PART NO. 01084SL (Rev. F)

Service Manual

Reelmaster® 6500-D/6700-D

Preface

NOTE:
For Machines With Serial Numbers Below 250000000: Use this book along with the Kubota Workshop Manual, 05 Series Diesel Engine (Toro Part No. 01090SL) (Tier 1 Emission Engine Models).

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 6500-D/6700-D Models 03806, 03807 & 03808.

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 Manual and Parts Catalog for your machine into Chapter 2 of this service manual. Additional copies of the Operator's Manual and Parts Catalog are available on the internet at www.Toro.com.

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

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

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

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

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Chapter 1

Safety

Safety

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Safety Instructions

The REELMASTER 6500-D and 6700-D were tested and certified by TORO for compliance with the B71.4-1990 specifications of the American National Standards Institute when ballast is added. See Operator's Manual for ballast requirements. 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. Read and understand the contents of the Operator's Manual before starting and operating the machine. Become familiar with the controls and know how to stop the machine and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

Use the Model and Serial Number when referring to your machine. If you have questions about this Service Manual, please contact:

The Toro Company
Commercial Service Department
8111 Lyndale Avenue South
Minneapolis, Minnesota 55420.

2. Never allow children to operate the machine. Do not allow adults to operate machine without proper instruction. Only trained operators who have read the Operator's Manual should operate this machine.

3. Never operate the machine when under the influence of drugs or alcohol.

4. 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.

5. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes, sneakers or when barefoot. Do not wear loose fitting clothing that could get caught in moving parts and possibly cause personal injury. Wearing safety glasses, safety shoes, long pants and a helmet is advisable and required by some local ordinances and insurance regulations.

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

7. Remove all debris or other objects that might be picked up and thrown by the reels or fast moving components from other attached implements. Keep all bystanders away from operating area.

8. Since diesel fuel is highly 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, throttle is in SLOW and the ENABLE / DISABLE switch is in DISABLE.

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

3. Seating capacity is one person. Therefore, never carry passengers.

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

5. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine. The interlock system is for your protection, so do not bypass it.

6. Using the machine demands attention and to prevent loss of control:

A. Operate only in daylight or when there is good artificial light.

B. Drive slowly

C. Watch for holes or other hidden hazards.

D. Look behind machine before backing up.

E. Do not drive close to a sand trap, ditch, creek or other hazard.

F. Reduce speed when making sharp turns and turning on a hillside.

G. Avoid sudden stops and starts.

7. Traverse slopes carefully. Do not start or stop suddenly when traveling uphill or downhill.

8. Operator must be skilled and trained in how to drive on hillsides. Failure to use caution on slopes or hills may cause loss of control and vehicle to tip or roll possibly resulting in personal injury or death. On 4 wheel drive model, always use the seat belt and ROPS together.

9. If engine stalls or loses power and cannot make it to the top of a slope, do not turn machine around. Always back slowly straight down the slope.

10. **DON'T TAKE AN INJURY RISK!** When a person or pet appears unexpectedly in or near the mowing area, **STOP MOWING**. Careless operation, combined with terrain angles, ricochets, or improperly positioned guards can lead to thrown object injuries. Do not resume mowing until area is cleared.

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

12. If cutting unit strikes a solid object or vibrates abnormally, stop cutting units immediately, turn engine off, set parking brake and wait for all motion to stop. Inspect for damage. If reel or bedknife is damaged, repair or replace it before operating. Do not attempt to free blocked cutting unit by reversing reel direction. Damage to reel may result.

13. Before getting off the seat:

A. Move traction pedal to neutral.

B. Set parking brake.

C. Disengage cutting units and wait for reels to stop.

D. Stop engine and remove key from switch.

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

Maintenance and Service

1. Before servicing or making adjustments, stop engine and remove key from the switch.

2. When changing attachments, tires or performing other service, use the correct blocks, hoists and jacks. Always chock or block the wheels and use jack stands or solid wood blocks to support the raised machine. If the machine is not properly supported by blocks or jack stands, the machine may move or fall, resulting in personal injury.

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

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

5. 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.

6. 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.

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

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

9. 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 everyone away.

10. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, have an Authorized Toro Distributor check maximum engine speed.

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

12. Disconnect battery before servicing the machine. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery.

13. 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.

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Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Reelmaster at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your Reelmaster, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

Maintenance

Maintenance procedures and recommended service intervals for the Reelmaster 6500–D and 6700–D are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

U.S.to Metric Conversions

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

Torque Specifications

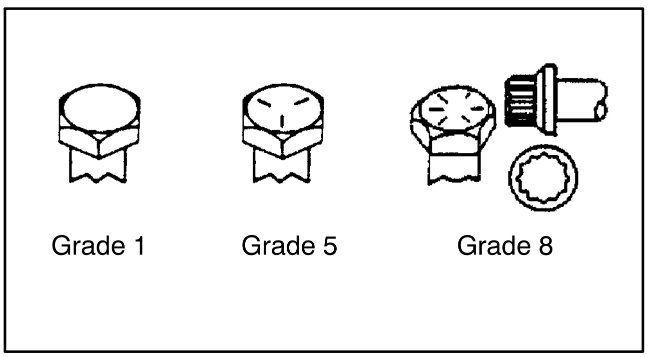
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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

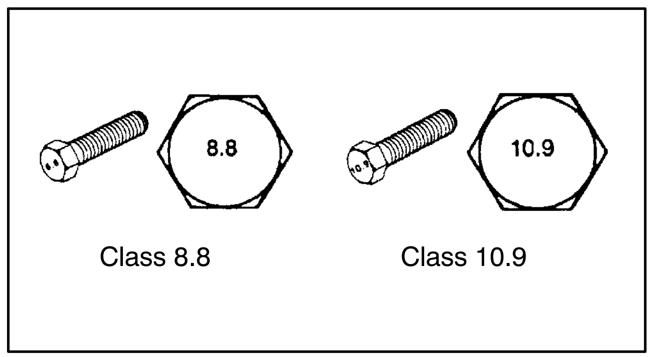
As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on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

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

Fastener Identification



Inch Series Bolts and Screws



Metric Bolts and Screws

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

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

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

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

Standard Torque for Dry, Zinc Plated, and Steel Fasteners (Metric 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 ± 5 in-lb	640 ± 60 N-cm	78 ± 7 in-lb	885 ± 80 N-cm
M6 X 1.0	96 ± 9 in-lb	1018 ± 100 N-cm	133 ± 13 in-lb	1500 ± 150 N-cm
M8 X 1.25	19 ± 2 ft-lb	26 ± 3 N-m	27 ± 2 ft-lb	36 ± 3 N-m
M10 X 1.5	38 ± 4 ft-lb	52 ± 5 N-m	53 ± 5 ft-lb	72 ± 7 N-m
M12 X 1.75	66 ± 7 ft-lb	90 ± 10 N-m	92 ± 9 ft-lb	125 ± 12 N-m
M16 X 2.0	166 ± 15 ft-lb	225 ± 20 N-m	229 ± 22 ft-lb	310 ± 30 N-m
M20 X 2.5	325 ± 33 ft-lb	440 ± 45 N-m	450 ± 37 ft-lb	610 ± 50 N-m

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

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the diesel engine used in the Reelmaster 6500-D and 6700-D.

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, 05 Series. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

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

Specifications

Item	Description
Make/Designation	Kubota V1505–T (E), 4-Cycle, 4 Cylinder, Turbocharged, Vertical, Water Cooled, Diesel Engine
Horse Power	42.5 HP @ 3000 RPM
Bore	3.07 in. (78 mm)
Stroke	3.09 in. (78 mm)
Total Displacement	91.4 cu. in. (1498 cc)
Torque	85.8 ft-lb (119.6 N-m) @ 2000 RPM
Firing Order	1-3-4-2
Combustion Chamber	Spherical Type
Fuel	No. 2 Diesel Fuel (ASTM D975)
Fuel Capacity	15 U.S. Gal. (57.0 l)
Fuel Injection Pump	Bosch MD Type Mini Pump
Governor	Centrifugal Mechanical
Low Idle (no load)	1150 +50/–150 RPM
High Idle (no load)	3200 +50/–150 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Compression Ratio	21:1
Injection Nozzles	Mini Nozzle (DNOPD)
Engine Oil	10W30 Detergent (API CE, or higher)
Oil Pump	Trochoid Type
Crankcase Oil Capacity (with filter)	7.5 U.S. qts (7.0 l) with Filter
Starter	12 VDC, 1.2 kW
Alternator/Regulator	12 VDC 40 AMP
Coolant Capacity	10 U.S. qt (9.4 l) with 1.0 U.S. qt (0.9 l) Reservoir
Dry Weight	251.3 lbs (114 kg)

General Information

Stopping The Engine

IMPORTANT: Before stopping the engine after mowing or full load operation, cool the turbo-charger by allowing the engine to idle at low speed for 5 minutes. Failure to do so may lead to turbo-charger trouble.

Check Engine Oil

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 latch and open hood.

3. Remove, wipe clean, and reinstall dipstick. Remove dipstick, and check oil level on dipstick. Oil level should be up to FULL mark.

4. If oil is below the FULL mark, remove fill cap and add SAE 10W-30 CD, CE, CF, CF-4, or CG4 oil until level reaches the FULL mark on the dipstick. **Do not overfill.** Capacity is 7.5 qt. (7 L) with filter

5. Install oil fill cap and close hood.

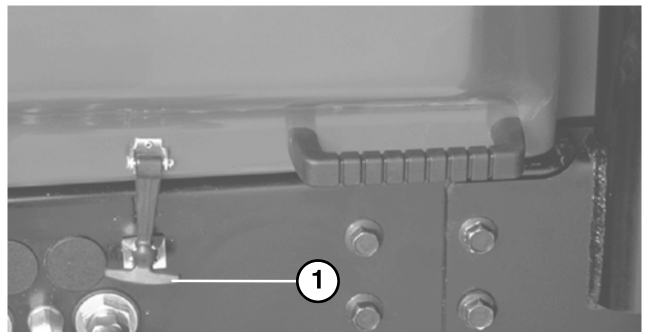

Figure 1

1. Hood Latch

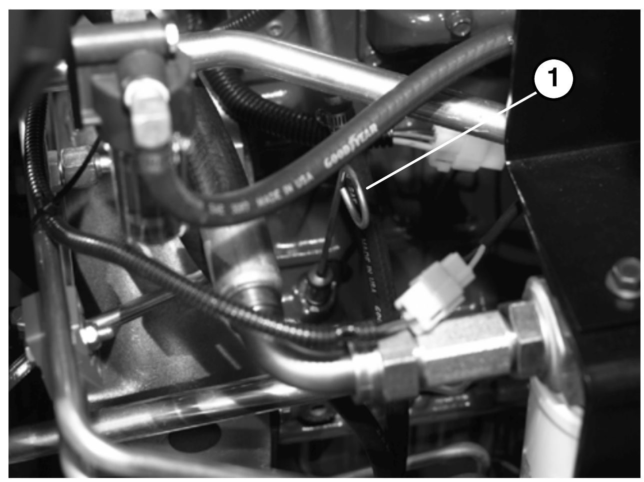

Figure 2

1. Dipstick

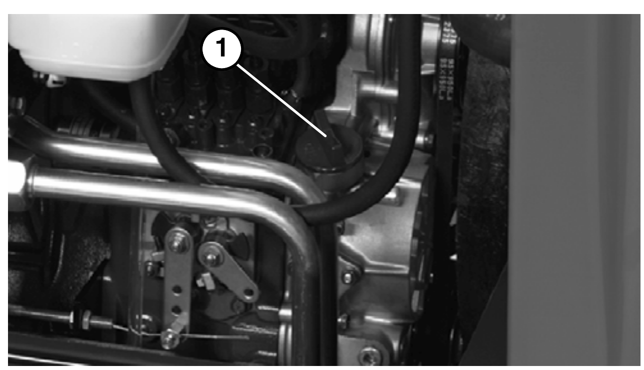

Figure 3

1. Filler Cap

Fill Fuel Tank

DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
- **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in a clean, safety-approved container and keep the cap in place.**

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

2. Clean area around the fuel tank cap. Remove cap from the tank.

3. Fill fuel tank to about one inch below the top of the tank (not the filler neck) with No. 2 diesel fuel. **Do not overfill.** Fuel tank capacity is 15 U.S. Gallons (57 l).

4. Install cap.

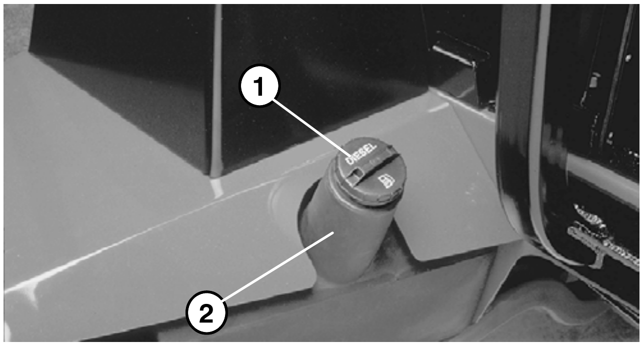

Figure 4

1. Fuel Tank Cap **2. Fuel Tank Filler Neck**

Check Cooling System

The cooling system is filled with a 50/50 solution of water and permanent ethylene glycol anti-freeze. Check level of coolant at the beginning of each day before starting the engine. System capacity is about 10 quarts (9.4 l).

IMPORTANT: Clean debris off the screen, oil cooler, and front of the radiator daily, and more often if conditions are extremely dusty or dirty (see Engine Cooling System).

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

> **CAUTION**
>
> **If the engine has been running, pressurized hot coolant can escape and cause burns if the radiator cap is removed.**
>
> **Allow the engine to cool at least 15 minutes or until the radiator cap is cool enough to touch without burning hands.**

2. Release hood latch and open hood.

3. Carefully remove radiator cap and expansion tank cap.

4. Check level of coolant in radiator and in expansion tank. Radiator should be filled to the top of the filler neck and the expansion tank filled to the FULL mark.

5. If coolant level is low, Fill expansion tank to the FULL mark and radiator to the top of the filler neck. **Do not overfill**.

Note: If air is trapped is system, remove vent plug from top of radiator side tank, to allow trapped air to escape. Reinstall vent plug using PTFE thread sealant.

6. Install radiator cap and expansion tank cap.

7. Close hood and secure latch.

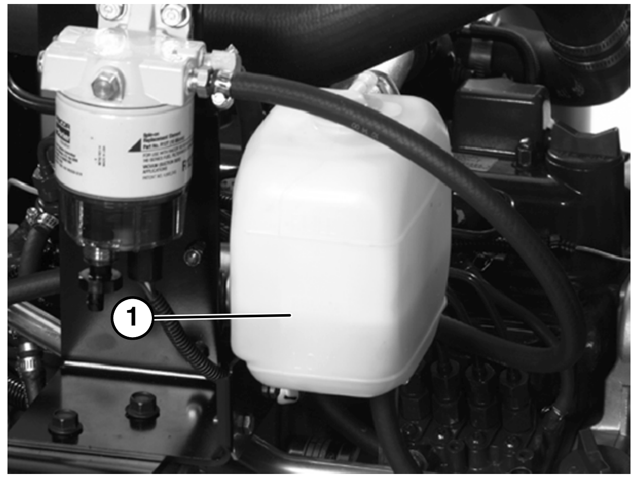

Figure 5

1. **Expansion Tank**

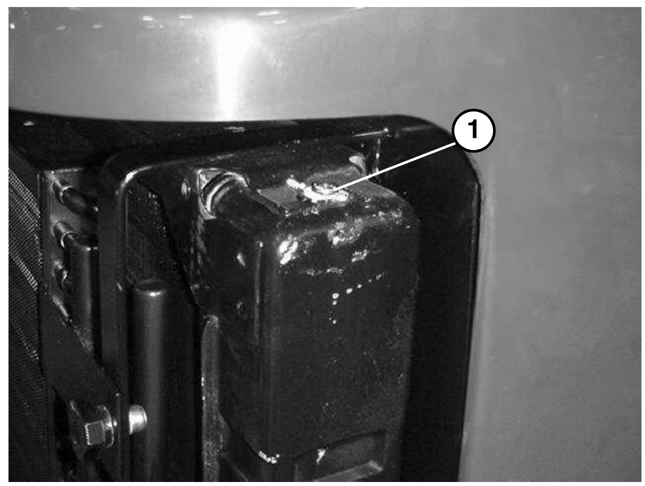

Figure 6

1. **Vent Plug**

Adjust Throttle Cable

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 latch and open hood.

3. Position throttle lever forward so it stops against the seat base slot.

4. At the fuel injection pump, loosen throttle cable connector on the control lever arm.

5. Hold fuel injection pump lever arm against the high idle stop screw and tighten the cable connector.

Note: Do not over tighten the cable connector. The connector must be free to swivel.

6. Torque lock nut used to set the friction device on the throttle lever from 40 to 55 in-lb (4.5 to 6.2 N-m). The maximum force required to operate the throttle lever should be 20 lb (9 kg).

7. Close hood and secure latch.

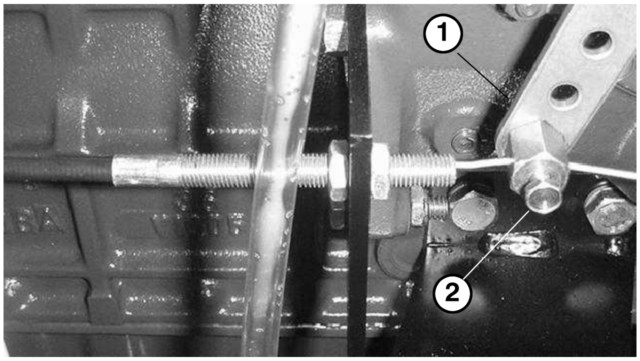

Figure 7

1. Injection Pump Lever Arm **2. Connector**

Adjust Alternator Belt

The condition and tension of all belts should be checked periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance.

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 latch and open hood.

3. Check tension by depressing belt midway between alternator and crankshaft pulleys with 22 lb. (9.9 Kg) of force. Belt should deflect 7/16 in. (11 mm). If belt adjustment is necessary, proceed to the next step.

4. Loosen bolts securing alternator to support bracket and to engine.

5. Gently pry alternator away from engine.

6. When proper tension is achieved, tighten alternator bolts.

7. Close hood and secure latch.

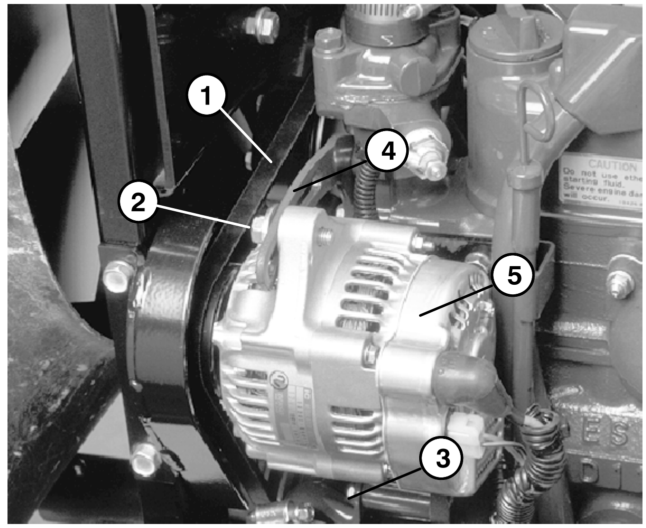

Figure 8

1. Belt
2. Bolt
3. Bolt
4. Support Bracket
5. Alternator

Bleed Fuel System

1. Park machine on a level surface, lower cutting units, stop engine, and engage parking brake. Make sure fuel tank is at least half full.

2. Release hood latch and open hood.

DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
- **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in a clean, safety-approved container and keep the cap in place.**

3. Loosen air bleed screw on the top of the fuel filter/water separator (Fig. 9).

4. Turn ignition switch to the ON position until a solid stream of fuel flows out around the bleed screw. Turn ignition switch to the OFF position and tighten air bleed screw.

5. Loosen air bleed screw on the fuel injection pump (Fig. 10).

6. Turn ignition switch to the ON position until a solid stream of fuel flows out around the bleed screw. Turn ignition switch to the OFF position and tighten air bleed screw.

IMPORTANT: The engine should normally start after the above bleeding procedures are followed. However, if the engine does not start, air may be trapped between injection pump and injectors (see Bleed Air from Fuel Injectors).

7. Close hood and secure latch.

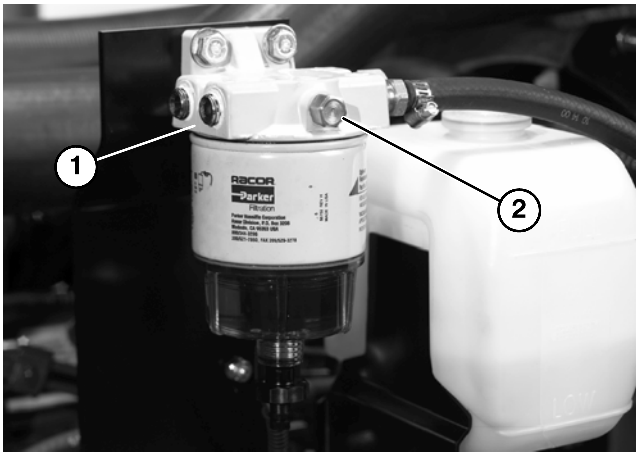

Figure 9

1. **Fuel Filter/Water Separator** 2. **Air Bleed Screw**

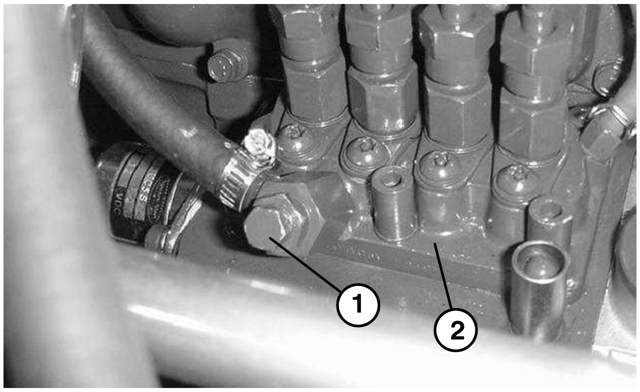

Figure 10

1. **Bleed Screw** 2. **Fuel Injection Pump**

Kubota Diesel Engine

Bleed Air from Fuel Injectors

IMPORTANT: This procedure should be used only if the fuel system has been purged of air through normal priming procedures (see Bleed Fuel System) and engine will not start.

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

> ⚠ **DANGER**
>
> **Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.**
>
> - **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
> - **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
> - **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
> - **Store fuel in a clean, safety-approved container and keep the cap in place.**

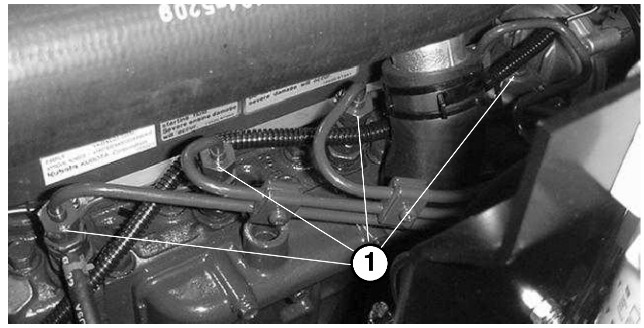

Figure 11

1. Injector/Pipe Connection

2. Release hood latch and open hood.

3. Loosen pipe connection to the No. 1 injector nozzle and holder assembly.

4. Move throttle to FAST position.

5. Turn ignition switch to START and watch fuel flow around connector. Turn key to OFF when solid flow is observed. Tighten pipe connector securely to the injector nozzle.

6. Repeat steps on the remaining injector nozzles.

7. Close hood and secure latch.

Change Engine Oil and Filter

Change oil and filter periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance.

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

2. Remove drain plugs and let oil flow into drain pan. When oil stops flowing, install the drain plugs.

3. Release hood latch and open hood.

4. Remove oil filter. Apply light coat of clean oil to the new filter seal before installing filter. **Do not over-tighten filter.**

5. Add 10W-30 CD, CE, CF, CF-4, or CG-4 oil to crankcase. Capacity is 7.5 qt. (7 L) with filter.

6. Close hood and secure latch.

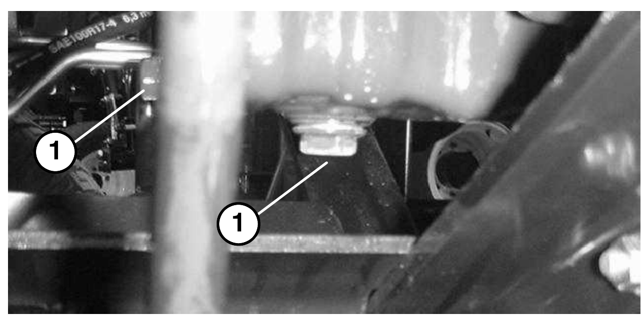

Figure 12

1. Drain Plugs

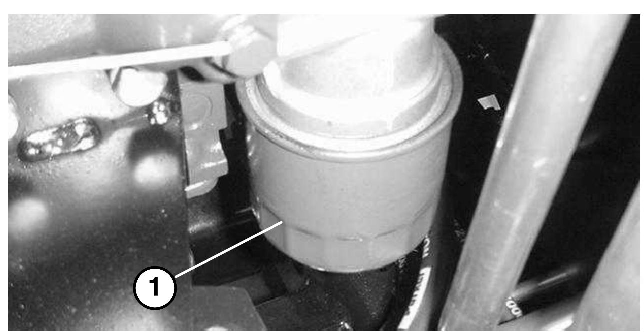

Figure 13

1. Oil filter

Clean Radiator and Oil Cooler

Remove debris from rear screen, oil cooler and radiator daily, clean more frequently in dirty conditions.

IMPORTANT: Never spray water onto a hot engine as damage to engine may occur.

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

CAUTION

If engine has been running, the radiator may be hot and cause burns. Work on radiator only when the engine and radiator are cool.

2. Unlatch and remove rear screen. Clean screen thoroughly.

3. Unscrew knobs and pivot oil cooler rearward. Clean both sides of oil cooler thoroughly with compressed air.

4. Open hood and clean engine area thoroughly of all dirt and debris. Blow debris from radiator out toward back of machine with compressed air.

Note: Fan shroud may be easily unbolted from machine to simplify cleaning.

5. Close hood and secure latch.

6. Pivot oil cooler back into position and tighten knobs. Install rear screen and secure latches.

Figure 14

1. Rear Screen

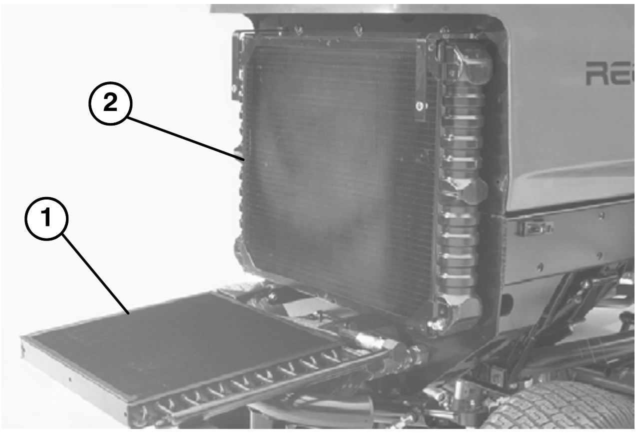

Figure 15

1. Oil Cooler **2. Radiator**

Fuel Filter/Water Separator

DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
- **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in a clean, safety-approved container and keep the cap in place.**

Draining

Drain water or other contaminants from fuel filter/water separator bowl daily, and replace filter canister as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance.

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 latch and open hood.

3. Place a suitable container under the fuel/water separator and loosen drain valve on the bottom of the separator base.

4. Allow all water and contaminants to drain from the separator. Tighten drain valve.

5. Close hood and secure latch.

Filter Element Replacement

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 latch and open hood.

3. Clean area where filter element mates with base and filter head.

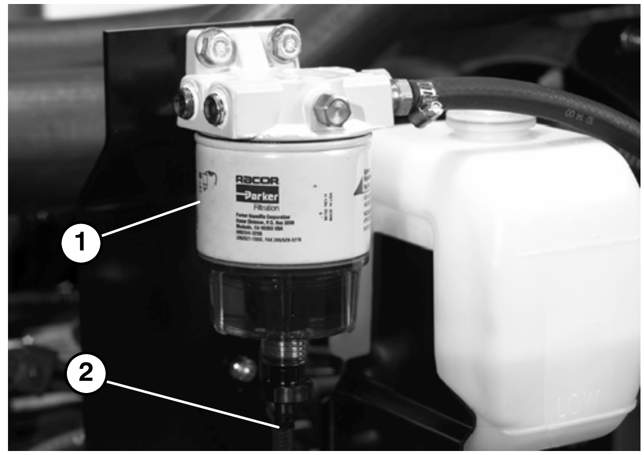

Figure 16

1. **Fuel Filter/Water Separator Cartridge**
2. **Drain Plug**

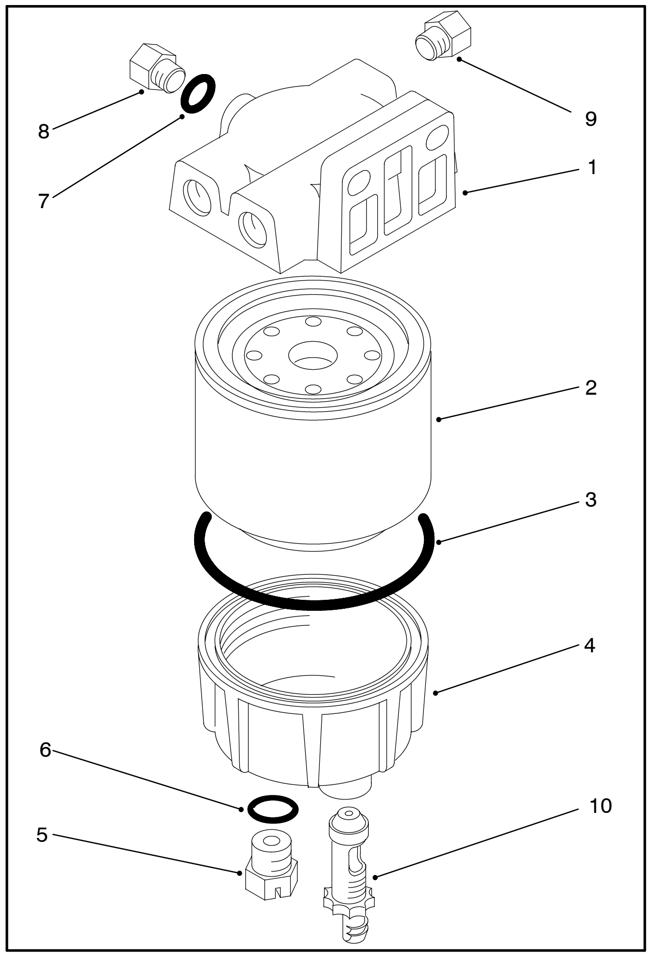

Figure 17

1. **Filter Head**
2. **Filter Element**
3. **O-ring**
4. **Base**
5. **Plug**
6. **O-ring**
7. **O-ring**
8. **Plug**
9. **Pipe Plug**
10. **Drain Valve**

4. Place a suitable container under fuel/water separator, and unscrew filter element and base from the filter head.

5. Unscrew filter element from base and discard element.

6. Lubricate gasket on new filter element and O-ring with clean diesel fuel.

7. Screw filter element into base by hand until the O-ring contacts the mounting surface. Rotate element an additional 1/2 turn.

