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TORO®

Count on it.

Service Manual

Multi Pro® 5800

(Machine Serial Numbers Above 316000000)

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2017	Initial Issue.
A	02/2018	Updated fault codes. Added revision history.
B	05/2018	Added VA02 series planetary information.
C	09/2020	Added 3 schematics, 2 wire harnesses, new tandem hyd pump, new steering control valve, AutoSteer information, nozzle flow meters.
D	07/2021	Updated Engine chapters.

Reader Comments

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

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NOTES

Service Manual
(Machine Serial Numbers Above 316000000)

Multi Pro® 5800

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Multi Pro 5800 machines serial number above 316000000. Equipment model numbers covered in this manual include 41393, 41394, 41593 and 41594. All of these models include a 5 button InfoCenter display on the control arm. Models 41394 and 41594 comply with EPA Tier 4 emission regulations. This manual also supports the optional GeoLink Spray System models 41623, 41624, 41625, 41630 and 41632, and optional Ultra-Sonic Boom Leveling Kit model 41219.

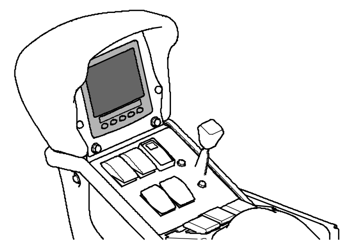
REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE, AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manual, Software Guide and Parts Catalog for your machine. Additional copies of these and other product support publications are available at www.Toro.com.

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.



5 Button InfoCenter Display

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Chapter 1

Safety

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Safety Instructions

The Multi Pro 5800 Turf Sprayer is designed and tested to offer safe service when operated and maintained properly. Although hazard control and accident prevention are partially dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

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

Before Operating

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

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

3. Various safety interlocks incorporated into the system prevent the engine from starting unless the following conditions are met:

- The spray pump enable switch is in the OFF position
- If an optional tank rinse kit is installed, the rinse pump enable switch is in the OFF position
- The seat switch is depressed indicating an Operator is present, or the parking brake is engaged
- The neutral switch indicates the traction pump is in neutral

NOTE: All of the interlock switches must be functioning and adjusted correctly for the engine to start (see Chapter 6 – Electrical System in this manual for switch adjustment and testing information).

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

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

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

C. Do not smoke while handling fuel.

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

While Operating

1. Sit on the operators seat while the machine is in motion, or engage the parking brake during stationary operation.

2. The engine will stop running it the vehicle is operated for more than ten seconds with the parking brake engaged.

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

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

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

6. Before stopping the engine:

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

   B. Engage the parking brake.

   C. Set spray pump enable switch to the OFF position.

   D. If an optional tank rinse kit is installed, set the rinse pump enable switch to the OFF position

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

Maintenance and Service

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Jacking Instructions

CAUTION

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

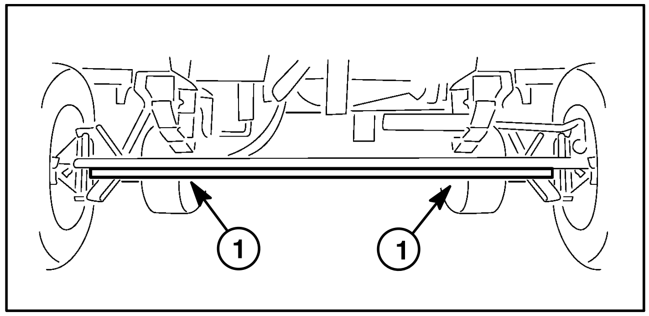

Figure 1

1. **Front jacking points**

Jacking the Front End

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

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

3. Jack front of machine off the ground.

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

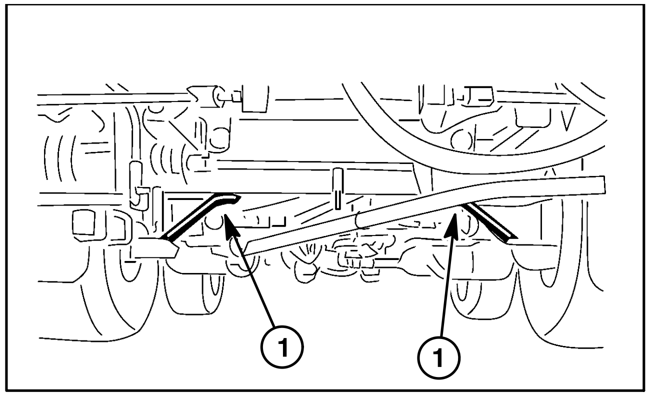

Figure 2

1. **Rear jacking points**

Jacking the Rear End

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

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

3. Jack rear of machine off the ground.

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

Safety and Instruction Decals

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

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Chapter 2

Product Records and Maintenance

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Product Records

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

Maintenance

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

Equivalents and Conversions

Decimal and Millimeter Equivalents

Fractions	Decimals	mm	Fractions	Decimals	mm
1/64	0.015625	— 0.397	33/64	0.515625	— 13.097
1/32	0.03125	— 0.794	17/32	0.53125	— 13.494
3/64	0.046875	— 1.191	35/64	0.546875	— 13.891
1/16	0.0625	— 1.588	9/16	0.5625	— 14.288
5/64	0.078125	— 1.984	37/64	0.578125	— 14.684
3/32	0.09375	— 2.381	19/32	0.59375	— 15.081
7/64	0.109275	— 2.778	39/64	0.609375	— 15.478
1/8	0.1250	— 3.175	**5/8**	0.6250	— 15.875
9/64	0.140625	— 3.572	41/64	0.640625	— 16.272
5/32	0.15625	— 3.969	21/32	0.65625	— 16.669
11/64	0.171875	— 4.366	43/64	0.671875	— 17.066
3/16	0.1875	— 4.762	11/16	0.6875	— 17.462
13/64	0.203125	— 5.159	45/64	0.703125	— 17.859
7/32	0.21875	— 5.556	23/32	0.71875	— 18.256
15/64	0.234375	— 5.953	47/64	0.734375	— 18.653
1/4	0.2500	— 6.350	**3/4**	0.7500	— 19.050
17/64	0.265625	— 6.747	49/64	0.765625	— 19.447
9/32	0.28125	— 7.144	25/32	0.78125	— 19.844
19/64	0.296875	— 7.541	51/64	0.796875	— 20.241
5/16	0.3125	— 7.938	13/16	0.8125	— 20.638
21/64	0.328125	— 8.334	53/64	0.828125	— 21.034
11/32	0.34375	— 8.731	27/32	0.84375	— 21.431
23/64	0.359375	— 9.128	55/64	0.859375	— 21.828
3/8	0.3750	— 9.525	**7/8**	0.8750	— 22.225
25/64	0.390625	— 9.922	57/64	0.890625	— 22.622
13/32	0.40625	— 10.319	29/32	0.90625	— 23.019
27/64	0.421875	— 10.716	59/64	0.921875	— 23.416
7/16	0.4375	— 11.112	15/16	0.9375	— 23.812
29/64	0.453125	— 11.509	61/64	0.953125	— 24.209
15/32	0.46875	— 11.906	31/32	0.96875	— 24.606
31/64	0.484375	— 12.303	63/64	0.984375	— 25.003
1/2	0.5000	— 12.700	**1**	1.000	— 25.400
1 mm = 0.03937 in.			**0.001 in. = 0.0254 mm**		

U.S.to Metric Conversions

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

Torque Specifications

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

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

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

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

Fastener Identification

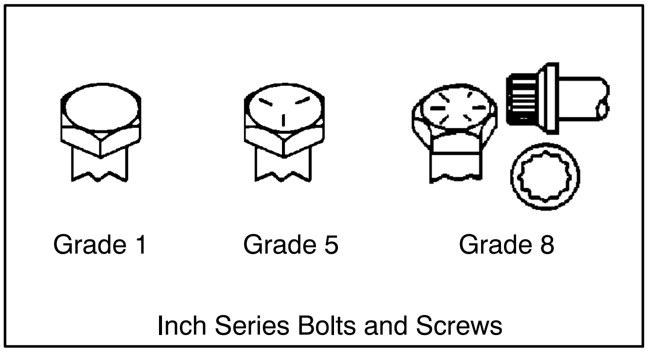

Figure 1

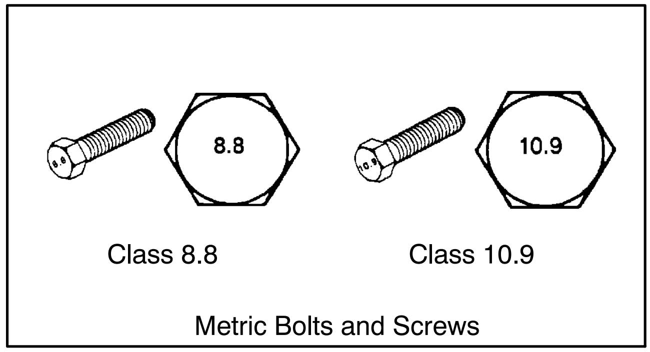

Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

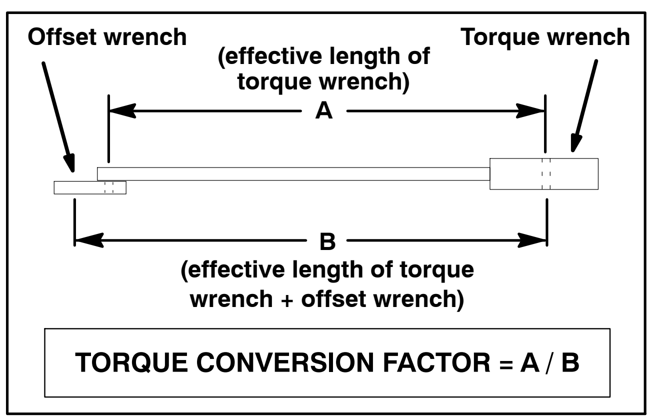

Figure 3

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

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in–lb	**in–lb**	**N–cm**	**in–lb**	**N–cm**	**in–lb**	**N–cm**
# 6 – 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	170 ± 20	23 ± 2	260 ± 20
# 6 – 40 UNF				17 ± 2	190 ± 20	25 ± 2	280 ± 20
# 8 – 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	330 ± 30	41 ± 4	460 ± 45
# 8 – 36 UNF				31 ± 3	350 ± 30	43 ± 4	485 ± 45
# 10 – 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 4	475 ± 45	60 ± 6	675 ± 70
# 10 – 32 UNF				48 ± 4	540 ± 45	68 ± 6	765 ± 70
1/4 – 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1125 ± 100	140 ± 15	1580 ± 170
1/4 – 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 10	1300 ± 100	160 ± 15	1800 ± 170
5/16 – 18 UNC	115 ± 15	105 ± 17	1186 ± 169	200 ± 25	2250 ± 280	300 ± 30	3390 ± 340
5/16 – 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2540 ± 280	325 ± 30	3670 ± 340
	ft–lb	**ft–lb**	**N–m**	**ft–lb**	**N–m**	**ft–lb**	**N–m**
3/8 – 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 4	58 ± 5
3/8 – 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 3	47 ± 4	50 ± 4	68 ± 5
7/16 – 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 – 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 5	75 ± 7	77 ± 7	104 ± 9
1/2 – 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 10	142 ± 14
1/2 – 20 UNF	32 ± 3	53 ± 7	72 ± 9	85 ± 8	115 ± 11	120 ± 10	163 ± 14
5/8 – 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 20	285 ± 27
5/8 – 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 15	230 ± 20	240 ± 20	325 ± 27
3/4 – 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 25	359 ± 34	375 ± 35	508 ± 47
3/4 – 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 25	407 ± 34	420 ± 35	569 ± 47
7/8 – 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 – 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 45	644 ± 61	660 ± 60	895 ± 81

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

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

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

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

Thread Size	Class 8.8 Bolts, Screws, and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws, and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 5 in–lb	640 ± 60 N–cm	78 ± 7 in–lb	885 ± 80 N–cm
M6 X 1.0	96 ± 9 in–lb	1018 ± 100 N–cm	133 ± 13 in–lb	1500 ± 150 N–cm
M8 X 1.25	19 ± 2 ft–lb	26 ± 3 N–m	27 ± 2 ft–lb	36 ± 3 N–m
M10 X 1.5	38 ± 4 ft–lb	52 ± 5 N–m	53 ± 5 ft–lb	72 ± 7 N–m
M12 X 1.75	66 ± 7 ft–lb	90 ± 10 N–m	92 ± 9 ft–lb	125 ± 12 N–m
M16 X 2.0	166 ± 15 ft–lb	225 ± 20 N–m	229 ± 22 ft–lb	310 ± 30 N–m
M20 X 2.5	325 ± 33 ft–lb	440 ± 45 N–m	450 ± 37 ft–lb	610 ± 50 N–m

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

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

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

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

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

Chapter 3

Kubota Diesel Engine

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Specifications

Item	Description
Make / Designation	V1505−E3B, Kubota, 4−Cycle, 4 Cylinder, Water Cooled, Diesel Engine
Bore x Stroke	3.07 in x 3.09 in (78 mm x 78.4 mm)
Total Displacement	91.4 in^3 (1498 cc)
Compression Ratio	23:1
Firing Order	1 – 3 – 4 – 2 (numbers start at fan end)
Low Idle (no load)	1200 to 1300 RPM
High Idle (no load)	3050 to 3150 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Fuel	No. 2−D Diesel Fuel (ASTM D975)
Fuel Injection Pump	Bosch MD Type Mini Pump
Injection Nozzles	Mini Nozzle (DNOPD)
Fuel Tank Capacity	12 U.S. gallons (45 liters)
Governor	Centrifugal Mechanical
Engine Oil	API Classification CH−4, CI−4 or Higher (see Operator's Manual for viscosity recommendations)
Oil Pump	Trochoid Type
Engine Oil Capacity (approximate)	4.9 U.S. quarts (4.6 liters) with Filter
Cooling System Capacity (approximate – including reserve tank)	5.9 U.S. quarts (5.6 liters)
Starter	12 VDC, 1.2 KW
Alternator/Regulator	12 VDC 60 AMP
Engine Dry Weight (approximate)	242 lbs (110 kg)

General Information

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

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the Kubota diesel engine that powers your Multi Pro 5800−D. Refer to that publication for additional information when servicing the machine.

Kubota Workshop Manual

General maintenance procedures are described in your Operator's Manual. Information on engine testing, disassembly and reassembly is identified in the Kubota Workshop Manual Diesel Engine, 05−E3B Series that is included at the end of this chapter. Make sure that the correct engine manual is used when servicing the engine on your Multi Pro.

Most engine repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual Diesel Engine, 05−E3B Series. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Adjustments

Adjust Throttle Cable

Proper engine RPM and machine performance is dependent upon proper adjustment of throttle cable.

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

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

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

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

4. After securing cable clamp, make sure that cable adjustment is still correct. Ensure the throttle swivel moves freely and the speed control lever travels fully from stop to stop.

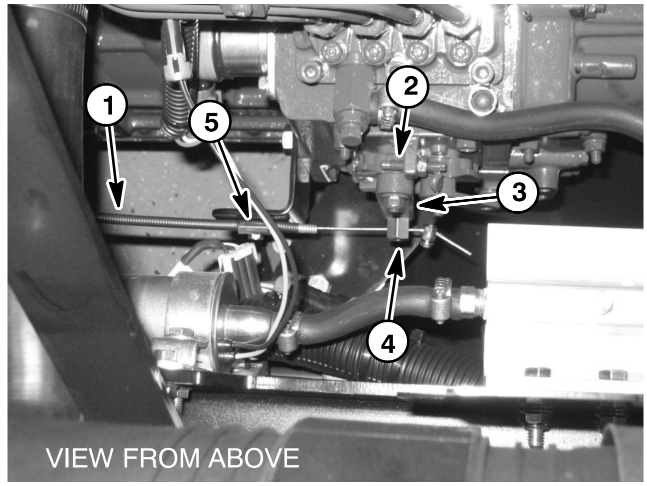


Figure 1

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

Service and Repairs

Fuel System

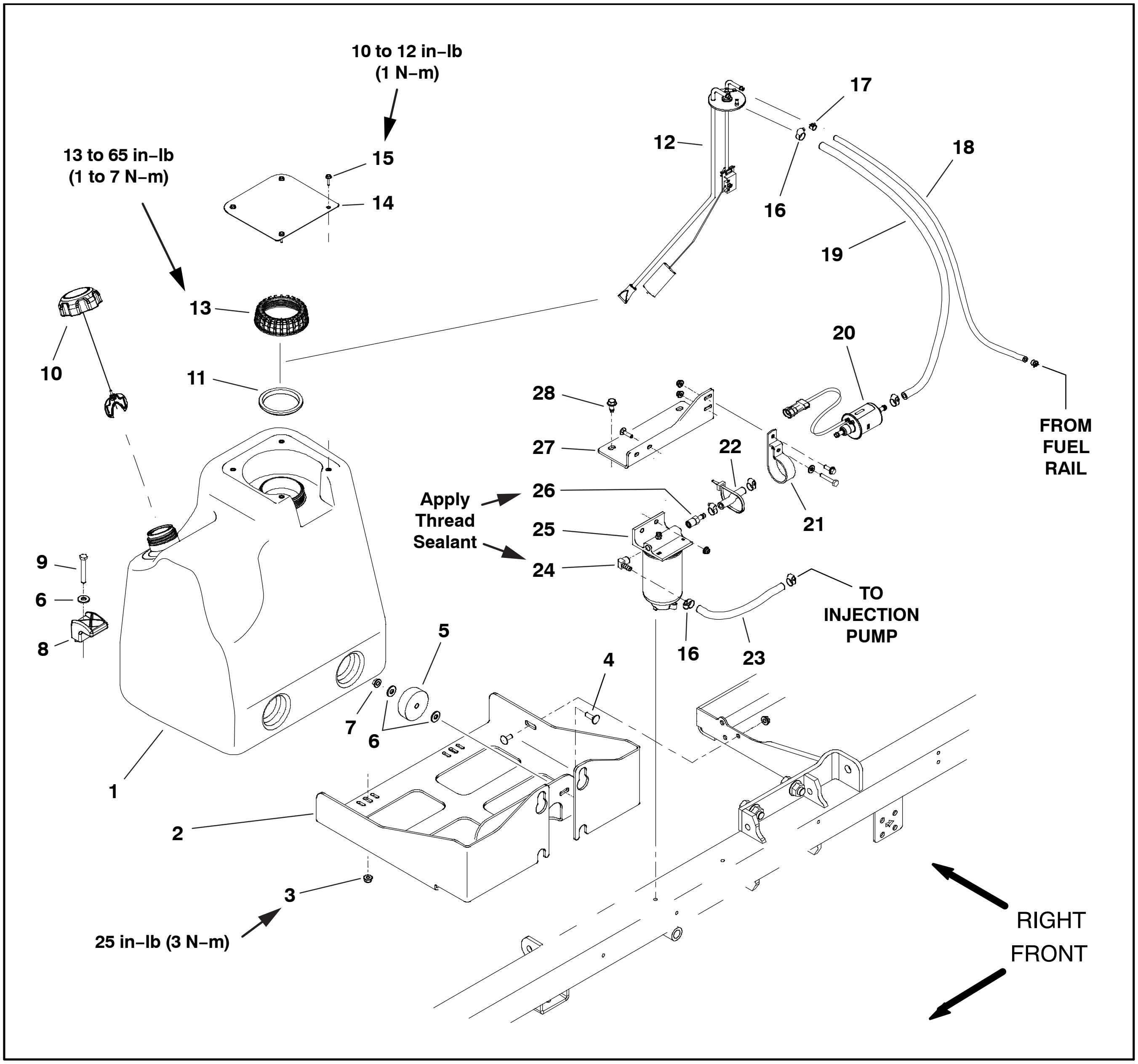


Figure 2

1. Fuel tank
2. Base
3. Flange nut (2)
4. Carriage bolt (2)
5. Rubber bumper (2)
6. Flat washer (6)
7. Flange nut (2)
8. Clamp (2)
9. Cap screw (2)
10. Fuel fill cap
11. Gasket
12. Fuel pickup/level sender
13. Fuel pickup/level sender cap
14. Tank cover
15. Flange head screw (4)
16. Hose clamp (6)
17. Hose clamp (2)
18. Fuel hose – return
19. Fuel hose – supply
20. Fuel pump
21. Fuel pump clamp
22. Fuel hose – supply
23. Fuel hose – supply
24. Elbow fitting
25. Fuel filter/separator
26. Straight fitting
27. Bracket
28. Flange head screw (2)

DANGER

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

Check Fuel Lines and Connections

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

Empty and Clean Fuel Tank

Empty and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

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

Fuel Tank Removal (Fig. 2)

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

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

3. Remove the fuel tank cover.

4. Disconnect the fuel pickup/level sender from the machine wire harness.

5. Loosen hose clamps that secure supply and return hoses to top of tank. Remove hoses from tank.

6. Remove two (2) fuel tank clamps from base and remove fuel tank from machine. Check condition of fuel tank rubber bumpers and replace if worn or damaged.

7. If necessary, remove fuel pickup/level sender from tank. Check condition of fuel pickup/level sender gasket and replace if worn or damaged. See Fuel Pickup/Level Sender in Chapter − 6 Electrical System for testing information.

8. If necessary, remove fuel hoses from machine. Record fuel hose routing for assembly purposes.

Fuel Tank Installation (Fig. 2)

1. If fuel hoses were removed from machine, route fuel hoses through machine as recorded during removal. Make sure that clearance exists between fuel hoses and machine components along full length of hoses.

2. Secure fuel tank to machine with two (2) clamps at base. Tighten clamp fasteners to **25 in−lbs (3 N−m)**.

3. Install fuel pickup/level sender if previously removed from tank. Tighten fuel pickup/level sender cap from **13 to 65 in−lbs (1 to 7 N−m)**.

4. Connect fuel hoses to top of fuel tank and secure with hose clamps.

5. Connect the fuel pickup/level sender to the machine wire harness.

6. Install fuel tank cover and tighten cover screws from **10 to 12 in−lbs (1 N−m)**.

7. Fill fuel tank and bleed air from the fuel system (see machine Operator's Manual).

8. Start engine and check fuel line connections for leaks.

Air Cleaner

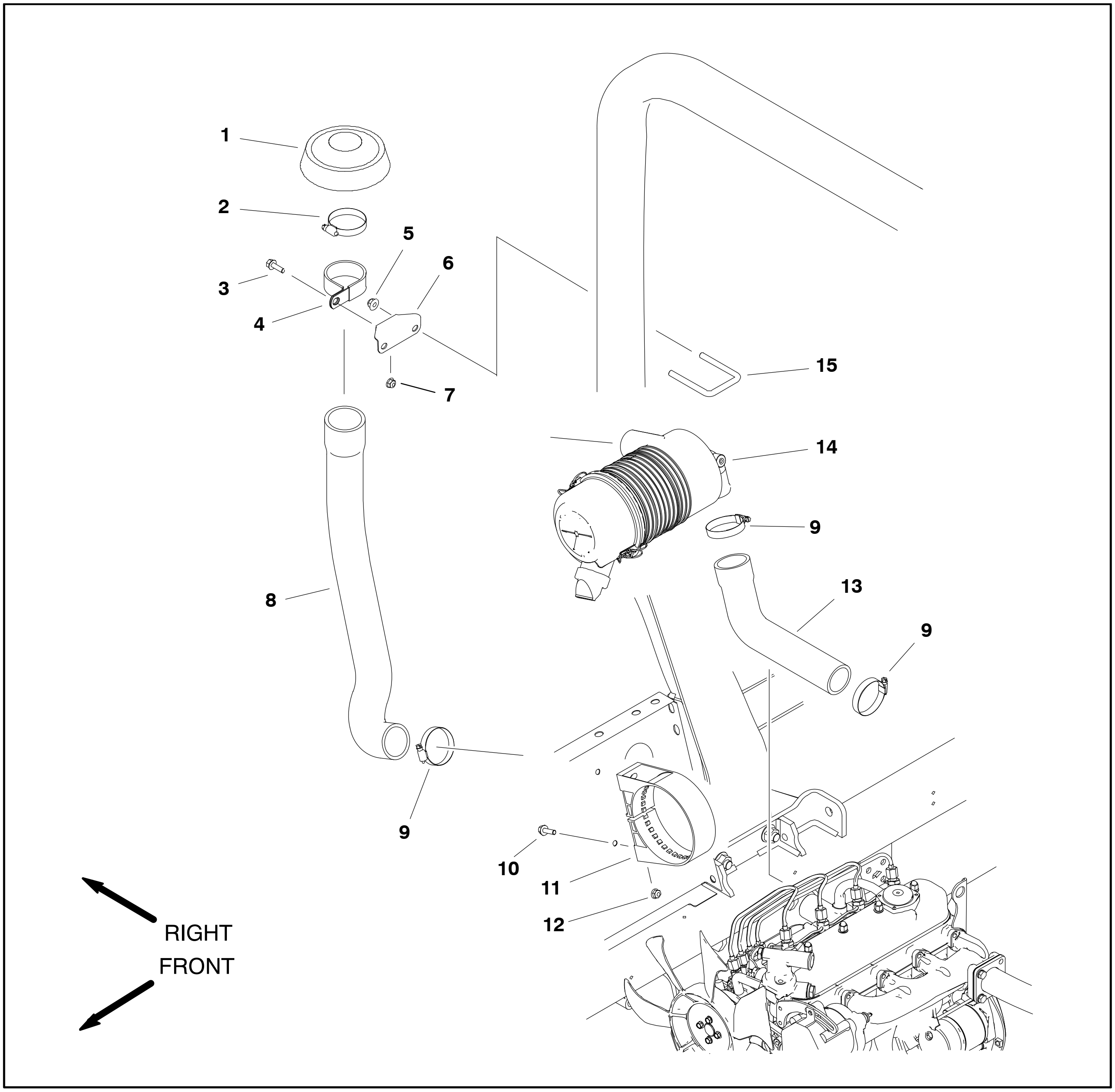


Figure 3

1. **Cap**
2. **Hose clamp**
3. **Flange head screw**
4. **Clamp**
5. **Flange nut (2)**
6. **Bracket**
7. **Flange nut**
8. **Hose**
9. **Hose clamp (3)**
10. **Flange head screw (2)**
11. **Air cleaner mount**
12. **Flange nut (2)**
13. **Hose**
14. **Air cleaner assembly**
15. **U−Bolt**

Removal (Fig. 3)

NOTE: For air cleaner maintenance information, see the machine Operator's Manual.

1. Raise passenger seat to access air cleaner assembly.

2. Remove air cleaner components as needed.

Installation (Fig. 3)

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

1. Assemble air cleaner system. Make sure that vacuator valve on air cleaner cover points downward after assembly (Fig. 4).

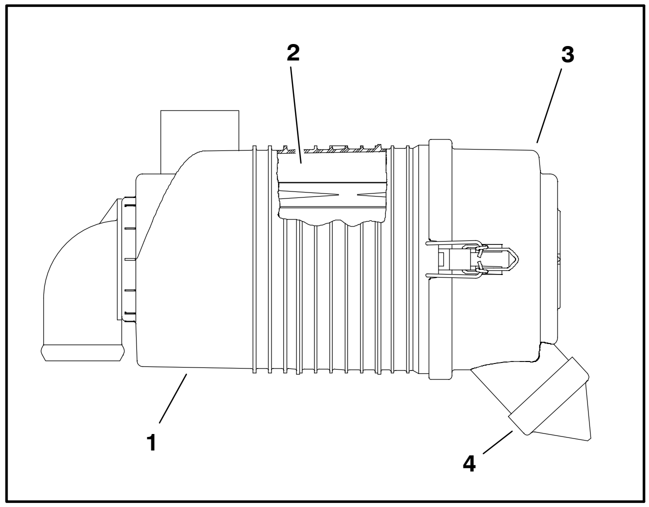


Figure 4

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

Exhaust System

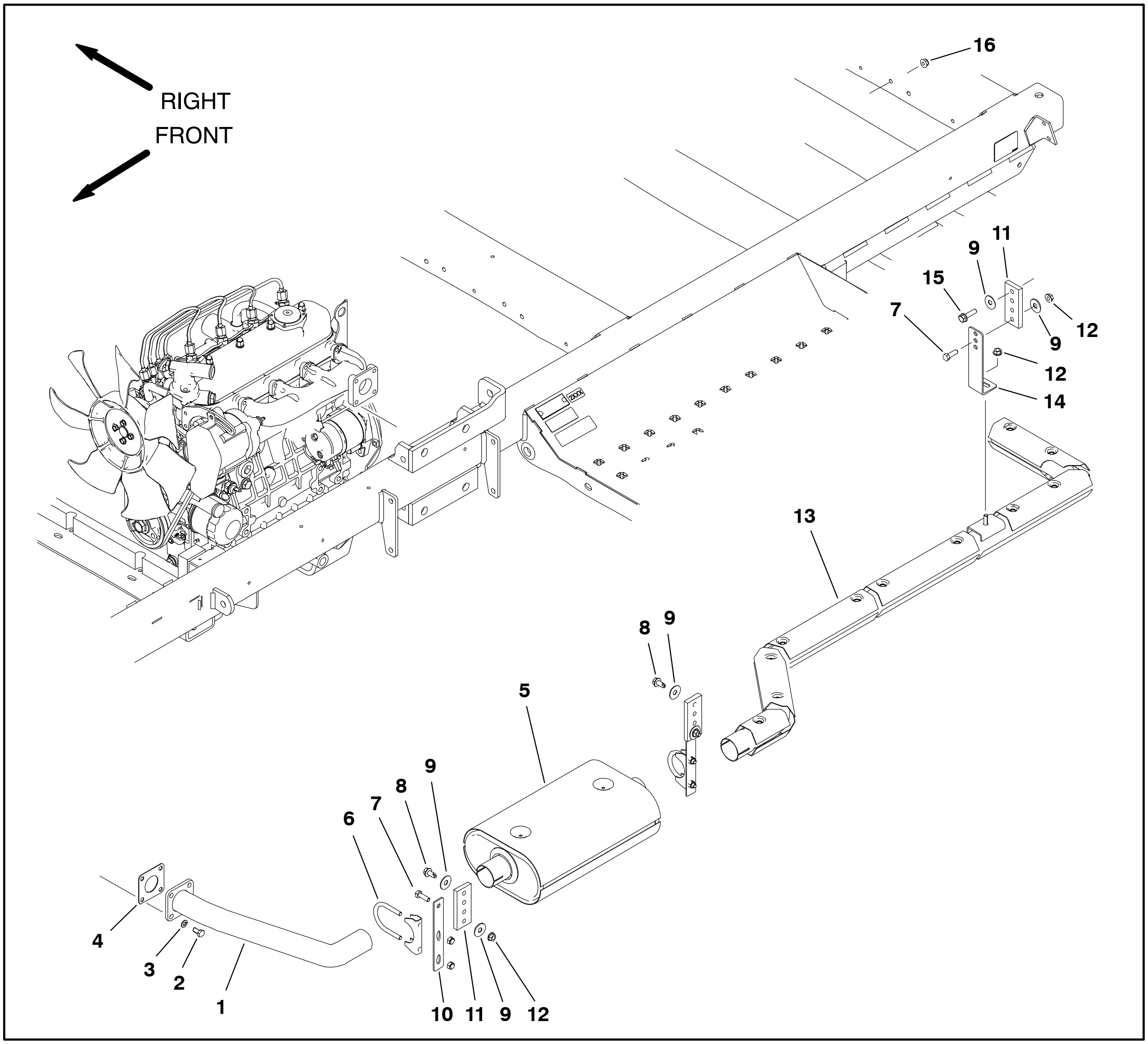


Figure 5

1. Exhaust pipe
2. Cap screw (4)
3. Lock washer (4)
4. Gasket
5. Muffler
6. Muffler clamp (2)
7. Cap screw (2)
8. Flange head screw (2)
9. Flat washer (6)
10. Hanger (2)
11. Rubber hanger (3)
12. Flange nut (3)
13. Tail pipe
14. Hanger
15. Flange head screw
16. Flange nut

CAUTION

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

Removal (Fig. 5)

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

2. Remove the rear undercarriage shroud from the machine (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

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

4. Remove exhaust system components as required. During removal, note location and orientation of fasteners, rubber hangers, clamps and brackets.

5. Locate and discard gasket between exhaust pipe and header if exhaust pipe is disconnected from header. Clean gasket surfaces on engine exhaust manifold and exhaust pipe.

Installation (Fig. 5)

1. If exhaust pipe was removed from engine, use a new gasket and install exhaust pipe and fasteners finger tight.

2. Install all remaining exhaust system components including hangers, clamps and brackets finger tight.

3. Tighten exhaust system components in the following order:

   A. Tighten fasteners securing exhaust pipe to exhaust header.

   B. Tighten exhaust system hanger and bracket fasteners. DO NOT tighten muffler clamps at this time.

   C. Position the tailpipe so the outlet is parallel to the ground and tighten muffler clamps.

4. Install the rear undercarriage shroud to the machine (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

Radiator

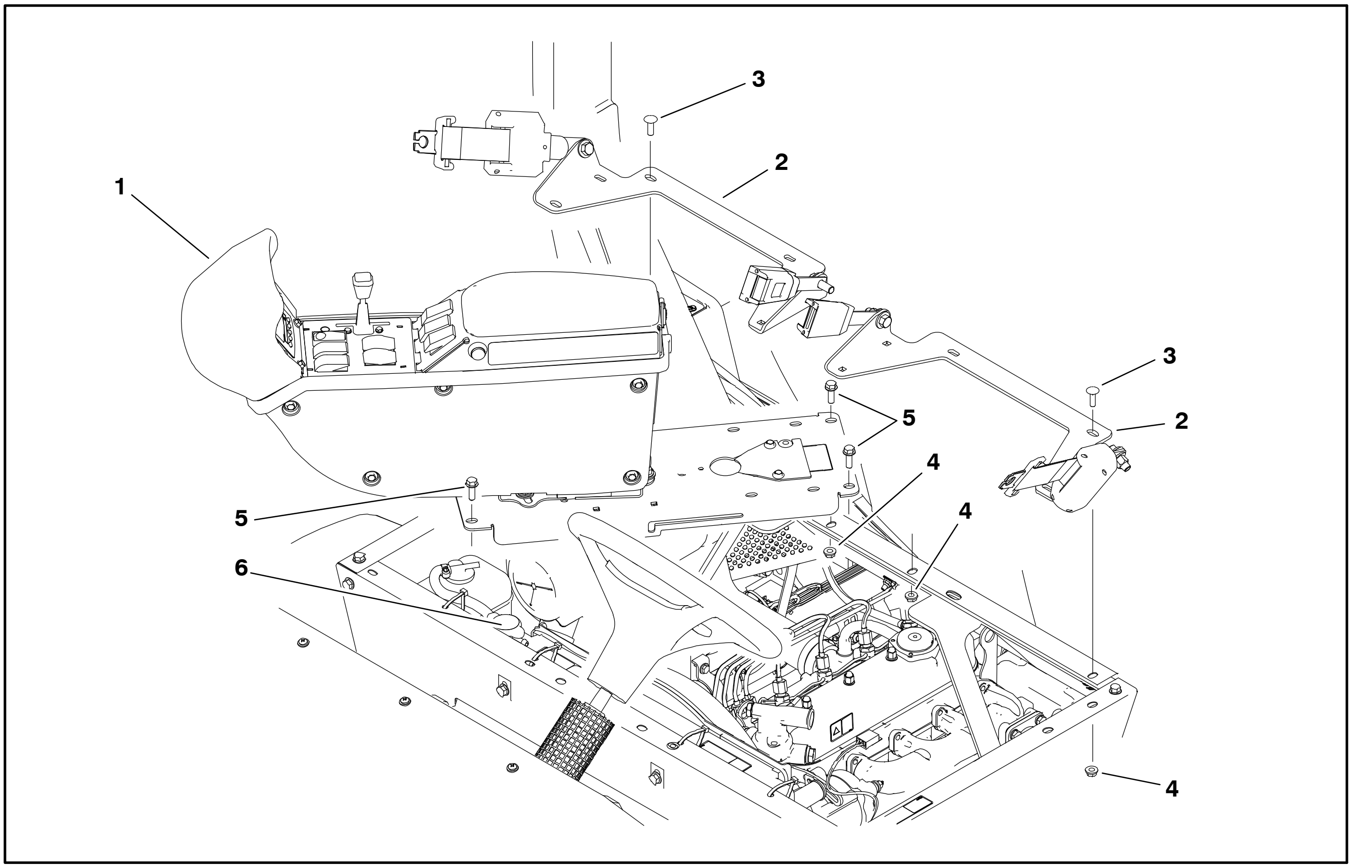


Figure 6

1. **Console assembly**
2. **Seat belt bracket assembly (2)**
3. **Carriage screw (12)**
4. **Flange nut (16)**
5. **Flange head screw (4)**
6. **Radiator**

Removal

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

2. Remove the seats and hinged seat panels from the seat box (see Seats in Chapter 9 – Chassis in this manual).

3. Remove the undercarriage shrouds from the machine (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns. Ethylene–glycol antifreeze is poisonous. Dispose of coolant properly or store it in a properly labeled container away from children and pets.

4. Drain coolant from radiator (see machine Operator's Manual). The coolant drain valve is located under the passenger seat, in the lower right corner of the radiator.

5. Loosen hose clamps that secure the upper and lower radiator hoses to the radiator and disconnect the hoses from the radiator.

6. Loosen hose clamp that secures overflow hose to radiator cap flange. Remove overflow hose from radiator.

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

8. Remove fasteners that secure console assembly to seat box (Fig. 6). Carefully pivot console assembly rearward and to the right to allow radiator access. Take care to not damage the wire harness or throttle cable. Support console to prevent it from shifting, falling, or hanging from wire harness or throttle cable.

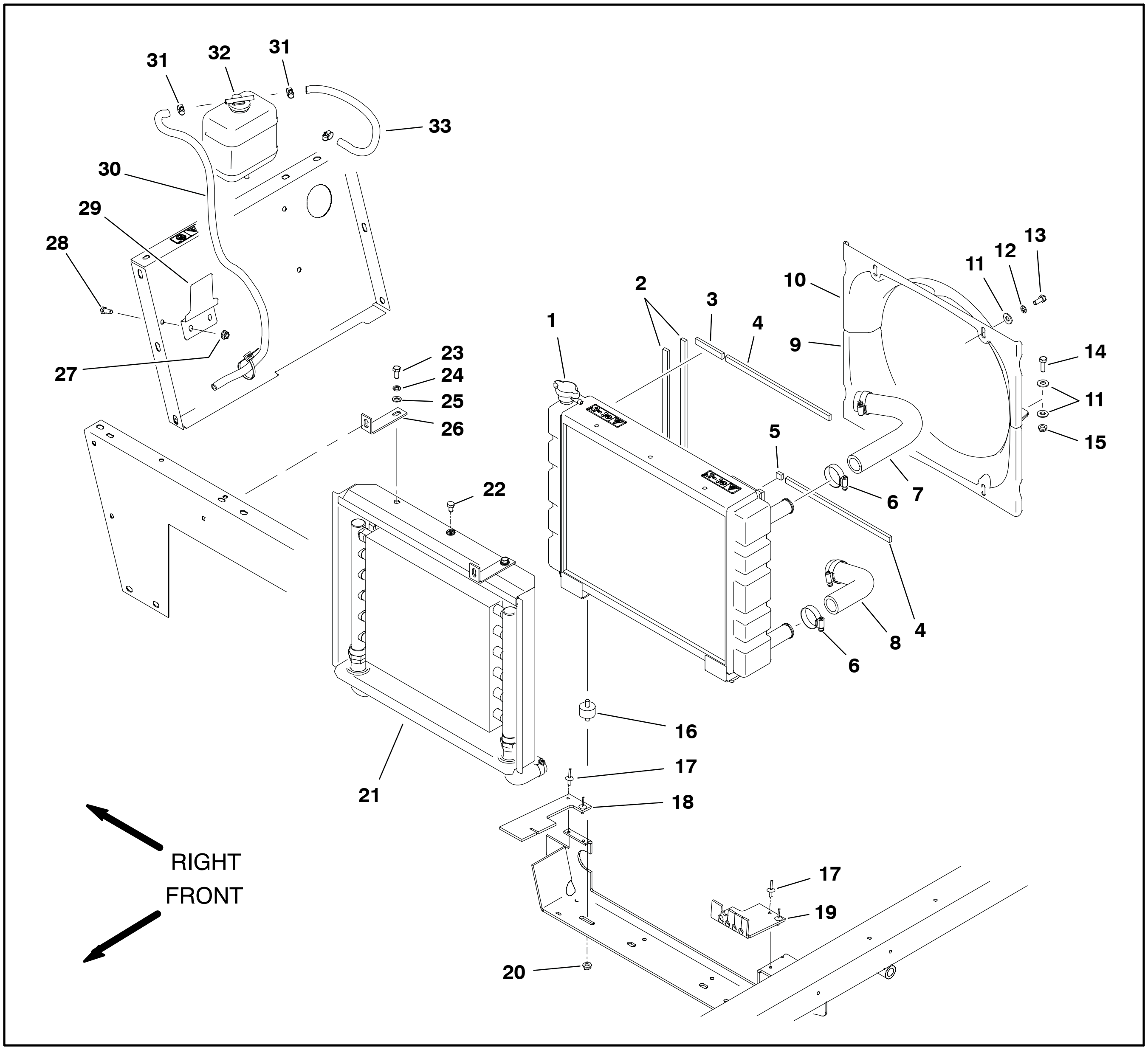


Figure 7

1. Radiator
2. Foam seal (4)
3. Foam seal
4. Foam seal (2)
5. Foam seal
6. Hose clamp (4)
7. Upper radiator hose
8. Lower radiator hose
9. Lower fan shroud
10. Upper fan shroud
11. Flat washer (8)
12. Lock washer (4)
13. Cap screw (4)
14. Cap screw (2)
15. Flange nut (2)
16. Iso−mount (2)
17. Pop rivet (4)
18. Heat baffle − RH
19. Heat baffle − LH
20. Flange nut (2)
21. Fan shroud and oil cooler
22. Cap screw (4)
23. Cap screw (2)
24. Lock washer (6)
25. Flat washer (6)
26. Bracket (2)
27. Flange nut (2)
28. Cap screw (2)
29. Overflow bottle bracket
30. Hose (vent)
31. Hose clamp (3)
32. Overflow bottle
33. Hose (radiator)

9. Remove four (4) cap screws (Fig. 7 item 13), lock washers and flat washers that secure fan shroud assembly to radiator.

10. Remove two (2) cap screws (Fig. 7 item 14), flat washers and flange nuts to separate the fan shroud halves and carefully remove the upper fan shroud from the machine.

11. Remove six (6) cap screws (Fig. 7 items 22 and 23), lock washers and flat washers that secure front radiator shroud and oil cooler (Fig. 7 item 21) to radiator.

12. Remove two (2) flange nuts (Fig. 7 item 20) that secure the iso−mounts on the bottom of the radiator to the machine frame.

13. Carefully lift radiator up and out of the machine.

14. Inspect radiator hoses and rubber iso−mounts. Replace worn or damaged components as necessary.

15.,Inspect foam radiator shroud seals and foam radiator seals in machine frame. Replace any foam seals that are damaged or deteriorated.

Installation

1. Position lower fan shroud below fan.

2. Carefully lower radiator into the machine. Secure iso−mounts on the bottom of the radiator to the machine frame with two (2) flange nuts.

3. Secure radiator to front radiator shroud and oil cooler (Fig. 7 item 21) with six (6) cap screws (Fig. 7 items 22 and 23), lock washers and flat washers.

4. Secure upper fan shroud to lower fan shroud with cap screws (Fig. 7 item 14), flat washers and flange nuts.

5. Secure fan shroud assembly to radiator with four (4) cap screws (Fig. 7 item13), lock washers and flat washers. Make sure that clearance exists between fan shrouds and fan at all points before tightening fasteners.

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

7. Carefully pivot console assembly back in position taking care to not damage wire harness or throttle cable. Install fasteners to secure console assembly to seat box assembly (Fig. 6).

8. Secure both seat belt bracket assemblies to seat box with carriage screws and flange nuts (Fig. 6).

9. Fit overflow hose to radiator flange and secure with hose clamp. Make sure overflow hose is not kinked.

10. Fill radiator with coolant (see machine Operator's Manual)

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

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

13. Install the undercarriage shrouds to the machine (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

14. Install the seats and hinged seat panels to the seat box (see Seats in Chapter 9 − Chassis in this manual).

Engine

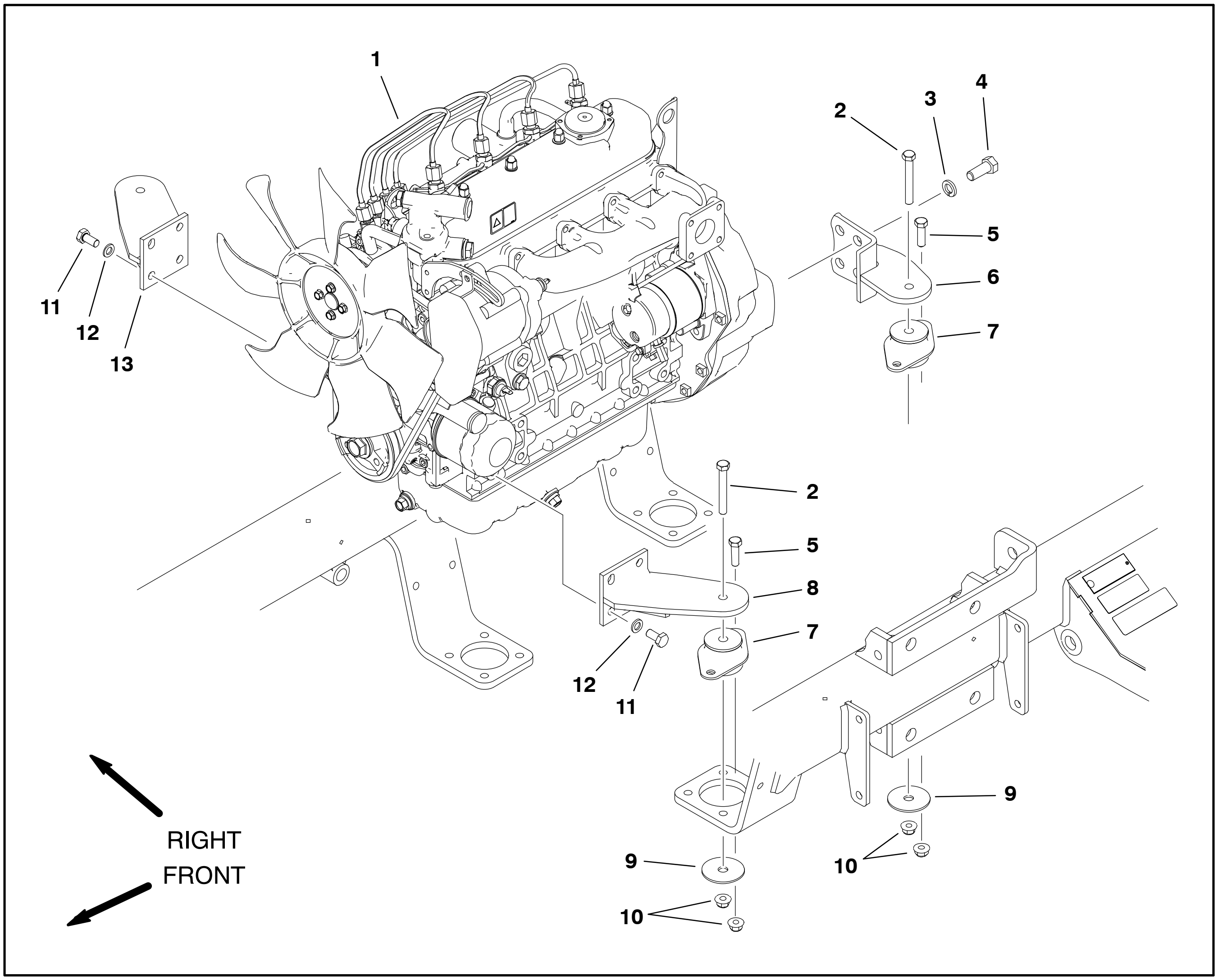


Figure 8

1. Engine assembly
2. Cap screw (4)
3. Lock washer (8)
4. Cap screw (8)
5. Cap screw (8)
6. Rear engine mount bracket (2)
7. Engine mount (4)
8. Front left engine mount
9. Snubbing washer (4)
10. Flange nut (12)
11. Cap screw (8)
12. Lock washer (8)
13. Front right engine mount

The following engine removal and installation procedures describe lifting and lowering the engine out from above the machine.

Removal (Fig. 8)

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

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

3. Remove battery and battery tray from machine.

4. Remove the front fenders.

5. Remove the radiator (see Radiator in this chapter).

6. Detach the air cleaner hose from the R.O.P.S. bar (see Air Cleaner in this chapter).

7. Loosen the hose clamp at the intake manifold of the engine and disconnect the air cleaner hose from the engine manifold (see Air Cleaner in this chapter).

8. Remove exhaust system from engine (see Exhaust System Removal in this chapter).

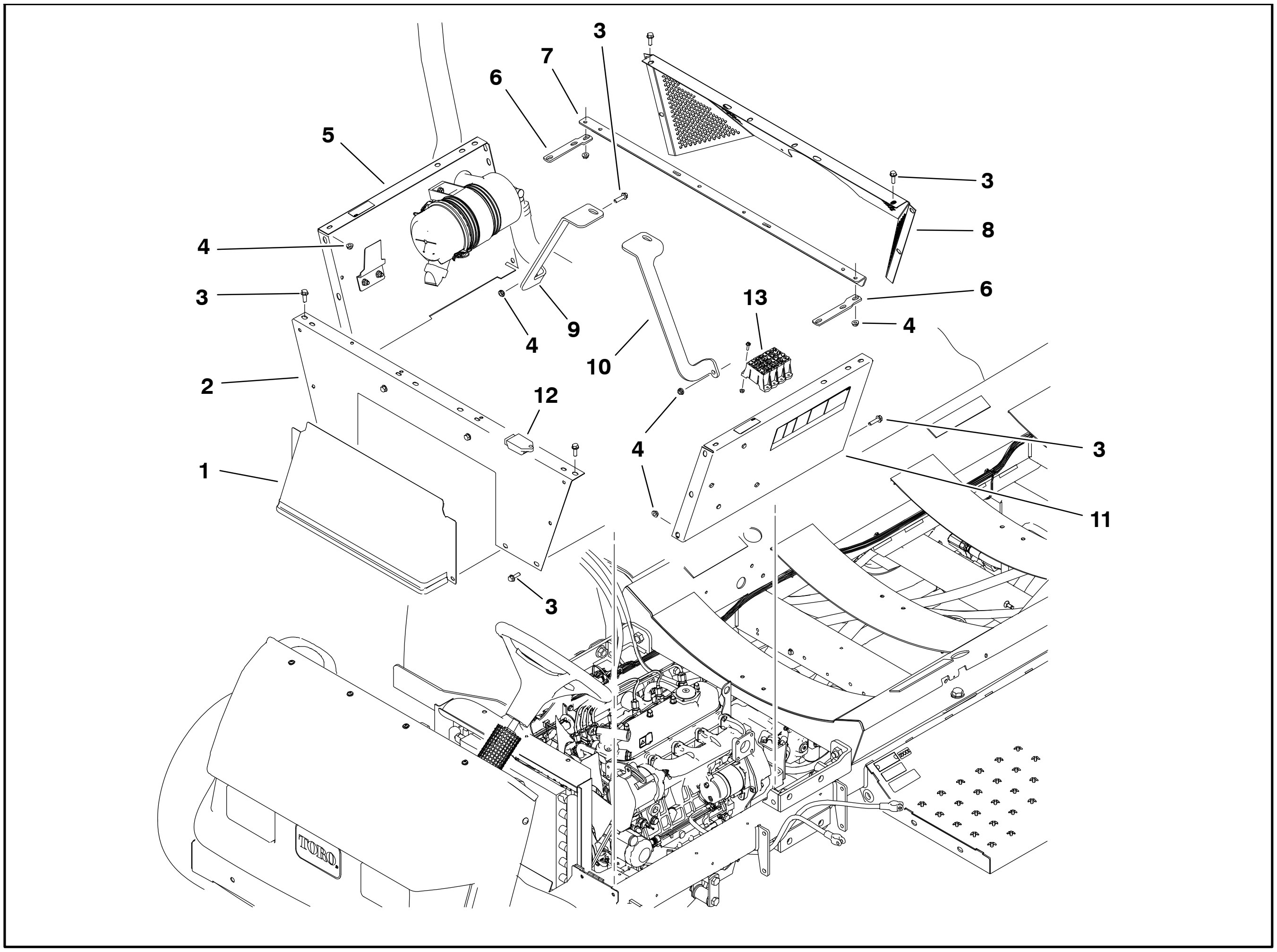


Figure 9

1. **Access panel**
2. **Seat base – front**
3. **Washer head screw (20)**
4. **Flange nut (20)**
5. **Seat base – RH**
6. **Support strap (2)**
7. **Cross member**
8. **Engine shroud**
9. **Cross member support – RH**
10. **Cross member support – LH**
11. **Seat base – LH**
12. **Glow plug controller**
13. **Fuse block**

9. Depending on the type of engine hoist you use, you may wish to remove the R.O.P.S. bar from the machine.

10. Remove spray tank (see Spray Tank in the Spray System chapters in this manual).

11. Remove engine shroud from back of seat base (Fig. 9).

12. Label the wire harness connector at the glow plug controller attached to the front seat base panel (Fig. 9).

13. Label the wire harness connectors at the relays and ground terminal block attached to the left side seat base panel.

14. Remove the fuse block from the mounting bracket on the left side seat base panel.

15. Remove seat base panels (left side, right side and front), rear cross member and cross member supports from machine (Fig. 9).

CAUTION

Hydraulic pump assembly weighs approximately 72 pounds (33 kg). Make sure that pump assembly is well supported (from above or below) during engine removal.

16. Detach hydraulic pump assembly from engine (see Piston (Traction) Pump in Chapter 4 – Hydraulic System in this manual).

17. Label and disconnect wire harness connectors at the following locations:

A. Remove positive battery cable and fusible link connector from starter motor solenoid stud (Fig. 10).

B. Disconnect wire harness connector from starter motor.

C. Remove cap screw and lock washer that secure negative battery cable and wire harness ground wire to engine block (Fig. 10).

D. Remove wire harness connector from glow plug terminal (Fig. 11).

E. Disconnect wire harness connector from temperature sender (Fig. 11).

F. Remove cable from alternator stud and disconnect wire harness connector from alternator (Fig. 12).

G. Disconnect wire harness connector from oil pressure switch.

H. Disconnect wire harness connector from fuel stop solenoid (Fig. 13).

18. Clamp fuel supply hose after the fuel/water separator to prevent leakage (Fig. 13). Disconnect fuel supply hose from the fuel injector pump on engine and fuel return hose from the fuel rail. Position disconnected fuel hoses away from engine.

19. Remove throttle cable from injector pump (Fig. 13):

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

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

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

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

21. Remove flange nuts, snubbing washers and cap screws securing the engine brackets to engine mounts (Fig. 8).

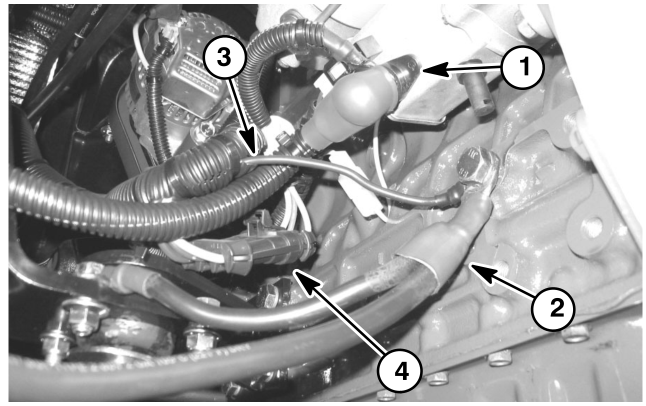


Figure 10

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

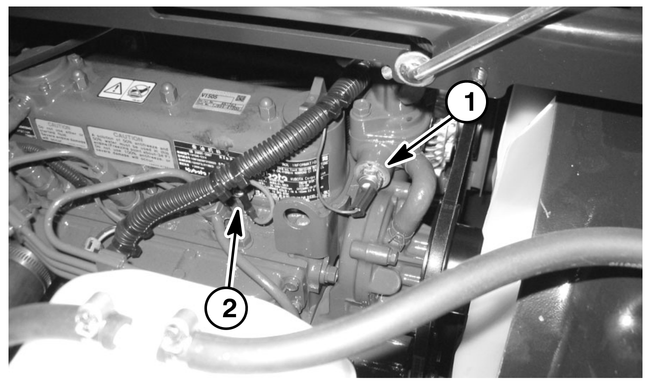


Figure 11

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

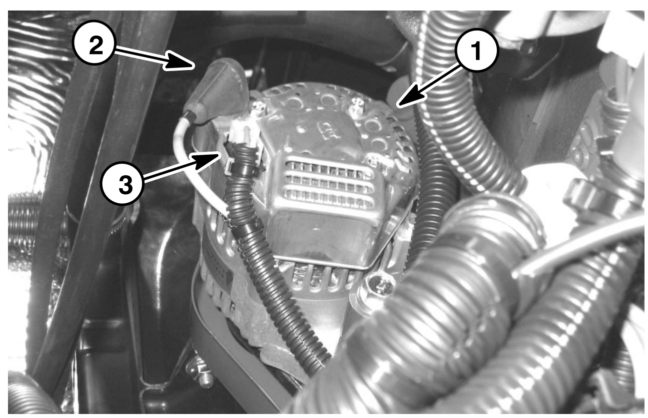


Figure 12

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

⚠ CAUTION

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

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

22. Using a hoist and the lifting lugs provided on the engine, carefully lift the engine from the machine.

23. If necessary, remove engine brackets, pump adapter and flywheel coupler from the engine, or engine mounts from frame.

Installation (Fig. 8)

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

2. Make sure that all parts removed from the engine during maintenance or rebuilding (including engine mount brackets) are reinstalled to the engine assembly.

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

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

⚠ CAUTION

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

4. Using a hoist and the lifting lugs provided on the engine, carefully lift the engine into the machine. Insert cap screws through engine brackets and motor mounts from above. Install snubbing washers and flange nuts on cap screws and tighten (Fig. 8).

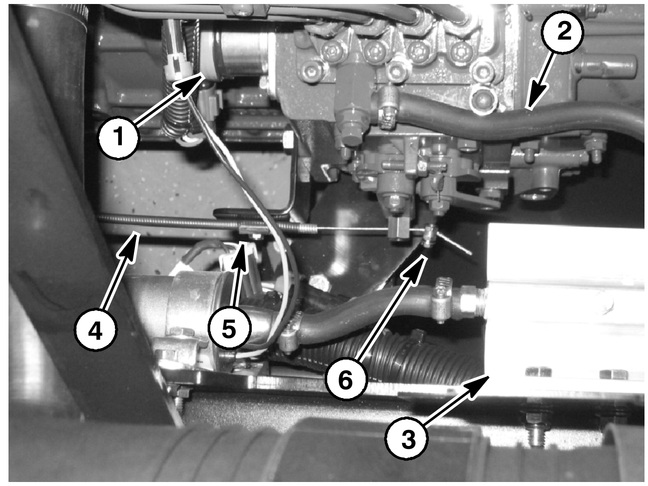


Figure 13

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

5. Connect throttle cable to injector pump (Fig. 13):

   A. Position throttle cable to engine.

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

   C. Position throttle cable under cable clamp.

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

6. Connect fuel supply hose to the fuel injector pump and fuel return hose to fuel rail on engine (Fig. 13). Remove clamp from fuel hose that was used to prevent leakage during engine removal.

7. Using labels placed during engine removal, attach all engine electrical connections (see step 17. in removal procedure).

Note: Make sure that the engine and frame ground surfaces are free from corrosion, oil and paint.

8. Torque the engine ground bolt to **34 to 42 ft-lbs (46 to 57 N-m)** and apply a coat of terminal protector.

9. 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.

10. Install hydraulic pump assembly to engine (see Piston (Traction) Pump Installation in Chapter 4 - Hydraulic System in this manual).

11. Install seat base panels (left side, right side and front), rear cross member and cross member supports to machine (Fig. 9).

12. Install fuse block to left side seat base panel.

13. Using labels placed during engine removal, attach wire harness connections at glow plug controller (front seat base panel) and relays (left side seat base panel.

14. Install engine shroud to back of seat base (Fig. 9).

15. Install spray tank (see Spray Tank in the Spray System chapters in this manual).

16. If previously removed, install the R.O.P.S. bar to the machine.

17. Install exhaust system (see Exhaust System Installation in this chapter).

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

18. Install air cleaner hoses to engine manifold and R.O.P.S. bar (see Air Cleaner in this chapter). Make sure that hose clamps are properly tightened.

19. Install the radiator (see Radiator in this chapter).

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

21. Install the front fenders.

22. Install battery and battery tray to machine.

23. Properly fill the radiator with coolant (see machine Operator's Manual).

24. Check engine oil level and adjust if necessary.

25. Connect positive (+) and then negative (-) battery cables to the battery.

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

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

Flywheel Coupler

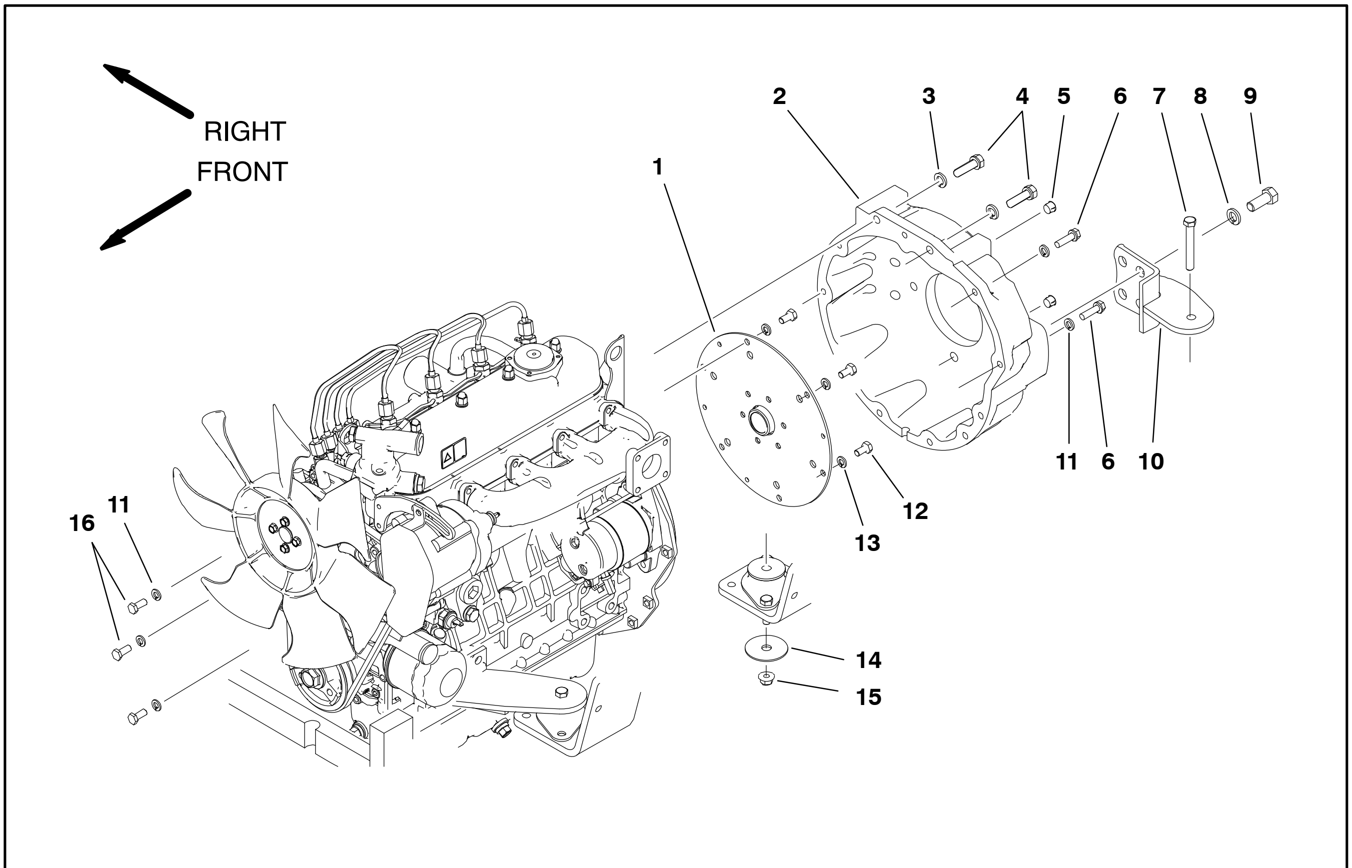


Figure 14

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

Coupler Removal (Fig. 14)

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

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

A. Remove hydraulic pump assembly (see Piston (Traction) Pump in Chapter 5 – Hydraulic System in this manual).

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

2. Remove flywheel housing and spring coupler from the engine.

3. If necessary, remove rear mount brackets from flywheel housing.

Coupler Installation (Fig. 14)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupler hub is away from engine flywheel (Fig. 15).

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

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

4. Position flywheel housing to engine. Secure flywheel housing with cap screws and lock washers. Tighten cap screws in a crossing pattern.

5. If engine is in machine:

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

   B. Install hydraulic pump assembly (see Piston (Traction) Pump Installation in Chapter 5 – Hydraulic System in this manual).

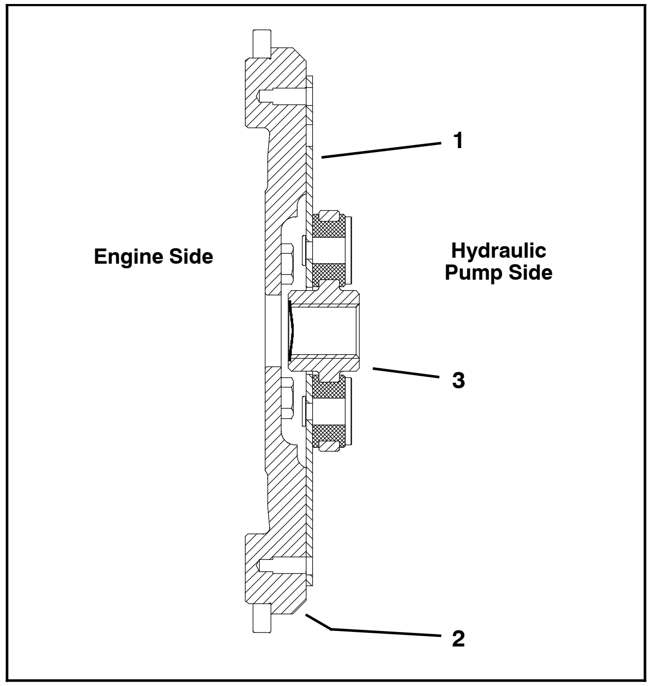


Figure 15

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

Chapter 4

Kubota Gasoline Engine

Table of Contents

Specifications

Item	Description
Make / Designation	WG1605−G−E3, Kubota, 4−Cycle, 4 Cylinder, Water Cooled, Gasoline Engine
Bore x Stroke	3.11 in x 3.09 in (79 mm x 78.4 mm)
Total Displacement	93.8 in^3 (1537 cc)
Compression Ratio	9.1:1
Ignition Timing	26 degrees BTDC @ 3000 rpm
Ignition System	Full Transistor Battery Ignition Type
Firing Order	1 – 3 – 4 – 2 (numbers start at fan end)
Low Idle (no load)	1000 RPM
High Idle (no load)	3200 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Spark Plug Type/Gap	NGK IFR6F8DN 0.028 to 0.031 in. (0.7 to 0.8 mm)
Fuel	Unleaded Gasoline (up to 10% ethanol), octane rating of 87 or higher ((R+M)/2 rating method)
Fuel Tank Capacity	12 U.S. gallons (45 liters)
Governor	Electronic
Engine Oil	API Classification SL or Higher (see Operator’s Manual for viscosity recommendations)
Oil Pump	Trochoid Type
Engine Oil Capacity (approximate)	5.4 U.S. quarts (5.1 liters) with Filter
Cooling System Capacity (approximate – including reserve tank)	5.8 U.S. quarts (5.5 liters)
Starter	12 VDC, 1.0 KW
Alternator/Regulator	12 VDC 60A
Engine Dry Weight (approximate)	262 lbs (119 kg)

General Information

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

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the Kubota gasoline engine that powers your Multi Pro 5800−G. Refer to that publication for additional information when servicing the machine.

Kubota Workshop and Troubleshooting Manuals

General maintenance procedures are described in your Operator's Manual. Information on engine testing, disassembly and reassembly is identified in the Kubota Workshop Manual (WG1605 Series) that is included at the end of this chapter. Information on engine troubleshooting and testing is identified in the Kubota Diagnosis Manual (WG1605 Series) that is included at the end of this chapter.

Most engine repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual EG1605 Series). The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Kubota Gasoline Engine

The engine used in your Multi Pro 5800−G is a Kubota WG1605 Series gasoline engine. Engine features include an electronic control module (ECM) that controls a common rail fuel injection system with direct injection, electronic throttle valve (ETV), an electronic governor and a catalytic muffler exhaust system with oxygen sensors. The ECM receives information from numerous engine sensors. The information provided allows the engine ECM to monitor and control engine operation for optimum engine performance.

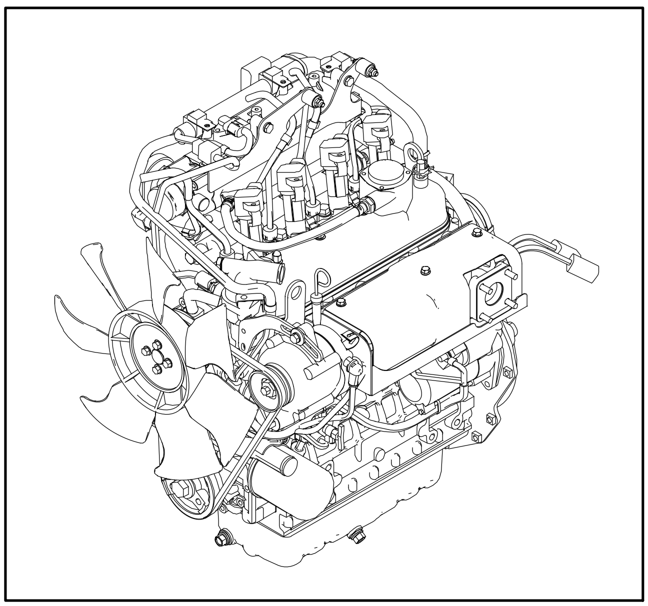


Figure 1

Kubota Gasoline Engine Electronic Control Module (ECM)

The Kubota gasoline engine that powers your Multi Pro 5800−G uses an electronic control unit (ECM) for engine management. All wire harness electrical connectors should be plugged into the ECM before the machine ignition switch is moved from the OFF position to either the ON or START position.

The engine electrical components (e.g. ECM, O2 sensor, throttle control, power relay, ETV relay) are identified and matched in the engine ECM program. If engine electrical components are replaced on the engine, the Kubota electronic tool must be used to update the ECM program which will ensure correct engine operation.

If the engine ECM identifies that an engine problem exists, an engine fault may appear on the InfoCenter Display. In addition, the engine speed may be reduced or the engine might stop. The Kubota Gasoline Service Tool (KGST) and software, and the Kubota Diagnosis Manual − ECM System should be used to provide assistance in identifying the cause of the problem and any repairs that are necessary. Contact your Toro distributor for assistance in Kubota engine troubleshooting.

IMPORTANT: Do not plug or unplug the engine ECM for a period of thirty (30) seconds after the machine key switch is turned OFF. The ECM may remain energized even though the ignition switch is OFF.

If the engine ECM is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the engine ECM. Also, to prevent possible ECM damage when welding on the machine, disconnect and remove the engine ECM from the machine before welding.

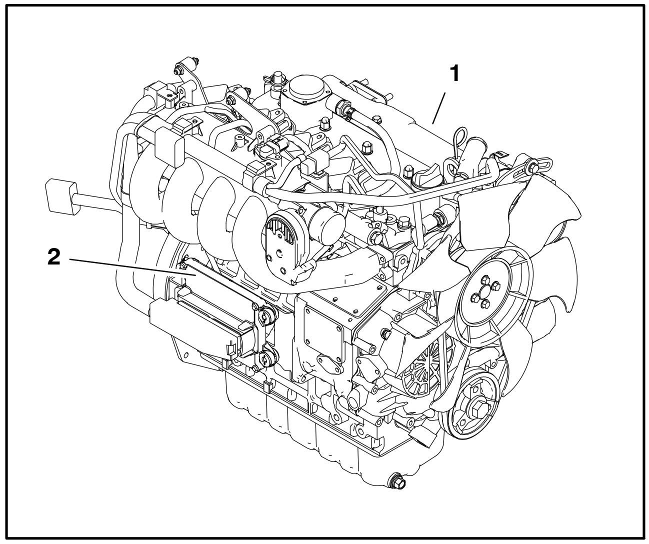


Figure 2

1. **Gasoline engine**
2. **Engine ECM**

Fuel Tank

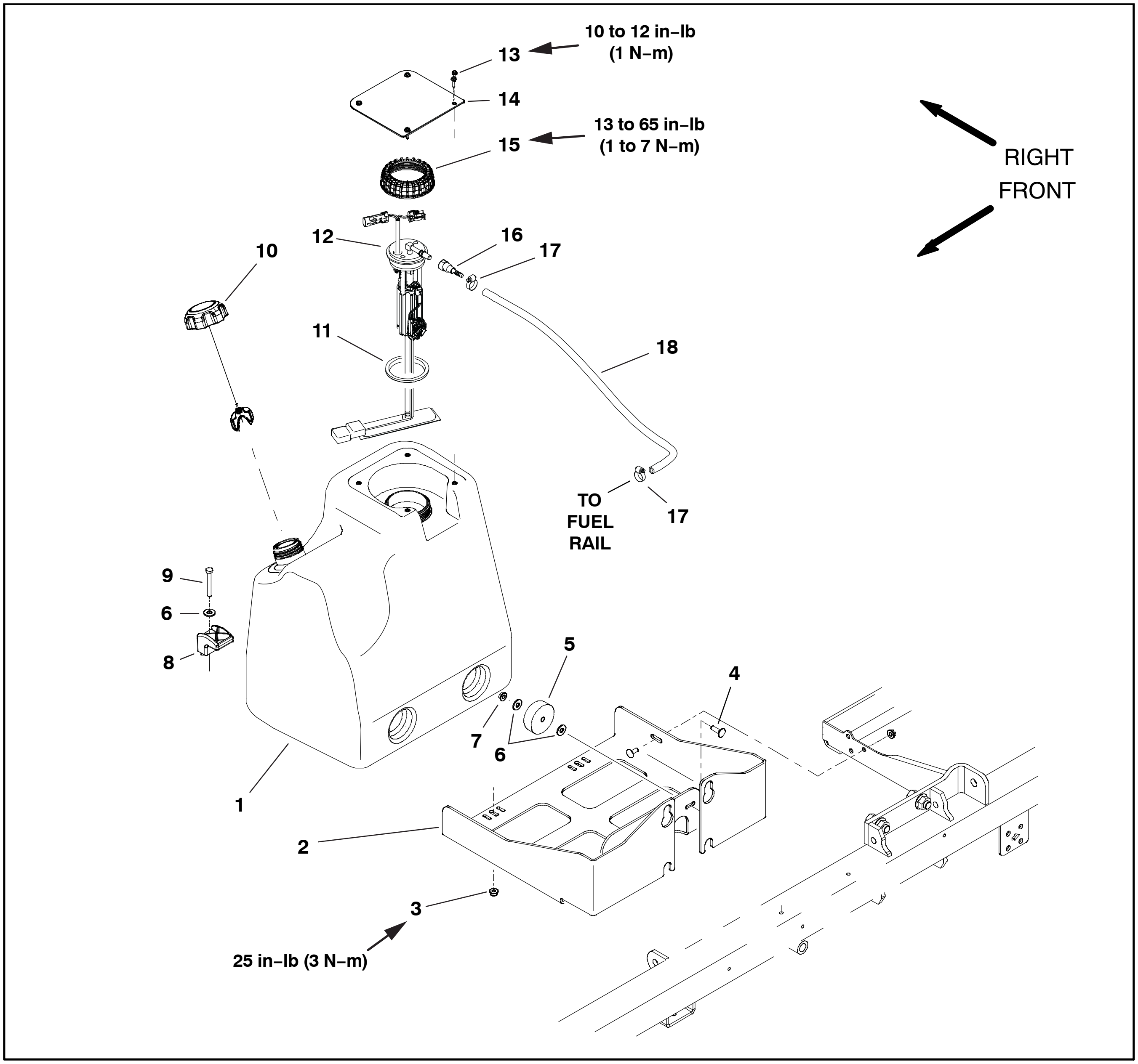


Figure 3

1. Fuel tank
2. Base
3. Flange nut (2)
4. Carriage bolt (2)
5. Rubber bumper (2)
6. Flat washer (6)
7. Flange nut (2)
8. Clamp (2)
9. Cap screw (2)
10. Fuel fill cap
11. Gasket
12. Fuel pump/level sender
13. Flange head screw (4)
14. Tank cover
15. Fuel pump/level sender cap
16. Barb fitting (2)
17. Hose clamp (2)
18. Fuel hose − supply

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 diesel fuel for the engine only; not for any other purpose.

Check Fuel Lines and Connections

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

Empty and Clean Fuel Tank

Empty and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

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

Fuel Tank Removal (Fig. 3)

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

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

3. Remove the fuel tank cover. For machines with an evaporative control system, remove the carbon canister from the fuel tank cover/canister bracket if necessary.

4. Disconnect the fuel pump/level sender form the machine wire harness (2 connectors).

CAUTION

Fuel in supply line may be under pressure. Cover supply hose barb fitting with rag while disconnecting to absorb any fuel leakage.

5. Disconnect the fuel supply hose from the fuel pump/level sender.

A. Lift supply hose barb fitting lock up to unlock fitting (Fig. 4).

B. Press barb fitting tab and pull fitting from fuel pump/level sender.

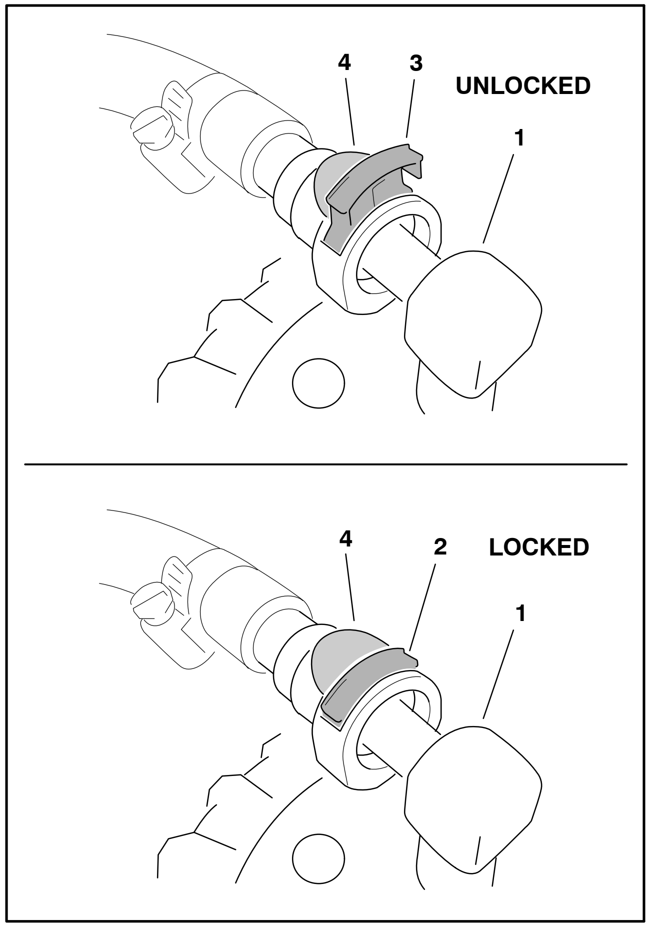


Figure 4

1. Fuel pump/level sender fitting
2. Barb fitting lock (locked − down)
3. Barb fitting lock (unlocked − up)
4. Barb fitting tab

6. Remove two (2) fuel tank clamps from base and remove fuel tank from machine. Check condition of fuel tank rubber bumpers and replace if worn or damaged.

7. If necessary, remove fuel pump/level sender from tank. Check condition of gasket and replace if worn or damaged. See Fuel Pump/Level Sender in Chapter − 6 Electrical System for testing information. Check and replace fuel filter at fuel pump/level sender pickup as necessary (see machine Operator's Manual).

8. If necessary, remove fuel hose from machine. Record fuel hose routing for assembly purposes.

Fuel Tank Installation (Fig. 3)

1. If fuel hose were removed from machine, route fuel hose through machine as recorded during removal. Make sure that clearance exists between fuel hose and machine components along full length of hoses.

2. Secure fuel tank to machine with two (2) clamps at base. Tighten clamp fasteners to **25 in−lbs (3 N−m)**.

3. Install fuel pump/level sender if previously removed from tank. Tighten fuel pump/level sender cap from **13 to 65 in−lbs (1 to 7 N−m)**.

4. Connect fuel hose to top of fuel tank.

A. Push supply hose barb fitting onto fuel pump/level sender until an audible *“Click”* is heard.

B. Press barb fitting lock down to lock fitting in place (Fig. 4).

5. Connect machine wire harness to fuel pump/level sender (2 connectors)

6. Install fuel tank cover and tighten cover screws from **10 to 12 in−lbs (1 N−m)**.

7. Fill fuel tank. Start engine and check fuel line connections for leaks.

Evaporative Control System (machine serial numbers above 405700000)

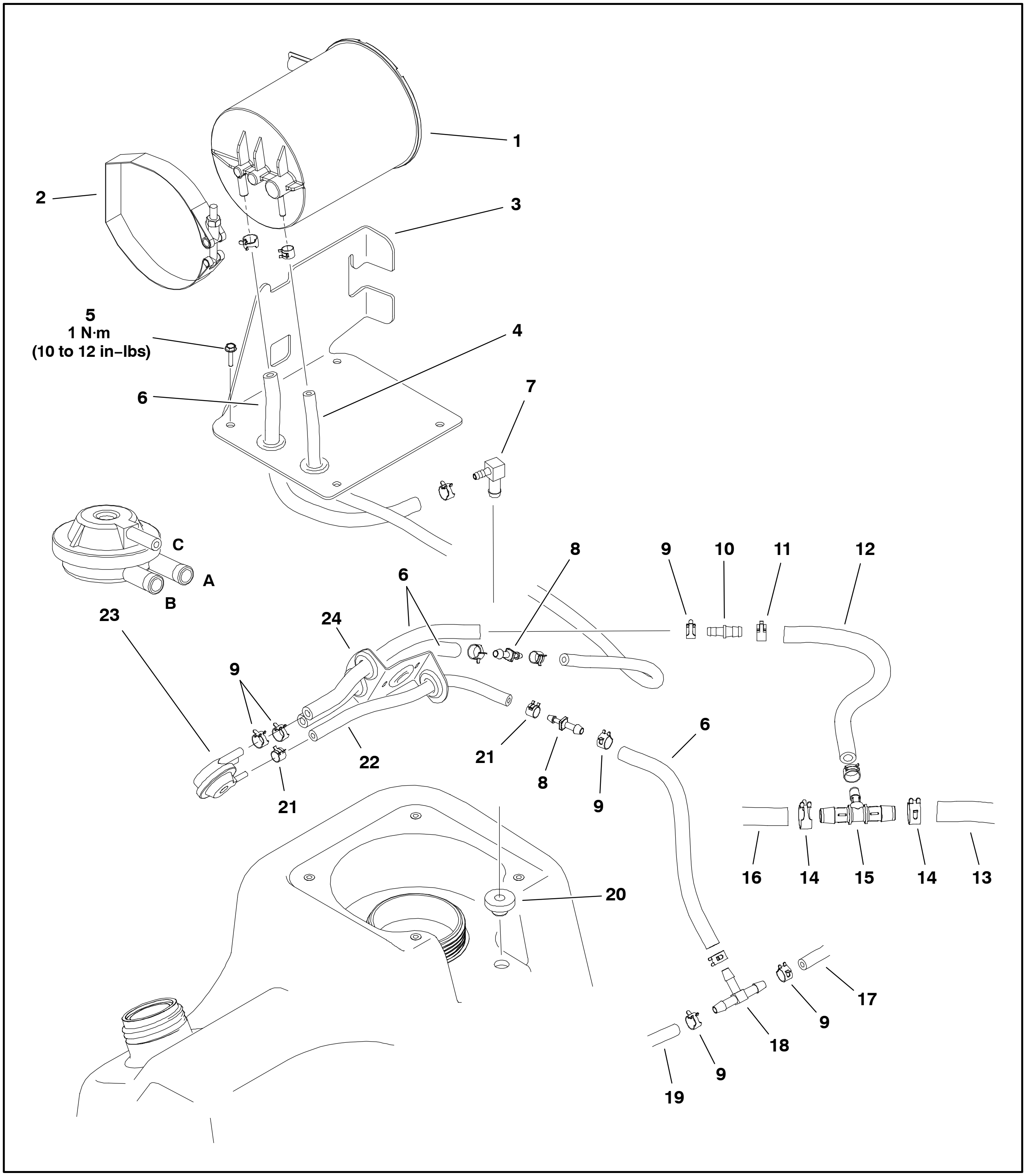


Figure 5

1. Carbon canister
2. Clamp
3. Canister bracket
4. Hose – fuel
5. Flange head screw (4)
6. Hose – fuel
7. Elbow fitting
8. Straight fitting (2)
9. Clamp (10)
10. Straight fitting
11. Clamp (2)
12. Hose – fuel (4)
13. Hose – fuel (to valve cover)
14. Clamp (2)
15. Tee fitting
16. Hose – fuel (to air intake)
17. Hose vacuum (to PCV valve)
18. Tee fitting
19. Hose – vacuum (to intake manifold)
20. Grommet
21. Clamp (4)
22. Hose – vacuum
23. Vacuum control valve
24. Hose bracket

Multi Pro 5800−G machines (model 41394 with serial numbers above 405700000) are equipped with a fuel evaporative control system designed to collect and store evaporative emissions from the fuel tank. The evaporate control system uses a carbon canister and a series of vent hoses to collect these evaporative emissions. The fuel tank uses a non−vented fuel cap. A fuel tank vent fitting is positioned in the top of the tank that allows tank venting through a carbon canister mounted on the fuel tank. Fuel vapors from the fuel tank are vented to the canister and consumed by the engine when the engine is running.

A vacuum control valve located near the air cleaner assembly is used to control evaporative emission flow through the system. The carbon canister is connected to both the fuel tank vent and the vacuum control valve. When the engine is running, engine intake vacuum unseats the vacuum control valve which then allows vapors from the canister to flow to the engine air intake. These vapors are then consumed during engine operation. When the engine is not running, evaporative vapors remain in the fuel tank and carbon canister.

Note: If there is restriction in the carbon canister, the fuel tank vent fitting or the vent hose, the fuel tank may distort due to venting issues. If the fuel tank returns to it's normal shape when the fuel cap is removed, restriction in the evaporative control system is likely.

1. Inspect the carbon canister and attached hoses for damage or leaks. A damaged or leaking canister should be replaced.

2. Ensure all evaporative control system hoses are not kinked or pinched and are secured at each end with hose clamps.

3. Test the operation of the vacuum control valve. The valve should open (allow flow between ports A and B) when 21 to 29 mm Hg (0.8 to 1.1 inch Hg) vacuum is applied to port C.

4. Repair or replace evaporative system components as necessary.

Air Cleaner

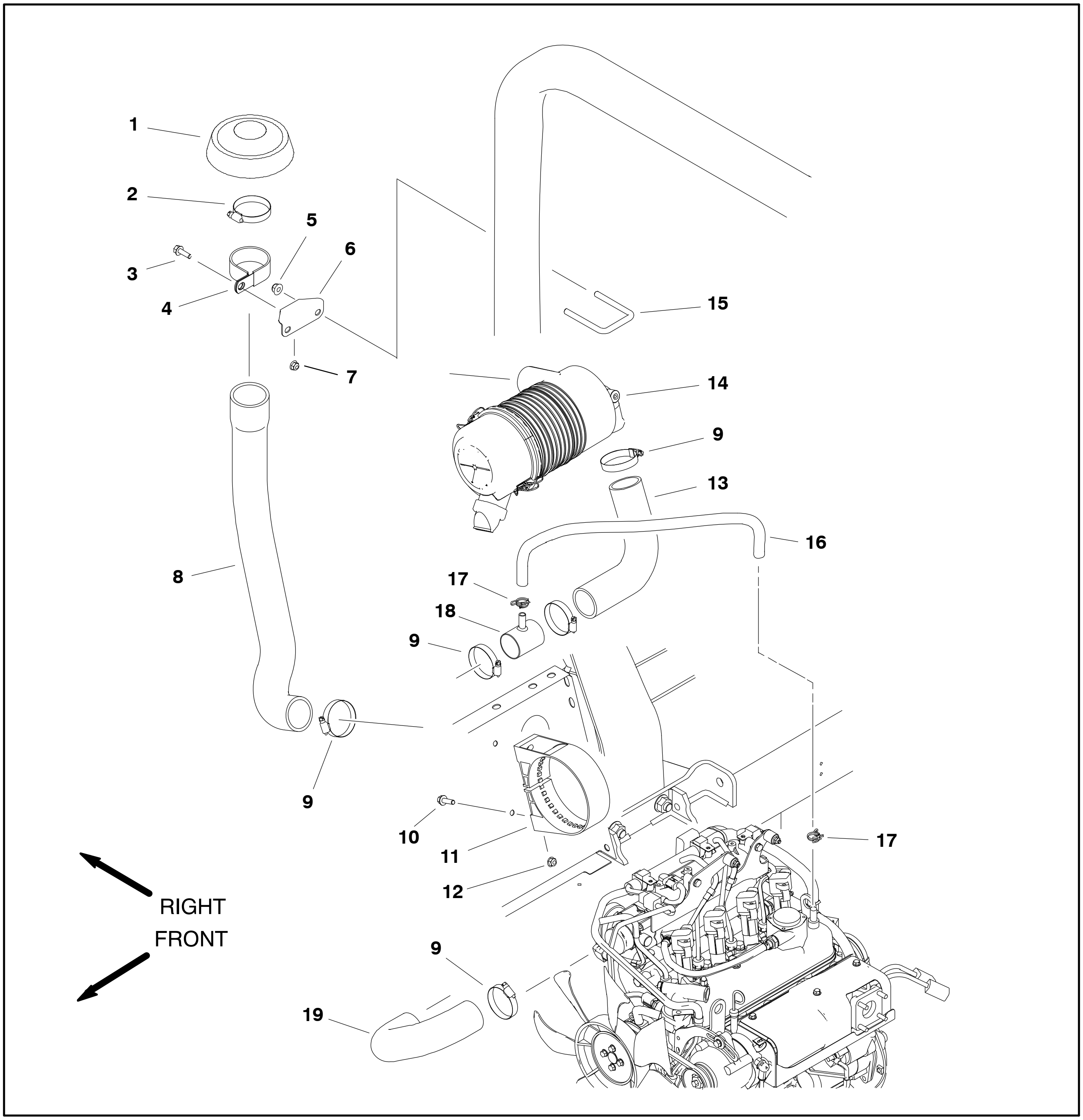


Figure 6

1. Cap
2. Hose clamp
3. Flange head screw
4. Clamp
5. Flange nut (2)
6. Bracket
7. Flange nut
8. Hose
9. Hose clamp (5)
10. Flange head screw (2)
11. Air cleaner mount
12. Flange nut (2)
13. Hose
14. Air cleaner assembly
15. U−Bolt
16. Breather hose
17. Hose clamp (2)
18. Tee
19. Hose

Removal (Fig. 6)

NOTE: For air cleaner maintenance information, see the machine Operator's Manual.

1. Raise passenger seat to access air cleaner assembly.

2. Remove air cleaner components as needed.

Installation (Fig. 6)

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

1. Assemble air cleaner system. Make sure that vacuator valve on air cleaner cover points downward after assembly (Fig. 7).

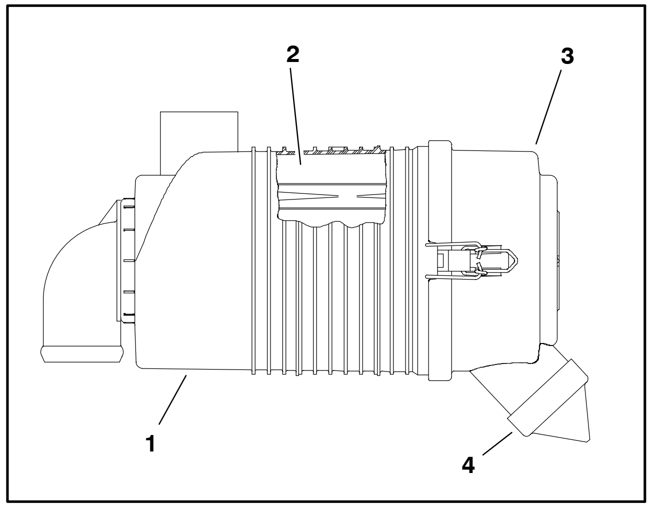


Figure 7

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

Exhaust System

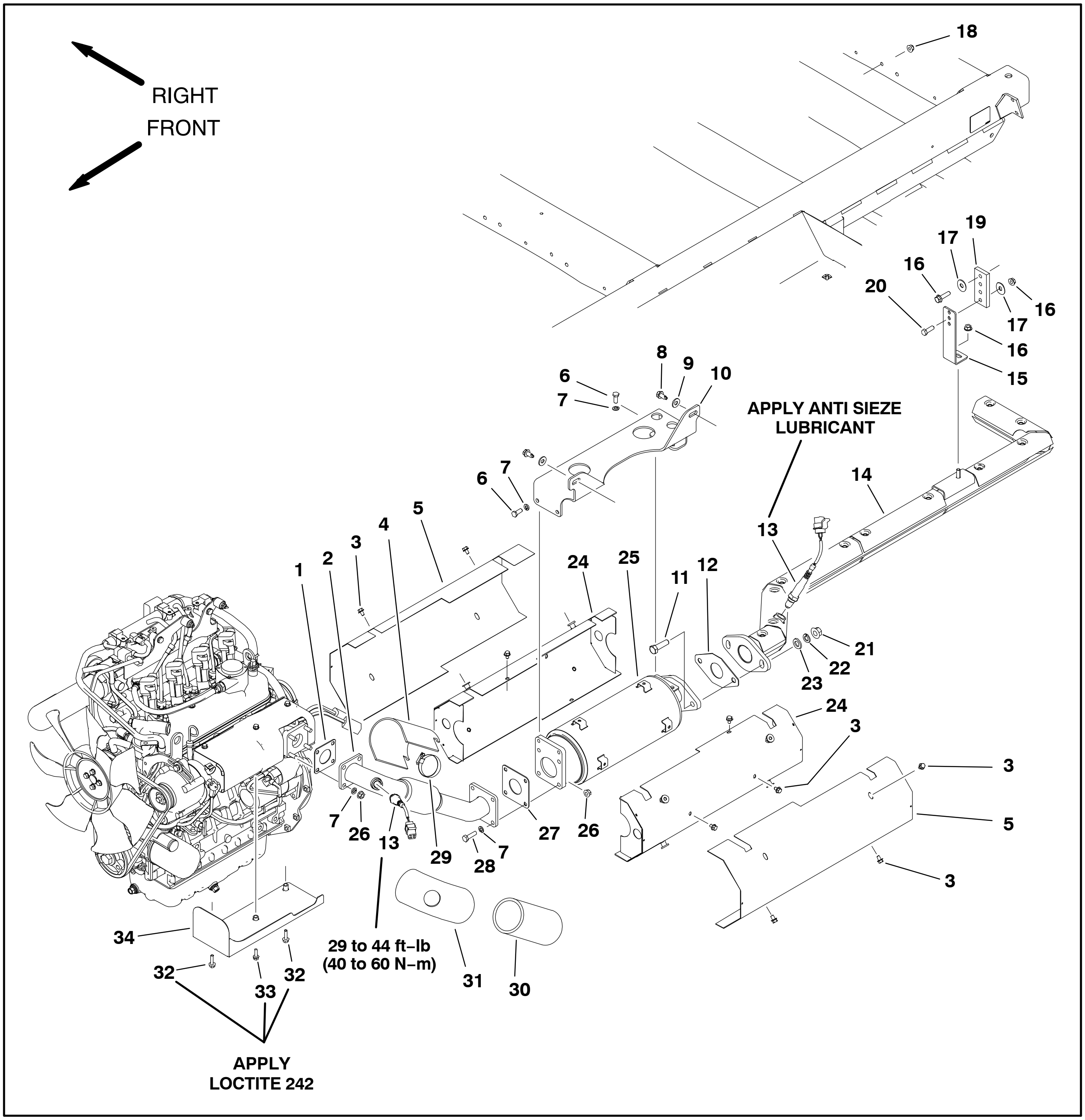


Figure 8

1. Gasket
2. Header pipe
3. Flange head screw (16)
4. Shield − composite
5. Muffler shield − outer (2)
6. Cap screw (4)
7. Lock washer (4)
8. Flange head screw (2)
9. Flat washer (2)
10. Bracket − catalyst
11. Cap screw (2)
12. Gasket
13. Oxygen sensor (2)
14. Tail pipe
15. Hanger
16. Flange nut (2)
17. Flat washer (2)
18. Flange nut
19. Rubber hanger
20. Cap screw
21. Flange nut (2)
22. Lock washer (2)
23. Flat washer (2)
24. Muffler shield − inner (2)
25. Catalytic muffler
26. Flange nut (8)
27. Gasket
28. Cap screw (4)
29. Hose clamp
30. Jacket lower
31. Jacket upper
32. Flange head screw (2)
33. Flange head screw
34. Manifold shield − bottom

CAUTION

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

Removal (Fig. 8)

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

2. Remove the rear undercarriage shroud from the machine (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

3. Disconnect rear oxygen sensor from machine wire harness and remove tail pipe.

4. Remove catalytic muffler outer and inner heat shields.

5. Disconnect catalytic muffler from header pipe and machine frame and remove muffler.

6. Disconnect front oxygen sensor from machine wire harness and remove header pipe.

7. Locate and discard exhaust system gaskets. Clean gasket surfaces on engine exhaust manifold, catalytic muffler and tail pipe.

8. Replace damaged or worn header pipe jackets or shield if necessary.

Installation (Fig. 8)

NOTE: New oxygen sensor threads come pre−coated with an anti seize compound. If a previously installed oxygen sensor is used, apply a small amount of anti−seize to the threads.

1. If installing an oxygen sensor, do not allow the tip of the sensor to touch anything as it may become contaminated. Tighten from **29 to 44 ft−lb (40 to 60 N−m)**.

2. If header pipe was removed from engine, use a new gasket and install header pipe and fasteners finger tight.

3. If catalyst muffler was removed, use a new gasket and install muffler and fasteners finger tight.

4. If tail pipe was removed from engine, use a new gasket and install pipe pipe, hanger and fasteners finger tight.

5. Tighten exhaust system components in the following order:

   A. Tighten fasteners securing header pipe to exhaust header.

   B. Tighten fasteners securing catalyst muffler to header pipe and to machine frame.

   C. Tighten fasteners securing tailpipe to catalyst muffler.

   D. Position the tailpipe so the outlet is parallel to the ground and tighten exhaust system hanger and bracket fasteners..

6. Install catalytic muffler inner and outer heat shields.

7. Install the rear undercarriage shroud to the machine (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

Radiator

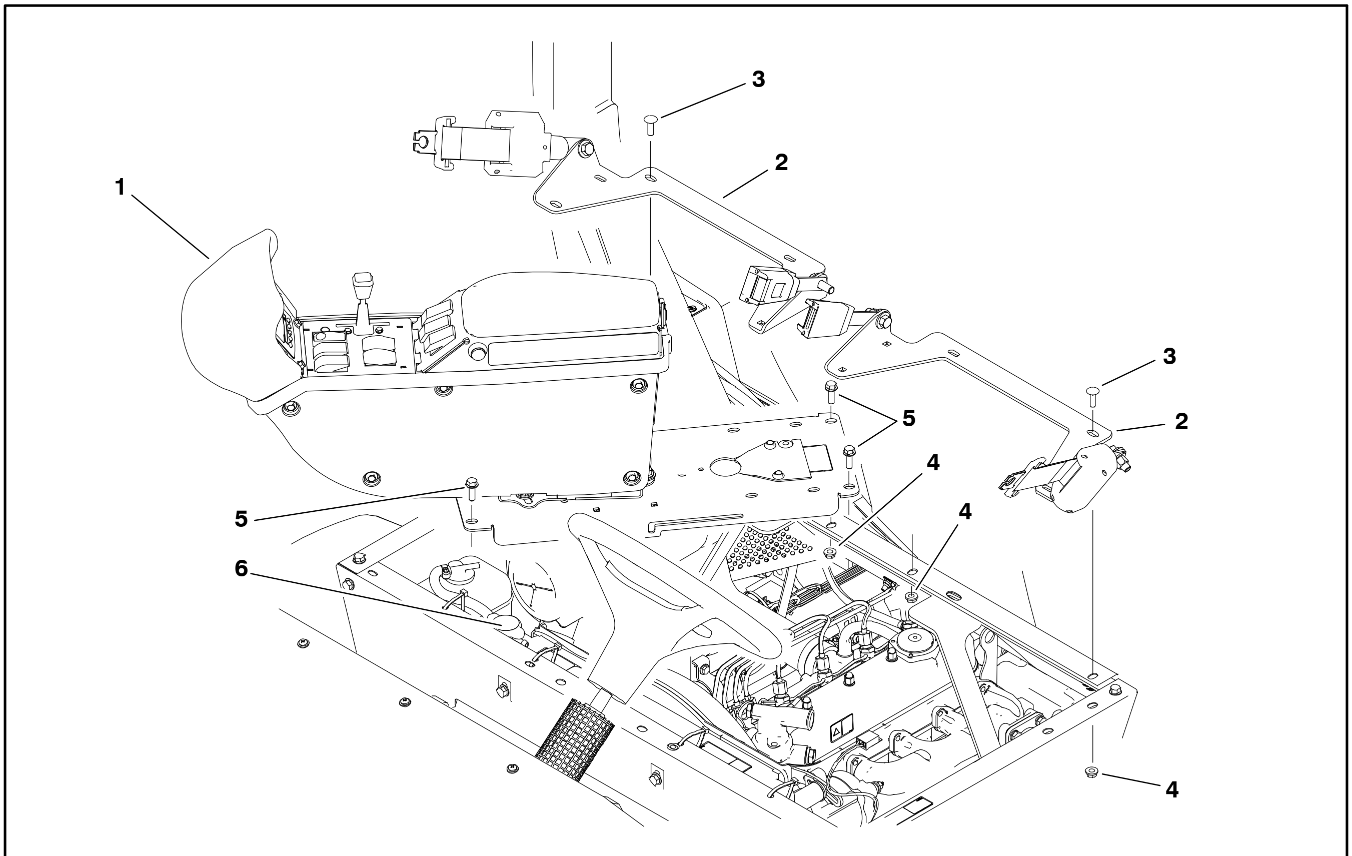


Figure 9

1. **Console assembly**
2. **Seat belt bracket assembly (2)**
3. **Carriage screw (12)**
4. **Flange nut (16)**
5. **Flange head screw (4)**
6. **Radiator**

Removal

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

2. Remove the seats and hinged seat panels from the seat box (see Seats in Chapter 9 − Chassis in this manual).

3. Remove the undercarriage shrouds from the machine (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns. Ethylene−glycol antifreeze is poisonous. Dispose of coolant properly or store it in a properly labeled container away from children and pets.

4. Drain coolant from radiator (see machine Operator's Manual). The coolant drain valve is located under the passenger seat, in the lower right corner of the radiator.

5. Loosen hose clamps that secure the upper and lower radiator hoses to the radiator and disconnect the hoses from the radiator.

6. Loosen hose clamp that secures overflow hose to radiator cap flange. Remove overflow hose from radiator.

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

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

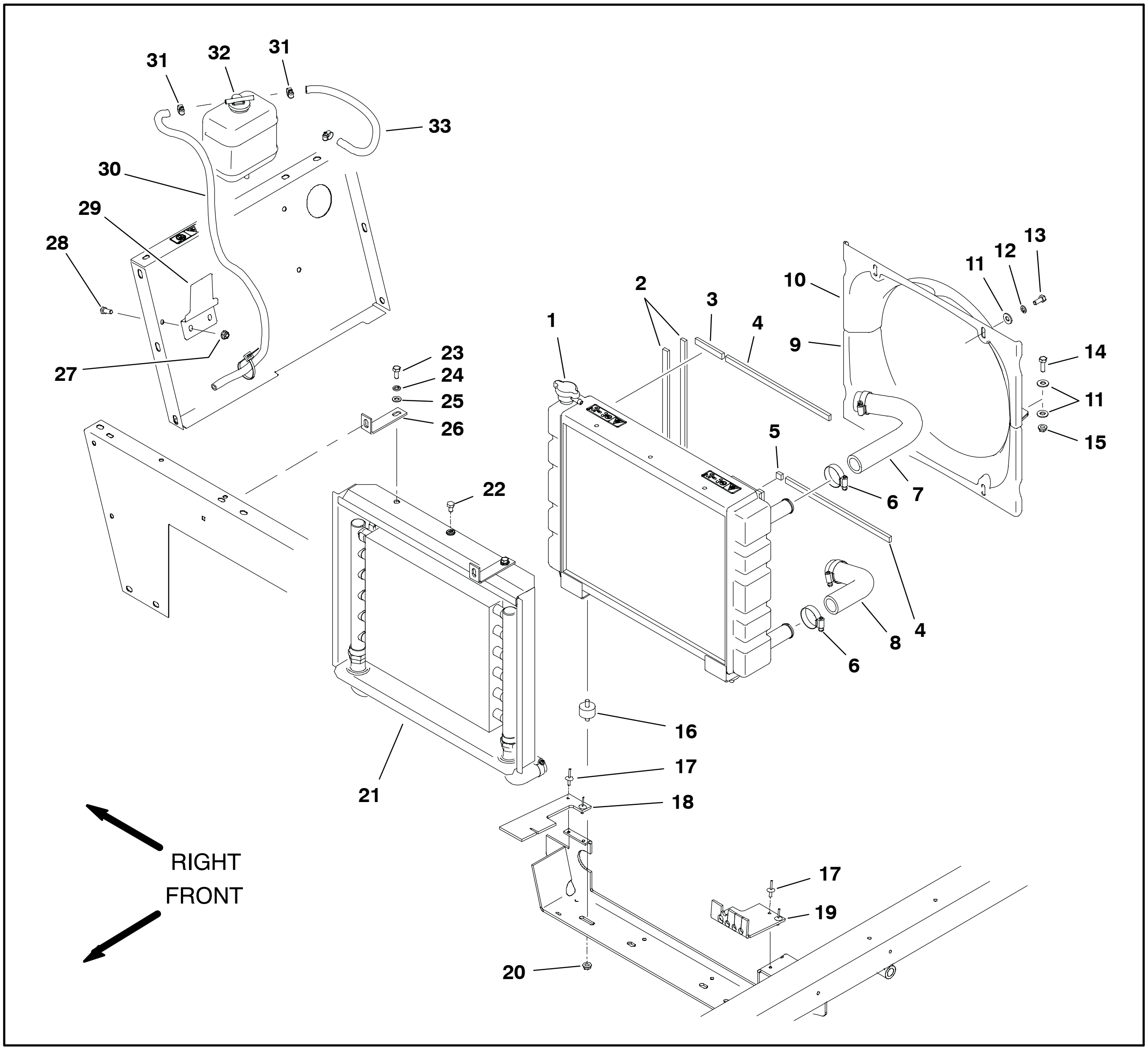


Figure 10

1. Radiator
2. Foam seal (4)
3. Foam seal
4. Foam seal (2)
5. Foam seal
6. Hose clamp (4)
7. Upper radiator hose
8. Lower radiator hose
9. Lower fan shroud
10. Upper fan shroud
11. Flat washer (8)
12. Lock washer (4)
13. Cap screw (4)
14. Cap screw (2)
15. Flange nut (2)
16. Iso−mount (2)
17. Pop rivet (4)
18. Heat baffle − RH
19. Heat baffle − LH
20. Flange nut (2)
21. Fan shroud and oil cooler
22. Cap screw (4)
23. Cap screw (2)
24. Lock washer (6)
25. Flat washer (6)
26. Bracket (2)
27. Flange nut (2)
28. Cap screw (2)
29. Overflow bottle bracket
30. Hose (vent)
31. Hose clamp (3)
32. Overflow bottle
33. Hose (radiator)

9. Remove four (4) cap screws (Fig. 10 item 13), lock washers and flat washers that secure fan shroud assembly to radiator.

10. Remove two (2) cap screws (Fig. 10 item 14), flat washers and flange nuts to separate the fan shroud halves and carefully remove the upper fan shroud from the machine.

11. Remove six (6) cap screws (Fig. 10 items 22 and 23), lock washers and flat washers that secure front radiator shroud and oil cooler (Fig. 7 item 21) to radiator.

12. Remove two (2) flange nuts (Fig. 10 item 20) that secure the iso−mounts on the bottom of the radiator to the machine frame.

13. Carefully lift radiator up and out of the machine.

14. Inspect radiator hoses and rubber iso−mounts. Replace worn or damaged components as necessary.

15.,Inspect foam radiator shroud seals and foam radiator seals in machine frame. Replace any foam seals that are damaged or deteriorated.

Installation

1. Position lower fan shroud below fan.

2. Carefully lower radiator into the machine. Secure iso−mounts on the bottom of the radiator to the machine frame with two (2) flange nuts.

3. Secure radiator to front radiator shroud and oil cooler (Fig. 10 item 21) with six (6) cap screws (Fig. 10 items 22 and 23), lock washers and flat washers.

4. Secure upper fan shroud to lower fan shroud with cap screws (Fig. 10 item 14), flat washers and flange nuts.

5. Secure fan shroud assembly to radiator with four (4) cap screws (Fig. 10 item13), lock washers and flat washers. Make sure that clearance exists between fan shrouds and fan at all points before tightening fasteners.

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

7. Carefully pivot console assembly back in position taking care to not damage wire harness or throttle cable. Install fasteners to secure console assembly to seat box assembly (Fig. 9).

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

9. Fit overflow hose to radiator flange and secure with hose clamp. Make sure overflow hose is not kinked.

10. Fill radiator with coolant (see machine Operator's Manual)

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

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

13. Install the undercarriage shrouds to the machine (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

14. Install the seats and hinged seat panels to the seat box (see Seats in Chapter 9 − Chassis in this manual).

Engine

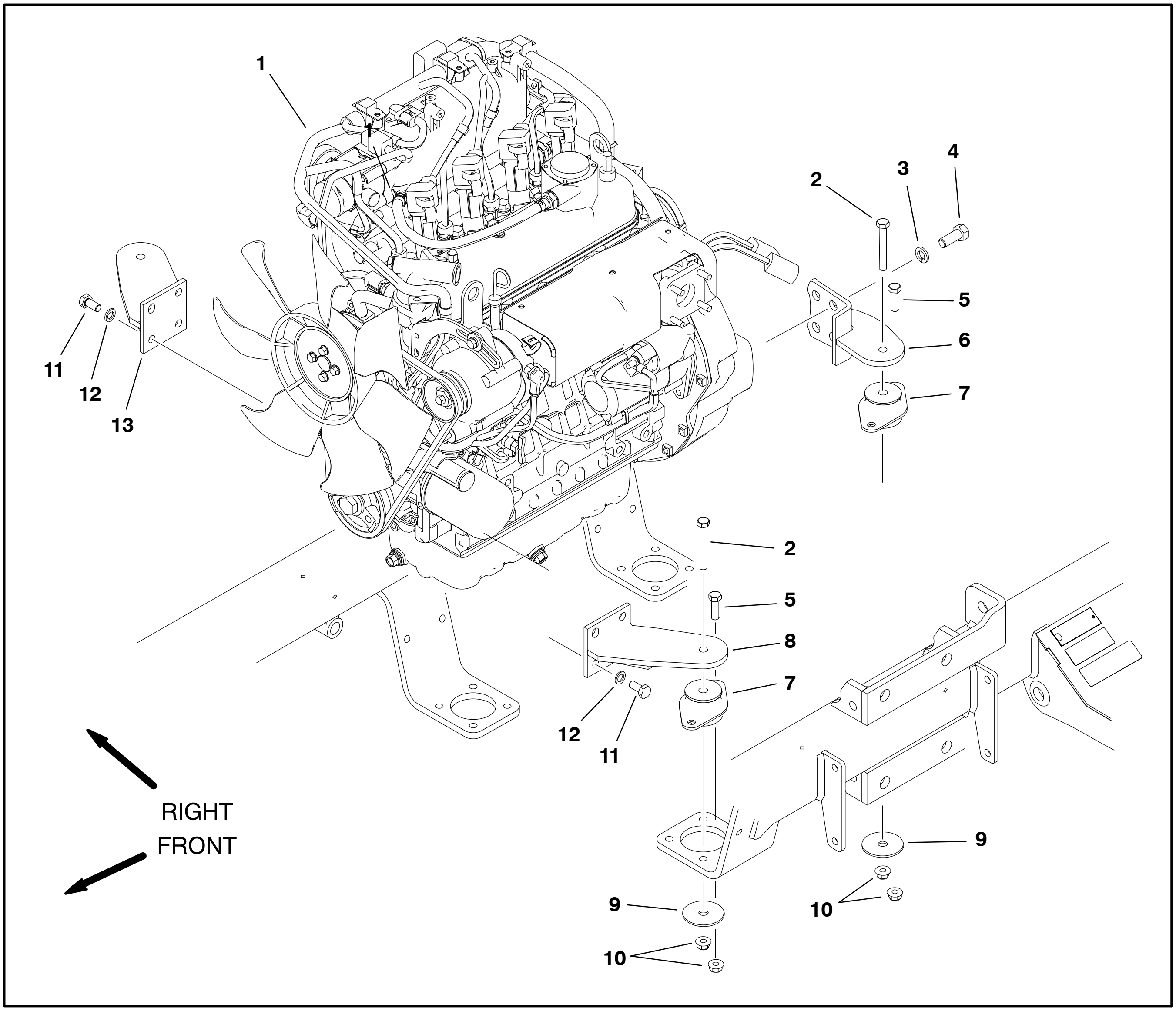


Figure 11

1. **Engine assembly**
2. **Cap screw (4)**
3. **Lock washer (8)**
4. **Cap screw (8)**
5. **Cap screw (8)**
6. **Rear engine mount bracket (2)**
7. **Engine mount (4)**
8. **Front left engine mount**
9. **Snubbing washer (4)**
10. **Flange nut (12)**
11. **Cap screw (8)**
12. **Lock washer (8)**
13. **Front right engine mount**

The following engine removal and installation procedures describe lifting and lowering the engine out from above the machine.

Removal

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

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

3. Remove battery and battery tray from machine.

4. Remove the front fenders.

5. Remove the radiator (see Radiator in this chapter).

6. Detach the air cleaner hose from the R.O.P.S. bar (see Air Cleaner in this chapter).

7. Loosen the hose clamp at the intake manifold of the engine and disconnect the air cleaner hose from the engine manifold (see Air Cleaner in this chapter).

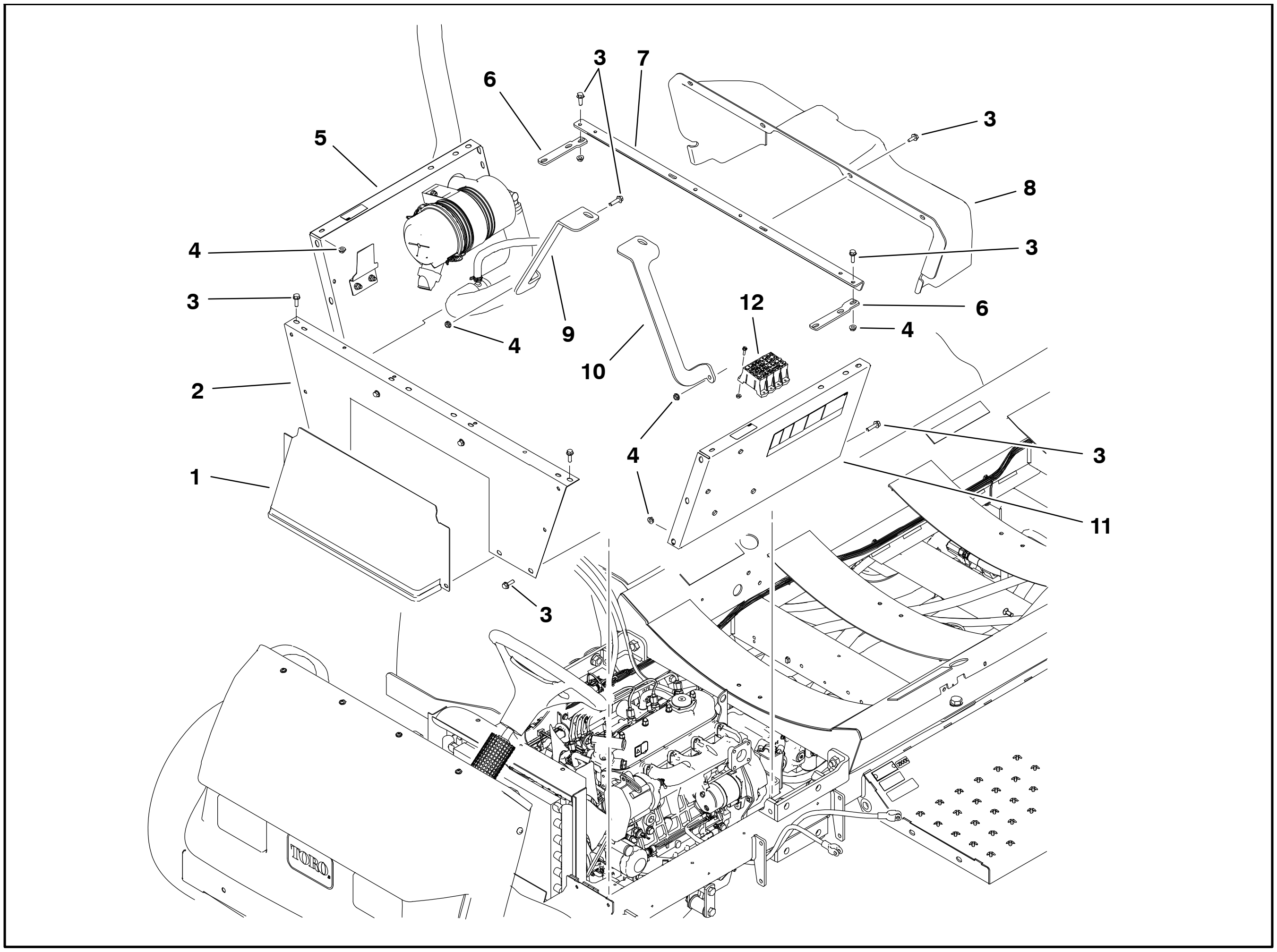


Figure 12

1. Access panel
2. Seat base – front
3. Washer head screw (20)
4. Flange nut (20)
5. Seat base – RH
6. Support strap (2)
7. Cross member
8. Engine shroud
9. Cross member support – RH
10. Cross member support – LH
11. Seat base – LH
12. Fuse block

8. Disconnect the breather hose from the engine valve cover.

9. Remove exhaust system from engine (see Exhaust System Removal in this chapter).

10. Depending on the type of engine hoist you use, you may wish to remove the R.O.P.S. bar from the machine.

11. Remove spray tank (see Spray Tank in the Spray System chapters in this manual).

12. Remove engine shroud from back of seat base (Fig. 12).

13. Label the wire harness connectors at the relays and ground terminal block attached to the left side seat base panel.

14. Remove the fuse block from the mounting bracket on the left side seat base panel.

15. Remove seat base panels (left side, right side and front), rear cross member and cross member supports from machine (Fig. 12).

CAUTION

Hydraulic pump assembly weighs approximately 72 pounds (33 kg). Make sure that pump assembly is well supported (from above or below) during engine removal.

16. Detach hydraulic pump assembly from engine (see Piston (Traction) Pump in Chapter 4 – Hydraulic System in this manual).

NOTE: Separate the Yanmar engine wire harness from the machine wire harness and remove the engine with the Yanmar engine wire harness connected to the individual engine electrical components.

17. Label and disconnect wire harness connectors at the following locations:

A. Remove positive battery cable and wire harness connector from starter motor (Fig. 13).

B. Remove cap screw and lock washer that secure negative battery cable and wire harness ground wire to engine block (Fig. 13).

C. Disconnect the 16 pin interconnect between the Yanmar engine wire harness and the machine wire harness. The interconnect is located on the right side of engine near the engine power center (Fig. 14).

18. Clamp fuel supply hose near the engine fuel rail to prevent leakage (see Fuel System in this chapter). Disconnect fuel supply hose from the fuel rail and position disconnected fuel hose away from engine.

19. Record location of any cable ties used to secure the wiring harness, fuel line or hydraulic hoses to the engine assembly. Remove cable ties attached to engine assembly.

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

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine assembly weighs approximately 295 pounds (134 kg).

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

21. Using a hoist and the lifting lugs provided on the engine, carefully lift the engine from the machine.

22. If necessary, remove engine brackets, pump adapter and flywheel coupler from the engine, or engine mounts from frame.

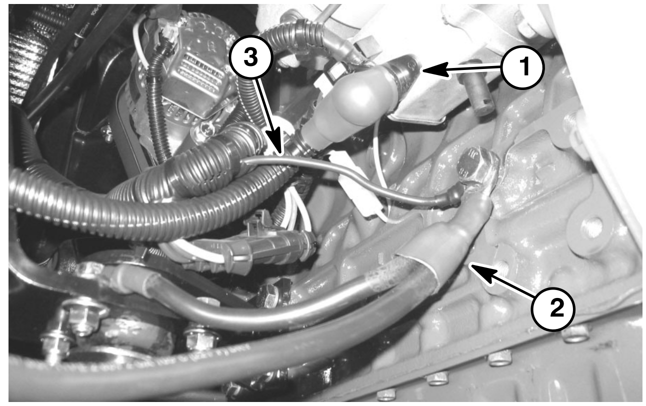


Figure 13

1. **Starter motor stud**
2. **Negative battery cable**
3. **Harness ground wire**

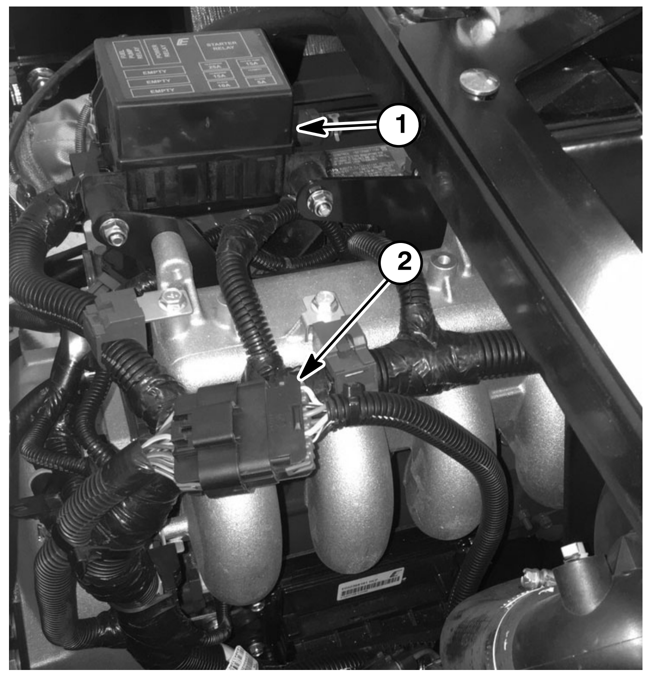


Figure 14

1. **Engine power center**
2. **16 pin interconnect**

Installation

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

2. Make sure that all parts removed from the engine during maintenance or rebuilding (including engine mount brackets, pump adapter and flywheel coupler) are reinstalled to the engine assembly.

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

CAUTION

Make sure that hoist or lift used to remove engine can properly support engine. Engine assembly weighs approximately 295 pounds (134 kg).

3. Using a hoist and the lifting lugs provided on the engine, carefully lift the engine into the machine. Insert cap screws through engine brackets and motor mounts from above. Install snubbing washers and flange nuts on cap screws and tighten (Fig. 11).

4. Connect fuel supply hose to the engine fuel rail. Remove clamp from fuel hose that was used to prevent leakage during engine removal.

5. Using labels placed during engine removal, attach all engine electrical connections (see step 17. in removal procedure).

Note: Make sure that the engine and frame ground surfaces are free from corrosion, oil and paint.

6. Torque the engine ground bolt to **34 to 42 ft-lbs (46 to 57 N-m)** and apply a coat of terminal protector.

7. 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.

8. Install hydraulic pump assembly to engine (see Piston (Traction) Pump Installation in Chapter 4 - Hydraulic System in this manual).

9. Install seat base panels (left side, right side and front), rear cross member and cross member supports to machine (Fig. 12).

10. Install fuse block to left side seat base panel.

11. Using labels placed during engine removal, attach wire harness connections at glow plug controller (front seat base panel) and relays (left side seat base panel.

12. Install engine shroud to back of seat base (Fig. 12).

13. Install spray tank (see Spray Tank in the Spray System chapters in this manual).

14. If previously removed, install the R.O.P.S. bar to the machine.

15. Install exhaust system (see Exhaust System Installation in this chapter).

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

16. Install air cleaner hoses to engine manifold and R.O.P.S. bar (see Air Cleaner in this chapter). Make sure that hose clamps are properly tightened.

17. Install the radiator (see Radiator in this chapter).

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

19. Install the front fenders.

20. Install battery and battery tray to machine.

21. Properly fill the radiator with coolant (see machine Operator's Manual).

22. Check engine oil level and adjust if necessary.

23. Connect positive (+) and then negative (-) battery cables to the battery.

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

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

Flywheel Coupler

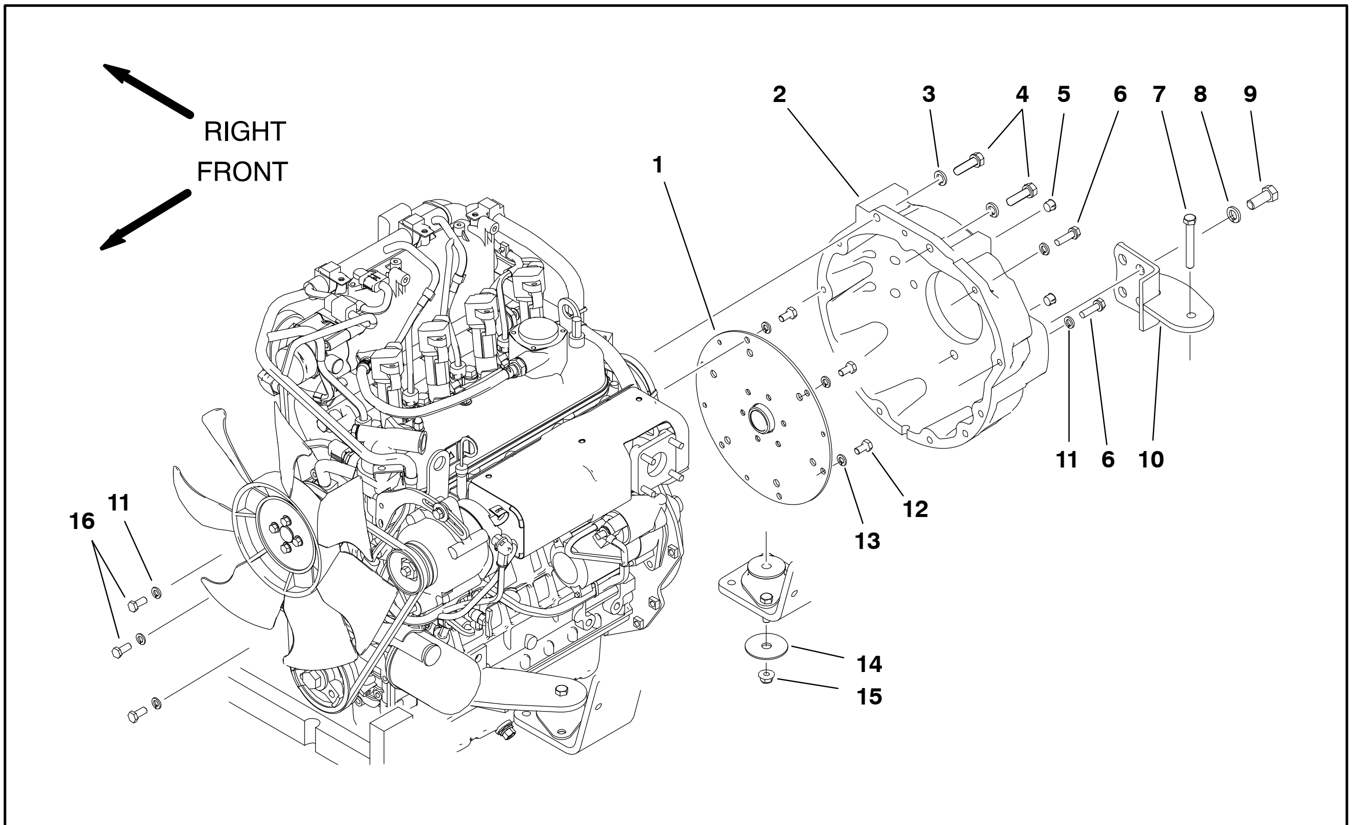


Figure 15

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

Coupler Removal (Fig. 15)

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

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

   A. Remove hydraulic pump assembly (see Piston (Traction) Pump in Chapter 5 – Hydraulic System in this manual).

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

2. Remove flywheel housing and spring coupler from the engine.

3. If necessary, remove rear mount brackets from flywheel housing.

Coupler Installation (Fig. 15)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupler hub is away from engine flywheel (Fig. 16).

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

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

4. Position flywheel housing to engine. Secure flywheel housing with cap screws and lock washers. Tighten cap screws in a crossing pattern.

5. If engine is in machine:

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

   B. Install hydraulic pump assembly (see Piston (Traction) Pump Installation in Chapter 5 – Hydraulic System in this manual).

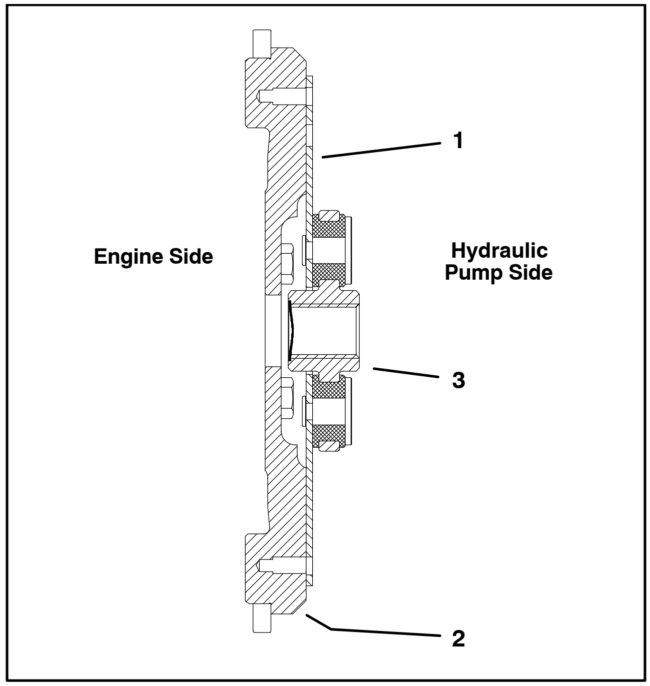


Figure 16

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

Chapter 5

Hydraulic System

Table of Contents

Specifications

Item	Description
Piston (Traction) Pump Maximum Displacement (per revolution) System Relief Pressure: Forward System Relief Pressure: Reverse	Variable displacement piston pump (Eaton model 72400) 2.48 in^3 (40.6 cc) 4000 PSI (276 bar) 4000 PSI (276 bar)
Charge Pump Displacement (per revolution) Charge Pressure	Positive displacement gear type pump (integral in piston (traction) pump) 0.42 in^3 (6.9 cc) 250 to 300 PSI (17 to 21 bar)
Gear Pump Front section (spray pump drive) displacement (per revolution) Rear section (steering/boom lift) displacement (per revolution)	2 section, positive displacement gear type pump 0.95 in^3 (15.6 cc) 0.34 in^3 (5.6 cc)
Rear Wheel Motors Displacement (per revolution)	Fixed displacement piston motor (Eaton model 74318) 2.48 in^3 (40.6 cc)
Spray Pump Motor Displacement (per revolution)	Orbital rotor motor (Parker series TE) 6.0 in^3 (100 cc)
Spray Pump Circuit Relief Pressure	2000 PSI (138 bar)
Steering Control Valve Displacement (per revolution)	Rotary valve steering unit with power beyond (Sauer Danfoss series OSPM) 4.3 in^3 (70 cc)
Steering/Boom Lift Circuit Relief Pressure	1015 PSI (69 bar)
Hydraulic Filter In−line Suction Strainer	Spin−on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir Capacity	14 U.S. gal (53 l)
Hydraulic Oil	See Operator’s Manual

General Information

Operator’s Manual

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

Traction Circuit Component Failure

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

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

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

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

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 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

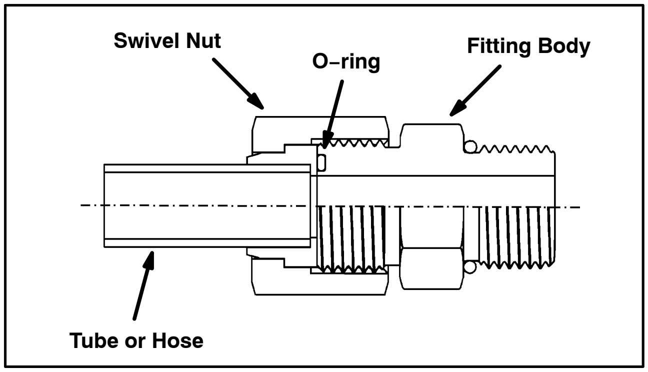


Figure 1

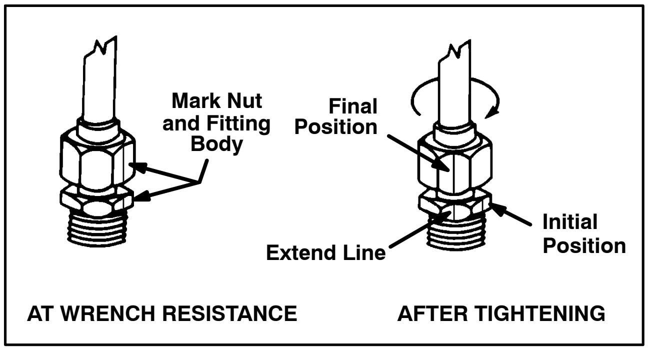


Figure 2

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

Non−Adjustable Fitting (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 hydraulic oil. Fitting threads should be clean with no lubricant applied.

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

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

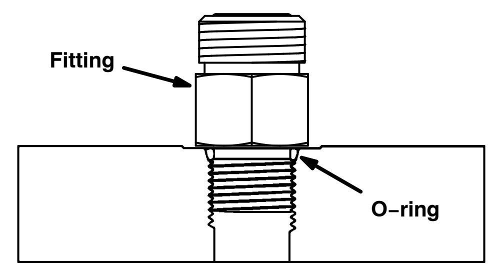


Figure 4

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

Adjustable Fitting (Fig. 6)

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

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

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

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 in Figure 7). 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

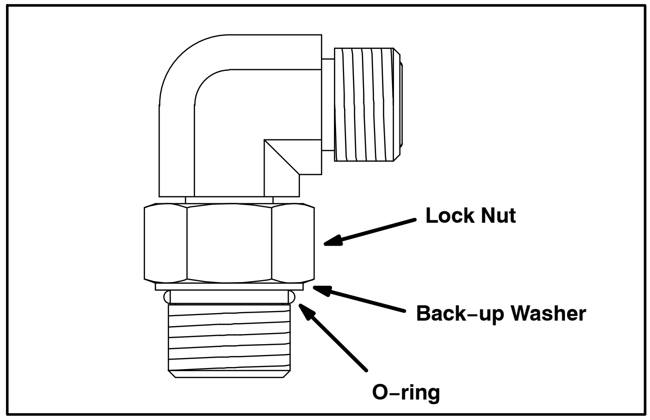


Figure 6

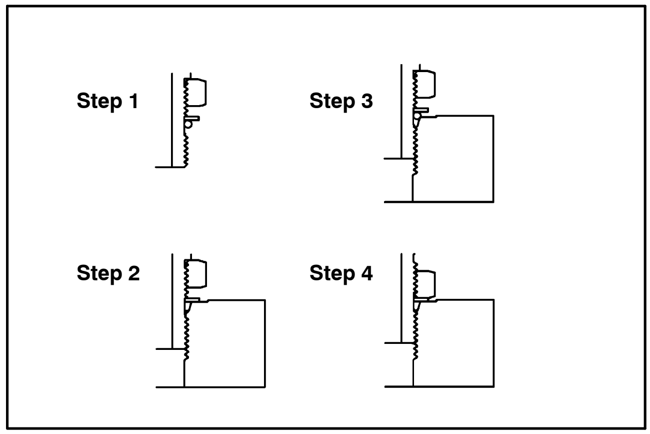


Figure 7

Hydraulic Schematics

The hydraulic schematics for the Multi Pro 5800 machines are located in Appendix A of this manual.

Hydraulic Flow Circuits

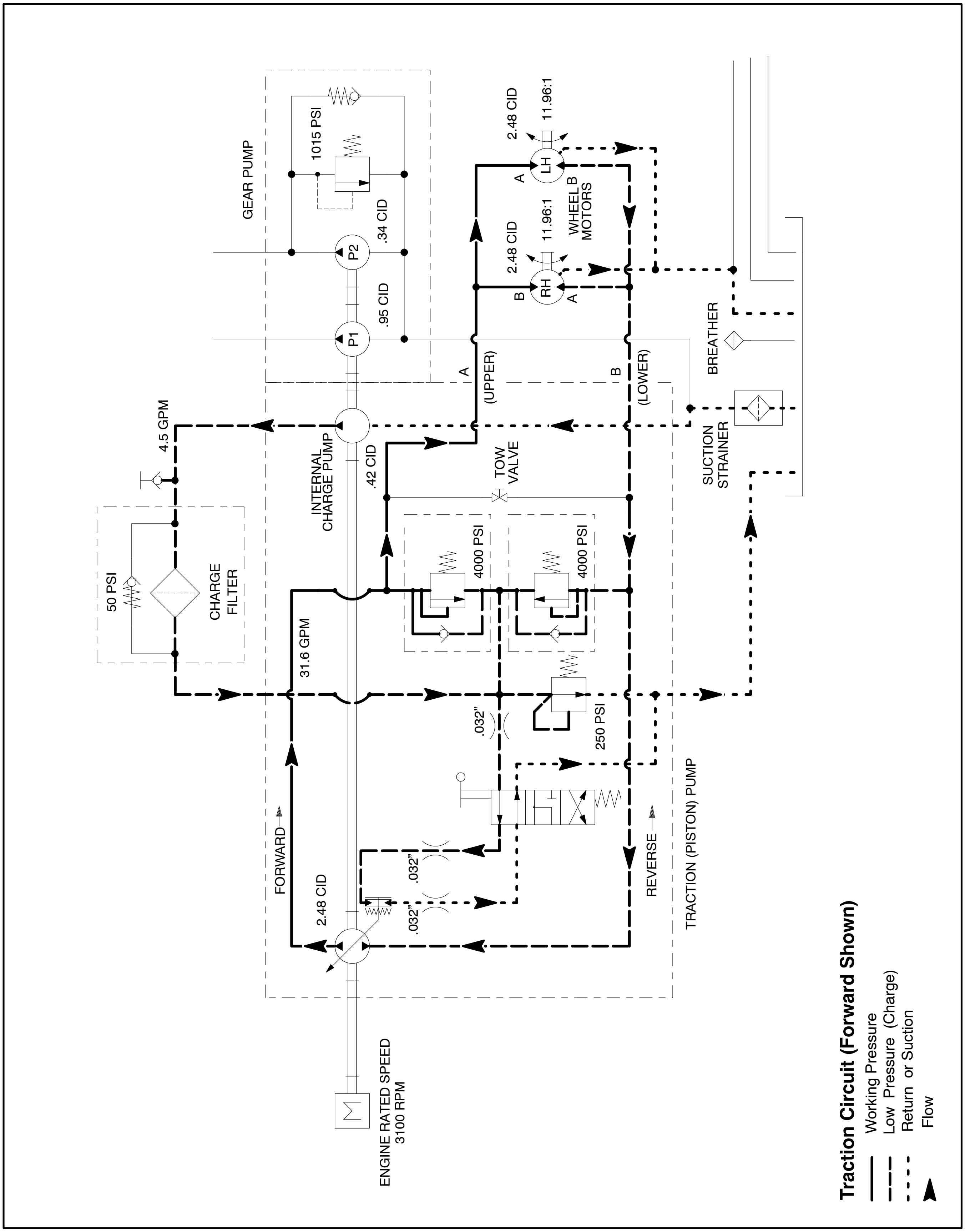


Figure 8

Traction Circuit

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

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

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

The piston (traction) pump assembly includes a charge pump that provides make–up oil for the traction circuit. This gerotor gear pump is driven by the piston pump drive shaft. It provides a constant supply of charge oil to the traction circuit to make up for oil that is lost due to internal leakage in the piston pump and wheel motors.

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

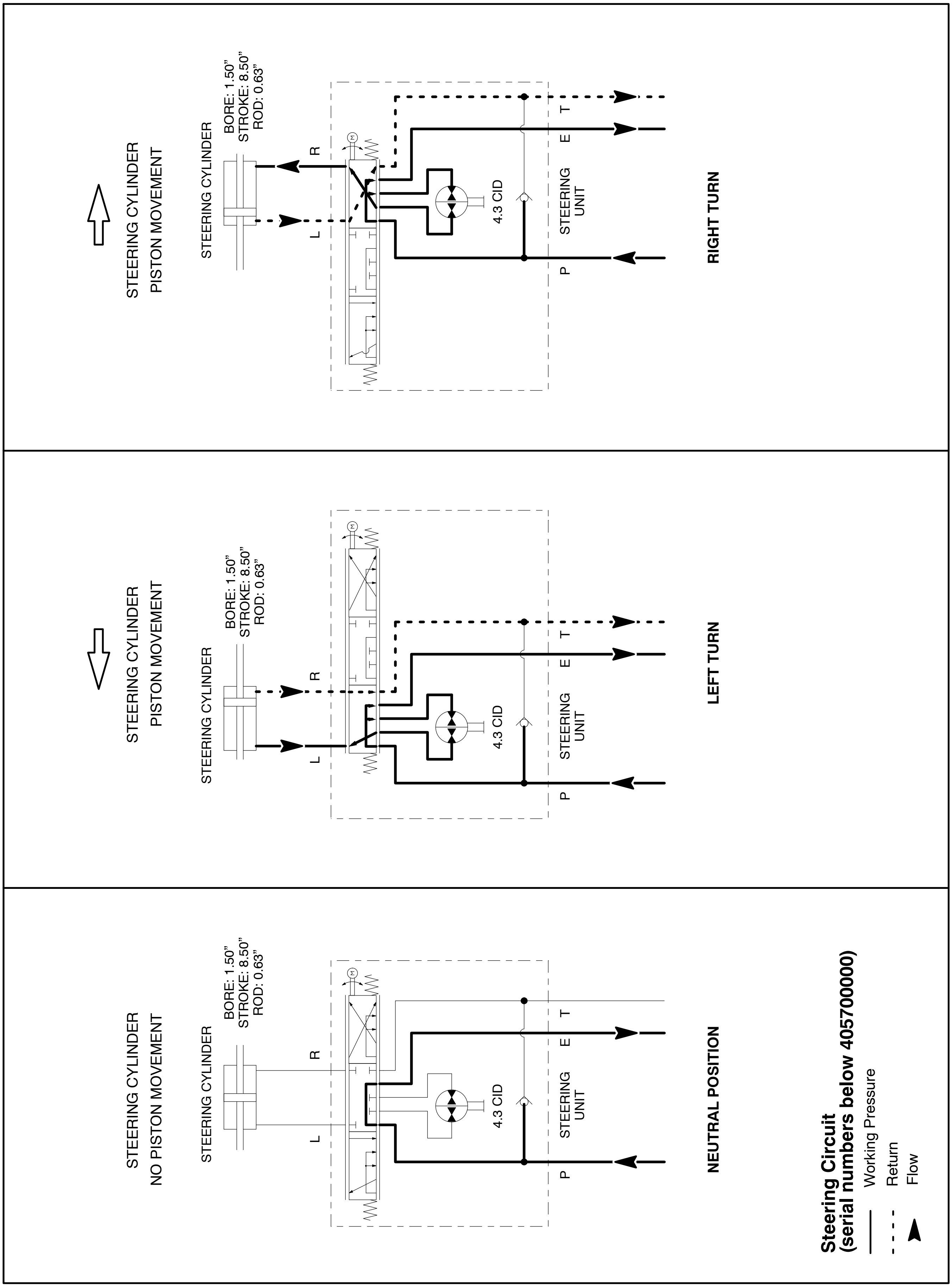

STEERING CYLINDER
NO PISTON MOVEMENT
STEERING CYLINDER
BORE: 1.50”
STROKE: 8.50”
ROD: 0.63”
L
R
4.3 CID
STEERING
UNIT
P
E
T
NEUTRAL POSITION
STEERING CYLINDER
PISTON MOVEMENT
STEERING CYLINDER
BORE: 1.50”
STROKE: 8.50”
ROD: 0.63”
L
R
4.3 CID
STEERING
UNIT
P
E
T
LEFT TURN
STEERING CYLINDER
PISTON MOVEMENT
STEERING CYLINDER
BORE: 1.50”
STROKE: 8.50”
ROD: 0.63”
L
R
4.3 CID
STEERING
UNIT
P
E
T
RIGHT TURN
Steering Circuit
(serial numbers below 405700000)
Working Pressure
Return
Flow

Figure 9

Steering Circuit (serial numbers below 405700000)

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

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

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

No Turn (Fig. 9)

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

Left Turn (Fig. 9)

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

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

Right Turn (Fig. 9)

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

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

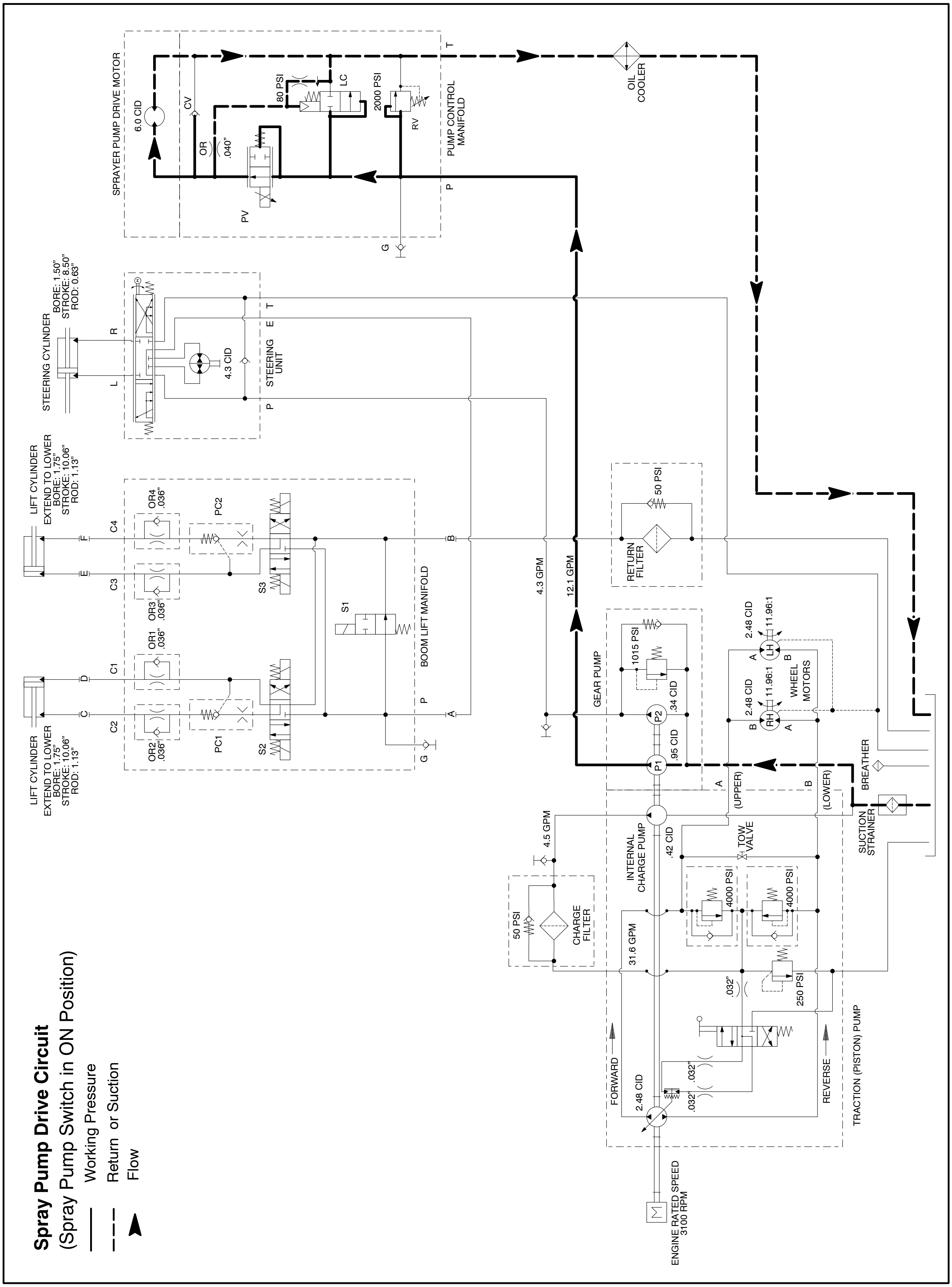

Spray Pump Drive Circuit
(Spray Pump Switch in ON Position)
Working Pressure
Return or Suction
Flow
SPRAYER PUMP DRIVE MOTOR
6.0 CID
CV
OR
.040"
80 PSI
LC
2000 PSI
RV
PUMP CONTROL
MANIFOLD
PV
T
P
G
OIL
COOLER
STEERING CYLINDER
BORE: 1.50"
STROKE: 8.50"
ROD: 0.63"
R
L
4.3 CID
STEERING
UNIT
LIFT CYLINDER
EXTEND TO LOWER
BORE: 1.75"
STROKE: 10.06"
ROD: 1.13"
OR4
.036"
PC2
C4
C3
OR3
.036"
S3
S1
BOOM LIFT MANIFOLD
OR1
.036"
C1
C2
OR2
.036"
PC1
S2
4.3 GPM
12.1 GPM
50 PSI
RETURN
FILTER
GEAR PUMP
1015 PSI
.34 CID
P2
P1
.95 CID
2.48 CID
11.96:1
LH
RH
WHEEL
MOTORS
(UPPER)
(LOWER)
BREATHER
SUCTION
STRAINER
4.5 GPM
INTERNAL
CHARGE PUMP
.42 CID
TOW
VALVE
4000 PSI
CHARGE
FILTER
31.6 GPM
250 PSI
.032"
FORWARD
REVERSE
TRACTION (PISTON) PUMP
ENGINE RATED SPEED
3100 RPM

Figure 10

Spray Pump Drive Circuit

A two (2) section gear pump is coupled to the piston (traction) pump. The front gear pump section (closest to the piston pump) supplies hydraulic flow to the spray pump drive circuit. The rear gear pump section supplies hydraulic flow to both the steering and spray boom lift/lower circuits. The gear pump takes its suction from the hydraulic reservoir.

Hydraulic flow control for the spray pump drive motor is completed by the spray pump control manifold. The spray pump control manifold is mounted directly to the hydraulic motor that drives the spray pump. The pump control manifold includes a solenoid controlled proportional valve (PV) that allows adjustment of the hydraulic flow to the spray pump motor. A pressure compensator valve (LC) located in the pump control manifold maintains a pressure differential of 80 PSI (5.5 bar) across the proportional valve (PV). Spray pump circuit pressure is limited to 2000 PSI (138 bar) by a relief valve located in the spray pump control manifold.

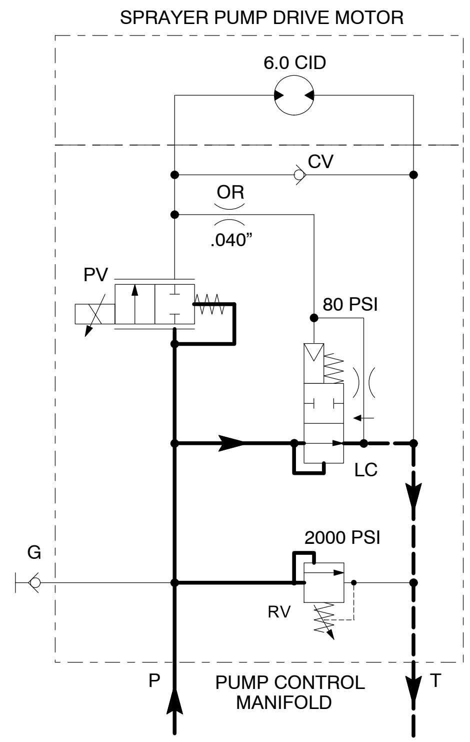
Spray pump drive circuit hydraulic flow can be monitored at the outlet of the front gear pump section. Circuit pressure can be measured at a diagnostic fitting in port G on the spray pump control manifold.

Machines with manually operated spray systems use the spray pump On/Off and application rate switches as inputs to adjust the electrical current to the control manifold solenoid (adjustable application rate).

Machines with ExcelaRate or GeoLink spray systems use the spray pump enable switch, the application rate switch, the flow meter and the speed sensor as inputs to adjust electrical current to the control manifold solenoid (variable application rate).

Spray Pump Enable Switch ON (Fig. 10)

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



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

Figure 11

Spray Pump Enable Switch OFF (Fig. 11)

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

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

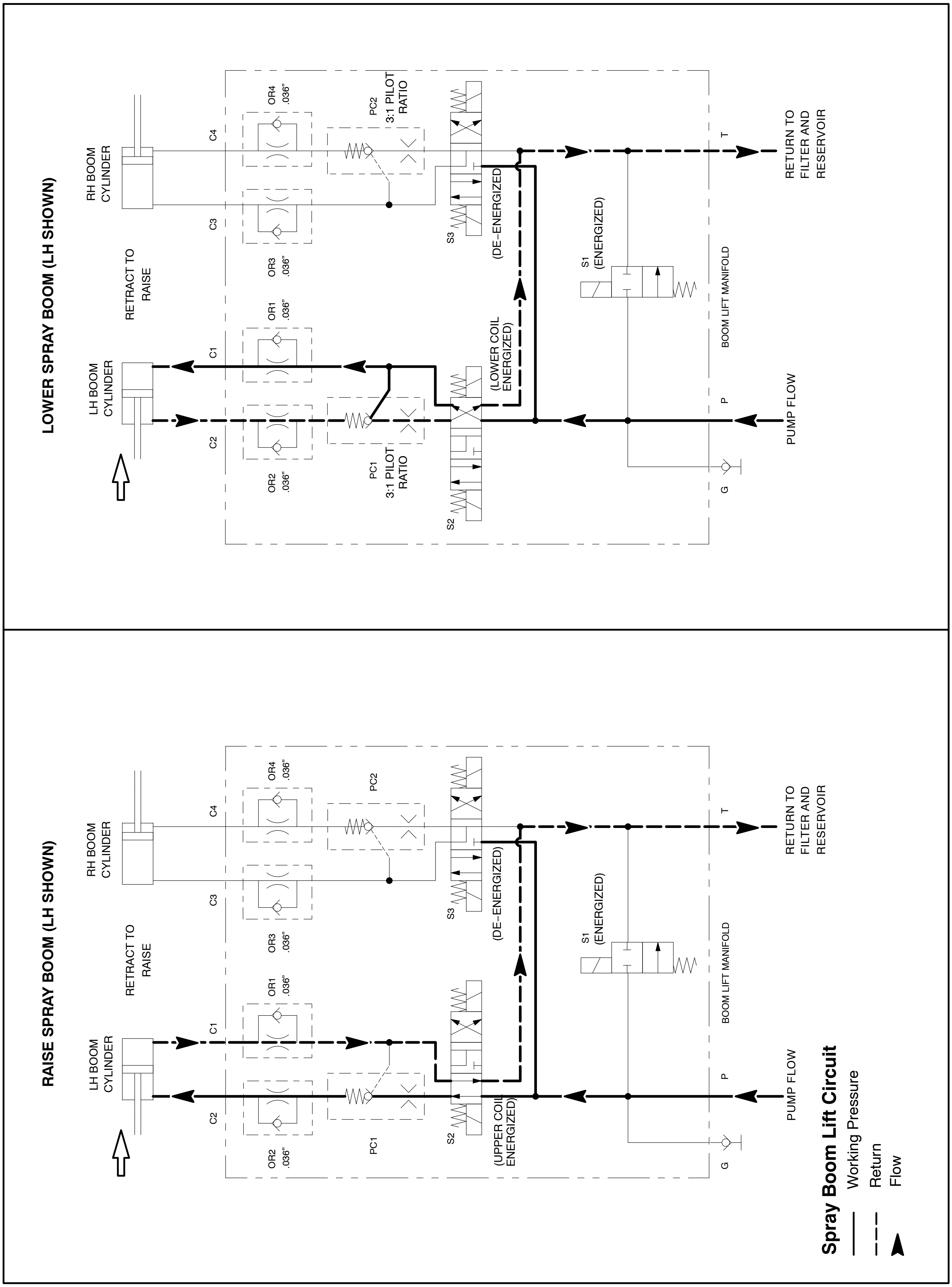

LOWER SPRAY BOOM (LH SHOWN)
RH BOOM CYLINDER
LH BOOM CYLINDER
RETRACT TO RAISE
C1
C2
C3
C4
OR1 .036"
OR2 .036"
OR3 .036"
OR4 .036"
PC1 3:1 PILOT RATIO
PC2 3:1 PILOT RATIO
S2
S3
(DE–ENERGIZED)
(LOWER COIL ENERGIZED)
S1 (ENERGIZED)
BOOM LIFT MANIFOLD
G
P
T
PUMP FLOW
RETURN TO FILTER AND RESERVOIR
RAISE SPRAY BOOM (LH SHOWN)
RH BOOM CYLINDER
LH BOOM CYLINDER
RETRACT TO RAISE
C1
C2
C3
C4
OR1 .036"
OR2 .036"
OR3 .036"
OR4 .036"
PC1
PC2
S2
S3
(DE–ENERGIZED)
(UPPER COIL ENERGIZED)
S1 (ENERGIZED)
BOOM LIFT MANIFOLD
G
P
T
PUMP FLOW
RETURN TO FILTER AND RESERVOIR
Spray Boom Lift Circuit
Working Pressure
Return
Flow

Figure 12

Spray Boom Lift Circuit

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

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

The boom lift control manifold includes three (3) electrically operated valves. Solenoid valve (S1) is used to direct oil flow toward the boom lift cylinders when energized or allow circuit flow to bypass the cylinders when de−energized. Solenoid valve (S2) controls hydraulic flow to raise or lower the left side boom lift cylinder. Solenoid valve (S3) controls hydraulic flow to raise or lower the right side boom lift cylinder. Solenoid valves S1 and S2 each have 2 coils (upper and lower).

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

Raise Spray Boom (Fig. 12)

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

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

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

Lower Spray Boom (Fig. 12)

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

As circuit pressure increases, a manifold sensing line shifts the pilot operated 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 check valve, is routed through the shifted valve (S2 or S3), exits the control manifold through port T, is routed to the oil filter and then returns to the hydraulic reservoir.

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

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

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

Toro Part Number: **TOR47009**

Figure 13

15 GPM Hydraulic Tester Kit (Pressure and Flow)

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

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

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

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

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

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

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

Toro Part Number: **TOR214678**

Figure 14

40 GPM Hydraulic Tester (Pressure and Flow)

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

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

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

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

Toro Part Number: **AT40002**

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

Figure 15

Hydraulic Hose Kit

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

Toro Part Number: **TOR6007**

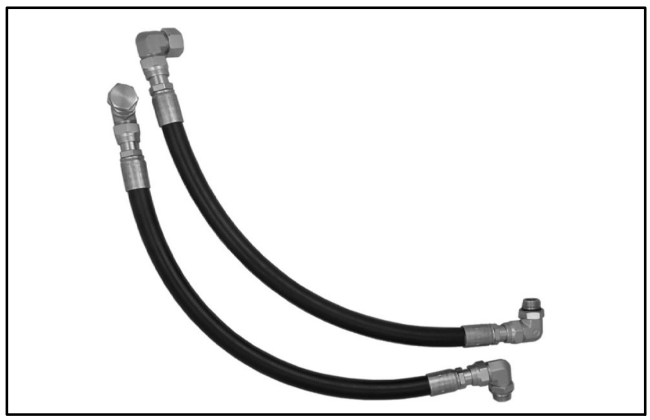


Figure 16

High Flow Hydraulic Filter Kit

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

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

Toro Part Number: **TOR6011**

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

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

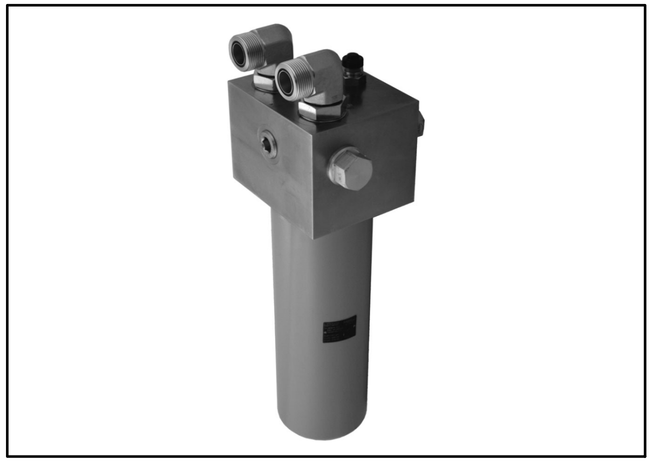


Figure 17

O−Ring Kit

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

Toro Part Number: **117−2727**

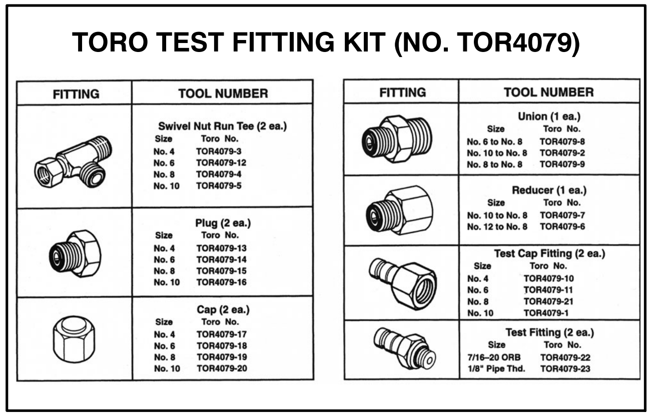
Figure 18

Hydraulic Test Fitting Kit

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

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

Toro Part Number: **TOR4079**


TORO TEST FITTING KIT (NO. TOR4079)

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

Figure 19

Remote Starter Switch

After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, wheel motor), it is necessary to prime the hydraulic pumps. A remote starter switch (Fig. 20) should be used for this purpose on machines with an engine control module (ECM) like the Multi Pro 5800−G. Obtain a remote starter switch locally.

IMPORTANT: When using a remote starter switch, it is highly recommended to include a 20 amp in−line fuse between the battery and switch connector for circuit protection.

A remote stater switch can also be constructed using Toro switch #106−2027, a length of 14 gauge wire, a 20 amp in−line fuse, two (2) alligator clips and necessary connectors. Connecting the wire to switch terminals 1 and 2 will allow the momentary switch contacts to be used for the remote starter switch (Fig. 21).

NOTE: For information on using the remote starter switch to prime the hydraulic pumps, see Priming Hydraulic Pumps in the Service and Repairs section of this chapter.

Figure 20

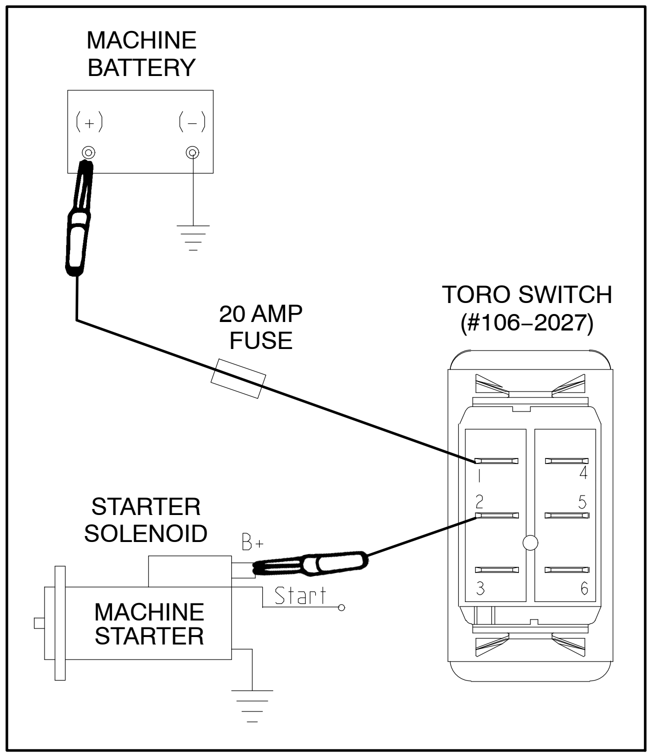


Figure 21

Troubleshooting

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

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

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

The chart that follows contains information to assist in troubleshooting. There may possibly be more than one cause for a machine malfunction.

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

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

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

One of the spray booms does not raise or lower.	Affected spray boom pivot is worn, binding or damaged. Boom lift control manifold solenoid coil (S2 or S3) or circuit wiring for affected boom has electrical problem (see Chapter 5 – Electrical System). Boom lift control manifold solenoid valve for affected boom is sticking or damaged (left boom = S2, right boom = S3, upper coil = raise boom, lower coil = lower boom). Boom lift control manifold pilot operated check valve for affected boom (PC1 or PC2) is sticking or damaged. Boom lift control manifold orifice for affected boom is plugged or damaged. Lift cylinder is worn or damaged.
Neither of the spray booms will raise or lower.	Oil level in reservoir is low. Boom lift control manifold solenoid coil S1 or circuit wiring has electrical problem (see Chapter 5 – Electrical System). Boom lift control manifold solenoid valve S1 is sticking or damaged. Check valve in steering control valve is sticking, worn or damaged. Relief valve in gear pump is faulty. Rear gear pump section is worn or damaged (steering circuit affected as well).
One of the spray booms will not remain in the raised position. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. A spray boom may eventually lower during storage.	Boom lift control manifold pilot operated check valve for affected boom (PC1 or PC2) is sticking or damaged. Cartridge valve seals are leaking in boom lift control manifold. Lift cylinder for affected boom leaks internally. Hydraulic hoses to lift cylinder for affected boom are incorrectly installed.

Testing

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

Before Performing Hydraulic Tests

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

WARNING

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

Precautions for Hydraulic Testing

CAUTION

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

WARNING

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

CAUTION

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

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

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

3. The engine must be in good operating condition. Use a 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 (aprox. 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.

Hydrostat: 100 engine RPM = 1.07 GPM or 137.4 oz. (4.06 ltr) of hydraulic fluid displaced per minute

Internal Charge Pump: 100 engine RPM = 0.18 GPM or 23.3 oz. (688 cc) of hydraulic fluid displaced per minute

Gear Pump (P1): 100 engine RPM = 0.41 GPM or 52.6 oz. (1556 cc) of hydraulic fluid displaced per minute

Gear Pump (P2): 100 engine RPM = 0.15 GPM or 118.8 oz. (557 cc) of hydraulic fluid displaced per minute

NOTE: The hydraulic pumps are connected directly to the engine crankshaft, so 1 engine RPM = 1 pump RPM.

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

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

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

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

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

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

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

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

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

Which Hydraulic Tests Are Appropriate

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

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

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

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

3. If a spray pump drive circuit problem exists, consider performing one or more of the following tests: Spray Pump Drive Circuit Pressure, Spray Pump Drive Relief Pressure or Spray Pump Drive Gear Pump Flow Tests.

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

Traction Circuit – Charge Pressure Test

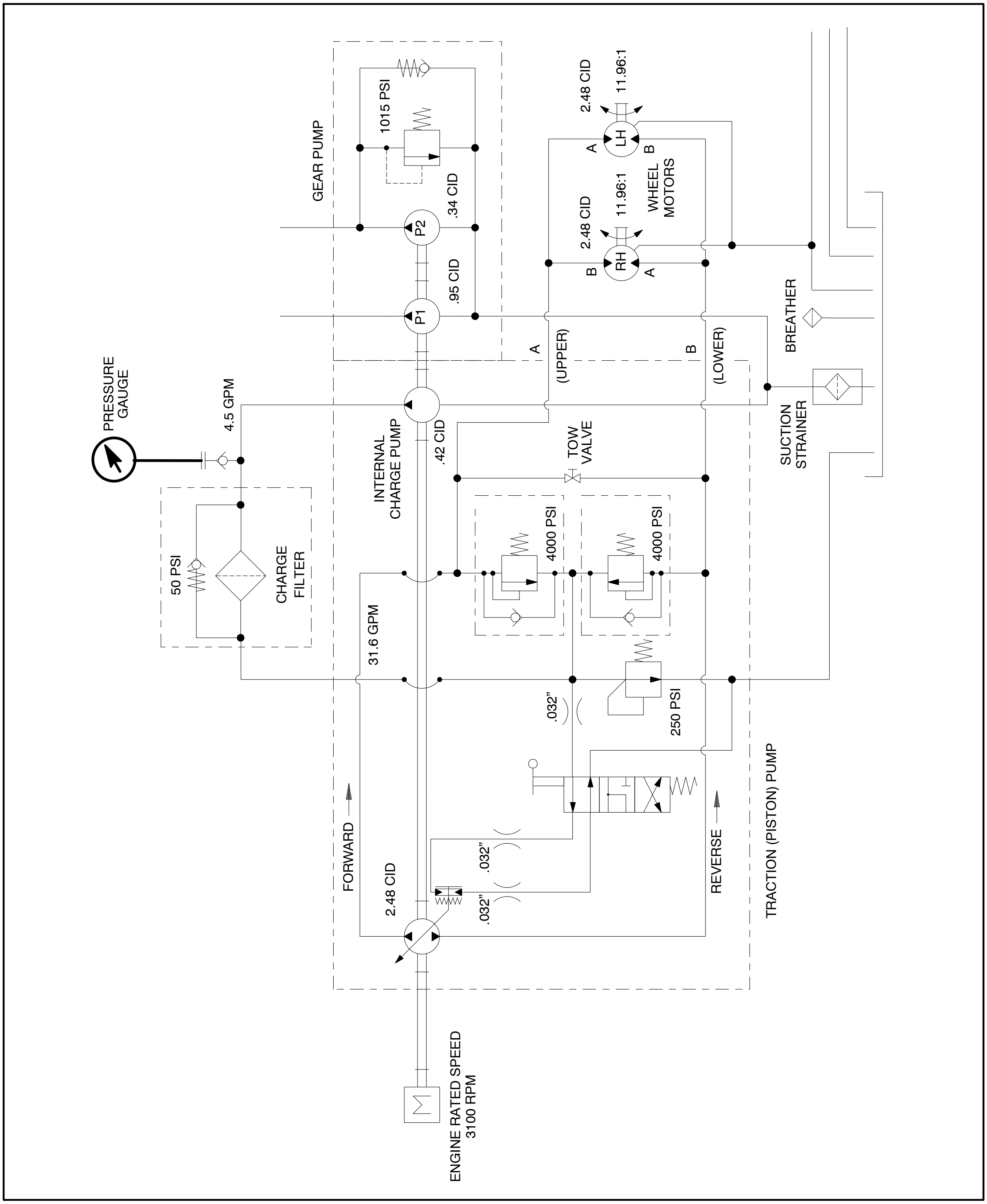


Figure 22

Traction Circuit – Charge Pressure Test

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

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

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

CAUTION

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

3. Thoroughly clean test port on tee fitting at charge circuit oil filter (under the hydraulic reservoir – Fig. 23). Install 1000 PSI (70 bar) pressure gauge to test port fitting.

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

5. Operate the engine at high idle engine speed **(Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM)** with no load on the traction circuit (traction pedal in the neutral position).

GAUGE READING: 250 to 300 PSI (17 to 21 bar)

6. Stop engine and record test results.

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

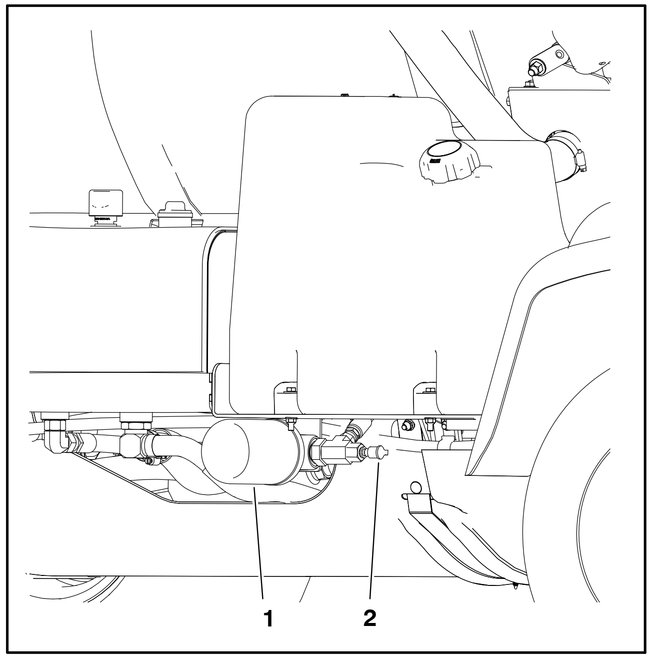


Figure 23

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

8. With the pressure gauge still connected to the test fitting on oil filter, take a pressure reading while applying load to the traction circuit in both forward and reverse.

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

B. Chock the wheels to prevent wheel rotation during testing.

C. Start the engine and put throttle at high idle engine speed **(Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM)**.

D. Engage the brake and push the traction pedal forward while monitoring the pressure gauge. Repeat for reverse direction. Record highest pressure reading obtained in each direction.

E. Stop engine and record test results.

9. If charge pressure drops more than 15% when under traction load, the piston (traction) pump and/or rear wheel motor(s) should be suspected of wear and inefficiency. The charge pump (integrated into the traction (piston) pump may be worm or damaged, or the piston pump and/or wheel motor(s) are worn or damaged. In each example, the charge pump is not able to keep up with internal leakage in traction circuit components.

10. After testing is completed, disconnect pressure gauge from piston pump and reinstall cap over test port.

Traction Circuit – Charge Pump Flow Test

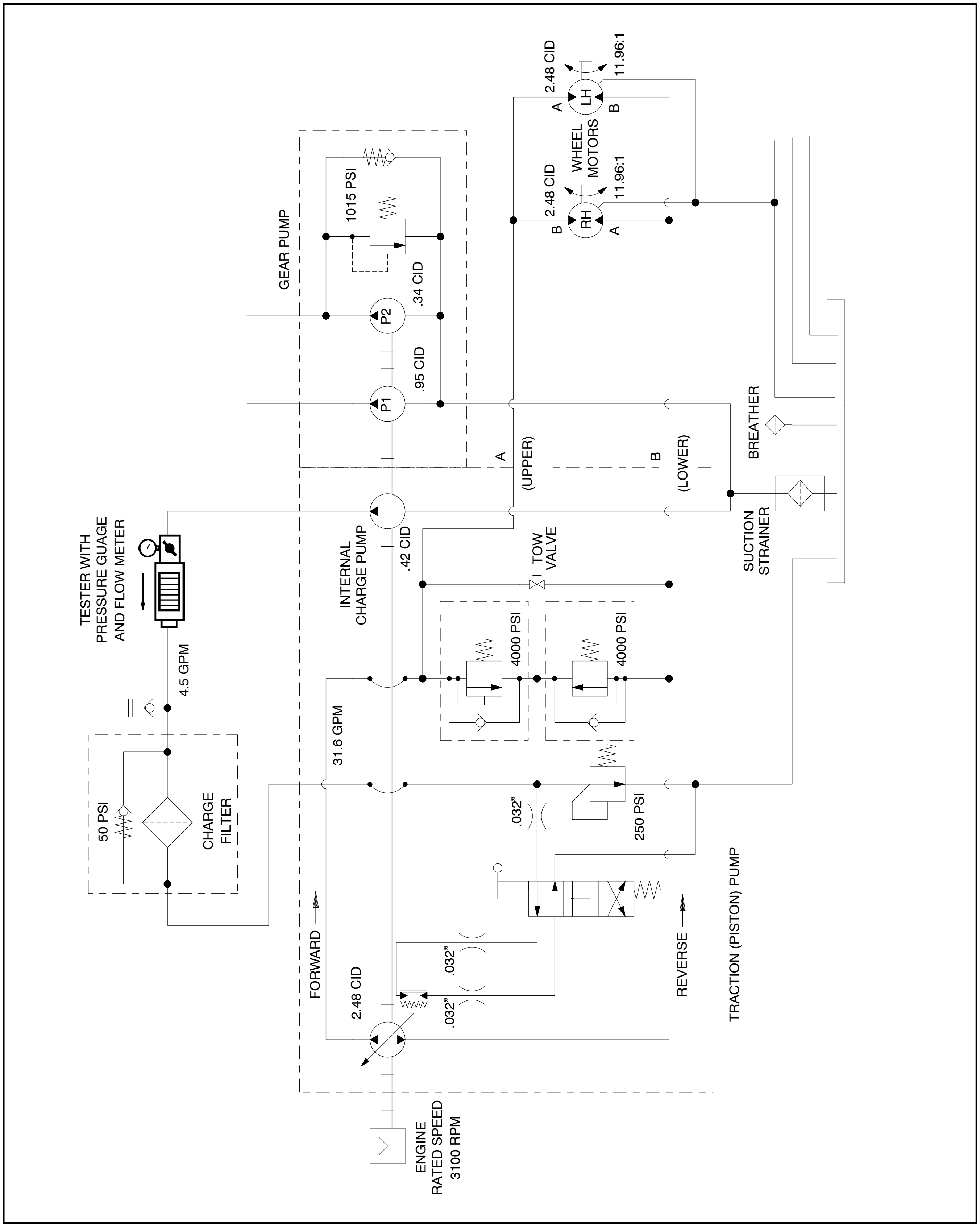


Figure 24

Traction Circuit – Charge Pump Flow Test

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

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

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

CAUTION

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

3. Thoroughly clean tee fitting and hydraulic hose at the front of the charge circuit oil filter under the hydraulic reservoir (Fig. 25).

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

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

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

6. Move throttle so engine is running at high idle speed **(Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM)**.

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

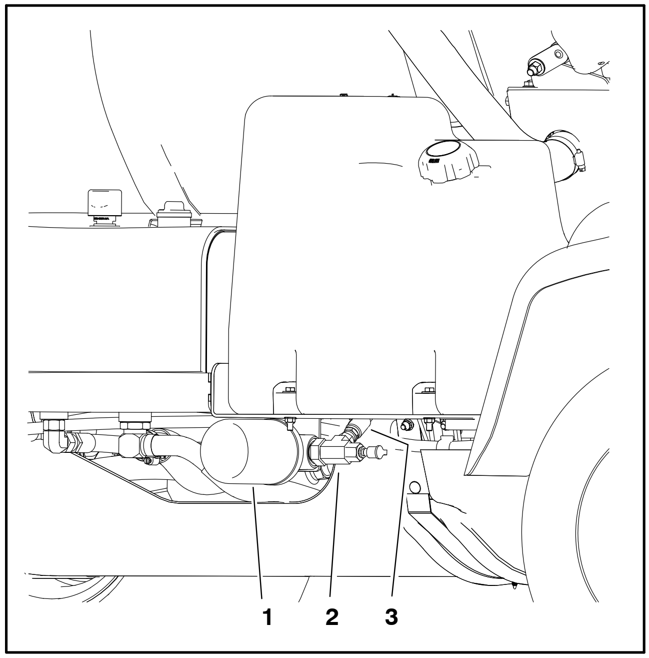


Figure 25

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

NOTE: If engine speed drops below specified RPM, pump flow will decrease. Adjust test specifications accordingly (see Testing in this chapter).

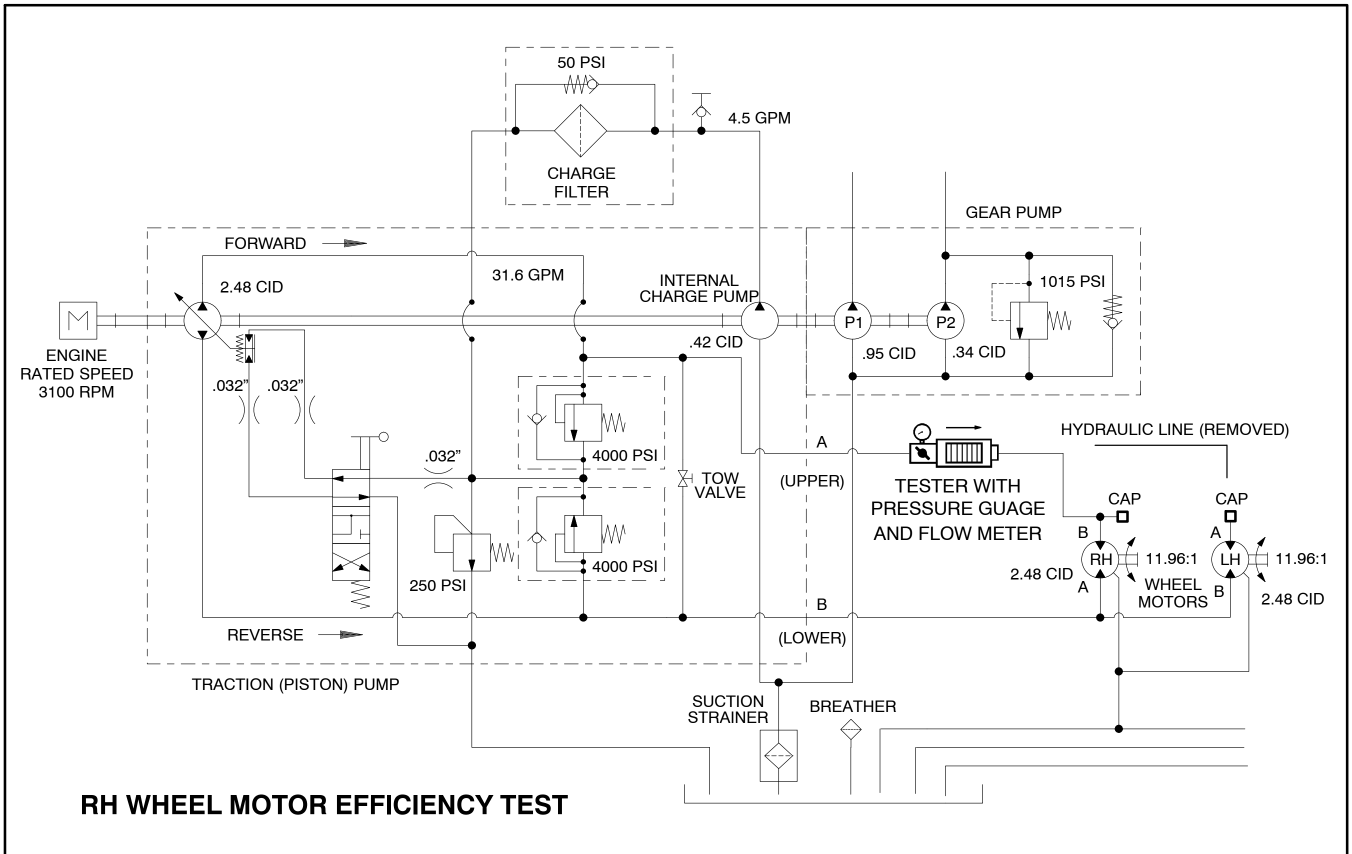
8. Observe flow gauge. Flow indication should be approximately **4.5 GPM (17 LPM)**.

