a switch lowers the appropriate spray boom section. Pressing the rear of a switch raises the boom section.

The boom lift switch terminals 1, 2 and 3 are used to energize the boom up and down solenoids of the hydraulic lift control manifold. Switch terminals 4, 5 and 6 are used to energize the boom enable solenoid of the hydraulic lift control manifold.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate switch that is to be tested and unplug wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the boom lift switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown in (Fig. 60) and the circuitry of the boom lift switch is shown in the chart in (Fig. 61). Verify continuity between switch terminals.
4. Replace boom lift switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After testing has been completed, connect the wire harness connector to the boom lift switch. Install console panel to machine.

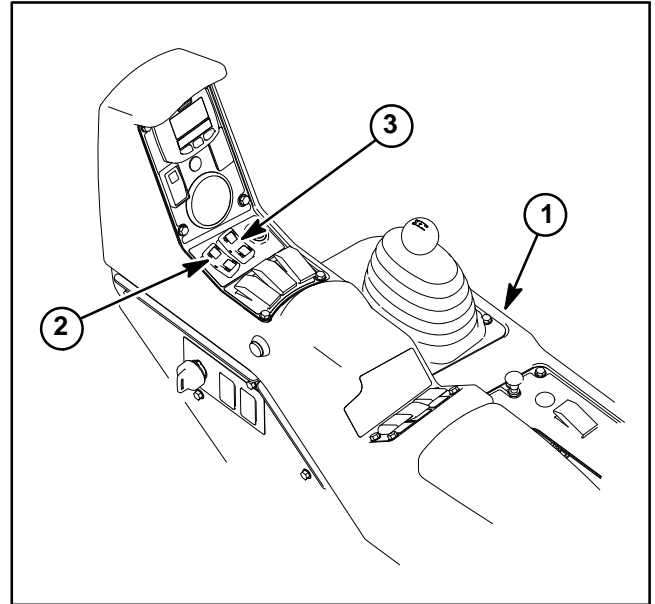


Figure 59

1. Control console
2. LH boom switch
3. RH boom switch

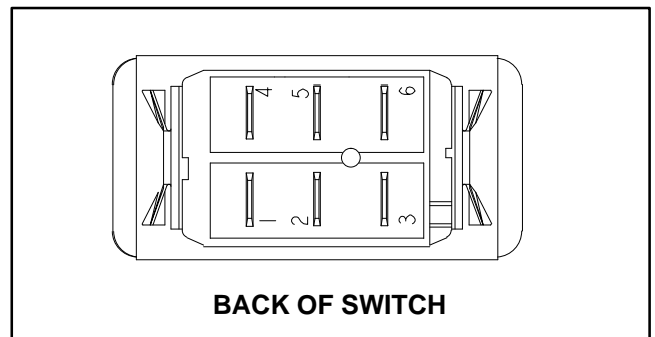


Figure 60

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 61

Speed/Throttle Lock Switch

The speed/throttle lock switch for the Multi Pro 1750 is used to turn the speed lock feature (vehicle in motion) or throttle lock feature (vehicle stationary) ON or OFF. When in the ON position, the light on the switch is illuminated. The Toro Electronic Controller (TEC) monitors the operation of the speed/throttle lock switch as an input and provides an output to energize the speed/throttle lock coil when appropriate. The speed/throttle lock switch is located on the control console below the InfoCenter Display (Fig. 62).

The speed lock is activated when the transmission is not in neutral and the clutch pedal is released (engaged). In addition, the operator must be in the seat, the parking brake is not set, the spray pump switch is set to ON, and then the throttle lock switch is set to ON. Use the speed lock to maintain a constant speed while spraying.

The throttle lock is activated when the transmission is in neutral, the parking brake is set, the spray pump switch and throttle lock switch is set to ON. Use the throttle lock for stationary hand sprayer operation.

Testing

The speed/throttle lock switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate speed/throttle lock switch and unplug machine wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the speed/throttle lock switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 63) and the circuitry of the switch is shown in the table (Fig. 64). Verify continuity between switch terminals.
4. Terminals 7 (–) and 8 (+) are used for the indicator light in the speed/throttle lock switch. The light should be illuminated when the switch is in the ON position.
5. Replace the speed/throttle lock switch if testing determined that it is faulty.

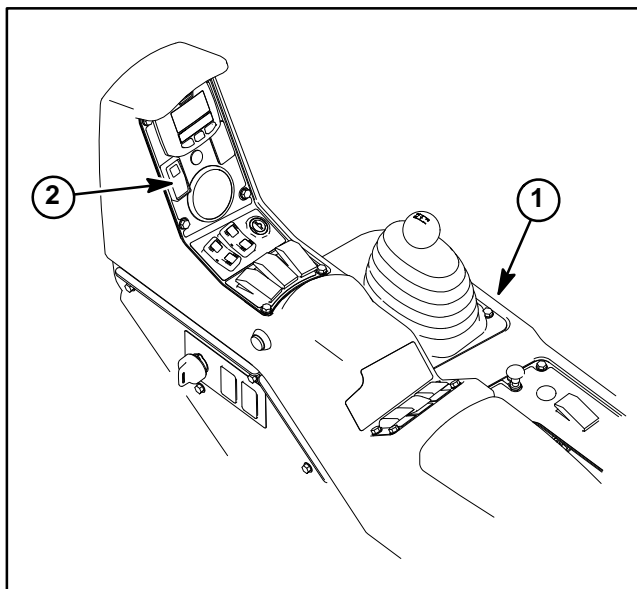
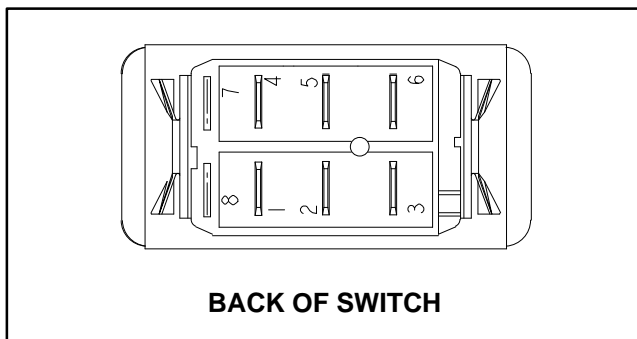


Figure 62

1. Control console
2. Speed/throttle lock switch



BACK OF SWITCH

Figure 63

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
ON	2 + 3	2 + 1
NEUTRAL	NONE	ALL
OFF	2 + 1	2 + 3

Figure 64

NOTE: Speed/throttle lock switch terminals 1, 4, 5 and 6 are not used on Multi Pro 1750 machines.

6. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

7. Connect the harness connector to the switch after testing. Install console panel to machine.

Headlight Switch

The headlight switch is used to turn the headlights on and off. The headlight switch is located on the control console next to the operator seat (Fig. 65).

Testing

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

2. Remove console panel. Locate headlight switch and unplug wire harness connector from 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 switch position. The switch terminals are marked as shown (Fig. 66) and the circuitry of the headlight switch is shown in the chart (Fig. 67). Verify continuity between switch terminals.

4. Replace headlight switch if testing determines that it is faulty.

5. If the headlight switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

6. After testing, connect the harness connector to the headlight switch. Install console panel to machine.

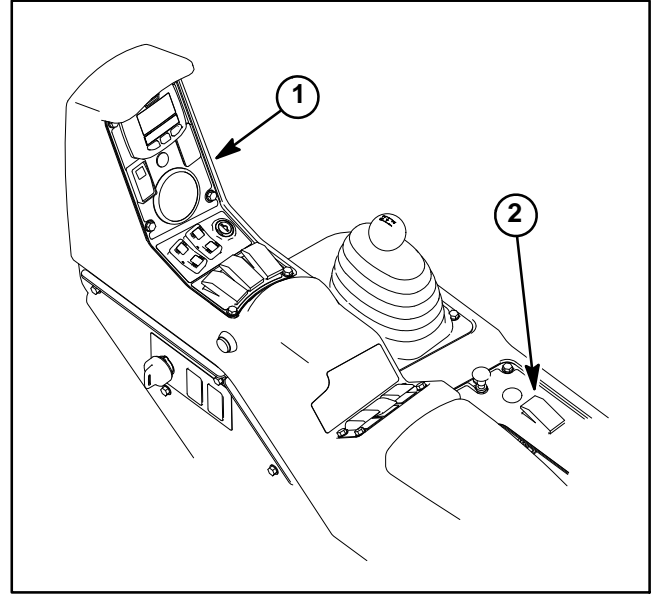
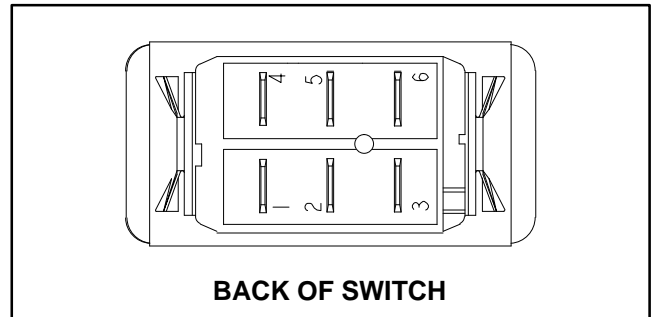


Figure 65

1. Control console 2. Headlight switch



BACK OF SWITCH

Figure 66

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 67

Brake Pressure Switch

The brake pressure switch is a normally open switch used to engage the hill assist (brake lock) feature. The Toro Electronic Controller (TEC) monitors the operation of the brake pressure switch as an input and provides an output to energize the brake lock solenoid when appropriate. The brake pressure switch is located below the operator's seat in the brake line for the rear brakes (Fig. 68).

NOTE: To engage the hill assist (brake lock) feature the clutch pedal and service brake pedal switches must be open (pedals depressed), the vehicle must not be moving, and enough pressure must exist in the rear brake line to close the brake pressure switch.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Raise the operator's seat and locate the brake pressure switch. Unplug wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the brake pressure switch may be tested to determine whether continuity exists across the terminals for each switch position. Continuity (zero ohms resistance) should exist across the switch terminals when the service brake pedal is depressed. There should not be continuity (infinite ohms resistance) across the switch terminals when the service brake pedal is not depressed.
4. Replace brake pressure switch if testing determines that it is faulty. Bleed the brake system after switch replacement (see Bleeding the Brake System in Chapter 8 – Chassis in this manual).
5. If the brake pressure switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. Connect the wire harness connector to the brake pressure switch after testing. Lower and secure the operator's seat.

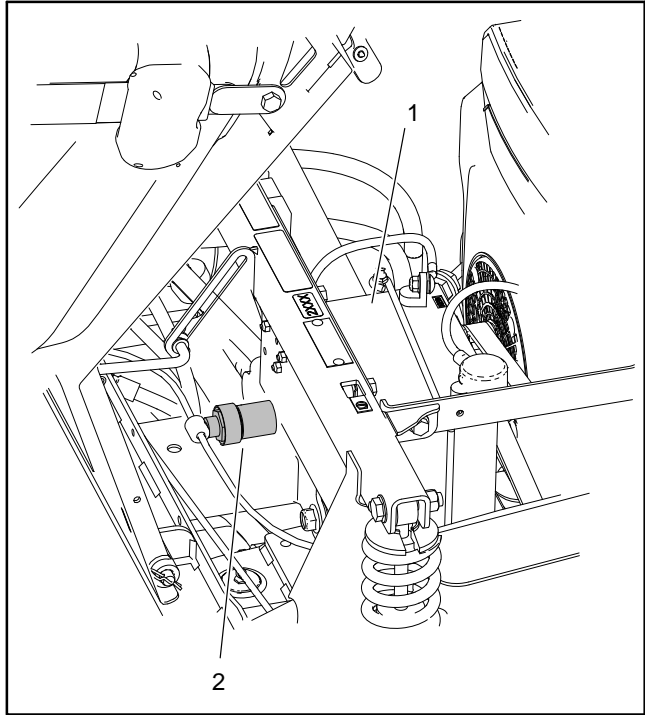


Figure 68

1. Battery

2. Brake pressure switch

Relays with Four (4) Terminals

Your Multi Pro 1750 uses a number of electrical relays that have four (4) terminals.

The main power relay is used to provide current to most of the fuse protected circuits (InfoCenter display, spray system components, headlights and optional electric equipment). The power relay is energized when the ignition switch is in the RUN or START position. This relay has four (4) terminals and is located under the operator seat next to the fuse blocks (Fig. 69). The main power relay can be identified by a tag at the relay wire harness connector.

If the machine is equipped with an optional electric hose reel kit, an additional four (4) terminal relay is added to the electrical system. The hose reel relay is energized when the hose reel switch is pressed. The hose reel relay is located in the power center compartment of the battery box.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Raise operator seat and locate the desired relay. Disconnect wire harness connector from the relay and remove the relay from the machine.
3. The relay terminals are marked as shown (Fig. 70).

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

4. Using a multimeter, verify that coil resistance between terminals 86 and 85 is approximately 72 ohms.

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

6. Disconnect voltage and test leads from the relay terminals. Replace relay if testing determines that the relay is faulty.

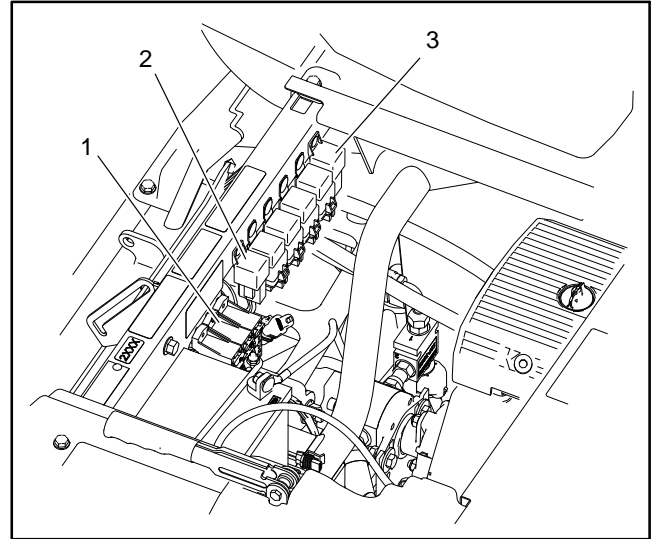


Figure 69

1. Fuse blocks
2. Main power relay
3. Electric hose reel kit relay (opt.)

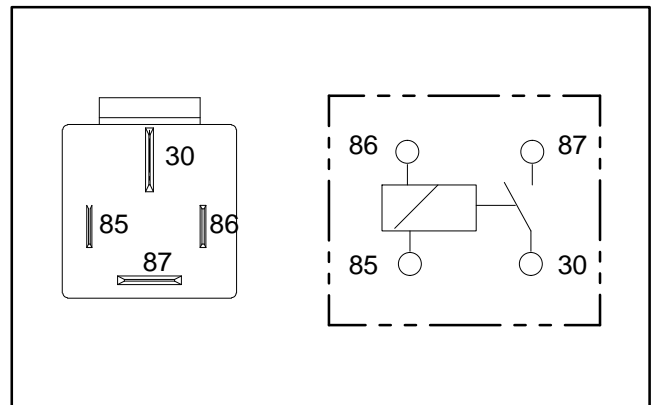


Figure 70

7. If the relay tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

8. Secure relay to mounting bracket and connect wire harness connector to relay.

9. Lower and secure operator seat.

Relays with Five (5) Terminals

Your Multi Pro 1750 uses a number of electrical relays that have five (5) terminals. The relays are located in the power center compartment of the battery box (Fig. 71).

The start relay is used to provide current to the engine starter motor solenoid. The start relay is energized by the Toro Electronic Controller (TEC). The start relay can be identified by a tag at the wire harness connector.

The kill relay is used to provide a complete circuit to allow the engine starter solenoid to be energized. When de-energized, the kill relay provides a ground for the engine magneto system which stops the engine. The kill relay is energized by the TEC. The kill relay can be identified by a tag at the wire harness connector.

If the machine is equipped with an optional tank clean rinse kit, an additional four (5) terminal relay is added to the electrical system. The rinse kit relay is energized when the hose reel switch is pressed.

If the machine is equipped with an optional foam marker kit, an additional four (5) terminal relay is added to the electrical system. The foam marker relay is energized when the foam marker power and control switches are set to ON.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Raise operator seat and locate the relay to be tested. Disconnect wire harness connector from relay and remove relay from panel.
3. The relay terminals are marked as shown (Fig. 72).

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

4. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.
5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as +12 VDC is applied and removed from terminal 85.

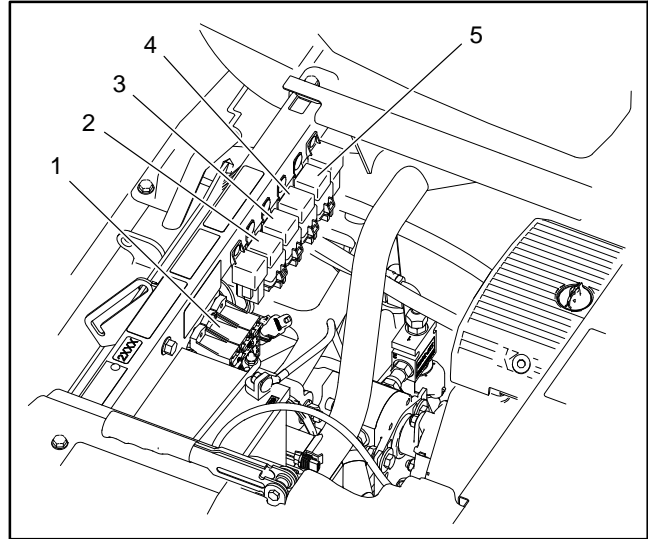


Figure 71

- | | |
|----------------|--------------------------------------|
| 1. Fuse blocks | 4. Tank clean rinse kit relay (opt.) |
| 2. Start relay | 5. Foam marker kit relay (opt.) |
| 3. Kill relay | |

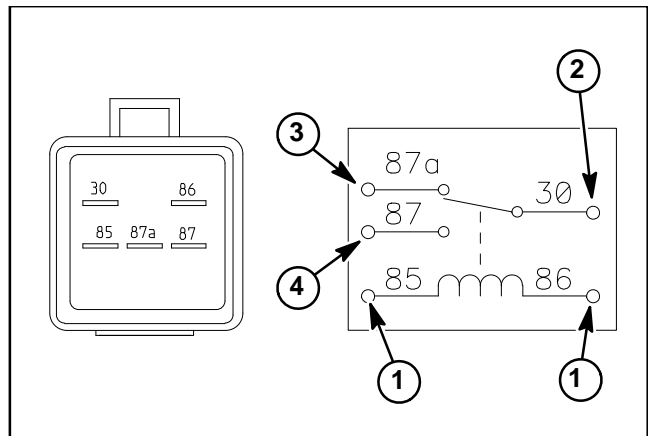


Figure 72

- | | |
|--------------------|--------------------------|
| 1. Coil terminal | 3. Normally closed term. |
| 2. Common terminal | 4. Normally open term. |

6. Disconnect voltage from terminal 85 and multimeter lead from terminal 87.
7. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as +12 VDC is applied and removed from terminal 85.
8. When testing is completed, disconnect voltage and multimeter leads from the relay terminals. Replace relay if testing determines that the relay is faulty.

9. If the relay tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

10. Secure relay to machine and connect wire harness to relay.

11. Lower and secure operator seat.

Speed/Throttle Lock Coil

The speed/throttle lock coil is attached to the frame next to the accelerator lever (Fig. 73). The speed/throttle lock coil is energized by the Toro Electronic Controller (TEC) output when the speed lock or throttle lock feature is used. The energized coil becomes a magnet to hold the accelerator lever in position to maintain engine speed.

The speed lock is activated when the transmission is not in neutral and the clutch pedal is released (engaged). In addition, the operator must be in the seat, the parking brake is not set, the spray pump switch is set to ON, and then the throttle lock switch is set to ON. Use the speed lock to maintain a constant speed while spraying.

The throttle lock is activated when the transmission is in neutral, the parking brake is set, the spray pump switch and throttle lock switch is set to ON. Use the throttle lock for stationary hand sprayer operation.

Testing

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

2. Locate control coil next to accelerator lever under the floorboard. Unplug coil connector from machine wire harness.

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

3. Using a multimeter (ohms setting), verify control coil resistance between the two terminals of the connector. Resistance should be from **10.2 to 11.2 ohms**.

4. If coil does not engage when voltage is applied or coil resistance is incorrect, replace control coil.

5. If the coil tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

6. Connect the coil connector to the machine wire harness after testing is completed.

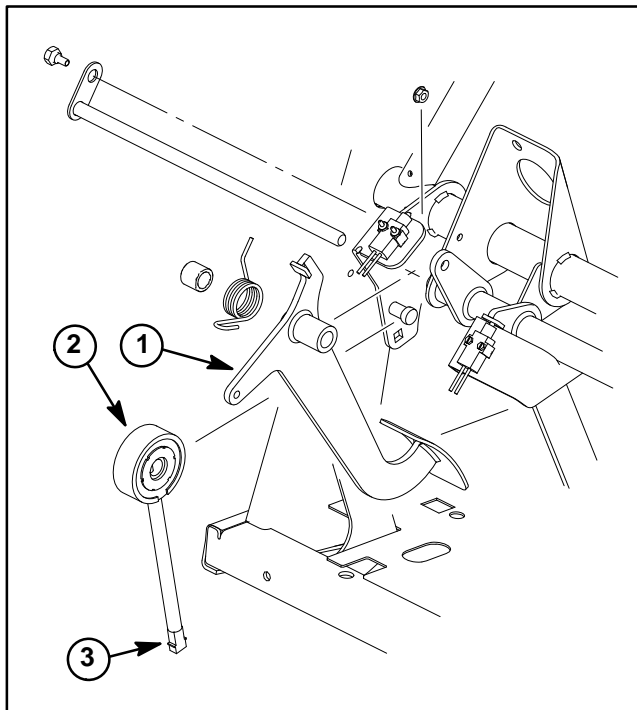


Figure 73

- 1. Accelerator lever
- 2. Speed control coil
- 3. Coil connector

Pump Drive Electric Clutch

An electric clutch is used to engage and drive the spray pump on the Multi Pro 1750. The electric clutch is mounted on the spray pump input shaft. Clutch operation is controlled by the pump switch located on the control console. The pump switch is an input for the Toro Electronic Controller (TEC), therefore, the clutch engages when current is applied to the clutch coil by the TEC (output). When engaged, the clutch allows the engine driven sprocket and drive belt system to rotate the spray pump for sprayer operation.

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate clutch on spray pump shaft. Carefully unplug machine wire harness connector from clutch terminals (Fig. 74).

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

3. For accurate clutch resistance measuring, clutch should be at approximately 70F (21C). Using a multimeter (ohms setting), verify clutch coil resistance between the two (2) terminals of the connector. Clutch coil resistance should be from **2.9 to 3.2 ohms**.

4. If clutch coil resistance is incorrect, replace clutch.

5. As an additional test, apply 12 volts to the terminals of the clutch. The clutch should engage. If clutch does not engage when voltage is applied, replace clutch.

6. If the clutch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

7. See Pump Drive Electric Clutch in this chapter if clutch removal is necessary.

8. After testing is completed, plug machine wire harness connector onto clutch terminals.

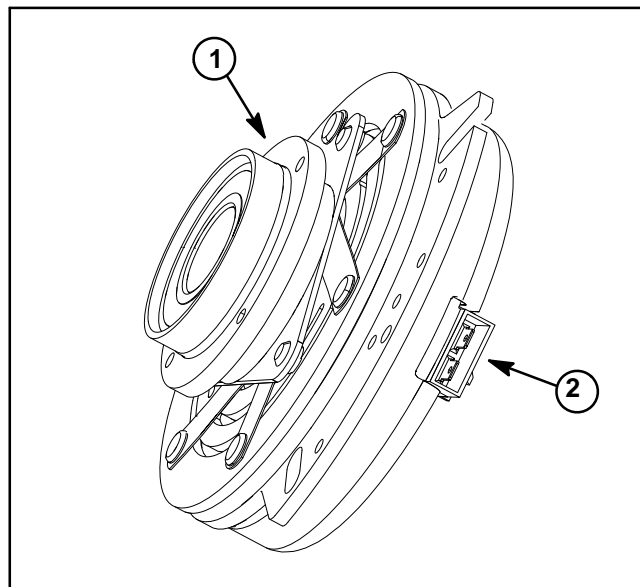


Figure 74

1. Electric clutch

2. Clutch terminals

Spray System Valve Actuators (ARAG – Serial Number Below 31500000)

The Multi Pro 1750 spray system uses a variety of valves to control the spray product flow (see Chapter 6 – Spray System in this manual). Each valve has a 12VDC actuator (motor) that can be tested individually. Each actuator receives its power through individual 5 amp fuses. The fuse is located in the wire harness near each valve actuator (see Fuses in this chapter).

The agitation valve and rate valve actuators are controlled using a two (2) wire circuit. The polarity of the power supplied changes to control the direction of actuator operation.

The master boom and boom section valve actuators are controlled using a three (3) wire circuit. A constant supply of power is applied to terminals 1 (+) and 2 (-), energizing the actuator to close the valve. Applying power to terminal (3) reverses the direction of actuator operation, opening the valve.

Testing

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

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

2. Locate valve actuator to be tested (Fig. 75). Carefully unplug machine wire harness connector from valve actuator and disconnect the hose from below the valve.

Two (2) wire operated actuators:

A. Connect 12VDC to terminal 1 (+) and connect terminal 2 to ground (-). The actuator should rotate in a counterclockwise direction to extend/close the valve.

B. Connect 12VDC to terminal 2 (+) and connect terminal 1 to ground (-). The actuator should rotate in a clockwise direction to open/retract the valve.

Three (3) wire operated actuators:

A. Connect 12VDC to terminal 1 (+) and connect terminal 2 to ground (-). The actuator should rotate in a counterclockwise direction to extend/close the valve.

B. Connect 12VDC to terminal 1 (+) and terminal 3 (activator), then connect terminal 2 to ground (-). The actuator should rotate in a clockwise direction to open/retract the valve.

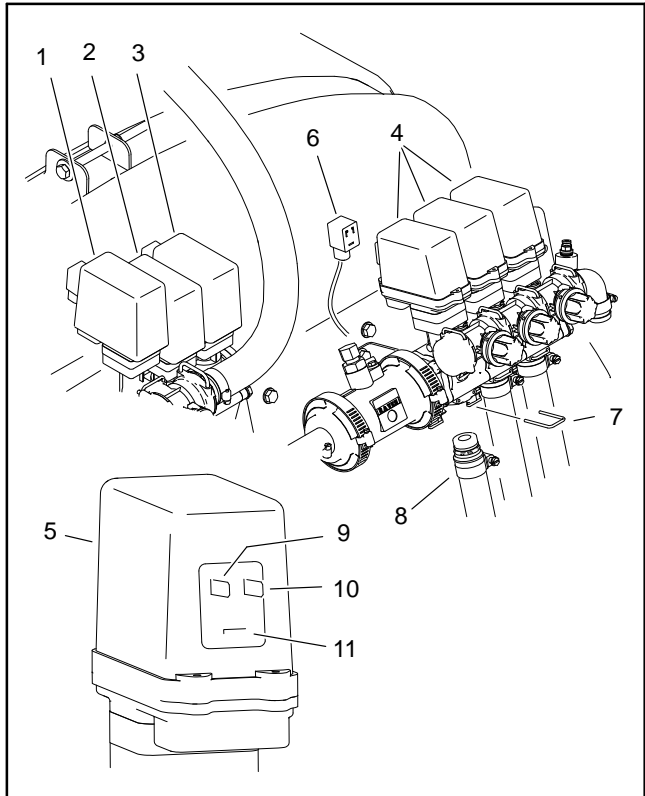


Figure 75

- | | |
|---------------------------|-------------------------|
| 1. Agitation valve | 7. Fork |
| 2. Rate valve | 8. Hose |
| 3. Master boom valve | 9. Actuator terminal 1 |
| 4. Boom spray valves (3) | 10. Actuator terminal 2 |
| 5. Valve actuator | 11. Actuator terminal 3 |
| 6. Wire harness connector | |

3. If the actuator does not operate smoothly in both directions, remove the valve piston and retest the actuator (see Spray Valve Service in Chapter 6 – Spray System in this manual). Replace the actuator if necessary.

4. If the actuator tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

5. Connect the machine wire harness to the valve actuator after testing is completed.

Spray System Valve Actuators (KZ – Serial Number Above 31500000)

The Multi Pro 1750 spray system uses a variety of valves to control the spray product flow (see Chapter 6 – Spray System in this manual). Each valve has a 12VDC actuator (motor) that can be tested individually.

The master boom, boom section valves, and agitation valve actuators are controlled using a three (3) wire circuit. A constant supply of power is applied to terminals A (+) and B (-), energizing the actuator to close the valve. Applying power to terminal (C) reverses the direction of actuator operation, opening the valve.

The rate valve actuator is controlled using a four (4) wire circuit. A constant supply of power is applied to terminals A (+) and B (-). Applying power to the open terminal (C) or the close terminal (D) controls the direction of actuator operation.

Testing

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

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components. Wear protective clothing, chemical resistant gloves, and eye protection during repair.

2. Locate valve actuator to be tested (Fig. 76). Carefully unplug machine wire harness connector from valve actuator, remove the retaining fork and remove the actuator from the valve assembly.

Three (3) wire operated actuators:

A. Connect 12VDC to terminal A (+ red wire) and connect terminal B to ground (- black wire) The actuator should rotate in a clockwise direction, stop, and a red LED should illuminate.

B. Connect 12VDC to terminal A (+ red wire) and terminal C (open white wire), then connect terminal B to ground (- black wire). The actuator should rotate in a counterclockwise direction, stop, and a green LED should illuminate.

Four (4) wire operated actuators:

A. Connect 12VDC to terminal A (+ red wire) and connect terminal B to ground (- black wire). The actuator should not rotate in either direction.

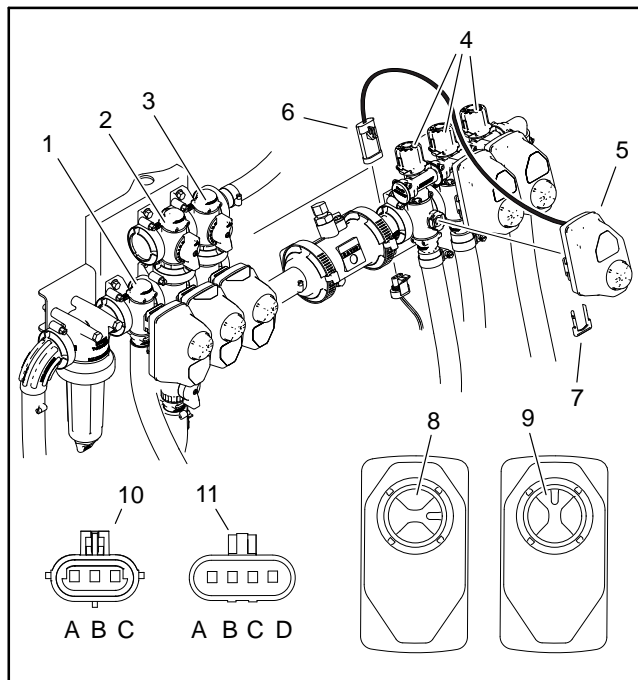


Figure 76

- | | |
|---------------------------|---------------------------|
| 1. Rate valve | 7. Fork |
| 2. Agitation valve | 8. Valve closed (red LED) |
| 3. Master boom valve | 9. Valve open (green LED) |
| 4. Boom spray valves (3) | 10. 3 Wire connector |
| 5. Valve actuator | 11. 4 Wire connector |
| 6. Wire harness connector | |

B. Connect 12VDC to terminal A (+ red wire) and terminal C (open white wire), then connect terminal B to ground (- black wire). The actuator should rotate in a clockwise direction, stop, and a red LED should illuminate.

C. Connect 12VDC to terminal A (+ red wire) and terminal D (close green wire), then connect terminal B to ground (- black wire). The actuator should rotate in a counterclockwise direction, stop, and a green LED should illuminate.

3. If actuator does not operate smoothly in both directions, replace the actuator.

4. If the actuator tests correctly, test the valve operation by manually rotating the valve shaft with a screwdriver. Repair or replace the valve if necessary (see Spray Valve Service in Chapter 6 – Spray System in this manual).

5. If the actuator and valve test correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

6. Install the valve actuator and connect it to the machine wire harness after testing is completed.

Hydraulic Solenoid Valve Coils

The Multi Pro 1750 hydraulic system uses several hydraulic solenoid valve coils for system control. The hydraulics enable valve assembly includes one (1) solenoid valve (Fig. 77). The boom lift control manifold includes five (5) solenoid valves (Fig. 78). The brake hold valve in the brake system also includes a solenoid valve (Fig. 79). 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. Park machine on a level surface, stop spray pump, stop engine and engage parking brake.

2. 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 the measured value of the solenoid you are testing.

NOTE: Solenoid coil resistance should be measured with solenoid at approximately 68F (20C). 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).

3. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid valve coil. The resistance for all solenoid coils used on Multi Pro 1750 machines should be **8.8 ohms**.

4. If solenoid coil resistance is incorrect, replace coil (see Hydraulics Enable Valve Assembly in Chapter 4 – Hydraulic System, Boom Lift Control Manifold Service in Chapter 4 – Hydraulic System, or Brake Hold Valve in Chapter 8 – Chassis in this manual).

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).

5. After testing is completed, connect wire harness electrical connector to the solenoid valve coil.

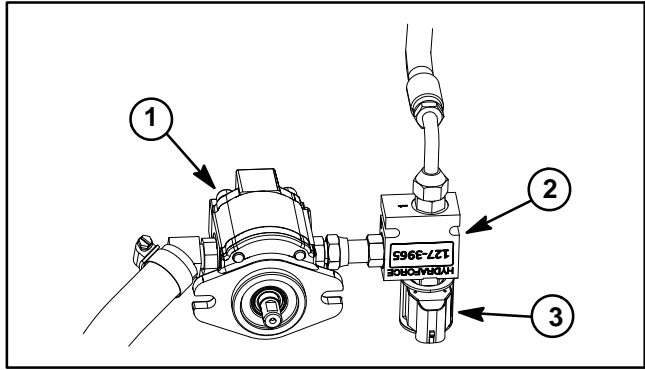


Figure 77

- | | |
|----------------------------|------------------------|
| 1. Gear pump | 3. Solenoid valve coil |
| 2. Hydraulics enable valve | |

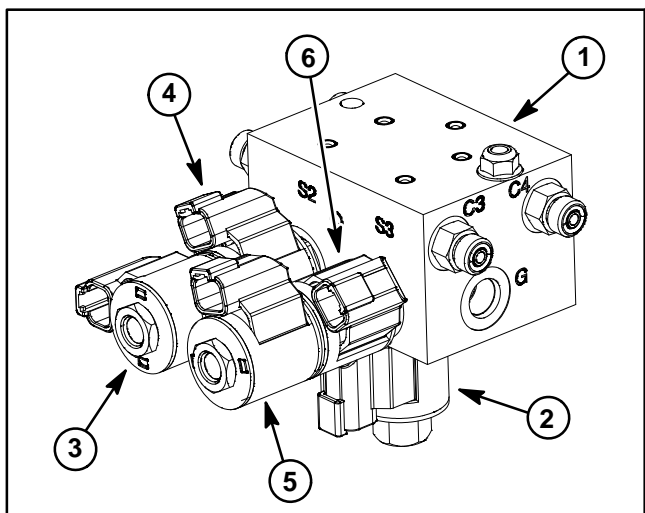


Figure 78

- | | |
|-------------------------|-------------------------|
| 1. Boom lift manifold | 4. Coil (S2) (RH lower) |
| 2. Coil (S1) (enable) | 5. Coil (S3) (LH raise) |
| 3. Coil (S2) (RH raise) | 6. Coil (S3) (LH lower) |

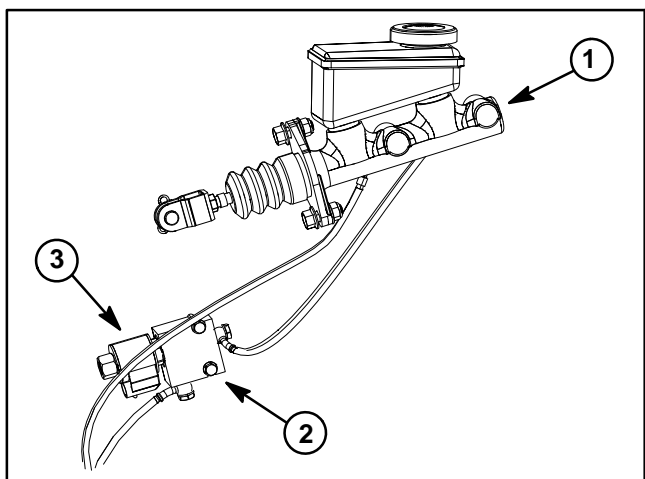


Figure 79

- | | |
|--------------------------|--------------------|
| 1. Brake master cylinder | 3. Brake hold coil |
| 2. Brake hold valve | |

CAN-bus Terminator Resistors

System communication between the Toro Electronic Controller (TEC) and the InfoCenter display is accomplished on a CAN-bus communication system. Two (2) specially designed, twisted cables form the bus for the network used on the machine. These wires provide the data pathways between machine components. At the ends of the twisted pair of bus cables near the InfoCenter display and the TEC are two (2) 120 ohm terminator resistors.

The CAN-bus terminator resistors plug into the wire harness in the control console. One of the terminator resistors is under the switch panel on the control console and the second resistor is located near the TEC and fuse block. The wire harness connectors have a blue insert to identify the proper location for the termination resistors.

NOTE: Refer to the electrical schematic and wire harness drawings in Chapter 10 – Electrical Drawings for additional information on termination resistor location and wire connections.

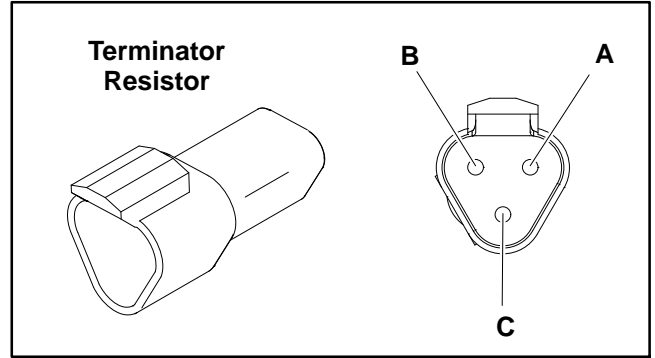


Figure 80

IMPORTANT: The terminator resistors are required for proper electrical system operation.

Termination Resistor Test

The terminator resistors (Fig. 80) can be tested using a digital multimeter (ohms setting). There should be **120 ohms** resistance between terminals A and B of the terminator resistors. Terminal C is not used on Multi Pro 1750 machines. Replace resistor if testing determines that it is faulty.

If the resistor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

Diode Assemblies

If the machine is equipped with an optional foam marker kit, a series of six (6) diodes are used to protect the circuit from voltage spikes when the foam pump is energized or de-energized. The diodes plug into the foam marker wiring harness.

Diode Test

The diode (Fig. 81) can be individually tested using a digital multimeter (diode test or ohms setting) and the table provided. Replace diode if testing determines that it is faulty.

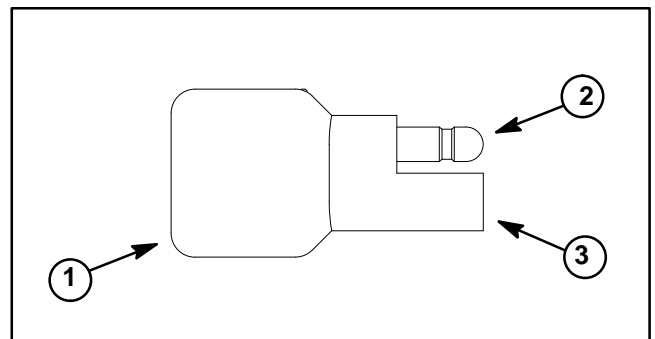


Figure 81

- 1. Diode
- 2. Male terminal
- 3. Female terminal

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

If the diode tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

Flow Meter Sensor

The flow meter measures the spray system flow as it moves through the flow meter. The sensor is an input to the Toro Electronic Controller (TEC). Accurate information from the flow meter is necessary to calculate application rate. The flow meter is located just upstream of the section manifold assembly (Fig. 82). The sensor uses a magnetically based, Hall Effect integrated circuit. As the rotor in the flow meter turns, the sensor accurately senses the rotor movement. The relationship of the sensor to the rotor is critical as the sensor is designed to read movement in one direction and must be perpendicular to the rotor. The sensor connector pin 2 is the positive lead, the connector pin 1 is the ground lead and the connector pin 3 is the signal output. For flow meter service information, see the Spray System chapters in this manual.

NOTE: If the flow meter sensor or body is being tested, serviced or replaced, calibrate the flow meter after installation (see Calibrating the Sprayer Flow in the machine Operator's Manual).

Testing

1. Park machine on a level surface, stop engine and engage parking brake.
2. Disconnect machine wire harness from flow meter sensor.
3. Test the machine wire harness to the flow meter sensor:
 - A. Set the ignition switch to the RUN/PREHEAT position.
 - B. Set the spray-mode switch located on the instrument panel to the MANUAL position.
 - C. Set the spray pump, master boom and Spray Boom switches located on the control console to the ON position.
 - D. Access the InfoCenter Display Total Area or Sub-Area Screens (see Spray System Chapters in this manual).
 - E. Connect a jumper wire across the ground (-) pin 1 and the signal (+) pin 3 (Fig. 83A). Watch the InfoCenter Display as you open and close the connection across the pins multiple times, the total volume sprayed reading should increase.
 - F. Remove the jumper wire.
 - G. Use a multimeter set to DC voltage and check for 5 VDC across the supply (+) pin 2 and ground (-) pin 1 of the machine wire harness (Fig. 83B).
 - H. Turn the ignition switch to OFF.

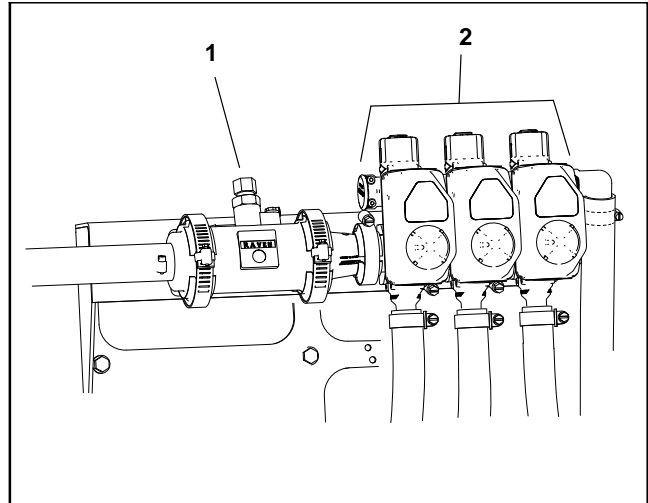


Figure 82

1. Flow meter
2. Section manifold assembly

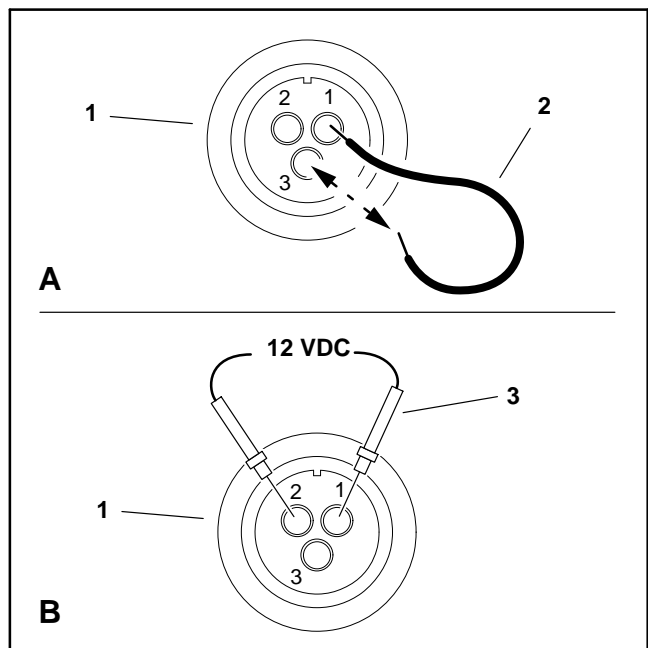


Figure 83

1. Machine wire harness connector
2. Jumper wire
3. Multimeter probe (typ.)

4. Test flow meter sensor:

A sensor test harness is required to quickly check sensor operation without removing the sensor from the flow meter.

NOTE: Instructions for fabricating and using a flow meter sensor test harness can be found in the Special Tools section of this chapter.

Tank Clean Rinse Kit Switch (Optional)

The clean tank rinse kit switch is used to turn the optional rinse pump ON or OFF. Pressing the upper portion of the switch energizes the rinse pump for a 60 second timed period. Pressing the lower portion of the switch energizes the rinse pump momentarily (pump remains ON only as long as the switch is pressed). The light on the switch will illuminate when the rinse pump is operating. The Toro Electronic Controller (TEC) monitors the operation of the rinse kit switch as an input and provides an output to energize the rinse pump relay. The rinse kit switch is located on the control console to the right of the operator seat (Fig. 84).

Testing

The rinse kit switch and its circuit wiring can be tested as a TEC input or qualifier using the InfoCenter Display (see InfoCenter Display – Diagnostics Screen in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate rinse kit switch and unplug machine wire harness connector from switch.
3. With the use of a multimeter (ohms setting), the speed/throttle lock switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown (Fig. 85) and the circuitry of the switch is shown in the table (Fig. 86). Verify continuity between 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 Timer ON or Momentary ON position.
5. Replace the rinse kit switch if testing determined that it is faulty.
6. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
7. Connect the harness connector to the speed/throttle lock switch after testing. Install console panel to machine.

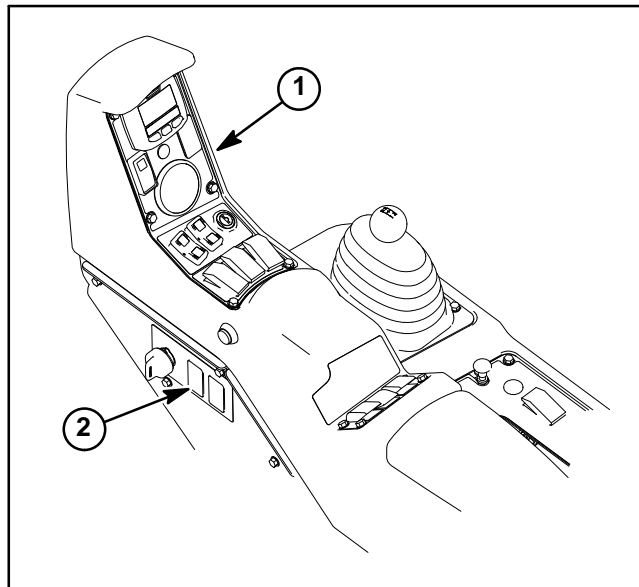
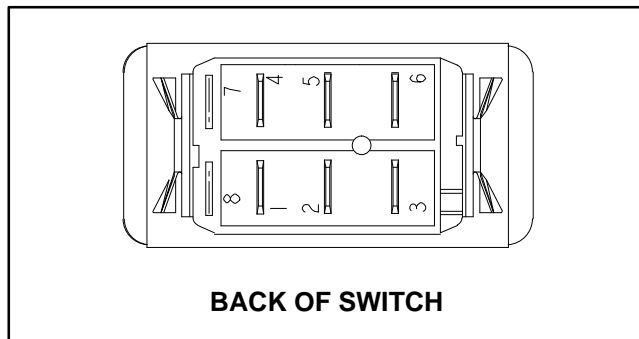


Figure 84

1. Control console 2. Rinse kit switch (opt.)



BACK OF SWITCH

Figure 85

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
ON	2 + 3	2 + 1
NEUTRAL	NONE	ALL
OFF	2 + 1	2 + 3

Figure 86

NOTE: Clean tank rinse kit switch terminals 4, 5 and 6 are not used on Multi Pro 1750 machines.

Foam Marker Kit ON/OFF Switch (Optional)

The foam marker kit ON/OFF switch is used to enable the foam marker system. The flow of foam to the right or left boom is controlled by the foam marker control switch. The foam marker ON/OFF switch is located on the control console below the InfoCenter display (Fig. 87).

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate the foam marker ON/OFF switch and unplug wire harness connector from 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 switch position. The switch terminals are marked as shown (Fig. 88) and the circuitry of the switch is shown in the chart (Fig. 89). Verify continuity between switch terminals.
4. Replace switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After testing, connect the harness connector to the switch. Install console panel to machine.

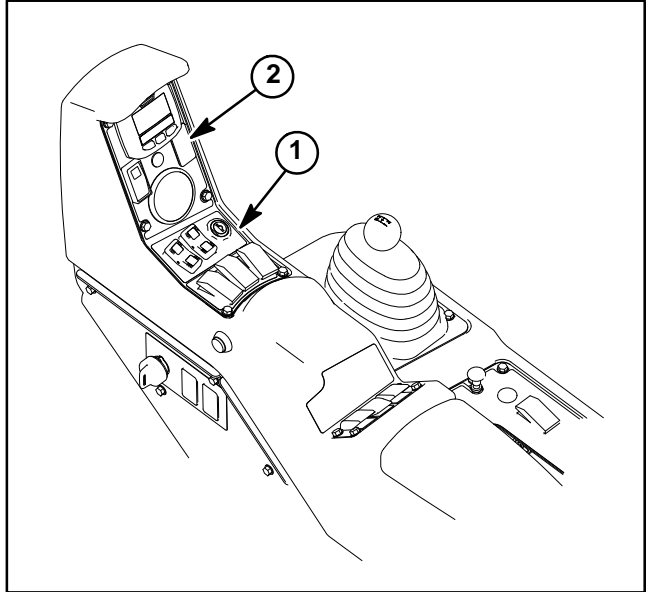
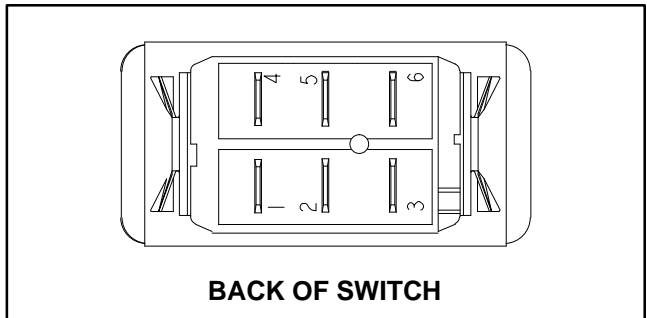


Figure 87

1. Control console
2. Foam marker kit ON/OFF switch (opt.)



BACK OF SWITCH

Figure 88

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	2 + 1	5 + 4
ON	2 + 3	5 + 6

Figure 89

Foam Marker Kit Control Switch (Optional)

The foam marker kit control switch is used to control the flow of foam to the right or left boom. Power to the entire foam marker system is controlled by the foam marker ON/OFF switch. The foam marker control switch is mounted to the steering column on the left side of the steering wheel (Fig. 87).

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate the foam marker control switch and unplug wire harness connector from 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 switch position. The switch terminals are marked as shown (Fig. 91) and the circuitry of the switch is shown in the chart (Fig. 92). Verify continuity between switch terminals.
4. Replace switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. After testing, connect the harness connector to the switch. Install console panel to machine.

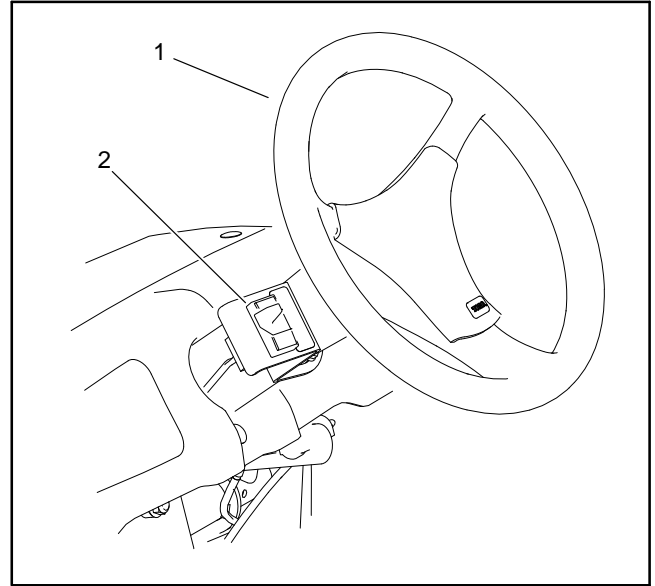


Figure 90

1. Steering wheel
2. Foam maker kit control switch (opt.)

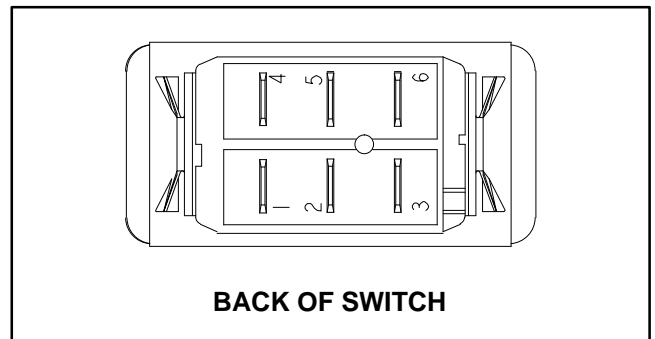


Figure 91

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
RIGHT	2 + 3	2 + 1
NEUTRAL	NONE	2 + 3
LEFT	2 + 1	ALL

Figure 92

NOTE: Foam marker kit control switch terminals 4, 5 and 6 are not used on Multi Pro 1750 machines.

Electric Hose Reel Kit Switch (Optional)

The electric hose reel kit switch is a momentary push button switch used to energize the hose reel relay. The hose reel switch is located toward the rear of the control console (Fig. 93).

Testing

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove console panel. Locate hose reel switch and unplug wire harness connector from switch.
3. With the use of a multimeter (ohms setting), electric hose reel kit switch functions may be tested to determine whether continuity exists across the terminals for each switch position. Continuity (zero ohms resistance) should exist across the switch terminals when the switch is depressed. There should not be continuity (infinite ohms resistance) across the switch terminals when the switch is not depressed.
4. Replace switch if testing determines that it is faulty.
5. If the switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).
6. Connect the wire harness connector to the switch after testing. Secure console panel to machine.

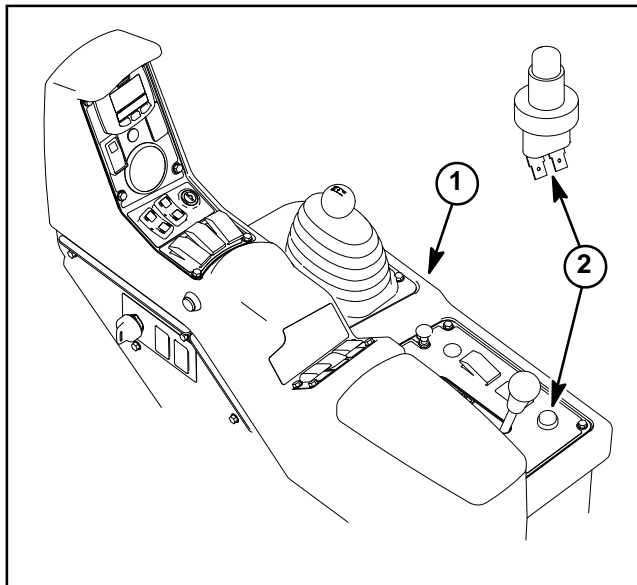


Figure 93

1. Control console

2. Electric hose reel kit switch (opt.)

Service and Repairs

NOTE: For engine electrical component information, see the Kohler Engine Repair Manual.

Battery Storage

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


1. Remove the battery and charge it fully (see Battery Service in this section).
2. Either store battery on a shelf or on the machine.
3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service in this section).


Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

**WARNING**

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gases produced while charging can dissipate. Since these 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.

3. Battery cables must be tight on terminals to provide good electrical contact.

**WARNING**

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

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Clean clamps and terminals separately. Connect cables with positive (+) cable first. Coat battery posts and cable connectors with Battery Terminal Protector (see Special Tools in this chapter) to prevent corrosion.

5. Maintain cell level with distilled water. Do not fill cells above the fill line.

IMPORTANT: Do not remove battery fill caps while cleaning.

2. Check battery condition weekly, after every 50 hours of operation or every 30 days if the machine is in storage. 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 (see Special Tools in this chapter) to prevent corrosion.

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 26 Battery
300 Amp Cranking Performance at 0°F (-18°C)
28 minute Reserve Capacity at 80°F (27°C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal (Fig. 94)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Disconnect negative (black) cable from battery first to prevent short circuiting the battery, other components or operator's hands. Then disconnect positive (red) cable.
3. Remove flange nuts and battery hold down rod.
4. Make sure that battery filler caps are on tightly.
5. Remove battery from chassis to a service area. This will minimize possible battery damage and allow better access for battery inspection and service.

Battery Installation (Fig. 94)

1. Make sure the key is removed from ignition switch.
2. Position the battery on the battery base with its posts toward the right side of the machine.
3. Secure positive cable (red) to positive battery post with cap screw and flange nut.
4. Connect a digital multimeter (set to amps) between the negative battery post and the negative cable (black) connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the electrical system should be tested and repaired.

5. Secure negative cable (black) to negative battery post with cap screw and flange nut.
6. Secure the battery to the machine with flange nuts and battery hold down rod. Do not over tighten flange nuts.
7. Apply battery terminal protector (see Special Tools in this chapter) on battery posts and cable connectors to reduce corrosion after connections are made.

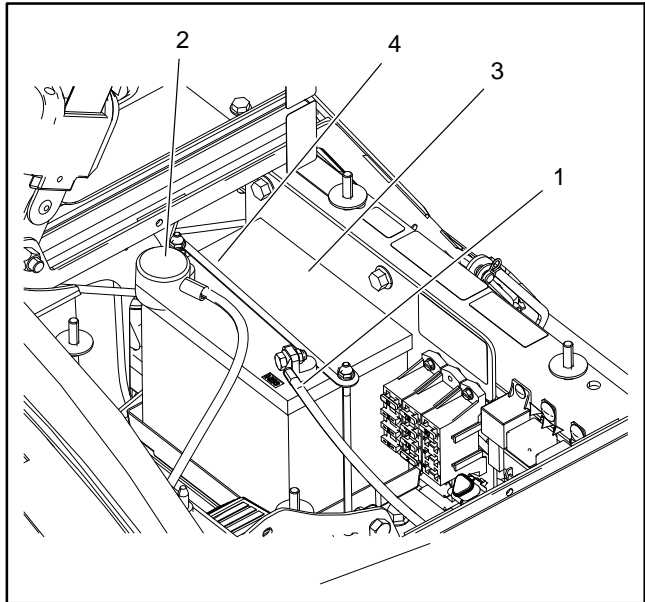


Figure 94

- | | |
|---------------------------|------------------|
| 1. Negative battery cable | 3. Battery |
| 2. Positive battery cable | 4. Hold down rod |

Battery Inspection and Maintenance

1. Check battery for cracks. Replace battery if cracked or leaking.
2. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

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. If the battery electrolyte is accessible, 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.

6. Make sure battery cables, battery connections and the battery hold down components are in good condition. Also, make sure the battery tray is clean and repainted if necessary.

Battery Testing

1. Perform a high-discharge test with an adjustable load tester. This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

	CAUTION
Follow the manufacturer's instructions when using a battery 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 before performing a load test.

B. If the battery has recently been charged, use a battery load tester following the manufacturer's instructions to apply a 150 amp load for fifteen (15) seconds. This step will remove the surface charge.

C. Make sure battery terminals are free of corrosion.

D. Estimate the internal temperature of the battery to the nearest 10 degrees F.

E. Connect a battery load tester to the battery terminals following the manufacturer's instructions. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 345 amps (one half the cranking performance rating of the battery) to the battery for fifteen (15) seconds.

G. Take a battery voltage reading at fifteen (15) seconds, then remove the load.

H. Using the table in the column to the right, determine the minimum voltage for the battery temperature reading. If the test voltage is below the minimum voltage for the battery temperature, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Minimum Voltage	Battery Temperature	
	70F (and up)	21C (and up)
9.6	70F (and up)	21C (and up)
9.5	60F	16C
9.4	50F	10C
9.3	40F	4C
9.1	30F	-1C
8.9	20F	-7C
8.7	10F	-12C
8.5	0F	-18C

2. If the battery electrolyte is accessible, the specific gravity of the electrolyte can be used to determine the battery condition.

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 10F (5.5C) above 80F (26.7C) add 0.004 to the specific gravity reading. For each 10F (5.5C) below 80F (26.7C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100F
Cell Gravity	1.245
100F minus 80F equals 20F	
(37.7C minus 26.7C equals 11.0C)	
20F multiply by 0.004/10F equals 0.008	
(11C multiply by 0.004/5.5C equals 0.008)	
ADD (conversion above)	<u>0.008</u>
Correction to 80F (26.7C)	1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Battery Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is readily available.

 CAUTION
<p>Follow the manufacturer's instructions when using a battery charger.</p>

NOTE: Using specific gravity of the battery electrolyte is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open circuit voltage or electrolyte specific gravity (if electrolyte is accessible).

Battery Charge Level	Open Circuit Voltage	Specific Gravity
100%	12.6	1.265
75%	12.4	1.225
50%	12.2	1.190
25%	12.0	1.155
0%	11.8	1.120

2. Determine the charging time and rate using the battery charger manufacturer's instructions or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps



CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (16°C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. Following the battery charger manufacturer's instructions, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery following the battery charger manufacturer's instructions.

5. While charging, occasionally check the battery. If the electrolyte is violently gassing or spewing or if the battery case feels hot to the touch, the charging rate must be lowered or temporarily stopped.

6. Determine if battery is fully charged before removing battery from charger. Either of the following procedures can be used:

A. Continue charging and reduce charging rate as needed until a two (2) hour period results in no increase in voltage. Open circuit voltage should be approximately 12.6 volts for a fully charged battery.

B. If the battery electrolyte is accessible, 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.

Flow Meter Sensor

Removal (Fig. 95)

1. Park machine on a level surface, stop engine and engage parking brake. Remove key from ignition switch.
2. Locate flow meter sensor in spray manifold at rear of machine. Disconnect flow meter sensor from machine wire harness.
3. Loosen lock nut and remove flow meter sensor from flow meter.

Installation (Fig. 95)

1. Thread jam nut against sensor hex head.
2. Thread sensor into flow meter body until bottom of sensor jam nut is **0.38 in. (9.6 mm)** from flow meter body.
3. Turn sensor out (counterclockwise) until orientation groove on top of sensor is parallel with flow meter body.
4. Hold sensor in position and turn jam nut down to contact flow meter body. Tighten jam nut from **15 to 20 in-lb (1.7 to 2.3 N-m)**.
5. Connect the wire harness to the flow meter sensor after testing is complete.

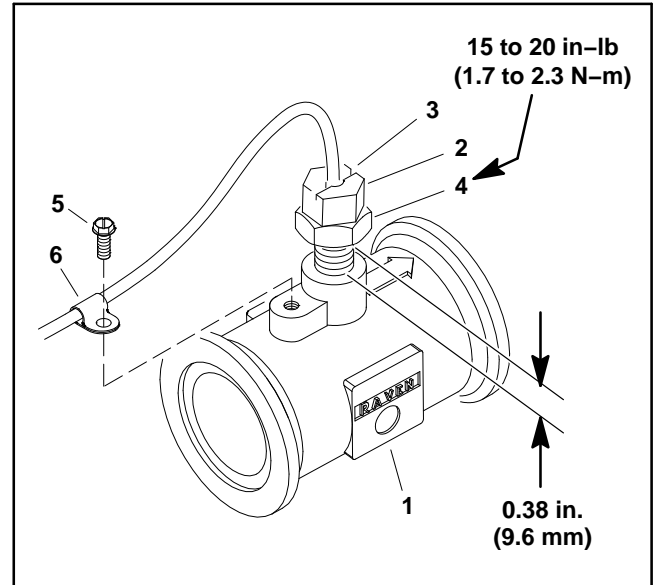


Figure 95

- | | |
|-----------------------|------------|
| 1. Flow meter body | 4. Jam nut |
| 2. Flow meter sensor | 5. Screw |
| 3. Orientation groove | 6. Clamp |

Headlights



CAUTION

The Multi Pro 1750 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 or explosion creating a serious safety hazard.

Headlight bulbs should be handled without touching the clear bulb surface. Handle the bulb by holding onto the base.

Headlight Disassembly (Fig. 96)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Disconnect the wire harness connector from the headlight bulb.
3. 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. Do not touch the clear bulb surface when removing bulb.
4. If necessary, remove headlight from hood.
 - A. Remove four (4) flat washers and plugs that secure headlight to hood. Discard plugs.
 - B. Remove headlight from hood.

Headlight Assembly (Fig. 96)

1. If headlight was removed, secure headlight to hood:
 - A. Insert headlight into hood opening. Make sure that manufacturer logo on headlight lens is at bottom.
 - B. Secure headlight to hood with four (4) flat washers and new plugs.
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. Connect the wire harness connector to the headlight.

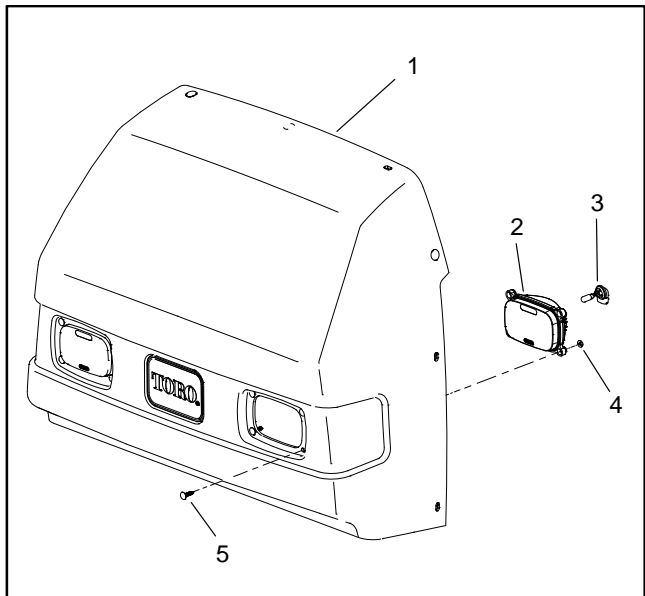


Figure 96

- | | |
|-------------------|-------------------------|
| 1. Front hood | 4. Washer (4 per light) |
| 2. Headlight (2) | 5. Plug (4 per light) |
| 3. Headlight bulb | |

Pump Drive Electric Clutch

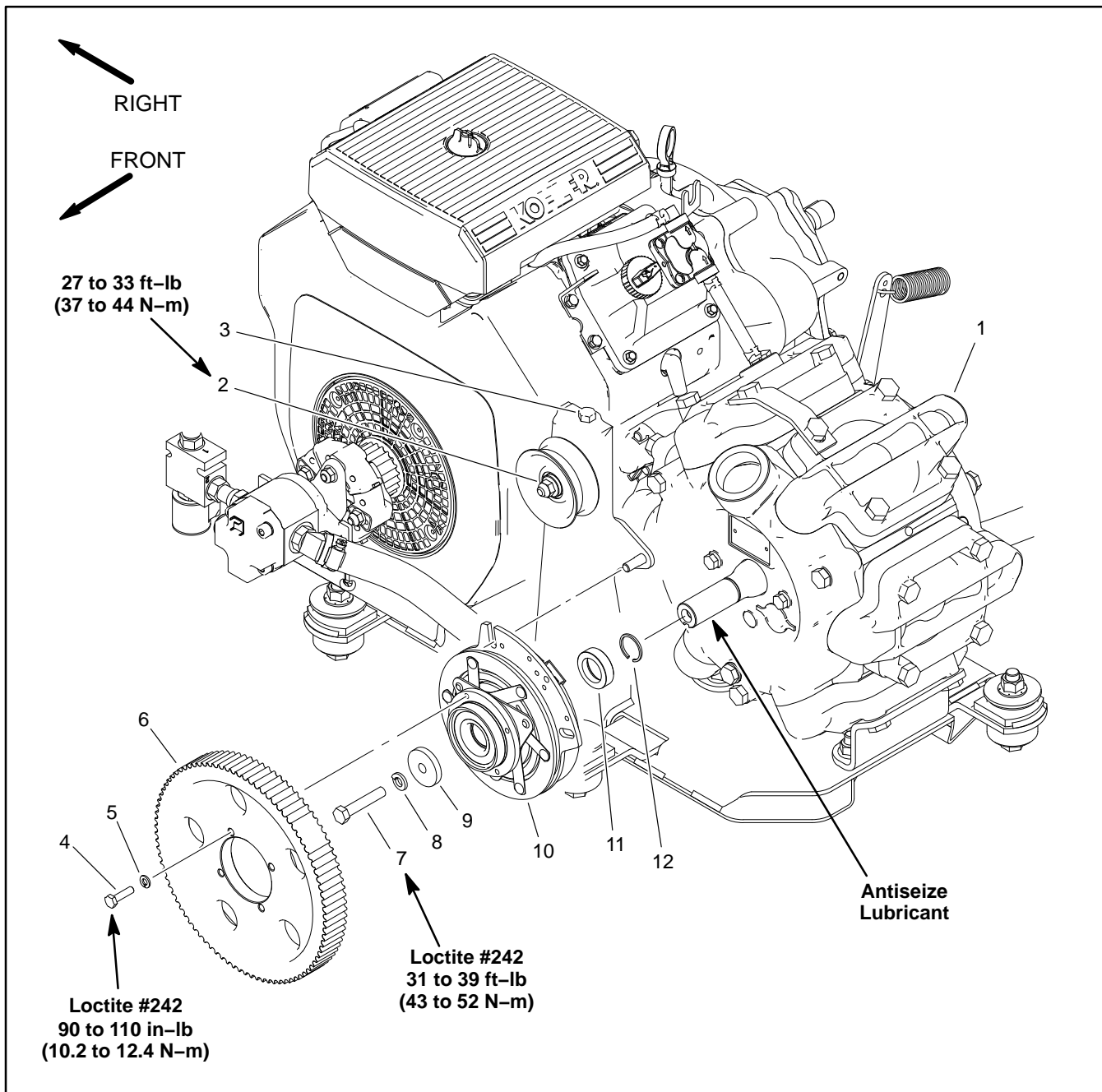


Figure 97

- 1. Spray pump
- 2. Flange nut
- 3. Cap screw
- 4. Cap screw (4)

- 5. Lock washer (4)
- 6. Clutch sprocket
- 7. Cap screw
- 8. Lock washer

- 9. Spacer
- 10. Electric Clutch
- 11. Spacer
- 12. Retaining ring

The pump drive electric clutch used on the Multi Pro has sealed, non-serviceable bearings. If clutch bearing failure occurs, clutch replacement is necessary.

Removal (Fig. 97)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Loosen idler pulley flange nut (item 2) and turn adjusting screw (item 3) counterclockwise to relieve drive belt tension. Remove spray pump drive belt from pump pulley.
3. Remove four (4) cap screws (item 4) and lock washers that secure pump sprocket to electric clutch. Remove pump sprocket from clutch.
4. Unplug machine wire harness connector from clutch terminals.
5. Remove cap screw (item 7), lock washer and clutch spacer (item 9) that secure electric clutch to spray pump shaft.
6. Slide electric clutch from pump shaft and anchor stud.
7. If necessary, remove spacer (item 11) from pump shaft. Inspect spacer and retaining ring for wear and replace if necessary.

Installation (Fig. 97)

1. Apply antiseize lubricant to pump input shaft. Make sure that retaining ring on pump shaft is fully seated in shaft groove.
2. If spacer (item 11) was removed from pump shaft, slide spacer onto pump shaft. Make sure that spacer groove fits around retaining ring on pump shaft.
3. Align key in clutch with key slot in pump shaft and align mounting slot of clutch to anchor stud on idler bracket. Slide clutch onto gearbox shaft making sure that anchor stud is positioned in slot of clutch.
4. Apply medium strength thread locker (ie. Loctite #242) to threads of cap screw (item 7). Install cap screw, lock washer and clutch spacer (item 9) to secure clutch to pump shaft. Torque screw from **31 to 39 ft-lb (43 to 52 N-m)**.
5. Attach machine wire harness connector to clutch terminals.
6. Apply medium strength thread locker (ie. Loctite #242) to threads of cap screws (item 4). Position pump sprocket to clutch and secure with four (4) cap screws and lock washers. Torque screws from **90 to 110 in-lb (10.2 to 12.4 N-m)**.
7. Install drive belt over sprockets and under idler pulley. Adjust drive belt tension (see Adjust Spray Pump Drive Belt in Chapter 6 – Spray System in this manual).



Spray System

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Specifications

Item	Description
Spray Pump	6-Diaphragm, Positive Displacement Pump Maximum Flow Rate of 45 GPM
Spray Pressure Relief Valve	Poppet Style, 218 PSI (15 Bar) Maximum
Sprayer Tank	175 Gallon, Polyethylene
Suction Strainer	50 Mesh (Blue), Stainless Steel, Tank Mounted (30 Mesh (Red) and 80 Mesh (Green) Optional)
Pressure Filter (Serial Number Above 315000000)	80 Mesh, Agitation Manifold Mounted

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 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. 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 system pressure is relieved before loosening any system component (e.g. spray valves, spray system hose).

Spray System Operation

The Multi Pro 1750 spray system uses a six (6) diaphragm positive displacement 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 pump is engine driven by a synchronous drive belt and is engaged with an electric clutch.

The downward stroke of the spray pump's connecting rods and diaphragms create suction to allow fluid to be drawn from the spray tank to the pump through 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 when the connecting rods change direction. Leaks in the suction line will cause system problems and often will be indicated by erratic suction line jumping, erratic pressure gauge reading and pump noise.

Once to the spray 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 at the rear of the sprayer. A pressure gauge on the operator control console indicates spray system pressure.

The machine operator controls the spray system on the Multi Pro 1750 with electrical switches located on the spray console. Switches include a spray pump ON/OFF switch, an application rate switch, an agitation control switch, a master boom switch, three (3) individual boom control switches and two (2) boom lift switches. These switches control the agitation valve motor, the regulating (rate control) valve motor, the master valve motor, three (3) boom valve motors and the hydraulic boom lift solenoid coils.

When the spray pump is on, the application rate (increase/decrease) switch allows the operator to adjust electrical current to the regulating (rate control) valve motor located behind the spray tank. Higher current results in a pressure rate increase and lower current results in a pressure rate decrease. Desired spray pump pressure should be based on boom nozzle selection and intended sprayer ground speed. See the Nozzle Selection Guide (Toro Form No. 3351-389) for information regarding boom nozzle selection.

When the spray pump is engaged and the agitation control switch is ON, the agitation valve motor located behind the spray tank is opened. This open valve directs system flow to three (3) agitation nozzles in the spray tank. When the agitation switch is OFF, the agitation valve motor is closed so no flow is directed to the tank agitation nozzles.

