Form No. 14210SL Rev B

TORO®

Count on it.

Service Manual

Sand Pro 2040Z

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2014	Initial Issue.
A	02/2018	Added revision history.
B	06/2020	Updated electrical drawings chapter.

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.
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NOTES

Part No. 14210SL (Rev. B)

Service Manual

Sand Pro 2040Z

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 Sand Pro 2040Z.

REFER TO THE OPERATOR'S MANUAL FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manual and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

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

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

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

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

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Chapter 1

Safety

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Safety Instructions

The Sand Pro 2040Z is tested and certified by Toro for compliance with existing safety standards and specifications. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

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

Before Operating

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

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine.

3. Before machine operation, tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

4. Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local safety and insurance regulations.

5. Ensure that the traction interlock switch is adjusted correctly so the engine cannot be started unless the control handles are placed in the neutral locked position.

6. When attachments are installed to your Sand Pro, additional weight may be required to comply to safety standards. Refer to your Operator's Manual for additional information.

7. Never operate your Sand Pro without the rear attachment installed.

8. Since gasoline is highly flammable, handle it carefully:

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

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

   C. Do not smoke while handling fuel.

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

   E. If fuel is spilled, do not start engine. Move the machine away from the area of spillage and allow the gasoline vapors to dissipate. Properly dispose of any spilled fuel.

While Operating

1. Operator should be in the operator's seat when operating the Sand Pro. Never carry passengers.

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

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

4. If abnormal vibration is detected, stop machine immediately and determine source of vibration. Correct problems before resuming the use of the machine.

5. While operating, the machine may exceed noise levels of 85 dB(A) at the operator position. Hearing protection is recommended for prolonged exposure to reduce the potential of permanent hearing damage.

6. Before leaving the operator's position of the machine:

   A. Stop movement of the machine and place control handles in the neutral locked position.

   B. Apply parking brake and take precautions to prevent accidental starts, rolling away, etc.

Maintenance and Service

1. Before servicing or making adjustments, position machine on a level surface and apply parking brake to prevent machine from moving.

2. Before servicing or making adjustments, disconnect the spark plug wires from the spark plugs and position the wires away from the spark plugs to ensure that the engine will not start unexpectedly.

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

6. Before disconnecting any hydraulic component or performing any work on the hydraulic system, all pressure in hydraulic system must be relieved. Place control handles in the neutral locked position and fully lower rear attachment to relieve system pressure.

7. 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 skin and do serious damage. If fluid is injected into the skin it must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

8. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed with a tachometer.

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

10. To reduce potential fire hazard, keep engine area free of excessive grease, grass, leaves and dirt.

11. If the engine must be running to perform a maintenance adjustment, keep clothing, hands, feet and other parts of the body away from the engine and all moving parts. Also, keep bystanders away.

12. When changing tires or performing other service that requires the machine to be raised off the ground, make sure machine is properly supported. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

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

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

15. Make sure to dispose of potentially harmful waste (e.g. fuel, oil, engine coolant, filters, battery) in an environmentally safe manner. Follow all local codes and regulations when recycling or disposing of waste.

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct jacks, hoists 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.

Use the following procedure when jacking up the machine:

1. To prevent the machine from shifting, place suitable chocks or blocks under tires that will remain on the ground.

2. Jack the front or rear of the machine at the support points of the frame as shown in Fig. 1. Make sure that jack is positioned securely under frame to reduce the chance that the machine could shift while being raised.

3. Use appropriate jackstands at frame support points to keep raised machine from moving.

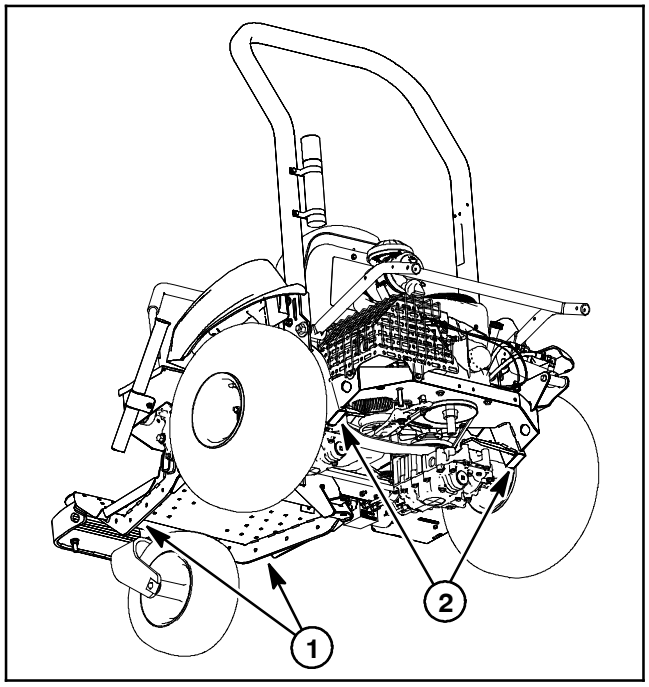

Figure 1

1. **Front support points**
2. **Rear support points**

Safety and Instruction Decals

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

Chapter 2

Product Records and Maintenance

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Product Records

Insert a copy of the Operator's Manual and Parts Catalog for your Sand Pro at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, 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 Sand Pro machines are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

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

U.S.to Metric Conversions

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

Torque Specifications

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

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

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

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

Fastener Identification

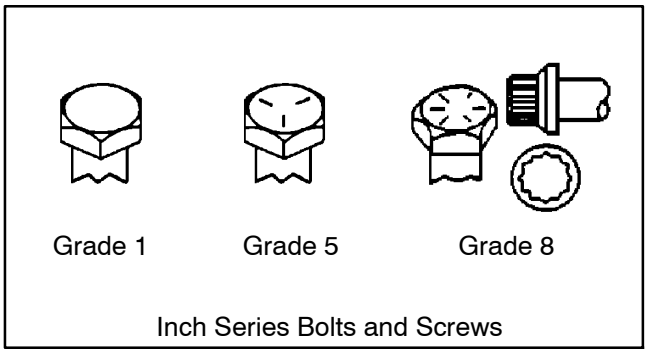

Figure 1

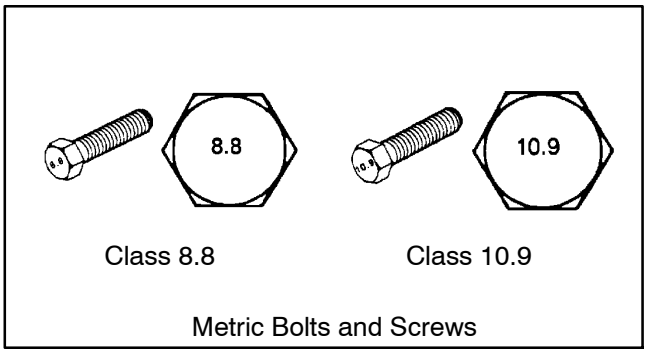

Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

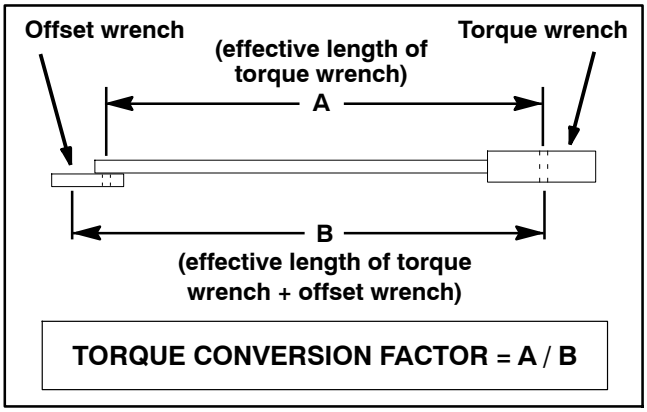

Figure 3

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

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in-lb	**in-lb**	**N-cm**	**in-lb**	**N-cm**	**in-lb**	**N-cm**
# 6 - 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 - 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 - 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 - 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 - 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 - 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 - 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 - 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 - 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 - 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	ft-lb	**ft-lb**	**N-m**	**ft-lb**	**N-m**	**ft-lb**	**N-m**
3/8 - 16 UNC	16 ± 2	16 ± 2	22 ± 3	30 ± 3	41 ± 4	43 ± 5	58 ± 7
3/8 - 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
7/16 - 14 UNC	27 ± 3	27 ± 3	37 ± 4	50 ± 5	68 ± 7	70 ± 7	95 ± 9
7/16 - 20 UNF	29 ± 3	29 ± 3	39 ± 4	55 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 - 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 - 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 - 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 - 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 - 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 - 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
7/8 - 9 UNC	140 ± 20	225 ± 25	305 ± 34	430 ± 45	583 ± 61	600 ± 60	813 ± 81
7/8 - 14 UNF	155 ± 25	260 ± 30	353 ± 41	475 ± 48	644 ± 65	667 ± 66	904 ± 89

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

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

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

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

Thread Size	Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 6 in- lb	644 ± 68 N- cm	78 ± 8 in- lb	881 ± 90 N- cm
M6 X 1.0	96 ± 10 in- lb	1085 ± 113 N- cm	133 ± 14 in- lb	1503 ± 158 N- cm
M8 X 1.25	19 ± 2 ft- lb	26 ± 3 N- m	28 ± 3 ft- lb	38 ± 4 N- m
M10 X 1.5	38 ± 4 ft- lb	52 ± 5 N- m	54 ± 6 ft- lb	73 ± 8 N- m
M12 X 1.75	66 ± 7 ft- lb	90 ± 10 N- m	93 ± 10 ft- lb	126 ± 14 N- m
M16 X 2.0	166 ± 17 ft- lb	225 ± 23 N- m	229 ± 23 ft- lb	310 ± 31 N- m
M20 X 2.5	325 ± 33 ft- lb	440 ± 45 N- m	450 ± 46 ft- lb	610 ± 62 N- m

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

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

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

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

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

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

Chapter 3

Gasoline Engine

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Specifications

Item	Description
Engine Make / Designation	Kawasaki, 4- cycle, V- Twin Cylinder, OHV, Air Cooled, Gasoline Engine
Bore x Stroke	2.874” x 2.835” (73mm x 72mm)
Engine Displacement	36.8 cu in (603cc)
Fuel	Unleaded Regular Grade Gasoline
Fuel Capacity	4.5 US gallons (17 liters)
Fuel Pump	Pulse Type
Carburetor	Float Feed, Single Barrel
Governor	Mechanical
High Idle Speed (No Load)	2750 to 2950 RPM
Low Idle Speed (No Load)	1450 to 1650 RPM
Lubrication System	Pressure Lubrication
Oil Pump	Gear Driven Geroter Type
Crankcase Oil Capacity	1.8 US quarts (1.7 liters) with new filter
Engine Oil	API SJ, SL, SM or higher (see Operator’s Manual for viscosity)
Spark Plugs	NGK BPR4ES (or equivalent)
Spark Plug Gap	0.028” to 0.030” (0.7 to 0.8 mm)
Starter	12 VDC
Alternator	12 VDC / 20 Amps @ 3600 RPM
Engine Weight (approximate)	90 lb (41 kg)

General Information

This chapter gives information about specifications and repair of the Kawasaki engine used in the Sand Pro 2040Z.

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

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

Service and repair parts for the Kawasaki engine used to power your Sand Pro are supplied through your local Toro distributor. Replacement engine part numbers can be found in the Parts Catalog for your Sand Pro.

Operator's Manuals

The Sand Pro 2040Z Operator's Manual and the Kawasaki Engine Owner's Manual provides information regarding the operation, general maintenance and maintenance intervals for the Kawasaki engine that powers your Sand Pro machine. Refer to that publication for additional information when servicing the machine.

Fuel Evaporative Control System

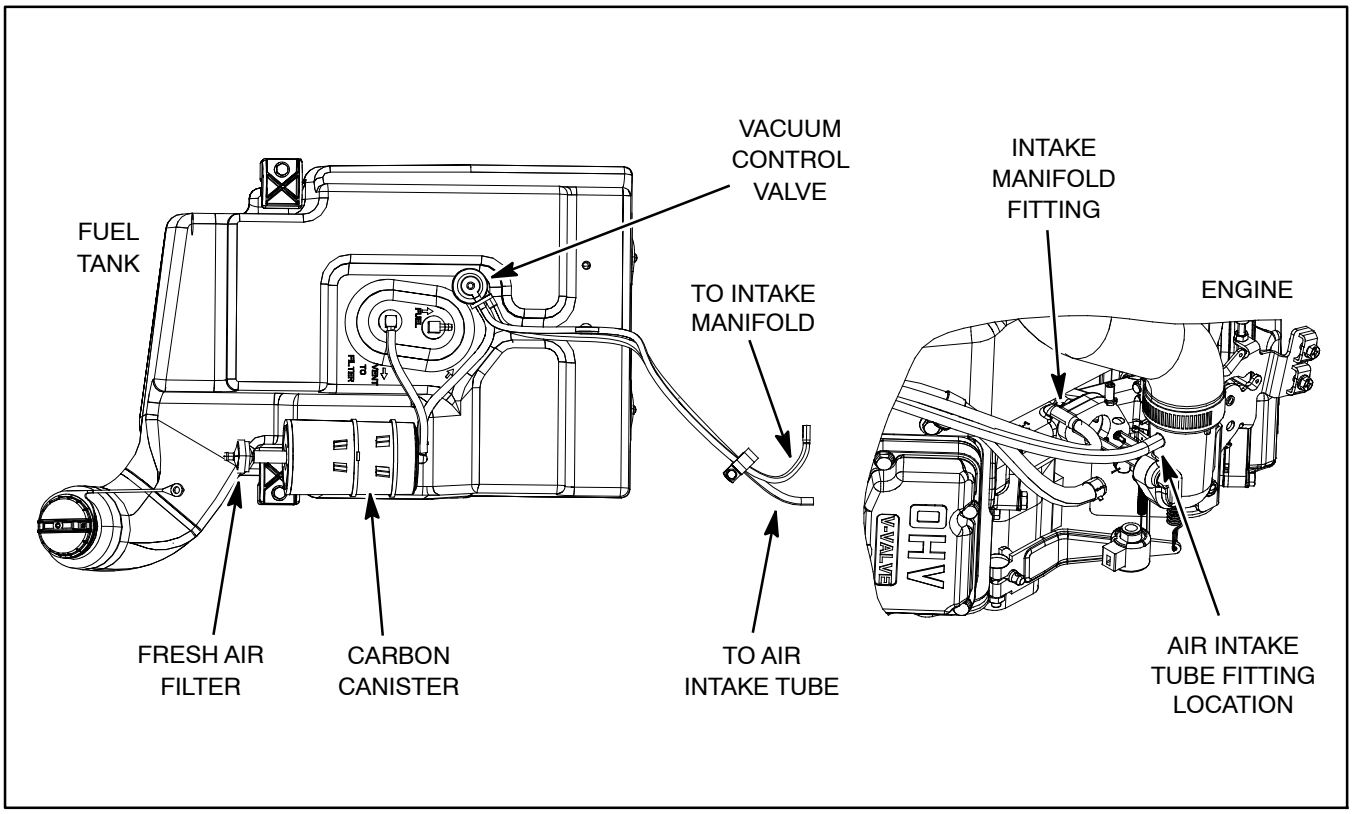

Figure 1

The function of the fuel evaporative control system is to collect and store evaporative emissions from the fuel tank and engine. The evaporate control system used on Sand Pro 2040Z machines uses a carbon canister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister when the engine is not running. Vapors from the canister are consumed when the engine is running.

The fuel tank on Sand Pro 2040Z machines uses a non-vented fuel cap. A vacuum control valve located above the fuel tank 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 the engine air intake tube. 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 fresh air filter, the carbon canister, the vacuum control valve or hoses in the evaporative control system, 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.

Cooling System

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

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

IMPORTANT: The engine that powers the Sand Pro 2040Z machine is air-cooled. Operating the engine with dirty or plugged cooling fins, a blocked rotating screen or a plugged or dirty blower housing will result in engine overheating and engine damage.

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

CAUTION

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

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

2. Carefully clean cooling fins on both cylinder heads.

3. Clean screen guard and blower housing of dirt and debris (Fig. 2).

4. If necessary, remove screen guard from blower housing and clean rotating screen that is attached to flywheel.

5. If necessary, remove blower housing from engine for complete cooling system cleaning.

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

6. Make sure rotating screen, blower housing and screen guard are reinstalled to the engine if removed.

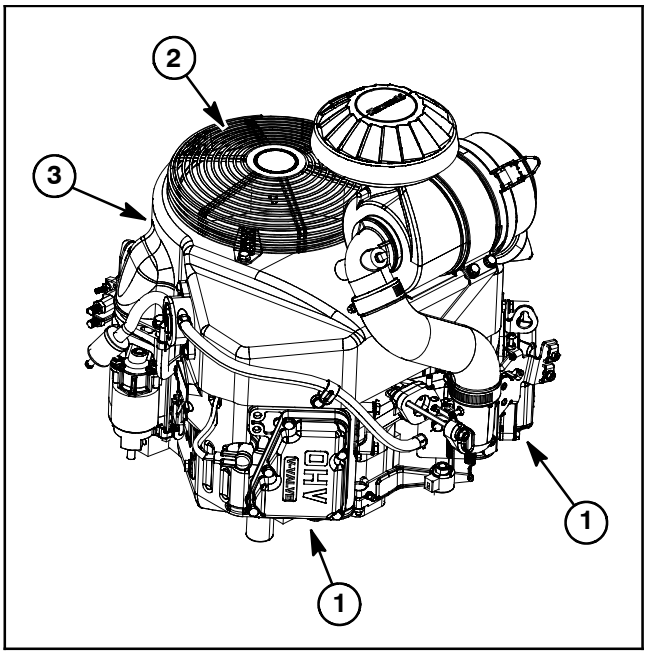

Figure 2

1. **Cylinder head**
2. **Screen guard**
3. **Blower housing**

Fuel Tank

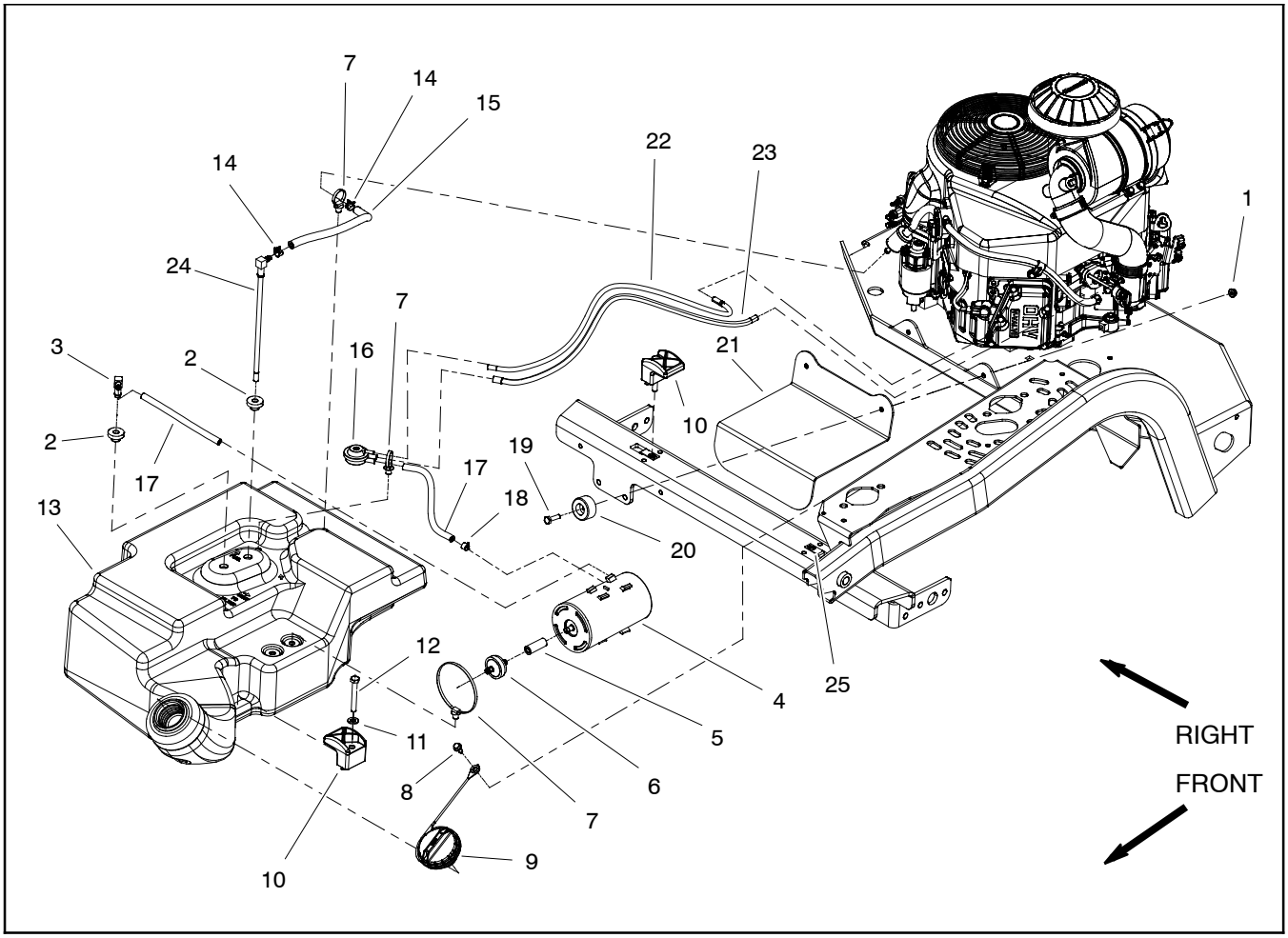

Figure 3

1. Flange nut (2 used)
2. Bushing (2 used)
3. 90º elbow fitting
4. Carbon canister
5. Fuel hose
6. Clean air filter
7. Tie clip (4 used)
8. Washer head screw
9. Fuel tank cap
10. Clamp (2 used)
11. Flat washer (2 used)
12. Cap screw (2 used)
13. Fuel tank
14. Hose clamp (2 used)
15. Fuel supply hose
16. Vacuum control valve
17. Fuel hose (2 used)
18. Hose clamp
19. Cap screw (2 used)
20. Recessed bumper (2 used)
21. Tank mount bracket
22. Vent hose (to intake manifold)
23. Vent hose (to air intake tube)
24. Stand tube
25. U- nut (2 used)

DANGER

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

Check Fuel Lines and Connections

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

Empty and Clean Fuel Tank

IMPORTANT: If fuel tank is to be emptied, empty fuel in a well ventilated area.

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

IMPORTANT: Follow all local codes and regulations when recycling or disposing waste fuel.

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

Fuel Tank Removal (Fig. 3)

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

2. To access fuel tank, remove seat support plate with attached operator seat (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis).

3. Remove washer head screw (item 8) that secures fuel tank cap retainer to frame.

4. Remove front cover from machine (Fig. 4).

5. Remove fuel from the fuel tank and into a suitable container.

6. Note routing of fuel and vent hoses for installation purposes. Disconnect fuel and vent hoses from fuel tank fittings. Plug hoses to prevent leakage or contaminant entry.

7. Remove two (2) clamps (item 10) that secure fuel tank to machine frame.

8. Slide fuel tank toward the front of the frame and carefully remove tank from machine. Make sure to clean up any spilled fuel.

9. If fuel in tank was contaminated, carburetor removal and cleaning may be necessary (see Kawasaki Service Manual at the end of this chapter).

NOTE: If fuel evaporative control system components require service, see Fuel Evaporative Control System Service in this section of this chapter.

Fuel Tank Installation (Fig. 3)

1. If carburetor was removed from engine for cleaning, install carburetor (see Kawasaki Service Manual at the end of this chapter).

2. Check that two (2) u-nuts (item 25) are properly placed in openings in machine frame.

3. Carefully slide fuel tank into position on machine frame. Make sure that fuel tank pockets engage both bumpers at rear of tank mount bracket.

4. Secure fuel tank to machine frame with two (2) clamps (item 10).

5. Remove plugs placed in fuel and vent hoses during fuel tank removal. Connect hoses to tank fittings and secure with hose clamps.

6. Secure front cover to machine (Fig. 4).

7. Secure fuel tank cap retainer to frame with washer head screw (item 8).

8. Add fresh fuel to tank and check for any fuel leaks.

9. Install and secure seat support plate with attached operator seat to machine (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis). Make sure that seat switch is connected to machine wire harness and that wire harness seat switch lead is secured to seat support plate with cable tie during seat installation.

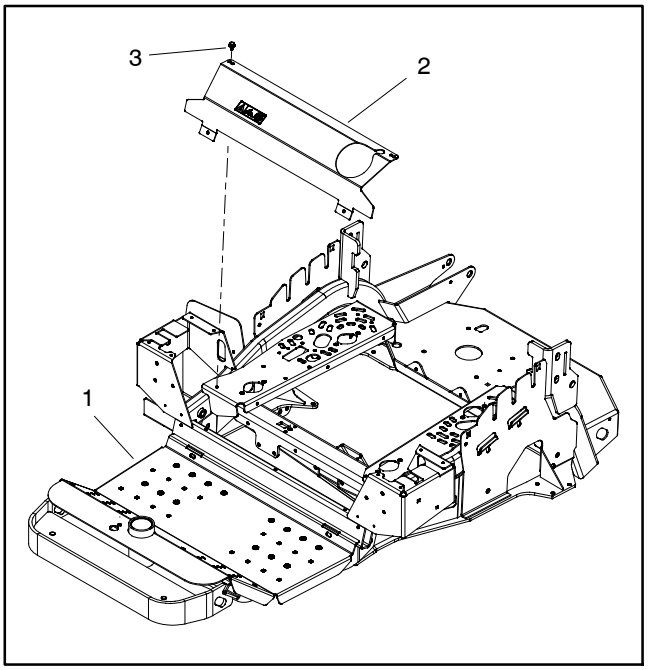

Figure 4

1. **Frame**
2. **Front cover**
3. **Screw (4 used)**

Exhaust System

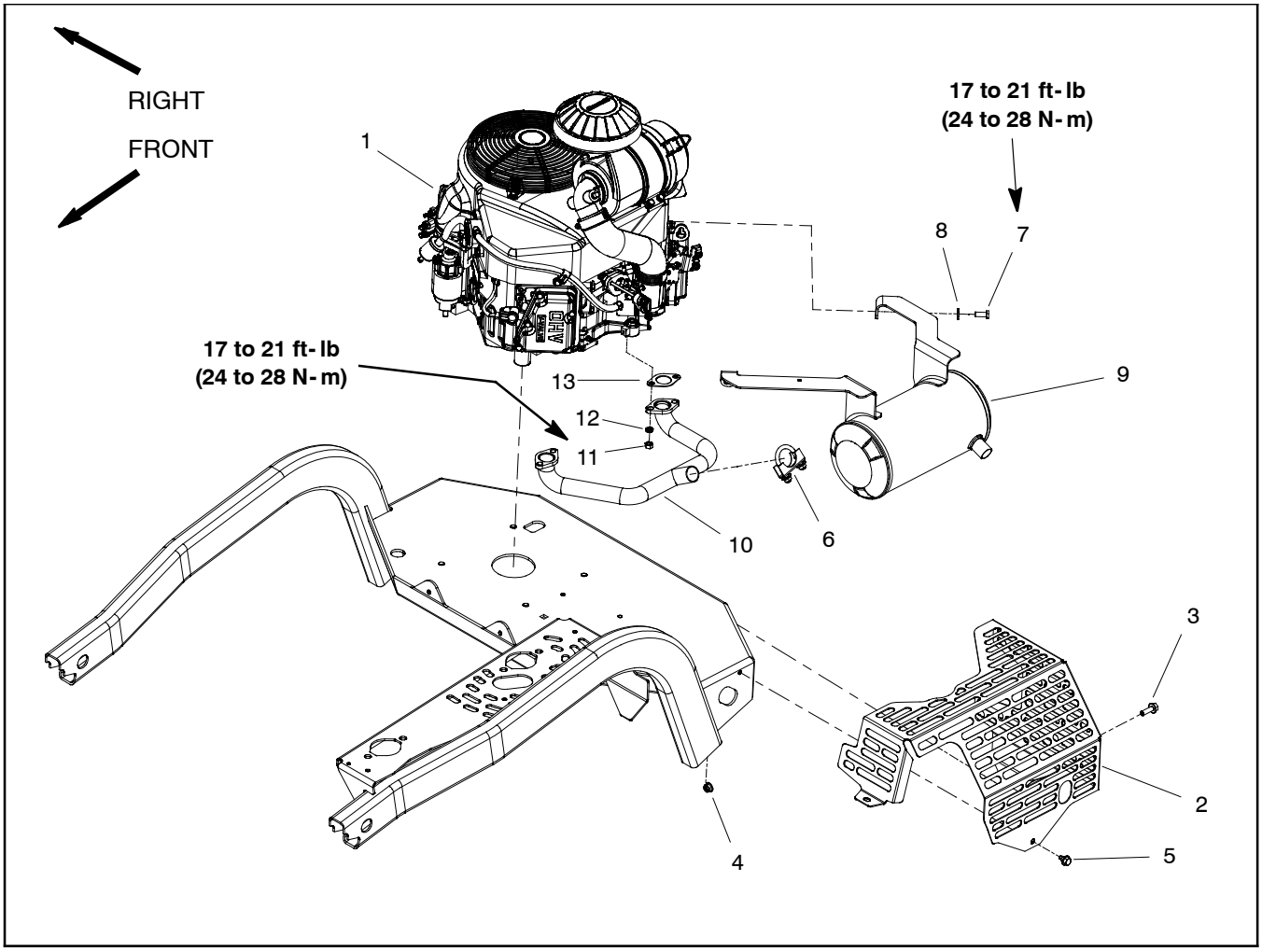

Figure 5

1. **Engine**
2. **Muffler shield**
3. **Flange head screw**
4. **Flange nut**
5. **Washer head screw (2 used)**
6. **Muffler clamp**
7. **Cap screw (2 used)**
8. **Spring washer (2 used)**
9. **Muffler**
10. **Exhaust manifold**
11. **Nut (4 used)**
12. **Lock washer (4 used)**
13. **Exhaust gasket (2 used)**

NOTE: Muffler shield (item 2) and muffler (item 9) can be removed with engine attached to the Sand Pro 2040Z frame. If it is necessary to remove exhaust manifold (item 10), engine removal is necessary.

Removal (Fig. 5)

CAUTION

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

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

2. Remove fasteners (items 3, 4 and 5) that secure muffler shield (item 2) to machine. Remove muffler shield.

3. Remove r- clamp from muffler support bracket (Fig. 6).

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

5. Remove muffler clamp (item 6), cap screws (item 7) and spring washers (item 8) that secure muffler to engine. During removal, note orientation of spring washers (item 8) for assembly purposes.

6. Slide muffler from exhaust manifold.

Installation (Fig. 5)

1. Slide muffler onto exhaust manifold.

2. Support muffler so that distance between frame and muffler is from **0.850" to 0.970" (21.6 to 24.6 mm)** (Fig. 8).

3. Secure muffler (item 9) to engine with cap screws (item 7) and spring washers (item 8), making sure that spring washers are orientated correctly (spring washer orientation is shown in Figure 7). Torque cap screws from **17 to 21 ft- lb (24 to 28 N- m)**.

4. Secure muffler inlet to exhaust manifold with muffler clamp (item 6).

5. Secure r- clamp to muffler support bracket (Fig. 6).

6. Secure muffler shield (item 2) to machine with removed fasteners (items 3, 4 and 5). Position muffler shield so that muffler tailpipe is centered in shield hole.

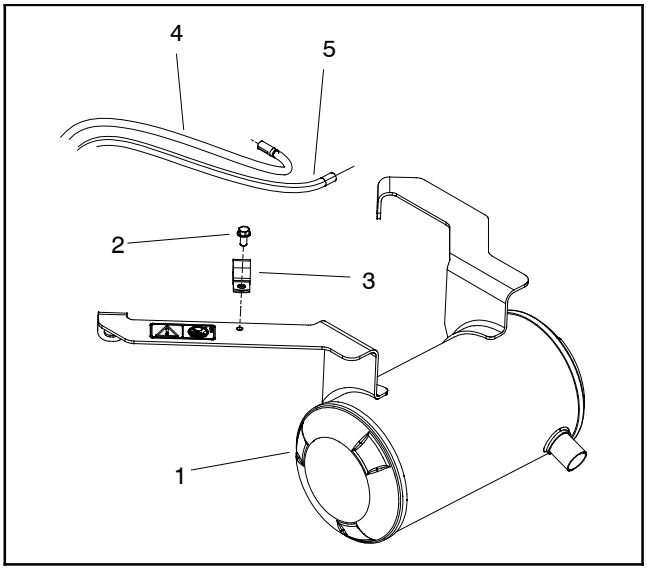

Figure 6

1. **Muffler**
2. **Washer head screw**
3. **R- clamp**
4. **EVAP manifold hose**
5. **EVAP intake hose**

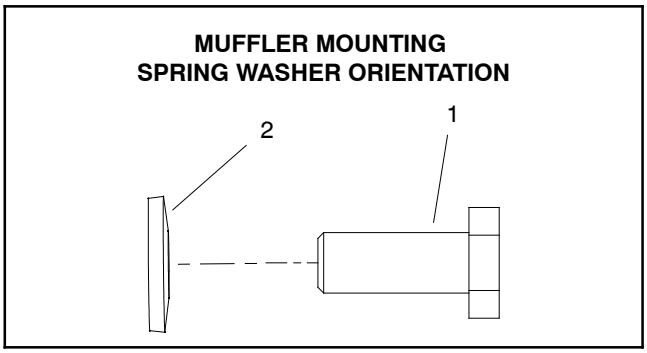

Figure 7

1. **Cap screw**
2. **Spring washer**

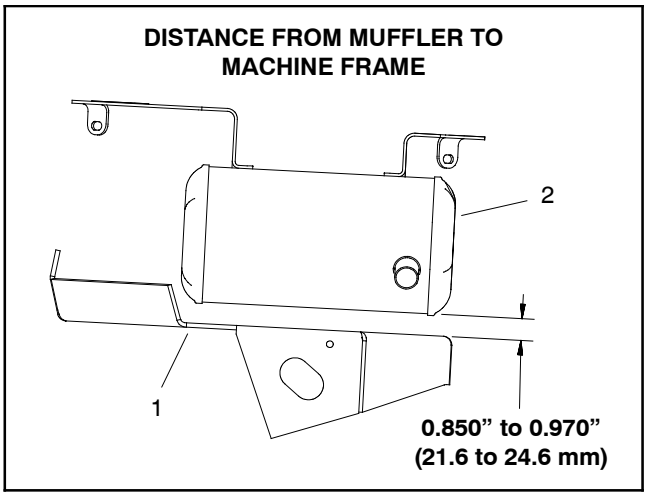

Figure 8

1. **Frame**
2. **Muffler**

Engine

Engine Removal (Fig. 9)

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

CAUTION

The engine and exhaust system may be hot. To avoid possible burns, allow the engine and exhaust system to cool before removing engine from machine.

2. If engine is to be disassembled, it may be easier to drain oil from engine before removing engine from machine.

3. Chock wheels to prevent the machine from moving.

4. Remove rear attachment from machine.

CAUTION

When disconnecting the battery cables from the battery, make sure to remove the negative (-) battery cable first and then remove the positive (+) battery cable.

5. Disconnect negative battery cable and then positive cable from the battery (see Battery Service in the Service and Repairs section of Chapter 5 - Electrical System).

6. Clamp fuel supply hose near engine to prevent fuel spillage. Loosen hose clamp at fuel pump and remove fuel supply hose from the pump.

7. Remove muffler shield and muffler from engine (see Exhaust System in this section).

8. Disconnect machine wire harness connections from engine:

   A. Disconnect machine wire harness engine connector from engine harness connector.

   B. Disconnect positive battery cable and wire harness connector (red wire) from starter solenoid on engine starter motor.

   C. Remove flange head screw that secures wire harness ground (black wire) and negative battery cable to engine beneath the starter motor.

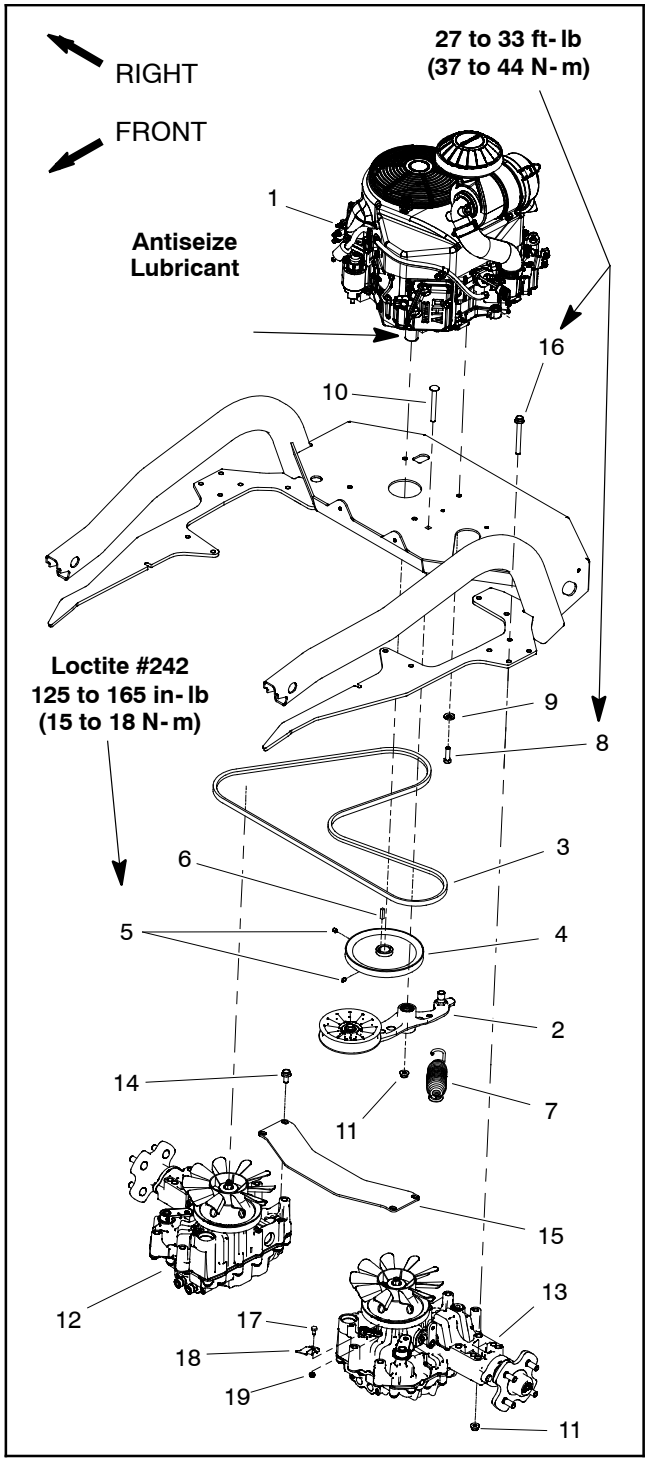

Figure 9

1. **Engine**
2. **Pump idler assembly**
3. **Drive belt**
4. **Drive pulley**
5. **Set screw (2 used)**
6. **Square key**
7. **Idler spring**
8. **Cap screw (4)**
9. **Belleville washer (4)**
10. **Carriage bolt**
11. **Flange nut**
12. **RH transmission**
13. **LH transmission**
14. **Flange head screw (4)**
15. **Crossmember**
16. **Flange head screw (16)**
17. **Cap screw (2)**
18. **Bypass valve lever (2)**
19. **Lock nut (2)**

9. Disconnect throttle control cable from the governor control plate and choke control cable from the choke lever.

10. Disconnect two (2) EVAP hoses from fittings on engine intake manifold and air intake tube (Fig. 10).

11. Remove transmission drive belt from engine pulley (Fig. 11):

A. Gain access to transmission drive belt assembly from below the machine. If necessary, raise and support rear of machine (see Jacking Instructions in Chapter 1 - Safety).

