Form No. 11185SL Rev D

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Service Manual

Reelmaster® 7000

(Model 03708)

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2011	Initial Issue.
A	2012	Updated Hydraulic chapter.
B	2015	Updated DPA Cutting Units chapter.
C	02/2018	Added revision history.
D	04/2018	Added VA02 planetary drive information. Revised bedknife installation procedure and painted/aluminum side plate cutting unit information. Added groomer chapters

Reader Comments

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NOTES

Part No. 11185SL Rev. D

Service Manual

(Model 03708)

Reelmaster® 7000–D

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing and repair of major systems and components on the Reelmaster 7000–D Model 03708.

REFER TO THE TRACTION UNIT AND CUTTING UNIT OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. For reference, insert a copy of the Operator's Manuals and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manuals 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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General Safety Instructions

The Reelmaster 7000 have been 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 Manuals 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. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

3. Assure interlock switches are adjusted correctly so engine cannot be started unless traction pedal is in NEUTRAL and cutting units are DISENGAGED.

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

   A. Use an approved fuel container.

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

   C. Do not smoke while handling fuel.

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

   E. Wipe up any spilled fuel.

While Operating

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

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure traction pedal is in neutral and the PTO switch is OFF (disengaged).

   C. After engine is started, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the traction pedal linkage is adjusted incorrectly; therefore, shut engine off and adjust traction pedal linkage until machine does not move when traction pedal is released.

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

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

5. Before getting off the seat:

   A. Ensure that traction pedal is in neutral.

   B. Engage parking brake.

   C. Disengage PTO and wait for cutting unit reel to stop rotating.

   D. Stop engine and remove key from switch.

   E. Toro recommends that anytime the machine is parked (short or long term), the cutting units should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of cutting units accidentally lowering to the ground.

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

Maintenance and Service

1. The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

2. Before servicing or making adjustments, lower cutting units, stop engine, set parking brake and remove key from the ignition switch.

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

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

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

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

7. Before disconnecting or performing any work on the hydraulic system, all pressure in system must be relieved by stopping engine and lowering cutting units to the ground.

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

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

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

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

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

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

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

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

16. When welding on machine, disconnect both battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Also, disconnect the wire harness connector from the machine TEC controller and disconnect the terminal connector from the alternator.

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

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

Jacking Instructions

CAUTION

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

Jacking the Front End (Fig. 1)

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

IMPORTANT: Do not place jack, jack stands or blocks under the wheel motors. Wheel motors can be damaged if used for jacking or support points.

2. Position jack securely under the frame, just to the inside of the front tire.

3. Jack front of machine off the ground.

4. Position appropriate jack stands under the frame as close to the wheels as possible to support the machine.

Jacking the Rear End (Fig. 2)

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

2. Place jack securely under the center of rear axle.

3. Jack rear of machine off the ground.

4. Position appropriate jack stands under the rear axle to support the machine.

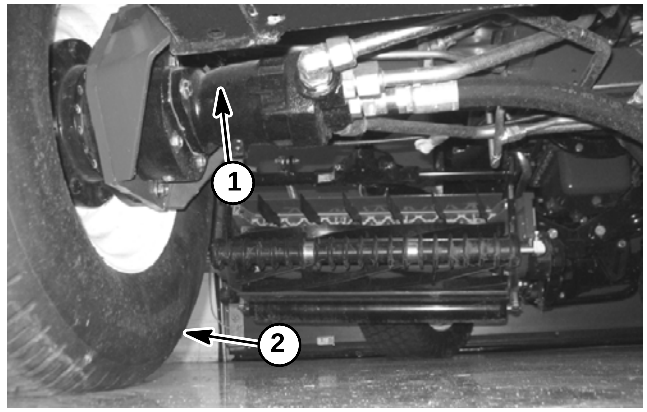

Figure 1

1. Frame **2. Front tire (RH shown)**

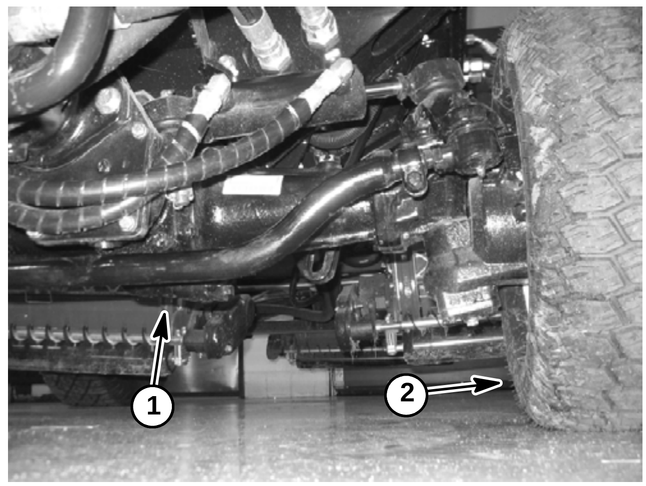

Figure 2

1. Rear axle **2. Rear tire (RH shown)**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Reelmaster 7000. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog.

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Product Records and Maintenance

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Product Records

Insert Operator’s Manuals and Parts Catalog for your Reelmaster at the end of this chapter. Additionally, insert Installation Instructions, Operator’s Manuals and Parts Catalogs for any accessories that have been installed on your Reelmaster at the end of this section.

Maintenance

Maintenance procedures and recommended service intervals for your Reelmaster are covered in the Traction Unit and Cutting Unit Operator’s Manuals. Refer to those publications when performing regular equipment maintenance. Several maintenance procedures have break–in intervals identified in the Operator’s Manuals. Refer to the Engine Operator’s Manual for additional engine specific maintenance procedures.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

U.S.to Metric Conversions

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

Torque Specifications

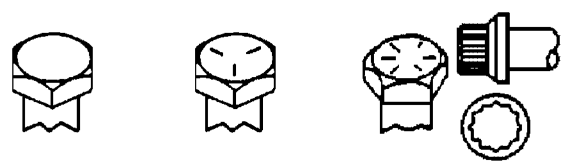
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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

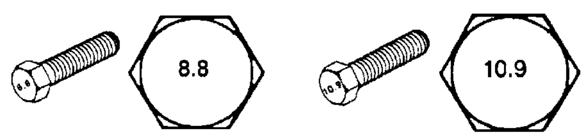
Fastener Identification



Grade 1 Grade 5 Grade 8

Inch Series Bolts and Screws

Figure 1



Class 8.8 Class 10.9

Metric Bolts and Screws

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.

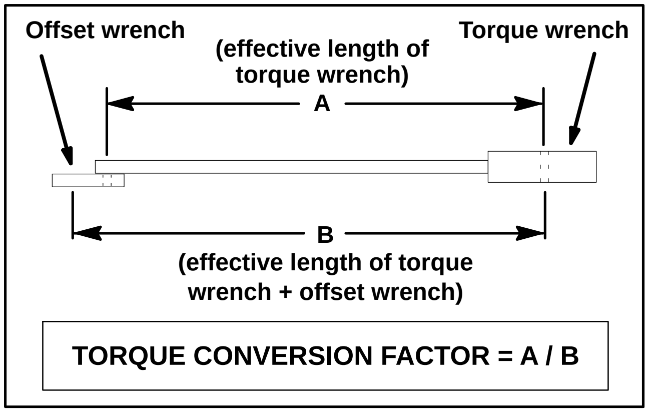


Figure 3

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

Kubota Diesel Engine

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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE,
  03–M–DI–E3B SERIES

Specifications

Item	Description
Make / Designation	Kubota Model V2403-M-DI-E3B 4-Cycle, 4 Cylinder, Liquid Cooled, Diesel Engine
Bore	3.425” (87.0 mm)
Stroke	4.031” (102.4 mm)
Total Displacement	148.5 in^3 (2434 cc)
Firing Order	1 (closest to gear case end) – 3 – 4 (closest to flywheel end) – 2
Combustion Chamber	Spherical Type (E-TVCS)
Compression Ratio	23.2:1
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Capacity	22 U.S. gallons (83 liters)
Fuel Injection Pump	Denso PFR 4M Type Mini Pump
Injection Nozzle	Denso OPD Mini Nozzle
Governor	Centrifugal Mechanical
Low Idle (no load)	1550 $\pm$ 50 RPM
High Idle (no load)	2850 +50/-120 RPM
Engine Oil	API CH-4, CI-4 or higher
Engine Oil Viscosity	See Operator’s Manual
Crankcase Oil Capacity	10.0 U.S. Quarts (9.5 Liters) with Filter
Oil Pump	Trochoid Type
Coolant Capacity	13 U.S. Quarts (12.3 Liters)
Starter	12 VDC, 2.0 kW
Alternator/Regulator Alternator Output	12 VDC 60 amp
Engine Dry Weight	406 U.S. pounds (184 kg)

General Information

This Chapter gives information about specifications and repair of the diesel engine used in the Reelmaster 7000.

General maintenance procedures are described in your Traction Unit Operator's Manual. Information on engine troubleshooting, testing, disassembly and assembly is identified in the Kubota Workshop Manual, Diesel Engine, 03–M–DI–E3B.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual, Diesel Engine, 03–M–DI–E3B. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

Service and repair parts for Kubota engines are supplied through your Authorized Toro Distributor. If no parts list is available, be prepared to provide your distributor with the Toro model and serial number.

Operator's Manual

The Traction Unit and Engine Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

Air Filter System

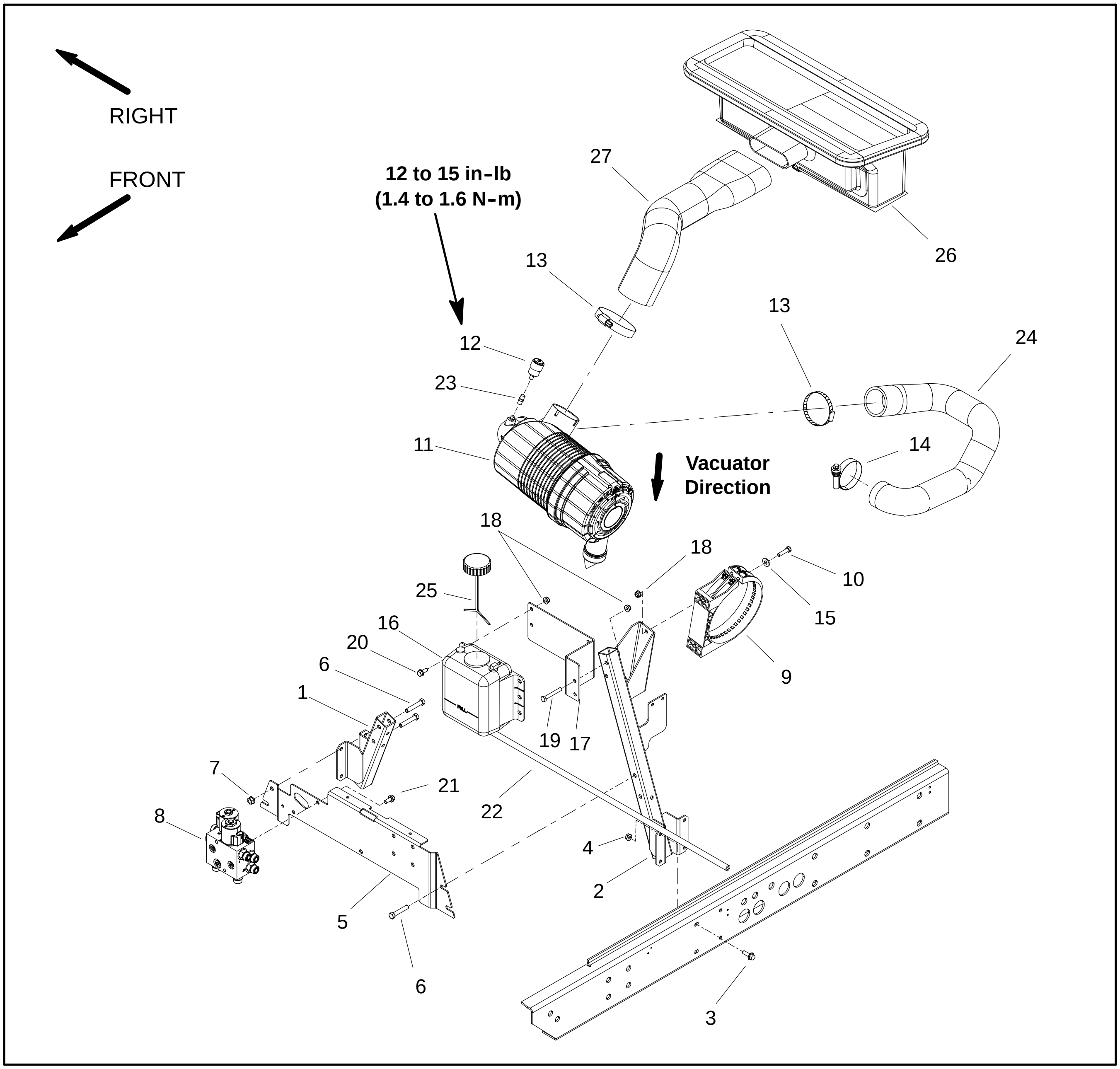

Figure 1

1. Battery support
2. Bracket
3. Flange head screw (8 used)
4. Flange nut (8 used)
5. Support bracket
6. Cap screw (4 used)
7. Flange nut (4 used)
8. Fan drive manifold
9. Air cleaner strap
10. Cap screw (2 used)
11. Air cleaner assembly
12. Service indicator
13. Hose clamp
14. Hose clamp
15. Flat washer (2 used)
16. Coolant reservoir
17. Reservoir bracket
18. Flange nut (8 used)
19. Cap screw (2 used)
20. Flange head screw (4 used)
21. Flange head screw (2 used)
22. Hose
23. Adapter
24. Air cleaner hose
25. Reservoir cap
26. Plenum
27. Air intake hose

Removal (Fig. 1)

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

2. Raise and support hood.

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

Installation (Fig. 1)

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

1. Assemble air filter system using Figure 1 as a guide.

   A. If service indicator (item 12) was removed from air cleaner housing, apply thread sealant to adapter threads before installing adapter and indicator to housing. Install adapter so that grooves in adapter hex and adapter filter element are installed toward service indicator (Fig. 3). Torque indicator from **12 to 15 in–lb (1.4 to 1.6 N–m)**.

   B. Orientate vacuator valve on air cleaner cover toward ground.

   C. Install air cleaner so air cleaner strap (item 9) is as close as possible to air cleaner cover.

   D. Make sure that air cleaner hose (item 24) does not contact engine valve cover or other engine components. To modify clearance, move and/or rotate air cleaner body in air cleaner strap. Verify that tabs in strap mesh fully with slots in air cleaner body.

2. After air cleaner installation is completed, lower and secure hood.

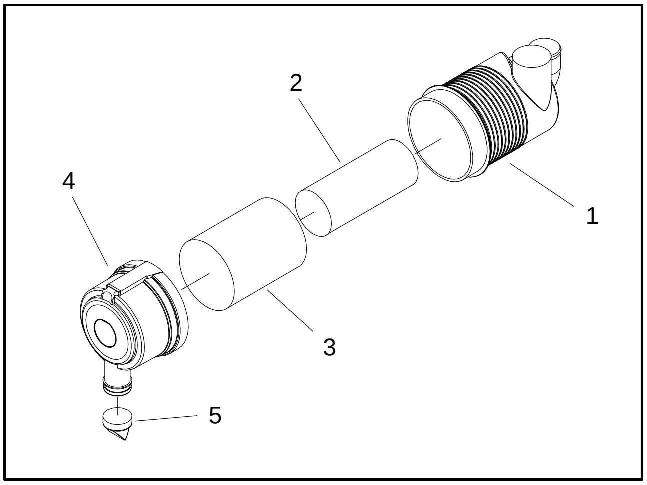

Figure 2

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

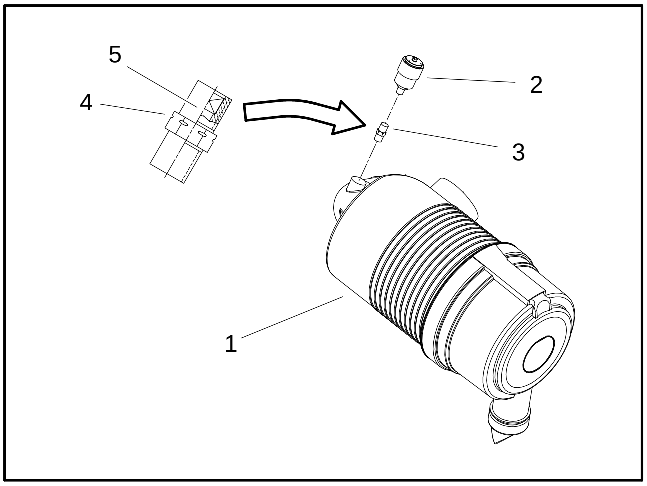

Figure 3

1. **Air cleaner assembly**
2. **Service indicator**
3. **Adapter**
4. **Groove**
5. **Filter element**

Exhaust System

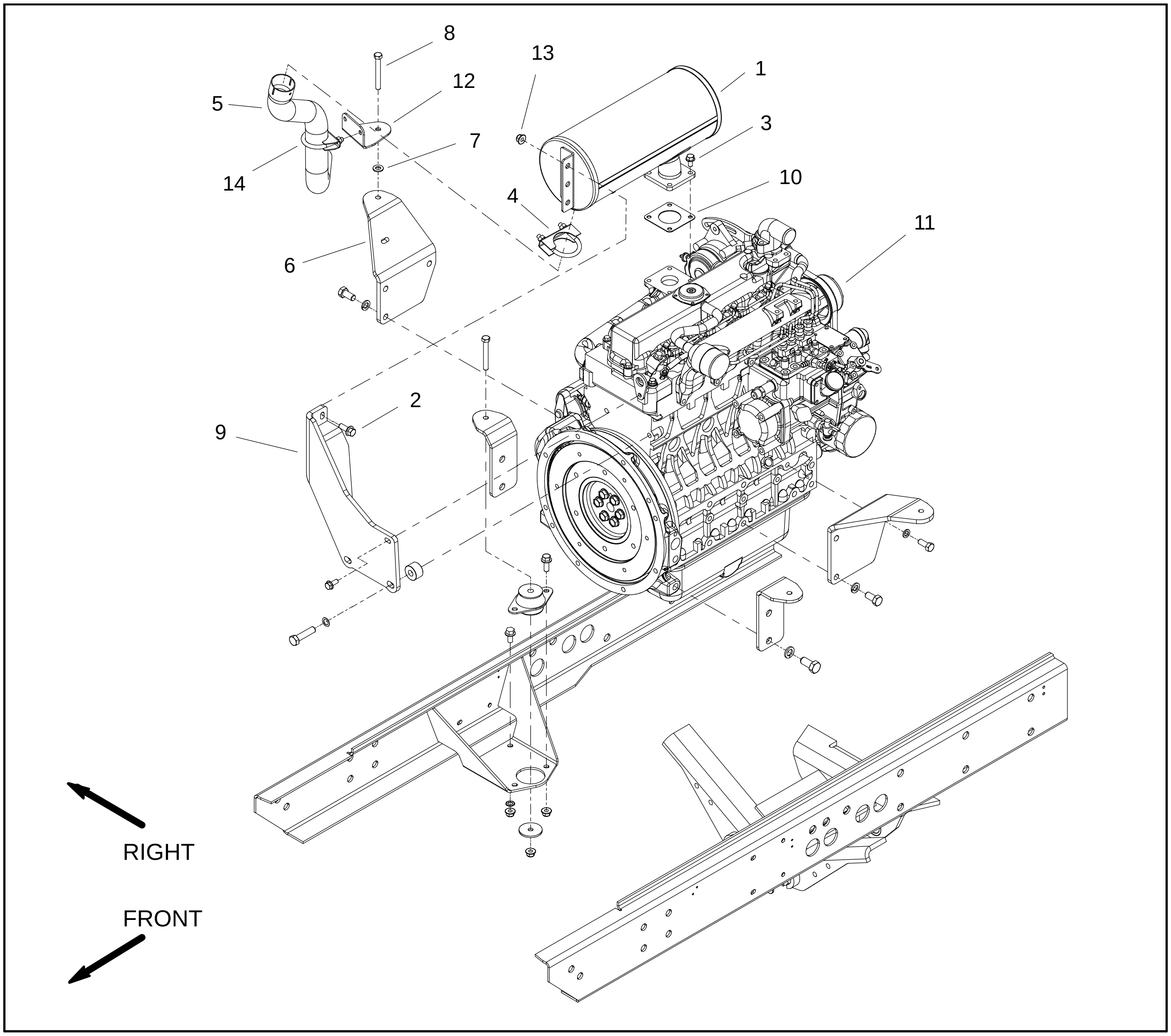

Figure 4

1. **Muffler**
2. **Flange head screw (2 used)**
3. **Flange head screw (4 used)**
4. **Muffler clamp**
5. **Tailpipe**
6. **RH engine mount**
7. **Flat washer**
8. **Cap screw**
9. **Muffler bracket**
10. **Muffler gasket**
11. **Engine**
12. **Muffler bracket**
13. **Flange nut (2 used)**
14. **Muffler clamp**

Removal (Fig. 4)

CAUTION

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

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

2. Raise and support hood.

3. Remove muffler and/or muffler bracket from the engine as necessary using Figure 4 as a guide.

Installation (Fig. 4)

IMPORTANT: If exhaust studs were removed from engine cylinder head, thoroughly clean threads in head and apply Loctite #277 (or equivalent) to stud threads before installing studs into head.

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

1. Install **new** exhaust gasket if original gasket is damaged or torn.

IMPORTANT: Failure to follow the suggested muffler fastener sequence may result in premature muffler failure.

2. Install exhaust system components to the engine using Figure 4 as a guide. Hand tighten all exhaust system fasteners before fully tightening any fastener.

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

4. After exhaust system installation is completed, lower and secure hood.

Fuel System

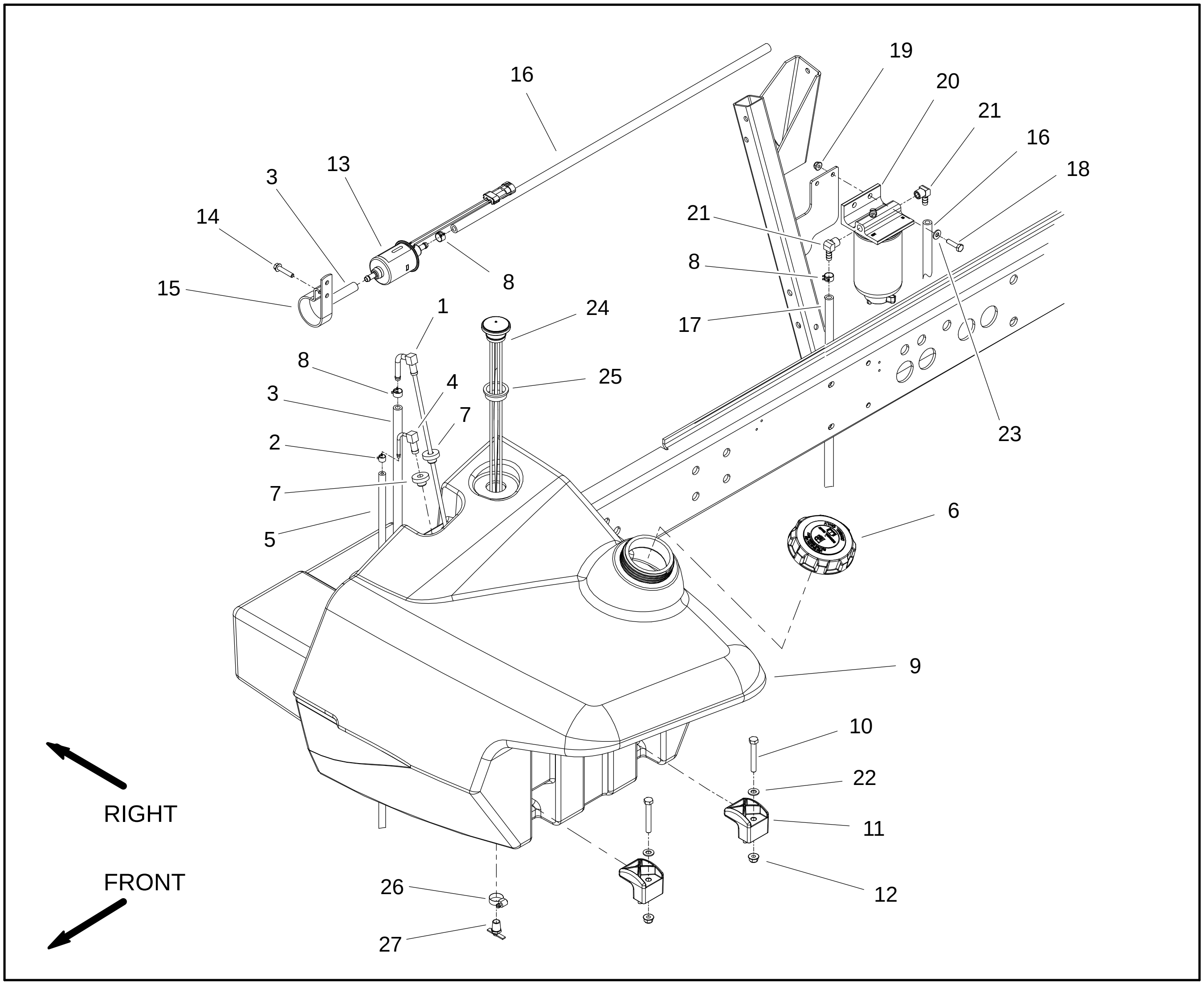

Figure 5

1. **Fuel suction tube**
2. **Fuel line clamp (2 used)**
3. **Fuel hose (supply)**
4. **Return fitting**
5. **Fuel hose (return)**
6. **Fuel tank cap**
7. **Bushing (2 used)**
8. **Hose clamp (6 used)**
9. **Fuel tank**
10. **Cap screw (2 used)**
11. **Clamp (2 used)**
12. **Flange nut (2 used)**
13. **Fuel pump**
14. **Washer head screw**
15. **Fuel pump bracket**
16. **Fuel hose (supply)**
17. **Fuel hose (supply)**
18. **Cap screw (2 used)**
19. **Flange nut (2 used)**
20. **Fuel/water separator**
21. **Elbow fitting (2 used)**
22. **Flat washer (2 used)**
23. **Flat washer (2 used)**
24. **Fuel gauge**
25. **Grommet**
26. **Hose clamp**
27. **Draincock**

DANGER

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

Check Fuel Lines and Connections

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

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Traction Unit Operator's Manual. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period. To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of contaminates and debris.

Fuel Tank Removal (Fig. 5)

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

2. Disconnect fuel hoses from the suction and return fittings in top of tank.

3. Use draincock on bottom of tank to empty fuel tank into a suitable container.

4. Remove fuel tank from machine using Figure 5 as a guide.

Fuel Tank Installation (Fig. 5)

1. Install fuel tank to frame using Figure 5 as a guide.

2. Connect fuel hoses to the suction and return fittings in top of tank.

3. Make sure that draincock on bottom of tank is closed.

4. Fill fuel tank with clean fuel.

Radiator

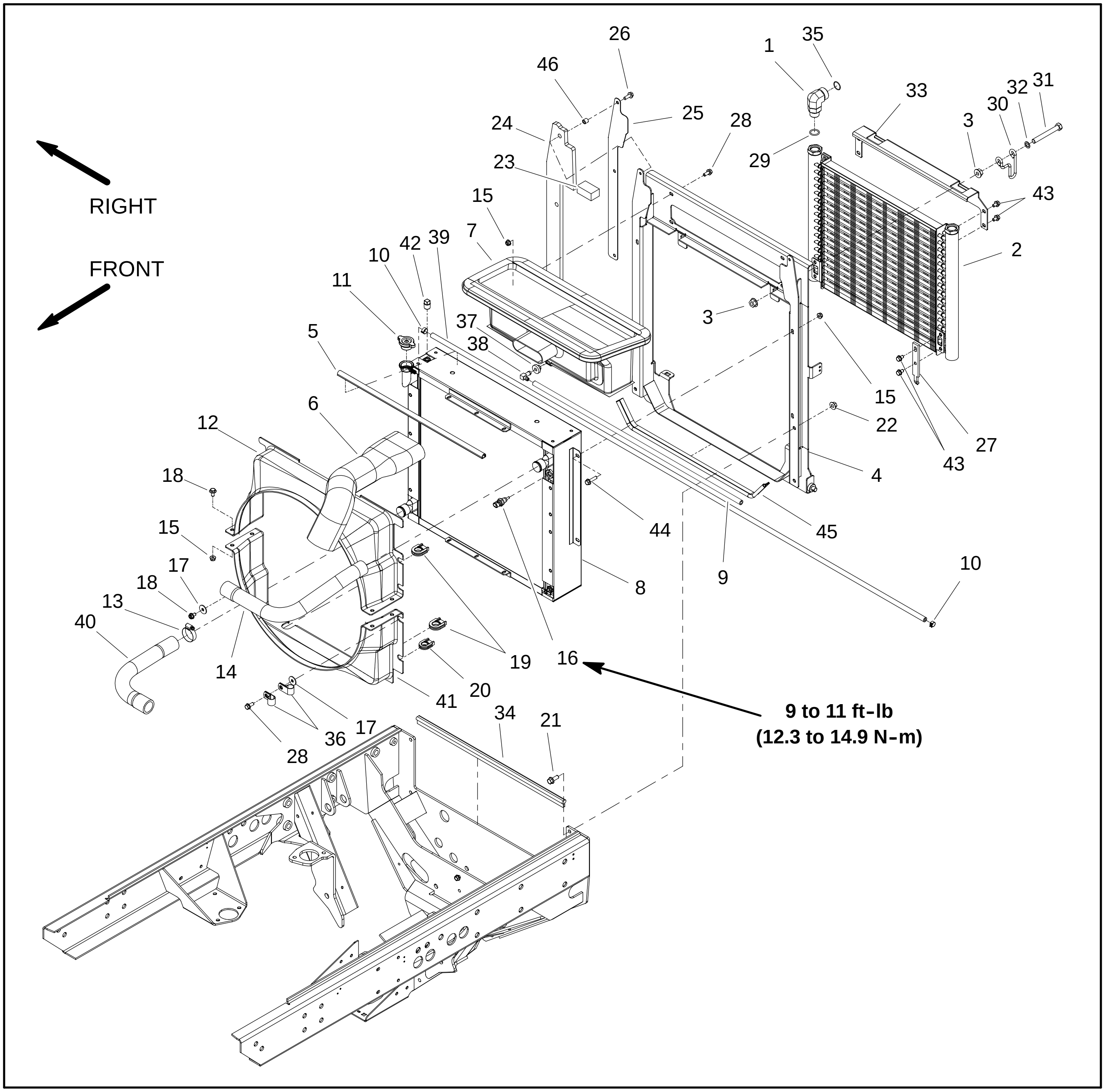

Figure 6

1. **90º hydraulic fitting (2 used)**
2. **Oil cooler**
3. **Flange nut (4 used)**
4. **Radiator mount**
5. **Bulb seal**
6. **Air cleaner hose**
7. **Plenum**
8. **Radiator**
9. **Hose**
10. **Hose clamp (3 used)**
11. **Radiator cap**
12. **Upper radiator shroud**
13. **Clamp (4 used)**
14. **Upper radiator hose**
15. **Flange nut (12 used)**
16. **Temperature sender**
17. **Flat washer (8 used)**
18. **Flange head screw (11 used)**
19. **Rubber grommet (2 used)**
20. **Rubber grommet**
21. **Flange head screw (4 used)**
22. **Flange nut (4 used)**
23. **Foam seal (2 used)**
24. **Recirculation barrier (2 used)**
25. **Recirculation barrier bracket (2 used)**
26. **Screw (2 used)**
27. **Oil cooler mount plate (2 used)**
28. **Flange head screw (9 used)**
29. **O-ring**
30. **Clamp (2 used)**
31. **Cap screw (2 used)**
32. **Washer (2 used)**
33. **Oil cooler top bracket**
34. **Bulb seal**
35. **O-ring**
36. **R-clamp (2 used)**
37. **Bushing**
38. **Elbow fitting**
39. **Reservoir hose**
40. **Lower radiator hose**
41. **Lower radiator shroud**
42. **Pipe plug**
43. **Flange head screw (8 used)**
44. **Flange head screw (4 used)**
45. **Bulb seal**
46. **Spacer**

Removal (Fig. 6)

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

2. Remove hood from the machine (see Hood Removal in the Service and Repairs section of Chapter 7 – Chassis).

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

Ethylene-glycol antifreeze is poisonous. Dispose of coolant properly or store it in a properly labeled container away from children and pets.

3. Remove radiator cap. Drain radiator into a suitable container using the radiator draincock.

4. Disconnect upper and lower hoses from the radiator.

5. Remove air cleaner hose (item 6).

6. Remove four (4) flange head screws and flange nuts that secure plenum (item 7) to radiator mount. Remove plenum.

7. Disconnect reservoir hose (item 39) from the radiator vent tube.

8. Detach upper radiator shroud from the radiator and lower radiator shroud. Remove upper shroud from machine.

9. Remove fasteners that secure lower radiator shroud to radiator.

10. Remove six (6) cap screws and flange nuts that secure fan motor bracket to radiator (Fig. 7).

11. Position lower radiator shroud and fan motor bracket assembly away from radiator.

12. Remove four (4) flange head screws and flange nuts securing the radiator and recirculation barriers (items 24 and 25) to the radiator mount. Carefully remove barriers and radiator from the machine.

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

Installation (Fig. 6)

1. Remove plugs placed in radiator and hose openings during the removal procedure. Make sure that radiator draincock is closed.

2. Carefully position radiator and recirculation barriers (items 24 and 25) to the radiator mount. Secure radiator and barriers in place with four (4) flange head screws and flange nuts.

3. Position lower radiator shroud and fan motor bracket assembly to the radiator. Make sure that hydraulic hoses are correctly positioned in grommets in lower radiator shroud.

4. Secure fan motor bracket to radiator with six (6) cap screws and flange nuts (Fig. 7).

5. Secure lower radiator shroud to radiator with removed fasteners.

6. Position upper radiator shroud to lower radiator shroud and radiator. Secure shrouds with removed fasteners. Make sure that clearance between shrouds and fan is at least 0.180” (4.6 mm) at all points.

7. Connect reservoir hose (item 39) to the radiator vent tube.

8. Connect upper and lower hoses to the radiator.

9. Install plenum (item 7) to radiator mount and secure with flange head screws and flange nuts.

10. Install air cleaner hose (item 6) to the air cleaner and plenum.

11. Fill radiator with coolant.

12. Install hood on the machine (see Hood Installation in the Service and Repairs section of Chapter 7 – Chassis).

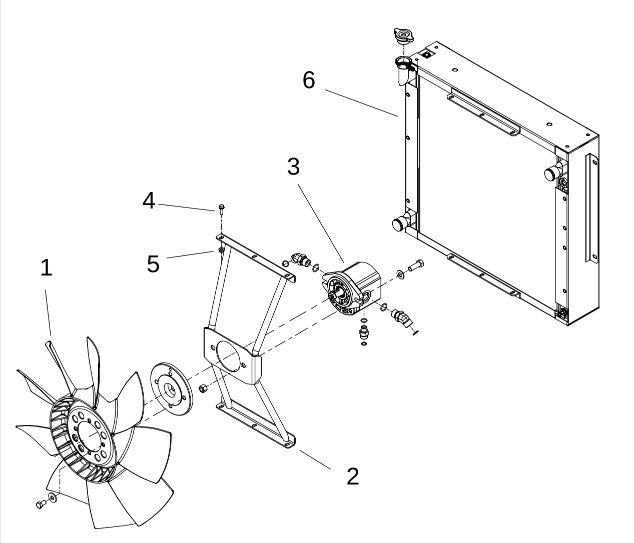

Figure 7

1. **Fan**
2. **Fan motor bracket**
3. **Fan motor**
4. **Cap screw (6 used)**
5. **Flange nut (6 used)**
6. **Radiator**

Kubota Diesel Engine

Engine

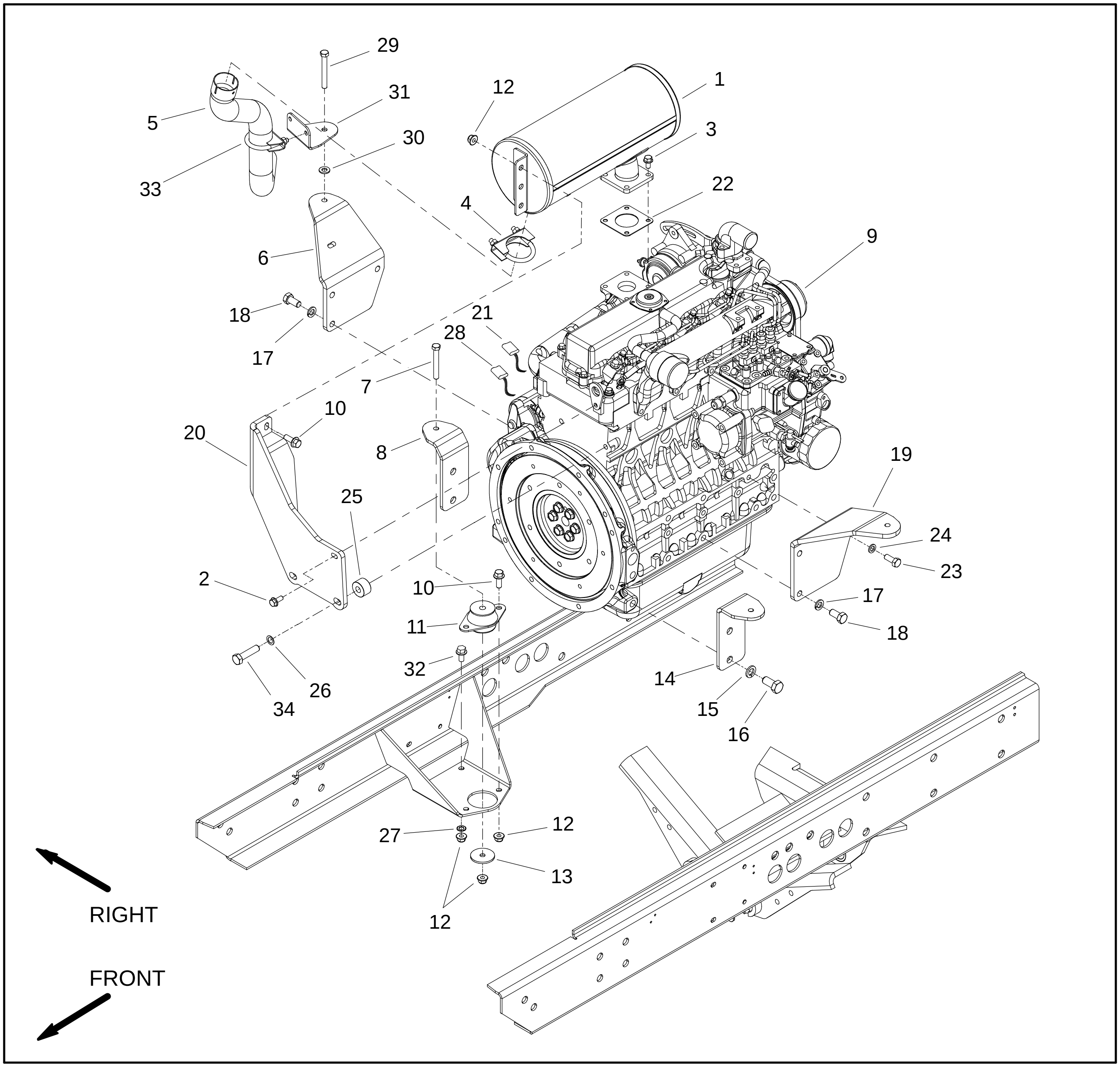

Figure 8

1. **Muffler**
2. **Flange head screw**
3. **Flange head screw (4 used)**
4. **Muffler clamp**
5. **Tailpipe**
6. **RH rear engine mount**
7. **Cap screw (3 used)**
8. **RH front engine mount**
9. **Engine**
10. **Flange head screw (10 used)**
11. **Engine mount (4 used)**
12. **Flange nut (15 used)**
13. **Rebound washer (4 used)**
14. **LH front engine mount**
15. **Lock washer (4 used)**
16. **Cap screw (4 used)**
17. **Lock washer (5 used)**
18. **Cap screw (5 used)**
19. **LH rear engine mount**
20. **Muffler bracket**
21. **Ground wire harness**
22. **Muffler gasket**
23. **Cap screw**
24. **Lock washer**
25. **Spacer (2 used)**
26. **Hardened washer (2 used)**
27. **Lock washer**
28. **Alternator wire harness**
29. **Cap screw**
30. **Flat washer**
31. **Muffler bracket**
32. **Flange head screw**
33. **Muffler clamp**
34. **Cap screw (2 used)**

Engine Removal (Fig. 8)

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

2. Remove hood from the machine (see Hood Removal in the Service and Repairs section of Chapter 7 – Chassis).

3. Remove battery cover. Disconnect negative battery cable first and then positive battery cable.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

Ethylene-glycol antifreeze is poisonous. Dispose of coolant properly, or store it in a properly labeled container away from children and pets.

4. Drain coolant from radiator into a suitable container (see Radiator Removal in this section). Disconnect coolant hoses from the radiator.

CAUTION

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

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

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

7. Note location of cable ties used to secure wire harness. Disconnect wire harness connectors from the following engine components:

A. The engine run solenoid (Fig. 9).

B. The temperature sender (Fig. 10).

C. The alternator (Fig. 10).

D. The glow plug connection.

E. Wire harness connector from engine ground harness.

F. The electric starter motor.

G. Low oil pressure switch located on alternator side of engine (above electric starter).

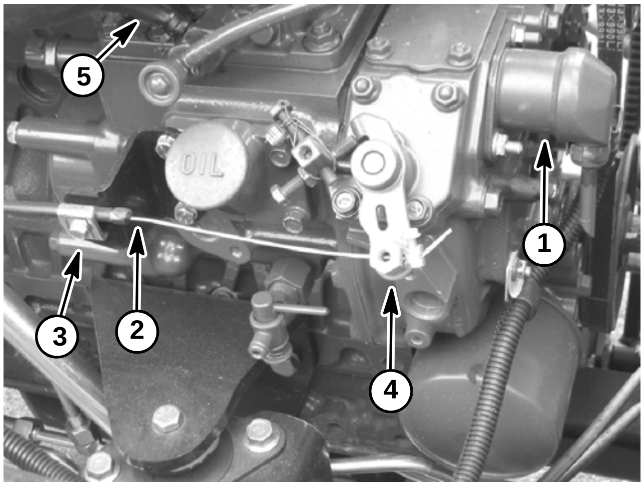

Figure 9

1. **Engine run solenoid**
2. **Throttle cable**
3. **Cable clamp**
4. **Cable swivel**
5. **Fuel supply hose**

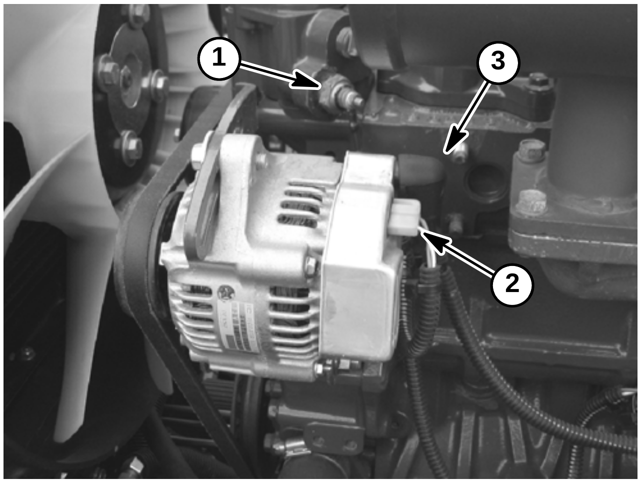

Figure 10

1. **Temperature sender**
2. **Harness connector**
3. **Battery cable**

8. Disconnect fuel supply hose from injection pump (Fig. 9). Cap fuel hose and injector pump fuel inlet to prevent contamination.

9. Remove throttle cable from engine (Fig. 9):

A. Remove lock nut that secures throttle cable swivel to speed control lever.

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

C. Position throttle cable away from the engine.

10. Remove fasteners that secure the upper radiator shroud to the lower shroud and radiator (see Radiator Removal in this section). Remove upper radiator shroud from machine.

11. Remove fan motor and fan assembly (Fig. 11).

A. To prevent contamination of hydraulic system, thoroughly clean exterior of fan motor and fittings.

B. Disconnect hydraulic hoses from cooling fan motor. Put caps or plugs on fittings and hoses to prevent contamination. Label hydraulic lines for proper assembly.

C. Remove six (6) cap screws and flange nuts that secure fan motor bracket to radiator.

D. Carefully remove fan motor, fan and motor bracket assembly from machine.

IMPORTANT: The hydraulic pump assembly can remain in machine during engine removal. To prevent pump assembly from shifting or falling, make sure to support pump assembly before pump mounting fasteners are removed.

12. Support hydraulic pump assembly. Remove fasteners that secure piston (traction) pump assembly to engine (see Piston (Traction) Pump Assembly Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

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

14. Connect lift or hoist to the lift tabs on engine.

15. Remove flange nuts, rebound washers and cap screws that secure the engine mount brackets to the rubber engine mounts.

CAUTION

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

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

16. Carefully raise engine from the machine.

17. If necessary, remove engine mounts from the engine using Figure 8 as a guide.

Engine Installation (Fig. 8)

1. Locate machine on a level surface with key removed from the ignition switch. Chock wheels to keep the machine from moving.

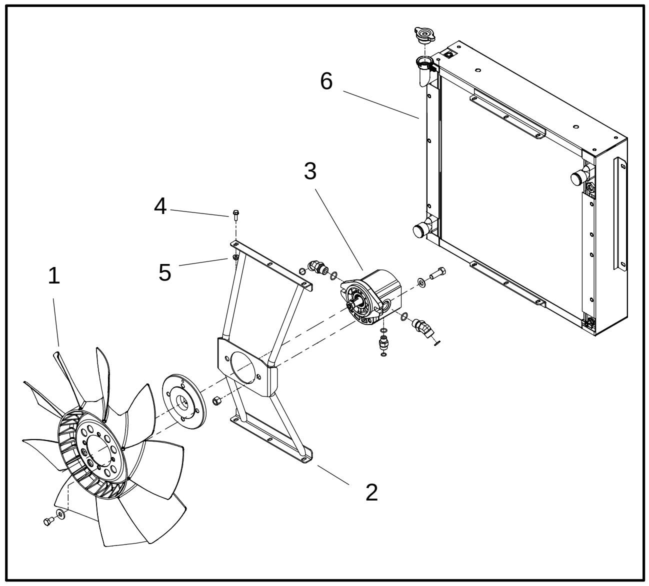

Figure 11

1. Fan	**4. Cap screw (6 used)**
2. Fan motor bracket	**5. Flange nut (6 used)**
3. Fan motor	**6. Radiator**

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

3. If removed, install engine mounts to the engine using Figure 8 as a guide.

4. Connect lift or hoist to the lift tabs on engine.

CAUTION

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

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

5. Carefully lower engine into the machine.

6. Align engine to the rubber engine mounts and hydraulic pump input shaft. Secure engine to engine mounts with cap screws, rebound washers and flange nuts.

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

8. Install fan motor and fan assembly (Fig. 11).

A. Carefully position fan motor, fan and motor bracket assembly to radiator.

B. Secure fan motor bracket to radiator with six (6) cap screws and flange nuts.

C. Remove caps and plugs placed in hoses and fittings during removal to prevent contamination.

D. Connect hydraulic hoses to cooling fan motor (see Hydraulic Hose and Tube Installation in the General Information section of Chapter 4 – Hydraulic System).

9. Position upper radiator shroud to the radiator. Secure shroud to the radiator and lower radiator bracket with removed fasteners (see Radiator Installation in this section). Make sure that clearance between shroud and fan is at least 0.180" (4.6 mm) at all points.

10. Connect throttle cable to engine (Fig. 9):

A. Secure throttle cable swivel to speed control lever with lock nut.

B. Place throttle cable under cable clamp.

C. Adjust throttle cable position in cable clamp so that engine governor lever contacts the high speed stop bolt at the same time that the throttle lever contacts the end of the slot in the control console.

D. Tighten cable clamp to secure throttle cable.

11. Remove caps from fuel hose and injector pump fuel inlet that were placed during engine removal to prevent contamination. Connect fuel supply hose to injection pump (Fig. 9). Secure hose with hose clamp.

12. Connect wire harness connectors to the following engine components:

A. The engine run solenoid (Fig. 9).

B. The temperature sender (Fig. 10).

C. The alternator (Fig. 10).

D. The glow plug connection.

E. Wire harness connector to engine ground harness.

F. The electric starter. Torque nut at starter B+ terminal from **70 to 86 in–lb (7.9 to 9.7 N–m)**.

G. Low oil pressure switch located on alternator side of engine (above electric starter).

13. Using notes taken during engine removal, secure wires with cable ties in proper locations.

14. Install air cleaner assembly to the engine (see Air Cleaner Installation in this section).

15. Install exhaust system to machine (see Exhaust System Installation in this section).

16. Connect coolant hoses to the radiator. Make sure radiator draincock is closed. Fill radiator and reservoir with coolant.

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

18. Connect positive battery cable first and then negative battery cable. Secure battery cover to machine.

19. Check and adjust engine oil level as needed.

20. Check and adjust hydraulic oil level as needed.

21. Bleed fuel system.

22. Operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in the Service and Repairs section of Chapter 4 – Hydraulic Systems).

23. Install hood on the machine (see Hood Installation in the Service and Repairs section of Chapter 7 – Chassis).

Pump Adapter Plate

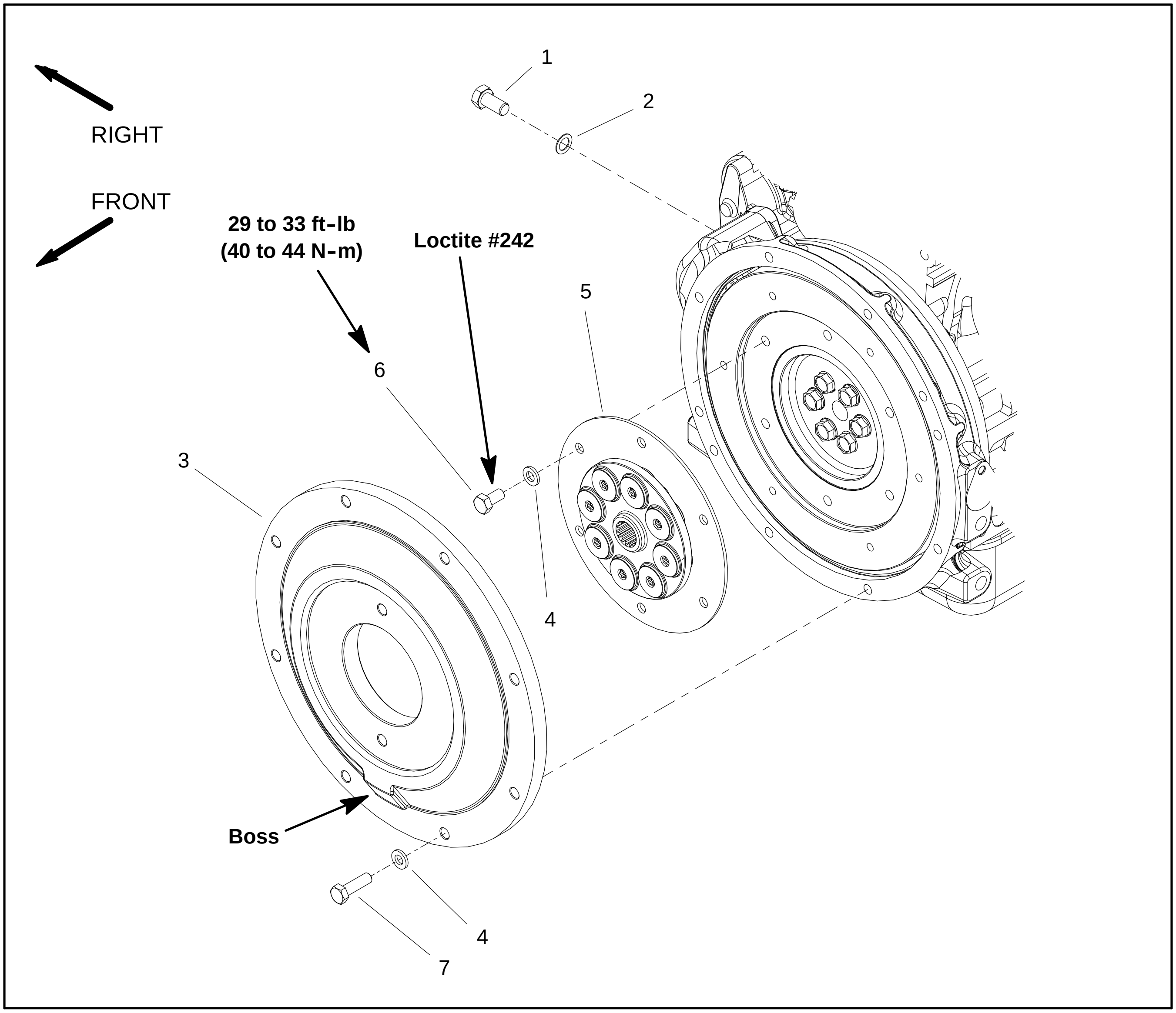

Figure 12

1. **Bolt**
2. **Lock washer**
3. **Flywheel plate**
4. **Hardened washer (14 used)**
5. **Spring coupler**
6. **Bolt (6 used)**
7. **Cap screw (8 used)**

Coupler Removal (Fig. 12)

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

1. If engine is in machine, remove hydraulic pump assembly (see Piston (Traction) Pump Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).

2. Remove flywheel plate and spring coupler from engine using Figure 12 as a guide.

Coupler Installation (Fig. 12)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupling hub is away from engine flywheel (Fig. 13).

2. Apply Loctite #242 (or equivalent) to threads of bolts (item 6). Secure coupler to flywheel with six (6) bolts and hardened washers. Torque bolts in a crossing pattern from **29 to 33 ft–lb (40 to 44 N–m)**.

3. Position flywheel plate to engine. Make sure that boss on plate is orientated down. Secure flywheel plate with cap screws (item 7) and hardened washers using a crossing pattern tightening procedure.

4. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).

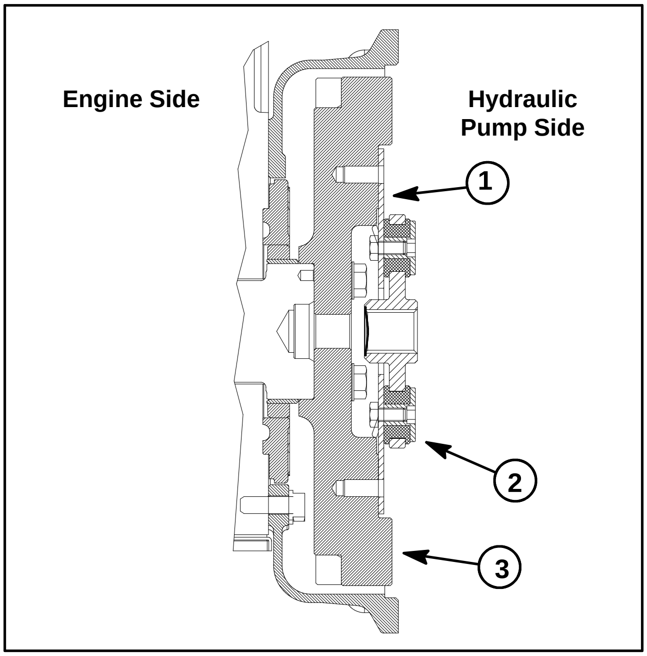

Figure 13

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

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Chapter 4

Hydraulic System

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Hydraulic System

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Specifications

Item	Description
Piston (Traction) Pump Maximum Displacement (per revolution) System Relief Pressure: Forward System Relief Pressure: Reverse	Eaton variable displacement piston pump (Model 72400) 2.48 in^3 (40.6 cc) 5000 PSI (345 bar) 5000 PSI (345 bar)
Charge Pressure	207 PSI (14.3 bar)
Front Wheel Motors Displacement (per revolution)	Eaton fixed displacement piston motors (Model 74315) 2.01 in^3 (32.9 cc)
Rear Axle Motor Displacement (per revolution)	Eaton fixed displacement piston motor (Model 74318) 2.48 in^3 (40.6 cc)
Gear Pump Section P1/P2 Displacement (per revolution) Section P3/P4 Displacement (per revolution)	Casappa 4 section, positive displacement gear type pump 1.03 in^3 (16.85 cc) 0.56 in^3 (9.16 cc)
Steering Control Valve Displacement (per revolution)	Sauer-Danfoss Steering Unit, Series OSPM 6.1 in^3 (100 cc)
Steering Circuit Relief Pressure	1050 PSI (72 bar)
Lift/Lower Circuit Relief Pressure	1700 PSI (117 bar)
Cutting Unit Motors Displacement (per revolution)	Casappa Gear Motor 1.61 in^3 (26.5 cc)
Cutting Unit Circuit Relief Pressure	3000 PSI (207 bar)
Engine Cooling Fan Motor Displacement (per revolution)	Casappa Gear Motor 0.51 in^3 (8.4 cc)
Engine Cooling Fan Circuit Relief Pressure	3000 PSI (207 bar)
Hydraulic Filters In-line Suction Strainer	Spin-on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir Capacity	8.25 U.S. Gallons (31.3 Liters)
Hydraulic Oil	See Traction Unit Operator's Manual

NOTE: The pressure specifications listed above are component settings. When using pressure gauges to measure circuit pressures, values may be different than these specifications. See the Testing section of this chapter for hydraulic test procedures and expected test results.

General Information

Operator's Manual

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

Towing Traction Unit

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

If it becomes necessary to tow (or push) the machine, tow (or push) in a **forward direction only**, at a speed **below 3 mph (4.8 kph)** and for a distance **less than 1/4 mile (0.4 km)**. The piston (traction) pump is equipped with a bypass valve that needs to be turned 90^{o} for towing (Fig. 1). Do not turn bypass valve when engine is running.

See Traction Unit Operator's Manual for additional towing procedures.

IMPORTANT: If the machine must be pushed or towed in a reverse direction, the check valve in the 4WD/2WD control manifold must be bypassed. To bypass this check valve, connect a hydraulic hose between the reverse traction pressure test port and the 4WD/2WD control manifold test port (G). Toro part numbers 95–8843 (hydraulic hose), 95–0985 (coupler fitting) (2 required) and 340–77 (hydraulic fitting) (2 required) are needed for this connection.

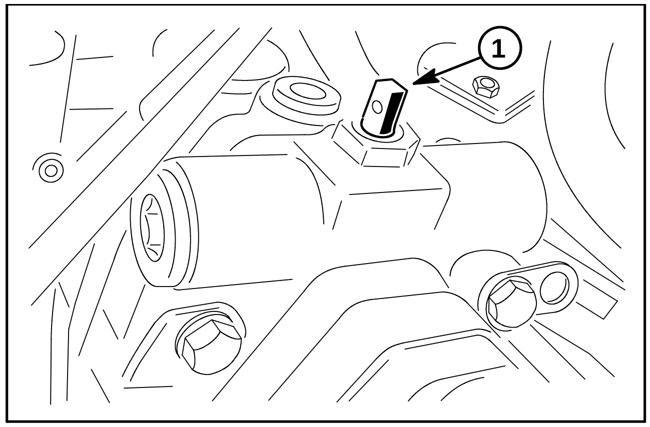


Figure 1

1. Bypass valve location

Check Hydraulic Fluid

The Reelmaster 7000 hydraulic systems are designed to operate on anti–wear hydraulic fluid. The reservoir holds approximately 8.25 U.S. gallons (31.3 liters) of hydraulic fluid. **Check level of hydraulic fluid daily.**

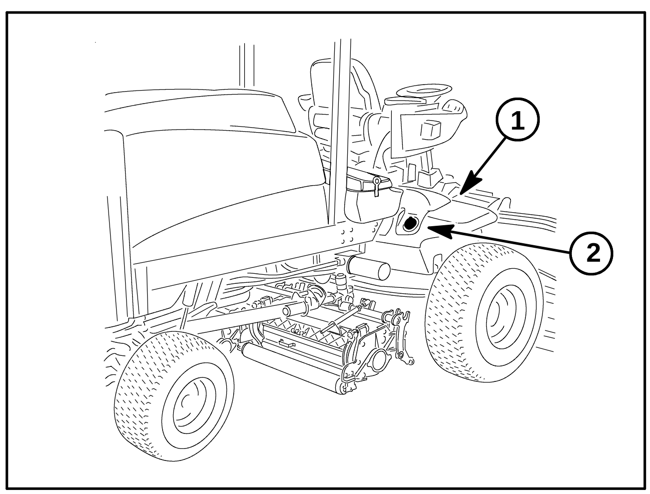


Figure 2

1. Hydraulic reservoir **2. 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, lower cutting units fully, stop engine and apply parking brake.

To relieve hydraulic pressure in traction circuit, move traction pedal to both forward and reverse directions. To relieve hydraulic pressure in steering circuit, rotate steering wheel in both directions.

System pressure in mow circuit is relieved when the cutting units are disengaged (PTO switch in OFF position).

To relieve hydraulic pressure in lift circuit, fully lower the cutting units to the ground. Turn ignition switch to OFF.

Traction Circuit Component Failure

The traction circuit on Reelmaster 7000 machines is a closed loop system that includes the piston (traction) pump, two (2) front wheel motors and the rear axle motor. If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

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

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

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

NOTE: If traction circuit contamination exists, the traction pump case drain could allow contaminates to enter other hydraulic circuits on the machine.

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

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

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

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

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

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

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

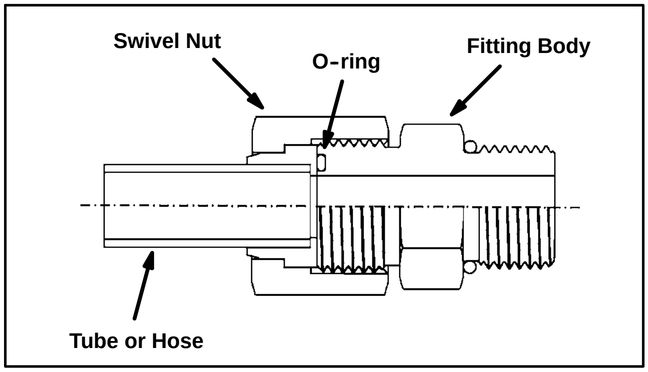


Figure 3

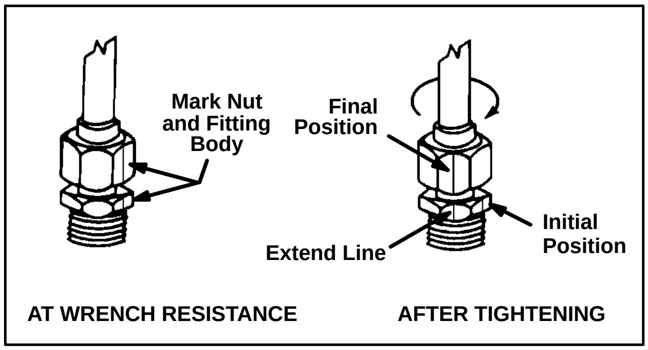


Figure 4

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

Figure 5

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

Non–Adjustable Fitting (Fig. 6)

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

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

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

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

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

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

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

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

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

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

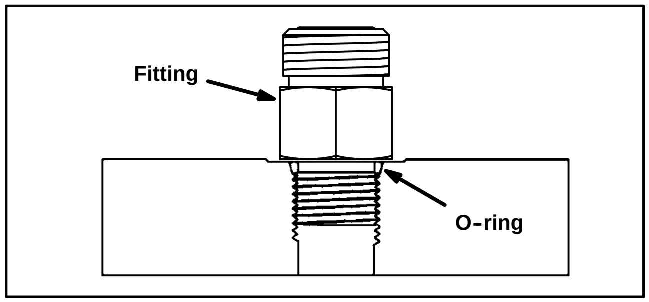


Figure 6

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

Figure 7

Adjustable Fitting (Fig. 8)

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

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

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

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

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

5. Install the fitting into the port and tighten finger tight until the washer contacts the face of the port (Step 2).

6. To put the fitting in the desired position, unscrew it by the required amount, but no more than one full turn (Step 3).

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

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

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

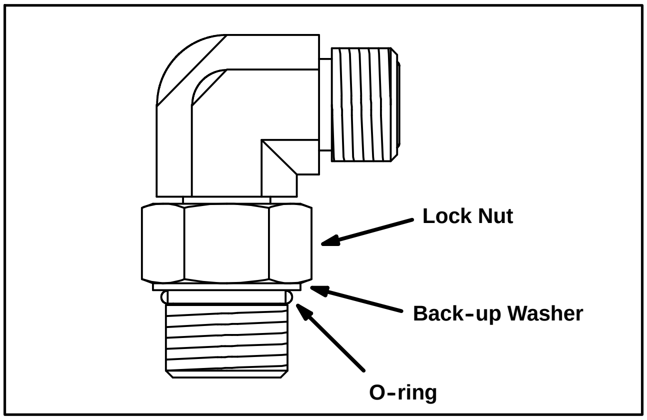


Figure 8

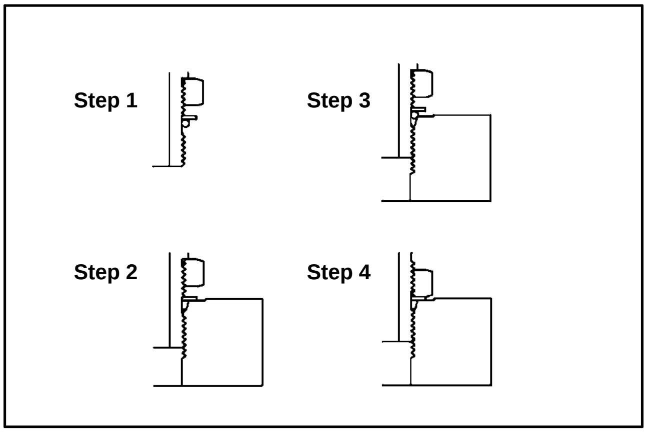
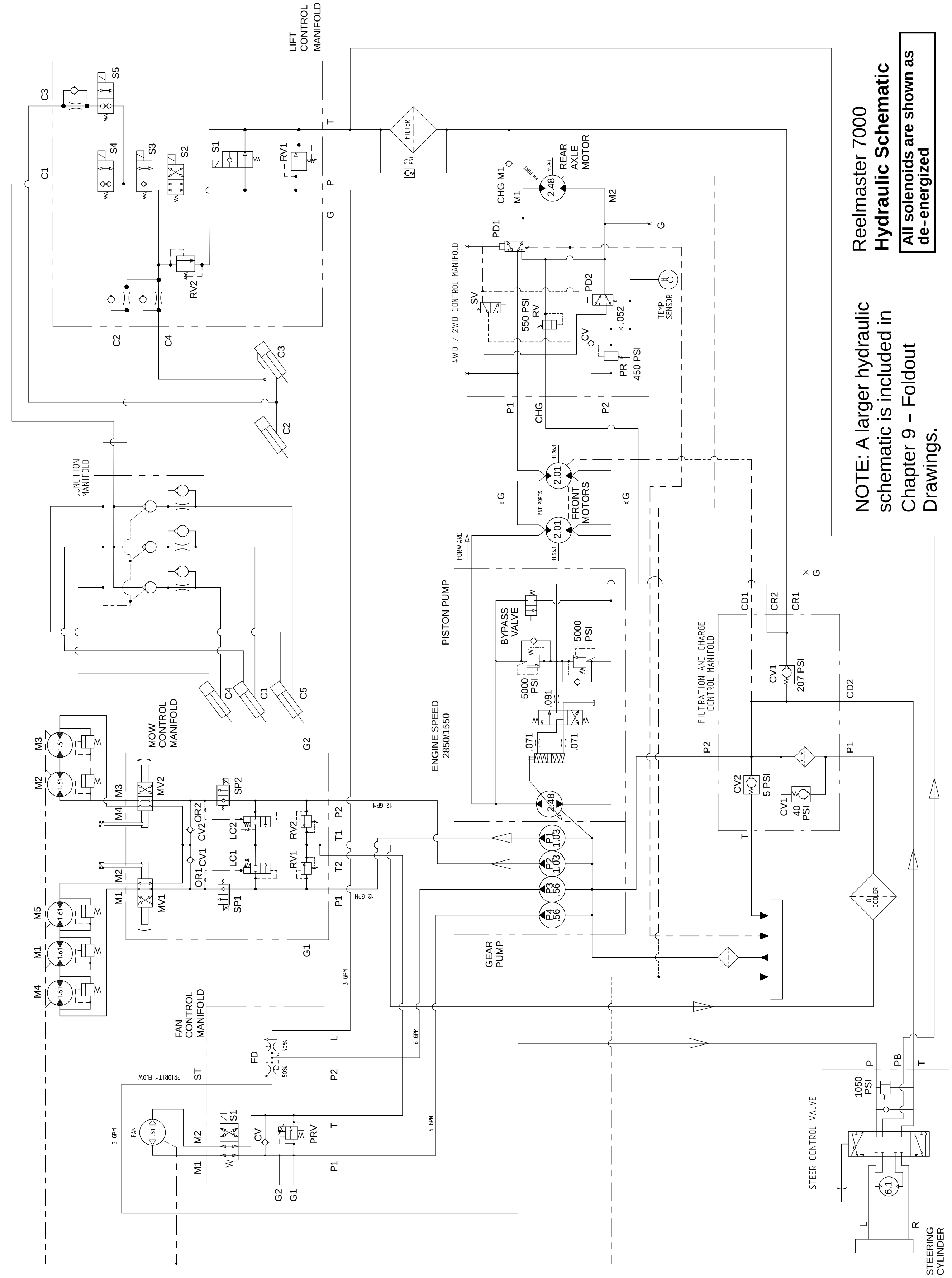


Figure 9

Hydraulic System

Hydraulic Schematic



Hydraulic System

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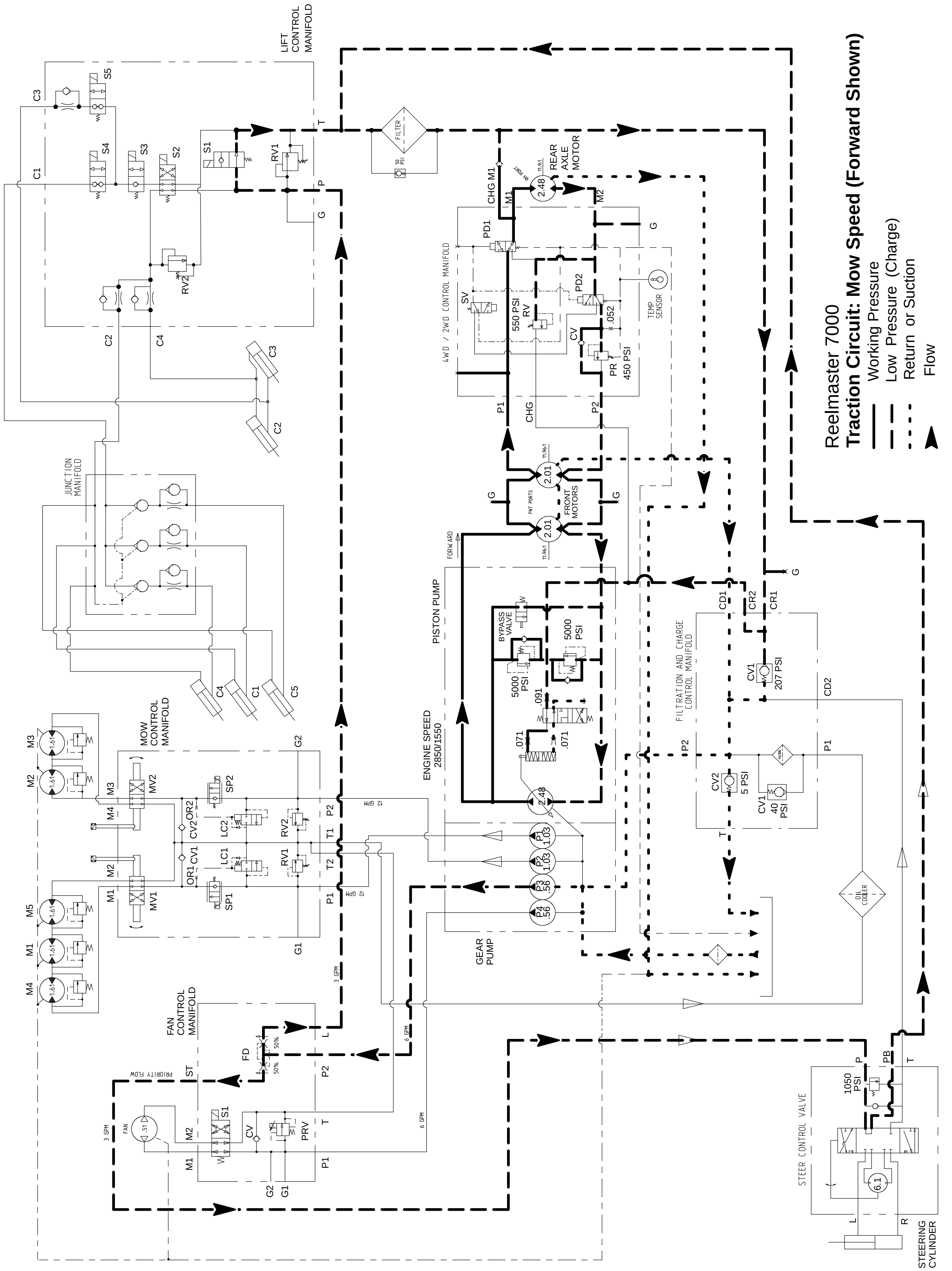
Hydraulic Flow Diagrams



Traction Circuit: Mow Speed (4WD)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. This oil is directed to the front wheel and rear axle motors. Operating pressure on the high pressure side of the closed traction circuit loop is determined by the amount of load developed at the fixed displacement wheel and axle motors. As the load increases, circuit pressure can increase to relief valve settings: 5000 PSI (345 bar) in both forward and reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit. The traction circuit provides operation in either mow speed (4WD) or transport speed (2WD).

Traction circuit pressure (forward and reverse) can be measured at test ports located on the traction circuit hydraulic tubes of the machine.

The traction circuit pump and motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The charge circuit is designed to replace this traction circuit leakage.

The gear pump section that supplies oil to the steering and lift/lower circuits also provides oil for the charge circuit. This gear pump is driven directly off the traction pump. It provides a constant supply of charge oil to make up for oil that is lost due to internal leakage in the traction pump and motors.

Pump flow for the charge circuit is directed through the oil filter and to the low pressure side of the closed loop traction circuit. A filter bypass valve allows charge oil flow to the closed loop if the filter becomes plugged. Charge pressure is limited to 207 PSI (14.3 bar) by a relief valve located in the filtration/charge control manifold. Charge pressure can be measured at the charge circuit pressure test port on the filtration/charge control manifold.

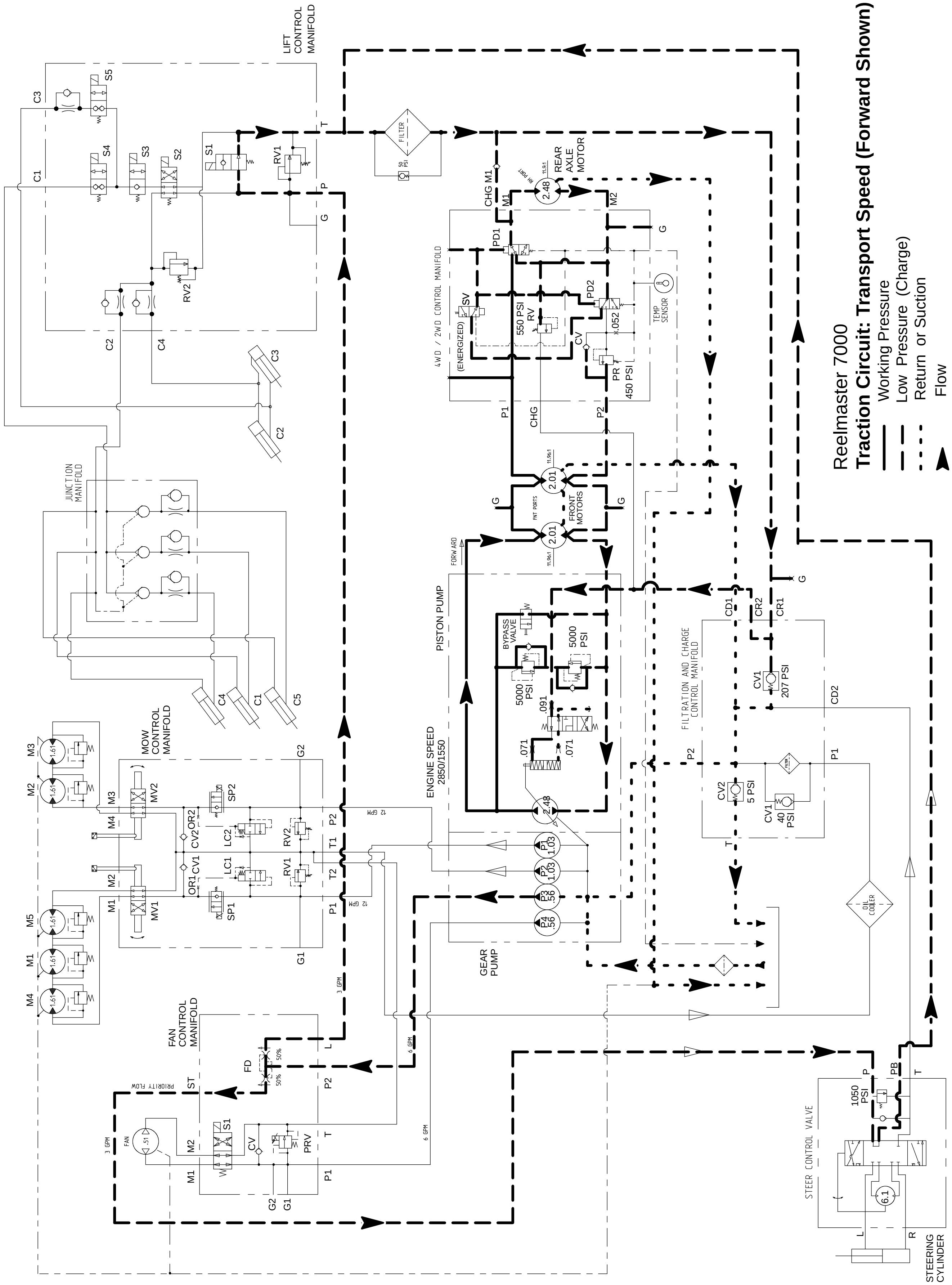
Forward Direction

When the mow speed limiter is in the mow speed (4WD) position and the traction pedal is pushed in the forward direction, oil from the piston pump is directed to the front wheel motors and 4WD/2WD control manifold. Oil flow to the front wheel motors drives the motors in the forward direction and then returns to the piston pump. Oil flow to the 4WD/2WD control manifold enters the P1 port and then is directed to the PD1 cartridge and out of the manifold M1 port to drive the rear axle motor in the forward direction. Oil returning from the rear motor re–enters the 4WD/2WD control manifold at the M2 port. Flow passes through the PD2 cartridge, through the check valve (CV), out manifold port P2 and back to the piston pump.

When going down a hill, the machine becomes an over–running load that drives the wheel and axle motors. In this condition, the rear axle motor could lock up as the oil pumped from the motor increases pressure as it returns to the piston pump. To prevent rear wheel lock up, an adjustable relief valve (RV) in the 4WD/2WD control manifold reduces rear axle motor pressure created in down hill, dynamic braking conditions.

Reverse Direction

The traction circuit operates essentially the same in reverse 4WD as it does in the forward direction. However, the flow through the circuit is reversed. Oil flow from the piston pump is directed to the front wheel motors and also to the 4WD/2WD control manifold. The oil to the front wheel motors drives them in the reverse direction and then returns to the piston pump. The oil to the 4WD/2WD control manifold enters the manifold at port P2 and flows through pressure reducing valve (PR) which limits the down stream pressure to the rear axle motor to 450 PSI (31 bar) so the rear wheels will not scuff the turf during reverse operation. This reduced pressure flows through the PD2 cartridge and out port M2 to the rear axle motor. Return oil from the rear motor re–enters the 4WD/2WD control manifold at port M1, flows through the PD1 cartridge, exits the manifold at port P1 and returns to the piston pump.


Reelmaster 7000
Traction Circuit: Transport Speed (Forward Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
JUNCTION MANIFOLD
MOW CONTROL MANIFOLD
FAN CONTROL MANIFOLD
4WD / 2WD CONTROL MANIFOLD
FILTRATION AND CHARGE CONTROL MANIFOLD
STEER CONTROL VALVE
STEERING CYLINDER
PISTON PUMP
GEAR PUMP
ENGINE SPEED 2850/1550
REAR AXLE MOTOR
FRONT MOTORS
BYPASS VALVE
OIL COOLER
FILTER
TEMP SENSOR
PRIORITY FLOW

Traction Circuit: Transport Speed (2WD)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. This oil is directed to the front wheel and rear axle motors. Operating pressure on the high pressure side of the closed traction circuit loop is determined by the amount of load developed at the fixed displacement wheel and axle motors. As the load increases, circuit pressure can increase to relief valve settings: 5000 PSI (345 bar) in both forward and reverse. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed loop traction circuit. The traction circuit provides operation in either mow speed (4WD) or transport speed (2WD).

Traction circuit pressure (forward and reverse) can be measured at test ports located on the traction circuit hydraulic tubes of the machine.

The traction circuit pump and motors use a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The charge circuit is designed to replace this traction circuit leakage.

The gear pump section that supplies oil to the steering and lift/lower circuits also provides charge oil for the traction circuit. This gear pump is driven directly off the traction pump. It provides a constant supply of charge oil to the traction circuit to make up for oil that is lost due to internal leakage in the traction pump and motors.

Charge pump flow is directed through the oil filter and to the low pressure side of the closed loop traction circuit. A filter bypass valve allows charge oil flow to the closed loop if the filter becomes plugged. Charge pressure is limited to 207 PSI (14.3 bar) by a relief valve located in the filtration/charge control manifold. Charge pressure can be measured at the test port on the filtration/charge control manifold.

NOTE: When the mow speed limiter is in the transport (2WD) position, the cutting units are prevented from being lowered and the mow circuit cannot be engaged.

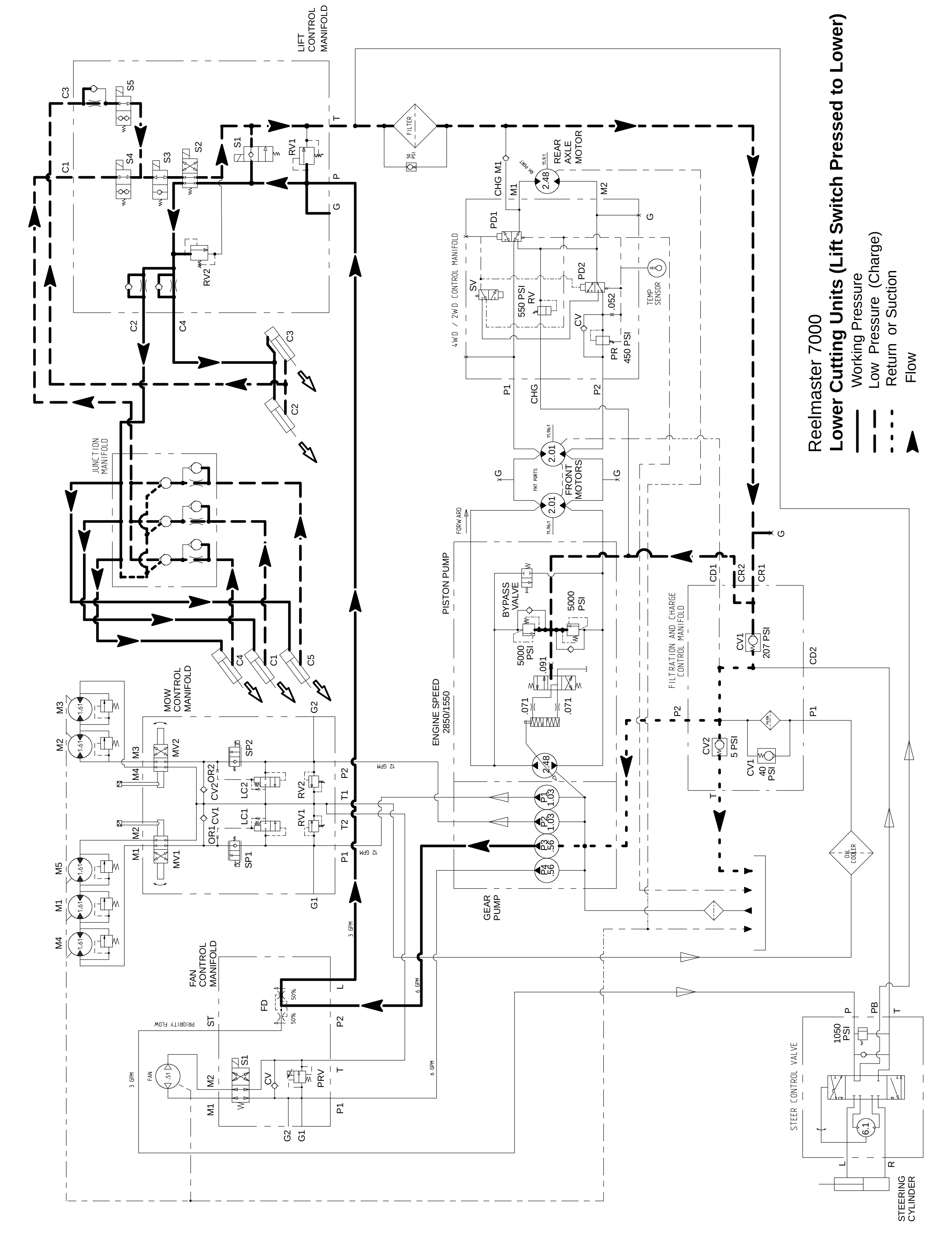
Forward Direction

With the mow speed limiter in the transport speed (2WD) position, solenoid valve (SV) in the 4WD/2WD control manifold is energized. The solenoid valve spool shifts to direct charge pressure that shifts the PD1 and PD2 control valve spools. The shifted PD1 and PD2 valves prevents hydraulic flow from the piston pump to the rear axle motor. With flow blocked to the rear axle motor, all piston pump flow is directed to the front wheel motors to allow a higher transport speed in the forward direction.

Without flow to the rear axle motor, the rotating rear wheels drive the axle motor so it acts like a pump. Inlet oil to the axle motor is provided by a check valve that allows charge circuit oil into the rear axle motor circuit. Oil leaving the axle motor enters the 4WD/2WD control manifold at port M2 and is directed back to the axle motor through the shifted PD1 cartridge and manifold port M1. To allow for rear wheel loop cooling when in forward transport speed operation, a small amount of oil exits through the shifted PD1 and PD2 cartridges that returns to the reservoir.

Reverse Direction

The traction circuit operates essentially the same in reverse transport speed as it does in the forward direction. However, the flow through the circuit is reversed. The shifted solenoid valve (SV) and directional valves PD1 and PD2 in the 4WD/2WD manifold prevent oil flow from the rear axle motor. Oil flow from the piston pump is therefore directed to only the front wheel motors. This oil drives the front wheel motors in the reverse direction and then returns to the piston pump. Oil circulation through the rear axle motor loop is the same as in the 2WD forward direction.


Reelmaster 7000
Lower Cutting Units (Lift Switch Pressed to Lower)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
FILTER
50 PSI
REAR AXLE MOTOR
4WD / 2WD CONTROL MANIFOLD
TEMP SENSOR
550 PSI
450 PSI
JUNCTION MANIFOLD
FRONT MOTORS
PISTON PUMP
BYPASS VALVE
5000 PSI
ENGINE SPEED 2850/1550
FILTRATION AND CHARGE CONTROL MANIFOLD
207 PSI
5 PSI
40 PSI
OIL COOLER
MOW CONTROL MANIFOLD
GEAR PUMP
FAN CONTROL MANIFOLD
PRIORITY FLOW
STEER CONTROL VALVE
1050 PSI
STEERING CYLINDER

Lower Cutting Units

A four section gear pump is coupled to the piston (traction) pump. Gear pump section P3 supplies hydraulic flow to both the lift control manifold and the steering control valve. Hydraulic flow from this pump section is delivered to the circuits through a proportional flow divider located in the fan control manifold. Maximum lift/lower circuit pressure is limited to 1700 PSI (117 bar) by a relief valve (RV1) in the lift control manifold. Lift circuit pressure can be monitored at the test fitting in lift control manifold port G.

A single lift switch on the console arm is used to raise and lower the five (5) cutting units (Fig. 10). The lift switch acts as an input to the TEC controller to send electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

When the cutting units are in a stationary position (not raising or lowering), lift circuit flow from gear pump section P3 bypasses the lift cylinders through the lift control manifold solenoid valve S1 (de–energized). Return flow from the manifold is routed to the oil filter and traction charge circuit.

Cutting Unit Lower

NOTE: The operator must be in the operator seat in order to lower the cutting units. Also, when in transport speed (2WD), the cutting units will not lower.

When the lift switch is pressed to the lower position, solenoid valve S1 along with solenoid valves S3, S4 and S5 are energized by the TEC controller. To allow the front cutting units to be lowered before the rear cutting units, the controller slightly delays energizing solenoid S5 after the lift switch is pressed. The energized solenoid valves direct gear pump oil flow to the barrel end of the lift cylinders. Flow control orifices in the lift control manifold (C2 and C4) are bypassed when lowering the cutting units.

Hydraulic pressure causes the lift cylinder shafts to extend, and lower the cutting units. The three (3) piloted check valves in the junction manifold are shifted by hydraulic pressure to allow return flow from the extending lift cylinders for the front cutting units. Flow control orifices in the junction manifold control the front cutting unit lowering speed by providing a restriction for the return flow from the front lift cylinders. Rear cutting unit lowering speed is controlled by a flow control orifice in the lift control manifold (port C3).

Because cutting unit weight assists in extending the lift cylinders when lowering the cutting units, less hydraulic pressure is necessary during the cutting unit lowering operation. Lift circuit lower relief valve (RV2) allows lift circuit pressure to be limited to 500 PSI (34 bar) while lowering the cutting units.

NOTE: Adjustment of lift circuit lower relief valve (RV2) is not recommended.

When the lift switch is released, solenoid valves S1, S3, S4 and S5 are de–energized and the lift cylinders and cutting units are held in position.

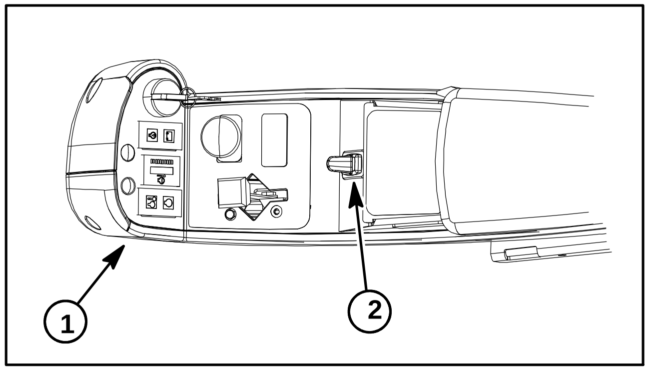


Figure 10

1. **Console**
2. **Lift switch**

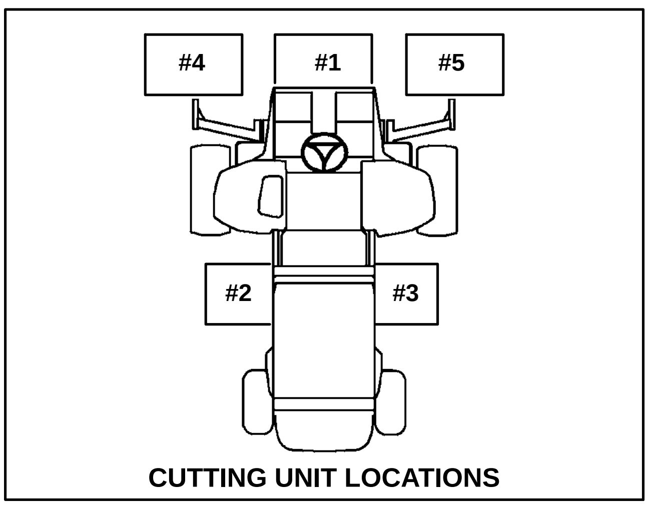
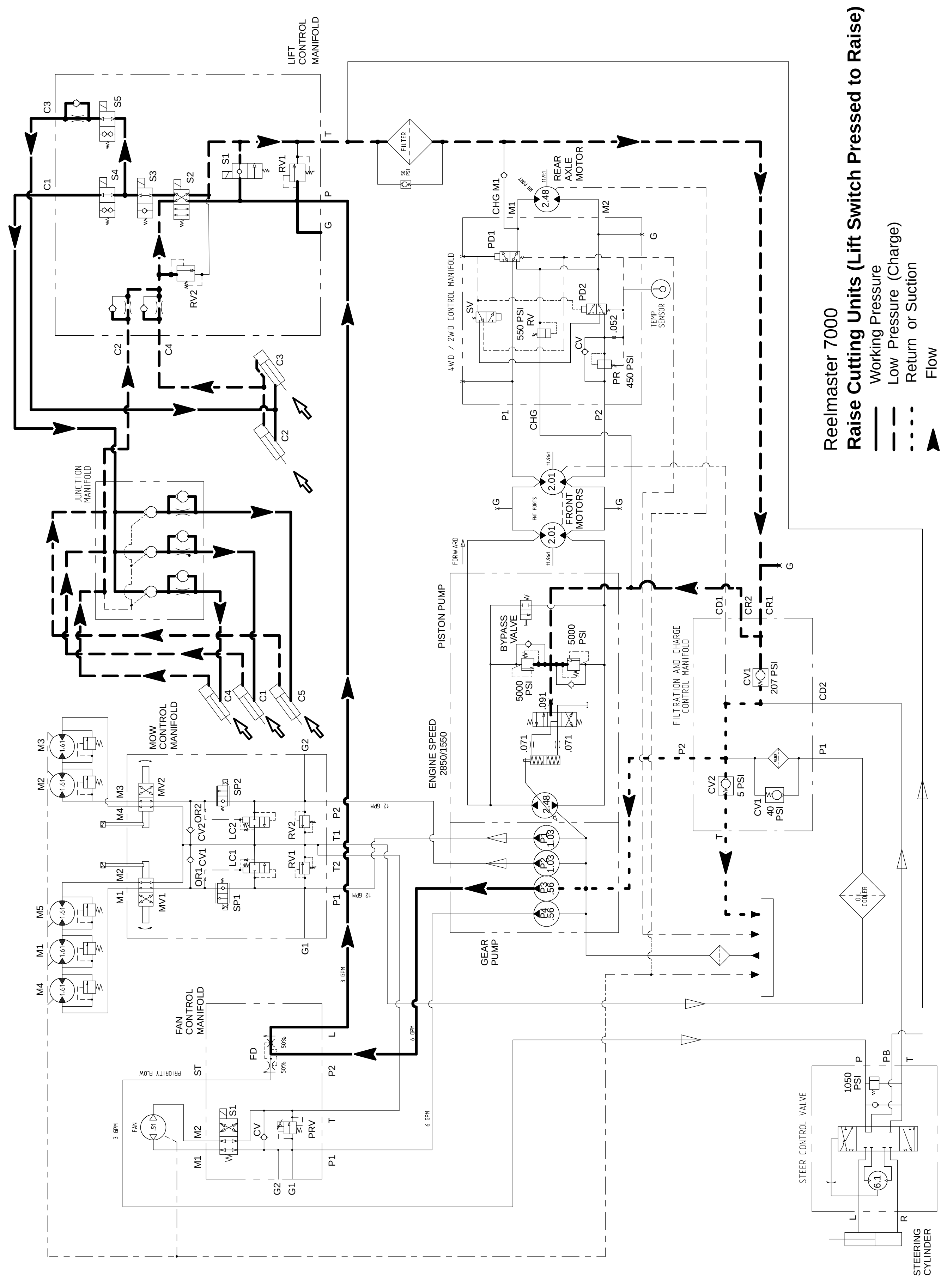


Figure 11


Reelmaster 7000
Raise Cutting Units (Lift Switch Pressed to Raise)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
JUNCTION MANIFOLD
MOW CONTROL MANIFOLD
FAN CONTROL MANIFOLD
4WD / 2WD CONTROL MANIFOLD
FILTRATION AND CHARGE CONTROL MANIFOLD
STEER CONTROL VALVE
STEERING CYLINDER
PISTON PUMP
GEAR PUMP
BYPASS VALVE
ENGINE SPEED 2850/1550
FRONT MOTORS
REAR AXLE MOTOR
TEMP SENSOR
FILTER
OIL COOLER
550 PSI RV
450 PSI
5000 PSI
207 PSI
40 PSI
5 PSI
1050 PSI
PRIORITY FLOW

Raise Cutting Units

A four section gear pump is coupled to the piston (traction) pump. Gear pump section P3 supplies hydraulic flow to both the lift control manifold and the steering control valve. Hydraulic flow from this pump section is delivered to the circuits through a proportional flow divider located in the fan control manifold. Maximum lift/lower circuit pressure is limited to 1700 PSI (117 bar) by a relief valve (RV1) in the lift control manifold. Lift circuit pressure can be monitored at the test fitting in lift control manifold port G.

A single lift switch on the console arm is used to raise and lower the five (5) cutting units (Fig. 10). The lift switch acts as an input to the TEC controller to send electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

When the cutting units are in a stationary position (not raising or lowering), lift circuit flow from gear pump section P3 bypasses the lift cylinders through the lift control manifold solenoid valve S1 (de–energized). Return flow from the manifold is routed to the oil filter and traction charge circuit.

Raise Cutting Units

NOTE: The operator must be in the operator seat in order to raise the cutting units.

When the lift switch is moved to the raise position, solenoid valve S1 along with solenoid valves S2, S3, S4 and S5 are energized by the TEC controller. To allow the front cutting units to be raised before the rear cutting units, the controller slightly delays energizing solenoid S5 after the lift switch is pressed. The energized solenoid valves direct gear pump oil flow to the rod end of the lift cylinders. The flow control orifice in the lift control manifold port C3 is bypassed when raising the cutting units.

Hydraulic pressure causes the lift cylinder shafts to retract, and raise the cutting units. The flow control orifices in the junction manifold are bypassed when raising the cutting units. Flow control orifices in the lift control manifold (ports C2 and C4) control the cutting unit raising speed by providing a restriction for the return flow from the lift cylinders.

When the lift switch is released, solenoid valves S1, S2, S3, S4 and S5 are de–energized and the lift cylinders and cutting units are held in position.

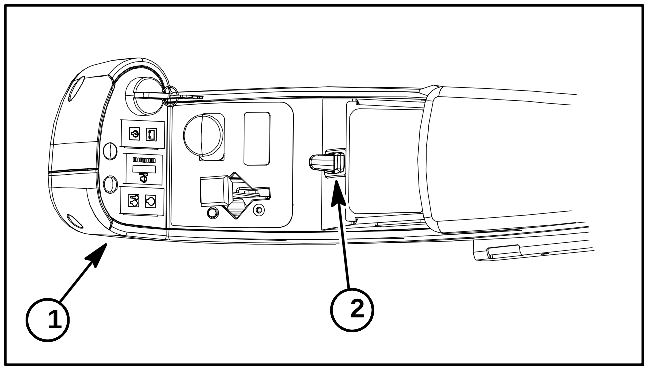


Figure 12

1. **Console**
2. **Lift switch**

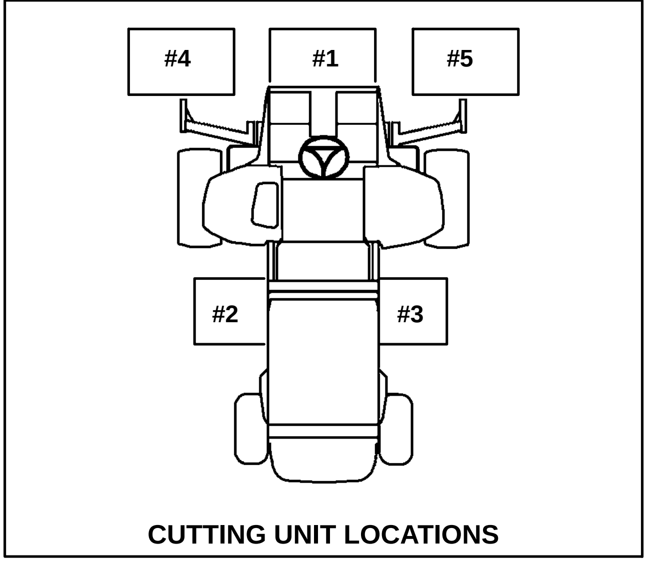
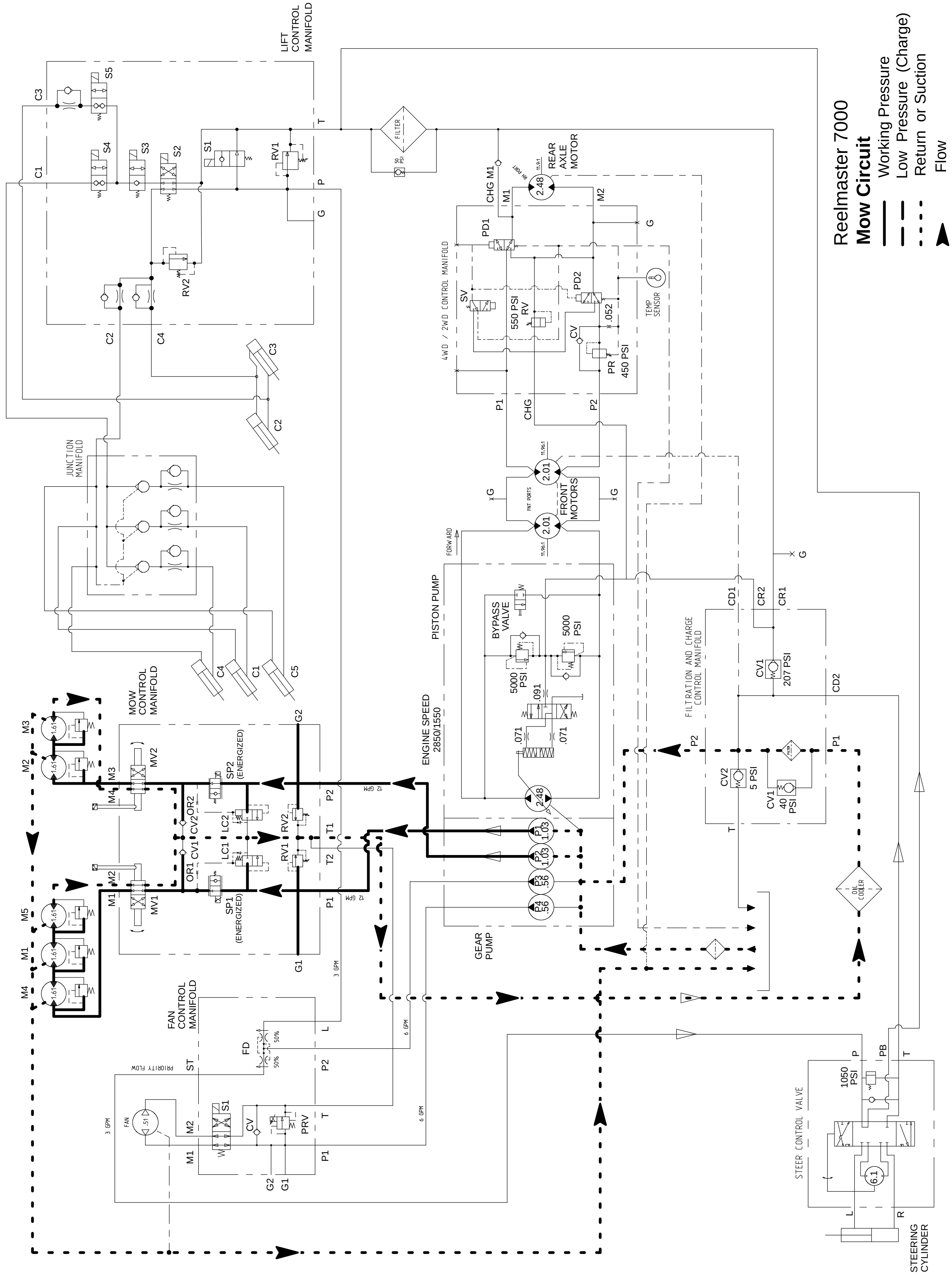


Figure 13


Reelmaster 7000
Mow Circuit
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
JUNCTION MANIFOLD
MOW CONTROL MANIFOLD
FAN CONTROL MANIFOLD
PISTON PUMP
GEAR PUMP
ENGINE SPEED 2850/1550
BYPASS VALVE
FRONT MOTORS
REAR AXLE MOTOR
4WD / 2WD CONTROL MANIFOLD
FILTRATION AND CHARGE CONTROL MANIFOLD
STEER CONTROL VALVE
STEERING CYLINDER
OIL COOLER
FILTER
TEMP SENSOR
FORWARD
PRIORITY FLOW
550 PSI
450 PSI
5000 PSI
207 PSI
5 PSI
40 PSI
1050 PSI
(ENERGIZED)

Mow Circuit

Hydraulic flow for the mow circuit is supplied by two (2) sections of the gear pump (P1 and P2). Gear pump section P1 supplies hydraulic flow to cutting units 1, 4 and 5 (front cutting units), while gear pump section P2 supplies cutting units 2 and 3 (rear cutting units).

A single mow control manifold is used to control flow from the two (2) pump sections. The manifold includes cartridge valves for control of each of the two (2) pump circuits. Each manifold circuit is equipped with a solenoid controlled, proportional valve (SP1 and SP2), a logic cartridge (LC1 and LC2) and a circuit relief cartridge (RV1 and RV2).

All cutting reel motors are equipped with cross over relief valves to prevent hydraulic component damage in case a cutting reel should stall.

The TEC controller uses inputs from various machine switches to determine when solenoid proportional valve (SP1 and SP2) are to be energized. The controller also provides a slight delay in activation of the rear cutting units.

NOTE: When the mow speed limiter is in the transport (2WD) position, the mow circuit cannot be engaged.

PTO Disengaged (Fig. 15)

When the PTO switch is OFF (or if the cutting units are raised), the manifold proportional valves (SP1 and SP2) are not energized, which causes a pressure increase that shifts the logic cartridges (LC1 and LC2). The pump flow is routed through the shifted logic cartridge and out manifold port T1. Return oil from the manifold is directed to the oil cooler and oil filter.

PTO Engaged

When the PTO switch is turned ON with the cutting units lowered, the manifold proportional valves (SP1 and SP2) are energized with outputs from the TEC–5002 controller. The energized valves shift to direct pump flow toward the cutting unit motors. Flow from the valves is proportional to current applied to the valve coil by the TEC controller. The setting of the reel speed control provides the input for the TEC controller to allow the appropriate current to the valve coil.

Flow through the speed control valve is pressure compensated by the logic cartridge valves (LC1 and LC2). The logic cartridge valve maintains a pressure of 110 PSI (7.6 bar) across the proportional valve. Any excess flow is returned to the hydraulic reservoir.

Maximum mow circuit pressure is limited at each mow manifold circuit by the relief valve (RV1 or RV2). The relief valve pressure is 3000 PSI (207 bar).

When the reels are shut off, the over–running inertia load of the reels keeps driving the reel motors and can turn them into pumps. The check valves (CV1 and CV2) in the mow control manifold will open to keep the reel motor circuit full of oil so the motors will not cavitate.

Backlap

When either of the mow control manifold backlap valves are rotated to the backlap (R) position, pump flow to the cutting unit motors is reversed. This change in flow direction reverses the rotation of the front or rear cutting reel motors allowing the backlap operation.

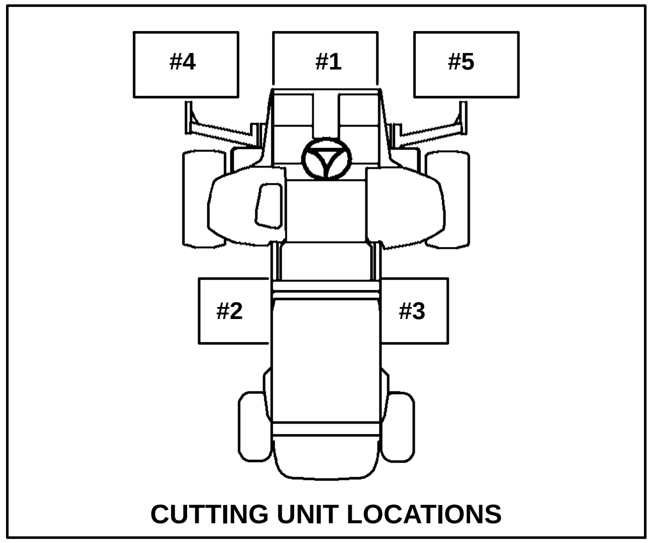


Figure 14

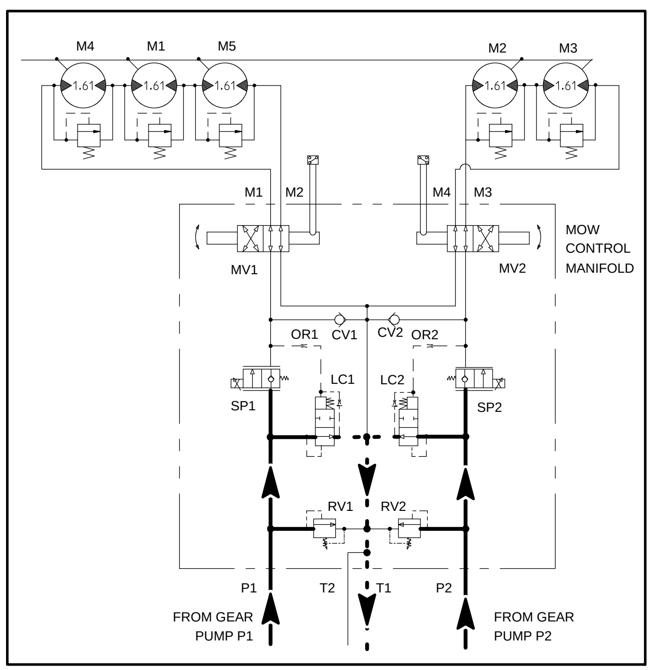
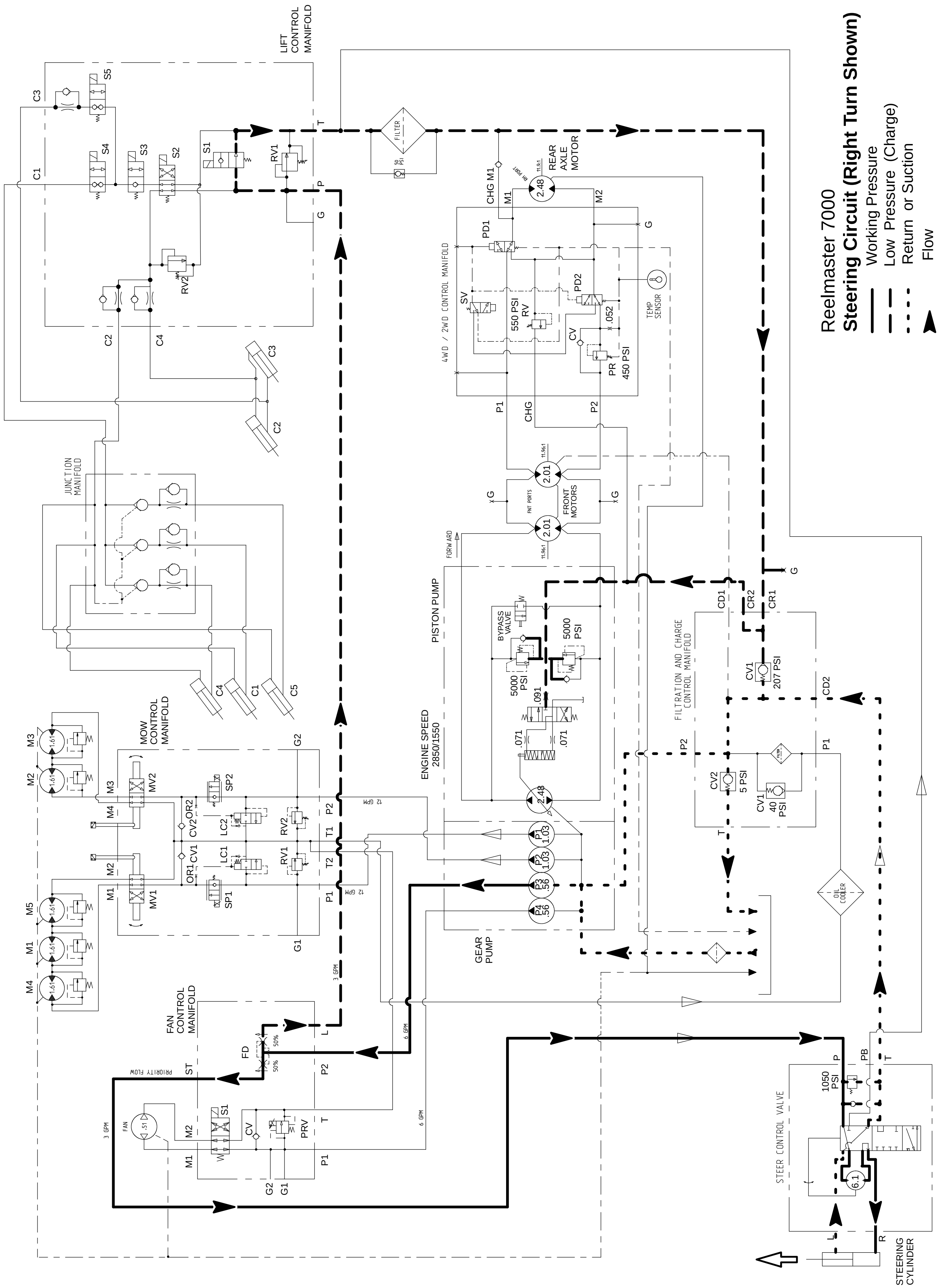


Figure 15


Reelmaster 7000
Steering Circuit (Right Turn Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
JUNCTION MANIFOLD
MOW CONTROL MANIFOLD
FAN CONTROL MANIFOLD
4WD / 2WD CONTROL MANIFOLD
REAR AXLE MOTOR
FRONT MOTORS
PISTON PUMP
ENGINE SPEED 2850/1550
GEAR PUMP
FILTRATION AND CHARGE CONTROL MANIFOLD
OIL COOLER
STEER CONTROL VALVE
STEERING CYLINDER
PRIORITY FLOW
TEMP SENSOR
FILTER

Steering Circuit

A four section gear pump is coupled to the piston (traction) pump. The gear pump section P3 supplies hydraulic flow to the steering control valve and the lift control manifold. Gear pump hydraulic flow is delivered to the two circuits through a proportional flow divider located in the fan control manifold. The steering circuit receives priority flow from the flow divider. Steering circuit pressure is limited to 1050 PSI (72 bar) by a relief valve located in the steering control valve.

With the steering wheel in the neutral position and the engine running, pump section P3 flow enters the steering control valve at the P port and goes through the steering control spool valve, bypassing the rotary meter and steering cylinder. Flow leaves the control valve through the PB port to the oil filter and traction charge circuit.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. First, most of the flow through the valve is bypassed out the PB port back to the oil filter and traction charge circuit. Second, the remainder of the flow is drawn through the rotary meter and out the L port. Pressure contracts the steering cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the T port and to the hydraulic reservoir.

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

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. As in a left turn, most of the flow through the valve is bypassed out the PB port back to the oil filter and traction charge circuit. Also like a left turn, the remainder of the flow is drawn through rotary meter but goes out port R. Pressure extends the steering cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the T port and to the hydraulic reservoir.

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

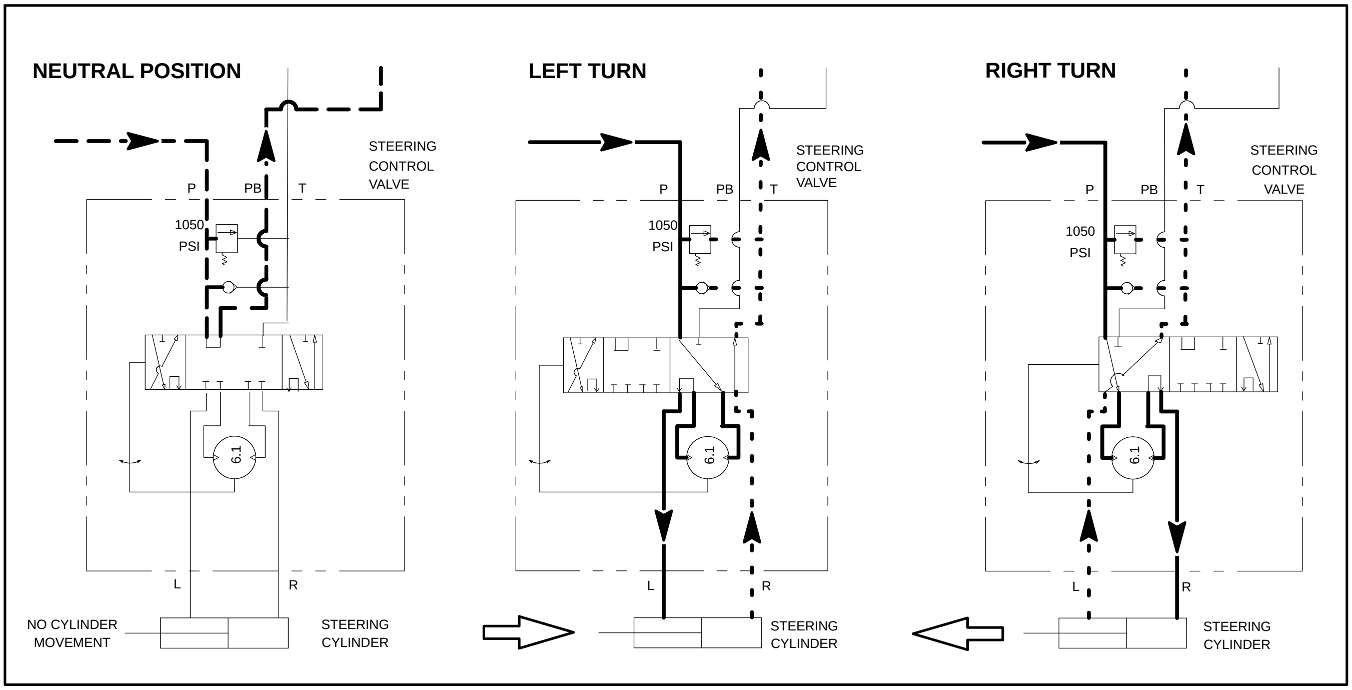
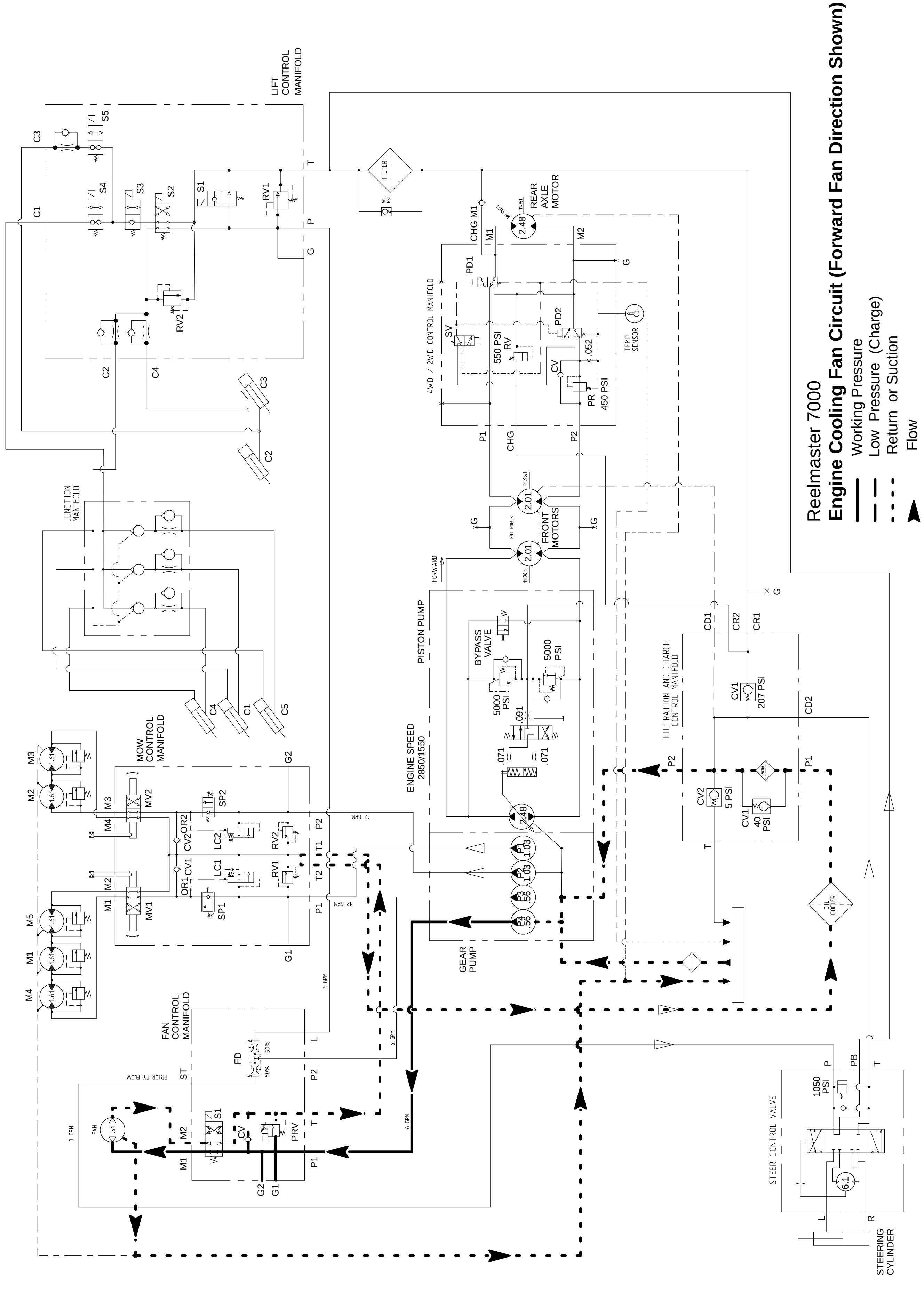


Figure 16


Reelmaster 7000
Engine Cooling Fan Circuit (Forward Fan Direction Shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CONTROL MANIFOLD
JUNCTION MANIFOLD
MOW CONTROL MANIFOLD
FAN CONTROL MANIFOLD
4WD / 2WD CONTROL MANIFOLD
FILTRATION AND CHARGE CONTROL MANIFOLD
STEER CONTROL VALVE
STEERING CYLINDER
PISTON PUMP
GEAR PUMP
ENGINE SPEED 2850/1550
REAR AXLE MOTOR
FRONT MOTORS
BYPASS VALVE
OIL COOLER
FILTER
TEMP SENSOR
PRIORITY FLOW

Engine Cooling Fan Circuit

A four section gear pump is coupled to the piston (traction) pump. The gear pump section P4 (farthest from the piston pump) supplies hydraulic flow for the hydraulic engine cooling fan motor (Fig. 17).

The fan control manifold controls the operation of the hydraulic motor that drives the engine cooling fan in addition to including the flow divider (FD) for the steering and lift circuits. The electronically controlled proportional relief valve (PRV) in the manifold controls the oil flow to the fan motor. The fan control manifold controls the speed and direction of the fan motor based on electrical output from the TEC controller.

Oil flow from the gear pump to the cooling fan motor is controlled by the proportional relief valve (PRV) in the fan control manifold. This valve adjusts fan circuit flow based on a PWM (Pulse Width Modulation) signal from the TEC controller. The controller uses engine coolant and hydraulic oil temperatures as inputs to determine the proper PWM signal for the PRV valve. The fan circuit flow determines the speed of the cooling fan motor.

> The fan motor runs at reduced speed until coolant reaches approximately 165^{o}F (74^{o}C). The fan motor increases to full speed (approximately 2800 RPM) as coolant reaches 180^{o}F (82^{o}C).
>
> The fan motor automatically slows down and then reverses direction if coolant reaches 203^{o}F (95^{o}C) or hydraulic oil reaches 212^{o}F (100^{o}C).

If the fan motor is stalled for any reason, the manifold proportional relief valve (PRV) has a secondary function as a circuit relief to limit fan motor pressure to 3000 PSI (207 bar).

When the engine is shut off, the over–running inertia load of the fan blades keeps driving the fan motor and turns it into a pump. The check valve (CV) in the fan control manifold will open to keep the motor circuit full of oil so the fan motor will not cavitate.

NOTE: If PWM current is not available to the fan control manifold proportional relief valve (PRV), the cooling fan motor will run at full speed in the normal (forward) direction.

Forward Direction Fan Operation

Oil flow from the gear pump is sent through the de–energized solenoid valve S1 to rotate the cooling fan motor. Return flow from the motor re–enters the manifold (port M2), through the de–energized solenoid valve S1, out of the manifold (port T) and then is routed through the mow control manifold, oil cooler and oil filter.

Reverse Direction Fan Operation (Fig. 18)

The TEC controller can reverse the cooling fan to clean debris from the rear intake screen. If hydraulic oil and/or engine coolant temperatures increase to an unsuitable level or if the engine cooling fan switch is pressed to manual reverse, a high PWM signal is sent to the PRV valve to slow the cooling fan and direct pump oil flow away from the fan motor. The controller then energizes solenoid valve S1 in the fan control manifold to reverse cooling fan motor oil flow so that the motor runs in the reverse direction. A lower PWM signal is sent to the PRV valve allowing oil flow to return to the fan motor but in the reverse direction causing the motor and cooling fan to run in reverse for a short time.

NOTE: The fan reversal process is not designed to clean the radiator of debris. Refer to Operator's Manual for radiator cleaning maintenance recommendations.