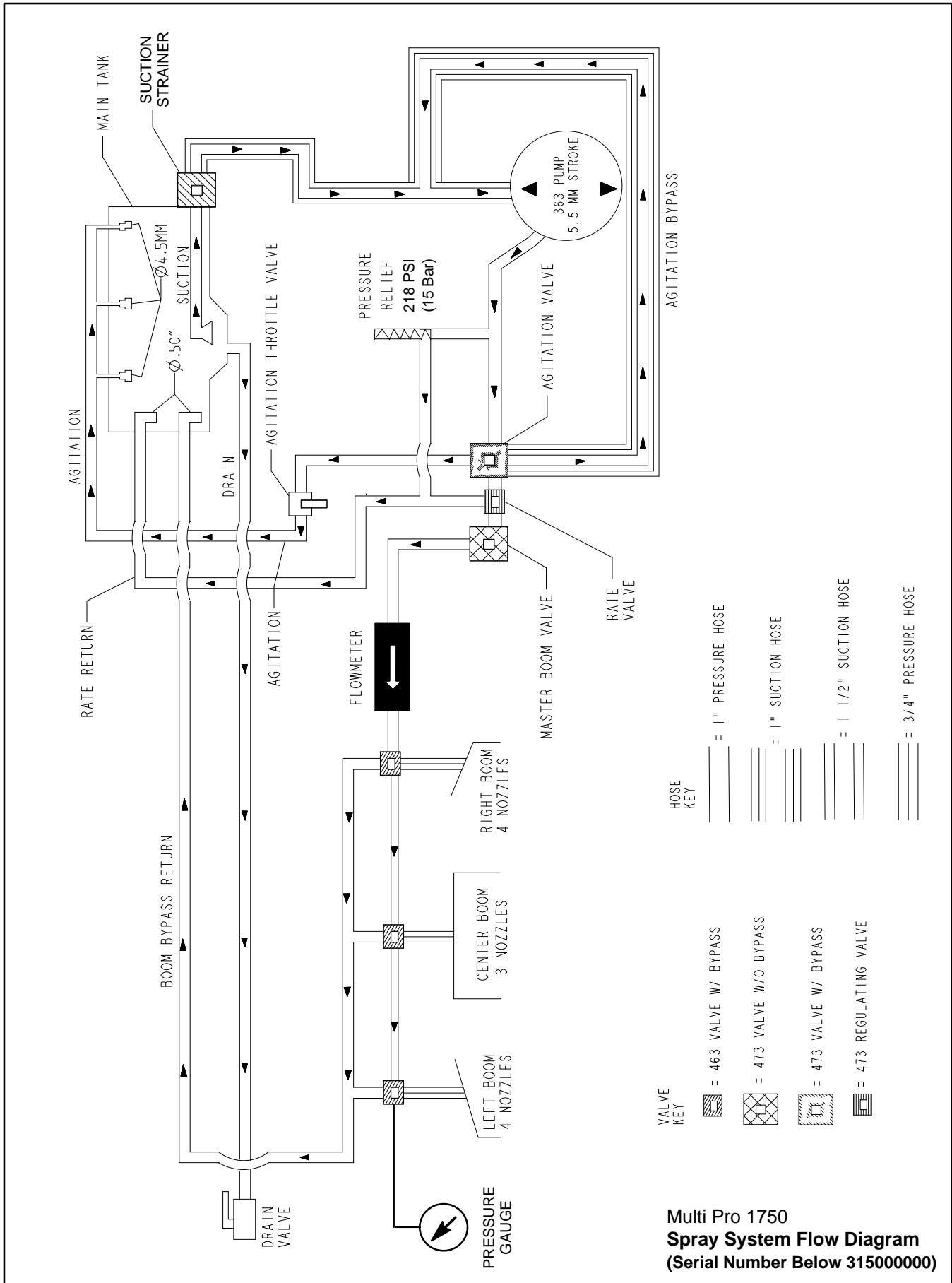
An in-line flowmeter in the pressure side of the system directly before the boom control valves measures flow to the spray booms. The InfoCenter display can be used by the operator to monitor information regarding spray system operation.

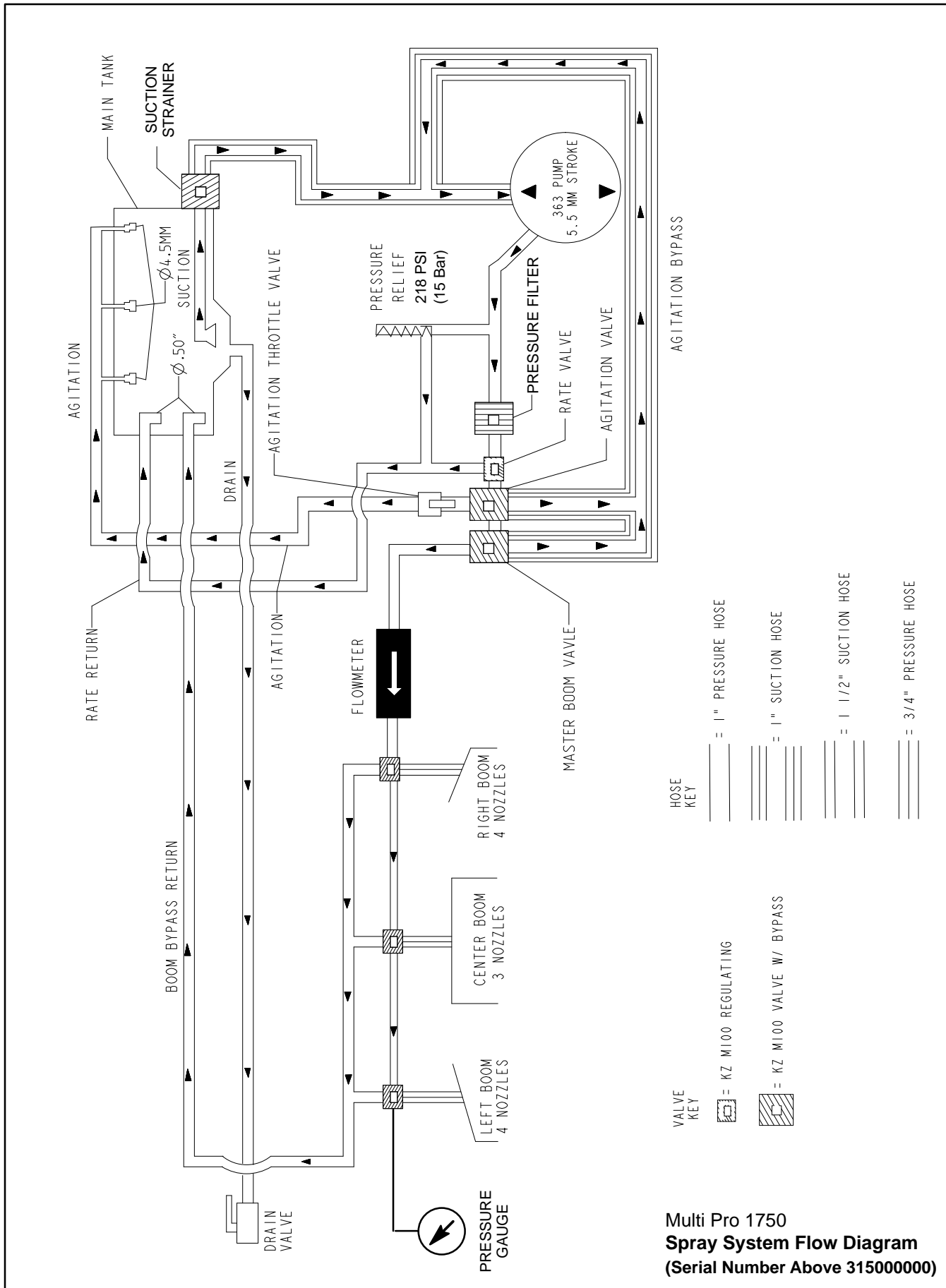
The master boom valve located behind the spray tank is controlled by the master boom switch on the spray console. When the master boom switch is ON, system flow is available for the spray boom sections (left, center and right).

The spray boom switches (left, center or right) allow the operator to control individual spray booms. When a spray boom switch is ON, an actuator for that boom control valve opens the valve. This open valve directs system flow to the spray nozzles located on the boom section. An adjustable boom bypass valve exists in each of the boom valve motors to prevent system pressure changes when a boom section is shut off. Flow in excess of control valve settings is directed back to the spray tank. When a boom control switch is OFF, the boom control valve is closed so no flow is available to that spray boom section.

Battery current for spray system fuses, switches, relays and other components is provided by the main power relay when the machine ignition switch is in the START or RUN position. For spray system electrical component information and test procedures, see Chapter 5 – Electrical System in this manual.

Spray System Flow Diagrams





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 is not seating.
Fluid leaking from bottom of spray pump	Faulty diaphragm(s) exist in spray pump. Spray 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 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. Pressure filter is plugged (machine serial number above 315000000) 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 for affected boom not sealing.

Problem	Possible Cause
Spray pump doesn't rotate	<p>Spray pump switch is OFF or is faulty.</p> <p>Accelerator pedal not actuating throttle home switch – Operator advisory “Pump Start Prevented–High Engine RPM” Accelerator pedal is not properly adjusted (see Chapter 3 – Kohler gasoline Engine). Throttle home switch is dirty, corroded or damaged (see Chapter 5 – Electrical System).</p> <p>Spray pump drive belt is damaged or missing.</p> <p>Spray pump drive electric clutch is not engaged or is faulty (see Chapter 5 – Electrical System).</p> <p>NOTE: To avoid damaging the spray pump drive, the spray pump switch will only engage when the engine is at low idle and either the master boom (spray enable) switch is disengaged or the master boom switch is engaged but none of the boom spray switches are engaged.</p>
Erratic spray operation from booms	<p>Suction screen in spray tank is plugged.</p> <p>Pressure filter is plugged (machine serial number above 315000000)</p> <p>Spray nozzle(s) are clogged or damaged.</p> <p>Boom bypass valves are not adjusted correctly.</p> <p>Spray nozzles are different sizes.</p> <p>Console boom switch(es) are dirty, corroded or damaged.</p> <p>Boom valve actuator is worn or damaged.</p>
No spray output from one spray boom	<p>Hoses on boom are pinched or kinked.</p> <p>Fuse for affected boom valve actuator is faulty (machine serial number below 315000000).</p> <p>Circuit breaker for affected boom valve actuator is faulty (machine serial number above 315000000). Remove power from circuit for 20 seconds to reset circuit breaker.</p> <p>Boom valve for affected boom is not opening.</p> <p>Console boom switch for affected boom valve is dirty, corroded or damaged.</p> <p>NOTE: Check for 12 VDC at affected boom valve motor in both directions (ON and OFF).</p>
Low spray rate from one boom nozzle	<p>Spray nozzle(s) are clogged or damaged on affected boom.</p> <p>Spray nozzles are different sizes on affected boom.</p>

Adjustments

Adjust Spray Pump Drive Belt

1. Loosen idler pulley flange nut (Fig. 1).
2. Turn adjusting screw clockwise to increase drive belt tension until belt deflection is **0.38 in (9.5 mm)** at 10 lb (kg) force applied half way between the engine and spray pump sprockets. Tighten belt to 73 to 75 hertz if using a sonic tension meter.
3. Tighten idler pulley flange nut from **27 to 33 ft-lb (37 to 44 N-m)**.

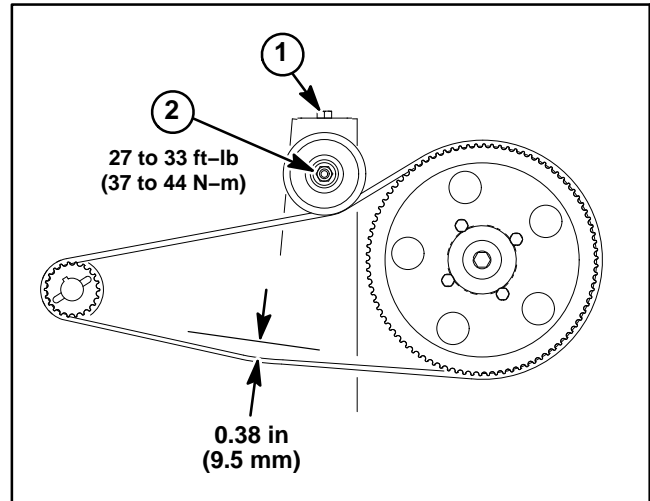


Figure 1

1. Adjusting screw
2. Idler pulley flange nut

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Service and Repairs

Spray Pump Drive Belt

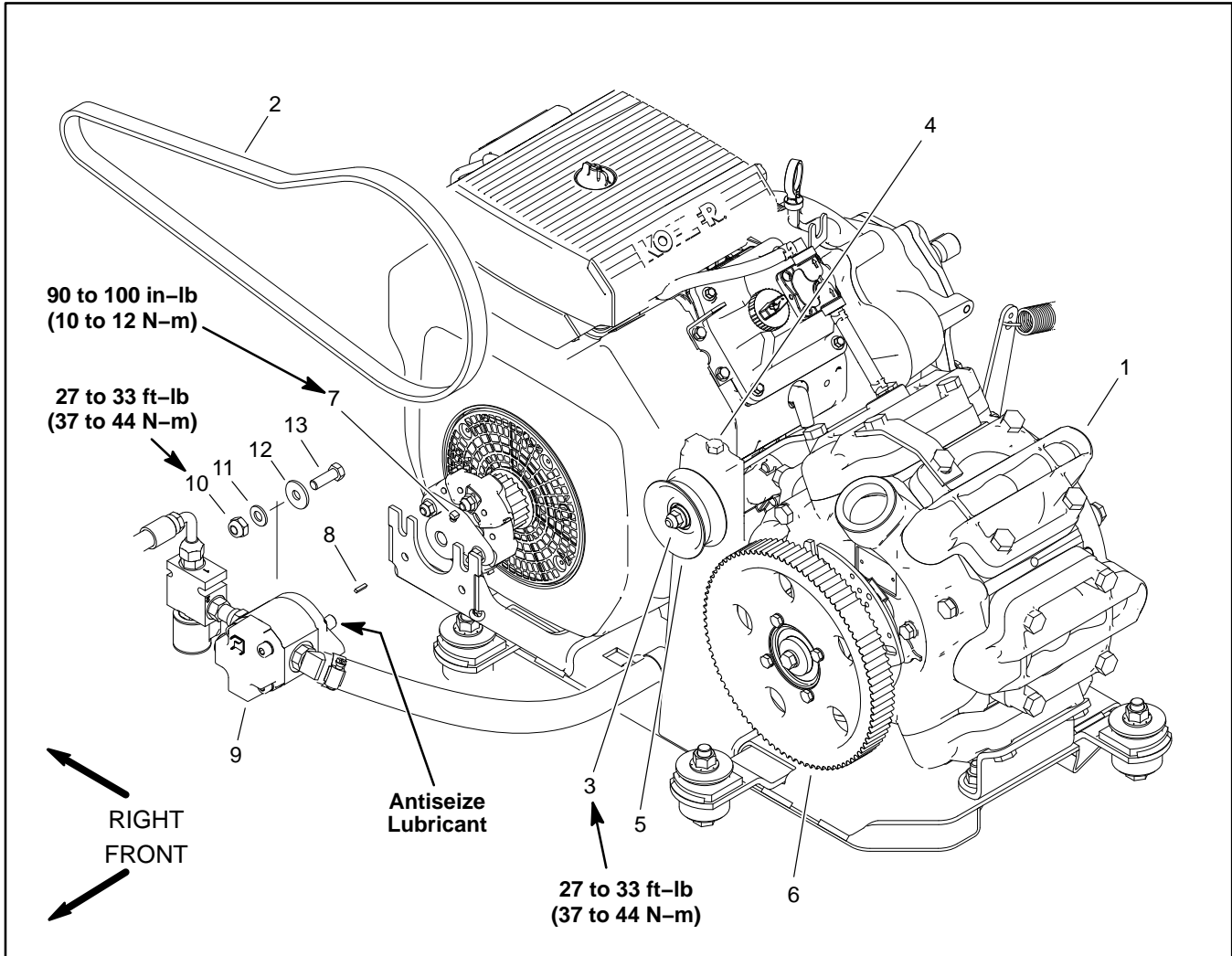


Figure 2

- 1. Spray pump
- 2. Drive belt
- 3. Flange nut
- 4. Adjusting screw
- 5. Idler pulley

- 6. Drive pulley
- 7. Square head set screw (2)
- 8. Key
- 9. Hydraulic pump assembly

- 10. Lock nut (2)
- 11. Flat washer (2)
- 12. Flat washer (2)
- 13. Cap screw (2)

Drive Belt Removal (Fig. 2)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch and raise operator seat.
2. Loosen idler pulley flange nut (item 3) and turn adjusting screw (item 4) counterclockwise to relieve drive belt tension. Remove spray pump drive belt from idler and pump drive pulleys.
3. Locate and retrieve hydraulic pump key (item 8)
4. Loosen two (2) set screws on pump hub (item 7).
5. Remove fasteners securing hydraulic pump assembly (item 9) to engine and pump mounting plate. Slide pump assembly from pump hub and set aside.
6. Remove drive belt.

Drive Belt Installation (Fig. 2)

1. Install drive belt over sprockets and under idler pulley.
2. Adjust drive belt tension (see Adjust Spray Pump Drive Belt in Chapter 6 – Spray System in this manual).
3. Position key into hydraulic pump shaft and apply anti-seize lubricant to pump shaft and key.
4. Align pump shaft with hub and install pump to mounting plate with fasteners shown. Tighten pump mounting fasteners from **27 to 33 ft-lb (37 to 44 N-m)**. Tighten two (2) pump hub set screws from **90 to 110 in-lb (10 to 12 N-m)**.
5. Lower operator seat.

Spray Pump

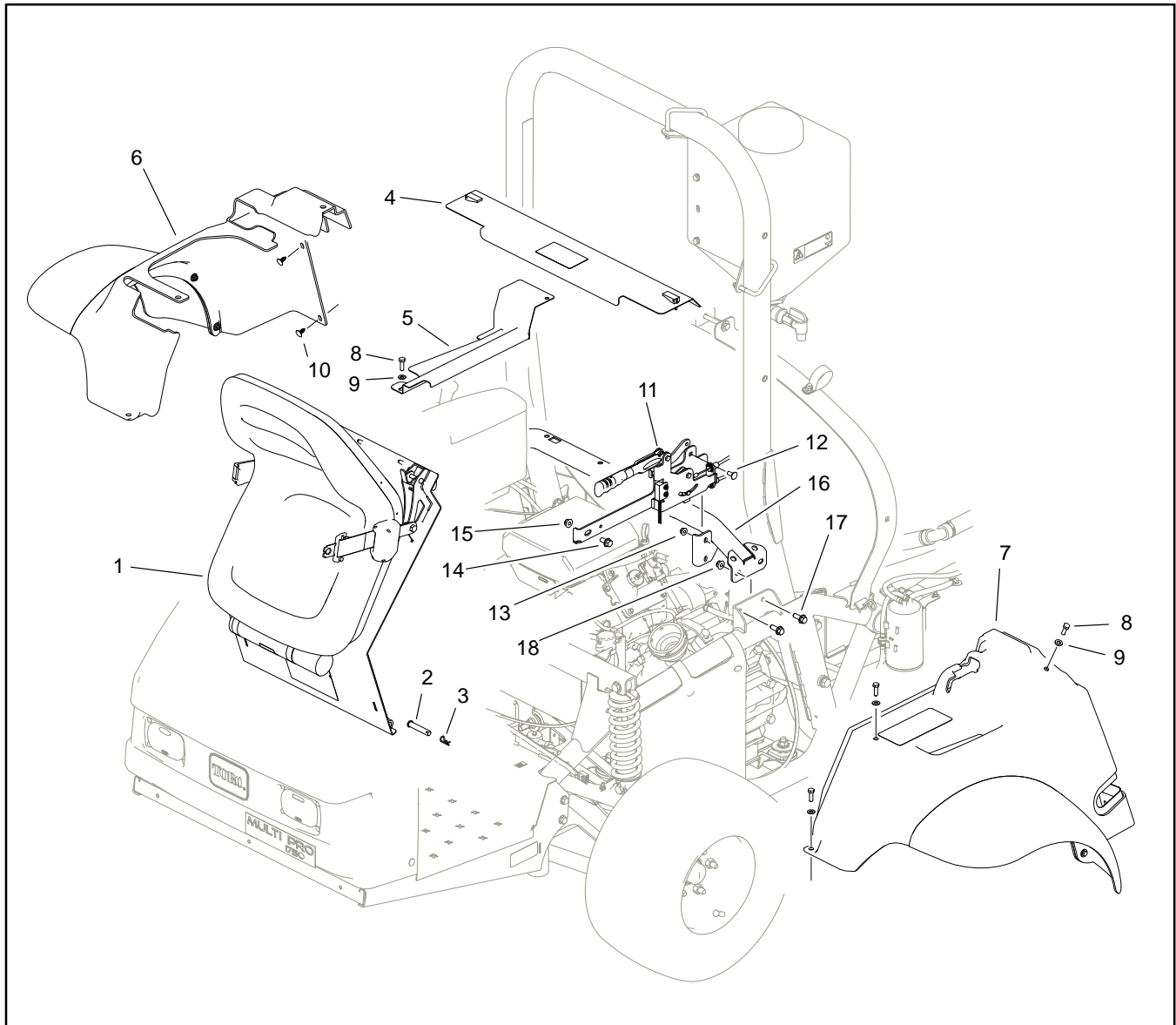



Figure 3

- | | | |
|--------------------------|----------------------------|---------------------------|
| 1. Seat assembly | 7. Left fender assembly | 13. Flange nut (2) |
| 2. Hinge pin (2) | 8. Hex head screw (7) | 14. Flange head screw (2) |
| 3. Hair pin (2) | 9. Flat washer (7) | 15. Flange nut (2) |
| 4. Engine cover | 10. Panel fastener (4) | 16. Frame cross member |
| 5. Console bottom cover | 11. Parking brake assembly | 17. Flange head screw (4) |
| 6. Right fender assembly | 12. Carriage bolt (2) | 18. Flange nut (4) |

Removal (Fig. 3)

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components. 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. Disconnect seat switch wire harness from machine main wire harness. Raise seat and remove hair pins (item 3) from seat prop rod and from two (2) seat hinge pins (item 4). Remove seat assembly from machine.
3. Remove engine cover (item 4).
4. Remove console bottom cover (item 5).
5. Remove left and right fender assemblies.
6. Remove parking brake assembly (item 11).
7. Remove frame cross member (item 16).
8. Remove forks that secure suction and pressure hoses to pump fittings and disconnect suction and pressure hoses from spray pump. Cover or plug pump fittings to prevent debris from entering the pump while the hoses are disconnected.
9. Remove pump clutch (see Pump Drive Electric Clutch in Chapter 5 – Electrical System in this manual).
10. Remove flange head screws and flange nuts that secure pump to engine and pump mounting plate (Fig. 4).

	CAUTION
Spray pump assembly weighs approximately 140 lbs (59 kg). Use an appropriate lifting device to safely lift the pump assembly.	

11. Use the lifting strap provided and carefully lift spray pump from machine.

Installation (Fig. 3)

1. Use the lifting strap provided and carefully lift spray pump into machine.
2. Install flange head screws and flange nuts that secure pump to mounting plate (Fig. 4). Tighten screws from **45 to 55 ft-lb (61 to 75 N-m)**.

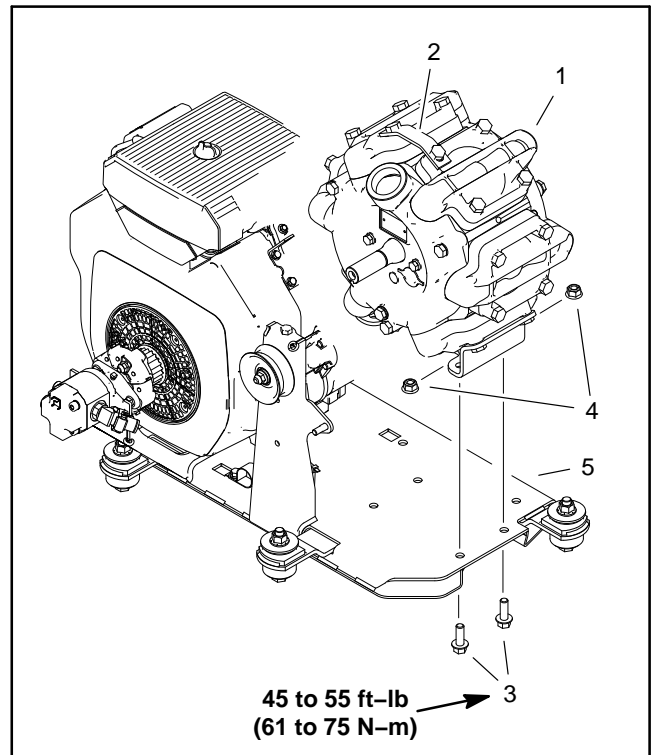


Figure 4

- | | |
|-------------------|--------------------------|
| 1. Spray pump | 4. Flange head screw (4) |
| 2. Lifting strap | 5. Mounting plate |
| 3. Flange nut (4) | |

3. Install pump clutch (see Pump Drive Electric Clutch in Chapter 5 – Electrical System in this manual).

NOTE: Coat spray system O-rings with vegetable oil before installation to reduce the chance of damage during assembly.

4. Remove covers or plugs from spray pump ports. Install suction and pressure hoses to pump and secure with forks.
5. Install frame cross member (item 16)
6. Install parking brake assembly (item 11).
7. Install left and right fender assemblies.
8. Install console bottom cover (item 5).
9. Install engine cover (item 4).

10. Align seat assembly to machine frame and install hinge pins (item 3). Install hair pins (item 4) in hinge pins and seat prop rod. Connect seat switch wire harness to machine main wire harness and lower seat assembly.

Spray Pump Service

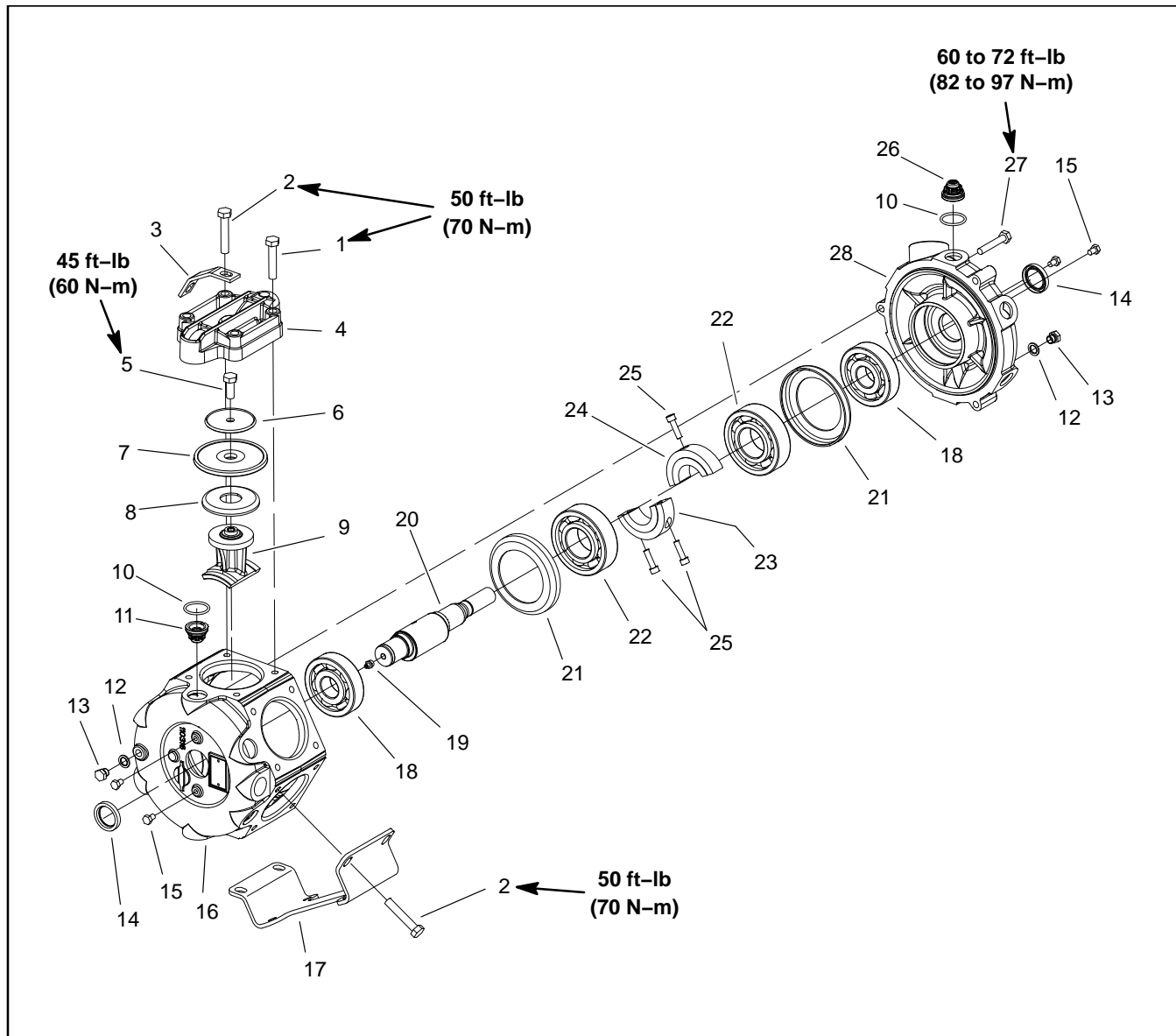


Figure 5

- | | | |
|-------------------------------|----------------------|--------------------------------|
| 1. Hex bolt (18) | 11. Pump valve (10) | 20. Crank shaft |
| 2. Hex bolt (6) | 12. Seal (2) | 21. Metal spacer (2) |
| 3. Pump bracket | 13. Plug (2) | 22. Ball bearing (2) |
| 4. Valve cover (6) | 14. Oil seal (2) | 23. Counterbalance |
| 5. Hex bolt (6) | 15. Hex bolt (4) | 24. Counterbalance |
| 6. Diaphragm disc (6) | 16. Pump housing | 25. Allen bolt (3) |
| 7. Diaphragm (6) | 17. Pump foot | 26. Pump valve (with hole) (2) |
| 8. Diaphragm backing disc (6) | 18. Ball bearing (2) | 27. Hex bolt (3) |
| 9. Connecting rod (6) | 19. Grease fitting | 28. Pump casting |
| 10. O-ring (12) | | |

NOTE: Many spray 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 13) and seals (item 12) 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 (item 4) on pump housing.

NOTE: When servicing the pump, it is recommended that all diaphragms and pump valves be replaced to ensure correct pump operation.

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 can be identified by the vent hole and white color.

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. If fluids are evident in crankcase, make sure that crankcase is drained and that crankshaft is greased thoroughly. Also, make sure that drain hole in bottom of pump is not blocked.

9. 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.

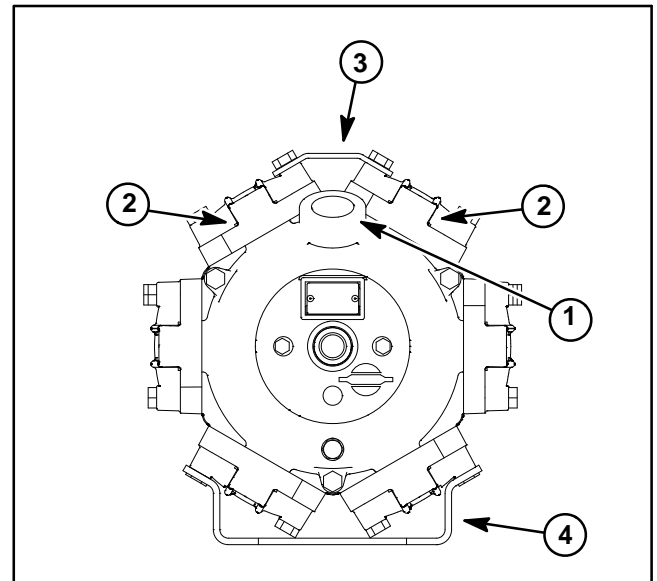


Figure 6

- | | |
|---------------------------|-----------------|
| 1. Pump inlet | 3. Pump bracket |
| 2. Pump valve (with hole) | 4. Pump foot |

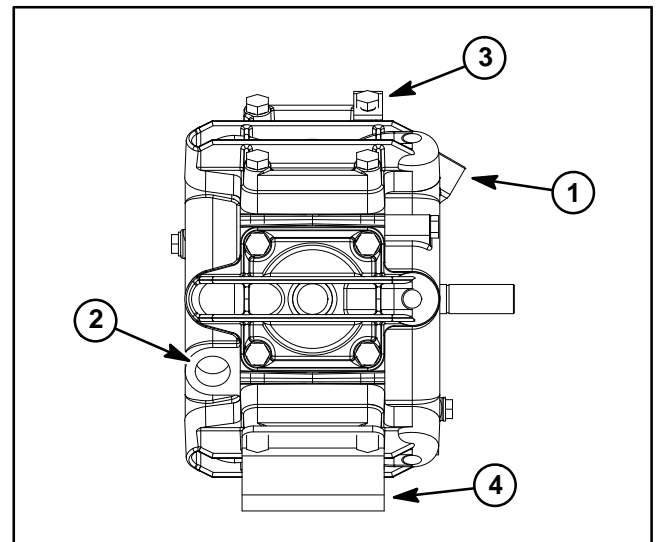


Figure 7

- | | |
|----------------|-----------------|
| 1. Pump inlet | 3. Pump bracket |
| 2. Pump outlet | 4. Pump foot |

Crankshaft Bearing Service (Fig. 5)

1. For assembly purposes, use marker to identify location of all connecting rods. Also, note orientation of pump housing and pump casting to ensure that pump inlet and outlet are properly positioned during assembly (Fig. 7).

2. Remove three (3) hex bolts (item 27) that secure pump casting halves together.

3. To separate the pump castings:
 - A. On crankshaft end with grease fitting, place spacer or socket on crankshaft.
 - B. Using dead blow hammer, tap the spacer to separate the pump casting from the pump housing.
 - C. Once a gap is created between the pump housing and casting, 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 metal spacers (item 21), bearings (item 22) and counterbalance halves (items 23 and 24) from pump casting.
6. Press ball bearings from crankshaft, pump housing and pump casting. If necessary, remove counterbalance halves (items 23 and 24) from crankshaft.
7. Remove seals (item 14) 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 housing and casting.
11. Install connecting rod bearings on crankshaft:
 - A. If counterbalance halves (items 23 and 24) were removed from crankshaft, install the counterbalance halves onto the crankshaft.
 - B. Pressing on bearing inner race, install first connecting rod bearing onto crankshaft. Then press second bearing onto crankshaft.
12. Install seals into pump housing and casting. Seal face should be flush with casting.
13. Position the pump housing (item 16) on a flat work surface with the seal end down.
14. Place metal spacer (item 21) and then crankshaft assembly into pump housing. Make sure that end of crankshaft with the grease fitting is inserted into the housing.
15. Using marks made during disassembly to identify connecting rod locations, install connecting rods to crankshaft. Make sure that rod flange fits under metal spacer that is installed in housing.

16. Place second metal spacer onto crankshaft and connecting rods and then install pump casting. Make sure that pump inlet and outlet ports are positioned as noted during disassembly (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 pump 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 **45 ft-lb (60 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 can be identified by the vent hole and white color.

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. To make sure that diaphragm lip fits properly in valve cover, rotate crank shaft so that diaphragm is positioned between the center and top of its travel.
 - C. 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 valve cover. It may be necessary to
 - D. Secure valve cover to pump using hex bolts (4 per cover). Torque bolts from **50 ft-lb (70 N-m)**.
 - E. Repeat for remaining valve covers.

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Spray System Components (Serial Number Below 31500000)

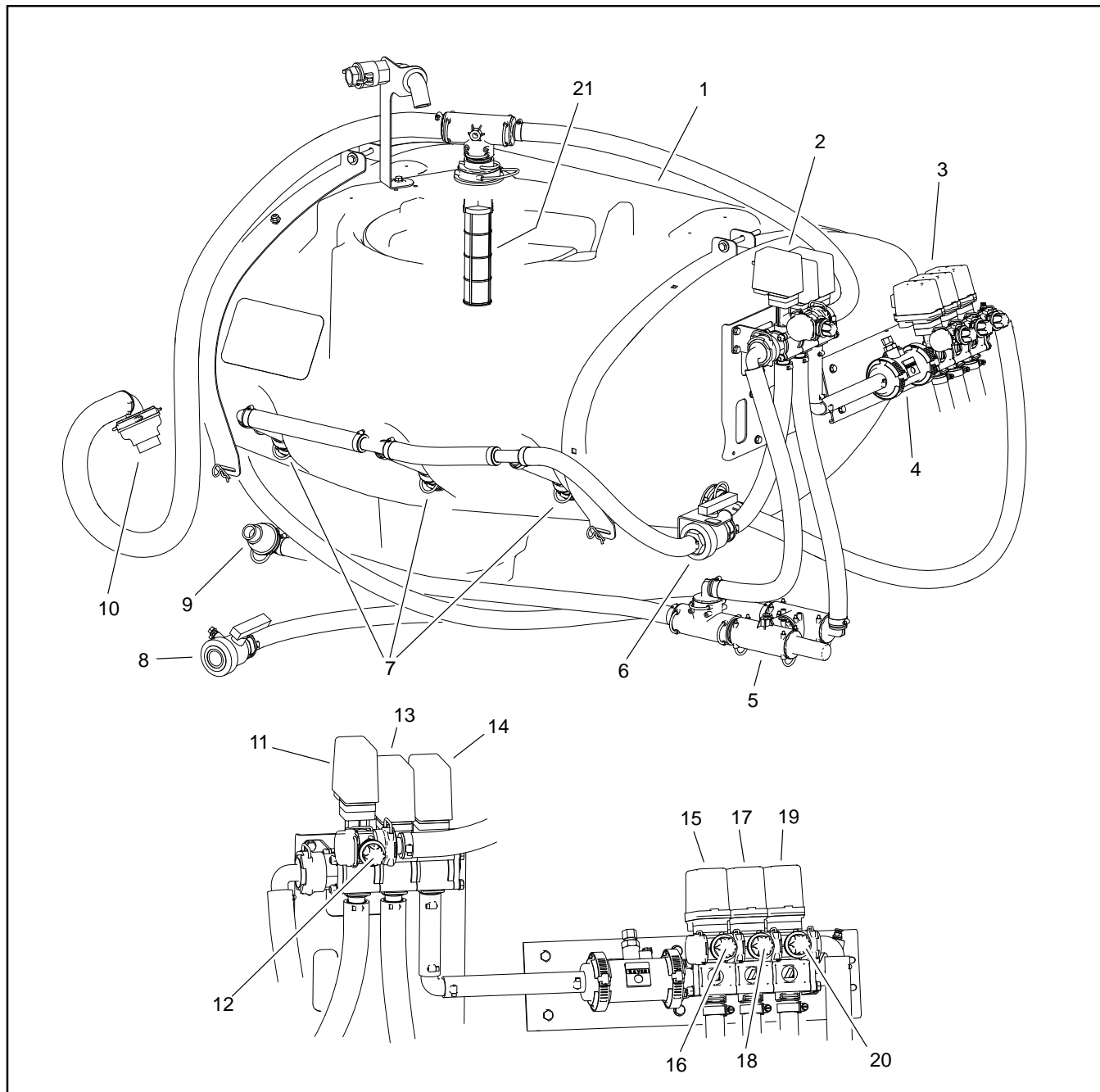


Figure 8

- | | | |
|------------------------------------|----------------------------------|--------------------------------|
| 1. Spray tank | 8. Drain valve | 15. Left boom valve |
| 2. Spray control manifold assembly | 9. Pressure connection (at pump) | 16. Left boom bypass valve |
| 3. Section manifold assembly | 10. Suction connection (at pump) | 17. Center boom valve |
| 4. Flowmeter | 11. Agitation valve | 18. Center boom bypass valve |
| 5. Pressure relief valve | 12. Agitation bypass valve | 19. Right boom valve |
| 6. Agitation throttle valve | 13. Rate control valve | 20. Right boom bypass valve |
| 7. Agitation nozzle (3) | 14. Master boom valve | 21. Suction strainer (50 mesh) |

Service procedures for individual spray system components are included in this chapter.

Spray System Components (Serial Number Above 31500000)

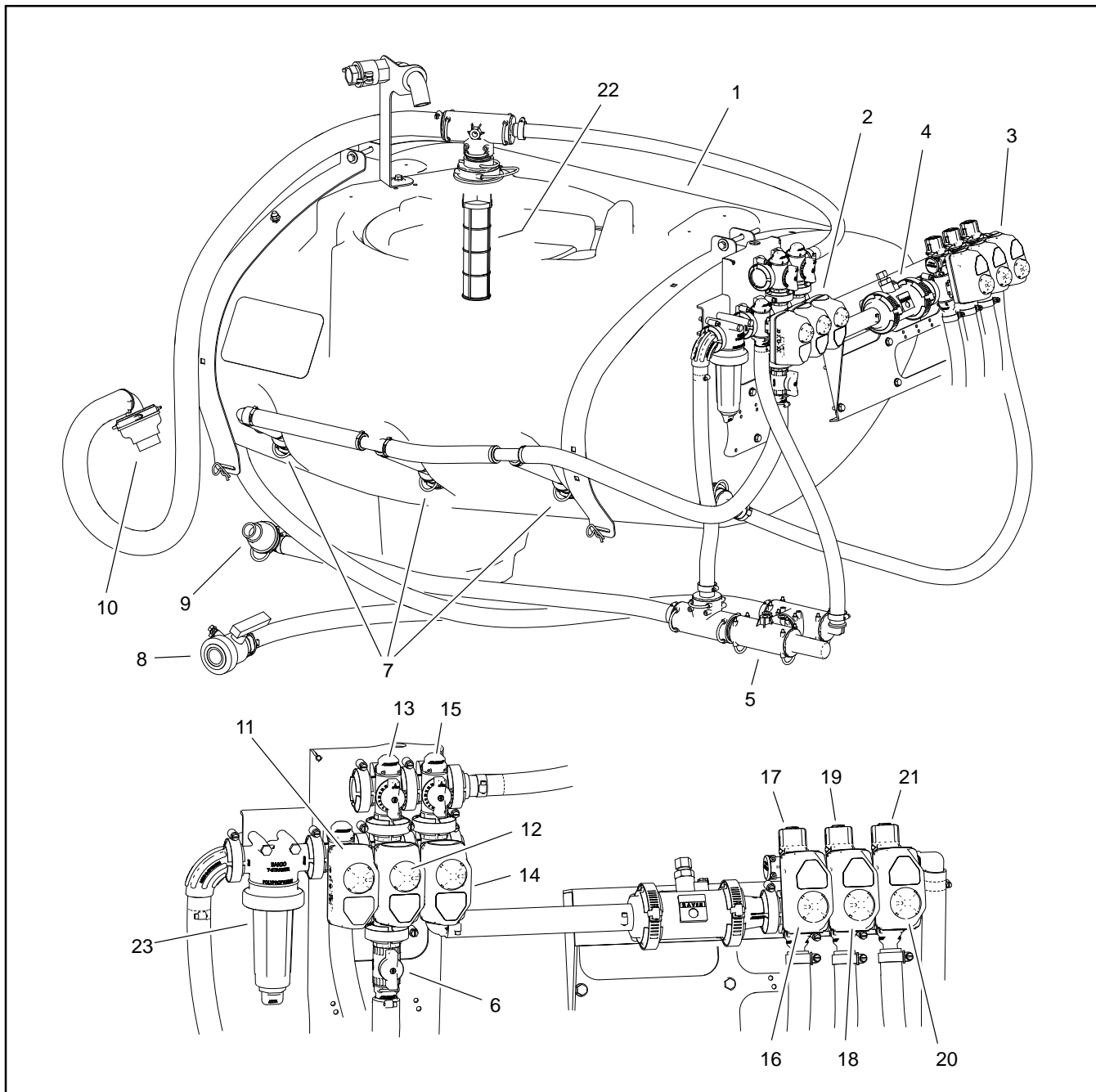


Figure 9

- | | | |
|------------------------------------|----------------------------------|--------------------------------|
| 1. Spray tank | 9. Pressure connection (at pump) | 17. Left boom bypass valve |
| 2. Spray control manifold assembly | 10. Suction connection (at pump) | 18. Center boom valve |
| 3. Section manifold assembly | 11. Rate control valve | 19. Center boom bypass valve |
| 4. Flowmeter | 12. Agitation valve | 20. Right boom valve |
| 5. Pressure relief valve | 13. Agitation bypass valve | 21. Right boom bypass valve |
| 6. Agitation throttle valve | 14. Master boom valve | 22. Suction strainer (50 mesh) |
| 7. Agitation nozzle (3) | 15. Master boom bypass valve | 23. In-line filter (80 mesh) |
| 8. Drain valve | 16. Left boom valve | |

Service procedures for individual spray system components are included in this chapter.

Spray System

Pressure Relief Valve

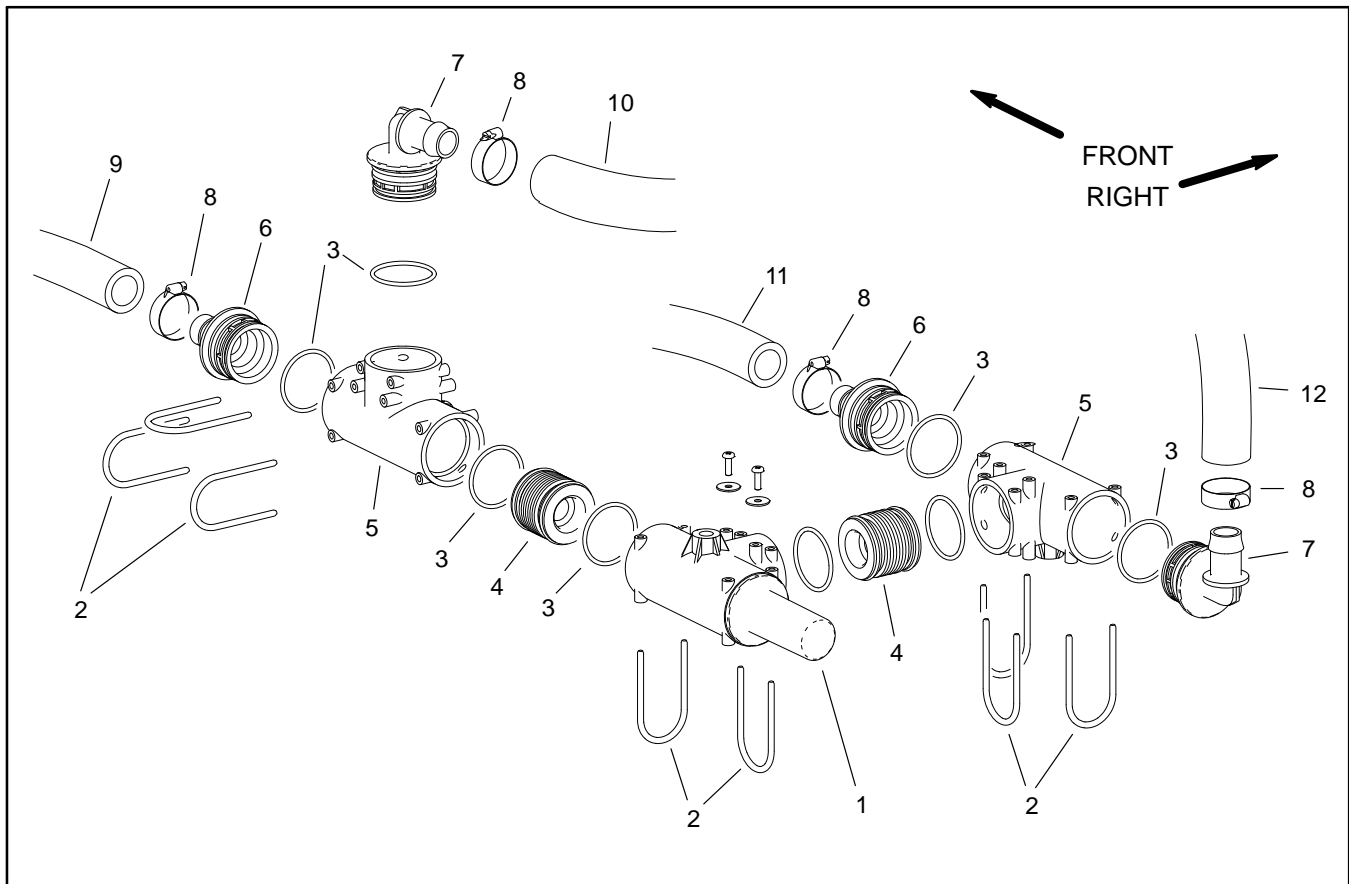


Figure 10

- | | | |
|--------------------------|-------------------------|--------------------------------------|
| 1. Pressure relief valve | 5. Tee (2) | 9. Hose (from pump) |
| 2. Fork – S67 (8) | 6. Straight fitting (2) | 10. Hose (to spray control manifold) |
| 3. O–Ring – S67 (8) | 7. Elbow (2) | 11. Hose (to tank) |
| 4. Connector (2) | 8. Hose clamp (4) | 12. Hose (from rate valve) |

The spray system pressure relief valve is a non adjustable, non repairable component. When spray system pressure exceeds the pressure limit of **218 PSI (15 Bar)**, the valve opens and spray product is directed to the spray tank. Replace the pressure relief valve if system pressure exceeds the pressure limit (valve not opening), or if desired system pressure near the pressure limit is not attainable (valve not closing).

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the pressure relief valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

NOTE: Replace, do not reuse O–rings. Coat O–rings with vegetable oil before installation to reduce damage during assembly.

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Spray Control Manifold Assembly (Serial Number Below 31500000)

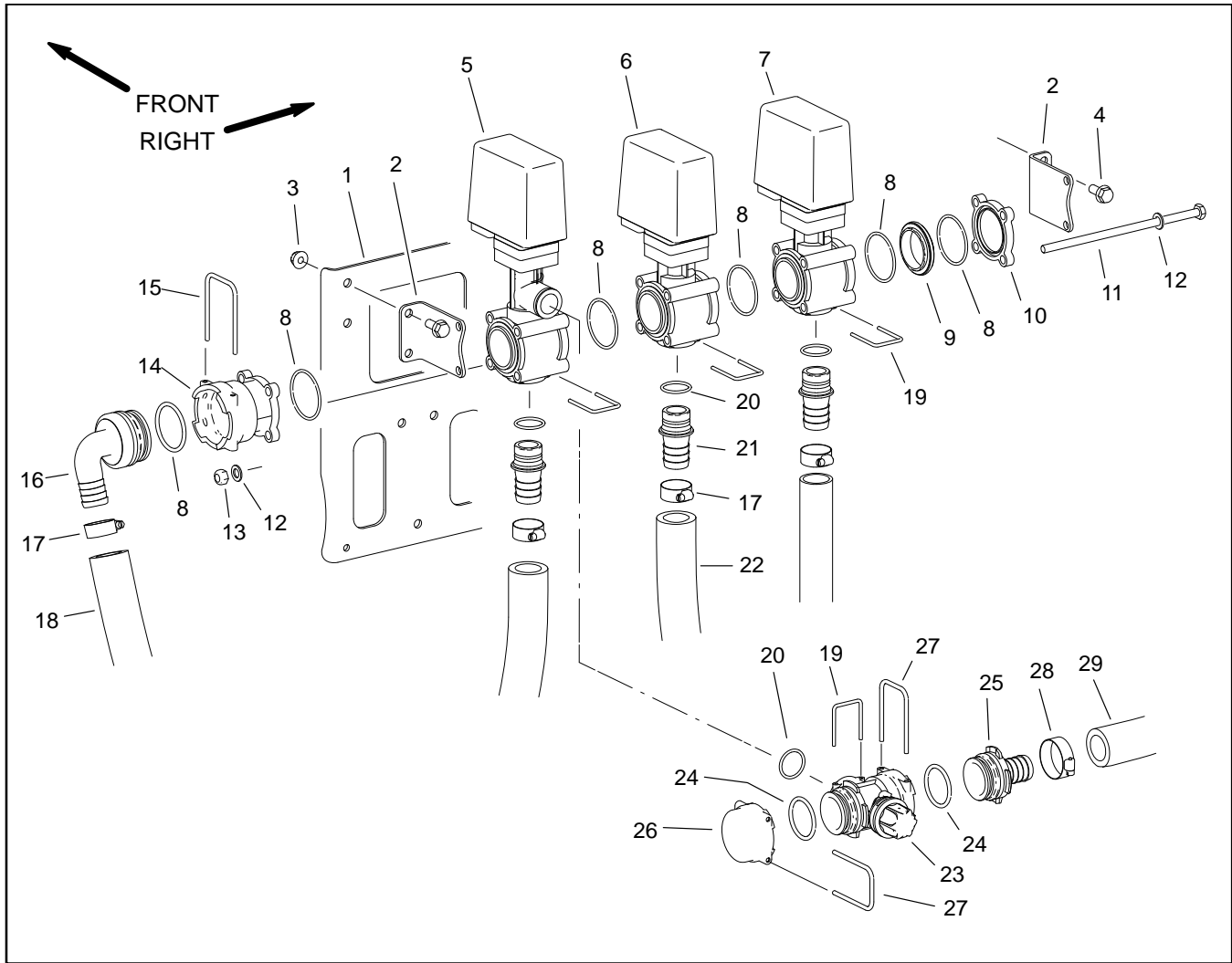


Figure 11

- | | | |
|--------------------------|------------------------|-------------------------------|
| 1. Mounting bracket | 11. Hex head screw (4) | 21. Straight fitting (3) |
| 2. Manifold bracket (2) | 12. Washer (4) | 22. Hose (to spray booms) (3) |
| 3. Flange nut (4) | 13. Lock nut (4) | 23. Bypass valve |
| 4. Flange head screw (4) | 14. Connector | 24. O-Ring - T5 (2) |
| 5. Agitation valve | 15. Fork - T6 | 25. Straight fitting |
| 6. Rate valve | 16. Elbow | 26. Cap |
| 7. Master boom valve | 17. Hose clamp (4) | 27. Fork (2) |
| 8. O-Ring - T6 (6) | 18. Hose (from pump) | 28. Hose clamp |
| 9. Male adapter | 19. Fork - T3 (4) | 29. Hose (to tank) |
| 10. Cover | 20. O-Ring - T3 (4) | |

The spray control manifold assembly includes the agitation valve with bypass valve, the rate control valve and the master boom valve.

IMPORTANT: Each valve actuator has a 5 amp fuse to protect the actuator motor. The fuse is located in an in-line fuse holder on the wire harness near the valve actuators.

Removal (Fig. 11)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the spray control manifold assembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Label all spray control manifold assembly hoses for proper installation. Disconnect hoses from spray control manifold.
3. Label all spray control manifold wire harness leads for proper installation. Disconnect wire harness connectors from valve actuators.
4. Support spray control manifold assembly and remove four (4) flange head screws (item 4) and flange nuts that secure manifold assembly to mounting bracket. Remove spray control manifold assembly from machine.
5. Remove bypass valve from agitation valve. The bypass valve is not repairable. Replace bypass valve if necessary.
6. Disassemble spray control manifold as needed. Discard any removed O-rings and gaskets.

NOTE: See Spray Valve Service (Serial Number Below 315000000) in this chapter for disassembly and assembly information of the valves and valve actuators (items 5, 6 and 7).

Installation (Fig. 11)

NOTE: Replace, do not reuse O-rings. Coat O-rings with vegetable oil before installation to reduce damage during assembly.

1. If spray control manifold was disassembled, install new O-rings prior to assembly.
2. Install new O-rings and install bypass valve.
3. Secure spray control manifold assembly with four (4) flange head screws (item 4) and flange nuts.
4. Using labels placed during removal, install hoses to manifold assembly.
5. Using labels placed during removal, install wire harness connectors to valve actuators.
6. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Spray Control Manifold Assembly (Serial Number Above 31500000)

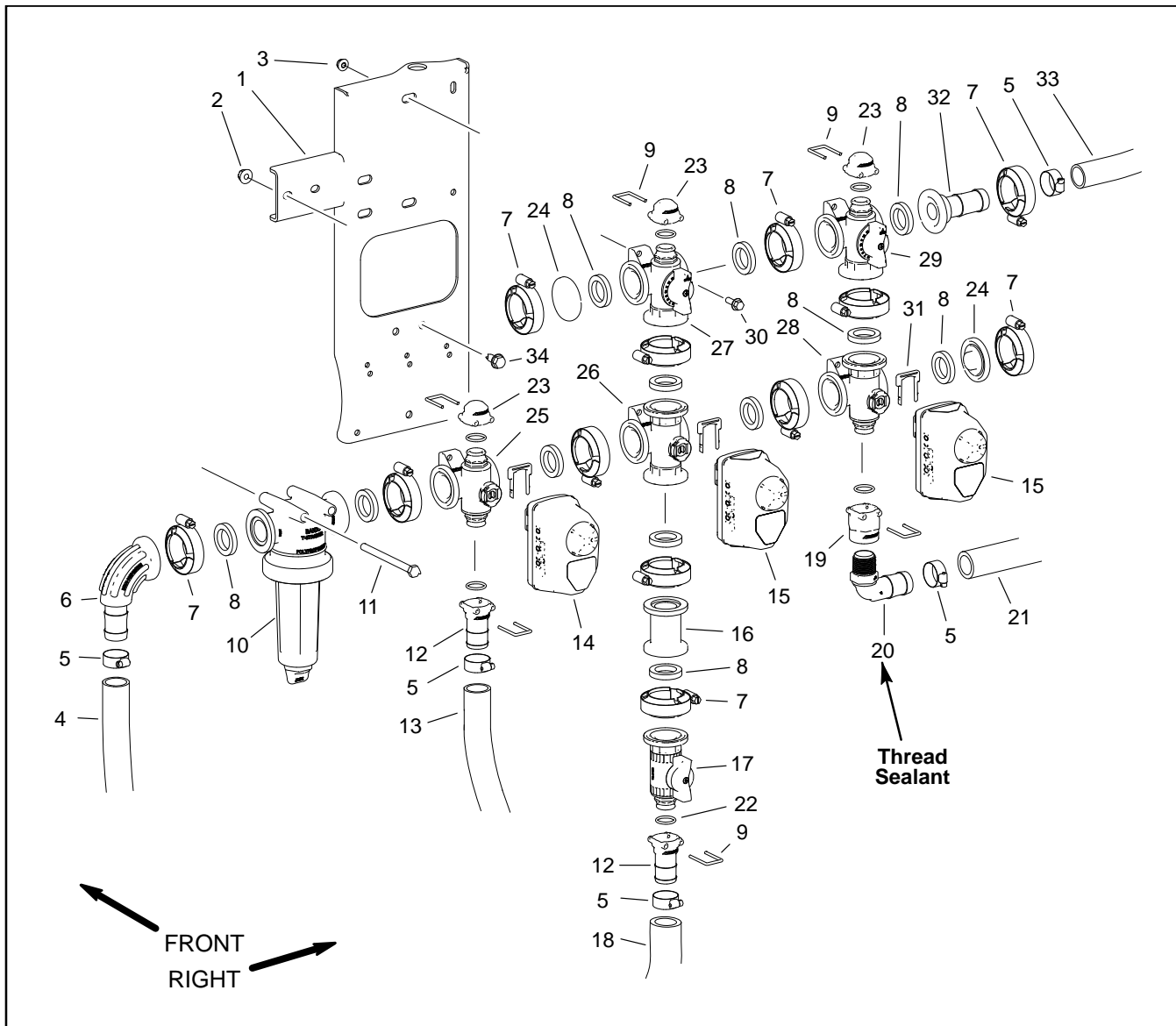


Figure 12

- | | | |
|------------------------------|---------------------------------|------------------------------|
| 1. Mounting plate | 13. Hose (to tank) | 24. Cap (2) |
| 2. Flange nut (2) | 14. Valve actuator – regulating | 25. Rate valve |
| 3. Flange nut (6) | 15. Valve actuator – On/Off | 26. Agitation valve |
| 4. Hose (from spray pump) | 16. Adapter | 27. Agitation bypass valve |
| 5. Hose clamp (5) | 17. Agitation throttle valve | 28. Master boom valve |
| 6. Elbow fitting | 18. Hose (to agitation nozzles) | 29. Master boom bypass valve |
| 7. Clamp (11) | 19. Threaded adapter | 30. Flange head screw (6) |
| 8. Gasket (11) | 20. Elbow fitting | 31. Actuator fork (3) |
| 9. Fork (6) | 21. Hose (to flowmeter) | 32. Hose adapter |
| 10. Pressure filter assembly | 22. O-ring (6) | 33. Hose (to pump) |
| 11. Hex head screw (2) | 23. Cap (3) | 34. Flange head screw (3) |
| 12. Straight fitting (2) | | |

The spray control manifold assembly includes a spray product filter, the rate control valve, the agitation valve with bypass valve, the master boom valve with bypass valve, and the agitation throttle valve.

IMPORTANT: Each valve actuator has an internal circuit breaker to protect the actuator motor. The circuit breaker should reset in 20 seconds after power to the actuator is removed.

Removal (Fig. 12)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the spray control manifold assembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Label all spray control manifold assembly hoses for proper installation. Disconnect hoses from spray control manifold.
3. Label all spray control manifold wire harness leads for proper installation. Disconnect wire harness connectors from spray control manifold.
4. Support spray control manifold assembly and remove four (4) flange nuts (item 3) and flange head screws that secure manifold assembly to mounting plate. Remove two (2) flange nuts (item 5) and hex head screws that secure the pressure filter to the mounting plate. Remove spray control manifold assembly from machine.
5. Disassemble spray control manifold as needed. Discard any removed O-rings and gaskets.

NOTE: See Valve Service (Serial Number Above 315000000) and Bypass Valve Service (Serial Number Above 315000000) in this chapter for disassembly and assembly information of the valves and valve actuators.

Installation (Fig. 12)

NOTE: Replace, do not reuse gaskets and O-rings. Coat O-rings and gaskets with vegetable oil before installation to reduce damage during assembly.

1. Assemble spray control manifold.
2. Secure spray control manifold assembly with four (4) flange nuts (item 3) and flange head screws, and two (2) flange nuts (item 5) and hex head screws.
3. Using labels placed during removal, install hoses to manifold assembly.
4. Using labels placed during removal, install wire harness connectors to manifold assembly.
5. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Flowmeter

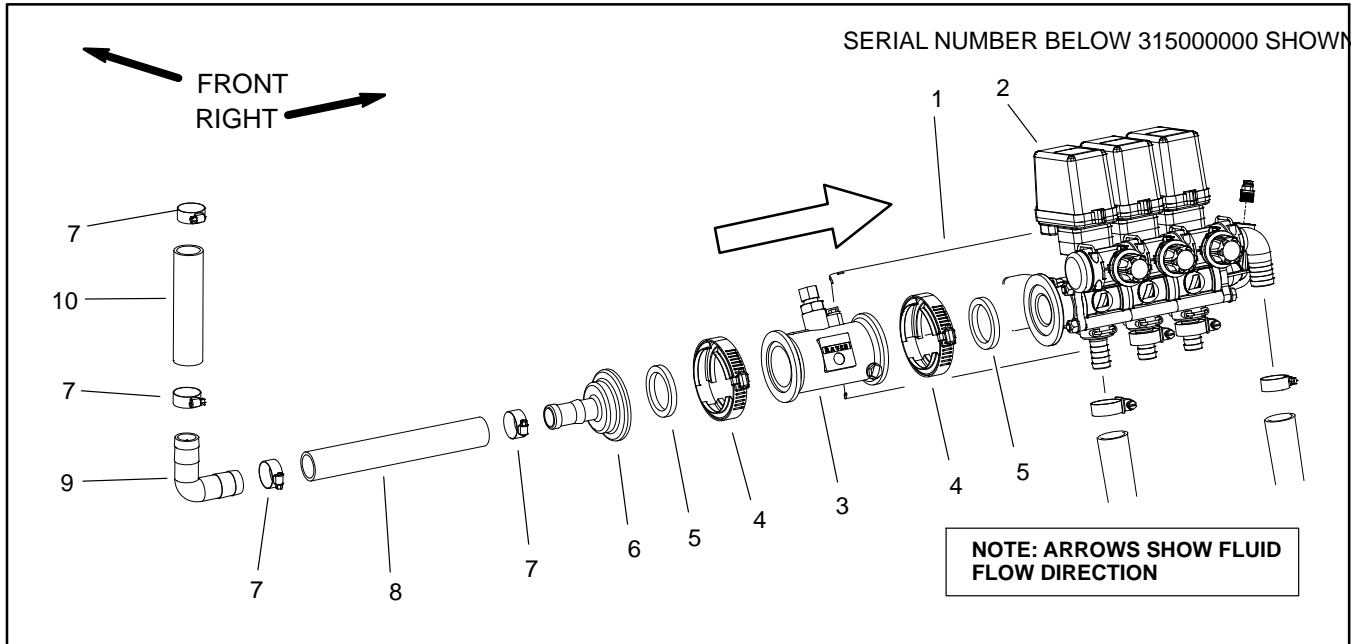


Figure 13

- | | | |
|--------------------------------------|-----------------|-----------------------------------|
| 1. Boom spray valve manifold bracket | 5. Gasket (2) | 8. Hose (from master boom valve) |
| 2. Boom spray valve manifold | 6. Barb fitting | 9. Barb elbow fitting |
| 3. Flowmeter | 7. Hose clamp | 10. Hose (from master boom valve) |
| 4. Clamp (2) | | |

The flowmeter (item 3) provides an input to the Toro Electronic Controller (TEC) regarding the spray system flow that is available to the boom spray valves. If the flowmeter is being replaced, calibrate the flowmeter after installation (see Calibrating the Sprayer Flow in the machine Operator's Manual).

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

Removal (Fig. 13)

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

2. Disconnect wire harness connector from flowmeter.

IMPORTANT: Note the direction of the arrow on top of flowmeter (Fig. 14). The arrow should point toward the boom valve manifold assembly.

3. Support flowmeter and loosen clamps that secure flowmeter to boom valve manifold assembly (item 2) and hose barb (item 6).

4. Remove flowmeter and discard gaskets (item 5). See Flowmeter Service in this chapter for additional information.

Spray System

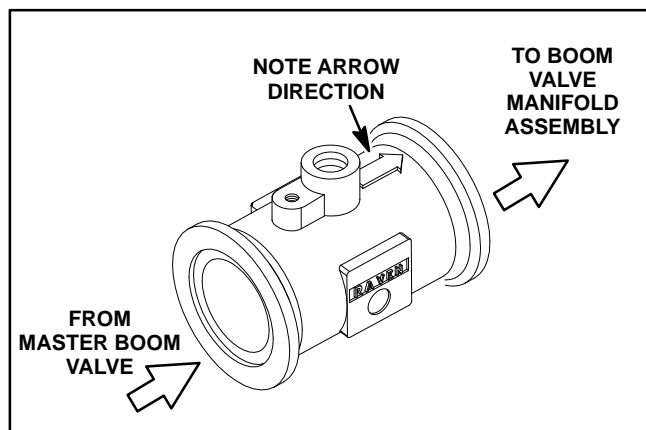


Figure 14

Installation (Fig. 13)

NOTE: Replace O-rings and gaskets. Coat O-rings and gaskets with vegetable oil to reduce the chance of damage during assembly.

1. Assemble flowmeter, clamps and new gaskets between boom valve manifold assembly and hose barb. Make sure that arrow on flowmeter body is pointing toward the boom valve manifold assembly (Fig. 14). Tighten flowmeter clamps.

2. Connect wire harness connector to flowmeter.

3. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

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Flowmeter Service

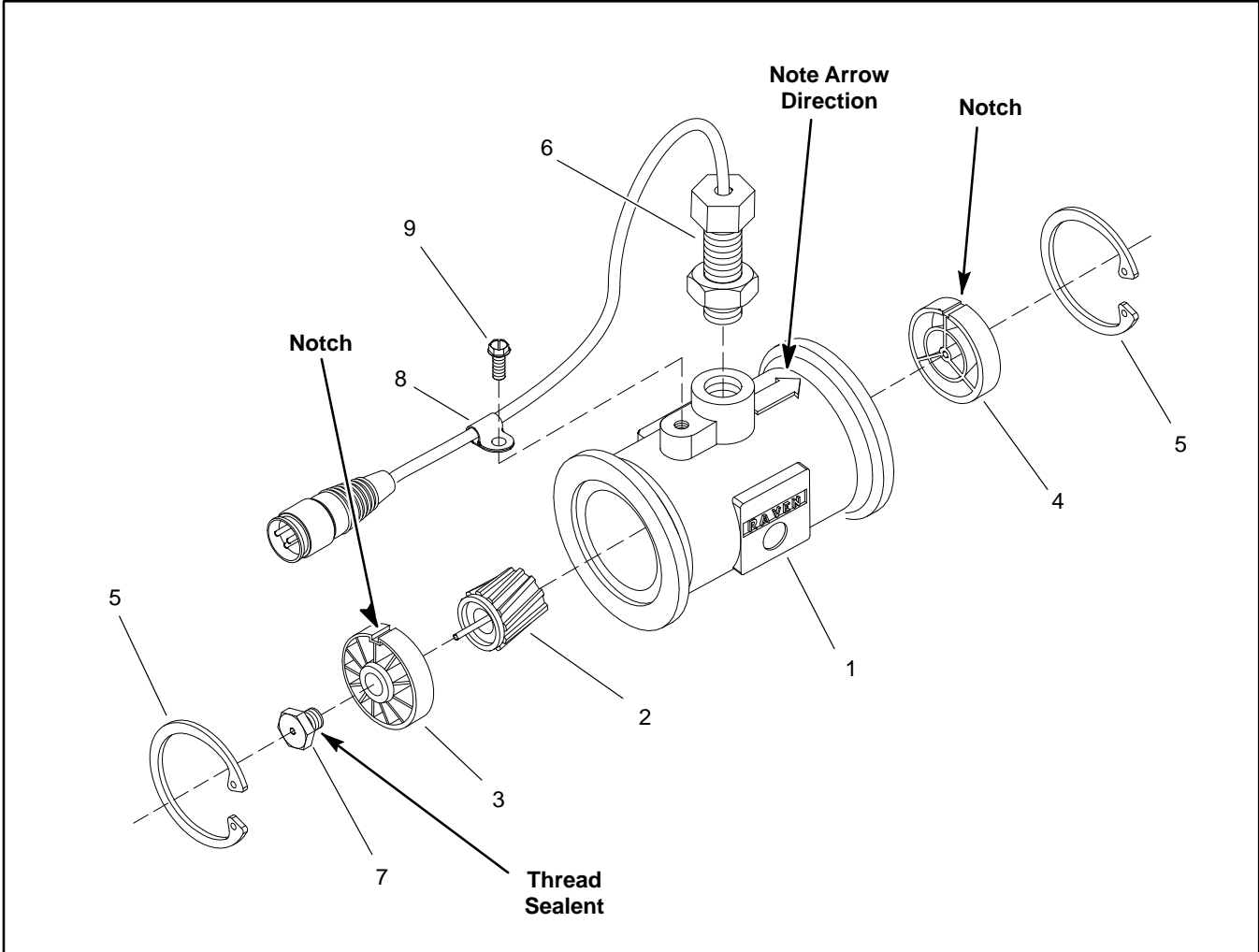


Figure 15

- 1. Flowmeter body
- 2. Rotor/magnet assembly
- 3. Upstream hub and bearing
- 4. Downstream hub
- 5. Retaining ring (2)
- 6. Sensor assembly
- 7. Turbine stud with bearing
- 8. Cable clamp
- 9. Screw

Disassembly (Fig. 15)

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. Remove flowmeter from machine (see Flowmeter in this chapter).
2. Disassemble flowmeter.
3. Clean rotor (item 2), both hubs (items 3 and 4) and flowmeter body to remove any debris, spray chemicals or other materials.

Assembly (Fig. 15)

1. Assemble flowmeter. Check the following items during flowmeter assembly.
 - A. If turbine stud was removed from upstream hub, apply thread sealant to threads of stud before installation.
 - B. Check that rotor spins freely with very little drag. If necessary, loosen the turbine stud 1/16 of a turn and check rotor drag. Continue the process of loosening stud until rotor spins freely.
 - C. When installing hubs (items 3 and 4) into housing, make sure to align locating notch on each hub with boss in housing bore.
 - D. If sensor (item 7) was removed from flowmeter body, thread sensor into housing so it lightly bottoms in housing. Secure sensor in position by tightening jam nut.
 - E. Make sure that retaining rings are fully seated in grooves of flowmeter housing.
2. Install flowmeter (see Flowmeter in this chapter).