8. Screw filter element and base onto filter head by hand until the gasket contacts the mounting surface. Rotate element and base an additional 1/2 turn.

9. Bleed air from fuel system (see Bleed Fuel System in this section of this manual).

10. Start engine and check for fuel leaks.

11. Close hood and secure latch.

Replace Fuel Prefilter

Replace fuel prefilter periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance.

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 latch and open hood.

3. Clean area where filter bowl mounts to filter head.

4. Remove filter bowl and clean mounting surface.

5. Remove filter element from the bowl and replace with new filter.

6. Install filter bowl by hand until O-ring contacts mounting surface.

7. Bleed air from fuel system (see Bleed Fuel System in this section of this manual).

8. Start engine and check for fuel leaks.

9. Close hood and secure latch.

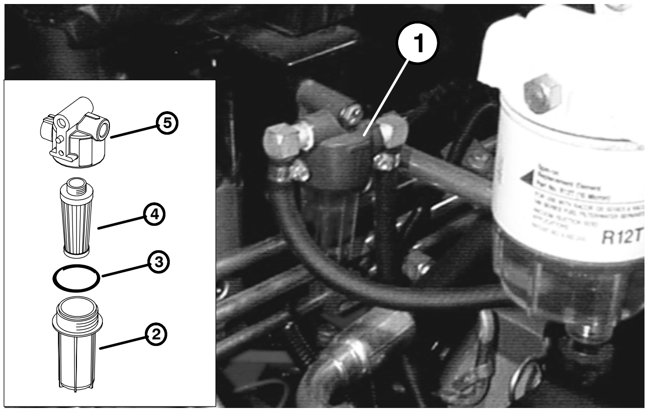

Figure 18

1. **Fuel Prefilter**
2. **Filter Bowl**
3. **O-ring**
4. **Filter Element**
5. **Filter Head**

Kubota Diesel Engine

Fuel System

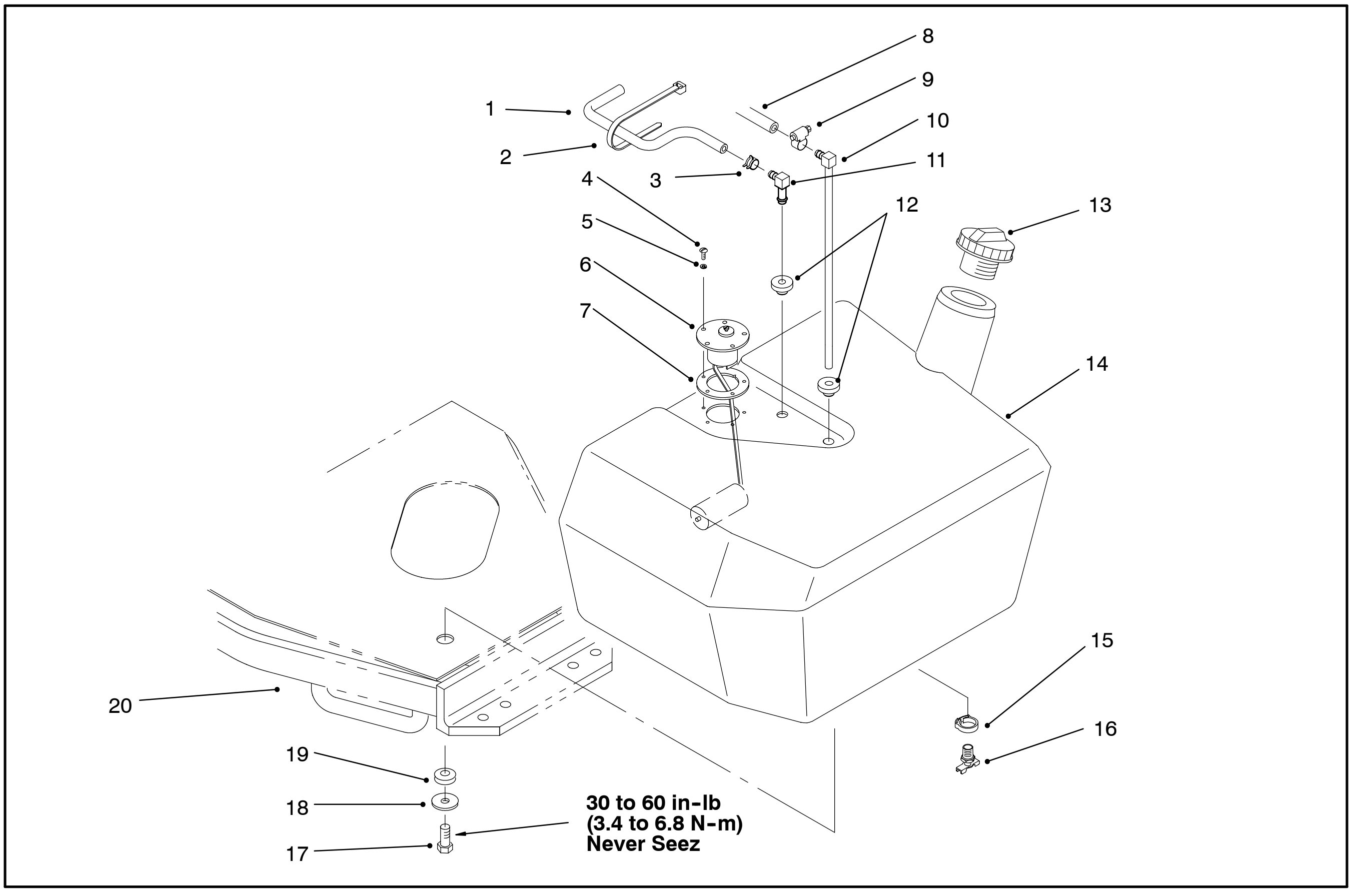

Figure 19

1. **Fuel Hose**
2. **Cable Tie**
3. **Spring Clamp**
4. **Round Head Screw**
5. **Lock Washer**
6. **Sending Unit**
7. **Gasket**
8. **Fuel Hose**
9. **Hose Clamp**
10. **Stand Pipe**
11. **Fuel Elbow Connector**
12. **Grommet**
13. **Tank Cap**
14. **Fuel Tank**
15. **Drain Clamp**
16. **Drain Fitting**
17. **Cap Screw**
18. **Flat Washer**
19. **Grommet**
20. **Frame**

DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
- **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in a clean, safety-approved container and keep the cap in place.**

Check Fuel Lines and Connections

Check fuel lines and connections periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance.

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

2. Check lines for deterioration, damage, leaking, or loose connections. Replace hoses, clamps, and connections as necessary.

Fuel Tank Removal (Fig. 19)

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

2. Drain fuel from the fuel tank into a suitable container by opening the drain fitting.

3. Remove left fender and tool box from the frame to gain access to the top of the fuel tank.

4. Disconnect electrical wiring from the sending unit. Disconnect both fuel hoses from the standpipe and fuel connector.

5. Remove fuel tank from the frame using Figure 19 as a guide.

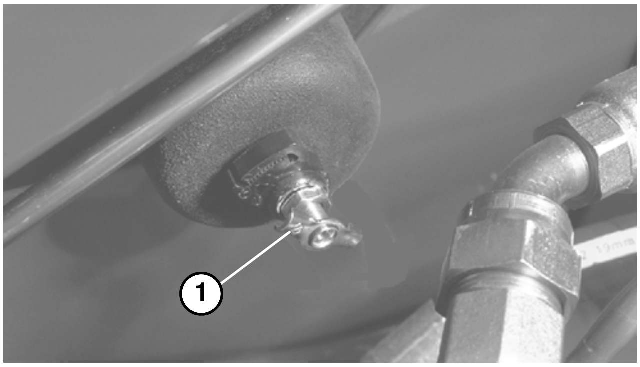

Figure 20
1. **Fuel Tank Drain**

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance. 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.

1. Remove fuel tank from the machine (see Fuel Tank Removal).

2. Flush fuel tank out with clean diesel fuel and completely drain. Make sure tank is free of contaminates and debris.

3. Install fuel tank to the machine (see Fuel Tank Installation).

Fuel Tank Installation (Fig. 19)

1. Install fuel tank to the frame using Figure 19 as a guide.

   A. Apply antiseize lubricant to the threads of all three cap screws.

   B. Torque all three cap screws from 30 to 60 in-lb (3.4 to 6.8 N-m).

2. Connect both fuel hoses to the standpipe and fuel connector.

3. Connect electrical wiring to the sending unit.

   A. Connect blue/green wire to the center terminal and black wire to any of the screws on the sender.

   B. Apply skin-over grease to the terminal connections.

4. Install left fender and tool box to the frame.

5. Make sure drain fitting is closed. Fill fuel tank (see Fill Fuel Tank).

Air Filter

General Maintenance

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 latch and open hood.

3. Check air cleaner, seals, and intake hose for damage which could cause an air leak. Be sure the air cleaner cover seals tightly around the air cleaner body. Replace damaged air cleaner components as necessary.

4. Service air cleaner filters whenever air cleaner indicator shows red or periodically as recommended in the maintenance schedules in Chapter 2 - Product Records and Maintenance (more frequently in extreme dusty or dirty conditions). Do not over service air filter.

Service Air Cleaner

1. Release latch securing air cleaner cover. Rotate cover counterclockwise and remove cover from body. Clean inside of the air cleaner cover.

2. Gently slide primary filter out of air cleaner body. To reduce the amount of dust dislodged, avoid knocking filter against air cleaner body.

3. Remove the safety filter only if it is being replaced.

IMPORTANT: Do not clean the safety filter. Replace the safety filter with a new one after every three primary filter services.

4. Inspect primary filter and discard if damaged. Do not wash or reuse a damaged filter.

5. Clean primary filter.

    A. Blow compressed air from inside to the outside of dry filter element. To prevent damage to the element, do not exceed 100 psi.

    B. Keep air hose nozzle at least 2 inches (5 cm) from the filter. Move nozzle up and down while rotating the filter element. Inspect for holes and tears by looking through the filter toward a bright light.

6. Check sealing end of filter. Do not install a damaged filter

7. Insert new filter into air cleaner body. Make sure filter is sealed properly by applying pressure to outer rim of filter when installing. Do not press on flexible center of filter.

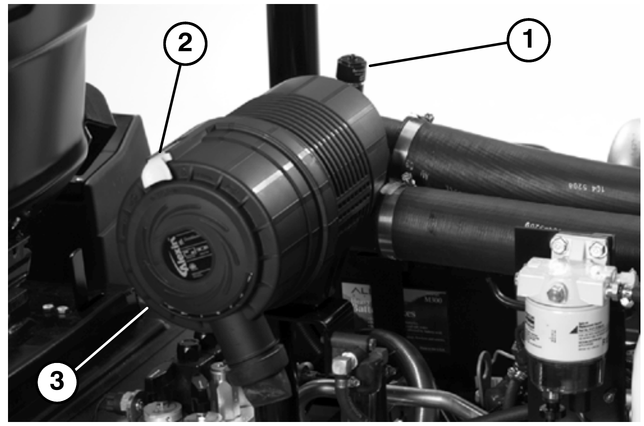

Figure 21
1. Indicator
2. Air Cleaner Latch
3. Dust Cap

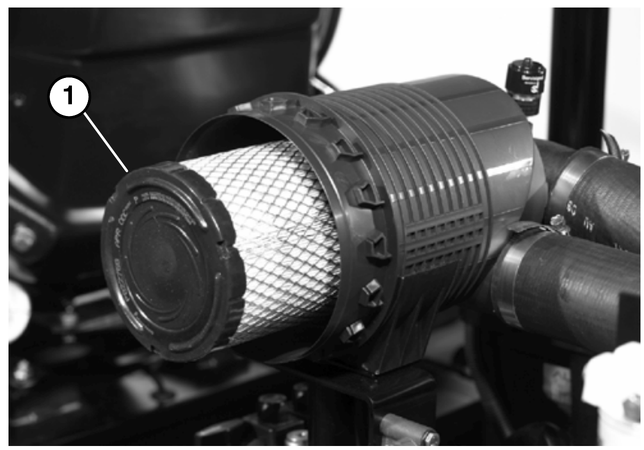

Figure 22
1. Primary Filter

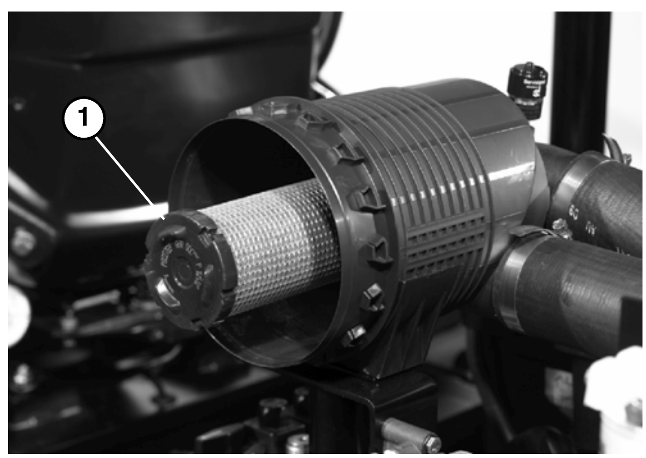

Figure 23
1. Safety Filter

8. Reinstall cover and secure latch. Reset indicator if showing red.

9. Close hood and secure latch.

Kubota
Diesel Engine

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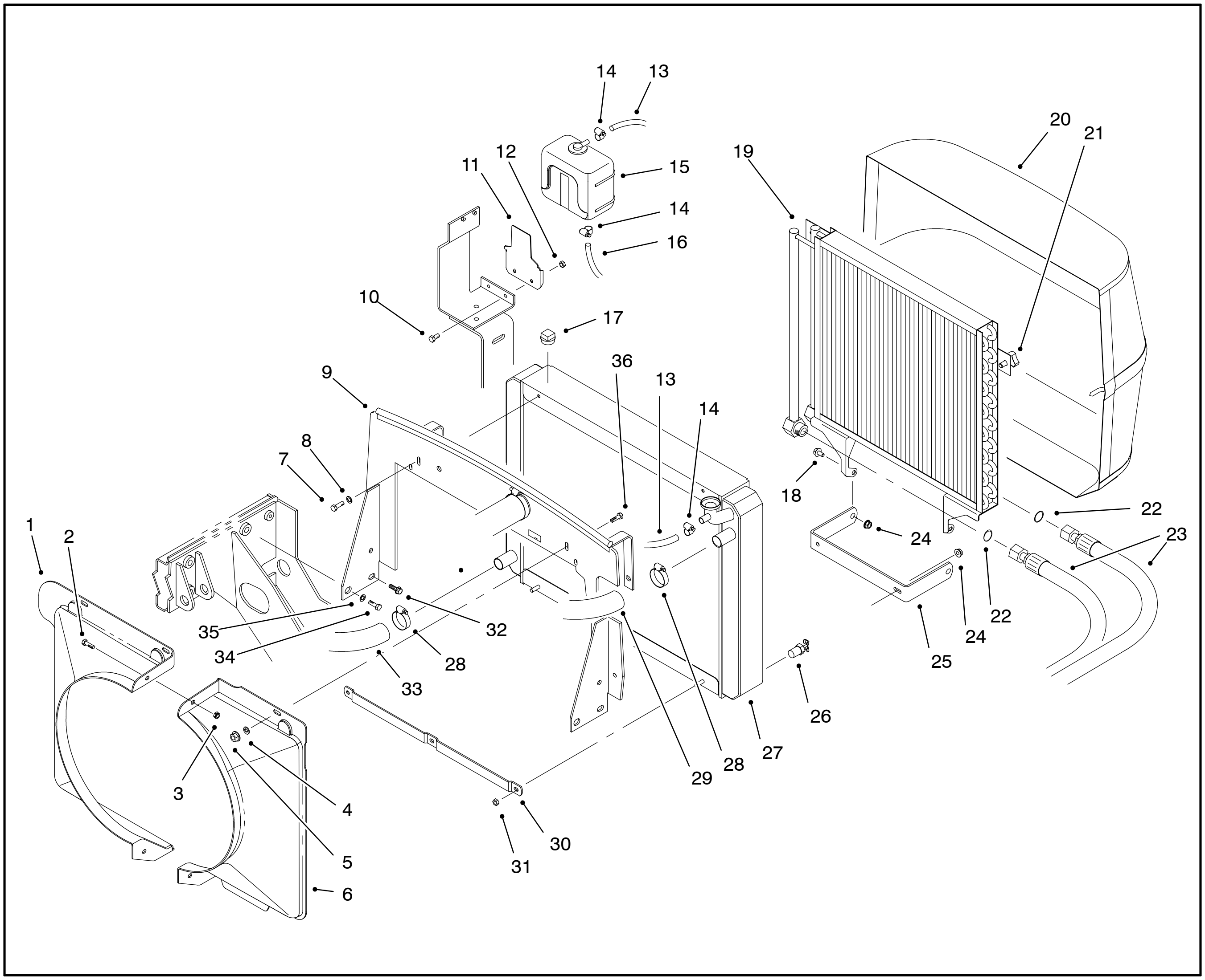

Figure 24

1. Fan Shroud RH
2. Screw
3. Hex Nut
4. Flat Washer
5. Hex Nut
6. Fan Shroud LH
7. Screw
8. Flat Washer
9. Radiator Support
10. Screw
11. Reservoir Bracket
12. Locknut
13. Overflow Hose (to ground)
14. Hose Clamp
15. Overflow Reservoir
16. Overflow Hose (to radiator)
17. Vent Plug
18. Shoulder Bolt
19. Oil Cooler
20. Rear Screen
21. Knob
22. O-ring
23. Hose Assembly
24. Hex Nut
25. Oil Cooler Support
26. Draincock
27. Radiator
28. Hose Clamp
29. Upper Radiator Hose
30. Radiator Strap
31. Locknut
32. Screw
33. Lower Radiator Hose
34. Screw
35. Flat Washer
36. Carriage Bolt

Removal (Fig. 24)

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

2. Unlatch and remove rear screen.

3. Unscrew knobs and pivot oil cooler rearward.

4. Release hood latch and open hood.

5. Remove hair pins and washers and remove hood.

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.

6. Remove the fan shroud.

7. Drain radiator into a suitable container using the radiator drain. Disconnect all hoses from the radiator.

8. Remove the locknuts and radiator strap securing the bottom of the radiator.

9. Remove the screws and washers securing the top of the radiator.

10. Pull the bottom of the radiator away from the radiator support and slide the radiator out to the left side of the machine.

11. Plug any openings to prevent contamination.

Installation (Fig. 24)

1. Remove any plugs used during the removal procedure.

2. Slide the radiator into the radiator support from the left of the machine.

3. Secure the top and bottom of the radiator to the radiator support.

4. Make sure radiator drain is closed. Fill radiator with fluid (see Check Cooling System).

5. Reinstall the fan shroud.

6. Reinstall hood, washers, and hairpins.

7. Close hood and secure latch.

8. Pivot oil cooler back into position and tighten knobs. Install rear screen and secure latches.

Engine

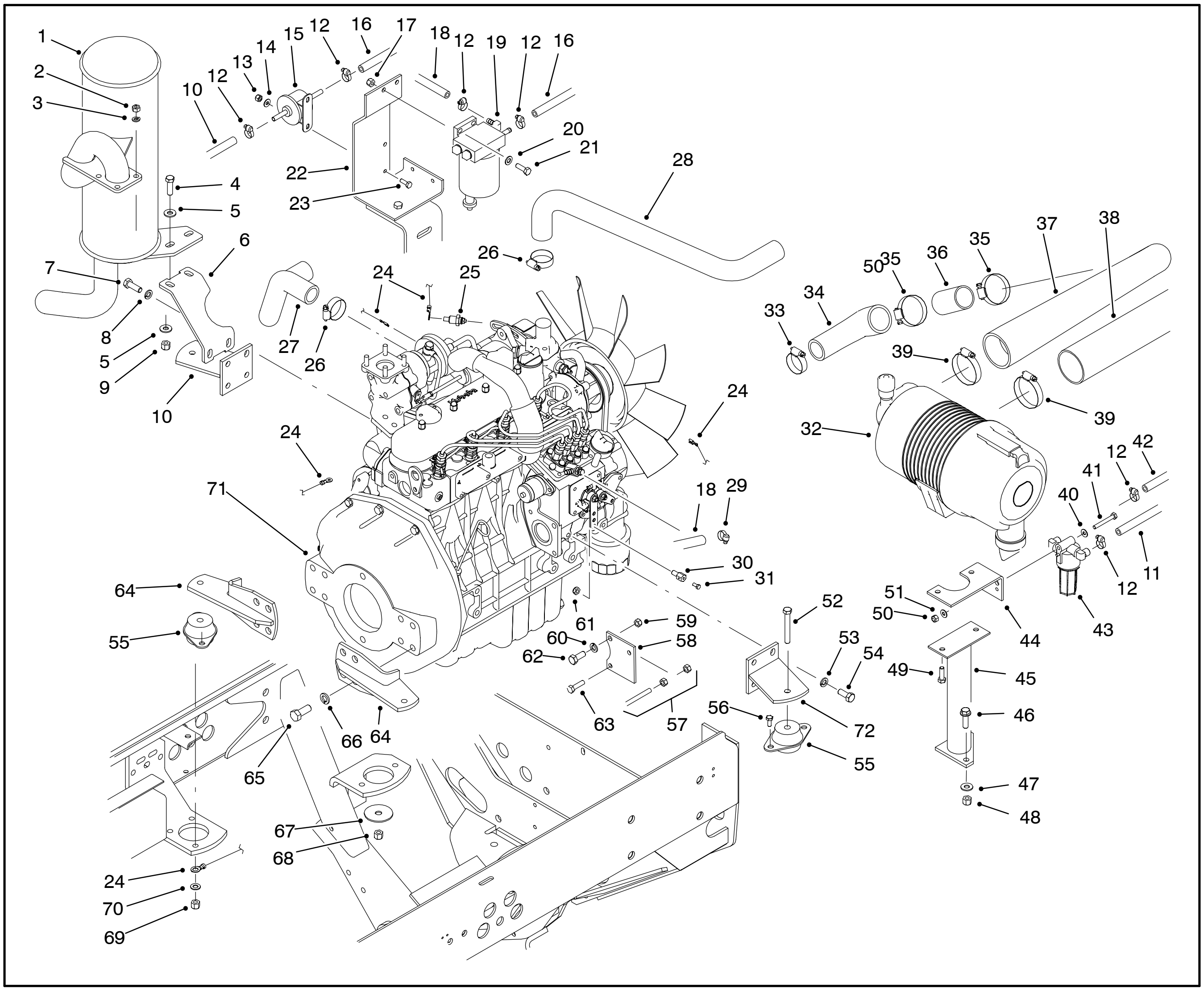

Figure 25

1. **Muffler**
2. **Hexnut**
3. **Lockwasher**
4. **Screw**
5. **Flat Washer**
6. **Muffler Support**
7. **Screw**
8. **Lockwasher**
9. **Locknut**
10. **Engine Bracket (front RH)**
11. **Fuel Hose**
12. **Hose Clamp**
13. **Locknut**
14. **Flat Washer**
15. **Fuel Pump**
16. **Fuel Hose**
17. **Locknut**
18. **Fuel Hose**
19. **Fuel Filter/Water Separator**
20. **Flat Washer**
21. **Screw**
22. **Filter/Separator Bracket**
23. **Screw**
24. **Wire Harness**
25. **Temperature Sensor**
26. **Hose Clamp**
27. **Radiator Hose (lower)**
28. **Radiator Hose (upper)**
29. **Hose Clamp**
30. **Throttle Swivel**
31. **Screw**
32. **Air Cleaner**
33. **Hose Clamp**
34. **Air Cleaner Hose**
35. **Hose Clamp**
36. **Spacer**
37. **Air Cleaner Hose**
38. **Air Cleaner Hose**
39. **Hose Clamp**
40. **Flat Washer**
41. **Screw**
42. **Fuel Hose**
43. **Fuel Filter**
44. **Fuel Filter/Air Cleaner Bracket**
45. **Fuel Filter/Air Cleaner Support**
46. **Screw**
47. **Flat Washer**
48. **Lock Nut**
49. **Screw**
50. **Locknut**
51. **Flat Washer**
52. **Screw**
53. **Lockwasher**
54. **Screw**
55. **Engine Mount**
56. **Screw**
57. **Throttle Cable**
58. **Throttle Plate**
59. **Locknut**
60. **Lockwasher**
61. **Locknut**
62. **Screw**
63. **Screw**
64. **Engine Bracket (rear)**
65. **Screw**
66. **Lockwasher**
67. **Washer**
68. **Locknut**
69. **Locknut**
70. **Flat Washer**
71. **Engine Assembly**
72. **Engine Bracket (front LH)**

Removal (Fig. 25)

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 latch and open hood.

3. Disconnect both battery cables at the battery (see Battery Service in Chapter 5 - Electrical system).

CAUTION

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

4. Remove muffler assembly.

5. Disconnect air filter hoses from the engine and air filter.

6. Remove radiator (see Radiator Removal in this section of this manual).

7. Remove oil cooler and radiator support.

DANGER

Under certain conditions, diesel fuel and fuel vapors are highly flammable and explosive. A fire or explosion from fuel can burn you and others and can cause property damage.