B. Use a ratchet in the square hole in the idler assembly to release transmission drive belt tension.

C. Remove drive belt from the idler pulley and carefully release spring tension on the idler assembly.

D. Remove transmission drive belt from engine pulley.

12. Loosen two (2) set screws (item 5) on the drive pulley hub to allow pulley removal from the engine shaft. Slide pulley from the shaft. Locate and retrieve square key from the engine shaft.

13. Remove four (4) cap screws and belleville washers that secure the engine to the frame. During removal, note orientation of belleville washer (item 9) for assembly purposes.

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

CAUTION

To prevent personal injury, make sure that engine is properly supported as it is removed from the machine. Engine weighs approximately 90 pounds (41 kg).

14. Carefully raise engine and remove from machine. Use lift tabs on engine if engine hoist is used.

15. If necessary, remove exhaust manifold from engine. Remove and discard exhaust gaskets manifold was removed.

Engine Installation (Fig. 9)

1. If exhaust manifold was removed from engine, install new exhaust gaskets between engine and exhaust manifold. When securing exhaust manifold to engine, torque nuts from **17 to 21 ft-lb (24 to 28 N-m)**.

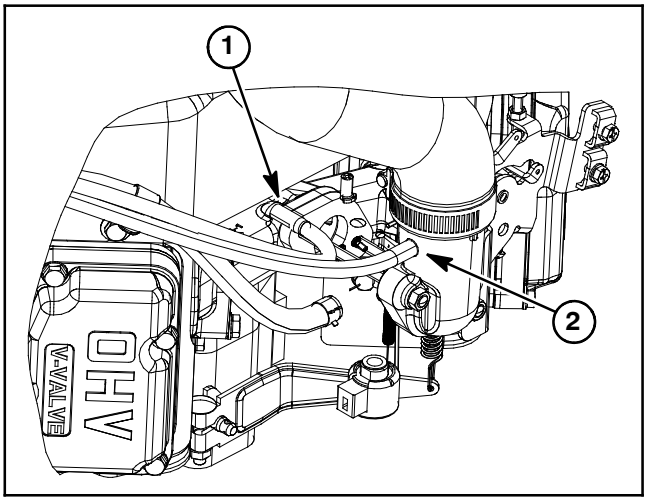

Figure 10

1. **Intake manifold hose**
2. **Air intake tube hose**

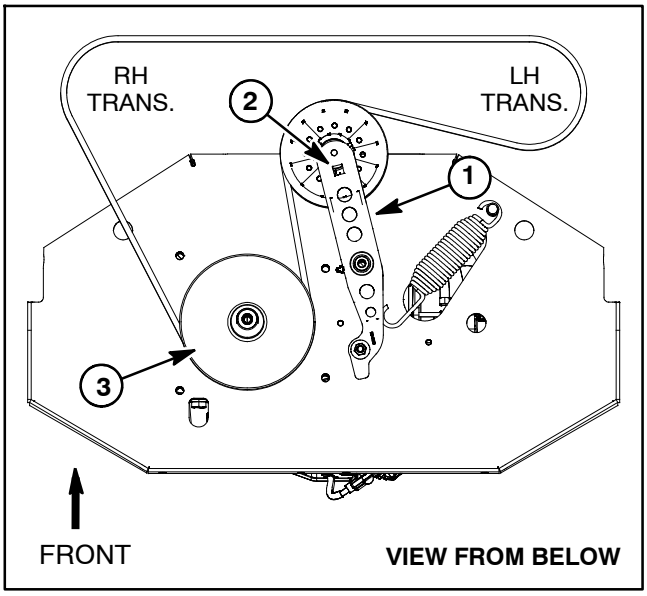

Figure 11

1. **Pump idler assembly**
2. **Square hole**
3. **Drive pulley**

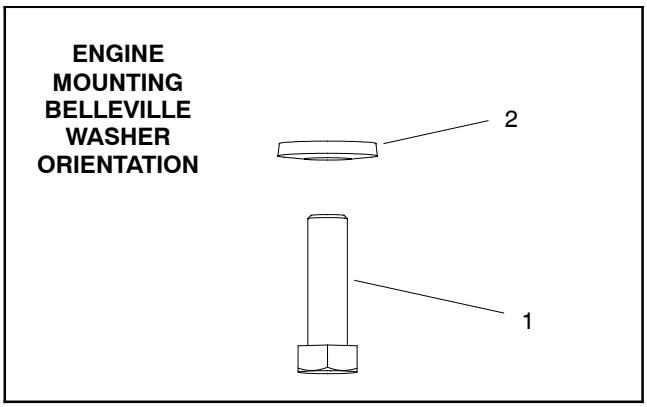

Figure 12

1. **Cap screw**
2. **Belleville washer**

2. Make sure that all parts removed from the engine during maintenance or rebuilding are properly installed to the engine. Position machine on a level surface.

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

3. Carefully position engine onto frame with air cleaner toward the left side of the machine.

4. Secure engine to machine frame with four (4) cap screws and belleville washers. Make sure that belleville washers are orientated correctly. Washer orientation is shown in Figure 12. Torque cap screws from **27 to 33 ft-lb (37 to 44 N-m)**.

5. Install drive pulley (item 4) to the engine crankshaft:

   A. Apply antiseize lubricant to engine shaft. Place square key into slot on the shaft.

   B. Apply Loctite #242 (or equivalent) to threads of set screws (item 5).

   C. Slide drive pulley onto engine shaft so that the distance from the pulley hub to the end of the shaft is from **1.080" to 1.140" (27.5 to 28.9 mm)** (Fig. 13).

   D. Install both set screws into the drive pulley hub to secure the pulley to the engine shaft. Torque set screws from **125 to 165 in-lb (15 to 18 N-m)**. Make sure that pulley location is correct after tightening set screws.

6. Install transmission drive belt to engine pulley (Fig. 11):

   A. Gain access to transmission drive belt assembly from below the machine. If necessary, raise and support rear of machine (see Jacking Instructions in Chapter 1 - Safety).

   B. Use a ratchet in the square hole in the idler assembly to rotate idler assembly so that drive belt can be installed to drive and idler pulleys.

   C. Make sure that drive belt is in transmission pulleys and then place belt to engine and idler pulleys. Carefully release idler assembly to apply spring tension to the idler.

7. Connect throttle control cable to the governor control plate and choke control cable to the choke lever.

8. Connect two (2) EVAP hoses to fittings on engine intake manifold and air intake tube (Fig. 10).

9. Connect machine wire harness connections to correct engine components.

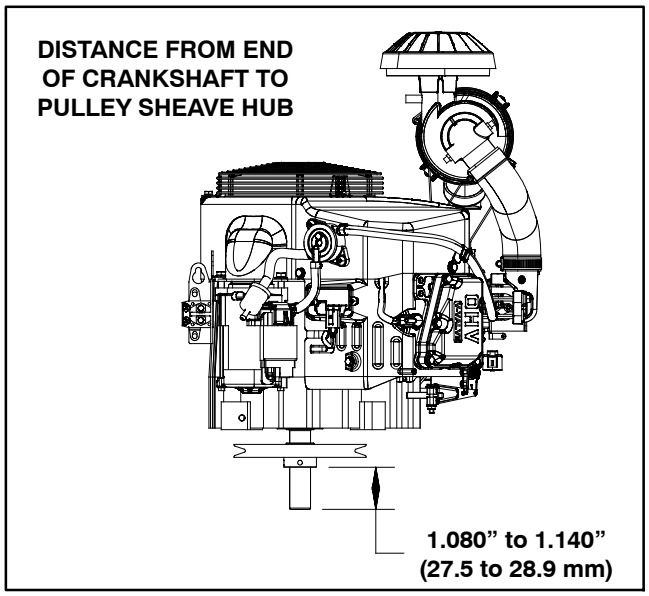

Figure 13

10. Install muffler and muffler shield to engine (see Exhaust System in this section).

11. Install and secure fuel hose to the fuel pump with hose clamp. Remove clamp from fuel hose that was used to prevent fuel spillage.

CAUTION

When connecting the battery cables to the battery, make sure to attach the positive (+) battery cable first and then attach the negative (-) battery cable.

12. Connect positive battery cable and then negative cable to the battery (see Battery Service in the Service and Repairs section of Chapter 5 - Electrical System).

13. Install rear attachment to the machine.

14. Check and adjust engine oil level.

15. Check operation of choke and throttle cables. Adjust if necessary.

16. Start engine and check engine operation. After engine is properly warmed up, use a tachometer to check low idle speed (1450 to 1650 RPM) and high idle speed (2750 to 2950 RPM).

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Fuel Evaporative Control System Service

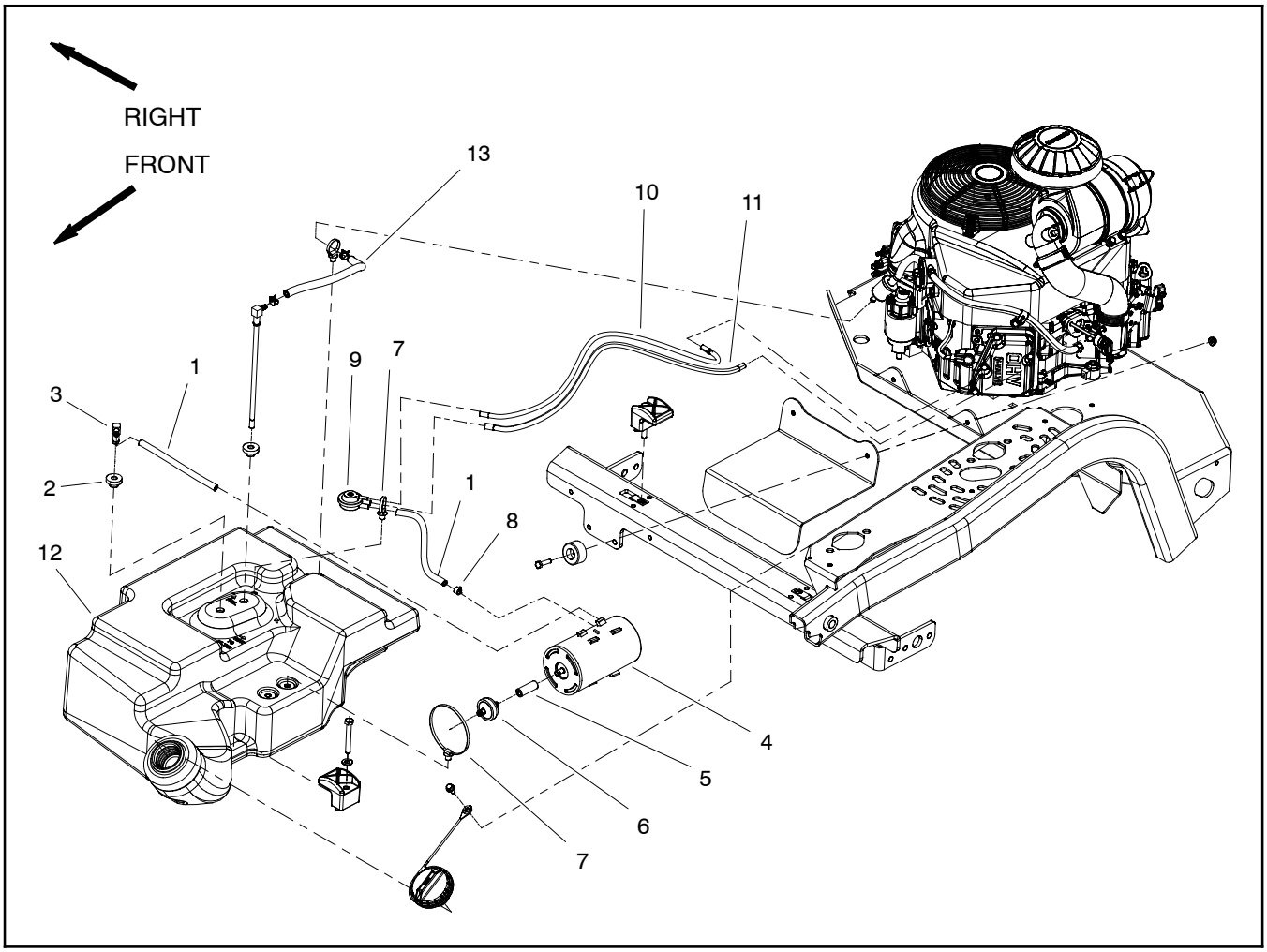

Figure 14

1. **Fuel hose (2 used)**
2. **Bushing**
3. **90º elbow fitting**
4. **Carbon canister**
5. **Fuel hose**
6. **Clean air filter**
7. **Tie clip (3 used)**
8. **Hose clamp**
9. **Vacuum control valve**
10. **Vent hose (to intake manifold)**
11. **Vent hose (to air intake tube)**
12. **Fuel tank**
13. **Fuel supply hose**

Disassembly (Fig. 14)

DANGER

Gasoline is flammable. Use caution when storing or handling it. Wipe up any spilled fuel before starting the engine.

1. If necessary to access fuel evaporative control system components, remove seat support plate with attached operator seat from machine (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis).

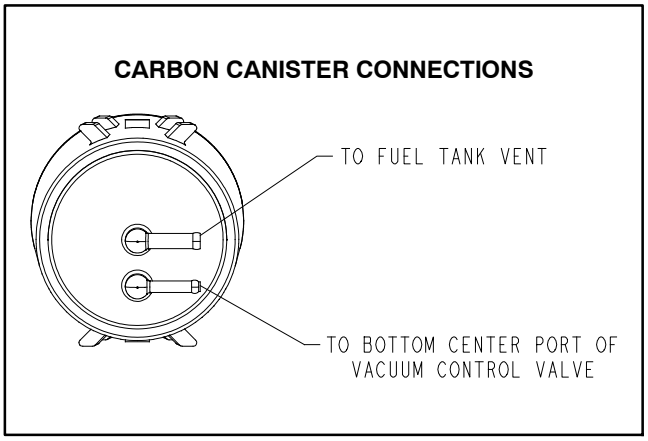

Figure 15

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

3. Remove fuel evaporative control system components as needed using Figure 14 and the following as guides.

IMPORTANT: To prevent damage to fuel hoses, cable ties are used to secure hoses to machine components. Take note of all cable ties that are removed from machine during the disassembly process so the cable ties can be properly replaced during assembly of removed components.

A. If hoses are removed from the carbon canister or vacuum control valve, note hose location for assembly purposes. Figures 15 and 16 identify hose location.

B. If EVAP hoses are removed from engine fittings, note hose location for assembly purposes. Figures 17 and 18 identify engine hose locations.

Assembly (Fig. 14)

1. Install all removed fuel evaporative control system components using Figure 14 as a guide. Make sure that evaporative system fuel hoses are not kinked and are properly secured after installation.

2. If seat support plate with attached operator seat was removed from machine, install seat assembly (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis). Make sure that seat switch is connected to machine wire harness and that wire harness seat switch lead is secured to seat support plate with cable tie during seat installation.

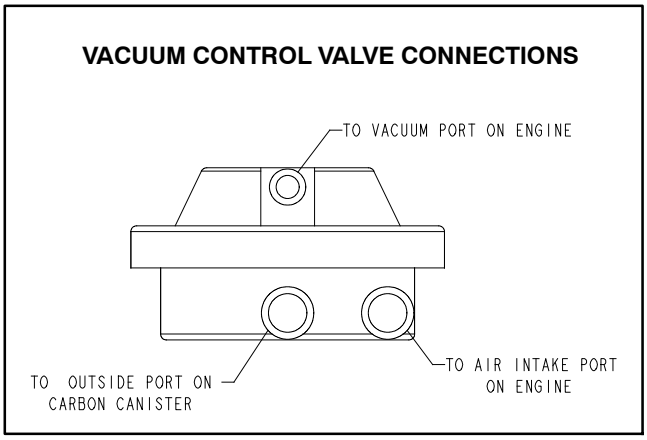

Figure 16

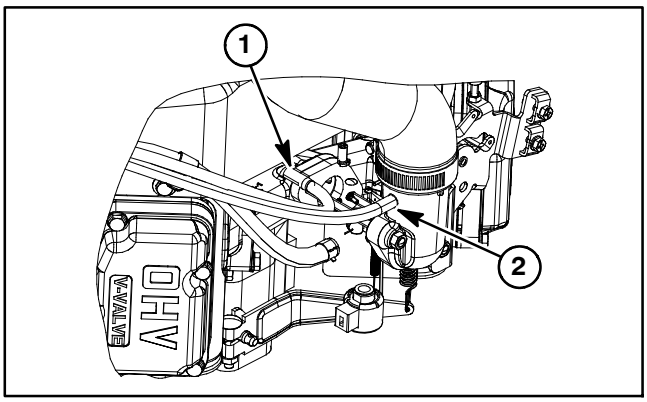

Figure 17

1. **Intake manifold hose**
2. **Air intake tube hose**

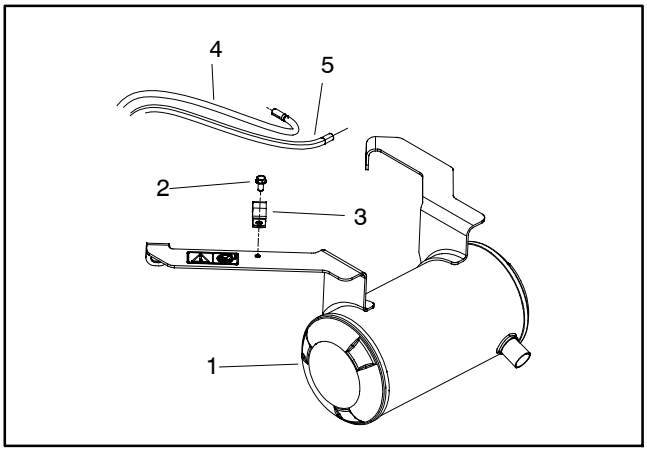

Figure 18

1. **Muffler**
2. **Washer head screw**
3. **R-clamp**
4. **EVAP manifold hose**
5. **EVAP intake hose**

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Chapter 4

Hydraulic System

Table of Contents

Specifications

Item	Description
Transmission	Dual Tuff Torq belt driven, variable displacement hydraulic transmissions with integral charge pump and wet disc brake system
Maximum Transmission Pump Displacement (per revolution)	0.79 in^3 (13 cc)
Maximum Transmission Pump Flow Rate (95% efficiency @ 2850 RPM x 1.18 (belt drive ratio))	11.2 GPM (42.4 LPM)
Charge Pump	Gerotor Pump in Transmission
Charge Pump Displacement (per revolution)	0.25 in^3 (4.125 cc)
Maximum Charge Pump Flow Rate (60% efficiency @ 2850 RPM x 1.18 (belt drive ratio))	2.2 GPM (8.3 LPM)
Charge Pressure	29 to 43 PSI (2 to 3 bar)
Implement Relief Pressure (RH transmission only)	581 to 725 PSI (40.02 to 50.02 bar)
Hydraulic Fluid	See Traction Unit Operator's Manual
Hydraulic Fluid Capacity	
Right Side of Machine	2.1 US quarts (2.0 liters)
Left Side of Machine	2.0 US quarts (1.9 liters)
Hydraulic Filters	
Transmission Mounted (each transmission)	Cartridge type
Control Manifold Mounted	Spin on cartridge type

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Sand Pro 2040Z machine. Refer to that publication for additional information when servicing the machine.

Check Hydraulic Fluid

The Sand Pro 2040Z hydraulic system is designed to operate on anti- wear hydraulic fluid. Two (2) hydraulic reservoirs are used on the Sand Pro: one for each of the dual transmissions. The right side reservoir capacity is approximately 2.1 U.S. quarts (2.0 liters) and the left side reservoir capacity is approximately 2.0 U.S. quarts (1.9 liters). **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and oil recommendations.

IMPORTANT: DO NOT overfill the hydraulic reservoirs.

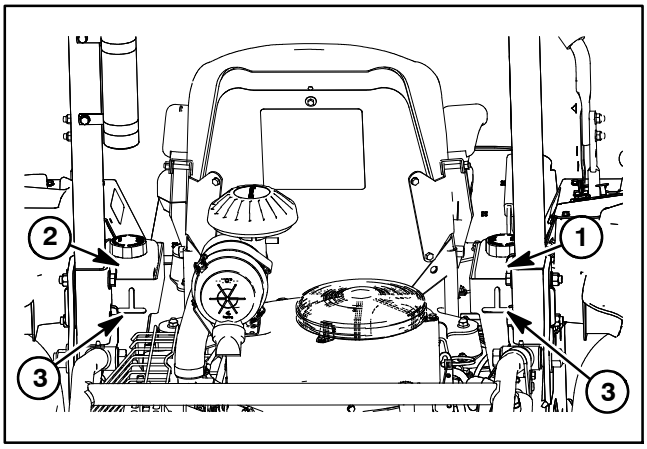


Figure 1

1. **RH hydraulic reservoir**
2. **LH hydraulic reservoir**
3. **Oil level**

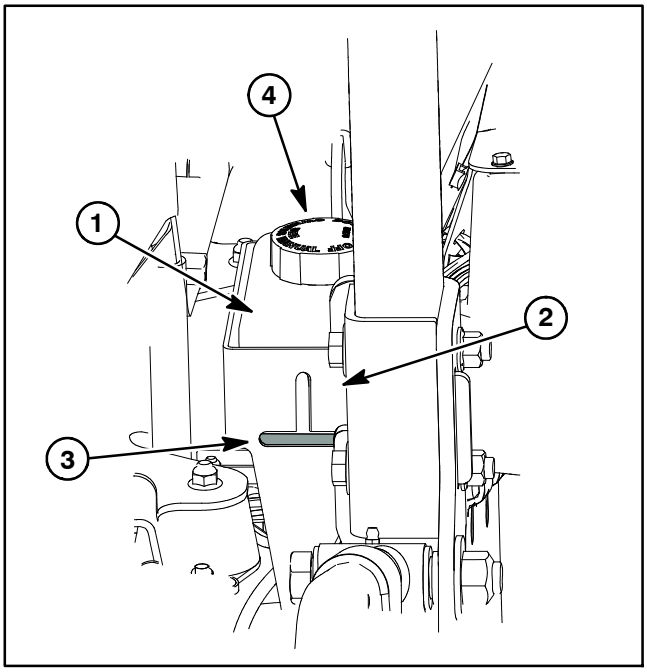


Figure 2

1. **Reservoir (RH shown)**
2. **Reservoir bracket**
3. **Oil level**
4. **Reservoir cap**

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the hydraulic system, all pressure in the hydraulic system must be relieved. Park machine on a level surface and relieve all pressure in the system by lowering the rear attachment fully to the ground. Stop the engine, wait for all moving parts to come to a complete stop and then remove key from ignition switch.

NOTE: If machine is parked on an incline or slope, pressure in the traction circuit WILL NOT be relieved. Also, make sure that after lowering the rear attachment, the attachment is not being supported by the lift cylinder.

Towing Machine

If it becomes necessary to tow (or push) the machine, tow (or push) at a speed below 1 mph (1.6 kph), and for a very short distance. If machine needs to be moved a considerable distance, machine should be transported on an appropriate truck or trailer. Refer to Traction Unit Operator's Manual for additional information regarding towing or transporting.

IMPORTANT: If towing limits are exceeded, severe damage to the transmission may occur. Also, if machine is towed too fast, wheels may lock up. If wheel lock up occurs, stop towing the machine. Wait for traction circuit pressure to stabilize before resuming towing at a slower speed.

WARNING

The engine and hydrostatic transmissions can become very hot and cause severe burns. Allow the engine and hydrostatic transmissions to cool completely before accessing the bypass- valve levers.

Also, stop the engine, remove the ignition key, and allow all moving parts to stop before accessing the transmission bypass- valve levers.

1. Stop the machine on a level surface and turn the ignition key to OFF. Move the control levers to the neutral-locked position, set the parking brake and remove the key from the ignition switch.

2. From beneath the machine, locate the bypass- valve levers that are on the top of each transmission (Fig. 3). Rotate the bypass- valve levers so that they point inward, toward the center of the machine. This allows the hydraulic oil to bypass the internal transmission motors, enabling the machine wheels to turn freely.

3. Release the parking brake and slowly push machine.

4. When finished moving machine, rotate the bypass-valve levers so that they point toward the front of the machine, to allow the machine to drive.

IMPORTANT: Make sure that transmission bypass valve levers are in the fully forward position when operating the machine. Severe damage to the hydraulic system can occur if machine is used with levers in the bypass position.

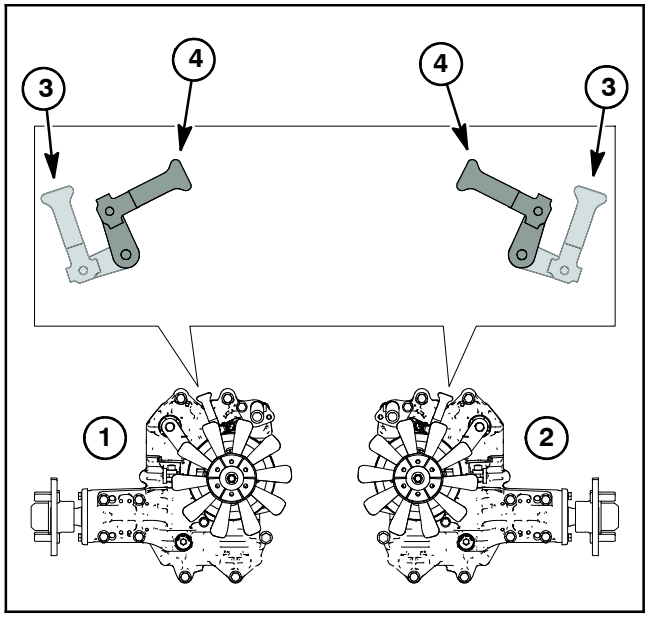


Figure 3

1. LH transmission
2. RH transmission
3. Lever in drive
4. Lever in bypass

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint (layline) on the hose. Use two (2) wrenches when tightening a hose; hold the hose straight with one wrench and tighten the hose swivel nut onto the fitting with the second wrench (see Hydraulic Hose and Tube Installation in this section). If the hose has an elbow at one end, tighten the swivel nut on that end before tightening the nut on the straight end of the hose.

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

WARNING

Before disconnecting 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 6. 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

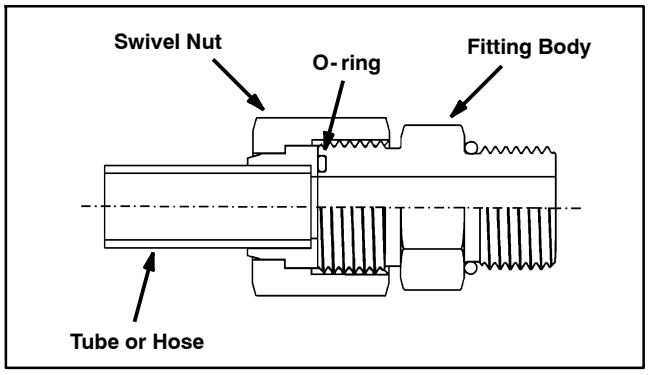


Figure 4

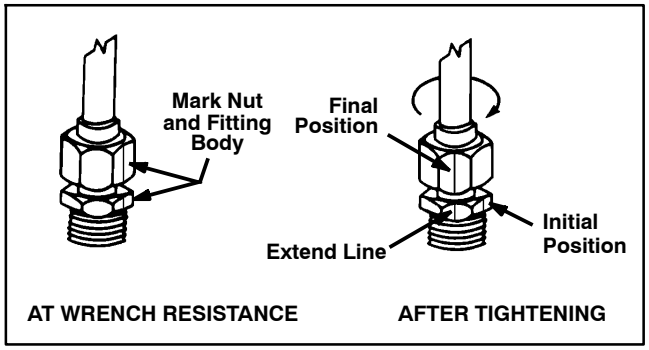


Figure 5

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 6

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

Non- Adjustable Fitting (Fig. 7)

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 8.

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

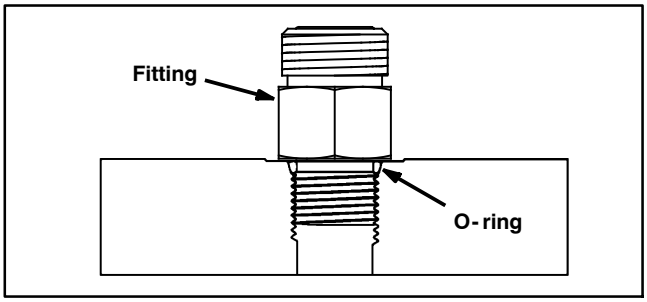


Figure 7

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 8

Adjustable Fitting (Fig. 9)

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 10).

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 10). 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 10).

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 8. 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 10). 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

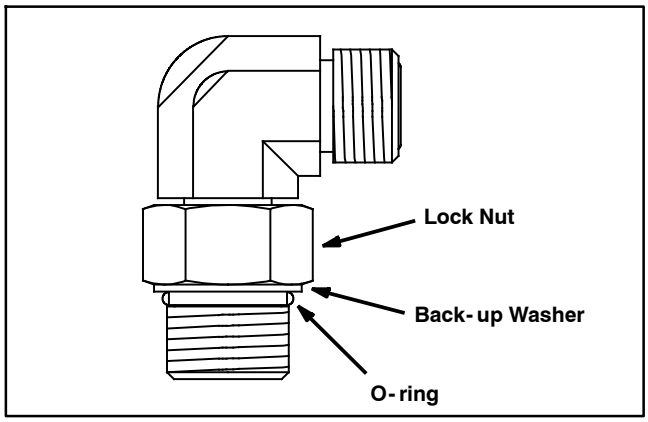


Figure 9

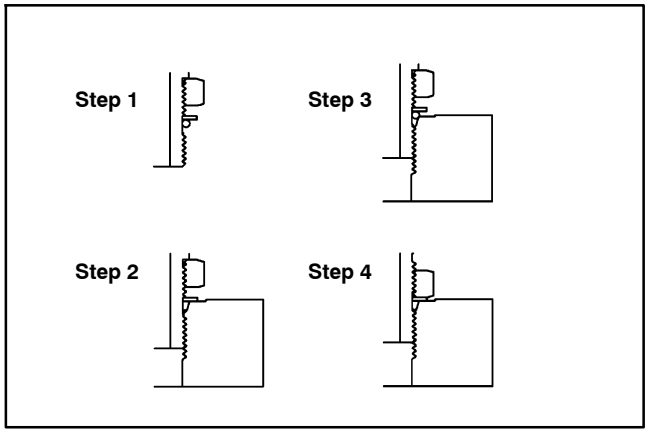
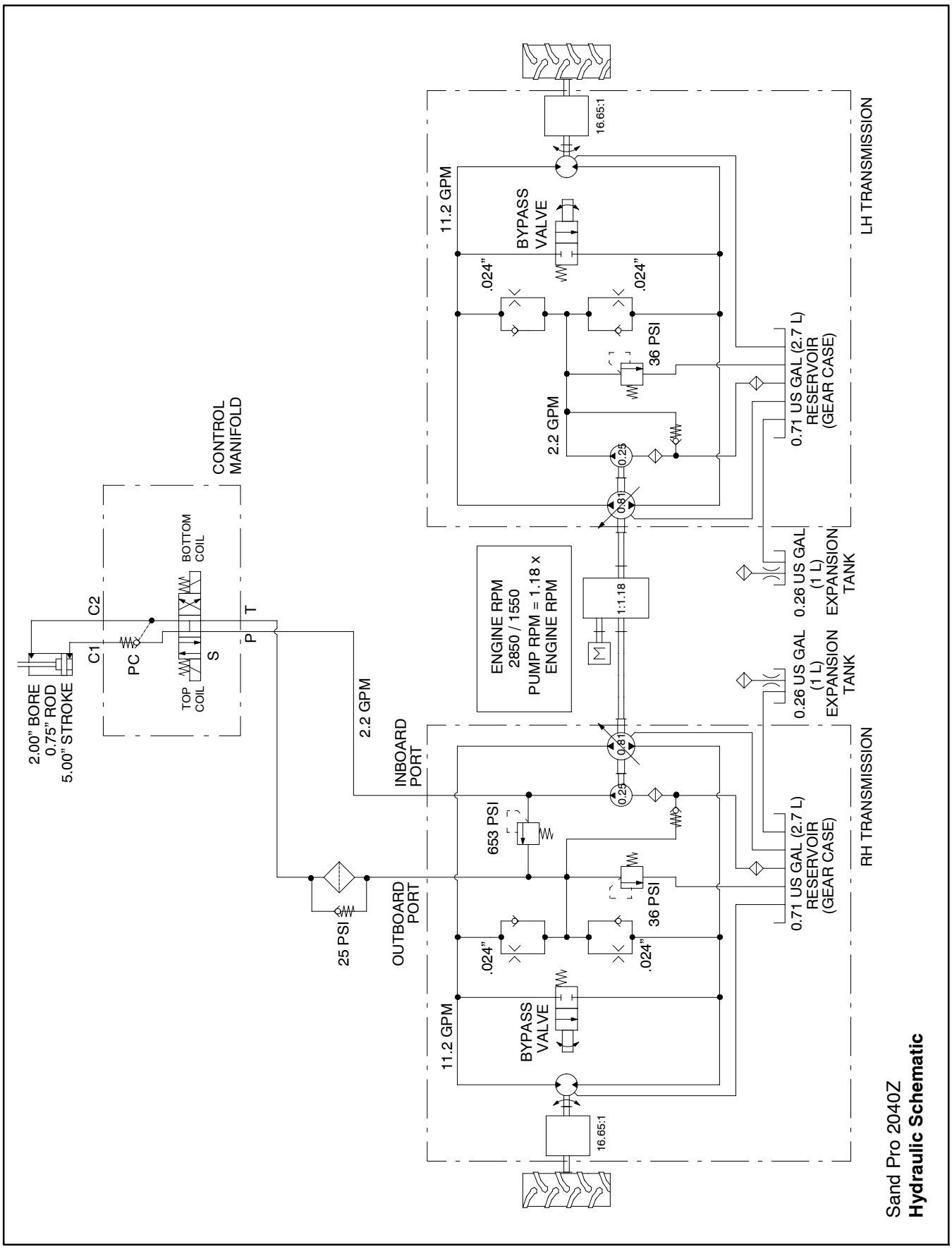
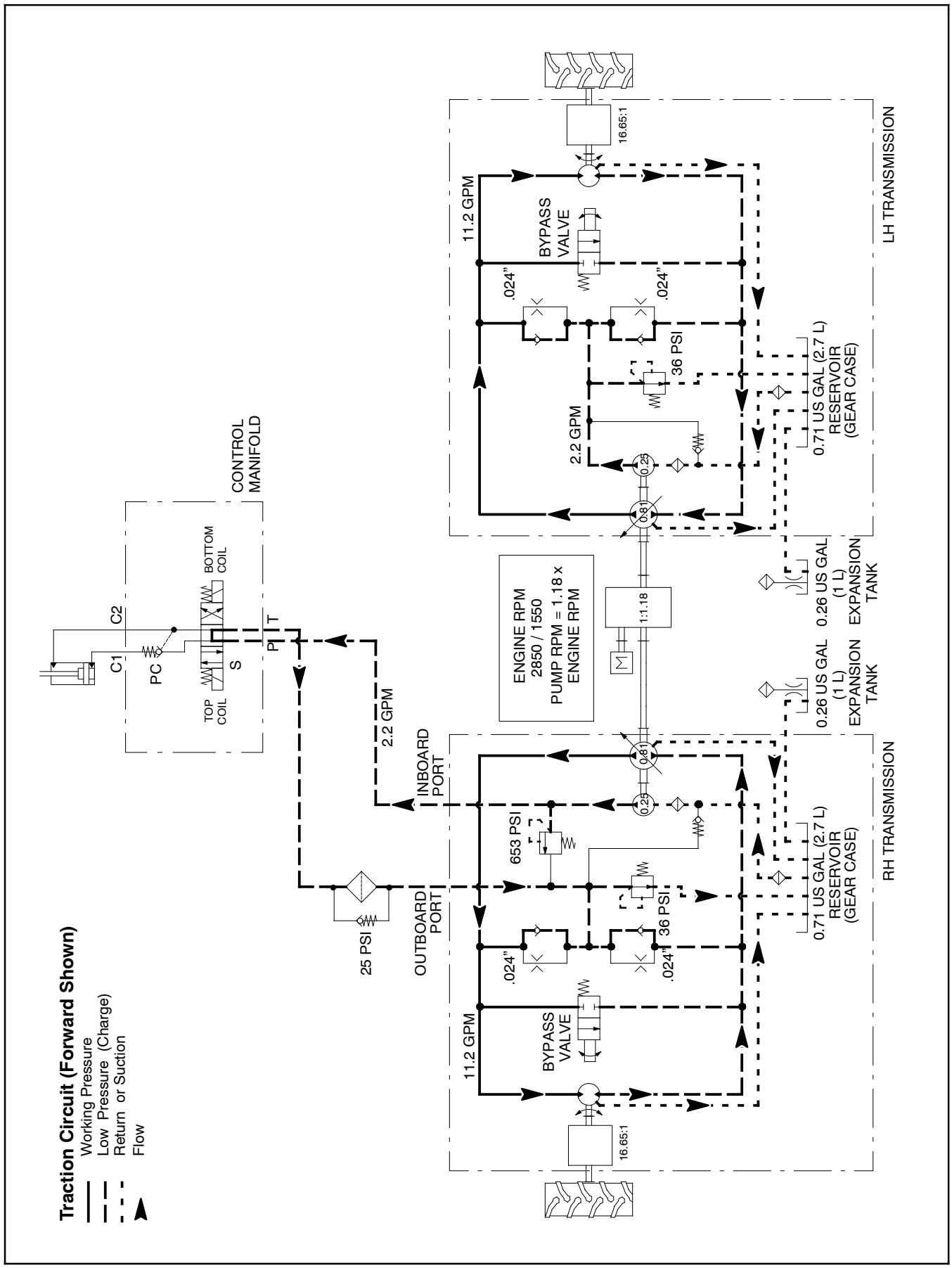


Figure 10

Hydraulic Schematic



Hydraulic Flow Diagrams



Traction Circuit

The Sand Pro traction system consists of two (2) independent unitized pump and wheel motor transmissions that are belt driven by the engine. The transmissions provide closed loop traction circuits: one for the right wheel drive and one for the left wheel drive. Each of these transmission circuits include a variable displacement piston pump which provides hydraulic flow for one wheel motor that drives a rear wheel through a reduction gear. The swash plate in each of the transmission piston pumps is controlled by one of the operator motion control handles. The motion control handles are connected to the transmission traction levers with a linkage rod and include integrated dampeners for enhanced traction control. The transmissions also include an internal brake used for the machine parking brake.

The angle of the piston pump swash plate determines pump flow and ultimately traction speed. When a motion control handle is moved a small amount, a small swash plate rotation results in low pump output and lower traction speed. When the control handle is moved fully, the pump swash plate rotates fully to provide maximum pump output flow and traction speed.

Because hydraulic flow to each rear wheel is determined by control handle movement and subsequent swash plate position, steering is accomplished by moving the two control handles a different amount or direction.

With the engine running and the motion control handles in the neutral position, the transmission piston pump swash plates are held in the vertical position, providing no flow to drive either rear wheel so the machine remains stationary. The traction circuit check valves include an orifice which allows the traction neutral position to be easier to adjust.

Forward

When a motion control handle is pushed forward, the rod connected to the control handle positions the swash plate in the transmission piston pump to provide oil flow through the traction circuit. This oil flows to the transmission motor and turns the motor in the forward direction. Oil flow from the motor returns to the transmission pump and is continuously pumped as long as the control handle is pushed forward.

The transmission pumps and motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across internal transmission parts into the transmission case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuits that must be replenished.

A charge pump in each transmission supplies hydraulic flow for maintaining 29 to 43 PSI (2 to 3 bar) to the low pressure side of both of the traction circuits. The charge pump replenishes the closed loop traction circuits with fluid from the hydraulic reservoir (transmission case). The charge relief valve in the transmission maintains sufficient pressure so that charge pump flow is guided past check valves to the low pressure side of each traction circuit. Charge pump flow in excess of system requirements is relieved through the charge relief valve back to the transmission case. The charge pump in the right side transmission also supplies flow for the groomer (rear attachment) lift circuit.

Reverse

The traction circuit operates essentially the same in reverse as it does in forward.