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

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

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

12. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.


50 PSI
4.5 GPM
CHARGE FILTER
GEAR PUMP
FORWARD
31.6 GPM
INTERNAL CHARGE PUMP
2.48 CID
1015 PSI
P1
P2
ENGINE RATED SPEED 3100 RPM
.42 CID
.95 CID
.34 CID
.032"
.032"
HYDRAULIC LINE (REMOVED)
A
4000 PSI
.032"
TOW VALVE
(UPPER)
TESTER WITH PRESSURE GUAGE AND FLOW METER
CAP
CAP
B
A
RH
11.96:1
LH
11.96:1
2.48 CID
A
WHEEL MOTORS
B
2.48 CID
4000 PSI
250 PSI
B
REVERSE
(LOWER)
TRACTION (PISTON) PUMP
SUCTION STRAINER
BREATHER
RH WHEEL MOTOR EFFICIENCY TEST

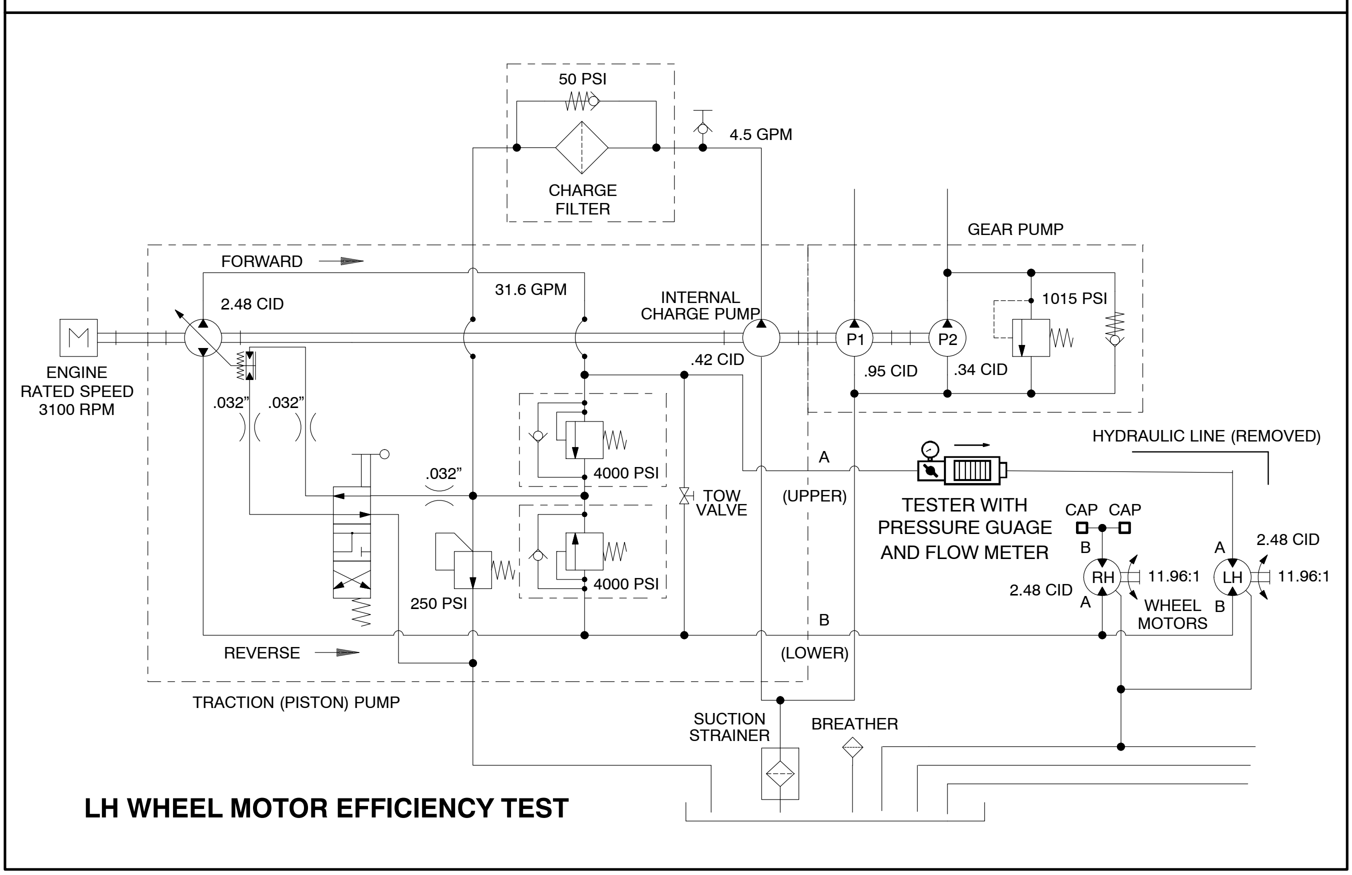

50 PSI
4.5 GPM
CHARGE FILTER
GEAR PUMP
FORWARD
31.6 GPM
INTERNAL CHARGE PUMP
2.48 CID
1015 PSI
P1
P2
ENGINE RATED SPEED 3100 RPM
.42 CID
.95 CID
.34 CID
.032"
.032"
HYDRAULIC LINE (REMOVED)
A
4000 PSI
.032"
TOW VALVE
(UPPER)
TESTER WITH PRESSURE GUAGE AND FLOW METER
CAP
CAP
B
A
2.48 CID
RH
11.96:1
LH
11.96:1
2.48 CID
A
WHEEL MOTORS
B
4000 PSI
250 PSI
B
REVERSE
(LOWER)
TRACTION (PISTON) PUMP
SUCTION STRAINER
BREATHER
LH WHEEL MOTOR EFFICIENCY TEST

Figure 26

Traction Circuit – Wheel Motor Efficiency Test

Over a period of time, a wheel motor can wear internally. A worn motor may by–pass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the wheel motor to stall under heavy load conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect overall machine performance.

IMPORTANT: If component failure is suspect, see Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit before operating the system.

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

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

CAUTION

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

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

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

5. Chock the wheels to prevent wheel rotation during testing.

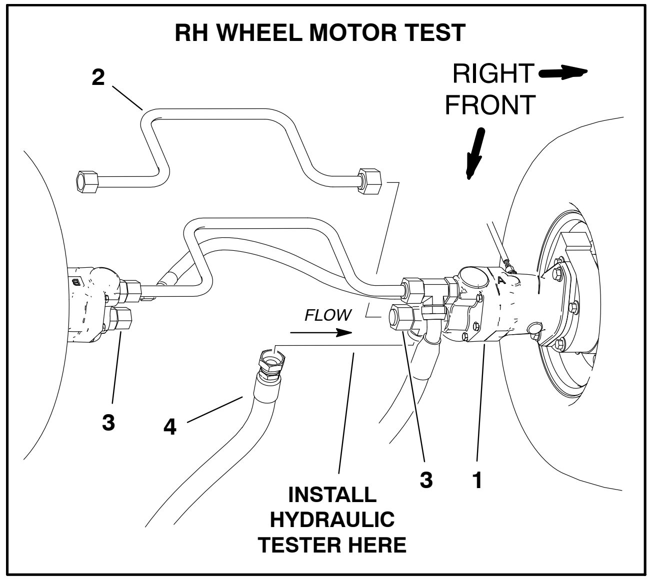


Figure 27

1. RH wheel motor
2. Hydraulic tube
3. Cap (2)
4. Hydraulic hose

6. To test right side (RH) wheel motor efficiency, isolate the hydraulic motors and connect a hydraulic tester as follows (Fig. 27):

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

B. Disconnect both ends of the hydraulic tube (item 2) and remove it from the machine.

C. Cap the open fittings (one at each of the wheel motors).

D. Disconnect hydraulic hose from tee fitting at the “A” port of the RH wheel motor.

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

E. Install 15 GPM Hydraulic Tester #TOR214678 (pressure and flow) in series between the tee fitting and the disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) if necessary to connect tester to machine. Make sure that flow control valve on tester is fully open.

7. To test left side (LH) wheel motor efficiency, isolate the hydraulic motors and connect a hydraulic tester as follows (Fig. 28):

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

B. Disconnect both ends of the hydraulic tube (item 2) and remove it from the machine.

C. Disconnect hydraulic hose from tee fitting at the “A” port of the RH wheel motor.

D. Cap both openings of the tee fitting at the RH wheel motor.

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

E. Install 15 GPM Hydraulic Tester #TOR214678 (pressure and flow) in series between the fitting at the “B” port of the LH wheel motor and the disconnected hydraulic hose. Use hydraulic hose kit (see Special Tools in this chapter) if necessary to connect tester to machine. Make sure that flow control valve on tester is fully open.

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

9. Increase engine speed to high idle **(Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM)**

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

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

11. Internal leakage for the wheel motor being tested will be shown on the flow meter in GPM. Flow should be **less than 2.5 GPM (9.4 LPM)** for the wheel motor being tested.

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

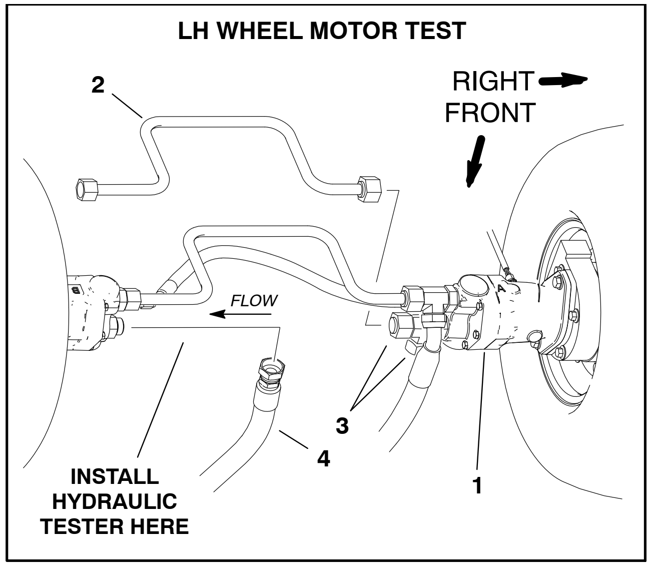


Figure 28

1. **RH wheel motor**
2. **Hydraulic tube**
3. **Cap (2)**
4. **Hydraulic hose**

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

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

15. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

Traction Circuit – Traction (Piston) Pump Flow and Relief Pressure Test

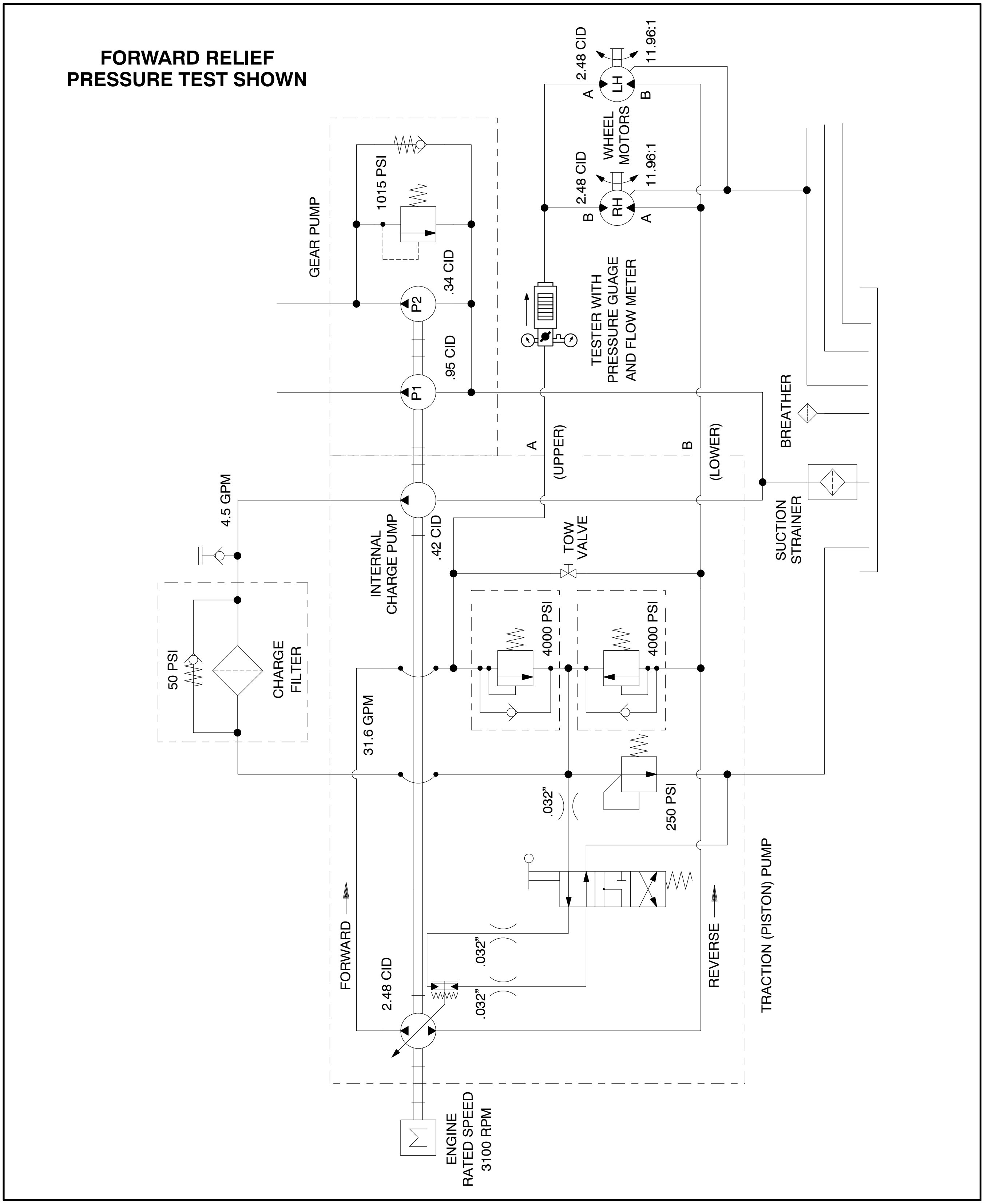


Figure 29

Traction Circuit – Traction (Piston) Pump and Relief Pressure Test

This test should be performed to measure the piston (traction) pump output (flow) and to make sure the forward and reverse traction circuit relief pressures are correct.

IMPORTANT: If component failure is suspect, see Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit before operating the system.

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

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

CAUTION

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

2. Make sure that traction pedal is adjusted to the neutral position (see Adjust Traction Pedal for Neutral in this chapter). Also, ensure that traction pump is at full stroke when pedal is pushed to fully forward position.

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

4. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

5. Clean hydraulic hoses and fittings on right side of pump (Fig. 30).

6. Disconnect the upper hose to test forward direction relief pressure and pump flow, or disconnect the lower hose to test reverse direction relief pressure.

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

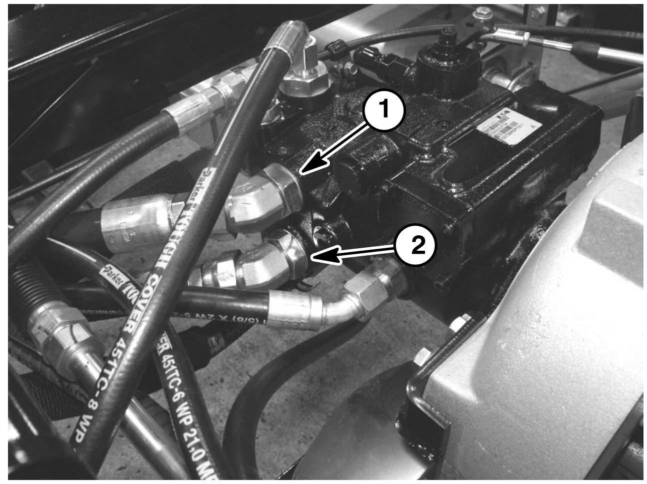


Figure 30

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

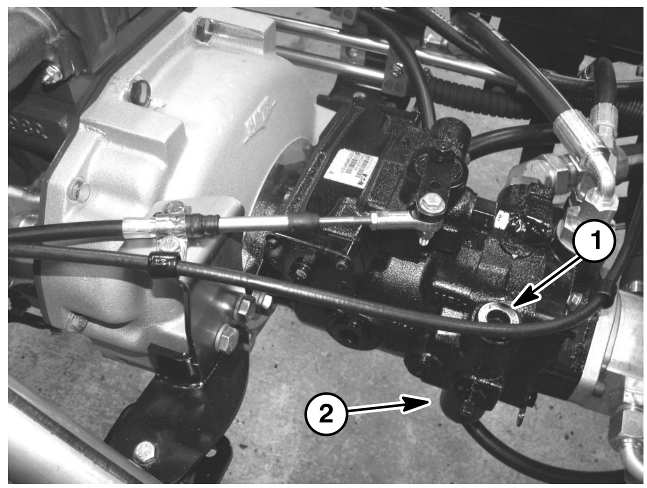


Figure 31

1. **Forward relief valve (upper)**
2. **Reverse relief valve (lower)**

7. Install 40 GPM Hydraulic Tester #AT40002 (pressure and flow) in series between piston pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect tester to machine. Make sure that flow control valve on tester is fully open.

CAUTION

Use extreme caution when performing traction pump flow tests. The traction unit wheels will be rotating during the test.

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

9. Increase engine speed to high idle **(Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM)**

NOTE: If engine speed drops below specified RPM, pump flow will decrease. Adjust test specifications accordingly (see Testing in this chapter).

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

11. Sit in the operator's seat and release the parking brake.

12. Verify pump flow at No Load as follows:

A. With the tester is installed in the upper pump port, slowly depress the traction pedal to full forward position.

B. Record tester pressure and flow readings. Unrestricted pump output should be approximately **32 GPM (121 LPM).**

13. Verify pump flow Under Load as follows:

A. With the tester is installed in the upper pump port, slowly depress the traction pedal to full forward position.

B. Apply an **additional load of 1500 to 2000 PSI (103 to 138 Bar)** by slowly closing the flow meter.

C. Record tester pressure and flow readings.

14. Verify traction relief valve operation as follows:

A. Return the traction pedal to neutral.

B. Fully close the flow meter flow control valve.

C. If the tester is installed in the upper pump port, slowly depress the traction pedal to full forward position. If the tester is installed in the lower pump port, slowly depress the traction pedal to full reverse position.

D. Record tester pressure reading.

System pressure should reach **4250 PSI (293 Bar)** before the relief valve opens.

NOTE: The relief valve setting is **4000 PSI (276 Bar).** An additional **250 PSI (17 Bar)** is necessary to overcome system charge pressure before the relief valve opens.

E. Release traction pedal, open flow control valve fully, move throttle to low speed and turn the engine off.

15. If relief pressure can not be met or is greater than specified, inspect traction pump relief valves (Fig. 31) (see Piston (Traction) Pump Service in this chapter). Clean or replace valves as necessary. These cartridge valves are factory set and are not adjustable. If relief valves are in good condition, traction pump or rear wheel motors should be suspected of wear and inefficiency.

16. The Under Load test flow reading (step 13.) **should not drop more than 12%** when compared to the No Load test flow reading (step 12.). A difference of more than 12% may indicate the traction (piston) pump is worn and should be repaired or replaced.

17. Disconnect tester and reconnect hose to pump.

18. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

Steering/Boom Lift Circuit – Gear Pump P2 Flow and Circuit Relief Pressure Test (Using Tester with Flow Meter and Pressure Gauge)

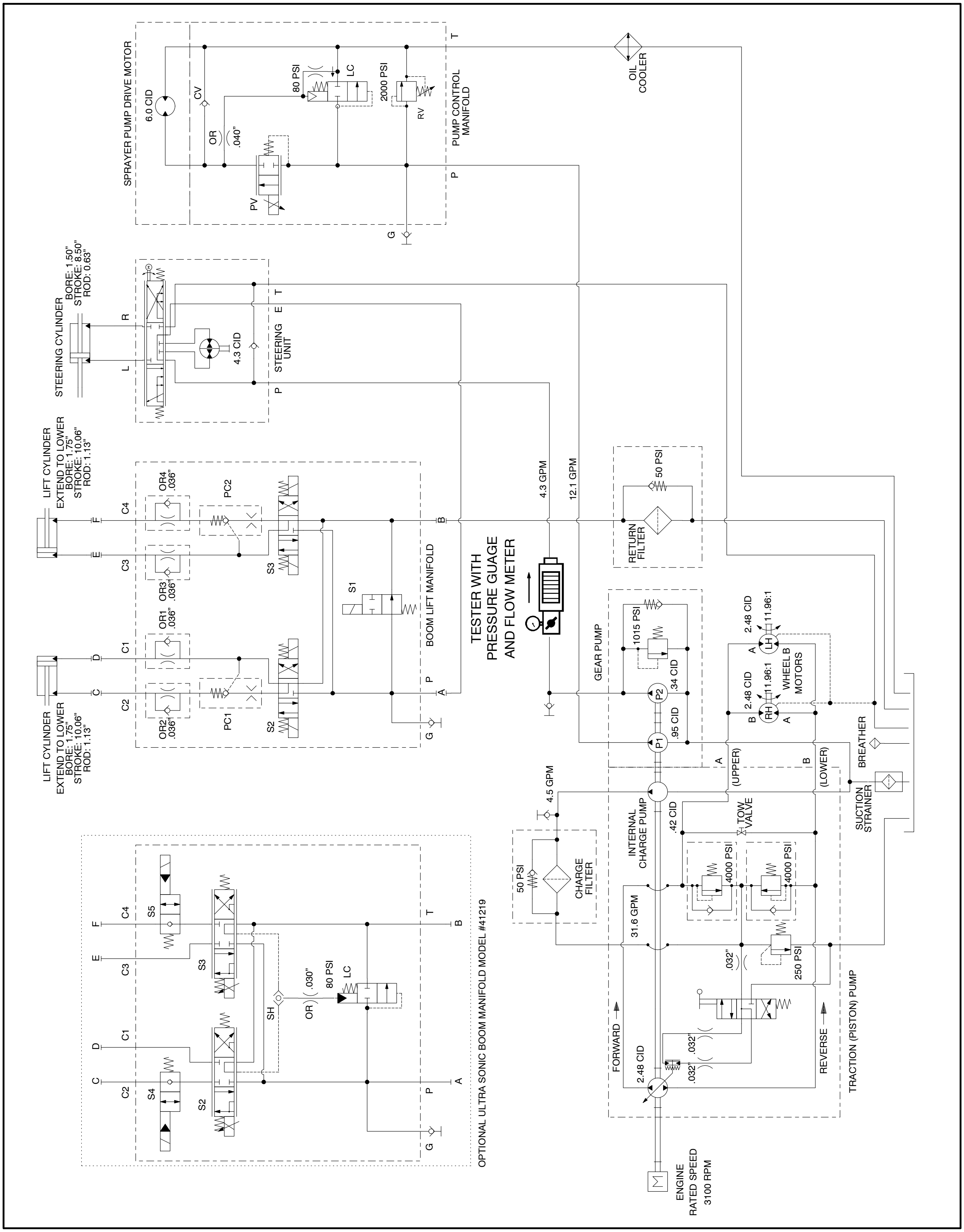


Figure 32

Steering/Boom Lift Circuit – Gear Pump P2 Flow and Circuit Relief Pressure Test (Using Tester with Flow Meter and Pressure Gauge)

Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by-pass oil and make the pump less efficient. Eventually, enough oil can by-pass to cause circuit performance problems. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

Gear pump (P2) is designed to satisfy both steering cylinder and lift cylinder needs simultaneously (at full speed throttle). The Gear Pump (P2) Flow Test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than **15%** indicates the gears and wear plates in the pump have worn.

If machine steering is sluggish or otherwise performs poorly, see Steering/Lift Circuit – Steering Control Valve and Steering Cylinder Test in this chapter.

If boom lift operation is unsatisfactory, check lift control manifold solenoid valves and/or lift cylinders. Additional information on these components is available in this chapter.

If both steering and lift operations perform poorly, perform the gear pump (P2) flow test and circuit relief pressure test (see Steering/Lift Circuit – Relief Pressure Test in this chapter).

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

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

3. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

CAUTION

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

4. Clean tee fitting and hydraulic hose on left side of rear gear pump section (Fig. 33). Disconnect hydraulic hose from the tee fitting.

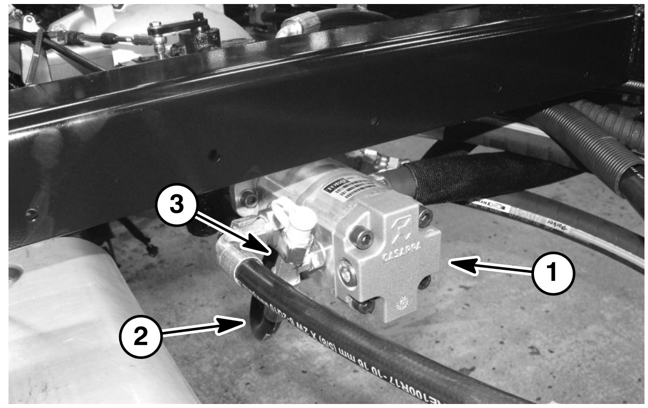


Figure 33

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

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

5. Install 15 GPM Hydraulic Tester #TOR214678 (pressure and flow) in series between piston pump fitting and disconnected hose. Make sure that flow control valve on tester is fully open.

6. Start engine and run at low idle speed. Check for hydraulic leaks and correct before proceeding with test.

7. Operate the engine at high idle speed **(Diesel engine = 3050 to 3150 RPM, Gasoline engine = 3200 RPM)**.

8. Verify pump flow at No Load as follows:

   Record tester pressure and flow readings at no load. Unrestricted pump output should be approximately **4.2 GPM (15.8 LPM)**.

9. Verify pump flow Under Load as follows:

   A. Watch pressure gauge carefully while slowly closing the flow control valve until **800 PSI (55.2 Bar)** is obtained on gauge.

   B. Verify engine speed with a phototac. If engine speed drops below minimum high idle speed, pump flow will decrease. Adjust test specifications accordingly (see Testing in this chapter).

   C. Record tester pressure and flow readings under load.

10. Test the pressure relief as follows:

   A. With the engine operating at high idle speed, continue to slowly close the tester flow control valve until the pressure on gauge stabilizes (continuing to close the flow control makes no change in pressure). Do Not exceed **1500 psi (103.4 Bar)**.

B. Record tester pressure.

11. Set throttle to low speed and shut off engine.

12. The under load test flow reading (step 9.B) should not drop **more than 15%** when compared to the no load test flow reading (step 8.). A difference in flow of more than 15%, or the inability to achieve specified pressure may indicate:

A. A restriction in the pump intake line

B. The gear pump (P2) is worn and should be repaired or replaced

13. The pressure relief test pressure should stabilize at approximately **1000 psi (69 Bar)**. If the pressure does not stabilize near this reading:

A. The pressure relief valve may be blocked or damaged and should be replaced.

B. Gear pump P2 cannot generate adequate pressure to open the relief valve (failed flow test).

14. Disconnect tester and reconnect hose to pump.

15. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

16. Install the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

Steering/Boom Lift Circuit – Steering Control Valve and Steering Cylinder Test

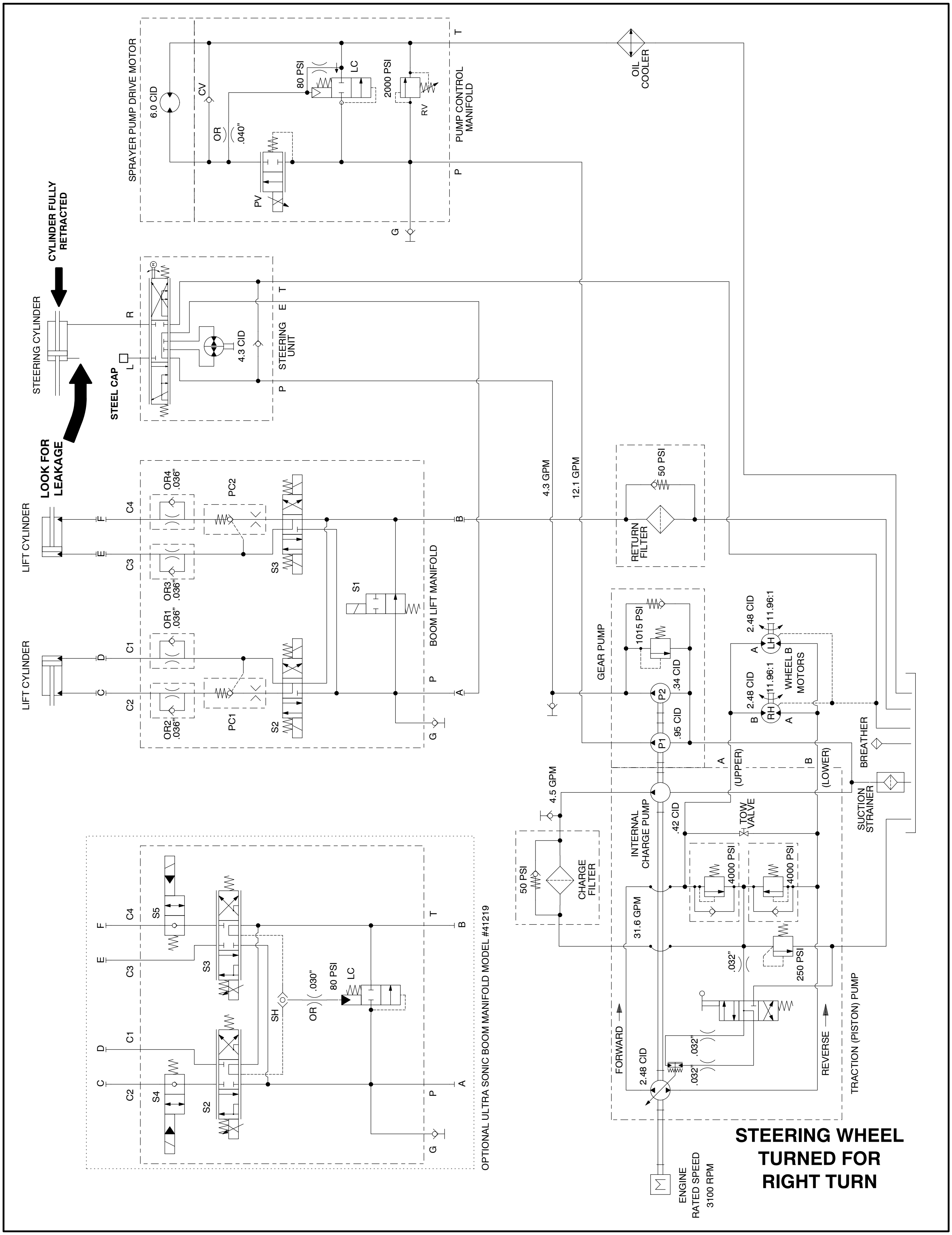


Figure 34

Steering/Boom Lift Circuit – Steering Control Valve and Steering Cylinder Test

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

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

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

2. Perform the steering/boom lift circuit – gear pump P2 flow and circuit relief pressure test to make sure that relief valve and gear pump are functioning correctly (see test procedure in this chapter).

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

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

5. Turn engine Off and engage the parking brake.

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

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

8. Remove all hydraulic oil from drain pan and place the empty drain pan under the open fitting of the steering cylinder.

WARNING

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

IMPORTANT: Do not turn steering wheel to the left (counterclockwise) as system damage may occur.

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

10. If steering problem exists and the steering cylinder and steering/boom lift circuit – gear pump P2 flow and circuit relief pressure tested acceptably, the steering control valve requires service (see Steering Control Valve Service in this chapter).

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

12. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

Steering/Boom Lift Circuit – Boom Lift Cylinder Internal Leakage Test

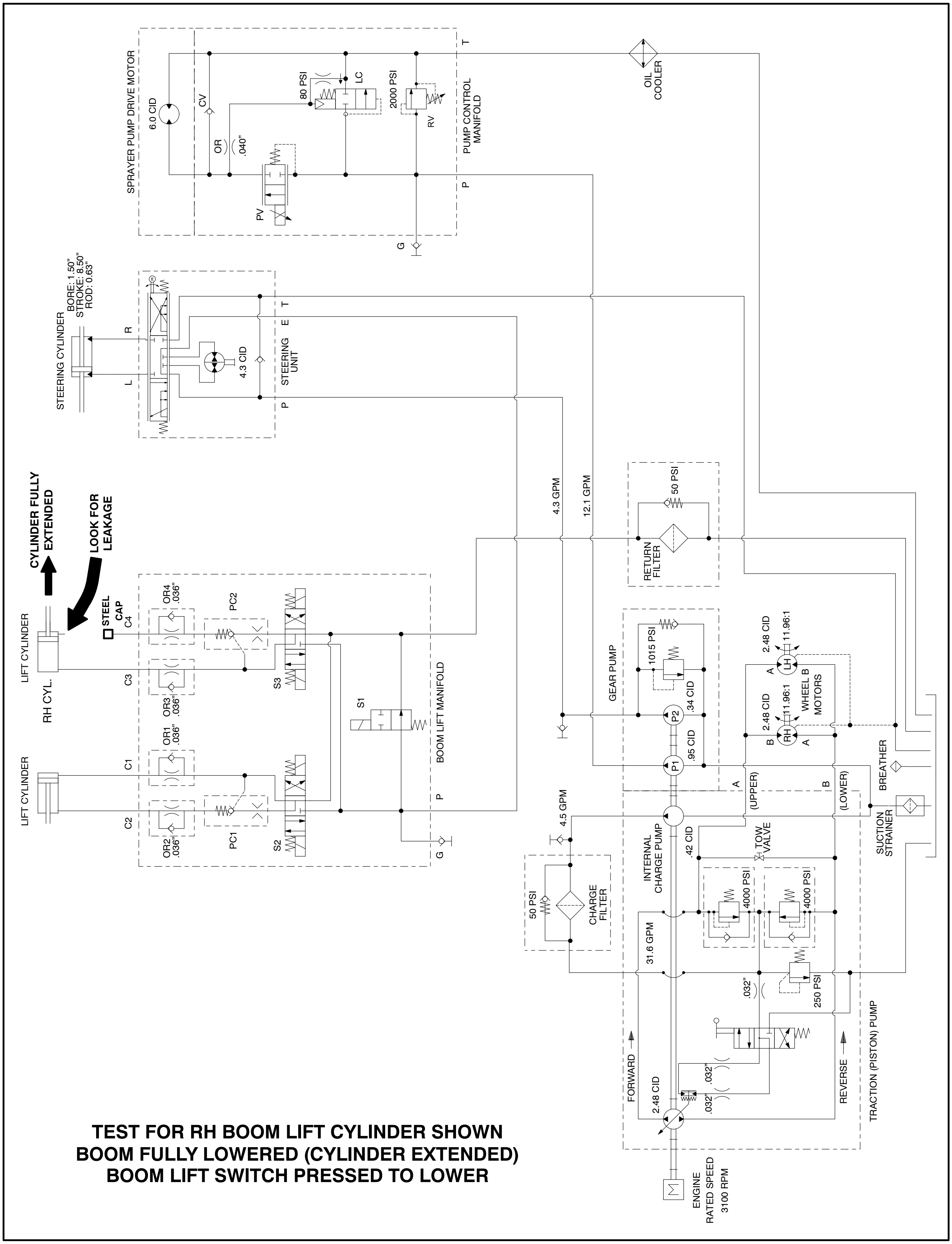


Figure 35

Steering/Boom Lift Circuit – Boom Lift Cylinder Internal Leakage Test

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

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

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

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

2. Perform the steering/boom lift circuit – gear pump P2 flow and circuit relief pressure test to make sure that gear pump P2 and the circuit relief valve are functioning correctly.

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

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

5. Turn engine Off and engage the parking brake.

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

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

8. Remove all hydraulic oil from drain pan and place the clean pan under the open fitting of the lift cylinder.

WARNING

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

IMPORTANT: While performing test, do not press boom lift switch to raise as system damage may occur.

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

10. If a boom lift problem exists and the boom lift cylinder and steering/boom lift circuit – gear pump P2 flow and circuit relief pressure tested acceptably, the boom lift control manifold requires service (see Boom Lift Control Manifold Service in this chapter).

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

12. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

Spray Pump Circuit – Gear Pump P1 Flow Test (Using Tester with Flow Meter and Pressure Gauge)

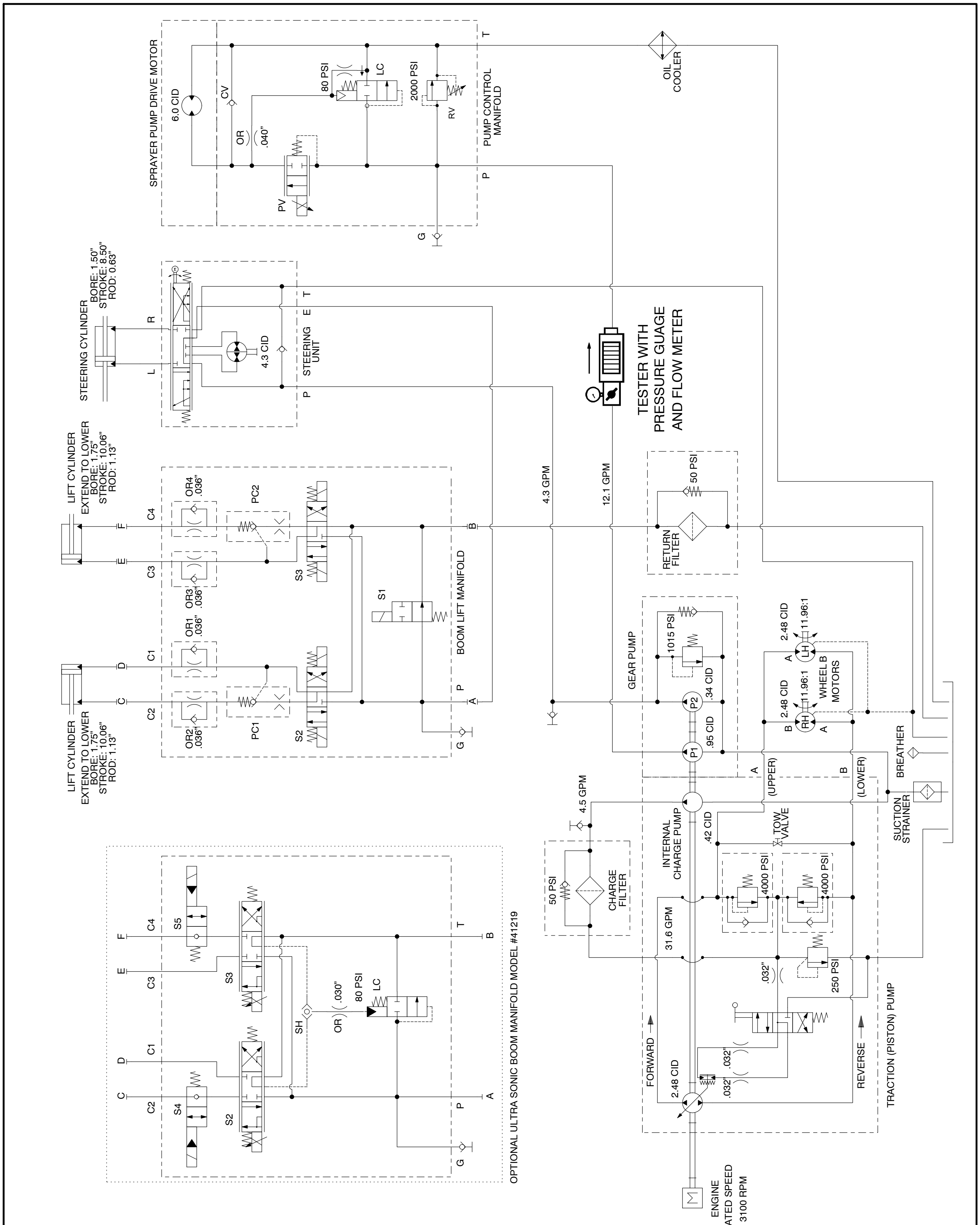


Figure 36

Spray Pump Circuit – Gear Pump P1 Flow Test (Using Tester with Flow Meter and Pressure Gauge)

Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by-pass oil and make the pump less efficient. Eventually, enough oil can by-pass to cause circuit performance problems. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to seals and other components in the hydraulic system.

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

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

3. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

CAUTION

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

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

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

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

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

CAUTION

Do not close tester valve fully when performing this test. In this test, the hydraulic tester is positioned before the circuit relief valve. Pump damage can occur if the fluid flow is blocked by fully closing the tester flow control valve.

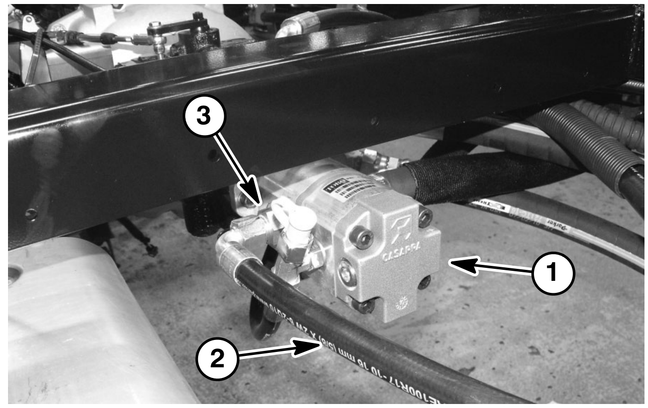


Figure 37

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

7. Operate the engine at high idle speed **(Diesel engine = 3050 to 3150 RPM, Gasoline engine = 3200 RPM)**.

8. Carefully watch pressure gauge on tester while slowly closing the flow control valve until **800 PSI (56 bar)** is obtained. Verify engine speed with a phototac.

NOTE: If engine speed drops below specified RPM, pump flow will decrease. Adjust test specifications accordingly (see Testing in this chapter).

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

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

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

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

13. Start engine and run at low idle speed. Check for hydraulic leakage and correct before returning machine to service.

14. Install the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

Adjustments

Adjust Traction Pedal for Neutral

The rear wheels should not rotate in either direction when the traction pedal is in the neutral position. The traction pedal linkage should return to the neutral position quickly when the traction pedal is released, and the traction pump lever must be at full stroke when the traction pedal is pushed to the fully forward position.

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

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

3. Make sure the traction linkage is not worn, damaged, or binding. Repair or replace components as necessary.

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

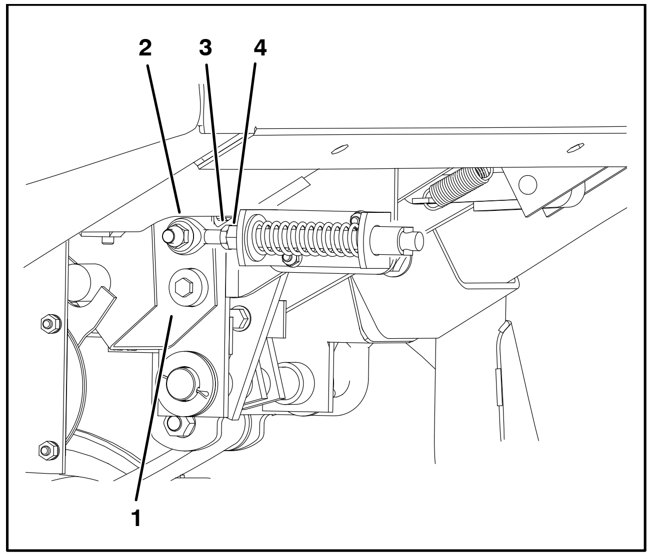


Figure 38

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

CAUTION

Use caution when adjusting traction pedal. The traction unit wheels may be rotating during the adjustment procedure.

5. Have an assistant sit in the operators seat, start engine and disengage parking brake.

6. Loosen jam nut on spring shaft (Fig. 38).

7. Adjust spring shaft until rear wheels do not move in either direction when traction pedal is in the neutral position.

8. Check traction pedal to ensure it returns to neutral quickly from reverse and forward direction.

9. Tighten jam nut to secure adjustment.

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake and stop engine. Remove key from the ignition switch.

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

CAUTION

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

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

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

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

6. Record the position of hydraulic fittings (especially elbow fittings) on hydraulic components before removal. Mark parts if necessary to make sure they will be aligned properly when reinstalling hydraulic lines.

After Repair or Replacement of Components

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

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

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

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

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

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

7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary (see machine Operator's Manual).

Check Hydraulic Lines and Hoses

WARNING

Keep body and hands away from pin hole leaks or nozzles that eject hydraulic fluid under high pressure. Use paper or cardboard to search for leaks. Hydraulic fluid escaping under pressure can have sufficient force to penetrate the skin and cause serious injury. If fluid is injected into the skin, it must be surgically removed within a few hours by a doctor familiar with this type of injury. Gangrene may result from such an injury.

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

Priming Hydraulic Pumps

Whenever the hydraulic system is flushed, the hydraulic system is charged or hydraulic components are installed, it is important to properly prime the hydraulic pumps. Hydraulic pump priming ensures that the gear pump and piston (traction) pump have adequate oil during initial start−up and running. The pumps can be primed by using a remote starter switch (see Special Tools in this chapter) to crank engine which allows the pumps to prime.

Use the following procedure to prime the hydraulic pumps:

1. Make sure that ignition switch is in the OFF position and key is removed from switch.

2. Check hydraulic reservoir oil level and adjust if necessary (see machine Operator's Manual).

3. To prevent engine from starting during priming:

   Diesel Engine: Disconnect wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting (Fig. 39).

   Gasoline Engine: Connect remote starter switch electrical leads to the starter motor solenoid B+ terminal and the positive post of the battery (Fig. 40).

4. Make sure traction pedal is in neutral. Turn ignition key switch to start; engage starter for thirty (30) seconds to prime hydraulic pumps. Wait thirty (30) seconds to allow the starter motor to cool and then repeat cranking procedure again.

5. To allow to start after priming:

   Diesel Engine: Connect wire harness electrical connector to fuel stop solenoid.

   Gasoline Engine: Disconnect remote starter switch leads from starter motor solenoid terminal and positive post of the battery.

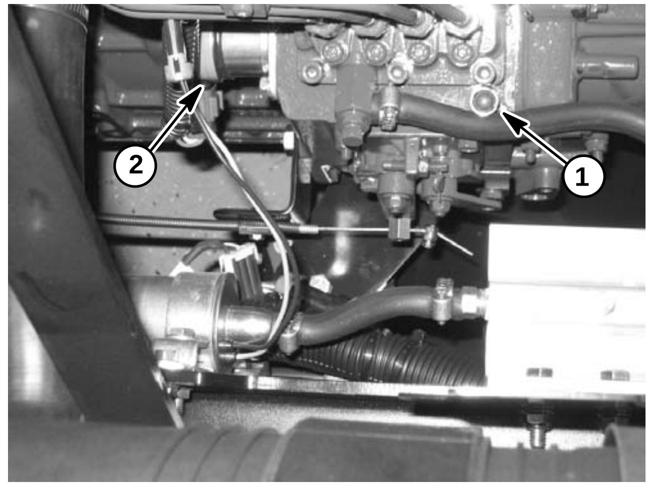


Figure 39

1. **Injection pump** 2. **Fuel stop solenoid**

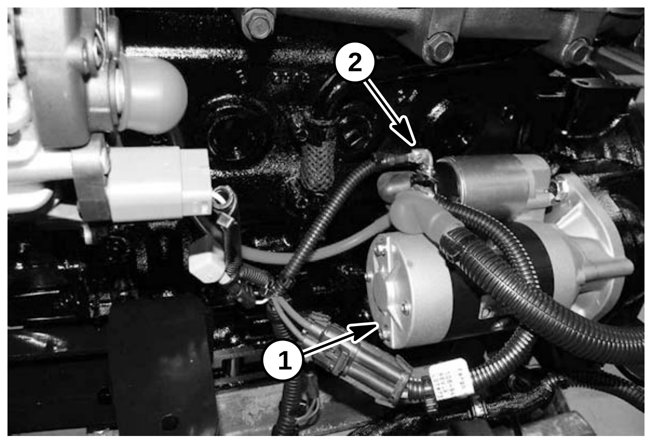


Figure 40

1. **Starter motor** 2. **B+ terminal**

Flush Hydraulic System

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

1. Make sure hydraulic oil is warm by operating the machine for at least ten (10) minutes. Park machine on a level surface. Stop engine, apply parking brake and remove key from ignition switch.

IMPORTANT: Follow all local codes and regulations when recycling or disposing hydraulic fluid and filters.

2. Clean area around hydraulic filter mounting areas and remove both hydraulic filters. Drain filters into a suitable container.

3. Drain hydraulic reservoir into a suitable container.

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

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

6. Reinstall all hoses and hydraulic components.

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

7. Fill hydraulic oil reservoir with NEW hydraulic fluid.

8. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

9. Start engine and run at low idle speed **(Diesel engine = 1200 to 1300 RPM, Gasoline engine = 1000 RPM)** for a minimum of two (2) minutes.

10. Increase engine speed to high idle **(Diesel engine = 3050 to 3150 RPM, Gasoline engine = 3200 RPM)** for minimum of one (1) minute under no load.

11. Turn steering wheel in both directions several times.

12. Raise and lower spray booms several times.

13. Shut off engine and check for hydraulic oil leaks. Check oil level in hydraulic reservoir and add correct oil if necessary (see machine Operator's Manual).

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

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

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

Filtering Closed−Loop Traction Circuit

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

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

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

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

3. Thoroughly clean junction of hydraulic hose and **lower** fitting on right side of traction pump (Fig. 41). Disconnect hose from lower right side pump fitting.

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

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

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

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

CAUTION

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

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

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

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

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

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

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

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

12. Lower machine to ground.

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

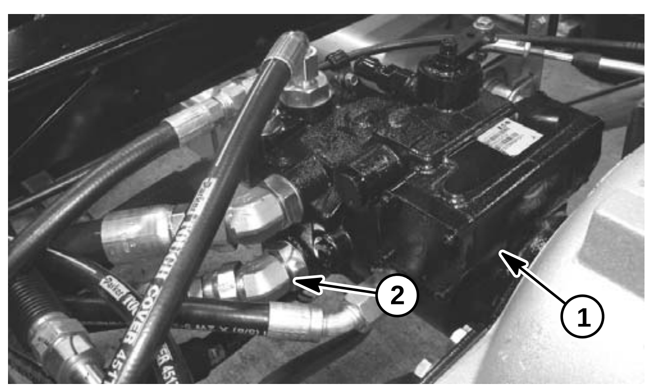


Figure 41

1. Piston (traction) pump 2. Lower fitting

Charging Hydraulic System

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

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

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

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

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

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

4. Make sure hydraulic reservoir is full. Add correct hydraulic oil if necessary (see machine Operators Manual).

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

6. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

WARNING

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

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

8. Start engine and run it at low idle **(Diesel engine = 1200 to 1300 RPM, Gasoline engine = 1000 RPM)**. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

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

   A. Loose filter or suction lines.

   B. Blocked suction line.

   C. Faulty charge relief valve.

   D. Faulty gear pump.

10. If cylinder does move in fifteen (15) seconds, proceed to step 11.

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

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

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

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

13. Check operation of the traction neutral switch.

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

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

16. Operate machine by gradually increasing its work load to full over a ten (10) minute period.

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

Gear Pump

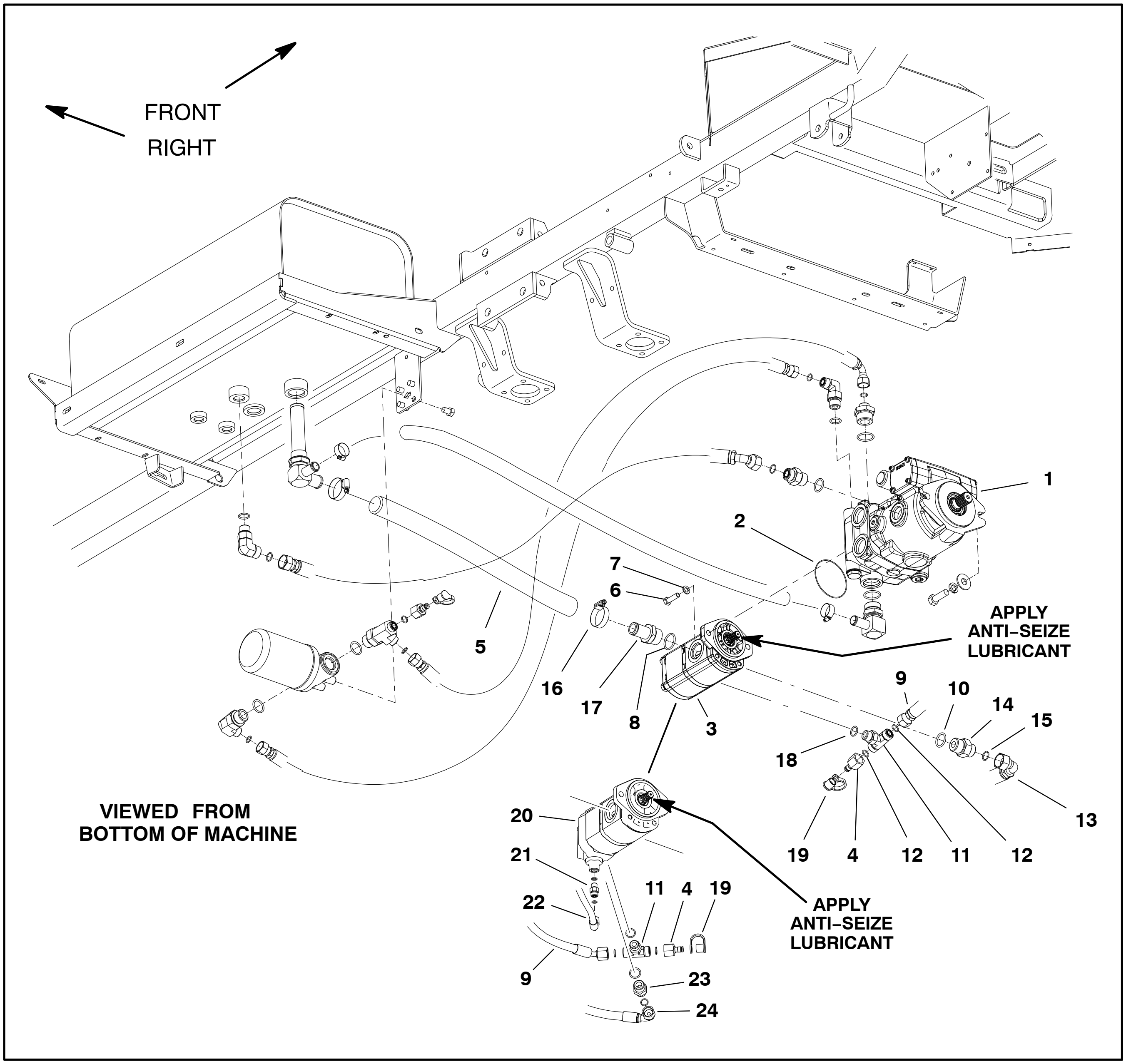


Figure 42

1. **Piston (traction) pump**
2. **O–ring**
3. **Gear pump (serial numbers below 405700000)**
4. **Test fitting**
5. **Hydraulic hose (with cover)**
6. **Cap screw (2)**
7. **Flat washer (2)**
8. **O–ring**
9. **Hydraulic hose (to steering control valve P port)**
10. **O–ring**
11. **Hydraulic tee fitting**
12. **O–ring**
13. **Hydraulic hose (to pump manifold P port)**
14. **Straight fitting**
15. **O–ring**
16. **Hose clamp**
17. **Hydraulic fitting**
18. **O–ring**
19. **Dust cap**
20. **Gear pump (serial numbers above 405700000)**
21. **Straight fitting**
22. **Hydraulic hose (to steering control valve E port)**
23. **Straight fitting**
24. **Hydraulic hose (to boom lift manifold P port)**

Removal (Fig. 42)

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

2. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

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

CAUTION

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

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

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

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

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

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

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

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

Installation (Fig. 42)

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

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

3. Apply anti−seize lubricant to the gear pump shaft splines and carefully raise gear pump and position it to the piston pump.

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

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

6. Charge the hydraulic system (see Charge Hydraulic System in this chapter).

7. Install the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

Gear Pump Service

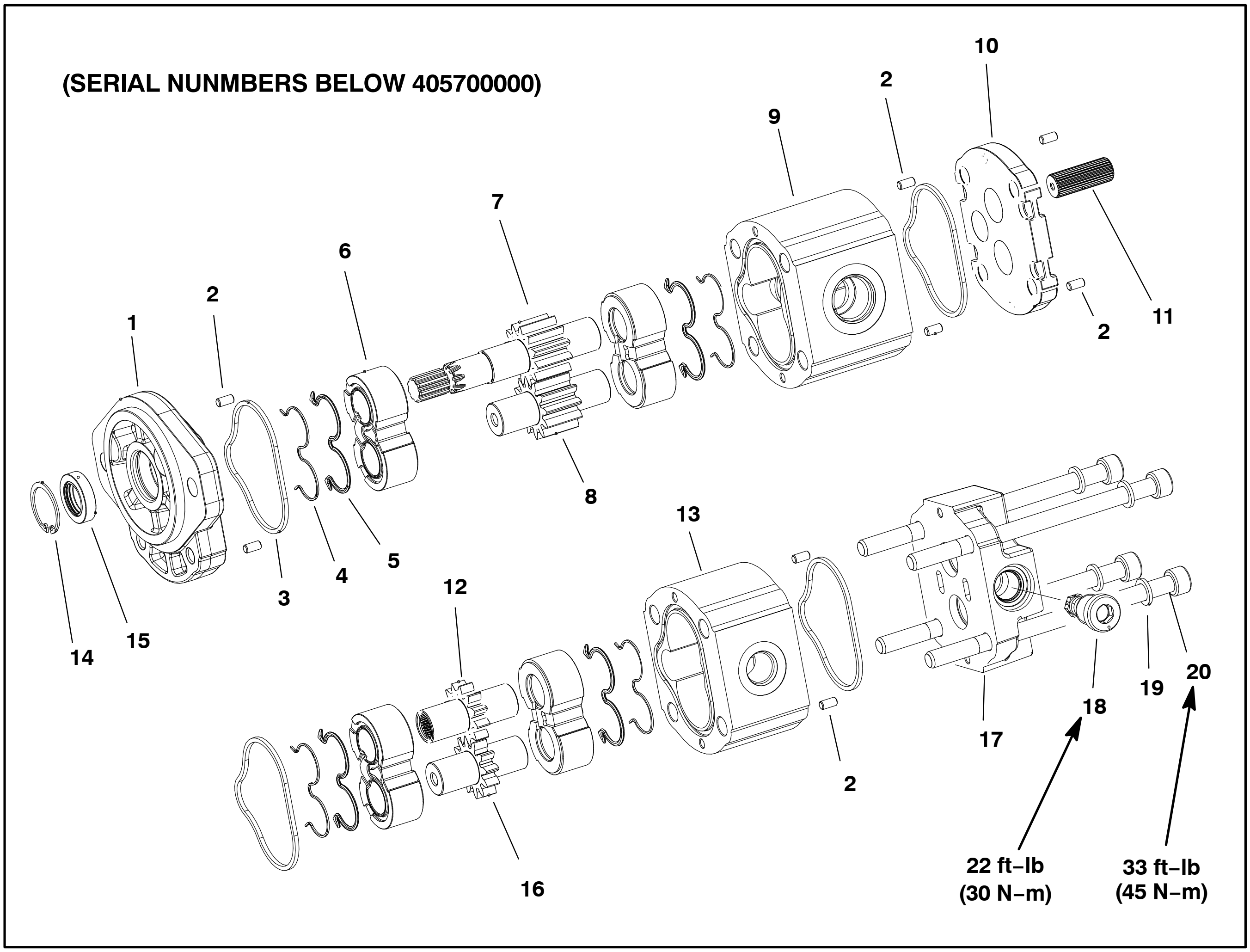


Figure 43

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

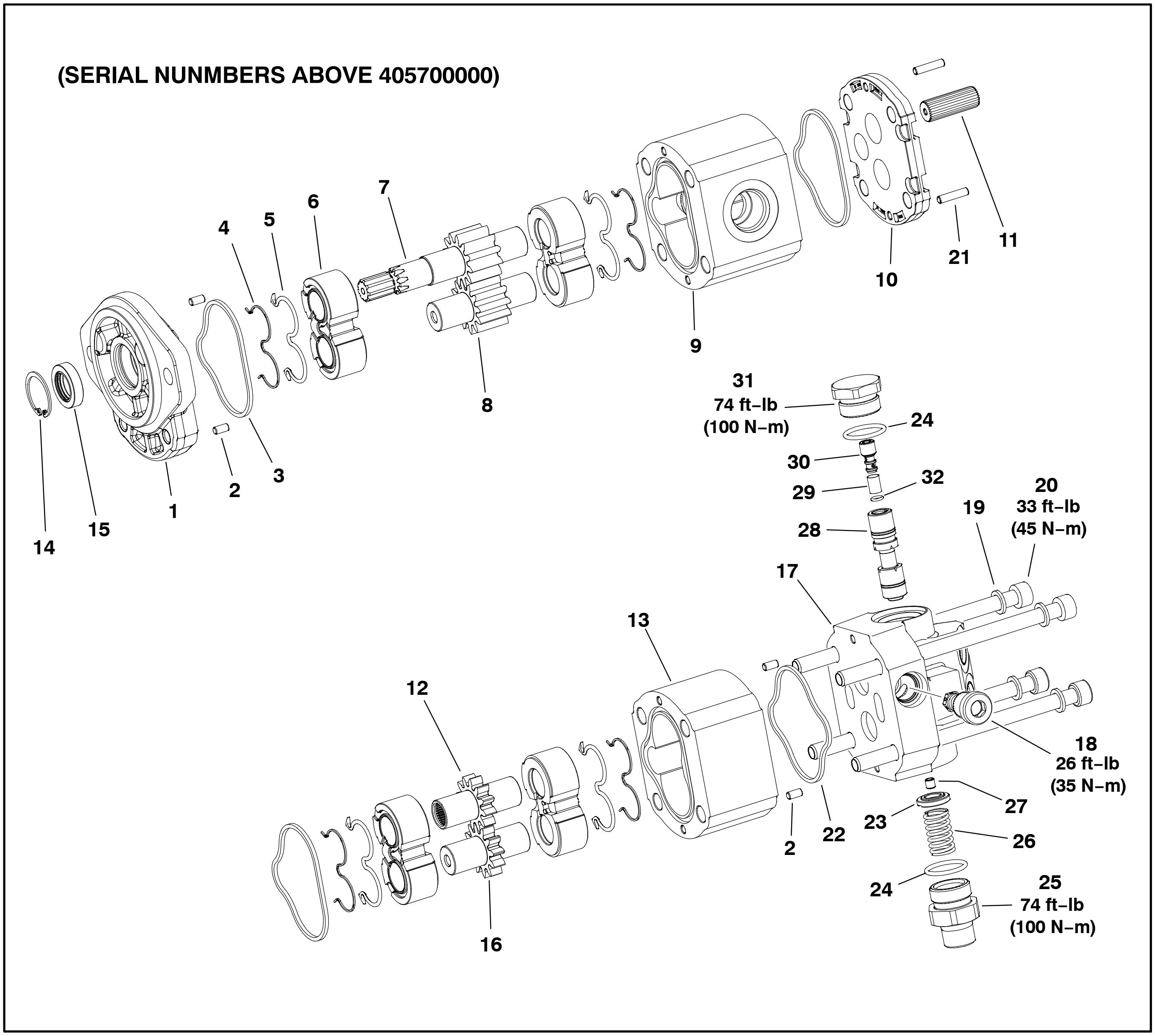


Figure 44

1. Front cover
2. Dowel pin (4)
3. Square section seal (3)
4. Back−up ring (4)
5. Pressure seal (4)
6. Thrust plate (4)
7. Drive shaft
8. Driven gear
9. Body (P1 section)
10. Flange
11. Splined connecting shaft
12. Drive gear
13. Body (P2 section)
14. Retaining ring
15. Front seal
16. Driven gear
17. Rear cover
18. Relief valve (steering/boom lift)
19. Washer (4)
20. Bolt (4)
21. Dowel pin (2)
22. Square section seal
23. Spring plate
24. O−ring (2)
25. Spring plug
26. LS valve spring
27. Grub screw
28. LS valve spool
29. Tubular filter
30. Throttling screw
31. Plug
32. O−ring

Disassembly (Fig. 43 or 44)

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

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

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

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 45).

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

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

4. For pumps from machines with serial numbers above 405700000, loosen the load sensing “LS” valve plugs and remove the components from the rear cover.

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

6. Remove pump from vise and remove fasteners.

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

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

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

Gear Pump Inspection

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

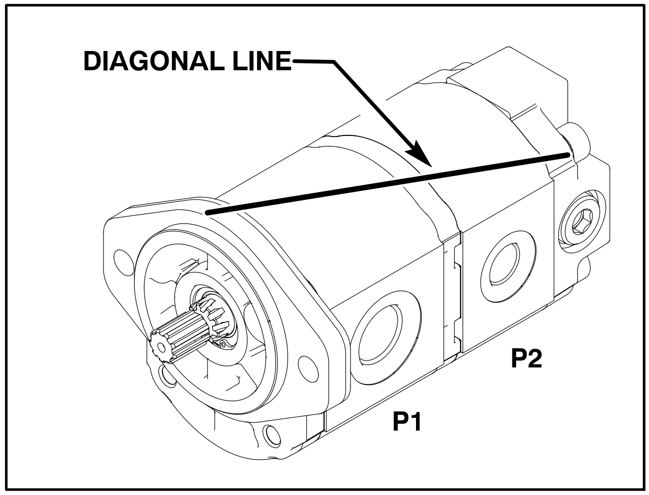


Figure 45

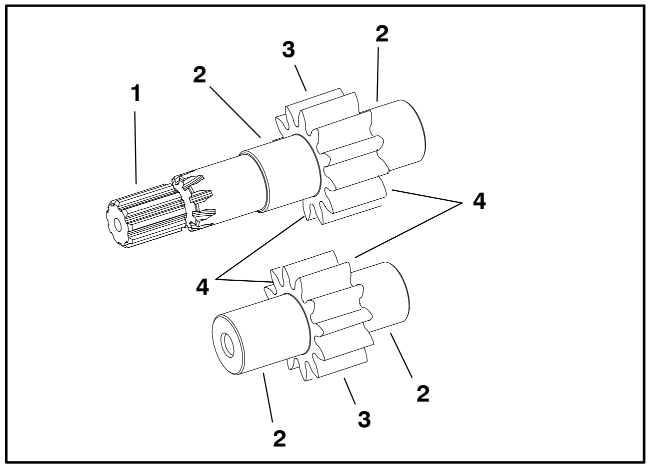


Figure 46

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive gears and idler gears for the following (Fig. 46):

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

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

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

4. Inspect thrust plates for the following:

A. Bearing areas should not have excessive wear or scoring.

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

C. Thickness of thrust plates should be equal.

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

6. If internal parts are found to be worn or damaged, gear pump replacement is necessary.

Assembly (Fig. 43 or 44)

NOTE: When assembling the motor, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate body seals, pressure seals, uni−rings and thrust plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new seal and retaining ring into front cover.

3. Assembly pump section P1:

A. Install the pressure seals, flat side outward, into the grooves in the thrust plates. Follow by carefully placing the uni−rings, flat side outward, between the pressure seals and the grooves in the wear plate.

B. Apply a light coating of petroleum jelly to the exposed side of the front flange.

C. Lubricate the drive shaft/gear with clean hydraulic oil. Insert the drive end of the drive shaft through the thrust plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Install shaft into front cover.

D. Lubricate the idler shaft/gear with clean hydraulic oil. Align the position markings made during disassembly and install idler gear shaft into the front thrust plate and front cover. Apply a light coating of clean hydraulic oil to gear faces.

E. Install rear thrust plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

F. Install steel bushings/dowel pins in body.

G. Apply a light coating of petroleum jelly to new body seal and body seal groove in the body. Install new body seal into the body.

IMPORTANT: Do not dislodge seals during installation.

H. Align marker lines and slide the body over the gear assembly. A slight tap with a soft hammer on the pump body should be sufficient to engage the steel sleeves.

4. Repeat step 3. for pump section P2.

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

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

6. Place front cover of the motor into a vise with soft jaws and alternately tighten the cap screws to **33 ft−lb (45 N−m)**.

7. For pumps from machines with serial numbers above 405700000, install the load sensing “LS” valve components in the rear cover. Tighten both LS valve plugs to **74 ft−lb (100 N−m)**.

8. Remove motor from vise.

9. Place a small amount of clean hydraulic oil in the inlet of each pump and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the pump and check for assembly problems.

Traction (Piston) Pump

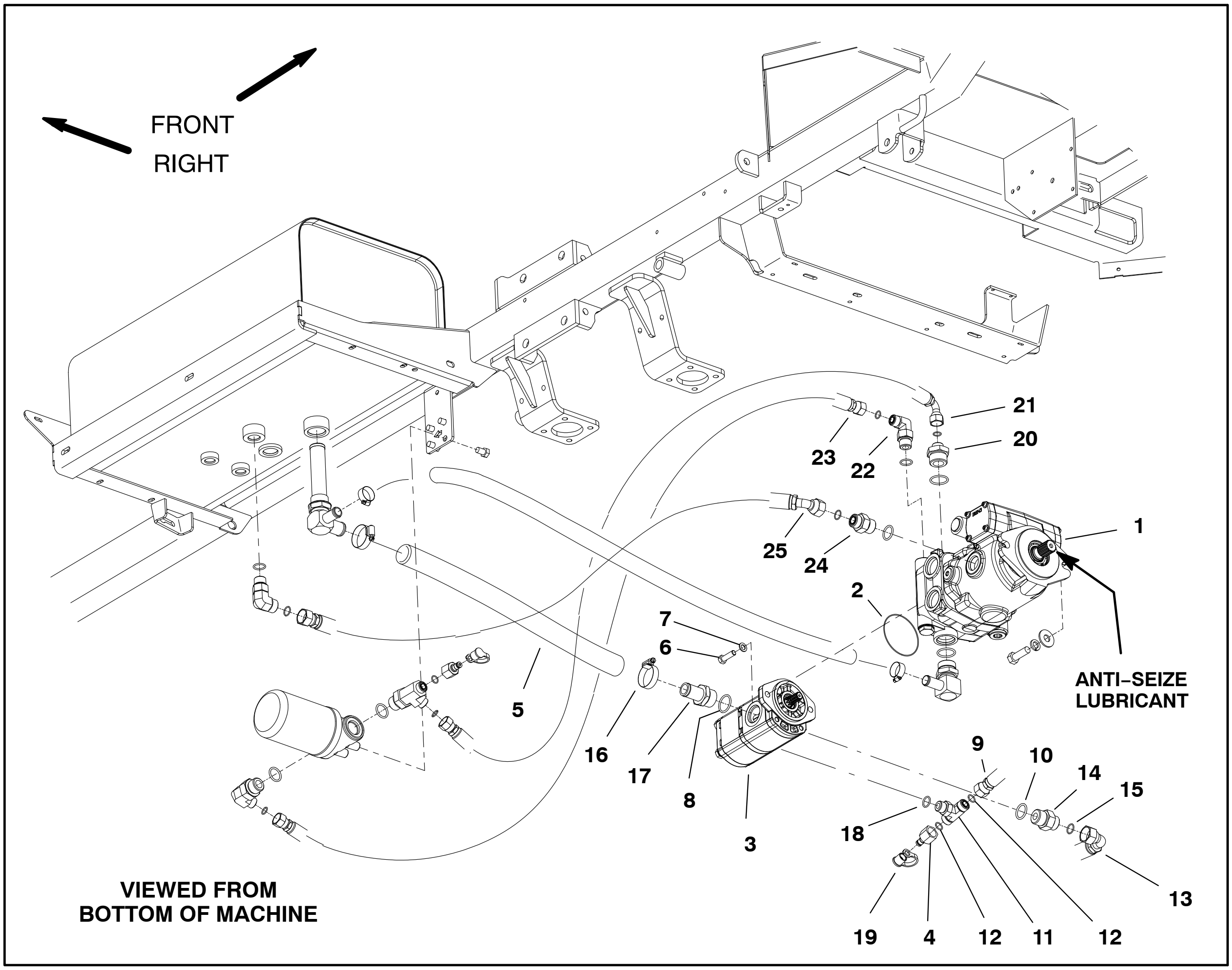


Figure 47

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

Removal (Fig. 47)

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

2. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

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

CAUTION

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

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

5. Remove traction cable ball joint from control plate on piston pump by removing lock nut, cap screw and three (3) flat washers from control plate (Fig. 48).

6. Disconnect wire harness connector from neutral switch on piston pump (Fig. 49).

7. Remove flange head screw and flange nut that secures R−clamp and right side brake cable to pump assembly (Fig. 49).

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

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

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

CAUTION

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

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

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

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

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

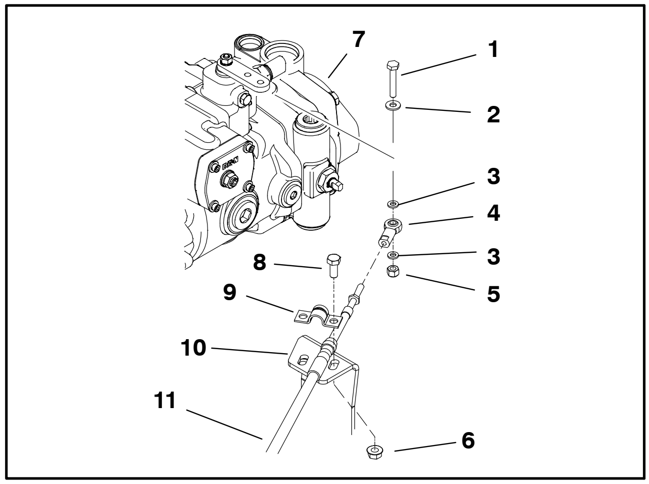


Figure 48

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

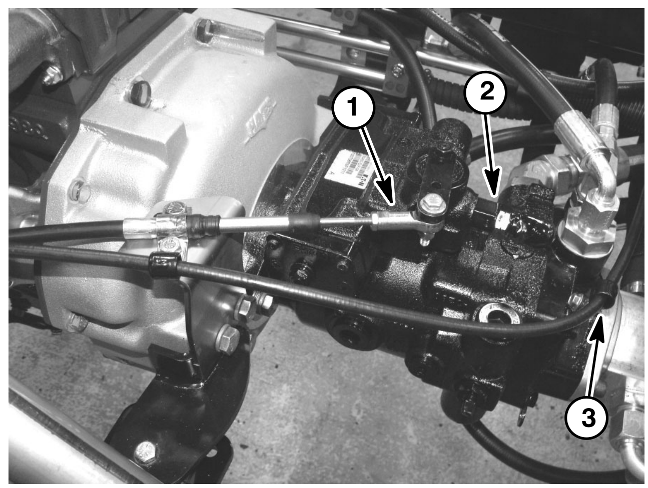


Figure 49

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

Installation (Fig. 47)

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

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

3. Apply antiseize lubricant to piston pump shaft splines.

CAUTION

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

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

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

6. Secure traction cable to control plate with cap screw, three (3) washers and lock nut (Fig. 48).

7. Connect wire harness connector to neutral switch on piston pump (Fig. 49).

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

9. Secure R−clamp and right side brake cable to pump assembly with flange head screw and flange nut (Fig. 49).

10. Charge the hydraulic system (see Charge Hydraulic System in this chapter).

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

12. Install the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 − Chassis in this manual).

Traction (Piston) Pump Service

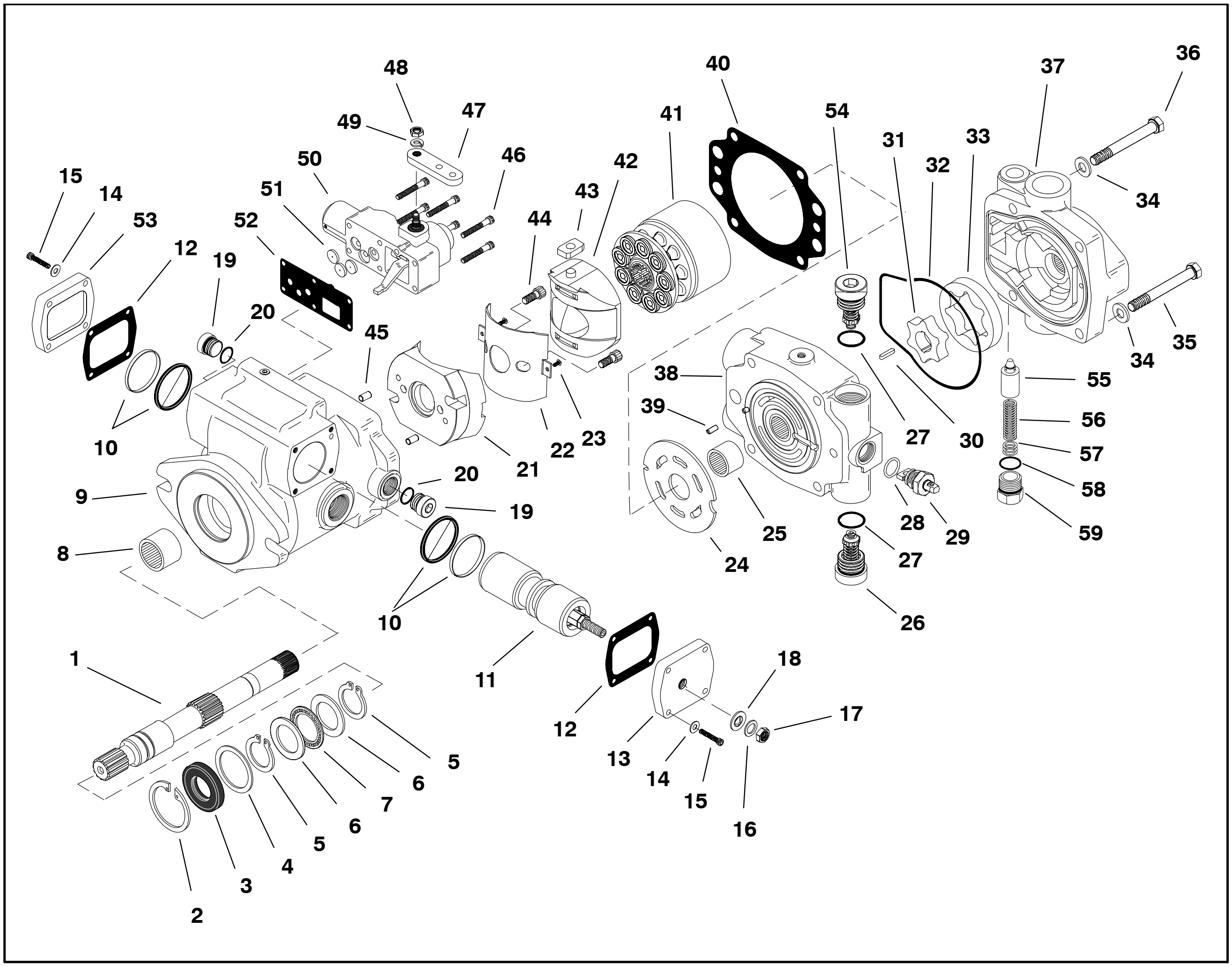


Figure 50

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

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

Wheel Motors

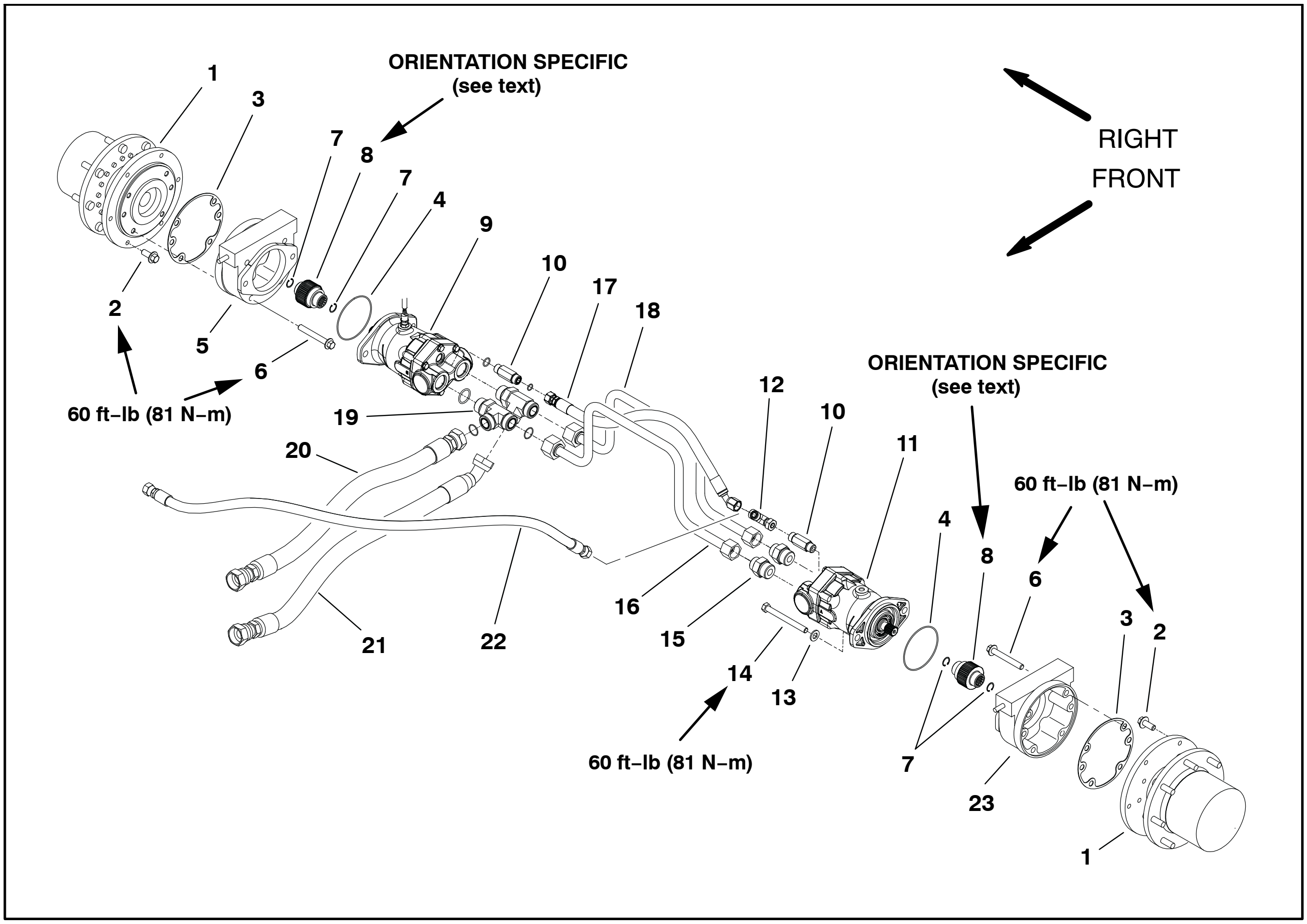


Figure 51

1. Planetary assembly
2. Flange head screw (6 per side)
3. Gasket
4. O−ring (2)
5. RH brake assembly
6. Flange head screw (4 per brake)
7. Retaining ring (2 per shaft)
8. Splined brake shaft
9. RH wheel motor
10. Hydraulic adapter (2)
11. LH wheel motor
12. Hydraulic tee fitting
13. Flat washer (2 per motor)
14. Cap screw (2 per motor)
15. Straight hydraulic fitting (2)
16. Hydraulic tube
17. Hydraulic hose
18. Hydraulic tube
19. Hydraulic tee fitting (2)
20. Hyd. hose (to lower pump fitting)
21. Hyd. hose (to upper pump fitting)
22. Hydraulic hose (to reservoir)
23. LH brake assembly

Removal (Fig. 51)

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

CAUTION

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

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

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

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

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

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

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

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

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

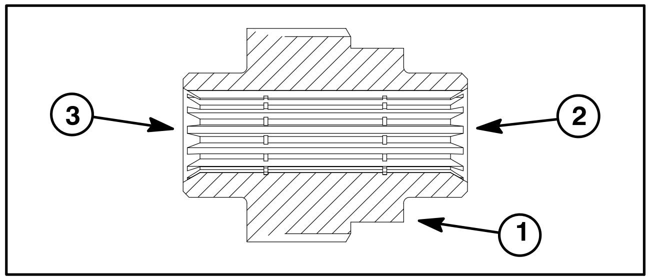


Figure 52

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

Installation (Fig. 51)

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

2. If splined brake shaft was removed from brake assembly, make sure that the stepped end of the shaft is aligned toward the hydraulic wheel motor (Fig. 52). Also, make sure that splines engage rotating discs in brake assembly.

3. Install O−ring (item 4) onto motor. Position wheel motor to brake assembly.

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

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

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

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

8. Charge the hydraulic system (see Charge Hydraulic System in this chapter).

9. Operate machine and inspect for leaks.

Wheel Motor Service

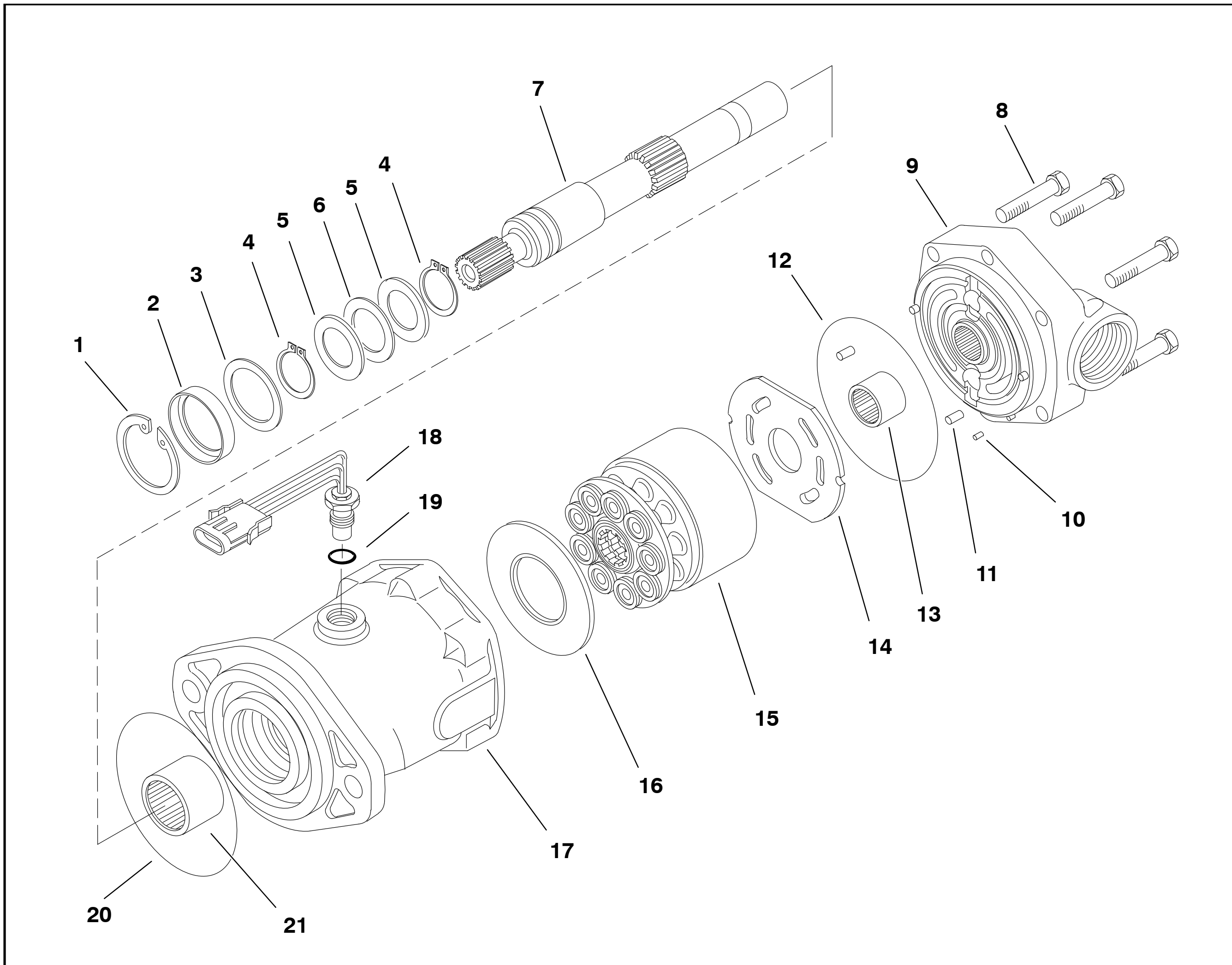


Figure 53

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

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

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

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

Spray Pump Drive Motor and Control Manifold Assembly

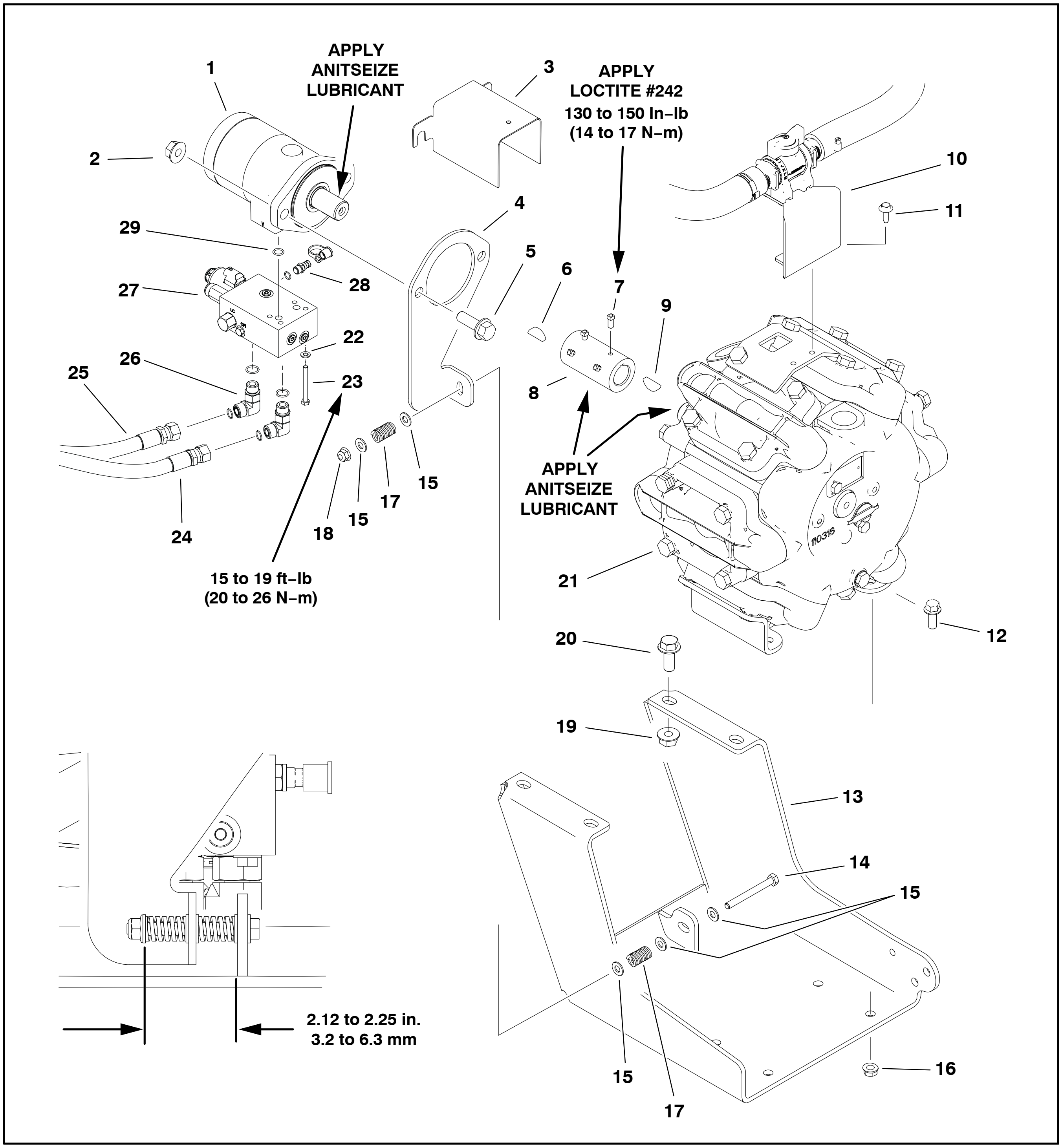


Figure 54

1. Hydraulic motor
2. Flange nut (2)
3. Guard
4. Motor mount plate
5. Flange head screw (2)
6. Woodruff key
7. Set screw (4)
8. Coupler
9. Woodruff key
10. Valve bracket
11. Flange head screw (2)
12. Flange head screw (4)
13. Pump bracket
14. Cap screw
15. Flat washer (5)
16. Flange nut (4)
17. Compression spring (2)
18. Lock nut
19. Flange nut (4)
20. Flange head screw (4)
21. Spray pump
22. Flat washer (4)
23. Cap screw (4)
24. Hydraulic hose (to oil cooler)
25. Hydraulic hose (from gear pump)
26. Elbow fitting (2)
27. Pump control manifold
28. Hydraulic test fitting
29. O−Ring (2)

Removal (Fig. 54)

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

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

3. Thoroughly clean hydraulic hose ends and fittings at the pump control manifold.

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

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

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

7. Loosen, but do not remove, flange nuts (item 2) that secure spray pump motor to motor mount plate and remove guard (item 3).

8. Loosen two (2) set screws (item 7) that secure coupler (item 8) to hydraulic motor shaft. Do not loosen two (2) set screws that secure coupler to spray pump shaft so that coupler remains on the pump shaft during motor removal.

9. Remove the lock nut (item 18) cap screw, flat washers and springs that secure the motor mount plate (item 4) to the pump bracket.

10. Support the motor mount plate, control manifold and motor assembly, slide motor shaft from coupler and remove hydraulic motor from machine.

11. Locate and remove woodruff key (item 6) from motor shaft.

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

13. Remove four (4) cap screws and flat washers that secure control manifold to motor and separate control manifold from motor. Locate and discard two (2) O−rings (item 29) from motor ports.

14. Remove set screws (item 7) that were loosened in coupler. Clean threads of set screws and coupler.

Installation (Fig. 54)

1. Secure control manifold to motor:

   A. Lubricate two (2) new O−rings and place O−rings (item 29) in motor ports.

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

   C. Install and tighten four (4) cap screws and flat washers to secure assembly. Tighten cap screws in a crossing pattern from **15 to 19 ft−lb (20 to 26 N−m)**.

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

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

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

5. Secure motor mount plate to pump bracket with cap screw (item 14), flat washers, compression springs and lock nut. Adjust spring tension to **2.12 to 2.25 in. (3.2 to 6.3 mm)** as shown.

6. Apply Loctite #242 (or equivalent) to threads of set screws (item 7) and install set screws into coupler. Fit motor squarely against motor mount plate and tighten set screws from **130 to 150 in−lbs (14 to 17 N−m)**.

7. Position guard (item 3) to motor mount plate making sure that guard fits around screws used to attach motor to mount plate. Tighten flange head screws and flange nuts to secure assembly.

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

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

10. Charge the hydraulic system (see Charge Hydraulic System in this chapter).

11. Operate machine and inspect for leaks.

Spray Pump Drive Motor Service

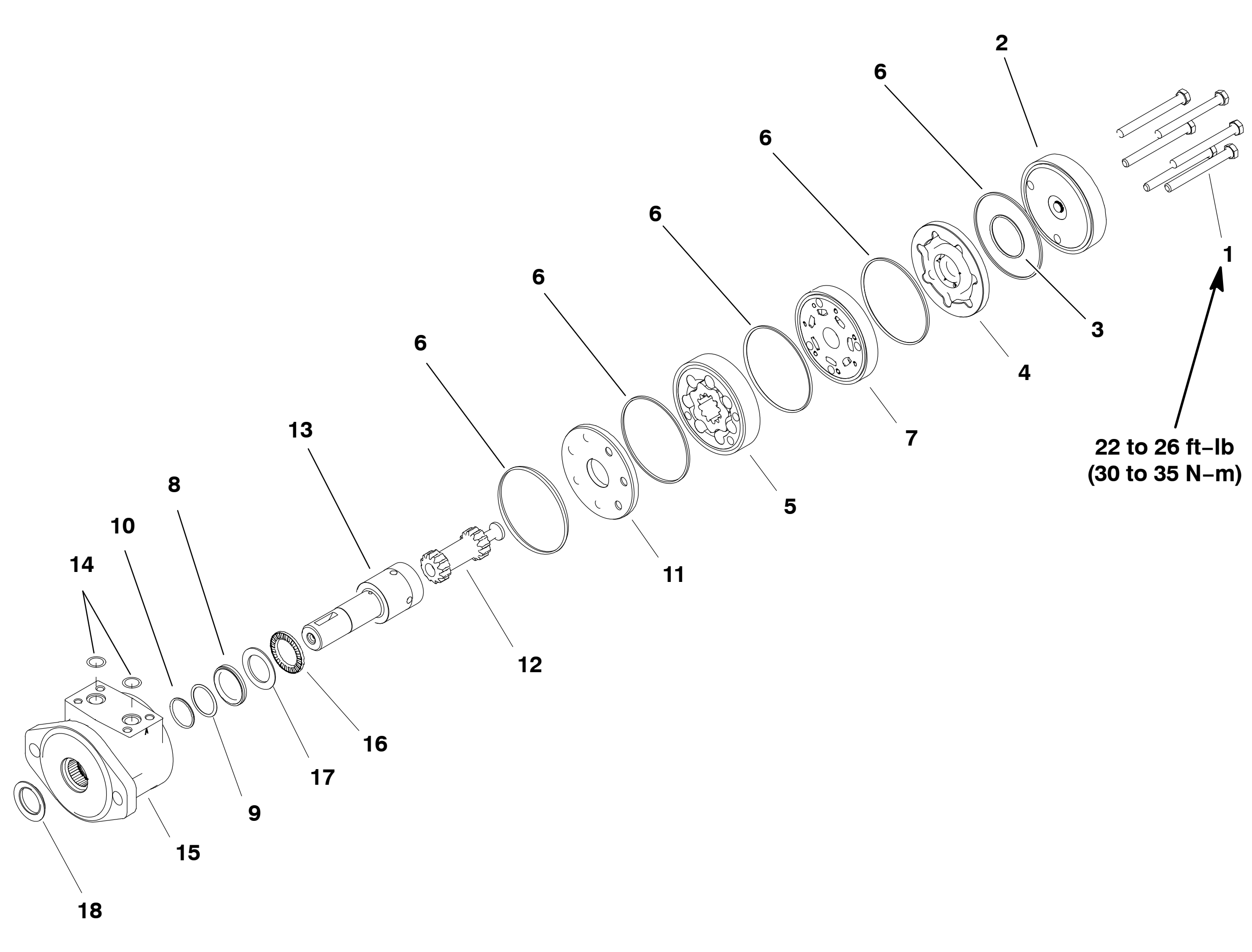


Figure 55

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

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

Spray Pump Control Manifold Service

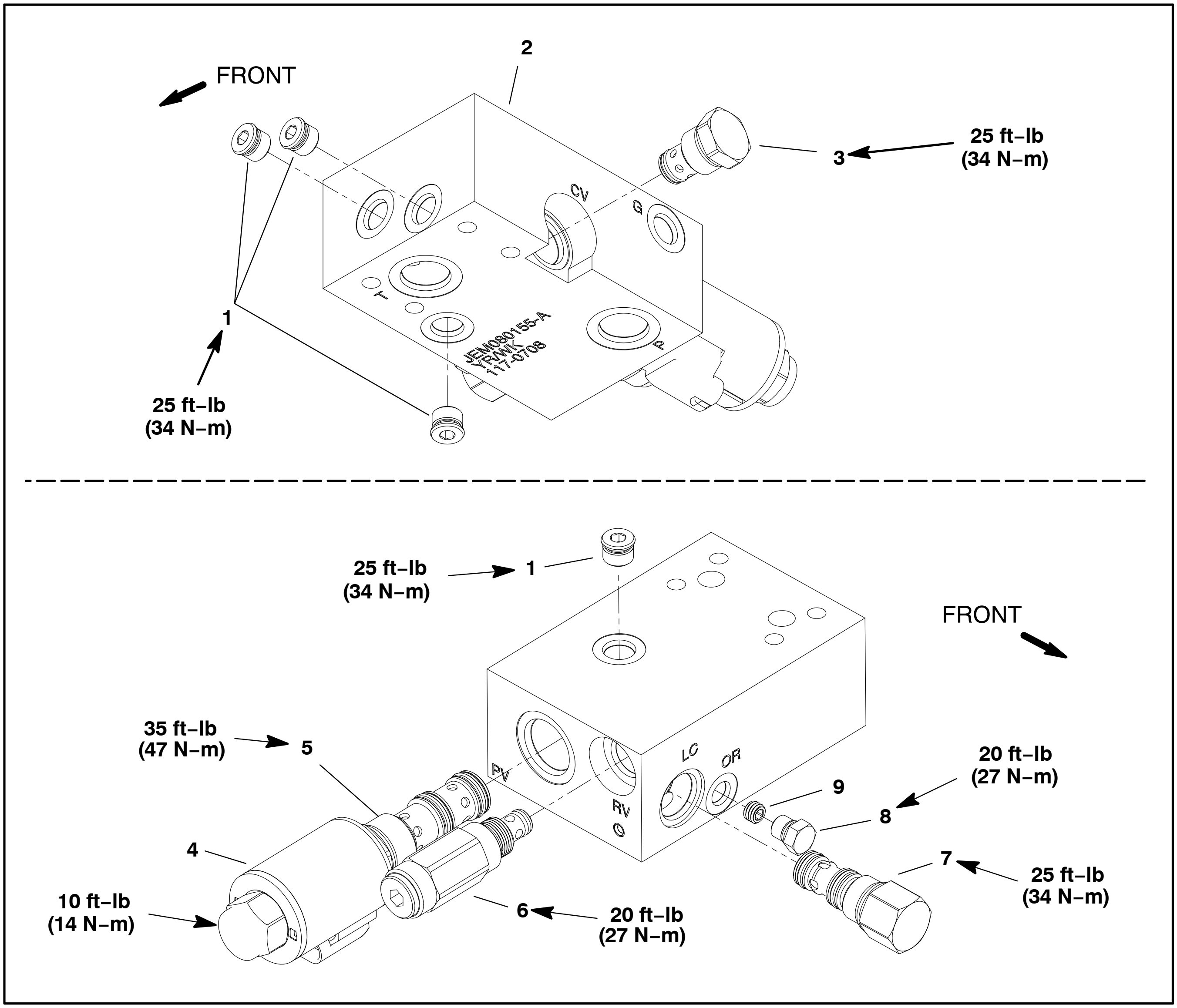


Figure 56

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

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

NOTE: The spray pump control manifold uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O−ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug.

Spray Pump Control Manifold Service (Fig. 56)

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

2. If cartridge is solenoid operated, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve (see component testing in Chapter 6 – Electrical System in this manual for additional information).

IMPORTANT: Use care when removing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

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

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

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

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

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

8. Install the cartridge valve:

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

IMPORTANT: Use care when installing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

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

D. If cartridge is solenoid operated, carefully install solenoid coil to the cartridge valve. Tighten nut to **10 ft–lb (14 N–m)**. Do not over–tighten nut.

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

Steering Control Valve

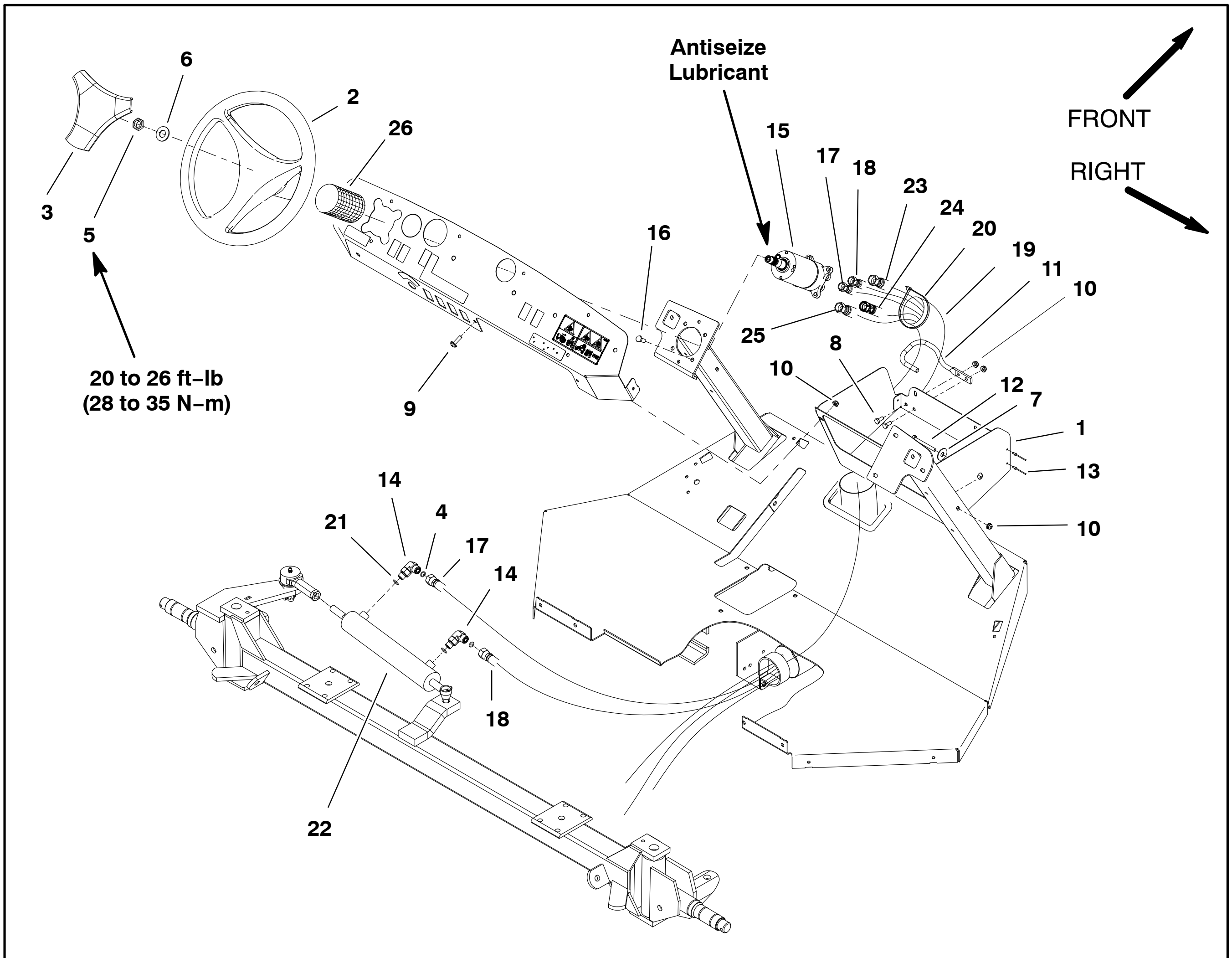


Figure 57

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

Removal (Fig. 57)

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

CAUTION

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

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

3. Remove steering wheel from steering control valve:

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

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

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

   D. Remove the cover sleeve (item 26).

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

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

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

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

8. Disconnect hydraulic hoses connected to the steering control valve (Fig. 58). Allow hoses to drain into a suitable container. Cap or plug openings of control valve and hoses to prevent contamination.

9. Remove control valve from machine.

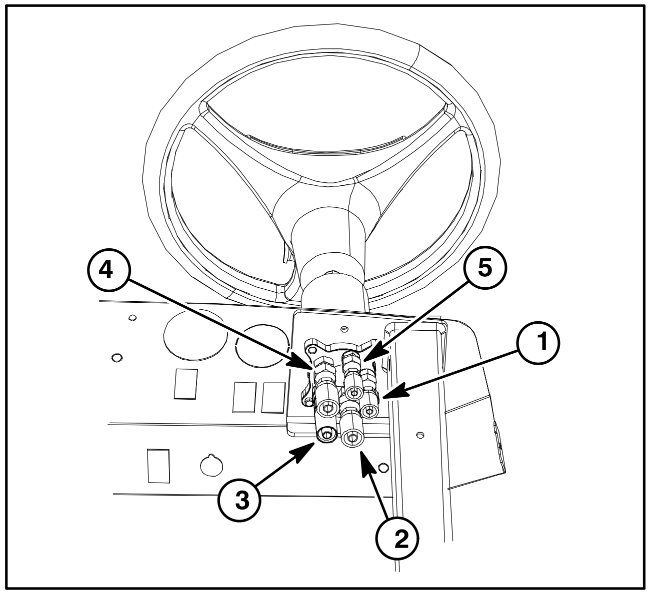


Figure 58

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

Installation (Fig. 57)

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

2. Using labels placed during control valve removal, lubricate new O–rings and connect hydraulic hoses to steering control valve (Fig. 58). Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

4. Install steering wheel to steering control valve:

   A. Install the cover sleeve (item 26).

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

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

   D. Install steering wheel cover to steering wheel.

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

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

Steering Control Valve Service

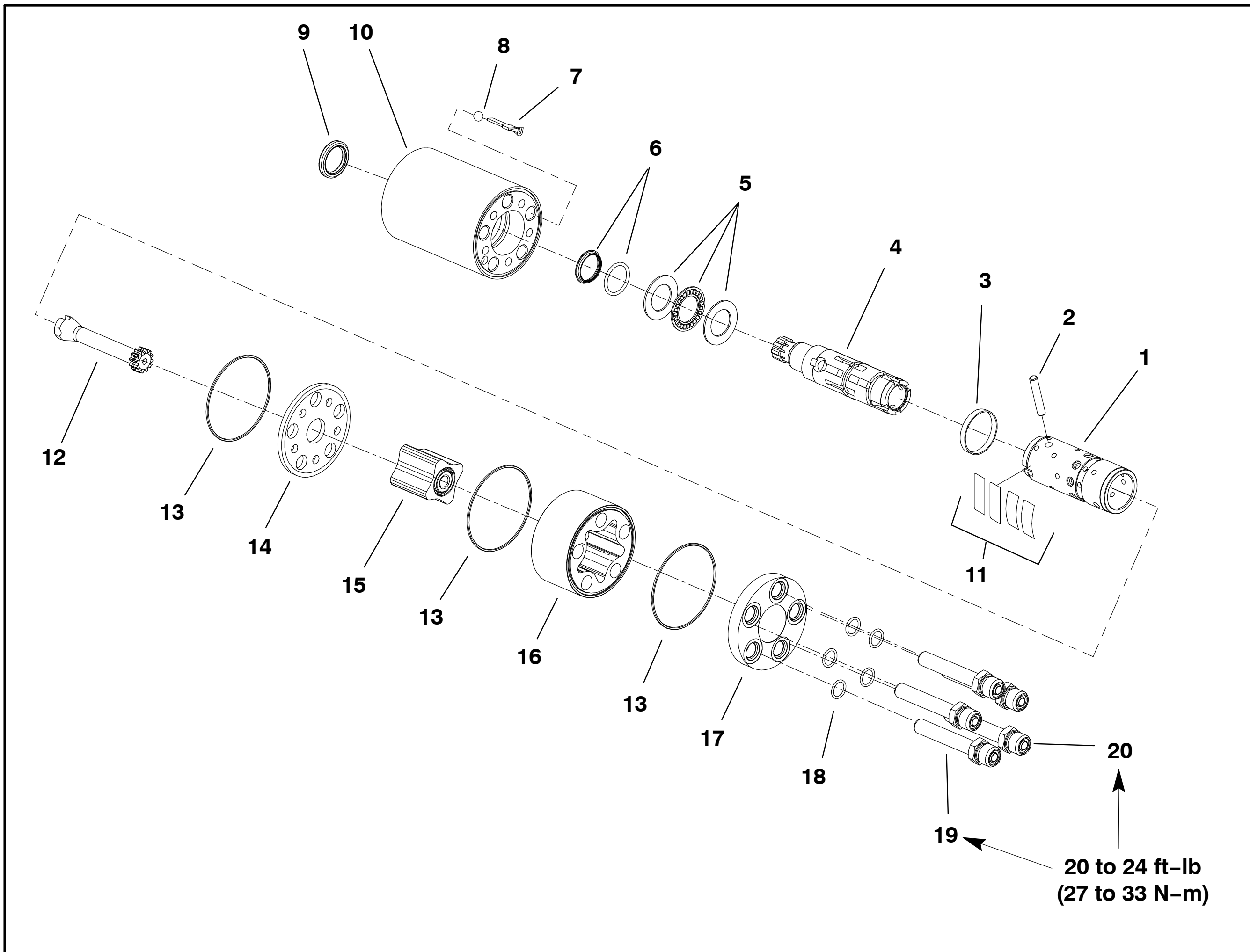


Figure 59

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

For service of the steering control valve, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter. Machines with serial numbers below 405700000 were originally equipped with an OSPM 70 PB steering control valve, and machines with serial numbers above 405700000 have an OSPM 70 LS steering control valve.

Steering Cylinder

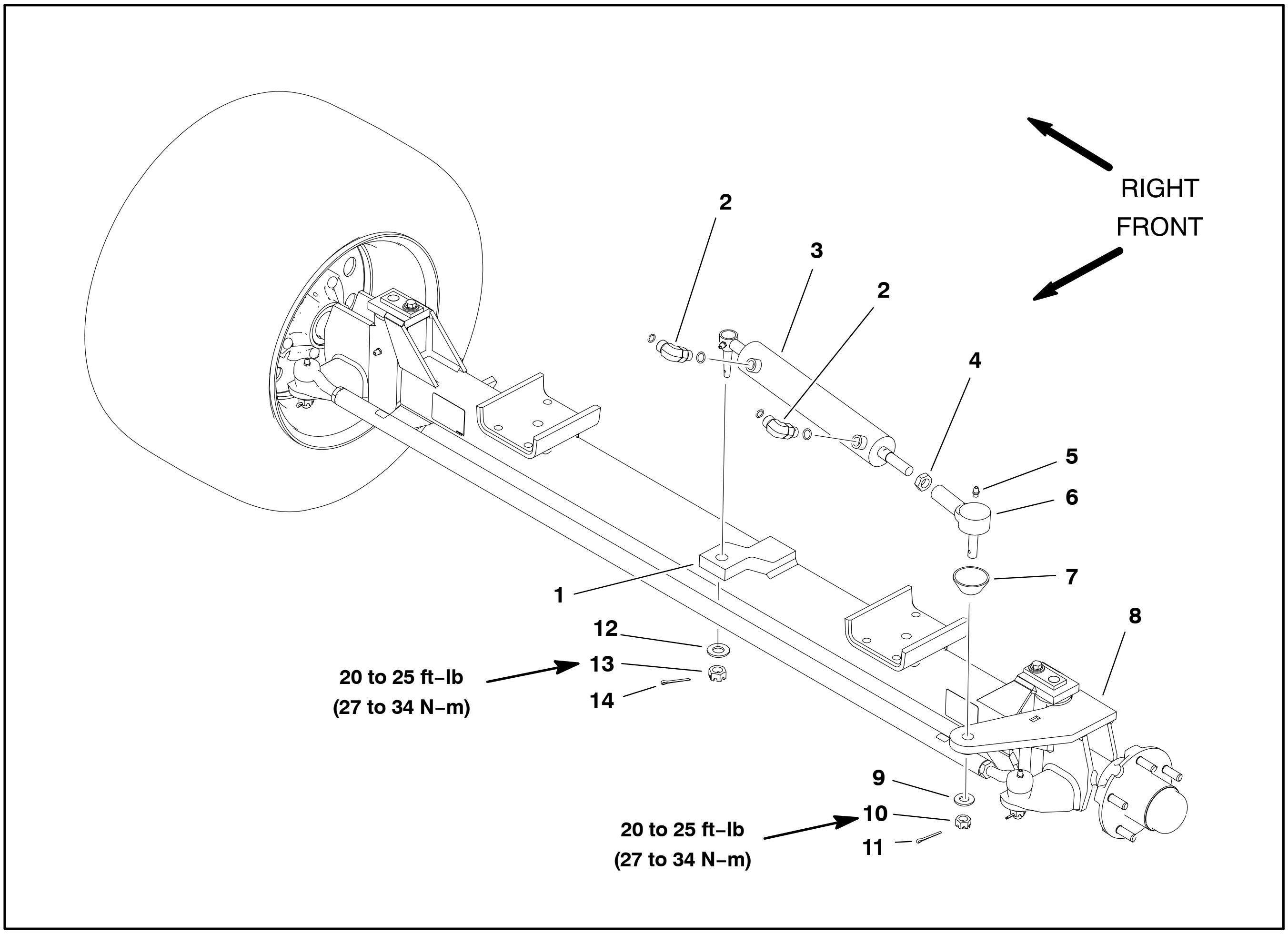


Figure 60

1. **Front axle**
2. **90° hydraulic fitting (2)**
3. **Steering cylinder**
4. **Jam nut**
5. **Grease fitting**
6. **Ball joint**
7. **Rod end seal**
8. **Front axle spindle**
9. **Thrust washer**
10. **Slotted hex nut**
11. **Cotter pin**
12. **Thrust washer**
13. **Lock nut**
14. **Cotter pin**

Removal (Fig. 60)

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

CAUTION

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

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

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

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

5. Disconnect hydraulic hoses from steering cylinder (Fig. 61). Allow hoses to drain into a suitable container.

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

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

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

9. Carefully pry cylinder with ball joints from axle and front axle spindle with a ball joint “pickle” fork and remove steering cylinder from machine.

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

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

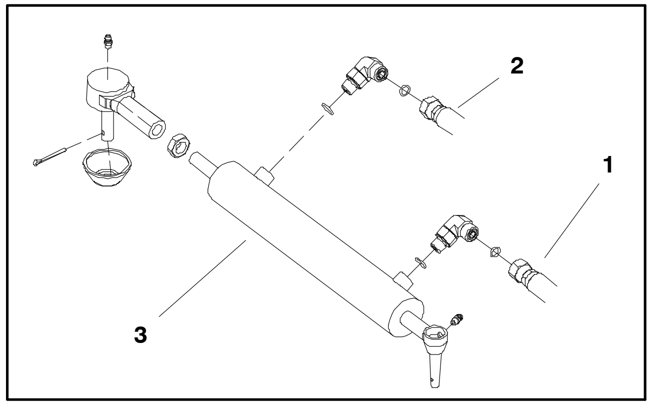


Figure 61

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

Installation (Fig. 60)

1. If ball joint was removed from cylinder shaft, install ball joint onto shaft the same number of revolutions needed to remove ball joint. Secure ball joint with jam nut. After ball joint installation, the distance between ball joint centers should be from 18.620 to 18.740 in (473.0 to 475.9 mm) with the cylinder shaft fully retracted (Fig. 62).

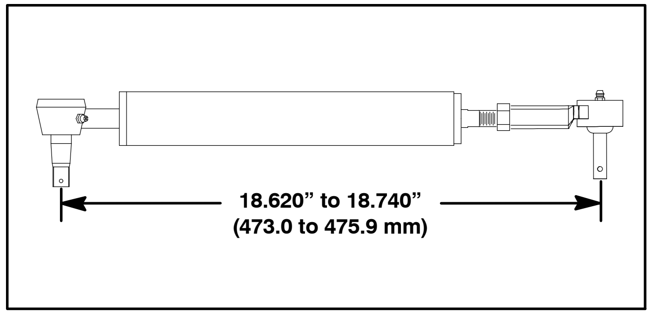


Figure 62

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

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

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

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

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

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

8. Lubricate new O−rings and connect hydraulic hoses to steering cylinder (Fig. 61). Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Check fluid level in hydraulic oil reservoir and adjust as required (see machine Operator’s Manual).

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

11. Grease steering cylinder ball joint fittings with high temperature grease.

12. Check vehicle toe in and adjust if necessary (see machine Operator’s Manual).

Steering Cylinder Service

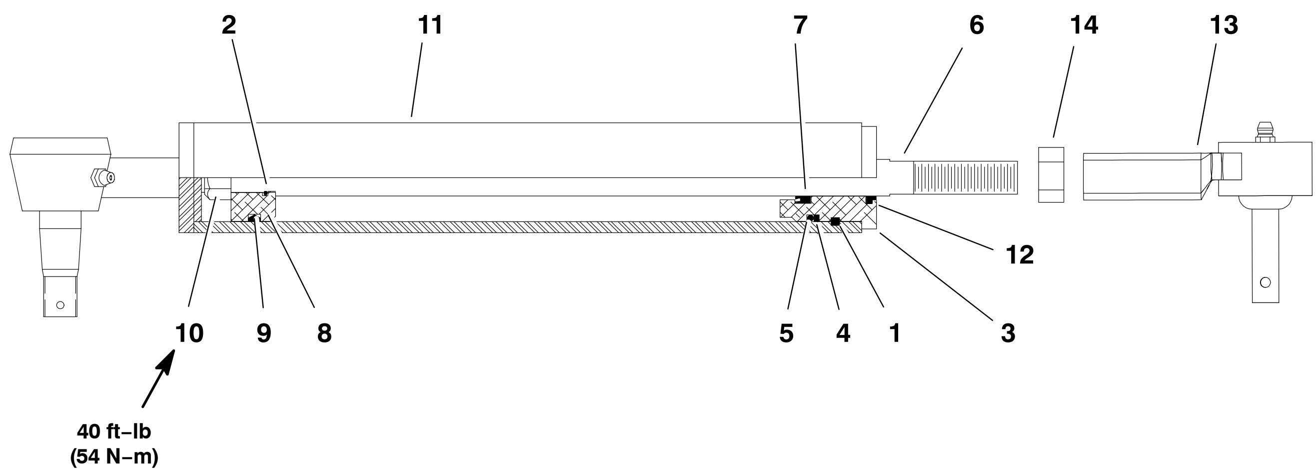


Figure 63

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

Disassembly (Fig. 63)

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

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

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

3. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

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

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

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

Assembly (Fig. 63)

1. Make sure all parts are clean before reassembly.

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

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

B. Install O-ring, back-up ring, rod seal and dust seal to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

3. Mount shaft securely in a vise by clamping on the end of the shaft.

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

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

C. Remove shaft from the vise.

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

4. Mount end of the barrel in a vise.

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

6. Secure head into the barrel with retaining ring.

Boom Lift Manifold

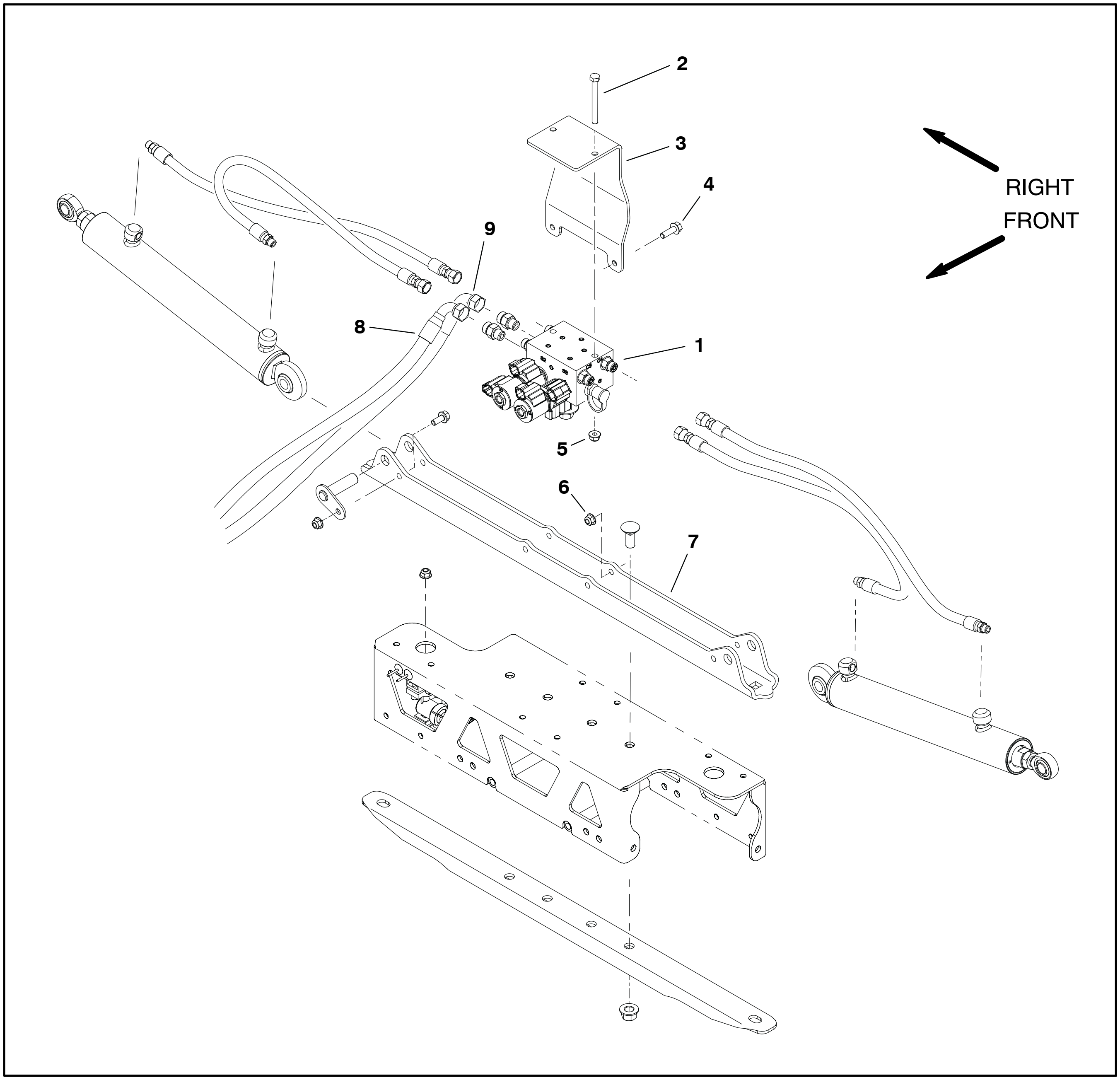


Figure 64

1. Boom lift manifold
2. Cap screw (2)
3. Manifold mount
4. Flange head screw (2)
5. Flange nut (2)
6. Flange nut (2)
7. Bracket
8. Hydraulic hose (to filter)
9. Hydraulic hose (from steering control valve)

Removal (Fig. 64)

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

WARNING

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

CAUTION

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

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

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

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

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

6. Thoroughly clean hydraulic hose ends and fittings prior to disconnecting the hoses from boom lift manifold.

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

7. Disconnect hydraulic hoses from fittings in boom lift manifold. Allow hoses to drain into a suitable container.

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

9. Remove two (2) flange nuts and cap screws that secure boom lift manifold to mount plate. Remove manifold from machine.

Installation (Fig. 64)

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

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

3. Lubricate new O–rings and install on fittings. Using labels placed during removal, correctly connect hydraulic hoses to lift control manifold fittings. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

5. Check fluid level in hydraulic oil reservoir and adjust as required (see machine Operator's Manual).

6. After assembly is completed, operate boom cylinders to verify that hydraulic hoses and fittings are not contacted by anything and that there are no leaks.

Boom Lift Manifold Service

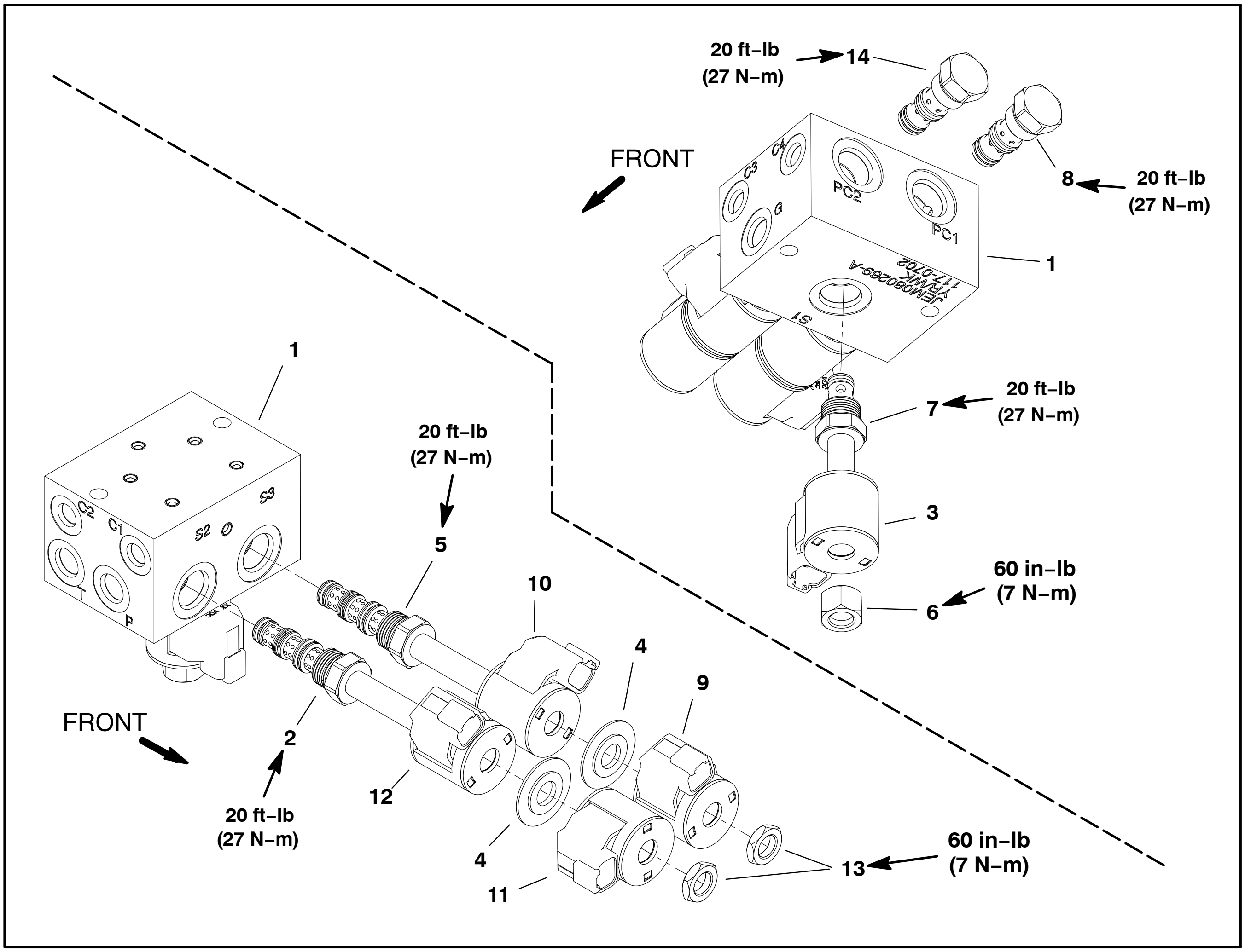


Figure 65

1. **Manifold**
2. **Solenoid valve (S2) (RH boom)**
3. **Solenoid coil (S1)**
4. **Coil spacer (2 used)**
5. **Solenoid valve (S3) (LH boom)**
6. **Nut**
7. **Solenoid valve (S1)**
8. **Check valve PC1**
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 PC2**

The ports on the boom lift control manifold are marked for easy identification of components. Example: P is the gear pump connection port and S1 is the location for solenoid valve S1 (see Hydraulic Schematic in Chapter 8 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each manifold port).

If sprayer is equipped with optional Sonic Boom System, the boom lift control manifold will be different than the manifold shown in Figure 65 (see Ultra Sonic Boom Lift Manifold Service in Chapter 9 in this manual). Service of the Sonic Boom System boom lift control manifold is similar to the standard manifold.

Boom Lift Control Manifold Service (Fig. 65)

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).

IMPORTANT: A flow control orifice (0.035) is placed beneath the hydraulic fittings in control manifold ports C1, C2, C3 and C4. If any of these fittings is removed from the manifold, make sure to remove orifice and label its position for assembly purposes. Also note location of slot in orifice for assembly purposes.

1. Make sure the manifold is clean before removing a fitting or cartridge valve.

2. If necessary, remove fittings and flow control orifices from control manifold and discard O−rings (Fig. 66).

3. If cartridge is solenoid operated, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve.

IMPORTANT: Use care when removing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

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

6. 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.

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

8. Install the cartridge valve:

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

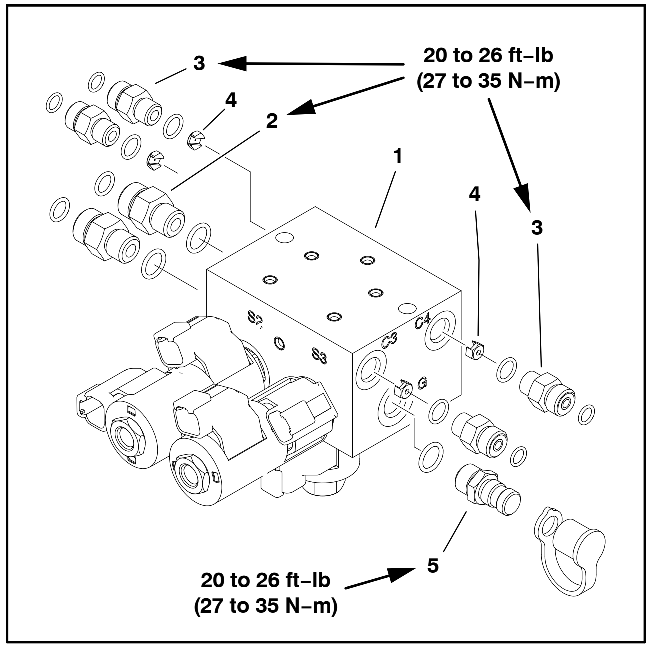


Figure 66

1. **Boom lift manifold**
2. **Straight fitting (2)**
3. **Straight fitting (4)**
4. **Orifice − 0.035 (4)**
5. **Test fitting**

IMPORTANT: Use care when installing cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

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

D. If cartridge is solenoid operated, carefully install solenoid coil to the cartridge valve. Tighten nut to **60 in−lb (7 N−m)**. Do not over−tighten nut.

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

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.

10. If fittings were removed from control manifold, lubricate and place new O−rings onto fittings. Install fittings into control manifold port openings. Tighten fittings to specified torque (Fig. 66).

Boom Lift Cylinders

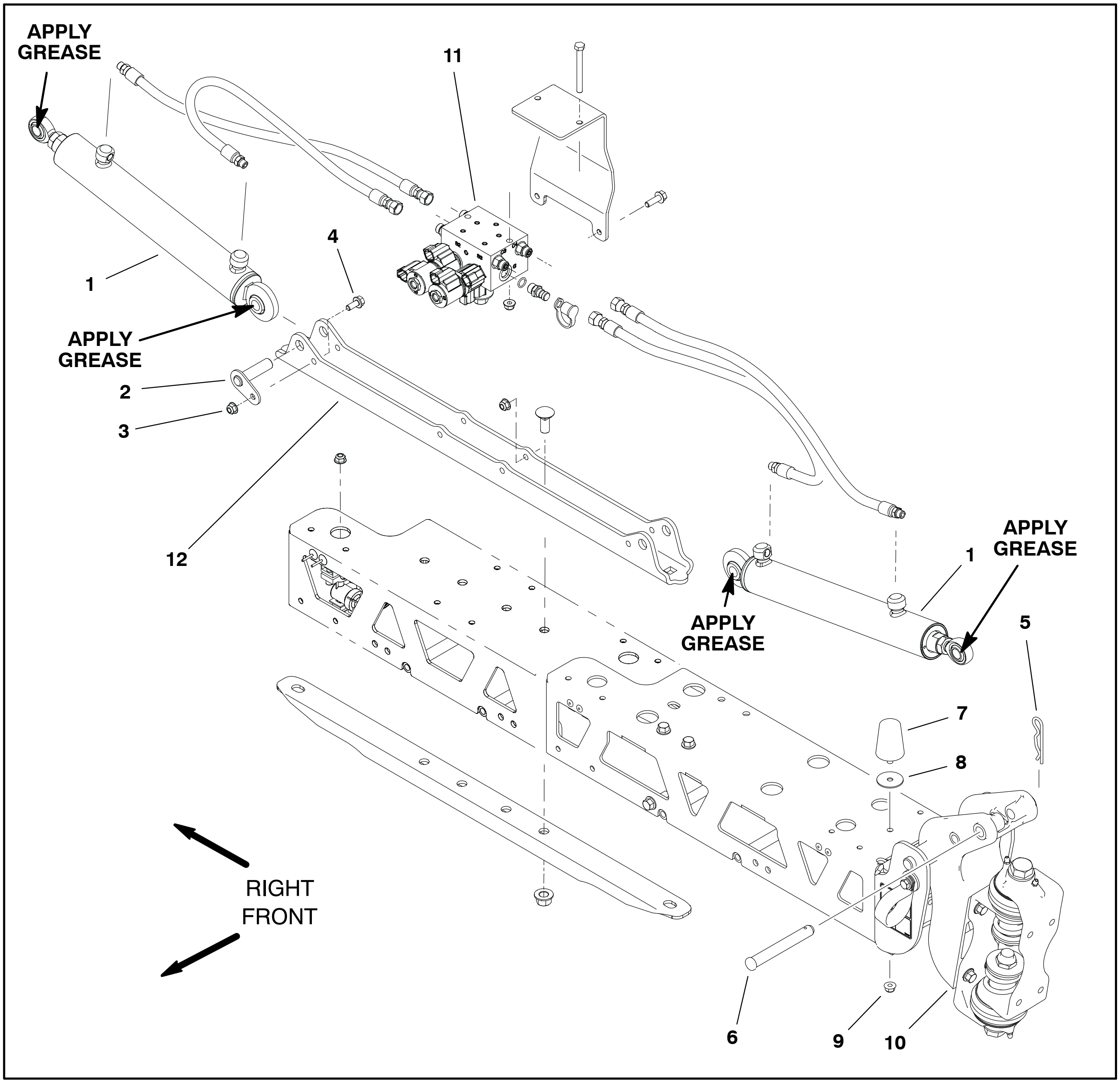


Figure 67

1. Boom lift cylinder (2)
2. Pivot pin (2)
3. Flange nut (2)
4. Flange head screw (2)
5. Hitch pin (2)
6. Clevis pin (2)
7. Bumper (2)
8. Flat washer (2)
9. Flange nut (2)
10. Boom pivot bracket (2)
11. Boom lift manifold
12. Cylinder mount plate

Removal (Fig. 67)

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

WARNING

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

CAUTION

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

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

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

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

5. Disconnect hydraulic hoses from boom lift cylinder. Allow hoses to drain into a suitable container.

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

7. Remove hitch pin and clevis pin (item 6) that secure lift cylinder rod end to boom pivot bracket.

8. Remove flange head screw and flange nut that secure pivot pin (item 2) to cylinder mount plate. Slide pivot pin from mount plate and lift cylinder.

9. Remove lift cylinder from machine.

Installation (Fig. 67)

1. Apply grease to cylinder barrel pivot and rod end and position lift cylinder to cylinder mount plate and boom pivot bracket.

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

3. Secure lift cylinder rod end to boom pivot bracket with clevis pin (item 6) and hitch pin.

4. Remove caps and plugs from disconnected hoses and cylinder ports.

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

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

7. After assembly is completed, operate boom lift cylinder to verify that hydraulic hoses and cylinder are not contacted by anything and that there are no leaks.

8. Adjust lift cylinder rod end as necessary so booms are level when the lift cylinder is fully extended.

Boom Lift Cylinder Service

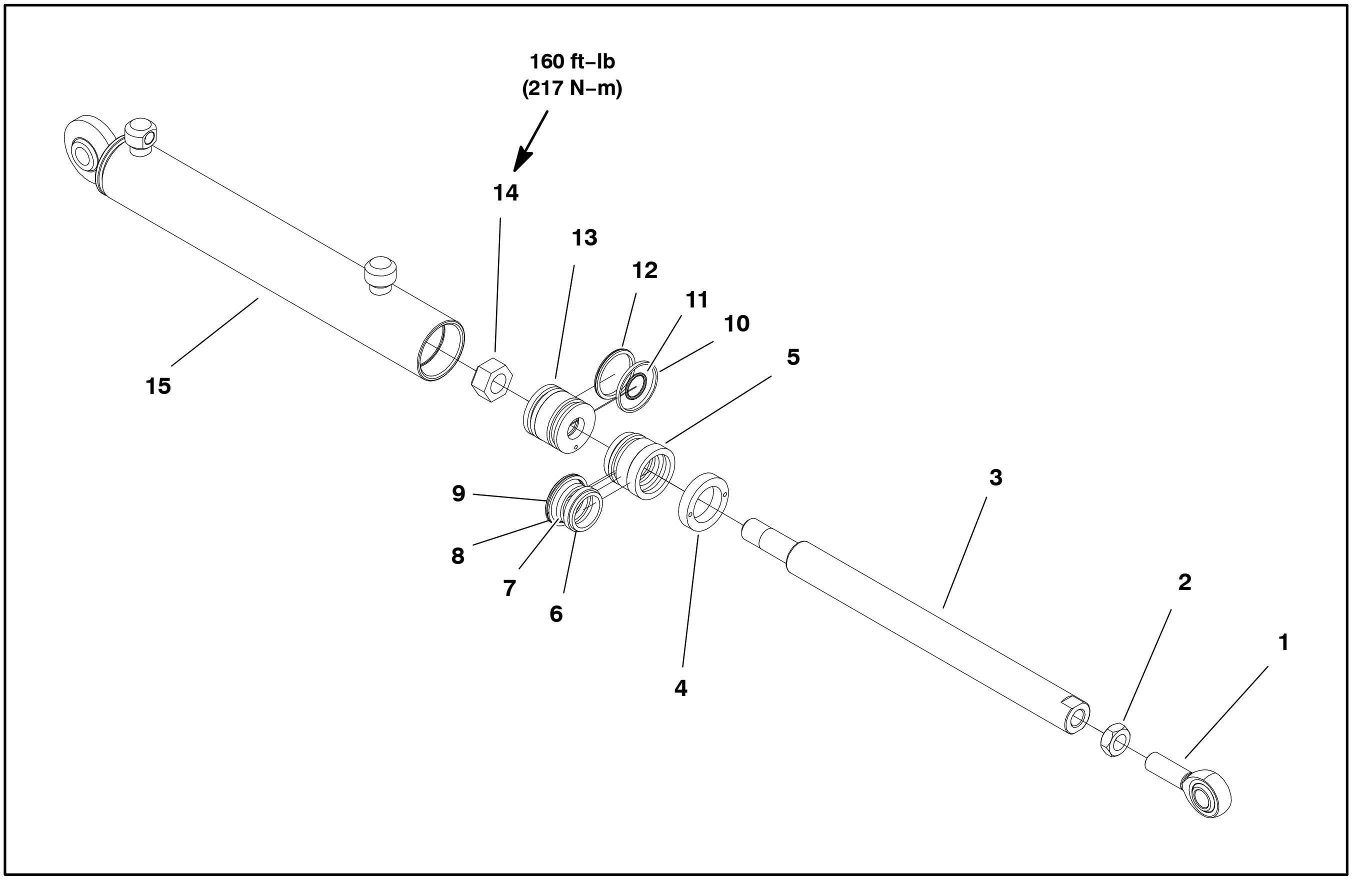


Figure 68

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

Disassembly (Fig. 68)

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

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

2. Mount barrel end of lift cylinder in a vise.

3. Remove internal collar (item 4) with a spanner wrench.

4. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

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

6. Remove seal kit components from the piston and head. Discard removed seals, back−up ring and O−rings.

Assembly (Fig. 68)

1. Make sure all cylinder parts are clean before assembly.

2. Coat all seat kit components with clean hydraulic oil.

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

   B. Install O−ring, back−up ring, shaft seal and dust seal to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

3. Mount shaft securely in a vise by clamping on the end of the shaft.

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

   B. Slide head assembly onto the shaft. Install piston and lock nut onto the shaft. Torque lock nut **160 ft−lb (217 N−m)** to secure assembly.

   C. Remove shaft from the vise.

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

4. Mount end of the barrel in a vise.

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

6. Install internal collar (item 4) with a spanner wrench to secure head into the barrel.

Oil Cooler

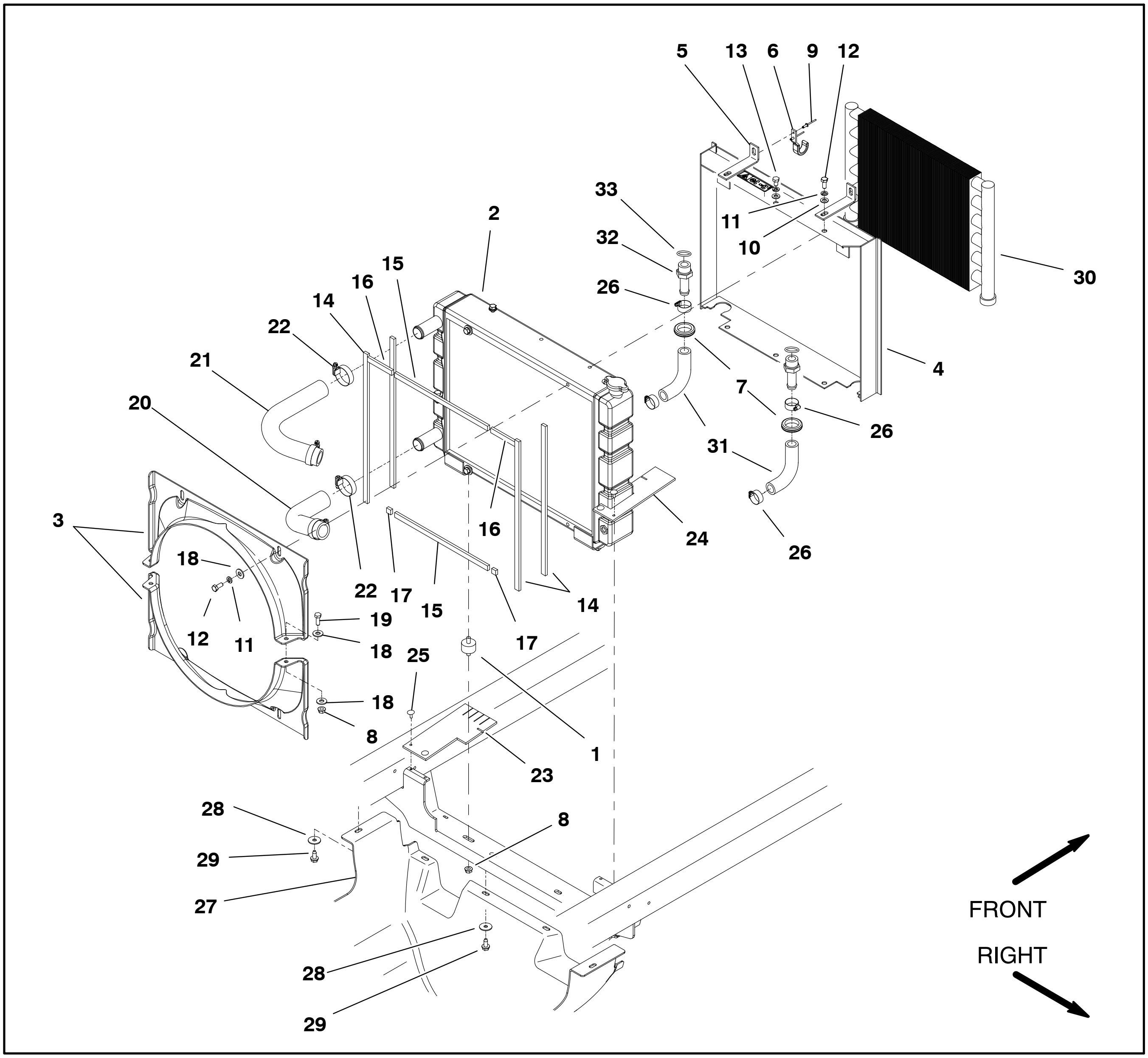


Figure 69

1. Isolator seat (2)
2. Radiator
3. Fan shroud (2)
4. Radiator shroud
5. Radiator brace (2)
6. Oil cooler mount hook (2)
7. Rubber grommet (2)
8. Flange nut (4)
9. Rivet (4)
10. Flat washer (6)
11. Lock washer (10)
12. Cap screw (6)
13. Cap screw (4)
14. Foam seal (4)
15. Foam seal (2)
16. Foam seal (2)
17. Foam seal (2)
18. Flat washer (8)
19. Cap screw (2)
20. Lower radiator hose
21. Upper radiator hose
22. Hose clamp (4)
23. LH heat baffle
24. RH heat baffle
25. Rivet (4)
26. Clamp (4)
27. Front undercarriage shroud
28. Flat washer (6)
29. Washer head screw (6)
30. Oil cooler
31. Oil cooler hose (2)
32. Hydraulic fitting (2)
33. O–ring (2)

Removal (Fig. 69)

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

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

3. Remove access panel from front of seat base (Fig. 70).

4. Label all hydraulic connections for reassembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from oil cooler.

5. From under front of machine, disconnect hydraulic hoses from oil cooler. Allow hoses to drain into a suitable container.

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

7. Lift oil cooler from hooks and remove from machine.

8. If necessary, remove fittings from oil cooler. Discard O−rings.

9. Clean oil cooler with solvent. Inspect for damage.

Installation (Fig. 69)

1. If fittings were removed from oil cooler, lubricate and place new O−rings onto fittings. Install fittings into oil cooler port openings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Place oil cooler onto hooks.

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

4. Connect hydraulic hoses to oil cooler fittings. Tighten hose clamps.

5. Install access panel to front of seat base (Fig. 70).

6. Check fluid level in hydraulic oil reservoir and adjust as required (see machine Operator’s Manual).

7. After assembly is completed, operate machine to verify that hydraulic hoses and fittings are not contacted by anything and that there are no hydraulic leaks.

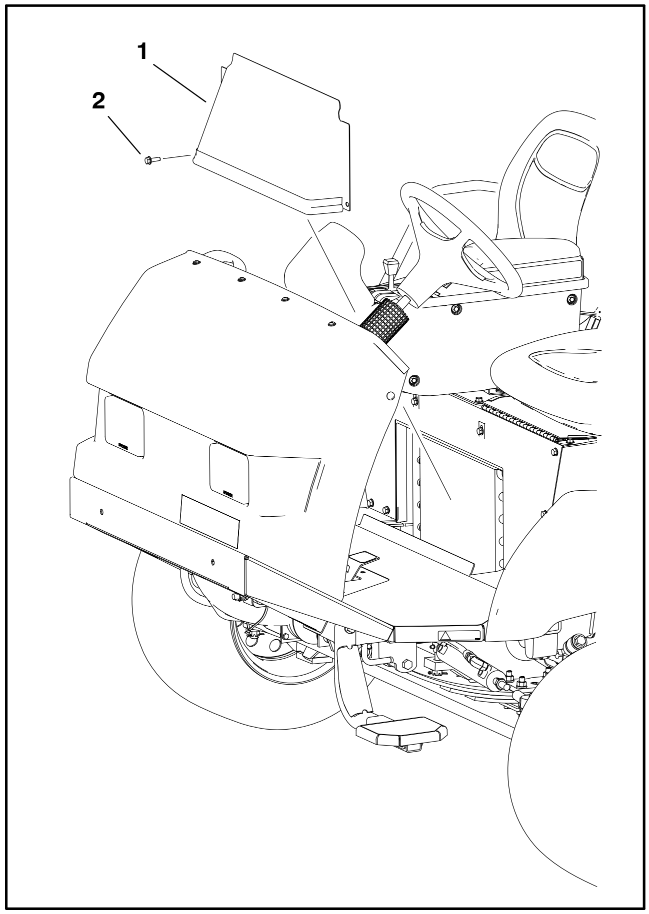


Figure 70

1. **Access panel**
2. **Flange head screw (2)**

Hydraulic Reservoir

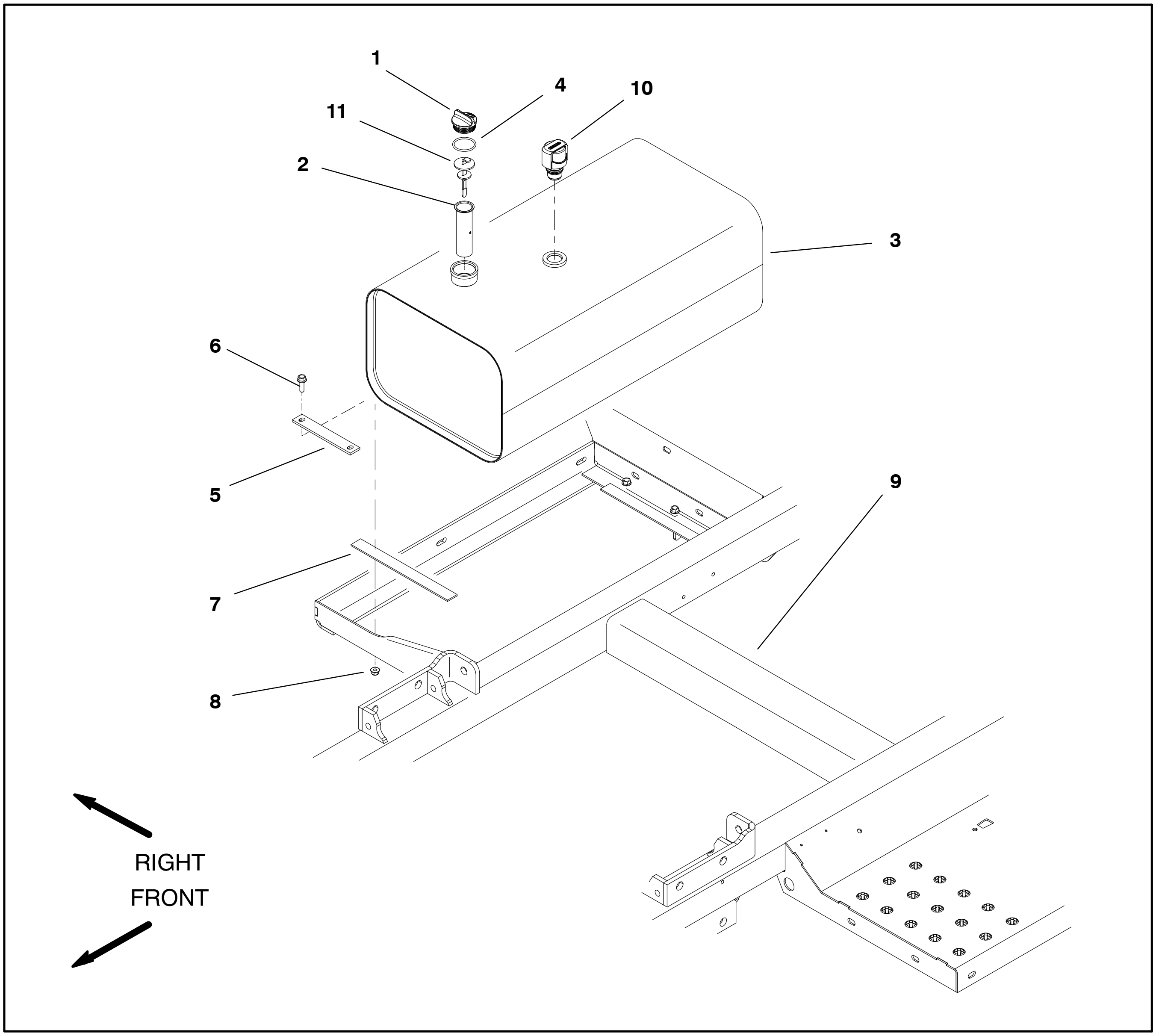


Figure 71

1. **Hydraulic reservoir cap**
2. **Strainer**
3. **Hydraulic reservoir**
4. **O−ring**
5. **Hold down strap (2)**
6. **Flange head screw (4)**
7. **Cushion (2)**
8. **Flange nut (4)**
9. **Frame**
10. **Breather**
11. **Dipstick**

Removal (Fig. 71)

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

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

3. Label all hydraulic hoses for assembly purposes. Clean hydraulic hose ends prior to disconnecting the hoses from reservoir.

4. Disconnect one hydraulic hose from the bottom of the hydraulic reservoir to drain reservoir.

5. Disconnect remaining hydraulic hoses from reservoir.

6. Remove hydraulic reservoir from machine.

7. Put caps or plugs on hydraulic lines and fittings to prevent contamination.

8. If hydraulic fittings are to be removed from reservoir, mark fitting orientation to allow correct assembly (Fig. 72). Remove fittings from reservoir and discard O−rings.

Inspection

1. Clean hydraulic reservoir with solvent.

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

Installation (Fig. 71)

1. If fittings were removed from reservoir, lubricate and place new O−rings onto fittings. Install fittings into manifold openings using marks made during the removal process to properly orientate fittings (Fig. 72). Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

1. Install hydraulic reservoir to machine using Figure 71 as a guide.

2. Lubricate new O−rings and reconnect hydraulic hoses to reservoir fittings (Fig. 72) (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

3. Fill reservoir with hydraulic fluid.

4. Operate machine and inspect for leaks.

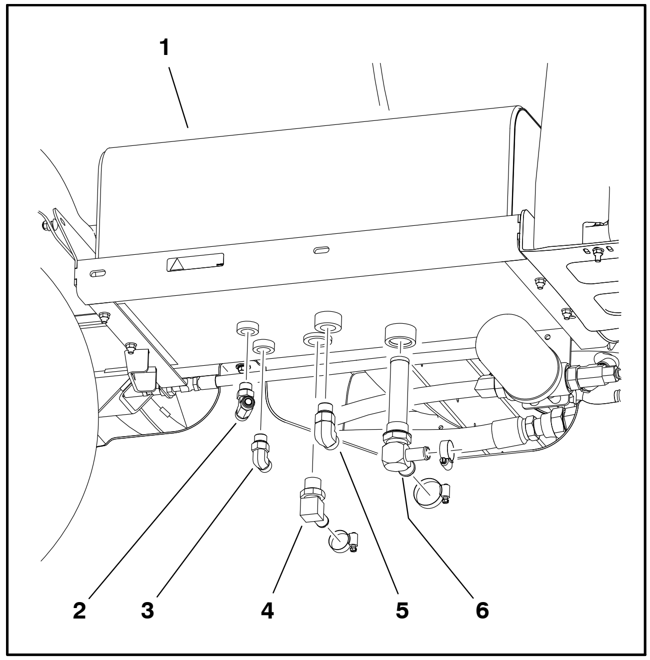


Figure 72

1. **Hydraulic tank**
2. **Tee (boom lift manifold/ steering unit return)**
3. **Elbow (wheel motor case drain)**
4. **Elbow (oil cooler return)**
5. **Elbow (charge return)**
6. **Suction strainer fitting**

Electrohydraulic In−line (EHi) Steering Valve (Optional AutoSteer Kit)

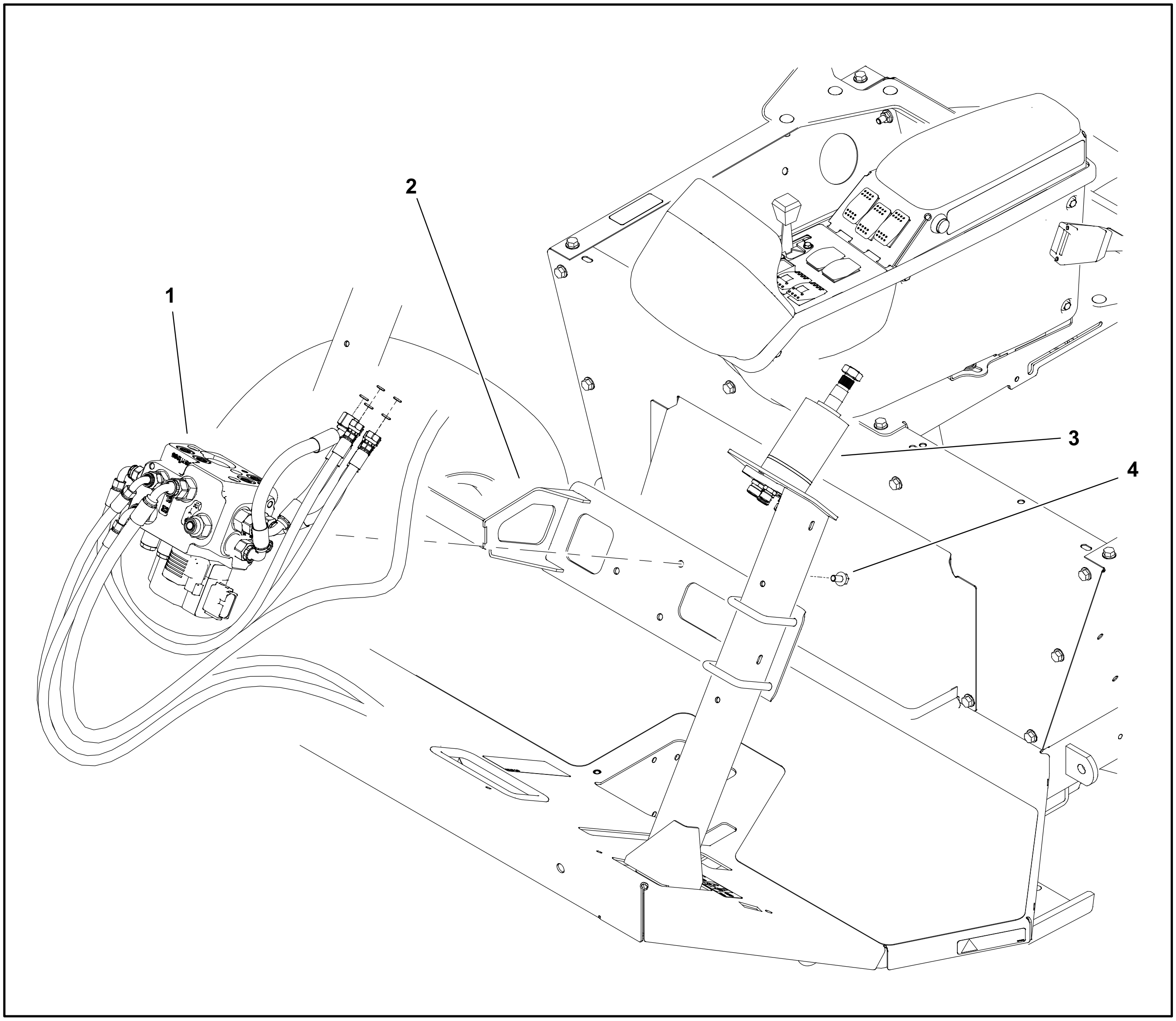


Figure 73

1. **Ehi Steering valve**
2. **Mounting bracket**
3. **Steering control valve**
4. **Flange head screw (3)**

Electrohydraulic steering is electrically actuated hydraulic steering that makes AutoSteer possible. The Electrohydraulic Steering Valve (EHi) is controlled by electrical input signal from the GPS (GeoLink) receiver/controller via the CAN bus for auto guidance.

The EHi steering valve assembly includes a PVED−CLS controller to operate the Ehi steering valve. The PVED−CLS controller has steering specific functions, including dedicated safety functions, which are programed specifically for the Multi Pro 5800 through the controller firmware. Refer to PVED−CLS Controller in Chapter 6 − Electrical System in this manual for additional information.

If the EHi steering valve is replaced, the steering position sensor and the Electrohydraulic (EH) valve spool must be calibrated; refer to Calibrating the AutoSteer Steering System in the Adjustments section of Chapter 8 − GeoLink Spray System in this manual.

Removal (Fig. 73)

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

2. Disconnect the wire harness from the headlights and remove the hood.

CAUTION

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

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

4. Disconnect the wire harness from the PVE actuator and the solenoid valve coil.

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

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

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

8. Remove the EHI steering valve from the machine.

Installation (Fig. 73)

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

2. Secure the EHI steering valve to the mounting bracket with three (3) flange head screws.

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

4. Connect the wire harness to the PVE actuator and the solenoid valve coil.

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

6. After assembly is completed, verify that hydraulic hoses and fittings are not contacted by anything and that there are no leaks from hydraulic connections.

7. Install the hood and connect the wire harness to the headlights.

Electrohydraulic In−line (EHI) Steering Valve Service (Optional AutoSteer Kit)

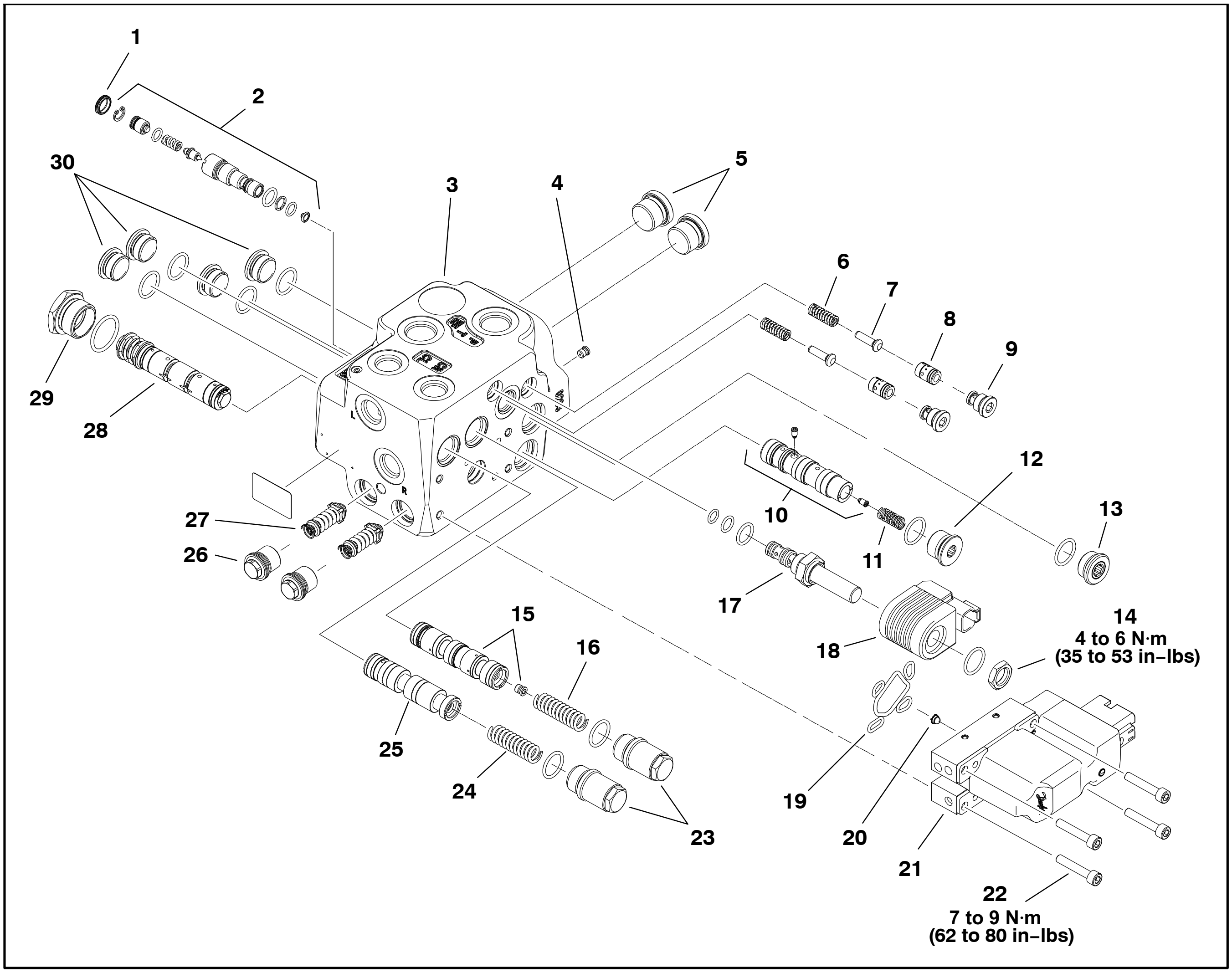


Figure 74

1. Plug
2. PV Valve
3. Housing
4. Orifice, LS
5. Plug
6. Compression spring
7. Cone, pilot supply
8. Spool, pilot supply
9. Plug
10. Spool PVFC/LS resolver
11. Compression spring
12. Plug
13. Plug
14. Nut
15. Spool, Cut off
16. Compression spring
17. Spool
18. Solenoid valve coil
19. PVE Seal kit
20. Filter
21. PVED−CLS Controller
22. Cap screw
23. Plug
24. Compression spring
25. Spool, RSV
26. Plug
27. Shock valve
28. Spool, EH Steering
29. Plug
30. Plug

For service of the steering valve, see the Danfoss EHi Steering Valve Service Manual.

Refer to Hydraulic Valve Solenoid Coils in Chapter 6 − Electrical System for solenoid valve coil testing information.

Chapter 6

Electrical System

Table of Contents

General Information

Operator's Manual

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

Toro Electronic Controller (TEC)

Multi Pro 5800 machines with serial numbers above 316000000 use a Toro Electronic Controller (TEC) to manage machine electrical functions. 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. Communication between the Toro controller, the InfoCenter Display, and in the case of Gasoline engine powered units the Kubota engine controller, is provided by a CAN bus network. The status of inputs to the controller as well as outputs from the controller can be monitored with the InfoCenter Display (see InfoCenter Display – Diagnostics in this chapter). The TEC controller is attached to the left side of the control console frame (Fig. 1).

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.

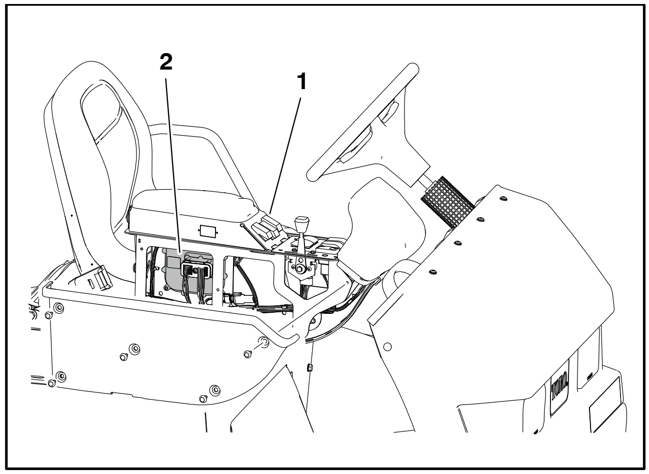


Figure 1

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

Kubota Gasoline Engine Electronic Control Unit (ECU)

The Kubota gasoline engine that powers Multi Pro 5800 models 41394 and 41594 uses an Electronic Control Unit (ECU) for engine management. The engine ECU communicates with the Toro Electronic Controller (TEC) and the InfoCenter display on the machine. The gasoline engine ECU is located on the right side of the engine. All wire harness electrical connectors should be plugged into the ECU before the machine ignition switch is moved from the OFF position to either the ON or START position.

If the engine ECU is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed for a minimum of thirty (30) seconds before disconnecting the engine ECU. Also, to prevent possible ECU damage when welding on the machine, disconnect the engine ECU from the machine before welding.

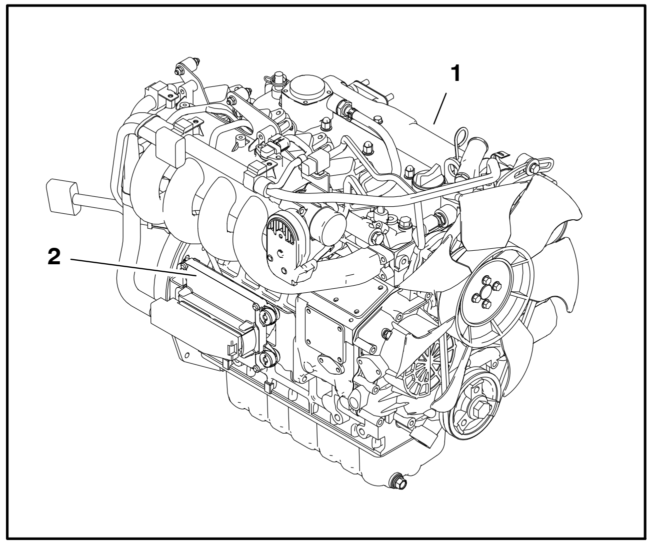


Figure 2

1. **Gasoline engine**
2. **Engine ECM**

Kubota Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual and troubleshooting manual. Also, for Gasoline engine powered units, your Toro Distributor can use the Kubota Gasoline Service Tool (KGST) and software to confirm the real−time engine running status and to offer timely technical services. Contact your Toro distributor for assistance in Kubota gasoline engine troubleshooting.

CAN−bus Communications

The TEC controller, the InfoCenter Display, and in the case of gasoline engine powered machines the Kubota Engine Controller communicate with each other on a Controller Area Network (CAN) bus system. Using this network allows the traction unit to fully integrate all the different electrical components of the tractor and bring them together as one. The CAN bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be significantly reduced. The integration of electrical functions also allows the InfoCenter Display to assist with electrical system diagnostics.

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, power and ground. The ignition switch needs to be in the RUN or START position for the components on the network to be active.

Two (2) specially designed, twisted wires form the CAN bus. These wires provide the data pathways between the components on the network. The engineering term for these cables are CAN High and CAN Low. The bus wires for the 12 VDC circuits are black/white and red/white. At the end of the twisted pair of bus cables is a 120 ohm termination resistor.

IMPORTANT: The termination resistor at the end of the bus wires is required for proper electrical system operation.

Electrical Drawings

The electrical schematic and wire harness drawings for the Multi Pro 5800 are located in Appendix A – Foldout Drawings – Foldout Drawings in this manual.

Special Tools

Order these special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The multimeter can test electrical components and circuits for current, resistance or voltage. Obtain this tool locally.

NOTE: Toro recommends the use of a DIGITAL Volt–Ohm–Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

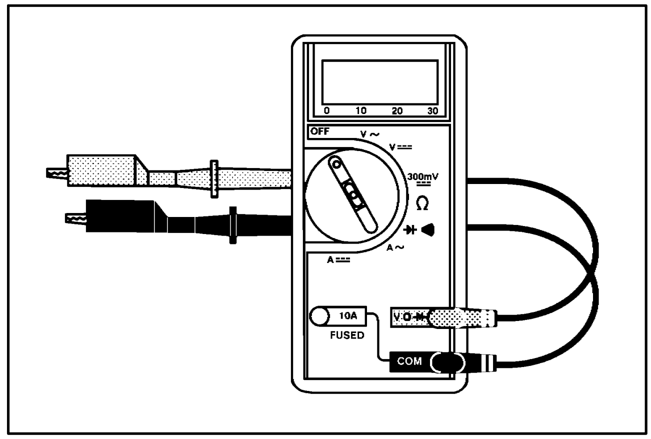


Figure 3

Dielectric Gel

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

Toro Part Number: **107–0342**

Figure 4

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 5

Battery Hydrometer

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

Figure 6

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 (available to authorized Toro Distributors or 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 wheel motor, connect traction speed sensor test harness between sensor and machine harness.

4. Plug white 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, verify orientation of grooves on sensor body. The grooves must be aligned perpendicular to wheel motor shaft (see Traction Speed 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 **75−125 in−lbs (8.5 to 14 N−m)** and re−test.

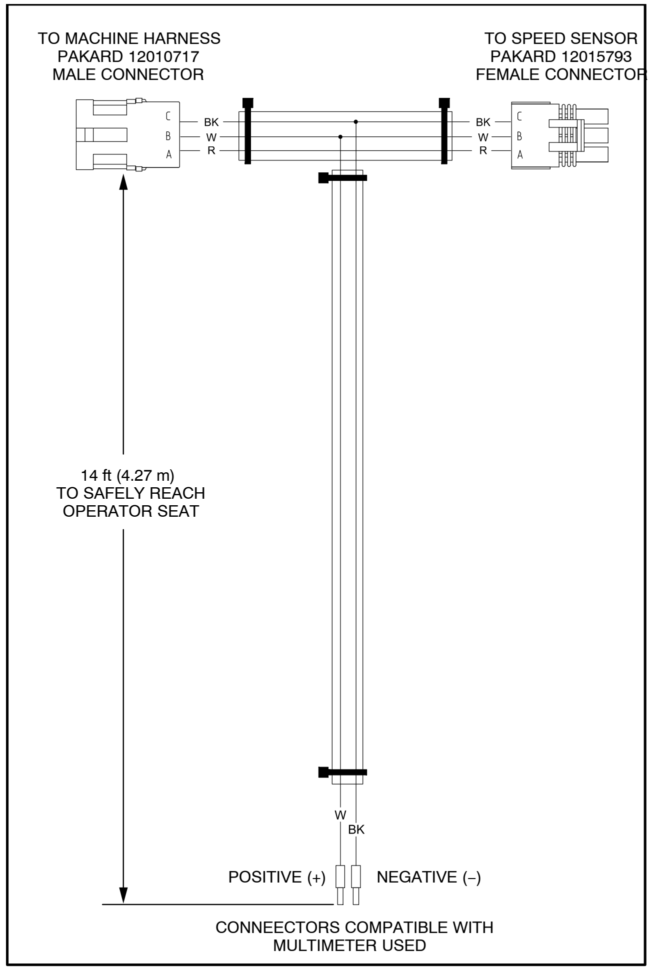


Figure 7
Traction Speed Sensor Test Harness

8. If frequency continues to not register, is erratic, or does not increase when increasing speed, remove and re−install sensor.

A. Remove sensor from wheel motor.

B. Turn wheel motor to center a wheel motor piston below the sensor port.

C. Thread the sensor into the port until it contacts the piston. Then turn sensor out (counter−clockwise) until angle of orientation grooves on the sensor and the motor center−line are between 90 and 93 degrees.

D. Then back out sensor one full turn and tighten the lock nut from **75−125 in−lbs (8.5 to 14 N−m)** and re−test.

9. If frequency measurement does not increase with increasing wheel speed after verifying alignment of sensor and re−installation, remove and replace the speed sensor. See Traction Speed Sensor in the Service and Repairs section of this chapter.

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)** form flow meter body.

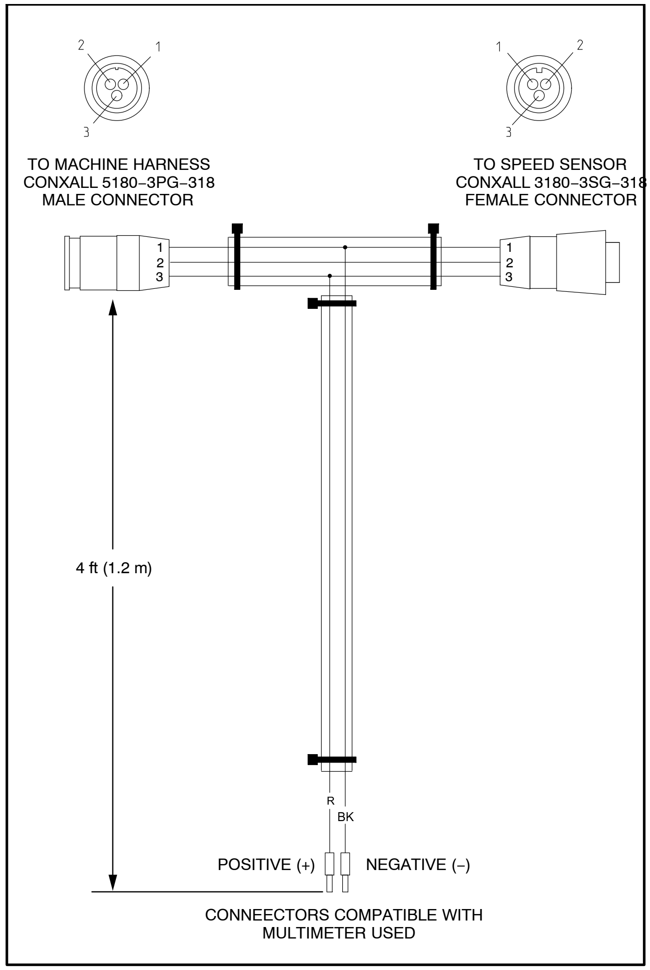


Figure 8
Flow Meter Sensor Test Harness

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 is a LCD device that is located in the Operator control console. The InfoCenter display provides information for the machine operator during machine operation and spray system calibration, provides electrical system diagnostic assistance for technicians and allows input for user adjustable machine settings.

Power for the InfoCenter is available when the main power relay is energized (ignition switch is in the START or RUN position). A 1 Amp fuse (FB1 5−6) protects the InfoCenter power circuit. A CAN bus network involving the InfoCenter, the Toro Electronic Controller (TEC), and in the case of gasoline engine powered machines the Kubota engine ECU is used to communicate machine information to and from the InfoCenter display.

NOTE: The TEC controller and the InfoCenter Display used on the Multi Pro 5800 are matched for correct machine operation. If either of these components are replaced for any reason, system software needs to be reprogrammed (contact an Authorized Toro Distributor for assistance).