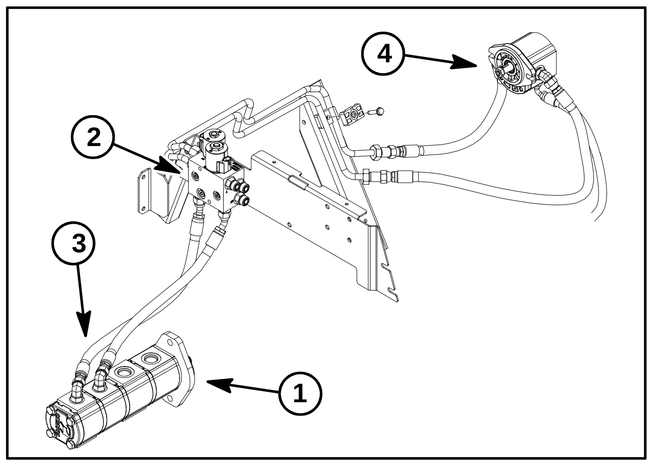


Figure 17

1. **Gear pump**
2. **Fan control manifold**
3. **Fan circuit supply hose**
4. **Hydraulic fan motor**

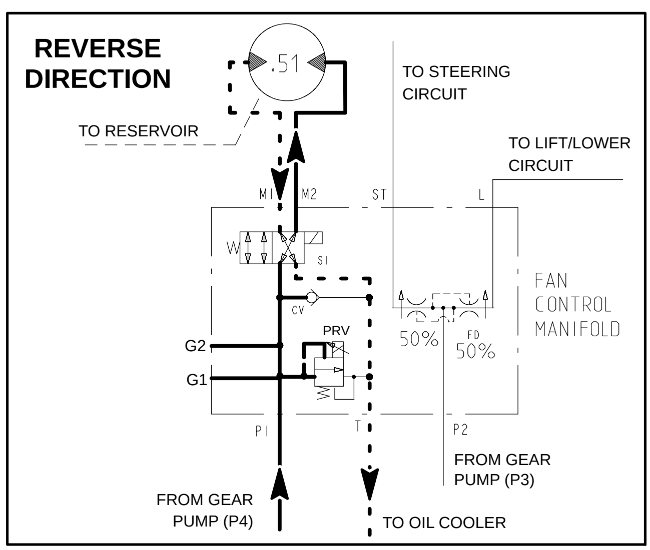


Figure 18

Special Tools

Order the following special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

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

Toro Part Number: **TOR47009**

Figure 19

Hydraulic Tester (Pressure and Flow)

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

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

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

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

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

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

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

Toro Part Number: **TOR214678**

Figure 20

40 GPM Hydraulic Tester (Pressure and Flow)

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

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

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

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

Toro Part Number: **AT40002**

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

Figure 21

Hydraulic Hose Kit

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

Toro Part Number: **TOR6007**

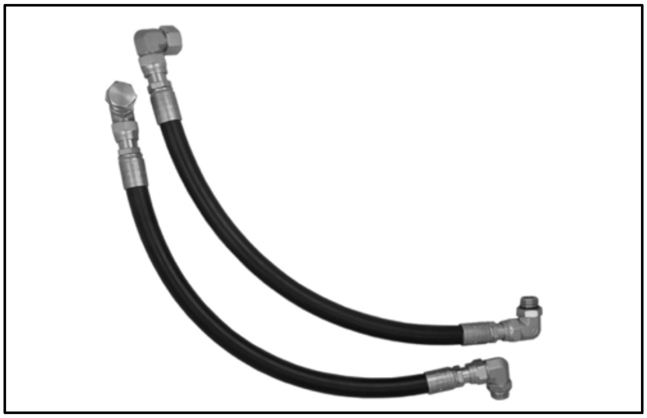


Figure 22

High Flow Hydraulic Filter Kit

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

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

Toro Part Number: **TOR6011**

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

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

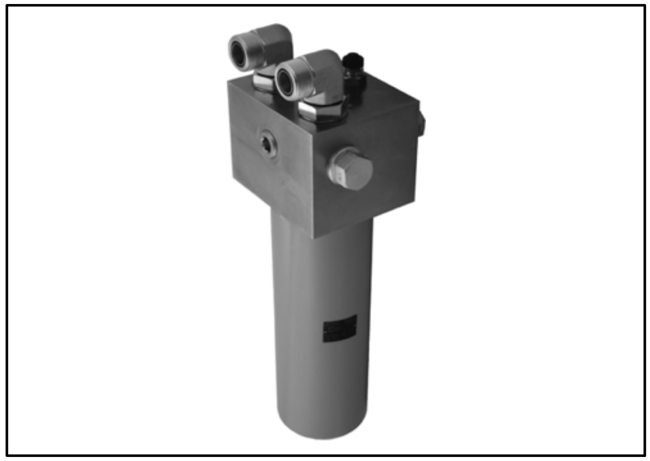


Figure 23

Hydraulic Test Fitting Kit

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

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

Toro Part Number: **TOR4079**

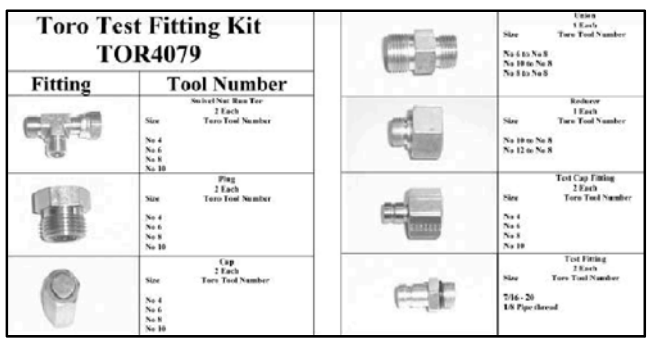


Figure 24

Measuring Container

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

The table in Figure 26 provides gallons per minute (GPM) conversion for measured milliliter or ounce motor case drain leakage.

Toro Part Number: **TOR4077**

Figure 25

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 26

O-ring Kit

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

Toro Part Number: **117-2727**

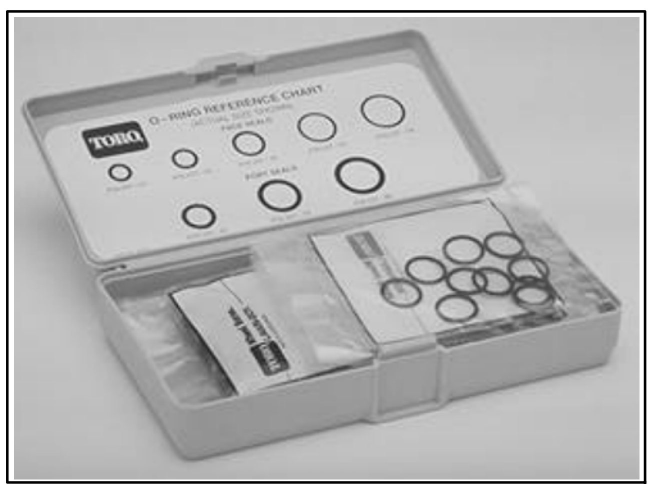


Figure 27

Troubleshooting

The charts that follow contain information to assist in hydraulic system troubleshooting. There may possibly be more than one cause for a machine malfunction.

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

General Hydraulic System Problems

Problem	Possible Cause
Hydraulic system operates hot. **NOTE:** An indication that the hydraulic system is operating at excessive temperatures would be frequent reversing of the cooling fan and a normal engine coolant temperature.	Engine RPM is too low. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Brakes are applied or sticking. Piston pump bypass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Engine cooling fan circuit is malfunctioning (see Engine Cooling Fan Circuit Problems in this section). Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking in suction line.
Hydraulic oil leak(s).	Fitting(s), hose or tube loose or damaged. Missing or damaged O-ring in fitting.

Traction Circuit Problems

NOTE: When troubleshooting traction circuit problems, if a problem exists in both mow speed (4WD) and transport speed (2WD), consider a faulty component that affects the entire traction circuit (e.g. charge circuit, relief valves, piston pump, front wheel motors). If the problem exists in mow speed (4WD) but not in transport speed (2WD), consider a problem in the 4WD traction system (e.g. rear axle motor, cartridge valves in 4WD/2WD control manifold).

Problem	Possible Cause
Machine operates in one direction only.	Traction control linkage is faulty. Traction relief valve is defective.
Traction pedal reaction is sluggish when in either mow speed (4WD) or transport speed (2WD).	Traction control linkage is stuck or binding. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged.
Traction pedal reaction is sluggish when in mow speed (4WD). Pedal reaction is normal when in transport speed (2WD).	PD1 and PD2 pilot directional valve seals in 4WD/2WD control manifold are leaking or damaged.
Machine travels too far before stopping when the traction pedal is released.	Traction linkage is out of adjustment. Charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged. Traction pedal does not return to neutral.
Traction power is lost or machine will not operate in either direction.	Hydraulic reservoir oil level is low. Piston pump bypass valve is open or damaged. Charge pressure is low. Traction circuit pressure is low. Front wheel motor couplers are damaged. If traction is lost in mow speed (4WD) but is normal in transport speed (2WD), rear axle motor or rear axle motor drive may be faulty.
Mow speed (4WD) will not engage.	Electrical problem exists (see Chapter 5 – Electrical System). Solenoid valve SV in 4WD/2WD control manifold is faulty. Cartridge valve(s) in 4WD/2WD control manifold is (are) faulty.
Mow speed (4WD) will not disengage.	Electrical problem exists (see Chapter 5 – Electrical System). Cutting units are fully lowered. Cartridge valve in 4WD/2WD control manifold is damaged or sticking.

PTO Problems

Problem	Possible Cause
None of the cutting units will operate. **NOTE:** Cutting units have to be fully lowered and traction speed needs to be in mow speed (4WD) for cutting units to operate.	Cutting units are not fully lowered to ground. Operator seat is unoccupied. Mow speed limiter is in transport (2WD) position. Electrical problem exists that prevents mow control manifold solenoid valve operation (see Chapter 5 – Electrical System). Gear pump sections P1 and P2 are damaged. Gear pump coupler is damaged (other hydraulic circuits will be affected as well).
One cutting unit will not operate.	System pressure to the affected cutting unit motor is low. Cutting unit problem exists (see Chapter 8 – Cutting Units). Spline on affected cutting unit motor is damaged. Cutting unit motor relief valve is stuck or damaged. Cutting unit motor is damaged. NOTE: If appropriate, transfer a suspected damaged motor to another cutting unit. If problem follows the motor, motor needs repair or replacement.
Several cutting units will not operate.	Electrical problem exists that prevents mow control manifold solenoid valve operation (see Chapter 5 – Electrical System). Cutting units are not fully lowered to ground. Mow control manifold proportional valve (SP1 or SP2) for affected cutting units is faulty. Mow control manifold logic cartridge valve (LC1 or LC2) for affected cutting units is stuck or damaged. Mow control manifold check valve (CV1 or CV2) for affected cutting units is stuck or damaged. Gear pump section (P1 or P2) is worn or damaged.

PTO Problems (Continued)

Problem	Possible Cause
All cutting units operate slowly.	Engine RPM is low. Cutting unit motor is damaged. Gear pump section (P1 or P2) is worn or damaged.
Cutting unit stops under load.	Relief valve in mow control manifold is bypassing. Cutting conditions (e.g. very tall or wet grass) exceed cutting unit capacity. Cutting unit motor relief valve is stuck or damaged. Cutting unit motor has internal leakage (bypassing oil). Gear pump section (P1 or P2) for affected cutting units is worn or damaged.

Steering Circuit Problems

Problem	Possible Cause
Steering inoperative or sluggish.	Steering components (e.g. tie rods, steering cylinder ends) are worn or binding. Steering cylinder is binding. Oil level in hydraulic reservoir is low (other hydraulic systems affected as well). Steering relief valve in steering control valve is stuck or damaged. Flow divider (FD) in fan control manifold is faulty. Steering cylinder leaks internally. Steering control valve is worn or damaged. Gear pump section (P3) is worn or damaged (NOTE: A worn or damaged gear pump section (P3) will also affect the traction (charge) and lift circuits).

Lift/Lower Circuit Problems

Problem	Possible Cause
Cutting units will not raise. **NOTE:** Operator must be in seat in order to raise the cutting units.	Operator seat is unoccupied. Hydraulic oil level in reservoir is low. Electrical problem exists that prevents lift control manifold solenoid valve operation (see Chapter 5 – Electrical System). Lift cylinder(s) is (are) damaged. Lift arm pivots are binding. Lift/lower circuit relief valve (RV1) in lift control manifold is stuck open. Solenoid valve(s) in lift control manifold is damaged or sticking. Flow divider (FD) in fan control manifold is faulty. Gear pump section (P3) is worn or damaged (NOTE: A worn or damaged gear pump section (P3) will also affect the traction (charge) and steering circuits).
Cutting units raise, but will not stay up. **NOTE:** Lift cylinders cannot provide an absolutely perfect seal. The lift arms will eventually lower if left in the raised position during storage.	Lift circuit hydraulic lines or fittings are leaking. Cartridge valve in lift control manifold is stuck open. Air exists in lift circuit. Lift cylinder is damaged.
Cutting units will not lower. **NOTE:** Operator must be in seat and traction system must be in mow speed (4WD) in order to lower the cutting units.	Operator seat is unoccupied. Mow speed limiter is in transport (2WD) position. Electrical problem exists that prevents lift control manifold solenoid valve operation (see Chapter 5 – Electrical System). Lift arm pivots are binding. Lift cylinder(s) is (are) is damaged. Lower circuit relief valve (RV2) in lift control manifold is stuck open. Solenoid valve(s) in lift control manifold is damaged or sticking.

Engine Cooling Fan Circuit Problems

Problem	Possible Cause
Cooling fan runs only in forward direction (fan does not run in reverse direction).	Fan control manifold solenoid cartridge valve (S1) is faulty. Electrical problem exists that prevents fan control manifold solenoid valve (S1) operation (see Chapter 5 – Electrical System).
Cooling fan does not rotate.	Fan motor is worn or damaged. Gear pump section (P4) is worn or damaged.
Cooling fan always rotates at slow speed.	Fan control manifold cartridge valve seals are leaking. Check valve in fan control manifold is not seating. Fan control manifold proportional relief valve (PRV) is stuck open. Hydraulic fan motor is worn or damaged.
Cooling fan always rotates at fast speed.	Fan control manifold proportional relief valve (PRV) is faulty. Electrical problem exists that prevents fan control manifold proportional relief valve (PRV) operation (see Chapter 5 – Electrical System).

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 oil supply, filter, binding linkages, loose fasteners or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

WARNING

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

CAUTION

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

CAUTION

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

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.

Precautions for Hydraulic Testing

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

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

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

4. When using hydraulic tester with pressure and flow capabilities, the inlet and the outlet hoses must be properly connected and not reversed to prevent damage to the hydraulic tester or machine components.

5. When using hydraulic tester with pressure and flow capabilities, open load valve completely in the tester to minimize the possibility of damaging components.

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

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

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

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

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

11. Before returning machine to use, make sure that hydraulic reservoir has correct fluid level.

Which Hydraulic Tests Are Necessary?

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, mow circuit, lift/lower circuit, steering circuit or engine cooling fan circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

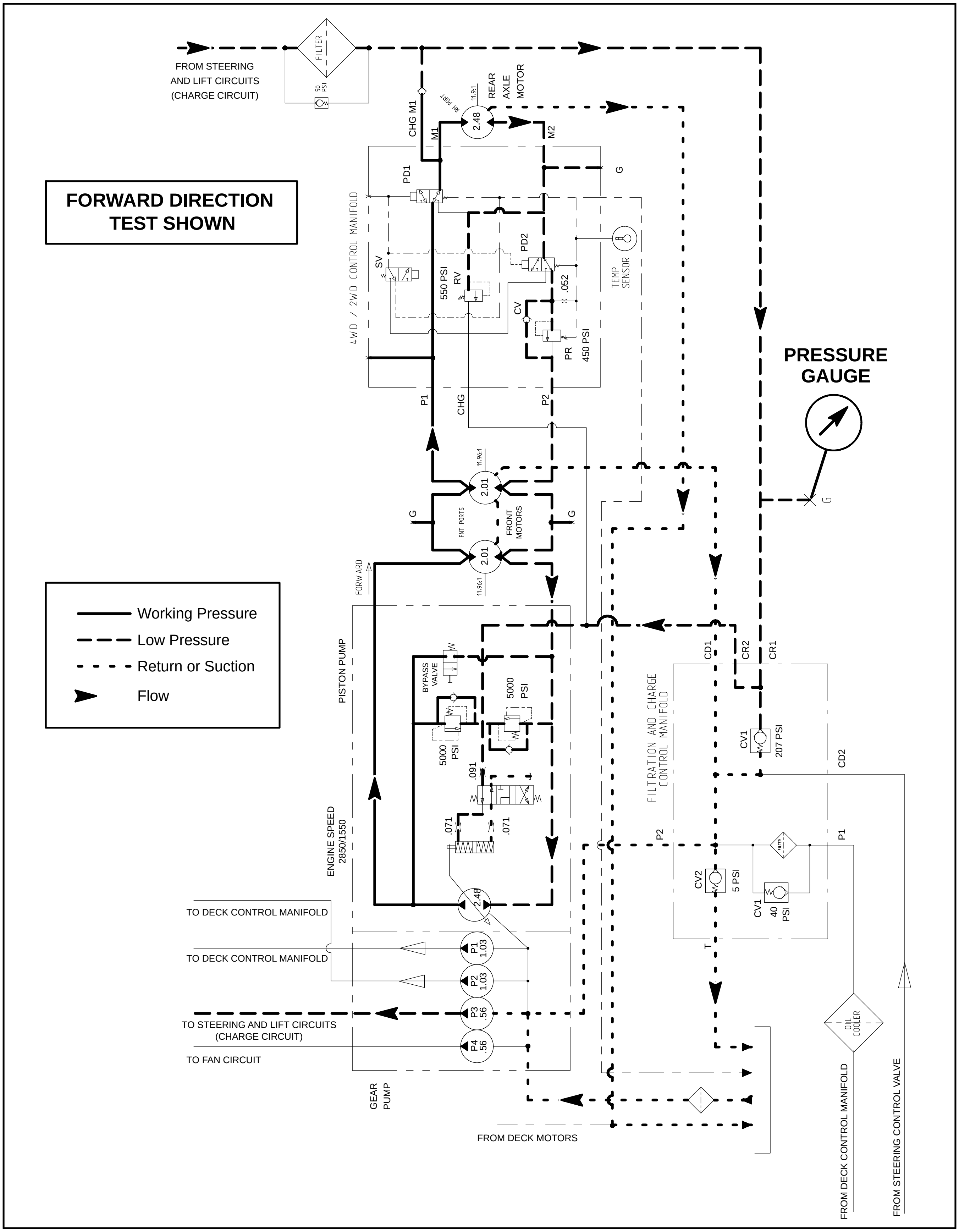
1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Charge Pressure, Traction Circuit Relief Pressure, Rear Traction Circuit Relief (RV) Pressure, Traction Circuit Reducing Valve (PR) Pressure and/or Piston (Traction) Pump Flow.

2. If a PTO circuit problem exists, consider performing one or more of the following tests: Mow Circuit Pressure, Mow Circuit Relief Pressure, Cutting Unit Motor Case Drain Leakage and/or Gear Pump P1 and P2 Flow.

3. If a lift/lower circuit problem exists, consider performing one or more of the following tests: Lift/Lower Circuit Relief Pressure, Lift Cylinder Internal Leakage and/or Gear Pump P3 Flow.

4. If a steering circuit problem exists, consider performing one or more of the following tests: Steering Circuit Relief Pressure, Steering Cylinder Internal Leakage and/or Gear Pump P3 Flow.

5. If an engine cooling fan circuit problem exists, consider performing one or more of the following tests: Cooling Fan Circuit and/or Gear Pump P4 Flow.


FORWARD DIRECTION TEST SHOWN
PRESSURE GAUGE
Working Pressure
Low Pressure
Return or Suction
Flow
FROM STEERING AND LIFT CIRCUITS (CHARGE CIRCUIT)
FILTER
50 PSI
REAR AXLE MOTOR
2.48
CHG M1
M1
M2
PD1
PD2
SV
550 PSI
RV
CV
.052
PR
450 PSI
TEMP SENSOR
4WD / 2WD CONTROL MANIFOLD
P1
CHG
P2
G
2.01
FNT PORTS
FRONT MOTORS
FORWARD
PISTON PUMP
BYPASS VALVE
5000 PSI
.091
.071
ENGINE SPEED 2850/1550
CD1
CR2
CR1
CV1
207 PSI
CD2
FILTRATION AND CHARGE CONTROL MANIFOLD
CV2
5 PSI
40 PSI
T
TO DECK CONTROL MANIFOLD
TO STEERING AND LIFT CIRCUITS (CHARGE CIRCUIT)
TO FAN CIRCUIT
P1 1.03
P2 1.03
P3 .56
P4 .56
GEAR PUMP
FROM DECK MOTORS
OIL COOLER
FROM DECK CONTROL MANIFOLD
FROM STEERING CONTROL VALVE

NOTE: The traction charge circuit is designed to replace loss of hydraulic fluid from the closed loop traction circuit.

Procedure for Traction Circuit Charge Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Raise and support operator seat to access charge pressure test port.

CAUTION

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

4. Connect a 1000 PSI (70 bar) pressure gauge onto charge pressure test port. Test port is located on hydraulic tube near hydraulic oil filter (Fig. 28).

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

6. Move throttle to high idle speed **(2850 RPM)** with no load on the hydraulic system. Identify charge pressure reading on gauge:

GAUGE READING TO BE **210 to 300 PSI (14.5 to 20.6 bar)**

7. Stop engine and record test results.

8. If there is no pressure or pressure is low, check for the following:

A. Restriction in gear pump intake line.

B. Charge relief valve in filtration and charge control manifold is leaking (see Filtration/Charge Control Manifold Service in the Service and Repairs section of this chapter).

C. If necessary, check for internal damage or worn parts in gear pump P3 (see Gear Pump P3 Flow Test in this section). NOTE: Steering and lift/lower circuits would also be affected if gear pump P3 is worn or damaged.

9. Also, with the pressure gauge still connected to the charge pressure test port, monitor the gauge reading while operating the machine in forward and reverse. Start the engine and put throttle at full engine speed **(2850 RPM)**. Apply the brakes and push the traction pedal forward, then reverse.

GAUGE READING TO BE **within 20% of no-load charge pressure measured in step 4 above** (e.g. if charge pressure in step 4 is 250 PSI (17.2 bar), charge pressure in forward or reverse should be from 200 to 250 PSI (13.8 to 17.2 bar)

10. If charge pressure is good under no load, but drops below specification when under traction load, the piston (traction) pump, front wheel motors and/or rear axle motor should be suspected of wear and inefficiency. When the pump and/or traction motor(s) are worn or damaged, the charge pump is not able to keep up with internal leakage in traction circuit components.

11. When testing is completed, disconnect pressure gauge from manifold test port. Install dust cap to test port fitting. Lower and secure operator seat.

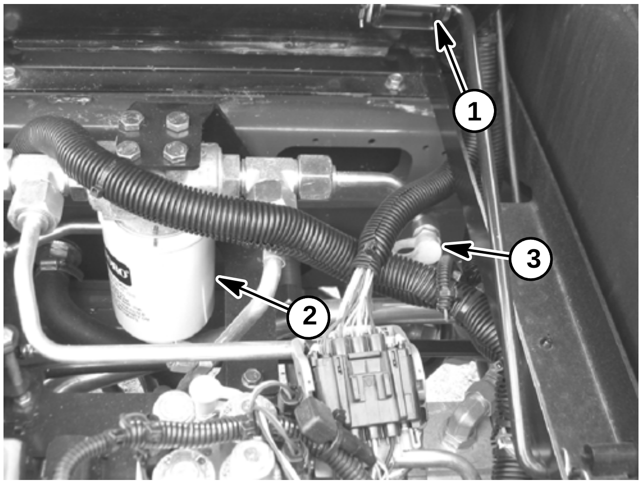
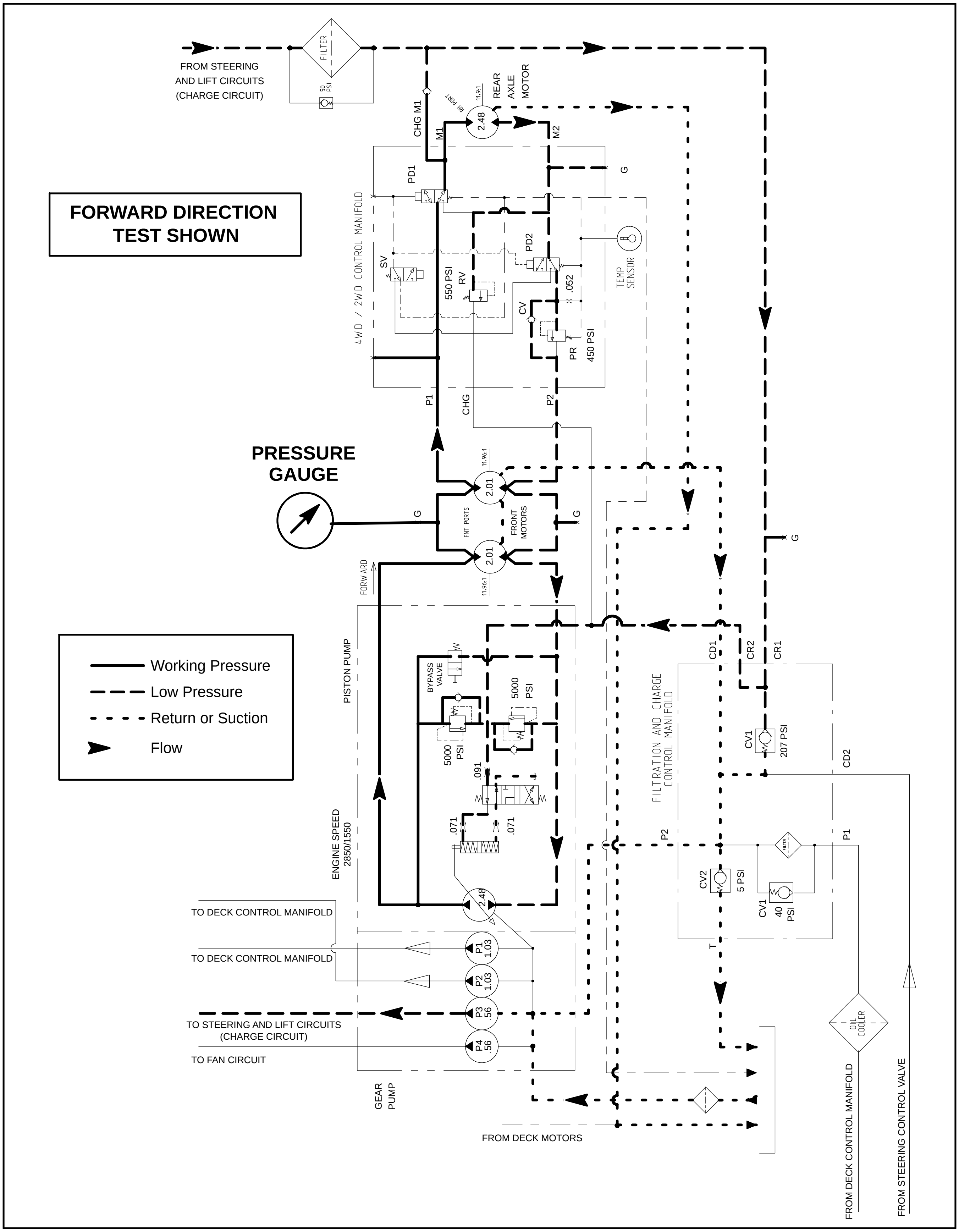


Figure 28

1. Operator seat
2. Oil filter
3. Test port location

Hydraulic System

Traction Circuit Relief Pressure Test (Using Pressure Gauge)



Procedure for Traction Circuit Relief Pressure Test

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

CAUTION

Move machine to an open area, away from people and obstructions.

2. Drive machine to an open area, lower cutting units, turn the engine off and apply parking brake.

CAUTION

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

3. Connect a 10,000 PSI (700 bar) pressure gauge to traction circuit test port for function to be checked (forward or reverse) (Fig. 29). Test ports are located on hydraulic lines toward the front of machine. **Forward traction port faces the front and reverse port faces rearward.**

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

5. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the transport (2WD) position. Release parking brake.

6. With seat occupied, apply brakes fully and slowly depress the traction pedal in the appropriate direction. While pushing traction pedal, identify pressure reading on gauge as relief valve opens:

GAUGE READING TO BE:
Forward: **4800 to 5300 PSI (332 to 365 bar)**
Reverse: **4800 to 5300 PSI (332 to 365 bar)**

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

8. If traction pressure is too low, makes sure that bypass valve on traction pump is fully seated and then inspect traction pump relief valves in piston (traction) pump (Fig. 30). Clean or replace valves as necessary. These cartridge type valves are factory set and are not adjustable. If relief valves are in good condition, piston (traction) pump, wheel motors and/or rear axle motor should be suspected of wear and inefficiency.

NOTE: Seal leakage across pilot directional valves PD1 and PD2 in 4WD/2WD control manifold can also cause low forward traction pressure with reverse pressure meeting specifications.

NOTE: Forward and reverse relief valves are identical. Relief valves can be switched in piston (traction) pump to help in identifying a faulty relief valve.

9. When testing is completed, disconnect pressure gauge from test port. Install dust cap to test port fitting.

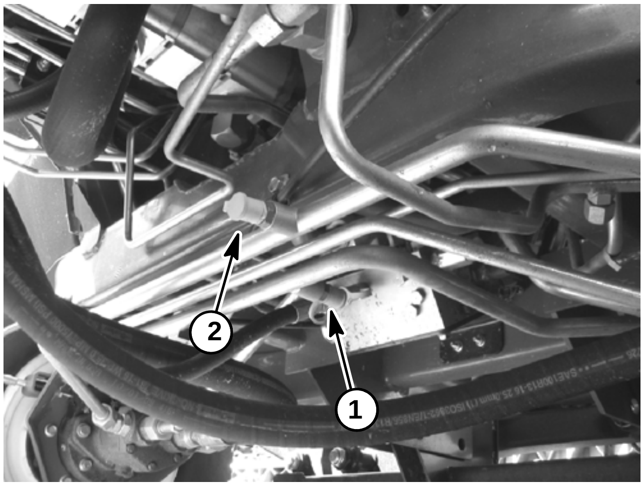


Figure 29

1. **Forward traction port (faces forward)**
2. **Reverse traction port (faces rearward)**

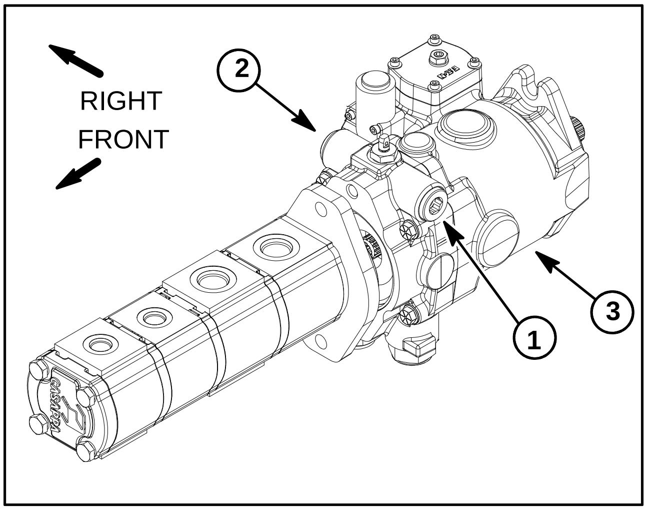
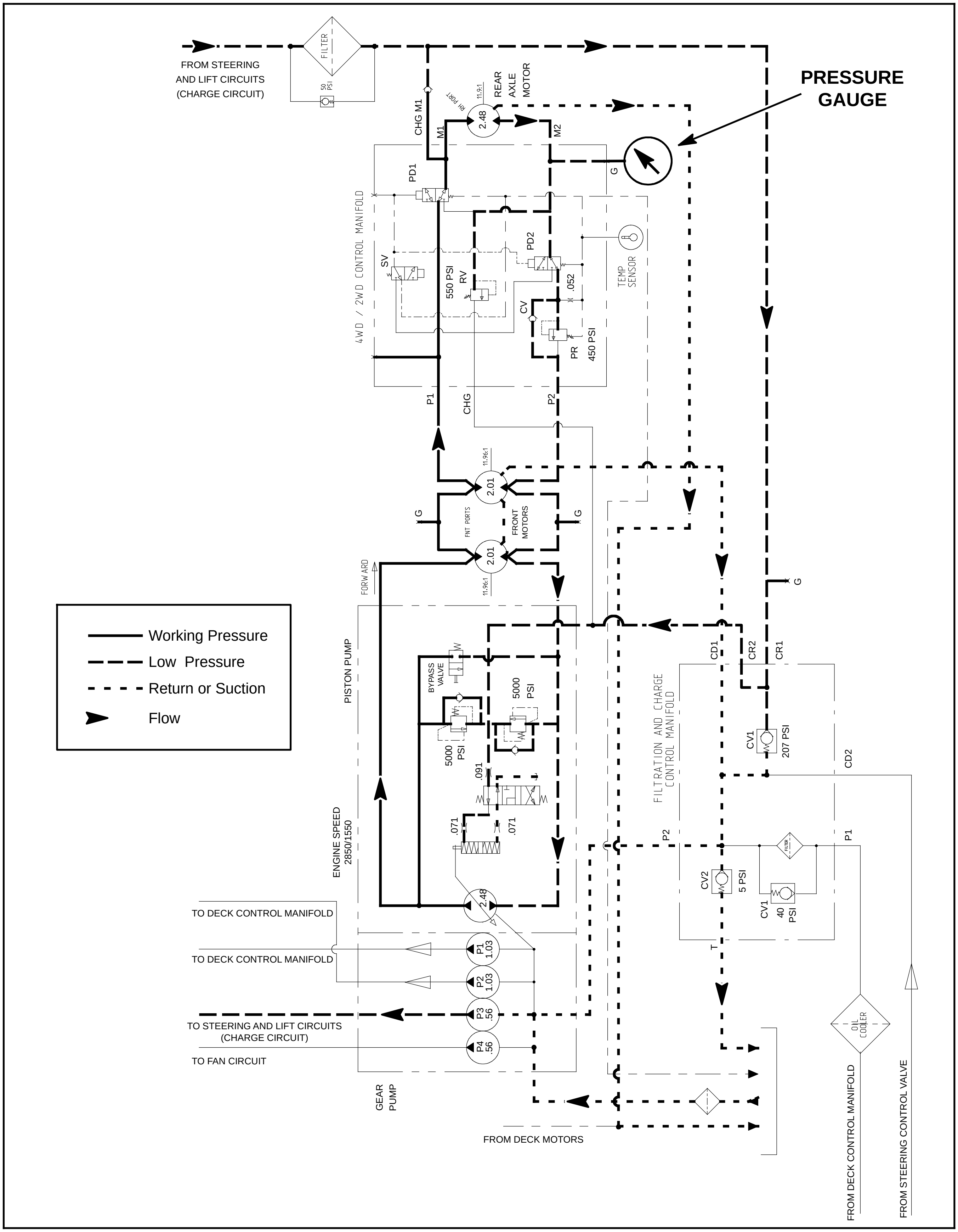


Figure 30

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

Traction Circuit Reducing Valve (PR) Pressure Test (Using Pressure Gauge)



NOTE: When in reverse, pressure reducing valve (PR) limits the pressure to the rear axle motor to 450 PSI (31 bar) so the rear wheels will not scuff the turf.

Procedure for Traction Circuit Pressure Reducing Valve (PR) Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

CAUTION

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

3. Connect a 1000 PSI (70 bar) pressure gauge to test fitting (port G) on rear side of 4WD/2WD control manifold under front of machine (Figs. 31 and 32).

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

5. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the mow (4WD) position. Release parking brake.

6. With seat occupied, apply brakes fully and slowly depress the traction pedal in the reverse direction. While pushing traction pedal, carefully monitor the pressure gauge. Pressure should increase until the pressure reducing valve opens.

GAUGE READING TO BE **420 to 470 PSI (29 to 32 bar)**.

7. Release traction pedal, stop engine and record test results.

8. If specification is **not** met, clean or adjust pressure reducing valve (port PR) located on the right side of the 4WD/2WD control manifold (Fig. 33) (see Adjust Control Manifold Relief Valves in the Adjustments section of this chapter for valve adjustment procedure). Recheck reducing valve pressure after adjustment.

9. When testing is completed, disconnect pressure gauge from test port. Install dust cap to test port fitting.

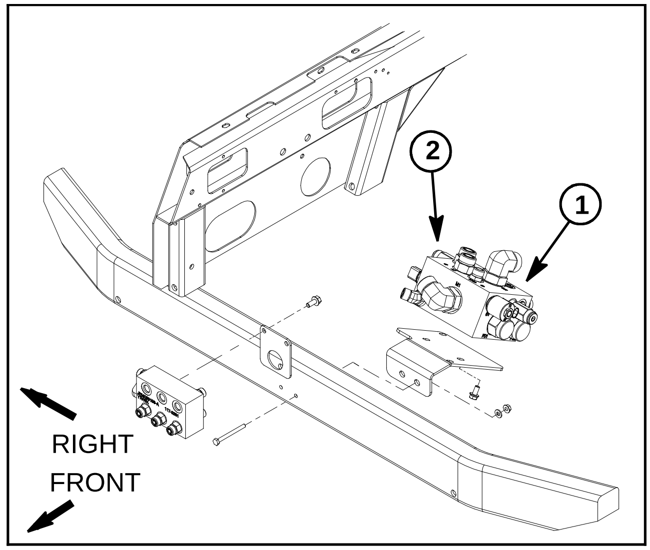


Figure 31

1. 4WD/2WD manifold
2. Reducing valve (PR)

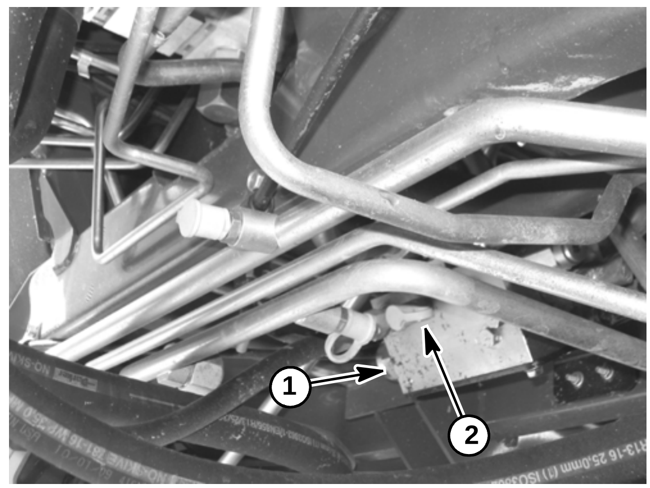


Figure 32

1. 4WD/2WD manifold
2. Test fitting (port G)

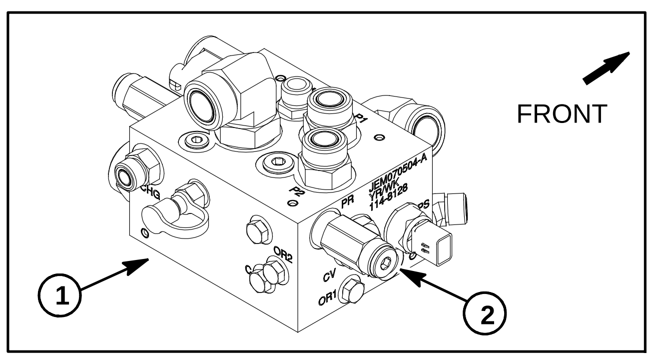
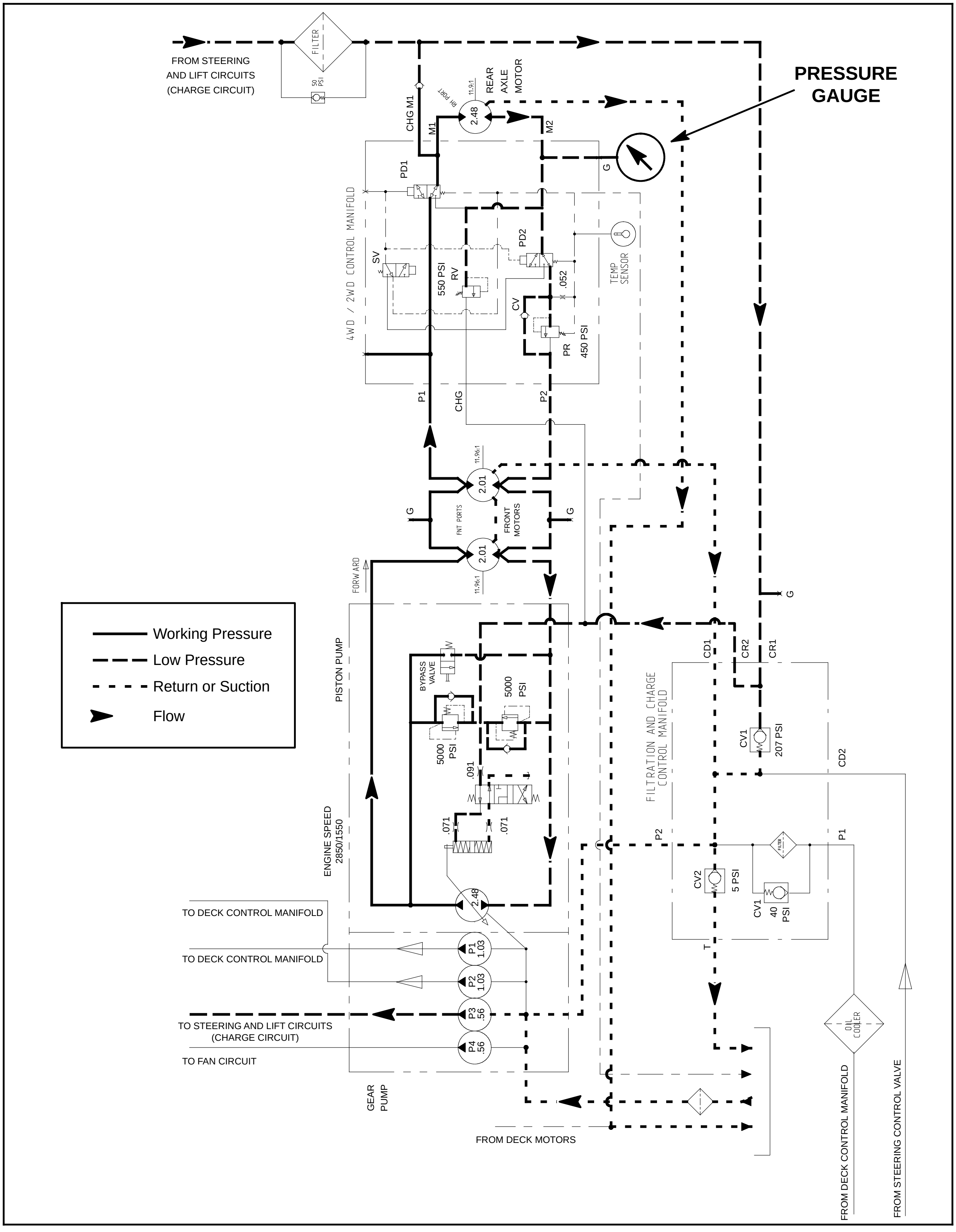


Figure 33

1. 4WD/2WD manifold
2. Reducing valve (PR)

Hydraulic System

Rear Traction Circuit Relief (RV) Pressure Test (Using Pressure Gauge)



NOTE: Adjustable relief valve (RV) in the 4WD/2WD control manifold reduces rear axle motor pressure created in down hill, dynamic braking conditions to prevent rear wheel lock up.

Procedure for Rear Traction Circuit Relief (RV) Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

CAUTION

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

3. Measure and record traction circuit pressure reducing valve (PR) pressure (see Traction Circuit Pressure Reducing Valve (PR) Pressure Test in this section).

4. Connect a 1000 PSI (70 bar) pressure gauge to test fitting (port G) on rear side of 4WD/2WD control manifold under front of machine (Figs. 34 and 35). This is the same pressure gauge position as used to measure traction circuit pressure reducing valve (PR) pressure.

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

6. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the mow (4WD) position. Release parking brake.

7. Operate the machine in mow speed (4WD) with the cutting units lowered. Drive down a slope in a forward direction and decrease pressure on the traction pedal while carefully monitoring the pressure gauge. Pressure should increase until relief valve (RV) lifts.

8. Stop engine and record test results.

9. Relief (RV) pressure should be **at least 100 PSI (7 bar) higher than the traction circuit pressure reducing valve (PR) pressure and also be between 520 and 570 PSI (36 to 39 bar)** (e.g. if the pressure reducing valve (PR) pressure is 450 PSI (31 bar), relief (RV) pressure should be from 550 to 570 PSI (38 to 39 bar)).

NOTE: Rear traction circuit relief (RV) pressure should be at least 100 PSI (7 bar) higher than traction circuit reducing (PR) pressure. If the difference in these pressures is less than 100 PSI (7 bar), reverse traction performance may be affected.

10. If specification is **not** met, clean or adjust relief valve (RV) which is located on the left side of the 4WD/2WD control manifold in the RV port (Fig. 34) (see Adjust Control Manifold Relief Valves in the Adjustments section of this chapter for valve adjustment procedure). Recheck relief (RV) pressure after adjustment.

11. When testing is completed, disconnect pressure gauge from test port. Install dust cap to test port fitting.

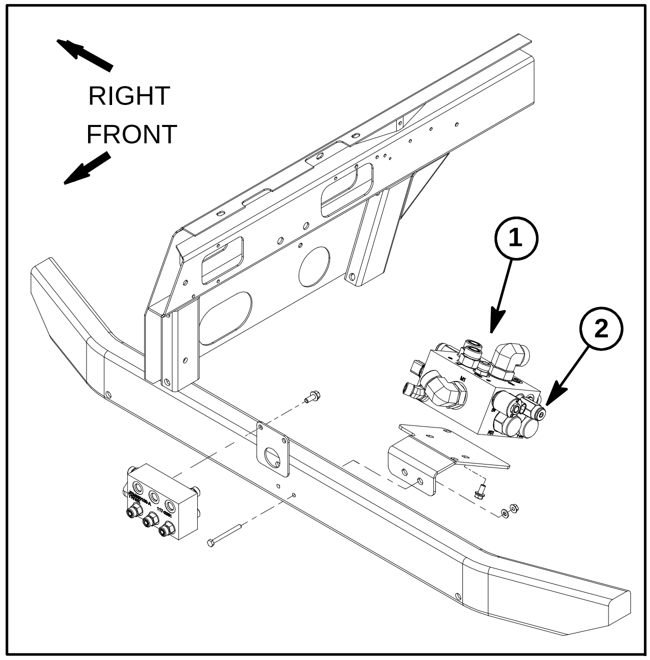


Figure 34

1. **4WD/2WD manifold**
2. **Relief valve (RV)**

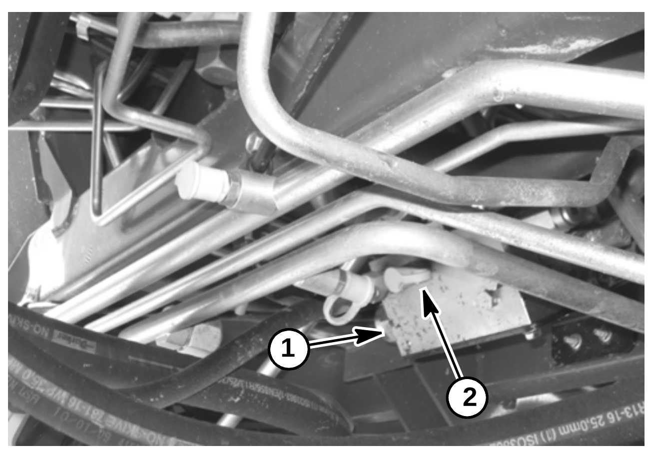
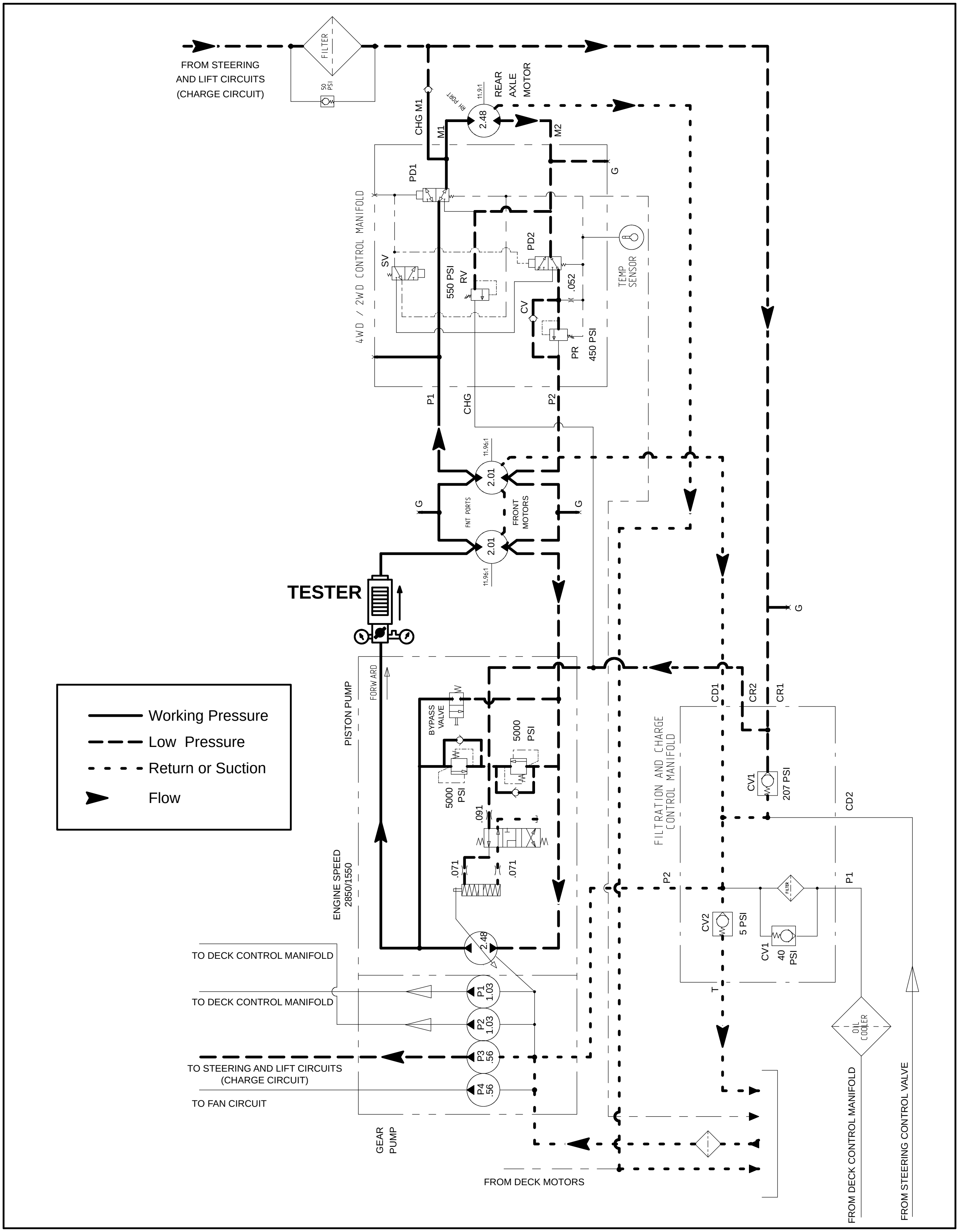


Figure 35

1. **4WD/2WD manifold**
2. **Test fitting (port G)**

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



Procedure for Piston (Traction) Pump Flow Test

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

IMPORTANT: Traction circuit flow for the Reelmaster 7000 is approximately 30 GPM (113.5 LPM). Use 40 GPM Hydraulic Tester #AT40002 (pressure and flow) for this test (see Special Tools in this chapter).

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

2. Park machine on a level surface with the cutting units raised and off. Make sure that the mow speed limiter is in the transport speed (2WD) position to ensure that traction pedal can move piston (traction) pump to full stroke. Shut off engine.

CAUTION

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

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

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

5. Thoroughly clean junction of hydraulic hose and **left** side fitting on bottom of piston pump (forward port) (Fig. 36). Disconnect hose from left side pump fitting.

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

CAUTION

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

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

8. Move throttle so engine is running at high idle speed **(2850 RPM)**.

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

10. Have second person carefully watch pressure gauge on tester while slowly closing the flow control valve until **1000 PSI (69 bar)** is obtained. Verify with a phototac that the **engine speed** is still **2850 RPM**.

NOTE: If engine speed drops below 2850 RPM, piston pump flow will decrease.

11. Observe flow gauge. If piston pump is in good condition, flow indication should be approximately **29 GPM (110 LPM)**.

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

13. If flow is less than **26 GPM (98 LPM)**, consider the following:

A. The piston pump swash plate is not being rotated fully (e.g. mow speed limiter is not in transport speed (2WD) position, traction pedal linkage may need adjustment).

B. The piston (traction) pump needs to be repaired or replaced as necessary.

14. Make necessary repairs before performing any additional tests.

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

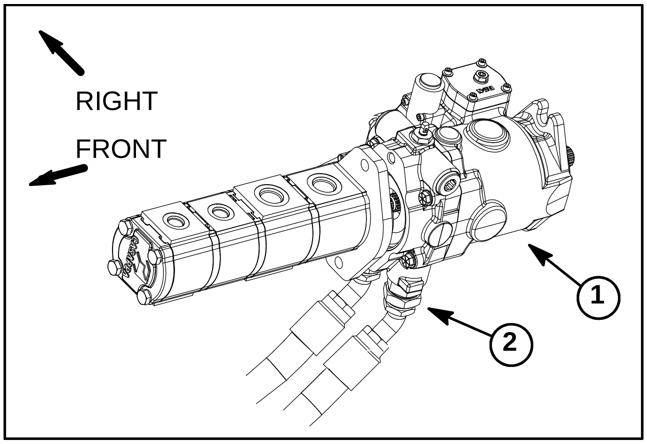
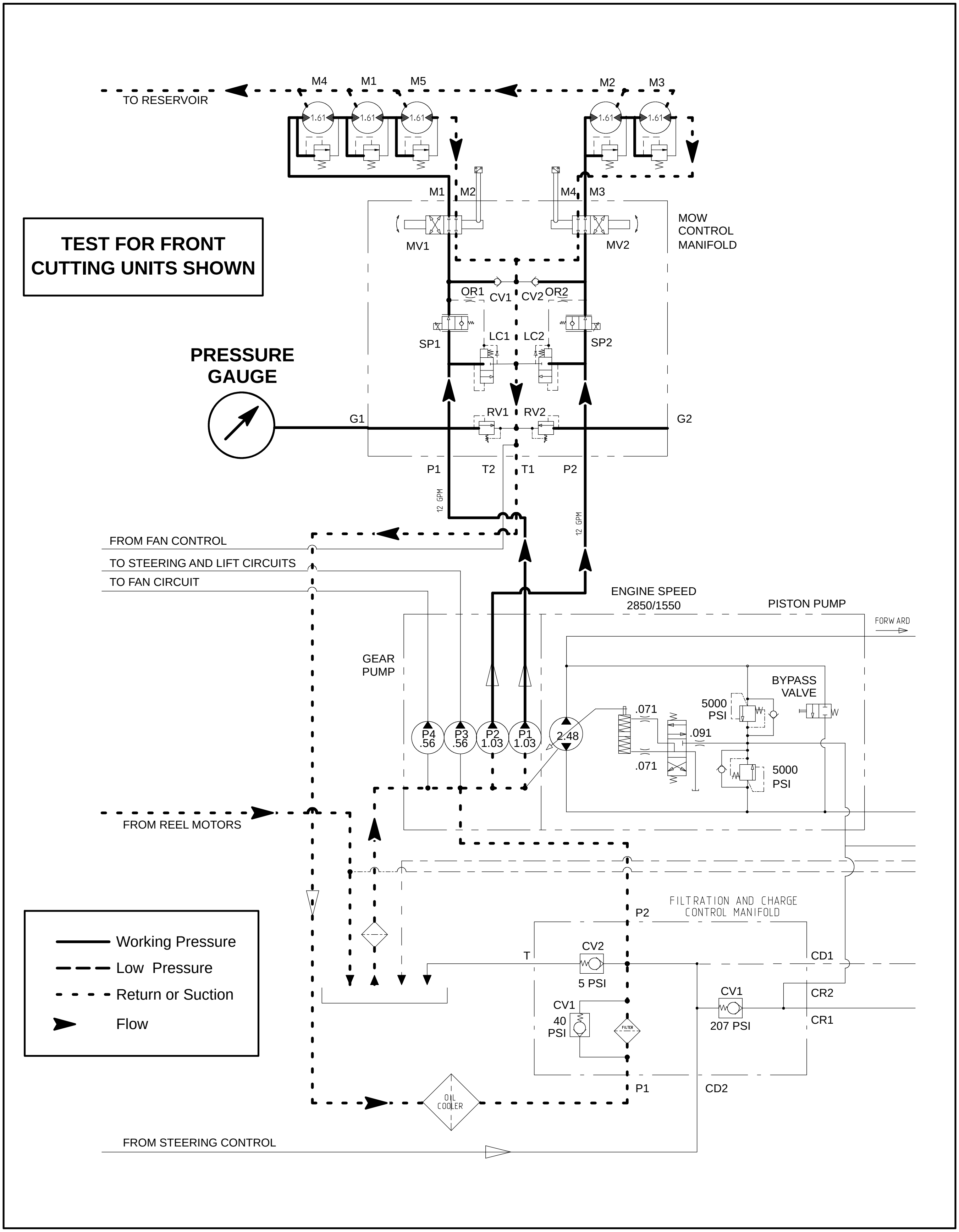


Figure 36

1. Piston (traction) pump
2. LH fitting (forward port)

Mow Circuit Pressure Test (Using Pressure Gauge)



Procedure for Mow Circuit Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Raise hood to allow access to mow control manifold.

CAUTION

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

4. Install 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to mow control manifold test port for the mow circuit (front or rear cutting units) to be tested (Fig. 37). Manifold test port G1 should be used for the front reel circuit and G2 should be used for the rear reel circuit.

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

6. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the mow (4WD) position. Release parking brake.

CAUTION

Cutting reel blades will rotate when lowered with PTO switch in ON position. Keep away from cutting units during test to prevent personal injury from rotating reel blades. Do not stand in front of the machine during test.

7. With seat occupied, engage the mow circuit. Watch pressure gauge carefully while mowing with the machine.

8. Mow circuit pressure should be from **1000 to 3000 PSI (69 to 207 bar)** and will vary depending on mowing conditions.

9. Disengage cutting units and shut off engine. Record test results.

10. After testing is complete, disconnect pressure gauge from manifold test port. Install dust cap to test port fitting. If necessary, repeat test for other mow circuit.

11. Lower and secure hood after all mow circuit pressure testing is completed.

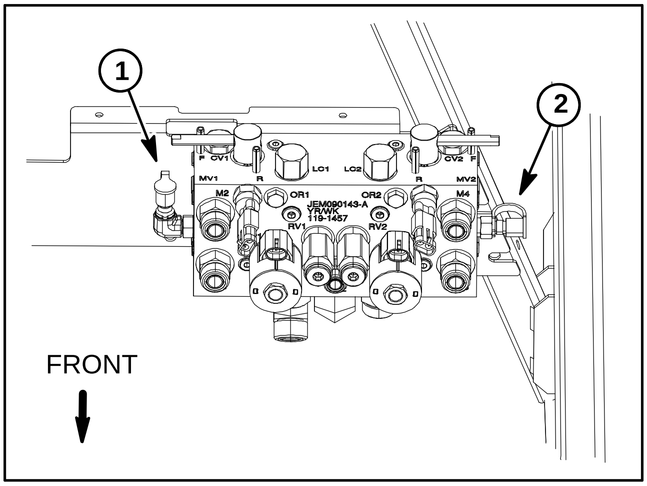


Figure 37

1. **Test port G1 (front cutting units)**
2. **Test port G3 (rear cutting units)**

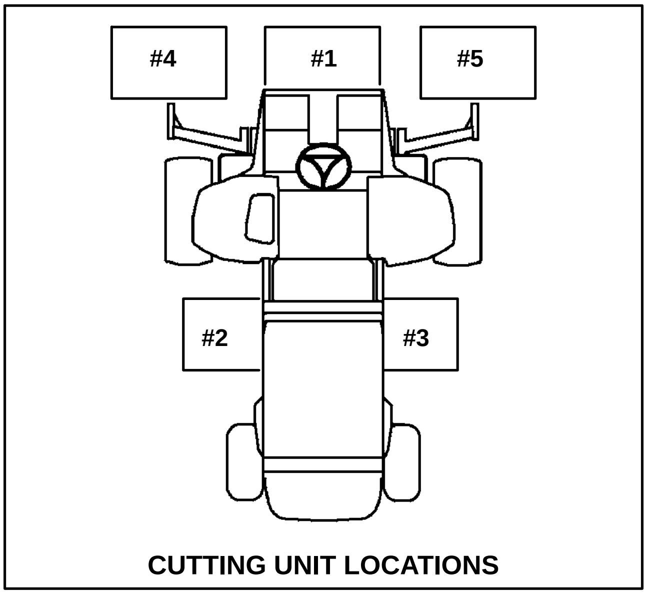
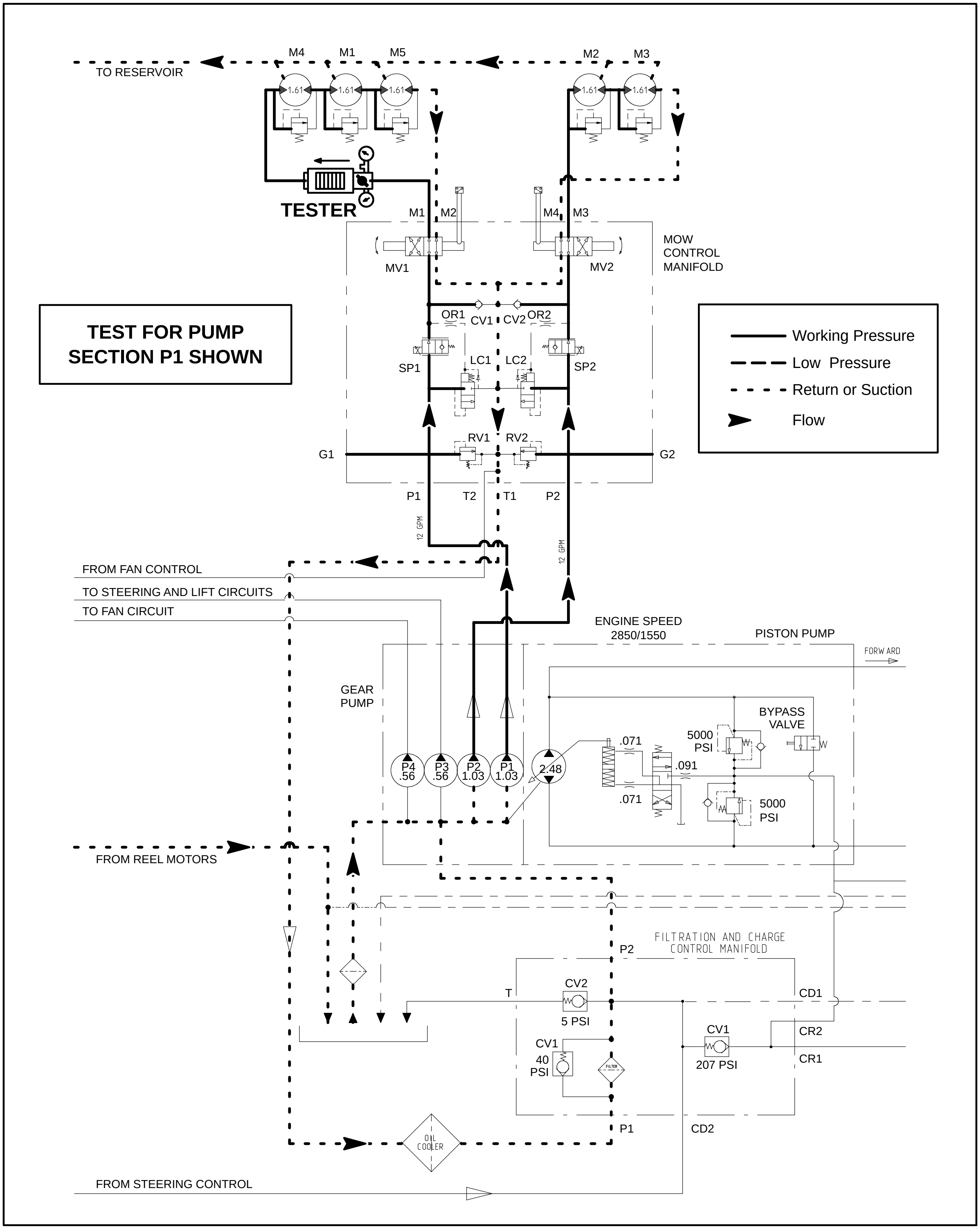


Figure 38

Mow Circuit Relief Pressure Test (Using Tester with Pressure Gauges and Flow Meter)



The mow circuit relief pressure test should be performed to make sure that the mow circuit relief pressures are correct.

Procedure for Mow Circuit Relief Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged. Also, make sure that the backlap levers on the mow control manifold are in the mow position (F on the manifold).

CAUTION

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

3. Determine mow manifold relief pressure to be tested:

A. For pump section (P1), mow manifold relief is tested at the forward direction supply hose (front hose) to the cutting unit #4 motor (Fig. 39).

B. For pump section (P2), mow manifold relief is tested at the forward direction supply hose (front hose) to the cutting unit #2 motor (Fig. 39).

4. Thoroughly clean junction of appropriate hydraulic supply hose and cutting unit motor fitting. Disconnect the supply hydraulic hose from the motor.

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

5. Install tester with pressure gauge and flow meter in series with the disconnected hose and front motor fitting.

6. Make sure the flow control valve on the tester is fully open.

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

8. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the mow (4WD) position. Release parking brake.

CAUTION

Cutting reel blades will rotate when lowered with PTO switch in ON position. Keep away from cutting units during test to prevent personal injury from rotating reel blades. Do not stand in front of the machine during test.

9. With seat occupied, engage the cutting units.

10. Have a second person carefully watch tester pressure gauge while slowly closing the flow control valve on tester.

11. As the relief valve lifts, system pressure should be from **2800 to 3200 PSI (193 to 220 bar)**.

12. After noting the relief pressure, open the tester flow control valve, disengage cutting units and stop the engine. Record test results.

13. If specification is **not** met, clean or adjust relief valve (RV1 or RV2) in the mow control manifold. See Adjust Control Manifold Relief Valves in the Adjustments section of this chapter for valve adjustment procedure. Recheck relief valve pressure setting after adjustment.

14. After testing is complete, disconnect tester from cutting unit motor and hose. Connect hydraulic hose to motor.

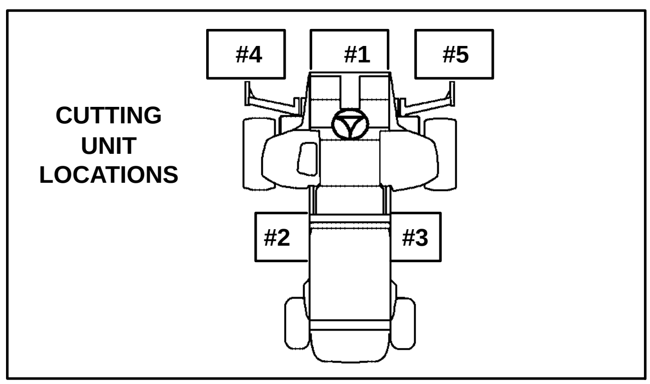


Figure 39

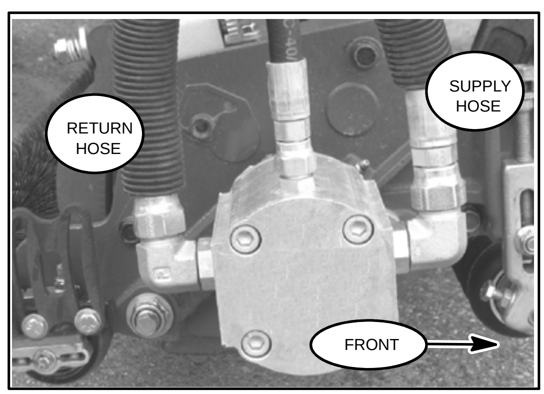
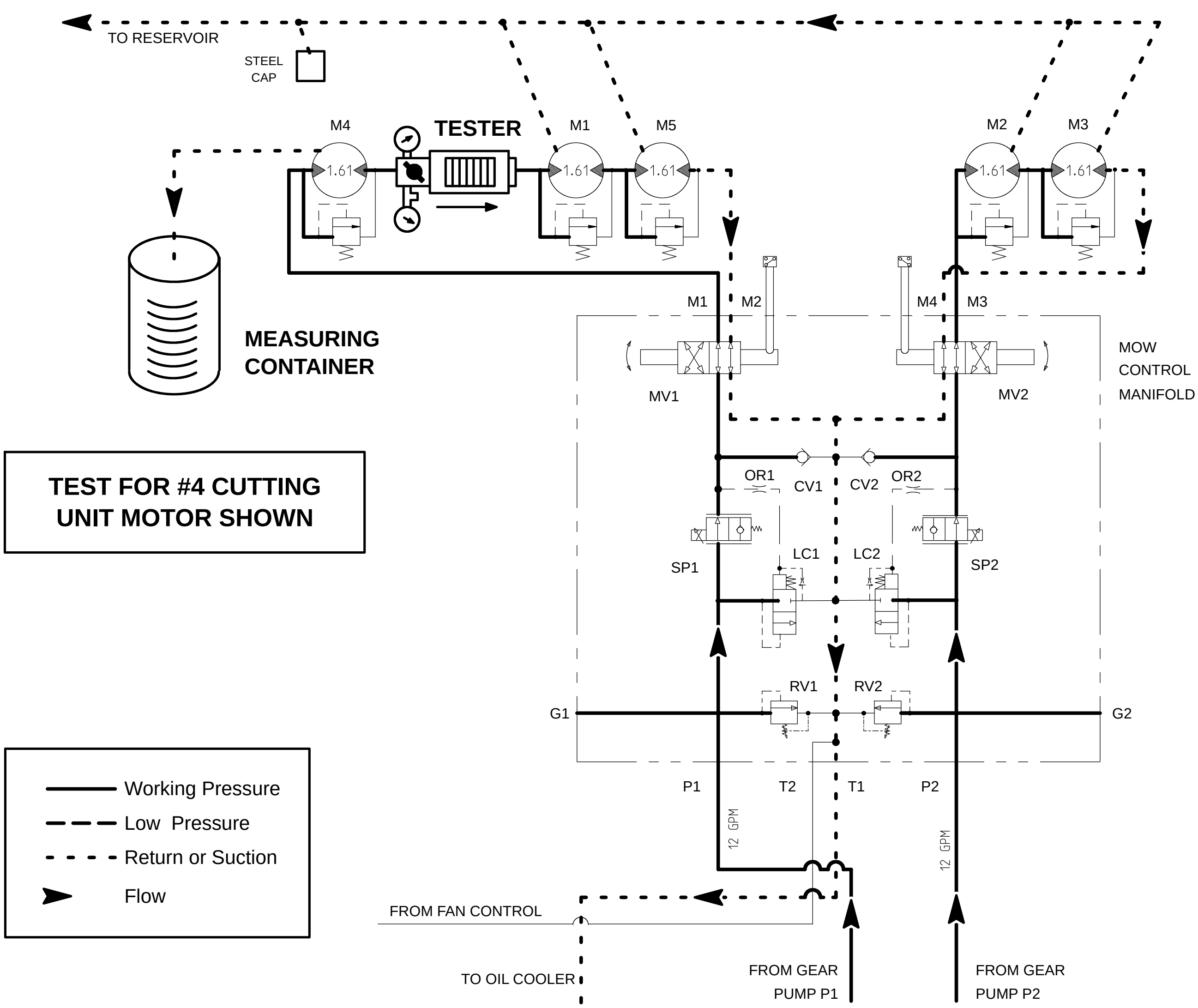
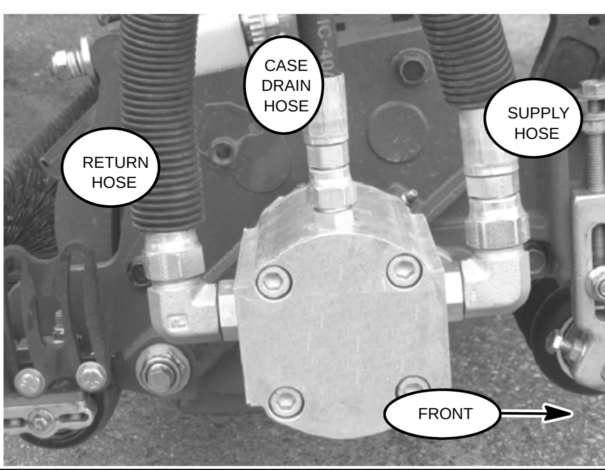


Figure 40

Hydraulic System


TO RESERVOIR
STEEL CAP
M4
TESTER
M1
M5
M2
M3
1.61
MEASURING CONTAINER
M1
M2
M4
M3
MOW CONTROL MANIFOLD
MV1
MV2
TEST FOR #4 CUTTING UNIT MOTOR SHOWN
OR1
CV1
CV2
OR2
SP1
LC1
LC2
SP2
RV1
RV2
G1
G2
P1
T2
T1
P2
12 GPM
Working Pressure
Low Pressure
Return or Suction
Flow
FROM FAN CONTROL
TO OIL COOLER
FROM GEAR PUMP P1
FROM GEAR PUMP P2


CASE DRAIN HOSE
SUPPLY HOSE
RETURN HOSE
FRONT

Procedure for Cutting Unit Motor Case Drain Leakage Test

NOTE: Over a period of time, a cutting unit motor can wear internally. A worn motor may bypass oil to its case drain causing the motor to be less efficient. Eventually, enough oil loss will cause the motor to stall under heavy cutting conditions. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system and affect quality of cut.

NOTE: One method to find a failing or malfunctioning cutting unit motor is to have another person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings and may cause a different appearance on the turf.

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

CAUTION

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

NOTE: The cutting unit motors are connected in series. To isolate a faulty motor, all motors in the circuit may have to be tested by starting with the first motor in the circuit (see Hydraulic Schematic).

IMPORTANT: Make sure that the oil flow indicator arrow on the tester is showing that the oil will flow from the motor fitting, through the tester and into the disconnected hose.

3. Disconnect hydraulic return hose (rear hose) from the motor to be tested. Install tester with pressure gauge and flow meter in series with the motor and the disconnected return hose. Make sure the flow control valve on tester is fully open.

4. Disconnect the motor case drain hose (small diameter hose) where it connects to bulkhead fitting at the frame rail (not at the motor). Put a steel cap on the bulkhead fitting; leave the case drain hose open.

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

CAUTION

Cutting reel blades will rotate when lowered with PTO switch in ON position. Keep away from cutting units during test to prevent personal injury from rotating reel blades. Do not stand in front of the machine during test.

6. Move throttle to high idle speed **(2850 RPM)**. Make sure that mow speed limiter is in the mow (4WD) position. With seat occupied, release the parking brake and engage the cutting units.

7. While watching tester pressure gauge, slowly close flow control valve on tester until a pressure of **1200 PSI (83 bar)** is obtained.

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

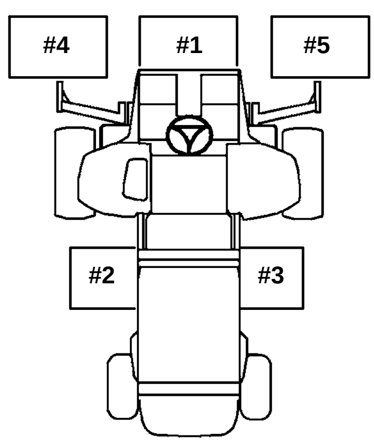
8. Have a second person measure flow from the case drain line for **fifteen (15) seconds**, then move the PTO switch to OFF, open the tester flow control valve and stop the engine. Record test results.

TEST RESULTS: Case drain leakage should be less than **22.4 ounces (662 ml)** of hydraulic fluid in fifteen (15) seconds (0.7 GPM / 2.7 LPM).

9. If case drain flow is more than **22.4 ounces (662 ml)** in fifteen (15) seconds, the reel motor is worn or damaged and should be repaired or replaced.

10. Disconnect tester from motor and hose. Reconnect hose to the cutting unit motor. Remove cap from bulkhead fitting and reconnect case drain hose.

11. Repeat test for additional reel motors if required.

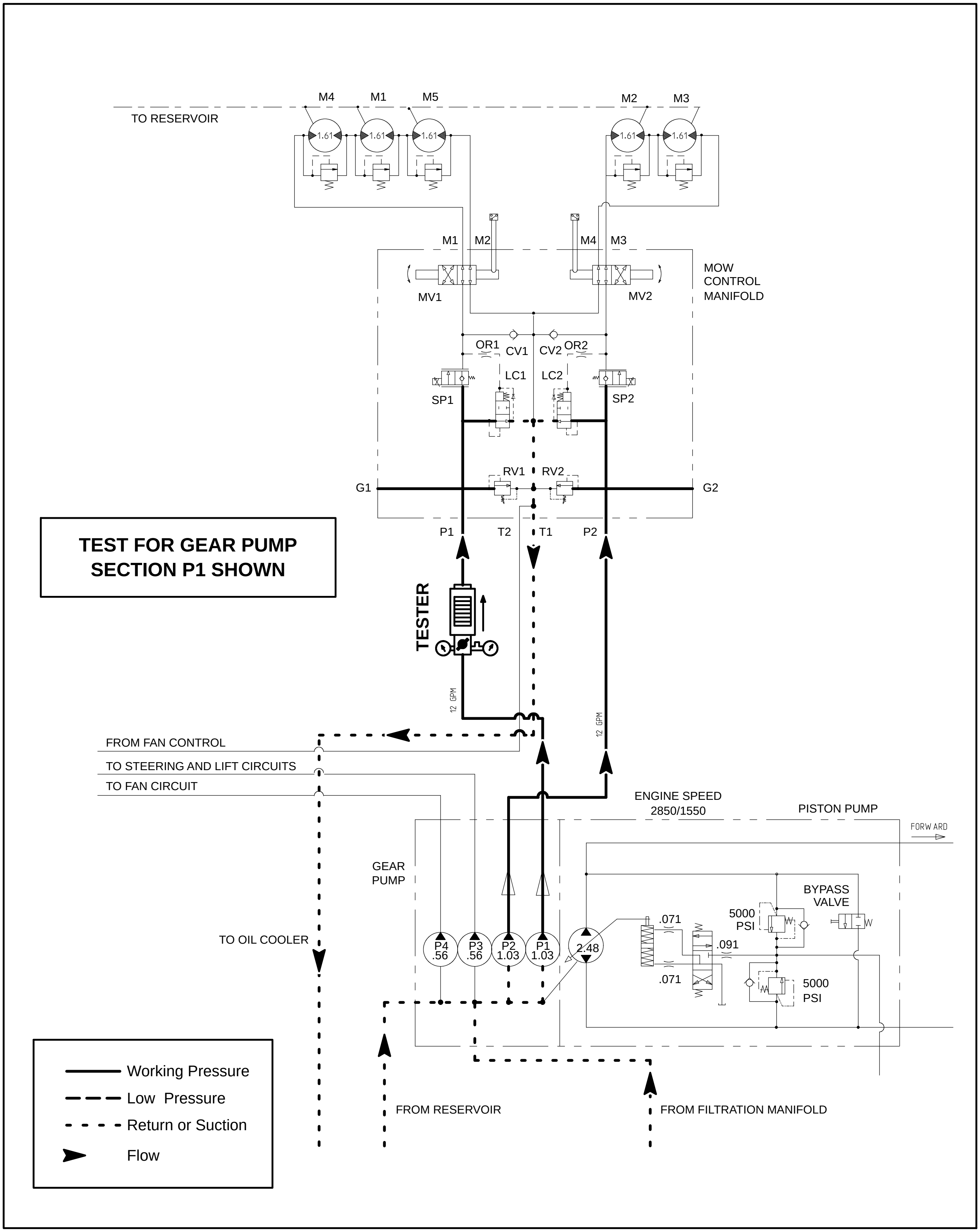


CUTTING UNIT LOCATIONS

Figure 41

Hydraulic System

Gear Pump P1 and P2 Flow (Mow Circuits) Test (Using Tester with Pressure Gauges and Flow Meter)



The gear pump P1 and P2 flow tests should be performed to make sure that the mow circuits have adequate hydraulic flow.

NOTE: Gear pump P1 supplies hydraulic flow to cutting units 1, 4 and 5. Gear pump P2 supplies flow to cutting units 2 and 3.

Procedure for Gear Pump P1 and P2 Flow Test

NOTE: Over a period of time, the gears and wear plates in the gear pump can wear. A worn pump will by pass oil and make the pump less efficient. Eventually, enough oil loss will occur to cause the cutting unit motors to stall under heavy cutting conditions. Continued operation with a worn, inefficient pump can generate excessive heat and cause damage to the seals and other components in the hydraulic system.

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Raise and support hood to allow access to pump assembly.

CAUTION

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

4. Locate gear pump section to be tested (P1 or P2). Thoroughly clean junction of appropriate hydraulic hose and gear pump fitting. Disconnect hydraulic hose from hydraulic fitting in gear pump (Fig. 42).

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

5. Install tester with pressure gauge and flow meter in series with the disconnected hose and fitting in gear pump section. **Make sure the flow control valve on the tester is fully open.**

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

7. Move throttle to high idle speed **(2850 RPM)**. **Do not engage the cutting units**.

IMPORTANT: Do not fully restrict oil flow through tester. In this test, the flow tester is positioned before the circuit relief valve. Pump damage can occur if the oil flow is fully restricted.

8. Watch tester pressure gauge carefully while slowly closing the flow control valve on tester until **2000 PSI (138 bar)** is obtained. Verify with a phototac that the **engine speed** is **2850 RPM**.

9. For a pump in good condition, flow indication should be approximately **12 GPM (45.4 LPM)**.

10. Fully open flow control valve on tester and then shut engine off. Record test results.

11. If measured flow is **less than 10.8 GPM (40.8 LPM)** or a pressure of **2000 PSI (138 bar)** cannot be obtained, check for restriction in the pump intake line (including oil filter and oil cooler). If line is not restricted, remove gear pump and repair or replace as necessary.

12. After testing is complete, disconnect tester from hydraulic hose and fitting. Connect hose to the gear pump fitting.

13. Repeat test for second pump section if required.

14. Lower and secure hood after testing is completed.

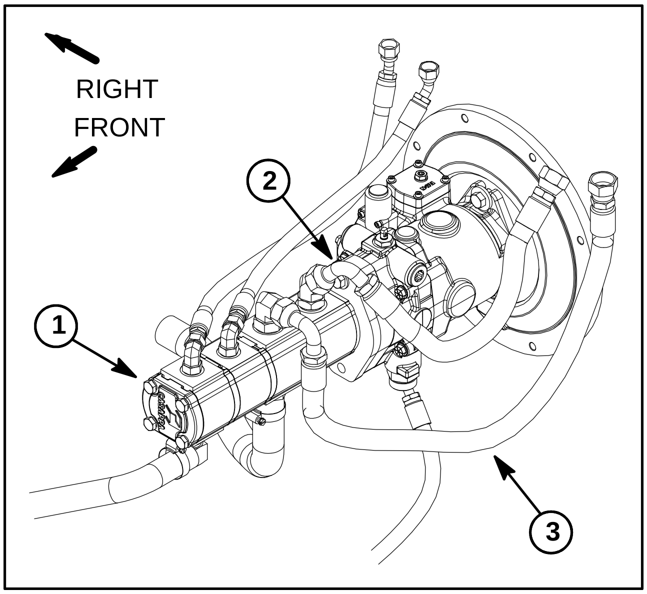
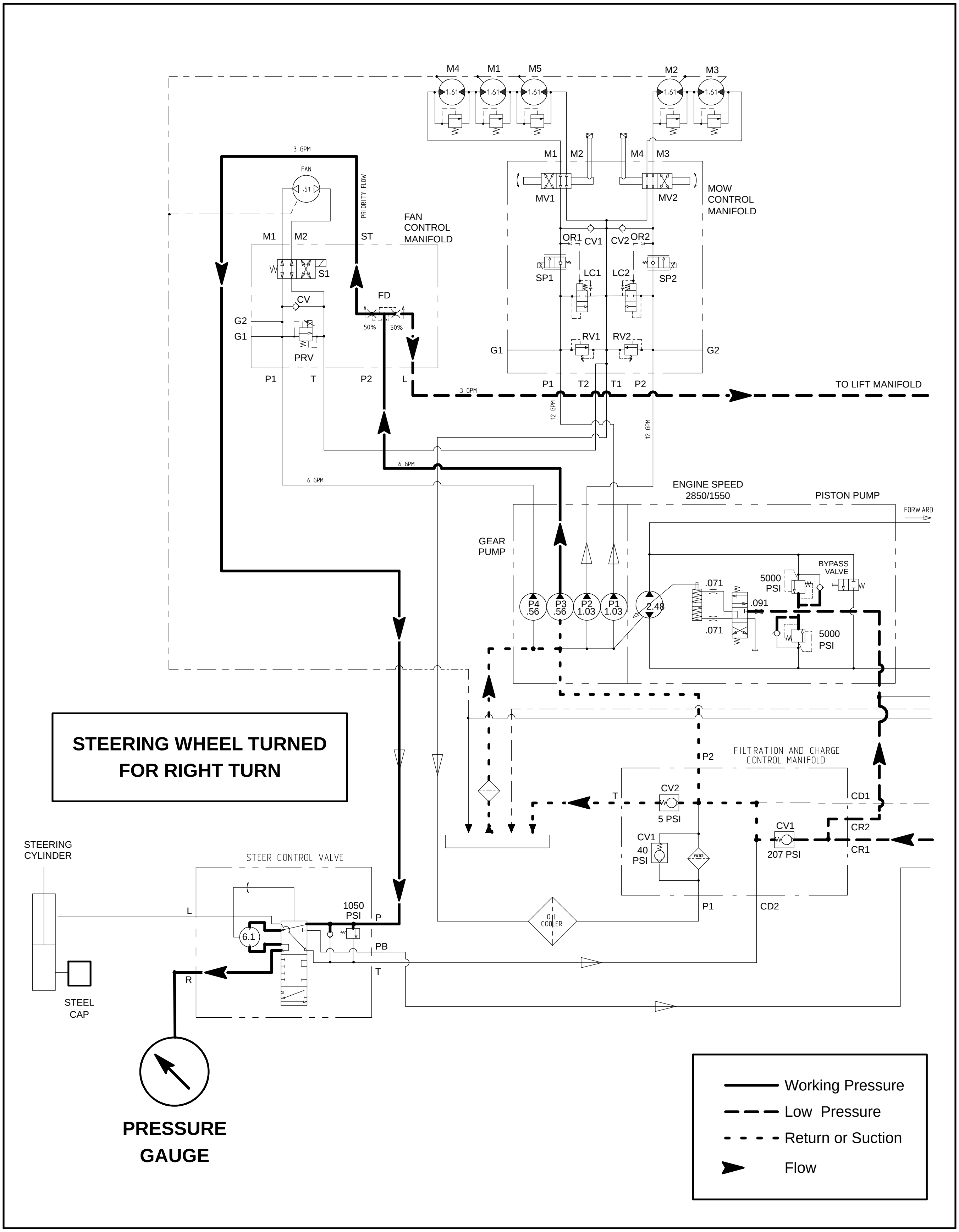


Figure 42

1. Gear pump
2. Pump section P1 hose
3. Pump section P2 hose

Hydraulic System



M4
M1
M5
M2
M3
3 GPM
FAN
PRIORITY FLOW
M1
M2
M4
M3
MV1
MV2
MOW
CONTROL
MANIFOLD
FAN
CONTROL
MANIFOLD
M1
M2
ST
S1
OR1
CV1
CV2
OR2
SP1
LC1
LC2
SP2
CV
FD
G2
G1
PRV
RV1
RV2
G1
G2
P1
T
P2
L
P1
T2
T1
P2
TO LIFT MANIFOLD
12 GPM
6 GPM
ENGINE SPEED
2850/1550
PISTON PUMP
FORWARD
GEAR
PUMP
BYPASS
VALVE
5000
PSI
.071
.091
.071
5000
PSI
P4
.56
P3
.56
P2
1.03
P1
1.03
2.48
STEERING WHEEL TURNED
FOR RIGHT TURN
P2
FILTRATION AND CHARGE
CONTROL MANIFOLD
T
CV2
5 PSI
CD1
CV1
40
PSI
CV1
207 PSI
CR2
CR1
STEERING
CYLINDER
STEER CONTROL VALVE
1050
PSI
P
L
6.1
PB
T
R
STEEL
CAP
P1
CD2
OIL
COOLER
PRESSURE
GAUGE
Working Pressure
Low Pressure
Return or Suction
Flow

The steering circuit relief pressure test should be performed to make sure that the steering circuit relief pressure is correct.

Procedure for Steering Circuit Relief Pressure Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

CAUTION

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

3. Thoroughly clean junction of hydraulic hose and steering cylinder fitting at the barrel end of the steering cylinder (Fig. 43). Disconnect hose from fitting in barrel end of steering cylinder.

4. Install 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to disconnected hose. Install steel cap on steering cylinder fitting to prevent any leakage from cylinder.

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

6. Move throttle to full engine speed **(2850 RPM)**.

IMPORTANT: While testing, rotate steering wheel only long enough to get a system relief pressure reading. Holding the steering circuit at relief pressure for an extended period may damage the steering control valve.

7. Turn steering wheel to the right while monitoring the pressure gauge. When steering circuit pressure reaches the relief pressure setting, pressure should stabilize briefly and then may continue to increase. The steering circuit relief pressure is the gauge reading when pressure stabilizes.

GAUGE READING TO BE **1150 TO 1500 PSI (80 to 103 bar)**

8. Stop the engine. Record test results.

9. If steering relief pressure is incorrect, inspect steering relief valve located in the steering control valve (see Steering Control Valve Service in the Service and Repairs section of this chapter). If relief valve is operating properly and if lift/lower problems also exist, gear pump P3 should be suspected of wear or damage. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), steering cylinder or steering control valve may be worn or damaged.

10. When testing is complete, turn steering wheel to both the right and the left with the engine not running to relieve steering circuit pressure. Remove pressure gauge from hydraulic hose and steel cap from steering cylinder fitting. Connect hydraulic hose to steering cylinder fitting.

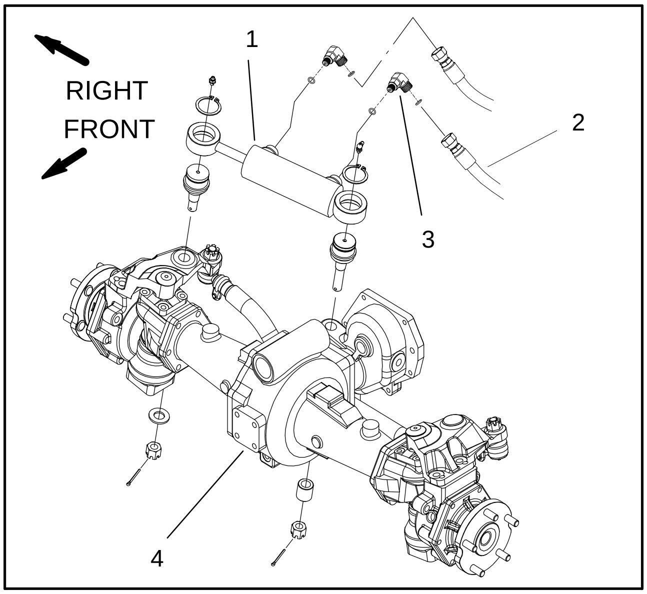
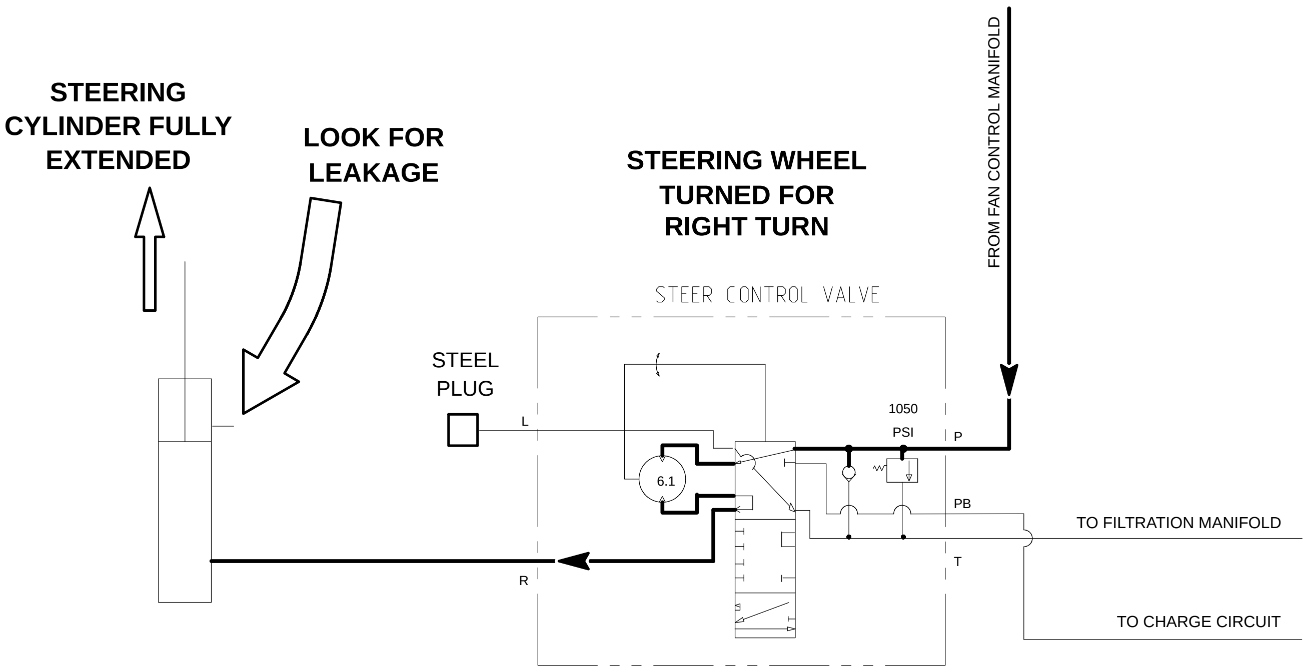


Figure 43

1. Steering cylinder
2. Barrel end hose
3. Barrel end fitting
4. Rear axle

Steering Cylinder Internal Leakage Test



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

Procedure for Steering Cylinder Internal Leakage Test

NOTE: Steering circuit operation will be affected by rear tire pressure, binding of steering cylinder, extra weight on the vehicle and/or binding of rear axle steering components. Make sure that these items are checked before proceeding with steering cylinder internal leakage test.

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

2. Park machine on a level surface with the cutting units lowered and off. Turn the steering wheel for a right turn so that the steering cylinder is fully extended. Turn engine off and apply the parking brake.

CAUTION

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

3. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder.

4. Place a drain pan under the steering cylinder. Remove hydraulic hose from the fitting on the rod end of the steering cylinder. Install a steel plug in the disconnected hose.

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

6. With the engine off, turn the steering wheel for a right turn. Observe the open fitting on the extended steering cylinder as the steering wheel is turned. If oil comes out of the fitting while turning the steering wheel, the steering cylinder has internal leakage and must be repaired (see Steering Cylinder and Steering Cylinder Service in the Service and Repairs section of this chapter). Check drain pan for any evidence of oil that would indicate cylinder leakage.

7. After testing is completed, remove plug from the hydraulic hose. Connect hose to the steering cylinder fitting.

8. If a steering problem exists and the steering cylinder tested acceptably, consider the following:

A. Gear pump section P3 (steering, lift/lower and charge circuits) is worn or damaged (see Gear Pump P3 Flow Test in this section).

NOTE: If gear pump P3 is worn or damaged, charge, steering and lift circuits will all be affected.

B. The flow divider in the fan drive control manifold is faulty (see Fan Drive Manifold Service in the Service and Repairs section of this chapter).

C. The steering control valve requires service (see Steering Control Valve and Steering Control Valve Service in the Service and Repairs section of this chapter).

9. Check oil level in hydraulic reservoir and adjust if needed.

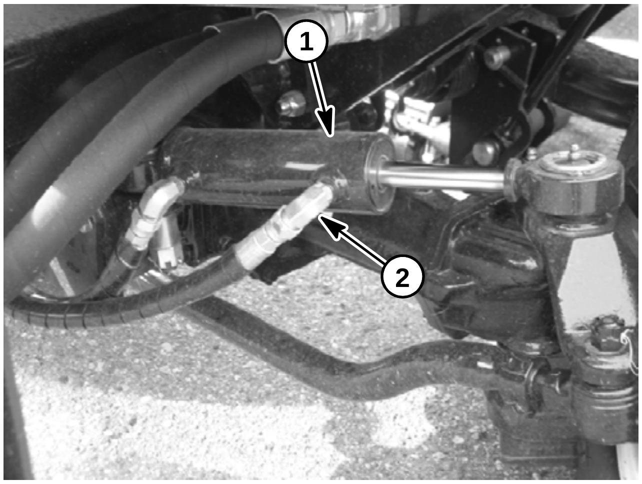
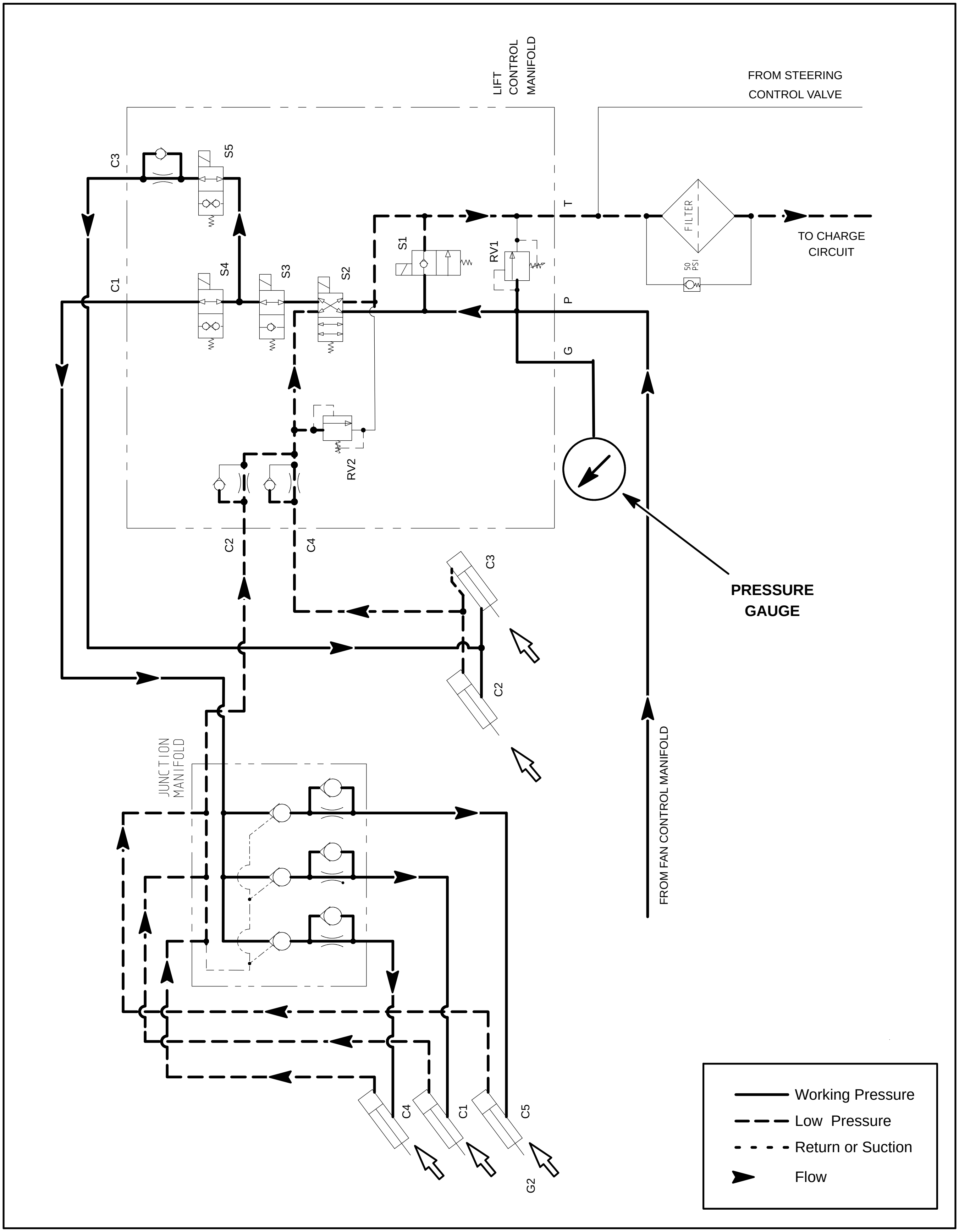


Figure 44

1. **Steering cylinder**
2. **Rod end fitting**

Lift/Lower Circuit Relief Pressure Test (Using Pressure Gauge)



The lift/lower circuit relief pressure test should be performed to make sure that the cutting unit lift and lower circuit relief pressure is correct.

Procedure for Lift/Lower Circuit Relief Pressure Test

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

2. Park machine on a level surface with the cutting units fully lowered. Apply the parking brake and stop engine.

CAUTION

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

3. Raise and support seat to gain access to lift control manifold (Fig. 45). Connect a 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to lift manifold test port G. Route gauge hose to allow seat to be safely lowered.

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

5. Move throttle to full engine speed **(2850 RPM)**.

6. While sitting on the seat, move lift switch to raise and allow the cutting units to fully raise. Momentarily hold the switch with the lift cylinders fully retracted while looking at the pressure gauge.

7. When the lift cylinders are fully retracted (cutting units fully raised) and the relief valve lifts, the pressure gauge needle will momentarily stop. System pressure as the relief valve RV1 opens should be be approximately **1700 PSI (117 bar)**. Release lift switch to the neutral position after observing relief valve pressure.

NOTE: If lift switch continues to be pressed after the relief valve has opened, system pressure can increase higher than relief pressure.

8. Stop the engine and record test results.

9. If specification is not met, clean or adjust relief valve RV1 located in the lift control manifold (see Lift Control Manifold Service in the Service and Repairs section of this chapter).

A. If pressure is too high, adjust relief valve RV1 to reduce lift/lower circuit relief pressure (see Adjust Control Manifold Relief Valves in the Adjustments section of this chapter).

B. If pressure is too low, check for restriction in gear pump intake line. Check the lift cylinders for internal leakage. If pump intake line is not restricted and lift cylinders are not leaking, adjust relief valve RV1 to increase lift/lower circuit relief pressure (see Adjust Control Manifold Relief Valves in the Adjustments section of this chapter).

C. If pressure is still too low after relief valve adjustment, lift cylinder(s) or gear pump P4 should be suspected of wear or damage.

10. After testing is completed, remove pressure gauge from manifold test port. Install dust cap to test port fitting. Lower and secure seat.

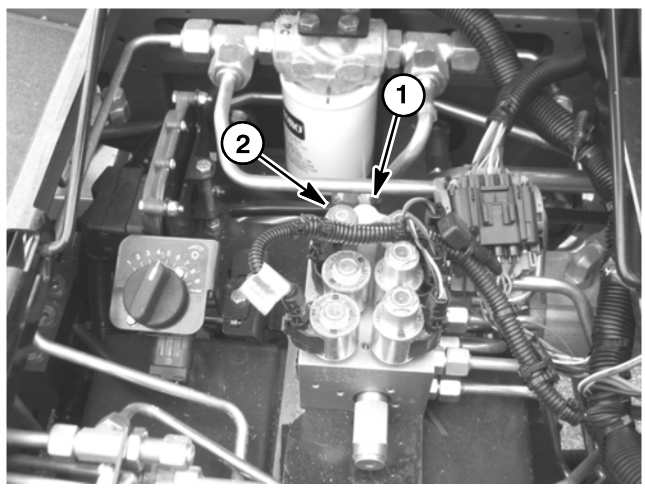
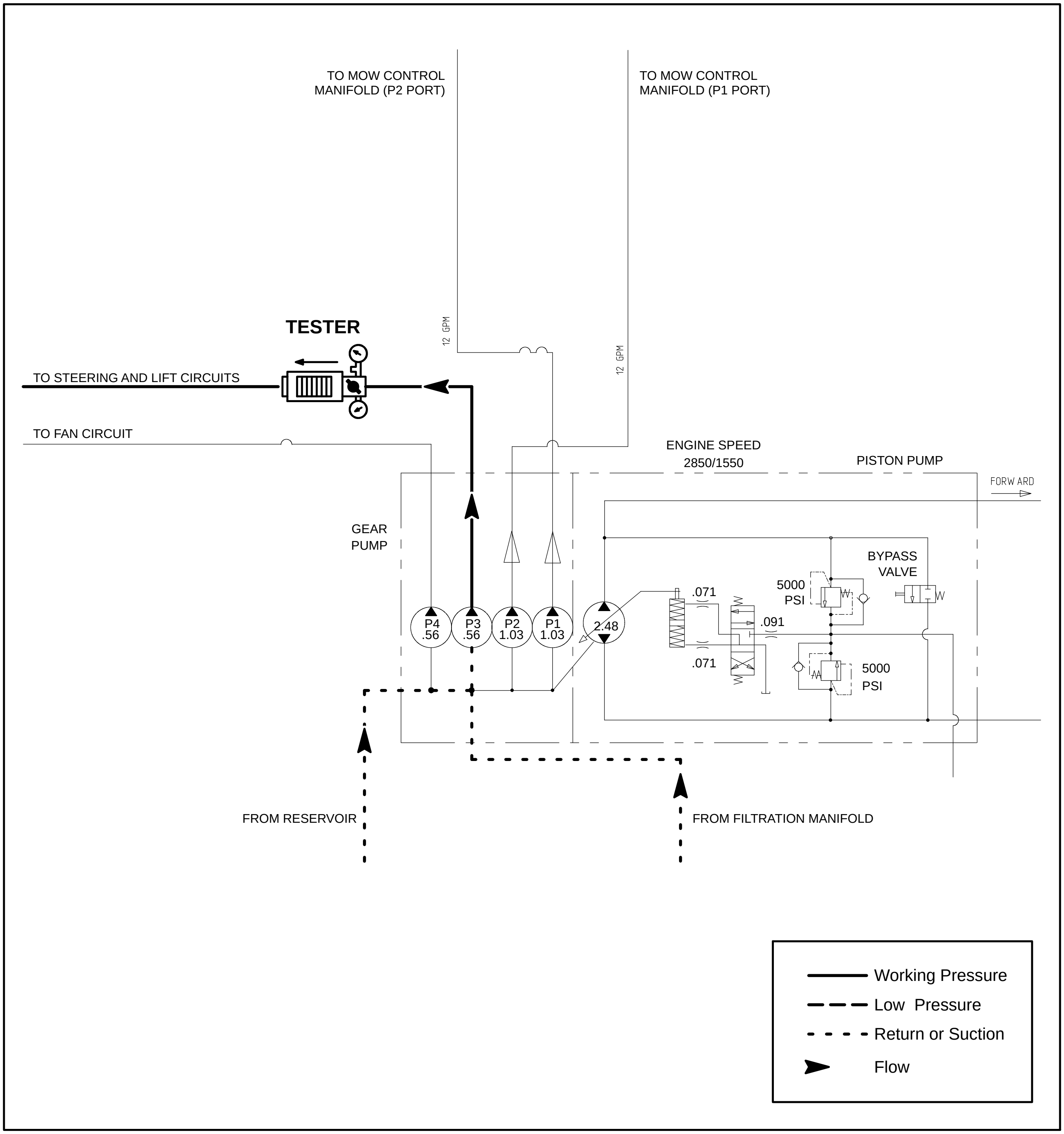


Figure 45

1. Test port G1
2. Relief valve RV1

Gear Pump P3 Flow (Steering and Lift/Lower Circuits) Test (Using Tester with Pressure Gauges and Flow Meter)



The gear pump P3 flow test should be performed to make sure that the steering, lift and traction charge circuits have adequate hydraulic flow.

NOTE: Gear Pump P3 supplies oil flow for the steering, lift and traction charge circuits.

Procedure for Gear Pump P3 Flow Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Raise hood to allow access to pump assembly.

CAUTION

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

4. Thoroughly clean junction of hydraulic hose and fitting in gear pump section P3 (Fig. 46). Disconnect hydraulic hose from fitting.

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

5. Install tester with pressure gauges and flow meter in series with the disconnected hose and fitting in gear pump section P3. **Make sure the flow control valve on the tester is fully open.**

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

7. Move throttle to full speed **(2850 RPM)**. **DO NOT** engage the cutting units.

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

8. While watching pressure gauges, slowly close flow control valve on tester until **1000 PSI (69 bar)** is obtained on pressure gauge. Verify engine speed continues to be correct **(2850 RPM)**.

9. For a pump in good condition, flow indication should be approximately **6.5 GPM (24.6 LPM)**.

10. Fully open flow control valve on tester and then shut engine off. Record test results.

11. If the flow is lower than **5.8 GPM (22 LPM)** or a pressure of **1000 PSI (69 bar)** could not be obtained, check for restriction in pump intake line. If intake line is not restricted, remove gear pump and repair or replace as necessary.

12. After testing is complete, disconnect tester from hydraulic hose and fitting. Connect hose to the gear pump fitting. Lower and secure hood.

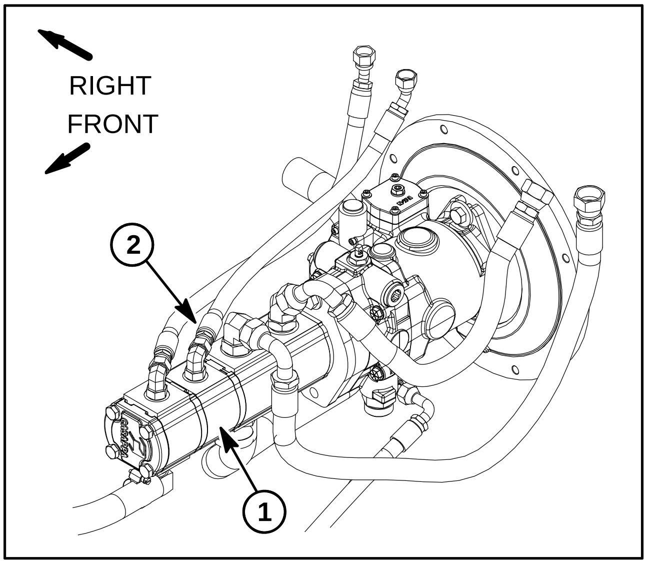
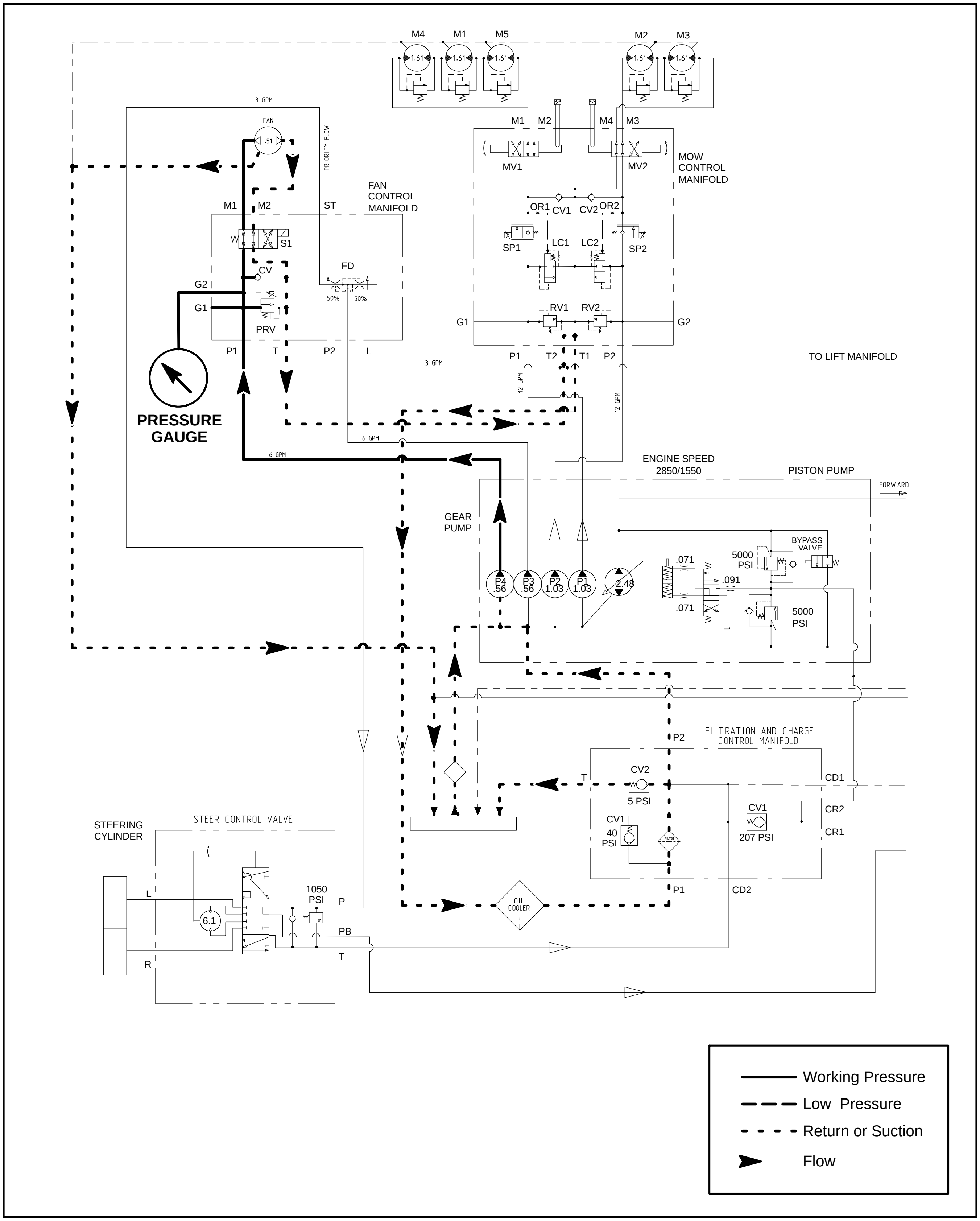


Figure 46

1. **Gear pump section P3**
2. **Pump section P3 hose**

Hydraulic System

Cooling Fan Circuit Test (Using Pressure Gauge and Phototac)



The cooling fan circuit test should be performed to make sure that the engine cooling fan circuit has the correct system pressure and fan speed.

Procedure for Cooling Fan Circuit Test

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

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

CAUTION

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

3. Raise and support hood to gain access to fan control manifold (Fig. 47). Connect a 5,000 PSI (345 bar) gauge with hydraulic hose attached to test fitting in port G2 on rear of manifold.

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

5. Move throttle to full speed **(2850 RPM)**.

6. While monitoring the pressure gauge and using a phototac to identify the cooling fan speed, disconnect the wire harness connector (white/green and black wires) from the proportional relief valve solenoid at fan control manifold (port PRV). Both fan speed and pressure should increase and stabilize after the solenoid is disconnected.

PRESSURE GAUGE READING TO BE approximately **3000 PSI (207 bar)**

PHOTOTAC (fan speed) READING TO BE approximately **2800 RPM**

7. Stop engine and record test results.

8. If pressure rises to approximately **3000 PSI (207 bar)** but fan speed is low, consider that the fan motor is worn or damaged. If pressure and fan speed are both low, consider that gear pump P4 is worn or damaged (see Gear Pump P4 Flow Test in this section).

NOTE: If pressure and fan speed are both low and gear pump P4 flow proves to be correct (see Gear Pump P4 Flow Test in this section), suspect that seals in fan control manifold are leaking or faulty (see Fan Control Manifold Service in the Service and Repairs section of this chapter) or that fan motor is worn or damaged.

9. When testing is complete, remove pressure gauge from manifold fitting and reconnect wire harness to proportional relief valve solenoid. Install dust cap to test port fitting. Lower and secure hood.

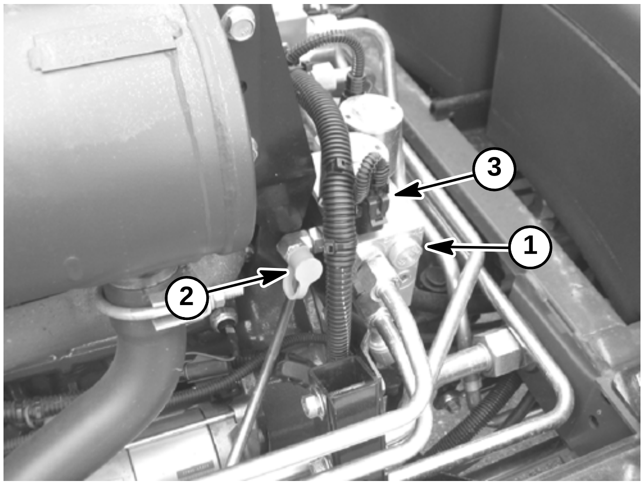
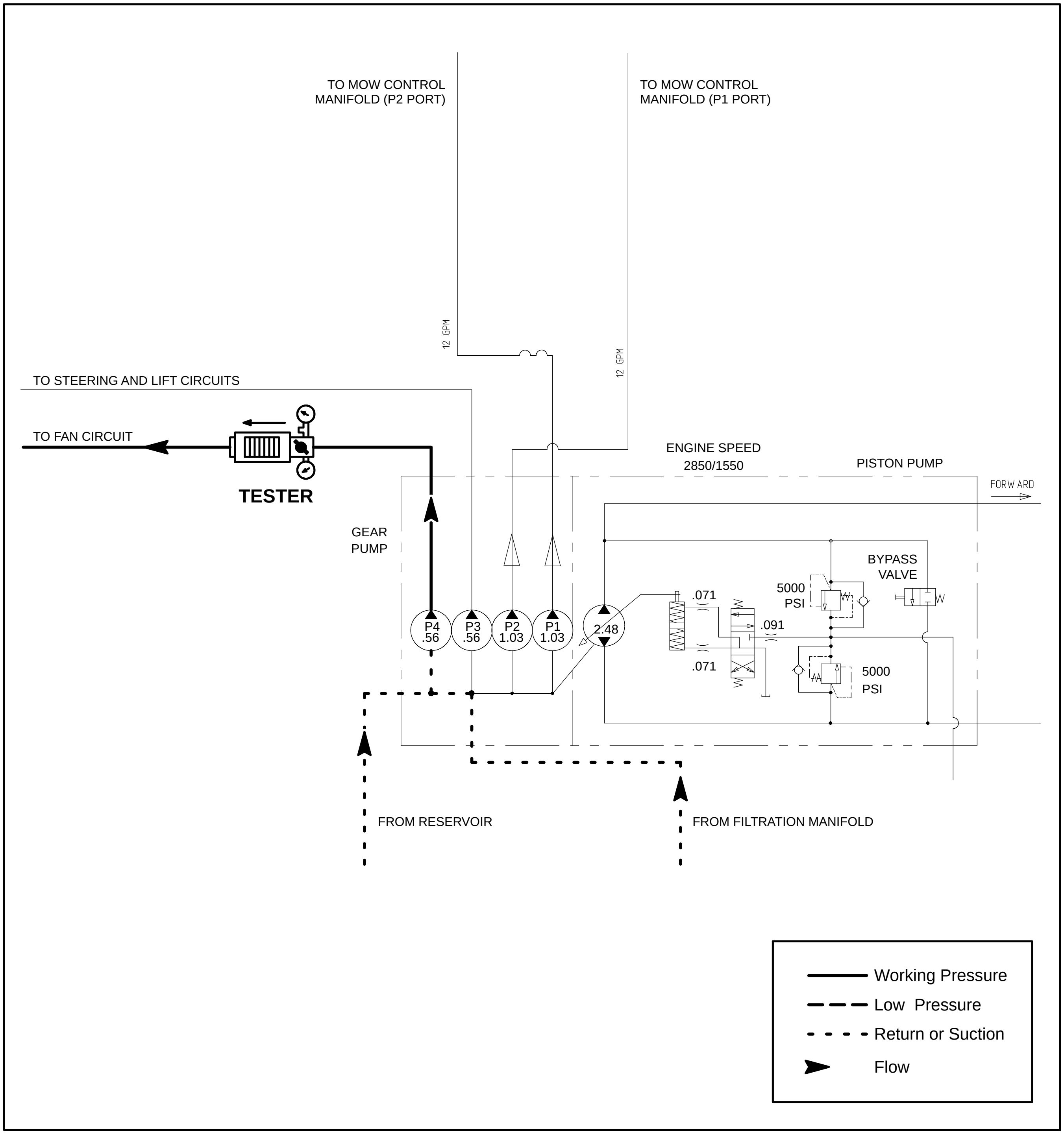


Figure 47

1. **Fan control manifold**
2. **Test fitting (port G2)**
3. **PRV solenoid**

Hydraulic System

Gear Pump P4 Flow (Cooling Fan Circuit) Test (Using Tester with Pressure Gauges and Flow Meter)



The gear pump P4 flow test should be performed to make sure that the engine cooling fan circuit has adequate hydraulic flow.

NOTE: Gear Pump P4 supplies oil flow for the engine cooling fan circuit.

Procedure for Gear Pump P4 Flow Test

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off and the parking brake is engaged.

3. Raise hood to allow access to pump assembly.

CAUTION

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

4. Thoroughly clean junction of hydraulic hose and fitting in gear pump section P4 (Fig. 48). Disconnect hydraulic hose from fitting.

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

5. Install tester with pressure gauge and flow meter in series with the disconnected hose and fitting in gear pump section P4. **Make sure the flow control valve on the tester is fully open.**

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

7. Move throttle to full speed **(2850 RPM)**. DO NOT engage the cutting units.

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

8. While watching pressure gauge on tester, slowly close flow control valve on tester until **1000 PSI (69 bar)** is obtained on pressure gauge. Verify engine speed continues to be correct **(2850 RPM)**.

9. For a pump in good condition, flow indication should be approximately **6.5 GPM (24.6 LPM)**.

10. Fully open flow control valve on tester and then shut engine off. Record test results.

11. If the flow is lower than **5.8 GPM (22 LPM)** or a pressure of **1000 PSI (69 bar)** could not be obtained, check for restriction in pump intake line. If intake line is not restricted, remove gear pump and repair or replace as necessary.

12. After testing is complete, disconnect tester from hydraulic hose and fitting. Connect hose to the gear pump fitting. Lower and secure hood.

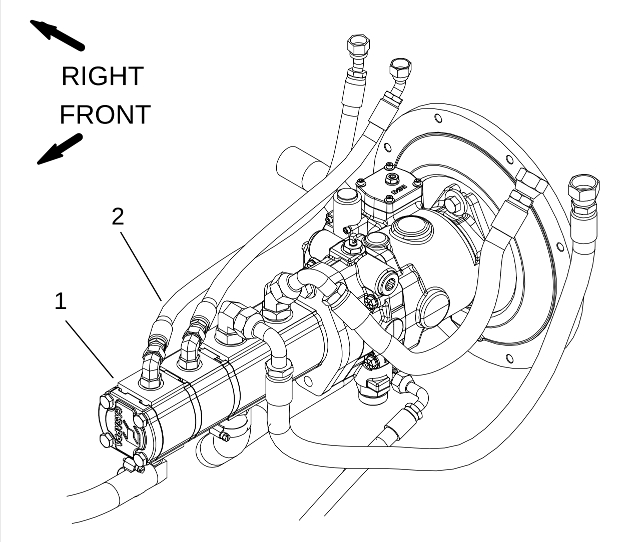


Figure 48

1. **Gear pump**
2. **Pump section P4 hose**

Hydraulic System

Adjust Control Manifold Relief Valves

Several of the hydraulic control manifolds on your Reelmaster include adjustable relief valves. The following procedure can be used to adjust these relief valves. Refer to the Testing section of this chapter for information on testing relief pressure.

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

1. Locate relief valve on control manifold.

2. Remove cap on relief valve with an allen wrench.

3. To **increase** pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

4. To **decrease** pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

5. Install and tighten cap on relief valve.

6. Recheck relief pressure and readjust as needed.

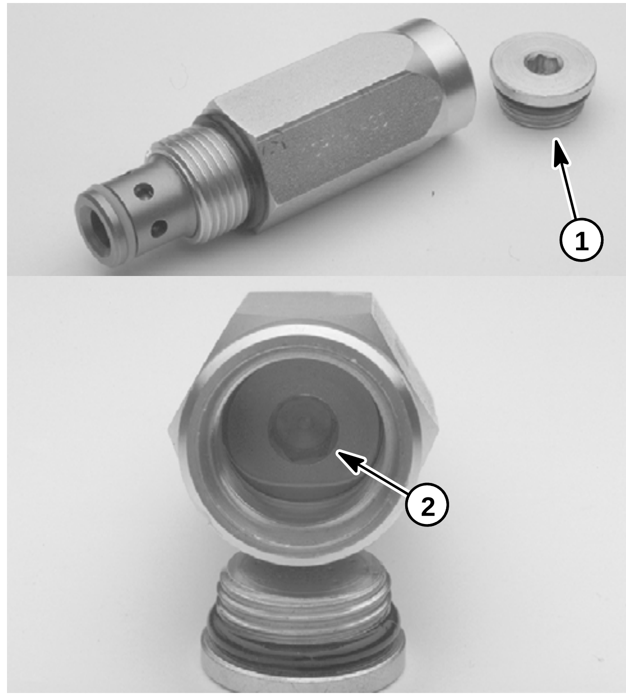


Figure 49

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

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Hydraulic Components

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

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

CAUTION

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

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

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

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

After Repair or Replacement of Hydraulic Components

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

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

3. Make sure caps or plugs are removed from the hydraulic tubes, 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 disconnecting 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 reservoir and add correct oil if necessary.

Check Hydraulic Lines and Hoses

WARNING

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

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

Flush Hydraulic System

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

IMPORTANT: Flush hydraulic system when changIng from petroleum base hydraulic fluid to a biodegradable fluid. Operate machine under normal operating conditions for at least four (4) hours before draining.

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

> **CAUTION**
>
> **Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.**

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

2. Drain hydraulic reservoir into a suitable container.

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

4. Change and replace both hydraulic oil filters.

5. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir Inspection in the Service and Repair section).

6. Connect all hydraulic hoses, lines and components that were disconnected while draining system.

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

7. Fill hydraulic reservoir with **new** hydraulic fluid.

8. Disconnect wire harness connector from engine run solenoid to prevent the engine from starting.

9. Turn ignition key switch to start and engage starter for ten (10) seconds to prime pump. Let starter cool and then repeat cranking procedure again.

10. Connect wire harness connector to engine run solenoid.

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

12. Raise and lower cutting units several times. Turn steering wheel fully left and right several times.

13. Move PTO switch to ON to engage cutting units and let them run for several minutes. Move PTO switch to OFF.

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

15. Operate 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 14 again until oil is clean. If changing to biodegradable fluid, repeat steps 1 through 15 again at least once and until the oil is clean.

17. Assume normal operation and follow recommended maintenance intervals.

Filtering Closed–Loop Traction Circuit

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

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

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

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

3. Thoroughly clean junction of hydraulic hose and **right** side fitting on bottom of traction pump (Fig. 50). Disconnect hose from right side pump fitting.

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

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

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

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

CAUTION

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

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

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

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

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

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

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

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

12. Lower machine to ground.

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

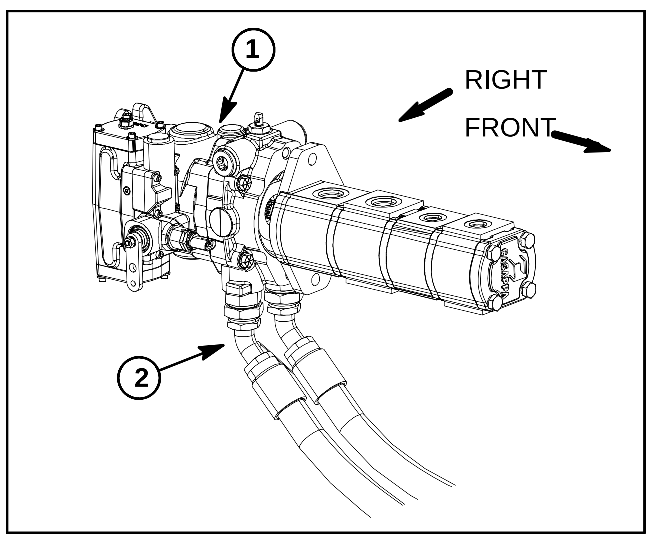


Figure 50

1. **Piston (traction) pump**
2. **Right side fitting/hose**

Charge Hydraulic System

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

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

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

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

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

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

5. Disconnect wire harness connector from engine run solenoid to prevent the engine from starting.

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

7. Make sure traction pedal is in the neutral position. Turn ignition key switch to start and engage starter for ten (10) seconds to prime the traction and gear pumps. Let starter cool and then repeat cranking procedure again.