When a motion control handle is pulled rearward, the rod connected to the control handle positions the swash plate in the transmission piston pump to provide oil flow through the traction circuit. This oil flows to the transmission motor and turns the motor in the reverse direction. Oil flow from the motor returns to the transmission pump and is continuously pumped as long as the control handle is pulled rearward.

The charge circuit functions the same in reverse as it does in the forward direction.

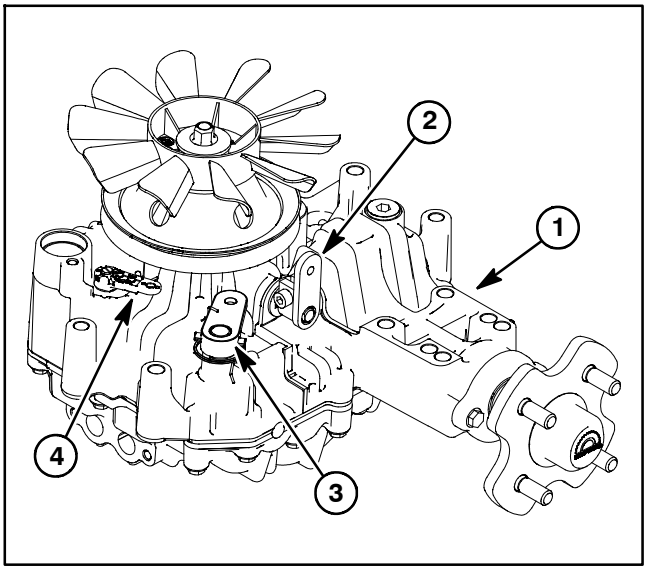
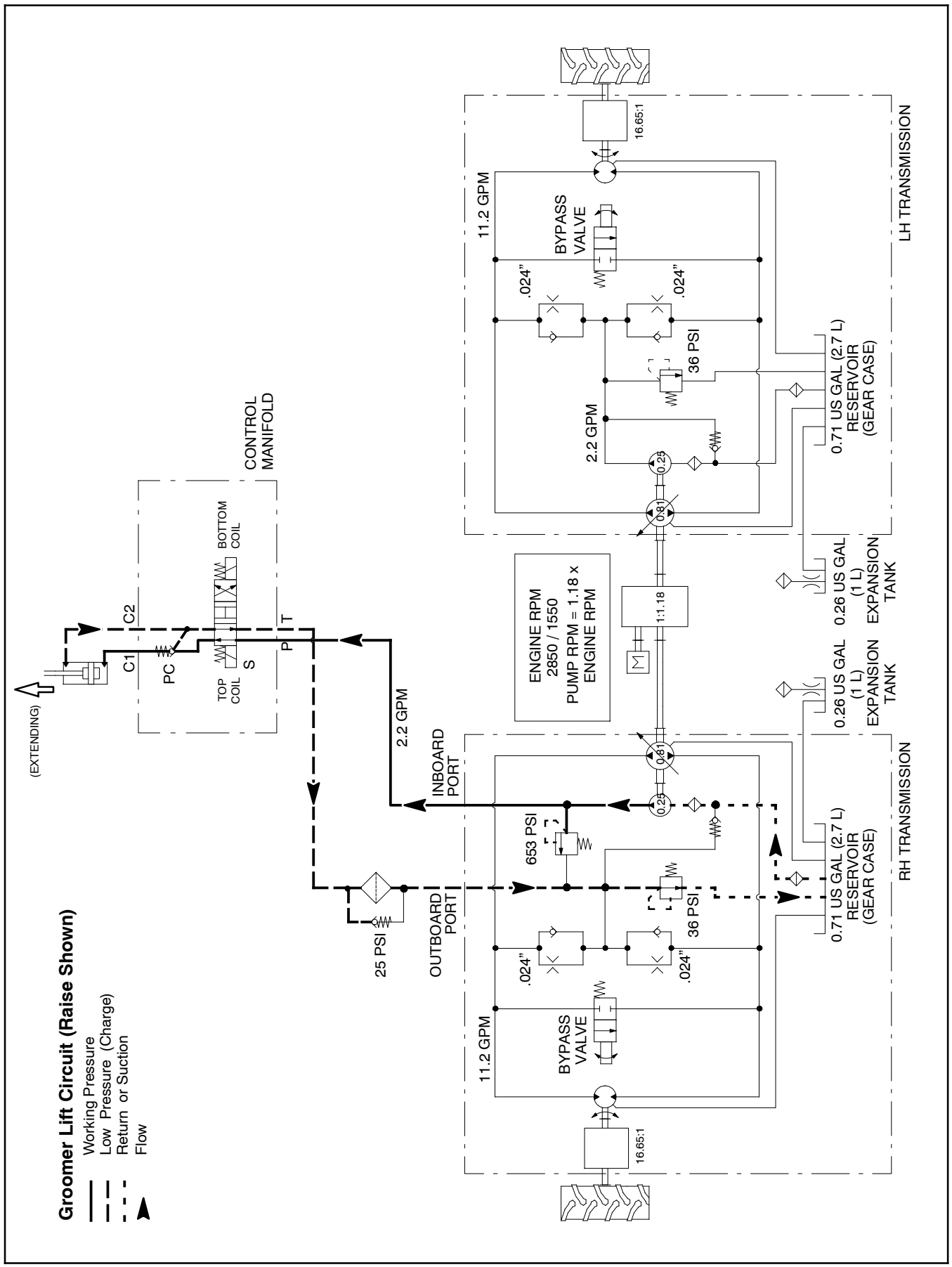


Figure 11

1. **Transmission (LH)**
2. **Traction lever**
3. **Brake lever**
4. **Bypass valve**


Groomer Lift Circuit (Raise Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
(EXTENDING)
C1
C2
PC
TOP COIL
S
BOTTOM COIL
P
T
CONTROL MANIFOLD
25 PSI
2.2 GPM
INBOARD PORT
OUTBOARD PORT
ENGINE RPM 2850 / 1550
PUMP RPM = 1.18 x ENGINE RPM
1:1.18
653 PSI
36 PSI
.024"
11.2 GPM
BYPASS VALVE
16.65:1
2.2 GPM
0.23
0.81
0.71 US GAL (2.7 L) RESERVOIR (GEAR CASE)
0.26 US GAL (1 L) EXPANSION TANK
RH TRANSMISSION
LH TRANSMISSION

Groomer Lift Circuit

In addition to replenishing the right side closed loop traction circuit with hydraulic oil, the charge pump in the right side transmission supplies flow for the groomer (rear attachment) lift circuit on Sand Pro 2040Z machines. Lift circuit pressure is limited to 650 PSI (45 bar) by the implement relief valve located in the right side transmission.

The charge pump is a fixed displacement gerotor pump that is driven directly off the traction pump input shaft. The pump has sufficient output to operate the rear attachment lift cylinder under load.

When the rear attachment switch is in the neutral position, neither of the control manifold solenoid coils is energized. Charge pump flow is directed back to the right side transmission as fluid flow from the pump is routed through the manifold and bypasses the groomer lift cylinder. Fluid returns through the hydraulic oil filter and then returns to the transmission as a normal part of the charge circuit.

Raise Rear Attachment

When the rear attachment switch is pressed and held in the raise position, the upper coil for solenoid valve (S) in the hydraulic control manifold is energized. The shifted valve allows a path for oil flow to the barrel end of the lift cylinder.

Oil flow through shifted (S) is directed through the manifold check valve (PC) and then out manifold port C1 to the barrel end of the lift cylinder. The lift cylinder will extend to cause the rear attachment to raise. Oil from the rod end of the lift cylinder returns to the right side transmission through manifold port C2, shifted (S), manifold port T and the hydraulic oil filter. Returning oil to the transmission supplies the charge circuit.

When the rear attachment switch is released to the neutral position, the upper solenoid coil will de- energize and oil flow to the lift cylinder will cease. The rear attachment will remain in position.

Lower Rear Attachment (Fig. 12)

When the rear attachment switch is pressed and held in the lower position, the lower coil for solenoid valve (S) in the hydraulic control manifold will be energized. The shifted valve allows a path for oil flow to the rod end of the lift cylinder.

Oil flow through shifted (S) is directed out manifold port C2 to the rod end of the lift cylinder. The lift cylinder will retract to cause the rear attachment to lower. As circuit pressure increases, a manifold sensing line unseats the manifold check valve (PC) to allow a return path for oil from the barrel end of the lift cylinder. Oil from the barrel end of the lift cylinder returns to the right side transmission through manifold port C1, shifted (S), manifold port T and the hydraulic oil filter. Returning oil to the transmission supplies the charge circuit.

When the rear attachment switch is released to the neutral position, the lower solenoid coil will de- energize and oil flow to the lift cylinder will cease. The rear attachment will remain in position.

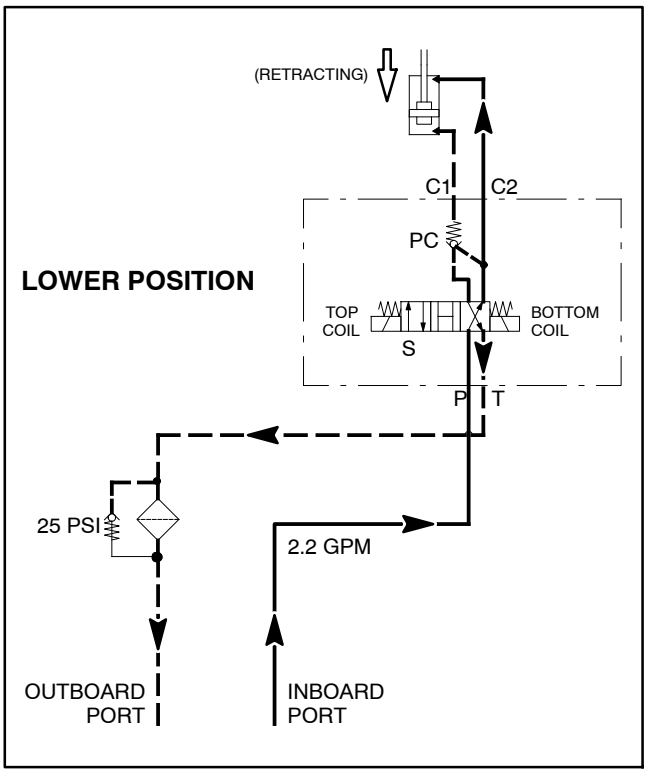


Figure 12

Special Tools

Order special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

Toro Part Number: **TOR47009**

Use to take various pressure readings for diagnostic tests. Quick disconnect fittings provided attach directly to mating fittings on machine test ports without tools. A high pressure hose is provided for remote readings. Kit 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.

Figure 13

15 GPM Hydraulic Tester Kit (Pressure and Flow)

Toro Part Number: **TOR214678**

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.

Figure 14

Hydraulic Test Fitting Kit

Toro Part Number: **TOR4079**

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

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

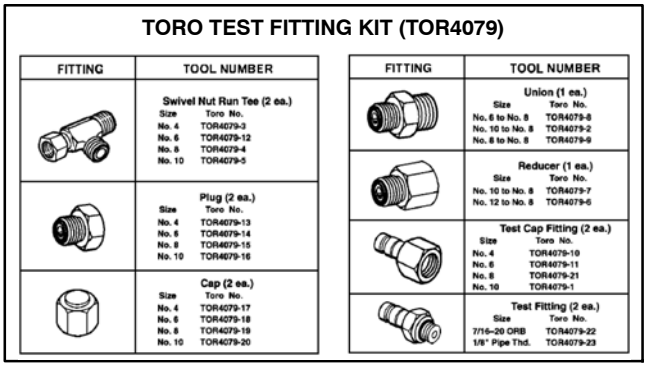


Figure 15

Measuring Container

Toro Part Number: **TOR4077**

Use this graduated container for doing hydraulic motor efficiency testing (motors with case drain lines only). Measure efficiency of a hydraulic motor by restricting the outlet flow from the motor and measuring leakage from the case drain line while the motor is pressurized by the hydraulic system.

The table in Figure 17 provides gallons per minute (GPM) conversion for measured milliliter or ounce leakage.

Figure 16

GPM	Milliliters in 15 sec.	Ounces in 15 sec.
.1	95	3.2
.2	189	6.4
.3	284	9.6
.4	378	12.8
.5	473	16.0
.6	568	19.2
.7	662	22.4
.8	756	25.6
.9	852	28.8
1.0	946	32.0

Figure 17

O- Ring Kit

Toro Part Number: **117- 2727**

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

Figure 18

Transmission Pulley Puller

Toro Part Number: **TOR6031**

The transmission pulley puller allows safe removal of the pulley from the input shaft of the transmissions used on the Sand Pro 2040Z.

Figure 19

Wheel Hub Puller

Toro Part Number: **TOR4097**

The wheel hub puller allows safe removal of the wheel hub from the transmission output shaft.

Figure 20

Troubleshooting

The chart that follows contains information to assist in troubleshooting the Sand Pro 2040Z hydraulic system. There may possibly be more than one cause for a machine malfunction.

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

Problem	Possible Cause
Hydraulic oil leaks from system.	Hydraulic fitting(s) or hose(s) are loose or damaged. O- ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams.	Hydraulic oil level in reservoirs is low. Hydraulic system is contaminated with water. Hydraulic system has wrong type of oil.
Hydraulic system operates hot.	Hydraulic oil level in reservoirs is low. Parking brake adjustment is incorrect causing brake to drag. Transmission bypass valve lever(s) is partially open. Transmission pressure is high due to excessive traction load. Transmission fan(s) is/are damaged. Hydraulic oil is contaminated or oil viscosity is too light. Hydraulic oil filter is plugged. Transmission(s) is/are worn or damaged.
Neutral is difficult to find or unit operates in one direction only.	Transmission control assembly components are misadjusted, disconnected, binding or damaged. Transmission(s) is/are worn or damaged.
Traction response is sluggish.	Hydraulic oil is very cold. Transmission control assembly components are misadjusted, disconnected, binding or damaged. Transmission drive belt is slipping. Transmission(s) is/are worn or damaged.
No traction movement exists in either direction.	Parking brake is applied or is mis- adjusted. Hydraulic oil level in both reservoirs is low. Transmission bypass valve levers are open. Transmission control assembly components are misadjusted, disconnected, binding or damaged. Transmission drive belt is slipping, broken or faulty. Transmissions are both worn or damaged.

Problem	Possible Cause
One rear wheel will not turn.	Hydraulic oil level in reservoir for non- moving wheel is low. Parking brake is applied for non- moving wheel (incorrect adjustment or internal transmission brake problem). Transmission bypass valve lever for non- moving wheel is open. Transmission drive belt is slipping on transmission pulley for non-moving wheel. Transmission for non- moving wheel is worn or damaged.
Rear attachment will not lift/lower or lifts slowly.	Engine speed is too low. Groomer (rear attachment) lift cylinder is binding or broken. Groomer lift arm bushings are binding. Oil level in right side hydraulic reservoir is low. Charge pump pressure or flow in RH transmission is insufficient. Charge pump in RH transmission is worn or damaged. Implement (lift) relief valve in RH transmission is stuck open. Groomer (rear attachment) lift cylinder leaks internally. NOTE: An electrical problem with the rear attachment switch, solenoid valve coils or circuit wiring could prevent the rear attachment from operating.
Rear attachment raises, but will not stay in the raised position.	Groomer (rear attachment) lift cylinder leaks internally. Check valve in hydraulic control manifold leaks.

Testing

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

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

CAUTION

Failure to use gauges with recommended pressure (PSI/bar) 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.

WARNING

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

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 test instruments and record test results.

1. Clean machine thoroughly before disconnecting or disassembling any hydraulic components. Always keep in mind the need for cleanliness when working on hydraulic equipment. System contamination can cause excessive wear or binding of hydraulic components.

2. Before testing, check all control linkages for improper adjustment, binding or broken parts.

3. Review all hydraulic test steps before starting the test procedure.

4. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or component removal.

5. When using hydraulic tester (pressure and flow), the inlet and the outlet hoses must be properly connected and not reversed to prevent damage to the hydraulic tester or components.

6. Install hydraulic 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. After connecting test equipment, check oil level in the hydraulic reservoir to make sure that oil level is correct.

9. After installing test gauges, run engine at low idle speed and check for any hydraulic oil leaks. Correct any leaks before proceeding with test procedure.

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

11. When using hydraulic tester (pressure and flow), open tester load valve completely before starting engine to minimize the possibility of damaging components.

12. The engine must be in good operating condition when conducting hydraulic tests. When performing a hydraulic test, use a phototac to ensure engine speed is correct. Engine speed can affect the accuracy of the tester readings.

Implement (Lift) Relief Valve Pressure Test

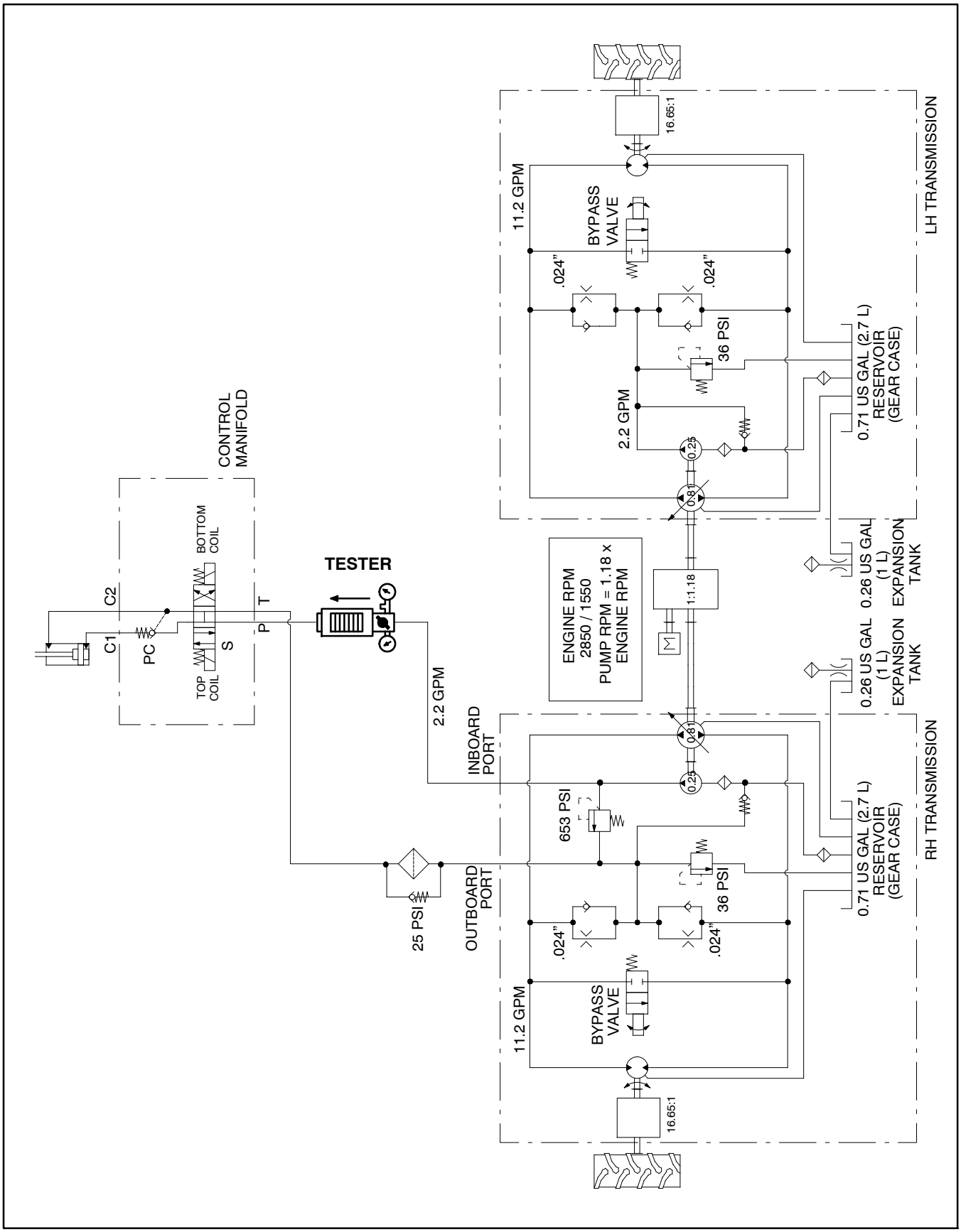


Figure 21

The implement relief valve pressure test should be performed to make sure that the relief pressure for the rear lift circuit is correct.

Procedure for Implement (Lift) Relief Valve Pressure Test:

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

2. Park machine on a level surface with the rear attachment lowered. Make sure engine is off and that the parking brake is applied.

3. Read and follow Precautions for Hydraulic Testing at the beginning of this section.

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disassembled.

4. Disconnect hydraulic hose from fitting in control manifold port P to allow tester with pressure gauge and flow meter installation (Fig. 22).

5. Install tester with pressure gauge and flow meter between disconnected hose and manifold fitting. Make sure that tester flow arrow points from the disconnected hose and toward the control manifold. **Also, make sure the flow control valve on the tester is fully open.**

6. Make sure that motion control handles are in the neutral locked position, the rear attachment switch is in neutral and the parking brake is applied.

7. Start engine and run at low idle speed. Check for hydraulic leakage at tester connections and correct before proceeding with test.

8. Operate engine at full speed **(2850 RPM)**. Verify engine speed with a phototac.

IMPORTANT: DO NOT hold system at implement relief for more than a few seconds.

9. With the engine running at full speed **(2850 RPM)**, move rear attachment switch to the lower position. Press and hold attachment switch in the lower position to allow the implement relief valve to activate. The pressure gauge should stabilize briefly at the implement relief pressure and then may continue to increase. The implement relief pressure is the gauge reading when pressure stabilizes and should be from **581 to 725 PSI (40 to 50 bar)**. After noting relief pressure, return lift switch to neutral position.

10. Shut off engine and record test results.

11. If implement relief specification is not met, inspect, repair or replace implement relief valve in RH transmission. The transmission needs to be disassembled to inspect the implement relief valve.

NOTE: The RH transmission gear pump flow can also be measured with hydraulic tester (flow meter) positioned as described in this test. If necessary, perform the flow test before removing the tester from the machine (see RH Transmission Gear Pump Flow Test in this section).

12. When testing is complete, remove hydraulic tester (flow meter) and reconnect hydraulic hose to fitting on control manifold.

13. Make sure hydraulic reservoir is full before returning machine to operation.

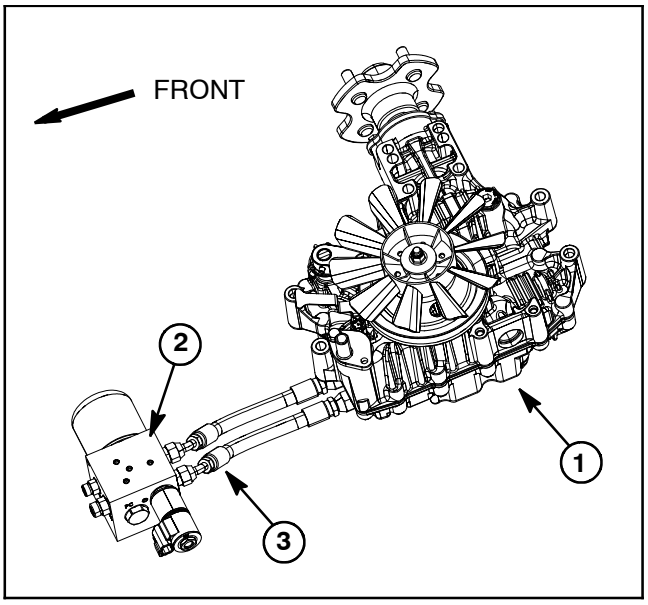


Figure 22

1. **RH transmission**
2. **Control manifold**
3. **Hose to port P**

RH Transmission Gear Pump Flow Test

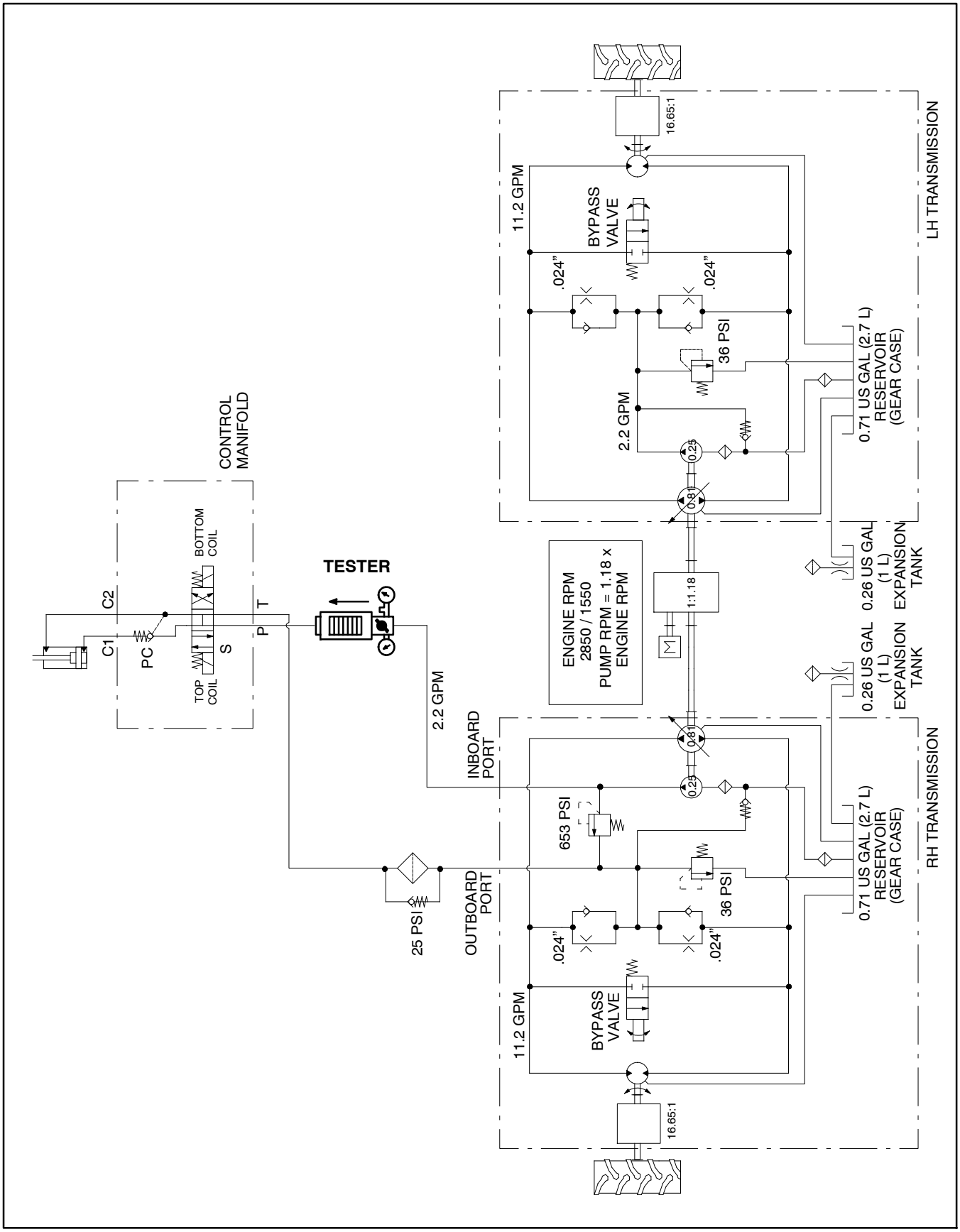


Figure 23

The RH transmission gear pump flow test should be performed to make sure that the gear pump flow for the rear lift circuit and RH transmission charge circuit is correct.

Procedure for <u>RH Transmission Gear Pump Flow</u> Test:

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

2. Park machine on a level surface with the rear attachment lowered. Make sure engine is off and that the parking brake is applied.

3. Read and follow Precautions for Hydraulic Testing at the beginning of this section.

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disassembled.

4. Disconnect hydraulic hose from fitting in control manifold port P to allow tester with pressure gauge and flow meter installation (Fig. 24).

5. Install tester with pressure gauge and flow meter between disconnected hose and manifold fitting. Make sure that tester flow arrow points from the hose and toward the control manifold. **Also, make sure the flow control valve on the tester is fully open.**

6. Make sure that motion control handles are in the neutral locked position, the rear attachment switch is in neutral and the parking brake is applied.

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

8. Operate engine at full speed **(2850 RPM)**. Verify engine speed with a phototac.

9. Watch pressure gauge on tester carefully while slowly closing the flow control valve until **400 PSI (28 bar)** is obtained. Verify that the engine speed is still **2850 RPM** (verify engine speed with a phototac).

NOTE: If engine speed drops during testing, pump flow will decrease and flow test results will be inaccurate.

10. Observe flow gauge on tester. Flow indication should be approximately **2 GPM (7.6 LPM)**.

11. Once flow has been determined, open flow control valve on tester, reduce engine speed and turn engine off. Record test results.

12. If **400 PSI (tester pressure)**, **2850 RPM (engine speed)** or **2 GPM flow** cannot be achieved, consider the following:

A. If the engine speed drops excessively (below 2850 RPM) as the tester flow control valve is closed, engine performance should be evaluated (see Chapter 3 - Gasoline Engine).

B. If engine speed does not drop and pressure and flow specifications are not met, the gear pump in the RH transmission needs to be repaired or replaced as necessary. The transmission needs to be disassembled to inspect the gear pump.

NOTE: If gear pump in RH transmission is faulty, charge pressure for RH transmission will be affected leading to possible piston pump and/or motor wear or damage in RH transmission.

NOTE: The implement (lift) relief valve pressure can also be measured with hydraulic tester (flow meter) positioned as described in this test. If necessary, perform the relief valve pressure test before removing the tester from the machine (see Implement (Lift) Relief Valve Pressure test Test in this section).

13. When testing is complete, remove hydraulic tester (flow meter) and reconnect hydraulic hose to fitting on control manifold.

14. Make sure hydraulic reservoir is full before returning machine to operation.

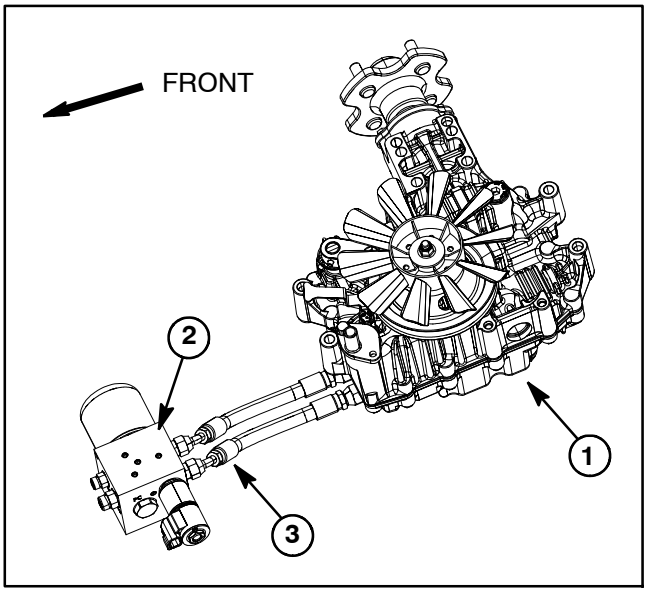


Figure 24

1. **RH transmission**
2. **Control manifold**
3. **Hose to port P**

Groomer (Rear Attachment) Lift Cylinder Internal Leakage Test

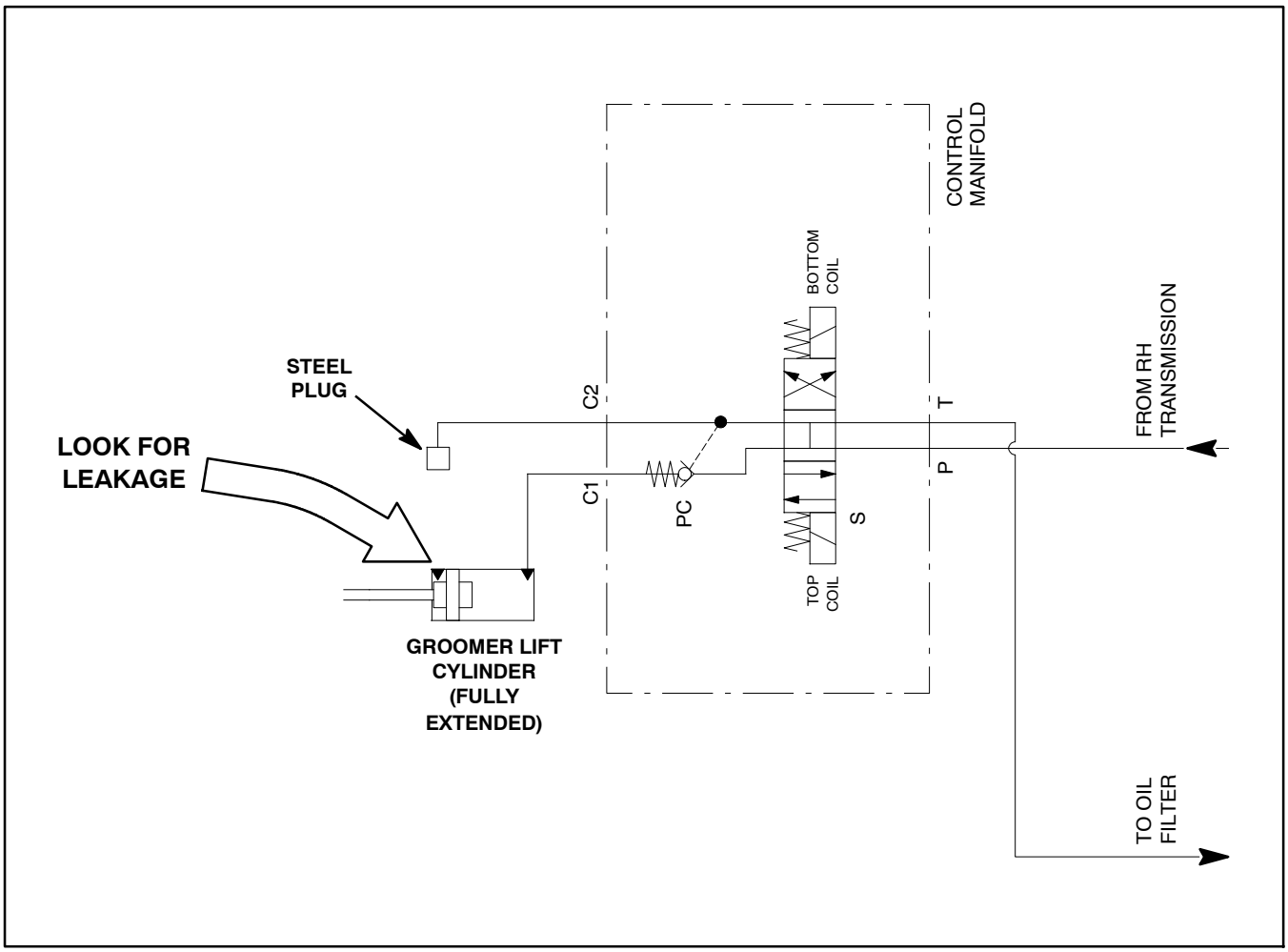


Figure 25

The groomer lift cylinder internal leakage test should be performed if a groomer (rear attachment) raise and lower problem is identified. This test will determine if the lift cylinder is faulty.

NOTE: Operation of the rear attachment on Sand Pro 2040Z machines will be affected by binding of the groomer lift assembly, extra weight on the groomer lift assembly and/or hydraulic lift cylinder binding. Make sure that these items are checked before proceeding with lift cylinder internal leakage test.

Procedure for Groomer (Rear Attachment) Lift Cylinder Internal Leakage Test:

1. Perform the Implement (Lift) Relief Valve Pressure and RH Transmission Gear Pump Flow tests to make sure that relief valve and gear pump are functioning correctly (refer to test procedures in this section).

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

3. Park machine on a level surface. With the engine running, use the rear attachment switch to fully raise the groomer lift assembly (lift cylinder rod is fully extended). Turn engine off and engage the parking brake.

4. Support the groomer lift assembly in the raised position to prevent it from lowering or shifting during testing.

5. Read and follow Precautions for Hydraulic Testing at the beginning of this section.

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disassembled.

6. Place a drain pan under the groomer lift cylinder. Clean and remove hydraulic hose from the 90º fitting on the rod end of the lift cylinder (Fig. 26). Plug the end of the disconnected hose with a steel plug.

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

8. Make sure that motion control handles are in the neutral locked position, the rear attachment switch is in neutral and the parking brake is applied.

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.

IMPORTANT: While performing test, do not press rear attachment switch to lower as system damage may occur.

9. Start engine and run at low idle speed. Have a second person observe the open fitting on the groomer lift cylinder. With the lift cylinder fully extended, momentarily press the rear attachment switch to raise. If oil comes out of the open fitting when the lift switch is pressed to raise, 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. Once the lift cylinder has been evaluated, shut engine off and wait for all machine movement to come to a complete stop.

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

12. If groomer lift problems exist and the groomer lift cylinder, implement (lift) relief valve pressure and RH transmission gear pump flow tested acceptably, consider that the hydraulic control manifold requires service (see Hydraulic Control Manifold and Hydraulic Control Manifold Service in the Service and Repairs section of this chapter).

13. Make sure hydraulic reservoir is full before returning machine to operation.

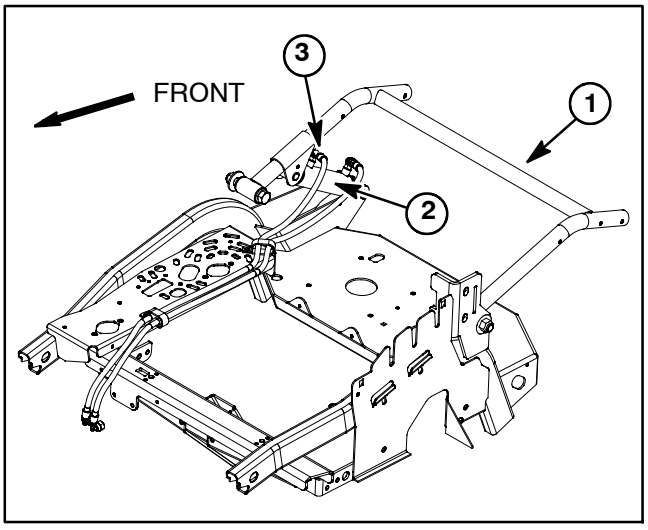


Figure 26

1. **Groomer lift assembly**
2. **Groomer lift cylinder**
3. **Rod end fitting**

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, apply parking brake, lower rear attachment and stop engine. Remove key from ignition switch.

WARNING

The engine, transmissions and hydraulic components can become very hot and cause severe burns. Allow the machine components to cool completely before servicing hydraulic components on the machine.

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

WARNING

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

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

4. Put labels on disconnected hydraulic lines for proper installation after repairs are completed.

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

After Repair or Replacement of Components

1. Check oil level in the hydraulic reservoirs and add correct oil if necessary. If component failure was severe or hydraulic systems are contaminated, drain hydraulic oil from all affected components, replace oil filters and refill system with new hydraulic fluid (see Flush Hydraulic System in this section).

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

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 lines, hydraulic fittings and components before reconnecting.

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

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

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

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

Check Hydraulic Lines and Hoses

WARNING

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

IMPORTANT: Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings or any hose deterioration. Make all necessary repairs before operating.

Flush Hydraulic System

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

IMPORTANT: If a failure occurs in the traction circuit, traction circuit component disassembly and thorough cleaning may be required to remove contaminates from the traction circuit. Because the traction circuit is a closed loop, any contamination will remain in the circuit and can cause additional component damage unless it is removed.

NOTE: Left and right transmissions are not connected to each other on the Sand Pro 2040Z. If a transmission issue arises with one of the transmissions that requires flushing, both transmissions do not have to be flushed.

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for at least four (4) hours.

2. Park machine on a level surface, lower rear attachment, stop engine, apply parking brake and remove key from ignition switch.

WARNING

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

IMPORTANT: Make sure to thoroughly clean around all hydraulic connections that will be disassembled.

3. Drain hydraulic reservoirs and transmissions.

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

5. Change and replace all hydraulic oil filters (control manifold, LH transmission and RH transmission).

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

6. Inspect and clean hydraulic oil reservoirs (see Hydraulic Reservoirs in this section).

7. Reconnect all hydraulic hoses and components that were disconnected to drain hydraulic system.

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

IMPORTANT: DO NOT overfill the hydraulic reservoirs.