- **Use a funnel and fill the fuel tank outdoors, in an open area, when the engine is off and is cold. Wipe up any fuel that spills.**
- **Do not fill the fuel tank completely full. Add fuel to the fuel tank until the level is 1 in. (25 mm) below the bottom of the filler neck. This empty space in the tank allows the fuel to expand.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in a clean, safety-approved container and keep the cap in place.**

8. Disconnect all fuel hoses from engine and fuel filter. To ease reinstallation, mark removed fuel hoses.

9. Disconnect, mark, and plug all hydraulic lines at the hydraulic pump assembly.

10. Disconnect and plug hydraulic lines and remove hydraulic oil filter assembly and bracket.

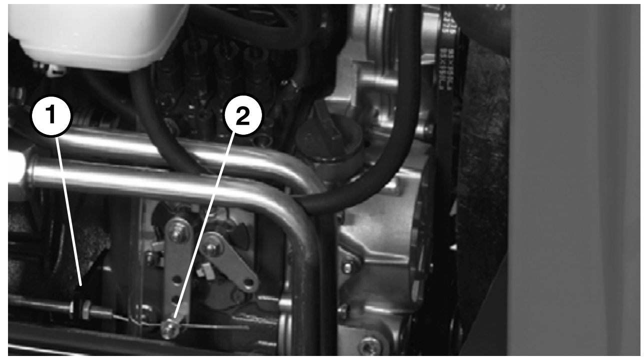

Figure 26

1. **Cable bracket** 2. **Cable swivel**

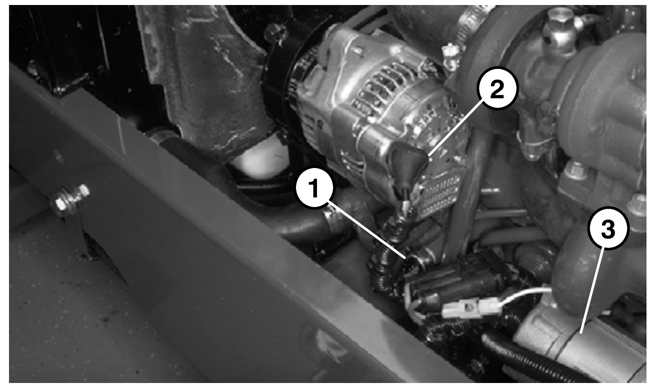

Figure 27

(shown with muffler removed)

1. **Oil low pressure switch**
2. **Alternator**
3. **Starter**

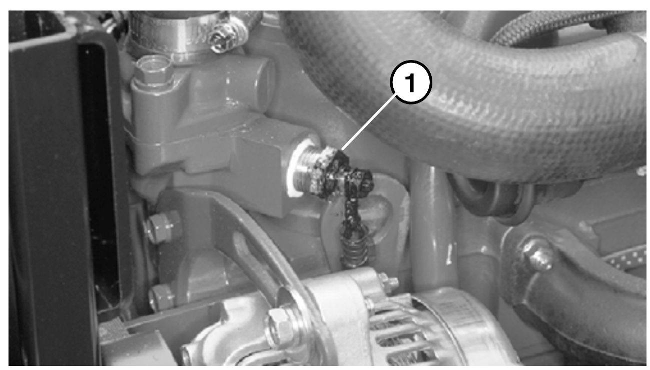

Figure 28

1. **Temperature sender**

11. Disconnect throttle cable from the swivel on the speed control lever and the cable bracket (Fig. 26).

12. Disconnect wires and/or electrical connections from the following electrical components:

A. The oil low pressure switch, starter, and alternator (Fig 27). The temperature sender (Fig. 28).

B. Battery, frame, and wire harness ground to the engine block and the ETR solenoid (Fig. 29).

C. High temperature shutdown switch (Fig. 30). Glow plug bus (Fig. 31).

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

14. Connect hoist or lift to the front and rear engine lift tabs.

15. Remove the nuts, washers, and cap screws securing the engine brackets to the engine mounts.

CAUTION

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

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

16. Slowly lift engine up and out the rear of the machine.

Engine Installation (Fig. 25)

1. Connect hoist or lift to the front and rear engine lift tabs.

CAUTION

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

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

2. Position engine slowly from the rear of the machine.

3. Secure the engine brackets to the engine mounts.

4. Disconnect hoist or lift from engine.

5. Connect wires and/or electrical connections to the following electrical components:

A. Glow plug bus (Fig. 31). High temperature shutdown switch (Fig. 30).

B. Battery, frame, and wire harness ground to the engine block and the ETR solenoid (Fig. 29).

C. The temperature sender (Fig. 28). The oil low pressure switch, starter, and alternator (Fig 27).

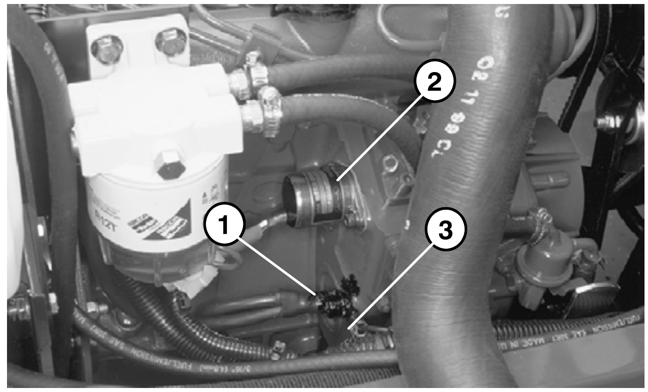

Figure 29
(shown with hydraulic filter & bracket removed)

1. **Battery & frame ground**
2. **ETR solenoid**
3. **Wire harness ground**

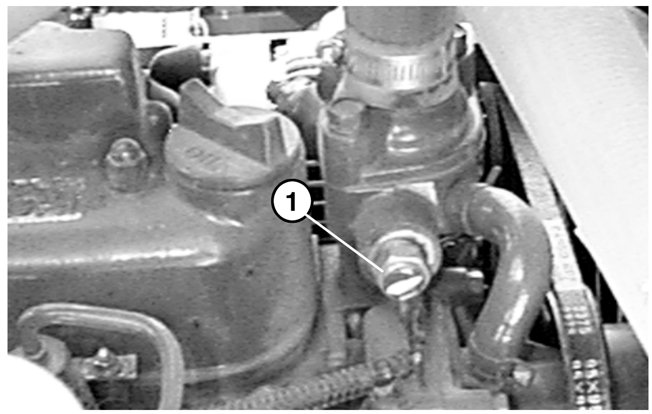

Figure 30

1. **High temperature shutdown switch**

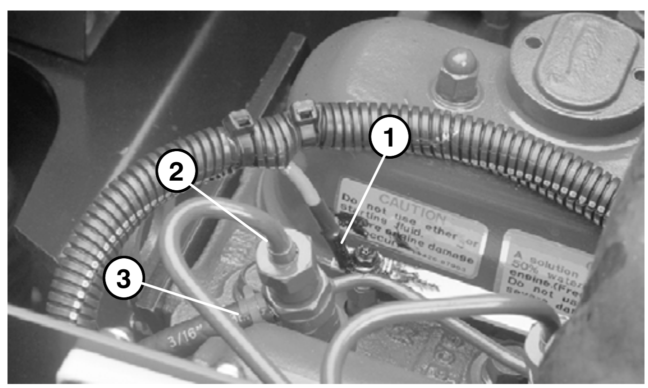

Figure 31

1. **Glow plug wire**
2. **Rear injection nozzle**
3. **Fuel hose**

6. Install hydraulic oil filter and bracket and connect hydraulic lines.

7. Connect throttle cable to the cable clamp and swivel on the speed control lever (Fig. 26).

8. Connect hydraulic lines at hydraulic pump assembly.

9. Connect all fuel hoses.

10. Install radiator support and oil cooler.

11. Install radiator (see Radiator Installation in this section of this manual).

12. Connect air filter hose to the engine.

13. Install muffler assembly.

14. Connect both battery cables to the battery (see Battery Service in Chapter 5 - Electrical system).

15. Adjust throttle cable (see Adjust Throttle Cable in this section of this manual).

16. Bleed air from fuel system (see Bleed Fuel System in this section of this manual).

17. Start engine and check for fuel leaks.

18. Close hood and secure latch.

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Chapter 4

Hydraulic System

Table of Contents

Hydraulic System

Specifications

Item	Specification
Traction Pump Traction Relief Pressure Charge Pressure	Servo controlled piston pump 4000 PSI (276 bar) 250 PSI (17 bar)
Reel/Steering/Lift Pump Maximum Operating Pressure Steering Relief Pressure	3 section, positive displacement gear type pump 3000 PSI (207 bar) 1500 PSI (103 bar)
Hydraulic Manifold (Reel) Front Reel Circuit Relief Pressure (R1) RM 6500-D Rear Reel Circuit Relief Pressure (R2) RM 6700-D Rear Reel Circuit Relief Pressure (R2)	 3000 PSI (207 bar) 2000 PSI (138 bar) 3000 PSI (207 bar)
Reel Motors Maximum Operating Pressure	Gear type 3000 PSI (207 bar)
Hydraulic Filter	Spin-on cartridge type with 50 PSI (3.4 bar) internal bypass
Hydraulic Oil Reservoir Capacity System Capacity	See Check Hydraulic System Fluid in General Information section 8.5 gal. U.S. (32.2 L) 10 gal. U.S. (37.8 L)

General Information

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 or maintenance. These conditions can cause damage or premature deterioration. Some hoses are more susceptible to these conditions than others. Inspect the hoses frequently for signs of deterioration or damage.

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 on the hose. Use two wrenches; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.

WARNING

Before disconnecting or performing any work on hydraulic system, relieve all pressure in system. Stop engine; lower or support cutting units and/or other attachment(s).

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 Fitting Installation

O-Ring Face Seal

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Make sure the O-ring is installed and properly seated in the groove. It is recommended that the O-ring be replaced any time the connection is opened.

3. Lubricate the O-ring with a light coating of oil.

4. Put the tube and nut squarely into position on the face seal end of the fitting and tighten the nut until finger tight.

5. Mark the nut and fitting body. Hold the body with a wrench. Use another wrench to tighten the nut to the correct flats from finger tight (F.F.F.T.). The markings on the nut and fitting body will verify that the connection has been tightened.

Size	F.F.F.T.
4 (1/4 in. nominal hose or tubing)	0.75 ± 0.25
6 (3/8 in.)	0.75 ± 0.25
8 (1/2 in.)	0.75 ± 0.25
10 (5/8 in.)	1.00 ± 0.25
12 (3/4 in.)	0.75 ± 0.25
16 (1 in.)	0.75 ± 0.25

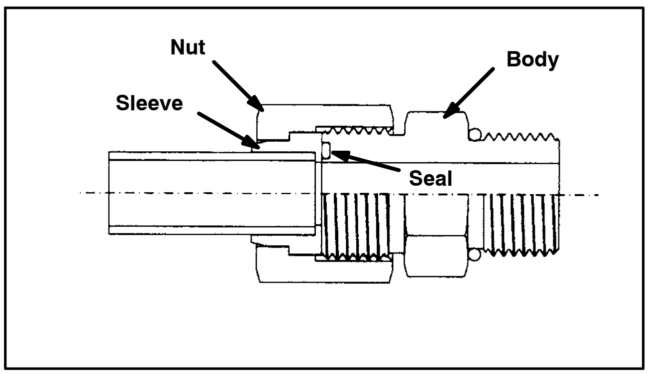


Figure 1

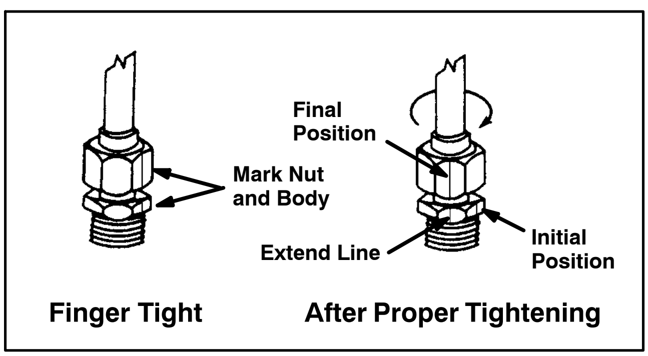


Figure 2

Hydraulic System

SAE Straight Thread O-Ring Port - Non-adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O-ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O-ring with a light coating of oil.

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

5. Tighten the fitting to the correct flats from finger tight (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

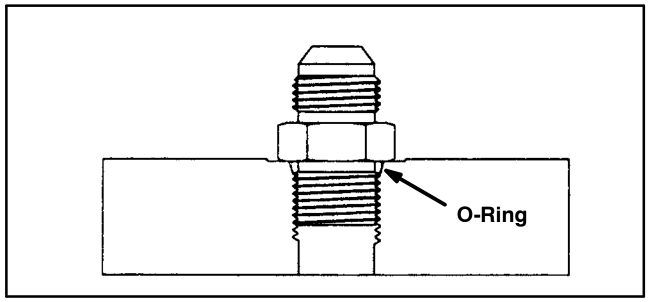


Figure 3

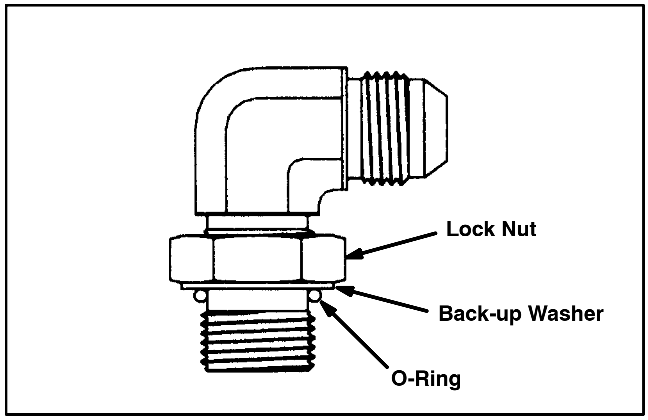


Figure 4

SAE Straight Thread O-Ring Port - Adjustable

1. Make sure both threads and sealing surfaces are free of burrs, nicks, scratches, or any foreign material.

2. Always replace the O-ring seal when this type of fitting shows signs of leakage.

3. Lubricate the O-ring with a light coating of oil.

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

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 turn the jam nut with another wrench to the correct flats from finger tight (F.F.F.T.) (Step 4).

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

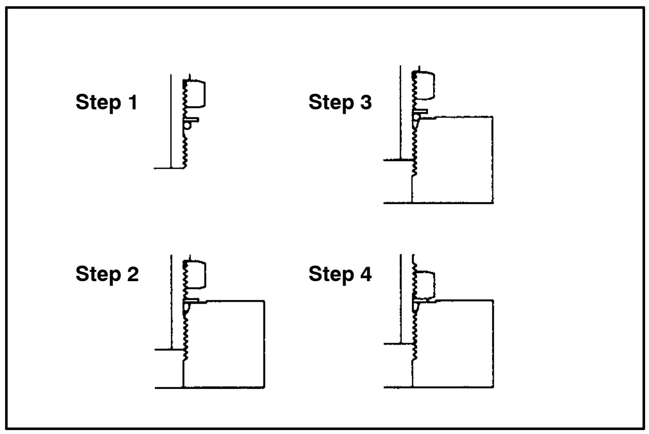


Figure 5

Pushing or Towing Traction Unit

In an emergency, the machine can be moved by actuating the bypass valve in the variable displacement hydraulic pump and pushing or towing the machine.

IMPORTANT: Do not push or tow the machine faster than 2 to 3 MPH (3 to 4.8 km/h) because internal transmission damage may occur. The bypass valve must be open whenever the machine is pushed or towed.

1. The bypass valve is located on top of variable displacement pump (Fig. 6). Rotate the valve 90° in either direction, to open and allow oil to bypass internally. Because fluid is bypassed, the machine can be moved slowly without damaging the transmission.

2. For towing, attach one end of a suitable chain, strap or cable to the front frame member (Fig. 7), and the other end to a vehicle that is capable of towing the machine safely. An operator must steer the machine being towed.

3. After towing or pushing, close the bypass valve before starting the engine. Do not exceed 5 to 8 ft.-lb. (7 to 11 Nm) torque to close the valve.

IMPORTANT: Running the engine with the bypass valve open will cause the transmission to overheat.

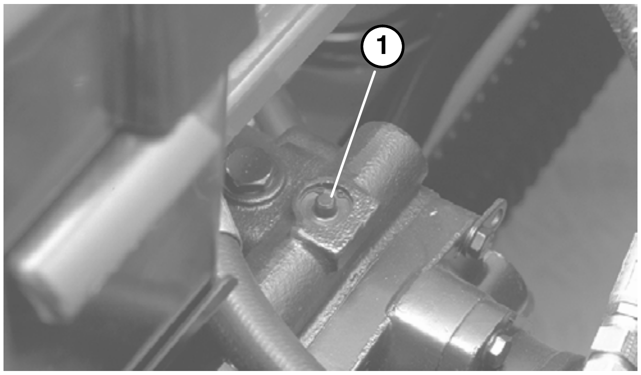


Figure 6
1. Bypass Valve

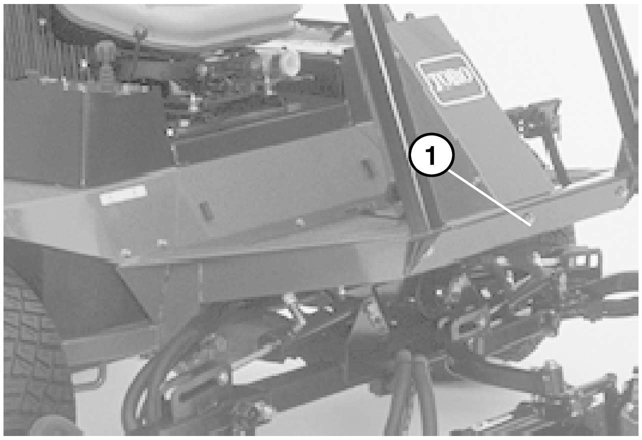


Figure 7
1. Front Frame Member

Hydraulic System

Check Hydraulic Fluid

The hydraulic system is designed to operate on antiwear hydraulic fluid. The reservoir holds about 8.5 U.S. gallons (32 L) hydraulic fluid. **Check level of hydraulic fluid daily.** See Operator's Manual for fluid level checking procedure and hydraulic oil recommendations.

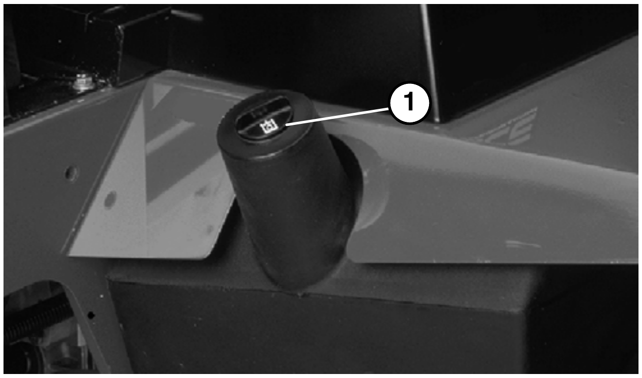
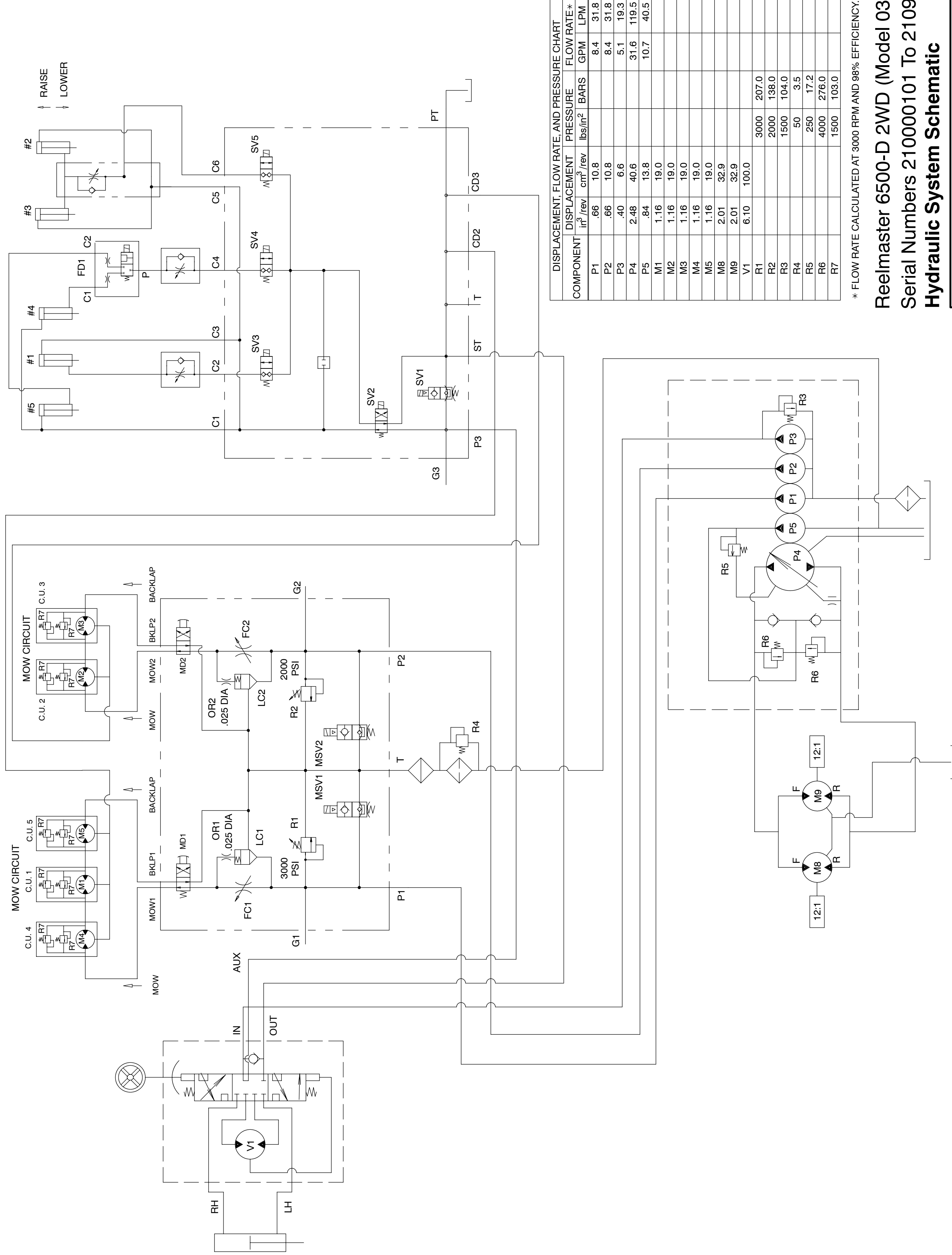


Figure 8
1. Hydraulic Reservoir Cap



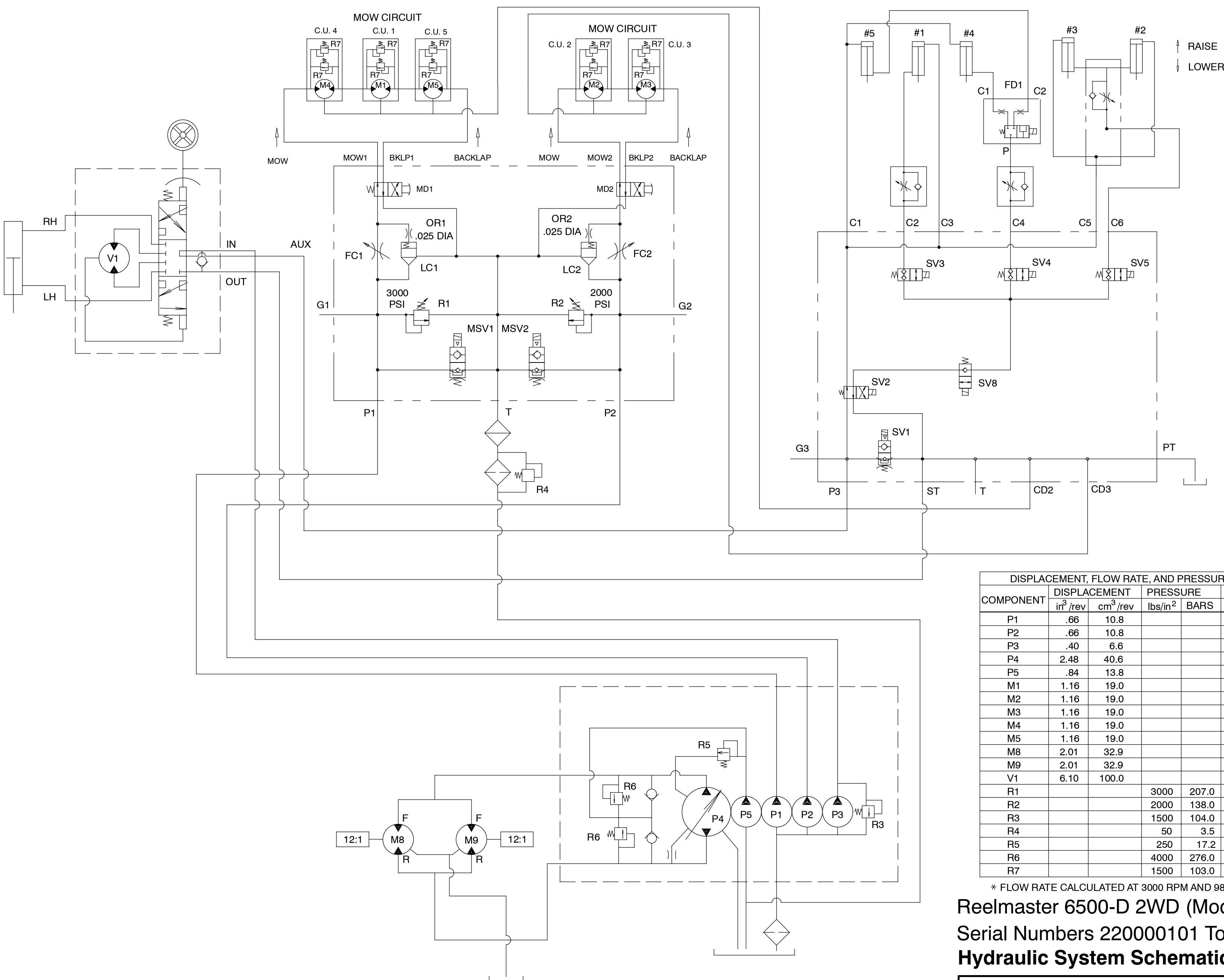
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT in³/rev	DISPLACEMENT cm³/rev	PRESSURE lbs/in²	PRESSURE BARS	FLOW RATE* GPM	FLOW RATE* LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
V1	6.10	100.0				
R1			3000	207.0		
R2			2000	138.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 2WD (Model 03806)
Serial Numbers 210000101 To 210999999
Hydraulic System Schematic

All solenoids are shown as de-energized.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		FLOW RATE *	
	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
V1	6.10	100.0				
R1			3000	207.0		
R2			2000	138.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

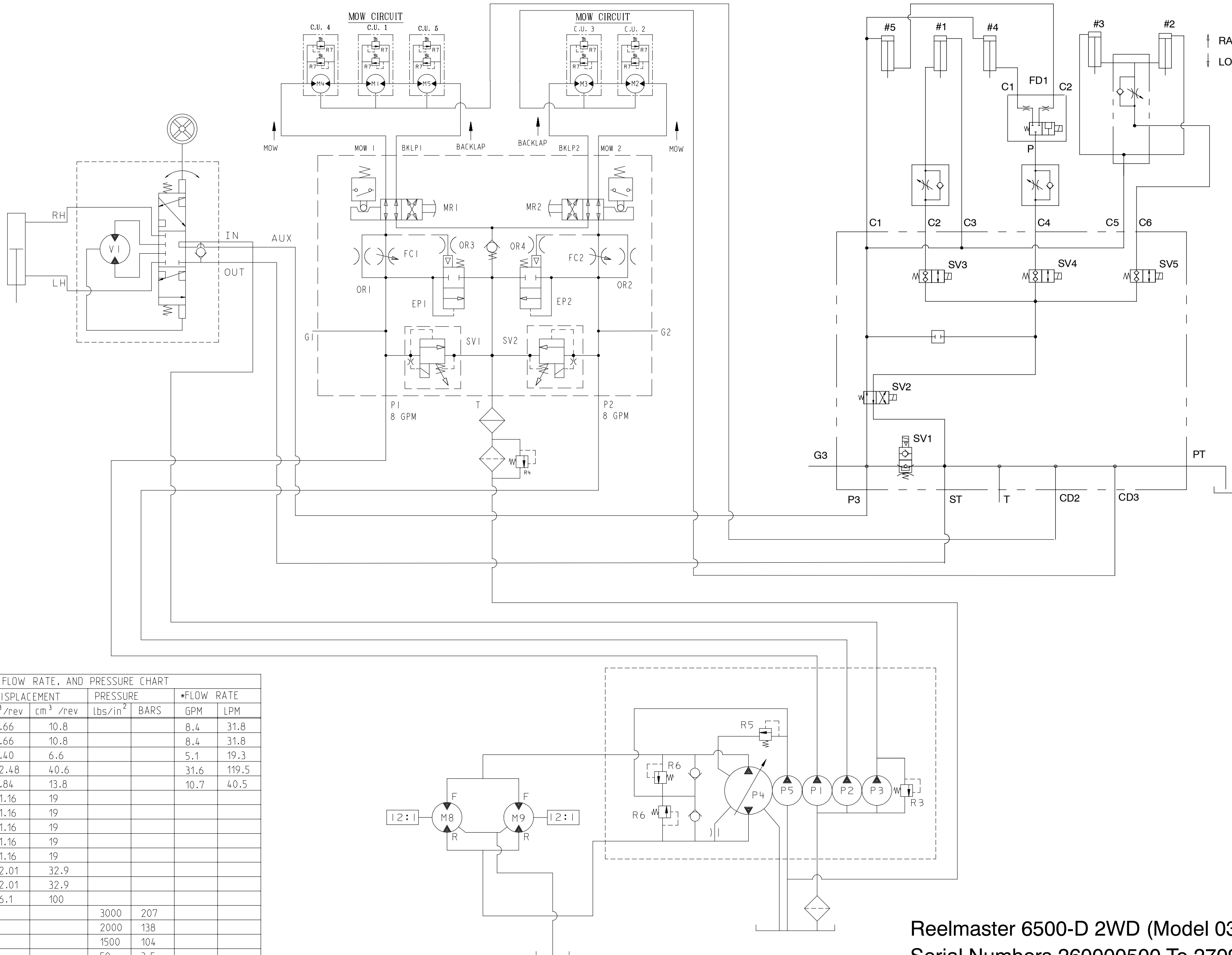
* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 2WD (Model 03806)

Serial Numbers 220000101 To 260000499

Hydraulic System Schematic

All solenoids are shown as de-energized.



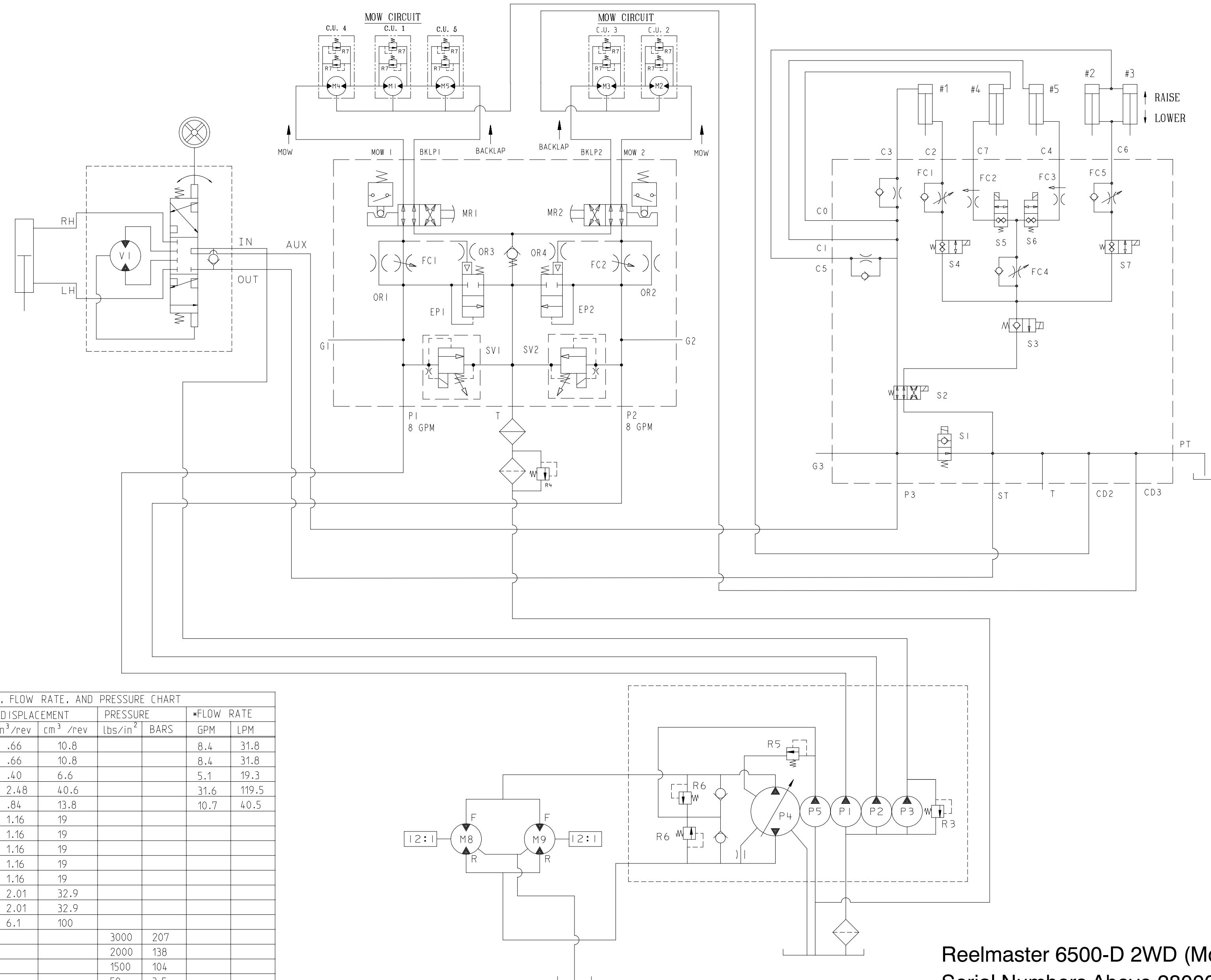
COMPONENT	DISPLACEMENT in^3/rev	DISPLACEMENT cm^3/rev	PRESSURE lbs/in^2	PRESSURE BARS	*FLOW RATE GPM	*FLOW RATE LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
V1	6.1	100				
SV1			3000	207		
SV2			2000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 2WD (Model 03806)
Serial Numbers 260000500 To 270999999
Hydraulic System Schematic

All solenoids are shown as de-energized.