8. Connect wire harness connector to engine run solenoid.

WARNING

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

9. Raise one front and one rear wheel off the ground and place support blocks under the frame. Chock remaining wheels to prevent movement of the machine.

10. Make sure traction pedal is in neutral. Start engine and run it at low idle **(1550 RPM)**. The 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.

11. After the hydraulic system starts to show signs of fill, actuate lift control switch until the lift cylinder rods move in and out several times. If the cylinder rods do not move after fifteen (15) seconds or the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:

    A. Loose filter or suction lines.

    B. Blocked suction line.

    C. Faulty charge relief valve.

    D. Faulty gear pump.

12. Once lift cylinders do move, proceed to step 13.

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

    A. If the wheels rotate in the wrong direction, stop engine and inspect hydraulic line placement at piston (traction) pump and wheel motors. Correct hydraulic line installation before proceeding.

    B. If the wheels rotate in the proper direction, proceed with procedure.

14. Adjust traction pedal to the neutral position.

15. Check operation of the traction interlock switch.

16. Stop engine, remove blocks from frame and lower machine. Remove chocks from remaining wheels.

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

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

19. Stop the machine. Check hydraulic reservoir and fill if necessary. Check hydraulic components for leaks and tighten any loose connections.

Gear Pump

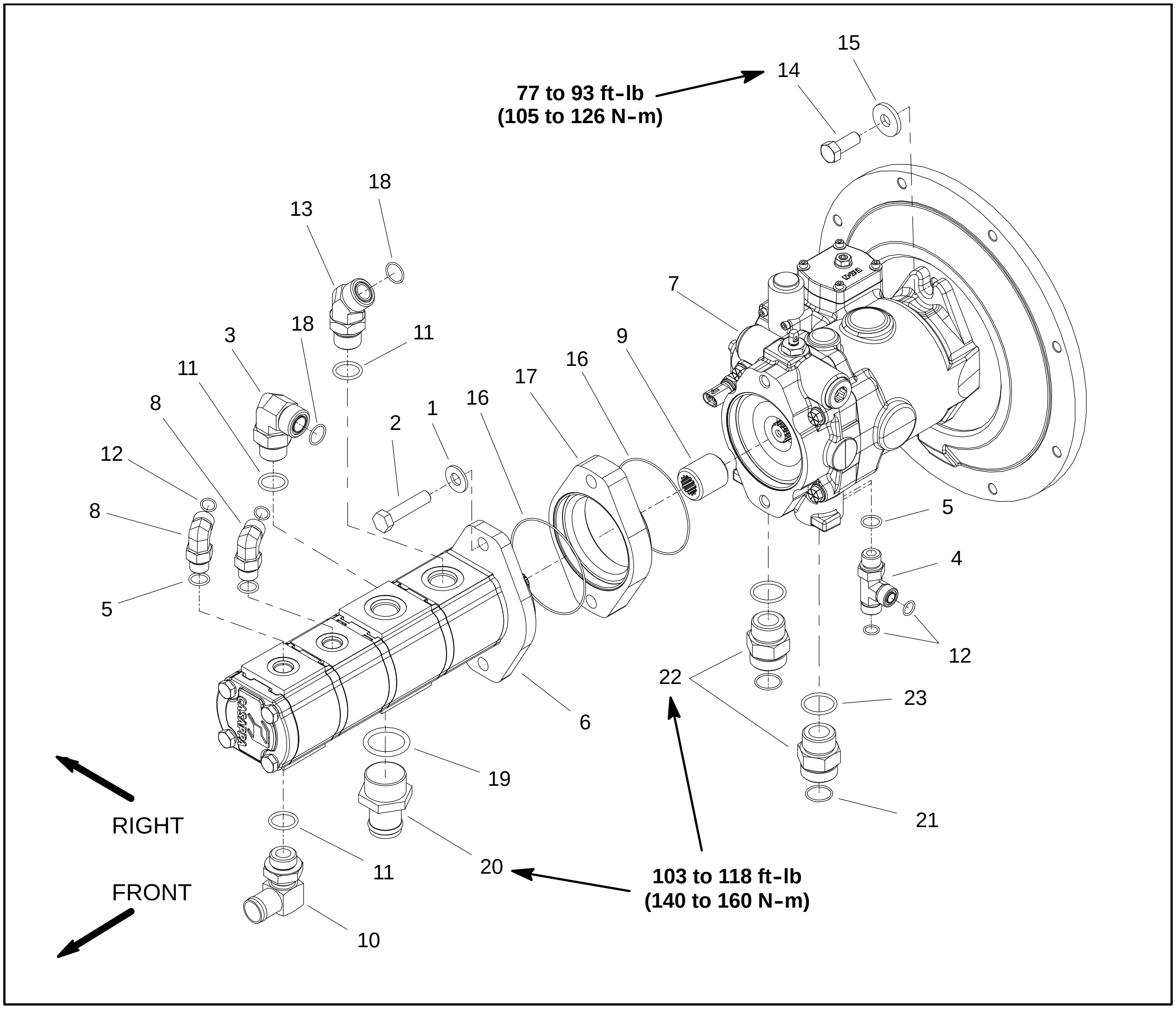


Figure 51

1. **Flat washer (2 used)**
2. **Cap screw (2 used)**
3. **90° hydraulic fitting**
4. **Hydraulic tee fitting**
5. **O-ring**
6. **Gear pump assembly**
7. **Piston pump assembly**
8. **90° hydraulic fitting**
9. **Coupler**
10. **90° hydraulic fitting**
11. **O-ring**
12. **O-ring**
13. **45° hydraulic fitting**
14. **Cap screw**
15. **Washer**
16. **O-ring**
17. **Spacer**
18. **O-ring**
19. **O-ring**
20. **Straight hose fitting**
21. **O-ring**
22. **Straight hydraulic fitting**
23. **O-ring**

Removal (Fig. 51)

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

2. Raise seat and secure it with prop rod to gain access to gear pump.

3. Drain the hydraulic reservoir into a suitable container.

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

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

6. Disconnect hydraulic lines from gear pump and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly (Fig. 52).

7. Support gear pump assembly to prevent it from falling.

8. Remove two (2) cap screws and washers securing gear pump to piston pump. Remove gear pump, coupler (item 9), spacer (item 17) and O–rings (item 16) from machine.

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

Installation (Fig. 51)

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

2. Lubricate new O–rings (item 16) with clean hydraulic oil. Position O–rings on gear pump and pump spacer flanges.

3. Slide coupler (item 9) onto the piston pump output shaft.

4. Position pump spacer (item 17) to gear pump. Align gear teeth and slide gear pump input shaft into coupler. Secure gear pump to piston pump with two (2) cap screws and flat washers.

5. Remove caps and plugs from hydraulic hoses and fittings. Install hoses to gear pump (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Replace hydraulic filter and fill hydraulic reservoir with new hydraulic oil.

7. Disconnect engine run solenoid electrical connector to prevent engine from starting. Prime the hydraulic pump by turning the ignition key switch to start and cranking the engine for ten (10) seconds. Let starter cool and then repeat cranking procedure again.

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

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

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

11. Lower and secure seat.

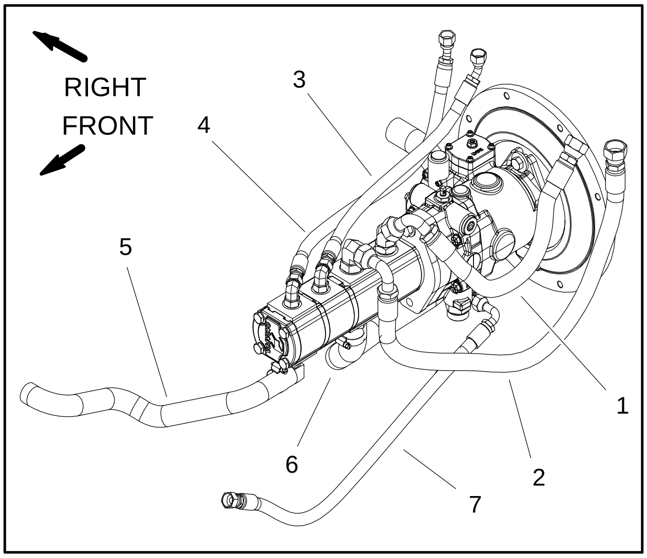


Figure 52

1. **Supply hose to mow manifold P1 port**
2. **Supply hose to mow manifold P2 port**
3. **Supply hose to fan manifold P2 port**
4. **Supply hose to fan manifold P1 port**
5. **Suction hose from filter manifold**
6. **Suction hose from reservoir**
7. **Supply hose for charge circuit**

Hydraulic System

Gear Pump Service

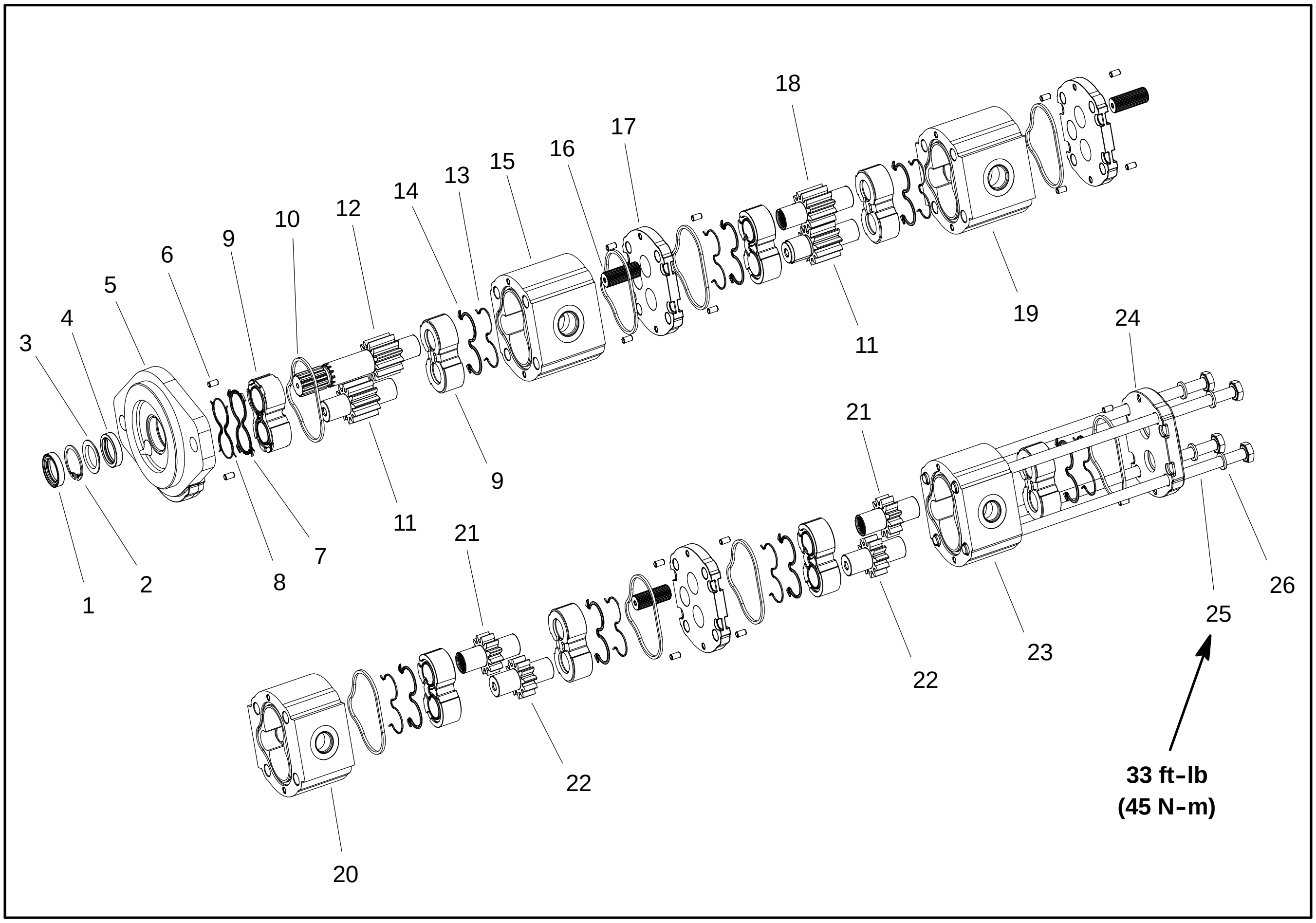


Figure 53

1. Dust seal
2. Retaining ring
3. Flange washer
4. Shaft seal
5. Front cover
6. Dowel pin (16 used)
7. Pressure seal
8. Back–up gasket
9. Thrust plate (8 used)
10. Seal (8 used)
11. Idler gear
12. Drive shaft
13. Back–up gasket
14. Pressure seal
15. Front body (section P1)
16. Splined connecting shaft (3 used)
17. Flange
18. Drive gear
19. Body (section P2)
20. Body (section P3)
21. Drive gear
22. Idler gear
23. Rear body (section P4)
24. Rear cover
25. Cap screw (4 used)
26. Washer (4 used)

Disassembly (Fig. 53)

NOTE: The gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

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

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

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 54).

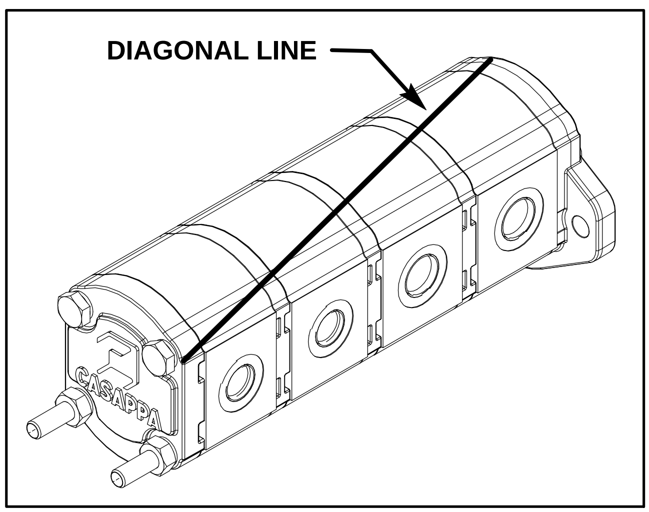


Figure 54

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

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

4. Loosen the four (4) cap screws that secure pump assembly.

5. Remove pump from vise and remove fasteners.

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

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

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

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

9. Replace the entire pump assembly if parts are excessively worn or scored.

Assembly (Fig. 53)

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

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

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

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

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

Piston (Traction) Pump

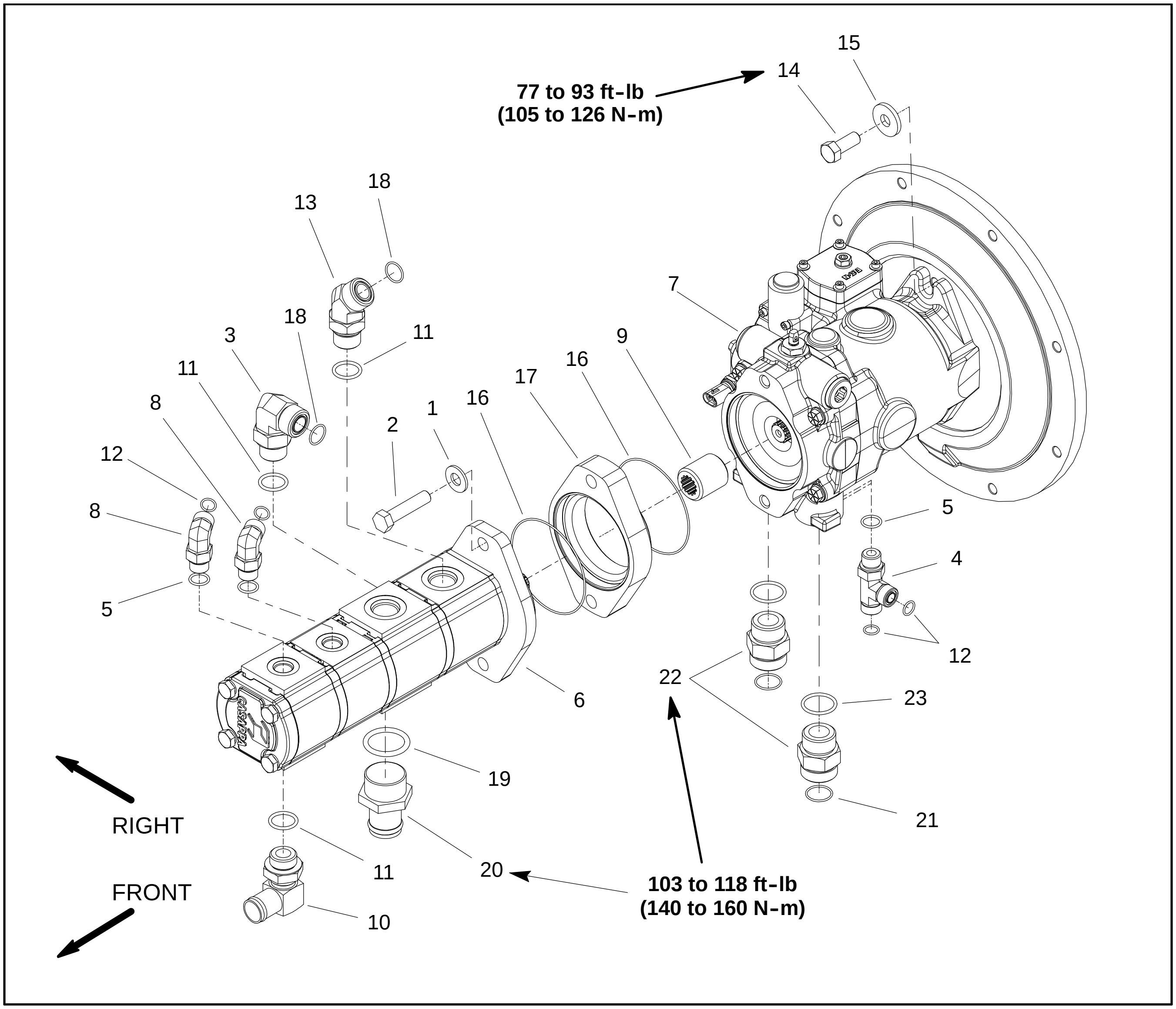


Figure 55

1. **Flat washer (2 used)**
2. **Cap screw (2 used)**
3. **90º hydraulic fitting**
4. **Hydraulic tee fitting**
5. **O-ring**
6. **Gear pump assembly**
7. **Piston pump assembly**
8. **90º hydraulic fitting**
9. **Coupler**
10. **90º hydraulic fitting**
11. **O-ring**
12. **O-ring**
13. **45º hydraulic fitting**
14. **Cap screw**
15. **Washer**
16. **O-ring**
17. **Spacer**
18. **O-ring**
19. **O-ring**
20. **Straight hose fitting**
21. **O-ring**
22. **Straight hydraulic fitting**
23. **O-ring**

Removal (Fig. 55)

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

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

3. Remove traction rod from control arm on piston pump by removing lock nut and flange head screw (Fig. 56).

4. Disconnect wire harness connector from neutral switch on traction pump (Fig. 56).

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

6. Put a drain pan below the pump assembly. Remove hydraulic hoses connected to piston and gear pumps. Put plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the system (Fig. 57).

7. Remove gear pump from machine (see Gear Pump Removal in this section).

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

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

Installation (Fig. 55)

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

IMPORTANT: To prevent spring coupler damage, make sure that piston pump is properly supported and does not put side load into coupler during pump installation.

2. Carefully lower piston pump into the machine and position it to the engine adapter plate. Support pump to prevent it from falling while installing two (2) cap screws and washers securing piston pump to engine adapter plate. Torque screws from **77 to 93 ft–lb (105 to 126 N–m)**.

3. Install gear pump to piston pump (see Gear Pump Installation in this section).

4. Position traction rod to control arm on piston pump and secure with flange head screw and lock nut (Fig. 56).

5. Connect wire harness connector to neutral switch on traction pump.

6. Remove plugs and caps from disconnected hydraulic hoses and open ports of the pump assembly. Install fittings and hoses to correct location on gear and piston pumps (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

8. Disconnect engine run solenoid electrical connector to prevent engine from starting. Prime pumps by turning ignition key switch to crank engine for ten (10) seconds. Repeat cranking procedure again.

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

10. Properly fill hydraulic system (see Charge Hydraulic System).

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

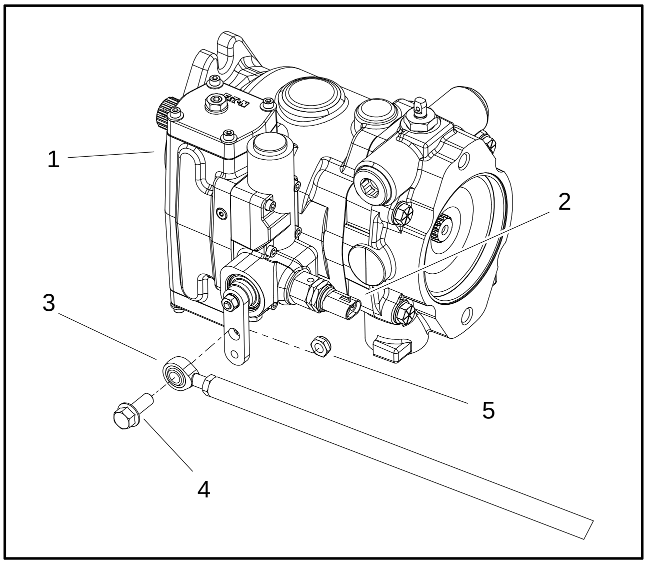


Figure 56

1. **Piston pump**
2. **Neutral switch**
3. **Traction rod**
4. **Flange head screw**
5. **Lock nut**

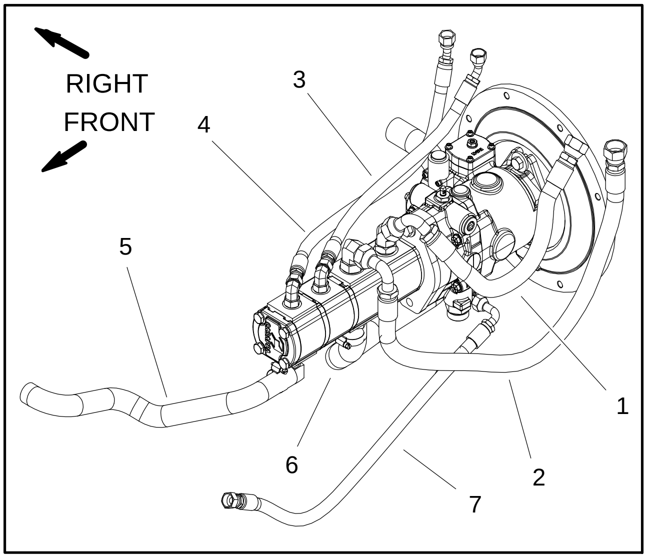


Figure 57

1. **Supply hose to mow manifold P1 port**
2. **Supply hose to mow manifold P2 port**
3. **Supply hose to fan manifold P2 port**
4. **Supply hose to fan manifold P1 port**
5. **Suction hose from filter manifold**
6. **Suction hose from reservoir**
7. **Supply hose for charge circuit**

Hydraulic System

Piston (Traction) Pump Service

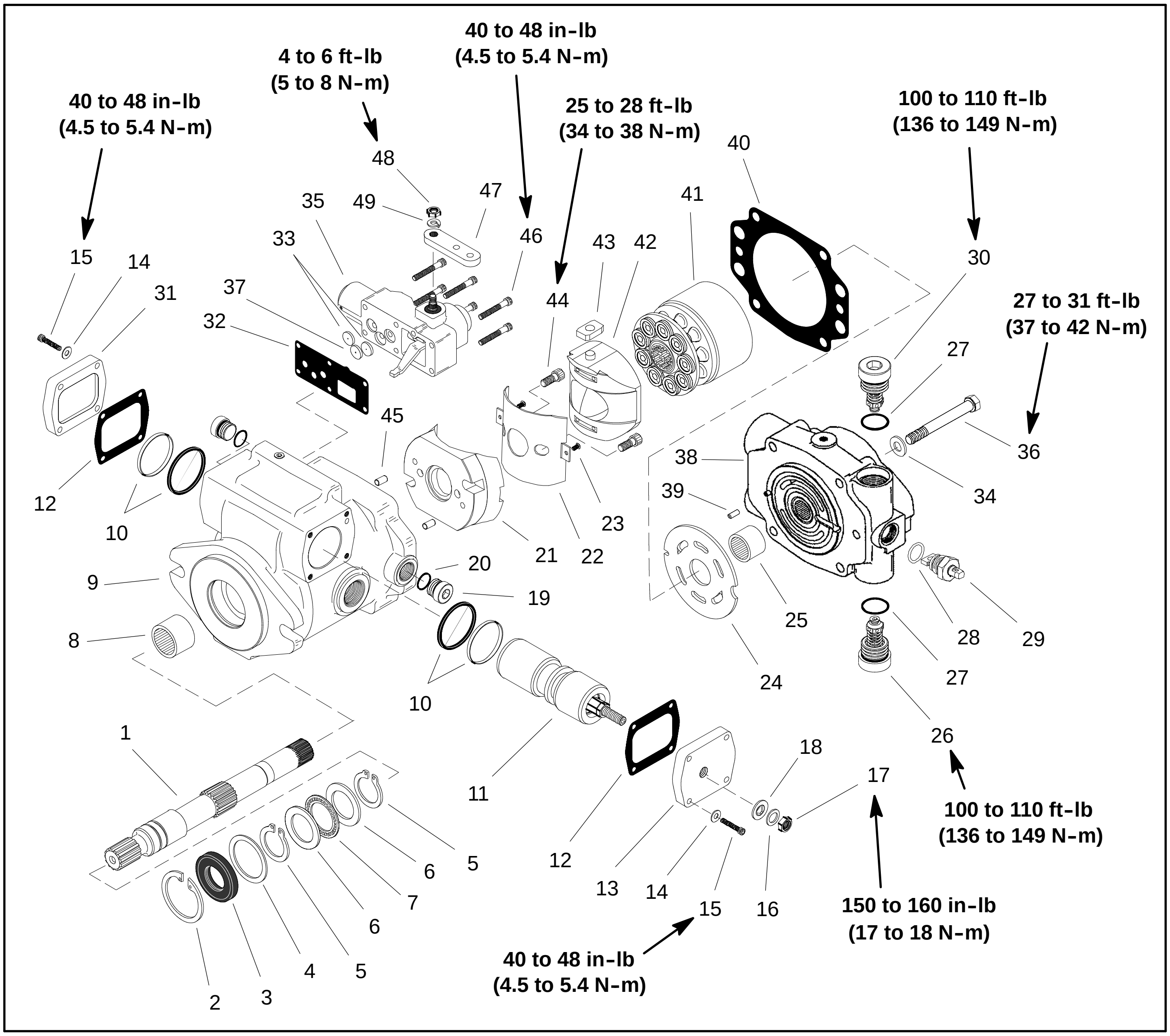


Figure 58

1. **Drive shaft**
2. **Retaining ring**
3. **Shaft seal**
4. **Washer**
5. **Retaining ring**
6. **Thrust bearing race**
7. **Thrust bearing**
8. **Bearing**
9. **Housing**
10. **Seal set**
11. **Servo piston**
12. **Gasket**
13. **Cover plate**
14. **Flat washer (4 used per cover)**
15. **Socket head screw (4 used per cover)**
16. **Washer**
17. **Jam nut**
18. **Seal washer**
19. **Plug**
20. **O–ring**
21. **Cradle**
22. **Bushing**
23. **Screw**
24. **Valve plate**
25. **Bearing**
26. **Reverse relief valve**
27. **O–ring**
28. **O–ring**
29. **Bypass valve**
30. **Forward relief valve**
31. **Cover plate**
32. **Housing gasket**
33. **Control orifice (.028) (2 used)**
34. **Flat washer (4 used)**
35. **Manual servo control assembly**
36. **Cap screw (4 used)**
37. **Control orifice (.036)**
38. **Backplate**
39. **Roll pin**
40. **Housing gasket**
41. **Rotating kit**
42. **Camplate**
43. **Servo piston follower**
44. **Cap screw (2 used)**
45. **Bushing dowel (2 used)**
46. **Socket head screw (6 used)**
47. **Control arm**
48. **Hex nut**
49. **Lock washer**

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

Hydraulic System

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4WD/2WD and Filtration/Charge Control Manifolds

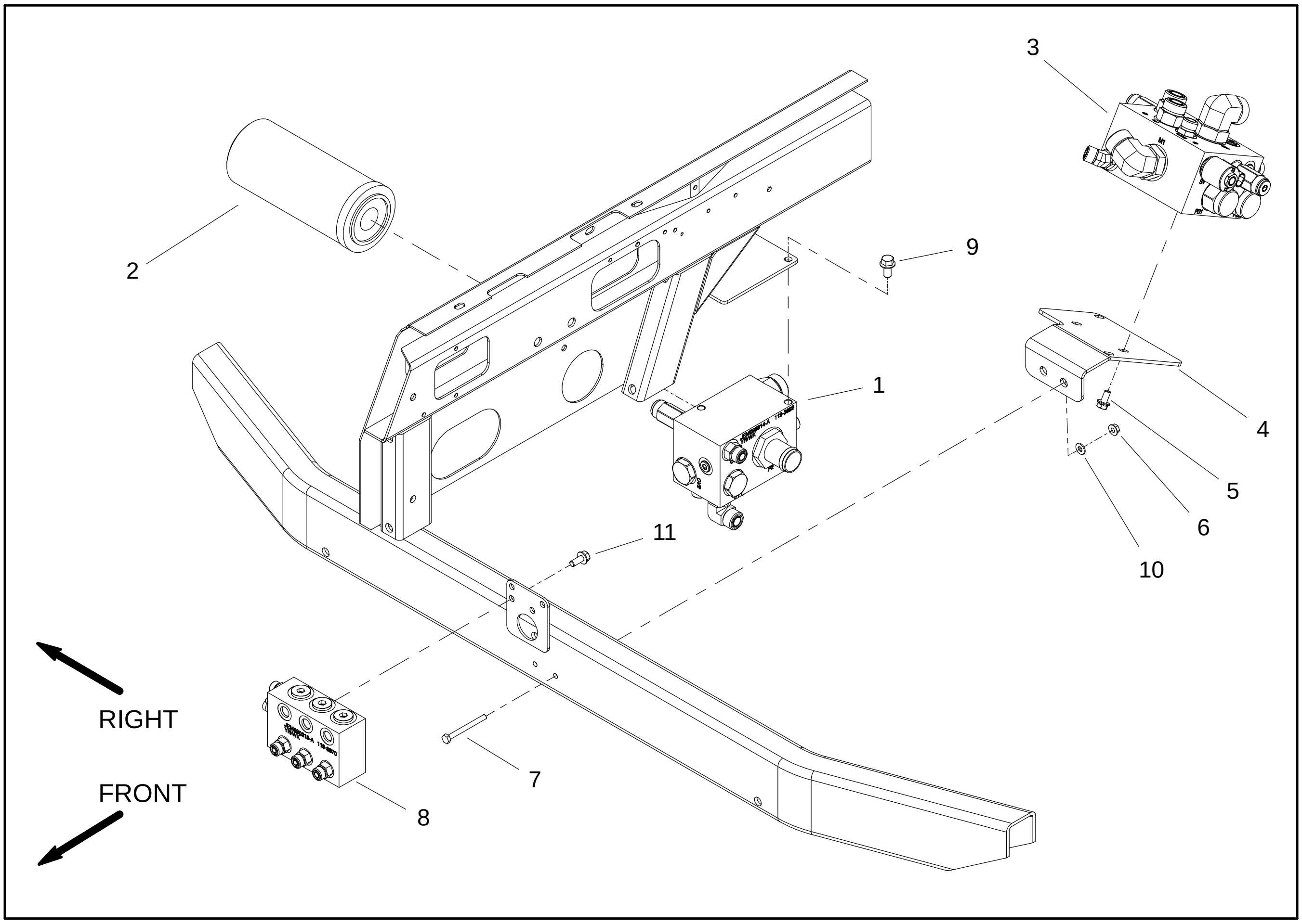

Figure 59

1. **Filtration/charge control manifold**
2. **Hydraulic oil filter**
3. **4WD/2WD control manifold**
4. **Manifold bracket**
5. **Flange head screw (3 used)**
6. **Flange nut (2 used)**
7. **Cap screw (2 used)**
8. **Lift circuit junction manifold**
9. **Flange head screw (2 used)**
10. **Flat washer (2 used)**
11. **Flange head screw (2 used)**

Removal (Fig. 59)

NOTE: The ports on the manifolds are marked for easy identification of components. Refer to the Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port.

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

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

3. If 4WD/2WD control manifold is being removed, label wire harness electrical connectors that attach to manifold components. Disconnect harness electrical connectors from the solenoid valve coil and electrical sensors (pressure and temperature).

4. Disconnect hydraulic lines from manifold being removed and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Remove hydraulic manifold from the frame using Figure 59 as guide.

6. If hydraulic fittings are to be removed from control manifold, mark fitting orientation to allow correct assembly (Figure 60 or 61). Remove fittings from manifold and discard O–rings.

Installation (Fig. 59)

1. If fittings were removed from control manifold, lubricate and place new O–rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Refer to Figure 60 or 61 for fitting installation torque.

2. Install hydraulic manifold to the frame using Figure 59 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. If 4WD/2WD control manifold was removed, connect wire harness electrical connectors to the solenoid valve coil and electrical sensors.

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

6. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

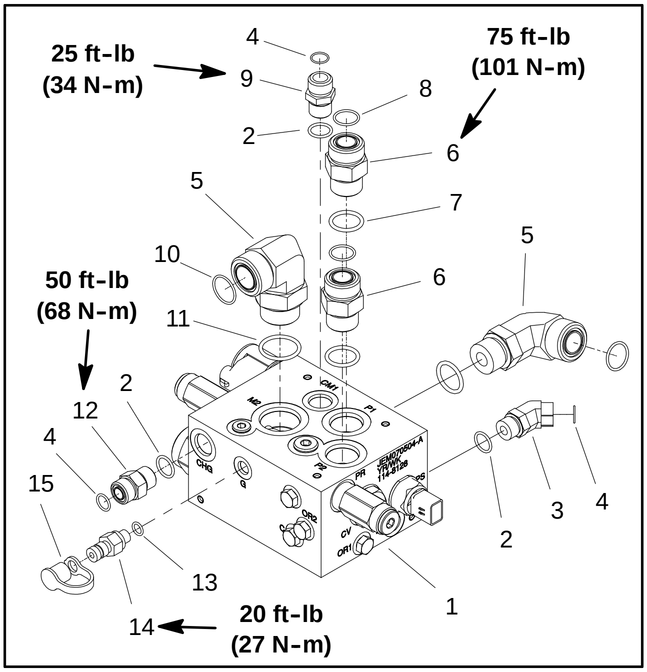

Figure 60

1. **4WD/2WD manifold**
2. **O–ring**
3. **45° fitting**
4. **O–ring**
5. **90° fitting**
6. **Straight fitting**
7. **O–ring**
8. **O–ring**
9. **Check fitting**
10. **O–ring**
11. **O–ring**
12. **Straight fitting**
13. **O–ring**
14. **Test fitting**
15. **Dust cap**

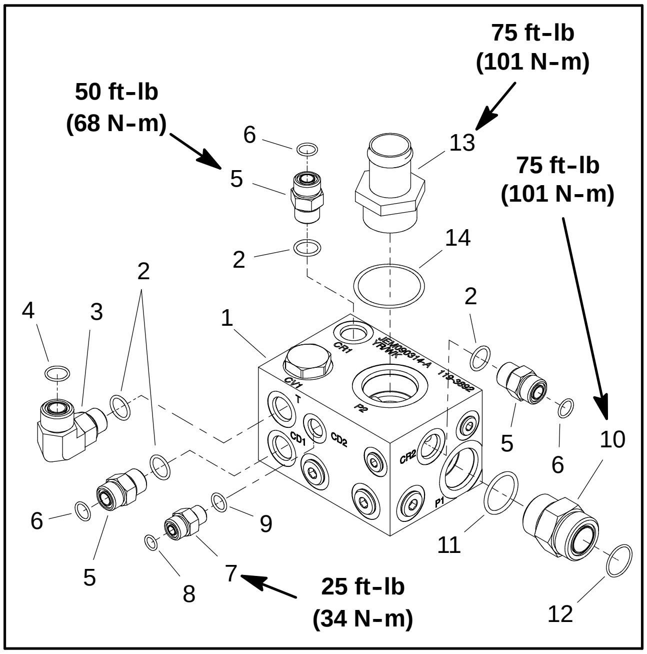

Figure 61

1. **Filtration manifold**
2. **O–ring**
3. **90° fitting**
4. **O–ring**
5. **Straight fitting (3 used)**
6. **O–ring**
7. **Straight fitting**
8. **O–ring**
9. **O–ring**
10. **Straight fitting**
11. **O–ring**
12. **O–ring**
13. **Barb fitting**
14. **O–ring**

4WD/2WD Control Manifold Service

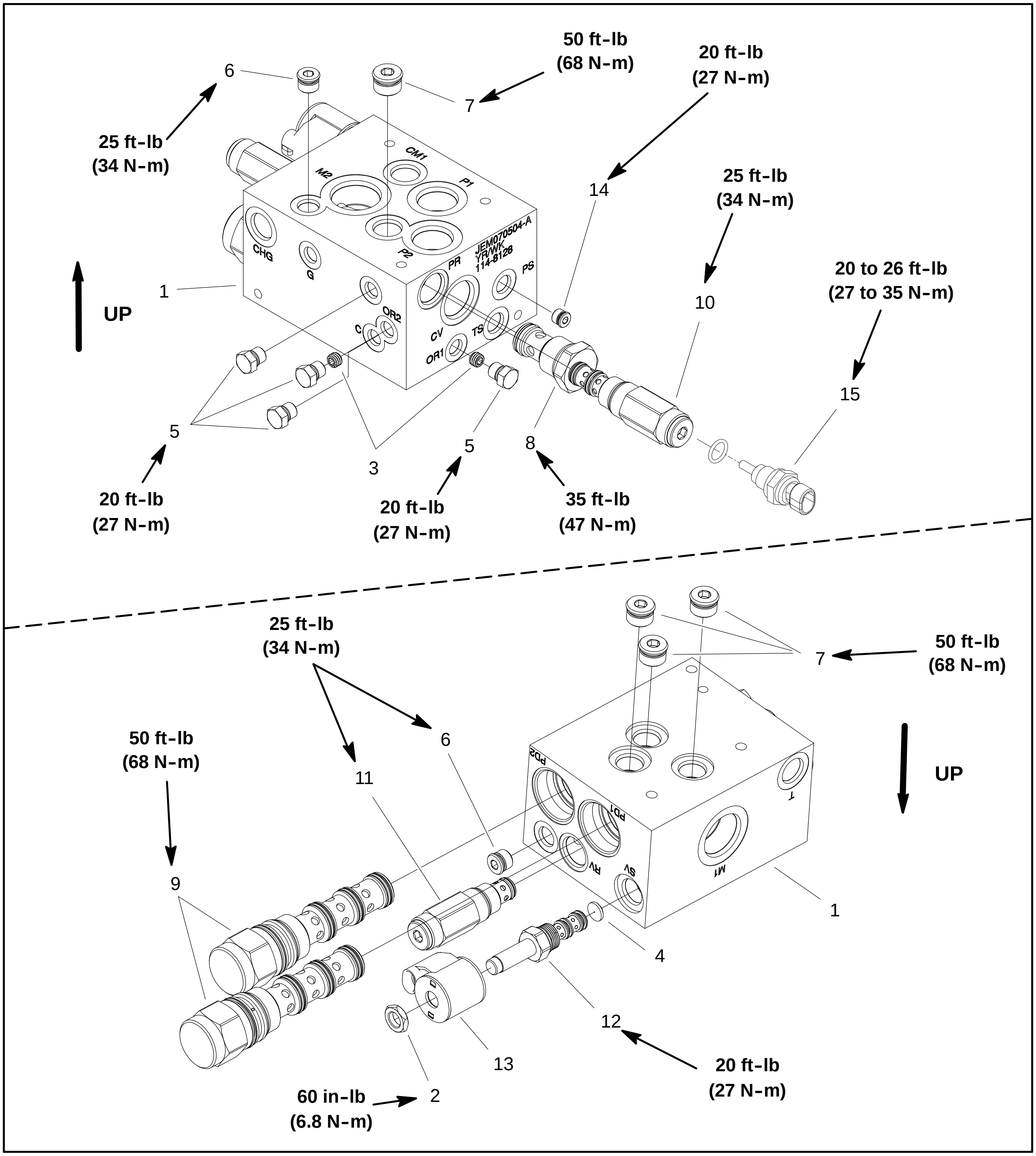

Figure 62

1. **Manifold body**
2. **Nut**
3. **Orifice (0.050)**
4. **Orifice disc (0.030)**
5. **Zero leak plug (#4) (4 used)**
6. **Zero leak plug (#6) (2 used)**
7. **Zero leak plug (#8) (4 used)**
8. **Check valve (CV)**
9. **Pilot directional valve (PD1 & PD2)**
10. **Pressure reducing valve (PR)**
11. **Relief valve (RV)**
12. **Solenoid valve (SV)**
13. **Solenoid coil**
14. **Zero leak plug (#4)**
15. **Temperature sensor (TS)**

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P1 is a piston pump connection port and SV is the location for the solenoid valve). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port.

NOTE: The 4WD/2WD control manifold uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a pin punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 62 for 4WD/2WD Control Manifold cartridge valve and plug installation torque.

IMPORTANT: A flow control orifice (item 3) is located beneath the plug in 4WD/2WD control manifold ports OR1 and OR2. If an orifice is removed from these manifold ports, make sure to label its position for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is properly tightened in the port.

IMPORTANT: An orifice disc (item 4) is located beneath the 4WD/2WD control manifold solenoid valve (SV). If this valve is removed from the manifold, make sure to remove orifice and label its position for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is flat in the base of the port.

Filtration/Charge Control Manifold Service

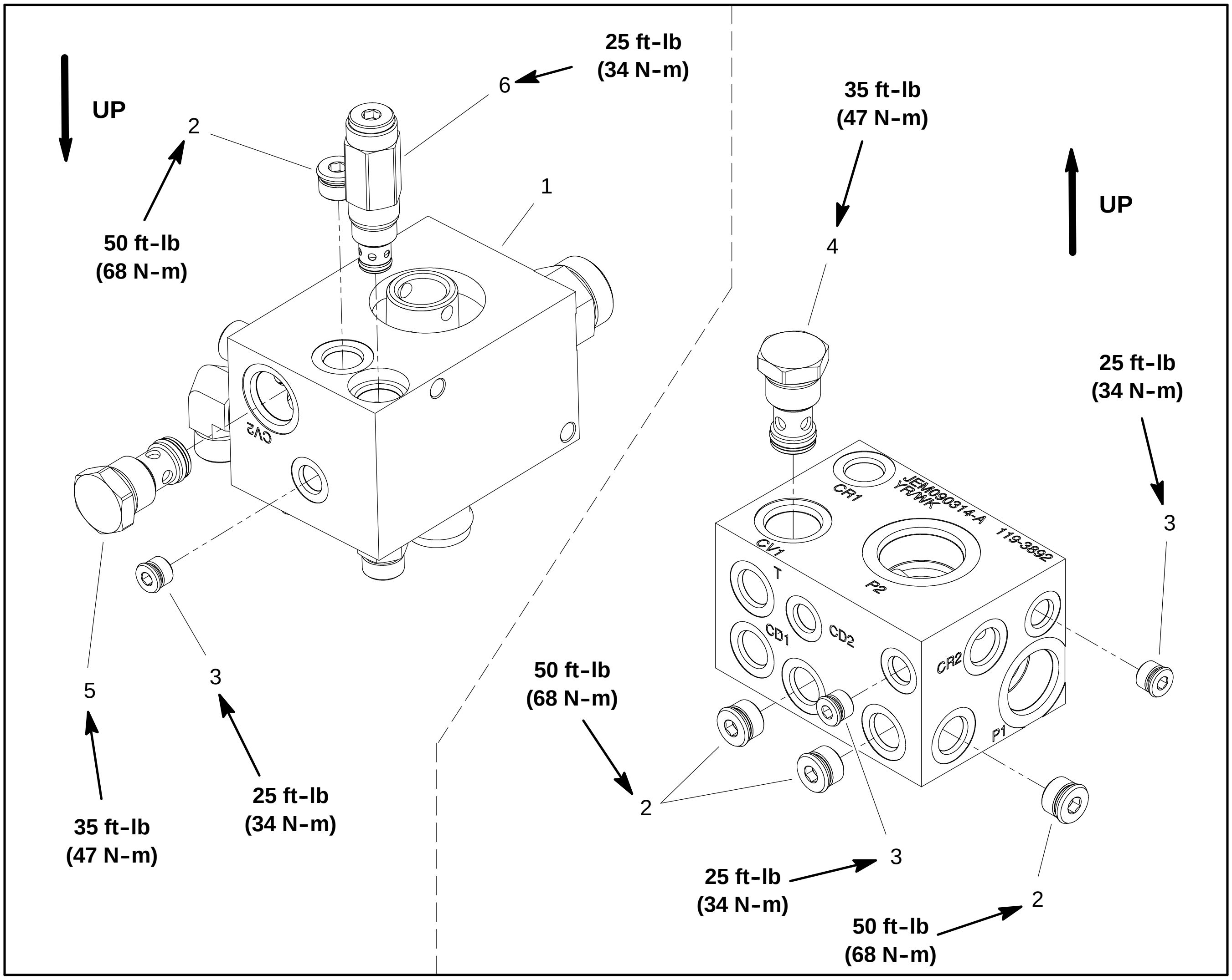

Figure 63

1. **Manifold body**
2. **Zero leak plug (#8)**
3. **Zero leak plug (#6)**
4. **Check valve (reservoir return)**
5. **Check valve (filter bypass)**
6. **Check valve (charge pressure)**

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P2 is the gear pump connection port and P1 is the connection from the oil cooler). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port.

NOTE: The control manifold uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a pin punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 63 for Filtration/Charge Control Manifold cartridge valve and plug installation torque.

Control Manifold Cartridge Valve Service

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

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

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

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

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 control manifold illustration.

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

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

Rear Axle Motor

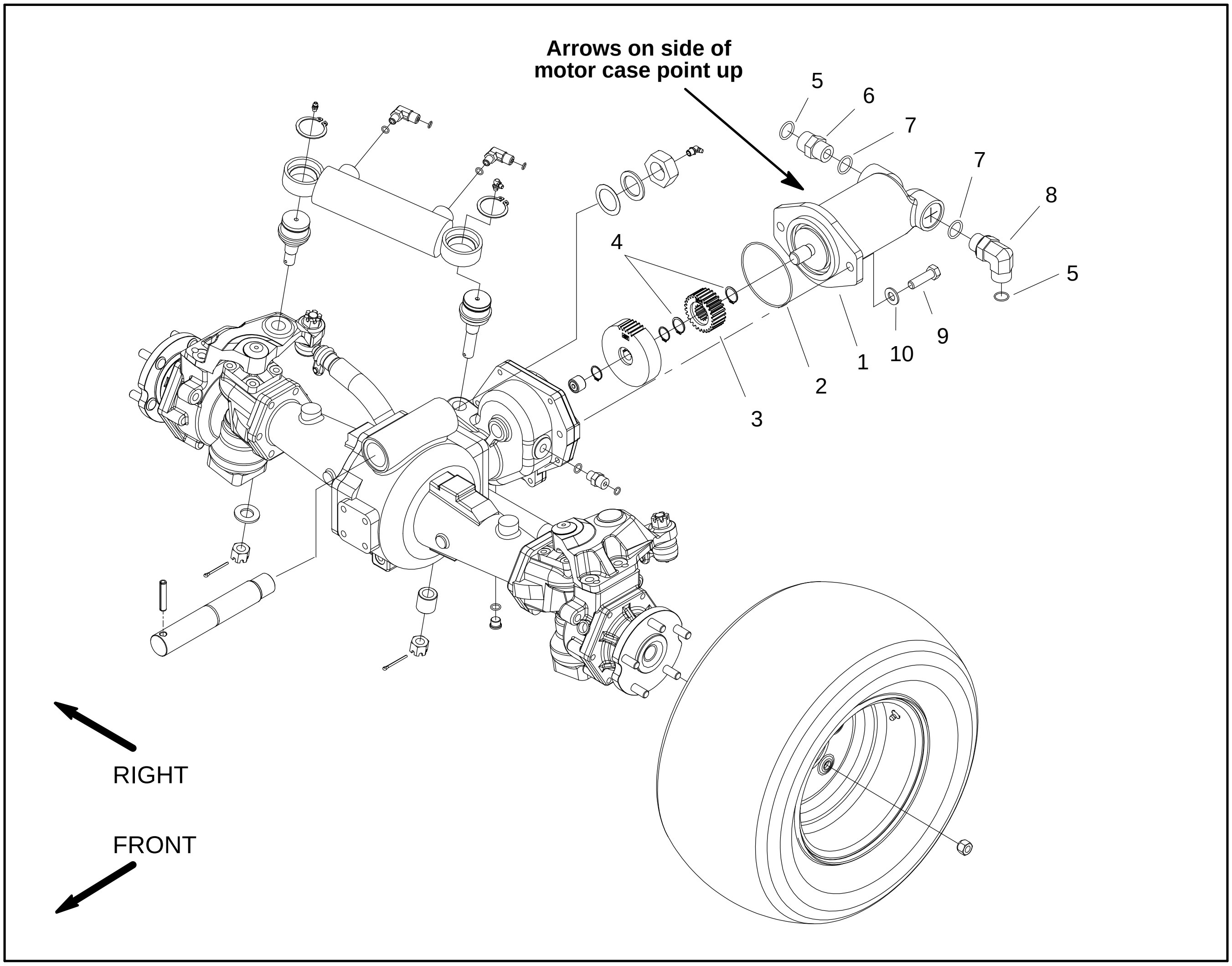

Figure 64

1. **Axle motor**
2. **O-ring**
3. **Pinion gear**
4. **External snap ring**
5. **O-ring**
6. **Hydraulic fitting**
7. **O-ring**
8. **90º hydraulic fitting**
9. **Cap screw (2 used)**
10. **Flat washer (2 used)**

Removal (Fig. 64)

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

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

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

4. Disconnect hydraulic lines from motor. Put caps or plugs on lines and fittings to prevent contamination. Label the hydraulic hoses to show their correct position on the axle motor for assembly purposes.

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

5. Remove motor using Figure 64 as a guide.

6. If hydraulic fittings are to be removed from axle motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O–rings.

Installation (Fig. 64)

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

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

3. Install O–ring onto motor. Position motor to rear axle assembly making sure that arrows on the side of motor case point upward. Align gear teeth and slide motor into place.

4. Secure motor to axle with cap screws and flat washers.

5. Remove plugs from lines and fittings. Attach hydraulic lines to axle motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Fill hydraulic reservoir with hydraulic fluid as required.

7. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

8. After assembly is completed, verify that hydraulic hoses and fittings do not contact anything.

Front Wheel Motors

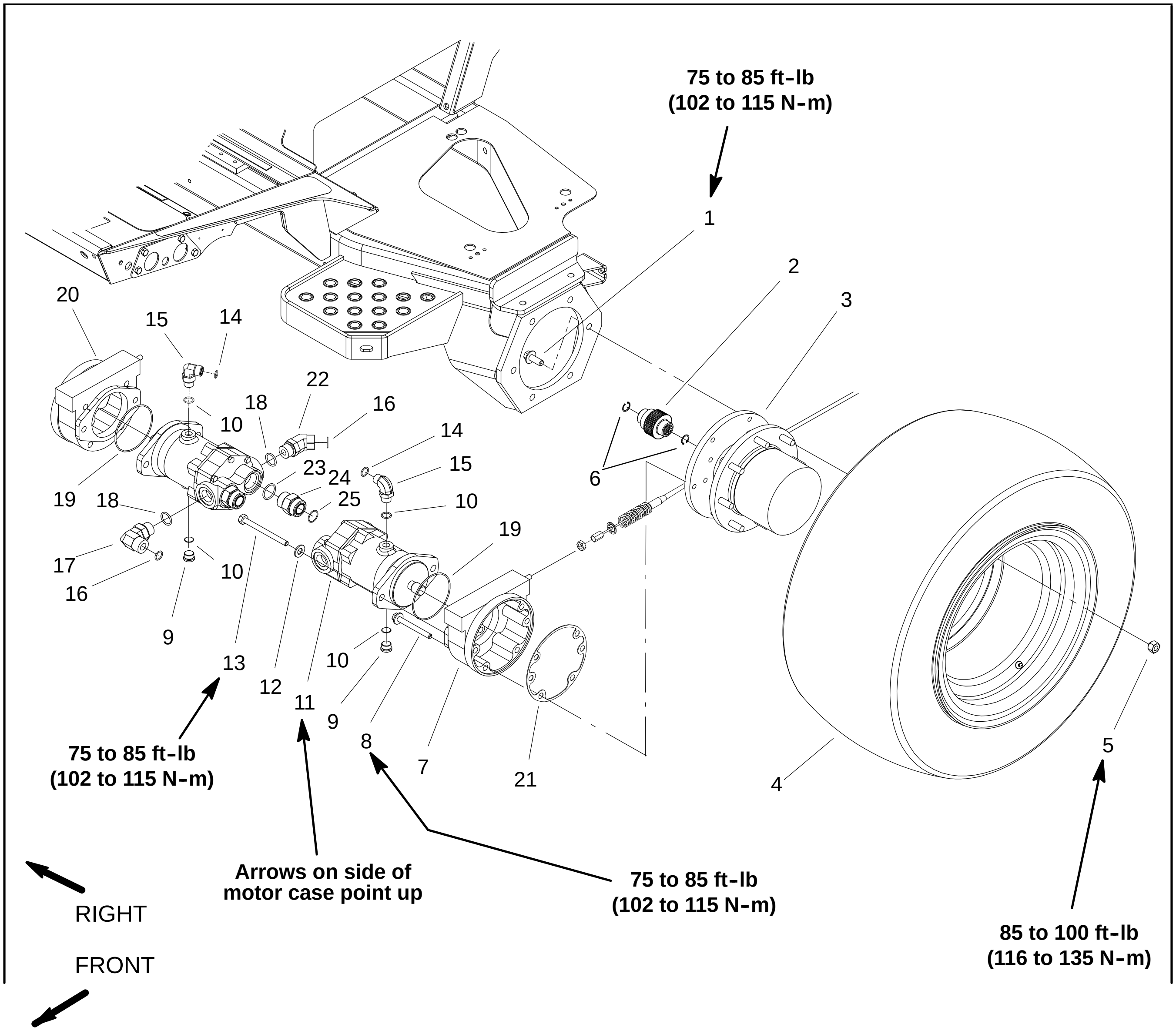

Figure 65

1. **Flange head screw (6 per planetary)**
2. **Splined brake shaft**
3. **Planetary assembly**
4. **Wheel assembly**
5. **Lug nut (8 per wheel)**
6. **Retaining ring**
7. **LH brake assembly**
8. **Flange head screw (4 per brake)**
9. **Plug**
10. **O-ring**
11. **Piston wheel motor**
12. **Flat washer (2 per motor)**
13. **Cap screw (2 per motor)**
14. **O-ring**
15. **90° hydraulic fitting**
16. **O-ring**
17. **90° hydraulic elbow**
18. **O-ring**
19. **O-ring**
20. **RH brake assembly**
21. **Gasket**
22. **45° hydraulic fitting**
23. **O-ring**
24. **Straight hydraulic fitting**
25. **O-ring**

Removal (Fig. 65)

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

2. Raise front of machine and support with jackstands.

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

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

5. Disconnect hydraulic hoses and tubes from wheel motor. Put caps or plugs on hoses and fittings to prevent contamination. Label the hydraulic lines to show their correct position on the wheel motor for assembly purposes.

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

6. Remove wheel motor using Figure 65 as a guide.

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

Installation (Fig. 65)

IMPORTANT: If fittings were removed from wheel motor backplate, make sure that straight hydraulic fittings (item 24) are installed and properly tightened first. Then, install and tighten angled fittings (items 17 and 22). If angled fittings are installed first, straight fittings may contact angled fittings before the straight fitting is properly tightened resulting in hydraulic leakage.

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

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

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

4. Secure motor to brake assembly with cap screws and flat washers. Tighten cap screws from **75 to 85 ft–lb (102 to 115 N–m)**.

5. Remove plugs from lines and fittings. Attach hydraulic lines and tubes to wheel motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Lower machine to ground.

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

8. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

Rear Axle and Front Wheel Motor Service

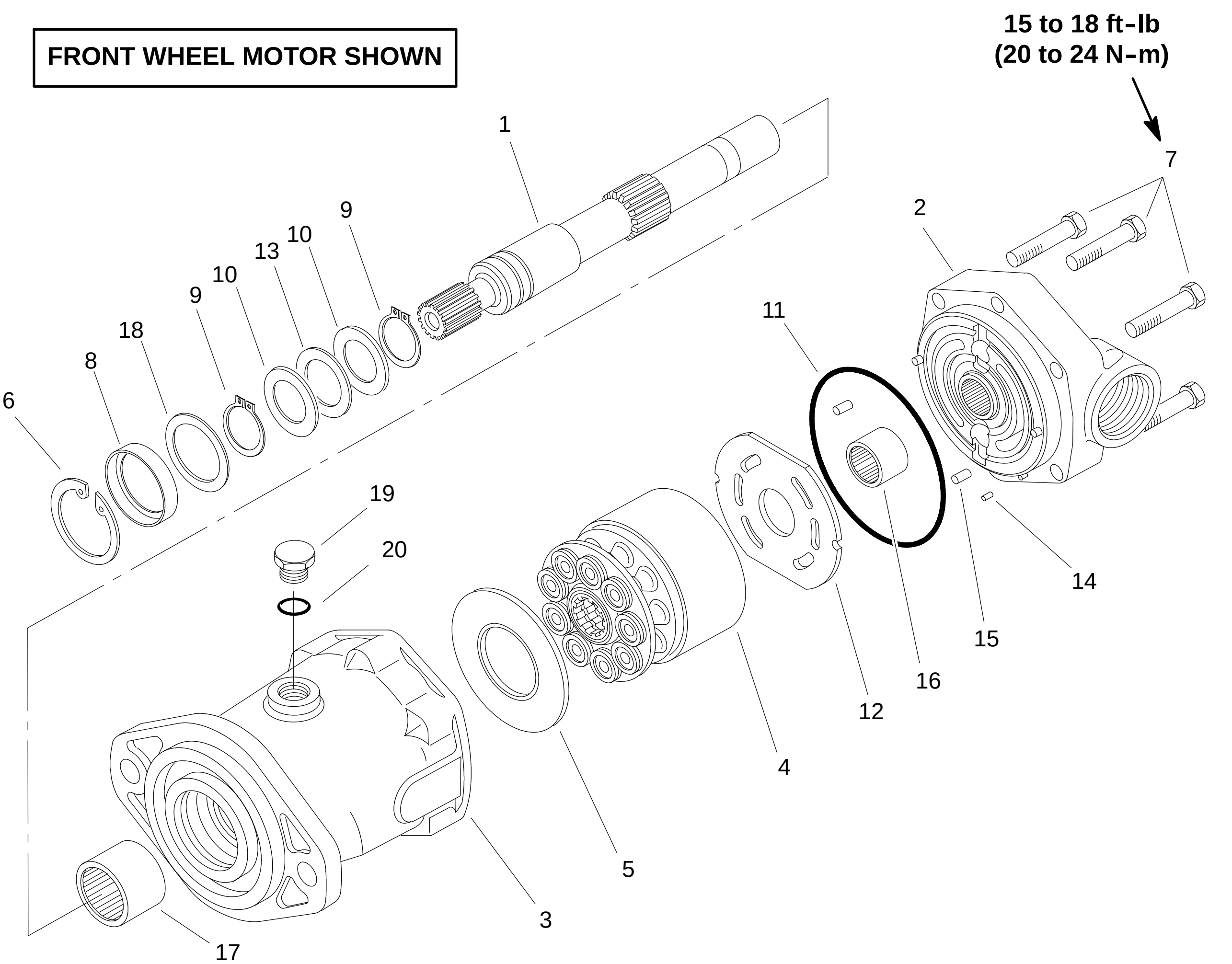

Figure 66

1. **Drive shaft**
2. **Backplate**
3. **Housing assembly**
4. **Rotating assembly**
5. **Cam plate insert**
6. **Retaining ring**
7. **Cap screw**
8. **Shaft seal (front motor only)**
9. **Retaining ring**
10. **Thrust race**
11. **O-ring**
12. **Valve plate**
13. **Thrust bearing**
14. **Roll pin**
15. **Roll pin**
16. **Bearing**
17. **Bearing**
18. **Washer**
19. **Plug**
20. **O-ring**

NOTE: The front wheel motors (shown in Figure 66) are identical. The rear axle motor is similar to the front wheel motors. Service of the front and rear motors requires the same procedure.

NOTE: The rear axle motor **does not** have a shaft seal (item 8). The case drain from the rear axle motor provides lubrication for the input gear case of the rear axle.

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

Cutting Reel Motor

The hydraulic reel motors used on all cutting units are the same.

Removal

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

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

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

4. Disconnect hydraulic hoses from reel motor. Put caps or plugs on fittings and hoses to prevent contamination of hydraulic system. Label hydraulic hoses for proper assembly.

5. Loosen two (2) cap screws that secure the hydraulic reel motor to the cutting unit side plate. Rotate motor clockwise and remove motor from cutting unit.

6. Inspect reel insert splines for wear. Replace if necessary (see Reel Removal and Installation in the Service and Repairs section of Chapter 7 – DPA Cutting Units).

7. Place protective plastic cap (see Special Tools in this chapter) into the hole in the cutting unit side plate to prevent debris entry into reel bearing area.

8. If hydraulic fittings are to be removed from reel motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O–rings.

Installation

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

2. Remove cover from cutting unit opening.

3. Coat spline shaft of the reel motor with No. 2 multipurpose lithium base grease.

4. Install the cap screws for the reel drive motor into the cutting unit side plate and leave approximately 1/2 inch (12.7 mm) of threads exposed on each screw.

5. Rotate the motor clockwise so the motor flanges clear the cap screws in the cutting unit side plates. Align reel motor shaft splines with cutting reel insert splines. Slide motor shaft into reel insert.

6. Rotate the motor counter–clockwise until the motor flanges are encircling the cap screws. Tighten two (2) cap screws to secure reel motor to cutting unit.

7. Remove caps or plugs from hydraulic fittings and hoses. Connect hydraulic hoses to reel motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

8. After assembly is completed, verify that hydraulic hoses and fittings are not contacted by any moving components.

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

10. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

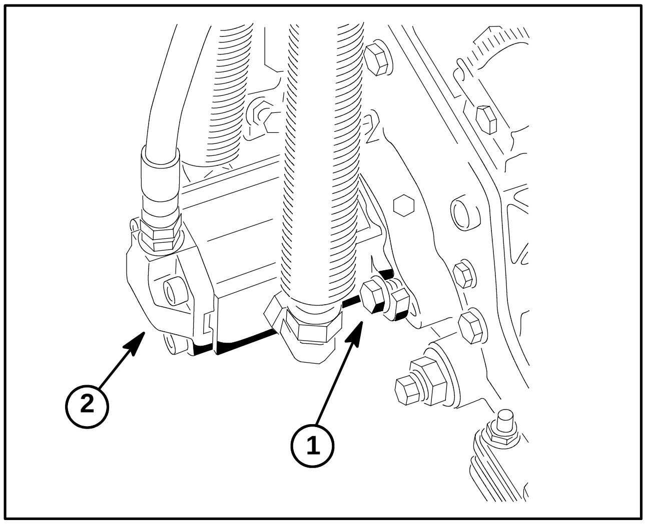

Figure 67

1. **Cap screw**
2. **Hydraulic reel motor**

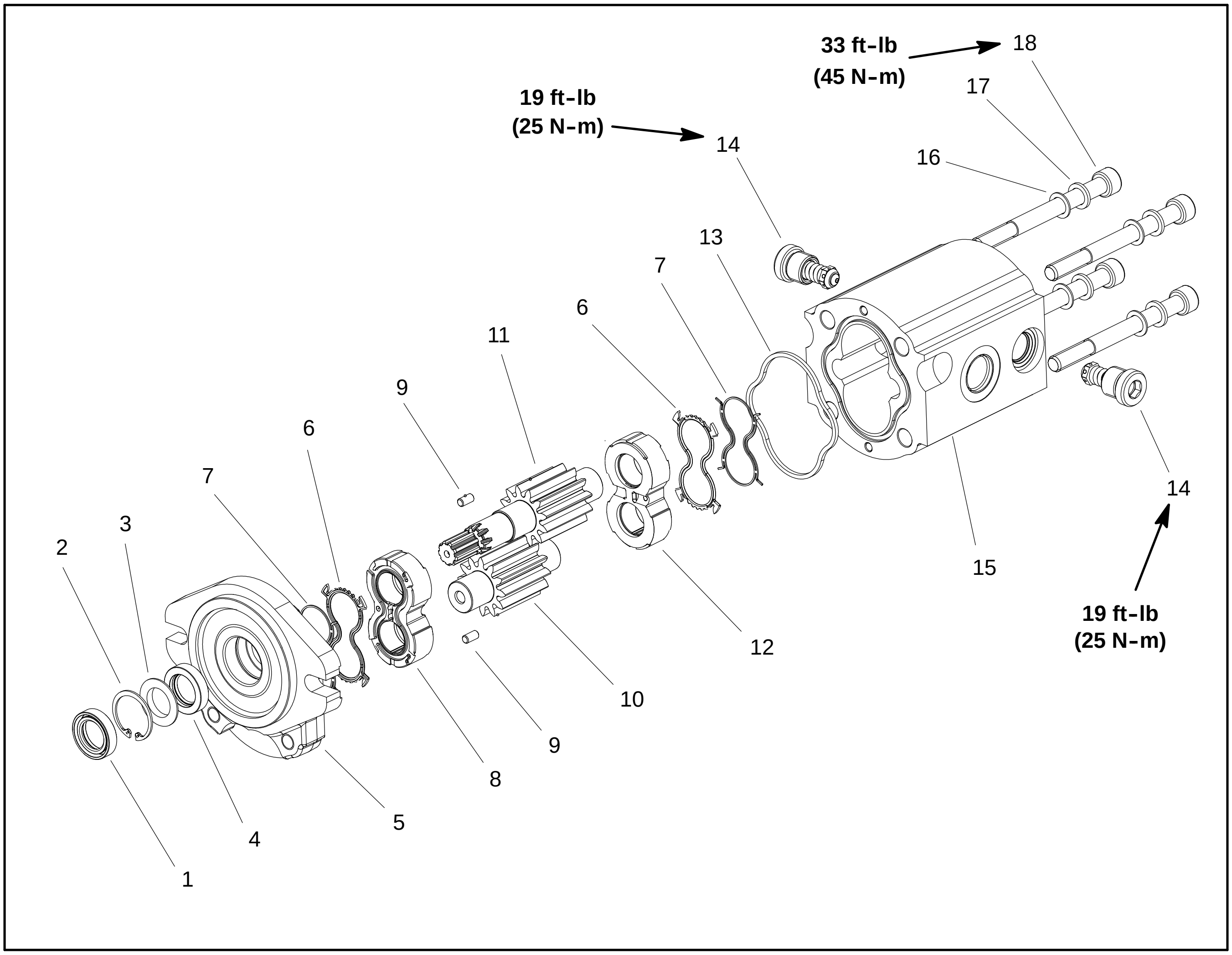

Figure 68

1. Dust seal
2. Retaining ring
3. Flange washer
4. Shaft seal
5. Front flange
6. Pressure seal
7. Back-up gasket
8. Front wear plate
9. Dowel pin
10. Idler gear
11. Drive shaft
12. Rear wear plate
13. O-ring
14. Relief valve
15. Body
16. Washer (4 used)
17. Lock washer (4 used)
18. Cap screw (4 used)

Disassembly (Fig. 68)

1. Plug motor ports and clean the outside of the motor thoroughly. After cleaning, remove plugs and drain any oil out of the motor.

2. Use a marker to make a **diagonal** line across the front flange and body for assembly purposes (Fig. 69).

IMPORTANT: Prevent damage when clamping the reel motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.

3. Clamp front flange of motor in a vise with soft jaws with the shaft end down.

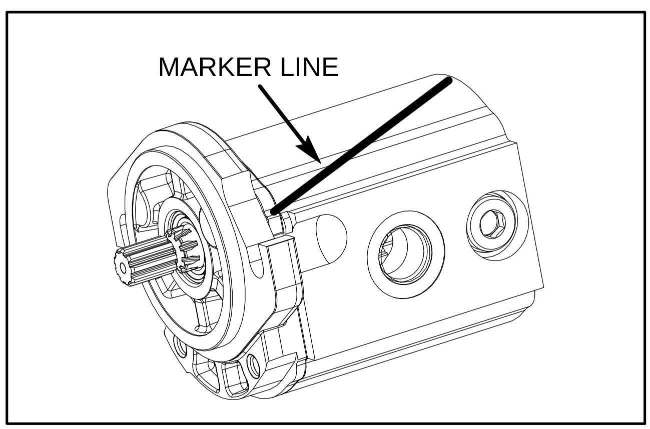

Figure 69

4. Loosen cap screws from the rear cover.

5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.

6. Carefully remove body. Lift body straight up to remove. Make sure the rear wear plate remains on the drive and idler gear shafts. Remove and discard O–rings from the body. Locate and retrieve dowel pins.

IMPORTANT: Note position of the open and closed side of the wear plates before removing. Also, identify wear plates (front and rear) with a marker for proper assembly.

7. Carefully remove rear wear plate, idler gear, drive shaft and front wear plate from the front flange.

8. Remove and discard back–up gaskets and pressure seals from wear plates.

9. Turn front flange over, with seal side up.

IMPORTANT: Make sure to not damage the front flange counter bore when removing the seals from the front flange.

10. Carefully remove dust seal, retaining ring, flange washer and shaft seal from the front flange (Fig. 70). Discard seals.

Inspection

1. Remove any nicks and burrs from all parts with emery cloth.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Clean all parts with solvent. Dry all parts with compressed air.

3. Inspect drive gears and idler gears for the following (Fig. 71):

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

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

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

4. Inspect wear plates for the following:

A. Bearing areas should not have excessive wear or scoring.

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

C. Thickness of wear plates should be equal.

5. Inspect front flange and rear cover for damage or wear.

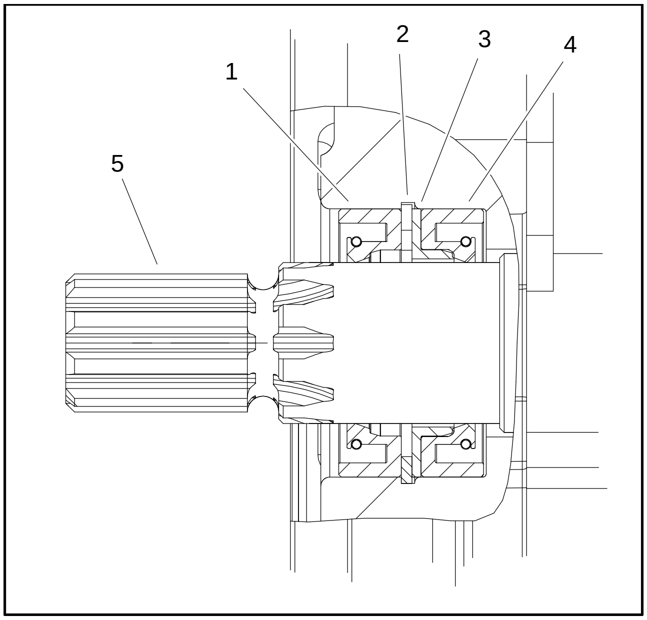

Figure 70

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Drive shaft**

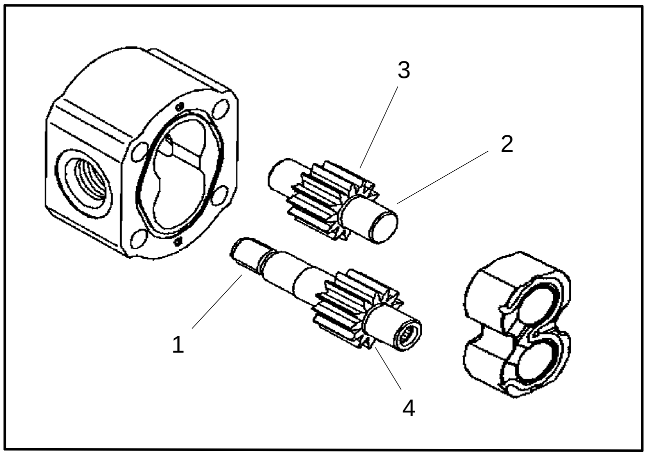

Figure 71

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

Assembly (Fig. 68)

NOTE: When assembling the motor, check the marker line on each part to make sure the parts are properly aligned during assembly.

1. Lubricate O–rings, pressure seals, back–up gaskets and wear plate grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new seals into front flange (Fig. 70):

   A. Press shaft seal into front flange until it reaches the bottom of the bore.

   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.

   C. Install new dust seal into front flange.

3. Place front flange, seal side down, on a flat surface.

4. Install the pressure seals, flat side outward, into the grooves in the wear plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the wear plate.

5. Apply a light coating of petroleum jelly to the exposed side of the front flange.

6. Lubricate the drive shaft with clean hydraulic oil. Insert the drive end of the drive shaft through the wear plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange.

7. Lubricate the idler gear shaft with clean hydraulic oil. Install idler gear shaft into the remaining position in the front wear plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear wear plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

9. Apply a light coating of petroleum jelly to new O–ring and O–ring groove in the body. Install new O–ring to the body.

10. Install locating dowel pins in body. Align marker line on the body and front flange.

IMPORTANT: Do not dislodge seals during installation.

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowel pins.

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

IMPORTANT: Prevent damage when clamping the reel motor in a vise; clamp on the front flange only. Also, use a vise with soft jaws.

13. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws **33 ft–lb (45 N–m)**.

14. Remove motor from vise.

15. Place a small amount of clean hydraulic oil in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

Hydraulic System

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Mow Control Manifold

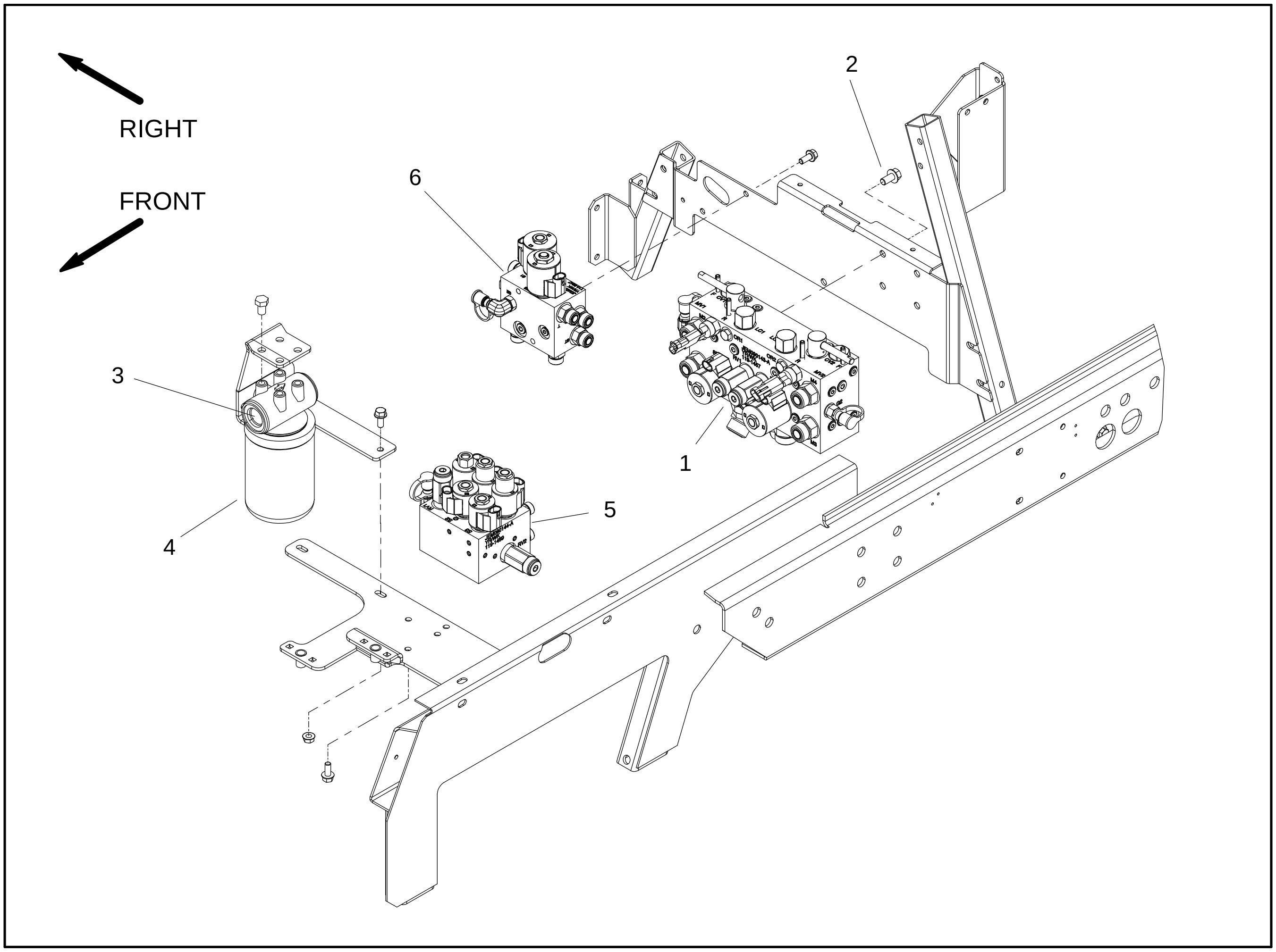

Figure 72

1. **Mow control manifold**
2. **Flange head screw (4 used)**
3. **Filter head**
4. **Hydraulic oil filter**
5. **Lift control manifold**
6. **Fan control manifold**

Removal (Fig. 72)

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the gear pump connection port (see Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

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

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

3. Unlatch and raise hood.

4. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect connectors from the solenoid coils and backlap switches.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame using Figure 72 as guide.

8. If hydraulic fittings are to be removed from control manifold, mark fitting orientation to allow correct assembly (Fig. 73). Remove fittings from manifold and discard O–rings.

Installation (Fig. 72)

1. If fittings were removed from control manifold, lubricate and place new O–rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Refer to Figure 73 for fitting installation torque.

2. Install hydraulic manifold to the frame using Figure 72 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness electrical connectors to the solenoid valve coils and backlap switches.

5. Lower and secure hood.

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

7. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

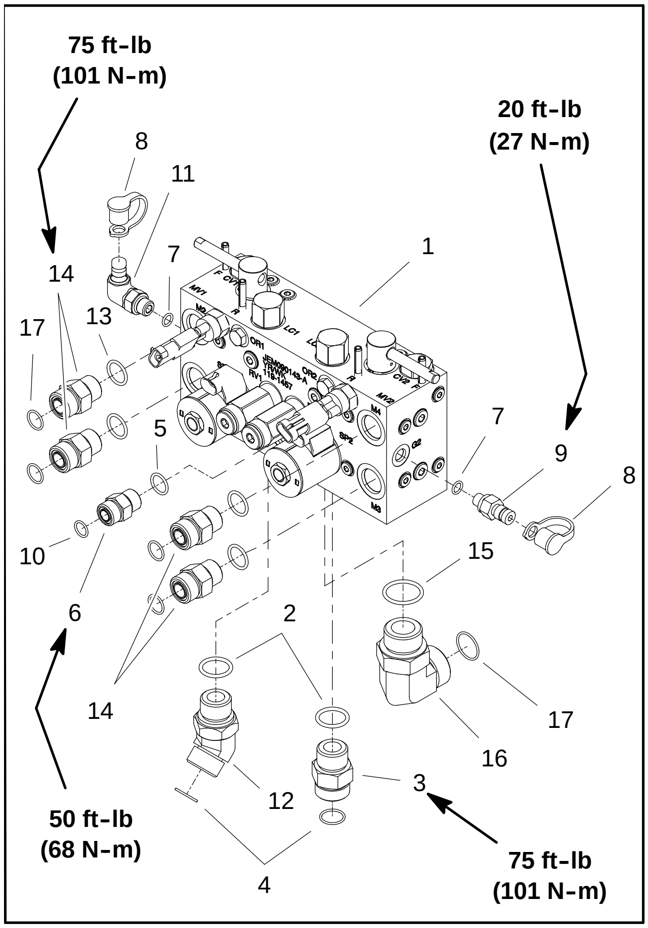

Figure 73

1. **Mow manifold**
2. **O–ring**
3. **Straight fitting (8 used)**
4. **O–ring**
5. **O–ring**
6. **Straight fitting**
7. **O–ring**
8. **Dust cover**
9. **Test fitting**
10. **O–ring**
11. **Test fitting**
12. **45º fitting**
13. **O–ring**
14. **Straight fitting (4 used)**
15. **O–ring**
16. **90º fitting**
17. **O–ring**

Hydraulic System

Mow Control Manifold Service

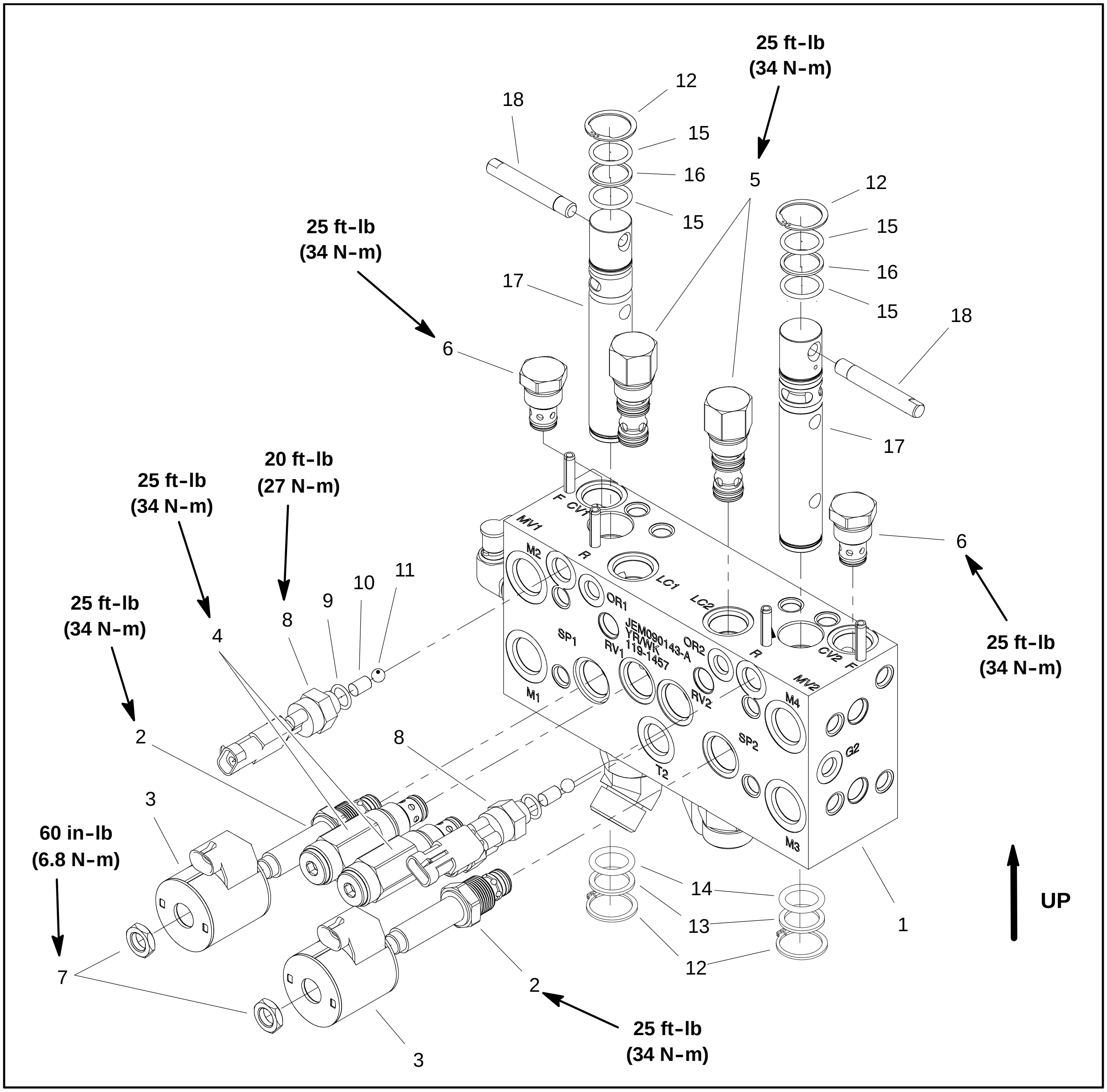

Figure 74

1. **Manifold body**
2. **Proportional valve (SP1 & SP2)**
3. **Solenoid coil (2 used)**
4. **Relief valve (RV1 & RV2)**
5. **Pressure compensator (LC1 & LC2)**
6. **Check valve (CV1 & CV2)**
7. **Nut**
8. **Backlap switch (2 used)**
9. **O-ring**
10. **Dowel**
11. **Ball**
12. **Retaining ring (2 used per spool)**
13. **Backup ring**
14. **O-ring**
15. **O-ring**
16. **Backup ring**
17. **Backlap spool (2 used)**
18. **Spool handle**

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P1 is a gear pump connection port and PRV1 is the location for a proportional relief valve). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

Cartridge Valve Service

1. For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 74 for cartridge valve installation torque.

Mow/Backlap Spool Service (Fig. 74)

1. To remove backlap spool (item 17) from mow manifold:

   A. Remove backlap switch (item 8) from mow manifold before removing mow/backlap spool. Remove dowel pin and ball from manifold port after switch is removed. Remove and discard O-ring from switch.

   B. Remove lower retaining ring from backlap spool. Raise backlap spool to allow access to retaining ring on upper end of spool. Remove upper retaining ring.

   C. Push spool down until O-ring and back-up ring are exposed on bottom of mow manifold. Remove lower O-ring and back-up ring from spool.

   D. Pull spool up and out of mow manifold. Remove O-rings and back-up ring from spool.

   E. Discard removed O-rings and back-up rings.

2. To install backlap spool (item 17) from mow manifold:

   A. Install O-rings and back-up ring to upper grooves on backlap spool. Apply a light coating of grease to O-rings.

   B. Carefully push backlap spool down into mow manifold port until lower O-ring and back-up ring groove is exposed on bottom of manifold. Install lower O-ring and back-up ring to spool. Apply a light coating of grease to O-ring.

   C. Carefully raise backlap spool until upper retaining ring groove on spool is exposed on top of manifold. Install upper retaining ring.

   D. Push backlap spool down and install lower retaining ring to spool.

   E. If handle was removed from spool, position spool so handle location of spool is between stop pins in manifold. Apply Loctite 603 Retaining Compound (or equivalent) to threads on handle and install handle into spool.

   F. Place ball and dowel pin in backlap switch manifold port. Install new O-ring onto backlap switch. Thread backlap switch into port and torque **20 ft-lb (27 N-m)**.

Manifold Plugs (Fig. 75)

NOTE: The mow control manifold uses several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O-ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a pin punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the head of the plug.

IMPORTANT: An orifice is located beneath the plug in mow control manifold ports OR1 and OR2. If an orifice is removed from these manifold ports, make sure to label its position for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is properly tightened in the port.

1. Remove plugs as needed using Figure 75 as a guide. Discard O-ring after plug removal.

2. Lubricate and place new O-ring onto removed plugs. If plug was removed from port OR1 or OR2, make sure that orifice is correctly installed before threading plug into manifold. Install plugs into manifold openings. Torque #4 plugs to **20 ft-lb (27 N-m)** and #6 plugs to **25 ft-lb (34 N-m)**.

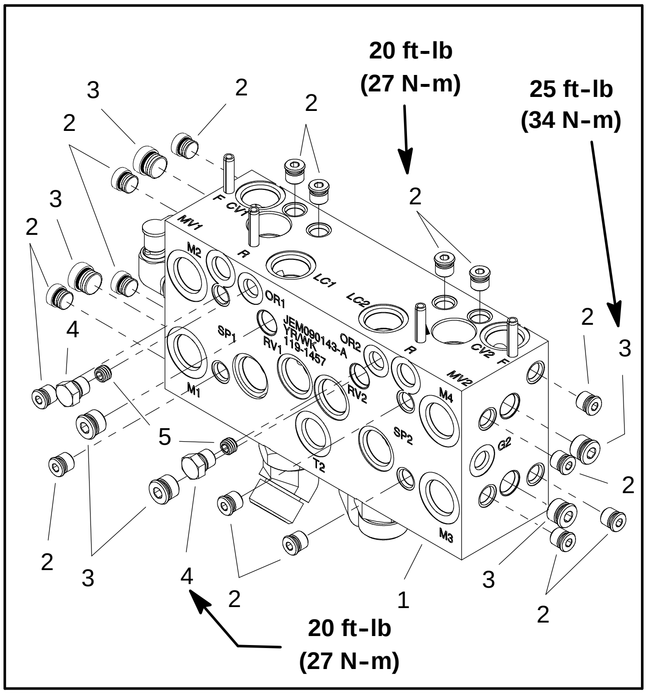

Figure 75

1. Mow manifold
2. #4 zero leak plug
3. #6 zero leak plug
4. #4 zero leak plug
5. Orifice (.040)

Hydraulic System

Steering Control Valve

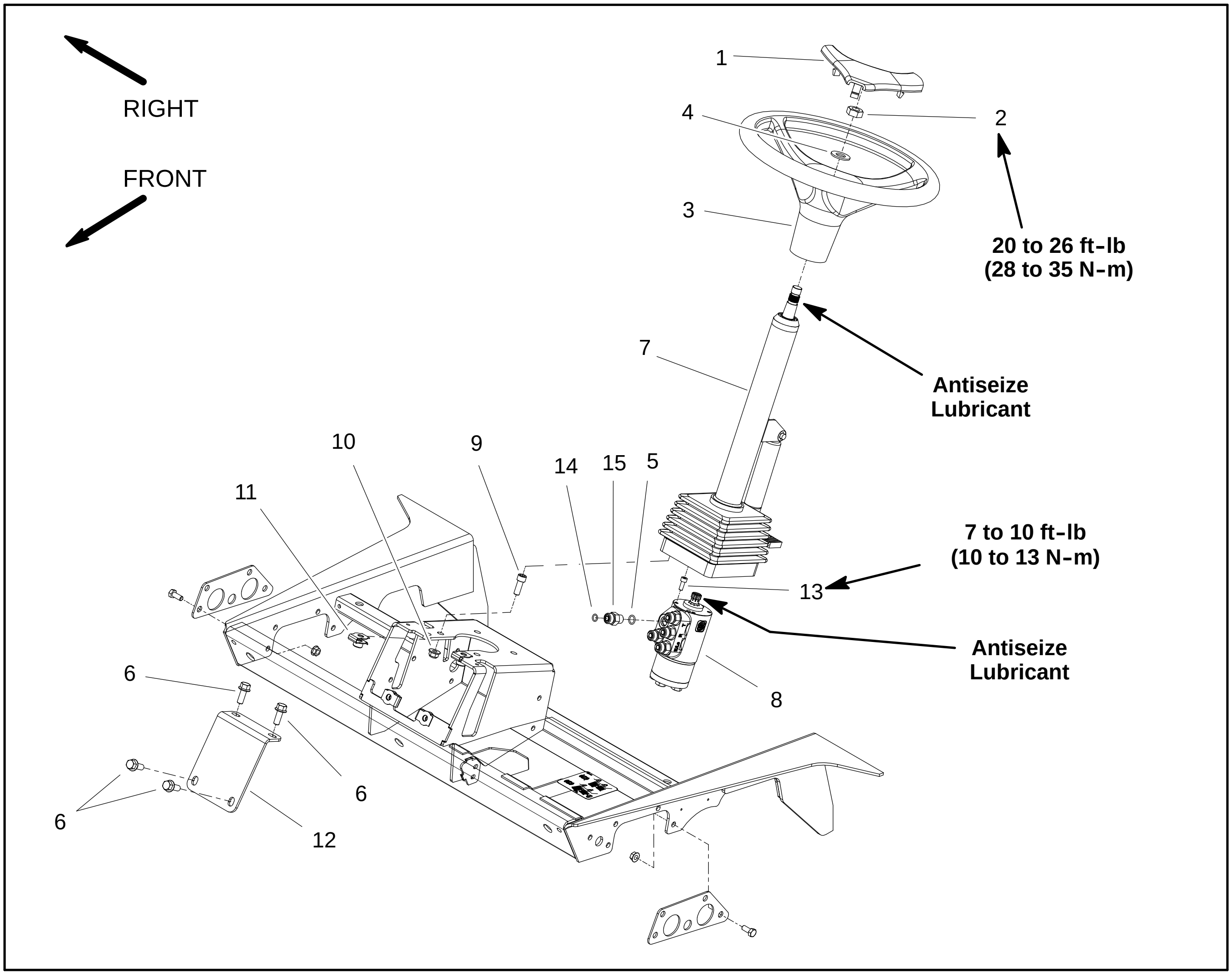

Figure 76

1. **Steering wheel cover**
2. **Lock nut**
3. **Steering wheel**
4. **Flat washer**
5. **O-ring**
6. **Flange head screw (4 used)**
7. **Steering column**
8. **Steering control valve**
9. **Socket head screw (4 used)**
10. **Flange nut (4 used)**
11. **Tinnerman nut (4 used)**
12. **Column brace**
13. **Socket head screw (4 used)**
14. **O-ring**
15. **Straight fitting (5 used)**

Removal (Fig. 76)

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

2. Remove fasteners that secure shroud to front of machine (Fig. 77). Remove shroud from machine to allow access to steering control valve.

3. Remove four (4) flange head screws that secure column brace (item 12) to frame platform. Remove brace from machine to allow access to steering column fasteners.

4. Slide rubber bellows up from bottom of steering column. Support steering column to prevent it from falling.

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

6. Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

7. Label all hydraulic connections for assembly purposes. Note port designations on steering control valve (Fig. 78).

CAUTION

Before opening hydraulic system, 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.

8. Disconnect hydraulic lines from steering control valve. Allow lines to drain into a suitable container.

9. Put caps or plugs on disconnected lines and fittings to prevent contamination.

10. Loosen and remove four (4) socket head screws and flange nuts that secure steering column to machine.

11. Remove steering column assembly with steering control valve attached from machine.

12. Loosen and remove four (4) socket head screws that secure steering control valve to steering column.

13. Remove steering control valve from steering column.

14. If necessary, remove fittings and O–rings from steering control valve. Discard all removed O–rings.

Installation (Fig. 76)

1. If fittings were removed, lubricate new O–rings with clean hydraulic oil and install fittings to steering control valve (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Apply antiseize lubricant to splines of steering control valve shaft.

3. Slide steering control valve shaft into steering column universal joint. Position control valve with ports toward front of machine. Secure steering control valve to steering column with four (4) socket head screws. Torque screws in a criss–cross pattern from **7 to 10 ft–lb (10 to 13 N–m)**.

4. Position steering column assembly to machine. Secure steering column in place with four (4) socket head screws and flange nuts.

5. Remove caps and plugs from disconnected lines and fittings.

6. Lubricate new O–rings and connect hydraulic lines to fittings on steering control valve (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Position steering column brace (item 12) to machine and secure with four (4) flange head screws.

8. Slide rubber bellows to bottom of steering column.

9. Position shroud in place and secure with removed fasteners (Fig. 77).

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

11. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

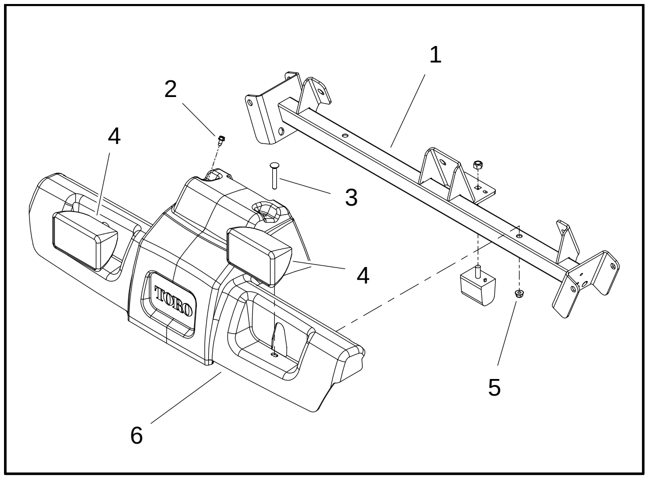

Figure 77

1. **Roller support**
2. **Screw (2 used)**
3. **Carriage screw (2 used)**
4. **Headlight assembly**
5. **Flange nut (2 used)**
6. **Platform shroud**

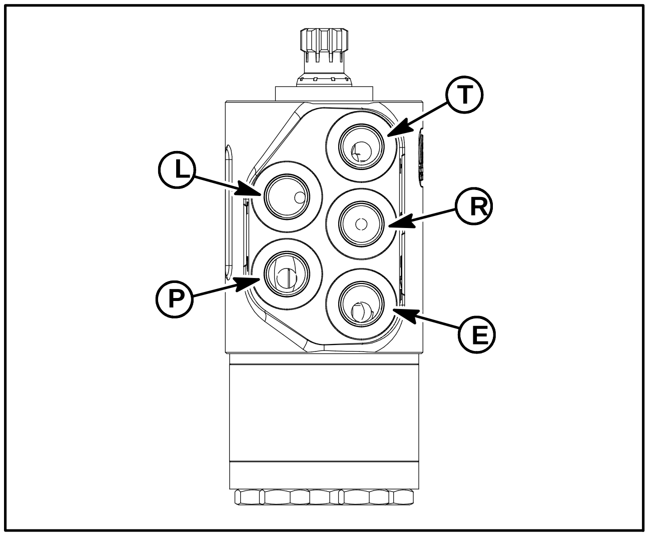

Figure 78

Hydraulic System

Steering Control Valve Service

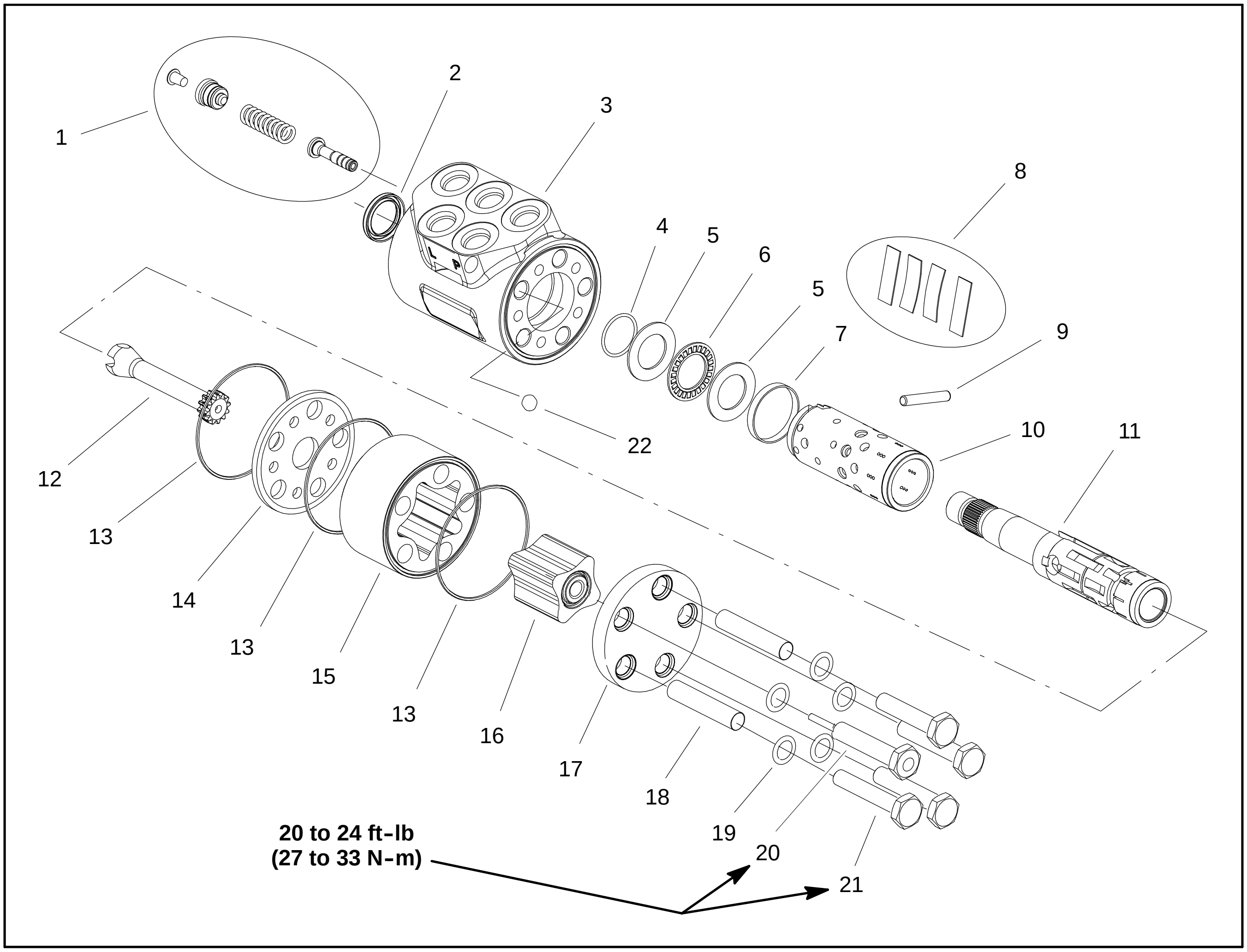

Figure 79

1. **Relief valve assembly**
2. **Dust seal ring**
3. **Steering valve housing**
4. **Shaft seal**
5. **Thrust washer**
6. **Bearing race**
7. **Ring**
8. **Spring set**
9. **Cross pin**
10. **Sleeve**
11. **Spool**
12. **Cardan shaft**
13. **O–ring**
14. **Distributor plate**
15. **Outer gearwheel**
16. **Inner gearwheel**
17. **End cover**
18. **Tube (2 used)**
19. **Washer (5 used)**
20. **Pin bolt**
21. **Cap screw (4 used)**
22. **Ball**

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

Hydraulic System

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Steering Cylinder

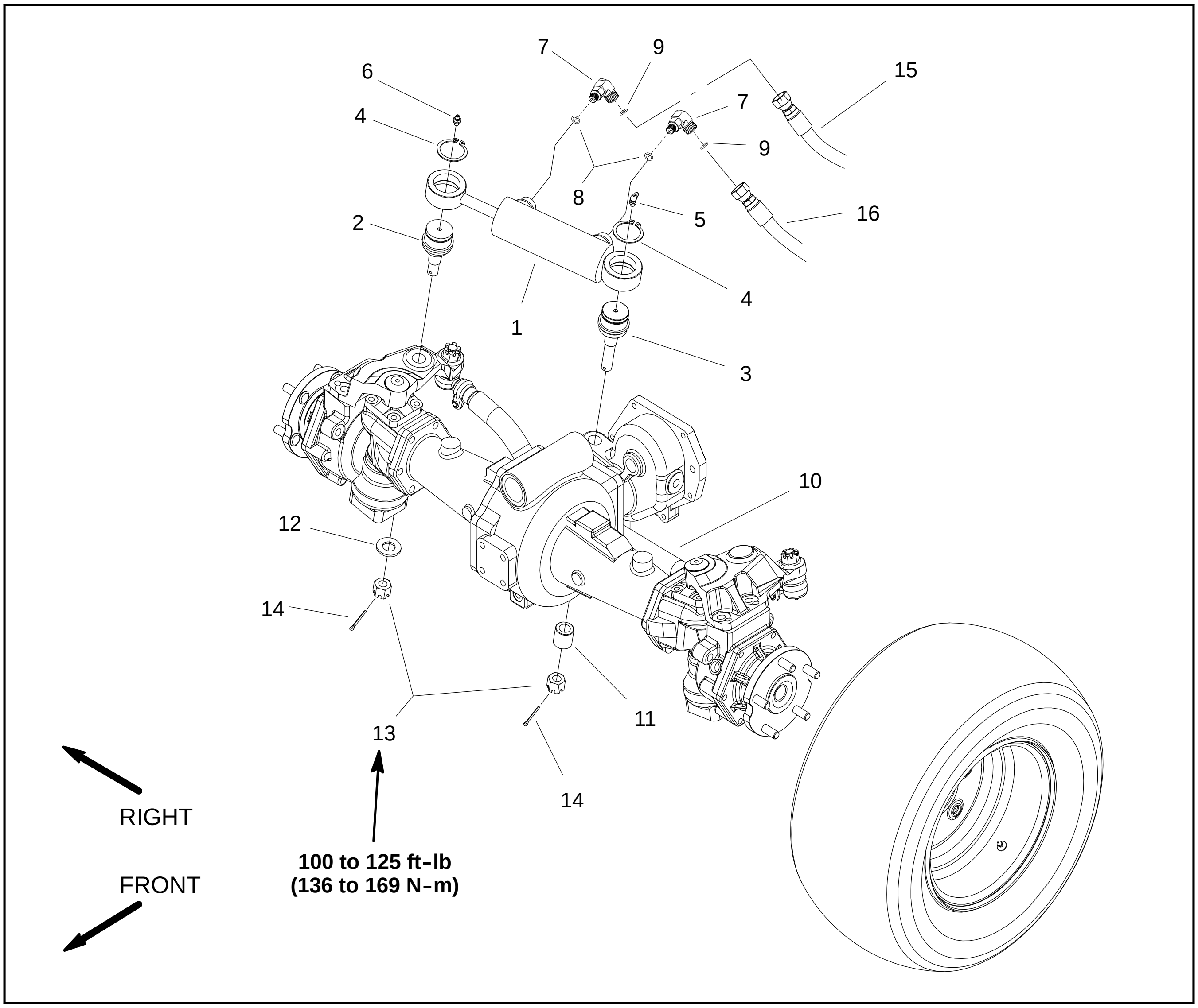

Figure 80

1. **Steering cylinder**
2. **Ball joint**
3. **Ball joint**
4. **Retaining ring**
5. **Grease fitting**
6. **Grease fitting**
7. **90° hydraulic fitting**
8. **O-ring**
9. **O-ring**
10. **Drive axle assembly**
11. **Ball joint spacer**
12. **Axle washer**
13. **Slotted hex nut**
14. **Cotter pin**
15. **Hydraulic hose**
16. **Hydraulic hose**

Removal (Fig. 80)

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

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

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

4. Remove hydraulic hoses from steering cylinder. Label the hydraulic hoses to show their correct position on the steering cylinder for assembly purposes.

5. Remove cotter pins, slotted hex nuts, axle washer and ball joint spacer from the threaded ends of ball joints. Remove steering cylinder with ball joints from machine.

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

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

Installation (Fig. 80)

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

2. If removed, press ball joints into lift cylinder and secure with retaining ring.

3. Slide ram end ball joint through hole on steering arm. Secure with axle washer and slotted hex nut. Slide fixed end of cylinder through hole on axle. Install spacer onto ball joint and secure with slotted hex nut. Torque slotted hex nuts from **100 to 125 ft–lbs (136 to 169 N–m)** prior to inserting cotter pins.

4. Install hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Fill reservoir with hydraulic fluid as required.

6. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

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

Steering Cylinder Service

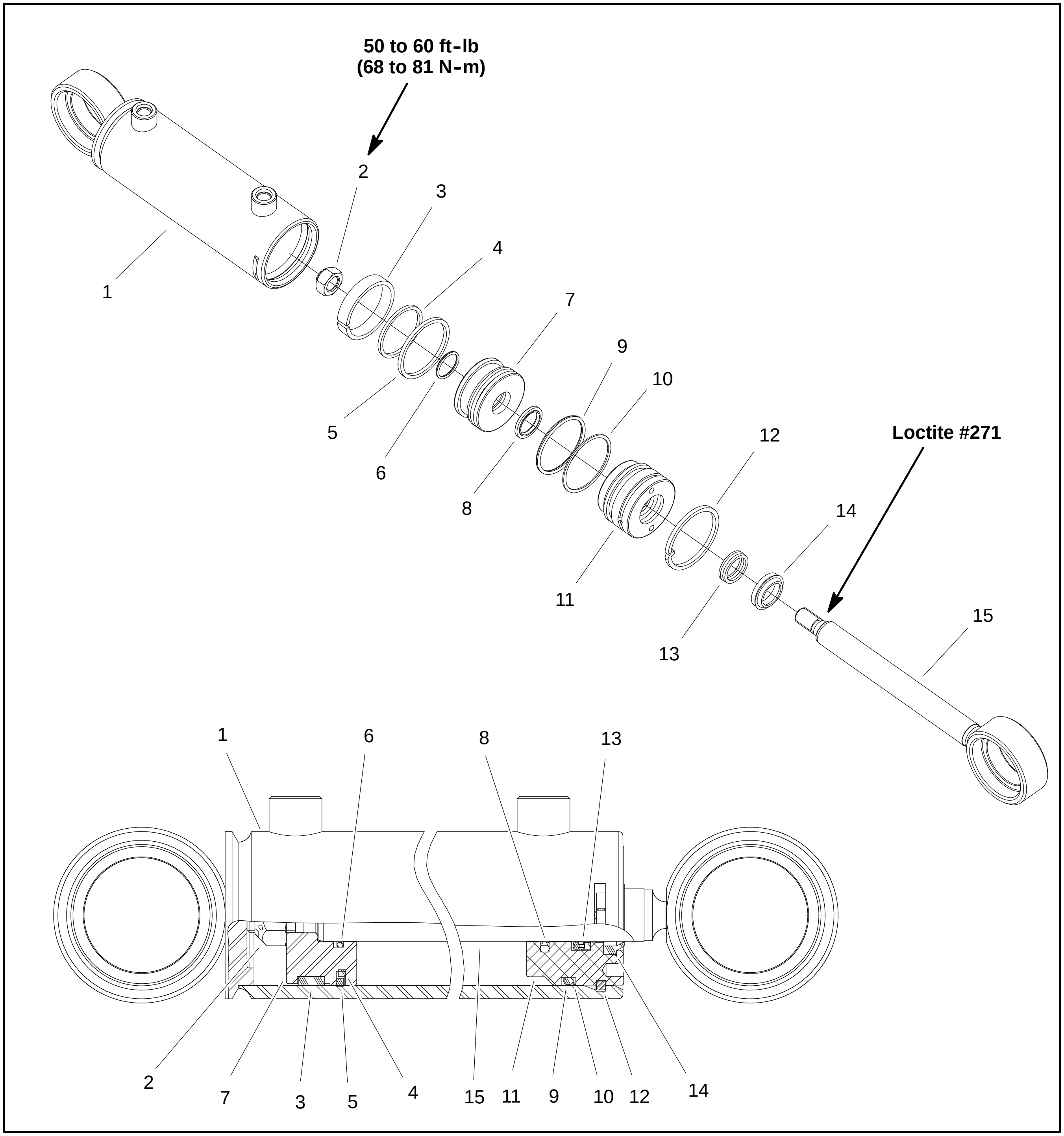

Figure 81

1. **Barrel**
2. **Lock nut**
3. **Wear band**
4. **Square ring**
5. **Piston seal**
6. **O-ring**
7. **Piston**
8. **Buffer seal**
9. **O-ring**
10. **Back-up ring**
11. **Head**
12. **Retaining ring**
13. **Head seal**
14. **Wiper**
15. **Rod assembly**

Disassembly (Fig. 81)

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

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

2. Mount steering cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Loosen head from barrel:

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

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

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

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

IMPORTANT: Do not clamp vise jaws against the rod surface. Protect rod surface before mounting in a vise.

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

6. For assembly purposes, note location and orientation of all seals and O–rings on piston and head. Remove and discard all seals and O–rings from the piston and the head.

7. 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.

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

Assembly (Fig. 81)

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

2. Coat new seal kit components with clean hydraulic oil.

   A. Install new seals, O–ring and wear band to the piston.

   B. Install new seals, O–ring and back–up ring to the head.

IMPORTANT: Do not clamp vise jaws against the rod surface. Protect rod surface before mounting in a vise.

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

   A. Coat rod with clean hydraulic oil.

   B. Carefully slide head and piston onto the rod.

   C. Clean threads on end of rod. Apply **Loctite #271** (or equivalent) to rod threads.

   D. Secure piston to rod with lock nut. Torque lock nut from **50 to 60 ft–lb (68 to 81 N–m)**.

IMPORTANT: When installing the rod assembly into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.

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

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

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

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

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

   C. Apply silicone sealer to barrel access slot.

Engine Cooling Fan Motor

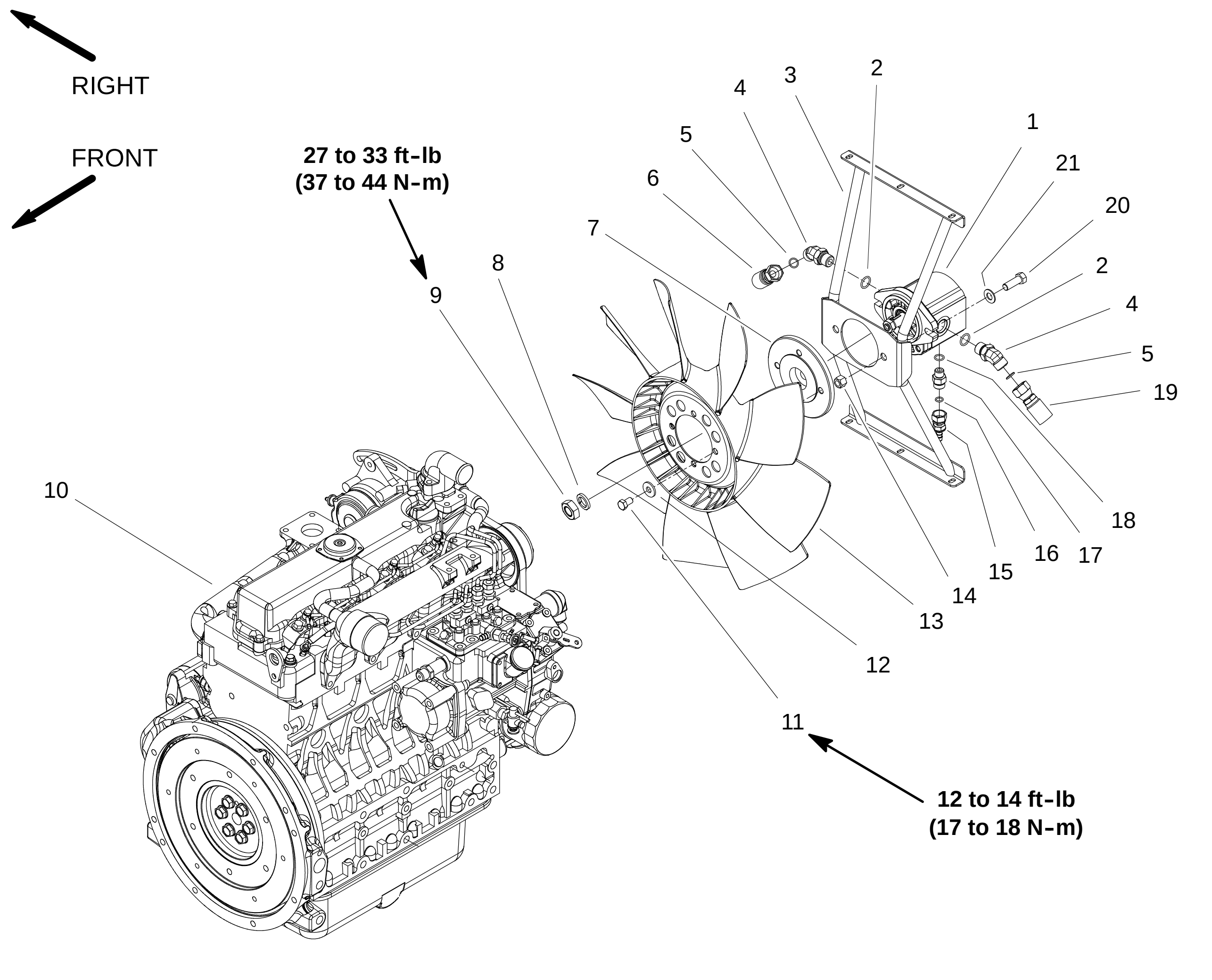

Figure 82

1. **Hydraulic fan motor**
2. **O-ring**
3. **Bracket**
4. **45° hydraulic fitting**
5. **O-ring**
6. **Hydraulic hose**
7. **Fan hub**
8. **Washer**
9. **Hex nut**
10. **Engine**
11. **Cap screw (4 used)**
12. **Washer (4 used)**
13. **Fan**
14. **Lock nut (2 used)**
15. **Hydraulic hose**
16. **O-ring**
17. **Hydraulic fitting**
18. **O-ring**
19. **Hydraulic hose**
20. **Cap screw (2 used)**
21. **Flat washer (2 used)**

Removal (Fig. 82)

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

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

3. Unlatch and raise hood.

CAUTION

The radiator and engine may be hot. To avoid possible burns, allow the engine and cooling systems to cool before removing fan motor.

4. Remove air cleaner hose and upper radiator shroud to allow access to hydraulic fan motor (Fig. 83).

5. Remove four (4) cap screws and washers used to secure fan (item 13) to fan hub. Remove fan.

IMPORTANT: Make sure to not damage the radiator or other machine components while loosening and removing the fan motor and bracket assembly.

6. Remove cooling fan motor and bracket assembly.

A. To prevent contamination of hydraulic system, thoroughly clean exterior of fan motor and fittings.

B. Disconnect hydraulic hoses from fan motor. Put caps or plugs on fittings and hoses to prevent contamination. Label hydraulic lines for proper assembly.

C. Remove six (6) cap screws and flange nuts that secure fan motor bracket to radiator.

D. Carefully remove fan motor and bracket assembly from machine and place on suitable work surface.

7. Remove hex nut (item 9) and washer (item 8) that secure fan hub to fan motor. Use suitable puller to carefully remove fan hub from fan motor shaft. Locate and retrieve woodruff key.

8. Remove two (2) cap screws (item 20), flat washers (item 21) and lock nuts (item 14) that secure fan motor to fan motor bracket. Remove fan motor from bracket.

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

Installation (Fig. 82)

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

2. Position fan motor to fan motor bracket and secure with cap screws (item 20), flat washers (item 21) and lock nuts (item 14).

3. Thoroughly clean tapered surfaces of fan motor shaft and fan hub. Place woodruff key in slot in motor shaft.

4. Position fan hub onto motor shaft and secure with washer (item 8) and hex nut (item 9). Torque nut from **27 to 33 ft–lb (37 to 44 N–m)**.

IMPORTANT: Make sure to not damage the radiator or other machine components while installing the fan motor and bracket assembly.

5. Carefully position fan motor and bracket assembly to radiator and secure with six (6) cap screws and flange nuts.

6. Remove caps and plugs placed in hoses and fittings during removal to prevent contamination. Connect hydraulic hoses to cooling fan motor (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

7. Position fan to fan hub and secure with four (4) cap screws and washers.

8. Install upper radiator shroud and air cleaner hose (Fig. 83). Make sure that clearance between shroud and cooling fan is at least 0.180” (4.6 mm) at all points.

9. Lower and secure hood.

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

11. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

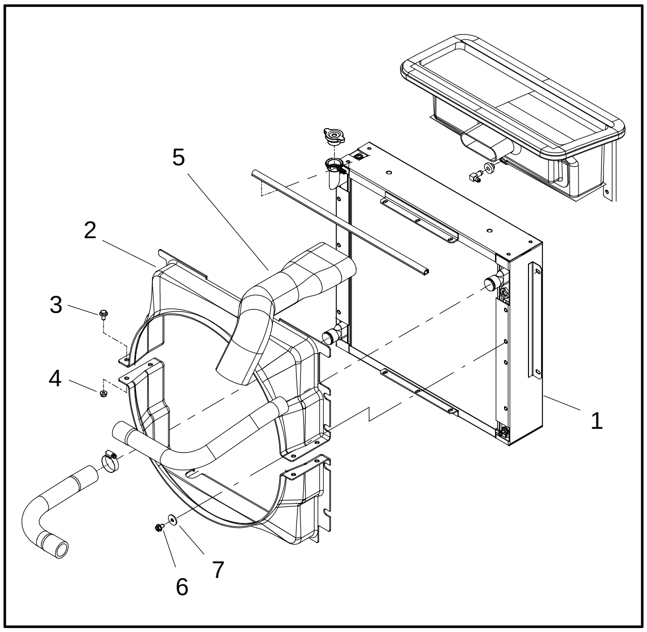

Figure 83

1. **Radiator**
2. **Upper radiator shroud**
3. **Screw (4 used)**
4. **Flange nut (4 used)**
5. **Air cleaner hose**
6. **Screw**
7. **Flat washer**

Hydraulic System

Engine Cooling Fan Motor Service

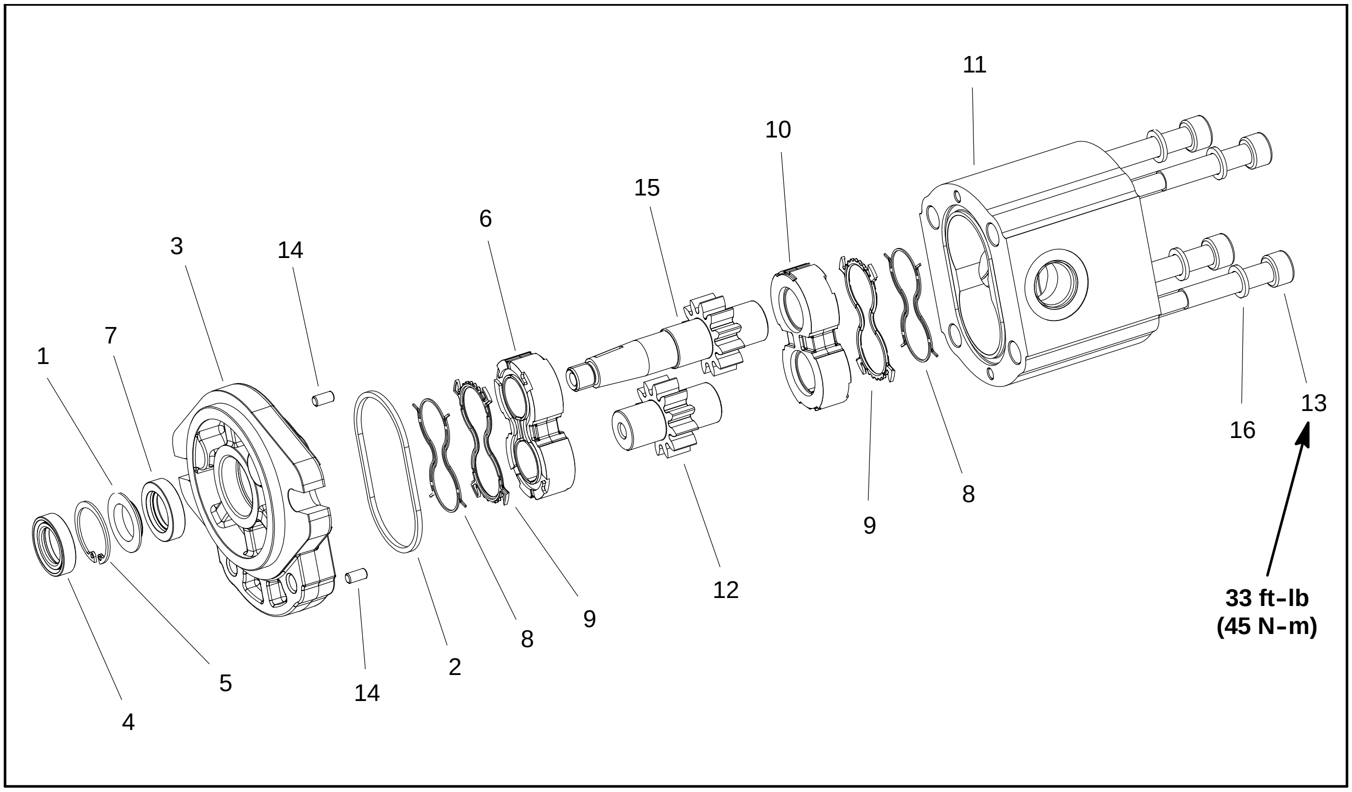

Figure 84

1. **Flange washer**
2. **O–ring**
3. **Front flange**
4. **Dust seal**
5. **Retaining ring**
6. **Front wear plate**
7. **Shaft seal**
8. **Backup gasket**
9. **Pressure seal**
10. **Rear wear plate**
11. **Body**
12. **Idler gear**
13. **Cap screw (4 used)**
14. **Dowel (2 used)**
15. **Drive gear**
16. **Washer (4 used)**

For disassembly, inspection and assembly procedures of the cooling fan motor, see Reel Motor Service in this section.

Hydraulic System

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Fan Control Manifold

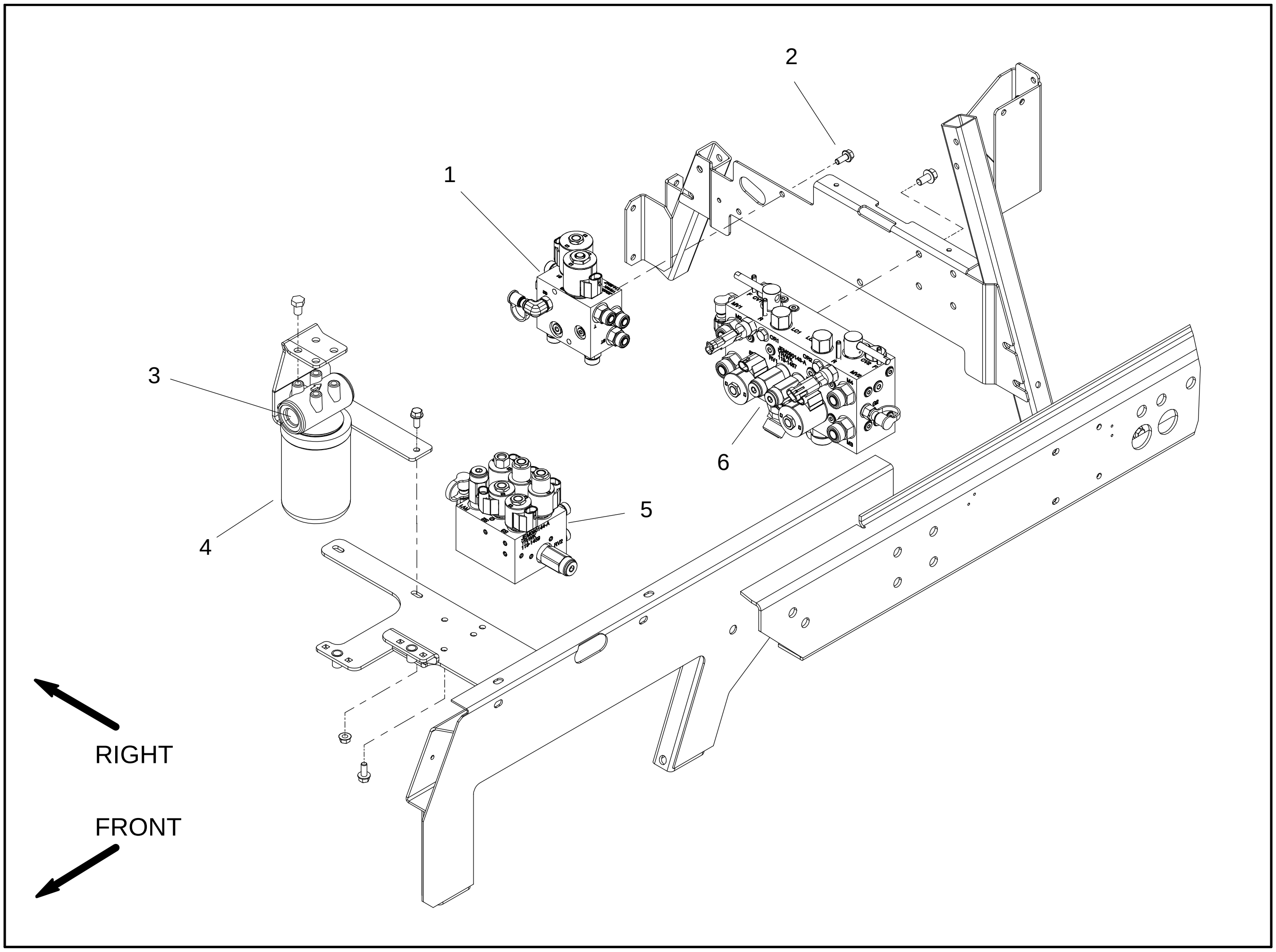

Figure 85

1. Fan control manifold
2. Flange head screw (2 used)
3. Filter head
4. Hydraulic oil filter
5. Lift control manifold
6. Mow control manifold

Removal (Fig. 85)

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the gear pump connection port (see Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

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

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

3. Unlatch and raise hood.

4. To prevent contamination of hydraulic system during fan control manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect connectors from the solenoid coils.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame using Figure 85 as guide.