8. Fill hydraulic reservoirs with **new** hydraulic fluid.

9. Disconnect and ground engine spark plug wires to prevent the engine from starting. Make sure that motion control handles and lift control switch are in the **neutral** position.

10. Turn ignition key switch to START and engage starter for ten (10) seconds to prime the hydraulic system. Wait sixty (60) seconds to allow the starter motor to cool and then repeat this step again.

11. Connect spark plug wires to spark plugs.

12. Start engine and let it run at low idle **(1550 RPM)** for a minimum of two (2) minutes. Increase engine speed to high idle **(2850 RPM)** for a minimum of one (1) minute under no load.

13. Raise and lower rear attachment several times.

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

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

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

17. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

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

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

1. Park machine on a level surface with the engine off.

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

3. Make sure all hydraulic connections, lines and components are secured tightly.

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

5. Make sure hydraulic reservoirs are full. Add correct oil if necessary.

6. Check traction control components for proper adjustment, binding or broken parts.

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

8. Make sure both motion control handles and rear attachment switch are in the **neutral** position. Turn ignition switch to START and engage starter for ten (10) seconds to prime the transmissions. Wait sixty (60) seconds to allow the starter motor to cool and then repeat this step again.

9. Connect spark plug wires to spark plugs.

WARNING

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

10. Raise and support machine with appropriate jack stands so that wheels are just off the ground to allow the wheels to rotate freely.

CAUTION

Drive (rear) wheels will be off the ground. Make sure machine is supported so it will not move and accidentally fall to prevent injury.

11. Make sure both motion control handles and rear attachment switch are in **neutral**. Start engine and run at low idle speed **(1750 RPM)**. The transmission charge pumps 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.

12. After the hydraulic system starts to show signs of fill, actuate rear attachment switch until the lift cylinder moves in and out several times. If the cylinder does not move after ten (10) to fifteen (15) seconds or if the transmission emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:

    A. Incorrect oil level in hydraulic reservoir(s).

    B. Loose oil filter.

    C. Incorrect hydraulic hose routing to hydraulic control manifold and/or lift cylinder.

    D. Consider a faulty implement relief valve in right side transmission or a faulty charge pump in either transmission. The transmission has to be removed, disassembled and inspection for these items.

13. Once lift cylinder does move in ten (10) to fifteen (15) seconds, proceed to step 14.

14. Place suitable weight in operator seat to allow traction circuit to be engaged. Also, make sure that parking brake is released.

15. Operate the motion control handles in the forward and reverse directions. Once wheel rotation is checked, stop engine.

16. Adjust motion control handles to the neutral position so that rear wheels do not move in neutral (see Operator's Manual).

17. Lower machine to ground.

18. If either transmission was replaced or rebuilt, operate the machine so all wheels turn slowly for ten (10) minutes.

19. Operate machine by gradually increasing its work load to full over a ten (10) minute period.

20. Stop the machine. Check hydraulic oil level and adjust if necessary. Check hydraulic components for leaks. Tighten any loose connections.

Hydraulic Reservoirs

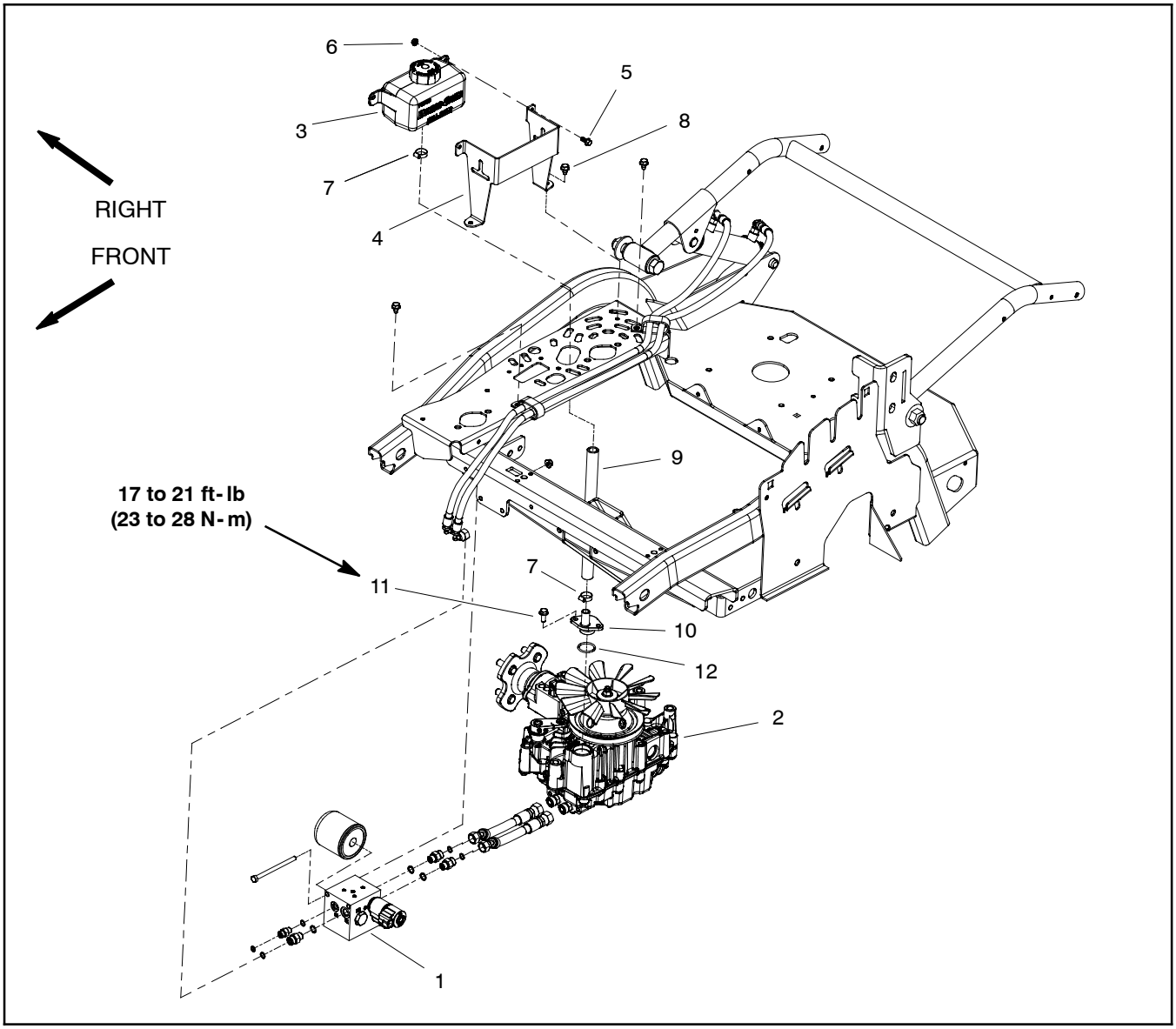


Figure 27

1. **Hydraulic manifold**
2. **Transmission (RH shown)**
3. **Hydraulic reservoir (RH shown)**
4. **Reservoir bracket (2 used)**
5. **Flange head screw (2 used per side)**
6. **Flange nut (2 used per side)**
7. **Hose clamp (2 used per hose)**
8. **Flange head screw (2 used per side)**
9. **Hydraulic hose (2 used)**
10. **Fitting (2 used)**
11. **Flange head screw (2 used)**
12. **O- ring (2 used)**

Removal (Fig. 27)

1. Park machine on a level surface, fully lower rear attachment, stop engine, apply parking brake and remove key from ignition switch.

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

3. Place drain pan under transmission for reservoir that is to be serviced. Make sure that drain pan is large enough to hold contents of transmission and hydraulic reservoir (see Specifications in this Chapter).

4. For reservoir that is to be serviced, remove two (2) transmission drain plugs (pump side and gear drive side) to allow transmission and hydraulic reservoir to drain (Fig. 28).

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

5. Thoroughly clean the end of hydraulic hose (item 9) at reservoir outlet to prevent hydraulic system contamination.

6. Loosen hose clamp and disconnect hydraulic hose from hydraulic reservoir outlet. Put plug in disconnected hose to prevent contamination.

7. Remove two (2) flange head screws and flange nuts (items 5 and 6) that secure hydraulic reservoir to the reservoir bracket.

8. Remove hydraulic reservoir from machine.

9. If necessary, remove hydraulic hose (item 9) from transmission fitting:

A. Thoroughly clean end of hydraulic hose at transmission fitting to prevent system contamination.

B. Loosen hose clamp and disconnect hydraulic hose from transmission fitting.

C. Put plug in transmission fitting to prevent system contamination.

Inspection

1. Clean hydraulic reservoir with solvent.

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

Installation (Fig. 27)

NOTE: If fitting (item 10) was removed from transmission, install new O-ring (item 12) into transmission port and ensure O-ring is bottomed completely against shoulder in transmission before installing fitting into port. Secure fitting to transmission with flange head screw (item 11) and torque screw from **17 to 21 ft- lb (23 to 28 N- m).**

1. If removed, install hydraulic hose (item 9) to transmission fitting:

A. Remove plug from transmission fitting that was placed to prevent system contamination.

B. Connect hydraulic hose to transmission fitting and secure with hose clamp. Make sure that hydraulic hose is routed through frame hole with grommet.

2. Position hydraulic reservoir to reservoir bracket.

3. Remove plug that was placed to prevent contamination from hydraulic hose. Connect hydraulic hose to hydraulic reservoir outlet and secure with hose clamp.

4. Secure hydraulic reservoir to the reservoir bracket with two (2) flange head screws and flange nuts (items 5 and 6).

5. Make sure that two (2) transmission drain plugs (pump side and gear drive side) are properly tightened (Fig. 28).

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

6. Fill hydraulic reservoir and transmission with new hydraulic oil to proper level.

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

8. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level and adjust if necessary.

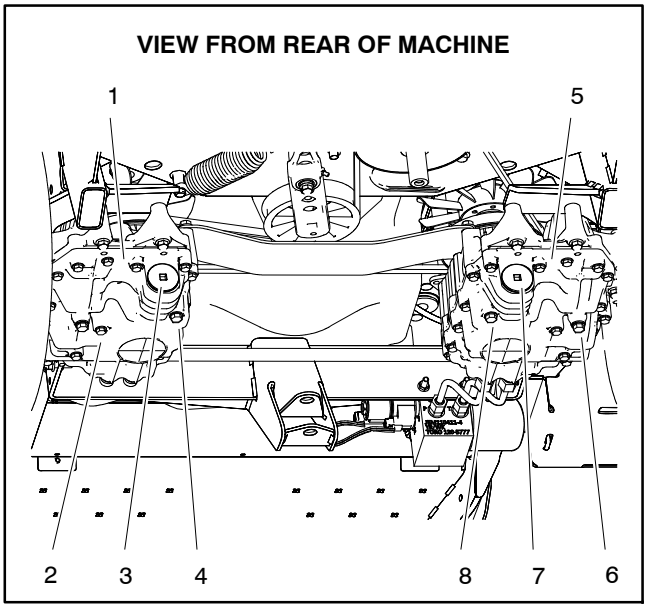


Figure 28

1. **LH transmission**
2. **LH gear side drain**
3. **LH transmission filter**
4. **LH pump side drain**
5. **RH transmission**
6. **RH gear side drain**
7. **RH transmission filter**
8. **RH pump side drain**

Hydraulic Control Manifold

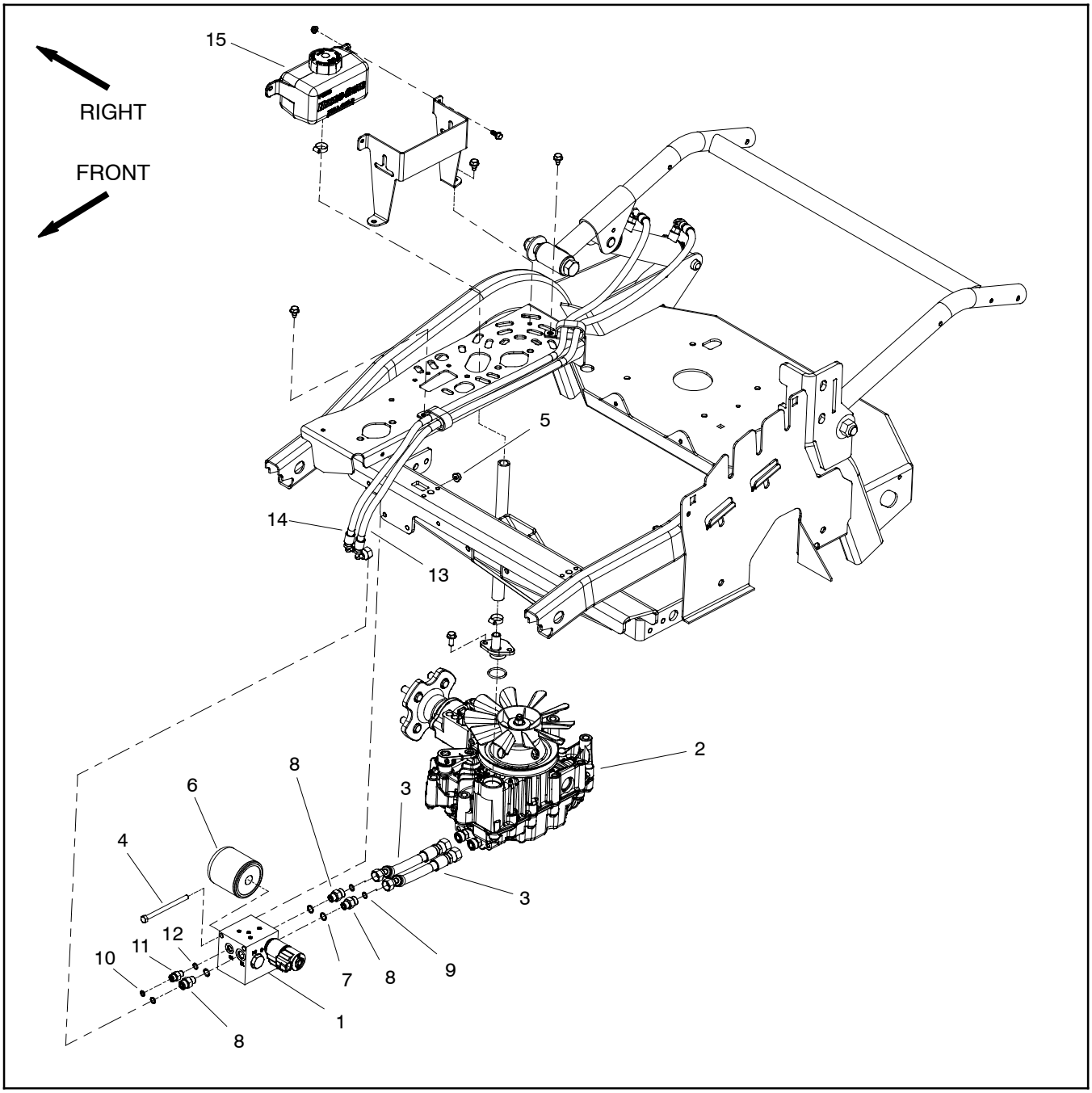


Figure 29

1. **Hydraulic manifold**
2. **RH transmission**
3. **Hydraulic hose (2 used)**
4. **Cap screw (2 used)**
5. **Flange nut (2 used)**
6. **Oil filter**
7. **O-ring**
8. **Hydraulic fitting (3 used)**
9. **O-ring**
10. **O-ring**
11. **Hydraulic fitting**
12. **O-ring**
13. **Hydraulic hose**
14. **Hydraulic hose**
15. **RH hydraulic reservoir**

Removal (Fig. 29)

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

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

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

WARNING

Make sure that rear attachment lift frame is fully lowered before loosening hydraulic lines from control manifold. If lift frame is not fully lowered as hydraulic lines are loosened, lift frame may drop unexpectedly.

4. Label all wire harness connectors that attach to solenoid coils on control manifold. Make sure to identify the upper (raise) and lower (lower) coil connections. Disconnect wire harness connectors from solenoid coils on the control manifold.

5. Disconnect hydraulic hoses from manifold and put caps or plugs on open hydraulic hoses and fittings. Label disconnected hydraulic hoses for proper installation.

6. Remove control manifold from the frame using Figure 29 as a guide.

7. If necessary, remove fittings from manifold and discard O- rings.

Installation (Fig. 29)

1. If fittings were removed from manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold openings and tighten fittings (see Hydraulic Fitting Installation in the General Information section of this Chapter).

2. Install control manifold to the frame using Figure 29 as a guide.

3. Remove caps and plugs from fittings and hoses. Using labels placed during manifold removal, properly connect hydraulic hoses to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this Chapter).

4. Using labels made during manifold removal, connect wire harness connectors to the solenoid coils on the control manifold.

5. Make sure hydraulic reservoir on the right side of the machine is full. Add correct oil if necessary before returning machine to service.

Hydraulic Control Manifold Service

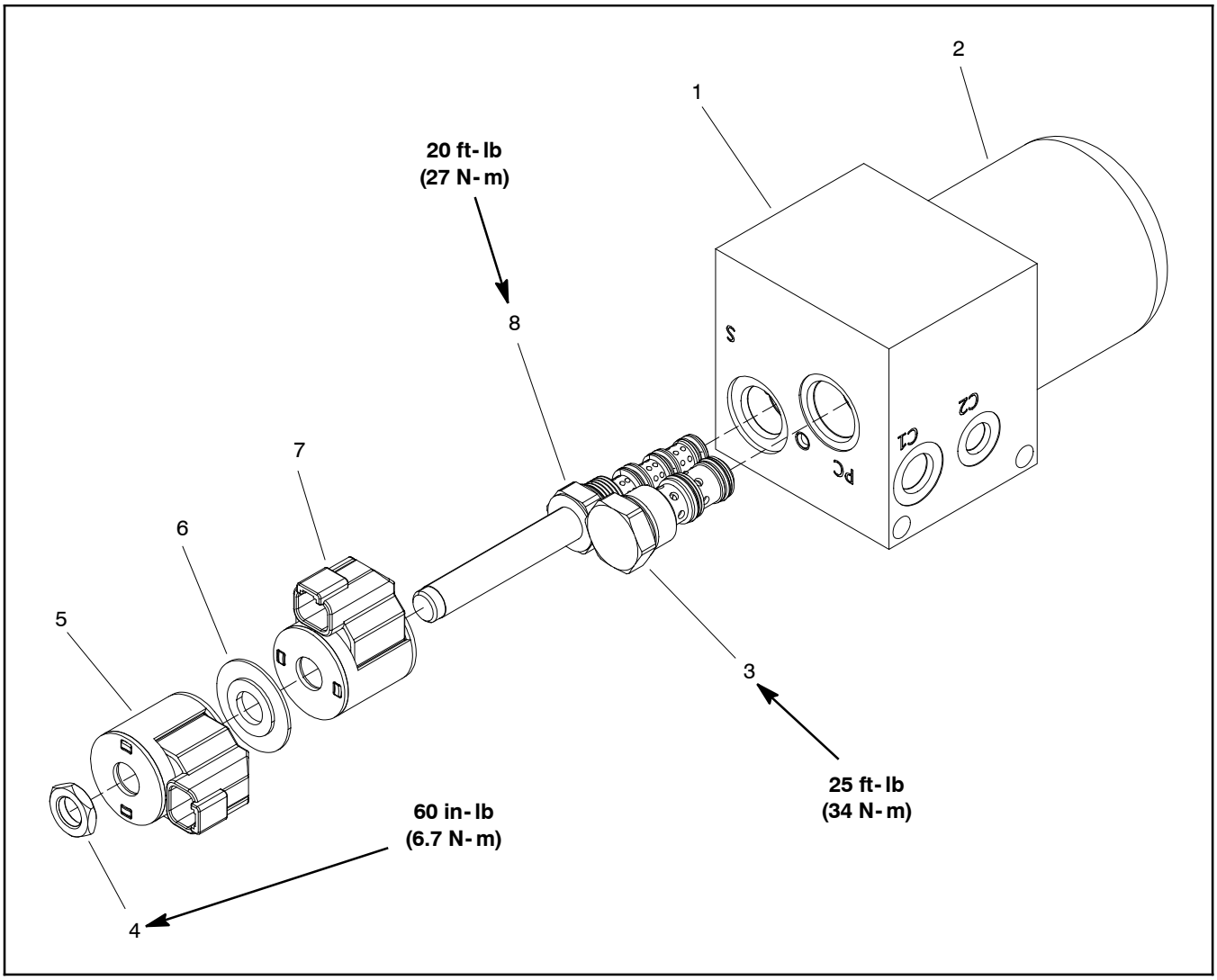


Figure 30

1. **Manifold**
2. **Hydraulic oil filter**
3. **Check valve**
4. **Nut**
5. **Solenoid coil (raise function)**
6. **Coil spacer**
7. **Solenoid coil (lower function)**
8. **Solenoid valve**

NOTE: The ports on the control manifold are marked for easy identification of components. Example: P is the oil supply connection port and PC is the check valve location (see Hydraulic Schematic in this Chapter to identify the function of the hydraulic lines and cartridge valves at each manifold port).

WARNING

If control manifold is attached to machine, make sure that rear attachment lift frame is fully lowered before loosening hydraulic lines or cartridge valves from control manifold. If lift frame is raised as components are loosened in manifold, lift frame may drop unexpectedly.

Cartridge Valve Service

1. Make sure the control manifold is clean before removing a cartridge valve from the control manifold.

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

NOTE: The two (2) solenoid coils are identical.

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

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

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

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

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

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

7. Install the cartridge valve into the manifold:

   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.

   B. Dip assembled cartridge into clean hydraulic oil.

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

   C. Thread cartridge valve carefully into manifold port by hand until the top O- ring is met. The valve should go into manifold port easily without binding.

   D. Torque cartridge valve using a deep socket wrench to value identified in Figure 30.

8. If cartridge valve is solenoid operated, carefully install solenoid coils to the cartridge valve. Secure coils to valve with nut and torque nut to **60 in- lb (6.8 N- m)**.

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

Groomer (Rear Attachment) Lift Cylinder

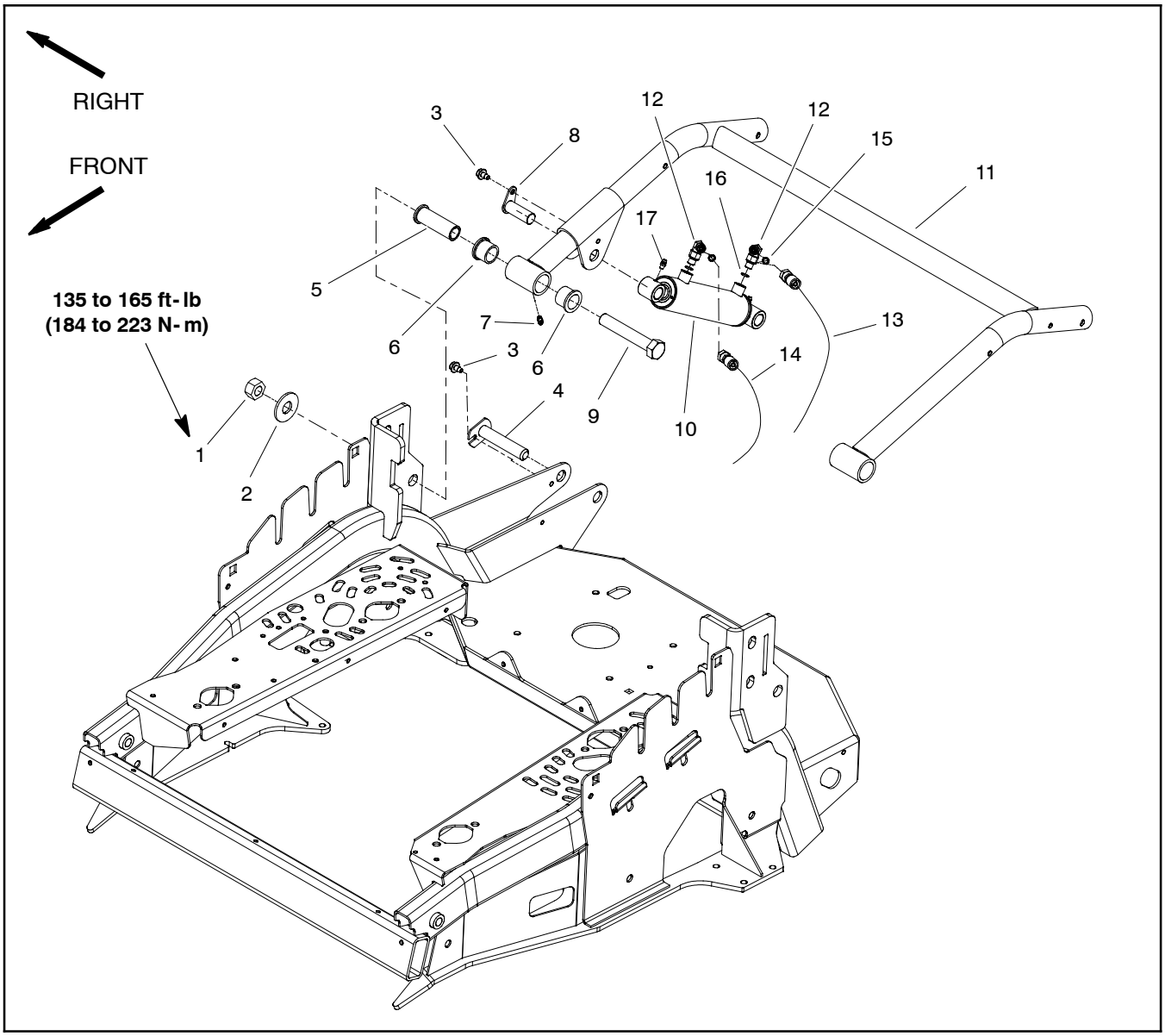


Figure 31

1. Lock nut (2 used)
2. Flat washer (2 used)
3. Washer head screw (2 used)
4. Pivot pin
5. Pivot sleeve (2 used)
6. Flange bushing (4 used)
7. Grease fitting (2 used)
8. Pivot pin
9. Cap screw (2 used)
10. Lift cylinder
11. Groomer lift frame
12. 90° hydraulic fitting (2 used)
13. Hydraulic hose
14. Hydraulic hose
15. O- ring
16. O- ring
17. Grease fitting (2 used)

Removal (Fig. 31)

1. Park machine on a level surface, fully lower rear attachment, stop engine, apply parking brake and remove key from ignition switch.

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

3. Thoroughly clean hydraulic hose ends and fittings on lift cylinder to prevent hydraulic system contamination.

4. Label all hydraulic connections on lift cylinder for assembly purposes.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil (see Relieving Hydraulic System Pressure in the General Information section of this Chapter). Also, make sure that rear attachment is fully lowered before loosening hydraulic hose connections at lift cylinder.

5. Disconnect hydraulic hoses from lift cylinder. Allow hoses to drain into a suitable container.

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

7. Remove washer head screws (item 3) that secure pivot pins (items 4 and 8) to machine frame and groomer lift frame. Slide pivot pins from frame and lift cylinder ends.

8. Remove lift cylinder from machine.

9. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly. Remove fittings from lift cylinder and discard O- rings.

Installation (Fig. 31)

1. If fittings were removed from lift cylinder, install and tighten fittings with new O- rings using marks made during the removal process to properly orientate fittings (see Hydraulic Fitting Installation in the General Information section of this Chapter).

2. Position lift cylinder to machine.

3. Secure lift cylinder to machine with pivot pins (items 4 and 8). Install washer head screws (item 3) to secure pivot pins in place.

4. Remove plugs and caps placed in hoses and fittings during cylinder removal. Use labels placed during the removal process to properly install hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this Chapter).

5. Make sure hydraulic reservoir on the right side of the machine is full. Add correct oil if necessary before returning machine to service.

6. Lubricate grease fittings on lift cylinder with general purpose lithium grease.

7. Operate machine functions slowly until air is out of system (see Charge Hydraulic System in this section).

Groomer (Rear Attachment) Lift Cylinder Service

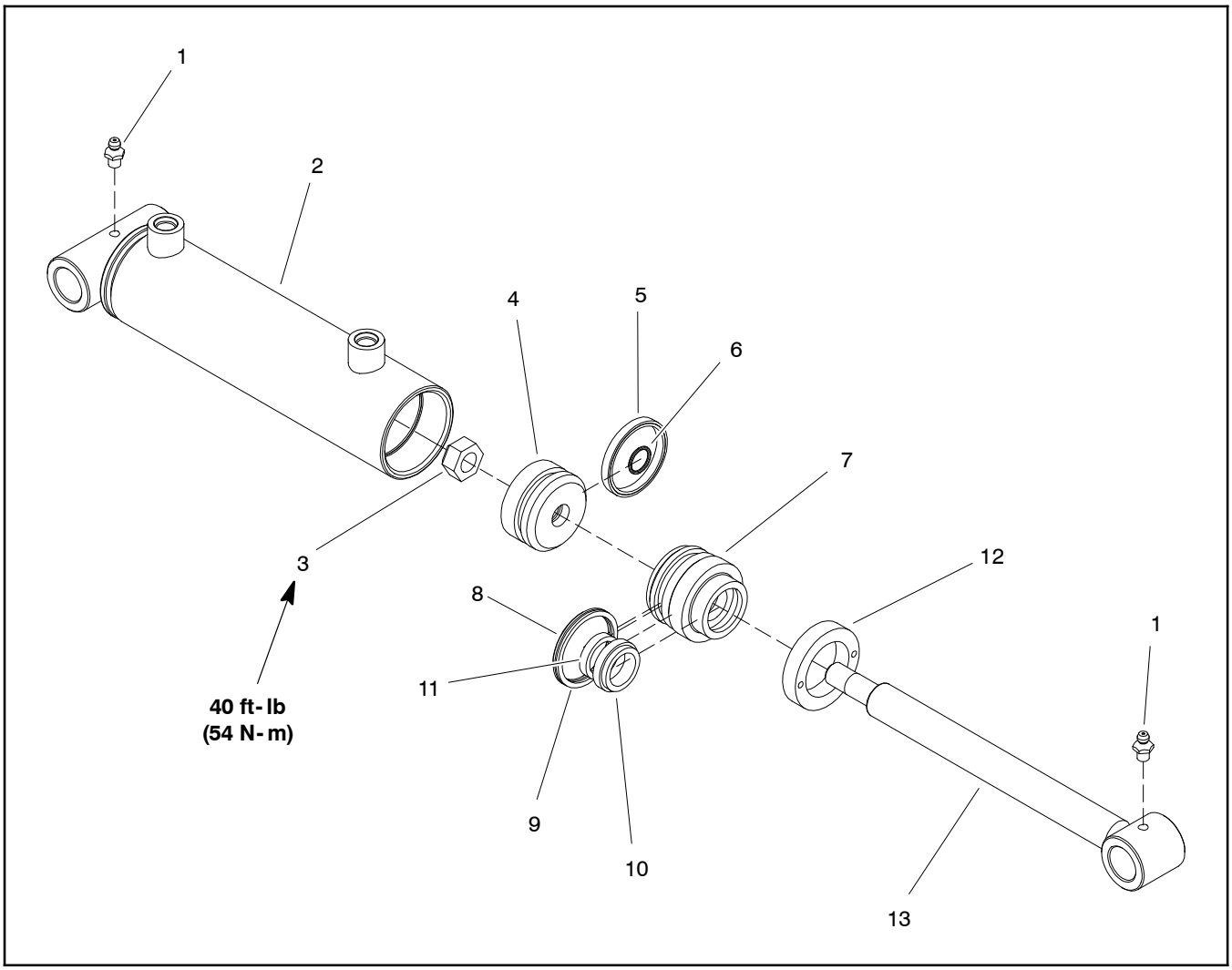


Figure 32

1. **Grease fitting (2 used)**
2. **Barrel**
3. **Lock nut**
4. **Piston**
5. **Piston seal**
6. **O- ring**
7. **Head**
8. **O- ring**
9. **Backup ring**
10. **Dust seal**
11. **Rod seal**
12. **Internal collar**
13. **Shaft**

Disassembly (Fig. 32)

1. Remove oil from lift cylinder ports 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 lift cylinder into a vise; clamp on the clevis end of the barrel ONLY. Use of a vise with soft jaws is recommended.

2. Mount lift cylinder securely in a vise by clamping on the clevis end of the barrel.

3. Using a spanner wrench, remove internal collar from barrel.

4. Remove plugs from ports. Extract shaft, internal collar, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY. Use of a vise with soft jaws is recommended.

5. Mount shaft securely in a vise by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Carefully slide head and internal collar off the shaft.

6. Taking care to not scratch or damage the piston, remove piston seal and O- ring from the piston.

7. Taking care to not scratch or damage the head, remove O- ring, back- up ring, dust seal and rod seal from the head.

8. Discard all removed seals.

CAUTION

Use eye protection such as goggles when using compressed air to dry cylinder components.

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

10. Carefully inspect internal surface of barrel for damage (deep scratches, out- of- round, etc.). Inspect rod and piston for evidence of excessive scoring, pitting or wear. Replace steering cylinder if internal components are worn or damaged.

Assembly (Fig. 32)

1. Make sure all cylinder parts are clean before assembly.

2. Coat new O- rings, back- up ring and other seals with clean hydraulic oil.

A. Carefully install new piston seal and O- ring to the piston.

B. Carefully install new rod seal, back- up ring, O- ring and dust seal to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the shaft clevis ONLY. Use of a vise with soft jaws is recommended.

3. Mount shaft securely in a vise by clamping on the clevis of the shaft.

A. Coat shaft with clean hydraulic oil.

B. Slide internal collar and then head onto the shaft.

C. Install piston onto the shaft and secure with lock nut. Torque lock nut to **40 ft- lb (54 N- m)**.

D. Remove shaft assembly from the vise.

IMPORTANT: Prevent damage when clamping the cylinder barrel into a vise; clamp on the clevis end of the barrel ONLY. Use of a vise with soft jaws is recommended.

4. Mount barrel securely in a vise by clamping on the clevis end of the barrel.

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

6. Secure head in barrel with internal collar. Use spanner wrench to tighten collar.

Transmission Control Assembly

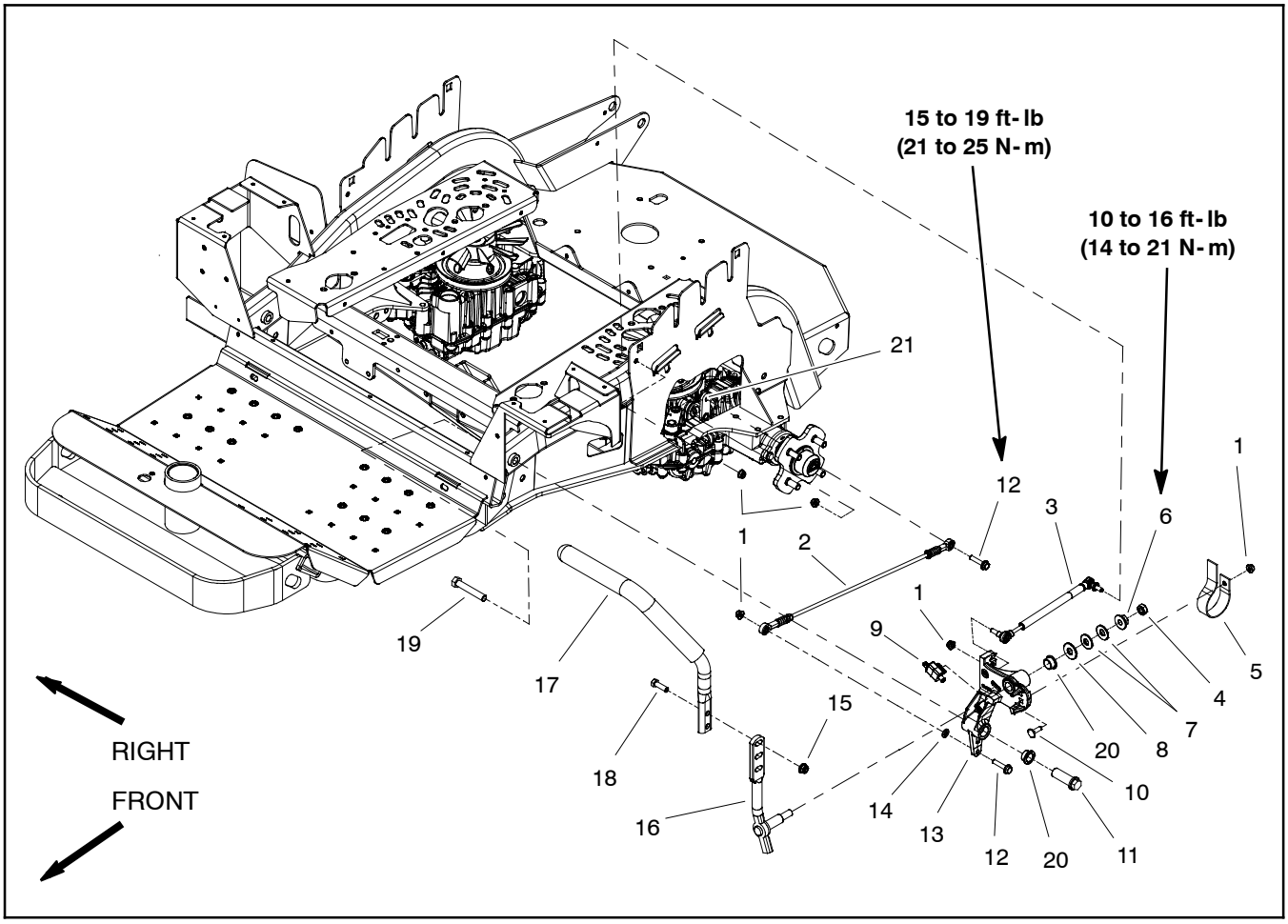


Figure 33

1. Flange nut (5 used per side)
2. Rear pump linkage assembly
3. Motion control damper
4. Jam nut
5. Leaf spring
6. Flange nut
7. Spring washer (2 used per side)
8. Flat washer
9. Traction switch
10. Carriage bolt
11. Threaded hub
12. Flange head screw (2 used per side)
13. Motion control (LH shown)
14. Flat washer
15. Flange nut (2 used per side)
16. Motion control handle (LH shown)
17. Motion handle (LH shown)
18. Cap screw (2 used per side)
19. Cap screw
20. Flange bushing (4 used per control)
21. Transmission traction lever

Disassembly (Fig. 33)

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

2. Disassemble transmission control components as needed using Figure 33 as a guide.

A. If needed, control cover can be removed to access control components for disassembly (Fig. 34). Remove four (4) flange head screws and lift control cover from machine.

B. If motion control handle (item 16) is removed, note orientation of spring washers for assembly purposes (shown in Fig. 35).

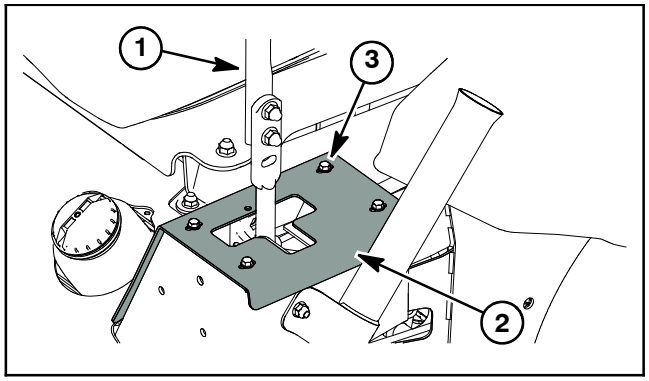


Figure 34

1. Motion control handle
2. Control cover
3. Screw (4 used)

C. If rear pump linkage assembly (item 2) needs to be disassembled, note that rear balljoint has left hand threads and a groove to identify it. Linkage assembly components are shown in Fig. 36.

Assembly (Fig. 33)

1. If rear pump linkage assembly was disassembled, use the following during assembly (Fig. 36):

A. If removed, thread both jam nuts onto linkage rod. Install outer jam nut so that it is **1.510" (38.4 mm)** from end of rod. Then tighten inner jam nut against outer jam nut and torque from **111 to 145 in-lb (12.6 to 16.3 N-m)**.