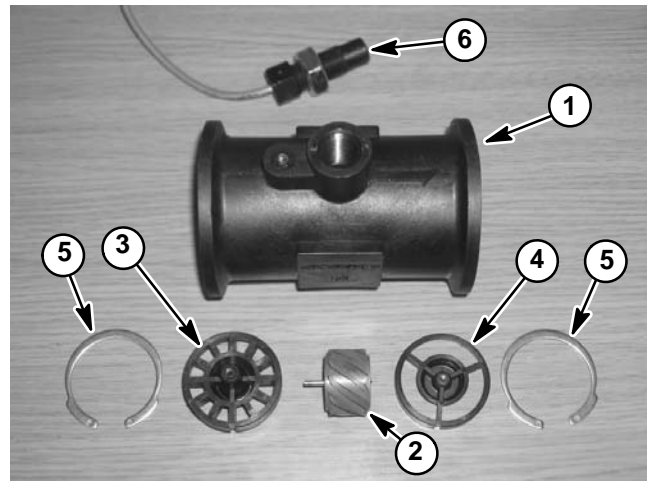


Figure 16

- | | |
|--------------------------|-----------------------|
| 1. Flowmeter body | 4. Downstream hub |
| 2. Rotor/magnet assembly | 5. Retaining ring (2) |
| 3. Upstream hub/bearing | 6. Sensor |

Boom Spray Valve Manifold Assembly (Serial Number Below 31500000)

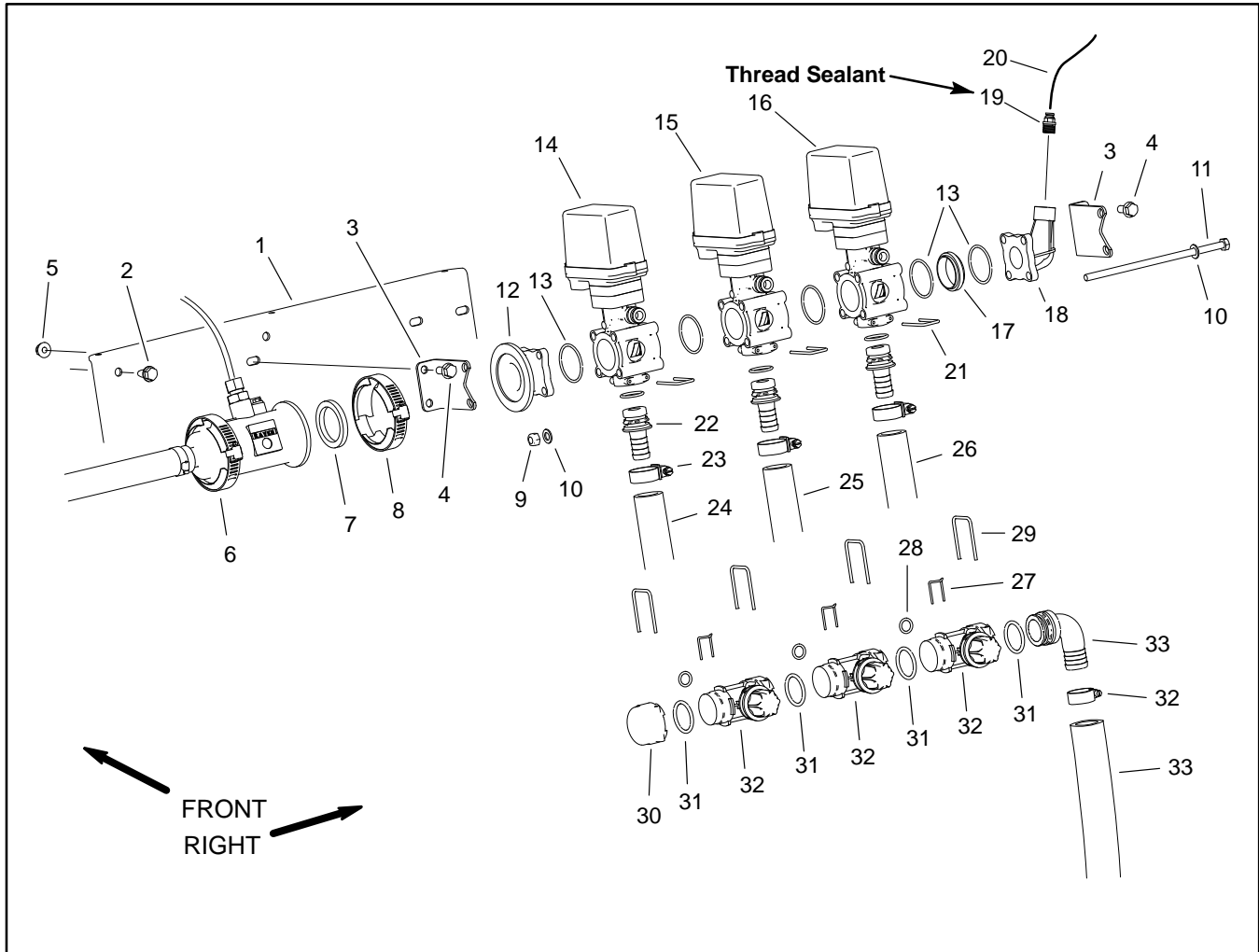


Figure 17

- | | | |
|--------------------------|------------------------------|---------------------------------|
| 1. Mounting bracket | 13. O-Ring - T6 (5) | 24. Hose (to left spray boom) |
| 2. Flange head screw (4) | 14. Left boom spray valve | 25. Hose (to center spray boom) |
| 3. Manifold bracket (2) | 15. Center boom spray valve | 26. Hose (to right spray boom) |
| 4. Flange head screw (4) | 16. Right boom spray valve | 27. Fork (3) |
| 5. Flange nut (4) | 17. Male adapter | 28. O-Ring (3) |
| 6. Flowmeter assembly | 18. Elbow | 29. Fork - T3 (4) |
| 7. Gasket | 19. Tube fitting | 30. Cap |
| 8. Clamp | 20. Tube (to pressure gauge) | 31. O-Ring - T3 (4) |
| 9. Lock nut (4) | 21. Fork - T3 (3) | 32. Bypass valve (3) |
| 10. Washer (4) | 22. Straight fitting (3) | 33. Elbow |
| 11. Hex head screw (4) | 23. Hose clamp (3) | 34. Hose clamp |
| 12. Flange fitting | | |

The boom spray valve manifold assembly includes the right, center and left spray boom valves. Each of the boom spray valves include a bypass valve.

IMPORTANT: Each valve actuator has a 5 amp fuse to protect the actuator motor. The fuse is located in an in-line fuse holder on the wire harness near the valve actuators.

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

Removal (Fig. 17)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Label boom spray valve manifold hoses for proper installation. Disconnect hoses from boom spray valves.
3. Label spray valve wire harness leads for proper installation. Disconnect wire harness connectors from the boom spray valves.
4. Remove pressure gauge tube from coupler on right side of boom spray valve manifold assembly.
5. Remove flowmeter from boom spray valve manifold (see Flowmeter Assembly in this chapter). Discard gasket between flowmeter and manifold assembly.
6. Support boom valve manifold assembly and remove four (4) flange head screws (item 4) and flange nuts that secure boom spray valve manifold assembly to mounting bracket. Remove boom spray valve manifold from machine.
7. Remove bypass valves from manifold assembly. The bypass valves are not repairable. Replace bypass valves if necessary.
8. Disassemble boom spray valve manifold as needed. Discard any removed O-rings and gaskets.

NOTE: See Spray Valve Service (Serial Number Below 315000000) in this chapter for disassembly and assembly information of the valves and valve actuators (items 14, 15 and 16).

Installation (Fig. 17)

NOTE: Replace, do not reuse O-rings. Coat O-rings with vegetable oil before installation to reduce damage during assembly.

1. If boom spray valve manifold was disassembled, install new O-rings prior to assembly.
2. Install new O-rings and install bypass valves.
3. Secure boom spray valve manifold assembly to mounting bracket and secure with four (4) flange head screws (item 4) and flange nuts.
4. Position new gasket between flowmeter and boom spray valve manifold. Install flowmeter to boom spray valve manifold (see Flowmeter Assembly in this chapter).
5. Using labels placed during removal, install hoses to manifold assembly.
6. Install pressure gauge tube to coupler on right side of boom spray valve manifold assembly.
7. Using labels placed during removal, install wire harness connectors to valve actuators.
8. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Boom Spray Valve Manifold Assembly (Serial Number Above 31500000)

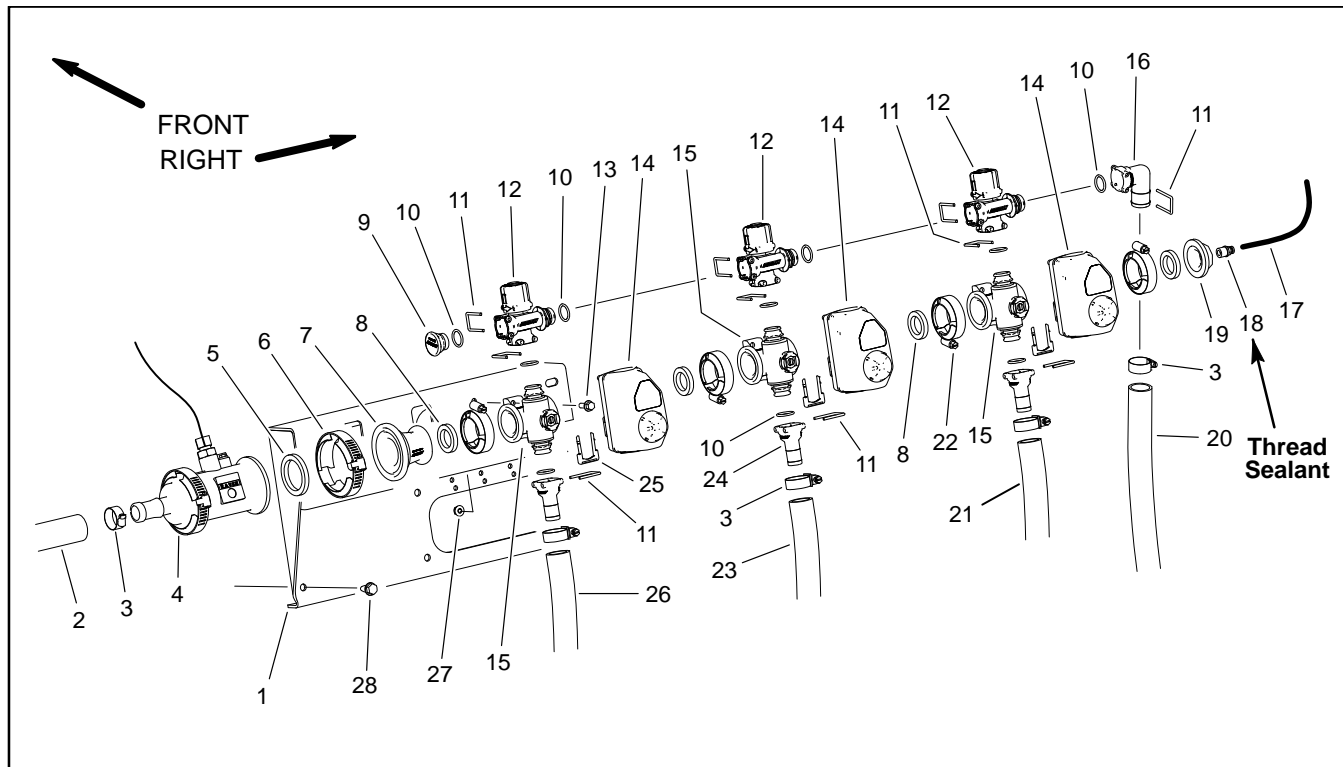


Figure 18

- 1. Mounting plate
- 2. Hose (from spray control manifold)
- 3. Hose clamp (5)
- 4. Flowmeter
- 5. Gasket
- 6. Clamp
- 7. Adapter
- 8. Gasket (4)
- 9. Cap
- 10. O-Ring (10)

- 11. Fork (10)
- 12. Bypass valve (3)
- 13. Flange head screw (4)
- 14. Valve actuator – On/Off (3)
- 15. Boom spray valve (3)
- 16. Elbow
- 17. Tube (to pressure gauge)
- 18. Tube fitting
- 19. Cap

- 20. Hose (to tank)
- 21. Hose (to left spray boom)
- 22. Clamp (4)
- 23. Hose (to center spray boom)
- 24. Adapter (3)
- 25. Actuator fork (3)
- 26. Hose (to right spray boom)
- 27. Flange nut (4)
- 28. Flange head screw (4)

The boom spray valve manifold assembly includes the right, center and left spray boom valves. Each of the boom spray valves include a bypass valve.

IMPORTANT: Each valve actuator has an internal circuit breaker to protect the actuator motor. The circuit breaker should reset in 20 seconds after power to the actuator is removed.

Removal (Fig. 17)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Label boom spray valve manifold hoses for proper installation. Disconnect hoses from boom spray manifold.
3. Label spray valve wire harness connectors for proper installation. Disconnect wire harness connectors from boom spray manifold.
4. Remove pressure gauge tube from coupler on right side of boom spray valve manifold assembly.
5. Remove flowmeter from boom spray valve manifold (see Flowmeter Assembly in this chapter). Discard gasket between flowmeter and manifold assembly.
6. Support boom spray valve manifold assembly and remove four (4) flange nuts (item 27) and flange head screws that secure boom spray valve manifold to mounting plate. Remove boom spray valve manifold from machine.
7. Disassemble boom spray valve manifold as needed. Discard any removed O-rings and gaskets.

NOTE: See Valve Service (Serial Number Above 315000000) and Bypass Valve Service (Serial Number Above 315000000) in this chapter for disassembly and assembly information of the valves and valve actuators.

Installation (Fig. 17)

NOTE: Replace, do not reuse gaskets and O-rings. Coat O-rings and gaskets with vegetable oil before installation to reduce damage during assembly.

1. Assemble boom spray valve manifold.
2. Secure boom spray valve manifold assembly to mounting plate and secure with four (4) flange nuts (item 27) and flange head screws.
3. Position new gasket between flowmeter and boom spray valve manifold. Install flowmeter to boom spray valve manifold (see Flowmeter Assembly in this chapter).
4. Using labels placed during removal, install hoses to manifold assembly.
5. Install pressure gauge tube to coupler on right side of boom spray valve manifold assembly.
6. Using labels placed during removal, install wire harness connectors to manifold assembly.
7. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Control Valve Service (Serial Number Below 31500000)

The Multi Pro 1750 uses several valves in the spray system. Use the following procedure for servicing the agitation, rate, master boom, left spray boom, center spray boom and right spray boom valves.

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 spray valve assemblies. Check your parts catalog for parts that are available.

Valve Actuator Cover Removal (Fig. 19)

1. Loosen the three (3) screws that secure the valve actuator cover to the base assembly.
2. Carefully lift and rotate the cover.
3. Unplug the wire connections between cover and drive remove the cover.

Valve Actuator Cover Installation (Fig. 19)

1. Make sure that all screws that secure the valve motor and drive are tight (item 4 and 5).
2. Connect wire connections between actuator cover and drive. Make sure that cover wire colors are the same as the drive wire colors when connecting wires.
3. Carefully install cover onto base taking care to not damage wires and tighten screws.

Piston Assembly Service (Fig. 20)

1. Remove the fork and hose barb from bottom of valve to allow access to piston assembly.
2. Make sure that valve is closed (piston fully extended). If valve is not closed, spring above piston assembly will be under compression and may damage valve motor or piston assembly during disassembly and assembly. End of piston assembly will extend into bottom of valve housing when valve is closed. If possible, reconnect actuator to machine wire harness and close valve before removing piston assembly.
3. Rotate the piston assembly counterclockwise to unscrew it from the valve actuator shaft. Locate and retrieve spring (if applicable) from above piston assembly.

4. Inspect seals on piston assembly. If seals in piston assembly are worn or damaged, replace piston assembly. The piston assembly is not designed to be disassembled so individual components for the assembly are not available.

5. Apply silicone grease to seals on piston assembly.
6. Position spring into valve motor housing (if applicable). Screw piston assembly onto actuator motor shaft and tighten.
7. Secure hose barb to bottom of valve motor.

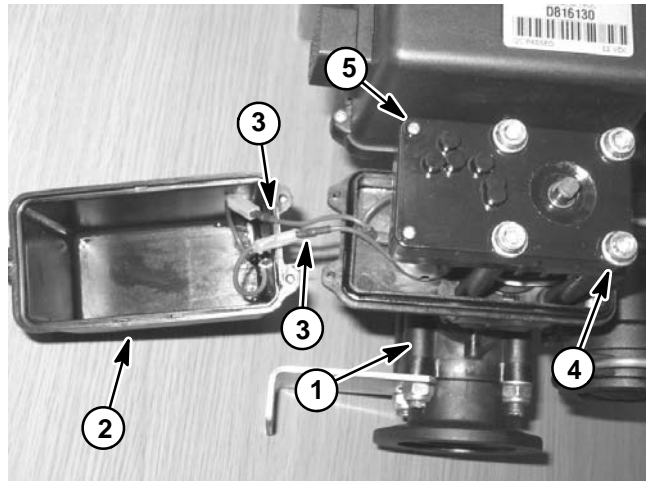


Figure 19

- | | |
|-------------------------|-----------------------|
| 1. Valve base | 4. Socket screw (4) |
| 2. Valve actuator cover | 5. Phillips screw (2) |
| 3. Wire connector (2) | |

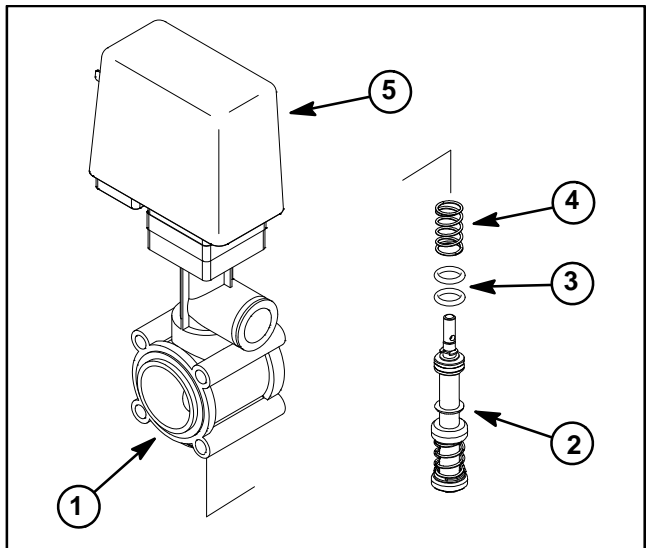


Figure 20

- | | |
|------------------------|-------------------|
| 1. Valve base assembly | 4. Spring |
| 2. Piston assembly | 5. Valve actuator |
| 3. O-Ring (2) | |

Control Valve Service (Serial Number Above 31500000)

The Multi Pro 1750 uses several valves in the spray system. Each valve is fully serviceable. Use the following procedure for servicing the rate, agitation, agitation bypass, master boom, master boom bypass, left spray boom, center spray boom and right spray boom valves.

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.

Disassembly (Fig. 21)

1. Locate the valve being serviced and remove either the actuator fork and the actuator assembly or the screw and knob from the valve.
2. Remove hoses, fittings, clamps and adapters as necessary to access valve end caps.
3. Rotate the end caps counterclockwise (unscrew) and remove the end caps.
4. Rotate the valve stem until the slot in the stem and valve ball are in-line with the valve body and remove the valve ball.
5. Remove the valve stem fork, seat, and remove the valve stem assembly.

Assembly (Fig. 21)

1. Inspect the end cap and the stem seals and O-rings. Replace components as necessary.
2. Apply silicone grease to seals and O-rings on stem assembly. Install stem assembly, seat and fork.
3. Rotate the valve stem until the slot in the stem is in-line with the valve body and install the valve ball.
4. Apply silicone grease to seals and O-rings on end caps and install end caps. Tighten end caps until seated. Do not over-tighten end caps.
5. Install hoses, fittings, clamps and adapters previously removed.
6. Install either the actuator and actuator fork or knob and screw.

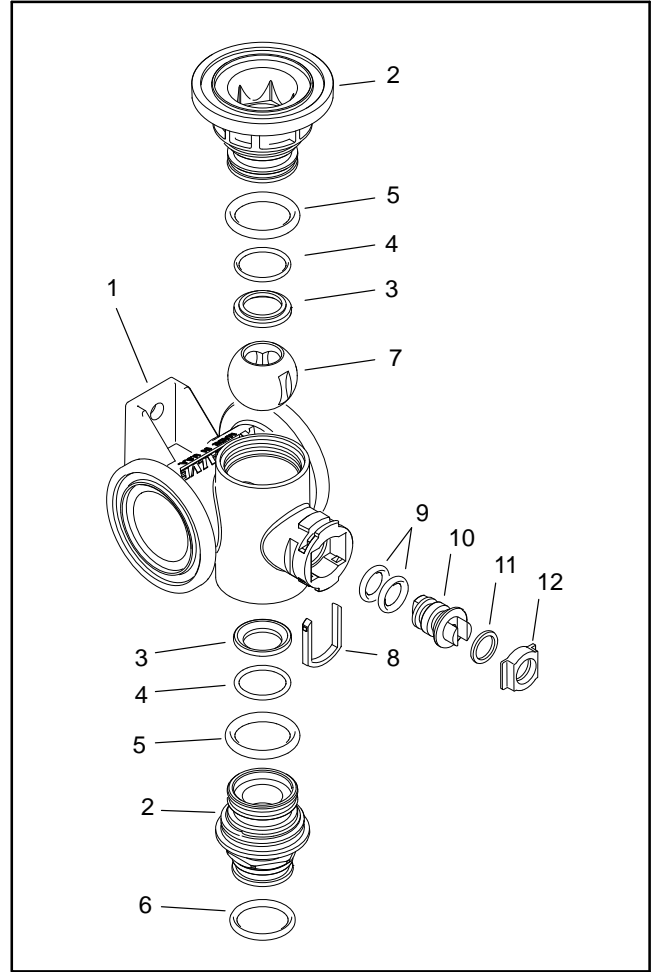


Figure 21

Typical Spray Valve Assembly

- | | |
|---------------|---------------|
| 1. Valve body | 7. Ball |
| 2. End cap | 8. Stem fork |
| 3. Seat (2) | 9. O-Ring (2) |
| 4. O-Ring (2) | 10. Stem |
| 5. O-Ring (2) | 11. Washer |
| 6. O-Ring | 12. Stem seat |

Bypass Valve Service (Serial Number Below 31500000)

The Multi Pro 1750 uses several bypass valves in the spray system. The bypass valves are non repairable components. Replace the agitation or spray boom bypass valves if necessary.

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the pressure relief valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

NOTE: Replace, do not reuse O-rings. Coat O-rings with vegetable oil before installation to reduce damage during assembly.

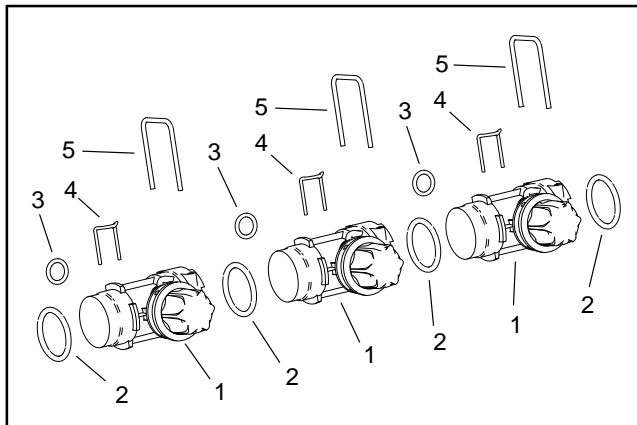


Figure 22

- 1. Bypass valve
- 2. O-Ring (4)
- 3. O-Ring (3)
- 4. Fork (3)
- 5. Fork (3)

Bypass Valve Service (Serial Number Above 31500000)

The Multi Pro 1750 uses several bypass valves in the spray system. Each valve is fully serviceable. Use the following procedure for servicing the three (3) spray boom bypass valves.

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the pressure relief valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

Disassembly (Fig. 23)

1. Locate the valve being serviced and remove the knob fork and the knob assembly.
2. Hold the valve stem and rotate the knob counter-clockwise (unscrew) and remove the knob.
3. Remove and discard the two (2) O-rings from the valve stem.
4. Remove valve body forks and separate bypass valves. Remove and discard O-rings.

Assembly (Fig. 23)

1. Install new O-rings and apply silicone grease to O-rings during assembly.
2. Turn the knob onto the valve stem until the stem extends out of the top of the knob.

NOTE: The cut-out in the valve stem must open toward the cross tube. If installed incorrectly, the bypass valve will not regulate the product flow.

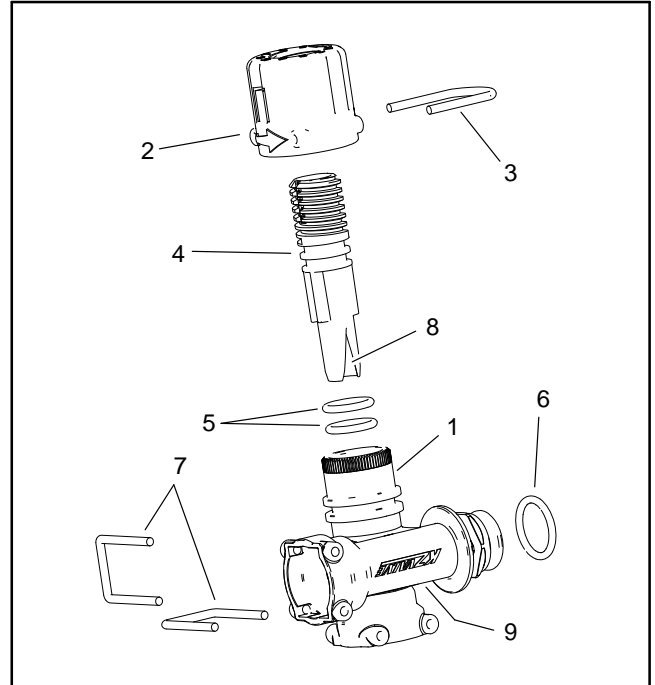


Figure 23

- | | |
|----------------------|------------------------|
| 1. Bypass valve body | 6. O-ring |
| 2. Knob | 7. Valve body fork (2) |
| 3. Knob fork | 8. Valve stem cut-out |
| 4. Valve stem | 9. Cross tube |
| 5. O-ring (2) | |

3. Install the knob assembly in the valve body and secure with the knob fork as shown.

4. Assembly bypass valves to each other and to manifold with forks.

Agitation Throttle Valve (Serial Number Below 31500000)

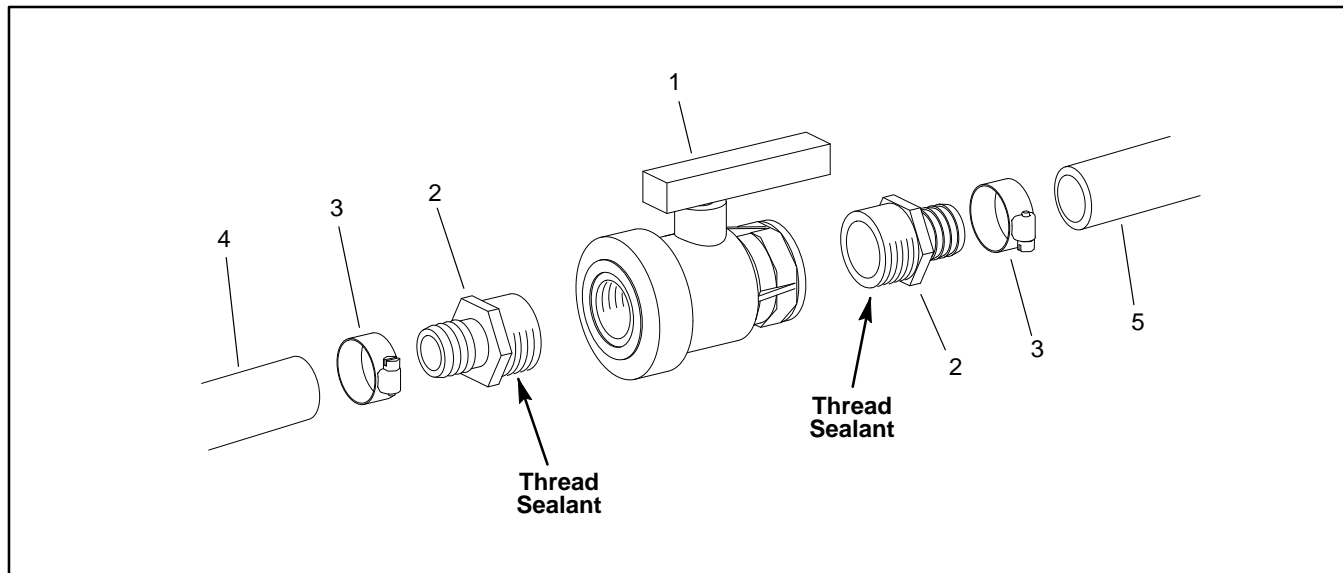


Figure 24

- 1. Agitation throttle valve
- 2. Straight fitting (2)

- 3. Hose clamp (2)
- 4. Hose (to agitation nozzles)

- 5. Hose (from agitation valve)

The agitation throttle valve is a non adjustable, non repairable component. Replace the valve if necessary.

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the agitation throttle valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

Agitation Throttle Valve (Serial Number Above 31500000)

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before removing the agitation throttle valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

Disassembly (Fig. 25)

1. Remove the screw and the knob from the valve.
2. Remove hoses, fittings, clamps and adapters as necessary to access valve end caps.
3. Rotate the end caps counterclockwise (unscrew) and remove the end caps.
4. Rotate the valve stem until the slot in the stem and valve ball are in-line with the valve body and remove the valve ball.
5. Remove the valve stem fork, seat, and remove the valve stem assembly.

Assembly (Fig. 25)

1. Inspect the end cap and the stem seals and O-rings. Replace components as necessary.
2. Apply silicone grease to seals and O-rings on stem assembly. Install stem assembly, seat and fork.
3. Rotate the valve stem until the slot in the stem is in-line with the valve body and install the valve ball.
4. Apply silicone grease to seals and O-rings on end caps and install end caps. Tighten end caps until seated. Do not over-tighten end caps.
5. Install hoses, fittings, clamps and adapters previously removed.
6. Install knob and screw.

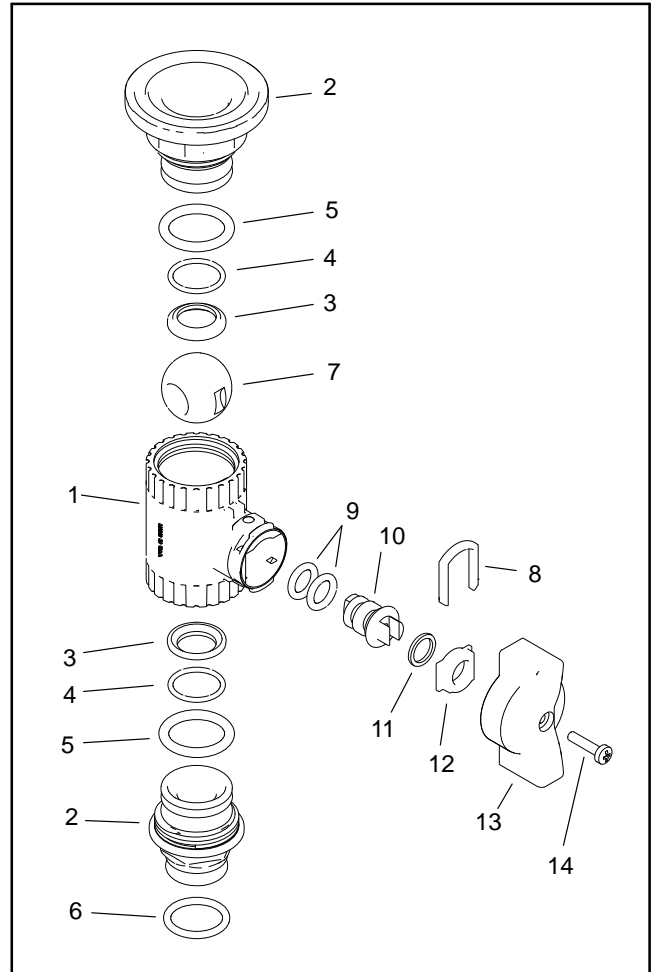


Figure 25

Typical Spray Valve Assembly

- | | |
|---------------|---------------|
| 1. Valve body | 8. Stem fork |
| 2. End cap | 9. O-Ring (2) |
| 3. Seat (2) | 10. Stem |
| 4. O-Ring (2) | 11. Washer |
| 5. O-Ring (2) | 12. Stem seat |
| 6. O-Ring | 13. Knob |
| 7. Ball | 14. Screw |

Agitation Hose Assembly

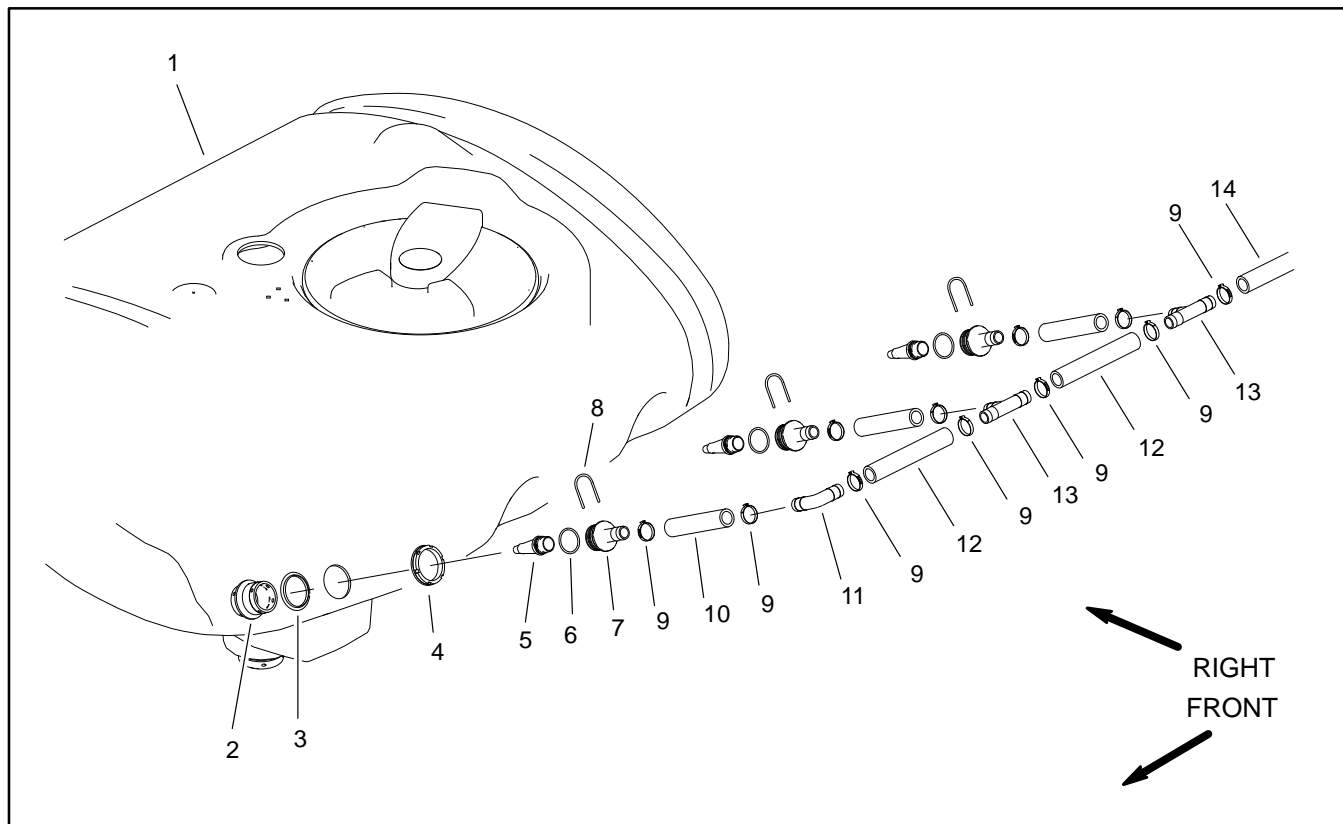


Figure 26

- | | | |
|-------------------------|-------------------------|--|
| 1. Spray Tank | 6. O-Ring (3) | 11. Elbow |
| 2. Bulkhead fitting (3) | 7. Straight fitting (3) | 12. Hose (2) |
| 3. Bulkhead gasket (3) | 8. Fork (3) | 13. Tee (2) |
| 4. Bulkhead nut (3) | 9. Hose clamp (12) | 14. Hose (from agitation throttle valve) |
| 5. Agitation nozzle (3) | 10. Hose (3) | |

Disassembly (Fig. 26)

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 spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Drain spray tank.
3. Remove hoses from bulkhead fittings in tank.
4. Disassemble agitation hose components as required. Discard all removed O-rings and gaskets.

Assembly (Fig. 26)

NOTE: Replace all removed O-rings and gaskets. Coat all O-rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble agitation hose components.
2. Install hoses to bulkhead fittings in tank.
3. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Bypass Fittings in Tank

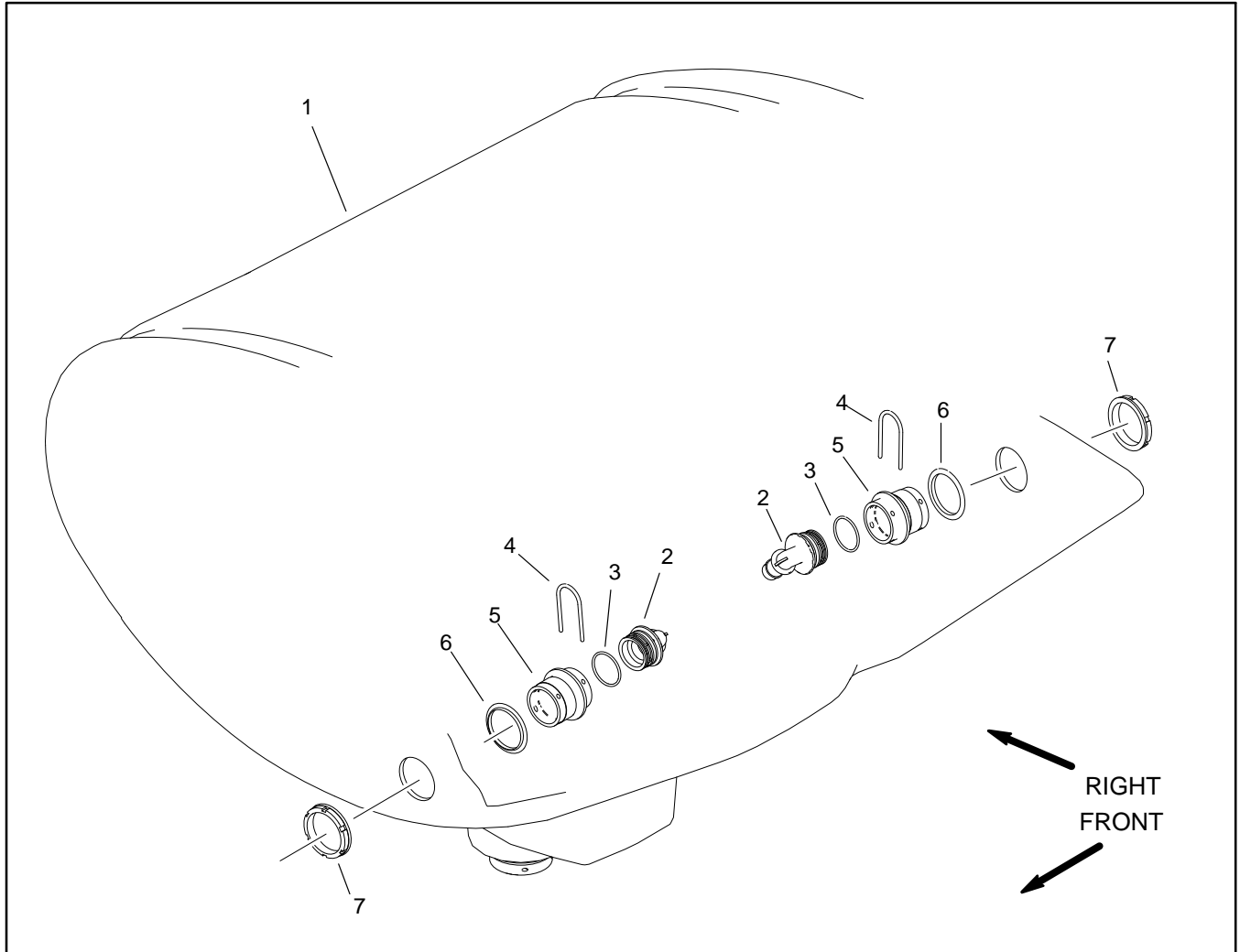


Figure 27

1. Spray tank
2. Elbow fitting (2)
3. O-ring (2)

4. Fork (2)
5. Bulkhead fitting (2)

6. Bulkhead gasket (2)
7. Bulkhead nut (2)

Disassembly (Fig. 27)

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 spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Drain spray tank.
3. Label hoses to for proper installation. Remove hoses from bypass fittings in tank.
4. Disassemble bypass fittings in tank. Discard all removed O-rings and gaskets.

Assembly (Fig. 27)

NOTE: Replace all removed O-rings and gaskets. Coat all O-rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble bypass fittings in tank. Aim elbow fittings to center of tank and downward approximately 45 degrees.
2. Using labels placed during disassembly, secure removed hoses to bypass fittings.
3. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

Suction Tube and Strainer

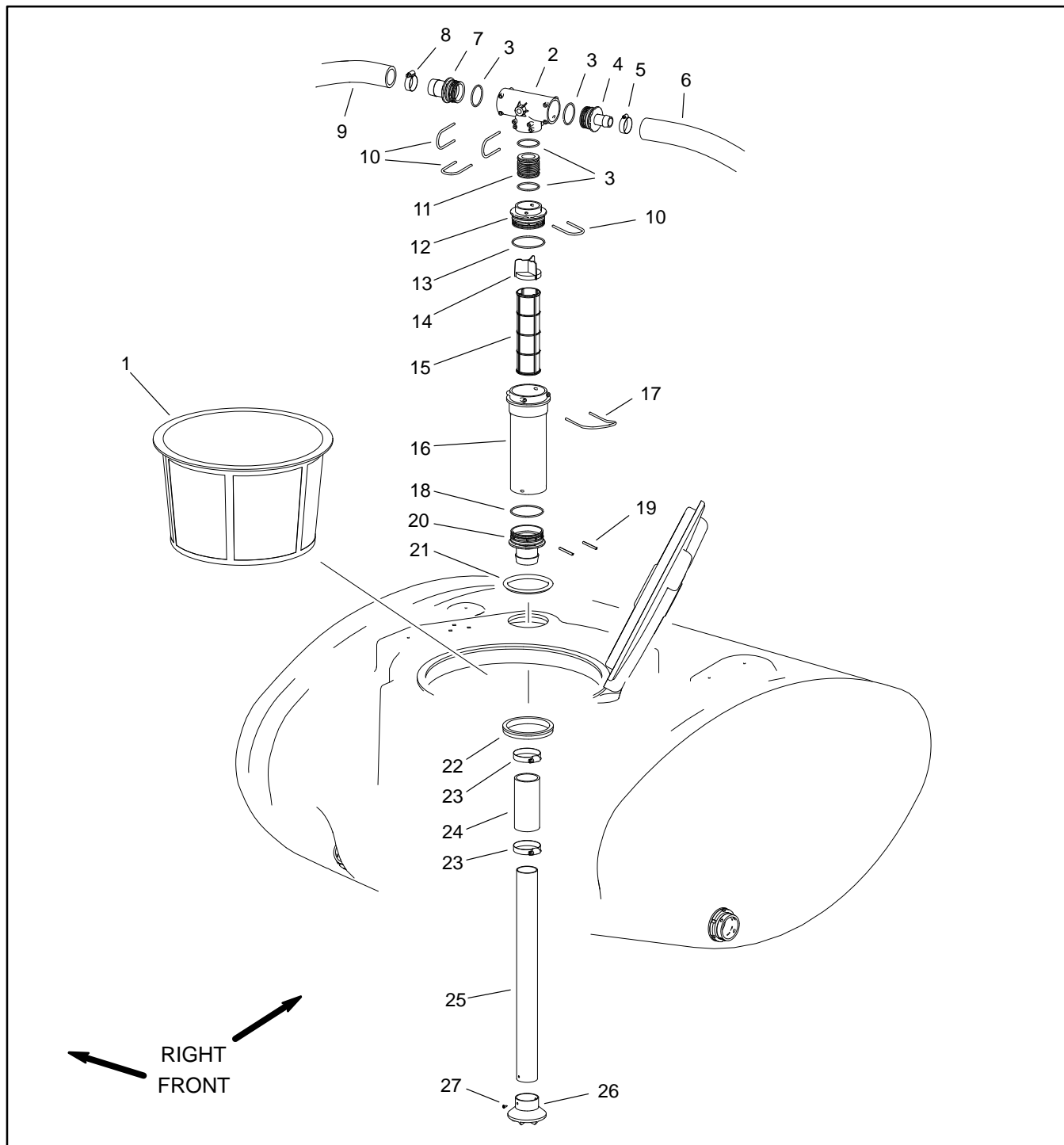


Figure 28

- | | | |
|---------------------------------------|-------------------------|-------------------------|
| 1. Filter basket | 10. Fork (4) | 19. Spring pin (2) |
| 2. Tee | 11. Connector | 20. Straight fitting |
| 3. O-Ring (4) | 12. Filter adapter | 21. Gasket |
| 4. Straight fitting | 13. O-Ring | 22. Filter bulkhead nut |
| 5. Hose clamp | 14. Screen vane | 23. Hose clamp (2) |
| 6. Hose (from agitation bypass valve) | 15. Strainer screen | 24. Hose |
| 7. Straight fitting | 16. Suction filter body | 25. Suction tube |
| 8. Hose clamp | 17. Fork | 26. Suction foot |
| 9. Hose (to spray pump) | 18. O-Ring | 27. Screw |

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.

NOTE: If suction tube in tank develops an air (vacuum) leak, spray performance will diminish when tank level reaches the leak point.

Removal (Fig. 28)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Label hoses to for proper installation. Remove hoses from tee coupling on top of suction tube assembly.
3. Remove fork (item 17) and filter adapter (item 12) from tank.
4. Remove vane screen and suction strainer from filter body.
5. Raise tank lid and remove filter basket to gain access to suction tube inside spray tank.
6. Remove filter bulkhead nut (item 22) and lift suction tube assembly from spray tank. Discard all removed O-rings and gaskets.
7. Measure and record the length of suction tube prior to disassembly (Fig. 29). Disassemble suction tube suction filter assembly as needed.

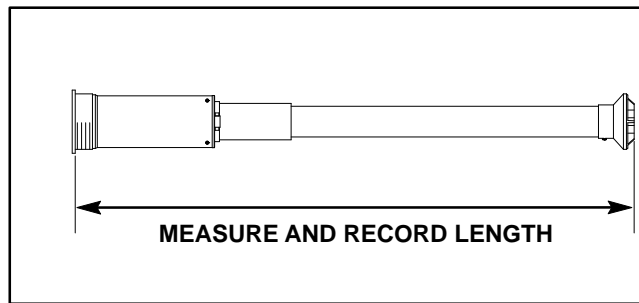


Figure 29

Installation (Fig. 28)

NOTE: Replace all removed O-rings and gaskets. Coat all O-rings and gaskets with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble suction tube. Make sure that assembled suction tube length is the same as the length recorder during disassembly (Fig. 29).
2. Guide suction tube assembly into spray tank and install filter bulkhead nut. The bottom of the suction foot should be less than **1/2 inch (12.7 mm)** from floor of spray tank after assembly. Loosen hose clamp (item 23) and adjust suction tube if necessary.
3. Install filter basket and close tank lid.
4. Install suction strainer and vane screen.
5. Install filter adapter (item 12) and fork (item 17).
6. Using labels placed during disassembly, secure removed hoses to tee coupling on top of suction tube assembly.
7. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

Tank Drain Assembly

Disassembly (Fig. 30)

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 spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Drain spray tank.
3. Remove fork (item 8) and remove drain hose assembly from tank.
4. Disassemble drain hose assembly as needed. Discard all removed O-rings and gaskets.

NOTE: The drain valve is a non adjustable, non repairable component. Replace the valve if necessary.

Assembly (Fig. 30)

NOTE: Replace all removed O-rings and gaskets. Coat all O-rings with vegetable oil before installation to reduce the chance of damage during assembly.

1. Assemble drain hose assembly. Apply thread sealant to hose connector threads (item 13).
2. Install drain hose to tank.
3. Make sure that drain valve is closed and secured to sprayer.
4. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

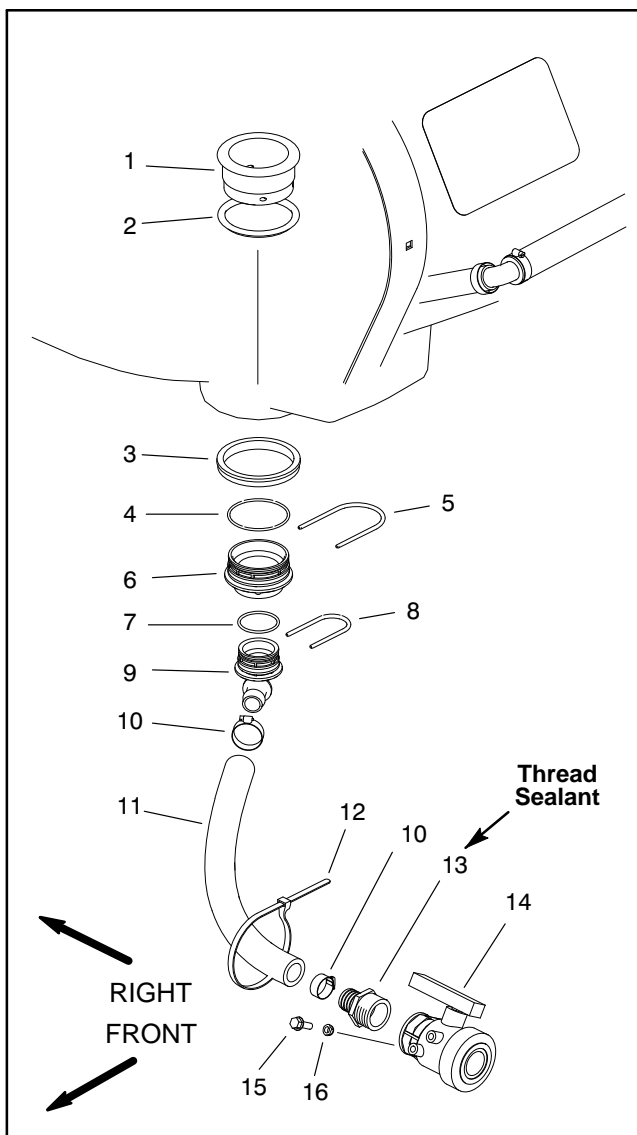


Figure 30

- | | |
|----------------------|---------------------------|
| 1. Adapter (in tank) | 9. Elbow fitting |
| 2. Gasket | 10. Hose clamp (2) |
| 3. Bulkhead nut | 11. Hose (drain) |
| 4. O-Ring | 12. Cable tie |
| 5. Fork | 13. Hose connector |
| 6. Adapter | 14. Drain valve |
| 7. O-Ring | 15. Flange head screw (2) |
| 8. Fork | 16. Hex Nut (2) |

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Spray Tank

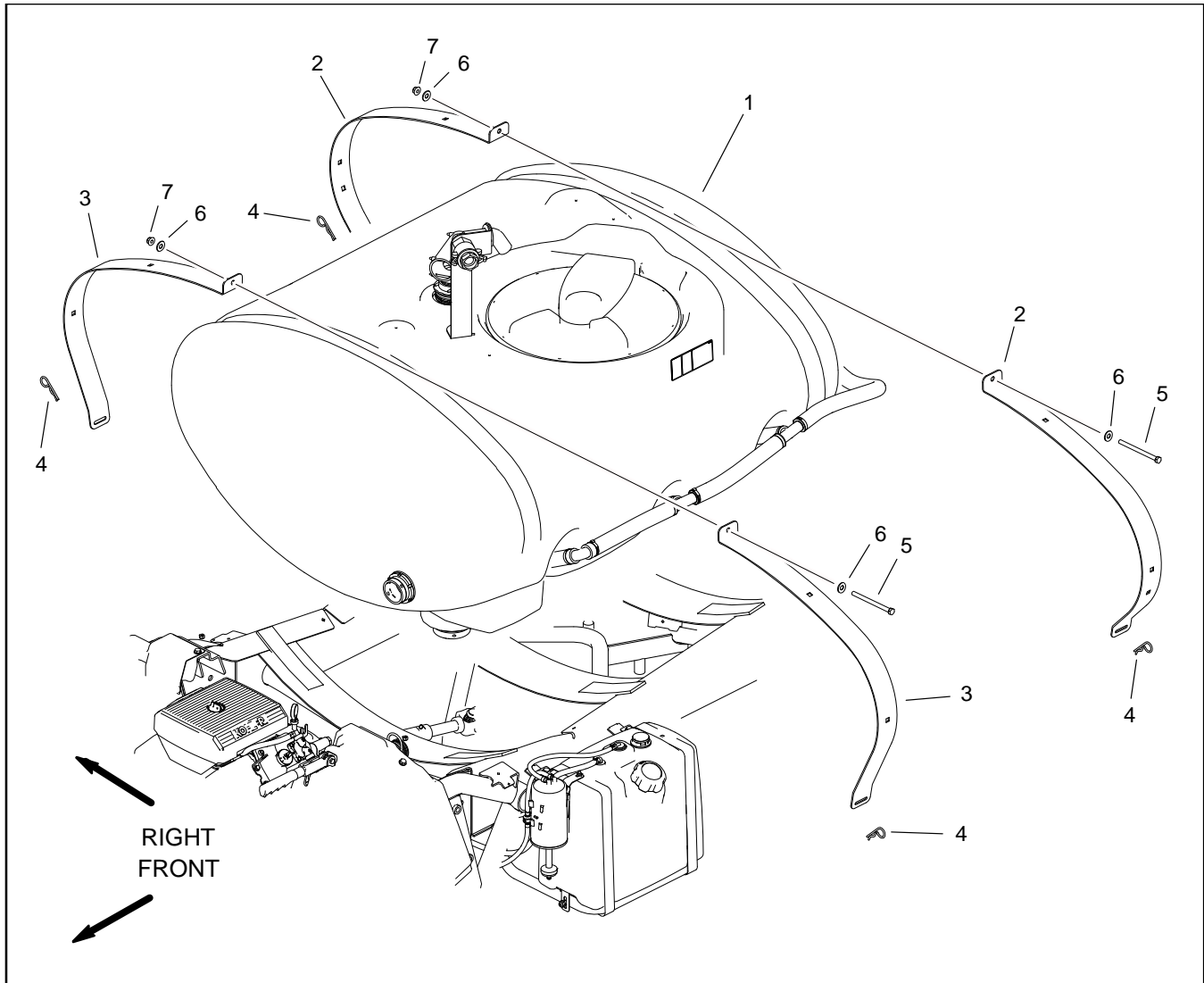


Figure 31

- 1. Spray tank
- 2. Tank strap - rear (2)
- 3. Tank strap - front (2)

- 4. Hair pin (4)
- 5. Hex head screw (2)

- 6. Flat washer (4)
- 7. Lock nut (2)

NOTE: For better service access to the engine and traction drive clutch, removing the spray tank is recommended.

Removal (Fig. 31)

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 spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Drain the spray tank.
3. Drain and remove fresh water tank.
4. Raise the operator seat and remove the engine cover.
5. Label all hoses for proper installation. Disconnect suction, pressure, and bypass hoses from tank. Disconnect agitation hose from agitation valve.
6. Remove flange nuts, flat washers and hex head screws (item 5) joining tank straps together on top of spray tank.
7. Remove hair pins (item 4) securing tank straps to machine frame and remove front and rear tank straps from machine.



8. Raise spray tank assembly from machine.

Installation (Fig. 31)

1. Make sure that pads on the spray tank saddles are in good condition. Install new pads if needed.
2. Carefully lower spray tank assembly onto machine.
3. Level the spray tank from side to side to within +/- .25" (6.3 mm). Make sure the front of the spray tank does not contact the engine, dipstick, or engine cover
4. Position tank straps to machine frame and secure with hair pins (item 4).
5. Install cap screws (item 5), flat washers and flange nuts joining tank straps together on top of spray tank.
6. Using labels placed during tank removal, correctly connect hoses to spray tank and agitation valve.
7. Make sure that drain valve is closed and secured to the sprayer.
8. After spray tank installation, make sure that spray hoses do not contact any moving parts on machine.
9. Install the engine cover.
10. Install fresh water tank.
11. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

Turret Bodies

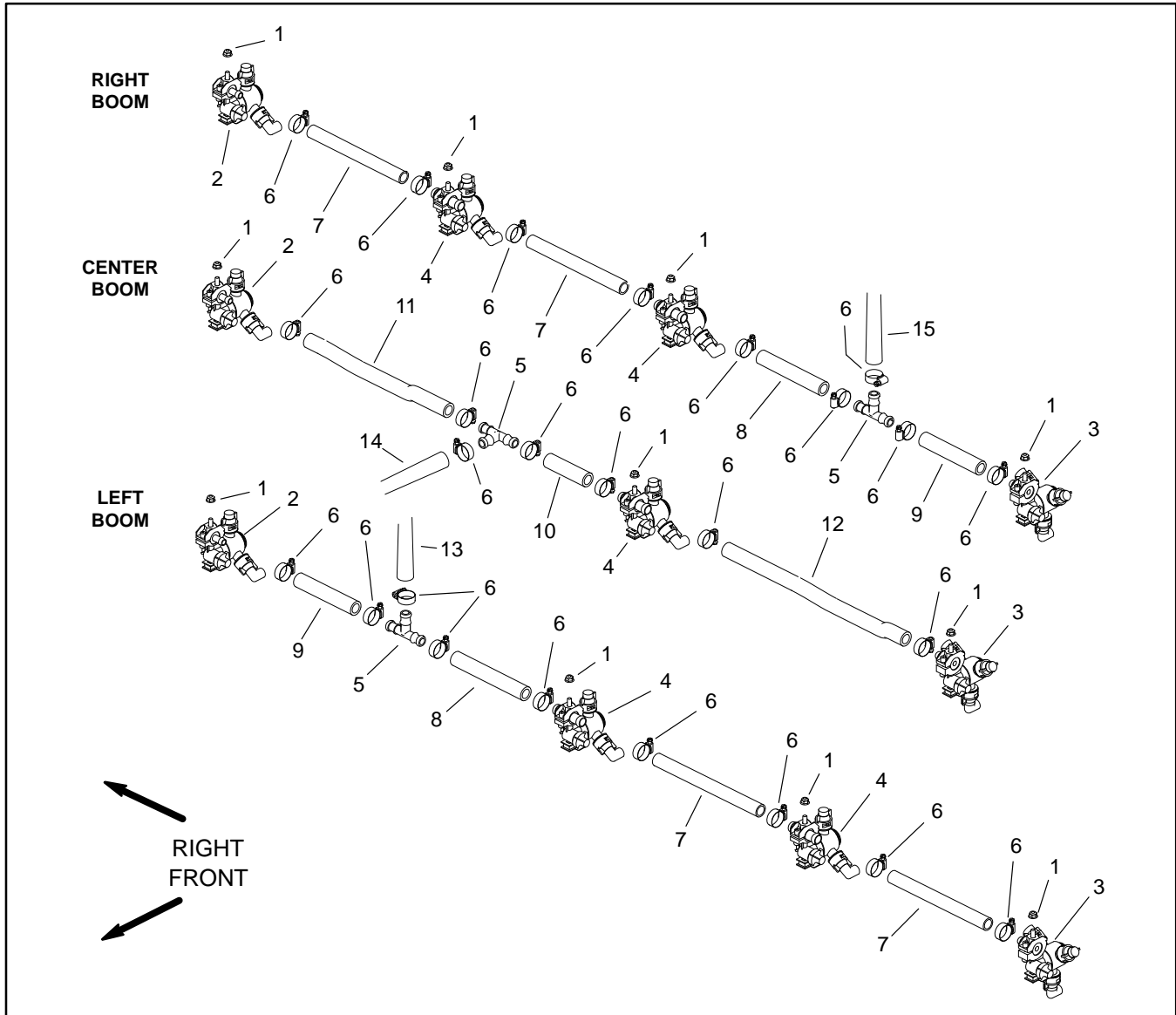


Figure 32

- | | | |
|--------------------------------|------------------------------|---|
| 1. Flange nut (11) | 6. Hose clamp (25) | 11. Hose – formed RH |
| 2. Turret body – RH barb (3) | 7. Hose 18.75" (47.6 cm) (4) | 12. Hose – formed LH |
| 3. Turret body – LH barb (3) | 8. Hose 12.25" (31 cm) (2) | 13. Hose (from left boom spray valve) |
| 4. Turret body – dual barb (5) | 9. Hose 6" (15.2 cm) (2) | 14. Hose (from center boom spray valve) |
| 5. Tee fitting (3) | 10. Hose 4.12" (10.5 cm) | 15. Hose (from right boom spray valve) |

Removal (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, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Loosen hose clamp(s) and remove supply hose(s) from turret body.

3. Remove flange nut (item 1) that secures turret body to mount bracket and remove turret body from machine.

Installation (Fig. 32)

NOTE: The position of the hose barb on the turret body determines the turret body's location on the spray boom.

1. Position turret body to mount bracket on spray boom and secure it in place with flange nut (item 1).
2. Install supply hose(s) to turret body. Tighten hose clamp(s).

Turret Body Service

Disassembly (Fig. 33)

1. Pull e-clip from body and slide plug with O-ring from body.
2. Disassemble turret body.
3. Discard all removed seals, gaskets, O-rings and diaphragms.

Assembly (Fig. 33)

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.

A. The end of the turret with the slightly larger bore has detent grooves (Fig. 34). The detent grooves need to align with the detent posts on the body.

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.

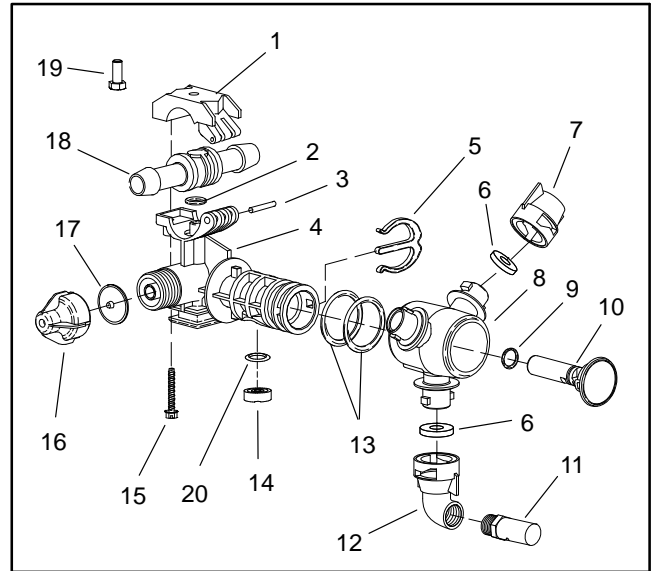


Figure 33

- | | |
|-----------------|----------------|
| 1. Upper clamp | 11. Nozzle |
| 2. O-ring | 12. Nozzle cap |
| 3. Pivot pin | 13. O-ring |
| 4. Body | 14. Seal |
| 5. E-clip | 15. Screw |
| 6. Gasket (3) | 16. End cap |
| 7. Dust cap (2) | 17. Diaphragm |
| 8. Turret | 18. Hose barb |
| 9. O-ring | 19. Cap screw |
| 10. Plug | 20. O-ring |

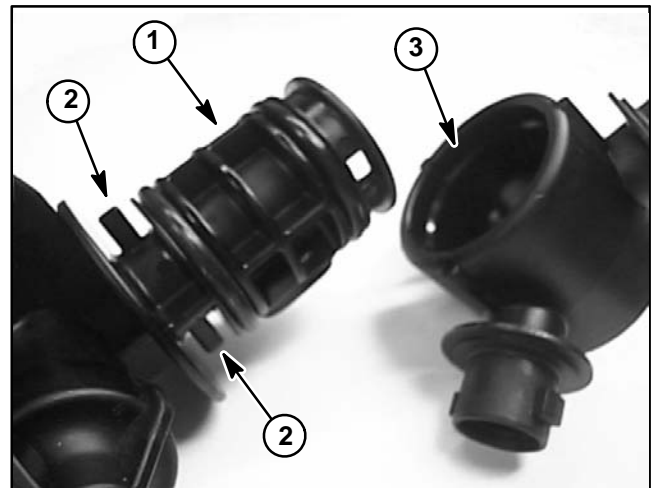


Figure 34

- | | |
|----------------|------------------|
| 1. Body | 3. Detent groove |
| 2. Detent post | |

Spray Boom Hinge

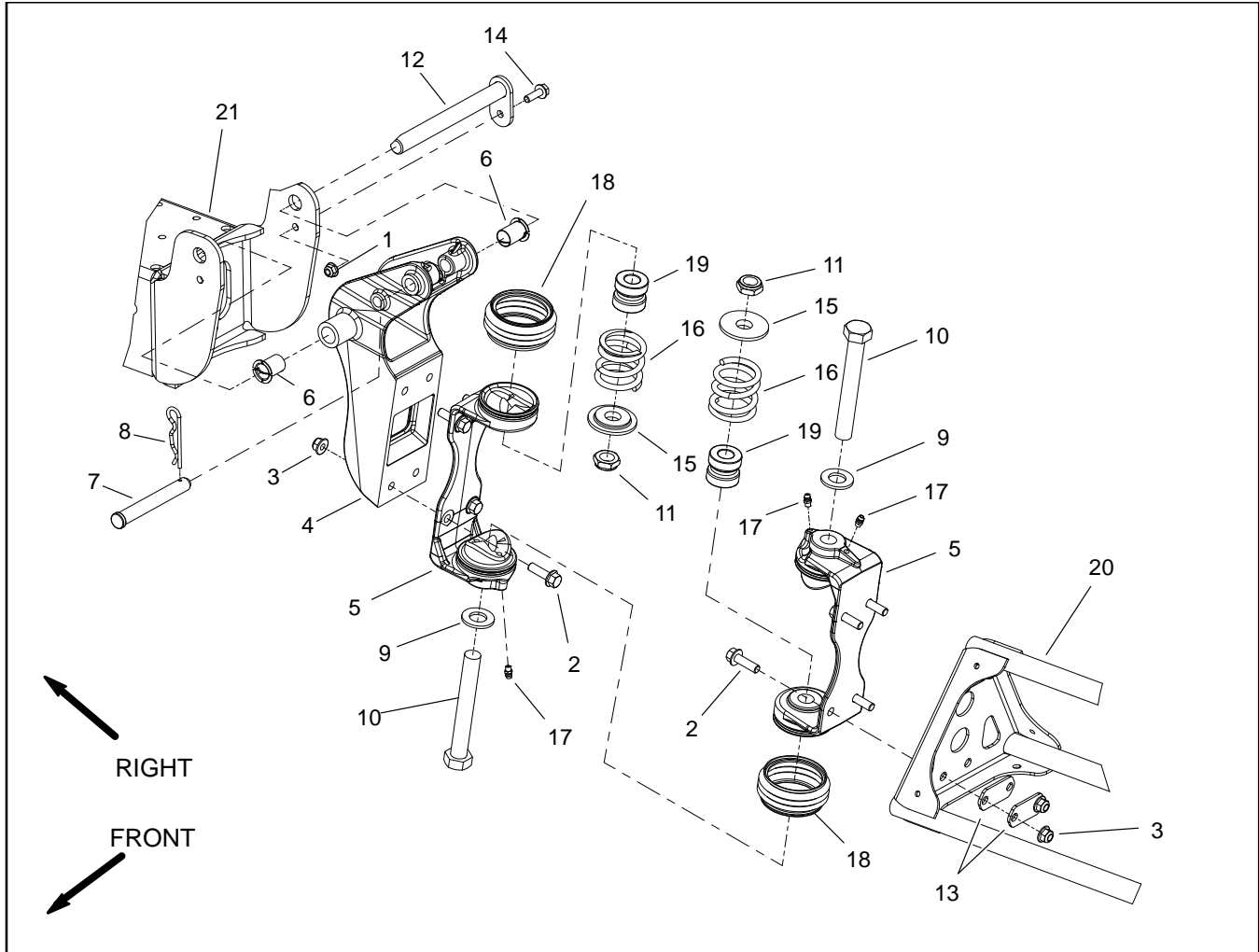


Figure 35

- | | | |
|----------------------------------|--------------------------------|-----------------------------------|
| 1. Flange nut | 8. Hair pin | 15. Spring retainer (2 per boom) |
| 2. Flange hd screw (4 per hinge) | 9. Flat washer (2 per boom) | 16. Breakaway spring (2 per boom) |
| 3. Flange nut (4 per hinge) | 10. Cap screw (2 per boom) | 17. Grease fitting (2 per hinge) |
| 4. Pivot bracket | 11. Lock nut (2 per boom) | 18. Rubber boot (2 per hinge) |
| 5. Hinge (2 per boom) | 12. Pivot pin | 19. Dampener (2 per boom) |
| 6. Bushing (2 per pivot bracket) | 13. Backing plate (4 per boom) | 20. Spray boom (LH shown) |
| 7. Clevis pin | 14. Flange head screw | 21. Boom frame |

Disassembly (Fig. 35)

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 spray pump, lower spray booms, stop engine and engage parking brake. Remove key from ignition switch.
2. Loosen hose clamp and remove supply hose from tee fitting on spray boom (Fig. 36).
3. Support spray boom to prevent it from falling.

4. Loosen two (2) cap screws (item 10) and lock nuts (item 11) to allow breakaway springs (item 16) to fully extend.

5. Disassemble boom hinge as required. If pivot bracket (item 4) is to be removed from machine, disconnect boom lift cylinder (not shown) from pivot bracket (see Boom Lift Cylinders in Chapter 4 – Hydraulic System in this manual).

6. Clean all removed components. If pivot bracket was removed, inspect bushings (item 6) and pivot pin (item 12) for damage or wear.

Assembly (Fig. 35)

1. If pivot bracket (item 4) was removed from machine:
 - A. Lightly lubricate bushings (item 6) with motor oil before assembly.
 - B. Install pivot pin (item 12) from rear of machine.
 - C. Connect boom lift cylinder (not shown) to pivot bracket (see Boom Lift Cylinders in Chapter 4 – Hydraulic System in this manual).
2. Make sure that hinges (item 5) are securely fastened to pivot bracket (item 4) and spray boom (item 20). The boom hinge uses four (4) backing plates (item 13) between the spray boom and flange nuts.
3. Position boom hinge to pivot bracket hinge. Make sure that rubber boots (item 18) are placed at hinge junctions and that ribs on boots are toward the top of the boom (Fig. 37).
4. Insert two (2) cap screws (item 10) through flat washers (item 9) and hinges. Place dampener (item 19), breakaway spring (item 16), spring retainer (item 15) and lock nut (item 11) on each cap screw. Make sure that shoulder on spring retainer fits into breakaway spring.
5. Tighten lock nuts to obtain a compressed spring height of **2.06" (52.3 mm)** (Fig. 38).
6. Connect supply hose to tee fitting on spray boom and secure with hose clamp (Fig. 36).
7. Lubricate grease fittings on boom hinge.

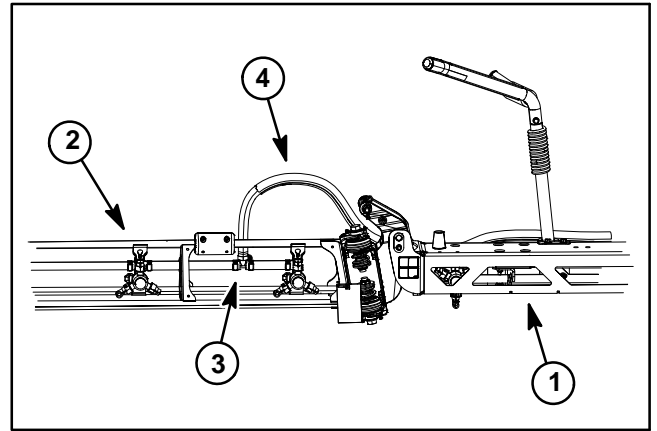


Figure 36

- | | |
|--------------------------|---------------------|
| 1. Boom frame | 3. Tee fitting |
| 2. Spray boom (LH shown) | 4. Boom supply hose |

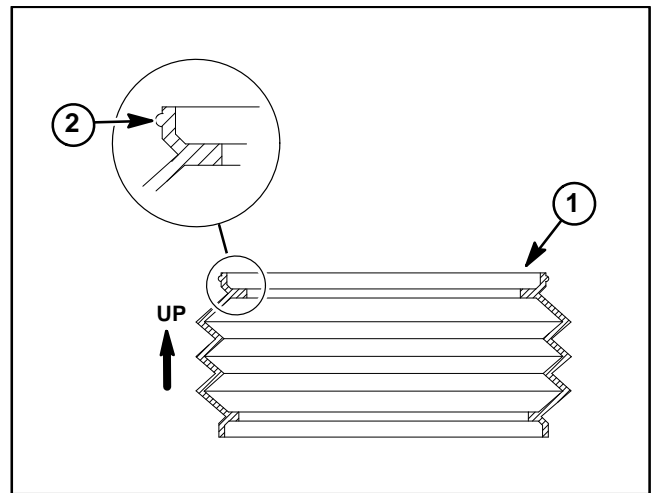


Figure 37

- | | |
|----------------|--------|
| 1. Rubber boot | 2. Rib |
|----------------|--------|

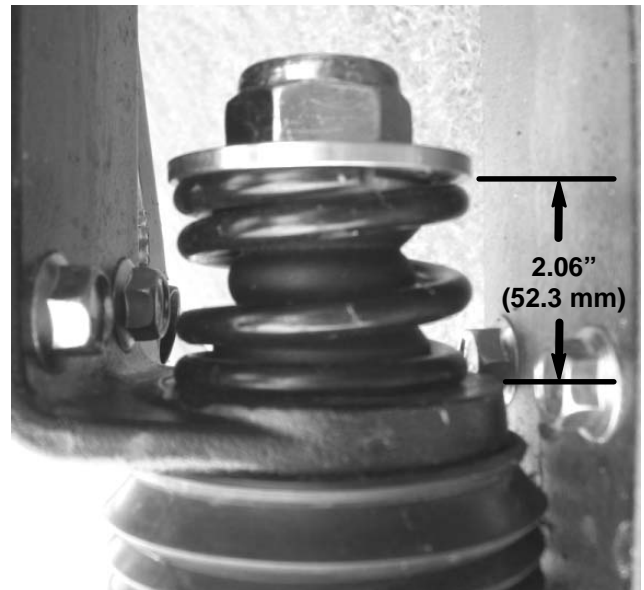


Figure 38

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Specifications

Item	Description
Transmission Fluid Capacity (also functions as hydraulic reservoir) Fluid Type	Integrated Transaxle with 3 Forward Speed Ranges and Reverse, Mechanical Clutch and Manual Engage Differential Lock 7.5 quarts (7 liters) Dexron III ATF

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.

Drive Train Operation

Multi Pro 1750 sprayers are equipped with a transaxle with 3 forward speed ranges, 1 reverse range, a neutral position and a differential lock feature. The transaxle is a constant mesh, collar shift transmission with synchronizers for speed ranges 1, 2 and 3. Two (2) shift cables from the shift lever assembly on the operator console allow transaxle shifting. Shifting from forward into reverse or from reverse into forward must be done with the vehicle stationary. A separate lever and cable operate the differential lock.

The transaxle is bolted to the vehicle frame. Two (2) heavy duty universal driveshafts transfer power from the transaxle to the rear wheels.

The transaxle housing also functions as the hydraulic system reservoir.