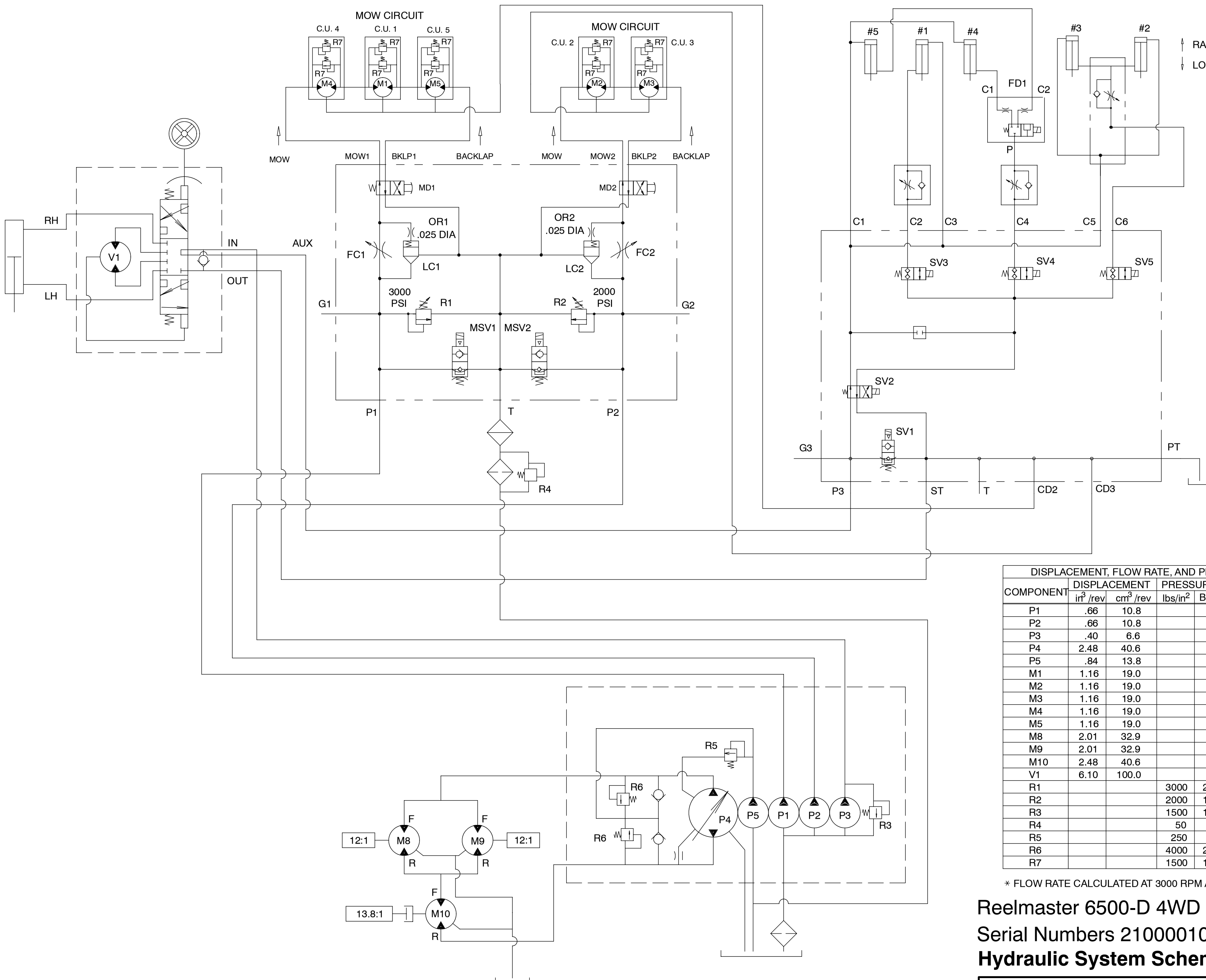


DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
	DISPLACEMENT		PRESSURE		*FLOW RATE	
COMPONENT	in^3/rev	cm^3 /rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
V1	6.1	100				
SV1			3000	207		
SV2			2000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 2WD (Model 03806)
Serial Numbers Above 280000000
Hydraulic System Schematic

All solenoids are shown as de-energized.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		FLOW RATE*	
	in^3 /rev	cm^3 /rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.10	100.0				
R1			3000	207.0		
R2			2000	138.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

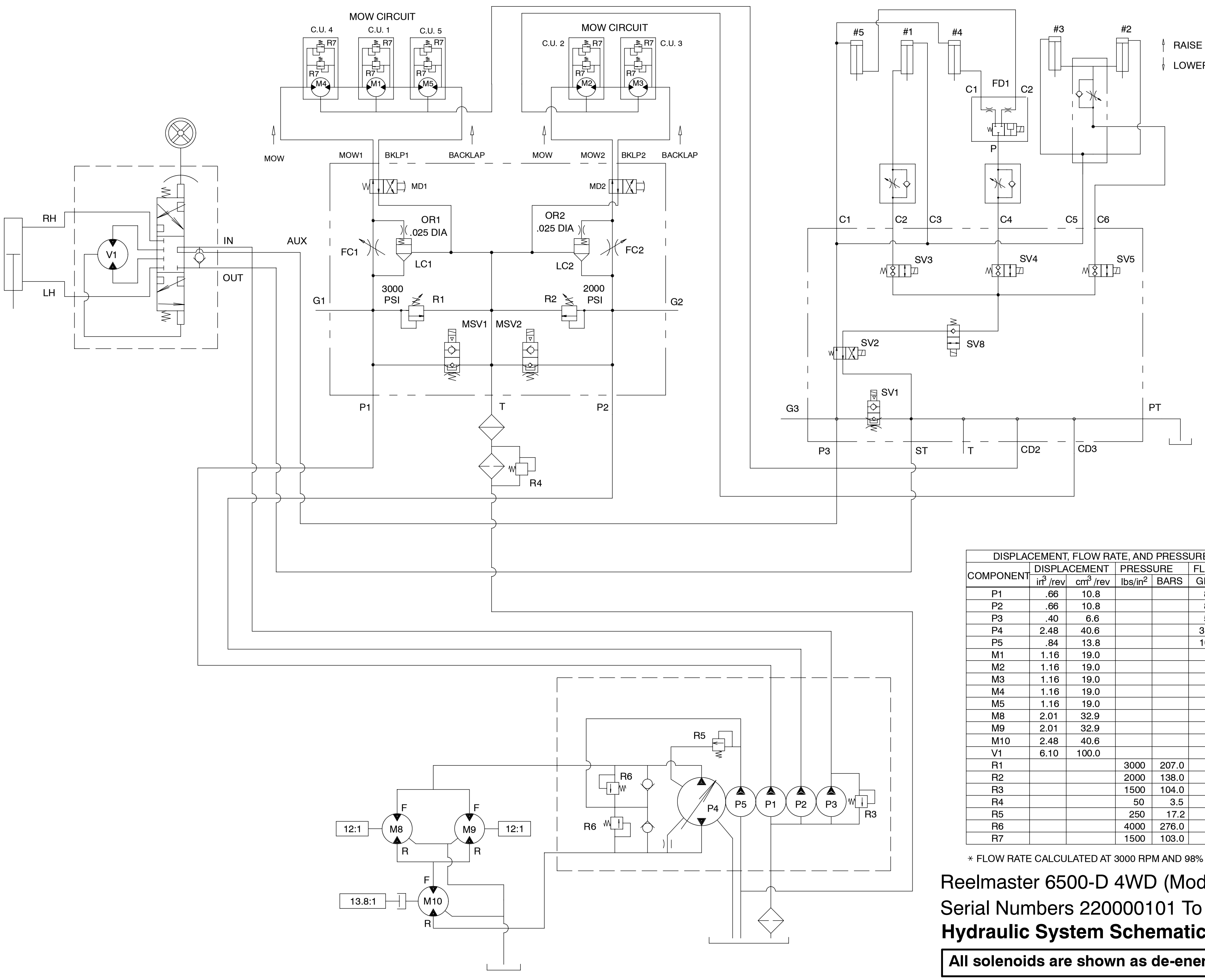
* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 4WD (Model 03807)

Serial Numbers 210000101 To 210999999

Hydraulic System Schematic

All solenoids are shown as de-energized.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		FLOW RATE*	
	in^3 /rev	cm^3 /rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.10	100.0				
R1			3000	207.0		
R2			2000	138.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

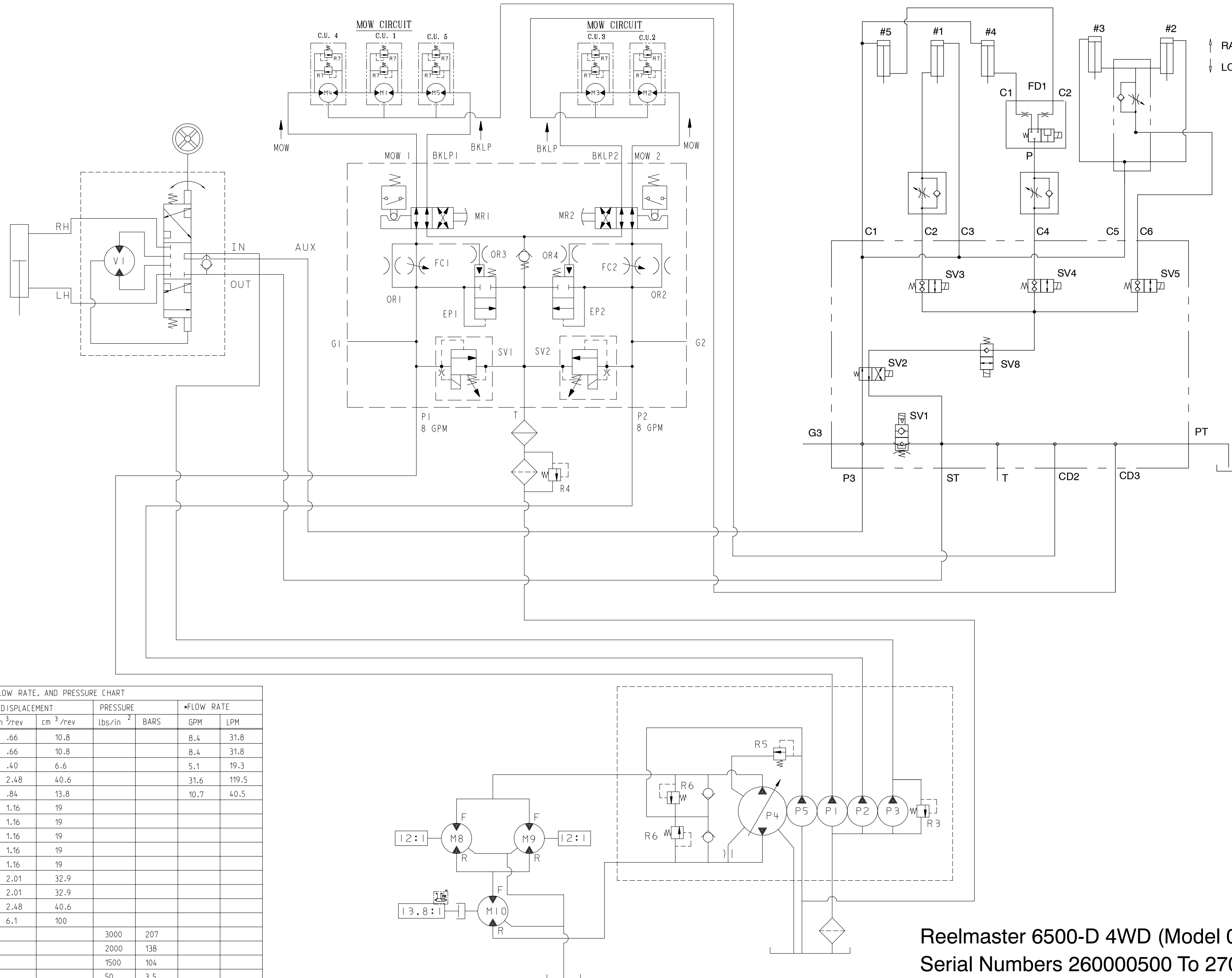
* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6500-D 4WD (Model 03807)

Serial Numbers 220000101 To 260000499

Hydraulic System Schematic

All solenoids are shown as de-energized.



Reelmaster 6500-D 4WD (Model 03807)
Serial Numbers 260000500 To 270999999

Hydraulic System Schematic

All solenoids are shown as de-energized.

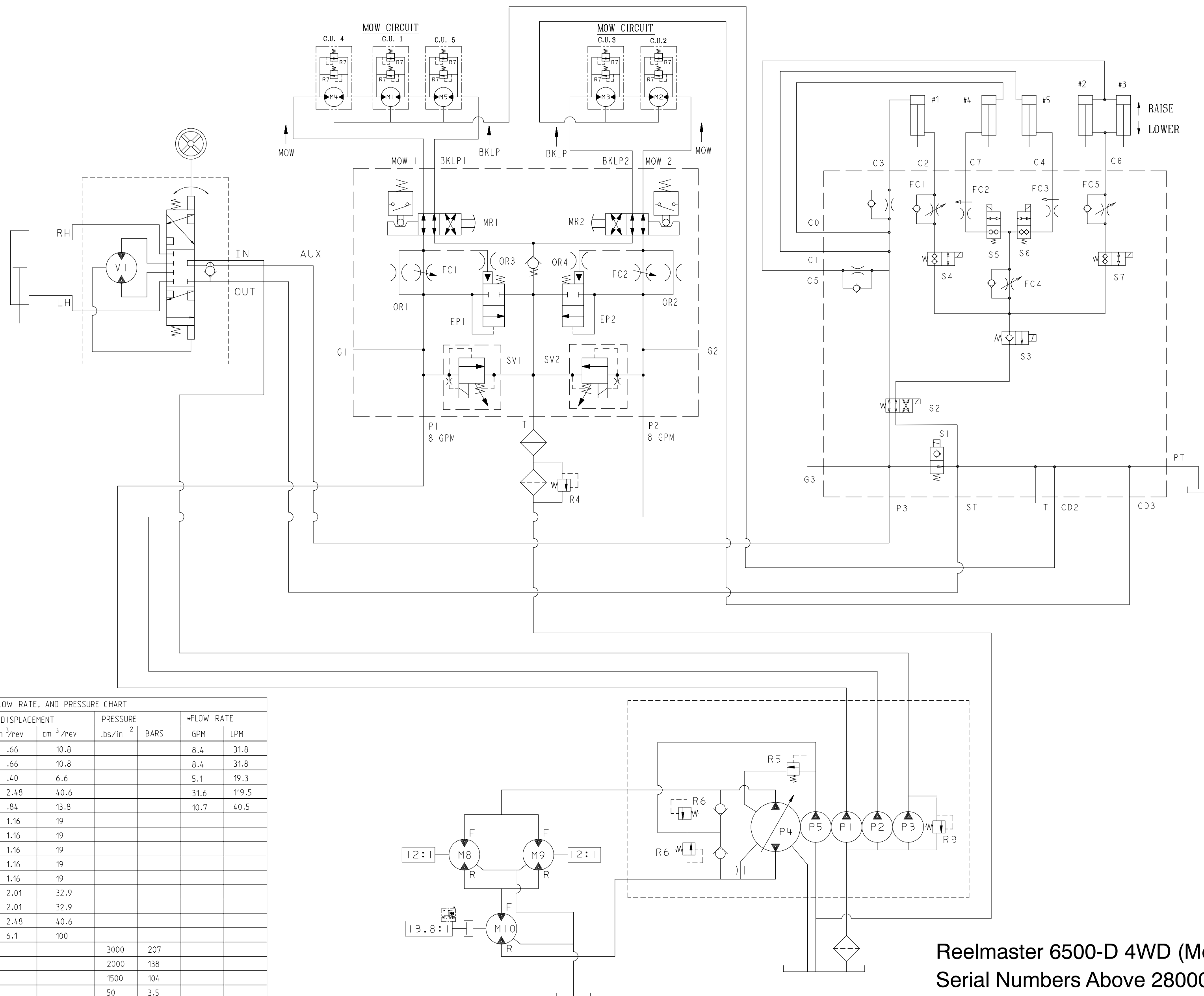
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT		PRESSURE		*FLOW RATE	
	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.1	100				
SV1			3000	207		
SV2			2000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

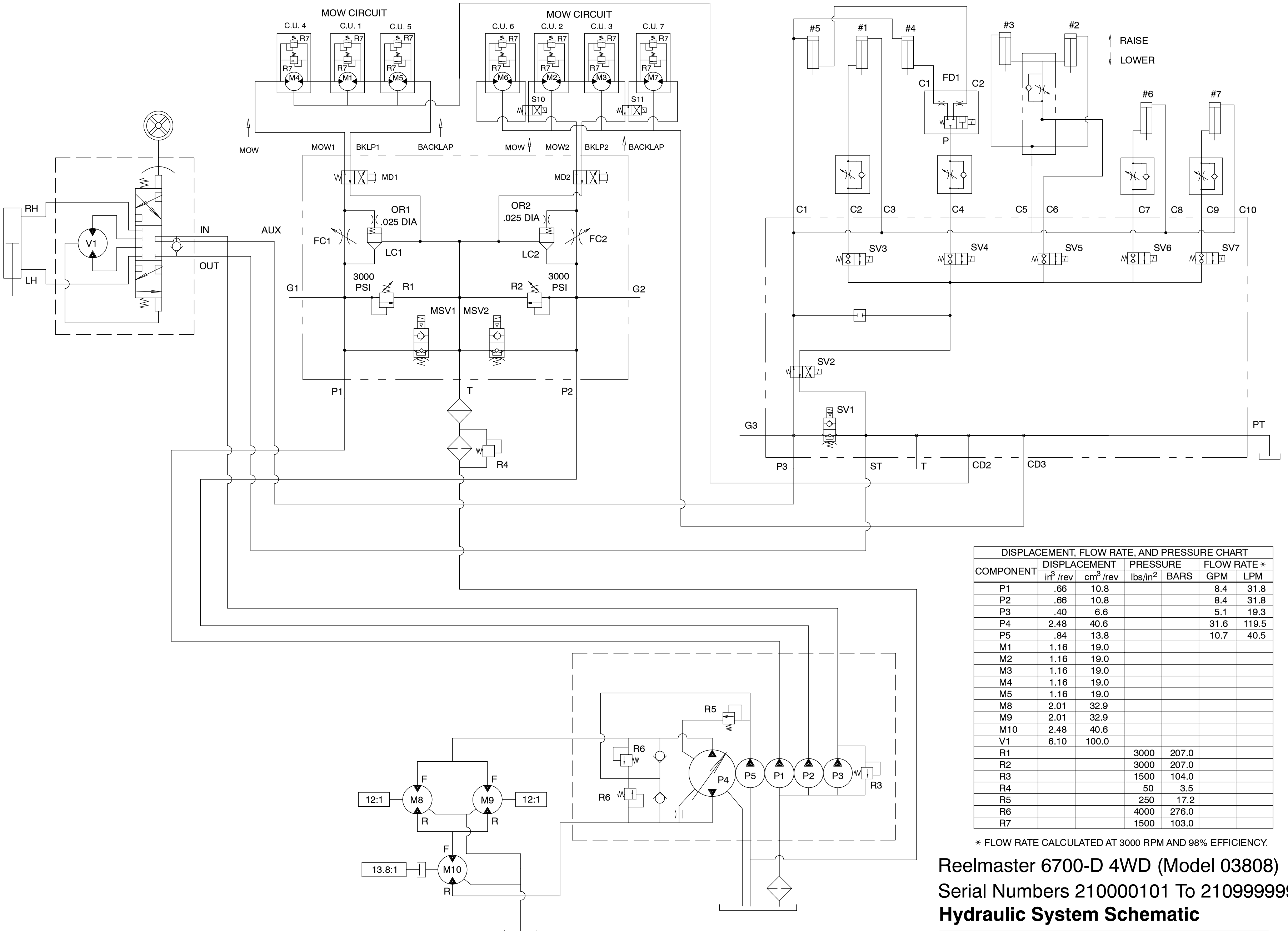
Reelmaster 6500-D 4WD (Model 03807)
Serial Numbers Above 280000000
Hydraulic System Schematic

All solenoids are shown as de-energized.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		•FLOW RATE	
	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.1	100				
SV1			3000	207		
SV2			2000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

• FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		FLOW RATE ∗	
	in^3 /rev	cm^3 /rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.10	100.0				
R1			3000	207.0		
R2			3000	207.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

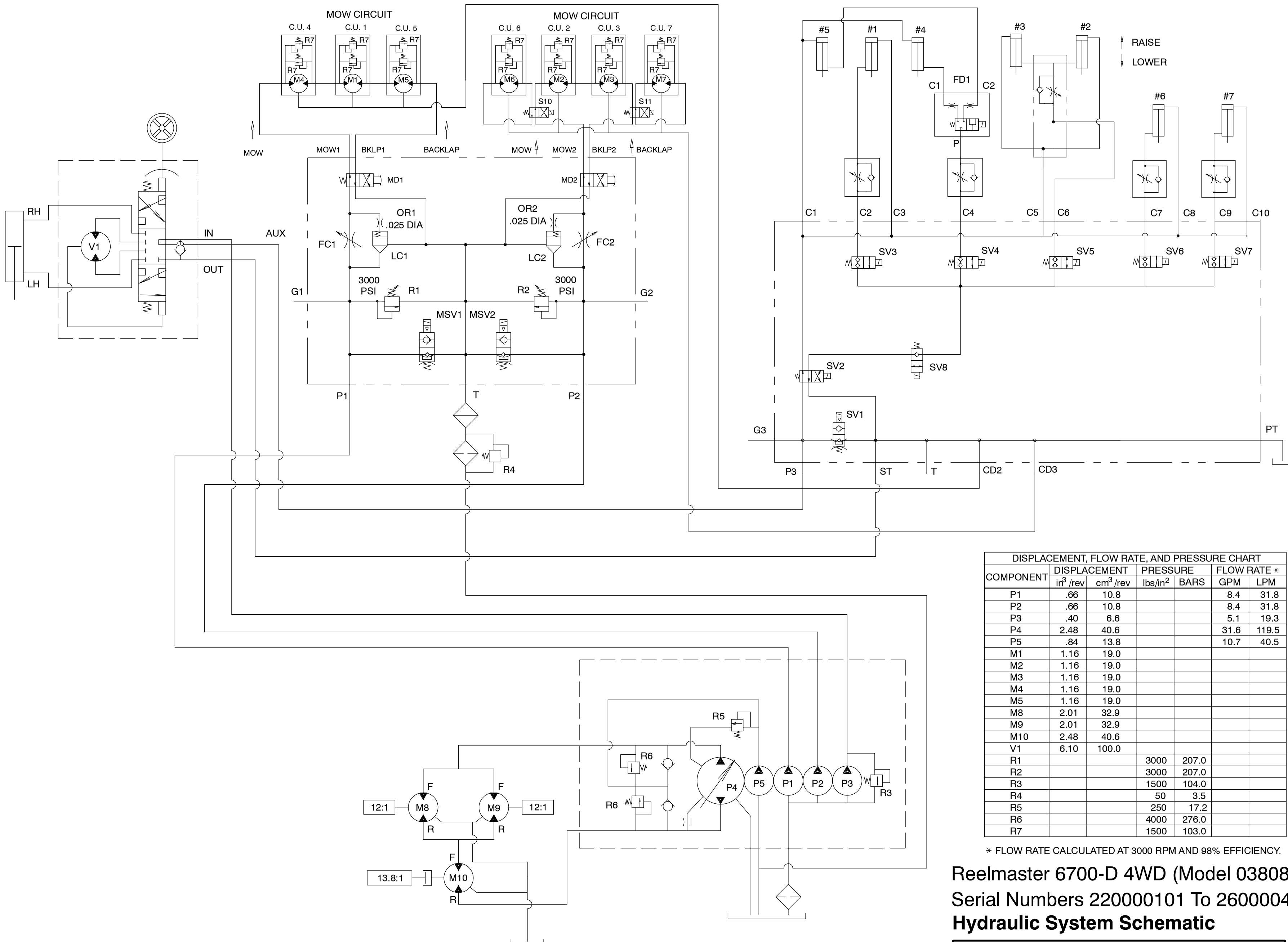
∗ FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6700-D 4WD (Model 03808)

Serial Numbers 210000101 To 210999999

Hydraulic System Schematic

All solenoids are shown as de-energized.



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
COMPONENT	DISPLACEMENT		PRESSURE		FLOW RATE *	
	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19.0				
M2	1.16	19.0				
M3	1.16	19.0				
M4	1.16	19.0				
M5	1.16	19.0				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.10	100.0				
R1			3000	207.0		
R2			3000	207.0		
R3			1500	104.0		
R4			50	3.5		
R5			250	17.2		
R6			4000	276.0		
R7			1500	103.0		

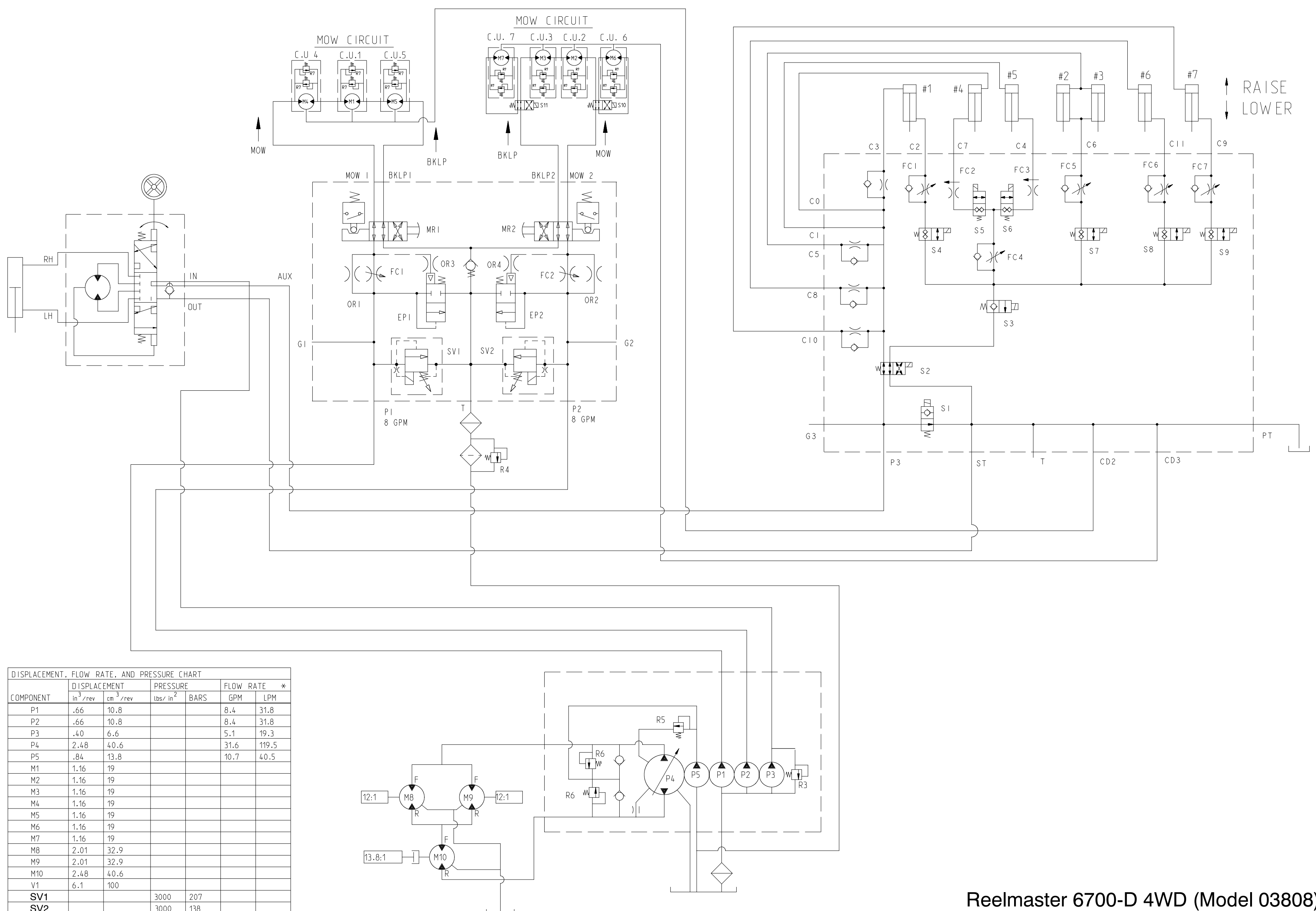
* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6700-D 4WD (Model 03808)

Serial Numbers 220000101 To 260000499

Hydraulic System Schematic

All solenoids are shown as de-energized.