B. Install springs and balljoints to the ends of the linkage rod so that the springs are compressed to a length of **1.000" (25.4 mm)**.

C. The standard balljoint center to center length of the rear pump linkage should be **21.010" (53.4 cm)** after assembly.

2. Assemble removed transmission control components using Figure 33 as a guide.

A. If rear pump linkage assembly (item 2 in Fig. 33) was removed, install pump linkage so that the end with jam nuts is orientated toward front of machine (shown in Fig. 37). When securing pump linkage to transmission traction lever (item 21 in Fig. 33), torque flange head screw (item 12 in Fig. 33) and flange nut (item 1 in Fig. 33) from **15 to 19 ft-lb (21 to 25 N-m)**.

B. If motion control handle (item 16 in Fig. 33) was removed from motion control (item 13), make sure that spring washers are installed with the concave sides facing each other as shown in Figure 35. Torque flange nut from **10 to 16 ft-lb (14 to 21 N-m)** to secure motion control handle. After flange nut is properly torqued, install and torque jam nut against flange nut from **38 to 52 ft-lb (52 to 70 N-m)**. Hold flange nut with wrench while torquing jam nut so that flange nut torque does not change.

C. If motion handles (item 17) were removed, align the ends of the handles during assembly.

3. After all transmission control components have been installed, perform adjustments for control handle position, neutral position, control handle dampening and neutral lock resistance (refer to Operators Manual). Also, make sure that traction interlock system correctly prevents engine starting and operation when motion control handles are not in the neutral locked position.

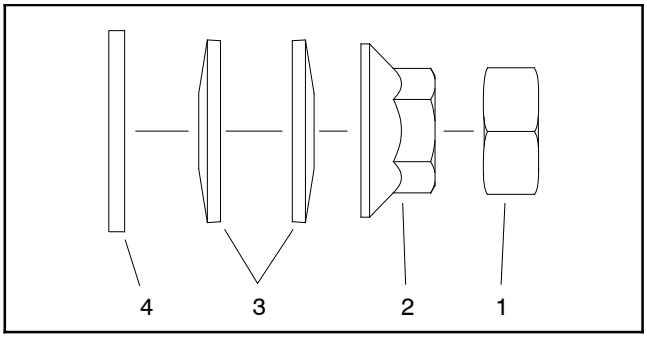


Figure 35

1. **Jam nut**
2. **Flange nut**
3. **Spring washer**
4. **Flat washer**

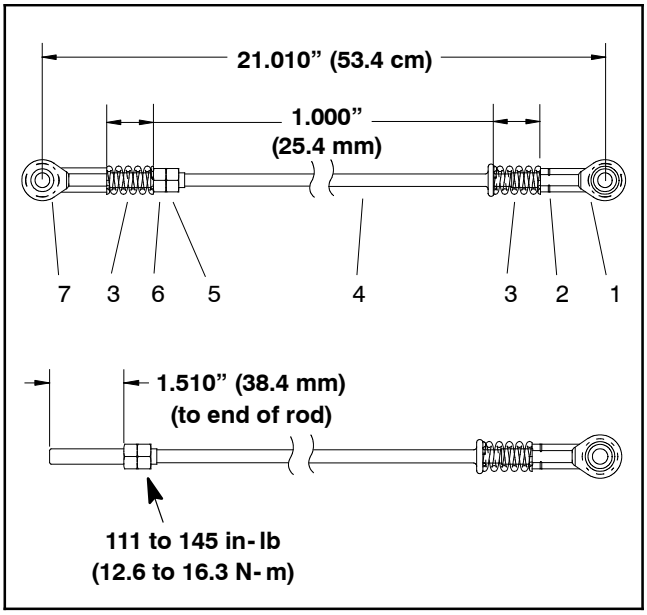


Figure 36

1. **Balljoint (LH threads)**
2. **Identification groove**
3. **Spring (2 used)**
4. **Linkage rod**
5. **Inner jam nut**
6. **Outer jam nut**
7. **Balljoint (RH threads)**

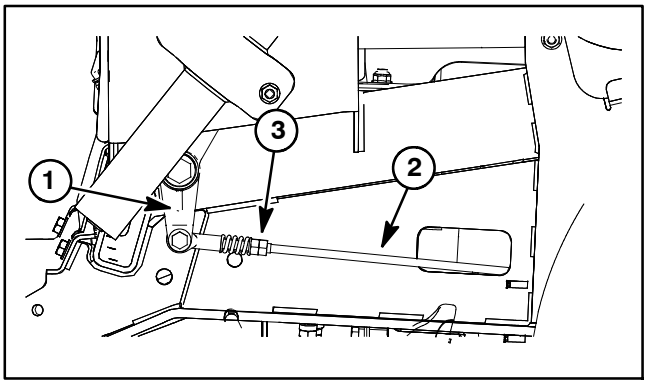


Figure 37

1. **Motion control assy**
2. **Rear pump linkage**
3. **Jam nuts**

Transmission Drive Belt

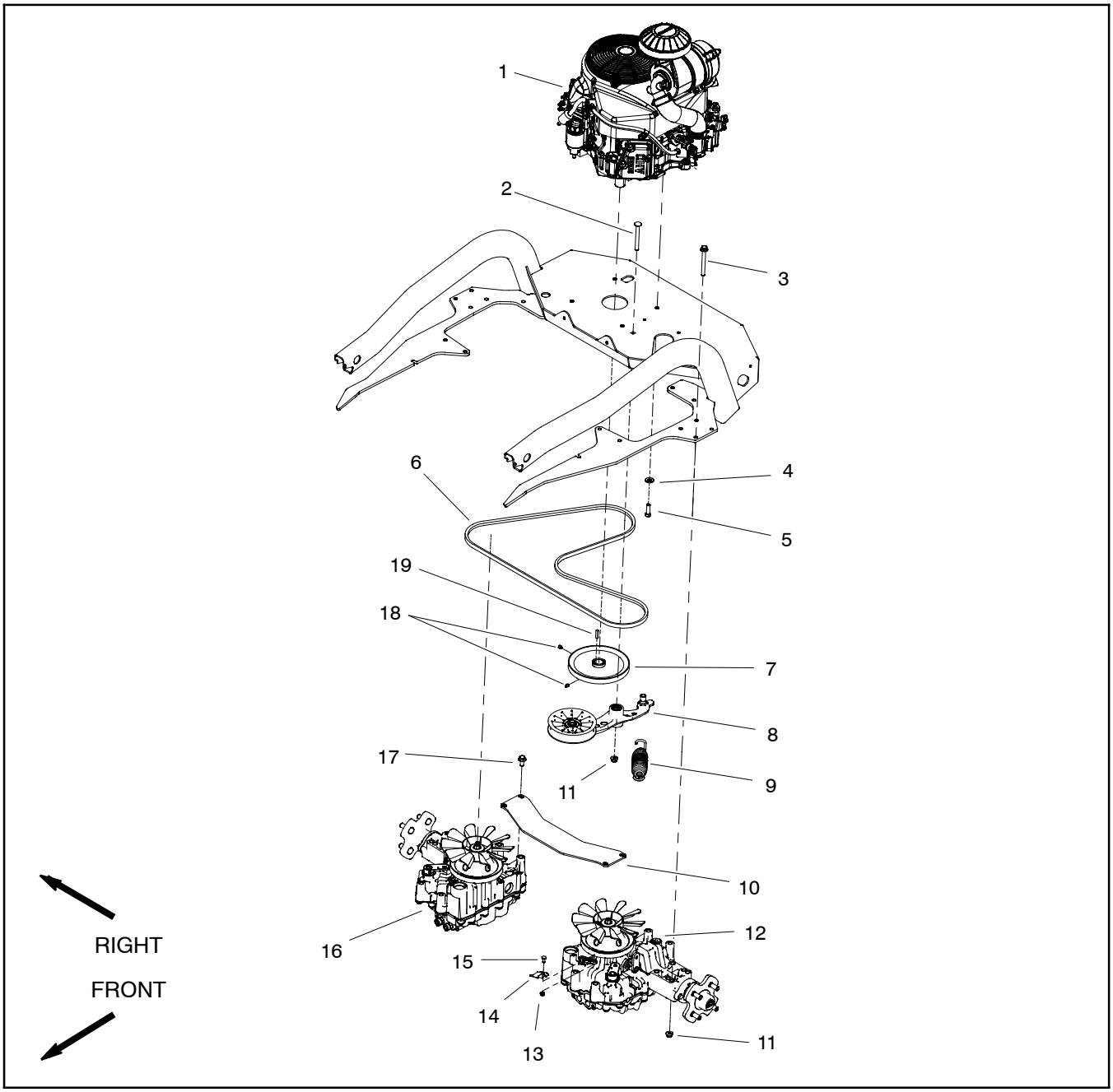


Figure 38

1. Engine
2. Carriage bolt
3. Flange head screw (16 used)
4. Belleville washer (4 used)
5. Cap screw (4 used)
6. V-belt
7. Engine drive pulley
8. Pump idler assembly
9. Extension spring
10. Crossmember
11. Flange nut (17 used)
12. LH transmission assembly
13. Lock nut (2 used)
14. Bypass valve lever (2 used)
15. Cap screw (2 used)
16. RH transmission assembly
17. Flange head screw (4 used)
18. Socket head screw (2 used)
19. Square key

Removal (Fig. 38)

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

WARNING

The engine, transmissions and hydraulic components can become very hot and cause severe burns. Allow the machine components to cool completely before removing the transmission drive belt from the machine.

2. Gain access to transmission drive belt assembly from below the machine. If necessary, raise and support rear of machine (see Jacking Instructions in Chapter 1 - Safety).

CAUTION

The pump idler assembly is under tension and may cause personal injury during transmission drive belt removal. Use caution when releasing drive belt tension.

3. Use a breaker bar or ratchet in the square hole in the pump idler assembly to release tension on the transmission drive belt. Remove drive belt from the idler pulley and carefully release spring tension from the idler assembly.

4. Note routing of drive belt for assembly purposes.

5. Carefully remove drive belt from engine and transmission pulleys. Take care to not damage the transmission cooling fans during belt removal.

Installation (Fig. 38)

1. Carefully position drive belt around transmission and engine pulleys taking note of routing shown in Figure 39. Take care to not damage the transmission cooling fans during belt installation.

2. Make sure that extension spring is attached to anchor points on frame and pump idler assembly.

CAUTION

The idler assembly will be under tension and may cause personal injury during drive belt installation. Use caution when applying drive belt tension.

3. Use a breaker bar or ratchet in the square hole in the pump idler assembly to extend the spring on the idler assembly. Position drive belt to the idler pulley and carefully release the idler assembly to tension the drive belt.

4. If machine was raised for drive belt service, lower machine to ground.

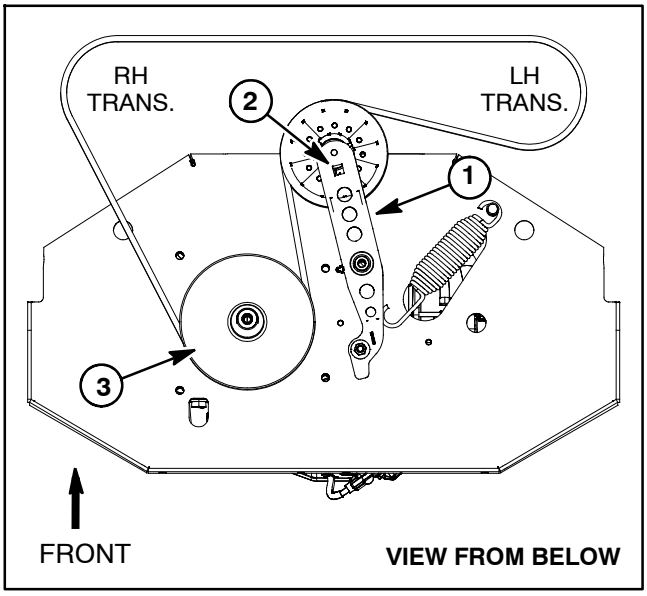


Figure 39

1. **Pump idler assembly**
2. **Square hole**
3. **Engine drive pulley**

Transmission Idler Assembly

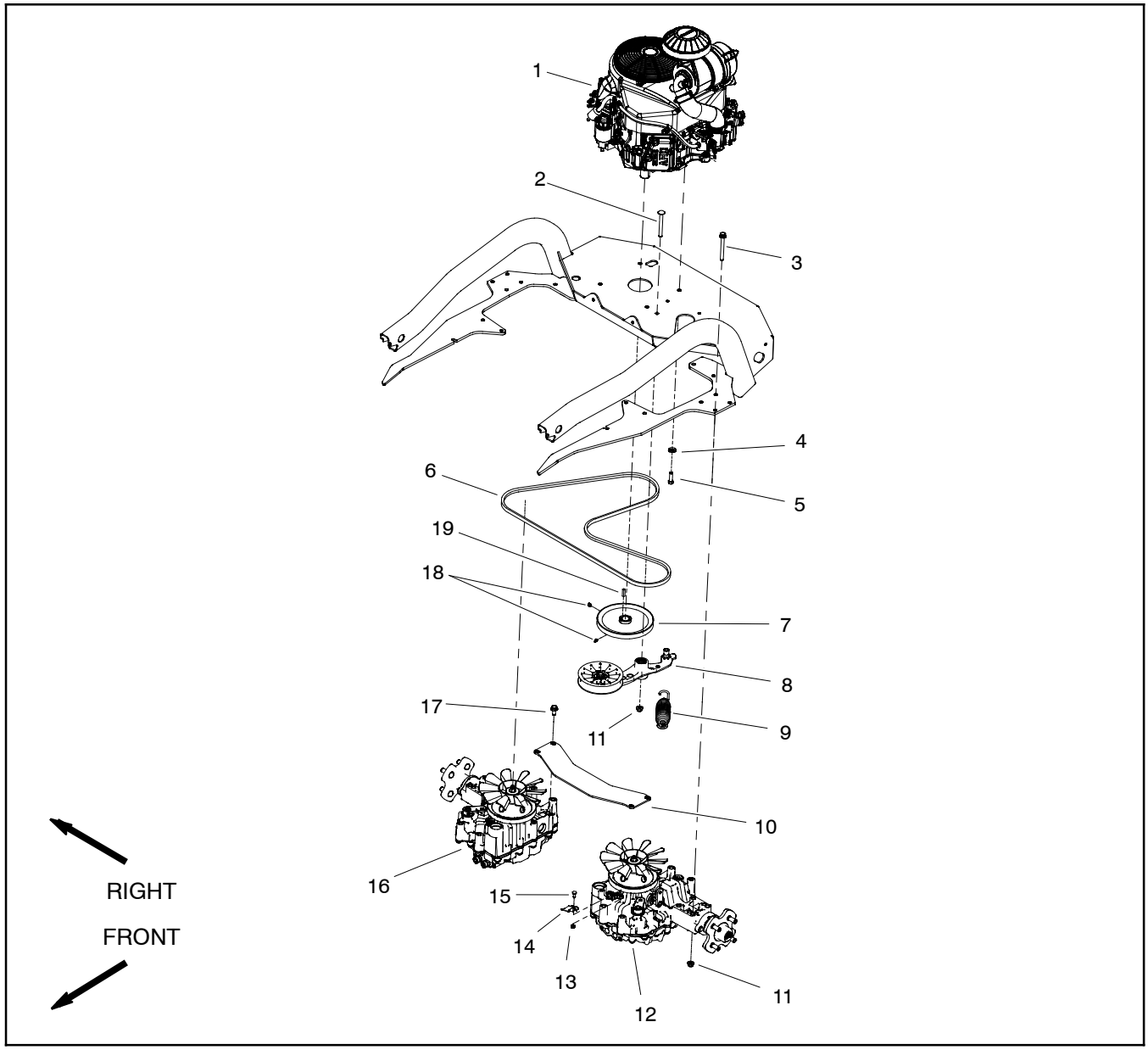


Figure 40

1. Engine
2. Carriage bolt
3. Flange head screw (16 used)
4. Belleville washer (4 used)
5. Cap screw (4 used)
6. V-belt
7. Pulley
8. Pump idler assembly
9. Extension spring
10. Crossmember
11. Flange nut (17 used)
12. LH transmission assembly
13. Lock nut (2 used)
14. Bypass valve lever (2 used)
15. Cap screw (2 used)
16. RH transmission assembly
17. Flange head screw (4 used)
18. Socket head screw (2 used)
19. Square key

Removal (Fig. 40)

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

2. Remove transmission drive belt to allow access to pump idler assembly (see Transmission Drive Belt in this section).

3. Remove flange nut (item 11) that secures idler assembly to carriage screw (item 2). Lower idler assembly from carriage screw and remove from machine.

4. Disassemble idler assembly as needed using Figure 41 as a guide. Note orientation of seals (items 4 and 5 in Fig. 41) during disassembly.

5. Clean and inspect all idler assembly components. Replace worn or damaged parts.

Installation (Fig. 40)

1. Assemble idler assembly using Figure 41 as a guide and the following:

   A. If removed, install new O- rings (item 7 in Fig. 41) into grooves of idler arm. Do not apply grease or oil to the O- rings.

   B. During bearing assembly into idler arm, press equally on inner and outer bearing races (item 3 in Fig. 41). Bearings should be pressed into arm so that retaining rings can be installed after bearing installation. Make sure that retaining rings are fully installed in idler arm grooves and that bearings turn freely after installation.

   C. The lips of the double lip seal (item 4 in Fig. 41) should be greased before installation.

   D. The lip of the single lip seal (item 5 in Fig. 41) should NOT be greased before installation. Also, the single lip seal garter spring should be installed facing outward.

   E. Torque cap screw (item 8 in Fig. 41) to **22 ft- lb (30 N- m)** to secure idler pulley to idler arm.

2. Slide idler assembly onto carriage screw (item 2) and secure to the machine with flange nut (item 11).

3. Lubricate grease fitting on pump idler assembly.

4. Install transmission drive belt (see Transmission Drive Belt in this section).

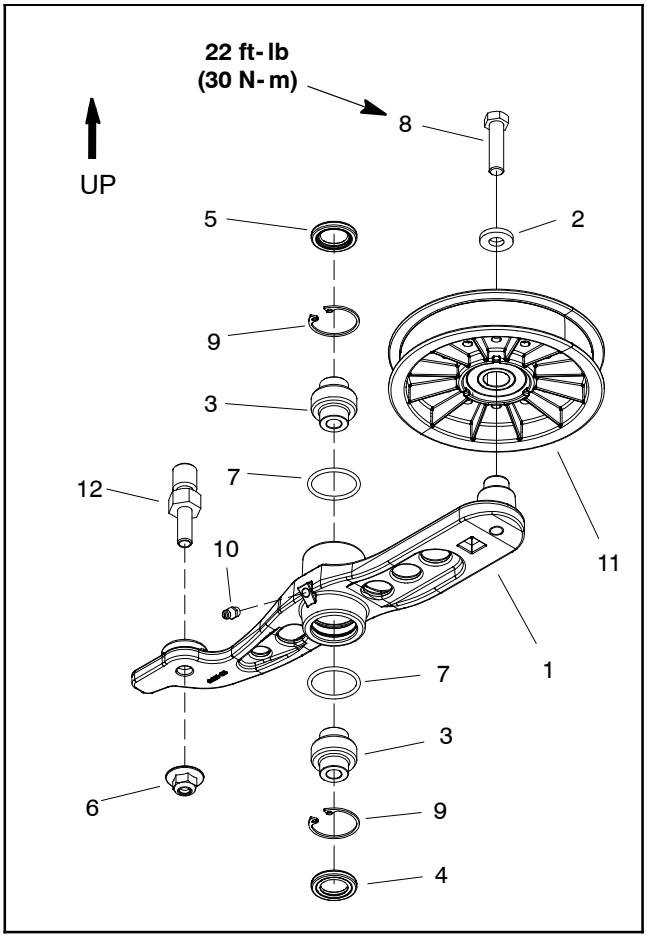


Figure 41

1. Idler arm
2. Spacer
3. Bearing (2 used)
4. Double lip seal
5. Single lip seal
6. Flange nut
7. O- ring (2 used)
8. Cap screw
9. Retaining ring (2 used)
10. Grease fitting
11. Idler pulley
12. Spring anchor pin

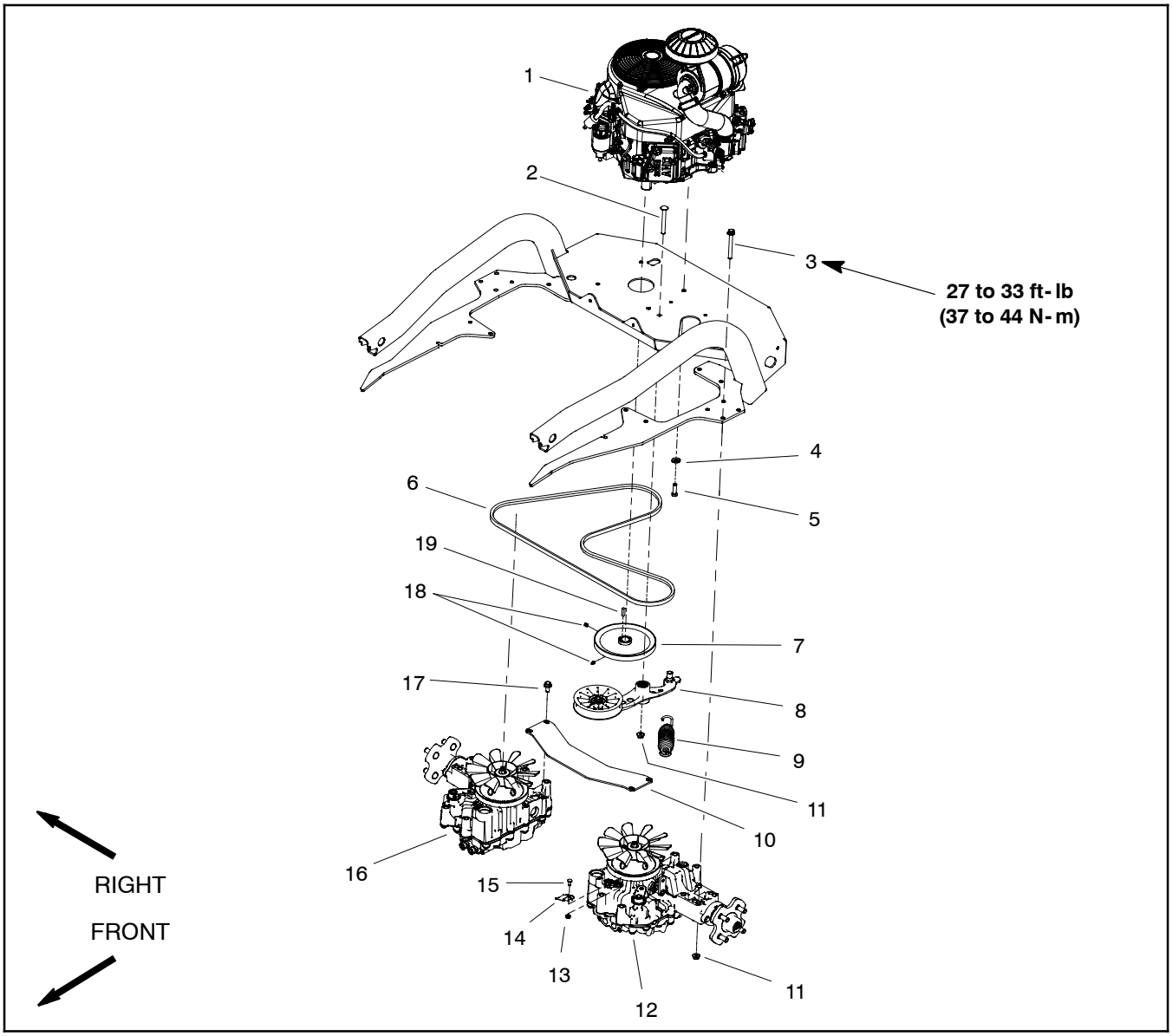


Figure 42

1. Engine
2. Carriage bolt
3. Flange head screw (16 used)
4. Belleville washer (4 used)
5. Cap screw (4 used)
6. V- belt
7. Pulley
8. Pump idler assembly
9. Extension spring
10. Crossmember
11. Flange nut (17 used)
12. LH transmission assembly
13. Lock nut (2 used)
14. Bypass valve lever (2 used)
15. Cap screw (2 used)
16. RH transmission assembly
17. Flange head screw (4 used)
18. Socket head screw (2 used)
19. Square key

WARNING

The engine, transmissions and hydraulic components can become very hot and cause severe burns. Allow the machine components to cool completely before removing the transmission from the machine.

Removal (Fig. 42)

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

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

3. Raise and support rear of machine (see Jacking Instructions in Chapter 1 - Safety).

4. Remove rear wheel from transmission that is to be removed (see Rear Wheels in the Service and Repairs section of Chapter 6 - Chassis).

5. Remove transmission drive belt (see Transmission Drive Belt in this section).

6. Place drain pan under transmission that is to be removed. Make sure that drain pan is large enough to hold contents of transmission and hydraulic reservoir (see Specifications in this Chapter).

7. Remove two (2) transmission drain plugs (pump side and gear drive) to allow transmission and hydraulic reservoir to drain (Fig. 43).

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

WARNING

Make sure that rear attachment lift frame is fully lowered before loosening hydraulic lines from RH transmission fittings. If lift frame is not fully lowered as hydraulic lines are loosened, lift frame may drop unexpectedly.

8. If RH transmission is being removed (Fig. 44):

   A. Thoroughly clean hydraulic hose ends at transmission prior to disconnecting hoses from transmission. Label hydraulic hoses for assembly purposes.

   B. Disconnect hydraulic hoses from fittings on transmission. Retain fittings with second wrench to prevent the fittings from loosening in transmission. Allow hoses to drain into a suitable container.

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

9. Loosen hose clamp that secures hydraulic hose from reservoir to fitting in top of transmission (shown in Fig. 44). Separate hose from transmission fitting.

10. Disconnect brake lever from transmission brake lever (Fig. 45).

11. Disconnect rear pump linkage from transmission traction lever (Fig. 46).

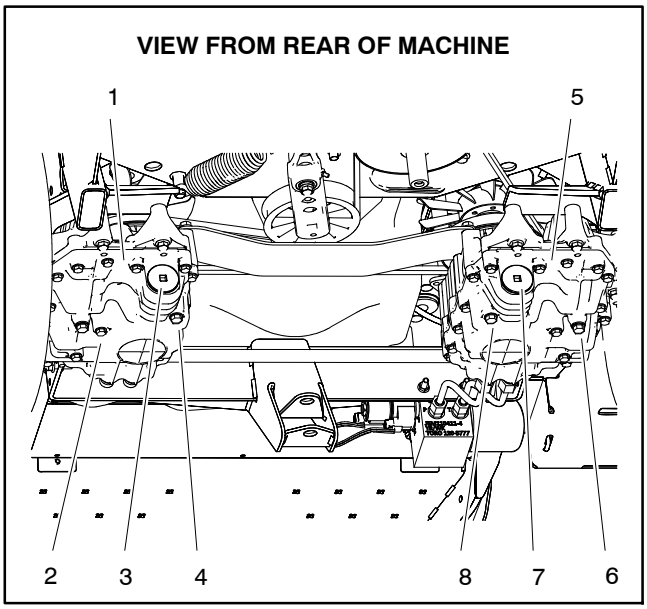


Figure 43

1. LH transmission
2. LH gear side drain
3. LH transmission filter
4. LH pump side drain
5. RH transmission
6. RH gear side drain
7. RH transmission filter
8. RH pump side drain

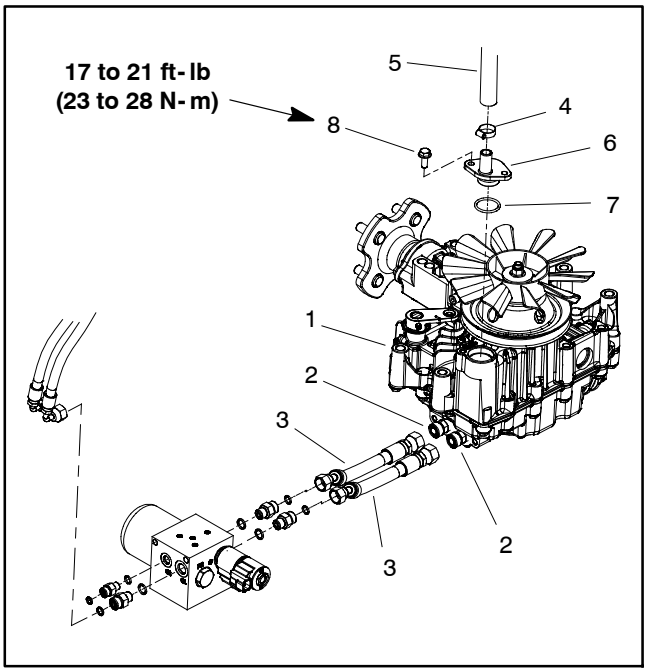


Figure 44

1. RH transmission
2. Hydraulic fitting (2 used)
3. Hydraulic hose (2 used)
4. Hose clamp
5. Hydraulic hose
6. Hydraulic fitting
7. O-ring
8. Flange screw

CAUTION

To prevent personal injury, make sure that transmission is properly supported as it is removed from the machine. Transmission weighs approximately 50 pounds (23 kg).

12. Remove transmission from machine as follows:

A. Support transmission to prevent it from moving.

B. Remove two (2) flange head screws (item 17) that secure the crossmember (item 10) to the transmission that is being removed.

C. Remove eight (8) cap screws and flange nuts that secure transmission to machine frame.

D. Carefully lower transmission from frame and remove from machine.

13. If necessary, remove flange head screw that secure hydraulic fitting (item 6 in Fig. 44) into transmission. Remove fitting and then O- ring from transmission. Discard removed O- ring.

IMPORTANT: If pulley is to be removed during transmission disassembly, make sure that pulley removal tool is used so pulley will not be damaged during removal (see Special Tools in this chapter).

Installation (Fig. 42)

1. If removed, install hydraulic fitting (item 6 in Fig. 44) into transmission:

A. Install new O-ring into transmission port and ensure O-ring is bottomed completely against shoulder in transmission before installing fitting into port.

B. Secure fitting to transmission with flange head screw (item 8 in Fig. 44). Torque screw from **17 to 21 ft- lb (23 to 28 N- m).**

2. Install transmission to machine as follows:

A. Carefully raise transmission to frame, align mounting holes and support transmission in position.

B. Install eight (8) cap screws and flange nuts to transmission and machine frame. Do not fully tighten fasteners at this time.

C. Align crossmember (item 10) to the installed transmission and secure with two (2) flange head screws (item 17). Take care when installing screws to prevent damaging threads in transmission.

D. Secure transmission by tightening eight (8) cap screws from **27 to 33 ft- lb (37 to 44 N- m)**.

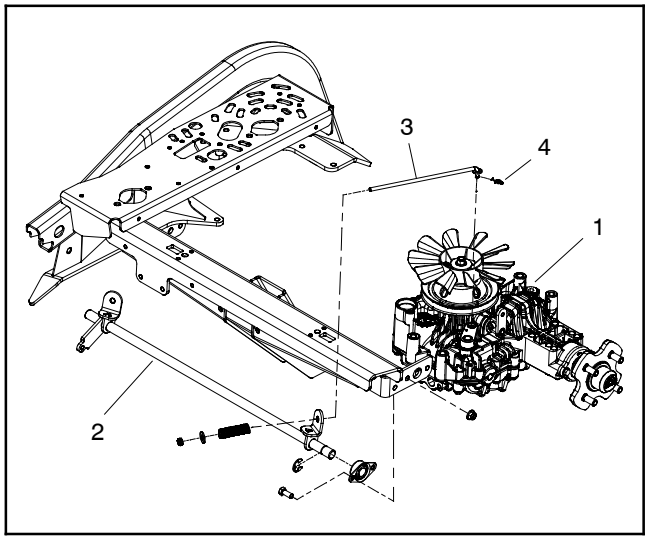


Figure 45

1. **Transmission**
2. **Brake shaft**
3. **Brake rod**
4. **Locking cotter pin**

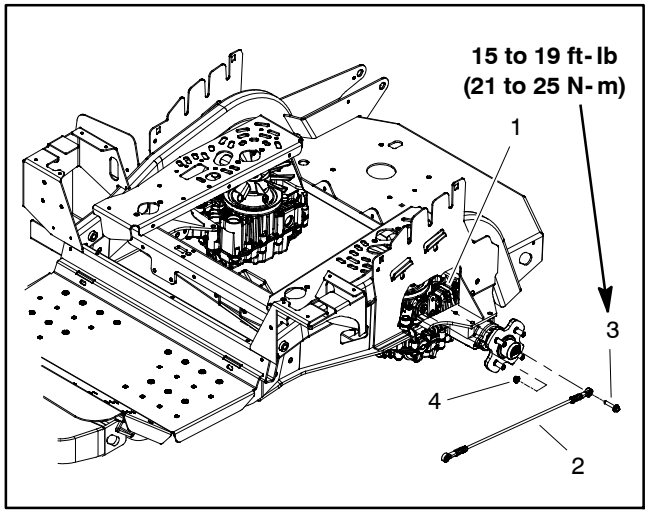


Figure 46

1. **Traction lever**
2. **Rear pump linkage**
3. **Flange head screw**
4. **Flange nut**

3. Connect rear pump linkage to transmission traction lever with flange head screw and flange nut (shown in Fig. 46). Torque flange head screw from **15 to 19 ft- lb (21 to 25 N- m)**.

4. Connect brake lever to transmission brake lever and secure with locking cotter pin (shown in Fig. 45).

5. Install hydraulic hose onto transmission fitting and secure with hose clamp (shown in Fig. 44).

6. If RH transmission was removed (shown in Fig. 44):

A. Remove plugs and caps placed in hoses and fittings during transmission removal.

B. Position new O- rings and connect hydraulic lines to fittings on RH transmission (see Hydraulic Hose and Tube Installation in the General Information section of this Chapter). As hydraulic lines are being tightened, use wrench on transmission fittings to prevent them from tightening into transmission.

7. Install transmission drive belt (see Transmission Drive Belt in this section).

8. Install rear wheel (see Rear Wheels in the Service and Repairs section of Chapter 6 - Chassis).

9. Make sure that two (2) transmission drain plugs (pump side and gear drive side) are properly tightened (Fig. 43).

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

10. Fill hydraulic reservoir and transmission with new hydraulic oil to proper level.

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

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

13. Check adjustments for control handle position, neutral position, control handle dampening and neutral lock resistance (refer to Operators Manual). Also, make sure that traction interlock system correctly prevents engine starting and operation when motion control handles are not in the neutral locked position.

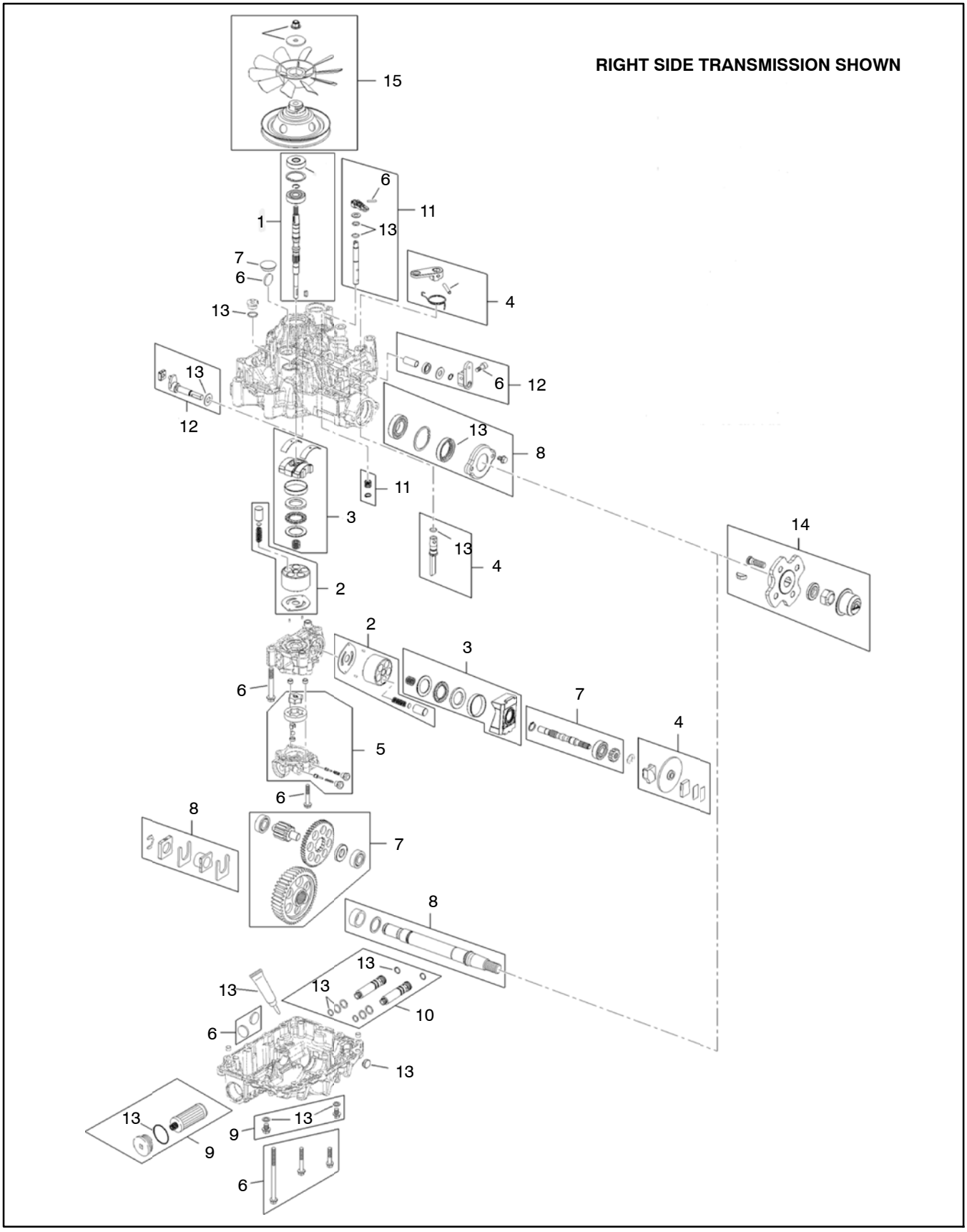

RIGHT SIDE TRANSMISSION SHOWN
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Figure 47

Figure 47 (Continued)

1. **Input shaft kit**
2. **Pump/motor kit**
3. **Thrust bearing kit**
4. **Brake kit**
5. **Charge pump kit**
6. **Fastener kit**
7. **Drive gear kit**
8. **Axle kit**
9. **Inner filter kit**
10. **Auxiliary port kit**
11. **Bypass valve kit**
12. **Trunnion kit**
13. **Seal kit**
14. **Axle hub kit**
15. **Pulley/fan kit**

NOTE: The illustration shown in Figure 47 shows the transmission used on the right side of the Sand Pro 2040Z. This transmission includes several components necessary for operation of the rear lift cylinder that are not necessary on the transmission used on the left side of the machine. Component parts groups are identified in Figure 47 because individual parts are not available separately. Refer to your parts catalog for part numbers for transmission component groups.

NOTE: For transmission repair information, see the Model TZT13 Tuff Torq Transaxle Service Manual at the end of this Chapter.

IMPORTANT: If pulley (item 15) or wheel hub (item 14) is to be removed during transmission disassembly, make sure that correct removal tool is used so component will not be damaged during removal (see Special Tools in this chapter).

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Chapter 5

Electrical System

Table of Contents

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Sand Pro 2040Z machine. Refer to that publication for additional information when servicing the machine.

Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the Kawasaki FX481V Service Manual.

Electrical Drawings

The electrical schematic and wire harness drawings for Sand Pro 2040Z machines are located in Chapter 7 - Electrical Drawings.

Special Tools

Order special tools from your Toro Distributor. Some tools may also be available from a local supplier.

Multimeter

The multimeter can test electrical components and circuits for current (amps), resistance (ohms) or voltage. Obtain this tool locally.

NOTE: Toro recommends the use of a DIGITAL Volt-Ohm- Amp multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter in the voltage mode will make sure that excess current is not allowed through the meter. This excess current can cause damage to circuits not designed to carry it.