8. If hydraulic fittings are to be removed from fan control manifold, mark fitting orientation to allow correct assembly (Fig. 86). Remove fittings from manifold and discard O–rings.

Installation (Fig. 85)

1. If fittings were removed from fan control manifold, lubricate and place new O–rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Refer to Figure 86 for fitting installation torque.

2. Install hydraulic manifold to the frame using Figure 85 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness electrical connectors to the solenoid valves.

5. Lower and secure hood.

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

7. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

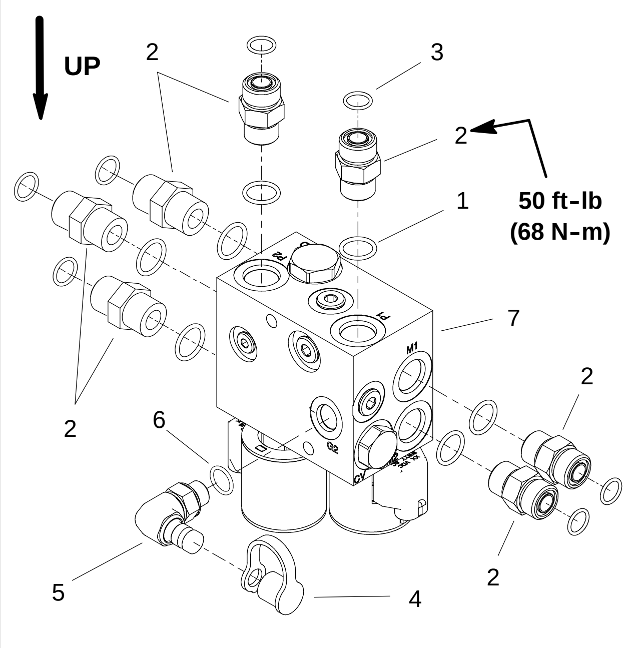

Figure 86

1. O–ring
2. Straight fitting (7 used)
3. O–ring
4. Dust cap
5. Test fitting
6. O–ring
7. Fan control manifold

Hydraulic System

Fan Control Manifold Service

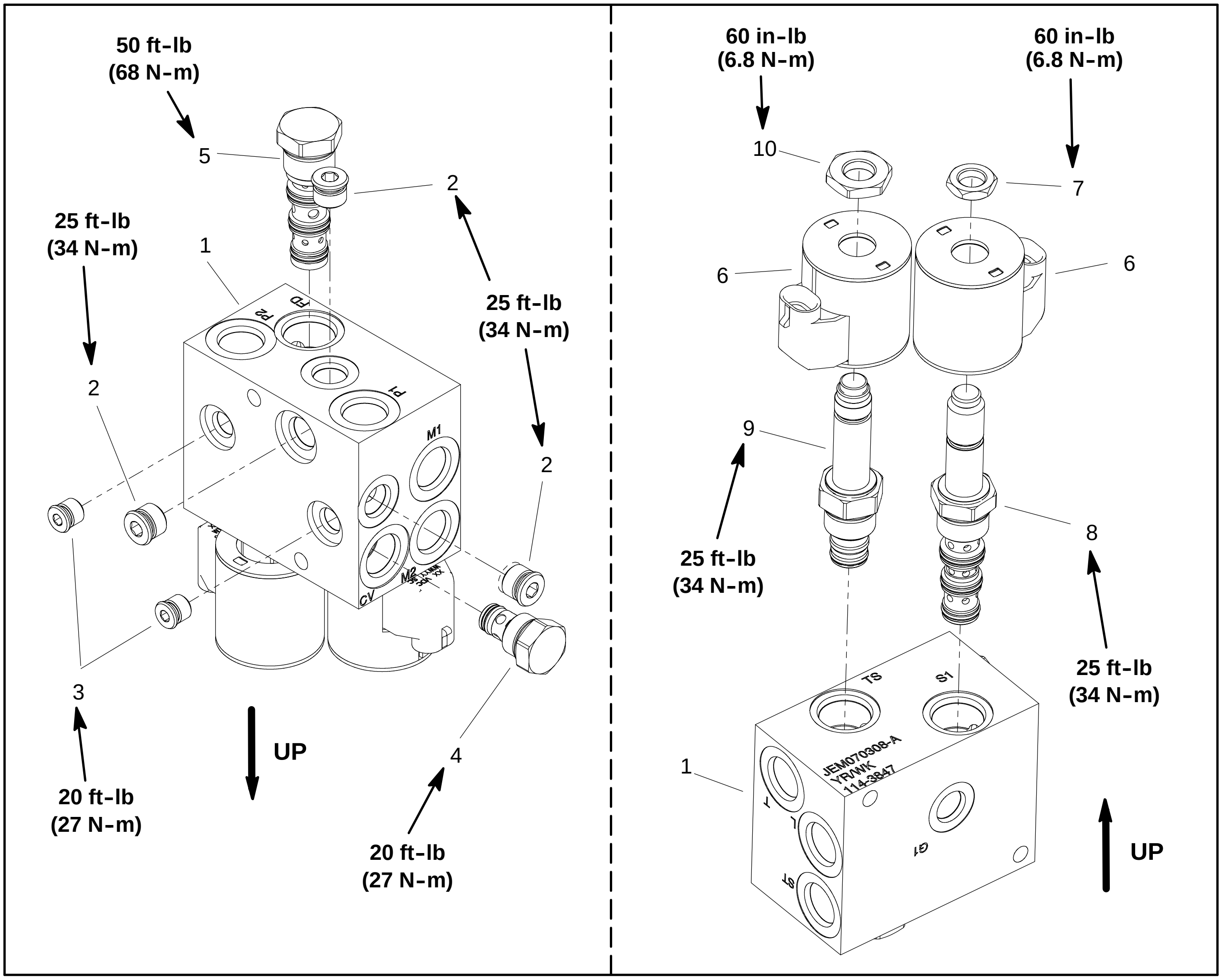

Figure 87

1. **Manifold body**
2. **Zero leak plug (#6) (3 used)**
3. **Zero leak plug (#4) (2 used)**
4. **Check valve (port CV)**
5. **Flow divider cartridge (port FD)**
6. **Solenoid coil (2 used)**
7. **Nut**
8. **Solenoid valve (port S1)**
9. **Proportional relief cartridge (port TS)**
10. **Nut**

NOTE: The ports on the fan control manifold are marked for easy identification of components (e.g. ST is the supply to the steering control valve and FD is the location of the flow divider cartridge valve). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 87 for cartridge valve and plug installation torque.

NOTE: The fan control manifold includes several zero leak plugs. These plugs have a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plugs also have an O–ring as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a punch and hammer before using an allen wrench to remove the plug: the impact will allow plug removal with less chance of damage to the socket head of the plug.

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Lift Control Manifold

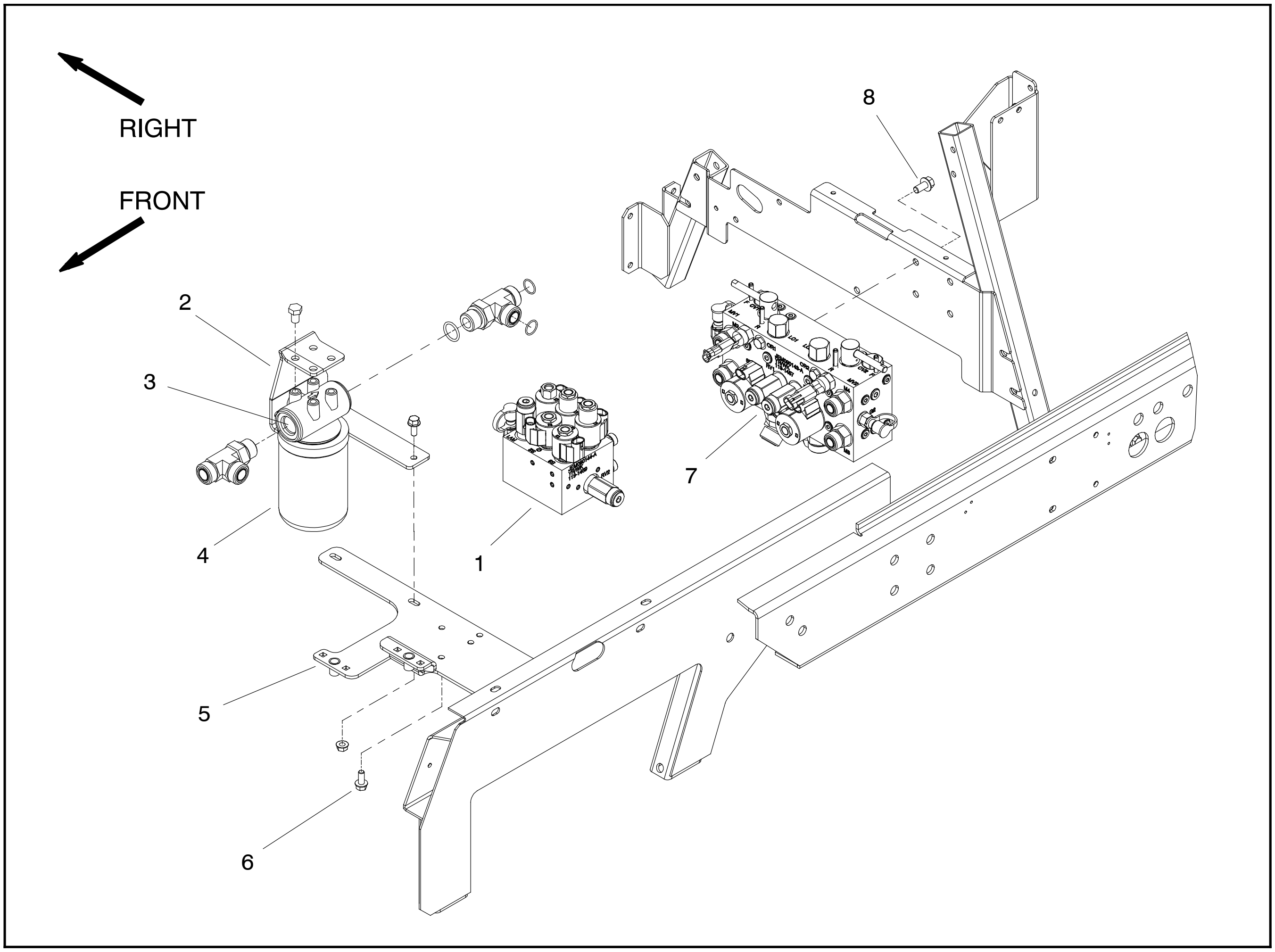


Figure 88

1. **Lift control manifold**
2. **Filter mount bracket**
3. **Filter head**
4. **Hydraulic oil filter**
5. **Valve mount bracket**
6. **Flange head screw (2 used)**
7. **Mow control manifold**

Removal (Fig. 88)

NOTE: The ports on the manifold are marked for easy identification of components. Example: P is the supply connection port (see Hydraulic Schematic in Chapter 9 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

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

IMPORTANT: To prevent unexpected cutting unit lowering, make sure that cutting units are fully lowered before loosening hydraulic lines from lift manifold.

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

3. Unlatch and raise seat.

4. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect wire harness electrical connectors from the solenoid valve coils.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift manifold. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame using Figure 88 as guide.

IMPORTANT: A flow control orifice is placed beneath hydraulic fittings in lift control manifold ports C2, C3 and C4 (Fig. 89). If a fitting is removed from the lift junction manifold and an orifice is in the manifold port, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes.

8. If hydraulic fittings are to be removed from lift control manifold, mark fitting orientation to allow correct assembly (Fig. 89). Remove fittings from manifold and discard O-rings.

Installation (Fig. 88)

IMPORTANT: When installing orifice in manifold port, make sure that orifice is flat in the base of the manifold port. Manifold damage is possible if the orifice is cocked in the cavity.

1. If fittings were removed from junction manifold, lubricate and place new O-rings onto fittings. Install fittings into manifold openings making sure that orifice is correctly placed before threading fitting into manifold. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Refer to Figure 89 for fitting installation torque.

2. Install hydraulic manifold to the frame using Figure 88 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness electrical connectors to the solenoid valve coils.

5. Lower and secure seat.

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

7. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

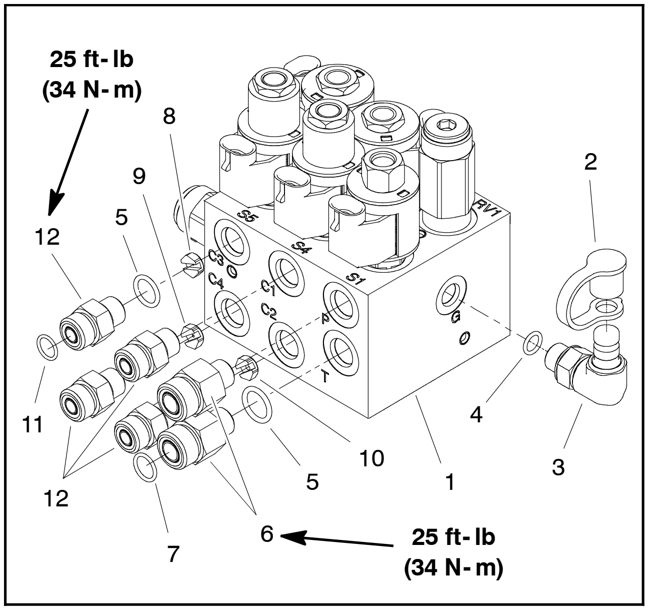


Figure 89

1. **Lift manifold**
2. **Dust cap**
3. **Test fitting**
4. **O-ring**
5. **O-ring**
6. **Straight fitting (2 used)**
7. **O-ring**
8. **Orifice (0.040) (port C3)**
9. **Orifice (0.055) (port C4)**
10. **Orifice (0.109) (port C2)**
11. **O-ring**
12. **Straight fitting (4 used)**

Hydraulic System

Lift Control Manifold Service

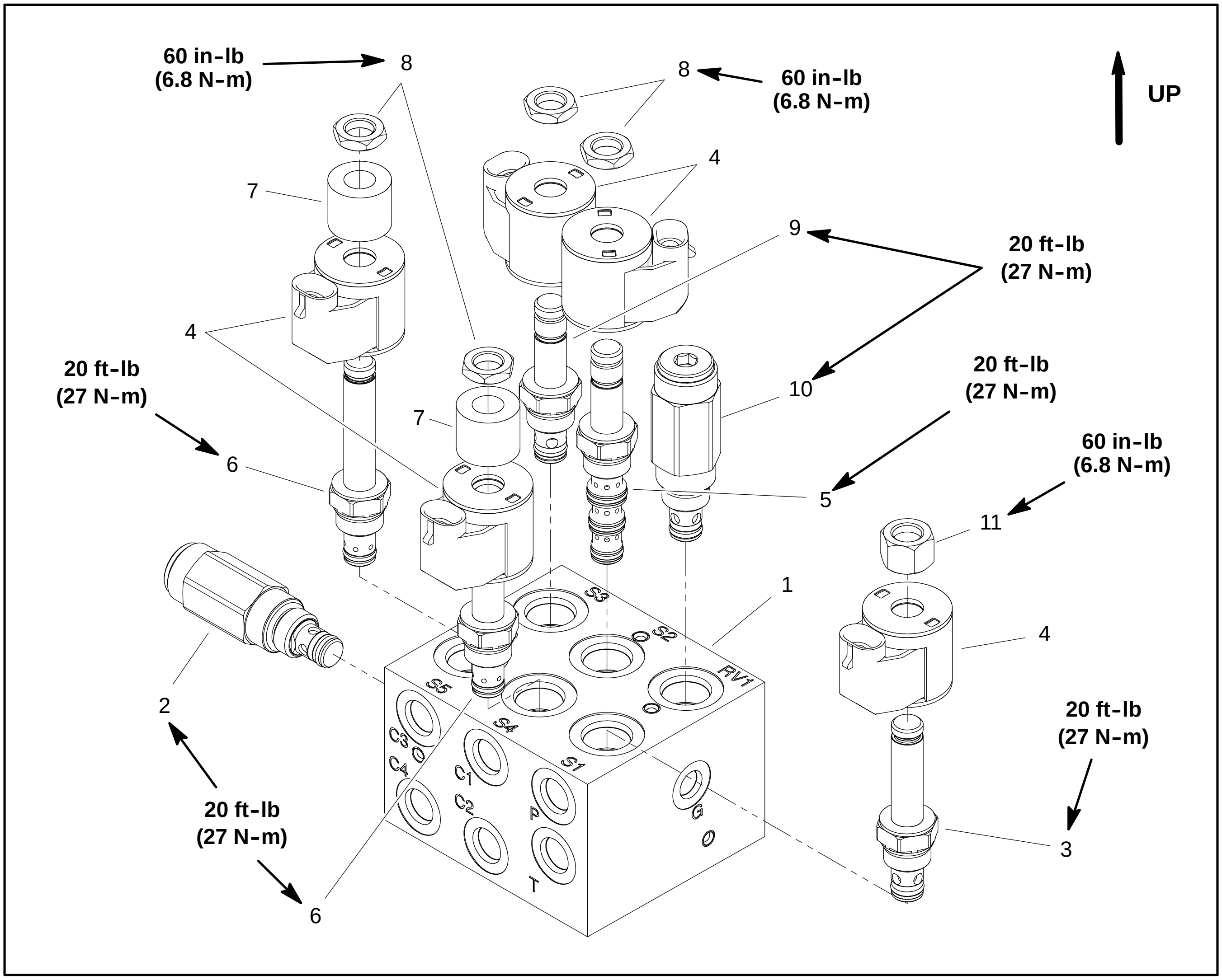


Figure 90

1. **Manifold body**
2. **Relief valve (port RV2)**
3. **Solenoid valve (port S1)**
4. **Solenoid coil (5 used)**
5. **Solenoid valve (port S2)**
6. **Solenoid valve (ports S4 and S5)**
7. **Coil spacer (2 used)**
8. **Nut**
9. **Solenoid valve (port S3)**
10. **Relief valve (port RV1)**
11. **Nut**

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P is the supply connection port and RV1 is the location for the lift relief valve). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

WARNING

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

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 90 for cartridge valve and plug installation torque.

IMPORTANT: A flow control orifice is placed beneath the hydraulic fittings in lift control manifold ports C2, C3 and C4. If any of these fittings are removed from the manifold, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is flat in the base of the port. Manifold damage is possible if the orifice is cocked in the port.

Lift Circuit Junction Manifold

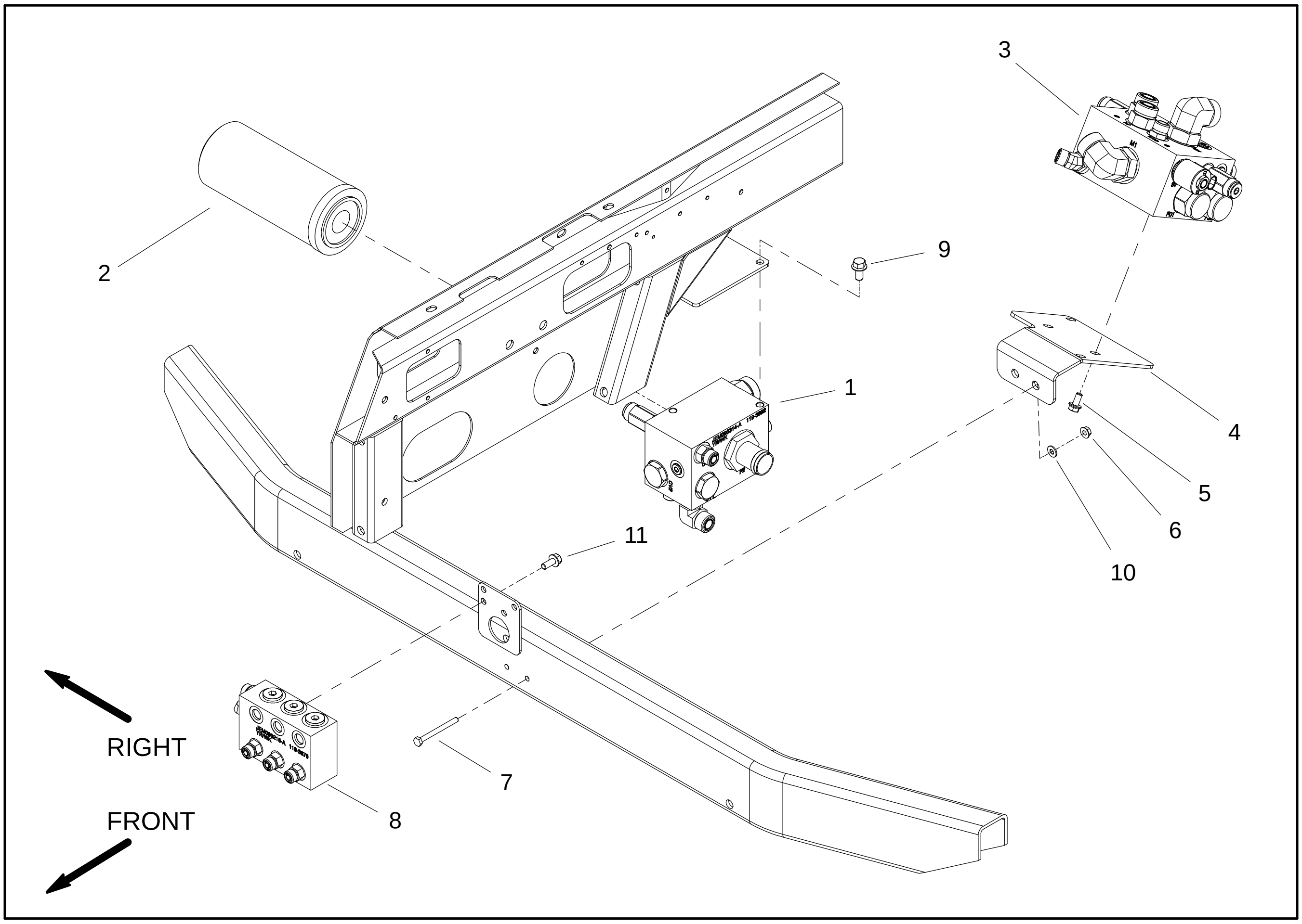


Figure 91

1. **Filtration/charge control manifold**
2. **Hydraulic oil filter**
3. **4WD/2WD control manifold**
4. **Manifold bracket**
5. **Flange head screw (3 used)**
6. **Flange nut (2 used)**
7. **Cap screw (2 used)**
8. **Lift circuit junction manifold**
9. **Flange head screw (2 used)**
10. **Flat washer (2 used)**
11. **Flange head screw (2 used)**

Removal (Fig. 91)

NOTE: The ports on the lift circuit junction manifold are marked for easy identification of components (e.g. P1 is the gear pump connection port). See Hydraulic Schematic in Chapter 9 – Foldout Drawings to identify the function of the hydraulic lines at each port.

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

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

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

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift circuit junction manifold. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Remove hydraulic manifold from the frame using Figure 91 as guide.

IMPORTANT: A flow control orifice is placed beneath several of the hydraulic fittings on the lift circuit junction manifold (Fig. 92). If a fitting is removed from the lift junction manifold and an orifice is in the manifold port, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes.

6. If necessary, remove fittings from manifold and discard O–rings (Fig. 92).

Installation (Fig. 91)

IMPORTANT: When installing orifice in manifold, make sure that orifice is flat in the base of the manifold port. Manifold damage is possible if the orifice is cocked in the cavity.

1. If fittings were removed from junction manifold, lubricate and place new O–rings onto fittings. Install fittings into manifold openings making sure that orifice is correctly placed before threading fitting into manifold. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter). Refer to Figure 92 for fitting installation torque.

2. Install hydraulic manifold to the frame using Figure 91 as guide.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

5. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

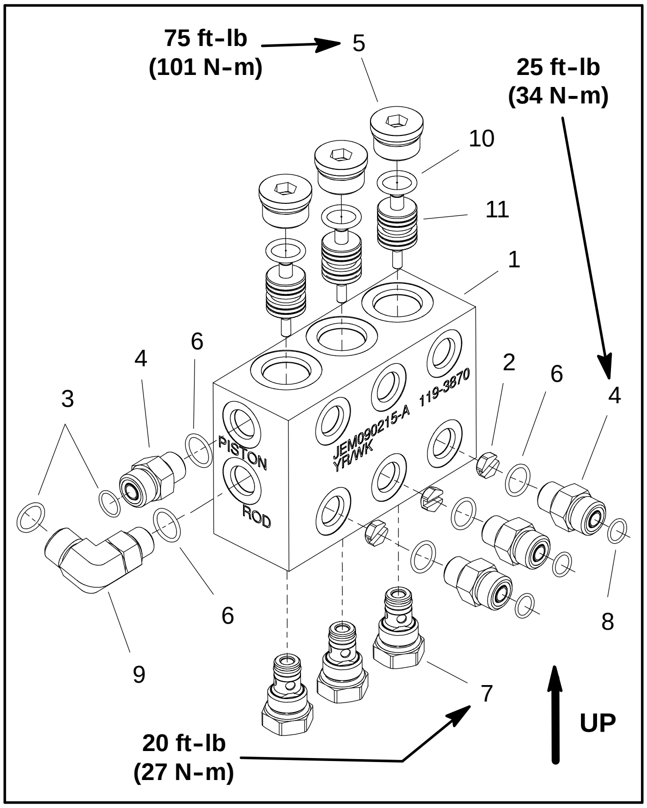


Figure 92

1. Manifold body
2. Orifice (0.030) (3 used)
3. O–ring
4. Straight fitting (4 used)
5. Zero leak plug (3 used)
6. O–ring
7. Check valve (3 used)
8. O–ring
9. 90° hydraulic fitting
10. O–ring
11. Pilot piston (3 used)

Front Lift Cylinders

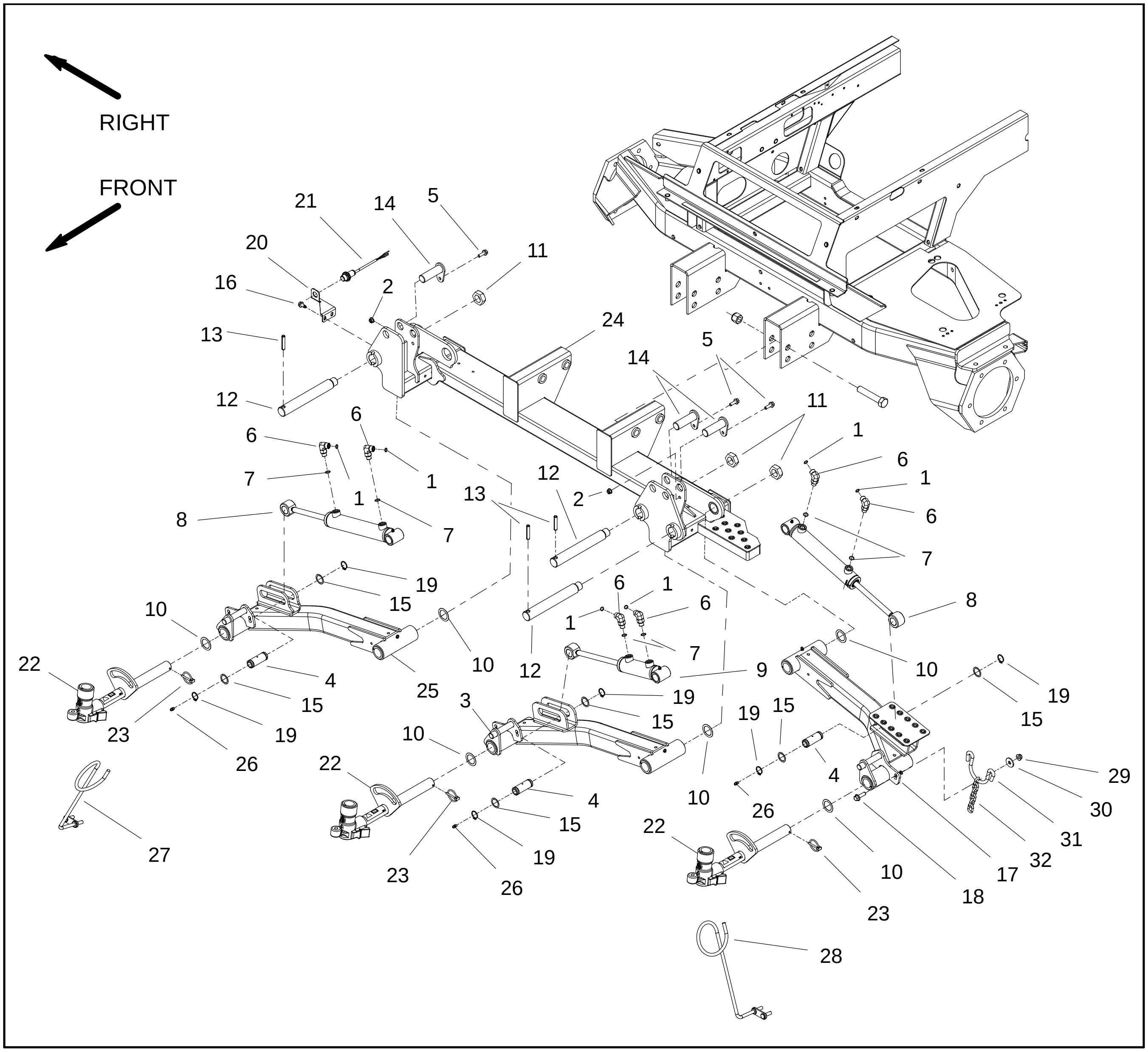


Figure 93

1. O-ring
2. Flange nut
3. Lift arm (cutting unit #1)
4. Cylinder pin
5. Flange head screw
6. 90° hydraulic fitting (2 per cylinder)
7. O-ring
8. Lift cylinder (cutting units #4 and #5)
9. Lift cylinder (cutting unit #1)
10. Thrust washer
11. Lock nut
12. Pivot pin
13. Slotted roll pin
14. Cylinder pin
15. Washer (2 per pin)
16. Washer head screw
17. Lift arm (cutting unit #4)
18. Flange head screw (2 per hoop)
19. Retaining ring (2 per pin)
20. Switch bracket
21. Cutting unit position sensor
22. Pivot yoke
23. Lynch pin
24. Front carrier frame
25. Lift arm (cutting unit #5)
26. Grease fitting
27. RH hose guide
28. LH hose guide
29. Flange nut (2 per hoop)
30. Washer (2 per hoop)
31. Chain hoop
32. Lift chain

Removal (Fig. 93)

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

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

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of lift cylinder that is to be removed from machine.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift cylinder. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic hoses from lift cylinder. Put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label disconnected hydraulic lines for proper assembly.

5. Remove one (1) retaining ring and washer from the cylinder pin (item 4). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

6. Remove flange nut and flange head screw that secure the cylinder pin (item 14) to the frame. Pull pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

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

Installation (Fig. 93)

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

2. Position lift cylinder barrel clevis to frame and insert cylinder pin (item 14) into frame and clevis. Secure pin with flange nut and flange head screw.

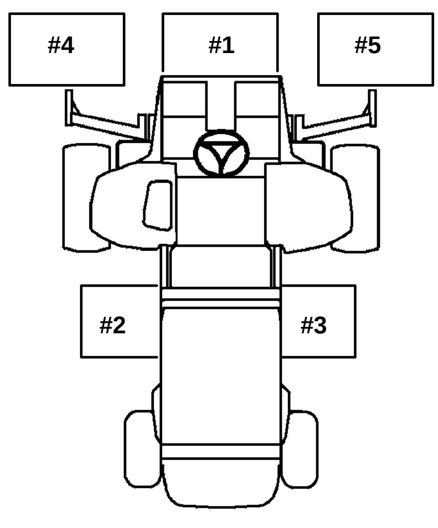
3. Position cylinder rod clevis to lift arm and insert cylinder pin (item 4) with one (1) retaining ring and washer installed through the lift arm and cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

4. Remove caps and plugs from hoses and fittings. Attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Fill reservoir with hydraulic fluid as required.

6. Follow Hydraulic System Start–up procedures (see Hydraulic System Start–up in this section).

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



CUTTING UNIT LOCATIONS

Figure 94

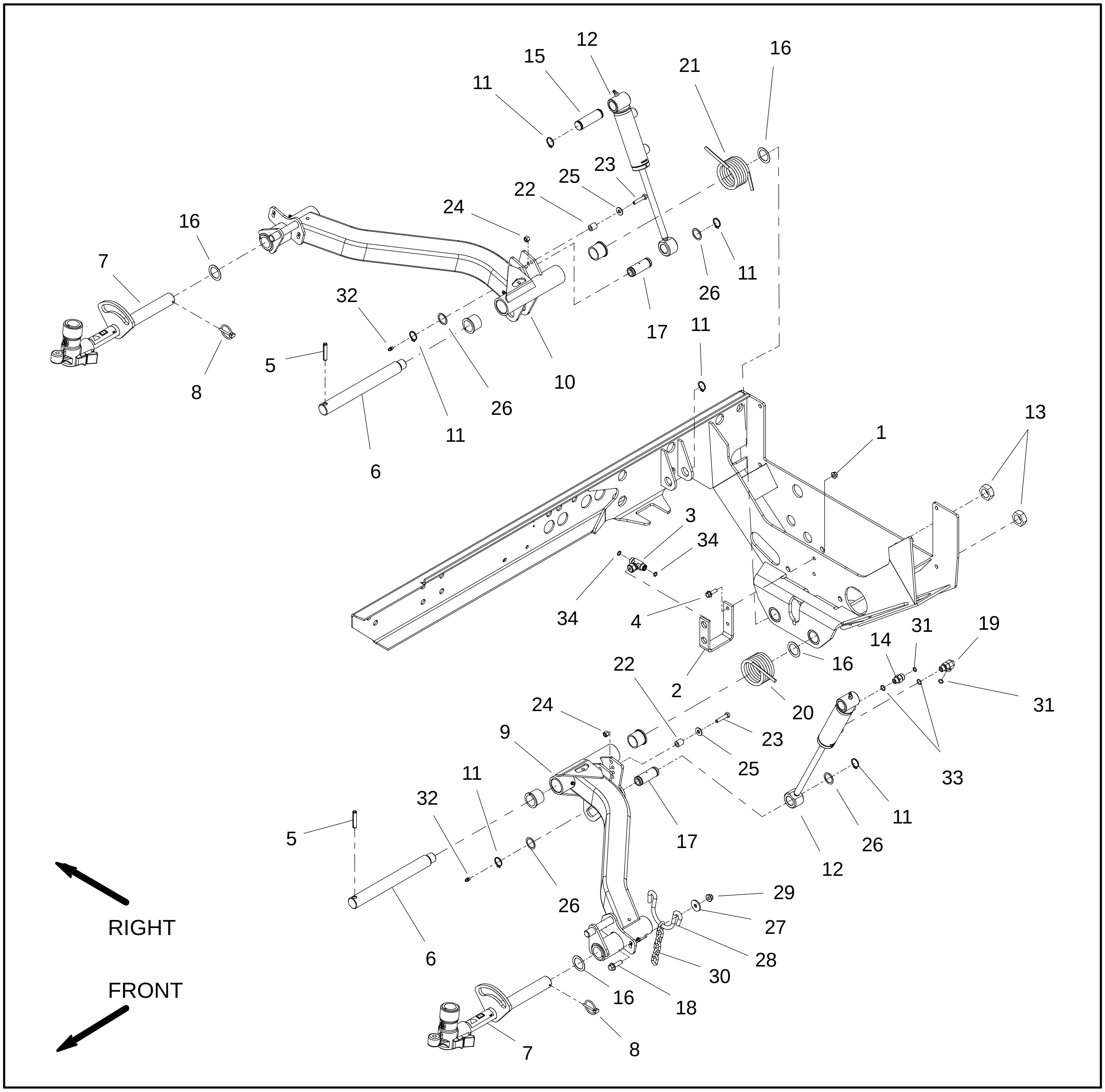


Figure 95

1. Flange nut (2 used)
2. Bulkhead bracket
3. Hydraulic tee fitting
4. Flange head screw (2 used)
5. Slotted roll pin
6. Pivot pin
7. Pivot yoke
8. Lynch pin
9. Lift arm (cutting unit #2)
10. Lift arm (cutting unit #3)
11. Retaining ring (2 per pin)
12. Lift cylinder (cutting units #2 and #3)
13. Lock nut
14. Straight hydraulic fitting
15. Cylinder pin
16. Thrust washer
17. Cylinder pin
18. Flange head screw (2 per hoop)
19. 90º hydraulic fitting
20. LH torsion spring
21. RH torsion spring
22. Spacer
23. Cap screw
24. Lock nut
25. Flat washer
26. Washer (2 per pin)
27. Washer (2 per hoop)
28. Chain hoop
29. Flange nut (2 per hoop)
30. Lift chain
31. O-ring
32. Grease fitting
33. O-ring
34. O-ring

Removal (Fig. 95)

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

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

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

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift cylinder. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic hoses from lift cylinder. Put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label the hydraulic hoses to show their correct position on the lift cylinder for assembly purposes.

5. Remove one (1) retaining ring and washer from the cylinder pin (item 17) that secures the lift cylinder rod clevis to the lift arm. Remove pin from lift arm and cylinder shaft clevis.

6. Remove one (1) retaining ring from the cylinder pin (item 15) that secures the lift cylinder barrel clevis to the frame. Remove cylinder pin from the frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

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

Installation (Fig. 95)

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

2. Position cylinder barrel clevis to frame and insert cylinder pin (item 15) with one (1) retaining ring installed through the frame and cylinder clevis. Secure pin with second retaining ring. Make sure that retaining ring is fully seated in pin.

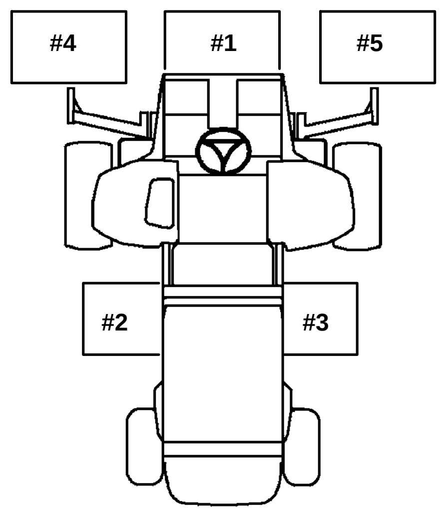
3. Position cylinder rod clevis to lift arm and insert cylinder pin (item 17) with one (1) retaining ring and washer installed through the lift arm and cylinder rod clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

4. Remove caps and plugs from hoses and fittings. Attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Fill reservoir with hydraulic fluid as required.

6. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

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



CUTTING UNIT LOCATIONS

Figure 96

Hydraulic System

Lift Cylinder Service (Serial Number Below 314000200)

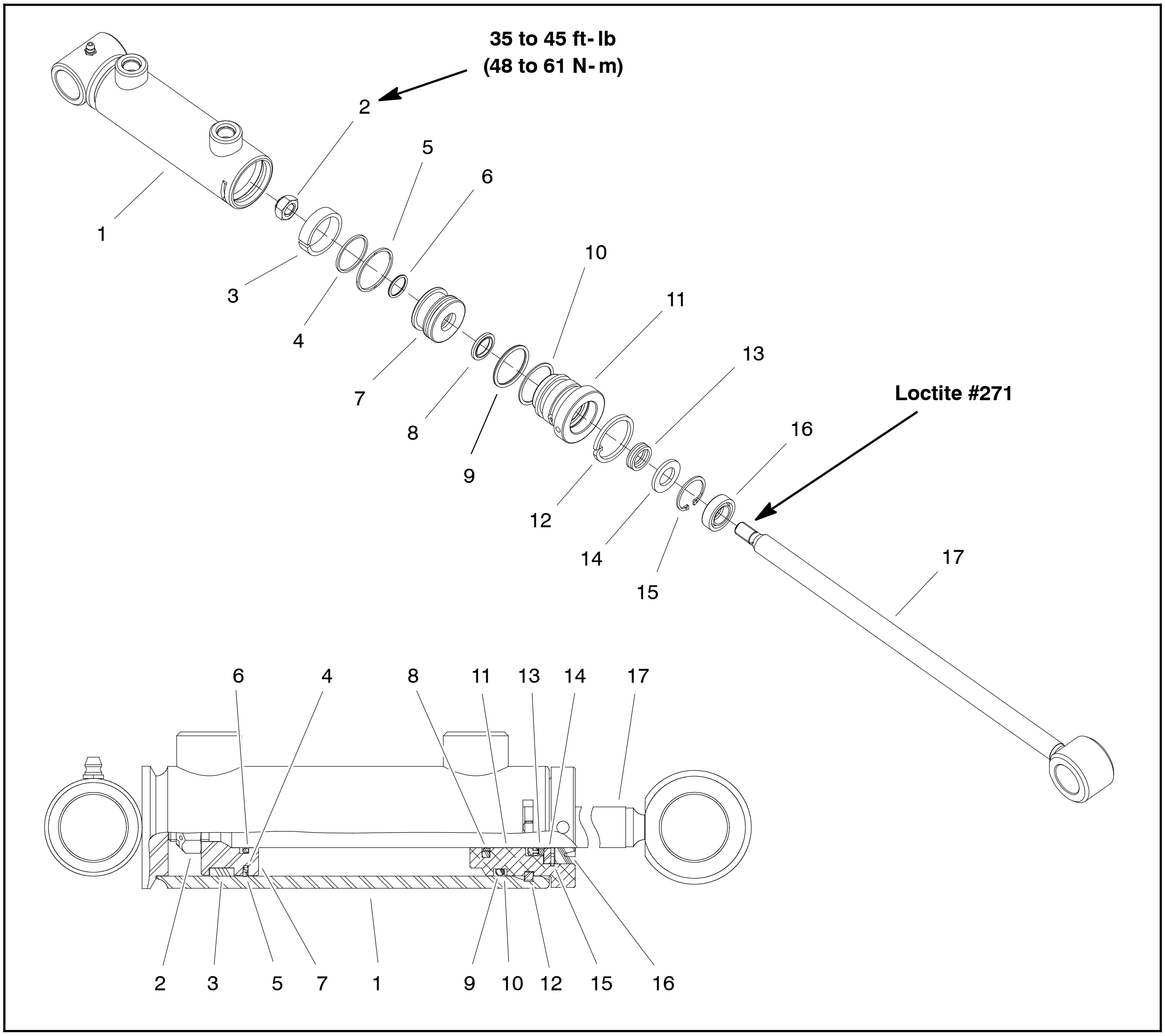


Figure 97

1. **Barrel**
2. **Lock nut**
3. **Wear band**
4. **Square ring**
5. **Piston seal**
6. **O-ring**
7. **Piston**
8. **Buffer seal**
9. **O-ring**
10. **Back-up seal**
11. **Head**
12. **Retaining ring**
13. **Head seal**
14. **Support washer**
15. **Retaining ring**
16. **Wiper**
17. **Rod assembly**

NOTE: The lift cylinders used on the Reelmaster 7000 with serial number below 314000200 are all very similar regardless of the location on the machine. The disassembly and assembly procedure is the same for all lift cylinders.

NOTE: If a lift cylinder on a machine with serial number below 314000200 has been replaced, the replacement lift cylinder may be the lift cylinder from a newer machine. Refer to Lift Cylinder Service (Serial Number Above 314000200) in this section if necessary.

Disassembly (Fig. 97)

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

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

2. Mount lift cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Carefully remove wiper (item 16) from the barrel taking care to not damage barrel. Slide wiper toward rod clevis.

4. Remove retaining ring (item 15) from barrel. Slide retaining ring and support washer (item 14) toward rod clevis.

5. Loosen head from barrel:

   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring (item 12) appears in the barrel opening.

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

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

6. Extract rod assembly with head and piston by carefully twisting and pulling on the rod clevis.

IMPORTANT: Do not clamp vise jaws against the rod surface. Protect shaft surface before mounting in a vise.

7. Mount rod assembly securely in a vise by clamping on the clevis of the rod. Remove lock nut from the rod. Slide piston, head, support washer, retaining ring and wiper off the rod.

8. Remove and discard all seals and O-rings from the piston and the head.

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.). Replace entire cylinder if barrel is damaged. Inspect rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 97)

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

2. Coat new seal kit components with clean hydraulic oil.

   A. Install new seals, wear band and O-ring to the piston.

   B. Install new seals, O-ring and back-up seal to the head.

IMPORTANT: Do not clamp vise jaws against the rod surface. Protect rod surface before mounting in a vise.

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

   A. Coat rod with clean hydraulic oil.

   B. Carefully slide wiper (item 16), retaining ring (item 15), support washer (item 14), head assembly and piston assembly onto the rod.

   C. Clean threads on end of rod. Apply **Loctite #271** (or equivalent) to rod threads.

   D. Secure piston to rod with lock nut. Torque lock nut from **35 to 45 ft-lb (48 to 61 N-m)**.

4. Lubricate head and piston with hydraulic oil. Carefully slide rod assembly into cylinder barrel.

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

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

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

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

   C. Apply silicone sealer to barrel access slot.

6. Slide support washer to top of head and then install retaining ring. Make sure that retaining ring is fully seated in slot in barrel.

7. Press wiper into barrel taking care to not damage wiper.

Lift Cylinder Service (Serial Number Above 314000200)

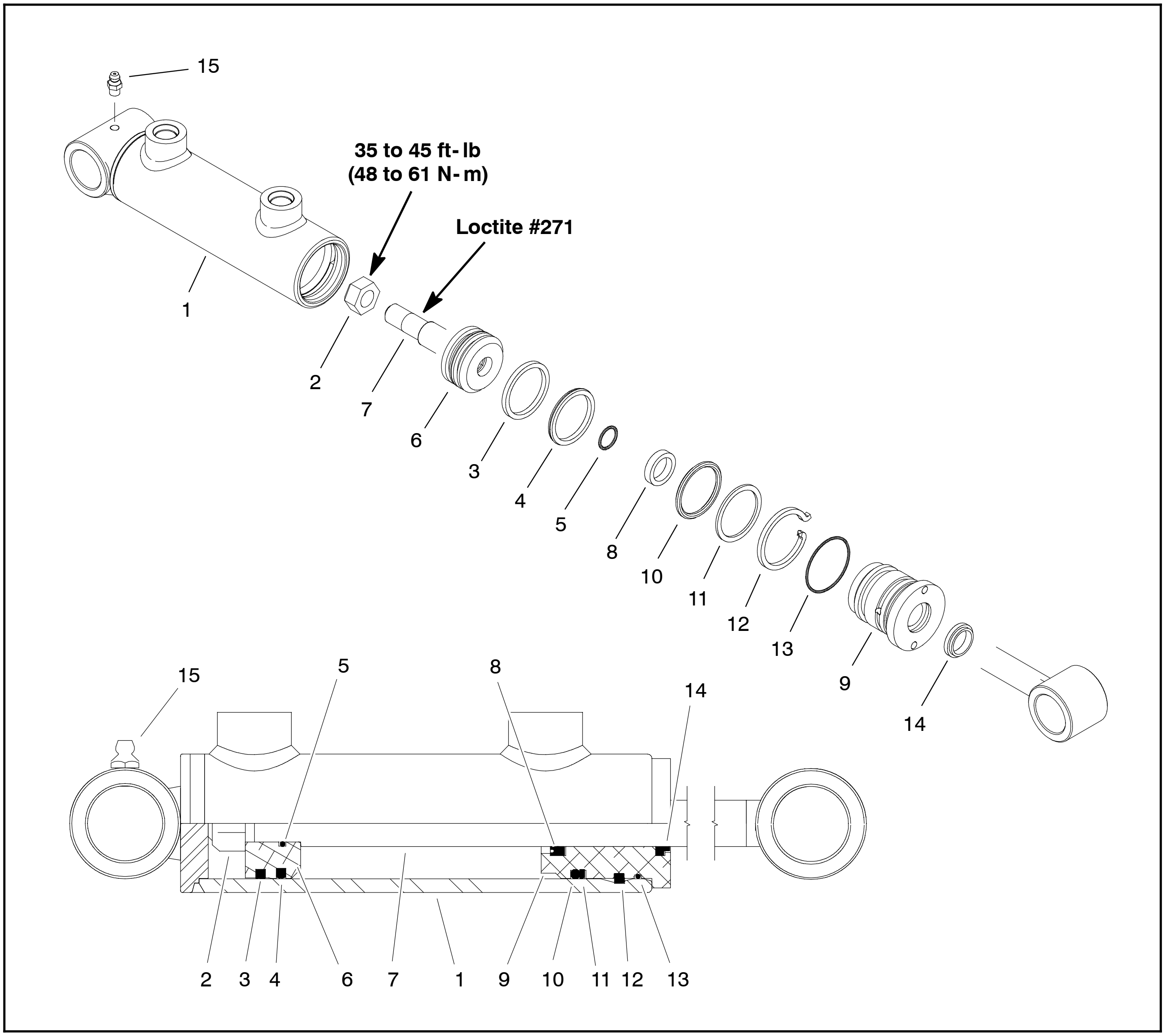


Figure 98

1. Barrel
2. Lock nut
3. Wear ring
4. Piston seal
5. O-ring
6. Piston
7. Rod
8. Head seal
9. Head
10. O-ring
11. Back-up
12. Retaining ring
13. O-Ring
14. Dust seal
15. Grease fitting

NOTE: The lift cylinders used on the Reelmaster 7000-D with serial number above 314000200 are all very similar regardless of the location on the machine. The disassembly and assembly procedure is the same for all lift cylinders.

NOTE: If a lift cylinder on a machine with serial number below 314000200 has been replaced, the replacement lift cylinder may be the lift cylinder as shown in Figure 98.

Disassembly (Fig. 98)

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

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

2. Mount lift cylinder securely in a vise by clamping on the barrel end clevis. Use of a vise with soft jaws is recommended.

3. Insert a screwdriver under the edge of the retaining ring outside hook and using a spanner wrench, rotate head clockwise to start the retaining ring through the opening. Continue rotating the head clockwise to remove retaining ring from barrel and head.

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

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.

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

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

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

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Wash all lift cylinder components in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel and external surface of rod for deep scratches, out-of-roundness and bending.

3. Inspect head and piston for excessive pitting, scoring and wear.

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

Assembly (Fig. 98)

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

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

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

B. Carefully install back-up washer, O-rings, and head seal.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the shaft clevis ONLY.

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

A. Coat shaft with clean hydraulic oil.

B. Slide head onto the shaft.

C. Install piston onto the shaft and secure with lock nut. Torque lock nut from **30 to 35 ft-lb (41 to 47 N-m)**.

D. Remove shaft assembly from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the barrel clevis ONLY.

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

IMPORTANT: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.

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

6. Secure head in barrel by installing retaining ring. Align retaining ring hole in the head with the access slot in the barrel. Insert the retaining ring inside hook into the hole and rotate head counter-clockwise until the retaining ring is completely pulled into the barrel.

Hydraulic Reservoir

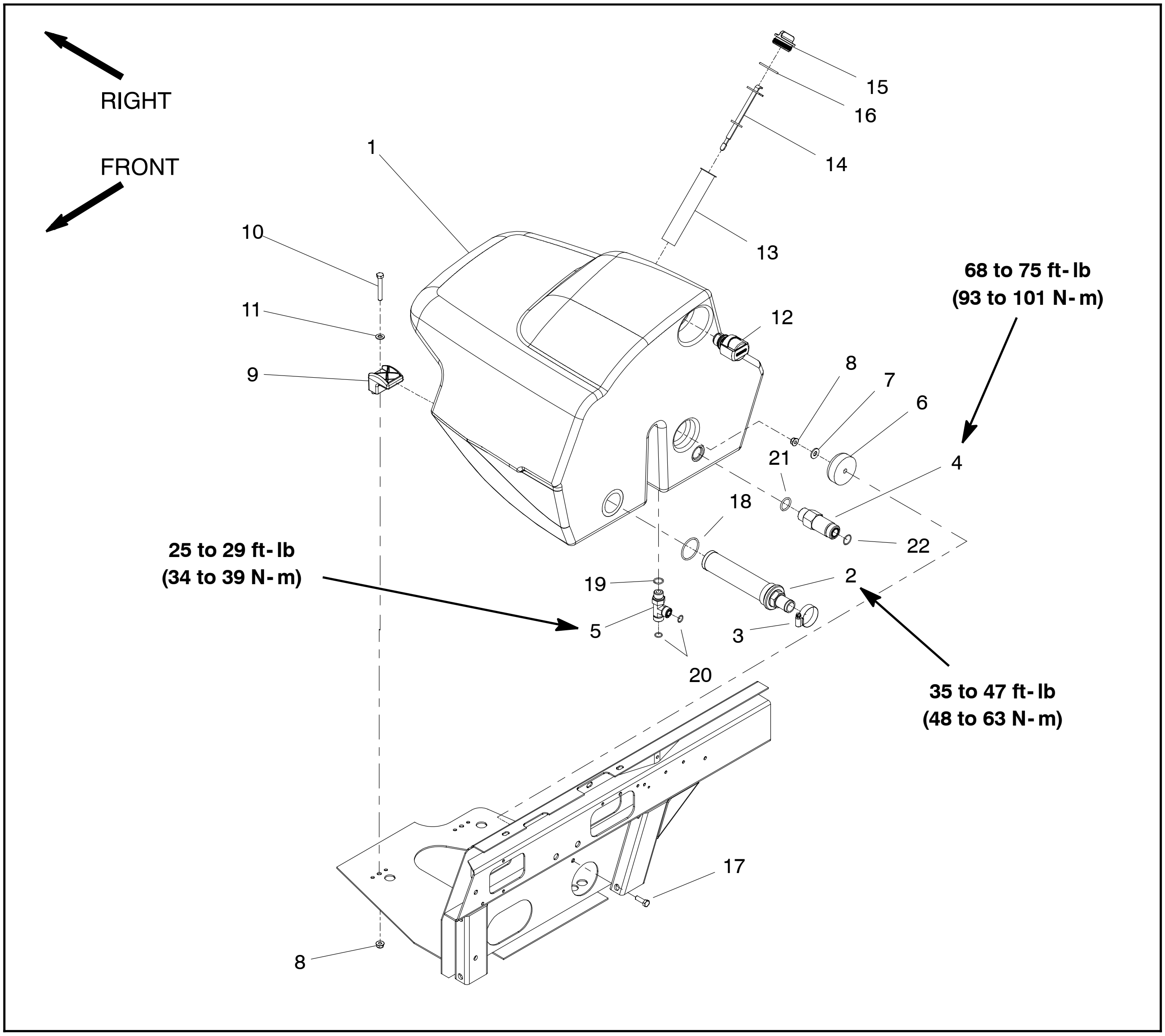


Figure 99

1. **Hydraulic reservoir**
2. **Tank strainer**
3. **Clamp**
4. **Hydraulic fitting**
5. **Hydraulic tee fitting**
6. **Bumper**
7. **Flat washer (2 used)**
8. **Flange nut (3 used)**
9. **Clamp (2 used)**
10. **Cap screw (2 used)**
11. **Flat washer (2 used)**
12. **Breather**
13. **Screen filter**
14. **Dipstick**
15. **Plug**
16. **O- ring**
17. **Cap screw**
18. **O- ring**
19. **O- ring**
20. **O- ring (2 used)**
21. **O- ring**
22. **O- ring**

Removal (Fig. 99)

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

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

3. To prevent contamination of hydraulic system during hydraulic reservoir removal, thoroughly clean exterior of reservoir.

4. Disconnect one of the hydraulic tubes from the tee fitting on bottom of reservoir to allow draining of reservoir. Drain reservoir into a suitable container.

5. Disconnect remaining hydraulic hoses from reservoir. Label the hydraulic hoses to show their correct position on the reservoir for assembly purposes.

6. Remove hydraulic reservoir using Figure 99 as a guide.

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

Inspection

1. Clean hydraulic reservoir and suction strainer with solvent.

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

Installation (Fig. 99)

1. If fittings were removed from reservoir, lubricate and place new O- rings onto fittings. Install fittings into reservoir openings using marks made during the removal process to properly orientate fittings. Torque fittings to values identified in Figure 99.

2. Install reservoir using Figure 99 as a guide.

IMPORTANT: When tightening hoses to reservoir fittings, hold fitting with wrench to prevent over-tightening of fitting and potential reservoir damage.

3. Connect hydraulic hoses to reservoir fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Fill reservoir with hydraulic fluid to proper level.

5. Follow Hydraulic System Start- up procedures (see Hydraulic System Start- up in this section).

Hydraulic Oil Cooler

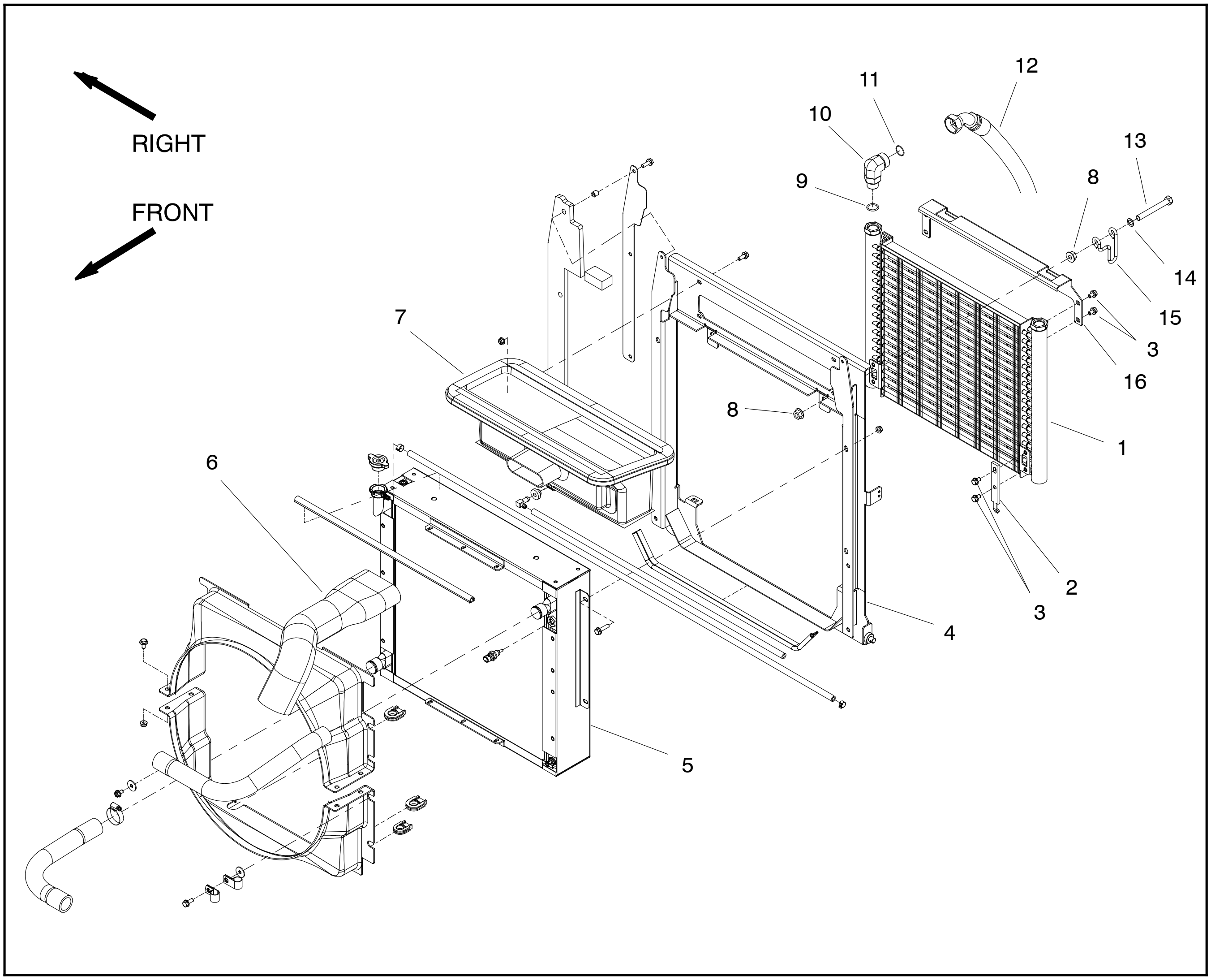


Figure 100

1. **Oil cooler**
2. **Mount plate (2 used)**
3. **Flange head screw (8 used)**
4. **Radiator mount**
5. **Radiator**
6. **Air intake hose**
7. **Plenum**
8. **Flange nut (4 used)**
9. **O-ring**
10. **90° hydraulic fitting (2 used)**
11. **O-ring**
12. **Hydraulic hose (2 used)**
13. **Cap screw (2 used)**
14. **Washer (2 used)**
15. **Wire form clamp (2 used)**
16. **Top oil cooler bracket**

Removal (Fig. 100)

CAUTION

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

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

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

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

4. Remove oil cooler using Figures 100, 101 and 102 as guides.

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

Inspection

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Plug both ends of oil cooler. Clean exterior of cooler. Make sure fins are clear of dirt and debris.

4. The oil cooler should be free of corrosion, cracked tubes and excessive pitting of tubes.

Installation (Fig. 100)

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

2. Install oil cooler using Figures 100, 101 and 102 as guides. See Hydraulic Hose and Tube Installation in the General Information section of this chapter for hydraulic hose installation information.

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

4. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

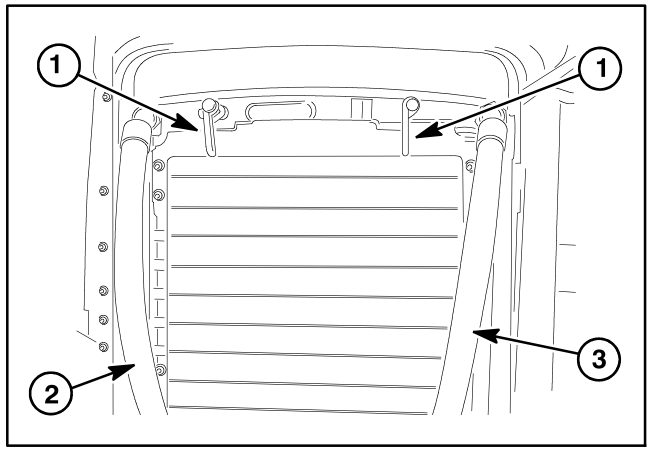


Figure 101

1. **Wire form clamp**
2. **Hose to oil cooler**
3. **Hose from oil cooler**

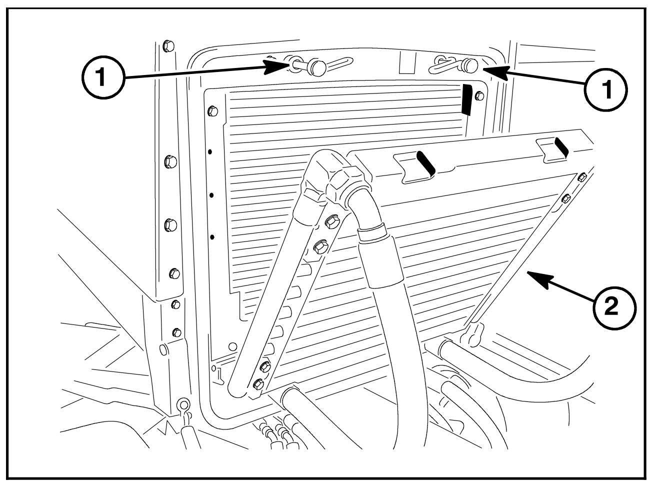


Figure 102

1. **Wire form clamp**
2. **Oil cooler**

Hydraulic System

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Electrical System

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General Information

Operator’s Manual

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

Toro Electronic Controller (TEC)

Reelmaster 7000 machines use a single Toro Electronic Controller (TEC) to manage machine electrical functions.

The controller is microprocessor controlled that senses the condition of various machine switches (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. The status of inputs to the controllers as well as outputs from the controllers can be checked with the Diagnostic Display (see Special Tools).

Because of the solid state circuitry built into the Toro Electronic Controller (TEC), there is no method to test it directly. The TEC may be damaged if an attempt is made to test it with an electrical test device, such as a digital multimeter.

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

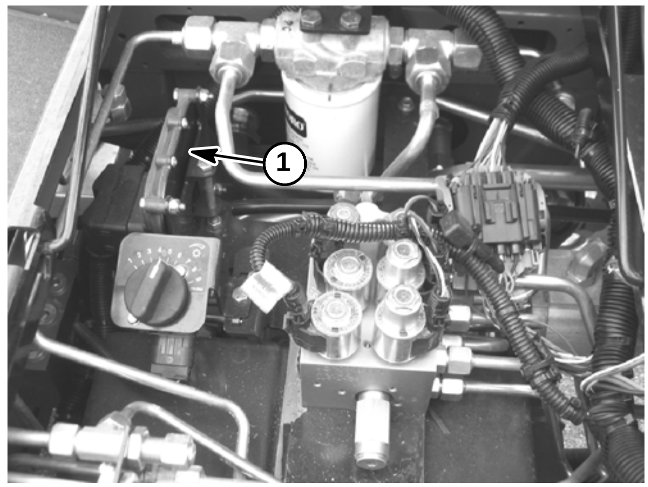


Figure 1

1. Toro Electronic Controller

CAN–bus Communications

The TEC controller used on the Reelmaster 7000 can communicate with other electrical components on a CAN–bus communication system. The CAN–bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be reduced.

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

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

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

Electrical Drawings

The electrical schematics and other electrical drawings for the Reelmaster 7000 are located in Chapter 9 – Foldout 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.

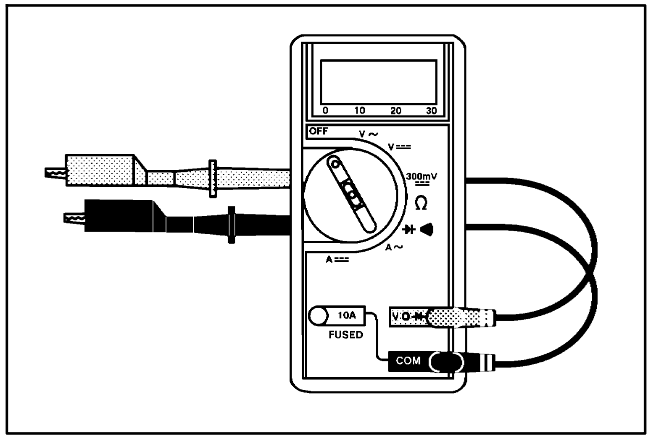


Figure 2

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 3

Battery Hydrometer

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

Figure 4

Diagnostic Display

The Diagnostic Display (Fig. 5) can be connected to the wiring harness connector located inside the console arm to verify correct electrical functions of the machine. Toro Electronic Controllers (TEC) inputs and outputs can be checked using the Diagnostic Display.

Toro Part Number for Diagnostic Display: **85-4750**

Toro Part Number for Overlay (English)**: 120-1679**

NOTE: Diagnostic Display overlays are available in several languages for your Reelmaster. Refer to your Parts Catalog for overlay language options and part numbers.

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of Diagnostic Display is completed, disconnect it from the machine and reconnect loop-back connector to harness connector. Machine will not operate without loop-back connector installed on harness. Store Diagnostic Display in a dry, secure, indoor location and not on machine.

Figure 5

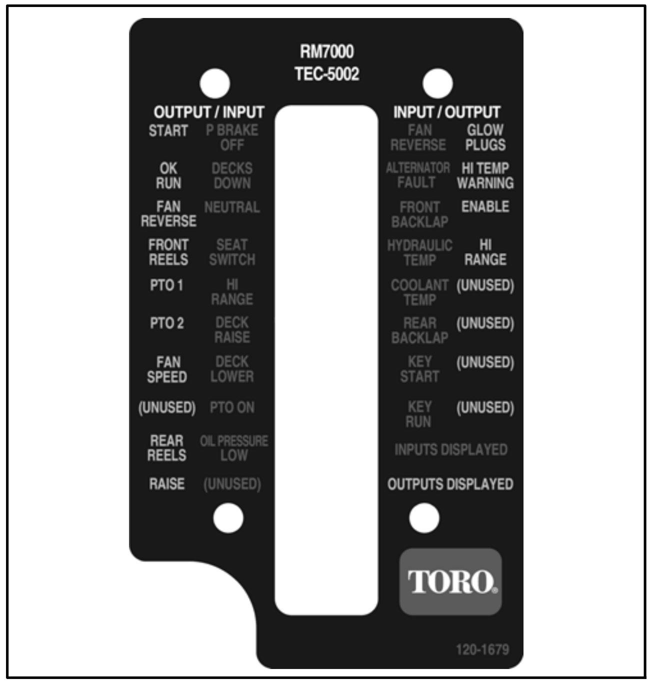


Figure 6

Battery Terminal Protector

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

Toro Part Number: **107-0392**

Figure 7

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this machine (see Chapter 9 – Foldout Drawings).

If the machine has any interlock switches by–passed, reconnect the switches for proper safety and trouble-shooting.

NOTE: Use the Diagnostic Display (see Special Tools in this chapter) to test Electronic Control Module inputs and outputs when troubleshooting an electrical problem on your Reelmaster.

Diagnostic Display

Reelmaster 7000 machines are equipped with a Toro Electronic Controller (TEC) which controls machine electrical functions. The controller monitors various input switches (e.g. ignition switch, seat switch, neutral switch) and energizes outputs to actuate solenoids or relays for the requested machine function.

For the TEC to control the machine as desired, each of the inputs (switches and sensors) and outputs (solenoids and relays) must be connected and functioning properly.

The Diagnostic Display (see Special Tools in this chapter) is a tool to help the technician verify correct electrical functions of the machine.

IMPORTANT: The Diagnostic Display must not be left connected to the machine. It is not designed to withstand the environment of the machine's every day use. When use of the Diagnostic Display is completed, disconnect it from the machine and reconnect loop–back connector to harness connector. The machine will not operate without the loop–back connector installed on the harness. Store the Diagnostic Display in a dry, secure, indoor location and not on machine.

CAUTION

The interlock switches are for the protection of the operator and bystanders and to ensure correct operation of the machine. Do not bypass or disconnect switches. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Verify Diagnostic Display Input Functions

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

2. Remove plate in front of seat to allow access to wire harness loop–back connector. Locate wire harness and loop–back connector (Fig. 8). Carefully unplug loop–back connector from harness connector.

3. Connect the Diagnostic Display connector to the wire harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 9).

4. Turn the ignition switch to the ON position, but do not start machine.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to TEC inputs and the **green** text refers to TEC outputs.

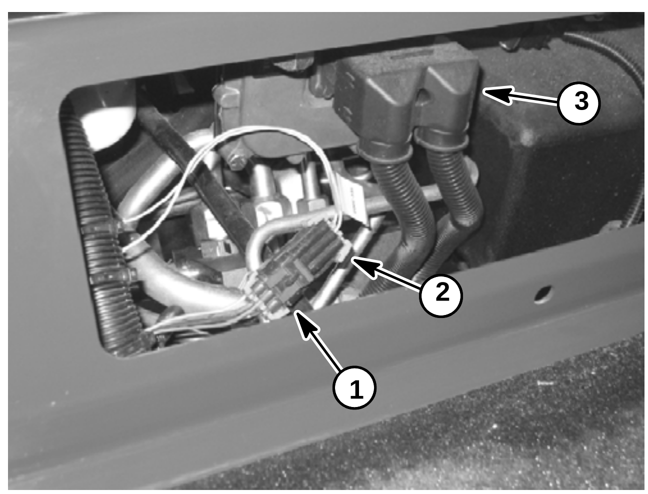


Figure 8

1. **Wire harness connector**
2. **Loop–back connector**
3. **TEC controller**

5. The “inputs displayed” LED, on lower right column of the Diagnostic Display, should be illuminated. If “outputs displayed” LED is illuminated, press the toggle button on the Diagnostic Display to change to “inputs displayed” LED.

6. The Diagnostic Display will illuminate the LED associated with each of the inputs when that input switch is closed. Individually, change each of the switches from open to closed (i.e., sit on seat, press traction pedal, etc.), and note that the appropriate LED on the Diagnostic Display will illuminate when the corresponding switch is closed. Repeat on each switch that is possible to be changed by hand (see Diagnostic Display Inputs and LED Operation chart on following page).

NOTE: When the Diagnostic Display is attached to the wire harness connector and the ignition switch is in the ON position, the input LED for hydraulic temp and coolant temp should be illuminated. If the harness connector is disconnected from the sensor for either of these inputs, the appropriate LED should go off after a few second delay. Then, if the harness connector is reattached to the sensor, the input LED should again illuminate after a few seconds.

7. If appropriate LED does not toggle on and off when switch state is changed, check all wiring and connections to that switch and/or test switch (see Component Testing in this chapter). Replace any defective switches and repair any damaged wiring.

8. After input functions testing is complete, disconnect the Diagnostic Display connector from the harness connector and plug loop–back connector into wire harness. Secure access plate to frame.

TEC OVERLAY

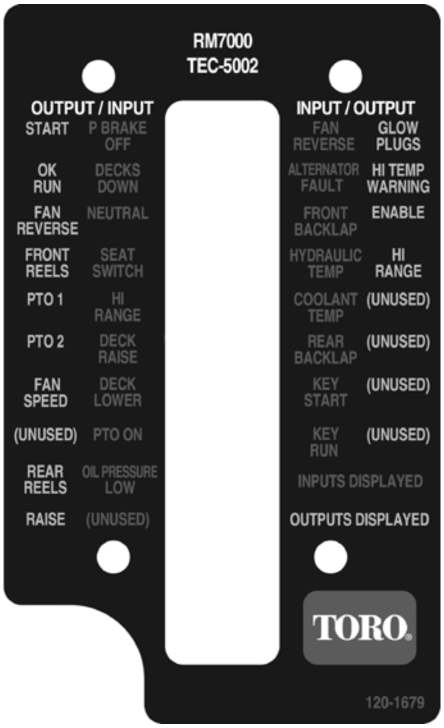


Figure 9

Diagnostic Display Inputs	Diagnostic Display LED Operation
P BRAKE OFF	Parking brake released: LED ON Parking brake applied: LED OFF
DECKS DOWN	Cutting units lowered: LED ON Cutting units raised: LED OFF
NEUTRAL	Traction pedal in neutral: LED ON Traction pedal in forward or reverse: LED OFF
SEAT SWITCH	Operator seat occupied: LED ON Operator seat empty: LED OFF
HI RANGE	Mow speed limiter is in the transport (2WD) position: LED ON Mow speed limiter is in the mow (4WD) position: LED OFF
DECK RAISE	Console arm lift switch in RAISE position: LED ON Lift switch NOT in RAISE position: LED OFF
DECK LOWER	Console arm lift switch in LOWER position: LED ON Lift switch NOT in LOWER position: LED OFF
PTO ON	PTO switch ON: LED ON PTO switch OFF: LED OFF
OIL PRESSURE LOW	Engine not running OR low engine oil pressure: LED ON Engine oil pressure OK: LED OFF
FAN REVERSE	Fan switch in momentary REVERSE position: LED ON Fan switch in AUTO position: LED OFF
ALTERNATOR FAULT	Engine not running or alternator faulty: LED ON Alternator OK: LED OFF
FRONT BACKLAP	Front reels in backlap position: LED ON Front reels NOT in backlap position: LED OFF
HYDRAULIC TEMP	Hydraulic temperature, switch and circuit wiring OK: LED ON Hydraulic temperature, switch or circuit wiring faulty: LED OFF
COOLANT TEMP	Engine coolant temperature, switch and circuit wiring OK: LED ON Coolant temperature, switch or circuit wiring faulty: LED OFF
REAR BACKLAP	Rear reels in backlap position: LED ON Rear reels NOT in backlap position: LED OFF
KEY START	Ignition switch in START: LED ON Ignition switch in ON or OFF: LED OFF
KEY RUN	Ignition switch in ON or START: LED ON Ignition switch in OFF: LED OFF

NOTE: When the ignition switch is in the OFF position, all Diagnostic Display LED’s should be OFF.

Verify Diagnostic Display Output Functions

The Diagnostic Display also has the ability to detect which output solenoids or relays are energized by the TEC controller(s). This is a quick way to determine if a machine malfunction is electrical or hydraulic.

NOTE: An open output (e.g. an unplugged connector or a broken wire) cannot be detected with the Diagnostic Display.

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

2. Remove plate in front of seat to allow access to wire harness loop–back connector. Locate wire harness and loop–back connector (Fig. 10). Carefully unplug loop–back connector from harness connector.

3. Connect the Diagnostic Display connector to the harness connector. Make sure correct overlay decal is positioned on the Diagnostic Display (Fig. 11).

4. Turn the ignition switch to the ON position.

NOTE: The **red** text on the Diagnostic Display overlay decal refers to input switches and the **green** text refers to TEC outputs.

5. The "outputs displayed" LED, on lower right column of the Diagnostic Display, should be illuminated. If "inputs displayed" LED is illuminated, press the toggle button on the Diagnostic Display to change the LED to "outputs displayed".

NOTE: It may be necessary to toggle between "inputs displayed" and "outputs displayed" several times to perform the following step. To change from inputs to outputs, press toggle button once. This may be done as often as required. **Do not press and hold toggle button**.

6. Sit on seat and attempt to operate the desired function of the machine. The appropriate output LED's should illuminate on the Diagnostic Display to indicate that the TEC controller is turning on that function. The GLOW PLUGS, HI RANGE and OK RUN outputs can be checked with the ignition switch in the ON position and the engine not running. For testing of the solenoid outputs (e.g. PTO 1, ENABLE, REAR REELS), the engine must be running.

A. If the correct output LED's do not illuminate, verify that the required input switches are in the necessary positions to allow that function to occur.

B. If the output LED's are on as specified, but the machine does not function properly, suspect a failed electrical component, an open in the tested circuit or a non-electrical problem (e.g. hydraulic component problem). Repair as necessary.

C. If each input switch is in the correct position and functioning correctly, but the output LED's are not correctly illuminated, this indicates a TEC controller problem. If this occurs, contact your Toro Distributor for assistance.

7. After output functions testing is complete, disconnect the Diagnostic Display connector from the harness connector and plug loop–back connector into wire harness. Secure access plate to frame.

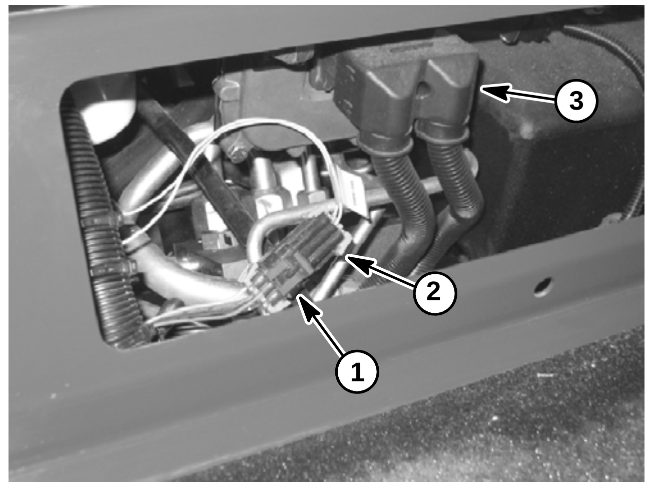


Figure 10

1. **Wire harness connector**
2. **Loop–back connector**
3. **TEC controller**

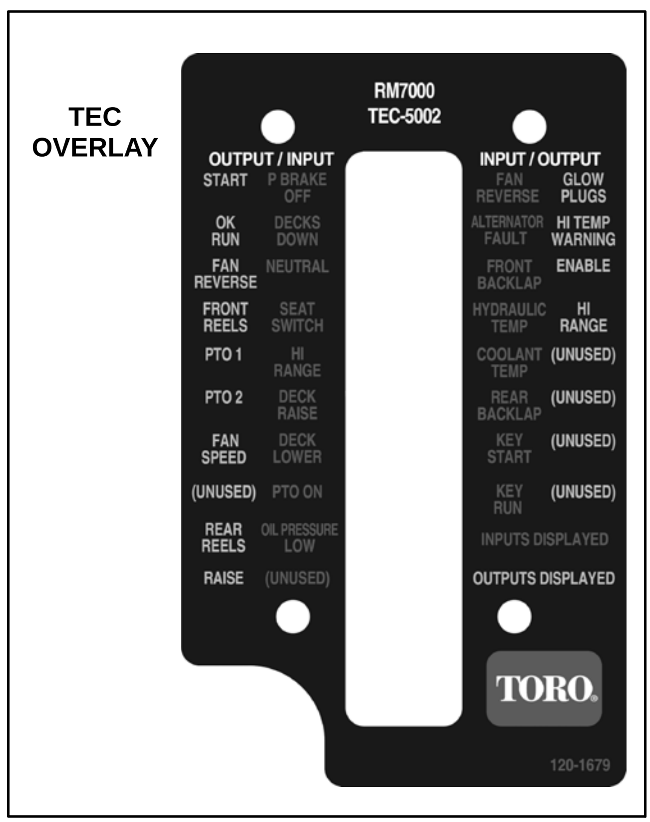


Figure 11

Starting Problems

Problem	Possible Causes
No electrical power to machine (including gauges).	Battery is discharged. Battery cables are loose or corroded. Ground connection on machine is loose or corroded. Fuse F3–1 (2 amp) is faulty (open). The ignition switch or circuit wiring is faulty.
Starter solenoid clicks, but starter will not crank. **NOTE:** If the solenoid clicks, the problem is **not** in the interlock circuit.	Battery is discharged. Battery cables are loose or corroded. Ground connection on machine is loose or corroded. Wiring at the starter is faulty. Starter solenoid is faulty. Starter is faulty.
Nothing happens when start attempt is made. Control panel lights and gauges operate with the ignition switch in ON.	The traction pedal is not in neutral position. Operator seat is unoccupied OR the parking brake is not applied. The PTO switch is ON (engaged). Fuse F1–1 (20 amp) is faulty (open). TEC fuses (F3–2, F3–3 or F3–4) are faulty. The traction neutral switch or circuit wiring is faulty. Seat switch or circuit wiring is faulty. Ignition switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. Start relay or circuit wiring is faulty. Starter solenoid or starter motor is faulty. TEC controller is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	The engine run solenoid or circuit wiring is faulty (solenoid pull coil operates but hold coil is faulty).

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Fuel tank is empty. Engine is not cranking fast enough. Engine and/or fuel may be too cold. Fuse F5–1 (40 amp) is faulty (open). Glow relay, glow plugs or fuse M1 (60 amp) are faulty. Engine run solenoid or circuit wiring is faulty. Fuel pump is faulty. Engine or fuel system is malfunctioning (see Chapter 3 – Kubota Diesel Engine).
Starter cranks, but should not when the traction pedal is depressed.	The traction neutral switch is out of adjustment. The traction neutral switch or circuit wiring is faulty.

General Run and Transport Problems

Engine continues to run, but should not, when the ignition switch is turned off.	The engine fuel stop solenoid is stuck open. Ignition switch or circuit wiring is faulty.
Engine continues to run, but should not, when the traction pedal is engaged with no operator in the seat.	The seat switch or circuit wiring is faulty. Traction neutral switch or circuit wiring is faulty.
The engine stops during operation, but is able to restart.	The operator is lifting off the seat. The seat switch or circuit wiring is faulty. The ignition switch or circuit wiring is faulty.
The engine kills when the traction pedal is depressed.	The operator is lifting off the seat. The parking brake is applied. The seat switch or circuit wiring is faulty. The parking brake switch or circuit wiring is faulty.
Battery does not charge.	Loose, corroded or broken wire(s) in charging circuit. The alternator is faulty. Battery is damaged.

Cutting Unit Operating Problems

Cutting units run, but should not, when raised. Cutting units shut off with PTO switch.	The cutting unit position switch or circuit wiring is faulty. Wire harness connections are incorrectly connected to hydraulic solenoid valve coils on hydraulic mow control manifold.
Cutting units run, but should not, when raised. Cutting units do not shut off with the PTO switch.	The cutting unit position switch or circuit wiring AND PTO switch or circuit wiring are faulty. A hydraulic problem exists (see Troubleshooting Section of Chapter 4 – Hydraulic System).
Cutting units run, but should not, when lowered with PTO switch in the OFF (disengage) position.	The PTO switch or circuit wiring is faulty.
Cutting unit(s) do not operate.	The cutting units are not fully lowered. The operator seat is unoccupied. Mow speed limiter is not in mow position (4WD). The PTO switch or circuit wiring is faulty. The cutting unit position switch or circuit wiring to the affected cutting unit(s) is faulty. Hydraulic solenoid valve coil(s) or circuit wiring to the affected cutting units is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 – Hydraulic System).
Cutting unit(s) operation is intermittent over rough terrain.	The cutting unit lift/lower switch or circuit wiring is faulty.

Electrical System Quick Checks

Battery Test (Open Circuit Test)

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

Set multimeter to the DC volts setting. The battery should be at a temperature of 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.

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

Use a digital multimeter set to DC volts. 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: 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 battery 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.

An 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

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of your Reelmaster glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive Ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to ON and record the multimeter results.

The Reelmaster glow plug system should have a reading of approximately nine (9) amps per glow plug (36 amps total). If low current reading is observed, one (or more) of the glow plugs is faulty.

Check Operation of Interlock Switches

CAUTION

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

Interlock switch operation is described in the Traction Unit Operator's Manual. Your Reelmaster is equipped with an Toro Electronic Controller (TEC) which monitors interlock switch operation. Testing of individual interlock switches and relays is included in the Component Testing section of this Chapter.

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

Adjustments

Mow/Transport Sensor

The mow/transport sensor is a normally open proximity sensor that closes when the mow speed limiter is placed in the transport position. The sensor mounts to a bracket on the footrest platform (Fig. 12). The sensing plate for the mow/transport sensor is a tab on the mow speed limiter.

Adjustment

1. The gap between the mow/transport sensor and the mow speed limiter should be from 0.040” to 0.100” (1.1 to 2.5 mm).

2. If gap is incorrect, loosen jam nuts that secure sensor to footrest platform. Position switch with jam nuts to allow correct gap between sensor and mow speed limiter. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **162 to 198 in–lb (18.4 to 22.4 N–m)**. After jam nuts are tightened, make sure that clearance between head of mow/transport sensor and the mow speed limiter has not changed.

3. After adjustment to the mow/transport sensor, use the Diagnostic Display (see Special Tools in this chapter) to verify that mow/transport sensor and circuit wiring are functioning correctly (see Mow/Transport Sensor in the Component Testing section of this chapter).

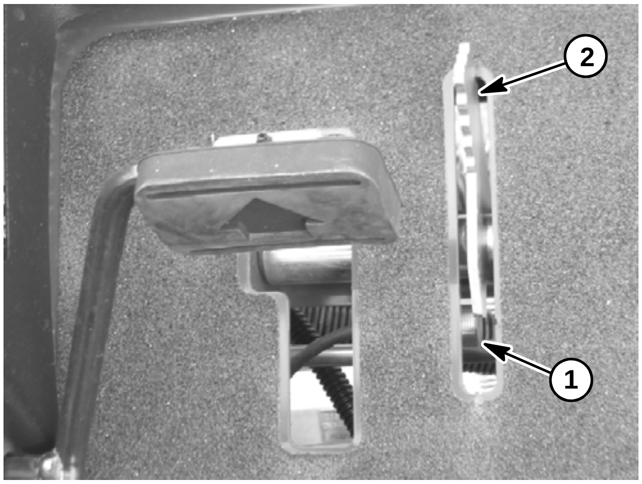


Figure 12

1. Mow/transport sensor
2. Mow speed limiter

Electrical System

Cutting Unit Position Sensor

The cutting unit position sensor is a normally open proximity sensor that is located on the front carrier frame (Fig. 13). The sensing plate that closes the sensor is a gusset on the front right cutting unit (#5) lift arm.

When the cutting units are lowered, the gusset on the lift arm is located near the position sensor and the sensor closes. This closed sensor provides an input for the TEC controller to allow the lowered cutting units to operate.

Adjustment

The gap between the cutting unit position sensor and the lift arm gusset should be 0.063" (1.6 mm). If distance is incorrect, loosen jam nuts that secure position sensor to bracket. Adjust sensor location with jam nuts to allow correct gap between sensor and lift arm gusset. Jam nuts should be torqued from **162 to 198 in-lb (18.4 to 22.4 N-m)**. After jam nuts are tightened, make sure that gap has not changed.

The vertical location of the cutting unit position sensor on the sensor bracket will determine the turn-around position of the cutting units. Raising the sensor on the bracket will allow a **higher** turn-around position of the cutting units. Lowering the sensor on the bracket will allow a **lower** turn-around position of the cutting units.

After adjustment to the position sensor, use the Diagnostic Display (see Special Tools in this chapter) to verify that cutting unit position sensor and circuit wiring **are** functioning correctly (see Cutting Unit Position Sensor in the Component Testing section of this chapter).

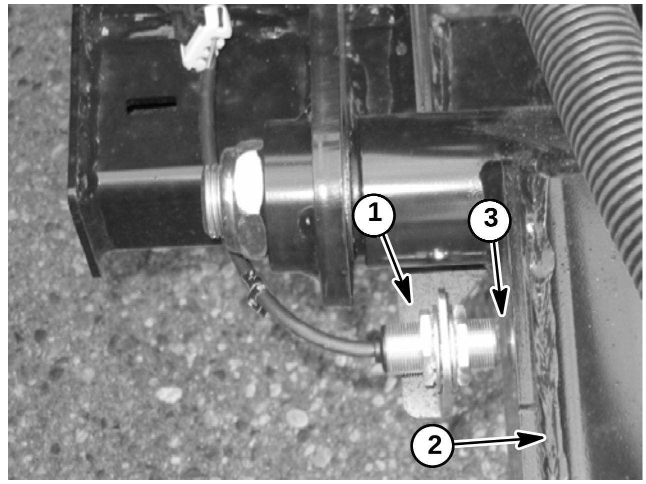


Figure 13

1. **Position sensor**
2. **#5 lift arm**
3. **Gap**

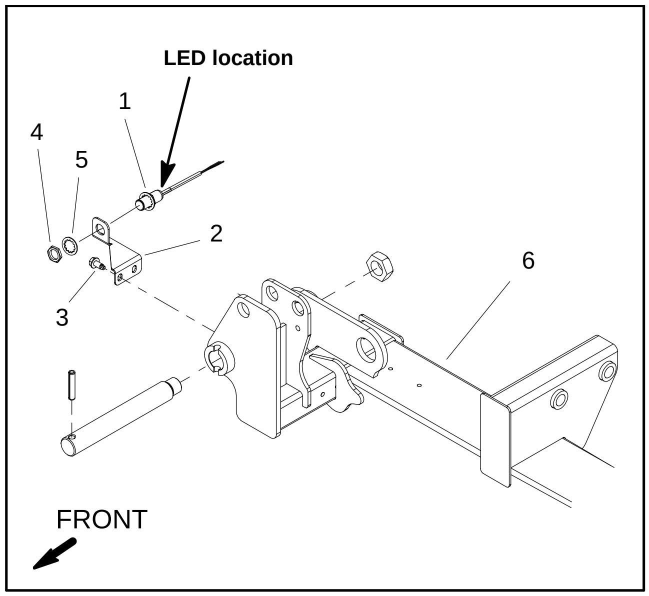


Figure 14

1. **Position sensor**
2. **Sensor bracket**
3. **Screw (2 used)**
4. **Jam nut (2 used)**
5. **Lock washer (2 used)**
6. **Front carrier frame**

Component Testing

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

NOTE: For engine component testing information, see the Kubota Workshop Manual, Diesel Engine, 03–M–DI–E3B.

CAUTION

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

Ignition Switch

The ignition (key) switch on the console arm has three (3) positions (OFF, ON/PREHEAT and START).

Testing

1. Before disconnecting the ignition switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the ignition switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the ignition switch and circuit wiring **are not** functioning correctly, proceed with test.

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

3. Disassemble console arm to gain access to ignition switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Disconnect wire harness electrical connector from the ignition switch.

5. The ignition switch terminals are identified as shown in Figure 16. The circuit logic of the ignition switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals. Replace switch if testing identifies that switch is faulty.

POSITION	CIRCUIT
OFF	NONE
ON/PREHEAT	B + C + F, D + E
START	A + B + C

6. If ignition switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

7. After testing is completed, connect the wire harness connector to the ignition switch.

8. Assemble console arm (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

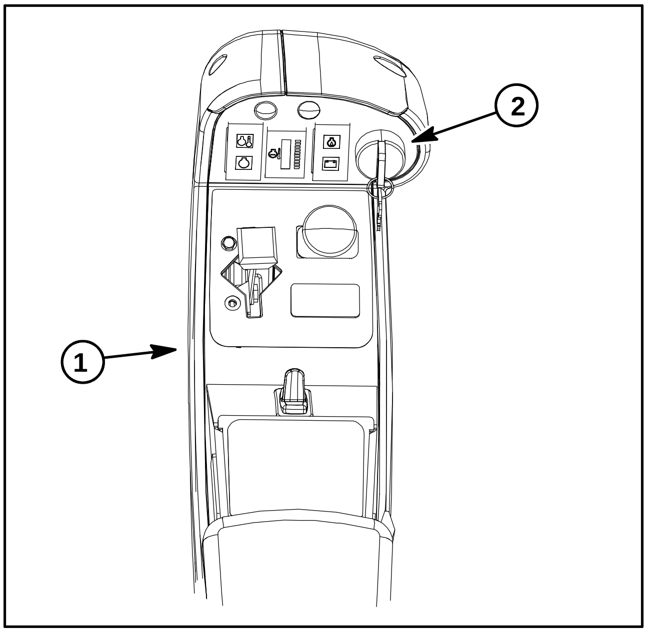


Figure 15

1. Console arm
2. Ignition switch

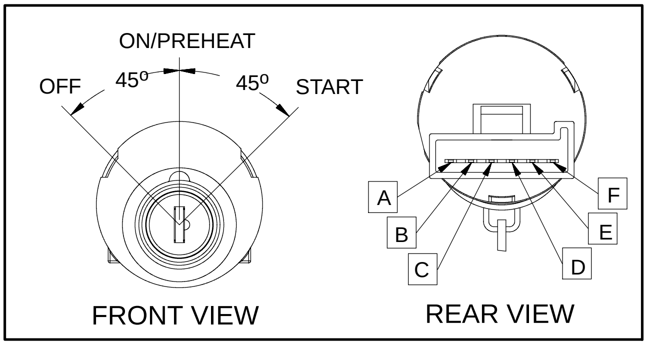


Figure 16

Electrical System

Fuses

Your Reelmaster 7000 uses numerous fuses for circuit protection. The fuses are located in two (2) areas of the machine. Most of the fuses reside in the power center behind the operator's seat. An in-line fuse holder located in the wire harness near the engine starter motor holds an additional fuse (F5-1) that protects the engine run solenoid pull coil circuit.

Fuse Identification and Function (Figs. 17 and 18)

Fuse F1-1 (20 Amp) protects power supply to engine starter motor circuit.

Fuse F1-2 position available for optional flow divider kit.

Fuse F1-3 position available for optional kit.

Fuse F1-4 position available for optional kit.

Fuse F2-1 (10 Amp) protects power supply to the light circuit.

Fuse F2-2 (10 Amp) protects power supply to the operator seat circuit.

Fuse F2-3 (10 Amp) protects power supply to the powerpoint.

Fuse F2-4 (10 Amp) protects power supply to the main power circuit.

Fuse F3-1 (2 Amp) protects logic power circuit to the TEC controller.

Fuse F3-2 (7.5 Amp) protects power supply to the TEC controller outputs.

Fuse F3-3 (7.5 Amp) protects power supply to the TEC controller outputs.

Fuse F3-4 (7.5 Amp) protects power supply to the TEC controller outputs.

Fuse M1 (60A) protects power supply to the glow plug circuit.

Fuse M2 position available for operator cab option.

Fuse F5-1 (in-line 40A) protects power supply for the engine run solenoid pull coil.

Fuse Testing

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

2. Remove power center cover from operator platform to access fuses.

3. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals.

4. After fuse testing is completed, install and secure power center cover.

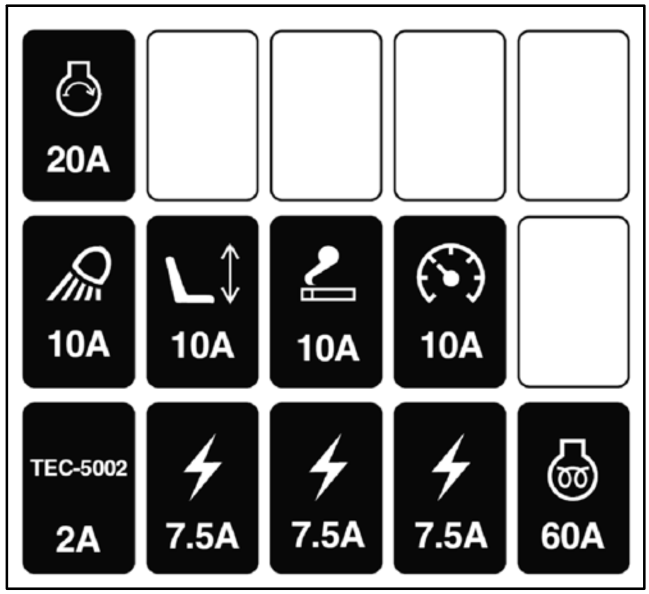


Figure 17

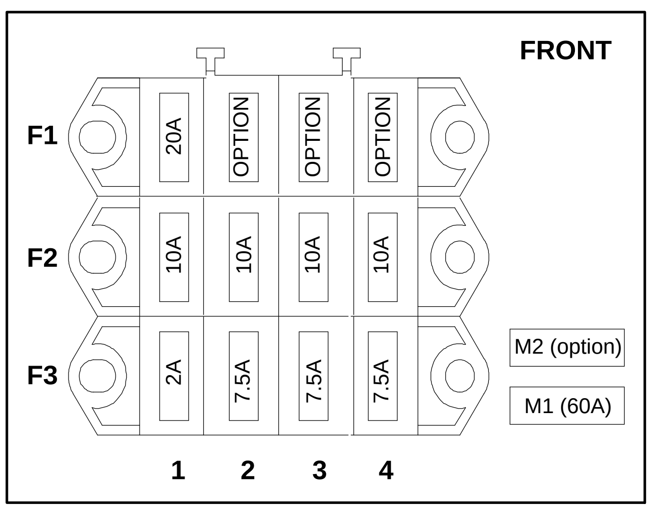


Figure 18

Indicator Lights

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in ON with the engine not running or with an improperly operating charging circuit while the engine is running.

To test the charge indicator light and circuit wiring, ground the white wire attached to alternator. Turn ignition switch to ON; the charge indicator light should illuminate indicating correct operation of the electrical wiring to the alternator.

Engine Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running if the engine oil pressure drops below 7 PSI (0.5 kg/cm^2).

To test the oil pressure light and circuit wiring, ground the green wire attached to oil pressure switch located on right side of engine near the starter motor. Turn ignition switch to ON; the oil pressure light should illuminate indicating correct operation of the electrical wiring to the oil pressure switch.

High Temperature Warning Light

If the engine coolant temperature rises to approximately 220^{o}F (105^{o}C), the high temperature light should come on and the PTO (cutting units) will disengage.

To test the high temperature shutdown light and circuit wiring, start the engine and ground the gray wire attached to the temperature sender attached to water flange on engine (see Temperature Sender in this section). Warning light should illuminate.

Glow Plug Indicator Light

The glow plug light should come on when the ignition switch is placed in ON/PREHEAT prior to placing the ignition switch in START. The light should stay lit for approximately seven (7) seconds while the ignition switch is left in ON.

Testing Indicator Lights

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

2. Ground terminals 1B and 2B.

3. Both indicator lights should light.

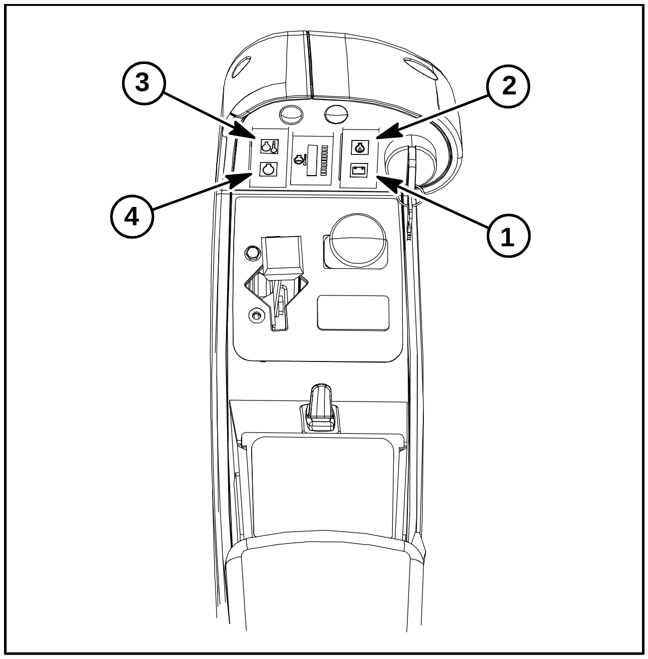


Figure 19

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

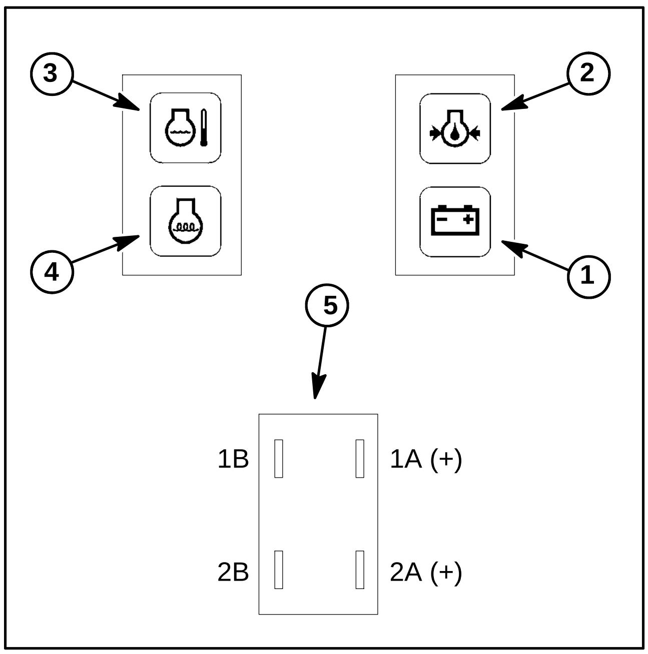


Figure 20

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

Hour Meter

The hour meter is located on the outside of the console arm.

1. Connect the positive (+) terminal of a 12 VDC source to the positive (+) terminal of the hour meter.

2. Connect the negative (–) terminal of the voltage source to the other terminal of the hour meter.

3. The hour meter should move a 1/10 of an hour in six (6) minutes.

4. Disconnect voltage source from the hour meter.

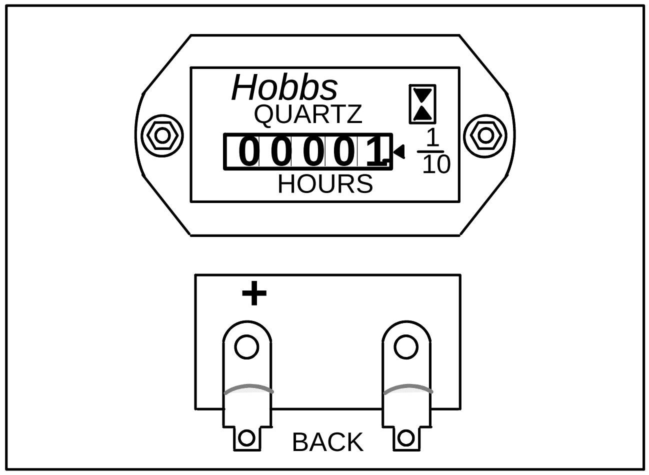


Figure 21

Temperature Gauge

The temperature gauge on the control panel indicates engine coolant temperature level during machine operation (Fig. 22). The changing resistance of the engine temperature sender signals the temperature gauge.

The temperature gauge should display the first green segment when the ignition switch is turned to ON. The first yellow segment on the gauge should display when engine coolant temperature is approximately 212°F (100°C).

When engine coolant temperature rises to approximately 221°F (105°C), the temperature gauge should display the first red segment.

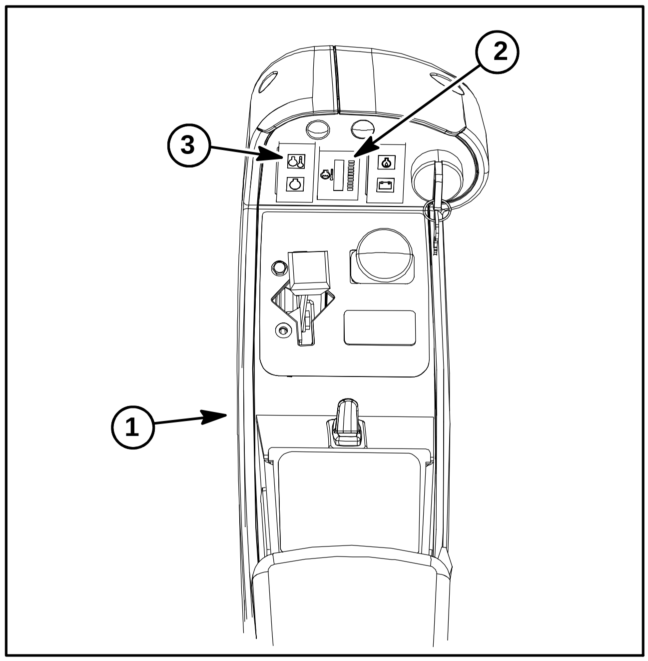


Figure 22

1. **Console arm**
2. **Temperature gauge**
3. **High temp indicator**

PTO Switch

The PTO switch is located on the console arm (Fig. 23). The PTO switch is pulled up to engage the PTO and pushed in to disengage the PTO.

NOTE: To engage the PTO, the seat has to be occupied, traction speed has to be in low range (4WD) and the cutting units have to be fully lowered.

Testing

1. Before disconnecting the PTO switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the PTO switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the PTO switch and circuit wiring **are not** functioning correctly, proceed with test.

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

3. Disassemble console arm to gain access to PTO switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Disconnect harness electrical connector from the PTO switch.

5. The switch terminals are marked as shown in Figure 24. The circuit logic of the PTO switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals. Replace switch if testing identifies that switch is faulty.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
OFF (DOWN)	COM B + NC B COM C + NC C	COM B + NO B COM C + NO C
ON (UP)	COM B + NO B COM C + NO C	COM B + NC B COM C + NC C

6. If PTO switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

7. After testing is completed, connect the wire harness connector to the PTO switch.

8. Assemble console arm (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

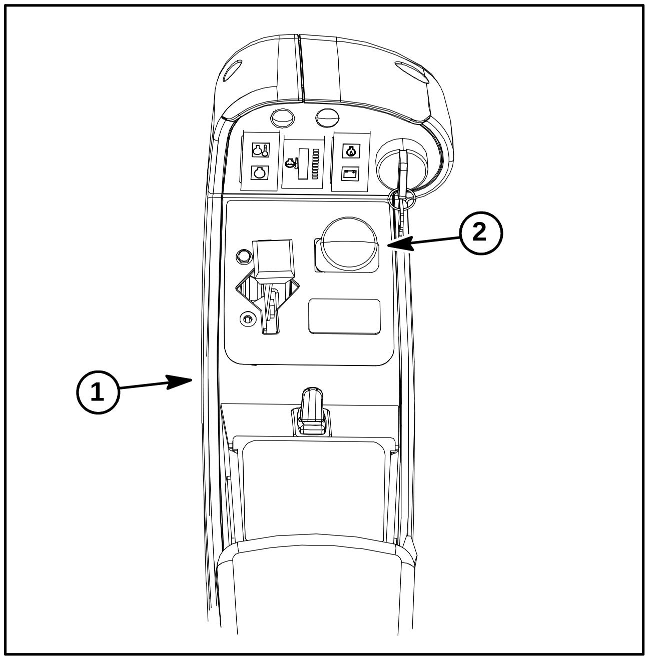


Figure 23

1. **Console arm**
2. **PTO switch**

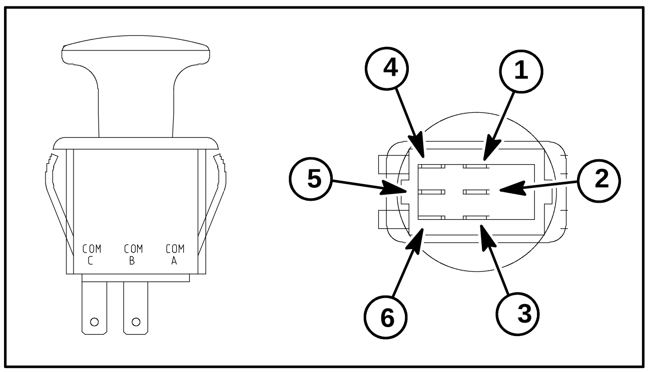


Figure 24

1. **COM B terminal**
2. **NO B terminal**
3. **NC B terminal**
4. **COM C terminal**
5. **NO C terminal**
6. **NC C terminal**

Cutting Unit Lift Switch

The cutting unit lift switch is used as an input for the TEC controller to raise or lower the cutting units. When the lift switch paddle is depressed and held, the cutting units will lower. When the lift switch paddle is raised and held, the cutting units will raise. The cutting units will remain in position when the switch is released. The lift switch is located on the console arm (Fig. 25).

NOTE: To lower the cutting units, the mow speed limiter has to be in mow range (4WD). Also, to raise or lower the cutting units, the seat has to be occupied.

Testing

1. Before disconnecting the lift switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the lift switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the lift switch and circuit wiring **are not** functioning correctly, proceed with test.

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

3. Disassemble console arm to gain access to cutting unit lift switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Disconnect harness electrical connector from the lift switch.

5. The switch terminals are marked as shown in Figure 27. The circuit logic of the lift switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals. Replace switch if testing identifies a faulty switch.

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
LOWER	2 + 1 6 + 5	2 + 4 6 + 8
NEUTRAL	NONE	ALL
RAISE	2 + 4 6 + 8	2 + 1 6 + 5

6. If lift switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

7. After testing is completed, connect wire harness connector to the lift switch.

8. Assemble console arm (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

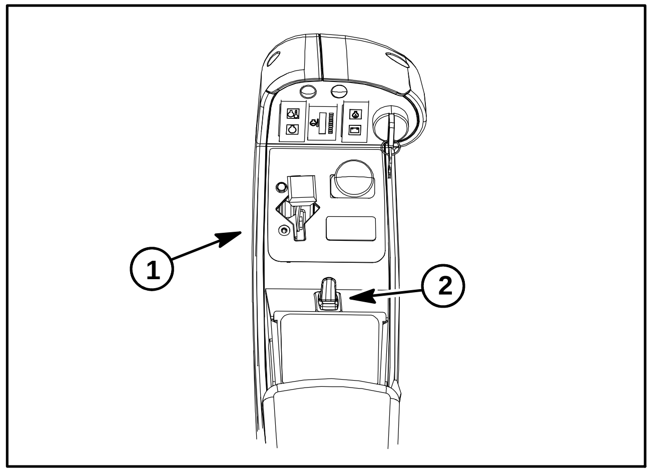


Figure 25

1. **Console arm**
2. **Lift switch**

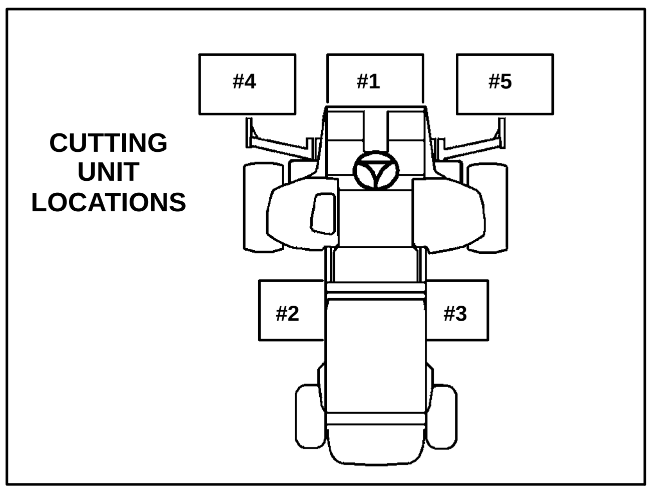


Figure 26

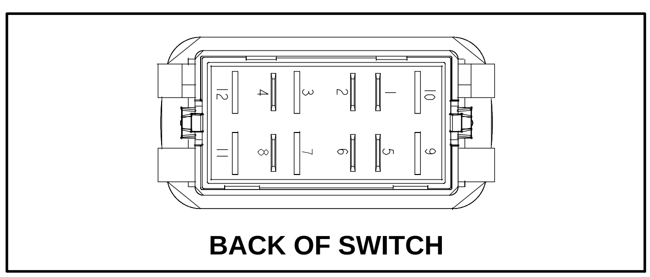


Figure 27

NOTE: Lift switch terminals 5, 6 and 8 are not used on Reelmaster 7000 machines.

Headlight Switch

The headlight switch is located on the operator side of the console arm (Fig. 28). This two (2) position rocker switch allows the headlights to be turned on and off.

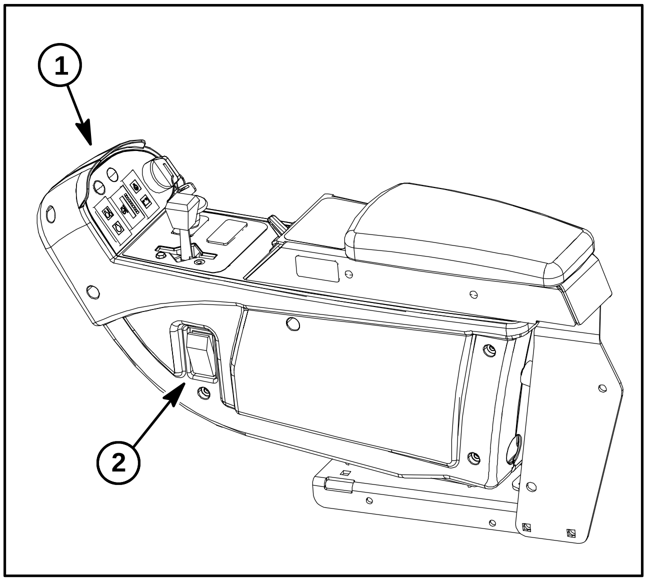


Figure 28

1. Console arm 2. Headlight switch

Testing

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

2. Disassemble console arm to gain access to headlight switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

3. Disconnect harness electrical connector from the switch.

4. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each switch position. The switch terminals are marked as shown in Figure 29. The circuitry of the switch is shown in the chart below. Verify continuity between switch terminals. Replace headlight switch if testing identifies a faulty switch.

SWITCH POSITION	CIRCUIT 1	CIRCUIT 2
ON	2 + 3	5 + 6
OFF	2 + 1	5 + 4

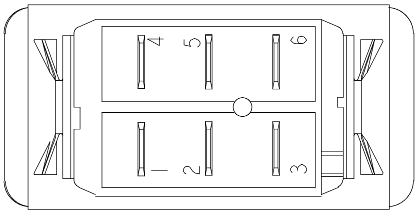


Figure 29

NOTE: Headlight switch terminals 1, 4, 5 and 6 are not used on Reelmaster 7000 machines.

5. If headlight switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

6. After testing is completed, connect wire harness connector to the headlight switch.

7. Assemble console arm (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Electrical System

Engine Cooling Fan Switch

The engine cooling fan switch is located on the outside of the console arm (Fig. 30). This two (2) position rocker switch allows the engine cooling fan to run in the normal, automatic mode or in the manual reverse (momentary) direction.

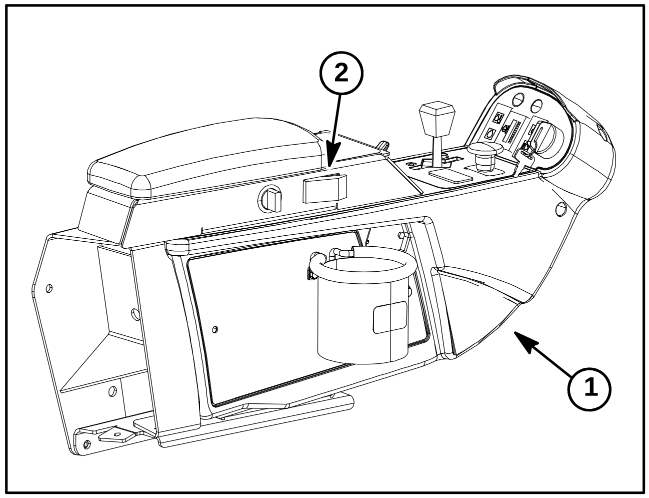
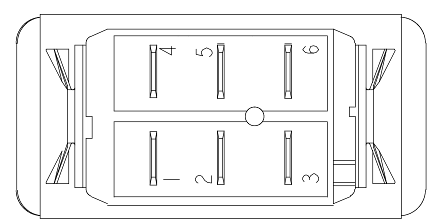


Figure 30

1. Console arm
2. Cooling fan switch



BACK OF SWITCH

Figure 31

NOTE: Cooling fan switch terminals 3, 4, 5 and 6 are not used on Reelmaster 7000 machines.

Testing

1. Before disconnecting the engine cooling fan switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that cooling fan switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that cooling fan switch and circuit wiring **are not** functioning correctly, proceed with test.

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

3. Disassemble console arm to gain access to the engine cooling fan switch (see Console Arm Disassembly in the Service and Repairs section of Chapter 7 – Chassis).

4. Disconnect harness electrical connector from the cooling fan switch.

5. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. The switch terminals are marked as shown in Figure 31. The circuitry of the cooling fan switch is shown in the chart below. Verify continuity between switch terminals.

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
AUTO	2 + 3	5 + 6
MANUAL REVERSE	2 + 1	5 + 4

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

7. After testing is completed, connect wire harness connector to the cooling fan switch.

8. Assemble console arm (see Console Arm Assembly in the Service and Repairs section of Chapter 7 – Chassis).

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch and its electrical connector are located in the seat assembly. If the traction system or PTO switch is engaged when the operator raises out of the seat, the engine will stop. Testing of the switch can be done without seat removal by disconnecting the switch wire from the machine wire harness (Fig. 32).

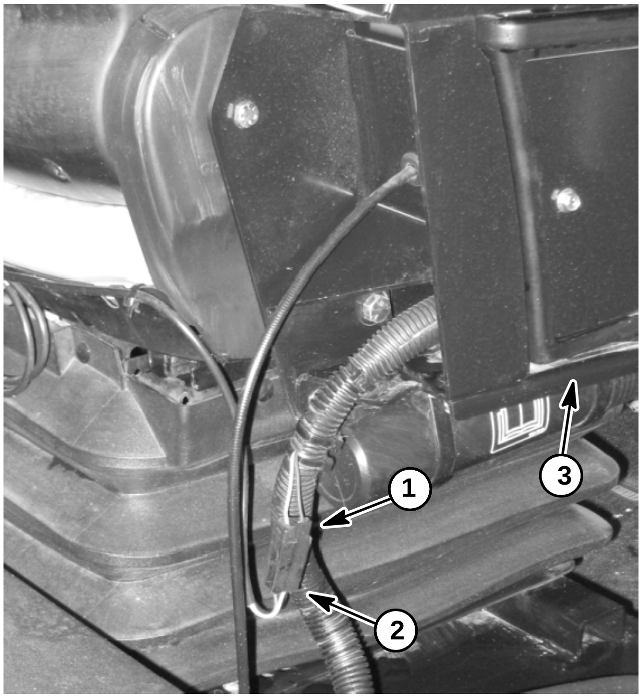


Figure 32

1. **Wire harness connector**
2. **Seat switch connector**
3. **Console arm**

Testing

1. Before disconnecting the seat switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the seat switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the seat switch and circuit wiring **are not** functioning correctly, proceed with test.

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

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

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

5. With no pressure on the seat, there should be no continuity between the seat switch terminals.

6. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

7. 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).

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

Parking Brake Switch

The parking brake switch is a normally open proximity switch. The parking brake switch is attached to the bottom of the RH brake pedal (Fig. 33).

When the parking brake is not applied, the parking brake detent is positioned near the target end of the parking brake switch so the switch is closed. The parking brake detent is moved away from the switch when the parking brake is applied causing the switch to open.

Switch Testing

1. Park machine on a level surface, lower cutting units, stop engine.

2. Before disconnecting the parking brake switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the brake switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the brake switch and circuit wiring **are not** functioning correctly, proceed with test.

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

4. Disconnect wire harness electrical connector from the parking brake switch.

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

6. When the parking brake is released (brake not applied), there should be continuity (closed) between the switch terminals.

7. When the parking brake pedal is depressed (brake applied), there should not be continuity (open) between the switch terminals.

NOTE: When installing the parking brake switch to the brake pedal, place switch plate tab into switch mounting hole that is closest to target end of switch (Fig. 34).

8. Replace parking brake switch if testing determines that it is faulty.

9. After testing is complete, connect wire harness electrical connector to the parking brake switch.

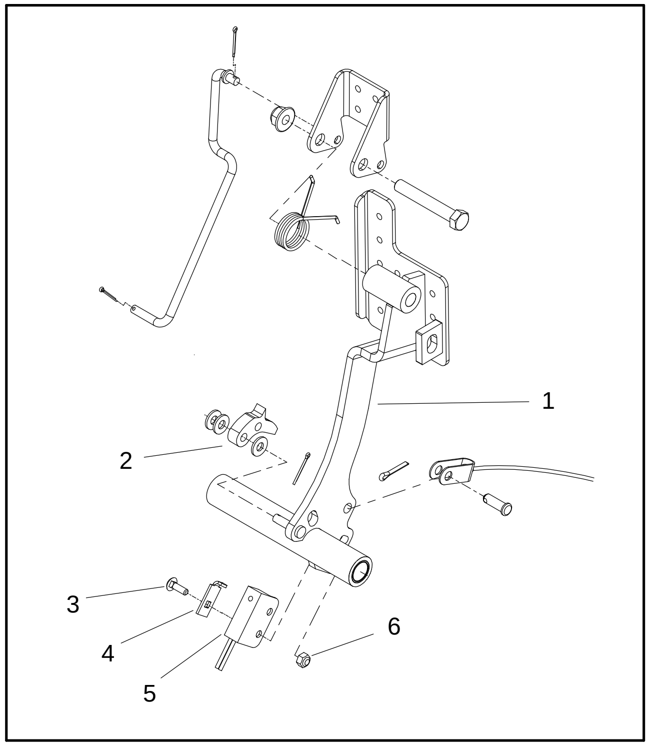


Figure 33

1. **RH brake pedal**
2. **Brake detent**
3. **Carriage screw**
4. **Switch plate**
5. **Parking brake switch**
6. **Lock nut**

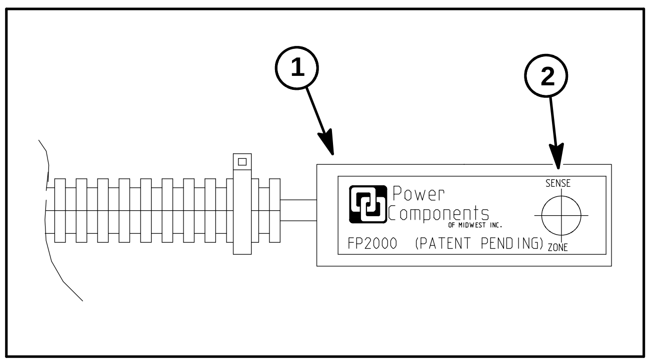


Figure 34

1. **Parking brake switch**
2. **Switch target area**

Mow/Transport Sensor

The mow/transport sensor is a normally open proximity sensor that closes when the mow speed limiter is placed in the transport (2WD) position. The sensor mounts to a bracket on the footrest platform. The sensing plate for the mow/transport sensor is the mow speed limiter. The mow/transport sensor is used as an input for the TEC controller.

Sensor Testing

1. Before disconnecting the mow/transport sensor for testing, the sensor and its circuit wiring should be tested as a TEC controller input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the mow/transport sensor and circuit wiring **are** functioning correctly, no further sensor testing is necessary. If, however, the Diagnostic Display determines that the mow/transport sensor and circuit wiring **are not** functioning correctly, proceed with testing procedure.

2. Turn ignition switch to the ON position (do not start engine) and check LED on cable end of mow/transport sensor (Fig. 35). LED **should be** illuminated when the mow speed limiter is in the TRANSPORT (2WD) position. The LED **should not be** illuminated when the limiter is in the MOW (4WD) position.

3. If the mow/transport sensor LED did not function correctly:

A. Make sure that the mow/transport sensor is properly adjusted (see Mow/Transport Sensor in the Adjustments section of this chapter). If necessary, adjust sensor and return to step 2 above.

B. Make sure ignition switch is OFF and disconnect the mow/transport sensor connector from machine wire harness.

C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

E. If black wire is closed to ground, pink wire has system voltage present and sensor LED did not function, replace mow/transport sensor. Adjust sensor after installation (see Mow/Transport Sensor in the Adjustments section of this chapter).

4. If the mow/transport sensor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

5. Make sure that mow/transport sensor is connected to wire harness when testing is complete.

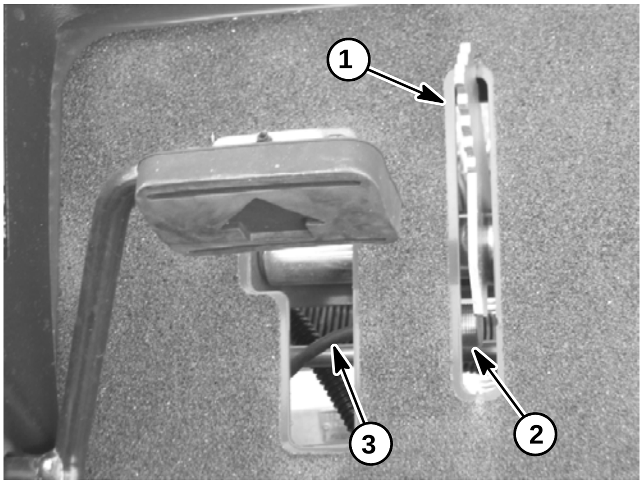


Figure 35

1. **Mow speed limiter**
2. **Mow/transport sensor**
3. **Sensor cable**

Cutting Unit Position Sensor

The cutting unit position sensor is a normally open proximity sensor that is located on the traction unit frame (Fig. 36). The sensing plate that closes the sensor is a gusset on the front right cutting unit (#5) lift arm.

When the cutting units are lowered, the gusset on the lift arm is located near the position sensor and the sensor closes. This closed sensor provides an input for the TEC controller to allow the lowered cutting units to operate.