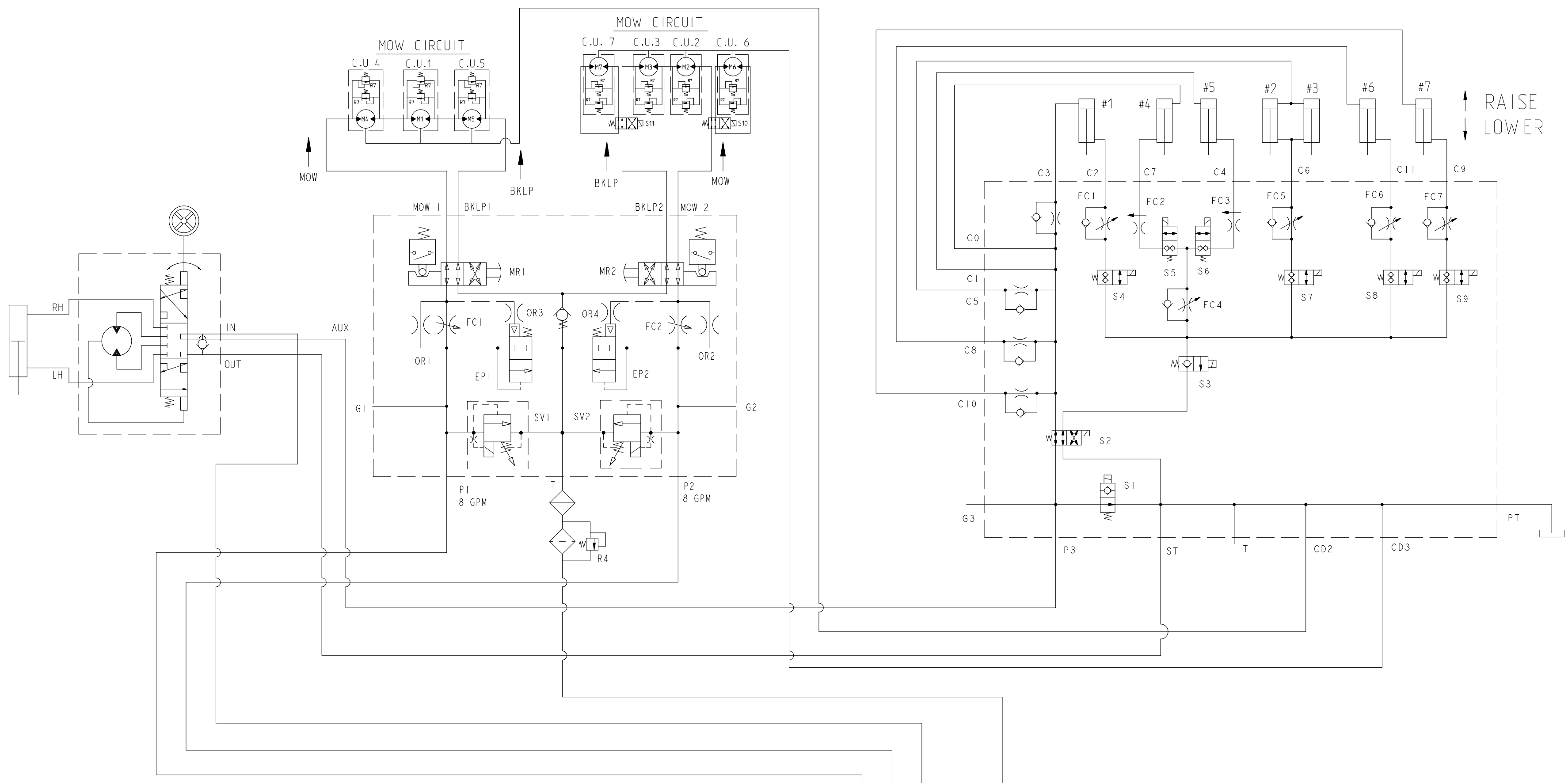


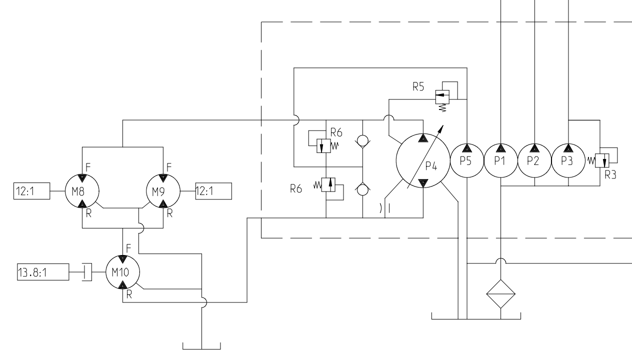
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
	DISPLACEMENT		PRESSURE		FLOW RATE *	
COMPONENT	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M6	1.16	19				
M7	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.1	100				
SV1			3000	207		
SV2			3000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6700-D 4WD (Model 03808)
Serial Numbers 260000500 To 270999999
Hydraulic System Schematic

All solenoids are shown as de-energized.





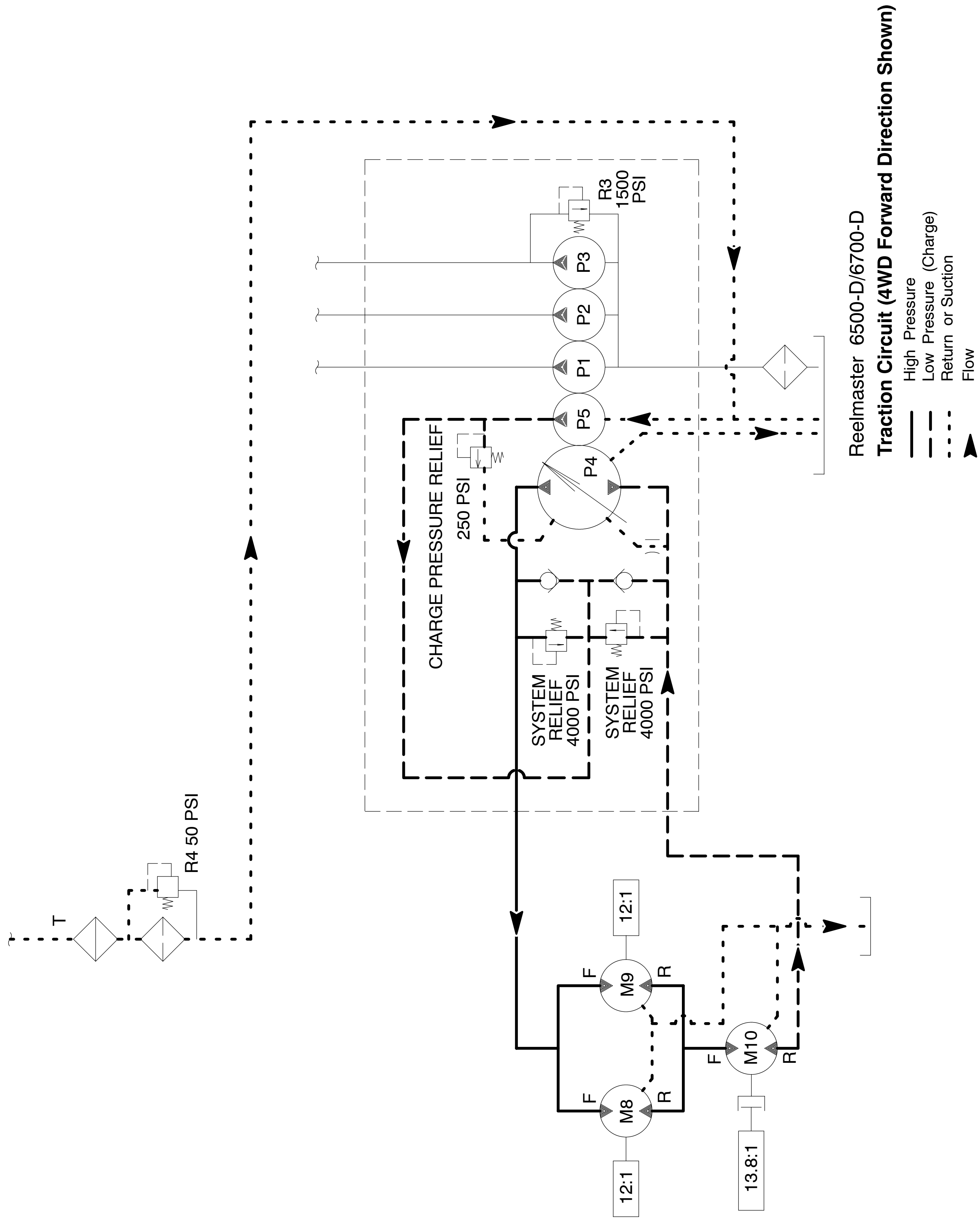
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART						
	DISPLACEMENT		PRESSURE		FLOW RATE *	
COMPONENT	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
P1	.66	10.8			8.4	31.8
P2	.66	10.8			8.4	31.8
P3	.40	6.6			5.1	19.3
P4	2.48	40.6			31.6	119.5
P5	.84	13.8			10.7	40.5
M1	1.16	19				
M2	1.16	19				
M3	1.16	19				
M4	1.16	19				
M5	1.16	19				
M6	1.16	19				
M7	1.16	19				
M8	2.01	32.9				
M9	2.01	32.9				
M10	2.48	40.6				
V1	6.1	100				
SV1			3000	207		
SV2			3000	138		
R3			1500	104		
R4			50	3.5		
R5			250	17.2		
R6			4000	276		
R7			1500	103		

* FLOW RATE CALCULATED AT 3000 RPM AND 98% EFFICIENCY.

Reelmaster 6700-D 4WD (Model 03808)
Serial Numbers Above 280000000
Hydraulic System Schematic

All solenoids are shown as de-energized.

Hydraulic Flow Diagrams



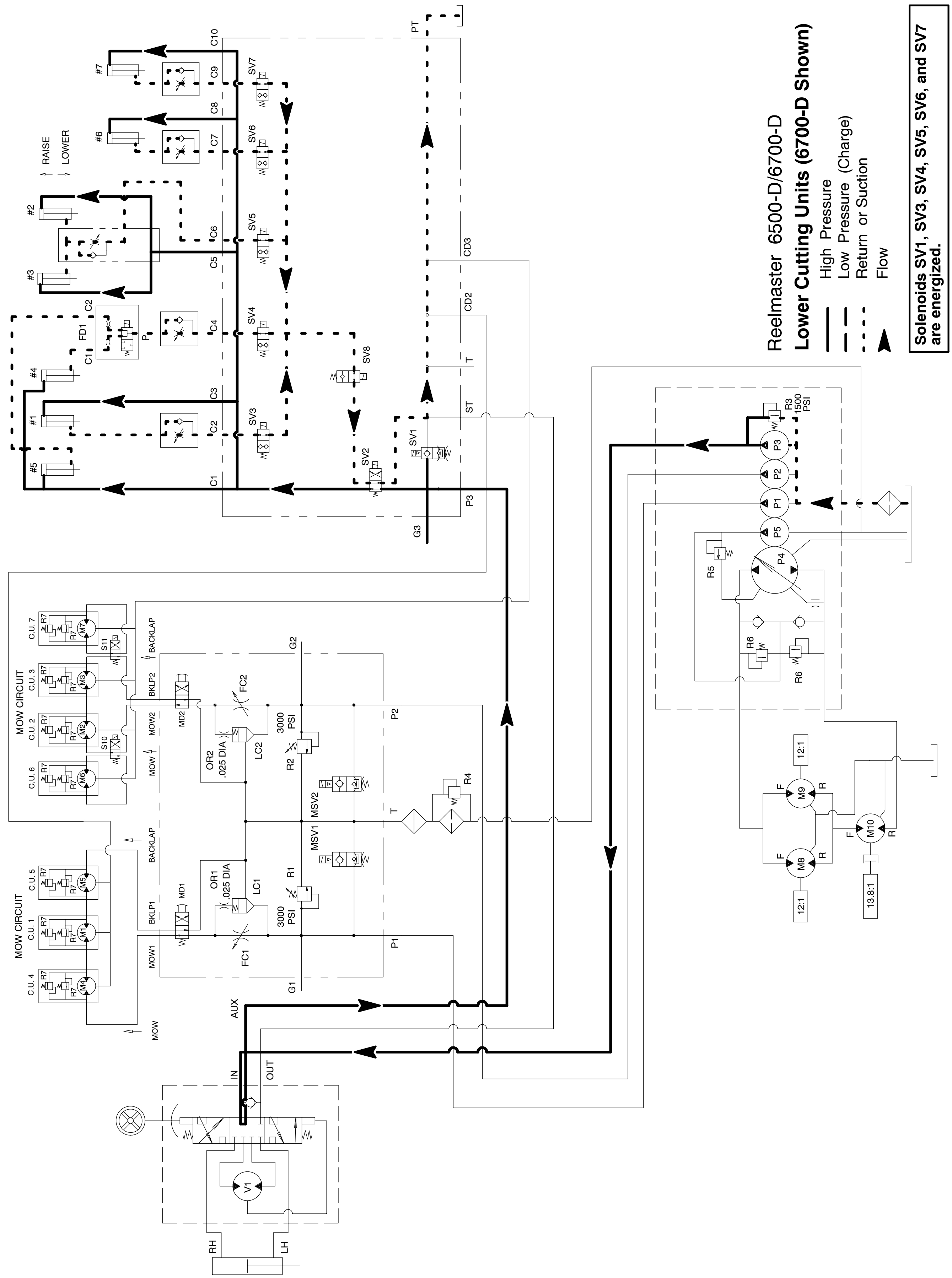
Traction Circuit

The hydraulic pump assembly is driven by a coupling attached to the engine flywheel. The pump assembly consists of a three section gear pump, a gerotor charge pump, and a variable displacement piston pump.

Pushing the top of 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 two fixed displacement motors. Each motor powers a planetary drive assembly located behind each of the front wheels. On 4WD units the hydraulic oil continues on to a fixed displacement motor and gearbox assembly attached to the rear axle.

Operating pressure on the high pressure side of the closed drive circuit is determined by the amount of load developed at the fixed displacement motors. As the load increases, pressure can increase to a maximum of 4000 PSI (276.0 bar). Main system pressure is limited by a high pressure relief valve on each side of the closed drive circuit. If pressure exceeds the relief setting, oil flows through the relief valve to the low pressure side of the closed drive circuit.

A gerotor charge pump provides a constant supply of oil to the variable displacement pump and closed drive circuit for lubrication and to make up for oil that is lost due to internal leakage in the pump and motors. Charge pressure is limited to 250 PSI (17.2 bar) by a relief valve (R5).


Reelmaster 6500-D/6700-D
Lower Cutting Units (6700-D Shown)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
Solenoids SV1, SV3, SV4, SV5, SV6, and SV7 are energized.

Lower Cutting Units

The hydraulic pump assembly is driven by a coupling attached to the engine flywheel. The pump assembly consists of a three section gear pump, a gerotor charge pump, and a variable displacement piston pump.

Gear pump section (P3) provides oil flow through the steering control valve and lift manifold to all cutting unit lift cylinders. Maximum circuit pressure (1500 PSI/104.0 bar) is limited by a relief valve in the gear pump (R3).

When the cutting units are in the raised position, flow from the gear pump (P3) passes through the steering control valve and into the lift manifold. All lift manifold solenoid valves are de-energized and flow is directed to the hydraulic reservoir. An electrically activated flow divider (FD1) is also de-energized, preventing flow between the #4 and 5 lift cylinders.

To lower the cutting units, solenoid valves (SV3), (SV4), (SV5), (SV6), (SV7), and (SV8) energize along with solenoid valve (SV1) and flow divider (FD1). Solenoid valve (SV2) is in its normally de-energized position, and directs oil flow to the piston end of the lift cylinders. Hydraulic pressure against the piston side of the cylinder causes the shafts to extend, and lower the cutting units. When the solenoids and the flow divider are de-energized, the lift cylinders are held in the lowered position.

Pressure to the lift manifold can be monitored at port (G3).

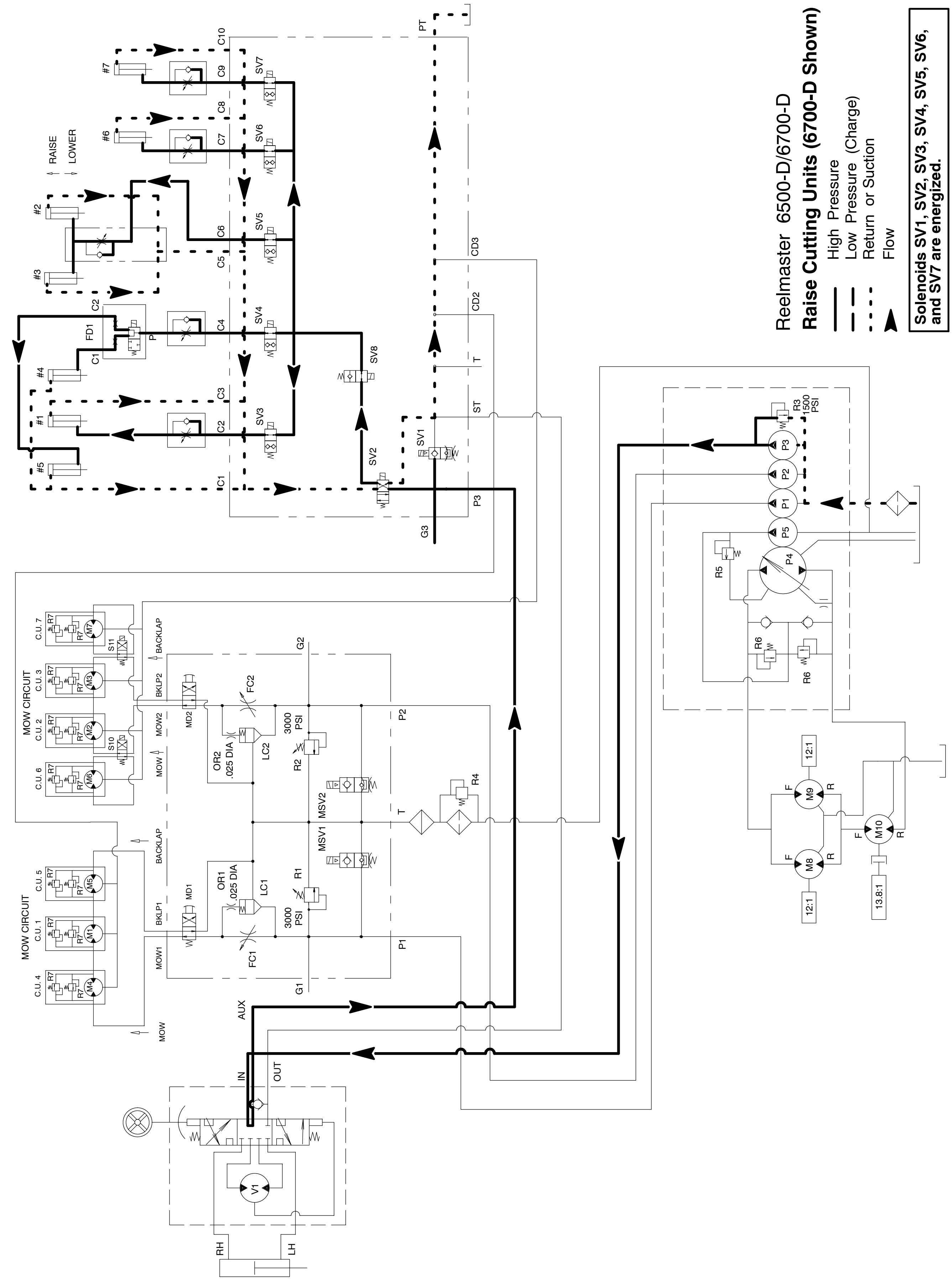
The lowering speed of the cutting units are regulated by several flow control valves. Location of these control valves depend on the machine as follows:

1. On RM-6500-D machines with serial number below 280000000, two adjustable flow control valves regulate lift cylinders #1, 4, and 5. These control valves are located on the main lift manifold (one flow control regulates lift cylinders #4 and 5). The adjustable flow control valve that regulates lift cylinders #2 and 3 is located in the rear of the traction unit.

2. On RM-6500-D machines with serial number above 280000000, three adjustable flow control valves in the lift control manifold regulate the lift cylinders. One control valve regulates cylinder #1, a second controls cylinders #2 and 3 and the third controls cylinders #4 and 5.

3. On RM-6700-D machines with serial number below 280000000, four adjustable flow control valves regulate lift cylinders #1, 4, 5, 6, and 7. These control valves are located on the main lift manifold (one flow control regulates lift cylinders #4 and 5). The adjustable flow control valve that regulates lift cylinders #2 & 3 is located in the rear of the traction unit.

4. On RM-6700-D machines with serial number above 280000000, five adjustable flow control valves in the lift control manifold regulate the lift cylinders. One control valve regulates cylinder #1, the second controls cylinders #2 and 3, the third controls cylinders #4 and 5, the fourth controls cylinder #6 and the fifth controls cylinder #7.


Reelmaster 6500-D/6700-D
Raise Cutting Units (6700-D Shown)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
Solenoids SV1, SV2, SV3, SV4, SV5, SV6, and SV7 are energized.

Raise Cutting Units

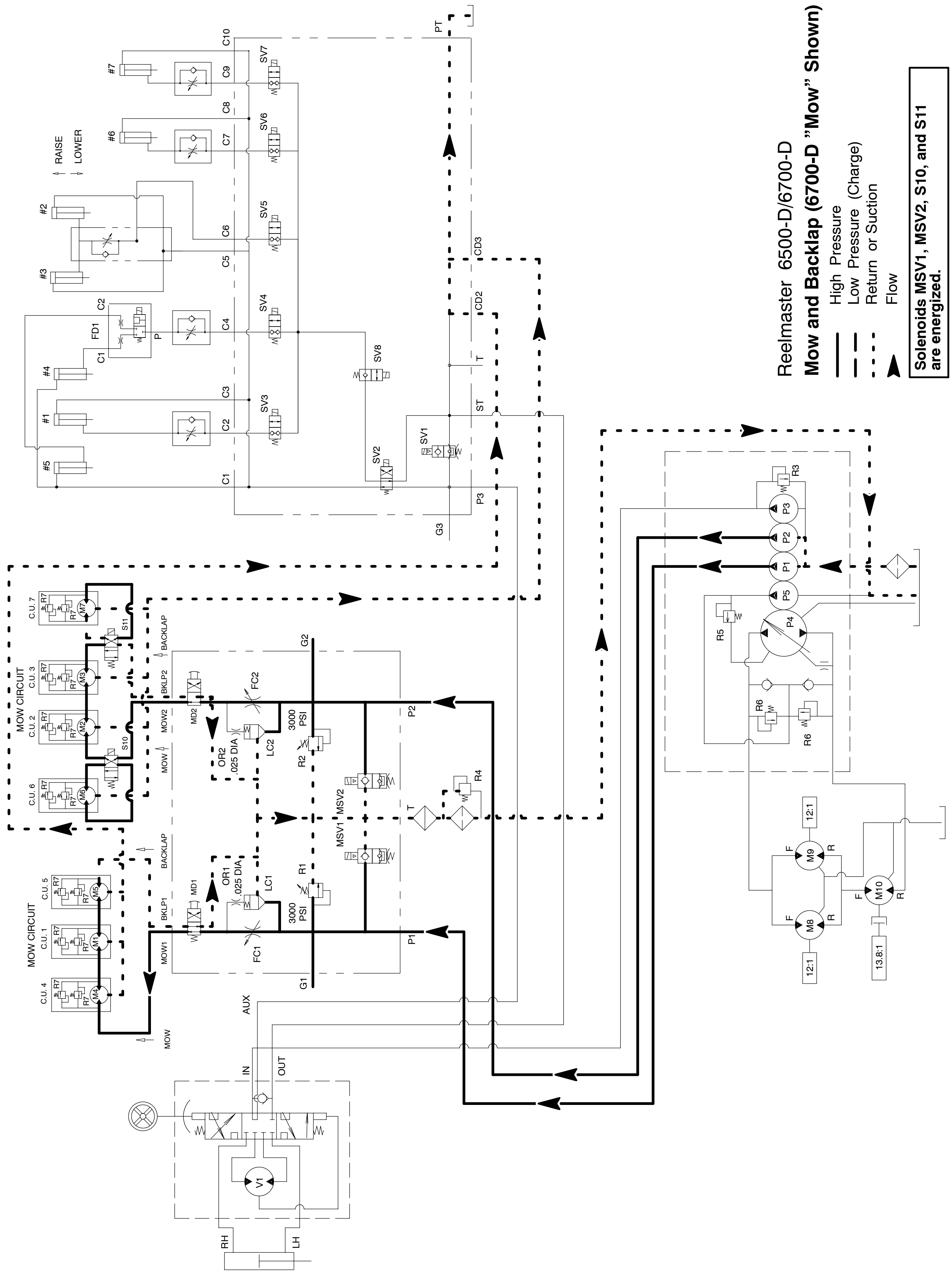
The hydraulic pump assembly is driven by a coupling attached to the engine flywheel. The pump assembly consists of a three section gear pump, a gerotor charge pump, and a variable displacement piston pump.

Gear pump section (P3) provides oil flow through the steering control valve and lift manifold to all five cutting unit lift cylinders. Maximum circuit pressure (1500 PSI/104.0 bar) is limited by a relief valve in the gear pump (R3).

When the cutting units are in the lowered position, flow from the gear pump (P3) passes through the steering control valve and into the lift manifold. All lift manifold solenoid valves are de-energized and flow is directed to the hydraulic reservoir. An electrically activated flow divider (FD1) is also de-energized, preventing flow between the #4 and 5 lift cylinders.

To raise the cutting units, solenoid valves (SV3), (SV4), (SV5), (SV6), (SV7), and (SV8) energize along with solenoid valve (SV1) and flow divider (FD1). Solenoid valve (SV2) is also energized, and directs oil flow to the rod end of the lift cylinders. Hydraulic pressure against the rod side of the cylinder causes the shafts to retract, and raise the cutting units. When the solenoids and the flow divider are de-energized, the lift cylinders are held in the raised position.

Pressure to the lift manifold can be monitored at port (G3).


Reelmaster 6500-D/6700-D
Mow and Backlap (6700-D "Mow" Shown)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
Solenoids MSV1, MSV2, S10, and S11 are energized.
MOW CIRCUIT
BACKLAP
MOW
RAISE
LOWER
3000 PSI
OR1 .025 DIA
OR2 .025 DIA
AUX
IN
OUT
RH
LH
12:1
13.8:1

Mow and Backlap

Mow

The reel manifold contains two independent control circuits for the front and rear cutting units. Each circuit is supplied by its own gear pump section. Gear pump section (P1) supplies hydraulic power to the front cutting units, while section (P2) supplies the the rear units. Both circuits share manifold port (T), which drains to the oil cooler, oil filter, and on to the hydraulic reservoir.

On the circuit supplied by pump section (P1), maximum system pressure is limited by relief valve (R1), which is set at 3000 PSI (207.0 bar). Solenoid valve (MSV1) must be energized to prevent hydraulic flow from by-passing the front reel circuit. When solenoid valve (MSV1) is energized, oil flow from port (P1) flows through reel speed control valve (FC1). Flow through the speed control valve is pressure compensated by logic cartridge valve (LC1). The logic cartridge valve maintains a pressure of 75 PSI (5.2 bar) across the speed control valve. Any excess flow is returned to the hydraulic reservoir. Regulated flow continues through valve (MD1) and out to the front reel motors. When valve (MD1) is in the **“Mow”** position, the front reels rotate correctly for mowing. Return oil from the motors is also directed to the reservoir through valve (MD1).

System pressure on the (P1) side can be measured at Port (G1).

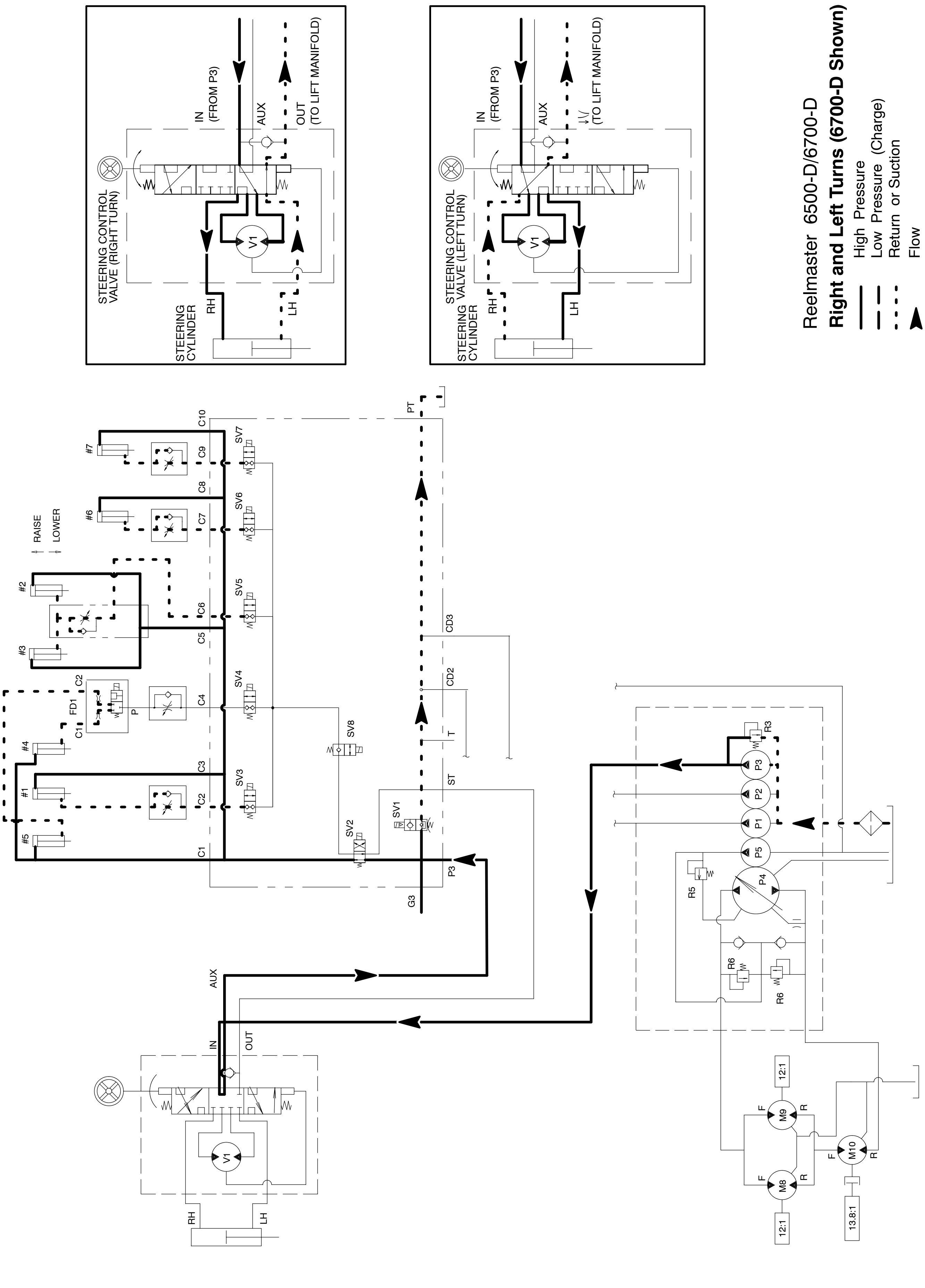
On the circuit supplied by pump section (P2), maximum system pressure is limited by relief valve (R2), which is set at 2000 PSI (138.0 bar) on Reelmaster 6500-D and 3000 PSI (207.0 bar) on Reelmaster 6700-D. Solenoid valve (MSV2) must be energized to prevent hydraulic flow from by-passing the rear reel circuit. When solenoid valve (MSV2) is energized, oil flow from port (P2) flows through reel speed control valve (FC2). Flow through the speed control valve is pressure compensated by logic cartridge valve (LC2). The logic cartridge valve maintains a pressure of 75 PSI (5.2 bar) across the speed control valve. Any excess flow is returned to the hydraulic reservoir. Regulated flow continues through valve (MD2) and out to the rear reel motors. On Reelmaster 6700-D, two solenoid valves (S10) and (S11) direct oil flow to cutting units #6 and #7. When valve (MD2) is in the **“Mow”** position, the rear reels rotate correctly for mowing. Return oil from the motors is also directed to the reservoir through valve (MD2).