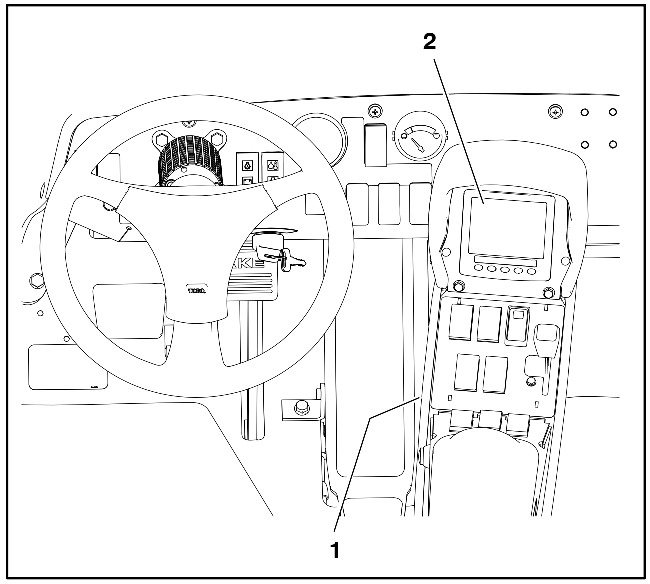
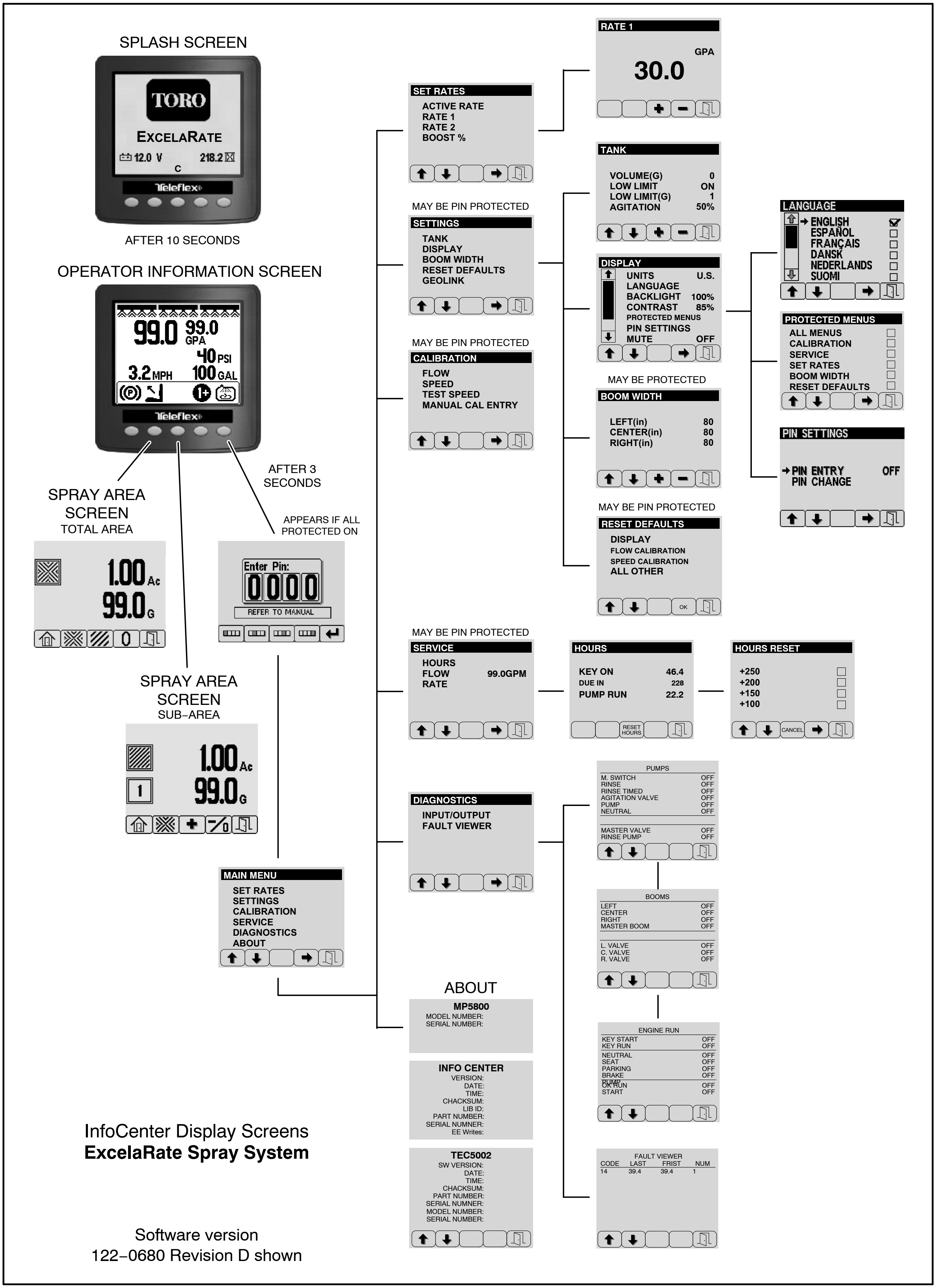


Figure 9

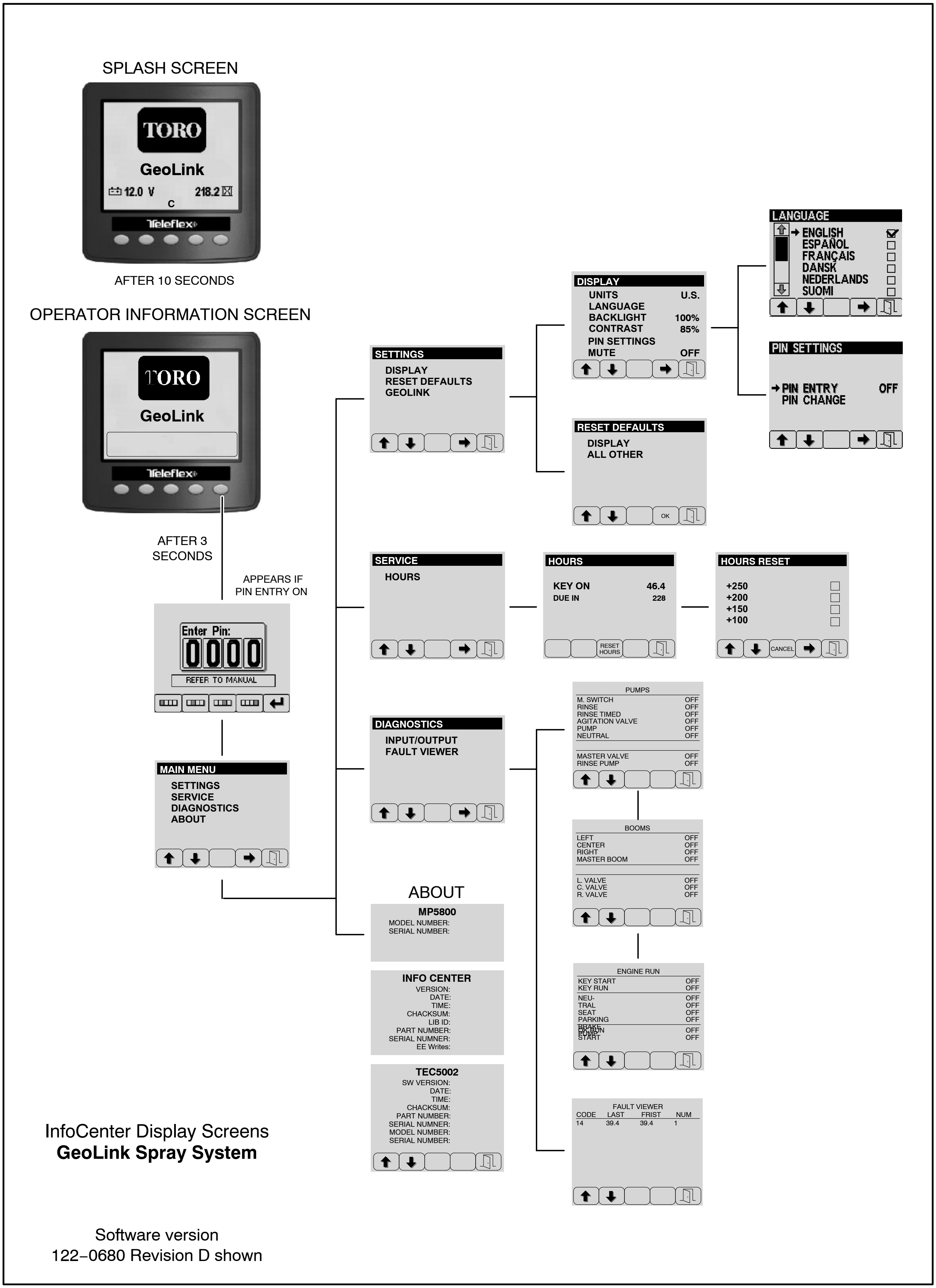
1. **Operator control console**
2. **InfoCenter Display**



InfoCenter Display Screens
ExcelaRate Spray System

Software version
122–0680 Revision D shown

Figure 10



InfoCenter Display Screens
GeoLink Spray System

Software version
122–0680 Revision D shown

Figure 11

Splash Screen

When the ignition switch is turned from the OFF position to the ON or START position, the InfoCenter splash screen appears (Fig. 12). The splash screen provides the following information to the operator:

Spray System Installed

Voltmeter

System Software Revision Level

Hour meter: For machines with gasoline engine, engine hours are displayed. For machines with diesel engine, key on hours are displayed.

After the splash screen has been displayed for ten seconds, the operator 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.

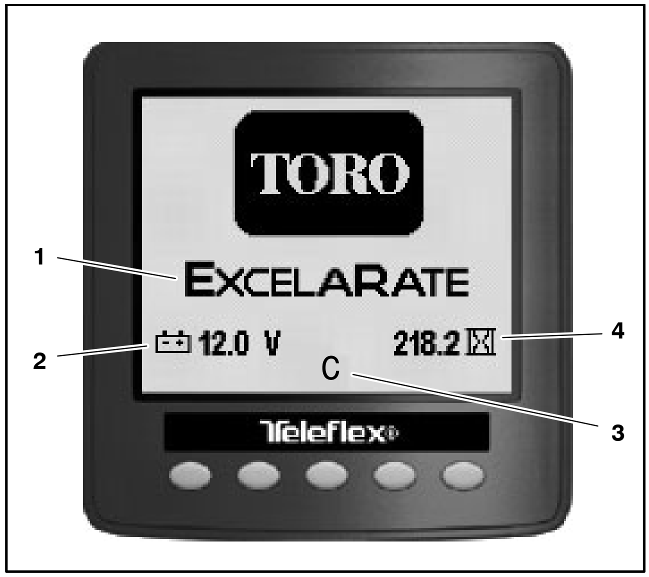


Figure 12

1. Spray system installed
2. Voltmeter
3. System software revision
4. Engine hour meter

Operator's Information

The operator's 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. 13). The operator's information screen is the "default" screen as it will be displayed during normal machine operation. See the machine Operators Manual or Software Guide for additional information.

NOTE: Depending on the spray system installed or operation mode, all indicators and icons may not appear. See the individual spray system chapters in this manual for specific information.

The operator's information screen provides the following information to the operator:

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.

Actual Spray System Application Rate: Indicates the actual rate at which the sprayed product is being applied.

Target Spray System Application Rate: Indicates the target rate that the user desires.

Spray System Pressure: Indicates the spray pressure when the boom sections are ON or the agitation pre−set pressure when the boom sections are OFF.

Vehicle Speed

Spray Tank Volume: Displays the amount of product remaining in the spray tank. This is a calculation based on the volume manually entered when the tank is filled, then reduced by the amount of product passing through the flow meter.

Brake: Icon appears whenever the brake is applied, and stays on when the parking brake is engaged.

Operator Presence: Icon appears when the operator is out of the operator seat.

Application Rate Selected: The selected pre−set application rate number is displayed. This represents the number of the pre−set rate, not the actual rate of spray product being applied. See Set Rates in this chapter for additional information.

Application Rate Boost: The + appears when the application rate boost is active.

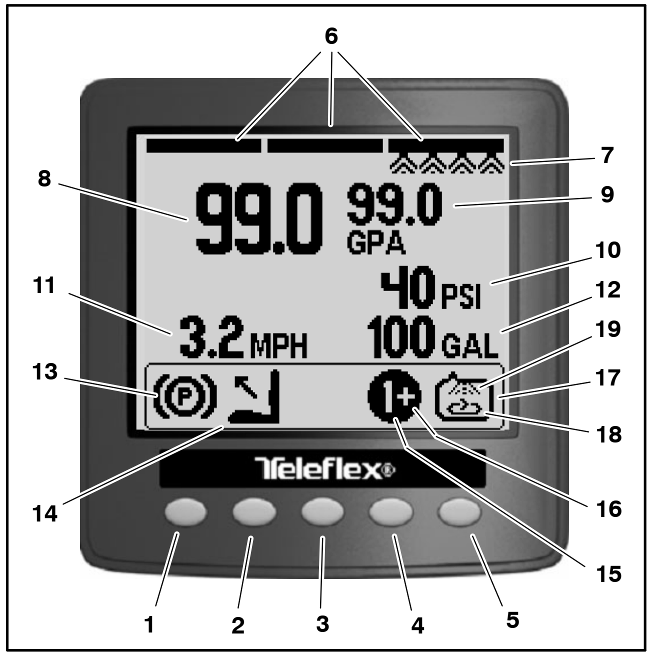


Figure 13

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Master boom(active
7. Boom section active
8. Actual application rate
9. Target application rate
10. Spray system pressure
11. Vehicle speed
12. Spray tank volume remaining
13. Brake applied
14. Operator presence
15. Pre−set application rate selected
16. Application boost active
17. Spray pump enabled
18. Agitation enabled
19. Tank Rinse enabled

NOTE: When the spray pump is enabled, press and hold buttons 1 and 5 simultaneously while viewing the Operator's Information screen to activate the boost feature. Boost is active only as long as the buttons are depressed. The spray system returns to the set application rate when the buttons are released.

Spray Pump: Icon (spray tank) appears when spray pump is enabled.

Spray Tank Agitation: Icon (spray tank with mixing pattern) appears when spray tank agitation is enabled.

Clean Tank Rinse Pump (optional kit): Icon (spray tank with spray pattern) appears when clean tank rinse pump is enabled.

Press and hold button 5 for 3 seconds to access the main menu screen.

Press any button 1−4 to expose the menu bar. From the menu bar, press button 2 to access the spray area screen−total area or press button 3 to access the spray area screen−sub area.

Spray Areas

Use the spray area screens to view the area and the amount of product sprayed since the screens were cleared (Fig. 14). See the machine Operators Manual or Software Guide for additional information.

NOTE: Depending on the spray system installed or operation mode, all indicators and icons may not appear. See the individual spray system chapters in this manual for specific information.

Total Area Screen

The total area screen displays the total area and total amount of product sprayed since last reset. The total area screen is accessed from the operator information screen by pressing any button 1–4 to expose the menu bar then press button 2.

Press any button 1–4 to expose the menu bar then press button 2. From the menu bar, press button 2 to access the spray area screen–total area or press button 3 to access the spray area screen–sub area.

NOTE: Resetting the total area will also reset all of the sub areas.

Press and hold button 4 to reset the total area.

Press button 3 to display the sub area screens.

Press button 1 to return to the operator information screen, or button 5 to hide the menu bar.

Sub–Area Screen

The sub–area screen displays the area and amount of product sprayed in the any of twenty (20) sub–areas since last reset. The sub–area screen is accessed from the operator information screen by pressing any button 1–4 to expose the menu bar then press button 3.

Press button 3 to select the next sub area, or button 4 to display the previous sub area.

Press and hold button 4 to reset the sub area currently displayed.

Press button 2 to display the total area screen.

Press button 1 to return to the operator information screen, or button 5 to hide the menu bar.

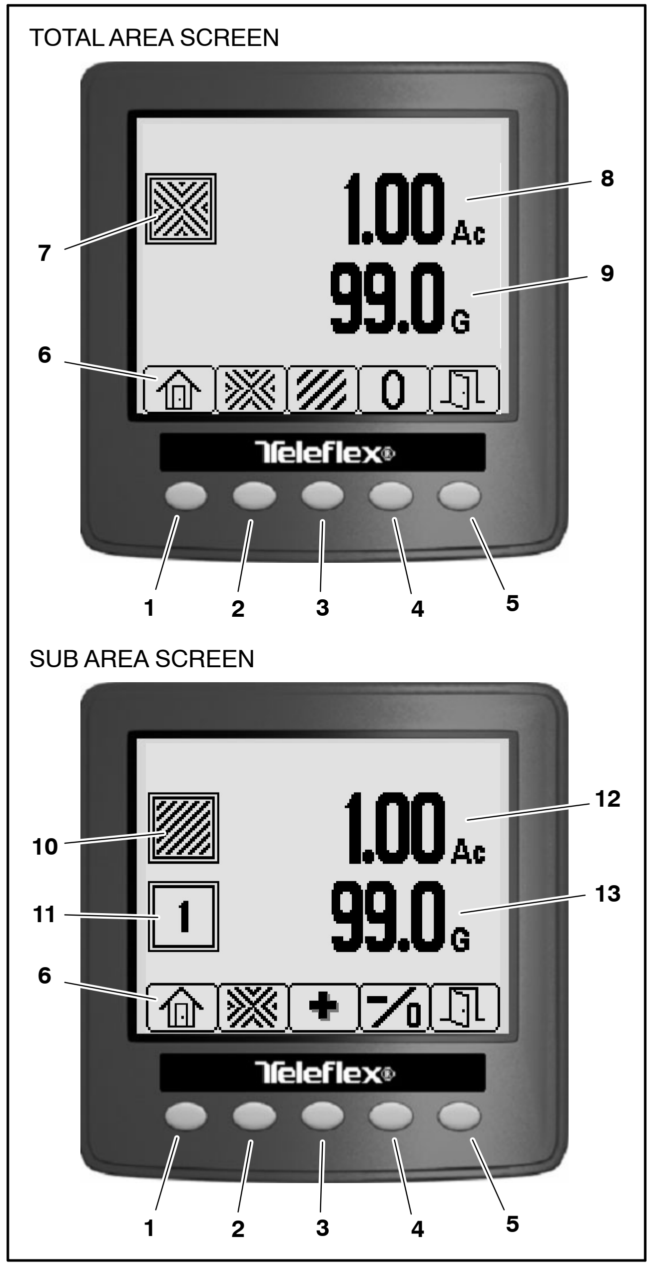


Figure 14

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Menu bar**
7. **Total area icon (pattern)**
8. **Total area applied**
9. **Total volume applied**
10. **Sub–area icon (pattern)**
11. **Sub–area number**
12. **Sub–area area applied**
13. **Sub–area volume applied**

Main Menu

NOTE: Depending on the spray system installed or operation mode, all indicators and icons may not appear. See the individual spray system chapters in this manual for specific information.

The main menu (Fig. 15) provides access to the following screens:

Set Rates

Settings

Calibration

Service

Diagnostics

About

NOTE: The Main Menu screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

The main menu screen is accessed by pressing an holding button 5 on the display for approximately 3 seconds.

NOTE: Access to the main menu screens may require entering a Personal Identification Number (PIN). The default PIN is either **1234** or **5900**. See the machine Operators Manual for additional PIN information.

Return to the previous screen by pressing button 5

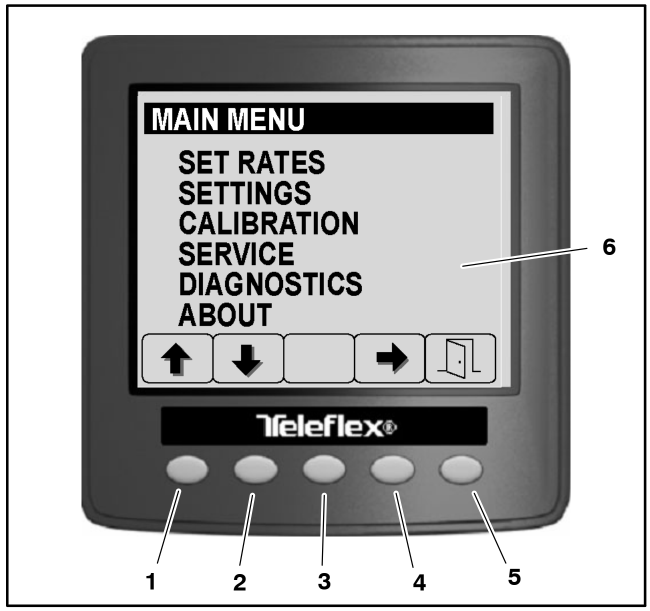


Figure 15

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Menu Menu screen**

Set Rates

The Set Rates screen (Fig. 16) is accessed from the main menu and provides selection between previously set application rates (Rate 1 or Rate 2). See the machine Operators Manual or Software Guide for additional information.

The Set Rate screen also allows access to the setting the following:

Rate 1: A programed rate of spray product deposited while operating in automatic–application mode.

Rate 2: A programed rate of spray product deposited while operating in automatic–application mode.

Boost %: The percentage of spray product deposited in addition to the current application rate while operating in automatic–application mode and Boost is active. Example: if boost % is set to 10, and the application rate is 30 GPA, the actual amount being deposited when the boost feature is active is 110% or 33 GPA.

NOTE: The Set Rates screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

Access the Set Rate screen by pressing buttons 1 or 2 to highlight SET RATES, then press button 4 to select the highlighted screen. Adjust the selected rate by pressing buttons 3 or 4.

Return to the previous screen by pressing button 5

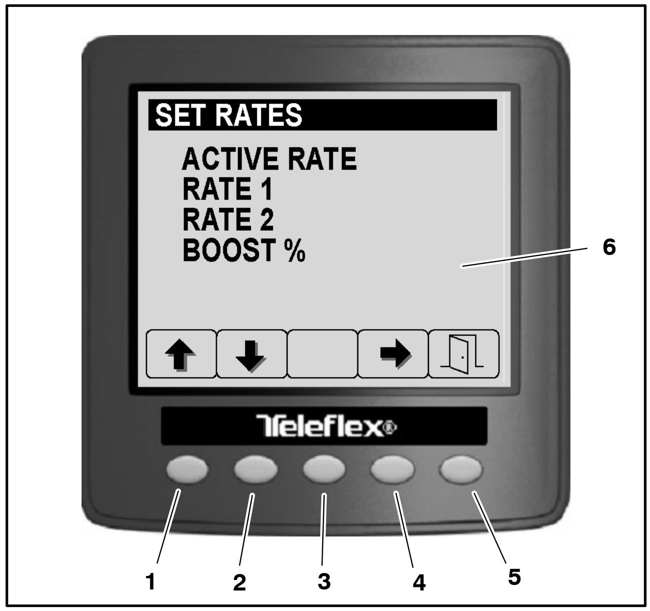


Figure 16

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Set rates screen**

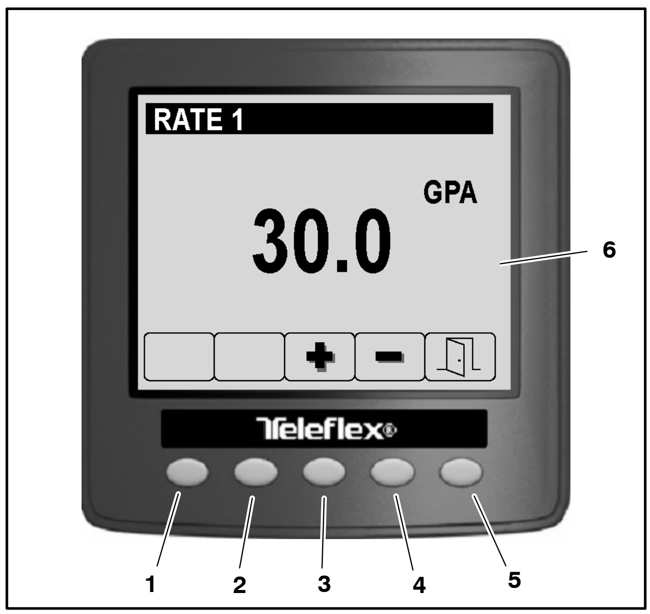


Figure 17

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Rate adjustment screen**

Settings

The Settings screen (Fig. 18) is accessed from the main menu and provides access to the following:

Tank

Display

Boom Width

Reset Defaults

GeoLink

Access the Settings screen by pressing buttons 1 or 2 to highlight SETTINGS, then press button 4 to select the highlighted screen. Scroll through the various Settings screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

TANK

The tank settings s (Fig. 19) are accessed from the settings screen and provide access to the following spray tank settings:

Volume (unit of measure): The amount of spray product being added to the tank. This should be manually entered by the operator or spray technician when the tank is filled and before starting to spray.

NOTE: When using the spray tank low limit feature, the spray tank volume must be entered every time the spray tank is filled (see the machine Operators Manual or Software Guide for additional information).

Low Limit: Switches the low spray tank alarm ON/OFF.

Low Limit (unit of measure): The tank volume that triggers the low spray tank alarm.

Agitation: The pump speed when the pump is enabled and all spray booms are OFF (idle). This setting is expressed as a percentage of maximum pump speed.

Access the various items by pressing buttons 1 or 2 to highlight the desired item, then buttons 3 or 4 to adjust the setting.

Return to the previous screen by pressing button 5

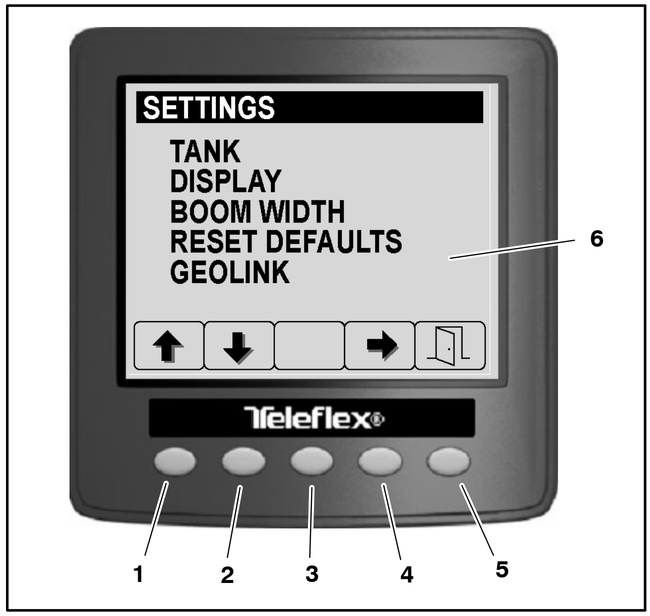


Figure 18

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Settings screen**

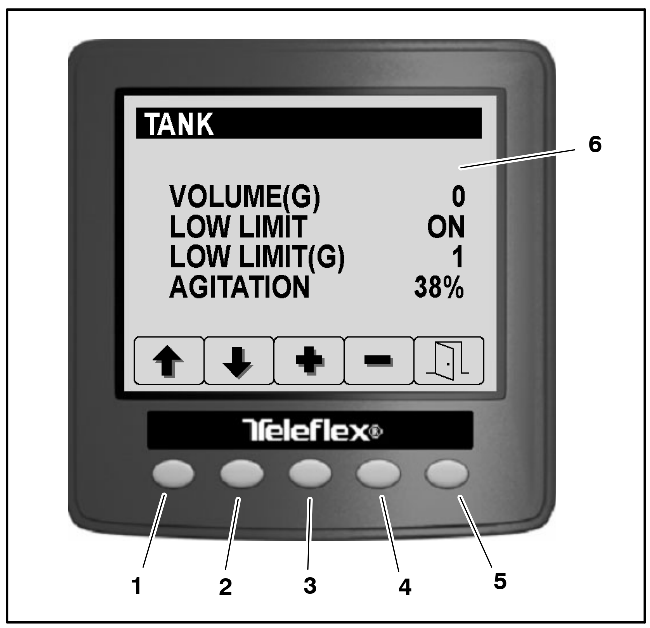


Figure 19

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Tank settings**

DISPLAY

The display settings (Fig. 20) are accessed from the settings screen and provide access to the following display settings:

Units

Language

Backlight

Contrast

Protected Menus

PIN Settings (personal identification number)

Mute

Access the various items by pressing buttons 1 or 2 to highlight the desired item, then button 4 to select the setting.

Return to the previous screen by pressing button 5

Units

The Units settings allow the display to show pressure, volume and temperature in English, Turf or SI (metric) units of measure.

NOTE: Changing the units of measure setting will clear the tank volume entry and the preset Rate 1 and Rate 2 settings.

U.S. (mph, gallons, acre)

Turf (mph, gallons, 1000 sq ft)

SI (kph, liter, hectare)

Language

The Language setting allows the InfoCenter Display language to be chosen (Fig. 21).

Backlight and Contrast

NOTE: The Backlight intensity or contrast changes on the InfoCenter display as you change the value for the setting.

Use the Backlight setting to increase or decrease the InfoCenter Display brightness, and the Contrast setting to increase or decrease the InfoCenter Display contrast.

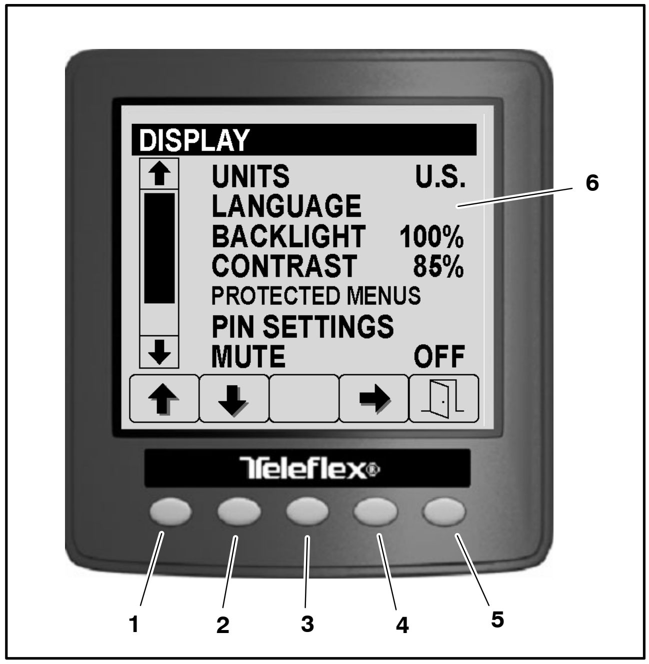


Figure 20

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Display settings**

Figure 21

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Language settings**

Protected Menus

Various InfoCenter menus/screens/settings can be protected so a four digit PIN (Personal Identification Number) is required prior to accessing the menu/screen or adjusting the setting (Fig. 22). Any combination of the following menus/screens/settings can be selected for protection:

All Menus: If selected, all menus/screens/settings other than the Operator Information Screen and the Spray Area Screens are protected.

Calibration: If selected, all calibration menus are protected.

Service: If selected, the service timer reset function is protected.

Set Rates: If selected, application rate adjustment and boost% adjustment is protected.

Boom Width: If selected, modifying the boom width setting is protected.

Reset Defaults: If selected, the InfoCenter default setting reset function is protected.

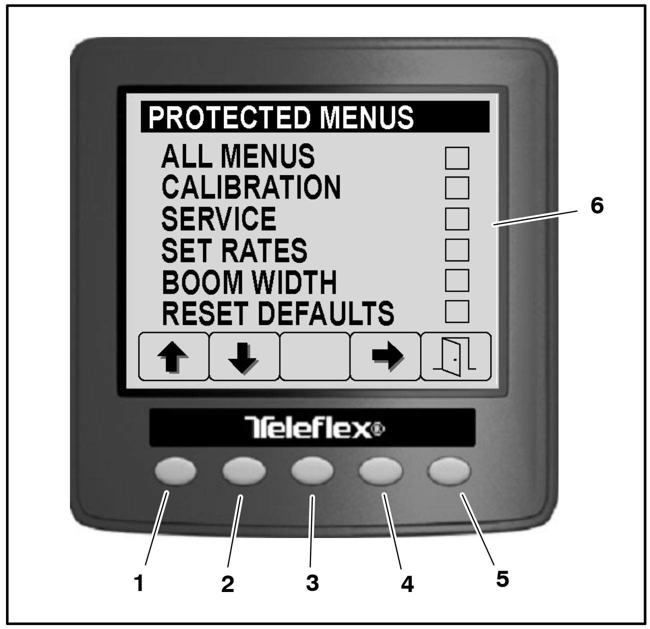


Figure 22

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Protected menus**

PIN Settings

Use of a PIN allows the ability to password protect access to all screens other than the Operators Information Screen and the Spray Area Screens. Use the PIN settings screen for turning the PIN protection feature ON or OFF (PIN ENTRY) or to change the current PIN (PIN CHANGE) (Fig. 23). See the machine Operator's Manual or Software Guide for additional information.

IMPORTANT: If PIN use is chosen (PIN ENTRY ON), and a custom PIN is entered, make sure to record the PIN for future InfoCenter Display access. If PIN reset is necessary (e.g. PIN has been forgotten), contact your Authorized Toro Distributor.

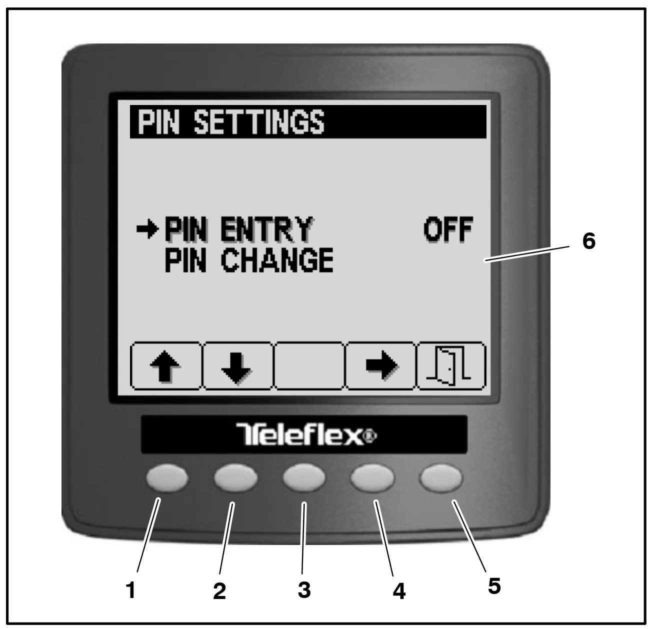


Figure 23

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **PIN settings**

Mute

The Mute setting controls the InfoCenter audio signal (ON/OFF).

NOTE: Setting the mute audio indicator to ON mutes the audio signal for the InfoCenter only—not the audio warning alarm for the machine.

BOOM WIDTH

The Boom Width settings entered on this screen are used by the spray system to calculate the area sprayed. The boom width settings (Fig. 24) are accessed from the settings screen and provide access to the following display settings:

Left: The width of left boom installed.

Center: The width of center boom installed.

Right: The width of right boom installed.

NOTE: The Boom Width screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

Access the various items by pressing buttons 1 or 2 to highlight the desired item and button 3 or 4 to adjust the setting.

Return to the previous screen by pressing button 5

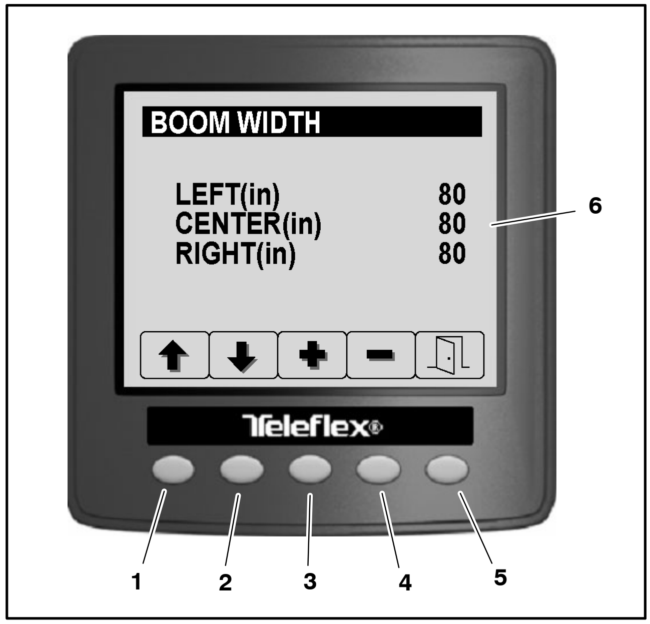


Figure 24

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Boom width settings**

RESET DEFAULTS

Use the Reset Defaults screen to reset the following settings to the factory defaults:

Display: Resets the language to English, Contrast to 85%, PIN Entry to OFF, PIN code to 1234 and Mute to ON.

Flow Calibration: Resets the calibration correction factors for 3−boom, 2−boom and 1−boom calculations to 100% (no correction).

Speed Calibration: Resets the calibration correction factor for speed calculations to 100% (no correction).

All Other

NOTE: The Reset Defaults screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

Access the various items by pressing buttons 1 or 2 to highlight the desired item, and then button 4 to reset the selection.

Return to the previous screen by pressing button 5

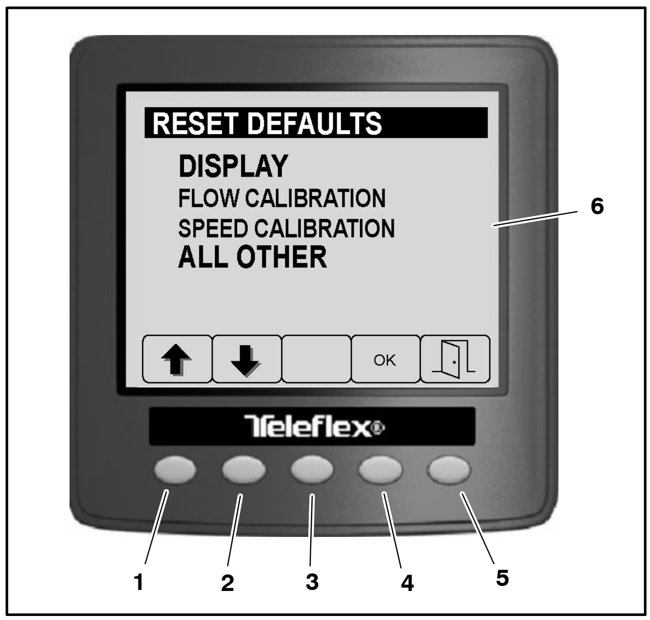


Figure 25

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Resettable items**

GEOLINK

Use the GeoLink screen to activate the GeoLink spray control system. Turn ON the GeoLink setting only if you have the optional GeoLink spray system installed on the machine. See Chapter 8 − GeoLink Spray System in this manual for additional service information.

Calibration

To assure accurate spray system performance, the flow meter and vehicle speed inputs must be calibrated and should be re−calibrated often. The result of the calibration process is a correction factor which modifies the default setting of the flow meter or speed sensor. The flow meter should be calibrated after changing spray nozzles or replacing a flow meter or flow meter sensor. See the machine Operator's Manual or Software Guide for additional information.

The Calibration screen (Fig. 26) is accessed from the main menu and provides access to the following:

Flow (calibration): initiates a multi−screen, step−by−step series of instructions to guide you through the flow meter input calibration process

Speed (calibration): initiates a multi−screen, step−by−step series of instructions to guide you through the speed sensor input calibration process

Test Speed: used to simulate a ground speed signal for stationary spray system testing like setting section bypass valves

Manual Cal (calibration) Entry: used to view and modify the calibration correction factor for 3−boom, 2−boom, 1−boom, and speed calculations

IMPORTANT: Toro does not recommend that you change calibration correction factors manually. Use the Flow Calibration and Speed Calibration procedures to set−up the spray system.

NOTE: The Calibration screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

Access the Calibration screen by pressing buttons 1 or 2 to highlight CALIBRATION, then press button 4 to select the highlighted screen. Scroll through the various Calibration menus by pressing buttons 1 or 2, then press button 4 to access the selection.

Return to the previous screen by pressing button 5

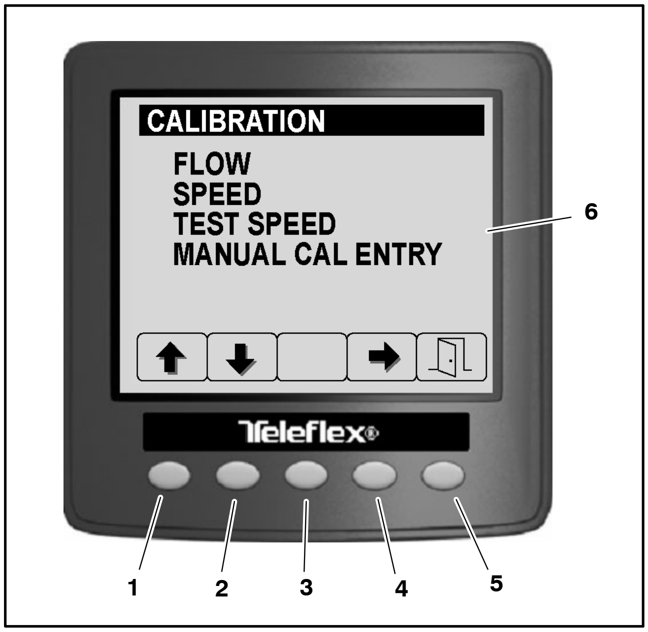


Figure 26

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Calibration screen**

Service

The service screen (Fig. 27) is accessed from the main menu and provides access to the following screens:

Hours (ignition key on, service due in, spray pump run hour meters)

Flow Rate: The current actual spray product flow.

NOTE: The Service screen may be PIN protected. See Settings Screen > Display > Protected Menus in this chapter or the machine Operator's Manual and Software Guide for additional information.

Access the Hours screen by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted item.

Return to the previous screen by pressing button 5

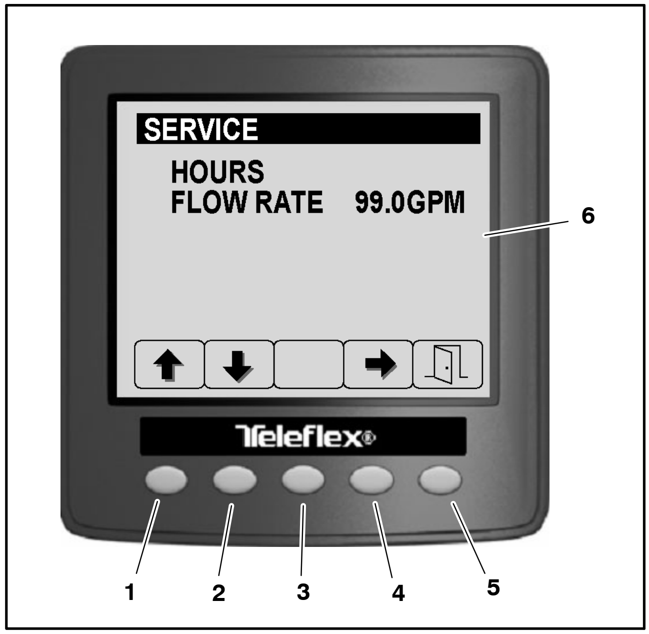


Figure 27

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Service screen**

HOURS

The hours screen contains a variety of machine hour meters (Fig. 28).

Use the Due In hour meter to notify the operator or service technician via the InfoCenter Display when scheduled maintenance is due.

IMPORTANT: When viewing the Hours Reset screen, use button 3 CANCEL to return to the previous screen without resetting the service due hours. Pressing button 5 when viewing the Hours Reset screen will reset the service due hours.

To reset the service due in hour meter, press button 3 from the hours screen. Use buttons 1 or 2 to highlight the desired time increment and button 4 to select the highlighted item.

Return to the previous screen by pressing button 5

FLOW RATE

The Flow Rate reading displayed on the Service Screen represents the actual volume of spray product passing through the flow meter at that moment (Fig. 29). Use the flow rate feature to monitor the flow meter reading at anytime during spray system operation. Viewing flow meter performance may be helpful while troubleshooting spray system or flow meter performance issues.

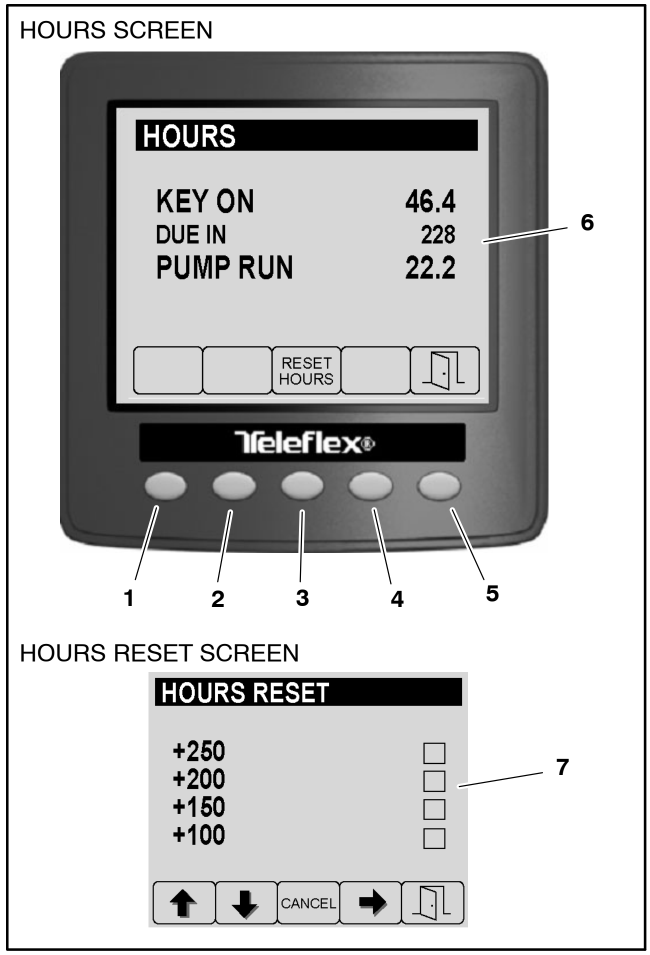


Figure 28

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Hours screen**
7. **Hours reset screen**

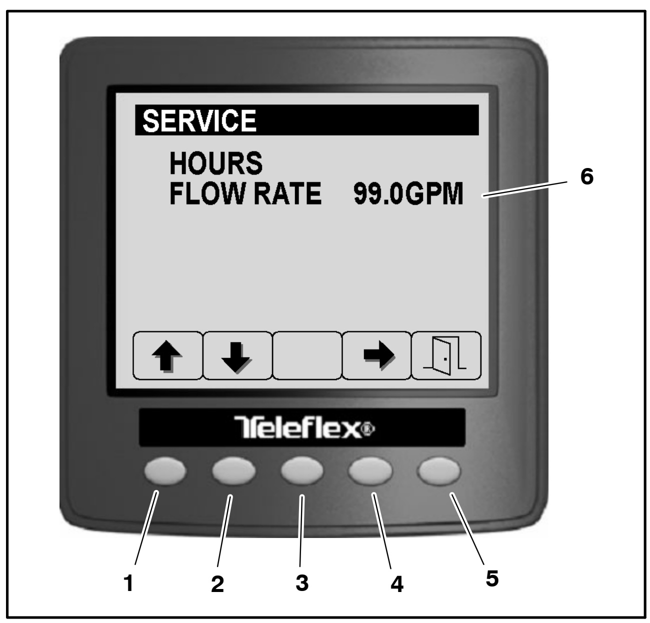


Figure 29

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Current actual flow rate**

Diagnostics

The Diagnostic screen (Fig. 30) is accessed from the main menu and provides access to the following screens:

Input / Output

Fault Viewer

Access the diagnostics screens by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted screen.

Return to the previous screen by pressing button 5

INPUT/OUTPUT

The input/output screens display the current state of the various Toro Electronic Controller (TEC) inputs, qualifiers and outputs necessary to allow a machine or spray system function to occur. The input/output screens should be used to troubleshoot machine operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting in this chapter). Scroll through the input/output screens by pressing buttons 1 or 2.

Each of the following machine functions has its own input/output screen:

Pumps

Booms

Engine Run

Each screen is separated into four (4) areas of information (Fig. 31). The first area identifies the machine function. The second area identifies the inputs that are necessary for the machine function to occur. The third area identifies qualifiers that are involved with the machine function (safety interlocks). The fourth area identifies the outputs that are necessary for the machine function to occur.

Return to the previous screen by pressing button 5

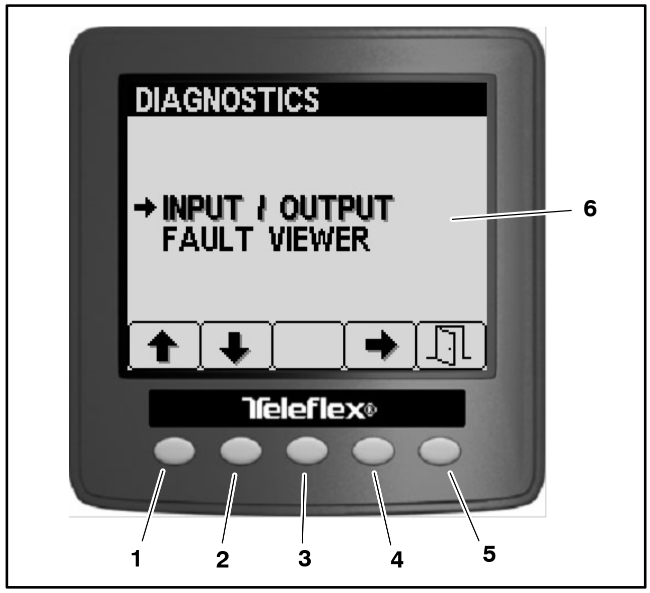


Figure 30

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Diagnostics screen**

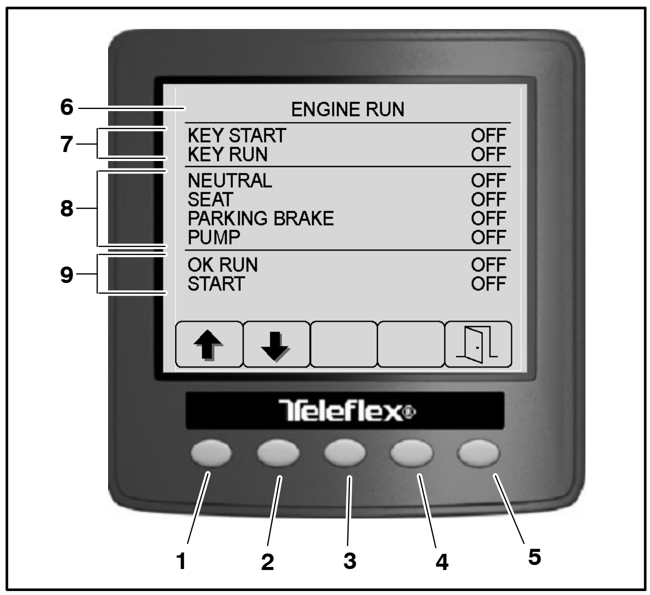


Figure 31

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Machine function**
7. **Inputs**
8. **Qualifiers**
9. **Outputs**

Pumps

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Pumps Screen:

M. SWITCH: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

RINSE: ON when the optional clean tank rinse kit rinse pump switch is held in the MOMENTARY (down) position.

RINSE TIMMED: ON for a 60 second timed period when the optional clean tank rinse kit rinse pump switch is in the ON (up) position.

AGITATION VALVE: ON when the agitation switch is in the ON position.

PUMP: ON when the spray pump switch is in the ON position.

NEUTRAL: ON when the traction pedal is in neutral.

There are no qualifiers involved in the PUMPS function.

When the pump switch input is in the ON position (PUMP ON), the following output should occur (Fig. 32):

MASTER VALVE ON – TEC output 9: The spray pump hydraulic proportional control valve PV in the spray pump control manifold should energize.

When the optional rinse pump switch input is in the ON (up) position (RINSE TIMED ON), the following output should occur (Fig. 33):

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for 60 seconds.

When the optional rinse pump switch input is held in the MOMENTARY (down) position (RINSE PUMP ON), the following output should occur:

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for as long as the switch is depressed.

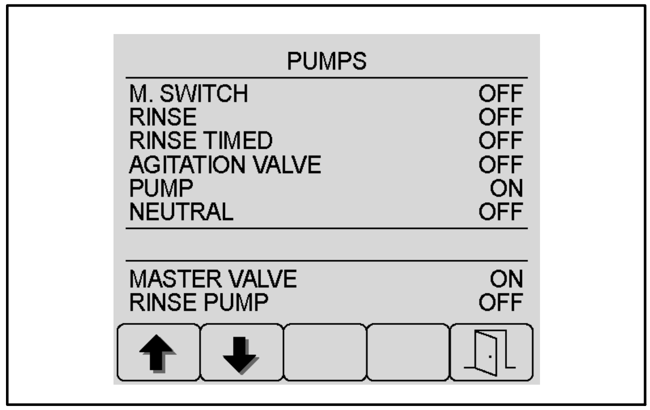


Figure 32 (Spray Pump)

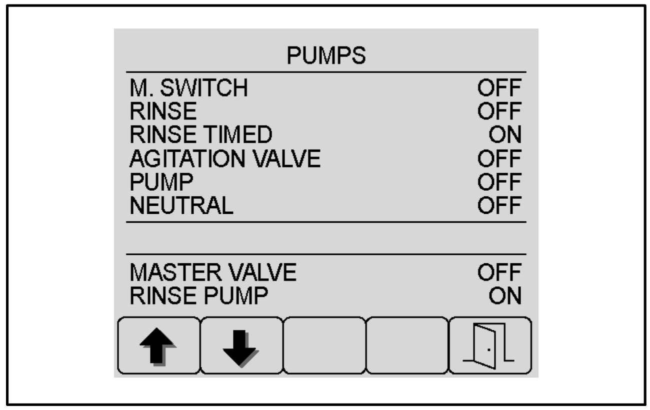


Figure 33 (Optional Rinse Pump)

Booms

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Booms Screen:

LEFT: ON when the left boom control switch is in the ON position.

CENTER: ON when the center boom control switch is in the ON position.

RIGHT: ON when the right boom control switch is in the ON position.

MASTER BOOM: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

There are no qualifiers involved in the BOOMS function.

When the left boom control switch input is in the ON position (LEFT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur (Fig. 34):

L. VALVE ON – TEC output 3: The left boom spray valve should open (valve indicator green).

When the center boom control switch input is in the ON position (CENTER ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

C. VALVE ON – TEC output 4: The center boom spray valve should open (valve indicator green).

When the right boom control switch input is in the ON position (RIGHT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

R. VALVE ON – TEC output 11: The right boom spray valve should energize open (valve indicator green).

When the master boom switch is depressed (switches the master boom control ON/OFF), any active boom spray valve (mating boom control switch ON) will switch ON/OFF (valve indicator green/red).

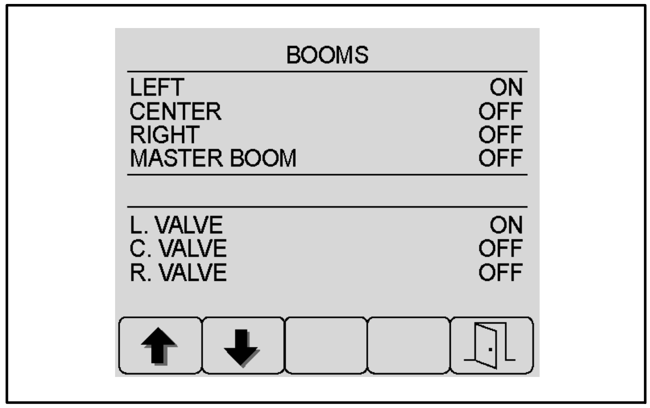


Figure 34

Engine Run

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings – Foldout Drawings in this manual for additional information.

When the ignition switch input is in the RUN position (KEY RUN ON), the following output should occur (Fig. 35):

OK RUN ON – TEC output 2: For gasoline engine machines the engine ECU ”ignition” is should energize, and for diesel engine machines the fuel stop/run solenoid hold coil should energize.

NOTE: The engine will not start if the operator is not in the seat and the parking brake is disengaged, the spray pump is engaged and the traction pedal is in forward or reverse.

When the ignition switch input is turned to the START position (KEY RUN ON), the following qualifiers are required for the engine starter to energize (Fig. 36):

SEAT ON and/or PARKING BRAKE ON: Operator seat needs to be occupied or the parking brake needs to be applied.

PUMP OFF: The PUMP switch must be disengaged.

NEUTRAL ON: The traction pedal must be in neutral.

If the proper inputs and qualifiers exist, the following outputs should occur (Fig. 36):

START ON – TEC output 1: For gasoline engine machines the engine ECU “start” should energize, and for diesel engine machines the start relay and glow controller “start” should energize and the starter motor should engage.

NOTE: The OK RUN output should remain ON when the ignition switch is in the START position.

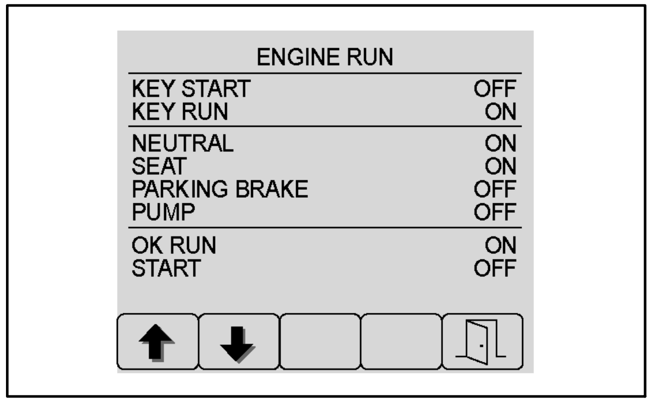


Figure 35 (RUN)

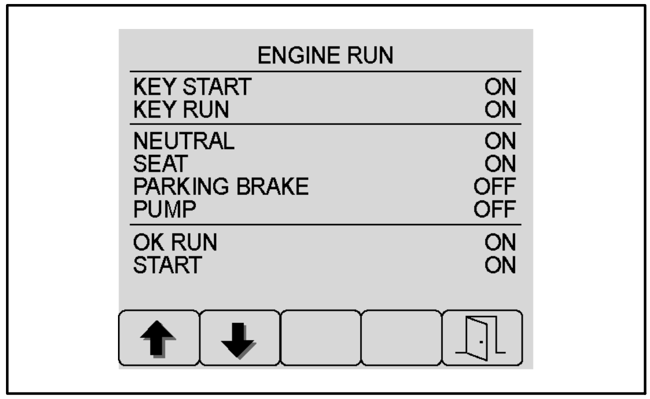


Figure 36 (START)

FAULT VIEWER

Machine faults are generated by the Toro Electronic Controllers (TEC) to identify an electrical system malfunction (fault) that occurs during machine or spray system operation. When a machine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Machine faults can be viewed via the InfoCenter Fault Viewer (Fig. 37). See Machine Faults in this chapter for additional information about specific machine faults.

On machines with gasoline engines only, the Kubota Engine Control Unit (ECU) can also generate electrical faults. The faults generated by the ECU are specific to the engine and cannot be viewed via the fault viewer (see Engine Faults in this chapter for additional information).

The fault viewer displays the following information about a machine fault:

CODE: fault code number

LAST: last time the fault occurred expressed in Key ON hours

FIRST: first time the fault occurred expressed in Key ON hours

NUM: number of times the fault has occurred

Scroll through the fault viewer screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

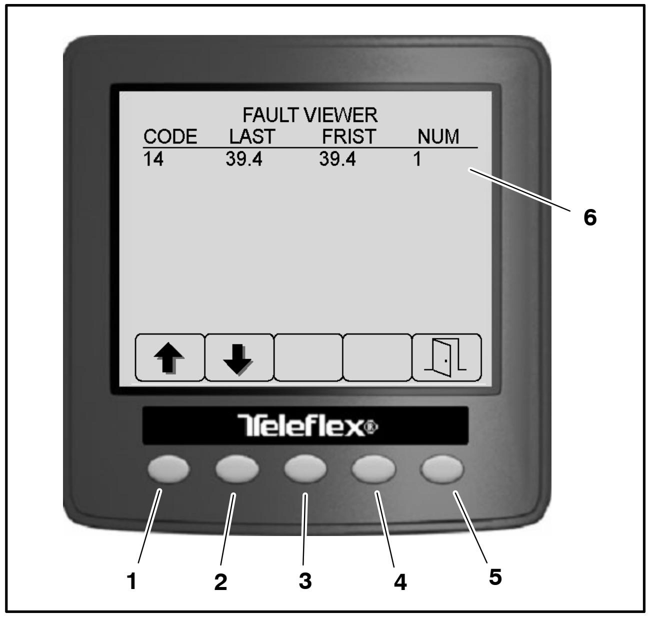


Figure 37

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Machine faults**

About

The About screens provide information about the machine, the InfoCenter Display and the Toro Electronic Controller (TEC). The About screens (Fig. 38) are accessed from the main menu.

Access the About screen by pressing buttons 1 or 2 to highlight ABOUT and button 4 to select the highlighted screen. Scroll through the various About screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

NOTE: The TEC controllers and the InfoCenter Display software is matched for correct machine operation. If any of these components are replaced for any reason, system software needs to be reloaded (contact your Authorized Toro Distributor).

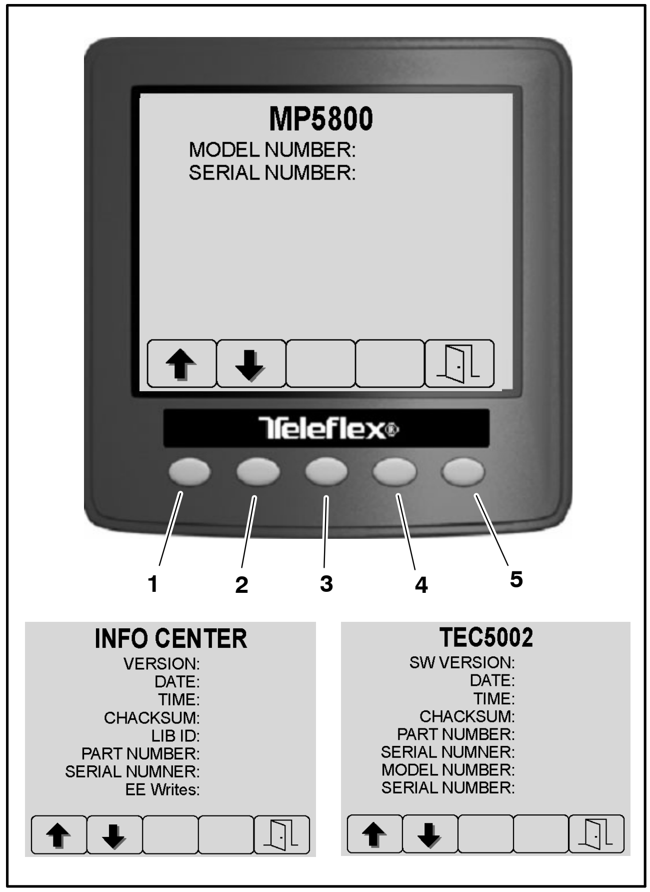


Figure 38

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**

Troubleshooting

CAUTION

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

Use the following table to assist in troubleshooting traction unit specific issues. A similar table discussing spray system issues can be found in the specific Spray System chapters of this manual.

Check the InfoCenter Display for any advisories or faults that may appear. Use the InfoCenter Display Diagnostics feature to help identify the problem (see InfoCenter Display – Diagnostics Screen in this chapter).

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics in Appendix A – Foldout Drawings – Foldout Drawings).

If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Nothing happens when start attempt is made.	Battery cables are loose or corroded Battery ground cable to frame is loose or corroded Battery is discharged or faulty Fuse (FB3 7–8 – 30 amp) is faulty Wiring to start circuit components is loose, corroded or damaged (see Appendix A – Foldout Drawings – Foldout Drawings) Seat switch and/or break pedal switch or circuit wiring is faulty Neutral switch is out of adjustment or faulty Spray pump enable switch or circuit wiring is faulty Clean rinse kit pump switches or circuit wiring is faulty (machines with clean rinse kit installed) Ignition switch or circuit wiring is faulty Starter solenoid or circuit wiring is faulty Start relay or circuit wiring is faulty (Diesel engine only) Engine coolant temperature exceeds 240F (116C) (Gasoline engine only) Engine intake air temperature exceeds 190F (88C) (Gasoline engine only)
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables (including ground cable to frame) are loose or corroded at battery, frame and/or at starter Starter, starter solenoid, or circuit wiring is faulty Starter mounting bolts are loose or not supplying a sufficient ground for solenoid operation

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Fuse (FB4 3–4 – 15 amp) is faulty Main relay is faulty Ignition switch is faulty Fuel pump is faulty Engine may be too cold. Fuel run/stop solenoid or circuit wiring (including fusible link) is faulty (Diesel engines only) The glow plug circuit does not operate properly – see below (Diesel engines only) Engine coolant temperature exceeds 240F (116C) (Gasoline engine only) Engine intake air temperature exceeds 190F (88C) (Gasoline engine only)
The glow plug circuit does not operate properly (Diesel engine only).	Wiring in the engine glow circuit (see Appendix A – Foldout Diagrams) is loose, corroded or damaged Engine glow plug(s) is (are) faulty The glow relay or glow plug controller is faulty Fusible link harness at the engine starter motor is faulty
Engine cranks (but should not)	
with the traction pedal out of the neutral position.	Neutral switch is out of adjustment, neutral switch or circuit wiring is faulty
without an Operator occupying the seat and without the brake engaged	Seat switch or circuit wiring is faulty Brake pedal switch strike plate is out of adjustment, or brake pedal switch or circuit wiring is faulty
with spray pump enable switch on ON position	Spray pump enable switch or circuit wiring is faulty
with optional clean rinse kit pump switch is in the ON position	Optional clean rinse kit pump switch or circuit wiring is faulty

General Operation Problems

Problem	Possible Causes
Battery does not charge.	Wiring to the charging circuit components is loose, corroded or damaged (see Appendix A – Foldout Drawings). Alternator belt is slipping or damaged. Alternator is faulty. Battery is faulty.
Engine stops during operation.	Ignition switch or circuit wiring is faulty. Engine oil pressure drops below 7 PSI (0.5 kg/cm^2) Fuel run/stop solenoid or circuit wiring is faulty (Diesel engine only). Engine coolant temperature exceeds 240F (116C) (Gasoline engine only) Engine intake air temperature exceeds 190F (88C) (Gasoline engine only)
Speed lock coil does not hold.	Brake pedal switch or circuit wiring is faulty. Speed lock circuit diodes (D1 & D2) are faulty.

Operator Advisories

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, an audio alarm will sound and an Operator advisory will appear on the InfoCenter Display (Fig. 39). Typically, an advisory can be eliminated with a change in machine controls by the operator. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the InfoCenter Display that the traction pedal needs to be in neutral. The advisory screen will clear automatically after a few seconds or can be cleared from the display manually by pressing any of the InfoCenter buttons. An advisory will not be recorded in any fault log. The following table explains each advisory in more detail.

The InfoCenter Display is also used during the flow meter Calibration and Speed Sensor Calibration process to display a variety of instructions and advisories (see Spray System Chapters in this manual for additional information).

In addition to Operator advisories, a machine fault may occur during machine operation. The InfoCenter Display will display the current machine fault code and log the specific fault information (see Faults Codes in this chapter).

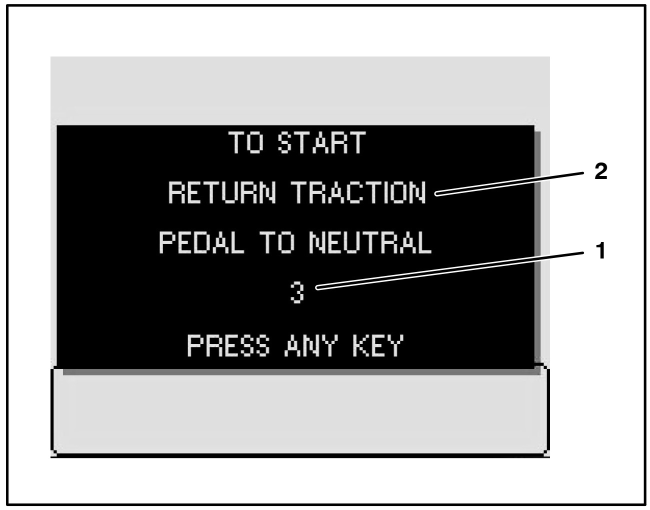


Figure 39

1. **Advisory number/code**
2. **Advisory description**

Advisory	Advisory Description	Recommended Action
2	Start Prevented – Pump switch active	Set spray pump enable switch to OFF position
3	Start Prevented – Not in neutral	Set traction pedal to neutral. Adjust traction pedal for Neutral if necessary (see Chapter 4 – Hydraulic System in this manual)
4	Start Prevented – Operator not in seat	Operator return to seat or set parking brake
5	Start Prevented – Starter engage timeout	Starter has been engaged for more than 30 seconds Allow starter to cool before reattempting to start engine
6	Start Prevented – Rinse pump switch active (optional clean rinse kit)	Set rinse pump enable switch to OFF position
102	Engine Stopped – Operator not in seat	Operator return to seat or set parking brake
103	Driving with parking brake is engaged	Disengage parking brake
202	Pump start prevented – Boom active	Set master boom switch to OFF position
203	Pump Start Prevented – Operator out of seat and parking brake not engaged	Operator return to seat or set parking brake
205	Pump Start Prevented – Engine starting	Set spray pump enable switch to OFF position
206	Pump Turned OFF – Operator not in seat	Operator return to seat or set parking brake
402	Tank Low Volume Alert	Prepare to discontinue spraying as the volume in the spray tank has dropper below the alert level set by the user
403	Rinse Pump ON (optional clean tank rinse kit)	Set optional clean tank rinse pump switch to OFF position
502	Invalid Parameter Value Entered	Only values within the defined software parameters can be entered by the user
503	Invalid Parameter Value Read from EPROM	Possible TEC damage Contact your Authorized Toro Distributor
802	Booms Turned Off – Vehicle speed too low for automatic mode function	Increase vehicle speed before attempting ExcelaRate (automatic application–rate) spray system control, or switch to Manual spray system control

Using the InfoCenter Display for Troubleshooting

The Diagnostics – Input/Output screens of the InfoCenter display can be very helpful when troubleshooting machine operation issues (see Diagnostics – Input/Output Screens in this chapter). Some of the electrical components and the circuit wiring involved in various machine operations can be evaluated using the Input/Output screens prior to testing each component individually. The Input/Output screens show the current state of the inputs, qualifiers and the outputs required to allow the operation to proceed (Fig. 40).

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

BOOMS The components necessary to operate the spray valves.

ENGINE RUN The components necessary to start and run the engine.

CAUTION

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

If a machine operation is malfunctioning, the following procedure can help identify 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 RUN/PREHEAT position and navigate to the InfoCenter Diagnostic – Input/Output Screen for the desired machine function.

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

When the necessary inputs and qualifiers are in the correct position, the outputs identified on the Input/Output screen should show as ON. If the output remains OFF, a problem with TEC power (circuit wiring or fuse) may exist, or the Toro Electronic Controller (TEC) or TEC software may require reloading or replacement. Contact your Authorized Toro Distributor for assistance.

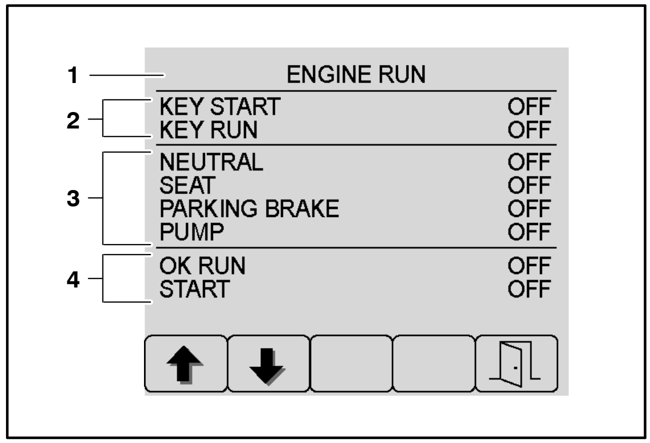


Figure 40

1. **Machine function**
2. **Inputs**
3. **Qualifiers**
4. **Outputs**

A faulty output component will not be identified by the Input/Output screen. If all inputs, qualifiers and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component or the circuit between the TEC and the output component may be faulty. In this case, the controller output is occurring but the faulty output component or circuit wiring is preventing the output from functioning. Test the specific output and output wiring (see Component Testing in this chapter).

ENGINE RUN operation example:

Test the inputs: In this example, the inputs are the ignition switch in the RUN position and the ignition switch in the START position. If ON and OFF do not correspond to the ignition switch (input) when moved to the OFF, RUN and START positions, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in this chapter).

Test the qualifiers: In this example, the qualifiers are the neutral switch, seat switch, parking brake switch and spray pump switch.

Test the neutral switch (qualifier). If ON and OFF do not alternate when the traction pedal is moved from NEUTRAL to FORWARD and back to NEUTRAL, and from NEUTRAL to REVERSE and back to NEUTRAL, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in this chapter).

Test the seat switch (qualifier). If ON and OFF do not alternate when an operator sits in and raises from the operator seat, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in this chapter).

Test the parking brake switch (qualifier). If ON and OFF do not alternate when the parking brake is engaged and disengaged, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in this chapter).

Test the spray pump switch (qualifier). If ON and OFF do not alternate when the spray pump switch is engaged and disengaged, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in this chapter).

Test the TEC outputs: In this example, the outputs are OK RUN – TEC output 2, and START – TEC output 1.

OK RUN: When the ignition switch (input) is set to the RUN position, the OK RUN output should energize (ON). For gasoline engine machines the engine ECU ”ignition” should energize, and for diesel engine machines the fuel stop/run solenoid hold coil should energize.

START: When the ignition switch (input) is set to the START position, the START output should energize (ON). For gasoline engine machines the engine ECU “start” should energize, and for diesel engine machines the start relay and glow controller “start” should energize and the starter motor should engage.

For gasoline engine machines, the engine ECU is an output energized by the TEC and therefore cannot be tested using the InfoCenter procedure. See the Kubota Workshop and Diagnosis Manual for additional information.

For diesel engine machines, the fuel stop/run solenoid hold coil is an output energized by the TEC and therefore cannot be tested using the InfoCenter procedure. Test the fuel stop/run solenoid or start relay and circuit wiring if necessary (see Component Testing in this chapter). See the Kubota Workshop and Diagnosis Manual for additional glow controller and starter motor information.

Machine Faults

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine operation. When a machine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Machine faults can be viewed via the InfoCenter Diagnostic Screen Fault Viewer (Fig. 41). See InfoCenter Diagnostic Screen Fault Viewer in this chapter for additional information.

For machines with gasoline engines, the Kubota Electronic Control Unit (ECU) can also generate electrical faults. The faults generated by the ECU are specific to the engine (see Engine Faults in this chapter for additional information).

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 for revision D software. Use the InfoCenter Display Diagnostics > Fault Viewer for fault retrieval.

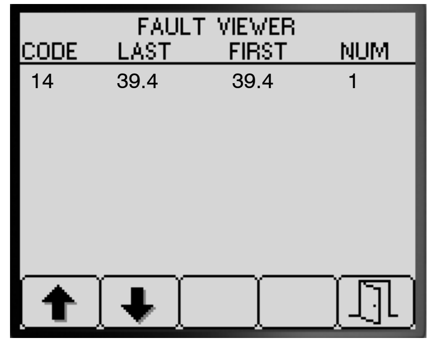


Figure 41

Fault Code	Fault Description	Recommended Action
1	TEC is faulty	Replace TEC
2	One or more of the TEC output fuses (7.5 Amp) is faulty	Replace fuse
3	Main power relay or circuit wiring is faulty	Test main power relay
4	Charging system or circuit wiring is faulty	Test charging system
14	InfoCenter software is not recognized by TEC	Reload system software Contact your Authorized Toro Distributor
17	Starter timeout (starter has been engaged for more than 30 seconds)	Allow starter to cool before reattempting to start engine Troubleshoot engine starting issues
18	Neutral switch stuck in neutral position (neutral switch reports it is in the neutral position, yet vehicle speed is at or above 2 MPH for approximately 10 seconds) Faults resets if speed drops below threshold, operator gets out of seat, neutral switch indicates not in neutral, or system is placed in Stationary Test Mode	Check Neutral Switch for adjustment and function Check harness connections to Neutral Switch

19	Spray System Fault – flow meter not working correctly or harness fault (No flow detected when based upon boom, pump and pressure it indicates there should be) Spray pump is ON,Master Boom switch is ON, at least one boom is ON, spray pressure is above 20 PSI, the booms have been on long enough for the system to stabilize and vehicle speed is fast enough for automatic application–rate control to be enabled	Check the flow meter harness for proper connection. Confirm fluid flow at spray nozzles. If so, flow should be displayed on the flow rate meter. If no fluid flow at spray nozzles, begin checking the spray system for a blockage. Check flow meter for proper function.
41	Spray System Fault – Controller has detected a short circuit on the spray pump PWM output circuit (TEC output 9 – pin 44). OR Controller has determined an internal component in the controller has overheated.	Check harness and associated components for a short to ground If fault persists, replace TEC due to internal damage. Contact your Authorized Toro Distributor

Engine Faults (Gasoline Engines Only)

Engine faults are generated by the by the Kubota engine Electronic Control Unit (ECU) to identify an electrical system malfunction (fault) pertaining to the engine during operation. When an engine fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Depending on the severity of the fault, a STOP icon may display as well (Fig. 42).

The Toro Electronic Controller (TEC) can also generate electrical faults. The faults generated by the TEC are specific to the machine (see Machine Faults in this chapter for additional information).

If an engine fault occurs:

1. Press any key to remove the fault information panel from Operator Information Screen. The audible alarm will continue to sound.

2. The fault description will be displayed on the InfoCenter (Fig. 43). Press button 3 to silence the audible alarm. Press buttons 1 and 2 to scroll through the list of active engine faults. Any active autosteer faults (optional AutoSteer kits only) will be displayed also.

3. If a STOP fault is displayed on the InfoCenter, the operator should cease operation of the machine and the engine as quickly and as safely as possible to reduce damage to the engine.

4. If a CHECK ENGINE fault is displayed on the InfoCenter, the operator should take the machine for service as soon as possible.

5. Return to the previous screen by pressing button 5

An icon will appear in the upper left corner of the Operators Information screen as long as an engine fault is active (Fig. 44). In order to clear the displayed fault, the engine problem has to be resolved. See the Kubota Diagnosis and Workshop Manual for additional information.

NOTE: Engine faults that are no longer active should be stored in the Kubota Engine Electronic Control unit (ECU) and should be viewed by using the Kubota Gasoline Service Tool (KGST) and software. Contact your Authorized Toro Distributor for assistance.

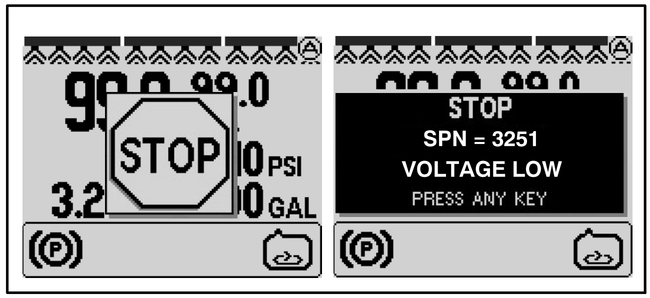


Figure 42

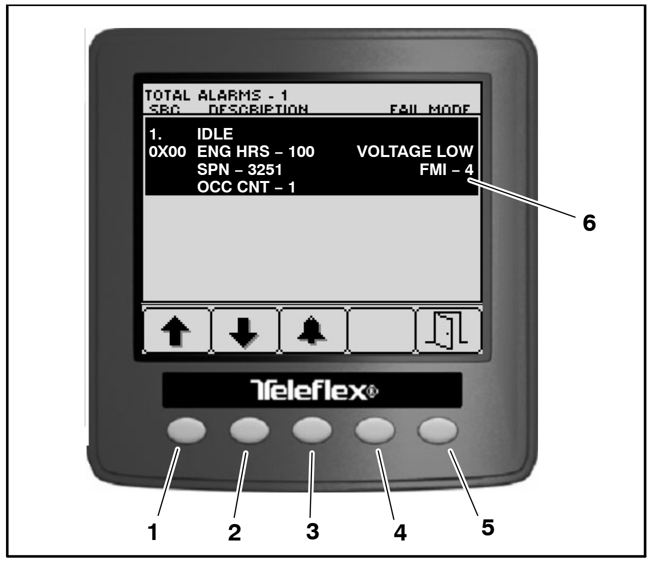


Figure 43

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Engine fault description

Figure 44

1. Operator information screen
2. Active engine fault icon

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 60F to 100F (16C to 38C). The ignition key should be in the OFF position and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post.

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

Voltage Measured	Battery Charge Level
12.68 v (or higher)	Fully charged (100%)
12.45 v	75% charged
12.24 v	50% charged
12.06 v	25% charged
11.89 v	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if a charging system has an output, but not its capacity.

Use a multimeter set to the DC volts setting. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle (Diesel Engine: 3050 to 3150 RPM, Gasoline Engine: 3200 RPM). Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

Test results should be (example):

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.80 v
Difference	= +0.50 v

Glow Plug System Test (Diesel Engine Only)

This is a fast, simple test that can help to determine the integrity and operation of your Multi Pro glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive Ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to RUN and record the multimeter results.

The Multi Pro 5800 glow plug system should have a reading of approximately 36 amps total (9 amps per glow plug). If low current reading is observed, one (or more) glow plugs is faulty.

Check Operation of Interlock Switches

CAUTION

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

Your Multi Pro is equipped with a Toro Electronic Controller (TEC) which monitors interlock switch operation. If all of the interlock switches necessary to allow a specific machine operation are not in their desired position, an Operator's Advisory will appear on the InfoCenter Display (see Operator's Advisories in this chapter).

The interlock system used on your Multi Pro includes the seat switch, the neutral switch, the brake pedal switch, the spray pump enable switch and the optional clean tank rinse pump switch (if equipped). Additional interlocks are incorporated into the various spray systems as well. Spray system interlocks are discussed in the specific Spray System chapter in this manual.

Use the InfoCenter Display to test the various interlock switches (TEC inputs) before physically testing the switch and its circuitry (see InfoCenter display in this chapter). Physically testing individual interlock switches is included in the Component Testing section of this Chapter.

Brake Pedal Switch

The brake pedal switch is a mechanical plunder switch used to monitor brake pedal movement. The brake pedal switch is mounted to the frame under the floorboard and is actuated by an adjustable strike plate attached to the brake lever (Fig. 45).

1. Make sure that ignition switch is in the OFF position and key is removed from ignition switch.

2. Make sure the brake pedal moves freely.

3. With the brake pedal fully at rest, the switch plunger should be partially depressed by the striker plate. The distance from the back of the switch cover to the striker plate should be **.75 in. (19 mm)** (Fig. 46).

4. Loosen the flange nut securing the striker plate to the brake lever and adjust the plate if necessary.

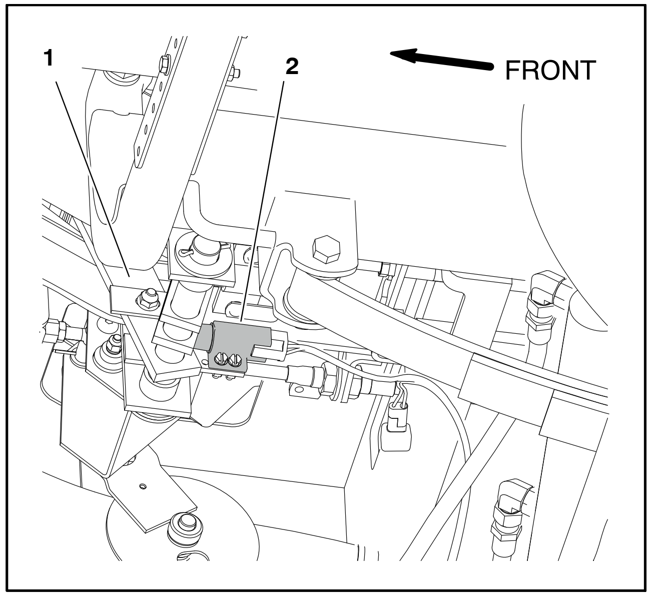


Figure 45

1. **Brake pedal**
2. **Brake pedal switch**

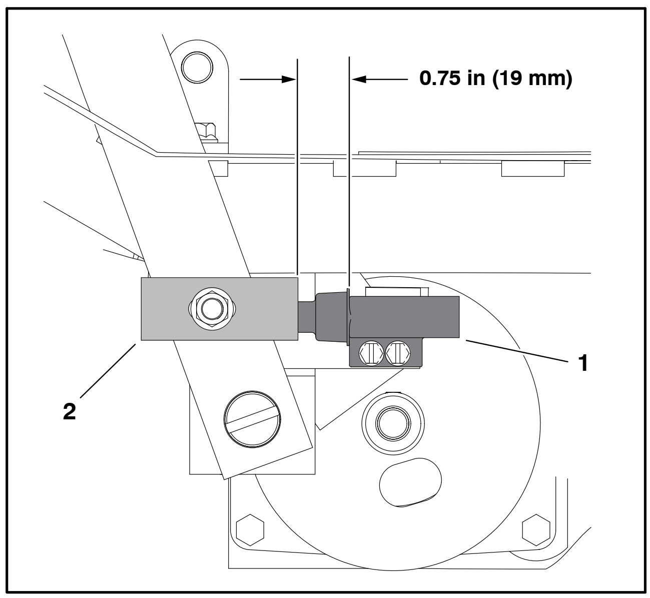


Figure 46

1. **Brake switch**
2. **Strike plate**

Steering Position Sensor (Optional AutoSteer)

The steering position sensor is a two–piece assembly located on top of the front left king pin. The sensor portion includes 2 analog hall effect sensors. The second piece of the assembly is a bolt with a magnetic head threaded into the king pin. The steering position sensor follows the front right wheel steering movement.

For steering position sensor testing information, refer to Steering Position Sensor in the Component Testing section of this chapter.

Aligning the Steering Position Sensor Components

The two pieces of the steering position sensor assembly must be in precise alignment with each other. If the sensor bracket is damaged or removed, align the sensor bracket with the king pin using the alignment tool supplied with the AutoSteer kit (Fig. 47).

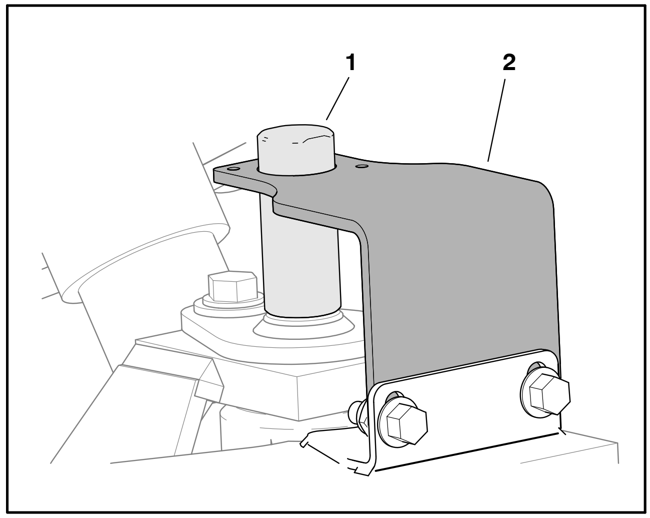


Figure 47

1. **Alignment tool**
2. **Sensor bracket**

Adjusting the Steering Position Sensor Air Gap

1. Ensure that the front wheels are aligned straight ahead.

2. Loosen the jam nut under the magnet bolt (Fig. 48).

3. Adjust the magnetic bolt so the slot in the bolt aligns with the wiring port of the steering position sensor and the gap between the top of the bolt and the bottom of the sensor is **2.0 to 7.0 mm (0.08 to 0.27 inch)**.

4. Tighten the jam nut against the king pin from **20 to 22 N·m (180 to 200 in–lb)** and recheck the gap between the top of the bolt and the bottom of the sensor. Adjust the gap if necessary.

5. Calibrate the steering system; refer to Calibrating the AutoSteer Steering System in Chapter 8 – GeoLink Spray System in this manual.

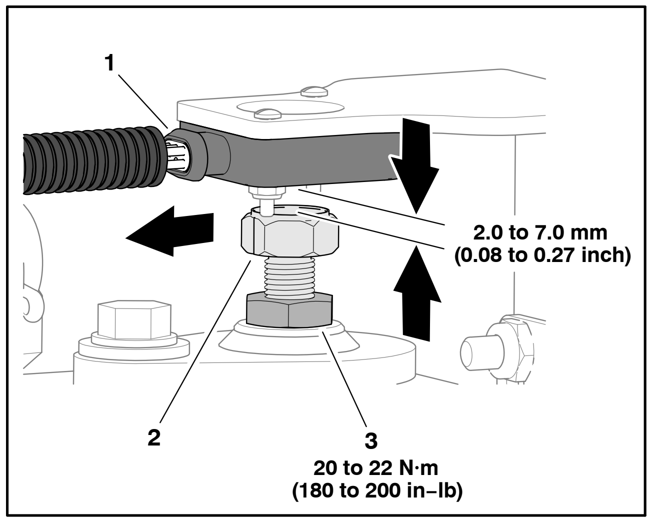


Figure 48

1. **Steering position sensor wiring port**
2. **Slot in magnetic head bolt**
3. **Jam nut**

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. disconnect the ignition switch connector before doing a continuity check on the ignition switch).

NOTE: For Multi Pro 5800–D machines, see the Kubota Workshop Manual (05–E3B Series) for engine component testing information. For Multi Pro 5800–G machines, see the Kubota Workshop or Diagnosis Manual (WG1605–G–E3 Series) for engine component testing information.

CAUTION

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

Fusible Links

Machines with diesel engines use four (4) fusible links for circuit protection. Three (3) of these fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Fig. 49). The remaining fusible link is included in the wire harness and connects the starter terminal G to the engine fuel stop solenoid pull coil (Fig. 49). Machines with gasoline engines use a fusible link integrated into the machine front wire harness. The link connects the starter terminal B+ terminal to the contacts of the main power relay. If any of these links should fail, current to the protected circuit will cease. Refer to wire harness drawings in Appendix A – Foldout Drawings for additional fusible link information.

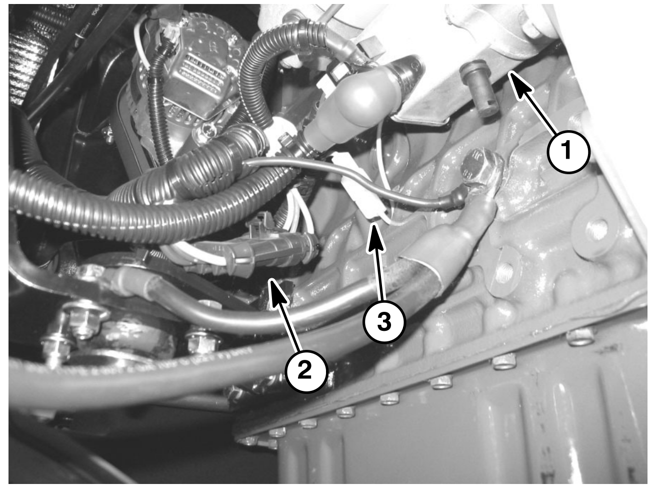


Figure 49

1. **Starter motor**
2. **Fusible link harness (3 wires – starter B+)**
3. **Fusible link harness (1 wire – pull coil)**

Testing

1. Make sure that ignition switch is OFF.

2. Disconnect negative (–) battery cable from battery terminal and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter).

3. For Multi Pro 5800–D fusible link harness (Fig. 50):

   A. Locate and unplug fusible link connector from machine wire harness.

   B. Use a multimeter to make sure that continuity exists between the fusible link terminal on the starter B+ terminal (terminal J1 on fusible link harness) and each of the terminals in the link harness connector P1 (Fig. 50). If any of the fusible links are open, replace the fusible link harness.

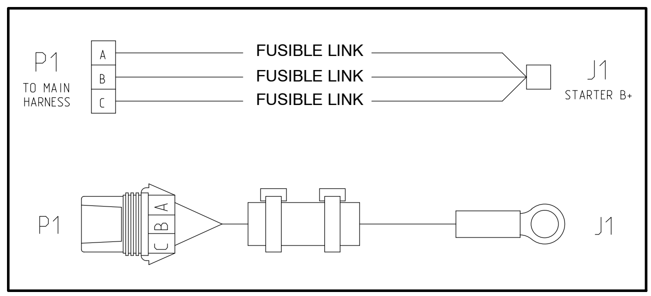


Figure 50

4. For fusible link in wire harness (Fig. 49):

   A. Locate and unplug machine wire harness connector from the starter.

   B. Use a multimeter to make sure that continuity exists across the segment of the wire harness with the fusible link. For Multi Pro 5800–D machines, test between the wire harness connector at the starter and the engine fuel stop solenoid connector for the solenoid pull coil (white wire). For Multi Pro 5800–G machines, test between the wire harness connector at the starter and terminal 30 of the main power relay connector (red wire).

   C. If this fusible link should fail, make sure that the wire harness is repaired with the correct fusible link. Do not replace a failed harness fusible link with a section of wire.

5. When testing is completed, make sure to connect all disconnected wire harness components. Connect positive (+) battery cable and then negative (–) cable (see Battery Service in the Service and Repairs section of this chapter).

Fuses

The fuse blocks are located under the operator seat on the left seat base panel. Machines with Kubota gasoline engines also have a number of fuses located in an engine power center located on top of the engine toward the rear and a Maxi–fuse located in the Kubota engine wire harness (see Engine Fuses (Kubota Gasoline Engine) in this chapter).

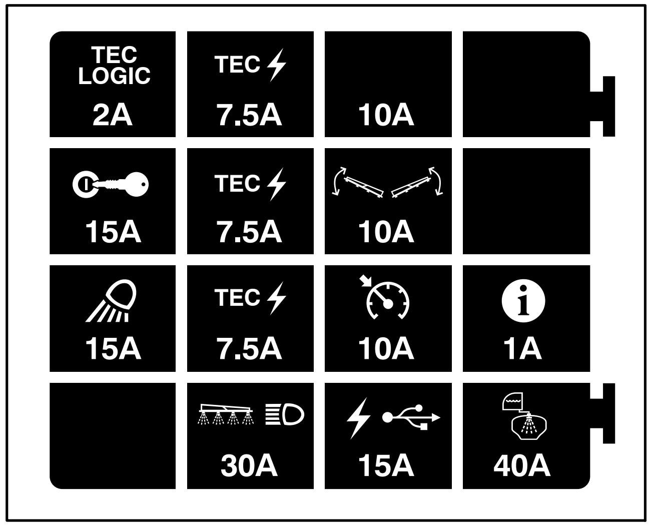


Figure 51

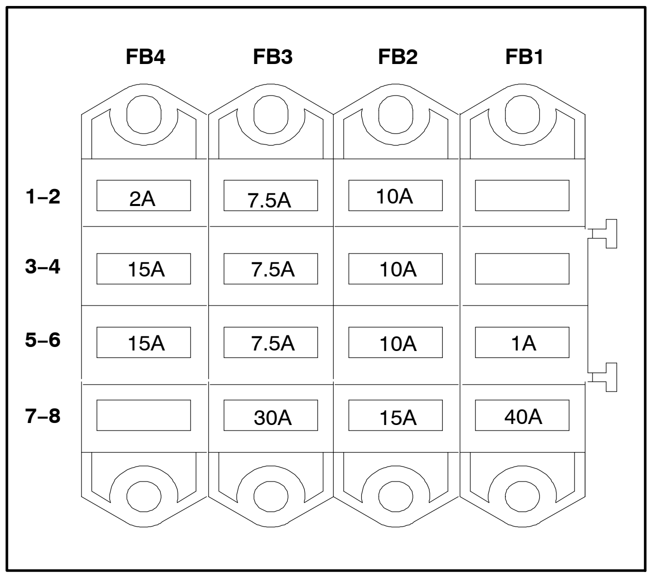


Figure 52

Fuse Identification and Function

NOTE: Fuses for optional equipment appear at end of the following Fuse Identification and Function list.

Use the fuse decal (Fig. 51) and fuse block (Fig. 52) to identify each individual fuse and its correct amperage. The fuses have the following functions:

FB1 1–2 and 3–4 available to protect switched power circuits for optional kits.

FB1 5–6 (1 amp) protects InfoCenter power circuit.

FB1 7–8 (40 amp) protects rinse pump circuit for optional tank clean rinse kit.

FB2 1–2 (10 amp) protects the agitation valve, right spray valve, center spray valve, and left spray valve close signal circuits.

FB2 3–4 (10 amp) protects boom lift circuits.

FB2 5–6 (10 amp) protects speed control circuit.

FB2 7–8 (15 amp) protects power point circuit.

FB3 1–2 (7.5 amp) protects TEC output power supply for engine start relay, hold coil of run/stop solenoid for diesel engines or fuel pump relay for gasoline engines, and the left and center boom valve open signal. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

FB3 3–4 (7.5 amp) protects TEC output power supply for the audible alarm and the spray pump control manifold solenoid valve. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

FB3 5–6 (7.5 amp) protects TEC output power supply for the right boom valve and agitation valve open signal, rinse pump relay for optional tank clean rinse kit and brake lights. Fault code #2 should be displayed on the InfoCenter Display if this fuse is faulty.

FB3 7–8 (30 amp) protects headlight, fuel gauge, optional MyTurf™ hour meter, turn signals, ground speed sensor, flow meter, pressure transducer, and spray pump switch and agitation switch indicator light circuits.

FB4 1–2 (2 amp) protects logic power circuit to the TEC.

FB4 3–4 (15 amp) protects main power relay circuit.

FB4 3–4 (15 amp) protects hazard flasher circuit.

FB4 7–8 available to protect maintained power circuits for optional kits

Optional electric hose reel (40 amp) protects the optional hose reel motor circuit. The fuse is located in the hose reel control box.

Optional homologation (road light) kit (5 amp – 2) protects the optional rear position light circuits. The fuses are located in the homologation kit wire harness near the rear light assemblies.

Optional GeoLink spray system (10 amp) protects the unswitched power supply circuit for the X25 or X30 console and the AGI−4 GPS antenna. The fuse is located in the GeoLink wire harness near the battery.

Optional GeoLink spray system (50 amp) protects the unswitched power supply circuit for the ASC−10 automatic section controller. The fuse is located in the GeoLink wire harness near the battery.

Testing

Locate the fuse to be tested. 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.

Engine Fuses (Gasoline Engines Only)

The engine fuses that protect the Kubota gasoline engine electrical circuits are installed in the engine power center located on top of the engine (Fig. 53).

In addition to the fuses in the power center, a 60 Amp Maxi−fuse is included in the Kubota engine wire harness to protect the charging circuit. This Maxi−fuse resides in an in−line fuse holder near the engine starter motor (Fig. 53).

Figure 53

1. Engine power center
2. 60 Amp Maxi−fuse

Identification and Function

Use Figure 54 to identify each individual fuse and its correct amperage. Engine fuses have the following function:

Fuse F−1 (5 Amp): Protects engine VSW (ignition switch voltage) circuit power supply.

Fuse F−2 (10 Amp): Protects engine ECU power supply.

Fuse F−3: Not used.

Fuse F−4 (15 Amp): Protects power supply for engine electrical system.

Fuse F−5 (15 Amp): Protects fuel pump circuit power supply.

Fuse F−6 (25 Amp): Protects starter motor circuit power supply.

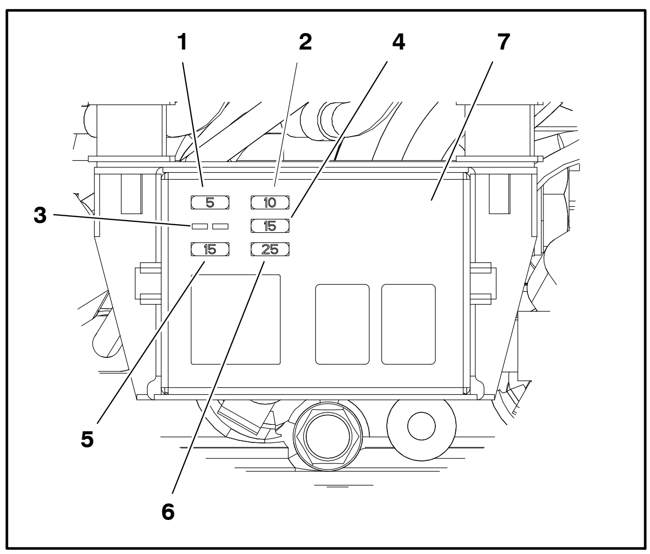


Figure 54

1. Fuse F−1 (5 Amp)
2. Fuse F−2 (10 Amp)
3. Fuse F−3 (not used)
4. Fuse F−4 (15 Amp)
5. Fuse F−5 (15 Amp)
6. Fuse F−6 (25 Amp)
7. Engine power center

Fuse Testing

1. Make sure that ignition switch is in the OFF position and key is removed from ignition switch.

2. Remove engine shroud (attached to back of seat base) to access engine fuses.

3. Remove fuse(s) from the engine power center or fuse holder for testing. Fuse should have continuity between fuse terminals.

IMPORTANT: If fuse replacement is necessary, make sure that replacement fuse has the correct amperage rating.

4. Replace fuse if testing determines that it is faulty.

5. Install engine shroud.

Toro Electronic Controller (TEC)

Multi Pro 5800 machines with serial numbers above 316000000 use a Toro Electronic Controller (TEC−5002) 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 the left side of the control console frame (Fig. 55). 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−5002 monitors the states of the following components:

Traction Unit Inputs: ignition switch, seat switch, brake pedal switch, neutral switch, spray pump switch and optional clean rinse kit switches (if equipped).

Manual Spray System Inputs: boom switches (master, left, right and center spray), agitation switch, speed sensor and manual rate control switch.

ExcelaRate Spray System Inputs (in addition to the manual spray system inputs): spray mode switch, spray system flow meter and spray pressure transducer.

The TEC−5002 controls electrical output to the following components:

Traction Unit Outputs (diesel engines): engine start relay, glow controller, run/stop solenoid hold coil, audible alarm and brake lights.

Traction Unit Outputs (gasoline engines): engine ECU, audible alarm and brake lights (opt.).

Spray System Outputs: spray pump control solenoid, boom spray valves, agitation valve and the clean rinse kit pump relay (opt.).

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. 56). 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.

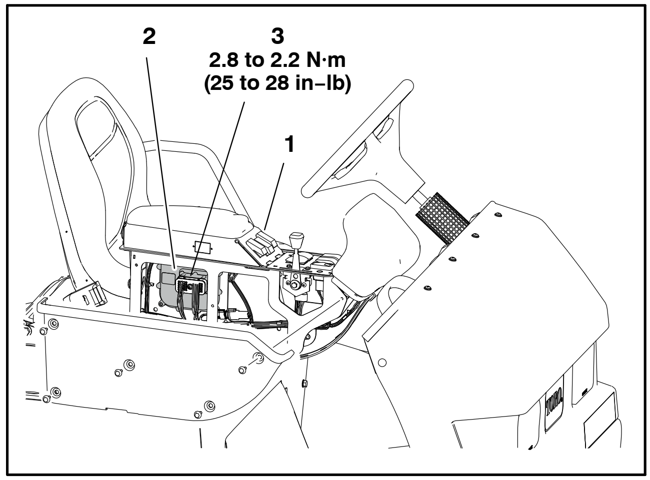


Figure 55

1. Control console
2. Toro Electronic Controller (TEC)
3. Harness connector screw

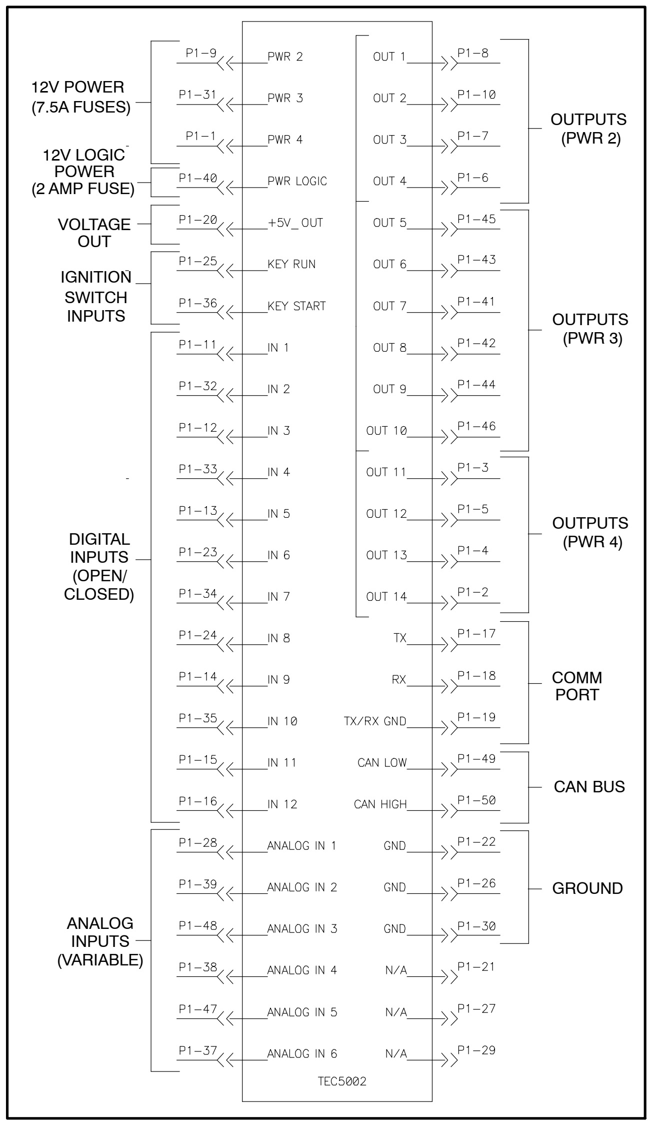


Figure 56

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. 57). If the wire harness connector is removed from the TEC for any reason, tighten the harness connector screw from **2.8 to 3.2 N·m (25 to 28 in–lb)**.

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

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

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 5800 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, the wire harness connecter from the ASC–10 on machines with GeoLink spray systems and disconnect the terminal connector from the engine alternator. These steps will prevent damage to the machine electrical system when welding.

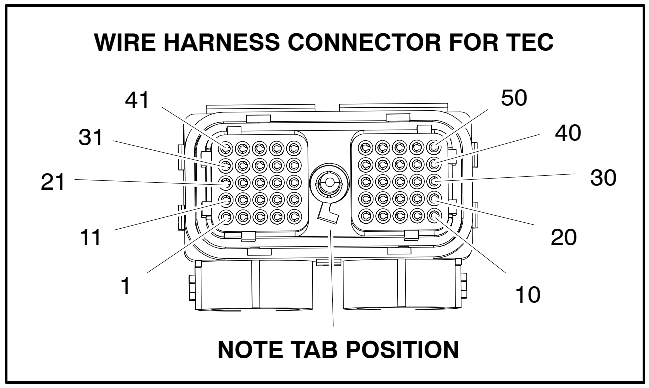


Figure 57

PVED−CLS Controller (Optional AutoSteer)

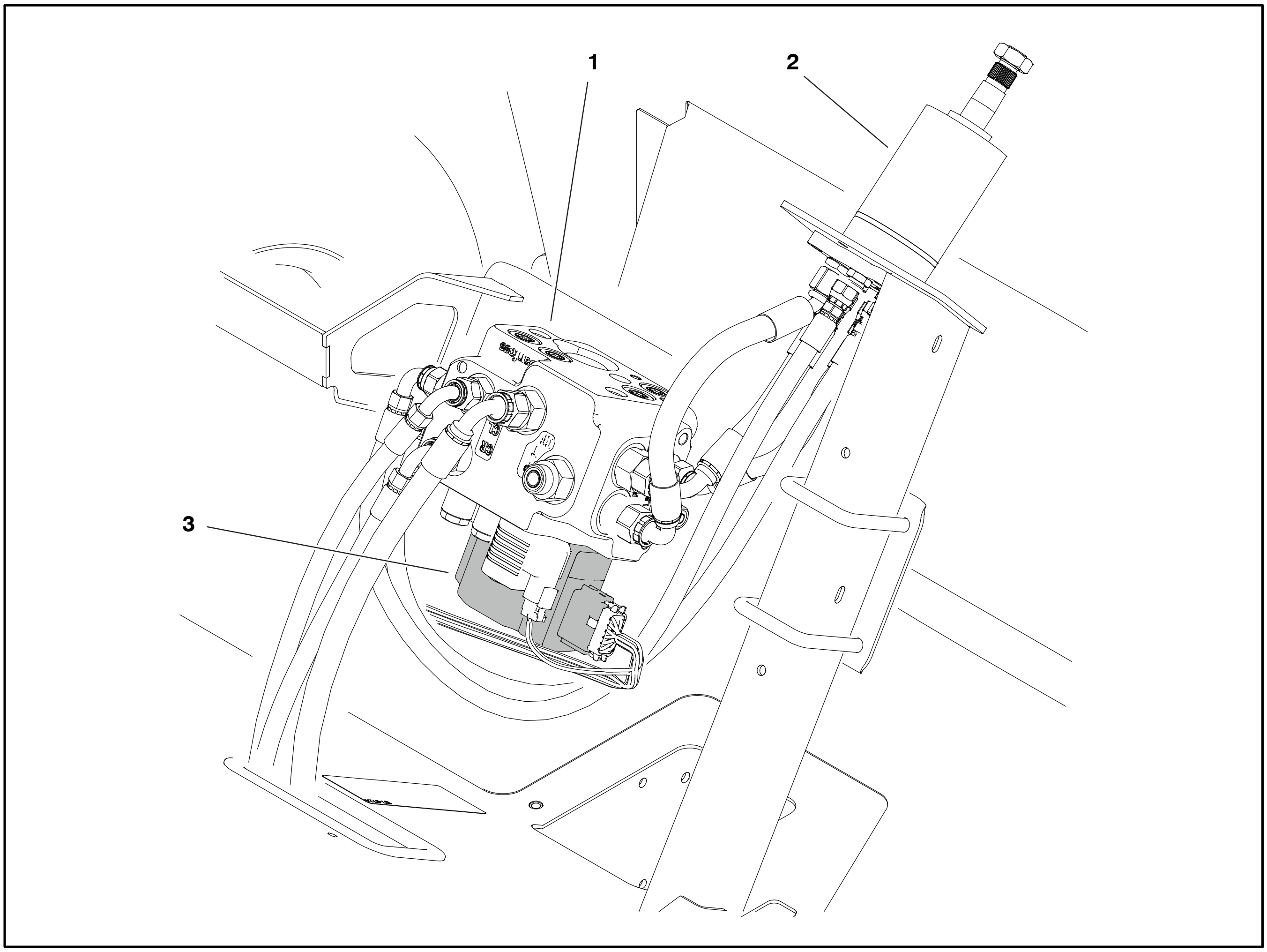


Figure 58

1. **EHi steering valve**
2. **Steering control valve**
3. **PVED−CLS controller**

The EHi steering valve assembly includes the PVED−CLS controller to operate the EHi steering valve. The PVED−CLS controller has steering specific functions and dedicated safety functions which are programed specifically for the Multi Pro 5800 through the controller firmware. The PVED−CLS includes two separate controllers (Main and Safety), creating a fail−safe redundancy feature which constantly cross−checks system data. The Main and Safety controllers inside the PVED−CLS are connected to the machine CAN bus via two separate sets of CAN bus connections. Refer to the wire harness drawings and diagrams in Appendix A in this manual for additional information.

Communication (firmware uploads and calibration) with the PVED−CLS controller is accomplished using a personal computer (PC) running Danfoss PLUS+1® Service Tool software and the vehicle's CAN network. Contact an Authorized Toro Distributor for assistance.

Because of the solid state circuitry built into the PVED−CLS controller, 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). Only the Tri−colored LED on the PVED−CLS controller and any "AUTOSTEER" fault codes that appear on the InfoCenter display should be used to troubleshoot controller operation issues (Fig. 59). Refer to AutoSteer Faults in the Troubleshooting section in this Chapter.

Only the seals and particle filter located between the PVED−CLS controller and the EHi steering valve body can be serviced. The PVED−CLS controller is not serviceable separately. The entire EHi steering valve and PVED−CLS controller must be replaced as an assembly. Refer to Electrohydraulic In−line (EHi) Steering Valve (Optional AutoSteer Kit) in Chapter 5 − Hydraulic System in this manual for additional information.

LED Color/flash pattern	Indication
Orange-Green, flashing	PVED-CLS controllers are in ‘boot-loader mode’
Orange	PVED-CLS is in initialization or in ‘on-road mode’
Orange, flashing	PVED-CLS is in safe state, fault code(s) on CAN bus
Green	PVED-CLS is in ‘off-road mode’ or ‘service mode’. Main spool in neutral position
Green, flashing	PVED-CLS is in ‘off-road mode’ or ‘service mode’. Main spool in flow position range
Red	PVED-CLS is in safe state due to internal synchronization fault, lost CAN address arbitration, unable to recover from bus-off state. No fault codes on CAN bus

Figure 59

Ignition Switch

The instrument panel mounted ignition (key) switch has three (3) positions (OFF, ON/PREHEAT and START). The ignition switch START circuit 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 determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

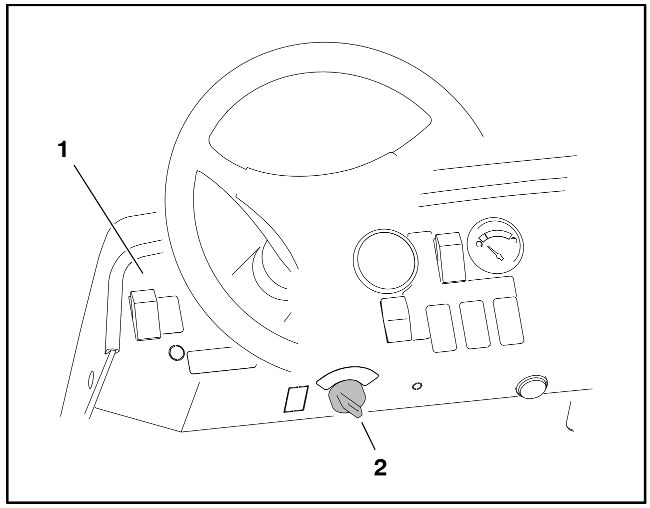


Figure 61

1. **Instrument panel** 2. **Ignition switch**

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

2. Locate the switch to be tested and disconnect wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine wh ether continuity exists between the various terminals for each switch position. The ignition switch terminals are marked as shown (Fig, 62) and the circuitry of this switch is shown in the chart (Fig. 60). Verify continuity between switch terminals.

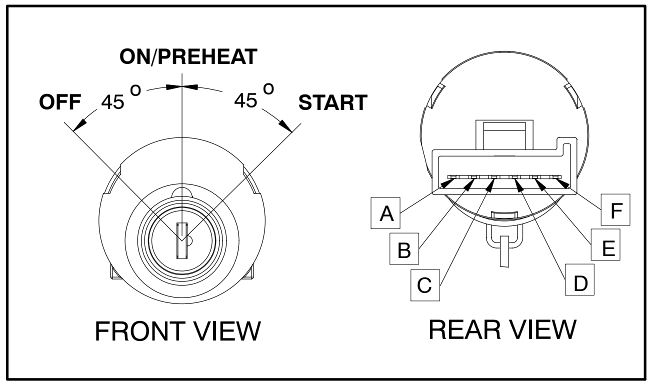


Figure 62

POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	NONE	ALL
ON/PREHEAT	B + C + F, D + E	A
START	A + B + C	D + E + F

Figure 60

4. Replace ignition switch if necessary.

5. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematic and Circuit Drawings in Appendix A – Foldout Drawings).

6. When testing is complete, connect wire harness electrical connector to the ignition switch.

Indicator Lights (Diesel Engines Only)

High Temperature Warning Light

If the engine coolant temperature rises to 216 to 226 F (102 to 108 C). the high temperature light should come on when the normally open temperature sender closes.

To test the high temperature warning light and circuit wiring, ground the blue wire attached to temperature sender located on water pump housing (see Temperature Sender in this section). Turn ignition switch to the ON position; the high temperature warning light should illuminate.

Glow Plug Indicator Light

The glow plug light should come on when the ignition switch is placed in the ON position prior to placing the ignition switch in START. The light should stay lit for approximately six (6) seconds while the ignition switch is left in the ON position.

Engine Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running if the engine oil pressure drops below 7 PSI (0.5 kg/cm^2).

To test the oil pressure light and circuit wiring, ground the brown wire attached to oil pressure switch located on the front side of engine near the oil dipstick. Turn ignition switch to the ON position; the oil pressure light should come on indicating correct operation of the electrical wiring to the oil pressure switch.

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the ON position with the engine not running or when the charging circuit output is approximately 1.5V less then the battery charge state while the engine is running.

Testing Indicator Lights

1. Apply 12 VDC to terminals 1A and 2A (Fig. 64).

2. Ground terminals 1B and 2B (Fig. 64).

3. Both indicator lights should illuminate.

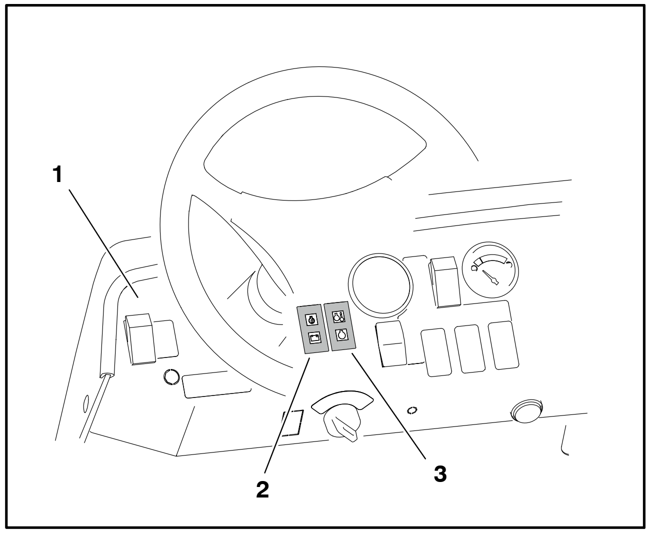


Figure 63

1. **Instrument panel**
2. **Engine oil pressure/ Charge indicator**
3. **High temp warning/Glow plug indicator**

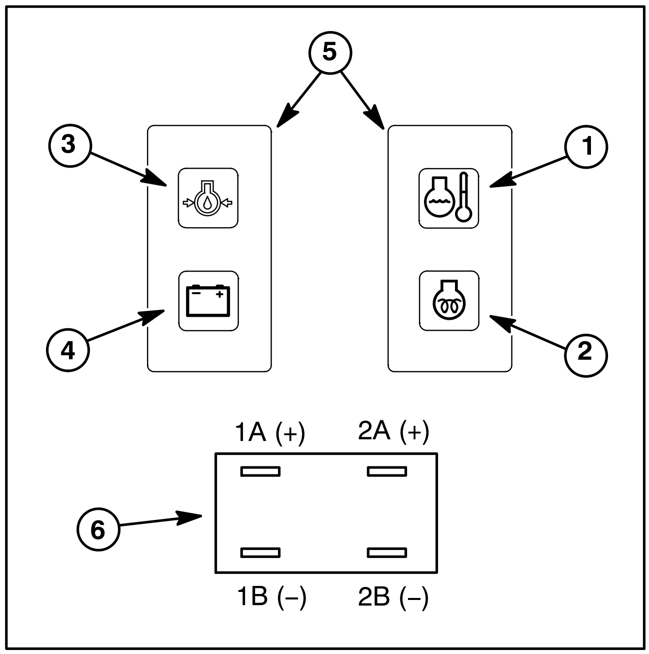


Figure 64

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

Headlight Switch (Standard)

The headlight switch is located on the left side of the instrument panel (Fig. 65) and is used to turn the headlights on and off. Machines with an optional homologation (road light) kit installed use a three (3) position headlight switch (see Homologation Kit Headlight Switch in this chapter)

Testing

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

2. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 66) and the circuitry of the headlight switch is shown in the chart (Fig. 67). Verify continuity between switch terminals.

4. Replace switch if necessary.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch after testing is complete.

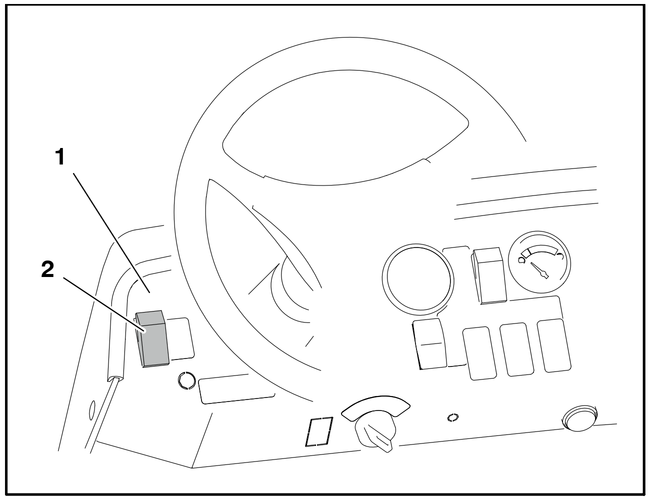


Figure 65

1. Instrument panel   2. Headlight switch

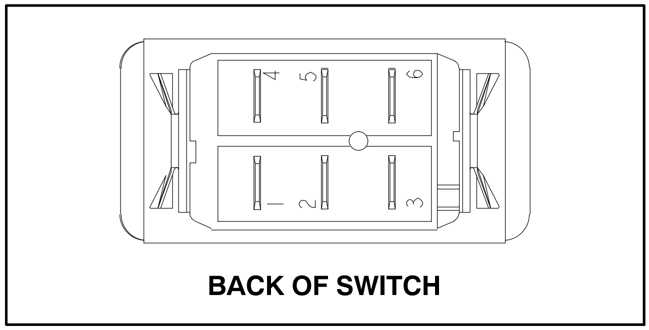


Figure 66

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	2 + 3, 5 + 6
ON	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 67

NOTE: Headlight switch terminals 1, 4, 5 and 6 are not used on Multi Pro 5800 machines.

Spray−Mode Switch (ExcelaRate Spray Systems Only)

The spray−mode switch is located on the right side of the instrument panel (Fig. 69) and is used to select between Auto and Manual spray mode control.

Testing

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

2. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 70) and the circuitry of the spray−mode switch is shown in the chart (Fig. 68). Verify continuity between switch terminals.

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
AUTO	2 + 1, 5 + 4	2 + 3, 5 + 6
MANUAL	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 68

4. Replace switch if necessary.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch after testing is complete.

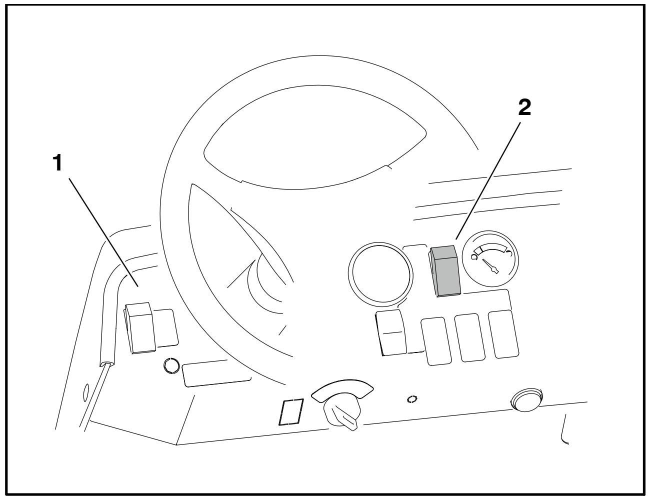


Figure 69

1. Instrument panel 2. Spray−mode switch

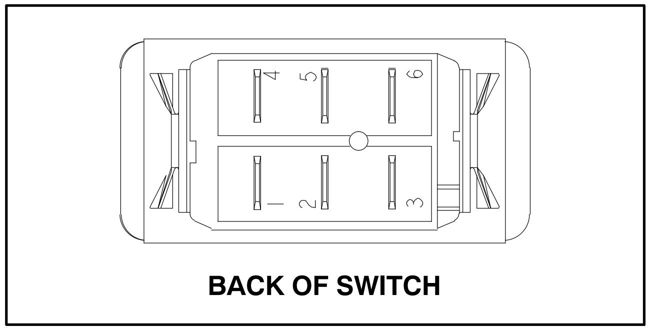


Figure 70

NOTE: Spray−mode switch terminals 1, 4, 5 and 6 are not used on Multi Pro 5800 machines.

Application−Rate Switch (machines without GeoLink Spray System)

The application−rate (increase/decrease) switch is located on the instrument panel directly below the pressure gauge (Fig. 72). The application−rate switch is an input to the TEC. When all necessary spray control conditions are met, the TEC modifies the current applied to the spray pump control manifold solenoid valve using a PWM (pulse width modulation) signal. Pressing the switch to the increase position increases the frequency of the PWM signal to the valve coil which increases hydraulic flow to the spray pump motor. Moving the switch to the decrease position reduces the frequency of the PWM signal to the valve coil and results in less hydraulic flow to the spray pump.

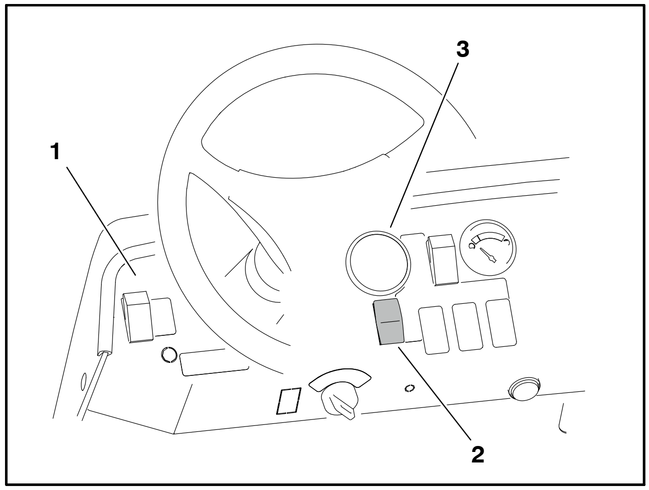


Figure 72

1. **Instrument panel**
2. **Application−rate switch**
3. **Pressure gauge**

Testing

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

2. Locate the switch to be tested ans disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 73) and the circuitry of the application−rate switch is shown in the chart (Fig. 71). Verify continuity between switch terminals.

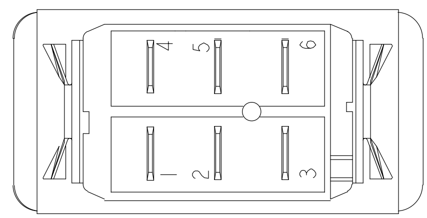
SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
INCREASE	2 + 3, 5 + 6	2 + 1, 5 + 4
OFF	NONE	ALL
DECREASE	2 + 1, 5 + 4	2 + 3, 5 + 6

Figure 71

4. Replace switch if necessary.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch after testing is complete.



BACK OF SWITCH

Figure 73

NOTE: Application−rate switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Road Switch (Optional AutoSteer)

The Road switch is located on the instrument panel directly below the pressure gauge (Fig. 74) and is used to manually enable and disable the AutoSteer function.

Testing

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

2. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 75) and the circuitry of the headlight switch is shown in the chart (Fig. 76). Verify continuity between switch terminals.

4. Replace switch if necessary.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch after testing is complete.

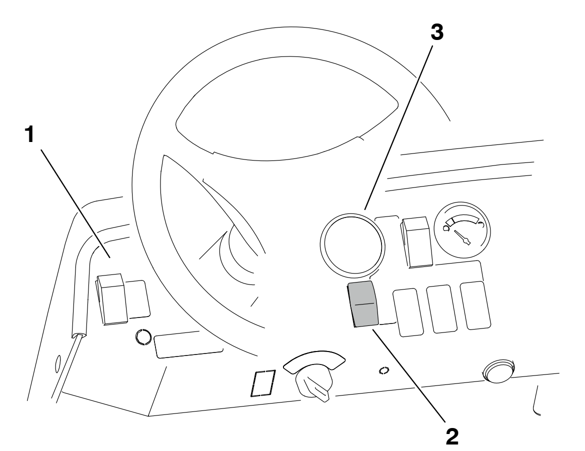
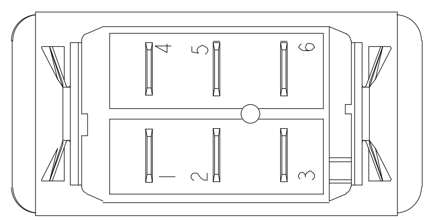


Figure 74

1. **Instrument panel**
2. **Road switch**
3. **Pressure gauge**



BACK OF SWITCH

Figure 75

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	2 + 3, 5 + 6
ON	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 76

NOTE: Road switch terminals 1, 4, 5 and 6 are not used on Multi Pro 5800 machines.

Speed−Lock Switch

The speed−lock switch is located on the console assembly (Fig. 78). This switch energizes the speed lock coil to allow the operator to maintain a constant ground speed. The switch includes a light that should illuminate when the switch is in the ON position.

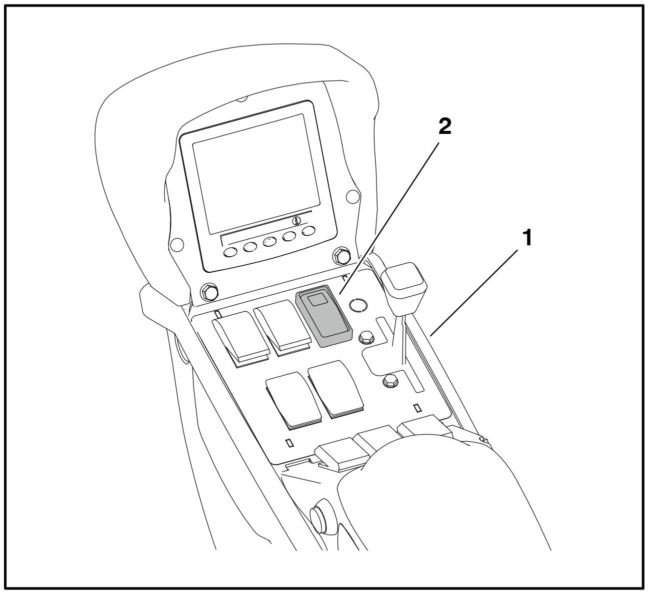


Figure 78

1. Console assembly 2. Speed lock switch

Testing

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

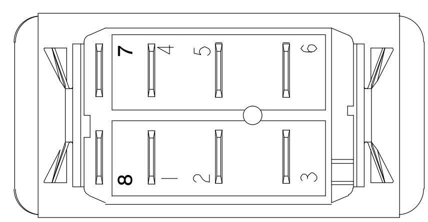
2. Remove RH console cover to gain access to speed lock switch (see Console Assembly in the Service and Repairs section of Chapter 9 − Chassis in this manual).

3. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 79) and the circuitry of the speed−lock switch is shown in the chart (Fig. 77). Verify continuity between switch terminals.

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	ALL
ON	2 + 3	2 +1, 5 + 4, 5 + 6
SET	2 + 3, 5 + 6	2 +1, 5 + 4

Figure 77



BACK OF SWITCH

Figure 79

5. Terminals 7 (−) and 8 (+) are used for the indicator light in the switch. The light should be illuminated when the speed−lock is energized (holding the traction pedal stationary).

6. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (−). The light should illuminate.

7. Replace switch if necessary.

8. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

9. Connect the wire harness connector to the switch after testing is complete.

10. Secure RH console cover to machine (see Console Assembly in the Service and Repairs section of Chapter 9 − Chassis).

NOTE: Speed−lock switch terminals1 and 4 are not used on Multi Pro 5800 machines.

Boom Lift Switches

The two (2) boom lift switches are used to raise or lower the spray booms. When the right side boom switch is pressed, solenoid valve S3 in the lift manifold is energized to allow hydraulic flow to the right side boom lift cylinder. When the left side boom switch is pressed, solenoid valve S2 in the lift manifold is energized to allow hydraulic flow to the left side boom lift cylinder. In each case, the upper solenoid valve coil is energized to raise the boom and the lower solenoid valve coil is energized to lower the boom. These switches are located on the console assembly (Fig. 81).

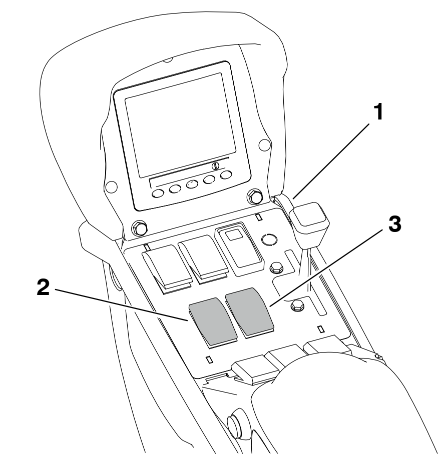


Figure 81

1. **Console assembly**
2. **Right boom lift switch**
3. **Left boom lift switch**

Testing

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

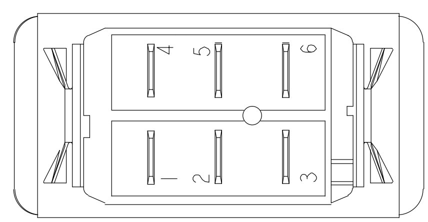
2. Remove console cover(s) to gain access to switch to be tested (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 82) and the circuitry of the boom lift switches is shown in the chart (Fig. 80). Verify continuity between switch terminals.

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
RAISE	2 + 1, 5 + 4	2 + 3, 5 + 6
OFF	NONE	ALL
LOWER	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 80



BACK OF SWITCH

Figure 82

5. Replace switch if necessary.

6. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A in this manual).

7. Connect the wire harness connector to the switch after testing is complete.

8. Install control console covers (see Console Assembly in Chapter 9 – Chassis in this manual).

NOTE: Boom lift switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Spray Pump Enable and Agitation Switches

The spray pump enable (on/off) and agitation (on/off) switches are located on the control console (Fig. 84). Both switches are inputs to the TEC. The switch includes a light that should illuminate when the switch is in the ON position.

Testing

The spray pump enable and agitation switches and their circuit wiring can be tested as TEC inputs or qualifiers 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 engine and engage parking brake. Remove key from ignition switch.

2. Remove console cover(s) to gain access to switch to be tested (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Locate the switch and disconnect the wire harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 85) and the circuitry of the spray pump enable and agitation switches is shown in the chart (Fig. 83). Verify continuity between switch terminals.

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	2 + 3, 5 + 6
ON	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 83

5. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (–). The light should illuminate.

6. Replace switch if necessary.

7. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A in this manual).

8. Connect the wire harness connector to the switch after testing.

9. Install console covers (see Console Assembly in Chapter 9 – Chassis of this manual).

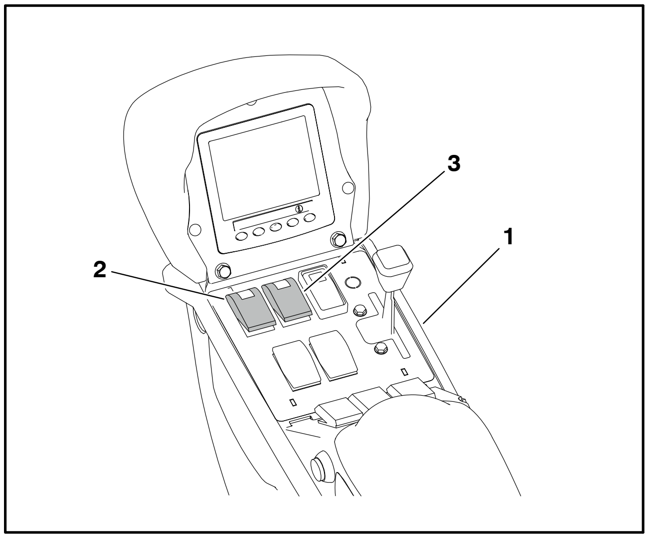


Figure 84

1. **Console assembly**
2. **Pump switch**
3. **Agitation switch**

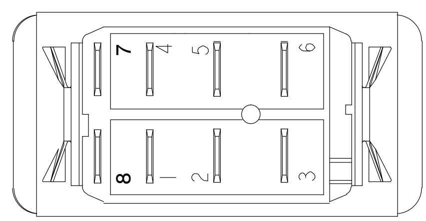


Figure 85

NOTE: Spray pump enable and agitation switch terminals 1 and 4 are not used on Multi Pro 5800 machines.

Master Boom (Spray Enable) Switch

The master boom switch is a momentary push button switch. The switch is an input to the TEC. The master boom switch controls the operation (on/off) of all the boom spray valves simultaneously. The master boom switch is located on the side of the control console (Fig. 86).

Testing

The master boom (spray enable 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 engine and engage parking brake. Remove key from ignition switch.

2. Remove console cover(s) to gain access to switch to be tested (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Locate the switch and disconnect the wire harness electrical connector from the switch.

4. 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.

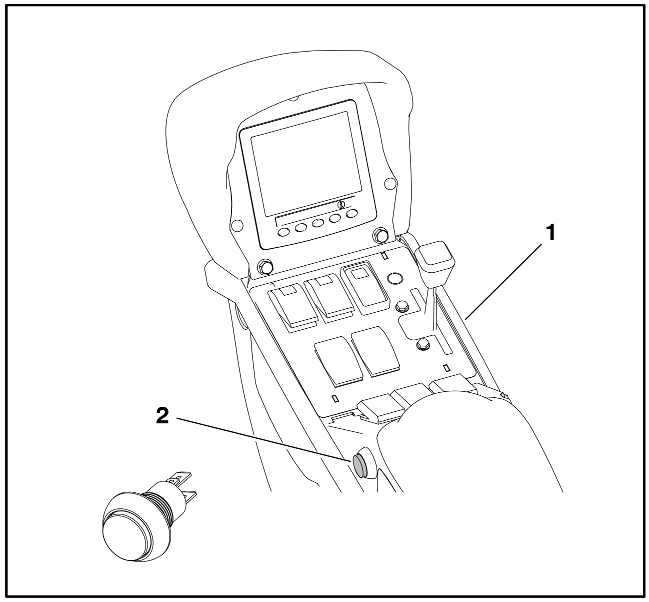


Figure 86

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

5. Replace master boom switch if testing determines that it is faulty.

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

7. Connect the wire harness connector to the switch after testing.

8. Install console covers (see Console Assembly in Chapter 9 – Chassis of this manual).

Remote Engage Switch (Optional AutoSteer)

The remote engage switch is a momentary push button switch. The remote engage switch is located on the side of the control console (Fig. 87).

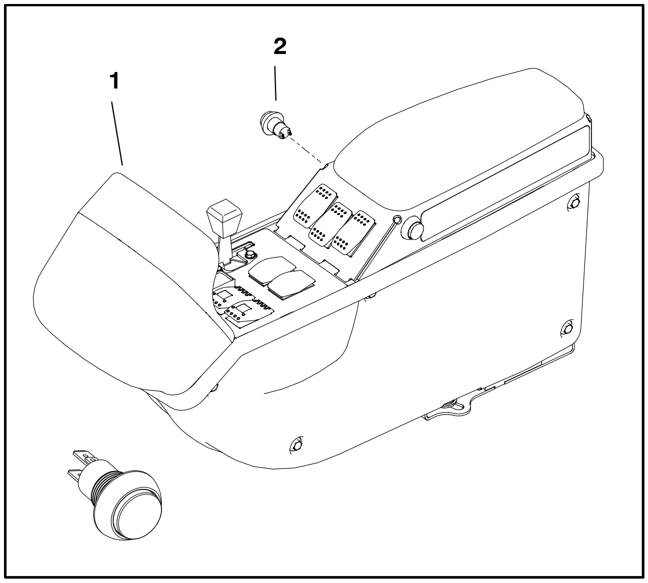


Figure 87

1. **Control console**
2. **Remote engage switch**

Testing

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

2. Remove console cover(s) to gain access to switch to be tested (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Locate the switch and disconnect the wire harness electrical connector from the switch.

4. 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.

5. Replace the remote enable switch if testing determines that it is faulty.

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

7. Connect the wire harness connector to the switch after testing.

8. Install console covers (see Console Assembly in Chapter 9 – Chassis of this manual).

Boom Control Switches

Three (3) identical boom control switches are used on the Multi Pro 5800 to turn the spray valve for the individual boom sections on or off. The boom control switches are inputs to the TEC. The boom switches are located on the control console (Fig. 89).

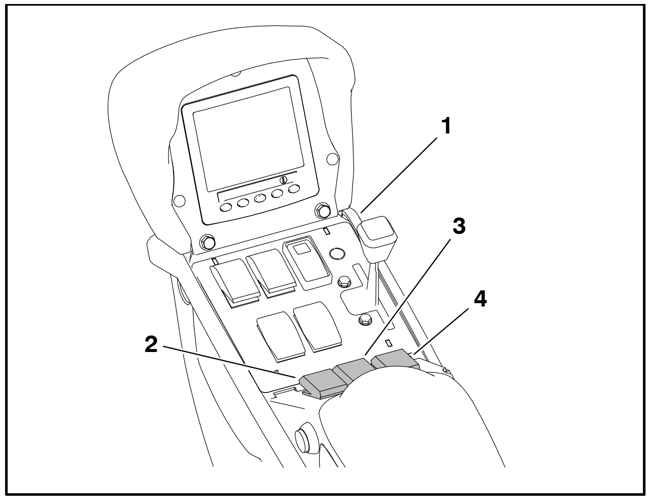


Figure 89

1. **Control console**
2. **Left side boom switch**
3. **Center boom switch**
4. **Right side boom switch**

With the ignition switch in the START or RUN position, a continuous supply of voltage is applied to the Close signal wire of the spray valve actuators, closing the boom spray valves. When the master boom switch is set to the ON position, a boom control switch is set to the ON position and all spray system conditions are met, the TEC supplies voltage to the Open signal wire of the boom spray valve actuator to open the boom spray valve.

Testing

The boom control switches and their circuit wiring can be tested as TEC inputs or qualifiers 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 engine and engage parking brake. Remove key from ignition switch.

2. Remove console cover(s) to gain access to switch to be tested (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 66) and the circuitry of the switch is shown in the chart (Fig. 88). Verify continuity between switch terminals.

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	2 + 3, 5 + 6
ON	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 88

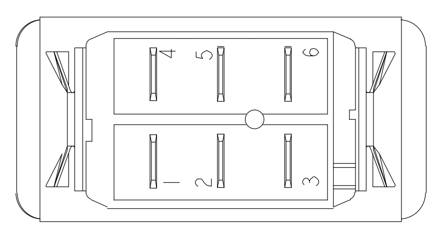


Figure 90

5. Replace switch if necessary.

6. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A in this manual).

7. Connect the wire harness connector to the switch after testing is complete.

8. Install control console covers (see Console Assembly in Chapter 9 – Chassis in this manual).

NOTE: Boom control switch terminals 1, 4, 5 and 6 are not used on Multi Pro 5800 machines.

Speed Lock Coil

The speed lock coil is energized by the speed lock switch on the console. The energized coil becomes an electromagnet and holds the traction pedal in position to maintain ground speed for accurate sprayer operation. The speed lock coil is located below the floorboard to the right of the traction pedal (Fig. 91).

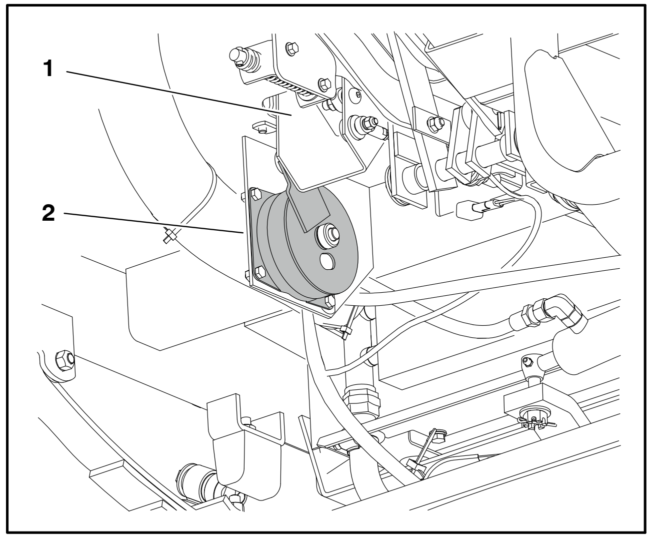


Figure 91

1. **Traction pedal**
2. **Speed lock coil**

Testing

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

2. Locate the speed lock coil and disconnect the wire harness electrical connector from the coil.

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

3. Using a multimeter (ohms setting), verify control coil resistance between the coil terminal and the frame of the coil. Resistance should be from 3.6 to 4.0 ohms.

4. If coil resistance is incorrect, replace speed lock coil.

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

6. After coil testing is complete, connect the coil connector to the machine harness.

Brake Pedal Switch

The brake pedal switch is a mechanical plunder switch used to monitor brake pedal movement. The switch has a normally open set of contacts and a normally closed set of contacts. The brake pedal switch is mounted to the frame under the floorboard and is actuated by an adjustable strike plate attached to the brake lever (Fig. 93). See Brake Pedal Switch in the Adjustments section of this chapter for additional information. The machine will not start if the operator seat is unoccupied and the parking brake is not engaged.

The normally closed contacts are open while the brake pedal is at rest and close when the brake is applied. The normally closed contacts are used as an input to the TEC. The normally open set of contacts are closed while the pedal is at rest and open when the brake is applied. The normally open contacts are used to create a holding circuit for the speed lock system.

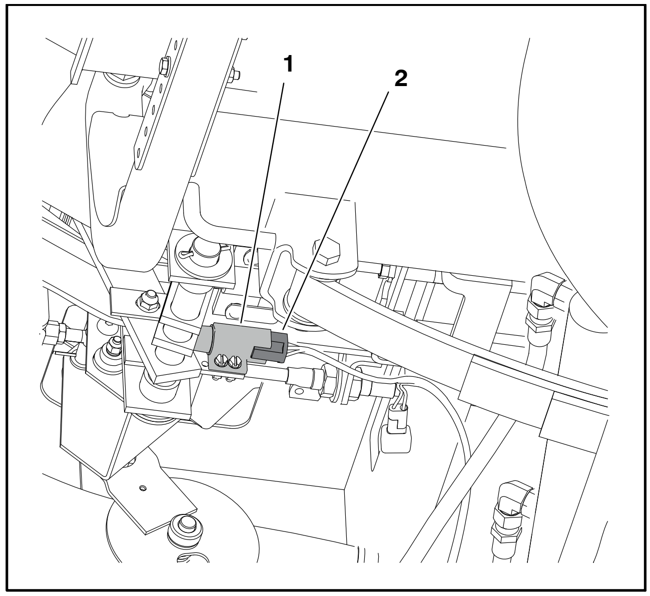


Figure 93

1. **Brake pedal switch**
2. **Wire harness connector**

Testing

The brake pedal 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 engine and engage parking brake. Remove key from ignition switch.

2. Locate the brake pedal switch and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 94) and the circuitry of the spray pump enable and agitation switches is shown in the chart (Fig. 92). Verify continuity between switch terminals.

BRAKE PEDAL POSITION	NORMALLY CLOSED TERMINALS	NORMALLY OPEN TERMINALS
AT REST	OPEN	CLOSED
APPLIED	CLOSED	OPEN

Figure 92

4. Replace switch if necessary.

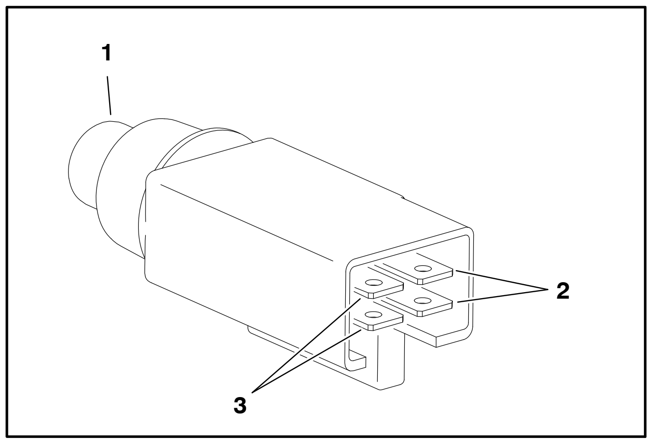


Figure 94

1. **Switch plunger**
2. **Normally closed switch terminals**
3. **Normally open switch terminals**

5. If the brake pedal switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Appendix A in this manual).

6. Connect the wire harness connector to the switch after testing is complete.

Relays with Four (4) Terminals

The Multi Pro 5800 uses a number of electrical relays that have four (4) terminals. The relays is located under the operator seat next to the fuse blocks (Fig. 95). The relays can be identified by a tag near the relay wire harness connector.

All Multi Pro 5800 machines use a four (4) terminal main power relay to provide current to most of the fuse protected circuits (TEC, InfoCenter display, spray system components, speed lock, power point, headlights and optional electric equipment). The power relay is energized when the ignition switch is in the RUN or START position.

Machines with diesel engines use a four (4) terminal glow relay to provide current to the engine glow plugs. The glow relay is energized by the Kubota glow plug controller for approximately six (6) seconds when the ignition switch is placed in the RUN/PREHEAT position and while the ignition switch is held in the START position.

If the machine is equipped with an optional clean tank rinse kit, an additional four (4) terminal relay is added to the electrical system. The rinse pump relay is energized by the TEC when the rinse pump switch is pressed.

If the machine is equipped with an optional 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 motor switch is pressed. The hose reel relay is located in the hose reel control box (not shown).

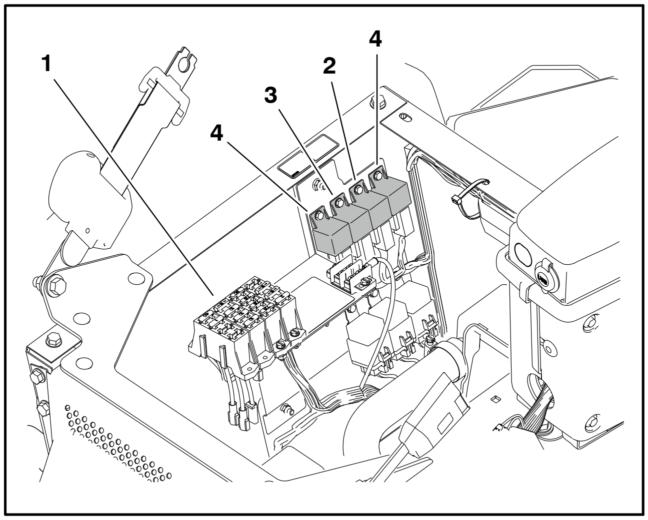


Figure 95

1. **Fuse blocks**
2. **Main power relay**
3. **Glow relay (diesel engines only)**
4. **Optional kit relays**

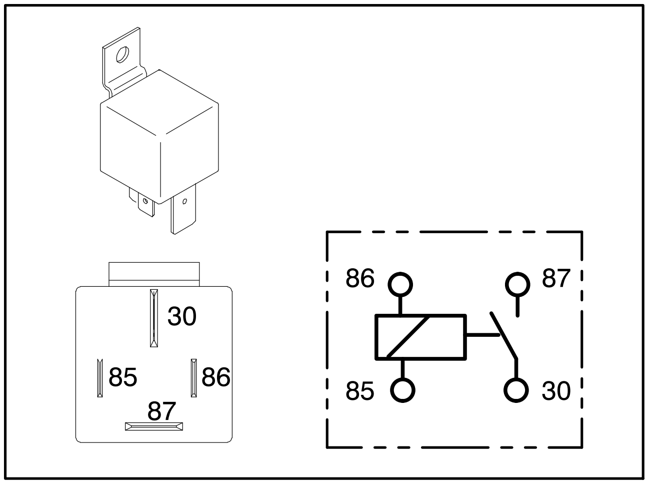


Figure 96

Testing

1. Park machine on a level surface, stop 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. 96).

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

4. 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. Replace relay if testing determines that the relay is faulty.

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

8. Install relay and connect to wire harness.

9. Lower and secure operator seat.

Relays with Five (5) Terminals

The Multi Pro 5800 uses a number of electrical relays that have five (5) terminals. The relays is located under the operator seat next to the fuse blocks (Fig. 97). The relays can be identified by a tag near the relay wire harness connector.

All Multi Pro 5800 machines use a five (5) terminal speed lock relay to provide current to the speed lock coil. The speed lock coil is energized when the speed lock switch is moved to the SET position. The relay remains energized until the brake pedal is depressed or the speed lock switch is set to the OFF position.

Machines with diesel engines use a five (5) terminal start relay to provide current to the engine starter motor solenoid. The start relay is energized by the Toro Electronic Controller (TEC).

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 the ON position.

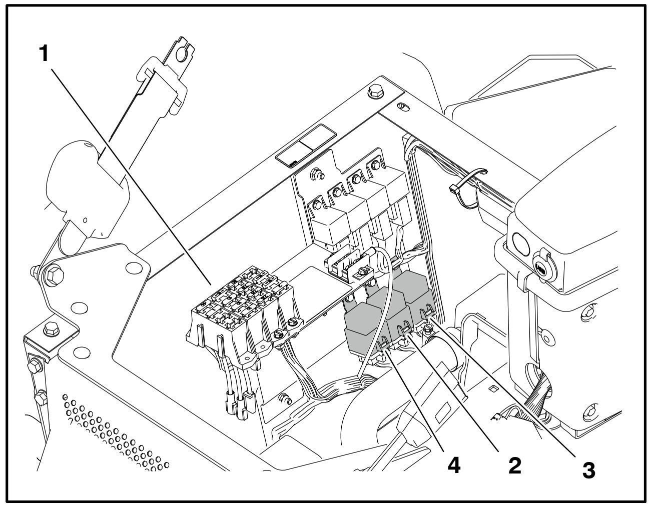


Figure 97

1. Fuse blocks
2. Speed lock relay
3. Start relay (diesel engines only)
4. Optional kit relay

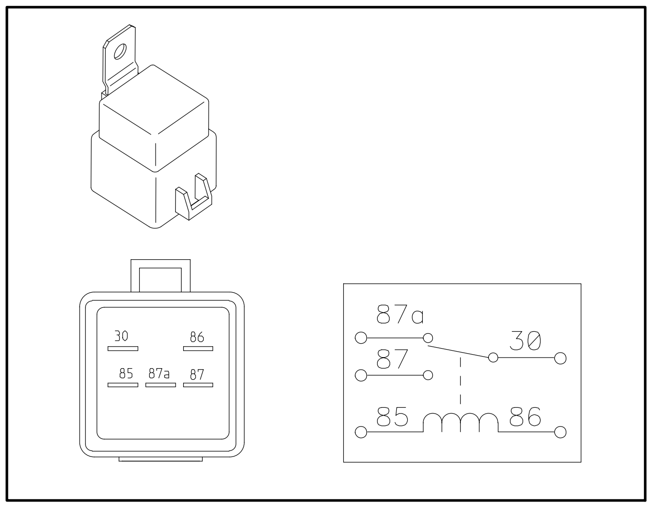


Figure 98

Testing

1. Park machine on a level surface, 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. 98).

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

4. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.

5. Test normally open terminal by connecting 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. Test normally closed terminal by connecting 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.

7. Replace relay if testing determines that the relay is faulty.

8. If the relay tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Appendix A in this manual).

9. Install relay and connect to wire harness.

10. Lower and secure operator seat.

Engine Relays (Gasoline Engines Only)

The engine electrical system in Multi Pro 5800 machines with gasoline engines includes three (3) electrical relays that have five (5) terminals. These relays are located in the engine power center located on top of the engine near the hydraulic pump adapter (Fig. 100).

The start relay is used to provide current to the engine starter solenoid. The start relay is energized by the engine ECU.

The power relay is used to provide electrical power to engine ignition coils, injectors, and oxygen (O2) sensors. The power relay is energized by the engine ECU.

The fuel pump relay is used to provide electrical power to the fuel pump. The fuel pump relay is energized by the engine ECU.

NOTE: An engine fault code may be displayed on the InfoCenter Display if the start relay, power relay or fuel pump relay or circuit wiring is faulty (see Engine Faults in this chapter for additional information).

Relay Testing

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

2. Remove engine shroud (attached to back of seat base) to access engine power center. Remove engine power center cover and remove suspect relay for testing.

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

3. Using a multimeter (ohms setting), measure coil resistance between terminals 85 and 86 (Fig. 101 or 102). Resistance should be as listed in table below (Fig. 99).

Relay	Coil Resistance
Start	81 to 99 ohms
Power or Fuel Pump	111 to 135 ohms

Figure 99

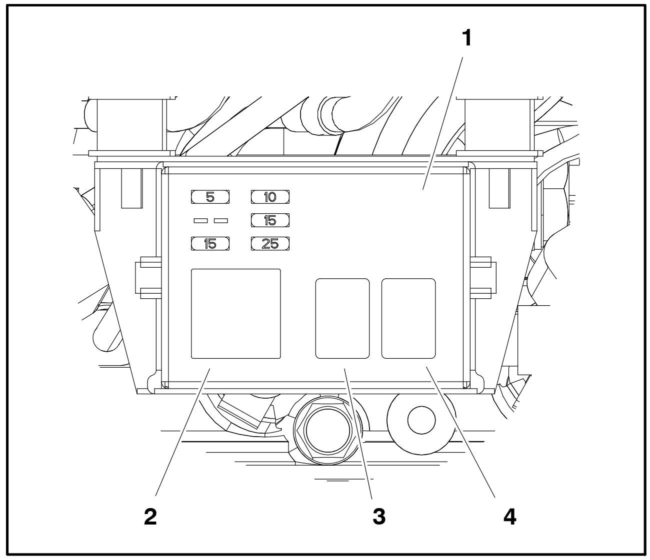


Figure 100

1. **Engine power center**
2. **Start relay**
3. **Power relay**
4. **Fuel pump relay**

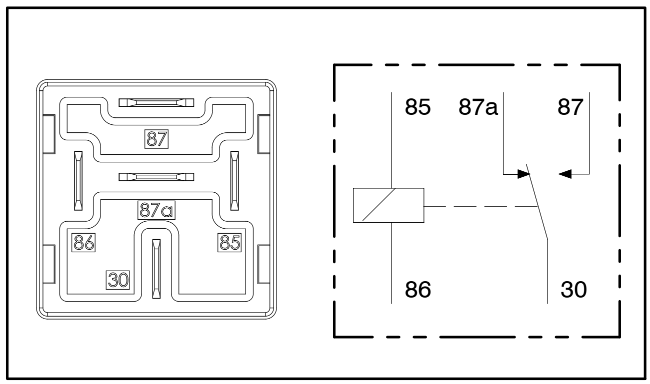


Figure 101

START RELAY

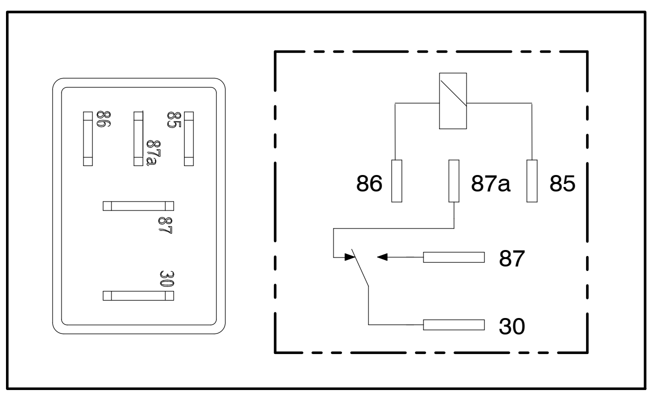


Figure 102

POWER AND FUEL PUMP RELAY

4. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should have continuity between terminals 30 and 87 as +12 VDC is applied to terminal 85. The relay should not have continuity between terminals 30 and 87 as +12 VDC is removed from terminal 85.

5. Connect multimeter (ohms setting) leads to relay terminals 30 and 87A. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should not have continuity between terminals 30 and 87A as +12 VDC is applied to terminal 85. The relay should have continuity between terminals 30 and 87A as +12 VDC is removed from terminal 85.

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

7. If the relay tests correctly and a circuit problem still exists, check wire harness (see Kubota WG1605−E3 Workshop Manual at the end of this chapter).

8. Install relay into power center, install power center cover and engine shroud when relay testing is complete.

Traction Speed Sensor

The traction speed sensor is attached to the right side rear wheel motor (Fig. 103). The sensor provides ground speed information to the InfoCenter display. Information from the ground speed sensor is used by the various spray control systems to control application rate. The sensor uses a magnetically based, Hall Effect integrated circuit. As the piston group in the wheel motor turns, the sensor accurately senses the movement of the pistons passing the sensor. The relationship of the sensor to the rotating piston group is critical as the sensor is designed to read movement in one direction and must be perpendicular to the piston group within three (3) degrees. The sensor red connector wire (pin A) is the positive lead, the black wire (pin C) is the ground lead and the white wire (pin B) is the signal output.

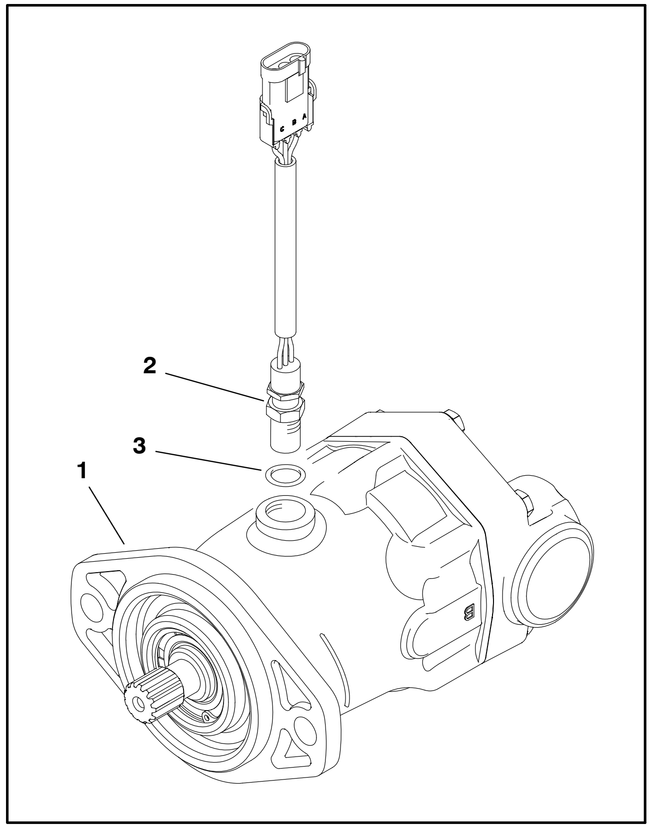


Figure 103

1. RH wheel motor
2. Speed sensor
3. O−ring

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. 104A). 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. 104B).

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.

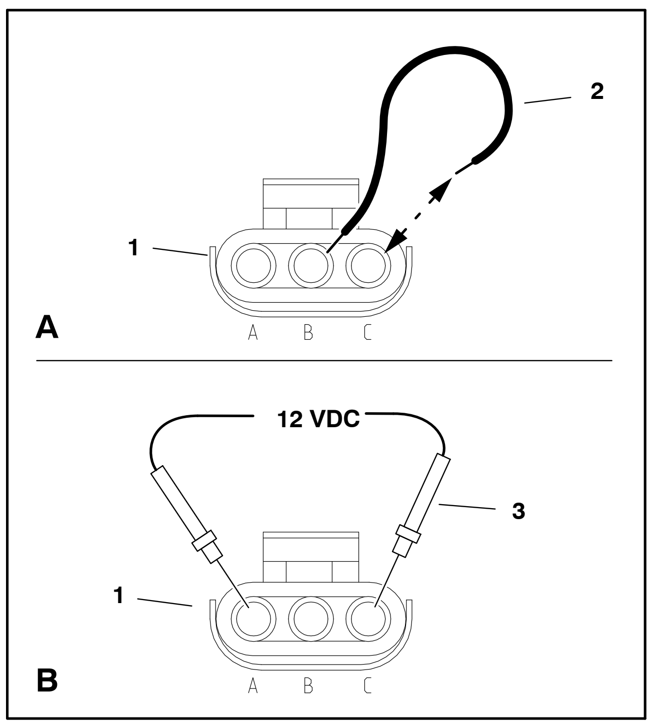


Figure 104

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

Steering Position Sensor (Optional AutoSteer)

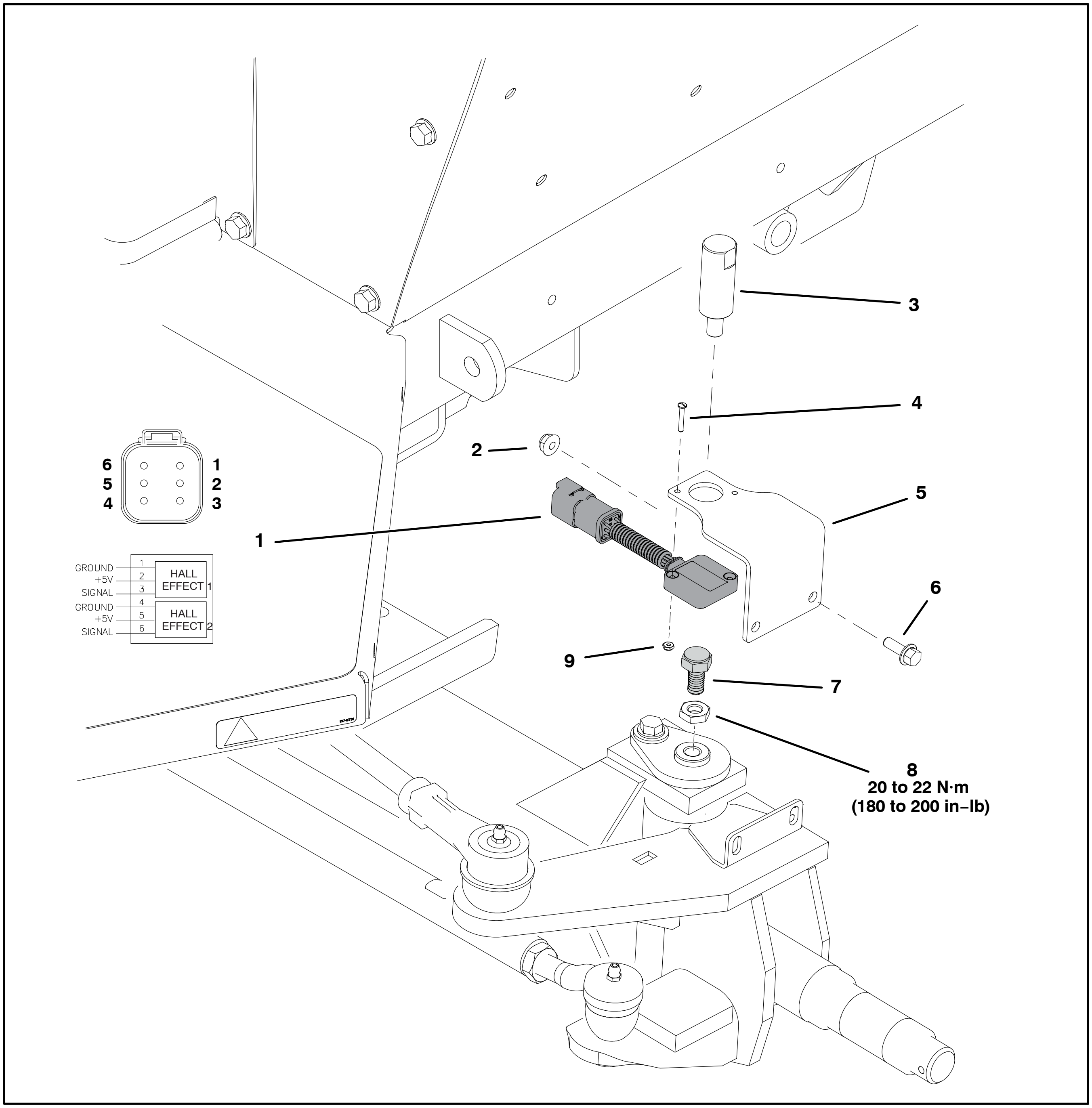


Figure 105

1. **Steering position sensor, sensor body**
2. **Flange nut (2)**
3. **Bracket alignment tool**
4. **Screw (2)**
5. **Sensor bracket**
6. **Flange head screw (2)**
7. **Steering position sensor, magnetic bolt**
8. **Jam nut**
9. **Hex nut (2)**

The steering position sensor is a two–piece assembly located on top of the front left king pin. The sensor portion includes 2 analog hall effect sensors. The second piece of the assembly is a bolt with a magnetic head threaded into the king pin. The steering position sensor follows the left front wheel steering movement. The steering position sensor is also referred to as the Wheel Angle Sensor (WAS).

Note: If a the steering position sensor is removed for any reason, the steering system must be calibrated; refer to Calibrating the AutoSteer Steering SystemComponents in Chapter 8 – GeoLink Spray System in this manual.

The sensor operates on 5VDC supplied by the PVED−CLS controller of the EHi steering valve. Signal voltage from the steering position sensor (along with GeoLink guidance information) is used by the PVED−CLS controller to determine the appropriate direction and current flow to operate the EHi steering valve. When the AutoSteer system is engaged, the steering position sensor signals are constantly monitored by the PVED−CLS for steering fault detection. If engaged, the AutoSteer system will disengage if a signal from the steering position is lost.

Testing

The steering position sensor and its circuit wiring can be tested using the GeoLink display; refer to Calibrating the AutoSteer Steering System in Chapter 8 – GeoLink Spray System in this manual. If it is determined that the sensor and circuit wiring are not functioning correctly, proceed with the following test procedure:

1. Check the steering position sensor adjustment and adjust as necessary; refer to Steering Position Sensor in the Adjustments section of this chapter.

2. Raise and support the front of the machine; refer to Jacking Instructions in Chapter 1 – Safety in this manual.

3. Ensure the front wheel assembly is able to move from full right stop to full left stop.

4. Disconnect the machine wire harness from the steering position sensor. Check the sensor and the harness connector for damage or corrosion and clean or repair as necessary.

5. Connect sensor connector pins 2 and 5 to a 5 VDC power supply, and connect pins 1 and 4 to ground.

6. Ensure that the front wheels are aligned straight ahead. Using a multimeter (DC voltage setting), 2.0 – 3.0 VDC should be present at both sensor connector pins 3 and 6.

7. Turn the front wheel fully to the left (counterclockwise). Using a multimeter (DC voltage setting), the voltage at sensor connector pin 3 should be higher than what was measured in step 6. and the voltage at sensor pin 6 should be lower than what was measured in step 6. The amount of voltage increase at pin 3 should be approximately the same as the amount of voltage decrease at pin 6.

8. Turn the front wheel fully to the right (clockwise). Using a multimeter (DC voltage setting), the voltage at sensor connector pin 3 should be lower than what was measured in step 6. and the voltage at sensor pin 6 should be higher than what was measured in step 6. The amount of voltage decrease at pin 3 should be approximately the same as the amount of voltage increase at pin 6.

9. Replace the steering position sensor if necessary. The sensor and the magnetic bolt are matched by the manufacturer and must be replaced as a set.

10. Adjust the steering position sensor; refer to Steering Position Sensor in the Adjustments section of this chapter.

11. If the steering position sensor tests correctly and a circuit problem still exists, check the machine wire harness; refer to Appendix A in this manual.

12. After testing, connect the machine wire harness and calibrate the steering system; refer to Calibrating the AutoSteer Steering System in Chapter 8 – GeoLink Spray System in this manual.

Hydraulic Valve Solenoid Coils

The Multi Pro 5800 hydraulic system uses several hydraulic solenoid valve coils for system control. The spray pump control manifold includes one (1) single coil solenoid valve (Fig. 106). The standard boom lift control manifold includes one (1) single coil solenoid valve and two (2) dual coil solenoid valves (Fig. 107). 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.

The boom lift control manifold for machines with an optional ultra sonic boom system includes two (2) single coil solenoid valves and two (2) dual coil solenoid valves. See Chapter 10 – Ultra Sonic Boom System in this manual for additional information.

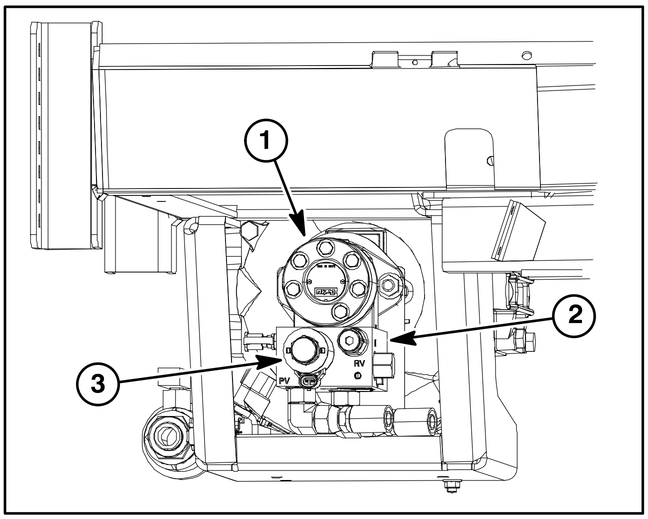


Figure 106

1. **Spray pump drive motor**
2. **Spray pump control manifold**
3. **Solenoid coil (PV)**

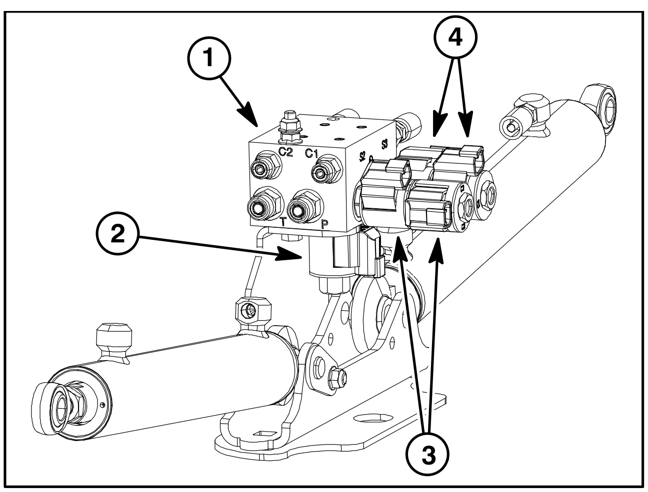


Figure 107

1. **Boom lift manifold**
2. **Solenoid coil (S1)**
3. **Solenoid coil (S2)**
4. **Solenoid coil (S3)**

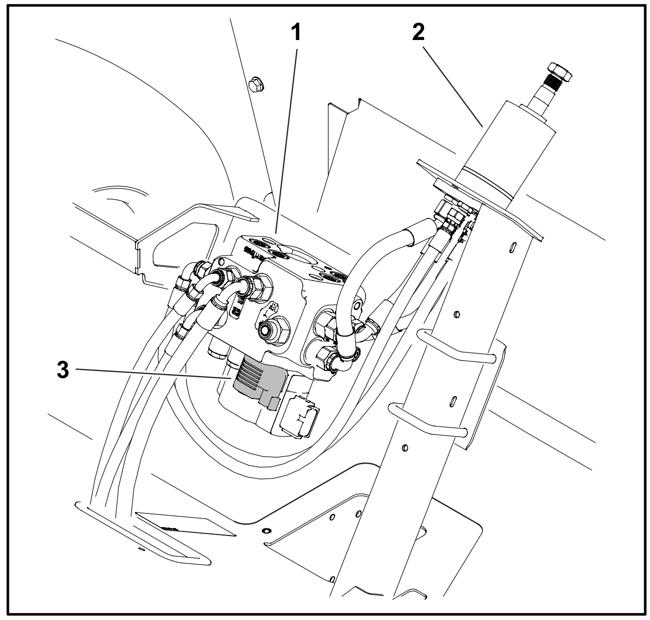


Figure 108

1. **EHi steering valve**
2. **Steering control valve**
3. **Solenoid coil**

The EHi steering valve for machines with an optional AutoSteer system includes a single coil solenoid valve (Fig. 108)

Testing

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

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 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 connector terminals on the solenoid valve coil. The resistance for the solenoid coils is identified below:

A. The resistance of the solenoid coil on the spray pump manifold should be 4.5 ohms.

B. The solenoid coils on the boom lift manifold are identical. Resistance of these coils should be 8.8 ohms.

C. The resistance of the solenoid coil on the EHi steering valve (optional AutoSteer system) should be 8.8 ohms.

NOTE: Because the 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.

4. If solenoid coil resistance is incorrect, replace coil (see Spray Pump Control Manifold Service or Boom Lift Control Manifold Service in the Service and Repairs section of Chapter 5 – Hydraulic System).

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

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

Neutral Switch

The neutral switch is located on the top side of the piston (traction) pump (Fig. 110). The switch is closed when the traction pedal is in the neutral position and opens when the pedal is depressed in either direction (forward or reverse). The neutral switch is an input to the TEC.

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 engine, apply parking brake and remove key from ignition switch.

2. Remove the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

3. Locate neutral switch and disconnect wire harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch function may be tested to determine whether continuity exists between the terminals for each position. The circuitry of the neutral switch is shown in the chart below. Slowly push the traction pedal in a forward and reverse direction while watching the multimeter. Allow the traction pedal to slowly return to the neutral position Verify continuity between switch terminals (Fig. 109).

TRACTION PEDAL POSITION	CIRCUITS
NEUTRAL	NONE
FORWARD	1 + 2
REVERSE	1 + 2

Figure 109

NOTE: For neutral switch disassembly, assembly and adjustment procedures, see the Eaton Model 72400 Servo Controlled Piston Pump Repair Information (manual servo control assembly) at the end of this chapter.

5. Replace switch if necessary.

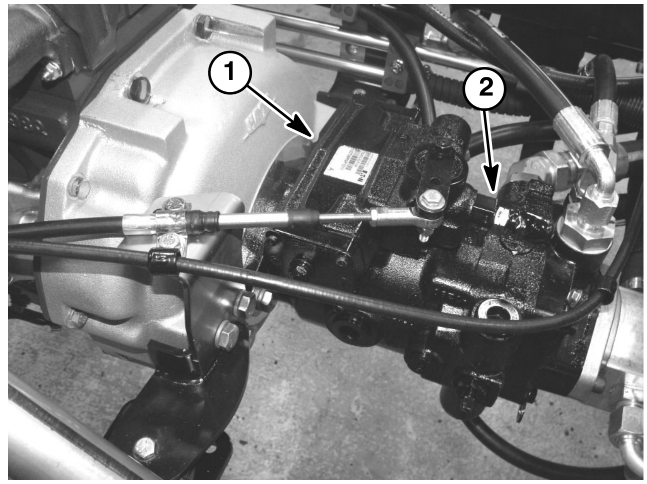


Figure 110

1. Piston (traction) pump **2. Neutral switch**

6. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A in this manual).

7. Connect the wire harness connector to the switch after testing.

8. Install the rear undercarriage shroud (see Undercarriage Shrouds in Chapter 9 – Chassis in this manual).

Fuel Run/Stop Solenoid (Diesel Engines Only)

The fuel stop solenoid must be energized for the engine to run. It is mounted to the injection pump on the engine (Fig. 111).

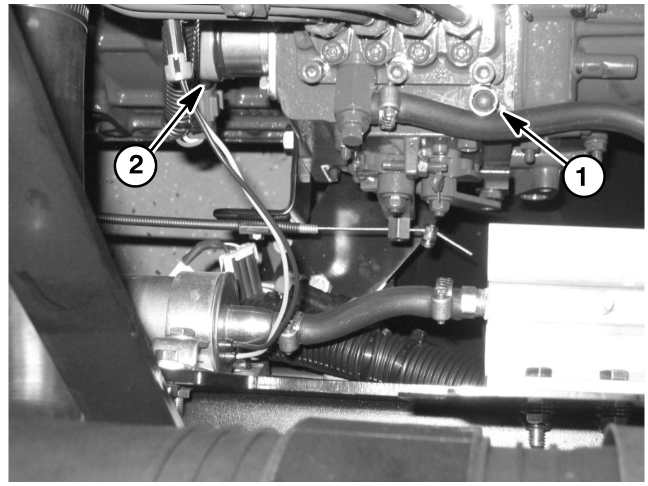


Figure 111

1. Injection pump
2. Fuel run/stop solenoid

In Place Testing

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

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

2. Disconnect wire harness connector from solenoid.

3. Using a digital multimeter, touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 112). The resistance of the pull coil should be less than 1 ohm (but not zero).

4. Using a digital multimeter, touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 112). The resistance of the hold coil should be approximately 15 ohms.

5. Connect harness wire connector to the solenoid.

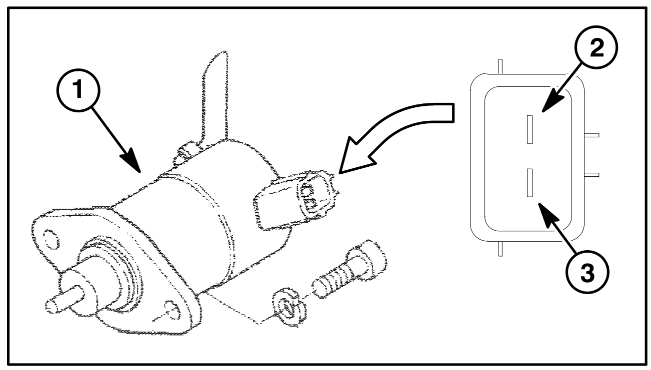


Figure 112

1. Fuel stop solenoid
2. Pull coil terminal
3. Hold coil terminal

Live Testing

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

2. Disconnect wire harness connector from solenoid and remove the solenoid from the engine.

3. Make sure that the solenoid plunger moves freely and is free of dirt, debris and corrosion.

4. Connect a positive (+) test lead from a 12 VDC source to the pull coil and hold coil terminals.

5. Touch a negative (–) test lead from the 12 VDC source to the fuel stop solenoid frame (ground) (Fig. 112). The solenoid should engage, making an audible "click," and the plunger should retract.

6. Remove positive (+) voltage from the pull coil terminal. The solenoid should stay engaged.

7. Remove positive (+) voltage from the hold coil terminal. The solenoid should release.

8. When testing is complete, install the solenoid to the engine and connect wire harness to the solenoid.

Glow Plug Controller (Diesel Engines Only)

The engine electrical system in Multi Pro 5800 machines with diesel engines includes a Kubota glow plug controller. The glow plug controller is energized by the TEC. The glow plug controller is attached to the front seat base panel under the operator seat (Fig. 113).

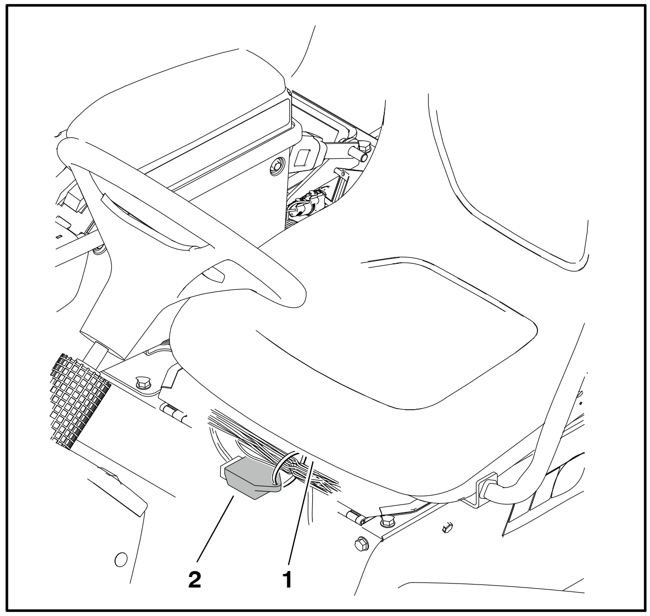


Figure 113

1. **Operator seat** 2. **Glow plug controller**

Controller Operation

1. When the ignition switch is placed in the RUN/PREHEAT position, the glow plug controller energizes the glow plugs and illuminates the glow plug indicator light for approximately six (6) seconds.

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

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

Testing

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

2. Raise the operator seat and disconnect wire harness connector from the fuel run/stop solenoid to prevent the engine from starting.

3. Make sure there is power from the battery at the ignition switch.

4. Place ignition switch in the RUN/PREHEAT position and verify the following conditions are present:

   A. Glow plug indicator light is illuminated.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow plug indicator light goes out and glow plugs de−energize after approximately six (6) seconds.

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

   A. Glow plug indicator light is out.

   B. Glow relay is energized.

   C. Glow plugs are energized.

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

NOTE: If there is no power to terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform Step 4 again (see Appendix A).

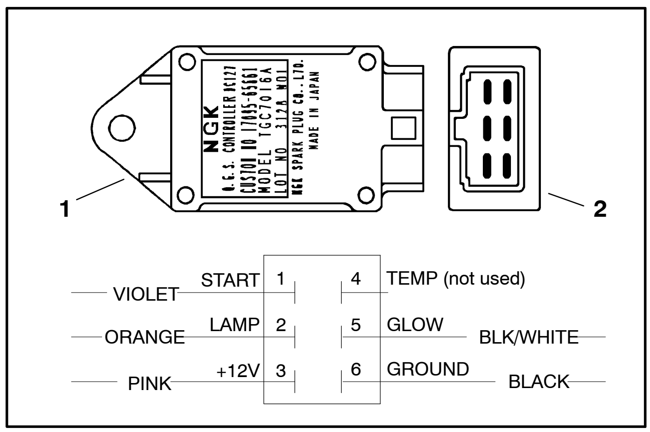


Figure 114

1. **Glow controller top view** 2. **Controller end view**

6. If any of the conditions in Step 3 are not met or power to terminal 1 exists and any of the other conditions in Step 4 are not met:

   A. Verify continuity of the circuitry from the battery to the glow relay and glow plugs (see Appendix A – Foldout Drawings).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow plug indicator light, glow relay and ground (see Appendix A – Foldout Drawings).