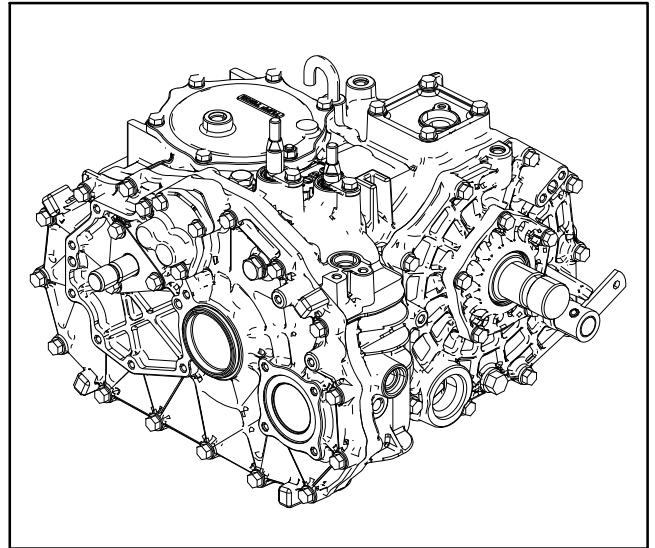


Figure 1
Transaxle Assembly

Troubleshooting

Transaxle

Problem	Possible Causes
Noisy operation.	<p>Low oil level in transaxle.</p> <p>Damaged or worn transaxle bearings.</p> <p>Transaxle gears worn, scuffed or broken.</p> <p>Excessive end play in transaxle countershaft.</p> <p>Transaxle gears loose on shaft.</p> <p>Excessive wear of differential side gear liners and pinion liners in transaxle.</p> <p>Excessive wear of splined slider on axle drive joints.</p>
Difficult shifting.	<p>Clutch not releasing fully.</p> <p>Shift cable out of adjustment.</p> <p>Shift cable damaged.</p> <p>Range selector cap screw loose (at operator console).</p> <p>Cable clamp securing cables near range selector is loose.</p> <p>Loose shift lever on transaxle.</p> <p>Sliding gear tight on transaxle shaft or splines.</p> <p>Synchronizing unit in transaxle damaged.</p> <p>Sliding gear teeth in transaxle damaged.</p> <p>Synchronizer keys in transaxle damaged.</p>
Gears make clashing noise when shifting.	<p>Operator is shifting too fast.</p> <p>Excessive wear of synchro rings in transaxle.</p> <p>Excessive wear of differential side gear liners and pinion liners in transaxle.</p> <p>Damaged synchro springs and/or keys in transaxle.</p> <p>Main gear needle bearings in transaxle are worn or damaged.</p> <p>Excessive wear of driveshaft(s).</p>

Problem	Possible Causes
Transaxle sticks in gear.	Clutch is not releasing fully. Shift linkage is damaged, loose or out of adjustment. Shift fork detent ball in transaxle is stuck. Sliding gears in transaxle are tight on shaft splines. Synchronizer shift keys in transaxle are damaged.
Transaxle slips out of gear.	Shift linkage out of adjustment. Transaxle gear loose on shaft. Worn or damaged teeth on transaxle gear. Excessive end play in transaxle gears. Lack of spring pressure on shift fork detent ball in transaxle. Badly worn bearings in transaxle.
Overheating of transaxle.	Oil level too high. Excessive hydraulic load. See Chapter 4 – Hydraulic System for hydraulic system issues.

Adjustments

Adjusting Shift Cables

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch. Place the range selector in the neutral position.
2. Remove cotter pins and clevis pins that secure shift cable clevises to transaxle shift levers (Fig. 2).
3. Check that the threads of the shift cables are centered in the shift cable clevises. If needed, adjust shift cable jam nuts so the cable clevises are properly positioned.
4. Adjust shift cable jam nuts at cable bracket so the cable clevis hole aligns with hole in transaxle shift lever.
5. Secure cable clevises to shift levers with clevis pins and cotter pins.
6. Check range selector for proper shift cable operation.

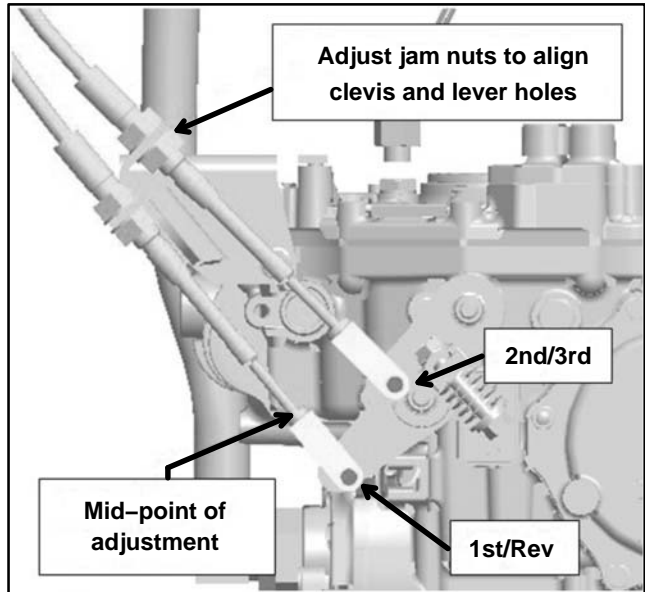


Figure 2

Adjusting Differential Lock Cable

1. Move the differential–lock lever to the Off position.
2. Loosen the jam nuts securing the differential–lock cable to the bracket on the transaxle (Fig. 3).
3. Adjust the jam nuts to obtain a **0.25 to 1.5 mm (0.01 to 0.06 inch)** gap between the spring hook and the OD of the hole in the transaxle lever.
4. Tighten the jam nuts when finished.

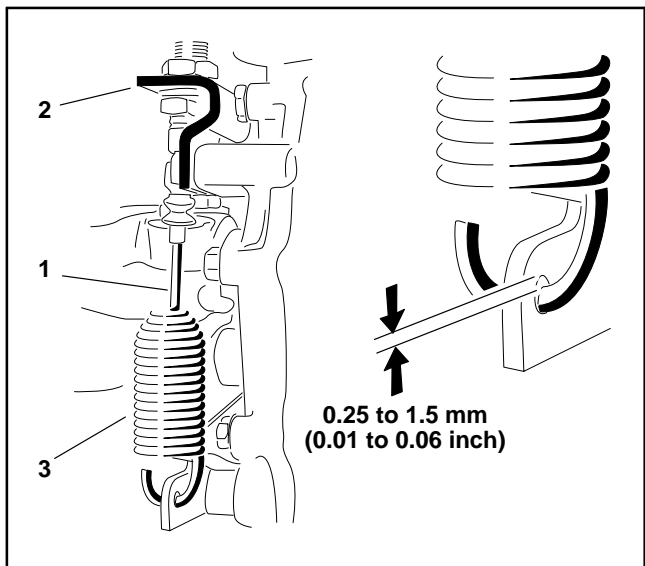


Figure 3

1. Differential lock cable
2. Transaxle bracket
3. Spring

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Drive Train

Service and Repairs

Control Cable Replacement

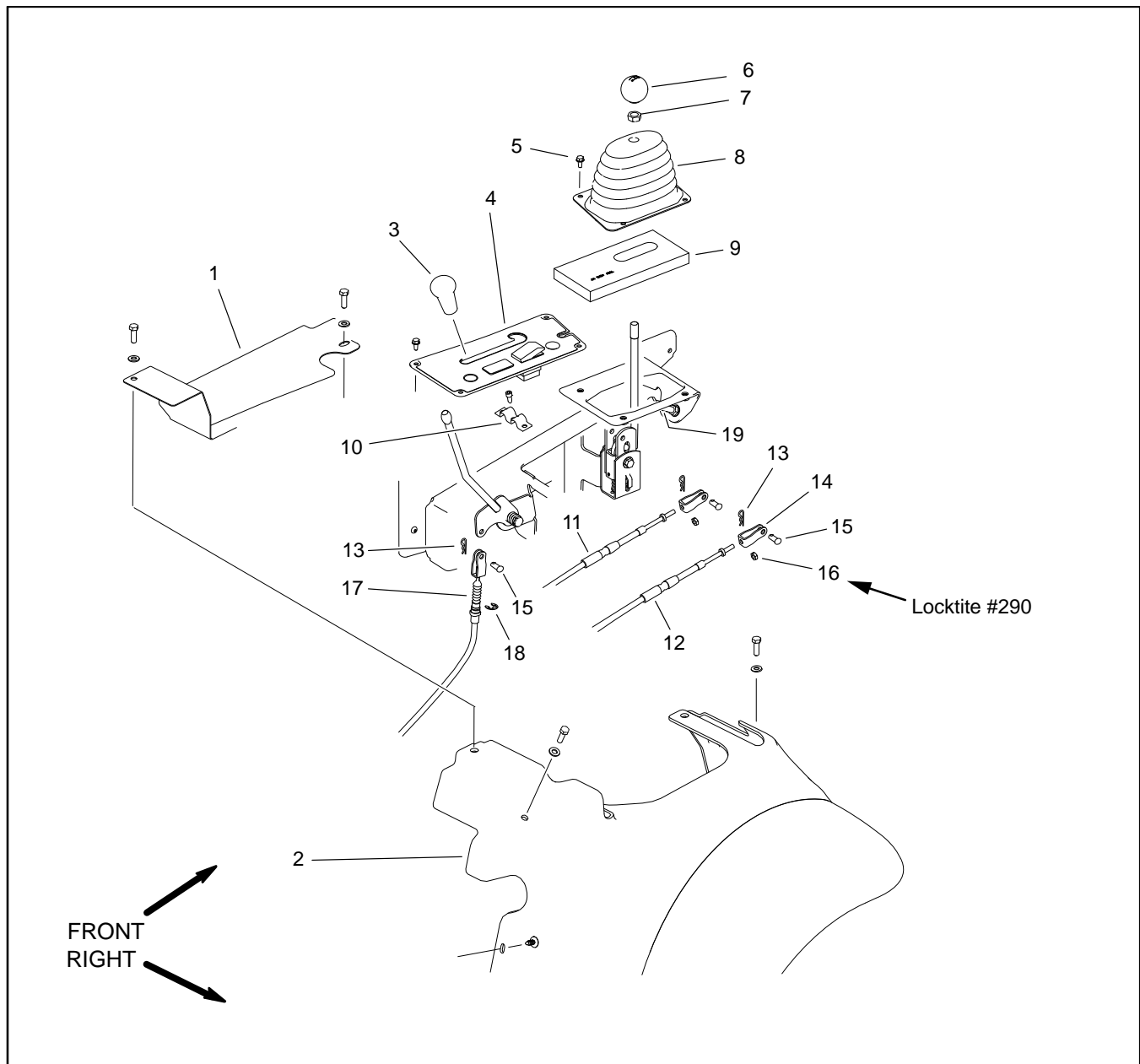


Figure 4

- | | | |
|---------------------------------|--|-----------------------------|
| 1. Bottom console cover | 8. Shift boot | 14. Clevis (2) |
| 2. Right fender assembly | 9. Foam seal | 15. Clevis pin (3) |
| 3. Differential lock lever knob | 10. Cable clamp | 16. Jam nut (2) |
| 4. Rear switch panel | 11. 1 st -Reverse shift cable | 17. Differential lock cable |
| 5. Flange head screw (4) | 12. 2 nd -3 rd shift cable | 18. Retaining ring |
| 6. Shift knob | 13. Hair pin (3) | 19. Shift stop bolt (2) |
| 7. Jam nut | | |

Shift Cable Removal (Fig. 4)

1. Park vehicle on a level surface, shut engine off and engage the parking brake. Remove key from the ignition switch.
2. Remove knobs from control levers, then remove shift boot and foam seal.
3. Remove rear switch panel (item 4). Disconnect rear switch panel switches from wire harness and remove choke cable from rear switch panel for better access to cable clamp if necessary.
4. Remove three (3) screws and cable clamp (item 10) that secure shift cables to support bracket.
5. Remove hair pin and clevis pin that secure the shift cable clevis to shifter link.
6. Remove shift cable from transaxle shift lever (Fig. 5):
 - A. Remove hair pin and clevis pin that secure shift cable to shift lever on transaxle.
 - B. Loosen jam nuts on bulkhead fitting of cable.
 - C. Disconnect cable from shift lever.
7. Loosen jam nut that secures clevis to shift cable end and remove clevis.

8. Record routing of shift cable and location of cable ties used to secure cable to machine. Slide shift cable from lower shift boot and remove cable from machine.

Shift Cable Installation (Fig. 4)

1. Route shift cable in same location as recorded during cable removal. Pass threaded end of cable through lower shift boot.
2. Install cable clevis (item 14) onto front of shift cable so clevis is at mid-point of threaded end of cable. Secure clevis to cable with jam nut. Apply Loctite 290 (wicking) or equivalent to cable at jam nut.
3. Secure shift cables to lever support with cable clamp (item 10) and three (3) screws.

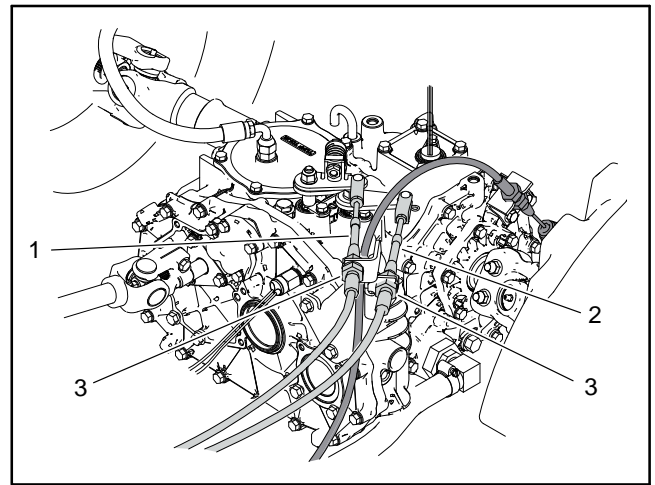


Figure 5

- | | |
|------------------------------|----------------------|
| 1. 2nd-3 rd cable | 3. Bulkhead jam nuts |
| 2. 1st-reverse cable | |

4. Connect shift cable to shifter link with clevis pin and hair pin.
5. Spread jam nuts on bulkhead fitting of cable (Fig. 5). With cable properly routed to transaxle, install cable bulkhead fitting to shift cable mount bracket on transaxle and tighten jam nuts.
6. Install cable ties in the original locations to secure shift cables to vehicle.
7. Adjust shift cables (see Shift Cable Adjustment in this chapter) and secure cable clevis to transaxle shift lever with clevis pin and hair pin.
8. Check adjustment of shift stop bolts (item 18). Move shift lever forward until lever stops. Hold lever in stopped position and adjust stop bolt so that head just contacts lever. Tighten hex nut on stop bolt.
9. Install rear switch panel.
10. Install foam seal, shift boot and control lever knobs.

Differential Lock Cable Removal (Fig. 4)

1. Park vehicle on a level surface, shut engine off and engage the parking brake. Remove key from the ignition switch.
2. Remove knob from differential lock lever and remove rear switch panel (item 4). Disconnect rear switch panel switches from wire harness and remove choke cable from rear switch panel for better access to cable.
3. Remove hair pin and clevis pin that secure the differential lock cable clevis to differential lock lever.
4. Remove the bottom console cover (item 1) and right front fender assembly.
5. Remove retaining ring (item 18) from differential lock cable and remove cable from slot in frame plate.
6. Remove differential cable from transaxle. (Fig. 6):
 - A. Loosen jam nuts on bulkhead fitting of cable.
 - B. Disconnect cable from bracket on transaxle.
 - C. Remove spring from differential lock lever on transaxle.
7. Record routing of differential lock cable and location of cable ties used to secure cable to machine. Remove cable from machine.

Differential Lock Cable Installation (Fig. 4)

1. Route shift cable in same location as recorded during cable removal.

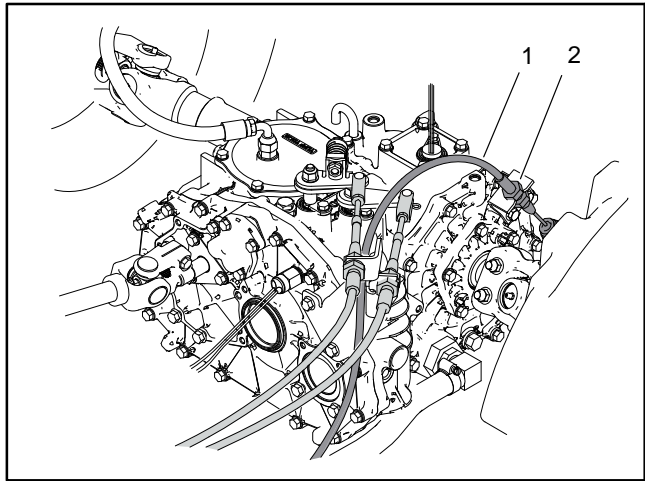


Figure 6

1. Differential lock cable 2. Bulkhead jam nuts
2. Install differential cable to transaxle. (Fig. 6):
 - A. Hook spring to differential lock lever on transaxle.
 - B. Install cable to bracket on transaxle.
 - C. Tighten jam nuts on bulkhead fitting of cable finger tight.
3. Fit cable to slot in frame plate and install retaining ring (item 18).
4. Install the right front fender assembly and bottom console cover (item 1).
5. Install hair pin and clevis pin that secure the differential lock cable clevis to differential lock lever.
6. Install rear switch panel and lever knob.
7. Check and adjust differential lock cable (see Shift Cable Adjustment in this chapter).

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Rear Wheel Driveshafts

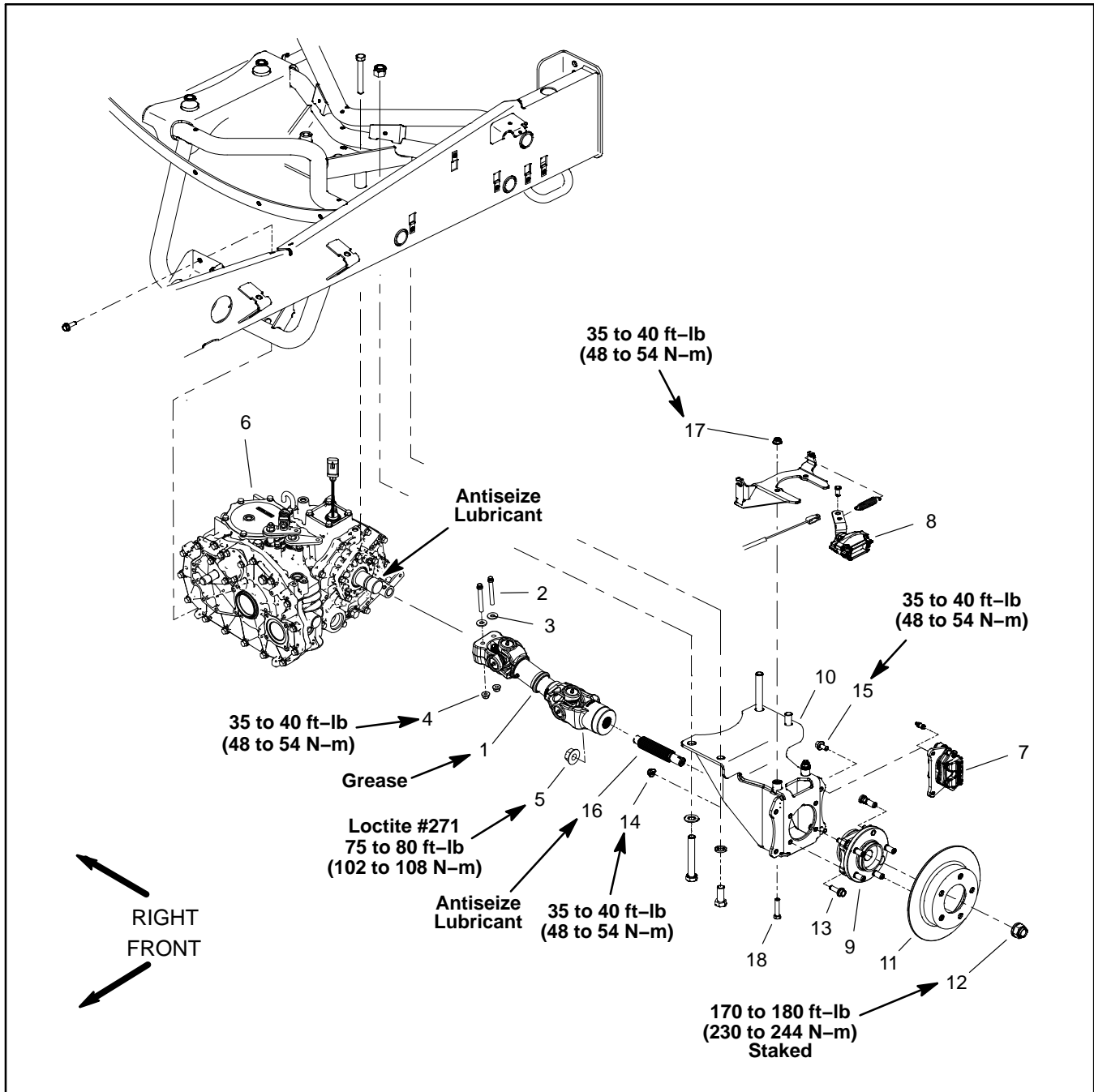


Figure 7

- | | | |
|-----------------------------------|-------------------------------------|---------------------------|
| 1. Rear wheel driveshaft assembly | 7. Rear brake caliper | 13. Cap screw (4) |
| 2. Cap screw (2) | 8. Parking brake caliper (LH shown) | 14. Flange nut (4) |
| 3. Flat washer (2) | 9. Wheel bearing hub | 15. Flange head screw (2) |
| 4. Flange nut (2) | 10. Hub support | 16. Splined shaft |
| 5. Flange nut | 11. Brake rotor | 17. Lock nut (2) |
| 6. Transaxle assembly | 12. Spindle nut | 18. Cap screw (2) |

Removal (Fig. 7)

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

NOTE: Support the brake caliper with a cable tie or wire once the brake caliper is removed from the machine. DO NOT allow the brake caliper to hang by the brake hose.

2. Remove rear wheel, rear brake caliper, parking brake caliper and brake rotor.

NOTE: Spindle nut is staked (deformed) to the splined shaft during assembly. Clear away the deformed area of the nut before removing the nut from the shaft or damage to the shaft threads will occur.

3. Remove and discard the spindle nut.

4. Remove the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access flange head screws. Remove wheel hub and bearing assembly from machine.

5. Loosen and remove flange nuts, cap screws and washers that secure driveshaft to transaxle shaft.

6. Slide driveshaft from transaxle shaft and remove from vehicle.

7. If necessary, loosen and remove flange nut (item 5) that secures splined shaft to driveshaft and remove splined shaft from driveshaft.

Installation (Fig. 7)

1. If removed, attach splined shaft (item 18) to driveshaft:

A. Apply antiseize lubricant to splined shaft and install into driveshaft.

B. Clean threads of splined shaft with solvent and apply heavy duty thread locking compound (ie. Loctite #271) to threads.

C. Install flange nut (item 5) onto splined shaft and torque nut from **70 to 80 ft-lb (102 to 108 N-m)**.

2. Secure driveshaft to transaxle shaft:

A. Apply antiseize lubricant to transaxle shaft.

B. Slide driveshaft yoke onto transaxle shaft.

C. Align mounting holes in driveshaft yoke with groove in transaxle shaft.

D. Install cap screws, washers and flange nuts to secure driveshaft to transaxle shaft. Torque fasteners from **35 to 40 ft-lb (48 to 54 N-m)**.

3. Apply antiseize lubricant to the splined shaft (item 18).

4. Install wheel hub and bearing assembly over the splined shaft. Install the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access mounting holes. Tighten the flange nuts from **35 to 40 ft-lb (48 to 54 N-m)**.

5. Install a new spindle nut. Tighten the spindle nut from **170 to 180 ft-lb (230 to 244 N-m)**. Stake (deform) the outer lip of the spindle nut into the slot in the splined shaft to lock the nut in place.

6. Install brake rotor with parking brake caliper in position on rotor.

7. Install rear brake caliper. Tighten rear brake caliper flange head screws from **35 to 40 ft-lb (48 to 54 N-m)**.

8. Install rear wheel. Tighten wheel lug nuts from **75 to 80 ft-lb (102 to 108 N-m)**.

9. Lubricate driveshaft grease fittings.

Transaxle Driveshaft

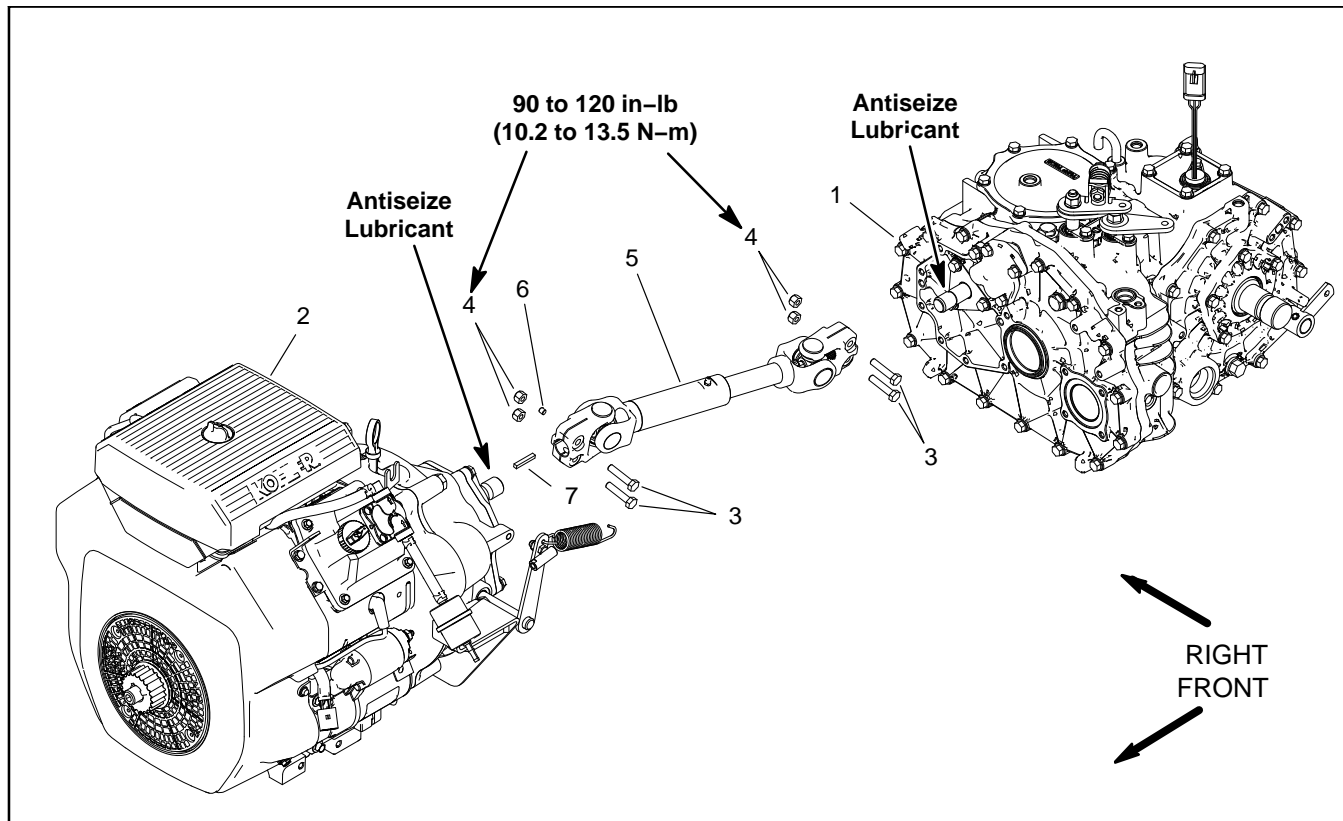


Figure 8

- | | | |
|-----------------------|-------------------------|---------------|
| 1. Transaxle assembly | 4. Lock nut (4) | 6. Set screw |
| 2. Engine | 5. Transaxle driveshaft | 7. Square key |
| 3. Cap screw (4) | | |

Driveshaft Removal (Fig. 8)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. To remove driveshaft from transaxle, loosen and remove lock nuts and cap screws securing driveshaft to splined input shaft of transaxle. Slide driveshaft yoke from transaxle.
3. To remove driveshaft yoke from clutch bell housing, loosen and remove lock nuts and cap screws securing driveshaft to output shaft at bell housing. Remove set screw (item 6) from yoke and then slide driveshaft yoke from shaft. Locate and retrieve square key.

Driveshaft Installation (Fig. 8)

1. Apply antiseize lubricant to clutch bell housing output shaft and transaxle input shaft
2. Position transaxle driveshaft to clutch bell housing and transaxle shafts. Make sure that square key is placed in shaft key slot.
3. Slide driveshaft yokes onto clutch bell housing and transaxle shafts.
4. Install cap screws and lock nuts to secure driveshaft yoke to output shaft at bell housing. Torque lock nuts from **90 to 120 in-lb (10.2 to 13.5 N-m)**. Install and tighten socket head screw (item 6) into yoke.
5. Install cap screws and lock nuts to secure driveshaft yoke to splined transaxle input shaft. Torque lock nuts from **90 to 120 in-lb (10.2 to 13.5 N-m)**.

Driveshaft Cross and Bearing Service

The following procedure can be used to replace the cross and bearings from either the rear wheel driveshafts or the transaxle driveshaft.

1. Remove driveshaft from vehicle (see Rear Wheel Driveshafts or Transaxle Driveshaft in this section).

IMPORTANT: When placing yoke in vise, clamp lightly on the solid part of the yoke to prevent yoke damage. Also, the use of a vise with soft jaws is recommended.

2. Lightly clamp yoke in vise. Remove snap rings that secure bearings at the inside of each yoke. Remove yoke from vise.

IMPORTANT: Yokes must be supported when removing and installing bearings to prevent damage.

3. Use a press to remove cross and bearings from yokes:

A. Place a small socket against one bearing and a large socket against the yoke on the opposite side.

B. While supporting the large socket, apply pressure on small socket to partially push the opposite bearing into the large socket.

C. Remove yoke from press, grasp partially removed bearing and tap on yoke to completely remove the bearing.

D. Repeat process for remaining bearings.

E. Thoroughly clean and inspect all components.

4. To install new cross and bearings:

A. Apply a coating of grease to bearing bores of end yoke and shaft yoke. Also, apply grease to bearings and seal of bearing assembly. Make sure that all bearing rollers are properly seated in bearing cage.

B. Press one bearing partially into yoke.

IMPORTANT: Take care when installing cross into bearing to avoid damaging bearing seal.

C. Carefully insert cross into bearing and yoke.

D. Hold cross in alignment and press bearing in until it hits the yoke.

E. Carefully place second bearing into yoke bore and onto cross shaft. Press bearing into yoke.

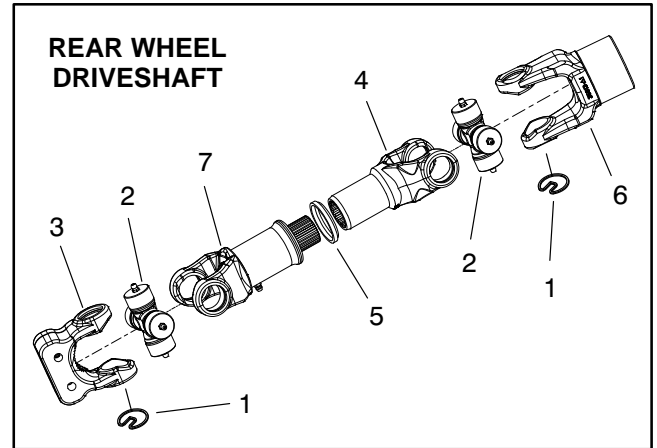


Figure 9

- | | |
|-----------------------|--------------|
| 1. Snap ring | 5. Seal |
| 2. Cross and bearings | 6. End yoke |
| 3. End yoke | 7. Tube yoke |
| 4. Yoke and hub | |

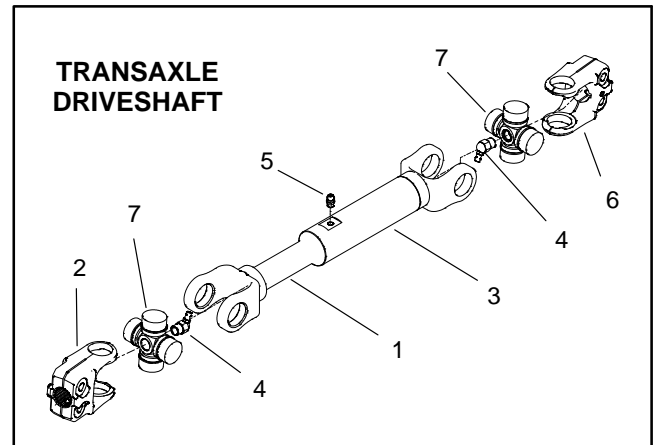


Figure 10

- | | |
|-----------------------------|--------------------------|
| 1. Slip shaft yoke | 5. Grease fitting |
| 2. Splined yoke (transaxle) | 6. Keyed yoke (engine) |
| 3. Slip tube yoke | 7. Cross and bearing kit |
| 4. Grease fitting | |

F. Secure bearings in yokes with snap rings.

G. Repeat procedure for remaining yoke.

5. Lubricate grease fittings until grease purges from bearing cups. Make sure to grease all cross fittings.

6. Make sure that assembled joint moves without binding. Slight binding can usually be eliminated by lightly rapping the yoke lugs with a soft faced hammer. If binding continues, disassemble joint to identify source of binding.

7. Install driveshaft to vehicle (see Rear Wheel Driveshafts or Transaxle Driveshaft in this section).

Transaxle

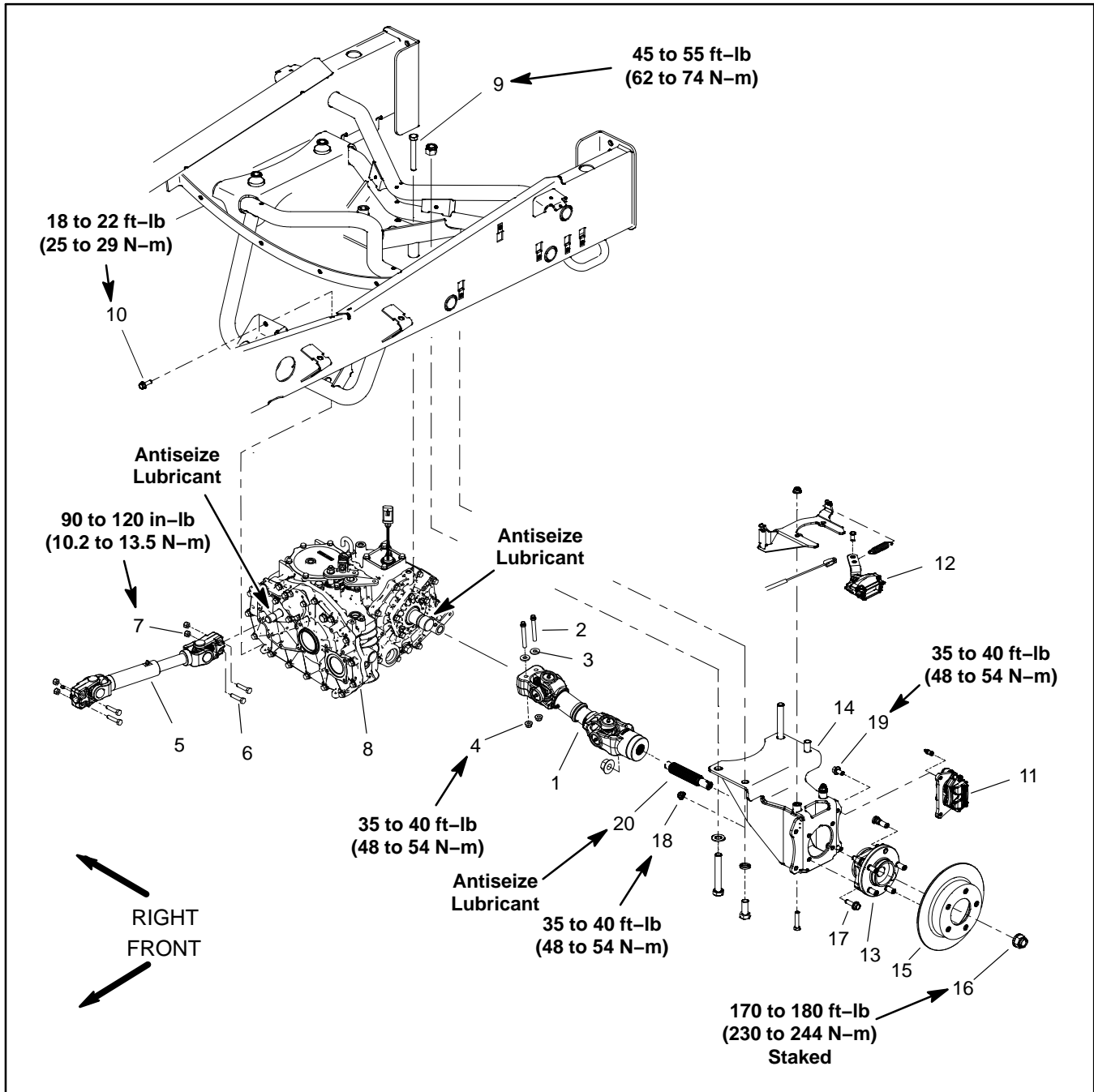


Figure 11

- | | | |
|---------------------------------------|--------------------------------------|---------------------------|
| 1. Rear wheel driveshaft assembly (2) | 8. Transaxle assembly | 15. Brake rotor |
| 2. Cap screw (2) | 9. Cap screw (2) | 16. Spindle nut |
| 3. Flat washer (2) | 10. Flange head screw (4) | 17. Cap screw (4) |
| 4. Flange nut (2) | 11. Rear brake caliper | 18. Flange nut (4) |
| 5. Transaxle driveshaft assembly | 12. Parking brake caliper (LH shown) | 19. Flange head screw (2) |
| 6. Cap screw (2) | 13. Wheel bearing hub | 20. Splined shaft |
| 7. Lock nut (2) | 14. Hub support | |

Transaxle Removal (Fig. 11)

1. Park machine on a level surface, stop engine, chock front wheels and remove key from the ignition switch.

2. Drain oil from transaxle into a suitable container.

3. Disconnect the negative (-) cable from the battery, then disconnect the positive (+) cable from the battery.

4. Block front wheels. Raise rear of machine and secure machine with jack stands high enough so the transaxle can be removed by sliding out under rear of machine (see Jacking Instructions in Chapter 1 – Safety in this manual).

5. Unplug speed sensor and neutral switch at machine wire harness connector (Fig. 12).

6. Label shift cables to ease reassembly. Loosen shift cable jam nuts at cable mount (Fig. 13). Remove cotter pin and clevis pin that attach shift cable ends to transaxle shift arm levers. Pull shift cables free from mount.

7. Loosen differential lock cable jam nuts at cable mount (Fig. 13). Pull cable free from mount and disconnect cable end (spring) from differential lock lever.

8. Disconnect hydraulic return hose from top of transaxle (Fig. 13). Locate, remove and discard hose O-ring.

9. Disconnect suction hose from transaxle (Fig. 13). Locate, remove and discard suction hose O-ring. Position suction hose away from transaxle.

10. Put caps or plugs on all open hoses and fittings to prevent contamination.

11. Remove two (2) cap screws and lock nuts from transaxle end of transaxle driveshaft assembly. Slide the driveshaft off of the transaxle input shaft.

12. Remove the lug nuts and the left side wheel & tire assembly.

NOTE: Support the brake caliper with a cable tie or wire once the brake caliper is removed from the machine. DO NOT allow the brake caliper to hang by the brake hose.

13. Remove the two (2) flange head screws that secure the rear brake caliper to the hub support. Slide the caliper from the brake rotor.

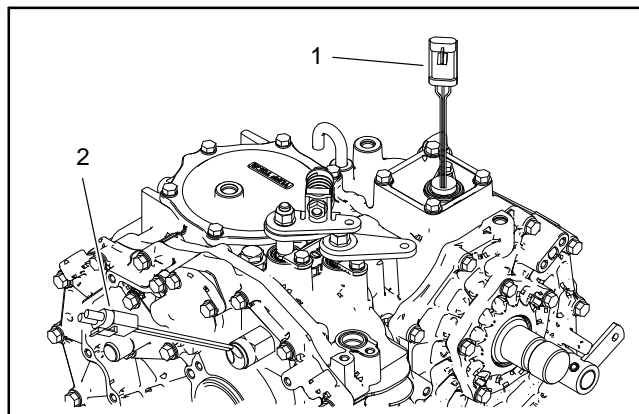


Figure 12

1. Speed sensor connector 2. Neutral switch connector

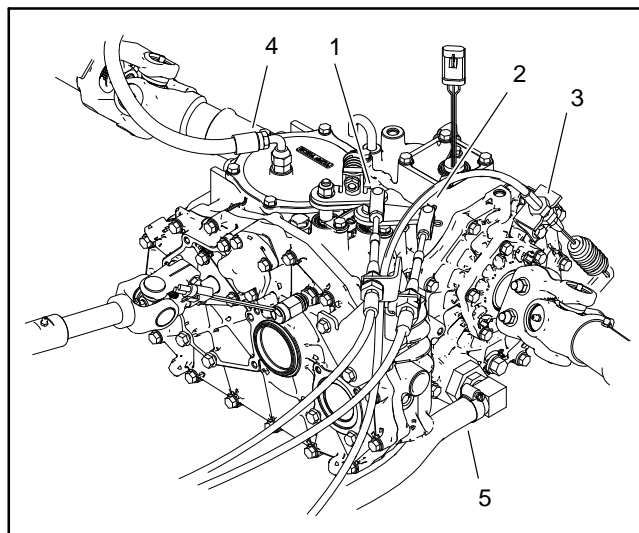


Figure 13

1. Shift cable 2. Shift cable
3. Differential lock cable 4. Hydraulic return hose
5. Suction hose

14. Remove the parking brake:

A. Record the amount of the threaded parking brake cable adjuster exposed behind the jam nuts that secure the parking brake cable to the caliper bracket. Loosen brake cable jam nuts.

B. Remove return spring end from clevis pin on parking brake lever.

C. Slide parking brake caliper from caliper bracket.


15. Remove brake rotor from wheel bearing.

NOTE: Spindle nut is staked (deformed) to the splined shaft during assembly. Clear away the deformed area of the nut before removing the nut from the shaft or damage to the shaft threads will occur.

16. Remove and discard the spindle nut.

17. Remove the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access flange head screws. Remove wheel hub and bearing assembly from machine.

18. Remove two (2) cap screws and lock nuts from transaxle end of the left wheel driveshaft assembly. Slide the left driveshaft off of the transaxle output shaft.

	CAUTION
The transaxle assembly weighs approximately 100 lbs (45 kg). Use an appropriate lifting device to safely lower the transaxle assembly.	

19. Support transaxle to prevent it from shifting or falling. Remove two (2) cap screws that secure top of transaxle to machine frame (item 11). Remove four (4) flange head screws that secure front of transaxle to machine frame.

20. Support the right wheel driveshaft assembly and move the transaxle assembly to the left until the right wheel driveshaft separates. Lower transaxle assembly from the machine.


21. Remove right wheel driveshaft yoke from transaxle if necessary.

22. If necessary, remove shift cable mount and differential lock cable mount from transaxle.

23. Remove oil strainer from transaxle. Locate, remove and discard strainer O-ring.

Transaxle Installation (Fig. 11)

1. Lubricate new oil strainer O-ring with Dexron III ATF oil and position on strainer. Install strainer into transaxle and tighten from **80 to 90 ft-lb (108 to 122 N-m)**.
2. If removed, install shift cable mount and differential lock cable mount to transaxle.
3. Apply antiseize lubricant to the transaxle input and output shafts.
4. Install right wheel driveshaft yoke to transaxle if previously removed. Driveshaft yoke cap screws must pass across the groove in transaxle output shaft. Tighten flange nuts from **35 to 40 ft-lb (48 to 54 N-m)**.

	CAUTION
The transaxle assembly weighs approximately 100 lbs (45 kg). Use an appropriate lifting device to safely raise the transaxle assembly.	

5. Align the splines and move the transaxle assembly to the right until the right wheel driveshaft splines mesh. Raise transaxle assembly to the machine.
6. Install the two (2) cap screws that secure top of transaxle to machine frame (item 11). Install four (4) flange head screws that secure front of transaxle to machine frame. Tighten cap screws (item 9) from **45 to 55 ft-lb (62 to 74 N-m)**.
7. Slide the left wheel driveshaft onto the transaxle output shaft. Install two (2) cap screws, hardened washers and lock nuts to driveshaft assembly. The cap screws should pass across the groove in the transaxle output shaft. Tighten the lock nuts from **35 to 40 ft-lb (48 to 54 N-m)**.
8. Apply antiseize lubricant to the splined shaft (item 20).
9. Install wheel hub and bearing assembly (item 13) over the splined shaft. Install the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access mounting holes. Tighten the flange nuts from **35 to 40 ft-lb (48 to 54 N-m)**.
10. Install a new spindle nut. Tighten the spindle nut from **170 to 180 ft-lb (230 to 244 N-m)**. Stake (deform) the outer lip of the spindle nut into the slot in the splined shaft to lock the nut in place.
11. Install the brake rotor.

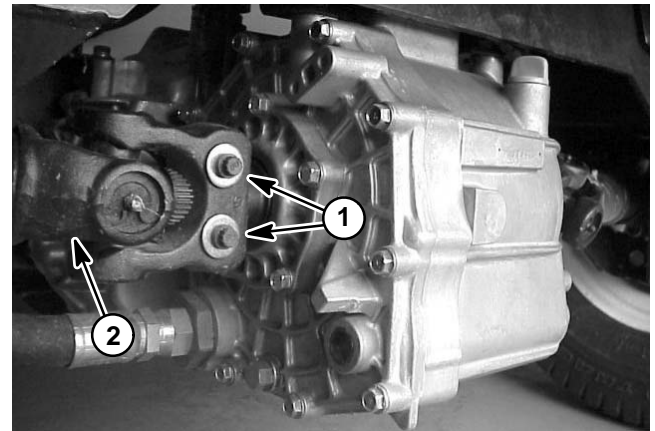


Figure 14

1. Cap screw, washer and flange nut (2)
2. Rear wheel driveshaft (LH)

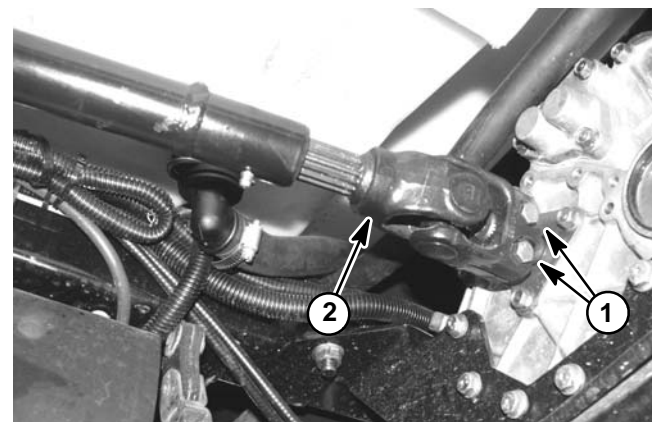


Figure 15

1. Cap screw
2. Transaxle driveshaft

12. Install the parking brake:

- A. Slide parking brake caliper onto caliper bracket.
- B. Install return spring end to clevis pin on parking brake lever.
- C. Fit parking brake cable to caliper bracket. Position the cable jam nuts to location recorded during removal and tighten jam nuts. Adjust the parking brake (see machine Operator's Manual).

13. Slide the brake caliper over the brake rotor. Install the two (2) flange head screws that secure the rear brake caliper to the hub support. Tighten the flange head screws from **35 to 40 ft-lb (48 to 54 N-m)**.

14. Install the left side wheel & tire assembly. Tighten the lug nuts from **70 to 80 ft-lb (95 to 108 N-m)**.

15. Slide the end of the transaxle driveshaft onto the transaxle input shaft. Install two (2) cap screws and lock nuts. The cap screws must pass across the groove in transaxle input shaft. Tighten lock nuts from **90 to 120 in-lb (10.2 to 13.5 N-m)**.

16. Remove all caps or plugs placed on hydraulic hoses and fittings during disassembly.

17. Lubricate new suction and return hose O-rings with Dexron III ATF oil. Install suction and return hoses to transaxle.


18. Install differential lock cable. Check and adjust differential lock cable (see Shift Cable Adjustment in this chapter).

19. Position shift cables to cable mount noting cable identification made during disassembly. Check and adjust shift cables (see Shift Cable Adjustment in this chapter).

20. Install the speed sensor if previously removed. Plug speed sensor connector into wire harness.

21. Install the neutral switch if previously removed (see Neutral Switch in Chapter 5 – Electrical System in this manual). Plug neutral switch connector into wire harness.

22. Lower machine to ground.

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

23. Connect positive (+) cable to battery first and then negative (-) cable.

24. Fill transaxle with Dexron III ATF oil (see Operator's Manual).

25. Check transaxle operation and inspect machine for hydraulic system leaks before returning the machine into service.

Transaxle Service

Transaxle Disassembly

1. Thoroughly clean outside surface of transaxle.

NOTE: Item numbers in figures are shown in order of disassembly; for example, remove item 1 first, then item 2, etc. Assemble in reverse order; for example, install item 1 last.

2. Loosen flange head screws and remove fork shaft case from center plate. Note location of longer flange head screw. Be careful when removing cover as steel balls inside are spring loaded.

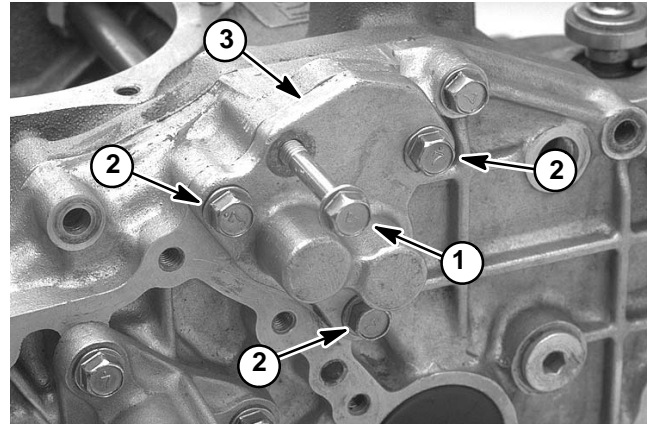


Figure 16

- 1. Flange head screw (1)
- 2. Flange head screw (2)
- 3. Fork shaft case

3. Hold your hand over the area and shift R-1 and 2-3 levers to move rails outward so balls, springs and spindle can be removed.

4. Inspect fork shaft case for cracks or damage and replace if necessary.

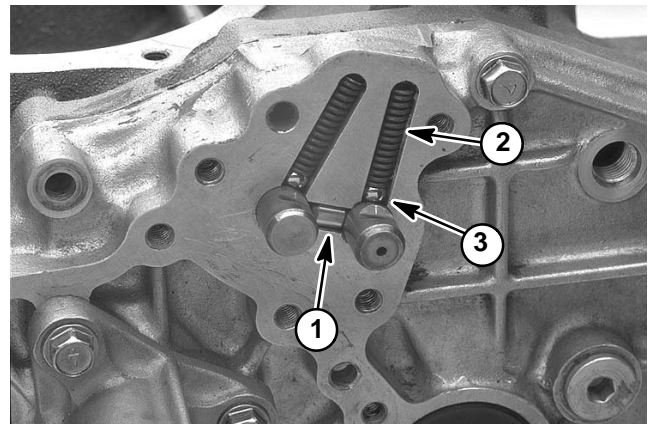


Figure 17

- 1. Spindle
- 2. Spring (2)
- 3. Ball (2)

5. Remove center plate assembly:

A. Loosen and remove fifteen (15) flange head screws and separate center plate from transaxle case. Note dowel pins in transaxle case.

B. Remove seal cap, shims and snap ring from center plate.

C. Remove input shaft cover and seal from center plate. Discard seal.

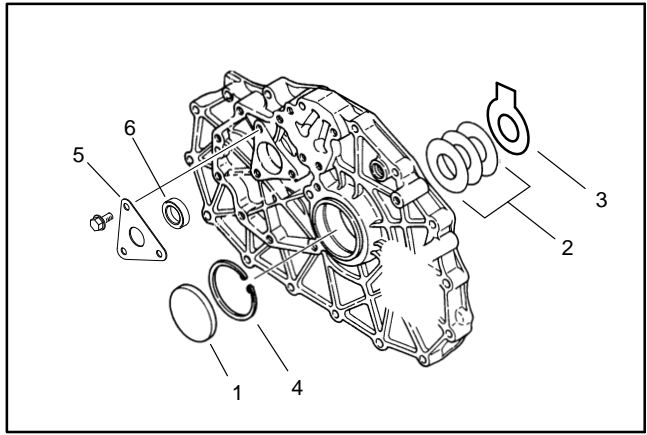


Figure 18

- | | |
|-------------|----------------------|
| 1. Seal cap | 4. Snap ring |
| 2. Shims | 5. Input shaft cover |
| 3. Shim | 6. Input shaft seal |

6. Remove reverse shaft from transaxle case.

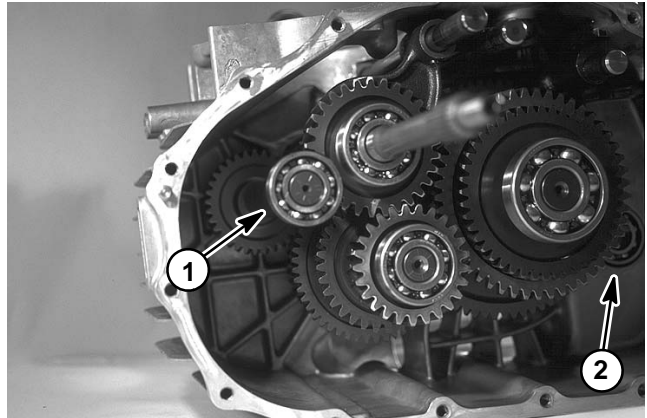


Figure 19

- | | |
|------------------|------------------------|
| 1. Reverse shaft | 2. Bearing (gear case) |
|------------------|------------------------|

7. Remove main shaft assembly together with fork shaft assembly from transaxle case.

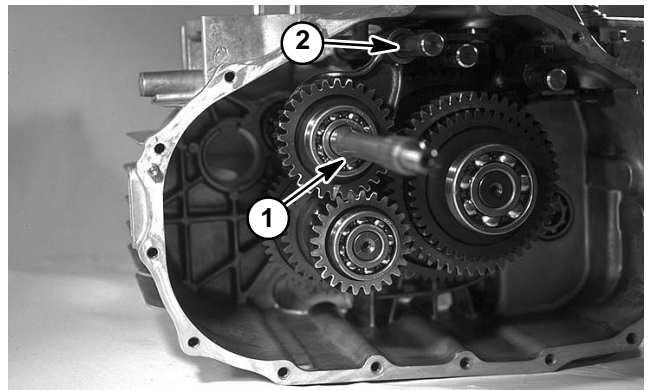


Figure 20

- | | |
|------------------------|------------------------|
| 1. Main shaft assembly | 2. Fork shaft assembly |
|------------------------|------------------------|

8. Remove, all at the same time, reduction shaft assembly, 2nd-3rd shift assembly and countershaft assembly.

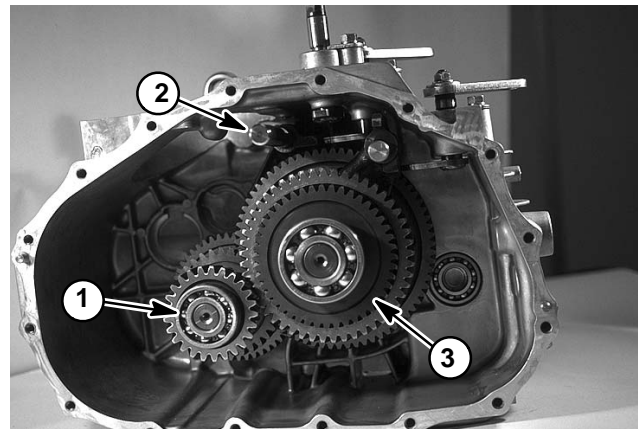


Figure 21

- | | |
|-----------------------------|--|
| 1. Reduction shaft assembly | 2. 2 nd -3 rd shaft assembly |
| | 3. Countershaft assembly |

9. Loosen flange head screws and remove L.H. axle shaft assembly and shims from L.H. side cover still attached to transaxle.

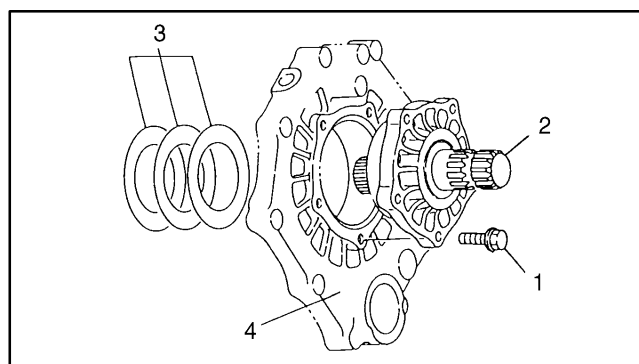


Figure 22

- | | |
|-----------------------------|--------------------|
| 1. Flange head screw (5) | 3. Shims |
| 2. L.H. axle shaft assembly | 4. L.H. Side cover |

10. Remove roll pin from differential lock lever and remove lever from shaft. Loosen and remove five (5) flange head screws. Remove L.H. side cover from transaxle case.

11. Inspect side cover for cracks or damage and replace if necessary.

12. Remove differential lock shaft seal from cover and discard seal.

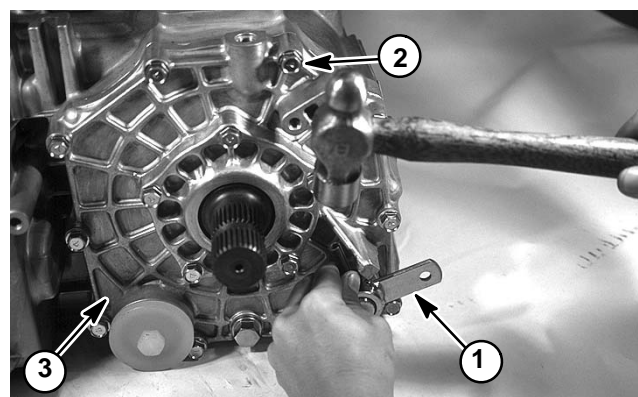


Figure 23

- | | |
|--------------------------|--------------------|
| 1. Lever | 3. L.H. Side cover |
| 2. Flange head screw (5) | |

13. Loosen and remove four (4) flange head screws. Remove R.H. axle shaft assembly from transaxle case.

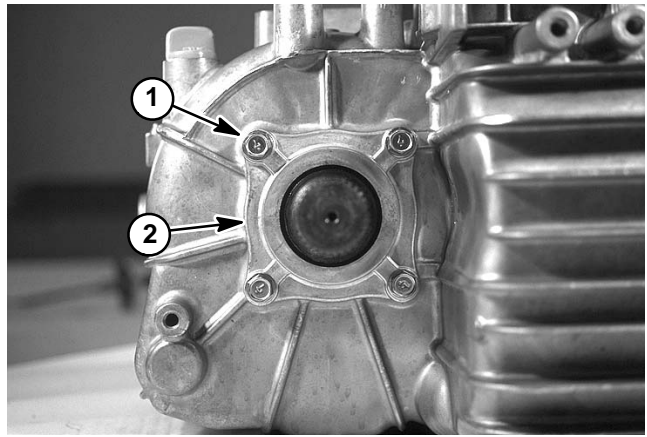


Figure 24

- 1. Flange head screw (4)
- 2. R.H. Axle shaft assy.

14. Remove differential gear assembly together with fork shaft assembly.

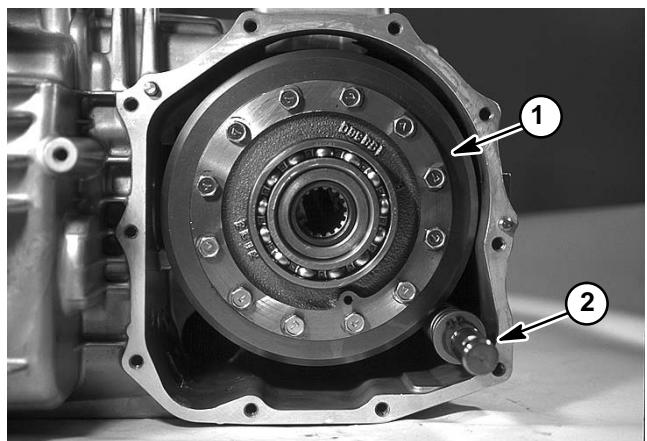


Figure 25

- 1. Differential gear assy.
- 2. Fork shaft assy.

15. Remove washer from inside of transaxle case.

NOTE: Washer may stick to fork shaft when removed in step 14.

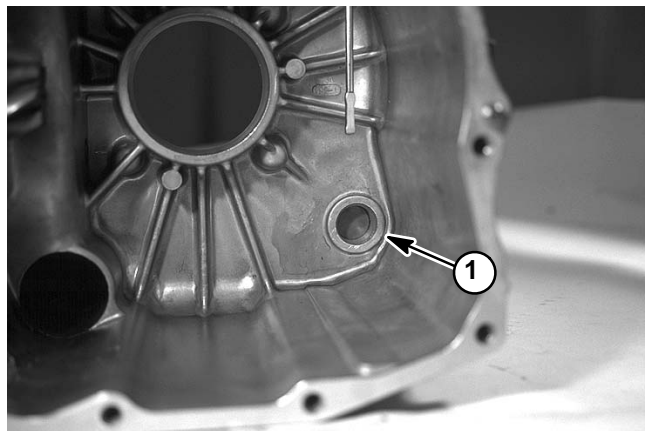


Figure 26

- 1. Washer

16. To remove shift arms:

A. Loosen and remove nut. Remove 2nd–3rd shift arm together with shift arm plate, spring, lock nut, washer and cap screw.

B. Loosen and remove lock nut from 1st–Rev. shift arm and remove shift arm.

C. Loosen cap screws (Fig. 28) and remove keeper plates.

D. Remove oil seals from transaxle case and discard seals.

E. Inspect shift arms and keeper plates for bending or damage and replace if necessary.

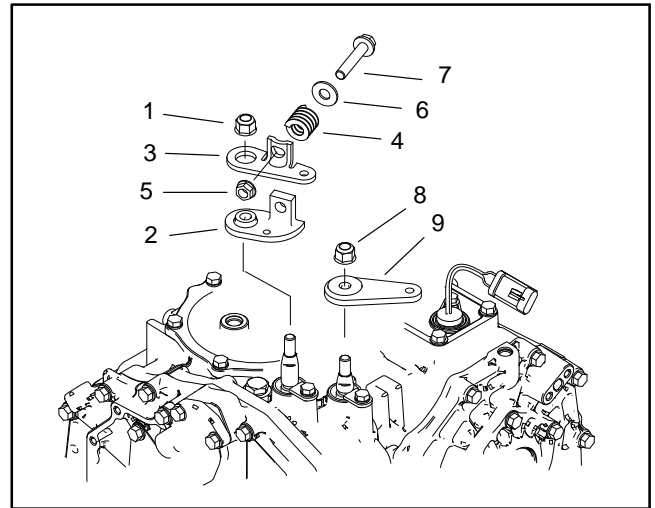


Figure 27

- | | |
|---|----------------------|
| 1. Nut | 6. Washer |
| 2. 2 nd -3 rd shift arm | 7. Cap screw |
| 3. Shift arm plate | 8. Lock nut |
| 4. Spring | 9. 1st-Rev shift arm |
| 5. Lock nut | |

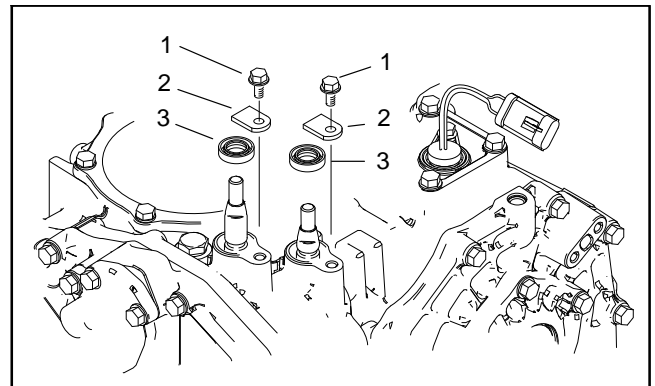


Figure 28

- | | |
|-----------------|-------------|
| 1. Cap screw | 3. Oil seal |
| 2. Keeper plate | |

17. Remove cap screws and nut with washer. Separate PTO cover from transaxle case. Inspect PTO cover for cracks or damage and replace if necessary.

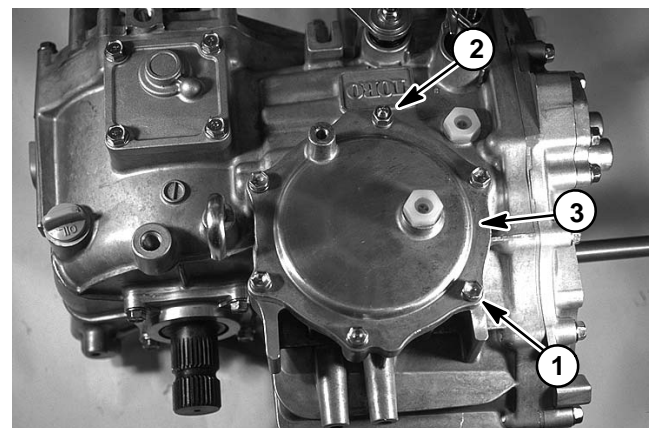


Figure 29

- | | |
|------------------|--------------|
| 1. Cap screw (5) | 3. PTO cover |
| 2. Nut | |

18.Remove oil cap and O–ring from transaxle case if necessary.

19.Remove air breather if necessary.

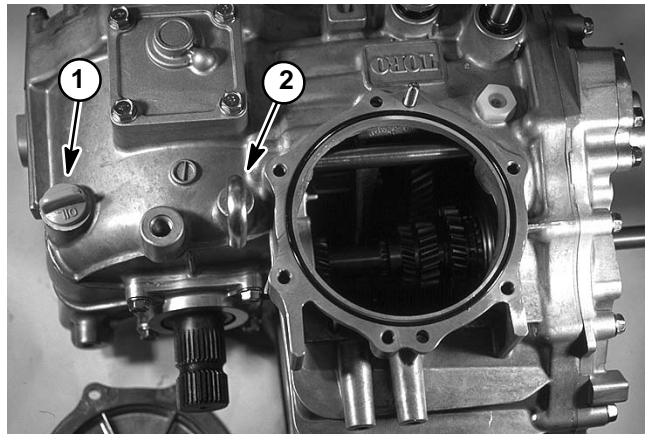


Figure 30

1. Oil cap

2. Air breather

20.If necessary, remove flange head screw and slide speed sensor from upper cover.

21.Loosen flange head screws and remove upper cover from transaxle case.

22.Remove oil seal from upper cover and discard seal.

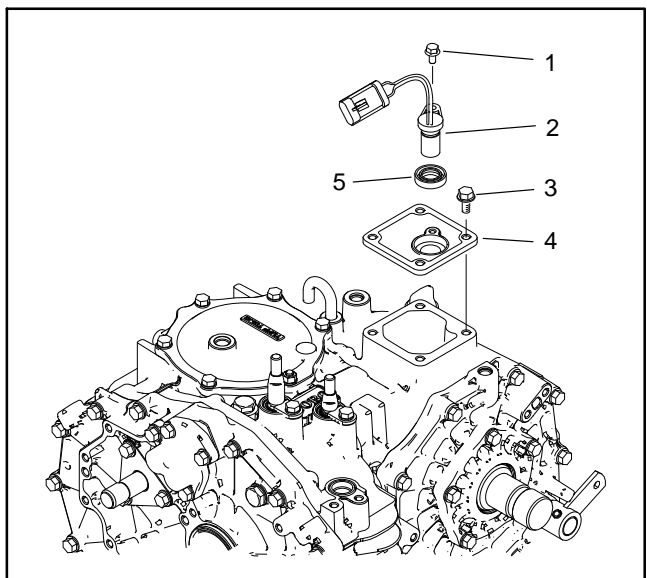


Figure 31

1. Flange head screw

2. Speed sensor

3. Flange head screw (4)

4. Upper cover

5. Oil seal

23. Disassemble main shaft assembly:

- A. Use a bearing puller to remove bearing from main shaft.
- B. Remove snap ring and washer. Measure thickness of washer. Replace washer if it is less than 0.0709 in. (1.8 mm) thick.
- C. Remove needle bearings and gear (item 4). Inspect needle bearings and replace if necessary.
- D. Remove synchro ring.
- E. Remove snap ring.
- F. Remove shifter together with spring, hub and keys.
- G. Remove key (item 9).
- H. Remove snap ring.
- I. Remove synchro ring, gear (item 11), needle bearings and washer. Inspect needle bearings and replace if necessary.
- J. Use a bearing puller to remove bearing (item 14).
- K. Remove remaining gears and snap ring.

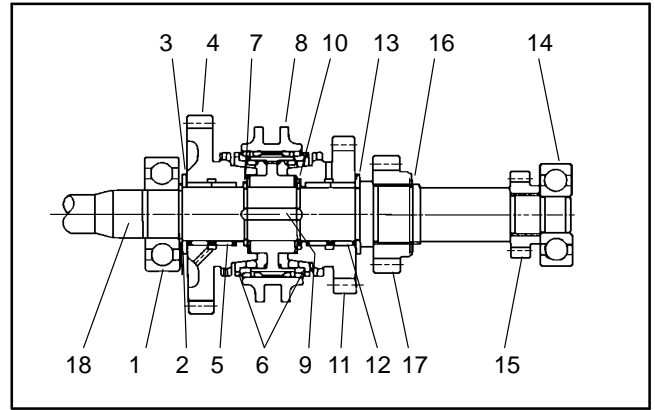


Figure 32

- | | |
|-----------------------|------------------------|
| 1. Bearing | 10. Snap ring |
| 2. Snap ring | 11. Gear |
| 3. Washer | 12. Needle bearing (2) |
| 4. Gear | 13. Washer |
| 5. Needle bearing (2) | 14. Bearing |
| 6. Synchro ring (2) | 15. Gear |
| 7. Snap ring | 16. Snap ring |
| 8. Shifter | 17. Gear |
| 9. Key | 18. Main shaft |

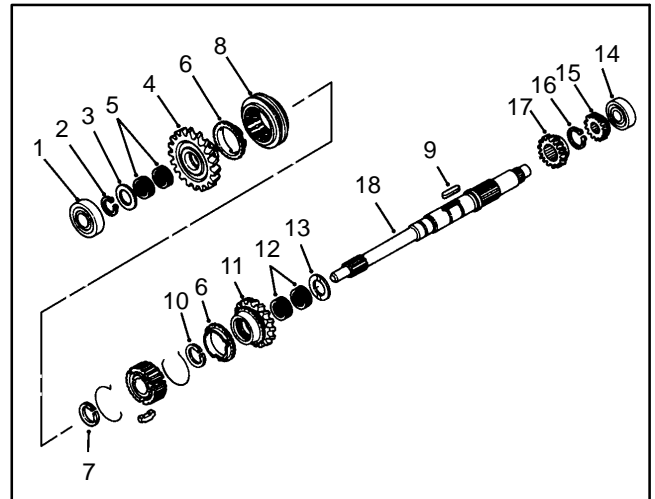


Figure 33

- | | |
|-----------------------|------------------------|
| 1. Bearing | 10. Snap ring |
| 2. Snap ring | 11. Gear |
| 3. Washer | 12. Needle bearing (2) |
| 4. Gear | 13. Washer |
| 5. Needle bearing (2) | 14. Bearing |
| 6. Synchro ring (2) | 15. Gear |
| 7. Snap ring | 16. Snap ring |
| 8. Shifter | 17. Gear |
| 9. Key | 18. Main shaft |

24. Disassemble reduction shaft assembly:

- A. Use a bearing puller to remove bearing from reduction shaft.
- B. Remove gear, helical gear, collar and gear.
- C. Use a bearing puller to remove bearing.
- D. Remove washer, needle bearing and gear.
- E. Remove retaining ring.
- F. Remove shifter together with spring, hub and keys.
- G. Remove key.
- H. Remove synchro ring from gear.

I. Remove gear, needle bearing and thrust washer. Inspect needle bearing and replace if necessary. Measure thickness of thrust washer. Replace thrust washer if thickness is less than **0.0709 in. (1.8 mm)**.

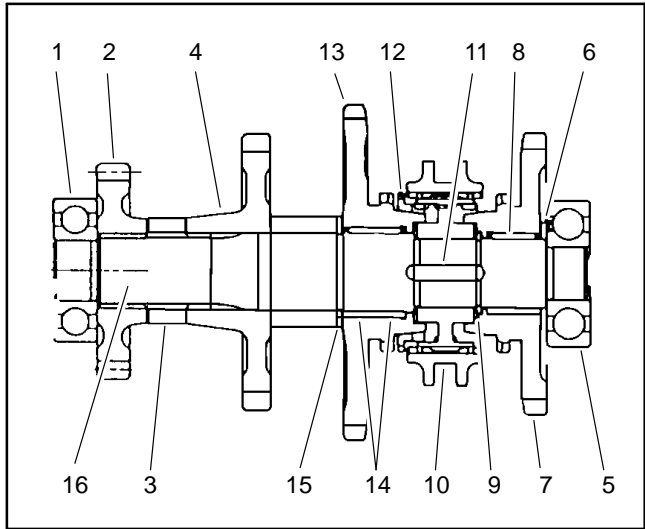


Figure 34

- | | |
|-------------------|------------------------|
| 1. Bearing | 9. Retaining ring |
| 2. Helical gear | 10. Shifter |
| 3. Collar | 11. Key |
| 4. Gear | 12. Synchro ring |
| 5. Bearing | 13. Gear |
| 6. Washer | 14. Needle bearing (2) |
| 7. Gear | 15. Thrust washer |
| 8. Needle bearing | 16. Reduction shaft |

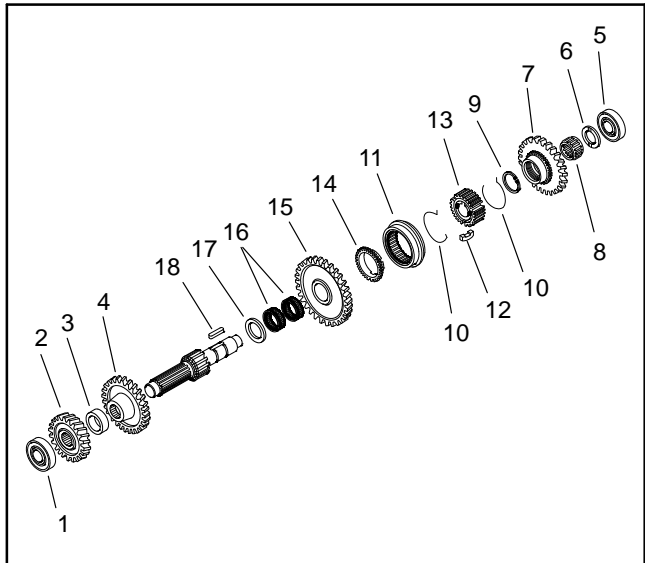


Figure 35

- | | |
|-------------------|------------------------|
| 1. Bearing | 10. Synchro spring (2) |
| 2. Helical gear | 11. Shifter |
| 3. Collar | 12. Synchro key (3) |
| 4. Gear | 13. Synchro hub |
| 5. Bearing | 14. Synchro ring |
| 6. Washer | 15. Gear |
| 7. Gear | 16. Needle bearing (2) |
| 8. Needle bearing | 17. Thrust washer |
| 9. Snap ring | 18. Key |

25. Disassemble reverse shaft assembly:

- A. Use a bearing puller to remove bearing from reverse shaft.
- B. Remove gear.
- C. Use a bearing puller to remove bearing from reverse shaft.