System pressure on the (P2) side can be measured at Port (G2).

Backlap

During the backlap mode of operation, the reel circuits operate the same as in the **”Mow”** mode. When either valve (MD1) or (MD2) is set to the **“Backlap”** position, the valve reverses the direction of hydraulic flow through the reel motors, and the reels rotate correctly for backlapping.

Hydraulic System



Reelmaster 6500-D/6700-D

Right and Left Turns (6700-D Shown)

High Pressure
Low Pressure (Charge)
Return or Suction
Flow

Right and Left Turns

In addition to supplying hydraulic flow to the cutting unit lift circuits, gear pump section (P3) supplies hydraulic flow to the steering control valve for turning the rear wheels.

With the the engine running and the steering wheel in the neutral position (rear wheels positioned straight ahead), the spool of the steering control valve is in the center position. Hydraulic flow enters the steering control valve at the IN port, by-passes the rotary meter (V1) and steering cylinder, and exits through the control valve through the AUX port. The flow continues on to the lift manifold (see Raise Cutting Units and Lower Cutting Units in this chapter) and returns to the hydraulic reservoir.

Left Turn

With the engine running, and the steering wheel turned to the left, the flow travels through the top of the steering control spool. Flow enters the steering control valve at the IN port and is divided into two paths. Most of the flow through the valve is directed out the AUX port back to the lift manifold, and on to the hydraulic reservoir. The remainder of the flow is sent through the rotary meter (V1) and out the (LH) port to the rod end of the steering cylinder. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of steering wheel rotation. The steering cylinder retracts, which results in a turn to the operator's left when the vehicle is moving forward. Fluid leaving the steering cylinder flows back through the steering control valve, exits through the OUT port, travels to the lift manifold, and returns to the hydraulic reservoir.

Right Turn

With the engine running, and the steering wheel turned to the right, the flow travels through the bottom of the steering control spool. Flow enters the steering control valve at the IN port and is divided into two paths. Most of the flow through the valve is directed out the AUX port back to the lift manifold, and on to the hydraulic reservoir. The remainder of the flow is sent through the rotary meter (V1) and out the (RH) port to the piston end of the steering cylinder. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of steering wheel rotation. The steering cylinder extends, which results in a turn to the operator's right when the vehicle is moving forward. Fluid leaving the steering cylinder flows back through the steering control valve, exits through the OUT port, travels to the lift manifold, and returns to the hydraulic reservoir.

Special Tools

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

Hydraulic Pressure Test Kit - TOR47009

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

Figure 9

Hydraulic Test Fitting Kit - TOR4079

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.

Figure 10

Measuring Container - TOR4077

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.

Figure 11

Hydraulic Tester - With Pressure and Flow Capabilities - TOR214678

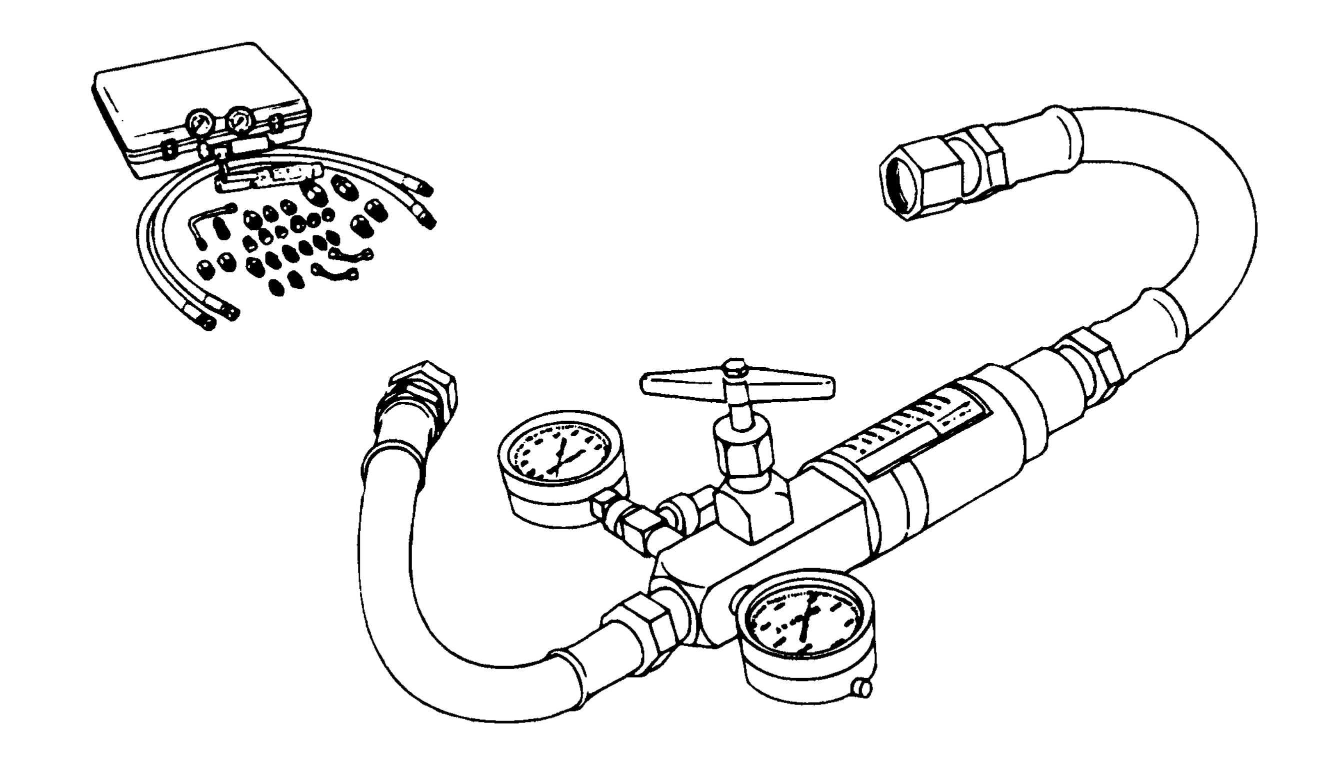


Figure 12

You must have o-ring face seal (ORFS) adapter fittings for this tester to use it on the Reelmaster 6500-D and 6700-D.

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

2. LOAD VALVE: If required, upon turning the valve to restrict flow, a simulated working load is created in the circuit.

3. LOW PRESSURE GAUGE: Low range gauge to provide accurate reading at low pressure, 0 - 1000 PSI.

This gauge has a protector valve which cuts out when pressure is about to exceed the normal range for the gauge. The cutout pressure is adjustable.

4. HIGH PRESSURE GAUGE: High range gauge to accommodate pressure beyond the capacity of the low pressure gauge, 0 - 5,000 PSI.

5. FLOW METER: This meter measures actual oil flow in the operation circuit, with a gauge rated at 15 GPM.

6. OUTLET HOSE: Hose from the outlet side of the hydraulic tester to be connected to the hydraulic system circuit.

Troubleshooting

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

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

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

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

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

General Troubleshooting

Cause	Correction
Hydraulic oil leak(s).	Fitting(s), hose or tube loose or damaged. Missing or damaged O-ring.

Difficult to Find Neutral

Cause	Correction
External control linkage misadjusted, disconnected, binding or damaged.	Adjust or repair linkage.
Servo control valve faulty.	Inspect control valve for: Plugged control orifices. Damaged mounting gasket. Misadjusted or damaged neutral return spring. Broken control connector pin. Galled or stuck control spool. Neutral switch misadjusted. Repair or replace control valve if necessary.
Pump worn or damaged.	Repair or replace pump.

Traction Pedal is Sluggish

Cause	Correction
Charge pressure low.	TEST NO. 1. Inspect charge relief valve R5. Repair or replace if defective.
Servo control valve faulty.	Inspect control valve for: Missing center orifice. Plugged control orifices. Galled or stuck control spool. Repair or replace control valve if necessary.

Transmission or Hydraulic System is Operating Hot

Cause	Correction
Oil in reservoir is below level.	Fill reservoir to proper level.
Contaminated oil.	Drain reservoir and refill with clean oil.
Oil in system too light.	Drain reservoir and refill with proper viscosity oil.
Heat exchanger defective.	Check oil cooler for obstructed air flow. Replace damaged or plugged oil cooler.
Charge pressure low.	TEST NO. 1. Inspect charge relief valve R5. Repair or replace if defective.
Transmission pressure high.	Reduce transmission load. Check to make sure brakes are not engaged.
Towing by-pass is open or defective.	Close towing by-pass valve. Repair or replace if necessary.
Wheel motor(s) worn or damaged. NOTE: If a motor has internal damage, it is likely that the pump and other motor are also damaged.	Inspect wheel motors and repair or replace if worn or damaged.
Pump worn or damaged.	Inspect pump and repair or replace if worn or damaged.

Hydraulic System

Transmission Operates in One Direction Only

Cause	Correction
External control linkage misadjusted, disconnected, binding or damaged.	Adjust or repair.
Servo control valve faulty.	Inspect control valve for: Plugged control orifices. Damaged mounting gasket. Misadjusted or damaged neutral return spring. Broken control connector pin. Galled or stuck control spool. Neutral switch misadjusted. Repair or replace control valve if necessary.
Transmission relief valve faulty.	TEST NO. 2. Inspect relief valves R6 and replace if necessary. NOTE: Relief valves can be exchanged in forward and reverse pump circuits for testing.
Pump worn or damaged.	Replace pump.

Transmission Response Sluggish

Cause	Correction
Charge pressure low.	TEST NO. 1. Inspect charge relief valve R5. Repair or replace if defective.
Servo control valve faulty.	Inspect control valve for: Plugged control orifices. Damaged mounting gasket. Misadjusted or damaged neutral return spring. Broken control connector pin. Galled or stuck control spool. Neutral switch misadjusted. Repair or replace control valve if necessary.
Towing by-pass valve open.	Close valve.
Wheel motor(s) worn or damaged. NOTE: If a motor has internal damage, it is likely that the pump and other motor are also damaged.	Inspect wheel motors and repair or replace if worn or damaged.
Pump worn or damaged.	Inspect pump and repair or replace if worn or damaged.

Transmission Will Not Operate in Either Direction

Cause	Correction
Oil level in reservoir is low.	Fill reservoir to proper level.
External control linkage misadjusted, disconnected, binding or damaged.	Adjust or repair linkage.
Towing by-pass valve open.	Close valve.
Charge pressure low.	TEST NO. 1. Inspect charge relief valve R5. Repair or replace if defective.
Servo control valve faulty.	Inspect control valve for: Plugged control orifices. Damaged mounting gasket. Misadjusted or damaged neutral return spring. Broken control connector pin. Galled or stuck control spool. Neutral switch misadjusted. Repair or replace control valve if necessary.

Transmission Will Not Operate in Either Direction (Continued)

Cause	Correction
Wheel motor(s) worn or damaged. NOTE: If a motor has internal damage, it is likely that the pump and other motor are also damaged.	Inspect wheel motors and repair or replace if worn or damaged.
Pump worn or damaged.	Inspect pump and repair or replace if worn or damaged.

Wheel Motor Turns While Unloaded, But Slows Down or Stops When Load Applied

Cause	Correction
Scored valve plate on wheel motor.	Remove backplate and inspect bronze surface of valve plate. Replace valve plate if scored.
Scored or worn piston shoes on wheel motor.	Disassemble motor and inspect condition of shoes on pistons. Replace rotating kit assembly as a complete set. DO NOT lap pistons.

Wheel Will Not Turn

Cause	Correction
Severely scored internal parts in wheel motor.	Disassemble motor completely. Inspect and clean all parts. Replace all worn parts or replace complete motor if necessary. Flush hydraulic system.
Brakes binding.	See Chapter 6 - Axles, Planetaries, and Brakes.
Splined coupler between wheel motor shaft and planetary wheel drive damaged or broken.	See Chapter 6 - Axles, Planetaries, and Brakes.
Planetary wheel drive damaged.	See Chapter 6 - Axles, Planetaries, and Brakes.

Wheel Motor Will Not Hold Load When System is in Neutral

Cause	Correction
No make up fluid from charge pump.	TEST NO. 1. Inspect charge relief valve R5. Repair or replace if defective.
Scored valve plate or piston shoes on wheel motor.	Disassemble motor and inspect valve plate and piston shoes. Replace as required.

Excessive Wheel Motor Case Drain Flow

Cause	Correction
Excessive internal wear in wheel motor.	Disassemble motor completely. Inspect parts and replace as necessary. Case drain flow should not exceed 2 gal/m (7.6 L/m) at full pressure.

Noisy Gear Pump Caused by Cavitation

Cause	Correction
Oil too heavy.	Change to proper viscosity oil.
Suction line restricted.	Check for bent or collapsed suction line. Check suction screen in reservoir for blockage - drain and clean reservoir if necessary.
Air leak in suction line.	Tighten fittings or repair suction plumbing.

Foaming Oil

Cause	Correction
Low oil level.	Fill reservoir.
Air leak in suction line.	Tighten fittings or repair suction plumbing.
Wrong kind of oil.	Drain and flush system. Fill with correct oil.

Front (Rear) Reels Will Not Turn

Cause	Correction
Solenoid Valve MSV1 (MSV2) not shifting.	Do electrical diagnostics to make sure that voltage is being applied to MSV1 (MSV2) and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve MSV1 (MSV2). Interchange MSV1 and MSV2 and check operation. Replace faulty valve.

Front (Rear) Reels Will Not Turn (Continued)

Cause	Correction
Relief valve R1 (R2) by-passing oil.	TEST NO. 3. Adjust relief valve R1 (R2) if necessary. Do cartridge valve service procedure for valve R1 (R2). Replace faulty valve.
Solenoid Valve SV10 and/or SV11 not shifting. (Reelmaster 6700-D #6 & #7 cutting units only)	Do electrical diagnostics to make sure that voltage is being applied to SV10 and/or SV11 and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve SV10 and/or SV11. Interchange SV10 and SV11 and check operation. Replace faulty valve.
Gear pump section P1 (P2) damaged.	TEST NO. 5. Repair or replace pump.

Front (Rear) Reels Do Not Turn or Turn Too Slow

Cause	Correction
Reel Speed Valve FC1 (FC2) improperly adjusted.	Make sure FC1 (FC2) is set to desired reel speed. Do cartridge valve service procedure for valve FC1 (FC2). Interchange FC1 and FC2 and check operation. Replace faulty valve.
Mow/Backlap Valve MD1 (MD2) partially rotated.	Make sure MD1 (MD2) is fully seated in either the “Mow” or “Backlap “ position. Do cartridge valve service procedure for valve MD1 (MD2). Interchange MD1 and MD2 and check operation. Replace faulty valve.
Relief valve R1 (R2) by-passing oil.	TEST NO. 3. Adjust relief valve R1 (R2) if necessary. Do cartridge valve service procedure for valve R1 (R2). Replace faulty valve.

Front (Rear) Reels Do Not Turn or Turn Too Slow (Continued)

Cause	Correction
Gear pump section P1 (P2) inefficient.	TEST NO. 5. Repair or replace pump.
Reel motor internal leakage (by-passing oil) or malfunctioning cross-over relief valve in motor.	TEST NO. 6 & 7. Repair or replace reel motor.

Front (Rear) Reels Turn Too Fast

Cause	Correction
Reel Speed Valve FC1 (FC2) improperly adjusted.	Make sure FC1 (FC2) is is set to desired reel speed. Do cartridge valve service procedure for valve FC1 (FC2). Interchange FC1 and FC2 and check operation. Replace faulty valve.

Front (Rear) Reels Turn in Only One Direction

Cause	Correction
Mow/Backlap Valve MD1 (MD2) not redirecting oil.	Make sure MD1 (MD2) is fully seated in either the “Mow” or “Backlap “ position. Do cartridge valve service procedure for valve MD1 (MD2). Interchange MD1 and MD2 and check operation. Replace faulty valve.

Front Reels Stop or Won’t Start - During Backlap Only

Cause	Correction
Cutting units not lowered completely.	Check cutting unit lift assemblies for proper operation and/or obstructions.
Reel motor load too high.	Decrease load.
Electrical problem.	See Chapter 5 - Electrical System.
Reel motor internal leakage (by-passing oil) or malfunctioning cross-over relief valve in motor.	TEST NO. 6 & 7. Repair or replace reel motor.

Front (Rear) Reels Stop Under Load

Cause	Correction
Relief valve R1 (R2) by-passing oil.	TEST NO. 3. Adjust relief valve R1 (R2) if necessary. Do cartridge valve service procedure for valve R1 (R2). Replace faulty valve.
Gear pump section P1 (P2) inefficient.	TEST NO. 5. Repair or replace pump.
Reel motor internal leakage (by-passing oil) or malfunctioning cross-over relief valve in motor.	TEST NO. 6 & 7. Repair or replace reel motor.

Cutting Units Will Not Raise

Cause	Correction
Solenoid Valve SV1 not shifting.	Do electrical diagnostics to make sure that voltage is being applied to SV1 and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve SV1. Replace faulty valve.
Solenoid Valve SV2 not shifting.	Do electrical diagnostics to make sure that voltage is being applied to SV2 and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve SV2. Replace faulty valve.
Solenoid valve(s) SV3, SV4, or SV5 not shifting. Solenoid valve(s) SV6 or SV7 not shifting. (Reelmaster 6700-D #6 & #7 cutting units only)	Do electrical diagnostics to make sure that voltage is being applied to solenoid for affected circuit and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve in affected circuit. Interchange suspect valve with any of the remaining valves (SV3 thru SV7) and check operation. Replace faulty valve.

Cutting Units Will Not Raise (Continued)

Cause	Correction
Engine high idle RPM too low.	See Chapter 3 - Kubota Diesel Engine. See Kubota Workshop Manual.
Relief valve R3 by-passing oil.	TEST NO. 4. Replace faulty valve.
Lift arm pivots bindings.	Lubricate bushings. Inspect for damage. Repair or replace damaged parts.
Electrical problem.	See Chapter 5 - Electrical System.
Gear pump section P3 inefficient.	TEST NO. 4. Repair or replace pump.
Lift cylinder(s) have internal leakage.	Check lift cylinder(s) and repair or replace if faulty.
Steering valve has internal leakage.	Test steering valve as described in Chapter 6 - Wheels, Brakes and Steering.

Cutting Units Raise, But Will Not Stay Up

NOTE: Lift cylinders and check valves cannot provide an absolutely perfect seal. The lift arms will eventually lower if left in the raised position during storage. It is recommended that the machine be stored with the cutting units in the lowered position. This also prevents accidental lowering of the cutting units if the lift lever (joystick) is bumped while the key switch is on.

Cause	Correction
Solenoid valve(s) SV3, SV4, or SV5 have internal leakage. Solenoid valve(s) SV6 or SV7 have internal leakage. (Reelmaster 6700-D #6 & #7 cutting units only)	Do cartridge valve service procedure for valve in affected circuit. Interchange suspect valve with any of the remaining valves (SV3 thru SV7) and check operation. Replace faulty valve.
Lift cylinder(s) have internal leakage.	Check lift cylinder(s) and repair or replace if faulty.

Cutting Units Lower Too Fast or Too Slow

Cause	Correction
Flow control valve(s) not adjusted properly.	Adjust flow control valve(s) to desired lowering speed.

Cutting Units Will Not Lower

Cause	Correction
Solenoid Valve SV1 not shifting.	Do electrical diagnostics to make sure that voltage is being applied to SV1 and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve SV1. Replace faulty valve.
Solenoid valve(s) SV3, SV4, or SV5 not shifting. Solenoid valve(s) SV6 or SV7 not shifting. (Reelmaster 6700-D #6 & #7 cutting units only)	Do electrical diagnostics to make sure that voltage is being applied to solenoid for affected circuit and that there is no electrical fault. See Chapter 5 - Electrical System. Test solenoid coil. Replace if faulty. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve in affected circuit. Interchange suspect valve with any of the remaining valves (SV3 thru SV7) and check operation. Replace faulty valve.
Solenoid Valve SV2 not returning.	Do electrical diagnostics to make sure that voltage is being removed from SV2 and that there is no electrical fault. See Chapter 5 - Electrical System. Do cartridge valve service procedure for valve SV2. Replace faulty valve.
Relief valve R3 by-passing oil.	TEST NO. 4. Replace faulty valve.
Flow control valve(s) closed.	Adjust flow control valve(s) to desired lowering speed.

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.)

Before Performing Hydraulic Tests

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.

Precautions for Hydraulic Testing

CAUTION

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

CAUTION

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

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.

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. Stop engine; lower or support attachments.

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.

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

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

3. The engine must be in good operating condition. Use a phototac when performing a hydraulic test. Engine speed can affect the accuracy of the tester readings. Check actual speed of the pump when performing flow testing.

4. The inlet and the outlet hoses must be properly connected and not reversed (tester with pressure and flow capabilities) to prevent damage to the hydraulic tester or components.

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

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

7. Position 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 tank 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.

TEST NO. 1: Traction Circuit Charge Pressure

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

2. Make sure machine is parked on a level surface with the cutting units lowered and off. Make sure engine is off.

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 gauge onto charge pressure test port (Fig. 13).

4. Start the engine and put throttle at full engine speed (3200 RPM) with no load on the system.

GAUGE READING: 220 to 280 PSI.

5. If there is no pressure, or pressure is low, check for restriction in pump intake line. Inspect charge relief valve and valve seat. Charge pressure can be adjusted by changing shim thickness behind the relief valve spring. Disassemble charge pump and check for internal damage or worn parts.

6. Start the engine and put throttle at full engine speed (3200 RPM). Apply the brakes and push the traction pedal forward, then reverse. Take a gauge reading while operating the machine in forward and reverse.

GAUGE READING: 220 to 280 PSI.

7. If pressure is good under no load, but drops below specification when under traction load, the piston pump should be suspected of wear and inefficiency. When the pump is worn or damaged the charge pump is not able to keep up with the internal leakage.

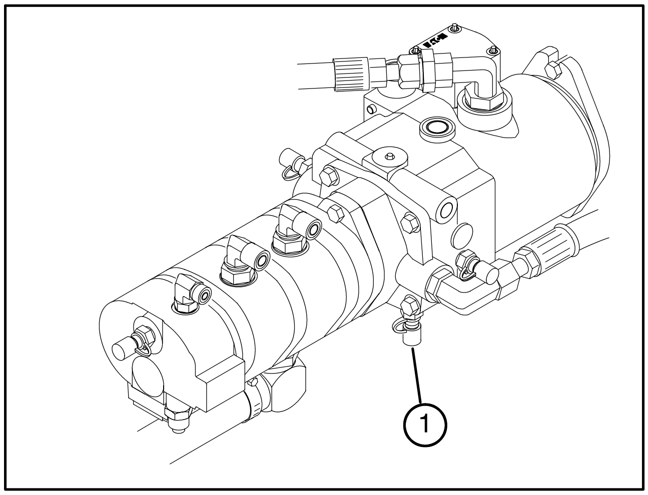


Figure 13

1. Charge Pressure Test Port

TEST NO. 2: Traction Circuit Pressure

1. Make sure hydraulic oil is at normal operating temperature before doing test.

2. Drive machine to an open area, lower cutting units, and shut off the engine.

3. Connect a 10,000 psi gauge to traction circuit test port for function to be checked (Fig. 14).

4. Start the engine and move throttle to full speed (approx. 3200 RPM).

CAUTION

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

5. With brakes locked, slowly depress the traction pedal. While pushing traction pedal down, look at pressure reading on gauge.

GAUGE READING: 4000 +/- 200 PSI.

6. Stop the engine.

7. If traction pressure is too low, inspect relief valves. If problem occurs in one direction only, interchange the relief valves to see if the problem changes to the other direction. Clean or replace valves as necessary. These cartridge type valves are factory set, and are not adjustable. If relief valves are in good condition, traction pump or wheel motors should be suspected of wear and inefficiency.

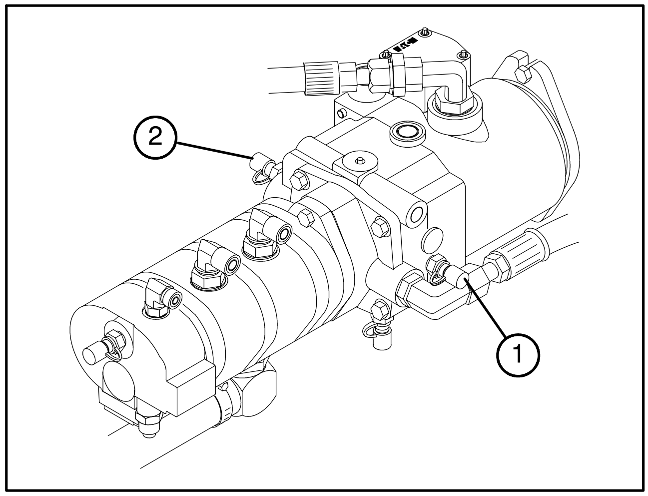


Figure 14

1. FORWARD Test Port **2. REVERSE Test Port**

TEST NO. 3: Cutting Unit Drive Circuit Pressure

Note: The front cutting unit drive circuit is protected by relief valve R1 and the rear circuit by relief valve R2. See Hydraulic Flow Diagrams at the beginning of this chapter.

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

2. Make sure machine is parked on a level surface with the cutting units lowered and off. Make sure engine is off.

> **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 hood to get access to hydraulic test fittings. Install a 5000 PSI gauge with extension hose onto quick disconnect fitting in port G1 or G2 (Fig. 15).

4. Set reel speed control FC1 or FC2 to position 5. Make sure Mow/Backlap valve MD1 or MD2 is in the "Mow" position.

5. Make sure cutting units are completely lowered and engine is OFF.

To check the front circuit, insert a block of wood between cutting unit reel blades and front cross tubes of any two-front cutting units to prevent the reels from turning (Fig. 16). Two cutting unit reels must be blocked to exceed the 3000 PSI front cutting unit circuit relief valve R1.

To check the rear circuit, insert a block of wood between cutting unit reel blades and front cross tubes of any two-rear cutting units to prevent the reels from turning (Fig. 16). Two cutting unit reels must be blocked to exceed the rear cutting unit circuit relief valve R2.

6. Sit on the seat and start the engine. Move throttle to full speed (3200 RPM).

> **WARNING**
>
> **Keep away from all reels during test to prevent personal injury from rotating reel blades.**

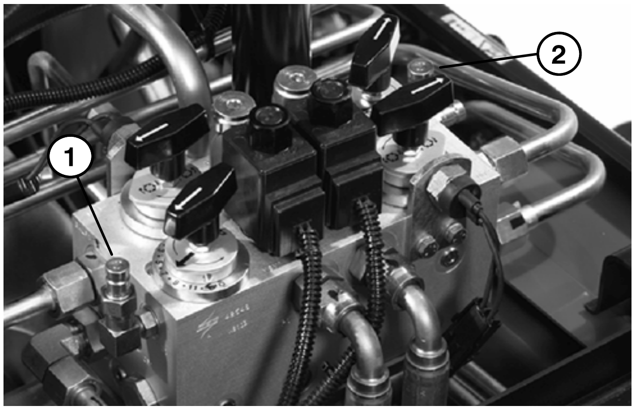


Figure 15

1. **Test Port G1 (front)**
2. **Test Port G2 (rear)**

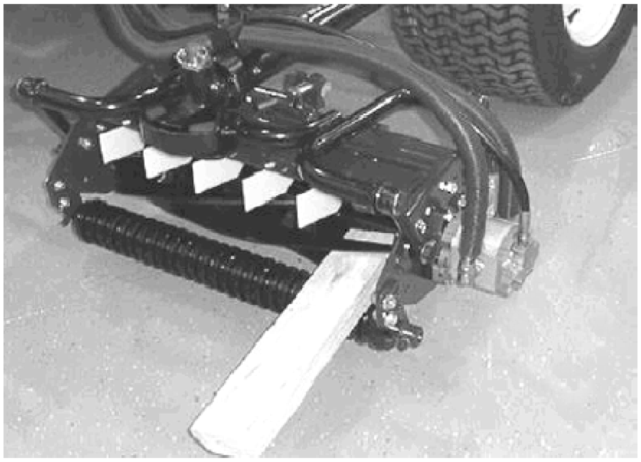


Figure 16

7. While sitting on seat, move "Enable/Disable" switch to ENABLE. Move "Lower- Mow/Raise" lever forward to engage cutting units, then look at the gauge.