   C. Repair or replace components as necessary.

7. When testing is complete, connect wire harness connector to the fuel run/stop solenoid.

Fuel Pump (Gasoline Engines Only)

The electric fuel pump assembly used on Multi Pro 5800 machines with a gasoline engine is a combination positive displacement fuel pump and a fuel level sender. The fuel pump assembly provides pressurized fuel to the engine fuel rail in a return−less system and includes a regulator to maintain fuel pressure of approximately 40 PSI (276 kPa). The fuel pump/level sender assembly is attached to the top of the fuel tank (Fig. 115).

Electrical power for the fuel pump portion of the assembly is available when the fuel pump relay is energized by the engine ECU. The fuel pump electrical circuit is protected by a 15 Amp fuse. Both the fuel pump relay and 15A fuse are located in the engine power center.

When the ignition switch is turned to RUN, the engine ECU energizes the fuel pump relay for approximately three (3) seconds which allows the fuel system to be pressurized. Once the engine is running, the fuel pump relay is always energized.

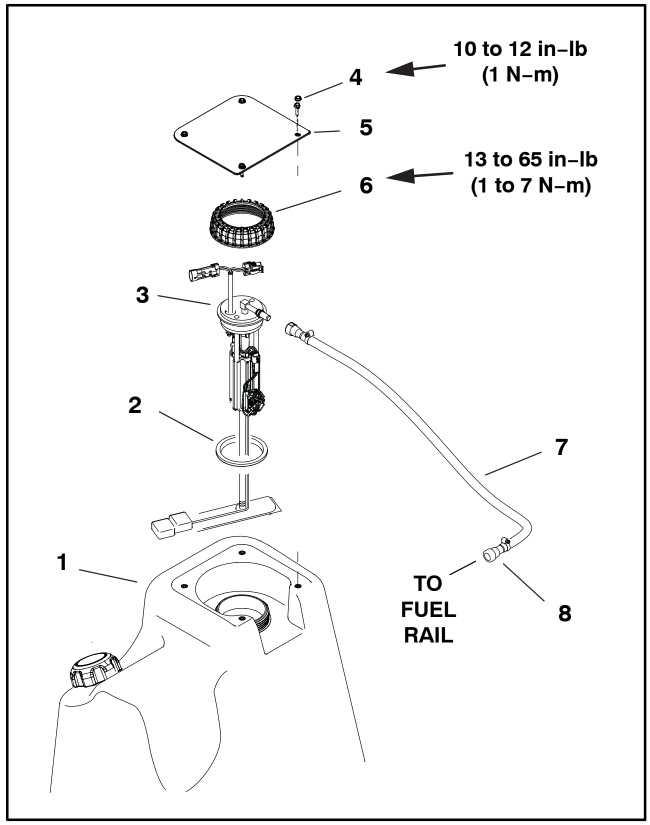


Figure 115

1. **Fuel tank**
2. **Gasket**
3. **Fuel pump/level sender**
4. **Flange head screw (4)**
5. **Tank cover**
6. **Cap**
7. **Fuel supply hose**
8. **Barb fitting**

Testing

NOTE: For information on testing the level sender portion of the fuel pump/level sender assembly, see Fuel Sender (Gasoline Engines Only) in this chapter.

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

2. Remove engine shroud (attached to back of seat base) to access fuel supply hose at engine.

CAUTION

The fuel supply hose will contain pressurized fuel. Be careful when disconnecting fuel supply hose. Always wipe up any spilled fuel before starting the engine.

3. Disconnect the fuel supply hose from the engine fuel rail.

   A. Lift supply hose barb fitting lock up to unlock fitting (Fig. 116).

   B. Press barb fitting tab and pull fitting from fuel rail.

4. Install a fuel pressure gauge capable of measuring 50 PSI (350 kPa) to the disconnected hose.

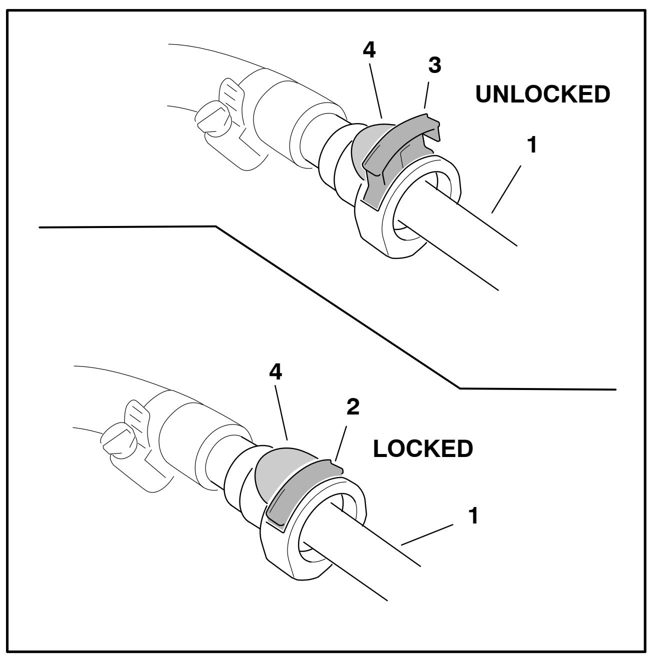


Figure 116

1. **Engine fuel rail**
2. **Barb fitting lock (down)**
3. **Barb fitting lock (up)**
4. **Barb fitting tab**

5. While monitoring pressure gauge, turn ignition switch to RUN/PREHEAT (do not start engine) so that fuel pump relay and fuel pump are energized. The fuel pressure displayed on the gauge should rise. After pump relay is de−energized (approximately 3 seconds), turn ignition switch to OFF and then back to RUN/PREHEAT (do not start engine) to re−energize the fuel pump relay and fuel pump. Fuel pump pressure should be approximately **40 PSI (276 kPa)**.

6. If fuel pump pressure is low, make sure that electrical power is available to fuel pump and fuel filter is not clogged. Replace fuel pump/level sender as necessary.

7. After testing is completed, remove pressure gauge from fuel supply hose and connect fuel hose to engine fuel rail.

   A. Push supply hose barb fitting onto fuel rail until an audible *"Click"* is heard.

   B. Press barb fitting lock down to lock fitting in place (Fig. 116).

8. Prime the fuel system (see Operator's Manual).

9. Make sure that no fuel leaks exist before returning machine to service.

10. Install engine shroud.

Fuel Pump (Diesel Engines Only)

Multi Pro 5800 machines with diesel engines include an electric fuel pump attached to the machine frame near the engine fuel injection pump (Fig. 117). The fuel pump is energized when the ignition switch is set to the RUN/PREHEAT position or the START position.

DANGER

Because diesel fuel is highly flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Make sure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.

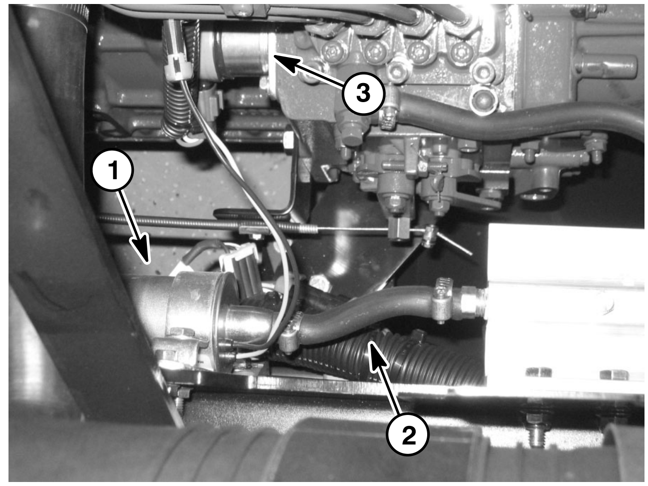


Figure 117

1. **Fuel pump**
2. **Pump discharge hose**
3. **Fuel stop solenoid**

Testing

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

2. Disconnect wire harness electrical connector from the fuel run/stop solenoid to prevent the engine from starting (see Fuel Stop Solenoid in this section).

3. Disconnect fuel pump discharge hose from the fuel filter.

4. Make sure fuel hoses attached to the fuel pump are free of obstructions.

5. Place fuel pump discharge hose into a large, graduated cylinder sufficient enough to collect 1 quart (950 ml).

IMPORTANT: When testing the fuel pump, DO NOT turn ignition switch to START.

6. Collect fuel in the graduated cylinder by turning ignition switch to the RUN/PREHEAT position. Allow pump to run for fifteen (15) seconds, then return switch to OFF.

7. The amount of fuel collected in the graduated cylinder should be approximately **16 fl oz (475 ml) after fifteen (15) seconds**.

8. Replace fuel pump as necessary.

9. Install disconnected fuel hose to the fuel filter.

10. Wipe up any spilled fuel and reconnect wire harness electrical connector to the fuel stop solenoid.

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

12. Make sure that no fuel leaks exist before returning machine to service.

Fuel Pump Specifications

Pump Capacity	64 fl oz/min (1.9 liters/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Fuel Level Sender (Gasoline Engines Only)

On Multi Pro 5800 machines with a Kubota gasoline engine, the fuel sender is a component of the fuel pump/level sender assembly which is secured to the top of the fuel tank (Fig. 118). The resistance of the fuel sender decreases as the fuel level in the fuel tank decreases. The fuel sender is connected to a fuel gauge mounted to the instrument panel.

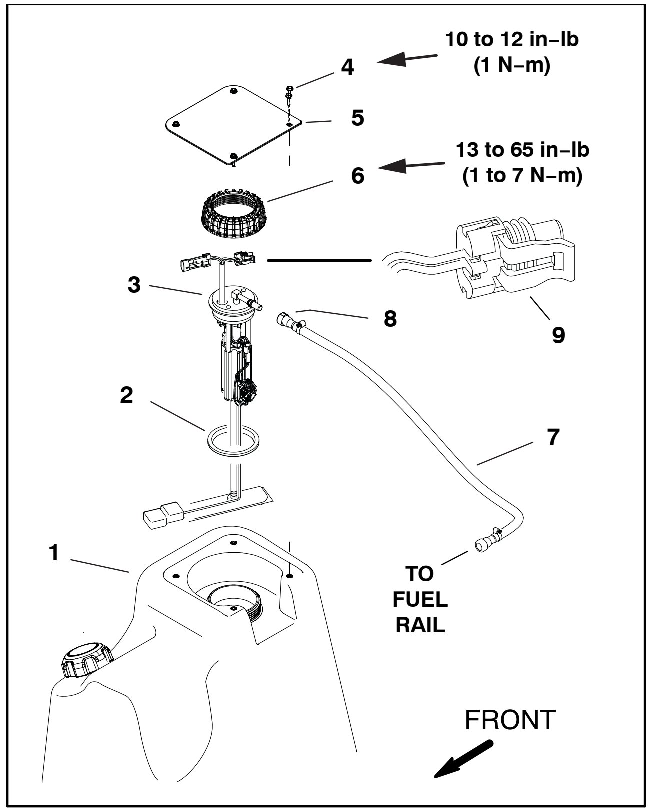


Figure 118

1. Fuel tank
2. Gasket
3. Fuel pump/level sender
4. Flange head screw (4)
5. Tank cover
6. Cap
7. Fuel supply hose
8. Barb fitting
9. Fuel sender harness connector

Testing

See Fuel Pump (Gasoline Engines Only) in this chapter for information on testing the fuel pump portion of the fuel pump/level sender assembly.

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

2. Remove fuel tank cover and disconnect both machine wire harness connectors from the fuel pump/sender assembly. On machines with an evaporative control system, remove the carbon canister from the fuel tank cover/canister bracket if necessary.

3. To test the circuit wiring and instrument panel fuel gauge, turn ignition switch to RUN/PREHEAT. The instrument panel fuel gauge should indicate full. Turn ignition switch OFF and proceed with fuel sender testing if circuit wiring and instrument panel fuel gauge are functioning correctly.

4. Disconnect the fuel supply hose from the fuel pump/level sender.

   A. Lift supply hose barb fitting lock up to unlock fitting (Fig. 119).

   B. Press barb fitting tab and pull fitting from fuel pump/level sender.

5. Remove cap and carefully lift fuel pump/level sender and gasket from fuel tank. Clean all fuel from the fuel pump/sender.

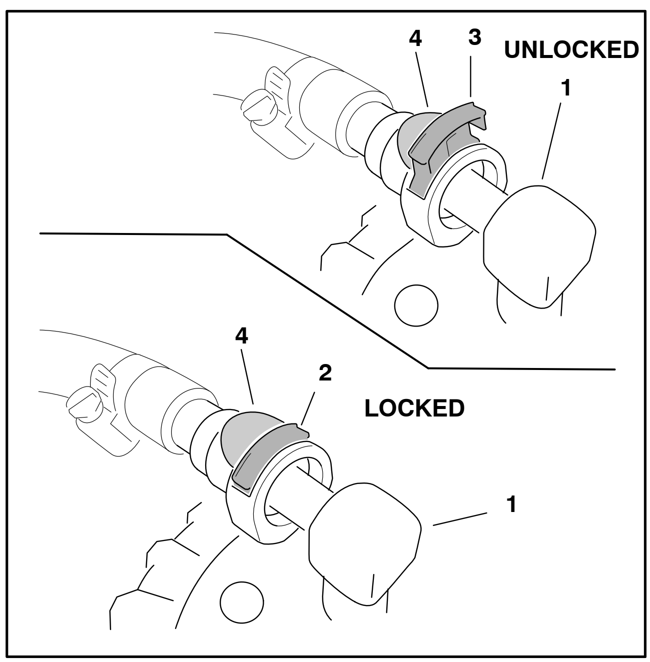


Figure 119

1. Fuel pump/level sender fitting
2. Barb fitting lock (down)
3. Barb fitting lock (up)
4. Barb fitting tab

CAUTION

Make sure fuel pump/level sender is completely dry (no fuel on it) before testing. Perform test away from the fuel tank to prevent an explosion or fire from sparks.

6. Using a multimeter, check resistance across the fuel sender connector terminals with the float in the full and empty positions (Fig. 120).

FLOAT ARM POSITION	RESISTANCE
FULL (UP)	102 ohms
EMPTY (DOWN)	2 ohms

Figure 120

7. Replace fuel sender as necessary.

8. When testing is complete, clean the fuel pick−up screen and carefully fit gasket and fuel pump/level sender into fuel tank. Make sure fuel pump/sender float arm is facing forward as shown (Fig. 118).

9. Secure fuel sender to tank with cap and tighten cap from **175 to 200 in−lb (20 to 22 N−m)**. To prevent damage to fuel sender during assembly, make sure that fuel sender does not turn as sender cap is tightened.

10. Secure wire harness connectors to fuel pump/level sender.

11. Connect fuel hose to top of fuel tank.

A. Push supply hose barb fitting onto fuel pump/level sender until an audible *"Click"* is heard.

B. Press barb fitting lock down to lock fitting in place (Fig. 119).

12. Prime the fuel system (see Operator's Manual).

13. Make sure that no fuel leaks exist and install the fuel tank cover before returning machine to service. Tighten fuel tank cover screws from **11 to 12 in−lb (1 N−m)**.

Fuel Level Sender (Diesel Engines Only)

On machines with a diesel engine, the fuel sender is attached to the top of the fuel tank (Fig. 122). The resistance of the fuel sender decreases as the fuel level in the fuel tank decreases. The fuel sender is connected to a fuel gauge mounted to the instrument panel.

Testing

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

2. Remove fuel tank cover and disconnect machine wire harness connector from fuel sender.

3. To test the circuit wiring and instrument panel fuel gauge, turn ignition switch to RUN/PREHEAT. The instrument panel fuel gauge should indicate full. Turn ignition switch OFF and proceed with fuel sender testing if circuit wiring and instrument panel fuel gauge are functioning correctly.

4. Label fuel hoses for assembly purposes then loosen hose clamps and carefully disconnect fuel supply and return hoses from fittings on the top of the fuel sender.

5. Remove cap and carefully lift fuel sender and gasket from fuel tank. Clean all fuel from the sender.

CAUTION

Make sure fuel sender is completely dry (no fuel on it) before testing. Perform test away from the fuel tank to prevent an explosion or fire from sparks.

6. Using a multimeter, check resistance across the fuel sender connector terminals with the float in the full and empty positions (Fig. 121).

FLOAT ARM POSITION	RESISTANCE
FULL (UP)	89 to 95 ohms
EMPTY (DOWN)	5 to 8 ohms

Figure 121

7. Replace fuel sender as necessary.

8. When testing is complete, clean the fuel pick−up screen and carefully fit gasket and fuel sender into fuel tank. Make sure fuel sender float arm is facing forward as shown (Fig. 122).

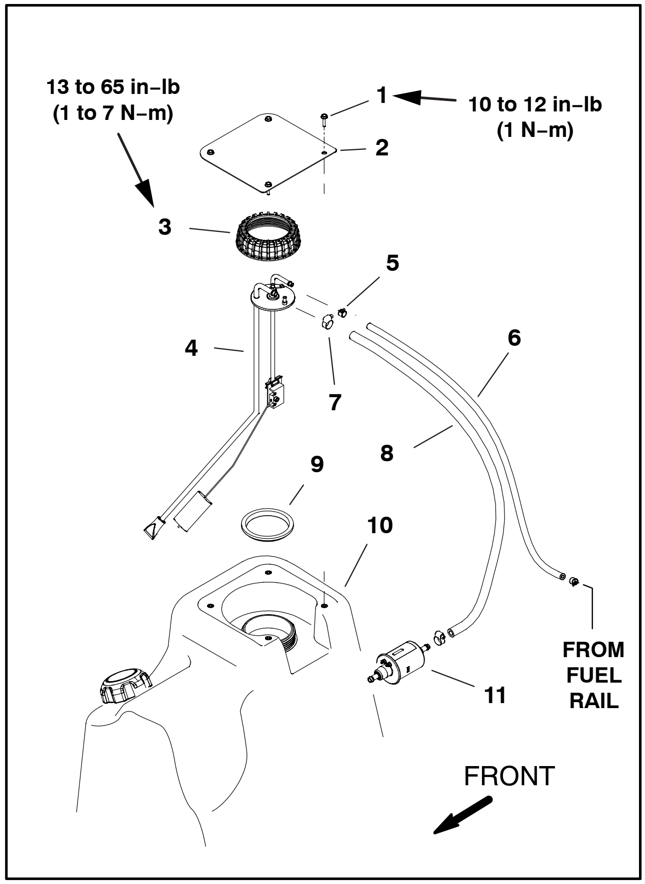


Figure 122

1. **Flange head screw (4)**
2. **Tank cover**
3. **Cap**
4. **Fuel level sender**
5. **Hose clamp (2)**
6. **Fuel hose − return**
7. **Hose clamp (2)**
8. **Fuel hose − supply**
9. **Gasket**
10. **Fuel tank**
11. **Fuel pump**

9. Secure fuel sender to tank with cap and tighten cap from **175 to 200 in−lb (20 to 22 N−m)**. To prevent damage to fuel sender during assembly, make sure that fuel sender does not turn as sender cap is tightened.

10. Secure wire harness connector to fuel sender.

11. Connect fuel supply and return hoses to fittings on the top of the fuel sender and secure hoses with hose clamps.

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

13. Make sure that no fuel leaks exist and install the fuel tank cover before returning machine to service. Tighten fuel tank cover screws from **11 to 12 in−lb (1 N−m)**.

Coolant Temperature Sender

The temperature sender is located on the intake side of the thermostat housing attached to the engine cylinder head (Fig. 123). On machines with Gasoline engines, the temperature sender is a thermistor that is monitored by the Kubota engine ECU. On machines with diesel engines, the temperature sender is a thermal switch used in the instrument panel warning light circuit.

To test the temperature sender on machines with gasoline engines, see the Kubota WG1605−E3 Workshop Manual.

Testing (Diesel Engines Only)

Use the following procedure to test the temperature sender used on machines with diesel engines.

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

2. Lower engine coolant level below thermostat housing and remove the temperature sender.

3. Put sender in a container of oil with a thermometer and slowly heat the oil (Fig. 124).

CAUTION

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

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

4. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases. The temperature sender is normally open and should close between 216 to 226 F (102 to 108 C).

5. Allow oil to cool while observing temperature. The temperature sender should open at approximately 208 F (98 C).

6. Replace sender if specifications are not met.

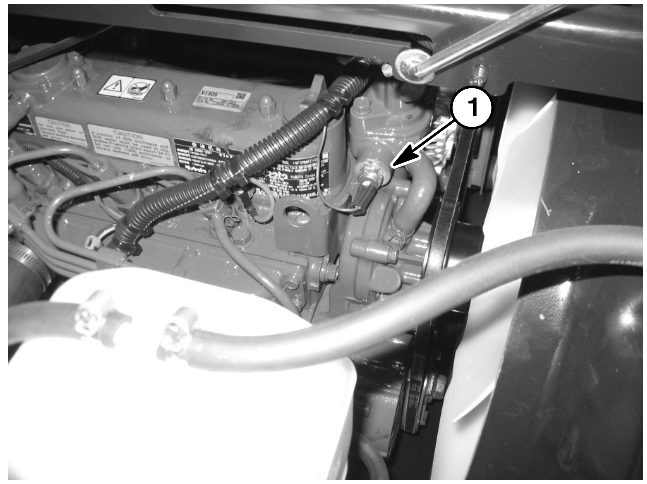


Figure 123

1. **Temperature sender (diesel engine shown)**

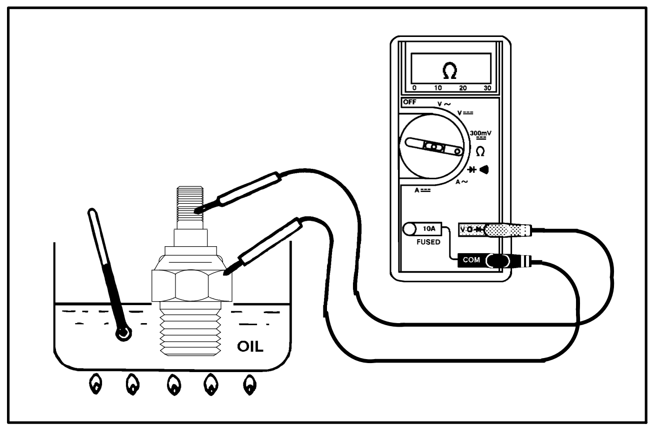


Figure 124

7. Thoroughly clean threads of thermostat housing and sender and apply thread sealant to the threads of the sender. Tighten sender in thermostat housing.

8. Reconnect wire harness to sender.

9. Fill engine cooling system (see Operator’s Manual).

Oil Pressure Switch

The engine oil pressure switch is a normally closed switch that opens with pressure during normal engine operation. The oil pressure switch is located on the engine near the oil filter (Fig. 125). On machines with Gasoline engines, the oil pressure switch is is monitored by the Kubota engine ECU. On machines with diesel engines, the oil pressure switch is used in the instrument panel warning light circuit.

Testing

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

2. Raise and support operator seat. Locate oil pressure switch on engine and disconnect the wire harness connector from the switch.

3. Use a digital multimeter to measure continuity between the oil pressure switch terminal and the switch base (ground connection) (Fig. 126).

   A. With the engine off, the oil pressure switch should be closed so there should be continuity between the switch terminal and the switch base (0 ohms).

   B. With the engine running, the oil pressure switch should be open so there should not be continuity between the switch terminal and the switch base (infinite ohms).

4. Replace the oil pressure switch if necessary.

5. If testing of oil pressure switch determines that the pressure switch operation is normal and the InfoCenter continues to display an engine fault identifying low engine oil as the cause of engine shutdown, or the instrument panel indicator remains illuminated, check for faulty wiring in the oil pressure switch circuit.

6. Connect the wire harness connector to the oil pressure switch and lower Operator seat.

NOTE: Refer to appropriate engine workshop manual for information regarding engine lubrication system and testing.

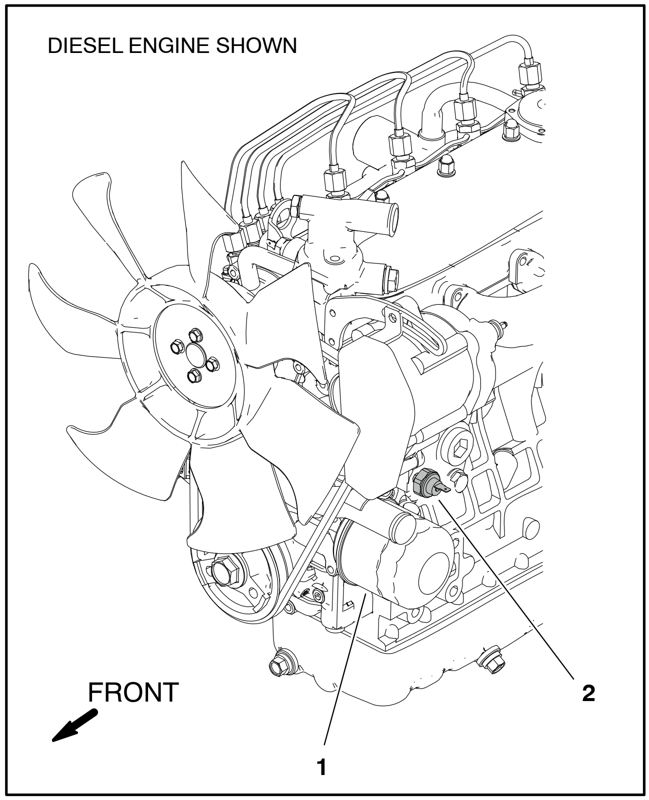


Figure 125

1. **Oil pressure switch** 2. **Oil filter**

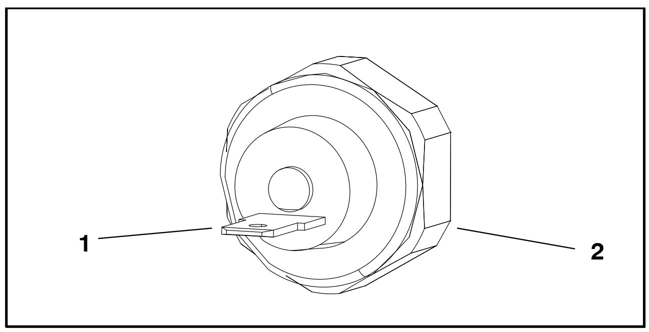


Figure 126

1. **Switch terminal** 2. **Switch base**

CAN−bus Terminator Resistors

System communication between the Toro Electronic Controller (TEC), the InfoCenter display, and in the case of gasoline engine powered machines, the Kubota Engine Controller 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 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.

For machines with GeoLink spray systems, the AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller communicate with each other on a separate CAN−bus network. At the ends of the twisted pair of bus cables are two (2) additional 120 ohm terminator resistors. The GeoLink Can−bus network is not connected to the sprayer traction unit CAN−bus.

For machines with GeoLink spray systems, one of the terminator resistors is under the operator seat and the second resistor is located near the ASC−10 at the rear of the machine. The wire harness connectors have a blue insert to identify the proper location for the termination resistors.

Testing

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

2. Locate resistor assembly to be tested and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

3. The terminator resistors (Fig. 127) 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.

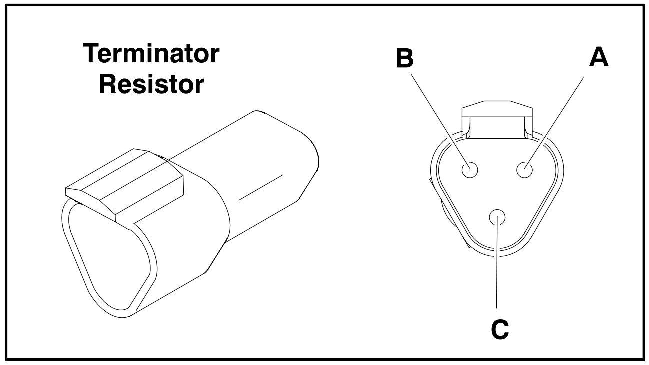


Figure 127

4. If testing determines that resistor is faulty, replace resistor assembly.

5. If the resistor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Appendix A − Foldout Drawings in this manual).

6. After resistor testing is complete, make sure that resistor is fully seated into wire harness connector and secured to the wire harness with a cable tie.

Diode Assemblies

All Multi Pro 5800 machines include several diode assemblies (Fig. 129). The diode assemblies plug into the vehicle wire harness at various locations (see Electrical Schematic and Wire Harness Drawings in Chapter 11 – Foldout Drawings).

The speed lock circuit includes two (2) diodes. One of the diodes is used to provide a holding circuit for the speed lock relay. The second diode is used for circuit protection from voltage spikes that occur when the speed lock coil is de–energized.

The spray boom lift circuit includes four (4) diodes for circuit logic. The diodes allow power to flow to the boom lift/lower enable solenoid (S1) when either boom lift/lower switch is set to the raise or lower position.

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 optional foam marker wiring harness.

If the machine is equipped with an optional homologation (road light) kit, three (3) diodes are used to control turn signal/flasher circuit power. The diodes plug into the optional homologation kit wiring harness.

Testing

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

2. Locate diode assembly to be tested and remove cable tie that secures diode to wire harness. Unplug the diode from the wire harness for testing.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (–) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Figure 128

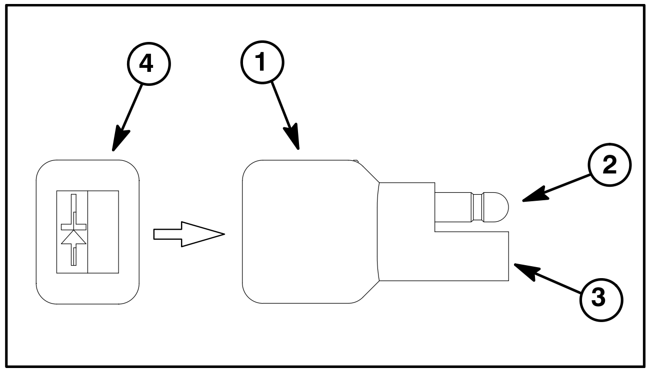


Figure 129

1. **Diode assembly**
2. **Male terminal**
3. **Female terminal**
4. **End of diode body**

3. The diode can be individually tested using a digital multimeter (diode test or ohms setting) and the table provided (Fig. 128).

4. If testing determines that diode is faulty, replace diode assembly.

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

6. After diode testing is complete, make sure that resistor is fully seated into wire harness connector and secured to the wire harness with a cable tie.

Resistor Assemblies

All Multi Pro 5800 machines include at lease one 75 ohm resistor assembly. The resistor assembly can be identified by its gray color, resistor symbol and Toro part number on the end of the resistor assembly body (Fig. 130). The resistor assembly plugs into the vehicle wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 11 – Foldout Drawings).

All machines include a 75 ohm resistor in the engine start circuit. The resistor is located under the instrument panel to the left of the steering column.

On machines with diesel engines, two (2) additional resistors are used in the instrument panel warning light circuit. The resistors are located under the instrument panel near the fuel gauge.

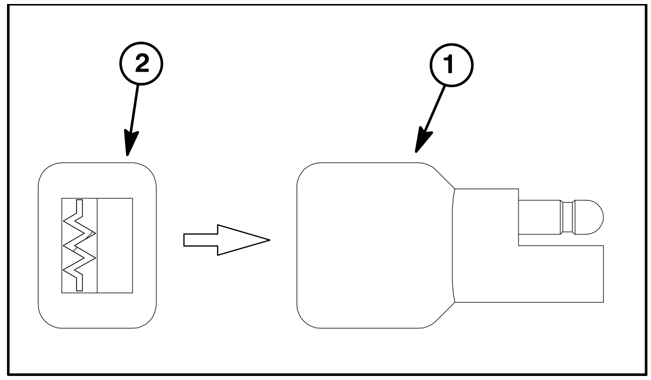


Figure 130

1. **Resistor assembly**
2. **End of resistor body**

Testing

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

2. Locate resistor assembly to be tested and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

3. The resistor can be tested using a digital multimeter (ohms setting). The resistance across the resistor terminals should be approximately **75 ohms**.

4. If testing determines that resistor is faulty, replace resistor assembly.

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

6. After resistor testing is complete, make sure that resistor is fully seated into wire harness connector and secured to the wire harness with a cable tie.

Spray System Valve Actuators

The Multi Pro 5800 spray system uses a number of valves to control the spray product flow (see the Spray System chapters in this manual). Each valve has a 12VDC actuator (motor) that can be tested individually.

The 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.

Testing

1. Park machine on a level surface, 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. 131). Carefully unplug machine wire harness connector from valve actuator, remove the retaining fork and remove the actuator from the valve assembly.

3. 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.

4. 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.

5. If actuator dose not operate smoothly in both directions, replace the actuator.

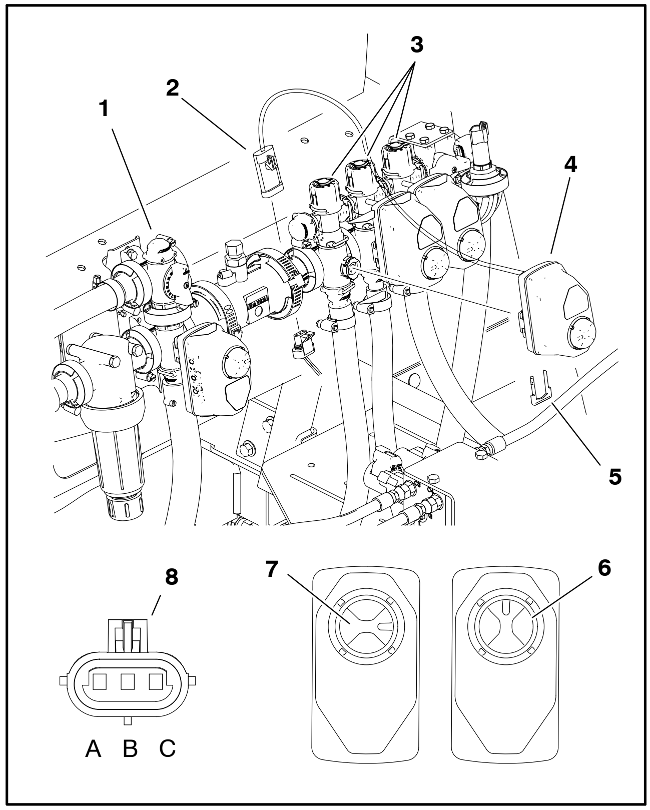


Figure 131

1. **Agitation valve**
2. **Wire harness connector**
3. **Boom spray valves (3)**
4. **Valve actuator**
5. **Fork**
6. **Valve closed (red LED)**
7. **Valve open (green LED)**
8. **3 Wire connector**

6. 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 the Spray System chapters in this manual).

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

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

Operator Seat Switch

The seat switch has normally open contacts that close when the operator seat is occupied. The seat switch is located directly under the operator seat. The Toro Electronic Controller (TEC) monitors the operation of the seat switch (input). The machine will not start it the operator seat is unoccupied and the parking brake is not engaged.

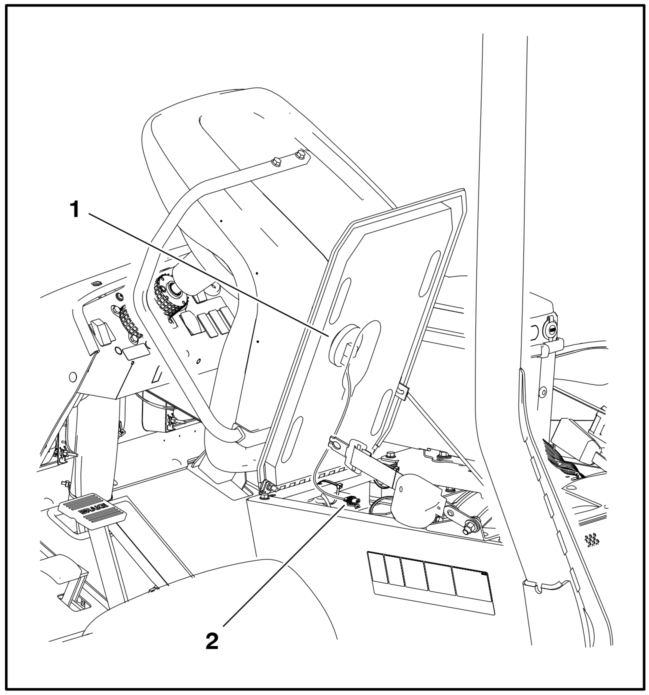


Figure 132

1. **Seat switch**
2. **Wire harness connector**

Testing

The seat 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 engine and engage parking brake. Remove key from ignition switch.

2. Raise and support operator seat to access seat switch harness connector.

3. Disconnect wire harness electrical connector from the seat switch harness (Fig. 132).

4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch harness 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, remove the seat and 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 Appendix A – Foldout Drawings in this manual).

9. After seat switch testing is completed, connect wire harness electrical connector to the seat switch. Lower and secure seat.

Audible Alarm

The audible alarm sounds to notify the operator when a machine problem exists. Electrical current for the alarm is provided as an output from the TEC. The audible alarm is located in the center of the instrument panel (Fig. 133).

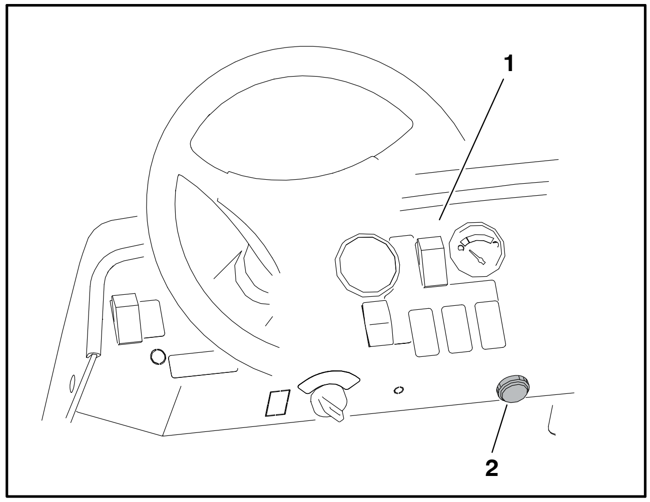


Figure 133

1. **Instrument panel**
2. **Audible alarm**

Testing

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

2. Locate alarm and disconnect machine wire harness from alarm.

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

3. Connect 12VDC power to the terminals as shown (Fig. 134). The alarm should sound. Replace the alarm if necessary.

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

5. Reconnect machine wire harness to alarm.

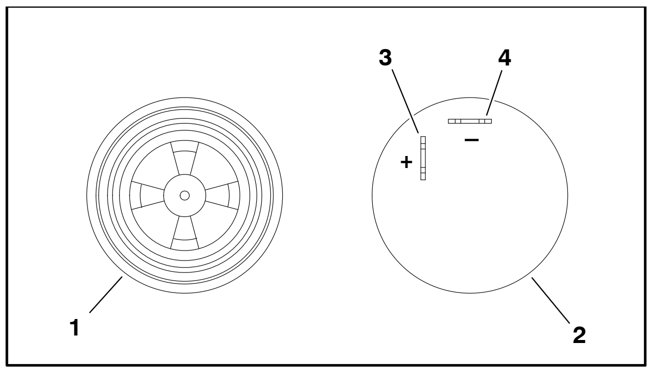


Figure 134

1. **Top view**
2. **Bottom view**
3. **Positive (+) terminal**
4. **Negative (–) terminal**

Throttle Assembly (Gasoline Engines Only)

The throttle assembly used on machines with gasoline engines is a rotary hall effect sensor. The throttle assembly is located on the Operator control console (Fig. 135). If an issue occurs with the throttle assembly or its circuit wiring, an engine fault should appear on the InfoCenter display and the engine RPM should remain at the low idle setting no matter the throttle position.

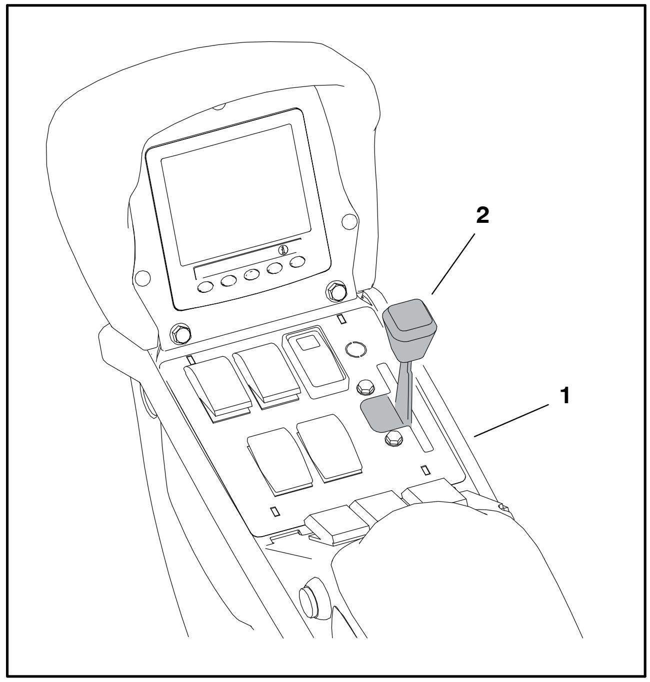


Figure 135

1. Control console
2. Throttle assembly

Testing

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

2. Remove console cover(s) to gain access to throttle assembly (see Console Assembly in Chapter 9 – Chassis in this manual).

3. Disconnect machine wire harness from throttle assembly.

4. Connect a 5 VDC power supply to throttle assembly terminals A and C as shown (Fig. 136).

5. Use a multimeter set to DC voltage and connect to throttle assembly terminals A and B as shown (Fig. 136).

6. The voltage reading on the multimeter should be 0.5 ± 0.1 VDC with the throttle lever in the low idle position, and 4.5 ± 0.1 VDC in the high idle position.

7. Replace throttle assembly if necessary.

8. If the throttle assembly tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual).

9. Connect the wire harness connector to the throttle assembly after testing is complete.

10. Install control console covers (see Console Assembly in Chapter 9 – Chassis in this manual).

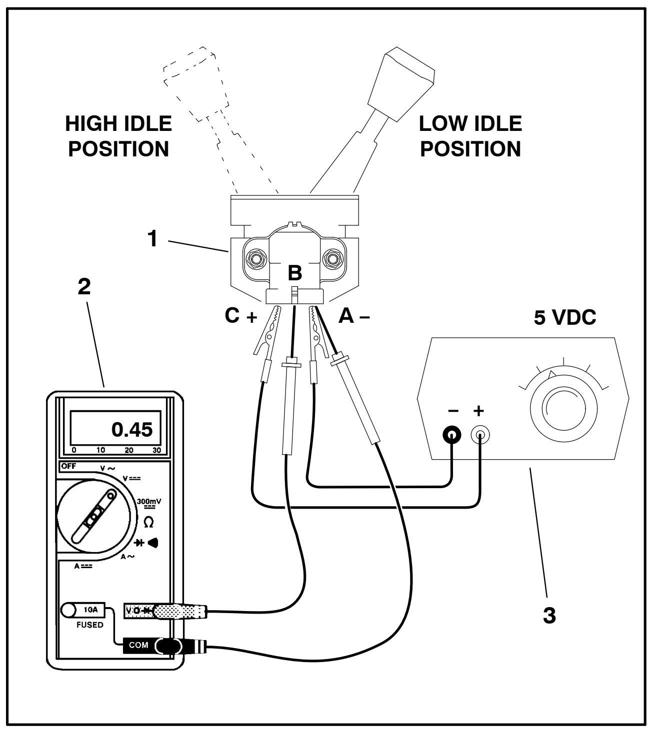


Figure 136

1. Throttle assembly
2. Multimeter (DC voltage)
3. DC Power supply

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 in the center of the spray manifold (Fig. 137). 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).

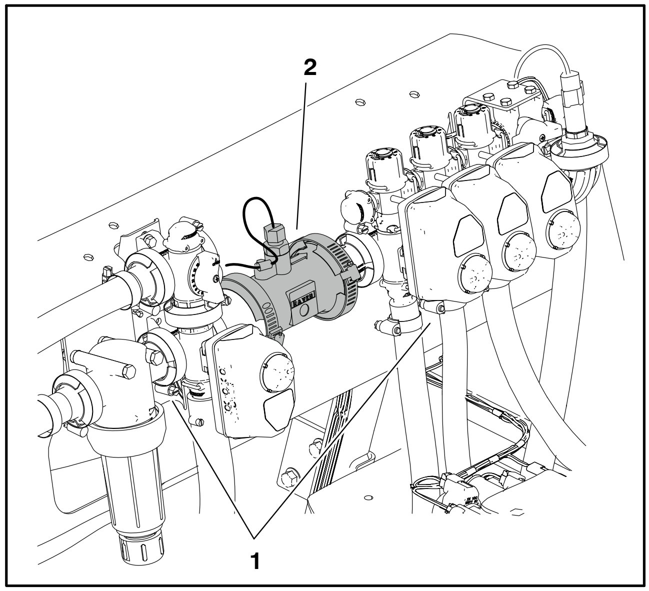


Figure 137

1. **Spray manifold** 2. **Flow meter**

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. 138A). 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 12 VDC across the supply (+) pin 2 and ground (−) pin 1 of the machine wire harness (Fig. 138B).

H. Turn the ignition switch to OFF.

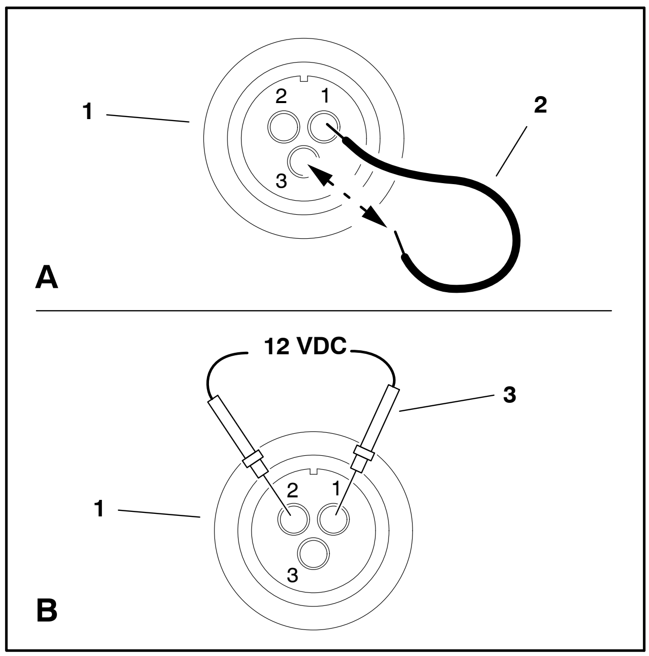


Figure 138

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.

Pressure Transducer

In addition to an analog pressure gauge on the instrument panel, the spray system includes a pressure transducer to provide spray system pressure information to the InfoCenter Display. The pressure transducer is located on the end of the Spray Manifold (Fig. 139).

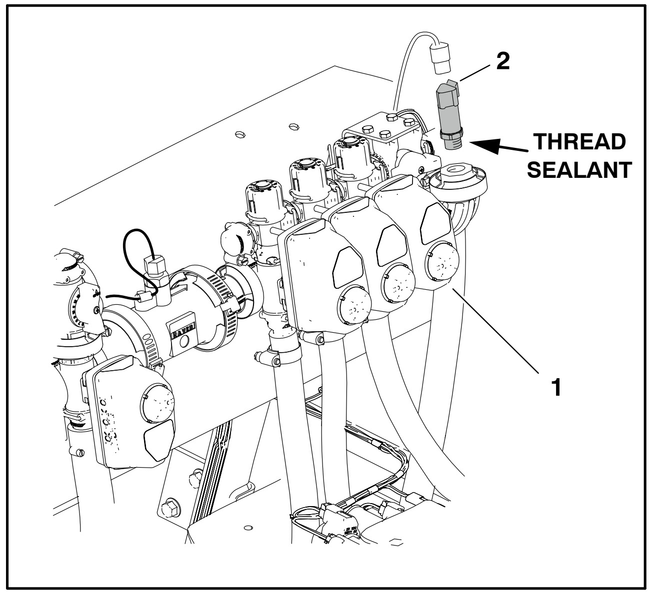


Figure 139

1. **Spray manifold**
2. **Pressure transducer**

Testing

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

2. Disconnect machine wire harness from the pressure transducer.

3. Test the machine wire harness to the pressure transducer:

   A. Set the ignition switch to the RUN/PREHEAT position.

   B. To simulate a functioning pressure transducer, connect a 1.5V dry cell battery across the signal (+) pin C and ground (–) pin B of the machine wire harness connector (Fig. 140A). A fully charged battery should produce approximately an **80 psi (5.5 bar)** reading on the InfoCenter Display.

   C. Use a multimeter set to DC voltage and check for 12 VDC across the supply (+) pin A and ground (–) pin B of the machine wire harness (Fig. 140B).

   D. Turn the ignition switch to OFF.

4. Test pressure transducer:

   E. Connect a 12 VDC power supply to the supply (+) pin A and ground (–) pin B of the sensor connector (Fig. 140B).

   F. Connect a multimeter set to DC voltage to the signal (+) pin C and ground (–) pin B of the sensor connector (Fig. 140C). A small amount of voltage should be present 0.5 VDC on the multimeter display.

5. Replace pressure transducer if necessary. Apply thread sealant to transducer threads prior to installation.

6. Connect the wire harness to the pressure transducer after testing is complete.

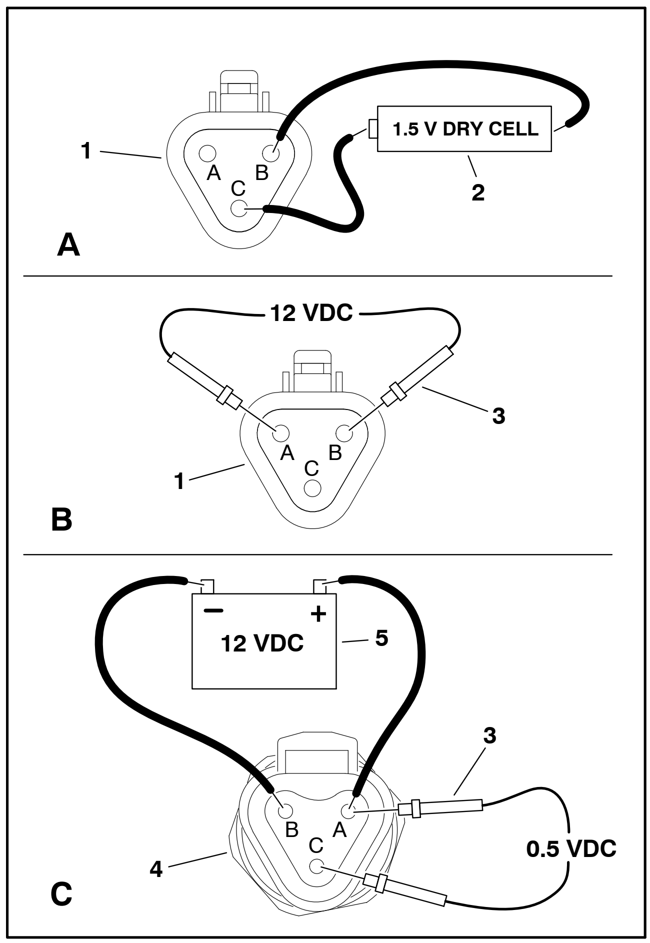


Figure 140

1. **Machine wire harness connector**
2. **1.5 V dry cell battery**
3. **Multimeter probe**
4. **Pressure transducer**
5. **12 VDC power supply**

Horn Button (Optional)

The horn button is a momentary push button switch used to sound the horn. The horn button is located on the instrument panel to the right of the steering wheel (Fig. 141).

A continuous supply of voltage is available to the horn button. When pressed the horn button energizes the horn. The horn and hazard light circuits are protected by a 15 amp fuse (FB4 5−6).

Testing

1. Park machine on a level surface, lower cutting decks and stop engine. Remove key from ignition switch.

2. Locate switch and disconnect machine wire harness connector from the switch.

3. With the use of a multimeter (ohms setting), the 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 the switch if testing determines that it is faulty.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

6. After testing is complete, connect machine wire harness connector to the switch.

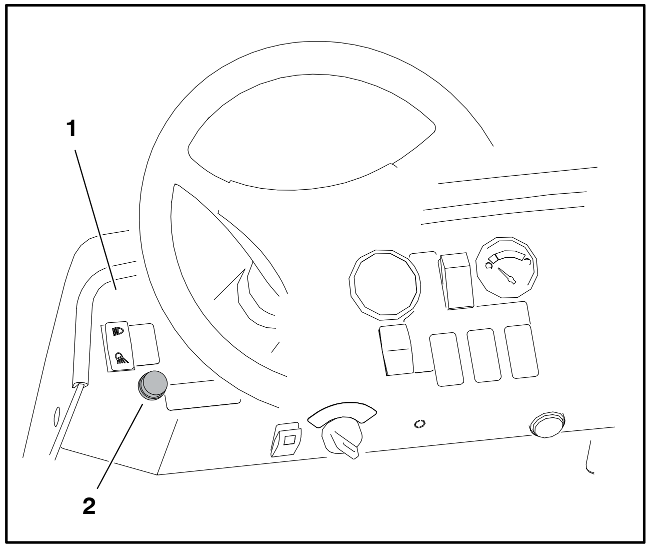


Figure 141

1. Operator control console **2. Horn button**

Tank Clean Rinse Pump 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). Kits with serial numbers below 316000000 use an illuminated switch. 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 instrument panel to the right of the steering column (Fig. 142).

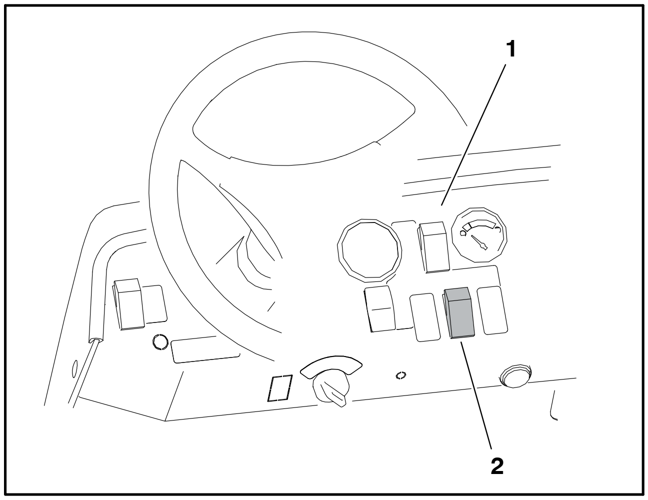


Figure 142

1. **Instrument panel** 2. **Rinse kit switch (opt.)**

Testing

The clean 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 engine and engage parking brake. Remove key from ignition switch.

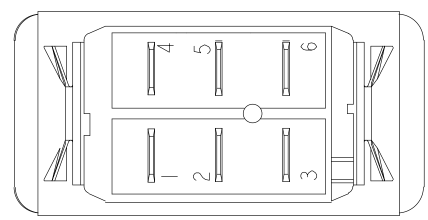
2. Locate clean rinse kit switch under instrument panel and unplug machine wire harness connector from switch.

3. With the use of a multimeter (ohms setting), the clean rinse kit 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. 143) and the circuitry of the switch is shown in the table (Fig. 144). 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 Appendix A – Foldout Drawings in this manual).

6. Connect the harness connector to the clean rinse kit switch after testing.



BACK OF SWITCH

Figure 143

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
ON	2 + 1, 5 + 4	2 + 3, 5 + 6
OFF	NONE	ALL
MOMENTARY	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 144

NOTE: Clean tank rinse kit switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Foam Marker ON/OFF Switch (Optional)

The foam marker kit ON/OFF switch is used to enable the optional foam marker system. The flow of foam to the right or left boom is controlled by the foam marker control switch mounted to the steering column. The foam marker ON/OFF switch is located on the instrument panel to the right of the steering column (Fig. 145).

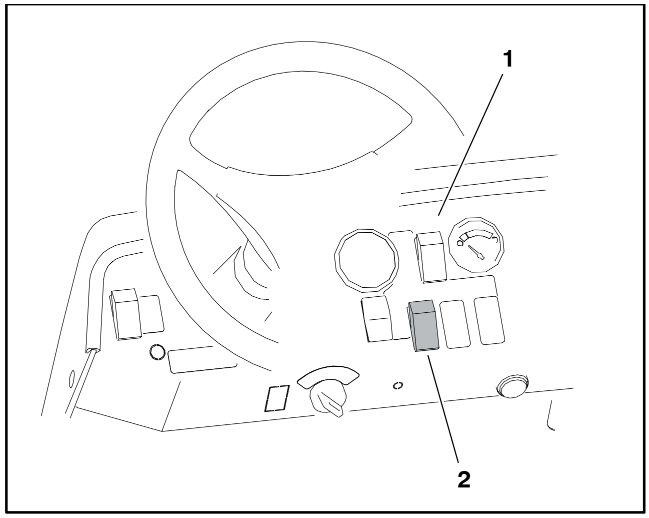


Figure 145

1. **Control console**
2. **Foam marker kit ON/OFF switch (opt.)**

Testing

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

2. Locate the foam marker ON/OFF switch under the instrument panel 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. 146) and the circuitry of the switch is shown in the chart (Fig. 147). 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 Appendix A – Foldout Drawings in this manual).

6. After testing, connect the harness connector to the switch.

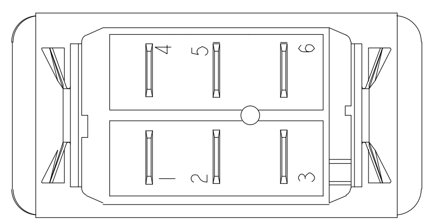


Figure 146

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF	2 + 1, 5 + 4	2 + 3, 5 + 6
ON	2 + 3, 5 + 6	2 + 1, 5 + 4

Figure 147

NOTE: Foam marker kit ON/OFF switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Foam Marker 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 left side of the steering column (Fig. 145).

Testing

1. Park machine on a level surface, 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. 149) and the circuitry of the switch is shown in the chart (Fig. 150). 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 Appendix A – Foldout Drawings in this manual).

6. After testing, connect the harness connector to the switch.

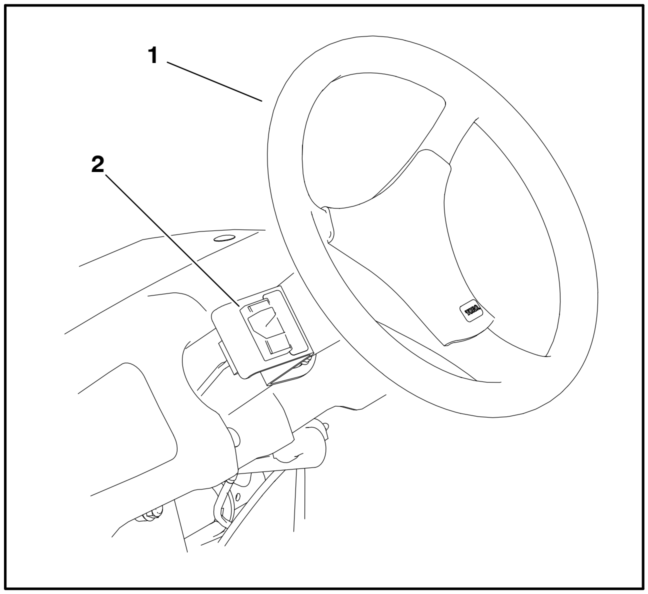
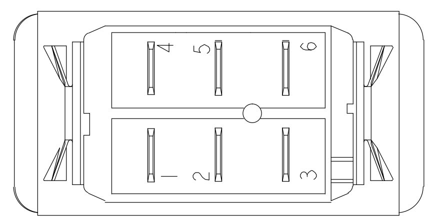


Figure 148

1. **Steering wheel**
2. **Foam maker kit control switch (opt.)**



BACK OF SWITCH

Figure 149

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
RIGHT	2 + 3, 5 + 6	2 + 1, 5 + 4
CENTER	NONE	ALL
LEFT	2 + 1, 5 + 4	2 + 3, 5 + 6

Figure 150

NOTE: Foam marker kit control switch terminals 4, 5 and 6 are not used on Multi Pro 5800 machines.

Electric Hose Reel Motor Switch (Optional)

The electric hose reel kit motor switch is a momentary push button switch used to energize the hose reel relay. The hose reel switch is located on the hose reel control box (Fig. 151).

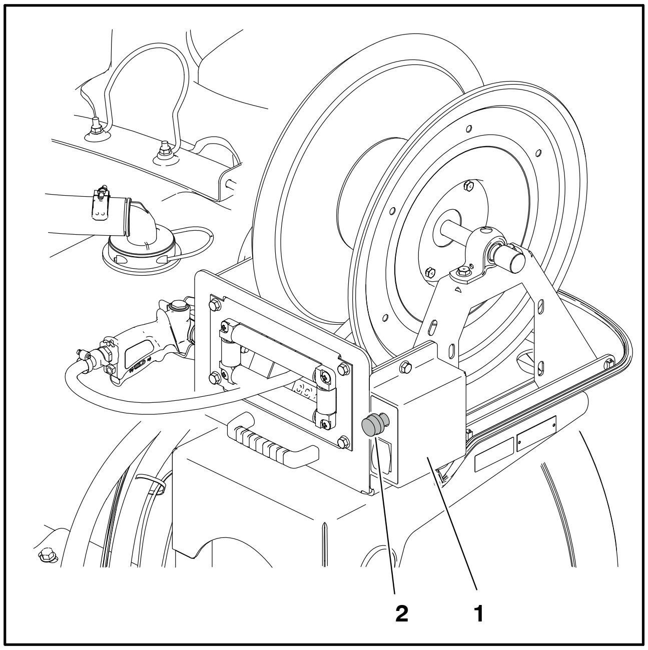


Figure 151

1. **Hose reel control box**
2. **Hose reel motor switch**

Testing

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

2. Remove the hose reel control box from the reel mount. 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 Appendix A – Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch and install the hose reel control box after testing is complete.

Electric Hose Reel Rate Switch (Optional)

The electric hose reel rate (increase/decrease) switch is located on the hose reel control box (Fig. 152). The electric hose reel rate switch is an input to the TEC. When all necessary spray control conditions are met, the TEC modifies the current applied to the spray pump control manifold solenoid valve using a PWM (pulse width modulation) signal. Pressing the switch to the increase position increases the frequency of the PWM signal to the valve coil which increases hydraulic flow to the spray pump motor. Moving the switch to the decrease position reduces the frequency of the PWM signal to the valve coil and results in less hydraulic flow to the spray pump.

Testing

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

2. Remove the hose reel control box from the reel mount. Locate hose reel rate switch and disconnect wire harness connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 153) and the circuitry of the switch is shown in the chart (Fig. 154). 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 the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch and install the hose reel control box after testing is complete.

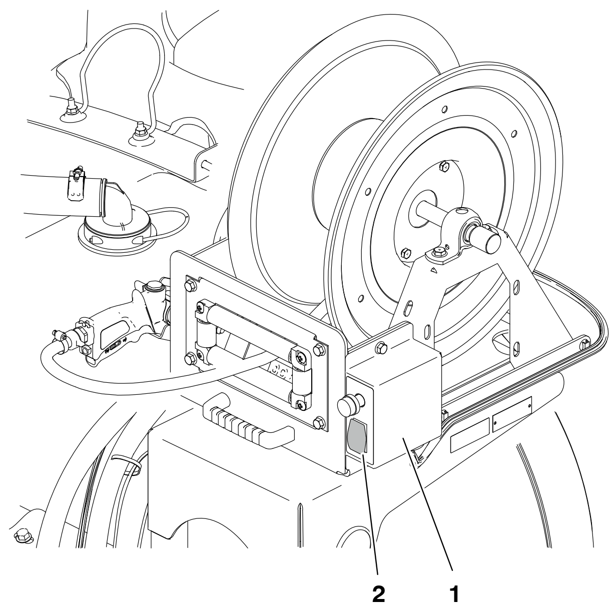
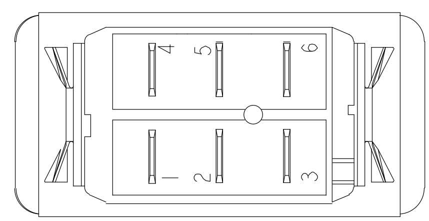


Figure 152

1. **Hose reel control box**
2. **Hose reel rate switch**



BACK OF SWITCH

Figure 153

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
INCREASE	2 + 3, 5 + 6	2 + 1, 5 + 4
OFF	NONE	ALL
DECREASE	2 + 1, 5 + 4	2 + 3, 5 + 6

Figure 154

Road Headlight Switch (Optional)

The three (3) position road headlight switch is located on the left side of the instrument panel (Fig. 155) and is used to turn the headlights on−high beam, off and on−low beam. Machines without an optional homologation (road light) kit installed use a two (2) position headlight switch in the same location (see Headlight Switch in this chapter).

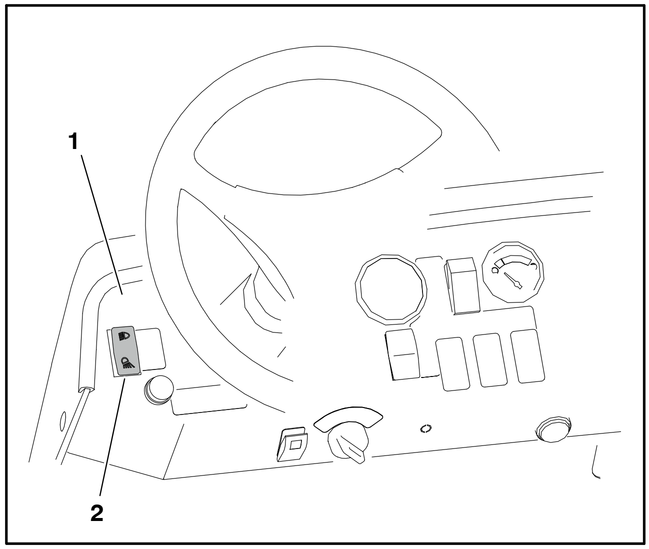


Figure 155

1. **Instrument panel**
2. **Headlight switch**

Testing

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

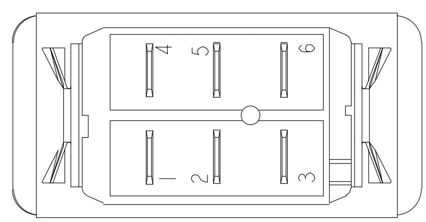
2. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 156) and the circuitry of the switch is shown in the chart (Fig. 157). Verify continuity between switch terminals.

4. Replace switch if necessary.

5. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

6. Connect the wire harness connector to the switch after testing is complete.



BACK OF SWITCH

Figure 156

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
HIGH BEAM	2 + 3, 5 + 6	1 + 2, 4 + 5
OFF	NONE	ALL
LOW BEAM	1 + 2, 4 + 5	2 + 3, 5 + 6

Figure 157

Hazard Light Switch (Optional)

The hazard light switch is located on the instrument panel to the left of the ignition switch (Fig. 158). The switch includes a light that should illuminate when the switch is in the ON position. The hazard light and horn circuits are protected by a 15 amp fuse (FB4 5−6).

Testing

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

2. Locate the switch to be tested and disconnect the wire harness electrical connector from the switch.

3. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown (Fig. 159) and the circuitry of the switch is shown in the chart (Fig. 160). Verify continuity between switch terminals.

4. To test switch light, apply 12 VDC to terminal 8 (+) and ground terminal 7 (−). The light should illuminate.

5. Replace switch if necessary.

6. If the switch tests correctly and a circuit problem still exists, check the wire harnesses (see Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A − Foldout Drawings in this manual).

7. Connect the wire harness connector to the switch after testing is complete.

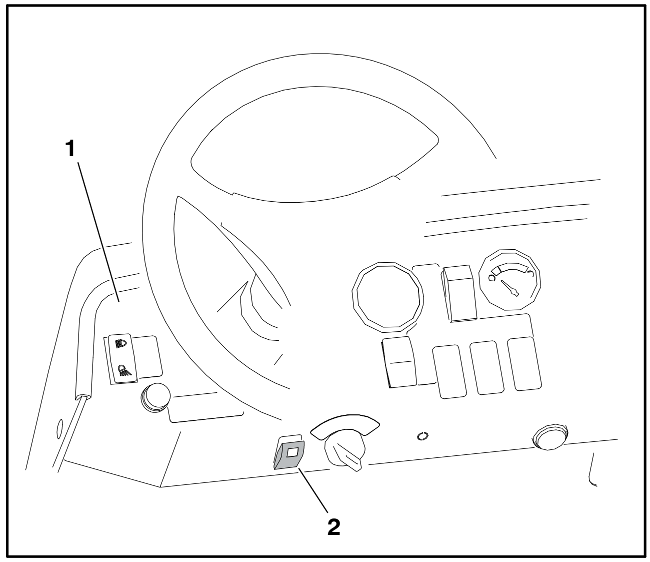
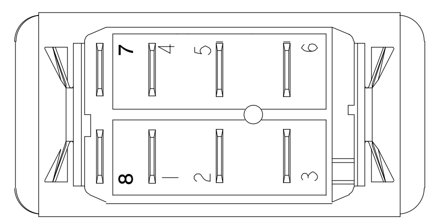


Figure 158

1. **Instrument panel** 2. **Hazard light switch**



BACK OF SWITCH

Figure 159

SWITCH POSITION	CLOSED TERMINALS	OPEN TERMINALS
OFF		
ON		

Figure 160

NOTE: Hazard light switch terminals 1 and 4 are not used on Multi Pro 5800 machines.

Service and Repairs

NOTE: See the Kubota Workshop Manuals for engine electrical component repair information.

Headlights

CAUTION

The headlights use a halogen bulb that becomes extremely hot when in operation. Handling a hot headlight bulb can cause severe burns and personal injury. Allow enough time for bulb to cool before handling.

CAUTION

Any surface contamination can damage the headlight bulb and lead to its failure 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. 161)

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

2. Access the headlight assembly from under the instrument panel on rear of hood and 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 machine.

   A. Remove three (3) clips that secure headlight to headlight brackets on rear of hood.

   B. Remove headlight from machine.

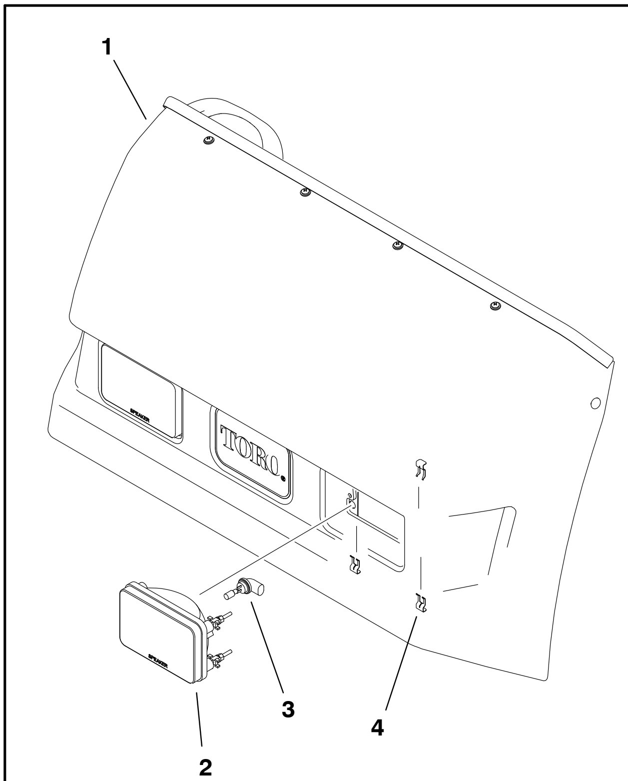


Figure 161

1. **Hood**
2. **Headlight assembly (2)**
3. **Halogen bulb**
4. **Clip (3)**

Headlight Assembly (Fig. 161)

1. If headlight was removed, secure headlight to machine:

   A. Insert headlight into hood opening. Make sure that SPEAKER logo on headlight lens is at bottom.

   B. Secure headlight to headlight brackets on rear of hood with three (3) clips.

2. If bulb was removed from headlight, align tabs on bulb with notches in headlight opening. Insert bulb into back of headlight without touching the clear bulb surface. Secure bulb to headlight by rotating it 1/4 turn clockwise.

3. Connect the wire harness connector to the headlight.

Traction Speed Sensor

Removal (Fig. 162)

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

2. Locate speed sensor on right side wheel motor. Disconnect speed sensor from machine wire harness.

3. Loosen lock nut and remove speed sensor from wheel motor.

4. Locate and discard sensor O−ring.

5. Plug sensor port to prevent hydraulic system contamination.

Installation (Fig. 162)

1. Thread lock nut fully onto speed sensor threads.

2. Center a wheel motor piston in the center of the sensor port (see Sensor Port View in Fig. 163). Use a suitable tool to feel when the center of a motor piston is in the center of the sensor port.

3. Lubricate new O-ring and thread sensor into port until sensor lightly contacts piston.

4. Turn sensor out (counter-clockwise) until angle between sensor orientation grooves and motor center−line is between 90 and 93 degrees (see Sensor Installation View in Fig. 163), then back out sensor one (1) full turn.

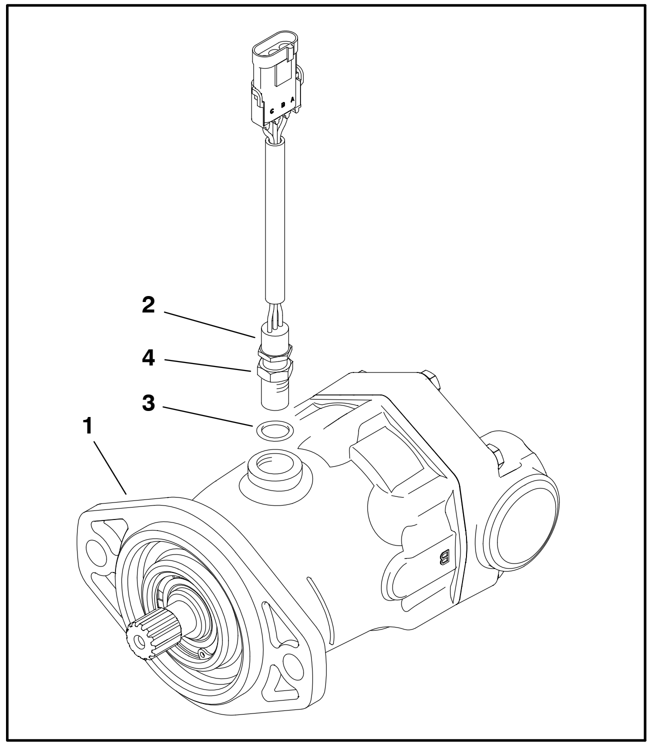


Figure 162

1. **RH wheel motor**
2. **Speed sensor**
3. **O−ring**
4. **Lock nut**

5. Hold sensor in position and rotate motor output shaft one complete revolution to make sure it rotates freely, then tighten sensor lock nut from **75 to 125 in-lb (8.5 to 14 N−m)**.

6. Plug speed sensor connector into machine wire harness.

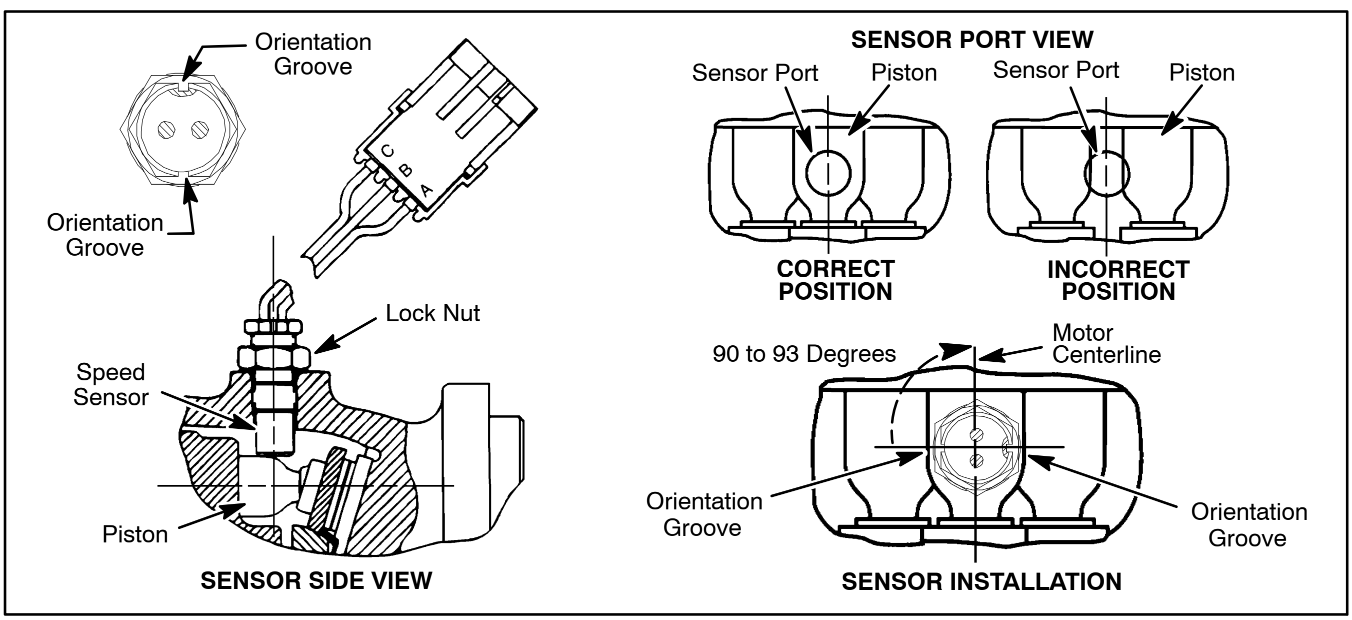


Figure 163

Flow Meter Sensor

Removal (Fig. 164)

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. 164)

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)** form 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.

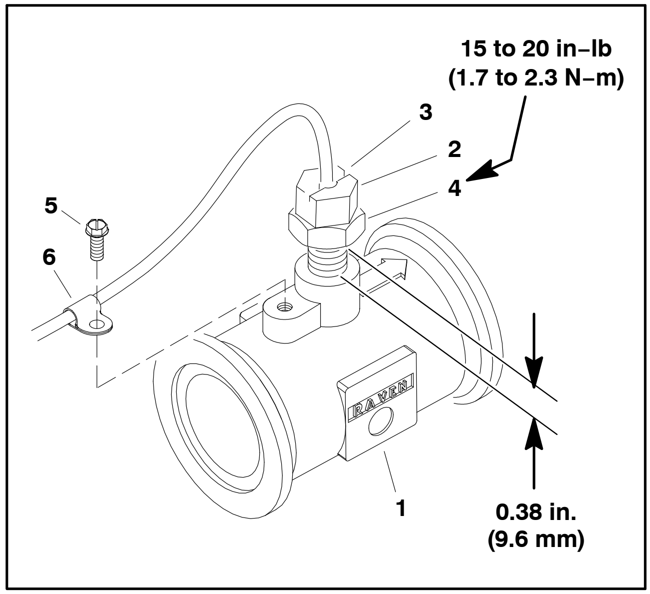


Figure 164

1. **Flow meter body**
2. **Flow meter sensor**
3. **Orientation groove**
4. **Jam nut**
5. **Screw**
6. **Clamp**

Speed Lock Coil

Removal (Fig. 166)

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

2. Remove hex nut and lock washer that secure shaft (item 6) to machine frame. Remove shaft with collar, flange bushing, plate and compression spring.

3. Unplug speed lock coil connector from machine wire harness.

4. Remove four (4) cap screws, lock washers and hex nuts that secure coil to frame and remove speed lock coil.

Installation (Fig. 166)

1. Attach speed lock coil to frame using four (4) cap screws, lock washers and hex nuts.

2. Position compression spring, plate and flange bushing to machine making sure to align slot in plate with post on traction pedal.

3. Apply anti−seize lubricant to shaft and insert shaft with collar. Secure shaft to frame with hex nut and lock washer.

4. Plug speed lock coil connector into machine wire harness.

5. Check that gap between speed lock coil and plate is approximately **3/32" (2.4 mm)**. If gap is incorrect, loosen set screw in collar and slide collar on shaft to allow proper gap. Tighten set screw to secure collar on shaft.

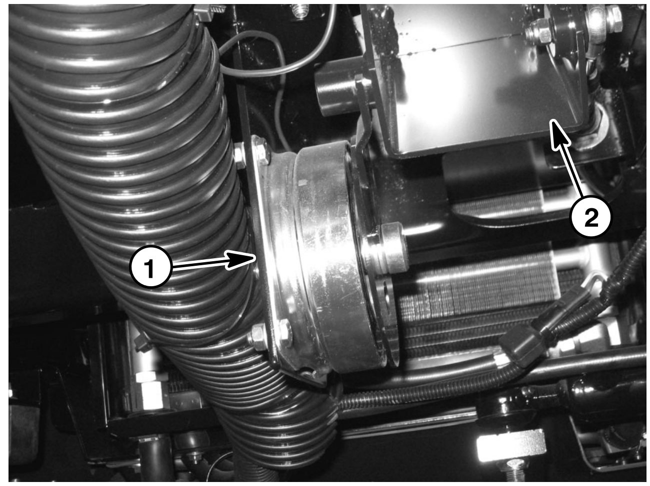


Figure 165

1. **Speed lock coil**
2. **Traction pedal**

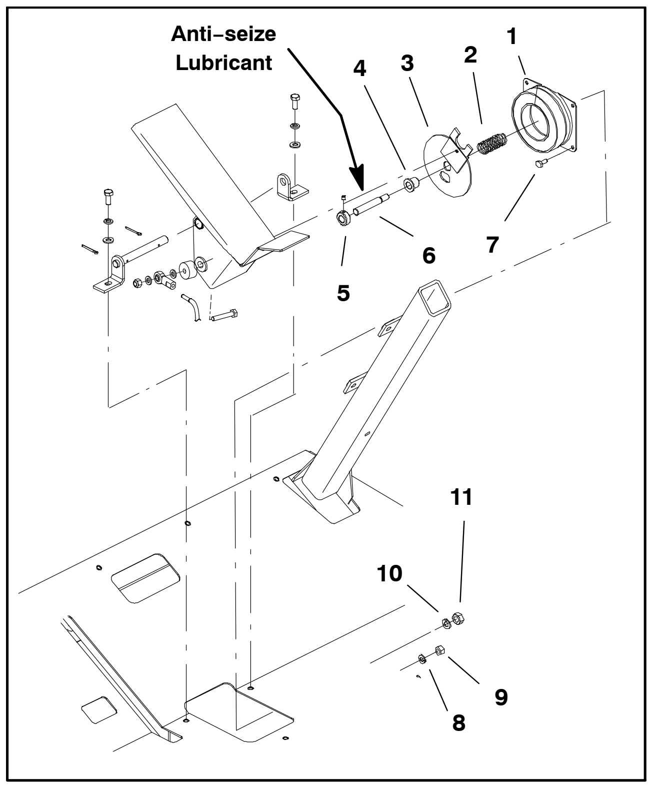


Figure 166

1. **Speed lock coil**
2. **Compression spring**
3. **Plate**
4. **Flange bushing**
5. **Collar w/set screw**
6. **Shaft**
7. **Cap screw (4)**
8. **Lock washer (4)**
9. **Hex nut (4)**
10. **Shaft lock washer**
11. **Shaft hex nut**

Battery Storage

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

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

2. Either store battery on a shelf or on the machine leaving cables disconnected.

3. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

4. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service).

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

IMPORTANT: Do not remove battery fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

   B. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

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

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (–) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours and every 30 days if machine is in storage.

6. Maintain cell electrolyte level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Specifications

BCI Group 34 Battery
690 Amp Cranking Performance at 0F (−18C)
100 minute Reserve Capacity at 80F (27C)
Electrolyte Specific Gravity (fully charged):
from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal (Fig. 167)

IMPORTANT: Be careful not to damage battery terminal posts or cable connectors when removing the battery cables.

1. Make sure ignition and all accessories are **OFF**.

2. Loosen strap and remove battery box cover from machine.

3. Using two (2) wrenches, loosen cap screw and nut on ground (–) cable connector first and then remove ground (–) cable from battery. This should prevent short circuiting the battery, other components or the operator's hands.

4. Loosen cap screw and nut on positive (+) cable connector using two (2) wrenches. Remove positive (+) cable from battery.

5. Make sure battery vent caps are on tightly.

6. Remove battery from the battery box and machine.

Battery Installation (Fig. 167)

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition and all accessories are **OFF**.

2. Make sure that battery box is clean and that battery cables and connections are in good condition.

3. Place battery into battery box and make sure battery is level and flat.

4. Connect positive (+) cable connector onto positive battery post. Tighten cap screw and nut using two (2) wrenches.

5. Connect a digital multimeter (set to amps) between the negative battery post and the ground (–) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

6. Connect ground (–) cable connector to the negative battery post. Tighten cap screw and lock nut using two (2) wrenches.

7. Coat battery posts and cable connectors with Battery Terminal Protector (Toro Part No. 107–0392) or petroleum jelly to prevent corrosion.

8. Install battery cover and secure with strap.

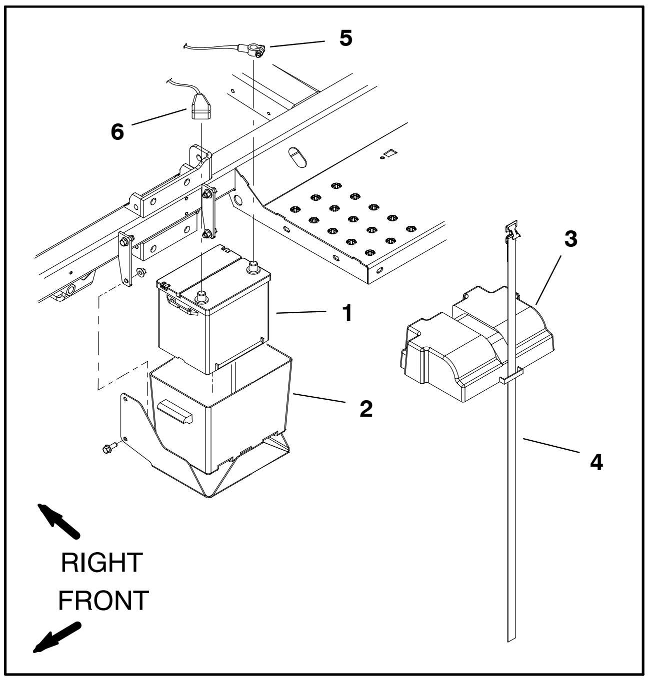


Figure 167

1. Battery
2. Battery box
3. Cover
4. Strap
5. Negative cable
6. Positive cable

Battery Inspection and Maintenance

1. Replace battery if cracked or leaking.

2. Check battery terminal posts and cables for corrosion. Use wire brush to clean corrosion from posts and cables.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

5. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled water** between the minimum and maximum fill lines. Charge at 15 to 25 amps for fifteen (15) minutes to allow sufficient mixing of the electrolyte (see battery charging in this section).

Battery Testing

1. Conduct a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm−up the hydrometer. At the same time take the temperature of the cell.

B. Temperature correct each cell reading. For each 10^{o} F (5.5 C) above 80^{o} F (26.7 C) add 0.004 to the specific gravity reading. For each 10^{o} F (5.5 C) below 80^{o} F (26.7 C) subtract 0.004 from the specific gravity reading.

Example:

Cell Temperature: 100 F
Cell Gravity: 1.245
100 F minus 80 F equals 20 F
(37.7 C minus 26.7 C equals 11.0C)
20 F multiply by 0.004/10F equals 0.008
(11 C multiply by 0.004/5.5 C equals 0.008)
ADD (conversion above) 0.008
Correction to 80 F (26.7 C) 1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

2. Perform a high−discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold−cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the battery load tester manufacturer's instructions when using a battery load tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, charge the battery (see battery charging in this section).

B. If the battery has been charged, apply a 150 amp load for fifteen (15) seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the battery tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 345 amps (one half the cranking performance rating of the battery) for fifteen (15) seconds.

G. Take a voltage reading after fifteen (15) seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70 F (and up)	21.1C (and up)
9.5	60 F	15.6 C
9.4	50 F	10.0 C
9.3	40 F	4.4 C
9.1	30 F	−1.1 C
8.9	20 F	−6.7 C
8.7	10 F	−12. 2C
8.5	0 F	−17.8 C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is available in most shops.

CAUTION

Follow the battery charger manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	**3.8 hrs @ 3 amps**	**7.5 hrs @ 3 amps**	**11.3 hrs @ 3 amps**	**15 hrs @ 3 amps**
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60 F (15.5 C) before connecting to a charger.

Charge the battery in a well−ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125 F (52 C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

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Chapter 7

ExcelaRate Spray System

Table of Contents

Specifications

Item	Description
Spray Pump	6–Diaphragm, Positive Displacement Pump Maximum Flow Rate of 42 GPM (159 lpm) at 475 rpm
Spray Pressure Relief Valve	Poppet Style, 218 PSI (15 Bar) Maximum
Sprayer Tank	300 U.S. Gallon (1136 Liter), Polyethylene
Suction Strainer	Stainless Steel, Tank Mounted (30 Mesh – Green, 50 Mesh – Blue, 80 Mesh – Red)
Pressure Filter	Agitation Manifold Mounted (16 Mesh – Brown Red, 30 Mesh – Red, 50 Mesh – Blue, 80 Mesh – Yellow, 100 Mesh – Green*)

*ISO colors beginning September 30, 2015 listed

General Information

User Manuals

A variety or User Manuals are available for Multi Pro machines with ExcelaRate spray systems. The Operator's Manual, Software Guide, Installation Instructions and Parts Catalogs provide information regarding the installation, operation, general maintenance and maintenance intervals for your Multi Pro machine. Refer to these publications for additional information when servicing the machine.

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil or other property. To reduce the risk of environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Stop the vehicle and set the parking brake.

2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure line pressure is relieved before loosening any system component (e.g. spray valves, spray system hose).

Special Tools

Quick Check Catch Jug – 64 oz (946 ml)

Use this container during flow calibration and spray nozzle catch tests.

NOTE: For most applications, a 32 oz (946 ml) catch jug may be more accurate and easier to use.

IMPORTANT: When you are reading the graduated container, you must set the container on a level surface. Read the fluid volume in the graduated container at the lowest point of the fluid–surface curve. Small errors reading the fluid volume in the graduated container will significantly impact the accuracy of the sprayer calibration.

Multi Pro 5800 sprayers using revision D software use a variable timed catch test to achieve the target spray volume. Revision D software is compatible with all Multi Pro 5800 sprayers with serial numbers above 316000000.

Multi Pro 5800 sprayers using revision A, B and C software use a fixed 15 second catch test time. The table in Figure 2 lists the desired nozzle volume for a 15 second catch test.

Toro Part Number: **131–7237**

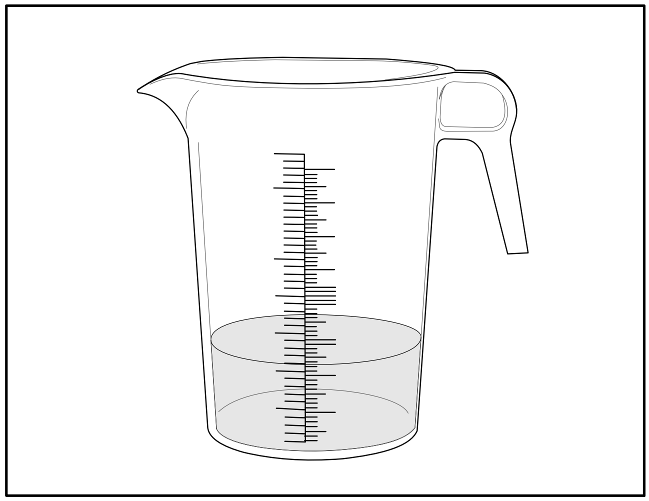

Figure 1

Nozzle Color	Ounces Collected in 15 Seconds (+/– ¼ oz)	Milliliters Collected in 15 Seconds (+/– 7.4 ml)
Yellow	6.4	189
Red	12.8	378
Brown	16.0	473
Gray	19.2	567
White	25.6	757
Blue	32.0	946
Green	48.0	1,419

Figure 2

ExcelaRate Spray System Diagram

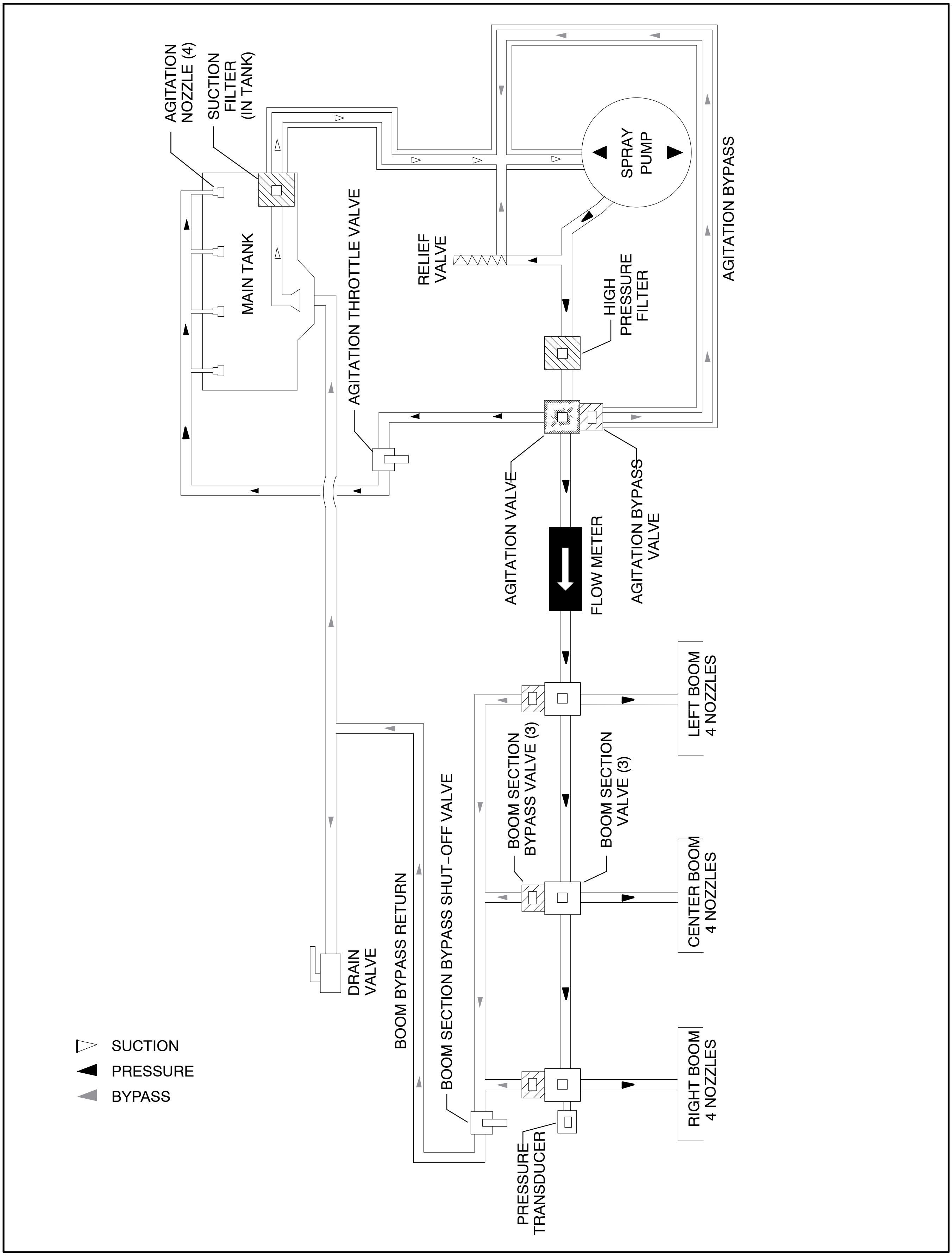

Figure 3

ExcelaRate Spray System Operation

The ExcelaRate system controls application rate by increasing/decreasing the hydraulic flow to the spray pump proportional valve (increasing/decreasing pump speed and therefore output/pressure) based on input from:

Operator programming (application rate)

Flow meter

Ground speed

Additional ExcelaRate system information can be found in the Multi Pro 5800 Operator's Manual and Software Guide.

Spray Pump

The ExcelaRate spray system on the Multi Pro 5800 uses a positive displacement six (6) diaphragm pump to move spray solution from the spray tank to the boom nozzles. The spray pump is self−priming with manually lubricated bearings and a dry crankcase.

The downward stroke of the pump's connecting rods and diaphragms creates suction to allow fluid to be drawn from the spray tank to the pump via the suction tube, suction strainer, hoses and connectors. Suction valves positioned in the pump valve chamber prevent fluid from being pumped back into the suction line during the upward stroke of the pump's connecting rods. Leaks in the suction line will cause system problems and often will be indicated by erratic spray, line jumping and excessive pump noise.

Once to the pump, the fluid is pushed by the upward stroke of the pump's connecting rods and diaphragms to the pressure side of the spray system. Pressure valves positioned in the pump head prevent fluid from being drawn back into the pump during the downward stroke of the pump's connecting rods. Maximum pressure in the system is limited by a pressure relief valve located near the pump. If spray system pressure exceeds 218 psi (15 Bar), spray product is directed back to the suction side of the spray pump. A pressure transducer in the system provides spray pressure information to the TEC and for the InfoCenter display. An analog pressure gauge is also located on the dash panel to indicate spray system pressure.

System Controls

Battery current for spray system fuses, switches, valve actuators and other electrical components is provided by the main relay when the machine ignition switch is in the RUN position. For spray system electrical component information and circuitry, see Chapter 6 − Electrical System and Appendix A − Foldout Drawings in this manual.

The spray system is configured and spray application is monitored through the InfoCenter display. The spray system is operated by a variety of electrical switches located on the dash and control console. Switches include a spray mode switch, spray pump enable switch, an application rate (increase/decrease) switch, an agitation control switch, three (3) boom section control switches and two (2) boom lift switches. These switches control the desired mode of spray system operation, control the spray pump hydraulic proportional valve, the agitation control valve, three (3) boom control valves and the hydraulic boom lift solenoid coils. Additionally, a master boom switch allows the operator to turn ON/OFF all active boom sections with one touch.

The spray pump is directly coupled to and driven by a hydraulic motor. Flow from the hydraulic system gear pump to the motor is controlled by a series of valves in the pump control manifold. Based on available current (mA) from the Toro Electronic Controller (TEC), the hydraulic proportional valve (PV) controls hydraulic flow to the spray pump motor. This hydraulic flow causes the motor to rotate the spray pump for spray system operation. A logic cartridge (LC) and a relief valve (RV) located in the pump control manifold help maintain consistent and safe operating pressure. See Hydraulic Flow Circuits − Spray Pump Drive Circuit in Chapter 5 − Hydraulic System in this manual for more detailed information.

When the spray pump is ON, the switch light is illuminated, the spray pump icon appears on the InfoCenter display and the application rate (increase/decrease) switch allows the operator to adjust the electrical current to the hydraulic proportional valve solenoid coil. Higher current (rate increase) to the solenoid coil increases hydraulic flow to the spray pump motor and results in a higher spray pump speed and more output/pressure. Lower current (rate decrease) to the solenoid coil decreases hydraulic flow to the spray pump motor and results in a lower spray pump speed and less output/pressure. The spray nozzles achieve their rated output at 40 psi (2.8 bar) unless otherwise stated. The application rate and nozzle selected will dictate the exact pressure. See the Spray Nozzle Selection Guide (Toro12−082−T) for information regarding spray nozzle selection.

Agitation circuit

When the agitation switch is ON, the switch light is illuminated, the agitation icon appears on the InfoCenter display and the agitation control valve is opened. This open valve directs spray system flow to four (4) agitation nozzles on the left side of the spray tank. The agitation nozzles direct spray product back into the lower portion of the tank to agitate or stir the contents of the tank. When the agitation switch is OFF, the agitation control valve is closed so no flow is directed to the tank agitation nozzles. The agitation valve includes an LED to indicate the current valve position (red = closed, green = open).

A manually adjustable agitation bypass valve is incorporated into the agitation control valve. Proper adjustment of the agitation bypass valve prevents system pressure changes when the agitation valve is switched ON/OFF while spraying. Flow from the agitation bypass valve is directed back to the suction side of the spray pump (agitation bypass).

A manually adjustable agitation throttle valve restricts the flow to the agitation nozzles. The valve allows controlling the spray system pressure at the agitation nozzles when larger application rates are used.

Spray boom circuit

The system includes an in−line flow meter to measure actual spray product flow to the boom control valves. The flow meter is positioned directly before the boom control valves.

The individual boom control switches (left, center, right) work together with the master boom switch to control the boom section valves. An open boom section valve directs spray system flow to the spray nozzles located on that boom section. When a boom section valve is closed, no spray system flow is available to that spray boom section. Each boom section valve includes an LED to indicate the current valve position (red = closed, green = open).

Manually adjustable boom bypass valves are incorporated into each of the boom control valves. Proper adjustment of the boom bypass valves prevent system pressure changes when one of boom section valves is switched ON/OFF while spraying in manual mode. Flow from the boom bypass valves is directed back to the spray tank (boom bypass). A boom section bypass shut−off valve is used to prevent spray product from bypassing when spraying in automatic application rate mode.

IMPORTANT: The boom section bypass shut−off valve must be closed during automatic application rate mode operation for the spray system to function accurately.

InfoCenter Display

The InfoCenter Display is a LCD device that is located in the Operator control console. The InfoCenter display provides information for the machine operator during spray system operation and calibration, provides electrical system diagnostic assistance for technicians and allows input for user adjustable spray system settings. See Chapter 6 Electrical System in this manual for additional information.

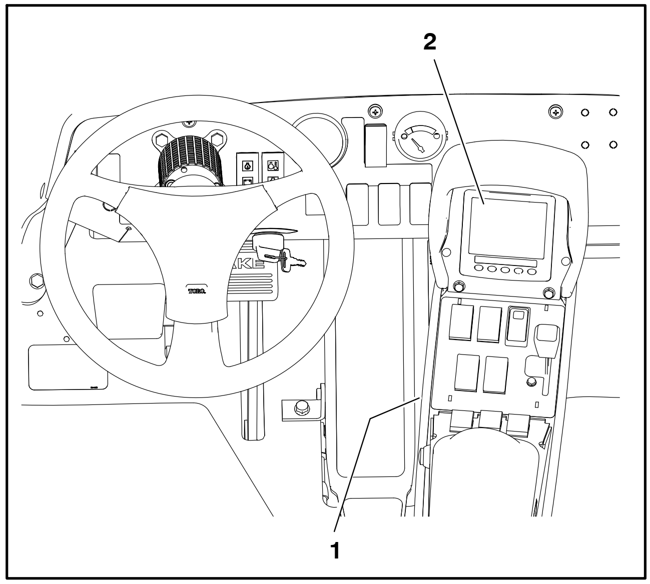

Figure 4

1. **Operator control console**
2. **InfoCenter Display**

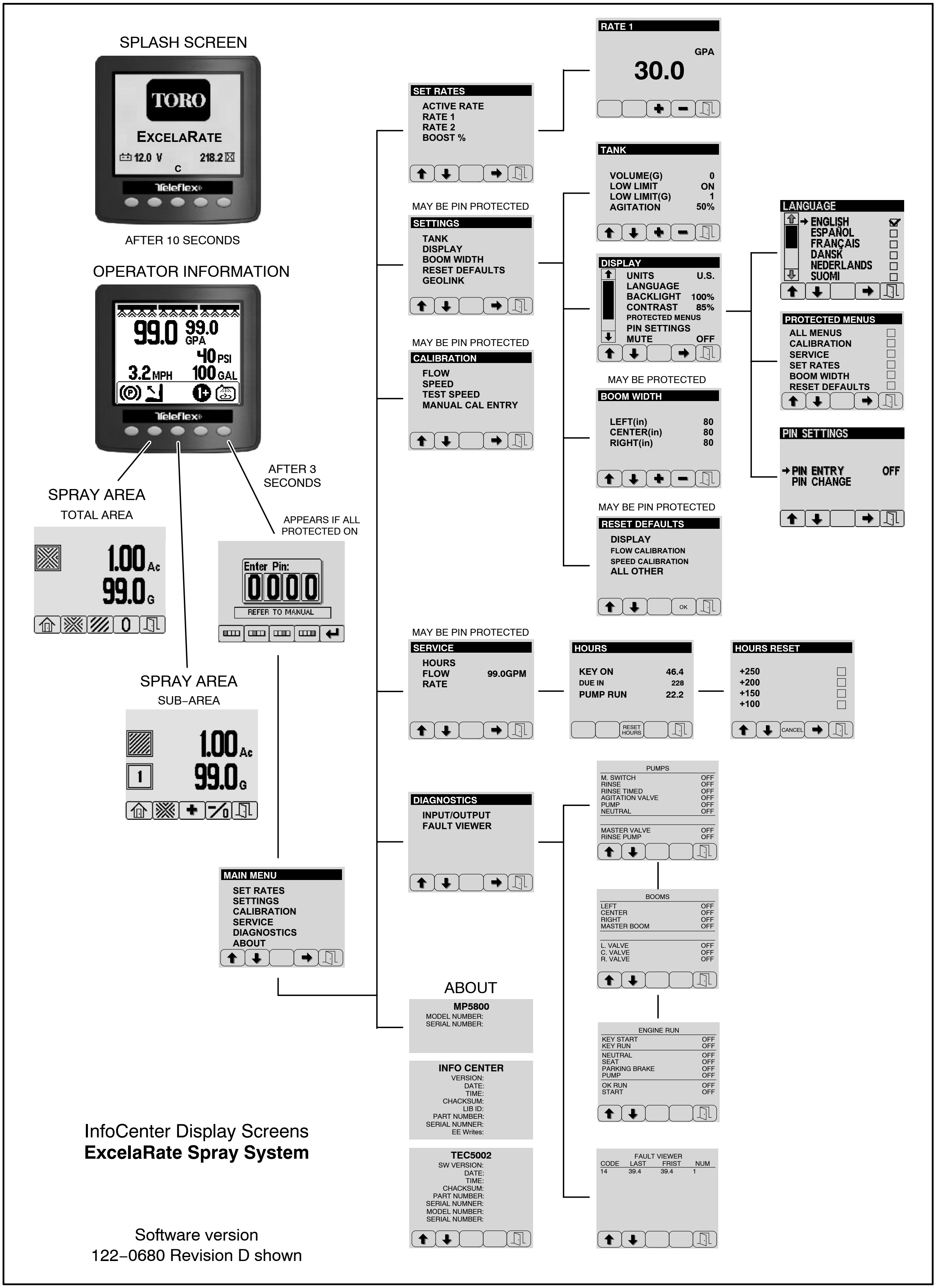
SPLASH SCREEN
TORO
EXCELARATE
12.0 V
218.2
C
Teleflex
AFTER 10 SECONDS
OPERATOR INFORMATION
99.0 99.0 GPA
40 PSI
3.2 MPH 100 GAL
Teleflex
AFTER 3 SECONDS
SPRAY AREA
TOTAL AREA
1.00 Ac
99.0 G
APPEARS IF ALL PROTECTED ON
Enter Pin:
0000
REFER TO MANUAL
SPRAY AREA
SUB-AREA
1.00 Ac
1
99.0 G
MAIN MENU
SET RATES
SETTINGS
CALIBRATION
SERVICE
DIAGNOSTICS
ABOUT
SET RATES
ACTIVE RATE
RATE 1
RATE 2
BOOST %
RATE 1
GPA
30.0
MAY BE PIN PROTECTED
SETTINGS
TANK
DISPLAY
BOOM WIDTH
RESET DEFAULTS
GEOLINK
TANK
VOLUME(G) 0
LOW LIMIT ON
LOW LIMIT(G) 1
AGITATION 50%
DISPLAY
UNITS U.S.
LANGUAGE
BACKLIGHT 100%
CONTRAST 85%
PROTECTED MENUS
PIN SETTINGS
MUTE OFF
LANGUAGE
ENGLISH
ESPAÑOL
FRANÇAIS
DANSK
NEDERLANDS
SUOMI
PROTECTED MENUS
ALL MENUS
CALIBRATION
SERVICE
SET RATES
BOOM WIDTH
RESET DEFAULTS
PIN SETTINGS
PIN ENTRY OFF
PIN CHANGE
MAY BE PIN PROTECTED
CALIBRATION
FLOW
SPEED
TEST SPEED
MANUAL CAL ENTRY
MAY BE PROTECTED
BOOM WIDTH
LEFT(in) 80
CENTER(in) 80
RIGHT(in) 80
MAY BE PIN PROTECTED
RESET DEFAULTS
DISPLAY
FLOW CALIBRATION
SPEED CALIBRATION
ALL OTHER
OK
MAY BE PIN PROTECTED
SERVICE
HOURS
FLOW 99.0GPM
RATE
HOURS
KEY ON 46.4
DUE IN 228
PUMP RUN 22.2
RESET HOURS
HOURS RESET
+250
+200
+150
+100
CANCEL
DIAGNOSTICS
INPUT/OUTPUT
FAULT VIEWER
PUMPS
M. SWITCH OFF
RINSE OFF
RINSE TIMED OFF
AGITATION VALVE OFF
PUMP OFF
NEUTRAL OFF
MASTER VALVE OFF
RINSE PUMP OFF
BOOMS
LEFT OFF
CENTER OFF
RIGHT OFF
MASTER BOOM OFF
L. VALVE OFF
C. VALVE OFF
R. VALVE OFF
ENGINE RUN
KEY START OFF
KEY RUN OFF
NEUTRAL OFF
SEAT OFF
PARKING BRAKE OFF
PUMP OFF
OK RUN OFF
START OFF
FAULT VIEWER
CODE LAST FRIST NUM
14 39.4 39.4 1
ABOUT
MP5800
MODEL NUMBER:
SERIAL NUMBER:
INFO CENTER
VERSION:
DATE:
TIME:
CHACKSUM:
LIB ID:
PART NUMBER:
SERIAL NUMNER:
EE Writes:
TEC5002
SW VERSION:
DATE:
TIME:
CHACKSUM:
PART NUMBER:
SERIAL NUMNER:
MODEL NUMBER:
SERIAL NUMBER:
InfoCenter Display Screens
ExcelaRate Spray System
Software version
122-0680 Revision D shown

Figure 5

Splash Screen

When the ignition switch is turned from the OFF position to the ON or START position, the InfoCenter splash screen appears (Fig.6). The splash screen provides the following information to the operator:

Spray System Installed

Voltmeter

System Software Revision Level

Hour meter: For machines with gasoline engine, engine hours are displayed. For machines with diesel engine, key on hours are displayed.

After the splash screen has been displayed for ten seconds, the operator 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.

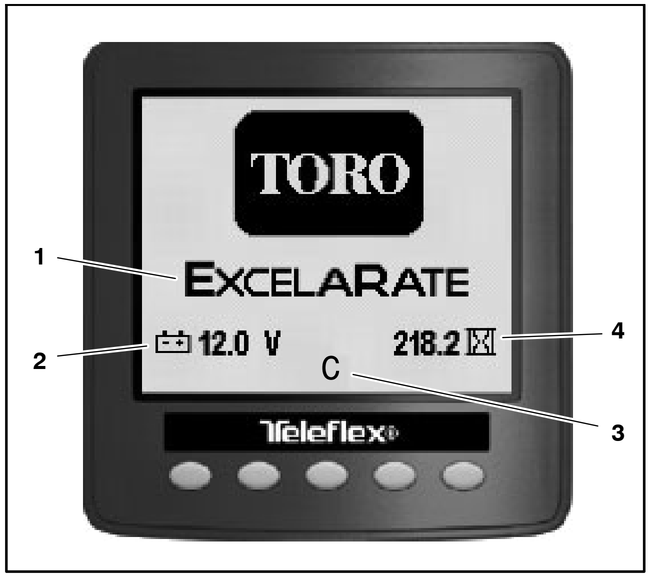

Figure 6

1. **Spray system installed**
2. **Voltmeter**
3. **System software revision**
4. **Engine hour meter**

Operator's Information

The operator's 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. 7). The operator's information screen is the "default" screen as it will be displayed during normal machine operation. See the machine Operators Manual or Software Guide for additional information.

NOTE: Depending on the operation mode, all indicators and icons may not appear.

The operator's information screen provides the following information to the operator:

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.

Actual Spray System Application Rate: Indicates the actual rate at which the sprayed product is being applied.

Target Spray System Application Rate: Indicates the target rate that the user desires.

Spray System Pressure: Indicates the spray pressure when the boom sections are ON or the agitation pre−set pressure when the boom sections are OFF.

Vehicle Speed

Spray Tank Volume: Displays the amount of product remaining in the spray tank. This is a calculation based on the volume manually entered when the tank is filled, then reduced by the amount of product passing through the flow meter.

Brake: Icon appears whenever the brake is applied, and stays on when the parking brake is engaged.

Operator Presence: Icon appears when the operator is out of the operator seat.

Application Rate Selected: The selected pre−set application rate number is displayed. This represents the number of the pre−set rate, not the actual rate of spray product being applied. See Set Rates in this chapter for additional information.

Application Rate Boost: The + appears when the application rate boost is active.

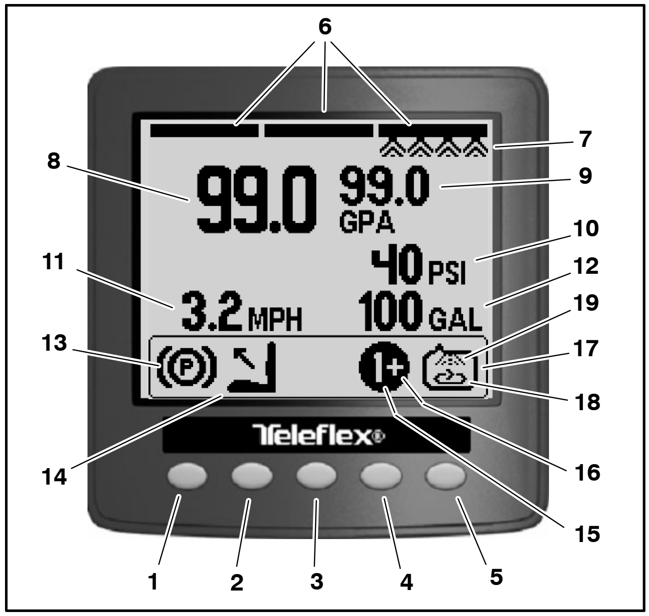

Figure 7

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Master boom(active
7. Boom section active
8. Actual application rate
9. Target application rate
10. Spray system pressure
11. Vehicle speed
12. Spray tank volume remaining
13. Brake applied
14. Operator presence
15. Pre−set application rate selected
16. Application boost active
17. Spray pump enabled
18. Agitation enabled
19. Tank Rinse enabled

NOTE: When the spray pump is enabled, press and hold buttons 1 and 5 simultaneously while viewing the Operator's Information screen to activate the boost feature. Boost is active only as long as the buttons are depressed. The spray system returns to the set application rate when the buttons are released.

Spray Pump: Icon (spray tank) appears when spray pump is enabled.

Spray Tank Agitation: Icon (spray tank with mixing pattern) appears when spray tank agitation is enabled.

Clean Tank Rinse Pump (optional kit): Icon (spray tank with spray pattern) appears when clean tank rinse pump is enabled.

Press and hold button 5 for 3 seconds to access the main menu screen.

Press any button 1−4 to expose the menu bar. From the menu bar, press button 2 to access the spray area screen−total area or press button 3 to access the spray area screen−sub area.

Spray Areas

Use the spray area screens to view the area and the amount of product sprayed since the screens were cleared (Fig. 8). See the machine Operators Manual or Software Guide for additional information.

NOTE: Depending on the operation mode, all indicators and icons may not appear.

Total Area Screen

The total area screen displays the total area and total amount of product sprayed since last reset. The total area screen is accessed from the operator information screen by pressing any button 1−4 to expose the menu bar then press button 2.

Press any button 1−4 to expose the menu bar then press button 2. From the menu bar, press button 2 to access the spray area screen−total area or press button 3 to access the spray area screen−sub area.

NOTE: Resetting the total area will also reset all of the sub areas.

Press and hold button 4 to reset the total area.

Press button 3 to display the sub area screens.

Press button 1 to return to the operator information screen, or button 5 to hide the menu bar.

Sub−Area Screen

The sub−area screen displays the area and amount of product sprayed in the any of twenty (20) sub−areas since last reset. The sub−area screen is accessed from the operator information screen by pressing any button 1−4 to expose the menu bar then press button 3.

Press button 3 to select the next sub area, or button 4 to display the previous sub area.

Press and hold button 4 to reset the sub area currently displayed.

Press button 2 to display the total area screen.

Press button 1 to return to the operator information screen, or button 5 to hide the menu bar.

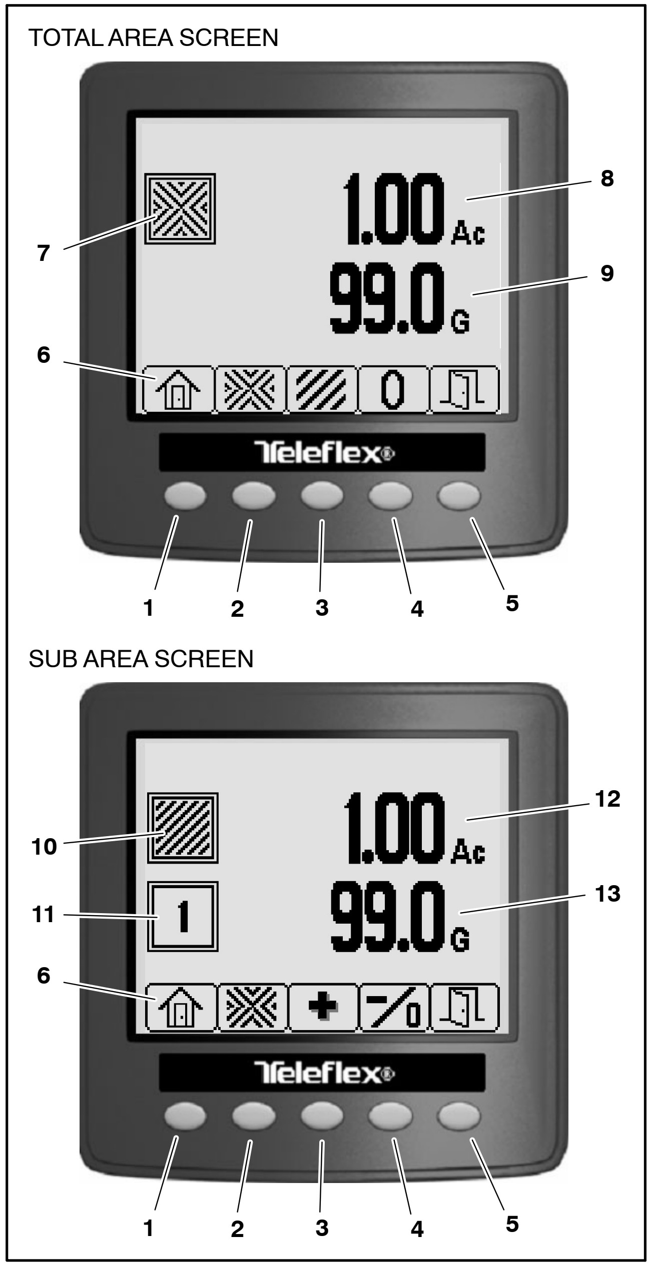

Figure 8

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Menu bar**
7. **Total area icon (pattern)**
8. **Total area applied**
9. **Total volume applied**
10. **Sub−area icon (pattern)**
11. **Sub−area number**
12. **Sub−area area applied**
13. **Sub−area volume applied**

Main Menu

The main menu (Fig. 9) provides access to the following screens:

Set Rates

Settings

Calibration

Service

Diagnostics

About

NOTE: The Main Menu screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

The main menu screen is accessed by pressing an holding button 5 on the display for approximately 3 seconds.

NOTE: Access to the main menu screens may require entering a Personal Identification Number (PIN). The default PIN is either **1234** or **5900**. See the machine Operator's Manual for additional PIN information.

Return to the previous screen by pressing button 5

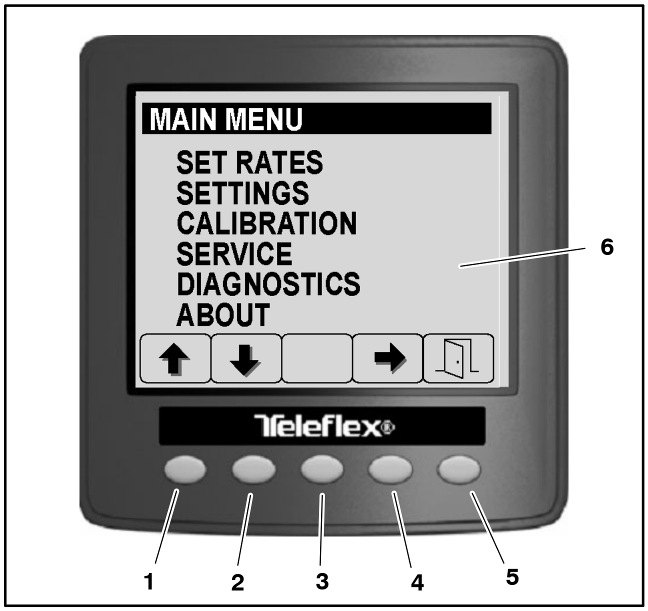

Figure 9

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Menu Menu screen**

Set Rates

The Set Rates screen (Fig. 10) is accessed from the main menu and provides selection between previously set application rates (Rate 1 or Rate 2). See the machine Operators Manual or Software Guide for additional information.

The Set Rate screen also allows access to the setting the following:

Rate 1: A programed rate of spray product deposited while operating in automatic–application mode.

Rate 2: A programed rate of spray product deposited while operating in automatic–application mode.

Boost %: The percentage of spray product deposited in addition to the current application rate while operating in automatic–application mode and Boost is active. Example: if boost % is set to 10, and the application rate is 30 GPA, the actual amount being deposited when the boost feature is active is 110% or 33 GPA.

NOTE: The Set Rates screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

Access the Set Rate screen by pressing buttons 1 or 2 to highlight SET RATES, then press button 4 to select the highlighted screen. Adjust the selected rate by pressing buttons 3 or 4.

Return to the previous screen by pressing button 5

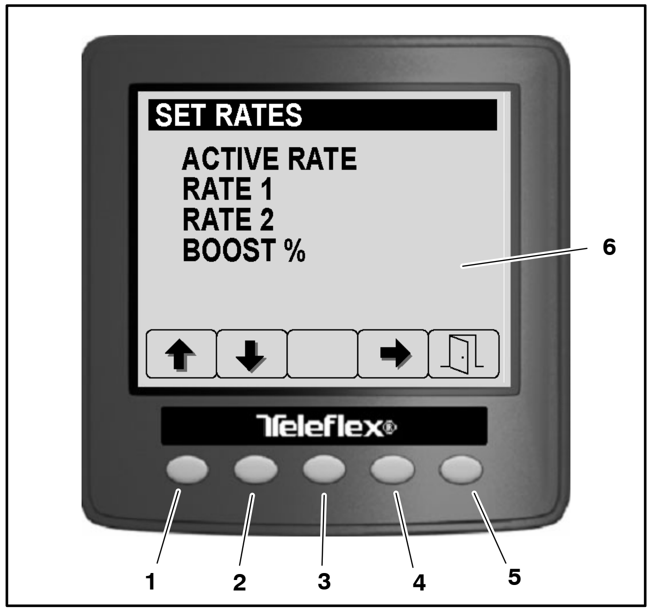

Figure 10

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Set rates screen**

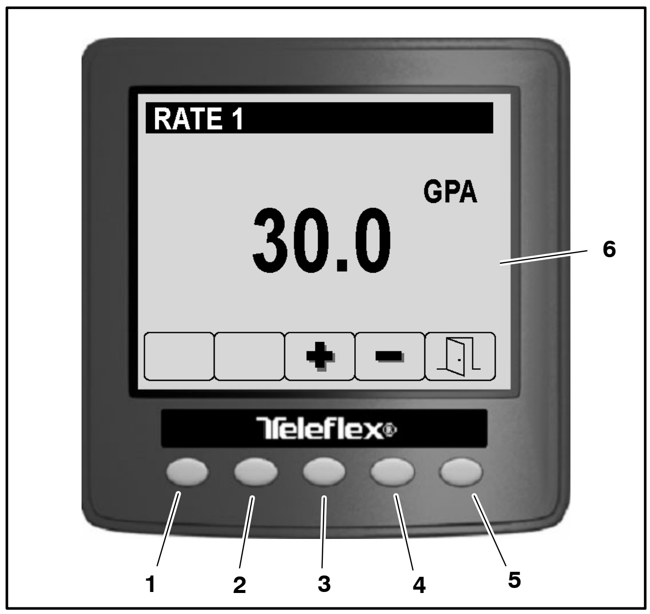

Figure 11

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Rate adjustment screen**

Settings

The Settings screen (Fig. 12) is accessed from the main menu and provides access to the following settings:

Tank

Display

Boom Width

Reset Defaults

GeoLink

Access the Settings screen by pressing buttons 1 or 2 to highlight SETTINGS, then press button 4 to select the highlighted screen. Scroll through the various Settings screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

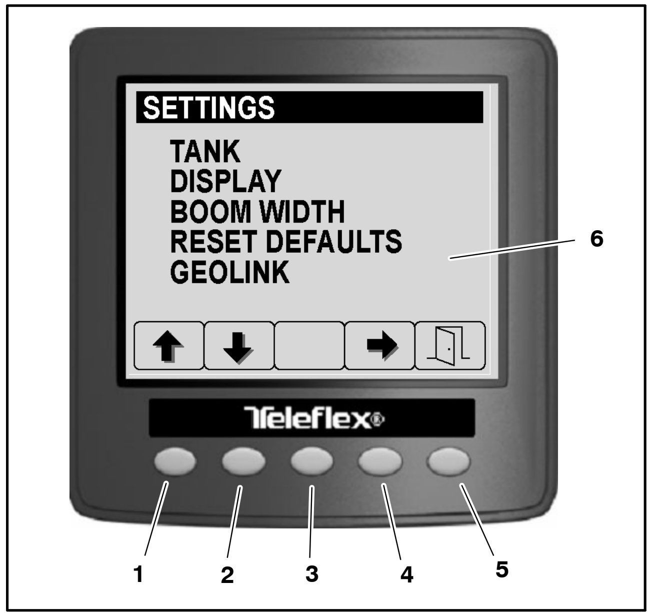

Figure 12

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Settings screen**

TANK

The tank settings s (Fig. 13) are accessed from the settings screen and provide access to the following spray tank settings:

Volume (unit of measure): The amount of spray product being added to the tank. This should be manually entered by the operator or spray technician when the tank is filled and before starting to spray.

NOTE: When using the spray tank low limit feature, the spray tank volume must be entered every time the spray tank is filled (see the machine Operators Manual or Software Guide for additional information).

Low Limit: Switches the low spray tank alarm ON/ OFF.

Low Limit (unit of measure): The tank volume that triggers the low spray tank alarm.

Agitation: The pump speed when the pump is enabled and all spray booms are OFF (idle). This setting is expressed as a percentage of maximum pump speed.

Access the various items by pressing buttons 1 or 2 to highlight the desired item, then buttons 3 or 4 to adjust the setting.

Return to the previous screen by pressing button 5

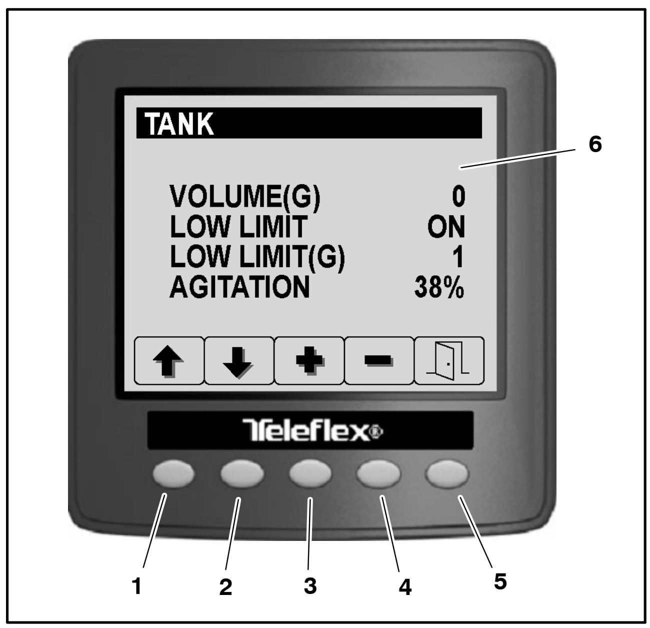

Figure 13

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Tank settings**

DISPLAY

The Display settings (Fig. 14) are discussed in Chapter 6 – Electrical System in this manual.

BOOM WIDTH

The Boom Width settings entered on this screen are used by the spray system to calculate the area sprayed. The boom width settings (Fig. 15) are accessed from the settings screen and provide access to the following display settings:

Left: The width of left boom installed.

Center: The width of center boom installed.

Right: The width of right boom installed.

NOTE: The Boom Width screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

Access the various items by pressing buttons 1 or 2 to highlight the desired item and button 3 or 4 to adjust the setting.

Return to the previous screen by pressing button 5

RESET DEFAULTS

The Reset Defaults screen is discussed in Chapter 6 – Electrical System in this manual.

GEOLINK

Use the GeoLink screen to activate the GeoLink spray control system. Turn ON the GeoLink setting only if you have the optional GeoLink spray system installed on the machine. See Chapter 8 – GeoLink Spray System in this manual for additional service information.

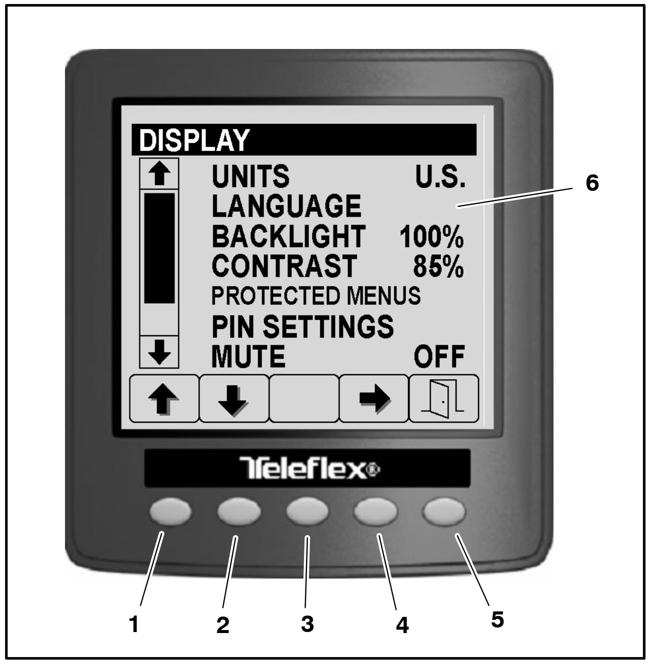

Figure 14

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Display settings

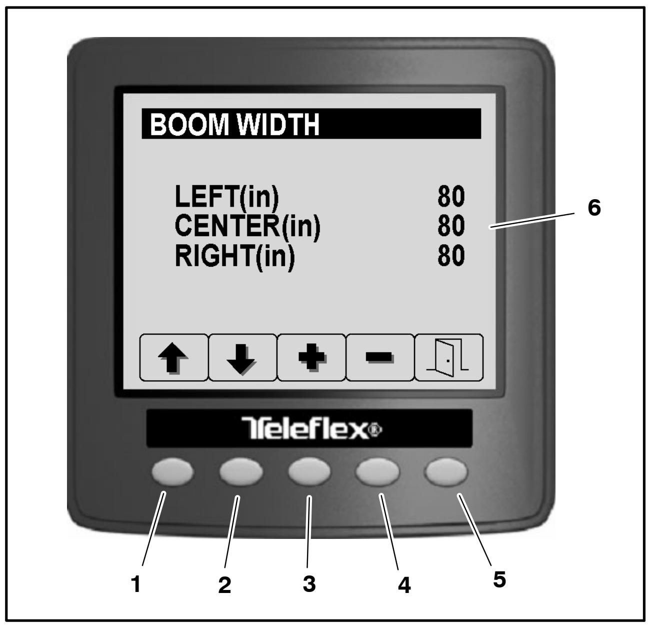

Figure 15

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Boom width settings

Calibration

To assure accurate spray system performance, the flow meter and vehicle speed inputs must be calibrated and should be re−calibrated often. The result of the calibration process is a correction factor which modifies the default setting of the flow meter or speed sensor. The flow meter should be calibrated after changing spray nozzles or replacing a flow meter or flow meter sensor. See the machine Operator's Manual or Software Guide for additional information.

The Calibration screen (Fig. 16) is accessed from the main menu and provides access to the following:

Flow (calibration): initiates a multi−screen, step−by−step series of instructions to guide you through the flow meter input calibration process

Speed (calibration): initiates a multi−screen, step−by−step series of instructions to guide you through the speed sensor input calibration process

Test Speed: used to simulate a ground speed signal for stationary spray system testing like setting section bypass valves

Manual Cal (calibration) Entry: used to view and modify the calibration correction factor for 3−boom, 2−boom, 1−boom, and speed calculations

IMPORTANT: Toro does not recommend that you change calibration correction factors manually. Use the Flow Calibration and Speed Calibration procedures to set−up the spray system.

NOTE: The Calibration screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 − Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

Access the Calibration screen by pressing buttons 1 or 2 to highlight CALIBRATION, then press button 4 to select the highlighted screen. Scroll through the various Calibration menus by pressing buttons 1 or 2, then press button 4 to access the selection.

Return to the previous screen by pressing button 5

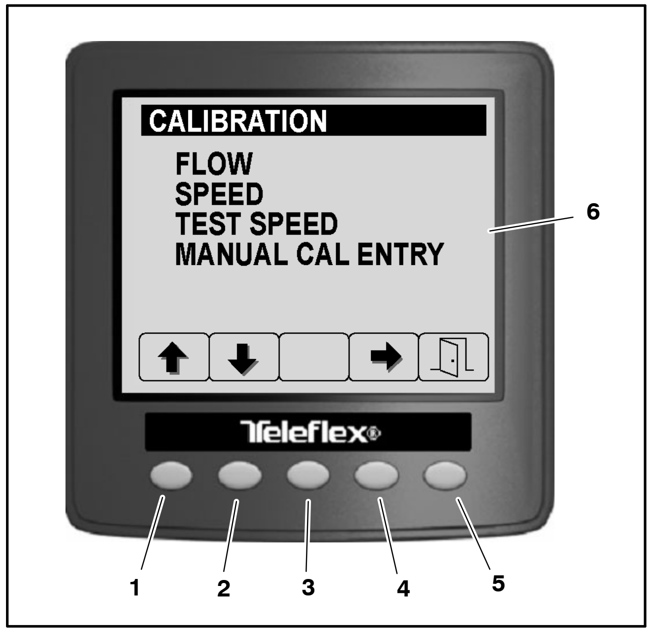

Figure 16

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Calibration screen**

Service

The service screen (Fig. 17) is accessed from the main menu and provides access to the following screens:

Hours (ignition key on, service due in, spray pump run hour meters)

Flow Rate: The current actual spray product flow.

NOTE: The Service screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

Access the Hours screen by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted item.

Return to the previous screen by pressing button 5

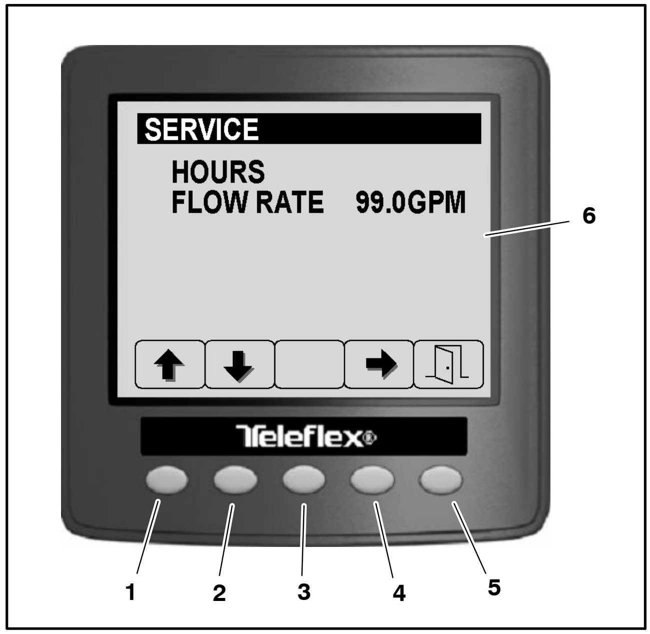

Figure 17

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Service screen**

HOURS

The hours screen contains a variety of machine hour meters including the total length of time the spray pump has been operating (Fig. 18).

NOTE: See InfoCenter > Service in Chapter 6 – electrical System in this manual for additional information on resetting the Due In hourmeter.

Return to the previous screen by pressing button 5

FLOW RATE

The Flow Rate reading displayed on the Service Screen represents the actual volume of spray product passing through the flow meter at that moment (Fig. 19). Use the flow rate feature to monitor the flow meter reading at anytime during spray system operation. Viewing flow meter performance may be helpful while troubleshooting spray system or flow meter performance issues.

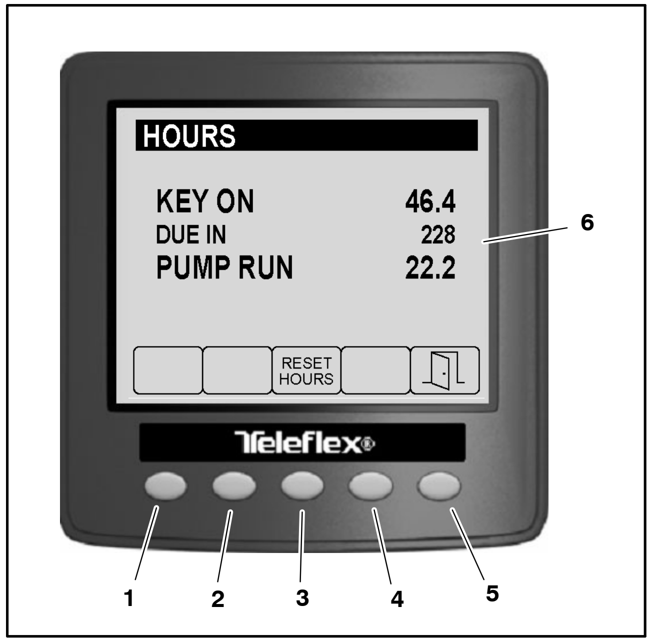

Figure 18

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Hours screen**

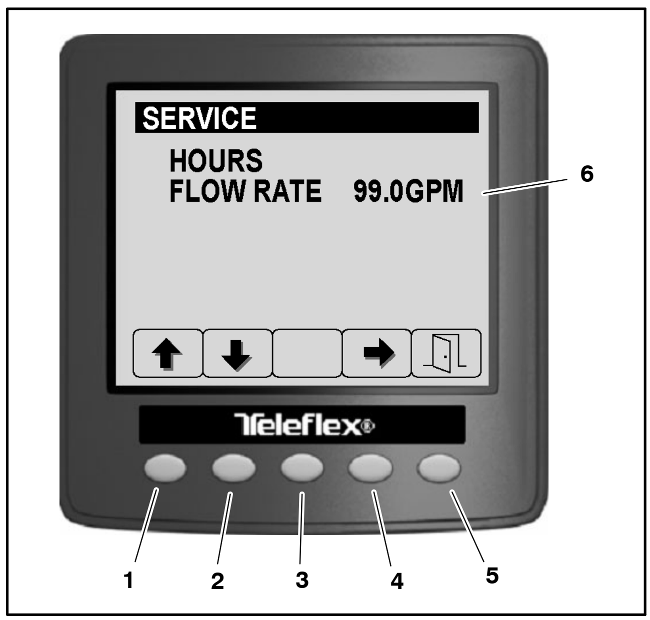

Figure 19

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Current actual flow rate**

Diagnostics

The Diagnostic screen (Fig. 20) is accessed from the main menu and provides access to the following screens:

Input / Output

Fault Viewer

Access the diagnostics screens by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted screen.

Return to the previous screen by pressing button 5

INPUT/OUTPUT

The input/output screens display the current state of the various Toro Electronic Controller (TEC) inputs, qualifiers and outputs necessary to allow a machine or spray system function to occur. The input/output screens should be used to troubleshoot spray system operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting in this chapter). Scroll through the input/output screens by pressing buttons 1 or 2.

Each of the following spray system functions has its own input/output screen:

Pumps

Booms

Engine Run

Each screen is separated into four (4) areas of information (Fig. 21). The first area identifies the spray system function. The second area identifies the inputs that are necessary for the function to occur. The third area identifies qualifiers that are involved with the function (safety interlocks). The fourth area identifies the outputs that are necessary for the function to occur.

Return to the previous screen by pressing button 5

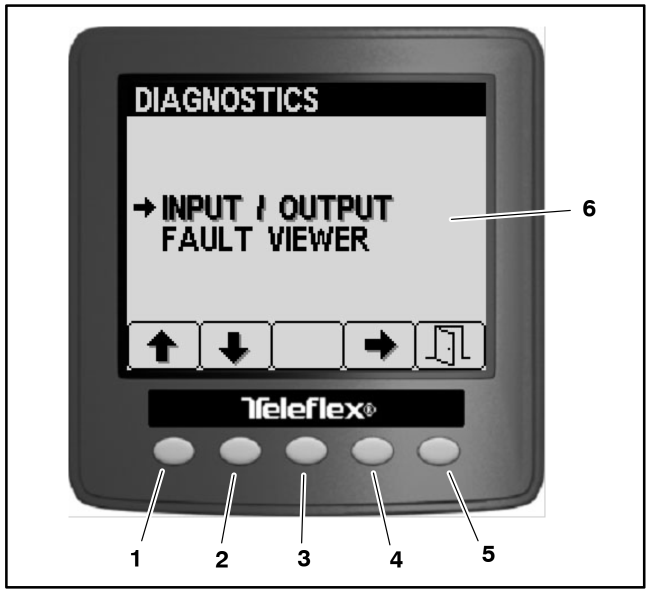

Figure 20

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Diagnostics screen

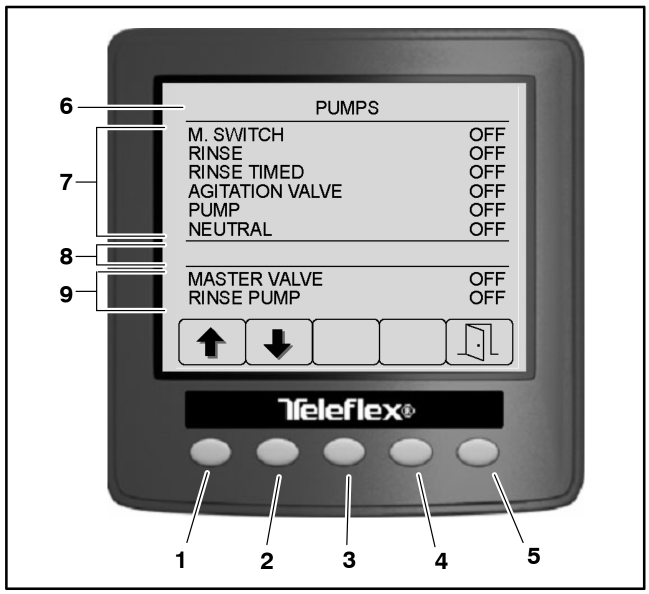

Figure 21

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Machine function
7. Inputs
8. Qualifiers (none)
9. Outputs

Pumps

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Pumps Screen:

M. SWITCH: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

RINSE: ON when the optional clean tank rinse kit rinse pump switch is held in the MOMENTARY (down) position.

RINSE TIMMED: ON for a 60 second timed period when the optional clean tank rinse kit rinse pump switch is in the ON (up) position.

AGITATION VALVE: ON when the agitation switch is in the ON position.

PUMP: ON when the spray pump switch is in the ON position.

NEUTRAL: ON when the traction pedal is in neutral.

There are no qualifiers involved in the PUMPS function.

When the pump switch input is in the ON position (PUMP ON), the following output should occur (Fig. 22):

MASTER VALVE ON – TEC output 9: The spray pump hydraulic proportional control valve PV in the spray pump control manifold should energize.

When the optional rinse pump switch input is in the ON (up) position (RINSE TIMED ON), the following output should occur (Fig. 23):

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for 60 seconds.

When the optional rinse pump switch input is held in the MOMENTARY (down) position (RINSE PUMP ON), the following output should occur:

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for as long as the switch is depressed.

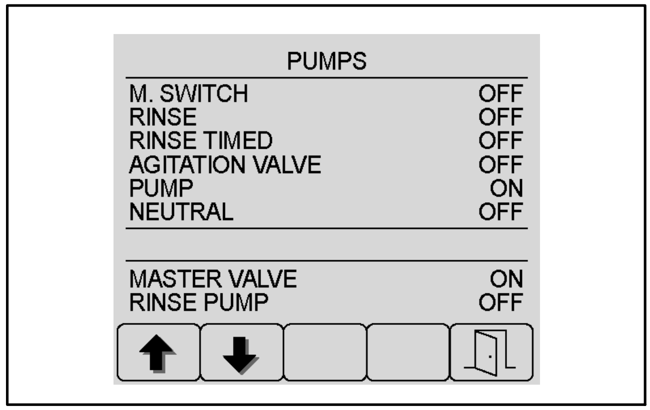

Figure 22 (Spray Pump)

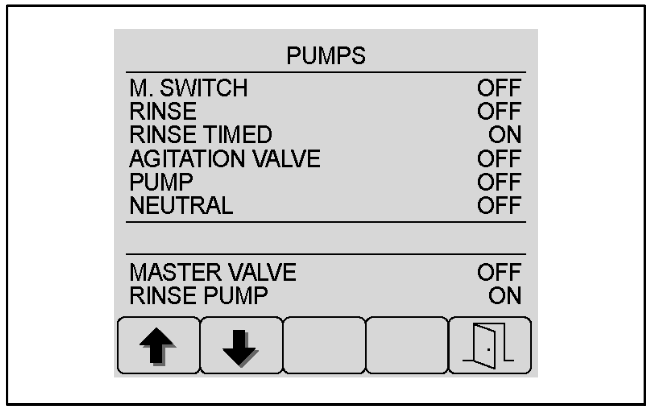

Figure 23 (Optional Rinse Pump)

Booms

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Booms Screen:

LEFT: ON when the left boom control switch is in the ON position.

CENTER: ON when the center boom control switch is in the ON position.

RIGHT: ON when the right boom control switch is in the ON position.

MASTER BOOM: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

There are no qualifiers involved in the BOOMS function.

When the left boom control switch input is in the ON position (LEFT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur (Fig. 24):

L. VALVE ON – TEC output 3: The left boom spray valve should open (valve indicator green).

When the center boom control switch input is in the ON position (CENTER ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

C. VALVE ON – TEC output 4: The center boom spray valve should open (valve indicator green).

When the right boom control switch input is in the ON position (RIGHT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

R. VALVE ON – TEC output 11: The right boom spray valve should energize open (valve indicator green).

When the master boom switch is depressed (switches the master boom control ON/OFF), any active boom spray valve (mating boom control switch ON) will switch ON/OFF (valve indicator green/red).

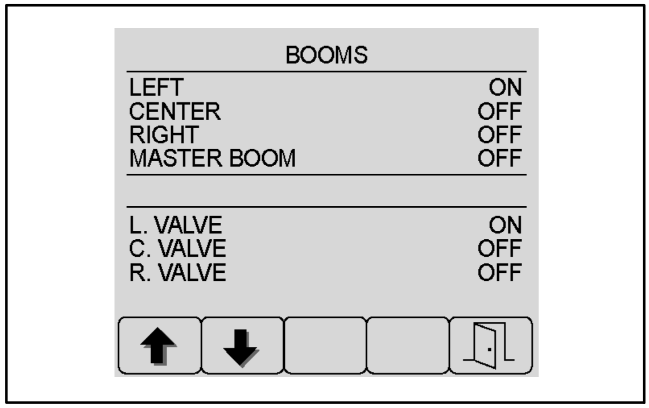

Figure 24

Engine Run

The Engine Run function is discussed in Chapter 6 – Electrical System in this manual.

FAULT VIEWER

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine or spray system operation. When a spray system fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Spray system faults can be viewed via the InfoCenter Fault Viewer (Fig. 25). See Machine Faults in this chapter for additional information about specific spray system faults.

The fault viewer displays the following information about a spray system fault:

CODE: fault code number

LAST: last time the fault occurred expressed in Key ON hours

FIRST: first time the fault occurred expressed in Key ON hours

NUM: number of times the fault has occurred

Scroll through the fault viewer screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

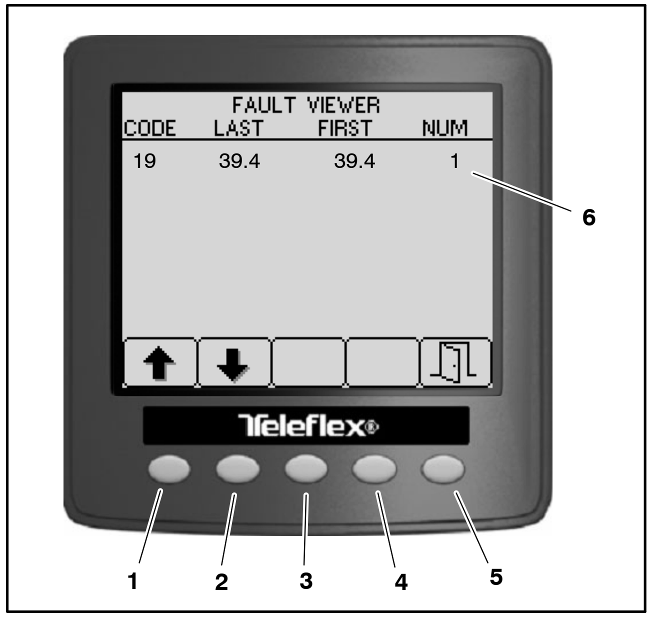

Figure 25

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Machine faults**

About

The About screens provide information about the machine, the InfoCenter Display and the Toro Electronic Controller (TEC). The About screens (Fig. 26) are discussed in Chapter 6 – Electrical System in this manual.

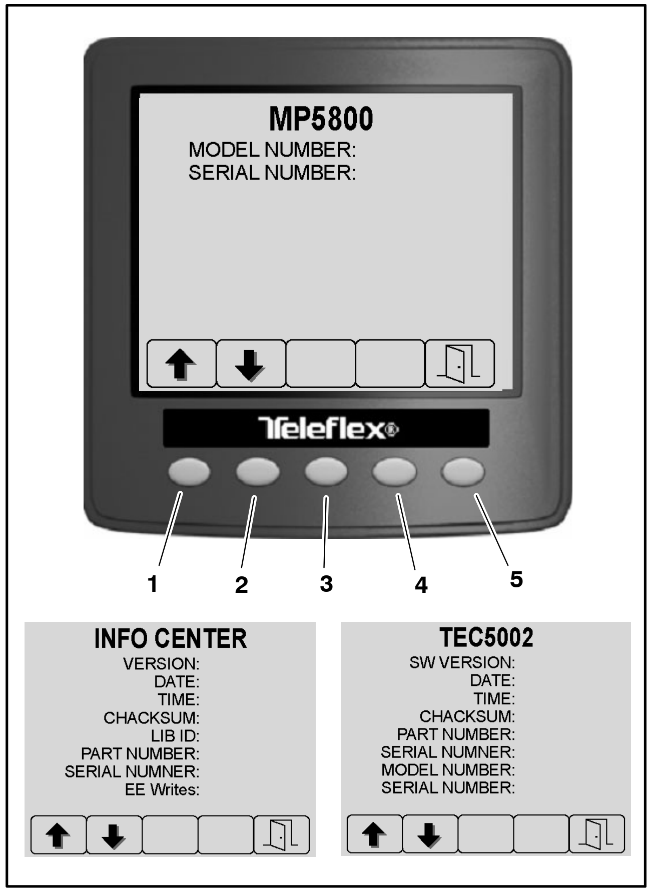

Figure 26

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**

Troubleshooting

CAUTION

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

Use the following table to assist in troubleshooting spray system specific issues. See Chapter 6 − Electrical System in this manual for a similar table discussing traction unit issues.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics in Appendix A − Foldout Drawings in this manual).

If the machine has any interlock switches by−passed, they must be reconnected for proper troubleshooting and safety.

Spray System Problems

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, damaged or improperly installed. Tank bulkhead fittings or agitation nozzles are damaged or improperly installed. Spray tank drain valve not seating.
Fluid leaking from bottom of spray pump.	Faulty diaphragm(s) exist in spray pump. Pump casting is cracked.
Fluid leaking from spray pump valve cover.	Valve cover bolts are loose. O−ring at inlet or outlet valve is faulty. Diaphragm is not seating against pump casting and valve cover. Valve cover is damaged.
Excessive suction hose vibration.	Suction screen in tank or suction line is restricted. Spray pump suction line has an air leak. Suction tube in spray tank has an air leak.

Spray pressure decreases while operating sprayer.	Suction screen in tank or suction line is restricted. Low fluid level exists in spray tank. Spray pump suction line has an air leak. Agitation nozzle(s) in tank are loose or damaged (only occurs if agitation switch is on). System bypass valves are improperly adjusted or damaged. Spray nozzles are worn or damaged. Pressure line or component is restricted or damaged. Pressure relief valve is stuck open. 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 or actuator for affected boom is damaged.
Spray pump does not rotate (Operator Advisories are not present).	Spray pump switch or circuit wiring are dirty, corroded or damaged. Spray pump drive coupler is damaged. Pump drive hydraulic motor is not engaging or is damaged (see Chapter 5 – Hydraulic System). ExcelaRate spray system is not configured correctly.
Spray operation from booms is erratic.	Suction screen in tank is plugged. Spray nozzle(s) are clogged or damaged. Spray nozzles selected are inconsistent (different color/size) or worn. Boom control switch(es) or circuit wiring are dirty, corroded or damaged. Boom valve or valve actuator is worn or damaged. Boom bypass valves are damaged or not adjusted correctly (manual spray mode operation).
No spray output from one spray boom.	Hoses on boom are pinched or kinked. Boom section valve or actuator for affected boom is not opening. TEC output fuse for affected boom valve actuator is faulty. Boom control switch for affected boom actuator or circuit wiring is dirty, corroded or damaged.
Low spray rate from one boom nozzle.	Nozzle is clogged or damaged. Spray nozzle selected is inconsistent (different color/size).

Operator Advisories

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, an audio alarm will sound and an Operator advisory will appear on the InfoCenter Display (Fig. 27). Typically, an advisory can be eliminated with a change in machine controls by the operator. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the InfoCenter Display that the traction pedal needs to be in neutral. The advisory screen will clear automatically after a few seconds or can be cleared from the display manually by pressing any of the InfoCenter buttons. An advisory will not be recorded in any fault log. See Chapter 6 – Electrical System in this manual or the machine Operator's Manual for the complete list of operator's advisories. The following table explains each spray system operator advisory specific to machines with ExcelaRate spray systems.

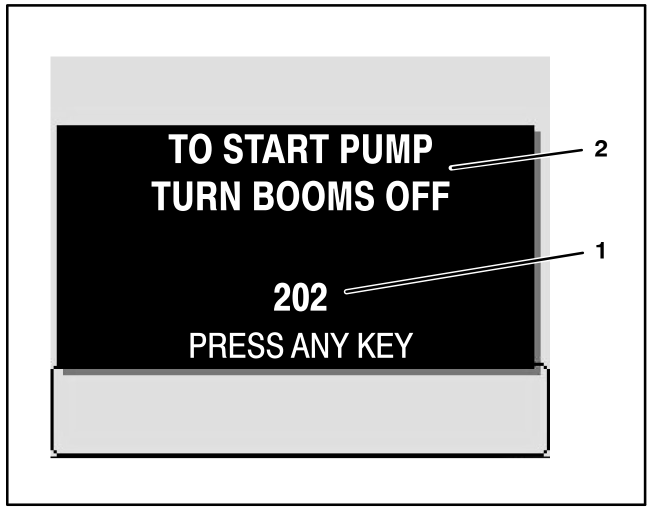

Figure 27

1. **Advisory number/code** 2. **Advisory description**

Advisory	Advisory Description	Recommended Action
202	Pump start prevented – Boom active	Set master boom switch to OFF position
203	Pump Start Prevented – Operator out of seat and parking brake not engaged	Operator return to seat or set parking brake
205	Pump Start Prevented – Engine starting	Set spray pump enable switch to OFF position
206	Pump Turned OFF – Operator not in seat	Operator return to seat or set parking brake
402	Tank Low Volume Alert	Prepare to discontinue spraying as the volume in the spray tank has dropped below the alert level set by the user
403	Rinse Pump ON (optional clean tank rinse kit)	Set optional clean tank rinse pump switch to OFF position
802	Booms Turned Off – Vehicle speed too low for automatic mode function	Increase vehicle speed before attempting ExcelaRate (automatic application–rate) spray system control, or switch to Manual spray system control

Using the InfoCenter Display for Troubleshooting

The Diagnostics – Input/Output screens of the InfoCenter display can be very helpful when troubleshooting spray system operation issues (see Diagnostics – Input/Output Screens in this chapter). Some of the electrical components and the circuit wiring involved in various spray system operations can be evaluated using the Input/Output screens prior to testing each component individually. The Input/Output screens show the current state of the inputs, and the outputs required to allow the operation to proceed (Fig. 28).

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

BOOMS The components necessary to operate the spray valves.

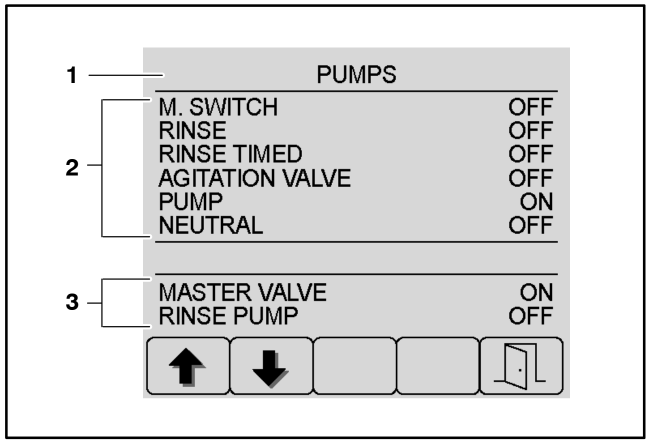

Figure 28

1. **Machine function**
2. **Inputs**
3. **Outputs**

CAUTION

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

If a spray system operation is malfunctioning, the following procedure can help identify 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 RUN/PREHEAT position and navigate to the InfoCenter Diagnostic – Input/Output Screen for the desired machine function.

3. Manually operate the input component. The component state on the InfoCenter display should alternate ON and OFF as the component is switched open and closed. If ON and OFF do not alternate during component operation, the component or its circuit wiring is faulty and should be tested (see Component Testing in Chapter 6 – Electrical System in this manual).

When the necessary input(s) is in the correct position, the output identified on the Input/Output screen should show as ON. If the output remains OFF, a problem with TEC power (circuit wiring or fuse) may exist, or the Toro Electronic Controller (TEC) or TEC software may require replacement/reloading. Contact your Authorized Toro Distributor for assistance.

A faulty output component will not be identified by the Input/Output screen. If all inputs and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component or the circuit wiring between the TEC and the output component may be faulty. In this case, the controller output is occurring but the faulty output component or circuit wiring is preventing the output from functioning. Test the specific output and output wiring (see Component Testing in Chapter 6 – Electrical System in this manual).

PUMP operation example:

Test the input: In this example, the input is the pump enable switch. If ON and OFF do not correspond to the pump enable switch (input) when moved to the ON/ENABLE and OFF positions, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in Chapter 6 – Electrical System in this manual).

Test the output: In this example, the output is MASTER VALVE – TEC output 9.

When the pump enable switch (input) is set to the ON/ENABLE position, the MASTER VALVE output should energize (ON). The solenoid coil for the spray pump hydraulic proportional valve (PV) should energize.

The solenoid coil for the spray pump proportional valve (PV) is an output energized by the TEC and therefore cannot be tested using the InfoCenter procedure. See Chapter 6 – Electrical System in this manual for additional solenoid coil testing information.

Machine Faults

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine or spray system operation. When a spray system fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Spray system faults can be viewed via the InfoCenter Diagnostic Screen Fault Viewer (Fig. 29). See InfoCenter Diagnostic Screen Fault Viewer in this chapter for additional information.

The list below identifies the fault codes that are generated by the Toro Electronic Controller (TEC) to identify an electrical spray system malfunction (fault) that occurred during spray system operation for revision D software. Use the InfoCenter Display Diagnostics > Fault Viewer for fault retrieval.

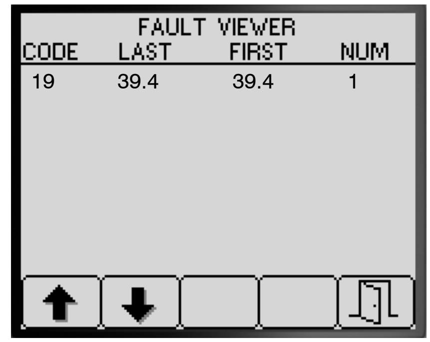

Figure 29

Fault Code	Fault Description	Recommended Action
19	Spray System Fault – Flow Meter not working correctly or harness fault (No flow detected when based upon boom, pump and pressure it indicates there should be) Spray pump is ON,Master Boom switch is ON, at least one boom is ON, spray pressure is above 20 PSI, the booms have been on long enough for the system to stabilize and vehicle speed is fast enough for automatic application–rate control to be enabled	Check the flow meter harness for proper connection. Confirm fluid flow at spray nozzles. If so, flow should be displayed on the flow rate meter. If no fluid flow at spray nozzles, begin checking the spray system for a blockage. Check flow meter for proper function.
41	Spray System Fault – Controller has detected a short circuit on the spray pump PWM output circuit (TEC output 9 – pin 44). OR Controller has determined an internal component in the controller has overheated.	Check harness and associated components for a short to ground If fault persists, replace TEC due to internal damage. Contact your Authorized Toro Distributor

NOTE: The above list pertains to spray system faults only. See Machine Faults in Chapter 6 – Electrical System in this manual for a complete list of all possible machine faults.

Service and Repairs

Spray System Components

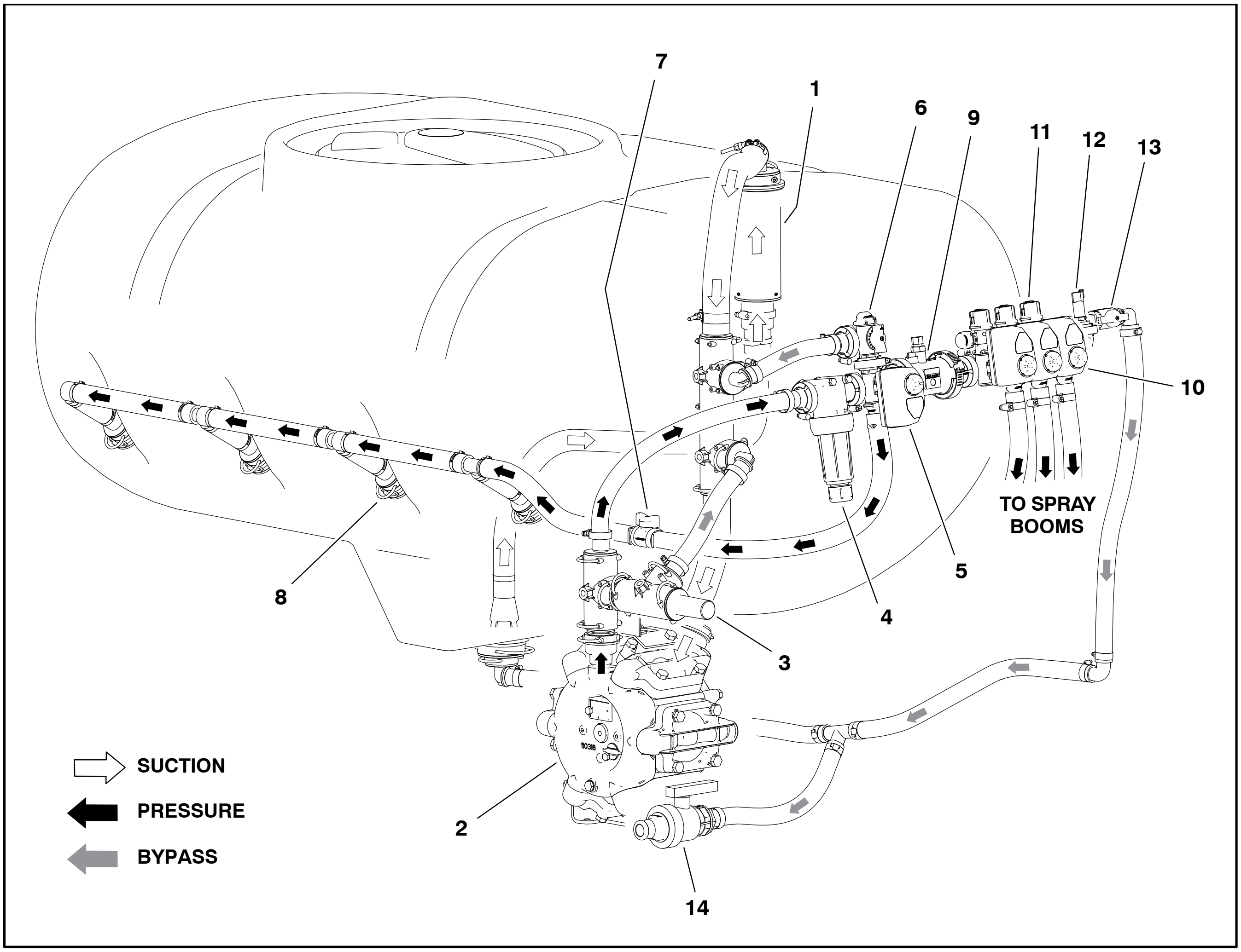

Figure 30

1. **Suction filter (in tank)**
2. **Spray pump**
3. **Relief valve**
4. **High pressure filter**
5. **Agitation valve**
6. **Agitation bypass valve**
7. **Agitation throttle valve (shown fully open)**
8. **Agitation nozzle (4)**
9. **Flow meter**
10. **Boom section valves (3)**
11. **Boom section bypass valves (3)**
12. **Pressure transducer**
13. **Boom section bypass shut–off valve (shown open – manual mode)**
14. **Drain valve**

Spray Pump

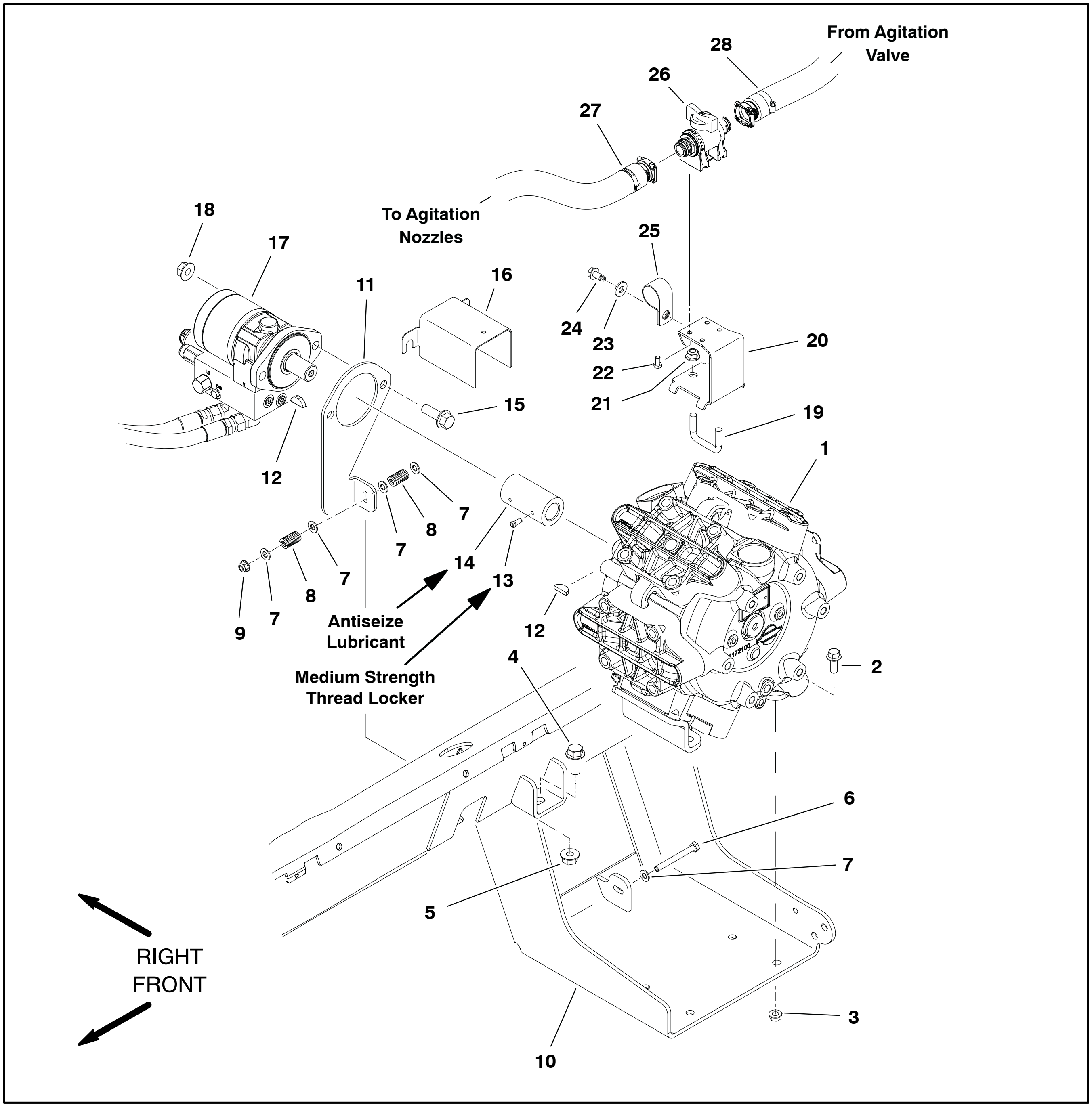

Figure 31

1. Spray pump assembly
2. Flange head screw (4)
3. Flange nut (4)
4. Flange head screw (2)
5. Flange nut (2)
6. Cap screw
7. Flat washer (5)
8. Spring (2)
9. Lock nut
10. Pump bracket
11. Motor mount plate
12. Woodruff key (2)
13. Set screw (4)
14. Coupler
15. Flange head screw (2)
16. Pump shaft guard
17. Control manifold/motor assembly
18. Flange nut (2)
19. U–Bolt
20. Valve bracket
21. Flange nut (2)
22. Flange head screw (4)
23. Flat washer
24. Cap screw
25. Clamp
26. Agitation throttle valve assembly
27. Hose (agitation)
28. Hose (agitation)

Removal (Fig. 31)

Machines with serial numbers below 400000000 were originally fit with a model 363 spray pump. Machines with serial numbers above 400000000 use a model 364 spray pump. Check the manufacturers build plate on the pump to verify the pump model being serviced.

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

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

2. Disconnect hoses as follows:

A. Remove fork from pump output fitting (item 4 Fig. 32) and separate tee from pump output fitting.

B. Remove fork from the bottom of the lower suction tee fitting (item 11 Fig. 32) and separate tee from pump suction hose.

3. Remove connector forks and disconnect hoses from agitation throttle valve (item 26). Position disconnected hoses away from pump.

4. If present, remove cap screw securing clamp (item 25) to valve bracket.

5. Loosen, but do not remove, two (2) flange head screws (item 15) and flange nuts (item 18) that secure control manifold/motor assembly to motor mount plate and remove guard from machine.

6. Remove two (2) set screws that secure coupler to pump shaft.

7. Remove four (4) flange head screws and flange nuts that secure spray pump to pump bracket.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is removed from the machine. Pump assembly weighs approximately 125 pounds (57 kg).

8. Slide pump out until shaft is removed from coupler. Locate and retrieve woodruff key from pump shaft.

9. Remove pump assembly (Fig. 33) from machine.

NOTE: Model 363 spray pumps use non−O−ring style suction and outlet fittings. Model 364 spray pumps use O−ring style suction and outlet fittings. Fitting styles are not interchangeable between pumps.

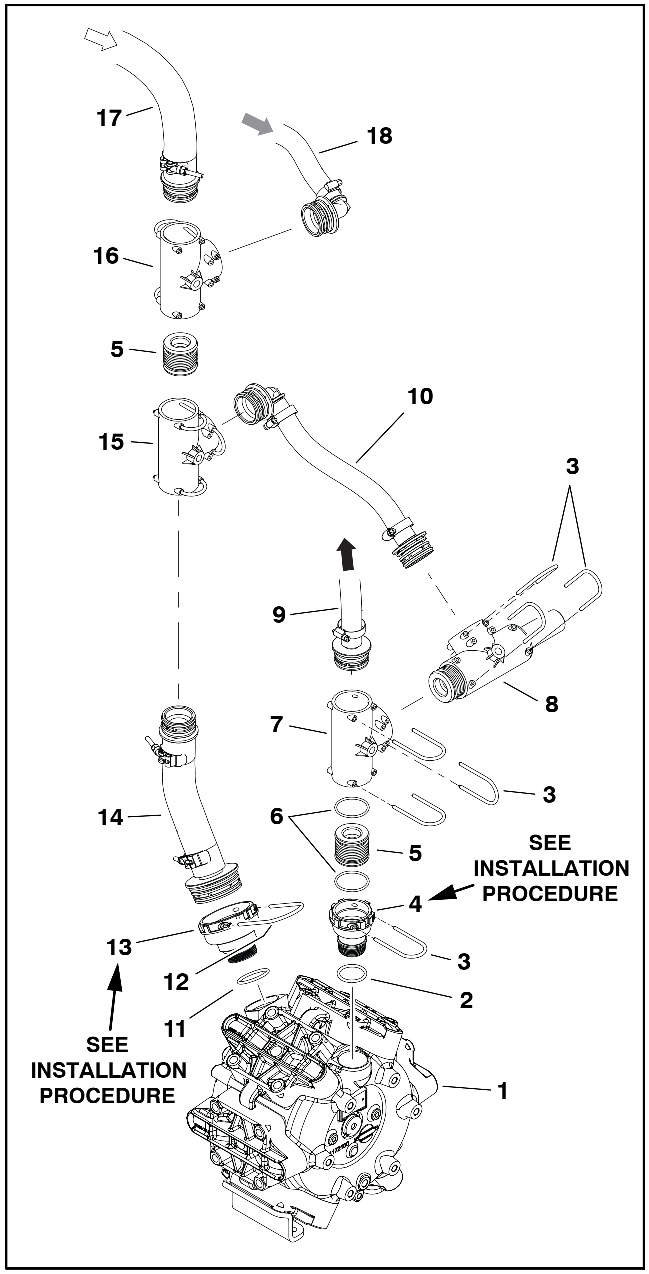

Figure 32

1. **Spray pump (model 364 shown)**
2. **O−ring**
3. **Fork (13)**
4. **Fitting − outlet (O−ring style shown)**
5. **Connector (3)**
6. **O−ring (12)**
7. **Tee (outlet)**
8. **Pressure relief valve**
9. **Hose (supply)**
10. **Hose (pressure relief)**
11. **O−Ring**
12. **Fork**
13. **Fitting suction**
14. **Hose (suction)**
15. **Tee (lower suction)**
16. **Tee (upper suction)**
17. **Hose (suction)**
18. **Hose (agitation bypass)**

10. If needed, remove suction hose and fittings from pump.

11. If needed, remove agitation throttle valve and valve bracket from pump.

12. Remove and discard all O−rings at disconnected fittings.

Installation (Fig. 31)

1. If valve bracket or agitation throttle valve was removed, install items with fasteners previously removed.

2. If suction and/or outlet fittings were removed from pump:

A. Model 363 spray pumps use non−O−ring style suction and outlet fittings. Apply thread sealant to fitting threads and install fitting(s) into correct pump port (Fig. 33).

B. Model 364 spray pumps use O−ring style suction and outlet fittings. Coat new O−ring with vegetable oil and install fitting(s) into correct pump port (Fig. 33).

NOTE: Replace, do not reuse O−rings. Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

3. If suction hose was removed from pump suction fitting, secure the suction hose assembly to the pump before the pump is installed to the machine. Install suction hose assembly and secure with fork.

4. Install woodruff key into pump shaft and apply anti-seize lubricant to inside of coupler (item 14) pump shaft and key.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is installed to the machine. Pump assembly weighs approximately 125 pounds (57 kg).

5. Place pump assembly (Fig. 33) onto pump bracket. Align pump shaft and key with coupler and slide pump shaft into coupler.

6. Install and finger tighten four (4) flange head screws (item 2) and flange nuts to attach pump assembly to pump bracket. DO NOT fully tighten fasteners at this time.

7. Turn spray pump shaft by hand and position pump on pump bracket to best align the pump shaft and the hydraulic motor shaft.

8. Secure pump to pump bracket by tightening flange head screws and flange nuts.

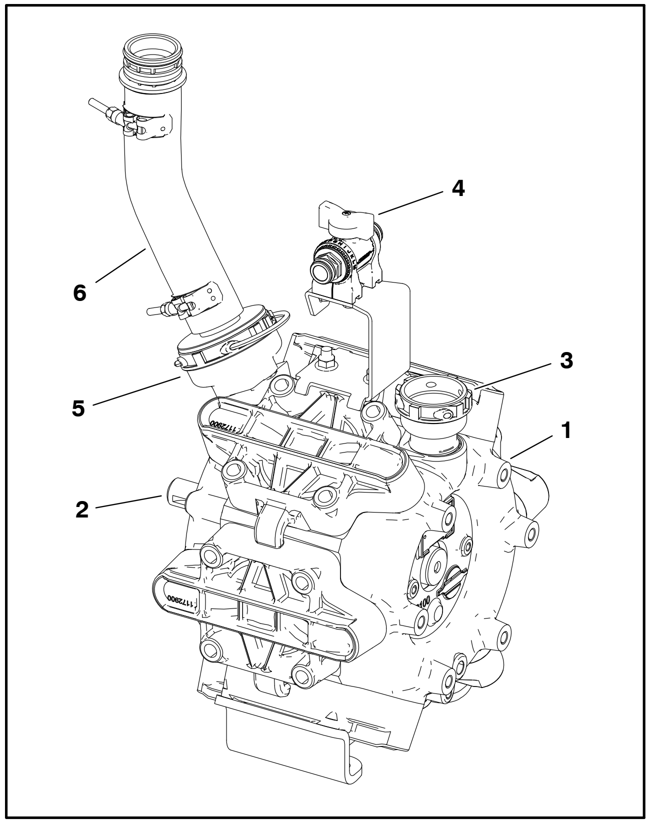

Figure 33

1. **Spray pump (model 364 shown)**
2. **Pump shaft**
3. **Fitting (outlet)**
4. **Agitation throttle valve**
5. **Fitting (suction)**
6. **Hose (suction)**

9. Apply medium strength thread locker to coupler set screws (item 13). then install and tighten set screws to secure coupler to pump shaft.

10. Position pump shaft guard over hydraulic motor mounting screws. Tighten flange head screws and flange nuts to secure control manifold/motor assembly to motor mount plate.

11. If present, install clamp (item 25) to valve bracket and secure with flat washer and cap screw previously removed.

12. Connect spray pump suction and supply hoses to spray pump and secure with forks (Fig. 32).

13. Connect hoses to agitation throttle valve (item 26) and secure hoses with forks.

14. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Spray Pump Service

Machines with serial numbers below 400000000 were originally fit with a model 363 spray pump. Machines with serial numbers above 400000000 use a model 364 spray pump. Check the manufacturers build plate on the pump to verify the pump model being serviced.