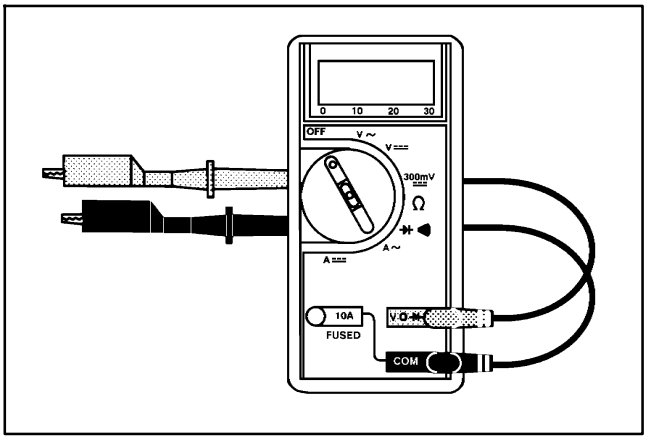

Figure 1

Dielectric Gel

Dielectric gel should be used to prevent corrosion of unsealed 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.

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

Toro Part Number: **107-0342**

Figure 2

Battery Terminal Protector

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

Toro Part Number: **107-0392**

Figure 3

Spark Tester

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

Toro Part Number: **TOR4036**

Figure 4

Battery Hydrometer

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

Figure 5

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical testing or troubleshooting.

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this machine (see Electrical Schematic and Wire Harness Drawings in Chapter 7 - Electrical Drawings).

NOTE: See the Kawasaki FX481V Service Manual at the end of Chapter 3 - Engine for troubleshooting of engine electrical components.

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.	Motion control handles are not in neutral locked position. Parking brake is not applied. Battery is discharged or faulty. Fuse F1 (20 amp) is open, loose or missing. Battery cables are loose or corroded. One or both of the traction neutral switches is improperly installed or faulty. Traction neutral switch circuit wiring is faulty. Parking brake switch circuit wiring is faulty. Wiring to starting circuitry components is loose, corroded or damaged (see electrical schematic and wire harness drawings in Chapter 7 - Electrical Drawings). Ground connection to frame is loose or corroded. Start relay is faulty. Fuse block is faulty. Ignition switch is faulty. Starter solenoid (attached to starter motor) is faulty. Starter motor is faulty.

Starting Problems (Continued)

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if starter solenoid clicks, problem is not in safety interlock system).	Battery is discharged or faulty. Battery cables are loose or corroded. Ground connection to frame is loose or corroded. Cable connection at starter is faulty. Starter solenoid is faulty. Starter motor mounting bolts are loose or not supplying a sufficient ground for starter operation. Engine starter motor is faulty.
Engine cranks, but does not start.	Fuel tank is empty. Engine may be too cold. Wiring to interlock components is loose, corroded or damaged (see electrical schematic and wire harness drawings in Chapter 7 - Electrical Drawings). Ignition switch or circuit wiring is faulty. Engine fuel solenoid or circuit wiring is faulty. Spark plugs are faulty. Engine or fuel system is malfunctioning (see Chapter 3 - Gasoline Engine and/or Kawasaki FX481V Service Manual).
Engine cranks slowly.	Battery is discharged or faulty. Engine is too cold. Battery cables are loose or corroded. Engine is malfunctioning (see Kawasaki FX481V Service Manual).

General Run Problems

Problem	Possible Causes
Engine stops when motion control handles are moved from the neutral locked position.	Operator seat is not occupied. Parking brake is applied. Seat switch or circuit wiring is faulty. Parking brake or circuit wiring is faulty. Wiring to interlock components is loose, corroded or damaged (see electrical schematic and wire harness drawings in Chapter 7 - Electrical Drawings).
Battery does not charge.	Fuse F2 (25 amp) is open, loose or missing. Wiring to charging circuit components is loose, corroded or damaged (see electrical schematic and wire harness drawings in Chapter 7 - Electrical Drawings). Charge relay or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Battery is faulty. Voltage regulator is faulty. Alternator stator is faulty.
Rear attachment does not raise or lower.	Fuse F3 (10 amp) is open, loose or missing. Wiring to rear attachment circuit components is loose, corroded or damaged (see electrical schematic and wire harness drawings in Chapter 7 - Electrical Drawings). Rear attachment switch is faulty. Hydraulic control manifold solenoid coils or circuit wiring are faulty. A hydraulic problem in the attachment lift/lower circuit exists (see Troubleshooting section of Chapter 4 - Hydraulic System).

Electrical System Quick Checks

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Tool required: Digital multimeter set to DC volts.

Test instructions: The battery should be at a temperature of 60º to 100ºF (16º to 38ºC). The ignition key should be OFF and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (-) meter lead to the negative battery post. Measure and record the battery voltage.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information (see Battery Service in the Service and Repairs section of this chapter).

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 the charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Tool required: Digital multimeter set to DC volts.

Test instructions: Connect the positive (+) multimeter lead to the positive battery post and the negative (-) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Battery voltage must be greater than 5 VDC for the alternator system to have any output. If battery voltage is less than 5 VDC, charge battery before performing charging system test.

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 **(2850 RPM)**. Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

After running the engine for at least three (3) minutes, battery voltage should be at least 0.50 volt higher than initial battery voltage.

Example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 v
Difference	= +0.55 v

Check Operation of Interlock Switches

CAUTION

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

Interlock switch operation is described in the Sand Pro 2040Z Operator's Manual. Testing of individual interlock switches and relays is included in the Component Testing section of this Chapter.

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch wire harness connector before checking continuity between switch terminals).

Ignition Switch

The ignition (key) switch has three positions (OFF, RUN, and START) (Fig. 6). The switch terminals are identified as shown in Figure 7.

Testing

The circuitry of the ignition switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position.

Unplug wire harness connector from switch and verify continuity between switch terminals. Reconnect the harness connector to the switch after testing.

POSITION	CIRCUIT
OFF	G + M + A
RUN	B + L + A
START	B + L + S

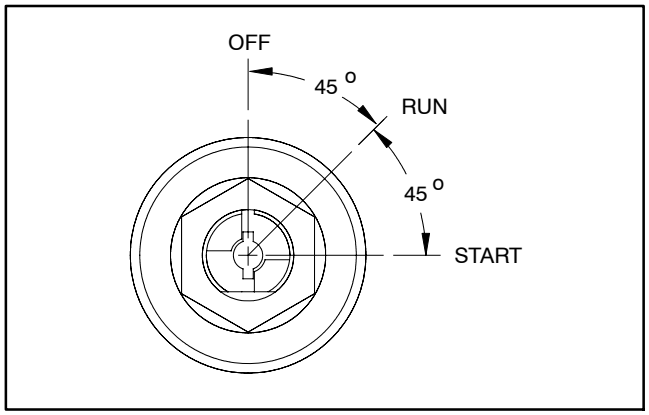

Figure 6

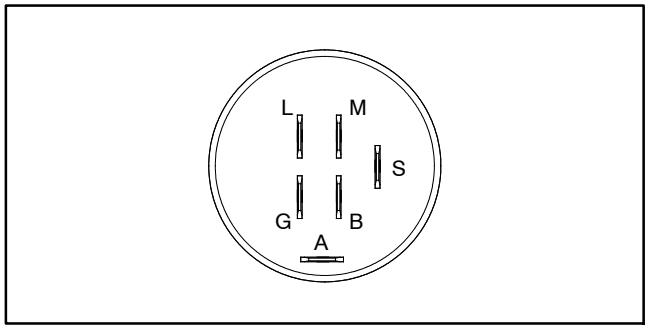

Figure 7

Fuses

The fuse block is located on the inside of the console next to the operator seat (Fig. 8).

Fuse Identification and Function

Use the fuse block illustration shown in Figure 8 to identify each individual fuse and its correct amperage. The fuses have the following functions and are listed from rear fuse to front fuse.

Fuse 1 (20 amp) protects ignition switch power supply circuits.

Fuse 2 (25 amp) protects engine alternator circuit.

Fuse 3 (10 amp) protects power supply for the rear attachment lift circuit.

Fuse 4 (15 amp) protects optional light circuit (if equipped).

Fuse Testing

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

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

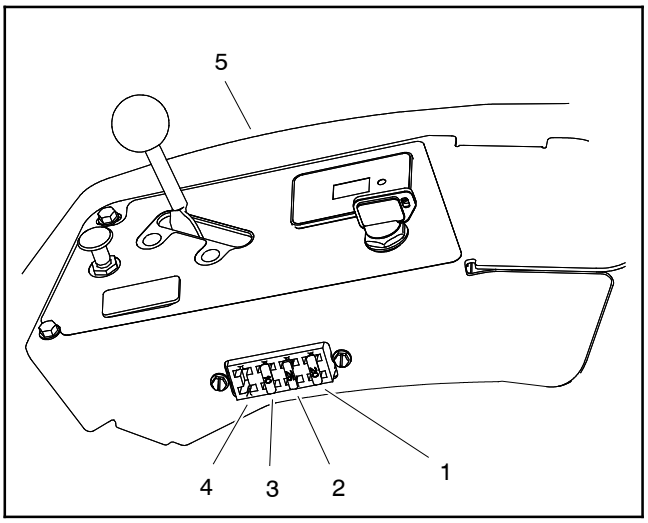

Figure 8

1. **Fuse 1 (20 amp)**
2. **Fuse 2 (25 amp)**
3. **Fuse 3 (10 amp)**
4. **Fuse 4 (15 amp)**
5. **Console**

Hour Meter Module

The hour meter module used on the Sand Pro 2040Z mounts to the console and is used to display the amount of time that the ignition switch has been in the ON position. The hour meter should move 1/10 of an hour in six (6) minutes.

The hour meter module is also used to monitor and display the status of several machine electrical components:

The battery indicator light should be illuminated briefly when the ignition switch is initially turned on. If the battery voltage falls below the correct operating level, the battery light will also be illuminated.

The operator seat indicator light should be illuminated when the ignition switch is in the ON position and the operator seat is occupied.

The neutral indicator light should be illuminated when the ignition switch is in the ON position and both of the motion control handles are in the neutral locked position.

The parking brake indicator light should be illuminated when the ignition switch is in the ON position and the parking brake is applied.

The PTO indicator light is not functional on the Sand Pro 2040Z. The PTO indicator light should be illuminated whenever the ignition switch is in the ON position.

NOTE: When the ignition switch is initially turned to the RUN position, all hour meter module indicator lights will be illuminated and the battery voltage will be displayed for a few seconds.

NOTE: The operator seat, neutral and parking brake switches and their circuit wiring can be checked using the hour meter module indicator lights. With the ignition switch in the ON position, the individual switches can be cycled (e.g. operator seat occupied and then not occupied) while watching the appropriate indicator light. The light should illuminate correctly if the switch and circuit wiring are functioning correctly.

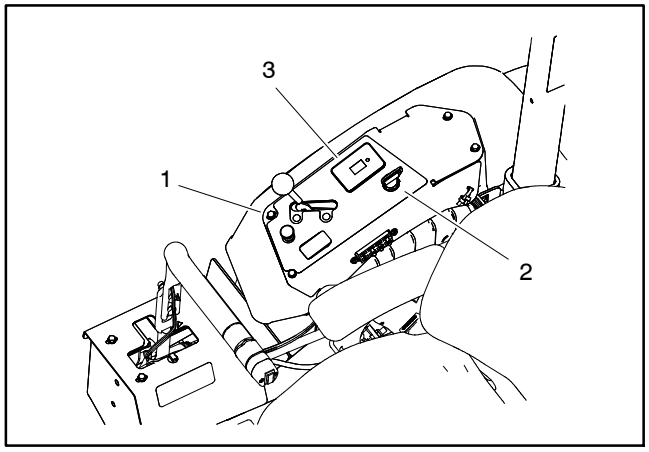

Figure 9

1. **Console**
2. **Ignition switch**
3. **Hour meter module**

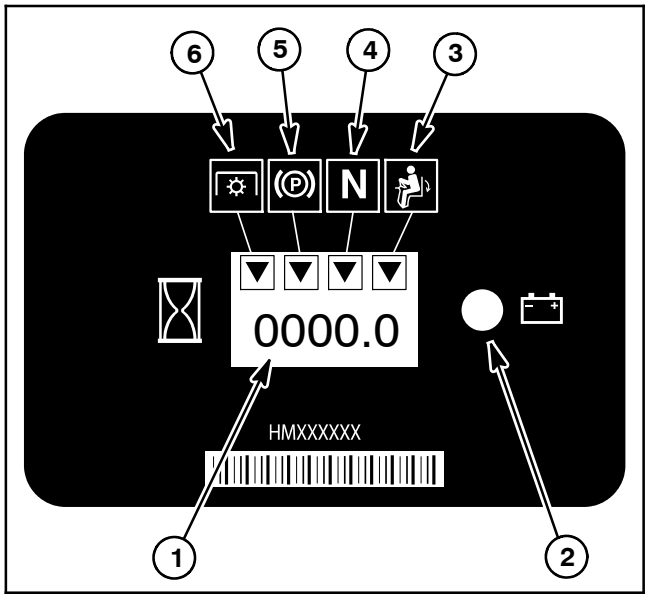

Figure 10

1. **Hour meter**
2. **Battery indicator**
3. **Operator seat indicator**
4. **Neutral indicator**
5. **Parking brake indicator**
6. **PTO indicator**

Parking Brake Switch

The parking brake switch is normally open and closes when the parking brake is applied. The brake switch is attached to the frame on the right side of the operator seat (Fig. 11). If the operator seat is not occupied, the engine can be started if the parking brake is applied and the motion control handles are in the neutral locked position.

Testing

1. Before removing the parking brake switch for testing, the switch and its circuit wiring should be tested with the Hour Meter Module (see Hour Meter Module in this chapter). If the Hour Meter Module verifies that the parking brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Hour Meter Module determines that the parking brake switch and circuit wiring **are not** functioning correctly, proceed with parking brake switch testing.

2. Make sure ignition switch is OFF. Remove key from ignition switch.

3. Disconnect machine wire harness connector from the parking brake switch.

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

5. With the parking brake released, there should be **no continuity** (open circuit) between the parking brake switch terminals.

6. Apply the parking brake. There should be **continuity** (closed circuit) between the parking brake switch terminals.

7. If testing determines that parking brake switch is faulty, replace parking brake switch.

8. Connect wire harness connector to parking brake switch after testing is complete.

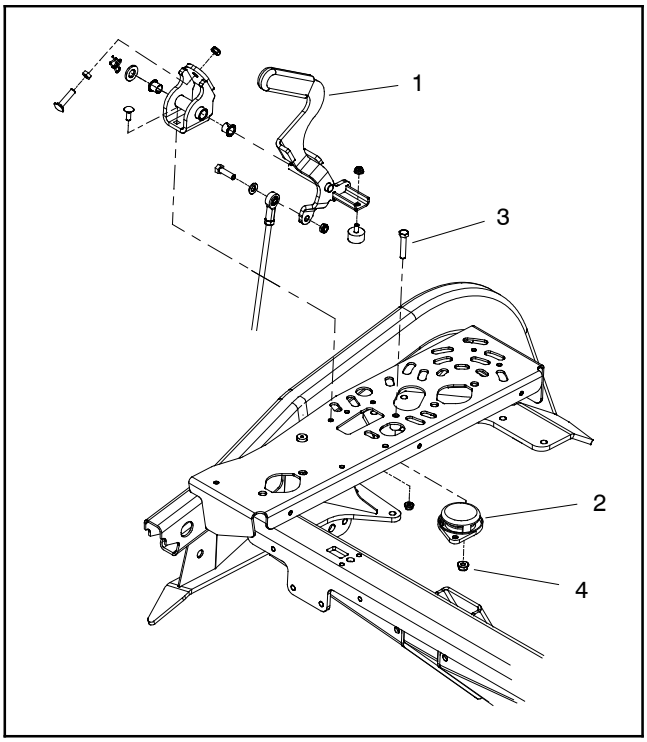

Figure 11

1. **Parking brake lever**
2. **Parking brake switch**
3. **Cap screw (2 used)**
4. **Flange nut (2 used)**

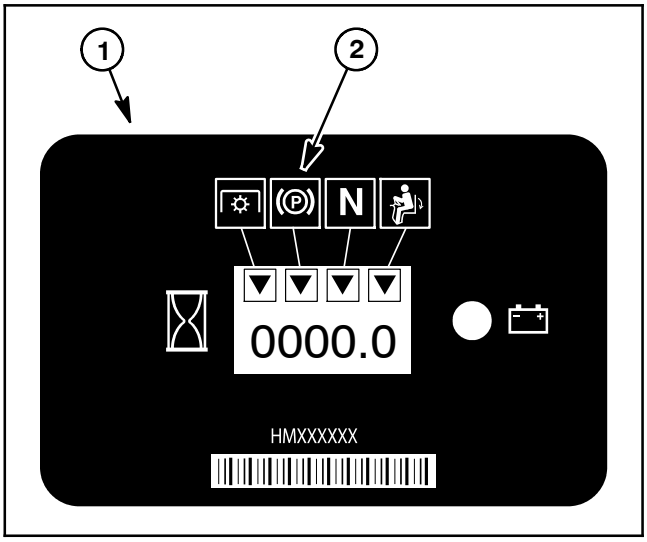

Figure 12

1. **Hour meter module**
2. **Parking brake indicator**

Rear Attachment Switch

The rear attachment switch is used to raise and lower the rear attachment. The switch is attached to the right side motion control handle (Fig. 13). The rear attachment switch is connected to the switch wire harness that runs through the right side handle and connects to the main wire harness below the control panel.

When the top of the rear attachment switch is pressed, the upper solenoid coil on the hydraulic manifold valve is energized causing the lift cylinder to extend and raise the rear attachment. When the bottom of the rear attachment switch is pressed, the lower solenoid coil on the hydraulic manifold valve is energized causing the lift cylinder to retract and lower the rear attachment.

Testing

1. Make sure ignition switch is OFF. Remove key from ignition switch.

2. Move RH control handle out of the neutral position and remove two (2) screws that secure switch cap to right side motion control handle (Fig. 14). Carefully slide switch cap with rear attachment switch and attached wire harness from control handle.

3. Disconnect wire harness connectors from the rear attachment switch.

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

5. With the switch is its normal, centered position, there should be **no continuity** (open circuit) between any of the switch terminals.

6. With the top of the switch pressed, there should be **continuity** (closed circuit) between the lower and center switch terminals and **no continuity** (open circuit) between the upper and center switch terminals.

7. With the bottom of the switch pressed, there should be **continuity** (closed circuit) between the upper and center switch terminals and **no continuity** (open circuit) between the lower and center switch terminals.

8. If testing determines that rear attachment switch is faulty, replace rear attachment switch.

9. Connect wire harness connectors to rear attachment switch after testing is complete. Make sure that harness wires are attached to the switch terminals as shown in Figure 14. The upper switch terminal should have the red wire connected to it for proper lift operation.

10. Carefully slide switch cap with rear attachment switch and attached wire harness into right side control handle and secure with two (2) screws.

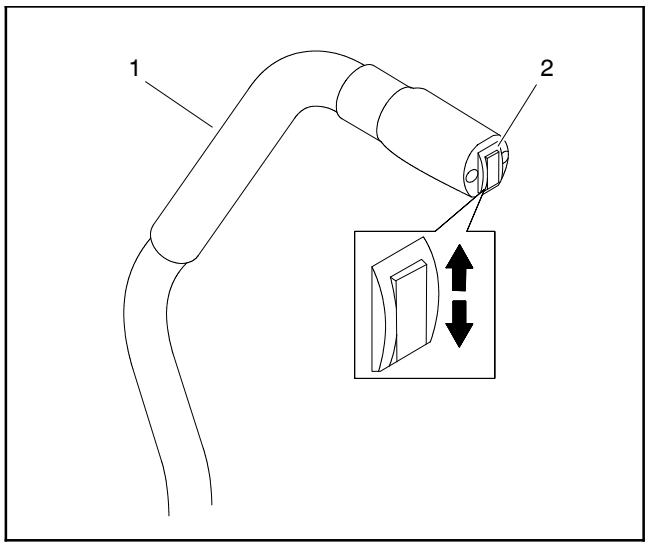

Figure 13

1. **RH control handle**
2. **Rear attachment switch**

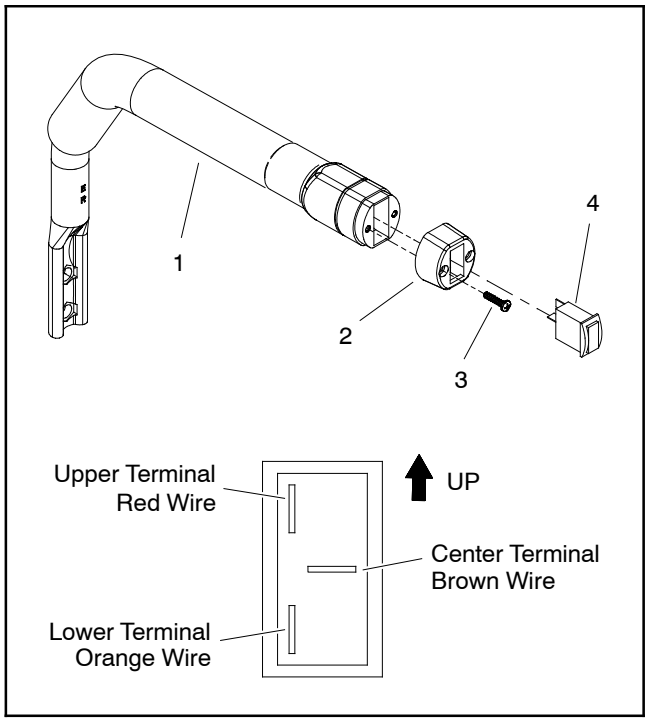

Figure 14

1. **RH control handle**
2. **Switch cap**
3. **Screw (2 used)**
4. **Rear attachment switch**

Seat Switch

The seat switch is normally open and closes when the operator is occupying the seat. The seat switch is located directly under the seat (Fig. 15). If the operator leaves the seat, the engine will stop unless the motion control handles are in the neutral locked position.

The closed seat switch (seat occupied) keeps the engine running when the motion control handles are moved from the neutral locked position.

Testing

1. Before removing the seat switch for testing, the switch and its circuit wiring should be tested with the Hour Meter Module (see Hour Meter Module in this chapter). If the Hour Meter Module verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Hour Meter Module determines that the seat switch and circuit wiring **are not** functioning correctly, proceed with seat switch testing.

2. Make sure ignition switch is OFF. Remove key from ignition switch.

3. To access seat switch, remove seat support plate with attached operator seat from machine (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis).

4. Disconnect machine wire harness connector from the seat switch.

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

6. With no pressure on the seat, there should be **no continuity** (open circuit) between the seat switch terminals.

7. Press directly onto the seat switch through the seat cushion. There should be **continuity** (closed circuit) as the seat cushion approaches the bottom of its travel.

8. If testing determines that seat switch is faulty, replace seat switch (see Operator Seat Service in the Service and Repairs section of Chapter 7 - Chassis).

9. Connect wire harness connector to seat switch after testing is complete.

10.Secure seat support plate with attached operator seat to machine (see Operator Seat in the Service and Repairs section of Chapter 6 - Chassis).

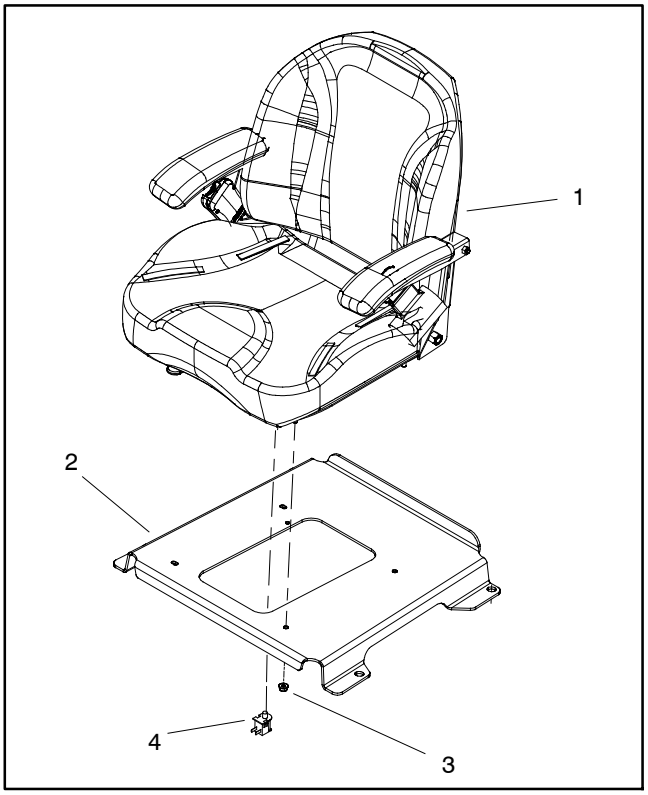

Figure 15

1. **Operator seat**
2. **Seat support plate**
3. **Flange nut (4 used)**
4. **Seat switch**

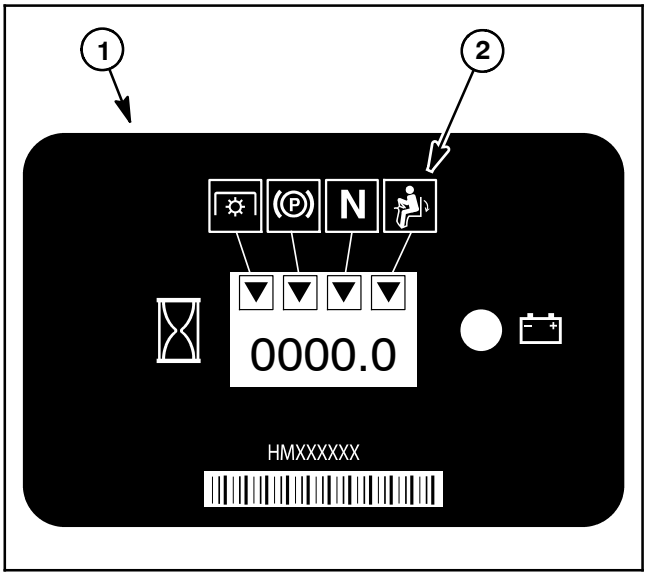

Figure 16

1. **Hour meter module**
2. **Operator seat indicator**

Traction Neutral Switches

The Sand Pro 2040Z use two (2), identical traction neutral switches. These switches are normally open and close when the motion control handles are in the neutral locked position. The neutral switches are attached to the motion control bracket at the lower end of the motion control handle assembly (Fig. 17).

Testing

1. Before removing the traction neutral switch for testing, the switch and its circuit wiring should be tested with the Hour Meter Module (see Hour Meter Module in this chapter). If the Hour Meter Module verifies that the neutral switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Hour Meter Module determines that the neutral switch and circuit wiring **are not** functioning correctly, proceed with traction neutral switch testing.

NOTE: Both of the traction neutral switches have to be closed (both motion control handles placed in the neutral locked position) in order for the hour meter module neutral indicator to be illuminated.

2. Make sure ignition switch is OFF. Remove key from ignition switch.

3. Remove control cover to access traction neutral switch that is to be tested (Fig. 19).

4. Locate neutral switch and disconnect machine wire harness connector from the neutral switch that is to be tested.

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

6. When the neutral switch plunger is depressed, there should be **continuity** (zero resistance) between the switch terminals.

7. When the neutral switch plunger is extended, there should be **no continuity** (infinite resistance) between the switch terminals.

8. Replace traction neutral switch if testing determines that it is faulty. If the neutral switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawing in Chapter 7 - Electrical Drawings).

9. Connect machine wire harness connector to the neutral switch after testing. Secure control cover to machine with removed fasteners.

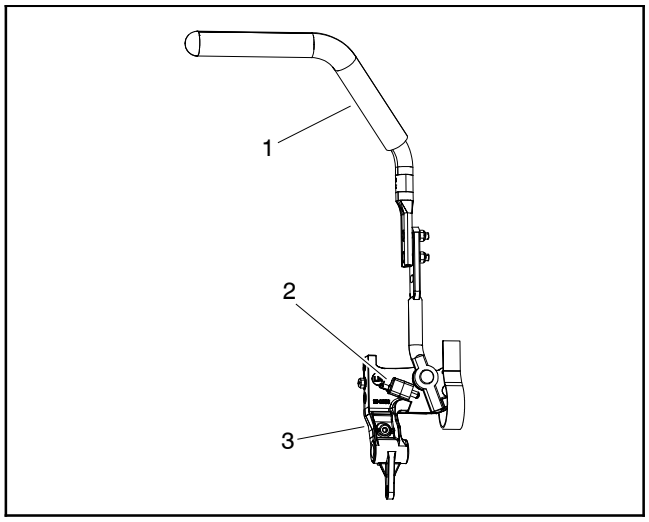

Figure 17

1. **Motion control handle**
2. **Traction neutral switch**
3. **Motion control bracket**

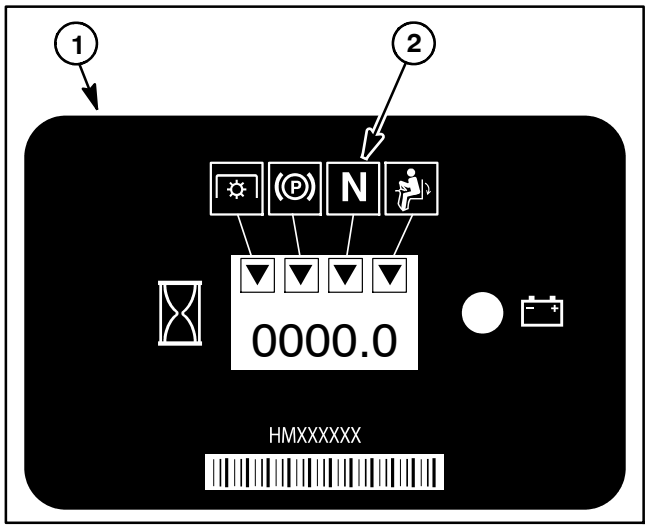

Figure 18

1. **Hour meter module**
2. **Neutral indicator**

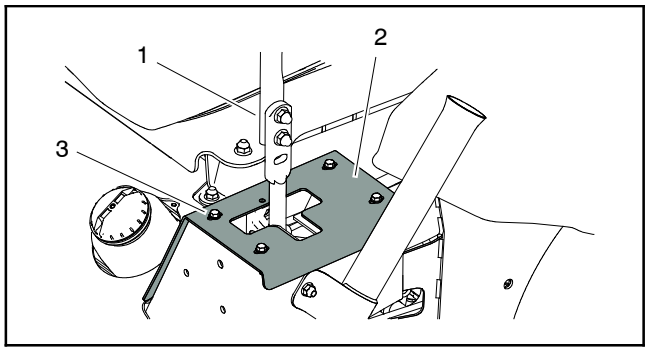

Figure 19

1. **Motion control handle**
2. **Control cover**
3. **Screw (4 used)**

Start and Charge Relays

Two (2) relays are used on the Sand Pro machine: start relay and charge relay. The relays are attached to the underside of the control panel next to the operator seat (Fig. 20). The relays are identical and are identified by a tag on the wire harness relay connector.

The start relay is used in the starting circuit. When energized, the start relay provides current to energize the starter solenoid.

When the charge relay is energized, a circuit from the alternator to the battery is completed to allow battery charging.

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.

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

2. Remove four (4) screws that secure control panel to right side console (Fig. 20). Carefully raise control panel to gain access to relays.

3. Locate relay to be tested on underside of control panel. Disconnect the machine wire harness connector from the relay.

4. Remove relay from control panel for testing.

5. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms.

6. 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.

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

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

9. After testing, disconnect voltage and multimeter test leads from the relay terminals. Secure relay to underside of control panel and connect wire harness connector to relay.

10. Carefully place control panel to right side console and secure with four (4) screws.

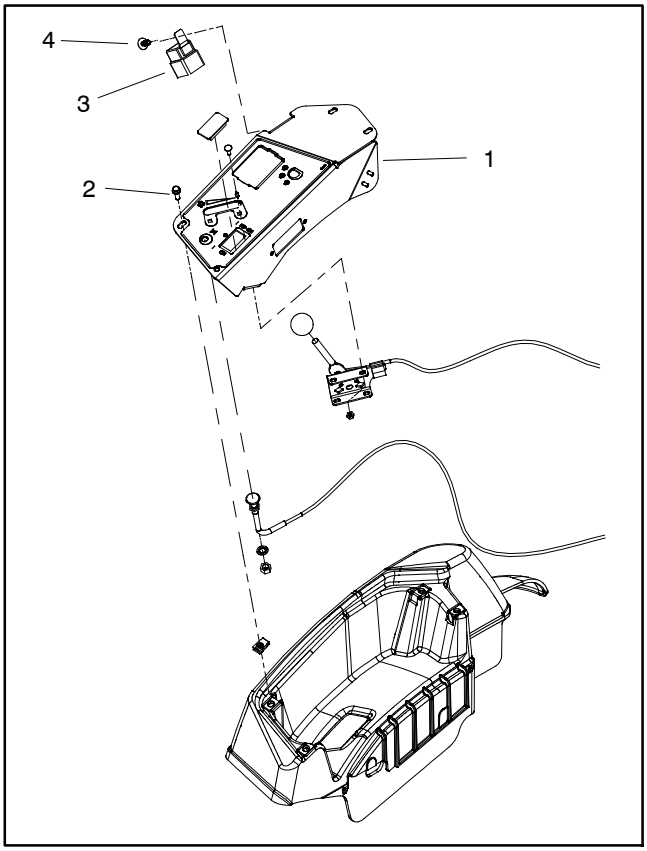

Figure 20

1. **Control panel**
2. **Screw (4 used)**
3. **Relay (2 used)**
4. **Plug (2 used)**

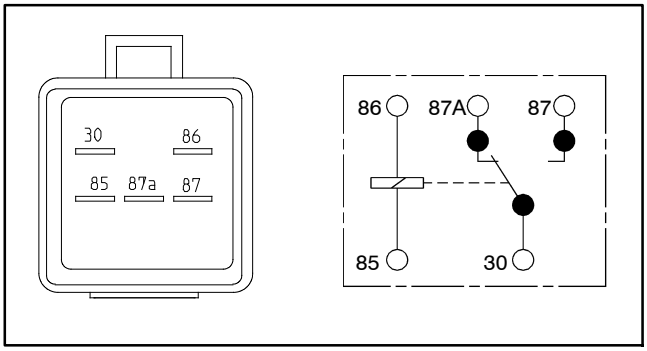

Figure 21

Hydraulic Manifold Solenoid Coils

Two (2) identical hydraulic solenoid valve coils are used on the Sand Pro hydraulic manifold (Fig. 22). The coils allow shifting of the hydraulic valve to cause the rear attachment to raise or lower and are energized when the attachment switch on the right motion control handle is pressed by the operator.

NOTE: To assist in troubleshooting, the two (2) hydraulic manifold solenoid coils can be exchanged. If the problem follows the exchanged coil, a problem with the coil likely exists. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. attachment switch, circuit wiring, hydraulic problem).

Testing

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

2. Locate hydraulic solenoid valve coil to be tested. For assembly purposes, label wire harness connectors that attach to solenoid coils on hydraulic manifold.

3. Disconnect wire harness connector from coil. Resistance testing of the coils can be done with the coil remaining on the hydraulic valve.

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 (ohms setting), measure resistance between the two (2) connector terminals on the solenoid valve coil. The correct resistance for the Sand Pro solenoid coils is **8.8 ohms**.

NOTE: Solenoid valve coil resistance should be measured with solenoid at approximately 68ºF (20ºC). 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).

5. If solenoid valve coil resistance is incorrect, replace solenoid coil:

   A. Remove nut securing solenoid coils to the cartridge valve. Carefully slide coils off the valve.

   B. Install new solenoid coil to the cartridge valve. Install and torque nut **5 ft- lb (6.7 N- m)**. Over- tightening may damage the solenoid coil or cause the cartridge valve to malfunction.

6. After testing is completed, connect wire harness connectors to the solenoid coils.

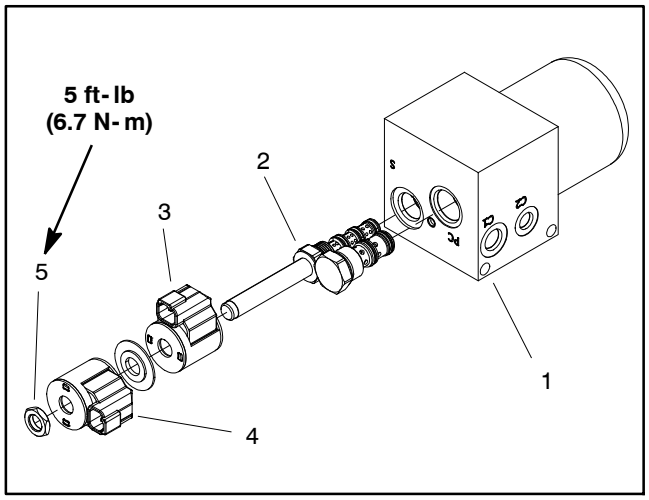

Figure 22

1. **Hydraulic manifold**
2. **Cartridge valve**
3. **Solenoid coil (lower)**
4. **Solenoid coil (raise)**
5. **Nut**

Service and Repairs

NOTE: For engine component repair information (e.g. starter motor), refer to the Kawasaki FX481V Service Manual.

Battery Care

1. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will discharge more rapidly than if the machine is stored in a location where temperatures are cool.

WARNING

Wear safety goggles and rubber gloves when working with electrolyte. Charge battery in a well ventilated place so gasses produced while charging can dissipate. Since the gases are explosive, keep open flames and electrical sparks away from the battery; do not smoke. Nausea may result if the gases are inhaled. Unplug charger from electrical outlet before connecting or disconnecting charger leads to or from battery posts.

IMPORTANT: Do not remove fill caps (if equipped) while cleaning the battery.

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

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Clean clamps and terminals separately. 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. If the battery electrolyte is accessible, check electrolyte level every 25 operating hours and every 30 days if machine is in storage. Maintain cell level with distilled water. Do not fill cells above the fill line.

Battery Storage

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

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

2. Either store battery on a shelf or on the machine.

3. Leave battery cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service in this section).

Battery 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.

CAUTION

Battery terminals or metal tools could short against metal machine components, causing sparks. Sparks can cause the battery gases to explode, resulting in personal injury.

- **When removing or installing the battery, do not allow the battery terminals to touch any metal parts of the machine.**
- **Do not allow metal tools to short between the battery terminals and metal parts of the machine.**

Battery Specifications

BCI Group Size U1
300 CCA at 0ºF (- 18ºC)
28 minutes reserve capacity at 80ºF (27ºC)

Electrolyte Specific Gravity

Fully charged: 1.265 corrected to 80ºF (27ºC)
Discharged: less than 1.240

Battery Removal and Installation (Fig. 23)

CAUTION

Incorrect battery cable routing could damage the machine and cables, causing sparks. Sparks can cause the battery gases to explode, resulting in personal injury.
Always disconnect the negative (black) battery cable before disconnecting the positive (red) cable.
Always connect the positive (red) battery cable before connecting the negative (black) cable.

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

2. Locate battery on right side of machine. Loosen and remove hex nut and cap screw that secure negative (-) cable to battery. Separate negative (-) cable from battery terminal. After negative cable is removed, loosen and remove positive (+) cable. Note that cap screws are inserted through cable end and battery terminal with the hex nuts on the opposite side of the battery terminal.

3. Remove wing nuts and washers that secure battery hold down rod. Slide hold down rod away from battery.

4. Carefully remove battery from machine.

5. Install battery in reverse order making sure to connect positive (+) cable to battery before connecting negative (-) cable. Slide boot over positive (+) battery post and cable end after installation of positive (+) cable.

NOTE: Before connecting the negative (ground) cable, connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the machine's electrical system should be inspected for short circuits or faulty components and repaired.