GAUGE READING (front): 3000 +/- 50 PSI.
GAUGE READING (RM 6500-D rear):
2000 +/- 50 PSI.
GAUGE READING (RM 6700-D rear):
3000 +/- 50 PSI.

8. Stop the engine. If pressure is too high, remove cap on relief valve R1 or R2 and adjust screw to get correct pressure (see Adjust Manifold Relief Valves). If pressure is too low, check for restriction in pump intake line. Remove cap from relief valve R1 or R2 and adjust screw to get correct pressure. If pressure is still too low, pump or reel motor should be suspected of wear, damage or inefficiency.

Note: Normal operating pressure when mowing is approximately 500 to 600 PSI. per cutting unit. The front circuit should operate at 1500 to 1800 PSI. and the rear circuit should operate at 1000 to 1200 PSI. for 6500-D and at maximum circuit pressure for 6700-D.

TEST NO. 4: Gear Pump Section P3 Flow and Relief Valve Pressure (Using Tester with Pressure Gauges and Flow Meter)

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

2. Make sure machine is parked on a level surface with the cutting units lowered and off. Make sure engine is off.

CAUTION

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

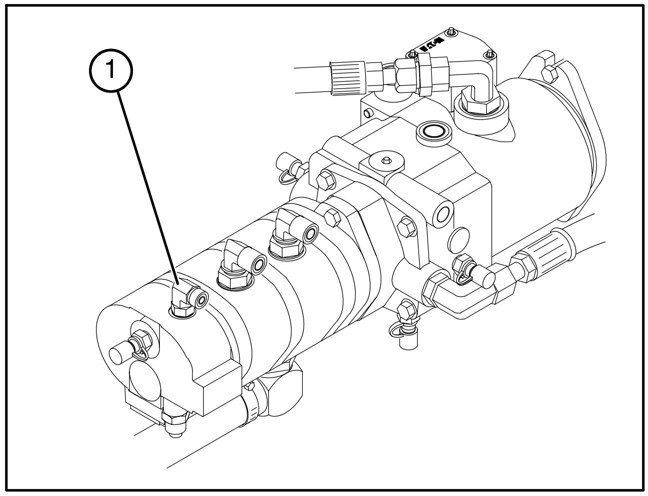


Figure 17

1. Gear Pump Section P3

3. With the engine off and cutting units lowered, install tester in series between pressure hose and the gear pump section P3 (Fig. 17). Make sure the tester flow control valve is OPEN.

IMPORTANT: Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the pump, through the tester and into the valve block.

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.

4. Make sure the parking brake is engaged. Start the engine and move throttle to full speed (3200 RPM). DO NOT engage the cutting units.

5. While watching pressure gauges, slowly close flow control valve until 1000 PSI. is obtained on gauge.

METER READING: 4 GPM or more at 1000 PSI.

6. If flow was lower than 4 GPM or a pressure of 1000 PSI cannot be obtained, check for restriction in pump intake line. If not restricted, verify relief setting first, then remove pump and repair or replace as necessary.

7. While watching pressure gauges, slowly close flow control valve further until the relief valve lifts.

METER READING: 1500 +/- 50 PSI.

8. If pressure is maintained below 1450 PSI or pressure goes beyond 1550 PSI, replace the relief valve.

9. Stop engine. Remove tester and reinstall hoses.

TEST NO. 5: Gear Pump Section P1 & P2 Flow
(Using Tester with Pressure and Flow Capabilities)

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

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

2. Make sure machine is parked on a level surface with the cutting units lowered and off. Make sure engine is off.

CAUTION

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

3. With the engine off and cutting units lowered, install tester in series between pressure hose and reel manifold fitting or between pressure hose and pump fitting (Fig. 18) for suspected pump section. Make sure the tester flow control valve is OPEN.

FRONT CIRCUIT: Pump Section P1

REAR CIRCUIT: Pump Section P2

IMPORTANT: Make sure that the oil flow indicator arrow on the flow gauge is showing that the oil will flow from the pump, through the tester and into the valve block.

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.

4. Make sure the parking brake is engaged. Start the engine and move throttle to full speed (3200 RPM). DO NOT engage the cutting units.

5. While watching pressure gauges, slowly close the tester flow control valve until 2000 PSI is obtained on gauge.

METER READING: 7 GPM or more at 2000 PSI.

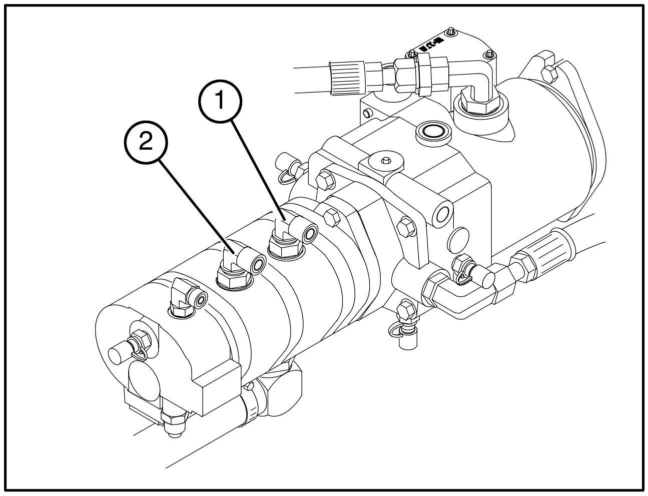


Figure 18

1. Gear Pump Section P1
2. Gear Pump Section P2

6. Stop the engine. If flow was lower than 7 GPM or a pressure of 2000 PSI cannot be obtained, check for restriction in pump intake line. If not restricted, remove pump and repair or replace as necessary.

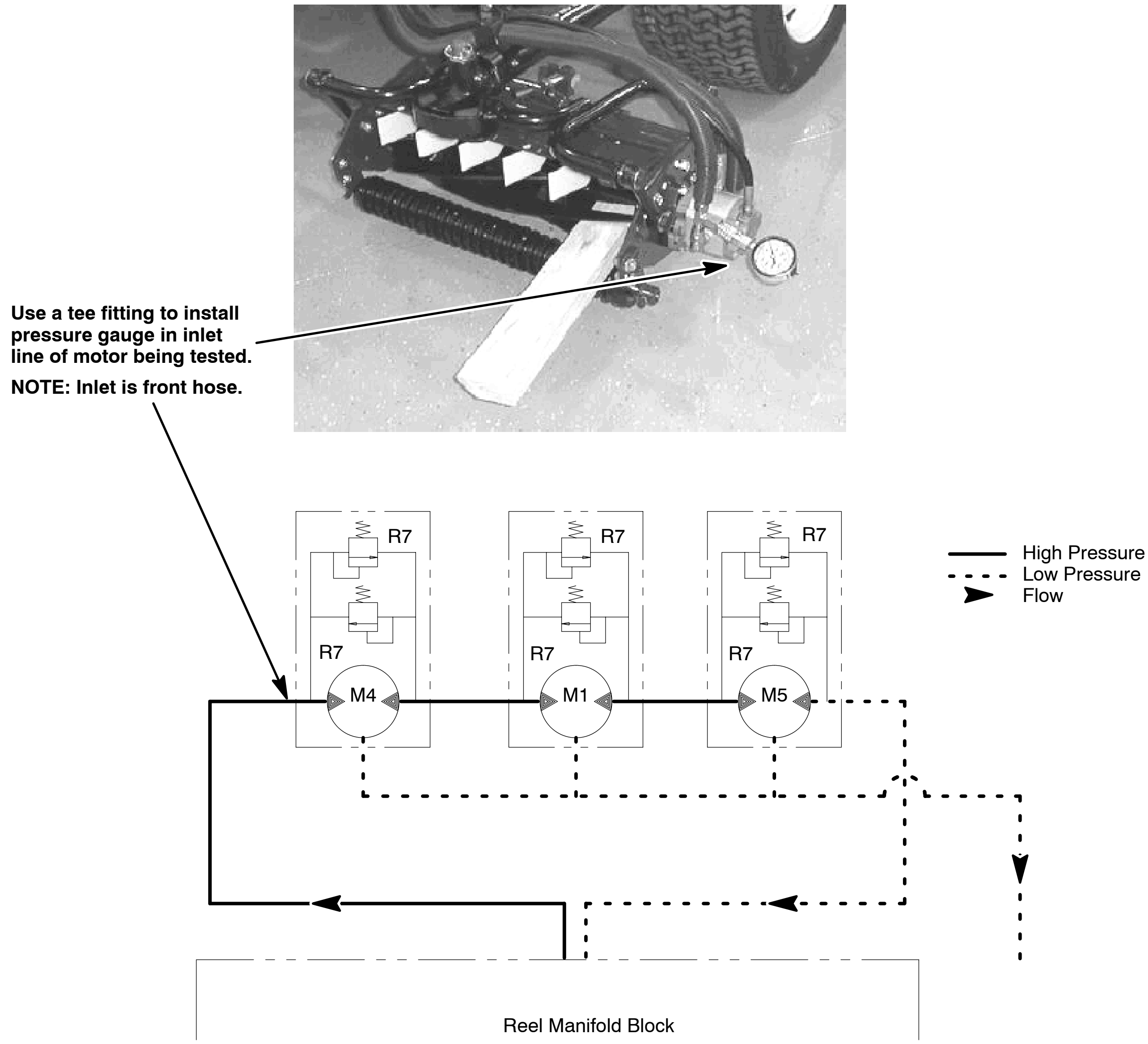


Figure 19

Note: One way to find a bad reel 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 marcelling (or a washboard appearance) on the turf.

1. Make sure hydraulic oil is at normal operating temperature before doing test.

CAUTION

Keep away from reels during tests to prevent personal injury from rotating blades. Do not stand in front of the machine.

2. Determine which reel motor is malfunctioning.

Note: The reel motors are connected in series. To isolate a faulty motor, you may have to test all three motors in the circuit by starting with the upstream motor first.

3. Lower cutting units, engage parking brake and stop the engine.

4. Install a tee fitting between the motor inlet fitting and hose. Install a 5000 PSI pressure gauge on the tee fitting (Fig. 19).

5. Set reel speed control to the full speed position. Make sure Mow/Backlap valve is in the “Mow” position.

6. With cutting units in lowered position and engine OFF, insert a block of wood between cutting unit reel blades and front cross tube of cutting unit to prevent reel from turning (Fig. 19).

7. One person should sit on the seat and operate the machine while another person reads the tester. Start the engine and move “Enable/Disable” switch to ENABLE. Move “Lower-Mow/Raise” lever forward to engage the cutting units.

GAUGE READING: 1500 +/- 100 PSI.

8. Disengage the cutting units and stop the engine. If pressure is less than 1400 PSI, cross-over relief valve on motor is malfunctioning or there is internal leakage in the reel motor and the motor efficiency should be checked.

TEST NO. 7: Reel Drive Motor Efficiency
(Using Tester with Pressure Gauges and Flow Meter)

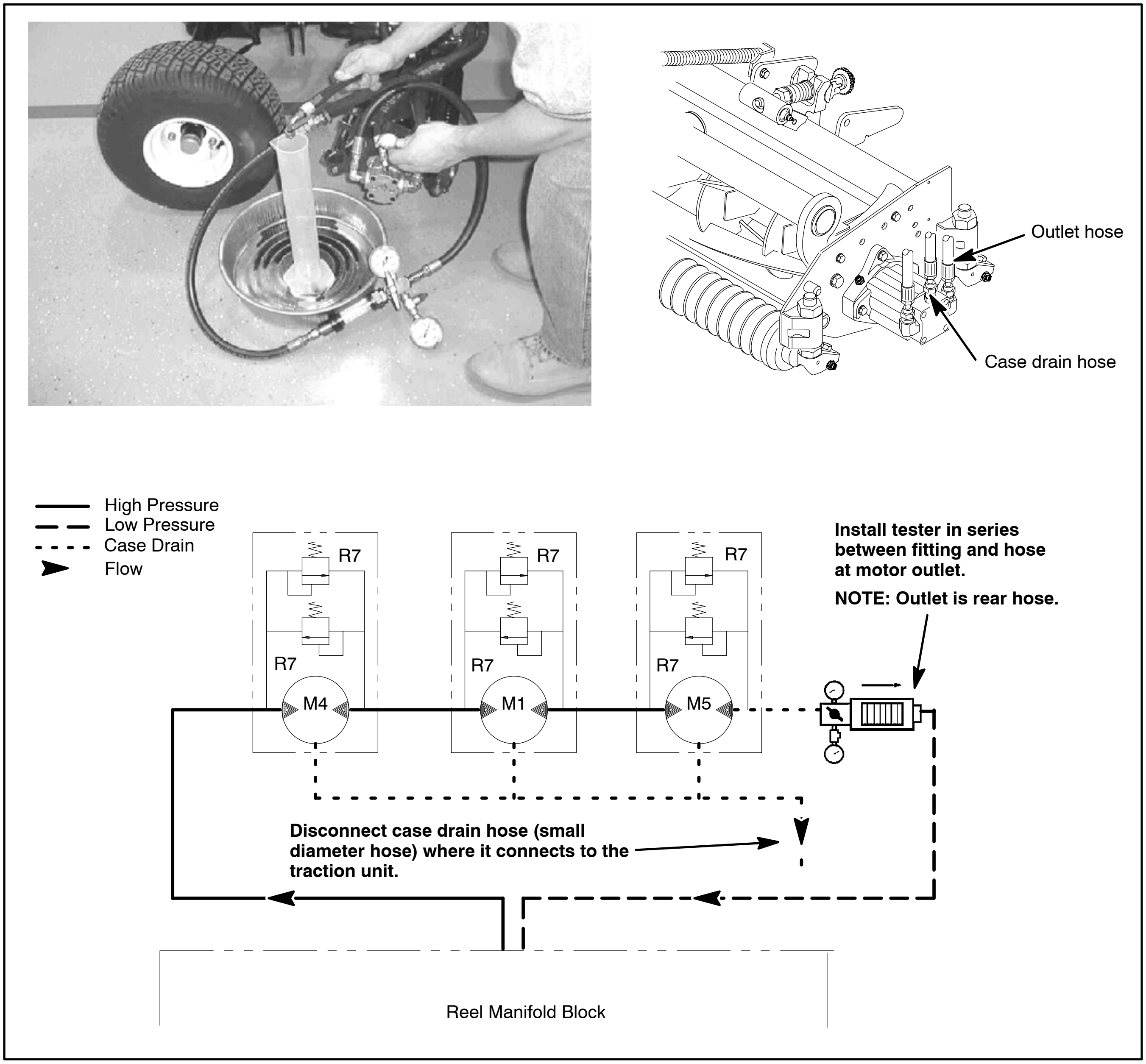


Figure 20

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

Note: One way to find a bad reel 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 marcelling (or a washboard appearance) on the turf.

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

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

3. Read Precautions for Hydraulic Testing.

Note: The reel motors are connected in series. To isolate a faulty motor, you may have to test all three motors in the circuit by starting with the upstream motor first.

4. Disconnect the motor case drain hose (small diameter hose) where it connects to traction unit (not at the motor). Put a steel cap on the fitting at the traction unit; leave the case drain hose open (Fig. 20)

5. Disconnect hose from return of the motor to be tested. Install tester in series with the motor and disconnected return hose. Make sure the flow control valve on tester is fully open. (Fig. 20).

6. Set reel speed control to the full speed position. Make sure Mow/Backlap valve is in the “Mow” position.

Note: Use a graduated container, special tool TOR4077, to measure case drain leakage (Fig. 20).

CAUTION

Cutting unit reels will rotate when lowered with Enable/Disable switch in ENABLE position. Keep away from cutting units during test to prevent personal injury from rotating reel blades. Do not stand in front of the machine.

7. Sit on seat and start the engine. Move throttle to full speed (3200 RPM). Move ”Enable/Disable” switch to ENABLE. Move ”Lower-Mow/Raise” lever forward to engage cutting units.

8. While watching pressure gauge, slowly close flow control valve on tester until a pressure of 1200 PSI is obtained.

9. Have another person measure flow from the case drain line for 15 seconds, then move the switch to DISABLE and stop the engine.

METER READING: 0.7 GPM or less at 1200 PSI.

10. Measure the amount of oil collected in the container. Multiply the amount collected by 4 (to get gallons per minute) or use the chart below. If flow exceeded .7 GPM, the reel motor should be repaired or replaced.

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

11. If flow is less than .7 GPM, disconnect tester from motor and hose. Reconnect hose to the reel motor. Remove plug from machine. Reconnect case drain hose to the reel motor.

Adjustments

Adjust Manifold Relief Valve (R1 and R2)

The hydraulic reel circuit is equipped with a relief valve. Valve (R1) is preset at the factory to 3000 PSI. Valve (R2) on Reelmaster 6500-D is set to 2000 PSI. Valve (R2) on Reelmaster 6700-D is set to 3000 PSI. However, an adjustment may be required if the setting proves to be off after testing (see TESTING). If an adjustment is required proceed as follows:

WARNING

Never adjust the relief valve with the hydraulic system pressurized. Hydraulic oil may spray out of the valve with the cap off. Personal injury may result. Always install the cap and tighten before pressurizing the system.

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

1. Remove cap from the relief valve with an allen wrench.

Note: A 1/8-turn of the adjustment socket is about 50 psi (3.5 bar), or 1 turn is about 400 psi (27.6 bar).

2. To INCREASE pressure setting, turn the adjustment socket inside the valve 1/8 of a turn clockwise.

3. To DECREASE pressure setting, turn the adjustment socket inside the valve 1/8 of a turn counterclockwise.

4. Install and tighten cap to valve. Retest pressure setting (see Testing).

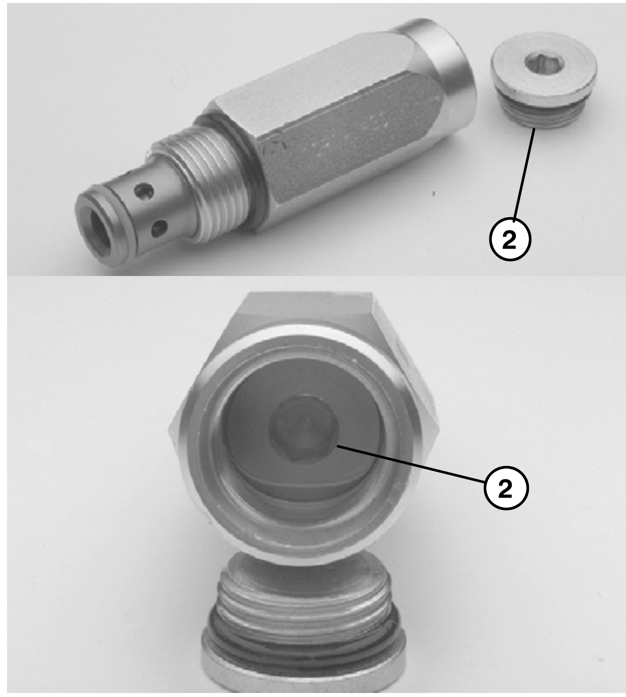


Figure 21

1. **Relief Valve Cap**
2. **Adjustment Socket**

Adjust Traction Drive for Neutral

The machine must not creep when traction pedal is released. If it does creep, an adjustment is required.

1. Park machine on a level surface, shut engine off and lower cutting units to the floor. Depress only the right brake pedal and engage the parking brake.

2. Jack up left side of machine until front tire is off the shop floor. Support machine with jack stands to prevent it from falling accidentally.

Note: On 4 wheel drive models, left rear tire must also be off the shop floor.

3. Start engine and allow run at low idle.

4. Adjust jam nuts on pump rod end to move pump control tube fore ward to eliminate forward creep or rearward to eliminate rearward creep.

5. After wheel rotation ceases, tighten jam nuts to secure adjustment.

6. Stop the engine and release the right brake. Remove jack stands and lower the machine to the shop floor. Test drive the machine to make sure it does not creep.

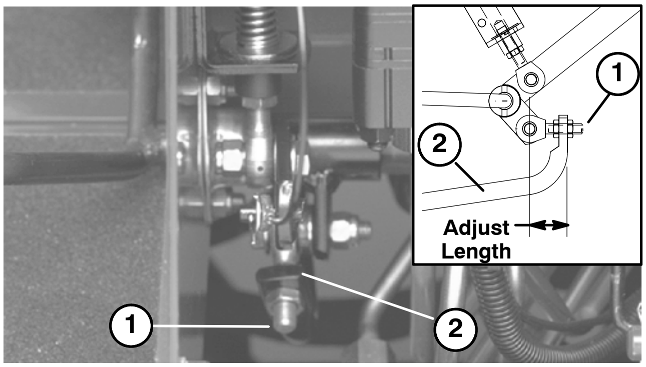


Figure 22

1. Pump Rod **2. Pump Control Tube**

Hydraulic System

Adjust Cutting Unit Drop Rates (Serial Numbers Below 280000000)

The cutting unit lift/lower circuit is equipped with adjustable flow control valves to ensure the cutting units do not drop too quickly and damage the turf.

Center (#1), Outside Front (#4 & 5) and Rear (6700-D #6 & 7) Cutting Units (Fig. 23)

1. Locate valve behind access panel above operator's platform.

2. Loosen setscrew on valve and rotate valve approximately 1/2 turn clockwise.

3. Verify drop rate adjustment by raising and lowering cutting unit several times. Readjust as required.

4. After desired drop rate is attained, tighten setscrew to lock adjustment.

Rear (#2 & 3) Cutting Units (Fig. 24)

1. Raise hood and locate valve in center of machine behind engine.

2. Loosen locking ring on valve and rotate valve approximately 1/2 turn clockwise.

3. Verify drop rate adjustment by raising and lowering cutting units several times. Readjust as required.

4. After desired drop rate is attained, tighten locking ring to lock adjustment.

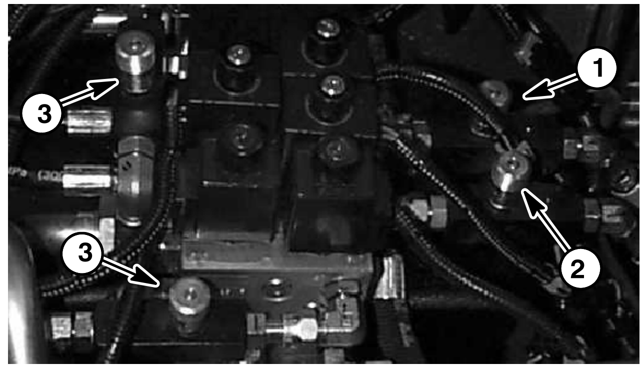


Figure 23

1. **Center front cutting unit (#1) flow control valve**
2. **Outside front cutting units (#4 & #5) flow control valve**
3. **Rear cutting units (6700-D #6 & #7) flow control valve**

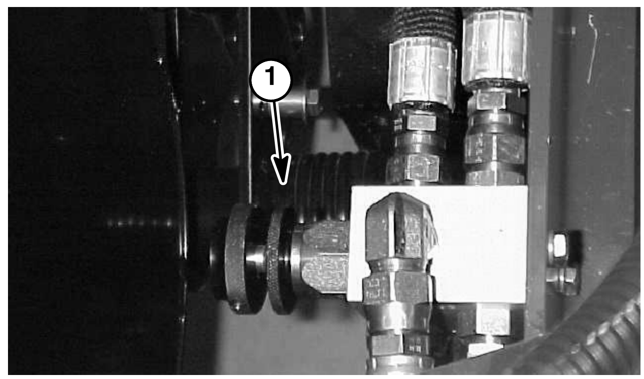


Figure 24

1. **Rear cutting unit (#2 & 3) drop flow control Valve**

Adjust Cutting Unit Drop Rates (Serial Numbers Above 280000000)

1. Raise hood and locate adjustment valve on the lift manifold for the desired cutting unit (Fig. 25).

2. Loosen locking nut on adjustment valve.

3. Using an allen wrench, rotate the valve clockwise to slow down drop rate of cutting unit.

4. Verify adjustment by raising and lowering cutting units several times. Readjust as required.

5. After desired drop rate is attained, tighten locking nut to secure adjustment.

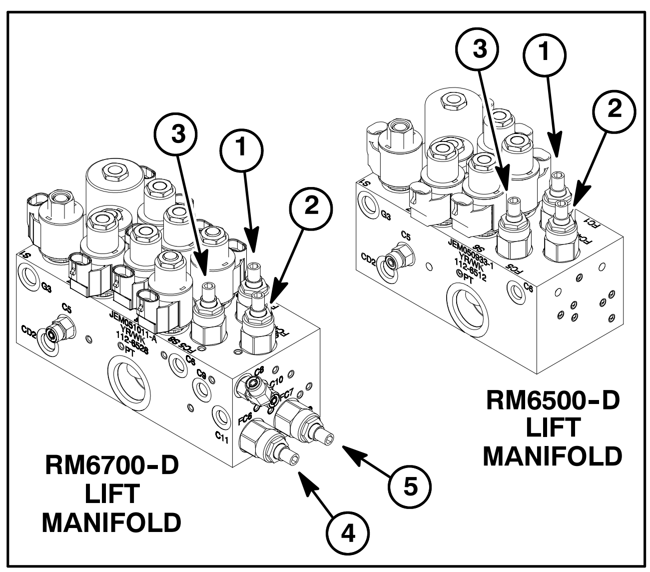


Figure 25

1. **Center front (#1)**
2. **Outside front (#4 & #5)**
3. **Rear (#2 & #3)**
4. **6700-D LH rear (#6)**
5. **6700-D RH rear (#7)**

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, 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 contamination.

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

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

After Repair or Replacement of 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).

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).

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

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

7. After disconnecting or replacing any hydraulic components, operate machine functions slowly until air is out of system (see Charge Hydraulic System).

8. 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, weather deterioration and chemical deterioration. Make all necessary repairs before operating.

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 such as Mobil EAU 224H. 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 hydraulic connections that will be disconnected for draining.

2. Drain hydraulic reservoir (see Change Hydraulic Fluid).

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

4. Change and replace oil filter (see Change Hydraulic Oil Filter).

5. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir Inspection).

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

Note: Use only hydraulic fluids specified in Operator's Manual. If changing to to biodegradable fluid, use Mobil EAU 224H for this step. Other fluids may cause system damage.

7. Fill hydraulic reservoir with new hydraulic fluid (see Change Hydraulic Fluid).

8. Disconnect electrical connector from run (ETR) solenoid.

9. Make sure traction pedal and lift control lever are in the neutral position. Turn ignition key switch; engage starter for fifteen (15) seconds to prime the pump. Allow starter to cool and then repeat this step.

10. Connect electrical connector to run (ETR) solenoid.

11. Start engine and run at low idle (1150 RPM) for a minimum of 2 minutes. Increase engine speed to high idle (3200 RPM) for minimum of 1 minute under no load.

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

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

14. Operate machine for 2 hours under normal operating conditions.

15. Check condition of hydraulic oil. If the new fluid shows any signs of contamination, repeat steps 1 through 15 again until oil is clean. If you are changing to biodegradable fluid, repeat steps 1 through 15 again at least once and until the oil is clean.

16. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

Note: When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, 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, and turn the engine off.

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).

4. Make sure hydraulic reservoir is full. Add correct oil if necessary (see Check Hydraulic System Fluid).

5. Disconnect electrical connector from run (ETR) solenoid.

6. Make sure traction pedal and the lift control lever are in the neutral position. Turn ignition key switch; engage starter for fifteen (15) seconds to the prime pump. Allow starter to cool and then repeat this step again.

7. Connect electrical connector to run (ETR) solenoid.

8. Make sure traction pedal and lift control lever are in neutral. Start engine and run it at low idle of 1150 rpm. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

9. After the hydraulic system starts to show signs of fill, actuate lift control lever until the lift cylinder rod moves in and out several times. If the cylinder rod does not move after 10 to 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. Loose or faulty coupler on the pump.

   C. Blocked suction line.

   D. Faulty charge relief valve.

   E. Faulty charge pump.

10. Adjust traction pedal to the neutral position (see Adjust Traction Drive for Neutral).

11. Check operation of the traction interlock switch (see Check Interlock System in Chapter - 5, Electrical Systems).

12. If the traction pump or a wheel motor was replaced or rebuilt, run the traction unit so all wheels turn slowly for 10 minutes.

13. Operate traction unit by gradually increasing its work load to full over a 10 minute period.

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

Change Hydraulic Fluid

Change hydraulic fluid after every 800 operating hours, in normal conditions. If fluid becomes contaminated, contact your local TORO distributor because the system must be flushed. Contaminated fluid looks milky or black when compared to clean oil.

1. Turn engine off and raise hood.

2. Remove drain plug from bottom of reservoir and let hydraulic fluid flow into drain pan (Fig. 25). Reinstall and tighten plug when hydraulic fluid stops draining.

IMPORTANT: Use only hydraulic fluids specified. Other fluids could cause system damage.

3. Fill reservoir with approximately 8.5 gallons (32 L) of hydraulic fluid. Refer to Checking Hydraulic Fluid.

4. Install reservoir cap (Fig. 26). Start engine and use all hydraulic controls to distribute hydraulic fluid throughout the system. Also check for leaks. Then stop the engine.