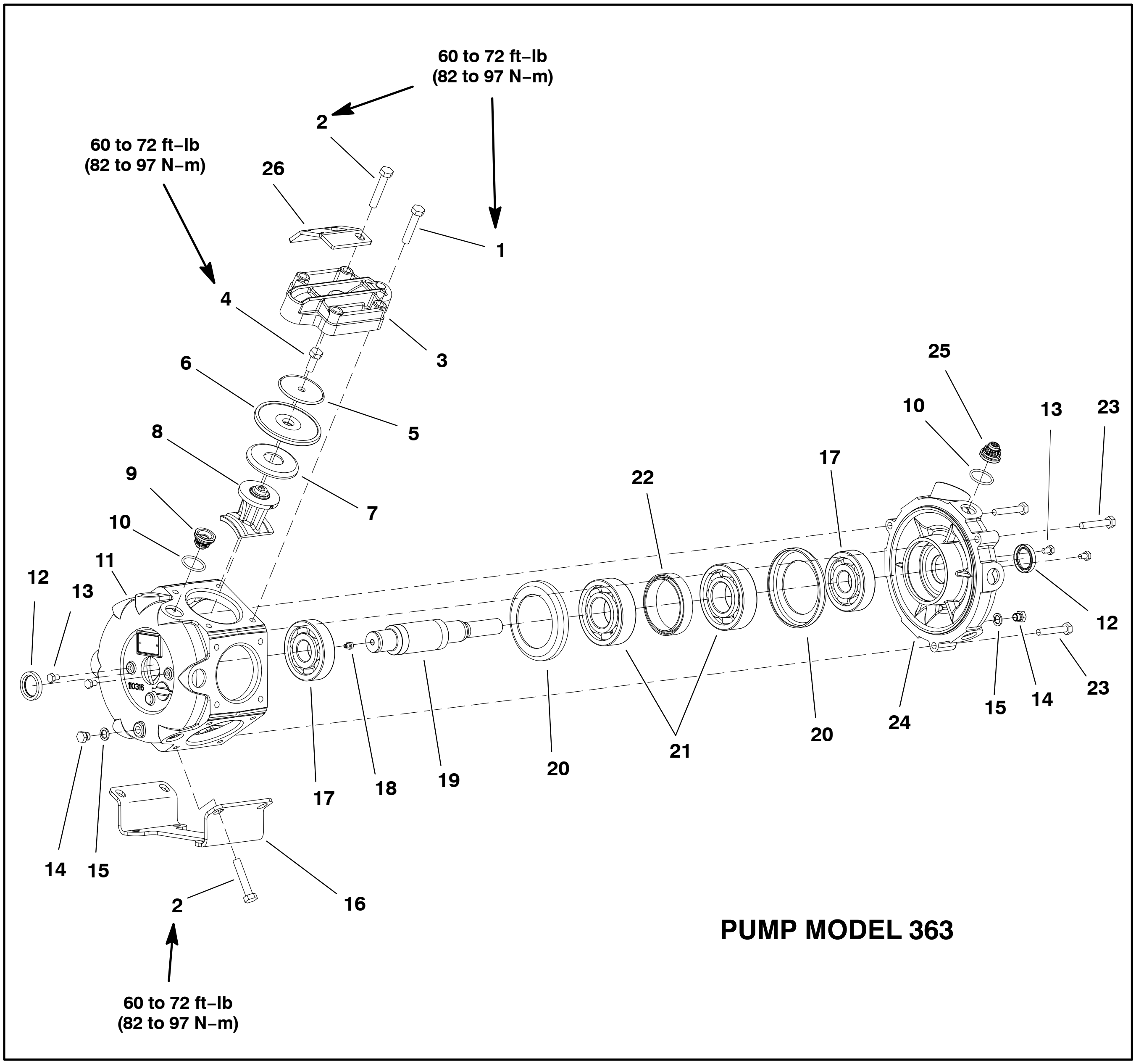

Figure 34

1. Hex bolt (60 mm long) (18)
2. Hex bolt (65 mm long) (6)
3. Valve cover (6)
4. Hex bolt (6)
5. Diaphragm disc (6)
6. Diaphragm (6)
7. Diaphragm backing disc (6)
8. Connecting rod (6)
9. Pump valve (10)
10. O−ring (12)
11. Pump casting
12. Oil seal (2)
13. Hex bolt (4)
14. Plug (2)
15. Seal (2)
16. Pump foot
17. Ball bearing (2)
18. Grease fitting
19. Crankshaft
20. Connecting rod spacer (2)
21. Ball bearing (2)
22. Bearing spacer
23. Hex bolt (60 mm long) (3)
24. Pump casting (suction)
25. Pump valve − white (2)
26. Pump bracket

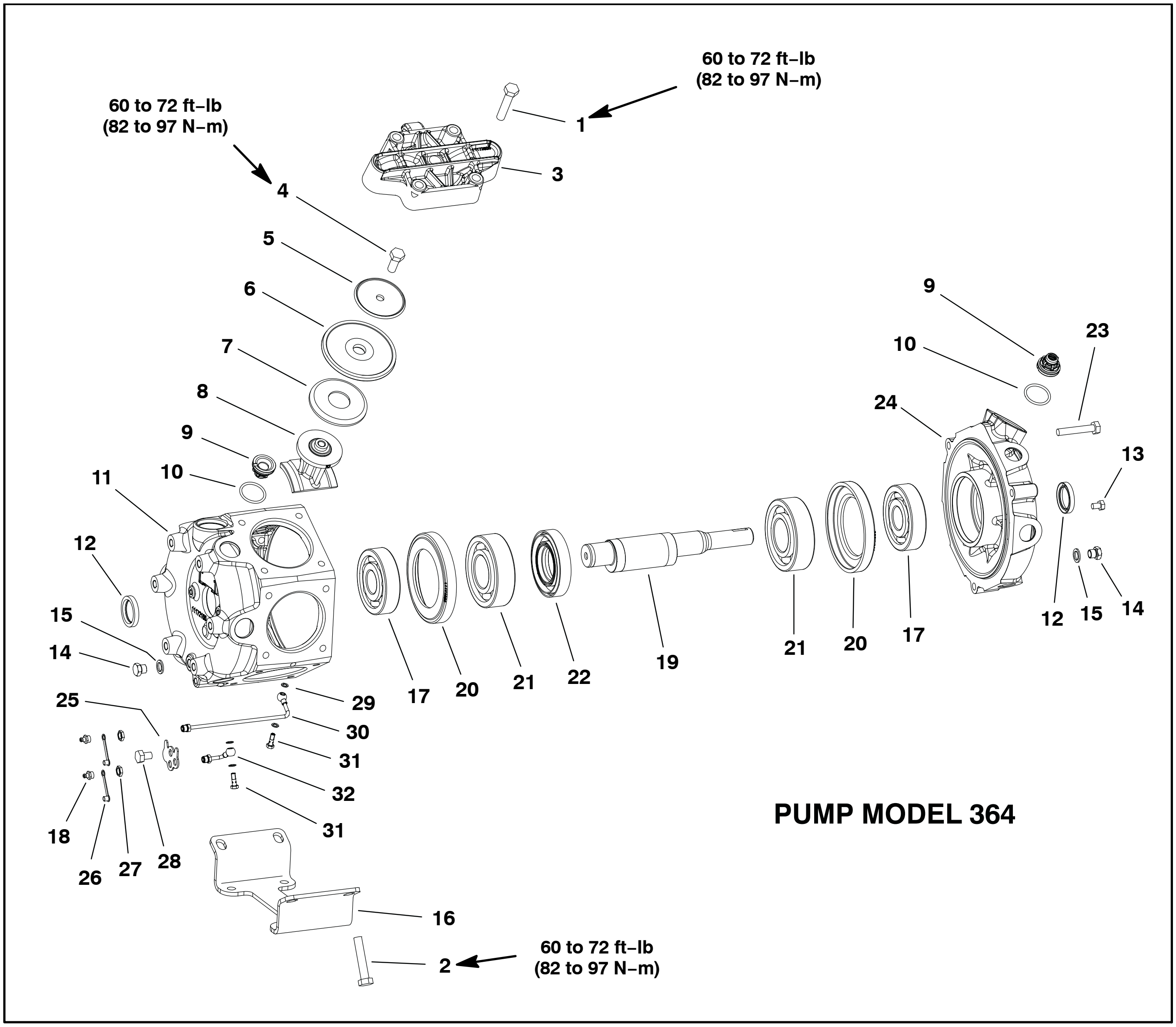

Figure 35

1. Hex bolt (60 mm long) (20)
2. Hex bolt (65 mm long) (4)
3. Valve cover (6)
4. Hex bolt (6)
5. Diaphragm disc (6)
6. Diaphragm (6)
7. Diaphragm backing disc (6)
8. Connecting rod (6)
9. Pump valve (12)
10. O–ring (12)
11. Pump casting
12. Oil seal (2)
13. Hex bolt (4)
14. Plug (2)
15. Seal (2)
16. Pump foot
17. Ball bearing (2)
18. Grease fitting (2)
19. Crankshaft
20. Connecting rod spacer (2)
21. Ball bearing (2)
22. Bearing spacer
23. Hex bolt (3)
24. Pump casting (suction)
25. Grease fitting plate
26. Cap (2)
27. Hex nut (2)
28. Hex bolt (16 mm long)
29. Gasket (4)
30. Grease tube
31. Banjo bolt (2)
32. Grease line

Disassembly

IMPORTANT: Make sure to remove and neutralize chemicals from pump before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during pump repair.

NOTE: Many pump components can be easily reversed. During disassembly, make note of component position (e.g. valve cover, pump valve, diaphragm) to assure correct assembly.

1. Remove plugs (item 14) and seals from pump to allow all fluid to be drained from pump. Install seals and plugs after draining is complete.

2. Thoroughly clean exterior of pump.

3. For assembly purposes, use marker to identify location of all valve covers on pump housing.

NOTE: Pump bracket on model 363 pumps (item 26 Fig. 34) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot for both model 363 and 364 pumps (item 16) is secured to pump with four (4) longer bolts on lower valve covers.

4. Remove hex bolts that retain valve covers (item 3) to pump. Separate and remove valve covers from pump.

NOTE: The two (2) pump inlet valves in the upper head positions (either side of suction port) are different than the rest of the valves used in the pump (item 25 Fig. 34). These two (2) valves are white in 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 performance.

7. Thoroughly clean all valve, diaphragm and O−ring seats in the valve covers and pump valve chambers.

8. Check the crankshaft for sufficient grease. Also, visually inspect crankshaft assembly for any signs of excessive wear or damage. Check that crankshaft turns freely. If crankshaft bearings are loose, rough or worn, crankshaft bearings should be replaced.

Crankshaft Bearing Service

1. For assembly purposes, use marker to identify location of all connecting rods.

2. Remove three (3) hex bolts that secure pump casting halves together.

3. To separate the pump castings:

   A. From the non−driven side of the pump, place a spacer or socket on crankshaft end.

   B. Using dead−blow hammer and tap the spacer to separate the pump castings.

   C. Once a gap is created between the castings, carefully pry pump castings apart.

4. Remove connecting rods and inspect the rod bearing surfaces which should be clean and smooth. Replace any of the connecting rods that have evidence of scoring, wear or damage.

5. Remove crankshaft with bearings and spacers (items 20 −22) from pump.

6. Press ball bearings from crankshaft and pump castings.

7. Remove seals from pump castings.

8. Clean crankshaft and internal surfaces of pump castings.

9. Pack new bearings with Mobil XHP 461 lithium−complex high temperature grease.

10. Press new bearings into pump castings.

11. Install connecting rod bearings on crankshaft:

    A. Pressing on bearing inner race, install first connecting rod bearing onto crankshaft.

    B. Place bearing spacer (item 22) onto crankshaft and then press second bearing onto crankshaft.

12. Install seals into pump castings. Seal face should be flush with casting.

13. Position the pump casting (item 11) with the seal side down.

14. Place connecting rod spacer (item 20) and then crankshaft assembly into pump casting. Make sure that non−driven end of crankshaft is inserted into the pump casting.

15. Using marks made during disassembly to identify connecting rod locations, install connecting rods to crankshaft. Makes sure that connecting rod flange fits under connecting rod spacers.

16. Place second connecting rod spacer onto crankshaft and connecting rods and then install pump casting (suction). Make sure that pump suction and outlet ports are aligned during assembly of the pump castings (Fig. 36).

17. Secure pump castings with three (3) hex bolts. Tighten bolts from **60 to 72 ft−lb (82 to 97 N−m)**. After assembly, check that crankshaft turns freely.

Assembly

1. Install diaphragms to connecting rods:

   A. Place diaphragm backing disc (item 7), new diaphragm (item 6) and diaphragm disc (item 5) on connecting rod. Make sure that the diaphragm disc lip faces away from the diaphragm.

   B. Thread hex bolt (item 4) into connecting rod.

   C. Rotate crankshaft so the connecting rod is at the top of its stoke and tighten the hex bolt from **60 to 72 ft−lb (82 to 97 N−m)**.

   D. Repeat for remaining diaphragms.

2. Install valves and valve covers:

IMPORTANT: The two (2) pump inlet valves in the upper head positions (either side of suction port) are different than the rest of the valves used in the pump (item 25 Fig. 34). These two (2) valves are white in color.

   A. Position new O−rings and valves (suction and outlet) to pump castings. Suction 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 cover.

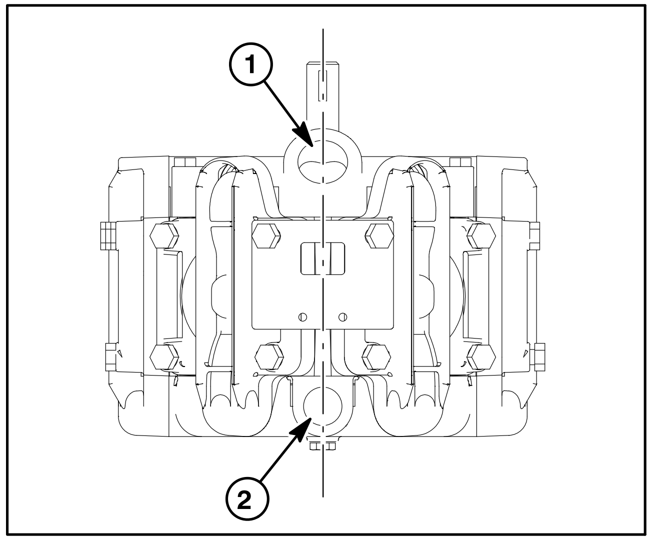

Figure 36

1. **Suction port**
2. **Outlet port**

NOTE: Pump bracket on model 363 pumps (item 26 Fig. 34) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot for both model 363 and 364 pumps (item 16) is secured to pump with four (4) longer bolts on lower valve covers.

   D. Secure valve cover to pump using hex bolts (4 per cover) and tighten bolts from **60 to 72 ft−lb (82 to 97 N−m)**.

   E. Repeat for remaining valve covers.

Pressure Relief 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 suction side of the spray pump. 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).

Pressure Relief Valve Testing

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before testing or removing the pressure relief valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

To test the operation of the pressure relief valve, follow the following steps:

A. Have machine on a level surface with engine off and parking brake engaged.

B. Drain the spray tank and fill the spray tank with clean water.

C. Close the agitation throttle valve and the boom section bypass shut−off valve. Make sure that the traction pedal is in the neutral position and the sprayer mode switch is set to manual mode operation.

D. Have a person in the operator seat to control the spray system and a second person near the pressure relief valve.

E. Have operator start the engine, turn spray pump switch ON and turn agitation switch ON.

F. While second person listens for pressure relief valve to open, have the operator slowly increase the application rate while watching the pressure gauge. Pressure gauge should open when system pressure reaches approximately 220 PSI (15 Bar).

Replace the pressure valve if necessary.

NOTE: Replace, do not reuse O−rings. Coat O−rings with vegetable oil before installation to reduce damage during assembly.

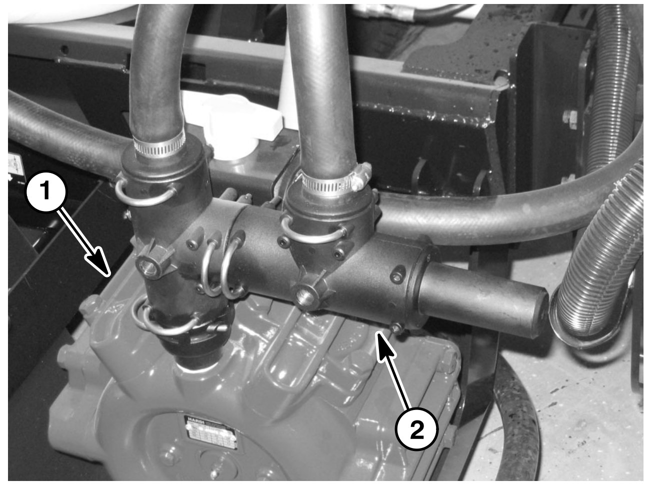

Figure 37

1. **Spray pump**
2. **Pressure relief valve**

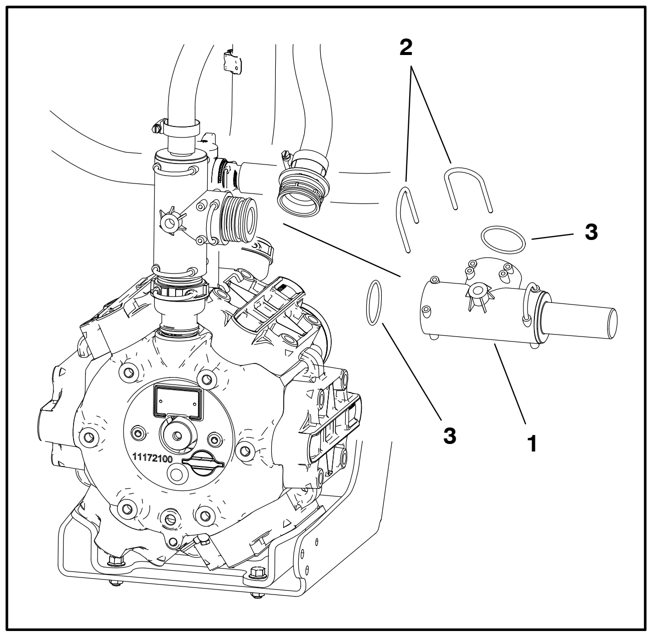

Figure 38

1. **Pressure relief assembly**
2. **Fork (2)**
3. **O−ring (2)**

Spray Control Manifold Assembly

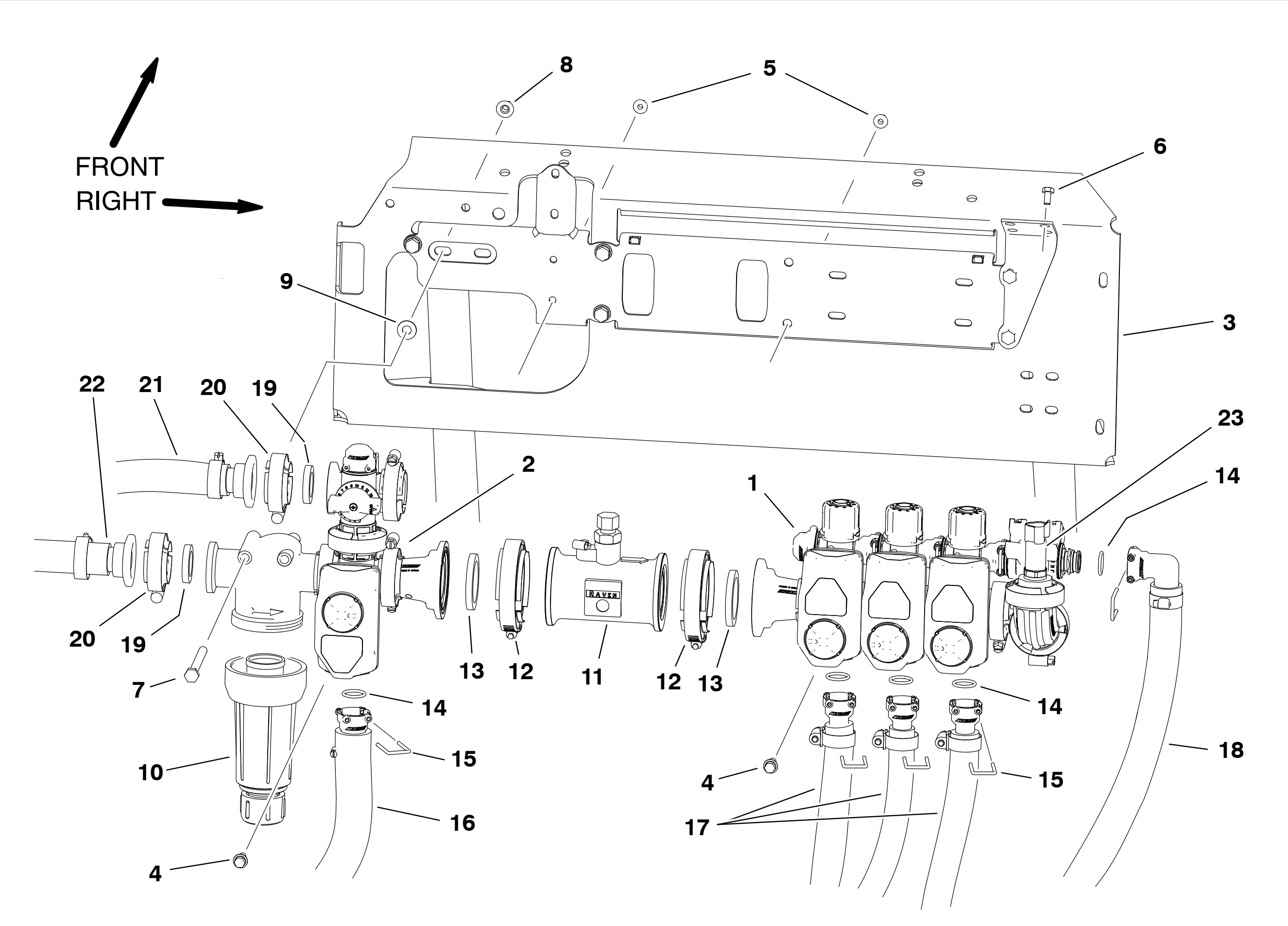

Figure 39

1. Boom section valve assy.
2. Agitation valve assy.
3. Valve mount
4. Flange head screw (6)
5. Flange nut (6)
6. Cap screw (4)
7. Cap screw (2)
8. Flange nut (2)
9. Washer/spacer (2)
10. High pressure filter bowl
11. Flow meter
12. Clamp (2)
13. Gasket (2)
14. O–ring (5)
15. Fork (5)
16. Hose (agitation supply)
17. Hose (boom supply – 3)
18. Hose (boom bypass)
19. Gasket (2)
20. Clamp (2)
21. Hose (agitation bypass)
22. Hose (supply from spray pump)

The spray control manifold assembly includes the high pressure spray product filter, the agitation valve with bypass valve, the flow meter, the three (3) boom section valves with bypass valves, the pressure transducer and the boom section bypass shut–off valve. Pressure transducer testing information can be found in Chapter 6 – Electrical System in this manual.

NOTE: The spray control manifold may be configured slightly different if the machine has any optional spray system kits installed (e.g. foam marker, hose reel, eductor, etc).

Removal (Fig. 39)

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

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

2. Label wire harness connectors for proper installation after repairs are completed (agitation valve, three (3) boom section valves, flow meter sensor, pressure transducer). Disconnect wire harness connectors from spray control manifold as needed.

3. Label hoses for proper installation after repairs are completed. Loosen hose clamps and disconnect hoses from spray control manifold as needed.

4. If boom section valve assembly is to be removed:

A. Remove pressure gauge tube from boom manifold assembly.

B. Remove four (4) cap screws (item 6) securing boom section bypass shut−off valve to bracket.

C. Disconnect clamp securing right side of flow meter to adapter.

D. Remove boom section manifold assembly from valve mount. Locate and discard gasket between flow meter and adapter (item 13).

5. If agitation valve assembly is to be removed:

A. Disconnect clamp securing left side of flow meter to adapter.

B. Remove bowl and screen from high pressure filter (item 10).

C. Remove fasteners that secure high pressure filter to mount bracket. Retrieve spacers/washers between filter and mount bracket.

D. Remove fasteners that secure agitation valve assembly to mount bracket.

E. Remove agitation valve assembly from machine. Locate and discard gasket between flow meter and adapter (item 13).

6. See Boom Section Valve and Agitation Valve Assembly in this chapter for additional service information.

Installation (Fig. 39)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Position a new gasket (item 13) between flow meter and removed assembly.

2. Fit screw clamp to flanges of flow meter and adapter. Tighten screw clamp to secure assembly.

3. Secure assembly to mount bracket with fasteners and spacers/washers previously removed.

4. Using labels placed during removal to install hoses to spray control manifold.

5. If removed, install pressure gauge tube to spray control manifold.

6. If removed, install screen and bowl to high pressure filter.

7. Using labels placed during removal to install wire harness connectors to spray control manifold.

8. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Agitation Valve Assembly

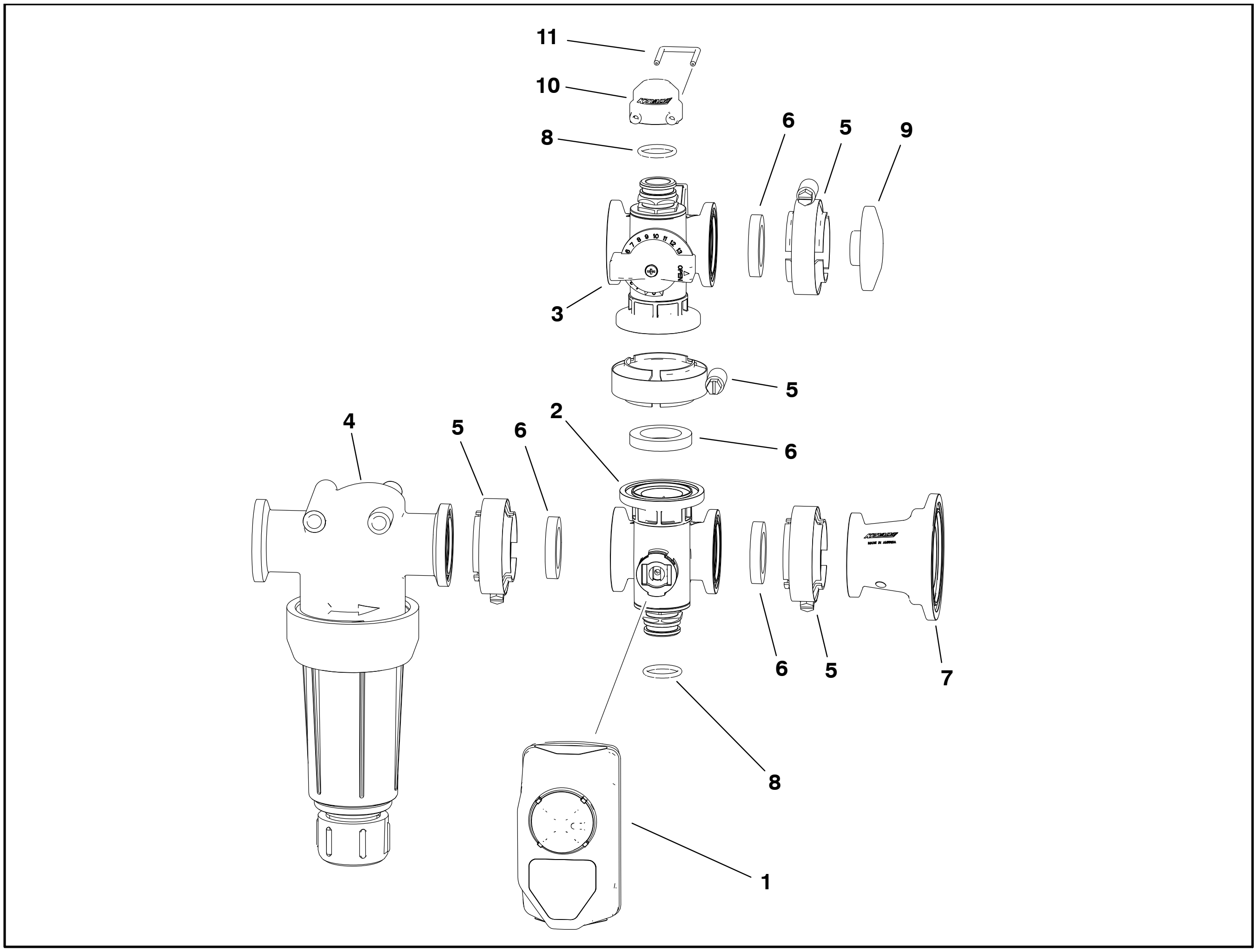

Figure 40

1. **Valve actuator**
2. **Agitation valve**
3. **Agitation bypass valve**
4. **High Pressure Filter**
5. **Clamp (4)**
6. **Gasket (4)**
7. **Adapter**
8. **O−ring (2)**
9. **Cap**
10. **Cap**
11. **Fork**

The agitation valve assembly includes the agitation valve, the agitation bypass valve and the high pressure product filter.

IMPORTANT: The 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.

Disassembly (Fig. 40)

1. Remove the agitation valve assembly from machine (see Spray Control Manifold Assembly in this chapter).

2. Disassemble agitation valve assembly as needed. Discard any removed O−rings and gaskets.

NOTE: See Agitation Valve Service and Agitation Bypass Valve Service in this chapter for disassembly and assembly information. The valve actuator is nor serviceable. See Spray System Valve Actuators in Chapter 6 − Electrical System in this manual for actuator testing information.

Assembly (Fig. 40)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Assemble agitation valve assembly.

2. Install agitation valve assembly on machine (see Spray Control Manifold Assembly in this chapter).

Boom Section Valve Assembly

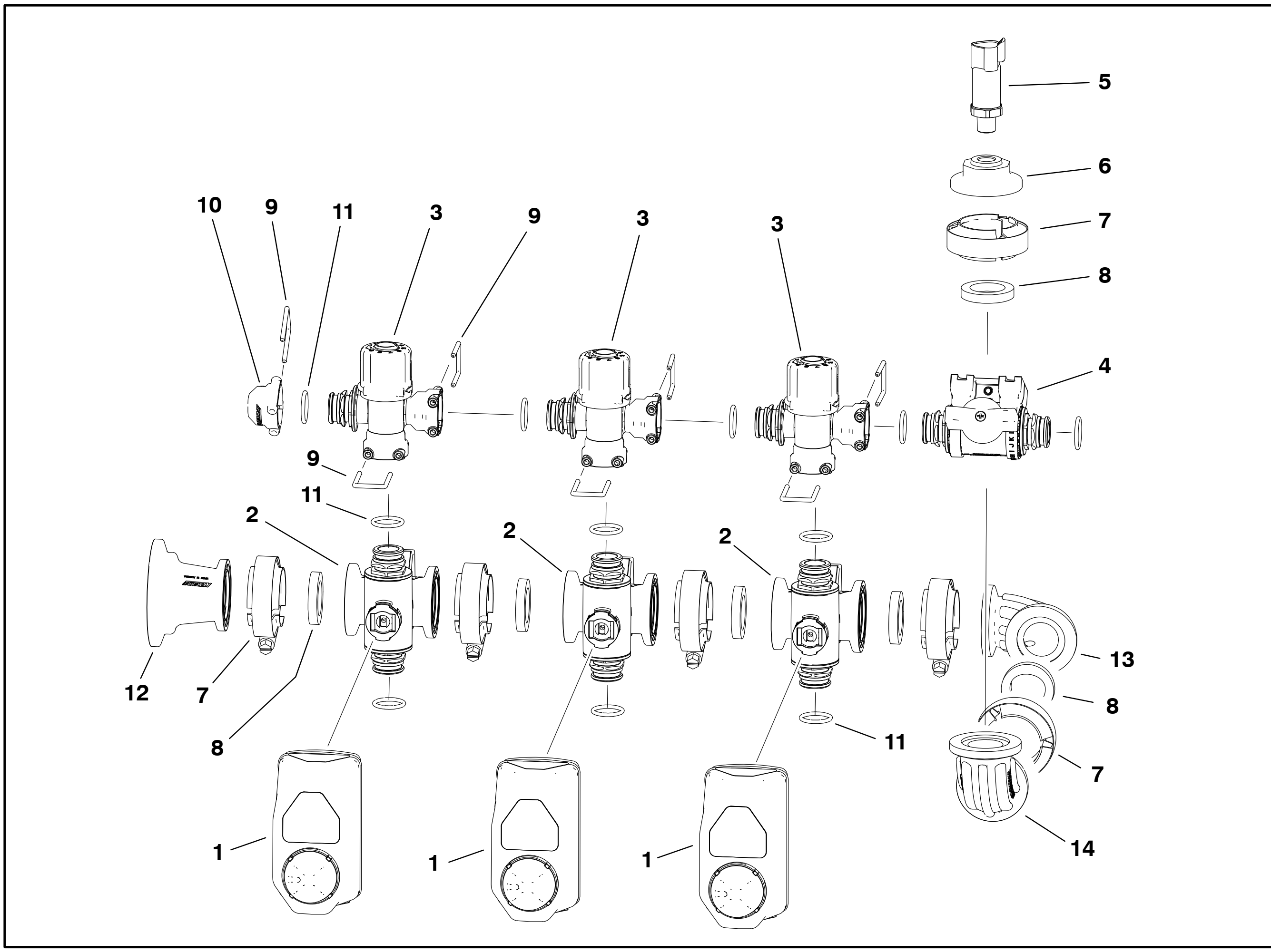

Figure 41

1. Valve actuator (3)
2. Boom section valve (3)
3. Boom section bypass valve (3)
4. Boom section bypass shut−off valve
5. Pressure transducer
6. Port adapter
7. Clamp (6)
8. Gasket (6)
9. Fork (7)
10. Cap
11. O−ring (11)
12. Adapter
13. Elbow (ported)
14. Elbow

The boom section valve assembly includes the right, center and left boom section valves, a bypass valve for each of the boom section valves and the boom section bypass shut−off 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.

Disassembly (Fig. 41)

1. Remove the boom section valve assembly from machine (see Spray Control Manifold Assembly in this chapter).

2. Disassemble boom section valve assembly as needed. Discard any removed O−rings and gaskets.

NOTE: See Boom Section Valve Service and Boom Section Bypass Valve Service in this chapter for disassembly and assembly information. The valve actuators are nor serviceable. See Spray System Valve Actuators in Chapter 6 − Electrical System in this manual for actuator testing information.

Assembly (Fig. 41)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Assemble boom section valve assembly.

2. Install boom section valve assembly on machine (see Spray Control Manifold Assembly in this chapter).

Boom Section Valve and Agitation Valve Service

The Multi 5800 ExcelaRate spray system uses three (3) boom section valves and an agitation valve. Each valve is fully serviceable. Use the following procedure for servicing the boom section valves and the agitation valve.

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

Disassembly (Fig. 42)

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.

6. Inspect the valve seats (item 4). Replace components as necessary.

Assembly (Fig. 42)

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. Apply silicone grease to seals and O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install either the actuator and actuator fork or knob and screw.

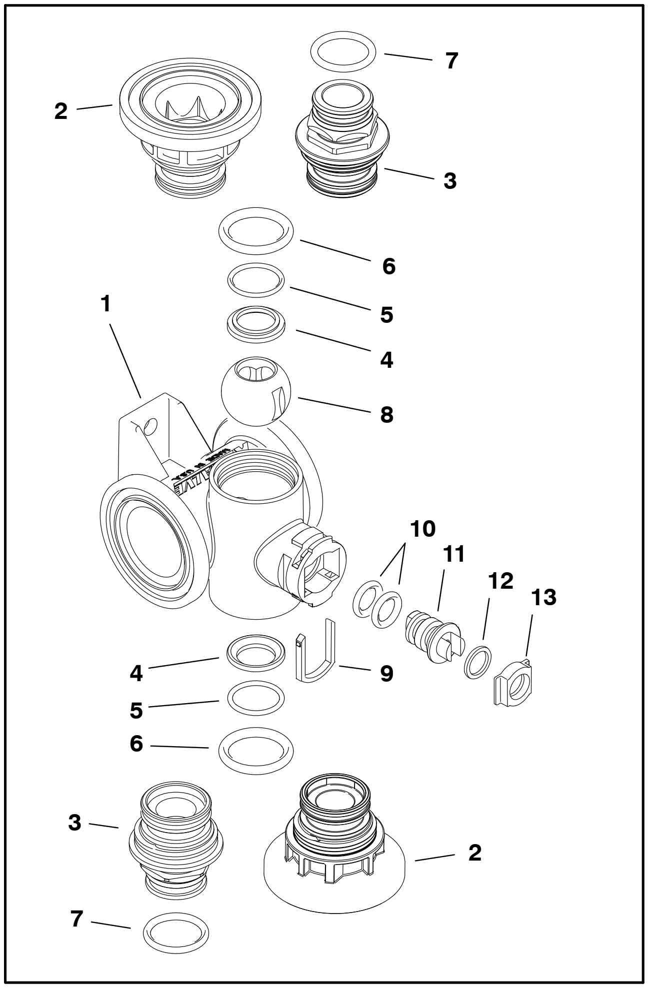

Figure 42

1. **Valve body**
2. **End cap (flanged − clamp)**
3. **End cap (male − fork)**
4. **Seat (2)**
5. **O−Ring (2)**
6. **O−Ring (2)**
7. **O−Ring**
8. **Ball (on/off)**
9. **Stem fork**
10. **O−Ring (2)**
11. **Stem**
12. **Washer**
13. **Stem seat**

Agitation Bypass Valve Service

The Multi Pro 5800 ExcelaRate spray system includes an agitation bypass valve. The bypass valve is fully serviceable. Use the following procedure for servicing the agitation bypass valve.

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

Disassembly (Fig. 43)

1. Locate the valve being serviced and remove the screw, knob and O−ring from the valve.

2. Remove hoses, fittings, clamps and caps 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.

6. Inspect the valve seats (item 4). Replace components as necessary.

Assembly (Fig. 43)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install new O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install either the actuator and actuator fork or knob and screw.

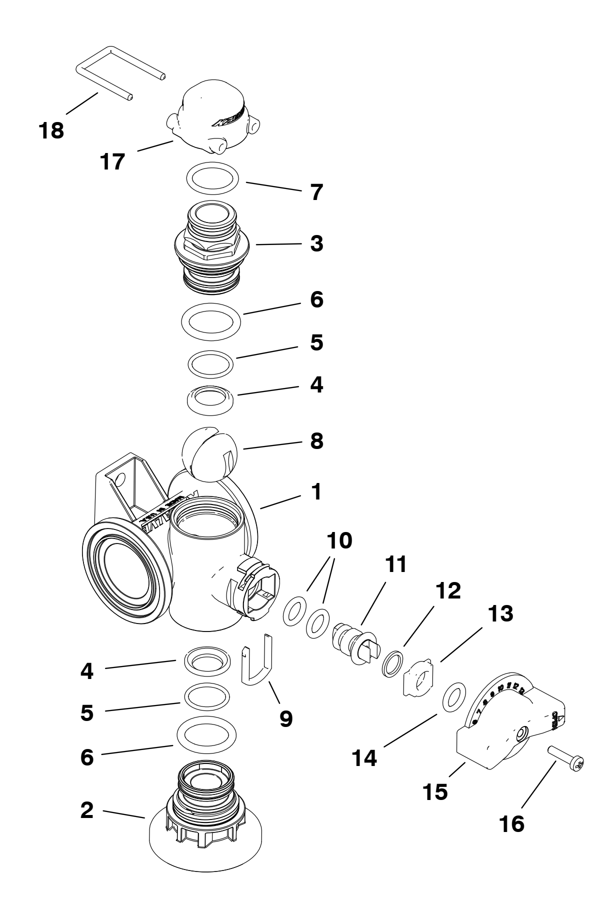

Figure 43

1. **Valve body**
2. **End cap (flanged − clamp)**
3. **End cap (male − fork)**
4. **Seat (2)**
5. **O−Ring (2)**
6. **O−Ring (2)**
7. **O−Ring**
8. **Ball (regulating)**
9. **Stem fork**
10. **O−Ring (2)**
11. **Stem**
12. **Washer**
13. **Stem seat**
14. **O−ring**
15. **Knob**
16. **Screw**
17. **Cap**
18. **Fork**

Boom Section Bypass Valve Service

Each Multi Pro 5800 ExcelaRate spray system includes three (3) boom section bypass valves. Each bypass valve is fully serviceable. Use the following procedure for servicing the boom section bypass valves.

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

Disassembly (Fig. 44)

1. Locate the valve being serviced and remove the knob fork and the knob assembly.

2. Hold the valve stem and rotate the knob counterclockwise (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. 44)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install new O−rings.

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.

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.

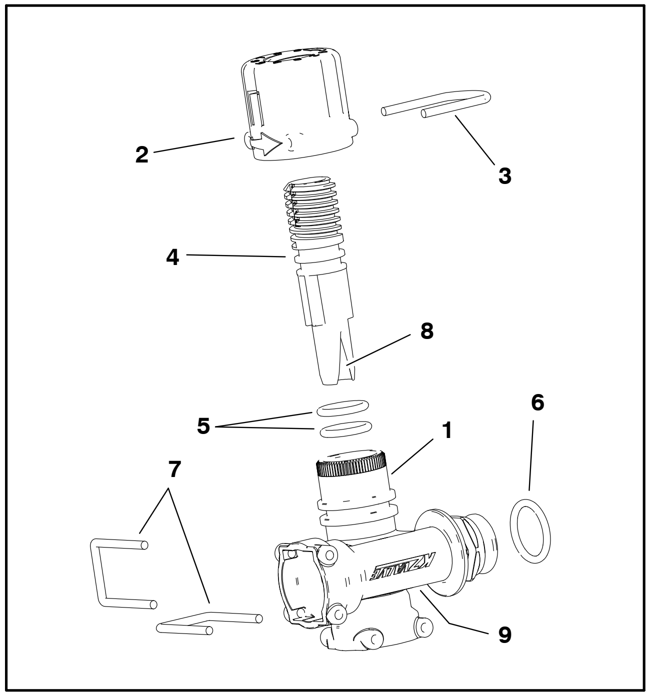

Figure 44

1. **Bypass valve body**
2. **Knob**
3. **Knob fork**
4. **Valve stem**
5. **O−ring (2)**
6. **O−ring**
7. **Valve body fork (2)**
8. **Valve stem cut−out**
9. **Cross tube**

Boom Section Bypass Shut−Off Valve and Agitation Throttle Valve Service

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

Disassembly (Fig. 45)

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.

6. Inspect the valve seats (item 3). Replace components as necessary.

Assembly (Fig. 45)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install new O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install knob and screw.

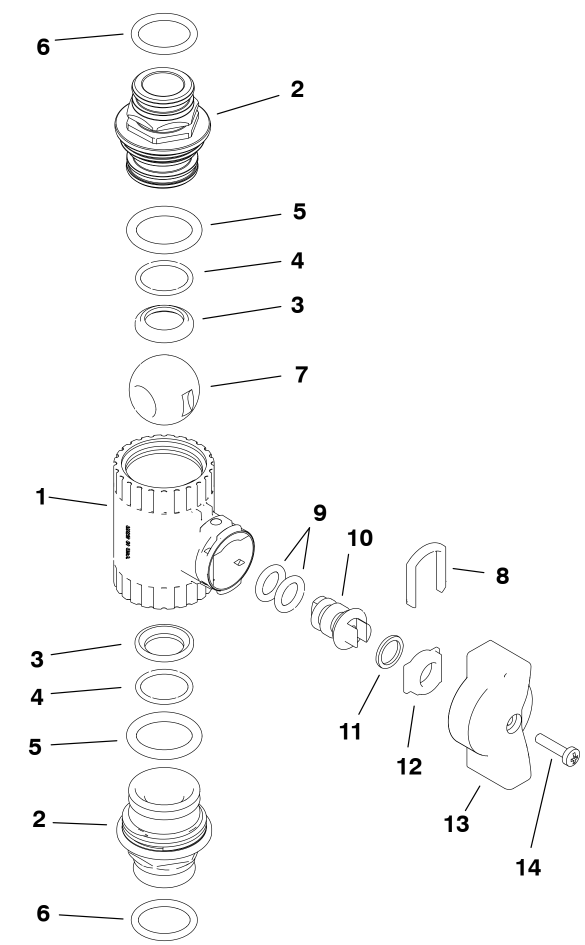

Figure 45

1. **Valve body**
2. **End cap (male − fork)**
3. **Seat (2)**
4. **O−Ring (2)**
5. **O−Ring (2)**
6. **O−Ring (2)**
7. **Ball**
8. **Stem fork**
9. **O−Ring (2)**
10. **Stem**
11. **Washer**
12. **Stem seat**
13. **Knob**
14. **Screw**

Flow Meter

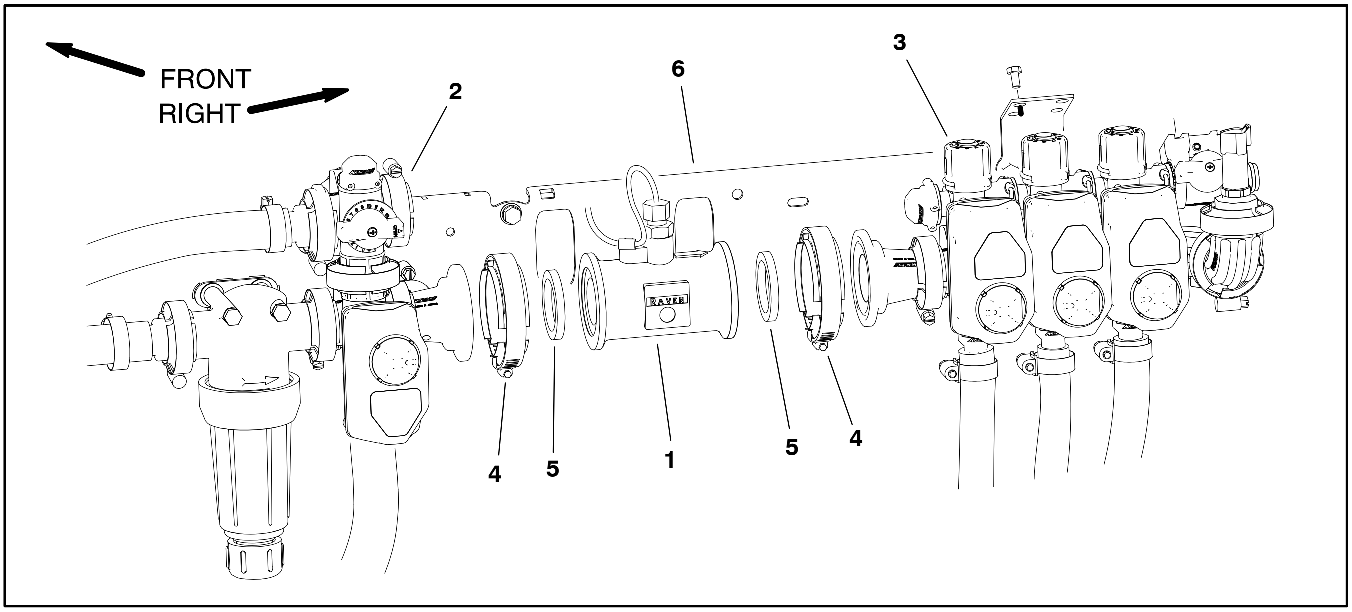

Figure 46

1. Flow meter
2. Agitation valve assembly
3. Boom section valve assembly
4. Clamp (2)
5. Gasket (2)
6. Valve mount

The flow meter (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 flow meter is being replaced, calibrate the flow meter after installation (see Flow Calibration in the machine Operator's Manual or Software Guide).

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. 46)

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 flow meter.

IMPORTANT: Note the direction of the arrow on top of flow meter (Fig. 47). The arrow should point toward the boom section valve assembly.

3. Remove the boom section valve assembly or agitation valve assembly from machine (see Spray Control Manifold Assembly in this chapter).

4. Support flow meter and loosen clamp that secures flow meter to remaining manifold assembly.

5. Remove flow meter and discard gaskets (item 5). See Flow Meter Service in this chapter for additional information.

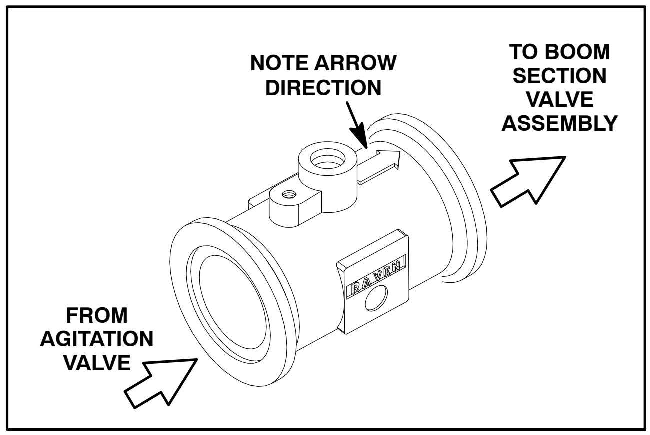

Figure 47

Installation (Fig. 46)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Make sure that arrow on flow meter body is pointing toward the boom section valve assembly (Fig. 47) and secure flow meter to valve assembly on machine with a clamp and a new gasket.

2. Connect wire harness connector to flow meter.

3. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Flow Meter Service

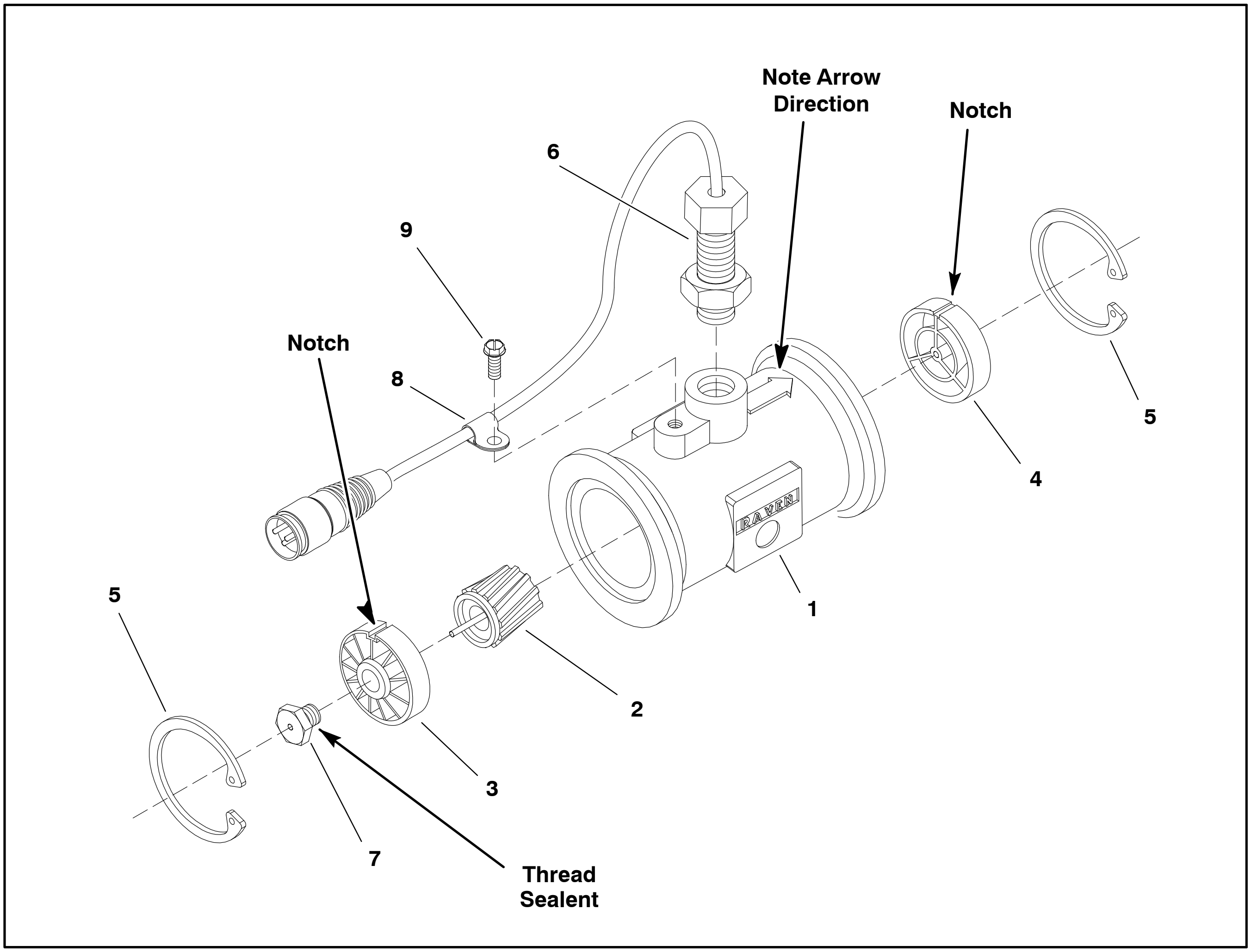

Figure 48

1. **Flow meter 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**

NOTE: Flow meter wire harness and sensor testing procedures can be found in Chapter 6 – Electrical System in this manual.

Disassembly (Fig. 48)

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 flow meter from machine (see Flow Meter in this chapter).

2. Disassemble flow meter.

3. Clean rotor (item 2), both hubs (items 3 and 4) and flow meter body to remove any debris, spray chemicals or other materials.

Assembly (Fig. 48)

1. Assemble flow meter. Check the following items during flow meter 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 flow meter 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 flow meter housing.

2. Install flow meter (see Flow Meter in this chapter).

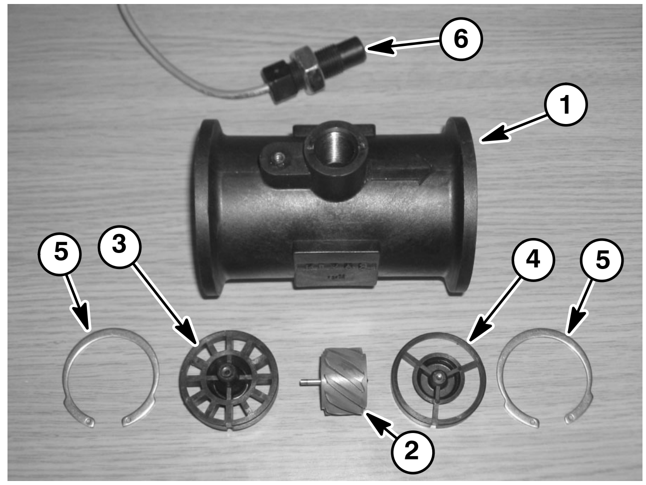

Figure 49

1. **Flow meter body**
2. **Rotor/magnet assembly**
3. **Upstream hub/bearing**
4. **Downstream hub**
5. **Retaining ring (2)**
6. **Sensor**

Suction Line

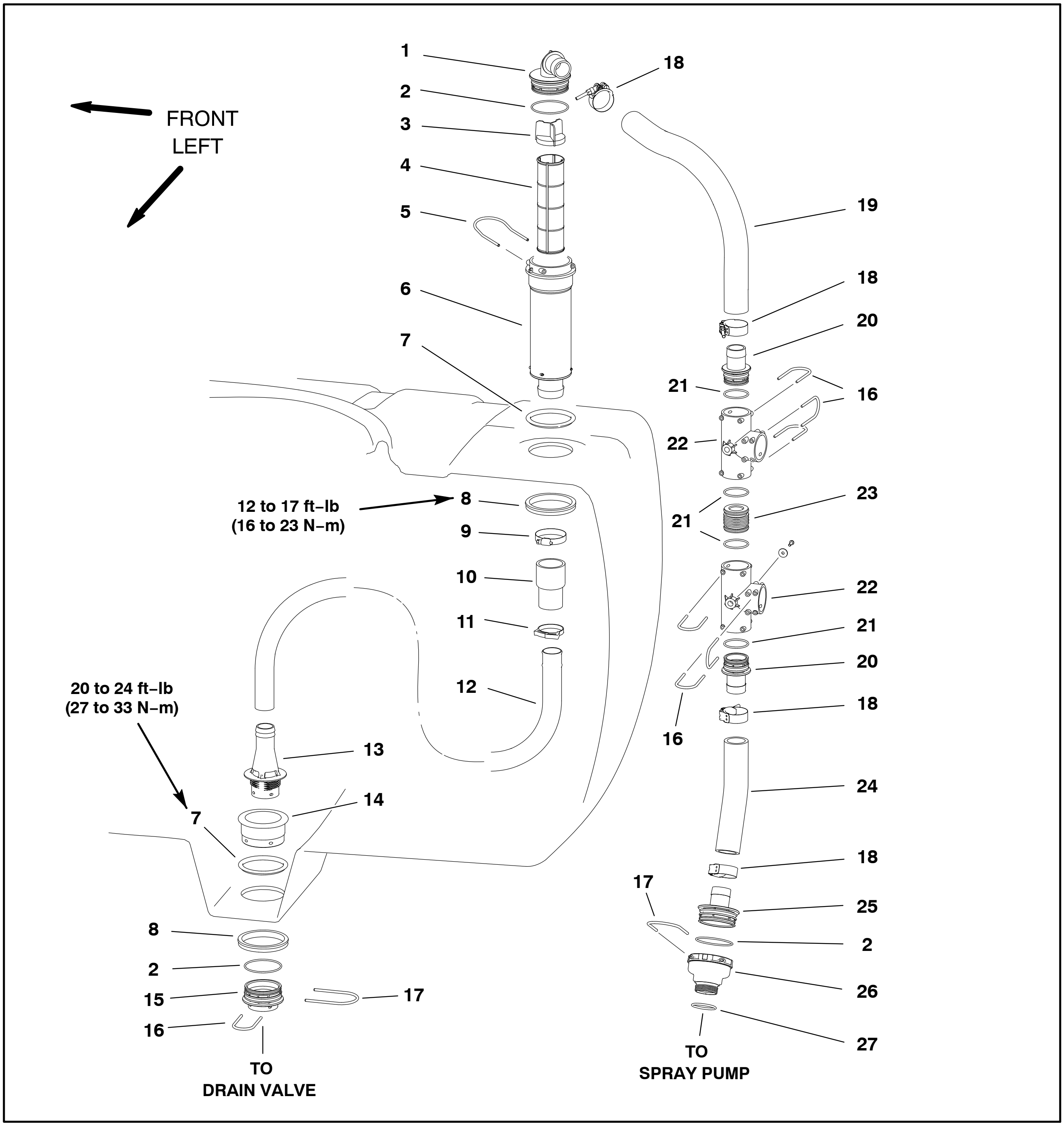

Figure 50

1. Elbow
2. O–ring (3)
3. Vane – strainer
4. Element – strainer
5. Fork
6. Strainer body
7. Gasket (2)
8. Nut (2)
9. Hose clamp
10. Connector
11. Clamp
12. Suction hose
13. Suction foot
14. Bulkhead
15. Adapter
16. Fork (7)
17. Fork (2)
18. Hose clamp (4)
19. Suction hose 27.5 in. (70 cm)
20. Hose barb (2)
21. O–ring (4)
22. Tee (2)
23. Connector
24. Suction hose 10 in.(25.4 cm)
25. Hose barb
26. Fitting – suction
27. O–ring

NOTE: If suction tube in tank develops an air leak, spray performance will diminish when tank level reaches the leak.

Removal (Fig. 50)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Disconnect elbow fitting above suction strainer (Fig. 51) and remove strainer vane and element.

3. Raise tank lid and remove strainer basket to gain access to suction line inside spray tank.

4. Remove suction line assembly and disassemble tube as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 50)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets. Assemble and install suction line assembly.

2. Install suction strainer element and vane, then connect suction line elbow above tank (Fig. 51).

3. Check suction line for leaks. Repair all leaks before returning the sprayer to service.

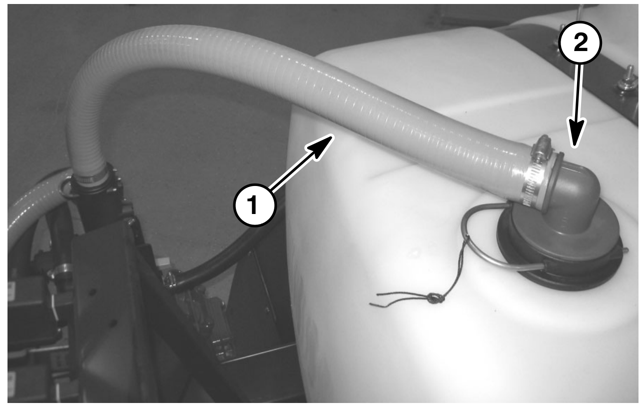

Figure 51

1. **Suction hose**
2. **Strainer location**

Agitation Line

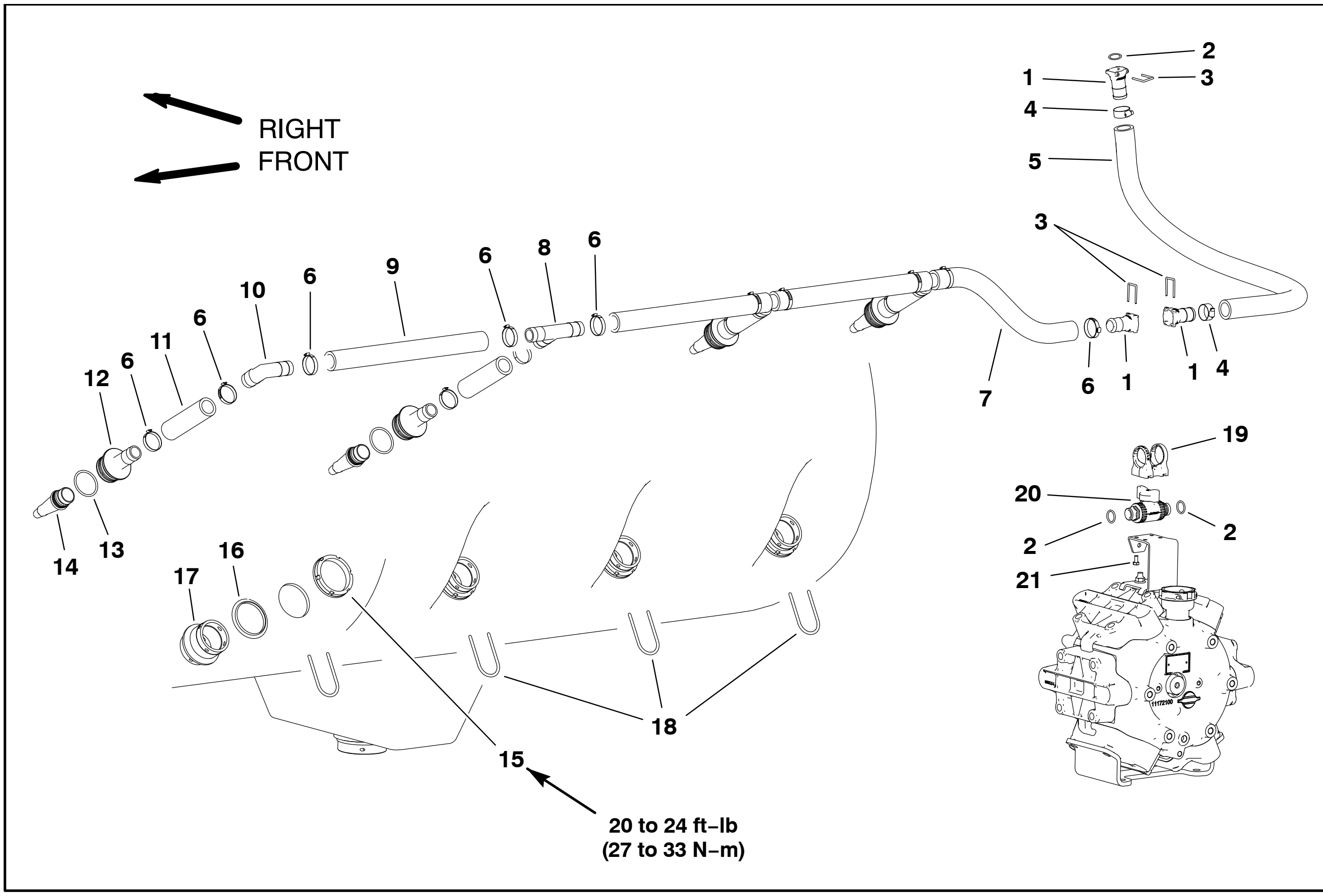

Figure 52

1. Hose barb (3)
2. O−ring (3)
3. Fork (3)
4. Clamp (2)
5. Agitation hose 32 in. (81 cm)
6. Clamp (16)
7. Agitation hose 16 (40 cm)
8. Tee (3)
9. Agitation hose 14 (35.5 cm) (3)
10. Elbow
11. Agitation hose 5 (12.7 cm) (4)
12. Adapter (4)
13. O−ring (4)
14. Nozzle (4)
15. Nut (4)
16. Seal (4)
17. Bulkhead (4)
18. Fork (4)
19. Clamp
20. Agitation throttle valve
21. Cap screw (4)

Disassembly (Fig. 52)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Label hoses that are to be disconnected for assembly purposes.

3. Remove agitation line components as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 52)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets and assemble drain line.

2. Using labels placed during disassembly, install disconnected hoses and secure with hose clamps.

3. Make sure that agitation throttle valve is open and secured to sprayer.

4. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Drain Line

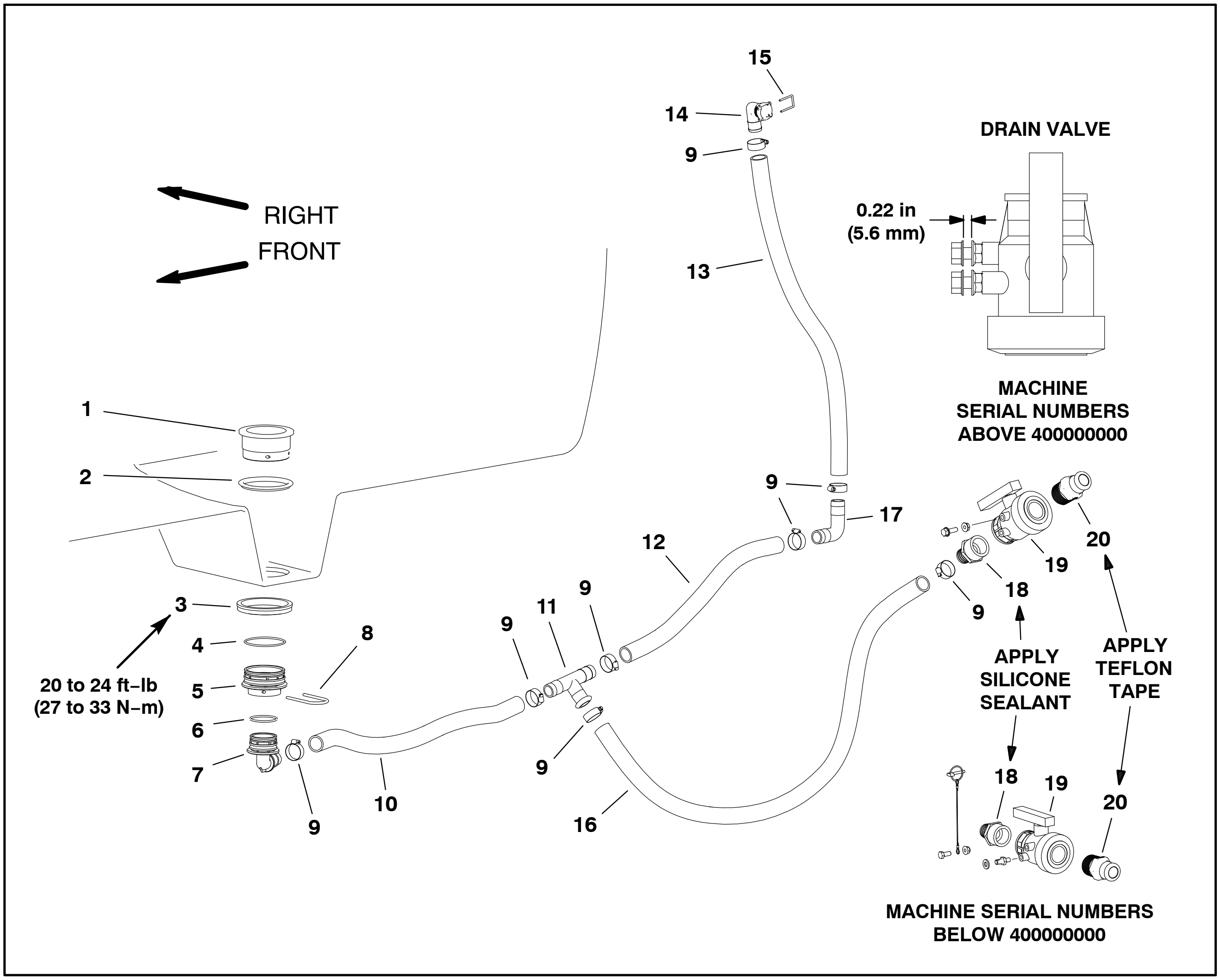

Figure 53

1. Bulkhead
2. Gasket
3. Nut
4. O–ring
5. Adapter
6. O–ring
7. Hose barb
8. Fork
9. Hose clamp (8)
10. Drain hose 26.5 in. (67 cm)
11. Tee
12. Drain hose 22 in. (56 cm)
13. Drain hose 25 in. (64 cm)
14. Elbow
15. Fork
16. Drain hose 41 in. (104 cm)
17. Hose barb
18. Hose barb – smooth
19. Drain valve
20. Hose barb – threaded

Disassembly (Fig. 53)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Label hoses to allow proper installation after repairs are completed. Loosen hose clamps and remove hoses from hose barbs that are to be disassembled.

3. Disassemble drain assembly as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 53)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets and assemble drain line.

2. Using labels placed during disassembly, install hoses to hose barbs and secure with hose clamps.

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.

Turret Bodies

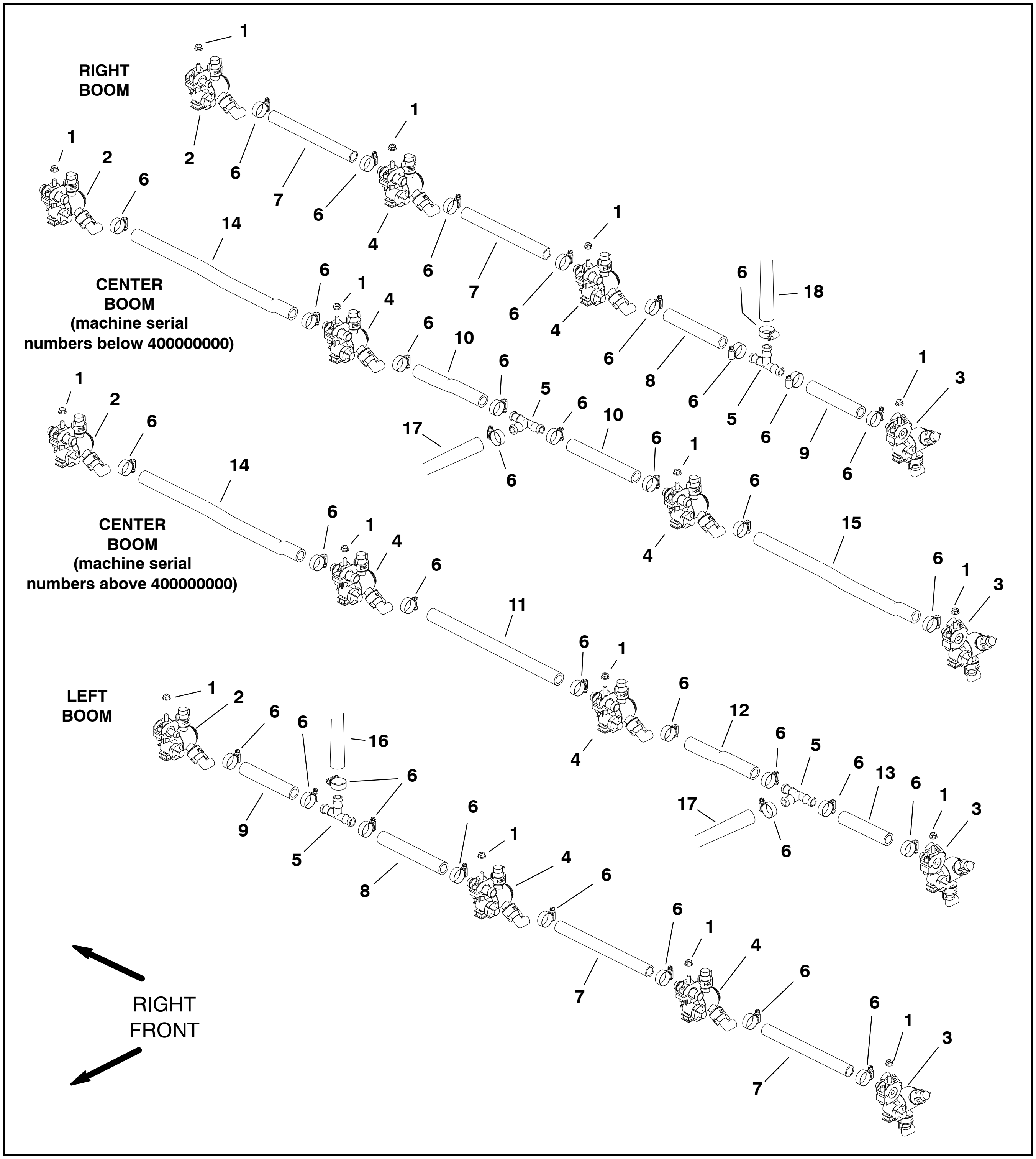

Figure 54

1. Flange nut (12)
2. Turret body – RH barb (3)
3. Turret body – LH barb (3)
4. Turret body – dual barb (6)
5. Tee fitting (3)
6. Hose clamp (27)
7. Hose 18.75 in. (47.6 cm) (4)
8. Hose 12.25 in. (31 cm) (2)
9. Hose 6 in. (15.2 cm) (2)
10. Hose 9.13 in. (23.2 cm) (2)
11. Hose 19 in. (48.3 cm)
12. Hose 5.25 in. (13.3 cm)
13. Hose 13 in. (33 cm)
14. Hose – formed RH
15. Hose – formed LH
16. Hose (from left boom spray valve)
17. Hose (from center boom spray valve)
18. Hose (from right boom spray valve)

Removal (Fig. 54)

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. 54)

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. 55)

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. 55)

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. 56). 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.

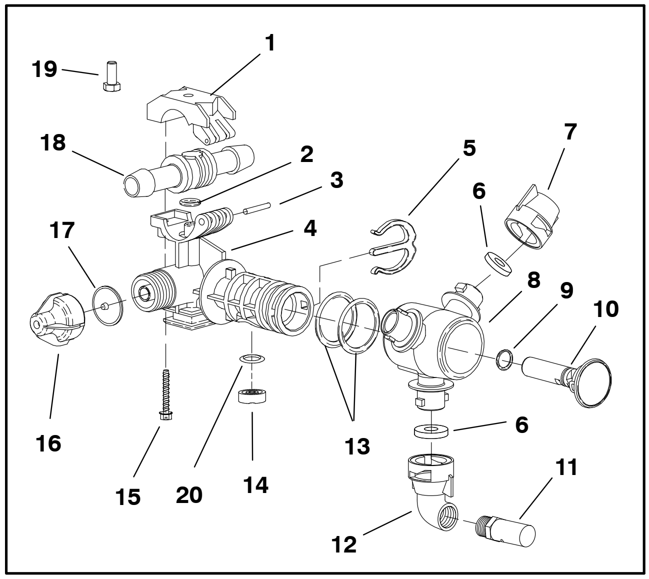

Figure 55

1. **Upper clamp**
2. **O−ring**
3. **Pivot pin**
4. **Body**
5. **E−clip**
6. **Gasket (3)**
7. **Dust cap (2)**
8. **Turret**
9. **O−ring**
10. **Plug**
11. **Nozzle**
12. **Nozzle cap**
13. **O−ring**
14. **Seal**
15. **Screw**
16. **End cap**
17. **Diaphragm**
18. **Hose barb**
19. **Cap screw**
20. **O−ring**

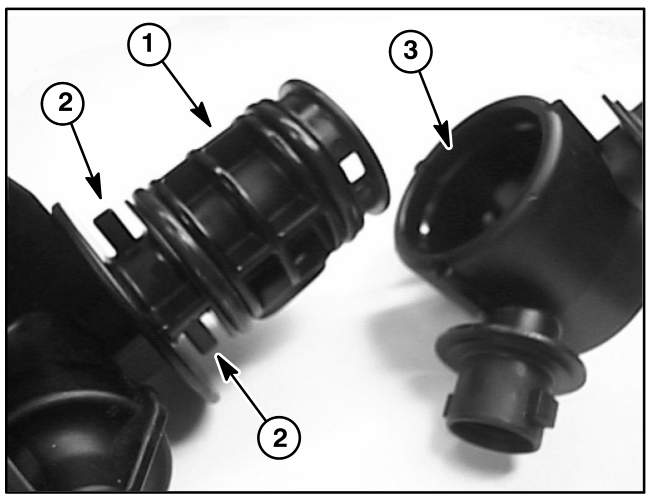

Figure 56

1. **Body**
2. **Detent post**
3. **Detent groove**

Nozzle Flow Meter (Optional NozzAlert Nozzle Sensing System)

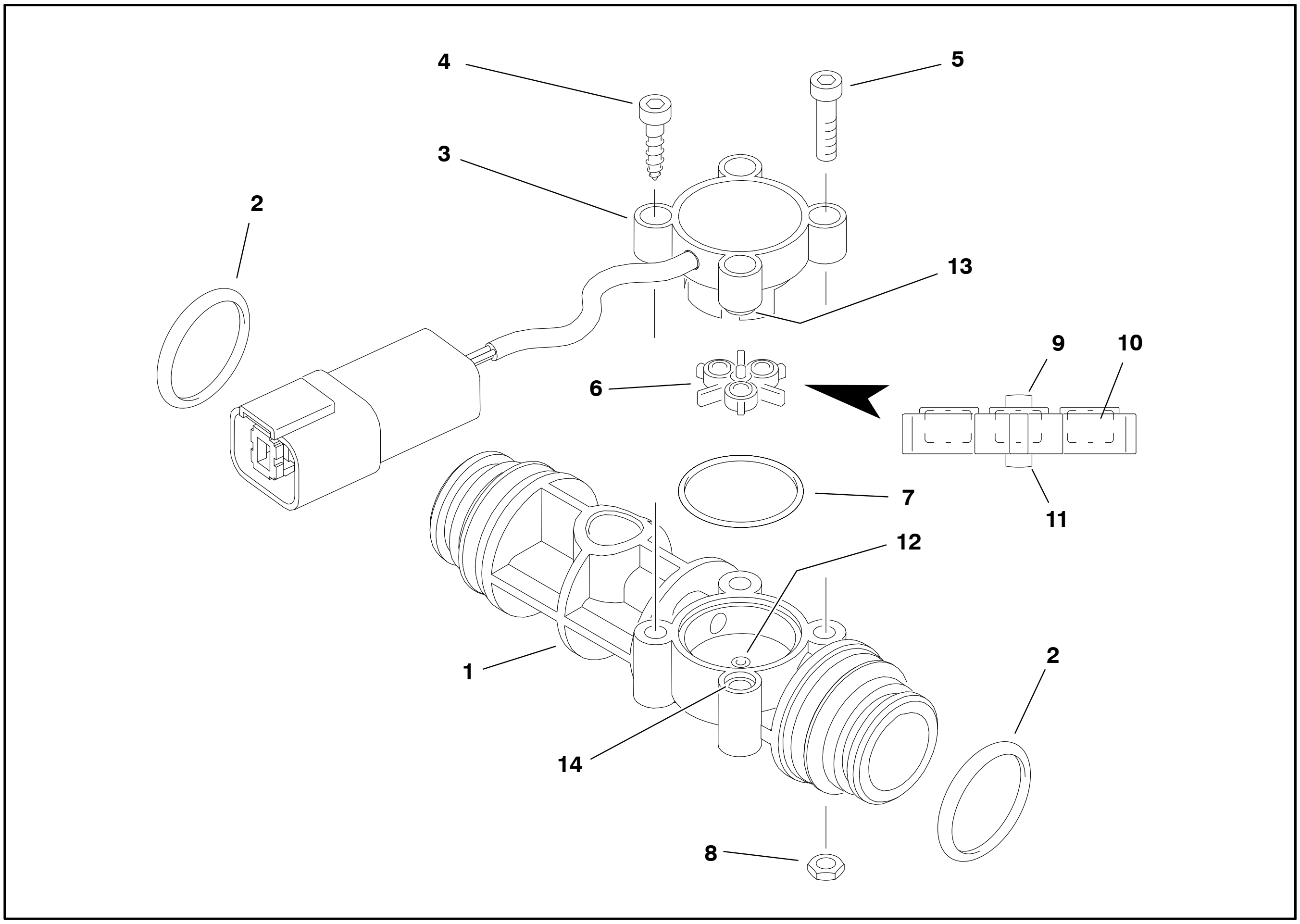

Figure 57

1. Flow meter body
2. O−ring (2)
3. Sensor assembly
4. Screw (2)
5. Cap screw (2)
6. Rotor/magnet assembly
7. O−ring
8. Hex nut (2)
9. Top rotor shaft
10. Magnet (3)
11. Bottom rotor shaft
12. Bearing
13. Boss
14. Recess

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

Disassembly (Fig. 57)

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

2. Disconnect the flow meter from the wire harness

3. Remove the forks from the adapter fittings at each end of the flow meter, and remove the flow meter from the machine.

4. Remove the fasteners securing the sensor assembly to the flow meter body and remover the sensor assembly.

5. Remove the rotor/magnet assembly and retrieve the O−ring.

6. Clean all of the components carefully. Ensure the rotor passages in the flow meter body are free of any obstructions.

Assembly (Fig. 57)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install a new O−ring in the sensor opening of the flow meter body.

2. Place the rotor/magnet assembly in the flow meter body with the magnets towards the sensor assembly. Ensure the bottom rotor shaft is centered on the bearing in the flow meter body.

3. Align the sensor assembly with the flow meter body. The boss on the underside of one of the sensor assembly mounting holes must align with the recess in the flow meter body.

4. Secure the sensor assembly with the previously removed fasteners. Do not overtighten the fasteners.

5. Use new O−rings at each end of the flow meter body, fit the flow meter assembly into the adapter fittings and secure it with the previously removed forks.

6. Connect the flow meter to the wire harness.

Spray Boom Hinge

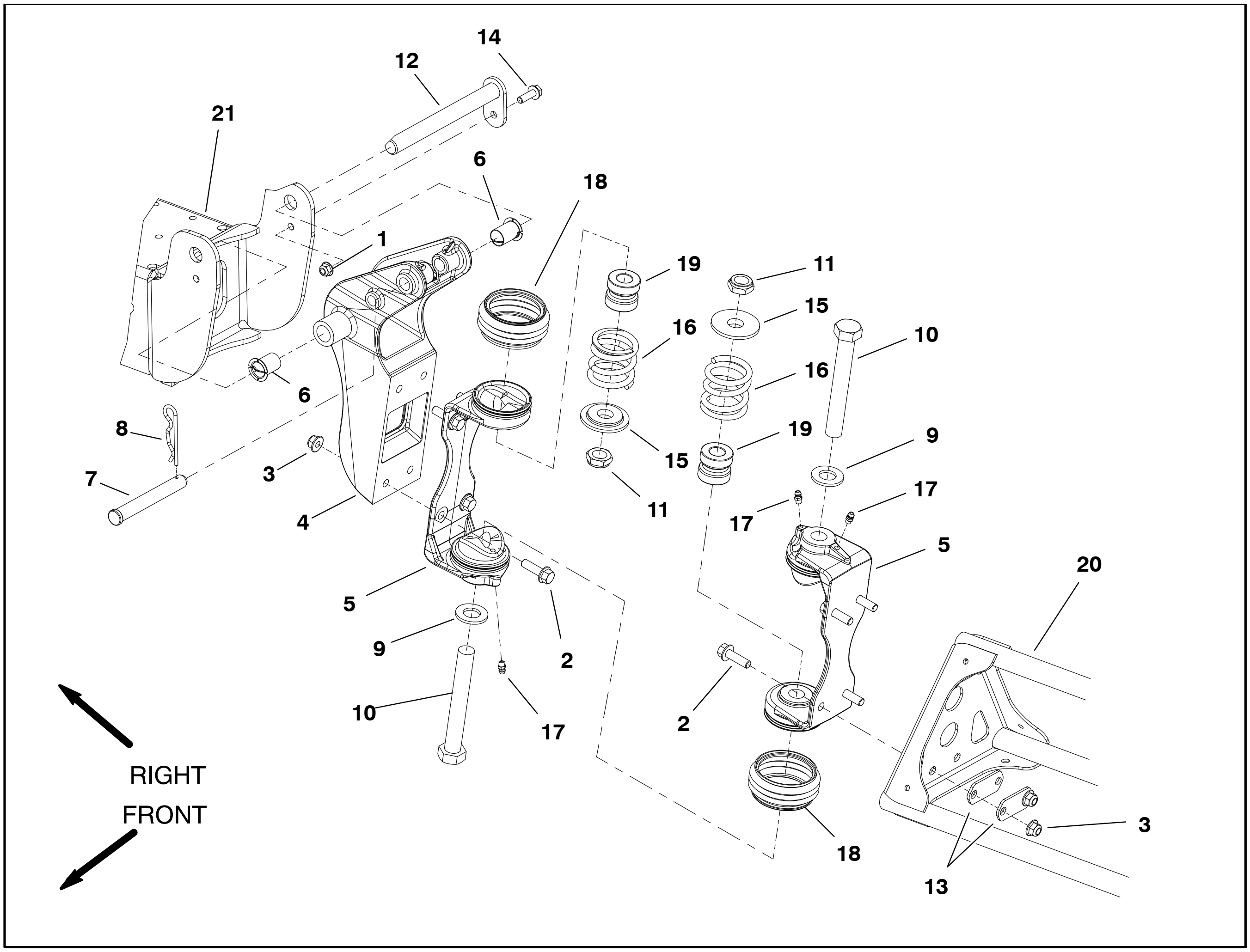

Figure 58

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. 58)

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. Remove fork and disconnect boom supply hose at boom section valve. Remove and discard o–ring at hose connection.

3. Record locations and remove any clamps or ties securing nozzle supply hoses to center boom.

4. Support spray boom to prevent it from falling.

5. Loosen two (2) cap screws (item 10) and lock nuts (item 11) to allow breakaway springs (item 16) to fully extend.

6. 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).

7. Clean all removed components. If pivot bracket was removed, inspect bushings (item 6) and pivot pin (item 12) for damage or wear.

Assembly (Fig. 58)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

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. 59).

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 **1.53 to 1.59” (39 to 40 mm)** (Fig. 60).

6. Connect boom supply hose to boom section valve.

7. Secure boom supply hose to center boom with clamps and ties as recorded during disassembly.

8. Lubricate grease fittings on boom hinge.

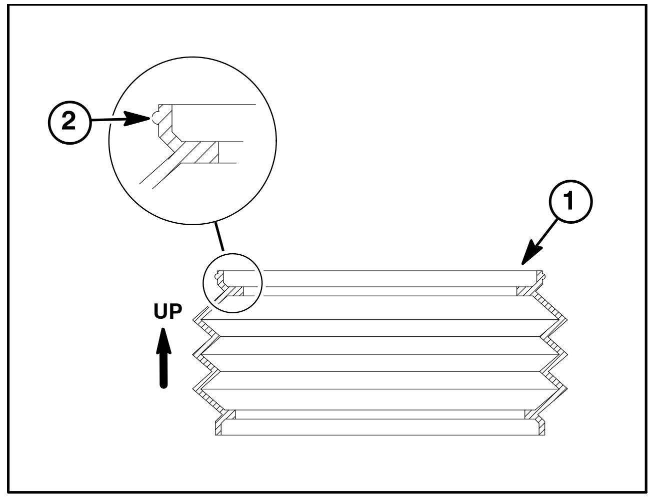

Figure 59

1. Rubber boot
2. Rib

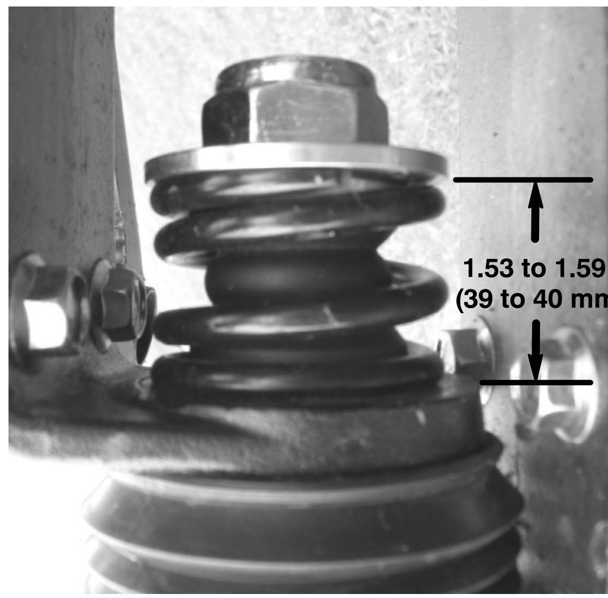

Figure 60

Spray Tank

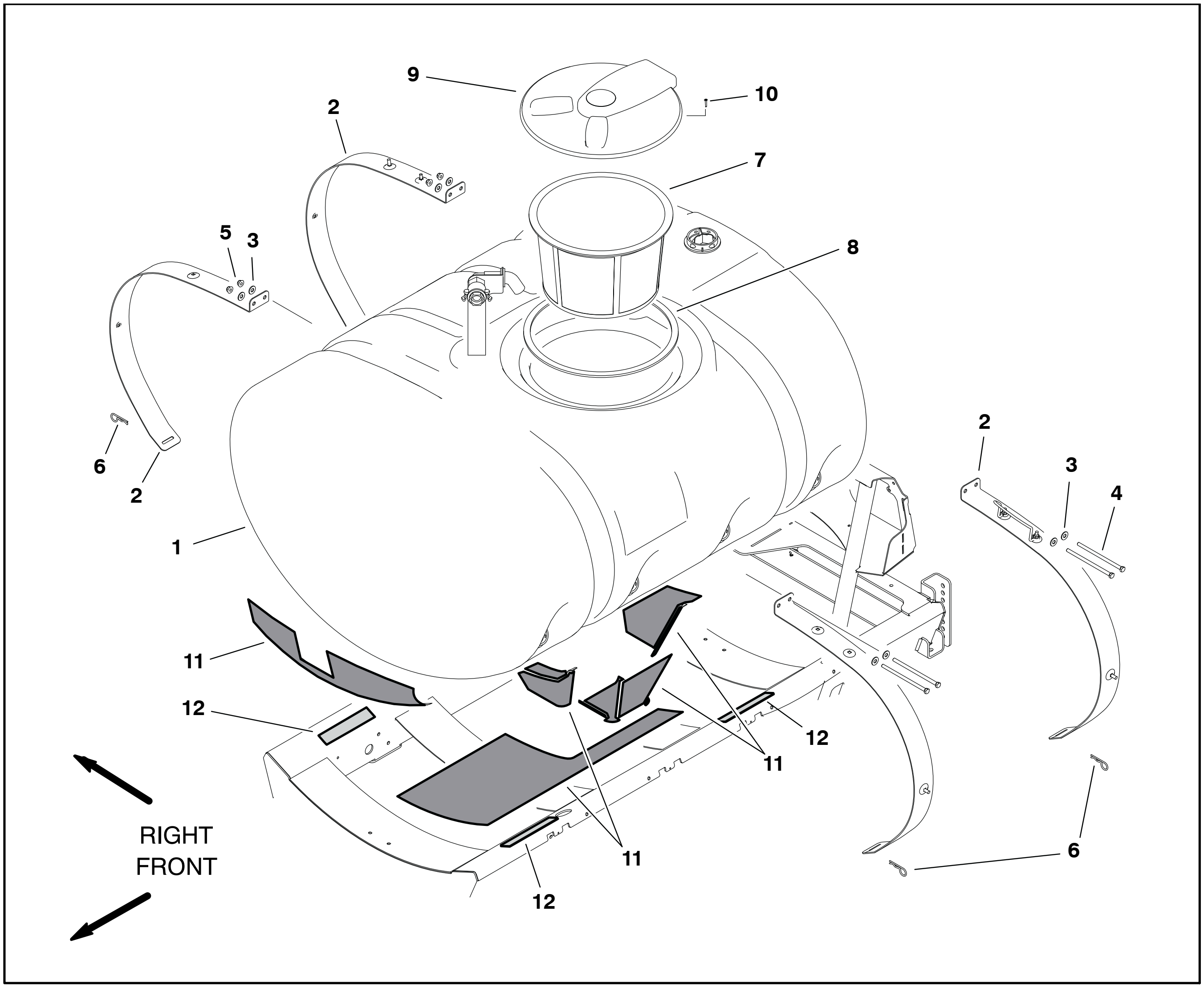

Figure 61

1. Spray tank
2. Tank strap (4)
3. Flat washer (8)
4. Hex head screw (4)
5. Lock nut (4)
6. Hair pin (4)
7. Filter basket
8. Gasket
9. Lid assembly
10. Pan head screw (8)
11. Heat shield (5)
12. Pad (4)

NOTE: Removing the spray tank may provide better service access to the engine and hydraulic pumps.

Removal (Fig. 61)

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 and any accessories that may block spray tank removal.

4. Raise the operator seat and remove the engine cover.

5. Disconnect suction line from top of tank and drain line from bottom of tank. Disconnect agitation hose from agitation throttle valve or remove four (4) agitation nozzles from tank fittings.

6. Remove flange nuts, flat washers and hex head screws (item 4) joining tank straps together on top of spray tank.

7. Remove hair pins (item 6) securing tank straps to machine frame and remove front and rear tank straps from machine.

CAUTION

Spray tank assembly weighs approximately 140 lbs (64 kg) when empty. Use an appropriate lifting device to safely lift the spray tank assembly.

8. Raise spray tank assembly from machine.

9. Make sure that heat shields on the spray tank and pads on spray tank frame are in good condition. Replace damaged shields and pads if needed.

10. Disassembly spray tank components as necessary. See Suction Line, Agitation Line and Drain Line in this chapter for specific component information.

Installation (Fig. 61)

1. Carefully lower spray tank assembly onto machine.

2. Level the spray tank from side to side. Make sure the tank drain reservoir is centered between tank frame cross−members.

3. Position tank straps to machine frame and secure with hair pins (item 6).

4. Install cap screws (item 4), flat washers and flange nuts joining tank straps together on top of spray tank.

5. Connect drain and suction hoses to spray tank. Connect agitation line or install agitation nozzles in tank.

6. Make sure that drain valve is closed and secured to the sprayer.

7. After spray tank installation, make sure that spray hoses do not contact any moving parts on machine.

8. Install the engine cover.

9. Install fresh water tank and any accessories previously removed.

10. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

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Chapter 8

GeoLink Spray System

Table of Contents

Specifications

Item	Description
Spray Pump	6–Diaphragm, Positive Displacement Pump Maximum Flow Rate of 42 GPM (159 lpm) at 475 rpm
Spray Pressure Relief Valve	Poppet Style, 218 PSI (15 Bar) Maximum
Sprayer Tank	300 U.S. Gallon (1136 Liter), Polyethylene
Suction Strainer	Stainless Steel, Tank Mounted (30 Mesh – Green, 50 Mesh – Blue, 80 Mesh – Red)
Pressure Filter	Agitation Manifold Mounted (16 Mesh – Brown Red, 30 Mesh – Red, 50 Mesh – Blue, 80 Mesh – Yellow, 100 Mesh – Green*)

*ISO colors beginning September 30, 2015 listed

General Information

User Manuals

A variety or User Manuals are available for Multi Pro machines with GeoLink spray systems. The Operator's Manual, Interactive Manual, Quick Start Guide, Installation Instructions and Parts Catalogs provide information regarding the installation, operation, general maintenance and maintenance intervals for your Multi Pro machine. Refer to these publications for additional information when servicing the machine.

GeoLink Spray System Service and Support

Unlike other Toro commercial products, the first call for assistance with your Multi Pro 5800 with optional GeoLink Spray System should be the Toro National Support Network (NSN) and not your Authorized Toro Distributor. The people at NSN configured and tested the GeoLink components on your machine prior to installation, and are best suited to help diagnose GeoLink spray system issues quickly. Contact NSN at 1−844−GEOLINK (436−5465) or NSNTech@toro.com.

Precautions Concerning Chemicals Used in Spray System

Chemicals can injure persons, animals, plants, soil or other property. To reduce the risk of environmental damage and personal injury:

1. Select the proper chemical for the job.

2. Carefully read the directions printed on the chemical manufacturer's labels before handling chemicals. Instructions on chemical manufacturer's container labels regarding mixing proportions should be read and strictly followed.

3. Keep spray material away from skin. If spray material comes in contact with a person, wash it off immediately in accordance with manufacturer's recommendations (container labels and Material Safety Data Sheets).

4. Always wear protective clothing, chemical resistant gloves, eye protection and other personal protective equipment as recommended by the chemical manufacturer.

5. Properly dispose of chemical containers, unused chemicals and chemical solution.

Precautions for Removing or Adjusting Spray System Components

1. Stop the vehicle and set the parking brake.

2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure line pressure is relieved before loosening any system component (e.g. spray valves, spray system hose).

GeoLink Terminology

Boundary (Spray Zone): A mapped area that resides within a Field. Examples include tees, greens, fairways, cart paths, bunkers, ponds, infield, outfield, etc.

Categories: A classification of boundaries (spray zones) with similar attributes. e.g. greens, tees, fairways, etc.

CDMA (Code Division Multiple Access): CDMA is the primary type cellular technology for cell phones used in the United States. Cell phone providers that use CDMA technology include Verison, Sprint, Bell and Telus.

Field: The name of the "virtual" area in which boundaries (spray zones) reside. As an example, a field may be named, "XYZ Country Club" or "Sportsfield 1. A customer may wish to use separate fields for situations such as "North Course" or "South Course" or "Back Nine" or "Front Nine" as long as a single job (spray application) never needs to include boundaries from each field. Fields are not mapped.

> **NOTE:** Toro recommends organizing the site using one field per propriety, with all the individual boundaries (spray zones) included in the single field. All boundaries for a single job must be in the same field. A single job cannot include boundaries from multiple fields.

GSM (Global System for Mobile): GSM is the primary type of cellular technology used for cell phones in countries other than the United States. Within the United States, a much smaller number of network service providers are on the GSM standard, among them AT&T, T−Mobile and Rogers.

IMU (Inertial Measurement Unit): The IMU is an electronic device that measures and reports the machines force and angular rate using an accelerometer and a gyroscope. The IMU allows the GPS receiver to work when GPS−signals are momentarily unavailable, or blocked, or when electronic interference is present.

Inventory Manager: The menu where jobs, fields, boundaries etc. reside. It is here that information may be edited, copied and deleted.

Job: A spraying application. Jobs are created by selecting categorized boundaries, or work regions.

> **NOTE:** All boundaries (spray zones) for a single job must be in the same field. A single job cannot include boundaries from multiple fields.

Job Notes: Job information entered manually by the user. e.g. weather conditions, operator name, various notes, etc.

Job Report: A report that contains data for each job.

Mapping: The process of creating a Boundary (spray zone) using the Map Point.

Map Point: The center of the outside edge of the driver's side front tire.

Modem: Used on units with RTK correction only to connect the machine to the Internet. Two different modems are used based on the type of cellular service used.

NSN (Toro's National Support Network): Provides GeoLink support directly to the end user. The "first point−of−contact" for customers with questions or issues. Contact NSN at 1−844−GEOLINK (436−5465) or NSNTech@toro.com.

RTK (Real Time Kinematic): The GPS correction service used to enhance the precision of position data derived from satellite−based positioning systems by incorporating a cellular signal. The system can be configured to support either CDMA or GSM cellular signals nd improves location accuracy from 3 meters to 0.01 meter or 1 cm.

TopNET Live: The RTK correction network, made up by a series of reference antennas located around the world provided by Topcon. Antenna locations may be found at http://www.topnetlive.com.

User Modes: Easy (general spraying − Operators), Standard (password protected for defining boundaries − Supervisors and Superintendents) and Expert (password protected, service information − NSN and Authorized Toro Distributors)

WAAS (Wide Area Augmentation System): A free GPS correction service that was developed to augment the standard Global Positioning System (GPS), with the goal of improving its accuracy (from 15 meters to 3 meters), integrity, and availability.

Special Tools

Quick Check Catch Jug – 64 oz (946 ml)

Use this container during flow calibration and spray nozzle catch tests.

NOTE: For most applications, a 32 oz (946 ml) catch jug may be more accurate and easier to use.

IMPORTANT: When you are reading the graduated container, you must set the container on a level surface. Read the fluid volume in the graduated container at the lowest point of the fluid−surface curve. Small errors reading the fluid volume in the graduated container will significantly impact the accuracy of the sprayer calibration.

Multi Pro 5800 sprayers using revision D software use a variable timed catch test to achieve the target spray volume. Revision D software is compatible with all Multi Pro 5800 sprayers with serial numbers above 316000000.

Multi Pro 5800 sprayers using revision A, B and C software use a fixed 15 second catch test time. The table in Figure 2 lists the desired nozzle volume for a 15 second catch test.

Toro Part Number: **131−7237**

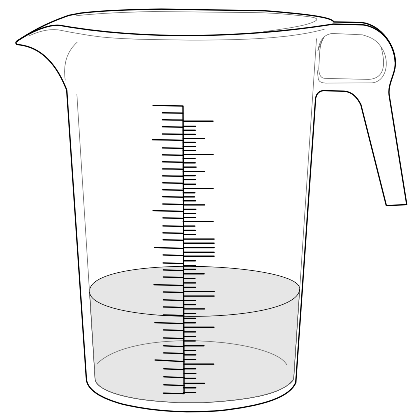


Figure 1

Nozzle Color	Ounces Collected in 15 Seconds (+/− ¼ oz)	Milliliters Collected in 15 Seconds (+/− 7.4 ml)
Yellow	6.4	189
Red	12.8	378
Brown	16.0	473
Gray	19.2	567
White	25.6	757
Blue	32.0	946
Green	48.0	1,419

Figure 2

GeoLink Spray System Diagram

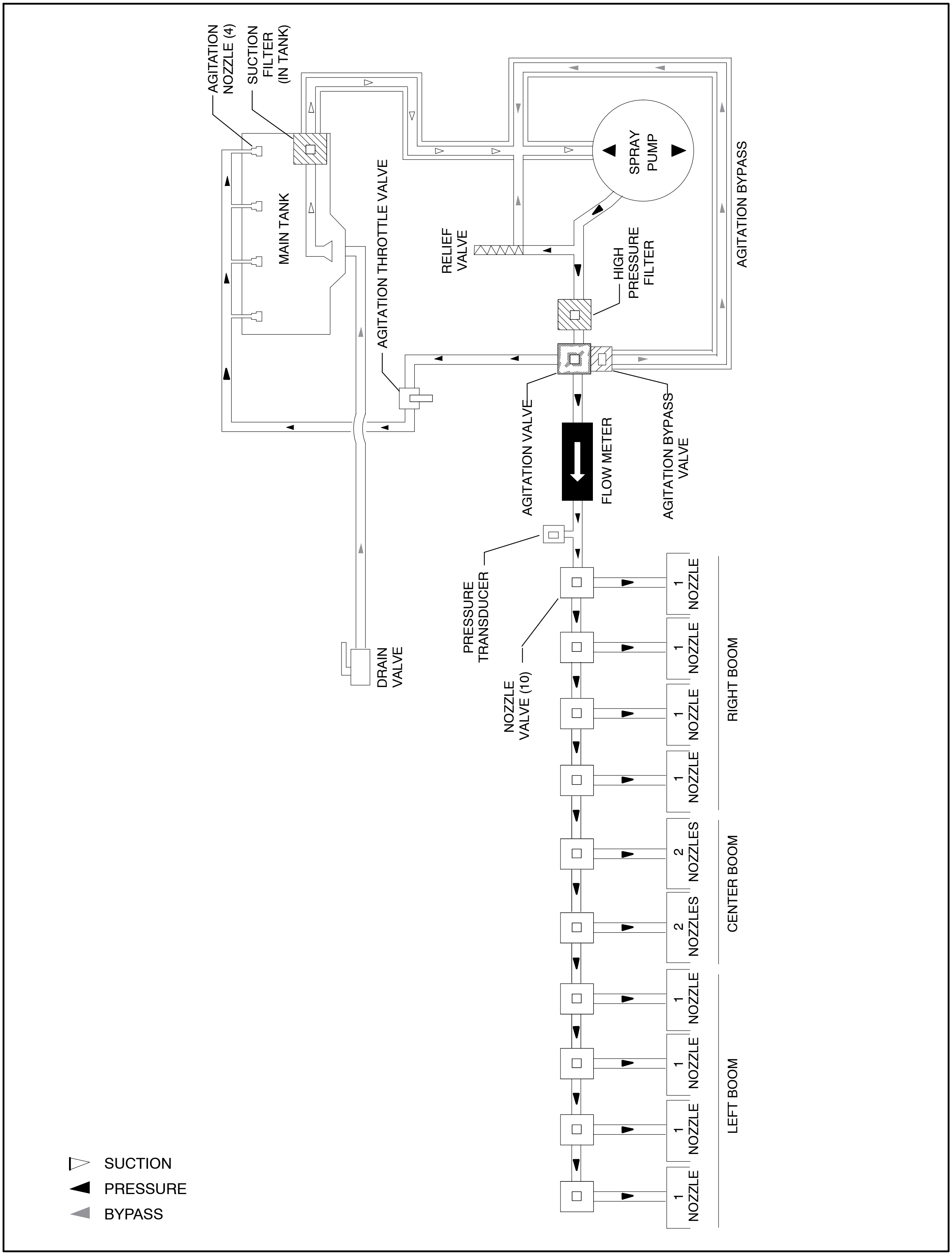


Figure 3

GeoLink Spray System Operation

GeoLink operation information can be found in the GeoLink Operator's Manual, Installation Instructions, Quick Start Guide and Interactive Manuals.

The optional GeoLink spray system utilizes Global Positioning Satellites (GPS) technology to determine exactly where you are and where you've sprayed. The system can automatically turn spray nozzles ON and OFF based on your exact location and any area previously sprayed areas. The system is designed to help prevent gaps and overlaps in spray product application, therefore avoiding costly chemical waste. In addition, the GeoLink system monitors vehicle speed and spray product flow to adjust the spray product output (flow rate) in real time.

Sprayer Positioning

GeoLink equipped machines use one of the following positioning systems: Wide Area Augmentation System (WAAS) or Real Time Kinematic (RTK). WAAS systems use only a signal from Global Positioning Satellites (GPS) and are accurate to approximately 3 meters. WAAS generated coordinates tend to move over time, therefore, machines using WAAS systems will need to define the boundary (spray zone) prior to each spray application. GPS position data is collected through the AGI−4 GPS antenna attached to the vehicle ROPS.

Units with RTK system correction use both a GPS signal and a cellular signal, improving system accuracy to approximately 0.01 meters (1 cm). RTK generated coordinates remain stationary, therefore, boundaries (spray zones) defined using RTK equipped machines need only be mapped once. GPS position data is collected through the AGI−4 GPS antenna, while the RTK correction signal is collected through a short vertical cellular antenna mounted alongside the GPS antenna. Both antennas are attached to the vehicle ROPS. A modem and IMU is installed in the GPS antenna housing on units with RTK correction.

NOTE: The system compass must be calibrated to allow the positioning feature of the system to function accurately (see Compass Calibration in this chapter).

Automatic Section Control (ASC)

Allows the system to turn spray nozzles ON when entering new areas, and turn nozzles OFF when passing over previously sprayed areas. When engaged, the ASC feature is used to prevent pass−to−pass overlapping coverage (boundary limit − Unlimited). The feature can also be set too control the spray nozzles to operate only in a previously defined boundary (boundary limit − Field Limit).

Automatic Rate Control

The GeoLink system controls application rate by increasing/decreasing the hydraulic flow to the spray pump (increasing/decreasing pump speed and therefore output/pressure) based on input from:

Operator programming (application rate)

Ground speed

Product flow (flow meter reading greater than 2 GPM (7.6 lpm))

Spray system pressure (flow meter reading less than 2 GPM (7.6 lpm))

NOTE: The system flow meter must be calibrated to allow the automatic rate feature of the system to function accurately (see Flow Meter Calibration in this chapter). Unlike other spray systems, the ground speed input of the application rate feature is constantly checked via GPS and does not require calibration.

Spraying Methods

The spray system can be easily set to operate using the following combinations of features:

Spraying with Field Boundary: system controls nozzles with boundary (spray zone) control and pass−to−pass (overlap) control, the system also controls the application rate

Spraying with Unlimited Boundary: boundary (spray zone) control is OFF, the system controls nozzles with pass−to−pass (overlap) control only, the system also controls the application rate

Spraying with Rate Control Only: operator controls the boom sections while the system controls application rate only

Spraying Manually: operator controls the boom sections and the application rate

GeoLink Components

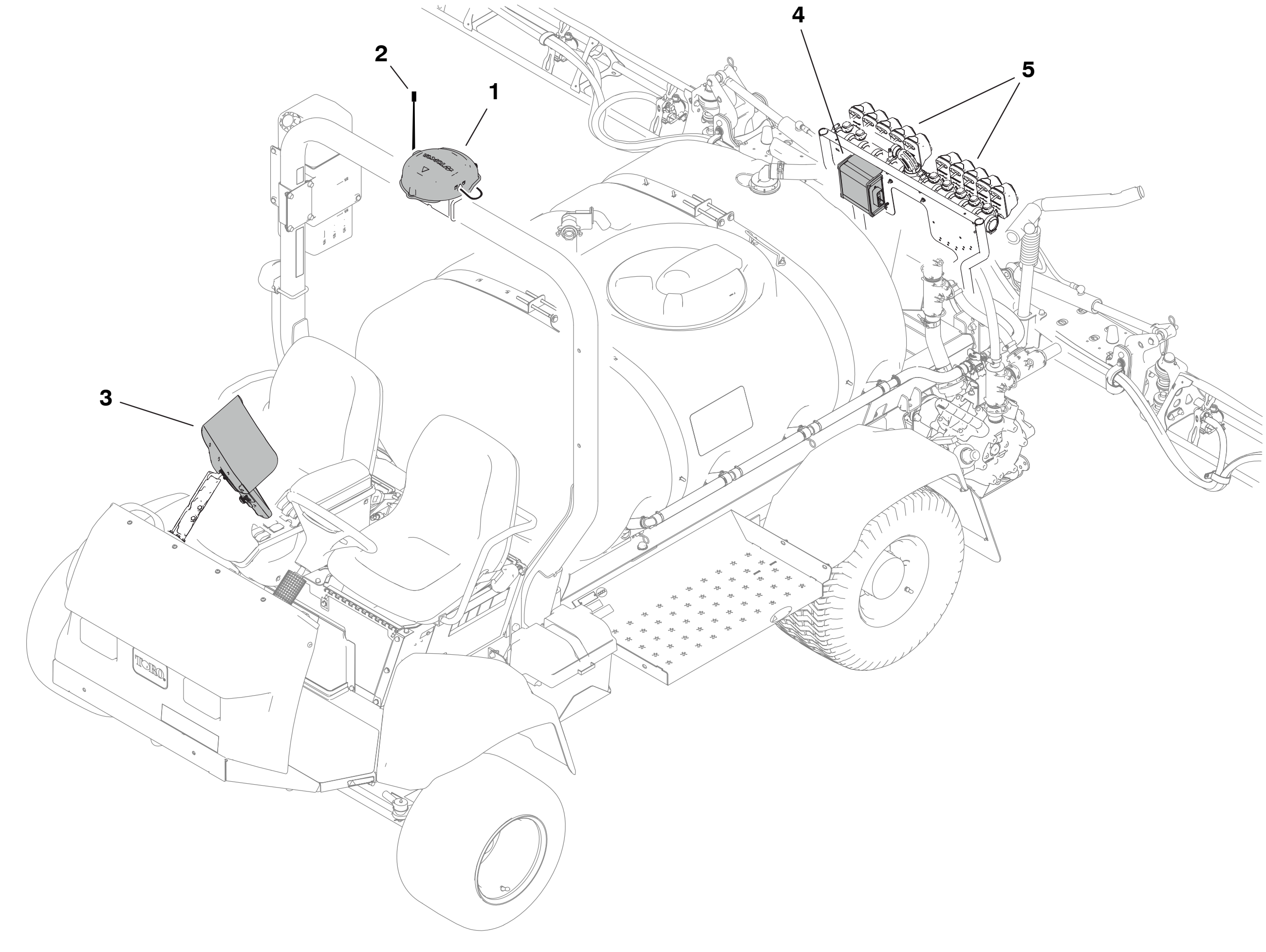


Figure 4

1. **GPS antenna AGI−4**
2. **Cellular antenna (machines with RTK correction only)**
3. **Control console X25 or X30**
4. **Automatic section controller ASC−10**
5. **Nozzle valves (10)**

AGI−4 GPS Antenna

The enclosed antenna is mounted to the machine ROPS. RTK enhanced systems also have a m and IMU installed in the antenna housing, plus a short vertical antenna mounted alongside the AGI−4 GPS antenna.

X25 or X30 Control Console

Operator control of the system is handled through either a X25 (8.5 in. diagonal) or X30 (12 in. diagonal) touch screen console mounted to the vehicle dash panel. The spray system is configured and spray application is monitored through the X25 or X30 console.

ASC−10 Auto Section Controller

The controller opens and closes the various nozzle valves, turning ON the flow of product to a nozzle as it enters an area that has not been sprayed, and turning OFF a nozzle as it exits an area that has already been sprayed. The controller is also responsible for varying the spray pump speed/system pressure and therefore the application rate.

Nozzle Control Valves

Standard spray systems such ExcelaRate use three (3) boom control valves to start and stop the flow of product to each of 3 booms. A total of ten (10) nozzle control valves are used to start and stop the flow of product to the twelve (12) spray nozzles on machines with GeoLink spray systems. Each valve controls one nozzle with the exception of the 4 center nozzles (nozzles 5 and 6 are controlled by a single valve, and nozzles 7 and 8 are controlled by a single valve).

NOTE: The AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller communicate with each other on a CAN−bus network. The GeoLink Can−bus network is separate from the sprayer traction unit CAN−bus.

Spray Pump

The GeoLink spray system on the Multi Pro 5800 uses a positive displacement six (6) diaphragm pump to move spray solution from the spray tank to the boom nozzles. The spray pump is self−priming with manually lubricated bearings and a dry crankcase.

The downward stroke of the pump's connecting rods and diaphragms creates suction to allow fluid to be drawn from the spray tank to the pump via the suction tube, suction strainer, hoses and connectors. Suction valves positioned in the pump valve chamber prevent fluid from being pumped back into the suction line during the upward stroke of the pump's connecting rods. Leaks in the suction line will cause system problems and often will be indicated by erratic spray, line jumping and excessive pump noise.

Once to the pump, the fluid is pushed by the upward stroke of the pump's connecting rods and diaphragms to the pressure side of the spray system. Pressure valves positioned in the pump head prevent fluid from being drawn back into the pump during the downward stroke of the pump's connecting rods. Maximum pressure in the system is limited by a pressure relief valve located near the pump. A pressure transducer in the system provides spray pressure information to the ASC−10 controller and for the X25 or X30 console display. An analog pressure gauge is also located on the dash panel to indicate spray system pressure.

System Controls

Constant (unswitched) battery current is supplied to the AGI−4 GPS antenna and the X25 or X30 console through a 10 amp fuse located in the wire harness near the vehicle battery. Constant (unswitched) battery current is supplied to the ASC−10 controller through a 50 amp fuse located in the wire harness near the ASC−10 controller. Switched battery current is supplied to the main fuse blocks by the main relay when the machine ignition switch is in the RUN position. A 30 Amp fuse in fuse block 3 (FB3) provides switched power to all of the spray system components. For spray system electrical component information and circuitry, see Chapter 6 − Electrical System and Appendix A − Foldout Drawings in this manual.

In addition to the X25 or X30 console, the spray system is operated by a variety of electrical switches located on the dash and control console. Switches include a spray pump enable switch, an agitation control switch, two (2) boom lift switches, three (3) boom section switches and a master boom switch. These switches control the spray pump hydraulic hydraulic drive motor flow ON/OFF, the agitation control valve ON/OFF, the hydraulic boom lift solenoid coils RAISE/LOWER, the spray nozzles on a specific boom section ENABLE/DISABLE and all of the boom sections ON/OFF.

NOTE: The three (3) boom section switches and the master boom switch are used to enable or disable the spray system nozzles by boom section. When operating the system using automatic section control, the switches must be set to ON to allow the ASC−10 to control the nozzles individually.

The spray pump is directly coupled to and driven by a hydraulic motor. Flow from the hydraulic system gear pump to the motor is controlled by a series of valves in the pump control manifold. Based on available current (mA) from the ASC−10 controller, the hydraulic proportional valve (PV) controls hydraulic flow to the spray pump motor. This hydraulic flow causes the motor to rotate the spray pump for spray system operation. The spray pump enable switch located on the control console must be in the ON/ENABLED position to allow the ASC−10 to control the spray pump. A logic cartridge (LC) and a relief valve (RV) located in the pump control manifold help maintain consistent and safe operating pressure. See Hydraulic Flow Circuits − Spray Pump Drive Circuit in Chapter 5 − Hydraulic System in this manual for more detailed information.

When the spray pump is ON, the switch light is illuminated, the spray pump icon appears on the InfoCenter display. Selecting and adjusting the application rate is handled through the X25 or X30 controller. The ASC−10 adjusts the electrical current to the spray pump hydraulic proportional valve solenoid coil. Higher current (rate increase) to the solenoid coil increases hydraulic flow to the spray pump motor and results in a higher spray pump speed and more output/pressure. Lower current (rate decrease) to the solenoid coil decreases hydraulic flow to the spray pump motor and results in a lower spray pump speed and less output/pressure. The spray nozzles achieve their rated output at 40 psi (2.8 bar) unless otherwise stated. The application rate and nozzle selected will dictate the exact pressure. See the Spray Nozzle Selection Guide (Toro12−082−T) for information regarding spray nozzle selection.

Agitation circuit

When the agitation switch is ON, the switch light is illuminated, the agitation icon appears on the InfoCenter display and the agitation control valve is opened. This open valve directs spray system flow to four (4) agitation nozzles on the left side of the spray tank. The agitation nozzles direct spray product back into the lower portion of the tank to agitate or stir the contents of the tank. When the agitation switch is OFF, the agitation control valve is closed so no flow is directed to the tank agitation nozzles. The agitation valve includes an LED to indicate the current valve position (red = closed, green = open).

A manually adjustable agitation bypass valve is incorporated into the agitation control valve. Proper adjustment of the agitation bypass valve prevents system pressure changes when the agitation valve is switched ON/OFF while spraying. Flow from the agitation bypass valve is directed back to the spray tank (agitation bypass).

A manually adjustable agitation throttle valve restricts the flow to the agitation nozzles. The valve allows controlling the spray system pressure at the agitation nozzles when larger application rates are used.

Spray boom circuit (nozzle circuit)

The system includes an in−line flow meter to measure actual spray product flow to the nozzle valves. The flow meter is positioned directly before the nozzle control valves.

There are 10 nozzle valves used to control the 12 spray nozzles on the Multi−Pro 5800 GeoLink spray system. The nozzles on the left and right booms are controlled individually (a nozzle valve for each nozzle). The nozzles on the center boon are controlled in pairs (a nozzle valve controls two nozzles)

The ASC−10 controller controls the nozzle valves. An open nozzle valve directs spray product flow to the spray nozzle(s). When a nozzle valve is closed, no spray product flow is available to that spray nozzle(s). Each nozzle valve includes an LED to indicate the current valve position (red = closed, green = open).

X25 and X30 Control Console Screens

Operator control of the system is handled through either a X25 (8.5 in. diagonal) or X30 (12 in. diagonal) touch screen console mounted to the vehicle dash panel. The spray system is configured and spray application is monitored through the X25 or X30 console.

Operation Screen

NOTE: Based on the console type and the software version, some differences may exist between your machine and the information provided here.

A brief explanation of each of the operation screen icons and the sub–menus and screens they expose follows in the order they appear in Figure 5.

Figure 5

1. About menu icon
2. Guidance menu icon
3. GPS menu icon
4. Job information menu icon
5. Automatic section control menu icon
6. Spray controller menu icon
7. Inventory manager menu icon
8. Setup screen icon
9. View controls menu
10. Help menu icon
11. Job assistant icon
12. Record job details menu icon
13. Receiver (compass) calibration menu icon
14. Sprayer icon
15. Virtual master switch icon
16. Virtual dashboard

About Menu

The about menu lists the time and date according to the GeoLink system clock and the GeoLink software version currently loaded on the machine (Fig. 6).

Figure 6 – About Menu

Guidance Menu

The guidance menu displays the sprayer and its current relationship to previously defined boundaries (spray zones).

Figure 7

1. **Sprayer icon**
2. **Previously defined boundaries (spray zones)**

GPS Menu

The GPS menu provides access to the following sub–menus and screens:

GPS Position: current latitude and longitude coordinates for the machine (Fig. 8)

Figure 8 – GPS Position

Vehicle Orientation: current altitude, heading, speed and roll/pitch of the machine (Fig. 9)

Figure 9 – Vehicle Orientation

GPS Accuracy: displays number of satellites currently being used to calculate machine position (Fig. 10) and access to a RTK Diagnostics screen (Fig. 11) and a Cellular Diagnostics screen (Fig. 12)

Figure 10 – GPS Accuracy

1. Number of satellites currently in use
2. Access to RTK diagnostics screen
3. Access to Cellular diagnostics screen

The RTK Diagnostics screen provides information about the current RTK connection. Important data includes Time Since Last Msg: (should be less than 5 seconds) and Distance: (distance to the current RTK tower).

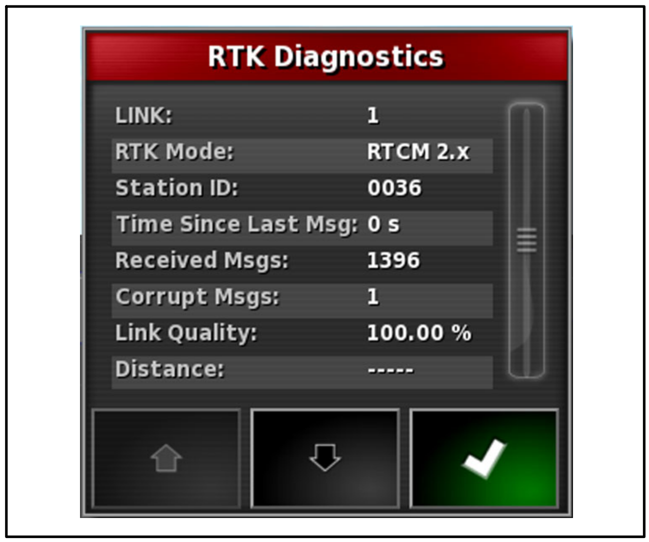


Figure 11 – RTK Diagnostics

The Cellular Diagnostics screen provides information about the current Cellular connection. Important data includes Cellular Status: (should be "NTRIP connected and receiving data").

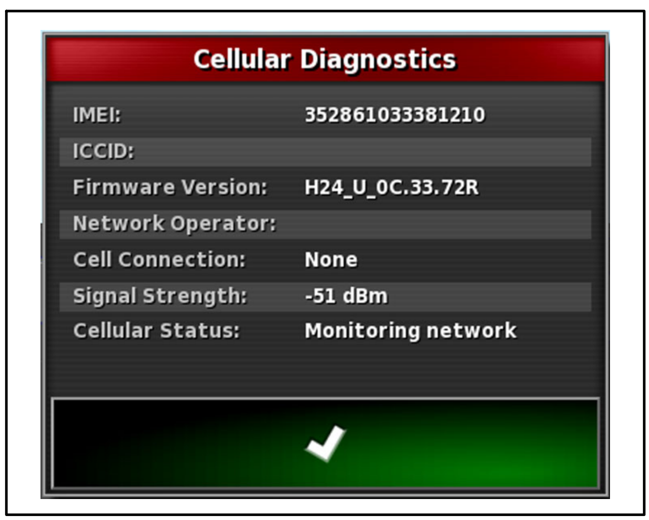


Figure 12 – Cellular Diagnostics

Job Information Menu

The job information menu (Fig. 13) displays information about the current spray jobs progress through the following sub–menus and screens:

Job Area Statistics

Job Time Statistics

Guidance Settings

Job Notes (edit task data)

Figure 13 – Job Information Menu

Automatic Section Control Menu

The automatic section control menu (Fig. 14) permits the system to turn nozzles ON for new areas to be covered and OFF for areas that have already been covered.

Control (coverage overlap – percentage): controls when a spray nozzle will turn ON or OFF based on the previous pass or boundary.

NOTE: ASC must be set to ON to utilize the coverage overlap feature.

The default Toro spray pattern is 20 in. wide, and the default coverage overlap setting is 50(%). This means that if a nozzle overlaps the previous pass by less than 50% (10 in.) the nozzle will stay ON, or a nozzle that overlaps the previous pass by 50% or more will turn OFF.

Boundary Limit (field boundary/unlimited): sets the spray system to recognize previously defined boundaries (boundary limit – Field Boundary), or only use pass–to–pass (overlap) control (boundary limit – Unlimited

NOTE: ASC must be set to ON to utilize the boundary limit feature.

Automatic Section Control (ASC) ON/OFF: sets the system to turn spray nozzles ON when entering new areas, and turn nozzles OFF when passing over previously sprayed areas

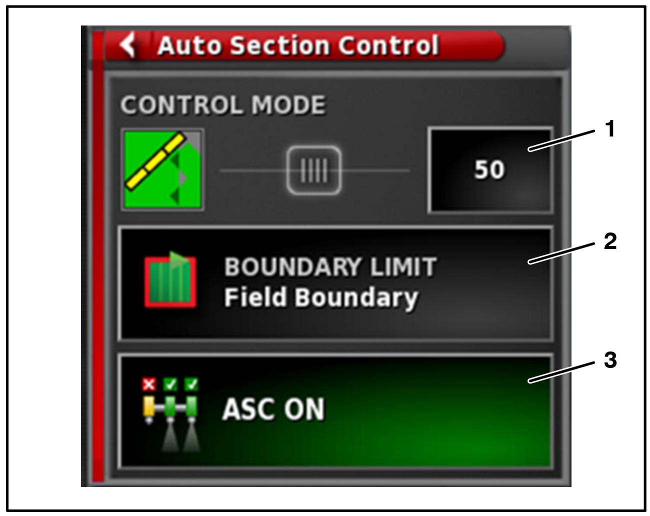


Figure 14

1. **Control mode (coverage overlap)**
2. **Boundary limit**
3. **Automatic section control**

Spray Controller Menu

The spray controller menu reports various aspects of the current spray application function in real time. A mini menu appears first (Fig. 15). Pressing the expand icon in the upper right corner of the mini menu exposes the full menu (Fig. 16).

With the exception of the application rate adjust buttons, all other items on this menu are for information only.

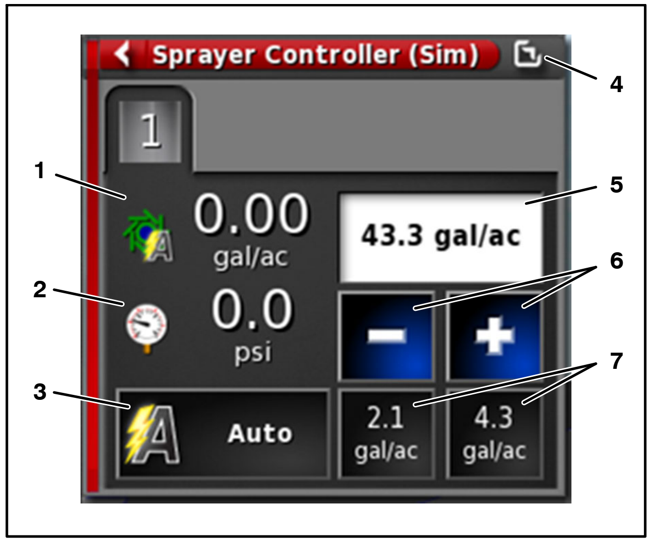


Figure 15 – Mini Menu

1. **Current application rate**
2. **Current system pressure**
3. **Rate control (auto/manual)**
4. **Expand to full menu**
5. **Target application rate**
6. **Application rate adjust**
7. **Pre–set application rates**

Similar to the sprayer icon on the operation screen, the nozzle valve icons will change color during operation to indicate the following:

Red: boom switched OFF, all nozzles on the boom disabled

Blue: boom switched ON, all nozzles on the boom are enabled and available to spray but no product is flowing from the nozzle (typically due to low vehicle speed)

Yellow: boom switched ON, all nozzles on the boom are enabled and available to spray but no product is flowing from the nozzle (typically due to automatic section control of nozzle)

Green: boom switched ON, all nozzles on the boom are enabled and available to spray and product is flowing from the nozzle

The circular indicators at the bottom of the screen indicate valve state and will be either red (manually disabled) or green (manually enabled).

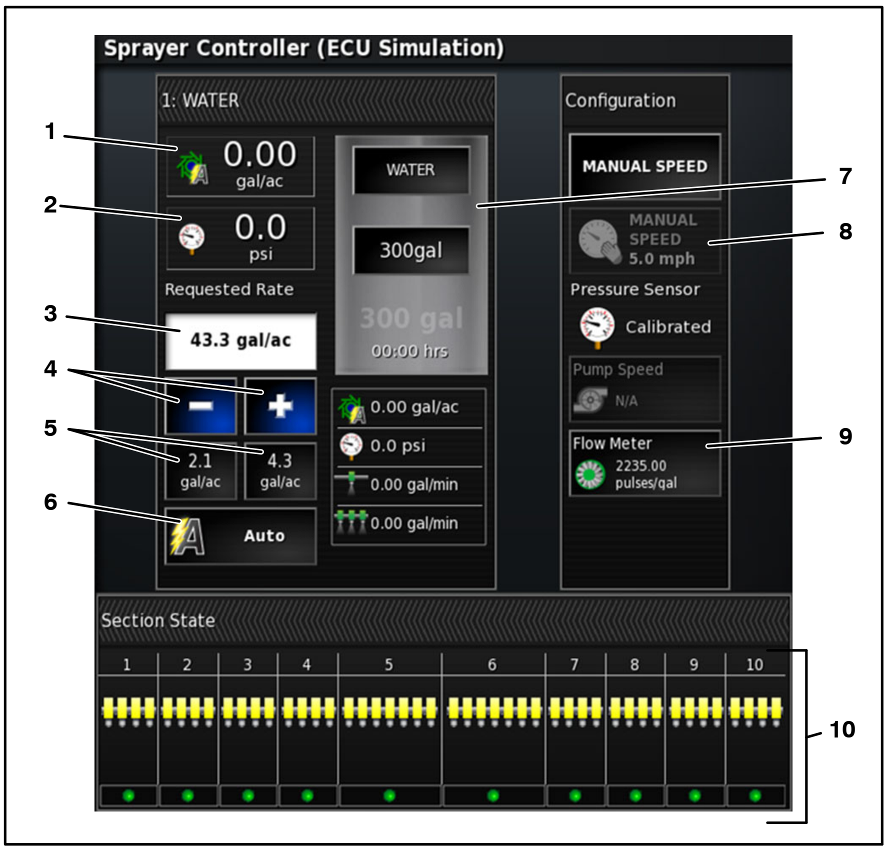


Figure 16 – Full Menu

1. **Current application rate**
2. **Current system pressure**
3. **Target application rate**
4. **Application rate adjust**
5. **Pre–set application rates**
6. **Rate control (auto/manual)**
7. **Product tank info**
8. **Stationary test speed**
9. **Flow meter calibration**
10. **Nozzle valve state**

Inventory Manager

The inventory manager (Fig. 17) allows the operator to access a variety of information files on the system. These files can be deleted, renamed, and imported or exported via a USB drive. A user can backup all system data onto a USB drive, or restore all system data from a backup USB drive using the inventory manager.

Figure 17 − Inventory Manager Menu

Setup Menu

The setup menu includes numerous sub−menus, option lists, and wizards necessary to configure all aspects of the GeoLink spray system. The setup menu icons and sub−menus are discussed in detail elsewhere in this chapter (see Setup Screen in this chapter).

View Controls Menu

Section State icon (Fig. 18) displays which boom sections the computer is currently controlling.

Selection icon (Fig. 18) allows the operator to scroll over numerous boundaries to reveal each boundary's name, category and area. Activate selection by holding your finger against the screen (icon highlights) then moving over the desired boundary lines while contacting the screen.

Use the following icons (Fig. 18) to manipulate the operation screen as follows:

Center Map Under Sprayer (Map Panning enabled)

Map Layers (grid, zones, fields, points, etc.)

Map View (perspective, North up, overhead)

Zoom (in/out)

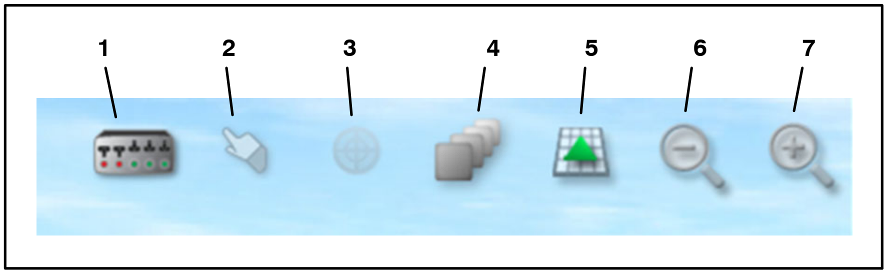


Figure 18

1. **Section state**
2. **Selection mode**
3. **Center map under sprayer**
4. **Map layers**
5. **Map view**
6. **Zoom view (out)**
7. **Zoom view (in)**

Job Assist/Quick Start

Early versions of the software included a job assistant in this location that opened a screen intended to instruct an operator through the tasks necessary to perform a typical job (field menu and job menu usage).

Later versions of the software include a quick start feature in this location. The quick start feature not only provides basic instructional information for performing a typical job, it steps the operator through the tasks required to complete a typical job. The operator can use the feature to enter actual job information (job name, nozzle selection, region(s) to be sprayed) and begin spraying.

NOTE: A written version of the quick start information can be found in the X25 and X30 Quick Start Guide.

Field Menu

The field menu (Fig. 19) provides access to the following sub–menus and screens:

Select Field (existing)

Create Field (new)

Unload Field

Set Flag

Record Field Boundary

Complete Boundary Recording

Create Boundary from a Spray Application – use to create a boundary immediately following an actual spray application.

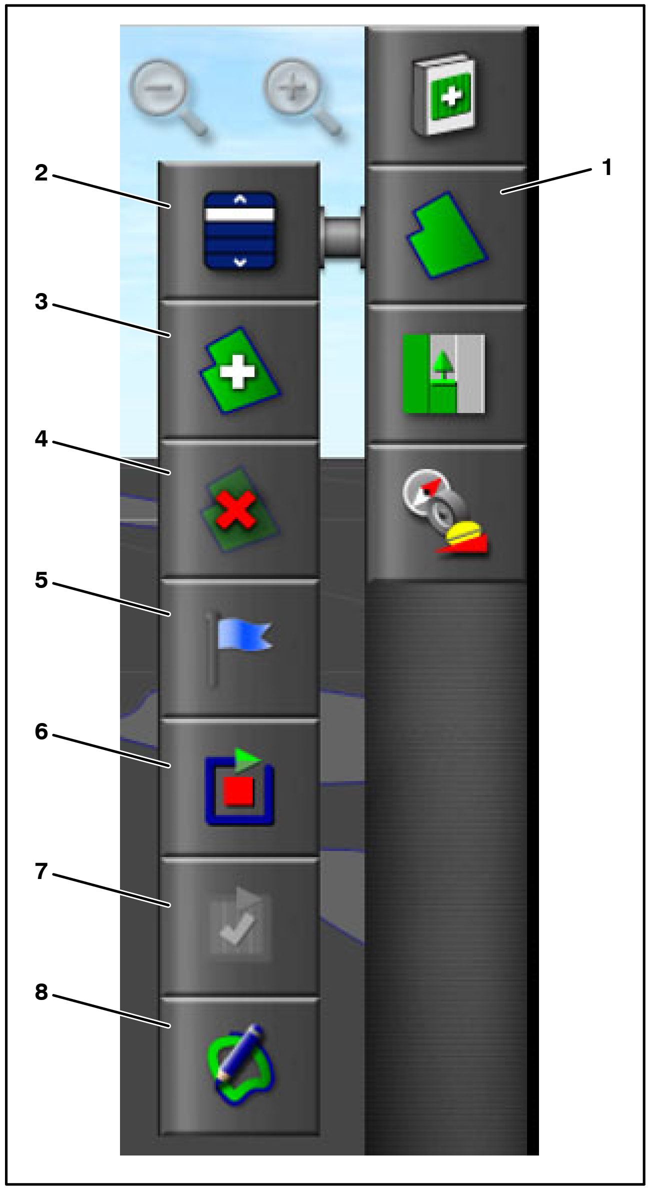


Figure 19

1. **Field menu icon**
2. **Select field icon**
3. **Create field icon**
4. **Unload field icon**
5. **Set flag icon**
6. **Record field boundary icon**
7. **Complete boundary recording icon**
8. **Create boundary from spray**

Record Job Details Menu

The job menu (Fig. 20) provides access to the following sub–menus and screens:

Select Job (existing)

Create Job (new)

Configure Job Regions

Record Job Details

Clear Job Data

Data Exchange Menu

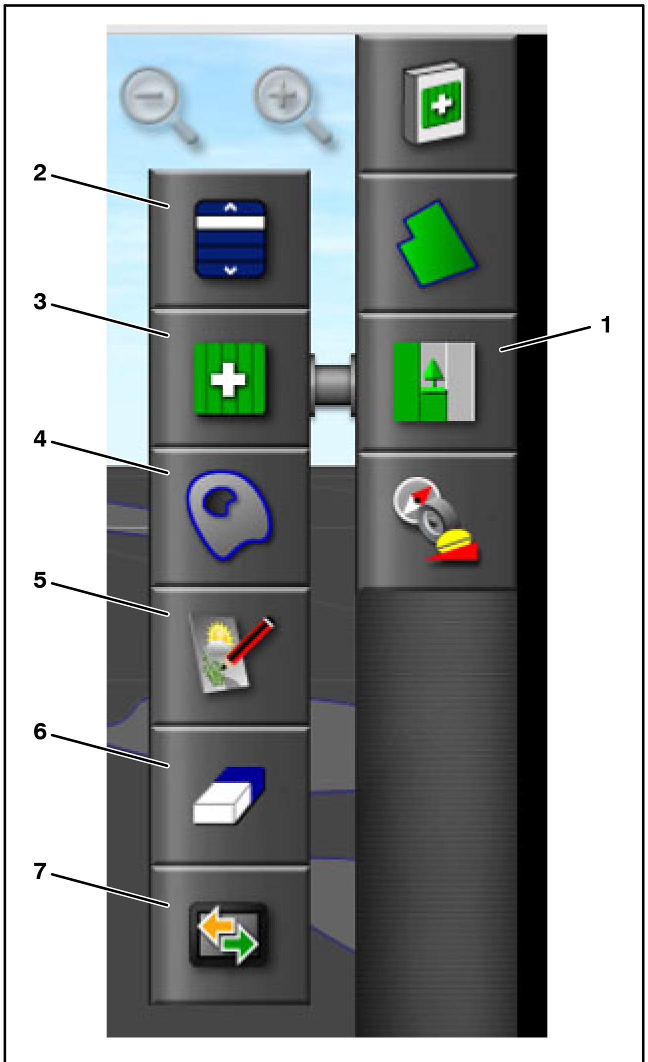


Figure 20

1. **Job menu icon**
2. **Select job icon**
3. **Create job icon**
4. **Configure job regions icon**
5. **Record job details icon**
6. **Clear job data icon**
7. **Data exchange menu icon**

Compass Calibration

Accuracy of the GeoLink guidance feature is dependant on information from the system compass located in the GPS antenna (AGI–4). Start the five step compass calibration wizard to calibrate the system compass by opening the receiver calibration menu icon and selecting compass (Fig. 21).

NOTE: See Calibrating the Compass in the Adjustments section of this chapter for additional information.

Figure 21

Sprayer Icon

The sprayer icon on the operation screen (similar to the nozzle valve icons on sprayer controller menu) will change color during operation to indicate the following (Fig. 22):

Red: boom switched OFF, all nozzles on the boom disabled

Blue: boom switched ON, all nozzles on the boom are enabled and available to spray but no product is flowing from the nozzle (typically due to low vehicle speed)

Yellow: boom switched ON, all nozzles on the boom are enabled and available to spray but no product is flowing from the nozzle (typically due to automatic section control of nozzle)

Green: boom switched ON, all nozzles on the boom are enabled and available to spray and product is flowing from the nozzle

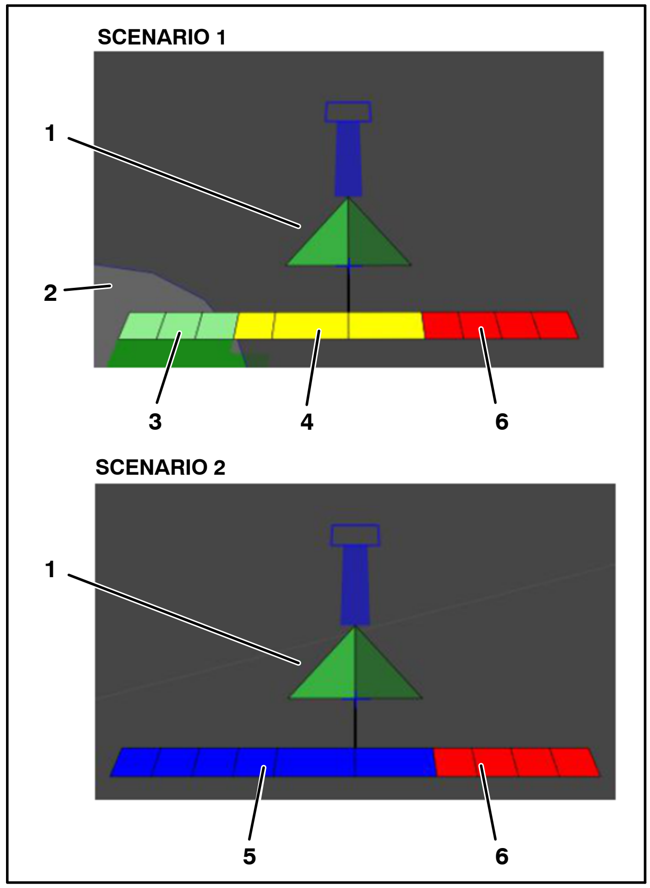


Figure 22

1. **Sprayer icon**
2. **Boundary (spray zone)**
3. **Green: spraying**
4. **Yellow: not spraying (outside of boundary)**
5. **Blue: not spraying (low vehicle speed)**
6. **Red: not spraying (boom manually OFF)**

Virtual Master Switch

The virtual master switch on the X25 or X30 console (Fig. 23) operates like the physical master boom switch on the operator console, stopping/starting the flow of product to all of the nozzles currently enabled. The color of the virtual master switch indicates the state or readiness of the spray system as follows:

Red: the system is not ready and cannot be used in its current condition

NOTE: Pressing the virtual master switch when red will expose the Master Switch Status screen and display which condition(s) are preventing the system from achieving standby status.

White: the system is ready but is not currently spraying (standby status)

Green: the system is ready and spraying (product flowing from the nozzle(s) if within a boundary)

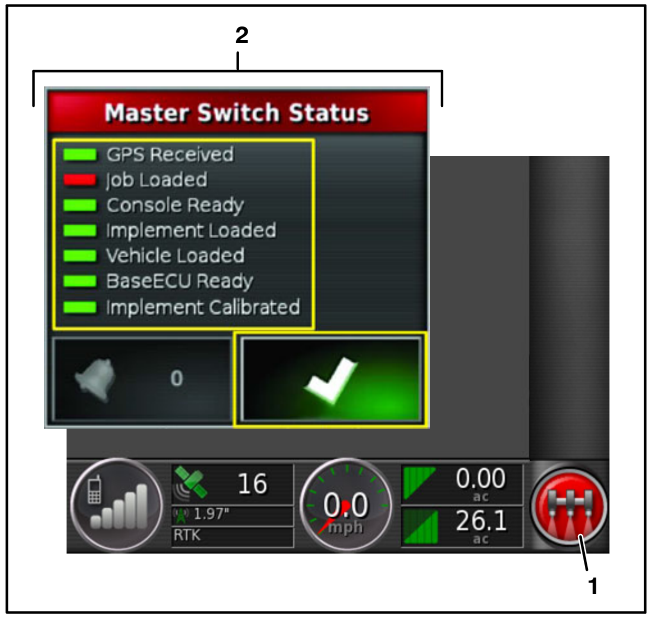


Figure 23

1. **Virtual master switch**
2. **Master switch status**

Virtual Dashboard

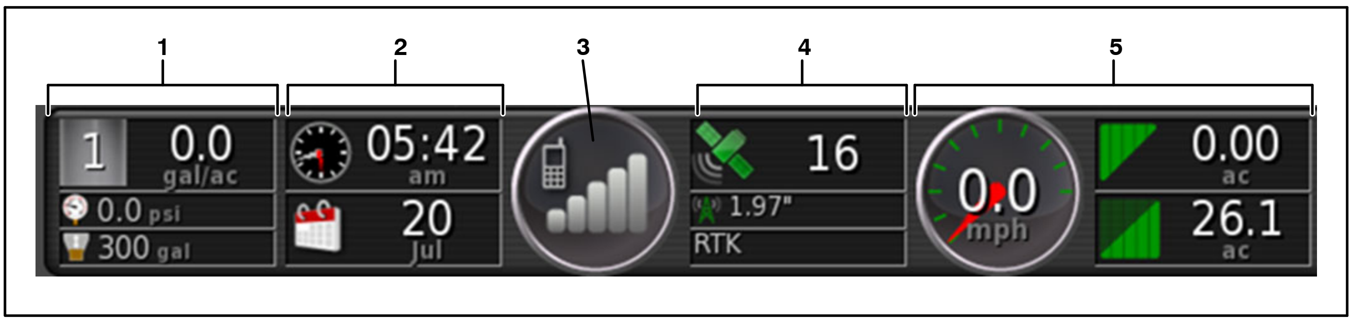


Figure 24

1. **Current spray application**
2. **Clock**
3. **Cellular signal strength**
4. **GPS signal**
5. **Guidance information**

The virtual dashboard (Fig. 24) is user customizable and can be set to include the following information:

Current Spray Application: rate, system pressure, product tank volume

Clock: time and date

Cellular Signal Strength: bar chart

GPS Signal and Correction: the panel includes system readiness (satellite icon color) and number of satellites being used, correction quality (antenna icon color) and position accuracy, and correction source.

Icon Color Chart		
Color	**Satellite Icon**	**Antenna Icon**
Green	Good Accuracy	Correction source has converged
Yellow	Average Accuracy	Correction source received but not accurate
Red	Poor Accuracy	Correction source received is different from system configuration
Grey	No signal	No correction source received

Guidance Information: select four of six possible display options including speed, cross track error (vehicle distance from the nearest way–line), heading, swath, area covered and area remaining.

Setup Screen

The setup screen includes a series of sub–menus, option lists and wizards necessary to configure the entire GeoLink spray system.

NOTE: Additional options and sub–menus appear or disappear on screen as features are selected or deselected.

Use the forward and backward arrows on the right and left sides of each setup sub–menu to display the next or the previous setup sub–menu

Use the Return Home icon at the lower left corner of the setup screen and each setup sub–menu to return to the operation screen.

The following outline is intended to illustrate the various setup screen sub–menu locations and provide a brief description of their usage. The setup screen with the User>Region>Language sub–menu selected is shown (Fig. 25).

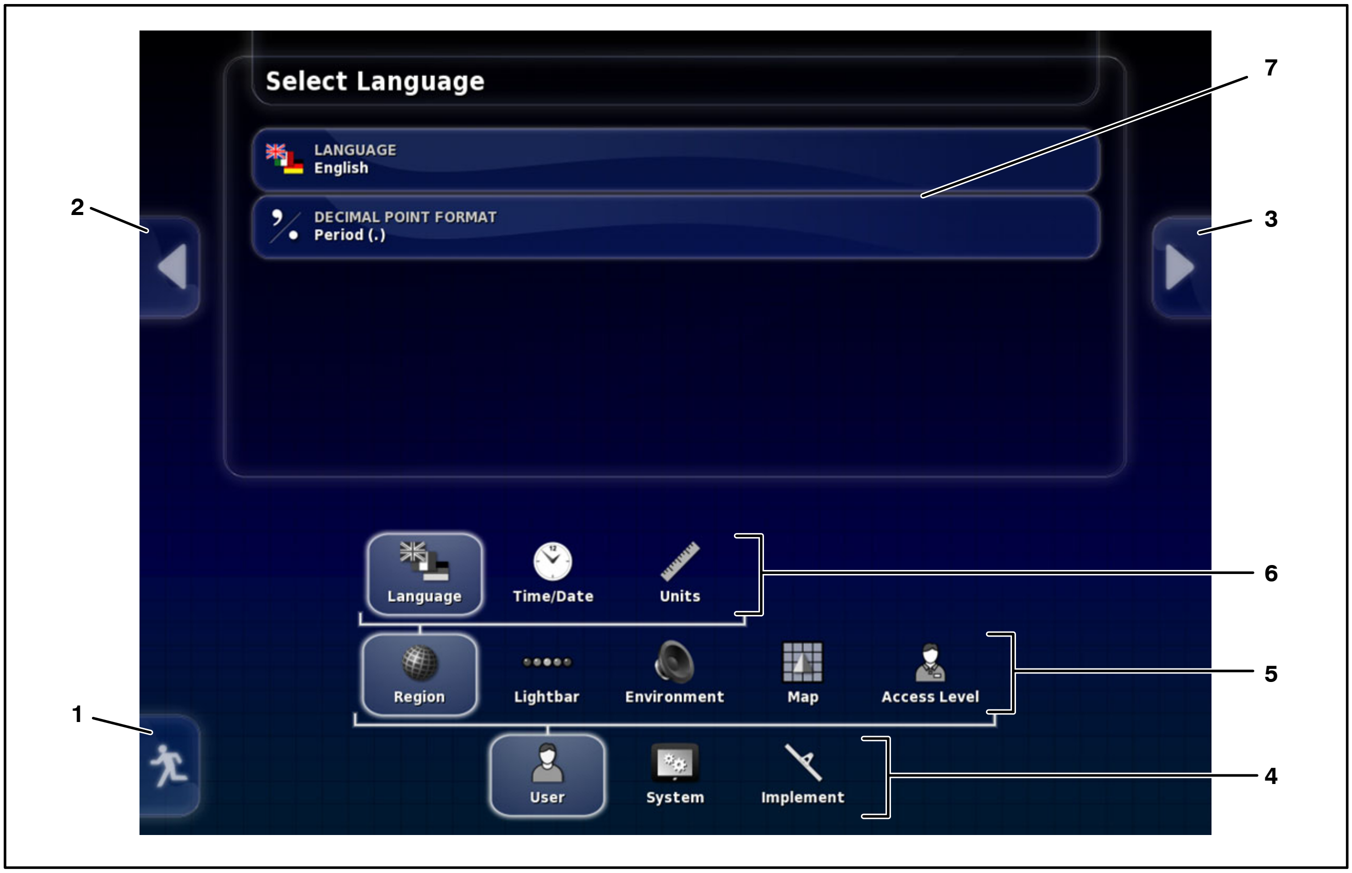


Figure 25

1. **Return home icon**
2. **Previous setup sub–menu**
3. **Next setup sub–menu**
4. **First level sub–menus**
5. **Second level sub–menus**
6. **Third level sub–menus (when used)**
7. **Sub–menu details/selections**

USER

REGION

Language: console display language

Time/Date: date format, time format, current time (date is provided by GPS signal so time and date will not function if there is no GPS signal)

Units of Measure: metric or imperial (pressure units, area units, spray product units, latitude/longitude format, application rate increment)

LIGHTBAR

Light bar: enable or disable

LED Spacing: the physical distance that each LED represents

LED Mode: drive away or drive towards (steer away from or towards the illuminated LEDs to return to the wayline)

ENVIRONMENT

Audio Volume: volume of X25 or X30 console sounds

Button Clicks: enable or disable console button sounds

Alarm Audio: enable or disable an audio signal when an alarm is triggered

Multi−function Region Mode: save a console screen shot directly to a USB drive (insert the USB drive before selecting the screen shot feature) and save or load custom operation screen layouts

System 150 File Transfers: allows files to be imported from or exported to Topcon's System 110/150 file format

Automatic Steering Status Button: disable (not currently offered on Toro GeoLink spray systems)

Toolbar Button Size: increase/decrease button size on operation screen

MAP

Point of Focus: vehicle or implement (centers vehicle or implement in screen)

Map Panning: enabled or disabled (touch screen panning of a map across the screen, presents the Center Map Under Sprayer icon in the view controls menu when enabled)

Map Focus Auto−Shift: enabled or disabled (sets the vehicle in the center of the screen space available as mini menus are opened and closed)

Highlight Loaded Coverage: enabled or disabled (shows previously completed coverage tan color and newly created coverage green color when an existing job is loaded)

Pause Boundary Recording with Master: enabled or disabled (boundary recording reflects master switch operation while recording, useful if product application is paused to maneuver the sprayer around tight corners)

Visual Reference Line Length: sets a display marker in front of the vehicle icon at the distance entered to help reacquire the wayline after a turn

ACCESS LEVEL

Easy: no password required (used for sprayer operation)

Standard: site operator may enable password requirement (used for sprayer setup and boundary creation/management)

Expert: password required (for use by NSN and an Authorized Toro Distributor)

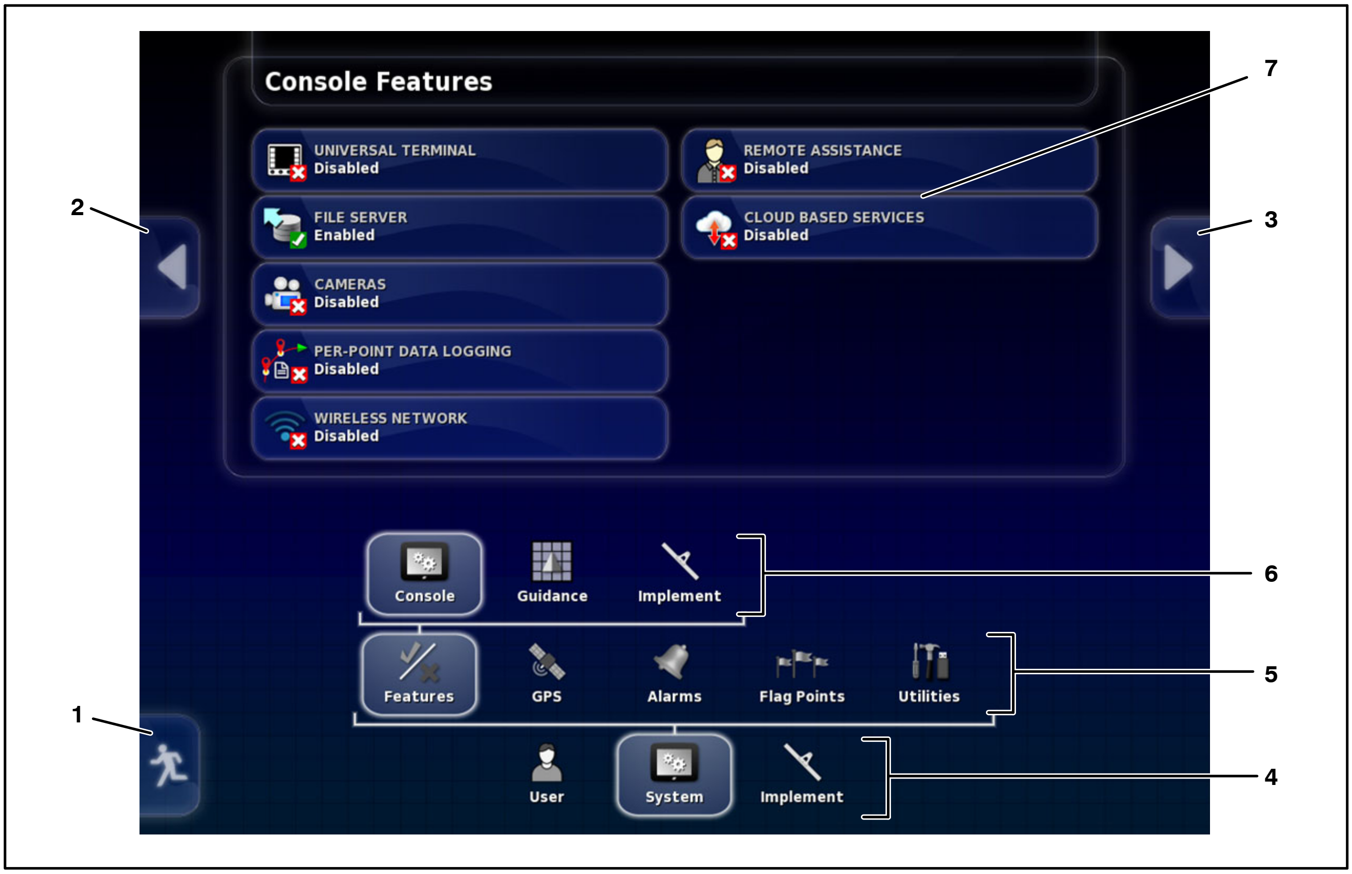


Figure 26

1. **Return home icon**
2. **Previous setup sub–menu**
3. **Next setup sub–menu**
4. **First level sub–menus**
5. **Second level sub–menus**
6. **Third level sub–menus (when used)**
7. **Sub–menu details/selections**

The following outline is intended to illustrate the various setup screen sub–menu locations and provide a brief description of their usage. The setup screen with the System>Features>Console sub–menu selected is shown (Fig. 26).

SYSTEM

FEATURES

Console: configure a variety of X25 and X30 console features including the ability for remote assistance (see Remote Assistance in the Troubleshooting Section of this Chapter for additional information)

Guidance: set guidance system functionality including job assist/quick start and guideline features

Implement: enable and disable automatic section control, variable rate control, area counters

GPS

GPS Receiver SIM Code

Simulator Start/Stop Button

Simulation Speed

Simulation Latitude

Simulation Longitude

ALARMS

General: enable or disable a variety of general guidance system alarms, some alarms require entering the desired point of alarm actuation

Sprayer: enable or disable a variety of sprayer specific alarms, some alarms require entering the desired point of alarm actuation

FLAG POINTS

Place markers in a field to appear on the operation screen that represent obstacles or other land features (markers include flags, water hazards, towers, holes, rocks, weeds and trees)

UTILITIES

Provision USB for Upgrade

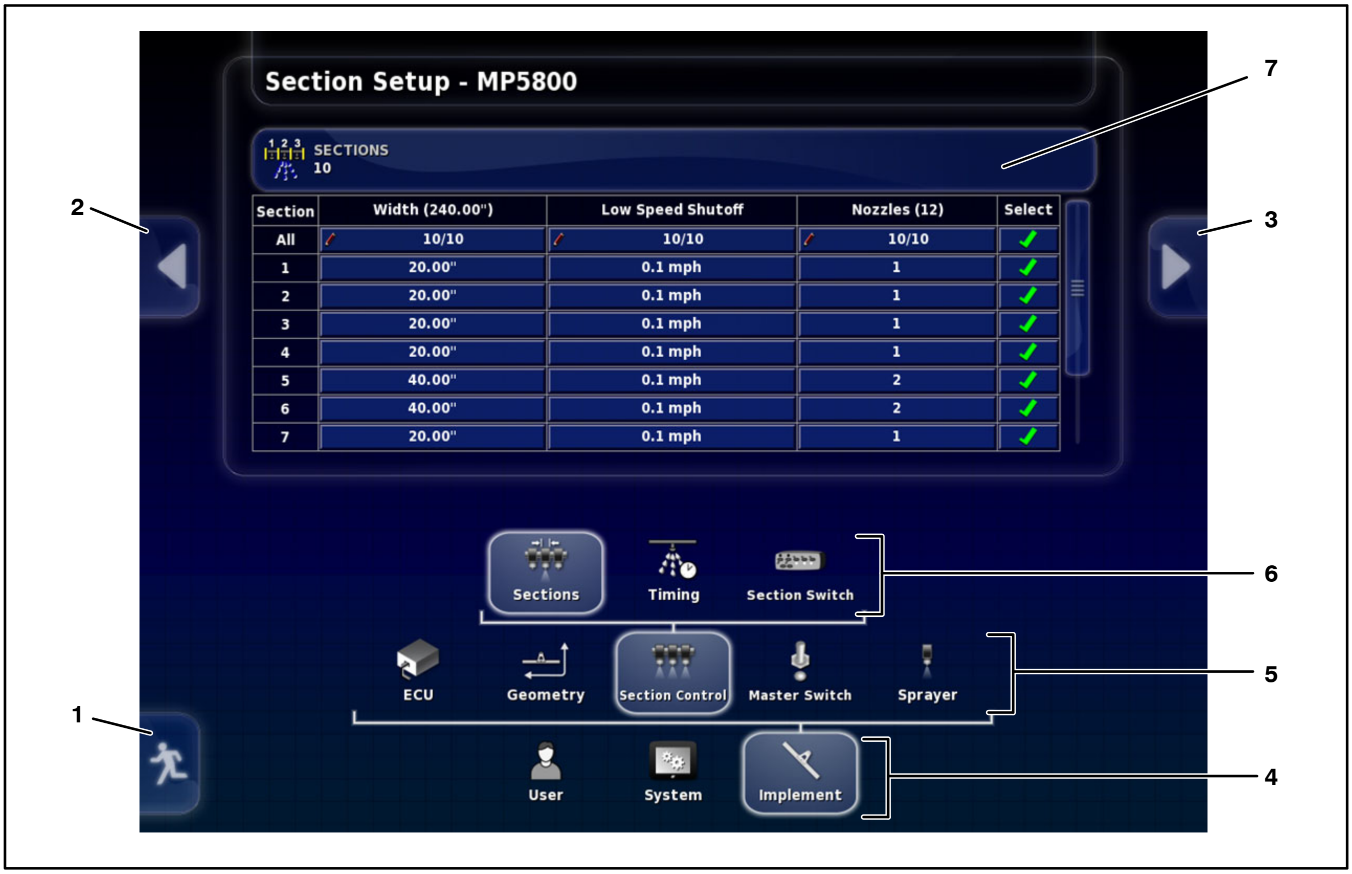


Figure 27

1. **Return home icon**
2. **Previous setup sub–menu**
3. **Next setup sub–menu**
4. **First level sub–menus**
5. **Second level sub–menus**
6. **Third level sub–menus (when used)**
7. **Sub–menu details/selections**

The following outline is intended to illustrate the various setup screen sub–menu locations and provide a brief description of their usage. The setup screen with the Implement>Section Control>Sections sub–menu selected is shown (Fig. 27).

IMPLEMENT

ECU (ASC–10)

ECU setup (name and firmware version)

ECU simulation mode

Geometry (enter precise sprayer dimensions so the guidance system can function accurately)

Boom location in relation to the sprayer

Boom width

Spray nozzle locations

Section Control (a section is defined by what a section valve/nozzle valve controls)

Section width

Low speed shutoff

Number of nozzles per section (center sections operate two nozzles each)

Section timing (ON and OFF)

Section switching

Master Switch Setup

Virtual (on X25 or X30 console)

External (on operator control console)

Sprayer (setup)

Tank

Flow

Pressure

Pressure Control

Control Valve

Pump Speed

Speed Source

Audio

InfoCenter Display

The InfoCenter Display is a LCD device that is located in the Operator control console. On machines with an optional GeoLink spray system, the X25 or X30 control console becomes the primary form of spray system control and the InfoCenter display provides limited spray system information (spray pump, agitation, and clean tank rinse pump status). The InfoCenter on GeoLink machines still provides electrical system diagnostic assistance for technicians. See Chapter 6 Electrical System in this manual for additional information.

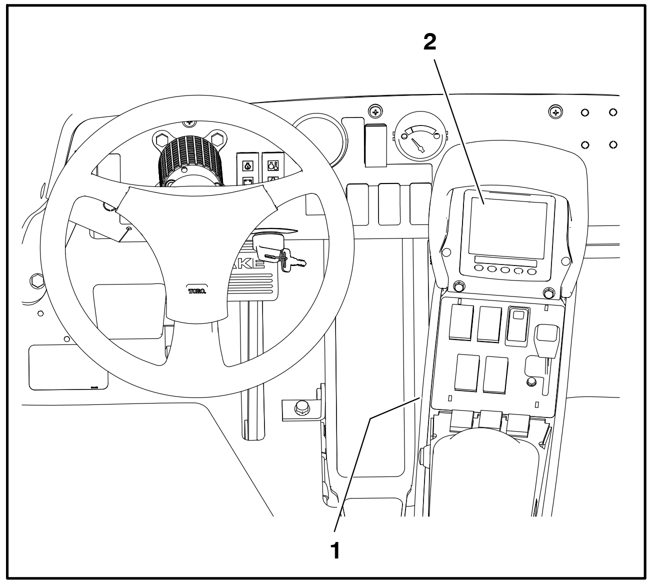
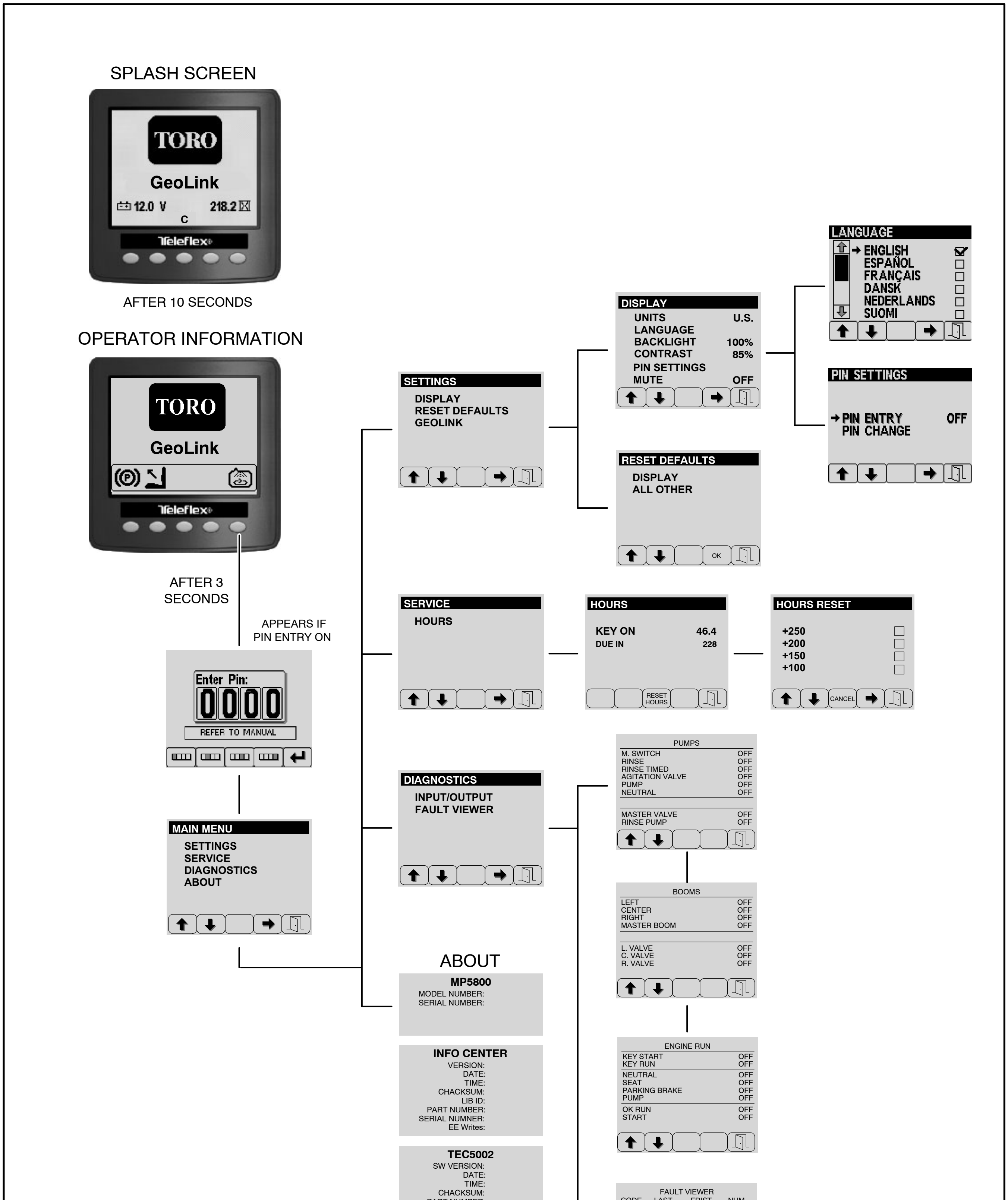


Figure 28

1. Operator control console
2. InfoCenter Display



InfoCenter Display Screens
GeoLink Spray System

Software version
122–0680 Revision D shown

Figure 29

Splash Screen

When the ignition switch is turned from the OFF position to the ON or START position, the InfoCenter splash screen appears (Fig.30). The splash screen provides the following information to the operator:

Spray System Installed

Voltmeter

System Software Revision Level

Hour meter: For machines with gasoline engine, engine hours are displayed. For machines with diesel engine, key on hours are displayed.

After the splash screen has been displayed for ten seconds, the operator 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.

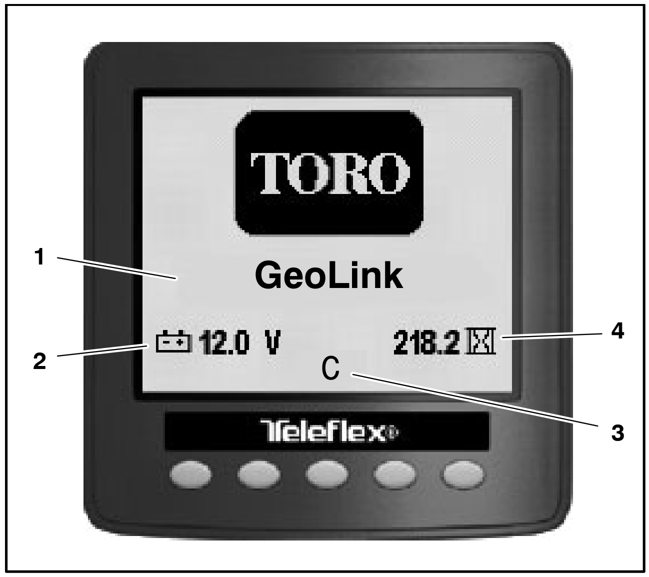


Figure 30

1. **Spray system installed**
2. **Voltmeter**
3. **System software revision**
4. **Engine hour meter**

Operator's Information

The operator's 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. 31). The operator's information screen is the "default" screen as it will be displayed during normal machine operation. See the machine Operators Manual, Quick Start Guide or Interactive Manual for additional information.

The operator's information screen provides the following information to the operator:

Brake: Icon appears whenever the brake is applied, and stays on when the parking brake is engaged.

Operator Presence: Icon appears when the operator is out of the operator seat.

Spray Pump: Icon (spray tank) appears when spray pump is enabled.

Spray Tank Agitation: Icon (spray tank with mixing pattern) appears when spray tank agitation is enabled.

Clean Tank Rinse Pump (optional kit): Icon (spray tank with spray pattern) appears when clean tank rinse pump is enabled.

Press and hold button 5 for 3 seconds to access the main menu screen.

Press any button 1−4 to expose the menu bar. From the menu bar, press button 2 to access the spray area screen−total area or press button 3 to access the spray area screen−sub area.

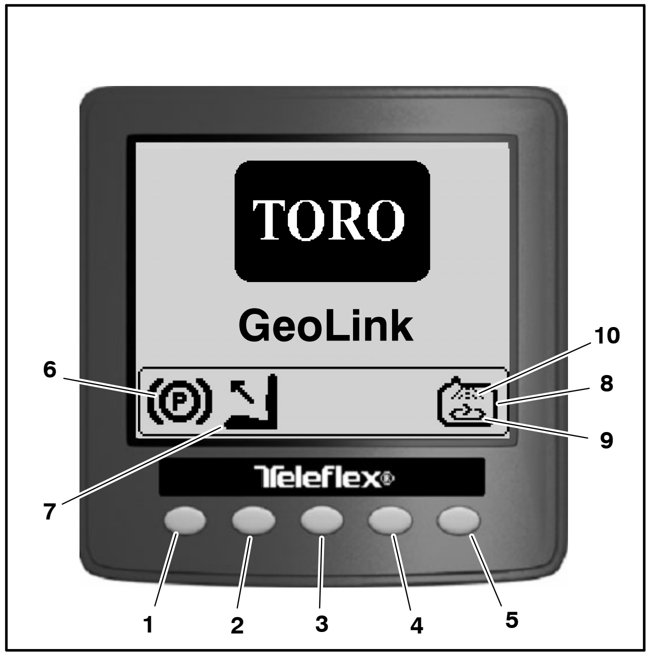


Figure 31

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Brake applied
7. Operator presence
8. Spray pump enabled
9. Agitation enabled
10. Tank Rinse enabled

Main Menu

The main menu (Fig.32) provides access to the following screens:

Settings

Service

Diagnostics

About

NOTE: The Main Menu screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

The main menu screen is accessed by pressing an holding button 5 on the display for approximately 3 seconds.

NOTE: Access to the main menu screens may require entering a Personal Identification Number (PIN). The default PIN is either **1234** or **5900**. See the machine Operator's Manual for additional PIN information.

Return to the previous screen by pressing button 5

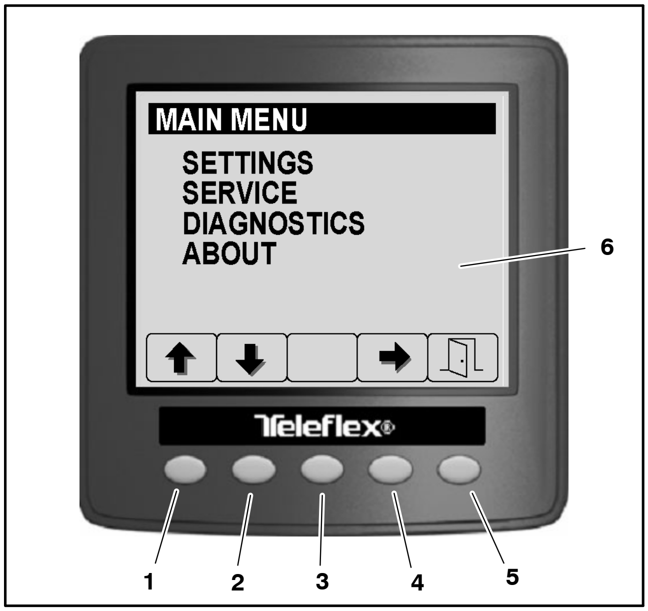


Figure 32

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Menu Menu screen**

Settings

The Settings screen (Fig. 33) is accessed from the main menu and provides access to the following settings:

Display

Reset Defaults

GeoLink

Access the Settings screen by pressing buttons 1 or 2 to highlight SETTINGS, then press button 4 to select the highlighted screen. Scroll through the various Settings screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

DISPLAY

The Display settings (Fig. 34) are discussed in Chapter 6 – Electrical System in this manual.

RESET DEFAULTS

The Reset Defaults screen is discussed in Chapter 6 – Electrical System in this manual.

EXCELARATE

Use the ExcelaRate screen to activate the ExcelaRate spray control system. Turn ON the ExcelaRate setting only if you have the ExcelaRate spray system installed on the machine. See Chapter 7 – ExcelaRate Spray System in this manual for additional service information.

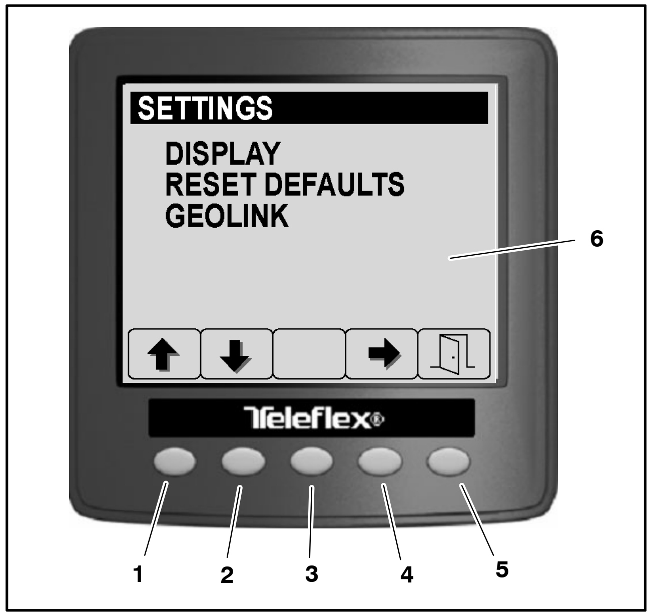


Figure 33

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Settings screen**

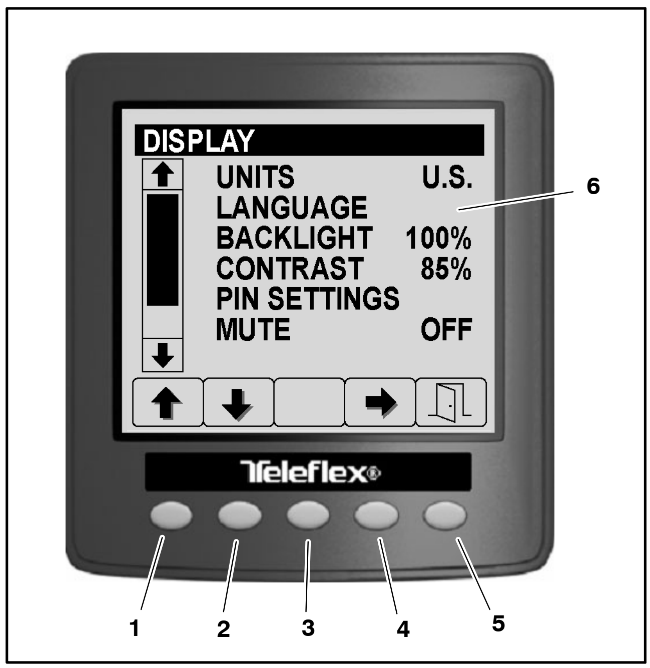


Figure 34

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Display settings**

Service

The service screen (Fig. 35) is accessed from the main menu and provides access to the following screens:

Hours (ignition key on, service due in, spray pump run hour meters)

NOTE: The Service screen may be PIN protected. See Settings Screen > Display > Protected Menus in Chapter 6 – Electrical System in this manual or the machine Operator's Manual and Software Guide for additional information.

Access the Hours screen by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted item.

Return to the previous screen by pressing button 5

HOURS

The hours screen includes a total key on hourmeter and a service due in countdown timer (Fig. 36).

NOTE: See InfoCenter > Service in Chapter 6 – electrical System in this manual for additional information on resetting the Due In hourmeter.

Return to the previous screen by pressing button 5

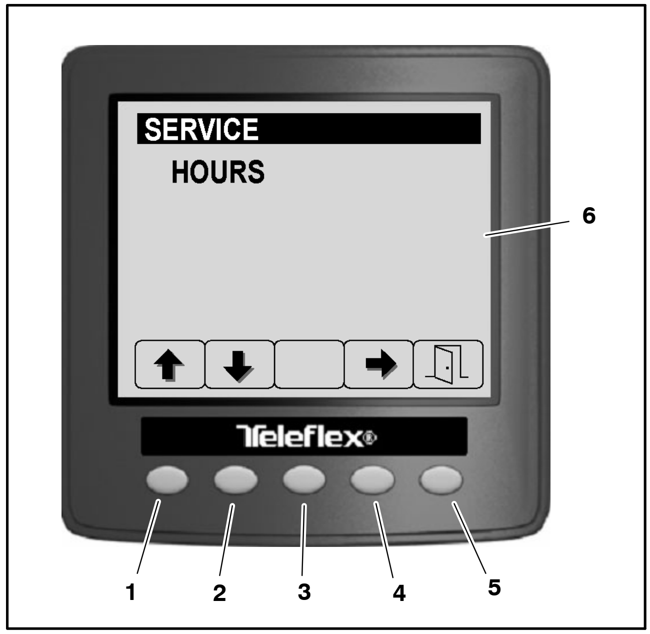


Figure 35

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Service screen**

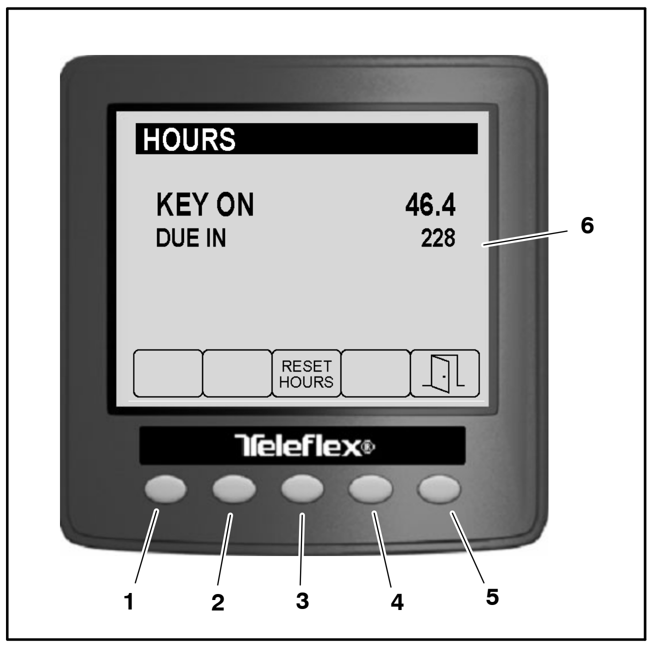


Figure 36

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Hours screen**

Diagnostics

The Diagnostic screen (Fig. 37) is accessed from the main menu and provides access to the following screens:

Input / Output

Fault Viewer

Access the diagnostics screens by pressing buttons 1 or 2 to highlight the desired screen then button 4 to select the highlighted screen.

Return to the previous screen by pressing button 5

INPUT/OUTPUT

The input/output screens display the current state of the various Toro Electronic Controller (TEC) inputs, qualifiers and outputs necessary to allow a machine or spray system function to occur. The input/output screens should be used to troubleshoot spray system operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting in this chapter). Scroll through the input/output screens by pressing buttons 1 or 2.

Each of the following spray system functions has its own input/output screen:

Pumps

Booms

Engine Run

Each screen is separated into four (4) areas of information (Fig. 38). The first area identifies the spray system function. The second area identifies the inputs that are necessary for the function to occur. The third area identifies qualifiers that are involved with the function (safety interlocks). The fourth area identifies the outputs that are necessary for the function to occur.

Return to the previous screen by pressing button 5

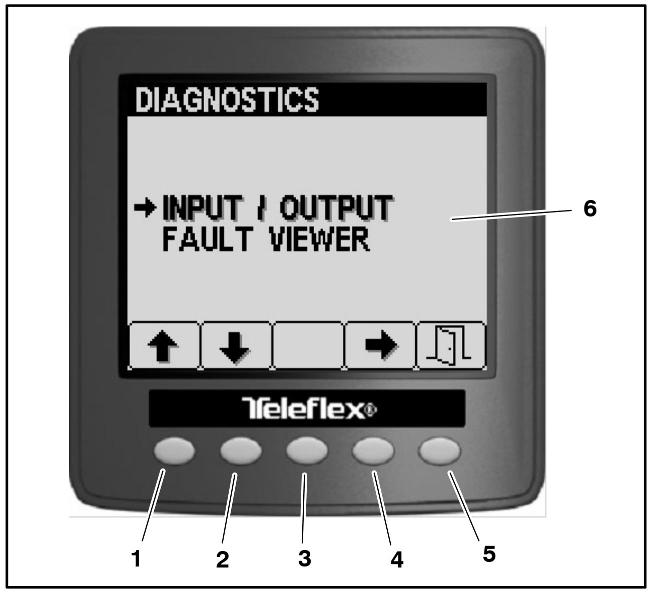


Figure 37

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Diagnostics screen

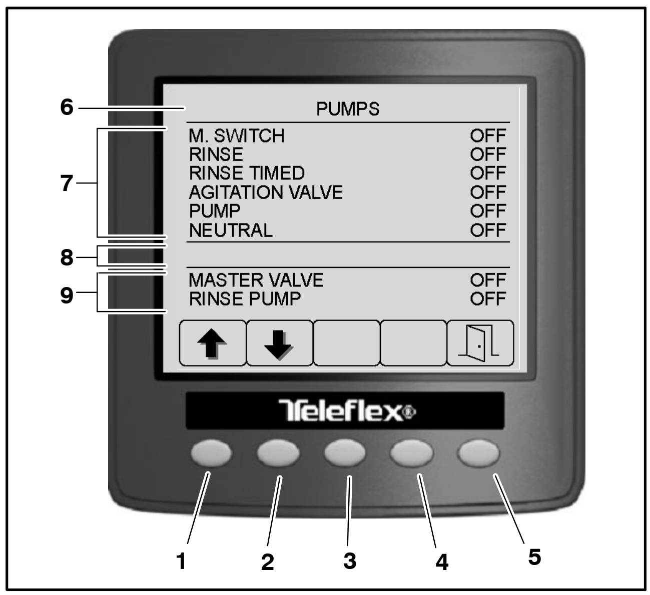


Figure 38

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Machine function
7. Inputs
8. Qualifiers (none)
9. Outputs

Pumps

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Pumps Screen:

M. SWITCH: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

RINSE: ON when the optional clean tank rinse kit rinse pump switch is held in the MOMENTARY (down) position.

RINSE TIMMED: ON for a 60 second timed period when the optional clean tank rinse kit rinse pump switch is in the ON (up) position.

AGITATION VALVE: ON when the agitation switch is in the ON position.

PUMP: ON when the spray pump switch is in the ON position.

NEUTRAL: ON when the traction pedal is in neutral.

There are no qualifiers involved in the PUMPS function.

When the pump switch input is in the ON position (PUMP ON), the following output should occur (Fig. 39):

MASTER VALVE ON – TEC output 9: The spray pump hydraulic proportional control valve PV in the spray pump control manifold should energize.

When the optional rinse pump switch input is in the ON (up) position (RINSE TIMED ON), the following output should occur (Fig. 40):

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for 60 seconds.

When the optional rinse pump switch input is held in the MOMENTARY (down) position (RINSE PUMP ON), the following output should occur:

RINSE PUMP ON – TEC output 13: For machines with an optional clean tank rinse kit installed, the rinse pump relay should energize for as long as the switch is depressed.