Sensor Testing

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

2. Before disconnecting the cutting unit position sensor for testing, the sensor and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the position sensor and circuit wiring **are** functioning correctly, no further sensor testing is necessary. If, however, the Display determines that the position sensor and circuit wiring **are not** functioning correctly, proceed with test.

3. Turn ignition switch to the ON position and check LED on cable end of cutting unit position sensor (Fig. 36). LED **should be** illuminated when the cutting units are fully lowered. The LED **should not be** illuminated when the cutting units are raised above the turn–around position.

4. If the position sensor LED did not function correctly:

    A. Make sure that the cutting unit position sensor is properly adjusted (see Cutting Unit Position Sensor in the Adjustments section of this chapter). If necessary, adjust sensor and return to step 2 above.

    B. Make sure ignition switch is OFF and disconnect the cutting unit position sensor connector from machine wire harness.

    C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

    D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

    E. If black wire is closed to ground, pink wire has system voltage present and sensor LED did not function, replace cutting unit position sensor. Adjust sensor after installation (see Cutting Unit Position Sensor in the Adjustments section of this chapter).

5. If the cutting unit position sensor tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

6. Make sure that cutting unit position sensor is connected to wire harness when testing is complete.

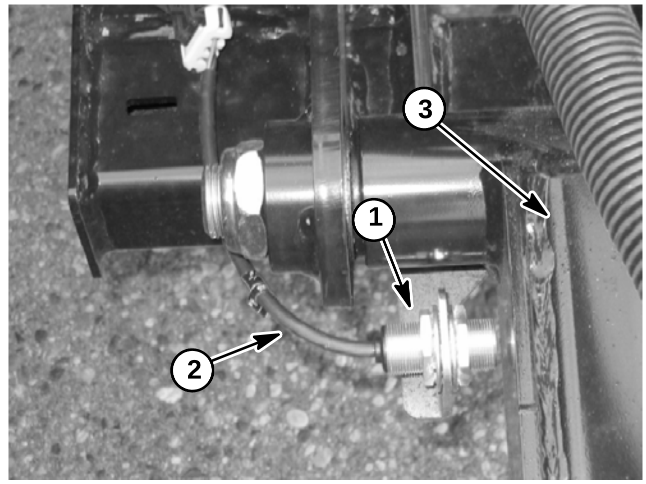


Figure 36

1. Position sensor
2. Sensor cable
3. Lift arm (#5)

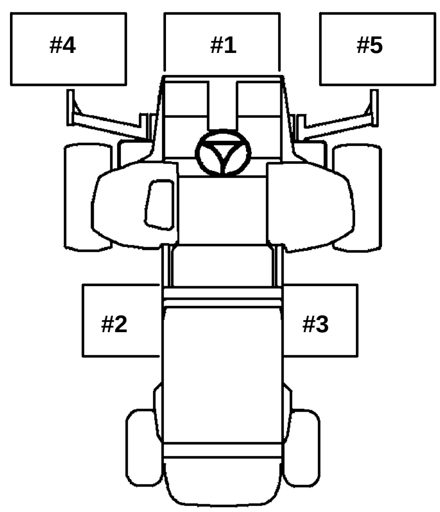


Figure 37

Backlap Switches

The backlap switches are normally open ball switches that are in the normal, open state when the backlap levers are in the mow position. When a backlap lever is in the backlap position, the switch closes. The backlap switches are attached to the hydraulic mow control manifold located under the hood (Fig. 38). The Toro Electronic Controller (TEC) uses the backlap switches as inputs.

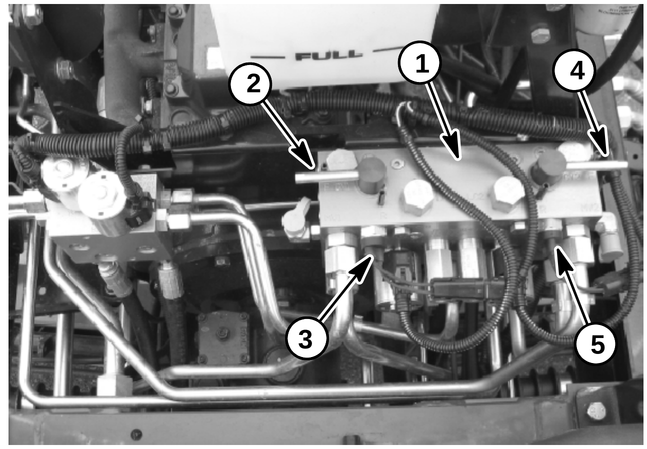


Figure 38

1. **Mow control manifold**
2. **Front backlap lever**
3. **Front backlap switch**
4. **Rear backlap lever**
5. **Rear backlap switch**

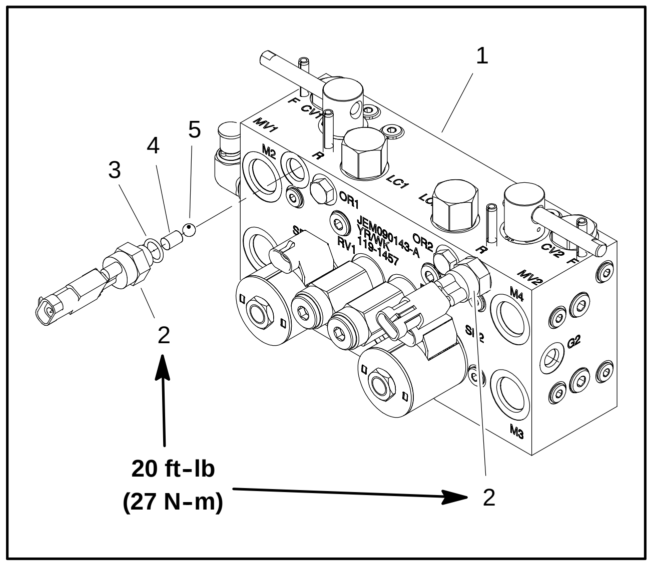


Figure 39

1. **Mow control manifold**
2. **Backlap switch (2 used)**
3. **O–ring**
4. **Dowel**
5. **Ball**

Testing

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

2. Before disconnecting a backlap switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the backlap switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that the backlap switch and circuit wiring **are not** functioning correctly, proceed with test.

3. Make sure ignition switch is in the OFF position.

4. Unlatch and raise hood to allow access to hydraulic mow control manifold. Locate the backlap switch on the front of the manifold. Disconnect the harness electrical connector from the backlap switch.

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

6. With the ignition switch in the OFF position, turn the backlap lever to the backlap position while watching the multimeter. Continuity should be made as the switch closes.

7. Turn the backlap lever to the mow position while watching the multimeter. Continuity should be broken as the switch opens.

8. If backlap switch is faulty, replace switch (Fig. 39).

9. If the backlap switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 9 – Foldout Drawings).

10. After testing is completed, connect harness electrical connector to the backlap switch. Lower and secure hood.

Glow and Main Power Relays

The glow and main power relays are located at the power center behind the operator seat (Fig. 40). These relays are attached to the wire harness with a four (4) wire connector (Fig. 41).

The glow relay is used to provide current to the engine glow plugs when energized by the TEC controller. The TEC controls and monitors the operation of the glow relay.

The main power relay is used to provide current to the TEC controllers and most of the fuse protected circuits (headlights, operator seat, power point and optional electric equipment). When the ignition switch is in the ON or START position, the main power relay is energized.

Testing

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

2. To make sure that machine operation does not occur unexpectedly, disconnect negative (–) cable from battery and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter).

3. Remove cover from power center and locate relay to be tested.

4. Disconnect wire harness connector from relay. Remove relay from mounting bracket for testing.

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

5. Using a multimeter, verify that coil resistance between terminals 86 and 85 is approximately 72 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 and test leads from the relay terminals.

8. Secure relay to mounting bracket and connect wire harness connector to relay. Install cover to power center.

9. Connect positive (+) cable to battery and then connect negative (–) cable to battery (see Battery Service in the Service and Repairs section of this chapter).

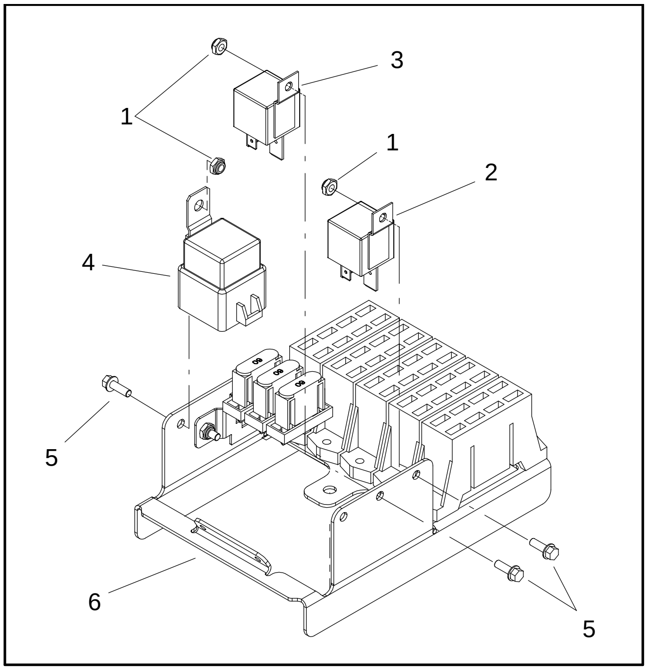


Figure 40

1. **Lock nut**
2. **Main power relay**
3. **Glow relay**
4. **Start relay**
5. **Flange head screw**
6. **Mounting bracket**

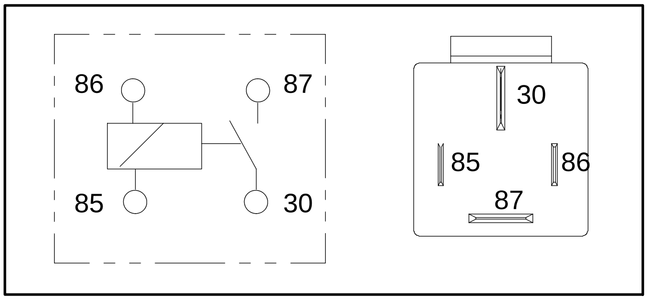


Figure 41

Start Relay

The start relay is located at the power center behind the operator seat (Fig. 42). This relay is attached to the wire harness with a five (5) wire connector (Fig. 43).

The start relay is used to provide current to the engine starter motor when energized by the TEC controller. The TEC controls and monitors the operation of the start relay.

Testing

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

2. To make sure that machine operation does not occur unexpectedly, disconnect negative (–) cable from battery and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter).

3. Remove cover from power center and locate start relay.

4. Disconnect wire harness connector from relay. Remove relay from mounting bracket for testing.

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

10. Secure relay to mounting bracket and connect wire harness connector to relay. Install cover to power center.

11. Connect positive (+) cable to battery and then connect negative (–) cable to battery (see Battery Service in the Service and Repairs section of this chapter).

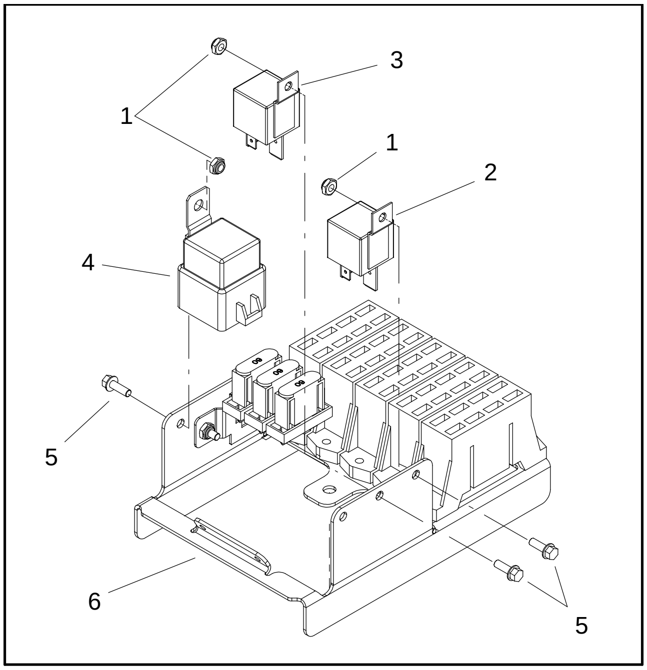


Figure 42

1. **Lock nut**
2. **Main power relay**
3. **Glow relay**
4. **Start relay**
5. **Flange head screw**
6. **Mounting bracket**

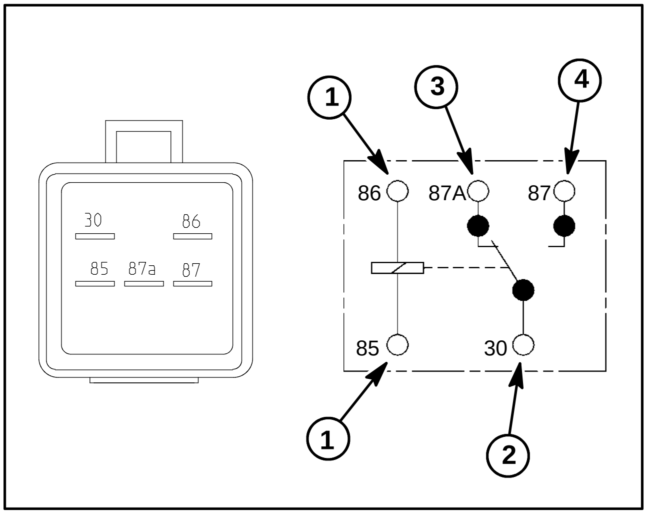


Figure 43

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

Electrical System

Reel Speed Potentiometer

The reel speed potentiometer controls the cutting reel speed. The TEC controller uses the potentiometer setting as an input to determine the necessary voltage output for the hydraulic mow control manifold proportional valves (SP1 and SP2) for correct cutting reel speed. The reel speed potentiometer is located under the operator seat (Fig. 44).

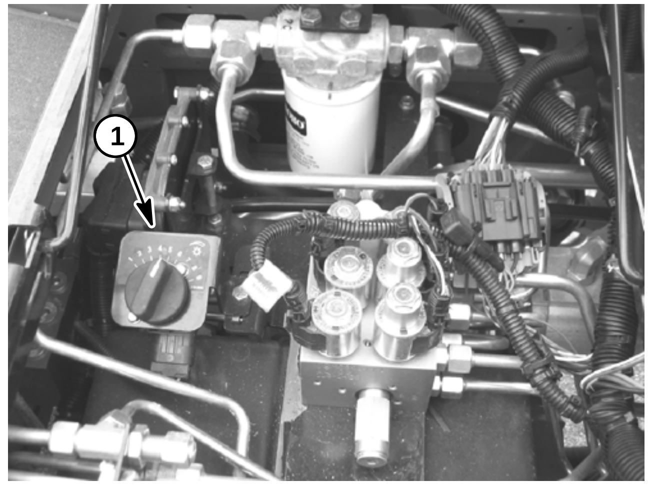


Figure 44

1. **Reel speed potentiometer**

Testing

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

2. Raise and support operator seat to gain access to reel speed potentiometer.

3. Carefully unplug wire harness connector from reel speed potentiometer.

4. Remove screw that secures potentiometer to machine and remove potentiometer from machine for testing.

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

5. Using a multimeter, measure resistances between potentiometer terminals as follows (Fig. 45):

   A. Verify that resistance between terminals B and C is approximately 5000 ohms. Record measured resistance.

   B. Measure resistance between terminals A and C and then measure resistance between terminals A and B. Record these resistances. The total of the two measured resistances should be approximately 5000 ohms.

   C. Rotate the reel speed potentiometer to other settings and repeat step 6. The total of the two resistances should consistently be approximately 5000 ohms.

   D. If measured resistances are incorrect, replace reel speed potentiometer.

6. After testing is completed, secure potentiometer to machine frame. Secure wire harness connector to potentiometer. Lower and secure seat.

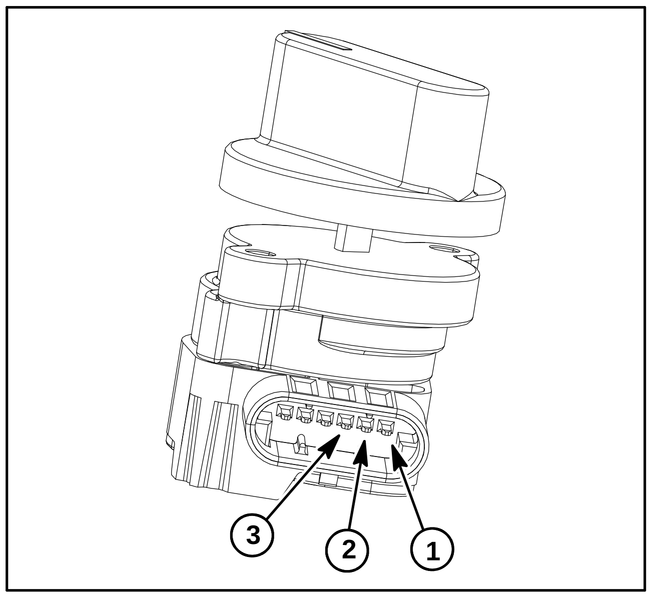


Figure 45

1. **Terminal A**
2. **Terminal B**
3. **Terminal C**

Hydraulic Solenoid Valve Coils

Numerous hydraulic solenoid valve coils are used on the hydraulic control manifolds of Reelmaster 7000 machines. When energized by the TEC controller, these coils provide hydraulic circuit control.

Two (2) different solenoid valve coils are used on the Reelmaster 7000. A coil can be identified by measuring it's height and diameter (Fig. 46). Testing of the coils can be done with the coil remaining on the hydraulic valve.

NOTE: To assist in troubleshooting, identical 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. switch, circuit wiring, hydraulic problem).

Testing

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

2. Locate hydraulic valve solenoid coil to be tested. Identify coil by measuring the coil diameter and coil height (Fig. 46).

3. Disconnect wire harness connector from coil.

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

COIL DIAMETER	COIL HEIGHT	COIL RESISTANCE
1.840 inch (46.7 mm)	1.960 inch (49.9 mm)	7.1 ohm
1.410 inch (35.8 mm)	1.430 inch (36.3 mm)	8.8 ohm

NOTE: Solenoid coil resistance should be measured with solenoid at approximately 68°F (20°C). Resistance may be slightly different than listed at different temperatures. Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

5. If solenoid coil resistance is incorrect, replace solenoid (see Hydraulic Solenoid Valve Coil Removal and Installation in the Service and Repairs section of this chapter).

6. After testing is completed, connect wire harness connector to the solenoid coil.

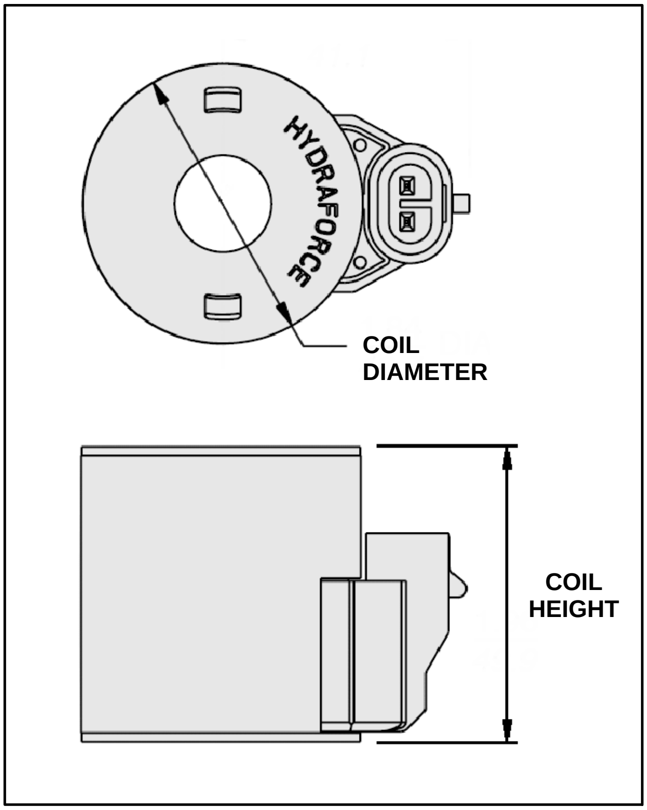


Figure 46

Traction Neutral Switch

The traction neutral switch is closed when the traction pedal is in the neutral position and opens when the pedal is depressed in either direction. The switch is located on the right side of the piston (traction) pump (Fig. 47).

Testing

Before disconnecting the traction neutral switch for testing, the switch and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that neutral switch and circuit wiring **are** functioning correctly, no further switch testing is necessary. If, however, the Display determines that neutral switch and circuit wiring **are not** functioning correctly, proceed with test.

To test the traction neutral switch, make sure that the ignition switch is in the OFF position and the key is removed from the switch. Disconnect the wire harness connector from the neutral switch and connect a multimeter across the two (2) switch terminals. With the engine turned off, slowly push the traction pedal in a forward or reverse direction while watching the multimeter. There should be indications that the traction neutral switch is opening and closing. Allow the traction pedal to return to the neutral position. There should be continuity across the switch terminals when the traction pedal is in the neutral position.

See Piston Pump Control Assembly in Chapter 4 – Hydraulic Systems for disassembly and assembly procedures for the neutral switch.

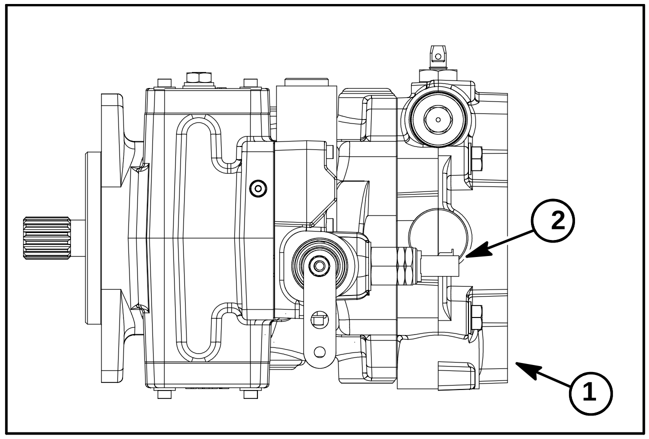


Figure 47

1. **Piston (traction) pump**
2. **Neutral switch**

Diode Assembly

The engine wire harness contains a diode that is used for circuit protection from voltage spikes when the engine starter solenoid is de–energized. The diode plugs into the wiring harness near the starter motor (see Engine Wire Harness Drawing in Chapter 9 – Foldout Drawings).

Diode Test

The diode (Fig. 48) can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

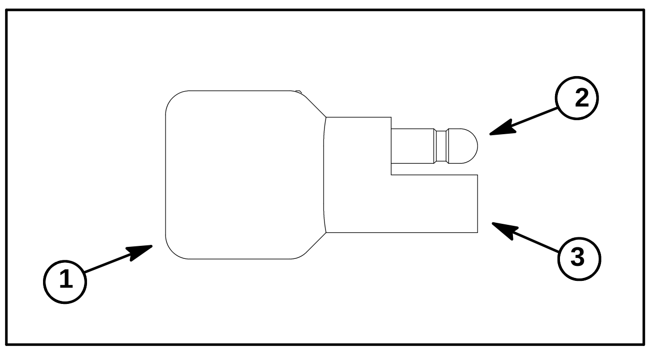


Figure 48

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (–) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Toro Electronic Controller (TEC)

The Reelmaster 7000 uses a Toro Electronic Controller (TEC) to monitor the condition of various switches (inputs) and then directs power output to allow certain machine functions. The controller is located under the operator seat (Fig. 49). The handheld Diagnostic Display (see Special Tools in this chapter) with the correct overlay should be used when checking inputs and outputs of the controller used on your Reelmaster (see Troubleshooting in this chapter).

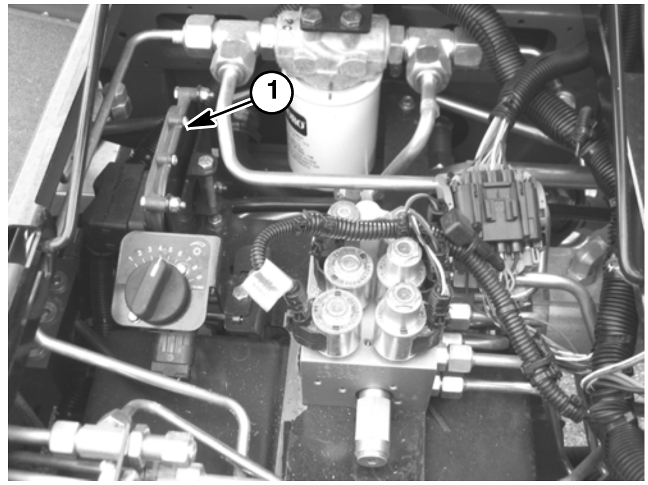


Figure 49

1. **TEC controller**

Logic power is provided to the controller as long as the battery cables are connected to the battery. A 2 amp fuse (F3- 1) provides circuit protection for this logic power to the controller.

Inputs from the ignition, traction neutral, parking brake, PTO, seat, cutting unit lift, mow/transport, engine cooling fan, backlap, reel position, hydraulic temperature, engine oil pressure and engine coolant switches are all monitored by the controller.

Current output to the mow circuit hydraulic valve solenoid coils, lift circuit hydraulic valve solenoid coils and engine components (glow plug relay, start relay, fuel pump and engine run solenoid) are controlled based on the inputs received by the controller. Circuit protection for the TEC outputs is provided by three (3) 7.5 amp fuses (F3- 2, F3- 3 and F3- 4).

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

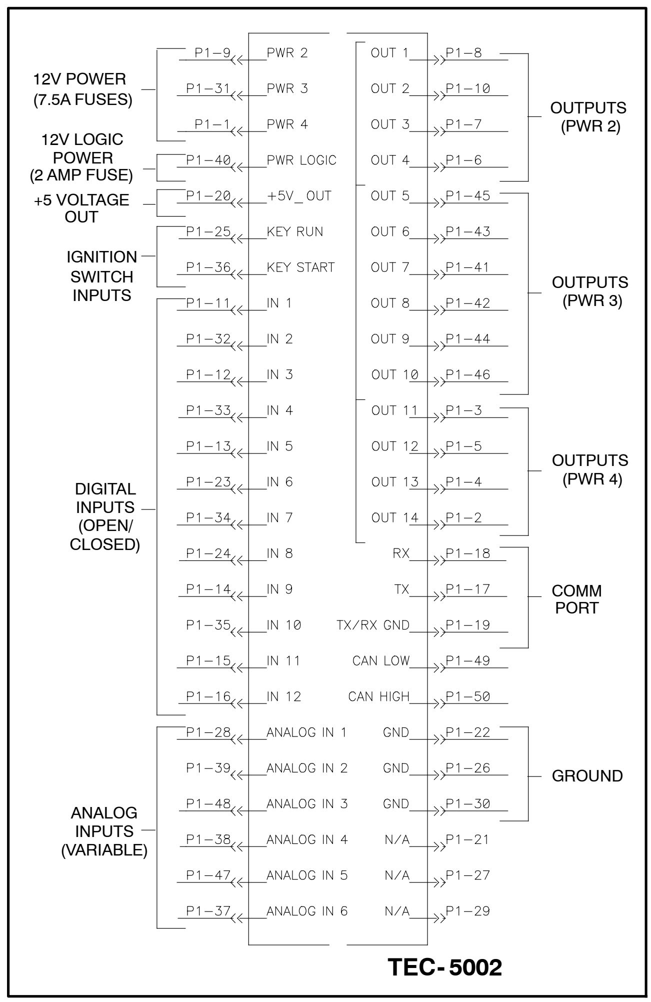


Figure 50

The machine electrical schematic and wire harness drawings in Chapter 9 - Foldout Drawings can be used to identify possible circuit problems between the controllers and the input/output devices (e.g. switches and solenoid coils). The connection terminal functions for the TEC controller is shown in Figure 50.

Because of the solid state circuitry built into the controller, there is no method to test the controller directly. The controller may be damaged if an attempt is made to test it with an electrical test device, such as a digital multimeter.

IMPORTANT: Before performing any welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC controller and disconnect the terminal connector from the alternator. This will prevent damage to the electrical system of your Reelmaster.

Engine Coolant and Hydraulic Oil Temperature Senders

Two (2) identical temperature senders are used as inputs for the TEC controller to identify if either the engine coolant or hydraulic oil temperature has reached an excessive level. The coolant temperature sender threads into the radiator (Fig. 50). The hydraulic oil temperature sender is attached to the 4WD/2WD control manifold at the front of the machine (Fig. 51).

Testing

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

2. Before disconnecting temperature sender for testing, the sender and its circuit wiring should be tested as a TEC input with the Diagnostic Display (see Diagnostic Display in the Troubleshooting section of this chapter). If the Diagnostic Display verifies that the sender and circuit wiring **are** functioning correctly, no further sender testing is necessary. If, however, the Display determines that the temperature sender and circuit wiring **are not** functioning correctly, proceed with test.

3. Locate temperature sender that is to be tested. Disconnect wire harness connector from sender.

4. Thoroughly clean area around temperature sender and remove sender.

5. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Fig. 52).

CAUTION

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

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

6. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases. Replace sender if specifications are not met.

OIL TEMP	SENDER RESISTANCE
68ºF (20ºC)	11.6 to 13.5 kilo ohms
140ºF (60ºC)	2.3 to 2.5 kilo ohms
212ºF (100ºC)	605 to 669 ohms

7. After allowing the sender to cool, install sender:

A. Install new O–ring on sender and thread sender into port. Torque sender to values identified in correct illustration (Fig. 50 or 51).

B. Connect wire harness connector to sender.

8. Check and fill system (coolant or hydraulic) to proper level.

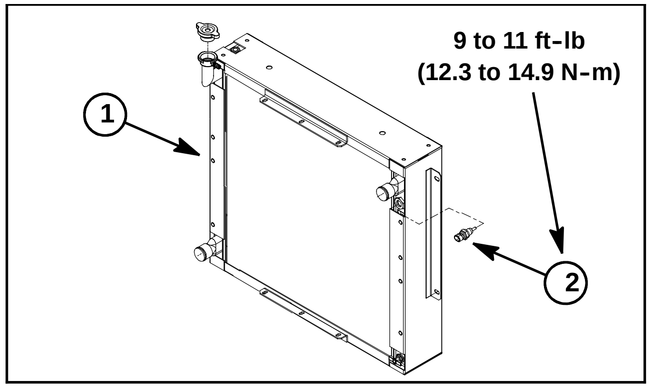


Figure 50

1. Radiator
2. Coolant temp sender

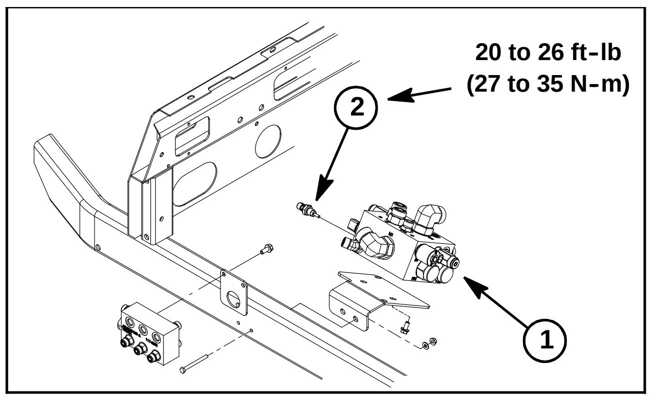


Figure 51

1. 4WD/2WD manifold
2. Oil temp sender

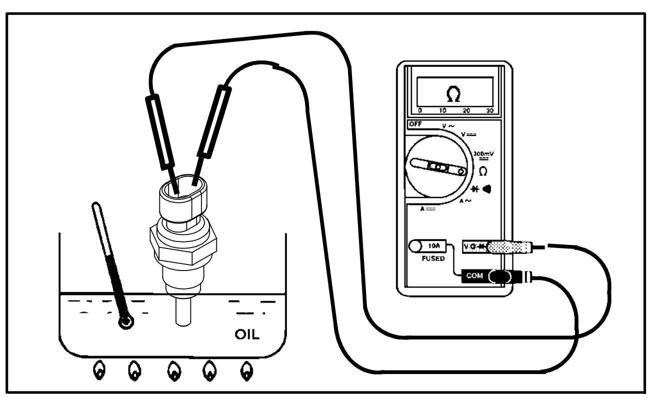


Figure 52

Fuel Pump

The fuel pump is energized by the TEC controller when the ignition switch is either in the START or ON position. The fuel pump is attached to the left side frame rail.

IMPORTANT: When testing fuel pump, make sure that pump is not operated without fuel.

Fuel Pump Capacity Test

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

2. Raise and support hood.

3. Remove 20A fuse (F1–1) (Fig. 54) from fuse block to prevent the engine from cranking.

4. Make sure fuel hoses attached to the fuel pump are free of obstructions.

5. Disconnect fuel pump discharge hose from the fuel/ water separator inlet fitting (Fig. 53).

6. Place disconnected fuel hose (pump discharge) into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

7. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for fifteen (15) seconds, then turn switch to OFF.

8. The amount of fuel collected in the graduated cylinder should be approximately 16 fl oz (475 ml) after fifteen (15) seconds.

9. Replace fuel pump if necessary.

10. Install fuel hose to the fuel/water separator. Secure hose with hose clamp.

11. Install 20A fuse into fuse block.

12. Bleed the fuel system.

13. Lower and secure hood.

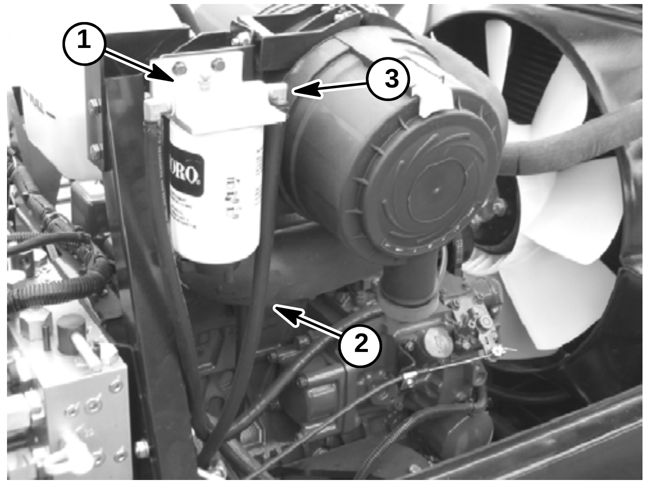


Figure 53

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

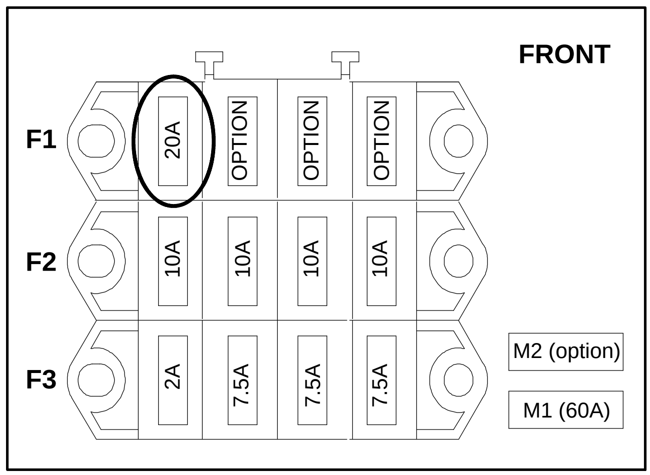


Figure 54

Fuel Pump Specifications

Pump Capacity	64 fl oz/min (1.9 l/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Fuel Stop Solenoid

The fuel stop solenoid used on your Reelmaster must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Fig. 55).

The TEC controller monitors the operation of the fuel stop solenoid. The solenoid and its circuit wiring **should** be tested as a controller output with the Diagnostic Display before following the testing procedure listed below (see Special Tools and Troubleshooting in this chapter).

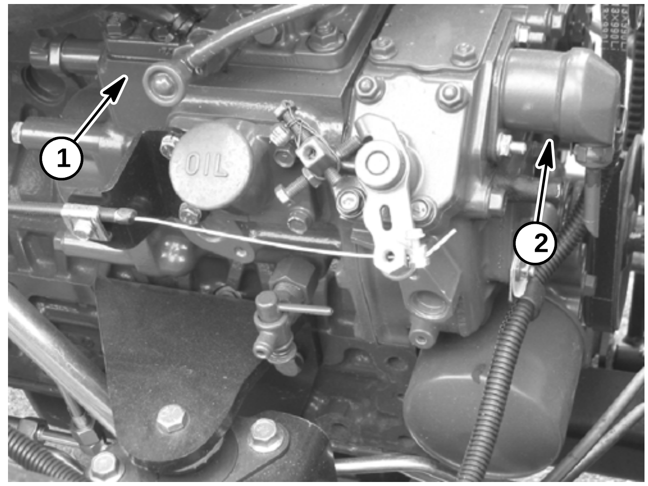


Figure 55

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

Testing

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

2. Disconnect wire harness connector from fuel stop solenoid.

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

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

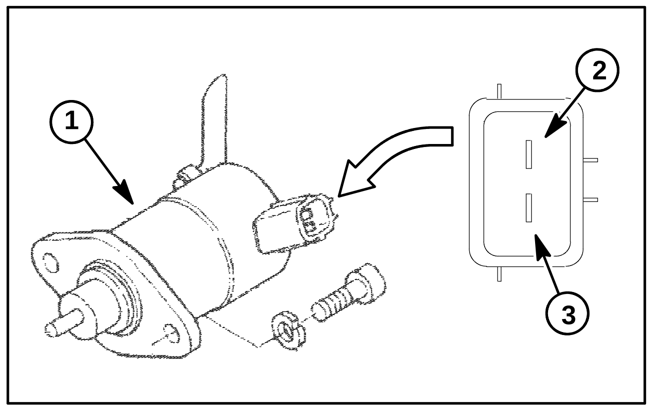


Figure 56

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

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

4. Using a digital multimeter (ohms setting), touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 56). The resistance of the pull coil should be less than 1 ohm (but not zero).

5. Using a digital multimeter (ohms setting), touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 56). The resistance of the hold coil should be approximately 15 ohms.

6. If either coil resistance is incorrect, replace fuel stop solenoid.

7. Connect wire harness connector to the fuel stop solenoid.

8. Lower and secure hood.

Engine Temperature Sender

The engine temperature sender is located near the alternator on the water flange attached to the engine cylinder head (Fig. 57). There is a gray wire attached to the terminal of the sender.

The resistance of the temperature sender reduces as the engine coolant temperature increases. The changing resistance of the temperature sender signals the console temperature gauge to indicate engine coolant temperature during machine operation.

Engine Temperature Sender Test

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

CAUTION

Make sure engine is cool before removing the temperature sender from engine.

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

3. Put sender in a container of oil with a thermometer and slowly heat the oil (Fig. 58).

CAUTION

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

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

4. Check resistance of the sender with a multimeter (ohms setting) as the temperature increases. Replace sender if specifications are not met.

OIL TEMP	TEMP SENDER RESISTANCE
100°F (38°C)	460 ohms (approximate)
160°F (71°C)	140 ohms (approximate)
200°F (93°C)	54 to 78 ohms
221°F (105°C)	50 ohms (approximate)

5. Install sender to the water flange.

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

B. Screw sender into the water flange. Torque sender from **16 to 20 ft–lb (22 to 27 N–m)**.

C. Connect gray wire to sender. Apply skin–over grease (Part Number **TOR50547**) to sender terminal.

6. Fill engine cooling system.

7. Close and secure hood.

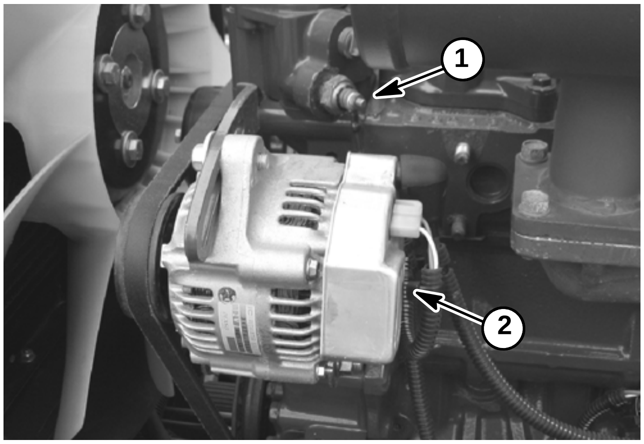


Figure 57

1. Temperature sender
2. Alternator

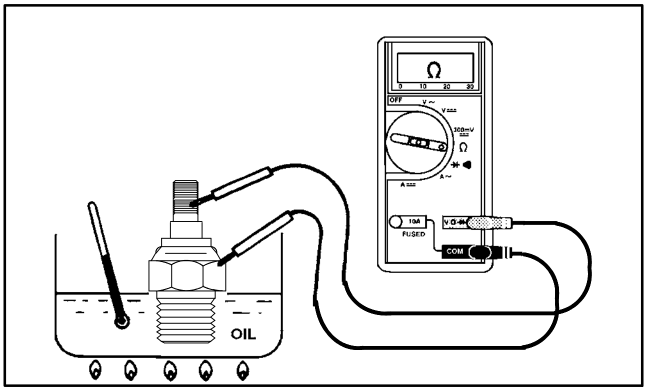


Figure 58

Electrical System

Oil Pressure Switch

The engine oil pressure switch is located on the engine above the starter motor (Fig. 59). The oil pressure switch is a normally closed switch that opens with pressure.

The oil pressure switch should open at approximately 8 PSI (0.56 kg/cm^2).

The TEC controller monitors the operation of the oil pressure switch. The switch and its circuit wiring **should** be tested as a controller input with the Diagnostic Display (see Special Tools and Troubleshooting in this chapter).

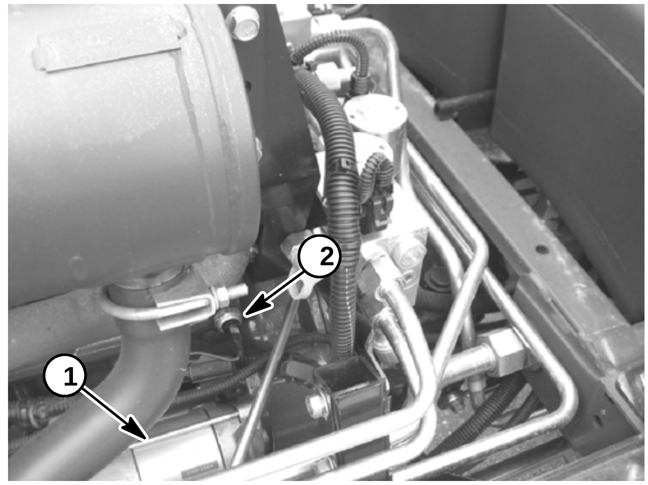


Figure 59

1. **Starter motor**
2. **Oil pressure switch**

Testing

NOTE: Refer to Kubota Workshop Manual, Diesel Engine, 03–M–DI–E3B for information regarding engine lubrication system and testing.

1. Turn the ignition switch to the ON position (do not start engine). The oil pressure indicator light on the control panel should be illuminated.

2. If the indicator light is not illuminated, open hood to gain access to engine.

3. Locate oil pressure switch on engine and disconnect the wire harness connector from the switch.

4. With the ignition switch in the ON position, ground the disconnected wire to the engine block.

5. If the indicator light comes on, the oil pressure switch is faulty.

6. If the indicator light does not come on after step 5, check the oil pressure indicator light and circuit wiring (see Indicator Lights in this section).

7. After testing is completed, connect the wire harness connector to the oil pressure switch. Lower and secure hood.

Service and Repairs

NOTE: For more component repair information, see the Kubota Workshop Manual, Diesel Engine, 03–M–DI–E3B.

Battery Storage

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

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

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

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

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

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

Battery Care

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

WARNING

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

IMPORTANT: Do not remove fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

   B. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on battery terminals to provide good electrical contact.

WARNING

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

4. If corrosion occurs at battery terminals, disconnect cables. Always disconnect negative (–) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours and every 30 days if machine is in storage.

6. Maintain battery cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Specifications

BCI Group 24 Battery
660 Amp Cranking Performance at 0°F (–18°C)
110 minute Reserve Capacity at 80°F (27°C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal and Installation (Fig. 60)

1. Unlatch and raise battery storage box cover behind the operator seat to access battery.

2. Loosen and remove negative cable from battery. After negative cable is removed, loosen and remove positive cable from battery.

3. Loosen strap that secures battery in storage box.

4. Carefully remove battery from machine.

5. Install battery in reverse order making sure to connect and tighten positive cable to battery before connecting the negative 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 tested for short circuits or faulty components and repaired.

6. Make sure that rubber boot is properly placed over positive cable end and positive battery post.

7. Lower and secure battery storage box cover.

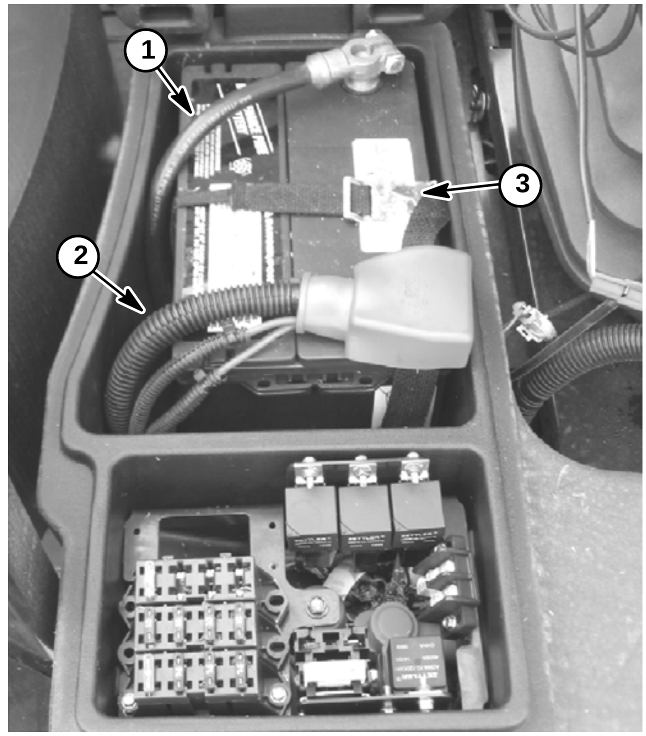


Figure 60

1. **Negative cable**
2. **Positive cable**
3. **Battery strap**

Battery Inspection and Maintenance

1. Replace battery if case is cracked or leaking.

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

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

5. 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. Conduct a hydrometer test of the battery electrolyte.

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

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

B. Temperature correct each cell reading. For each 10°F (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°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 **Battery Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

2. Perform a high–discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold–cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

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

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

B. If the battery has been charged, apply a 150 amp load for fifteen (15) seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center battery 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. Apply a test load of 330 amps (one half the Cranking Performance rating of the battery) for fifteen (15) seconds.

G. Take a battery voltage reading after the load has been applied to the battery for fifteen (15) seconds, then remove the load. Record the voltage reading.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

Minimum Voltage	**Battery Electrolyte Temperature**	
9.6	70°F (and up)	21°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	–7°C
8.7	10°F	–12°C
8.5	0°F	–18°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery Charging

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

CAUTION

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

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its specific gravity or open circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the battery charger manufacturer's instructions** or the following table.

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

CAUTION

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

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

3. **Following the battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (52°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

6. Three (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.

Hydraulic Solenoid Valve Coils

A solenoid valve coil on a hydraulic control manifold can be replaced without opening the hydraulic system.

Removal (Fig. 61)

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

2. Locate solenoid valve coil that is to be removed.

3. Disconnect wire harness electrical connector from the coil that is to be removed. Note orientation of electrical connector on coil for assembly purposes.

4. Remove nut that secures coil to hydraulic valve.

5. Slide solenoid coil from valve.

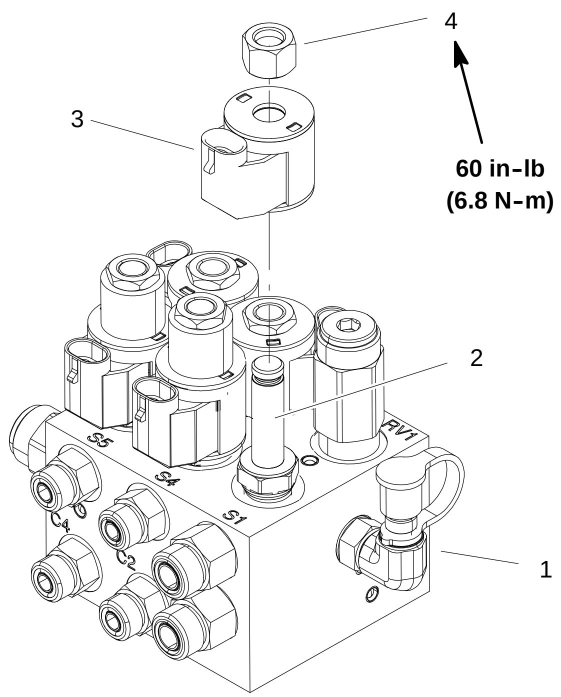
6. Clean any corrosion or dirt from valve stem.

Installation (Fig. 61)

1. Slide solenoid coil onto the hydraulic valve. Position coil so that connector is properly orientated.

2. Install nut onto valve and torque nut **60 in–lb (6.8 N–m)** (do not over tighten).

3. Connect machine wire harness connector to the solenoid coil.



LIFT/LOWER CONTROL MANIFOLD SHOWN

Figure 61

1. Control manifold
2. Solenoid valve
3. Solenoid coil
4. Nut

Electrical System

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Chapter 6

Axles, Planetaries and Brakes

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Specifications

Item	Specification
Wheel lug nut torque (front and rear)	85 to 100 ft−lb (116 to 135 N−m)
Steering cylinder bolt torque	100 to 125 ft−lb (136 to 169 N−m)
Planetary, Brake Assembly and Wheel Motor Mounting Screw Torque OPH−2 series planetary VA02 series planetary	 60 ft−lb (81 N−m) 75 to 85 ft−lb (101 to 115 N−m)
Rear wheel toe−in	0.125 in (3 mm)
Tire pressure (front and rear)	20 psi (138 kPa)
Planetary Drive Lubricant Capacity (each wheel)	SAE 85W−140 wt. Gear Lube 16 to 20 fl oz (0.47 to 0.59 L)
Rear axle lubricant Rear axle gear lube capacity	SAE 85W−140 wt. gear lube 80 fl oz (2.37 l)

General Information

Operator's Manual

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

Adjustments

Planetary Drive Assembly Endplay (OPH−2 series planetary drives)

A front planetary wheel drive assembly that is properly operating should have no endplay. Any endplay in a planetary assembly indicates that there are potential problems with the planetary. Check planetary endplay at intervals specified in your Operator's Manual.

Endplay Checking Procedure

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

CAUTION

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

2. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 − Safety). Support machine with jack stands.

3. Grasp front wheel and check for endplay in the planetary assembly as indicated by axial wheel movement. Make sure that there is no endplay in assembly.

4. If any endplay is detected, the planetary should be disassembled, inspected and serviced as necessary (see Planetary Wheel Drive Assembly in the Service and Repairs section of this chapter).

5. After planetary endplay checking is completed, lower machine to ground.

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Axles, Planetaries and Brakes

Service and Repairs

Brake Assembly

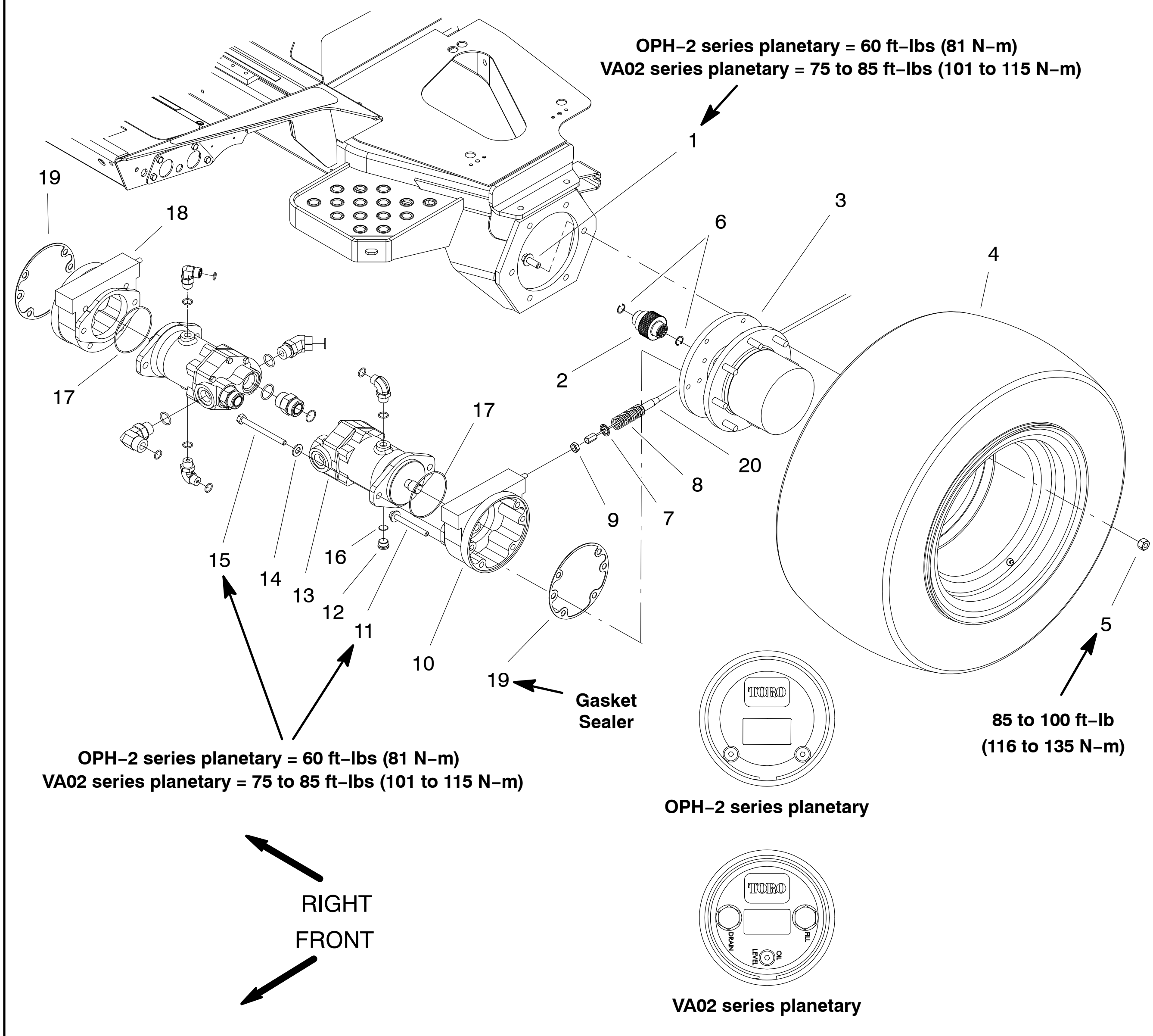

Figure 1

1. **Flange head screw (6 per planetary)**
2. **Splined brake shaft**
3. **Planetary assembly (2 used)**
4. **Front wheel assembly (2 used)**
5. **Lug nut (8 per wheel)**
6. **Retaining ring**
7. **Spring plate**
8. **Compression spring**
9. **Jam nut**
10. **LH Brake assembly**
11. **Flange head screw (4 per brake)**
    OPH−2 planetary = 90 mm lg
    VA02 planetary = 80 mm lg
12. **Hex plug**
13. **Piston motor (2 used)**
14. **Flat washer (2 per motor)**
15. **Cap screw (2 per motor)**
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
16. **O−ring**
17. **O−ring**
18. **RH brake assembly**
19. **Gasket**
20. **Brake cable (LH shown)**

Brake Assembly Removal (Fig. 1)

1. Park machine on a level surface and raise cutting units to allow easier access to front brake assembly. Stop engine, engage parking brake and remove key from the ignition switch.

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

CAUTION

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

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 − Safety). Support machine with appropriate jack stands.

4. Remove wheel assembly.

5. Remove hydraulic wheel motor (see Front Wheel Motors in Service and Repairs section of Chapter 4 − Hydraulic System).

6. Disconnect brake cable from pull rod on brake.

NOTE: Be careful to not drop splined brake shaft as brake assembly is removed.

7. Support brake assembly and remove flange head cap screws (item 11) securing brake assembly to frame. Remove brake assembly.

8. Remove splined brake shaft.

9. Complete brake inspection and repair (see Brake Inspection and Repair in this section).

Brake Assembly Installation (Fig. 1)

NOTE: The stepped end of the splined brake shaft must be aligned toward the hydraulic wheel motor (Fig. 2).

1. Install splined brake shaft into brake assembly. Make sure that splines engage rotating discs in brake assembly.

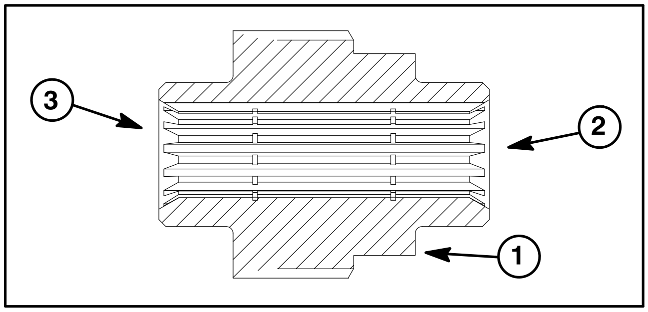

Figure 2

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

2. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with eight (8) flange head screws.

For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

3. Make sure that gasket surfaces of planetary and brake assembly are clean. Position new gasket (item 3) to brake assembly.

4. Position brake assembly to machine, aligning splined brake shaft with input shaft on planetary wheel drive.

5. Make sure gasket (item 3) is properly aligned and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

6. Install brake cable to pull rod on brake assembly. Brake cable end should be completely threaded onto pull rod before tightening jam nut.

7. Make sure wheel motor O−ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

8. Install wheel assembly.

9. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

10. Test planetary drive operation.

11. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

12. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Brake Inspection and Repair

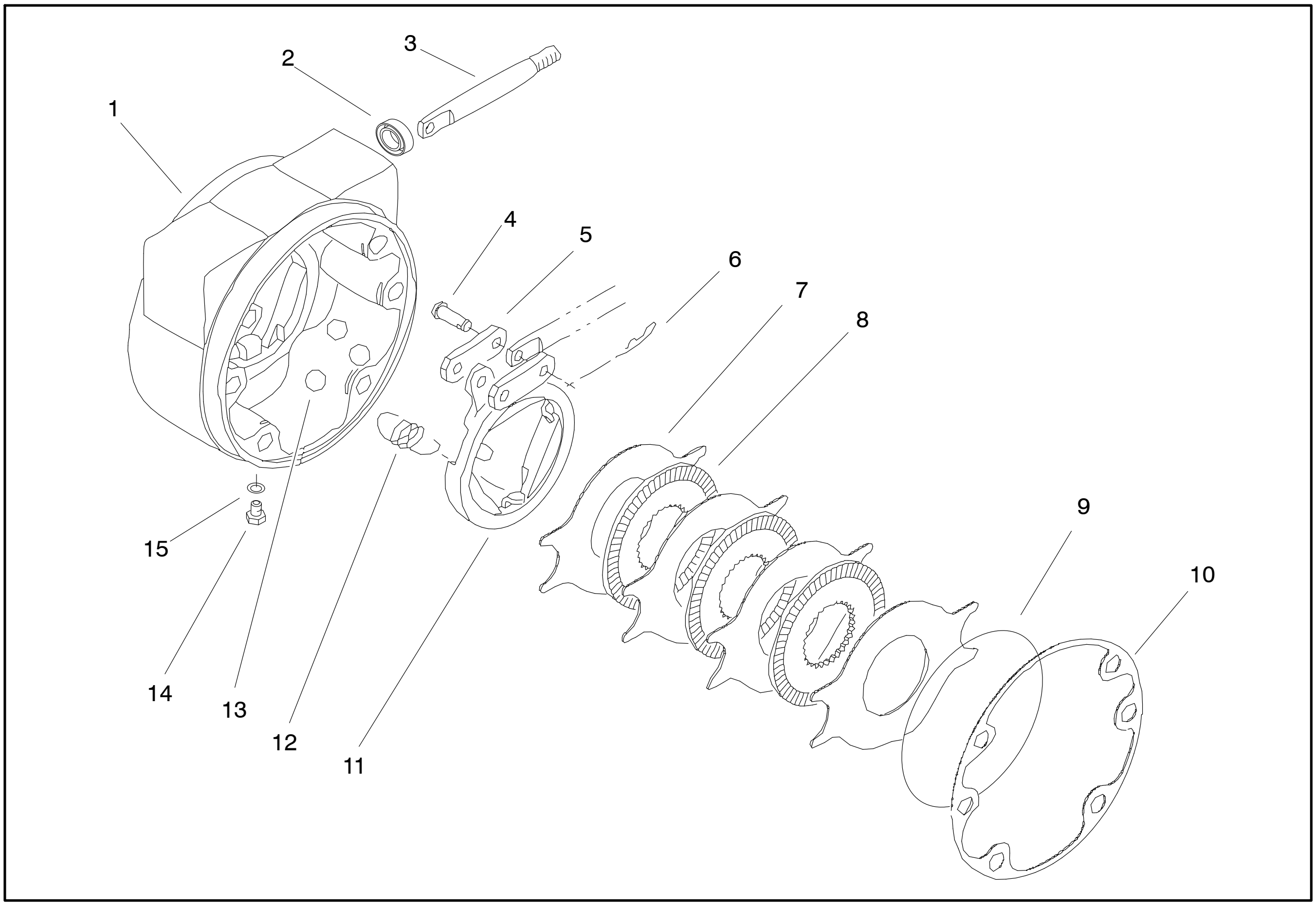

Figure 3

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin (2 used)**
5. **Link (2 used)**
6. **Hitch pin (2 used)**
7. **Stationary disc (4 used)**
8. **Rotating disc (3 used)**
9. **Retaining ring**
10. **Gasket**
11. **Rotating actuator**
12. **Extension spring (3 used)**
13. **Ball (3 used)**
14. **Plug**
15. **O−ring**

Brake Inspection and Repair (Fig. 3)

1. Carefully scrape gasket material (item 10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (item 9).

3. Remove stationary discs (item 7) and rotating discs (item 8).

4. Remove extension springs (item 12).

5. Remove actuator assembly (items 3, 4, 5, 6 and 11) and balls (item 13).

6. Remove seal (item 2) from brake housing.

7. Wash parts in cleaning solvent. Inspect components for wear or damage.

8. Reverse steps 2 − 6 to assemble brakes, installing new parts as necessary. Install a new seal (item 2).

9. Use a new gasket (item 10) when installing brake assembly to machine.

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Axles, Planetaries and Brakes

Planetary Drive Assembly

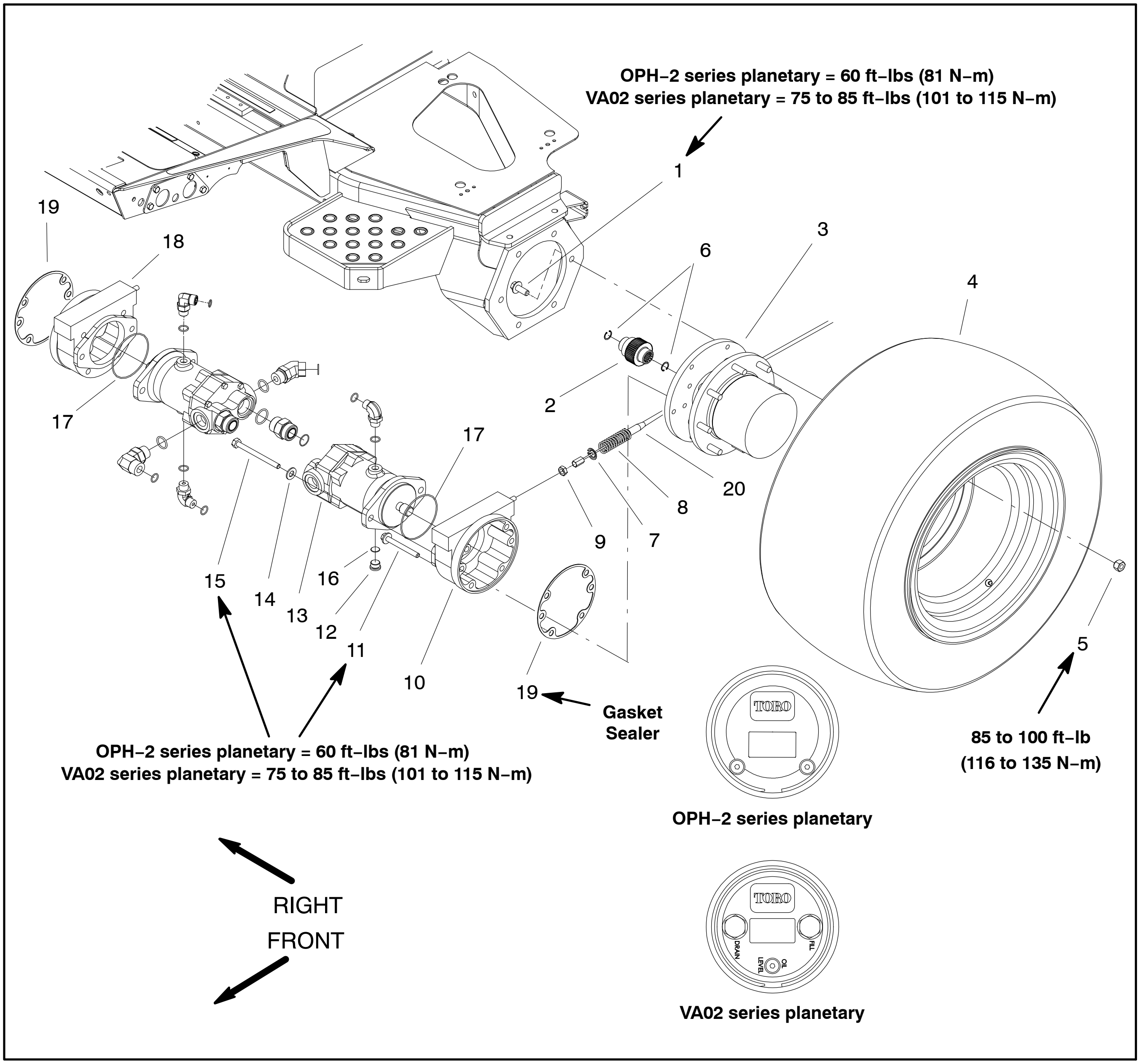

Figure 4

1. **Flange head screw (6 per planetary)**
2. **Splined brake shaft**
3. **Planetary assembly (2 used)**
4. **Front wheel assembly (2 used)**
5. **Lug nut (8 per wheel)**
6. **Retaining ring**
7. **Spring plate**
8. **Compression spring**
9. **Jam nut**
10. **LH Brake assembly**
11. **Flange head screw (4 per brake)**
    OPH−2 planetary = 90 mm lg
    VA02 planetary = 80 mm lg
12. **Hex plug**
13. **Piston motor (2 used)**
14. **Flat washer (2 per motor)**
15. **Cap screw (2 per motor)**
    OPH−2 planetary = 120 mm lg
    VA02 planetary = 110 mm lg
16. **O−ring**
17. **O−ring**
18. **RH brake assembly**
19. **Gasket**
20. **Brake cable (LH shown)**

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine (see Planetary Wheel Drive Service in this section). Use the following procedure to remove and install the planetary wheel drive assembly from machine.

Planetary Drive Removal (Fig. 4)

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

2. Drain the oil from the brake assembly and the Planetary drive; refer to the traction unit Operator's Manual.

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 − Safety in this manual). Support machine with jack stands.

4. Remove front wheel assembly.

5. Support wheel motor and brake assembly to prevent them from shifting during planetary removal.

NOTE: The wheel motor and brake assembly fasteners thread into the planetary housing, and must be removed prior to removing the planetary drive from the machine.

6. Remove two (2) cap screws and flat washers that secure wheel motor to planetary assembly. Check condition of O−ring (item 17) and replace if necessary (see wheel motors in Chapter 4 − Hydraulic System in this manual).

7. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly in this chapter). Remove and discard gasket (item 19).

8. Support planetary assembly to prevent it from falling. Loosen and remove six (6) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

Planetary Drive Installation (Fig. 4)

1. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with six (6) flange head screws.

For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

2. Make sure that gasket surfaces of planetary and brake assembly are clean.

3. Make sure gasket (item 19) is properly aligned and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

For OPH−2 series planetary drives: tighten screws to **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

4. Make sure wheel motor O−ring (item 17) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

For OPH−2 series planetary drives: tighten screws from **60 ft−lb (81 N−m)**.

For VA02 series planetary drives: tighten screws from **75 to 85 ft−lb (101 to 115 N−m)**.

5. Install wheel assembly.

6. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

7. Test planetary drive operation.

8. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

WARNING

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

9. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

OPH−2 Series Planetary Drive Service

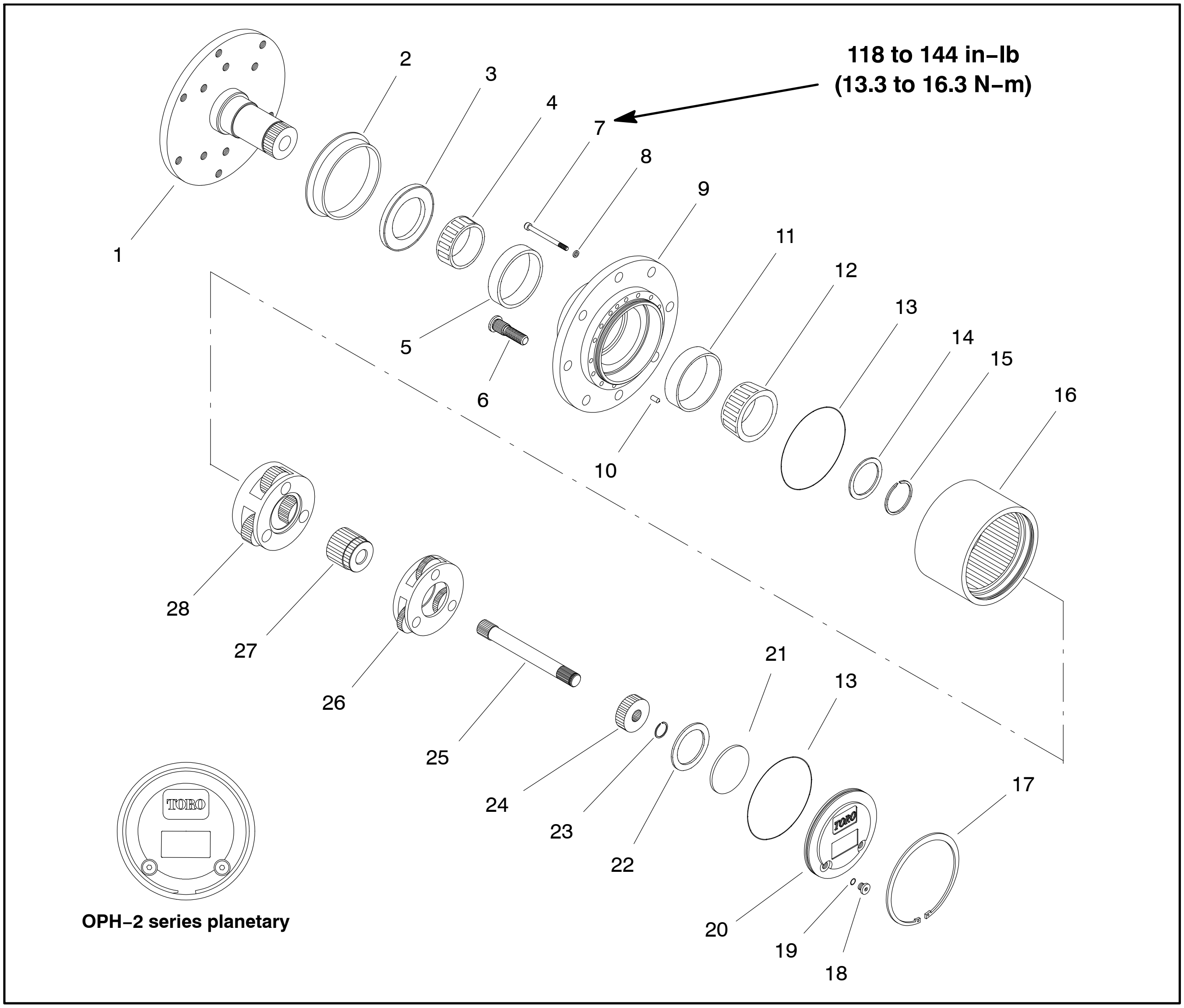

Figure 5

1. **Spindle**
2. **Boot seal**
3. **Oil seal**
4. **Inner bearing cone**
5. **Inner bearing cup**
6. **Wheel stud (8 used)**
7. **Socket head screw (16 used)**
8. **Lock washer (16 used)**
9. **Housing**
10. **Dowel pin (2 used)**
11. **Outer bearing cup**
12. **Outer bearing cone**
13. **O−ring**
14. **Thrust washer**
15. **Retaining ring (external)**
16. **Ring gear**
17. **Retaining ring (internal)**
18. **Plug (2 used)**
19. **O−ring (2 used)**
20. **End cap**
21. **Thrust plug**
22. **Thrust washer**
23. **Retaining ring**
24. **Primary gear**
25. **Drive shaft**
26. **Primary carrier assembly**
27. **Secondary gear**
28. **Secondary carrier assembly**

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed from machine, see Planetary Wheel Drive Assembly in this section.

Disassembly (Figs. 5 and 6)

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

2. Drain oil from planetary wheel drive/brake assembly; refer to traction unit Operator's Manual.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove wheel assembly.

4. Remove retaining ring (item 17).

5. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

6. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

7. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 8. through 11. are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 10) after it has been removed.

8. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

9. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

10. Remove and discard seals (items 2 and 3) and O–rings (item 13) from housing.

11. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

12. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

13. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

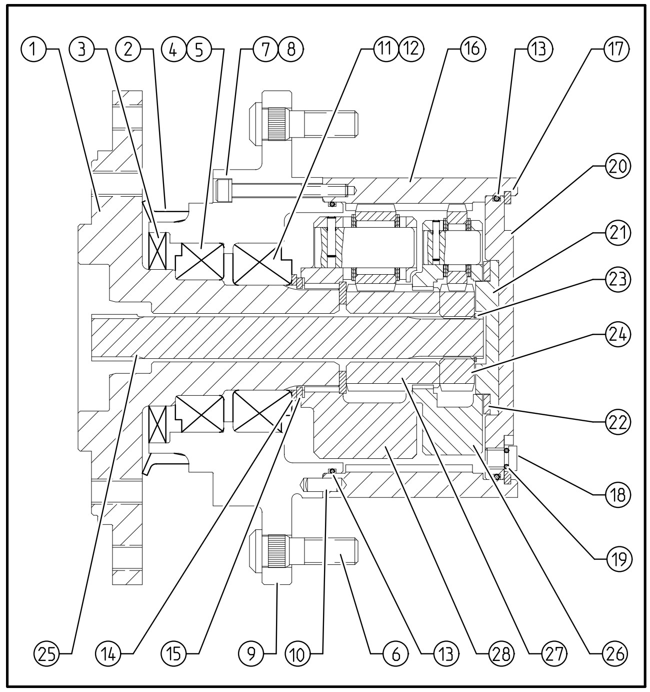

Figure 6

1. **Spindle**
2. **Boot seal**
3. **Oil seal**
4. **Inner bearing cone**
5. **Inner bearing cup**
6. **Wheel stud (8)**
7. **Socket head screw (16)**
8. **Lock washer (16)**
9. **Housing**
10. **Dowel pin (2)**
11. **Outer bearing cup**
12. **Outer bearing cone**
13. **O–ring**
14. **Thrust washer**
15. **Retaining ring (external)**
16. **Ring gear**
17. **Retaining ring (internal)**
18. **Plug (2)**
19. **O–ring (2)**
20. **End cap**
21. **Thrust plug**
22. **Thrust washer**
23. **Retaining ring**
24. **Primary gear**
25. **Drive shaft**
26. **Primary carrier assy.**
27. **Secondary gear**
28. **Secondary carrier assy.**

Assembly (Figs. 5 and 6)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary wheel drive.

3. If spindle and housing were separated:

A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

B. Set inner bearing cone (item 4) into inner bearing cup.

C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

D. Pack boot seal (item 2) with grease and install.

E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in−lb (13.3 to 16.3 N−m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 inch (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O−ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O−ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

NOTE: If the planetary drive is not installed on the machine, check operation of planetary drive by hand. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

9. Install wheel assembly.

10. Fill planetary drive with gear lube; refer to traction unit Operator’s Manual. A portion of the gear lube will pass into the brake assembly automatically.

11. Test planetary drive operation.

WARNING

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

12. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Axles, Planetaries and Brakes

VA02 Series Planetary Drive Service

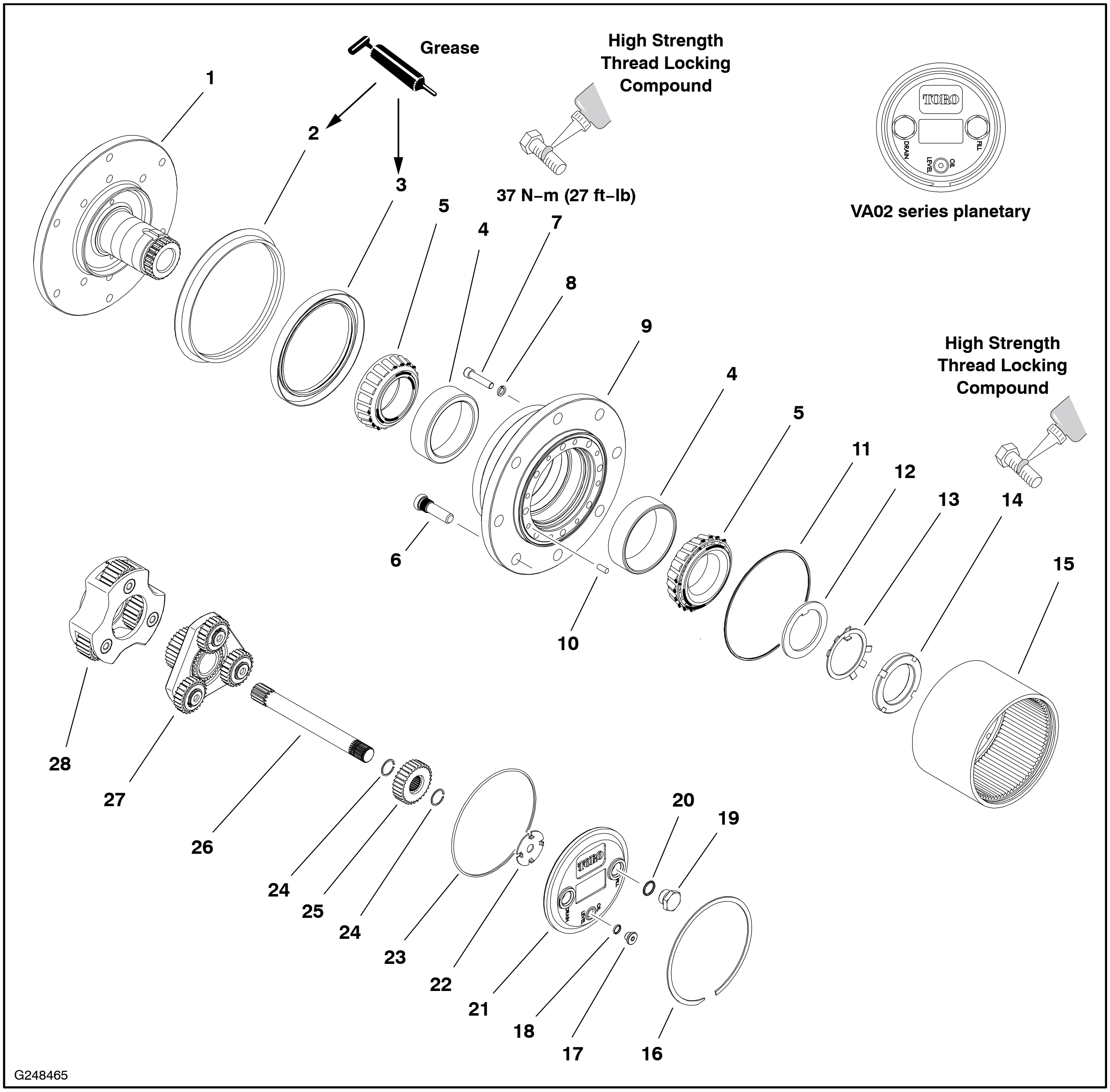

Figure 7

1. Spindle
2. Boot seal
3. Lip seal
4. Inner bearing cup (2)
5. Inner bearing cone (2)
6. Wheel stud (8)
7. Socket head screw (8)
8. Lock washer (8)
9. Housing
10. Dowel pin (4)
11. O−ring
12. Spacer
13. Locking washer
14. Lock nut
15. Ring gear
16. Retaining ring
17. Plug
18. O−ring
19. Plug (2)
20. O−Ring (2)
21. End cap
22. Thrust plate
23. O−Ring
24. Retaining ring (2)
25. Primary gear
26. Drive shaft
27. Primary carrier assembly
28. Secondary carrier assembly

NOTE: The planetary drive assembly is best serviced with the planetary installed to machine or the spindle firmly secured to a fixture or workbench. If the spindle (item 1) needs to be removed from machine, see Planetary Drive Assembly in this chapter.

Disassembly

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

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove wheel assembly.

4. Remove retaining ring (item 16).

5. Remove end cap and thrust plate. Retrieve and discard O–ring from ring gear bore.

6. Remove primary gear and drive shaft assembly (items 24–26).

7. Remove primary carrier and secondary carrier from ring gear.

8. Bend the locking washer tab away from the lock nut. Use a TMFS12 spanner socket to remove the 55 x 1.5 mm lock nut. Remove the locking washer and spacer. Discard the locking washer.

9. Carefully remove housing and bearing cones from spindle.

10. Remove and discard seals from housing.

11. If necessary, remove bearing cups from housing.

12. If wheel stud removal is necessary, use a press to remove the stud(s) from the housing.

13. If necessary, remove the ring gear from the housing:

    NOTE: High strength thread locking compound was used during assembly. It may be necessary to heat the ring gear near the mounting screws to release the screws.

    A. Remove socket head screws (item 7) and lock washers that secure the ring gear to the housing.

    B. Remove the ring gear and retrieve the four (4) dowel pins (item X) from housing.

    C. Remove the O–ring from the housing bore and discard.

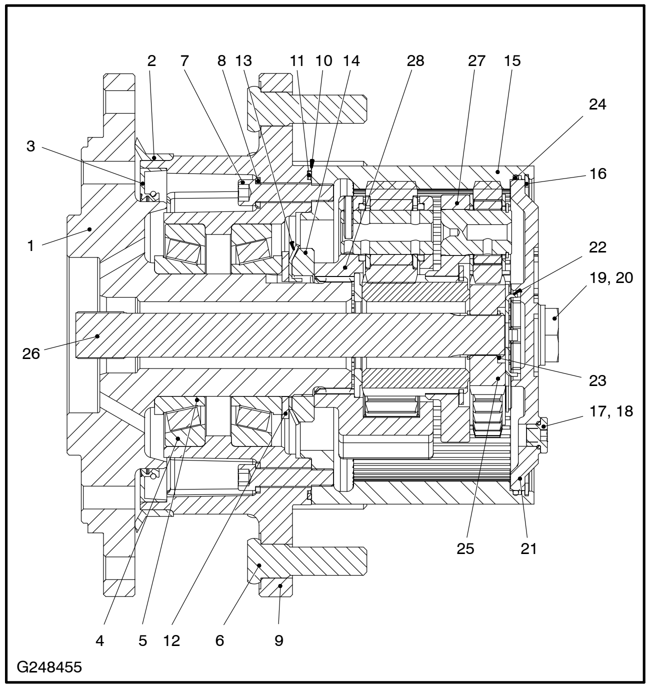

Figure 8

1. **Spindle**	15. **Ring gear**
2. **Boot seal**	16. **Retaining ring**
3. **Lip seal**	17. **Plug**
4. **Inner bearing cup (2)**	18. **O–ring**
5. **Inner bearing cone (2)**	19. **Plug (2)**
6. **Wheel stud (8)**	20. **O–Ring (2)**
7. **Socket head screw (8)**	21. **End cap**
8. **Lock washer (8)**	22. **Thrust plate**
9. **Housing**	23. **O–Ring**
10. **Dowel pin (4)**	24. **Retaining ring (2)**
11. **O–ring**	25. **Primary gear**
12. **Spacer**	26. **Drive shaft**
13. **Locking washer**	27. **Primary carrier asm**
14. **Lock nut**	28. **Secondary carrier asm**

Assembly

NOTE: Use new seals, O–rings and locking washer when assembling the planetary drive.

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

3. If ring gear was removed from housing:

    A. Fit four (4) dowel pins in housing.

    B. Apply a light coat of grease to a new O–ring and install it in the housing bore.

    C. Apply high strength thread locking compound and secure ring gear to housing with lock washers and socket head screws. Tighten screws to **27 ft–lb (37 N–m)**.

4. If previously removed, press bearing cups into housing. Cups should be pressed fully to shoulder of the housing bore.

5. Fit inner bearing cone onto spindle. Make sure inner bearing cone seats fully against spindle shoulder. If inner bearing is not seated fully, lightly tap bearing cone on inner hub until it seats properly.

6. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal is not rubber or does not have a sealant coating, apply a light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face.

7. Install boot seal. Cover surface of lip seal and boot seal with grease.

8. Lightly oil bearing cups then place housing assembly over spindle and inner bearing cone. Take care to not damage seals or spindle during installation.

9. Fit outer bearing cone onto spindle.

10. Align key on spacer and install spacer onto spindle shaft.

11. Align key on locking washer and install locking washer onto spindle shaft.

IMPORTANT: .Perform the following steps without interruption. Once the thread locking compound is applied, you have only a few minutes before the curing process will influence the bearing lock nut torque.

12. Install the bearing lock nut:

A. Apply high strength thread locking compound (Loctite 263 or equivalent) and install the lock nut.

B. Tighten the lock nut to **110 ft−lb (150 N−m)**.

C. Rotate the housing on the spindle a few revolutions to align the bearings.

D. Tighten the lock nut to **150 ft−lb (200 N−m)**.

E. Rotate the housing on the spindle a few revolutions to seat the bearings.

IMPORTANT If installing the bearing nut with the spindle installed on machine, have an assistant hold the housing firmly in position during the following step.

F. Loosen the lock nut completely, then tighten to **90 ft−lb (122 N−m).**

IMPORTANT: Continue to tighten the lock nut until it aligns with one of the locking washer tabs. Do Not loosen the lock nut to align it with the locking washer tabs.

G. Secure the lock nut by bending one of the locking washer tabs into a slot in the lock nut.

13. Install secondary carrier and primary carrier making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

14. If primary gear (item 25) was removed from drive shaft, slide gear onto shaft and secure with retaining rings.

15. Install drive shaft assembly (items 24−26) making sure that drive shaft spline aligns with carrier gears.

16. Cover the outer face of the thrust plate with grease and fit thrust plate onto end cap. Make sure that thrust plate tabs are captive in end cap.

17. Apply a light coat of grease to a new O−ring and install it in the ring gear bore. Avoid pinching or cutting the O−ring and install the end cap. Use a soft mallet to fully seat the end cap.

18. Secure the end cap with the retaining ring. Make sure the retaining ring is fully seated in the ring groove.

NOTE: If the planetary drive is not installed on the machine, check operation of planetary drive by hand. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

19. Install wheel assembly.

20. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

21. Test planetary drive operation.

WARNING

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

22. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Axles, Planetaries and Brakes

Rear Axle Assembly

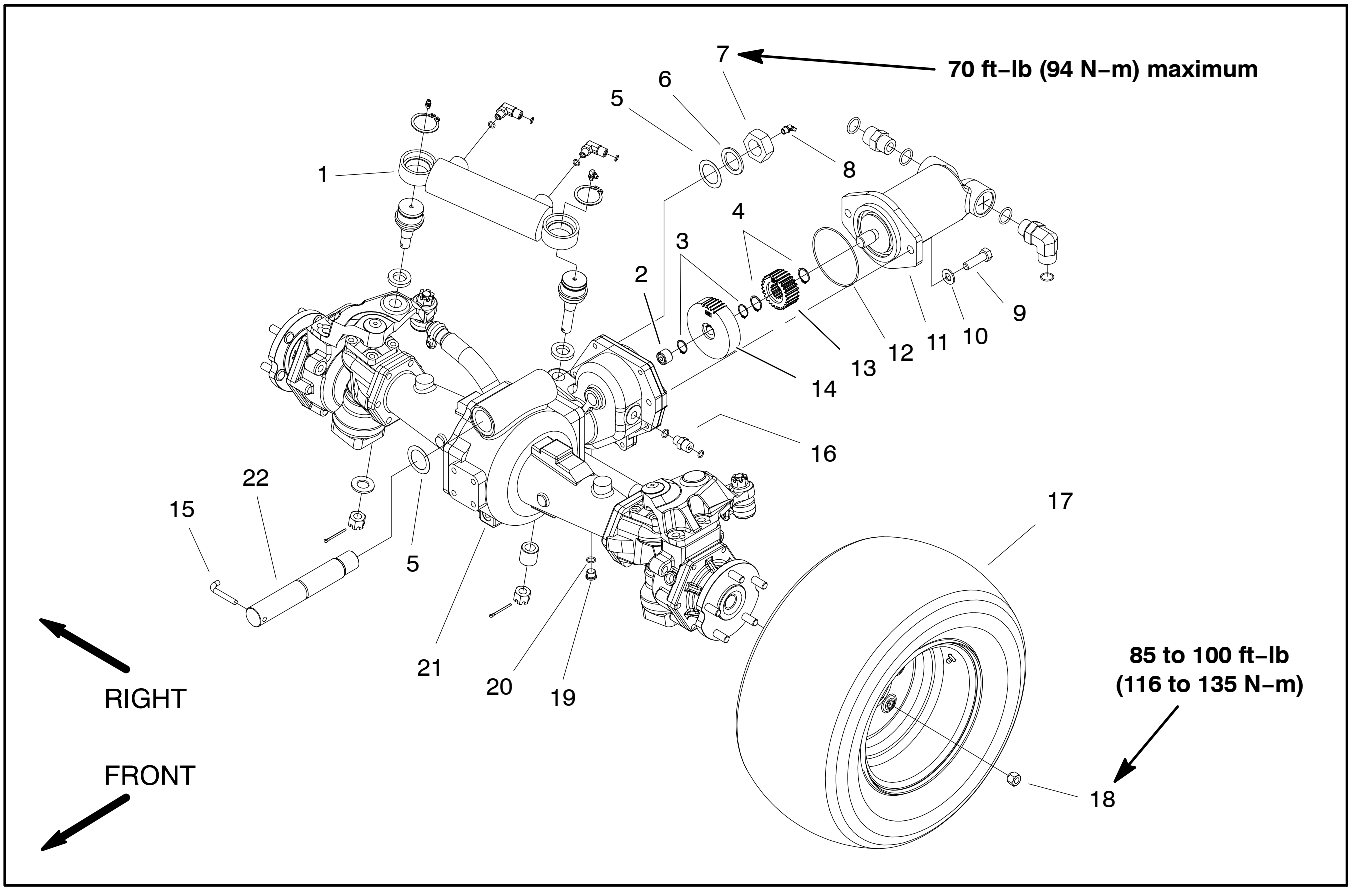

Figure 9

1. Steering cylinder
2. Needle bearing
3. External snap ring
4. External snap ring
5. Thrust washer
6. Flat washer
7. Lock nut
8. Grease fitting
9. Cap screw (2 used)
10. Flat washer (2 used)
11. Rear axle motor
12. O−ring
13. Pinion gear
14. Gear
15. Stop pin
16. Hydraulic fitting
17. Rear wheel assembly (2 used)
18. Lug nut (5 used per wheel)
19. Hex plug
20. O−ring
21. Drive axle assembly
22. Axle pivot pin

CAUTION

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

Remove Rear Axle (Fig. 9)

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

2. Drain oil from rear axle and axle gearbox.

3. Chock front wheels and jack up rear of machine (see Jacking Instructions in Chapter 1 − Safety). Support machine with appropriate jack stands.

4. Remove both wheels from rear axle.

5. Remove hydraulic motor from axle assembly (see Rear Axle Motor in the Service and Repairs section of Chapter 4 − Hydraulic System).

6. Remove hydraulic hoses from steering cylinder.

7. Remove hydraulic hose from hydraulic fitting on side of input gear case.

8. Remove lock nut and flat washer from axle pivot pin.

9. Support rear axle to prevent it from falling. Remove pivot pin. Lower rear axle from machine. Note location of thrust washer on both ends of axle mounting boss.

10. If needed for further axle disassembly, remove steering cylinder from axle (see Steering Cylinder in Service and Repairs section of Chapter 4 − Hydraulic System).

11. If required, remove tie rod ends from steering arms on rear axle (Fig. 10). Remove the cotter pins and castle nuts from the tie rod ball joints. Use a ball joint fork and remove the tie rod ends from the axle steering arms.

12. Clean the rear axle pivot pin and pivot bushings. Inspect the pin and bushings for wear or damage. Replace components as necessary.

Install Rear Axle (Fig. 9)

1. If removed, install steering cylinder to axle assembly (see Steering Cylinder in Service and Repairs section of Chapter 4 − Hydraulic System).

2. If removed, install the tie rod to rear axle (Fig. 10). Tighten ball joint castle nuts and install new cotter pins.

3. Support axle under machine with a jack. Position axle assembly to rear frame mount.

4. Install axle pivot pin to secure axle to frame. Make sure to install thrust washer between axle pivot and frame on both ends of the pivot. With washers installed, there should be from 0.002 to 0.020 inch (0.05 to 0.51 mm) clearance between rear frame mount and axle mounting boss. Add thrust washers if needed to adjust clearance.

5. Install flat washer and lock nut onto axle pivot pin. Lock nut should be tightened enough to allow pivot pin to rotate (**70 ft−lb (94 N−m) maximum**).

6. Install hydraulic motor to axle assembly (see Rear Axle Motor in Service and Repairs section of Chapter 4 − Hydraulic System).

7. Install hydraulic hoses to steering cylinder and input gear case.

WARNING

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

8. Install wheels to axle. Lower machine to ground. Torque wheel lug nuts from **85 to 100 ft−lb (116 to 135 N−m)**.

9. Fill axle with SAE 85W−140 weight gear lube.

10. Check rear wheel toe−in and adjust if necessary (see Traction Unit Operator's Manual).

11. Check steering stop bolt adjustment. When the steering cylinder is fully contracted (left turn), a gap of 1/16" (1.6 mm) should exist between bevel gear case casting and stop bolt on left axle case. Figure 11 shows stop bolt location.

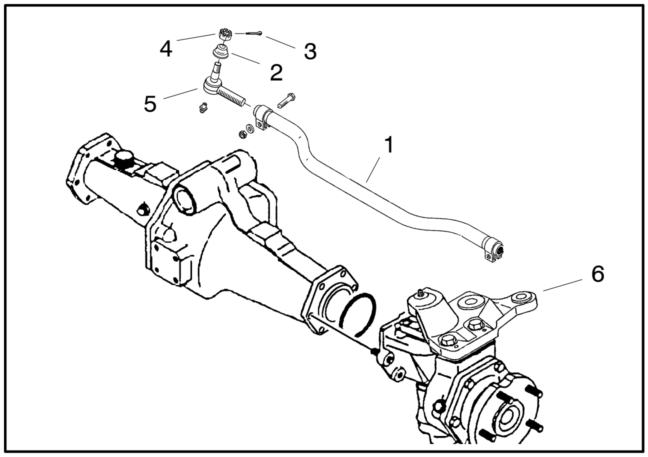

Figure 10

1. **Tie rod**
2. **Dust cover**
3. **Cotter pin**
4. **Castle nut**
5. **Tie rod end**
6. **Steering arm (LH)**

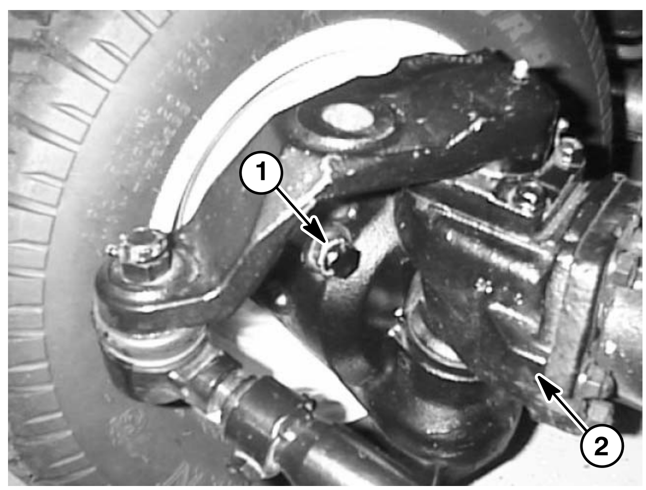

Figure 11

1. **Steering stop bolt**
2. **Bevel gear case (LH)**

Axles, Planetaries and Brakes

Rear Axle Service

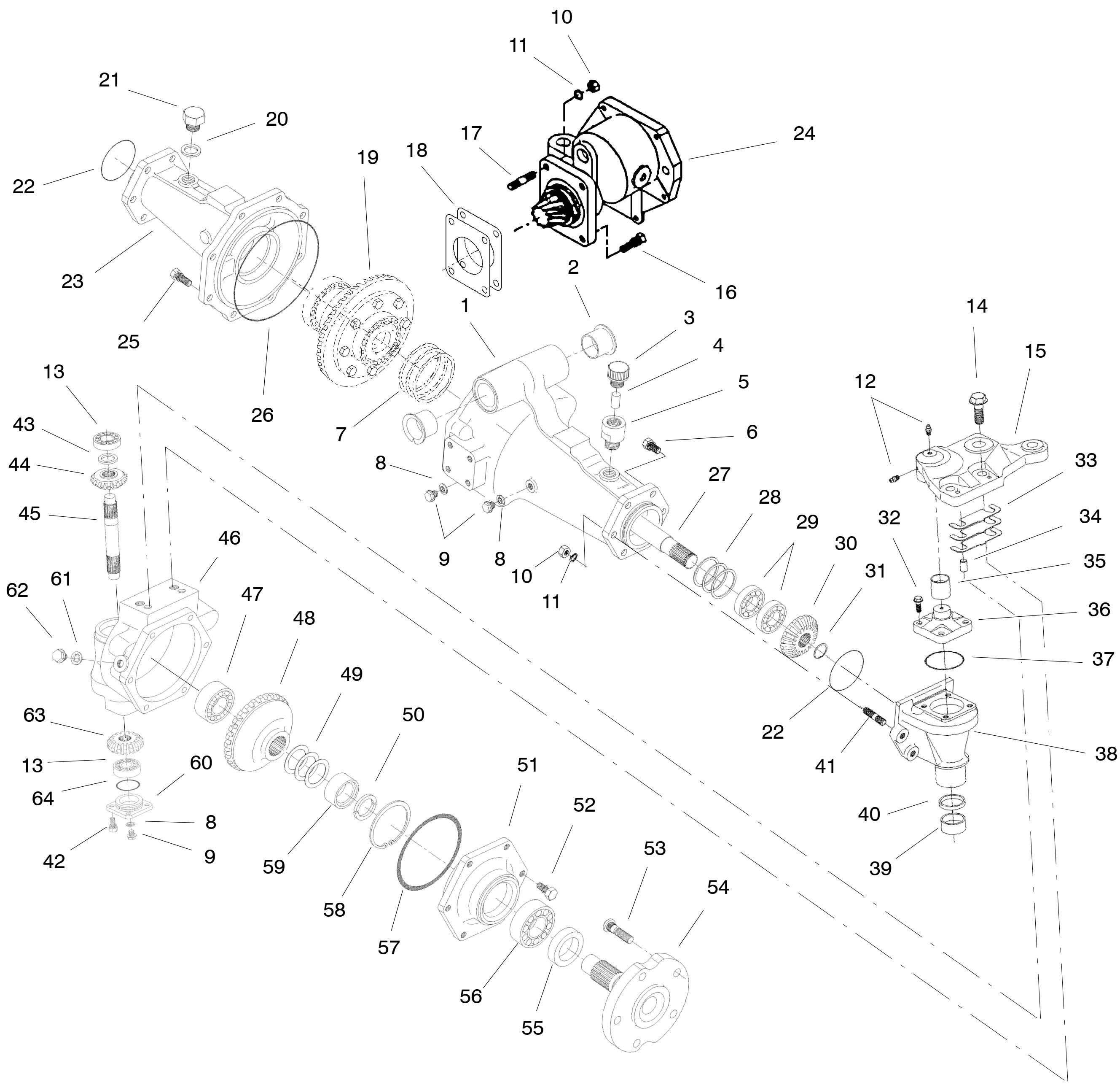

Figure 12

Figure 12 (Continued)

1. LH axle support
2. Flange bushing (2 used)
3. Axle vent
4. Filter
5. Vent extension
6. Cap screw (4 used per gear case)
7. Shim set
8. Seal washer
9. Plug
10. Lock nut
11. Lock washer
12. Grease fitting
13. Ball bearing
14. Screw (2 used per steering arm)
15. Axle case support (LH shown)
16. Bolt (2 used)
17. Stud (2 used)
18. Shim set
19. Differential assembly
20. O−ring
21. Plug
22. O−ring
23. RH axle support
24. Input shaft assembly
25. Bolt (8 used)
26. O−ring
27. Differential shaft (LH shown)
28. Shim set
29. Ball bearing
30. Bevel gear (15 tooth)
31. Retaining ring
32. Bolt (4 used per knuckle)
33. Shim set
34. Dowel pin (2 used per axle case)
35. Bushing
36. Knuckle pin
37. O−ring
38. Bevel gear case (LH shown)
39. Bushing
40. Shaft seal
41. Stud (2 used per gear case)
42. Bolt (4 used per cover)
43. Collar
44. Bevel gear (17 tooth)
45. Bevel gear shaft
46. Axle case (LH shown)
47. Ball bearing
48. Bevel gear (29 tooth)
49. Shim set
50. Clip (2 used per axle case)
51. Axle cover
52. Screw (6 used per cover)
53. Wheel stud (5 used per axle)
54. Axle
55. Oil seal
56. Ball bearing
57. O−ring
58. Retaining ring
59. Spacer
60. Axle case cover
61. Seal washer
62. Plug
63. Bevel gear (17 tooth)
64. O−ring

NOTE: Figure 12 illustrates the rear axle used on the Reelmaster 7000. Service procedures for the rear axle is on the following pages of this section.

Bevel Gear Case and Axle Case

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 13).

2. Mark both right and left bevel gear case/axle case assemblies.

IMPORTANT: Do not interchange right and left bevel gear case/axle case assemblies.

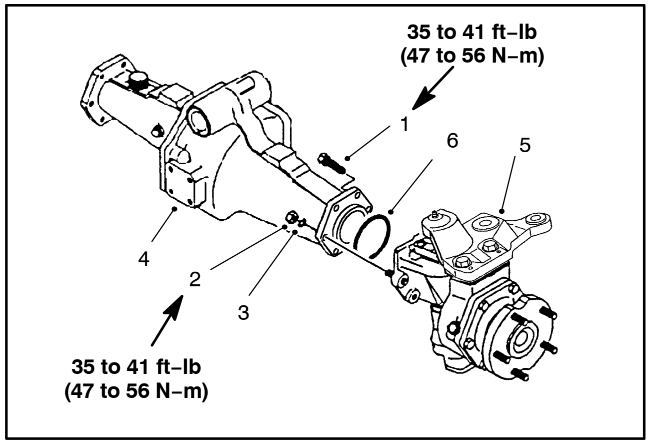

Figure 13

1. **Cap screw (4 used)**
2. **Lock nut (2 used)**
3. **Lock washer (2 used)**
4. **Axle support**
5. **Bevel gear case/axle case assembly**
6. **O-ring**

3. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 14).

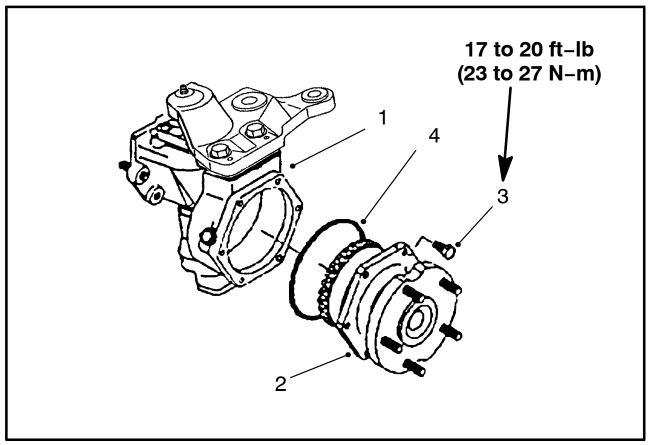

Figure 14

1. **Axle case**
2. **Axle cover assembly**
3. **Screw (6 used)**
4. **O-ring**

4. Remove the axle case support mounting screws, the axle case support and the support shims (Fig. 15).

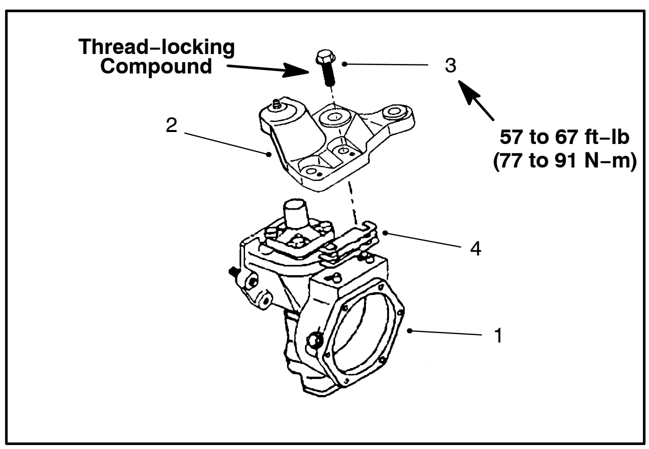

Figure 15

1. **Axle case**
2. **Axle case support**
3. **Screw (2 used)**
4. **Support shim**

5. Remove the knuckle pin mounting screws and the knuckle pin. Remove the gasket and any remaining gasket material from either mating surface (Fig. 16).

6. While holding the bevel gear case, tap the upper end of the bevel gear shaft out of the upper bearing and upper bevel gear.

7. Pull the bevel gear case from the axle case and remove the upper bevel gear and collar from the gear case.

8. Remove the axle case cover screws, cover and the O-ring from the axle case.

9. Remove the plug and sealing washer from the center of the axle case cover. While holding the axle case cover, lightly tap the lower end of the bevel gear shaft out of the lower bearing and lower bevel gear.

10. Remove and discard bevel gear shaft seal from axle case (Fig. 16).

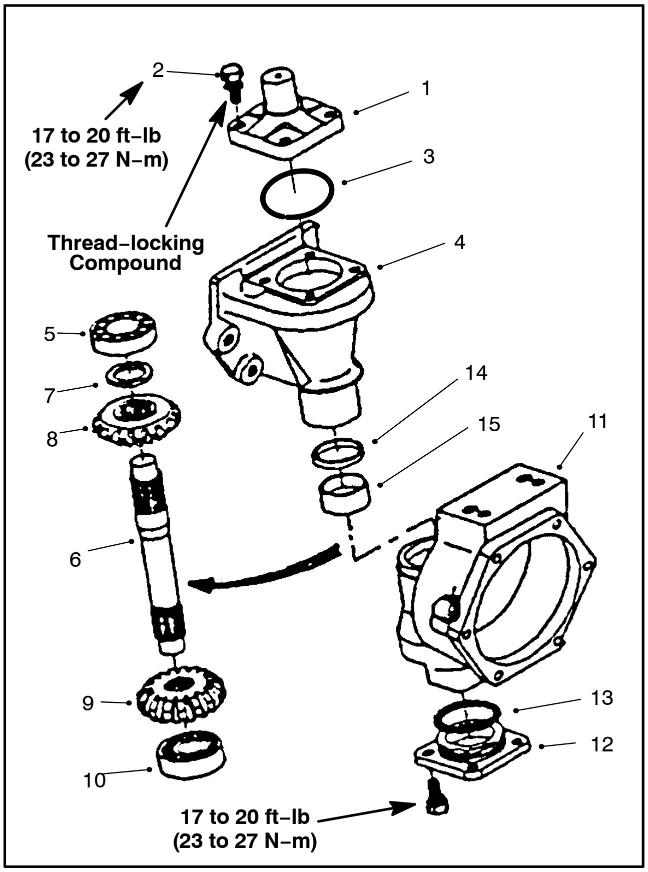

Figure 16

1. Knuckle pin
2. Mounting screw (4 used)
3. O−ring
4. Bevel gear case
5. Upper bearing
6. Bevel gear shaft
7. Collar
8. Upper bevel gear
9. Lower bevel gear
10. Lower bearing
11. Axle case
12. Axle case cover
13. O-ring
14. Shaft seal
15. Bushing

Inspection

1. Measure the knuckle pin O.D. and the axle case support bushing I.D. to determine the bushing to pin clearance (Fig. 17). Replace components as necessary.

BUSHING TO PIN CLEARANCE:
0.002 to 0.016 inch (0.05 to 0.40 mm)

KNUCKLE PIN O.D. (Factory Spec.):
0.982 to 0.983 inch (24.95 to 24.98 mm)

AXLE CASE SUPPORT BUSHING I.D.
(Factory Spec.):
0.984 to 0.987 inch (25.00 to 25.08 mm)

2. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

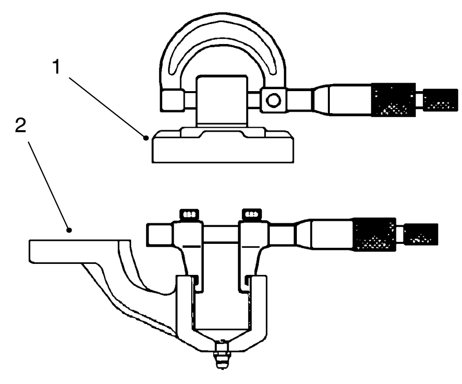

Figure 17

1. Knuckle pin
2. Axle case support

Axles, Planetaries and Brakes

Installation

1. Coat new shaft seal with grease and install in axle case as shown (Fig. 18).

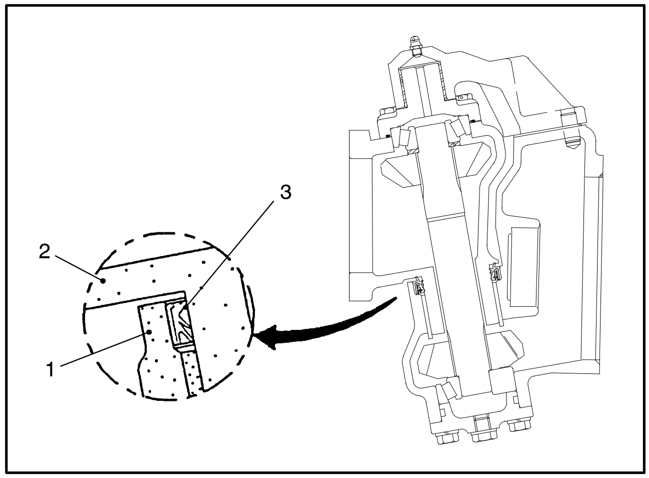

Figure 18

1. **Axle case**
2. **Bevel gear case**
3. **Shaft seal**

2. Install the lower bevel gear and bevel gear shaft in the axle case cover. Coat a new O-ring with grease and install the axle case cover (Fig. 19). Tighten cover screws from **17 to 20 ft-lb (23 to 27 N−m)**.

3. Slide the bevel gear case over the bevel gear shaft and install the bevel gear and collar. Make sure the bevel gear shaft is completely seated in the upper and lower bearings (Fig. 19).

4. Install the knuckle pin. Use medium strength thread-locking compound and tighten the knuckle pin mounting screws from **17 to 20 ft-lb (23 to 27 N−m)**.

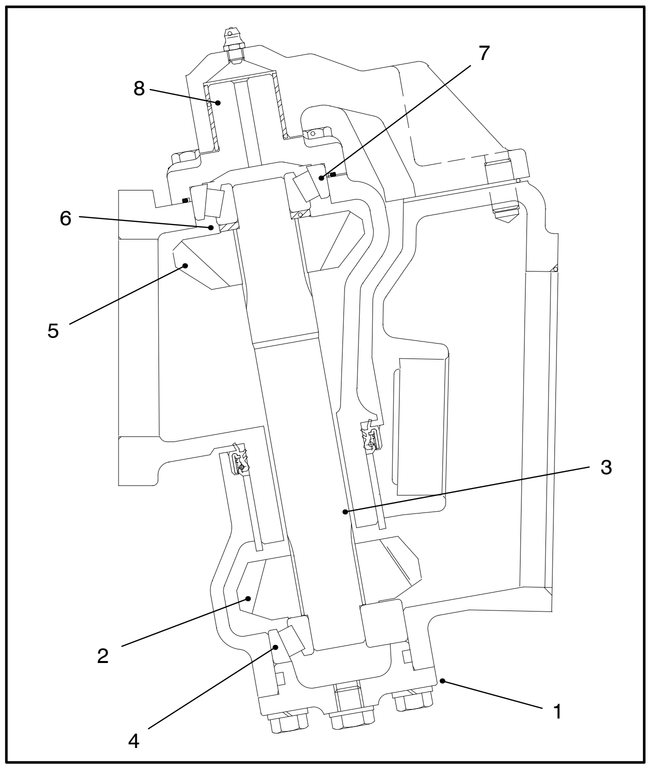

Figure 19

1. **Axle case cover**
2. **Lower bevel gear**
3. **Bevel gear shaft**
4. **Lower bearing**
5. **Upper bevel gear**
6. **Collar**
7. **Upper bearing**
8. **Knuckle pin**

5. Determine necessary quantity of support shims.

A. Lubricate the axle case support bushing with a thin coat of grease and slide axle case support onto knuckle pin.

B. Position support shims that were removed during disassembly between axle case support and axle case. Install mounting screws into axle case. Slowly tighten screws while frequently checking for clearance (vertical endplay) between axle case support and knuckle pin. If binding of components is noted before screws are fully tightened, add additional support shims. Torque screws from **57 to 67 ft−lb (77 to 91 N−m)**.

C. Use dial indicator to measure vertical endplay of axle case (Fig. 20).

AXLE CASE ASSEMBLY ENDPLAY:
0.001 to 0.008 inch (0.02 to 0.20 mm)

D. Adjust endplay by increasing or reducing number of axle case support shims.

NOTE: Axle case support shims are available in 0.004 inch (0.1 mm), 0.008 inch (0.2 mm) and 0.016 inch (0.4 mm) thickness.

6. After correct support shims have been determined, remove mounting screws, apply heavy strength thread−locking compound to screw threads, reinstall screws and torque from **57 to 67 ft−lb (77 to 91 N−m)**.

IMPORTANT: Correct engagement between bevel gears is critical to axle performance and durability.

7. Temporarily install the bevel gear case/axle case assembly on the axle support. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the upper bevel gear to differential shaft gear backlash (Fig. 21).

UPPER BEVEL GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

8. Adjust backlash by increasing or reducing axle bearing shim thickness (see Differential Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.004 inch (0.1 mm), 0.008 inch (0.2 mm) and 0.020 inch (0.5 mm) thickness.

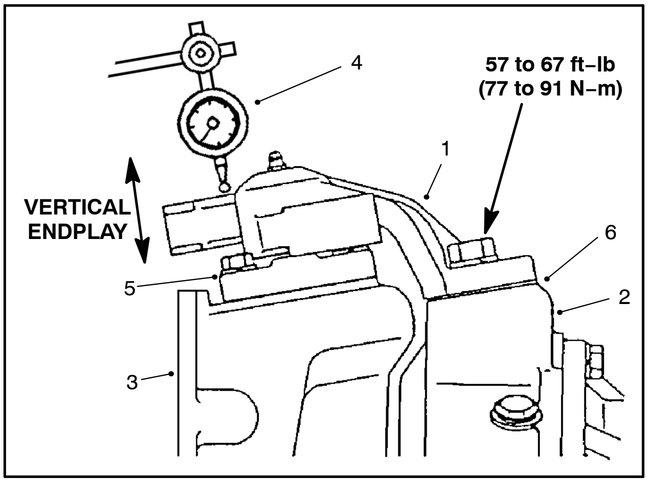

Figure 20

1. **Axle case support**
2. **Axle case**
3. **Bevel gearcase**
4. **Dial indicator**
5. **Knuckle pin**
6. **Support shim location**

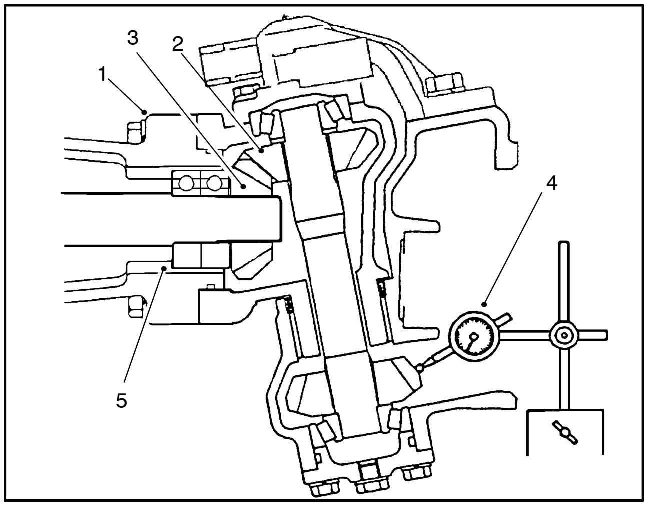

Figure 21

1. **Axle support**
2. **Upper bevel gear**
3. **Differential shaft gear**
4. **Dial indicator**
5. **Axle bearing shims**

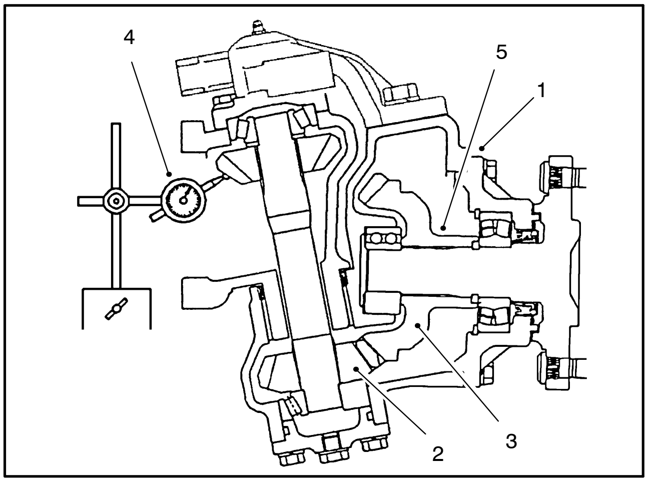

Figure 22

1. **Axle cover assembly**
2. **Lower bevel gear**
3. **Axle gear**
4. **Dial indicator**
5. **Axle bearing shims**

Axles, Planetaries and Brakes

9. Remove the bevel gear case/axle case assembly from the axle support. Coat a new O-ring with grease and temporarily install the axle cover assembly. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the lower bevel gear to axle gear backlash (Fig. 22).

LOWER BEVEL GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

10. Adjust backlash by increasing or reducing axle bearing shim thickness (see Axle Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.008 inch (0.2 mm), 0.012 inch (0.3 mm) and 0.020 inch (0.5 mm) thickness.

11. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N−m)**.

12. Coat a new O-ring with grease and install the bevel gear case/axle case assembly on the axle support. Tighten mounting screws and nuts from **35 to 41 ft-lb (47 to 56 N−m)** (Fig. 13).

Differential Shafts

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

IMPORTANT: Do not interchange right and left differential shaft assemblies.

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 23).

2. Mark and pull the differential shaft assembly from the axle support.

3. Remove the retaining ring and bevel gear (Fig 24).

4. Drive the differential shaft out of the bearings. Remove the bearings and bearing shims.

5. Inspect all gears, shafts, bearings and cases for damage and wear. Replace components as necessary.

Installation

1. Press bearings onto differential shaft. Place correct combination of bearing shims in axle support and drive differential shaft and bearing assembly into axle support.

2. Install bevel gear and retaining ring.

3. Coat new O-ring with grease. Align differential shaft splines with differential gear assembly and slide differential shaft assembly onto axle support.

4. Install bevel gear case/axle case assembly (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

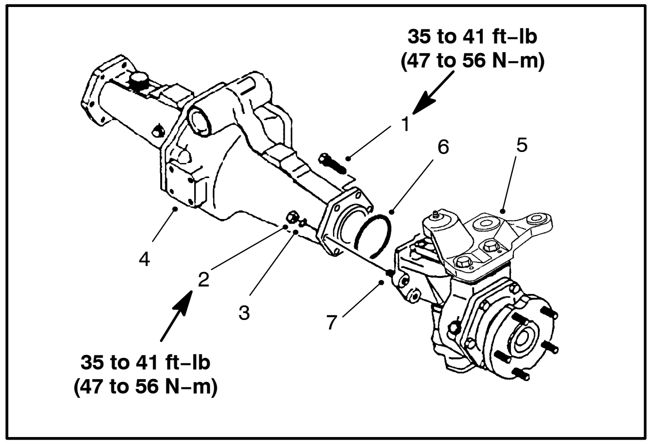

Figure 23

1. **Cap screw (4 used)**
2. **Lock nut (2 used)**
3. **Lock washer (2 used)**
4. **Axle support**
5. **Bevel gear/axle case assembly**
6. **O-ring**
7. **Stud (2 used)**

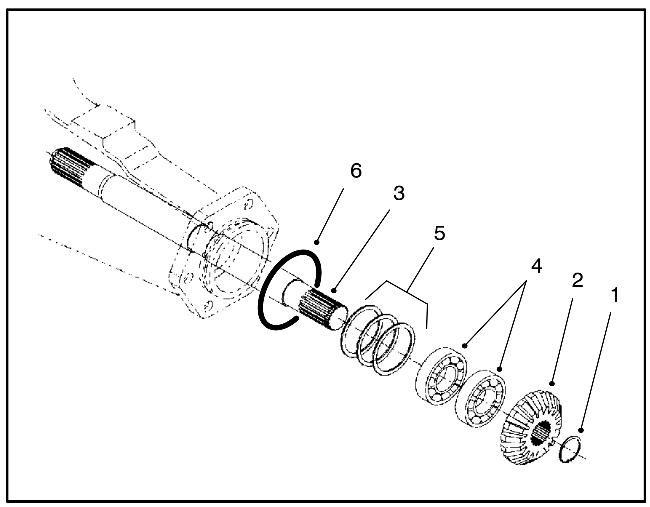

Figure 24

1. **Retaining ring**
2. **Bevel gear**
3. **Differential shaft**
4. **Bearing**
5. **Bearing shims**
6. **O-ring**

Axle Shafts

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 25).

2. Use a bearing puller to remove the bearing and bevel gear as shown (Fig. 26).

3. Remove the shims, spacer and retaining ring. Drive the axle out of the bearing and cover. Remove and discard the axle shaft seal.

4. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

Installation

1. Coat new axle shaft seal with grease and install in axle cover as shown (Fig. 27).

2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Fig. 27).

3. Install retaining ring, spacer and correct combination of bearing shims. Install bevel gear and bearing.

4. Coat a new O-ring with grease and install the axle cover assembly. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N−m)**.

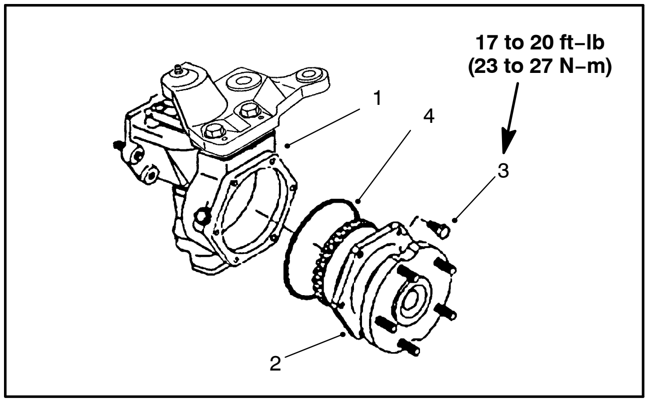

Figure 25

1. **Axle case**
2. **Axle cover assembly**
3. **Screw (6 used)**
4. **O-ring**

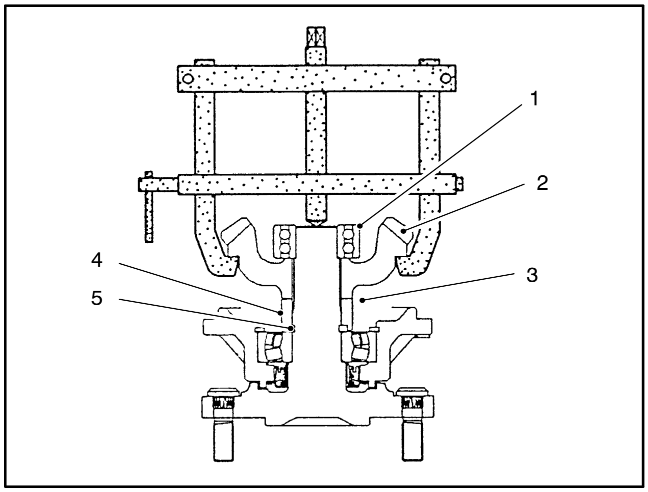

Figure 26

1. **Bearing**
2. **Bevel gear**
3. **Shims**
4. **Spacer**
5. **Retaining ring**

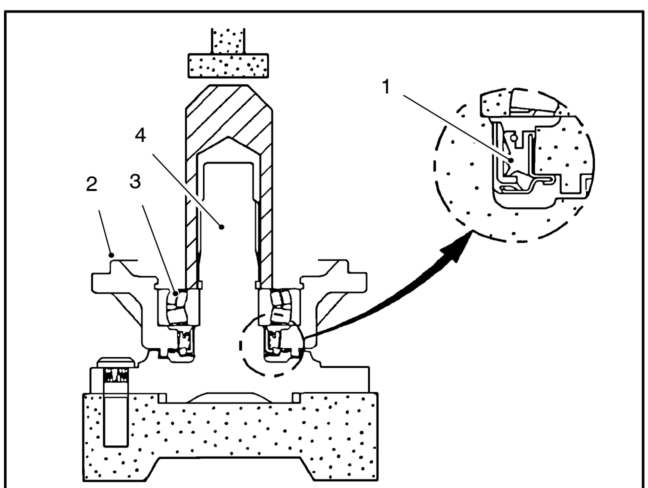

Figure 27

1. **Axle shaft seal**
2. **Axle cover**
3. **Bearing**
4. **Axle shaft**

Axles, Planetaries and Brakes

Input Shaft/Pinion Gear

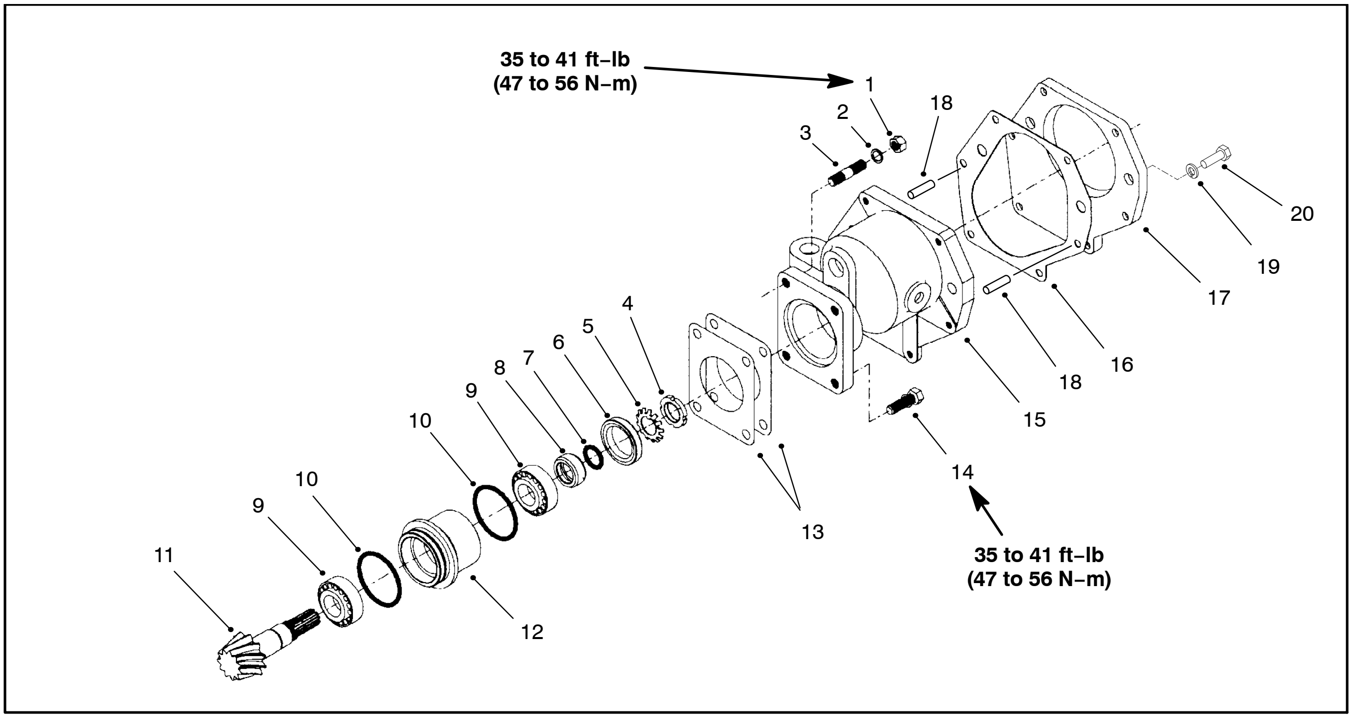

Figure 28

1. **Nut (2 used)**
2. **Lock washer (2 used)**
3. **Stud (2 used)**
4. **Lock nut**
5. **Stake washer**
6. **Oil seal**
7. **O-ring**
8. **Seal collar**
9. **Bearing**
10. **O-ring**
11. **Input shaft/pinion gear**
12. **Bearing case**
13. **Shim**
14. **Screw (2 used)**
15. **Gear case**
16. **Gasket**
17. **Cover plate**
18. **Dowel pin**
19. **Lock washer (6 used)**
20. **Cap screw (6 used)**

The following procedures assume the rear axle assembly has been removed from the machine.