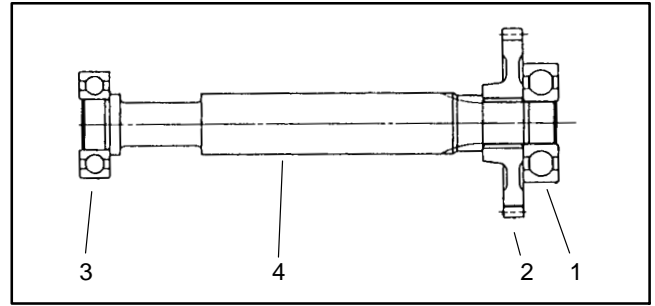


Figure 36

- 1. Bearing
- 2. Gear
- 3. Bearing
- 4. Reverse shaft

26. Disassemble countershaft assembly:

- A. Use a bearing puller to remove bearing from countershaft.
- B. Remove collar and retaining ring.
- C. Remove countershaft gear.
- D. Remove retaining ring and collar from shaft.
- E. Use a bearing puller to remove two (2) bearings from shaft.

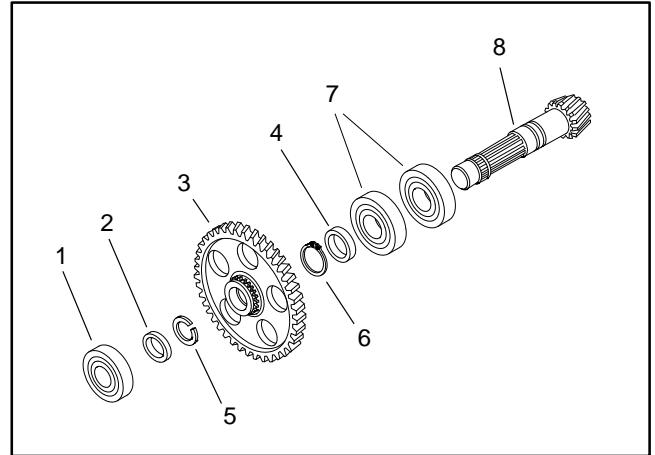


Figure 37

- 1. Bearing
- 2. Collar
- 3. Gear
- 4. Collar
- 5. Retaining ring
- 6. Retaining ring
- 7. Bearing (2)
- 8. Countershaft

27. Disassemble fork shaft assemblies:

- A. Remove lock pin from 2nd–3rd fork shaft assembly.
- B. Note or mark mating shafts and forks for assembly.
- C. Remove shift fork from fork shaft.
- D. Remove lock pin from 1st–R fork shaft assembly.
- E. Remove shift fork from fork shaft.

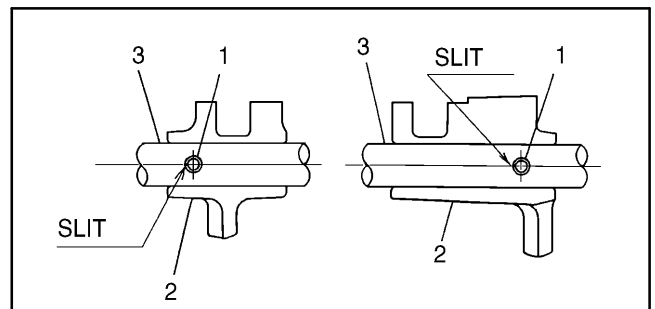


Figure 38

- 1. Lock pin
- 2. Shift fork
- 3. Fork shaft

28. Disassemble differential gear assembly:

- A. Use a bearing puller to remove bearing (item 1) from differential case.
- B. Remove snap ring.
- C. Use a bearing puller to remove bearing and slider.
- D. Loosen screws from ring gear.
- E. Remove ring gear from differential case and remove dowel pins.
- F. Drive lock pin out of pinion shaft.
- G. Remove pinion shaft from differential case.
- H. Remove differential pinions and liners.
- I. Remove L.H. side gear, R.H. side gear and liners.

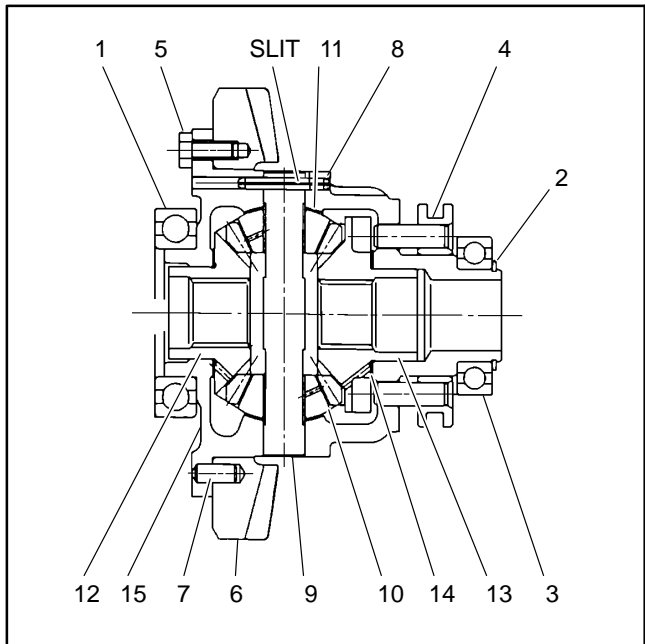


Figure 39

- | | |
|---------------------|--------------------|
| 1. Bearing | 8. Lock pin |
| 2. Snap ring | 9. Pinion shaft |
| 3. Bearing | 10. Pinion (2) |
| 4. Diff lock slider | 11. Liner (2) |
| 5. Screws | 12. L.H. side gear |
| 6. Ring gear | 13. R.H. Side gear |
| 7. Dowel pin (2) | 14. Liner (2) |

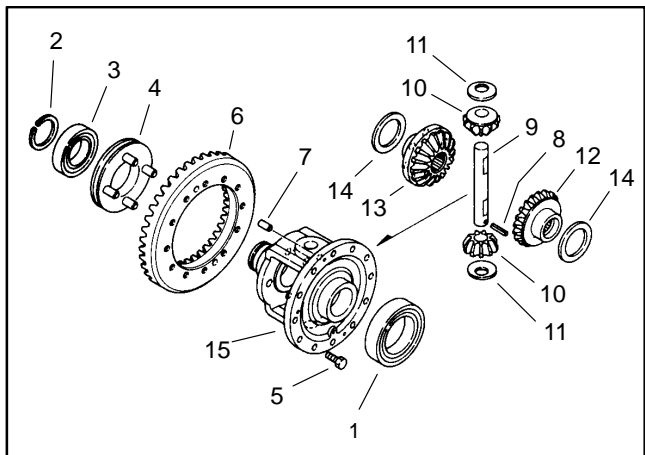


Figure 40

- | | |
|---------------------|--------------------|
| 1. Bearing | 8. Lock pin |
| 2. Snap ring | 9. Pinion shaft |
| 3. Bearing | 10. Pinion (2) |
| 4. Diff lock slider | 11. Liner (2) |
| 5. Screws | 12. L.H. side gear |
| 6. Ring gear | 13. R.H. Side gear |
| 7. Dowel pin (2) | 14. Liner (2) |

29. Disassemble differential lock fork shaft assembly:

- A. Remove O-ring from fork shaft.
- B. Remove snap ring, washer and spring.
- C. Remove fork.
- D. Remove lock pin if necessary.

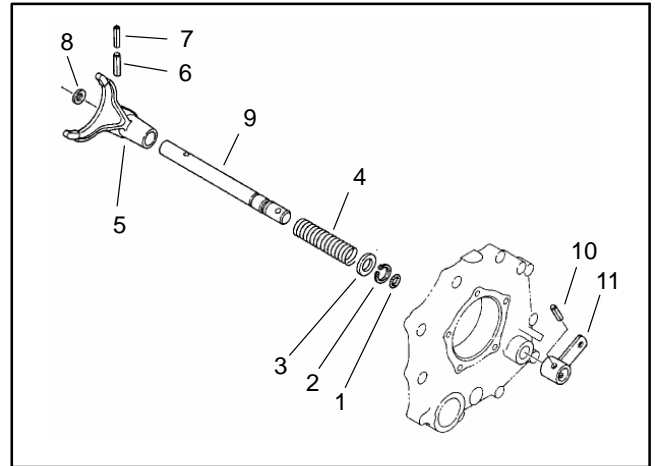


Figure 41

- | | |
|--------------|---------------|
| 1. O-ring | 7. Roll pin |
| 2. Snap ring | 8. Washer |
| 3. Washer | 9. Fork shaft |
| 4. Spring | 10. Roll pin |
| 5. Fork | 11. Arm |
| 6. Roll pin | |

30. Disassemble L.H. axle shaft:

- A. Remove O-ring from differential carrier.
- B. Remove snap ring.
- C. Remove L.H. axle shaft assembly.
- D. Remove snap ring and washer.
- E. Use a bearing puller to remove bearing from axle shaft.
- F. Remove oil seal from differential carrier.

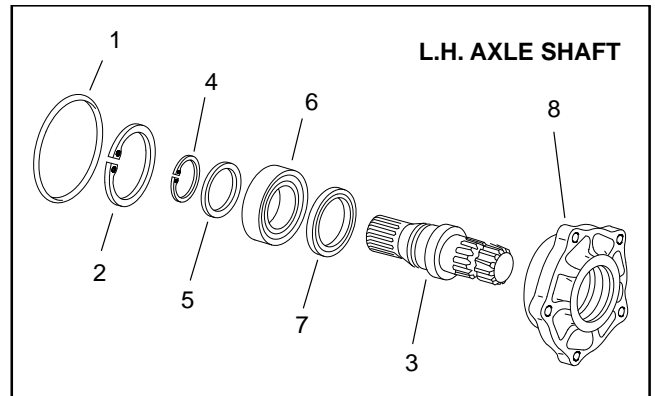


Figure 42

- | | |
|-----------------------------|-------------------------|
| 1. O-ring | 5. Washer |
| 2. Snap ring | 6. Bearing |
| 3. L.H. axle shaft assembly | 7. Oil seal |
| 4. Snap ring | 8. Differential carrier |

31. Disassemble R.H. axle shaft:

- A. Remove R.H. axle shaft assembly from seal cover.
- B. Remove snap ring and washer from axle shaft.
- C. Use a bearing puller to remove bearing.
- D. Remove washer and oil seal from seal cover.

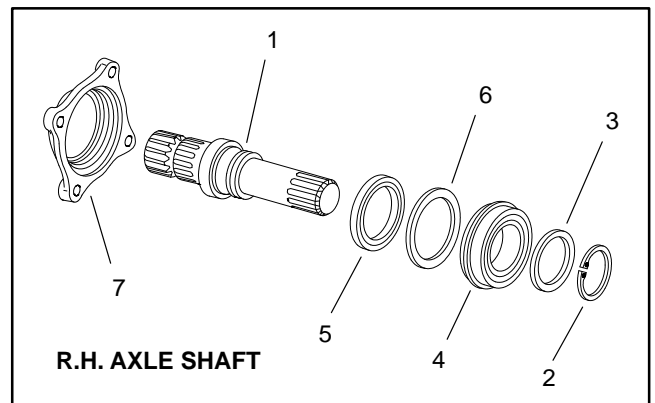


Figure 43

- | | |
|-----------------------------|---------------|
| 1. R.H. axle shaft assembly | 5. Oil seal |
| 2. Snap ring | 6. Washer |
| 3. Washer | 7. Seal cover |
| 4. Bearing | |

Transaxle Inspection

1. Thoroughly clean and dry all transaxle parts.
2. Use emery cloth to remove nicks and burrs from all parts.
3. Inspect synchronizer ring:
 - A. Inspect the chamfer for excessive wear or damage.
 - B. Inspect inner tapered area for excessive wear or damage.
 - C. Measure the clearance between synchronizer ring and synchro gear in three (3) equally spaced points. If clearance is less than **0.0195" (0.5 mm)** replace the synchronizer ring.

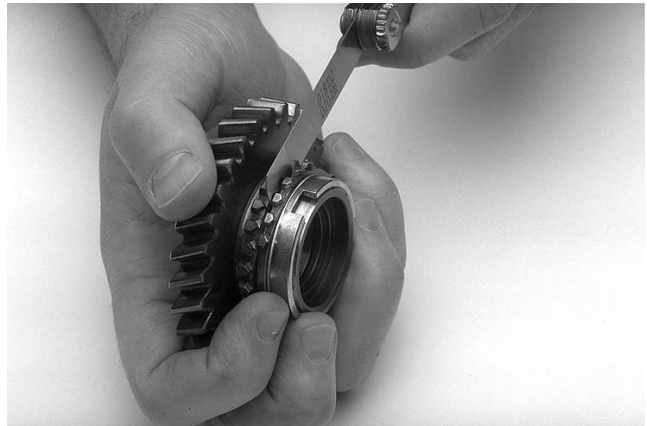


Figure 44

4. Inspect synchro gears:
 - A. Inspect the cone surface for roughness, material transfer (brass color material) or damage.
 - B. Inspect the spline chamfer for excessive chipping or damage.
 - C. Inspect I.D. of synchro gears on main shaft for excessive wear or scoring. Measure I.D. of synchro gear and replace if:

23T gear I.D. exceeds **1.027" (26.08 mm)**
36T gear I.D. exceeds **1.027" (26.08 mm)**

- D. Inspect I.D. of synchro gears on reduction shaft for excessive wear or scoring. Measure I.D. of synchro gear and replace if:

40T gear I.D. exceeds **1.027" (26.08 mm)**
47T gear I.D. exceeds **1.145" (29.08 mm)**

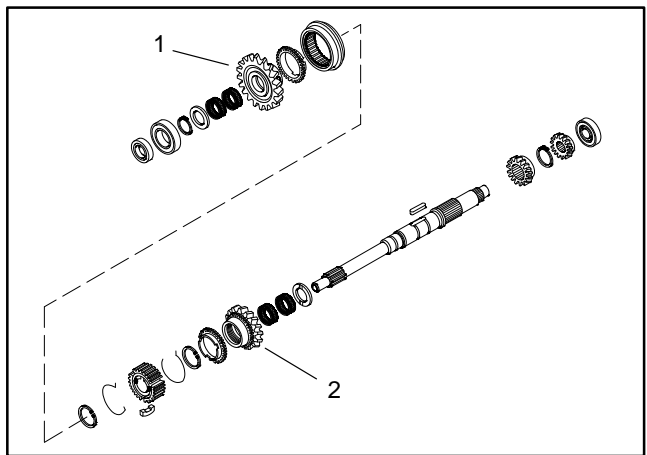


Figure 45

1. 36T gear

2. 23T gear

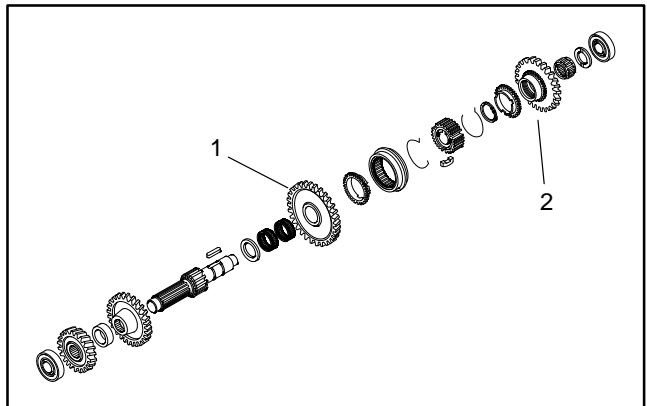


Figure 46

1. 47T gear

2. 40T gear

5. Inspect hub, shifter, synchro key and synchro spring:

- A. Inspect hub for worn or damaged spline.
- B. Inspect shifter for chipping or damaged chamfer.
- C. Inspect synchro keys for wear or damage.
- D. Inspect synchro springs for wear or damage.
- E. The shifter should move freely on the hub.

F. Measure the clearance between shifter groove and fork. Replace shift fork, if the clearance exceeds **0.039 in. (1.0 mm)**.

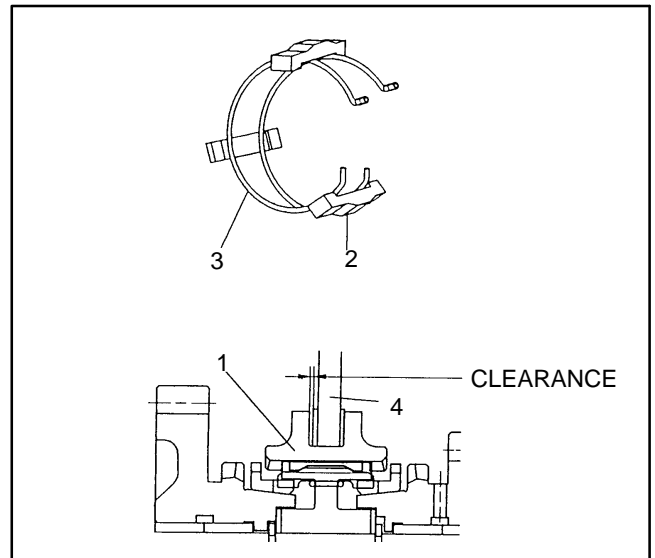


Figure 47

- | | |
|------------|-----------|
| 1. Shifter | 3. Spring |
| 2. Key (3) | 4. Fork |

6. Inspect main shaft:

A. Inspect main shaft for worn or damaged surfaces. If O.D. of needle bearing surface is less than **0.864 in. (21.95 mm)**, replace the main shaft.

B. Inspect lip portion of oil seal and oil seal surface of main shaft for wear or damage.

C. Insert spline for clutch disk and check for excessive looseness and free sliding of clutch disk hub.

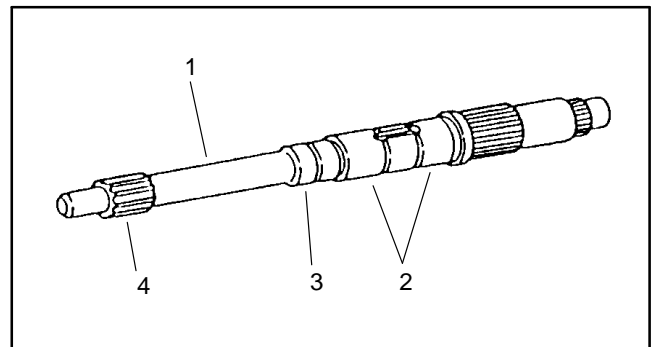


Figure 48

- | | |
|---------------------------|---------------------------|
| 1. Main shaft | 3. Oil seal surface |
| 2. Needle bearing surface | 4. Spline for clutch disc |

7. Inspect snap ring and shim(s) for damage. Replace all parts if any part is cracked or broken.

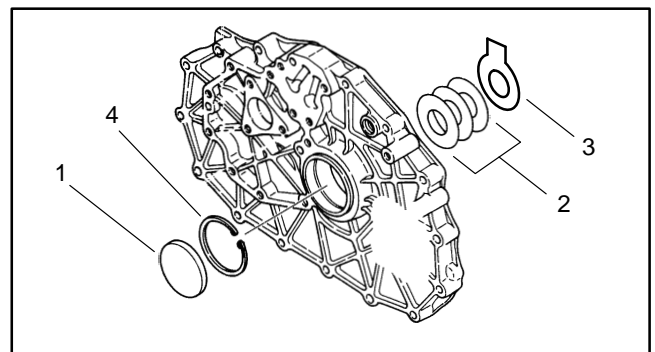


Figure 49

- | | |
|-------------|--------------|
| 1. Seal cap | 3. Shim |
| 2. Shims | 4. Snap ring |

8. Inspect center plate for cracks and damage. Replace center plate if the snap ring groove has more than 15% of its edges damaged due to nicks, rounding, cracks or dents.

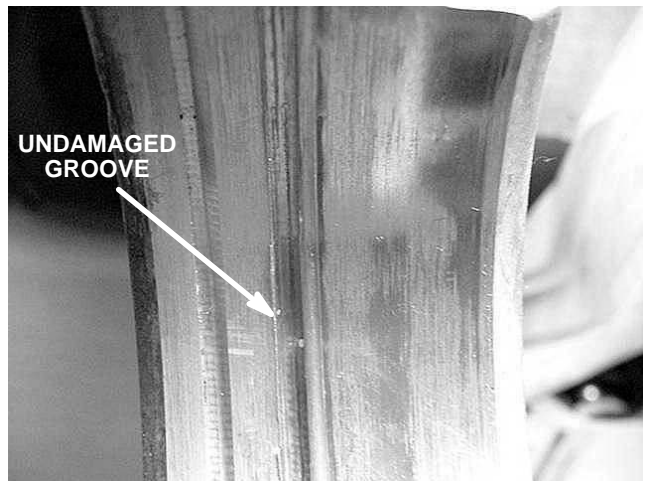


Figure 50

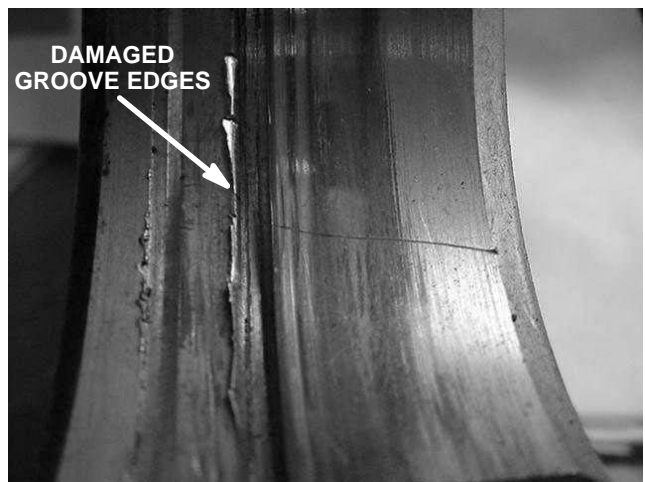


Figure 51

9. Inspect reduction shaft for wear or damage. If O.D. of outer needle bearing area is less than **0.864 in. (21.95 mm)** or inner needle bearing area is less than **0.982 in. (24.95 mm)**, replace the reduction shaft.

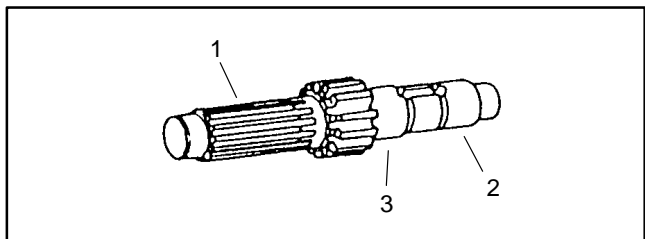


Figure 52

- 1. Reduction shaft
- 2. Outer bearing area
- 3. Inner bearing area

10. Inspect countershaft:

A. Inspect countershaft for wear or damage. If O.D. of inner portion is less than **1.100 in. (27.95 mm)** or 71T gear portion is less than **1.179 in. (29.95 mm)**, replace the countershaft.

B. Inspect the gear contact condition of the bevel gear.

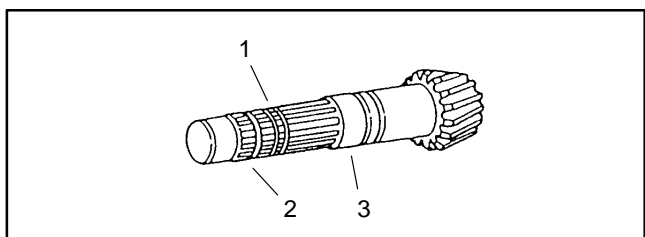


Figure 53

- 1. Countershaft
- 2. Inner portion
- 3. Gear portion

11. Inspect differential:

A. Inspect pinion shaft for excessive wear or damage. If O.D. is less than **0.707 in. (17.95 mm)**, replace the pinion shaft.

B. Measure thickness of pinion liners. If thickness is less than **0.035 in. (0.9 mm)**, replace the pinion liners.

C. Measure thickness of side gear liners. If thickness is less than **0.043 in. (1.1 mm)**, replace the side gear liners.

D. Inspect the gear contact condition between spiral bevel pinion and ring gear.

E. Inspect differential case for wear in side gears and pinion shaft mating area. Replace the case if machined surfaces are scored or if the pinion shaft fits loosely in the bore.

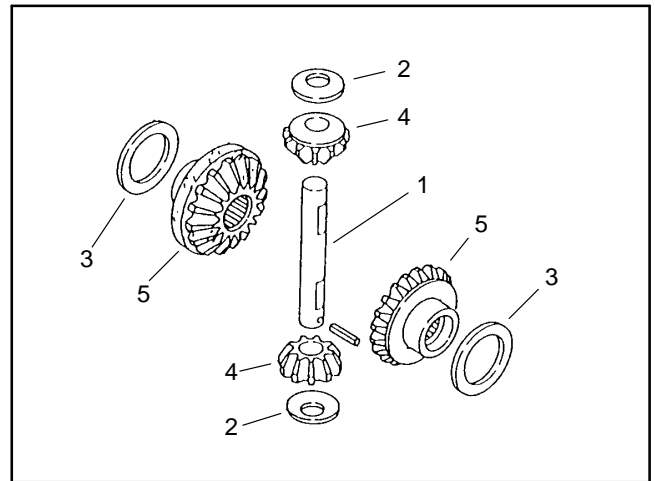


Figure 54

- | | |
|------------------------|--------------------|
| 1. Pinion shaft | 4. Pinion gear (2) |
| 2. Pinion liner (2) | 5. Side gear (2) |
| 3. Side gear liner (2) | |

Transaxle Assembly

1. Clean gasket material from all transaxle mating surfaces before assembling transaxle. Make sure all parts are clean and free of dirt and dust.

IMPORTANT: Be careful to not damage mating surfaces when removing gasket material.

2. Assemble L.H. axle shaft:

- A. Install new oil seal into differential carrier.
- B. Use a press to install bearing onto L.H. axle shaft.
- C. Install washer and snap ring.
- D. Install L.H. axle shaft assembly into differential carrier.
- E. Install snap ring.
- F. Install new O-ring. Apply multi-purpose grease on O-ring before installing.

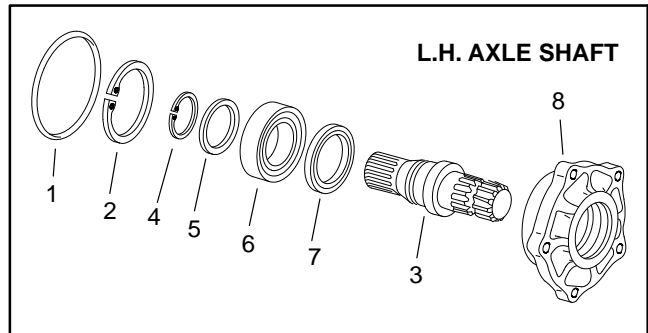


Figure 55

- | | |
|-----------------------------|-------------------------|
| 1. O-ring | 5. Washer |
| 2. Snap ring | 6. Bearing |
| 3. L.H. axle shaft assembly | 7. Oil seal |
| 4. Snap ring | 8. Differential carrier |

3. Assemble R.H. axle shaft:

- A. Install new oil seal into seal cover. Apply multi-purpose grease on O-ring before installing.
- B. Insert washer.
- C. Use a press to install bearing onto R.H. axle shaft.
- D. Install washer and snap ring.
- E. Install R.H. axle shaft assembly into seal cover.

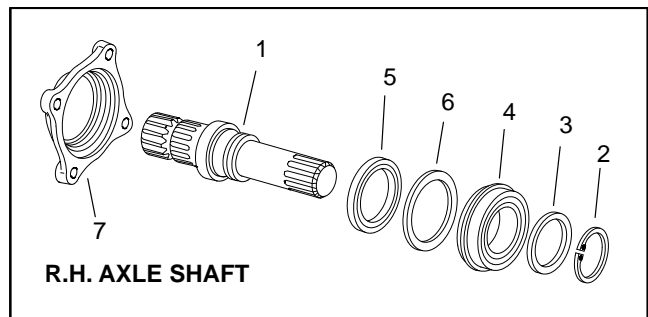


Figure 56

- | | |
|-----------------------------|---------------|
| 1. R.H. axle shaft assembly | 5. Oil seal |
| 2. Snap ring | 6. Washer |
| 3. Washer | 7. Seal cover |
| 4. Bearing | |

4. Assemble differential lock fork shaft:

- A. Drive lock pins into fork shaft. Make sure lock pins are installed with slit facing the correct direction.
- B. Install fork, spring, washer and snap ring onto fork shaft using a press. Apply moly disulfide grease onto fork portion of fork shaft before installing.
- C. Install new O-ring. Apply multi-purpose grease on O-ring before installing.

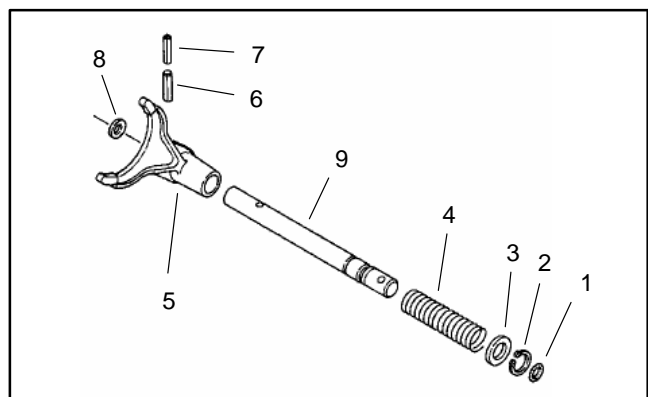


Figure 57

- | | |
|--------------|---------------|
| 1. O-ring | 6. Roll pin |
| 2. Snap ring | 7. Roll pin |
| 3. Washer | 8. Washer |
| 4. Spring | 9. Fork shaft |
| 5. Fork | |

5. Assemble differential gears:

A. Apply moly disulfide grease on pinion liners, holes of pinion gears, side gear liners and hubs of side gears.

B. Install side gear liners, side gears, pinion liners and pinion gears.

C. Rotate side gears until holes of pinion gears and liners align with holes of differential case.

D. Grease the pinion shaft and insert it into the differential case.

E. Assemble lock pin (Fig. 60). Drive the pin to the approximate center location of the pinion mate shaft. Pay attention to direction of slit in lock pin.

F. Check for smooth revolution of pinion gears and side gears.

G. Completely clean oil from threads in ring gear.

NOTE: Ring gear and countershaft are supplied in matched sets only.

H. Insert dowel pins onto ring gear.

I. Completely clean oil from threads of cap screws.

NOTE: It is recommended that whenever the ring gear screws are removed that they be replaced with new screws.

J. Apply Loctite to threads of cap screws.

K. Clean oil from contact surface of differential case and ring gear.

L. Drive ring gear onto differential case.

M. Install and tighten cap screws to a torque from **18.5 to 22 ft-lb (24.5 to 29.5 N-m)**.

N. Use a press to install bearing onto differential case.

O. Install slider. Put moly disulfide grease onto sliding area of differential case before installing.

P. Use a press to install bearing.

Q. Install snap ring.

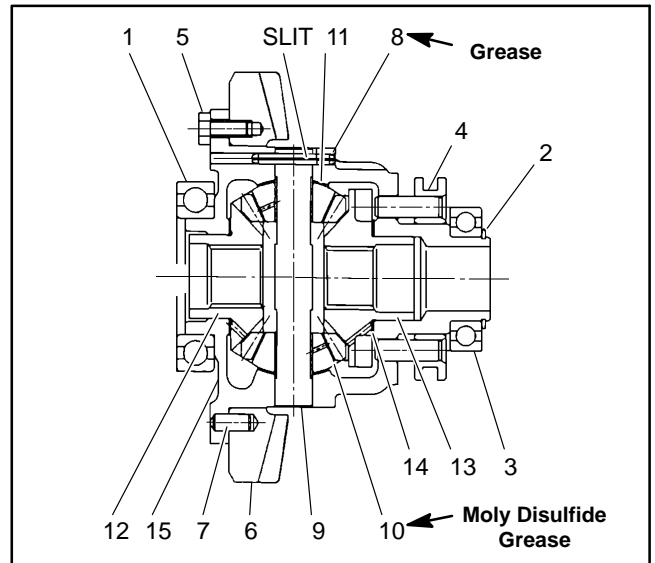


Figure 58

- | | |
|---------------------|--------------------|
| 1. Bearing | 8. Lock pin |
| 2. Snap ring | 9. Pinion shaft |
| 3. Bearing | 10. Pinion (2) |
| 4. Diff lock slider | 11. Liner (2) |
| 5. Screws | 12. L.H. side gear |
| 6. Ring gear | 13. R.H. Side gear |
| 7. Dowel pin (2) | 14. Liner (2) |

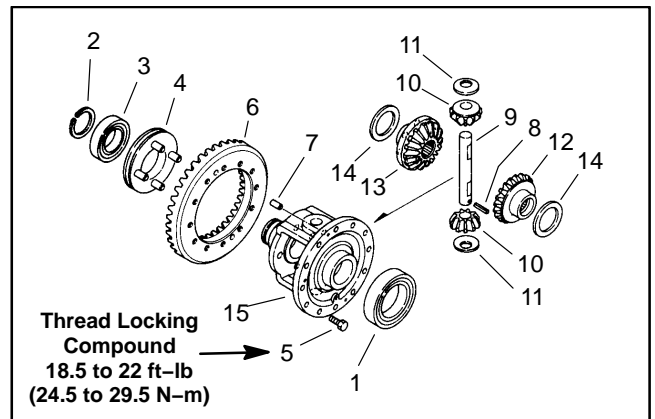


Figure 59

- | | |
|---------------------|--------------------|
| 1. Bearing | 8. Lock pin |
| 2. Snap ring | 9. Pinion shaft |
| 3. Bearing | 10. Pinion (2) |
| 4. Diff lock slider | 11. Liner (2) |
| 5. Screws | 12. L.H. side gear |
| 6. Ring gear | 13. R.H. Side gear |
| 7. Dowel pin (2) | 14. Liner (2) |



Figure 60

6. Assemble R-1 and 2-3 fork shaft:

- A. Insert R-1 fork shaft into R-1 fork.
- B. Drive lock pin into fork and fork shaft. Pay attention to direction of slit in lock pin.
- C. Insert 2-3 fork shaft into 2-3 fork.
- D. Drive lock pin into fork and fork shaft. Pay attention to direction of slit in lock pin.

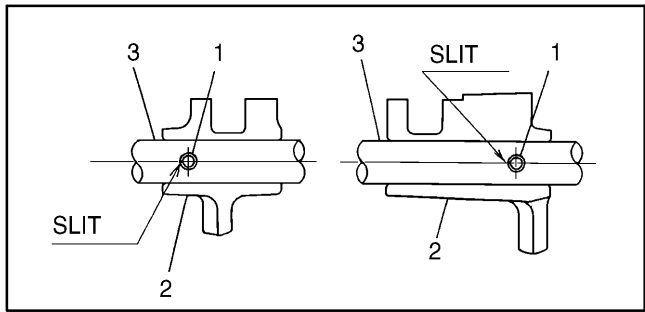


Figure 61

- 1. Lock pin
- 2. Shift fork
- 3. Fork shaft

7. Assemble countershaft:

- A. Use a press to install two (2) new bearings onto countershaft.
- B. Install collar and retaining ring.
- C. Install countershaft gear onto shaft.
- D. Install retaining ring.
- E. Slide collar onto shaft.
- F. Use a press to install new bearing.

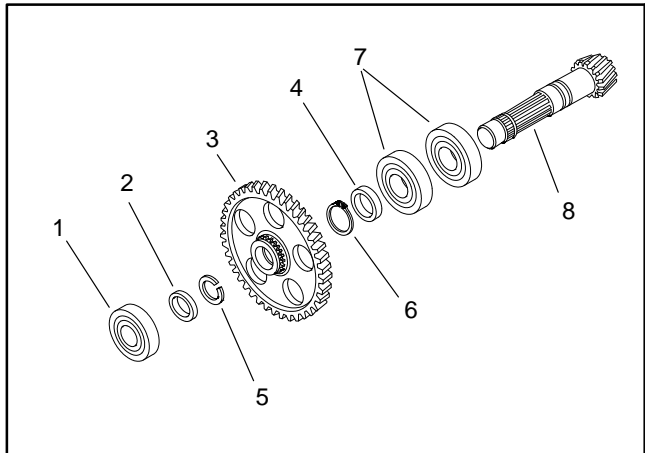


Figure 62

- 1. Bearing
- 2. Collar
- 3. Gear
- 4. Collar
- 5. Retaining ring
- 6. Retaining ring
- 7. Bearing (2)
- 8. Countershaft

- 8. Assemble synchro hub:
 - A. Install keys into grooves of hub.

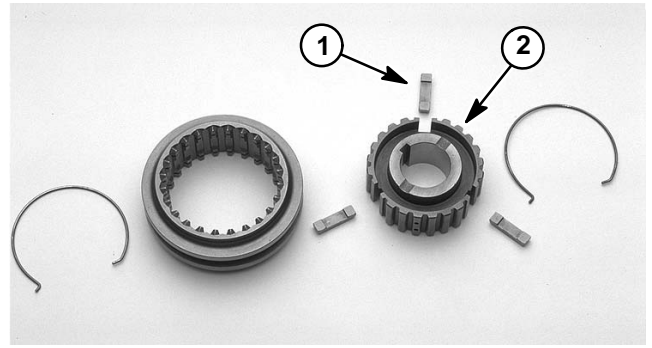


Figure 63

- 1. Key (3)
- 2. Hub

- B. Install shifter onto hub.

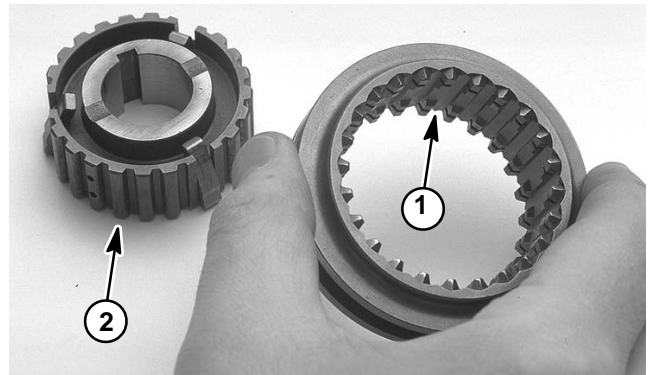


Figure 64

- 1. Shifter
- 2. Hub

- C. Insert springs into hub. Pay attention to direction of spring.

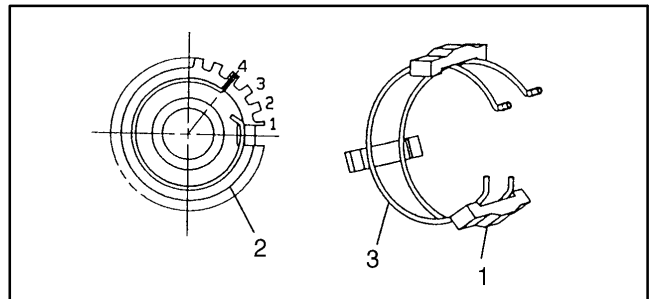


Figure 65

- 1. Key (3)
- 2. Hub
- 3. Spring (2)



Figure 66

Drive Train

9. Assemble reduction shaft:

A. Apply moly disulfide grease to thrust washer and two (2) needle bearings (item 14). Install washer, needle bearings and gear (item 13) onto reduction shaft. Oil groove on washer must face the gear.

B. Apply Dexron III ATF oil on cone face of gear and install synchro ring onto gear.

C. Insert key into reduction shaft slot.

D. Install synchro hub sub-assembly.

E. Install retaining ring.

F. Insert needle bearing into gear (item 7) and slide gear and bearing assembly onto shaft.

G. Install thrust washer. Oil groove on washer must face the gear.

H. Use a press to install bearing (item 5) onto shaft.

I. Install gear (item 4), collar and gear (item 1) onto shaft.

J. Use a press to install bearing onto shaft.

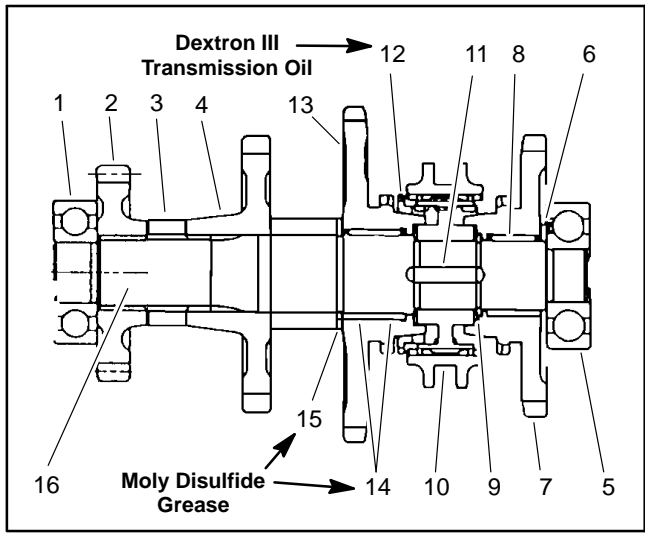


Figure 67

- | | |
|-------------------|------------------------|
| 1. Bearing | 9. Retaining ring |
| 2. Helical gear | 10. Shifter |
| 3. Collar | 11. Key |
| 4. Gear | 12. Synchro ring |
| 5. Bearing | 13. Gear |
| 6. Washer | 14. Needle bearing (2) |
| 7. Gear | 15. Thrust washer |
| 8. Needle bearing | 16. Reduction shaft |

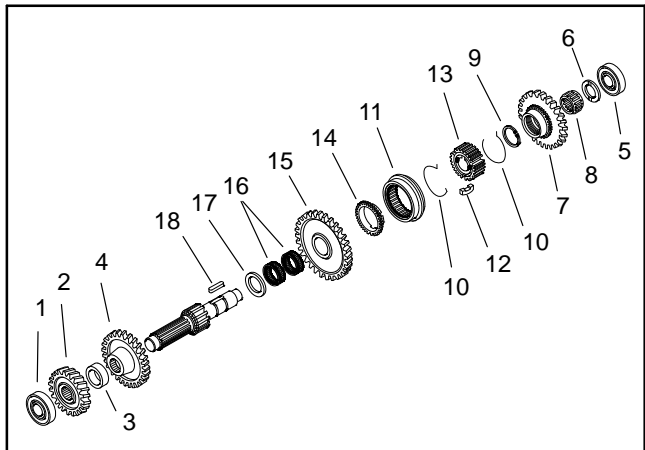


Figure 68

- | | |
|-------------------|------------------------|
| 1. Bearing | 10. Synchro spring (2) |
| 2. Helical gear | 11. Shifter |
| 3. Collar | 12. Synchro key (3) |
| 4. Gear | 13. Synchro hub |
| 5. Bearing | 14. Synchro ring |
| 6. Washer | 15. Gear |
| 7. Gear | 16. Needle bearing (2) |
| 8. Needle bearing | 17. Thrust washer |
| 9. Snap ring | 18. Key |

10. Assemble reverse shaft:

A. Install gear onto reverse shaft.

B. Use a press to install bearings.

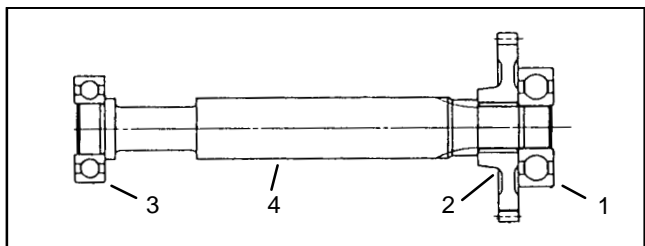


Figure 69

- | | |
|------------|------------------|
| 1. Bearing | 3. Bearing |
| 2. Gear | 4. Reverse shaft |

11. Assemble main shaft:

- A. Install gear (item 17) and snap ring.
- B. Install gear (item 15).
- C. Use a press to install bearing.
- D. Install washer and needle bearings onto main shaft. Apply moly disulfide grease onto washer and needle bearings before installing. Oil groove on washer must face the gear.
- E. Install gear (item 11) and snap ring.
- F. Apply clean Dexron III transmission oil on cone face of gear and install synchro ring onto gear.
- G. Insert key.
- H. Install synchro hub sub-assembly.
- I. Install snap ring.
- J. Install synchro ring onto gear. Apply clean Dexron III transmission oil to cone face of gear before installing synchro ring.
- K. Insert needle bearings into gear. Apply moly disulfide grease onto needle bearings before installing.
- L. Install gear with synchro ring onto main shaft.
- M. Install washer and snap ring. Apply moly disulfide grease to washer before installing. Oil groove on washer must face the gear.

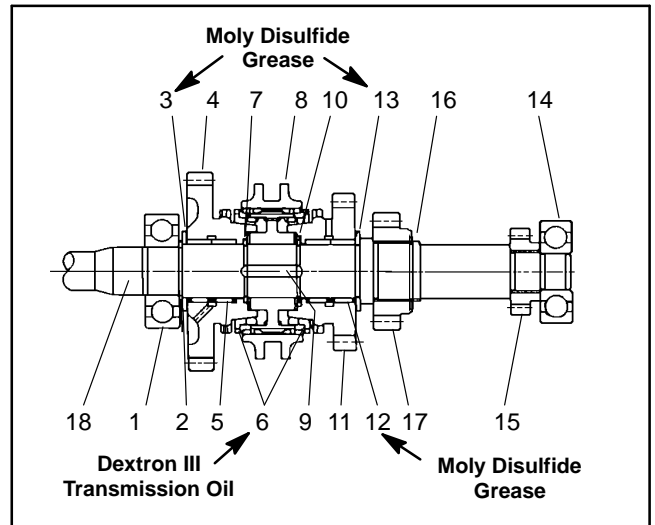


Figure 70

- | | |
|-----------------------|------------------------|
| 1. Bearing | 10. Snap ring |
| 2. Snap ring | 11. Gear |
| 3. Washer | 12. Needle bearing (2) |
| 4. Gear | 13. Washer |
| 5. Needle bearing (2) | 14. Bearing |
| 6. Synchro ring | 15. Gear |
| 7. Snap ring | 16. Snap ring |
| 8. Shifter | 17. Gear |
| 9. Key | 18. Main shaft |

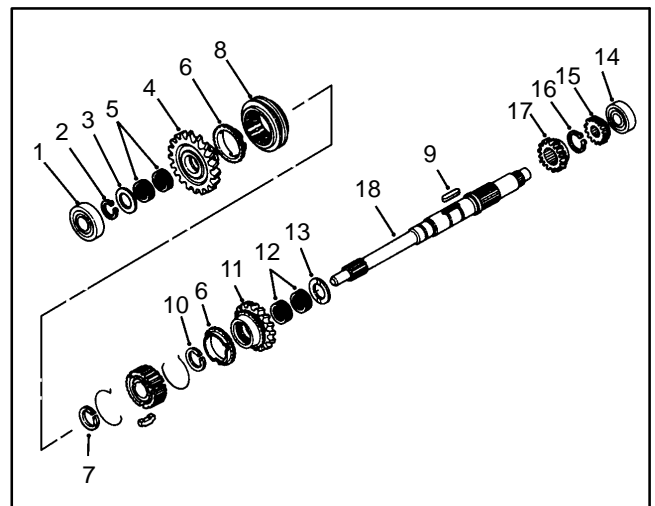


Figure 71

- | | |
|-----------------------|------------------------|
| 1. Bearing | 10. Snap ring |
| 2. Snap ring | 11. Gear |
| 3. Washer | 12. Needle bearing (2) |
| 4. Gear | 13. Washer |
| 5. Needle bearing (2) | 14. Bearing |
| 6. Synchro ring | 15. Gear |
| 7. Snap ring | 16. Snap ring |
| 8. Shifter | 17. Gear |
| 9. Key | 18. Main shaft |

12. Assemble shift arms:

A. Apply multi-purpose grease on lips of oil seals and install new shift arm oil seals in transaxle case.

B. Install keeper plates and tighten flange head screws to a torque from **11 to 13 ft-lb (15 to 17 N-m)**.

C. Apply high strength bonding compound (ie. Loctite #680) to tapers of shift fork arms.

D. Install shift arms. Install shift arm assembly.

E. Install lock nuts. Tighten shift arm retaining lock nuts to a torque from **230 to 240 in-lb (26 to 27 N-m)**.

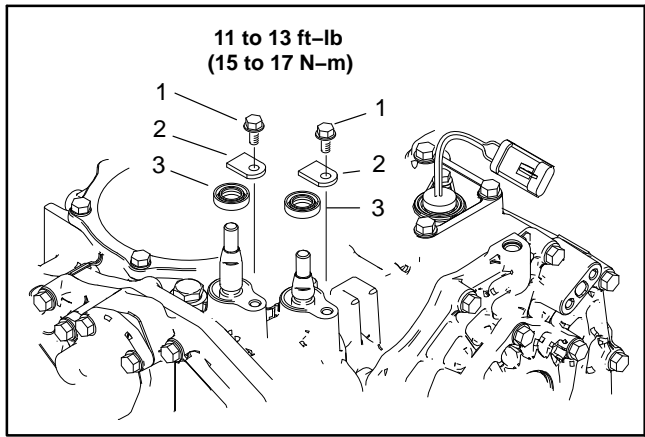


Figure 72

- 1. Cap screw (2)
- 2. Keeper plate (2)
- 3. Oil seal (2)

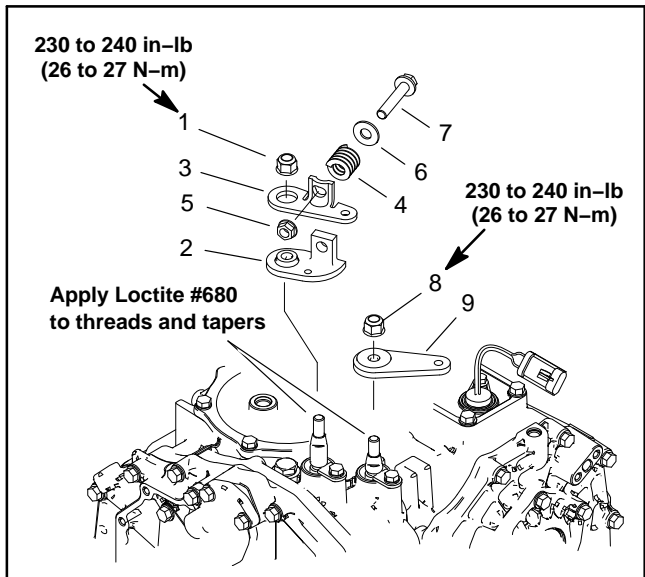


Figure 73

- 1. Nut
- 2. 2nd-3rd shift arm
- 3. Shift arm plate
- 4. Spring
- 5. Lock nut
- 6. Washer
- 7. Cap screw
- 8. Lock nut
- 9. 1st-Rev shift arm

13. Install oil cap with O-ring. Apply multi-purpose grease to O-ring.

14. If removed, install air breather. Use sealing tape on threads of air breather.

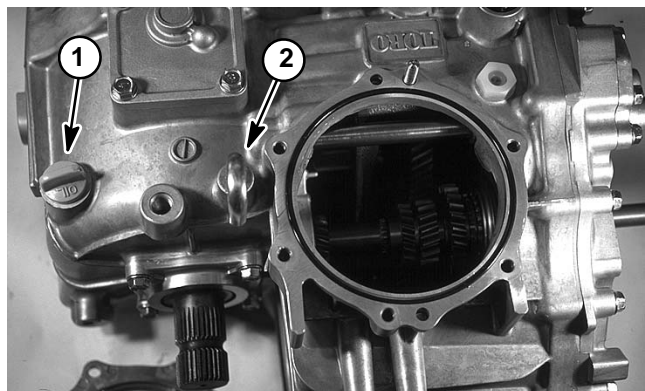


Figure 74

- 1. Oil cap
- 2. Air breather

15. Assemble reduction shaft and countershaft together with 1st–reverse fork shaft.

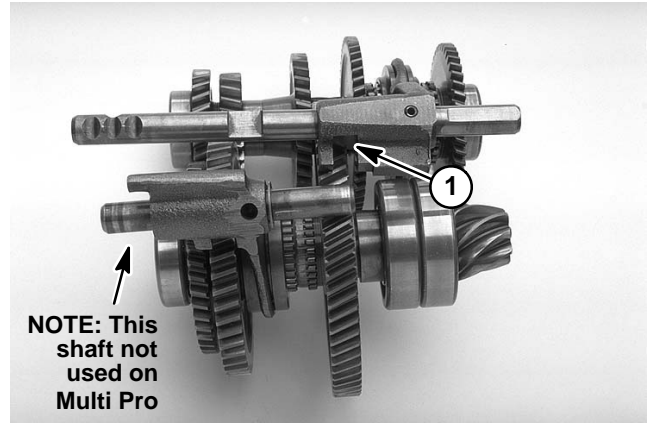


Figure 75

16. Insert reduction shaft and countershaft assembly into transaxle case. Insert head of shift arm into groove of fork when installing the assembly.

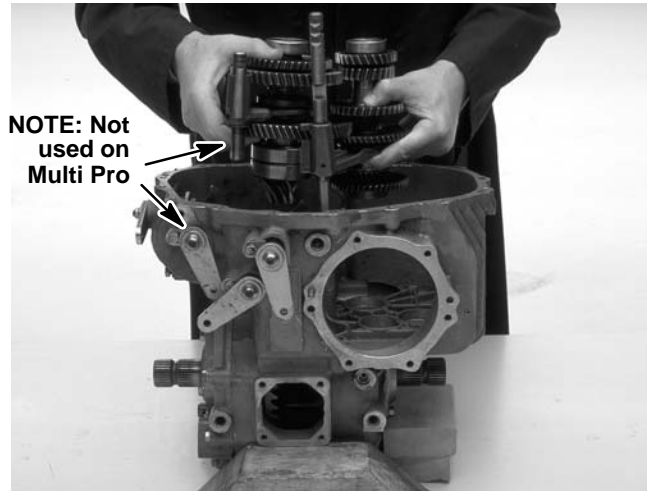


Figure 76

17. Assemble main shaft together with 2nd–3rd fork shaft.

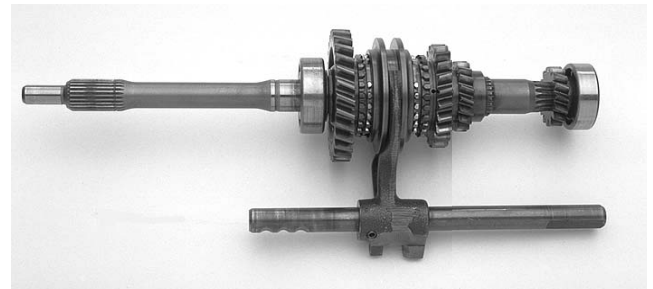


Figure 77

18. Insert main shaft and 2–3 fork shaft assembly into transaxle case. Insert head of shift arm into groove of fork while installing.

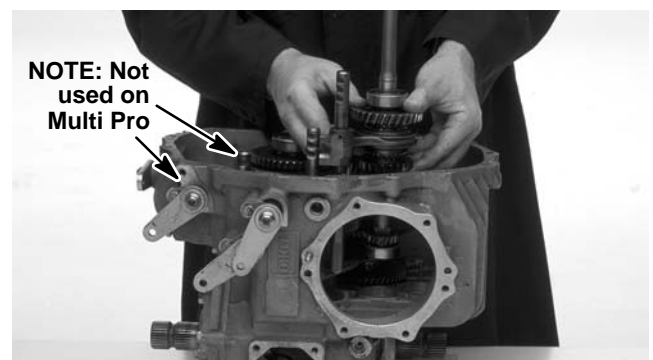


Figure 78

Drive Train

19. Install reverse shaft into transaxle case. Rotate main shaft and reverse shaft gears to mesh gears when installing.

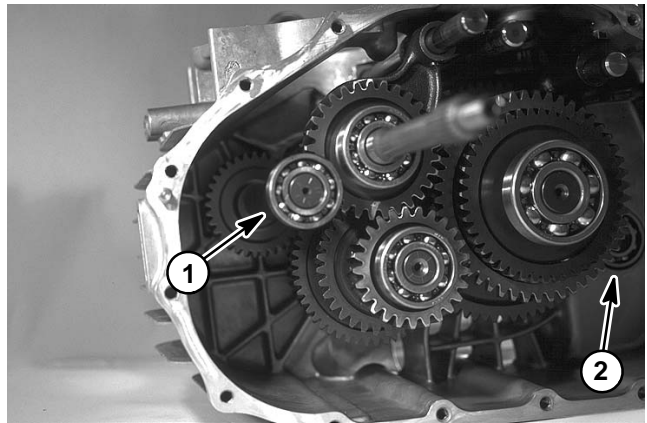


Figure 79

- 1. Reverse shaft
- 2. Bearing (gear case)

20. Install center plate:

- A. Insert dowel pins into transaxle case.
- B. Apply silicone sealant onto mating surface of center plate.
- C. Position center plate to transaxle.
- D. Install and tighten fifteen (15) flange head screws to a torque from **18 to 22 ft-lb (25 to 29 N-m)**.
- E. Apply multi-purpose grease onto lips of oil seal, then insert oil seal flush with face of housing.

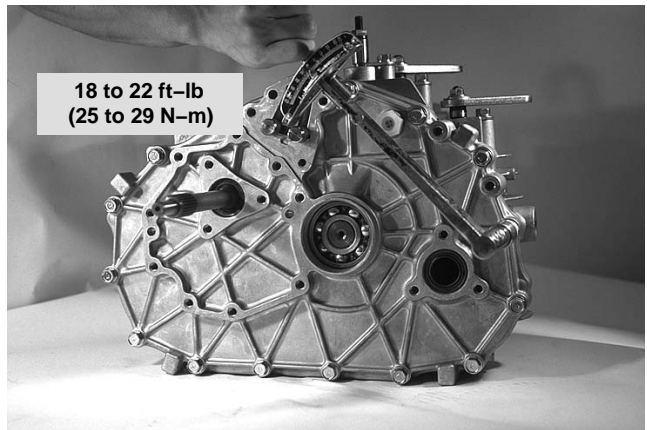


Figure 80

NOTE: The thickest shim of the shim set should be positioned against the retaining ring.

21. Insert tabbed shim against the bearing. Insert shim set against the tabbed shim. Use thickest shims in set possible, that will permit installation of the retaining ring.

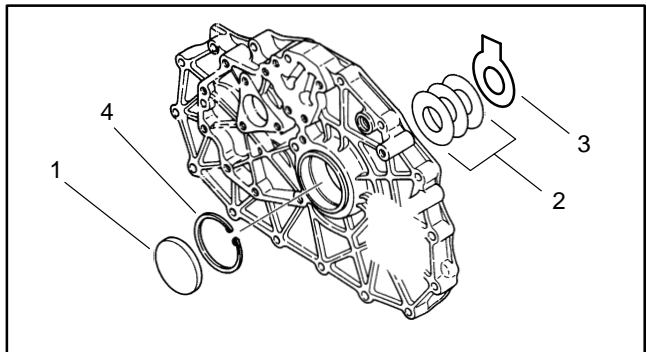


Figure 81

- 1. Seal cap
- 2. Shims
- 3. Shim ring
- 4. Snap ring

22. Install snap ring into the groove of the bearing housing.

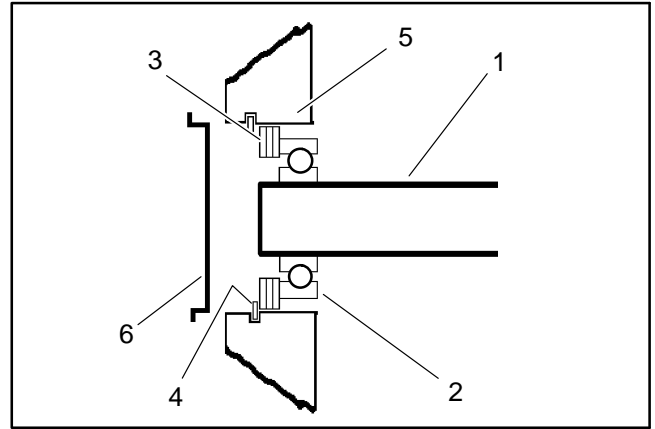


Figure 82

- 1. Countershaft
- 2. Bearing
- 3. Shims
- 4. Retaining ring
- 5. Center plate
- 6. Sealing cap



Figure 83

23. Measure countershaft end play. Rotate one of the axle shafts back and forth to take up all back lash. Rotating the shaft in one direction will pull the shaft and bearing away from the snap ring. Rotate axle shaft in this direction, then measure space between the snap ring and shim (set) with a feeler gauge. Make sure shim set is pressed against the bearing during the measurement. End play should be from **0.000 to 0.0039 in. (0.00 to 0.10 mm)**.

IMPORTANT: If end play is too great, replace shim/shim set with thicker shims to allow correct end play. If end play is too small, replace shim/shim set with thinner shims to allow correct end play.

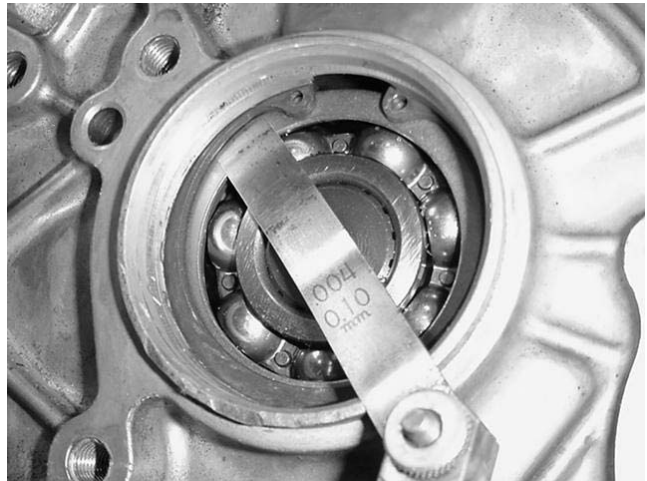


Figure 84

24. Insert sealing cap flush with face of center plate. Make sure to not insert sealing cap too far. Pay attention to direction of sealing cap.

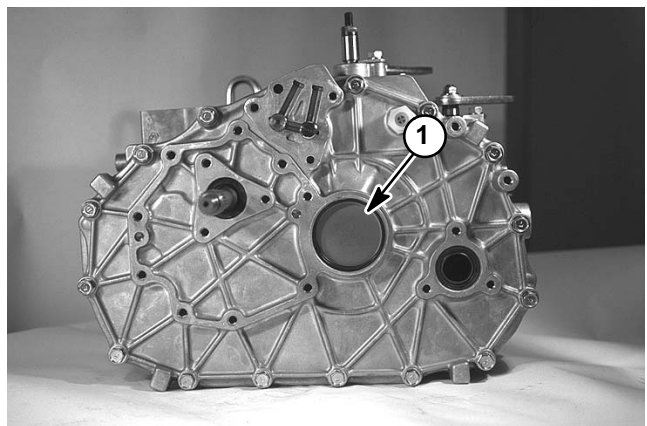


Figure 85

1. Sealing cap

25. Install fork shaft case:

- A. Thoroughly clean mating surface of transaxle case and fork shaft case.
- B. Insert spindle lock between fork shafts.

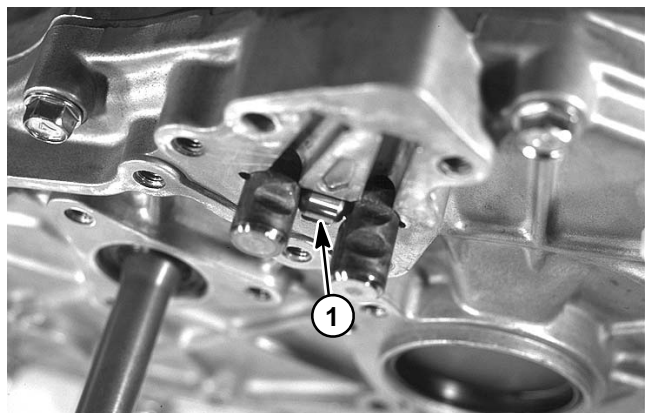


Figure 86

1. Spindle Lock

C. Insert steel balls and springs into the grooves.

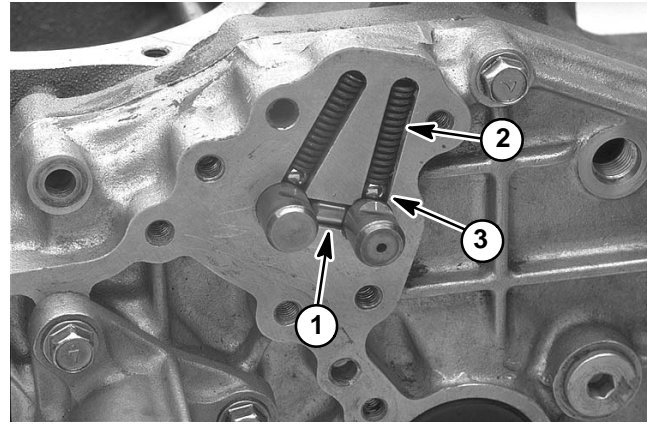


Figure 87

- 1. Spindle
- 2. Spring (2)
- 3. Ball (2)

D. Apply silicone sealant to mating surface of fork shaft case.

E. Install fork shaft case. Install and tighten flange head screws to a torque from **18 to 22 ft-lb (25 to 29 N-m)**.

F. Check operation of shifters and detent.

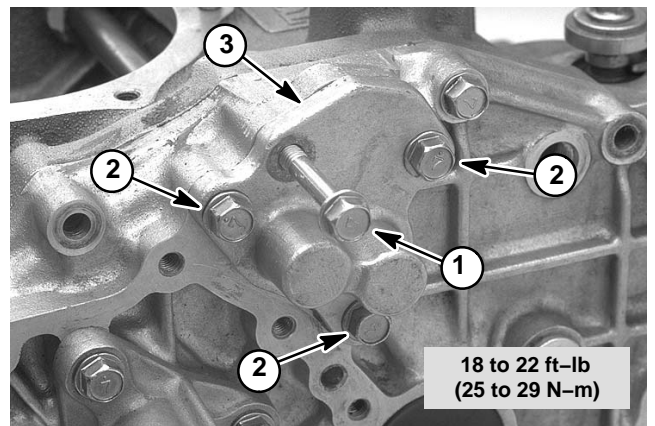


Figure 88

- 1. Flange head screw (1)
- 2. Flange head screw (3)
- 3. Fork shaft case

26. Apply moly disulfide grease to washer and insert washer into housing of transaxle case.

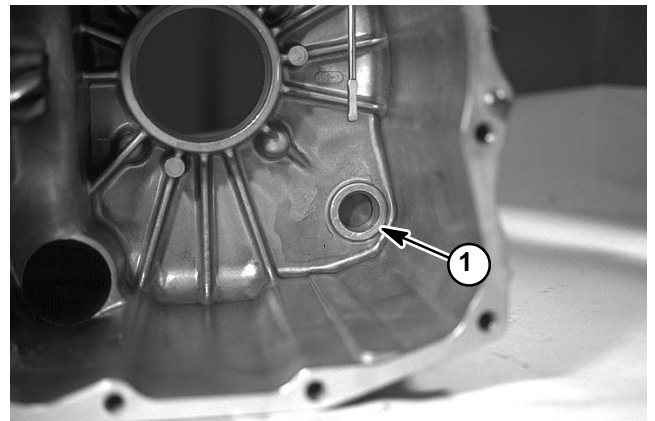


Figure 89

- 1. Washer

27. Install differential gear assembly together with differential lock fork shaft onto transaxle case.



Figure 90

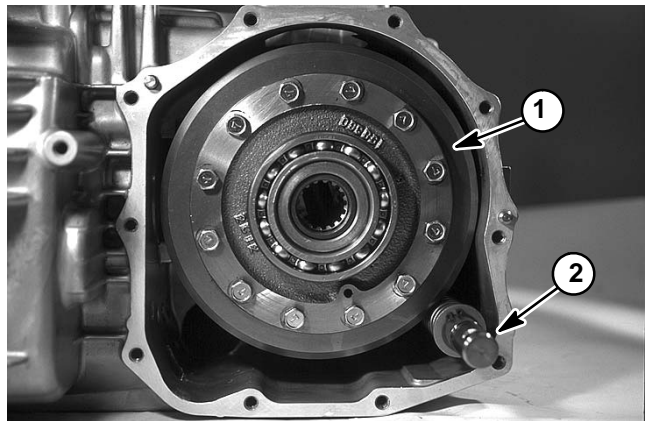


Figure 91

- 1. Differential gear assy.
- 2. Fork shaft

28. Install side cover:

- A. Insert dowel pins onto transaxle case.
- B. Apply multi-purpose grease on lip of oil seal and install new differential lock shaft oil seal in side cover.
- C. Apply silicone sealant onto mating surface of side cover.
- D. Install side cover and secure with ten (10) flange head screws. Torque screws from **18 to 22 ft-lb (25 to 29 N-m)**.

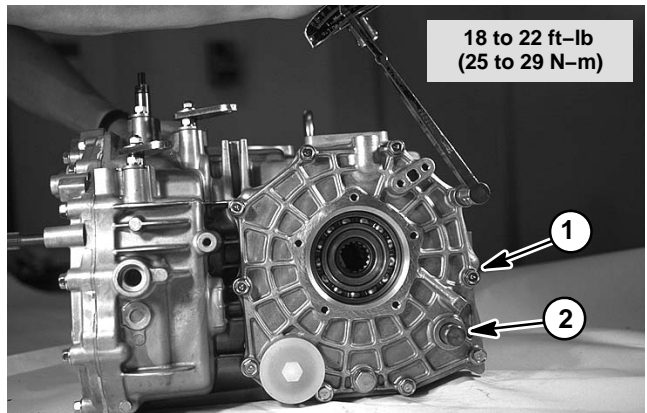


Figure 92

- 1. Flange head screw (10)
- 2. Differential lock shaft oil seal

29. Install R.H. axle shaft assembly:

- A. Thoroughly clean mating surface of transaxle case and seal cover of R.H. axle shaft assembly
- B. Apply silicone sealant onto mating surface of seal cover.
- C. Install axle shaft assembly and secure with four (4) cap screws. Torque cap screws from **18 to 22 ft-lb (25 to 29 N-m)**.

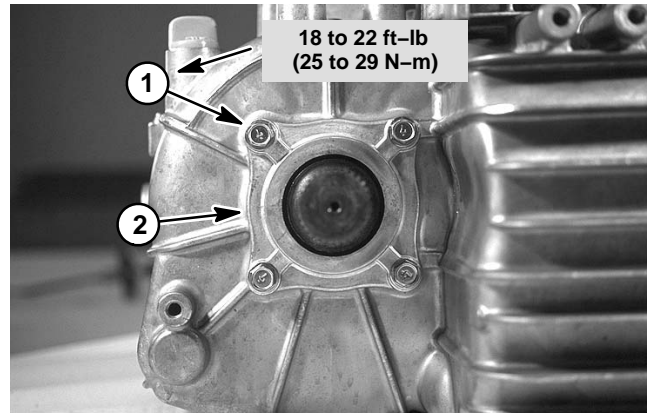


Figure 93

30. Install L.H. axle shaft assembly:

- A. Thoroughly clean mating surface of differential carrier and side cover.
- B. Insert selected shims into housing of side cover.

NOTE: The thickest shim should be installed against the bearing.

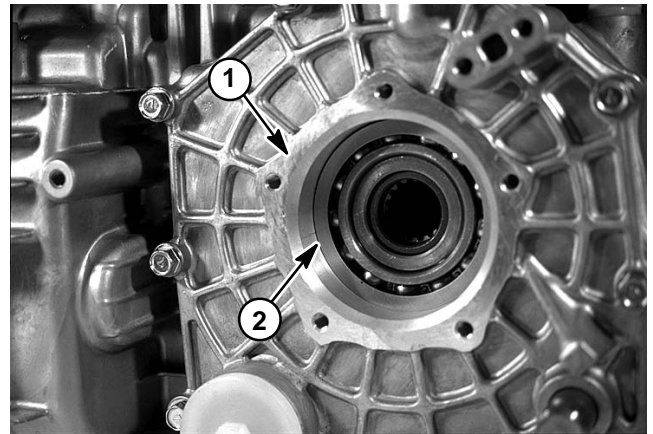


Figure 94

- 1. Mating surface
- 2. Shim

- C. Install axle shaft assembly and secure with flange head screws. Torque cap screws from **18 to 22 ft-lb (25 to 29 N-m)**.

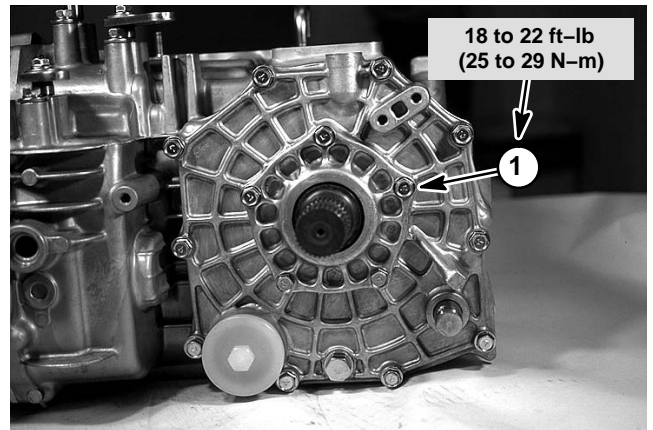


Figure 95

- 1. Flange head screw (5)

31. Measure backlash of ring gear through P.T.O. cover opening on top of transaxle. Using a dial indicator, check ring gear backlash in three (3) equally spaced points. Backlash should be **0.0031" to 0.0071" (0.08 to 0.18 mm)** and must not vary more than **0.002" (0.05 mm)** at the points checked. If backlash is not in this range, replace shim set in end of differential carrier:

- A. If backlash is less than target range, decrease total thickness of shim set until correct backlash is achieved.
- B. If backlash exceeds the target range, increase total thickness of shim set until correct backlash is achieved.

NOTE: The thickest shim should be installed against the bearing.

32. Install differential lock arm onto fork shaft. Insert lock pin into fork shaft and arm. Pay attention to direction of slit in lock pin.



Figure 96

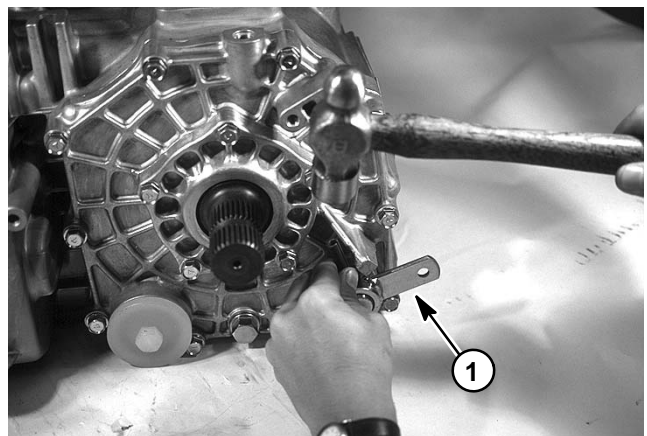


Figure 97

- 1. Differential lock arm

33. Apply multi-purpose grease to O-ring and insert O-ring into groove of transaxle case. Install cover and secure with nut, lockwasher and cap screws. Torque fasteners from **11 to 13 ft-lb (15 to 17 N-m)**.