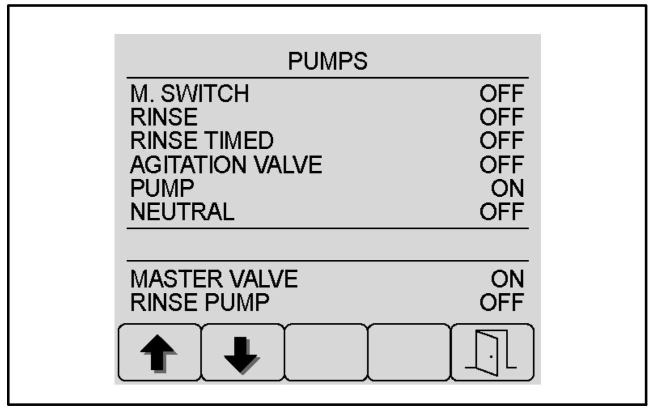


Figure 39 (Spray Pump)

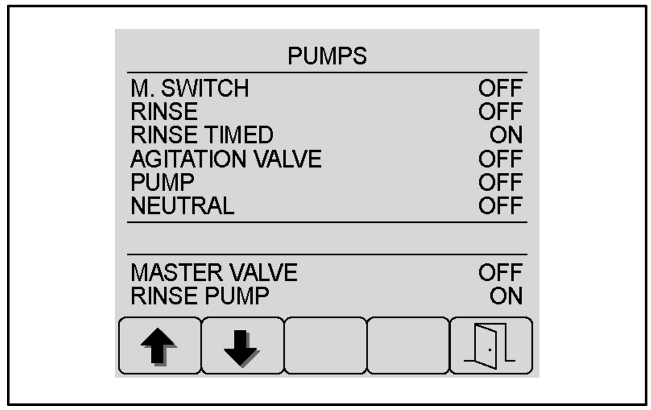


Figure 40 (Optional Rinse Pump)

Booms

Refer to the Electrical Schematics and Wire Harness Drawings and Diagrams in Appendix A – Foldout Drawings in this manual for additional information.

The following inputs can be checked from the Booms Screen:

LEFT: ON when the left boom control switch is in the ON position.

CENTER: ON when the center boom control switch is in the ON position.

RIGHT: ON when the right boom control switch is in the ON position.

MASTER BOOM: ON while the master boom switch is depressed.

NOTE: The Master Boom Switch is a momentary switch that switches the master boom control ON/OFF. ON will only be displayed on this screen while the switch is depressed. Therefore, the master boom control may be active (master boom icon visible on the Operator's Information Screen) while OFF appears on this screen.

There are no qualifiers involved in the BOOMS function.

When the left boom control switch input is in the ON position (LEFT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur (Fig. 41):

L. VALVE ON – TEC output 3: The left boom spray valve should open (valve indicator green).

When the center boom control switch input is in the ON position (CENTER ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

C. VALVE ON – TEC output 4: The center boom spray valve should open (valve indicator green).

When the right boom control switch input is in the ON position (RIGHT ON), and the master boom control is active (master boom icon visible on the Operator's Information Screen), the following output should occur:

R. VALVE ON – TEC output 11: The right boom spray valve should energize open (valve indicator green).

When the master boom switch is depressed (switches the master boom control ON/OFF), any active boom spray valve (mating boom control switch ON) will switch ON/OFF (valve indicator green/red).

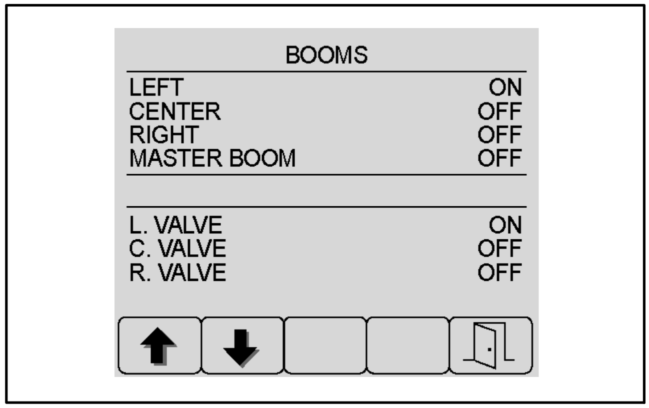


Figure 41

Engine Run

The Engine Run function is discussed in Chapter 6 – Electrical System in this manual.

FAULT VIEWER

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine or spray system operation. When a spray system fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Spray system faults can be viewed via the InfoCenter Fault Viewer (Fig. 42). See Machine Faults in this chapter for additional information about specific spray system faults.

The fault viewer displays the following information about a spray system fault:

CODE: fault code number

LAST: last time the fault occurred expressed in Key ON hours

FIRST: first time the fault occurred expressed in Key ON hours

NUM: number of times the fault has occurred

Scroll through the fault viewer screens by pressing buttons 1 or 2.

Return to the previous screen by pressing button 5

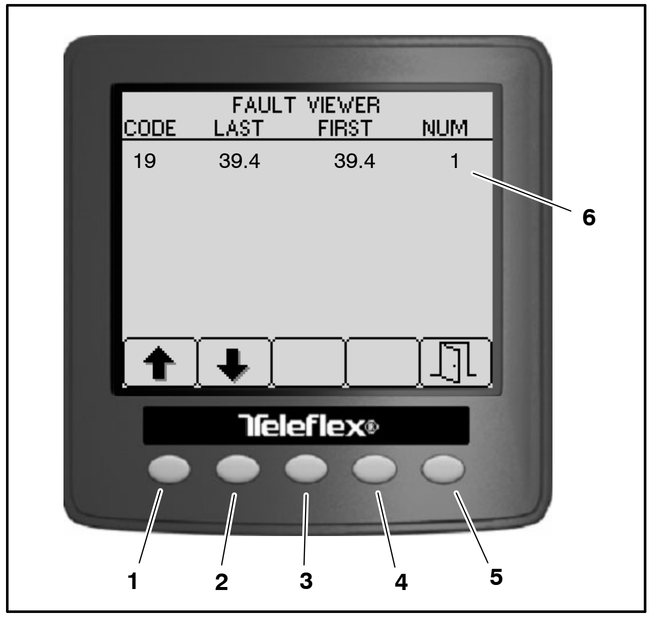


Figure 42

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**
6. **Machine faults**

About

The About screens provide information about the machine, the InfoCenter Display and the Toro Electronic Controller (TEC). The About screens (Fig. 43) are discussed in Chapter 6 – Electrical System in this manual.

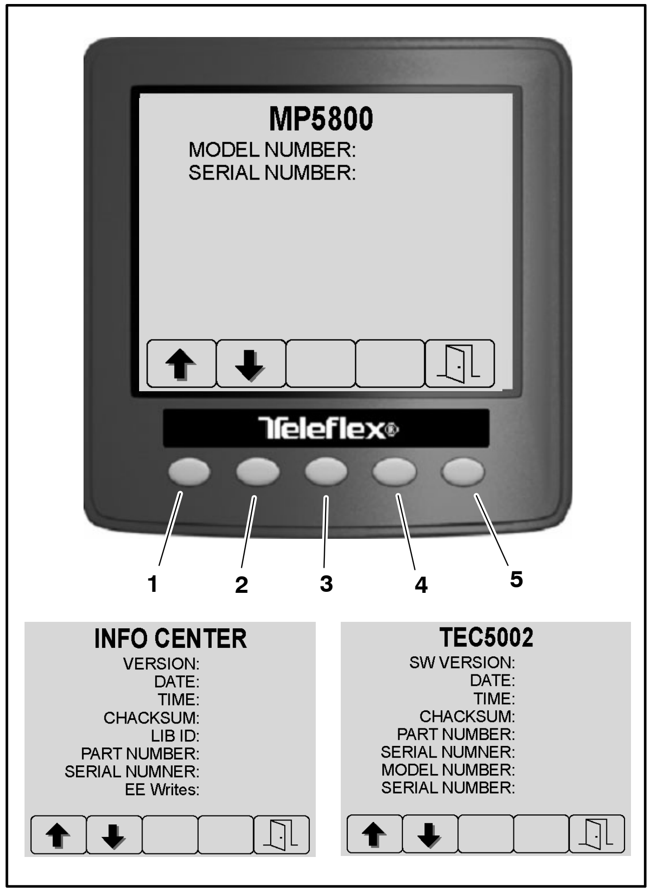


Figure 43

1. **Button 1**
2. **Button 2**
3. **Button 3**
4. **Button 4**
5. **Button 5**

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics in Appendix A – Foldout Drawings).

If the machine has any interlock switches by–passed, they must be reconnected for proper troubleshooting and safety.

Automatic Section Control Override

While troubleshooting spray system issues, it may be helpful to by–pass certain features of the GeoLink control system to verify the operation of different aspects of the system. Use the Automatic Section Control Menu and the Spray Controller Menu (Fig. 44) to select the various operation modes to assist troubleshooting:

Field Boundary/Auto Rate: system controls nozzles with boundary (spray zone) control and pass–to–pass (overlap) control, the system also controls the application rate

Unlimited Boundary/Auto Rate: boundary (spray zone) control is OFF, the system controls nozzles with pass–to–pass (overlap) control only, the system also controls the application rate

Auto Rate Only: operator controls the boom sections manually while the system controls application rate only

Manual: operator controls the boom sections and the application rate manually

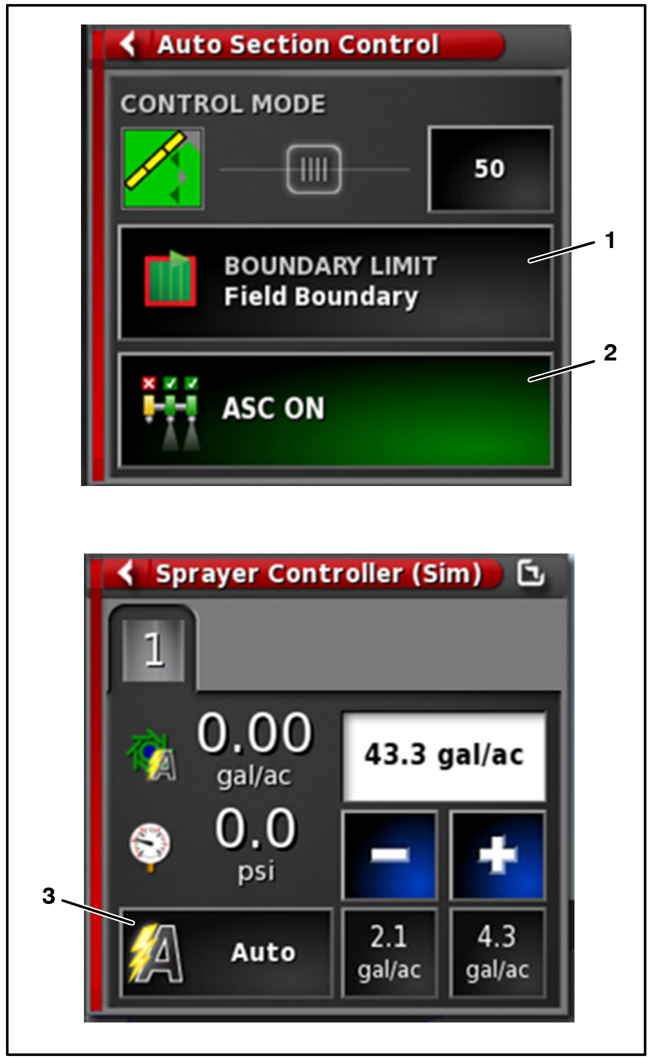


Figure 44

1. **Boundary limit**
2. **Automatic section control**
3. **Automatic rate control**

Remote Assistance (X30 Consoles Only)

Troubleshooting assistance may be obtained from NSN or your Authorized Toro Distributor by enabling the remote log–in feature of the X30 console. This feature enables the service representative to take control of the sprayer console to view and adjust system settings if needed.

NOTE: A wireless hot spot provided by a cell phone or cellular enabled tablet can be used for the remote access feature.

IMPORTANT: The operator must remain in full control of the sprayer at all times while the remote assistance feature is in use.

1. Turn the X30 console ON and allow the system to complete its start–up routine.

2. Insert the system compatible USB Wi–Fi adapter shipped with your GeoLink spray system (Fig. 45) in the USB port.

3. Access the Setup>System>Features>Console screen and select Wireless Network (Fig. 46).

   A. Select Enable

   B. The eight step Wireless Networking wizard will begin.

   C. Select the desired wireless network from the list of available networks displayed.

   D. Press OK once successfully connected to the desired network.

4. Select Remote Access (Fig. 46).

   A. Select Enable

   B. The five step Remote Access wizard will begin.

   C. The system will attempt to connect to the TeamViewer application. Record the values for "Your ID" and "Password", and provide this information to the remote service technician (Fig. 47).

5. Disable both the Remote Access feature and the Wireless Network feature when finished, and before returning the sprayer to service.

Figure 45 – USB Wi–Fi Adapter

Figure 46

1. **Wireless network button**
2. **Remote assistance button**

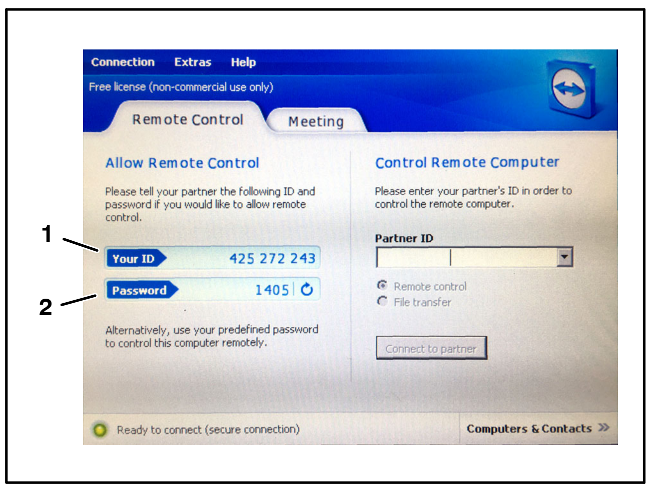


Figure 47

1. **Your ID**
2. **Password**

X25 or X30 Control Console Error Messages

For many errors an error code, or trouble code, will display. It is also possible to view the errors on the screen. The errors listed below are common and are correctable. For other errors or if a problem persists, always record the error message to report to NSN or your Authorized Toro Distributor, including any code displayed.

Error Code	Possible Cause	Corrective Action
U1066	The compass is not calibrated	Calibrate the compass (see the Adjustments section in this chapter)
U1067	A new vehicle has been detected	Calibrate the compass (see the Adjustments section in this chapter)
U1082	The compact flash file system has less than 1% space remaining	Confirm memory usage in the mini−view. It may be necessary to remove or transfer old files using the Inventory Manager.
U3001	The file transfer failed	Try exporting or importing the file from a USB devise again.
U5004	The implement is not defined	Confirm the correct implement has been chosen.
U6905	An unknown machine type defined	Return to main setup menu, and revise vehicle setup.

Crash Reports

Crash reports are commonly generated if the system is incorrectly powered down.

A crash report notice (Fig. 48) will appear each time the system is powered up until the report is correctly transferred and deleted using a USB drive and the Inventory Manager menu.

To delete a crash report, select Vehicle>Crash Reports and the desired report (if more than one appear) from the Inventory Manager screen (Fig. 49).

Figure 48 – Crash Report Notice

Figure 49

Guidance and Rate Management System

Use the following tables to assist in troubleshooting specific issues with the guidance and rate management (dry) portion of the spray system.

Problem	Possible Cause	Corrective Action
There is no power to the display.	The connectors are not installed correctly The fuse(s) for the GeoLink system blown The battery connections are loose	Ensure the connectors are installed correctly at the back of the display Replace the fuse(s) Secure the battery connections
The monitor is frozen	There is a malfunction with the software	Hold in the green button on the back of the display until the front LED lights flash
The sprayer does not spray	The virtual or external master switch is OFF The boom section switches on the operator console (between the seats) are OFF No job and boundary are created The incorrect nozzle is selected in sprayer−control setup menu	Set the virtual or external master switch to ON Set the boom section switches on the operator console (between the seats) to ON Create a job and boundary Select the correct nozzle in sprayer−control setup menu that matches the nozzles being used
The No GPS alarm is on	The display is not connected to GPS receiver correctly The machine is under trees or other obstructions	Ensure the connections are installed correctly Allow the machine to make connection after driving under obstructions
The sprayer sprays outside boundaries	The auto section control (ASC) is set to unlimited or OFF	Set the auto section control (ASC) to field boundary
You cannot create boundaries	The display is not in standard operating mode There is no field created	Switch the user profile to standard operating mode Create a field
The machine is not shown on the screen	The display screen map has been moved (panned)	Select the center−map under sprayer icon on the view controls menu
The lights are not blinking on the GPS receiver located on the ROPS	There is no power to the GPS receiver The GPS receiver (AGI−4) is off−line	Ensure the connectors are installed correctly
The pressure is not high enough	The nozzle size used is incorrect The nozzle size selected in the display does not match the nozzles on the booms The agitation is set too low	Refer to the nozzle selection chart for the proper nozzle sizing Ensure the nozzle size selected in the display matches the boom nozzles Adjust the agitation until the desired pressure is realized
The LED lights on the controller (ASC−10) are not on	There is no power to the controller (ASC−10)	Ensure the connectors are installed correctly

Problem	Possible Cause	Corrective Action
The speed is not showing when moving	The compass is not calibrated	Calibrate the compass
	The receiver is lacking satellite reception	Drive away from reception obstructions and allow time for the receiver to connect to the satellites
	The vehicle ground speed is less than 1.1 km/h (0.7 mph)	Increase the speed above 1.1 km/h (0.7 mph)
There is condensation inside the display	The display warms up too quickly in direct sunlight with the display at 100 percent brightness	Change the screen brightness to 85 percent and allow the display to warm up
	The receiver is lacking satellite reception	Drive away from reception obstructions and allow time for the receiver to connect to the satellites
	The vehicle ground speed is less than 1.1 km/h (0.7 mph)	Increase the speed above 1.1 km/h (0.7 mph)

Operator Advisories (InfoCenter Display)

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, an audio alarm will sound and an Operator advisory will appear on the InfoCenter Display (Fig. 50). Typically, an advisory can be eliminated with a change in machine controls by the operator. For example, if the operator attempts to start the engine when the traction pedal is depressed, an advisory is identified on the InfoCenter Display that the traction pedal needs to be in neutral. The advisory screen will clear automatically after a few seconds or can be cleared from the display manually by pressing any of the InfoCenter buttons. An advisory will not be recorded in any fault log. See Chapter 6 – Electrical System in this manual or the machine Operator's Manual for the complete list of operator's advisories. The following table explains each spray system operator advisory specific to machines with GeoLink spray systems.

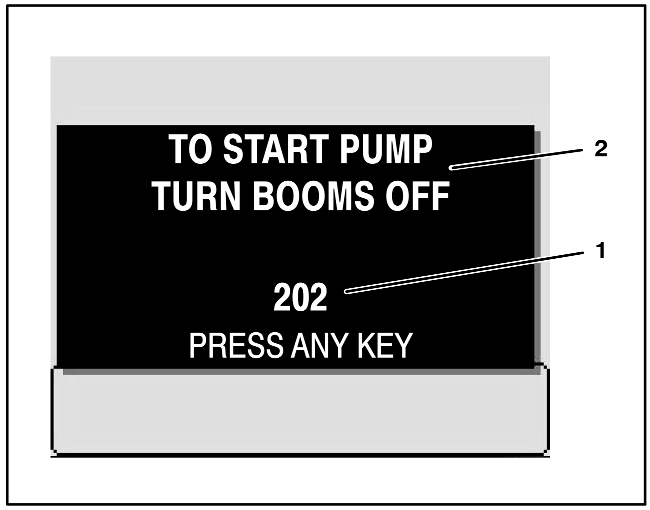


Figure 50

1. **Advisory number/code**
2. **Advisory description**

Advisory	Advisory Description	Recommended Action
202	Pump start prevented – Boom active	Set master boom switch to OFF position
203	Pump Start Prevented – Operator out of seat and parking brake not engaged	Operator return to seat or set parking brake
205	Pump Start Prevented – Engine starting	Set spray pump enable switch to OFF position
206	Pump Turned OFF – Operator not in seat	Operator return to seat or set parking brake
403	Rinse Pump ON (optional clean tank rinse kit)	Set optional clean tank rinse pump switch to OFF position

Using the InfoCenter Display for Troubleshooting

The Diagnostics – Input/Output screens of the InfoCenter display can be very helpful when troubleshooting spray system operation issues (see Diagnostics – Input/ Output Screens in this chapter). Some of the electrical components and the circuit wiring involved in various spray system operations can be evaluated using the Input/Output screens prior to testing each component individually. The Input/Output screens show the current state of the inputs, and the outputs required to allow the operation to proceed (Fig. 51).

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

BOOMS The components necessary to operate the spray valves.

CAUTION

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

If a spray system operation is malfunctioning, the following procedure can help identify 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 RUN/PREHEAT position and navigate to the InfoCenter Diagnostic – Input/ Output Screen for the desired machine function.

3. Manually operate the input component. The component state on the InfoCenter display should alternate ON and OFF as the component is switched open and closed. If ON and OFF do not alternate during component operation, the component or its circuit wiring is faulty and should be tested (see Component Testing in Chapter 6 – Electrical System in this manual).

When the necessary input(s) is in the correct position, the output identified on the Input/Output screen should show as ON. If the output remains OFF, a problem with TEC power (circuit wiring or fuse) may exist, or the Toro Electronic Controller (TEC) or TEC software may require replacement/reloading. Contact your Authorized Toro Distributor for assistance.

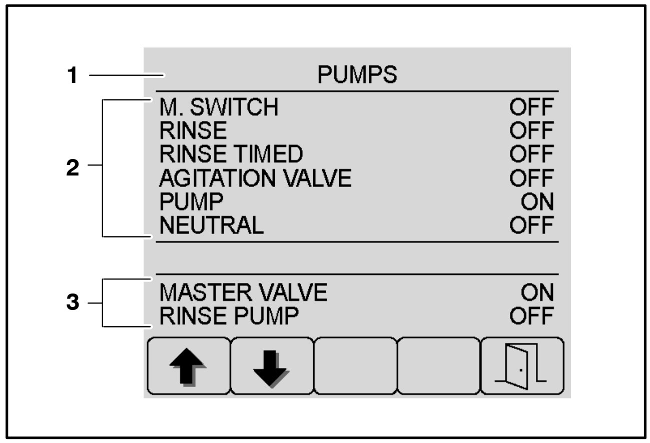


Figure 51

1. **Machine function**
2. **Inputs**
3. **Outputs**

A faulty output component will not be identified by the Input/Output screen. If all inputs and outputs are correct for the machine operation selected, yet the operation does not function as it should, the output component or the circuit wiring between the TEC and the output component may be faulty. In this case, the controller output is occurring but the faulty output component or circuit wiring is preventing the output from functioning. Test the specific output and output wiring (see Component Testing in Chapter 6 – Electrical System in this manual).

PUMP operation example:

Test the input: In this example, the input is the pump enable switch. If ON and OFF do not correspond to the pump enable switch (input) when moved to the ON/ENABLE and OFF positions, the switch or the circuit wiring for the switch is faulty and should be tested (see Component Testing in Chapter 6 – Electrical System in this manual).

Test the output: In this example, the output is MASTER VALVE – TEC output 9.

When the pump enable switch (input) is set to the ON/ENABLE position, the MASTER VALVE output should energize (ON). The solenoid coil for the spray pump hydraulic proportional valve (PV) should energize.

The solenoid coil for the spray pump proportional valve (PV) is an output energized by the TEC and therefore cannot be tested using the InfoCenter procedure. See Chapter 6 – Electrical System in this manual for additional solenoid coil testing information.

Machine Faults (InfoCenter Display)

Machine faults are generated by the Toro Electronic Controller (TEC) to identify an electrical system malfunction (fault) that occurs during machine or spray system operation. When a spray system fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault. Spray system faults can be viewed via the InfoCenter Diagnostic Screen Fault Viewer (Fig. 52). See InfoCenter Diagnostic Screen Fault Viewer in this chapter for additional information.

The list below identifies the fault codes that are generated by the Toro Electronic Controller (TEC) to identify an electrical spray system malfunction (fault) that occurred during spray system operation for revision D software. Use the InfoCenter Display Diagnostics > Fault Viewer for fault retrieval.

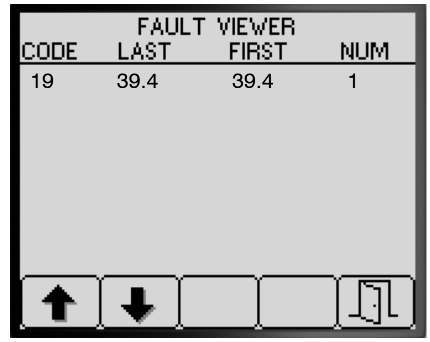


Figure 52

Fault Code	Fault Description	Recommended Action
19	Spray System Fault – Flow Meter not working correctly or harness fault (No flow detected when based upon boom, pump and pressure it indicates there should be) Spray pump is ON,Master Boom switch is ON, at least one boom is ON, spray pressure is above 20 PSI, the booms have been on long enough for the system to stabilize and vehicle speed is fast enough for automatic application–rate control to be enabled	Check the flow meter harness for proper connection. Confirm fluid flow at spray nozzles. If so, flow should be displayed on the flow rate meter. If no fluid flow at spray nozzles, begin checking the spray system for a blockage. Check flow meter for proper function.
41	Spray System Fault – Controller has detected a short circuit on the spray pump PWM output circuit (TEC output 9 – pin 44). OR Controller has determined an internal component in the controller has overheated.	Check harness and associated components for a short to ground If fault persists, replace TEC due to internal damage. Contact your Authorized Toro Distributor

NOTE: The above list pertains to spray system faults only. See Machine Faults in Chapter 6 – Electrical System in this manual for a complete list of all possible machine faults.

AutoSteer Faults (Optional AutoSteer Only)

AutoSteer faults are generated by the by the Danfoss EHi steering valve PVED−CLS controller to identify an electrical system malfunction (fault) pertaining to the autosteer system during operation. When an autosteer fault occurs, an audible alarm will sound and the InfoCenter will display information about the fault (Fig. 53).

If an AutoSteer fault occurs:

1. Press any key to remove the fault information panel from Operator Information Screen. The audible alarm will continue to sound.

2. The fault description will be displayed on the InfoCenter (Fig. 54). Press button 3 to silence the audible alarm. Press buttons 1 and 2 to scroll through the list of active steering faults. Any active engine faults will be displayed also.

3. Return to the previous screen by pressing button 5

An icon will appear in the upper left corner of the Operators Information screen as long as an autosteer fault is active (Fig. 55). In order to clear the displayed fault, the autosteer problem has to be resolved. Refer to the following Danfoss Error Codes table.

Note: Additional autosteer fault information may be available by connecting a PC running the Danfoss PLUS+1 Service Tool to the machines diagnostic port; contact an Authorized Toro Distributor for assistance.

Figure 53

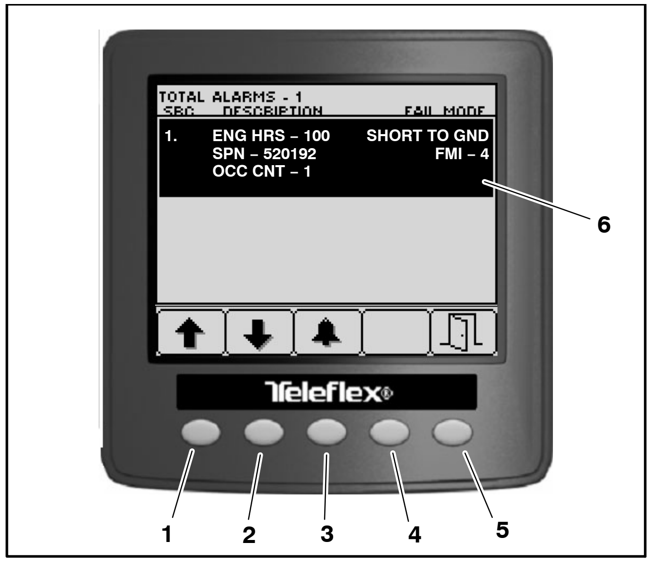


Figure 54

1. Button 1
2. Button 2
3. Button 3
4. Button 4
5. Button 5
6. Autosteer fault description

Figure 55

1. Operator information screen
2. Active fault icon

PVED-CLS CONTROLLER ERROR CODES

The list of DTC is divided in 7 sections:

1. **I/O signals:** This sections lists all failures related to analogue and digital inputs & outputs
2. **CAN Messages:** This Section lists all failures related to CAN messages
3. **Safety Functions:** This Section lists all failures caused by Safety functions and externally triggered safe state DTC's
4. **Diagnostic functions:** This section lists all failures detected by diagnostic functions
5. **Internal Hardware:** This section lists all failures found on the in ternal PCB in PVED -CLS
6. **Software:** This section lists all failures detected inside the software
7. **Monitoring:** This section lists all failures detected by crosscheck input signal and calculation results on SPI between main and Safety UC

Category	SPN	Signal Name	Failure mode	FMI	Severity	Possible root cause(s)
I/O Signals	520192	Analogue sensor connected to AD1	Short circuit to GND	4 - Voltage below normal or short-circuit to low source	Severe	1. Wire connected to AD1 lost connection (open circuit). 2. Wire connected to AD1 short circuit to GND.
			Short circuit to VCC	3 - Voltage above normal or short-circuit to high source	Severe	1. Wire connected to AD1 short circuit to a source higher than 4.9V.
			Too high deviation	25 - Signal crosscheck failed	Severe	1. Wheel angle sensors are not calibrated properly. 2. Sensor characteristics have changed. 3. If two physical separated sensors are used, one of them has lost the mechanical connection or has increased hysteresis 4. WAS crosscheck threshold parameter (P3375) does not match the wheel angle sensor mounting.
			Signal exceeded calibration limit	13 - Out of calibration	Severe	1. Wheel angle sensors are not calibrated properly. 2. Vehicle geometry has changed and it's now possible to steer the wheels further than the calibrated max points. 3. Mechanical link integrity lost
I/O Signals	520193	Analogue sensor connected to AD2	Short circuit to GND	4 - Voltage below normal or short-circuit to low source	Severe	1. Wire connected to AD2 lost connection (open circuit). 2. Wire connected to AD2 short circuit to GND.
			Short circuit to VCC	3 - Voltage above normal or short-circuit to high source	Severe	1. Wire connected to AD2 short circuit to a source higher than 4.9V.
I/O Signals	520195	Temperature Sensor	too low	1 - Data valid, but below normal operational range - Most severe level	Severe	1. Ambient Temperature is below -40 °C.
			too high	0 - Data valid, but above normal operational range - Most severe level	Severe	1. Ambient Temperature + self-heating of PVED-CLS (~15 °C) is above 120 °C.
			too high average	16 - Data valid, but above normal operating range - Moderately severe level	Info	1. Average ambient temperature + self-heating of PVED-CLS (~15 °C) is above 85 °C. This error code can only get active above 500hours of operation and has severity level INFO.
I/O Signals	627	Vbat	too high	3 - Voltage above normal or short-circuit to high source	Severe	1. Supply voltage is above 35.5V.
			too low	4 - Voltage below normal or short-circuit to low source	Info	1. Supply voltage is below 9V. This error code has severity level INFO
			Power on self-test failed due to too low battery supply	1 - Data valid, but below normal operational range - Most severe level	Severe	1. Supply voltage has been below 9V during Power-On-Self-Test for too long time
I/O Signals	520197	Sensor_+5V	too high	3 - Voltage above normal or short-circuit to high source	Severe	1. Sensor supply wire above 5.25V
			too low	4 - Voltage below normal or short-circuit to low source	Severe	1. Sensor supply wire below 4.75V 2. Sensor supply wire shortcut to GND 3. Too high load on sensor supply wire
I/O Signals	520198	Cut-Off supply	shortcut to GND	4 - Voltage below normal or short-circuit to low source	Severe	1. DOUT short-circuited to GND
			Shortcut to Vbat	3 - Voltage above normal or short-circuit to high source	Severe	1. DOUT short-circuited to Vbat
			Dutycycle differs from expected value	8 - Abnormal frequency or pulse width or period	Severe	1. Internal Failure
			Open circuit	5 - Current below normal or open circuit	Severe	1. No load connected to DOUT 2. Parameterized current levels (P3074 & P3076) do not match the connected load 3. DOUT short-circuited to Vbat
			Too high load	6 - Current above normal or grounded circuit	Severe	1. Load connected to DOUT is too high >2.5A 2. DOUT short-circuited to GND
SASAIID sensor	520199	CAN messages	never received (boot-up timeout)	22 - Message missing	Severe	1. SASAIID Not powered 2. SASAIID CAN Bus not connected 3. Incorrect parameter setting of SASAIID source address or PGN
			message lost (timeout)	9 - Abnormal update rate	Severe	1. SASA lost CAN bus or power connection
			invalid CRC or message sequence	19 - Received network data in error	Severe	1. CAN bus disturbance
			invalid velocity value	2 - Data erratic, intermittent or incorrect	Severe	1. SASA data out of range
			invalid position value	2 - Data erratic, intermittent or incorrect	Severe	1. SASA data out of range
			Error code signal displays active error	2 - Data erratic, intermittent or incorrect	Severe	1. SASAIID is sending error code - See communication protocol
CAN messages	520200	Vehicle Speed sensor	never received (boot-up timeout)	22 - Message missing	Severe	1. Vehicle speed sensor not powered 2. Vehicle speed sensor CAN Bus not connected 3. Incorrect parameter setting of VSP source address or PGN
			message lost (timeout)	9 - Abnormal update rate	Severe	1. Vehicle speed sensor lost CAN bus or power connection 2. Wrong message timing
			invalid CRC or message sequence	19 - Received network data in error	Severe	1. CAN bus disturbance 2. Incorrect Vehicle speed sensor message implementation
			invalid speed value	2 - Data erratic, intermittent or incorrect	Severe	1. Vehicle speed sensor data out of range
CAN messages	520201	MMI	never received (boot-up timeout)	22 - Message missing	Severe	1. MMI Not powered 2. MMI CAN Bus not connected 3. Incorrect parameter setting of MMI source address or PGN
			message lost (timeout)	9 - Abnormal update rate	Severe	1. MMI lost CAN bus or power connection 2. Wrong message timing
			invalid CRC or message sequence	19 - Received network data in error	Severe	1. CAN bus disturbance 2. Incorrect MMI message implementation
			invalid program	2 - Data erratic, intermittent or incorrect	Severe	1. MMI data out of range
			invalid off-road flag value	2 - Data erratic, intermittent or incorrect	Severe	1. MMI data out of range
			invalid enable/disable command	2 - Data erratic, intermittent or incorrect	Severe	1. MMI data out of range

Category	SPN	Signal Name	Failure mode	FMI	Severity	Possible root cause(s)
CAN messages	520202	Auxiliary steering device	never received (boot-up timeout)	22 - Message missing	Severe	1. AUX Not powered 2. AUX CAN Bus not connected 3. Incorrect parameter setting of AUX source address or PGN
			message lost (timeout)	9 - Abnormal update rate	Severe	1. AUX lost CAN bus or power connection 2. Wrong message timing
			invalid CRC or message sequence	19 - Received network data in error	Severe	1. CAN bus disturbance 2. Incorrect AUX message implementation
			Invalid flag value	2 - Data erratic, intermittent or incorrect	Severe	1. AUX data out of range
			invalid set-point	2 - Data erratic, intermittent or incorrect	Severe	1. AUX data out of range
CAN messages	520228	WAS CAN sensor	never received (boot-up timeout)	22 - Message missing	Severe	1. WAS Not powered 2. WAS CAN Bus not connected 3. Incorrect parameter setting of WAS source address or PGN
			message lost (timeout)	9 - Abnormal update rate	Severe	1. WAS lost CAN bus or power connection 2. Wrong message timing
			invalid CRC or message sequence	19 - Received network data in error	Severe	1. CAN bus disturbance 2. Incorrect WAS message implementation
			invalid position value	2 - Data erratic, intermittent or incorrect	Severe	1. WAS data out of range
			Signal exceeded calibration limit	13 - Out of calibration	Severe	1. Wheel angle sensors are not calibrated properly. 2. Vehicle geometry has changed and it is now possible to steer the wheels further than the calibrated max points. 3. Mechanical link integrity lost
Safety Functions	520203	Vehicle speed triggered EH-steering shut-off (Safety function 3)	Vehicle speed too high	31 - Condition exists	Severe	1. Vehicle speed is higher than the specified threshold specified by P3253
Safety Functions	520204	EH-main spool monitoring	EH spool position greater than set-point	7 - Mechanical system not responding or out of adjustment	Severe	1. EH-Spool out of control
			EH spool moved without steering input	23 - Unintended Steering	Severe	1. SASA disconnected from OSPCX in EHPS system
			Not in neutral at startup	28 - Not in neutral at Power-up	Severe	1. EH-Spool not in neutral at startup
Safety Functions	520205	Fault Detection Algorithm Monitoring	Unintended steering	23 - Unintended Steering	Severe	1. Improper sensor parameter setup 2. Chock valves have been open 3. Wheel angle sensor detached 4. SASAIID sensor detached from steering column 5. Improper calibration of wheel angles 6. Change in spool calibration values
Safety Functions	520206	Safe ON-Road Monitoring	Switch stuck closed	30 - Stuck Closed	Severe	1. Road switch relay failure (relay is not able to disconnect load)
			Switch state undefined	2 - Data erratic, intermittent or incorrect	Severe	1. AD3 Road switch signal in undefined range
			Switch state missing	22 - Message missing	Severe	1. AD3 Road switch signal not able to stabilize within valid range during initialization
			Switch state crosscheck failed	25 - Signal crosscheck failed	Severe	If P3072 = 255: 1. Internal failure If P3072 = 0 & P3242 = 255: 1. Mismatch in Road switch states between DOUT resistance and AD3 voltage signal
Safety Functions	520207	Road switch resistance monitoring	Switch state undefined	2 - Data erratic, intermittent or incorrect	Severe	1. DOUT Resistance in invalid range
			Switch state missing	22 - Message missing	Severe	1. DOUT Resistance not able to stabilize within valid range during initialization
			Switch state crosscheck failed	25 - Signal crosscheck failed	Severe	1. Mismatch in Road switch states between DOUT resistance and AD3 voltage signal
Safety Functions	520208	Demanded safe state	externally triggered safe state	31 - Condition exists	Severe	1. Controller forced to safe state by peer controller via SPI. This happens for example when one of the controllers detects a failure, which the other controller is not capable of detecting
Diagnostic functions	520210	Cut-off solenoid	unable to supply pilot flow to PVED	30 - Stuck Closed	Severe	1. No/insufficient Pump pressure
			unable to cut pilot flow to PVED	29 - Stuck Open	Severe	1. Internal hydraulic failure in OSPE/EHi
			Synchronization failed	19 - Received network data in error	Severe	Internal failure
Diagnostic functions	299023	Coils Supply Switch	Self-test failed	12 - Bad intelligent device or component	Severe	Internal failure
			Safety switch state not in sync with operation	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
			Synchronization failed	19 - Received network data in error	Severe	Internal failure
Diagnostic functions	520211	Overvoltage supervisor	Self-test failed	12 - Bad intelligent device or component	Severe	Internal failure
			Synchronization failed	19 - Received network data in error	Severe	Internal failure
Internal Hardware	520582	+5V	+5V signal out of range	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Internal Hardware	298967	CAN bus	CAN bus off and recovered	19 - Received network data in error	Severe	1. CAN bus disturbance 2. No/insufficient termination on the CAN bus network 3. Shortcut or wire breakage on CAN bus wire
			Address arbitration lost	11 - Unknown root-cause	Severe	1. Address conflict on the CAN bus
			Internal CAN Rx buffer overflow	12 - Bad intelligent device or component	Severe	2. Excessive number of messages intended for PVED CLS
			Internal CAN Tx buffer overflow for CAN priority 3 (safety related messages)	0 - Data valid, but above normal operational range - Most severe level	Severe	3. Excessive number of Priority 3 messages
			Internal CAN Tx buffer overflow for CAN priority 6 (status messages)	15 - Data valid, but above normal operating range - Least severe level	INFO	4. Excessive number of Priority 6 messages

Category	SPN	Signal Name	Failure mode	FMI	Severity	Possible root cause(s)
Internal Hardware	299029	EEPROM	Verified write fails on EEPROM cell	12 - Bad intelligent device or component	Severe	Internal failure
Internal Hardware	520212	LVDT sinus signal	LVDT sinus frequency out of range	8 - Abnormal frequency or pulse width or period	Severe	Internal failure
Internal Hardware	520585	Vref generation	Vref signal out of range	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Internal Hardware	520586	GND level	GND level above upper limit	3 - Voltage above normal or short circuit to high source	Severe	Internal failure
Internal Hardware	520588	LVDT demod A	LVDT demo A signal out of range	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Internal Hardware	520589	LVDT demod B	LVDT demo B signal out of range	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Software	520229	Soft error	Soft error detected	31 - Condition exists	Severe	Internal failure
Software	520213	SPI Communication	Connection loss	11 - Unknown root-cause	Severe	Internal failure
			SPI message queue full	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Software	1557	RAM test	RAM-code test fails	12 - Bad intelligent device or component	Severe	Internal failure
Software	520579	EEPROM VPS data	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520232	EEPROM Hydraulic config	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520233	EEPROM SEHS FDA	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520234	EEPROM Valve calibration data	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520235	EEPROM CAN WAS Calibration data	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 17.4.4 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520236	EEPROM Analogue Sensor Calibration data	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 17.4.5 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520237	EEPROM Peripherals config	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 17.4.6 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520238	EEPROM SEHS Protocol data	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520239	EEPROM Internal monitoring	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520241	EEPROM Vehicle geometry	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520242	EEPROM GPS config	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 12 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520243	EEPROM STW config	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 10 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520244	EEPROM AUX config	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Illegal parameter combinations – see section 11 3. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC
Software	520245	EEPROM Auto-Calibration config sector	Parameter value out of range/Incorrect configuration of EEPROM data	2 - Data erratic, intermittent or incorrect	Severe	1. Parameter setting out of range 2. Incorrect sector CRC
			Approval CRC failure	14 - Special instructions	Severe	1. Incorrect Approval CRC

Category	SPN	Signal Name	Failure mode	FMI	Severity	Possible root cause(s)
Software	520246	Invalid sensor configuration	Invalid sensor configuration	31 – Condition exists	Severe	If parameter settings are not done as per section 6.1.1
Software	299005	Software Initialization	Fault in software configuration or initialization process	11 - Unknown root-cause	Severe	Internal failure
Software	299004	Division by zero	Division by zero	11 - Unknown root-cause	Severe	Internal failure
Software	628	Flash test	Flash test failure	12 - Bad intelligent device or component	Severe	Internal failure
Software	299002	Variable truncation	Variable truncation	11 - Unknown root-cause	Severe	Internal failure
Software	299001	I2C communication	I2C communication failure	12 - Bad intelligent device or component	Severe	Internal failure
Software	520592	Too many errors	Too many errors to handle	0 - Data valid, but above normal operational range - Most severe level	Severe	1. If more than 5 errors happen at the same time, this error code will be shown by PVED-CLS
Software	298968	Interpolation	Interpolation overflow or underflow or incorrect data	11 - Unknown root-cause	Severe	Internal failure
Software	520577	SVC Parameters	Invalid PWM calibration values	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Software	298966	Program sequence monitoring	Program sequence monitoring failure	11 - Unknown root-cause	Severe	Internal failure
Software	298965	PSM task	PSM task record buffer full or slow PSM data processing	11 - Unknown root-cause	Severe	Internal failure
Software	520583	LVDT calculation	Denominator used in LVDT calculation out of range	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Software	1563	Software Mismatch	Software does not match peer controller	31 - Condition exists	Severe	PVED-CLS main controller contains a different software version than the PVED-CLS safety controller
Software	1562	Incompatible Bootloader	Bootloader is not compatible to application	31 - Condition exists	Severe	PVED-CLS main and/or safety controller contains a bootloader version not compatible to the application software
Software	520240	PVED-CLS Spare part	This DTC informs that this unit is running a spare part software (Info level DTC)	31 - Condition exists	Info	This DTC is shown by spare parts
Monitoring	520214	Flow command crosscheck	crosscheck failure	25 - Signal crosscheck failed	Severe	1. Flow command calculation by PVED-CLS Main controller and PVED-CLS Safety controller. This can happen if fx. Gain parameters are not equal in Main and Safety controller.
			loops to look back in Flow CMD buffer exceeded buffer length	2 - Data erratic, intermittent or incorrect	Severe	Internal failure
Monitoring	520225	EH-Mainspool Position crosscheck	crosscheck failure	25 - Signal crosscheck failed	Severe	Internal failure
Monitoring	520215	Wheel angle crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	If P3244 is set to 0: Internal failure If P3244 is set to 255: 1. CAN Wheel angle sensors are not calibrated properly. 2. Sensor characteristics have changed. 3. If two physical separated sensors are used, one of them has lost the mechanical connection or has increased hysteresis 4. WAS crosscheck threshold parameter (P3352) does not match the wheel angle sensor mounting. 5. CAN Wheel angle sensor transmit rate of primary and redundant signal deviate too much from each other
Monitoring	520216	Vehicle Speed sensor speed crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. Vehicle speed signal deviation too high between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3363 & P3364 settings does not fit to the vehicle speed sensor
Monitoring	520217	STW sensor Position crosscheck (SASA)	cross-check failure	25 - Signal crosscheck failed	Severe	SASA Failure
Monitoring	520227	STW sensor Speed crosscheck (SASA)	cross-check failure	25 - Signal crosscheck failed	Severe	SASA Failure
Monitoring	520218	Auxiliary steering device Steering angle crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. AUX mini wheel steering angle deviation too high between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3371 & P3372 settings does not fit to the AUX mini wheel device
Monitoring	520230	Auxiliary steering device Steering angle velocity crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. AUX mini wheel steering angle velocity deviation too high between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3365 & P3366 settings does not fit to the AUX mini wheel device
Monitoring	520231	Auxiliary steering device Joystick position crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. AUX Joystick flow request deviation too high between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3368 & P3369 settings does not fit to the AUX joystick
Monitoring	520247	Auxiliary steering device Joystick trim value crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. AUX Joystick trim signal deviation too high between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3388 & P3389 settings does not fit to the AUX joystick
Monitoring	520248	Auxiliary steering device Joystick enable signal crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. Transmit rate of primary and redundant signal deviate too much from each other 2. P3387 setting does not fit to the AUX joystick
Monitoring	520219	Executed steering device/program crosscheck (application state)	cross-check failure	25 - Signal crosscheck failed	Severe	1. P3237, P3238, P3239, P3241, P3250 or P3251 are set to different values in PVED-CLS Main and Safety controller
Monitoring	520224	MMI flag crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	1. MMI signals do not match between primary and redundant signal 2. Transmit rate of primary and redundant signal deviate too much from each other 3. P3374 setting does not fit to the MMI device
Monitoring	520249	IMD status crosscheck	cross-check failure	25 - Signal crosscheck failed	Severe	4.

Product Handling System

Use the following table to assist in troubleshooting specific issues with the product handling (wet) portion of the spray system. See Chapter 5 – Electrical System in this manual for a similar table discussing traction unit issues.

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, damaged or improperly installed. Tank bulkhead fittings or agitation nozzles are damaged or improperly installed. Spray tank drain valve not seating.
Fluid leaking from bottom of spray pump.	Faulty diaphragm(s) exist in spray pump. Pump casting is cracked.
Fluid leaking from spray pump valve cover.	Valve cover bolts are loose. O–ring at inlet or outlet valve is faulty. Diaphragm is not seating against pump casting and valve cover. Valve cover is damaged.
Excessive suction hose vibration.	Suction screen in tank or suction line is restricted. Spray pump suction line has an air leak. Suction tube in spray tank has an air leak.
Spray pressure decreases while operating sprayer.	Suction screen in tank or suction line is restricted. Low fluid level exists in spray tank. Spray pump suction line has an air leak. Agitation nozzle(s) in tank are loose or damaged (only occurs if agitation switch is on). Agitation bypass valve is improperly adjusted or damaged. Spray nozzles are worn or damaged. Pressure line or component is restricted or damaged. Pressure relief valve is stuck open. Spray pump is damaged.
Spray nozzle leaks when nozzle is switched off.	Diaphragm in turret body is leaking or damaged. Nozzle valve or actuator for affected nozzle is damaged.

Spray pump does not rotate (Operator Advisories are not present).	Spray pump switch or circuit wiring are dirty, corroded or damaged. Spray pump drive coupler is damaged. Pump drive hydraulic motor is not engaging or is damaged (see Chapter 5 – Hydraulic System). GeoLink spray system is not configured correctly.
Spray operation from booms is erratic.	Suction screen in tank is plugged. Spray nozzle(s) are clogged or damaged. Spray nozzles selected are inconsistent (different color/size) or worn. Nozzle valve or valve actuator is worn or damaged.
No spray output from one or more nozzles.	Hoses to nozzle(s) is pinched or kinked. Nozzle valve or actuator for affected nozzle is not opening. TEC output fuse for affected nozzle valves (boom section) is faulty. Affected nozzle actuator circuit wiring is dirty, corroded or damaged.
Low spray rate from one boom nozzle.	Nozzle is clogged or damaged. Spray nozzles selected is inconsistent (different color/size).

Compass Calibration

Accuracy of the GeoLink guidance feature is dependant on information from the system compass located in the GPS antenna (AGI–4). A five step compass calibration wizard is provided to calibrate the system compass.

1.Locate an area with enough room to complete the compass calibration process uninterrupted. The area should be at least 125 yards (114 m) long and wide enough to comfortably drive the sprayer in a complete circle at 75% of full steering lock. The area should be level and away from high voltage and large metal objects.

2. Select the compass calibration menu icon (Fig. 56).

3. Select Compass to start the five step compass calibration wizard.

1/5: Drive the sprayer to an acceptable area

2/5: Drive the sprayer in a circle at approximately 75% full steering lock in either direction for 1–1/2 complete circles (Fig. 57)

3/5: Drive the sprayer straight ahead for approximately 110 yards (100 m) then stop (Fig. 57)

4/5: Allow system to save calibration data

5/5: Confirm a successful calibration

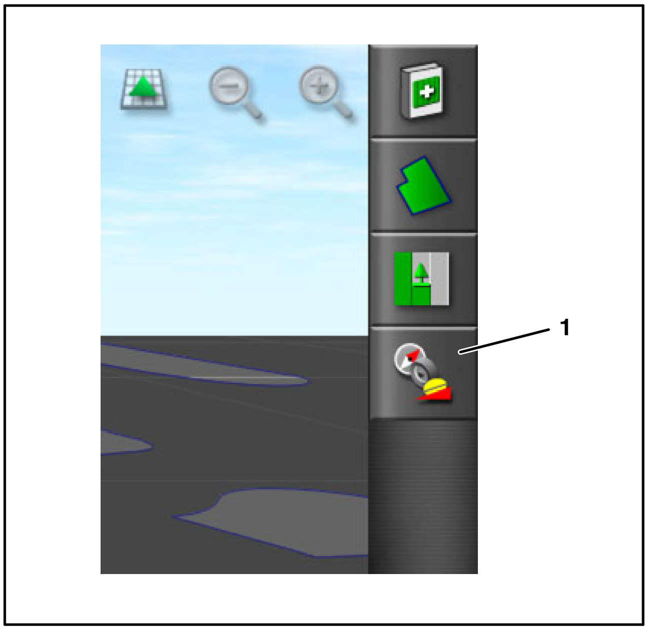


Figure 56

1. Compass calibration menu icon

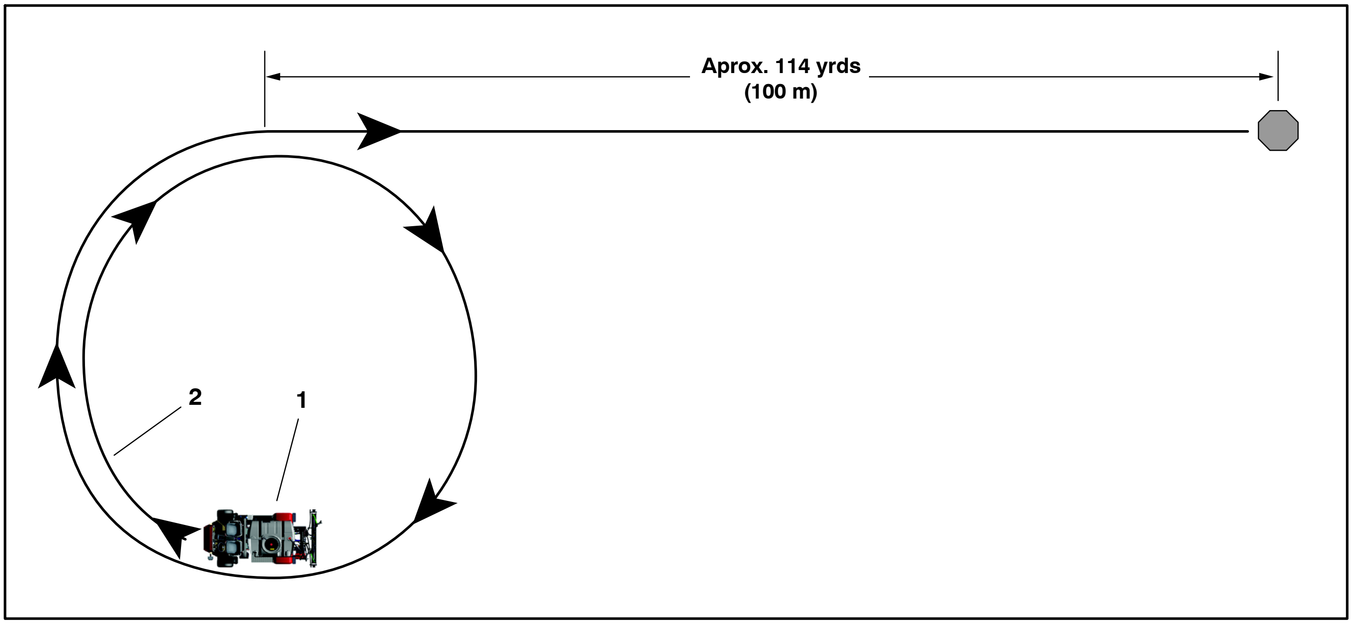


Figure 57

1. Sprayer **2. 1–1/2 circles at 75% full steering lock**

Flow Meter Calibration

Special Equipment Required:

- A graduated catch container (a container with 1/2 oz (0.01 ml) increments is preferred)

Preparation

1. Ensure that the sprayer tank is clean.

2. Fill the sprayer tank with at least 150 gallons of fresh water.

3. Ensure that the nozzles that you intend to test are in the active spray (down) position.

4. Engage the parking brake and start the engine.

NOTE: Allow the engine and hydraulic system to warm for 10 minutes.

Pretest Priming

1. Open the spray controller menu and click on the expand icon (Fig. 58).

2. Switch the sprayer to manual mode.

3. Set all of the spray section switch(es) to the ON position.

4. Set the throttle to the FAST position.

5. Set the master section switch to the ON position.

6. Turn on the sections using the master section switch.

7. Increase or decrease the pump speed to the desired spray pressure.

8. Turn off the sections with the master section switch.

Catch Test and Volume Entry

NOTE: 2 people are needed to perform the catch test in this procedure.

1. Open the spray controller menu and click on the expand icon (Fig. 58).

2. Set all of the spray section switch(es) to the ON position.

3. Set the throttle to the FAST position.

4. Set the master section switch to the ON position.

5. Select the flow meter icon to start the 4 step calibration process (Fig. 58).

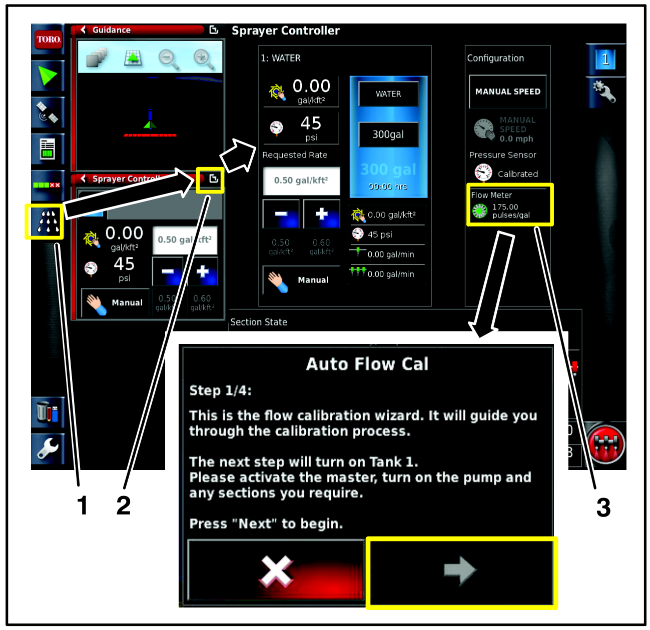


Figure 58

1. **Spray controller menu icon**
2. **Expand icon**
3. **Flow meter icon**

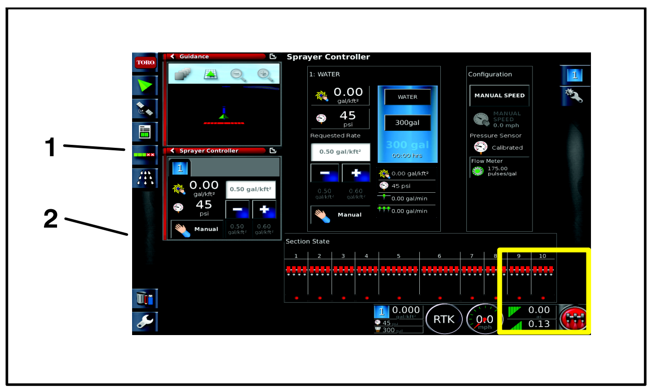


Figure 59

1. **Run the catch test**
2. **Verify the fluid amount**

IMPORTANT: Ensure the catch container is under the nozzle before turning on the sections.

6. Place the catch container under the nozzle before turning on the sections.

7. Turn on the sections using the master section switch.

8. Perform the catch test for at least 15–seconds or more at 1 of the nozzles.

NOTE: The length of the catch test depends on the size of the container, but more time is best.

9. Shut off the master section switch, set the throttle to the slow position, and shut off the spray pump (Fig. 59).

10. Set the graduated container on a level surface and note the fluid volume.

IMPORTANT: When you are reading the graduated container, you must set the container on a level surface. Read the fluid volume at the lowest point of the fluid–surface curve. Small errors reading the fluid volume in the graduated container will significantly impact the accuracy of the sprayer calibration.

11. Using the fluid amount from the 1 nozzle, multiply that amount by the number of nozzles used to spray during the catch test. Then convert that amount into liters or gallons (128 fl oz equals 1 gallon).

Example: 44 fl oz X 12 nozzles = 528 fl oz / 128 fl oz = 4.125 gallons

12. Enter the fluid amount from the calculation with the key pad (Fig. 60).

13. Confirm the flow cal factor.

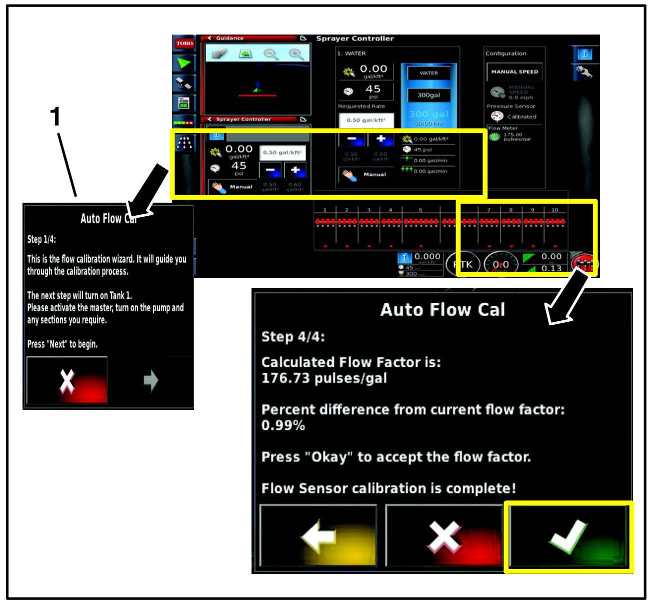


Figure 60

1. Keypad

Calibrating the Steering Position Sensor

The steering position sensor is also referred to as the Wheel Angle Sensor (WAS).

1. Drive the machine to an open, flat area; clear of trees and buildings; and where you can drive the machine in a straight line for 92 m (300 ft).

2. Start the GeoLink control console.

3. Press the STEERING OPTIONS icon (Fig. 61) to display the steering options menu.

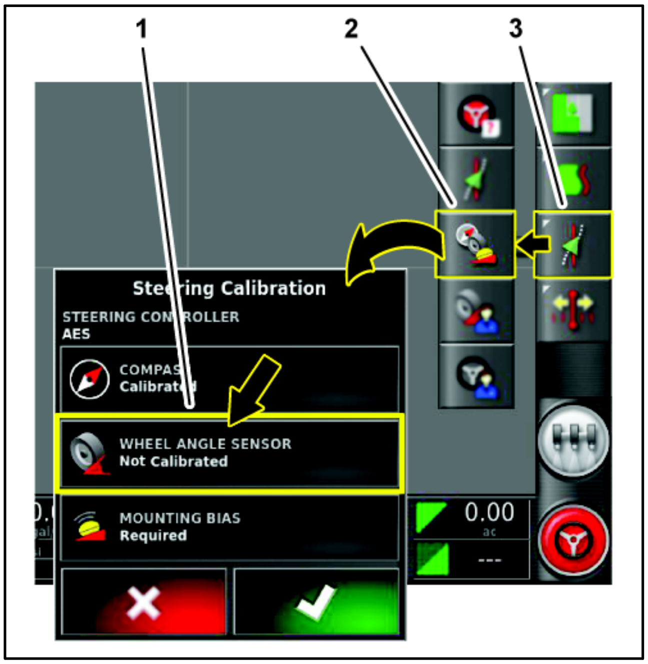


Figure 61

1. **WHEEL ANGLE SENSOR icon**
2. **AUTO STEER CALIBRATION icon**
3. **STEERING OPTIONS icon**

4. Press the AUTO STEER CALIBRATION icon (Fig. 61) to display the steering calibration menu.

5. Press the WHEEL ANGLE SENSOR icon (Fig. 61) to start the wheel angle sensor calibration wizard.

NOTE: If a NOT INITIALIZED message displays in the control console, drive the machine for several minutes.

6. At wizard step 1, wait until the wheel angle sensor calibration initializes, and press the next step icon (Fig. 62).

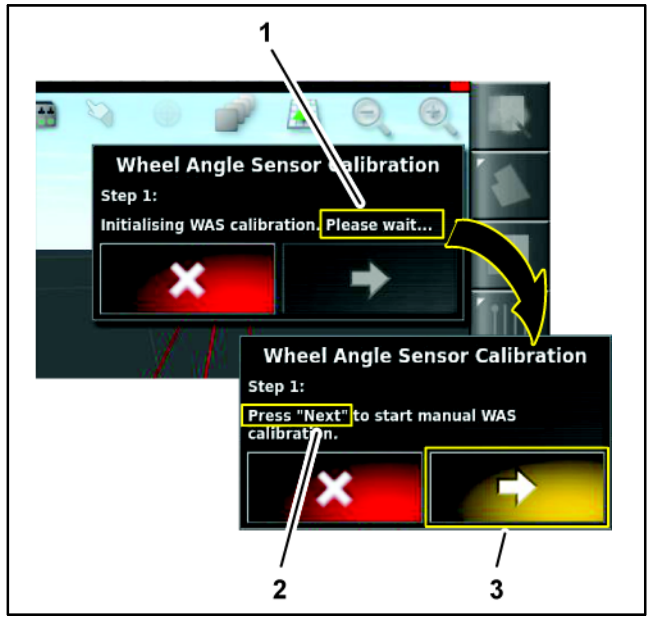


Figure 62

1. **Initializing ... wait message**
2. **Wizard step 1 press NEXT message**
3. **Next step icon**

7. At wizard step 2, fully turn the steering wheel to the left, stop, and press the next step icon (Fig. 63).

IMPORTANT: Verify that the wheel–angle sensor values change when the steer wheel turns.

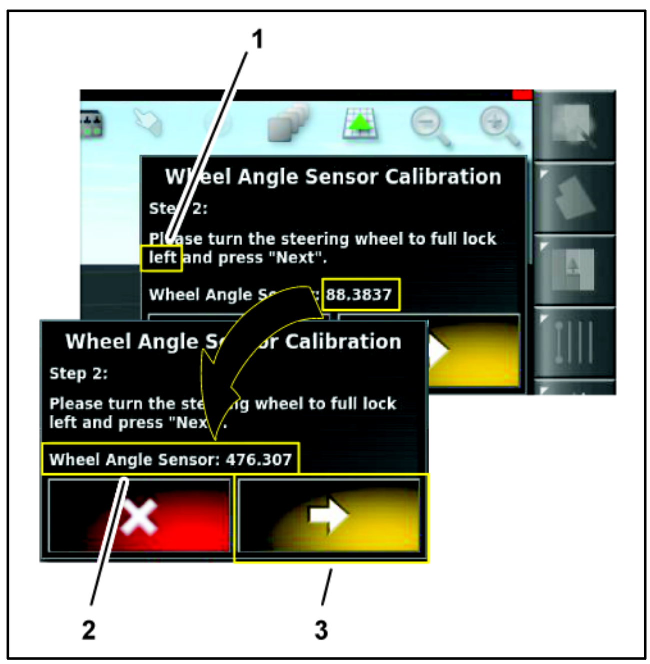


Figure 63

1. **Wizard step 2: turn the steering wheel left message**
2. **Wheel–angle sensor value**
3. **Next step icon**

8. At wizard step 3, fully turn the steering wheel to the right, stop, and press the next step icon (Fig. 64).

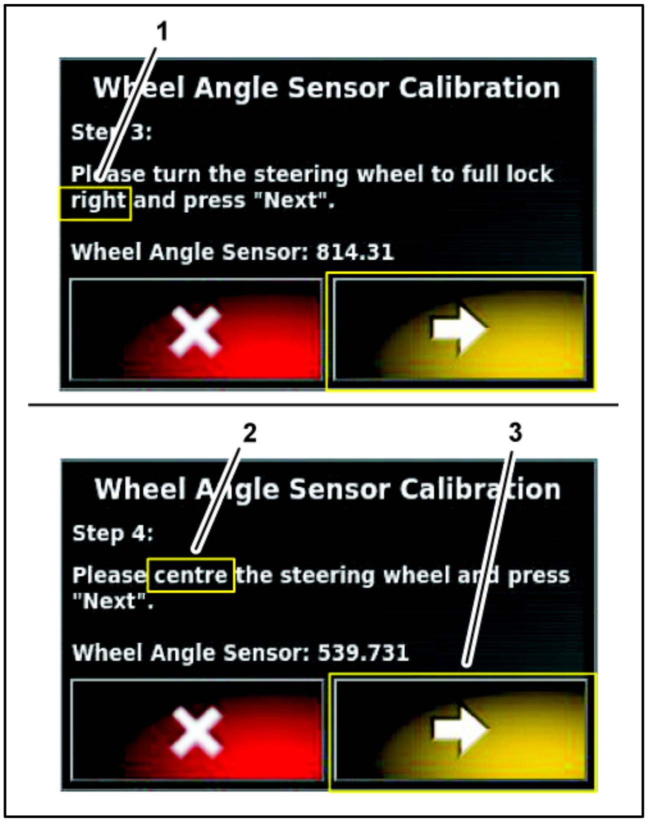


Figure 64

1. **Wizard step 3: turn the steering wheel right message**
2. **Wizard step 4: turn the steering wheel to center message**
3. **Next step icon**

9. At wizard step 4, turn the steering wheel until the tires align straight ahead, stop, and press the next step icon (Fig. 64).

Figure 65

1. **Wizard step 5:saving calibration data message**
2. **Confirm icon**

10. At wizard step 5, wait until the wheel angle sensor calibration saves data, and press the next step icon (Fig. 65)

11. At wizard step 6, press the conform icon (Fig. 65).

Calibrating the EHi Steering Valve

Calibrating the EHi Steering Valve requires the use of the Danfoss PLUS+ 1 Service Tool application running on a compatible laptop computer and a USB/CAN interface cable Part No. 115–1944.

1. Ensure that the GeoLink compass is calibrated; refer to the GeoLink Operator's Manual for your machine.

2. Park the machine on a level location, shut off the engine and engage the parking brake.

IMPORTANT: Close all applications running on the laptop computer being used before connecting the USB/CAN interface cable to the machine.

3. Plug the USB/CAN interface cable into a USB port of the laptop computer.

4. At the machine, rotate the key to the ON position.

5. In Windows task bar, click the SEARCH icon (Fig. 66).

6. In the TYPE HERE TO SEARCH text box, type .P1D and press the enter key (Fig. 66).

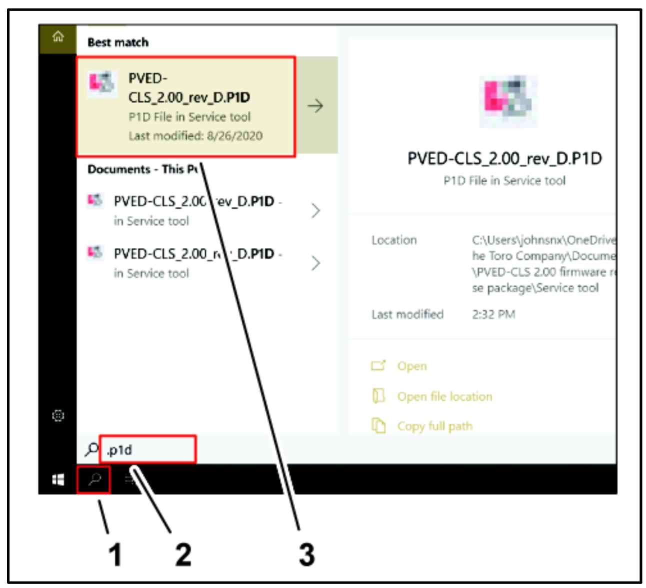


Figure 66

1. **SEARCH icon**
2. **.P1D (Type Here to Search text box**
3. **DVED–CLS_2.0 rev_D.P1 icon**

7. Click PVED–CLS_2.00_rev_D.P1D icon (Fig. 66). The PLUS+ 1 Service Tool application should display on the laptop screen (Fig. 67).

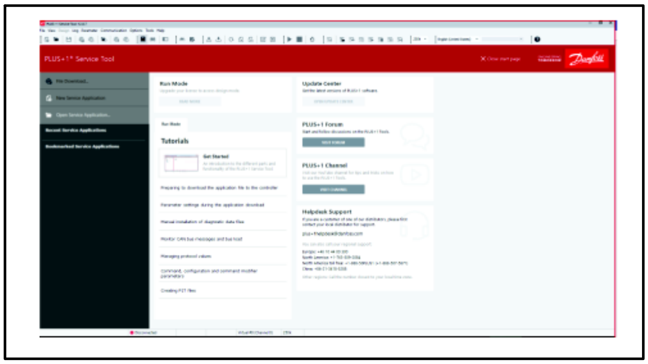


Figure 67

8. Remove the cap from the 3–socket connector of the kit wire harness CAN port labeled DUPLICATE DIAG CONNECTOR, and plug the 3–pin connector USB/CAN interface cable into the 3–socket connector (Fig. 68).

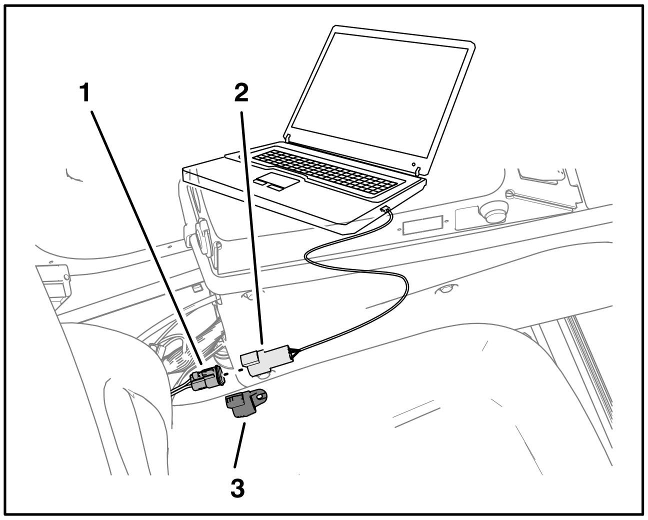


Figure 68

1. **3–socket connector (labeled DUPLICATE DIAG CONNECTOR— AutoSteer wire harness)**
2. **3–pin connector (USB/CAN interface cable)**
3. **Cap**

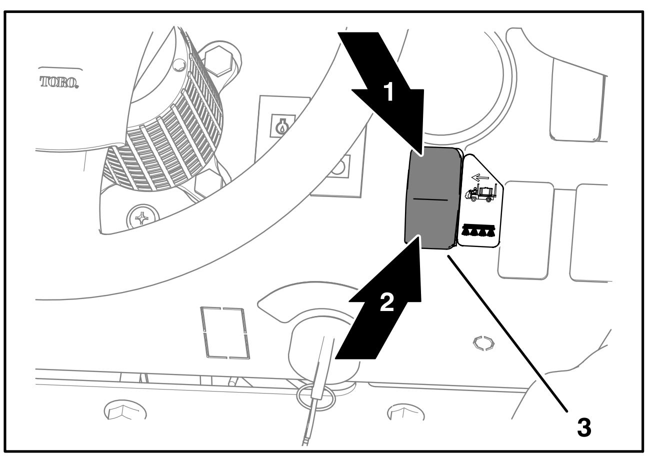


Figure 69

1. **Transport position**
2. **Enable position**
3. **Enable/Transport switch**

9. On the dash panel of the machine, press the enable/ transport switch to the ENABLE position (Fig. 69).

10. On your laptop computer, click the PVED–CLS_2.00_REV_D.P1D file.

11. In the System Navigator tab, navigate the AUTO CALIBRATION directory, and click the + icon (Fig. 70).

12. Start the engine of the machine.

13. Turn the steering wheel as needed to position the front tires straight ahead.

14. Click the SPOOL CALIBRATION icon (Fig. 70).

15. On the spool calibration page, click the GOTO SPOOL CALIBRATION MODE icon (Fig. 70).

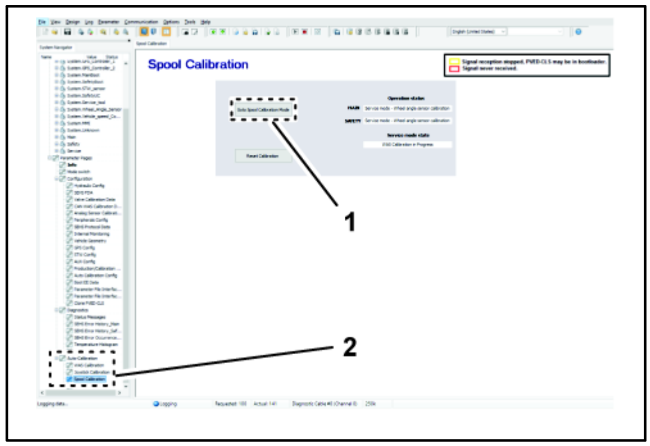


Figure 70

1. **GOTO SPOOL CALIBRATION MODE icon**
2. **System Navigator tab, AUTO CALIBRATION directory, and SPOOL CALIBRATION icon**

16. Click the START CALIBRATION icon (Fig. 71).

NOTE: The service mode state must display Spool Calibration Armed before starting calibration.

IMPORTANT: DO NOT touch the steering wheel.

The steering wheel moves while spool calibrations proceeds. The spool calibration process takes several minutes. Note that the wheel movement status changes in Status tab. Calibration is finished when Service Mode State field displays SPOOL PARAMETERS READY TO UPDATE.

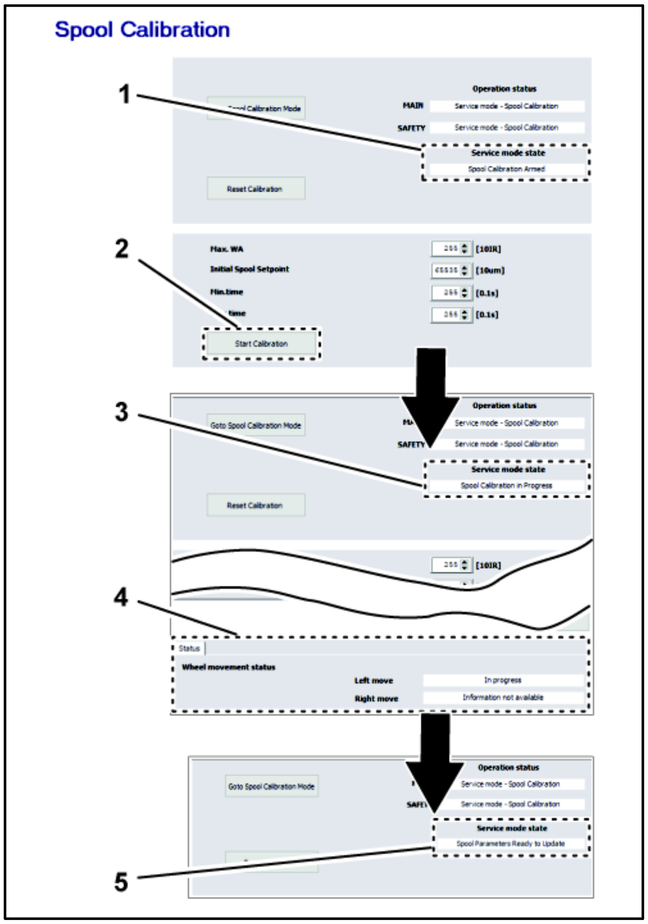


Figure 71

1. **Service mode state field—SPOOL CALIBRA–TION ARMED**
2. **START CALIBRA–TION icon**
3. **Service mode state field—SPOOL CALIBRA–TION IN PROGRESS**
4. **Wheel movement status**
5. **Service mode state field—SPOOL PARAM–ETERS READY TO UPDATE**

17. At the bottom of the spool calibration screen, click the ACCEPT AND SAVE icon (Fig. 72).

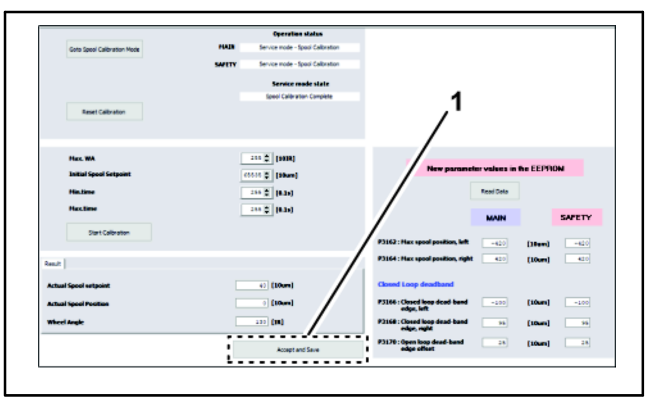


Figure 72

1. **ACCEPT AND SAVE icon**

18. On the WAS CALIBRATION screen, click the GOTO WAS CALIBRATION MODE icon (Fig. 73).

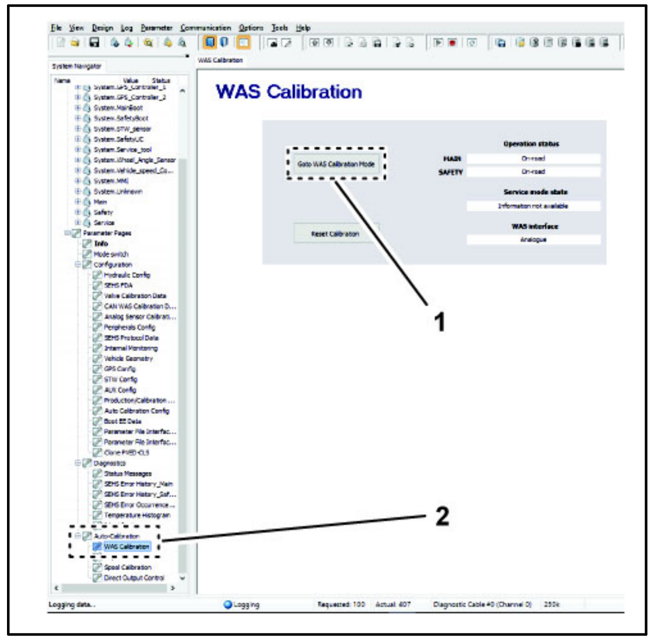


Figure 73

1. **GOTO WAS CALI–BRATION MODE icon**
2. **System Navigator tab, AUTO CALIBRATION directory, and WAS CALIBRATION icon**

19. Fully turn the steering wheel to the left and stop.

20. Click the WAS CALIBRATION icon (Fig. 73).

21. Click the CAPTURE L icon (Fig. 74).

NOTE: The sensor value changes as you turn the steer-ing wheel.

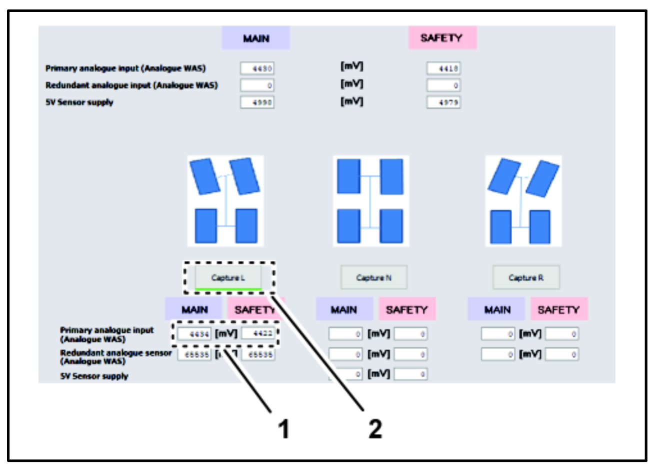


Figure 74

1. **Sensor value**
2. **CAPTURE L icon**

22. Fully turn the steering wheel to the right and stop.

23. Click the CAPTURE R icon (Fig. 75).

NOTE: The sensor value changes as you turn the steer-ing wheel.

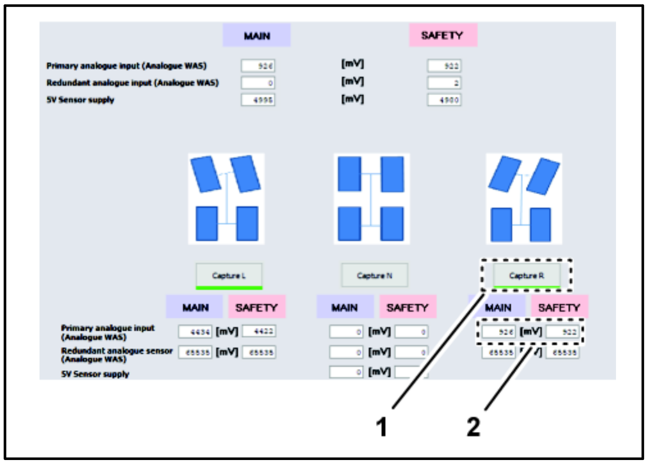


Figure 75

1. **Sensor value**
2. **CAPTURE R icon**

24. Turn the steering wheel until the tires align straight ahead and stop.

25. Click the CAPTURE N icon (Fig. 76).

NOTE: The sensor value changes as you turn the steering wheel.

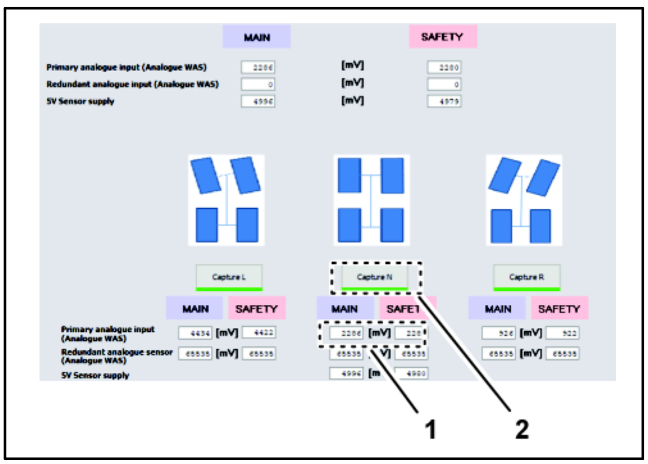


Figure 76

1. **Sensor value**
2. **CAPTURE N icon**

26. Click the ACCEPT AND SAVE icon (Fig. 77).

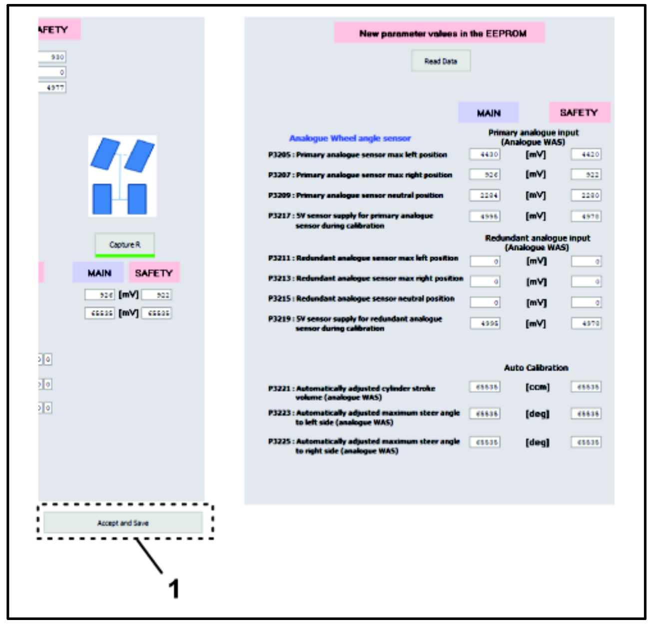


Figure 77

1. **ACCEPT AND SAVE icon**

27. Shut off the engine.

28. Remove the connector of the USB/CAN interface cable from the connector of the AutoSteer wire harness, and install the cap onto the wire harness connector.

GPS Antenna (AGI−4)

The GPS antenna assembly is mounted to the machine ROPS. Unswitched power is provided to the antenna as long as the battery cables are connected to the battery. A 10 amp fuse provides circuit protection for the unswitched power to the antenna. A switched power circuit is also required to operate the antenna.

The AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller communicate with each other on a CAN−bus network. The GeoLink Can−bus network is separate from the sprayer traction unit CAN−bus.

NOTE: The AGI−4 antenna may include a cellular modem and IMU for machines with RTK correction.

Minimum voltage requirement: 5.5 VDC.

Diagnostic LEDs

PWR: power supply status (steady green = OK)

STAT: satellite and receiver status (flashing red = no satellites, flashing yellow or green = satellites OK)

RX/TX: modem status (flashing green = receiving position correction information)

SYSFIX: record and data status (flashing green = correction information processed and position established)

Connections

Coaxial connector for cellular antenna (machines with RTK correction only)

12 pin harness connection (black)

12 pin harness connection (gray)

Coaxial connector for external GPS antenna (not used)

A pair of similar twelve (12) pin connectors are used at the GPS antenna. The layout of the wire harness connectors is shown (Fig. 79). See the electrical schematics and wire harness drawings and diagrams in Appendix A − Foldout Drawings in this manual for additional information.

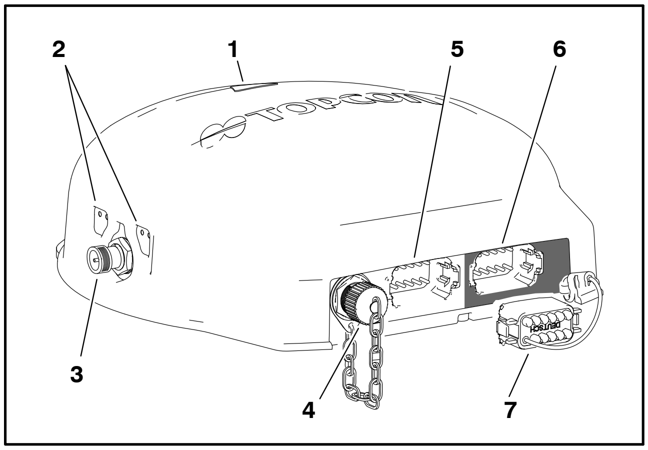


Figure 78

1. **GPS antenna assembly**
2. **Diagnostic LEDs**
3. **Coaxial connector for cellular antenna**
4. **Coaxial connector for external GPS antenna (not used)**
5. **12 pin harness connection (gray)**
6. **12 pin harness connection (black)**
7. **Tethered plug**

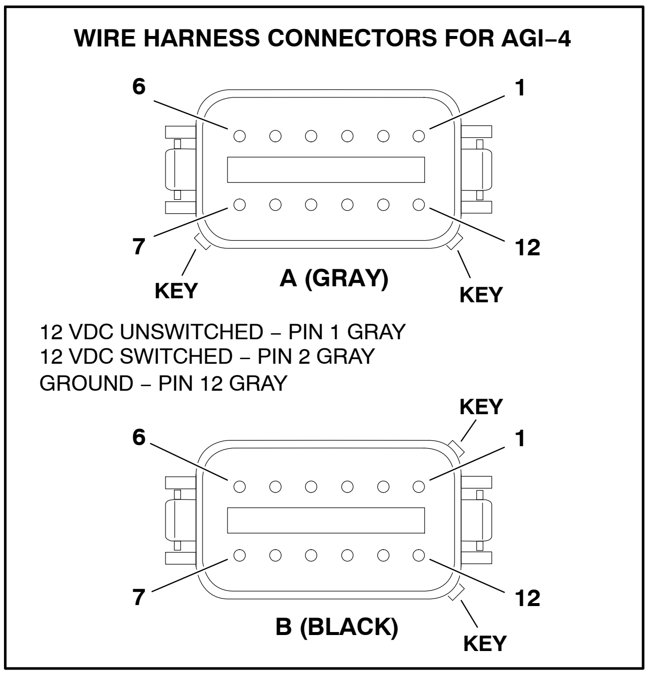


Figure 79

NOTE: The ASC−10, the X25 or X30 control console, the GPS antenna assembly (including the modem and the IMU for machines with RTK correction) are programmed specifically for each sprayer. If any of these components require replacement for any reason, contact the National Service Network (NSN) or your Toro Distributor. The replacement components provided should arrive pre−programmed for the specific sprayer.

Modem (machines with RTK correction)

A modem is required on units with RTK correction to connect the machine to the Internet. Two different modems are used based on the type of cellular service chosen.

CDMA (Code Division Multiple Access): The primary type cellular technology for cell phones used in the United States. Cell phone providers that use CDMA technology include Verison, Sprint, Bell and Telus.

GSM (Global System for Mobile): The primary type of cellular technology used for cell phones in countries other than the United States. Within the United States, a much smaller number of network service providers are on the GSM standard, among them AT&T, T−Mobile and Rogers.

NOTE: RTK enhanced systems include a modem and IMU installed in the GPS antenna housing, plus a short vertical antenna mounted alongside the GPS antenna.

NOTE: The ASC−10, the X25 or X30 control console, the GPS antenna assembly (including the modem and the IMU for machines with RTK correction) are programmed specifically for each sprayer. If any of these components require replacement for any reason, contact the National Service Network (NSN) or your Toro Distributor. The replacement components provided should arrive pre−programmed for the specific sprayer.

Removal (Fig. 80)

1. Disconnect the cellular antenna from the GPS antenna and remove the GPS antenna from the sprayer.

2. Remove the bottom cover from the antenna housing.

3. .If removing an existing modem:

A. Detach the coaxial cellular antenna connector from the GPS antenna housing.

B. Carefully remove the modem from the antenna housing.

Installation (Fig. 80)

NOTE: For initial installation, remove the antenna plug assembly from the antenna housing.

1. Align and install the coaxial cellular antenna connector to the GPS antenna housing.

2. Align the 10−pin connector and press the modem into the GPS antenna housing until it is fully seated.

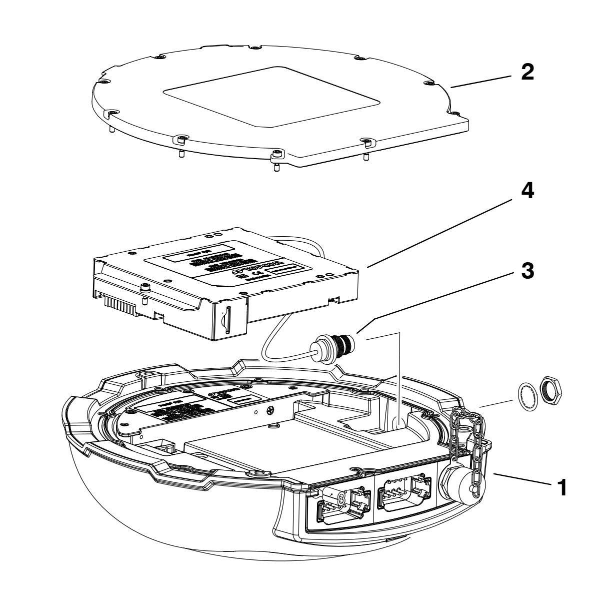


Figure 80

1. GPS antenna assembly (shown upside−down)
2. Bottom cover
3. Coaxial cellular antenna connector
4. Modem

3. Secure the modem to the antenna housing with the two (2) captive screws.

4. Install the GPS antenna bottom cover.

5. Install the GPS antenna to the sprayer and connect the cellular antenna.

Inertial Measurement Unit (IMU) (machines with RTK correction)

The IMU is an electronic device that measures and reports the machines force and angular rate using an accelerometer and a gyroscope. The IMU allows the GPS receiver to work when GPS−signals are momentarily unavailable, or blocked, or when electronic interference is present.

NOTE: RTK enhanced systems include a modem and IMU installed in the GPS antenna housing, plus a short vertical antenna mounted alongside the GPS antenna.

NOTE: The ASC−10, the X25 or X30 control console, the GPS antenna assembly (including the modem and the IMU for machines with RTK correction) are programmed specifically for each sprayer. If any of these components require replacement for any reason, contact the National Service Network (NSN) or your Toro Distributor. The replacement components provided should arrive pre−programmed for the specific sprayer.

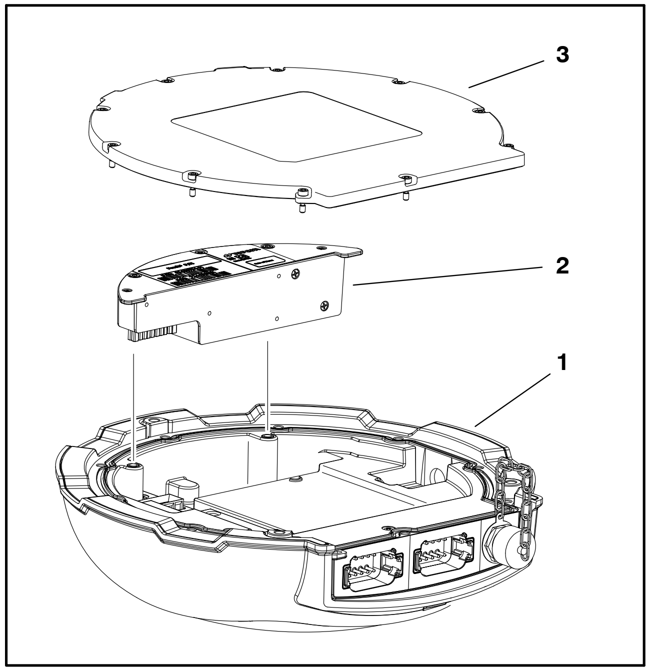


Figure 81

1. **GPS antenna assembly (shown upside−down)**
2. **Inertial measurement unit (IMU)**
3. **Bottom cover**

Removal (Fig. 81)

1. Disconnect the cellular antenna from the GPS antenna and remove the GPS antenna from the sprayer.

2. Remove the bottom cover from the antenna housing.

3. Carefully remove the IMU from the antenna housing.

Installation (Fig. 81)

1. Align the 10−pin connector and press the IMU into the GPS antenna housing until it is fully seated.

2. Secure the IMU to the antenna housing with the two (2) captive screws.

3. Install the GPS antenna bottom cover.

4. Install the GPS antenna to the sprayer and connect the cellular antenna.

Automatic Section Controller (ASC−10)

The controller opens and closes the various nozzle valves, turning ON the flow of product to a nozzle as it enters an area that has not been sprayed, and turning OFF a nozzle as it exits an area that has already been sprayed. The controller is also responsible for varying the spray pump speed/system pressure and therefore the application rate.

The controller is attached to the nozzle valve mount at the rear of the machine (Fig. 82). Unswitched power is provided to the controller as long as the battery cables are connected to the battery. A 50 amp fuse provides circuit protection for the unswitched power to the controller.

Three diagnostic LEDs are provided on the ASC−10 located near the CAN−bus connecter:

STATUS: switched and unswitched power supply status (flashing blue = OK)

RS232: not used

CAN: CAN−bus network status (flashing green = OK)

The ASC−10 monitors the states of the following components: boom section switches, flow meter and pressure transducer.

The ASC−10 controls electrical output to the following components: spray pump control solenoid and nozzle valves.

The AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller communicate with each other on a CAN−bus network. The GeoLink Can−bus network is separate from the sprayer traction unit CAN−bus.

The connection terminal functions for the ASC−10 are shown (Fig. 84). A forty (40) pin wire harness connector and a four (4) pin wire harness connector attach to the controller. The four (4) pin connector supports the GeoLink CAN−bus network. The layout of the wire harness connectors is shown (Fig. 83). See the electrical schematics and wire harness drawings and diagrams in Appendix A − Foldout Drawings in this manual for additional information.

The GeoLink Spray System electrical schematic and wire harness drawings in Appendix A − Foldout Drawings can be used to identify possible circuit problems between the controller and the input/output devices (e.g. switches and valves).

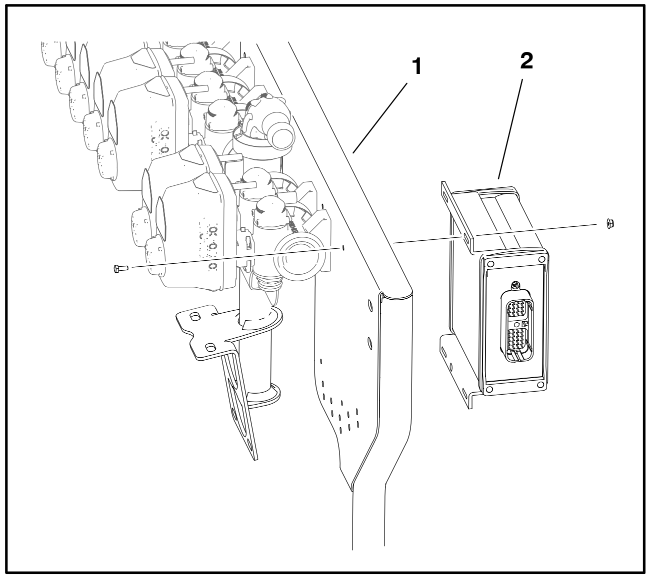


Figure 82

1. Nozzle valve mount
2. Automatic section controller (ASC−10)

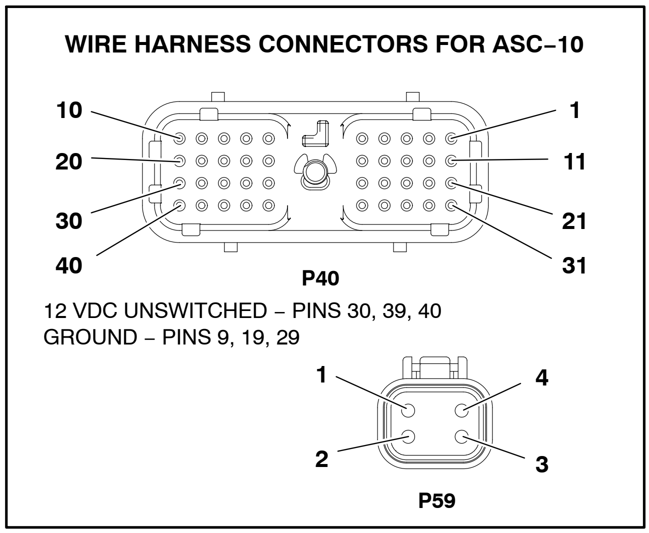


Figure 83

Because of the solid state circuitry built into the ASC−10, 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 ASC−10, the X25 or X30 control console, the GPS antenna assembly (including the modem and the IMU for machines with RTK correction) are programmed specifically for each sprayer. If any of these components require replacement for any reason, contact the National Service Network (NSN) or your Toro Distributor. The replacement components provided should arrive pre−programmed for the specific sprayer.

IMPORTANT: Before performing welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the ASC−10, the machine TEC and disconnect the terminal connector from the engine alternator. These steps will prevent damage to the machine electrical system when welding.

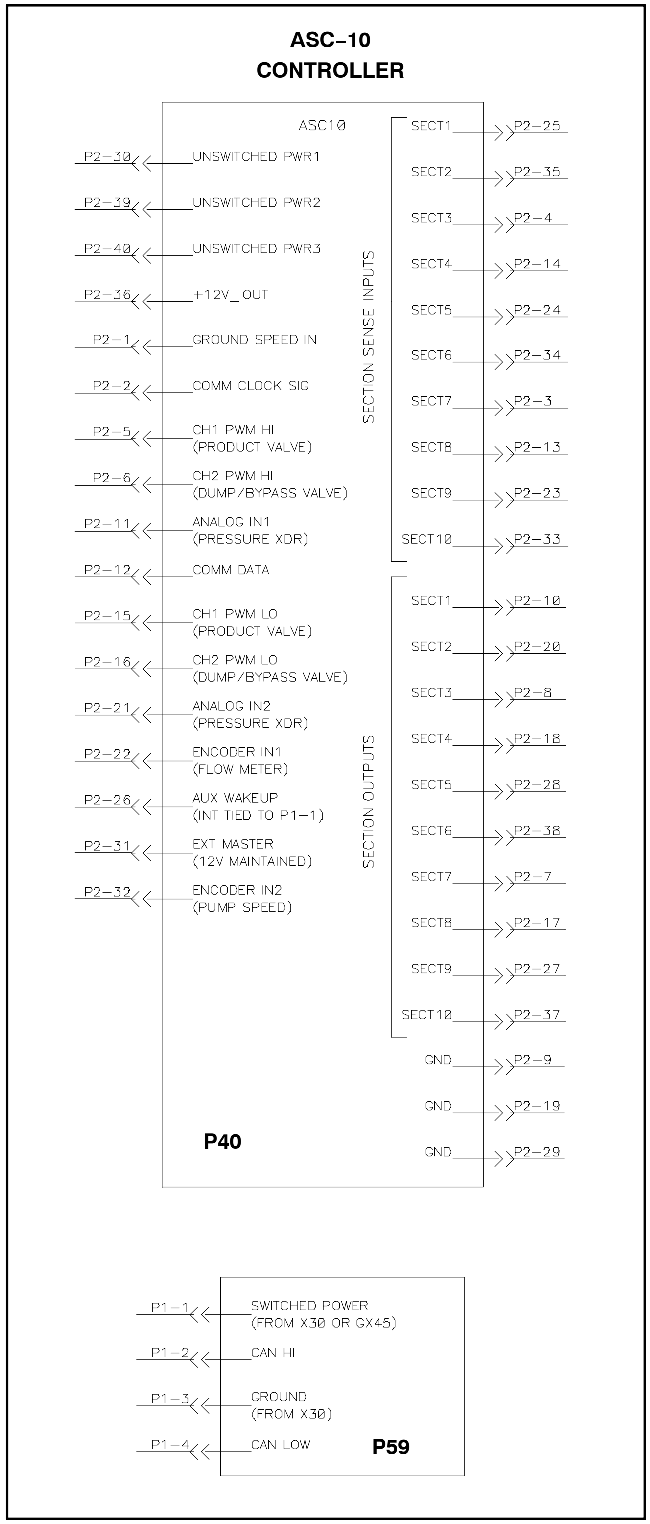


Figure 84

X25 or X30 Control Console

The X25 or X30 control console is mounted to the machine instrument panel. The console includes a battery to safely shut the console down if power to the console is suddenly lost. In addition to the controls that appear on the various sub−menus and screens, the console includes the following LED indicator lights along the top and sides of the console, and control buttons at the bottom of the console:

LED light bar − displays the direction and distance the sprayer is currently traveling in relation to a wayline. The LEDs will change from blue to green to orange and red as the sprayer moves further from the wayline.

Light sensor − used to set the display brightness based on ambient light

Console battery status LED

Green = fully charged +7.5 VDC

Yellow = partially charged −7.2 VDC

Red = discharged

Combined with Blue flashing = charging

Supply status LED

Green—good supply +12 VDC

Yellow—low supply −12 VDC

Red—very low supply or off −9VDC

Toolbar (displayed on X25 consoles by swiping upwards from the base of the screen)

Help button − pressing the help button allows the operator to view icon names on the screen without opening the icon menu or initiating the icon command

USB eject button − use whenever you remove a USB device from the console (the primary USB port is located on the left side of the console)

Screen brightness control buttons

Day/Night mode button − one touch control of screen brightness and contrast settings for better viewing in light or dark conditions

Unswitched power is provided to the console as long as the battery cables are connected to the battery. A 10 amp fuse provides circuit protection for the unswitched power to the console. A switched power circuit is also required to operate the console.

A twenty−six (26) pin connector is used at the control console. The layout of the wire harness connector is shown (Fig. 86). See the electrical schematics and wire harness drawings and diagrams in Appendix A − Foldout Drawings in this manual for additional information.

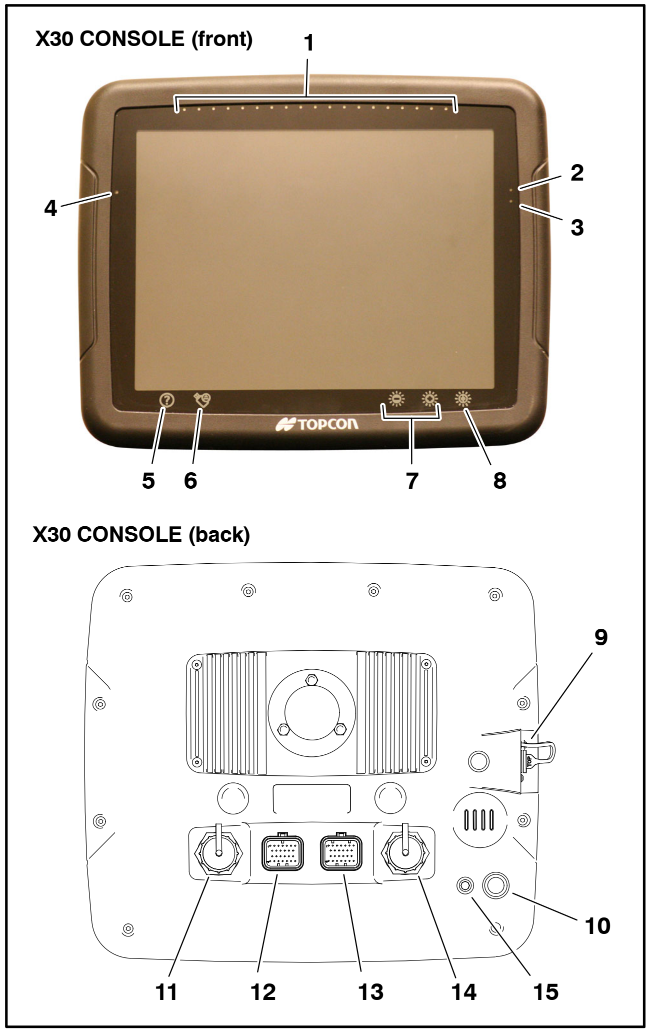


Figure 85

1. **LED light bar**
2. **Battery status**
3. **Supply status**
4. **Light sensor**
5. **Help button**
6. **USB eject button**
7. **Screen brightness control buttons**
8. **Day/Night mode button**
9. **USB port**
10. **Power button**
11. **CAT5 cable connector**
12. **Harness connecter**
13. **Harness connecter (not used)**
14. **USB port (auxiliary)**
15. **Reset button**

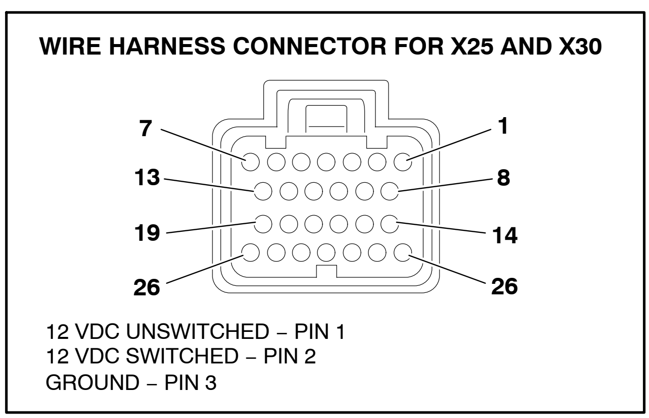


Figure 86

The AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller communicate with each other on a CAN−bus network. The GeoLink Can−bus network is separate from the sprayer traction unit CAN−bus.

NOTE: The ASC−10, the X25 or X30 control console, the GPS antenna assembly (including the modem and the IMU for machines with RTK correction) are programmed specifically for each sprayer. If any of these components require replacement for any reason, contact the National Service Network (NSN) or your Toro Distributor. The replacement components provided should arrive pre−programmed for the specific sprayer.

IMPORTANT: The console should be removed from the sprayer when not in use to protected it from extreme temperatures, damage and theft.

CAN−bus Terminator Resistors

System communication between the AGI−4 antenna, X25 or X30 control console and ASC−10 auto section controller is accomplished on a separate CAN−bus communication system. The GeoLink Can−bus network is not connected to the sprayer traction unit CAN−bus. 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 are two (2) 120 ohm terminator resistors.

The CAN−bus terminator resistors plug into the wire harness. One of the terminator resistors is under the operator seat and the second resistor is located near the ASC−10 at the rear of the machine. The wire harness connectors have a blue insert to identify the proper location for the termination resistors.

Testing

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

2. Locate resistor assembly to be tested and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

3. The terminator resistors (Fig. 87) 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.

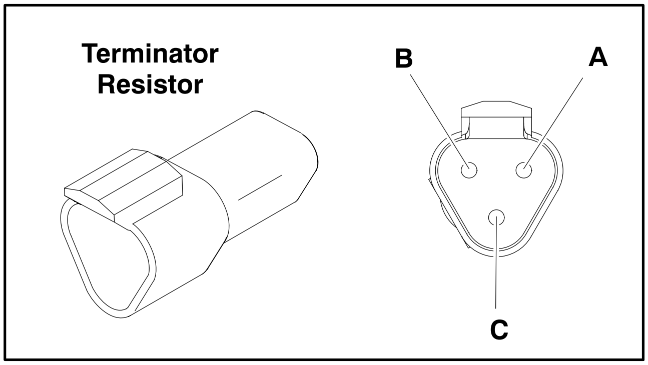


Figure 87

4. If testing determines that resistor is faulty, replace resistor assembly.

5. If the resistor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Appendix A − Foldout Drawings in this manual).

6. After resistor testing is complete, make sure that resistor is fully seated into wire harness connector and secured to the wire harness with a cable tie.

Fuses

Two in−line fuses are located in the GeoLink wire harnesses near the battery.

Fuse Identification and Function

In−line fuse (10 amp) protects the unswitched power supply circuit for the X25 or X30 console and the AGI−4 GPS antenna.

P05 In−line fuse (50 amp) protects the unswitched power supply circuit for the ASC−10 automatic section controller.

Testing

Remove fuse from the fuse holder and check that fuse has continuity across the fuse terminals. Use a multimeter to verify that 12 VDC exists at the terminals of the fuse holder. Replace the fuse or continue to check the wire harness connections as necessary.

Material Handling “Wet” Components

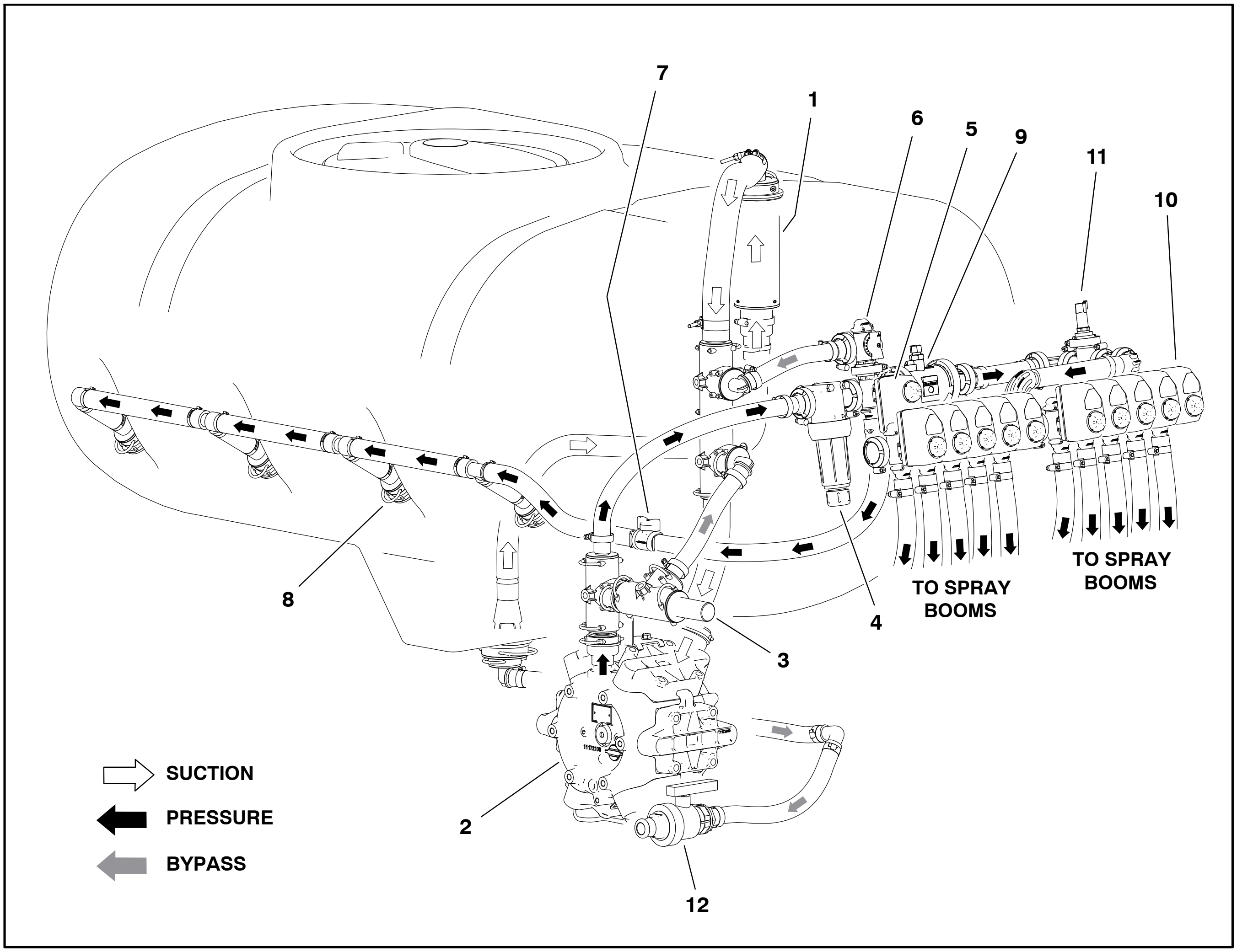


Figure 88

1. **Suction filter (in tank)**
2. **Spray pump**
3. **Relief valve**
4. **High pressure filter**
5. **Agitation valve**
6. **Agitation bypass valve**
7. **Agitation throttle valve (shown fully open)**
8. **Agitation nozzle (4)**
9. **Flow meter**
10. **Nozzle valves (10)**
11. **Pressure transducer**
12. **Drain valve**

Spray Pump

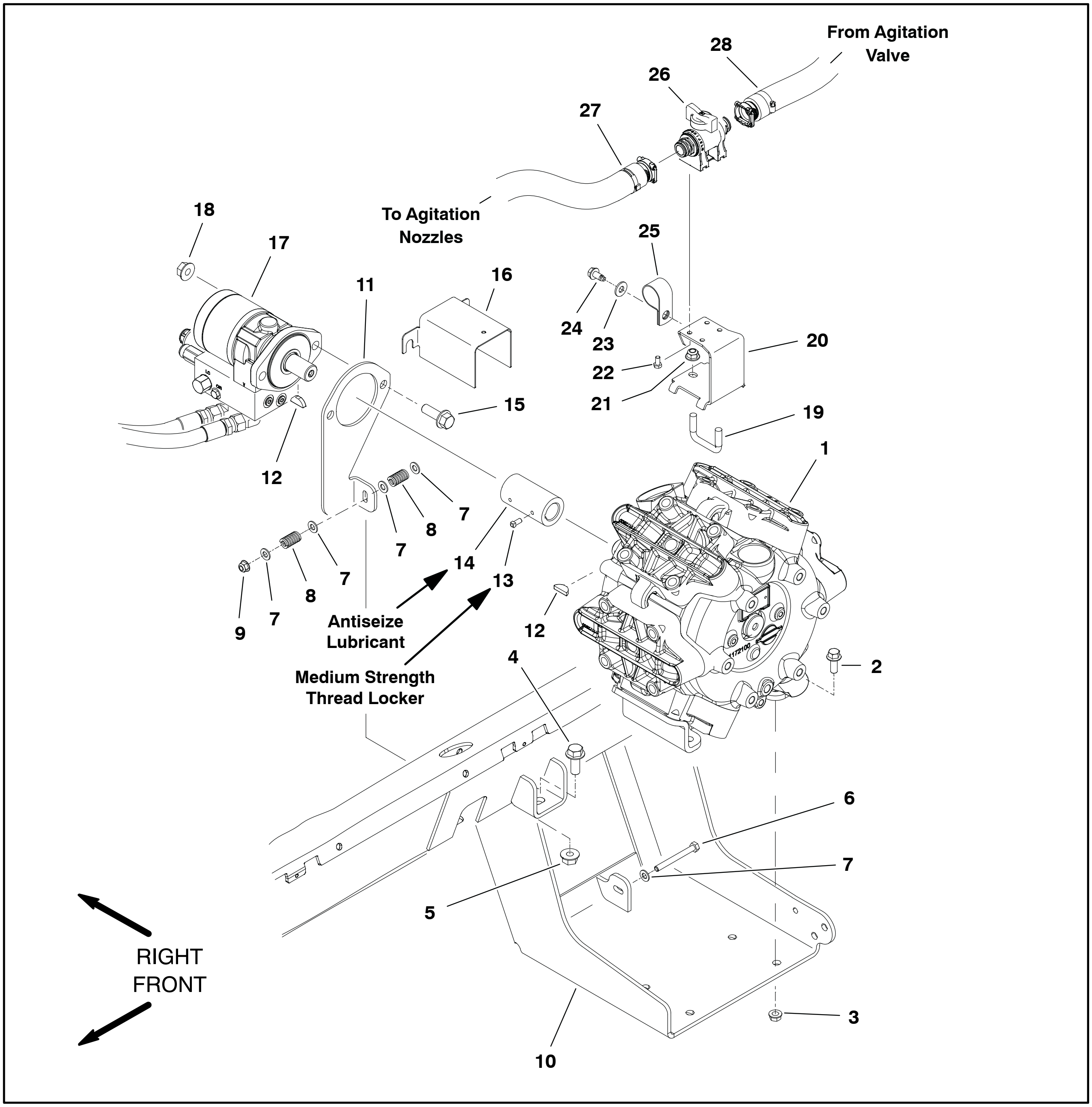


Figure 89

1. Spray pump assembly
2. Flange head screw (4)
3. Flange nut (4)
4. Flange head screw (2)
5. Flange nut (2)
6. Cap screw
7. Flat washer (5)
8. Spring (2)
9. Lock nut
10. Pump bracket
11. Motor mount plate
12. Woodruff key (2)
13. Set screw (4)
14. Coupler
15. Flange head screw (2)
16. Pump shaft guard
17. Control manifold/motor assembly
18. Flange nut (2)
19. U–Bolt
20. Valve bracket
21. Flange nut (2)
22. Flange head screw (4)
23. Flat washer
24. Cap screw
25. Clamp
26. Agitation throttle valve assembly
27. Hose (agitation)
28. Hose (agitation)

Removal (Fig. 89)

Machines with serial numbers below 400000000 were originally fit with a model 363 spray pump. Machines with serial numbers above 400000000 use a model 364 spray pump. Check the manufacturers build plate on the pump to verify the pump model being serviced.

IMPORTANT: Make sure to neutralize and remove chemicals from pump and hoses before loosening and removing spray system components.

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

2. Disconnect hoses as follows:

A. Remove fork from pump output fitting (item 4 Fig. 90) and separate tee from pump output fitting.

B. Remove fork from the bottom of the lower suction tee fitting (item 11 Fig. 90) and separate tee from pump suction hose.

3. Remove connector forks and disconnect hoses from agitation throttle valve (item 26). Position disconnected hoses away from pump.

4. If present, remove cap screw securing clamp (item 25) to valve bracket.

5. Loosen, but do not remove, two (2) flange head screws (item 15) and flange nuts (item 18) that secure control manifold/motor assembly to motor mount plate and remove guard from machine.

6. Remove two (2) set screws that secure coupler to pump shaft.

7. Remove four (4) flange head screws and flange nuts that secure spray pump to pump bracket.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is removed from the machine. Pump assembly weighs approximately 125 pounds (57 kg).

8. Slide pump out until shaft is removed from coupler. Locate and retrieve woodruff key from pump shaft.

9. Remove pump assembly (Fig. 91) from machine.

NOTE: Model 363 spray pumps use non−O−ring style suction and outlet fittings. Model 364 spray pumps use O−ring style suction and outlet fittings. Fitting styles are not interchangeable between pumps.

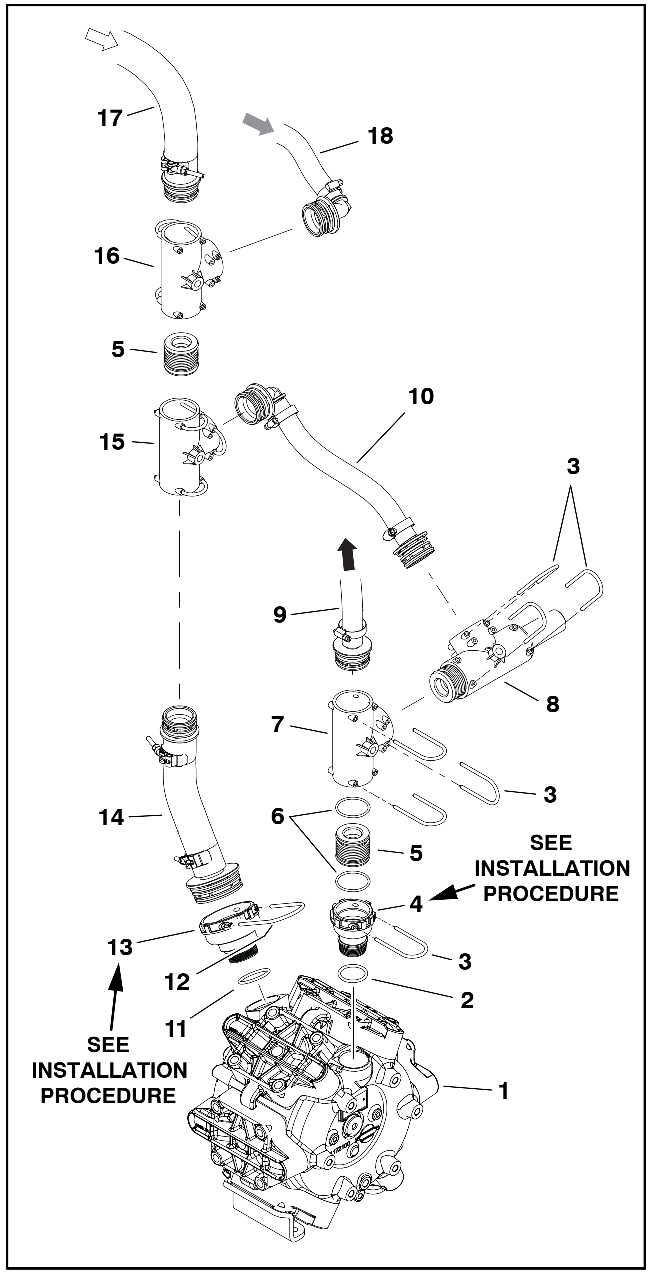


Figure 90

1. **Spray pump (model 364 shown)**
2. **O−ring**
3. **Fork (13)**
4. **Fitting − outlet (O−ring style shown)**
5. **Connector (3)**
6. **O−ring (12)**
7. **Tee (outlet)**
8. **Pressure relief valve**
9. **Hose (supply)**
10. **Hose (pressure relief)**
11. **O−Ring**
12. **Fork**
13. **Fitting suction**
14. **Hose (suction)**
15. **Tee (lower suction)**
16. **Tee (upper suction)**
17. **Hose (suction)**
18. **Hose (agitation bypass)**

10. If needed, remove suction hose and fittings from pump.

11. If needed, remove agitation throttle valve and valve bracket from pump.

12. Remove and discard all O−rings at disconnected fittings.

Installation (Fig. 89)

1. If valve bracket or agitation throttle valve was removed, install items with fasteners previously removed.

2. If suction and/or outlet fittings were removed from pump:

A. Model 363 spray pumps use non−O−ring style suction and outlet fittings. Apply thread sealant to fitting threads and install fitting(s) into correct pump port (Fig. 91).

B. Model 364 spray pumps use O−ring style suction and outlet fittings. Coat new O−ring with vegetable oil and install fitting(s) into correct pump port (Fig. 91).

NOTE: Replace, do not reuse O−rings. Coat all O−rings with vegetable oil before installation to reduce the chance of damage during assembly.

3. If suction hose was removed from pump suction fitting, secure the suction hose assembly to the pump before the pump is installed to the machine. Install suction hose assembly and secure with fork.

4. Install woodruff key into pump shaft and apply anti-seize lubricant to inside of coupler (item 14) pump shaft and key.

CAUTION

To prevent personal injury, make sure that pump is properly supported as it is installed to the machine. Pump assembly weighs approximately 125 pounds (57 kg).

5. Place pump assembly (Fig. 91) onto pump bracket. Align pump shaft and key with coupler and slide pump shaft into coupler.

6. Install and finger tighten four (4) flange head screws (item 2) and flange nuts to attach pump assembly to pump bracket. DO NOT fully tighten fasteners at this time.

7. Turn spray pump shaft by hand and position pump on pump bracket to best align the pump shaft and the hydraulic motor shaft.

8. Secure pump to pump bracket by tightening flange head screws and flange nuts.

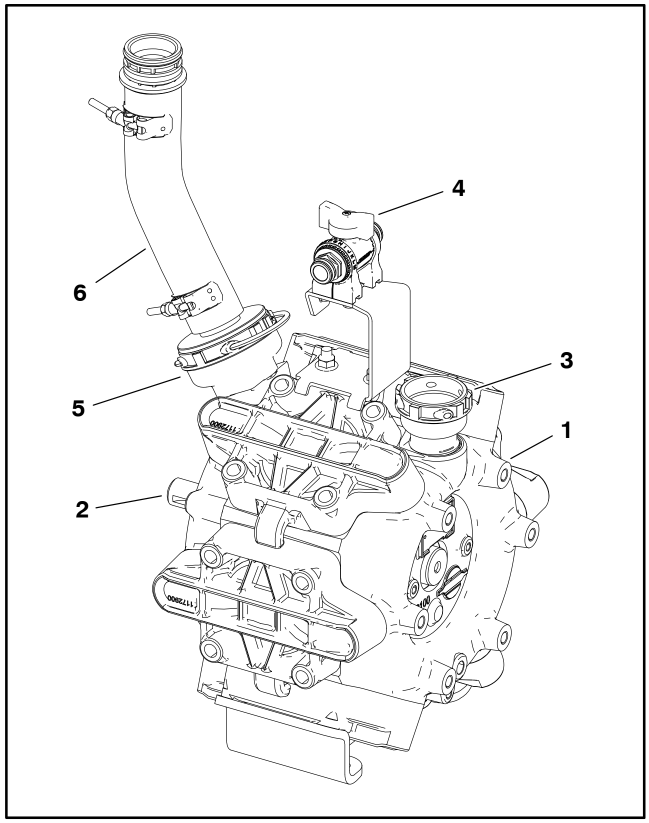


Figure 91

1. **Spray pump (model 364 shown)**
2. **Pump shaft**
3. **Fitting (outlet)**
4. **Agitation throttle valve**
5. **Fitting (suction)**
6. **Hose (suction)**

9. Apply medium strength thread locker to coupler set screws (item 13). then install and tighten set screws to secure coupler to pump shaft.

10. Position pump shaft guard over hydraulic motor mounting screws. Tighten flange head screws and flange nuts to secure control manifold/motor assembly to motor mount plate.

11. If present, install clamp (item 25) to valve bracket and secure with flat washer and cap screw previously removed.

12. Connect spray pump suction and supply hoses to spray pump and secure with forks (Fig. 90).

13. Connect hoses to agitation throttle valve (item 26) and secure hoses with forks.

14. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Spray Pump Service

Machines with serial numbers below 400000000 were originally fit with a model 363 spray pump. Machines with serial numbers above 400000000 use a model 364 spray pump. Check the manufacturers build plate on the pump to verify the pump model being serviced.

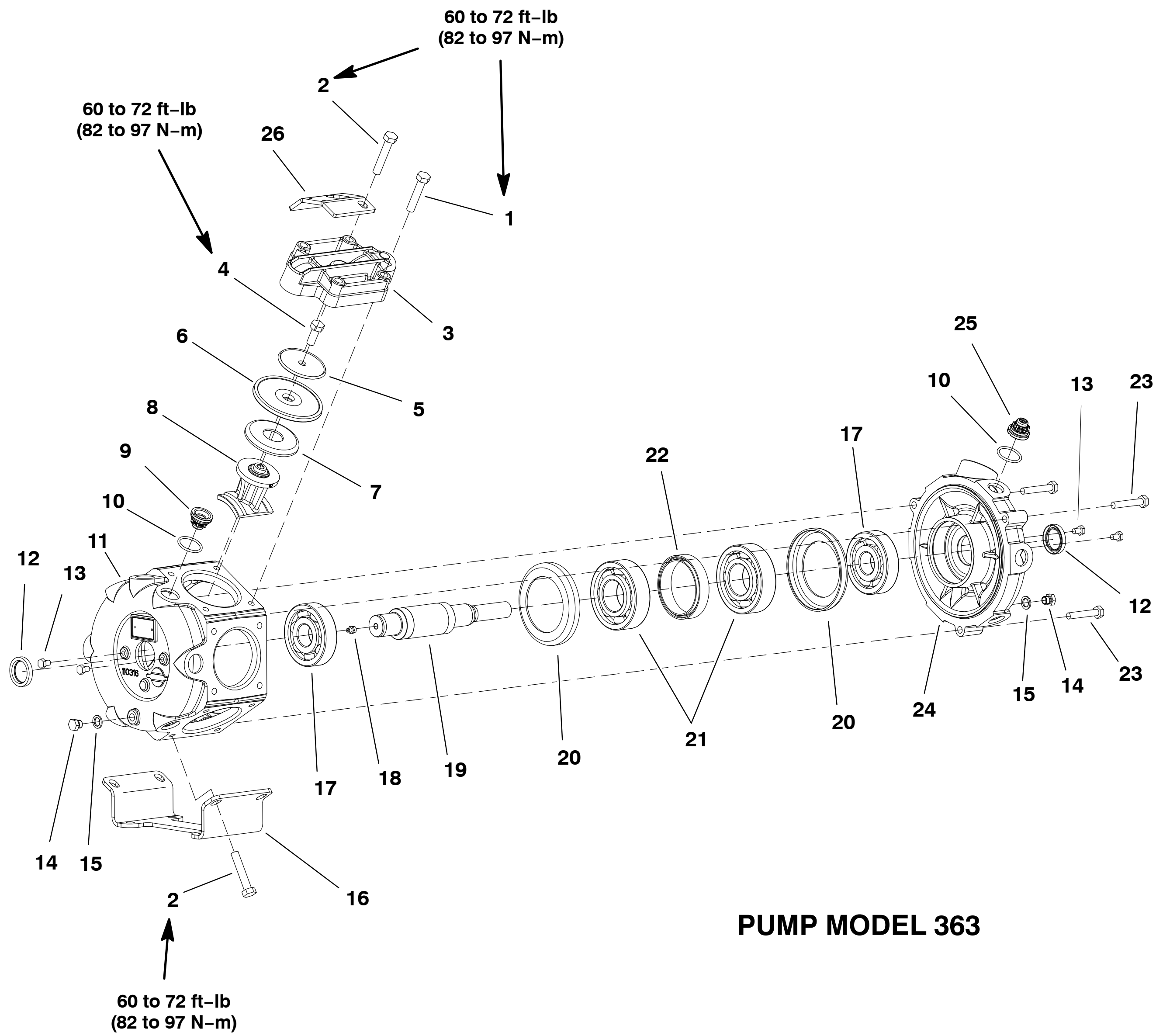


Figure 92

1. Hex bolt (60 mm long) (18)
2. Hex bolt (65 mm long) (6)
3. Valve cover (6)
4. Hex bolt (6)
5. Diaphragm disc (6)
6. Diaphragm (6)
7. Diaphragm backing disc (6)
8. Connecting rod (6)
9. Pump valve (10)
10. O−ring (12)
11. Pump casting
12. Oil seal (2)
13. Hex bolt (4)
14. Plug (2)
15. Seal (2)
16. Pump foot
17. Ball bearing (2)
18. Grease fitting
19. Crankshaft
20. Connecting rod spacer (2)
21. Ball bearing (2)
22. Bearing spacer
23. Hex bolt (60 mm long) (3)
24. Pump casting (suction)
25. Pump valve − white (2)
26. Pump bracket

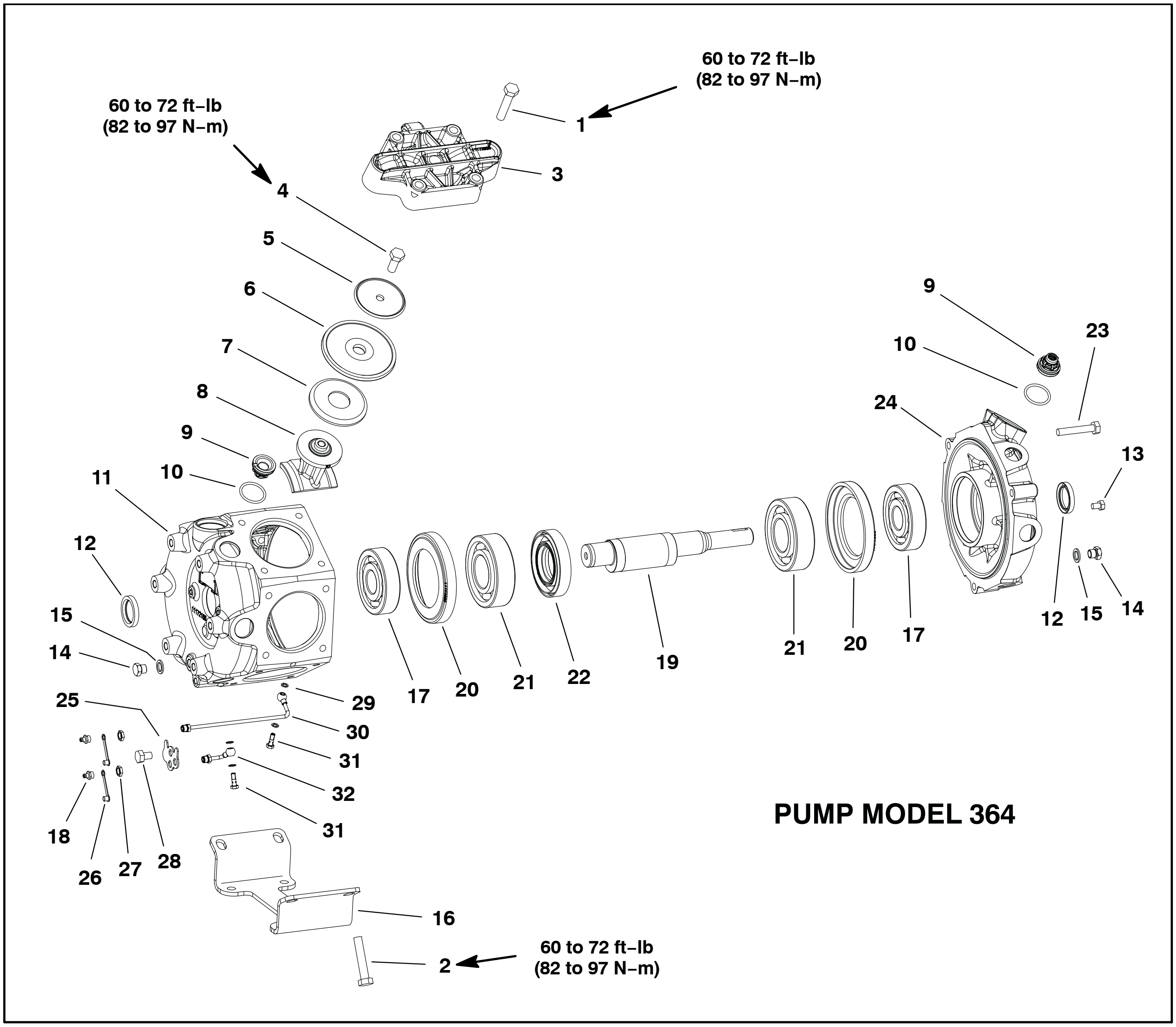


Figure 93

1. Hex bolt (60 mm long) (20)
2. Hex bolt (65 mm long) (4)
3. Valve cover (6)
4. Hex bolt (6)
5. Diaphragm disc (6)
6. Diaphragm (6)
7. Diaphragm backing disc (6)
8. Connecting rod (6)
9. Pump valve (12)
10. O-ring (12)
11. Pump casting
12. Oil seal (2)
13. Hex bolt (4)
14. Plug (2)
15. Seal (2)
16. Pump foot
17. Ball bearing (2)
18. Grease fitting (2)
19. Crankshaft
20. Connecting rod spacer (2)
21. Ball bearing (2)
22. Bearing spacer
23. Hex bolt (3)
24. Pump casting (suction)
25. Grease fitting plate
26. Cap (2)
27. Hex nut (2)
28. Hex bolt (16 mm long)
29. Gasket (4)
30. Grease tube
31. Banjo bolt (2)
32. Grease line

Disassembly

IMPORTANT: Make sure to remove and neutralize chemicals from pump before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during pump repair.

NOTE: Many pump components can be easily reversed. During disassembly, make note of component position (e.g. valve cover, pump valve, diaphragm) to assure correct assembly.

1. Remove plugs (item 14) and seals from pump to allow all fluid to be drained from pump. Install seals and plugs after draining is complete.

2. Thoroughly clean exterior of pump.

3. For assembly purposes, use marker to identify location of all valve covers on pump housing.

NOTE: Pump bracket on model 363 pumps (item 26 Fig. 92) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot for both model 363 and 364 pumps (item 16) is secured to pump with four (4) longer bolts on lower valve covers.

4. Remove hex bolts that retain valve covers (item 3) to pump. Separate and remove valve covers from pump.

NOTE: The two (2) pump inlet valves in the upper head positions (either side of suction port) are different than the rest of the valves used in the pump (item 25 Fig. 92). These two (2) valves are white in 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 performance.

7. Thoroughly clean all valve, diaphragm and O−ring seats in the valve covers and pump valve chambers.

8. Check the crankshaft for sufficient grease. Also, visually inspect crankshaft assembly for any signs of excessive wear or damage. Check that crankshaft turns freely. If crankshaft bearings are loose, rough or worn, crankshaft bearings should be replaced.

Crankshaft Bearing Service

1. For assembly purposes, use marker to identify location of all connecting rods.

2. Remove three (3) hex bolts that secure pump casting halves together.

3. To separate the pump castings:

   A. From the non−driven side of the pump, place a spacer or socket on crankshaft end.

   B. Using dead−blow hammer and tap the spacer to separate the pump castings.

   C. Once a gap is created between the castings, carefully pry pump castings apart.

4. Remove connecting rods and inspect the rod bearing surfaces which should be clean and smooth. Replace any of the connecting rods that have evidence of scoring, wear or damage.

5. Remove crankshaft with bearings and spacers (items 20 −22) from pump.

6. Press ball bearings from crankshaft and pump castings.

7. Remove seals from pump castings.

8. Clean crankshaft and internal surfaces of pump castings.

9. Pack new bearings with Mobil XHP 461 lithium−complex high temperature grease.

10. Press new bearings into pump castings.

11. Install connecting rod bearings on crankshaft:

    A. Pressing on bearing inner race, install first connecting rod bearing onto crankshaft.

    B. Place bearing spacer (item 22) onto crankshaft and then press second bearing onto crankshaft.

12. Install seals into pump castings. Seal face should be flush with casting.

13. Position the pump casting (item 11) with the seal side down.

14. Place connecting rod spacer (item 20) and then crankshaft assembly into pump casting. Make sure that non−driven end of crankshaft is inserted into the pump casting.

15. Using marks made during disassembly to identify connecting rod locations, install connecting rods to crankshaft. Makes sure that connecting rod flange fits under connecting rod spacers.

16. Place second connecting rod spacer onto crankshaft and connecting rods and then install pump casting (suction). Make sure that pump suction and outlet ports are aligned during assembly of the pump castings (Fig. 94).

17. Secure pump castings with three (3) hex bolts. Tighten bolts from **60 to 72 ft−lb (82 to 97 N−m)**. After assembly, check that crankshaft turns freely.

Assembly

1. Install diaphragms to connecting rods:

   A. Place diaphragm backing disc (item 7), new diaphragm (item 6) and diaphragm disc (item 5) on connecting rod. Make sure that the diaphragm disc lip faces away from the diaphragm.

   B. Thread hex bolt (item 4) into connecting rod.

   C. Rotate crankshaft so the connecting rod is at the top of its stoke and tighten the hex bolt from **60 to 72 ft−lb (82 to 97 N−m)**.

   D. Repeat for remaining diaphragms.

2. Install valves and valve covers:

IMPORTANT: The two (2) pump inlet valves in the upper head positions (either side of suction port) are different than the rest of the valves used in the pump (item 25 Fig. 92). These two (2) valves are white in color.

   A. Position new O−rings and valves (suction and outlet) to pump castings. Suction 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 cover.

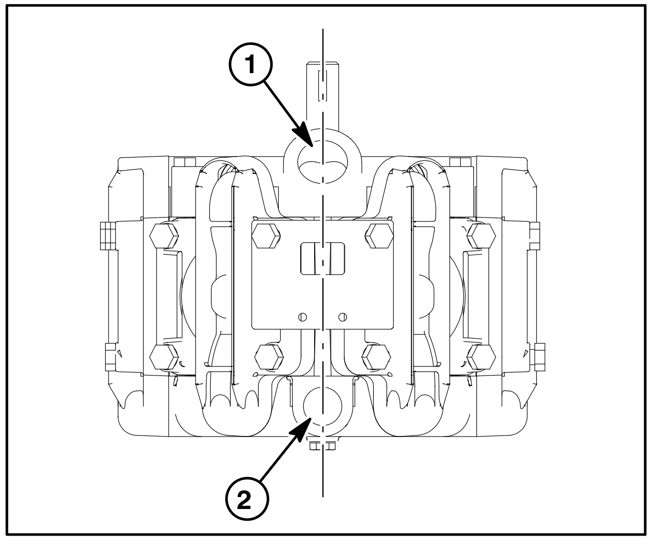


Figure 94

1. **Suction port** 2. **Outlet port**

NOTE: Pump bracket on model 363 pumps (item 26 Fig. 92) is secured to pump with two (2) longer bolts on upper valve covers. Pump foot for both model 363 and 364 pumps (item 16) is secured to pump with four (4) longer bolts on lower valve covers.

   D. Secure valve cover to pump using hex bolts (4 per cover) and tighten bolts from **60 to 72 ft−lb (82 to 97 N−m)**.

   E. Repeat for remaining valve covers.

Pressure Relief 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 suction side of the spray pump. 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).

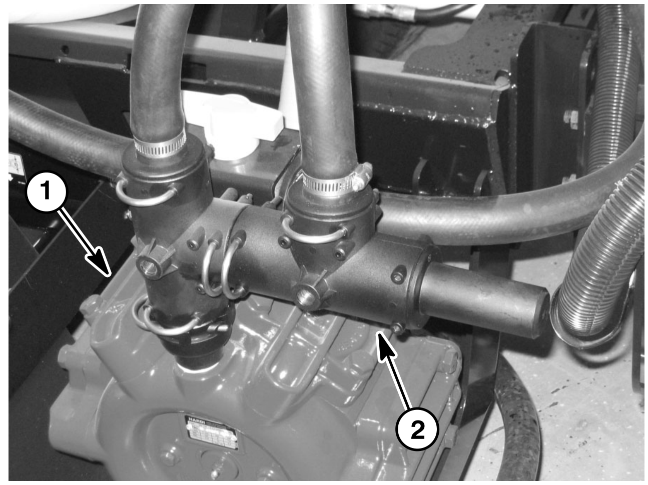


Figure 95

1. **Spray pump**
2. **Pressure relief valve**

Pressure Relief Valve Testing

IMPORTANT: Make sure to remove and neutralize chemicals from spray components before testing or removing the pressure relief valve. Wear protective clothing, chemical resistant gloves and eye protection during repair.

To test the operation of the pressure relief valve, follow the following steps:

A. Have machine on a level surface with engine off and parking brake engaged.

B. Drain the spray tank and fill the spray tank with clean water.

C. Close the agitation throttle valve and the boom section bypass shut−off valve. Make sure that the traction pedal is in the neutral position and the spray method is set to manual operation.

D. Have a person in the operator seat to control the spray system and a second person near the pressure relief valve.

E. Have operator start the engine, turn spray pump switch ON and turn agitation switch ON.

F. While second person listens for pressure relief valve to open, have the operator slowly increase the application rate while watching the pressure gauge. Pressure gauge should open when system pressure reaches approximately 220 PSI (15 Bar).

Replace the pressure valve if necessary.

NOTE: Replace, do not reuse O−rings. Coat O−rings with vegetable oil before installation to reduce damage during assembly.

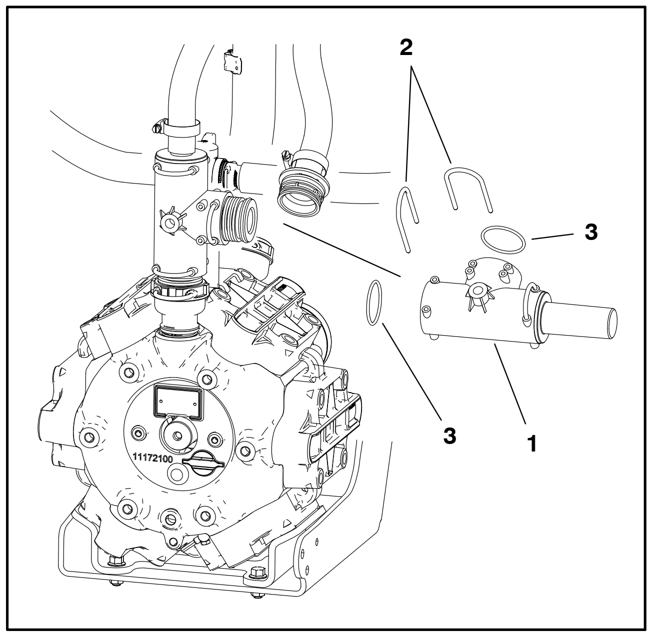


Figure 96

1. **Pressure relief assembly**
2. **Fork (2)**
3. **O−ring (2)**

Spray Control Manifold Assembly

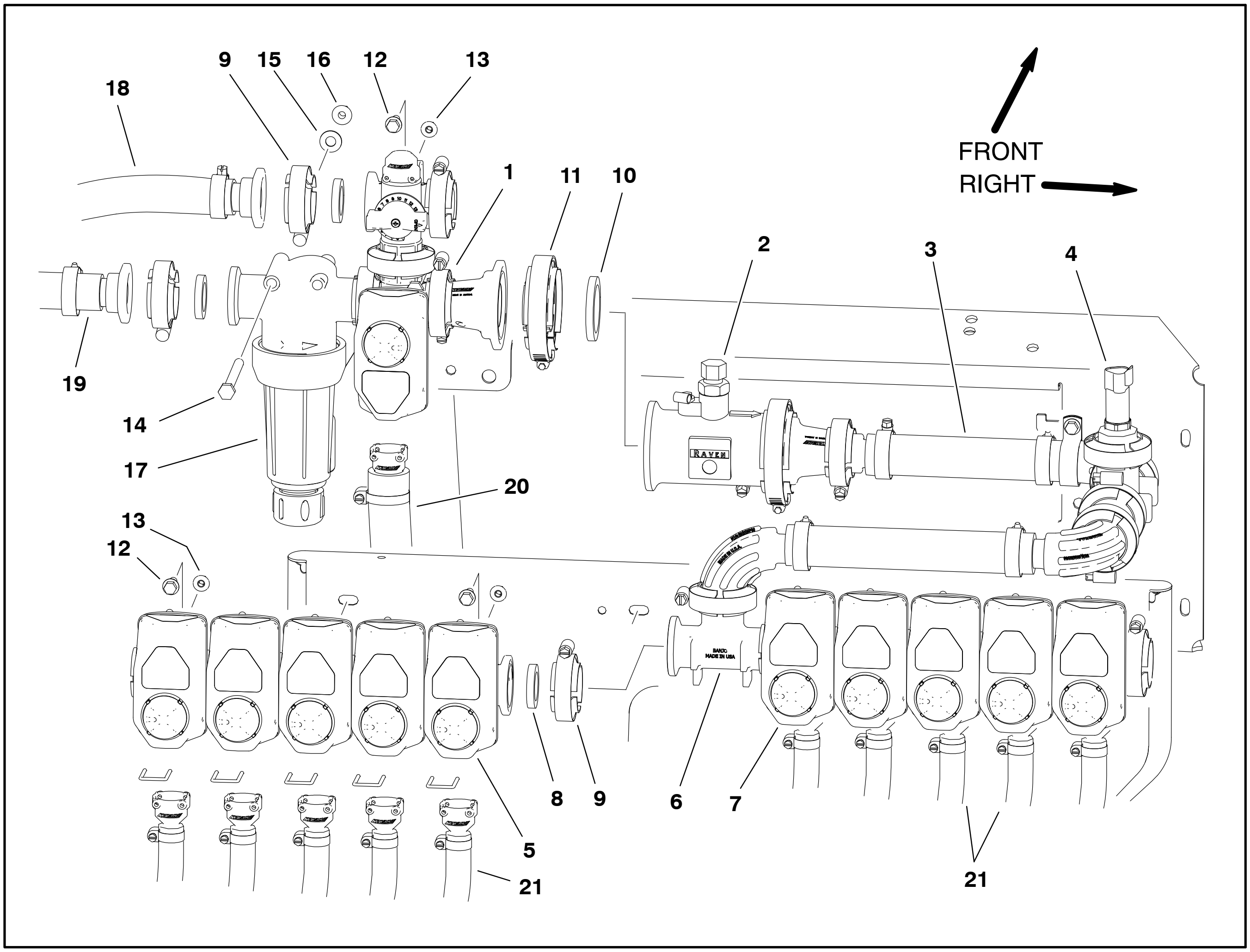


Figure 97

1. Agitation valve assy.
2. Flow meter
3. Elbow assembly
4. Pressure transducer
5. Nozzle valve assembly (nozzles 1–6)
6. Tee
7. Nozzle valve assembly (nozzles 7–12)
8. Gasket (4)
9. Clamp (4)
10. Gasket
11. Clamp
12. Cap screw (12)
13. Flange nut (12)
14. Cap screw (2)
15. Washer/spacer (2)
16. Flange nut (2)
17. High pressure filter bowl
18. Hose (agitation bypass)
19. Hose (supply from spray pump)
20. Hose (agitation supply)
21. Hose (nozzle supply – 10)

The spray control manifold assembly includes the high pressure spray product filter, the agitation valve assembly, the flow meter, the pressure transducer and the nozzle valve assembly. Pressure transducer testing information can be found in Chapter 6 – Electrical System in this manual.

NOTE: The spray control manifold may be configured slightly different if the machine has any optional spray system kits installed (e.g. foam marker, hose reel, eductor, etc).

Removal (Fig. 97)

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

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

2. Label wire harness connectors for proper installation after repairs are completed (agitation valve, ten (10) nozzle valves, flow meter sensor, pressure transducer). Disconnect wire harness connectors from spray control manifold as needed.

3. Label hoses for proper installation after repairs are completed. Loosen hose clamps and remove forks to disconnect hoses from spray control manifold as needed.

4. To remove agitation valve assembly:

   A. Disconnect clamp securing the left side of flow meter to adapter.

   B. Remove bowl and screen from high pressure filter if necessary to access valve assembly mounting fasteners (item 16).

   C. Remove fasteners that secure high pressure filter to mount bracket. Retrieve spacers/washers between filter and mount bracket.

   D. Remove fasteners that secure agitation valve assembly to mount bracket and remove agitation valve assembly from machine. Discard any removed O−rings and gaskets.

5. The nozzle valve assembly is split by a tee fitting between nozzle valve 5 and 6, and nozzle valve 7 and 8. To remove the nozzle valve assembly:

   A. Disconnect clamp securing one half of the nozzle valve assembly to the tee fitting.

   B. Remove fasteners that secure the nozzle valve assembly half being removed to the valve mount and remove the assembly from the machine. Discard any removed O−rings and gaskets.

6. See Agitation Valve Assembly and Nozzle Valve Assembly in this chapter for additional service information.

Installation (Fig. 97)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Fit screw clamp and a new gasket to flanges of adapter or tee fitting. Tighten screw clamp to secure assembly.

2. Secure assembly to mount bracket with fasteners and spacers/washers previously removed.

3. Using labels placed during removal to install hoses to spray control manifold.

4. If removed, install screen and bowl to high pressure filter.

5. Using labels placed during removal to install wire harness connectors to spray control manifold.

6. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Agitation Valve Assembly

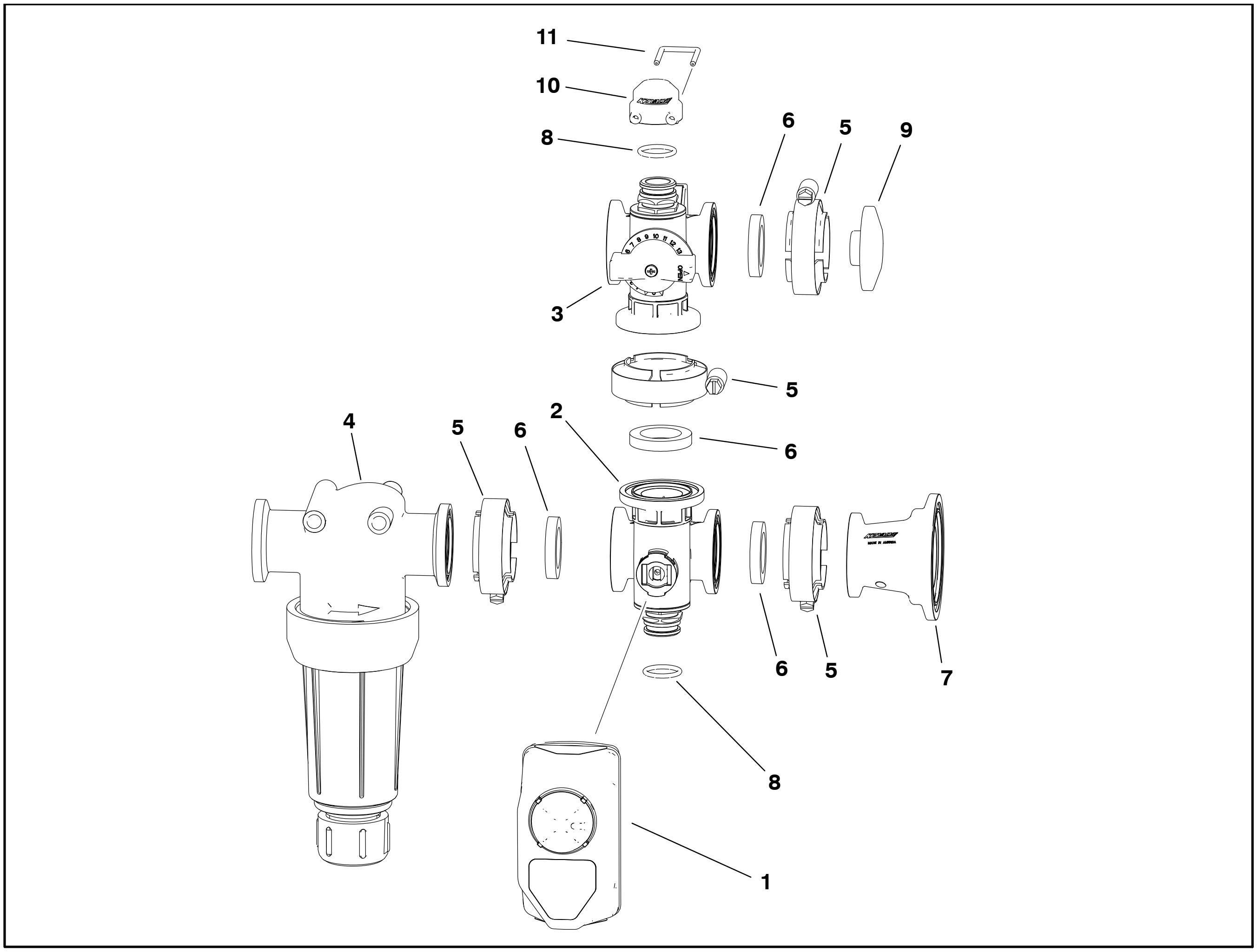


Figure 98

1. **Valve actuator**
2. **Agitation valve**
3. **Agitation bypass valve**
4. **High Pressure Filter**
5. **Clamp (4)**
6. **Gasket (4)**
7. **Adapter**
8. **O−ring (2)**
9. **Cap**
10. **Cap**
11. **Fork**

The agitation valve assembly includes the agitation valve, the agitation bypass valve and the high pressure product filter.

IMPORTANT: The 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.

Disassembly (Fig. 98)

1. Remove the agitation valve assembly from machine (see Spray Control Manifold Assembly in this chapter).

2. Disassemble agitation valve assembly as needed. Discard any removed O−rings and gaskets.

NOTE: See Agitation Valve Service and Agitation Bypass Valve Service in this chapter for disassembly and assembly information. The valve actuator is nor serviceable. See Spray System Valve Actuators in Chapter 6 − Electrical System in this manual for actuator testing information.

Assembly (Fig. 98)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Assemble agitation valve assembly.

2. Install agitation valve assembly on machine (see Spray Control Manifold Assembly in this chapter).

Nozzle Valve Assembly

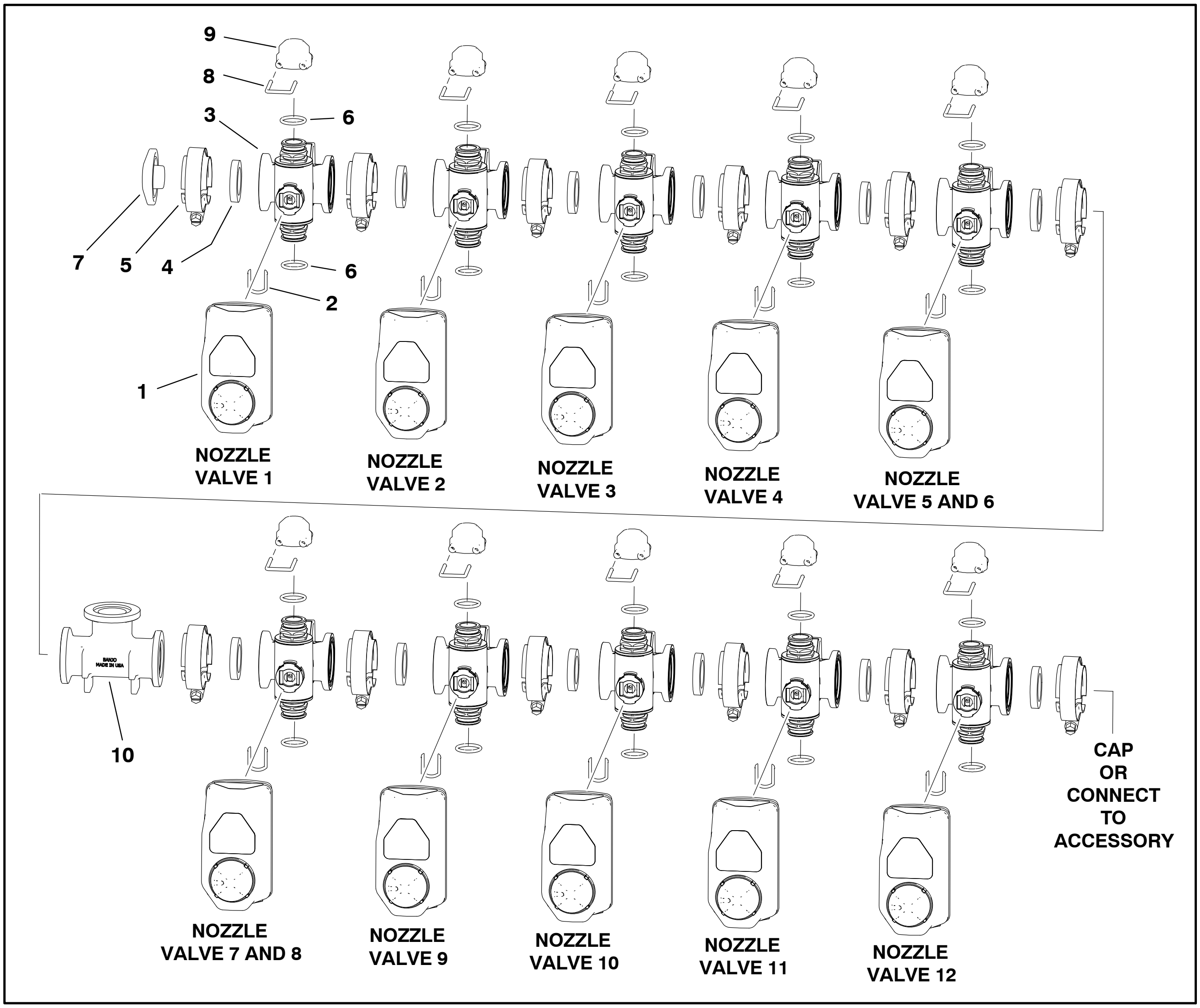


Figure 99

1. **Valve actuator (10)**
2. **Fork (10)**
3. **Nozzle valve (10)**
4. **Gasket (12)**
5. **Clamp (12)**
6. **O−ring (20)**
7. **Port cap**
8. **Fork (10)**
9. **Cap (10)**
10. **Tee**

The nozzle valve assembly includes the ten (10) nozzle valves that control the twelve (12) spray nozzles. The nozzles and valves are referred to by number from right to left across the back of the machine. Nozzles number 5 and 6 are controlled by a single valve, and nozzles number 7 and 8 are controlled by a single 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.

Disassembly (Fig. 99)

1. Remove the nozzle valve assembly from machine (see Spray Control Manifold Assembly in this chapter).

2. Disassemble nozzle valve assembly as needed. Discard any removed O−rings and gaskets.

NOTE: See Nozzle Valve Service in this chapter for disassembly and assembly information. The valve actuators are not serviceable. See Spray System Valve Actuators in Chapter 6 − Electrical System in this manual for actuator testing information.

Assembly (Fig. 99)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Assemble nozzle valve assembly.

2. Install nozzle valve assembly on machine (see Spray Control Manifold Assembly in this chapter).

Nozzle Valve and Agitation Valve Service

The Multi 5800 GeoLink spray system uses ten (10) nozzle valves and an agitation valve. Each valve is fully serviceable. Use the following procedure for servicing the nozzle valves and the agitation valve.

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. 100)

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.

6. Inspect the valve seats (item 4). Replace components as necessary.

Assembly (Fig. 100)

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. Apply silicone grease to seals and O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install either the actuator and actuator fork or knob and screw.

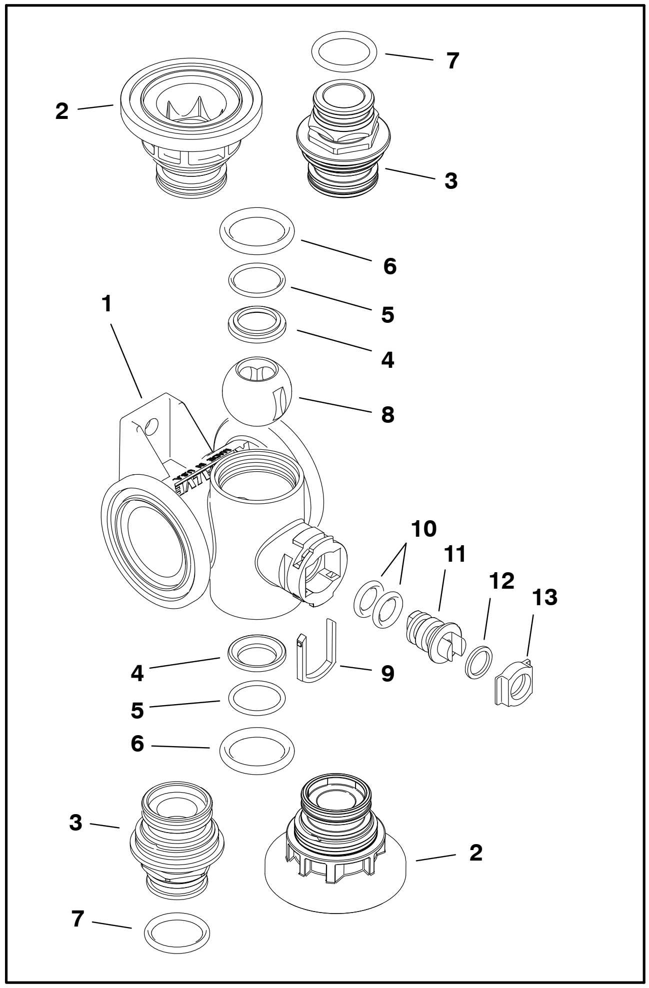


Figure 100

1. **Valve body**
2. **End cap (flanged − clamp)**
3. **End cap (male − fork)**
4. **Seat (2)**
5. **O−Ring (2)**
6. **O−Ring (2)**
7. **O−Ring**
8. **Ball (on/off)**
9. **Stem fork**
10. **O−Ring (2)**
11. **Stem**
12. **Washer**
13. **Stem seat**

Agitation Bypass Valve Service

The Multi Pro 5800 GeoLink spray system includes an agitation bypass valve. The bypass valve is fully serviceable. Use the following procedure for servicing the agitation bypass valve.

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. 101)

1. Locate the valve being serviced and remove the screw, knob and O−ring from the valve.

2. Remove hoses, fittings, clamps and caps 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.

6. Inspect the valve seats (item 4). Replace components as necessary.

Assembly (Fig. 101)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install new O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install either the actuator and actuator fork or knob and screw.

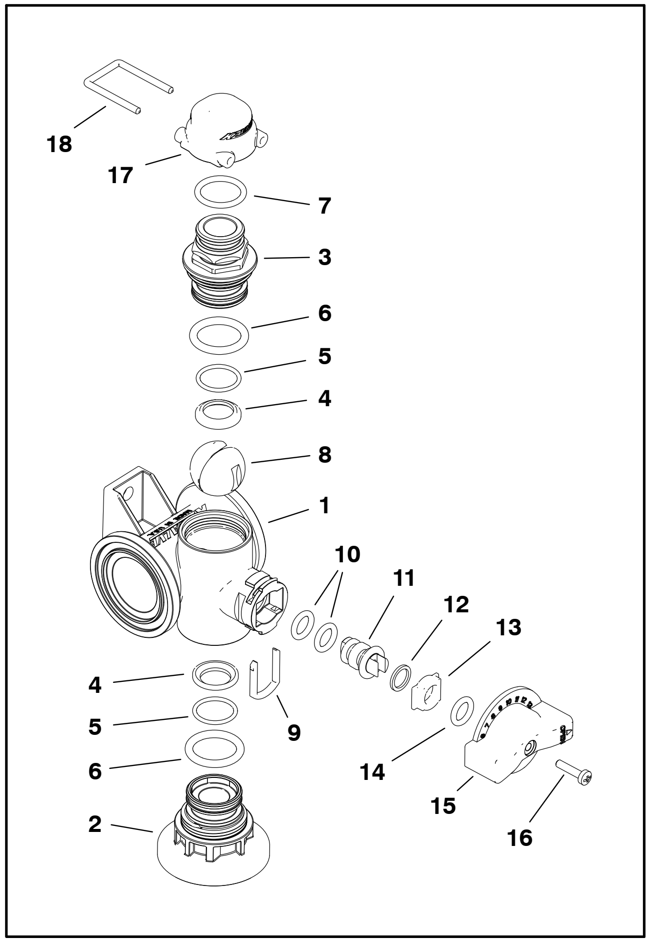


Figure 101

1. **Valve body**
2. **End cap (flanged − clamp)**
3. **End cap (male − fork)**
4. **Seat (2)**
5. **O−Ring (2)**
6. **O−Ring (2)**
7. **O−Ring**
8. **Ball (regulating)**
9. **Stem fork**
10. **O−Ring (2)**
11. **Stem**
12. **Washer**
13. **Stem seat**
14. **O−ring**
15. **Knob**
16. **Screw**
17. **Cap**
18. **Fork**

Agitation Throttle Valve Service

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. 102)

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.

6. Inspect the valve seats (item 3). Replace components as necessary.

Assembly (Fig. 102)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install new O−rings on stem assembly. Install stem assembly, seat and fork.

2. Rotate the valve stem until the slot in the stem is in−line with the valve body and install the valve ball.

3. 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.

4. Install hoses, fittings, clamps and adapters previously removed.

5. Install knob and screw.

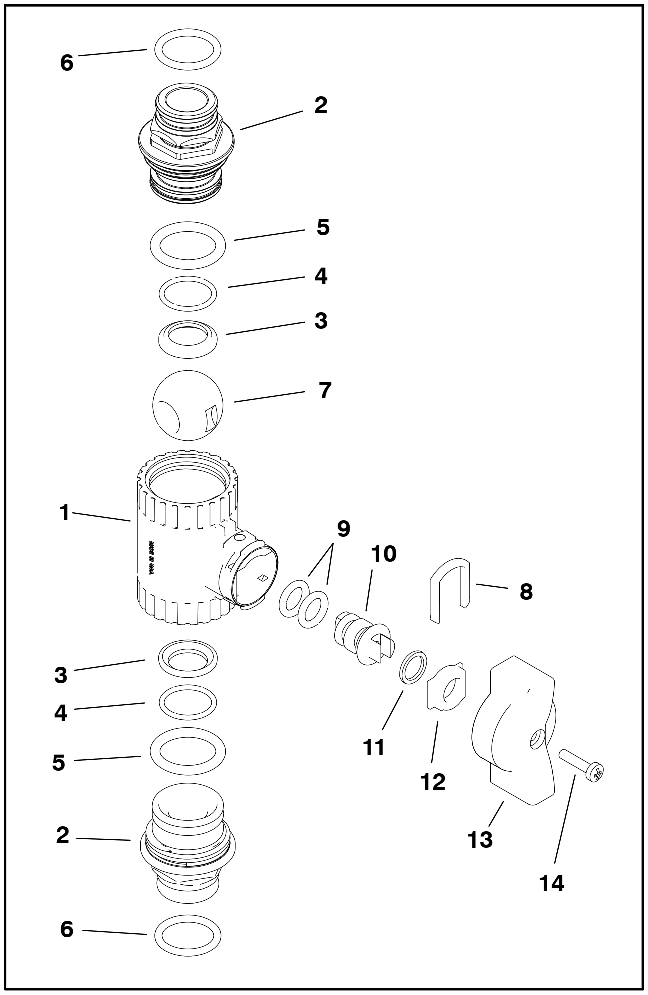


Figure 102

1. **Valve body**
2. **End cap (male − fork)**
3. **Seat (2)**
4. **O−Ring (2)**
5. **O−Ring (2)**
6. **O−Ring**
7. **Ball**
8. **Stem fork**
9. **O−Ring (2)**
10. **Stem**
11. **Washer**
12. **Stem seat**
13. **Knob**
14. **Screw**

Flow Meter

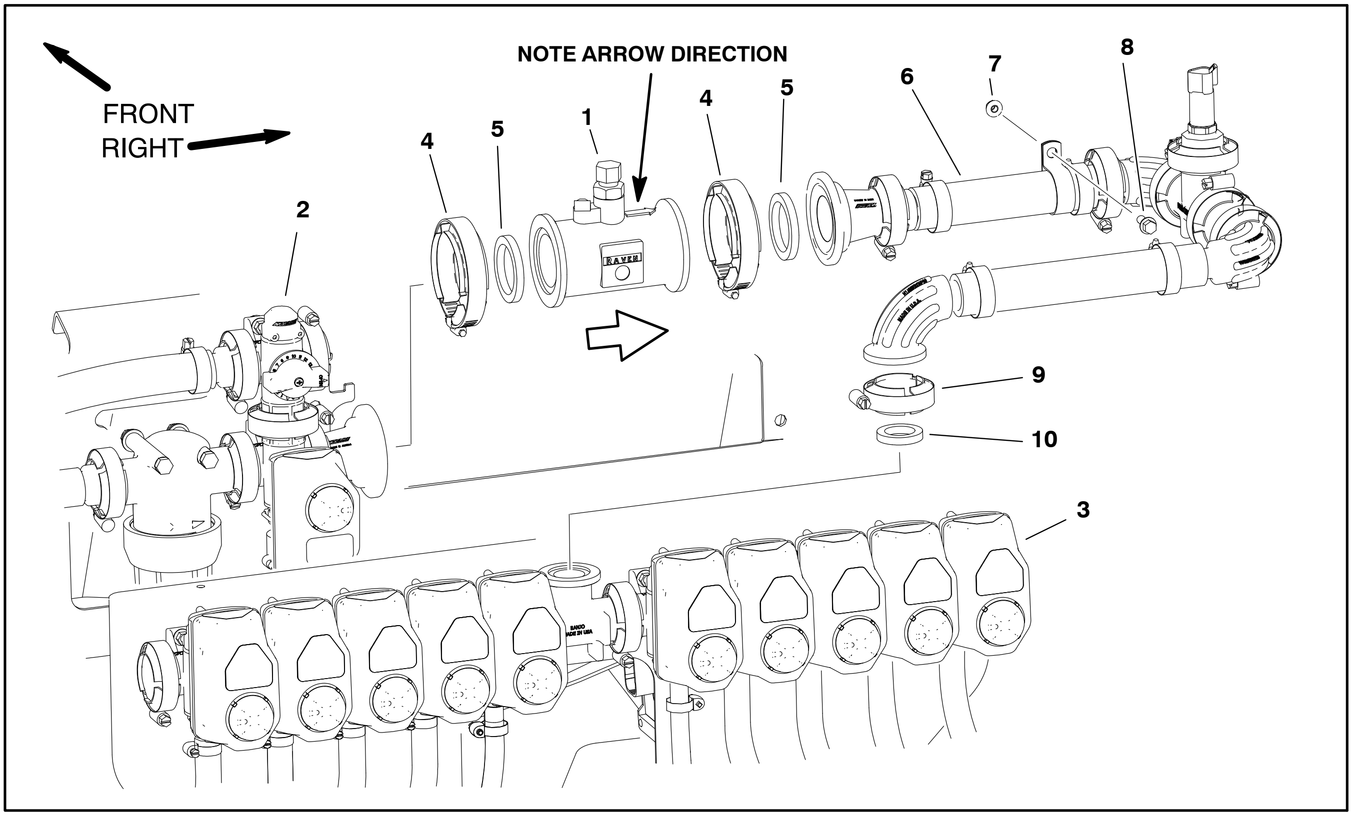


Figure 103

1. **Flow meter**
2. **Agitation valve assembly**
3. **Nozzle valve assembly**
4. **Clamp (2)**
5. **Gasket (2)**
6. **Elbow assembly**
7. **Flange nut**
8. **Flange head screw**
9. **Clamp**
10. **Gasket**

The flow meter (item 3) provides an input to the ASC−10 Controller regarding the spray system flow that is available to the nozzle valves. If the flow meter is being replaced, calibrate the flow meter after installation (see Flow Meter Calibration in this chapter).

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. 103)

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 flow meter.

IMPORTANT: Note the direction of the arrow on top of flow meter. The arrow should point toward the elbow assembly.

3. Remove the flange head screw (item 8) and flange nut securing the R−clamp to the valve mount.

4. Remove elbow assembly (item 6) and discard gaskets.

5. Remove flow meter and discard gaskets. See Flow Meter Service in this chapter for additional information.

Installation (Fig. 103)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Make sure that arrow on flow meter body is pointing toward elbow assembly (item 6) and secure the flow meter to the agitation valve assembly.

2. Install the elbow assembly.

3. Connect wire harness connector to flow meter.

4. Operate spray system and check for leaks. Repair all leaks before returning the sprayer to service.

Flow Meter Service

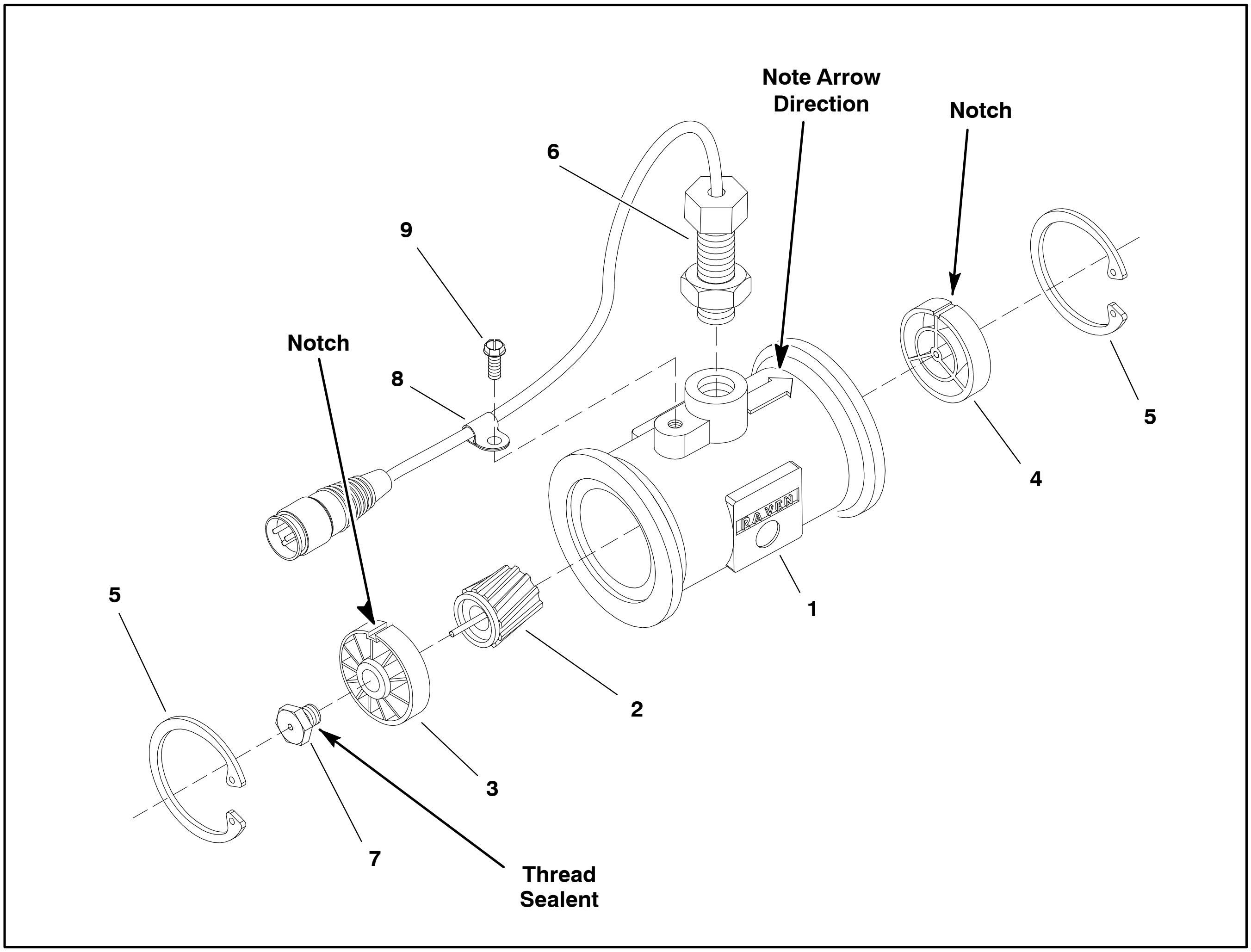


Figure 104

1. **Flow meter 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**

NOTE: Flow meter wire harness and sensor testing procedures can be found in Chapter 6 – Electrical System in this manual.

Disassembly (Fig. 104)

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 flow meter from machine (see Flow Meter in this chapter).

2. Disassemble flow meter.

3. Clean rotor (item 2), both hubs (items 3 and 4) and flow meter body to remove any debris, spray chemicals or other materials.

Assembly (Fig. 104)

1. Assemble flow meter. Check the following items during flow meter 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 flow meter 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 flow meter housing.

2. Install flow meter (see Flow Meter in this chapter).

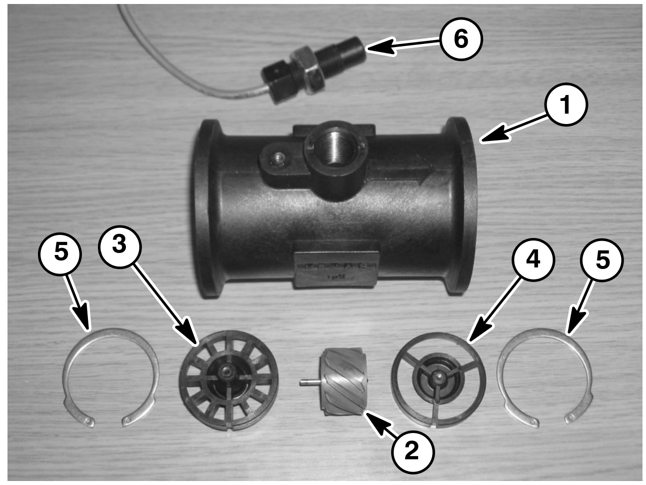


Figure 105

1. **Flow meter body**
2. **Rotor/magnet assembly**
3. **Upstream hub/bearing**
4. **Downstream hub**
5. **Retaining ring (2)**
6. **Sensor**

Suction Line

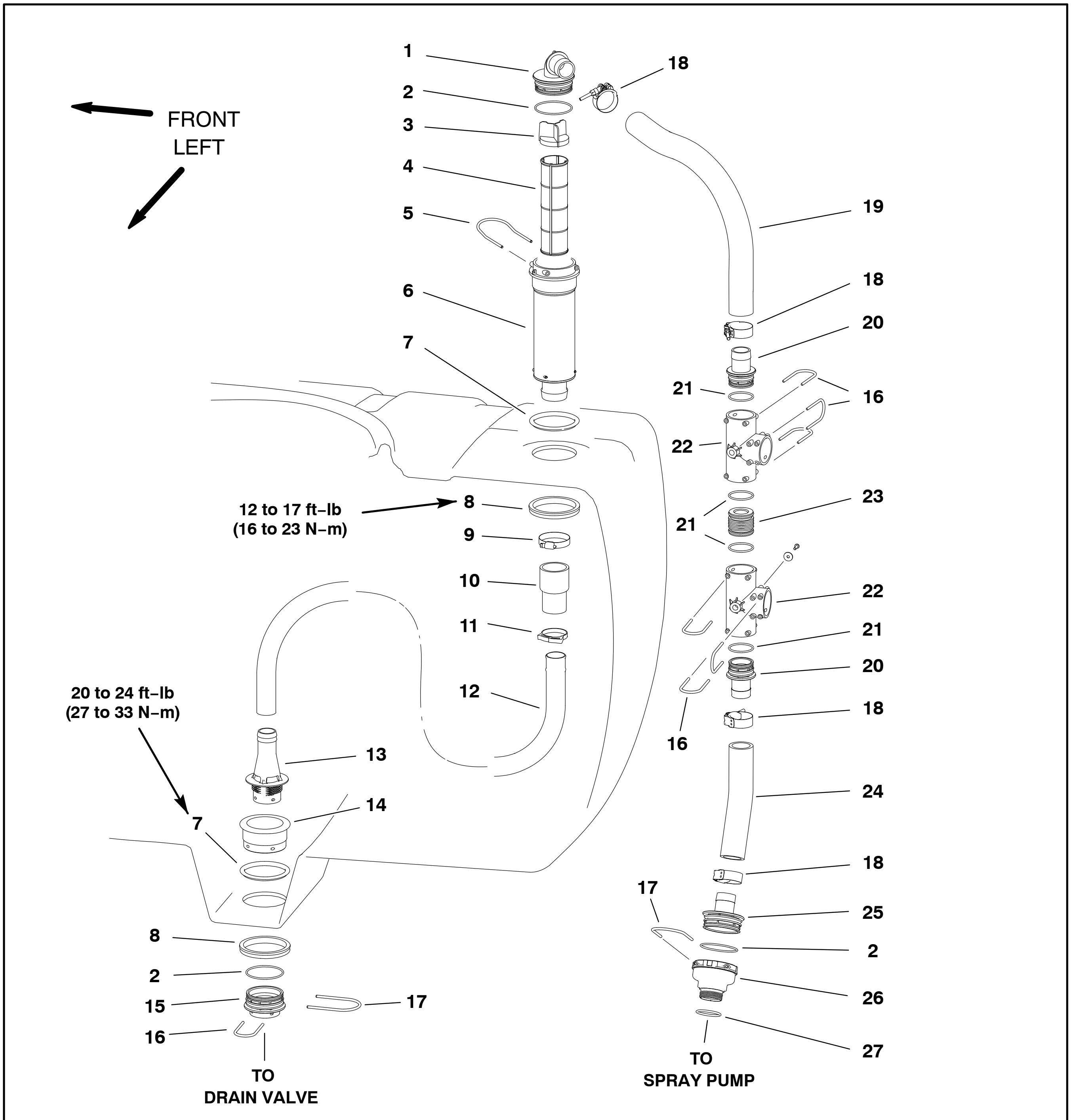


Figure 106

1. Elbow
2. O-ring (3)
3. Vane - strainer
4. Element - strainer
5. Fork
6. Strainer body
7. Gasket (2)
8. Nut (2)
9. Hose clamp
10. Connector
11. Clamp
12. Suction hose
13. Suction foot
14. Bulkhead
15. Adapter
16. Fork (7)
17. Fork (2)
18. Hose clamp (4)
19. Suction hose 27.5 in. (70 cm)
20. Hose barb (2)
21. O-ring (4)
22. Tee (2)
23. Connector
24. Suction hose 10 in.(25.4 cm)
25. Hose barb
26. Fitting - suction
27. O-ring

NOTE: If suction tube in tank develops an air leak, spray performance will diminish when tank level reaches the leak.