Removal (Fig. 28)

1. Remove the cover plate, gasket and gear case assembly from the axle assembly. Remove the gasket and any remaining gasket material.

2. Remove the retaining rings and the driven gear from the input shaft/pinion gear.

3. Remove input shaft/pinion gear assembly from the gear case. Remove the shims and bearing case O-rings.

4. Release the stake washer and remove the lock nut. Remove and discard the stake washer.

5. Drive the input shaft/pinion gear out from the outer bearing cone and bearing case. Remove and discard the oil seal and O-ring.

6. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

NOTE: Replacement input shaft/pinion gear (item 11) is only available in matched set with differential ring gear.

Installation (Fig. 28)

NOTE: When installing bearing cones onto the input shaft/pinion gear, press only on the inner race of the bearing cone.

1. If the inner bearing cone was removed, press a new bearing cone all the way onto the input shaft/pinion gear.

2. Place the shaft and bearing assembly in the bearing case and install the outer bearing cone.

NOTE: The bearings must be completely seated. There should be no input shaft/pinion gear end play.

3. Coat a new oil seal with grease and install as shown (Fig. 29). The seal should be installed with the garter spring towards the hydraulic motor location.

4. Coat new O-ring with grease. Install O-ring in the oil seal collar and install the collar.

5. Install a new stake washer. Install the lock nut finger tight.

6. Set the bearing preload by securing the bearing case in a vise. Thread a M12 x 1.5 hex head cap screw into the splined end of the input shaft/pinion gear and slowly tighten the lock nut until 4 to 6 in-lb (0.4 to 0.7 N–m) of force is required to rotate the input shaft/pinion gear in the bearing case.

7. Secure the lock nut with the stake washer.

8. Use a depth gauge to measure the distance from the end face of the input shaft/pinion gear to the mating surface of the bearing case. Subtract the “Design Cone Center Distance” from this distance to determine initial shim thickness (Fig. 30).

DESIGN CONE CENTER DISTANCE
(distance from mating surface of axle support to end face of pinion gear):
1.870 ± 0.002 inch (47.5 ± 0.05 mm)

NOTE: Bearing case shims are available in 0.004 inch (0.1 mm) and 0.008 inch (0.2 mm) thickness.

9. Coat new O-rings with grease and install the bearing case in the gear case. Place shims on the gear case and temporarily install gear case assembly into axle case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N–m)**.

10. Insert a screwdriver through the drain plug hole to hold ring gear and measure the pinion gear to ring gear backlash (Fig. 31).

PINION GEAR TO RING GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

11. Adjust backlash by increasing or reducing gear case shim thickness.

12. Check pinion gear to ring gear engagement (see Pinion Gear to Ring Gear Engagement in this section of this manual).

13. Place the correct combination of shims on the gear case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N–m)**.

14. Install retaining rings and driven gear on input shaft/pinion gear.

15. If the drive gear (on drive motor shaft) was removed, install the retaining rings and drive gear on the motor shaft.

16. Use a new gasket and install the cover plate. Use a new O-ring and install the drive motor.

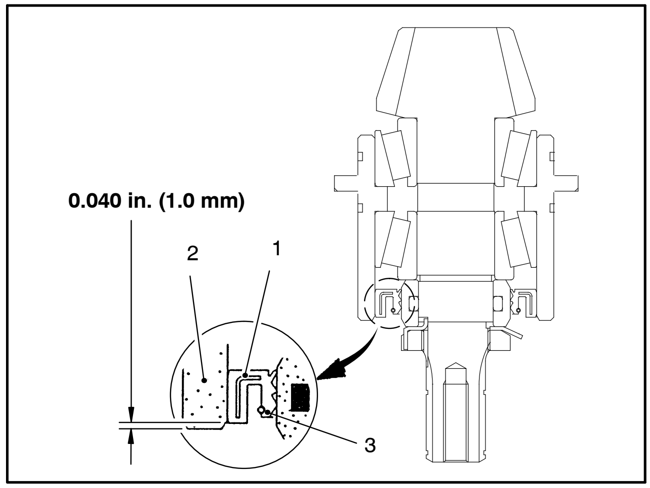

Figure 29

1. **Oil seal**
2. **Bearing case**
3. **Seal garter spring**

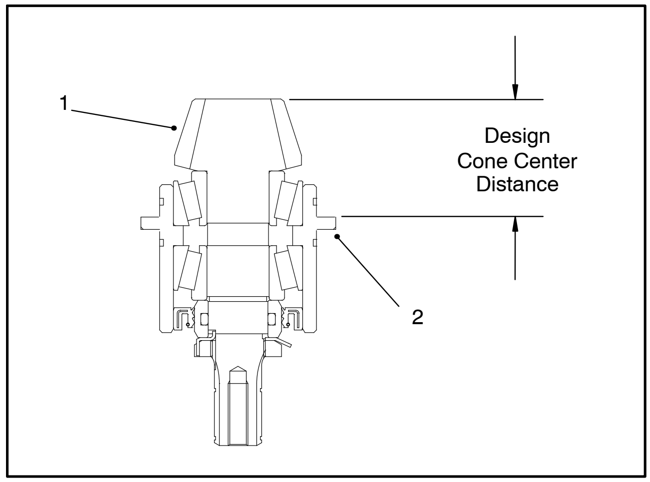

Figure 30

1. **Input shaft/pinion gear**
2. **Bearing case**

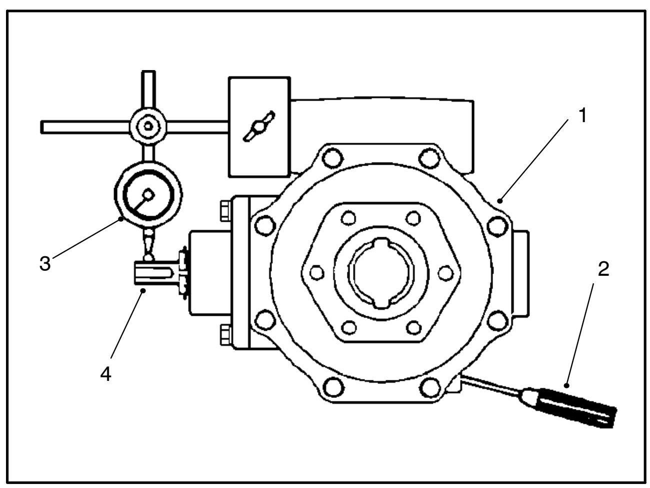

Figure 31

1. **Axle case**
2. **Screwdriver**
3. **Dial indicator**
4. **Input shaft/pinion gear**

Differential Gear

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

IMPORTANT: Do not interchange right and left differential shafts assemblies.

2. Mark and pull the differential shaft assemblies from the axle support.

3. Remove input shaft/pinion gear assembly, shims and O-ring from the axle support (Fig. 32).

4. Remove the axle support case screws. Separate the axle support halves and remove the O-ring.

5. Remove the differential gear assembly, bearings and adjusting shims from the axle case.

6. Drive the spring pin from the differential case with a punch and hammer. Discard the spring pin (Fig. 33).

NOTE: Mark and arrange all components so they can be reassembled in their original position.

7. Remove the differential pinion shaft, pinion gears and pinion washers. Remove the differential side gears and side gear shims. Remove the ring gear only if it will be replaced (Fig. 34).

NOTE: Replacement ring gears are only available in matched ring and pinion sets.

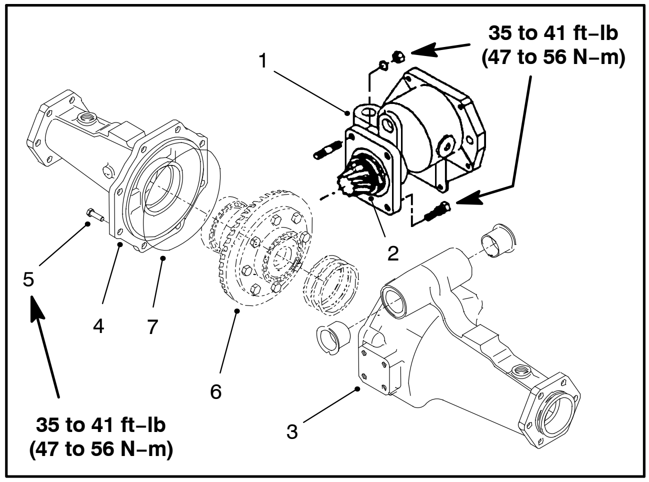

Figure 32

1. **Gear Case**
2. **Pinion Gear**
3. **Axle support (left)**
4. **Axle support (right)**
5. **Case screw (8 used)**
6. **Differential gear**
7. **O-ring**

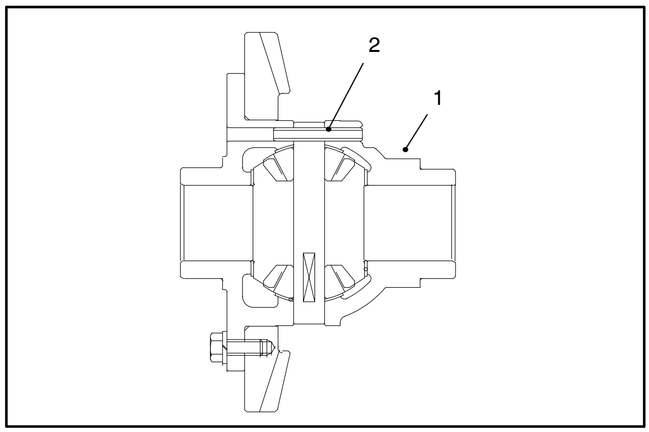

Figure 33

1. **Differential case**
2. **Spring pin**

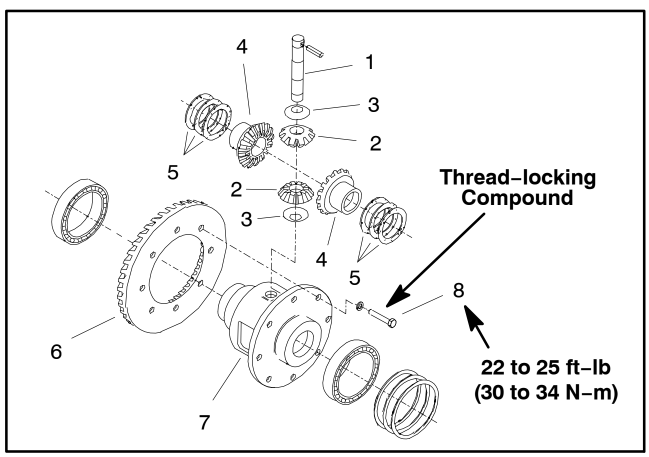

Figure 34

1. **Differential pinion shaft**
2. **Pinion gear**
3. **Pinion washer**
4. **Side gear**
5. **Side gear shims**
6. **Ring gear**
7. **Differential case**
8. **Bolt/washer (8 used)**

Inspection

1. Measure the differential side gear O.D. and the differential case I.D. to determine the side gear to case clearance (Fig. 35). Replace components as necessary.

SIDE GEAR TO CASE CLEARANCE:
0.002 to 0.012 inch (0.05 to 0.30 mm)

SIDE GEAR O.D. (Factory Spec.):
1.335 to 1.337 inch (33.91 to 33.95 mm)

DIFFERENTIAL CASE I.D. (Factory Spec.):
1.339 to 1.341 inch (34.00 to 34.06 mm)

2. Measure the differential pinion shaft O.D. and the pinion gear I.D. to determine the pinion shaft to pinion gear clearance (Fig. 36). Replace components as necessary.

PINION SHAFT TO PINION GEAR CLEARANCE:
0.001 to 0.010 inch (0.03 to 0.25 mm)

PINION SHAFT O.D. (Factory Spec.):
0.550 to 0.551 inch (13.97 to 13.10 mm)

PINION GEAR I.D. (Factory Spec.):
0.551 to 0.552 inch (13.10 to 14.02 mm)

3. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

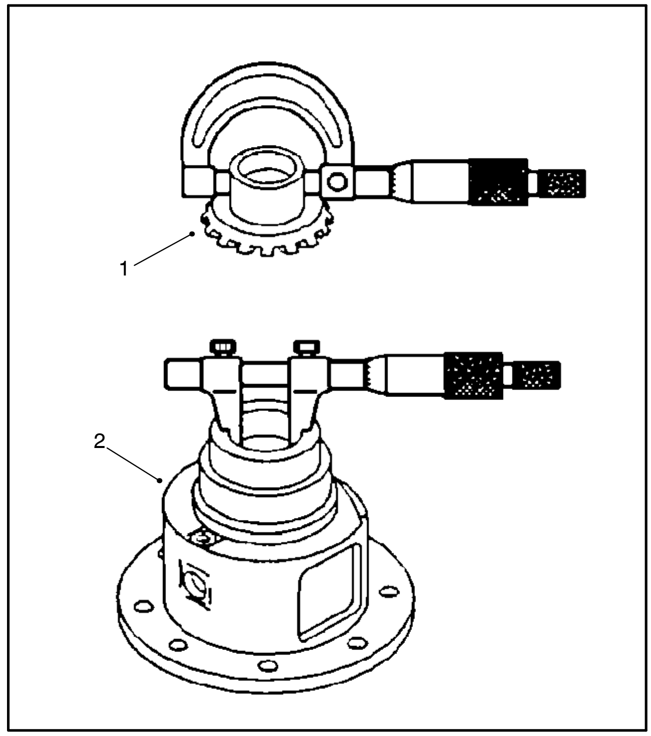

Figure 35

1. **Side gear** 2. **Differential case**

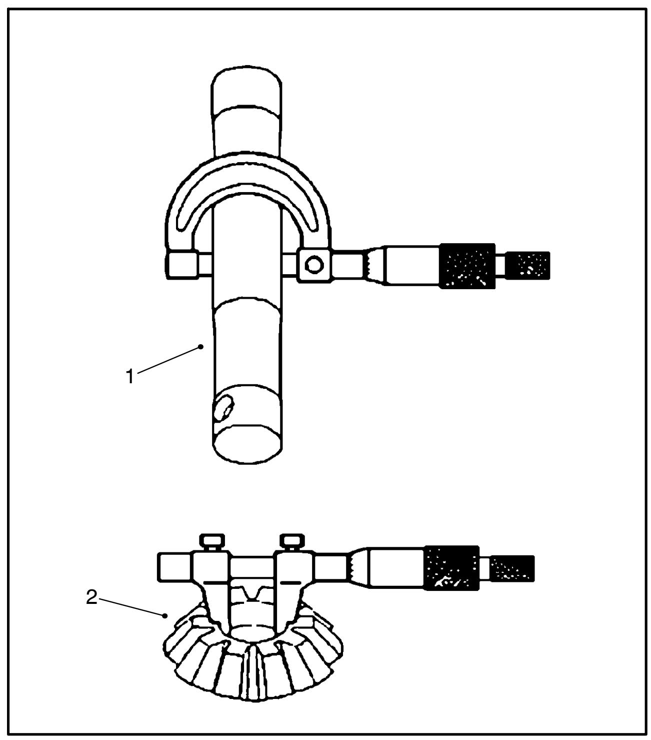

Figure 36

1. **Pinion shaft** 2. **Pinion gear**

Installation

1. If the ring gear was removed from the differential case, use medium strength Loctite thread locker and tighten the mounting screws from **22 to 25 ft-lb (30 to 34 N-m)**.

2. Apply molybdenum disulfide lubricant (Three Bond 1901 or equivalent) to the splines and bearing surfaces of the differential pinion gears, pinion washers and side gears.

3. Install the side gear shims and side gears in their original location in the differential case.

4. Place the differential pinion gears and pinion washers in their original location in the differential case. Temporarily install the differential pinion shaft.

5. Secure the differential case in a soft jawed vise. Position a dial indicator on a tooth of the differential pinion gear. Press the pinion and side gear against the differential case and measure the pinion gear to side gear backlash (Fig. 37).

PINION GEAR TO SIDE GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

6. Adjust backlash by increasing or reducing side gear shim thickness.

NOTE: Side gear shims are available in 0.043 inch (1.10 mm), 0.047 inch (1.20 mm) and 0.051 inch (1.30 mm) thickness.

7. Apply gear marking compound, such as DyKem® Steel Blue lightly over several gear teeth.

8. While applying a light load to either side gear, rotate either pinion gear until the side gears have made one complete revolution.

9. Ideal tooth contact should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe (small) end (Fig. 38).

10. Adjust side gear shims if necessary to correct tooth contact. Recheck differential pinion gear to side gear backlash if any changes are made.

11. After backlash and tooth contact have been adjusted, align the hole in the differential pinion shaft with the hole in the differential case and install a new spring pin.

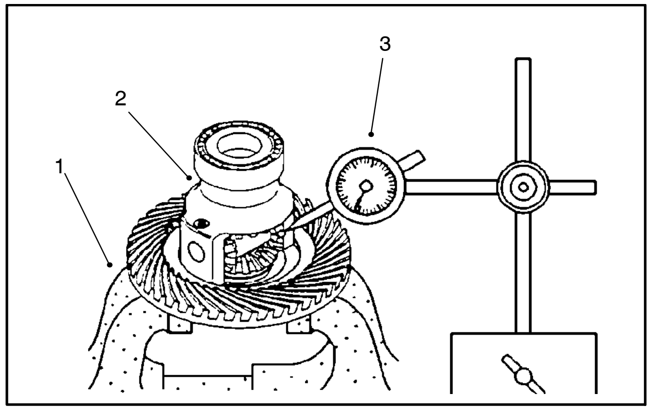

Figure 37

1. **Vise**
2. **Differential gear case**
3. **Dial indicator**

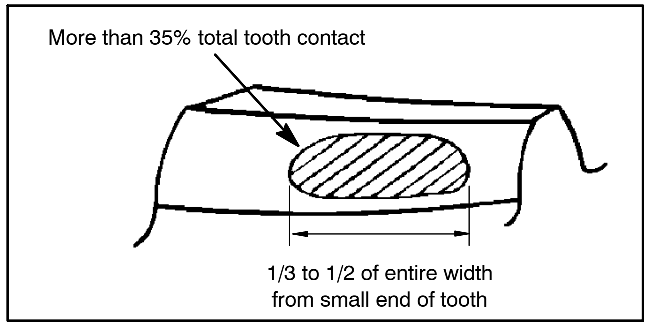

Figure 38

12. Install differential gear assembly in right side axle support half.

13. Coat a new o-ring with grease and install left side axle support half. Tighten axle support case screws from **35 to 41 ft-lb (47 to 56 N-m)**.

14. Install input shaft/pinion gear assembly (see Input Shaft/Pinion Gear in this section of this manual).

15. Coat new o-rings with grease, align differential shaft splines with differential gear assembly and slide differential shaft assemblies onto axle support.

16. Install bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

Pinion Gear to Ring Gear Engagement

The final position of the pinion gear is verified by using the gear contact pattern method as described in the following procedure.

GEAR TOOTH DEFINITIONS (Fig. 39):

Toe – the portion of the tooth surface at the end towards the center.

Heel – the portion of the gear tooth at the outer end.

Top Land – top surface of tooth.

1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem® Steel Blue.

2. Install the input shaft/pinion gear assembly into axle case.

3. While applying a light load to the ring gear, rotate the pinion gear in the direction of forward travel until the ring gear has made one complete revolution.

Ideal tooth contact observed on the ring gear should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe end (Fig. 40).

Adjustments to the gear contact position are made by moving the input shaft/pinion gear (bearing case shims) or by moving the differential gear case (differential bearing shims) (Fig. 41).

NOTE: Bearing case shims are available in 0.004 inch (0.10 mm) and 0.008 inch (0.20 mm) thickness.

NOTE: Differential bearing shims are available in 0.004 inch (0.10 mm), 0.008 inch (0.20 mm) and 0.016 inch (0.40 mm) thickness.

Study the different contact patterns (Figs. 42 and 43) and correct gear engagement as necessary.

NOTE: When making changes, note that two variables are involved (see Gear Pattern Movement Summary in this section of this manual).

Example: If the pinion gear to ring gear backlash is set correctly to specifications and the bearing case shim is changed to adjust tooth contact, it may be necessary to readjust backlash to the correct specification before checking the contact pattern.

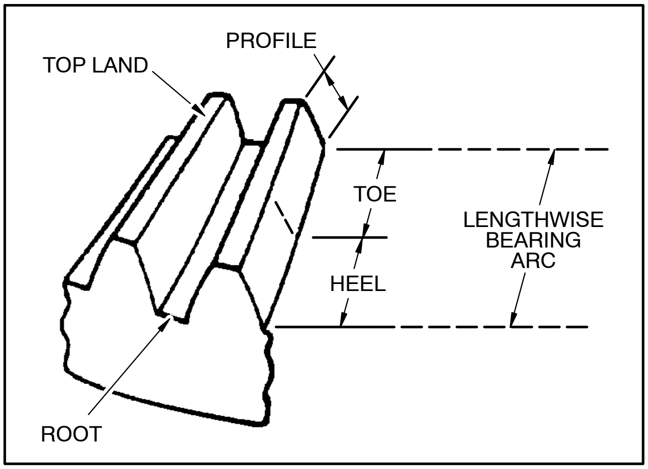

Figure 39

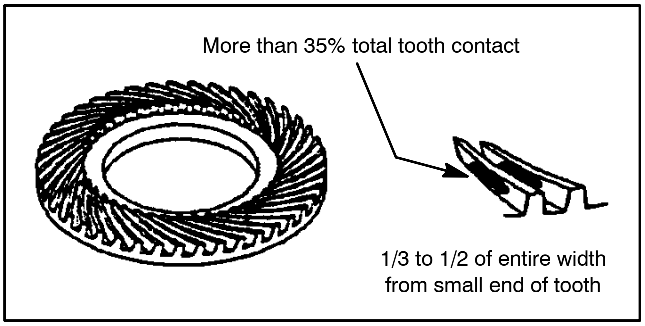

Figure 40

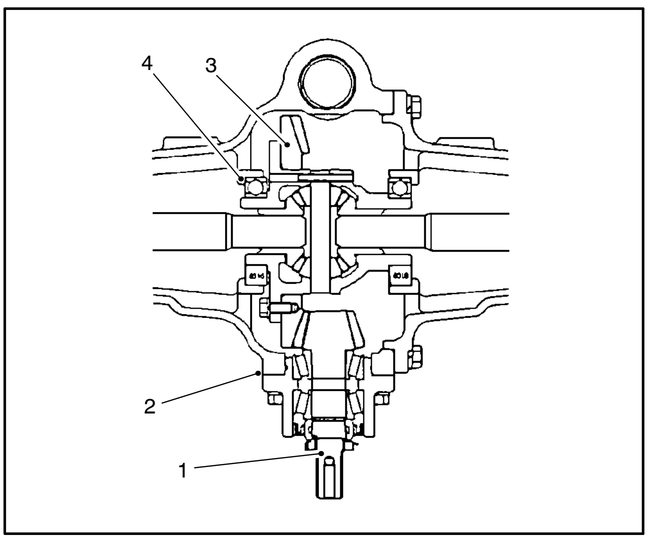

Figure 41

1. **Input shaft/pinion gear**
2. **Bearing case shims**
3. **Differential gear case**
4. **Differential bearing shims**

Gear Pattern Movement Summary

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as gear location is changed.

1. If contact is toward the heel or base of the gear (Fig. 42):

   A. Install thicker or additional bearing case shim(s) to move pinion shaft toward ring gear.

   B. Install thinner or remove differential bearing shim(s) to move ring gear backward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

2. If contact is toward the toe or tip of the gear (Fig. 43):

   A. Install thinner or remove bearing case shim(s) to move pinion shaft away from ring gear.

   B. Install thicker or additional differential bearing shim(s) to move ring gear forward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

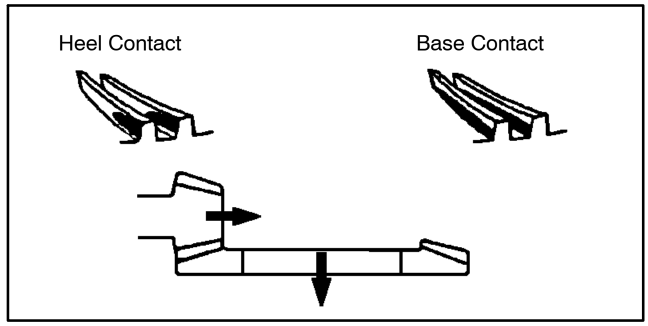

Figure 42

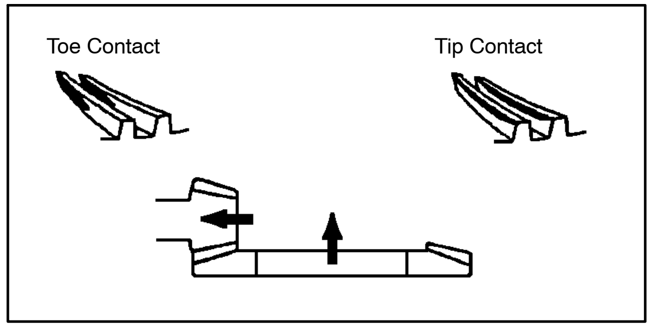

Figure 43

Chapter 7

Chassis

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Chassis

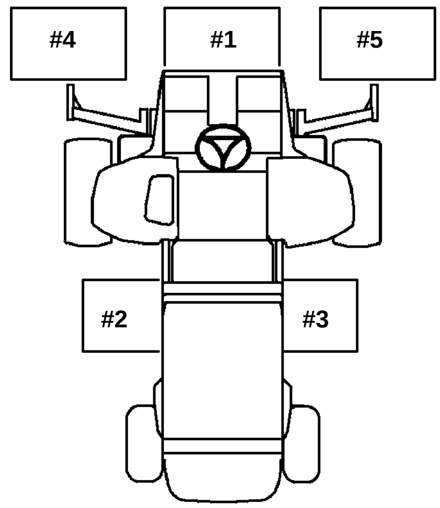
General Information

Operator's Manual

The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

Cutting Unit Identification

Cutting units on the Reelmaster 7000 are identified as shown in Figure 1.



CUTTING UNIT LOCATIONS

Figure 1

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Chassis

Service and Repairs

Steering Column

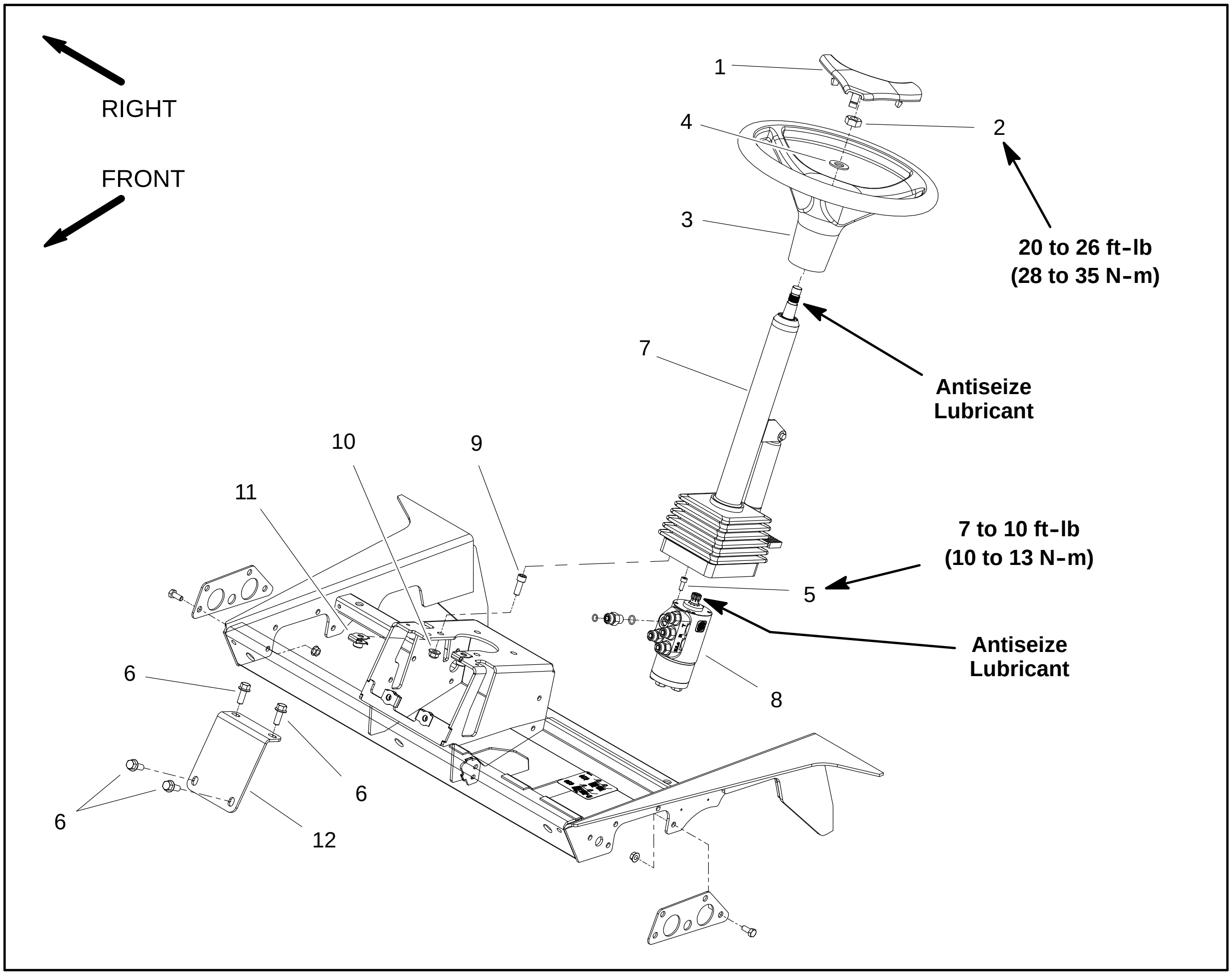

Figure 2

1. Steering wheel cover	**5. Socket head screw (4 used)**	**9. Socket head screw (4 used)**
2. Lock nut	**6. Flange head screw (4 used)**	**10. Flange nut (4 used)**
3. Steering wheel	**7. Steering column**	**11. Tinnerman nut (4 used)**
4. Flat washer	**8. Steering control valve**	**12. Column brace**

Removal (Fig. 2)

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

2. Remove platform shroud from machine to allow access to steering column fasteners (Fig. 3).

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

4. Remove lock nut and flat washer that secure steering wheel to steering column.

5. Use a suitable puller to remove steering wheel from steering column.

6. Remove four (4) flange head screws that secure column brace (item 12) to frame platform. Remove brace from machine to allow access to steering column fasteners.

7. Slide rubber bellows up steering column to allow access to fasteners that secure steering control valve and steering column to machine.

8. Support steering control valve to prevent it from shifting during steering column removal.

9. Loosen and remove four (4) socket head screws (item 5) that secure steering control valve to steering column.

10. Loosen and remove four (4) socket head screws (item 9) and flange nuts (item 10) that secure steering column to machine.

11. Raise steering column assembly from steering control valve and machine.

12. Disassemble steering column assembly as needed using Figure 4 as a guide.

Installation (Fig. 2)

1. Assemble steering column using Figure 4 as a guide.

2. Apply antiseize lubricant to input shaft of steering control valve.

3. Slide steering column onto steering control valve. Secure steering column in place with four (4) socket head screws (item 9) and flange nuts (item 10).

4. Secure steering control valve to steering column with four (4) socket head screws (item 5). Torque screws from **7 to 10 ft-lb (10 to 13 N-m)**.

5. Slide rubber bellows to bottom of steering column.

6. Position column brace (item 12) in place and secure with four (4) flange head screws.

7. Thoroughly clean tapered surfaces of steering wheel and steering column.

8. Apply antiseize lubricant to splines of steering column taking care to keep antiseize lubricant from column taper. Slide steering wheel onto steering column.

9. Secure steering wheel to steering column with flat washer and lock nut. Torque hex nut from **20 to 26 ft-lb (28 to 35 N-m)**.

10. Install steering wheel cover to steering wheel.

11. Install and secure platform shroud to machine (Fig. 3).

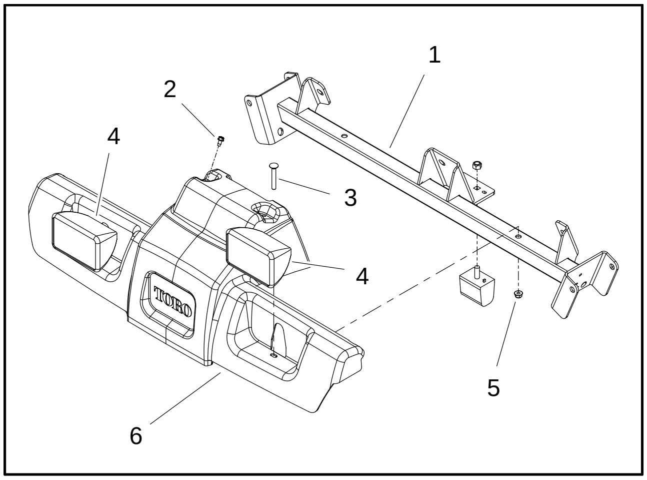

Figure 3

1. Roller support
2. Screw (2 used)
3. Carriage screw (2 used)
4. Headlight assembly
5. Flange nut (2 used)
6. Platform shroud

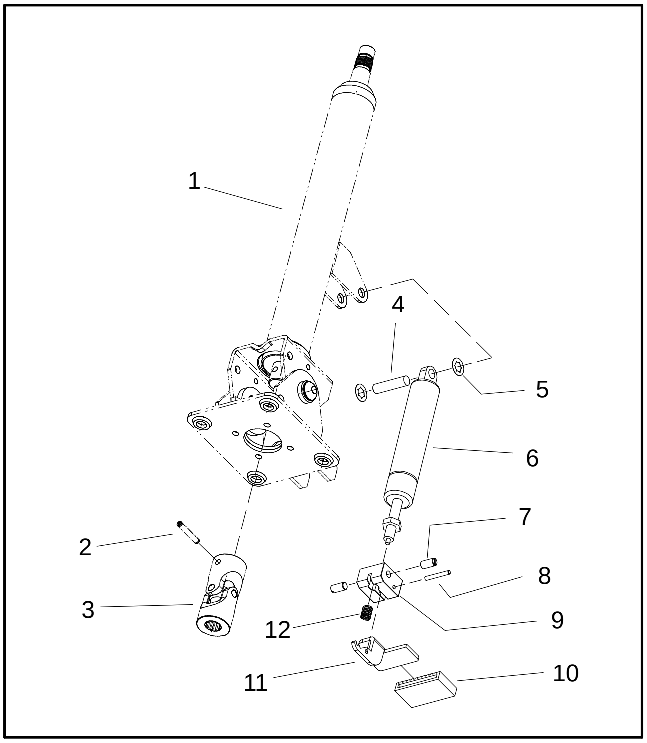

Figure 4

1. Steering column
2. Pin
3. Universal joint
4. Pin
5. Lock washer (2 used)
6. Cylinder
7. Bolt (2 used)
8. Pin
9. Pedal block
10. Pedal cover
11. Pedal
12. Spring

Console Arm

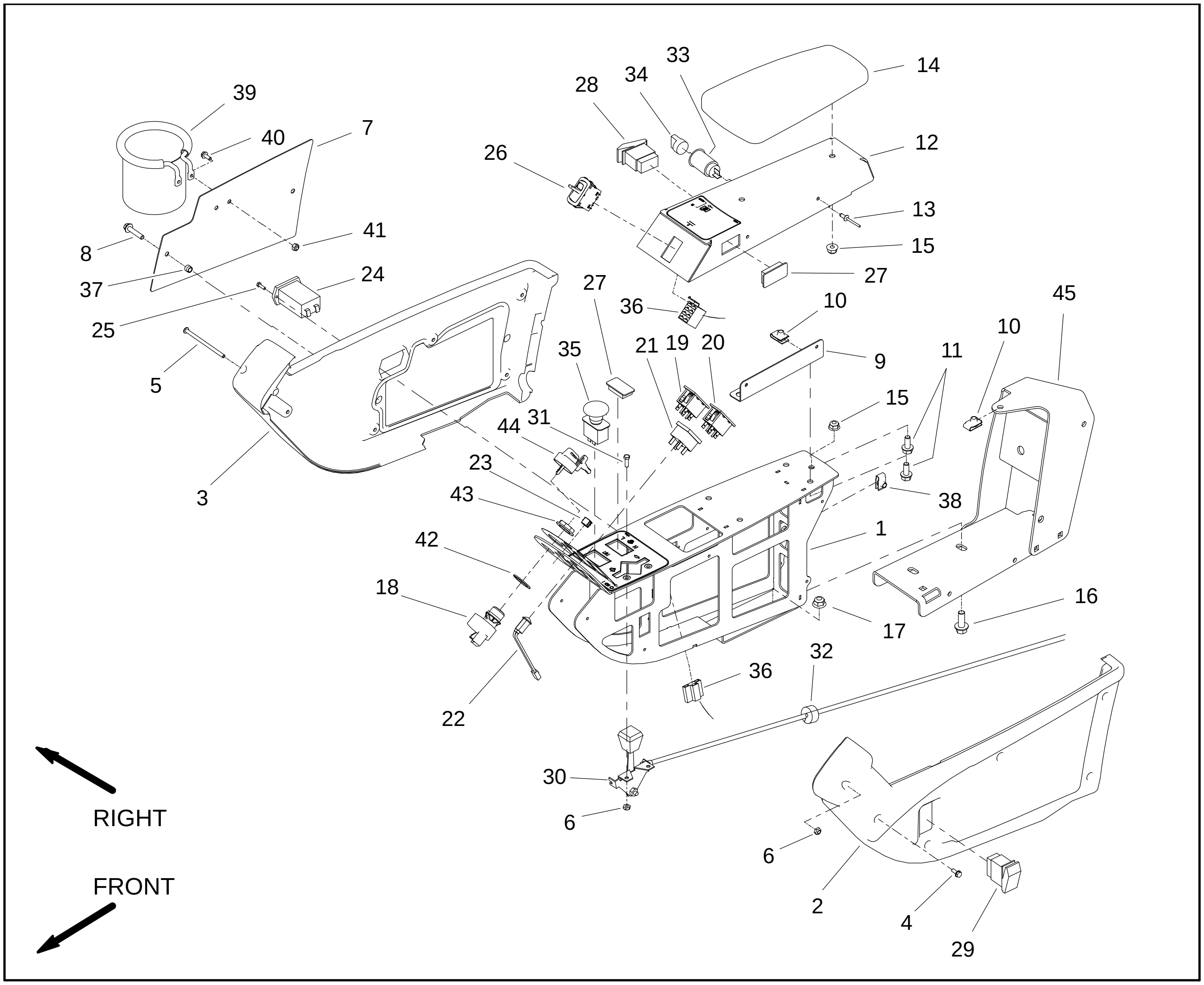

Figure 5

1. **Console arm frame**
2. **LH cover**
3. **RH cover**
4. **Washer head screw (10 used)**
5. **Phillips head screw**
6. **Lock nut (3 used)**
7. **Cover plate**
8. **Flange head screw (2 used)**
9. **Mount**
10. **U–nut (5 used)**
11. **Flange head screw (5 used)**
12. **Switch panel**
13. **Rivet (2 used)**
14. **Arm rest**
15. **Flange nut (3 used)**
16. **Flange head screw (2 used)**
17. **Flange nut (2 used)**
18. **Ignition switch**
19. **Indicator light (charge/oil pressure)**
20. **Indicator light (high temp/glow plug)**
21. **Temperature gauge**
22. **Indicator light**
23. **Button plug**
24. **Hour meter**
25. **Cap screw (2 used)**
26. **Cutting unit lift switch**
27. **Hole plug**
28. **Engine cooling fan switch**
29. **Headlight switch**
30. **Throttle cable**
31. **Screw (2 used)**
32. **Foam seal**
33. **Power point**
34. **Cap**
35. **PTO switch**
36. **Console wire harness**
37. **Flange spacer (2 used)**
38. **Clip (2 used)**
39. **Bag holder**
40. **Washer head screw (2 used)**
41. **Lock nut (2 used)**
42. **Lock washer**
43. **Nut**
44. **Ignition key**
45. **Arm support**

Disassembly (Fig. 5)

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

2. Remove two (2) flange head screws (item 8) and then cover plate (item 7) from outside of console arm. Locate and retrieve two (2) flange spacers (item 37).

3. At front of console arm, remove screw (item 5) and lock nut (item 6) that secure console arm covers to each other.

4. Remove five (5) washer head screws (item 4) that secure each cover to console arm panel.

5. Remove console arm covers from machine. As LH cover (item 2) is removed from console arm, unplug wire harness connector from headlight switch.

6. Remove electrical components from console arm as needed using Figure 5 as a guide.

7. If necessary, remove console panel and supports from machine using Figures 5 and 6 as guides.

Assembly (Fig. 5)

1. Install all removed electrical and console arm components using Figure 5 and 6 as guides.

2. Position covers to console arm. As LH cover (item 2) is placed, plug wire harness connector to headlight switch.

3. Secure each cover to console arm with five (5) washer head screws (item 4). Install screw (item 5) and lock nut (item 6) to secure covers at front of console arm.

4. Position cover plate and flange spacers to outside of console arm. Secure with two (2) flange head screws.

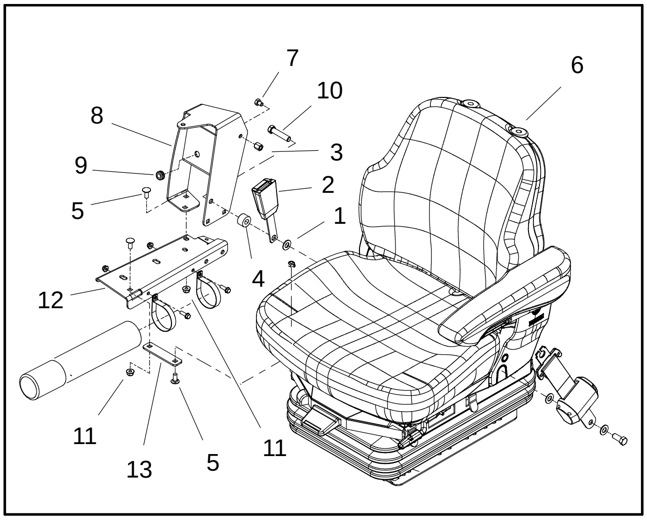

Figure 6

1. **Flat washer**
2. **Seat belt buckle**
3. **Coupling nut**
4. **Spacer**
5. **Carriage screw (6 used)**
6. **Operator seat**
7. **Cap screw**
8. **Arm support**
9. **Grommet**
10. **Cap screw**
11. **Flange nut**
12. **Support channel**
13. **Support bracket**

Chassis

Lift Arms for Front Cutting Units (#1, #4 and #5)

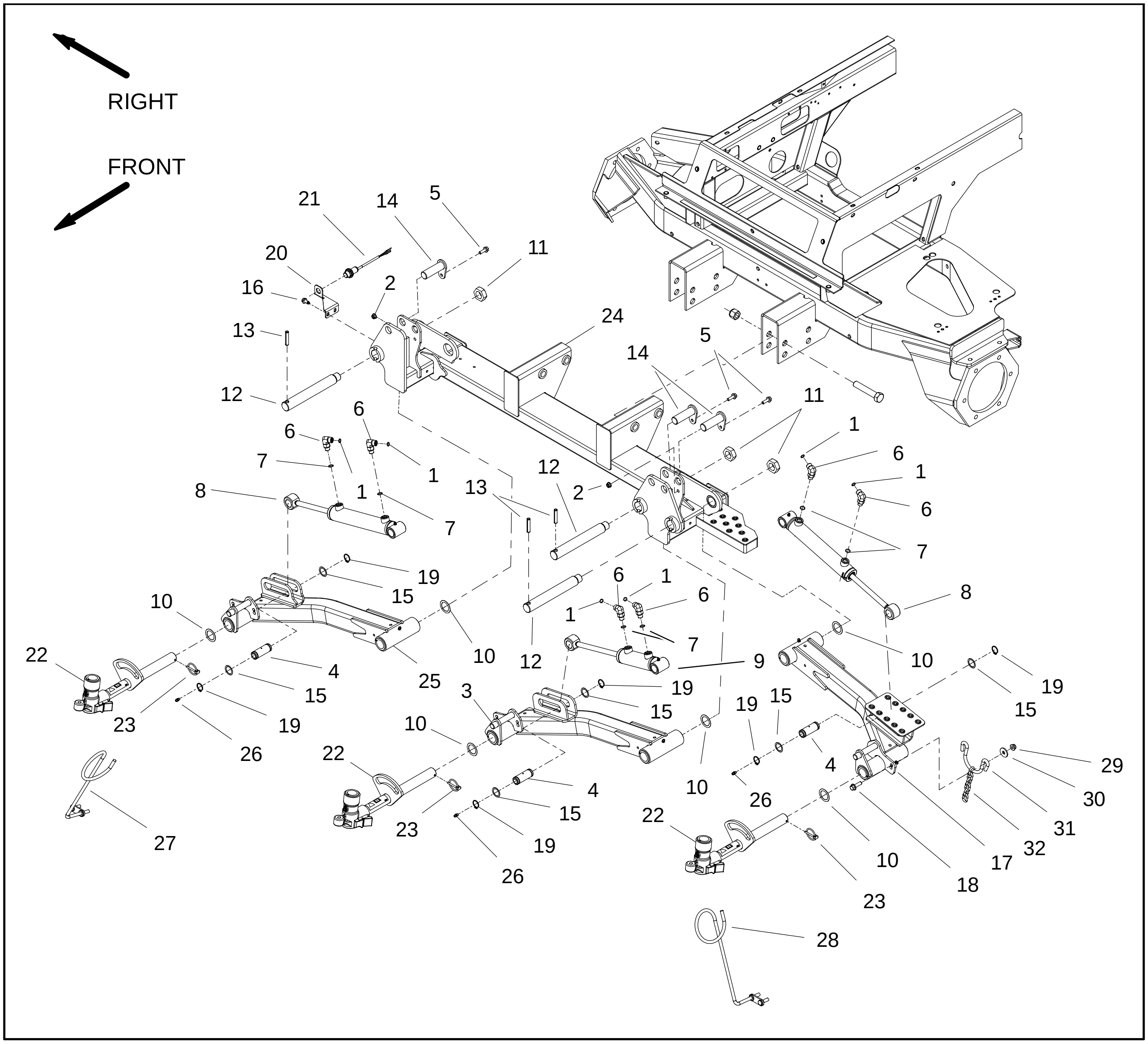

Figure 7

1. O–ring
2. Flange nut
3. Lift arm (cutting unit #1)
4. Cylinder pin
5. Flange head screw
6. 90º hydraulic fitting (2 per cylinder)
7. O–ring
8. Lift cylinder (cutting units #4 and #5)
9. Lift cylinder (cutting unit #1)
10. Thrust washer
11. Lock nut
12. Pivot pin
13. Slotted roll pin
14. Cylinder pin
15. Washer (2 per pin)
16. Washer head screw
17. Lift arm (cutting unit #4)
18. Flange head screw (2 per hoop)
19. Retaining ring (2 per pin)
20. Switch bracket
21. Cutting unit position sensor
22. Pivot yoke
23. Lynch pin
24. Front carrier frame
25. Lift arm (cutting unit #5)
26. Grease fitting
27. RH hose guide
28. LH hose guide
29. Flange nut (2 per hoop)
30. Washer (2 per hoop)
31. Chain hoop
32. Lift chain

Removal (Fig 7)

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

2. Remove cutting unit assembly from lift arm (see Cutting Unit Removal in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

3. If lift arm for either cutting unit #4 or #5 (Fig. 8) is to be removed, remove hose guide (item 27 or 28) from the cutting unit.

4. Remove one (1) retaining ring and washer from the cylinder pin (item 4). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

5. Loosen and remove lock nut (item 11) from lift arm pivot pin.

6. Support lift arm and pull lift arm pivot pin from lift arm and frame. Locate and remove thrust washer (item 10) from rear of lift arm during pivot pin removal.

7. Disassemble lift arm as needed using Figure 7 as a guide.

8. Clean lift arm and pivot pin. Inspect lift arm bushings and pivot pin for damage or wear. Replace worn or damaged components.

Installation (Fig 7)

1. Assemble lift arm using Figure 7 as a guide.

2. Position lift arm to frame. Fit thrust washer (item 10) between rear of lift arm and frame. Slide pivot pin into frame and lift arm. Align roll pin in pivot pin with slot in frame flange.

3. Install and tighten lock nut (item 11) to secure lift arm pivot pin.

4. Position lift cylinder rod clevis to lift arm

5. Make sure that one (1) retaining ring and washer are installed on cylinder pin (item 4). Insert cylinder pin through the lift arm and lift cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

NOTE: Install thrust washer (item 10) on carrier pivot shaft before installing cutting unit on pivot shaft.

6. Position and install cutting unit to lift arm (see Cutting Unit Installation in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

7. If lift arm for either cutting unit #4 or #5 was removed, install hose guide (item 27 or 28) to the cutting unit.

8. Lubricate lift arm and lift cylinder grease fittings after assembly is complete.

9. After assembly, raise and lower the cutting unit to verify that hydraulic hoses and fittings do not contact anything.

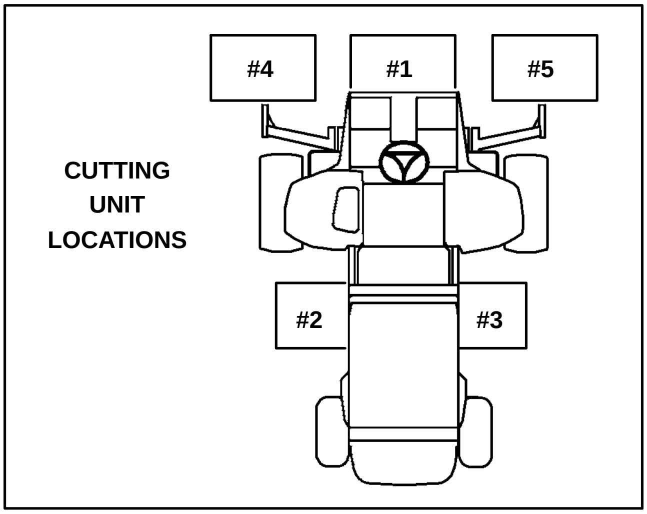

Figure 8

Lift Arms for Rear Cutting Units (#2 and #3)

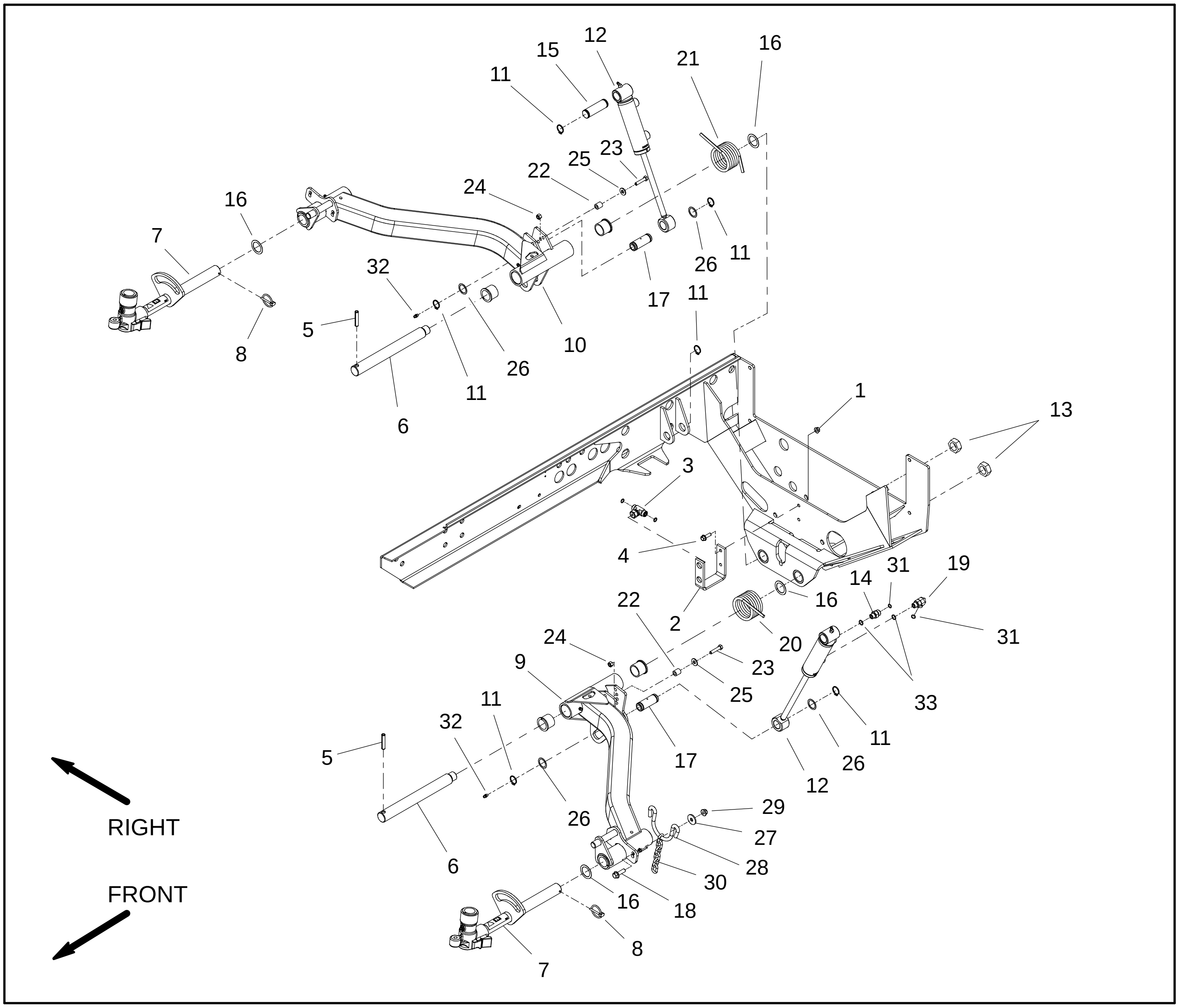

Figure 9

1. Flange nut (2 used)
2. Bulkhead bracket
3. Hydraulic tee fitting
4. Flange head screw (2 used)
5. Slotted roll pin
6. Pivot pin
7. Pivot yoke
8. Lynch pin
9. Lift arm (cutting unit #2)
10. Lift arm (cutting unit #3)
11. Retaining ring (2 per pin)
12. Lift cylinder (cutting units #2 and #3)
13. Lock nut
14. Straight hydraulic fitting
15. Cylinder pin
16. Thrust washer
17. Cylinder pin
18. Flange head screw (2 per hoop)
19. 90º hydraulic fitting
20. LH torsion spring
21. RH torsion spring
22. Spacer
23. Cap screw
24. Lock nut
25. Flat washer
26. Washer (2 per pin)
27. Washer (2 per hoop)
28. Chain hoop
29. Flange nut (2 per hoop)
30. Lift chain
31. O–ring
32. Grease fitting
33. O–ring

Removal (Fig. 9)

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

2. Remove cutting unit from lift arm (see Cutting Unit Removal in the Service and Repairs section of Chapter 8 – DPA Cutting Units).

3. Remove one (1) retaining ring and washer from the cylinder pin (item 17). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

CAUTION

Be careful when removing tension from the torsion spring on the rear lift arms. The spring is under heavy load and may cause personal injury.

4. Remove tension from torsion spring on rear of lift arm tube (Fig. 11):

A. Insert nut driver or small piece of pipe onto the end of the torsion spring that is on the rear of the lift arm.

B. Push down and rearward on the spring end to unhook the spring from the stop on the lift arm.

5. Loosen and remove lock nut (item 13) from lift arm pivot pin.

6. Support lift arm and pull lift arm pivot pin from lift arm and frame. Locate and remove thrust washer (item 16) from rear of lift arm during pivot pin removal.

7. Remove lift arm and torsion spring from machine.

8. Disassemble lift arm as needed using Figure 9 as a guide.

9. Clean lift arm and pivot pin. Inspect lift arm bushings and pivot pin for damage or wear. Replace worn or damaged components.

Installation (Fig. 9)

1. Assemble lift arm using Figure 7 as a guide.

2. Place torsion spring over rear of lift arm tube. Position long leg of spring forward and pointing out from top of spring.

3. Position lift arm to frame (Fig. 9). Fit thrust washer (item 16) between rear of lift arm and frame. Slide pivot pin into frame and lift arm. Align roll pin in pivot pin with slot in frame flange.

4. Install and tighten lock nut (item 13) to secure lift arm pivot pin.

5. Position lift cylinder rod clevis to lift arm

6. Make sure that one (1) retaining ring and washer are installed on cylinder pin (item 17). Insert cylinder pin through the lift arm and lift cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

CAUTION

Be careful when applying tension to the torsion spring on the rear lift arms. The spring is under heavy load and may cause personal injury.

7. Apply tension to torsion spring (Fig. 11):

A. Insert nut driver or small piece of pipe onto the long leg of the torsion spring on the rear of the lift arm.

B. Push down and forward on the spring end to hook the spring to the stop on the lift arm.

8. Position and install cutting unit to lift arm (see Cutting Unit Installation in the Service and Repairs section of Chapter 8 – DPA Cutting Units)

9. Lubricate lift arm and lift cylinder grease fittings after assembly is complete.

10. After assembly, raise and lower the cutting unit to verify that hydraulic hoses and fittings do not contact anything.

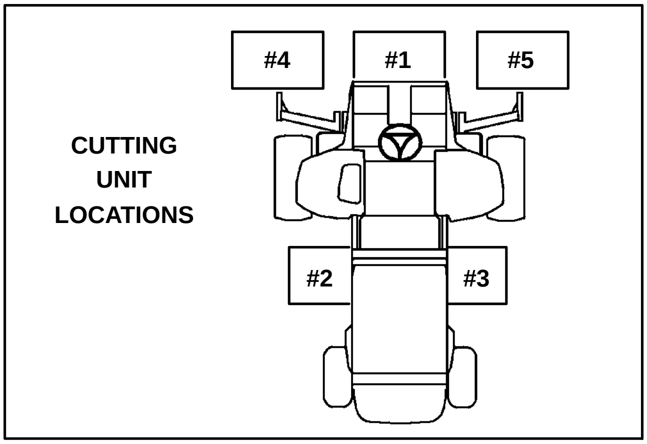

Figure 10

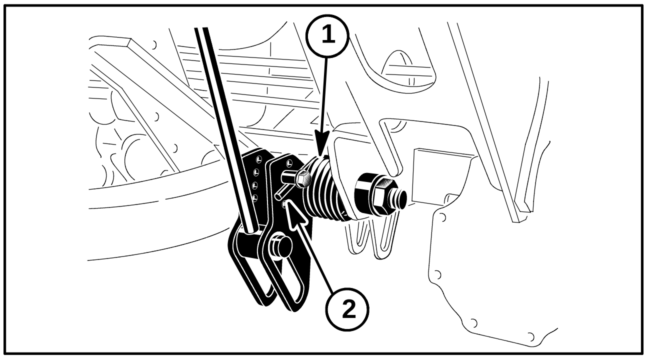

Figure 11

1. **Torsion spring** 2. **Spring end**

Chassis

Operator Seat

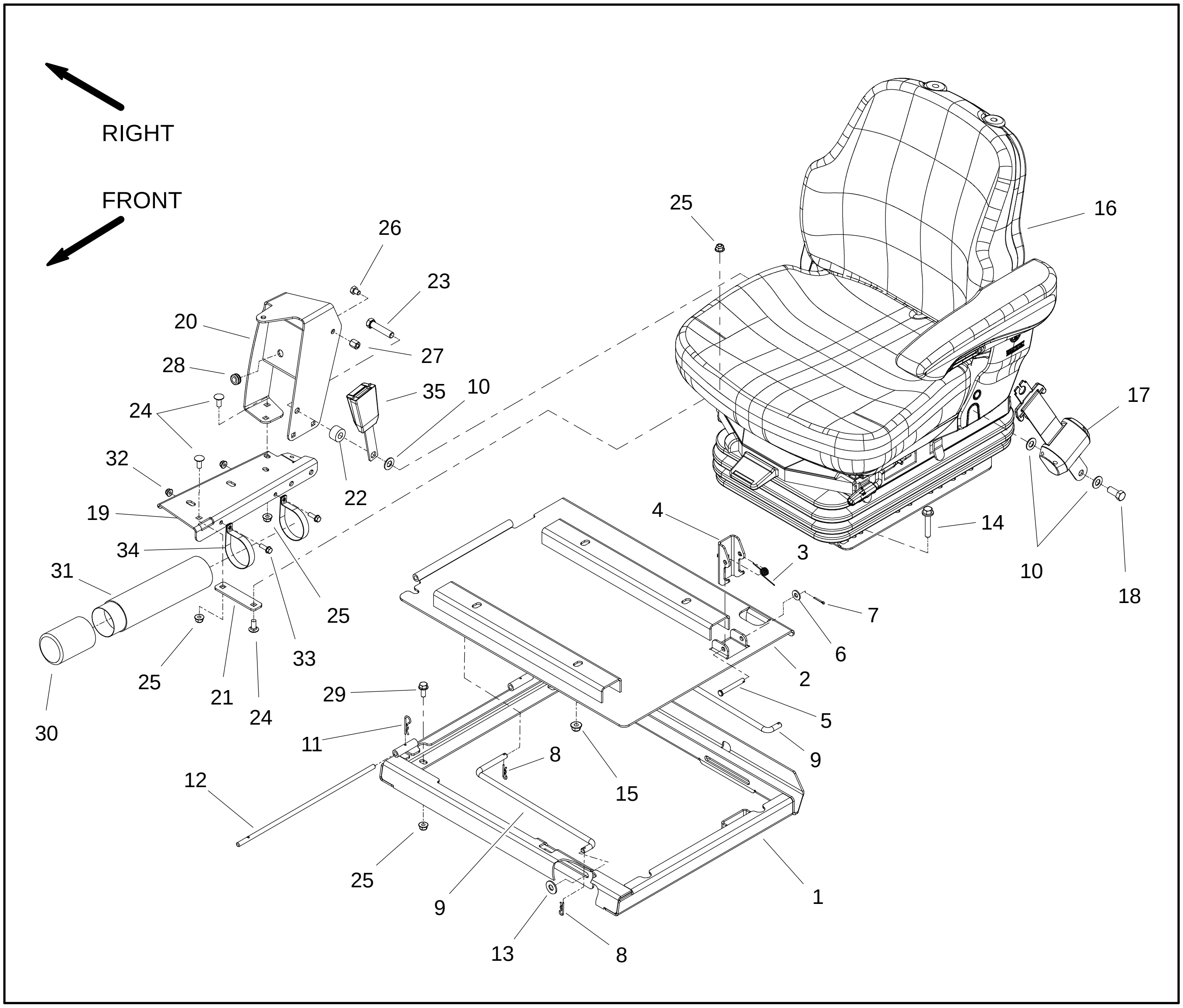

Figure 12

1. Seat frame
2. Seat plate
3. Torsion spring
4. Seat plate latch
5. Clevis pin
6. Flat washer
7. Cotter pin
8. Hair pin (4 used)
9. Seat frame rod (2 used)
10. Flat washer (3 used)
11. Hair pin
12. Seat pivot shaft
13. Flat washer (2 used)
14. Flange head screw (4 used)
15. Flange nut (4 used)
16. Seat assembly
17. Seat belt
18. Cap screw
19. Support channel
20. Arm support
21. Support bracket
22. Spacer
23. Cap screw
24. Carriage screw (6 used)
25. Flange nut (10 used)
26. Cap screw
27. Hex nut
28. Grommet
29. Flange head screw (4 used)
30. Housing cap
31. Manual tube
32. Flange nut (2 used)
33. Screw (2 used)
34. R–clamp (2 used)
35. Seat belt buckle

Removal (Fig. 12)

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

2. Disconnect seat electrical connector from machine wire harness.

3. Support console arm assembly to prevent it from shifting.

4. Remove flange nut (item 25) and carriage screw (item 24) that secure support bracket (item 21) to support channel (item 19).

5. Remove cap screw (item 26) that secures console arm support (item 20) to hex nut (item 27).

6. Remove cap screw (item 23), flat washer (item 10), spacer (item 22) and seat belt buckle (item 35) from seat and console arm support (item 20).

IMPORTANT: Make sure to not damage the electrical harness, control cable or other parts while moving the console arm assembly.

7. Carefully move console arm assembly away from seat. Support console arm to prevent it from falling.

8. Remove four (4) torx head screws that secure seat to seat suspension (Fig. 13). Note that the screw near the seat adjustment handle is longer than the other three (3) screws.

9. Lift seat from seat suspension and remove from machine.

Installation (Fig. 12)

1. Carefully position seat to seat suspension.

2. Secure seat to seat suspension with four (4) torx head screws (Fig. 13). Make sure that longer screw is positioned near the seat adjustment handle. Torque screws **18 ft-lb (25 N-m)**.

IMPORTANT: Make sure to not damage the electrical harness, control cable or other parts while moving the console arm assembly.

3. Position and secure console arm assembly to seat. Install all fasteners before fully tightening them.

A. Secure support bracket (item 21) and support channel (item 19) with flange nut (item 25) and carriage screw (item 24).

B. Secure console arm support (item 20) to hex nut (item 27) with cap screw (item 26).

C. Place flat washer (item 10), seat belt buckle (item 35) and spacer (item 22) between seat and console arm support (item 20). Secure with cap screw (item 23).

D. Fully tighten all fasteners to secure console arm assembly to seat.

4. Connect seat electrical connector to machine wire harness.

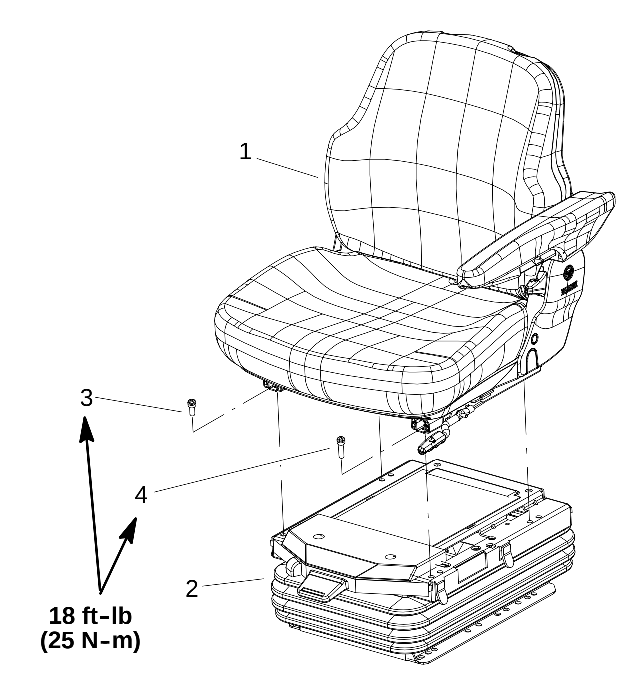

Figure 13

1. **Seat**
2. **Suspension assembly**
3. **Screw (M8x12) (3 used)**
4. **Screw (M8x16)**

Chassis

Operator Seat Service

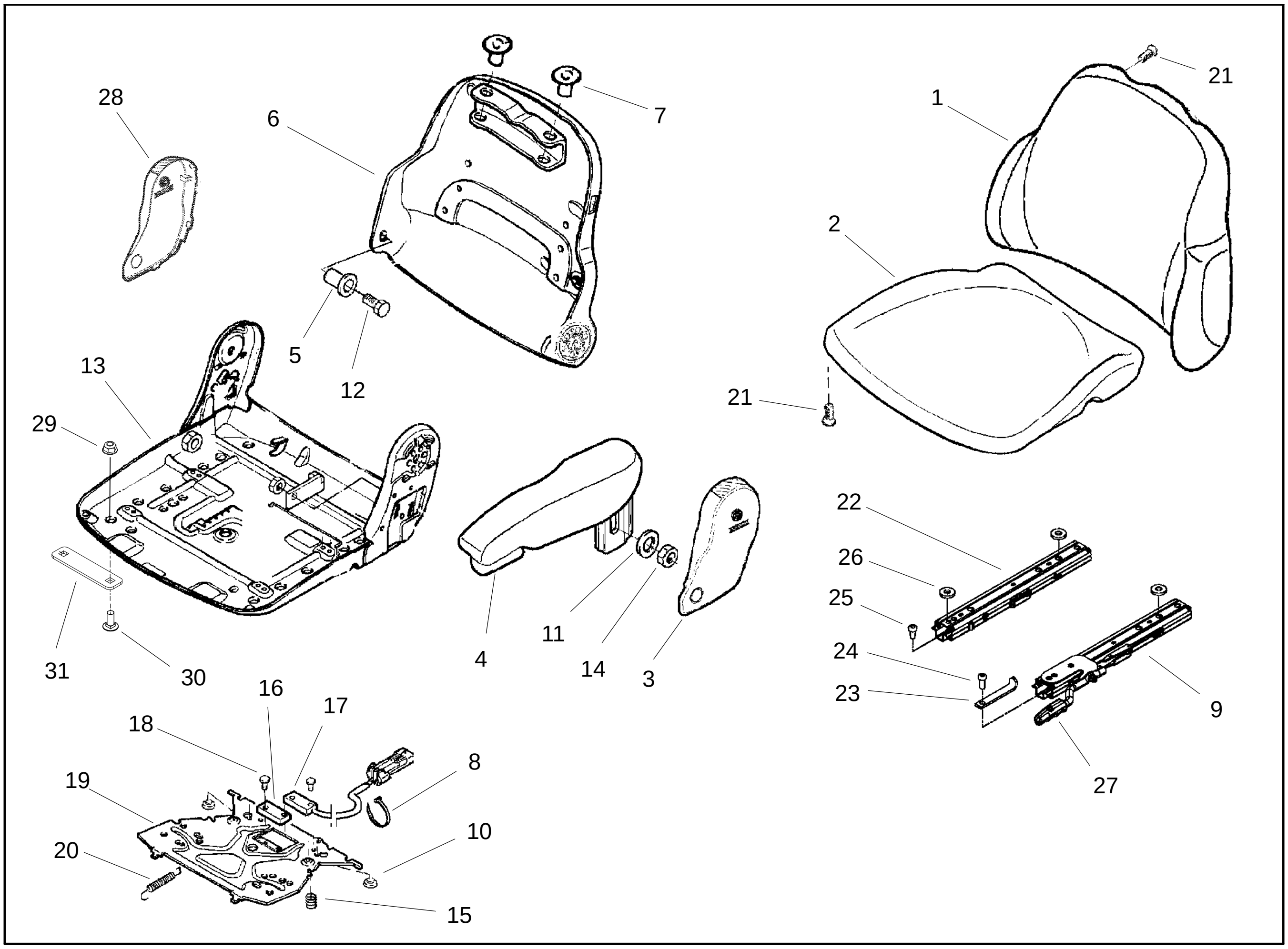

Figure 14

1. **Backrest cushion**
2. **Seat cushion**
3. **LH armrest cover**
4. **LH armrest**
5. **Bushing (2 used)**
6. **Backrest**
7. **Plug (2 used)**
8. **Cable tie (3 used)**
9. **LH adjustment rail**
10. **Bumper (2 used)**
11. **Washer**
12. **Cap screw (2 used)**
13. **Seat**
14. **Nut**
15. **Spring (2 used)**
16. **Magnet**
17. **Seat switch**
18. **Rivet (4 used)**
19. **Mounting plate**
20. **Return spring**
21. **Torx screw (5 used)**
22. **RH adjustment rail**
23. **Rail stop**
24. **Torx screw**
25. **Torx screw (3 used)**
26. **Washer (3 used)**
27. **Handle**
28. **RH armrest cover**
29. **Flange nut**
30. **Carriage screw**
31. **Support bracket**

Disassembly (Fig. 14)

1. Remove seat from machine for service (see Operator Seat Removal in this section).

2. Disassemble operator seat as necessary using Figure 14 as a guide.

Assembly (Fig. 14)

1. Assemble operator seat using Figure 14 as a guide.

2. Install seat to machine (see Operator Seat Installation in this section).

Operator Seat Suspension

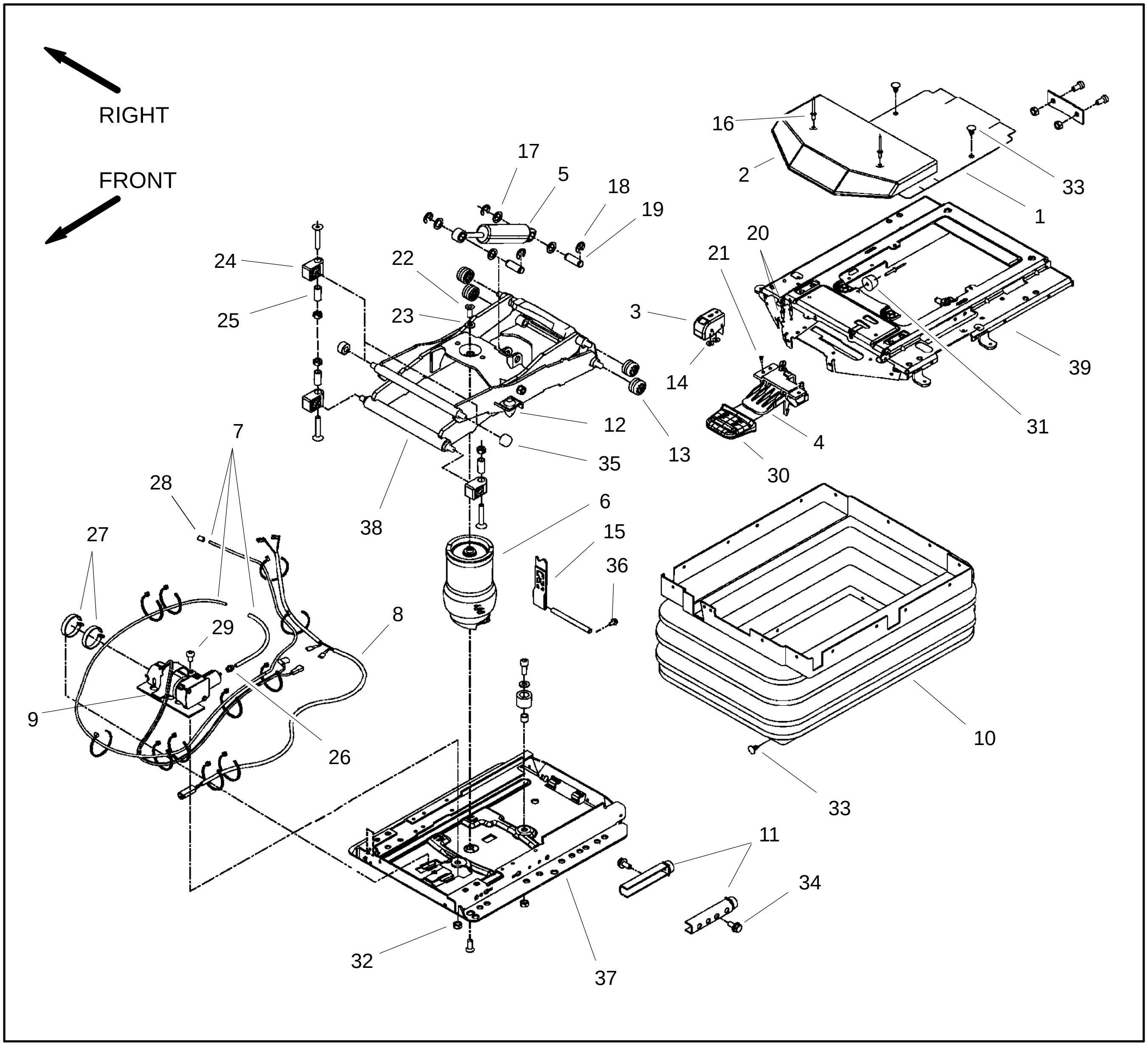

Figure 15

1. **Cover**
2. **Cover**
3. **Level control**
4. **Air control valve**
5. **Shock absorber**
6. **Air spring**
7. **Air tube assembly**
8. **Wire harness**
9. **Compressor**
10. **Bellows**
11. **Stop**
12. **Bumper set (2 used)**
13. **Roller (4 used)**
14. **Washer (2 used)**
15. **Tether**
16. **Rivet (2 used)**
17. **Washer (4 used)**
18. **C-clip (4 used)**
19. **Pin (2 used)**
20. **Rivet (2 used)**
21. **Washer (3 used)**
22. **Screw (2 used)**
23. **Washer**
24. **Housing support (4 used)**
25. **Spacer (4 used)**
26. **Hose nipple**
27. **Clamp (2 used)**
28. **Hose nipple**
29. **Screw**
30. **Handle**
31. **Bumper**
32. **Nut**
33. **Plastic plug (23 used)**
34. **Screw (2 used)**
35. **Roller (2 used)**
36. **Screw (4 used)**
37. **Base plate**
38. **Suspension frame**
39. **Upper plate**

NOTE: Most of the seat suspension components can be serviced with the seat suspension base mounted to the seat plate. If the air spring assembly (item 6) requires removal, the seat suspension base will have to be removed from the seat plate.

Disassembly (Fig. 15)

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

2. Remove operator seat from seat suspension (see Operator Seat Removal in this section).

3. Disconnect seat suspension electrical connector from machine wire harness.

4. If the air spring assembly (item 6) or base plate (item 37) requires removal, remove seat suspension from seat plate (Fig. 16):

   A. Raise and support seat plate assembly. Support seat suspension to prevent it from falling.

   B. Remove four (4) flange head screws and flange nuts that secure seat suspension to seat plate.

   C. Remove seat suspension from machine.

5. Remove seat suspension components as needed using Figure 15 as a guide.

Assembly (Fig. 15)

1. Install all removed seat suspension components using Figure 15 as a guide.

2. If seat suspension was removed from seat platform (Fig. 16):

   A. Position seat suspension onto seat plate.

   B. Secure seat suspension to seat plate with four (4) flange head screws and flange nuts.

3. Install operator seat to seat suspension (see Operator Seat Installation in this section).

4. Make sure that seat electrical connectors are secured to machine wire harness.

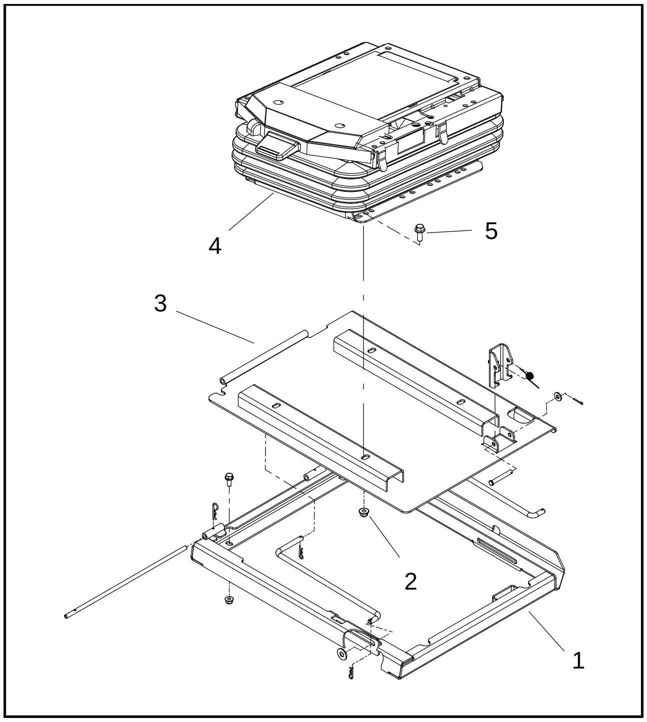

Figure 16

1. **Seat frame**
2. **Flange nut (4 used)**
3. **Seat plate**
4. **Seat suspension**
5. **Flange screw (4 used)**

Chassis

Hood

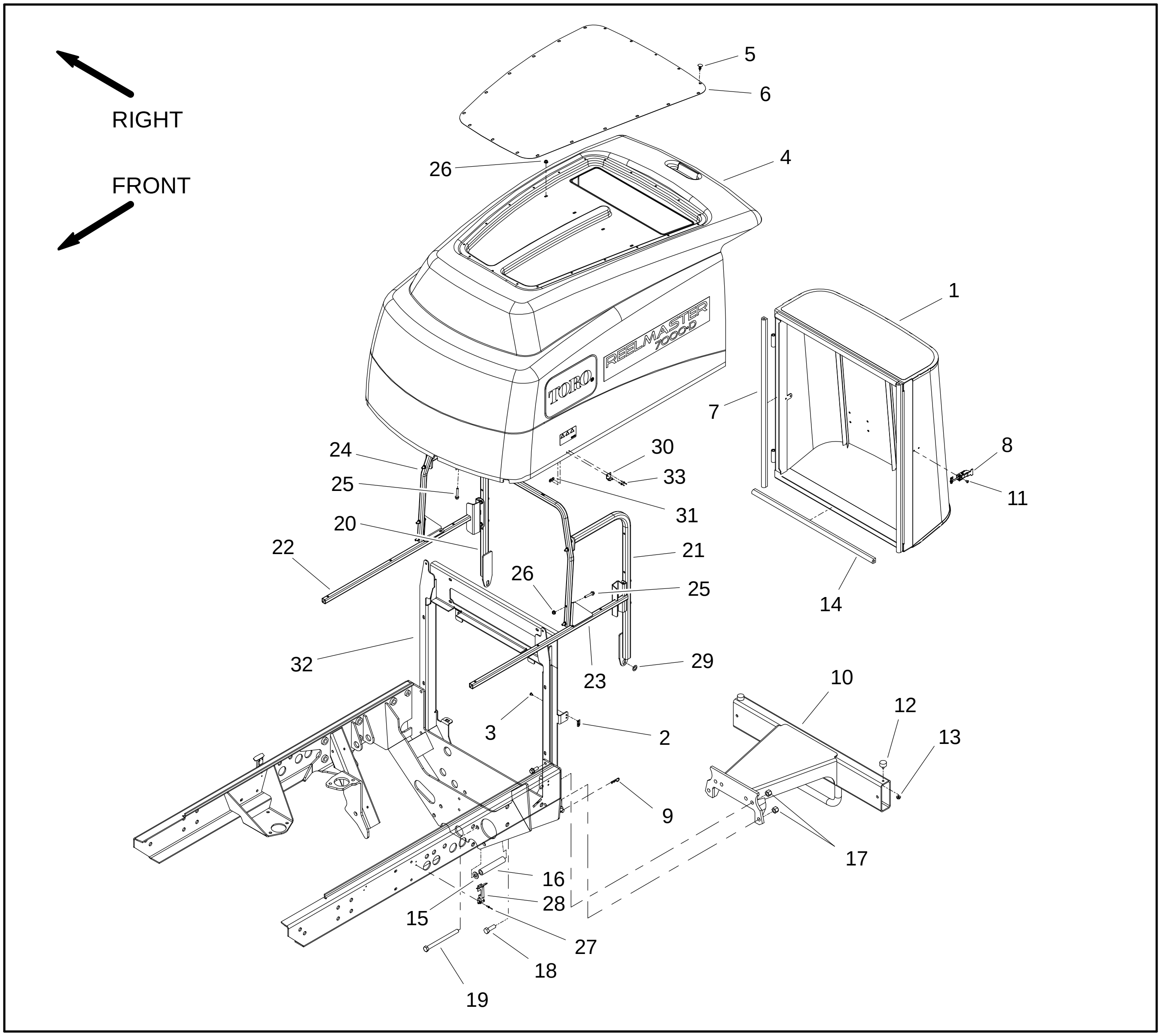

Figure 17

1. **Screen**
2. **Latch keeper**
3. **Pop rivet (2 used)**
4. **Hood**
5. **Plastic plug (20 used)**
6. **Hood screen**
7. **Bulb seal (2 used)**
8. **Adjustable latch**
9. **Hair pin (2 used)**
10. **Rear bumper**
11. **Pop rivet (2 used)**
12. **Rubber bumper (2 used)**
13. **Flange nut (2 used)**
14. **Bulb seal (2 used)**
15. **Flat washer (2 used)**
16. **Axle stop (2 used)**
17. **Lock nut (4 used)**
18. **Cap screw (2 used)**
19. **Cap screw (2 used)**
20. **RH hood frame tube**
21. **LH hood frame tube**
22. **RH hood frame tube**
23. **LH hood frame tube**
24. **Hood frame tube**
25. **Flange head screw (26 used)**
26. **Flange nut (26 used)**
27. **Pop rivet (4 used)**
28. **Flex draw latch (2 used)**
29. **Washer (2 used)**
30. **Latch keeper (2 used)**
31. **Back washer (4 used)**
32. **Radiator mount**
33. **Pop rivet (4 used)**

Removal (Fig. 17)

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

2. Release hood latches and raise hood.

3. Remove hair pins and washers from pivot pins on radiator frame.

4. Remove hood from pivot pins and machine.

5. If necessary, disassemble hood using Figure 17 as a guide.

Installation (Fig. 17)

1. If components were removed from hood, assemble hood using Figure 17 as a guide.

2. Slide hood frame onto radiator frame pivot pins.

3. Secure hood to frame with hair pins and washers.

4. Check hood alignment for correct operation of hood latches and dust seals.

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Chapter 8

DPA Cutting Units

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DPA Cutting Units

Specifications

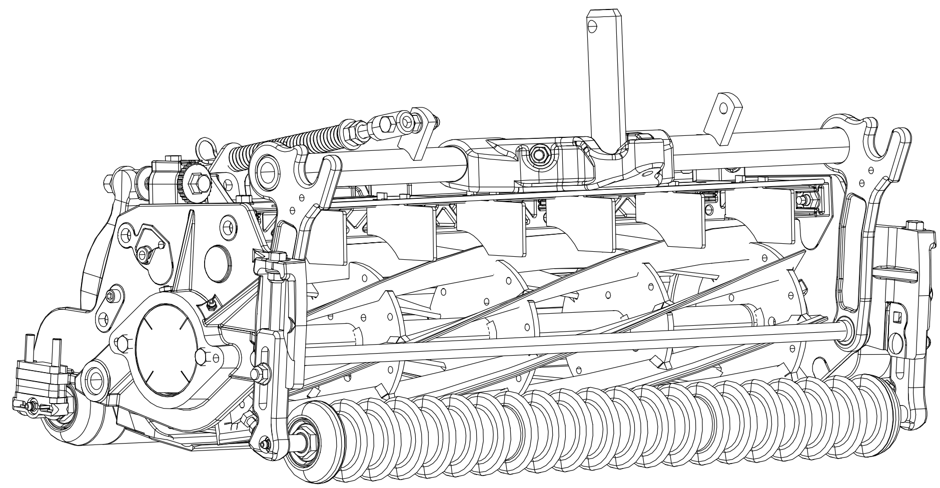

Figure 1

Frame Construction: Precision machined die cast aluminum cross member with bolt−on cast ductile iron or aluminum side plates.

Reel Construction: Reels are 27 inches (69 cm) in length and 7 inch (18 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in 8 and 11 blade configurations. Optional 32 inch (81 cm), 8 blade reels are available for the rear cutting unit positions.

Reel Bearings:

Cutting units with painted side plates have two double row, self−aligning ball bearings press fit onto reel shaft with inboard seal for protection. Reel bearing adjustment is maintained by an adjuster nut in the left side plate of the cutting unit.

Cutting units with aluminum side plates have two stainless steel sealed radial ball bearings pressed onto the reel shaft. Reel end play is maintained by an internal wave spring (no adjustment required).

Reel Drive: The reel weldment shaft is a 1 5/16 inch (33.3 mm) diameter tube with drive inserts threaded into both ends. The reel drive inserts have an internal nine (9) tooth spline.

Height−of−Cut (HOC): Cutting height is adjusted on the front roller by two (2) vertical screws. Effective HOC may vary depending on turf conditions, type of bedknife, roller type and installed attachments.

Bedknife: Replaceable, tool steel EdgeMax™ bedknife is fastened to a machined cast iron bedbar with 10 screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw assemblies allow for precise bedknife adjustment. Adjustment detents correspond to bedknife movement of 0.0009 inch (0.022 mm) for each indexed position.

Front and Rear Rollers: Greaseable through−shaft front and rear rollers are used with these cutting units. All rollers use the same heavy duty, stainless steel ball bearings and seal package.

Counterbalance Weight: A cast iron weight or a groomer and/or a powered rear roller brush accessory is mounted opposite to the hydraulic drive motor to balance the cutting unit.

Cutting Unit Weight:

27” Reel, 8 Blade	**170 lb. (77 kg)**
27” Reel, 11 Blade	**175 lb. (79 kg)**
32” Reel, 8 Blade (optional)	**191 lb. (87 kg)**

Options:
Refer to Cutting Unit Parts Catalog for available options for your Reelmaster DPA cutting unit.

General Information

Cutting Unit Operator's Manual

The Cutting Unit Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the DPA cutting units on your Reelmaster machine. Additionally, if optional kits have been installed on the cutting units (e.g. rear roller brush), the installation instructions for the kit includes set−up and operation information. Refer to those publications for additional information when servicing the cutting units.

Special Tools

Special tools are available from your Toro Distributor. Some tools may have been supplied with your machine or are available as TORO parts.

Gauge Bar Assembly

Toro Part Number: **108−6715**

Use gauge bar to verify height−of−cut adjustment.

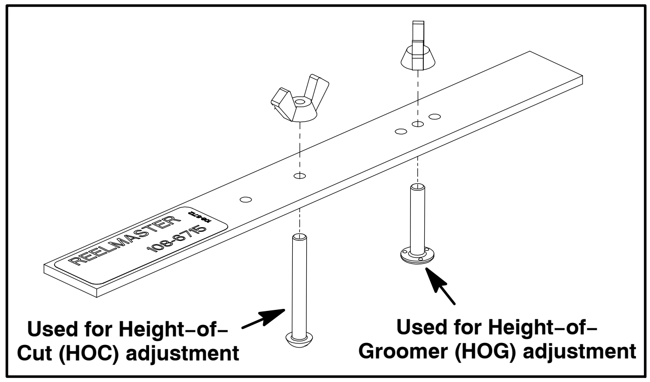

Figure 2

Bedknife Screw Tool

Toro Part Number: **TOR510880**

This screwdriver−type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT: To prevent damage to the bedbar, DO NOT use an air or manual impact wrench with this tool.

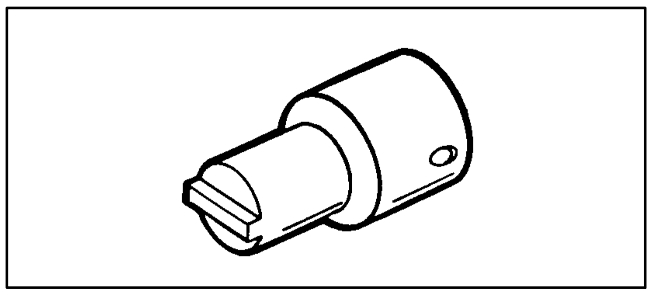

Figure 3

Handle Assembly

Toro Part Number: **29−9100**

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

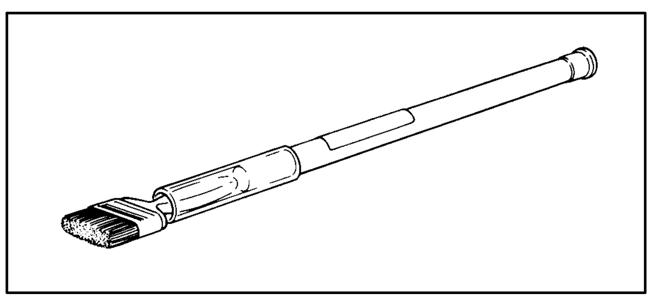

Figure 4

Plastic Plug

Toro Part Number: **94–2703**

This plug is used for placement into the side plate bearing housing when the hydraulic reel motor is removed. It prevents dirt and debris from entering the cutting reel bearing area.

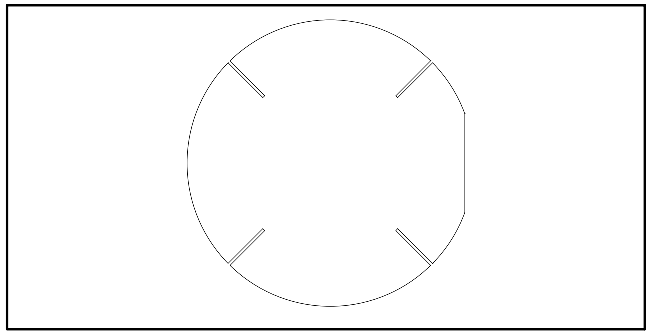

Figure 5

Cutting Unit Kickstand

Toro Part Number: **119–8010–03**

The cutting unit kickstand is used to prop up the rear of the cutting unit during service. Use of this tool prevents the bedbar adjusting screws from resting on the work surface.

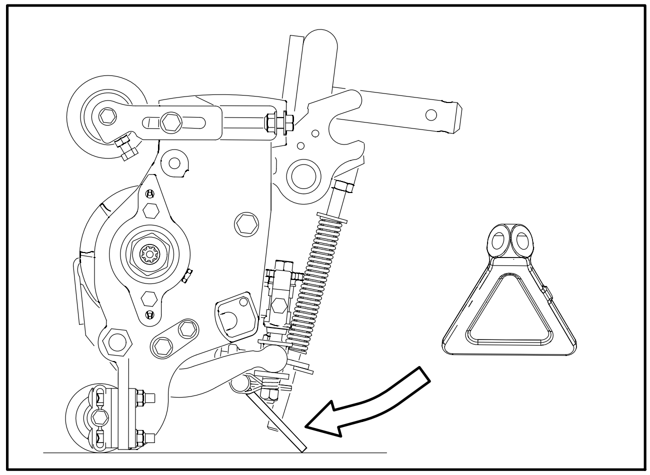

Figure 6

Spline Insert Tool

Toro Part Number: **TOR4074** (9 tooth)

Use the spline insert tool for rotating the cutting reel when hydraulic motor is removed. Also, use this tool for installation of threaded inserts into the cutting reel shaft.

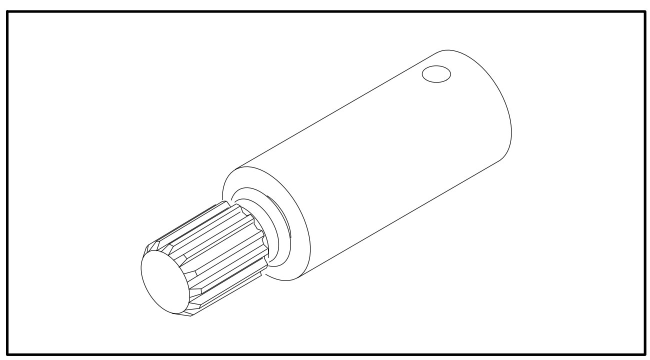

Figure 7

Diameter/Circumference Measuring Tape

Toro Part Number: **TOR6023**

Spring steel measuring tape for accurately measuring the circumference and outside diameter of cutting reel and other spherical components. Tape calibration is in fixed inch readings (no adjustments).

Figure 8

Roller Rebuild Kit

Toro Part Number: **115−0803**

This tool kit is used to assemble the cutting unit rollers. Tools in this kit are also available individually as follows:

115−0852 Inner Seal Tool
115−0853 Bearing/Outer Seal Tool
107−8133 Bearing Installation Washer

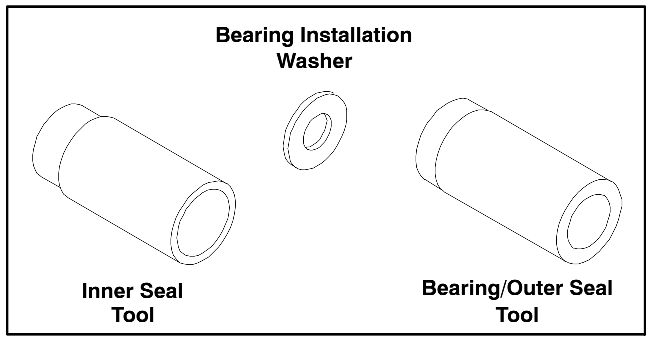

Figure 9

Turf Evaluator Tool

Toro Model Number: **04399**

Many turf discrepancies are subtle and require closer examination. In these instances, the Turf Evaluator grass viewing tool is helpful. It can assist turf managers and service technicians in determining causes for poor reel mower performance and in comparing the effective height−of−cut of one mowed surface to another. This tool should be used with the Toro Guide to Evaluation Reel Mower Performance and Using the TurfEvaluator (Toro part no. 97931SL).

Figure 10

Reel Bearing Installation Tool (cutting units with painted side plates)

Toro Part Number: **117–0975**

Use the reel bearing installation tool to keep the reel bearing aligned as the cutting unit side plate is installed on the bearing.

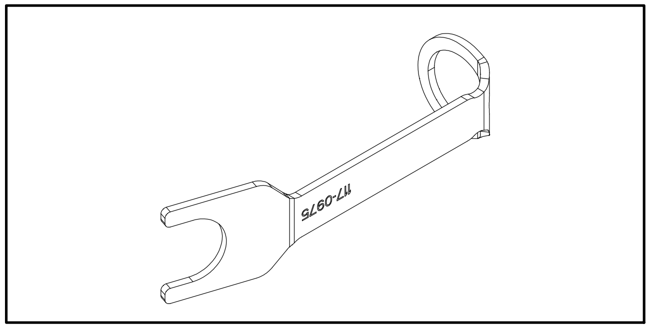

Figure 11

Cutting Reel Shim

Toro Part Number: **125–5611**

The cutting reel shim (0.002”) is used to help parallel the bedknife and cutting reel.

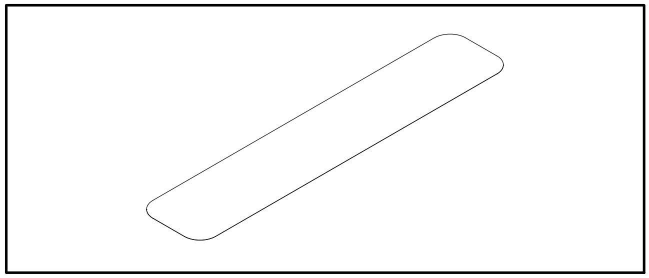

Figure 12

Cutting Performance Paper

Toro Part Number: **125–5610**

Cutting performance paper is used to test the cutting reel performance after adjusting the reel to bedknife clearance. 10 packs (30 strips per pack) of cutting performance paper are included in this part number.

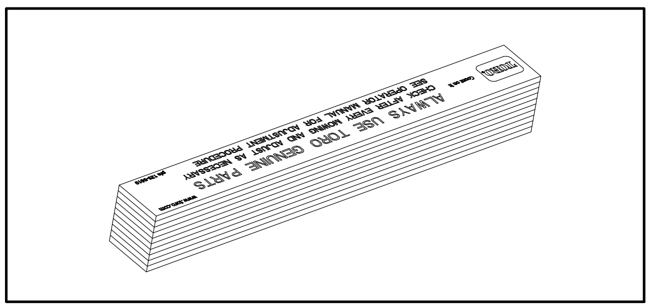

Figure 13

Pulley Alignment Tool

Toro Part Number: **114–5446**

Use pulley alignment tool to verify alignment of groomer and/or rear roller brush drive and driven pulleys.

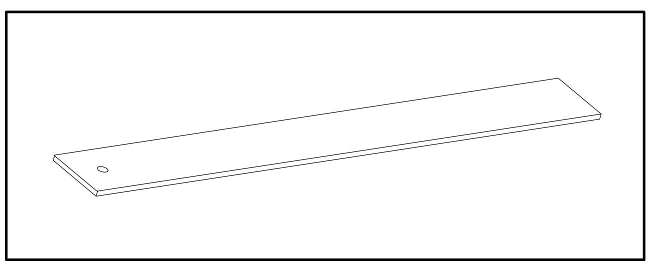

Figure 14

Bedknife Top Angle Indicator and Mount

Toro Part Numbers: **131−6828** and **131−6829**

Because the top grind angle on bedknives is critical for edge retention, and therefore after− cut appearance, Toro has developed these service tools for accurately measuring the top grind angle on all bedknives.

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar.

1. Place the angle indicator on the bottom side of the bedknife with the digital display facing you as shown (Fig. 15).

2. Press the Alt Zero button on the angle indicator.

3. Remove the angle indicator and place the angle−indicator mount on the edge of the bedknife so the face of the magnet is flat against the top of the bedknife (Fig. 16).

4. Place the angle indicator on the mount with the digital display facing you as shown (Fig. 16). The angle displayed on the indicator is the current bedknife top angle. The angle measured should be between 8° and 12°.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

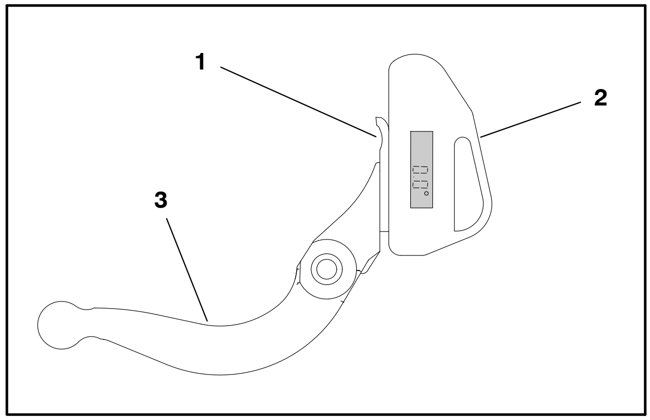

Figure 15

1. **Bedknife**
2. **Angle indicator**
3. **Bedbar**

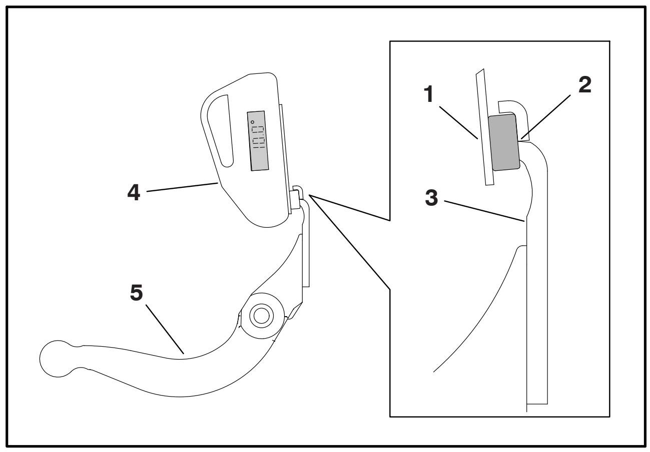

Figure 16

1. **Angle indicator mount**
2. **Magnet**
3. **Bedknife**
4. **Angle indicator**
5. **Bedbar**

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, "sponginess" or attempting to cut off too much grass height may not always be overcome by adjusting the cutting unit. It is important to remember that the lower the height−of−cut, the more critical these factors are.

Refer to the Cutting Unit's Operator's Manual for detailed cutting unit adjustment procedures. For cutting unit repair information, refer to the Service and Repairs section of this chapter.

NOTE: For additional information regarding cutting unit troubleshooting, see **Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL)**.

Factor	Possible Problem/Correction
Tire pressure	Check tire pressure of all traction unit tires. Adjust tire pressure as necessary. See the Traction Unit Operator's manual.
Governed engine speed	For best cutting performance and appearance, engine should be run at maximum governed speed during machine operation. Check maximum governed engine speed. Adjust engine to specifications if necessary. See the Traction Unit Operator's Manual and Chapter 3 − Kubota Diesel Engine in this manual.
Reel speed	All cutting reels must rotate at the same speed (within 100 rpm) (see Troubleshooting in Chapter 4 − Hydraulic System in this manual). All cutting units must have equal bedknife to reel and height−of−cut adjustments. Make sure that reel speed selection is correct (see Clip Chart in Traction Unit Operator's Manual).
Reel bearing condition	Check reel bearings for wear and replace if necessary. See Reel Assembly Service in the Service and Repairs section of this chapter.
Bedknife to reel adjustment	Check bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions (see Bedknife to Reel Adjustment in the Cutting Unit Operator's Manual).

Factor	Possible Problem/Correction
Reel and bedknife sharpness	A reel and/or bedknife that has rounded cutting edges or “rifling” (grooved or wavy appearance) **cannot** be corrected by tightening the bedknife to reel contact. Grind cutting reel to remove taper and/or rifling. Grind bedknife to sharpen and/or remove rifling. The most common cause of rifling is bedknife to reel contact that is too tight. Dull cutting edges must be corrected by grinding the bedknife and cutting reel (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). **A new bedknife must be ground flat (within 0.002”) after installation to the bedbar. Backlapping may be required to properly mate the reel and bedknife after installation into the cutting unit.** **NOTE:** On cutting units equipped with optional bedknives, slightly dull cutting edges may be corrected by backlapping (see Backlapping in the Service and Repairs section of this chapter).
Rear roller adjustment	Adjust the rear roller brackets to correct position depending on the height−of−cut range desired. See Rear Roller Adjustment in the Cutting Unit Operator’s Manual.
Height−of−cut	“Effective” or actual height−of−cut depends on the cutting unit weight and turf conditions. Effective height−of−cut will be different from the bench set height−of−cut. See Height−of−Cut Adjustment in the Cutting Unit Operator’s Manual.
Proper bedknife selection for height−of−cut desired	If the bedknife is incorrect for effective height−of−cut, poor quality of cut will result. See Cutting Unit Operator’s Manual for bedknife options.
Stability of bedbar	Make sure bedbar pivot bolts are seated securely. Check condition of the bushings in the side plates. See Bedbar Assembly in the Service and Repairs section of this chapter.
Number of reel blades	Use correct number of reel blades for clip frequency and optimum height−of−cut range.
Cutting unit alignment and carrier frame ground following	Check carrier frames and lift arms for damage, binding conditions or bushing wear. Repair if necessary.

Factor	Possible Problem/Correction
Roller condition and roller type	Make sure rollers rotate freely. Repair roller bearings as necessary. See Roller Service in the Service and Repairs section of this chapter. Refer to Cutting Unit Operator's Manual for roller options.
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to Operator's Manual for a listing of available accessories.

Adjustments

Characteristics

CAUTION

Never install or work on the cutting units or lift arms with the engine running. Always stop engine and remove key first.

The dual knob bedknife−to−reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self−sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping.

In addition, the rear roller positioning system allows for various height-of-cut ranges and aggressiveness of cut selections.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.

2. Determine desired height−of−cut range and install rear roller mounting shim(s) accordingly.

3. Adjust the height−of−cut.

See Cutting Unit Operator's Manual for cutting unit adjustment procedures for your Reelmaster.

Reel Bearing Adjustment (cutting units with painted side plates)

NOTE: Cutting units that have aluminum side plates do not require reel bearing adjustment.

To insure cut quality and long life of the cutting reel bearings, periodically check reel bearing adjustment.

Check Reel Bearing Adjustment

1. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of this chapter).

2. Loosen bedknife to reel adjustment until no contact exists (see Cutting Unit Operator's Manual).

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. Hold on to the reel shaft and try to move the reel assembly side to side. If reel end play exists, side to side movement will be detected.

4. Using a suitable torque wrench and spline insert tool (see Special Tools), measure the rolling resistance of the cutting reel. Cutting reel rolling torque should not exceed **10 in−lb (1.1 N−m)**.

5. If reel has end play or if rolling torque is incorrect, perform reel bearing adjustment (see below).

6. After checking or adjusting reel bearings, adjust cutting unit (see Cutting Unit Operator's Manual).

7. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of this chapter).

Reel Bearing Adjustment (Fig. 17)

1. Make sure that no contact exists between bedknife and reel.

2. Remove cutting unit components on LH side plate to allow access to bearing adjuster nut. If cutting unit is equipped with an optional groomer or rear roller brush, remove components for those options from left hand side plate of cutting unit. See Service and Repairs section of Chapter 9 − Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

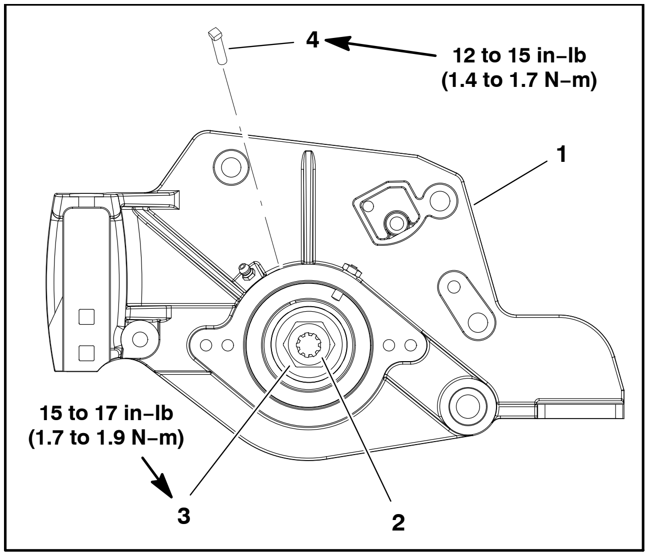

Figure 17

1. LH side plate
2. Threaded insert
3. Bearing adjuster nut
4. Set screw

3. Loosen set screw that secures bearing adjuster nut in LH side plate of cutting unit.

IMPORTANT: Over tightening reel bearing adjuster nut may damage reel bearings.

4. With the cutting unit and reel in a horizontal position, use a 1 3/8" socket and torque wrench to overtighten the bearing adjuster nut to **40 to 45 in−lb (4.5 to 5.1 N−m)**.

5. Loosen the bearing adjuster nut and then torque bearing adjuster nut from **15 to 17 in−lb (1.7 to 1.9 N−m)**.

6. Using a suitable torque wrench and spline insert tool (see Special Tools), check that reel rolling torque does not exceed **10 in−lb (1.1 N−m)**. Also, check if reel bearing endplay exists. If endplay exists after bearing adjuster nut is properly torqued, replace the cutting reel bearings and seals (see Reel Assembly and Reel Assembly Service in the Service and Repairs section of this chapter).

7. Apply Loctite #243 (or equivalent) to threads of set screw and secure bearing adjuster nut in place with set screw. Torque set screw from **12 to 15 in−lb (1.4 to 1.7 N−m)**.

8. After reel bearing adjustment, install all removed cutting unit components or accessories.

Leveling Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled or as the cutting reel wears, a limited amount of side plate adjustment is possible to make sure that the cutting unit is properly aligned.

1. Place the assembled cutting unit on a surface plate.

2. Make sure that bedknife is properly adjusted to cutting reel.

3. Check if the rear roller is level to the cutting reel by using a 0.005” (0.13 mm) feeler gauge to determine the clearance between the surface plate and the rear roller at each end of the roller. As the rear roller is rotated one full turn, check if the feeler gauge will consistently pass under the roller at one end but will not pass under the opposite end. Check rear roller with the feeler gauge just inside the machined ends of the roller. A frame adjustment should be made if there is consistently more than 0.005” (0.13 mm) clearance under the roller on one end but not on the other.

4. Loosen, but do not remove, the three (3) shoulder bolts that secure the side plate to the frame opposite the side that is not level (Fig. 18).

5. Adjust the position of the side plate to parallel the rear roller and cutting reel. Then, tighten the shoulder bolts to a torque from **27 to 33 ft−lb (37 to 44 N−m)**.

6. After tightening the side plate, recheck the rear roller. If necessary, loosen and adjust second side plate.

7. If rear roller is still not level after adjusting both side plates, check to see if cutting reel is tapered (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). If cutting reel is not tapered and rear roller is not level, a 0.010” shim (part number 107−4001) is available to allow additional rear roller adjustment. Use the shim on one side of the rear roller and install it between the rear roller bracket and roller shim (Fig. 19).

8. After leveling rear roller, complete cutting unit set−up and adjustment sequence.

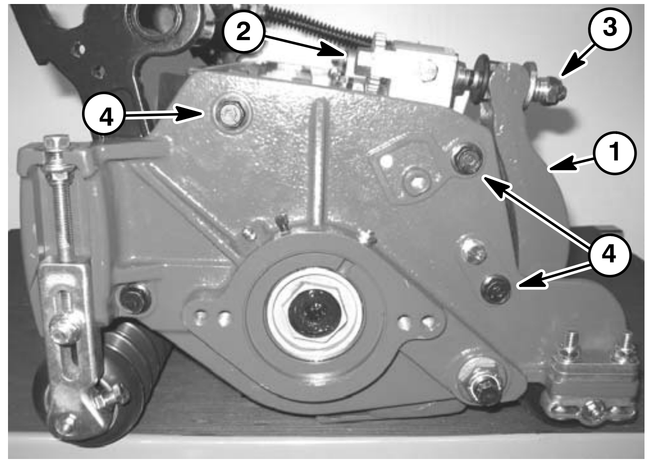

Figure 18

1. Bedbar
2. Bedbar adjuster screw
3. Spring tension lock nut
4. Shoulder bolt

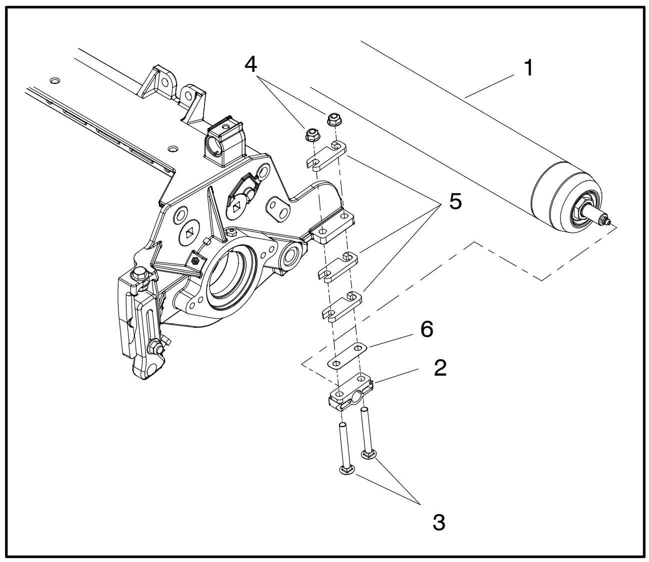

Figure 19

1. Rear roller assembly
2. Rear roller bracket
3. Carriage screw
4. Flange nut
5. Roller shim
6. 0.010” shim (if needed)

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DPA Cutting Units

Service and Repairs

Hydraulic Reel Motor

IMPORTANT: When performing maintenance procedures on the cutting units, carefully position the cutting unit reel motors to prevent damage to the motors or hydraulic hoses.

Removal

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Loosen two (2) cap screws that secure the hydraulic reel motor to the cutting unit side plate. Rotate motor clockwise and remove motor from cutting unit.

3. Inspect reel insert splines for wear. Replace if necessary (see Reel Assembly in the Service and Repairs section of this chapter).

4. Place protective plastic cap (see Special Tools) into the hole in the cutting unit side plate to prevent debris entry into reel bearing area.

Installation

NOTE: Refer to Figure 20 for correct placement of cutting unit reel motors and weights.

1. Coat spline shaft of the reel motor with No. 2 multi-purpose lithium base grease.

2. Install the cap screws for the reel drive motor into the cutting unit side plate and leave approximately 1/2 inch (12.7 mm) of threads exposed on each screw.

3. Rotate the motor clockwise so the motor flanges clear the cap screws in the cutting unit side plates. Align reel motor shaft splines with cutting reel insert splines. Slide motor shaft into reel insert.

4. Rotate the motor counter−clockwise until the motor flanges are encircling the cap screws. Tighten two (2) cap screws to secure reel motor to cutting unit.

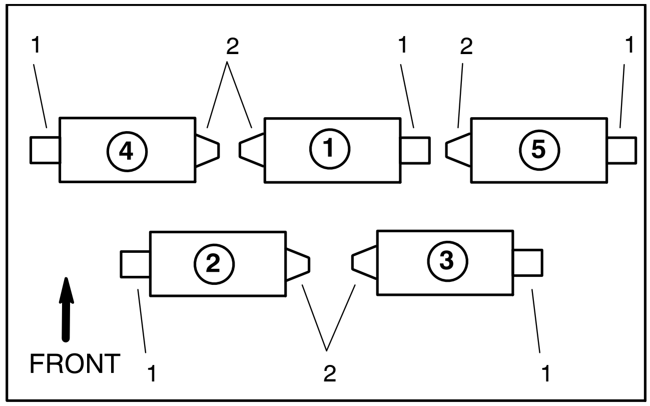

Figure 20

1. **Reel motor location**
2. **Weight location**

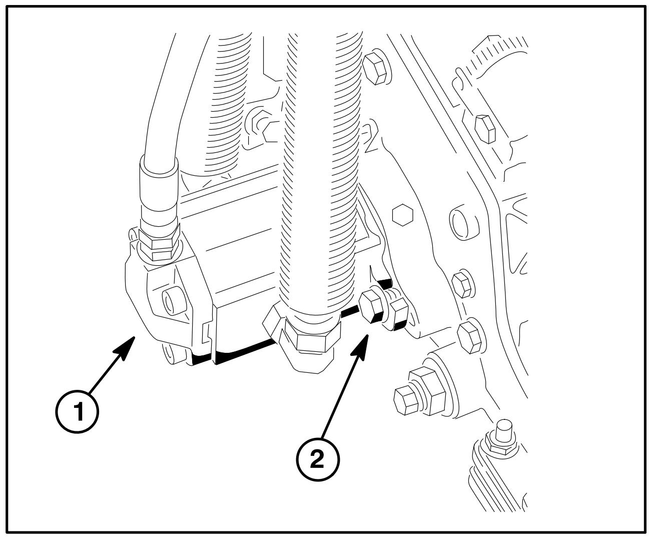

Figure 21

1. **Hydraulic reel motor**
2. **Cap screw**

Backlapping

> **DANGER**
>
> **TO AVOID PERSONAL INJURY OR DEATH:**
> - **Never place hands or feet in the reel area while the engine is running. Stay away from the cutting reels when backlapping.**
> - **When backlapping, run engine at idle speed only.**
> - **While backlapping, the reels may stall and then restart.**
> - **Do not attempt to restart reels by hand or foot.**
> - **Do not adjust reels while the engine is running.**
> - **If a reel stalls, stop engine before attempting to clear the reel.**
> - **Reel motors are connected in series: rotating one motor causes rotation in other motors.**

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

2. On all cutting units, make initial reel to bedknife adjustments appropriate for backlapping.

IMPORTANT: Do not attempt to rotate the directional valve lever on the hydraulic mow control manifold when the engine or reels are running.

3. Raise seat, locate hydraulic mow control manifold and rotate directional valve lever fully to the R (backlap) position (Fig. 22). Rotate flow control valve knob to position 1.

4. Start engine and run at **low idle speed**.

5. With the mow speed limiter in the mow position, move the PTO switch to the ON position. Press the lift switch to start the backlapping operation on the designated reels.

6. Apply lapping compound to cutting reels with a long handle brush (see Special Tools). Never use a short handled brush to apply lapping compound.

> **CAUTION**
>
> **Be careful when backlapping the reel because contact with the reel or other moving parts can result in personal injury.**

7. To make a cutting unit adjustment while backlapping, turn reels OFF, shut off engine and wait for all machine and cutting unit motion to completely stop. Then, after cutting unit adjustments have been completed, repeat steps 4 through 6.

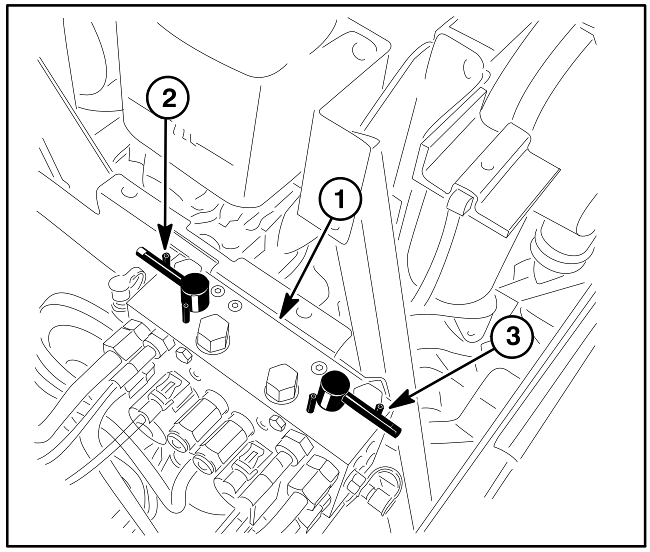

Figure 22

1. **Mow manifold**
2. **Front backlap lever**
3. **Rear backlap lever**

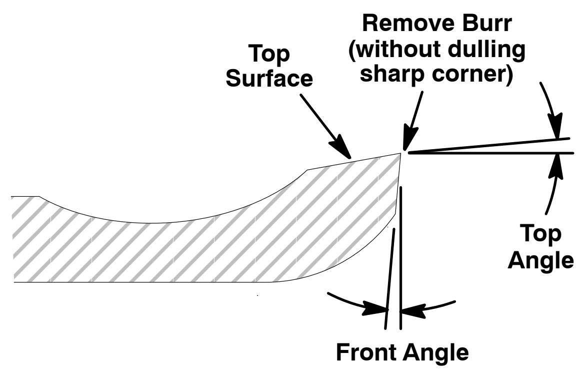

Figure 23

8. When the backlap operation is completed, shut off engine and rotate directional valve lever fully (90º from the backlap position) to the F (forward) position. Also, rotate flow control valve knob to correct mowing position.

9. Wash all lapping compound from the cutting units.

10. For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed (Fig. 23). This will remove any burrs or rough edges that may have built up on the cutting edge.

NOTE: Additional instructions and procedures on backlapping are available in the **Toro General Service Training Book, Reel Mower Basics (part no. 09168SL)**.

Bedbar Assembly

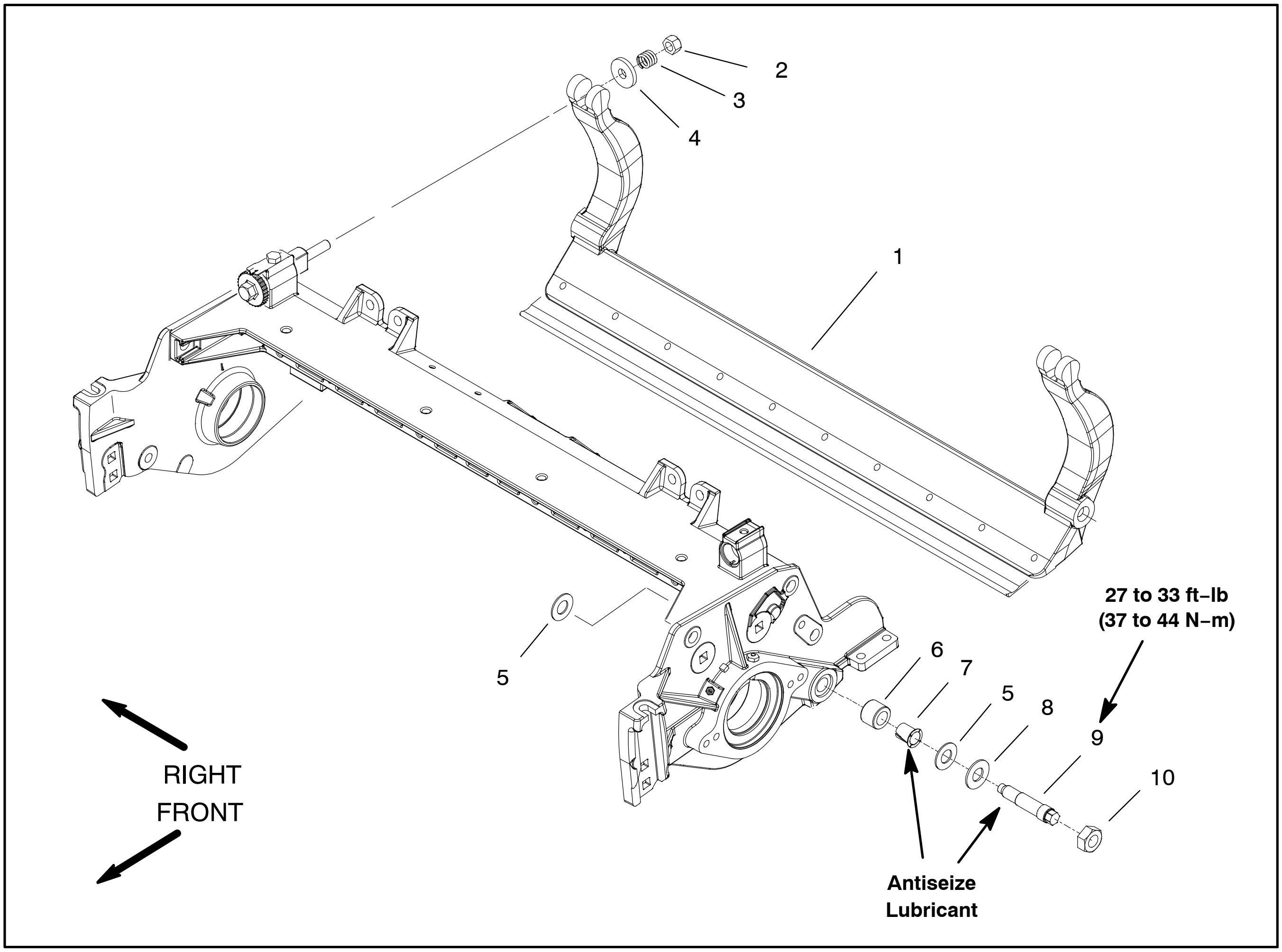

Figure 24

1. Bedbar assembly
2. Lock nut (2 used)
3. Compression spring (2 used)
4. Washer (2 used)
5. Plastic washer (4 used)
6. Rubber bushing (2 used)
7. Flange bushing (2 used)
8. Metal washer (2 used)
9. Bedbar pivot bolt (2 used)
10. Lock nut (2 used)

Bedbar Removal (Fig. 24)

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

2. Remove the cutting unit from the machine. Use the cutting unit kickstand to support the cutting unit (see Special Tools).