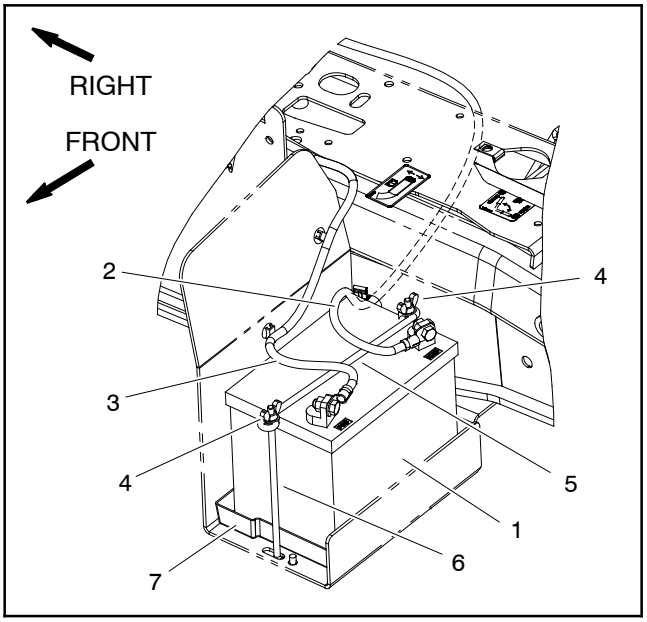

Figure 23

1. **Battery**
2. **Negative (-) cable**
3. **Positive (+) cable**
4. **Wing nut and washer**
5. **Hold down rod**
6. **Hold down post (2 used)**
7. **Battery tray**

Battery Inspection and Maintenance

1. Check for cracks in battery case. Replace battery if cracked or leaking.

2. Check battery terminals for corrosion. Use wire brush to clean corrosion from terminals.

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.

Battery Testing

1. To properly test a battery, perform a high- discharge test using an adjustable load tester. This is one of the most reliable means of testing a battery as it simulates the cold- cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the manufacturer's instructions when using a battery load tester or a battery charger.

A. Check the voltage across the battery terminals prior to testing the battery. If the battery voltage is less than 12.4 VDC, charge the battery.

B. If the battery has recently been charged, remove the battery surface charge before performing the load test. Disconnect and ground the engine spark plug wires to prevent the engine from starting. Engage the starter motor for ten (10) seconds to remove battery surface charge. Reconnect the spark plug wires.

C. Make sure battery terminals are free of corrosion.

D. Measure the battery electrolyte temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the load tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Using the battery load tester, apply a test load of 150 amps (one half the CCA rating of the battery) for fifteen (15) seconds. Note the battery voltage reading at fifteen (15) seconds, then remove the load.

G. Using the table below, determine the minimum voltage for the electrolyte temperature reading:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21°C (and up)
9.5	60°F	16°C
9.4	50°F	10°C
9.3	40°F	4°C
9.1	30°F	- 1°C
8.9	20°F	- 6°C
8.7	10°F	- 12°C
8.5	0°F	- 17°C

H. If the test voltage is below the minimum voltage, charge the battery and perform load test again. If test voltage still is below minimum voltage, replace the battery. If the test voltage is at or above the minimum voltage, return the battery to service.

2. If a battery load tester is not available, the battery can be tested by conducting a hydrometer test of the battery electrolyte.

IMPORTANT: Make sure the area around the cells is clean before opening the battery caps.

A. Measure the specific gravity of each cell with a hydrometer. Draw electrolyte in and out of the hydrometer barrel prior to taking a reading to warm-up the hydrometer. At the same time, take the temperature of the cell.

B. Temperature correct each cell reading. For each 10°F (6°C) above 80°F (27°C) add 0.004 to the specific gravity reading. For each 10°F (6°C) below 80°F (27°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	
(38°C minus 27°C equals 11.0°C)	
20°F multiply by 0.004/10°F equals 0.008	
(11°C multiply by 0.004/6°C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80°F (27°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 the specific gravity of all cells is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

Battery Charging

To minimize possible damage to the battery and allow the battery to be fully charged, the slow charging method is presented here. This charging method can be accomplished with a constant current battery charger which is commonly available.

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.

NOTE: The reserve capacity of the battery used in Sand Pro 2040Z machines is 28 minutes.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	**3.8 hrs @ 3 amps**	**7.5 hrs @ 3 amps**	**11.3 hrs @ 3 amps**	**15 hrs @ 3 amps**
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (16° C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery terminals. 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 battery charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

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Chapter 6

Chassis

Table of Contents

Specifications

Item	Description
Tire Pressure Front Tire Rear Tire	 7 PSI (48 kPa) 7 PSI (48 kPa)
Rear Wheel Lug Nut Torque	70 to 90 ft- lb (95 to 122 N- m)

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Sand Pro 2040Z machine. Refer to that publication for additional information when servicing the machine.

Rear Wheels

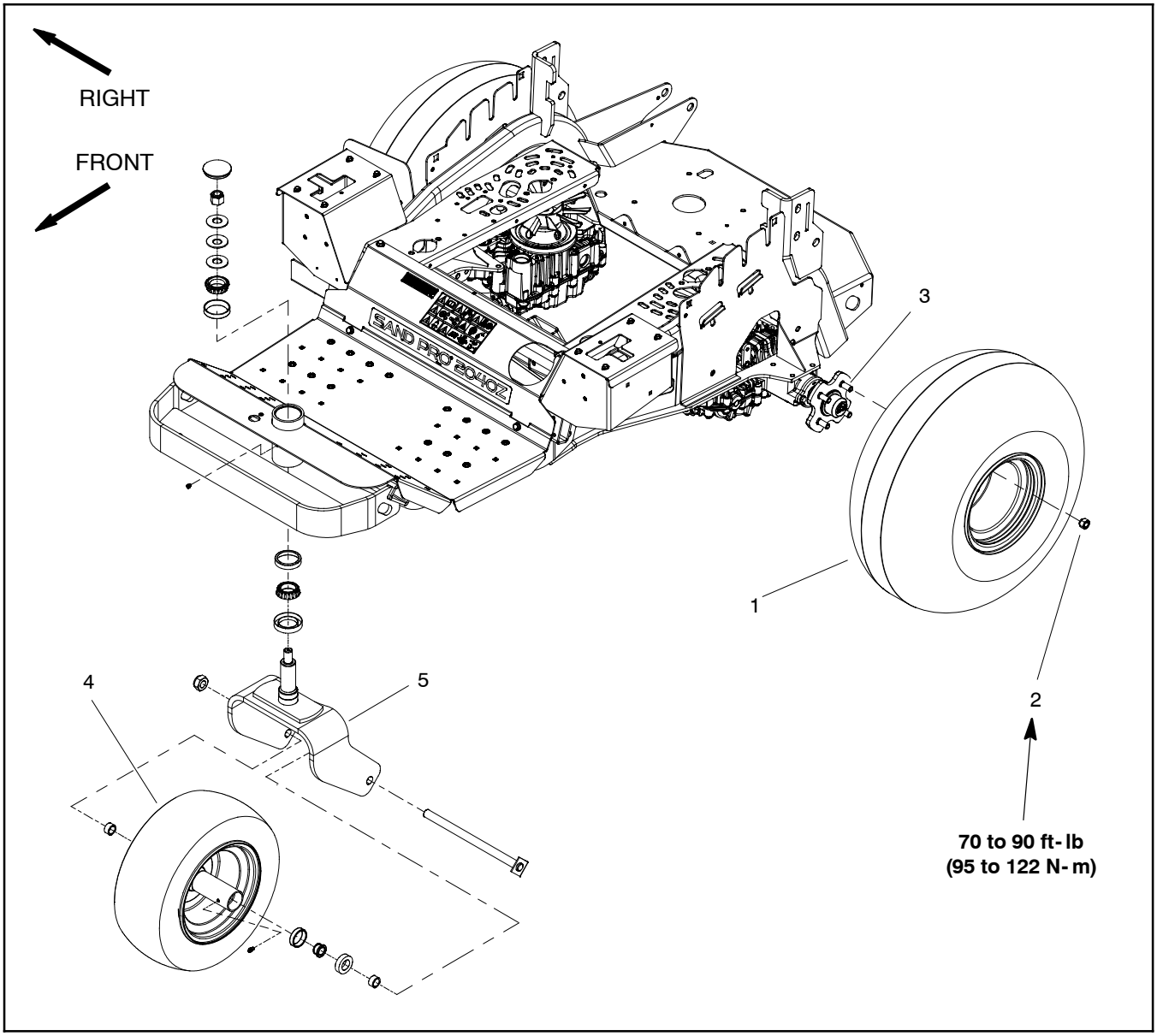

Figure 1

1. **Rear wheel assembly**
2. **Lug nut (4 used per rear wheel)**
3. **Drive stud (4 used per rear wheel)**
4. **Front wheel assembly**
5. **Front castor fork**

Removal (Fig. 1)

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

CAUTION

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

2. Chock front wheel to prevent machine from shifting. Using a jack or hoist, raise machine so rear wheel is off ground. Support machine with jack stands (see Jacking Instructions in Chapter 1 - Safety).

3. Remove four (4) lug nuts and remove rear wheel.

Installation (Fig. 1)

1. Install rear wheel and secure with four (4) lug nuts.

2. Lower machine to ground.

WARNING

Failure to maintain proper wheel lug nut torque could result in failure or loss of wheel and may result in personal injury.

3. Torque lug nuts evenly in a crossing pattern from **70 to 90 ft- lb (95 to 122 N- m)**.

Front Wheel

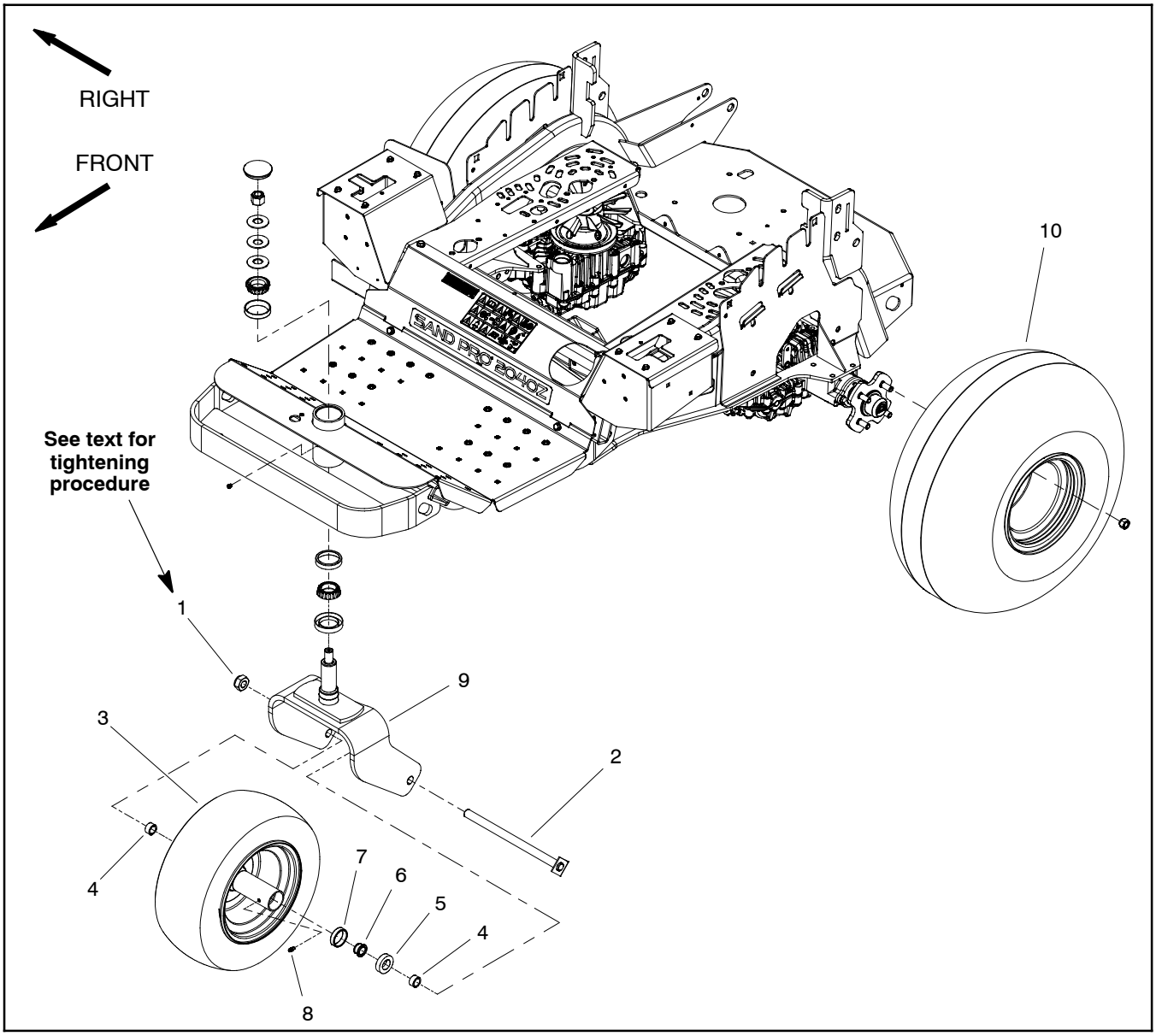

Figure 2

1. **Lock nut**
2. **Castor bolt**
3. **Front wheel assembly**
4. **Spacer (2 used)**
5. **Oil seal (2 used)**
6. **Bearing cone (2 used)**
7. **Bearing cup (2 used)**
8. **Grease fitting**
9. **Castor fork**
10. **Rear wheel assembly**

Front Wheel Removal (Fig. 2)

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

CAUTION

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

2. Chock rear wheels to prevent machine from shifting. Using a jack or hoist, raise machine so front wheel is off ground. Support front of machine with jack stands (see Jacking Instructions in Chapter 1 - Safety).

3. Remove lock nut (item 1) from castor bolt (item 2). Pull bolt from castor fork, two (2) spacers (item 4) and front wheel assembly.

4. Remove front wheel assembly from castor fork.

NOTE: If castor fork removal is necessary, see Front Castor Fork in this section.

Wheel Rim Service

NOTE: The front wheel rim assembly consists of the wheel rim, oil seals, bearing cones, bearing cups, valve stem and grease fitting (Fig. 3).

1. Remove oil seals, bearing cones and bearing cups from the wheel rim hub. Clean hub and inspect for wear or damage.

2. Press new bearing cups into the wheel rim hub with the thick edges towards the inside. Cups should be recessed into wheel rim hub from **0.500" to 0.540" (12.7 to 13.7 mm)** after installation.

3. Pack new bearing cones with general purpose lithium grease.

4. Install greased bearing cones into the wheel rim hub. Press new oil seals into the hub.

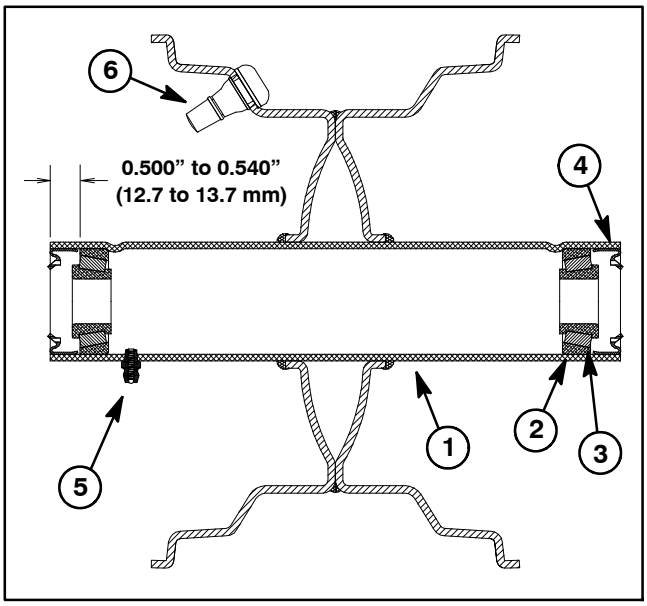

Figure 3

1. **Wheel rim**
2. **Bearing cup (2 used)**
3. **Bearing cone (2 used)**
4. **Oil seal (2 used)**
5. **Grease fitting**
6. **Valve stem**

Front Wheel Installation (Fig. 2)

1. Install spacers (item 4) into oil seals in front wheel rim.

2. Slide wheel assembly into the castor fork. Insert castor bolt (item 2) through castor fork mounting holes and wheel assembly.

3. Position bent lip of the bolt head under the bottom edge of the castor fork. Thread lock nut (item 1) onto bolt but do not fully tighten.

4. Clean grease fitting on wheel rim. Pump general purpose lithium grease into hub until grease is visible at both seals. Wipe off excess grease.

5. Tighten lock nut (item 1) so that all axial endplay is removed from wheel assembly. Once endplay has been removed, torque lock nut an **additional 75 to 150 in-lb (8.5 to 16.9 N-m)**. Make sure that the front wheel still rotates freely after tightening lock nut.

6. Lower machine to ground.

Front Castor Fork

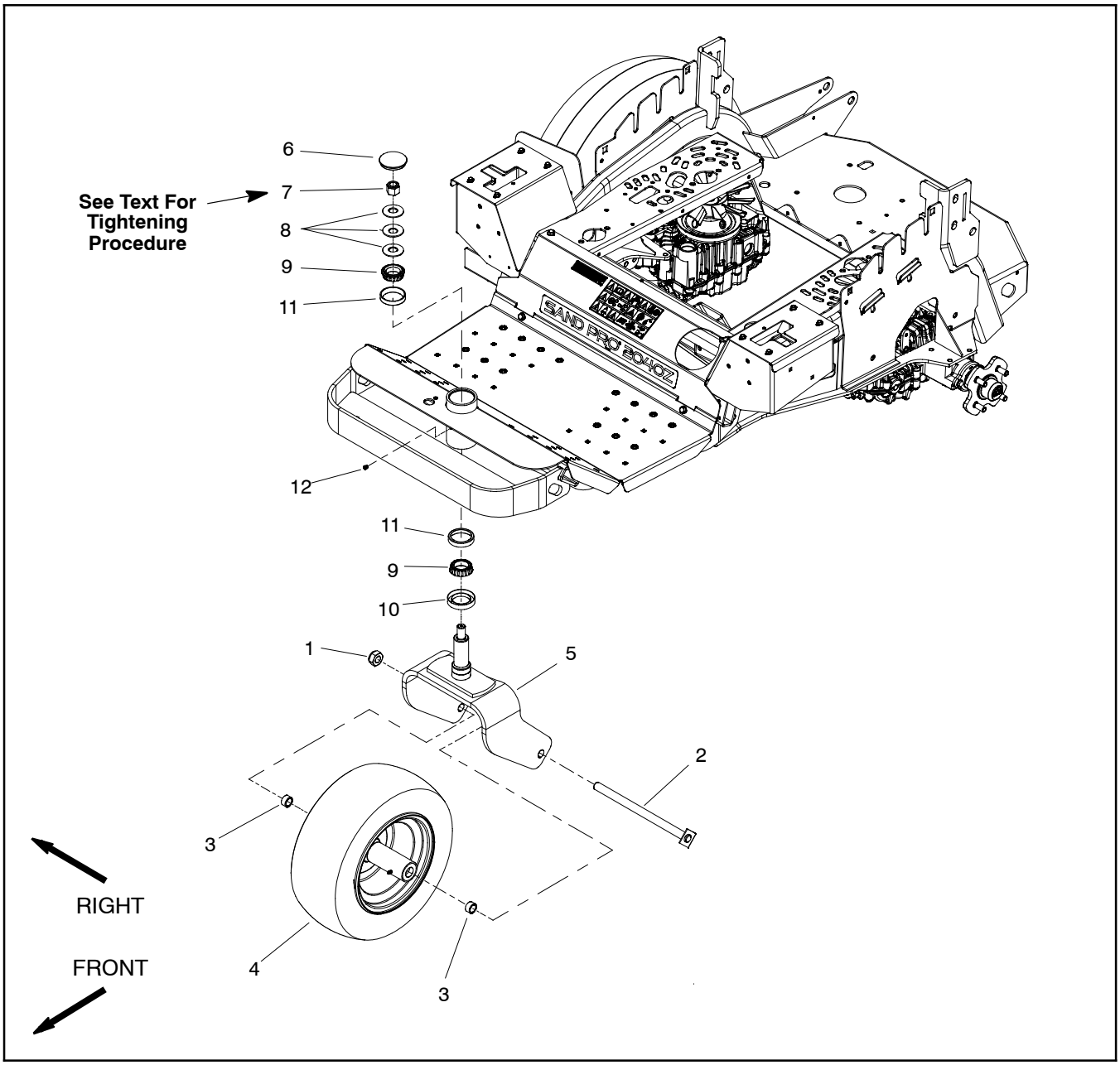

Figure 4

1. **Lock nut**
2. **Castor bolt**
3. **Spacer (2 used)**
4. **Front wheel assembly**
5. **Castor fork**
6. **Grease cap**
7. **Lock nut**
8. **Belleville washer (3 used)**
9. **Bearing cone (2 used)**
10. **Seal**
11. **Bearing cup (2 used)**
12. **Plug**

Removal (Fig. 4)

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

2. Remove front wheel (see Front Wheel in this section).

3. Carefully remove grease cap (item 6) from top of frame castor hub. Discard grease cap.

4. Support castor fork to prevent it from falling. Remove lock nut from top of castor fork. Slide castor fork from frame.

5. Remove three (3) belleville washers and upper bearing cone from frame. Note orientation of washers as they are removed (Fig. 5). Belleville washer orientation is critical for proper castor fork movement.

6. Pry seal (item 10) from frame and discard seal. Remove lower bearing cone from frame.

7. Clean and inspect bearing cups and cones. If wear or damage is identified, replace bearings.

8. If necessary, remove bearing cups from machine frame.

Installation (Fig. 4)

1. If bearing cups were removed from frame, press new bearing cups into frame making sure that cups are pressed fully to the shoulder in the frame.

2. Pack bearing cones with general purpose lithium grease.

3. Position greased lower bearing cone into frame and then install new seal (item 10) into bottom of frame hub.

4. Carefully raise castor fork up through frame taking care to not damage seal in bottom of frame hub. Place upper bearing cone and three (3) belleville washers onto castor fork shaft. Make sure that belleville washers are properly orientated (Fig. 5).

IMPORTANT: After correctly tightening the lock nut that secures castor fork to frame, it should take from 65 to 75 in-lb (7.4 to 8.4 N-m) to rotate the castor fork.

5. Install lock nut onto castor fork. Tighten lock nut until castor fork requires from **65 to 75 in-lb (7.4 to 8.4 N-m)** to rotate.

6. Remove plug (item 12) from frame. Using grease gun through plug hole in frame, fill area surrounding the castor fork shaft with general purpose lithium grease. Allow grease to fill cavities below lower bearing, between bearings and above upper bearing. Reinstall plug into frame.

7. Install new grease cap (item 1) so cap shoulder is flush with top of carrier frame. There should be no evidence that the cap is indented by top of castor fork.

8. Install front wheel (see Front Wheel in this section).

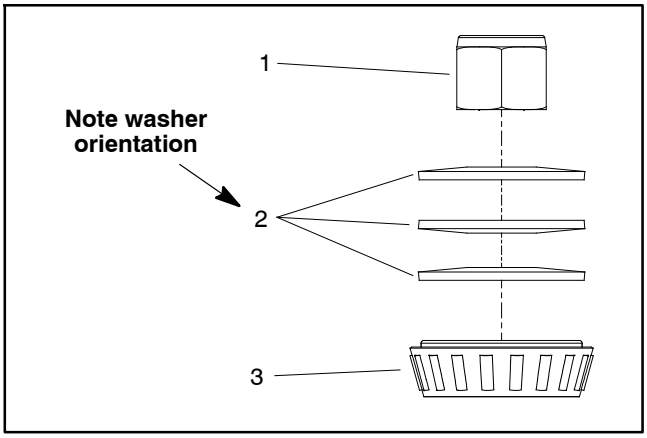

Figure 5

1. **Lock nut**
2. **Belleville washer**
3. **Bearing cone**

Parking Brake Linkage

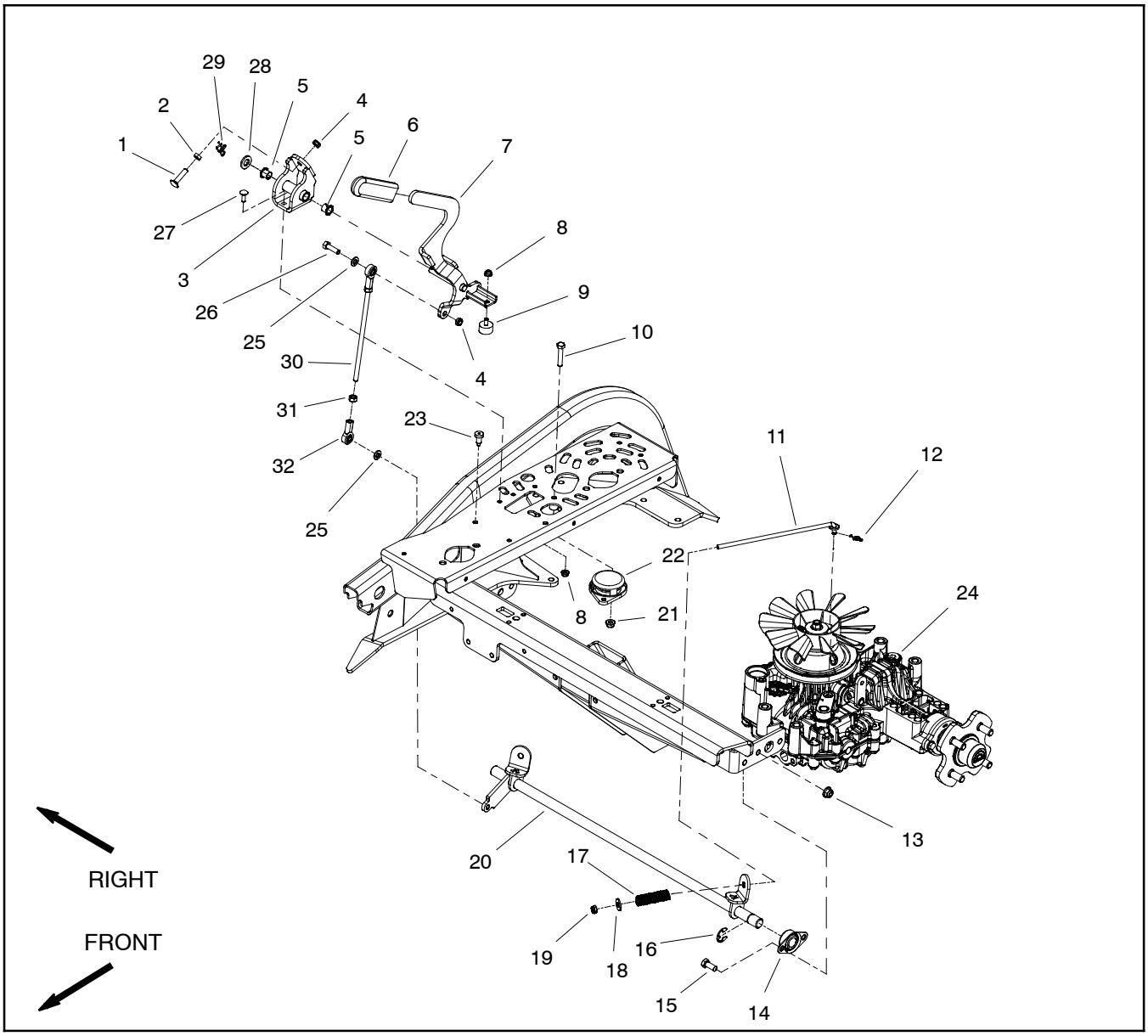

Figure 6

1. Carriage screw
2. Jam nut
3. Brake handle bracket
4. Lock nut (3 used)
5. Nylon bushing (2 used)
6. Grip
7. Brake handle
8. Flange nut (3 used)
9. Rubber bumper
10. Cap screw (2 used)
11. Brake rod (2 used)
12. Locking cotter pin (2 used)
13. Flange nut (4 used)
14. Flange bearing (2 used)
15. Cap screw (4 used)
16. E-ring
17. Compression spring (2 used)
18. Flat washer (2 used)
19. Lock nut (2 used)
20. Brake shaft
21. Flange nut (2 used)
22. Parking brake switch
23. Rubber bumper
24. Hydraulic transmission (LH shown)
25. Flat washer (3 used)
26. Cap screw (2 used)
27. Carriage screw (2 used)
28. Flat washer
29. Cotter pin
30. Brake rod
31. Hex nut (2 used)
32. Balljoint (2 used)

Removal (Fig. 6)

1. Park machine on a level surface, lower rear attachment, stop engine and remove key from ignition switch.

2. Make sure parking brake is disengaged.

3. Remove parking brake components as needed using Figure 6 as a guide.

Installation (Fig. 6)

1. Install removed parking brake components using Figure 6 as a guide. Also, use the following adjustment dimensions and Figures 7, 8 and 9 during assembly:

A. If carriage bolt (item 1 in Fig. 6) was removed from brake handle bracket, adjust head of bolt so that it is from **0.640" to 0.760" (16.3 to 19.3 mm)** from brake handle bracket.

B. If ball joint or hex nut was removed from brake rod (item 30 in Fig. 6), make sure that the balljoint centers measure from **9.040" to 10.060" (229.7 to 255.5 mm)** and that the balljoints are parallel.

C. If brake rod (item 11 in Fig. 6) was removed from brake shaft, engage parking brake and adjust length of compression spring from **1.875" to 2.125" (47.7 to 53.9 mm)** measured at top of brake shaft bracket.

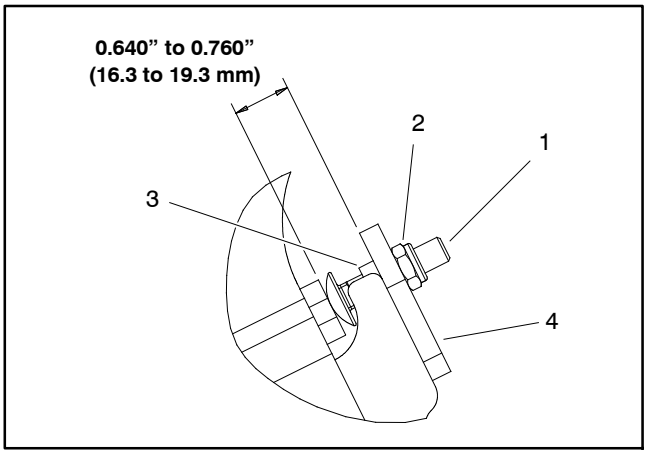

Figure 7

1. **Carriage screw**
2. **Lock nut**
3. **Jam nut**
4. **Brake handle bracket**

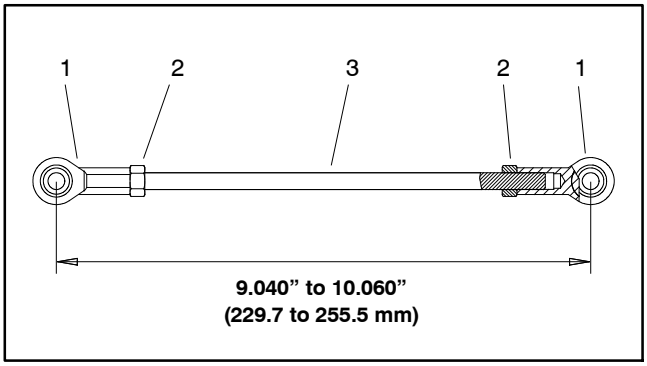

Figure 8

1. **Balljoint**
2. **Hex nut**
3. **Brake rod**

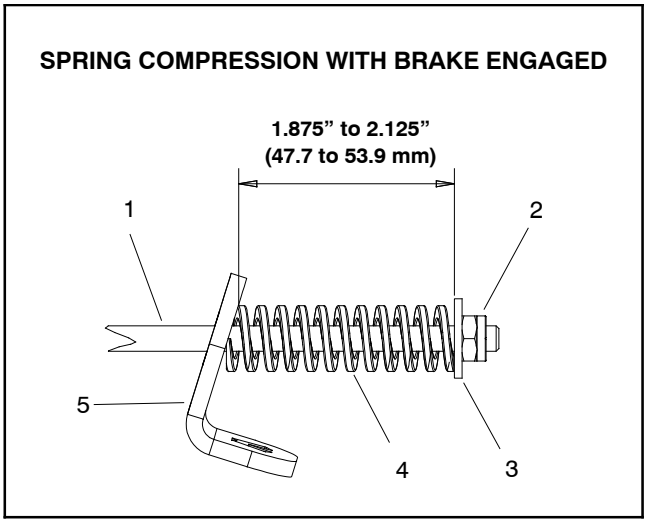

Figure 9

1. **Brake rod**
2. **Lock nut**
3. **Flat washer**
4. **Compression spring**
5. **Brake shaft bracket**

Groomer Lift Assembly

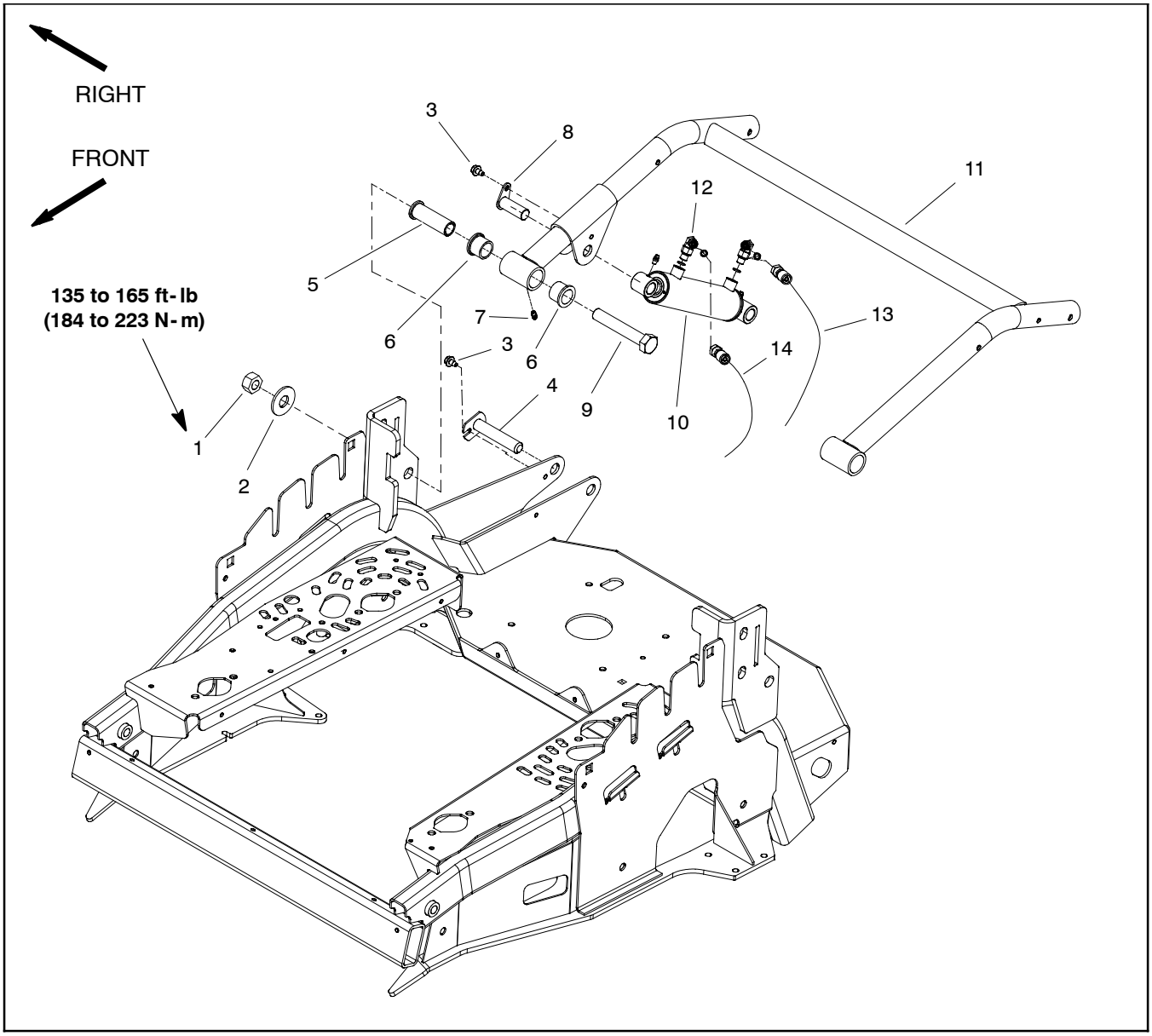

Figure 10

1. **Lock nut (2 used)**
2. **Flat washer (2 used)**
3. **Washer head screw (2 used)**
4. **Pivot pin**
5. **Pivot sleeve (2 used)**
6. **Flange bushing (4 used)**
7. **Grease fitting (2 used)**
8. **Pivot pin**
9. **Cap screw (2 used)**
10. **Lift cylinder**
11. **Groomer lift frame**
12. **90º hydraulic fitting (2 used)**
13. **Hydraulic hose**
14. **Hydraulic hose**

Removal (Fig 10)

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

2. Remove rear attachment from machine.

3. Remove washer head screw that secures pivot pin (item 8) to groomer lift frame. Slide pivot pin from frame and lift cylinder. Separate lift cylinder from lift frame.

4. Remove groomer lift frame from machine:

   A. Support lift frame to prevent it from falling during removal.

   B. Remove two (2) cap screws (item 9), lock nuts (item 1) and flat washers (item 2) that secure lift frame to machine.

   C. Remove lift frame from machine.

5. If required, remove pivot sleeves and flange bushings from groomer lift frame.

Installation (Fig 10)

1. If removed, press new flange bushings and pivot sleeves into groomer lift frame.

2. Install groomer lift frame to machine frame:

   A. Position lift frame to machine frame.

   B. Secure lift frame with two (2) cap screws (item 9), lock nuts (item 1) and flat washers (item 2). Torque lock nuts from **135 to 165 ft-lb (184 to 223 N-m)**.

3. Position lift cylinder clevis to groomer lift frame. Slide pivot pin (item 8) into frame and lift cylinder. Secure pivot pin to lift frame with washer head screw.

4. Lubricate groomer lift frame grease fittings.

5. Install rear attachment to machine.

Operator Seat

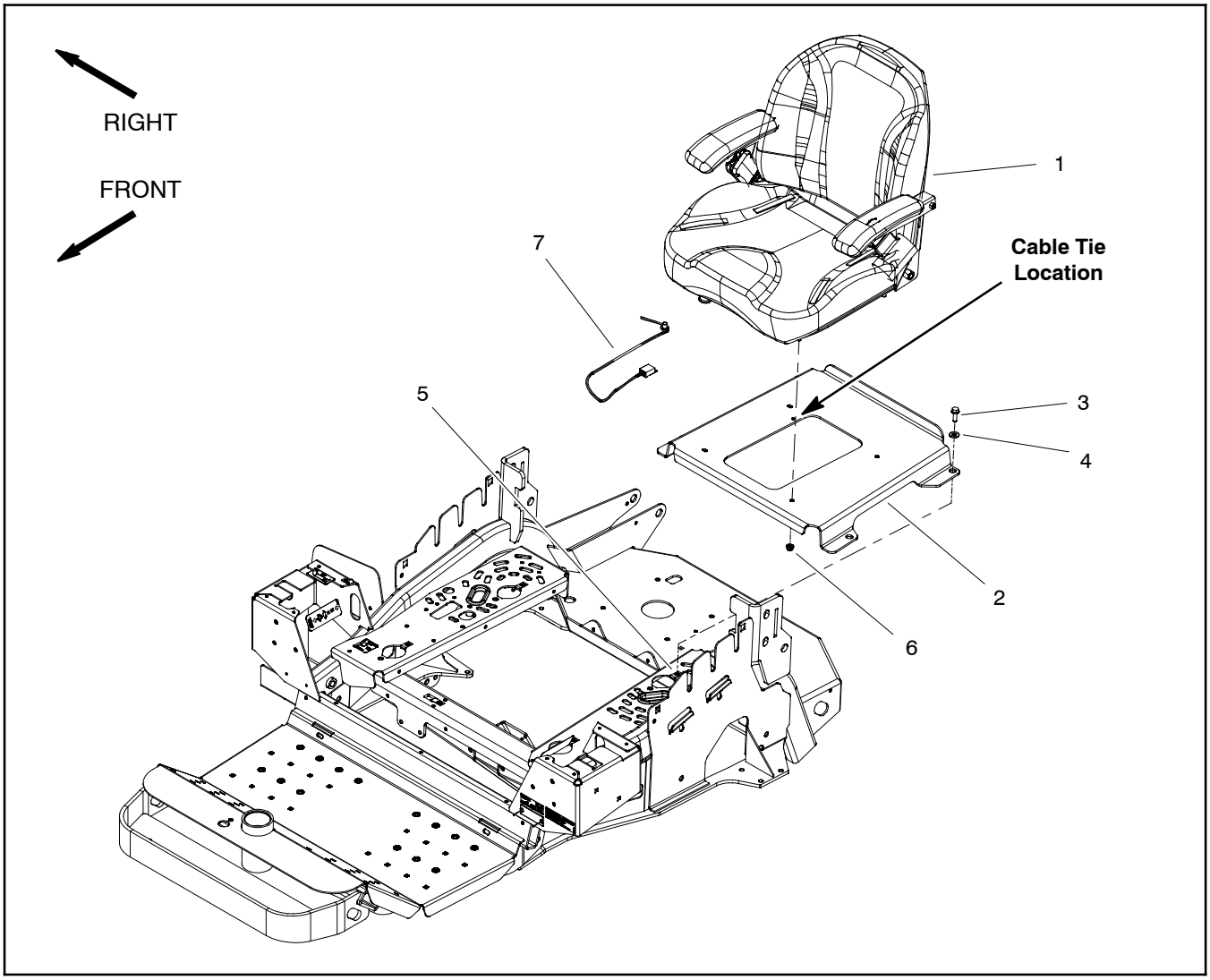

Figure 11

1. **Operator seat**
2. **Seat support plate**
3. **Flange head screw (4 used)**
4. **Flat washer (4 used)**
5. **Clip nut (4 used)**
6. **Flange nut**
7. **Harness seat switch connection**

Removal (Fig. 11)

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

2. Remove four (4) flange head screws (item 3) and flat washers (item 4) that secure seat support plate to machine frame.