Removal (Fig. 106)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Disconnect elbow fitting above suction strainer (Fig. 107) and remove strainer vane and element.

3. Raise tank lid and remove strainer basket to gain access to suction line inside spray tank.

4. Remove suction line assembly and disassemble tube as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 106)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets. Assemble and install suction line assembly.

2. Install suction strainer element and vane, then connect suction line elbow above tank (Fig. 107).

3. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

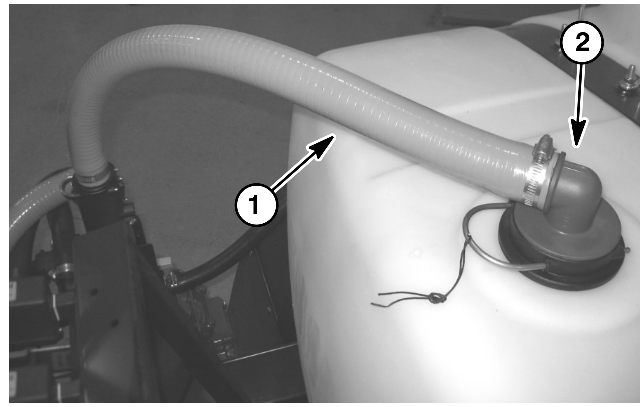


Figure 107

1. **Suction hose**
2. **Strainer location**

Agitation Line

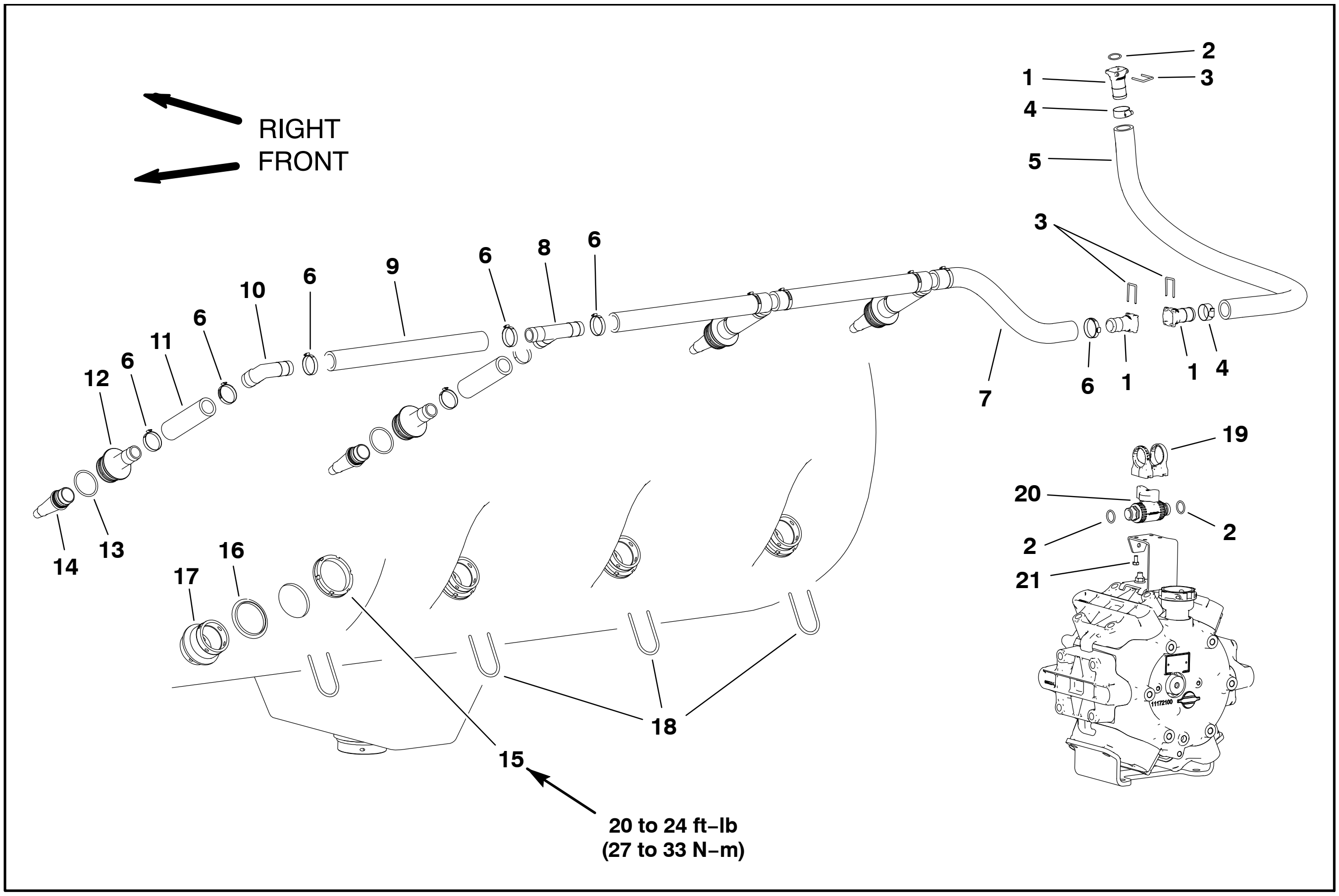


Figure 108

1. **Hose barb (3)**
2. **O−ring (3)**
3. **Fork (3)**
4. **Clamp (2)**
5. **Agitation hose 32 in. (81 cm)**
6. **Clamp (16)**
7. **Agitation hose 16 (40 cm)**
8. **Tee (3)**
9. **Agitation hose 14 (35.5 cm) (3)**
10. **Elbow**
11. **Agitation hose 5 (12.7 cm) (4)**
12. **Adapter (4)**
13. **O−ring (4)**
14. **Nozzle (4)**
15. **Nut (4)**
16. **Seal (4)**
17. **Bulkhead (4)**
18. **Fork (4)**
19. **Clamp**
20. **Agitation throttle valve**
21. **Cap screw (4)**

Disassembly (Fig. 108)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and other components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Label hoses that are to be disconnected for assembly purposes.

3. Remove agitation line components as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 108)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets and assemble drain line.

2. Using labels placed during disassembly, install disconnected hoses and secure with hose clamps.

3. Make sure that agitation throttle valve is open and secured to sprayer.

4. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Drain Line

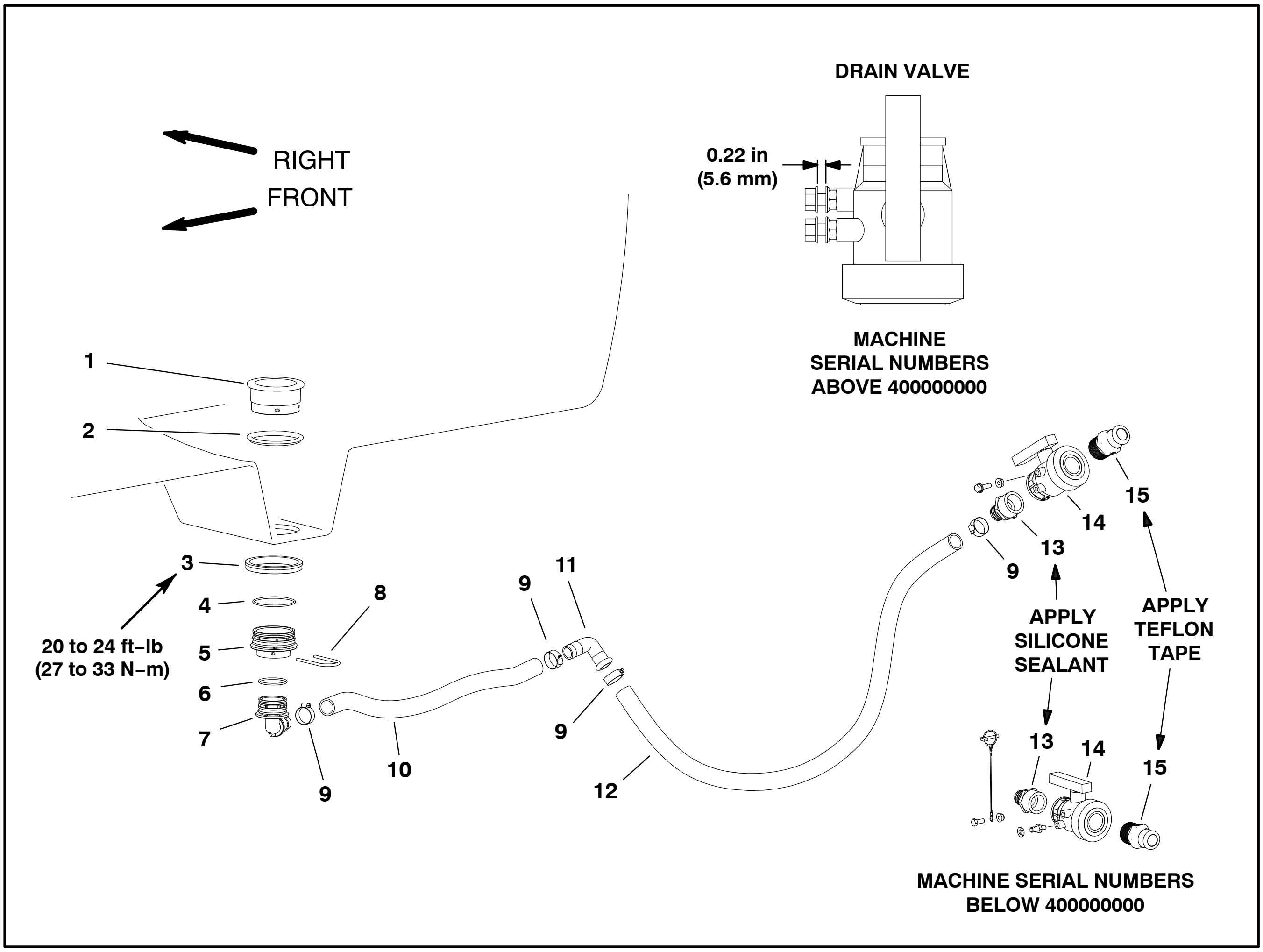


Figure 109

1. **Bulkhead**
2. **Gasket**
3. **Nut**
4. **O−ring**
5. **Adapter**
6. **O−ring**
7. **Hose barb**
8. **Fork**
9. **Hose clamp (4)**
10. **Drain hose 26.5 in. (67 cm)**
11. **Elbow**
12. **Drain hose 41 in. (104 cm)**
13. **Hose barb − smooth**
14. **Drain valve**
15. **Hose barb − threaded**

Disassembly (Fig. 109)

IMPORTANT: Make sure to remove and neutralize chemicals from tank and spray components before disassembly. Wear protective clothing, chemical resistant gloves and eye protection during repair.

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

2. Label hoses to allow proper installation after repairs are completed. Loosen hose clamps and remove hoses from hose barbs that are to be disassembled.

3. Disassemble drain assembly as necessary. Discard all removed O−rings and gaskets.

Assembly (Fig. 109)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Replace all removed O−rings and gaskets and assemble drain line.

2. Using labels placed during disassembly, install hoses to hose barbs and secure with hose clamps.

3. Make sure that drain valve is closed and secured to sprayer.

4. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Turret Bodies

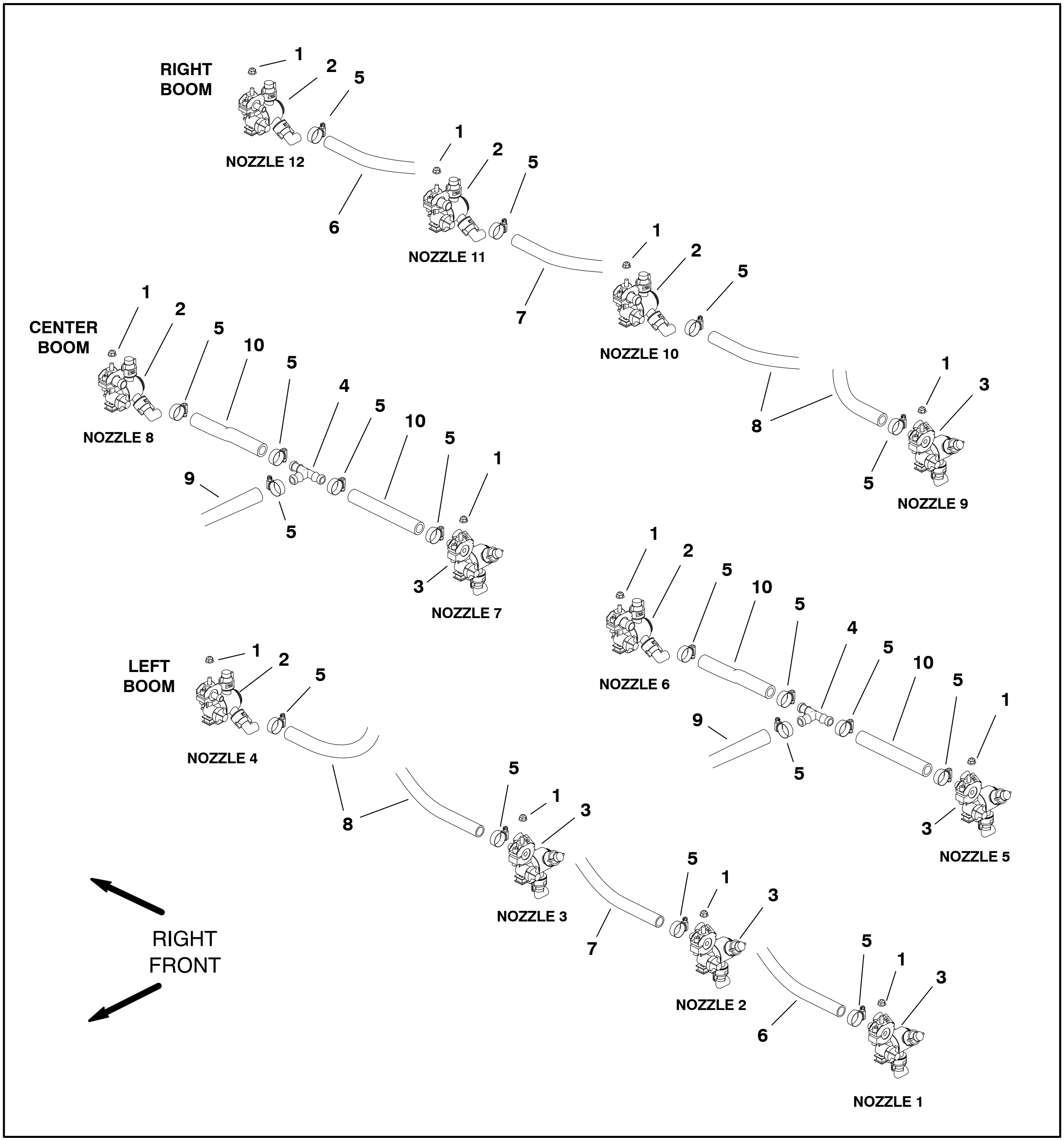


Figure 110

1. Flange nut (12)
2. Turret body – RH barb (6)
3. Turret body – LH barb (6)
4. Tee fitting (2)
5. Hose clamp (18)
6. Hose 110 in. (279 cm) (2)
7. Hose 92 in. (234 cm) (2)
8. Hose 74 in. (188 cm) (4)
9. Hose 32 in. (81 cm) (2)
10. Hose 10 in. (25 cm) (4)

Removal (Fig. 110)

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. 110)

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).

3. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

Turret Body Service

Disassembly (Fig. 111)

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. 111)

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. 112). 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.

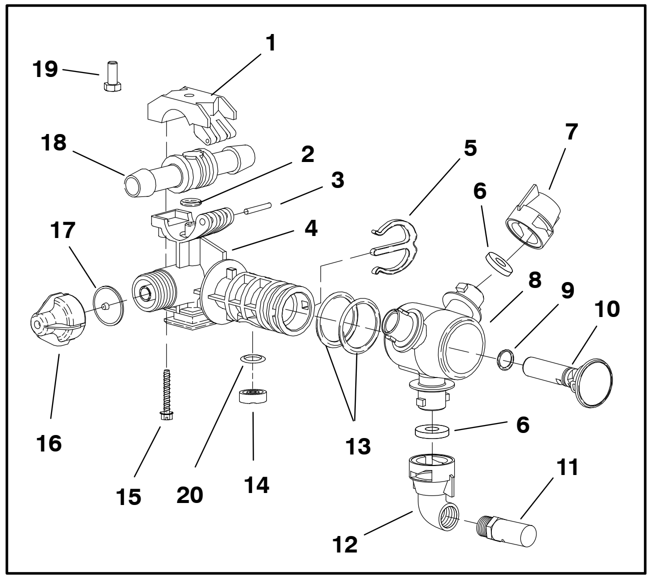


Figure 111

1. **Upper clamp**
2. **O–ring**
3. **Pivot pin**
4. **Body**
5. **E–clip**
6. **Gasket (3)**
7. **Dust cap (2)**
8. **Turret**
9. **O–ring**
10. **Plug**
11. **Nozzle**
12. **Nozzle cap**
13. **O–ring**
14. **Seal**
15. **Screw**
16. **End cap**
17. **Diaphragm**
18. **Hose barb**
19. **Cap screw**
20. **O–ring**

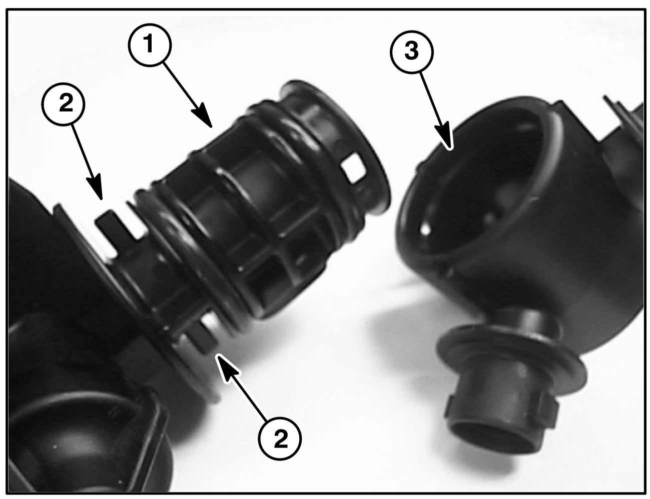


Figure 112

1. **Body**
2. **Detent post**
3. **Detent groove**

Nozzle Flow Meter (Optional NozzAlert Nozzle Sensing System)

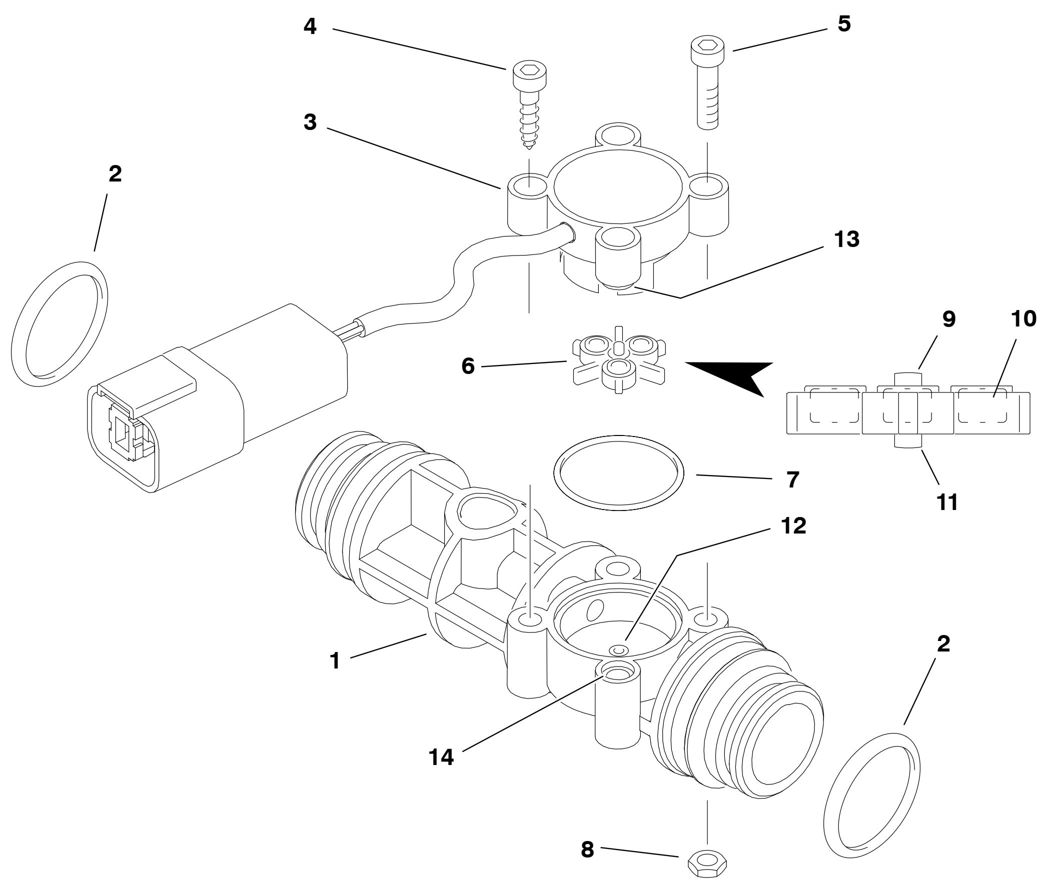


Figure 113

1. Flow meter body
2. O−ring (2)
3. Sensor assembly
4. Screw (2)
5. Cap screw (2)
6. Rotor/magnet assembly
7. O−ring
8. Hex nut (2)
9. Top rotor shaft
10. Magnet (3)
11. Bottom rotor shaft
12. Bearing
13. Boss
14. Recess

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

Disassembly (Fig. 113)

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

2. Disconnect the flow meter from the wire harness

3. Remove the forks from the adapter fittings at each end of the flow meter, and remove the flow meter from the machine.

4. Remove the fasteners securing the sensor assembly to the flow meter body and remover the sensor assembly.

5. Remove the rotor/magnet assembly and retrieve the O−ring.

6. Clean all of the components carefully. Ensure the rotor passages in the flow meter body are free of any obstructions.

Assembly (Fig. 113)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

1. Install a new O–ring in the sensor opening of the flow meter body.

2. Place the rotor/magnet assembly in the flow meter body with the magnets towards the sensor assembly. Ensure the bottom rotor shaft is centered on the bearing in the flow meter body.

3. Align the sensor assembly with the flow meter body. The boss on the underside of one of the sensor assembly mounting holes must align with the recess in the flow meter body.

4. Secure the sensor assembly with the previously removed fasteners. Do not overtighten the fasteners.

5. Use new O–rings at each end of the flow meter body, fit the flow meter assembly into the adapter fittings and secure it with the previously removed forks.

6. Connect the flow meter to the wire harness.

Spray Boom Hinge

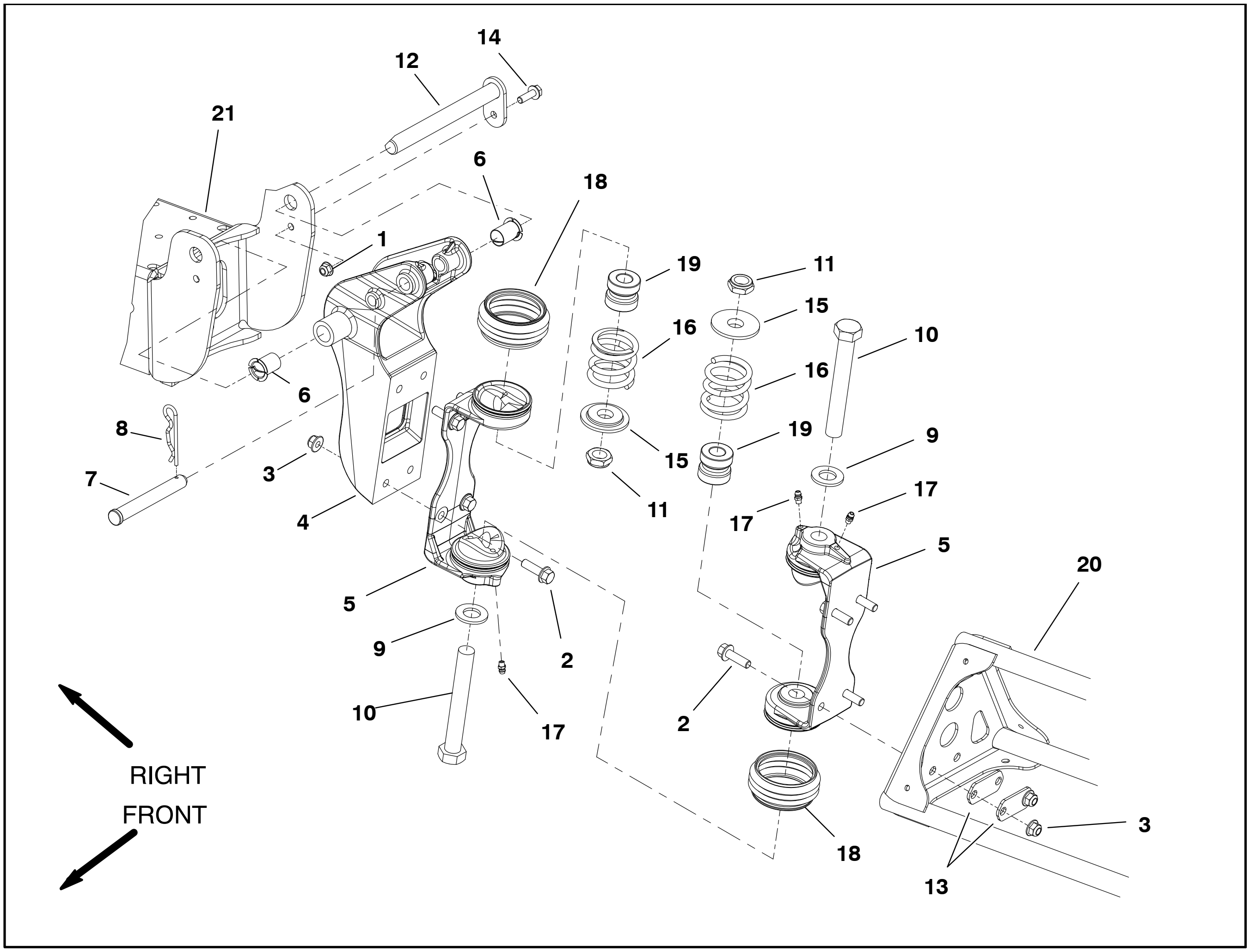


Figure 114

1. Flange nut
2. Flange hd screw (4 per hinge)
3. Flange nut (4 per hinge)
4. Pivot bracket
5. Hinge (2 per boom)
6. Bushing (2 per pivot bracket)
7. Clevis pin
8. Hair pin
9. Flat washer (2 per boom)
10. Cap screw (2 per boom)
11. Lock nut (2 per boom)
12. Pivot pin
13. Backing plate (4 per boom)
14. Flange head screw
15. Spring retainer (2 per boom)
16. Breakaway spring (2 per boom)
17. Grease fitting (2 per hinge)
18. Rubber boot (2 per hinge)
19. Dampener (2 per boom)
20. Spray boom (LH shown)
21. Boom frame

Disassembly (Fig. 114)

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. Mark nozzle supply hose connections, remove forks and disconnect nozzle supply hoses at nozzle valves. Remove and discard o−rings at hose connections.

3. Record locations and remove any clamps or ties securing nozzle supply hoses to center boom.

4. Support spray boom to prevent it from falling.

5. Loosen two (2) cap screws (item 10) and lock nuts (item 11) to allow breakaway springs (item 16) to fully extend.

6. 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).

7. Clean all removed components. If pivot bracket was removed, inspect bushings (item 6) and pivot pin (item 12) for damage or wear.

Assembly (Fig. 114)

NOTE: Replace, do not reuse gaskets and O−rings. Coat O−rings and gaskets with vegetable oil or silicone grease before installation to reduce damage during assembly.

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. 115).

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 **1.53" to 1.59 (39 to 40 mm)** (Fig. 116).

6. Connect nozzle supply hoses to nozzle valves as marked during disassembly.

7. Secure nozzle supply hoses to center boom with clamps and ties as recorded during disassembly.

8. Lubricate grease fittings on boom hinge.

9. Check spray system for leaks. Repair all leaks before returning the sprayer to service.

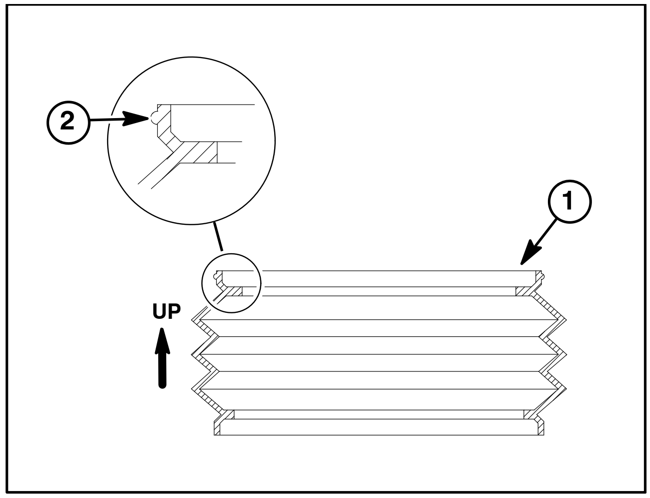


Figure 115

1. **Rubber boot** 2. **Rib**

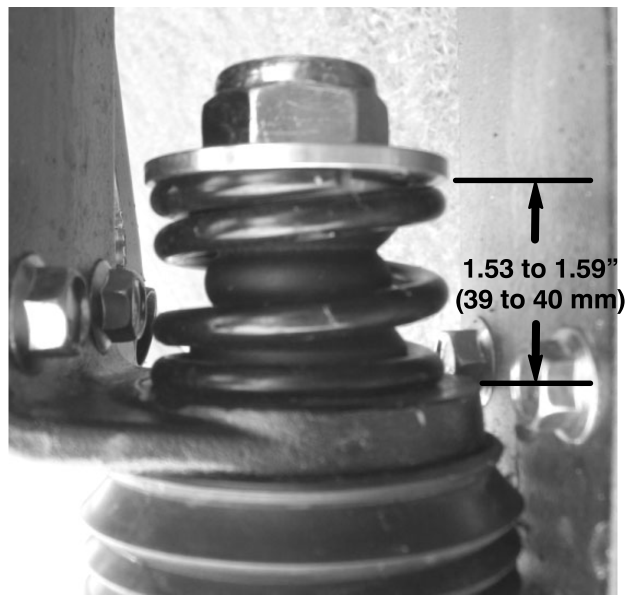


Figure 116

Spray Tank

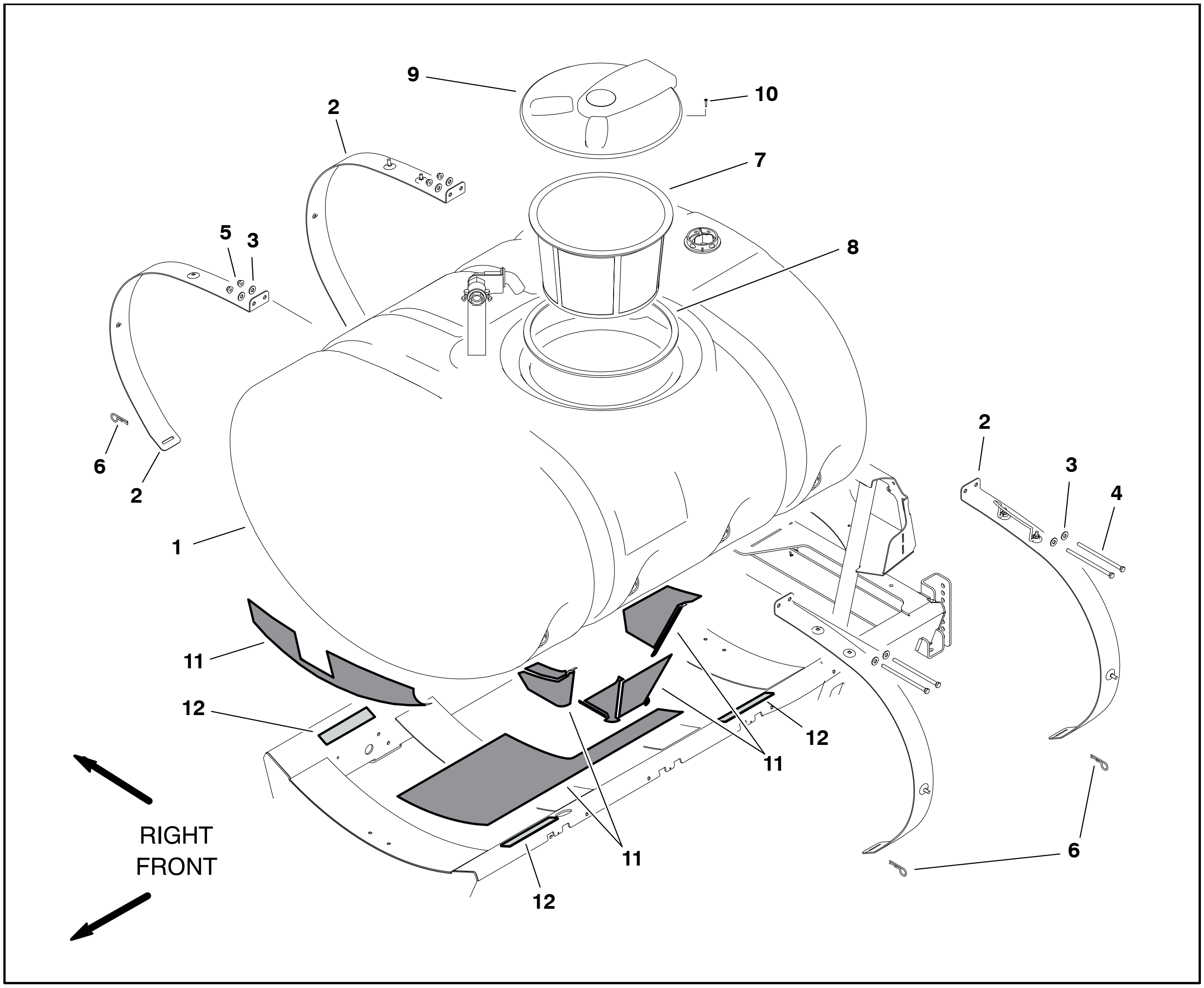


Figure 117

1. Spray tank
2. Tank strap (4)
3. Flat washer (8)
4. Hex head screw (4)
5. Lock nut (4)
6. Hair pin (4)
7. Filter basket
8. Gasket
9. Lid assembly
10. Pan head screw (8)
11. Heat shield (5)
12. Pad (4)

NOTE: Removing the spray tank may provide better service access to the engine and hydraulic pumps.

Removal (Fig. 117)

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 and any accessories that may block spray tank removal.

4. Raise the operator seat and remove the engine cover.

5. Disconnect suction line from top of tank and drain line from bottom of tank. Disconnect agitation hose from agitation throttle valve or remove four (4) agitation nozzles from tank fittings.

6. Remove flange nuts, flat washers and hex head screws (item 4) joining tank straps together on top of spray tank.

7. Remove hair pins (item 6) securing tank straps to machine frame and remove front and rear tank straps from machine.

CAUTION

Spray tank assembly weighs approximately 140 lbs (64 kg) when empty. Use an appropriate lifting device to safely lift the spray tank assembly.

8. Raise spray tank assembly from machine.

9. Make sure that heat shields on the spray tank and pads on spray tank frame are in good condition. Replace damaged shields and pads if needed.

10. Disassembly spray tank components as necessary. See Suction Line, Agitation Line and Drain Line in this chapter for specific component information.

Installation (Fig. 117)

1. Carefully lower spray tank assembly onto machine.

2. Level the spray tank from side to side. Make sure the tank drain reservoir is centered between tank frame cross−members.

3. Position tank straps to machine frame and secure with hair pins (item 6).

4. Install cap screws (item 4), flat washers and flange nuts joining tank straps together on top of spray tank.

5. Connect drain and suction hoses to spray tank. Connect agitation line or install agitation nozzles in tank.

6. Make sure that drain valve is closed and secured to the sprayer.

7. After spray tank installation, make sure that spray hoses do not contact any moving parts on machine.

8. Install the engine cover.

9. Install fresh water tank and any accessories previously removed.

10. Check spray tank for leaks. Repair all leaks before returning the sprayer to service.

TORO®

Chapter 9

Chassis

Table of Contents

Specifications

Item	Description
Front Tire Pressure (22 x 12 – 12, 4 ply, tubeless, smooth) (23 x 10.5 – 12, 4 ply, tubeless, turf tread – optional)	20 PSI (138 kPa)
Rear Tire Pressure (26.5 x 14 – 12, 4 ply, tubeless, turf tread)	20 PSI (138 kPa)
Front Wheel Lug Nut Torque	55 to 75 ft–lb (75 to 102 N–m)
Rear Wheel Lug Nut Torque	85 to 100 ft–lb (115 to 135 N–m)
Planetary, Brake Assembly and Wheel Motor Mounting Screw Torque OPH–2 series planetary VA02 series planetary	 60 ft–lb (81 N–m) 75 to 85 ft–lb (101 to 115 N–m)
Front Wheel Toe–In	1/8 to 1/4 inch (3.2 to 6.4 mm)
Planetary Drive Lubricant Capacity (each wheel)	SAE 85W–140 wt. Gear Lube 16 to 20 fl oz (0.47 to 0.59 L)

General Information

Operator's Manual

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

Adjustments

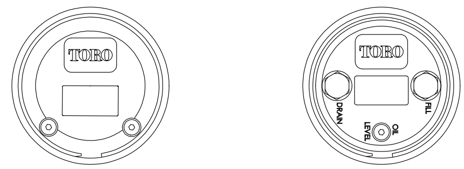
Planetary Drive Assembly Endplay (OPH−2 series planetary drives)

A front planetary drive assembly that is properly operating should have no endplay. Any endplay in a planetary assembly indicates that there are potential problems with the planetary. Check planetary endplay at intervals specified in your Operator's Manual.

Endplay Checking Procedure

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

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



OPH−2 series planetary **VA02 series planetary**

Figure 1

2. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 − Safety). Support machine with jack stands.

3. Grasp rear wheel and check for endplay in the planetary assembly as indicated by axial wheel movement. Make sure that there is no endplay in assembly.

4. If any endplay is detected, the planetary should be disassembled, inspected and serviced as necessary (see Planetary Drive Assembly in the Service and Repairs section of this chapter).

5. After planetary endplay checking is completed, lower machine to ground.

Service and Repairs

Undercarriage Shrouds

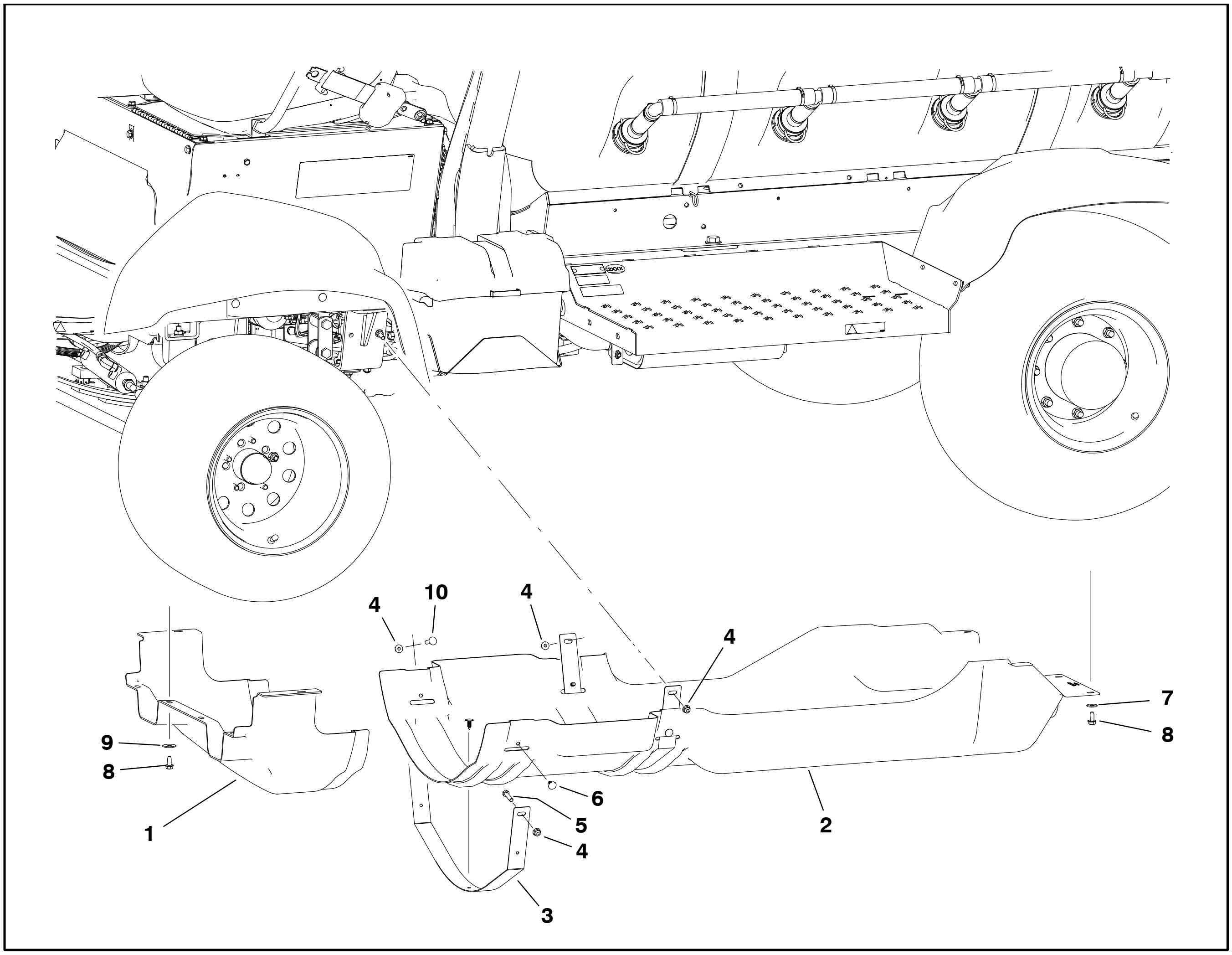


Figure 2

1. Front undercarriage shroud
2. Rear undercarriage shroud
3. Strap (machine serial number below 4000000000) (2)
4. Flange nut (4)
5. Cap screw
6. Panel fastener (6)
7. Flat washer (7)
8. Flange head screw (13)
9. Flat washer (6)
10. Carriage screw

Remove and install the undercarriage shrouds as needed to access a variety of machine components.

NOTE: Remove the rear shroud from the machine with the straps attached to the shroud.

Park machine on a level surface, stop engine, engage parking brake and remove key from the ignition switch before removing or installing undercarriage shrouds.

Wheel Assemblies

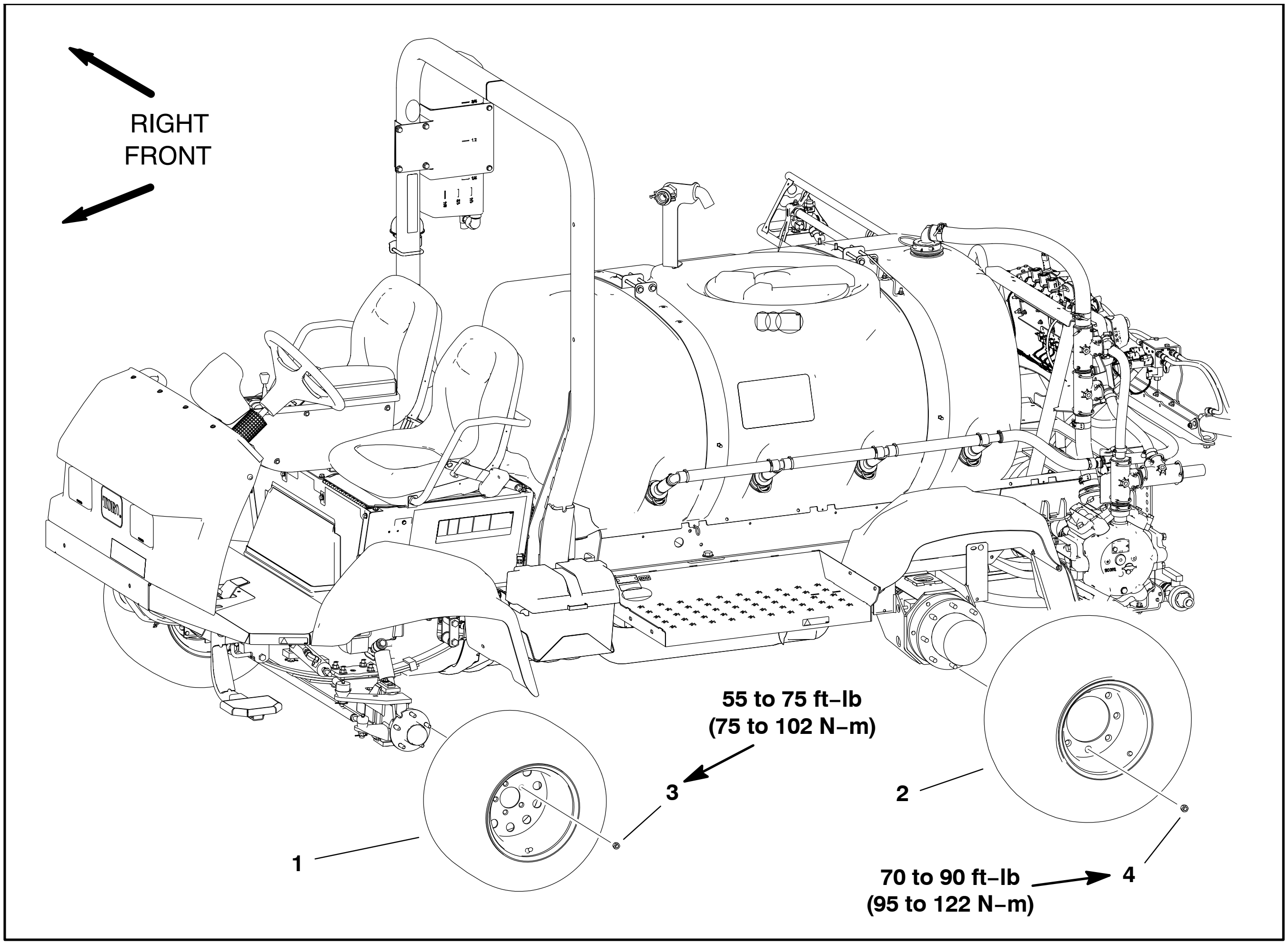


Figure 3

1. **Front wheel assembly (2)**
2. **Rear wheel assembly (2)**
3. **Lug nut (5 per front wheel)**
4. **Lug nut (8 per rear wheel)**

Wheel Removal (Fig. 3)

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

2. Chock 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. 3)

1. Install wheel assembly and secure 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 front wheel lug nuts from 55 to 75 ft-lb (75 to 102 N-m), and rear wheel lug nuts from 70 to 90 ft-lb (95 to 122 N-m).

2. Torque front lug nuts evenly in a crossing pattern from **55 to 75 ft-lb (75 to102 N-m)**.

3. Torque rear lug nuts evenly in a crossing pattern from **70 to 90 ft-lb (95 to122 N-m)**.

4. Lower machine to ground.

Tie Rod

Removal (Fig. 4)

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

NOTE: Left side tie rod end has a left hand threaded jam nut.

2. Loosen jam nut on tie rod end.

3. Remove cotter pin and castle nut that secure tie rod end to spindle.

4. Use a suitable puller (pickle fork) to separate tie rod end from spindle.

5. When removing tie rod end from tie rod, count the number of revolutions it takes to remove so new tie rod end can be installed with minimal change to front wheel toe−in.

Installation (Fig. 4)

1. Install dust boot on new tie rod end.

2. Thread tie rod end into tie rod the same number of revolutions as the old tie rod end took to remove.

3. Install grease fitting into tie rod end.

4. Insert tie rod end shaft into spindle and secure with castle nut. Torque castle nut from **20 to 25 ft−lb (27 to 33 N−m)**. If necessary, nut can be tightened slightly further to align cotter pin position in spindle and nut. Install cotter pin.

5. Grease tie rod end.

6. Check front wheel toe−in and adjust if needed. Front wheel toe−in should be from 1/8 to 1/4 inch (3.2 to 6.4 mm).

7. Adjust steering stop bolt on each spindle so that at full turn, there is a gap from 1/16" to 1/8" (1.6 to 3.2 mm) between the head of the stop bolt and the axle stop lug.

8. Verify that there is at least a 1/16" (1.6 mm) gap between the tie rod and front axle when turning full right to left.

9. After assembly is complete, make sure that steering components do not contact hoses and/or electrical harness wires.

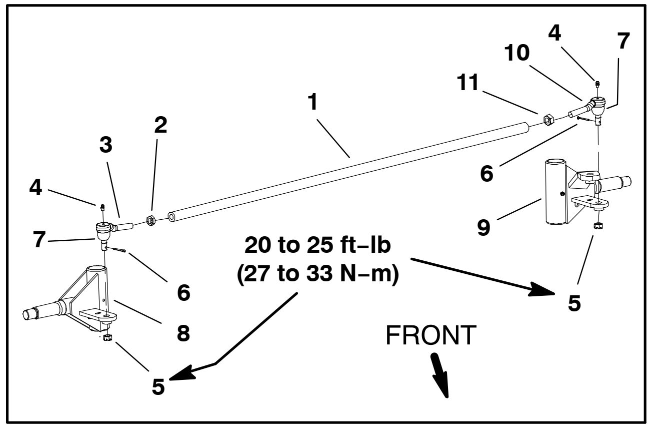


Figure 4

1. **Tie rod**
2. **Jam nut (RH thread)**
3. **RH tie rod end**
4. **Grease fitting**
5. **Castle nut**
6. **Cotter pin**
7. **Dust boot**
8. **RH spindle**
9. **LH spindle**
10. **LH tie rod end**
11. **Jam nut (LH thread)**

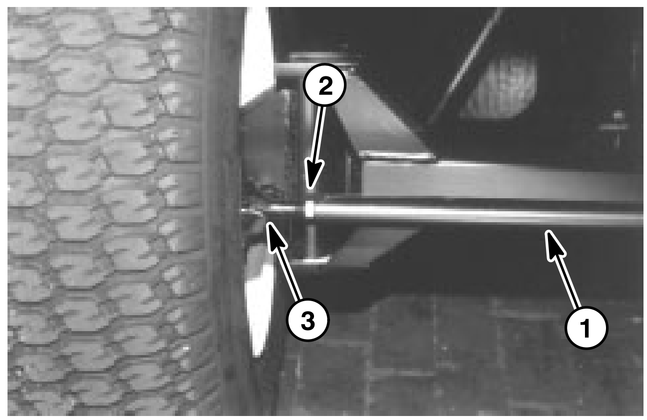


Figure 5

1. **Tie rod**
2. **Jam nut**
3. **Tie rod end**

Front Wheel Hubs

Removal and Disassembly

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

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety).

3. Remove front wheel assembly (see wheel removal in this chapter).

4. Carefully pry dust cap from wheel hub.

5. Remove cotter pin from front spindle.

6. Remove slotted hex nut and washer that secures wheel hub to spindle. Slide wheel hub with bearings from spindle.

7. If required, disassemble wheel hub:

A. Pull seal out of the wheel hub.

B. Remove bearings from both sides of wheel hub. Clean bearings in solvent. Clean inside of the hub.

C. Inspect wheel bearings. Check the bearings and cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

D. If necessary, press wheel studs from hub.

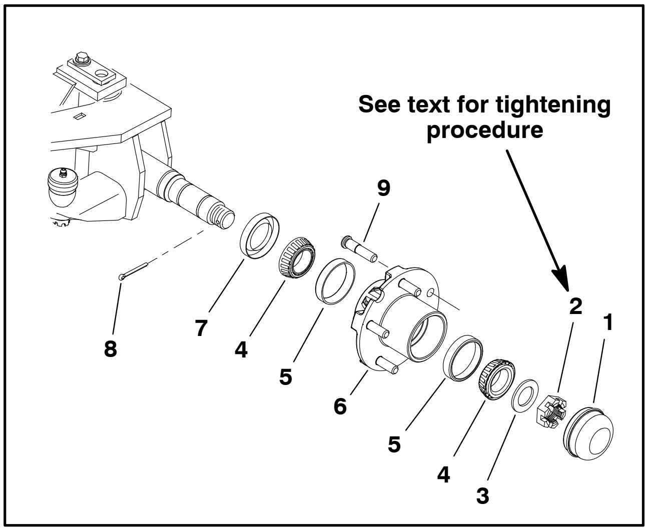


Figure 6

1. **Dust cap**
2. **Slotted hex nut**
3. **Washer**
4. **Bearing cone (2)**
5. **Bearing cup (2)**
6. **Hub**
7. **Seal**
8. **Cotter pin**
9. **Wheel stud (5)**

Assembly and Installation

1. Clean all parts thoroughly before reassembly.

2. If wheel bearings were removed from wheel hub, assemble wheel hub:

A. If bearing cups were removed from the wheel hub, press inner and outer cups into the hub until they seat against the hub shoulder.

B. Pack both bearings with grease. Install greased inner bearing into the cup on inboard side of the wheel hub.

C. Fill hub approximately 50% full of grease.

IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must face the bearing.

D. Lubricate the inside of a new lip seal and press it into the wheel hub.

E. If wheel studs were removed from hub, press studs fully into hub. Make sure that stud flange is pressed fully to hub surface.

3. Install the wheel hub onto the spindle shaft taking care to not damage seal.

4. Install greased outer bearing cone, washer and slotted hex nut onto spindle shaft.

5. Rotate the wheel hub by hand and torque the slotted hex nut from **75 to 180 in-lb (8.5 to 20.3 N−m)** to seat bearings. Loosen nut until it is away from washer and hub has end play. Finally, tighten slotted hex nut from **15 to 20 in−lbs (1.7 to 2.2 N−m)** while rotating hub.

6. Install cotter pin through spindle shaft hole. Install dust cap to hub.

7. Install front wheel assembly (see wheel installation in this chapter).

8. Lower machine to ground.

Front Spindles

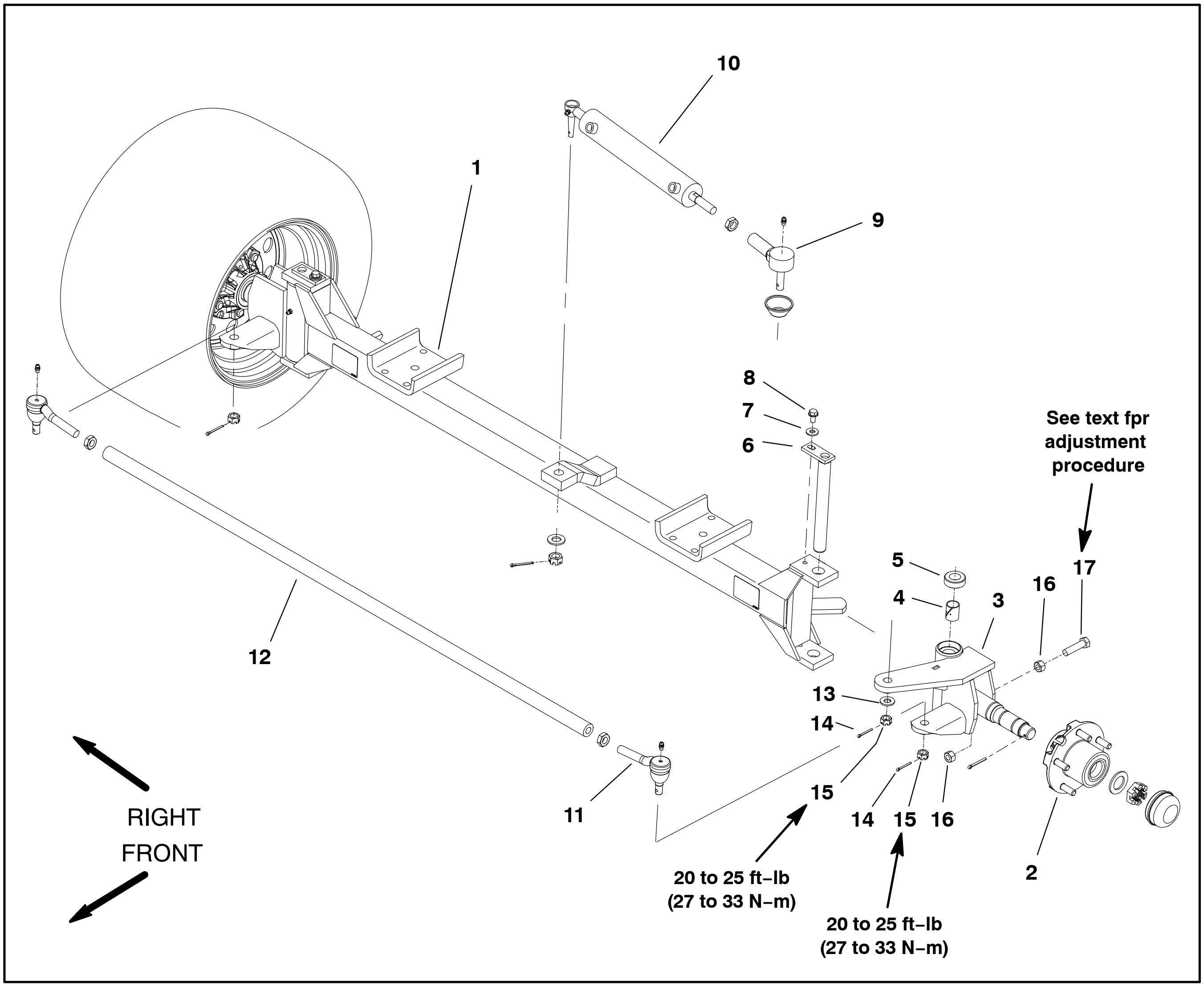


Figure 7

1. Front axle
2. Wheel hub
3. LH spindle assembly
4. Bushing (2)
5. Thrust bearing
6. King pin
7. Flat washer
8. Washer head screw
9. Steering cylinder ball joint
10. Hydraulic steering cylinder
11. Tie rod ball joint
12. Tie rod
13. Thrust washer
14. Cotter pin (2)
15. Castle nut (2)
16. Hex nut
17. Stop bolt

Removal (Fig. 7)

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

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety).

3. Remove front wheel assembly (see wheel removal in this chapter).

4. Remove front wheel hub (see front wheel hub removal in this chapter).

5. Remove tie rod end from spindle (see Tie Rod in this section).

6. If left side spindle is being removed, separate hydraulic steering cylinder from spindle (see Steering Cylinder in Chapter 5 – Hydraulic System in this manual).

7. Remove washer head screw and flat washer that secure king pin to front axle.

8. Support spindle assembly to prevent it from falling during disassembly. Slide king pin from front axle and spindle. Remove spindle from front axle.

9. Remove thrust bearing from top of spindle.

10. If needed, remove bushings and steering stop bolt from spindle.

Installation (Fig. 7)

1. Clean all parts thoroughly before reassembly.

2. If removed, install bushings and steering stop bolt into spindle.

3. Place thrust bearing in top of spindle. Top of bearing is identified on bearing case.

4. Lubricate spindle bushings and position spindle to front axle and install king pin. King pin must slide through spindle freely and spindle must rotate freely on king pin.

5. Install washer head screw and flat washer to secure king pin to front axle.

6. If left side spindle was removed, attach hydraulic steering cylinder to spindle (see Steering Cylinder in Chapter 4 – Hydraulic System in this manual).

7. Secure tie rod end to spindle (see Tie Rod in this section).

8. Install front wheel hub (see front wheel hub installation in this chapter).

9. Install front wheel assembly (see wheel installation in this chapter).

10. Lubricate spindle grease fitting on front axle assembly.

11. Lower machine to ground.

12. Check and adjust front wheel toe–in. Front wheel toe–in should be from 1/8” to 1/4” (3.2 to 6.4 mm).

13. Adjust steering stop bolt on each spindle so that at full turn, there is a gap from 1/16” to 1/8” (1.6 to 3.2 mm) between the head of the stop bolt and the axle stop lug.

14. Verify that there is at least a 1/16” (1.6 mm) gap between the tie rod and front axle when turning full right to left.

15. After assembly is complete, make sure that steering components do not contact hoses and/or electrical harness wires.

Front Suspension

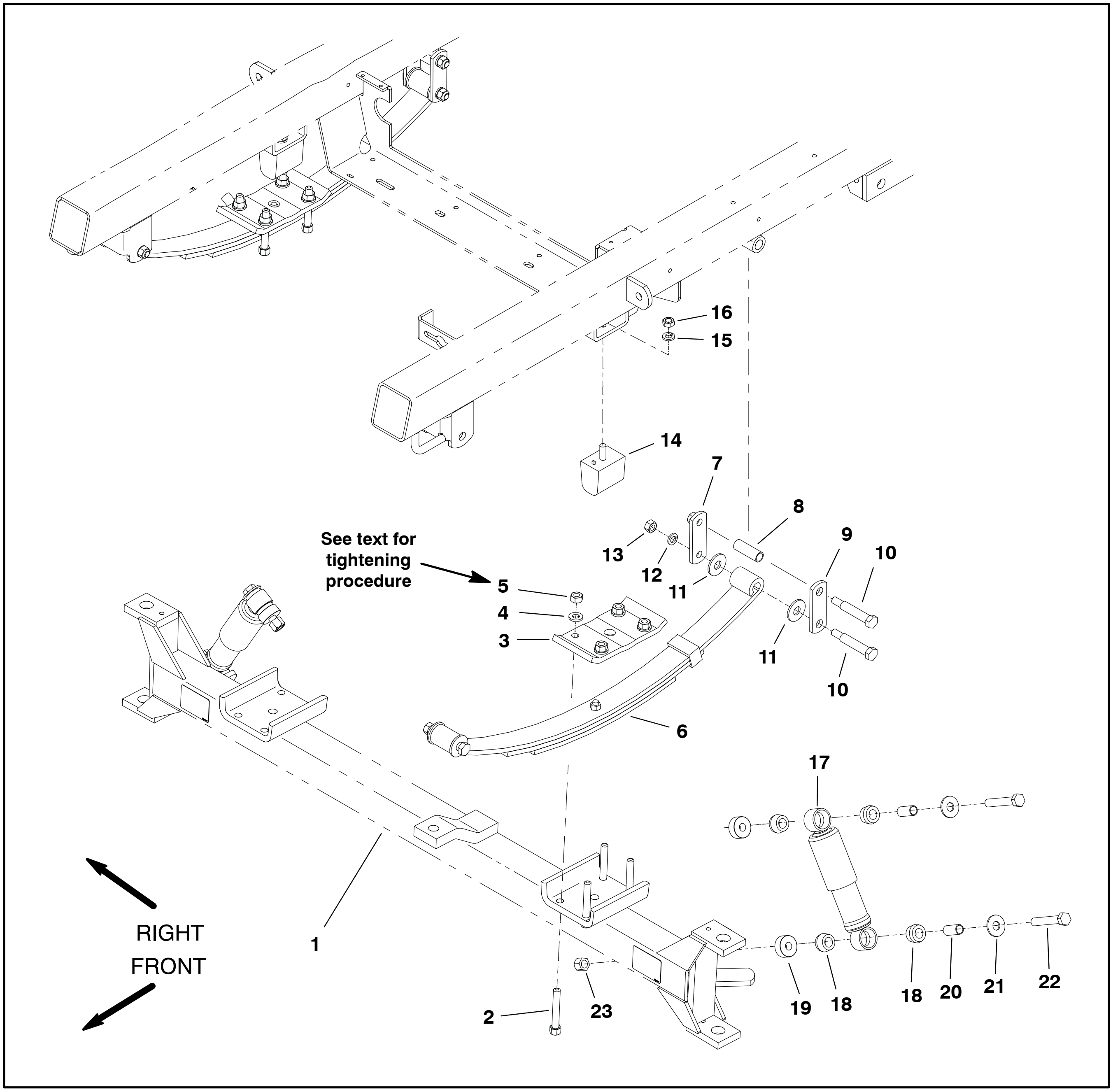


Figure 8

1. **Front axle assembly**
2. **Cap screw (4 per spring)**
3. **Spring plate**
4. **Hardened washer (4 per spring)**
5. **Lock nut (4 per spring)**
6. **Leaf spring (2)**
7. **Shackle – inside**
8. **Shackle bushing**
9. **Shackle outside**
10. **Shoulder bolt (3 per spring)**
11. **Flat washer (4 per spring)**
12. **Lock washer (4 per spring)**
13. **Hex nut (3 per spring)**
14. **Axle bumper (2)**
15. **Lock washer (2)**
16. **Hex nut (2)**
17. **Shock absorber (2)**
18. **Rubber bushing (4 per shock)**
19. **Spacer (2 per shock)**
20. **Spacer (2 per shock)**
21. **Washer (2 per shock)**
22. **Cap screw (2 per shock)**
23. **Hex nut (2 per shock)**

Disassembly (Fig. 8)

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

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

2. Jack front of machine off ground (see Jacking Instructions in Chapter 1 – Safety in this manual). Support machine to allow front suspension to hang freely from machine.

3. Remove front wheels (see Wheel Assemblies in this chapter).

4. Support axle to prevent it from shifting or falling.

5. To remove leaf springs:

A. Loosen fasteners that secure springs to frame attachment points.

B. Loosen and remove fasteners that secure spring plate (item 3).

C. Remove shackles, bushings, shoulder bolts, washers, lock washers and hex nuts from spring and frame.

D. Remove leaf springs from machine.

IMPORTANT: If leaf spring replacement is needed, always replace both springs for proper vehicle performance.

6. If front axle removal is required, remove steering cylinder (see Steering Cylinder Removal in Chapter 4 – Hydraulic System in this manual) and shock absorbers from axle.

Assembly (Fig. 8)

1. If axle was removed from vehicle, position and support axle under frame.

2. To install leaf springs:

NOTE: When installing leaf springs, make sure front axle and spring plate are centered on the screw head and nut that secure spring leaves.

A. Apply a light coating of oil to bushing (item 8) and loosely attach springs to frame with shackles, bushings, shoulder bolts, washers, lock washers and hex nuts. Do not fully tighten fasteners.

B. Install spring plate (item 3) to top of spring assembly with curved ends upward.

C. Install and tighten cap screws (item 2), hardened washers (item 4) and lock nuts (item 5) in a crossing pattern until spring plate, leaf spring and axle are in contact.

D. Fully tighten fasteners that secure springs to frame.

E. Using a crossing pattern, tighten lock nuts (item 5) that secure spring plate from **34 ft–lb (46 N–m)**. Using a crossing pattern, tighten lock nuts from **69 to 85 ft–lb (94 to 115 N–m)**. Finally, use a crossing pattern to check that lock nuts are all tight from **69 to 85 ft–lb (94 to 115 N–m)**.

F. Apply medium strength wicking thread locker (Loctite 290 or equivalent) to bolt threads.

3. If shock absorbers were removed, install shocks to vehicle. Make sure that spacer is positioned between shock and frame.

4. If steering cylinder was removed, install steering cylinder (see Steering Cylinder in Chapter 4 – Hydraulic System in this manual)

5. Install front wheels (see Wheel Assemblies in this chapter).

6. Lower vehicle to ground.

7. Check front suspension and steering operation. Make sure that steering components do not contact hoses and/or wires throughout their entire range of motion.

Planetary Drive Assembly

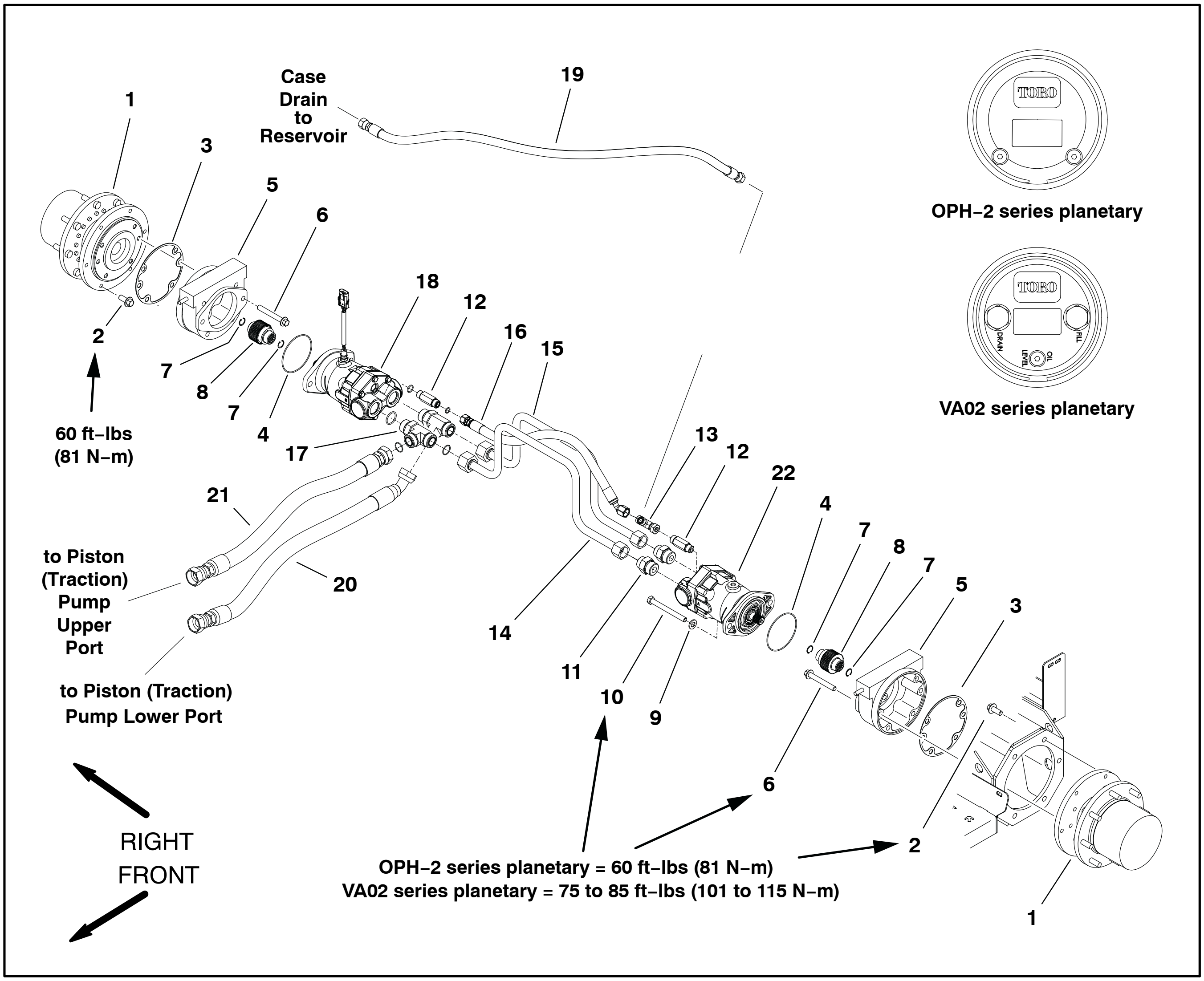


Figure 9

1. **Planetary assembly**
2. **Flange head screw (6 each)**
3. **Gasket (2)**
4. **O−ring (2)**
5. **Brake assembly**
6. **Flange head screw (4 per brake)**
   OPH−2 planetary = 90 mm lg
   VA02 planetary = 80 mm lg
7. **Retaining ring (4)**
8. **Splined brake shaft (2)**
9. **Flat washer (4)**
10. **Cap screw (2 per motor)**
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
11. **Straight hydraulic fitting (2)**
12. **Hydraulic adapter (2)**
13. **Hydraulic tee fitting**
14. **Hydraulic tube assembly**
15. **Hydraulic tube assembly**
16. **Hydraulic hose**
17. **Hydraulic tee fitting (2)**
18. **RH wheel motor (with speed sensor)**
19. **Hydraulic hose (to reservoir)**
20. **Hydraulic hose**
    (to lower pump fitting)
21. **Hydraulic hose**
    (to upper pump fitting)
22. **LH wheel motor**

NOTE: The planetary drive assembly can be serviced with the planetary installed to machine (see Planetary Drive Service in this section). Use the following procedure to remove and install the planetary drive assembly from machine.

Removal (Fig. 9)

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

2. Drain the oil from the brake assembly and the Planetary drive; refer to the traction unit Operator's Manual.

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety in this manual). Support machine with jack stands.

4. Remove rear wheel assembly (see Wheel Assemblies in the chapter).

5. Support wheel motor and brake assembly to prevent them from shifting during planetary removal.

NOTE: The wheel motor and brake assembly fasteners thread into the planetary housing, and must be removed prior to removing the planetary drive from the machine.

6. Remove two (2) cap screws and flat washers that secure wheel motor to planetary assembly. Check condition of O−ring (item 4) and replace if necessary (see wheel motors in Chapter 5 – Hydraulic System in this manual).

7. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly in this chapter). Remove and discard gasket (item 3).

8. Support planetary assembly to prevent it from falling. Loosen and remove eight (8) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

9. Remove and discard gasket (item 3). Make sure that all gasket material and sealant is removed from both brake and planetary assemblies.

Installation (Fig. 9)

1. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with eight (8) flange head screws.

For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

2. Apply gasket sealant (Loctite #2 or equivalent) to sealing surfaces of new gasket (item 3). Align gasket and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

3. Make sure wheel motor O−ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

4. Install rear wheel assembly (see Wheel Assemblies in this chapter).

5. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

6. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

7. Remove jack stands and lower machine to ground.

OPH−2 Series Planetary Drive Service

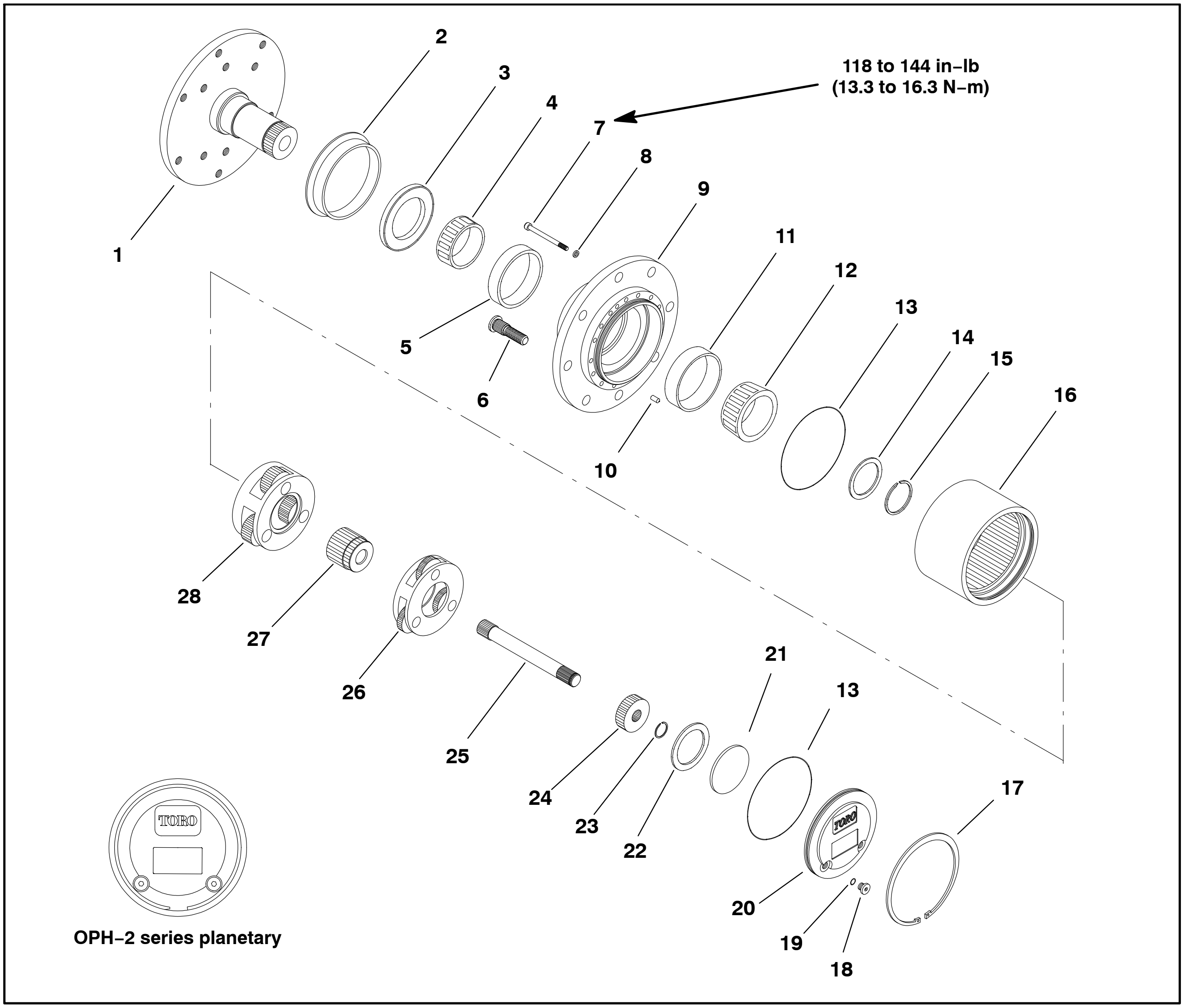


Figure 10

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8)
7. Socket head screw (16)
8. Lock washer (16)
9. Housing
10. Dowel pin (2)
11. Outer bearing cup
12. Outer bearing cone
13. O−ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2)
19. O−ring (2)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assembly
27. Secondary gear
28. Secondary carrier assembly

NOTE: The planetary drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed, see Planetary Drive Assembly in this chapter.

Disassembly (Figs. 10 and 11)

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

2. Drain oil from planetary drive/brake assembly; refer to traction unit Operator's Manual.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove rear wheel assembly.

4. Remove retaining ring (item 17).

5. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

6. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

7. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 6 through 10 are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 15) after it has been removed.

8. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

9. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

10. Remove and discard seals (items 2 and 3) and O–rings (item 13) from housing.

11. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

12. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

13. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

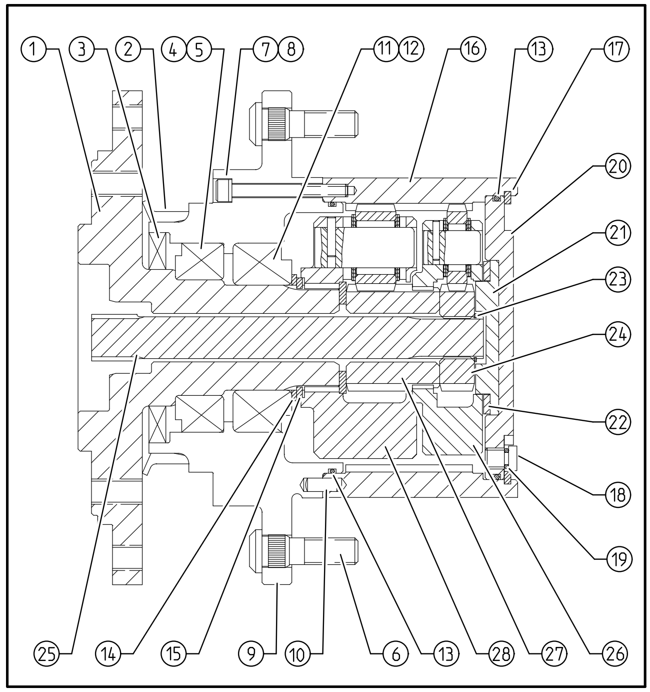


Figure 11

1. **Spindle**
2. **Boot seal**
3. **Oil seal**
4. **Inner bearing cone**
5. **Inner bearing cup**
6. **Wheel stud (8)**
7. **Socket head screw (16)**
8. **Lock washer (16)**
9. **Housing**
10. **Dowel pin (2)**
11. **Outer bearing cup**
12. **Outer bearing cone**
13. **O–ring**
14. **Thrust washer**
15. **Retaining ring (external)**
16. **Ring gear**
17. **Retaining ring (internal)**
18. **Plug (2)**
19. **O–ring (2)**
20. **End cap**
21. **Thrust plug**
22. **Thrust washer**
23. **Retaining ring**
24. **Primary gear**
25. **Drive shaft**
26. **Primary carrier assy.**
27. **Secondary gear**
28. **Secondary carrier assy.**

Assembly (Figs. 10 and 11)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary drive.

3. If spindle and housing were separated:

A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

B. Set inner bearing cone (item 4) into inner bearing cup.

C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

D. Pack boot seal (item 2) with grease and install.

E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in–lb (13.3 to 16.3 N–m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 in. (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O–ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O–ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

9. Check operation of planetary drive. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

10. Install rear wheel assembly (see Wheel Assemblies in this chapter).

11. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

12. Test planetary drive operation.

13. Remove jack stands and lower machine to ground.

VA02 Series Planetary Drive Service

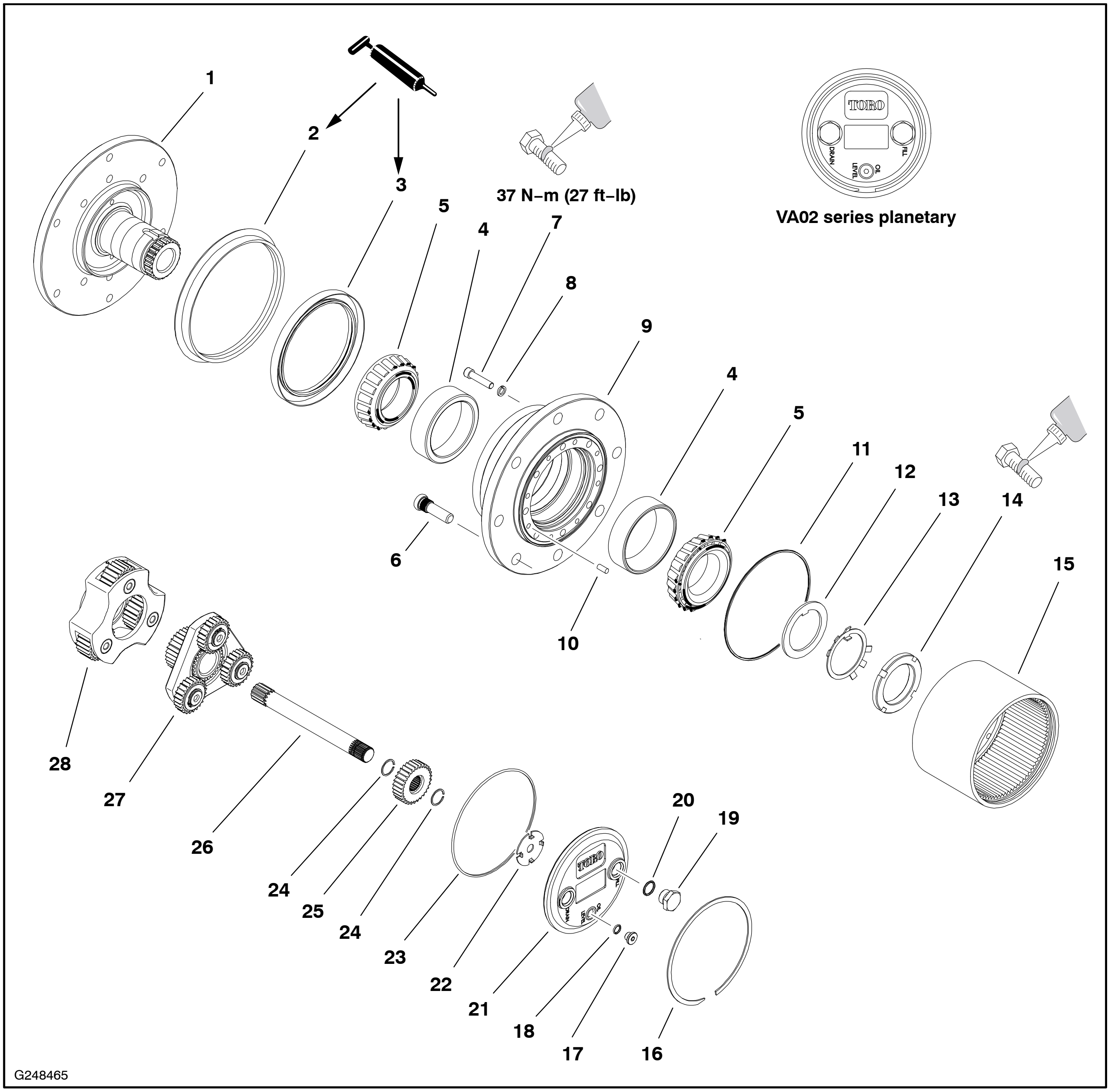


Figure 12

1. **Spindle**
2. **Boot seal**
3. **Lip seal**
4. **Inner bearing cup (2)**
5. **Inner bearing cone (2)**
6. **Wheel stud (8)**
7. **Socket head screw (8)**
8. **Lock washer (8)**
9. **Housing**
10. **Dowel pin (4)**
11. **O–ring**
12. **Spacer**
13. **Locking washer**
14. **Lock nut**
15. **Ring gear**
16. **Retaining ring**
17. **Plug**
18. **O–ring**
19. **Plug (2)**
20. **O–Ring (2)**
21. **End cap**
22. **Thrust plate**
23. **O–Ring**
24. **Retaining ring (2)**
25. **Primary gear**
26. **Drive shaft**
27. **Primary carrier assembly**
28. **Secondary carrier assembly**

NOTE: The planetary drive assembly is best serviced with the planetary installed to machine or the spindle firmly secured to a fixture or workbench. If the spindle (item 1) needs to be removed from machine, see Planetary Drive Assembly in this chapter.

Disassembly

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

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

3. Chock **rear**/**front** wheels and jack up **front**/**rear** of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove rear wheel assembly.

4. Remove retaining ring (item 16).

5. Remove end cap and thrust plate. Retrieve and discard O–ring from ring gear bore.

6. Remove primary gear and drive shaft assembly (items 24–26).

7. Remove primary carrier and secondary carrier from ring gear.

8. Bend the locking washer tab away from the lock nut. Use a TMFS12 spanner socket to remove the 55 x 1.5 mm lock nut. Remove the locking washer and spacer. Discard the locking washer.

9. Carefully remove housing and bearing cones from spindle.

10. Remove and discard seals from housing.

11. If necessary, remove bearing cups from housing.

12. If wheel stud removal is necessary, use a press to remove the stud(s) from the housing.

13. If necessary, remove the ring gear from the housing:

NOTE: High strength thread locking compound was used during assembly. It may be necessary to heat the ring gear near the mounting screws to release the screws.

A. Remove socket head screws (item 7) and lock washers that secure the ring gear to the housing.

B. Remove the ring gear and retrieve the four (4) dowel pins (item 10) from housing.

C. Remove the O–ring from the housing bore and discard.

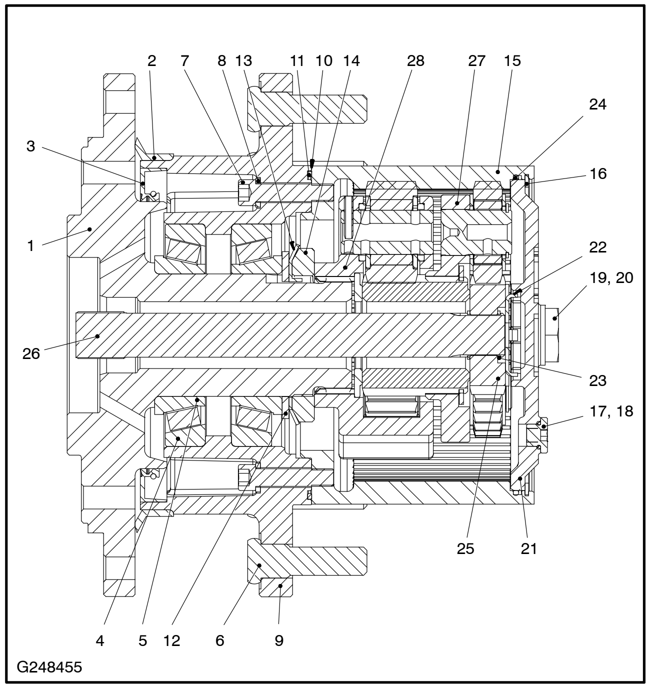


Figure 13

1. **Spindle**
2. **Boot seal**
3. **Lip seal**
4. **Inner bearing cup (2)**
5. **Inner bearing cone (2)**
6. **Wheel stud (8)**
7. **Socket head screw (8)**
8. **Lock washer (8)**
9. **Housing**
10. **Dowel pin (4)**
11. **O–ring**
12. **Spacer**
13. **Locking washer**
14. **Lock nut**
15. **Ring gear**
16. **Retaining ring**
17. **Plug**
18. **O–ring**
19. **Plug (2)**
20. **O–Ring (2)**
21. **End cap**
22. **Thrust plate**
23. **O–Ring**
24. **Retaining ring (2)**
25. **Primary gear**
26. **Drive shaft**
27. **Primary carrier asm**
28. **Secondary carrier asm**

Assembly

NOTE: Use new seals, O–rings and locking washer when assembling the planetary drive.

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

3. If ring gear was removed from housing:

A. Fit four (4) dowel pins in housing.

B. Apply a light coat of grease to a new O–ring and install it in the housing bore.

C. Apply high strength thread locking compound and secure ring gear to housing with lock washers and socket head screws. Tighten screws to **27 ft–lb (37 N–m)**.

4. If previously removed, press bearing cups into housing. Cups should be pressed fully to shoulder of the housing bore.

5. Fit inner bearing cone onto spindle. Make sure inner bearing cone seats fully against spindle shoulder. If inner bearing is not seated fully, lightly tap bearing cone on inner hub until it seats properly.

6. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal is not rubber or does not have a sealant coating, apply a light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face.

7. Install boot seal. Cover surface of lip seal and boot seal with grease.

8. Lightly oil bearing cups then place housing assembly over spindle and inner bearing cone. Take care to not damage seals or spindle during installation.

9. Fit outer bearing cone onto spindle.

10. Align key on spacer and install spacer onto spindle shaft.

11. Align key on locking washer and install locking washer onto spindle shaft.

IMPORTANT: .Perform the following steps without interruption. Once the thread locking compound is applied, you have only a few minutes before the curing process will influence the bearing lock nut torque.

12. Install the bearing lock nut:

A. Apply high strength thread locking compound (Loctite 263 or equivalent) and install the lock nut.

B. Tighten the lock nut to **110 ft−lb (150 N−m)**.

C. Rotate the housing on the spindle a few revolutions to align the bearings.

D. Tighten the lock nut to **150 ft−lb (200 N−m)**.

E. Rotate the housing on the spindle a few revolutions to seat the bearings.

IMPORTANT If installing the bearing nut with the spindle installed on machine, have an assistant hold the housing firmly in position during the following step.

F. Loosen the lock nut completely, then tighten to **90 ft−lb (122 N−m).**

IMPORTANT: Continue to tighten the lock nut until it aligns with one of the locking washer tabs. Do Not loosen the lock nut to align it with the locking washer tabs.

G. Secure the lock nut by bending one of the locking washer tabs into a slot in the lock nut.

13. Install secondary carrier and primary carrier making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

14. If primary gear (item 25) was removed from drive shaft, slide gear onto shaft and secure with retaining rings.

15. Install drive shaft assembly (items 24−26) making sure that drive shaft spline aligns with carrier gears.

16. Cover the outer face of the thrust plate with grease and fit thrust plate onto end cap. Make sure that thrust plate tabs are captive in end cap.

17. Apply a light coat of grease to a new O−ring and install it in the ring gear bore. Avoid pinching or cutting the O−ring and install the end cap. Use a soft mallet to fully seat the end cap.

18. Secure the end cap with the retaining ring. Make sure the retaining ring is fully seated in the ring groove.

19. Check operation of planetary drive by hand. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

20. Install rear wheel assembly (see Wheel Assemblies in this chapter).

21. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

22. Test planetary drive operation.

23. Remove jack stands and lower machine to ground.

Brake Cables

Brake Cable Removal

1. Remove brake cable from brake equalizer at front of machine under floorboard (Fig. 14 and 15):

   A. Remove cotter pin, flat washer and clevis pin that secure brake cable to brake equalizer.

   B. Loosen jam nuts that secure cable to cable bracket on frame.

2. Remove brake cable from rear brake (Fig. 16):

   A. Loosen and remove cable end from pull rod on brake assembly.

   B. Loosen jam nut that secures brake cable to cable bracket on frame.

3. Remove R−clamp that secures brake cable:

   A. R−clamp for right side cable is on top of traction pump.

   B. R−clamp for left side cable is inside left frame rail.

4. Note routing of brake cable and remove cable from machine.

Brake Cable Installation

1. Install brake cable to rear brake assembly:

   A. Insert rear end of cable through cable bracket on frame and through hole in rear axle frame.

   B. Connect cable end to brake pull rod on brake assembly. Tighten cable end.

   C. Place cable in cable bracket. Secure with jam nut.

2. Route brake cable to front of machine.

3. Install brake cable to brake equalizer:

   A. Pass cable through cable bracket on frame and position cable to brake equalizer.

   B. Attach cable to equalizer with clevis pin, flat washer and cotter pin.

   C. Position cable to cable bracket and adjust cable free play with jam nuts. There should be no slack in cable and brake equalizer should be perpendicular to vehicle center−line after adjustment.

4. Secure cable to machine with R−clamp.

5. Check brake operation before using the machine.

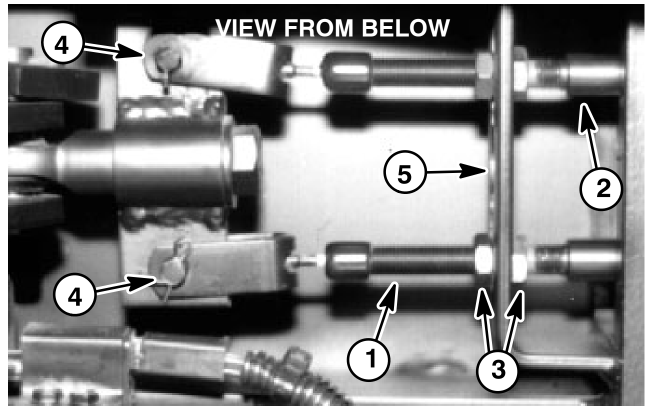


Figure 14

1. **RH brake cable**
2. **LH brake cable**
3. **Cable jam nut**
4. **Clevis pin**
5. **Frame cable bracket**

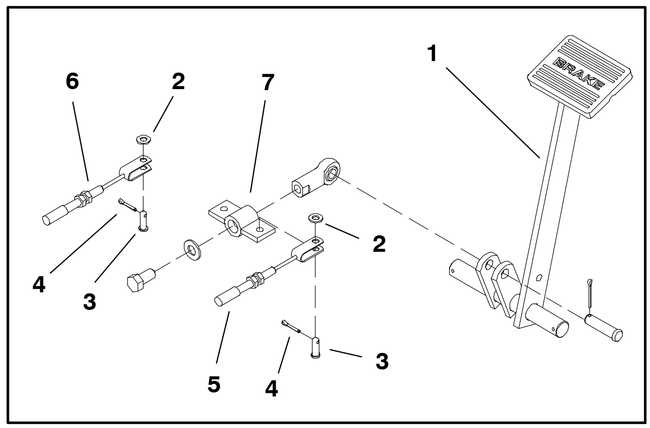


Figure 15

1. **Brake pedal**
2. **Flat washer**
3. **Clevis pin**
4. **Cotter pin**
5. **RH brake cable**
6. **LH brake cable**
7. **Brake equalizer**

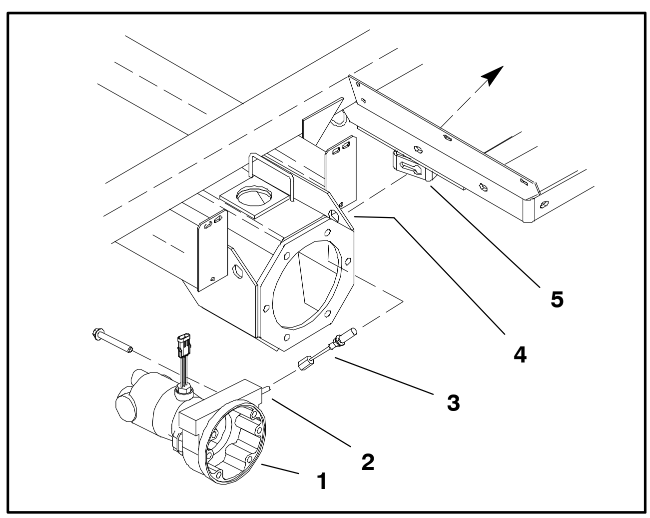


Figure 16

1. **Brake (RH shown)**
2. **Brake pull rod**
3. **Brake cable (RH shown)**
4. **Axle frame hole**
5. **Cable bracket**

Brake Assembly

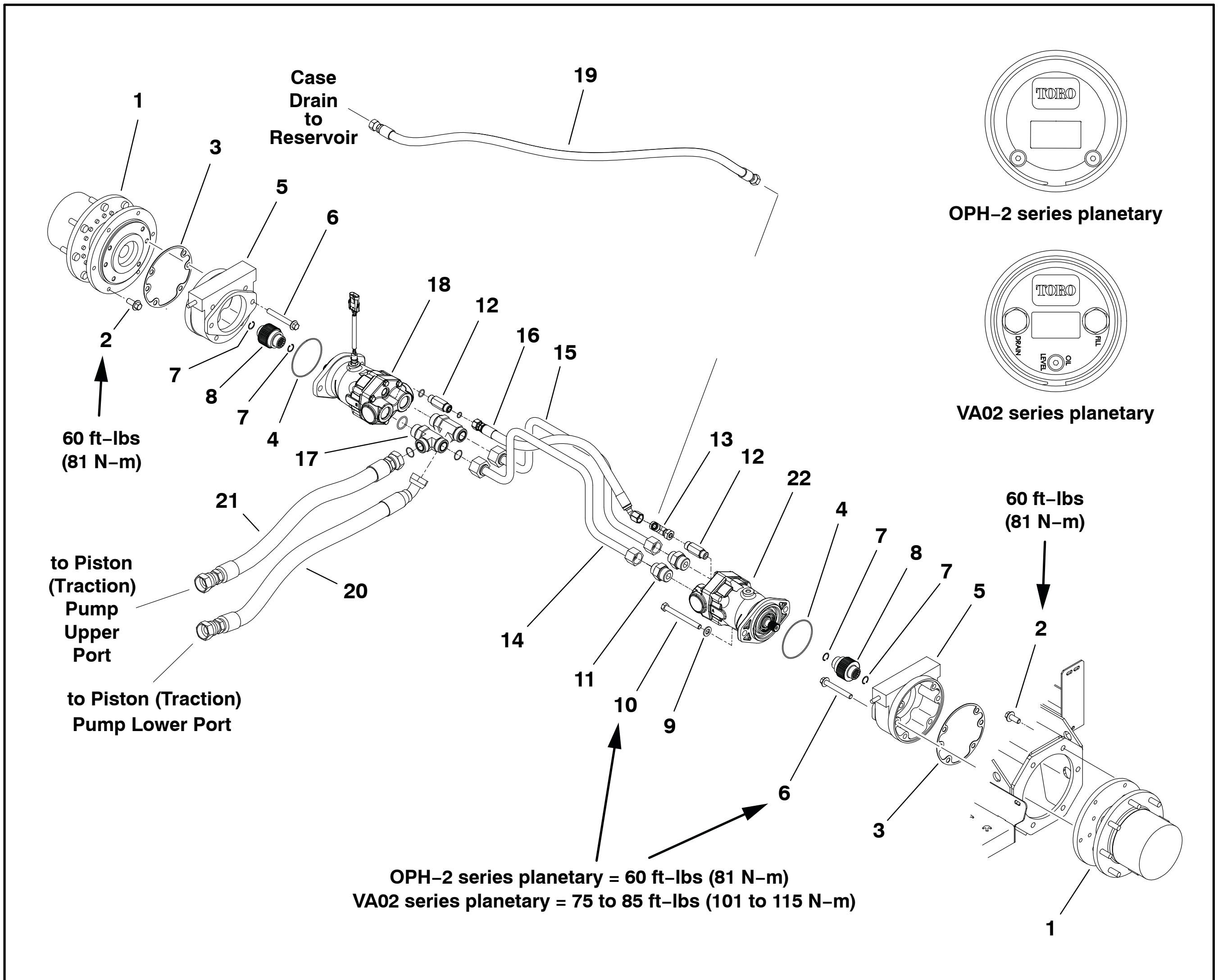


Figure 17

1. **Planetary assembly**
2. **Flange head screw (6 each)**
3. **Gasket (2)**
4. **O−ring (2)**
5. **Brake assembly**
6. **Flange head screw (4 per brake)**
   OPH−2 planetary = 90 mm lg
   VA02 planetary = 80 mm lg
7. **Retaining ring (4)**
8. **Splined brake shaft (2)**
9. **Flat washer (4)**
10. **Cap screw (2 per motor)**
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
11. **Straight hydraulic fitting (2)**
12. **Hydraulic adapter (2)**
13. **Hydraulic tee fitting**
14. **Hydraulic tube assembly**
15. **Hydraulic tube assembly**
16. **Hydraulic hose**
17. **Hydraulic tee fitting (2)**
18. **RH wheel motor (with speed sensor)**
19. **Hydraulic hose (to reservoir)**
20. **Hydraulic hose**
    (to lower pump fitting)
21. **Hydraulic hose**
    (to upper pump fitting)
22. **LH wheel motor**

Removal (Fig. 17)

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

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 – Safety in this manual). Support machine with jack stands.

4. Remove rear wheel assembly (see Wheel Assemblies in the chapter).

5. Remove hydraulic wheel motor (see Rear Wheel Motors in Chapter 4 – Hydraulic System in this manual). Discard O–ring (item 4).

6. Disconnect brake cable from pull rod on brake (Fig. 19).

NOTE: Be careful to not drop splined brake shaft as brake assembly is removed.

7. Support brake assembly and remove four (4) flange head screws (item 6) that secure brake assembly to planetary assembly. Remove brake assembly and discard gasket (item 3).

8. Locate and remove splined brake shaft (item 8).

9. Remove and discard gasket (item 3). Make sure that all gasket material and sealant is removed from both the brake and the planetary assembly.

10. Complete brake inspection and repair (see Brake Inspection and Repair in this chapter).

Installation (Fig. 17)

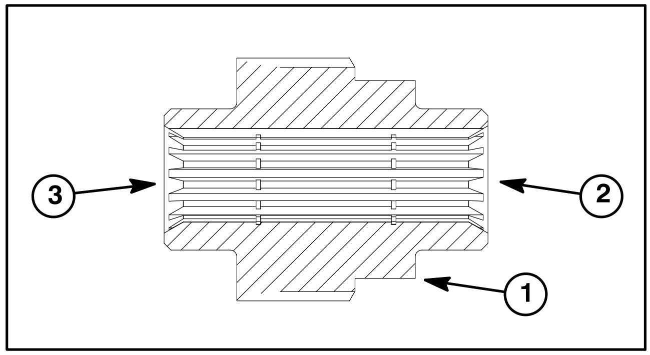


Figure 18

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

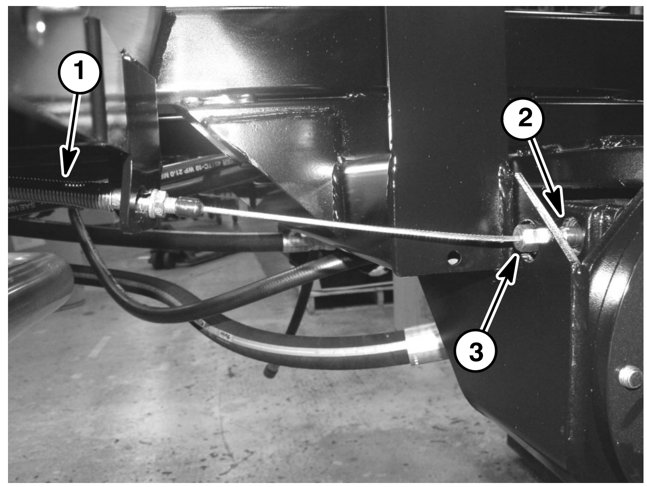


Figure 19

1. **Brake cable**
2. **Brake pull rod**
3. **Brake cable end**

NOTE: The stepped end of the splined brake shaft must be aligned toward the hydraulic wheel motor (Fig. 18).

1. Install splined brake shaft into brake assembly. Make sure that splines engage rotating discs in brake assembly.

2. Apply gasket sealant (Loctite #2 or equivalent) to sealing surfaces of new gasket (item 12). Align gasket and secure brake assembly to planetary.

For OPH–2 series planetary drives: tighten screws from **60 ft–lb (81 N–m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

3. Install brake cable to pull rod on brake assembly (Fig. 19). Brake cable end should be completely threaded onto pull rod.

4. Make sure wheel motor O−ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

5. Install rear wheel assembly (see Wheel Assemblies in this chapter).

6. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

7. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

8. Lower machine to ground.

Brake Inspection and Repair

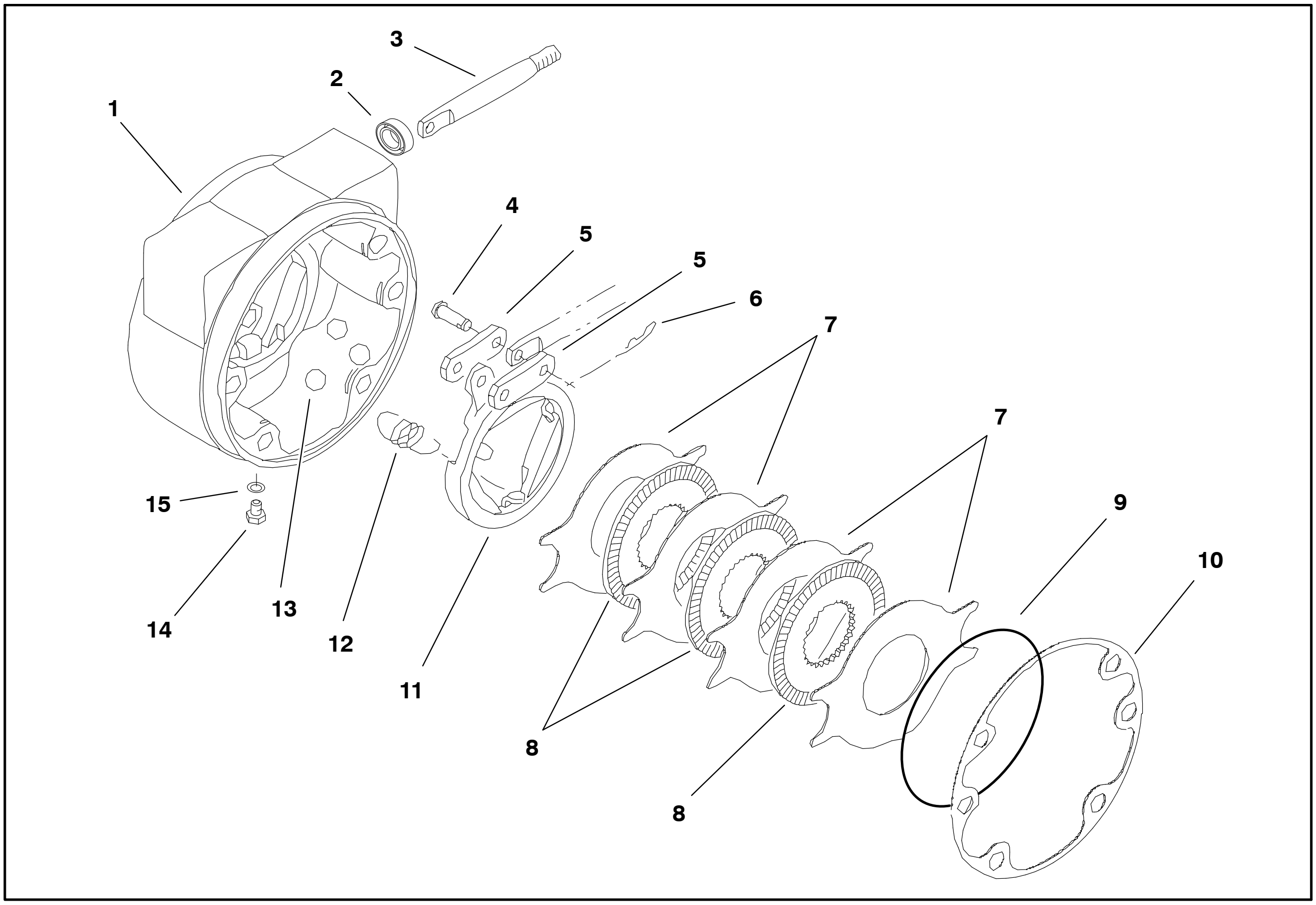


Figure 20

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin**
5. **Link**
6. **Hitch pin (2)**
7. **Stationary disc**
8. **Rotating disc**
9. **Retaining ring**
10. **Gasket**
11. **Rotating actuator**
12. **Extension spring (3)**
13. **Ball (3)**
14. **Plug (2)**
15. **O–ring**

Brake Inspection and Repair (Fig. 20)

1. Scrape gasket material (item 10) from brake housing and planetary drive mounting surfaces.

2. Remove retaining ring (item 9).

3. Remove four (4) stationary discs (item 7) and three (3) rotating discs (item 8).

4. Remove three (3) extension springs (item 12).

5. Remove actuator assembly (items 3, 4, 5, 6 and 11) and three (3) balls (item 13).

6. Remove seal (item 2) from brake housing.

7. Wash parts in cleaning solvent. Inspect components for wear or damage.

8. Reverse steps 2 through 6 to assemble brakes, installing new parts as necessary. Install a new seal (item 2).

9. Use a new gasket (item 10) when installing the brake assembly to machine.

Seats

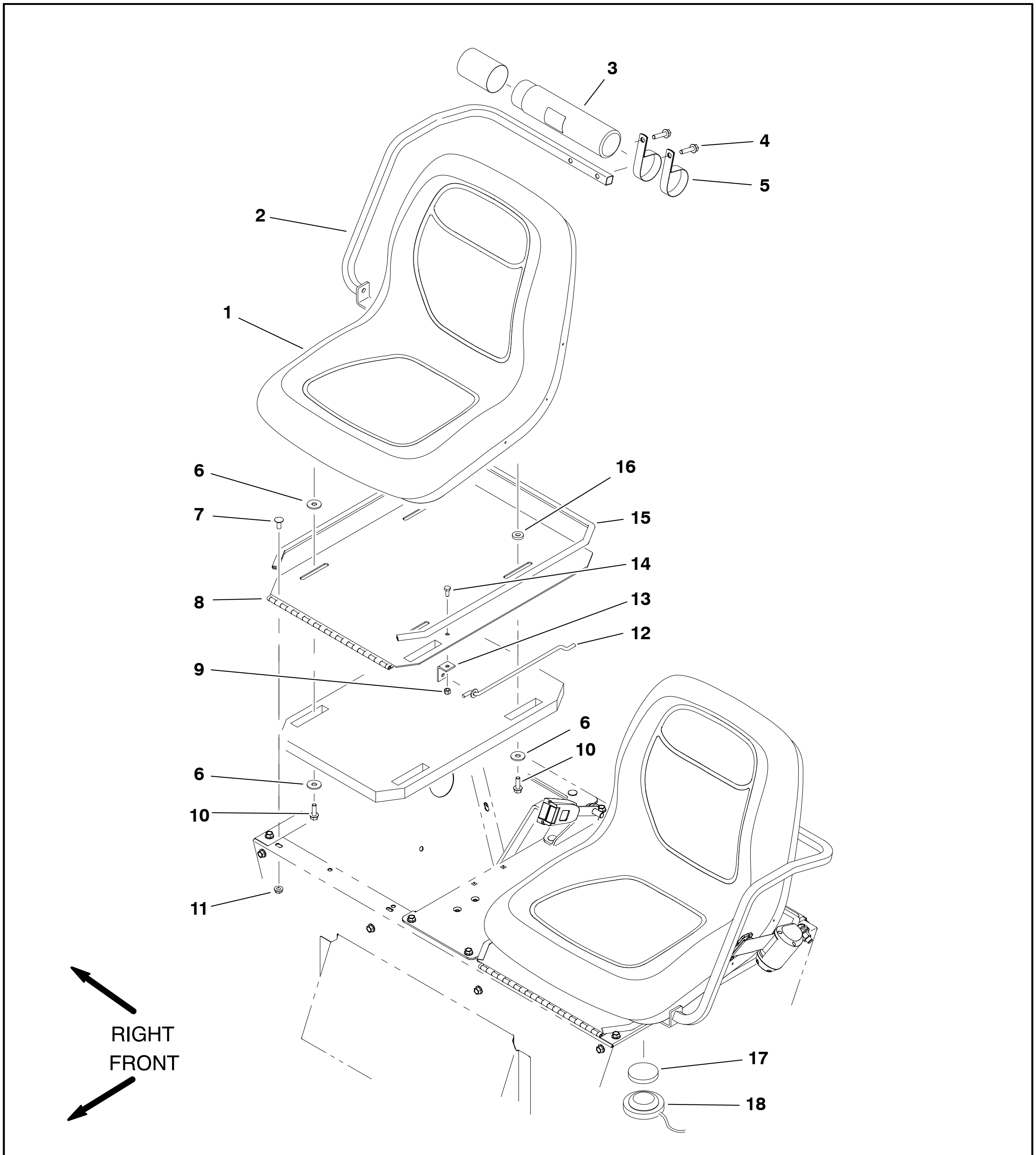


Figure 21

1. Seat assembly (2)
2. Armrest (2)
3. Manual storage tube
4. Flange head screw (2)
5. R–Clamp (2)
6. Flat washer (10)
7. Carriage screw (4)
8. Hinged seat panel (2)
9. Lock nut (2)
10. Flange head screw (8)
11. Flange nut (4)
12. Prop rod (2)
13. Prop rod bracket (2)
14. Cap screw (2)
15. Trim (2)
16. Flat washer (6)
17. Plunger disc
18. Seat switch

Removal (Fig. 21)

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

2. Raise and latch seat.

3. Disconnect seat switch from machine wire harness (Operator seat only).

4. Remove two (2) carriage screws and flange nuts securing hinged seat panel to seat box.

5. Slide seat assembly forward until prop rod can be removed from slot in console base and lift seat assembly from machine.

6. Repeat steps 4. and 5. for remaining seat assembly.

7. Record fastener location in mounting slot and remove four (4) flange head screws and flat washers securing seat to hinged seat panel and remove seat if necessary.

8. Remove hex nut and cap screw securing prop rod bracket to seat panel and remove prop rod and bracket if necessary.

Installation (Fig. 21)

1. Install prop rod and bracket to seat panel if previously removed.

NOTE: Seat mounting slots in hinged seat panel are slotted to afford some seat adjustment for operator comfort.

2. Install seat to seat panel with four (4) flange head screws and flat washers. Locate screws in seat panel slot position recorded during removal before tightening.

3. Pass prop rod through slot in console base and secure hinged seat panel to seat box with two (2) carriage screws and flange nuts.

4. Connect seat switch to machine wire harness (Operator seat only).

Console Assembly

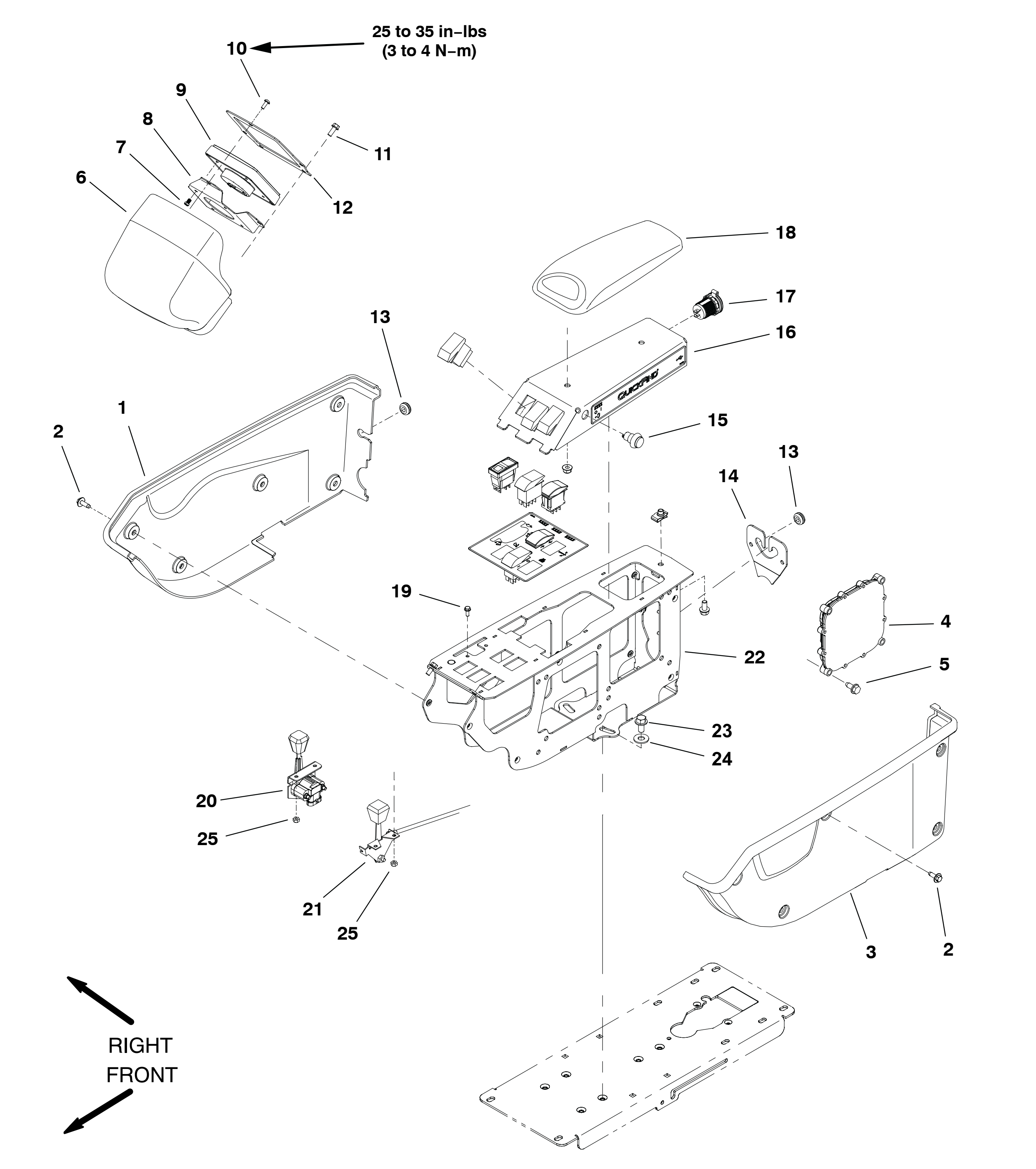


Figure 22

1. RH cover
2. Washer head screw (10)
3. LH cover
4. Toro Electronic Controller (TEC)
5. Washer head screw (4)
6. Console hood
7. Pan head screw (4)
8. Retainer
9. InfoCenter display
10. Pan head screw (3)
11. Washer head screw (2)
12. Plate
13. Grommet (2)
14. Retainer
15. Master boom switch
16. Arm rest panel
17. USB socket
18. Arm rest
19. Washer head screw (2)
20. Throttle control (gasoline engine)
21. Throttle control (diesel engine)
22. Console arm
23. Flange head screw (3)
24. Flat washer (3)
25. Flange nut (2)

Disassembly (Fig. 22)

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

2. Remove five (5) washer head screws (item 2) that secure each cover to console assembly and remove console assembly covers from machine.

3. Remove components from console assembly as needed. Record the location of any wire harness clips. clamps or anchors.

NOTES:

USB Socket: Install with cap hinge to top, grey wire to top terminal and black wire to bottom terminal.

Throttle control (diesel engines): Pass throttle cable through grommets in console frame and console base. Secure throttle cable to R−clamp on engine shroud. Make sure throttle cable swivel at engine rotates freely and that throttle arm at engine travels fully from stop to stop.

Console frame: Install as far to right as possible without interfering with passenger seat movement (open/close).

Assembly (Fig. 22)

1. Install all removed components to console assembly. Secure wire harness to machine as noted during disassembly.

2. Position covers to console assembly. Make sure that wire harness and throttle control cable (diesel engines) are routed correctly through cover openings.

3. Secure each cover to console assembly with five (5) washer head screws (item 2).

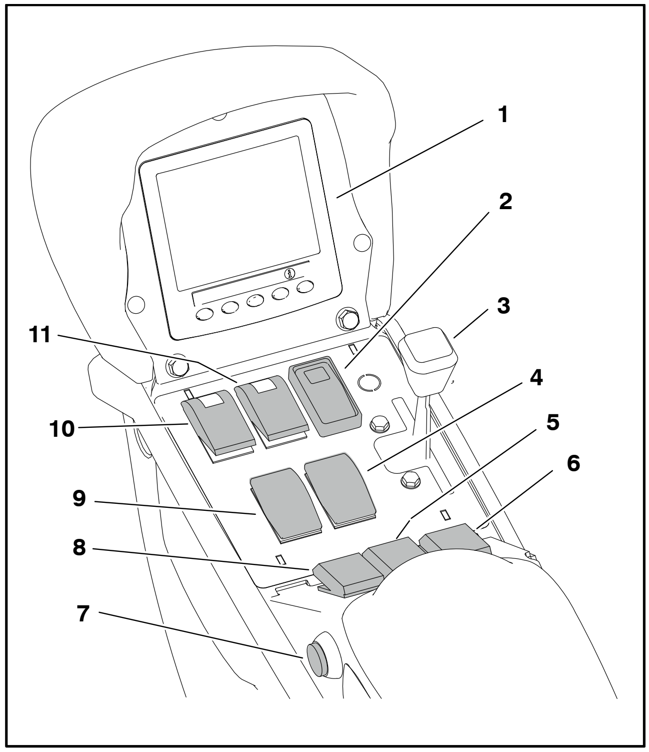


Figure 23

1. **InfoCenter display**
2. **Speed lock switch**
3. **Throttle control**
4. **Right boom lift switch**
5. **Center boom switch**
6. **RH boom switch**
7. **Master boom switch**
8. **LH boom switch**
9. **Left boom lift switch**
10. **Pump switch**
11. **Agitation switch**

Chapter 10

Ultra Sonic Boom Kit (Optional)

Table of Contents

General Information

Installation Instructions

The Ultra Sonic Boom Kit Installation Instructions provides information regarding the installation, operation and general maintenance for your Ultra Sonic Boom System. Refer to that publication for additional information when servicing the machine.

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 5800 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. The operation of inputs to the TEC as well as outputs from the TEC can be monitored via a separate CAN−bus network not connected to the machine CAN−bus network. The diagnostic connector for the ultra sonic boom Can−bus network is located just below the ultra sonic boom TEC behind the operator control console (Fig. 1). Contact an Authorized Toro Distributor for ultra sonic boom TEC diagnostic and reprogramming assistance.

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.

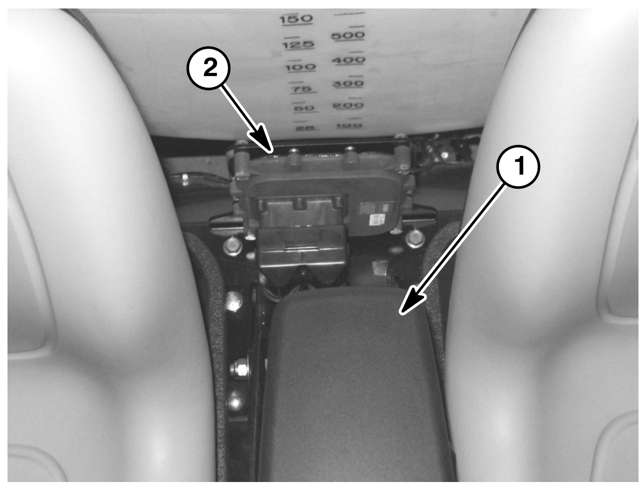


Figure 1

1. Operator control console
2. Toro Electronic Controller (TEC)

CAN–bus Communications

Communication (diagnostics and reprogramming) with the ultra sonic boom TEC controller is accomplished via a separate Controller Area Network (CAN) bus system not connected to the machine CAN–bus network. The ultra sonic boom switch needs to be in the AUTOMATIC or MANUAL position for the network to be active.

Two (2) specially designed, twisted wires form the CAN bus. The engineering term for these cables are CAN High and CAN Low. The bus wires for the 12 VDC circuits are black/white and red/white. At the ends of the twisted pair of bus cables are two (2) 120 ohm termination resistors.

IMPORTANT: The termination resistor at the end of the bus wires is required for proper electrical system operation.

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.

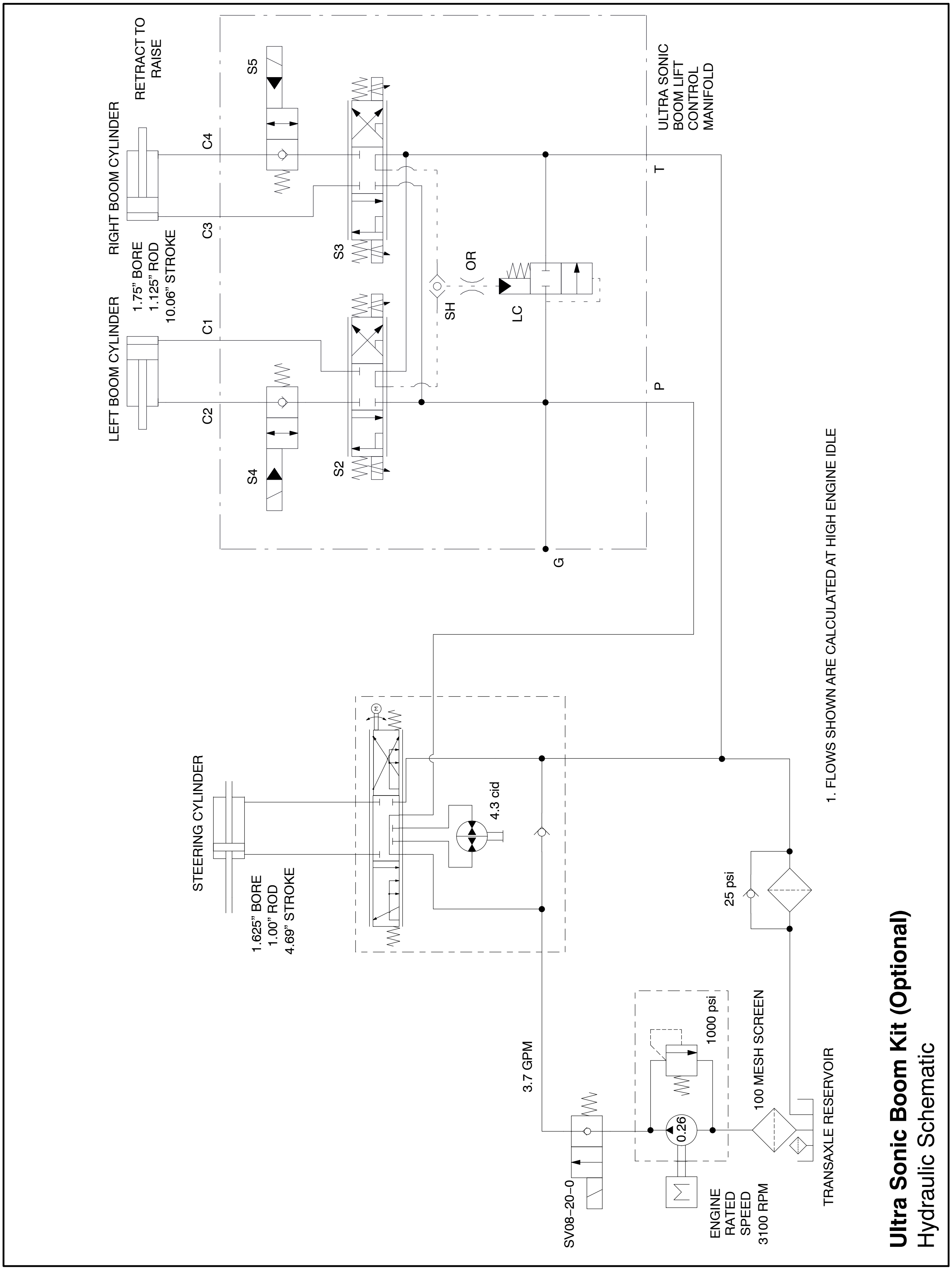
2. Shut off the vehicle's engine and remove the key from the ignition switch.

3. Disengage all power and wait until all moving parts have stopped.

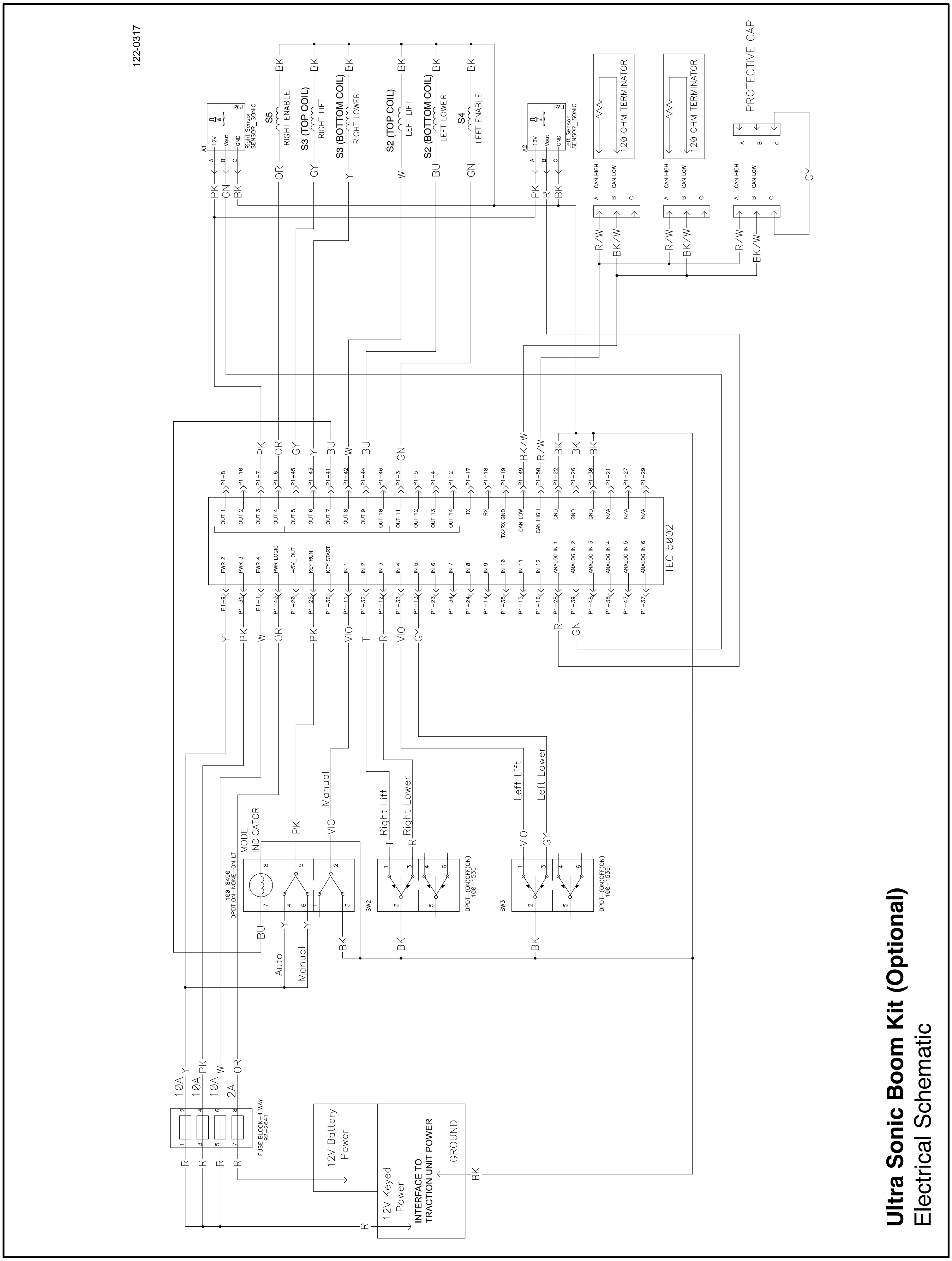
4. Remove chemicals from pump, hoses and other spray components. Thoroughly neutralize and rinse spray system before loosening or removing any spray system component(s).

5. Make sure spray system pressure is relieved before loosening any system component.

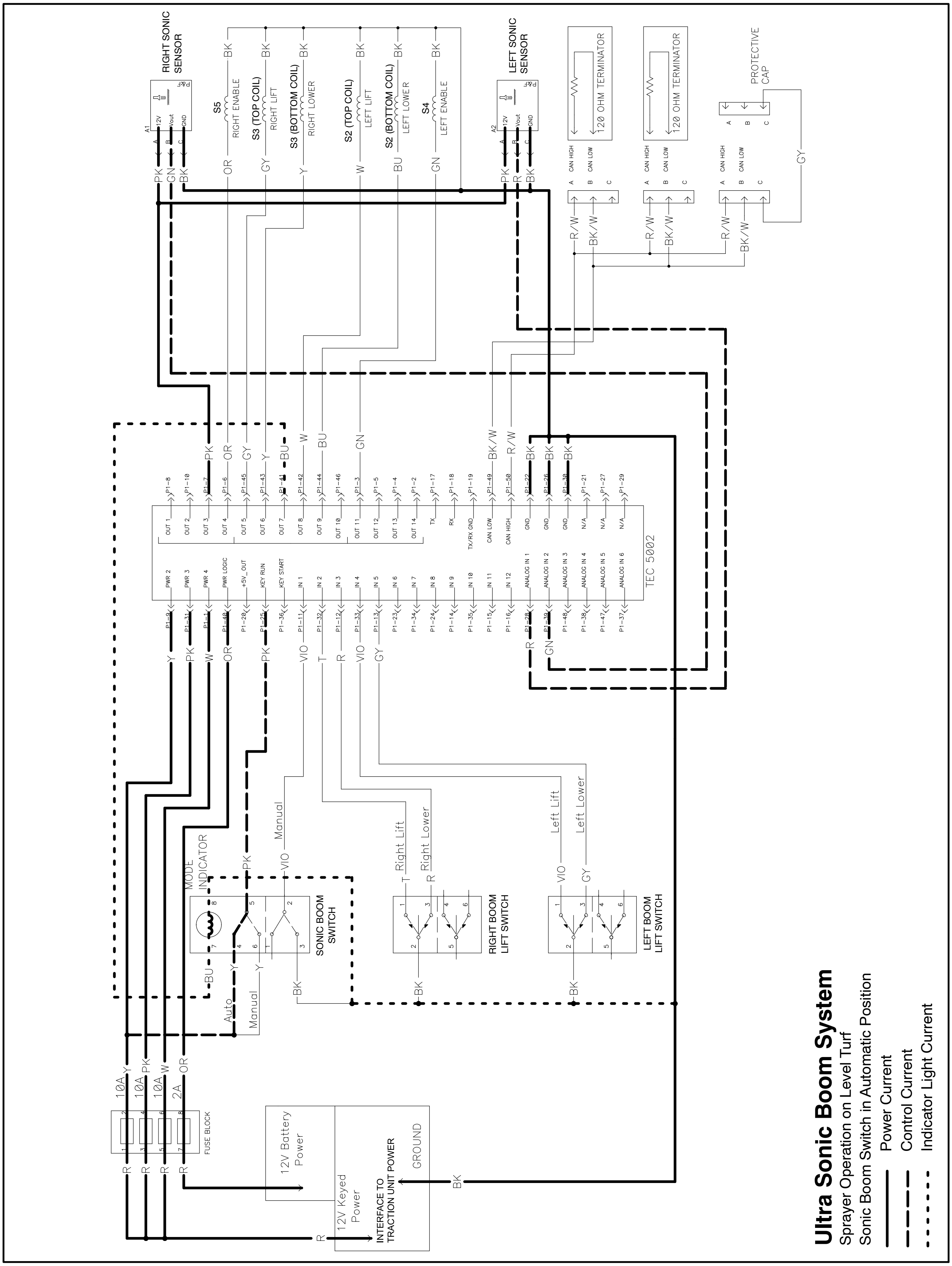
Hydraulic Schematic



Electrical Schematic



Ultra Sonic Boom System Operation



Sprayer Operation on Level Turf

During sprayer operation with the sonic boom switch in the automatic position (sonic boom light is illuminated), the boom mounted sonic boom sensors continually send impulse signals and then receive echoes as the signals bounce off the turf. The Toro electronic controller (TEC) determines the sensor distance from the ground based on the elapsed time between the sensor signal generation and the received echo. As long as the sensor height remains the same as the calibrated height, the spray boom will remain at a fixed height from the ground for spraying accuracy.

On level turf, the boom sensors continually send signals and receive echoes that determine that the boom sections are at the calibrated height. Thus, there is no need to change boom height. The TEC does not energize lift control manifold solenoid coils so hydraulic flow bypasses the boom lift cylinders (Fig. 2). The boom sections will remain at the correct, level position.

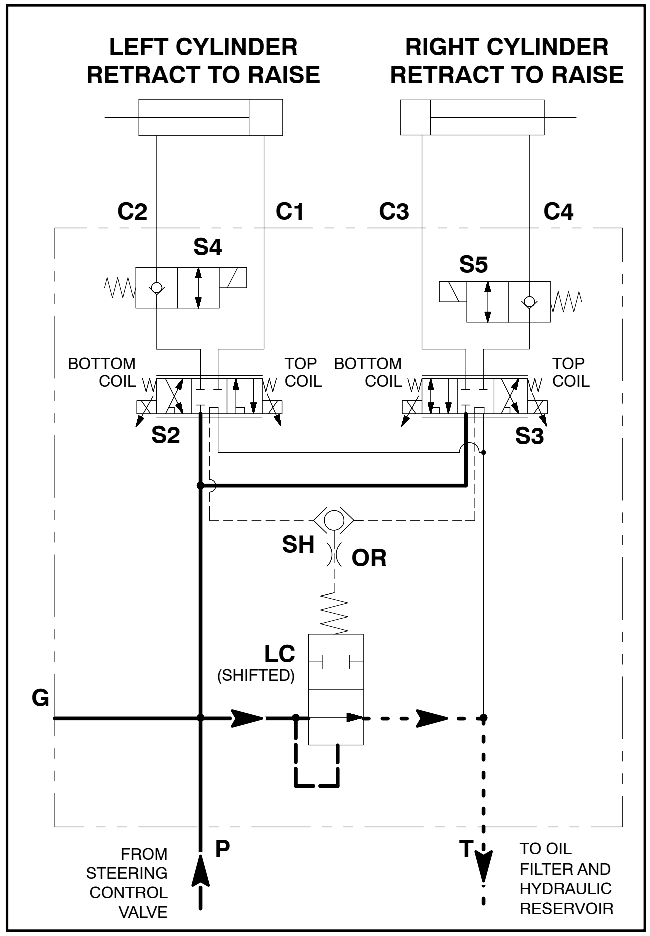


Figure 2

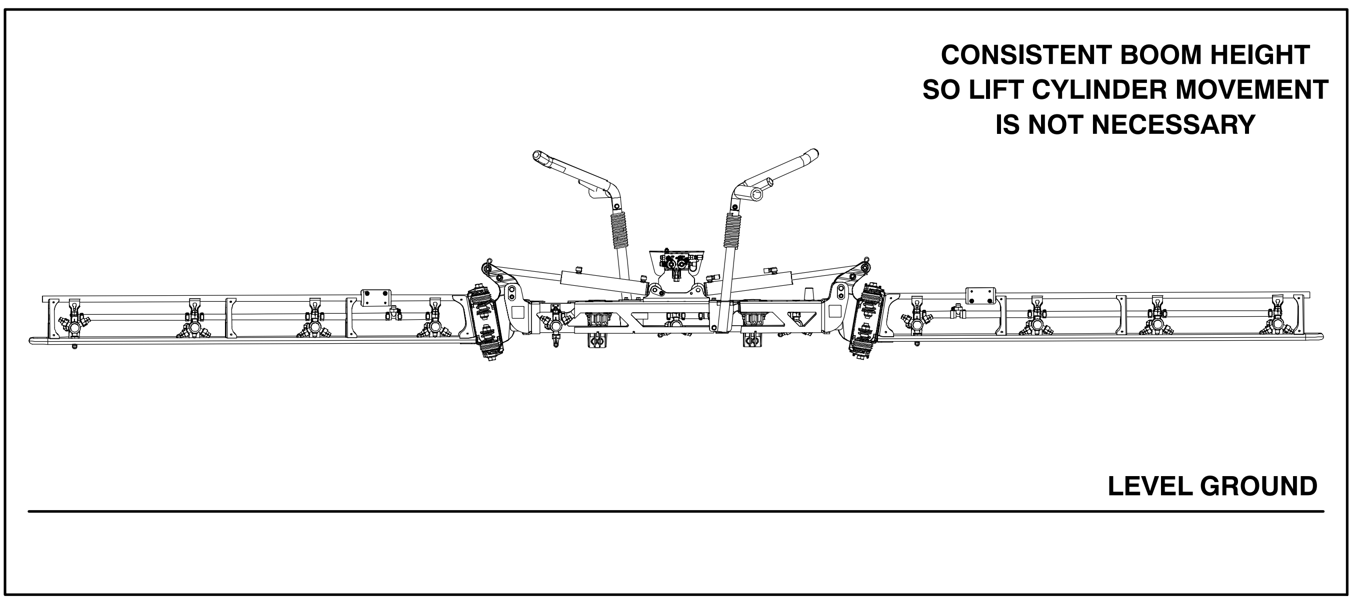
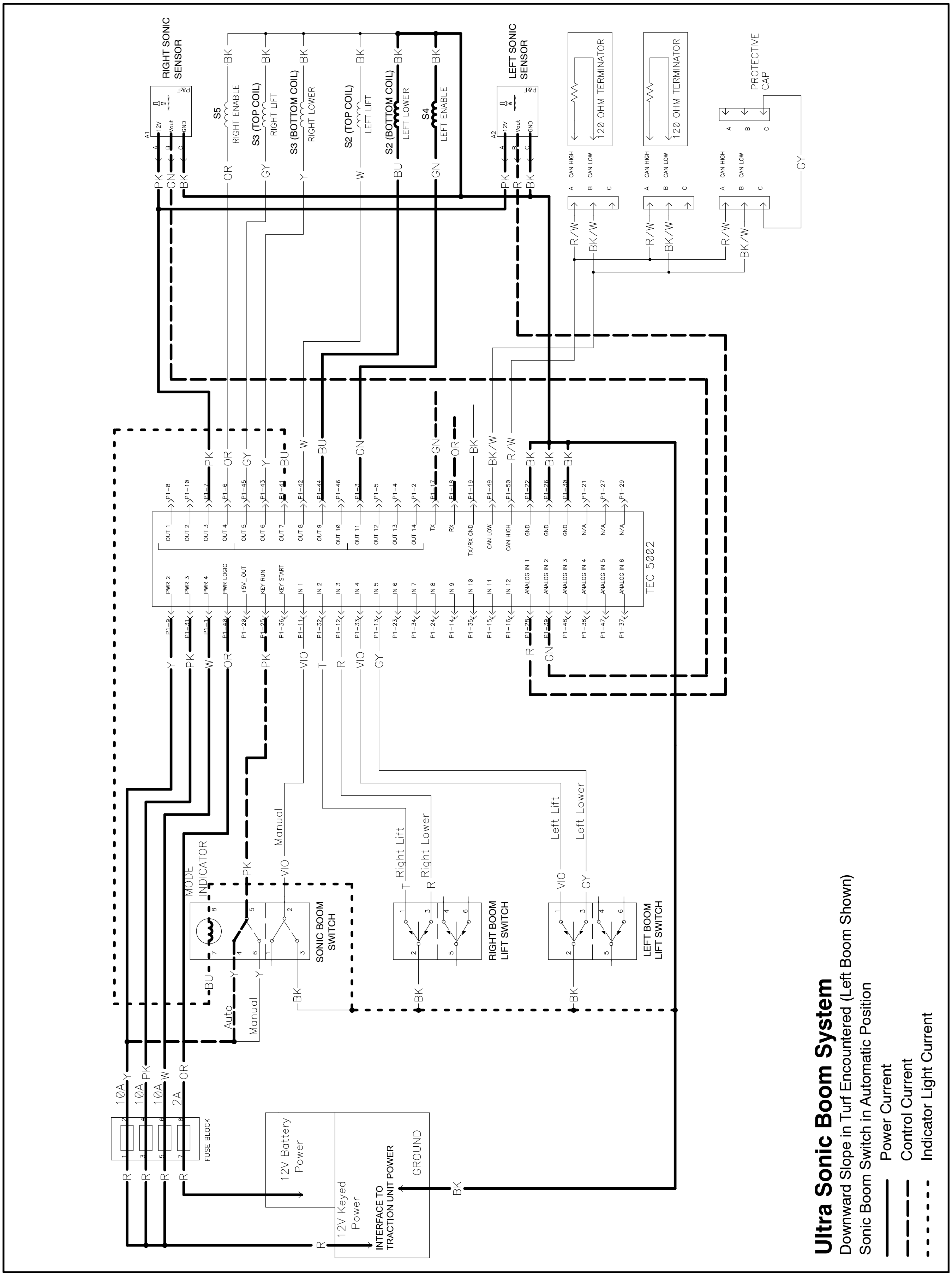


Figure 3


Ultra Sonic Boom System
Downward Slope in Turf Encountered (Left Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
TEC 5002
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
FUSE BLOCK
120 OHM TERMINATOR
PROTECTIVE CAP
INTERFACE TO TRACTION UNIT POWER
MODE INDICATOR

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.

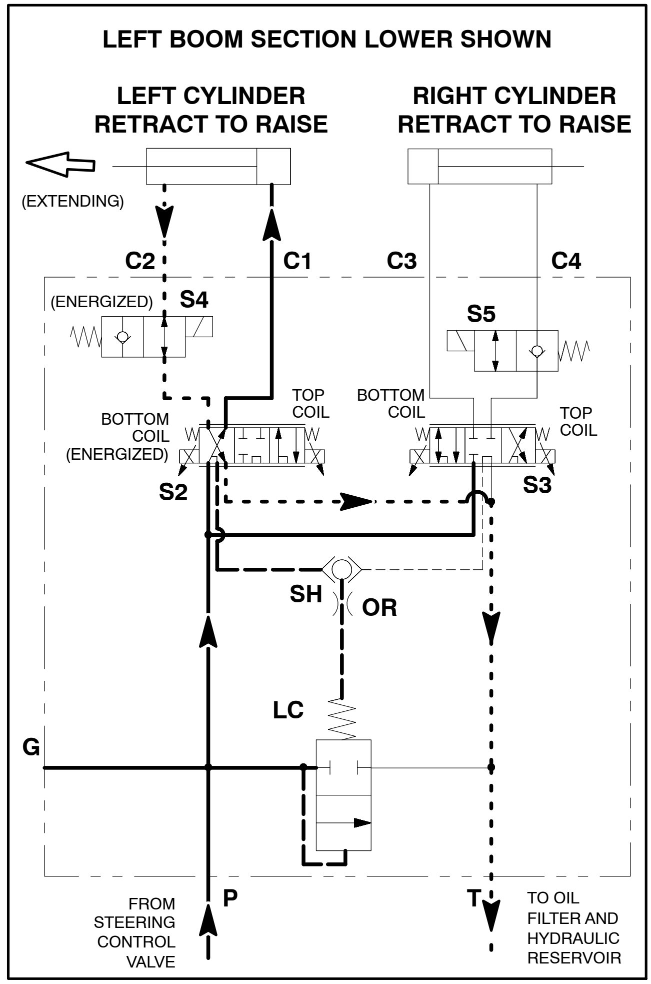


Figure 4

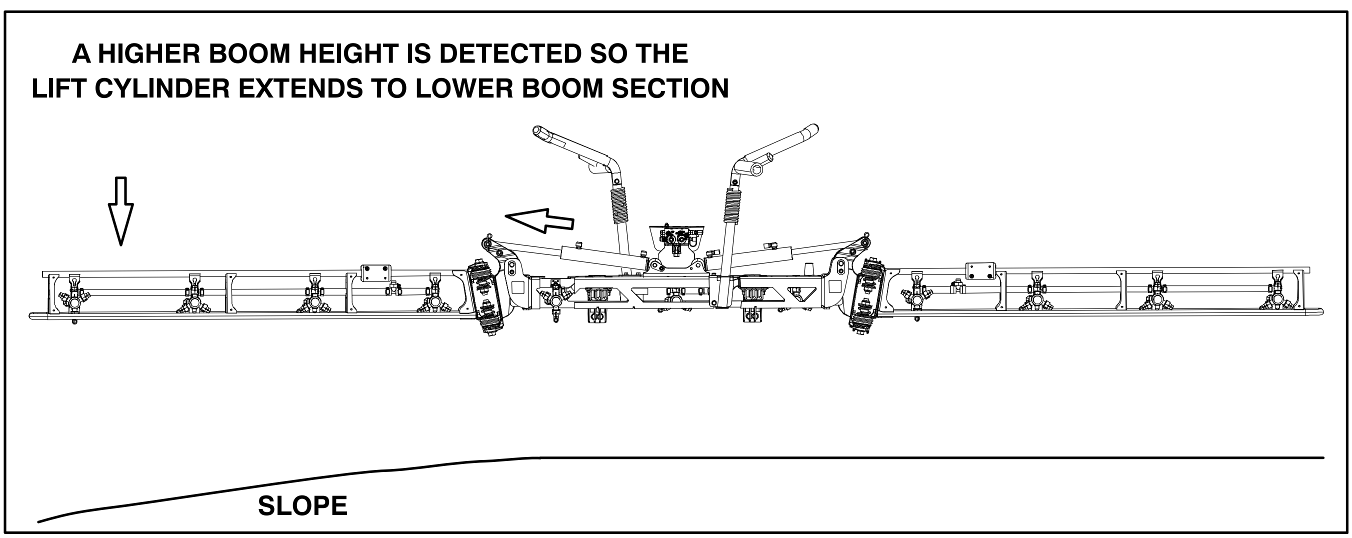
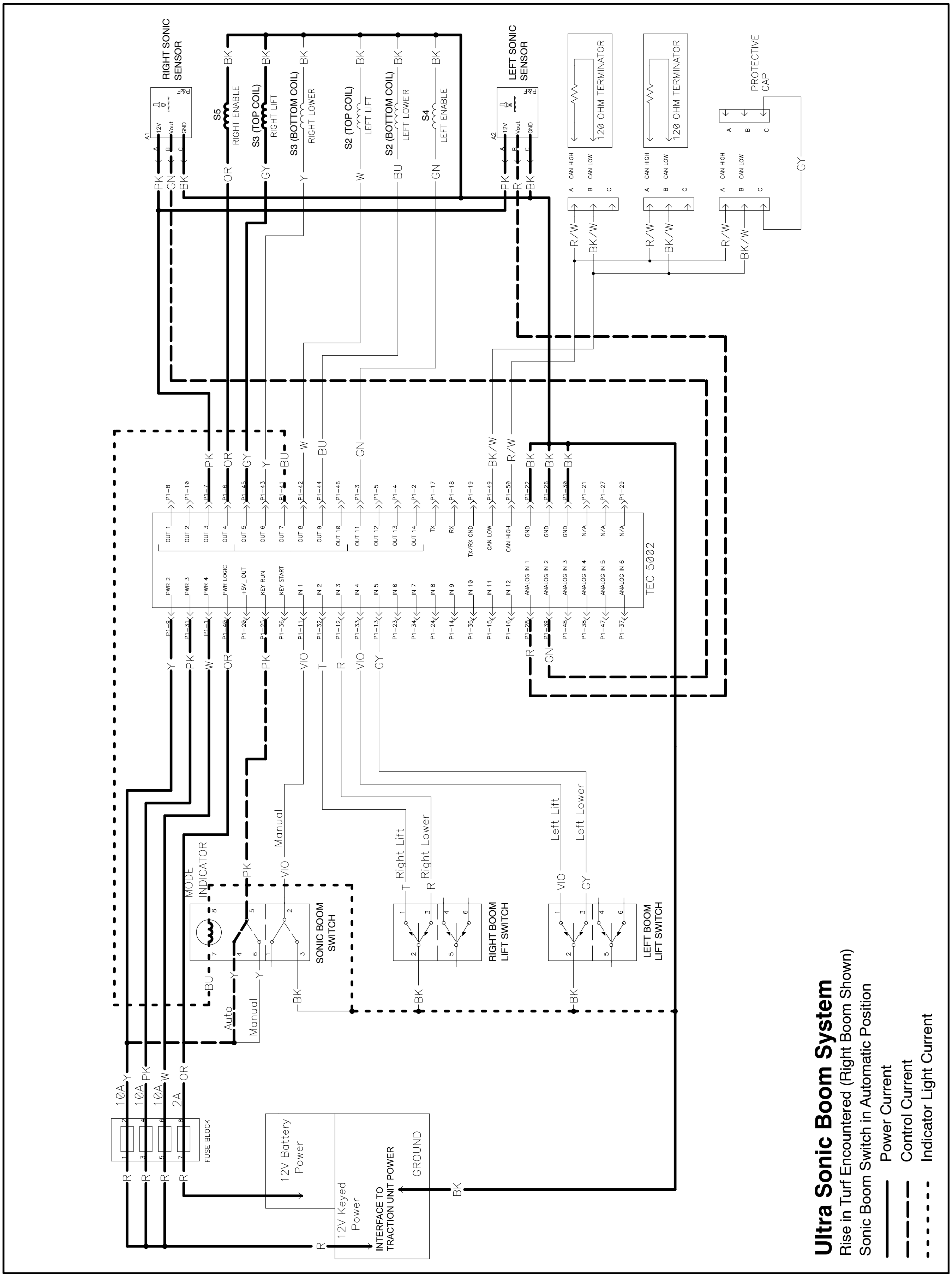


Figure 5


Ultra Sonic Boom System
Rise in Turf Encountered (Right Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
S5 RIGHT ENABLE
S3 (TOP COIL) RIGHT LIFT
S3 (BOTTOM COIL) RIGHT LOWER
S2 (TOP COIL) LEFT LIFT
S2 (BOTTOM COIL) LEFT LOWER
S4 LEFT ENABLE
120 OHM TERMINATOR
120 OHM TERMINATOR
PROTECTIVE CAP
TEC 5002
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
Right Lift
Right Lower
Left Lift
Left Lower
Manual
Auto
FUSE BLOCK
10A
10A
10A
2A
12V Battery Power
12V Keyed Power
GROUND
INTERFACE TO TRACTION UNIT POWER

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.

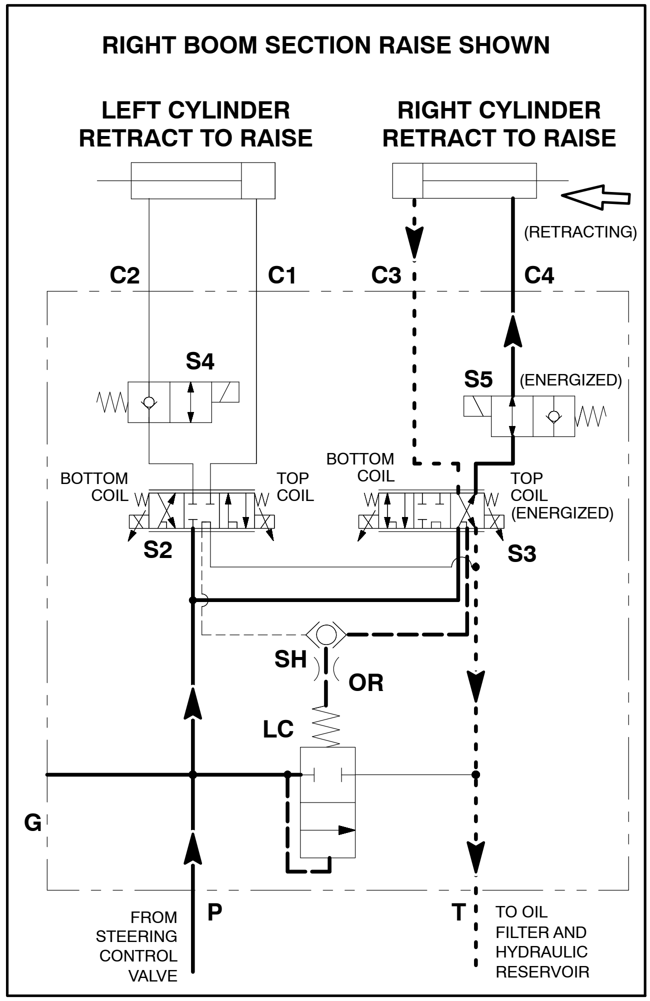


Figure 6

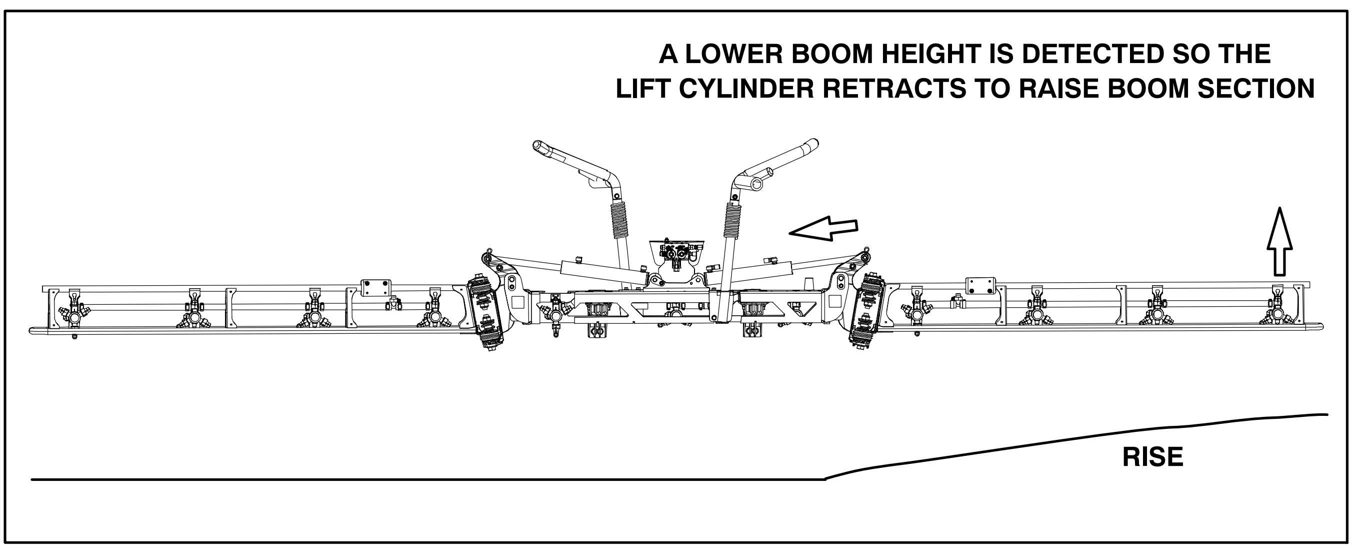
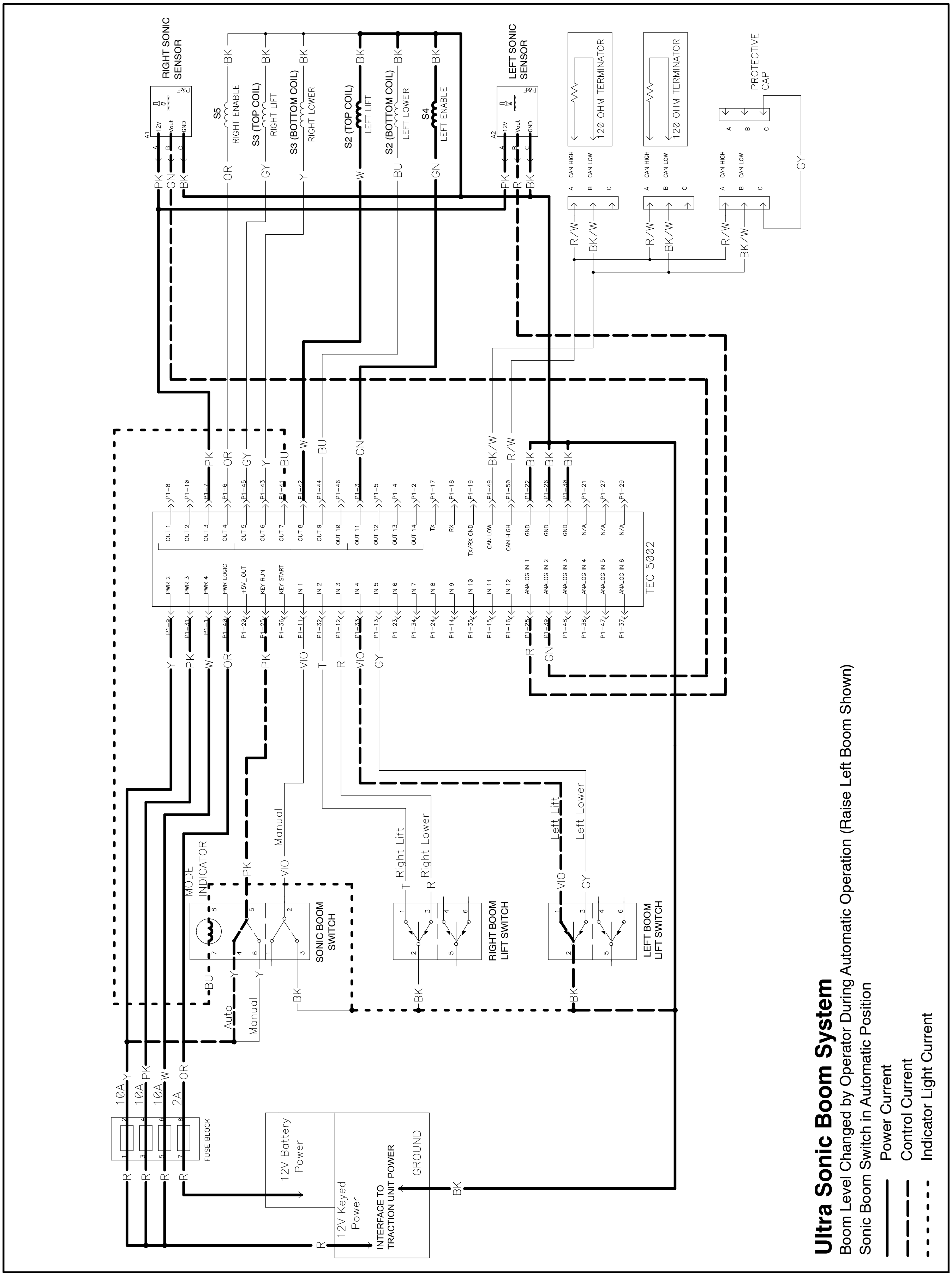


Figure 7


Ultra Sonic Boom System
Boom Level Changed by Operator During Automatic Operation (Raise Left Boom Shown)
Sonic Boom Switch in Automatic Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
S5
RIGHT ENABLE
S3 (TOP COIL)
RIGHT LIFT
S3 (BOTTOM COIL)
RIGHT LOWER
S2 (TOP COIL)
LEFT LIFT
S2 (BOTTOM COIL)
LEFT LOWER
S4
LEFT ENABLE
120 OHM TERMINATOR
120 OHM TERMINATOR
PROTECTIVE CAP
TEC 5002
MODE INDICATOR
SONIC BOOM SWITCH
Manual
Auto
Right Lift
Right Lower
RIGHT BOOM LIFT SWITCH
Left Lift
Left Lower
LEFT BOOM LIFT SWITCH
FUSE BLOCK
10A
10A
10A
2A
12V Battery Power
12V Keyed Power
GROUND
INTERFACE TO TRACTION UNIT POWER

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.

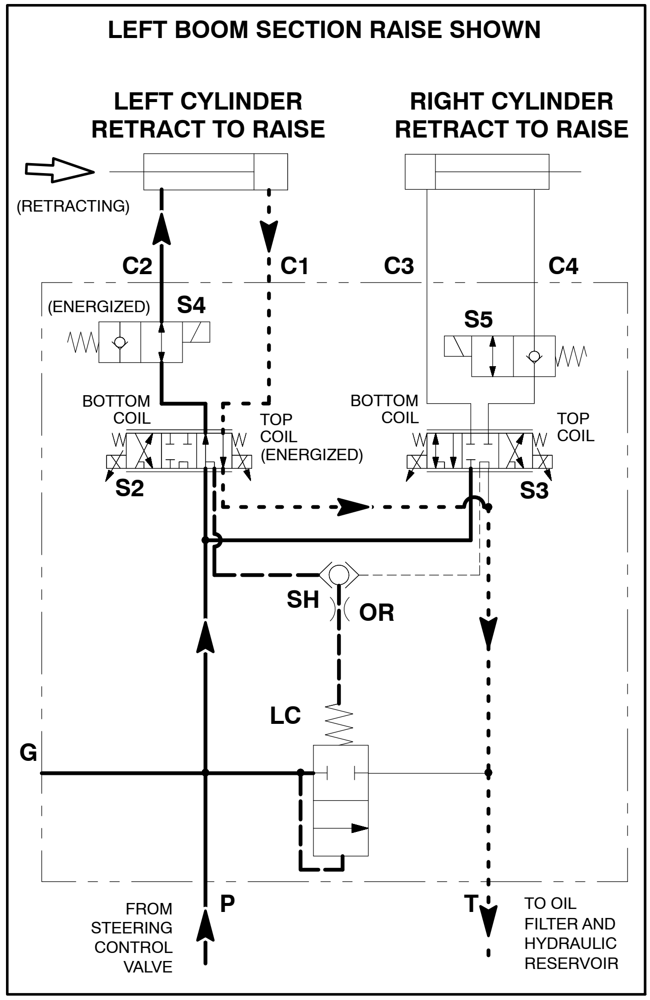
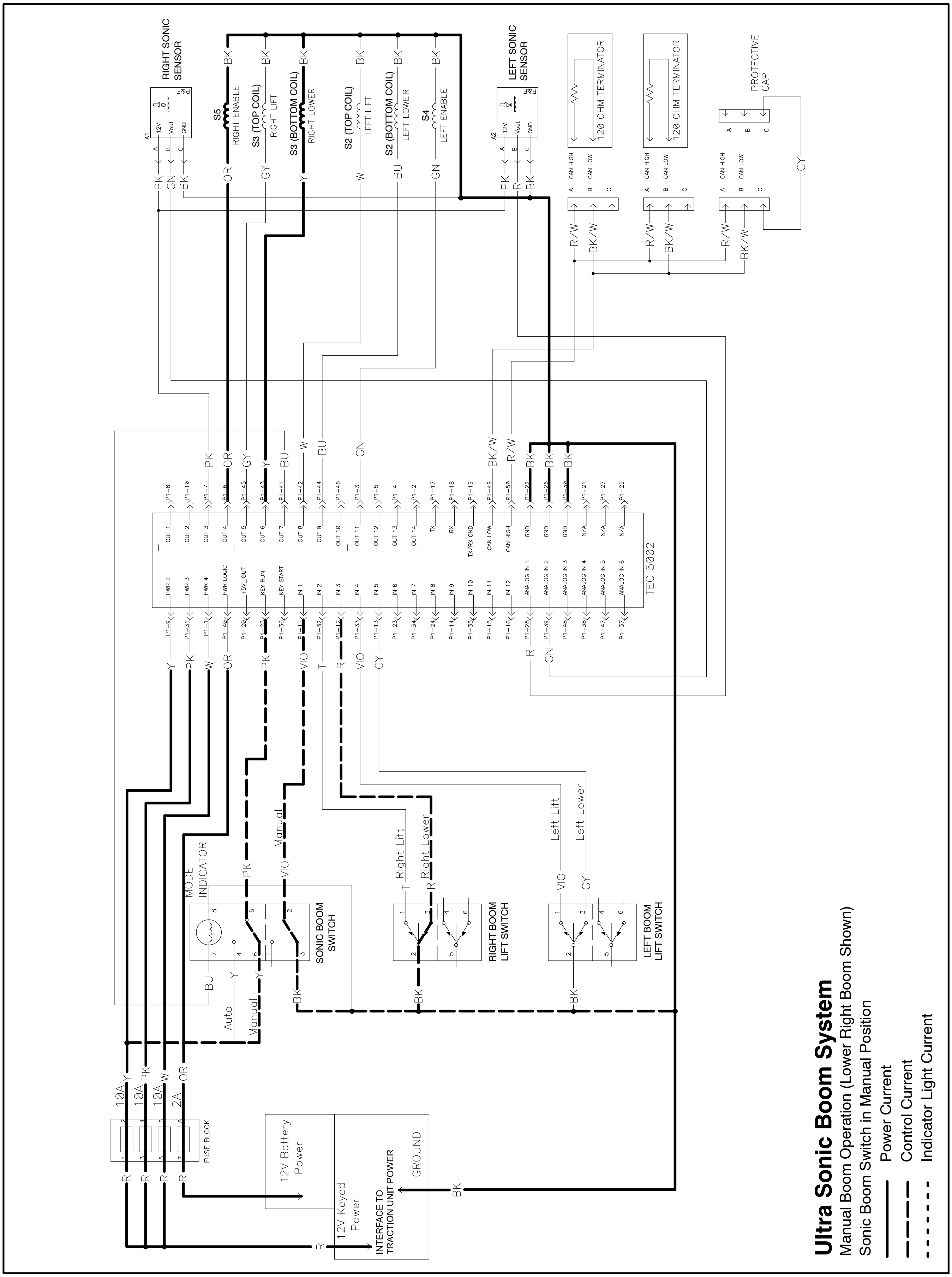


Figure 8



Ultra Sonic Boom System
Manual Boom Operation (Lower Right Boom Shown)
Sonic Boom Switch in Manual Position
Power Current
Control Current
Indicator Light Current
RIGHT SONIC SENSOR
LEFT SONIC SENSOR
120 OHM TERMINATOR
120 OHM TERMINATOR
PROTECTIVE CAP
TEC 5002
MODE INDICATOR
SONIC BOOM SWITCH
RIGHT BOOM LIFT SWITCH
LEFT BOOM LIFT SWITCH
FUSE BLOCK
12V Battery Power
12V Keyed Power
GROUND
INTERFACE TO TRACTION UNIT POWER

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.

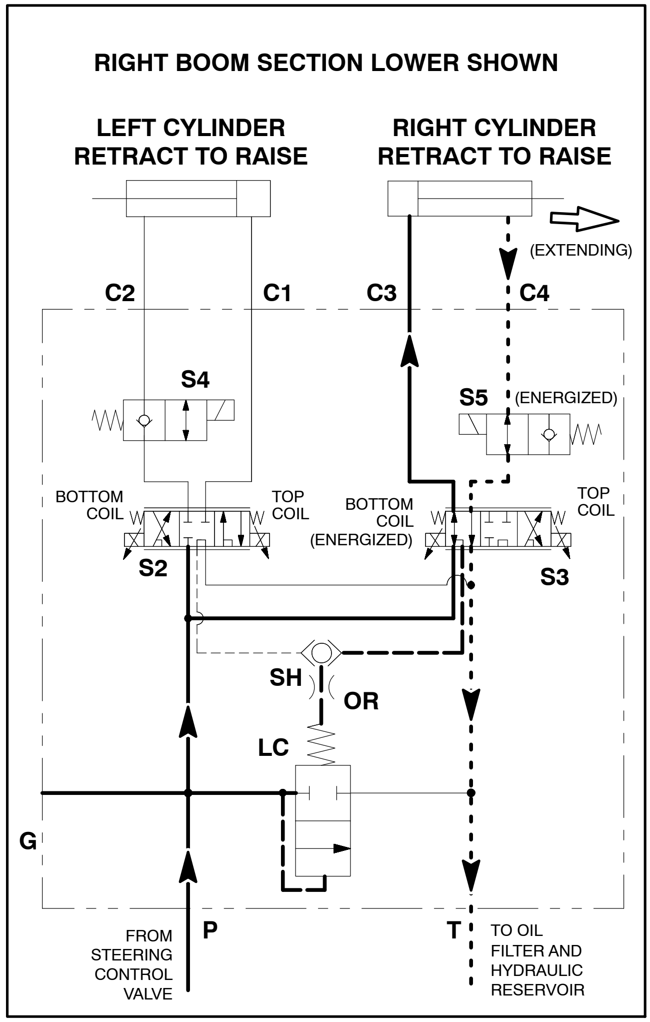


Figure 9

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 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. 10). This light should be illuminated whenever the vehicle ignition switch is ON and the sonic boom switch is in the automatic position.

The sonic boom light flashing quickly indicates that the Ultra Sonic Boom System is in the calibration mode. This mode allows the spray booms to be adjusted for the desired boom height. The calibration mode lasts for twenty (20) seconds after which the sonic boom light should quit flashing.

NOTE: A sequence of switch movements is necessary to engage the calibration mode. Refer to the Sonic Boom Kit Installation Instructions for this sequence.

The sonic boom light flashes slowly when the sonic boom switch is in the automatic position and a boom lift switch is pressed to manually change the boom height. The flashing light will return to being constantly ON and automatic operation will be re–engaged once the boom switch is manually pressed to the lower position.

A slowly flashing 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. If this occurs, refer to the Troubleshooting Chart in this section.

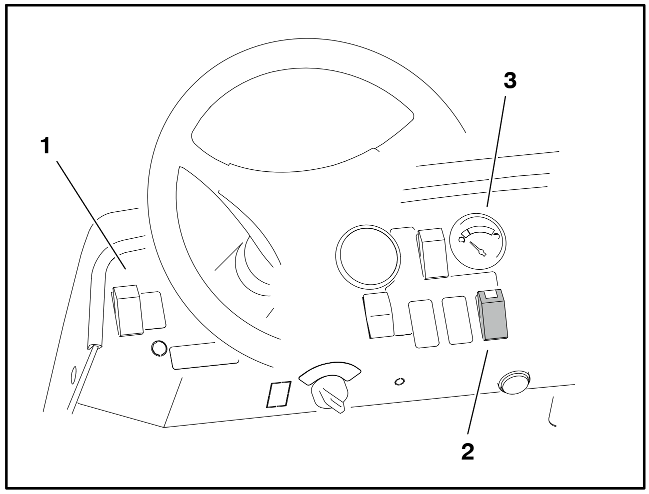


Figure 10

1. **Instrument panel**
2. **Ultra sonic boom switch**
3. **Fuel gauge**

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.

Troubleshooting Chart

The chart that follows contains suggestions that can be used to assist in diagnosing Ultra Sonic Boom System performance issues. These suggestions are not all−inclusive. Also, consider that there may be more than one cause for a machine problem.

NOTE: When troubleshooting an electrical problem on your Ultra Sonic Boom System, refer to information regarding the sonic boom light in this section.

Problem	Possible Cause
Light in sonic boom switch is not illuminated.	Sonic boom switch is in the MANUAL position. Fuse D (2 amp) in sonic boom fuse block is faulty (all sonic boom functions are affected). Fuse B (10 amp) in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). Sonic boom switch or circuit wiring is faulty.
One of the boom lift cylinders will not extend or retract.	Boom lift switch or circuit wiring for affected lift cylinder is faulty. Boom lift control manifold solenoid coil or circuit wiring for affected lift cylinder is faulty. A hydraulic problem exists with the lift cylinder, boom lift control manifold or other hydraulic component.
Neither of the boom lift cylinders will extend or retract.	Fuse(s) in sonic boom fuse block is faulty. Electrical power from vehicle is not available (all sonic boom functions are affected). A hydraulic problem exists with the lift cylinders, boom lift control manifold or other hydraulic component. The Toro electronic controller (TEC) or circuit wiring is faulty.
The LED's on one of the sonic boom sensors are not illuminated.	Sonic boom sensor or circuit wiring is faulty.
The LED's on both of the sonic boom sensors are not illuminated.	Sonic boom switch is in the MANUAL position. Fuse A (10 amp) in sonic boom fuse block is faulty. Sonic boom switch or circuit wiring is faulty.

Problem	Possible Cause
One of the booms does not automatically follow ground irregularities. Boom can be controlled with boom lift switch.	On affected boom, the sonic boom sensor cover is on sensor. On affected boom, calibration of the sonic boom sensors is incorrect. The sonic boom sensor is incorrectly installed. Sonic boom sensor or circuit wiring for affected boom is faulty. The Toro electronic controller (TEC) or circuit wiring is faulty.
Neither boom automatically follows ground irregularities. Booms can be controlled with boom lift switches.	Sonic boom switch is not in the AUTOMATIC position. Sonic boom sensor covers are on both sensors. Calibration of the sonic boom sensors is incorrect. Both sonic boom sensors or circuit wiring are faulty. The Toro electronic controller (TEC) or circuit wiring is faulty.

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 1−2 (10 Amp): Protects power supply for TEC outputs (sonic sensors and solenoid coil S5).

Fuse 3−4 (10 Amp): Protects power supply for TEC outputs (sonic boom light and hydraulic solenoid coils S2 and S3).

Fuse 5−6 (10 Amp): Protects power supply for TEC outputs (hydraulic solenoid coil S4).

Fuse 7−8 (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.

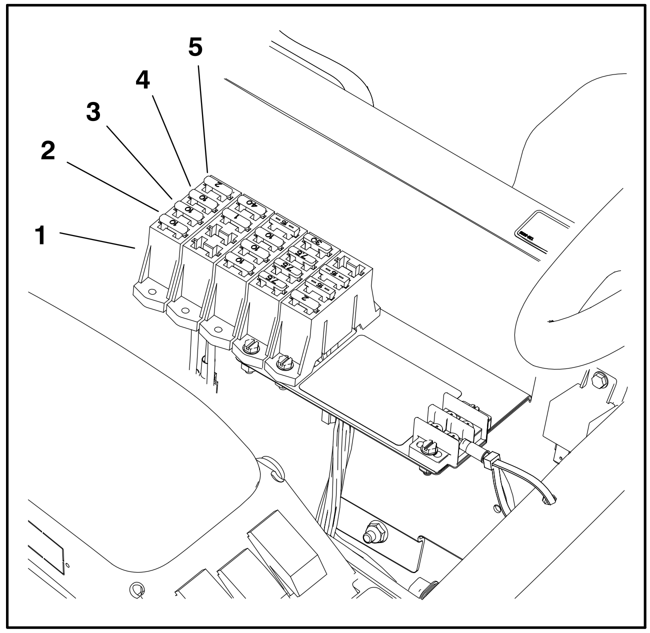


Figure 11

1. **Fuse block**
2. **Fuse 1−2**
3. **Fuse 3−4**
4. **Fuse 5−6**
5. **Fuse 7−8**

Ultra Sonic Boom Switch

The sonic boom switch is used as an input for the Toro electronic controller (TEC) to activate the Ultra Sonic Boom System. This switch has three (3) positions: automatic system off, automatic system on and a third position to allow the operator to operate the booms in manual mode. The sonic boom switch is located on the dash panel (Fig. 12).

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 and the boom lift switches are used to raise/lower the booms.

Testing

The ultra sonic boom switch and its circuit wiring can be tested as a TEC input (contact an Authorized Toro Distributor). If testing determines that the switch and circuit wiring are not functioning correctly, or if Toro diagnostic equipment is not available, proceed with the following test procedure:

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

2. Disconnect wire harness electrical connector from the sonic boom switch on the dash.

3. The switch terminals are marked as shown in Figure 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), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

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 circuit problem still exists, check wire harness.

6. After testing is completed, connect wire harness connector to the sonic boom switch.

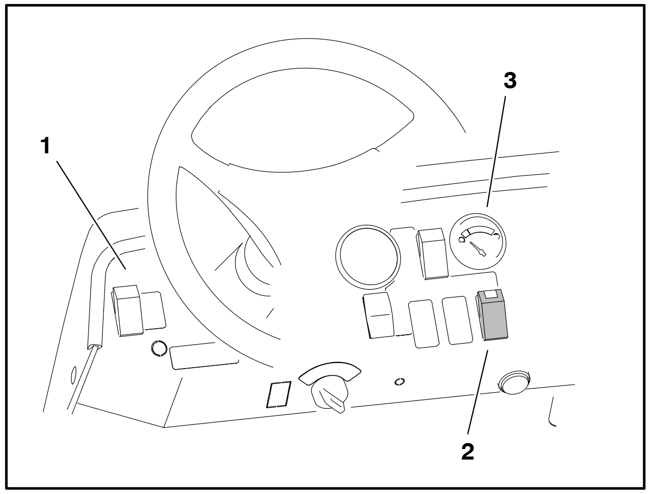


Figure 12

1. **Instrument panel**
2. **Ultra sonic boom switch**
3. **Fuel gauge**

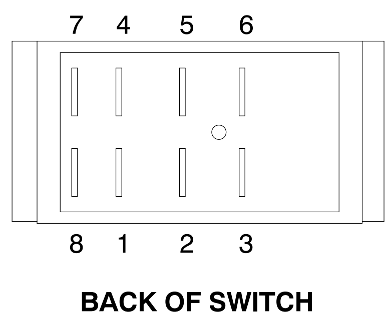


Figure 13

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
MANUAL	2 + 3 5 + 6	2 + 1 5 + 4
AUTOMATIC	2 + 1 5 + 4	2 + 3 5 + 6

Sonic Sensors

Two (2) identical sonic sensors are used in the Ultra Sonic Boom System. The sensors are mounted to the spray booms (Figs. 14, 15 and 16). During sprayer operation with the sonic boom switch in the automatic position, the sonic sensors will provide inputs for the Toro Electronic Controller (TEC) to keep the booms at a constant distance from the ground.