3. Loosen the lock nuts (item 2) on the end of each bedbar adjuster assembly until washer (item 2) is loose.

4. Loosen the lock nuts (item 10) on each bedbar pivot bolt.

5. Remove two (2) bedbar pivot bolts (item 9), two (2) metal washers and four (4) plastic washers from the cutting unit side plates.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

6. Remove bedbar assembly from cutting unit.

7. Inspect flange bushings (item 7) and rubber bushings (item 6) in side plates for wear or damage. Remove bushings and replace if necessary.

Bedbar Installation (Fig. 24)

1. If rubber bushing was removed from either cutting unit side plate, install a new bushing. The bushing should be installed flush with the inside of the side plate (Fig. 25).

2. If removed, install the flange bushings with flange facing outward. Apply antiseize lubricant to inside of flange bushing.

3. Apply antiseize lubricant to the bedbar threads and the shoulder area of each bedbar pivot bolt.

4. Slide one metal washer and one plastic washer onto each bedbar pivot bolt.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

5. Position bedbar into cutting unit. Make sure that the top of each bedbar arm is between washer (item 4) and adjuster screw flange.

6. Position a plastic washer between bedbar and each cutting unit side plate (Fig. 25).

7. Install the bedbar pivot bolt assemblies:

A. Push each bedbar pivot bolt through the side plate and into the bedbar enough to hold the bedbar in position.

IMPORTANT: Do Not use a powered wrench or an impact wrench to install the bedbar pivot bolts.

B. Start threading of one of the pivot bolts into the bedbar and continue until the pivot bolt bottoms out. Repeat for remaining pivot bolt.

C. Make sure that plastic washers are not caught on the threads of the pivot bolts.

D. Tighten each bedbar pivot bolt from **27 to 33 ft−lbs (37 to 44 N−m)**.

8. Tighten both lock nuts (item 10) until outside metal washer just rotates. Do not over tighten the lock nuts as this can distort the side plates and affect reel to bedknife contact, or in the case of cutting units with painted side plates, reel bearing adjustment. The plastic washer between the bedbar and side plate should be loose.

9. Tighten the lock nut (item 2) on each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen lock nut 1/2 turn.

10. Adjust cutting unit (see Cutting Unit Operator's Manual).

11. Install cutting unit to machine.

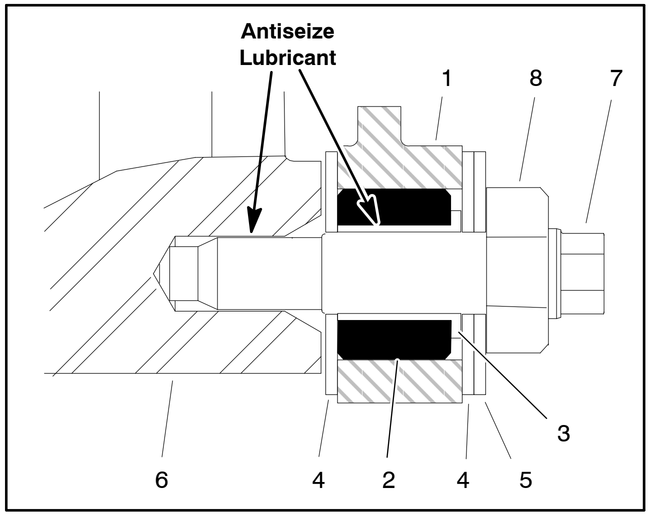

Figure 25

1. **Cutting unit sideplate**
2. **Rubber bushing**
3. **Flange bushing**
4. **Washer (plastic)**
5. **Washer (metal)**
6. **Bedbar**
7. **Bedbar pivot bolt**
8. **Lock nut**

Bedknife Replacement and Grinding

Bedknife Removal

1. Remove bedbar assembly from cutting unit (see Bedbar Assembly in this chapter).

2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools in this chapter). Discard screws. Remove bedknife from the bedbar (Fig. 26).

3. See bedknife grinding information on the following pages.

Bedknife Installation

1. Use scraper to remove all rust, scale and corrosion from bedbar surface. Lightly oil bedbar surface before installing bedknife.

2. Make sure that screw threads in bedbar (5/16−18UNC−2A) are clean.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

3. Use new screws to secure bedknife to bedbar. Apply antiseize lubricant to the threads of new screws. Do not apply antiseize lubricant to the taper of the screw heads.

4. Install all screws but do not tighten.

5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to **10 in−lb (1 N−m)**.

6. Working from the center of the bedknife toward each end (Fig. 27), tighten screws from **200 to 250 in−lb (23 to 28 N−m)**.

7. After installing bedknife to bedbar, grind bedknife.

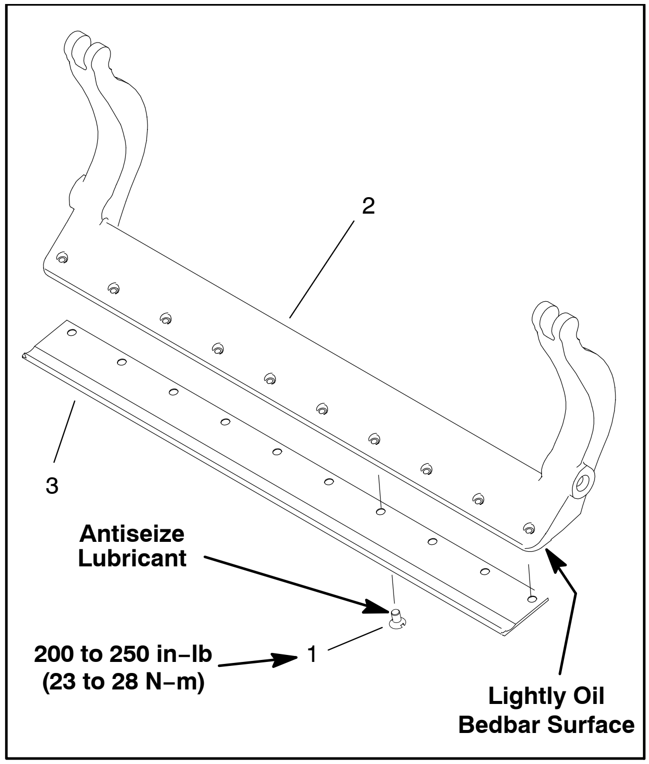

Figure 26

1. **Screw (8 used)**
2. **Bedbar**
3. **Bedknife**

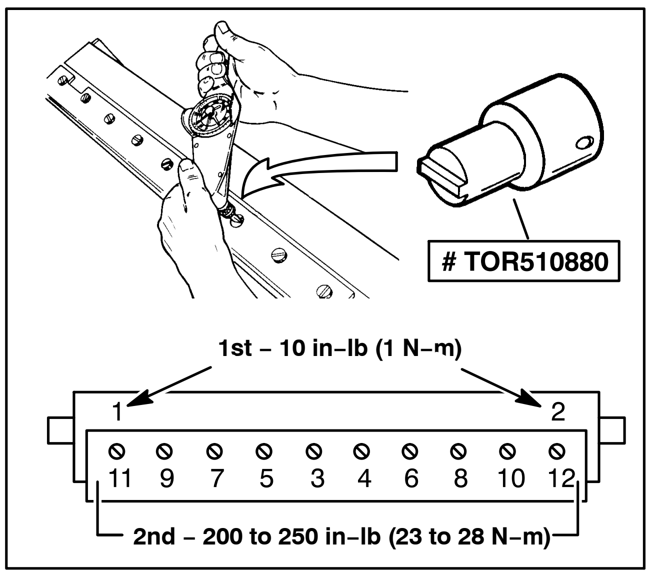

Figure 27

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided and grind only enough to make sure the top surface of the bedknife is true (Fig. 28 and 29).

IMPORTANT: Do Not grind the bedknife below it's service limit (Fig. 30). Operating the cutting unit with the bedknife below the service limit may result in poor after−cut appearance and reduce the structural integrity of the bedknife for impacts.

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

NOTE: EdgeMax® bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after−cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to the Angle Indicator and Magnetic Mount in the Special Tools section of this Chapter.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

<table>
<tr><th colspan="4">Bedknife Grinding Specifications</th></tr>
<tr><th>Bedknife</th><th>Lip Height Service Limit</th><th>Top Angle</th><th>Front Angle</th></tr>
<tr><td>EdgeMax
Low HOC</td><td rowspan="8">0.19”
(4.8 mm)</td><td rowspan="8">10°</td><td rowspan="3">5°</td></tr>
<tr><td>Premium
Low HOC</td></tr>
<tr><td>Standard
Low HOC</td></tr>
<tr><td>Extended EdgeMax
Low HOC</td><td rowspan="2">10°</td></tr>
<tr><td>Extended
Low HOC</td></tr>
<tr><td>EdgeMax
Standard HOC</td><td rowspan="3">5°</td></tr>
<tr><td>Standard
Standard HOC</td></tr>
<tr><td>Heavy Duty
Standard HOC</td></tr>
</table>

Figure 28

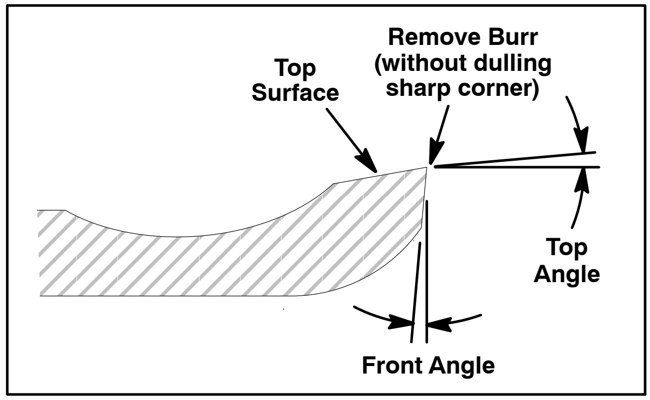

Figure 29

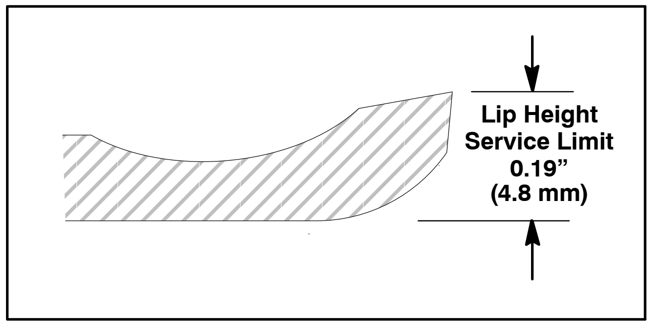

Figure 30

1. Bedknife

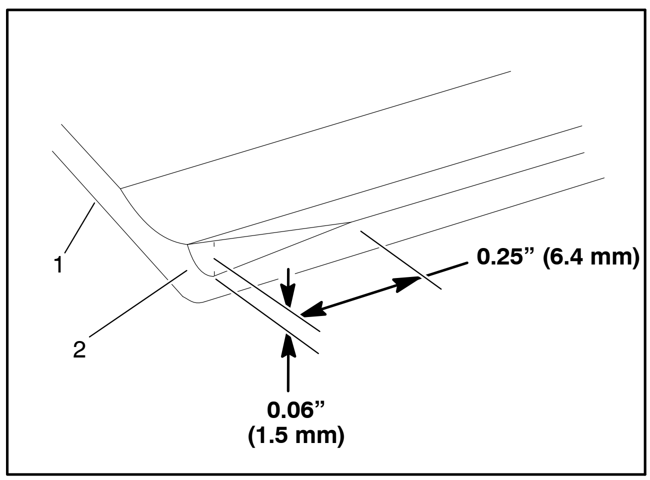

Figure 31

1. Bedknife
2. Lead −in Chamfer

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.

2. A lead−in chamfer is ground into all new bedknives (Fig. 31). The original chamfer should last for the first 40% of the bedknife service life. Check and re−grind the lead−in chamfer as necessary.

3. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Installation in this section).

Bedbar Adjuster Service

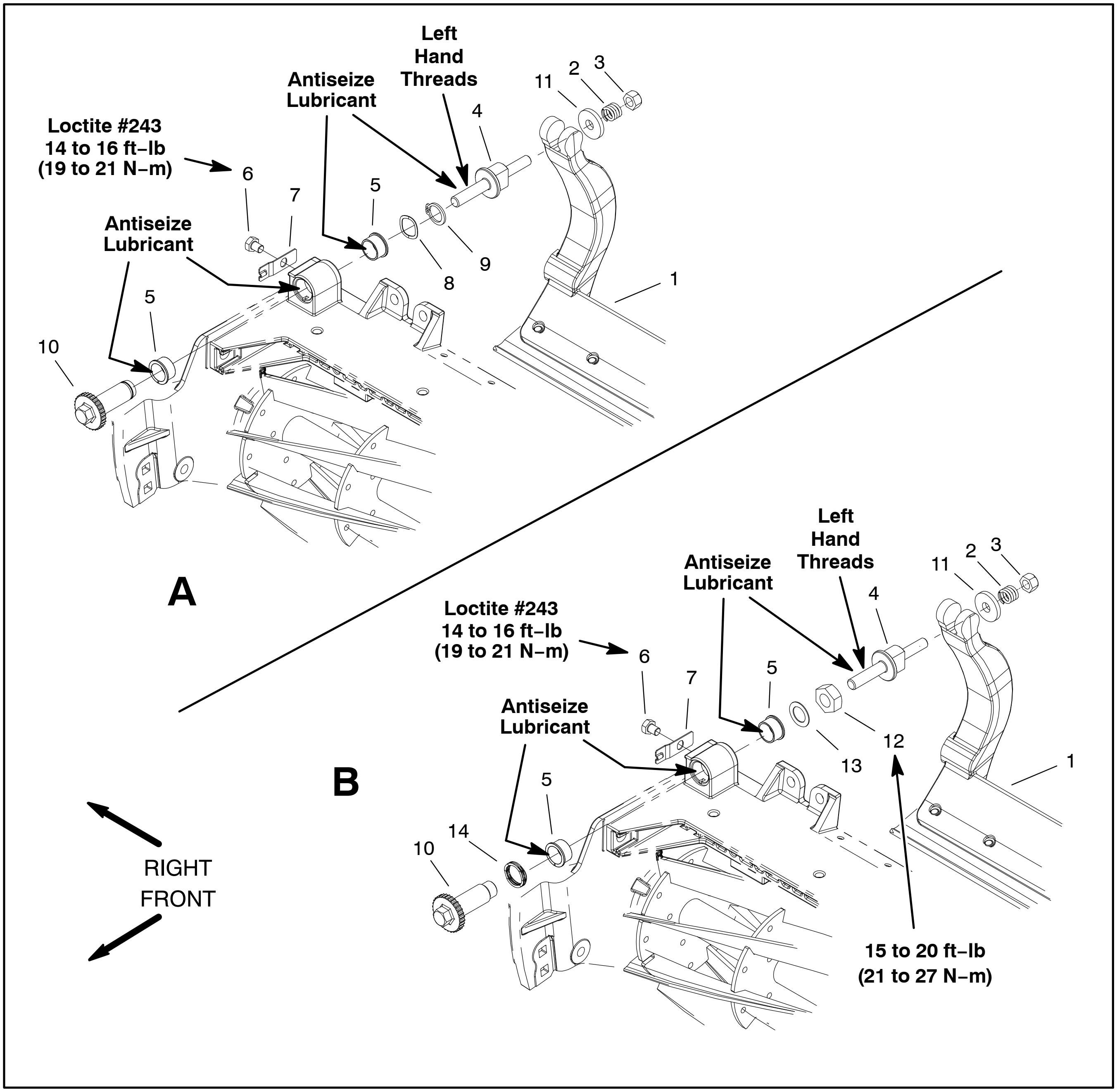

Figure 32

1. **Bedbar assembly**
2. **Compression spring**
3. **Lock nut**
4. **Bedbar adjuster screw**
5. **Flange bushing**
6. **Cap screw**
7. **Detent**
8. **Wave washer**
9. **Retaining ring**
10. **Bedbar adjuster shaft**
11. **Washer**
12. **Lock nut**
13. **Flat washer**
14. **Wave washer**

NOTE: The bedbar adjuster system for early production DPA cutting units (Fig. 32 A) used a retaining ring on the end of the bedbar adjuster shaft. Current production DPA cutting units (Fig. 32 B) include a lock nut on the end of the bedbar adjuster shaft. Upgrading to the current production style adjusters is recommended using Heavy Duty DPA Kit p/n 120−7230. The bedbar adjuster service procedures for either style of adjuster shaft is very similar.

Removal (Fig. 32)

1. Remove lock nut (item 3), compression spring and washer from bedbar adjuster screw (item 4).

2. Remove bedbar assembly (see Bedbar Assembly Removal in this section).

3. Remove bedbar adjuster screw (left hand threads) from the bedbar adjuster shaft (item 10).

4. Remove adjuster shaft from cutting unit frame:

   A. On early production cutting units (Fig. 32 A), remove retaining ring and wave washer from adjuster shaft. Slide adjuster shaft from cutting unit frame.

   B. On current production cutting units (Fig. 32 B), remove lock nut and flat washer from adjuster shaft. Slide adjuster shaft and wave washer from cutting unit frame.

5. Inspect flange bushings (item 5) in cutting unit frame and remove if necessary.

6. If detent (item 7) is damaged, remove it from cutting unit side plate.

Installation (Fig. 32)

1. If detent (item 7) was removed, apply Loctite #243 (or equivalent) to threads of cap screw and secure detent to cutting unit side plate with cap screw. Tighten cap screw from **14 to 16 ft−lb (19 to 21 N−m)**.

2. If flange bushings (item 5) were removed, apply antiseize lubricant to bore of cutting unit frame. Align key on bushing to slot in frame and install bushings into frame. Apply antiseize lubricant to bore of each flange bushing.

3. Install adjuster shaft to cutting unit frame:

   A. On early production cutting units (Fig. 32 A), slide bedbar adjuster shaft into flange bushings in cutting unit frame. Secure adjuster shaft with wave washer and retaining ring.

   B. On current production cutting units (Fig. 32 B), slide wave washer onto adjuster shaft and then slide adjuster shaft into flange bushings in cutting unit frame. Secure adjuster shaft with flat washer and lock nut. Tighten lock nut to shoulder of adjuster shaft and then torque lock nut from **15 to 20 ft−lb (21 to 27 N−m)**.

NOTE: Inside threads in bedbar adjuster shaft (item 4) are left−hand threads.

4. Apply antiseize lubricant to left hand threads threads of bedbar adjuster screw (item 4). Thread bedbar adjuster screw into adjuster shaft (item 10).

5. Install washer (item 11), compression spring and lock nut onto adjuster screw.

6. Install bedbar assembly (see Bedbar Assembly Installation in this section).

7. Adjust cutting unit (see Cutting Unit Operator's Manual).

Reel Assembly (cutting units with painted side plates)

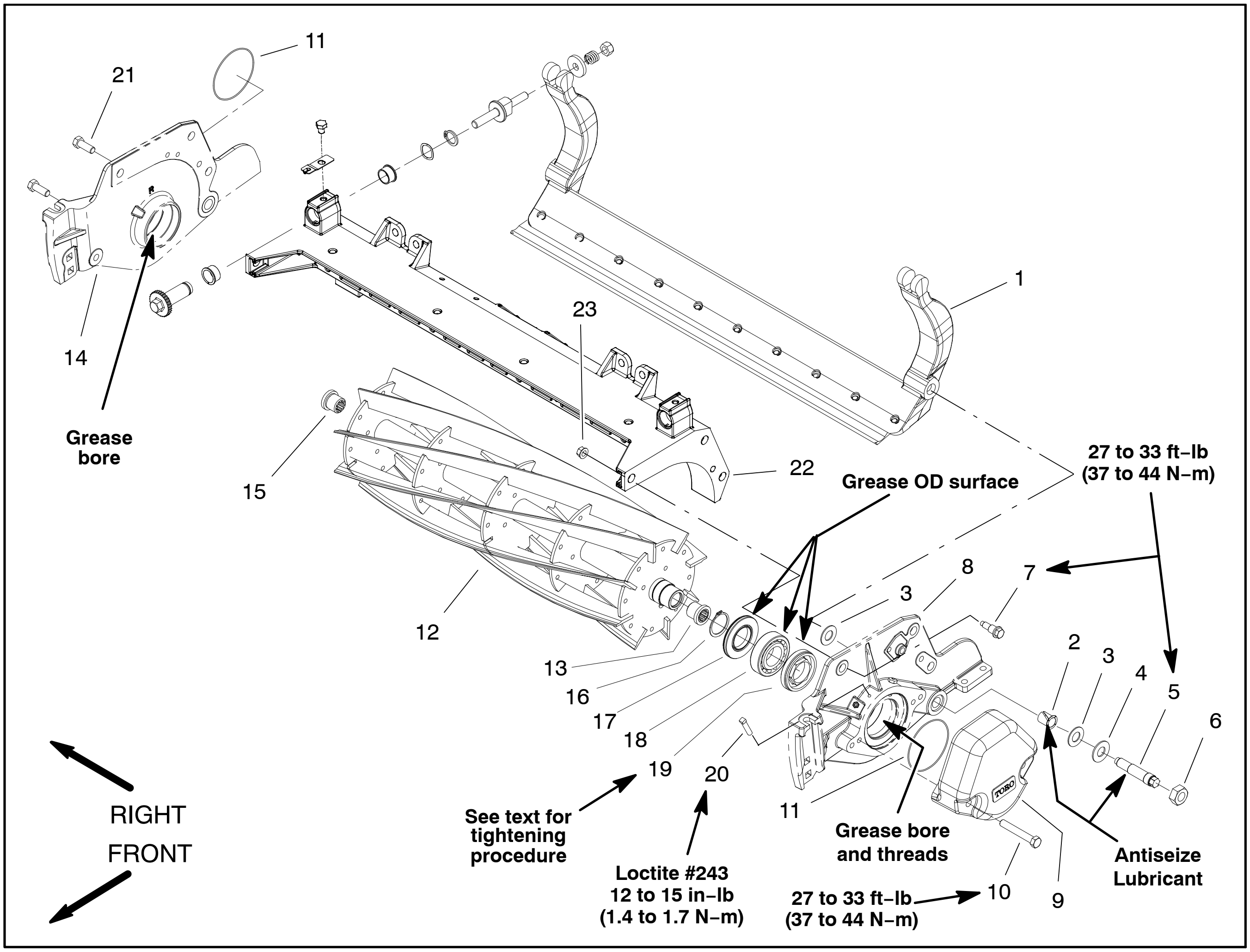

Figure 33

1. **Bedbar assembly**
2. **Flange bushing (2 used)**
3. **Plastic washer (4 used)**
4. **Metal washer (2 used)**
5. **Bedbar pivot bolt (2 used)**
6. **Lock nut (2 used)**
7. **Shoulder bolt (3 used per side plate)**
8. **LH side plate**
9. **Weight**
10. **Cap screw (2 used)**
11. **O−ring**
12. **Cutting reel**
13. **Spline insert (LH thread)**
14. **RH side plate**
15. **Spline insert (RH thread)**
16. **Retaining ring (2 used)**
17. **Grease seal (2 used)**
18. **Bearing (2 used)**
19. **Bearing adjuster nut**
20. **Set screw**
21. **Cap screw (2 used)**
22. **Cutting unit frame**
23. **Flange nut (3 used per side plate)**

NOTE: This section provides the procedure for removing and installing the cutting reel assembly (cutting reel, spline inserts, grease seals and bearings) from the cutting unit.

NOTE: Refer to Reel Assembly Service later in this section for information on replacing cutting reel grease seals, bearings and spline inserts.

NOTE: Removal of the cutting reel requires removal of the left side plate from the cutting unit frame. The right side plate does not have to be removed from the frame.

Reel Assembly Removal (Fig. 33)

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

2. Remove the cutting unit from the machine and place on a flat work area.

3. If the cutting unit is equipped with a counterweight or accessory on LH side plate, remove the counter weight or accessory. Remove and discard the O−ring from counter weight.

4. If cutting unit is equipped with an optional groomer or rear roller brush, remove components for those options from left hand side plate of cutting unit. See Service and Repairs section of Chapter 9 − Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

5. Remove the bedbar pivot bolt and washers from the LH side plate.

6. Loosen fasteners that secure front and rear rollers to LH side plate (see Front Roller Removal and Rear Roller Removal in this section).

7. Remove cap screw and flat washer that secure rear grass shield to LH side plate (Fig. 34).

8. Remove flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 34).

NOTE: The reel bearings and grease seals are press fit on the cutting reel shaft and should remain on the reel when removing the LH side plate.

9. Remove shoulder bolts (item 7) and flange nuts that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft, rollers, bedbar assembly and cutting unit frame.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

10. Carefully pull the cutting reel with bearings, grease seals and splined inserts from the RH side plate.

11. Inspect and service cutting reel assembly as required (see Reel Assembly Service in this section).

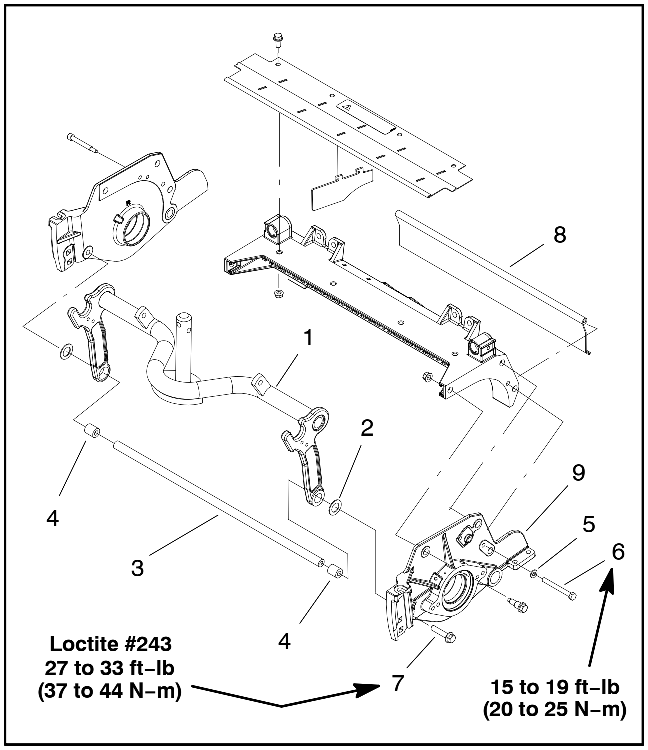

Figure 34

1. Carrier frame
2. Shim (if equipped)
3. Support tube
4. Frame spacer
5. Flat washer
6. Cap screw
7. Flange head screw
8. Rear grass shield
9. LH side plate

Reel Assembly Installation (Fig. 33)

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates for wear or damage and replace if needed.

NOTE: Check that grease seals on cutting reel shaft are flush to 0.060” (1.5 mm) away from retaining ring on reel shaft. If necessary, adjust position of grease seals to allow proper clearance.

2. Make sure that grease seals and bearings are properly greased and positioned on cutting reel (see Reel Assembly Service in this section). Apply thin coat of grease to outside of grease seals and bearings on cutting reel to ease reel installation. Also, apply grease to bearing bores and threads in side plates.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

DPA Cutting Units

IMPORTANT: During cutting reel installation, keep inner and outer bearing races aligned. If bearing races are not aligned, binding will occur and reel installation may cause bearing damage. Use reel bearing installation tool (Toro part number 117−0975) to help with bearing alignment during reel installation.

3. Using reel bearing installation tool (see Special Tools in this chapter) to keep reel bearing aligned, carefully slide the cutting reel with bearings and grease seals into the RH side plate. Make sure that bearing is fully seated into side plate.

4. Loosen set screw (item 20) and back−off (loosen) bearing adjuster nut one complete turn.

5. Slide the LH side plate onto the cutting reel assembly, front roller and rear roller. Make sure that reel end in RH side plate does not shift in position.

6. Install shoulder bolts (item 7) and flange nuts that secure the LH side plate to the cutting unit frame. Torque the shoulder bolts from **27 to 33 ft-lbs (37 to 44 N−m)**.

7. Apply Loctite #243 (or equivalent) to threads of flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 34). Install screw and torque from **27 to 33 ft-lbs (37 to 44 N−m)**. After tightening screw, check the clearance between the carrier frame and side plate. If clearance is more than 0.090” (2.3 mm), remove flange head screw and position shim(s) (part number 67−9410) between carrier frame and side plate so that clearance is less than 0.090” (2.3 mm). Make sure that the carrier frame pivots freely after assembly.

8. Install cap screw and flat washer that secure rear grass shield to LH side plate (Fig. 34). Torque screw from **15 to 19 ft-lbs (20 to 25 N−m)**.

9. Secure the bedbar assembly to LH side plate (see Bedbar Installation in this section).

10. Secure front and rear rollers to LH side plate (see Front Roller Installation and Rear Roller Installation in this section).

IMPORTANT: Over tightening reel bearing adjuster nut may damage reel bearings.

11. Make sure that set screw is loose in LH side plate to allow bearing adjuster nut movement. With the cutting unit and reel in a horizontal position, tighten the bearing adjuster nut to **25 in−lb (2.8 N−m)** to remove cutting reel end play.

12. Loosen the bearing adjuster nut. Then torque bearing adjuster nut from **15 to 17 in−lb (1.7 to 1.9 N−m)**. After torquing nut, check that reel rolling torque does not exceed 10 in−lb (1.1 N−m).

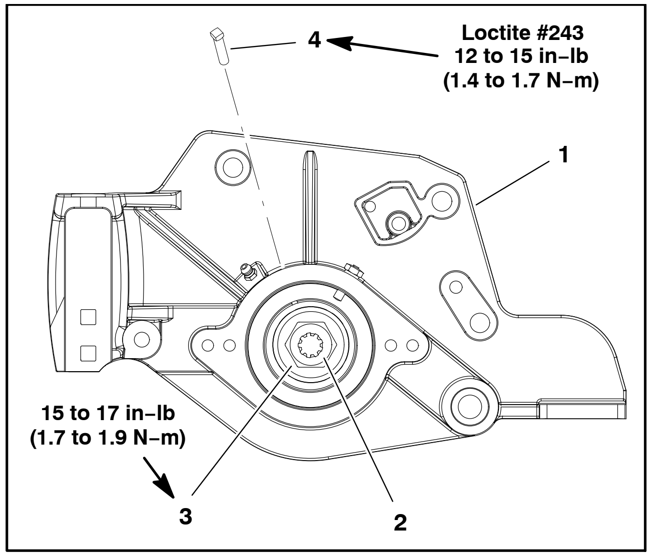

Figure 35

1. **LH side plate**
2. **Threaded insert**
3. **Bearing adjuster nut**
4. **Set screw**

13. Loosen the bearing adjuster nut. Then torque bearing adjuster nut from **15 to 17 in−lb (1.7 to 1.9 N−m)**. After torquing nut, check that reel rolling torque does not exceed 10 in−lb (1.1 N−m).

14. Apply Loctite #243 (or equivalent) to threads of set screw and secure bearing adjuster nut in place with set screw. Torque set screw from **12 to 15 in−lb (1.4 to 1.7 N−m)**.

15. Adjust cutting unit (see Cutting Unit Operator’s Manual).

NOTE: The parallel position of the rear roller to the cutting reel is controlled by the precision machined frame and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in the Adjustments section of this Chapter).

16. If cutting unit is equipped with optional groomer or rear roller brush, install components for those options to left hand side plate of cutting unit. See Service and Repairs section of Chapter 9 − Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

17. If counterweight or accessory was removed from cutting unit, install new O−ring (item 11). Secure counter weight or accessory to cutting unit. Tighten counterweight screws from **27 to 33 ft-lbs (37 to 44 N−m)**.

18. Lubricate cutting unit grease fittings until grease purges from relief valves in side plates. Initial greasing may require several pumps of a hand grease gun.

19. Install cutting unit to the machine.

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DPA Cutting Units

Reel Assembly Service (cutting units with painted side plates)

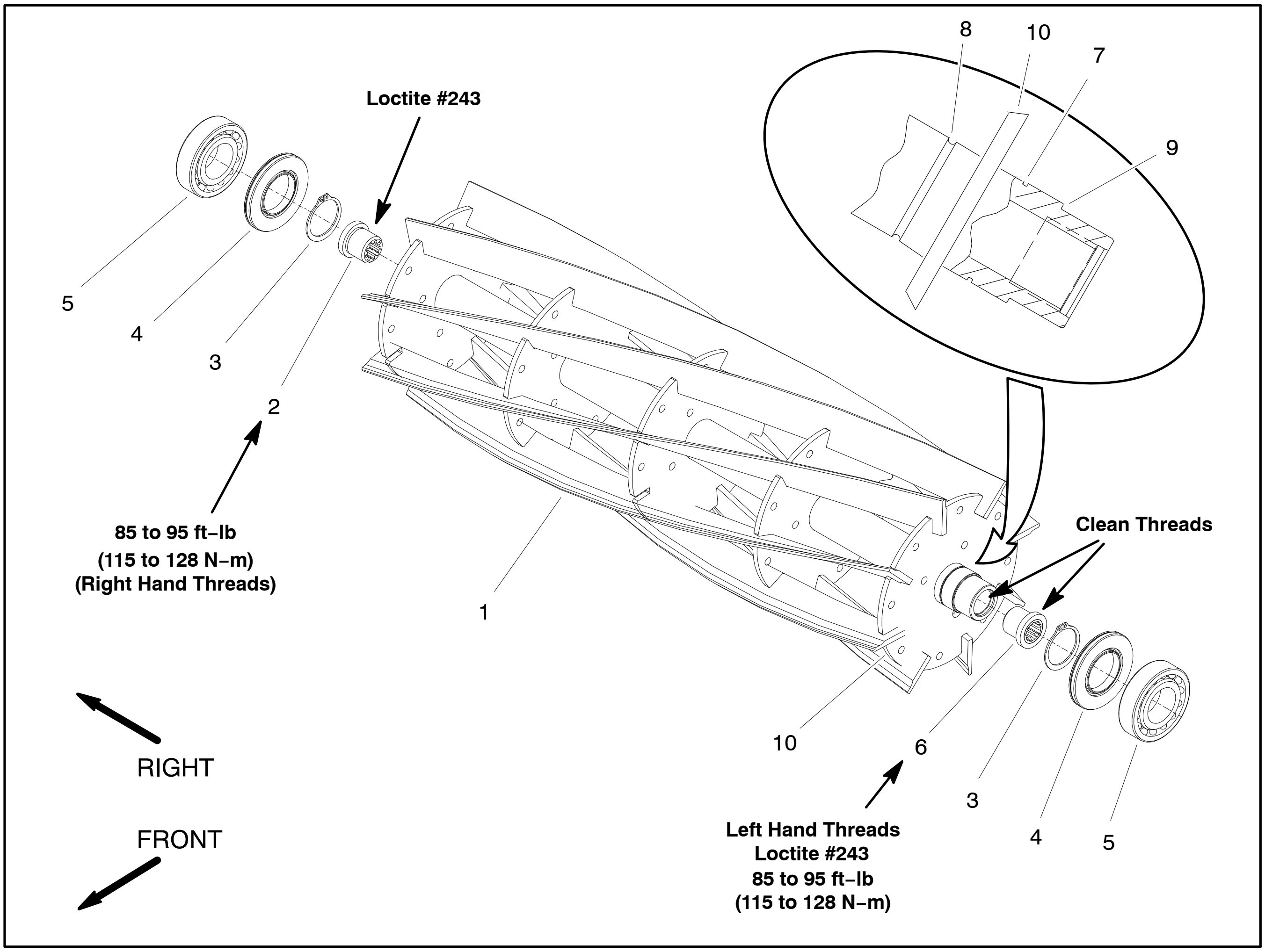

Figure 36

1. **Cutting reel**
2. **Threaded insert (RH thread)**
3. **Retaining ring**
4. **Grease seal**
5. **Bearing**
6. **Threaded insert (LH thread)**
7. **Retaining ring groove**
8. **Groove indicating LH threads**
9. **Bearing shoulder**
10. **Reel spider**

Inspection of Cutting Reel (Fig. 36)

1. Inspect reel bearings to insure that they spin freely and have minimal axial play. The bearing balls must be free of deformation and scoring.

2. Inspect the reel shaft as follows. If reel damage is detected, replace reel.

A. Check the reel shaft for bending and distortion by placing the shaft ends in V−blocks.

B. Check the reel blades for bending or cracking.

C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).

3. Check the threaded inserts in the reel shaft for excessive wear or distortion. Replace inserts if damage is evident.

A. The threaded inserts are installed with thread locking compound (Loctite #243 or equivalent). One insert has LH threads and the other RH threads. The insert with LH threads has an identification groove on the flange face. A groove on the reel shaft identifies the reel end that has LH threads (see illustration in Fig. 36).

B. To remove or install threaded spline inserts, use correct spline insert tool (see Special Tools).

C. To install spline insert into cutting reel, clean threads of insert and cutting reel shaft. Apply Loctite #243 (or equivalent) to threads of insert, thread insert into reel shaft and torque from **85 to 95 ft-lb (115 to 128 N−m)**.

Assembly of Cutting Reel (Fig. 36)

1. If seals and/or bearings were removed from reel shaft, discard removed components and replace.

2. Make sure that the two (2) retaining rings are fully seated into the grooves on the cutting reel shaft.

3. If bearings and seals were removed from reel shaft:

A. Make sure that bore of seals are clean with **no** grease or lubricant applied to ID of seal.

IMPORTANT: The grease seal should be installed so the metal side of the seal is toward the bearing location.

B. Press grease seals onto reel shaft with metal side orientated toward bearing location. Final position of seal should be flush to 0.060" (1.5 mm) away from retaining ring on reel shaft. Do not force seal against retaining ring. Seal must be perpendicular to reel shaft after installation.

C. Pack replacement reel bearings with Mobil High Temperature HP grease (or equivalent).

D. Press grease packed bearings fully onto reel shaft. Bearings should bottom on reel shaft shoulder. Press equally on inner and outer bearing race when installing bearings onto reel shaft.

4. Fill threaded insert splines with high temp Mobil XHP−222 grease or equivalent.

Reel Assembly (cutting units with aluminum side plates)

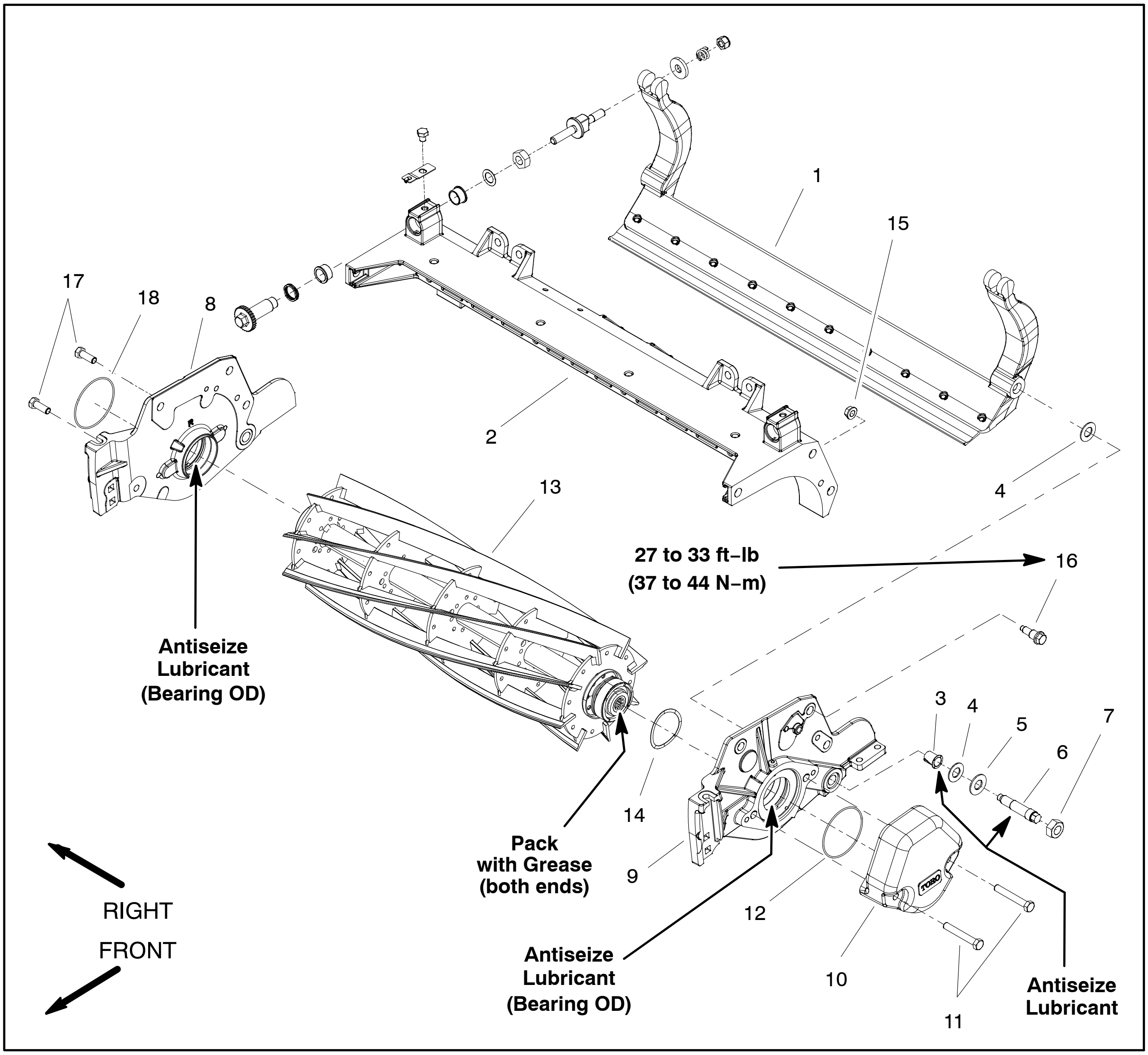

Figure 37

1. **Bedbar assembly**
2. **Cutting unit frame**
3. **Flange bushing (2 used)**
4. **Plastic washer (4 used)**
5. **Metal washer (2 used)**
6. **Bedbar pivot bolt (2 used)**
7. **Lock nut (2 used)**
8. **RH side plate**
9. **LH side plate**
10. **Weight**
11. **Cap screw (2 used)**
12. **O−ring**
13. **Cutting reel assembly**
14. **Wire spring**
15. **Flange nut (3 used per side plate)**
16. **Shoulder bolt (3 used per side plate)**
17. **Cap screw (2 used)**
18. **O−ring**

NOTE: Refer to Reel Assembly Service later in this section for information on replacing cutting reel seals and bearings.

NOTE: Removal of the cutting reel requires removal of the left side plate from the cutting unit frame. The right side plate does not have to be removed from the frame.

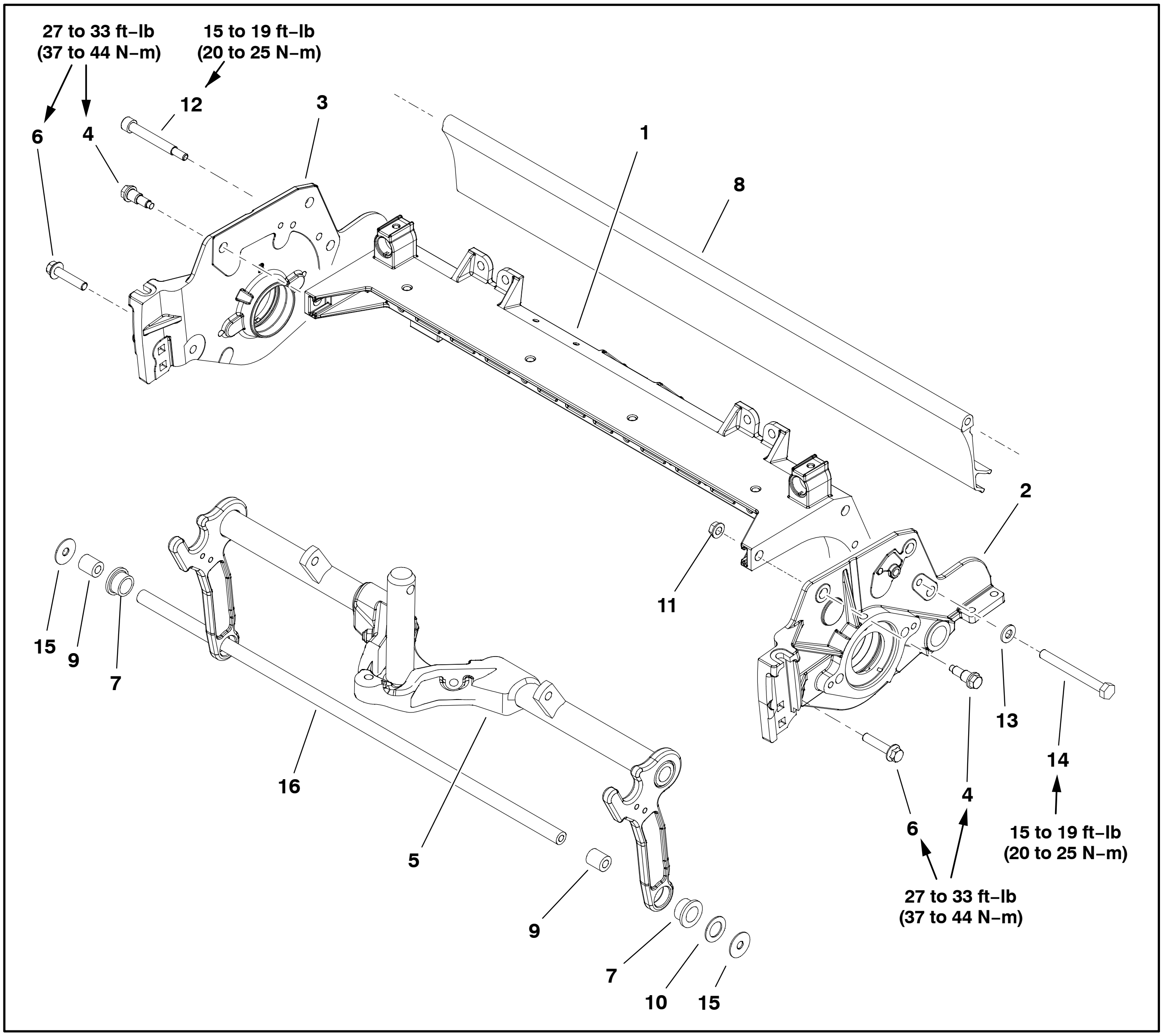

Figure 38

1. Frame
2. LH side plate
3. RH side plate
4. Shoulder bolt (6)
5. Carrier frame
6. Flange head screw (2)
7. Flange bushing (2)
8. Rear grass shield
9. Spacer (2)
10. Shim (0.060” − as required)
11. Flange nut (6)
12. Special screw
13. Flat washer
14. Cap screw
15. Washer (2)
16. Support rod

Reel Assembly Removal

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

2. Remove the cutting unit from the machine and place on a flat work area.

3. If cutting unit is equipped with a counterweight or accessory on LH side plate, remove the counter weight or accessory. Remove and discard O−ring from counter weight. See Chapter 9 − Belt Driven Groomer or Chapter 10 − Universal Groomer for more information. See Rear Roller Brush in this chapter for more information.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

4. Remove bedbar assembly (see Bedbar Assembly Removal in this chapter).

5. Remove front and rear rollers (see Front Roller Removal and Rear Roller Removal in this chapter).

6. Remove cap screw and flat washer that secure rear grass shield to LH side plate.

7. Remove flange head screw and flange nut that secures frame spacer and carrier frame to LH side plate.

NOTE: The reel bearings and grease seals are press fit on the cutting reel shaft and should remain on the reel when removing the LH side plate.

8. Remove three (3) shoulder bolts and flange nuts that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft and cutting unit frame.

9. Carefully pull the cutting reel assembly from the RH side plate.

10. Inspect and service cutting reel assembly as required (see Reel Assembly Service in this chapter).

Reel Assembly Installation

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates for wear or damage and replace if needed.

2. Make sure that grease seals and bearings are properly installed on cutting reel (see Reel Assembly Service in this Chapter).

3. Cutting unit serial nos. 315000001 & Up have O−rings in the reel bearing bore of each side plate. Make sure the O−rings are in good condition and properly installed in the side plates.

4. Apply a thin coat of antiseize lubricant to the reel bearing bore of each side plate (Fig. 39).

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

5. Make sure that flat wire spring (item 14 in Fig. 37) is installed into LH side plate.

6. Carefully slide the RH end of the cutting reel assembly (no groove in reel shaft or on face of threaded insert) into the RH side plate. Make sure that bearing is fully seated into side plate.

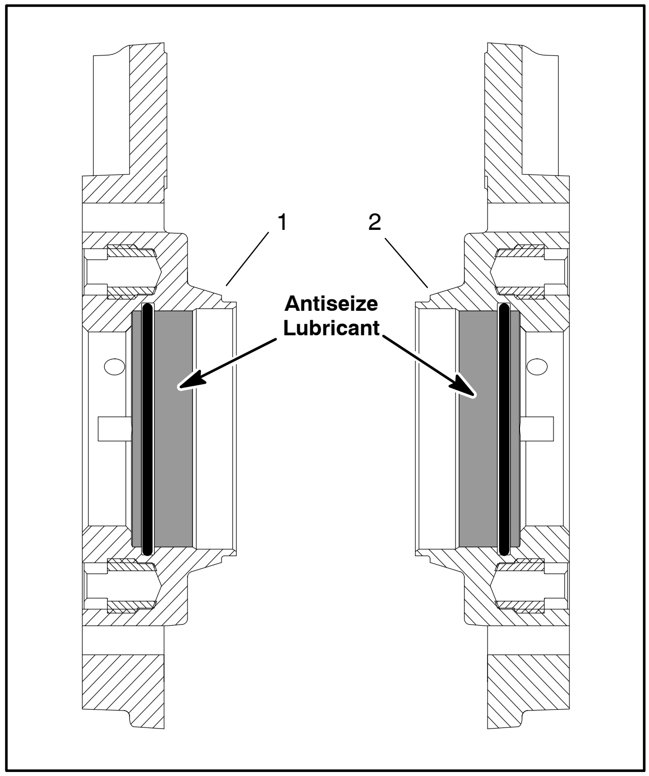

Figure 39

1. **Side plate − RH** 2. **Side plate − LH**

7. Slide the LH side plate onto the cutting reel assembly.

8. Install shoulder bolts and flange nuts that secure the LH side plate to the cutting unit frame. Torque the shoulder bolts from **27 to 33 ft-lbs (37 to 44 N−m)**.

9. Apply Loctite #243 (or equivalent) to threads of flange head screw that secures frame spacer and carrier frame to LH side plate. Install screw and torque from **27 to 33 ft-lbs (37 to 44 N−m)**. After tightening screw, check the clearance between the carrier frame and side plate. If clearance is more than **0.065” (1.6 mm)**, remove flange head screw and position shim(s) between carrier frame and side plate so that clearance is less than **0.065” (1.6 mm)**. Make sure that the carrier frame pivots freely after assembly.

10. Install cap screw and flat washer that secure rear grass shield to LH side plate. Torque screw from **15 to 19 ft-lbs (20 to 25 N−m)**.

11. Install the bedbar assembly (see Bedbar Installation in this section).

12. Install front and rear rollers (see Front Roller Installation and Rear Roller Installation in this section).

13. Adjust cutting unit (see Cutting Unit Operator’s Manual).

NOTE: The parallel position of the rear roller to the cutting reel is controlled by the precision machined frame and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in this Chapter).

14. Install accessories if equipped. See Chapter 9 – Belt Driven Groomer or Chapter 10 – Universal Groomer in this manual for additional Groomer information. See Rear Roller Brush in this chapter for information on rear roller brush.

15. If counterweight was removed from cutting unit, install new O–ring on counter weight. Secure counter weight to cutting unit side plate with two (2) flange nuts. Torque screws from **27 to 33 ft-lbs (37 to 44 N–m)**.

16. Install cutting unit to the machine.

Reel Assembly Service (cutting units with aluminum side plates)

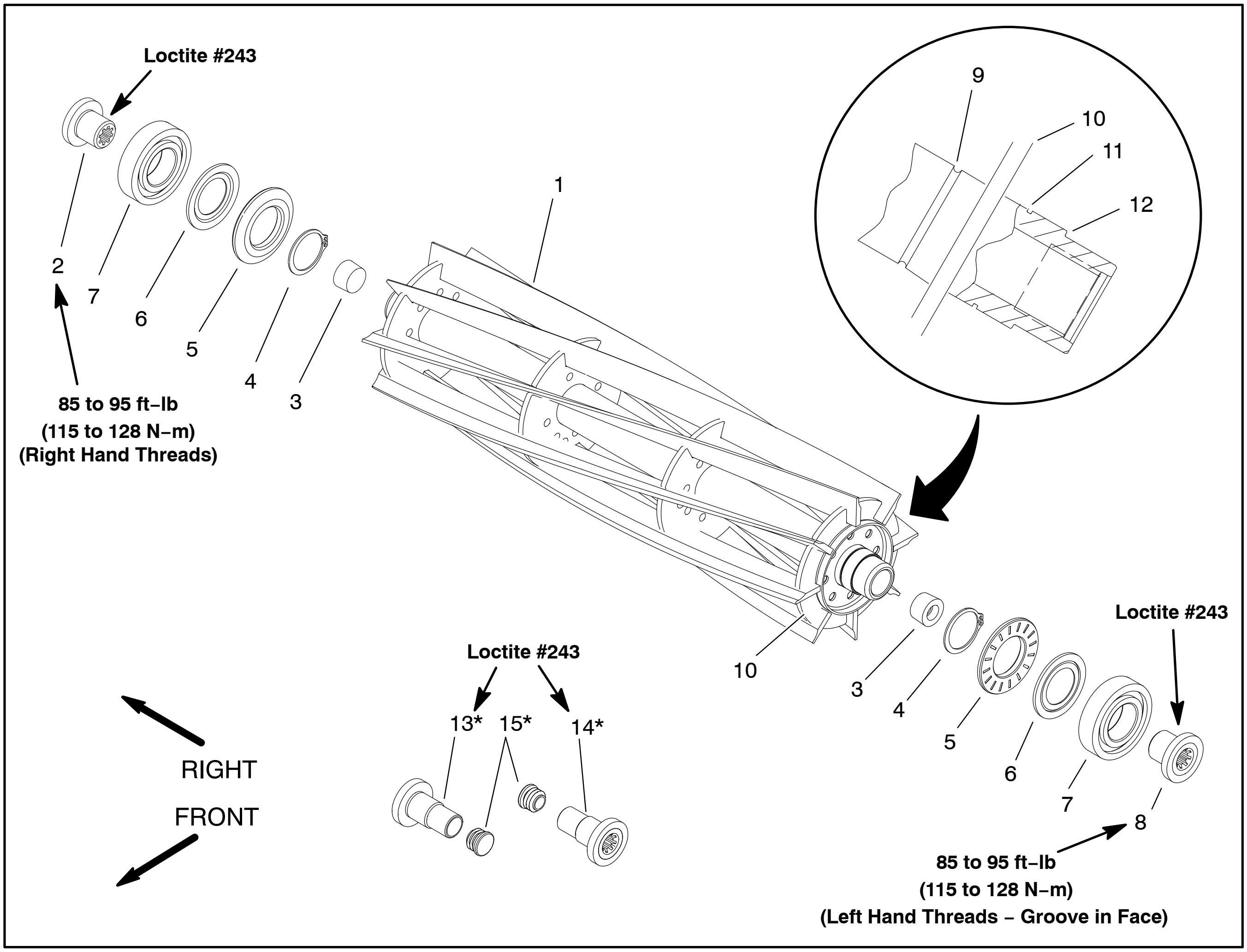

Figure 40

1. **Cutting reel**
2. **Threaded insert (RH thread)**
3. **Plastic plug (2)**
4. **Retaining ring**
5. **Special washer**
6. **Flocked seal**
7. **Sealed bearing**
8. **Threaded insert (LH thread)**
9. **Groove indicating LH threads**
10. **Reel spider**
11. **Retaining ring groove**
12. **Bearing shoulder**
13. **Threaded insert (RH thread)***
14. **Threaded insert (LH thread)***
15. **Plastic plug (2)***

***Used on cutting units prior to serial no. 315000001.

Reel Assembly Inspection

1. Inspect reel bearings to insure that they spin freely and have minimal axial play.

2. Inspect the reel shaft as follows. If reel damage is detected, replace reel.

A. Check the reel shaft for bending and distortion by placing the shaft ends in V−blocks.

B. Check the reel blades for bending or cracking.

C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).

3. Check the threaded inserts in the reel shaft for excessive wear or distortion. Replace inserts if damage is evident.

A. One insert has LH threads and the other insert has RH threads. The insert with LH threads has a groove on the insert face. A groove is cut in the end of the reel shaft that has LH threads.

B. Use correct spline insert tool to remove threaded inserts (see Special Tools in this chapter).

Reel Assembly

1. If removed, install new reel shaft plugs into cutting reel shaft. For cutting unit serial no. prior to 315000001, make sure plastic plug is pressed flush into end of threaded insert. For cutting unit serial no. 315000001 & Up, make sure plastic plug is pressed unto reel shaft **1.63 to 1.37 in. (41 to 35 mm)** below the end of the shaft (Fig. 41)

NOTE: One insert has LH threads and the other insert has RH threads. The insert with LH threads has a groove on the insert face. A groove is cut in the end of the reel shaft that has LH threads.

2. If previously removed, use correct spline insert tool to install threaded inserts (see Special Tools in this chapter). Apply thread locking compound (Loctite #243 or equivalent) to threaded portion of insert. Tighten threaded insert from **85 to 95 ft-lb (115 to 128 N−m)**.

3. Make sure that the two (2) retaining rings are fully seated into the grooves on the cutting reel shaft.

4. Carefully drive special washers onto reel shaft with tapered side of washers toward reel (flat side toward bearing location). Installed washers should be tight against retaining ring and should not wobble as the reel is rotated.

IMPORTANT: The flocked seal should be installed so the flocked (red) side of the seal is toward the bearing location.

5. Slide flocked seals (flocked (red) side orientated toward bearing location) and bearings fully onto reel shaft. Flocked seals and bearings should bottom on reel shaft shoulder.

6. Fill threaded insert splines with high temp Mobil XHP−222 grease or equivalent.

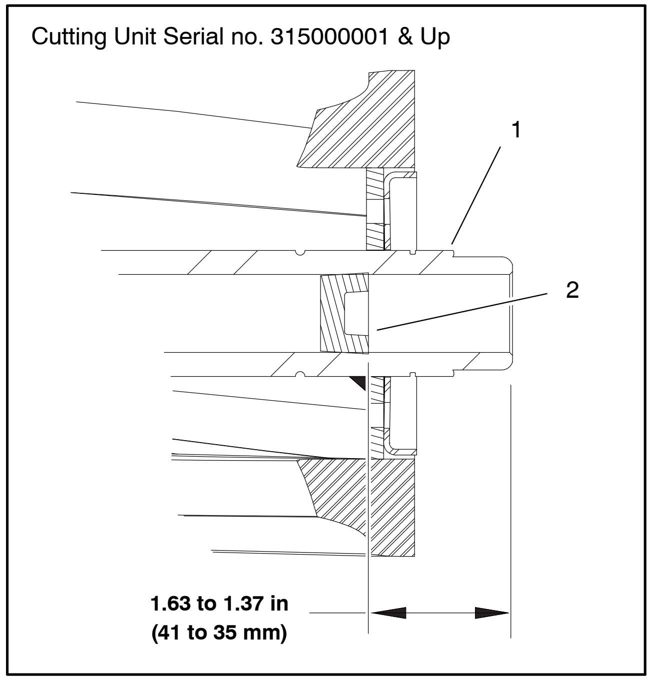

Figure 41

1. **Reel shaft**
2. **Plastic plug (2)**

DPA Cutting Units

Preparing Reel for Grinding

Three (3) types of reel designs are used in Reelmaster cutting units: scalloped radial reel, tapered radial reel and tapered forward swept reel (Fig. 42). The radial reel designs have blades that are placed in line with the center of the reel shaft. The rear of the blades either have a scalloped relief or a tapered relief. The forward swept reel have blades that have a slight forward slant. The rear of the forward swept reel blades have a tapered relief. Before grinding a reel, identify the type of reel design to make sure that grinding is correctly done.

Before grinding a cutting reel, make sure that all cutting unit components are in good condition. Depending on type of grinder used, faulty cutting unit components can affect grinding results. When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications (see Reel Grinding Specifications chart below). Additional reel grinding information can be found in your Cutting Unit Operator's Manual. An additional resource is the Toro Basics Series Training Book, Reel Mower Basics (part no. 09168SL) found on the Service Reference Set available from your Authorized Toro Distributor.

Reel Grinding Specifications	
Reel Diameter (New)	7.060 in (179.3 mm)
Service Limit - Reel Diameter	6.600 in (168.0 mm)
Reel Shaft Diameter (OD)	1.313 in (34.4 mm)
Reel Diameter Taper (Fig. 43)	0.010 in (0.25 mm)
Blade Land Width	0.050 to 0.060 in (1.3 to 1.8 mm) Service Limit: .120 in (3.0 mm)
Blade Relief Angle	30º +/− 5º

Relief grind the reel blades to the minimum blade land width if the reel blade land width exceeds the service limit. Spin grind the reel to restore its cylindrical shape.

NOTE: Spin grind the reel and establish the specified blade land width after relief grinding.

After grinding the reel and/or bedknife, adjust the cutting unit (see Cutting Unit Operator's Manual). Check the reel to bedknife contact again after cutting two (2) fairways. During this initial use, any burrs will be removed from reel and bedknife which may create improper reel to bedknife clearance and thus accelerate wear. This practice of re−checking the reel to bedknife contact after grinding will extend the longevity of the sharpness of the edge of the reel and the bedknife.

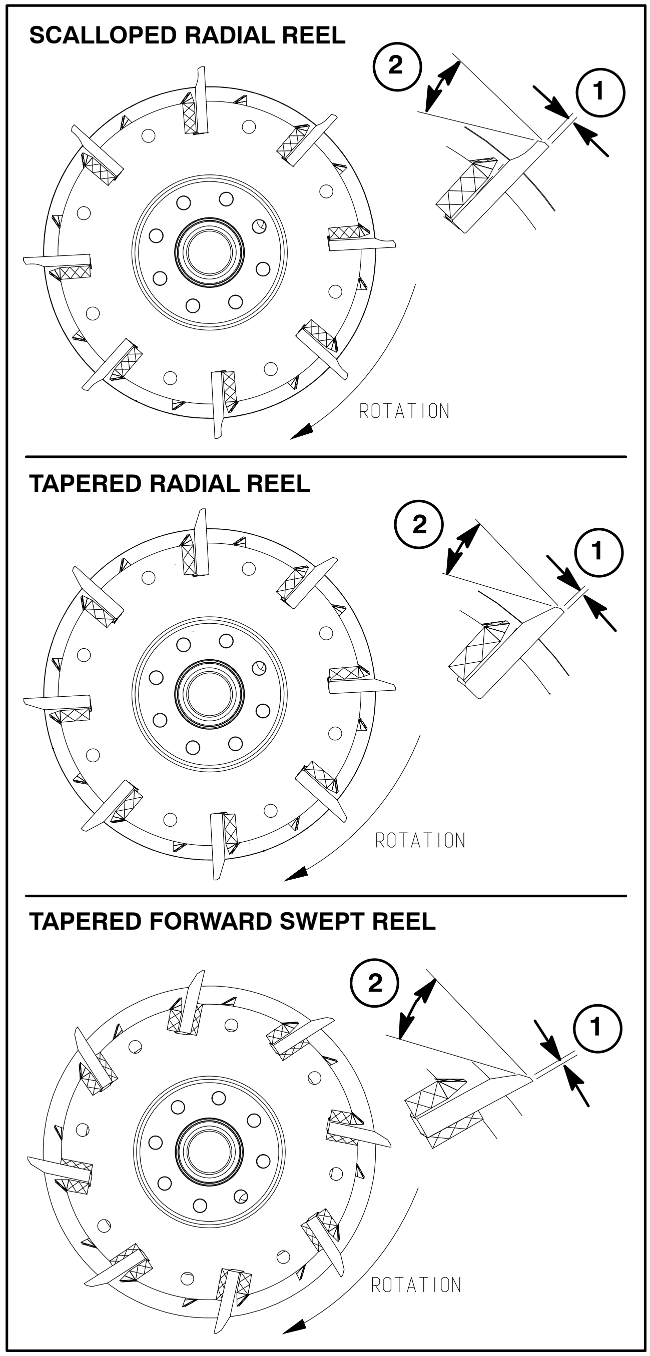

Figure 42

1. **Blade land width**
2. **Blade relief angle**

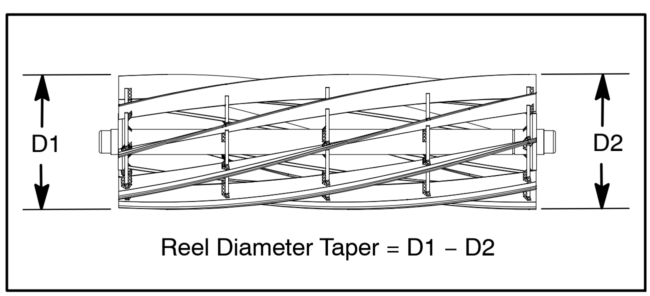

Figure 43

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DPA Cutting Units

Front Roller

Removal (Fig. 44)

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

2. Remove the cutting unit from the machine and place on a level working surface. Use cutting unit kickstand (see Special Tools) to raise front roller from work surface.

3. Loosen flange nut and cap screw securing the front roller shaft to each front height−of−cut (roller) bracket.

4. On one of the height−of−cut (roller) brackets:

   A. Remove flange lock nut and carriage screw that secure bracket to the cutting unit side plate.

   B. Remove the height−of−cut (roller) bracket from the cutting unit.

5. Slide the front roller assembly from the remaining height−of−cut (roller) bracket on the cutting unit.

6. If necessary, remove the second height−of−cut (roller) bracket from the cutting unit.

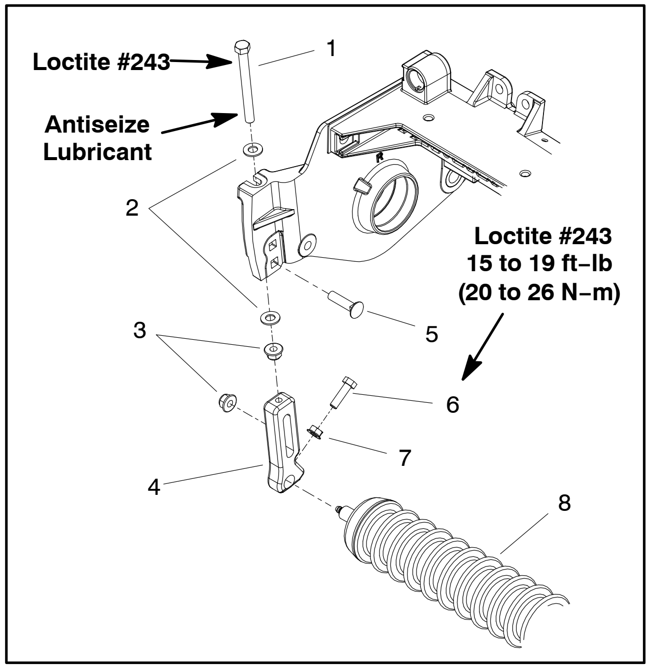

Figure 44

1. **Cap screw**
2. **Flat washer**
3. **Flange lock nut**
4. **HOC (roller) bracket**
5. **Carriage screw**
6. **Cap screw**
7. **Flange nut**
8. **Front roller assembly**

Installation (Fig. 44)

1. Place cutting unit on a level working surface and use cutting unit kickstand (see Special Tools) to support cutting unit.

2. Inspect condition of cap screws (item 1) in both height−of−cut (roller) brackets. Replace cap screw(s) if necessary:

   A. Place two (2) flat washers on cap screw and thread flange lock nut onto cap screw to a position 0.750” (19 mm) from screw head.

   B. Apply antiseize lubricant to cap screw threads that will extend into height−of−cut (roller) bracket.

   C. Thread cap screw into height−of−cut (roller) bracket.

NOTE: When assembling height−of−cut (roller) brackets to side plate, make sure that cap screw head and one washer are above adjustment flange on side plate and second washer and flange lock nut are below flange.

3. If both front height−of−cut (roller) brackets were removed from cutting unit side plate, position one of the brackets to side plate. Secure bracket to side plate with carriage screw and flange lock nut.

4. Slide front roller shaft into bracket attached to the cutting unit. Slide second height−of−cut (roller) bracket onto the other end of roller shaft. Secure second bracket to cutting unit side plate with carriage screw and flange nut.

5. Apply Loctite #243 (or equivalent) to exposed threads of cap screw (item 1) between flange of side plate and position of flange lock nut (item 3) on cap screw. Tighten flange lock nut on cap screw and then loosen nut 1/4 to 1/2 turn. Cap screw should rotate freely with little (if any) endplay after lock nut installation.

6. Apply Loctite #243 (or equivalent) to threads of two (2) cap screws (item 6). Center front roller to the cutting reel and secure roller in place with two (2) cap screws. Torque cap screws from **15 to 19 ft−lb (20 to 26 N−m)**. Secure cap screws with flange nuts.

7. Lubricate front roller.

8. Adjust cutting unit (see Cutting Unit Operator’s Manual).

Rear Roller

Removal (Fig. 45)

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

2. Remove the cutting unit from the machine and place on a level working surface. Place support blocks under bedbar to raise rear roller from work surface.

3. Loosen two (2) flange nuts that secure the rear roller shaft to each rear roller bracket.

4. On one of the rear roller brackets:

   NOTE: On cutting units equipped with optional High Height of Cut Kit, there will be additional roller shims installed between rear roller bracket and cutting unit side plate.

   A. Remove flange nuts and carriage screws that secure rear roller bracket and roller shims to the cutting unit side plate.

   B. Remove the roller bracket and roller shims from the rear roller and cutting unit.

5. Slide the rear roller assembly from the remaining rear roller bracket on the cutting unit.

6. If necessary, remove the second rear roller bracket and roller shims from the cutting unit.

Installation (Fig. 45)

1. Place cutting unit on a level working surface.

NOTE: Refer to Cutting Unit Operator's Manual for number of roller shims required for various height of cut settings.

NOTE: A 0.010" shim (part number 107–4001) is available to allow for leveling of the rear roller (see Leveling Rear Roller in the Adjustments section of this chapter). If necessary, this shim would be used on one side of the rear roller and should be installed between the rear roller bracket and roller shim.

2. If both rear roller brackets were removed from cutting unit side plate, position brackets and roller shims to one of the side plates. Install two (2) carriage screws and flange nuts to retain bracket in position. Do not fully tighten flange nuts.

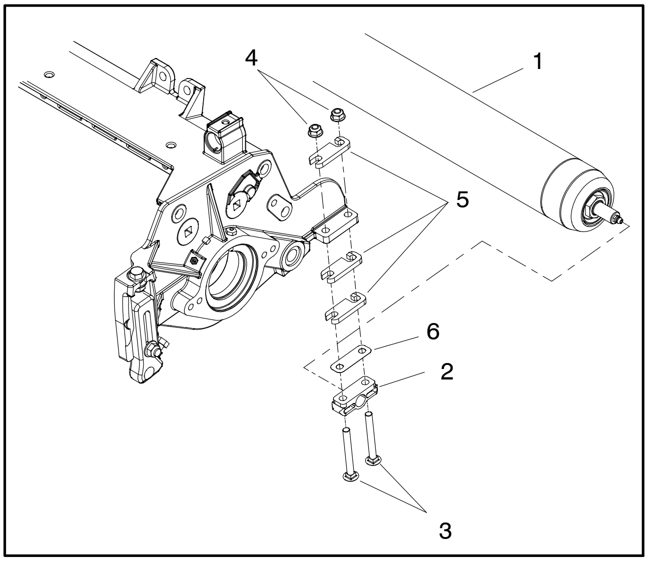

Figure 45

1. Rear roller assembly	**4. Flange nut**
2. Rear roller bracket	**5. Roller shim**
3. Carriage screw	**6. 0.010" shim (if needed)**

3. Slide rear roller shaft into the rear roller bracket attached to the cutting unit. Slide second rear roller bracket onto the other end of roller shaft. Secure second roller bracket and shims to cutting unit side plate with two (2) carriage screws and flange nuts. Do not fully tighten flange nuts.

4. Center rear roller to the cutting reel and secure in place by tightening four (4) flange nuts.

5. Lubricate rear roller.

6. Adjust cutting unit (see Cutting Unit Operator's Manual).

DPA Cutting Units

Roller Service (greasable bearings with retaining ring)

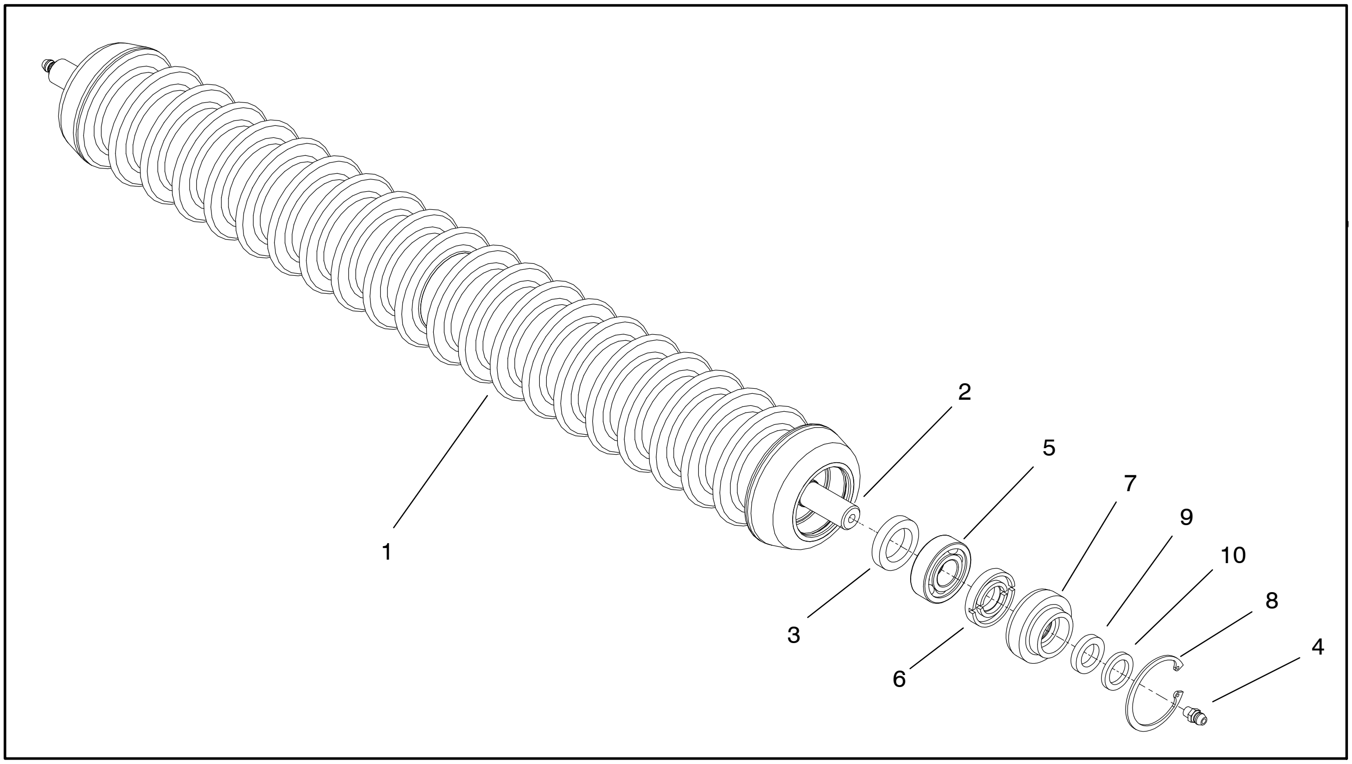

Figure 46

1. **Roller tube (front Wiehle shown)**
2. **Roller shaft**
3. **Inner oil seal**
4. **Grease fitting**
5. **Ball bearing**
6. **Inner seal**
7. **Outer seal**
8. **Retaining ring**
9. **Outer oil seal**
10. **Roller washer**

NOTE: Numerous front and rear rollers are available for the Reelmaster cutting units. These rollers use one of two styles of bearing and seal configurations. The first design has retaining rings that secure the bearings and seals in the roller (Fig. 46). The second design uses a bearing lock nut to retain bearings and seals (Fig. 48).

Disassembly (Figs. 46 and 47)

1. Remove retaining ring from both ends of roller.

2. Support roller assembly and press one end of roller shaft to remove seals and bearing from opposite end of roller. Press on other end of roller shaft to remove remaining seals and bearing from roller. Be careful not to drop roller shaft or tube when removing seals and bearings.

3. Discard removed seals and bearings.

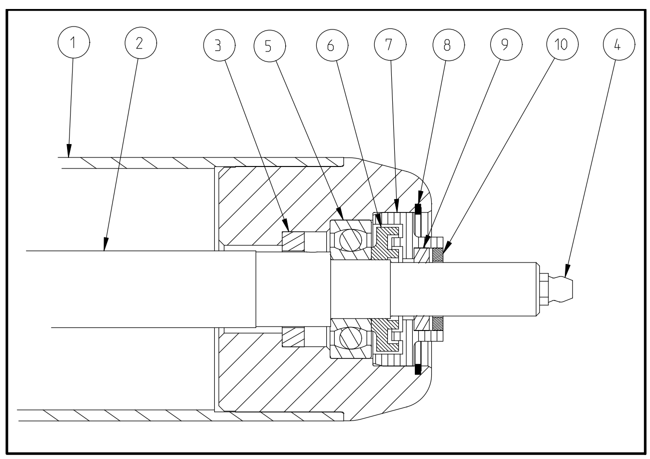

Figure 47

1. **Roller tube**
2. **Roller shaft**
3. **Inner oil seal**
4. **Grease fitting**
5. **Ball bearing**
6. **Inner seal**
7. **Outer seal**
8. **Retaining ring**
9. **Outer oil seal**
10. **Roller washer**

Assembly (Figs. 46 and 47)

NOTE: Use of a press is recommended to assemble the roller. If a press is not available, a soft face hammer can be used with the special tools to assemble the roller.

1. Use installation tool TOR4065 and handle TOR4073 to install inner oil seal into each end of roller tube. Apply grease to ID of seal after installation.

2. Install bearings into roller tube:

   A. Use tool TOR4066 and handle TOR4073 to install bearing into one end of roller.

   B. Install roller shaft from opposite end of roller. Be careful not to damage the inner oil seals when installing shaft.

   C. Put roller in a vertical position and support shaft and installed bearing with tool TOR4067.

   D. Use tool TOR4067 to install second bearing.

3. Use tool TOR4068 to install inner seal.

4. Use tool TOR4069 to install outer seal.

5. Install retaining ring.

6. Use tool TOR4071 to install outer oil seal.

7. Use tool TOR4067 to install roller washer.

8. Put opposite end of roller facing up and support bottom end with tool TOR4067. Repeat steps 3 through 7.

9. Use a hand operated grease gun and No. 2 general purpose lithium base grease to lubricate bearings until grease appears at roller washer. Wipe off excess grease.

Roller Service (greasable bearings with bearing nut)

Disassembly (Fig. 48)

1. Remove bearing lock nut from each end of roller shaft.

2. Loosely secure roller assembly in bench vise and lightly tap one end of roller shaft until outer seals and bearing are removed from opposite end of roller tube. Remove second set of outer seals and bearing from roller tube by tapping on opposite end of shaft. Remove shaft from roller tube.

3. Carefully remove inner seal from both ends of roller tube taking care to not damage tube surfaces.

4. Discard removed seals and bearings.

5. Clean roller shaft and all surfaces on the inside of the roller tube. Inspect components for wear or damage. Also, carefully inspect seating surface and threads of bearing lock nuts. Replace all damaged components.

Assembly (Fig. 48)

1. Install both inner seals into roller tube making sure that seal lip (and garter spring) faces end of tube. Use inner seal tool (see Special Tools) and soft face hammer to fully seat seals against roller shoulder (Fig. 49). Apply a small amount of grease around the lip of both inner seals after installation.

IMPORTANT: During assembly process, frequently check that bearings rotate freely and do not bind. If any binding is detected, consider component removal and reinstallation.

2. Install new bearing and outer seals into one end of roller tube:

A. Position a new bearing into one end of roller tube. Use bearing/outer seal tool (see Special Tools) with a soft face hammer to fully seat bearing against roller shoulder (Fig. 50). After bearing installation, make sure that it rotates freely with no binding.

B. Apply a small amount of grease around the lip of both outer seals.

C. Install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools) and soft face hammer to lightly seat seal against roller shoulder (Fig. 51). Make sure that bearing still freely rotates after seal installation.

D. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that bearing still freely rotates.

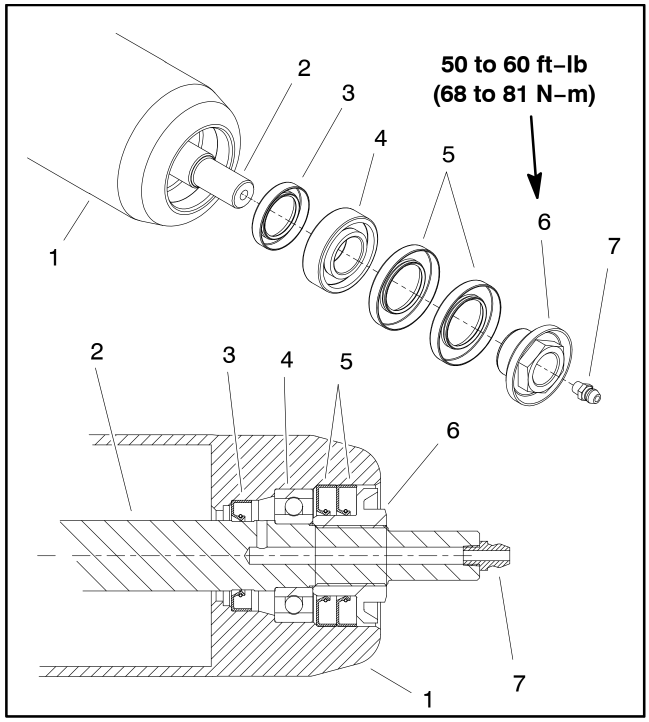

Figure 48

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing lock nut**
7. **Grease fitting**

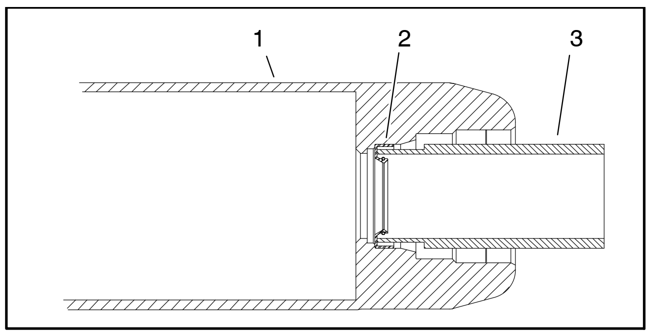

Figure 49

1. **Roller tube**
2. **Inner seal**
3. **Inner seal tool**

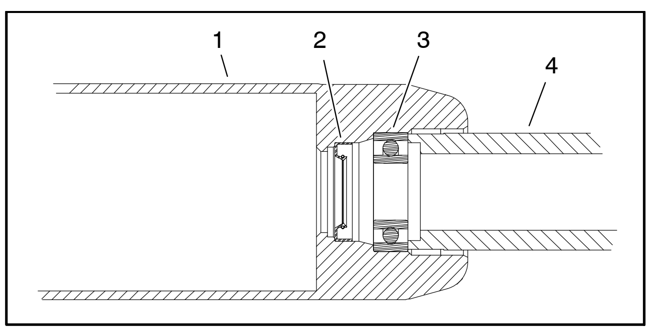

Figure 50

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Bearing/outer seal tool**

3. From the roller tube end with only the inner seal installed, carefully install the roller shaft into the roller tube. Make sure that seals are not damaged as shaft is installed.

4. Install new bearing and outer seals into second end of roller tube:

A. Position a second new bearing to roller shaft and tube. Position washer (see Special Tools) on bearing to allow pressing on both inner and outer bearing races simultaneously.

B. Use washer and bearing/outer seal tool (see Special Tools) with a soft face hammer to fully seat bearing (Fig. 52). After bearing installation, make sure that shaft freely rotates and that no binding is detected. If necessary, lightly tap bearing and/or shaft ends to align shaft and bearings. Remove washer from roller.

C. Apply a small amount of grease around the lip of both outer seals.

D. Carefully install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools) and soft face hammer to lightly seat seal (Fig. 53). Make sure that shaft and bearings still freely rotate after seal installation.

E. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that shaft and bearings still freely rotate.

IMPORTANT: Make sure that all grease is removed from shaft threads to prevent bearing lock nut loosening.

5. Thoroughly clean threads on both ends of roller shaft.

NOTE: If original bearing lock nut(s) are being used, apply Loctite #243 (or equivalent) to threads of lock nut(s).

6. Install bearing lock nut onto each end of the roller shaft. Make sure that outer seals are not damaged during nut installation. Torque bearing lock nuts from **50 to 60 ft−lb (68 to 81 N−m)**.

7. If grease fittings were removed from end of roller shaft, install fittings in shaft.

NOTE: After roller is installed to cutting unit, lubricate roller grease fittings, rotate roller to properly distribute grease in bearings and clean excess grease from roller ends. A properly assembled roller should rotate with less than **5 in−lb (0.68 N−m)** resistance.

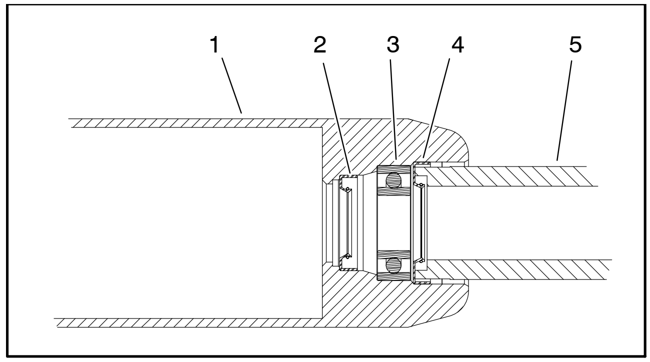

Figure 51

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Outer seal**
5. **Bearing/outer seal tool**

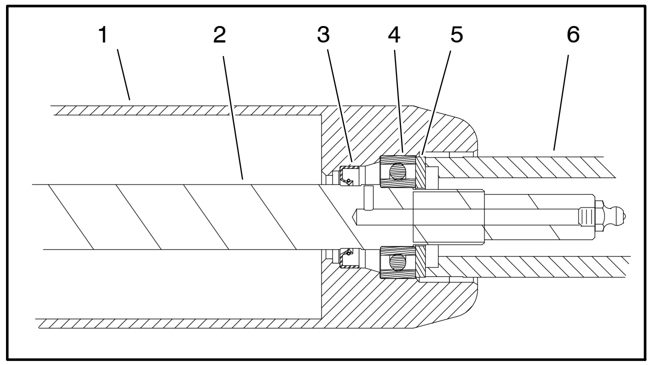

Figure 52

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Washer**
6. **Bearing/outer seal tool**

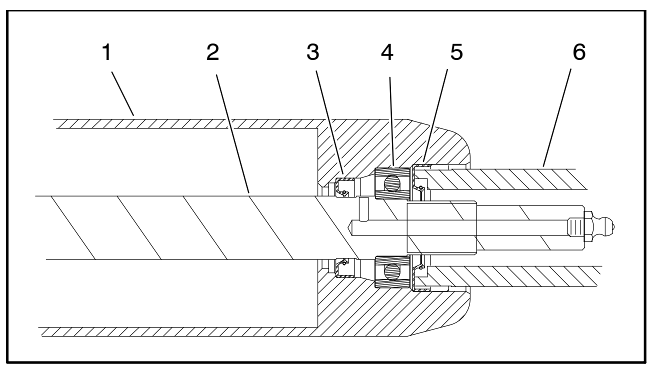

Figure 53

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing/outer seal tool**

Rear Roller Brush – Optional (cutting units with painted side plates)

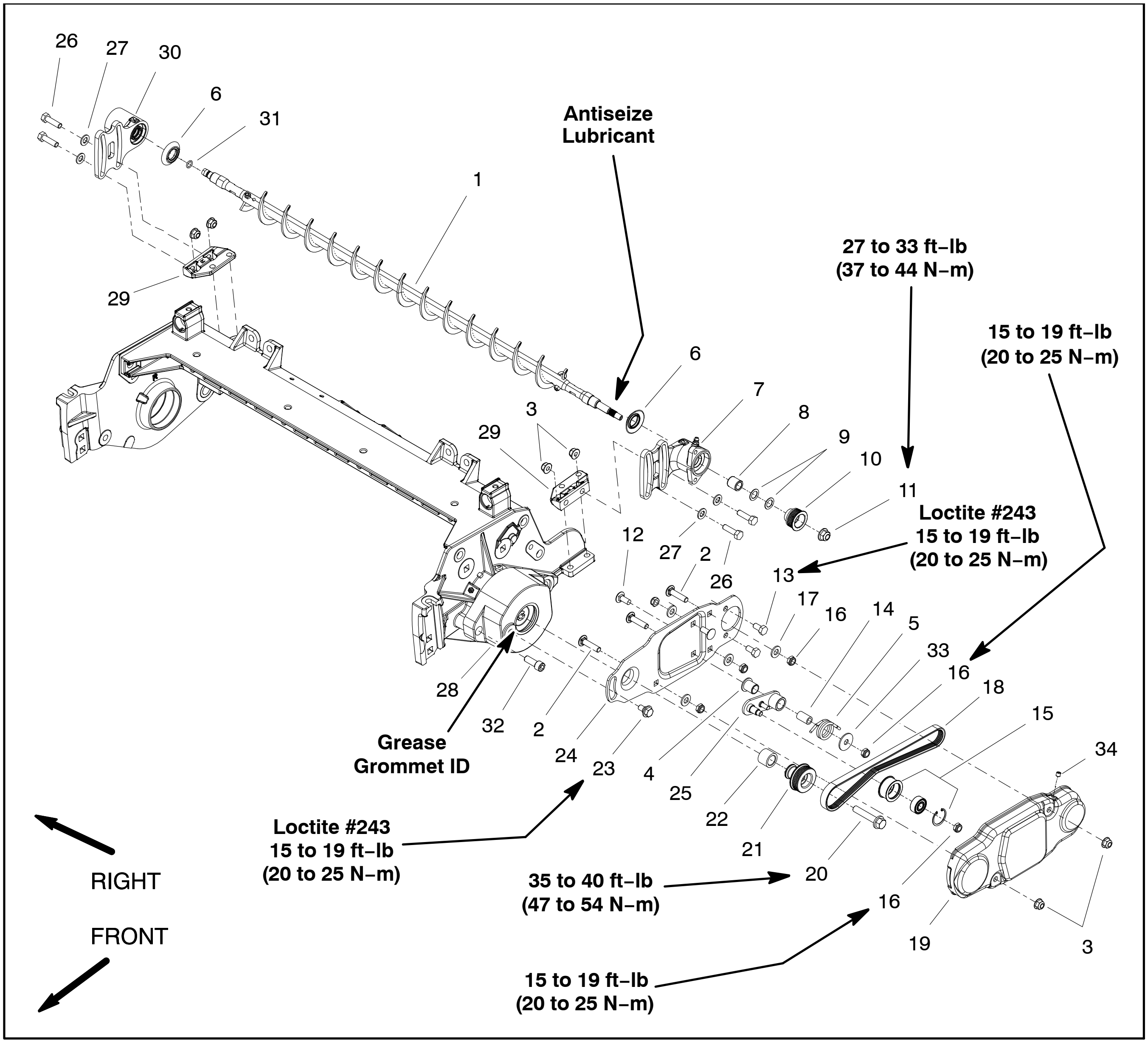

Figure 54

1. **Roller brush assembly**
2. **Carriage screw (3 used)**
3. **Flange nut**
4. **Flange bushing**
5. **Idler spring**
6. **Excluder seal (2 used)**
7. **Bearing assembly (driven)**
8. **Spacer**
9. **Hardened washer (as required)**
10. **Driven pulley**
11. **Flange nut**
12. **Carriage screw (2 used)**
13. **Cap screw (2 used)**
14. **Idler spacer**
15. **Idler pulley assembly**
16. **Lock nut**
17. **Flat washer (4 used)**
18. **Drive belt**
19. **Brush cover**
20. **Flange head screw**
21. **Drive pulley**
22. **Spacer**
23. **Shoulder bolt**
24. **Brush plate**
25. **Idler plate**
26. **Cap screw (4 used)**
27. **Hardened washer (4 used)**
28. **Drive bearing housing**
29. **Mounting bracket (2 used)**
30. **Bearing assembly (non–driven)**
31. **O–ring**
32. **Socket head screw (2 used)**
33. **Pivot washer**
34. **Set screw (top hole in cover)**

NOTE: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 54 shows components used when the brush drive is on the left side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

Disassembly (Fig. 54)

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

2. To remove roller brush from brush shaft:

A. Remove the non−driven brush bearing assembly (item 30) from cutting unit.

B. Slide excluder seal (item 6) from roller brush shaft.

C. Remove lock nut and J−bolt from both ends of the brush (Fig. 55).

D. While rotating brush, slide brush from the shaft.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. To remove roller brush drive belt, rotate the cutting reel and carefully pry the belt off the drive pulley.

4. Disassemble roller brush components as necessary using Figures 54 as a guide.

Assembly (Fig. 54)

1. If brush was removed from shaft, slide brush onto shaft while rotating brush. Secure brush to shaft with two (2) J−bolts and lock nuts. Make sure that the J−bolts are installed with the threaded portion on the outside of the brush (Fig. 55). Torque lock nuts from **20 to 25 in−lb (2.3 to 2.8 N−m)**.

2. If seals or bearings were removed from brush bearing housings, install new components noting proper orientation as shown in Figure 56.

A. Pack bearings with grease before installation.

B. Press bearing into bearing housing so that bearing contacts shoulder in housing bore.

C. Install grease seals so that seal lips are positioned toward the brush location. Press inner seals into housing so that seal contacts bore shoulder. Press outer seals into housing until inner seal is contacted.

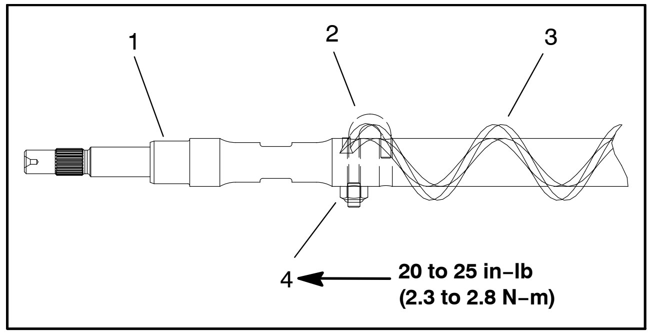

Figure 55

1. **Roller brush shaft**
2. **J−bolt**
3. **Roller brush**
4. **Lock nut**

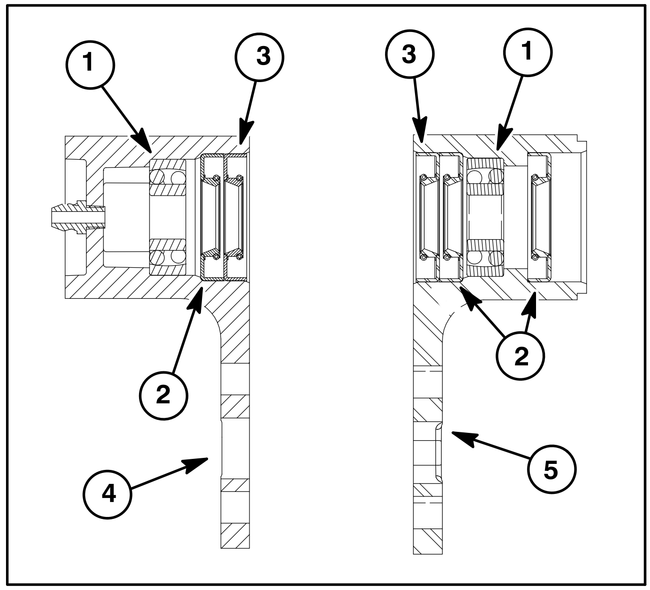

Figure 56

1. **Bearing**
2. **Inner grease seal**
3. **Outer grease seal**
4. **Housing (non−driven)**
5. **Housing (driven)**

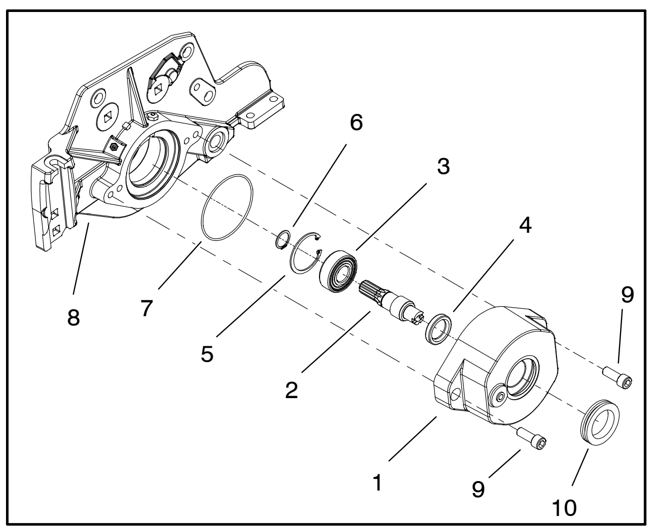

Figure 57

1. **Bearing housing**
2. **Drive shaft**
3. **Ball bearing**
4. **Grease seal**
5. **Retaining ring**
6. **Snap ring**
7. **O−ring**
8. **Side plate**
9. **Socket head screw**
10. **Grommet**

DPA Cutting Units

3. If drive bearing housing was disassembled, install new components noting proper orientation as shown in Figures 57 and 58.

A. Install bearing on shaft by pressing equally on the inner and outer bearing races. Install the bearing so that the bearing seal is closest to the shoulder on the shaft. Install snap ring (Fig. 57, item 6) onto shaft to retain bearing.

B. Install new grease seal into housing with the lip of the seal toward the drive shaft splines. Apply grease to lip of seal.

C. Fill cavity between bearing location and grease seal 50% to 75% full with high temperature Mobil XHP−222 grease (or equivalent).

D. Carefully slide shaft and bearing fully into housing bore taking care to not damage the grease seal. Install retaining ring (Fig. 57, item 5) to secure bearing in housing.

4. Assemble roller brush components using Figure 54 as a guide.

A. Apply a light coating of grease to inner diameter of the grommet in drive bearing housing.

B. Apply Loctite #243 (or equivalent) to threads of cap screws (item 13) that secure brush plate to driven bearing housing assembly. Torque cap screws from **15 to 19 ft−lb (20 to 25 N−m)**.

C. Check that brush plate is parallel to cutting unit side plate. If necessary, change position of mounting bracket (item 29) to allow brush plate to be parallel to side plate.

D. Apply Loctite #243 (or equivalent) to threads of flange head screw (item 20) that secures drive pulley to drive shaft. Torque flange head screw from **35 to 40 ft−lb (47 to 54 N−m)**.

E. Apply antiseize lubricant to splines of roller brush shaft before sliding hardened washer(s) (item 9) and driven pulley (item 10) onto shaft. Torque flange nut (item 11) that secures driven pulley to roller brush shaft from **15 to 19 ft−lb (20 to 25 N−m)**.

F. Position excluder seals on brush shaft so that seals just touch bearing housings.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

G. To install drive belt, loop belt around driven pulley and over the top of the idler pulley. While rotating the cutting reel, carefully guide belt onto drive pulley. After belt installation, make sure that belt and pulley grooves are aligned and that belt is centered in idler pulley.

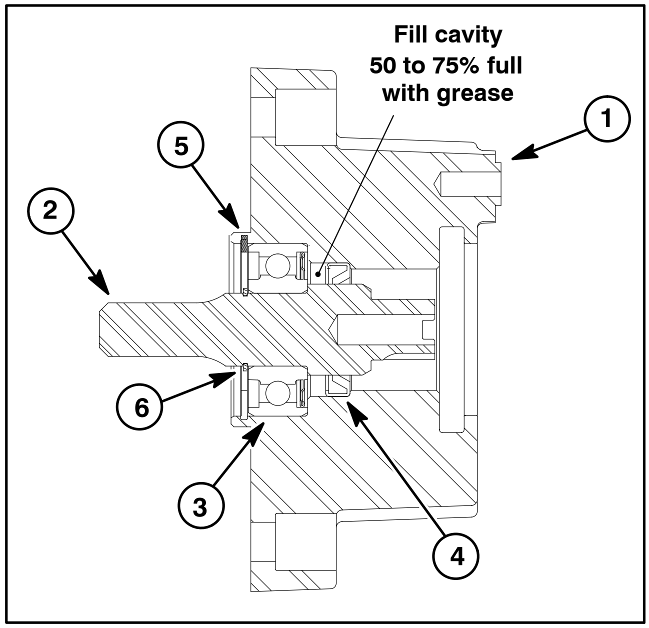

Figure 58

1. **Bearing housing**
2. **Drive shaft**
3. **Ball bearing**
4. **Grease seal**
5. **Retaining ring**
6. **Snap ring**

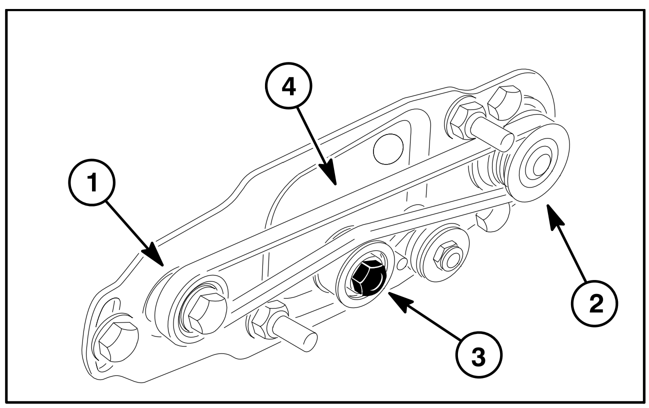

Figure 59

1. **Drive pulley**
2. **Driven pulley**
3. **Idler pulley**
4. **Drive belt**

5. Check alignment of pulleys with a straight edge placed along the outer face of the driven pulley (Fig. 60). The outer faces of the driven and drive pulleys (not the idler pulley) should be in line within 0.030” (0.76 mm). If necessary to align pulleys, remove driven pulley from brush shaft and add or remove hardened washer(s) (item 9) until drive and driven pulleys are aligned within 0.030” (0.76 mm).

6. Check that roller brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with roller (Fig. 61). If contact is incorrect, brush operation will be adversely affected.

7. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

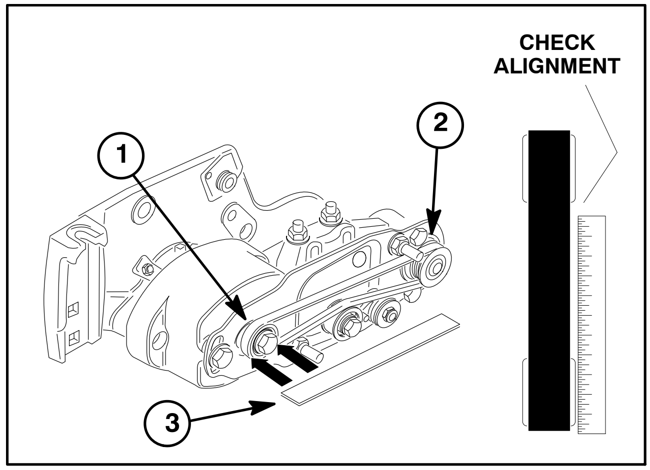

Figure 60

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

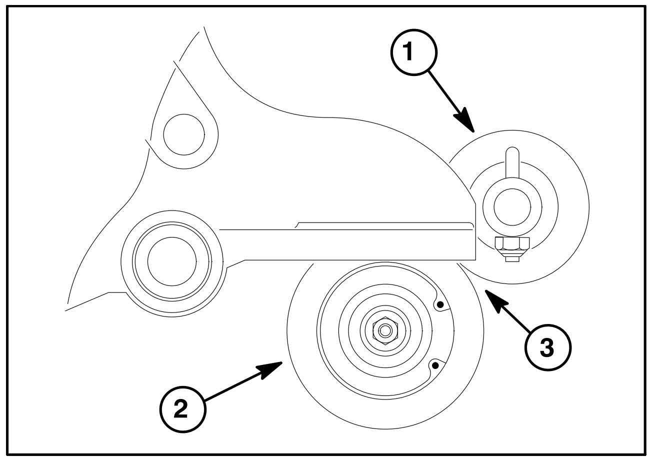

Figure 61

1. **Rear roller brush**
2. **Rear roller**
3. **Light contact**

DPA Cutting Units

Rear Roller Brush – Optional (cutting units with aluminum side plates)

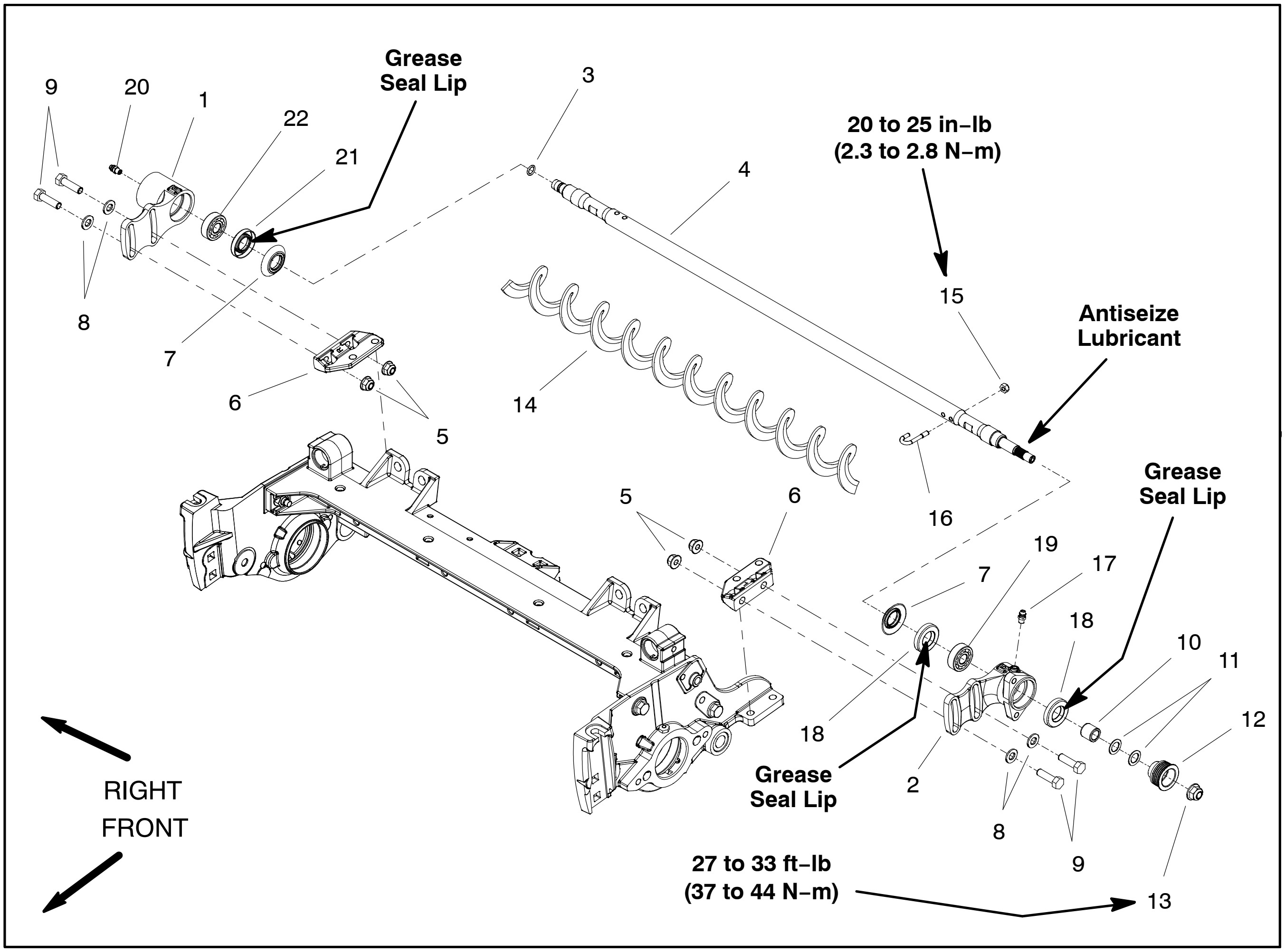

Figure 62

1. Brush bearing housing (non–drive)
2. Brush bearing housing (drive)
3. O–ring
4. Roller brush shaft
5. Flange nut (4 used)
6. Mounting bracket (2 used)
7. Excluder seal (2 used)
8. Flat washer (4 used)
9. Cap screw (4 used)
10. Spacer
11. Flat washer (for pulley alignment)
12. Driven pulley
13. Flange nut
14. Roller brush
15. Lock nut
16. J–bolt (2 used)
17. Grease fitting
18. Grease seal
19. Ball bearing
20. Grease fitting
21. Grease seal
22. Ball bearing

NOTE: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel motor. Figure 54 shows components used when the brush drive is on the left side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

Rear Roller Brush Disassembly (Fig. 54)

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

2. To remove roller brush from brush shaft:

A. Remove the non–drive brush bearing housing (item 1) from cutting unit.

B. Slide excluder seal from roller brush shaft.

C. Remove lock nut and J–bolt from both ends of the brush.

D. While rotating brush, slide brush from the shaft.

3. Disassemble roller brush components as necessary using Figures 54 as a guide. If drive brush bearing housing (item 2) or driven pulley (item 12) need to be removed, brush cover and drive belt removal will be necessary (see Rear Roller Brush Drive System in this section).

Rear Roller Brush Assembly (Fig. 54)

1. If seals or bearings were removed from brush bearing housings, install new components noting proper orientation as shown in Figure 56.

A. Pack bearings with high temp Mobil XHP−222 grease (or equivalent) before installation.

B. Press bearing into bearing housing so that bearing contacts shoulder in housing bore.

C. Install grease seals so that seal lips are positioned toward the brush location as shown in Fig. 56. Press seals into housing so that seal contacts bore shoulder.

2. If roller brush was removed from roller shaft, slide brush onto shaft while rotating brush. Secure brush to shaft with two (2) J−bolts and lock nuts. Make sure that the J−bolts are installed with the threaded portion on the outside of the brush (Fig. 55). Torque lock nuts from **20 to 25 in−lb (2.3 to 2.8 N−m)**.

3. Assemble roller brush components using Figure 54 as a guide noting the following items:

A. Apply coating of grease to lips of grease seals in brush bearing housing before inserting brush shaft into housing.

B. If driven pulley (item 12) was removed from roller brush shaft, apply antiseize lubricant to splines of pulley bore and slide pulley onto shaft. Install and tighten flange nut until pulley is seated onto shaft and then torque flange nut from **27 to 33 ft−lb (37 to 44 N−m)**. Use a ½ wrench on roller brush shaft flats to prevent shaft from rotating when tightening nut.

C. Position excluder seals on brush shaft so that seals just touch bearing housings.

D. If driven pulley (item 12) was removed, check and adjust alignment of drive and driven pulleys (see Rear Roller Brush Drive System in this section).

4. Check that brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with rear roller (Fig. 61). If contact is incorrect, brush operation will be adversely affected.

5. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

6. Once all rear roller brush service is completed, plug the 48 VDC battery disconnect back in before operating the machine.

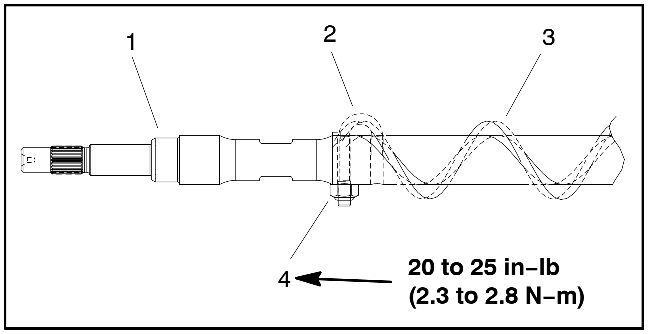

Figure 63

1. **Roller brush shaft**
2. **J−bolt**
3. **Roller brush**
4. **Lock nut**

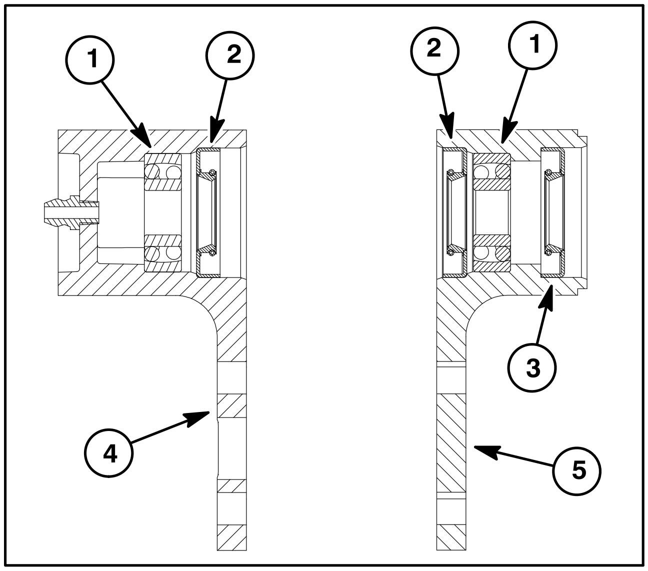

Figure 64

1. **Bearing**
2. **Inner grease seal**
3. **Outer grease seal**
4. **Housing (non−driven)**
5. **Housing (driven)**

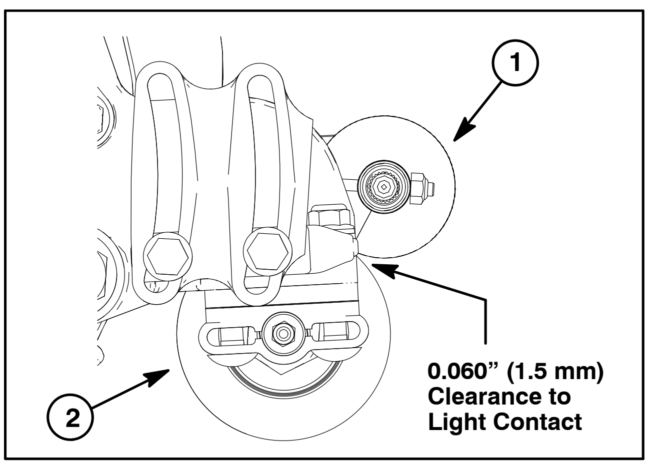

Figure 65

1. **Rear roller brush**
2. **Rear roller**

DPA Cutting Units

Drive System Disassembly (Fig. 66)

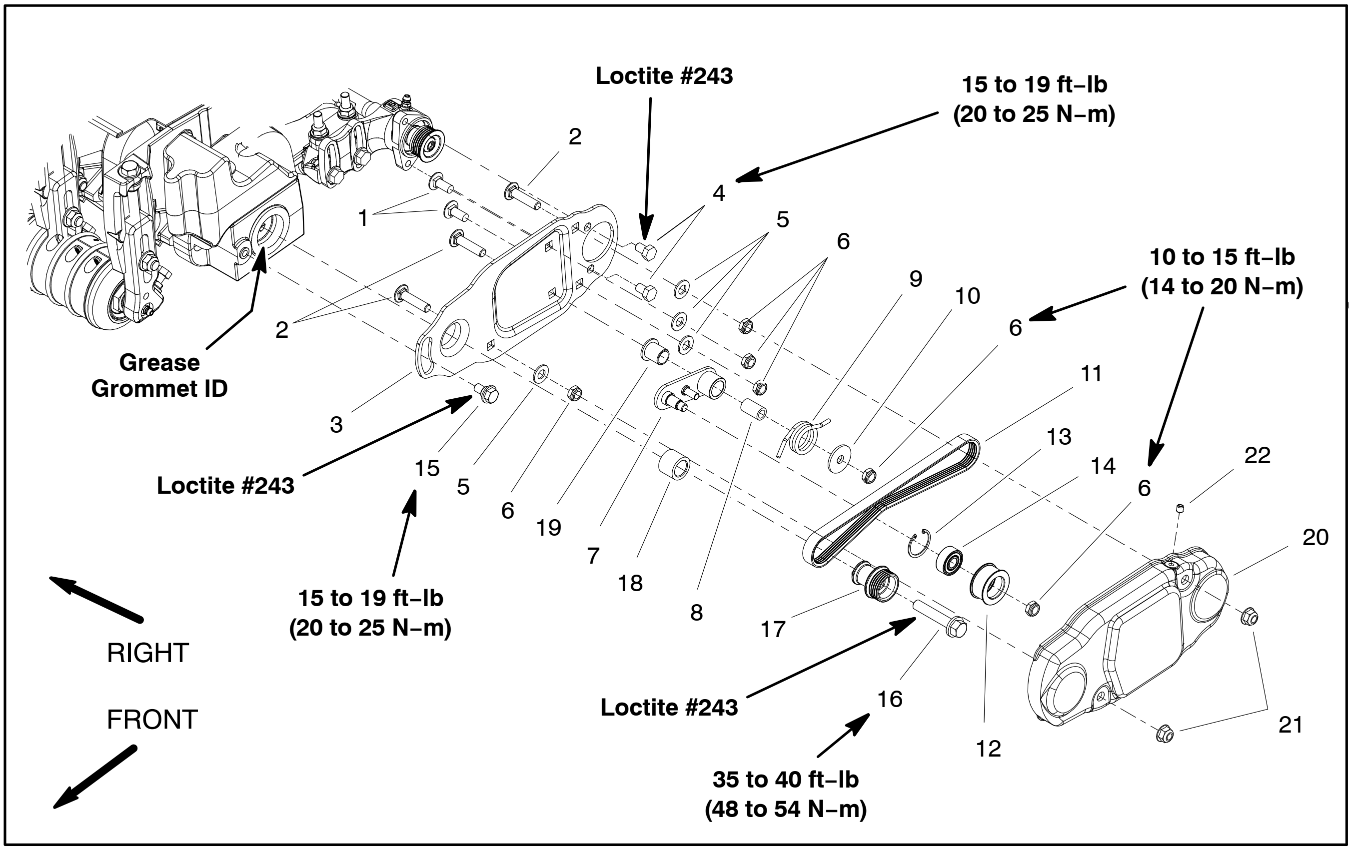

Figure 66

1. **Carriage screw (2 used)**
2. **Carriage screw (3 used)**
3. **Brush plate**
4. **Cap screw (2 used)**
5. **Flat washer (4 used)**
6. **Lock nut (6 used)**
7. **Idler arm**
8. **Idler spacer**
9. **Idler spring**
10. **Pivot washer**
11. **Drive belt**
12. **Idler pulley**
13. **Retaining ring**
14. **Bearing**
15. **Shoulder screw**
16. **Flange head screw**
17. **Drive pulley**
18. **Spacer**
19. **Flange bushing**
20. **Cover**
21. **Flange nut (2 used)**
22. **Set screw (top of cover only)**

NOTE: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel motor. Figure 54 shows components used when the brush drive is on the left side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

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

2. Remove cover (item 20) to access rear roller brush drive components.

3. Remove roller brush drive components as necessary using Figure 66 as a guide.

4. Remove roller brush drive shaft if needed:

A. Remove socket head screws that secure drive housing to cutting unit side plate and remove housing from cutting unit.

IMPORTANT: If rear roller brush drive is on left side of cutting unit, drive shaft has left hand threads and can be identified by a groove on the flange. If the rear roller brush drive is on right side of cutting unit, drive shaft has right hand threads and does not have a groove on the flange (Fig. 68).

B. Loosen and remove drive shaft from cutting reel.

Drive System Assembly (Fig. 66)

1. Install drive shaft if it was removed:

IMPORTANT: If rear roller brush drive is on left side of cutting unit, drive shaft has left hand threads and can be identified by a groove on the flange. If the rear roller brush drive is on right side of cutting unit, drive shaft has right hand threads and does not have a groove on the flange (Fig. 68).

A. Apply Loctite #243 (or equivalent) to threads of drive shaft. Thread drive shaft into cutting reel and torque from **85 to 95 ft−lb (115 to 128 N−m)**.

B. Make sure that O−ring is placed on inner flange of drive housing.

C. Position housing to cutting unit side plate and secure to cutting unit with two (2) socket head screws.

D. Make sure that grommet groove is correctly seated on flange in drive housing bore.

2. Assemble roller brush components using Figure 66 as a guide.

A. During assembly, apply Loctite #243 (or equivalent) to threads of fasteners and torque fasteners as shown in Figure 66.

B. Apply a light coating of grease to inner diameter of the grommet in drive bearing housing before installing brush plate.

C. Brush plate should be installed so that idler pulley assembly is toward the bottom of the plate. Also, the shoulder bolt (item 15) should not clamp the brush plate to the drive housing during assembly.

D. When installing drive pulley (item 17), make sure that tabs on pulley engage slot in drive shaft.

E. Idler arm (item 7) should be free to rotate after assembly to brush plate. Make sure that idler spring is installed so that it can rotate the idler arm and pulley and apply tension to the drive belt.

F. After drive belt installation, make sure that the ribs on the belt are properly seated in the grooves of both the drive and driven pulleys and that the belt is in the center of the idler pulley.

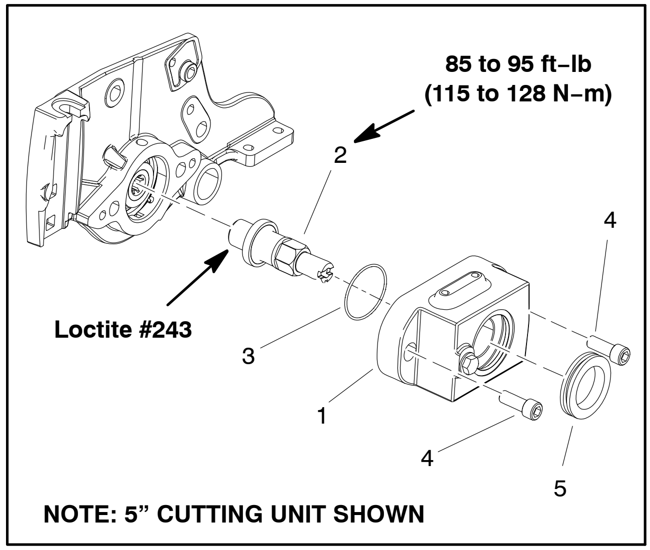

Figure 67

1. **Drive housing**
2. **Drive shaft**
3. **O−ring**
4. **Socket head screw**
5. **Grommet**

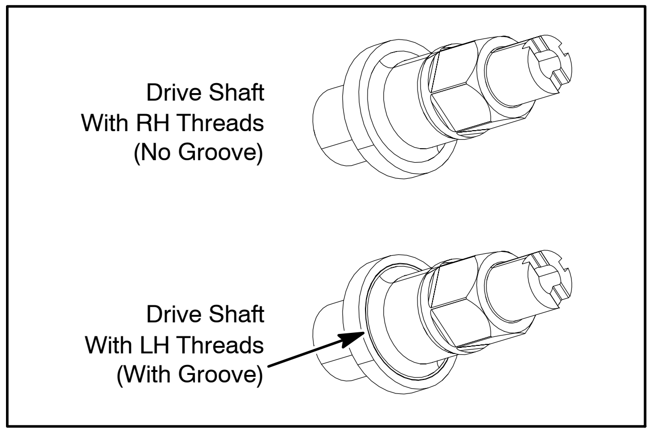

Figure 68

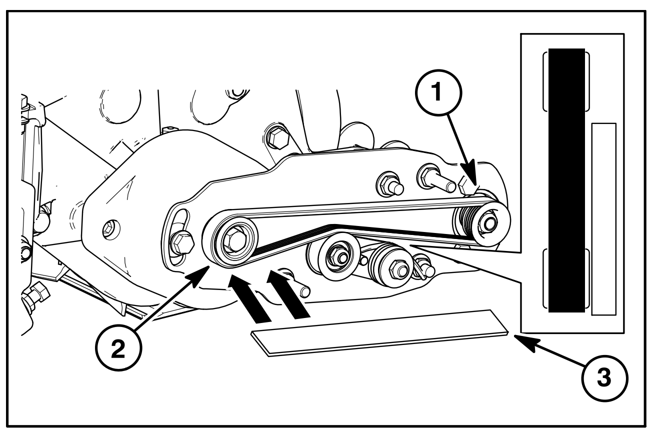

Figure 69

1. **Driven pulley**
2. **Drive pulley**
3. **Straight edge**

DPA Cutting Units

3. After assembly (including drive belt installation), check alignment of pulleys with a straight edge placed along the outer face of the drive pulley (Fig. 60).

A. The outer faces of the drive and driven pulleys (not the idler pulley) should be in−line within 0.030” (0.76 mm).

B. If necessary to align pulleys, remove driven pulley from brush shaft and add or remove flat washer(s) until drive and driven pulleys are correctly aligned (Fig. 70).

C. If driven pulley was removed from roller brush shaft, apply antiseize lubricant to splines of pulley bore and slide pulley onto shaft. Install and tighten flange nut until pulley is seated onto shaft and then torque flange nut from **27 to 33 ft−lb (37 to 44 N−m)**. Use a ½ wrench on roller brush shaft flats to prevent shaft from rotating when tightening nut.

IMPORTANT: The roller brush shaft must nor contact the cutting unit side plate. Also, heavy brush contact on the rear roller will cause premature brush wear.

4. Check that brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with rear roller. If contact is incorrect, brush operation will be adversely affected.

5. Install cover (item 20).There **should not** be a set screw installed in the bottom of the cover.

6. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

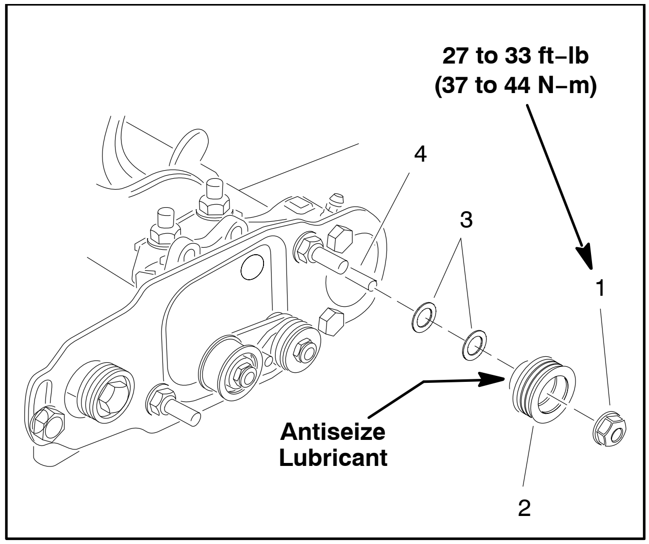

Figure 70

1. **Flange nut**
2. **Driven pulley**
3. **Flat washer**
4. **Roller brush shaft**

Chapter 9

Belt Driven Groomer (Optional)

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Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT: Improper or overaggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. READ AND UNDERSTAND THE GROOMER OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

It is important to remember that factors affecting quality of cut also affect grooming performance.