3. Carefully tilt seat support plate up and disconnect wire harness connector from the seat switch located on the bottom of the seat. Also, remove cable tie that secures wire harness seat switch lead to seat support plate.

4. Remove seat support plate with attached seat from machine.

5. Remove four (4) flange nuts (item 6) that secure seat to seat support plate. Separate seat from support plate.

6. Disassemble seat as necessary using Figures 12 and 13 as guides.

Installation (Fig. 11)

1. Assemble seat using Figures 12 and 13 as guides.

2. Secure seat to seat support plate with four (4) flange nuts.

3. Make sure that clip nuts (item 5) are properly positioned on frame.

4. Secure support plate with attached seat to machine

   A. Position support plate to machine frame.

   B. Connect wire harness connector to the seat switch. Secure wire harness seat switch lead to seat support plate with cable tie.

   C. Align support plate to clip nuts on frame and secure with four (4) flange head screws and flat washers.

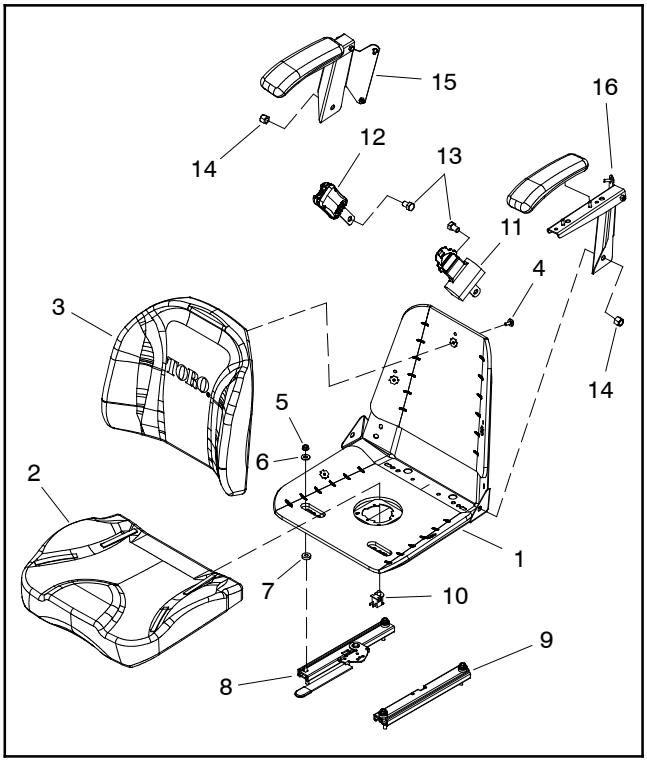

Figure 12

1. **Seat frame**
2. **Bottom cushion**
3. **Back cushion**
4. **Bolt (7 used)**
5. **Flange nut (4 used)**
6. **Washer (4 used)**
7. **Spacer (4 used)**
8. **RH seat adjuster**
9. **LH seat adjuster**
10. **Seat switch**
11. **Seat belt**
12. **Seat belt latch**
13. **Cap screw (2 used)**
14. **Hex nut (2 used)**
15. **RH arm rest assembly**
16. **LH arm rest assembly**

RIGHT HAND ARM REST ASSEMBLY SHOWN

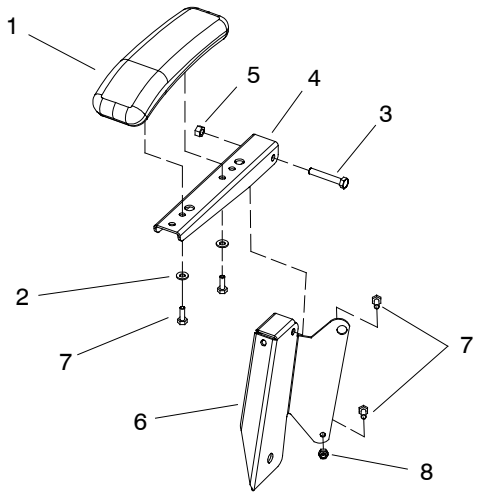

Figure 13

1. **Arm rest cushion**
2. **Flat washer (2 used)**
3. **Cap screw**
4. **Arm rest channel**
5. **Hex nut**
6. **Arm rest bracket**
7. **Cap screw (4 used)**
8. **Lock nut (2 used)**

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Chapter 7

Electrical Drawings

Table of Contents

Electrical Drawing Designations

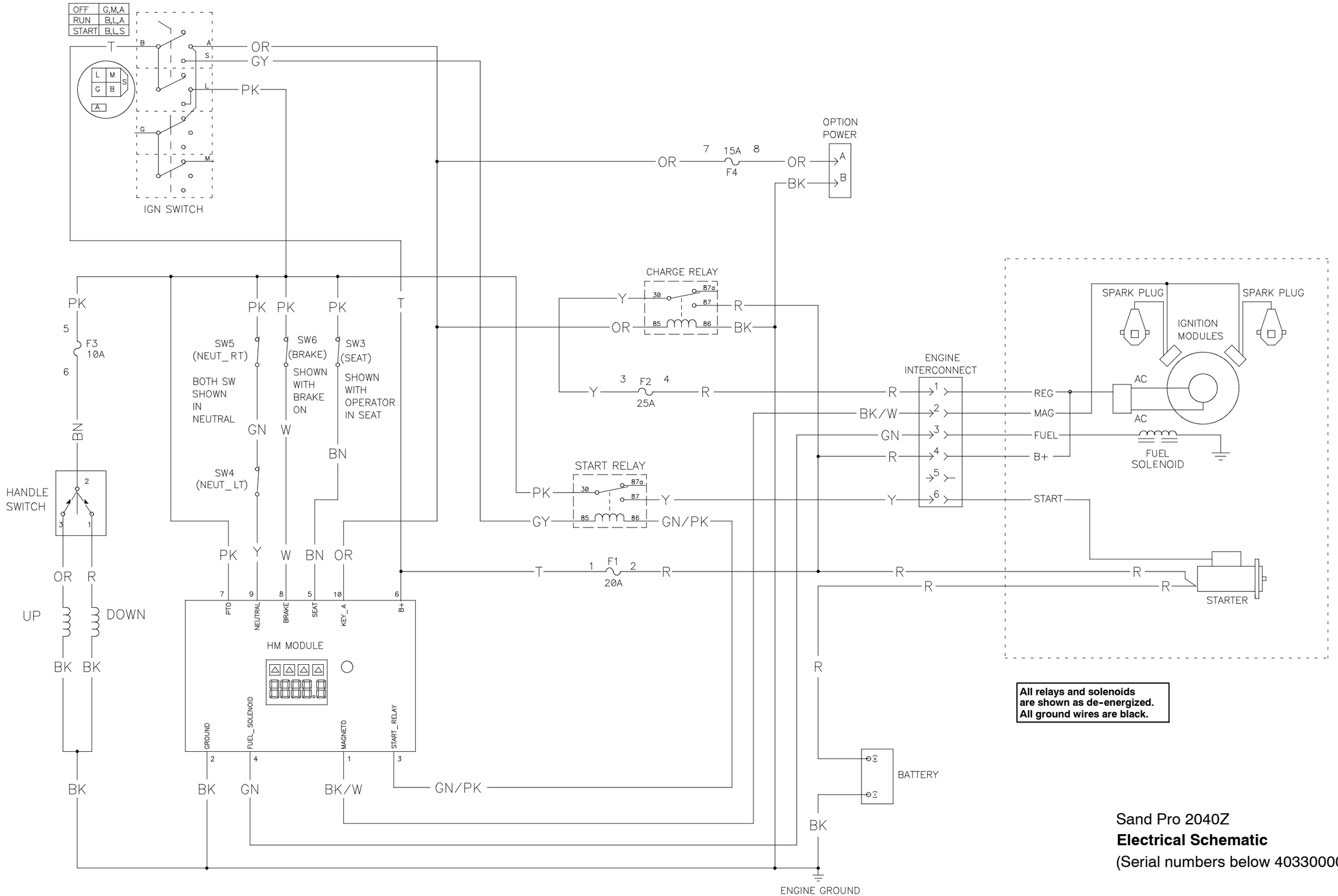
The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
BK	BLACK
BR or BN	BROWN
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on Sand Pro 2040Z 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. BK/W is a black wire with a white line, GN_PK is a green wire with a pink line).

NOTE: The electrical harness drawings in this chapter identify both the wire color and the wire gauge. For example, 16 BK on a harness diagram identifies a 16 gauge wire that has a black insulator.

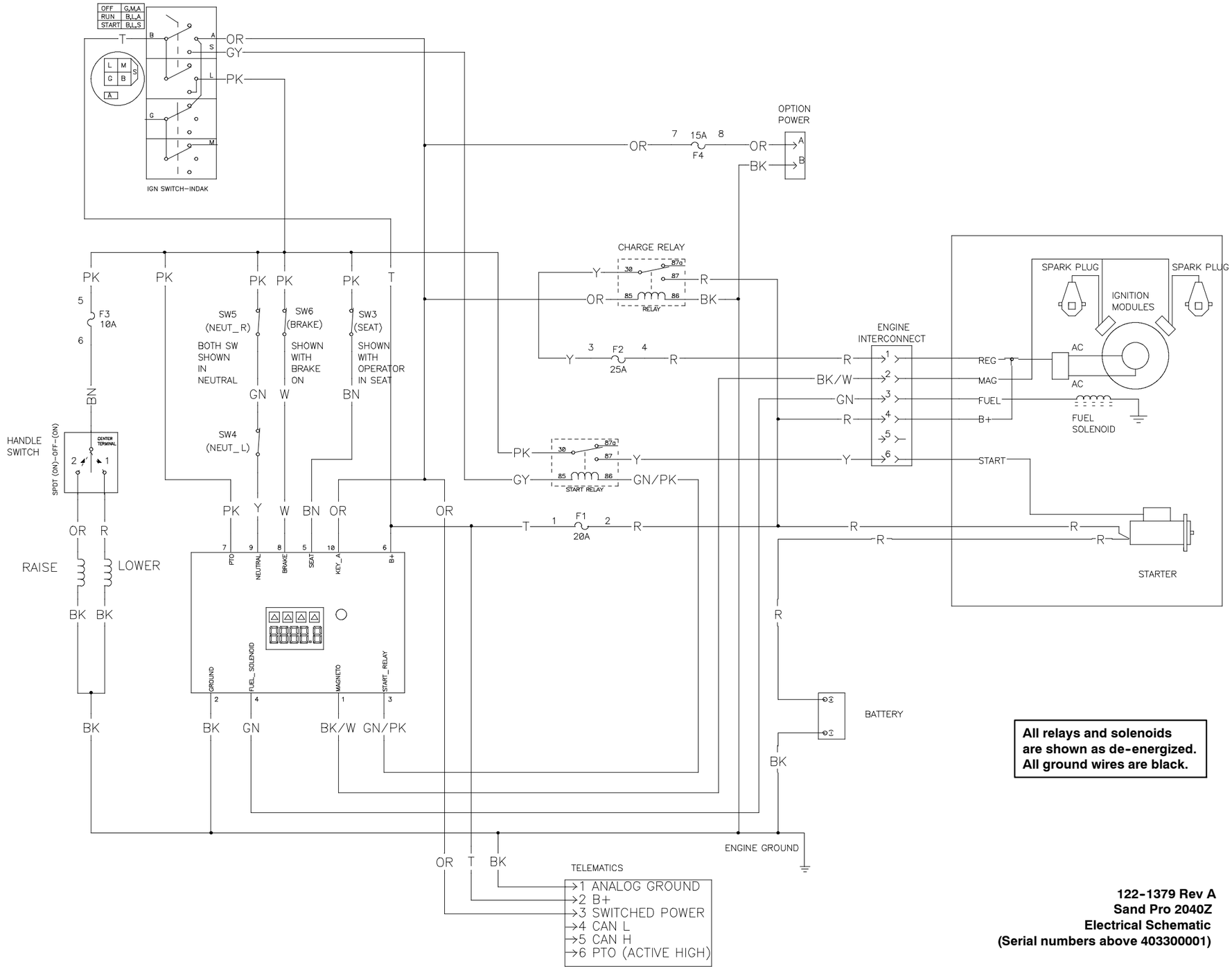
NOTE: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g. SP01 is splice number 1).



Sand Pro 2040Z

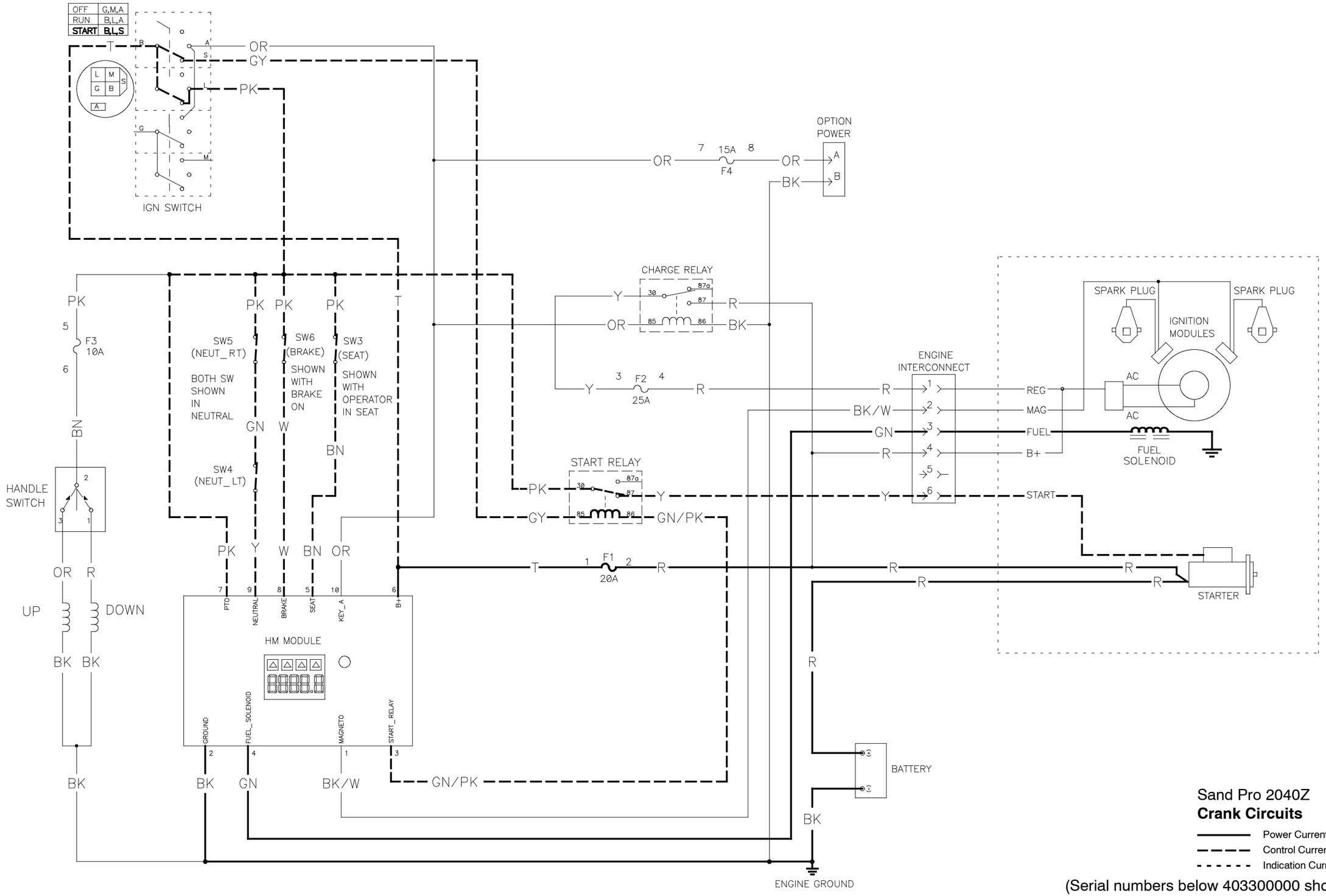
Electrical Schematic

(Serial numbers below 403300000)



All relays and solenoids are shown as de-energized. All ground wires are black.

122-1379 Rev A
Sand Pro 2040Z
Electrical Schematic
(Serial numbers above 403300001)



Sand Pro 2040Z

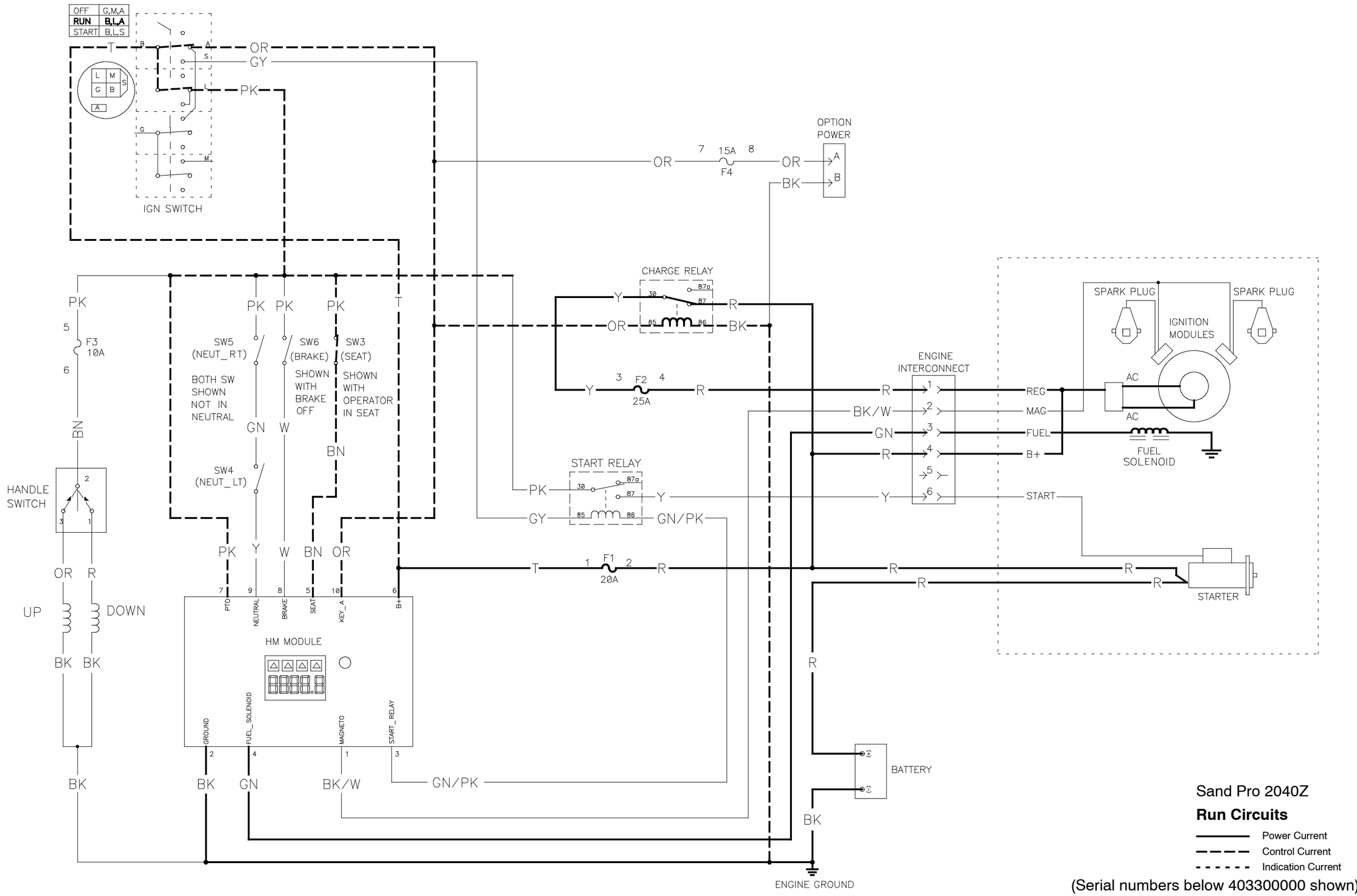
Crank Circuits

Power Current

Control Current

Indication Current

(Serial numbers below 403300000 shown)



Sand Pro 2040Z

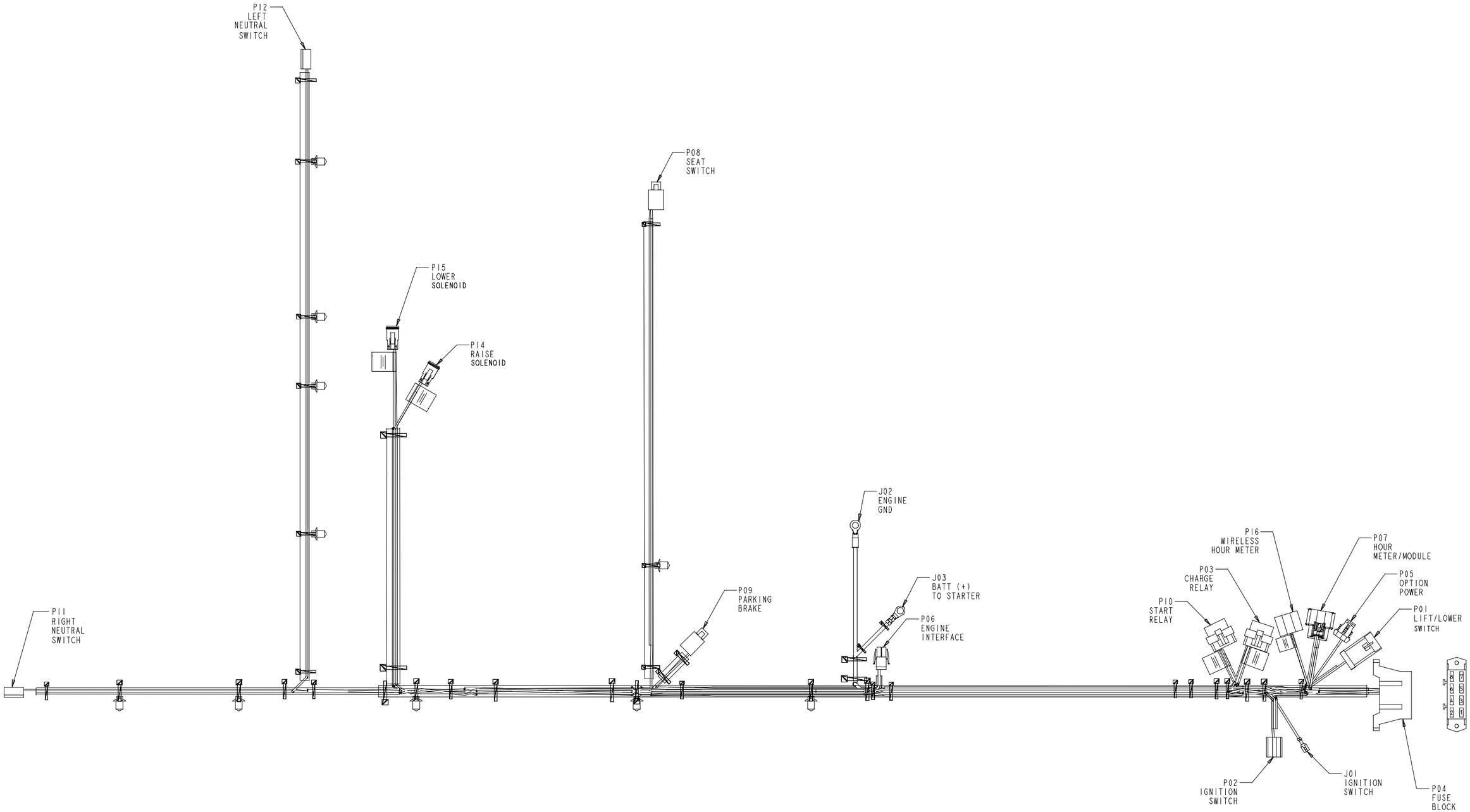
Run Circuits

Power Current

Control Current

Indication Current

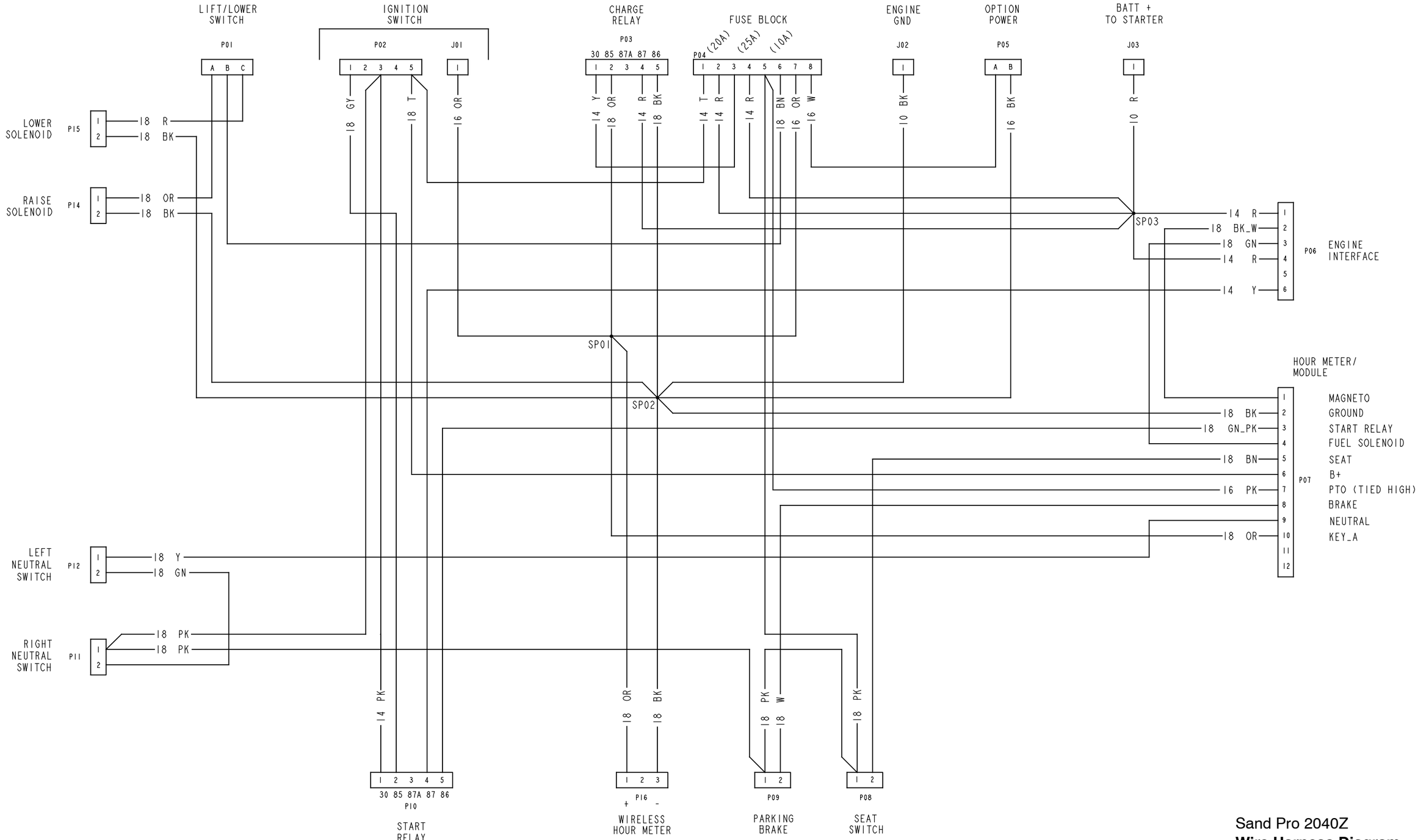
(Serial numbers below 403300000 shown)



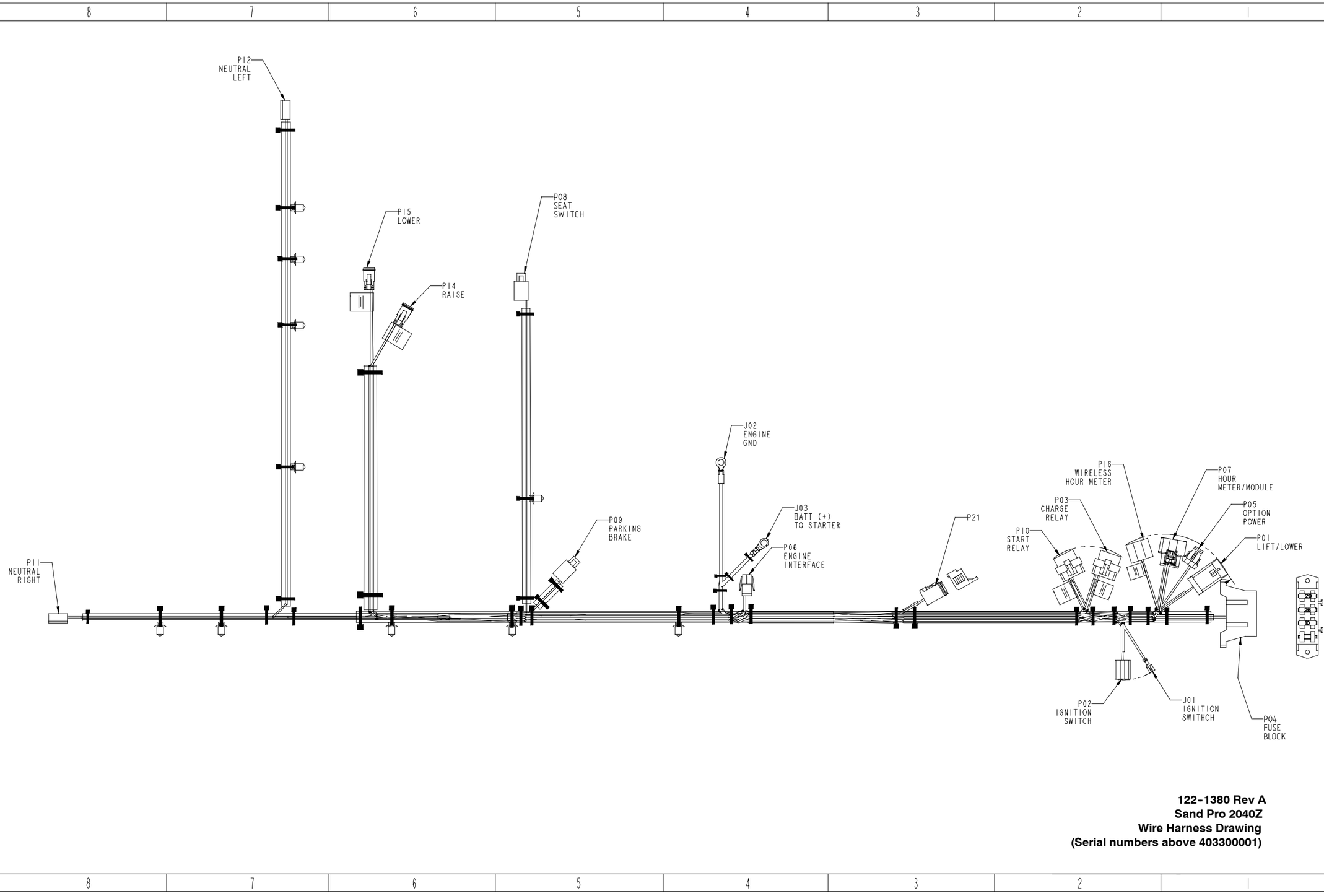
Sand Pro 2040Z

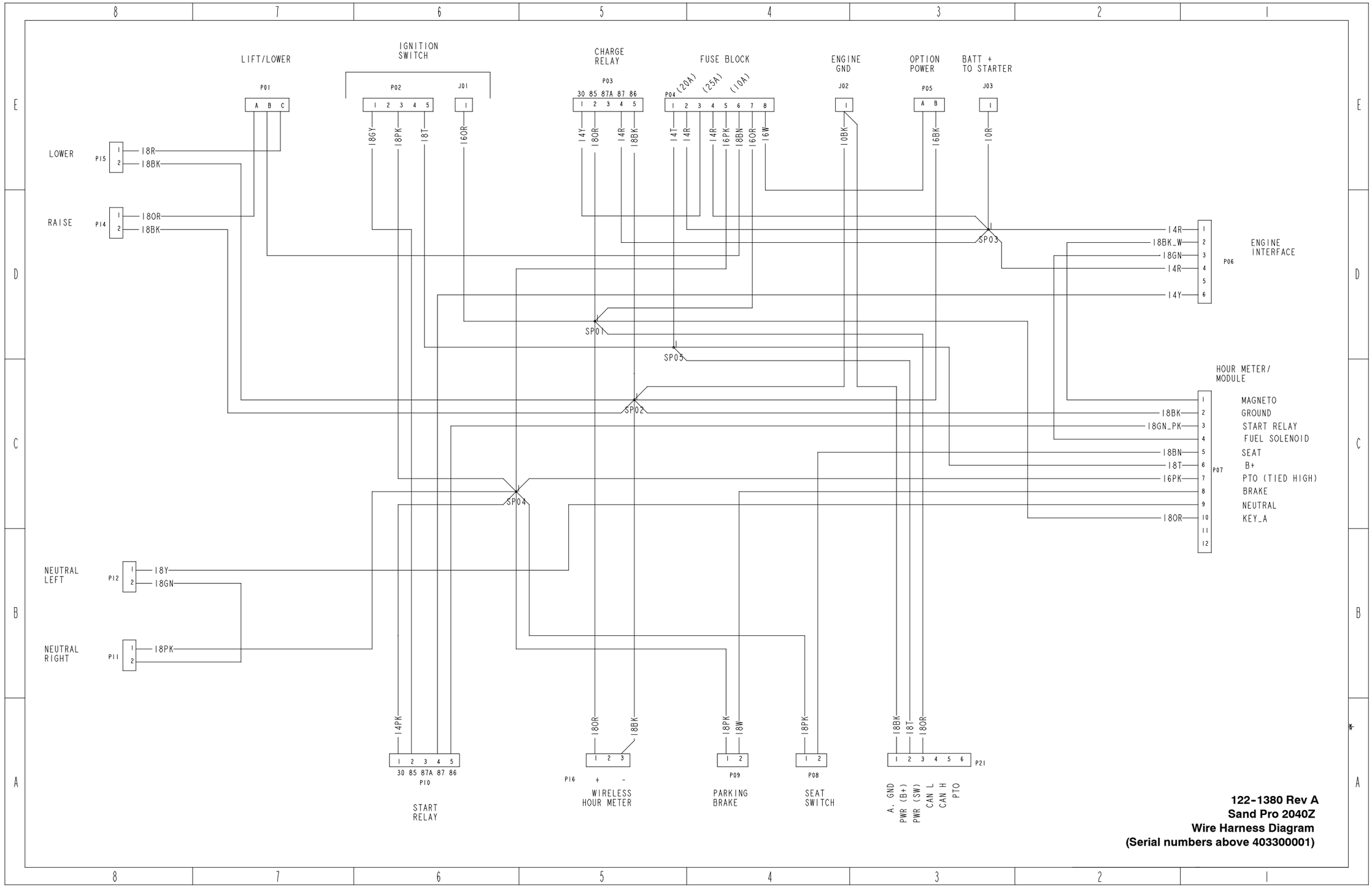
Wire Harness Drawing

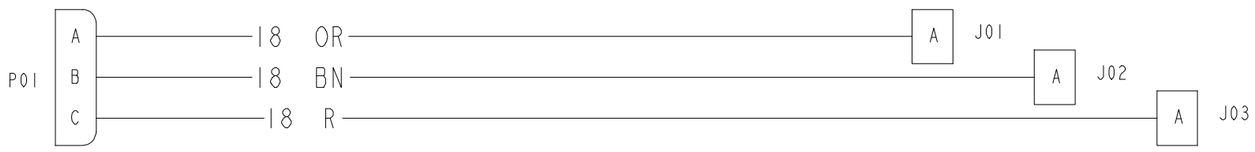
(Serial numbers below 403300000)



Sand Pro 2040Z
Wire Harness Diagram
(Serial numbers below 403300000)


P12
NEUTRAL
LEFT
P15
LOWER
P14
RAISE
P08
SEAT
SWITCH
J02
ENGINE
GND
P09
PARKING
BRAKE
J03
BATT (+)
TO STARTER
P06
ENGINE
INTERFACE
P21
P11
NEUTRAL
RIGHT
P16
WIRELESS
HOUR METER
P07
HOUR
METER/MODULE
P03
CHARGE
RELAY
P05
OPTION
POWER
P10
START
RELAY
P01
LIFT/LOWER
P02
IGNITION
SWITCH
J01
IGNITION
SWITHCH
P04
FUSE
BLOCK
122-1380 Rev A
Sand Pro 2040Z
Wire Harness Drawing
(Serial numbers above 403300001)


LIFT/LOWER
IGNITION SWITCH
CHARGE RELAY
FUSE BLOCK
ENGINE GND
OPTION POWER
BATT + TO STARTER
P01
P02
J01
P03
30 85 87A 87 86
P04
(20A)
(25A)
(10A)
J02
P05
J03
LOWER
P15
RAISE
P14
18R
18BK
18OR
18BK
18GY
18PK
18T
16OR
14Y
18OR
14R
18BK
14T
14R
14R
16PK
18BN
16OR
16W
10BK
16BK
10R
SP01
SP02
SP03
SP04
SP05
14R
18BK_W
18GN
14R
14Y
P06
ENGINE INTERFACE
HOUR METER/ MODULE
MAGNETO
18BK
GROUND
18GN_PK
START RELAY
FUEL SOLENOID
18BN
SEAT
18T
B+
16PK
PTO (TIED HIGH)
BRAKE
NEUTRAL
18OR
KEY_A
P07
NEUTRAL LEFT
P12
18Y
18GN
NEUTRAL RIGHT
P11
18PK
14PK
30 85 87A 87 86
P10
START RELAY
18OR
18BK
P16
+
-
WIRELESS HOUR METER
18PK
18W
P09
PARKING BRAKE
18PK
P08
SEAT SWITCH
18BK
18T
18OR
P21
A. GND
PWR (B+)
PWR (SW)
CAN L
CAN H
PTO
122-1380 Rev A
Sand Pro 2040Z
Wire Harness Diagram
(Serial numbers above 403300001)



Sand Pro 2040Z
Rear Attachment Switch
Wire Harness Drawing