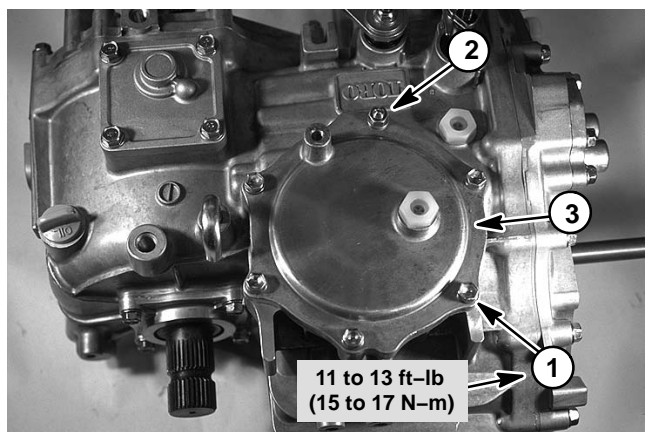


Figure 98

- 1. Cap screw (5)
- 2. Nut
- 3. PTO cover

34. Apply multi-purpose grease on lip of oil seal and install new speed sensor oil seal in upper cover.

35. Apply silicone sealant to mating surface of upper cover. Pay attention to direction of cover and install. Tighten cap screws from **18 to 22 ft-lb (25 to 29 N-m)**.

36. If removed, slide speed sensor into upper cover and secure with cap screw and lock washer.

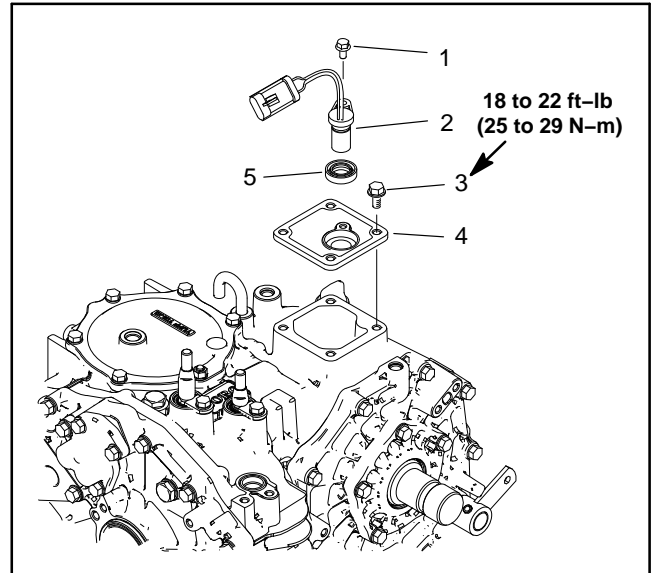


Figure 99

- | | |
|--------------------------|----------------|
| 1. Flange head screw | 4. Upper cover |
| 2. Speed sensor | 5. Oil seal |
| 3. Flange head screw (4) | |

37. Apply multi-purpose grease on lip of oil seal and install new input shaft oil seal in center plate.

38. Position input shaft cover plate to center plate and secure with cap screws. Tighten cap screws from **18 to 22 ft-lb (25 to 29 N-m)**.

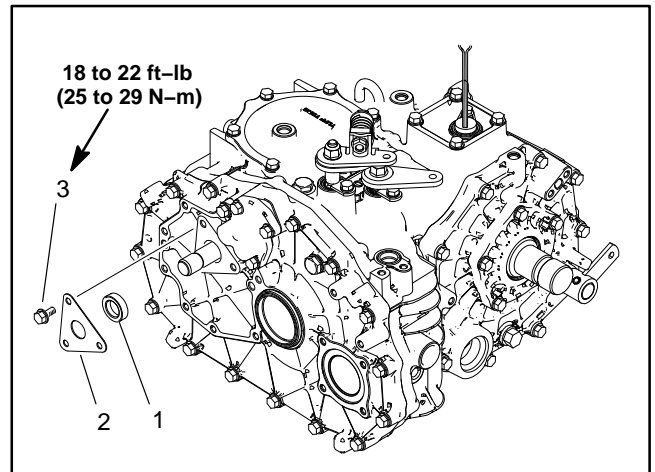


Figure 100

- | | |
|----------------------|------------------|
| 1. Input shaft seal | 3. Cap screw (3) |
| 2. Input shaft cover | |

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Specifications

Item	Description
Front tire pressure (20 x 10 – 10, tubeless)	20 PSI (138 kPa) Maximum
Rear tire pressure (24 x 13 – 12, tubeless)	20 PSI (138 kPa) Maximum
Front wheel lug nut torque	75 to 80 ft–lb (102 to 108 N–m)
Rear wheel lug nut torque	75 to 80 ft–lb (102 to 108 N–m)
Front wheel toe-in	0 to 1/4 inch (0 to 6 mm)

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Multi Pro 1750 machine. Refer to this publication for additional information when servicing the machine.

Parts Catalog

The Parts Catalog can be used to provide disassembly and assembly information for the chassis on your Multi Pro 1750 machine. Refer to this publication for additional information when servicing the machine.

Special Tools

Order special tools from your Toro Distributor.

Spanner Wrench

Use spanner wrench to rotate front shock absorber collar which changes the length of the shock spring to affect front wheel camber. Make sure that vehicle is jacked up off the ground to allow shock spring to be at full extension before using spanner wrench.

Toro Part Number: **TOR6010**

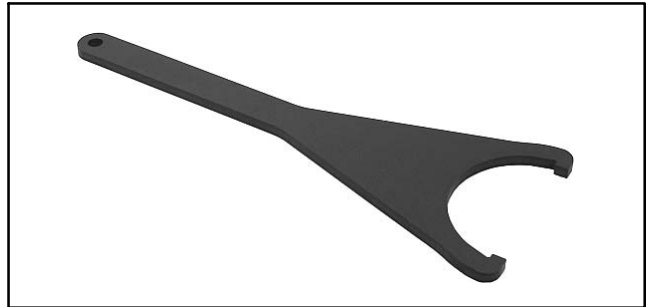


Figure 1

Shock Spring Compressor

Use shock spring compressor to remove spring from front shock absorber.

Toro Part Number: **TOR6015**



Figure 2

Troubleshooting

Suspension and Steering

Problem	Possible Cause
Front end is noisy.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Front shocks are loose or worn. Front end components (e.g. tie-rod, spindle, control arms) are loose or worn.
Rear end is noisy.	Rear wheel lug nuts are loose. Clutch problem (see Chapter 3 – Kohler Gasoline Engine) Transaxle problem (see Chapter 7 – Drive Train).
Excessive steering play.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Steering linkage is loose or worn. Tie rod ends are worn. Control arm bushings are loose or worn.
Vehicle is unstable or wanders.	Tire pressure is low or uneven between tires. Wheel lug nuts are loose. Front wheel bearings are loose or worn. Front wheel alignment (toe-in) is incorrect. Front shock absorber bushings or bushings in control arms are loose or worn.
Front end shimmies.	Front wheel lug nuts are loose. Front wheel bearings are loose or worn. Steering linkage is loose or worn. Tie rod ends are loose or worn. Front wheel alignment (toe-in) is incorrect. Front shock absorber bushings or bushings in control arms are loose or worn.

Suspension and Steering (continued)

Problem	Possible Cause
Steering inoperative or sluggish	<p>Tire pressure is low or uneven between tires.</p> <p>Front wheel alignment (toe-in) is incorrect.</p> <p>Engine speed is too low.</p> <p>Oil level in transaxle is incorrect.</p> <p>Steering pitman arm pivot is not greased and binding.</p> <p>Steering cylinder is binding.</p> <p>Steering relief valve is stuck open.</p> <p>Steering control valve is worn or damaged.</p> <p>Pulley key (either on engine or gear pump) is sheared.</p> <p>Steering cylinder leaks internally.</p> <p>Hydraulic pump is worn or damaged (boom lift affected as well).</p>
Vehicle pulls to one side when not braking.	<p>Tire pressure is low or uneven between tires.</p> <p>Front wheel alignment (toe-in) is incorrect.</p> <p>Steering or suspension component may be damaged.</p>

Brakes

Problem	Possible Cause
Brake pedal goes to the floor.	<p>Brake fluid level in master cylinder is low.</p> <p>Brake fluid leak exists at hose, caliper or wheel cylinder.</p> <p>Brake master cylinder is faulty.</p>
Brake pedal is spongy.	<p>Brake pads are contaminated.</p> <p>Brake pads are excessively worn.</p> <p>Air is trapped in brake lines.</p> <p>Engine has excessive run-on when accelerator pedal is released or low idle speed setting is too high (see Chapter 3 – Kohler Gasoline Engine).</p>
Brakes squeal.	<p>Brake pads are glazed or saturated.</p> <p>Brake rotors are scored or warped.</p>

Brakes (continued)

Problem	Possible Cause
Brakes pull to either side.	Tire pressure is incorrect or uneven between tires. Brake pads are contaminated. Front wheel alignment (toe-in) is incorrect.
Brakes drag.	Parking brake is applied or incorrectly adjusted. Brake pedal is binding. Parking brake cable is binding. Brake pads are saturated. Brake rotors are bent or out-of-round.
Brake pedal is hard to push.	Incorrect brake pad material. Brake pedal linkage is binding.
Wheels lock-up when braking.	Brake pads are contaminated. Brake pads are loose or damaged. Wheel or transaxle bearings are damaged.
Brakes fade.	Brakes are overheated. Brake pads are saturated.
Vehicle surges at slow speeds and chatters at fast speeds.	Brake rotors are bent or out-of-round.

Adjustments

Adjusting Service Brake Pedal

The brake pedal must contact the service brake switch and come to rest against the hard pedal stop when released. The brake master cylinder shaft must fully extend, relieving any system pressure when the service brake pedal is released.

1. Remove the cotter pin and clevis pin from the master cylinder clevis.
2. Loosen the jam nut securing the clevis to the master cylinder shaft.
3. With the brake pedal resting against the hard pedal stop, turn the master cylinder shaft until the hole in the clevis aligns with the hole in the brake pedal.
4. Install the clevis pin and cotter pin.
5. Tighten the jam nut against the clevis.

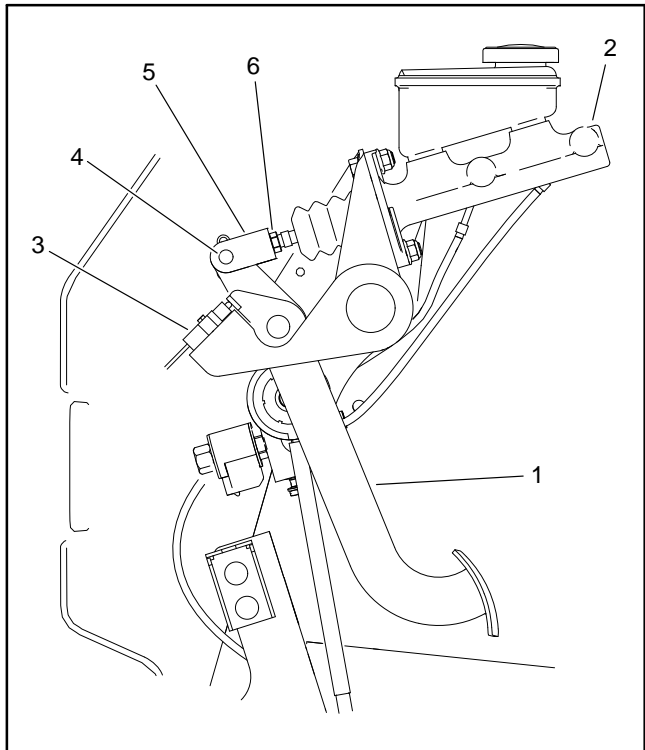


Figure 3

- | | |
|-------------------------|---------------|
| 1. Service brake pedal | 4. Clevis pin |
| 2. Master cylinder | 5. Clevis |
| 3. Service brake switch | 6. Jam nut |

Adjusting Front Suspension (Coil Over Shocks)

The front shock absorbers are set to the softest setting (shock adjustment collar at its lowest point) at the factory. The factory setting should be suitable for most applications. If additional weight is added to the operator's platform (i.e. cab, heavy operator, etc.) the front shock spring pre-load can be increased. Incorrect front suspension setting can change the spray nozzle height relative to the ground, affect steering and can cause accelerated tire wear and scuffing.

NOTE: The front shocks can be adjusted with the machine on the ground, but is easier when the front of the machine is safely lifted off the ground.

1. Chock rear wheels to prevent vehicle from shifting. Lift front of machine using a jack or hoist to allow front suspension to relax (see Jacking Instructions in Chapter 1 – Safety in this manual). Support raised machine with jack stands.

2. Turn the front wheels all the way to the left or right as needed to better access the shock adjustment collar (Fig. 4).

3. Use spanner wrench (TOR6010: see Special Tools in this chapter) to rotate shock absorber adjustment collar which changes the length/pre-load of the shock spring.

4. Remove jack stands and lower machine to ground.

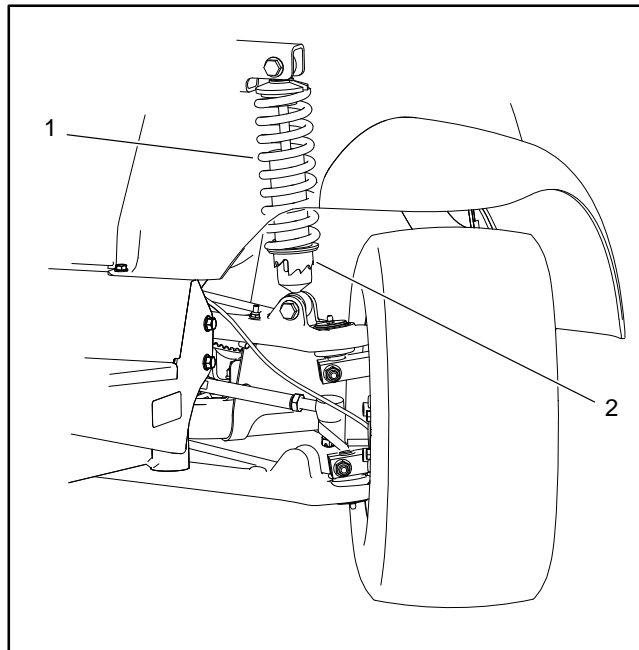


Figure 4

1. Front shock absorber 2. Shock adjustment collar assembly

Service and Repairs

Wheel Assemblies

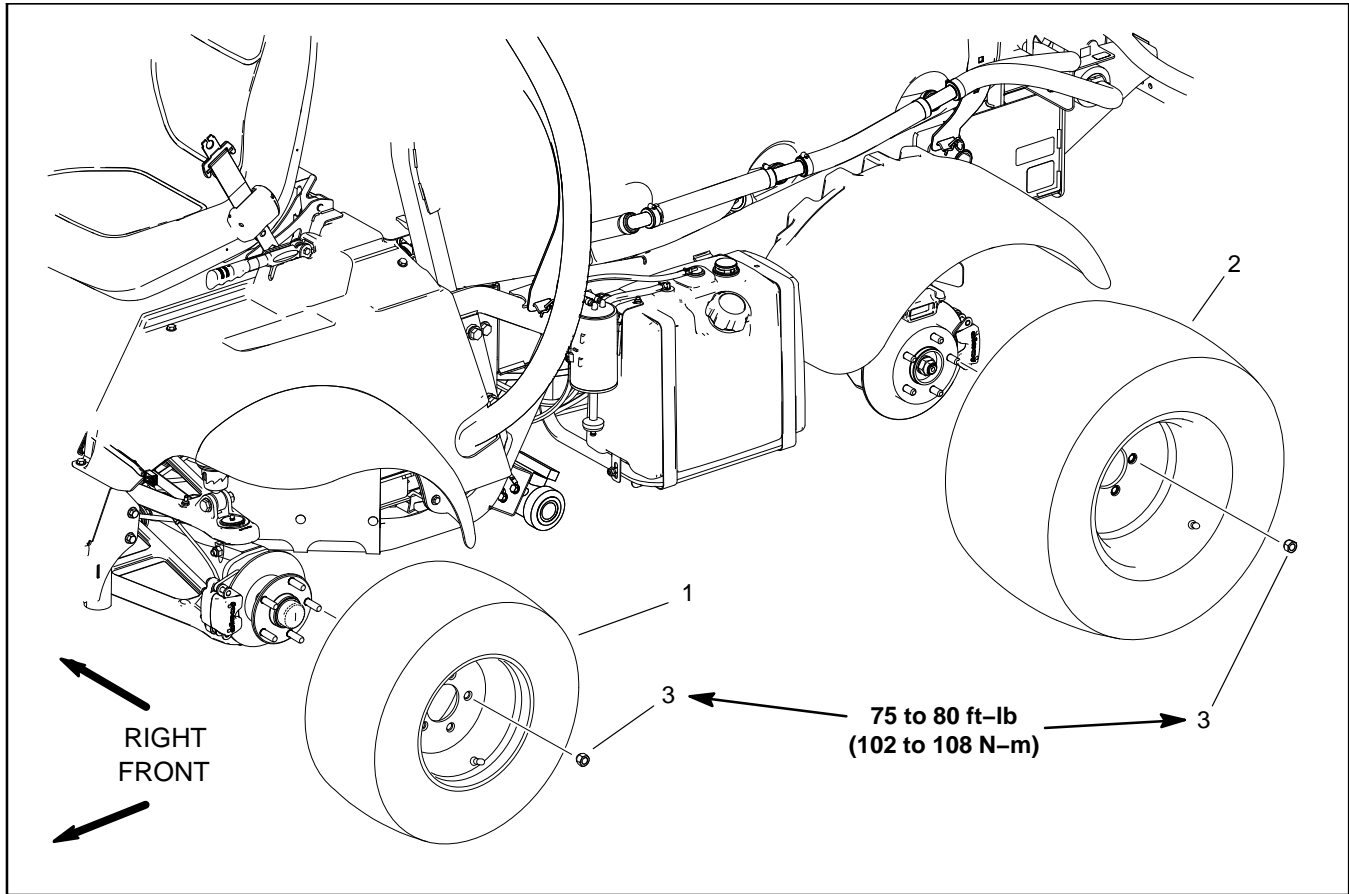


Figure 5

1. Front wheel assembly (2)

2. Rear wheel assembly (2)

3. Lug nut (5 per wheel)

Wheel Removal (Fig. 5)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Check front and rear of wheels that are not to be removed.
3. Jack wheel that is to be removed off the ground (see Jacking Instructions in Chapter 1 – Safety in this manual). Support raised machine with jack stands.
4. Remove lug nuts and wheel assembly.

Wheel Installation (Fig. 5)

1. Install wheel assembly with valve stem facing out and secure to hub with lug nuts.



WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury. Torque wheel lug nuts from 75 to 80 ft-lb (102 to 108 N-m).

2. Torque lug nuts evenly in a crossing pattern from 75 to 80 ft-lb (102 to 108 N-m).
3. Lower machine to ground.

Front Brakes

Removing (Fig. 6)

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

2. For front brake that is to be serviced, remove wheel assembly from vehicle (see Wheel Assemblies in this chapter). Make sure that vehicle is supported with jack stands.

NOTE: Brake caliper can be removed from brake rotor without removing brake line from caliper. Support the brake caliper with a cable tie or wire once the brake caliper is removed from the machine. DO NOT allow the brake caliper to hang by the brake hose.

3. If brake caliper is to be removed from vehicle, thoroughly clean junction of brake line and caliper. Loosen and remove banjo bolt from caliper and separate brake line from caliper. Discard sealing washers.

4. Remove two (2) cap screws and lock washers that secure brake caliper to the front spindle. Slide caliper from brake rotor. If front brake calipers need to be serviced, see Brake Caliper Service in this chapter.

5. Inspect brake pads for wear or damage. Minimum brake pad thickness is $1/16''$ (1.6 mm).

6. Inspect brake rotor for wear or damage. Minimum brake rotor thickness is $0.154''$ (3.9 mm).

NOTE: If front brake rotor needs to be removed, removing the wheel hub assembly is required (see Front Wheel Hubs in this chapter for additional information).

Installing (Fig. 6)

1. Thoroughly clean all front brake components before assembly.

2. Install the front wheel hub and brake rotor if they were removed (see Front Wheel Hubs in this chapter).

3. Slide front brake caliper onto brake rotor. Make sure that rotor is between brake pads.

4. Align caliper with mounting holes and secure caliper to front spindle with two (2) cap screws and lock washers. Tighten screws from **35 to 40 ft-lb (47 to 54 N-m)**.

5. If brake line was removed from brake caliper:

A. Place a new sealing washer on each side of brake line fitting.

B. Install banjo bolt through brake line fitting and banjo washers and then thread into caliper. Tighten banjo bolt from **108 to 132 in-lb (12 to 15 N-m)**.

C. Bleed brakes (see Bleed Brake System in this chapter).

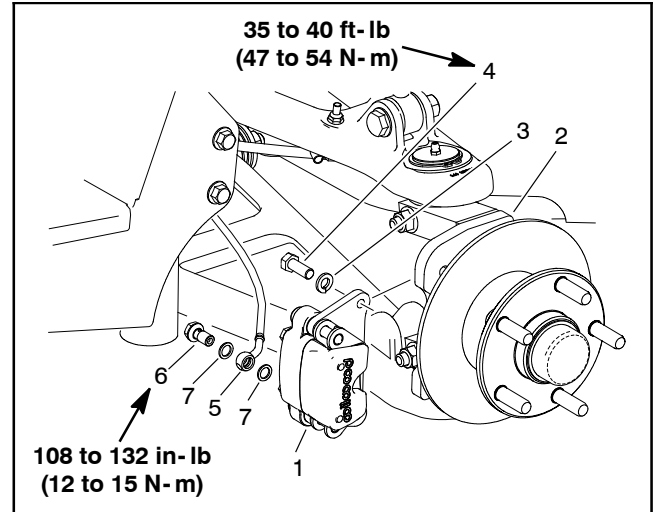


Figure 6

- | | |
|-----------------------------|-----------------------|
| 1. Brake caliper | 5. Brake hose |
| 2. Front spindle (LH shown) | 6. Banjo bolt |
| 3. Lock washer (2) | 7. Sealing washer (2) |
| 4. Cap screw (2) | |



WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury. Torque wheel lug nuts from **75 to 80 ft-lb (102 to 108 N-m)**.

6. Install wheel assembly to vehicle (see Wheel Assemblies in this chapter).

7. Lower machine to ground.



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

8. After assembly is completed, check brake operation.

Burnish Brake Pads

After brake pad replacement, burnish (break-in) the brakes before use.

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.

Rear Brakes

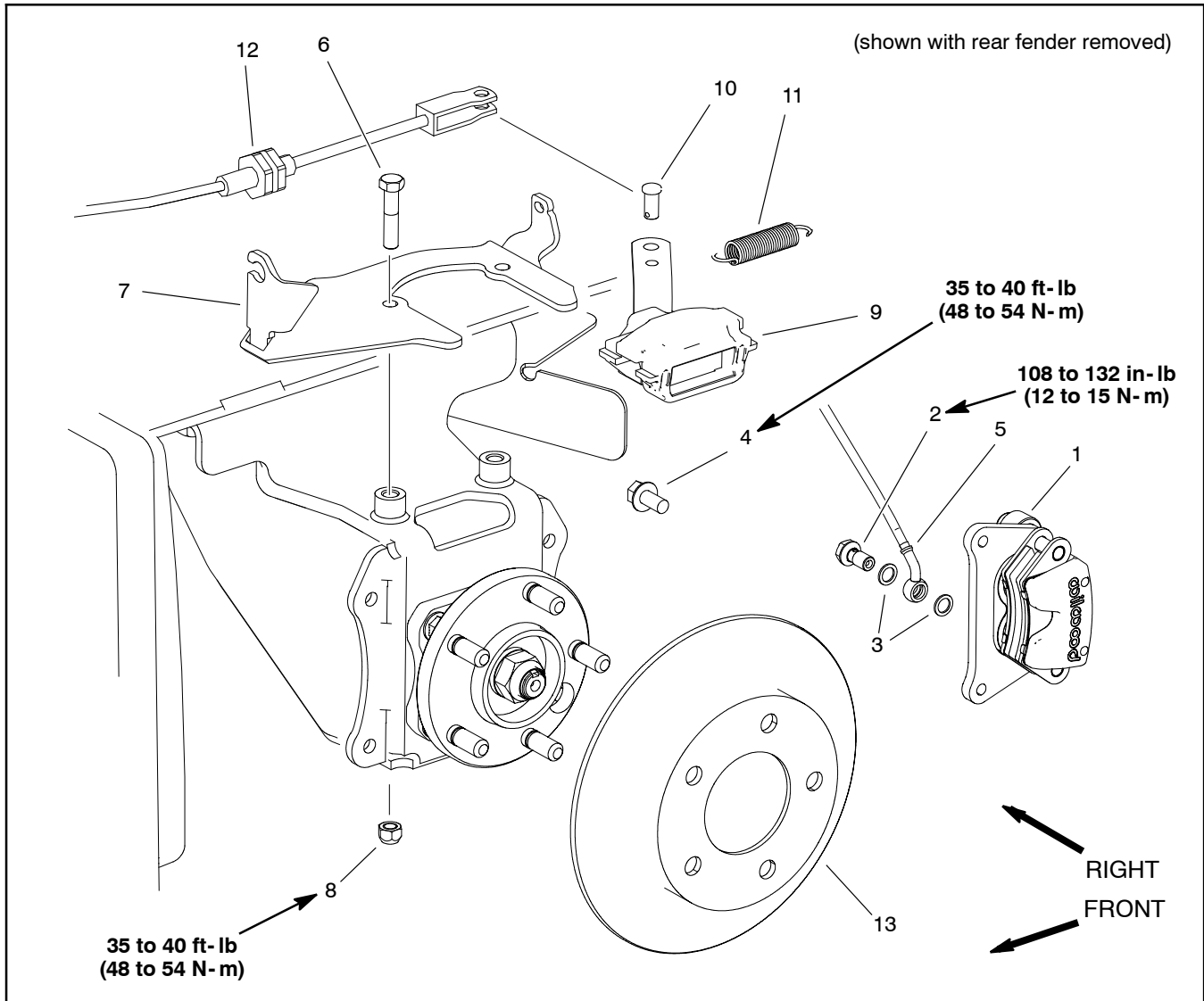


Figure 7

- | | | |
|--------------------------------------|--------------------------|--------------------------|
| 1. Rear brake caliper | 5. Brake line | 9. Parking brake caliper |
| 2. Banjo bolt | 6. Cap screw (2) | 10. Clevis pin |
| 3. Sealing washer (2) | 7. Parking brake bracket | 11. Return spring |
| 4. Flange head screw (2 per caliper) | 8. Lock nut (2) | 12. Parking brake cable |

Removing (Fig. 7)

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

2. For rear brake that is to be serviced, remove wheel from vehicle (see Wheel Assemblies in this chapter). Make sure that vehicle is supported with jack stands.

NOTE: Brake caliper can be removed from brake rotor without removing brake line from caliper. Support the brake caliper with a cable tie or wire once the brake caliper is removed from the machine. **DO NOT** allow the brake caliper to hang by the brake hose.

3. If brake caliper is to be removed from vehicle, thoroughly clean junction of brake line and caliper. Loosen and remove banjo bolt from caliper and separate brake line from caliper. Discard sealing washers.

4. Remove two (2) flange head screws that secure caliper to hub. Slide caliper from brake rotor. If rear brake caliper needs to be serviced, see Brake Caliper Service in this chapter.

5. Inspect brake pads for wear or damage. Minimum brake pad thickness is **1/16"** (1.6 mm).

6. If necessary, remove parking brake assembly from brake rotor:

A. Remove two (2) cap screws and flange nuts that secure caliper bracket to rear axle.

B. Raise caliper bracket assembly (bracket, cable and parking brake caliper) from brake rotor. Position bracket assembly away from rotor.

7. If parking brake caliper removal is needed:

A. Loosen brake cable jam nuts that secure parking brake cable to caliper bracket.

B. Remove return spring end from clevis pin on parking brake lever.

C. Disconnect parking brake cable from caliper bracket and caliper lever.

D. Slide parking brake caliper from caliper bracket. If parking brake caliper needs to be serviced, see Parking Brake Caliper Service in this chapter.

8. Inspect brake rotor for wear or damage. Minimum brake rotor thickness is **0.154" (3.9 mm)**.

9. If necessary, remove brake rotor from wheel bearing hub.

Installing (Fig. 7)

1. If brake rotor was removed, place brake rotor onto studs in wheel bearing hub.

2. If parking brake caliper was removed from caliper bracket:

A. Slide parking brake caliper onto caliper bracket.

B. Connect parking brake cable to parking brake lever with clevis pin.

C. Secure clevis pin by inserting return spring end into clevis pin.

D. Tighten cable jam nuts to secure parking brake cable to caliper bracket. Position jam nuts so that all threads on cable are showing towards the rear of the vehicle.

3. If removed, install parking brake assembly to brake rotor:

A. Slide parking brake bracket assembly (bracket, cable and parking brake caliper) onto brake rotor. Make sure that rotor is between brake pads.

B. Secure parking brake bracket to rear axle with two (2) cap screws and flange nuts. Tighten flange nuts from **35 to 40 ft-lb (48 to 54 N-m)**.

4. Slide brake caliper onto brake rotor. Make sure that rotor is between brake pads.

5. Align caliper with mounting holes and secure caliper to machine hub with two (2) flange head screws. Tighten screws from **35 to 40 ft-lb (48 to 54 N-m)**.

6. If brake line was removed from brake caliper:

A. Place a new sealing washer on each side of brake line fitting.

B. Install banjo bolt through brake line fitting and banjo washers and then thread into caliper. Tighten banjo bolt from **108 to 132 in-lb (12 to 14 N-m)**.

C. Bleed brakes (see Bleed Brake System in this chapter).



WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury. Torque wheel lug nuts from 75 to 80 ft-lb (102 to 108 N-m).

7. Install wheel assembly to vehicle (see Wheel Assemblies in this chapter).

8. Check parking brake operation and adjust if necessary (see machine Operators manual).

9. Lower machine to ground.



CAUTION

After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.

10. After assembly is completed, check brake operation.

Burnish Brake Pads

After brake pad replacement, burnish (break-in) the brakes before use.

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.

Service Brake Caliper Service

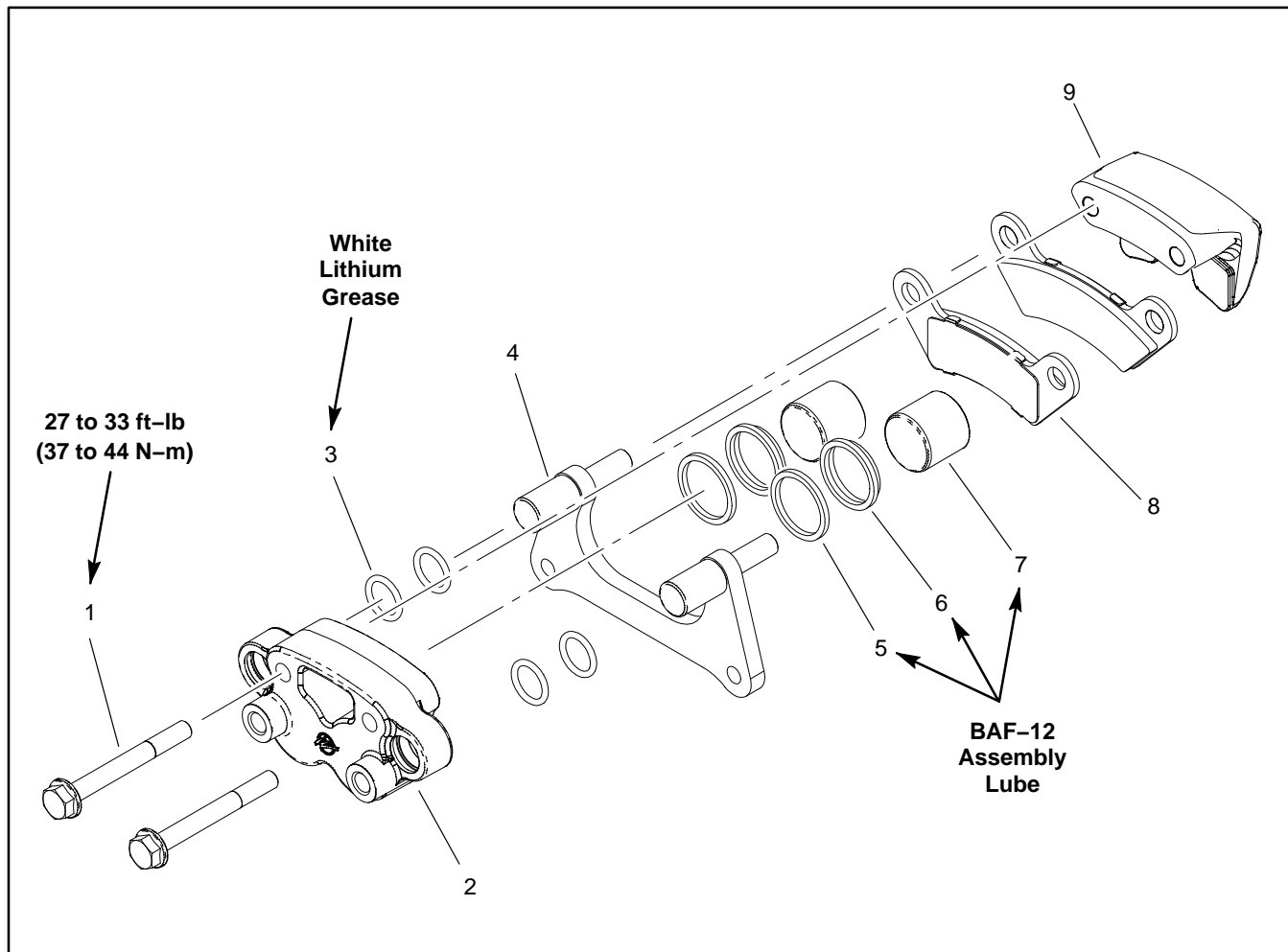


Figure 8

- | | | |
|-----------------|--------------------------------|------------------|
| 1. Bolt (2) | 4. Caliper bracket | 7. Piston (2) |
| 2. Caliper body | 5. Square seal (2) | 8. Brake pad (2) |
| 3. O-ring (4) | 6. Dust seal (2) (if equipped) | 9. Caliper anvil |

NOTE: The Multi Pro 1750 front and rear service brake calipers are identical.

NOTE: Early production Multi Pro 1750 service brake brake caliper pistons use only a square seal. These calipers do not include a piston dust seal.

Disassembly (Fig. 8)

1. Remove two (2) bolts that secure brake caliper body to the caliper anvil.
2. Remove caliper anvil and then slide brake pads from pins on caliper bracket.
3. Slide caliper body assembly from caliper bracket.
4. If necessary, remove remaining components from caliper body:
 - A. Carefully remove pistons from caliper body making sure that outer surface of pistons are not damaged during removal.
 - B. Carefully, remove and discard O-rings, square seals and dust seals (if equipped) from caliper body. Make sure that caliper body is not damaged during removal of O-rings and seals.
5. Clean caliper components with brake cleaner.

Inspection

1. Check brake pads for uneven wear that would indicate binding in the caliper assembly. Replace the brake pads if the friction material is worn to less than **1/16" (1.6 mm)**. Also, if pads are contaminated with grease or oil, they must be replaced.
2. Inspect brake pistons and piston bores in caliper body for damage or wear. Replace brake pistons or complete brake caliper assembly if necessary.
3. Check that pins on caliper bracket are not worn or damaged. Wear on the pins will prevent smooth brake operation.

Assembly (Fig. 8)

1. If caliper body was disassembled, install components in caliper body:
 - A. Apply hydraulic brake cylinder assembly lube (BAF-12 or equivalent) to square seals, dust seals (if equipped) and piston before installation.
 - B. Fit lubricated seals into grooves of caliper body. Make sure that seals are not twisted in groove after installation.
 - C. Install lubricated pistons into caliper body bores. Pistons should slide into bores with light resistance.
 - D. Lubricate O-rings with white lithium grease and install into grooves in caliper body.
 - E. Slide caliper body assembly onto pins on caliper bracket.

NOTE: If brake pads are being replaced, it will be necessary to push caliper pistons back into the caliper bore before installing new pads.

2. Slide brake pads onto pins on caliper bracket. Make sure that friction material on pads is toward brake rotor position.
3. Fit caliper anvil to assembly and secure caliper components with two (2) bolts. Tighten bolts from **27 to 33 ft-lb (37 to 44 N-m)**.

Parking Brake Caliper Service

Disassembly (Fig. 9)

1. Remove carrier side brake pad and pad support from caliper.
2. Remove cam side brake pad and pad support from caliper.
3. Replace the brake pads if the friction material is worn to less than **0.135" (3.4 mm)**.
4. If necessary, remove lever retainer spring, pivot pins and cam lever from caliper body.

Assembly (Fig. 9)

1. If removed, install cam lever into caliper body and then place pivot pins into lever holes. Insert lever retainer spring with tangs bent away from housing until the spring tabs contact the pivot pin at the bottom of the housing pocket.
2. Install cam side pad support (notch facing cam lever) and brake pad into caliper body.
3. Slide carrier side pad support and brake pad into caliper body.

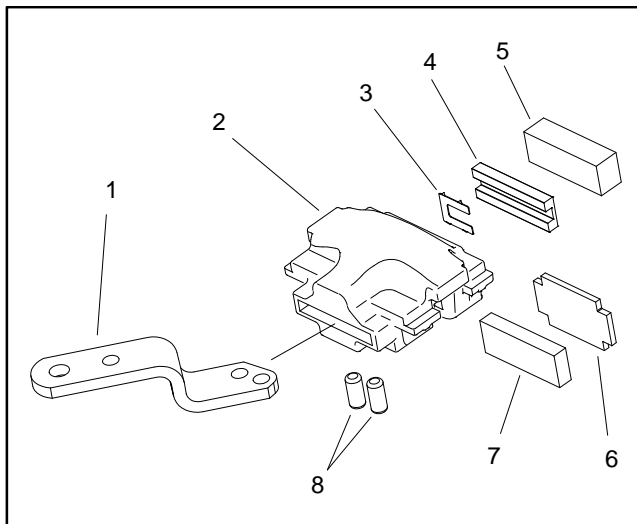


Figure 9

- | | |
|--------------------------|---------------------------|
| 1. Cam lever | 5. Cam side brake pad |
| 2. Caliper | 6. Pad support |
| 3. Lever retainer spring | 7. Carrier side brake pad |
| 4. Pad support | 8. Pivot pin |

Brake Lines

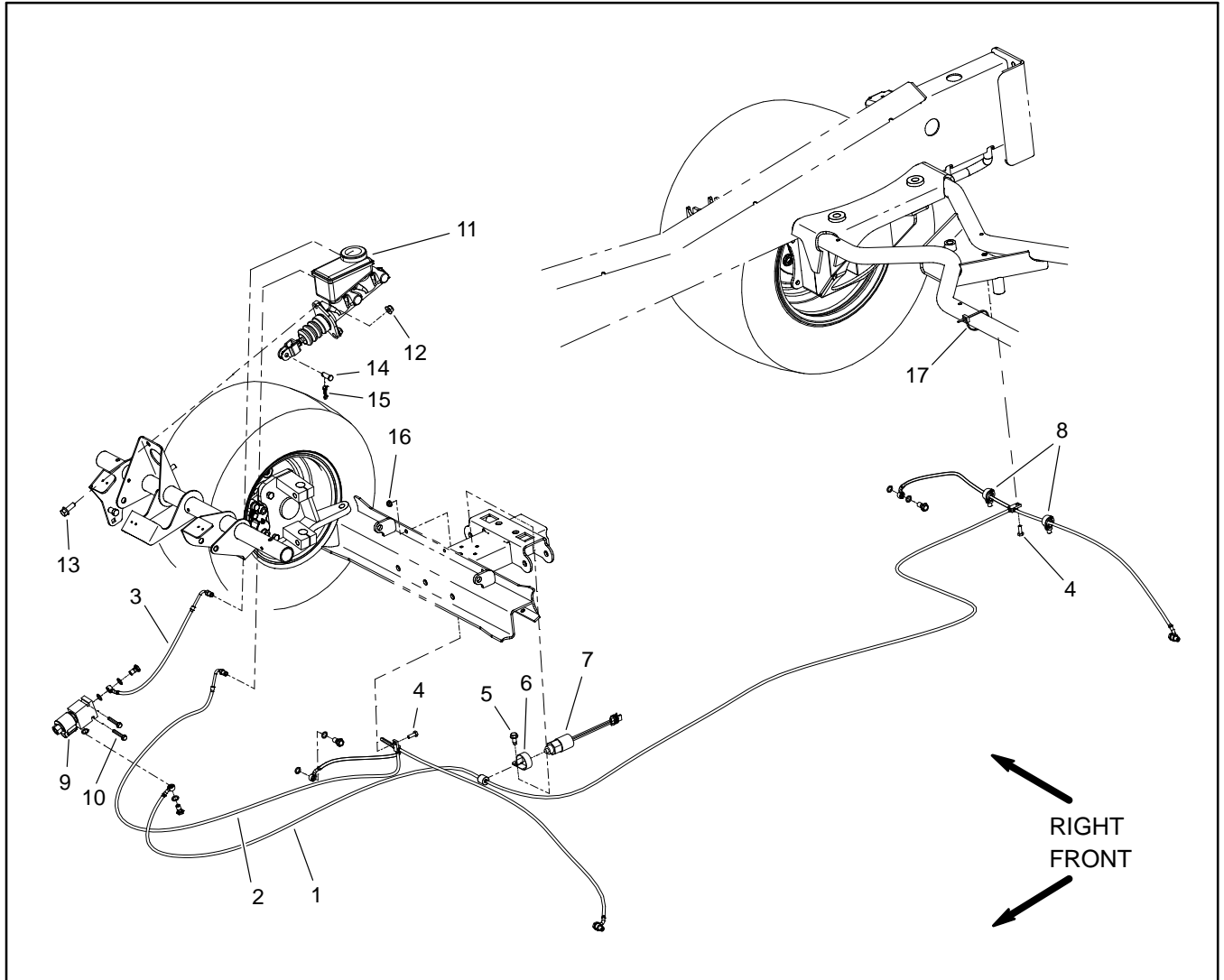


Figure 10

- | | | |
|-----------------------|-------------------------|---------------------------|
| 1. Brake line – rear | 7. Pressure switch | 13. Flange head screw (2) |
| 2. Brake line – front | 8. Tie clip (2) | 14. Clevis pin |
| 3. Brake line – rear | 9. Brake hold valve | 15. Hair pin |
| 4. Cap screw (2) | 10. Hex washer head (2) | 16. Lock nut |
| 5. Flange head screw | 11. Master cylinder | 17. Cable tie |
| 6. R-Clamp | 12. Flange nut (2) | |

When performing service work on the Multi Pro brake lines, make sure to clean brake components before disassembly. Record routing of brake lines and location of cable ties and clamps before removing brake lines from machine. Reinstall brake lines with all cable ties and clamps as recorded. Make sure that the brake lines do not contact moving components during machine operation.

Parking Brake Cables

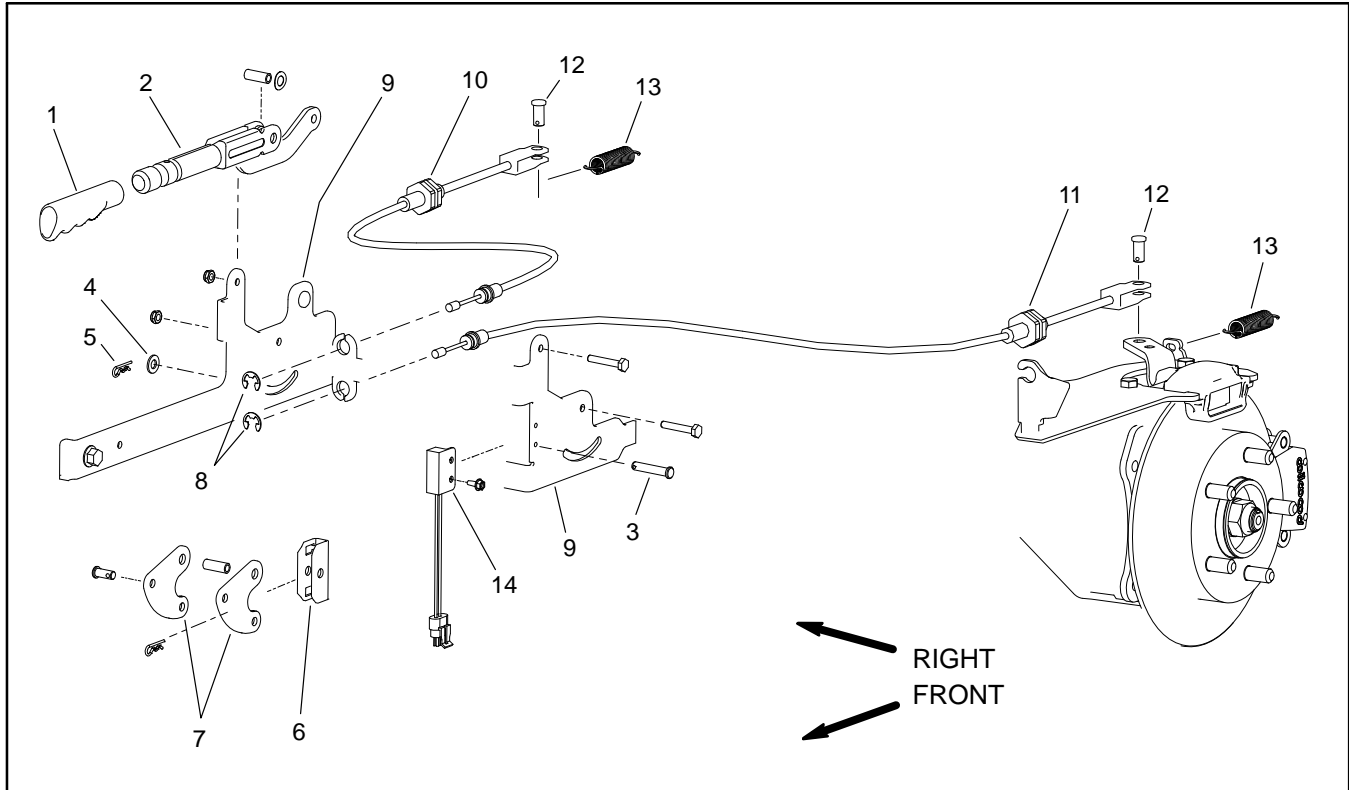


Figure 11

- | | | |
|------------------------|---|---------------------------------|
| 1. Hand grip | 6. Equalizer | 10. Parking brake cable – right |
| 2. Parking brake lever | 7. Bellcrank | 11. Parking brake cable – left |
| 3. Clevis pin | 8. Retaining rings (2) | 12. Clevis pin (2) |
| 4. Flat washer | 9. Parking Brake bracket
(shown split) | 13. Return spring (2) |
| 5. Hair pin | | 14. Parking brake switch |

Removing (Fig. 11)

1. Set the parking brake lever to the disengaged (down) position.
2. Remove the hand grip from the parking brake lever. Loosen set screw on parking brake lever knob and turn knob fully counterclockwise to loosen cable adjustment.
3. Remove the front left fender assembly to allow access to cable connection at parking brake lever.
4. Remove hair pin, flat washer and clevis pin (item 3) that secures the brake equalizer to the bellcrank.
5. Remove retaining rings that secure brake cables to parking brake bracket.
6. Remove cable ends from equalizer plate and remove cables from parking brake bracket.
7. Remove both rear wheels (see Wheel Assemblies in this chapter).

8. Loosen brake cable jam nuts that secure parking brake cable to caliper bracket.
9. Remove return spring end from clevis pin on parking brake lever.
10. Disconnect parking brake cable from caliper bracket and caliper lever.
11. Record routing of cables and location of cable ties and r-clamps before removing cables from machine.

Installing (Fig. 11)

1. Route cables through machine and secure with cable ties and r-clamps as recorded. Make sure that the brake cables do not contact moving components during machine operation.
2. Slide parking brake caliper onto caliper bracket.
3. Connect parking brake cable to parking brake lever with clevis pin.

4. Secure clevis pin by inserting return spring end into clevis pin.
5. Tighten cable jam nuts to secure parking brake cable to caliper bracket. Position jam nuts so that all threads on cable are showing towards the rear of the vehicle.
6. Position cables in parking brake bracket and install cable ends in brake equalizer.
7. Secure parking brake cables to bracket with retaining rings.
8. Attach equalizer to parking brake lever with clevis pin (item 3), flat washer and hair pin.
9. Install rear wheels (see Wheel Assemblies in this chapter).
10. Install front left fender assembly.
11. Adjust parking brake (see Operator's Manual). Check parking brake operation before returning machine to regular service.

Brake Master Cylinder Service

Testing

1. Insure that brake system is properly adjusted and bled.
2. Apply light pressure to brake pedal.
3. If brake pedal fades or falls away while applying light pressure to pedal, the master cylinder should be serviced.

Disassembly (Fig. 12)

1. Remove reservoir and flange seal. Push in on the push rod so the stop pin can be removed.
2. Disconnect lower end of the dust cover from the housing.
3. Push in on the push rod and remove circlip, then remove push rod with dust cover and clevis. Remove retainer washer.
4. Remove primary piston assembly and secondary piston assembly from cylinder housing.

Inspection

1. Clean all metal parts with isopropyl alcohol, then clean out and dry grooves and passageways with compressed air. Make sure cylinder bore and component pieces are thoroughly clean.

NOTE: Do not hone bore of brake cylinder.

2. Check cylinder bore, pistons and springs for damage or excessive wear. Replace brake cylinder assembly if signs of pitting, scoring or cracks are evident in cylinder bore.

Assembly (Fig. 12)

1. Apply a film of clean brake fluid to cylinder bore and piston assemblies.
2. Install secondary piston assembly and primary piston assembly into cylinder.
3. Install retainer washer.
4. Install push rod and secure in place with circlip. Install lower end of dust cover to housing.
5. Push in on push rod so stop pin can be installed to retain secondary piston assembly, then install flange seal and reservoir.

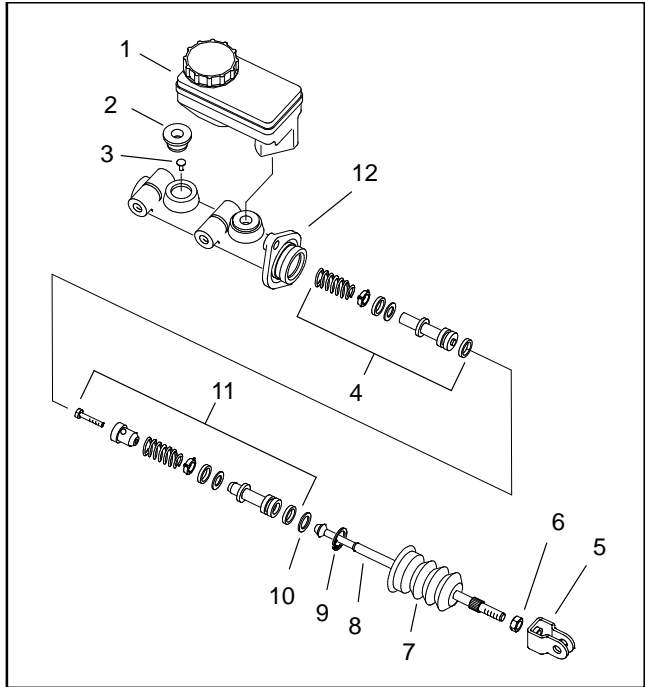


Figure 12

- | | |
|--------------------------|-------------------------|
| 1. Reservoir | 7. Dust cover |
| 2. Flange seal | 8. Push rod |
| 3. Stop pin | 9. Circlip |
| 4. Secondary piston assy | 10. Retainer washer |
| 5. Clevis | 11. Primary piston assy |
| 6. Jam nut | 12. Cylinder housing |

Bleeding Brake System

After loosening or removing any hydraulic brake component, the brake system should be bled to insure proper brake operation.

NOTE: A power/vacuum brake bleeding tool may provide faster and more effective brake bleeding than manual bleeding.

1. Connect a suitable transparent hose to bleeder valve on left rear wheel caliper and submerge other end of hose in a clean glass container partially filled with clean brake fluid.
2. Have a second person pump brake pedal several times, then hold pedal down firmly.
3. With pedal firmly depressed, open bleeder valve of left rear brake until pedal fades to floor, then close bleeder valve.
4. Repeat procedure until a continuous flow of brake fluid, with no air bubbles, is released from bleeder valve.
Make sure fluid level is maintained in brake fluid reservoir at all times.
5. Torque bleeder valve from **54 to 66 in-lb (6 to 7 N-m)**.
6. Complete steps 2 through 6 for right rear, left front and then right front brake calipers.
7. Install hood (see Hood in this section).

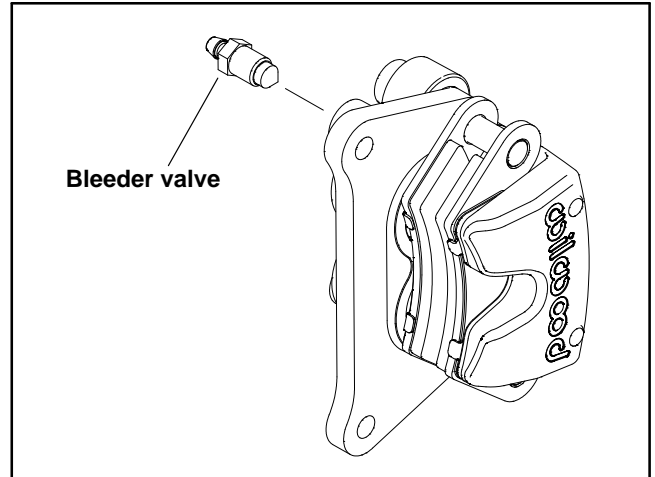



Figure 13

	CAUTION
After servicing the brakes, always check the brakes in a wide open, level area that is free of other persons and obstructions.	

8. After bleeding of brakes is completed, test vehicle to make sure brakes are operating correctly and brake pedal is solid.

Front Wheel Hubs

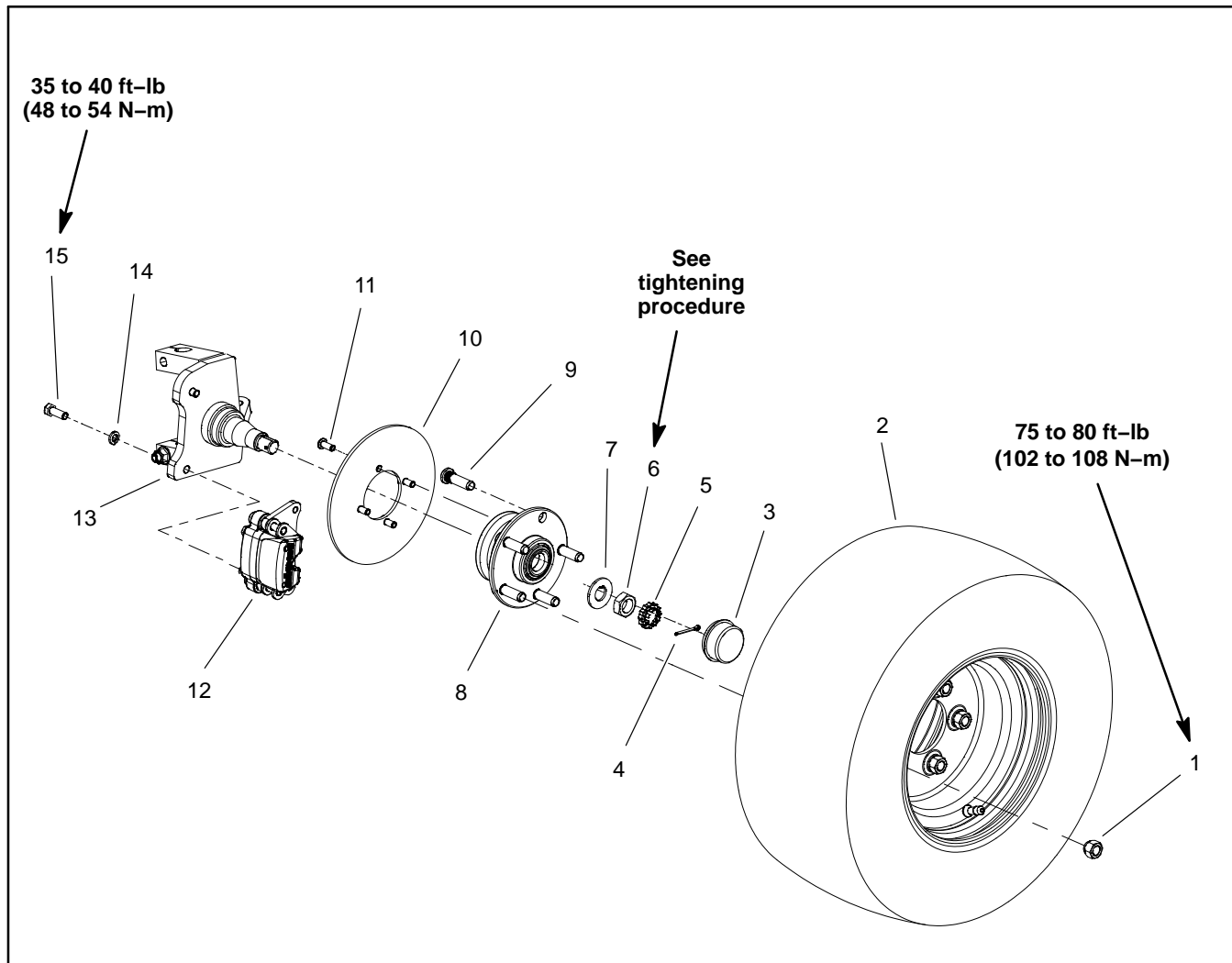


Figure 14

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|----------------------------|-----------------------|-------------------------------------|
| 1. Lug nut (5 per wheel) | 6. Slotted hex nut | 11. Socket head screw (4 per rotor) |
| 2. Wheel and tire assembly | 7. Tab washer | 12. Brake caliper |
| 3. Dust cap | 8. Wheel hub assembly | 13. Front spindle (LH shown) |
| 4. Cotter pin | 9. Lug stud (5) | 14. Lock washer (2 per caliper) |
| 5. Nut retainer | 10. Brake rotor | 15. Cap screw (2 per caliper) |

Removal (Fig. 14)

1. Park machine on a level surface, stop spray pump, stop engine and engage parking brake. Remove key from ignition switch.
2. Remove front wheel and front brake caliper (see Front Brakes in this chapter).
3. Carefully pry dust cap (item 3) from wheel hub.
4. Remove cotter pin and nut retainer (item 5) from spindle.
5. Remove spindle nut (item 6) and tab washer that secure wheel hub assembly to spindle. Slide wheel hub with bearings and brake rotor from spindle.

6. Disassemble the wheel hub (Fig. 15):

A. Pull the seal out of the wheel hub and discard seal.

B. Remove bearings from both sides of the wheel hub. Clean bearings in solvent. Make sure bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

C. Inspect wheel studs in hub and replace studs if damaged. Use a press to remove wheel stud(s).

7. If necessary, remove brake rotor from wheel hub.

Installation (Fig. 14)

1. Assemble wheel hub (Fig. 17):

A. If any wheel studs were removed from hub, press new stud(s) fully into hub making sure that stud shoulder is tight against hub.

B. If bearing cups were removed from the wheel hub, press bearing cups into the hub until they seat against the hub shoulder.

C. Pack both bearings with grease and position inner bearing into cup in the wheel hub.

IMPORTANT: The wheel hub seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the inner bearing.

D. Lubricate the inside of the new seal and press it into the wheel hub.

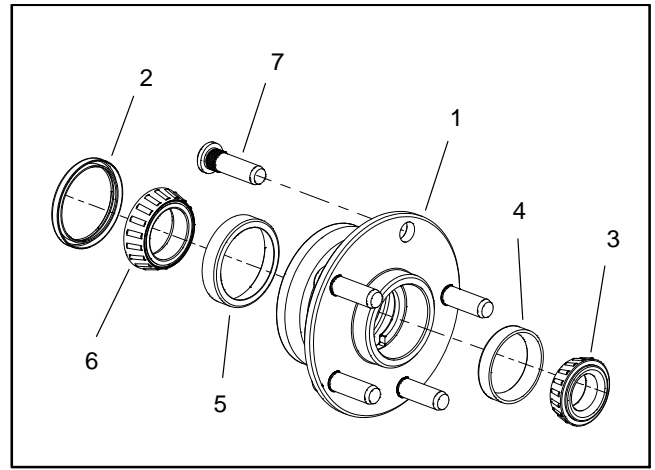


Figure 15

- | | |
|--------------------|-------------------|
| 1. Front wheel hub | 5. Bearing cup |
| 2. Seal | 6. Bearing cone |
| 3. Bearing cone | 7. Wheel stud (5) |
| 4. Bearing cup | |

2. If brake rotor was removed, secure rotor to hub with four (4) socket head screws.

3. Slide wheel hub assembly onto spindle. Install greased outer bearing, tab washer and jam nut onto spindle.

4. Rotate the wheel hub by hand and tighten the jam nut from **75 to 100 in-lb (8.5 to 11.3 N-m)** to set the bearings. Then, loosen the nut until the hub has end play.

5. Again, rotate the wheel hub by hand and tighten the jam nut from **15 to 20 in-lb (1.7 to 2.3 N-m)**.

6. Position nut retainer over jam nut and install cotter pin through spindle shaft hole. Install dust cap to hub.

7. Install front brake caliper and wheel (see Front Brakes in this chapter).

Rear Wheel Hubs

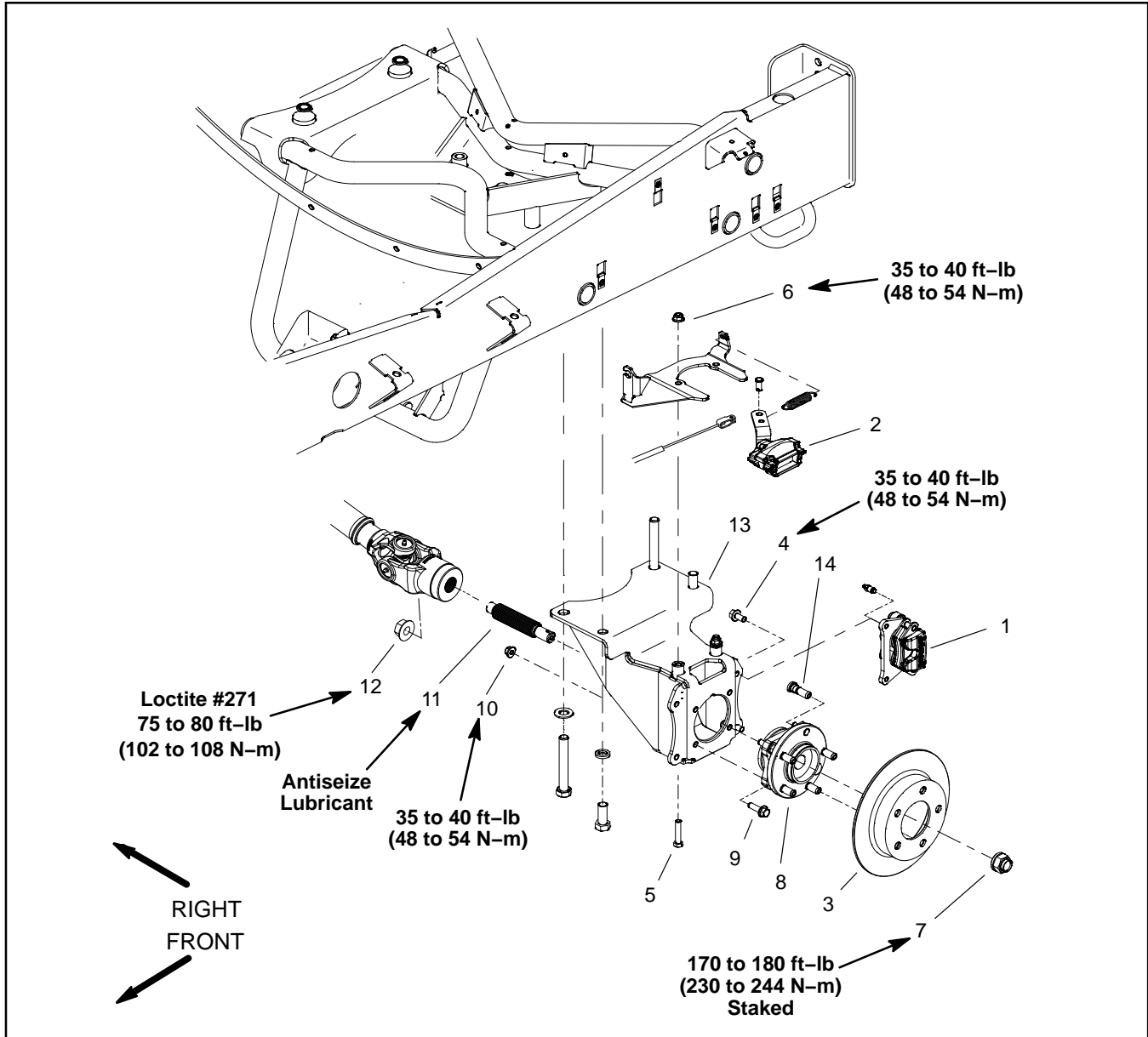


Figure 16

- | | | |
|-------------------------------------|----------------------|-------------------|
| 1. Rear brake caliper | 6. Flange nut (2) | 11. Splined shaft |
| 2. Parking brake caliper (LH shown) | 7. Spindle nut | 12. Flange nut |
| 3. Brake rotor | 8. Wheel bearing hub | 13. Hub support |
| 4. Flange head screw (2) | 9. Cap screw (4) | 14. Drive stud |
| 5. Cap screw (2) | 10. Flange nut (4) | |

NOTE: If rear wheel hub wear or damage exists, replacement of the wheel hub assembly is necessary. Rear wheel hubs on the Multi Pro 1750 are not rebuildable.

Removal (Fig. 16)

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

2. Remove rear wheel, brake caliper, parking brake caliper and brake rotor (see Rear Brakes in this chapter).

NOTE: Spindle nut is staked (deformed) to the splined shaft during assembly. Clear away the deformed area of the nut before removing the nut from the shaft or damage to the shaft threads will occur.

3. Remove and discard the spindle nut.

4. Remove the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access flange head screws. Remove wheel hub and bearing assembly from machine.

5. Carefully inspect threads of splined shaft (item 11) and replace if necessary.

6. Inspect wheel studs in hub and replace studs if damaged. Use a press to remove stud(s) from hub.

Installation (Fig. 16)

1. If any wheel studs were removed from hub, press new stud(s) fully into hub making sure that stud shoulder is tight against hub.

2. Apply antiseize lubricant to the splined shaft (item 11).

3. Install wheel hub and bearing assembly over the splined shaft. Install the four (4) flange head screws and flange nuts that secure the wheel hub and bearing to the machine. Use the hole in the wheel hub to access mounting holes. Tighten the flange nuts from **35 to 40 ft-lb (48 to 54 N-m)**.

4. Install a new spindle nut. Tighten the spindle nut from **170 to 180 ft-lb (230 to 244 N-m)**. Stake (deform) the outer lip of the spindle nut into the slot in the splined shaft to lock the nut in place.

5. Install brake rotor, parking brake caliper, brake caliper and wheel (see Rear Brakes in this chapter).

Front Suspension

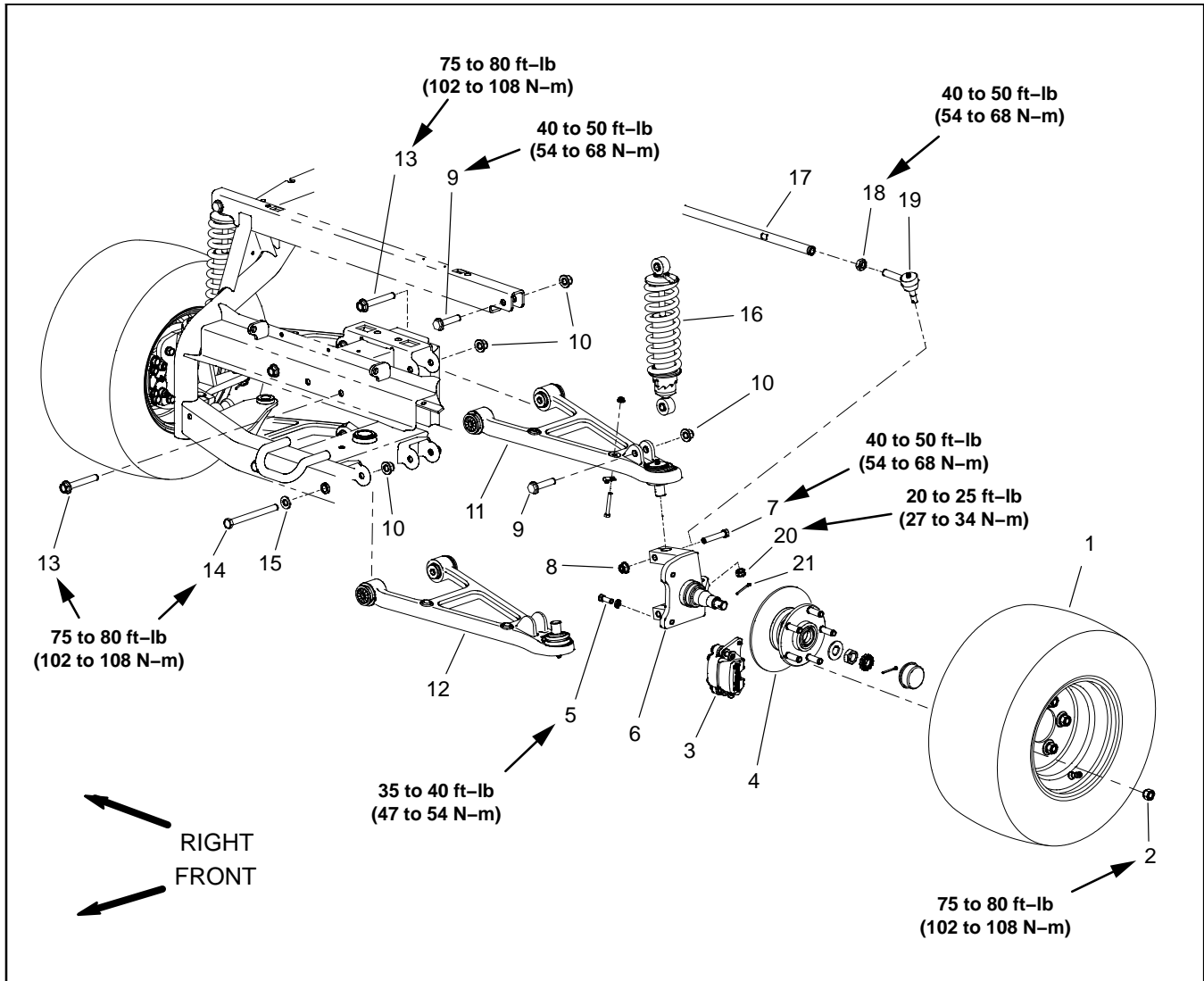


Figure 17

- | | | |
|----------------------------|----------------------------|---------------------------------|
| 1. Front wheel and tire | 8. Flange nut (4) | 15. Flat washer (2) |
| 2. Lug nut (5 per wheel) | 9. Flange head screw (4) | 16. Shock absorber assembly (2) |
| 3. Front brake caliper (2) | 10. Flange nut (12) | 17. Tie rod (2) |
| 4. Front hub assembly (2) | 11. Upper left control arm | 18. Jam nut (2) |
| 5. Cap screw (4) | 12. Lower left control arm | 19. Tie rod end (2) |
| 6. Left spindle | 13. Flange head screw (6) | 20. Castle nut (2) |
| 7. Cap screw (4) | 14. Cap screw (2) | 21. Cotter pin (2) |

Disassembly (Fig. 17)

1. Park machine on a level surface, stop engine, engage parking brake and remove key.
2. Lift front of machine using a jack or hoist to allow front suspension to hang freely from machine. Chock rear wheels to prevent vehicle from shifting.
3. Remove front wheel assembly (see Wheels in this chapter).
4. If necessary, remove front brake assembly from spindle (see Front Brakes in this chapter).
5. If necessary, remove front wheel hub from spindle (see Front Wheel Hub in this chapter).
6. Support brake, hub and spindle assembly to prevent them from falling during disassembly.
7. Disassemble front suspension as needed.
8. Disassemble control arms as needed.
 - A. Remove retaining ring that secures ball joint.
 - B. Use a suitable press and remove ball joint from control arm.
 - C. Use a suitable press and remove flange bushings from control arm.

Assembly (Fig. 17)

1. Assemble front suspension components as needed.
 - A. If control arm ball joint or flange bushings are removed, use a suitable press to install ball joint with notch facing inward as shown (Fig. 18). Press flange bushings tight to machined surface of control arm.
 - B. Position control arms to the frame and secure to frame with flange head screws, cap screws, flat washers and flange nuts (items 10 thru 15). Do not fully tighten screws and nuts.
 - C. Install shock absorbers. Tighten shock absorber mounting flange head screws and flange nuts from **40 to 50 ft-lbs (54 to 68 N-m)**.
 - D. Install spindle assembly to the control arms. Tighten cap screws and flange nuts (items 7 and 8) from **40 to 50 ft-lbs (54 to 68 N-m)**.

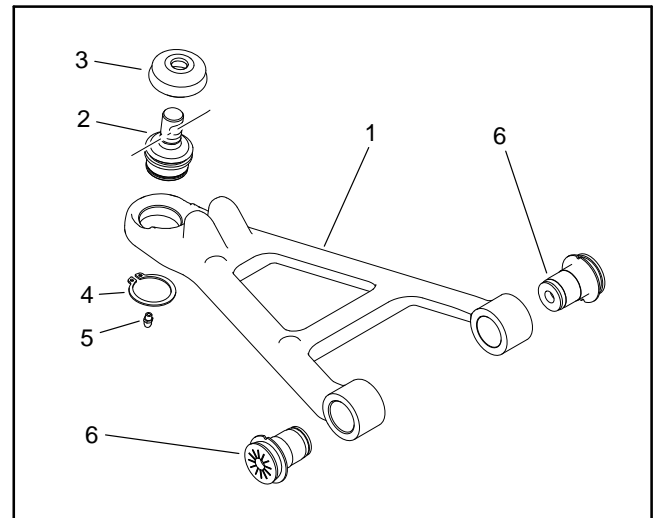


Figure 18
(lower right control arm shown)

- | | |
|----------------|-------------------|
| 1. Control arm | 4. Retaining ring |
| 2. Ball joint | 5. Grease fitting |
| 3. Boot | 6. Flange bushing |

IMPORTANT: The control arms should not be allowed to move more than five degrees up or down once the mounting bolts and nuts have been fully tightened or damage to the control arm bushings may occur.

- E. Fully tighten flange nuts and flange head screws securing control arms to frame from **75 to 80 ft-lb (102 to 108 N-m)**.
 - F. If tie rod ends were loosened or removed from spindle, tighten castle nut from **20 to 25 ft-lb (27 to 34 N-m)**. If necessary, tighten castle nut further until cotter pin can be installed.
2. If previously removed, install front wheel hub (see Front Wheel Hub in this chapter).
 3. If previously removed, install front brake caliper (see Front Brakes in this chapter).
 4. After assembly is complete, make sure that suspension components do not contact hoses and/or wires throughout their full range of motion.
 5. Lubricate upper and lower ball joint and tie rod end grease fittings.
 6. Install wheel and secure with lug nuts. Tighten lug nuts evenly in a crossing pattern from **75 to 80 ft-lb (102 to 108 N-m)**.
 7. Lower machine to ground.
 8. Check and adjust front wheel toe-in (see Operator's Manual).