Variables That Affect the Use and Performance of Groomers:

1. The growing season and weather conditions.

2. General turf conditions.

3. The frequency of grooming/cutting – number of cuttings per week and how many passes per cutting.

4. The height−of−cut.

5. The grooming depth.

6. The type of grass.

7. The amount of time that a groomer reel has been in use on a particular turf area.

8. The amount of traffic on the turf.

9. The overall turf management program – irrigation, fertilizing, weed control, coring, overseeding, sand dressing, disease control and pest control.

10. Stress periods for turf – high temperatures, high humidity, unusually high traffic.

Troubleshooting

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
No rotation of the groomer reel.	The groomer drive belt needs to be adjusted.	Adjust groomer drive belt.
	Seized groomer reel or idler bearing(s) in groomer side plate(s).	Identify and replace faulty bearing(s).
	Broken or damaged idler spring.	Replace spring.
	The groomer drive belt is worn, broken or damaged.	If the drive belt slips, it probably is out of adjustment or worn.
		Repair or replace drive belt if necessary. A broken or worn belt could be the result of improper belt routing or seized bearings in groomer assembly.
	Grooming depth is too deep.	Change grooming depth.
The turf is damaged or has uneven grooming.	The groomer reel blades are bent, damaged or missing.	Repair or replace blades if necessary.
	The groomer reel shaft is bent or damaged.	Replace groomer reel shaft.
	Grooming depth is not equal on both ends of groomer reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height−of−cut, etc.).

Adjustments

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Installation Instructions provide information regarding the installation, set−up and operation of the optional groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

Groomer Height/Depth Adjustment

NOTE: Grooming is performed above the soil level. When adjusting groomer height/depth, groomer blades should never penetrate the soil.

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Make sure rollers are clean and cutting unit is set to the desired height−of−cut (see Cutting Unit Operator's Manual).

3. Place the groomer reel in the grooming (lowered) position by rotating the raise/lower lever toward the front of the cutting unit (Fig. 1).

NOTE: Improper or over−aggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer cautiously.

4. On one end of the groomer reel, measure the distance from the lowest tip of the groomer blade to the working surface. Turn groomer height adjuster to raise or lower the groomer blade tip to the desired height (Fig. 1).

5. Repeat step 4 on the opposite end of the groomer. Then, recheck setting on the first side of groomer. Height setting on both ends of groomer should be identical.

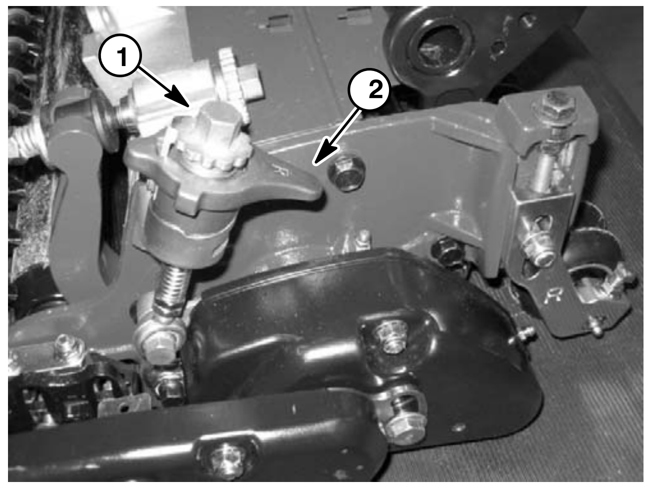

Figure 1

1. **Groomer height adjuster** 2. **Raise/lower lever**

Service and Repairs

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Installation Instructions provide information regarding the installation, set-up and operation of the optional groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

Groomer Drive Belt Replacement

The groomer drive belt should be inspected/replaced **annually or after 750 hours of operation**.

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to replace groomer drive belt (see Roller Brush (Optional) in the Service and Repairs section of Chapter 8 – Cutting Units).

NOTE: When removing groomer cover, groomer weight does not have to be removed from cover.

2. Remove two (2) flange nuts that secure groomer cover, then remove cover (Fig. 2).

3. Remove groomer belt tension by pivoting idler plate and pulley using a wrench on pulley nut. Slip groomer drive belt off pulleys (Fig. 3). Carefully release idler plate and pulley.

4. Install new drive belt to drive pulley, idler pulley and driven pulley observing correct belt routing (Fig. 3). Make sure that groomer drive belt is above idler pulley after belt installation.

5. Install groomer cover and secure with two (2) flange nuts.

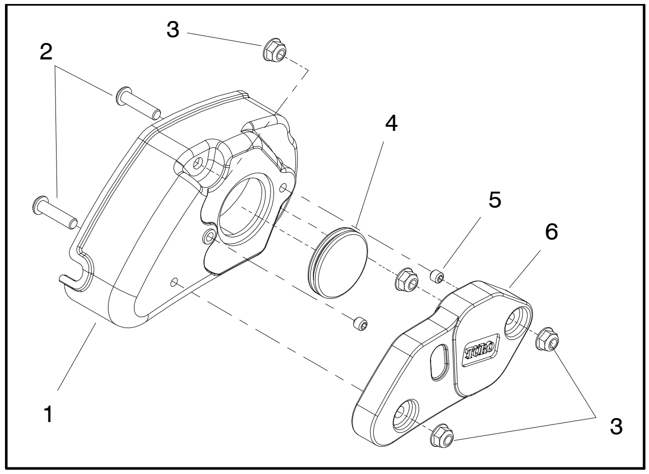

Figure 2

1. Groomer cover
2. Socket head screw
3. Flange nut
4. Rubber grommet
5. Set screw
6. Groomer weight

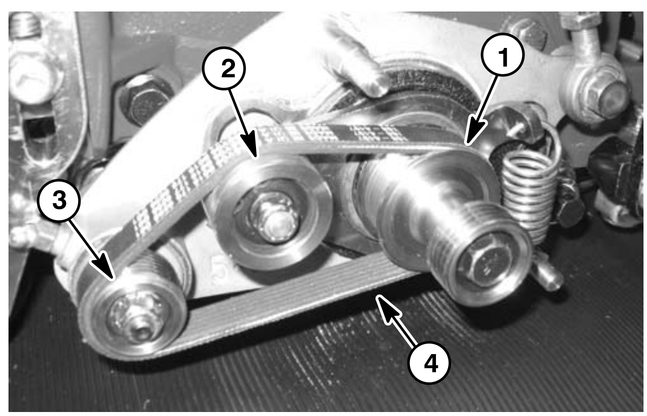

Figure 3

1. Drive pulley
2. Idler pulley
3. Driven pulley
4. Groomer drive belt

Groomer Plate Assembly

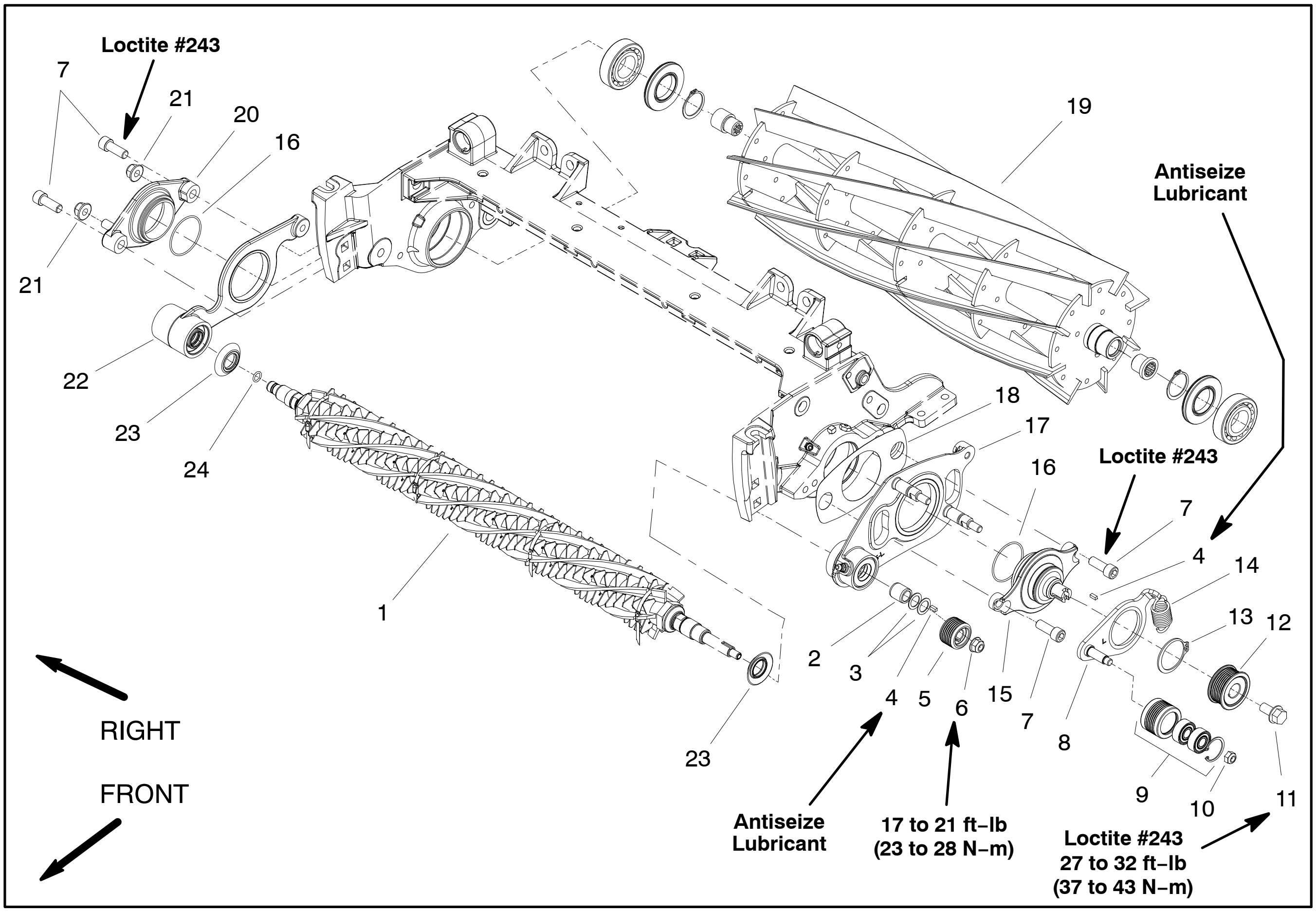

Figure 4

1. **Groomer reel**
2. **Pulley spacer**
3. **Washer (as required)**
4. **Square key**
5. **Driven pulley**
6. **Flange nut**
7. **Socket head screw**
8. **Idler plate**
9. **Idler pulley assembly**
10. **Lock nut**
11. **Flange head screw**
12. **Drive pulley**
13. **Retaining ring**
14. **Extension spring**
15. **Pivot hub assembly (drive)**
16. **O−ring**
17. **Groomer plate (drive)**
18. **Groomer shim**
19. **Cutting reel**
20. **Pivot hub assembly (non−drive)**
21. **Flange nut**
22. **Groomer plate (non−drive)**
23. **Excluder seal**
24. **O−ring**

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 4 shows components used when the groomer reel drive is on the left side of the cutting unit.

Removal (Fig. 4)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to service groomer plate assemblies (see Roller Brush (Optional) in the Service and Repairs section of Chapter 8 − Cutting Units).

2. To remove groomer plate assembly from groomer drive side of cutting unit:

A. Remove groomer belt cover and groomer drive belt from groomer drive (see Groomer Belt Replacement in this section).

NOTE: To prevent cutting reel from turning when removing drive pulley, block reel with piece of wood.

B. Remove flange head screw (item 11) that retains drive pulley. Pull drive pulley from drive shaft. Locate and retrieve square key (item 4) from drive shaft.

NOTE: To prevent groomer shaft from turning when removing driven pulley, use wrench on shaft flats to hold groomer shaft.

C. Remove the flange nut (item 6) that secures driven pulley (item 5) to groomer shaft. Remove driven pulley from shaft. Locate and retrieve square key (item 4) that locates driven pulley on shaft.

D. Slide washer (item 3) and pulley spacer (item 2) from groomer shaft.

E. Remove shoulder bolt that secures quick−up ball joint rod to groomer plate (Fig. 10).

F. Disconnect extension spring (item 14) from stud on groomer plate.

G. Remove two (2) socket head screws (item 7) that secure groomer components to cutting unit side plate.

H. Remove pivot hub and idler plate assembly from cutting unit.

I. Support groomer shaft to prevent it from falling. Carefully slide drive side groomer plate from groomer shaft and cutting unit. Remove groomer shim.

3. To remove groomer plate assembly from groomer non−drive side of cutting unit:

A. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of Chapter 8 − Cutting Units).

B. Remove two (2) socket head screws (item 7) that secure groomer components to cutting unit side plate.

C. Remove pivot hub from cutting unit.

D. Support groomer shaft to prevent it from falling. Carefully slide non−drive side groomer plate from groomer shaft and cutting unit.

4. Inspect seals, bearings and bushing in groomer plates. Remove and discard damaged or worn components.

Installation (Fig. 4)

1. If seals, bearings or bushing was removed from groomer plates, install new components noting proper orientation as shown in Figure 5.

A. Pack bearings with grease before installation.

B. Press bearings into groomer plate so that bearings contact shoulder in groomer plate bore.

C. Install grease seals so that seal lips are positioned toward the groomer blade location. Seals should be flush with surface of groomer plate.

D. Press bushings into groomer plate until the bushing contacts the shoulder in the groomer plate bore.

E. If groomer studs (not shown) were removed from groomer plate (item 17), install new studs into groomer plate and torque from **14 to 18 ft−lb (19 to 24 N−m)**.

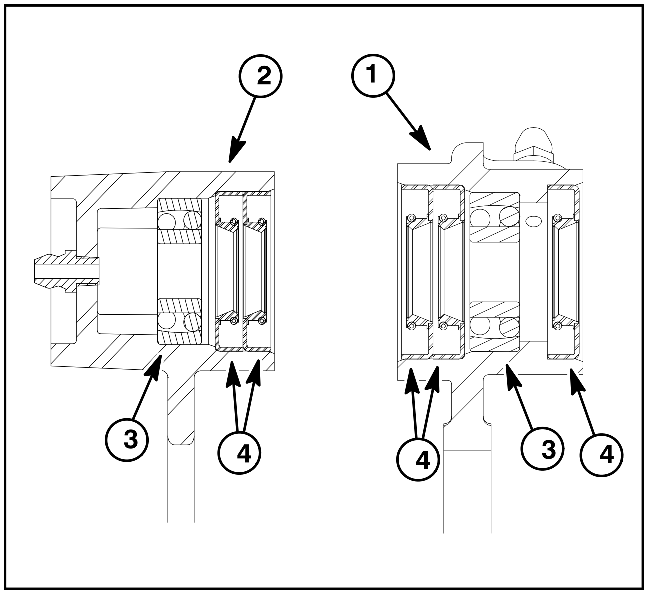

Figure 5

1. **Drive side groomer plate**
2. **Non−drive groomer plate**
3. **Bearing**
4. **Grease seal**

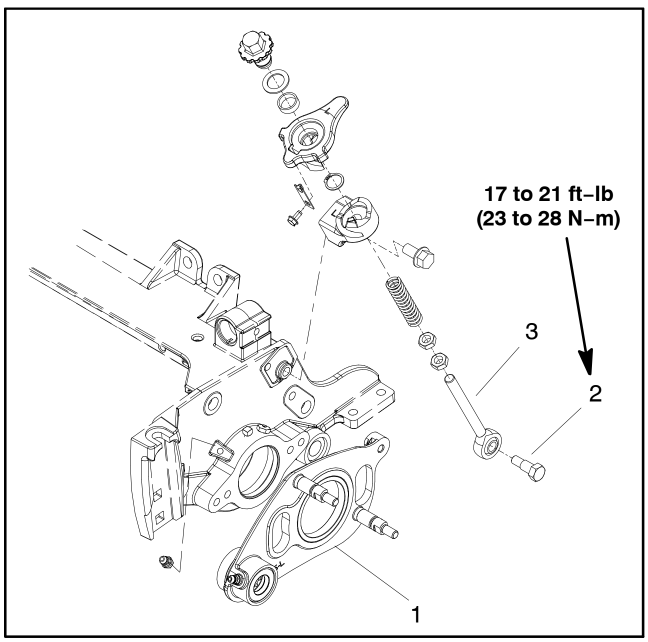

Figure 6

1. **Groomer plate**
2. **Shoulder bolt**
3. **Quick−up ball joint rod**

2. Install groomer plate assembly to groomer non−drive side of cutting unit:

A. Carefully position non−drive side groomer plate onto groomer shaft and slide to cutting unit.

B. Position pivot hub to cutting unit.

C. Secure groomer components to cutting unit side plate with two (2) socket head screws (item 7).

D. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of Chapter 8 − Cutting Units).

3. Install groomer plate assembly to groomer drive side of cutting unit:

A. Position groomer shim to cutting unit side plate. Carefully position drive side groomer plate onto groomer shaft and slide to cutting unit.

B. Position pivot hub and idler plate assembly to cutting unit side plate and secure with two (2) socket head screws (item 7).

C. Connect extension spring (item 14) to stud on groomer plate. Make sure that spring is in the stud groove and that spring hook is positioned toward the drive pulley.

D. Secure quick−up ball joint rod to drive side groomer plate with shoulder bolt (Fig. 6). Torque shoulder bolt from **17 to 21 ft−lb (23 to 28 N−m)**.

E. Slide pulley spacer (item 2) and washer (item 3) onto groomer shaft.

F. Apply antiseize lubricant to square keys (item 4) that locate drive and driven pulleys. Position keys into shaft slots.

NOTE: To prevent cutting reel from turning when installing drive pulley, block cutting reel with piece of wood.

G. Apply Loctite #243 to threads of flange head screw that secures drive pulley to pivot hub shaft. Slide drive pulley onto shaft and secure with flange head screw. Torque screw from **27 to 32 ft−lb (37 to 43 N−m)**.

NOTE: To prevent groomer shaft from turning when installing driven pulley, use wrench on groomer shaft flats.

H. Slide driven pulley onto groomer shaft and secure with flange nut. Torque flange nut from **17 to 21 ft−lb (23 to 28 N−m)**.

I. Check pulley alignment by laying a straight edge along the outer face of the drive pulley (Fig. 7). Drive and driven pulleys should be in line within 0.030” (0.76 mm). If necessary, align pulleys by removing driven pulley and installing or removing washer(s) (item 3) between pulley and pulley spacer.

J. After pulleys are aligned, install groomer drive belt and groomer belt cover (see Groomer Belt Replacement in this section).

4. Check that excluder seals just touch groomer plate assembly. Reposition excluder seals on groomer shaft if necessary.

5. Check groomer reel height and mower height−of−cut settings. Adjust as needed.

6. Lubricate groomer bearings.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

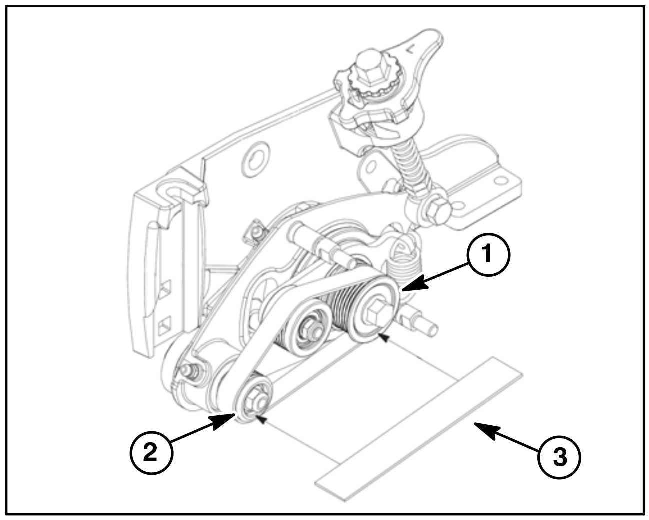

Figure 7

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

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Groomer Reel

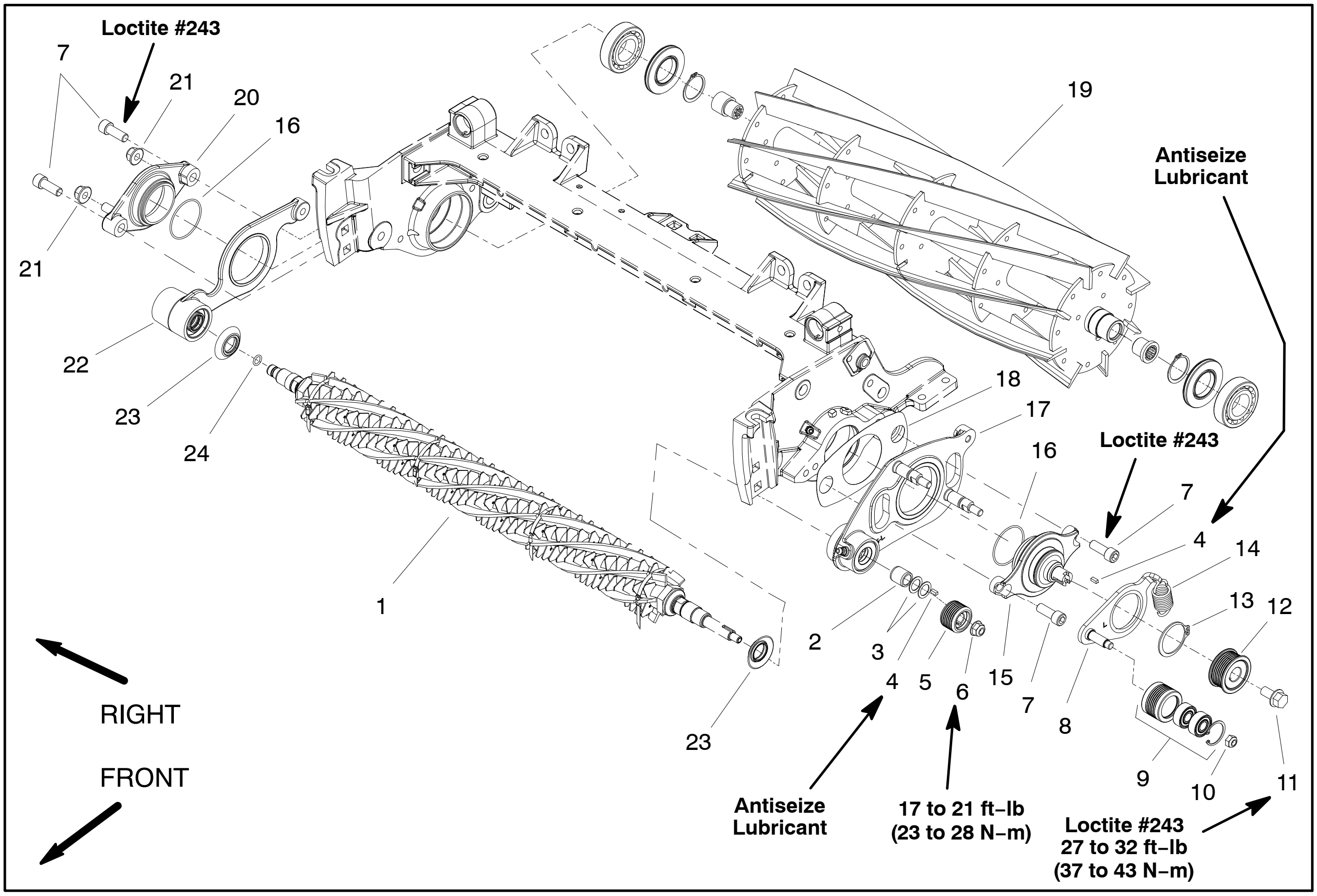

Figure 8

1. **Groomer reel**
2. **Pulley spacer**
3. **Washer**
4. **Square key**
5. **Driven pulley**
6. **Flange nut**
7. **Socket head screw**
8. **Idler plate**
9. **Idler pulley assembly**
10. **Lock nut**
11. **Flange head screw**
12. **Drive pulley**
13. **Retaining ring**
14. **Extension spring**
15. **Pivot hub assembly (drive)**
16. **O−ring**
17. **Groomer plate (drive)**
18. **Groomer shim**
19. **Cutting reel**
20. **Pivot hub assembly (non−drive)**
21. **Flange nut**
22. **Groomer plate (non−drive)**
23. **Excluder seal**
24. **O−ring**

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer blades can be reversed on the shaft to provide additional blade life.

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the reel hydraulic motor. Figure 8 shows the groomer reel drive on the left side of the cutting unit.

Removal (Fig. 8)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch. If desired, remove cutting unit from machine (see Traction Unit Operator's Manual).

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to remove groomer reel (see Roller Brush (Optional) in the Service and Repairs section of Chapter 8 − Cutting Units).

2. Remove groomer plate assembly from groomer drive side of cutting unit (see Groomer Plate Assembly Removal in this section).

3. Carefully pull the groomer reel from the non−drive side groomer plate assembly.

4. Inspect all seals, bushings and bearings in groomer plate assemblies for wear or damage. Replace components as needed (see Groomer Plate Assembly in this section).

Installation (Fig. 8)

1. Position cutting unit on a level surface. If cutting unit is attached to traction unit, make sure to stop engine, engage parking brake and remove key from the ignition switch.

2. Apply a light coating of grease to seal lips in groomer plate assemblies.

3. Make sure that excluder seals (item 23) and O−ring (item 24) are positioned on groomer shaft. The excluder seal lips should be toward the end of the groomer shaft. Apply a film of grease onto seal lip.

4. Carefully slide the groomer reel into the non−drive side groomer plate assembly taking care not to damage seals in groomer plate assembly.

5. Carefully install groomer plate assembly to groomer reel and groomer drive side of cutting unit (see Groomer Plate Assembly Installation in this section).

6. Check that excluder seals just touch groomer plate assembly (Fig. 10). Reposition excluder seals on groomer shaft if necessary.

7. Check groomer reel height and mower height−of−cut settings. Adjust as needed.

8. Lubricate groomer bearings.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

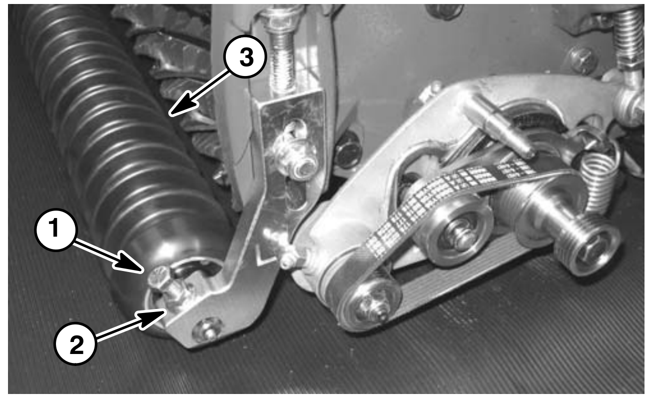

Figure 9

1. **Cap screw**
2. **Flange nut**
3. **Front roller**

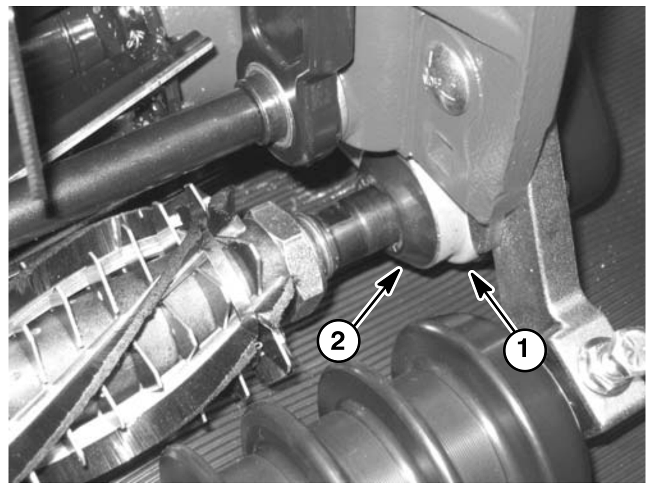

Figure 10

1. **Groomer plate**
2. **Excluder seal**

Groomer Reel Service

Inspect groomer reel blades frequently for damage and wear. Straighten bent blades with a pliers. Either replace worn blades or reverse the blades to put the sharpest blade edge forward (Fig. 11). Blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

Groomer shafts are either hex shaped or splined so two styles of groomer blades are available. The blade shown in Figure 11 is for the hex shaft and the blade shown in Figure 12 is for the splined shaft.

Disassembly (Fig. 13)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove groomer reel from cutting unit (see Groomer Reel Removal in this section).

3. Remove excluder seals from groomer reel.

4. If groomer reel is equipped with broomer kit (Fig. 14), remove straps and broomer brushes from reel.

5. Remove lock nut from either end of the shaft (Fig. 13).

6. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

7. If necessary, remove groomer shaft ends from groomer shaft.

Assembly (Fig. 13)

1. Install lock nut on drive end of groomer shaft. Place first spacer and then first blade on shaft.

2. Alternately install remaining spacers and blades making sure that all blades are separated by a spacer. Additionally, if groomer shaft has a hex shape, rotate location hole on each installed blade one flat of the shaft, in a counterclockwise direction.

3. When all blades have been installed, place final spacer on shaft and then thread second lock nut onto the shaft. Center blades on shaft with lock nuts.

4. Using wrench on shaft flats to prevent shaft from turning, torque second lock nut from **200 to 250 in−lb (23 to 28 N−m)**. After torquing lock nut, spacers should **not** be free to rotate and groomer blades should be centered on shaft.

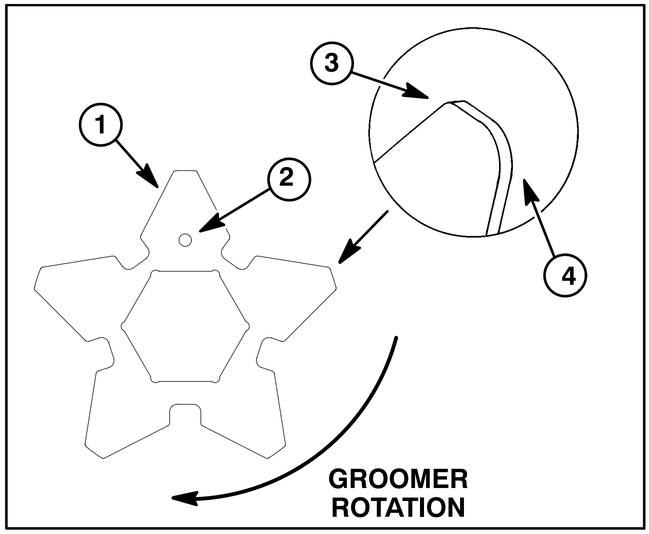

Figure 11

1. Groomer blade
2. Location hole
3. Sharp edge
4. Dull (rounded) edge

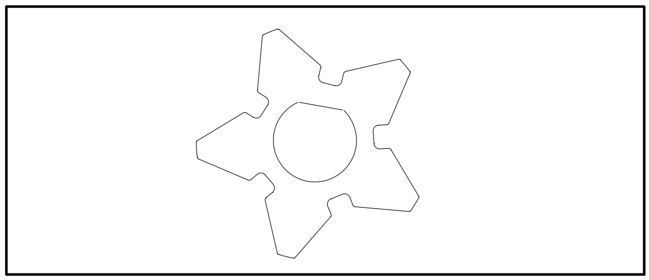

Figure 12

1. Groomer blade for splined shaft

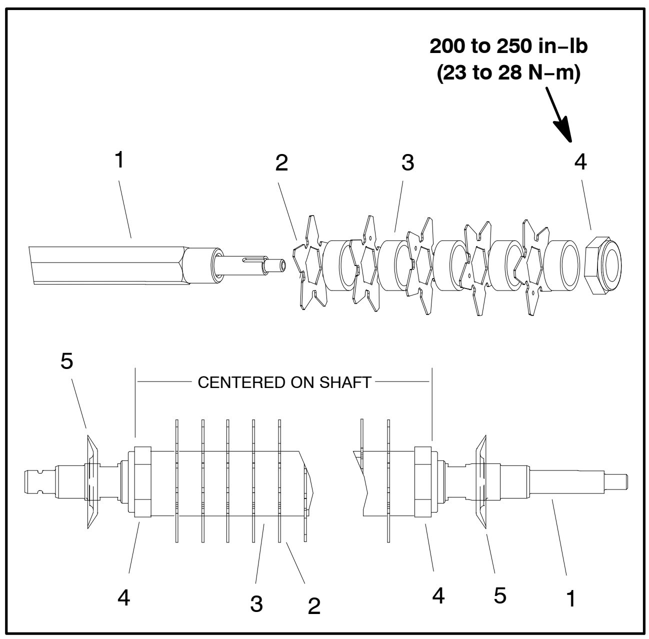

Figure 13

1. Groomer reel shaft
2. Groomer blade (42 used)
3. Spacer (43 used)
4. Lock nut (2 used)
5. Excluder seal

5. If groomer reel is equipped with broomer kit (Fig. 14), position broomer brushes to reel blades and secure with straps. Straps should be positioned between blades 1−2, 14−15, 28−29 and 41−42. Pull straps tight and cut off strap extension approximately 1/4" (6 mm) beyond retainer.

6. Place excluder seals on groomer shaft.

7. Install O−ring on non−drive end of groomer shaft.

8. Install groomer reel back on cutting unit (see Groomer Reel Installation in this section).

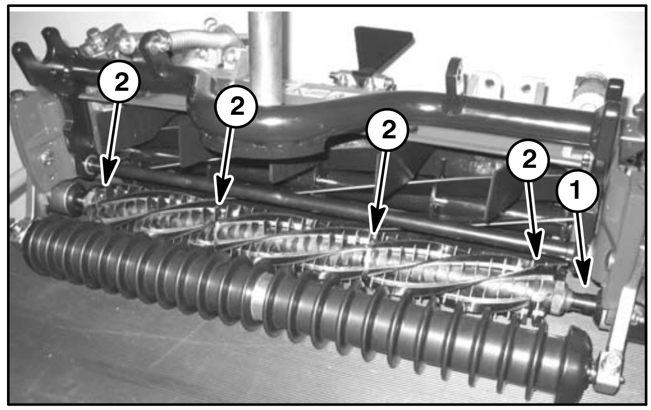

Figure 14

1. **Groomer shaft**
2. **Broomer strap**

Groomer Pivot Hub

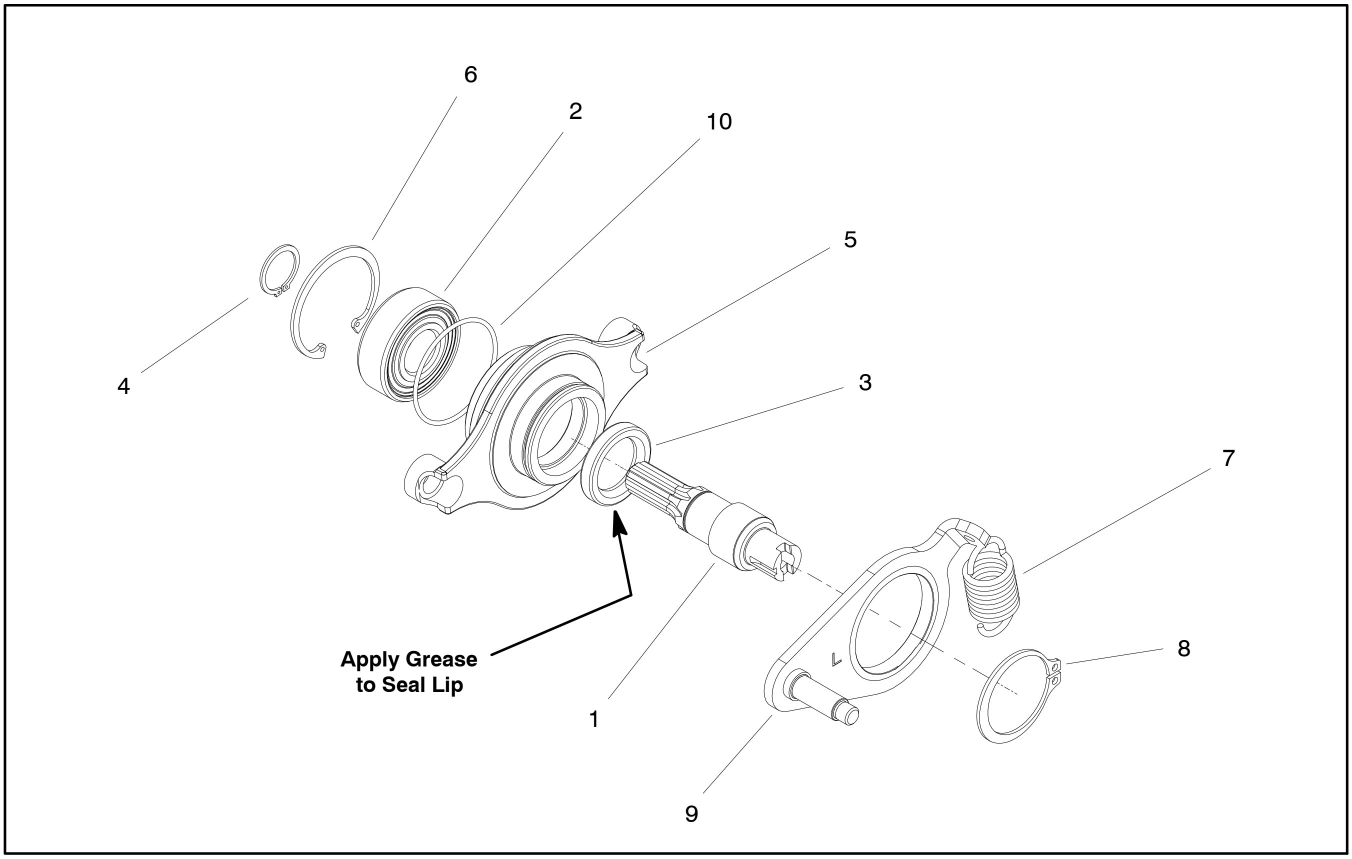

Figure 15

1. **Groomer drive shaft**
2. **Ball bearing**
3. **Grease seal**
4. **Retaining ring**
5. **Pivot hub**
6. **Retaining ring**
7. **Extension spring**
8. **Retaining ring**
9. **Idler plate**
10. **O−ring (7” cutting unit only)**

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 15 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 15)

1. Remove pivot hub assembly (with idler plate) from cutting unit (see Groomer Plate Assembly Removal in this section).

2. Remove retaining ring (item 4) that secures idler plate to pivot hub. Slide idler plate from pivot hub.

3. Remove retaining ring (item 8) that retains ball bearing into pivot hub. Slide drive shaft and bearing out of hub.

4. Remove retaining ring (item 7) that retains bearing on drive shaft. Press ball bearing from shaft. Discard bearing.

5. Remove grease seal from pivot hub. Discard seal.

6. On 7" cutting units, remove and discard O−ring (item 10) from flange of pivot hub.

7. Clean all pivot hub components and inspect for wear or damage.

Assembly (Fig. 15)

1. Install bearing on drive shaft by pressing equally on the inner and outer bearing races. Install the bearing so that the bearing seal is closest to the shoulder on the shaft. Install retaining ring (item 7) onto shaft to retain bearing.

2. Install new grease seal into housing with the lip of the seal toward the outside of the housing. Apply grease to lip of seal.

3. Fill cavity between bearing location and grease seal 50% to 75% full with high temperature Mobil XHP−222 grease (or equivalent) (Fig. 16).

4. Carefully slide shaft and bearing fully into pivot hub bore taking care to not damage the grease seal. Install retaining ring (item 8) to secure bearing in pivot hub.

5. Install new O−ring (item 10) into groove in pivot hub flange.

6. Slide idler plate onto pivot hub and secure with retaining ring (item 4).

7. Install pivot hub and idler plate assembly to cutting unit (see Groomer Plate Assembly Installation in this section).

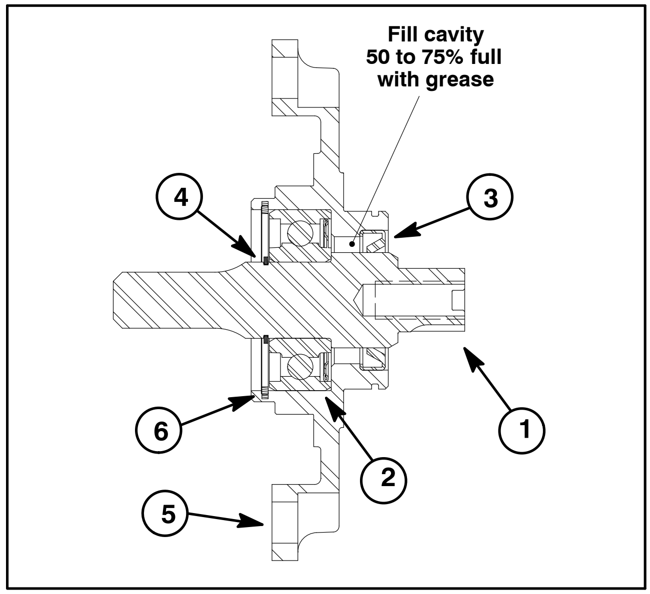

Figure 16

1. **Drive shaft**
2. **Bearing**
3. **Oil seal**
4. **Retaining ring**
5. **Pivot hub**
6. **Retaining ring**

Height Adjuster Assembly

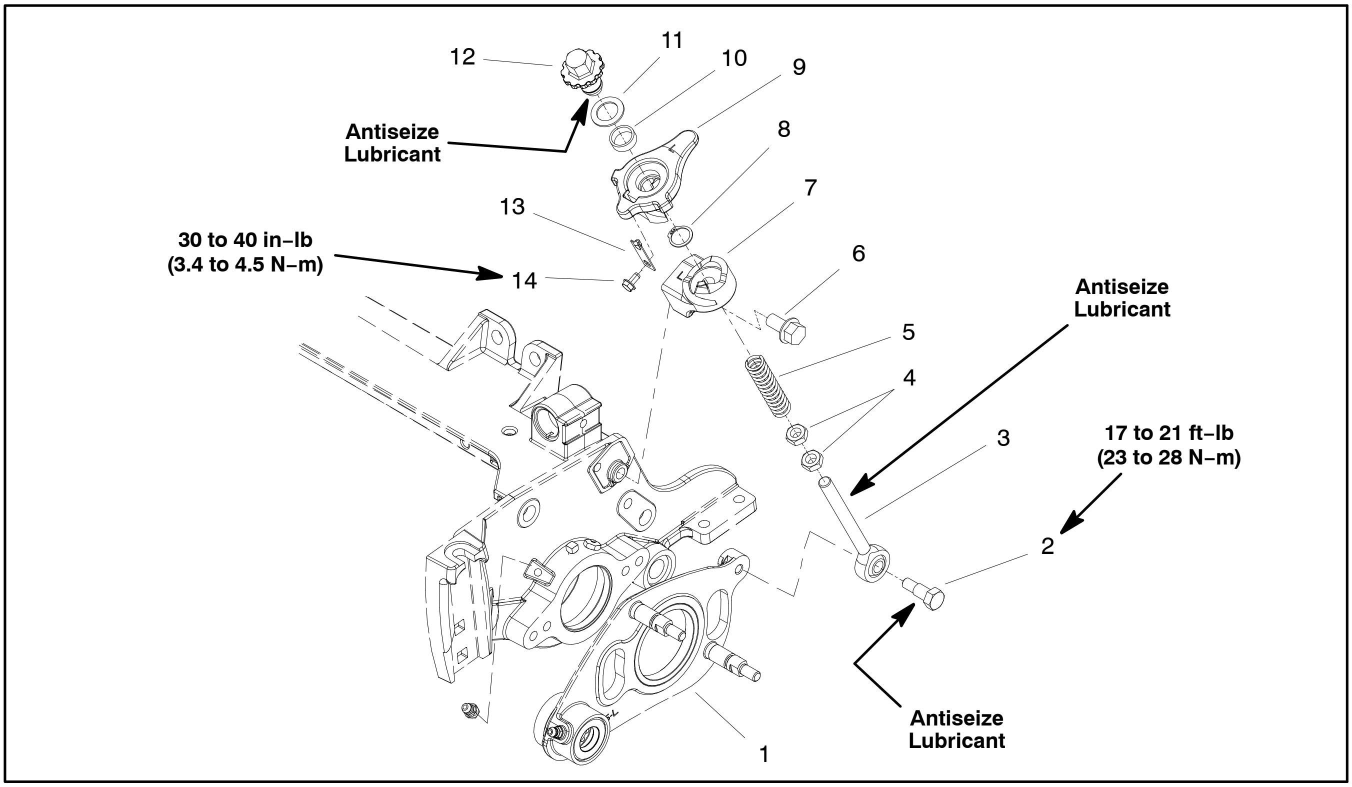

Figure 17

1. **Groomer plate (LH drive shown)**
2. **Shoulder bolt**
3. **Ball joint rod**
4. **Jam nut**
5. **Compression spring**
6. **Flange head screw**
7. **Lower ramp**
8. **External snap ring**
9. **Upper ramp**
10. **Bushing**
11. **Flat washer**
12. **Groomer adjuster**
13. **Detent spring**
14. **Washer head screw**

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 17 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 17)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Disassemble height adjuster using Figure 17 as a guide.

3. Clean all components and inspect for wear or damage. Replace all worn or damaged components.

Assembly (Fig. 17)

1. Assemble height adjuster using Figure 17 as a guide noting the following items:

A. If bushing (item 10) was removed from upper ramp, press new bushing into housing fully to the shoulder in the bore.

B. If jam nuts (item 4) were removed from ball joint rod, apply antiseize lubricant to threads of rod where jam nuts will be positioned. Install jam nuts so that distance from end of ball joint rod to top of upper nut is from 3.060” to 3.180” (7.8 to 8.0 cm).

C. Apply antiseize lubricant to threads of groomer adjuster (item 12) before installing it on threads of ball joint rod.

D. If detent spring (item 13) was removed, secure detent spring to upper ramp with washer head screw. Torque screw from **30 to 40 in−lb (3.4 to 4.5 N−m)**.

2. Secure ball joint rod to groomer plate with shoulder bolt (item 2). Torque shoulder bolt from **17 to 21 ft−lb (23 to 28 N−m)**.

3. Check groomer reel height and adjust as needed.

4. After groomer height has been adjusted, adjust location of jam nuts so compression spring length is 1.375” (3.5 cm) when the groomer handle is in the disengaged position (handle toward rear of cutting unit).

Chapter 10

Universal Groomer (Optional)

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Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT: Improper or overaggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. READ AND UNDERSTAND THE GROOMER OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

It is important to remember that factors affecting quality of cut also affect grooming performance.

Variables That Affect the Use and Performance of Groomers:

1. The growing season and weather conditions.

2. General turf conditions.

3. The frequency of grooming/cutting − number of cuttings per week and how many passes per cutting.

4. The height−of−cut.

5. The grooming depth.

6. The type of grass.

7. The amount of time that a groomer reel has been in use on a particular turf area.

8. The amount of traffic on the turf.

9. The overall turf management program − irrigation, fertilizing, weed control, coring, over−seeding, sand dressing, disease control and pest control.

10. Stress periods for turf − high temperatures, high humidity, unusually high traffic.

Troubleshooting

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
No rotation of the groomer reel.	The groomer drive is in Neutral.	Engage groomer drive to Forward or Reverse.
	Damaged or seized groomer drive gears.	Repair groomer drive.
The turf is damaged or has uneven grooming.	The groomer reel blades are bent, damaged or missing.	Repair or replace blades if necessary.
	The groomer reel shaft is bent or damaged.	Replace groomer reel shaft.
	Grooming depth is not equal on both ends of groomer reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height−of−cut, etc.).

Service and Repairs

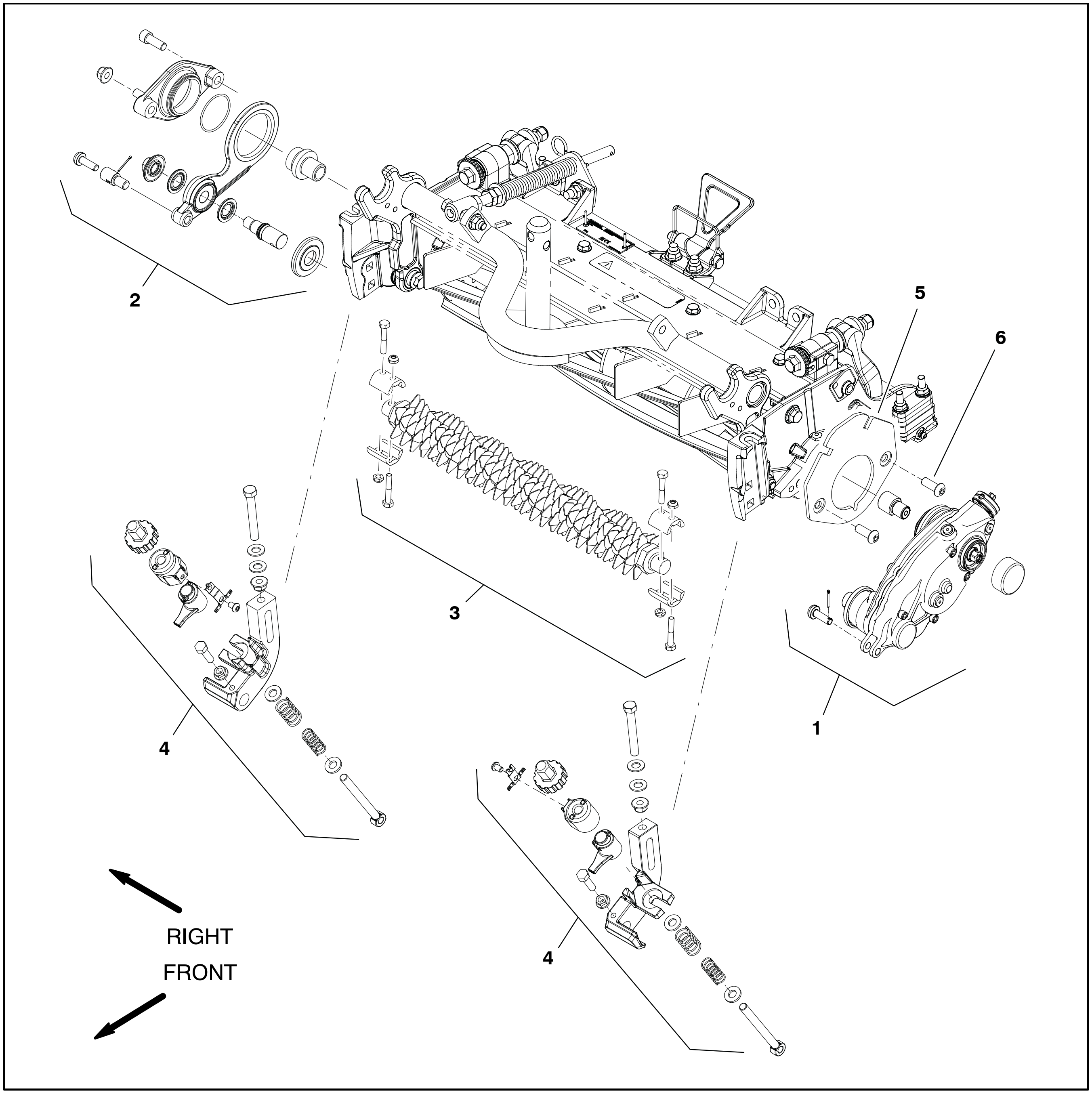

Figure 1

1. **Gear box assembly**
2. **Idler assembly**
3. **Groomer reel**
4. **Height adjuster assembly (2)**
5. **Weight**
6. **Button head screw (2)**

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Operator's Manual provides information regarding the installation, set−up, operation and maintenance of the universal groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

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Gear Box Assembly

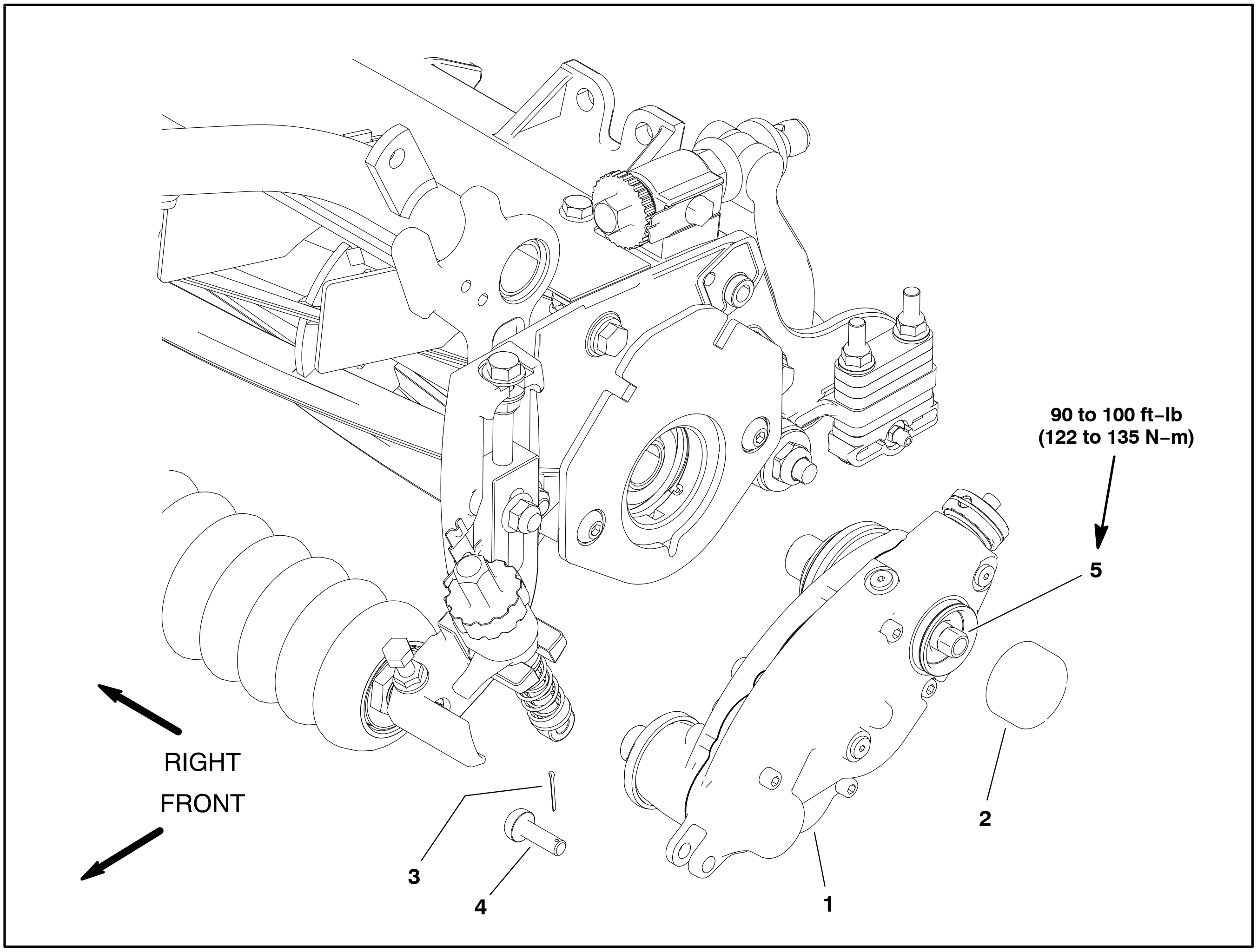

Figure 2

1. **Gear box assembly**
2. **Rear roller brush drive shield**
3. **Cotter pin**
4. **Clevis pin**
5. **Input shaft**

NOTE: The groomer gear box assembly is located on the opposite side of the cutting unit from the cutting unit hydraulic motor.

Removal (Fig. 2)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the groomer reel assembly (see Groomer reel in this chapter).

NOTE: If cutting unit is equipped with an optional powered rear roller brush, remove the rear roller brush cover, drive belt and drive housing assembly to service the groomer drive (see Roller Brush (Optional) in Chapter 8 − Cutting Units in this manual for additional information).

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. Safely prevent reel from rotating by blocking the cutting reel with piece of wood near one of the reel spiders.

4. If installed, remove the rear roller brush drive shield from the gear box.

IMPORTANT: Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft (rear roller brush drive shaft) clockwise to remove the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread. Turn the input shaft counterclockwise to remove the gear box.

5. To detach the gear box from the cutting unit:

   A. Turn the input shaft in the correct direction to loosen it from the reel.

   B. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the groomer gear box. Discard cotter pin.

   C. Continue to unscrew the input shaft and remove the gear box from the cutting unit.

Disassembly (Fig. 3)

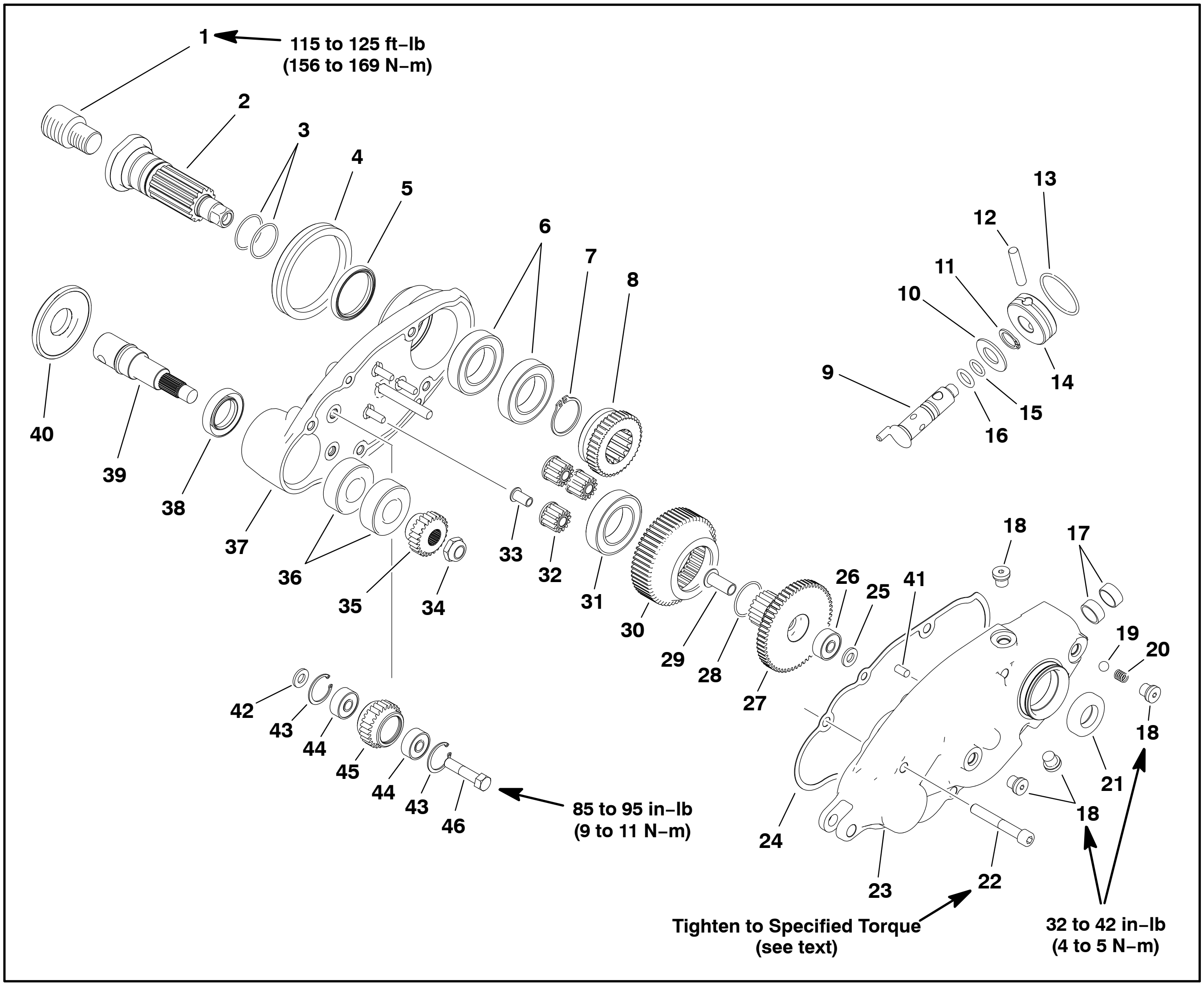

Figure 3

1. **Threaded adapter**
2. **Input shaft**
3. **O−Ring (2)**
4. **V−Ring**
5. **Seal**
6. **Bearing (2)**
7. **Retaining ring**
8. **Slider gear**
9. **Shifter shaft**
10. **Thrust washer**
11. **Retaining ring**
12. **Dowel pin**
13. **O−ring**
14. **Knob**
15. **O−ring**
16. **O−ring**
17. **Bushing (2)**
18. **Drain/fill plug (4)**
19. **Ball**
20. **Detent spring**
21. **Seal**
22. **Socket head screw (4)**
23. **Cover**
24. **Gasket**
25. **Thrust washer**
26. **Bearing**
27. **Sun gear**
28. **O−ring**
29. **Bushing**
30. **Ring gear**
31. **Bearing**
32. **Planet gear (3)**
33. **Bushing (3)**
34. **Lock nut**
35. **Output gear**
36. **Bearing (2)**
37. **Housing**
38. **Seal**
39. **Output shaft**
40. **Shield**
41. **Dowel pin (2)**
42. **Thrust washer (2)**
43. **Retaining ring (2)**
44. **Bearing (4)**
45. **Idler gear (2)**
46. **Cap screw (2)**

CAUTION

Use the 1−3/8” flats on the input shaft to prevent the input shaft from rotating during adapter removal. DO NOT use the 1/2” hex on the input shaft to secure the shaft during adapter removal or input shaft damage may occur.

1. Remove input shaft adapter (item 1) if necessary.

2. Remove the drain/fill plug and drain the oil from the gear box.

3. Remove four (4) socket head cap screws (item 22) and separate the gear box cover and housing.

4. Remove and discard the cover gasket.

5. Slide the sun gear, ring gear and planet gears from the pins on the gear box housing.

6. Continue to disassemble the gear box as necessary.

7. Carefully clean any gasket material from gear box housing and cover.

8. Inspect V−ring, seals, bearings, gears and bushings in gear box assembly. Replace damaged or worn components as necessary.

Assembly (Fig. 3)

1. If sun gear, ring gear or gear box housing bearings are replaced, press bearings all the way to shoulder in part.

2. If flange bushings are replaced, ensure bushing flange is fully seated against part.

3. Ensure all retaining rings and O−rings are fully seated in ring groove.

4. Lubricate seal lips and O−rings before installing shafts.

5. If idler gear assemblies were removed (Gear box for 7 in. reel cutting units only) tighten idler gear cap screw from **85 to 95 in−lb (9 to 11 N−m)**.

6. Lubricate planet gear and sun gear pins in gear box housing with gear oil and install planet, ring and sun gears.

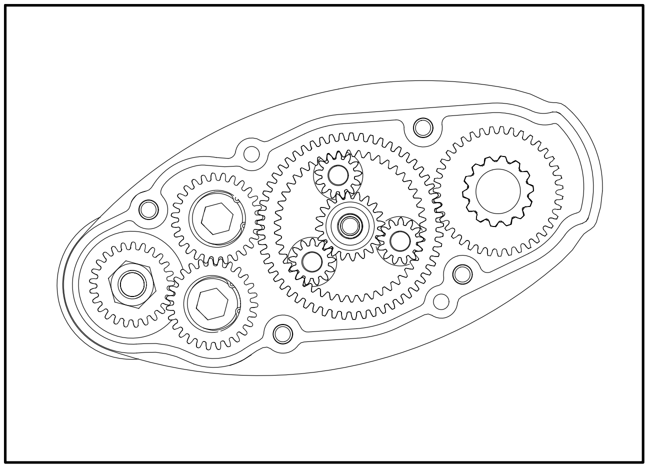

Figure 4

7. Clean gasket surface on gear box housing and cover with solvent and install new gasket.

8. Fit gear box cover over dowel pins and install four (4) socket head screws. Tighten screws from **15 to 40 in−lb (2 to 4 N−m)**. In an alternating cross pattern, tighten four (4) socket head screws from **75 to 85 in−lb (8 to 9 N−m)**.

9. Fill the gear box with 80W−90 gear oil and tighten drain/fill plug from **32 to 52 in−lb (4 to 5 N−m)**.

Gear box oil capacity for 7 in. reel cutting units = 3 oz. (90 cc)

CAUTION

Use the 1−3/8” flats on the input shaft to prevent the input shaft from rotating during adapter installation. DO NOT use the 1/2” hex on the input shaft to secure the shaft during adapter installation or input shaft damage may occur.

10. If removed, install the threaded adapter in the input shaft. If reusing a previously installed threaded adapter, apply medium strength thread locker to the smaller (5/8−11) threads only. Tighten threaded adapter from **115−125 ft−lb (156−196 N−m)**.

11. Operate groomer gear box by hand to check for proper operation prior ro installation.

Installation (Fig. 2)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

2. Safely prevent reel from rotating by blocking the cutting reel with piece of wood near one of the reel spiders.

IMPORTANT: Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft (rear roller brush drive shaft) counterclockwise to install the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread. Turn the input shaft clockwise to install the gear box.

3. To attach the gear box to the cutting unit:

   A. Turn the input shaft in the correct direction until it is seated against the reel.

   B. Use a new cotter pin and install the cotter pin and clevis pin securing the height adjustment rod to the front of the groomer gear box.

   C. Tighten the input shaft from **90 to 100 ft−lb (122 to 153 N−m)**.

4. Install the rear roller brush drive shield if previously removed.

NOTE: If cutting unit is equipped with an optional powered rear roller brush, install the rear roller brush drive housing assembly, drive belt and cover (see Roller Brush (Optional) in Chapter 8 − Cutting Units in this manual for additional information).

5. Install the groomer reel assembly (see Groomer reel in this chapter).

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Idler Assembly

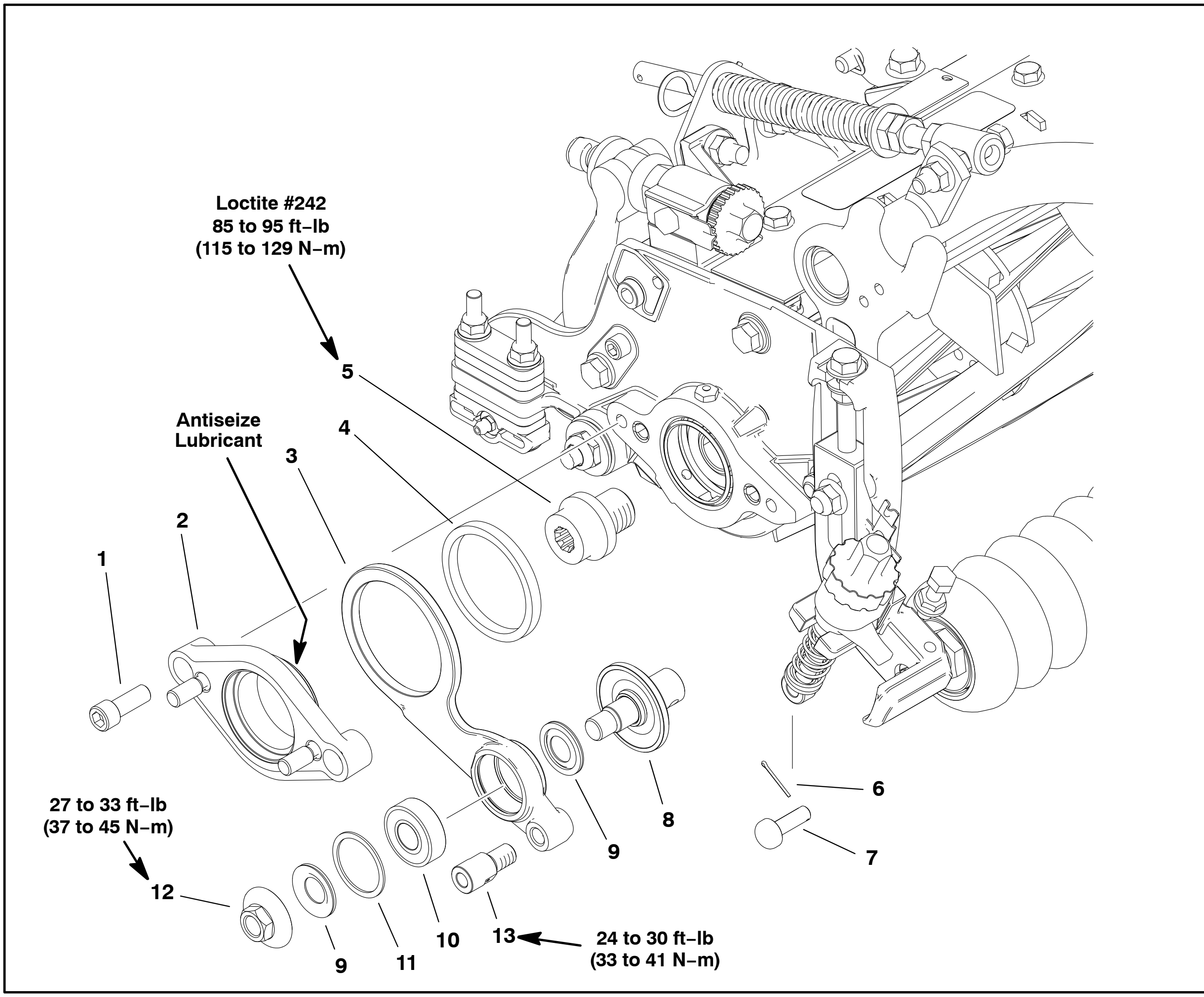

Figure 5

1. **Socket head screw (2)**
2. **Pivot hub**
3. **Idler arm**
4. **Bushing**
5. **Threaded insert**
6. **Cotter pin**
7. **Clevis pin**
8. **Stub shaft and shield**
9. **Bearing shield (2)**
10. **Bearing**
11. **Retaining ring**
12. **Flange nut**
13. **Collar**

NOTE: The groomer idler assembly is located on the same side of the cutting unit as the cutting unit hydraulic motor.

Removal (Fig. 5)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in Chapter 8 − Cutting Units in this manual).

3. Remove the groomer reel assembly (see Groomer reel in this chapter).

4. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the idler arm. Discard cotter pin.

5. Remove the socket head cap screws securing the pivot hub to the cutting unit and remove the pivot hub and idler assembly from the cutting unit.

6. Inspect shields, bearing and bushing in idler assembly. Remove and discard damaged or worn components.

Installation (Fig. 5)

1. If shields, bearing or bushing was removed from idler arm, install new components.

   A. Press bushing into groomer plate until the bushing is centered in the idler arm bore.

   B. Press bearing into idler arm so that bearing contact shoulder in idler arm bore and install bearing retaining ring.

   C. Install bearing shields with flocked side of shield toward bearing.

   D. Verify idler arm orientation (LH or RH cutting unit) and insert stub shaft through shields and bearing. Using through hole in shaft to prevent shaft from rotating, tighten flange nut from **27 to 33 ft−lb (37 to 45 N−m)**.

   E. If collar was removed from idler arm, install collar and tighten from **24 to 30 ft−lb (33 to 41 N−m)**.

2. Apply antisieze lubricant to the outside diameter of the pivot hub (Fig. 6). Position idler arm over pivot hub.

3. Apply Loctite to two (2) socket head screws and secure pivot hub and idler arm to cutting unit side plate.

4. Use a new cotter pin and install the cotter pin and clevis pin securing the height adjustment rod to the front of the idler arm.

5. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in Chapter 8 − Cutting Units in this manual).

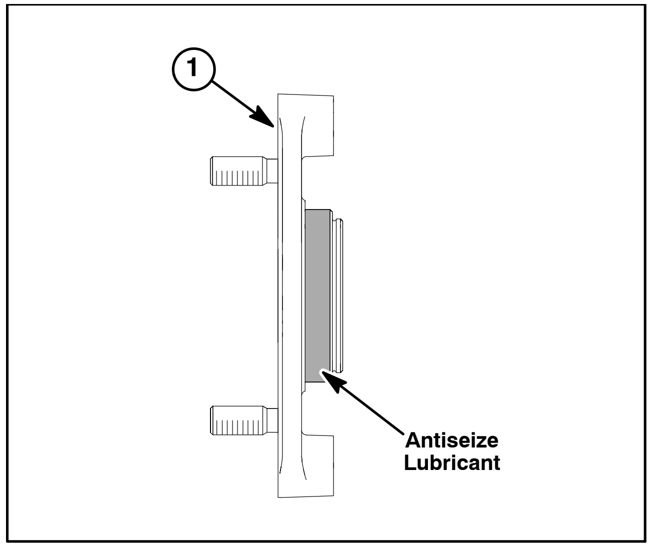

Figure 6

1. **Pivot hub**

Groomer Reel

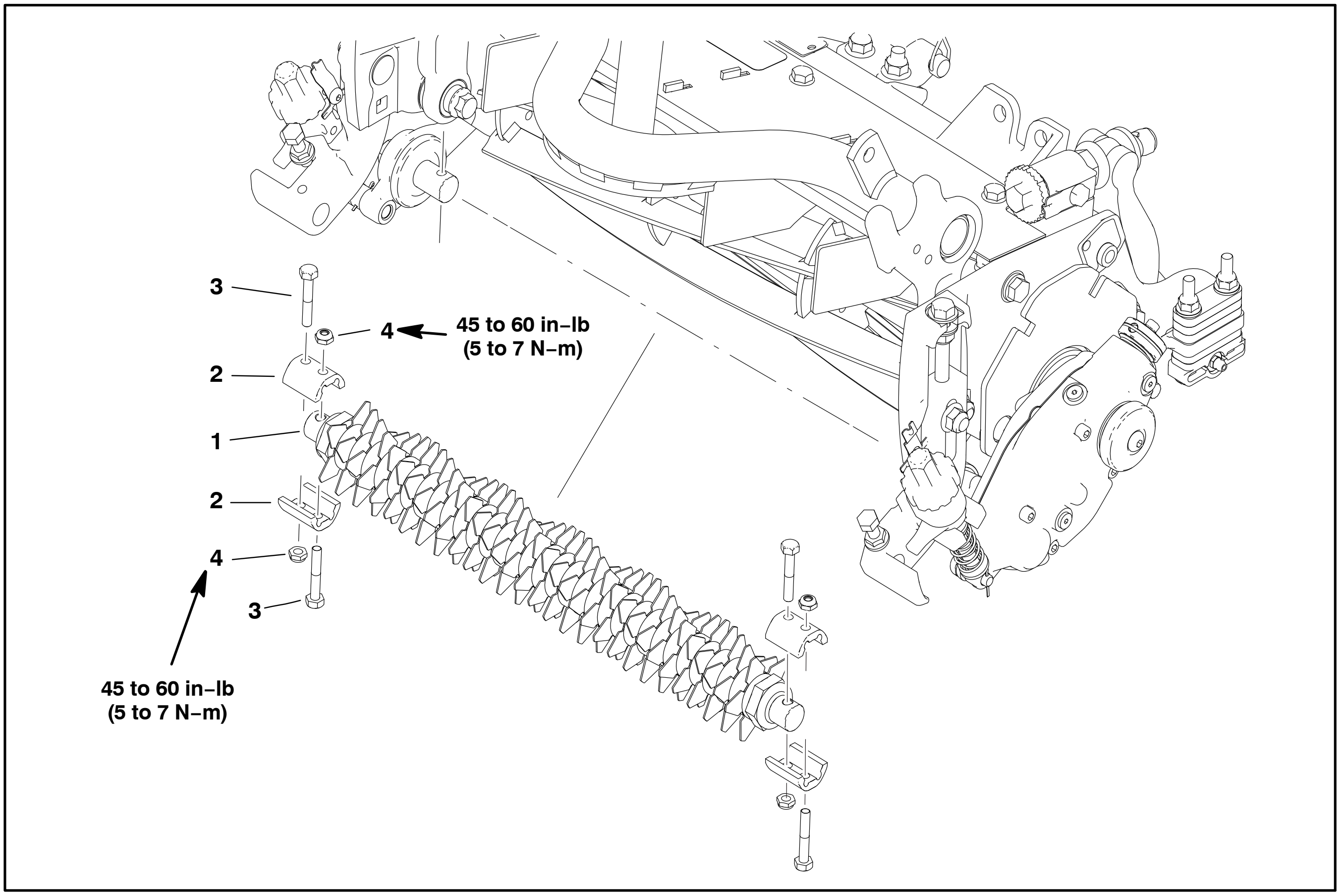

Figure 7

1. **Groomer reel**
2. **Shaft clamp (4)**
3. **Cap screw (4)**
4. **Jam nut (4)**

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer reel can be reversed to provide additional blade life.

Removal (Fig. 7)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch. If desired, remove cutting unit from machine (see Traction Unit Operator's Manual).

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the groomer reel.

2. Carefully remove the four (4) jam nuts, cap screws and shaft clamps securing the groomer reel to the output and stub shafts.

3. Lift the groomer reel from the cutting unit.

4. Inspect seal, shields, bushing and bearings for wear or damage. Replace components as needed (see Gear Box Assembly and Idler Assembly in this section).

Installation (Fig. 7)

1. Position cutting unit on a level surface. If cutting unit is attached to traction unit, make sure to stop engine, engage parking brake and remove key from the ignition switch.

2. Position the groomer reel between the groomer output and stub shafts.

3. Secure the groomer reel to the cutting unit with four (4) jam nuts, cap screws and shaft clamps. Tighten the cap screws to **46 to 60 in−lb (5 to 7 N−m)**.

4. Check groomer reel height and mower height−of−cut settings. Adjust as needed.

Groomer Reel Service

Inspect groomer reel blades frequently for damage and wear. Straighten bent blades. Either replace worn blades or reverse the individual blades to put the sharpest blade edge forward (Fig. 8). Blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

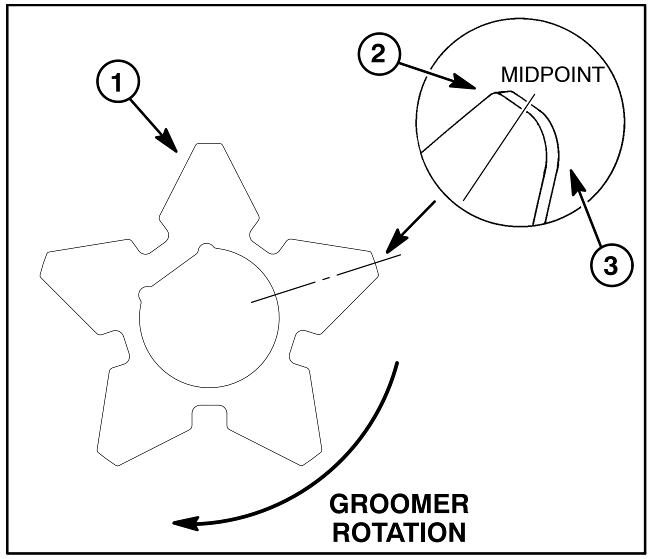

Figure 8

1. **Groomer blade**
2. **Sharp edge**
3. **Dull (rounded) edge**

Disassembly (Fig. 9)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove groomer reel from cutting unit (see Groomer Reel Removal in this section).

3. If groomer reel is equipped with broomer kit, remove straps and broomer brushes from reel (Fig. 12).

4. Remove lock nut from either end of the shaft (Fig. 9).

5. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

Assembly (Fig. 9)

1. Install lock nut on drive end of groomer shaft. Place a 1/4” (6.3 mm) spacer on the groomer shaft followed by the first groomer blade.

2. Alternately install 1−1/4” (31.7 mm) spacers and blades making sure that all blades are separated by a spacer.

3. When all blades have been installed, place remaining 1/4” (6.3 mm) on shaft. Thread second lock nut onto the shaft. Center blades on shaft by adjusting lock nuts.

4. Using through holes in shaft to prevent shaft from rotating, tighten second lock nut from **31 to 35 in−lb (42 to 48 N−m)**. After tightening lock nut, spacers should not be free to rotate and groomer blades should be centered on shaft.

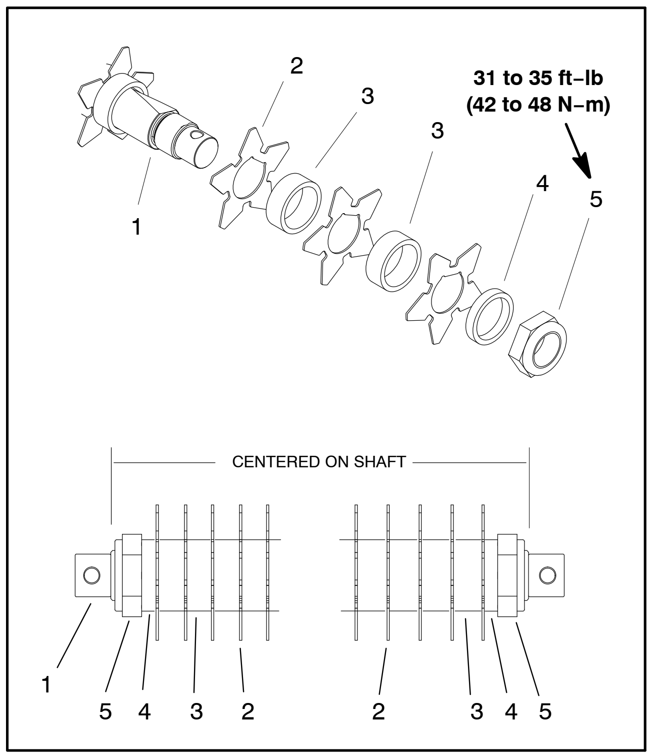

Figure 9

1. **Groomer reel shaft**
2. **Groomer blade (18 in. Reel = 32) (11 in. Reel = 40)**
3. **1−1/4” (31.7 mm) Spacer (18 in. reel = 31) (22 in. Reel = 39)**
4. **1/4” (6.3 mm) Spacer (2)**
5. **Lock nut (2)**

5. If groomer reel is equipped with broomer kit:

A. Loosen the groomer blade retaining nuts on each end of the groomer shaft.

B. Slide a brush into each groove around the full length of the groomer reel (Fig. 10). Make sure brushes are seated in groomer blade slots (Fig. 11)

IMPORTANT: The straps must be wrapped around the groomer blade and brush assembly in the correct direction.

C. Loosely wrap the straps around the groomer reel shaft and brushes as shown (Fig. 10). Straps should be positioned in the pre−cut notches of each brush and at the following locations on the broomer shaft:

18” reels − between blades 2−3, 11−12, 21−22 and 30−31.

22” reels − between blades 2−3, 14−15, 26−27 and 38−39.

Position the broomer brushes properly in the blade slots, and tighten the groomer blade−retaining nuts from **31 to 35 ft−lb (42 to 48 N−m).**

D. While holding strap buckle in place, pull straps tight into the pre−cut notches of each brush.

E. Cut off strap extension approximately 1/4” (6 mm) beyond retainer and fold the excess strap over the buckle (Fig. 12).

6. Install O−ring on non−drive end of groomer shaft.

7. Install groomer reel back on cutting unit (see Groomer Reel Installation in this section).

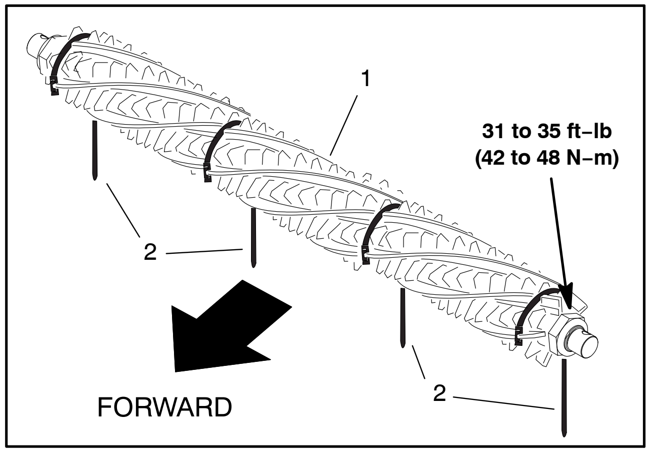

Figure 10

1. **Groomer reel** 2. **Broomer strap (4)**

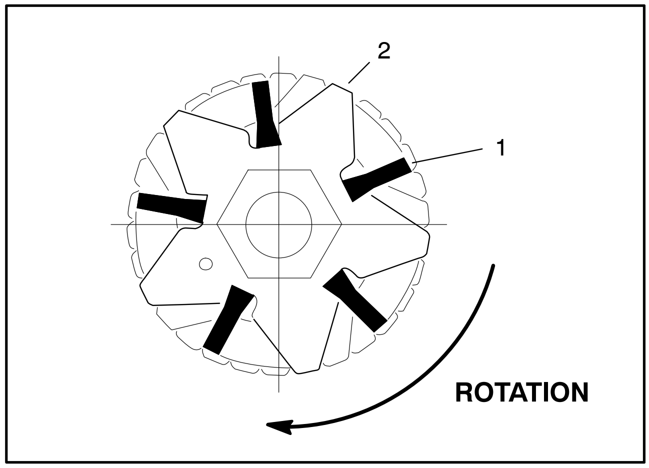

Figure 11

1. **Brush** 2. **Blade**

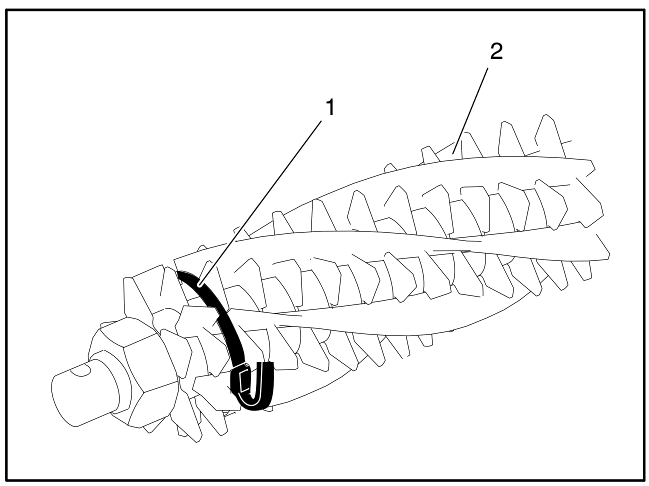

Figure 12

1. **Strap** 2. **Brush**

Grooming Brush (Optional) Service

The optional grooming brush is removed and installed from the groomer in the same manner as the groomer reel (see Groomer Reel in this chapter).

The grooming brush element or shaft can be serviced separately (Fig. 13).

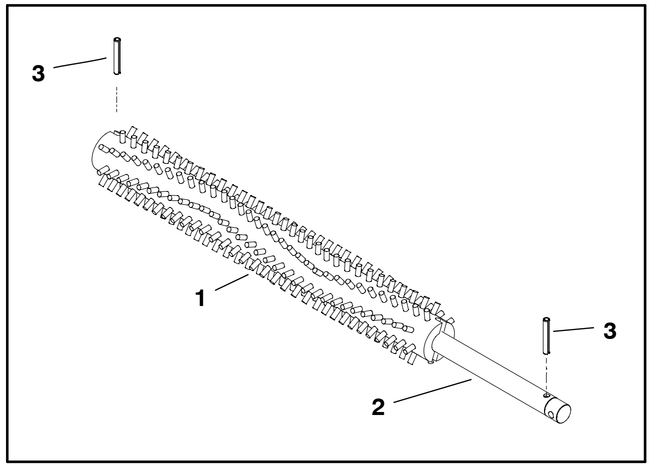

Figure 13

1. **Brush element**
2. **Shaft**
3. **Roll pin (2)**

Height Adjuster Assembly

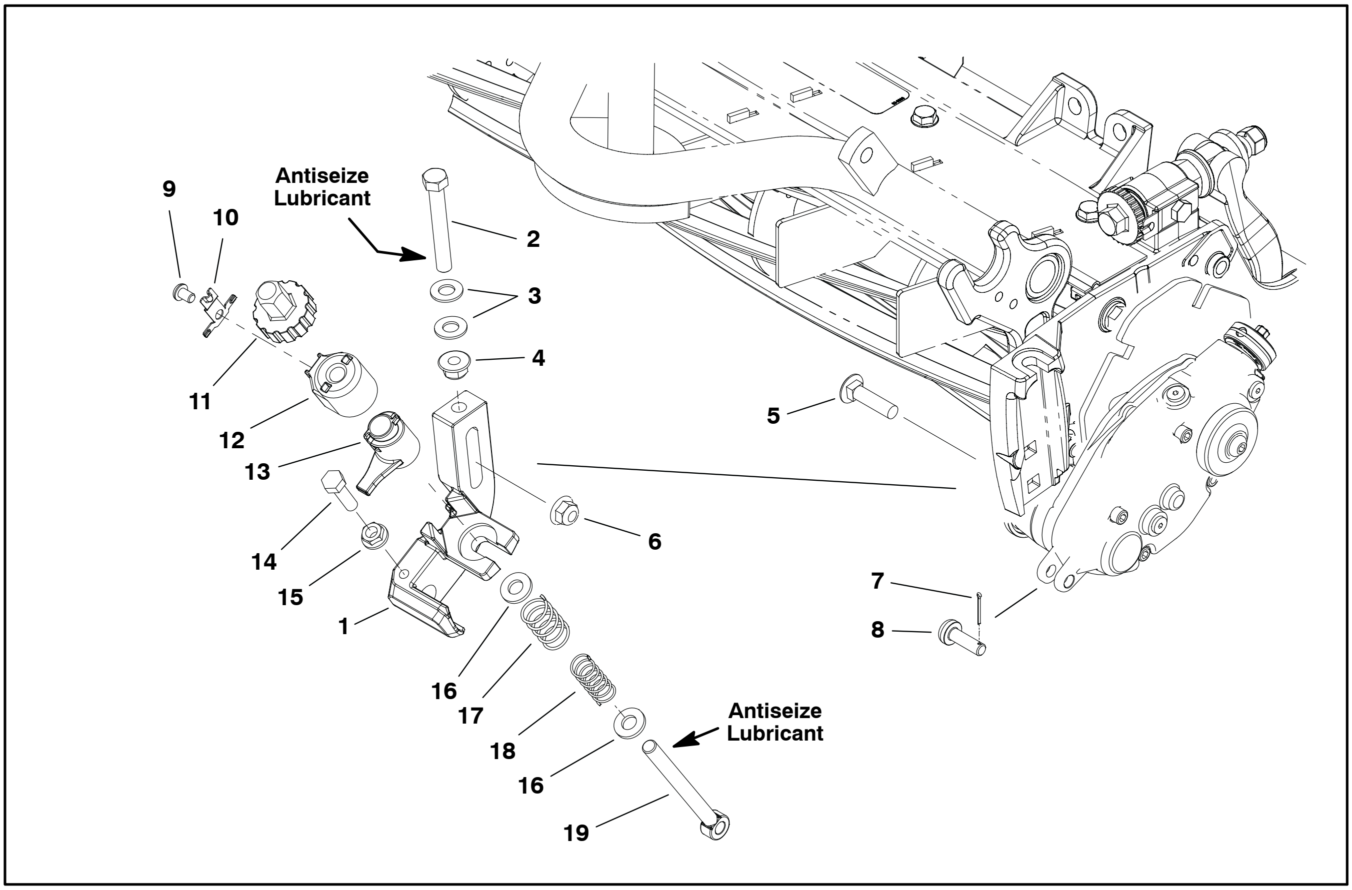

Figure 14

1. Height of cut bracket
2. Height adjustment bolt
3. Washer (2)
4. Lock nut
5. Carriage bolt
6. Flange nut
7. Cotter pin
8. Clevis pin
9. Button head screw
10. Detent spring
11. Groomer height adjuster knob
12. Quick up cover
13. Quick up lever
14. Pinch bolt (front roller)
15. Lock nut
16. Washer (2)
17. Outer spring
18. Inner spring
19. Height adjustment rod

Disassembly (Fig. 14)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch.

2. Remove the cotter pins and clevis pins securing the height adjustment rods to the groomer gear box and idler arm. Discard cotter pins.

3. Loosen the two (2) height adjustment bolt lock nuts.

4. Loosen the two (2) front roller pinch bolt lock nuts and cap screws.

5. Remove the flange nut and carriage bolt securing the height adjuster assembly to the cutting unit side plate and remove the front roller and height adjuster from the cutting unit.

6. Disassemble height adjuster assembly.

7. Clean all components and inspect for wear or damage. Replace all worn or damaged components.

Assembly (Fig. 14)

1. Apply antiseize lubricant to upper threads of adjustment rod and lower threads of height adjusters. Assemble height adjuster assembly as shown.

2. If both height adjusters were removed, fit one height adjuster assembly to the cutting unit side plate and secure with carriage bolt and flange nut. Do Not tighten the flange nut at this time. Ensure the height adjustment bolt and one (1) washer is above slot in side plate and one (1) washer and lock nut is below slot in side plate.

3. Position front roller between height adjuster assemblies and secure height adjuster assembly to cutting unit side plate with carriage bolt and flange nut. Do Not tighten the flange nut at this time. Ensure the height adjustment bolt and one (1) washer is above slot in side plate and one (1) washer and lock nut is below slot in side plate.

4. Use new cotter pins and install the cotter pins and clevis pins securing the height adjustment rods to the groomer gear box and idler arm.

5. Adjust the cutting unit height of cut (see Cutting Unit Operators Manual).

6. Check groomer reel height and adjust as needed.

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Chapter 11

Foldout Drawings

Fooldout Drawings

Table of Contents

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ELECTRICAL SCHEMATIC 4
WIRE HARNESS DRAWINGS
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Seat and Console Wire Harness 8
Power Center Wire Harness 10

Electrical Drawing Designations

NOTE: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g. SP01 is splice number 1).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
BK	BLACK
BR or BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
VIO	VIOLET
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g. R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

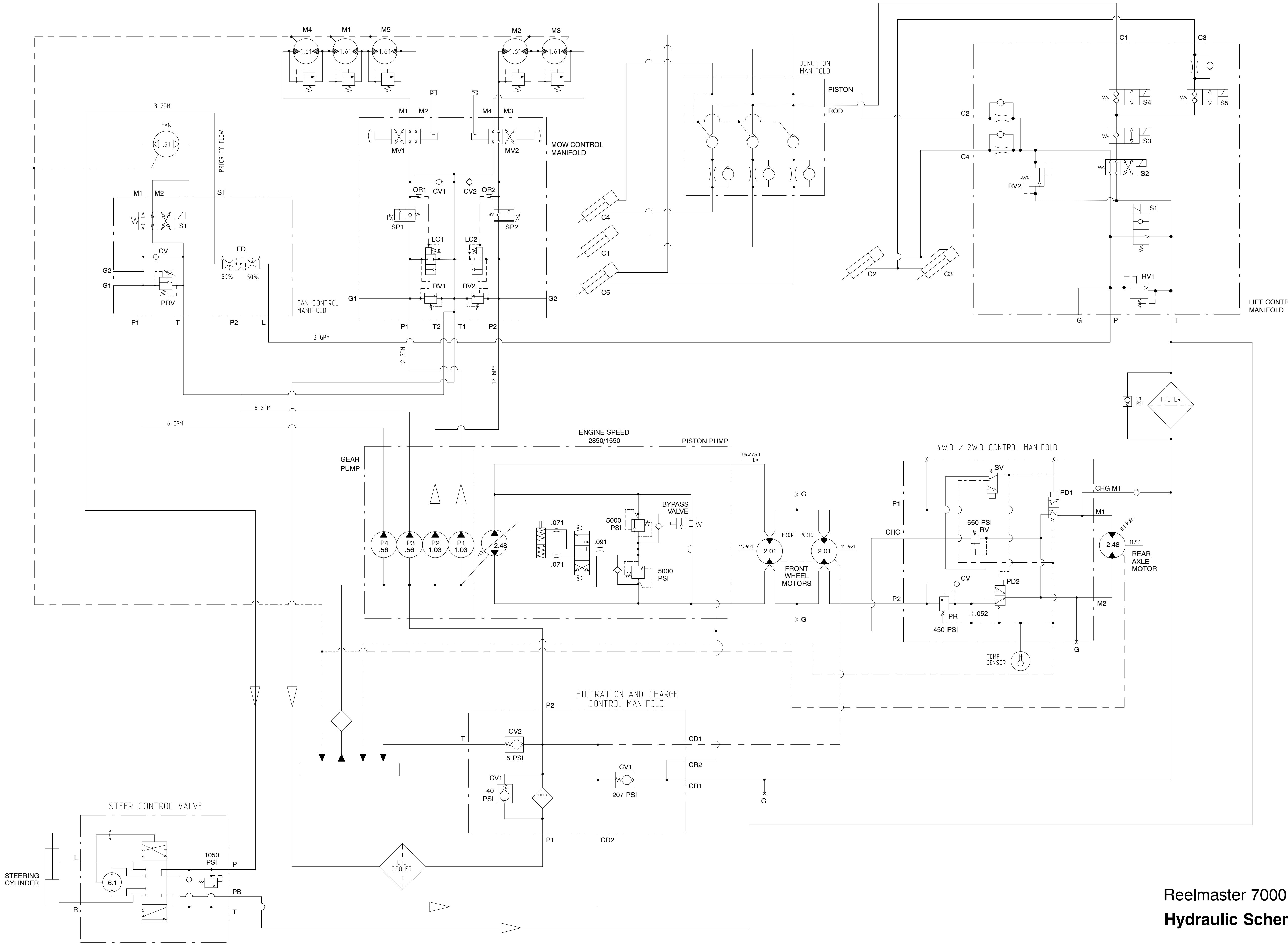
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator

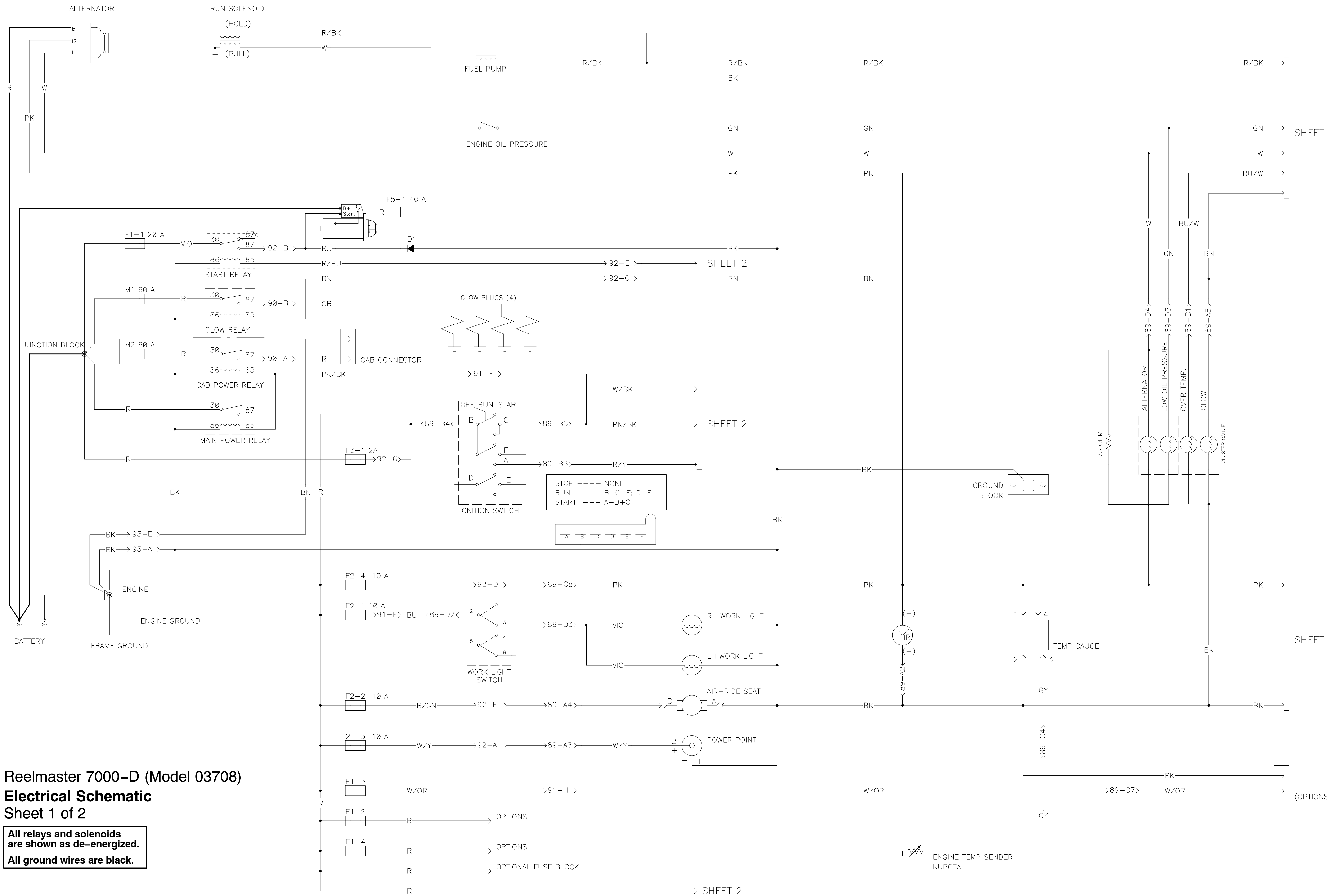
050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

AWG EQUIVALENTS FOR METRIC WIRE		
DIAGRAM LABEL	METRIC SIZE	AWG EQUIVALENT
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA



Reelmaster 7000–D (Model 03708

Hydraulic Schematic



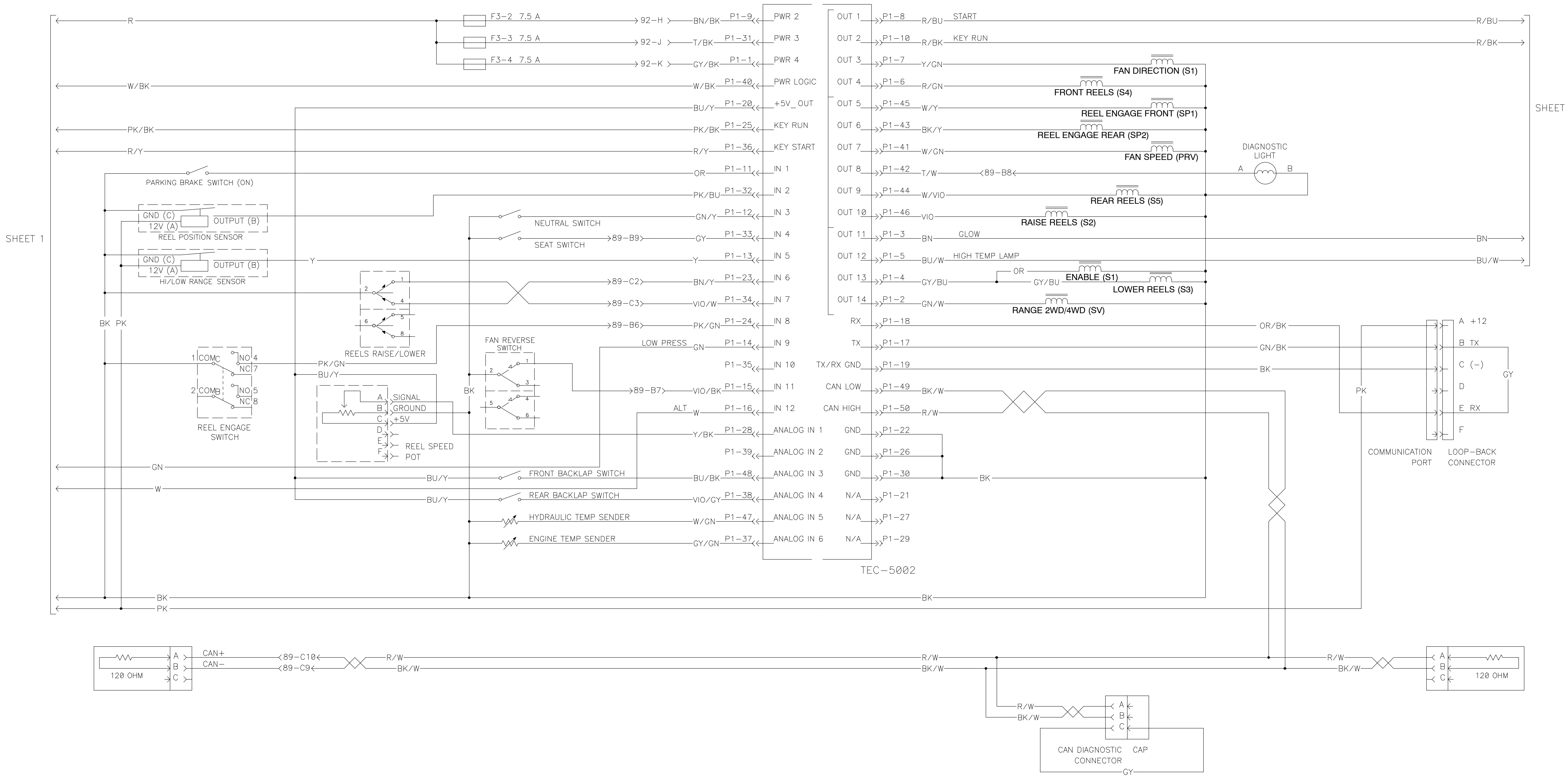
Reelmaster 7000–D (Model 03708)

Electrical Schematic

Sheet 1 of 2

All relays and solenoids are shown as de–energized.

All ground wires are black.



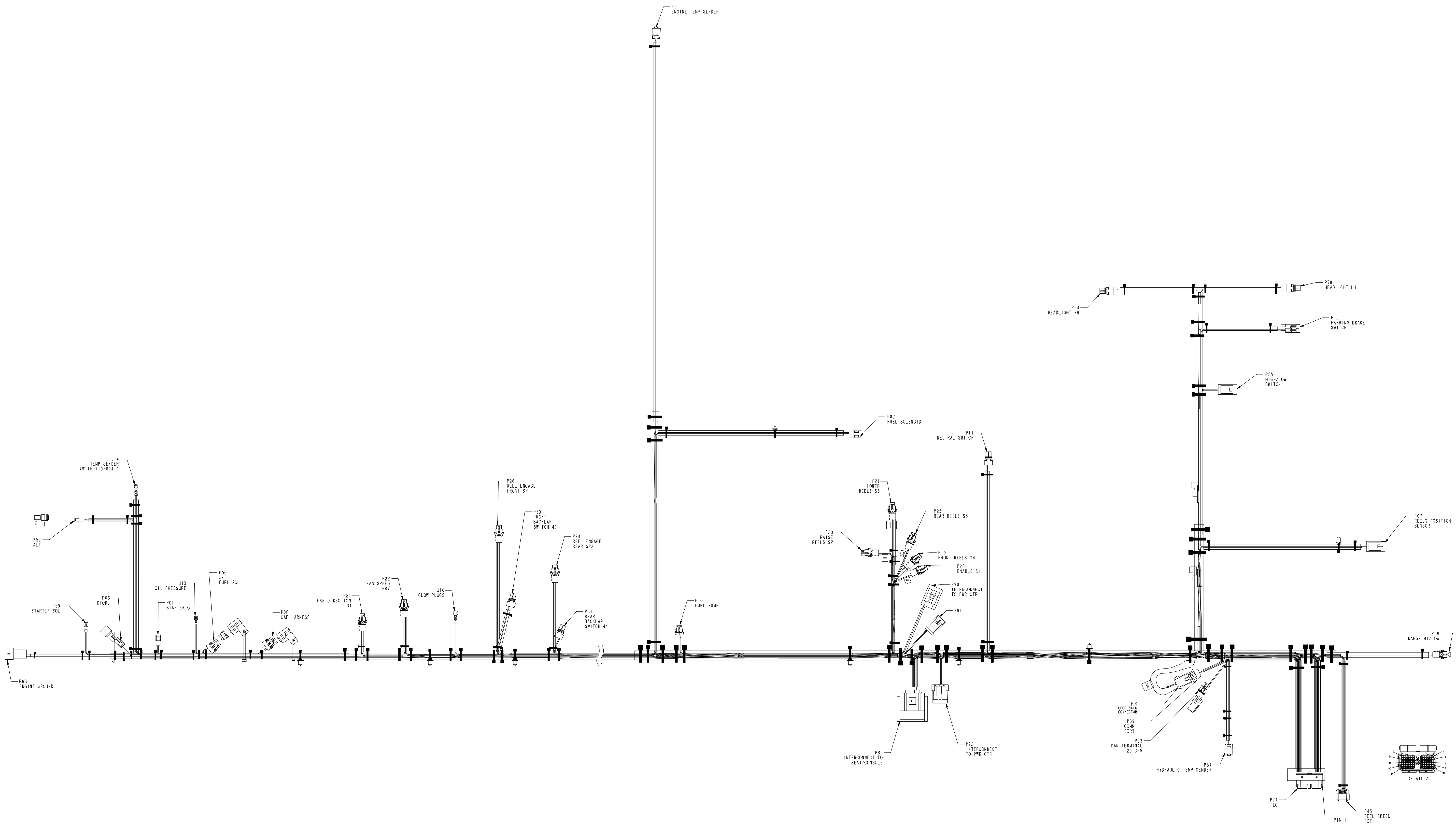
Reelmaster 7000-D (Model 03708)

Electrical Schematic

Sheet 2 of 2

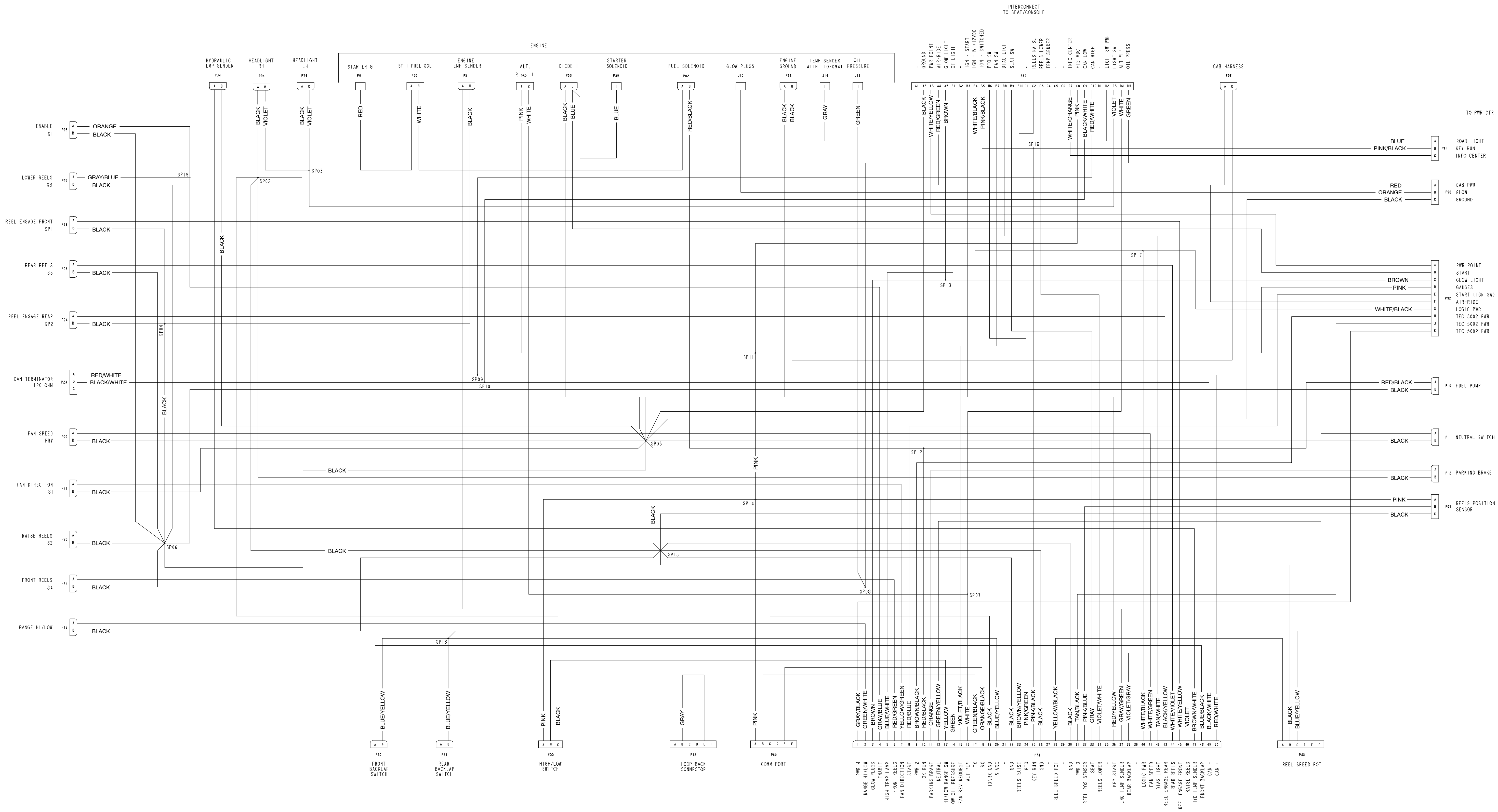
All relays and solenoids are shown as de-energized.

All ground wires are black.



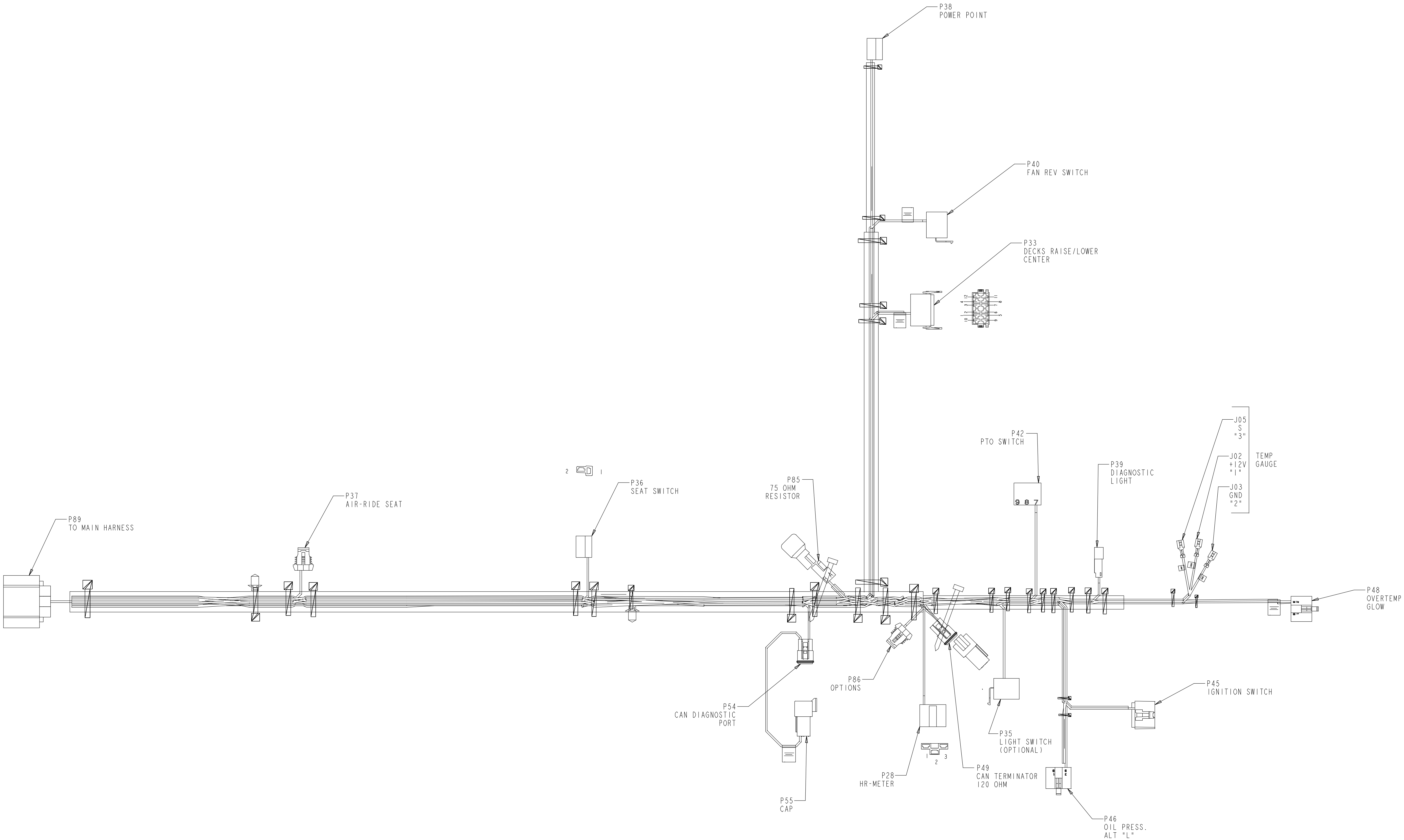
Reelmaster 7000–D (Model 03708)

Main Wire Harness



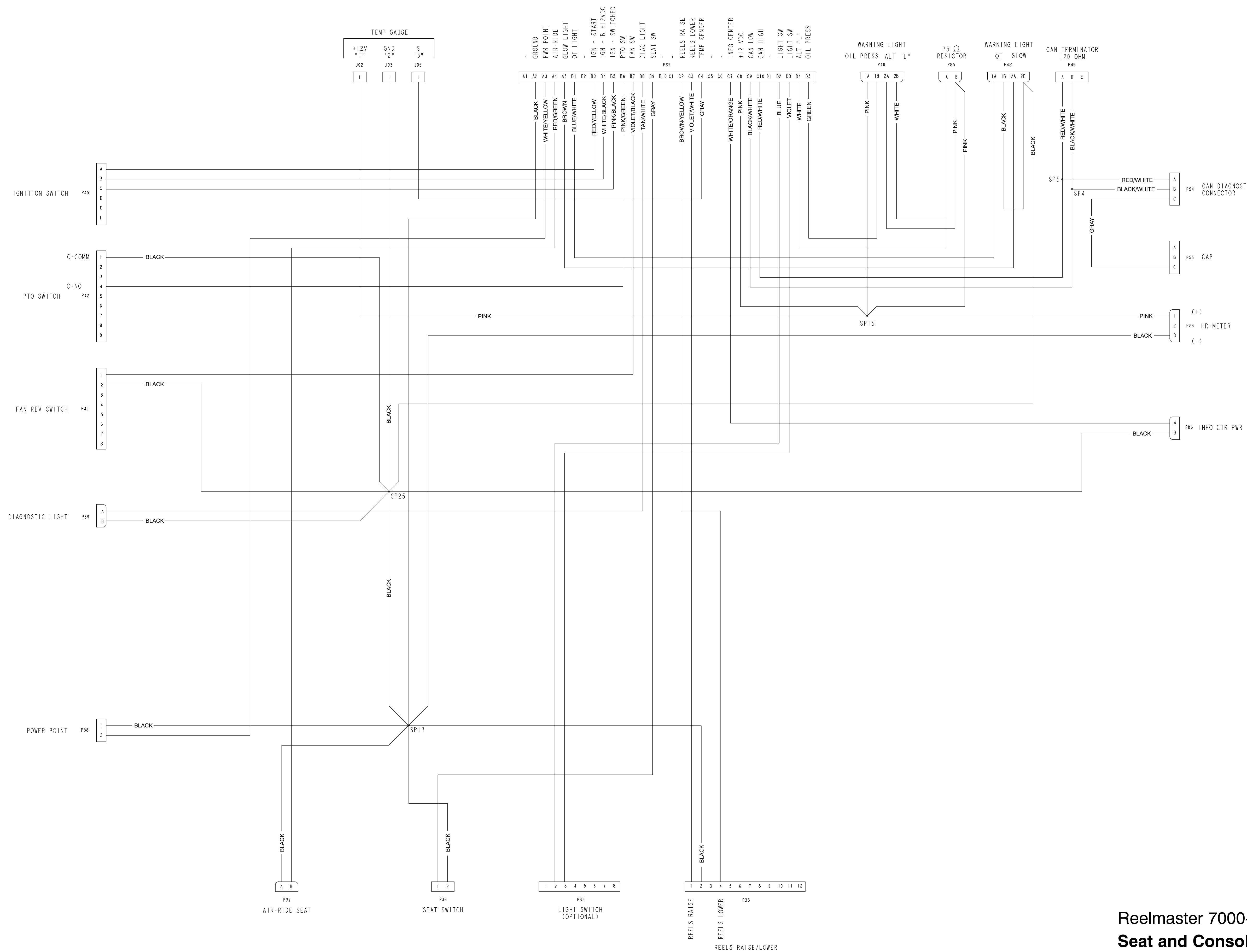
Reelmaster 7000-D (Model 0370

Main Wire Harness



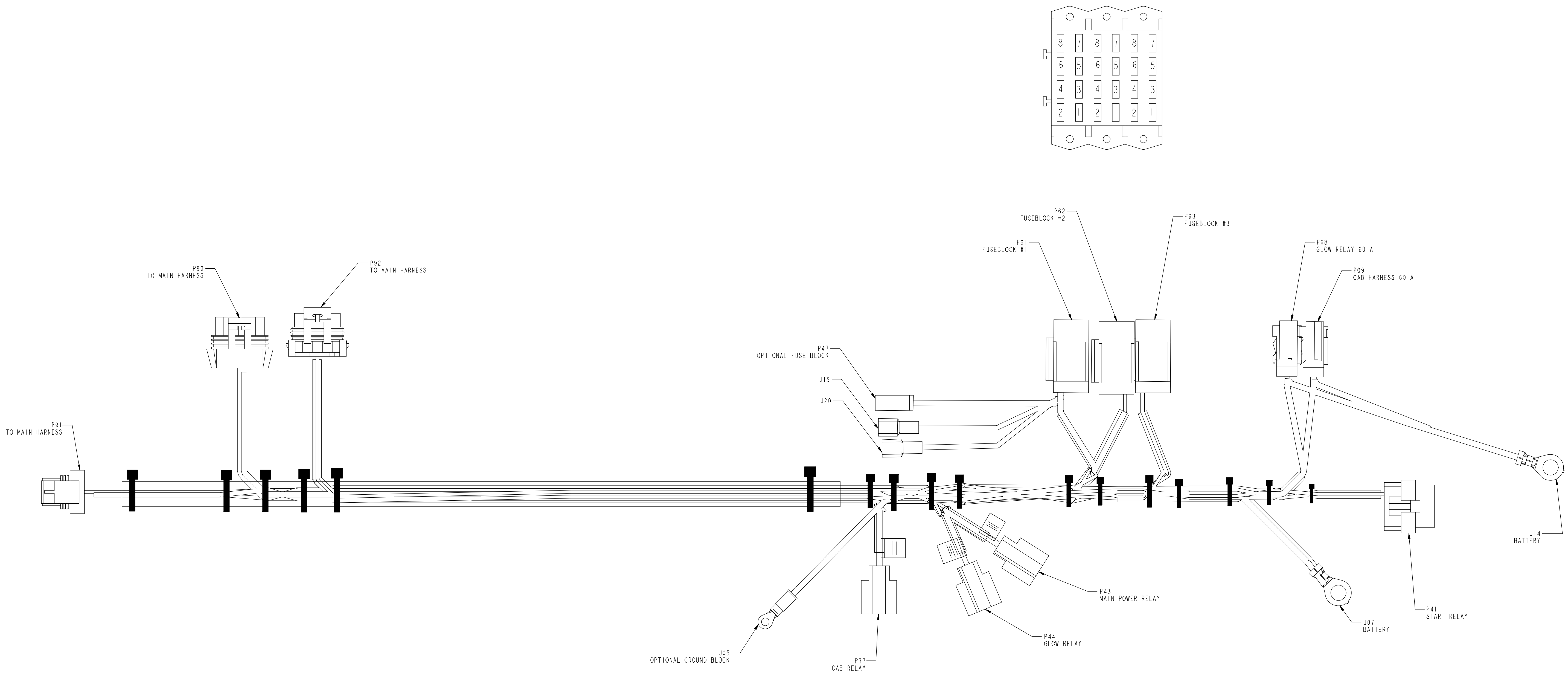
Reelmaster 7000–D (Model 03708)

Seat and Console Wire Harness

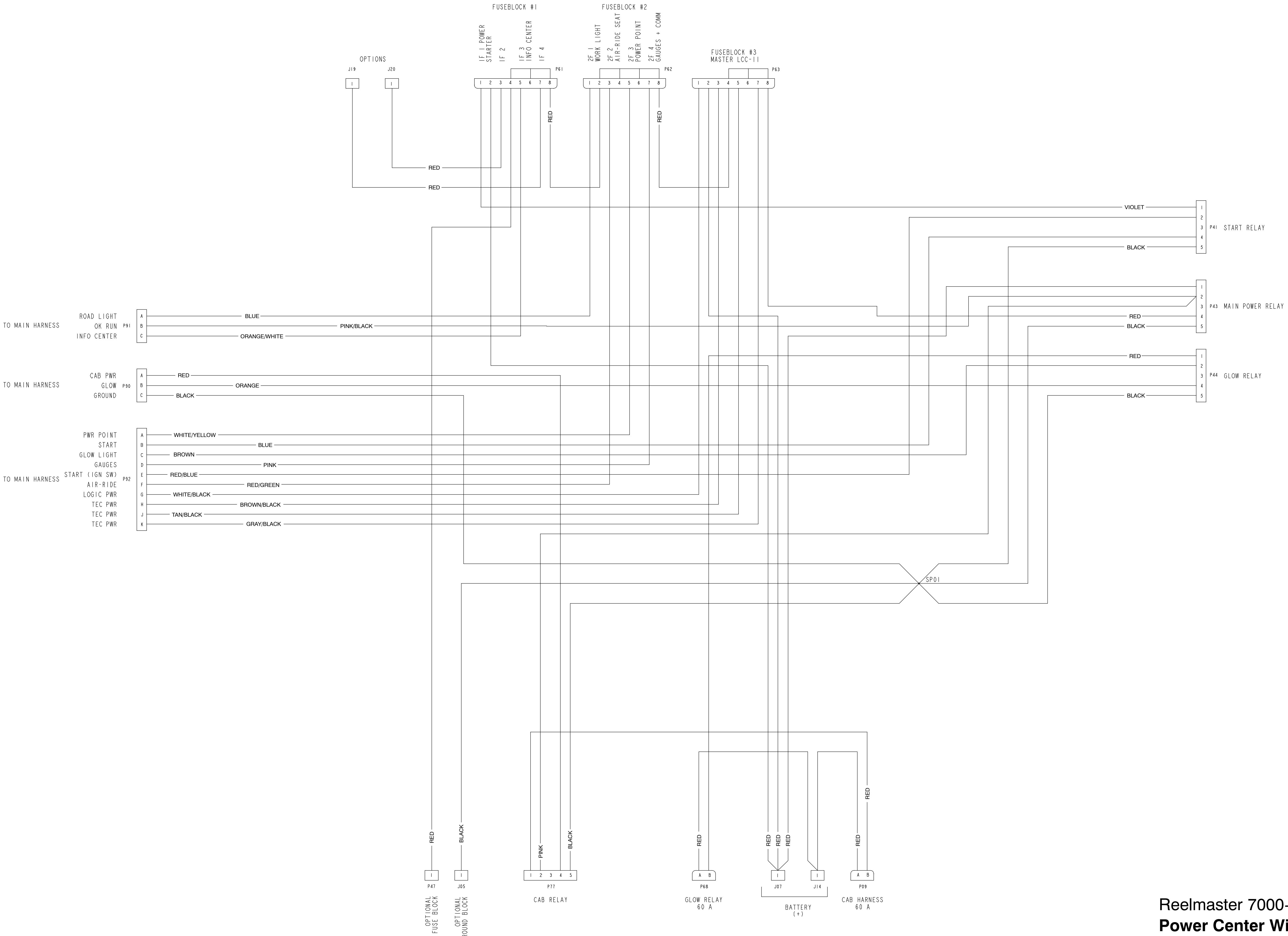


Reelmaster 7000–D (Model 03708)

Seat and Console Wire Harness



Reelmaster 7000–D (Model 03708)
Power Center Wire Harness



Reelmaster 7000–D (Model 0370

Power Center Wire Harness