During sprayer operation, the sonic boom sensor continually sends an impulse signal and then receives an echo as the signal bounces off the turf. The TEC establishes the sensor distance from the ground based on the time between the sensor signal generation and the received echo. The TEC then determines if the boom height is different than the calibrated height and, if necessary, energizes the appropriate solenoid(s) on the hydraulic lift control manifold to change the boom height.

Sensors should be secured to the spray booms correctly for proper sonic sensor operation. Refer to the Ultra Sonic Boom Kit Installation Instructions for sonic sensor installation and setup information.

The sonic sensors and their circuit wiring can be tested as TEC inputs (contact an Authorized Toro Distributor). 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. 17).

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.

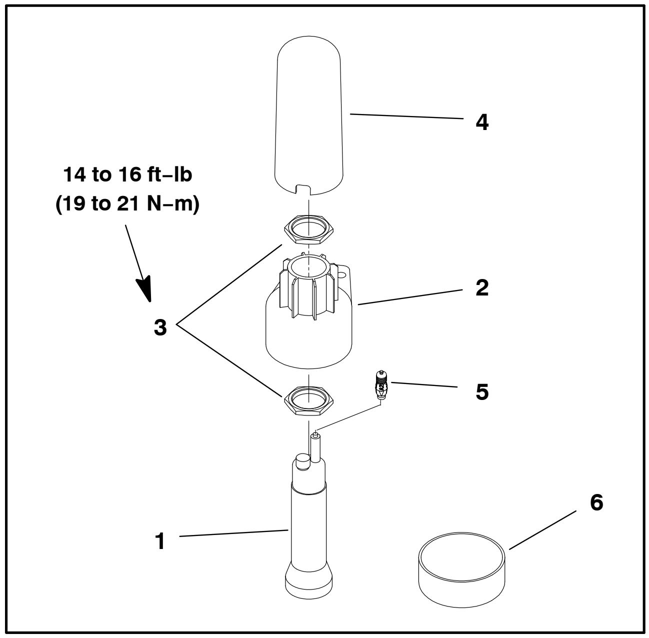


Figure 14

1. **Sonic sensor**
2. **Lower housing**
3. **Nut (2 used)**
4. **Cover**
5. **Programming plug**
6. **Cap**

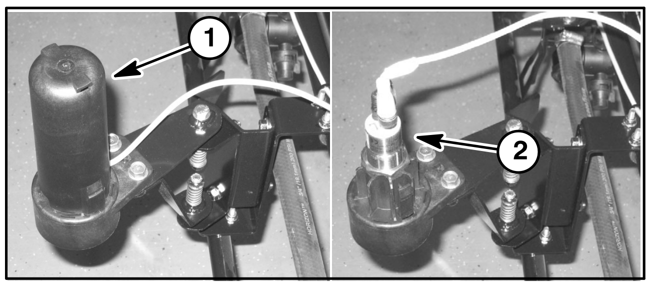


Figure 15

1. **Sensor with cover**
2. **Sensor without cover**

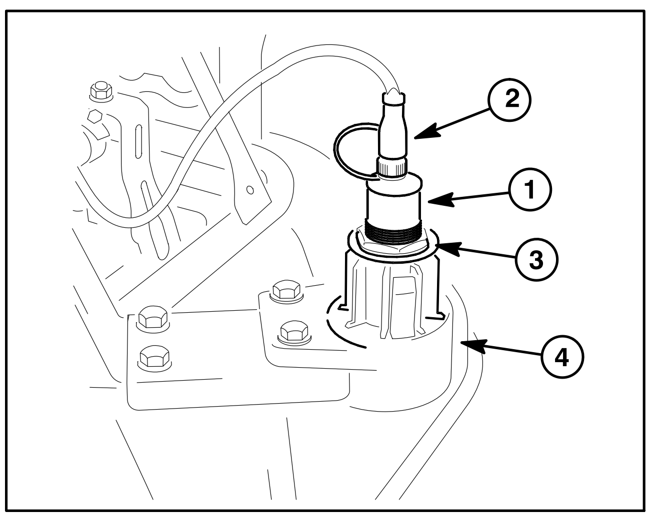


Figure 16

1. **Sonic sensor**
2. **Harness connector**
3. **Nut (2 used)**
4. **Lower housing**

Sonic Sensor LED Window

The sonic sensor includes a LED window that identifies sensor status during Ultra Sonic Boom system operation (Fig. 18). To view the LED window, carefully remove cover from sonic sensor. The LED window includes four (4) LED's.

During normal operation, the green LED and both yellow LED's should be illuminated. The red LED will be off.

If there is some interference with normal sensor operation, the red LED will be flashing. The green LED will be off. The yellow LED's may flash, be illuminated or be off.

If the sensor programming plug is removed or is faulty, the red LED will be illuminated. The green LED will be off. The yellow LED's may flash, be illuminated or be off.

The status of the LED's on the sensors can be used to identify a faulty or unplugged programming plug. The LED's also can be used to identify the presence of interference that can affect Ultra Sonic Boom system operation. If the LED's do not illuminate correctly, a problem may exist with circuit wiring to the sensor or with the sensor itself.

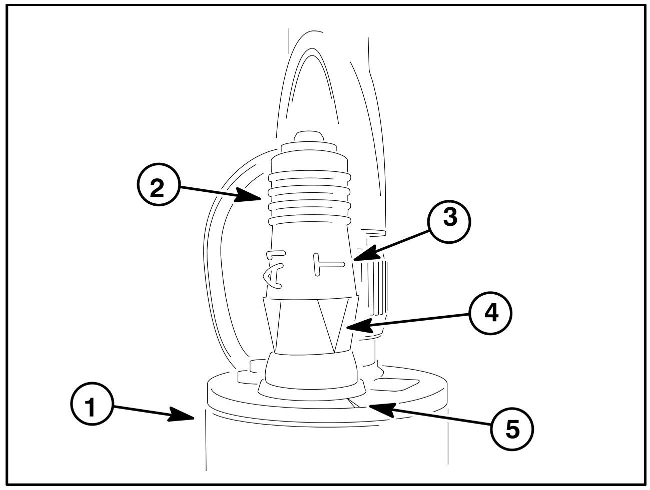


Figure 17

1. **Sonic sensor**
2. **Programming plug**
3. **Letter T**
4. **Plug arrow**
5. **Sensor notch**

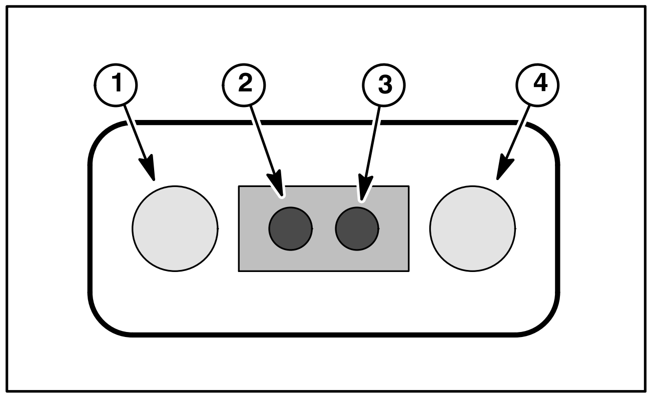


Figure 18

1. **Yellow LED**
2. **Green LED**
3. **Red LED**
4. **Yellow LED**

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 bracket behind the operator control console (Fig. 19).

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 six (6) hydraulic solenoid coils that 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. 20). The Electrical power for controller outputs is provided through three (3) connector terminals (PWR 2, PWR 3 and PWR 4). 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. 21).

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 Appendix A – Foldout 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: If TEC for the Ultra Sonic Boom Kit is replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

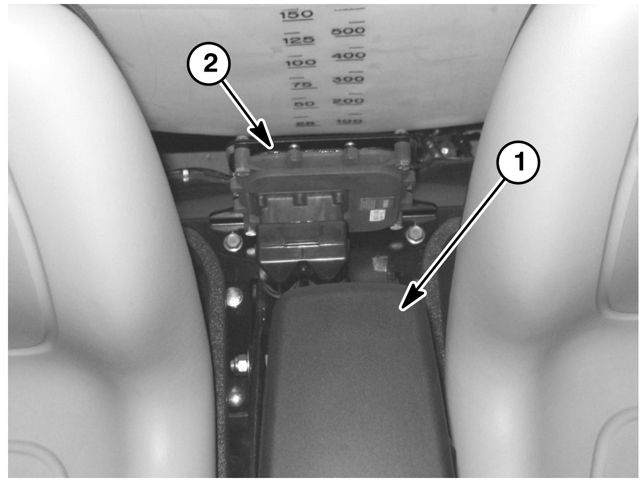


Figure 19

1. **Operator control console**
2. **Toro Electronic Controller (TEC)**

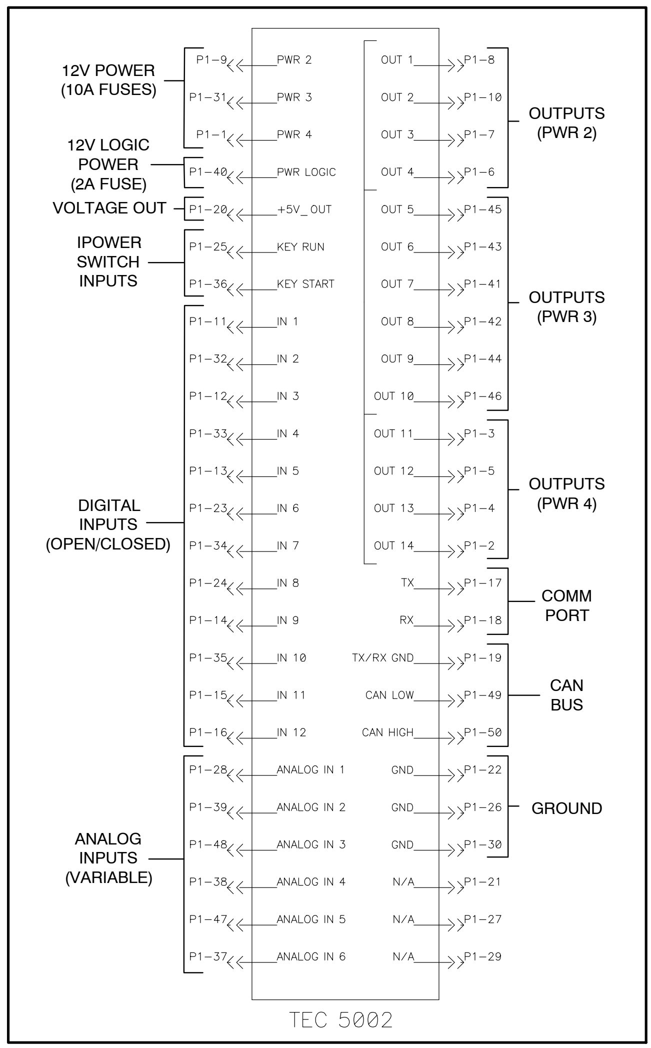


Figure 20

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.

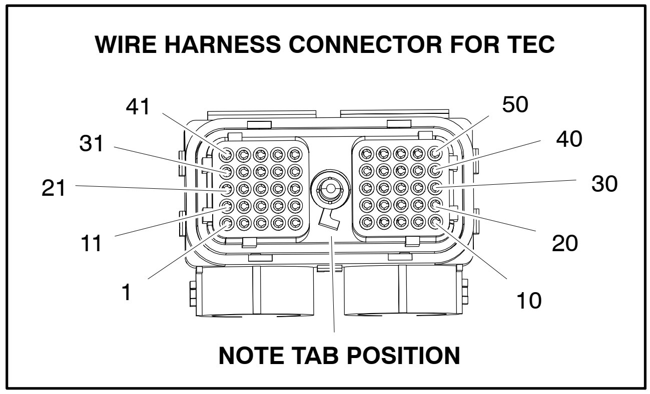


Figure 21

CAN−bus Termination Resistors

IMPORTANT:The Ultra Sonic Boom Leveling Kit is not designed to communicate with the machine InfoCenter. 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 diagnostic/reprogramming tools via a CAN−bus communication system (contact an Authorized Toro Distributor). Two (2) specially designed, twisted cables form the bus for the communication network. At the ends of the twisted pair of bus cables are two (2) 120 ohm termination resistors.

IMPORTANT: The termination resistor at the end of the bus wires is required for proper electrical system operation.

The CAN−bus termination resistors plug into the ultra sonic boom kit wire harness. The termination resistors are located below the ultra sonic boom TEC behind the operator's control console. 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 Appendix A − Foldout Drawings for additional information on termination resistor location and wire connections.

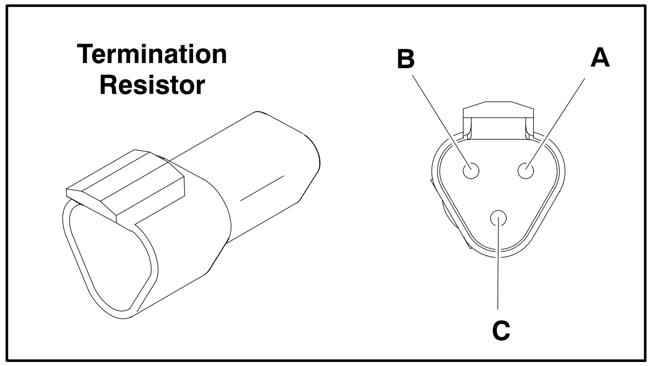


Figure 22

Termination Resistor Test

The termination resistors (Fig. 22) 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 Appendix A − Foldout Drawings in this manual).

Ultra Sonic Boom Lift Manifold Service

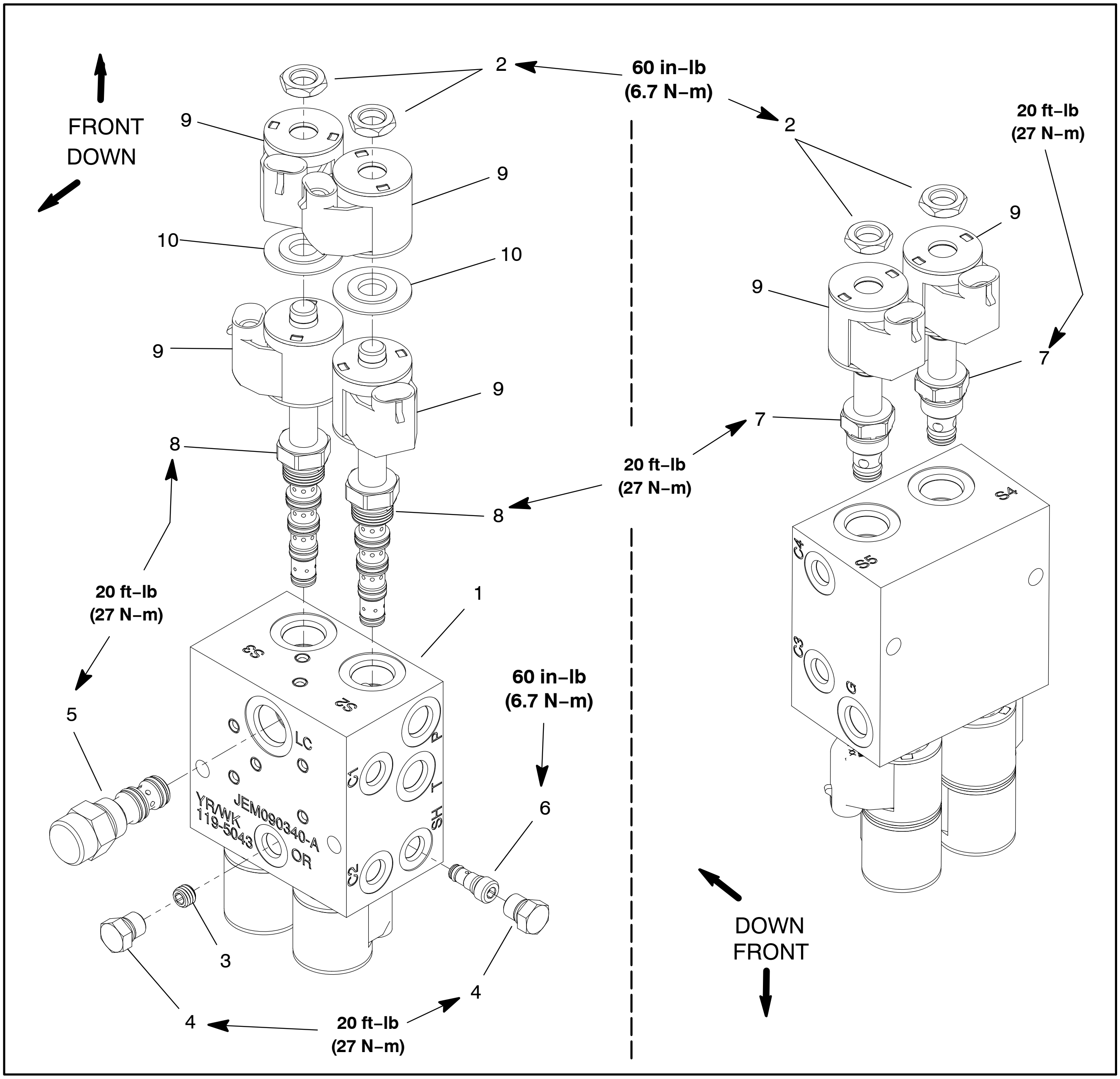


Figure 23

1. **Lift control manifold**
2. **Coil nut (4)**
3. **Orifice (0.030)**
4. **Zero leak plug (2)**
5. **Logic element (LC)**
6. **Load shuttle (SH)**
7. **Solenoid valve (2)**
8. **Solenoid valve (2)**
9. **Solenoid coil (6)**
10. **Coil spacer (2)**

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 24 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.

WARNING

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

CAUTION

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

For boom lift manifold cartridge valve service procedures, see Spray Pump Control Manifold Service in the Service and Repairs section of Chapter 4 − Hydraulic System. Refer to Figure 23 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 6 − Electrical System in this manual. Refer to Figure 23 for solenoid valve coil installation torque.

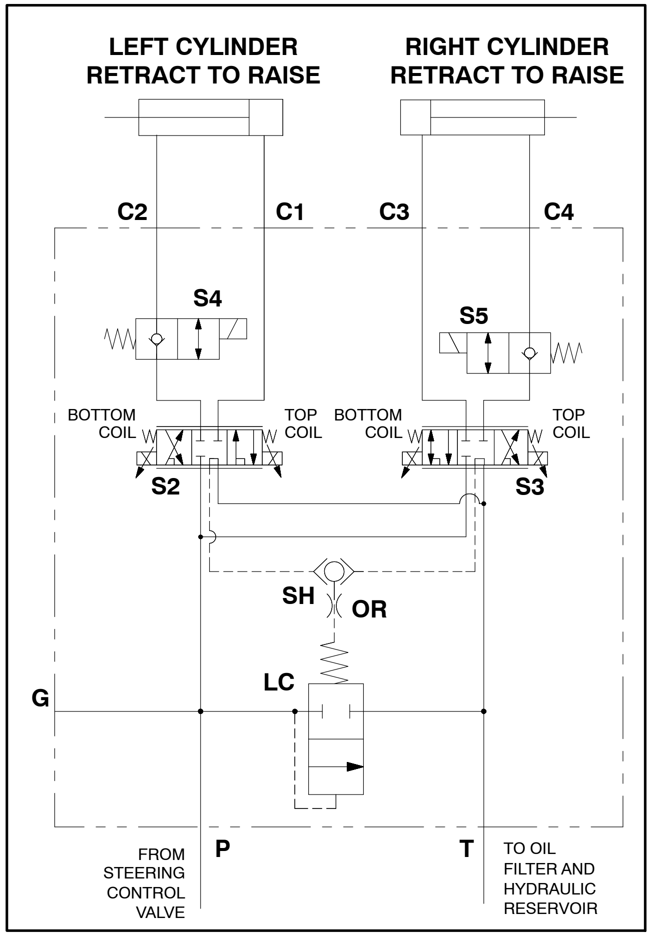


Figure 24

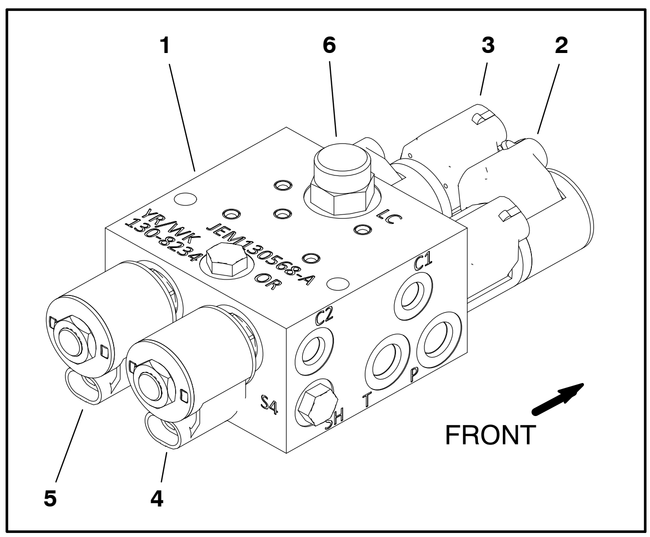


Figure 25

1. **Boom lift manifold**
2. **Solenoid S2**
3. **Solenoid S3**
4. **Solenoid S4**
5. **Solenoid S5**
6. **Logic cartridge LC**

Appendix A

Foldout Drawings

Table of Contents

Electrical Drawing Designations

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).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
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 the Toro 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).

Wire Size

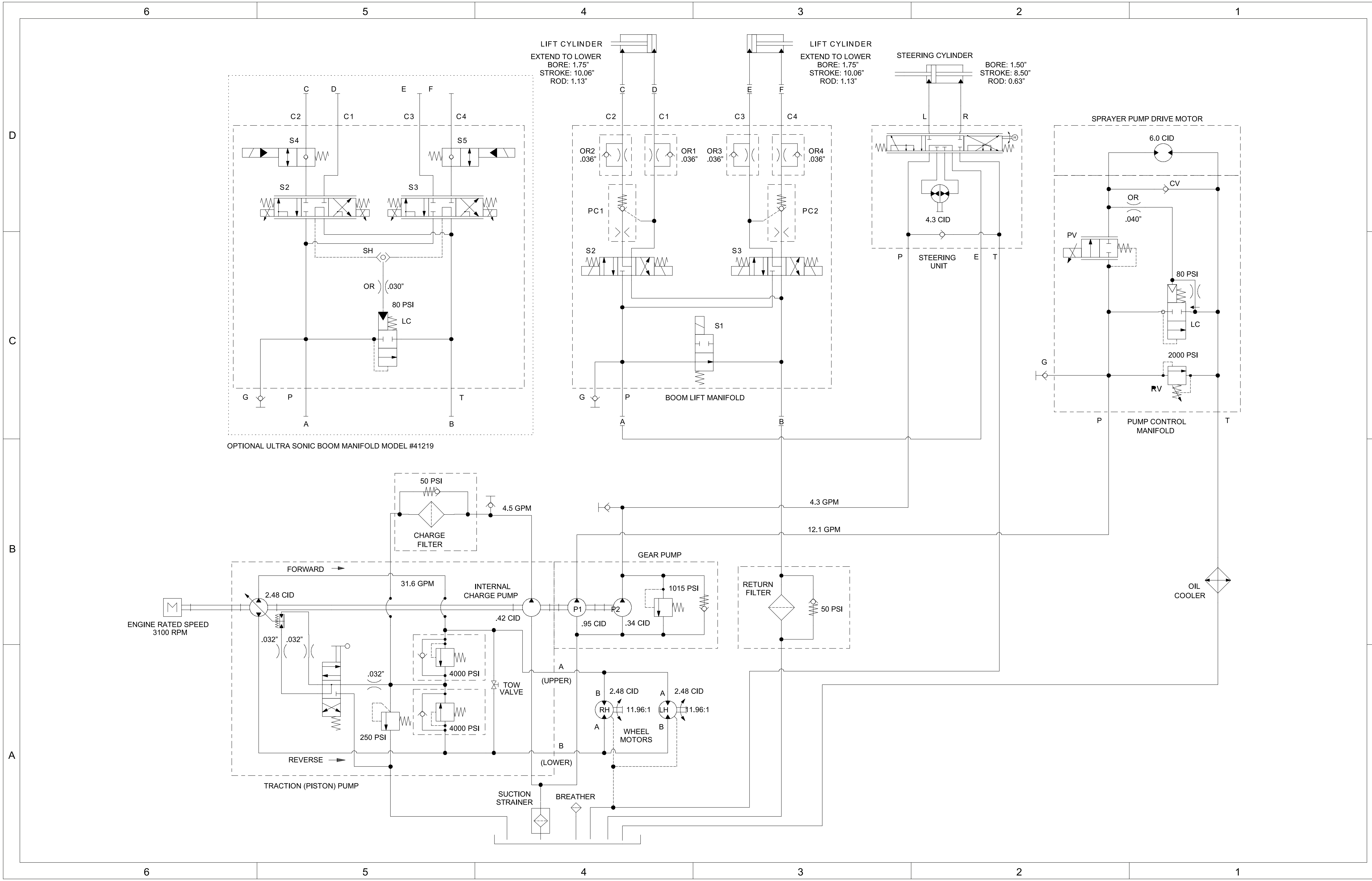
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

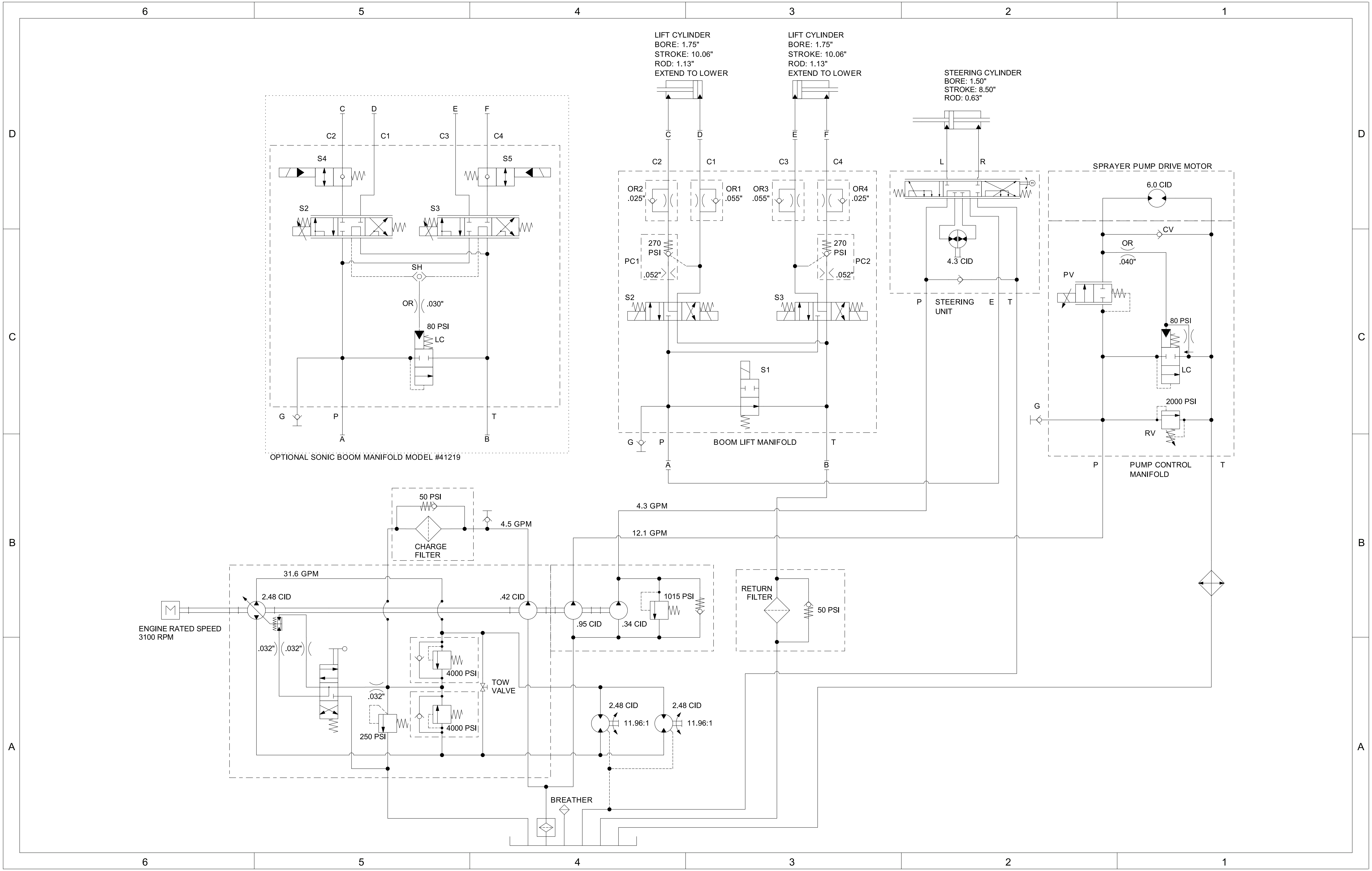
Examples:

- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

AWG Equivalents for Metric Wire		
Diagram Label	Metric Size	AWG Equivalent
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA

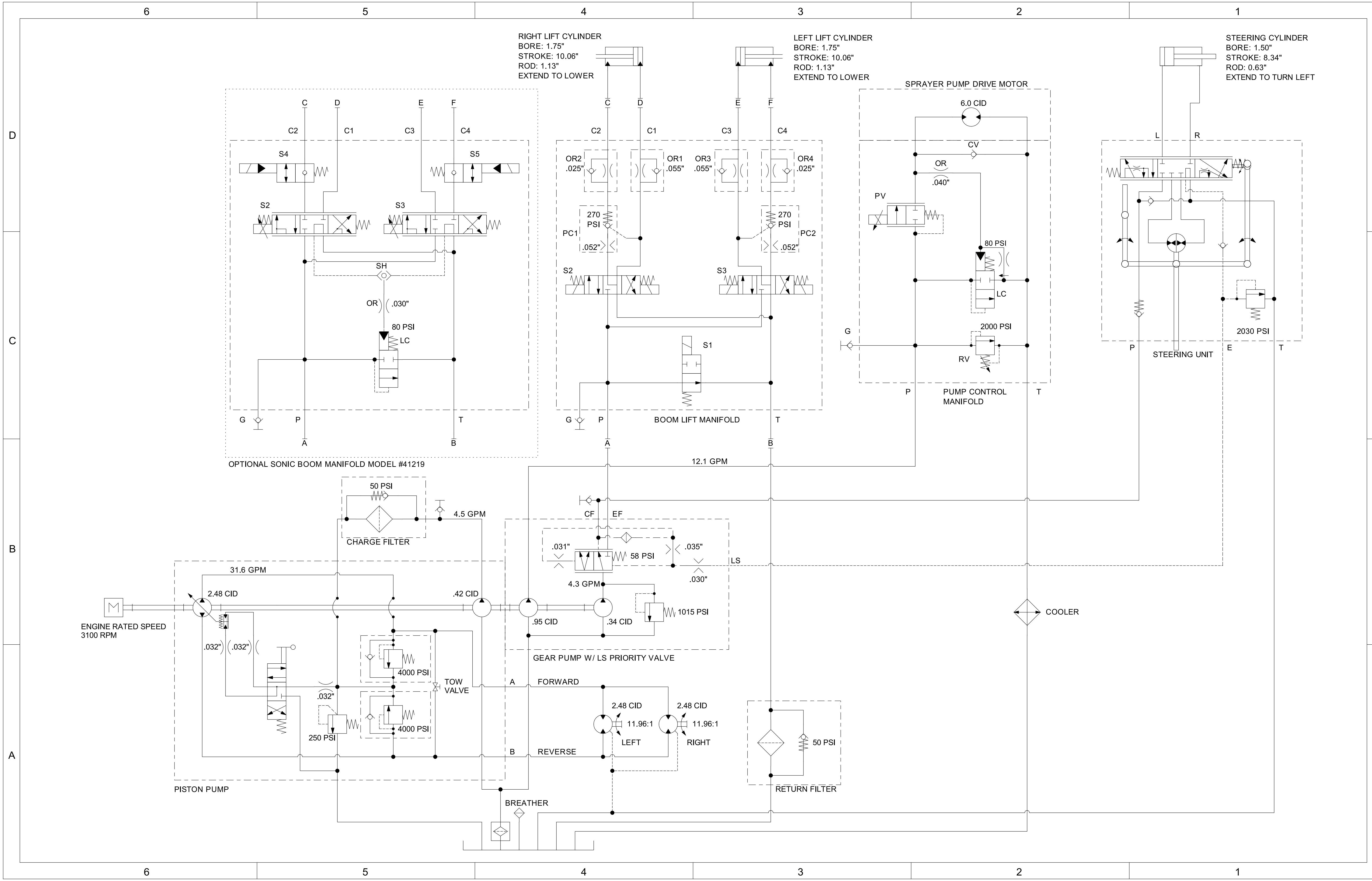
Hydraulic Schematic – Multi Pro 5800 (serial numbers 316000000 to 400699413)



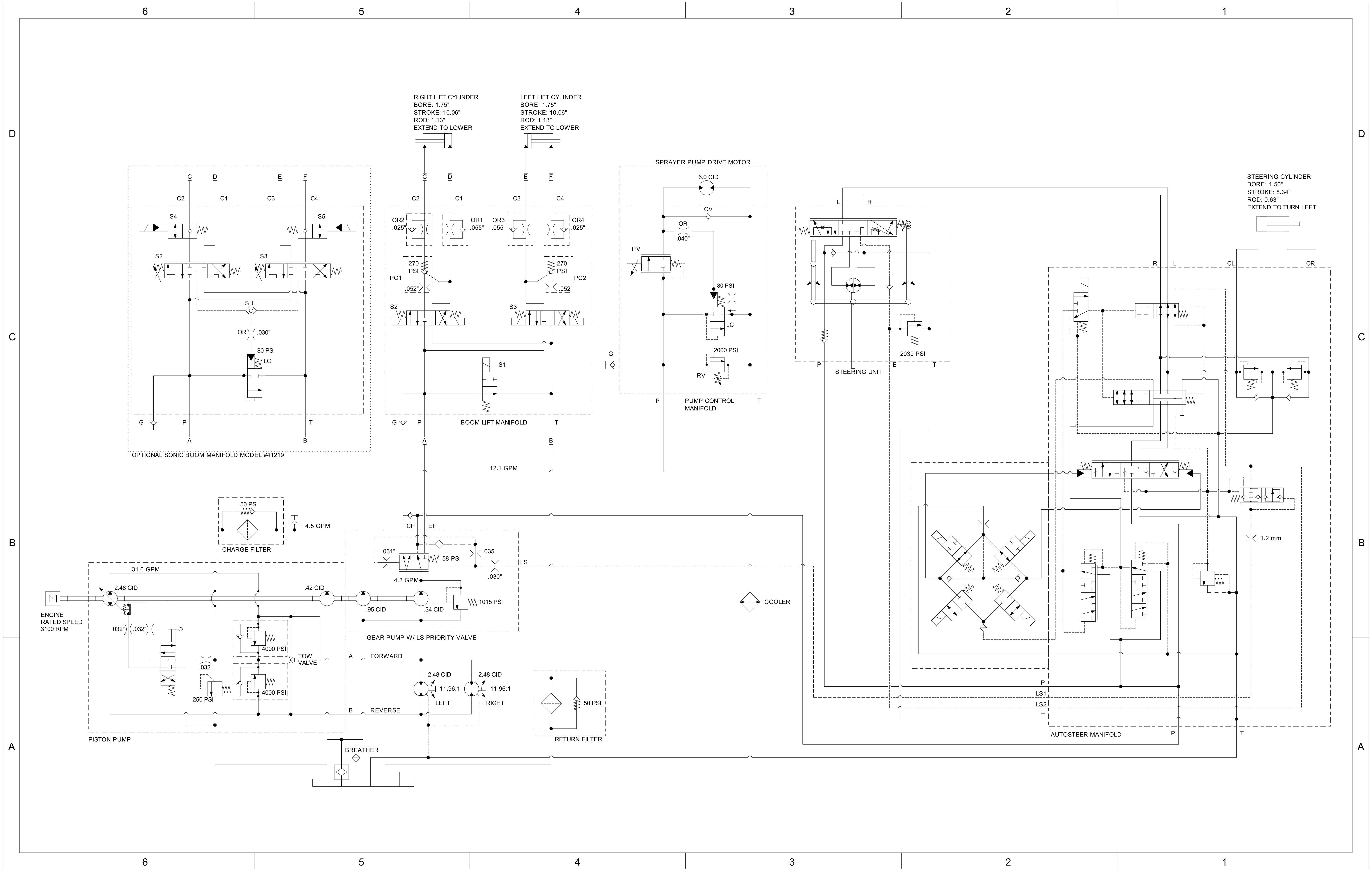


6
5
4
3
2
1
D
C
B
A
LIFT CYLINDER
BORE: 1.75"
STROKE: 10.06"
ROD: 1.13"
EXTEND TO LOWER
LIFT CYLINDER
BORE: 1.75"
STROKE: 10.06"
ROD: 1.13"
EXTEND TO LOWER
STEERING CYLINDER
BORE: 1.50"
STROKE: 8.50"
ROD: 0.63"
C
D
E
F
C2
C1
C3
C4
S4
S5
S2
S3
SH
OR
.030"
80 PSI
LC
G
P
T
A
B
OPTIONAL SONIC BOOM MANIFOLD MODEL #41219
OR2
.025"
OR1
.055"
OR3
.055"
OR4
.025"
270
PSI
PC1
PC2
.052"
S1
BOOM LIFT MANIFOLD
L
R
4.3 CID
STEERING
UNIT
E
SPRAYER PUMP DRIVE MOTOR
6.0 CID
CV
.040"
PV
2000 PSI
RV
PUMP CONTROL
MANIFOLD
50 PSI
CHARGE
FILTER
4.5 GPM
4.3 GPM
12.1 GPM
31.6 GPM
2.48 CID
.42 CID
.95 CID
.34 CID
1015 PSI
RETURN
FILTER
ENGINE RATED SPEED
3100 RPM
.032"
4000 PSI
TOW
VALVE
250 PSI
11.96:1
BREATHER
g329270

Hydraulic Schematic – Multi Pro 5800 (serial numbers above 405700000)

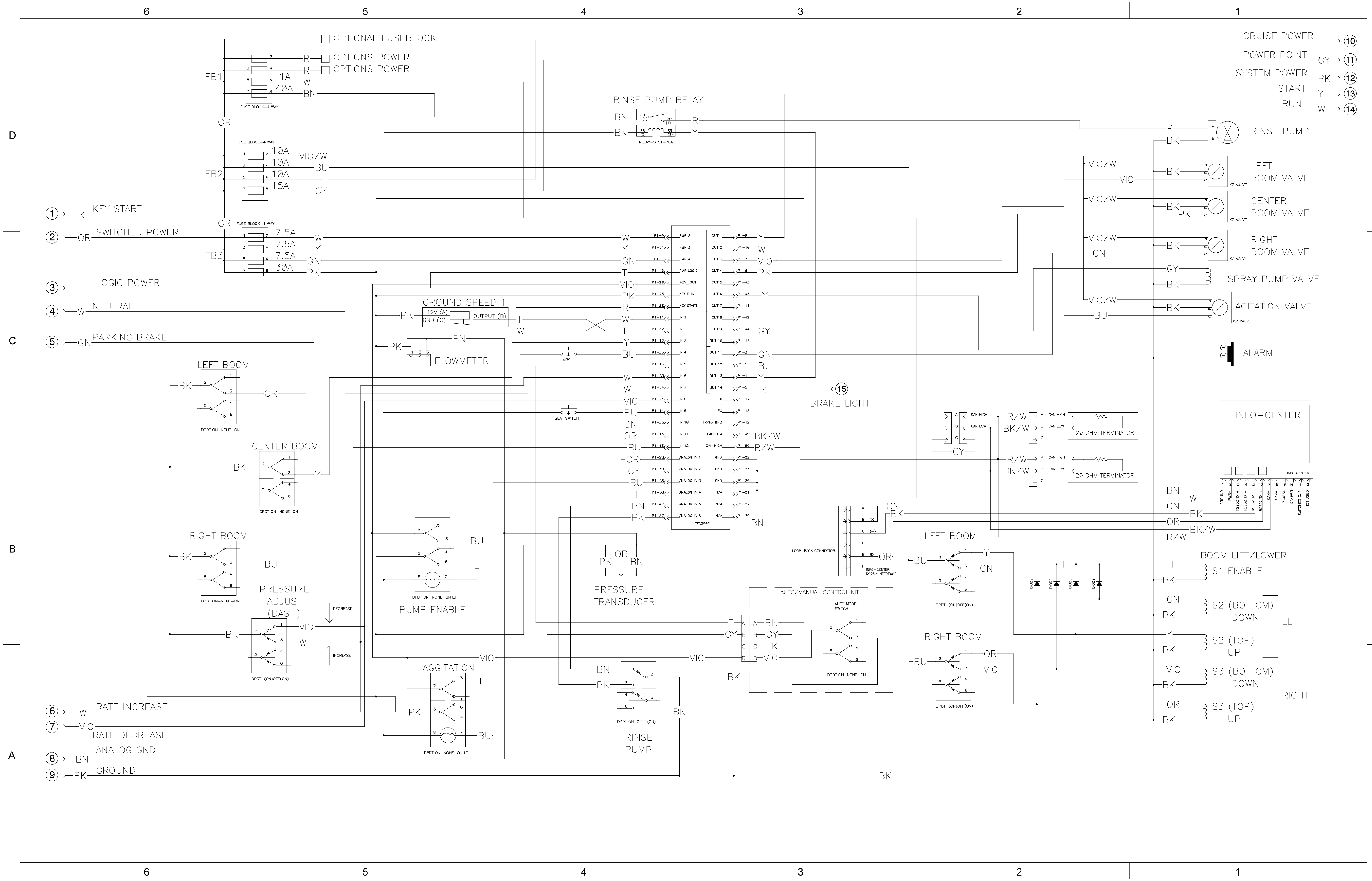


Hydraulic Schematic – Multi Pro 5800 (serial numbers above 405700000) with AutoSteer (Optional)

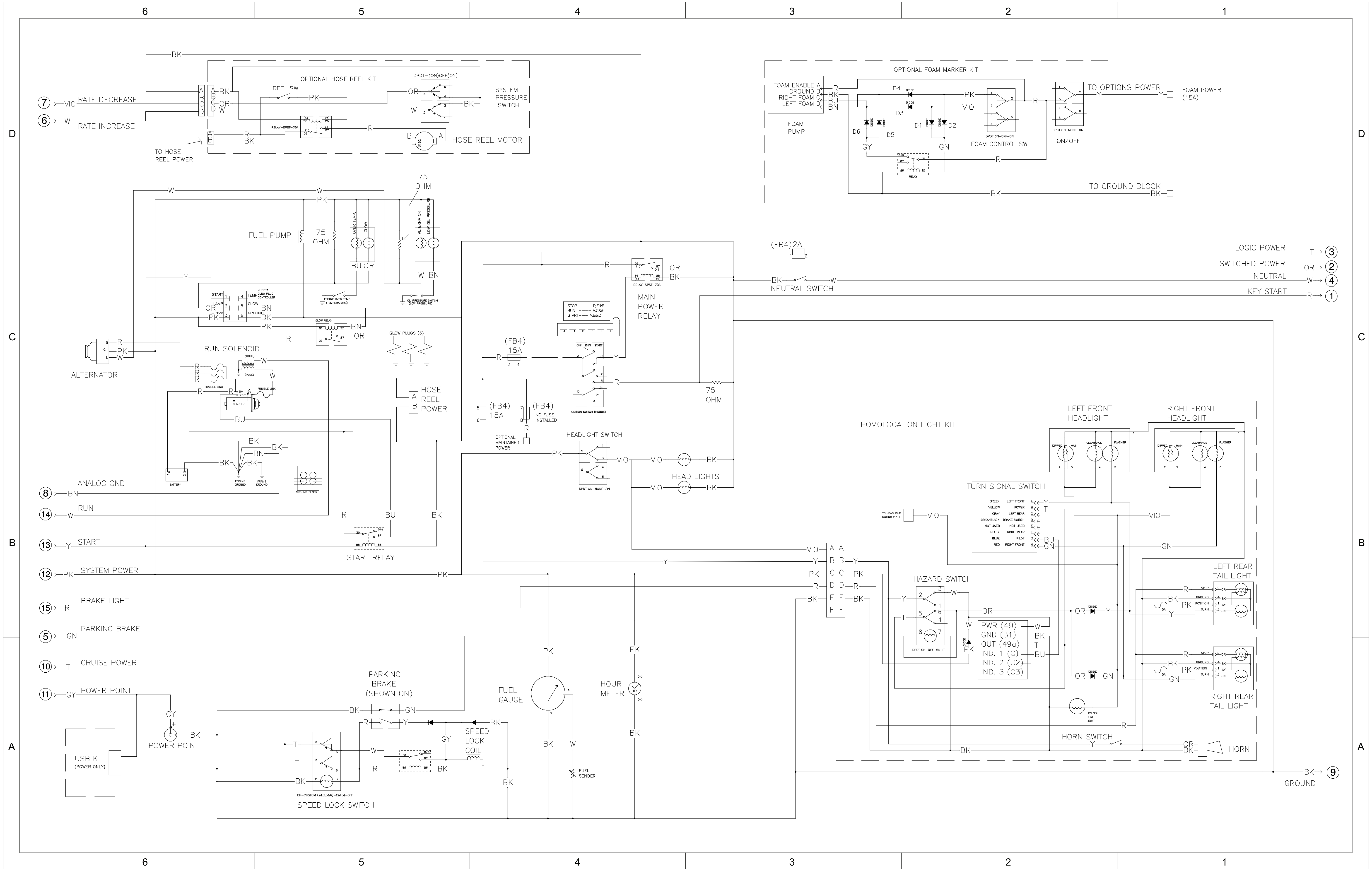


g329272

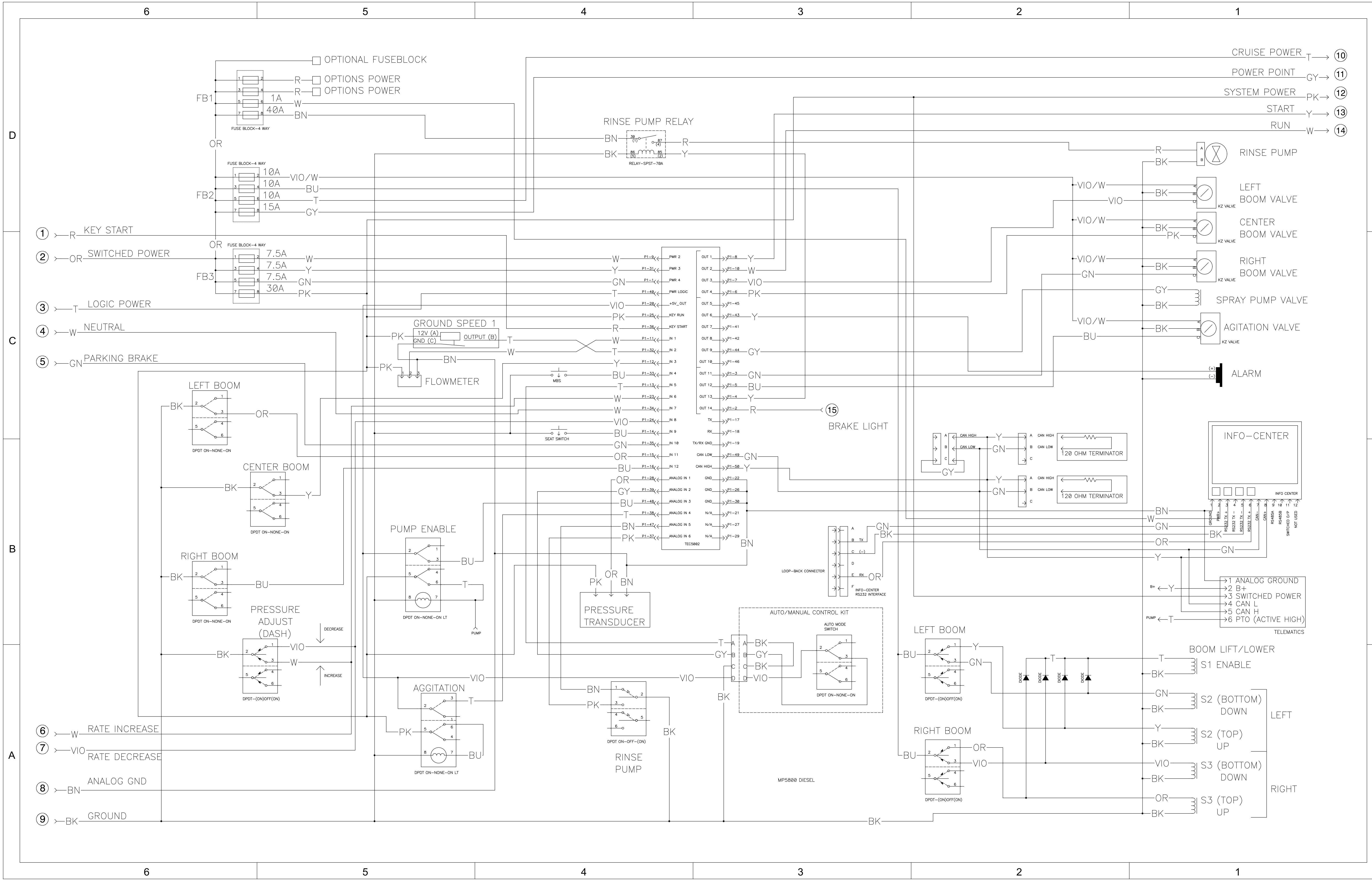
Electrical Schematic – Multi Pro 5800-D (serial numbers 316000000 to 403460000)



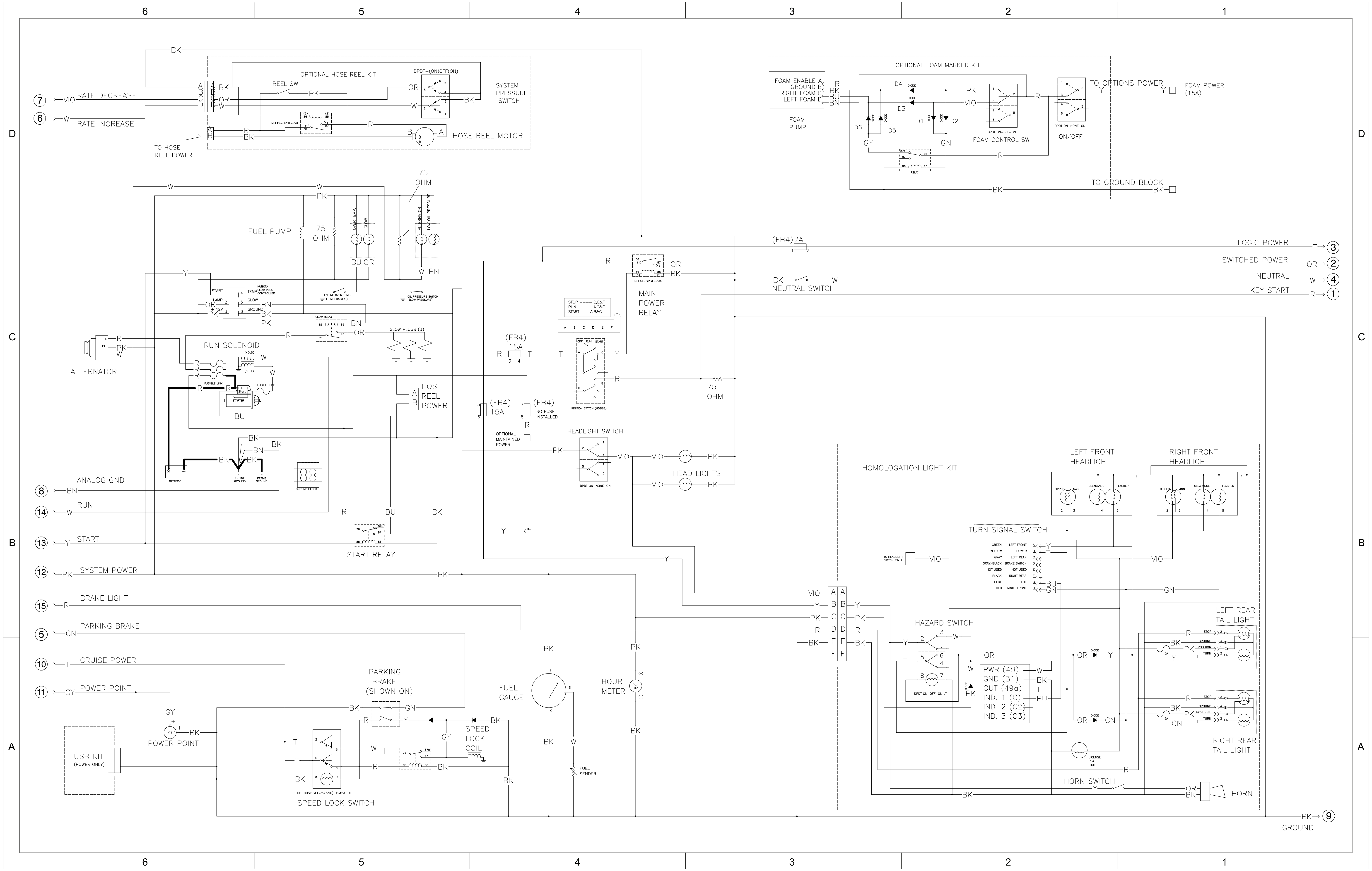
Electrical Schematic – Multi Pro 5800-D (serial numbers 316000000 to 403460000)



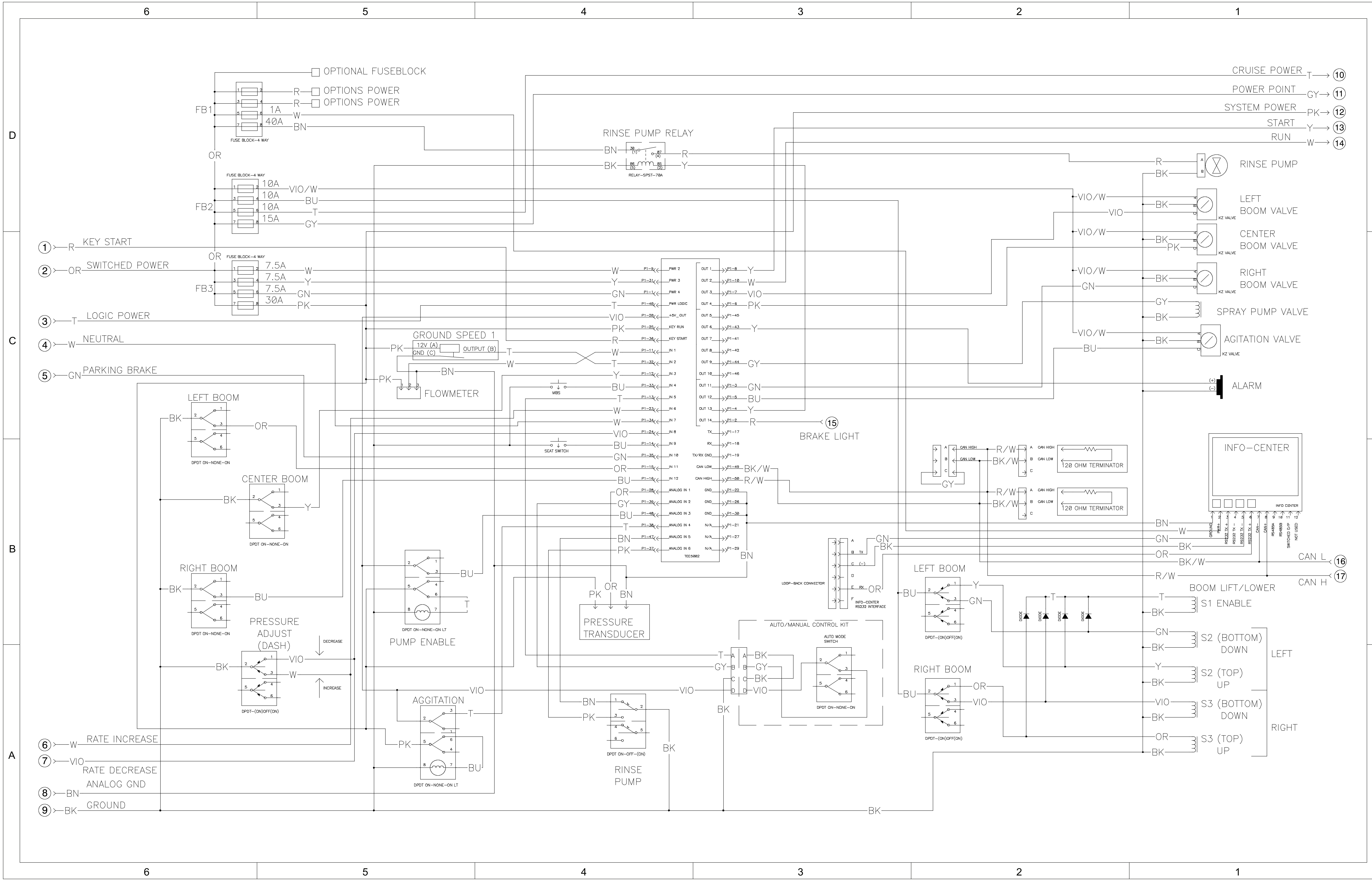
Electrical Schematic – Multi Pro 5800-D (serial numbers above 40346000)



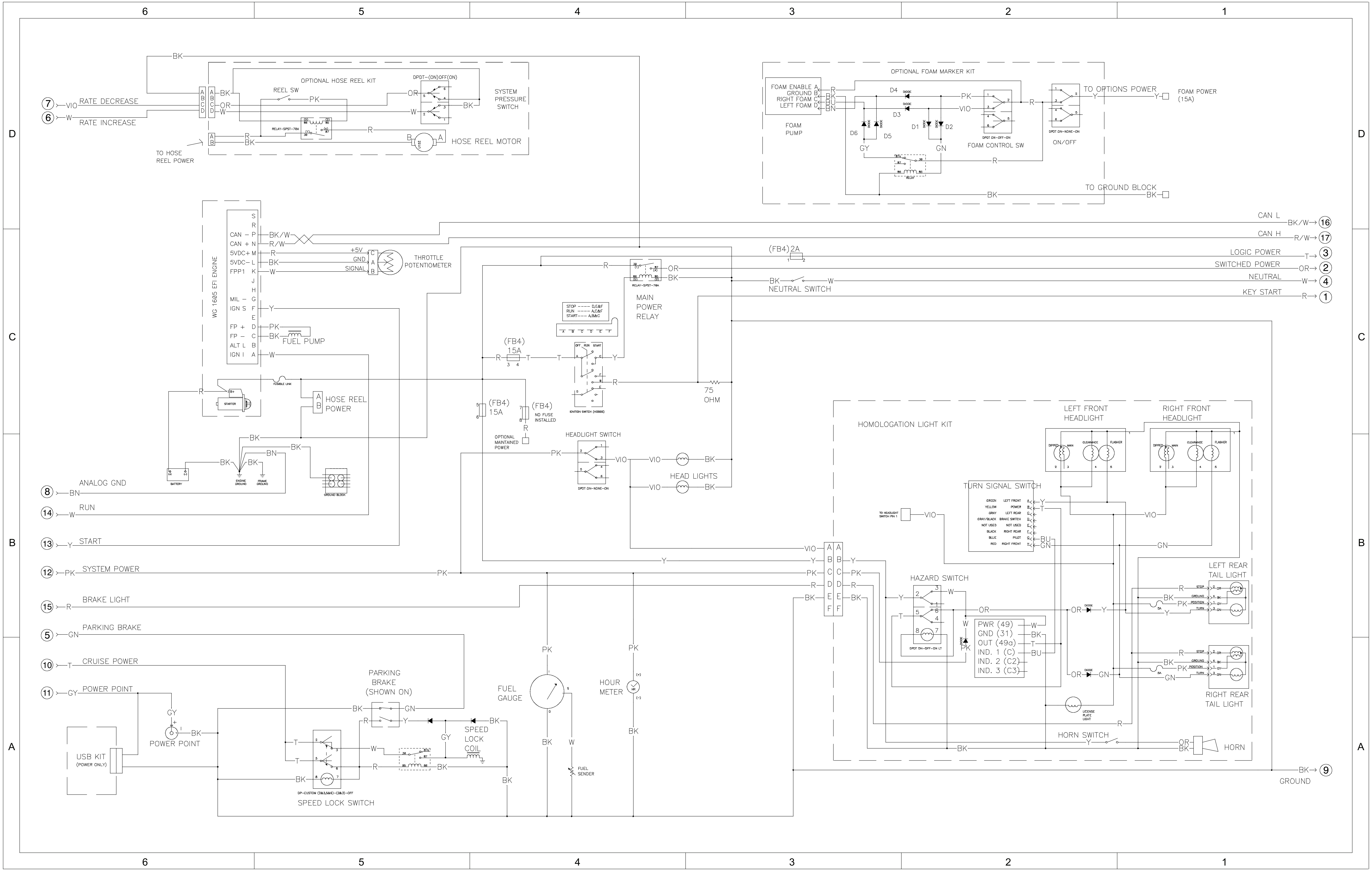
g329290


OPTIONAL HOSE REEL KIT
REEL SW
DPDT–(ON)OFF(ON)
SYSTEM PRESSURE SWITCH
RATE DECREASE
RATE INCREASE
TO HOSE REEL POWER
HOSE REEL MOTOR
OPTIONAL FOAM MARKER KIT
FOAM ENABLE
GROUND
RIGHT FOAM
LEFT FOAM
FOAM PUMP
FOAM CONTROL SW
ON/OFF
TO OPTIONS POWER
FOAM POWER (15A)
TO GROUND BLOCK
FUEL PUMP
75 OHM
ALTERNATOR
RUN SOLENOID
GLOW PLUGS (3)
LOGIC POWER
SWITCHED POWER
NEUTRAL
NEUTRAL SWITCH
KEY START
MAIN POWER RELAY
HOSE REEL POWER
HEADLIGHT SWITCH
HEAD LIGHTS
HOMOLOGATION LIGHT KIT
LEFT FRONT HEADLIGHT
RIGHT FRONT HEADLIGHT
TURN SIGNAL SWITCH
ANALOG GND
RUN
START
SYSTEM POWER
BRAKE LIGHT
PARKING BRAKE
CRUISE POWER
POWER POINT
START RELAY
HAZARD SWITCH
LEFT REAR TAIL LIGHT
RIGHT REAR TAIL LIGHT
FUEL GAUGE
HOUR METER
PARKING BRAKE (SHOWN ON)
SPEED LOCK COIL
USB KIT (POWER ONLY)
SPEED LOCK SWITCH
HORN SWITCH
HORN
GROUND
g329291

Electrical Schematic – Multi Pro 5800-G (serial numbers 316000000 to 403460000)

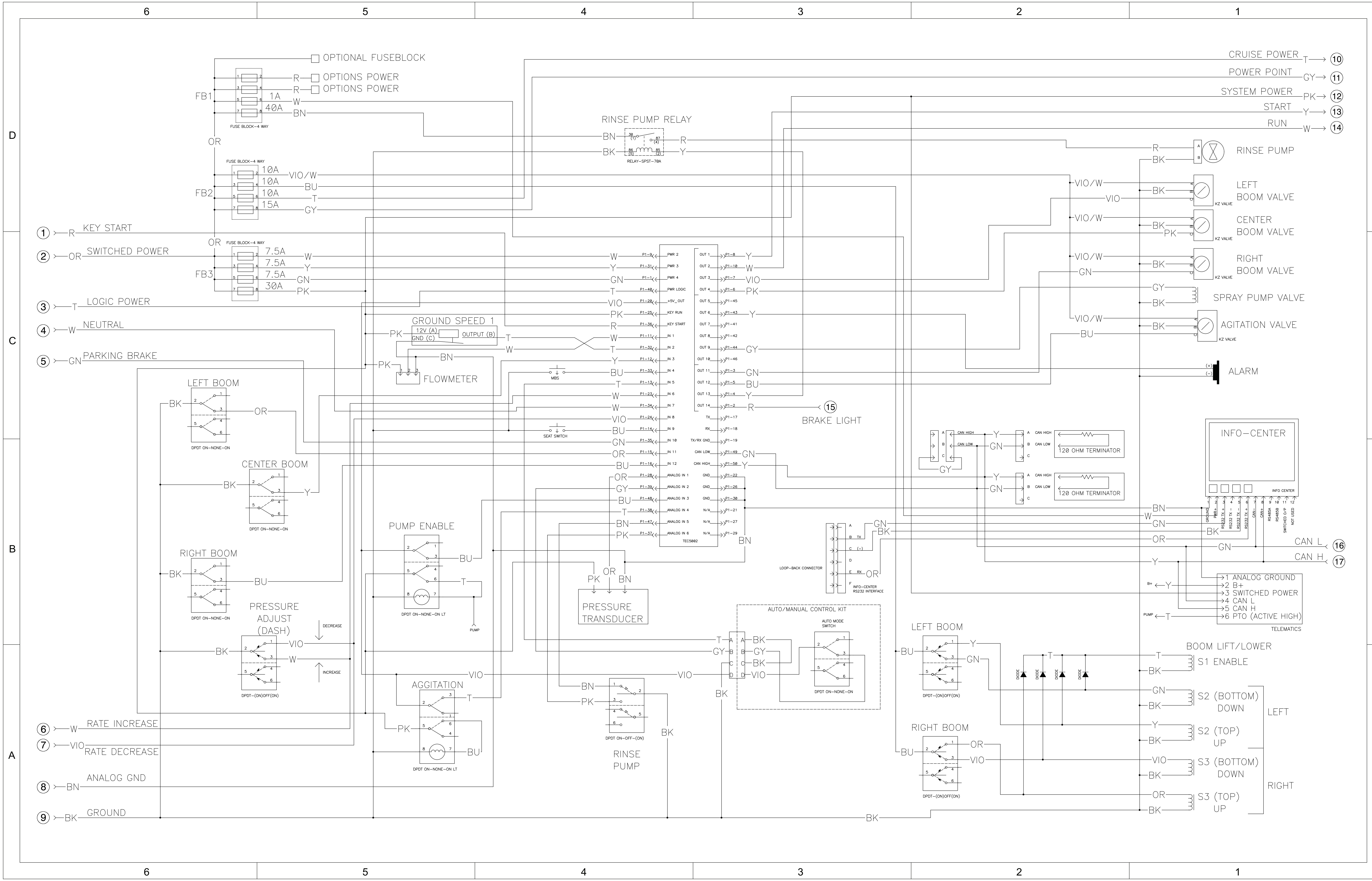


g329288

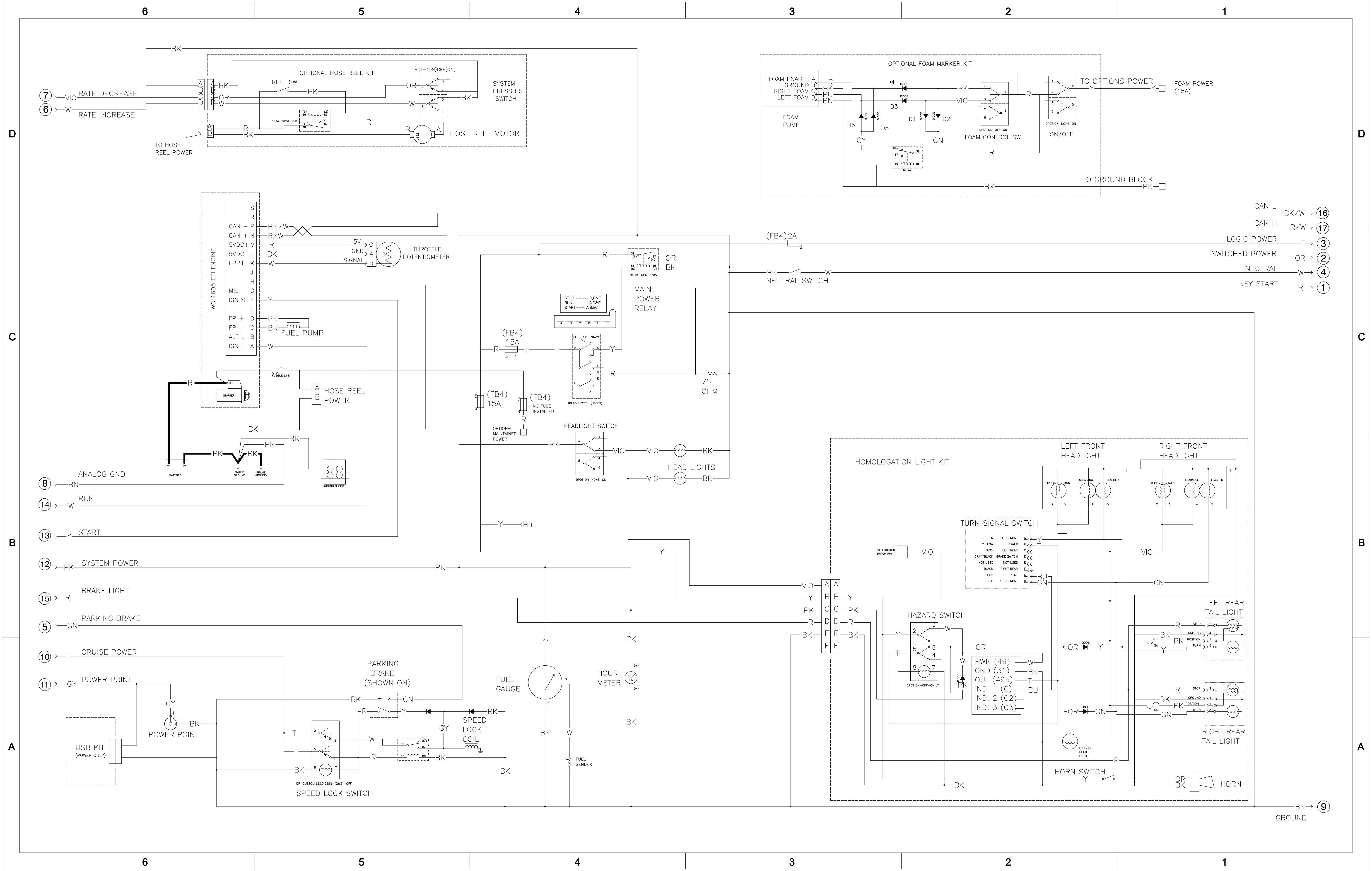


OPTIONAL HOSE REEL KIT
REEL SW
SYSTEM PRESSURE SWITCH
HOSE REEL MOTOR
TO HOSE REEL POWER
RATE DECREASE
RATE INCREASE
OPTIONAL FOAM MARKER KIT
FOAM ENABLE
GROUND
RIGHT FOAM
LEFT FOAM
FOAM PUMP
FOAM CONTROL SW
ON/OFF
TO OPTIONS POWER
FOAM POWER (15A)
TO GROUND BLOCK
CAN L
CAN H
LOGIC POWER
SWITCHED POWER
NEUTRAL
KEY START
WG 1605 EFI ENGINE
THROTTLE POTENTIOMETER
FUEL PUMP
HOSE REEL POWER
MAIN POWER RELAY
NEUTRAL SWITCH
(FB4) 2A
(FB4) 15A
(FB4) NO FUSE INSTALLED
OPTIONAL MAINTAINED POWER
75 OHM
HEADLIGHT SWITCH
HEAD LIGHTS
ANALOG GND
RUN
START
SYSTEM POWER
BRAKE LIGHT
PARKING BRAKE
CRUISE POWER
POWER POINT
USB KIT (POWER ONLY)
PARKING BRAKE (SHOWN ON)
SPEED LOCK COIL
SPEED LOCK SWITCH
FUEL GAUGE
FUEL SENDER
HOUR METER
HOMOLOGATION LIGHT KIT
LEFT FRONT HEADLIGHT
RIGHT FRONT HEADLIGHT
TURN SIGNAL SWITCH
HAZARD SWITCH
PWR (49)
GND (31)
OUT (49a)
IND. 1 (C)
IND. 2 (C2)
IND. 3 (C3)
LEFT REAR TAIL LIGHT
RIGHT REAR TAIL LIGHT
LICENSE PLATE LIGHT
HORN SWITCH
HORN
GROUND
g329289

Electrical Schematic – Multi Pro 5800-G (serial numbers above 40346000)



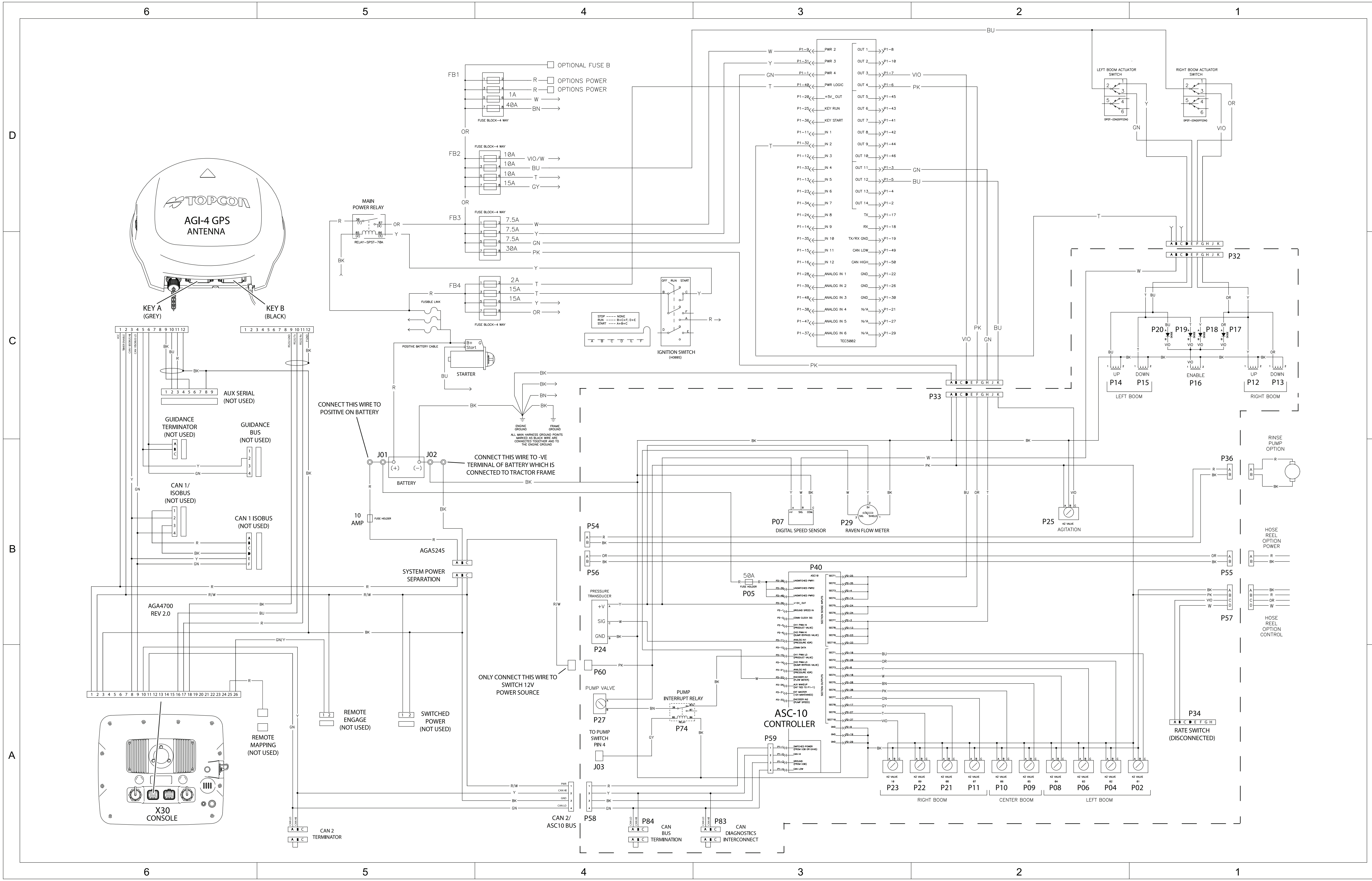
g329292



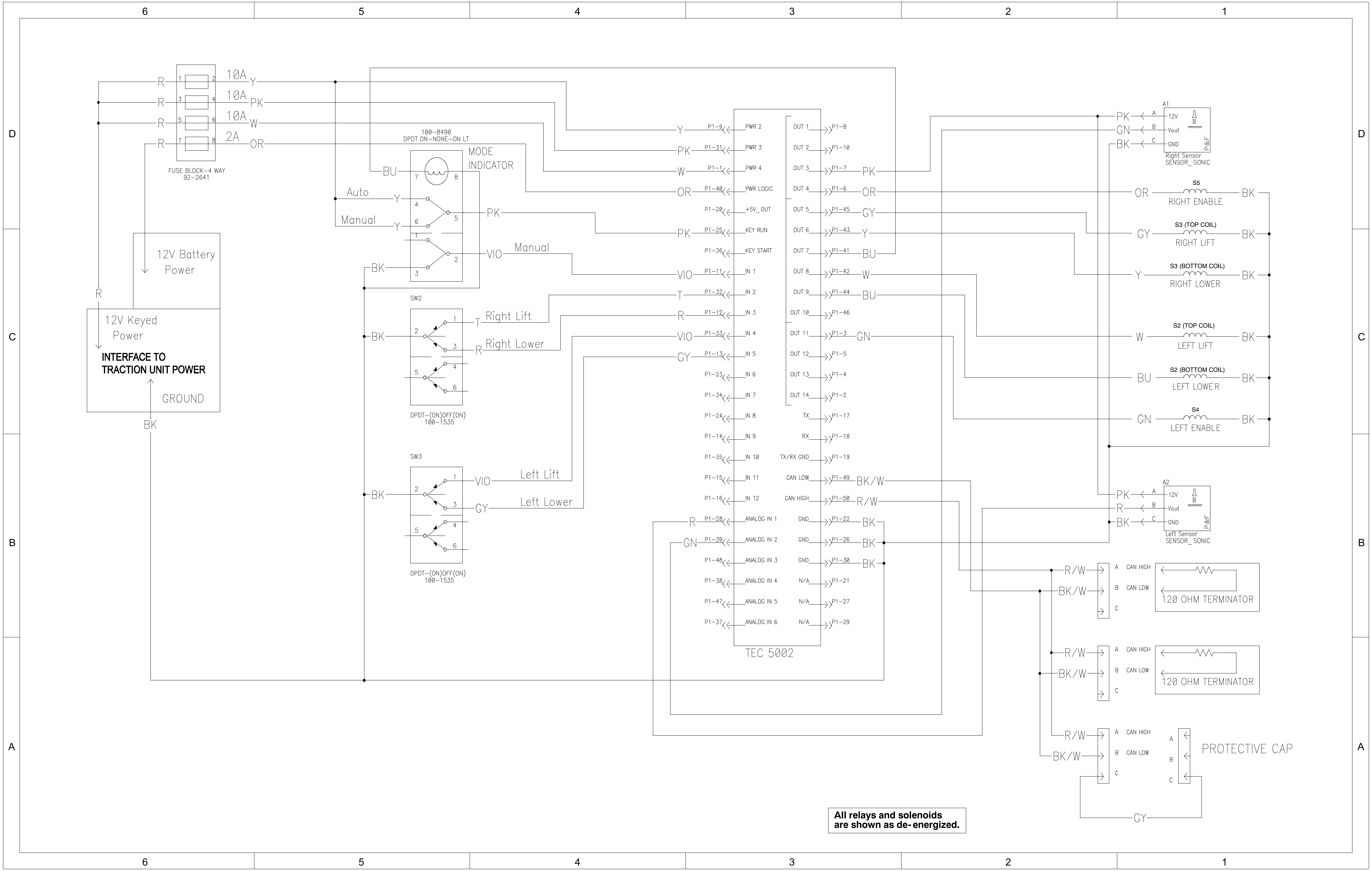
OPTIONAL HOSE REEL KIT
REEL SW
SYSTEM PRESSURE SWITCH
HOSE REEL MOTOR
RATE DECREASE
RATE INCREASE
TO HOSE REEL POWER
OPTIONAL FOAM MARKER KIT
FOAM ENABLE A
GROUND B
RIGHT FOAM C
LEFT FOAM D
FOAM PUMP
FOAM CONTROL SW
ON/OFF
TO OPTIONS POWER
FOAM POWER (15A)
TO GROUND BLOCK
WG 1605 EFI ENGINE
THROTTLE POTENTIOMETER
FUEL PUMP
HOSE REEL POWER
MAIN POWER RELAY
75 OHM
CAN L
CAN H
LOGIC POWER
SWITCHED POWER
NEUTRAL
KEY START
NEUTRAL SWITCH
HEADLIGHT SWITCH
HEAD LIGHTS
OPTIONAL MAINTAINED POWER
(FB4) NO FUSE INSTALLED
ANALOG GND
RUN
START
SYSTEM POWER
BRAKE LIGHT
PARKING BRAKE
CRUISE POWER
POWER POINT
USB KIT (POWER ONLY)
PARKING BRAKE (SHOWN ON)
SPEED LOCK COIL
SPEED LOCK SWITCH
FUEL GAUGE
HOUR METER
FUEL SENDER
HOMOLOGATION LIGHT KIT
LEFT FRONT HEADLIGHT
RIGHT FRONT HEADLIGHT
TURN SIGNAL SWITCH
HAZARD SWITCH
LEFT REAR TAIL LIGHT
RIGHT REAR TAIL LIGHT
LICENSE PLATE LIGHT
HORN SWITCH
HORN
GROUND

g329293

Electrical Schematic – Multi Pro 5800 (serial numbers above 316000000) with GeoLink Spray System (Optional)



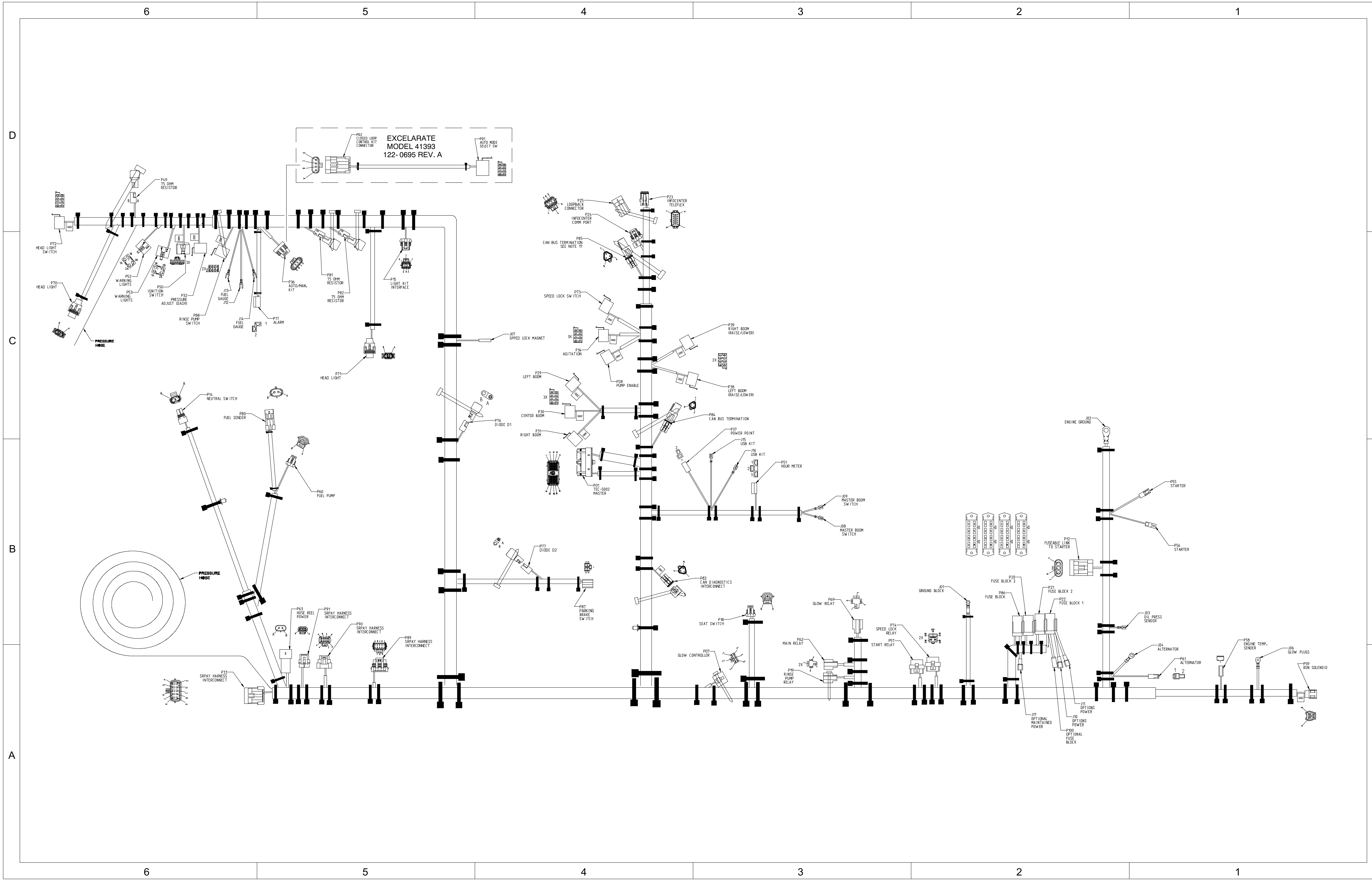
g329315



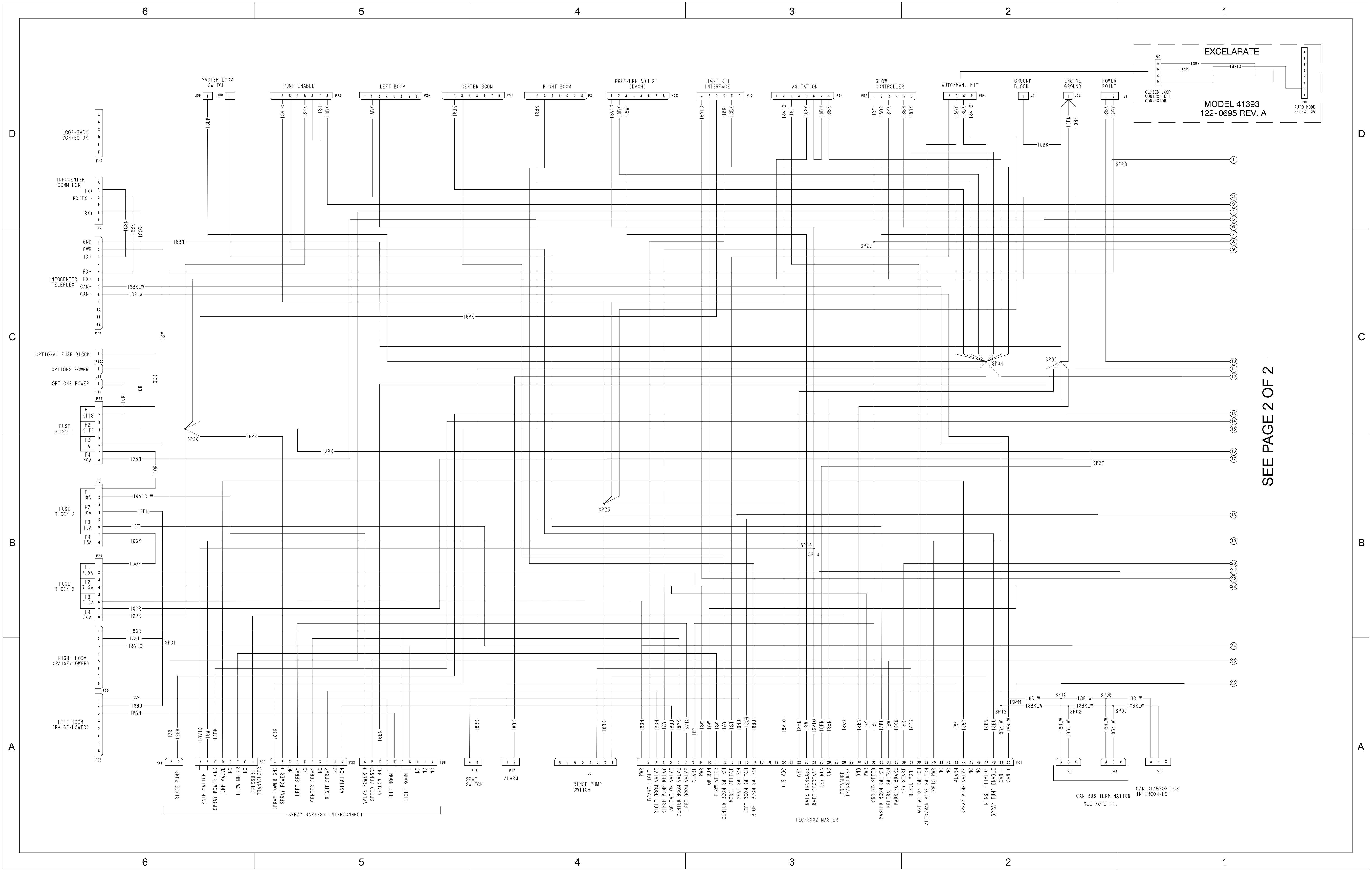
FUSE BLOCK–4 WAY
92–2641
10A
10A
10A
2A
12V Battery Power
12V Keyed Power
INTERFACE TO TRACTION UNIT POWER
GROUND
100–8490
DPDT ON–NONE–ON LT
MODE INDICATOR
Auto
Manual
Manual
SW2
Right Lift
Right Lower
DPDT–(ON)OFF(ON)
100–1535
SW3
Left Lift
Left Lower
DPDT–(ON)OFF(ON)
100–1535
TEC 5002
PWR 2
PWR 3
PWR 4
PWR LOGIC
+5V_OUT
KEY RUN
KEY START
IN 1
IN 2
IN 3
IN 4
IN 5
IN 6
IN 7
IN 8
IN 9
IN 10
IN 11
IN 12
ANALOG IN 1
ANALOG IN 2
ANALOG IN 3
ANALOG IN 4
ANALOG IN 5
ANALOG IN 6
OUT 1
OUT 2
OUT 3
OUT 4
OUT 5
OUT 6
OUT 7
OUT 8
OUT 9
OUT 10
OUT 11
OUT 12
OUT 13
OUT 14
TX
RX
TX/RX GND
CAN LOW
CAN HIGH
GND
N/A
A1
Right Sensor
SENSOR_SONIC
S5
RIGHT ENABLE
S3 (TOP COIL)
RIGHT LIFT
S3 (BOTTOM COIL)
RIGHT LOWER
S2 (TOP COIL)
LEFT LIFT
S2 (BOTTOM COIL)
LEFT LOWER
S4
LEFT ENABLE
A2
Left Sensor
SENSOR_SONIC
120 OHM TERMINATOR
120 OHM TERMINATOR
PROTECTIVE CAP
All relays and solenoids are shown as de-energized.

g329314

Front Wire Harness Drawing – Multi Pro 5800-D (serial numbers 316000000 to 403460000)

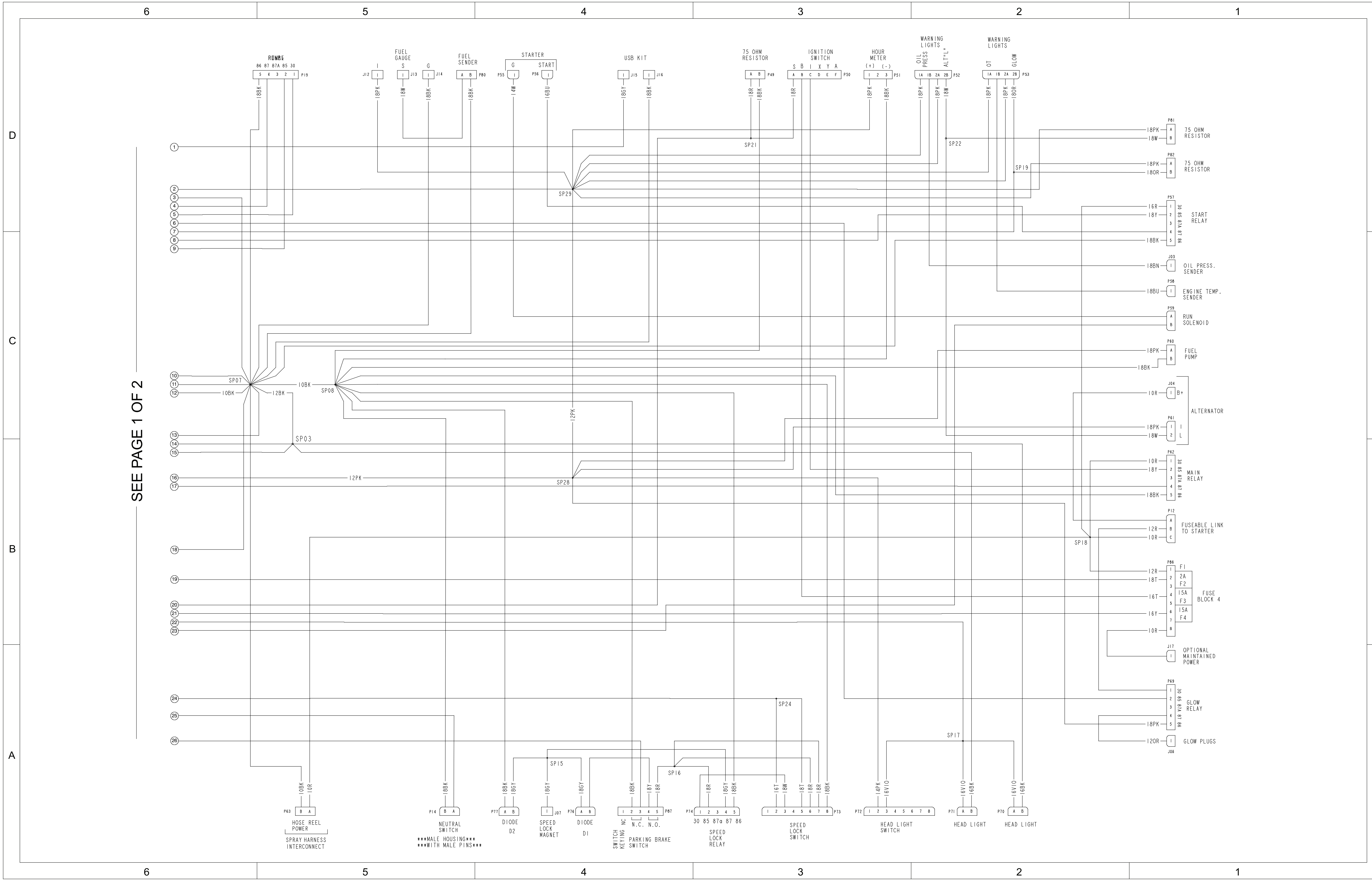


g329321

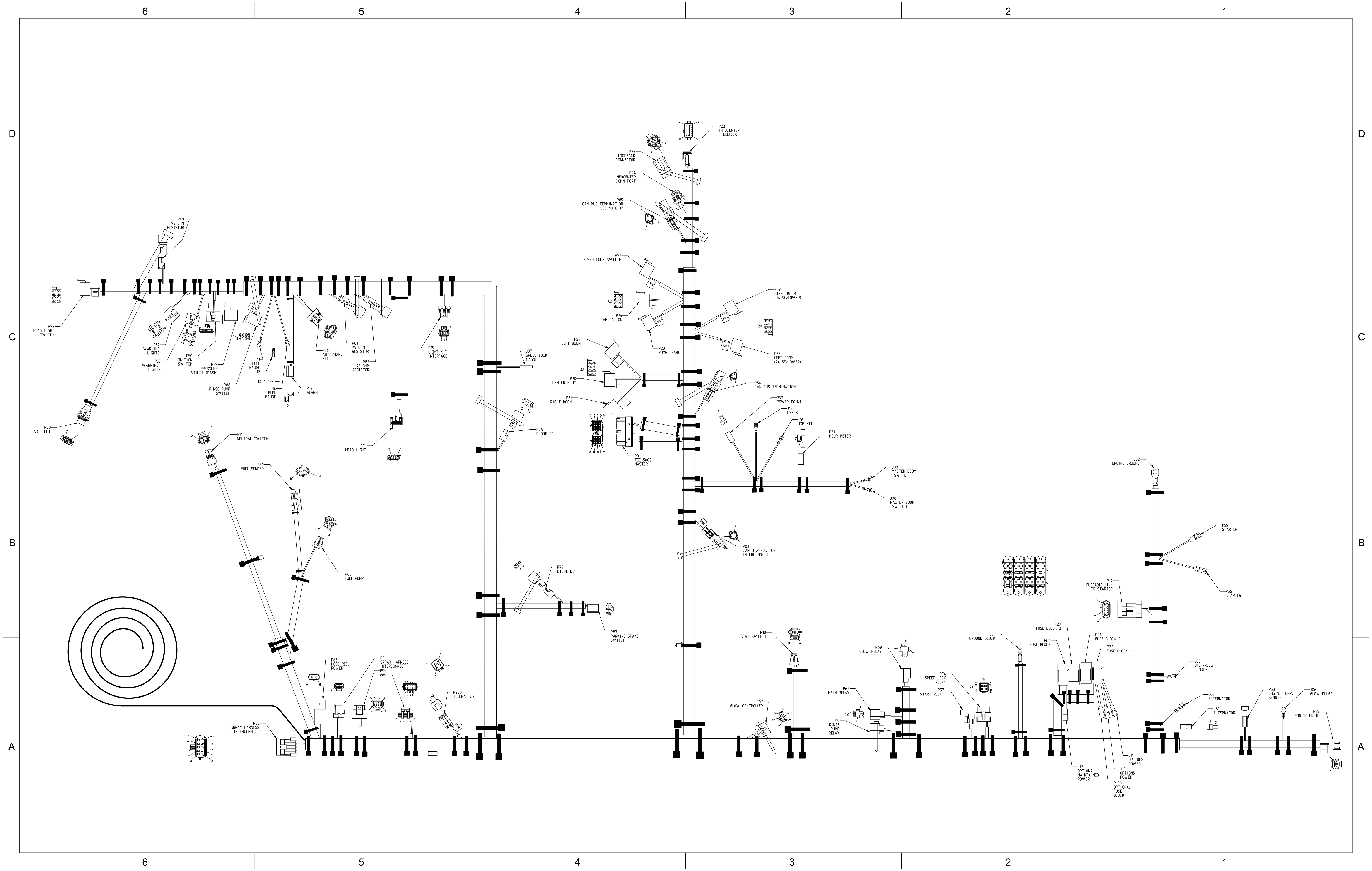


g329319

Front Wire Harness Diagram – Multi Pro 5800-D (serial numbers 316000000 to 403460000)

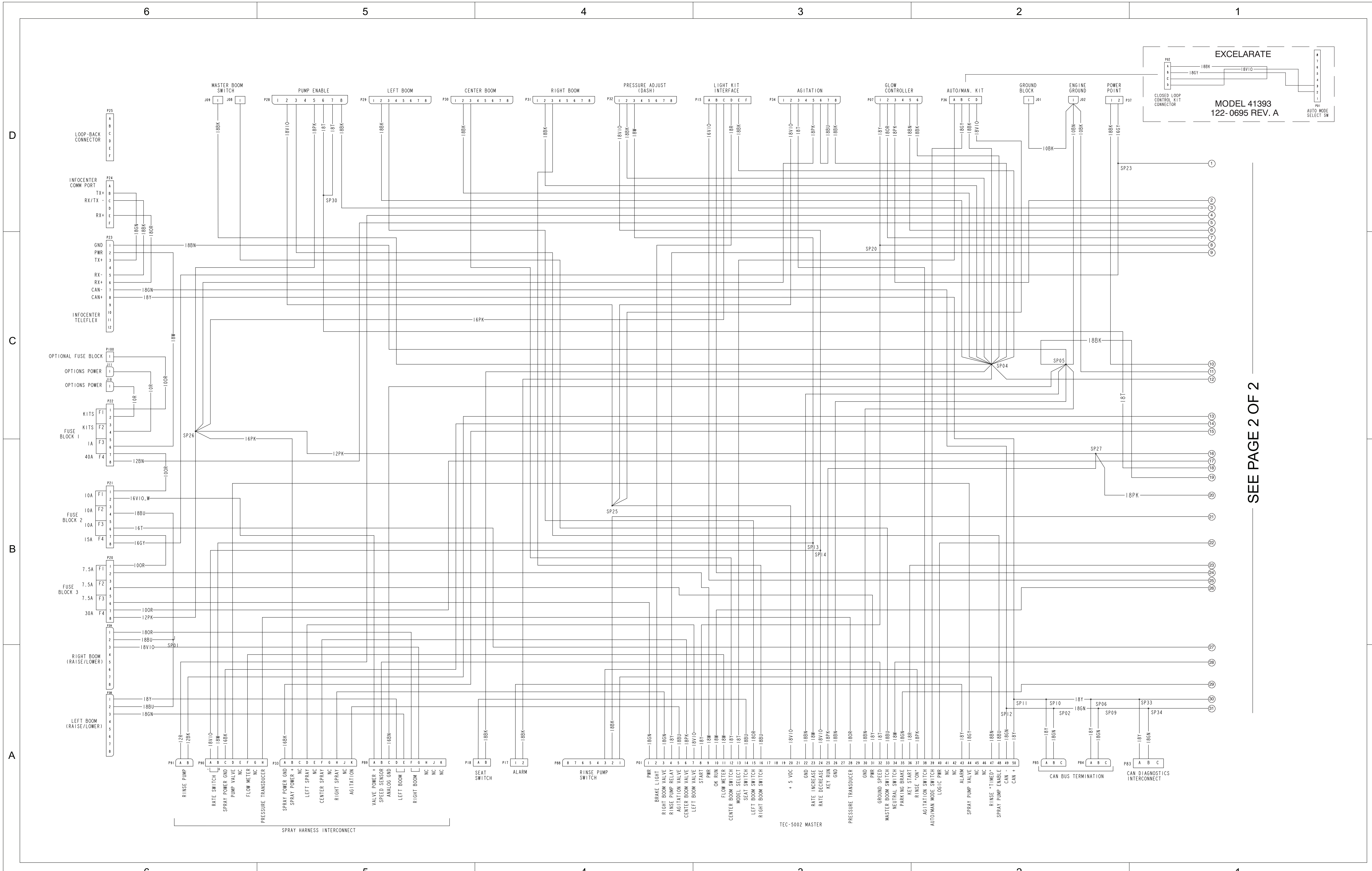


Front Wire Harness Drawing – Multi Pro 5800-D (serial numbers above 403460000)



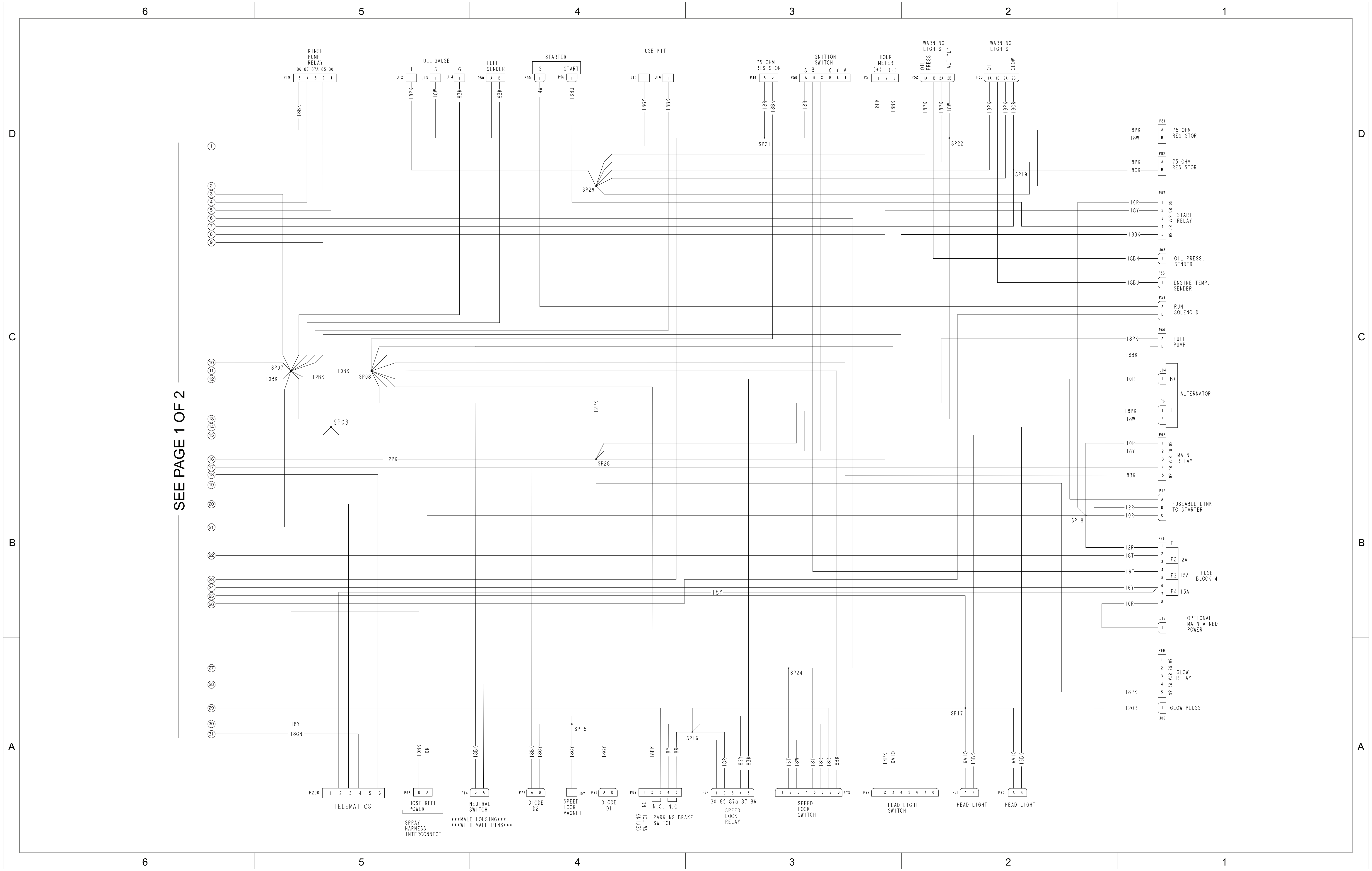
g329324

Front Wire Harness Diagram – Multi Pro 5800-D (serial numbers above 403460000)



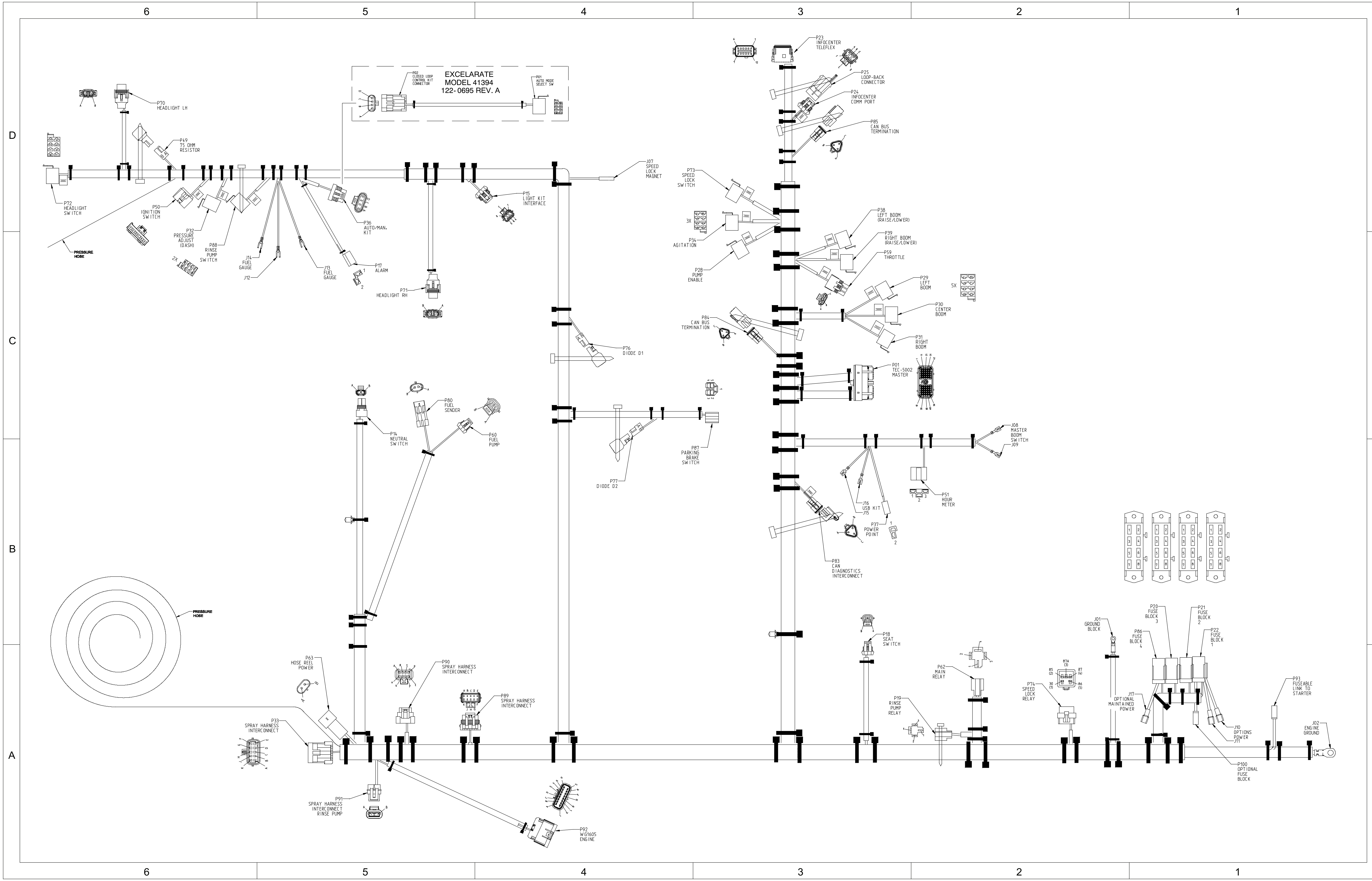
g329322

Front Wire Harness Diagram – Multi Pro 5800-D (serial numbers above 403460000)



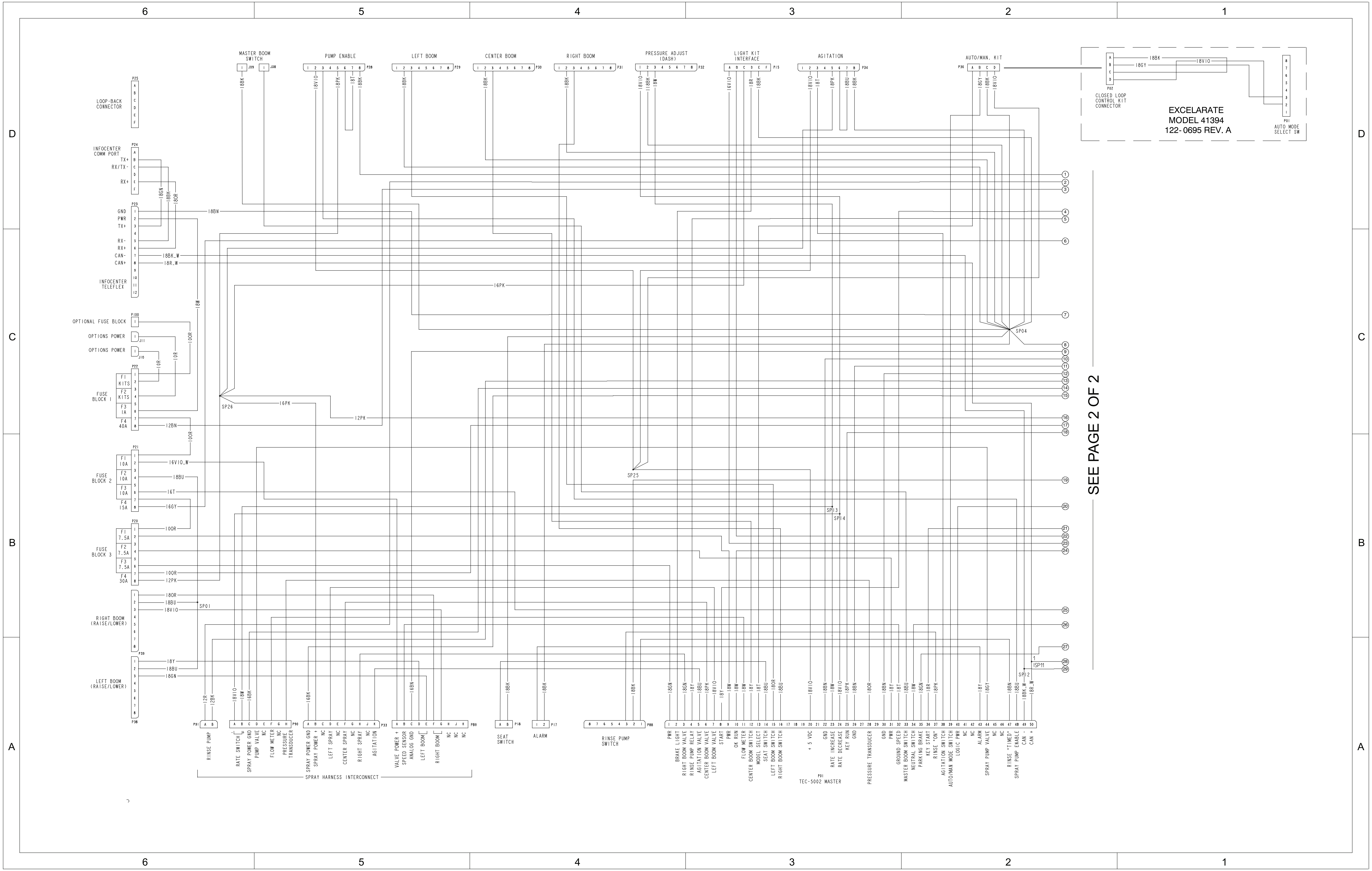
g329323

Front Wire Harness Drawing – Multi Pro 5800-G (serial numbers 316000000 to 403445000)



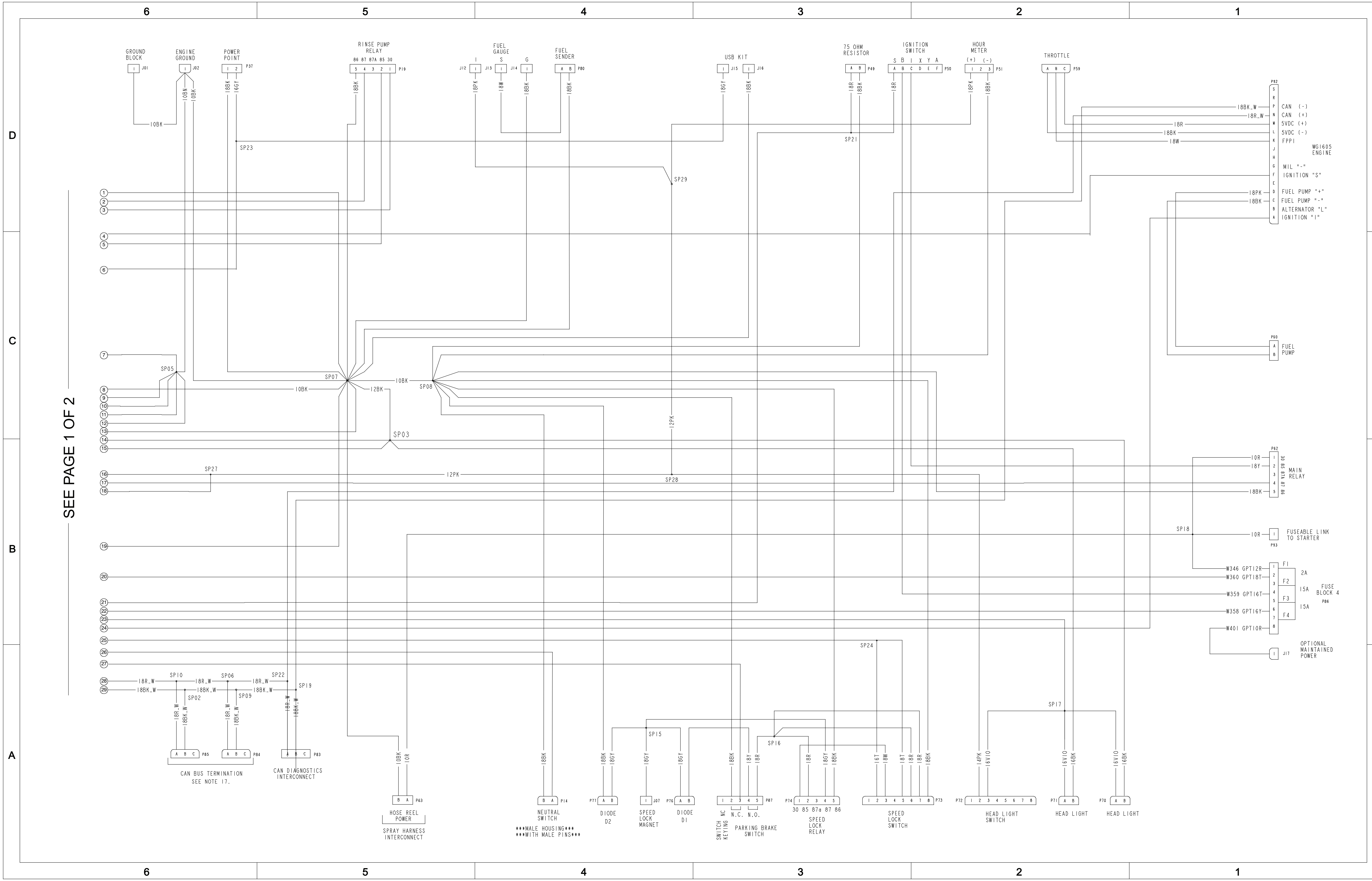
g329318

Front Wire Harness Diagram – Multi Pro 5800-G (serial numbers 316000000 to 403445000)

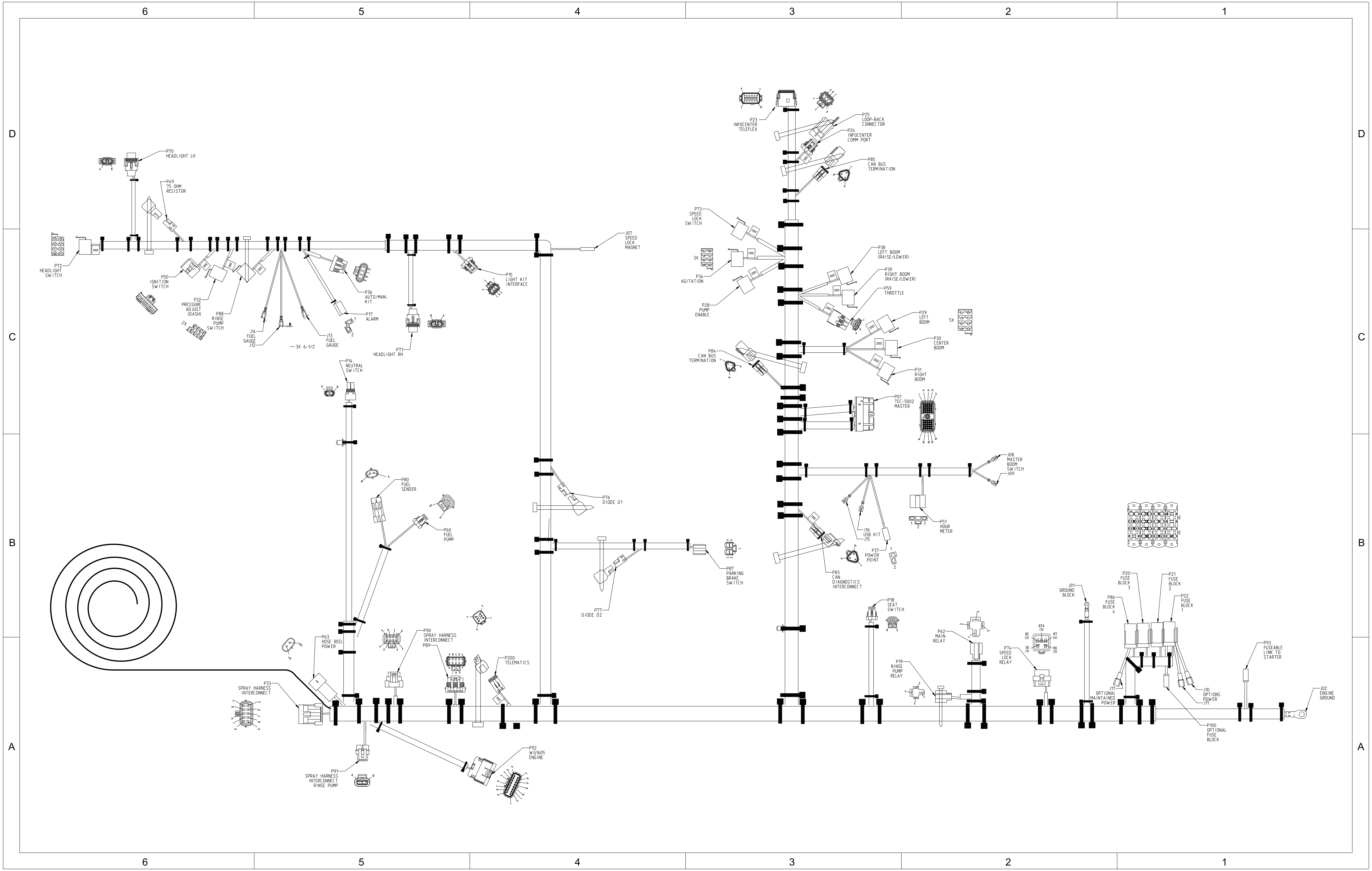


g329316

Front Wire Harness Diagram – Multi Pro 5800-G (serial numbers 316000000 to 403445000)



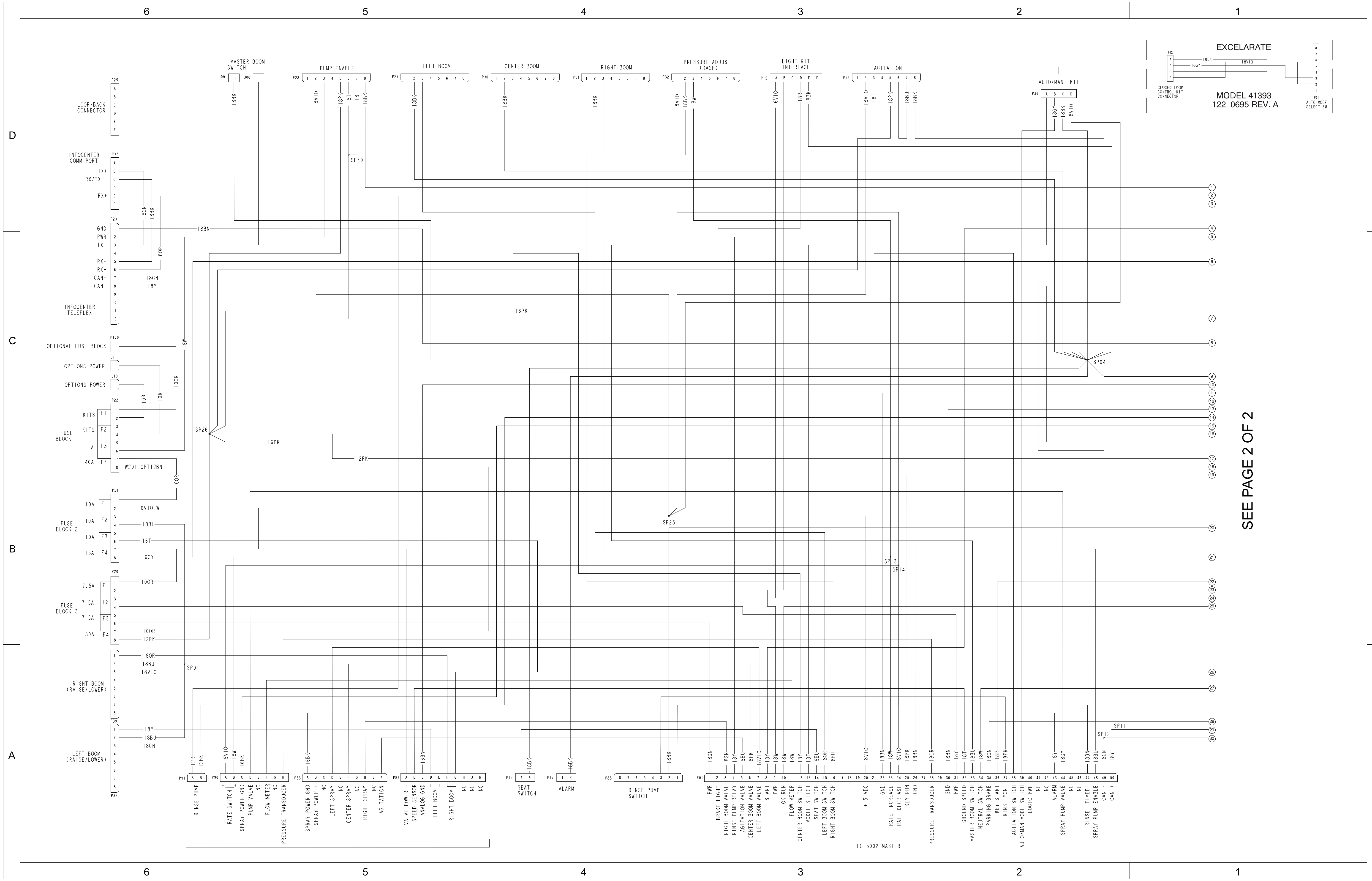
g329317



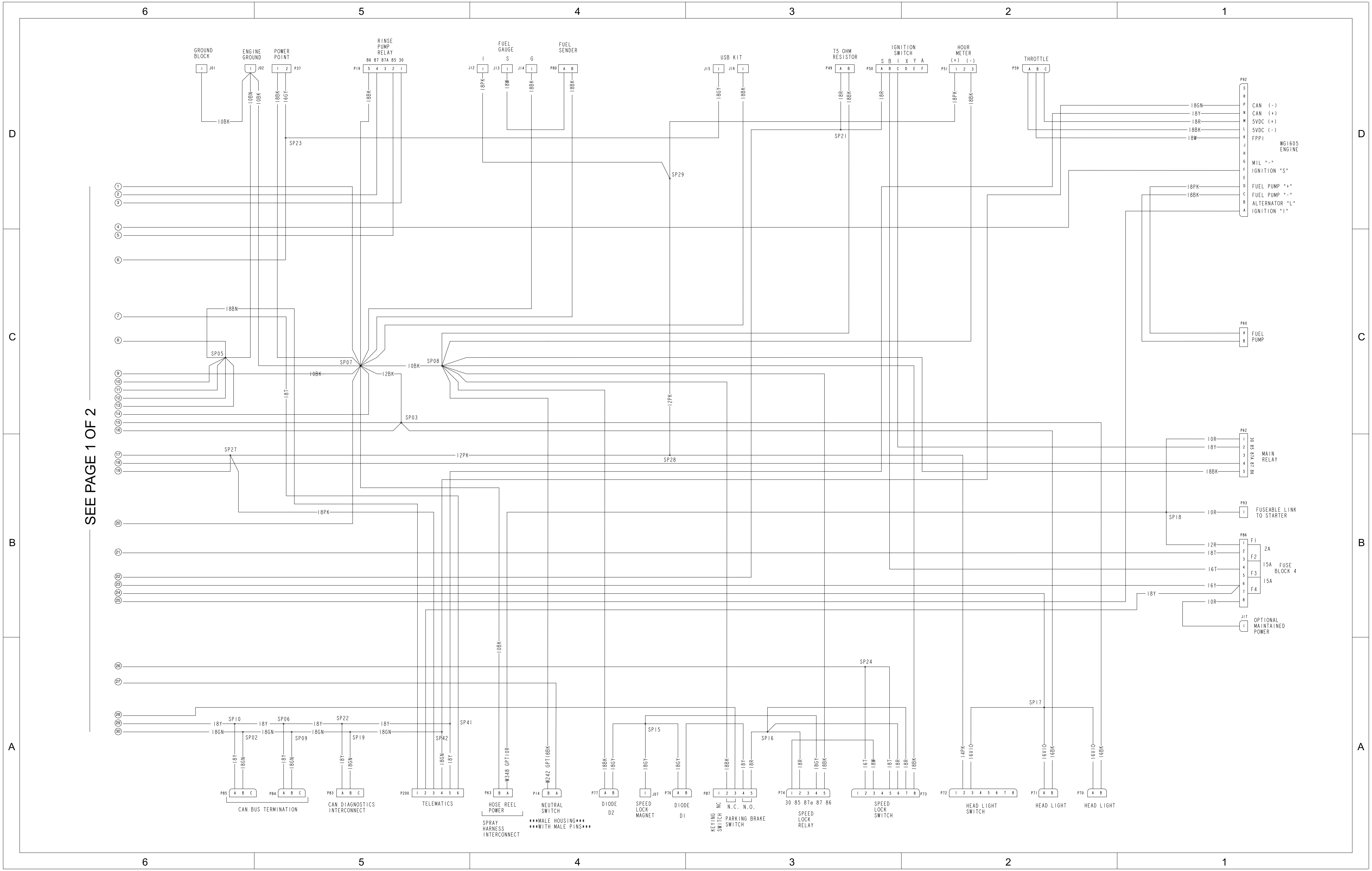
P70 HEADLIGHT LH
P49 75 OHM RESISTOR
P72 HEADLIGHT SWITCH
P50 IGNITION SWITCH
P32 PRESSURE ADJUST (DASH)
P88 RINSE PUMP SWITCH
J14 FUEL GAUGE
J12
J13 FUEL GAUGE
3X 6-1/2
P36 AUTO/MAN. KIT
P17 ALARM
P71 HEADLIGHT RH
P15 LIGHT KIT INTERFACE
J07 SPEED LOCK MAGNET
P14 NEUTRAL SWITCH
P80 FUEL SENDER
P60 FUEL PUMP
P76 DIODE D1
P77 DIODE D2
P87 PARKING BRAKE SWITCH
P63 HOSE REEL POWER
P33 SPRAY HARNESS INTERCONNECT
P90 SPRAY HARNESS INTERCONNECT
P89
P200 TELEMATICS
P91 SPRAY HARNESS INTERCONNECT RINSE PUMP
P92 WG1605 ENGINE
P23 INFOCENTER TELEFLEX
P25 LOOP-BACK CONNECTOR
P24 INFOCENTER COMM PORT
P85 CAN BUS TERMINATION
P73 SPEED LOCK SWITCH
3X
P34 AGITATION
P28 PUMP ENABLE
P38 LEFT BOOM (RAISE/LOWER)
P39 RIGHT BOOM (RAISE/LOWER)
P59 THROTTLE
P29 LEFT BOOM
5X
P30 CENTER BOOM
P31 RIGHT BOOM
P84 CAN BUS TERMINATION
P01 TEC-5002 MASTER
J08 MASTER BOOM SWITCH
J09
P51 HOUR METER
J16 USB KIT
J15
P37 POWER POINT
P83 CAN DIAGNOSTICS INTERCONNECT
P18 SEAT SWITCH
P19 RINSE PUMP RELAY
P62 MAIN RELAY
P74 SPEED LOCK RELAY
J01 GROUND BLOCK
P86 FUSE BLOCK 4
P20 FUSE BLOCK 3
P21 FUSE BLOCK 2
P22 FUSE BLOCK 1
J17 OPTIONAL MAINTAINED POWER
J10 OPTIONS POWER
J11
P100 OPTIONAL FUSE BLOCK
P93 FUSEABLE LINK TO STARTER
J02 ENGINE GROUND

g329327

Front Wire Harness Diagram – Multi Pro 5800-G (serial numbers above 403445000)

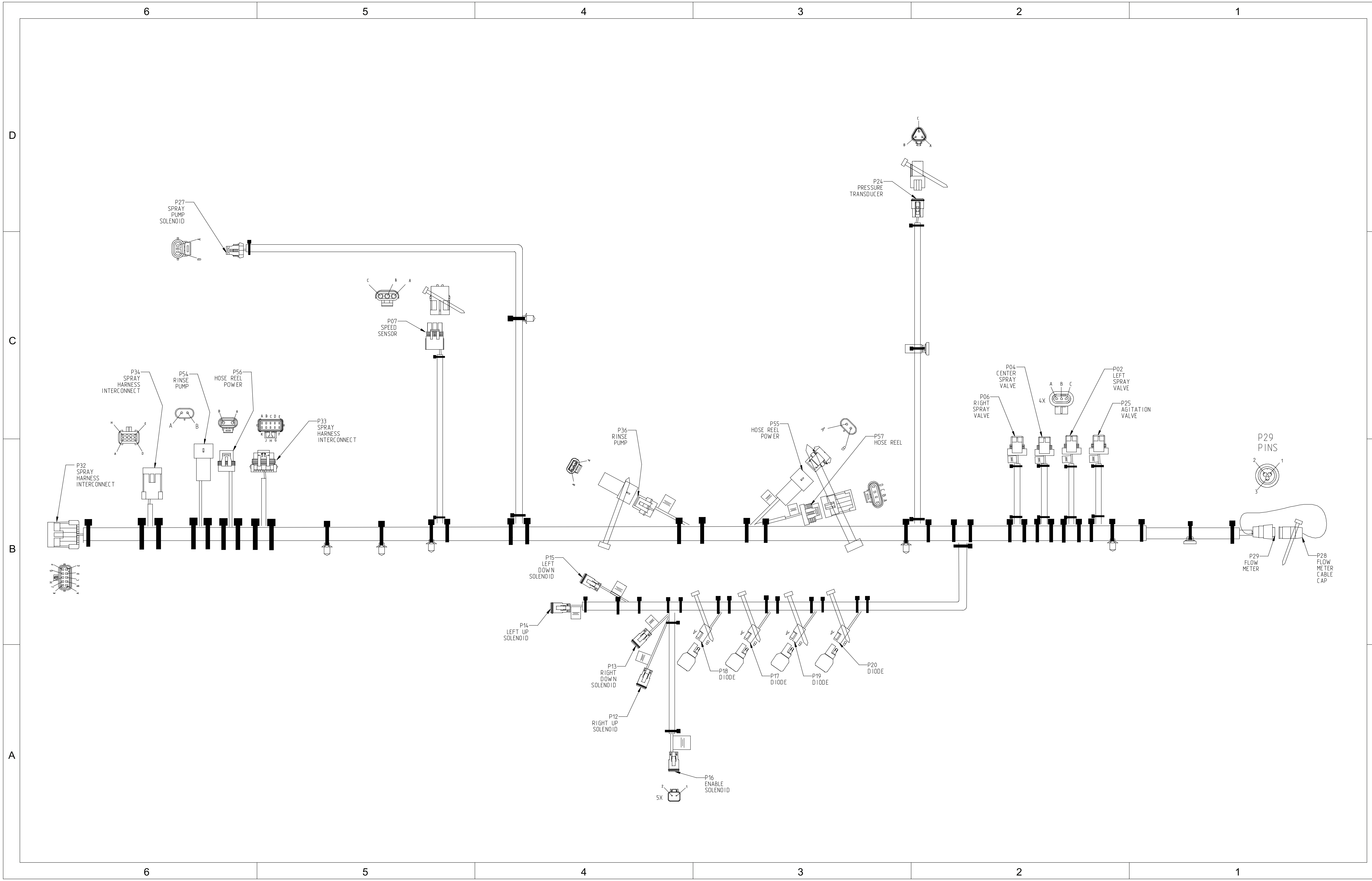


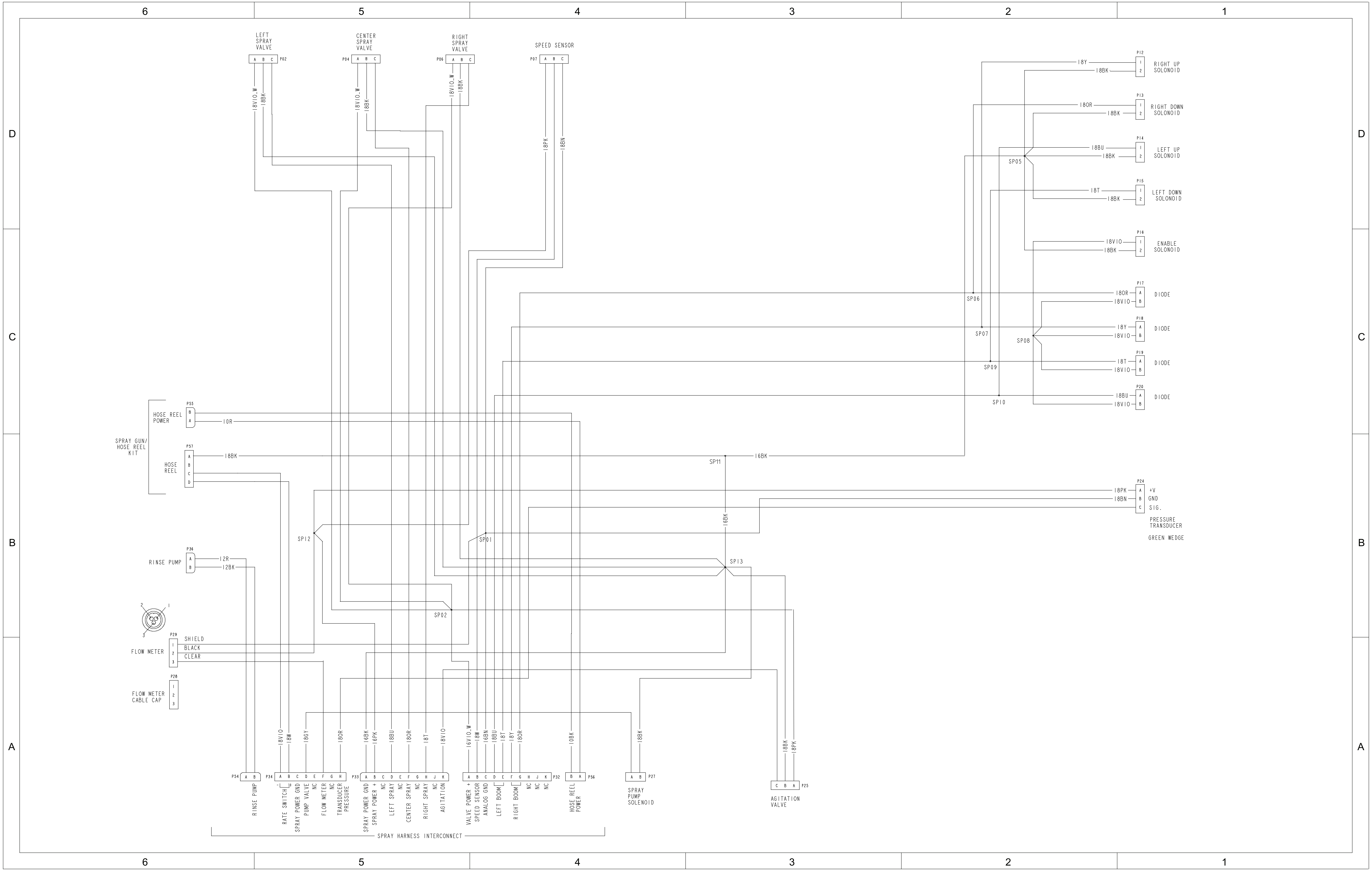
g329325


GROUND BLOCK
ENGINE GROUND
POWER POINT
RINSE PUMP RELAY
FUEL GAUGE
FUEL SENDER
USB KIT
75 OHM RESISTOR
IGNITION SWITCH
HOUR METER
THROTTLE
CAN (-)
CAN (+)
5VDC (+)
5VDC (-)
FPPI
WGI605 ENGINE
MIL "-"
IGNITION "S"
FUEL PUMP "+"
FUEL PUMP "-"
ALTERNATOR "L"
IGNITION "I"
FUEL PUMP
MAIN RELAY
FUSEABLE LINK TO STARTER
FUSE BLOCK 4
OPTIONAL MAINTAINED POWER
SEE PAGE 1 OF 2
CAN BUS TERMINATION
CAN DIAGNOSTICS INTERCONNECT
TELEMATICS
HOSE REEL POWER
SPRAY HARNESS INTERCONNECT
NEUTRAL SWITCH
MALE HOUSING
WITH MALE PINS
DIODE D2
SPEED LOCK MAGNET
DIODE D1
KEYING SWITCH
PARKING BRAKE SWITCH
SPEED LOCK RELAY
SPEED LOCK SWITCH
HEAD LIGHT SWITCH
HEAD LIGHT
HEAD LIGHT

g329326

Rear Wire Harness Drawing – Multi Pro 5800 (serial numbers above 316000000)

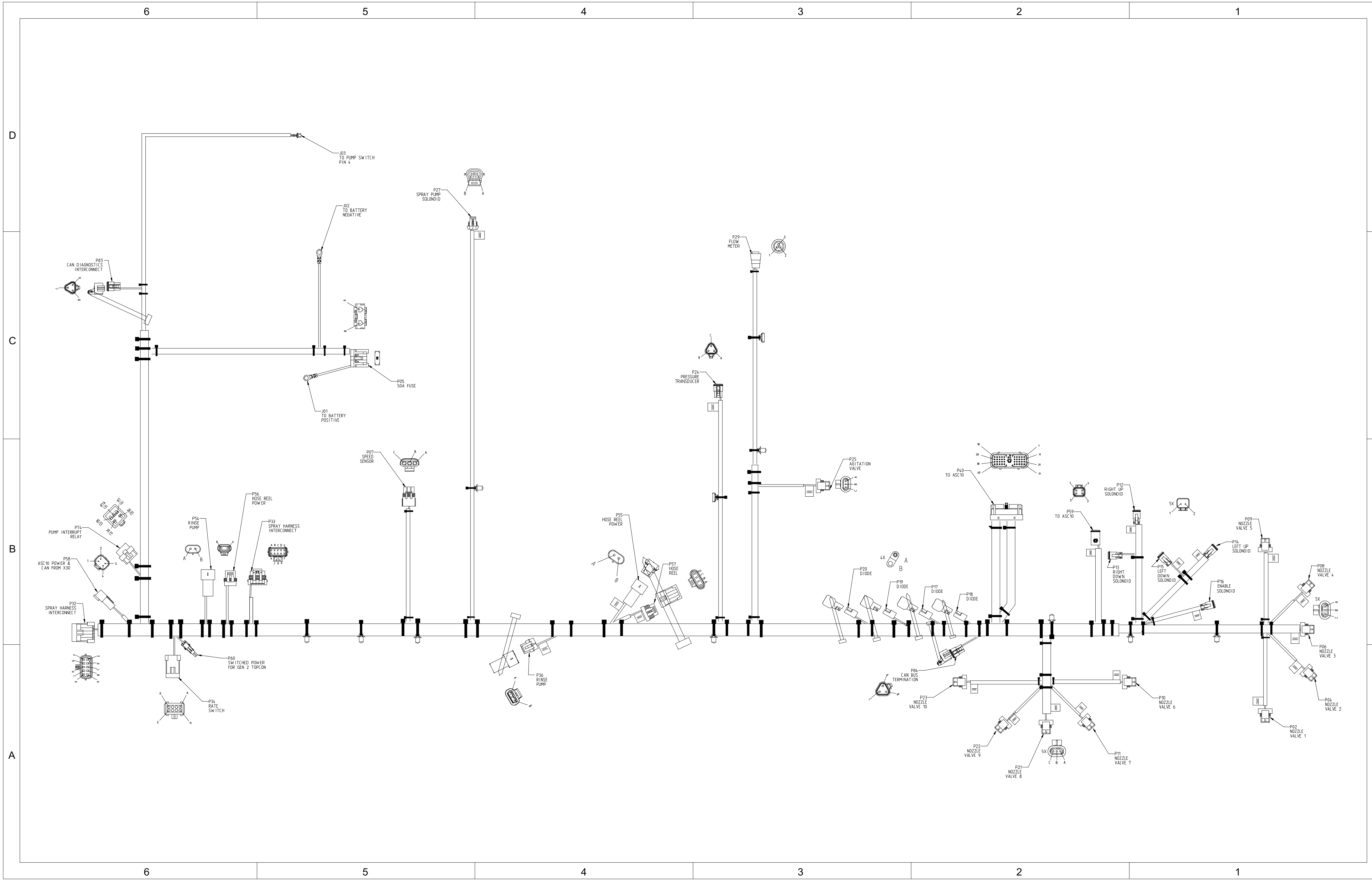




LEFT SPRAY VALVE
CENTER SPRAY VALVE
RIGHT SPRAY VALVE
SPEED SENSOR
RIGHT UP SOLONOID
RIGHT DOWN SOLONOID
LEFT UP SOLONOID
LEFT DOWN SOLONOID
ENABLE SOLONOID
DIODE
SPRAY GUN/ HOSE REEL KIT
HOSE REEL POWER
HOSE REEL
RINSE PUMP
FLOW METER
SHIELD
BLACK
CLEAR
FLOW METER CABLE CAP
PRESSURE TRANSDUCER
GREEN WEDGE
+V
GND
SIG.
SPRAY PUMP SOLENOID
AGITATION VALVE
SPRAY HARNESS INTERCONNECT

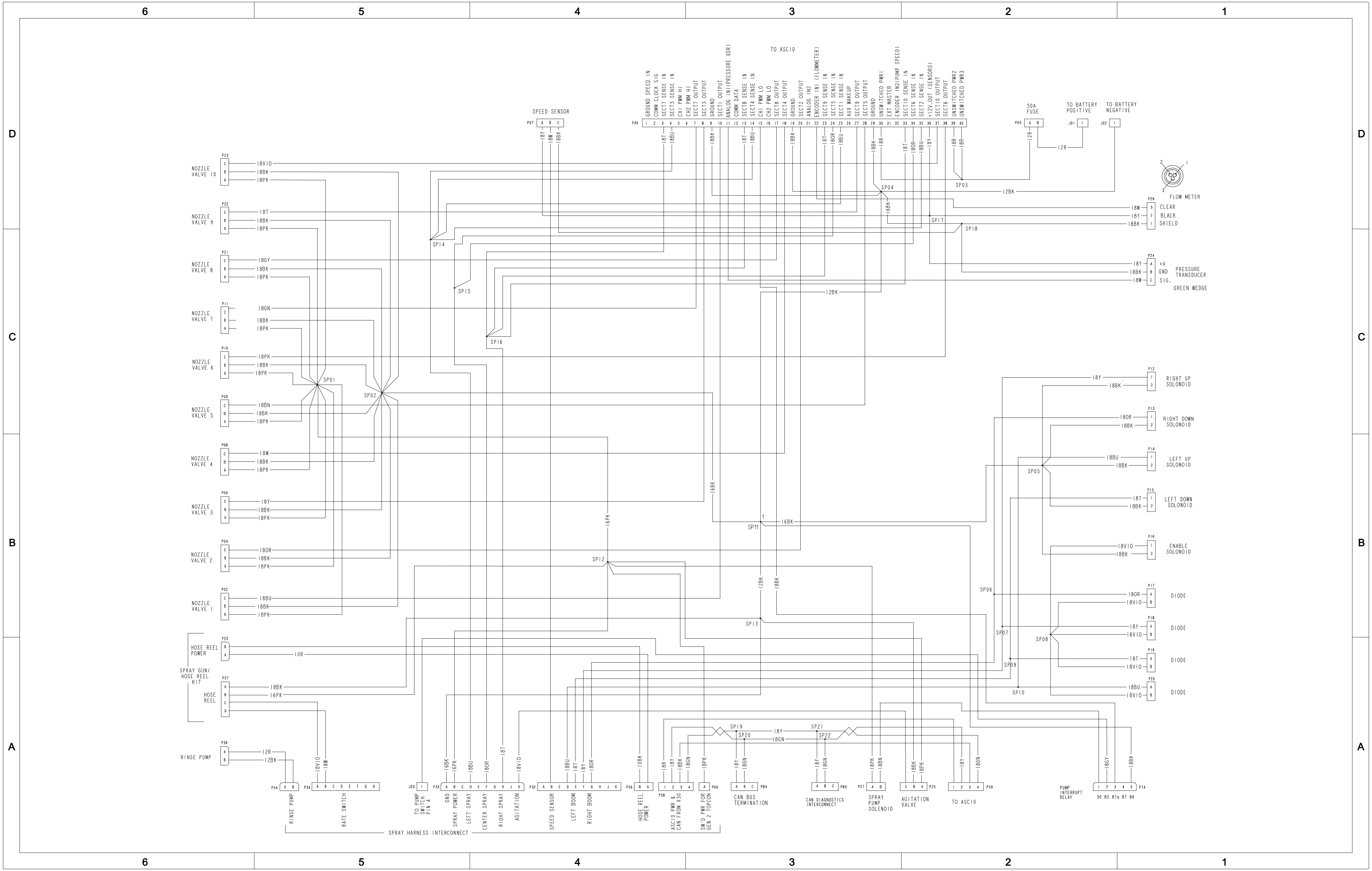
g329328

Rear Wire Harness Drawing – Multi Pro 5800 (serial numbers above 316000000) with GeoLink Spray System (Optional)

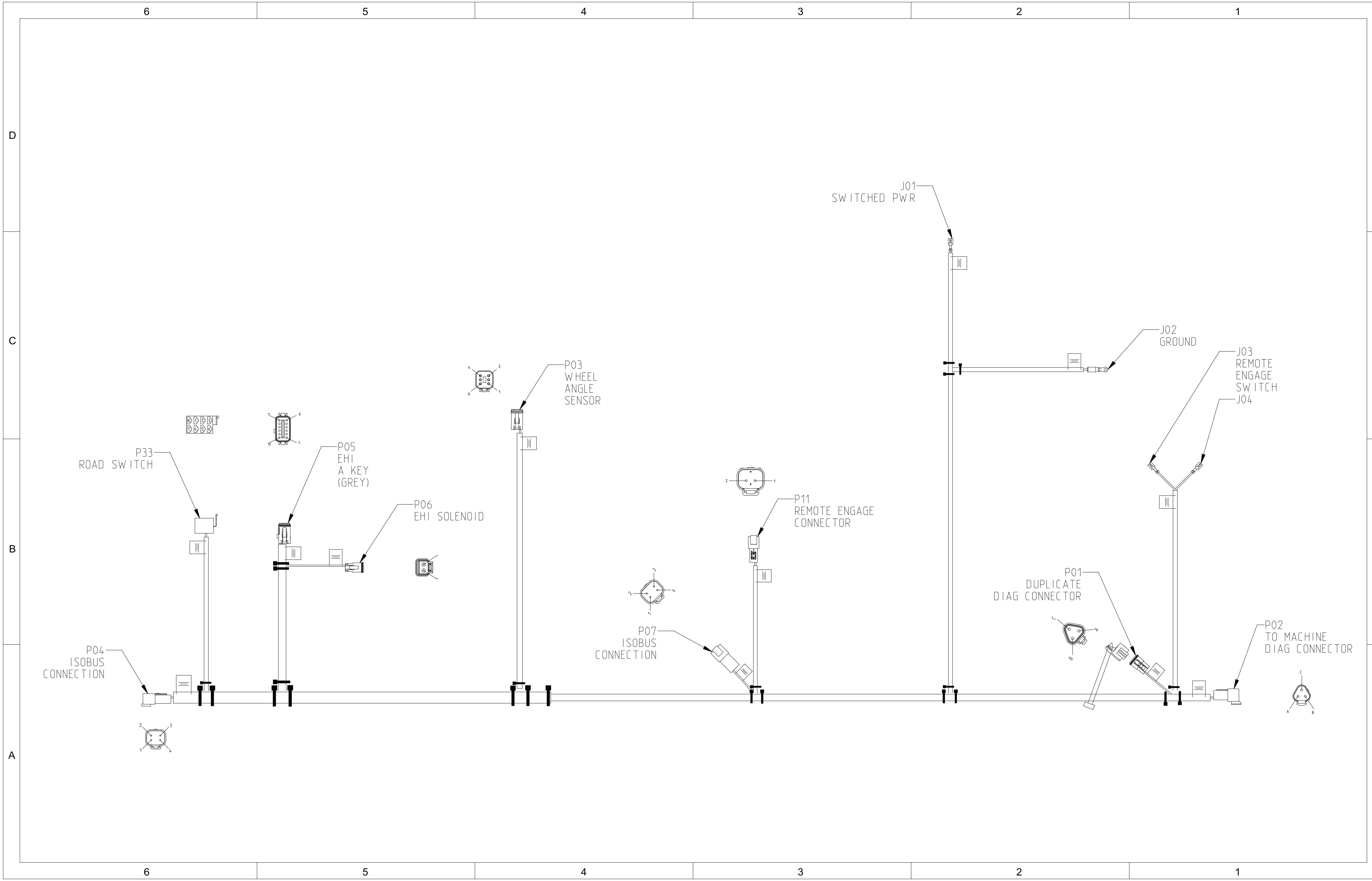


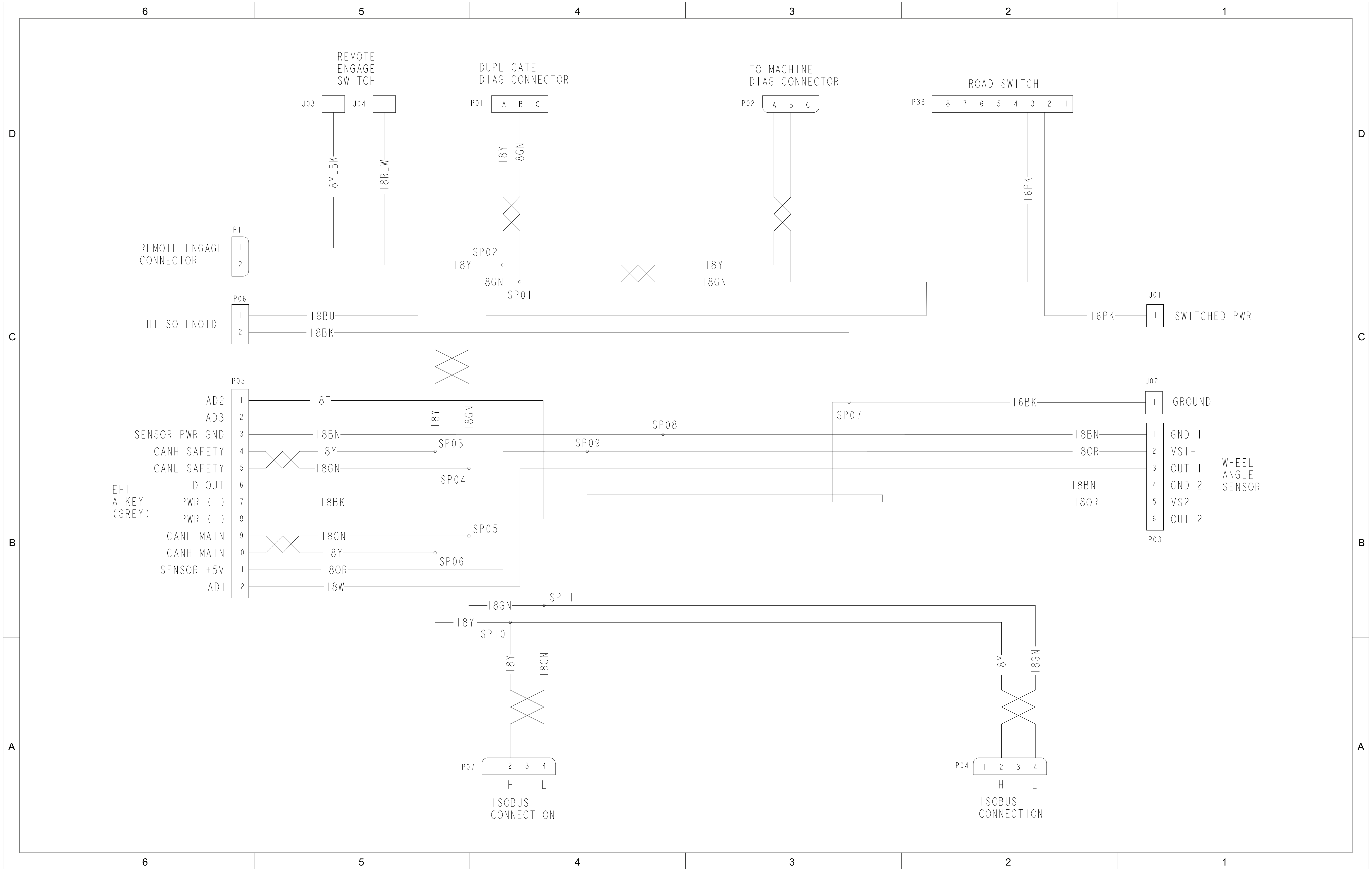
g329333

Rear Wire Harness Diagram – Multi Pro 5800 (serial numbers above 316000000) with GeoLink Spray System (Optional)

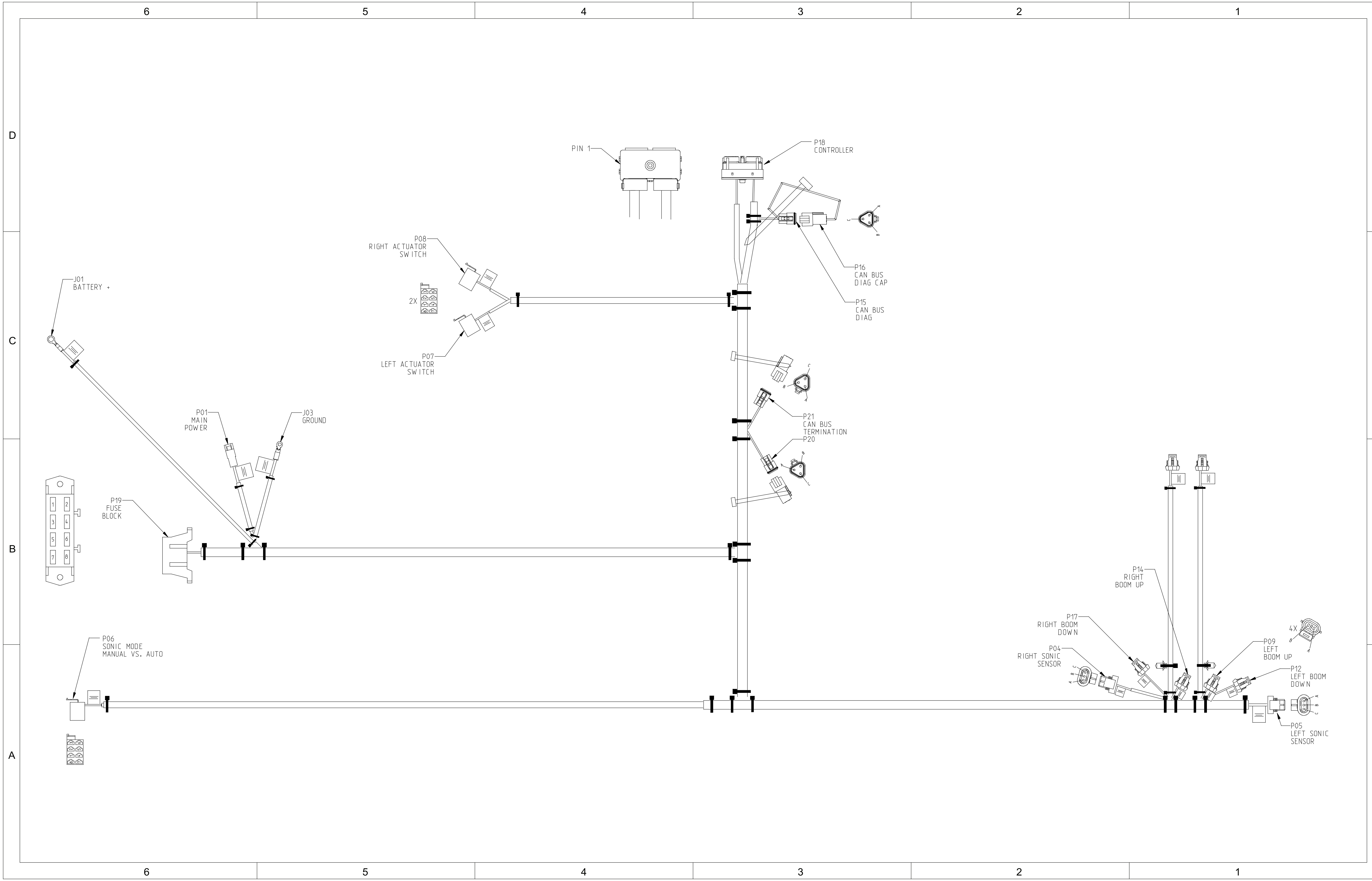


Wire Harness Drawing – AutoSteer Kit (Optional)

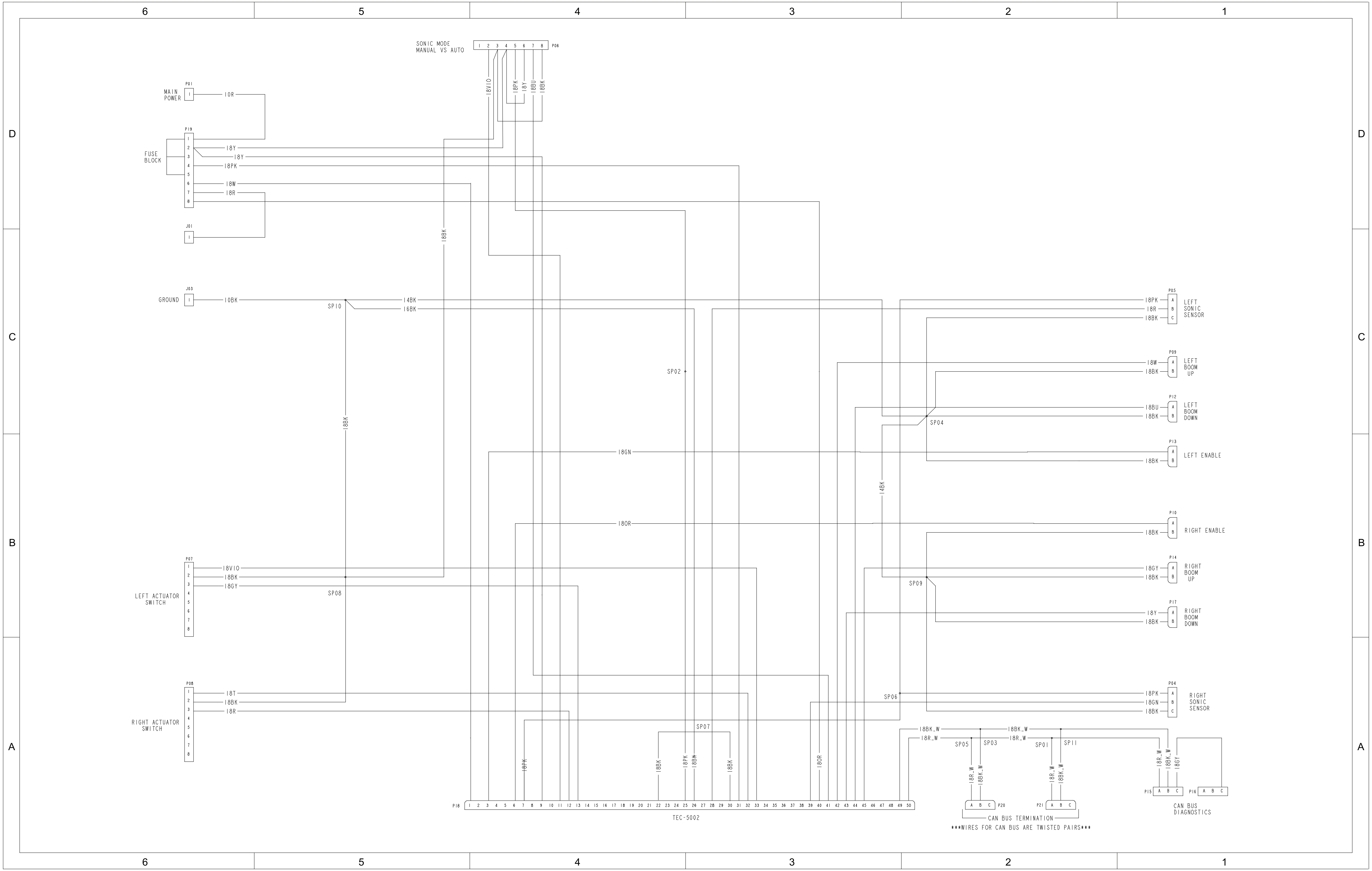



REMOTE ENGAGE SWITCH
J03 1
J04 1
18Y_BK
18R_W
DUPLICATE DIAG CONNECTOR
P01 A B C
18Y
18GN
TO MACHINE DIAG CONNECTOR
P02 A B C
ROAD SWITCH
P33 8 7 6 5 4 3 2 1
16PK
P11
REMOTE ENGAGE CONNECTOR
SP02
18Y
18GN
SP01
J01
16PK
SWITCHED PWR
P06
EHI SOLENOID
18BU
18BK
P05
AD2
AD3
SENSOR PWR GND
CANH SAFETY
CANL SAFETY
D OUT
PWR (-)
PWR (+)
CANL MAIN
CANH MAIN
SENSOR +5V
AD1
EHI A KEY (GREY)
18T
18BN
18OR
18W
SP03
SP04
SP05
SP06
SP07
SP08
SP09
J02
16BK
GROUND
GND 1
VS1+
OUT 1
GND 2
VS2+
OUT 2
WHEEL ANGLE SENSOR
P03
SP11
SP10
P07 1 2 3 4
H L
ISOBUS CONNECTION
P04 1 2 3 4
H L
ISOBUS CONNECTION
g329335

Wire Harness Drawing – Ultra Sonic Boom Kit (Optional)

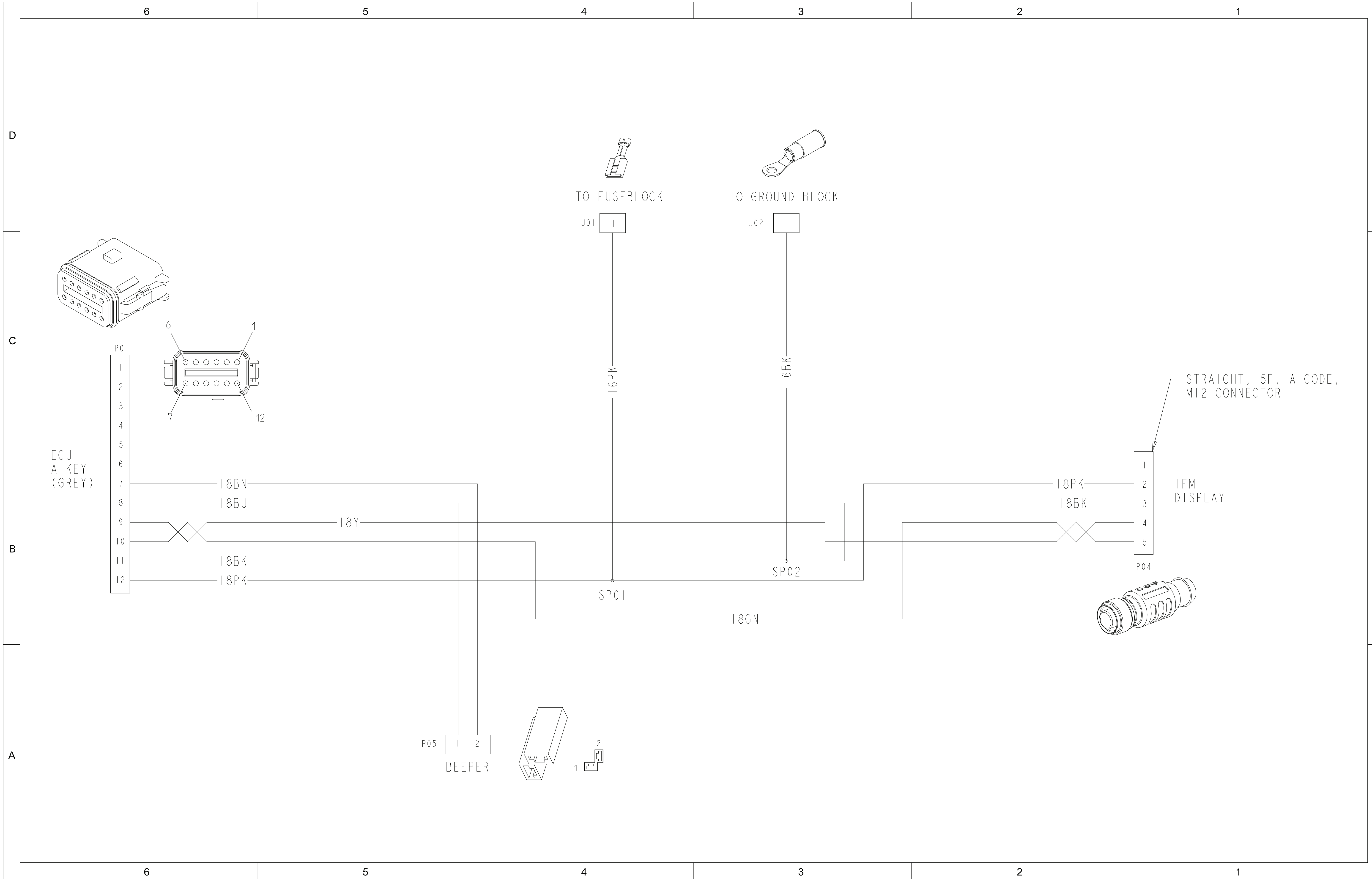


g329331

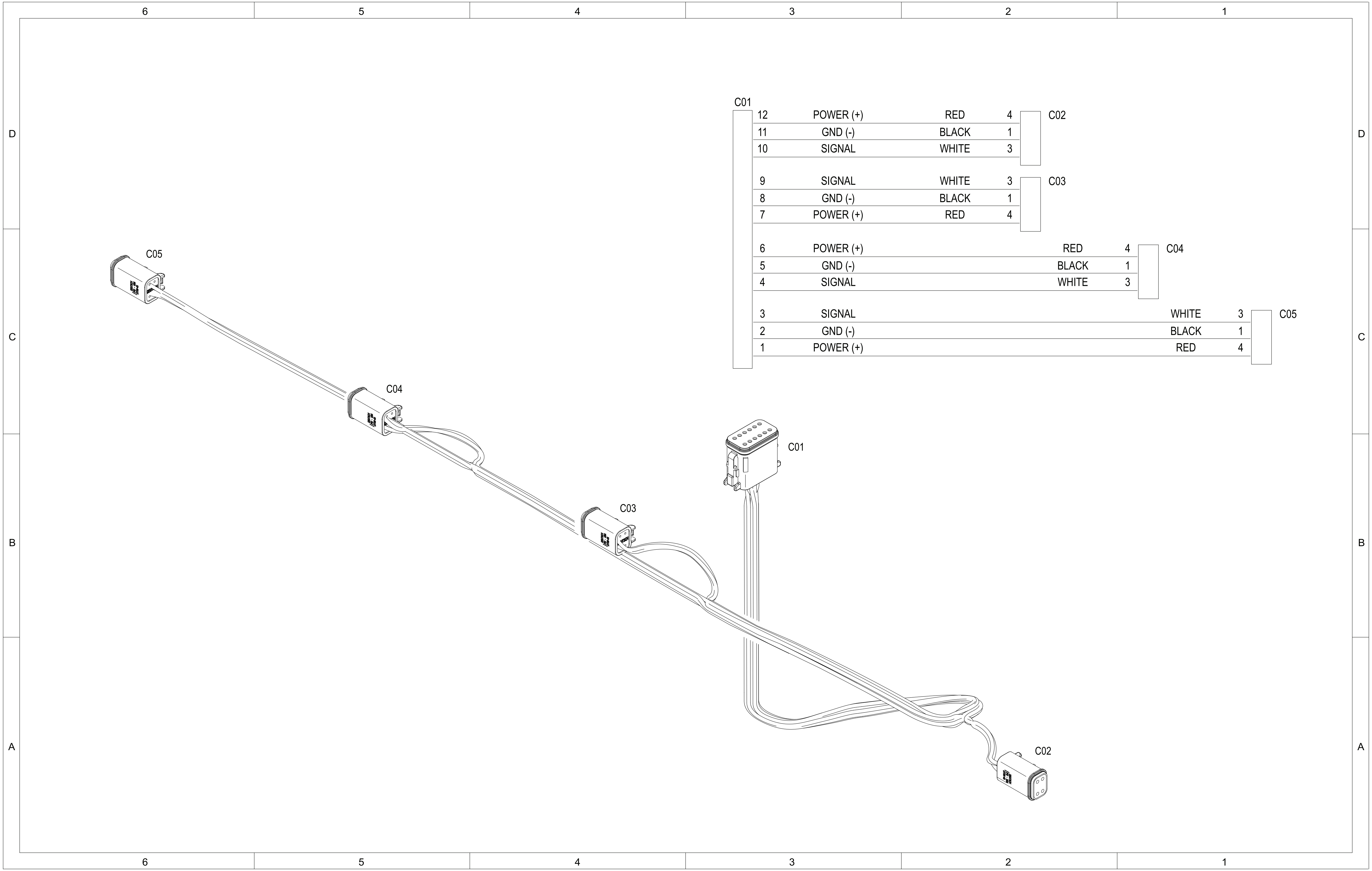

SONIC MODE
MANUAL VS AUTO
P06
MAIN
POWER
P01
FUSE
BLOCK
P19
J01
GROUND
J03
SP10
SP02
SP04
SP08
SP09
SP06
SP07
LEFT ACTUATOR
SWITCH
P07
RIGHT ACTUATOR
SWITCH
P08
LEFT
SONIC
SENSOR
P05
LEFT
BOOM
UP
P09
LEFT
BOOM
DOWN
P12
LEFT ENABLE
P13
RIGHT ENABLE
P10
RIGHT
BOOM
UP
P14
RIGHT
BOOM
DOWN
P17
RIGHT
SONIC
SENSOR
P04
P18
TEC-5002
SP05
SP03
SP01
SP11
P20
P21
CAN BUS TERMINATION
WIRES FOR CAN BUS ARE TWISTED PAIRS
P15
P16
CAN BUS
DIAGNOSTICS

g329330

Main Wire Harness – NozzAlert Nozzle Sensing System (Optional)

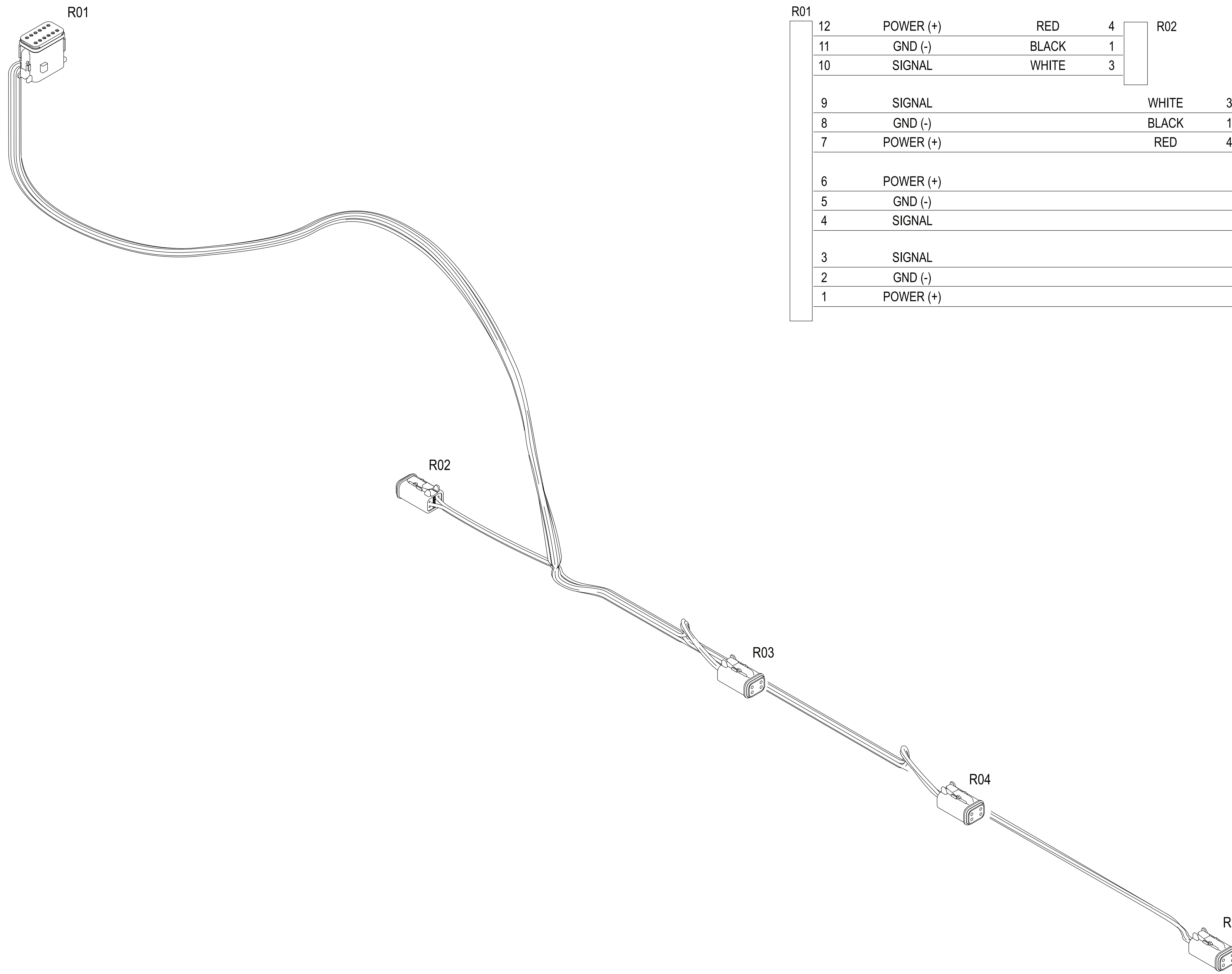


g329334



C01
12 POWER (+) RED 4 C02
11 GND (-) BLACK 1
10 SIGNAL WHITE 3
9 SIGNAL WHITE 3 C03
8 GND (-) BLACK 1
7 POWER (+) RED 4
6 POWER (+) RED 4 C04
5 GND (-) BLACK 1
4 SIGNAL WHITE 3
3 SIGNAL WHITE 3 C05
2 GND (-) BLACK 1
1 POWER (+) RED 4
C05
C04
C03
C01
C02
g329338

Right Boom Wire Harness – NozzAlert Nozzle Sensing System (Optional)



R01 Pin	Function	Wire Color	Pin	Connector
12	POWER (+)	RED	4	R02
11	GND (-)	BLACK	1	R02
10	SIGNAL	WHITE	3	R02
9	SIGNAL	WHITE	3	R03
8	GND (-)	BLACK	1	R03
7	POWER (+)	RED	4	R03
6	POWER (+)	RED	4	R04
5	GND (-)	BLACK	1	R04
4	SIGNAL	WHITE	3	R04
3	SIGNAL	WHITE	3	R05
2	GND (-)	BLACK	1	R05
1	POWER (+)	RED	4	R05

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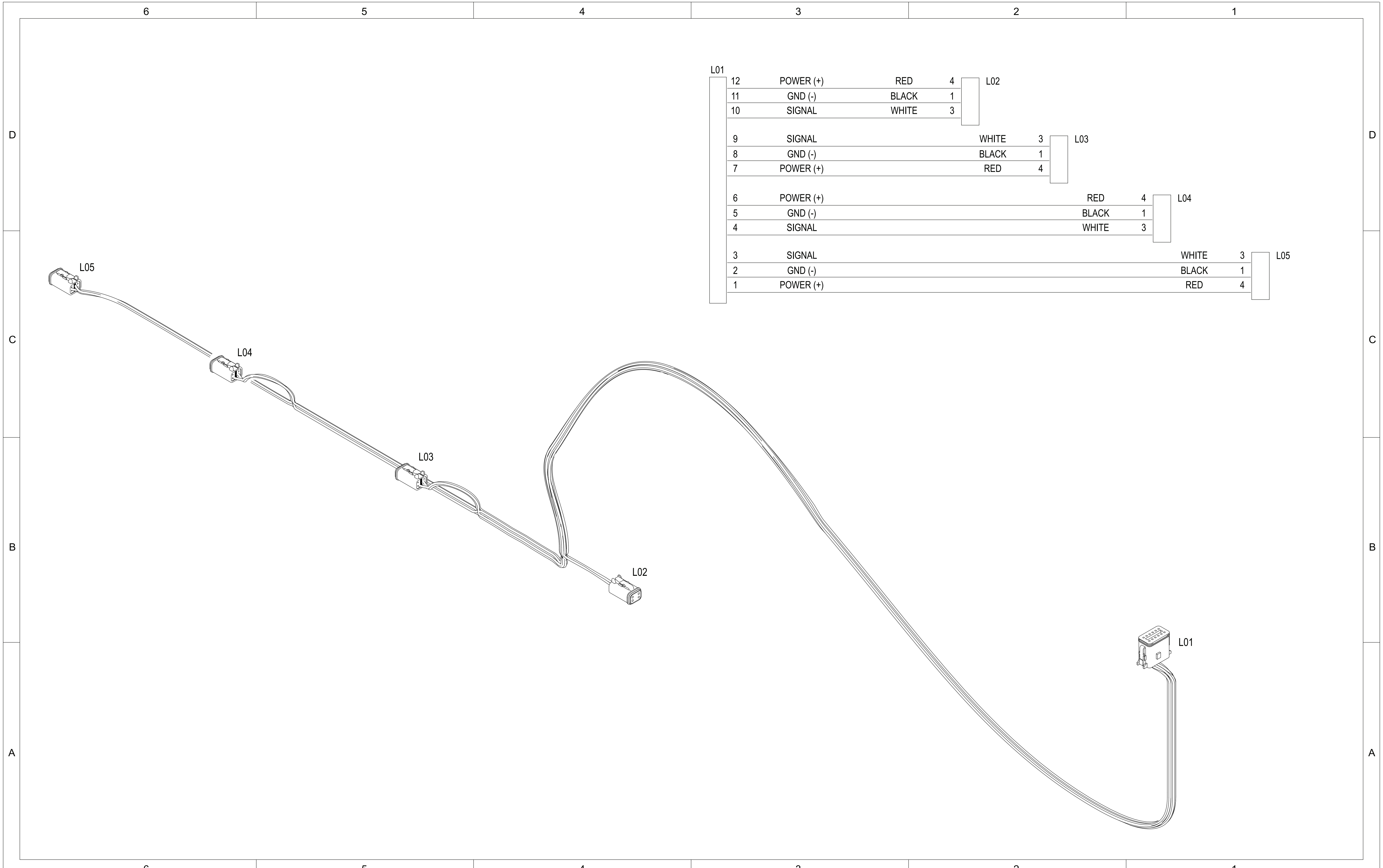
6
5
4
3
2
1
D
C
B
A
L01
12 POWER (+) RED 4
11 GND (-) BLACK 1
10 SIGNAL WHITE 3
L02
9 SIGNAL WHITE 3
8 GND (-) BLACK 1
7 POWER (+) RED 4
L03
6 POWER (+) RED 4
5 GND (-) BLACK 1
4 SIGNAL WHITE 3
L04
3 SIGNAL WHITE 3
2 GND (-) BLACK 1
1 POWER (+) RED 4
L05
L05
L04
L03
L02
L01

g329337

Count on it.