Front Shock Absorber Service

The front shock absorbers used on the Multi Pro 1750 can be dis assembled to allow replacement of the shock spring or dampener cartridge. If the shock absorber end bushings are worn, the dampener cartridge must be replaced.

1. Remove the shock absorber from the machine (see Front Suspension in this chapter).
2. Use shock spring compressor (TOR6015: see Special Tools in this chapter) to safely compress the spring. While the spring is compressed, remove the spring collar and spring from the dampener cartridge (Fig. 19).
3. Slide the adjustment collar from the dampener cartridge.
4. Replace desired components as necessary. Assemble shock absorber in reverse order.
5. Tighten shock absorber mounting screws from **40 to 50 ft-lbs (54 to 68 N-m)**.

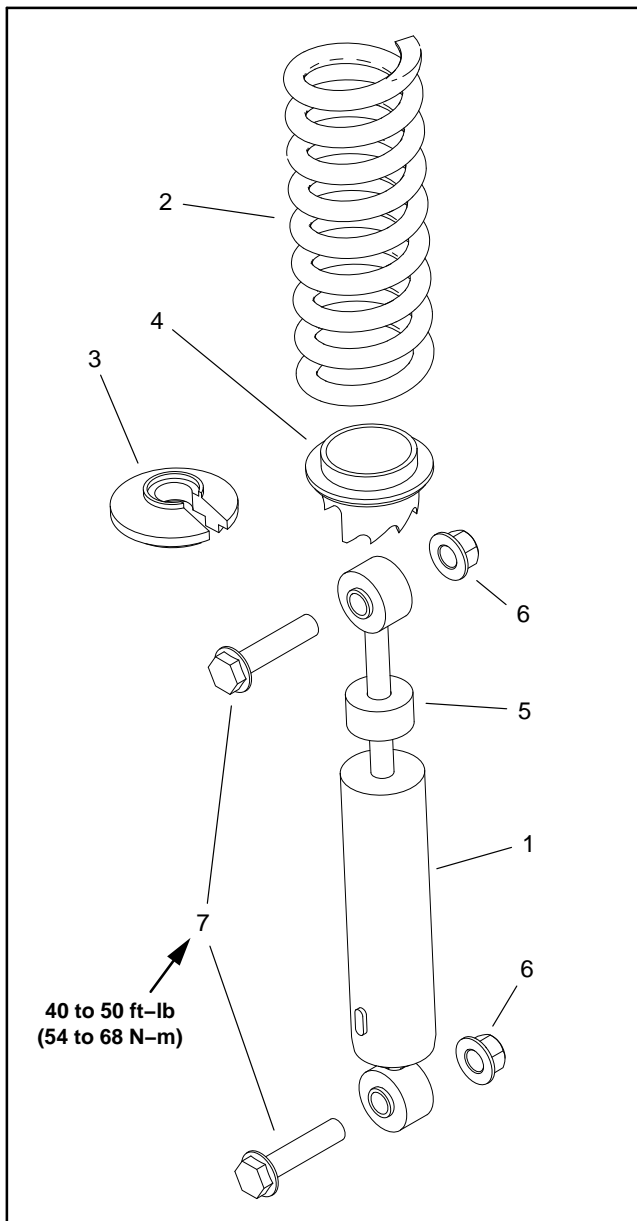


Figure 19

- | | |
|-----------------------|----------------------|
| 1. Dampener cartridge | 5. Bumper |
| 2. Spring | 6. Flange nut |
| 3. Collar | 7. Flange head screw |
| 4. Adjuster | |

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Steering Assembly

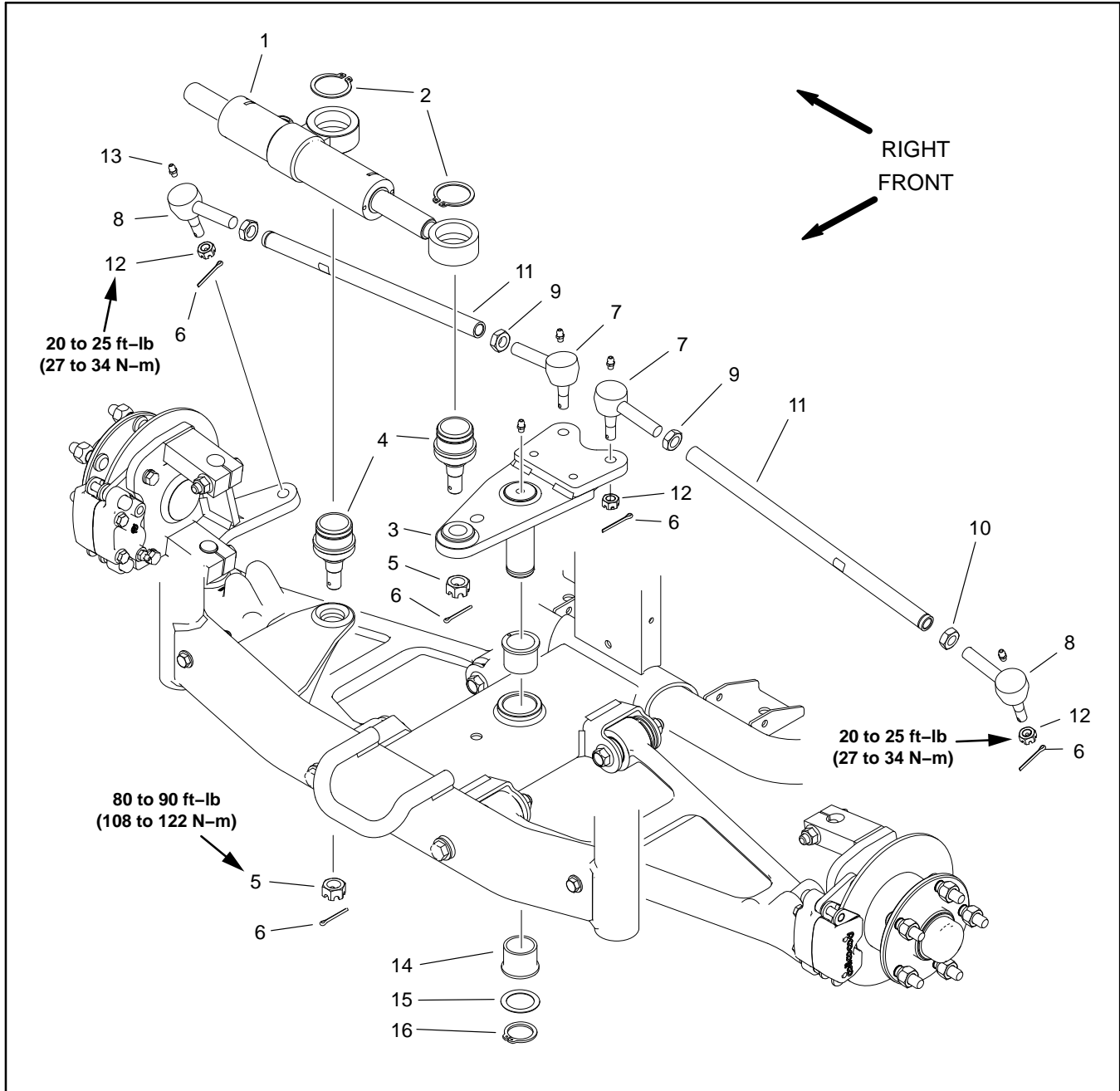


Figure 20

- 1. Steering cylinder
- 2. Retaining ring (2)
- 3. Steering pivot
- 4. Ball joint (2)
- 5. Castle nut (2)
- 6. Cotter pin (6)

- 7. Tie rod end – RH thread (2)
- 8. Tie rod end – LH thread (2)
- 9. Jam nut – RH thread (2)
- 10. Jam nut – LH thread (2)
- 11. Tie rod

- 12. Castle nut (4)
- 13. Grease fitting (4)
- 14. Flange bushing (2)
- 15. Thrust washer
- 16. Retaining ring

Disassembly (Fig. 20)

1. Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch.
2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety). Front of machine should be lifted enough to allow front suspension to hang freely from machine. Support raised machine with jack stands.
3. Remove front wheel assembly (see Wheel Assemblies in this chapter).
4. If necessary, remove tie rods.
 - A. Remove cotter pins and castle nuts from tie rod end. Discard cotter pins.
 - B. Use a suitable puller (pickle fork) to separate tie rod ends from spindle and/or steering pivot and remove tie rod assemblies.
5. If necessary, remove steering cylinder (see Steering Cylinder in Chapter 4 – Hydraulic System in this manual).
6. Disassemble steering components as needed.

Assembly (Fig. 20)

1. Assemble steering components needed.
2. Install steering cylinder assembly (see Steering Cylinder in Chapter 4 – Hydraulic System in this manual).
3. Install tie rod ends to spindle and/or steering pivot. Tighten castle nuts from **20 to 25 ft-lbs (27 to 34 N-m)**. Install new cotter pins.
4. After assembly is complete, make sure that steering components do not contact hoses and/or wires through their entire range of movement.
5. Lubricate steering assembly grease fittings.
6. Install wheel and secure with lug nuts. Tighten lug nuts evenly in a crossing pattern from **75 to 80 ft-lb (102 to 108 N-m)**.
7. Lower machine to ground.

NOTE: Right and left tie rods should have the same length.
8. Check and adjust front wheel toe-in (see machine Operator's Manual).

Tie Rod End Replacement

Removal (Fig. 21)

NOTE: The outside tie rod end (at spindle) has left hand threads.

1. Loosen jam nut on tie rod end.
2. Remove cotter pin and slotted hex nut from tie rod end to be removed. Discard cotter pin.
3. Use a suitable puller (pickle fork) to separate tie rod end from spindle or steering pivot.
4. Record the number of revolutions it takes to remove the tie rod ends so new tie rod end can be installed in approximately the same location.

Installation (Fig. 21)

1. Thread the new rod end into the tie rod the same number of revolutions as the old one took to remove.
2. Install grease fitting into tie rod end.
3. Insert tie rod end shaft into spindle or steering pivot and secure with castle nut. Tighten castle nut from **20 to 25 ft-lb (27 to 34 N-m)** and install new cotter pin.
4. Grease tie rod end.

NOTE: Right and left tie rods should have the same length.

5. Check and adjust front wheel toe-in (see machine Operator's Manual).

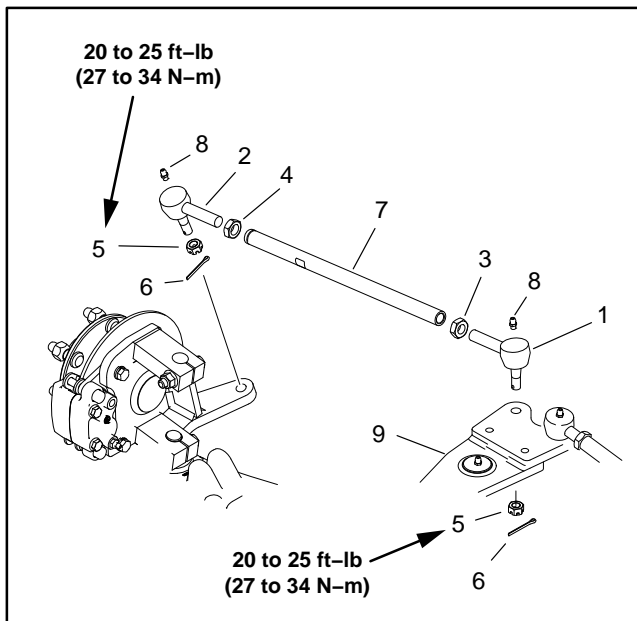


Figure 21

- | | |
|----------------------------|-----------------------|
| 1. Tie rod end (RH thread) | 6. Cotter pin (2) |
| 2. Tie rod end (LH thread) | 7. Tie rod |
| 3. Jam nut (RH thread) | 8. Grease fitting (2) |
| 4. Jam nut (LH thread) | 9. Steering pivot |
| 5. Slotted hex nut (2) | |



Ultra Sonic Boom Kit (Optional)

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Ultra Sonic
Boom (Opt.)

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.

Parts Catalog

A separate Parts Catalog is available for the Ultra Sonic Boom Kit. The Parts catalog can provide disassembly and assembly information for the Ultra Sonic Boom Kit. Refer to the parts catalog for additional information when servicing the Ultra Sonic Boom Kit.

System Configuration

The Ultra Sonic Boom Kit is an automatic boom leveling accessory for the Multi Pro 1750 that dynamically controls the flow of hydraulic fluid to the boom hydraulic lift cylinders to maintain the booms at a constant height above the ground.

Two (2) ultrasonic sensors are mounted on the right and left booms between the two outermost spray nozzles. The sensors emit a signal that is reflected off of the ground, received again by the sensor and processed by

a separate Toro Electronic Controller (TEC) supplied with the kit. The controller regulates hydraulic proportional valves which control fluid flow to the boom hydraulic lift cylinders.

There is a 3-position switch on the Operator control console that allows the operator to select from three different operating modes: automatic system off, automatic system on and a third position to allow the operator to operate the booms in manual mode.

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).

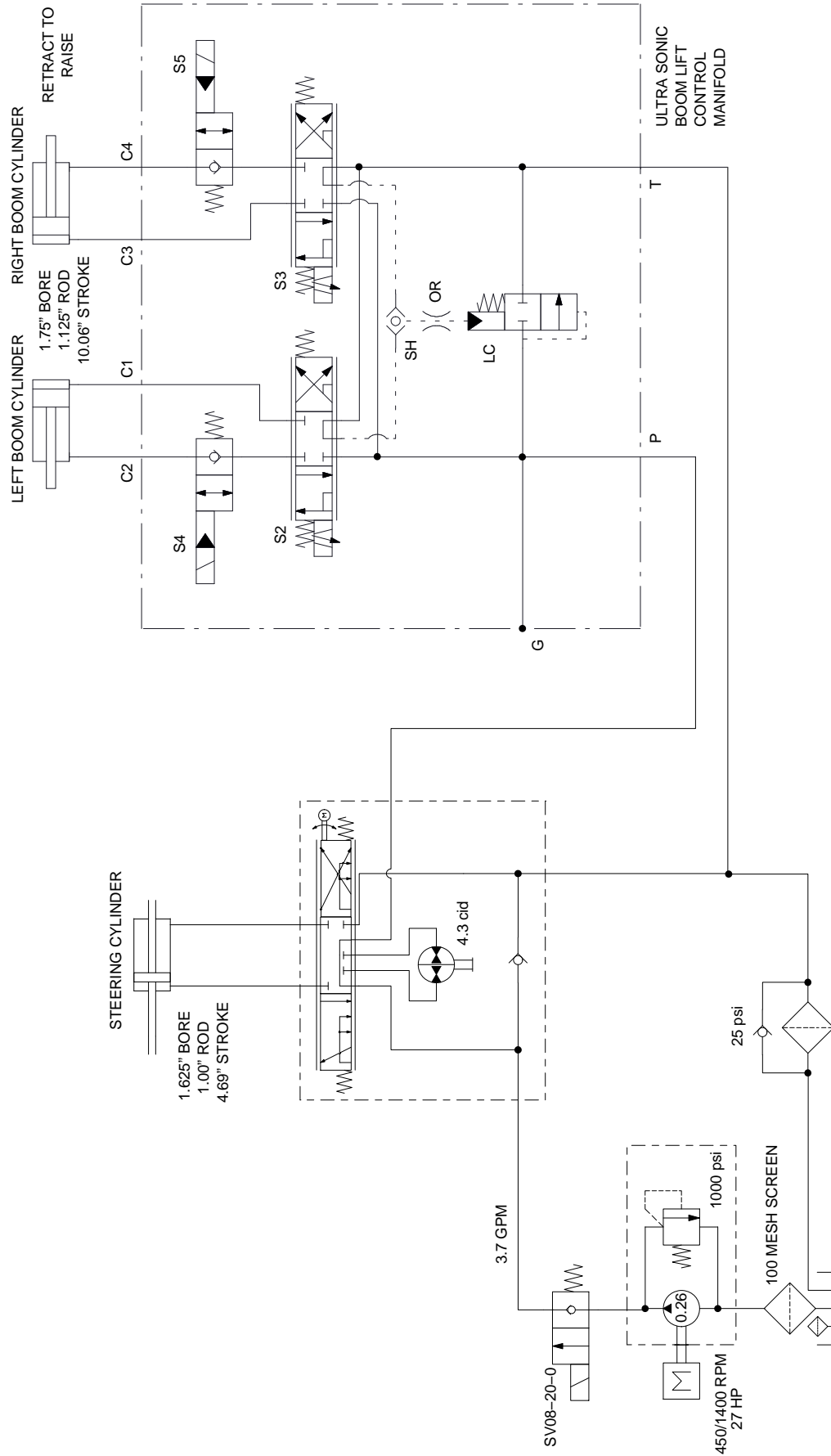
4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

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.

Hydraulic Schematic

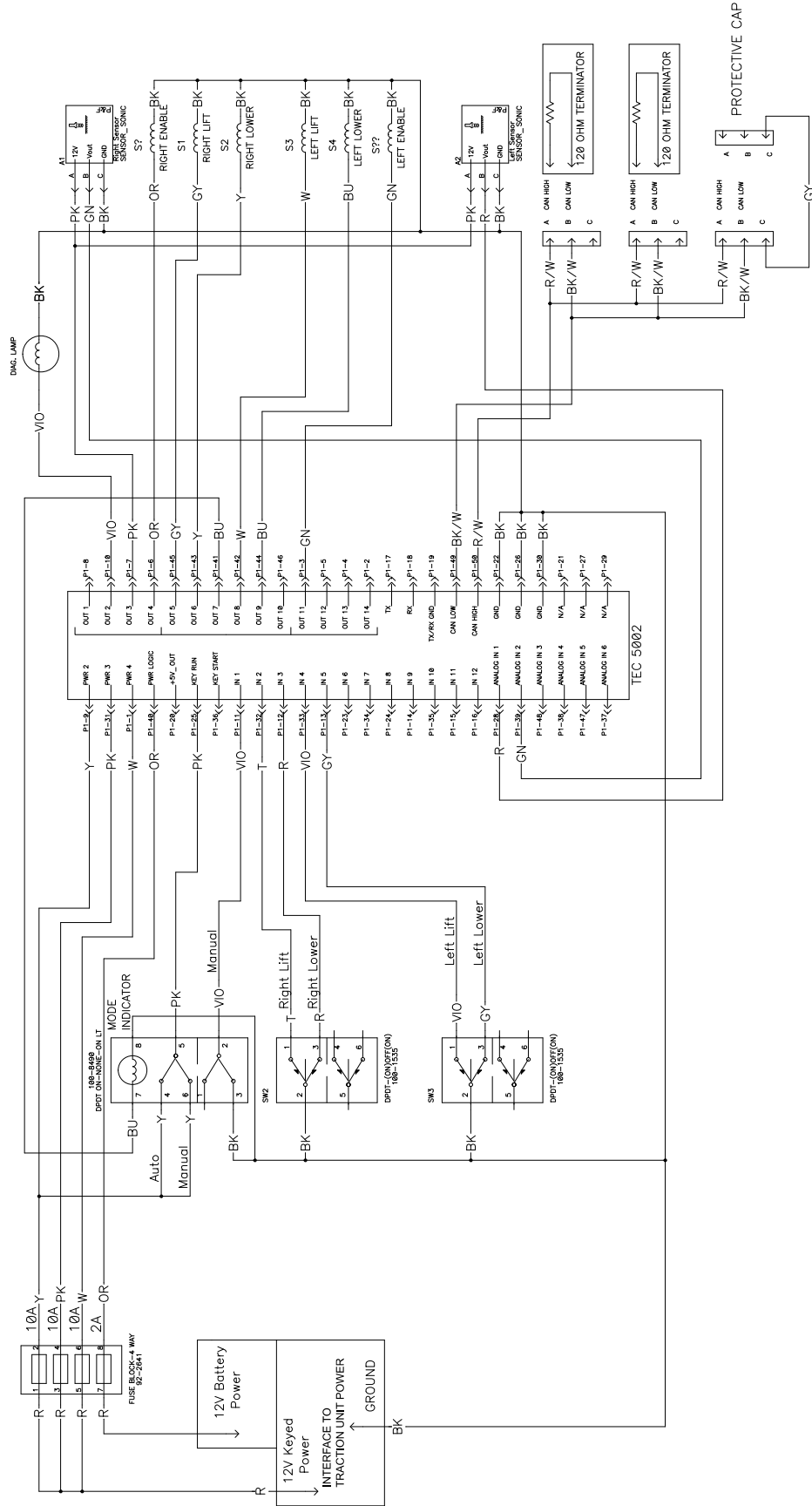


1. FLOWS SHOWN ARE CALCULATED AT HIGH ENGINE IDLE

Ultra Sonic Boom Kit (Optional)
Hydraulic Schematic

Electrical Schematic

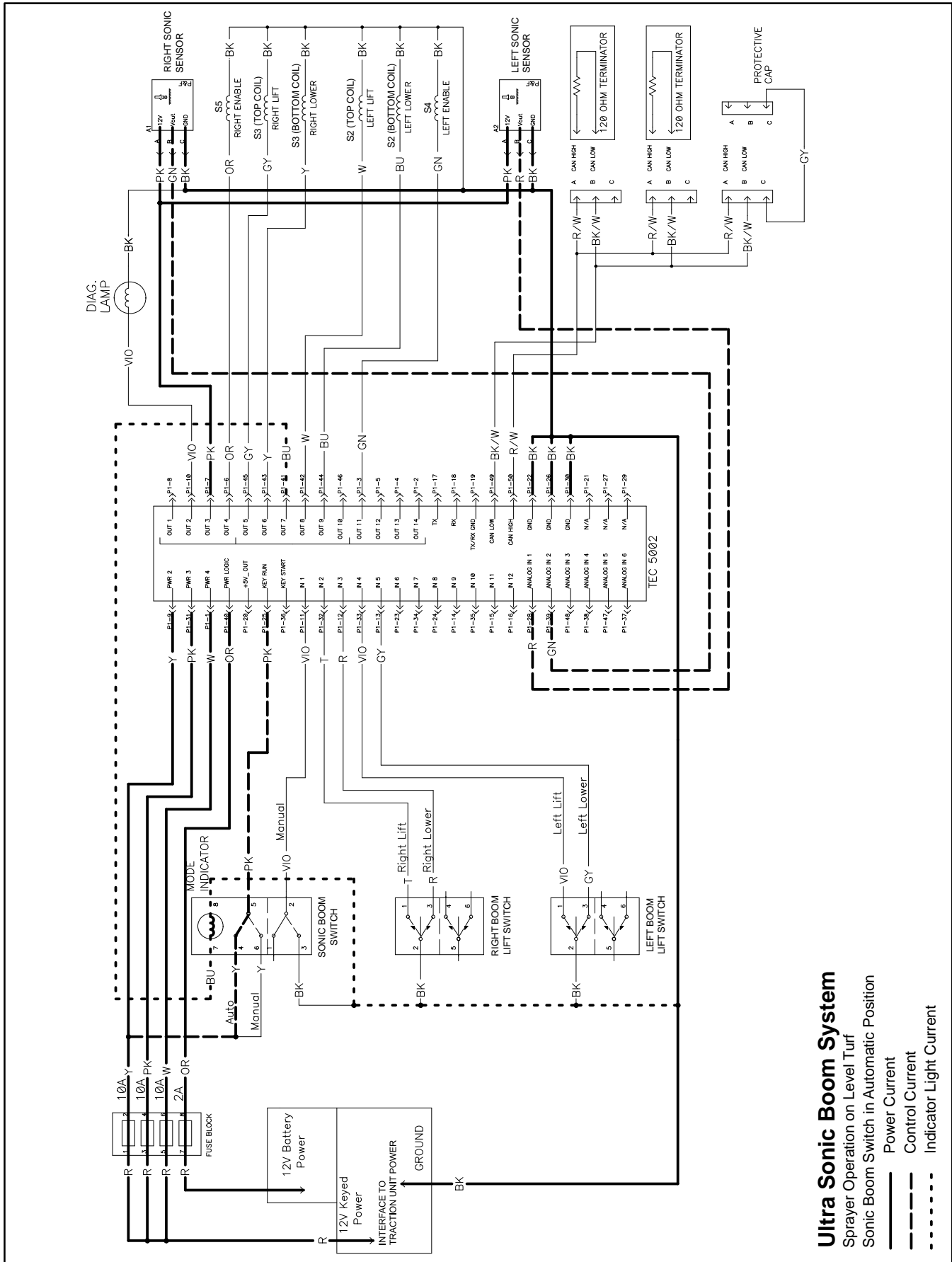
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Ultra Sonic Boom Kit (Optional)
Electrical Schematic

Ultra Sonic
Boom (Opt.)

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. 1). The boom sections will remain at the correct, level position.

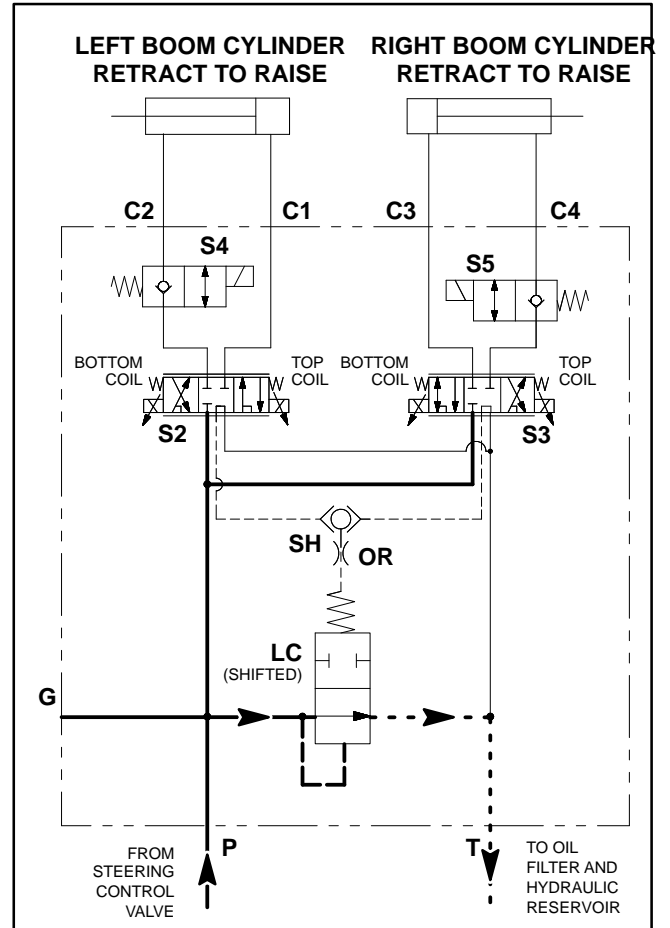


Figure 1

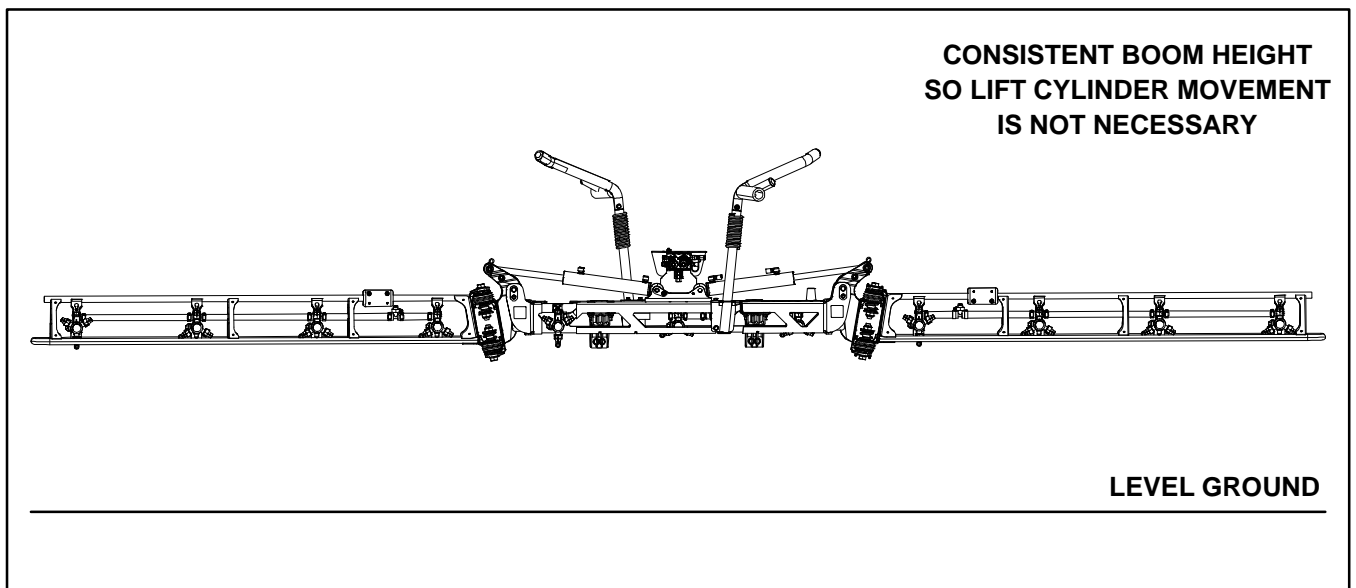
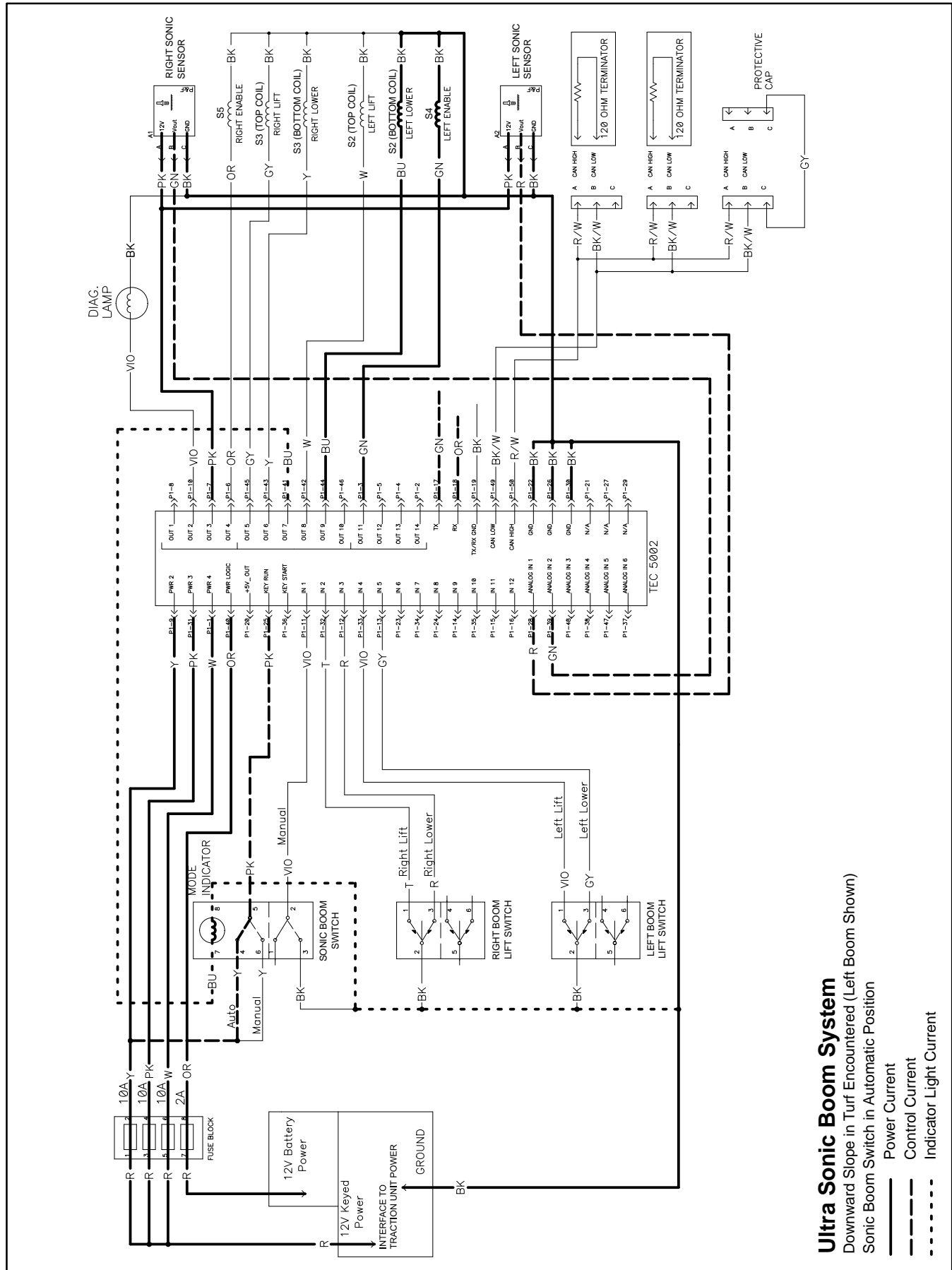


Figure 2



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

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 time-frame. 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 time-frame, 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.

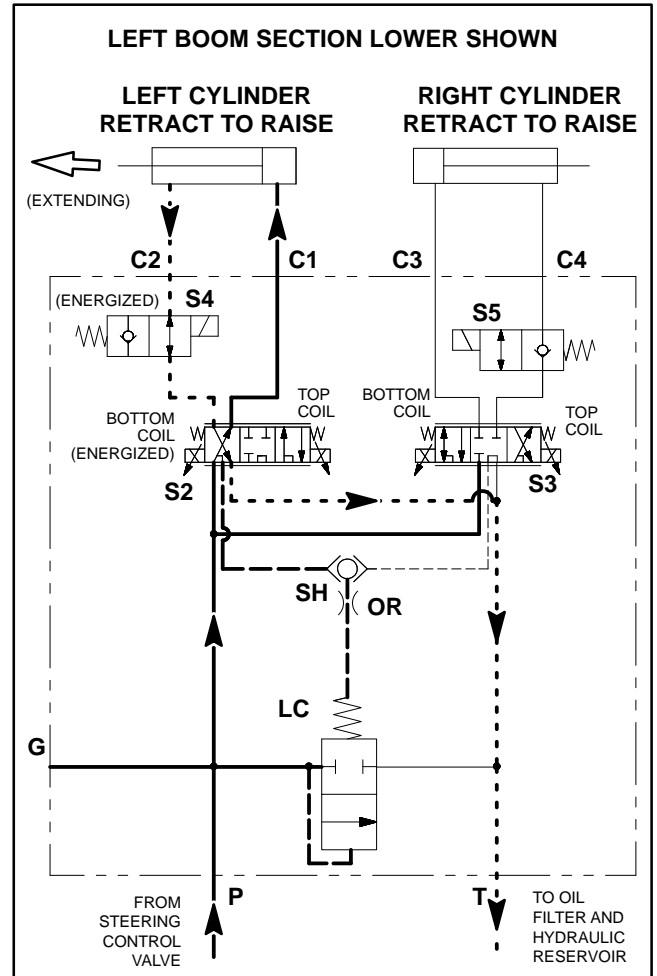


Figure 3

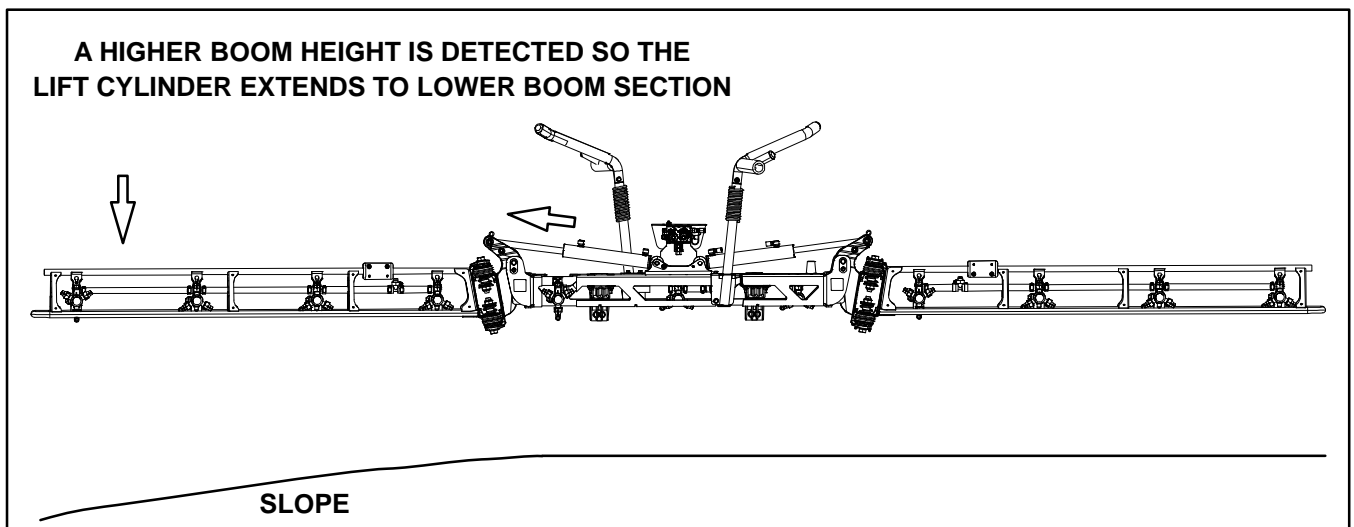
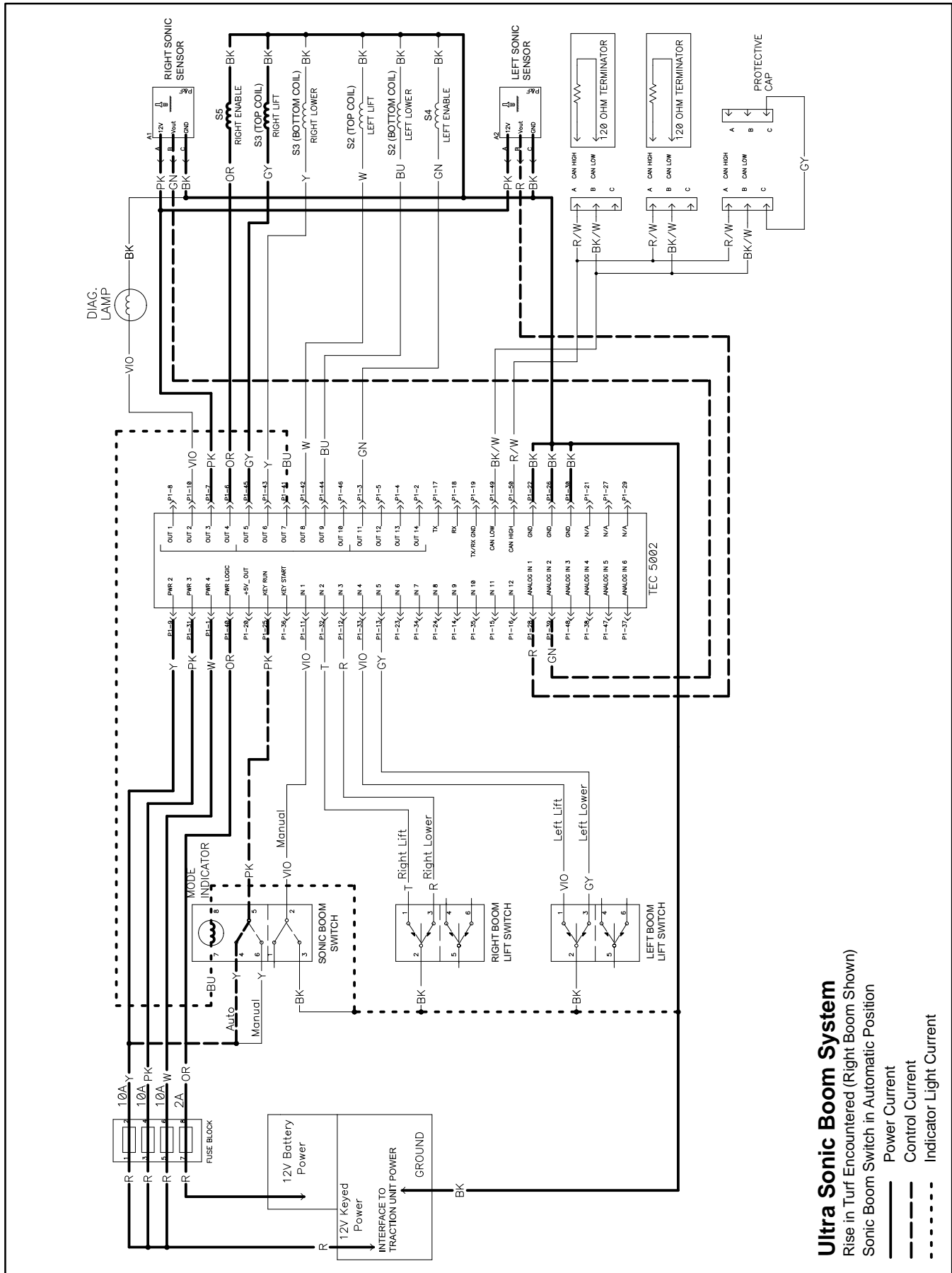


Figure 4



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 time-frame. 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 time-frame 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.

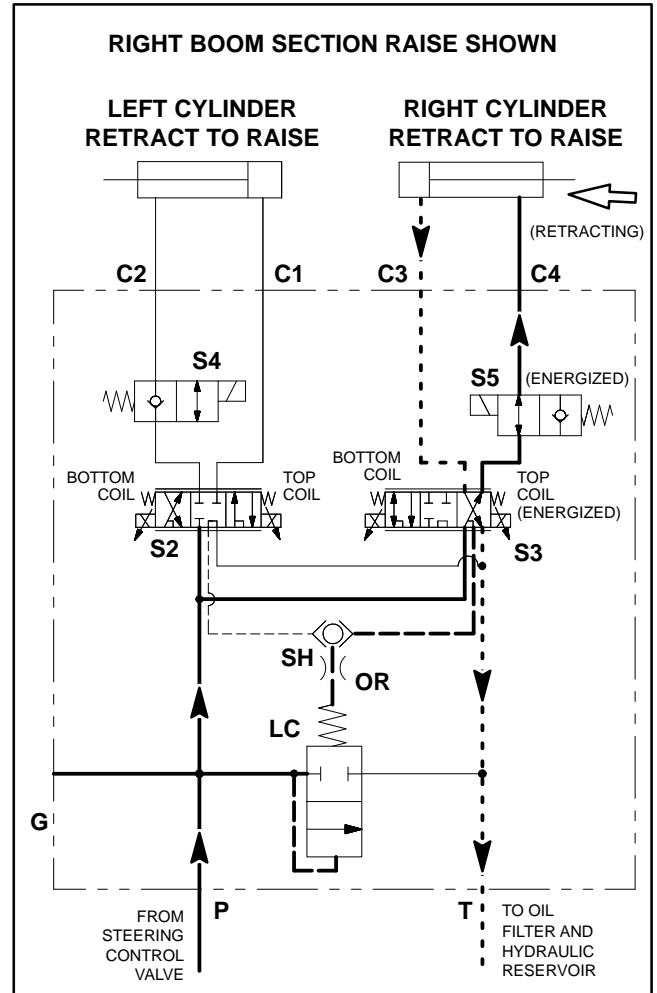


Figure 5

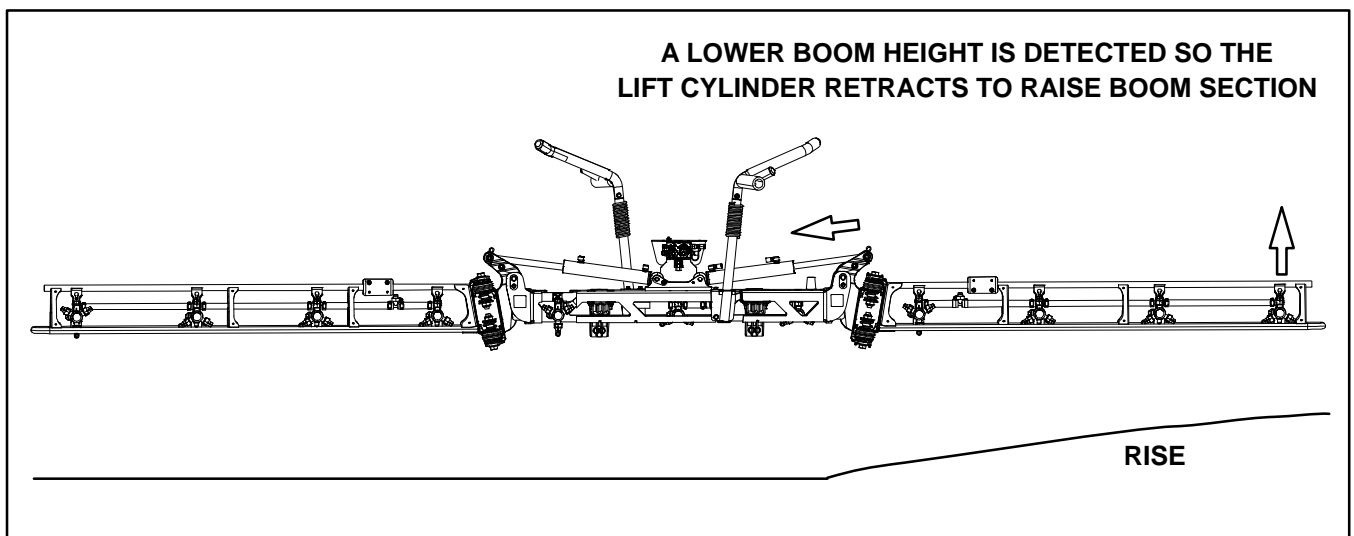
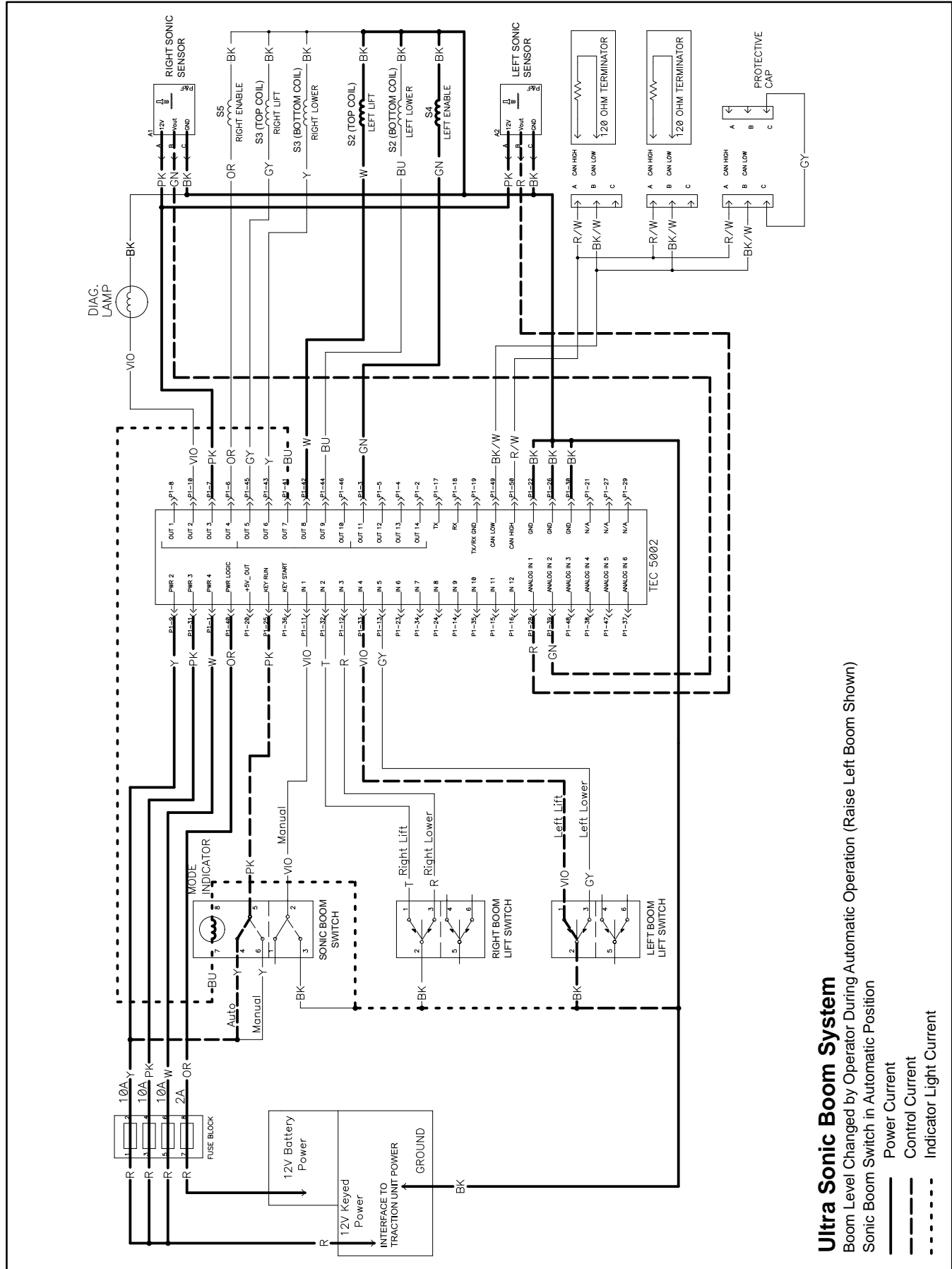


Figure 6

Ultra Sonic Boom (Opt.)



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.

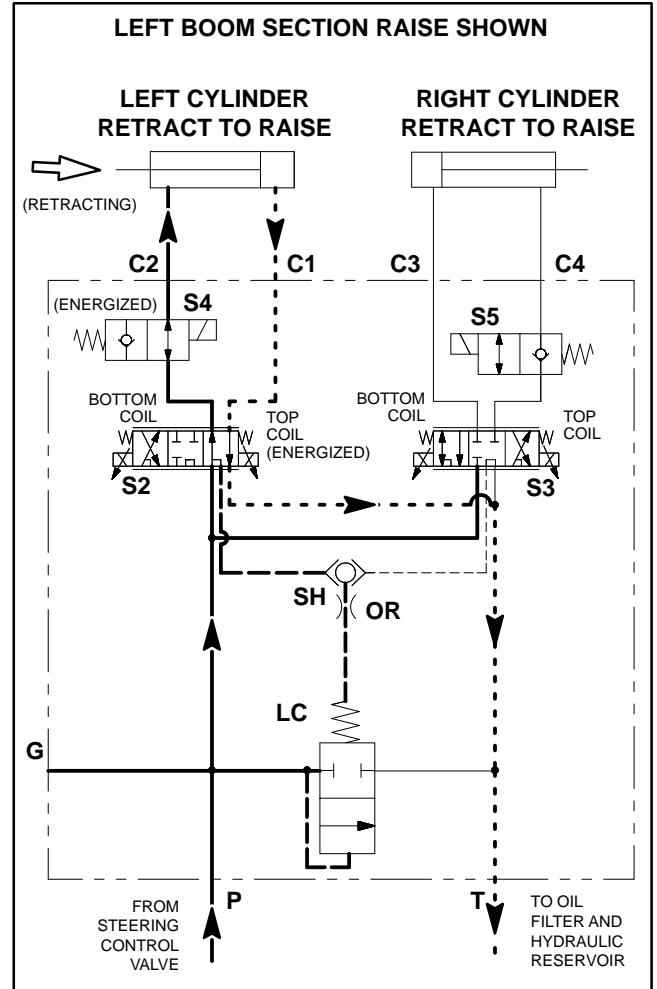
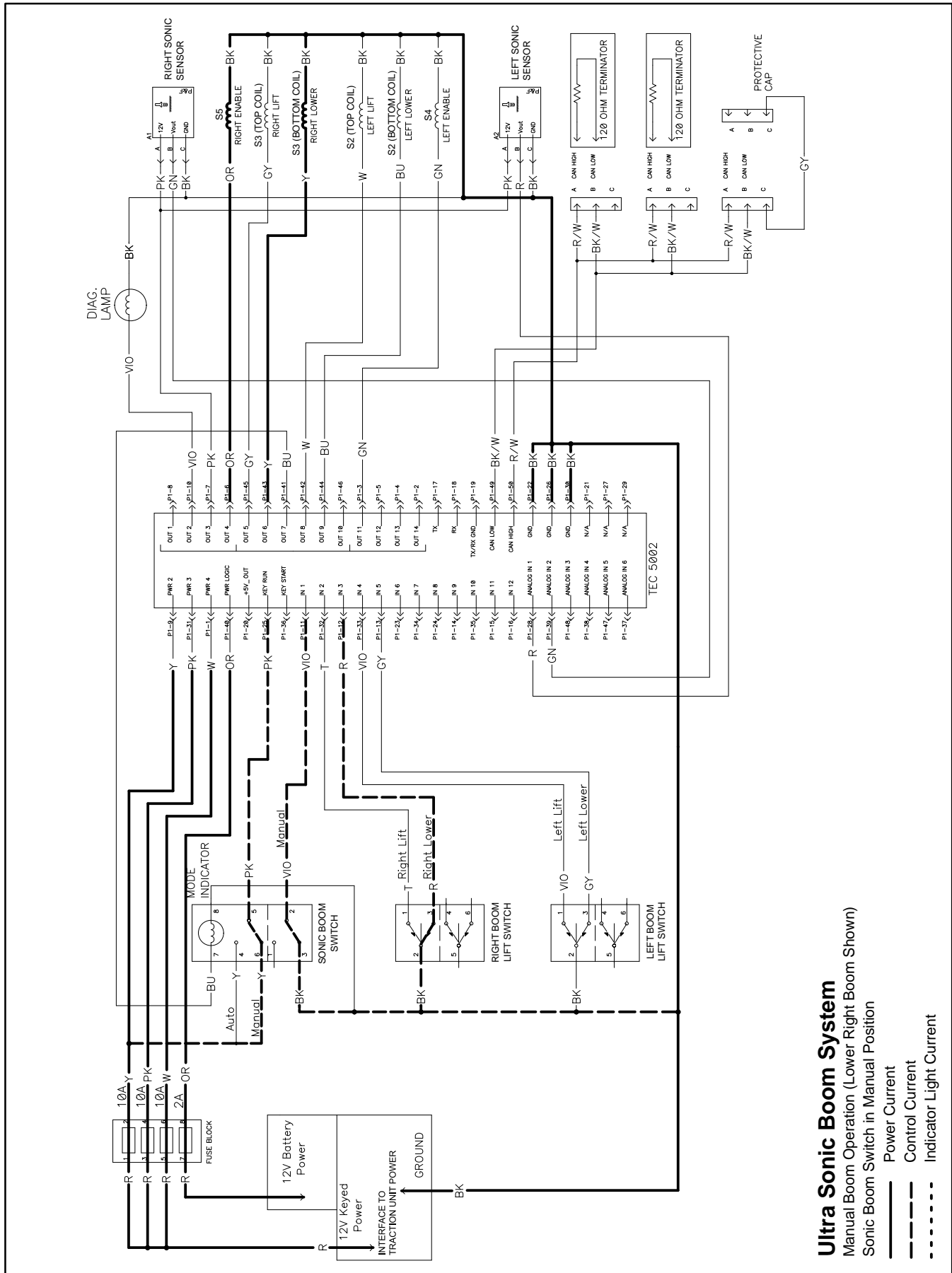


Figure 7

Ultra Sonic
Boom (Opt.)



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 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.

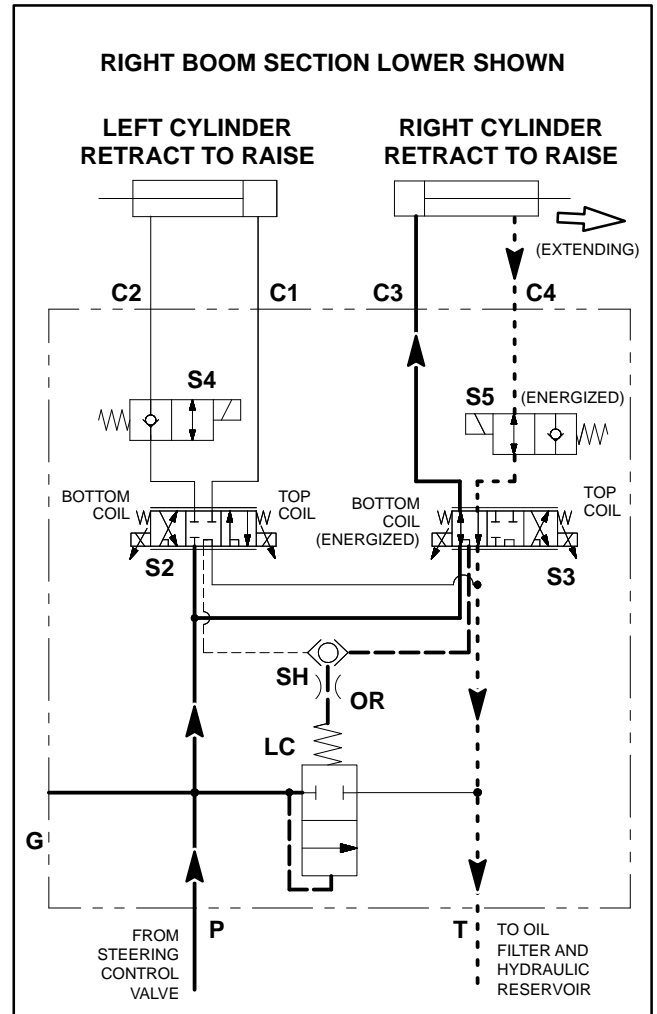


Figure 8

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.

Ultra Sonic Boom Light

The ultra sonic boom light is included in the ultra sonic boom switch on the dash panel (Fig. 9). This light should be illuminated whenever the vehicle ignition switch is ON and the sonic boom switch is in the automatic position.

The ultra 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 ultra 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 ultra 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 and Troubleshooting Chart in this chapter.

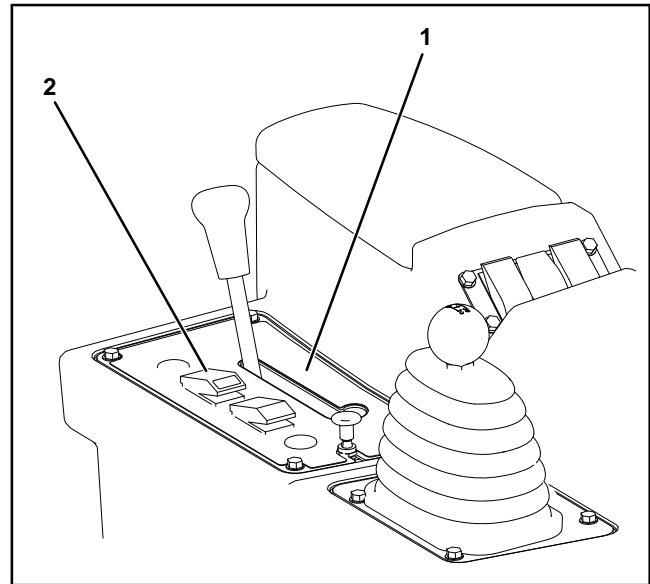


Figure 9

1. Lower Operator console 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 (51 cm). 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 upper Operator's console (Fig. 10).

When the ignition switch is moved to the ON position and the Ultra Sonic Boom System electrical system is ON and 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 Toro Electronic Controller (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 by your Toro Distributor.

If the diagnostic lamp does not illuminate when the ignition switch is turned to the ON position, possible causes are:

- The diagnostic lamp (or circuit wiring) is faulty.
- TEC fuse(s) are faulty.
- The TEC is faulty.

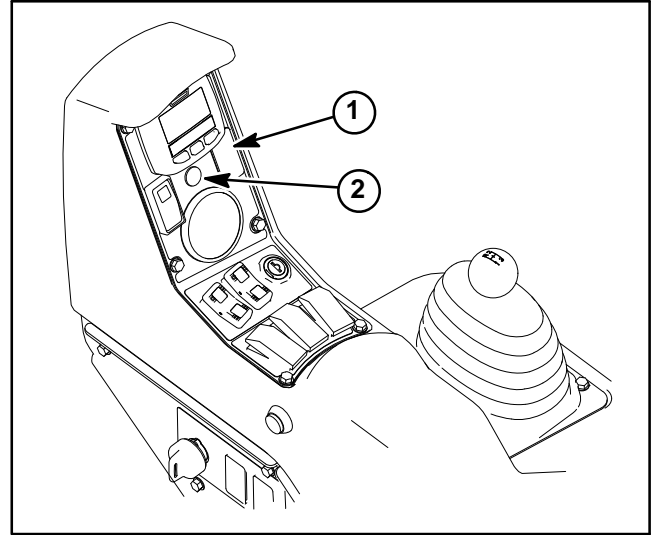


Figure 10

1. Upper console
2. Diagnostic lamp

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 and the diagnostic light in this chapter.

Problem	Possible Cause
Light in sonic boom switch is not illuminated.	<p>Sonic boom switch is in the MANUAL position.</p> <p>Fuse D (2 amp) in sonic boom fuse block is faulty (all sonic boom functions are affected).</p> <p>Fuse B (10 amp) in sonic boom fuse block is faulty.</p> <p>Electrical power from vehicle is not available (all sonic boom functions are affected).</p> <p>Sonic boom switch or circuit wiring is faulty.</p>
One of the boom lift cylinders will not extend or retract.	<p>Boom lift switch or circuit wiring for affected lift cylinder is faulty.</p> <p>Boom lift control manifold solenoid coil or circuit wiring for affected lift cylinder is faulty.</p> <p>A hydraulic problem exists with the lift cylinder, boom lift control manifold or other hydraulic component.</p>
Neither of the boom lift cylinders will extend or retract.	<p>Fuse(s) in sonic boom fuse block is faulty.</p> <p>Electrical power from vehicle is not available (all sonic boom functions are affected).</p> <p>A hydraulic problem exists with the lift cylinders, boom lift control manifold or another hydraulic component.</p> <p>The Toro Electronic Controller (TEC) or circuit wiring is faulty.</p>
The LED's on one of the sonic boom sensors are not illuminated.	<p>Sonic boom sensor or circuit wiring is faulty.</p>
The LED's on both of the sonic boom sensors are not illuminated.	<p>Sonic boom switch is in the MANUAL position.</p> <p>Fuse A (10 amp) in sonic boom fuse block is faulty.</p> <p>Sonic boom switch or circuit wiring is faulty.</p>

Problem	Possible Cause
<p>One of the booms does not automatically follow ground irregularities. Boom can be controlled with boom lift switch.</p>	<p>On affected boom, the sonic boom sensor cover is on sensor.</p> <p>On affected boom, calibration of the sonic boom sensors is incorrect.</p> <p>The sonic boom sensor is incorrectly installed.</p> <p>Sonic boom sensor or circuit wiring for affected boom is faulty.</p> <p>The Toro Electronic Controller (TEC) or circuit wiring is faulty.</p>
<p>Neither boom automatically follows ground irregularities. Booms can be controlled with boom lift switches.</p>	<p>Sonic boom switch is not in the AUTOMATIC position.</p> <p>Sonic boom sensor covers are on both sensors.</p> <p>Calibration of the sonic boom sensors is incorrect.</p> <p>Both sonic boom sensors or circuit wiring are faulty.</p> <p>The Toro Electronic Controller (TEC) or circuit wiring is faulty.</p>

Service and Repairs

Ultra Sonic Boom Fuses

Fuses for the Ultra Sonic Boom system are included in the bottom fuse block under the operator seat (Fig. 11).

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.

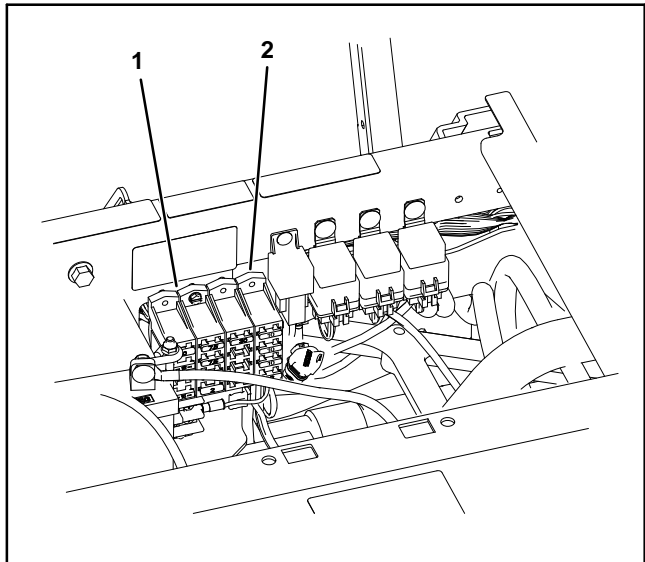


Figure 11

1. Fuse block

2. Sonic boom fuses

Ultra Sonic Boom Switch

The ultra 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 lower Operator's control console.

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. The light in the switch should not be illuminated when the switch is in the manual position.

Testing

1. Park vehicle on a level surface, stop engine, engage parking brake and remove key from ignition switch.
2. Remove the lower control console panel and disconnect wire harness electrical connector from the sonic boom switch.
3. The switch terminals are marked as shown (Fig. 13). The circuit logic of the sonic boom switch is shown in the chart to the right. With the use of a multimeter (ohms setting), test the switch functions for continuity between the various terminals for each switch position. Replace switch if testing identifies a faulty switch.
4. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (-). The light should illuminate.
5. If the sonic boom switch tests correctly and a circuit problem still exists, check wire harness (see Chapter 10 – Electrical Drawings in this manual).
6. After testing is complete, connect wire harness connector to the sonic boom switch and install the lower console panel.

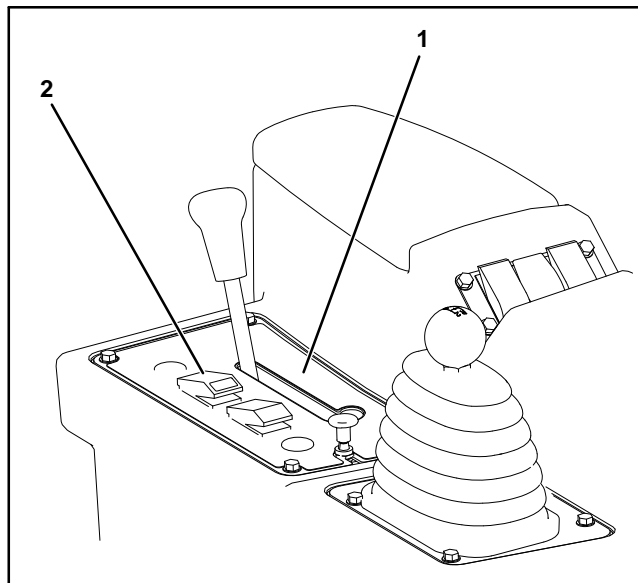


Figure 12

1. Lower Operator console 2. Sonic boom switch

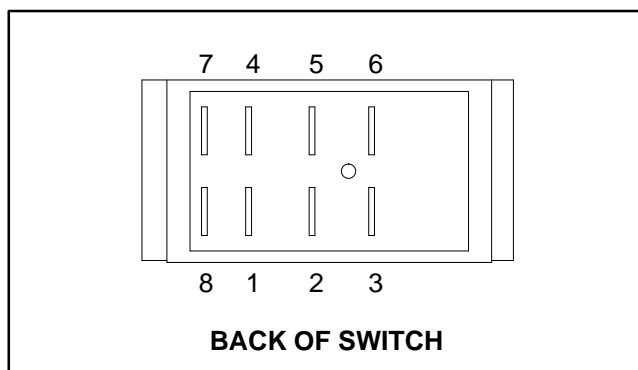


Figure 13

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
MANUAL	2 + 3 5 + 6	2 + 1 5 + 4
AUTOMATIC	2 + 1 5 + 4	2 + 3 5 + 6

Ultra Sonic Boom (Opt.)

Diagnostic Lamp

When the ignition switch is moved to the ON position and the Ultra Sonic Boom System electrical system is ON and 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. The diagnostic lamp is located on the upper Operator's control console.

If the ultra sonic boom system Toro Electronic Controller (TEC) detects an electrical system malfunction (fault) during operation, 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 by your Toro Distributor.

To test the diagnostic lamp:

1. Park vehicle on a level surface, stop engine, engage parking brake and remove key from ignition switch.
2. Remove the upper console panel and disconnect wire harness electrical connector from the diagnostic lamp.
3. Apply 12 VDC to terminal 8 (+) and ground terminal 7 (-). The light should illuminate
4. If the diagnostic lamp tests correctly and a circuit problem still exists, check wire harness (see Chapter 10 – Electrical Drawings in this manual).
5. After testing is complete, connect wire harness connector to the diagnostic lamp and install the upper console panel.

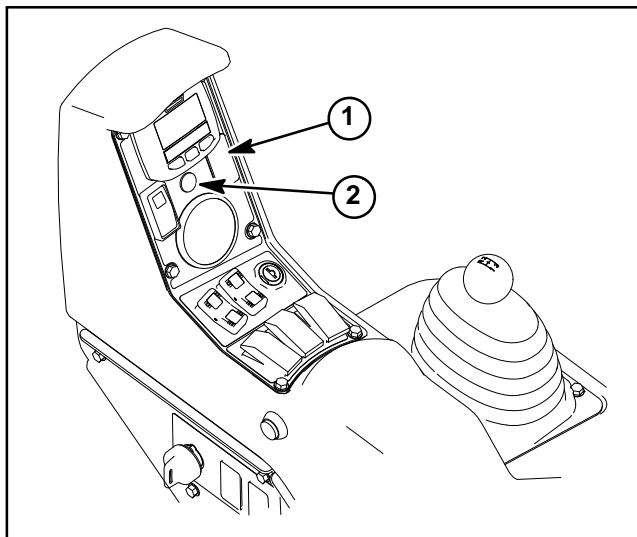


Figure 14

1. Upper console 2. Diagnostic lamp

Sonic Sensors

Two (2) identical sonic sensors are used in the Ultra Sonic Boom System. The sensors are mounted to the spray booms (Figs. 15, 16 and 17). During sprayer operation with the sonic boom switch in the automatic position, the sonic sensors 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. 18).

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.

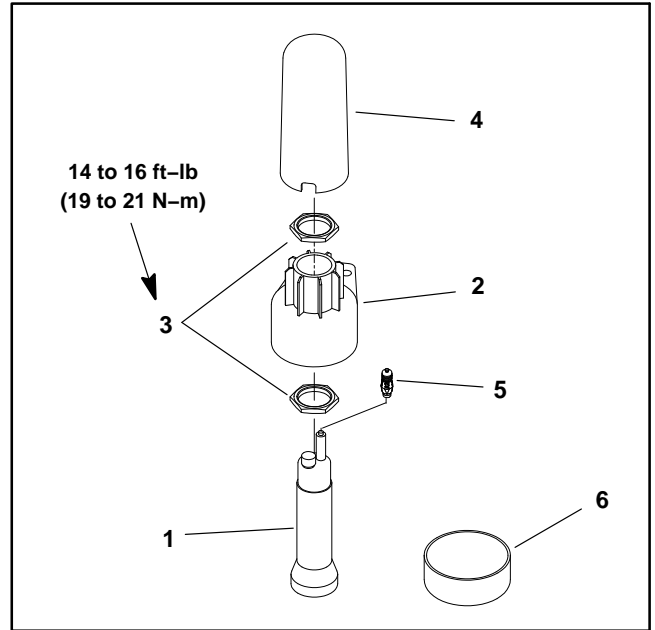


Figure 15

- | | |
|------------------|---------------------|
| 1. Sonic sensor | 4. Cover |
| 2. Lower housing | 5. Programming plug |
| 3. Nut (2 used) | 6. Cap |

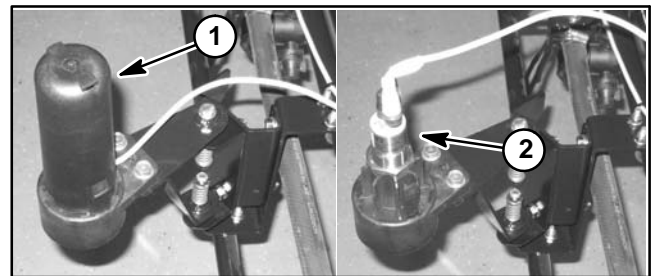


Figure 16

- | | |
|----------------------|-------------------------|
| 1. Sensor with cover | 2. Sensor without cover |
|----------------------|-------------------------|

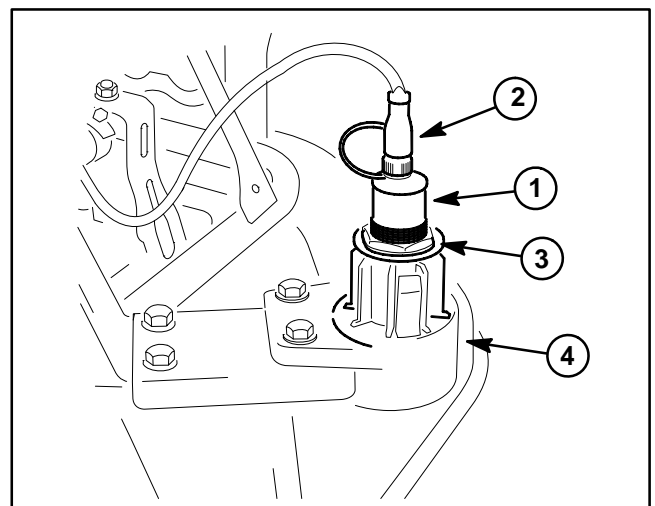


Figure 17

- | | |
|----------------------|------------------|
| 1. Sonic sensor | 3. Nut (2 used) |
| 2. Harness connector | 4. Lower housing |

Ultra Sonic Boom (Opt.)

Sonic Sensor LED Window

The sonic sensor includes a LED window that identifies sensor status during Ultra Sonic Boom system operation (Fig. 19). 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 (see Chapter 10 – Electrical Drawings in this manual) or with the sensor itself.

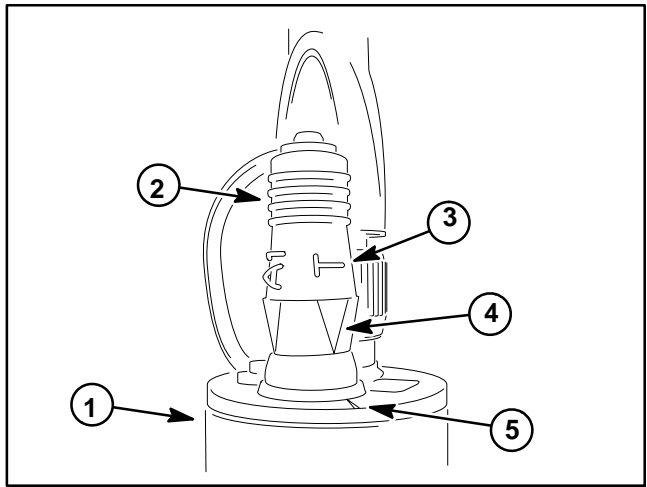


Figure 18

- 1. Sonic sensor
- 2. Programming plug
- 3. Letter T
- 4. Plug arrow
- 5. Sensor notch

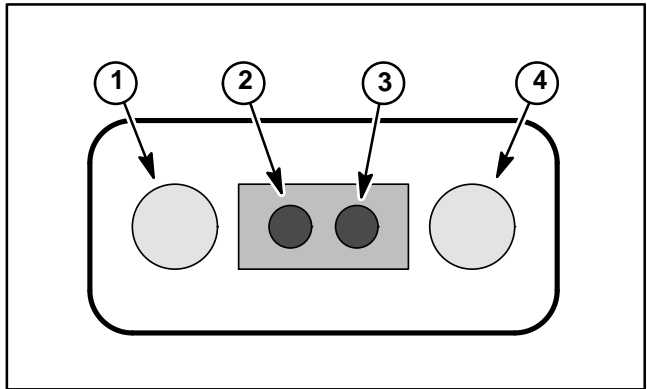


Figure 19

- 1. Yellow LED
- 2. Green LED
- 3. Red LED
- 4. Yellow LED

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Toro Electronic Controller (TEC)

The Ultra Sonic Boom System includes a Toro Electronic Controller (TEC) to control electrical operation of the ultra sonic boom system. The TEC is attached to a mounting plate below the boom lift control manifold (Fig. 20).

Logic power is provided to the TEC when the vehicle ignition switch is in the RUN position. A 2 amp fuse provides circuit protection for this logic power to the TEC. The fuse is located in the fuse block under the Operator's seat.

The TEC monitors the states of the following components as inputs: the sonic boom switch, the two (2) boom lift switches and the two (2) sonic boom sensors.

The TEC controls electrical output to the sonic boom switch light, the diagnostic lamp, the six (6) hydraulic solenoid coils that electrically control the operation of the boom lift cylinders and the two (2) sonic sensors. Circuit protection for the TEC outputs is provided by three (3) 10 amp fuses. The fuses are located in the fuse block under the Operator's seat.

The connection terminal functions for the TEC are shown (Fig. 21). The Electrical power for controller outputs is provided through three (3) connector terminals (PWR 2, PWR 3 and PWR 4) each protected with a 10 amp fuse. A fifty (50) pin wire harness connector attaches to the controller. The layout of the wire harness connector that plugs into the TEC is shown (Fig. 22).

IMPORTANT: When testing for wire harness continuity at the connector for the TEC, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair will be necessary for proper machine operation.

The Ultra Sonic Boom Kit electrical schematic and wire harness drawings in Chapter 10 – Electrical Drawings can be used to identify possible circuit problems between the controller and the input/output devices (e.g. switches and solenoid coils).

Because of the solid state circuitry built into the TEC, there is no method to test the controller directly. The controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

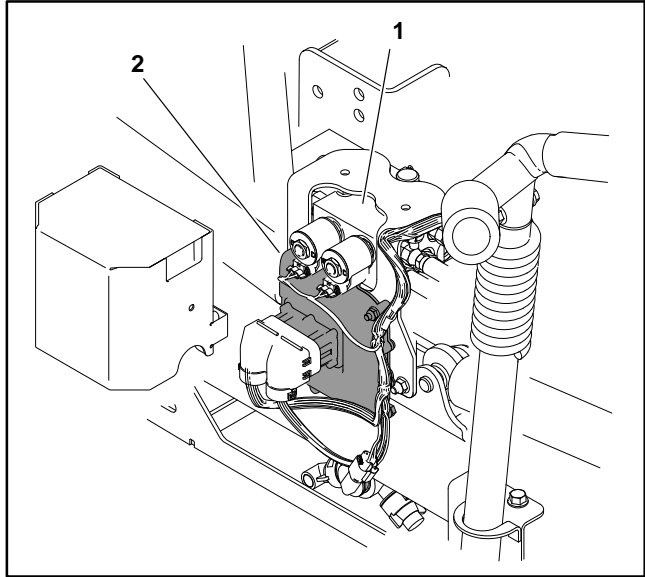


Figure 20

1. Boom lift control manifold
2. Toro Electronic Controller (TEC)

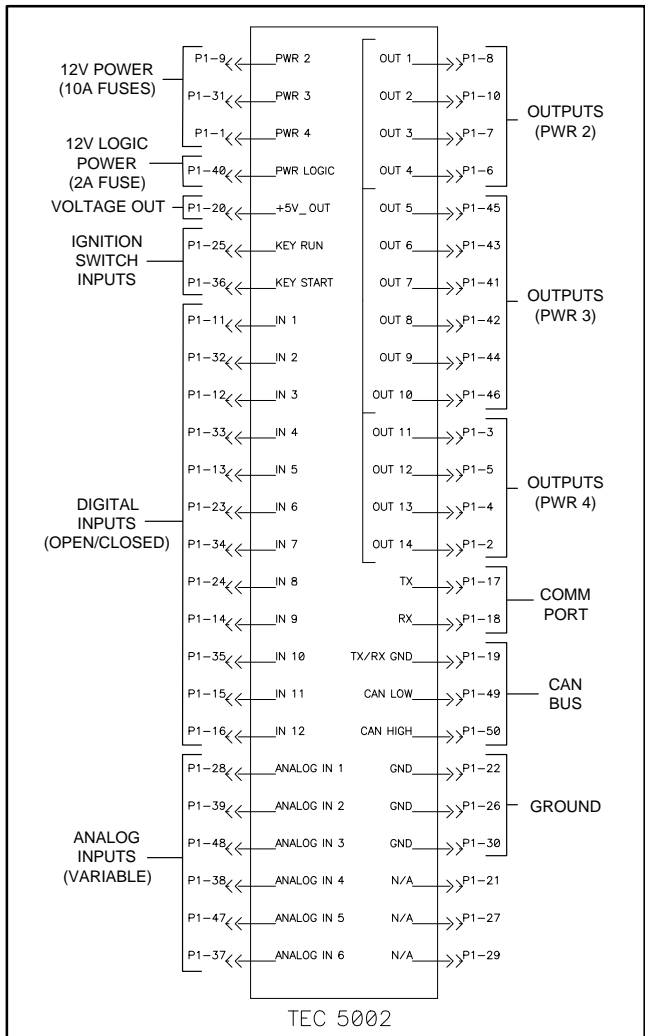


Figure 21

NOTE: If TEC for the Ultra Sonic Boom Kit is replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

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.

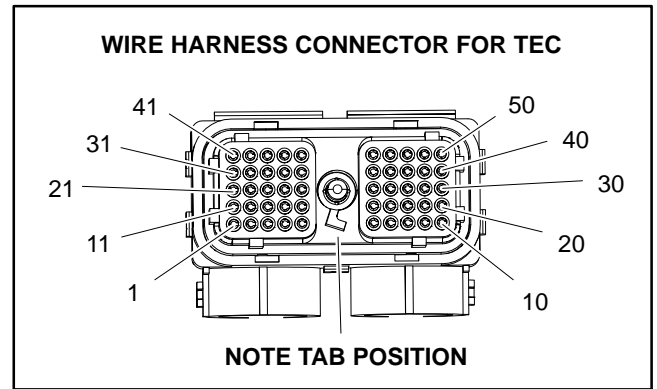


Figure 22

CAN-bus Termination Resistors

IMPORTANT: The Ultra Sonic Boom Leveling Kit is not designed to communicate with the machine In-foCenter. Even though the communication network is not being used, the termination resistors are required for proper electrical system operation.

The Toro Electronic Controller (TEC) used for the ultra sonic boom kit has the ability to communicate with other components in the machine via a CAN-bus communication system. Two (2) specially designed, twisted cables form the bus for the communication network. When used, these wires provide the data pathways between machine components. At the ends of the twisted pair of bus cables are two (2) 120 ohm termination resistors. Even though the network is not being used for the ultra sonic boom kit, the termination resistors are required for proper electrical system operation.

The CAN-bus termination resistors plug into the ultra sonic boom kit wire harness. One of the termination resistors is under the operator's seat near the control console and the second resistor is located near the ultra sonic boom kit TEC at the rear of the machine. The wire harness connectors have a blue insert to identify the proper location for the termination resistors.

NOTE: Refer to the Ultra Sonic Boom Kit electrical schematic and wire harness drawings in Chapter 10 – Electrical Drawings for additional information on termination resistor location and wire connections.

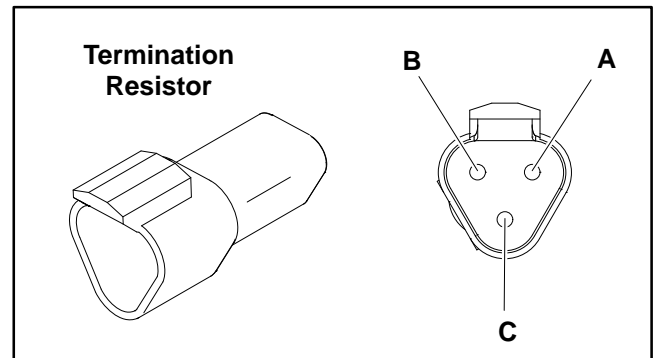


Figure 23

Termination Resistor Test

The termination resistors (Fig. 23) can be tested using a digital multimeter (ohms setting). There should be **120 ohms** resistance between terminals A and B of the termination resistors. Terminal C is not used on Multi Pro 1750 machines. Replace resistor if testing determines that it is faulty.

If the resistor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 – Electrical Drawings in this manual).

Boom Lift Control Manifold

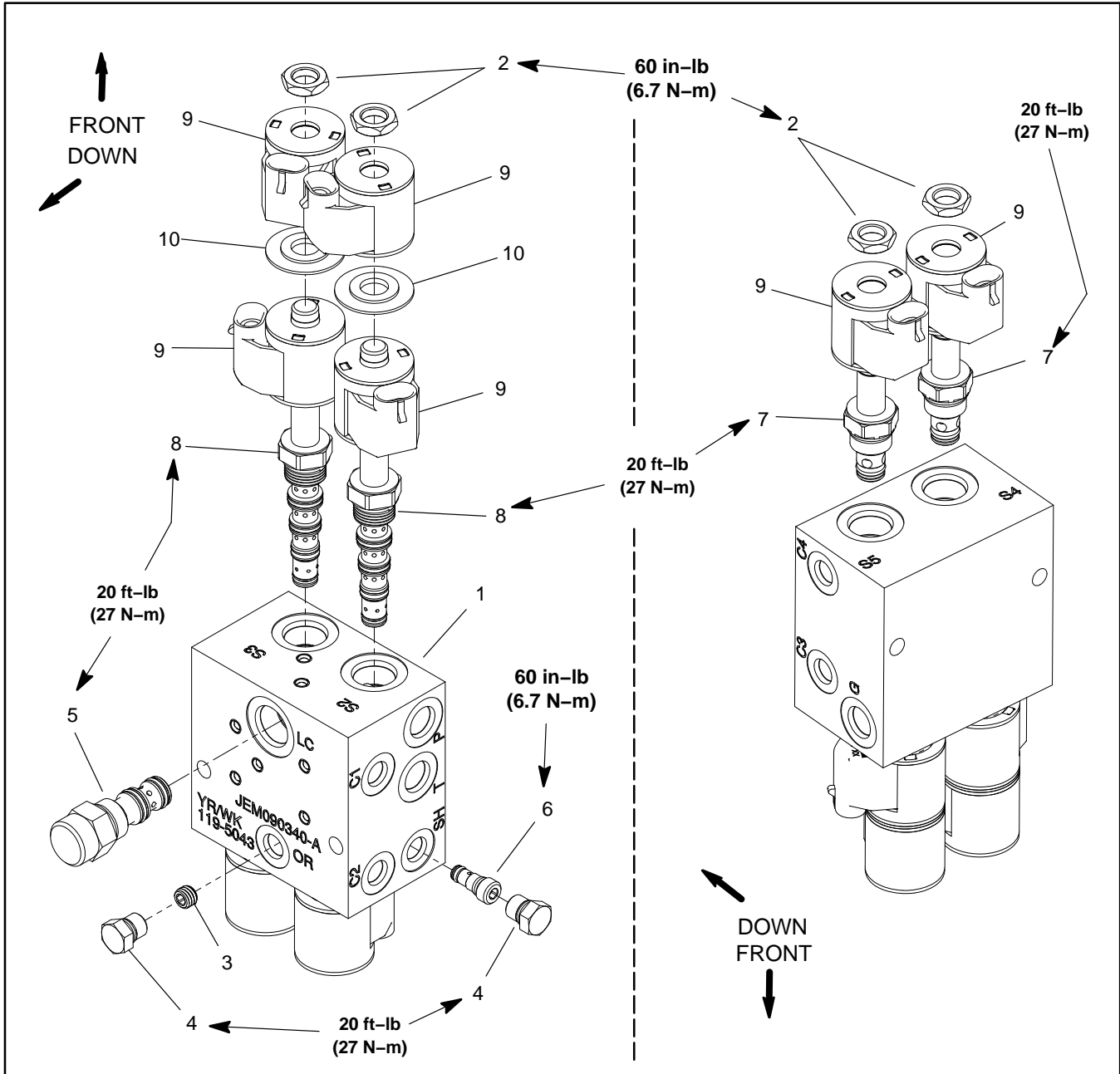


Figure 24

- | | | |
|--------------------------|-----------------------|-----------------------|
| 1. Lift control manifold | 5. Logic element (LC) | 8. Solenoid valve (2) |
| 2. Coil nut (4) | 6. Load shuttle (SH) | 9. Solenoid coil (6) |
| 3. Orifice (0.030) | 7. Solenoid valve (2) | 10. Coil spacer (2) |
| 4. Zero leak plug (2) | | |

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 25 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 (Fig. 24)

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 Cartridge Valve Service in Chapter 4 – Hydraulic System in this manual. Refer to Figure 24 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).

For solenoid valve coil testing procedures, see Hydraulic Solenoid Valve Coils in Chapter 5 – Electrical System in this manual. Refer to Figure 24 for solenoid valve coil installation torque.

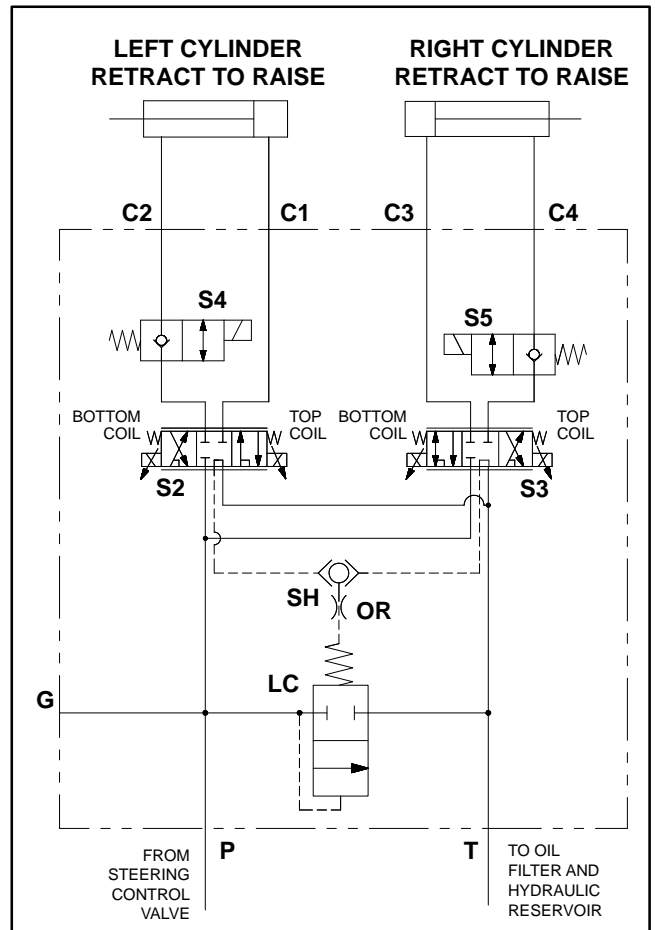


Figure 25

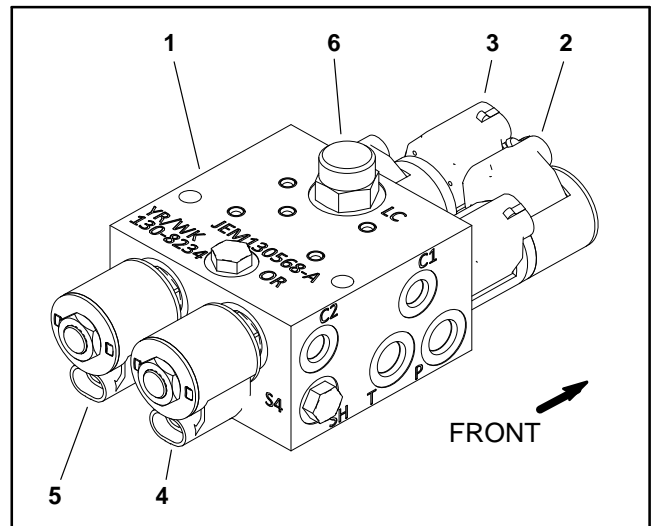


Figure 26

- | | |
|-----------------------|-----------------------|
| 1. Boom lift manifold | 4. Solenoid S4 |
| 2. Solenoid S2 | 5. Solenoid S5 |
| 3. Solenoid S3 | 6. Logic cartridge LC |

Ultra Sonic Boom (Opt.)

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Electrical Drawing Designations

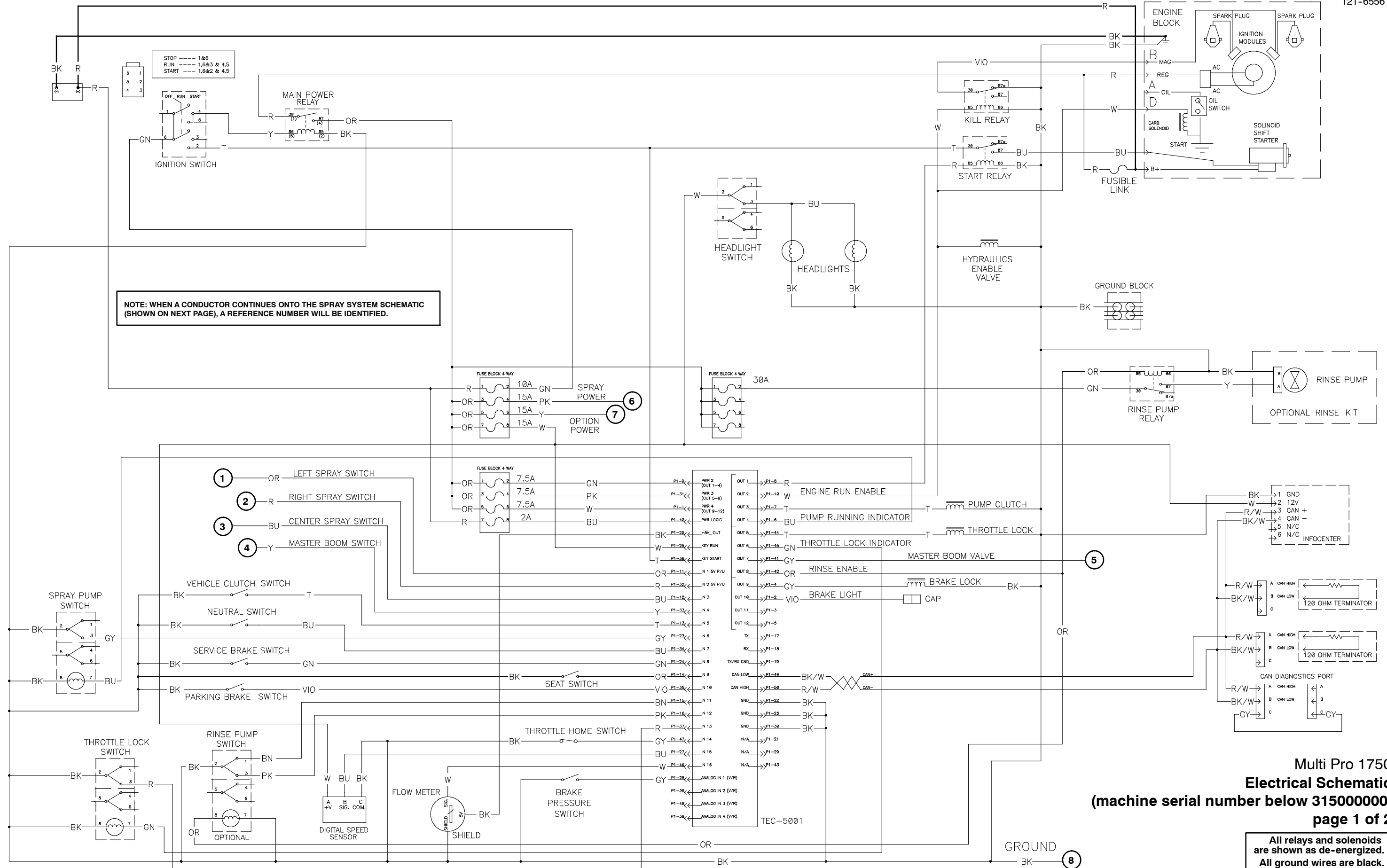
The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

<u>ABBREVIATION</u>	<u>COLOR</u>
BK	BLACK
BR or BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
VIO	VIOLET
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on Multi Pro 1750 machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g. R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

NOTE: The electrical harness drawings in this chapter identify both the wire color and the wire gauge. For example, 16 BK on a harness diagram identifies a 16 gauge wire that has a black insulator.

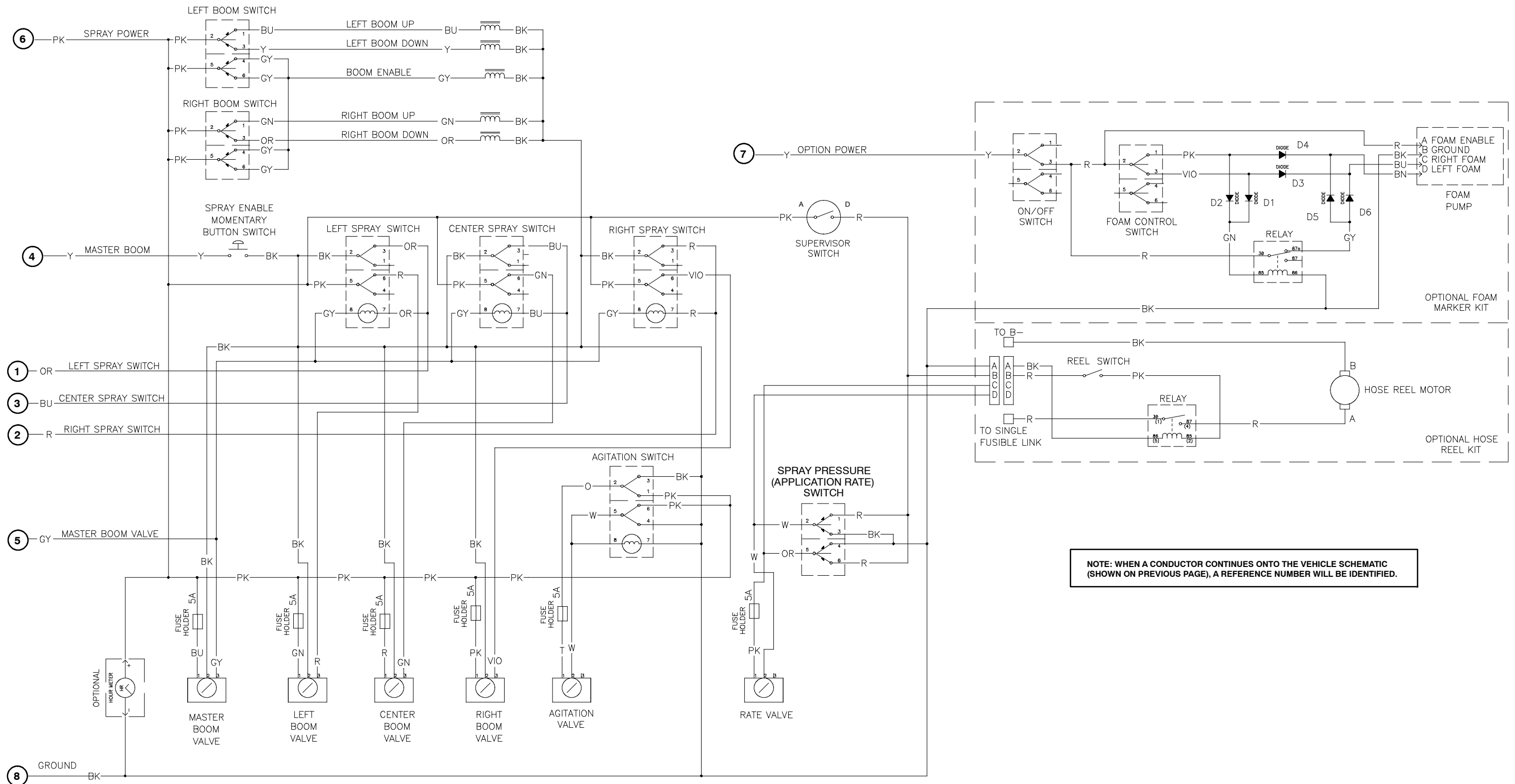
NOTE: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g. SP01 is splice number 1).



NOTE: WHEN A CONDUCTOR CONTINUES ONTO THE SPRAY SYSTEM SCHEMATIC (SHOWN ON NEXT PAGE), A REFERENCE NUMBER WILL BE IDENTIFIED.

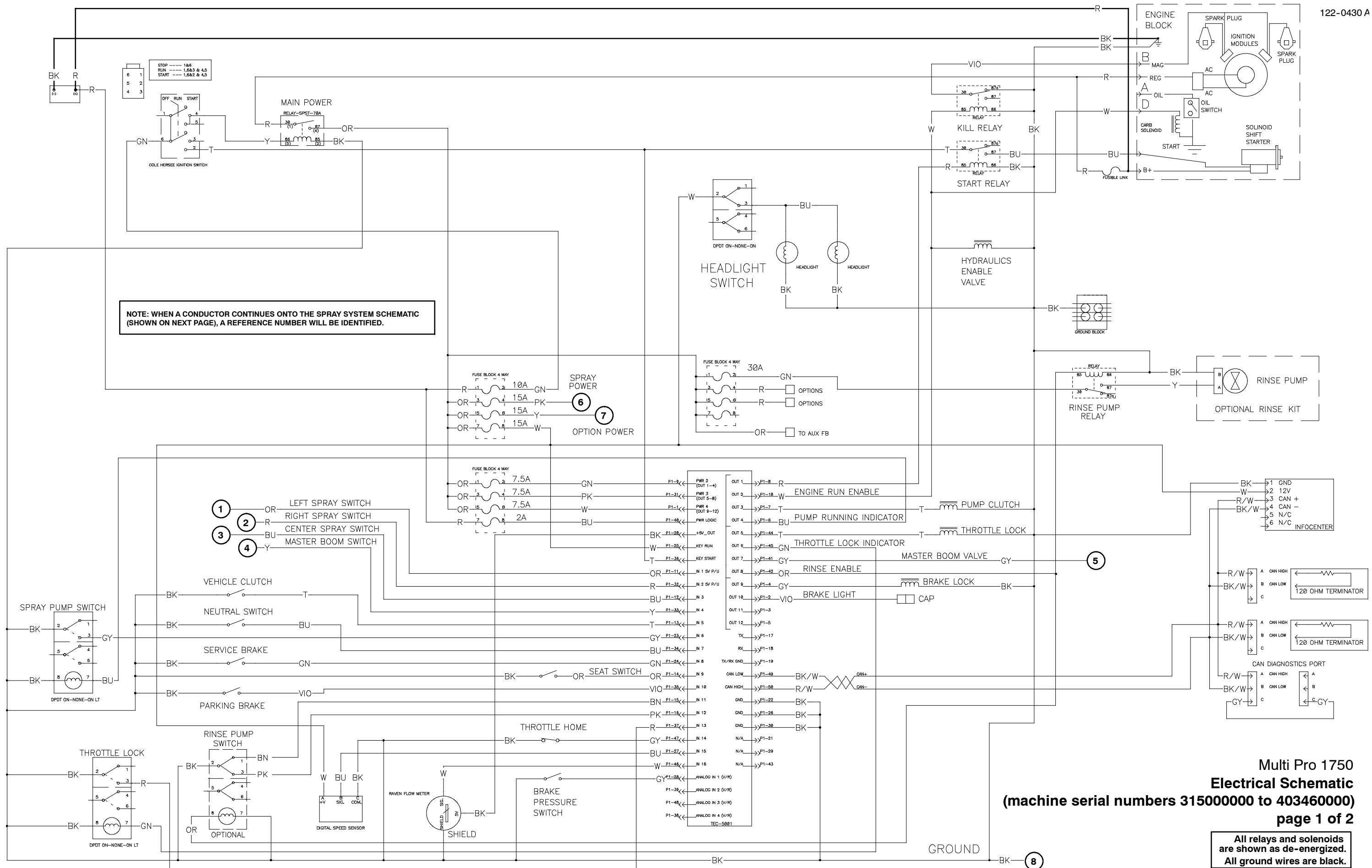
**Multi Pro 1750
Electrical Schematic
(machine serial number below 31500000)
page 1 of 2**

**All relays and solenoids
are shown as de-energized.
All ground wires are black.**



**Multi Pro 1750
Electrical Schematic
(machine serial number below 31500000)
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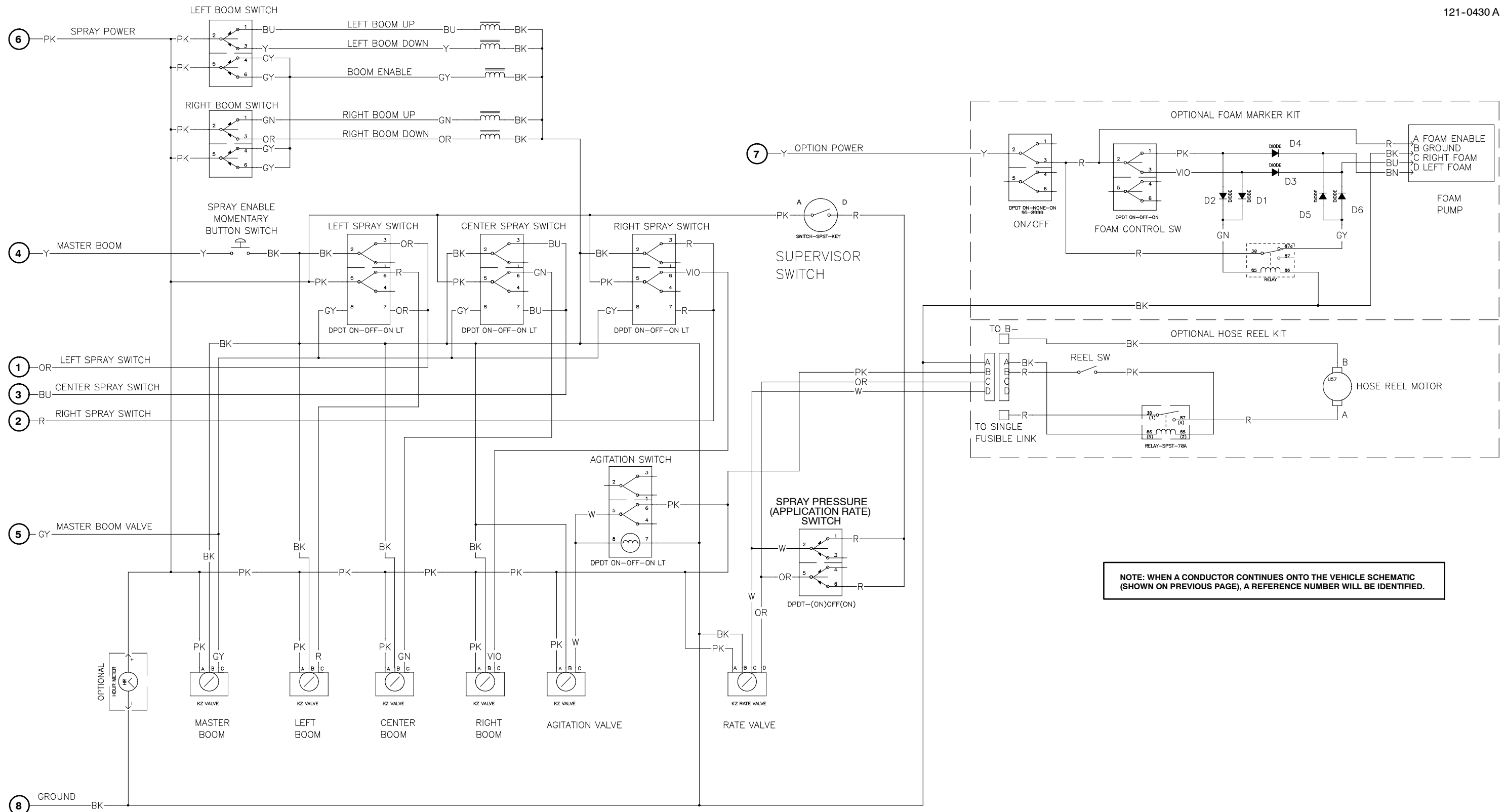
All relays and solenoids are shown as de-energized.
All ground wires are black.



NOTE: WHEN A CONDUCTOR CONTINUES ONTO THE SPRAY SYSTEM SCHEMATIC (SHOWN ON NEXT PAGE), A REFERENCE NUMBER WILL BE IDENTIFIED.

**Multi Pro 1750
Electrical Schematic
(machine serial numbers 31500000 to 40346000)
page 1 of 2**

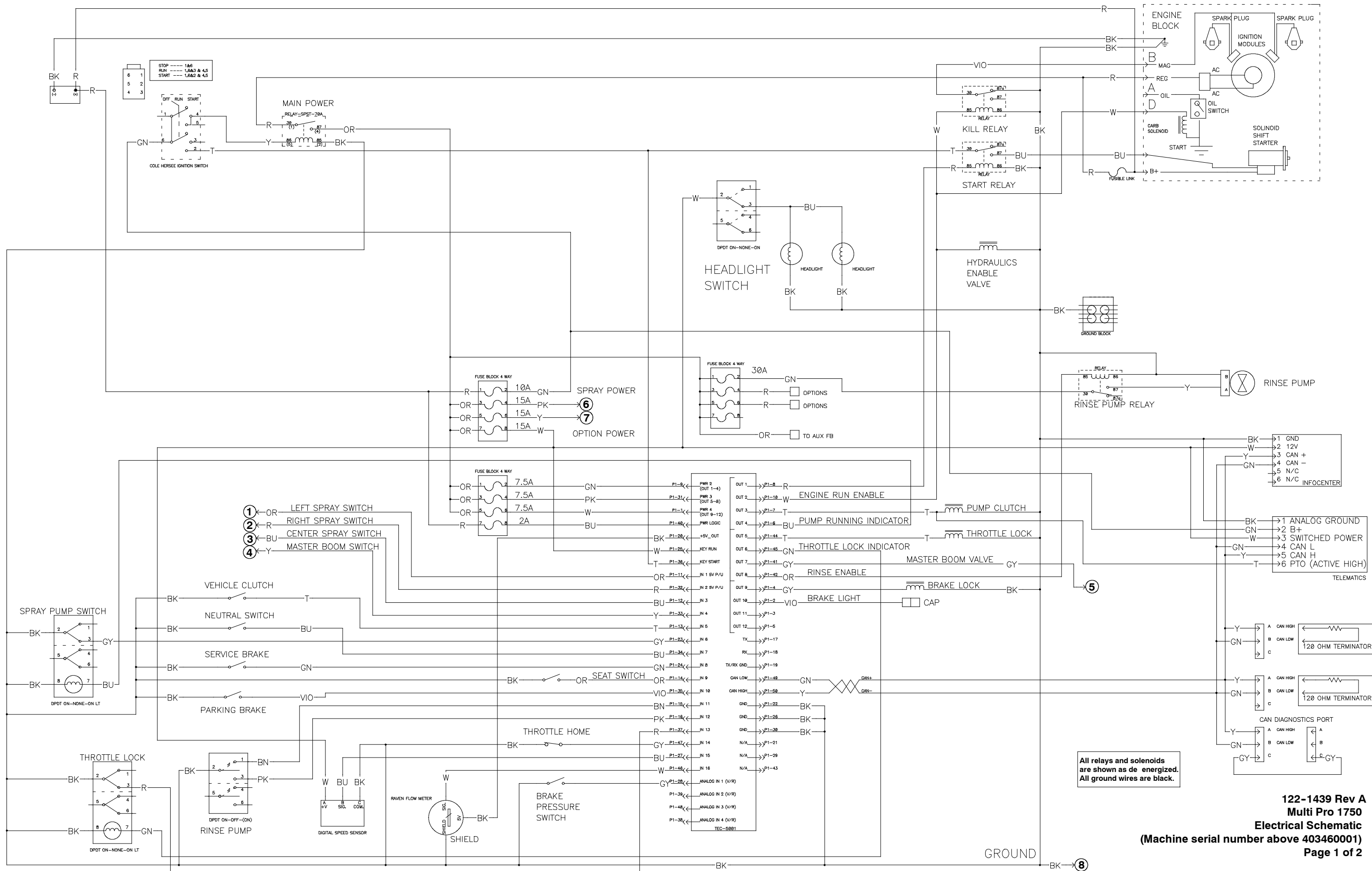
**All relays and solenoids are shown as de-energized.
All ground wires are black.**



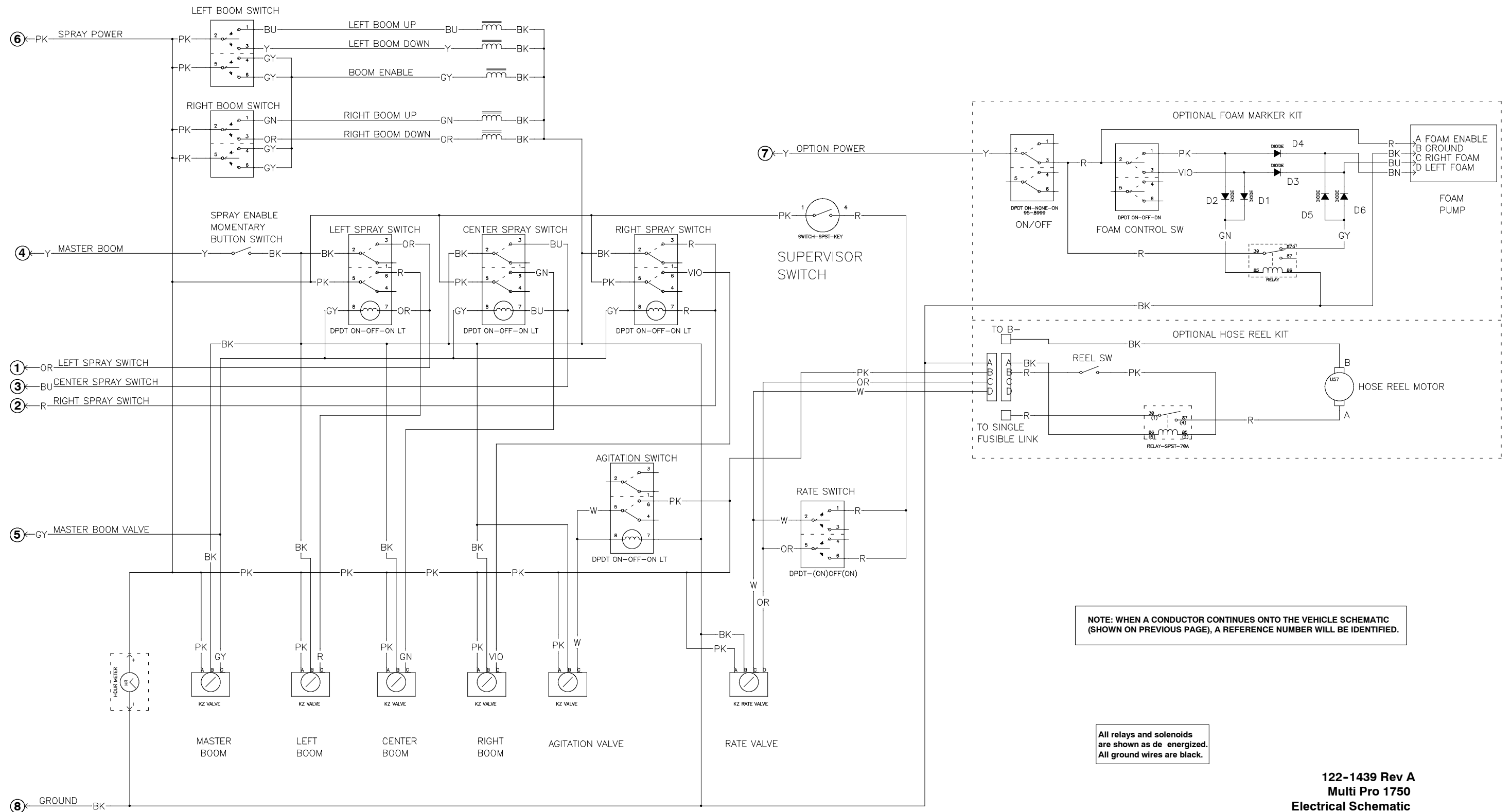
NOTE: WHEN A CONDUCTOR CONTINUES ONTO THE VEHICLE SCHEMATIC (SHOWN ON PREVIOUS PAGE), A REFERENCE NUMBER WILL BE IDENTIFIED.

Multi Pro 1750
Electrical Schematic
 (machine serial numbers 31500000 to 403460000)
 page 2 of 2

All relays and solenoids are shown as de-energized.
 All ground wires are black.



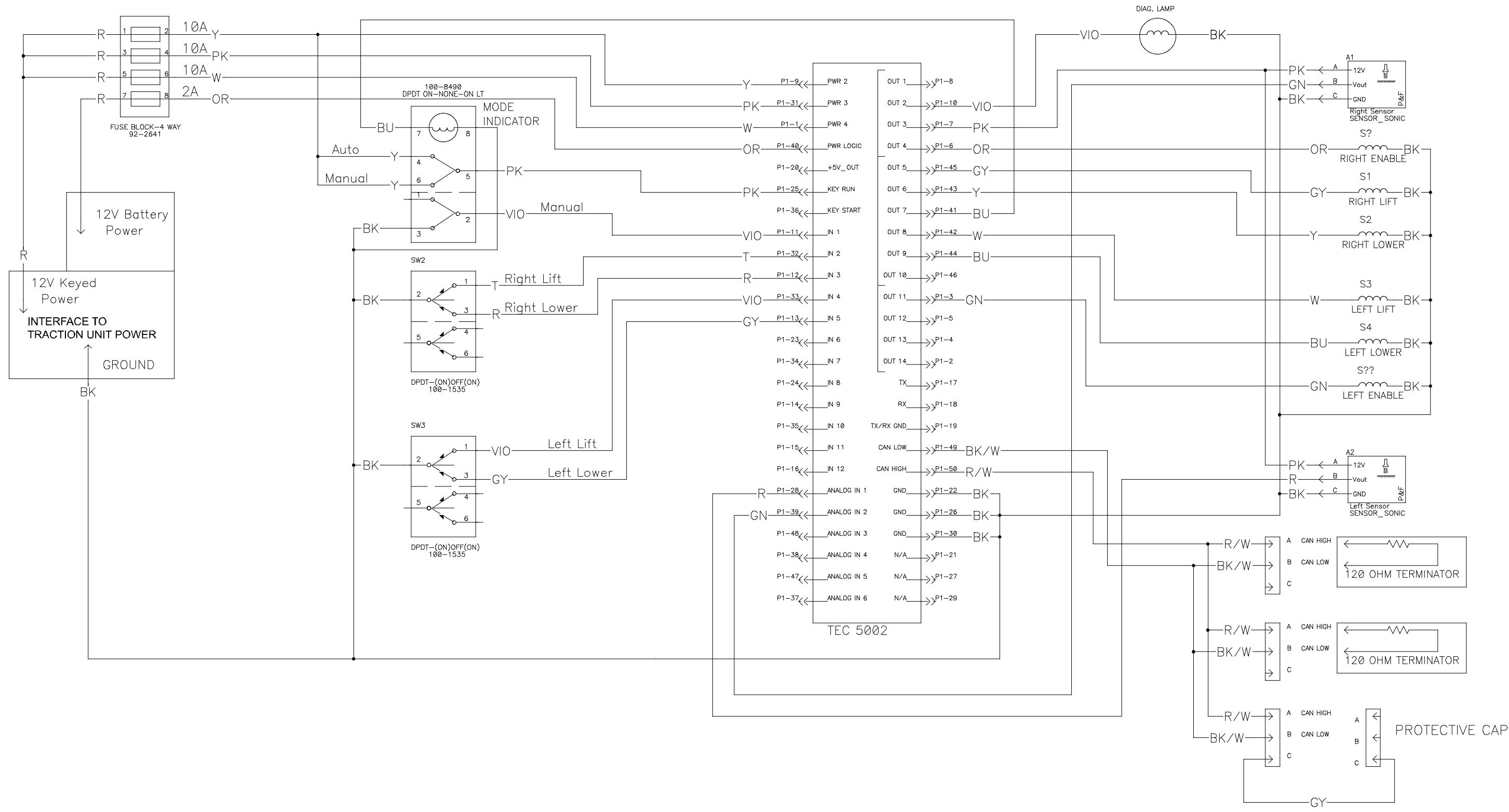
122-1439 Rev A
Multi Pro 1750
Electrical Schematic
 (Machine serial number above 403460001)
 Page 1 of 2



NOTE: WHEN A CONDUCTOR CONTINUES ONTO THE VEHICLE SCHEMATIC (SHOWN ON PREVIOUS PAGE), A REFERENCE NUMBER WILL BE IDENTIFIED.

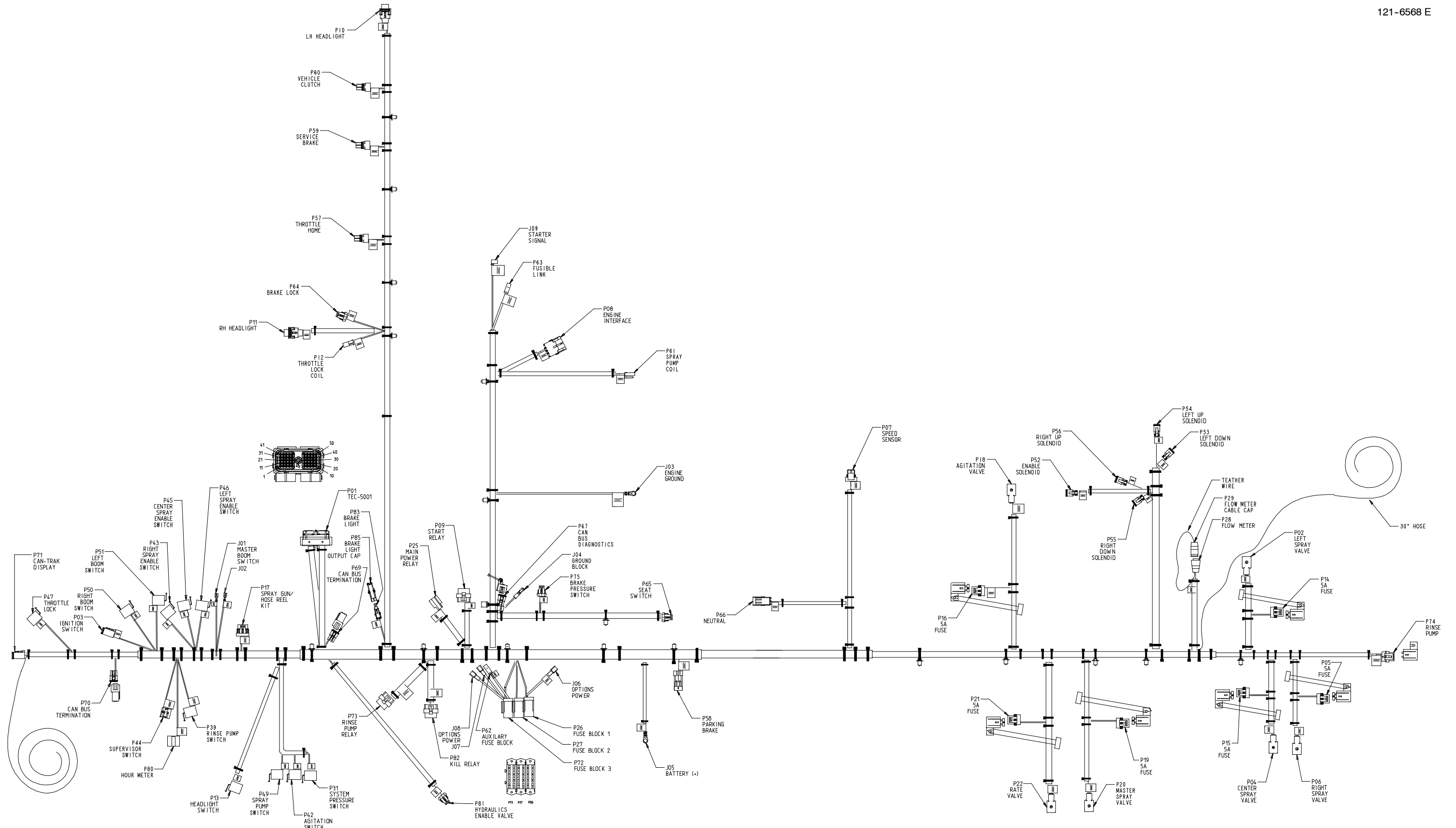
All relays and solenoids are shown as de energized. All ground wires are black.

**122-1439 Rev A
Multi Pro 1750
Electrical Schematic
(Machine serial number above 403460001)
Page 2 of 2**

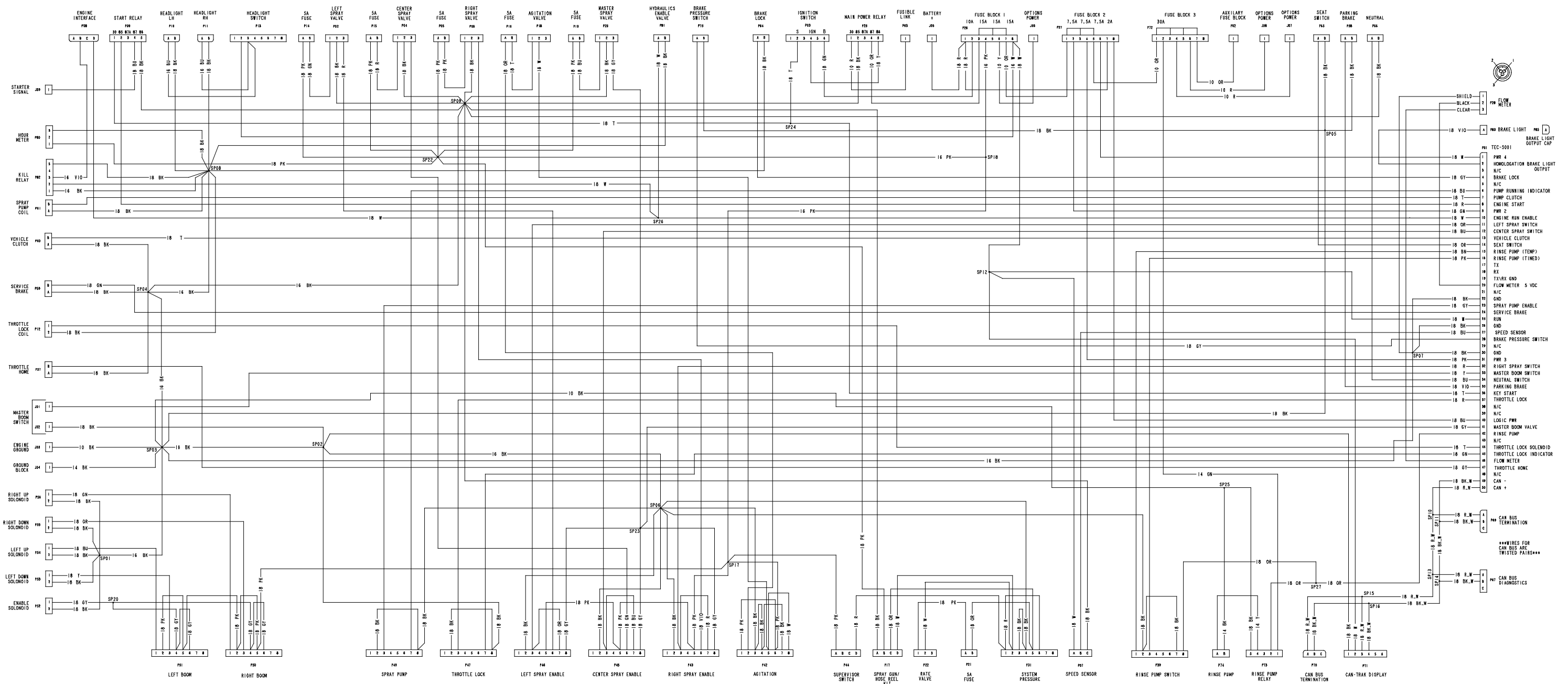


Ultra Sonic Boom Kit (Optional)
Electrical Schematic

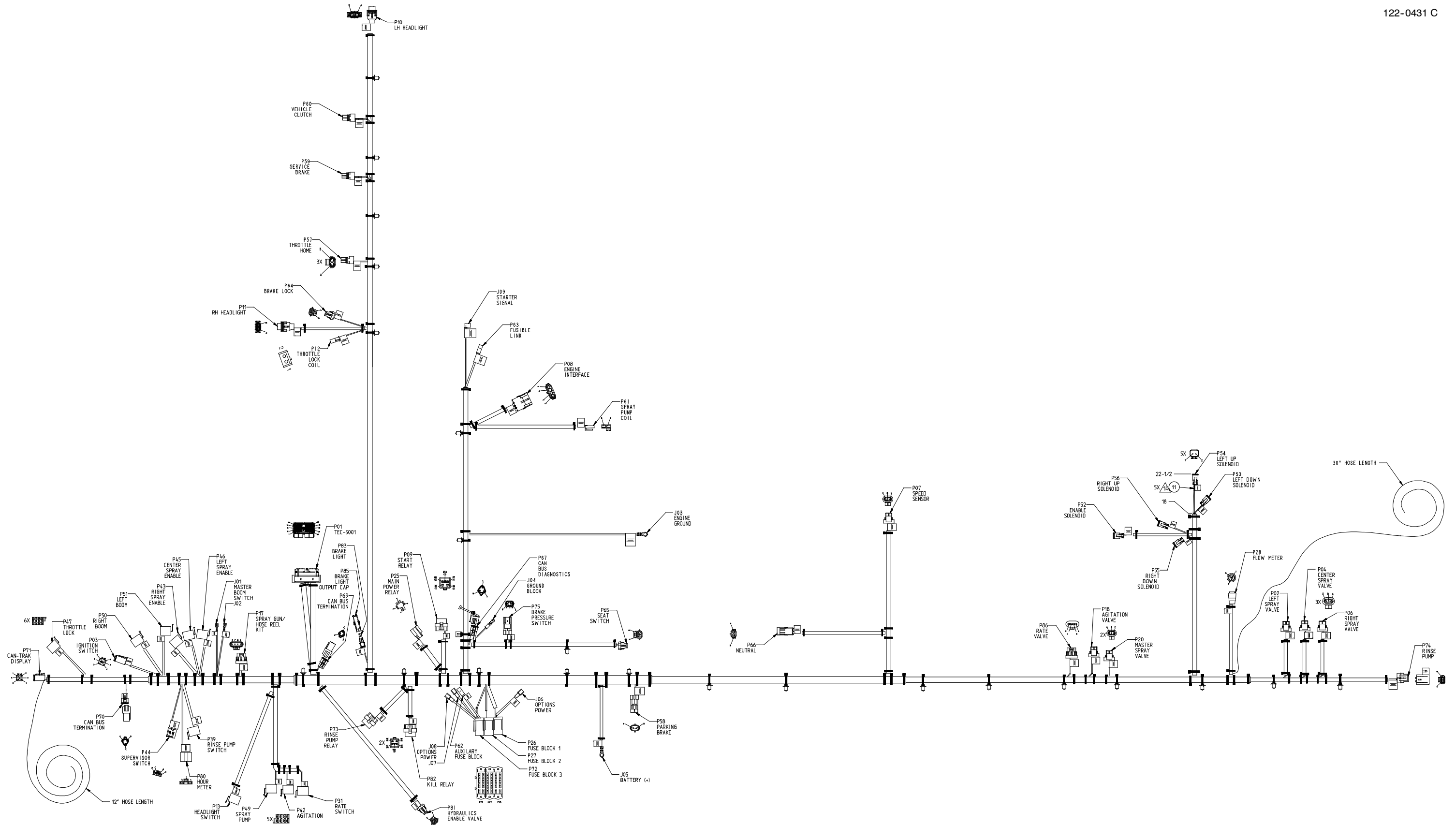
All relays and solenoids
 are shown as de-energized.
 All ground wires are black.



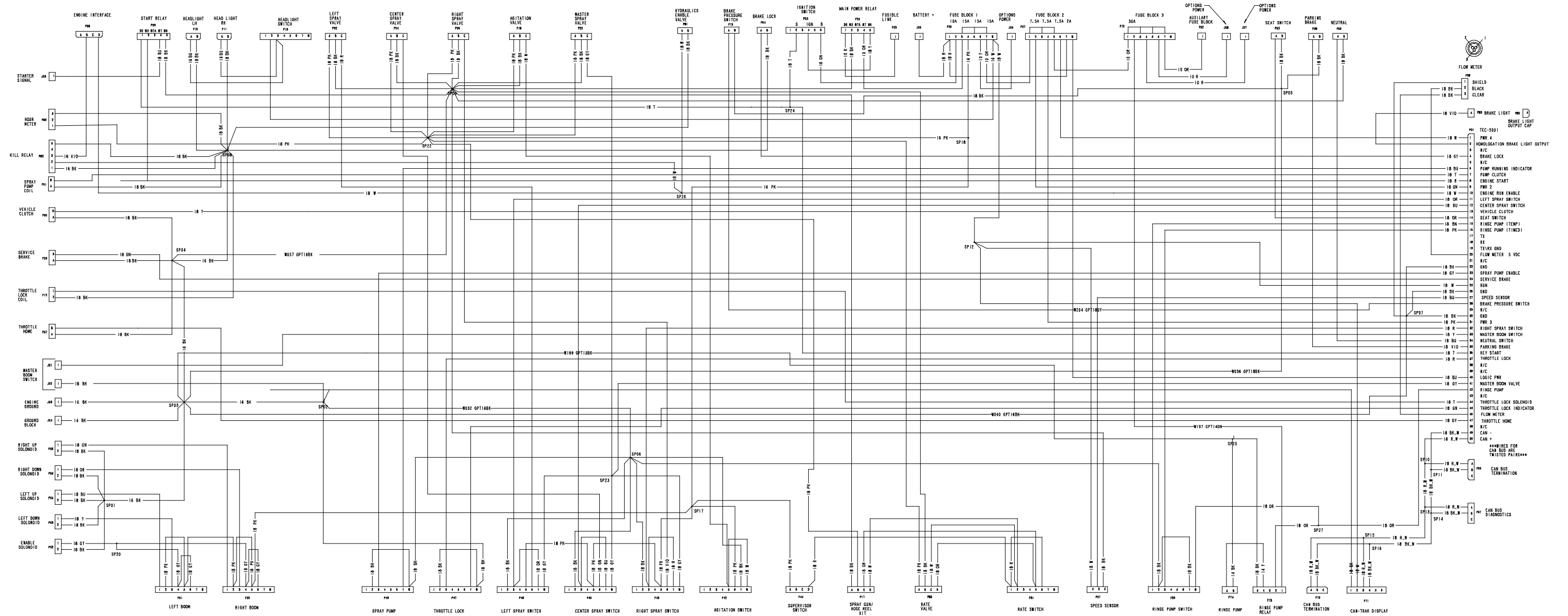
Multi Pro 1750
Main Wire Harness Drawing
 (machine serial number below 31500000)
 Page 10 - 10

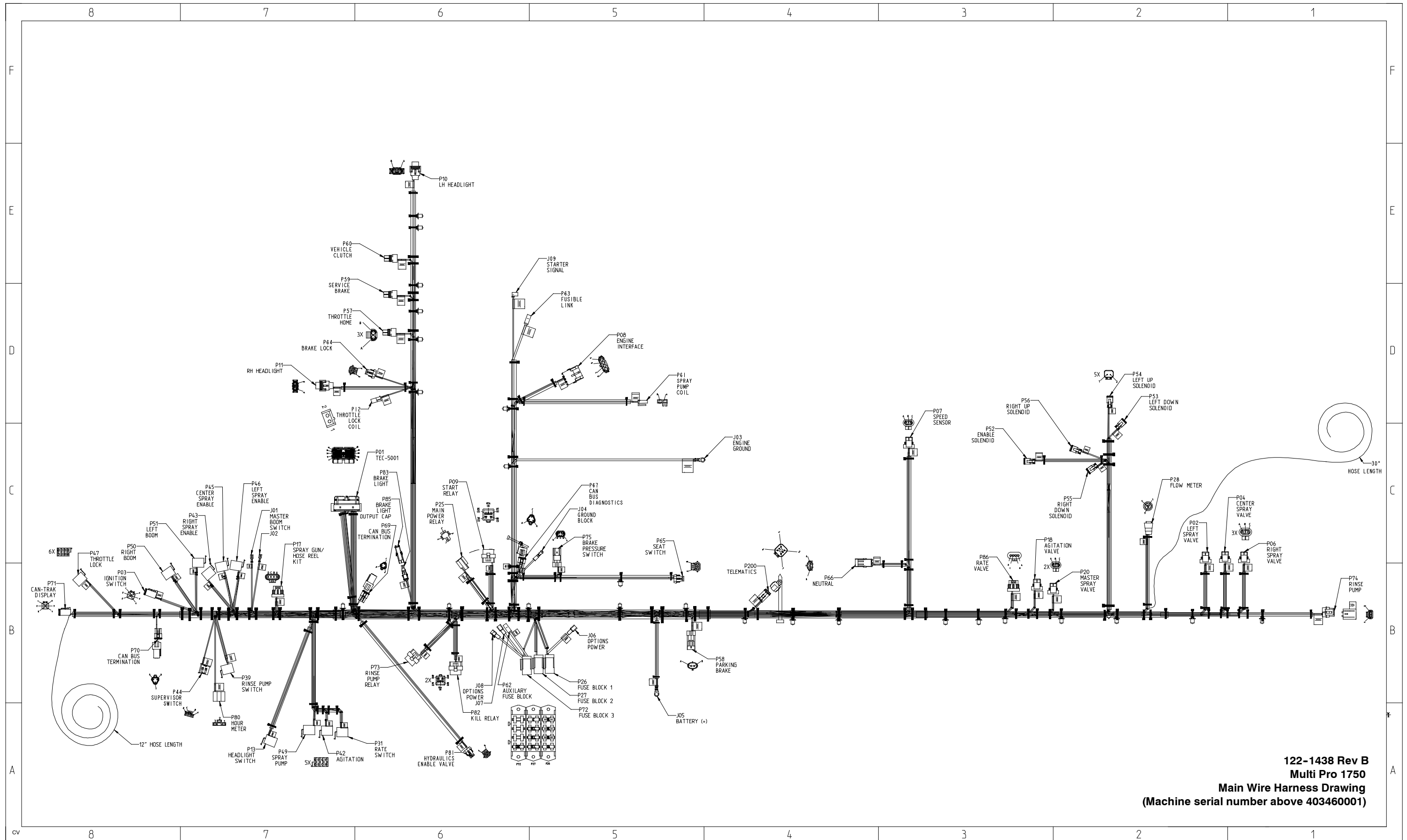


Multi Pro 1750
Main Wire Harness Diagram
(machine serial number below 31500000)

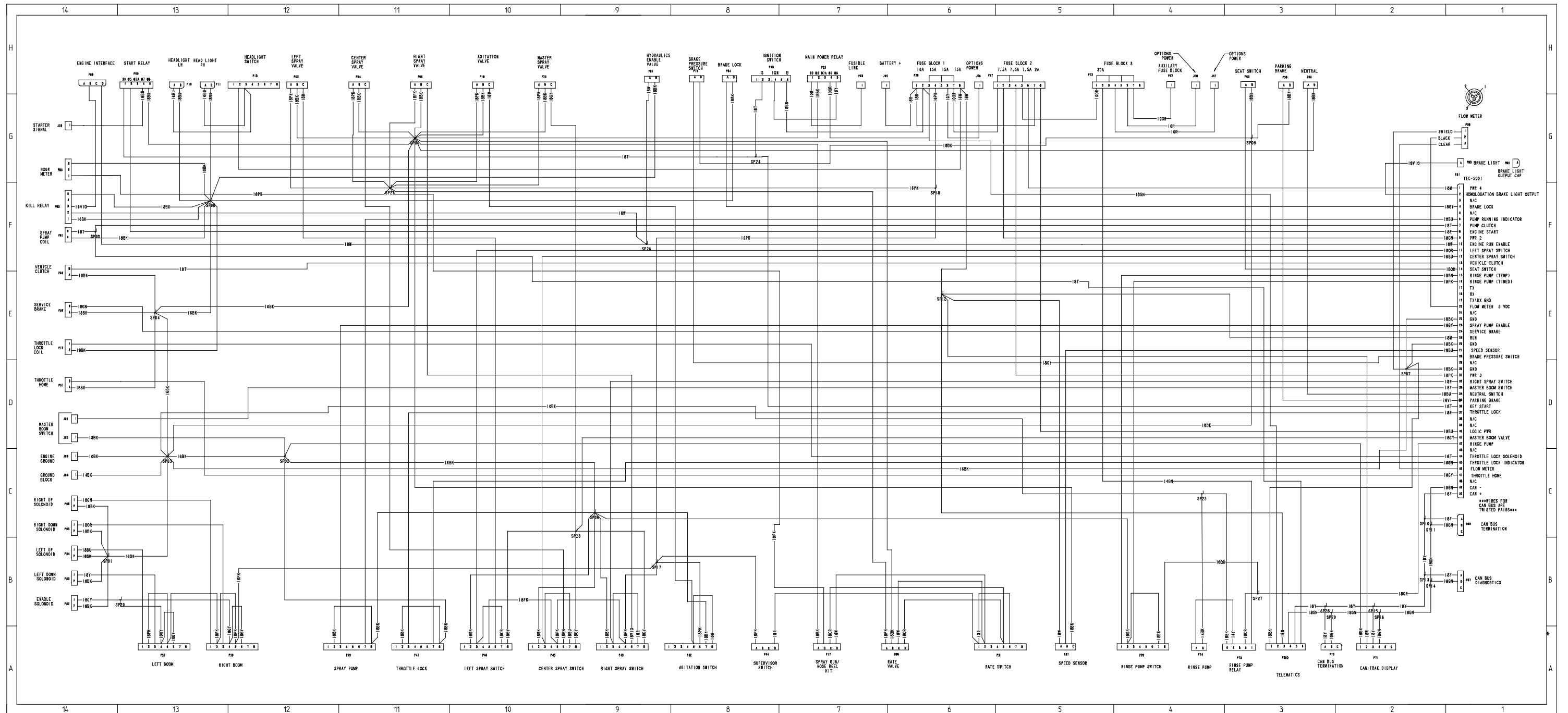


Multi Pro 1750
Main Wire Harness Drawing
(machine serial numbers 31500000 to 403460000)

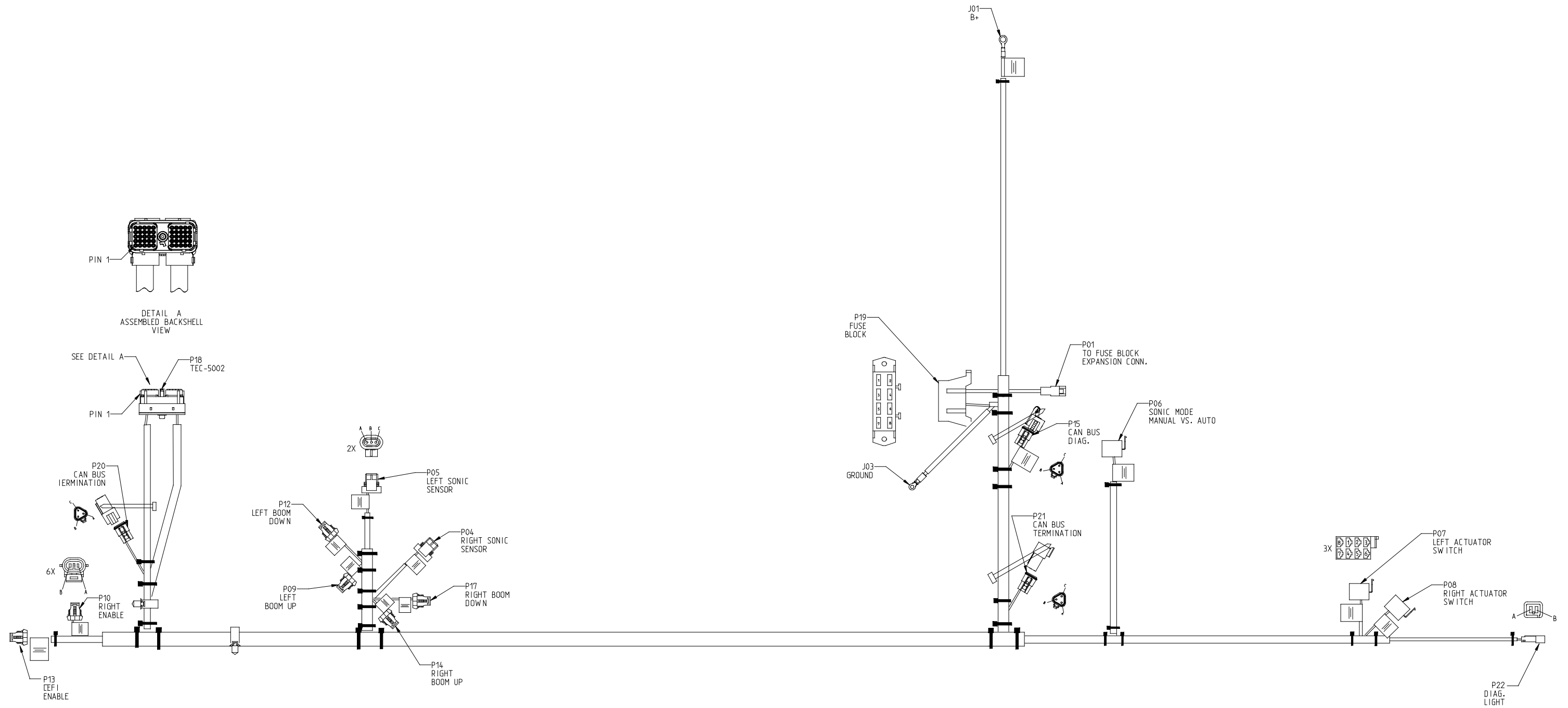




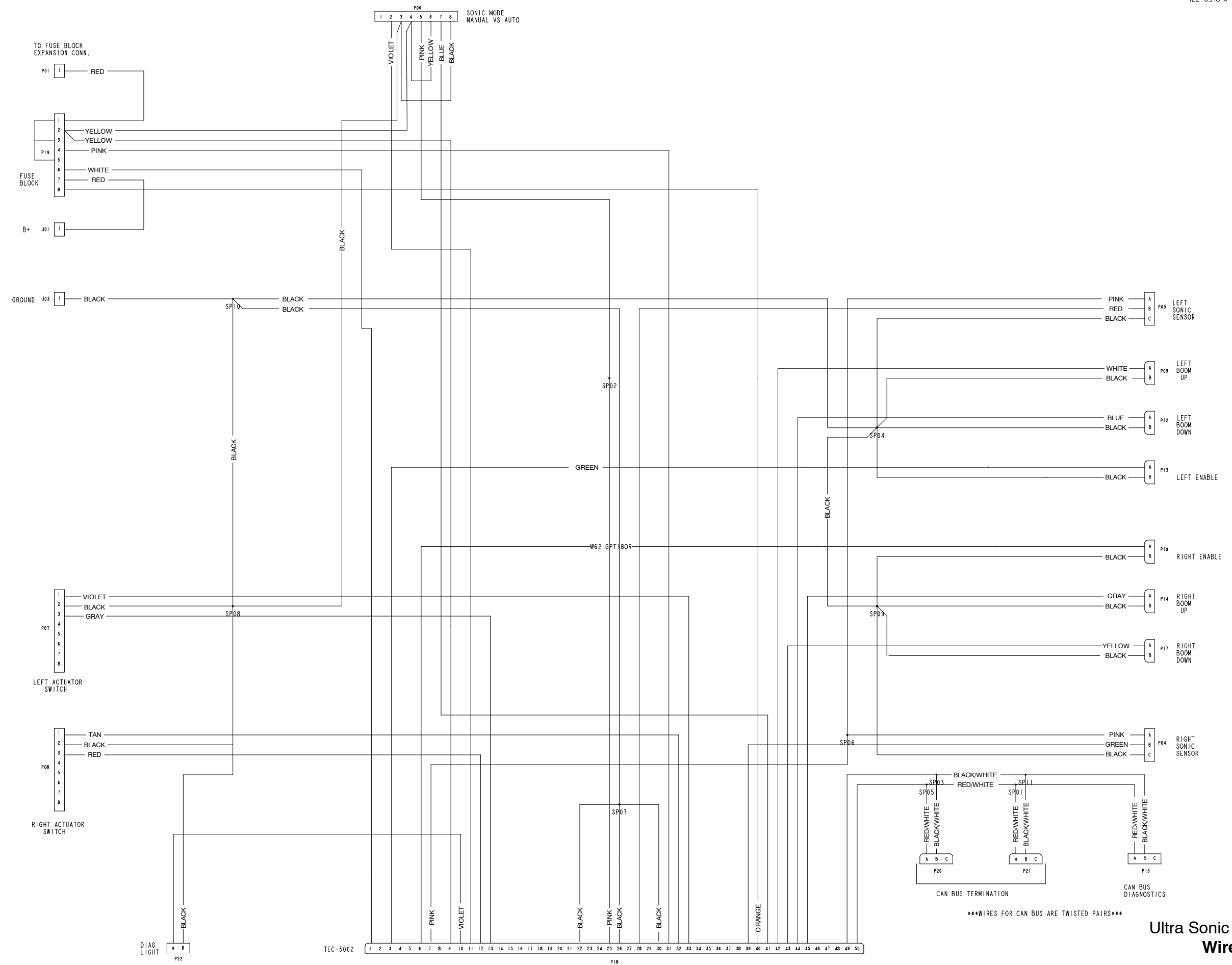
122-1438 Rev B
 Multi Pro 1750
 Main Wire Harness Drawing
 (Machine serial number above 403460001)



122-1438 Rev B
 Multi Pro 1750
 Main Wire Harness Diagram
 (Machine serial number above 403460001)



Ultra Sonic Boom Kit (Optional)
Wire Harness Drawing



WIRES FOR CAN BUS ARE TWISTED PAIRS

Ultra Sonic Boom Kit (Optional) Wire Harness Diagram