5. Check level of fluid and add enough to raise level to FULL mark on dipstick. DO NOT OVER FILL.

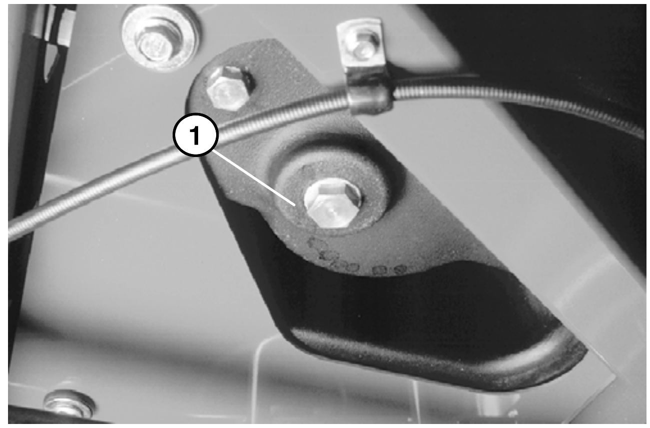


Figure 25

1. **Drain Plug**

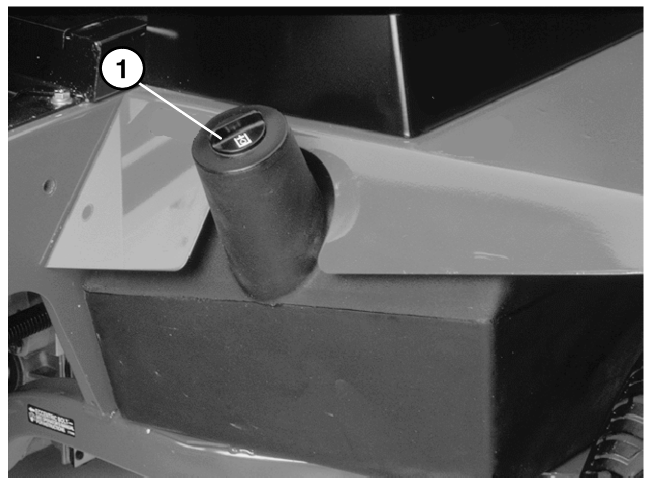


Figure 26

1. **Hydraulic Reservoir Cap**

Replace Hydraulic Oil Filter

The hydraulic system filter head is equipped with a service indicator. With the engine running, view the indicator, it should be in the GREEN zone. When the indicator is in the RED zone, the filter element should be changed.

IMPORTANT: Use only the Toro replacement filter recommended for this product (see parts catalog or service reference decal on unit). Use of any other filter may void the warranty on some components.

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

2. Clean area around filter mounting area. Place drain pan under filter and remove filter (Fig. 27).

3. Lubricate new filter gasket and fill the filter with hydraulic fluid.

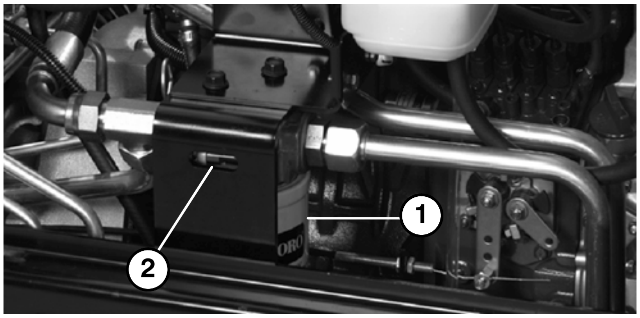


Figure 27

1. **Hydraulic Filter** 2. **Service Indicator**

4. Assure filter mounting area is clean. Screw filter on until gasket contacts mounting plate. Then tighten filter one-half turn.

5. Start engine and let run for about two minutes to purge air from the system. Stop the engine and check for leaks.

Hydraulic System

Piston Pump (Traction Pump)

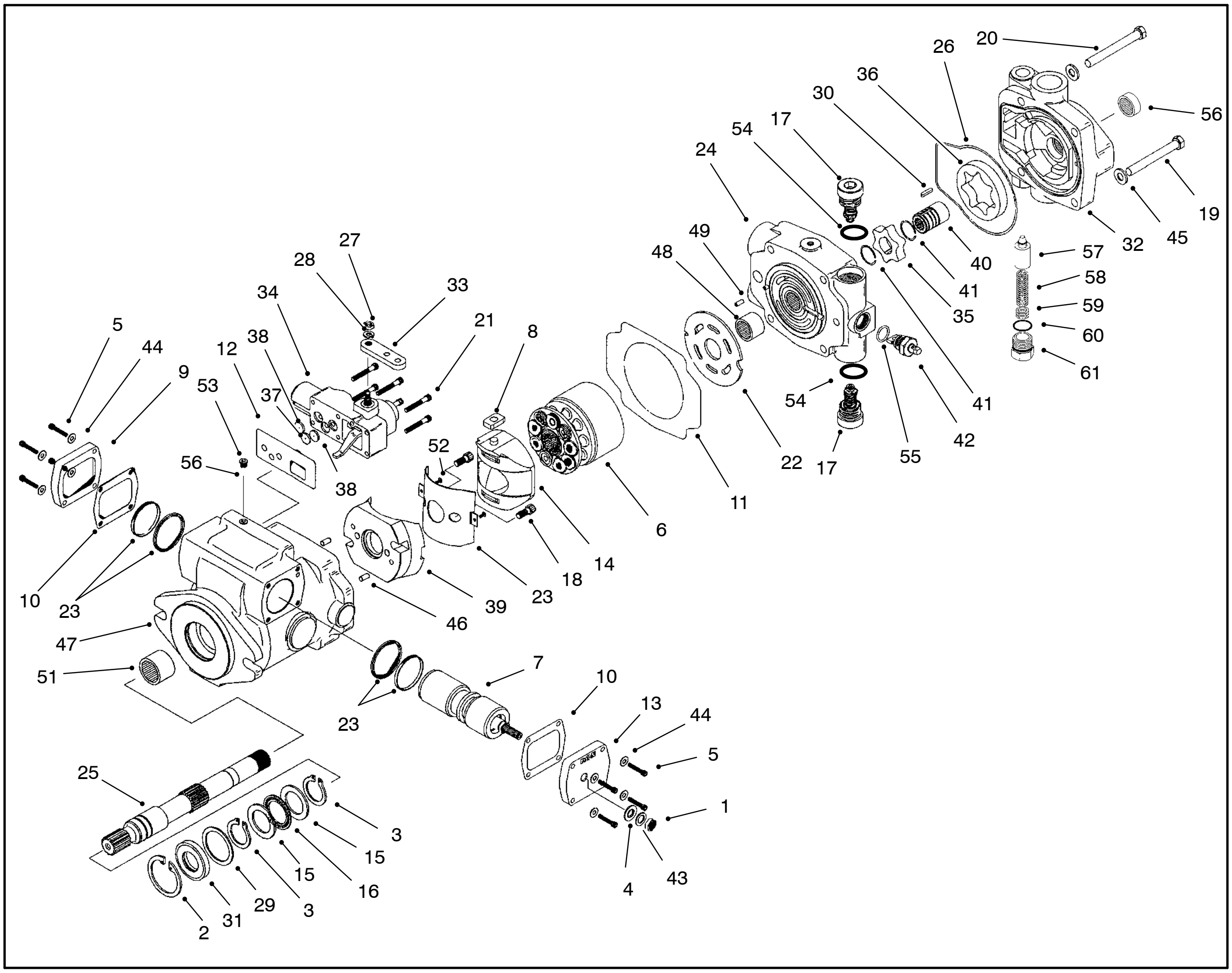


Figure 28

1. Nut
2. Retaining Ring
3. Retaining Ring
4. Sealing Washer
5. Screw
6. Rotating Kit Assembly
7. Servo Piston Assembly
8. Piston Follower
9. Cover Plate
10. Gasket
11. Housing Gasket
12. Control Housing Gasket
13. Cover Plate
14. Camplate Assembly
15. Thrust Race
16. Thrust Bearing
17. Relief Valve
18. Screw
19. Screw
20. Screw
21. Screw
22. Valve Plate
23. Cradle Bushing
24. Backplate Subassembly
25. Drive Shaft
26. O-ring
27. Nut
28. Lockwasher
29. Washer
30. Key
31. Shaft Seal
32. Charge Pump Adapter Subassembly
33. Control Arm
34. Servo Control Assembly
35. Inner Gerotor
36. Outer Geroter
37. Control Valve Orifice
38. Control Valve Orifice
39. Cradle Assembly
40. Coupler
41. Retaining Ring
42. Bypass Valve
43. Washer
44. Washer
45. Flat Washer
46. Dowel
47. Housing Assembly
48. Bearing
49. Roll Pin
50. Gasket
51. Bearing
52. Screw
53. Plug
54. O-ring
55. Quad Ring
56. Bearing
57. Charge Pump Relief Valve
58. Spring
59. Shims
60. O-ring
61. Plug

Disassembly (Fig. 28)

1. Position the pump into a protected jaw vise, clamping onto the outer portion of the flange, with the cap screws up. Mark the relationship of the working ports (for reassembly identification) to the servo control assembly with a scribe. Remove the four screws (19 & 20).

2. Lift the charge pump adapter assembly (32) straight up off backplate (24) and shaft (25). Remove the outer gerotor (36).

3. Remove O-ring (26) from charge pump adapter.

4. Remove the inner gerotor and coupler assembly (35 & 40) from the drive shaft.

5. Remove the outer gerotor and charge pump relief valve from the charge pump adapter.

Charge Pump Inspection:

- Check the coupler (40) and gerotors (35 & 36) for wear, cracks, or damage.
- Inspect the charge pump relief valve seat inside the charge pump adapter. The seat should be smooth and free of burrs and other damage.
- Inspect the charge pump relief valve spring (58).
- Check the bearing (56) (press fit) in charge pump adapter. If needles remain in cage, move freely, and bearing is set to the dimension shown, removal not required (Fig. 29).
- Check the gerotor pocket inside the charge pump adapter. The gerotor pocket should not be excessively scored.

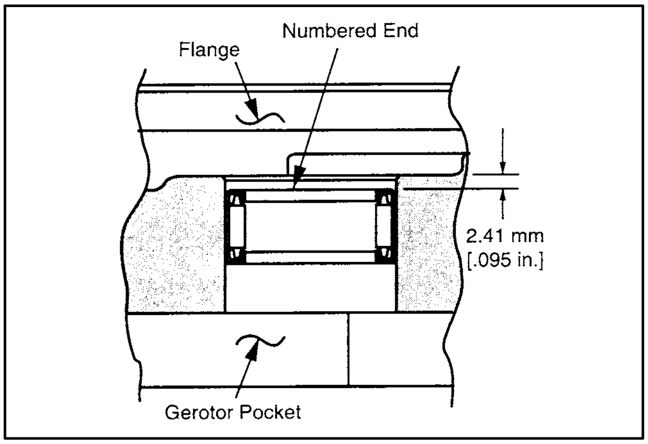


Figure 29

6. Lift backplate straight up off shaft and housing (47). Remove valve plate (22) from backplate or from rotating kit assembly (6) still in housing.

7. From backplate, remove dump valve (42), and relief valve assemblies (17).

Note: Mark the relief valve in relationship to the cavity it was removed, for reassembly purposes.

Backplate Inspection:

- Check the bearing (48) (press fit) in backplate. If needles remain in cage, move freely, and bearing is set to the dimension shown, removal not required (Fig. 30).
- Check roll pin (49) in backplate. If tight and set to the dimension shown, removal not required (Fig. 30).

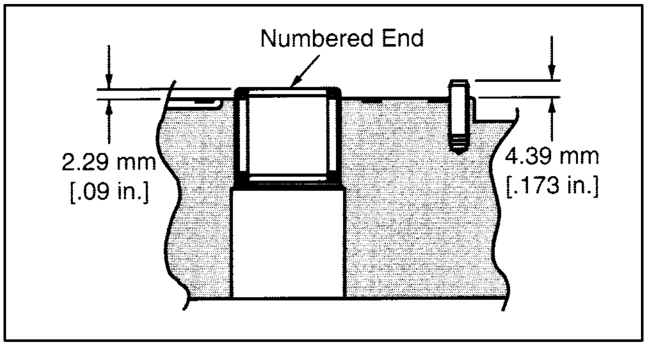


Figure 30

8. Remove housing gasket (11) from housing and/or backplate.

9. With pump still in vise, remove the six cap screws (21) retaining the servo control assembly (34). Remove the control assembly and control housing gasket (50) from the housing. Remove orifice plates (37 & 38), noting location for reassembly. Remove nut and lock washer (27 & 28) and remove control arm (33). Note position of control arm for reassembly.

10. To remove rotating kit assembly (6) from housing, first remove pump from vise while holding the rotating kit assembly in position. Lower pump so that the shaft end (flange end) is up. Set the rear of housing onto table with housing flat and rotating kit assembly at rest on table. (Hole in table, for protruding shaft, is required.) Lift and remove the housing and shaft from rotating kit assembly, and camplate.

11. Remove camplate (14) from rotating kit assembly. Remove piston follower (8) from camplate.

Camplate Inspection:

- The finish on the piston shoe surfaces of the camplate should show no signs of scoring.
- Inspect camplate bushing (23) surface for wear and surface for coating transfer from bushing.

12. To remove servo piston assembly (7) from housing, start with the four each cap screws and washers (5 & 44) retaining each cover plate (13 & 9).

13. In removing the cover plate (13) from the servo piston bolt, remove nut (1), washer (43), and seal washer (4). Hold the servo piston bolt with hex key and unscrew cover plate (13).

14. Remove servo piston assembly (7) and both seal sub-assemblies (23) from housing.

Note: Disassembly of servo piston assembly is not required.

15. Remove retaining ring (2) from the front of housing. Press the shaft (25), shaft seal (31), and washer (29) from housing. Remove both retaining rings (3), both thrust races (15), and thrust bearing (16) from shaft.

Housing Inspection:

- Check the bearing (51) (press fit) in housing. If needles remain in cage, move freely, and bearing is set to the dimension shown, removal not required (Fig. 31).

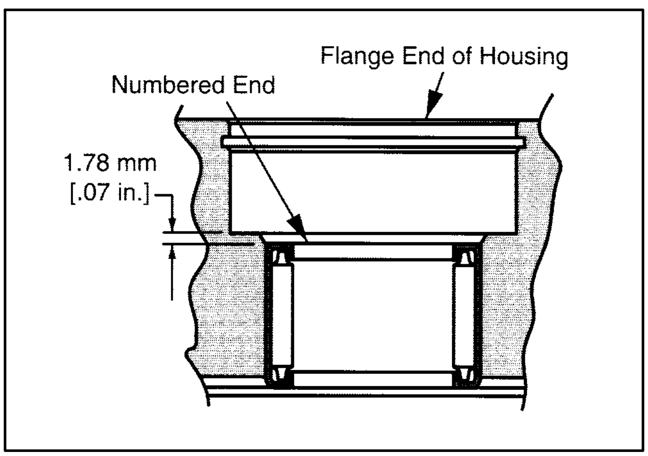


Figure 31

16. To remove cradle assembly (39), remove the two cap screws (18). Move the cradle assembly back-and-forth to release dowels (46) and remove cradle assembly.

17. Remove screw (52) to remove cradle bushing from cradle.

Bushing Inspection:

- Inspect cradle bushing (23) for contamination embedment within coating of bushing surface coming in contact with camplate.

18. Remove all plugs (53) from housing.

19. Discard seals, gaskets, and O-rings from all assemblies. Replace with new components upon reassembly.

Assembly (Fig. 28)

1. All parts should be cleaned and critical moving parts lubricated before reassembly.

2. If necessary, press new bearing in housing with the numbered end of bearing outward (Fig. 31).

3. Install new seal sub-assemblies (23) into the servo piston cavity of housing.

4. Screw the cover plate (13) onto the servo piston assembly (7). Install new cover plate gasket (10). Install servo piston assembly and cover plate onto right side of housing (Fig. 32). Retain cover plate with four washers and cap screws (5 & 44). Tighten cap screws to 40 to 48 in-lbs. (4.5 to 5.4 Nm).

5. To obtain neutral, centering the servo piston assembly is required. Measure in from the left side and set servo piston 0.5 in. (12.7 mm) from surface of housing servo bore (Fig. 32).

Note: Re-adjustment may be required for neutral at unit start-up.

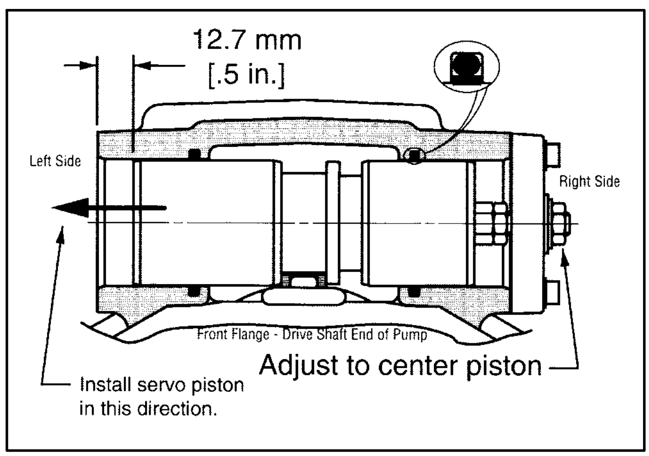


Figure 32

6. Install new seal washer (4), washer (43), and nut (1) to servo piston bolt. Holding servo piston bolt with hex key wrench. Tighten nut to 150 to 160 in-lbs. (17 to 18 Nm).

7. Install new cover plate gasket (10) and cover plate (9) to left side of housing and retain with four washers and cap screws (5 & 44). Tighten cap screws to 40 to 48 in-lbs. (4.5 to 5.4 Nm).

8. To assemble cradle assembly, press dowels (46) into cradle and install cradle bushing (23) onto cradle. Install screw (52). and tighten to 14 to 16 in-lbs. (1.6 to 1.8 Nm).

9. Place cradle assembly into housing making sure dowels and cradle are completely seated into housing. Apply Loctite #277 (or equivalent) to the end of threads and install two cap screws (18). Tighten cap screws to 25 to 28 ft-lbs. (34 to 38 Nm).

10. To install shaft (25), place outer retaining ring (3), thrust race (15), thrust bearing (16). Install inner thrust race (15), and inner retaining ring (3) onto shaft. Position washer (29) and shaft seal (31) onto shaft.

11. Install shaft assembly into front of housing. Seat shaft seal into position with seal driver and install retaining ring (2).

12. Install servo piston follower (8) onto camplate. Coat cradle bushing surface with hydraulic oil. Align servo piston follower (8) with slot in servo piston assembly (7) and carefully install camplate (14) into cradle bushing (23).

13. To install rotating kit assembly (6), leave housing and shaft in the horizontal position. Holding camplate into position with screw driver through controller linkage passageway at the top of housing, place rotating kit assembly over shaft and into housing until pistons rest against camplate. Make sure all parts are in housing completely and properly positioned. Return the pump to the vise with open end of housing up, clamping housing on the outer portion of the flange.

14. Install gasket (11) onto housing.

15. If necessary, press new bearing (48) with the numbered end outward, and roll pin (49) with split oriented away from bearing into backplate (Fig. 30).

16. Install new O-rings (54) on relief valves (17). Install relief valve in its original cavity in backplate. Tighten to 100 to 110 ft-lbs. (136 to 149 Nm).

17. Install new Quad-ring (55) on dump valve (42). Install dump valve and tighten to 27 to 30 ft-lbs. (36 to 40 Nm).

Note: Make sure paddle of dump valve is perpendicular to relief valve axis prior to installing or damage could result.

18. Apply a small amount of petroleum jelly to the steel side of valve plate (22). Install the valve plate with the index pin aligned and the steel side of the valve plate against the backplate (24).

19. Install backplate assembly onto housing assembly. Make sure ports are positioned correctly, and the valve plate and gasket stay in place.

20. If necessary, press new bearing (56) with the numbered end outward into charge pump adapter (Fig. 29).

21. Install new O-ring (60) on plug (61). Install relief valve in its original cavity in charge pump adapter. Tighten to 27 to 30 ft-lbs. (36 to 40 Nm).

22. Install inner gerotor and coupler assembly (35 & 40) onto drive shaft splines. Install outer gerotor (36).

23. Use a new O-ring (26) and place the charge pump adapter plate (32) over the inner gerotor and coupler assembly until it contacts the packplate.

24. Install charge pump adapter plate with four cap screws (19 & 20) and tighten to 27 to 31 ft-lbs. (37 to 42 Nm).

25. Place control housing gasket (12) on housing. Install orifices (37 & 38) into control assembly (34) and hold in position with petroleum jelly. Position the feedback link at 90° from control housing. Install servo control assembly onto housing making sure feedback link enters small groove in servo piston assembly (7).

26. Attach servo control assembly with six cap screws (21) and tighten to 40 to 48 in-lbs. (4.5 to 5.4 Nm).

27. Install control arm (33) onto servo control assembly. Retain with lock washer and nut (27 & 28) and tighten to 4 to 6 ft-lbs. (5 to 8 Nm).

28. Install new O-rings (56) on all plugs (53) and install plugs into housing. Tighten 3/4 in. plugs to 21 to 24 ft-lbs. (28 to 32 Nm). Tighten 1-1/4 in. plugs to 40 to 45 ft-lbs. (54 to 61 Nm).

Servo Control

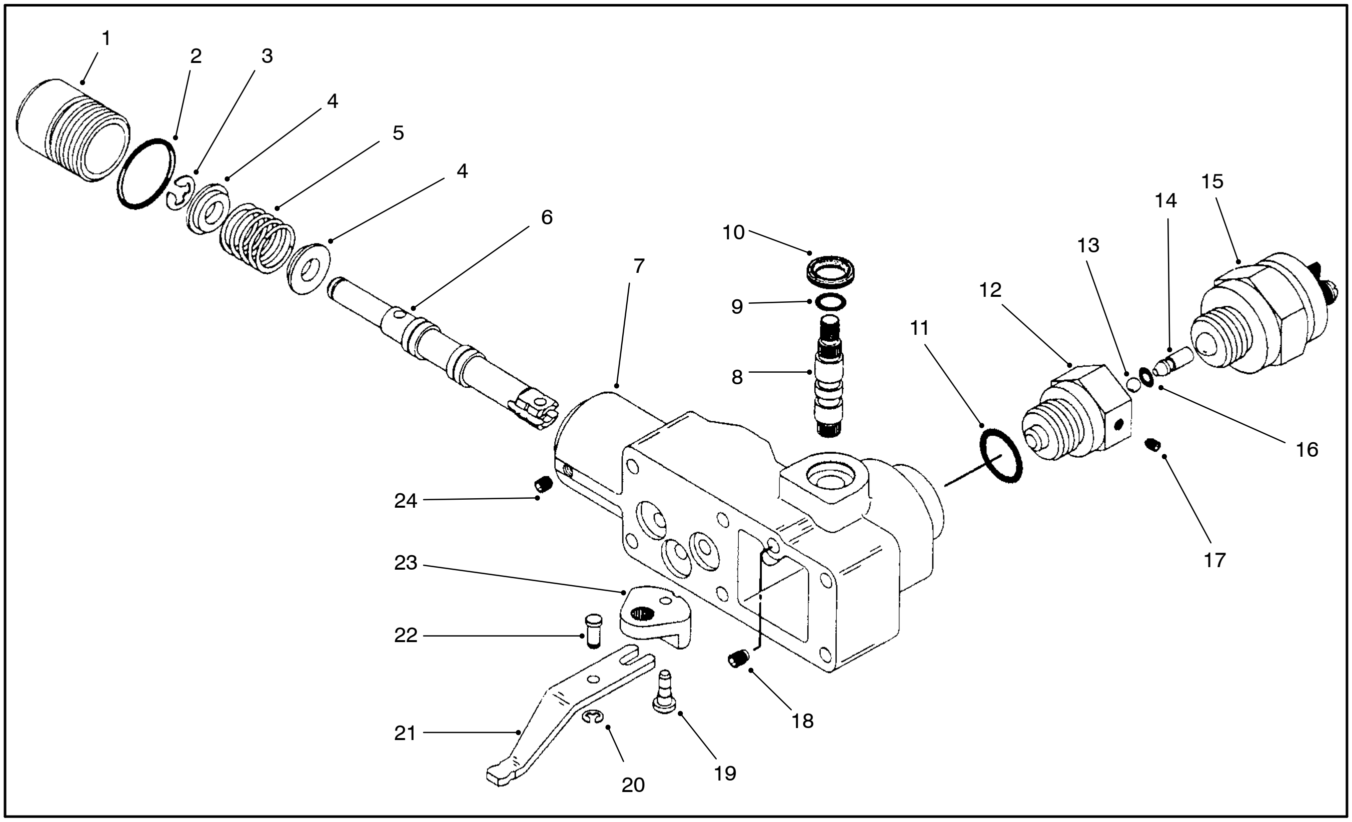


Figure 33

1. **Plug**
2. **O-ring**
3. **Retaining Ring**
4. **Spring Retainer**
5. **Spring**
6. **Spool Valve**
7. **Control Housing**
8. **Input Shaft**
9. **O-ring**
10. **Wiper Seal**
11. **O-ring**
12. **Adapter**
13. **Ball**
14. **Pin**
15. **Neutral Lockout Switch**
16. **O-ring**
17. **Set Screw**
18. **Set Screw**
19. **Pin**
20. **Retaining Ring**
21. **Link**
22. **Dowel Pin**
23. **Bell Crank**
24. **Set Screw**

Disassembly (Fig. 33)

1. Remove wiper seal (10) with screw driver. Remove set screw (18) and input shaft (8).

2. Remove set screw (24) and plug (1).

3. Remove retaining ring (20). Remove pin (22), feedback link (21), valve spool (6), and bell crank (23) from control housing.

4. Compress spring (5) and remove retaining ring (3), spring retainer (4), spring (5), and second spring retainer (4) from valve spool.

5. Remove O-rings (2 & 9) from plug and input shaft. Clean all parts and lubricate in prep for reassembly.

Assembly (Fig. 33)

1. Install spring retainer (4), spring (5), and second spring retainer (4) onto spool. Compress spring and install retaining ring (3).

2. Slide valve spool into control housing making sure that metering notches on valve spool can be seen in the metering ports.

3. Position bell crank (23) in housing. Slide feedback link (21) into position between clevis on valve spool. Align holes and install dowel pin (22) and retaining ring (20).

4. Install new O-ring (9) onto input shaft. Hold bell crank (23) in position with feedback link slot and align splined hole of bell crank with input shaft cavity. Install input shaft (8) into control housing and bell crank (23).

5. Apply Loctite #242 or equivalent to set screw (18) and install. Adjust set screw until it bottoms out on input shaft then back out one-quarter turn.

6. Install wiper seal (10) on input shaft.

7. Install new O-ring (2) onto plug (1) and install plug. Adjust plug until there is no play in the valve spool with input shaft held stationary. Install set screw (24) and tighten to 17 to 25 in-lbs. (2 to 3 Nm).

Neutral Lockout Switch Disassembly

1. Loosen set screw (17) and remove neutral lockout switch (15) from adapter (12).

2. Remove Neutral lockout adapter (12) from control assembly.

3. Remove pin (14), ball (13), and O-rings (16) from adapter (12).

Neutral Lockout Switch Assembly

1. Install new O-rings (11 & 16) onto adapter and pin (14).

2. Install ball (13) and pin (14) into adapter. Lubricate with petroleum jelly to hold in place during installation.

3. Install adapter (12) into control assembly and tighten to 44 to 53 ft-lbs. (60 to 70 Nm).

4. Apply Loctite #222 or equivalent to threads of neutral lockout switch (15) and install into adapter (12). Adjust neutral lockout switch as follows:

A. Install switch, while moving control arm back and forth, until "detent" action is detected. Back out the switch until the "detent" action is very slight.

B. Obtain a test light or use a multimeter. Attach the leads from the test light to the switch or the wiring connector.

C. Move the control arm out of the detent position. The test light will go on. Screw in the switch until the light goes off. Mark this as position "A" (Fig. 34). Move the control arm to the detent position and the test light should come back on.

D. Leaving the control arm in the detent position, the light will remain on. Screw in the switch until the light goes off. Mark this position "B" (Fig. 34).

E. Unscrew the switch one third of the distance between "B" and "A". Install and tighten the hex socket head set screw in one of the upper quadrants of the hex of the switch adapter (Fig. 34). Tighten set screw to 28 to 34 in-lbs. (3.2 to 3.8 Nm).

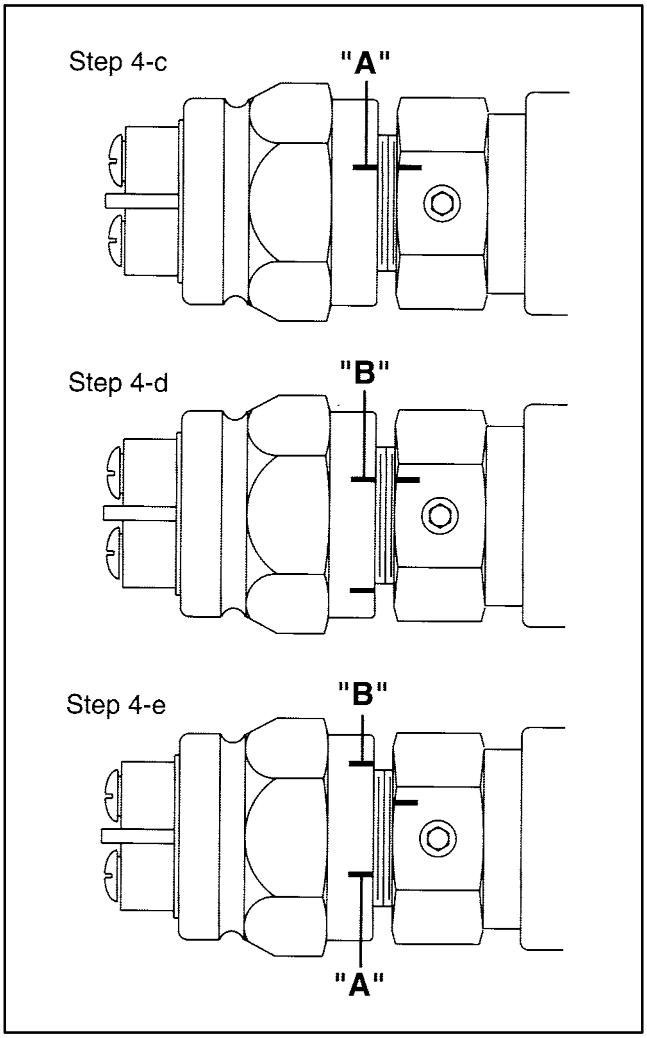


Figure 34

5. Test the switch by moving the control arm to the detent position, the light should be on. Move the control arm out of detent, the light should go off.

6. Remove test light and put servo control assembly into operation.

Gear Pump

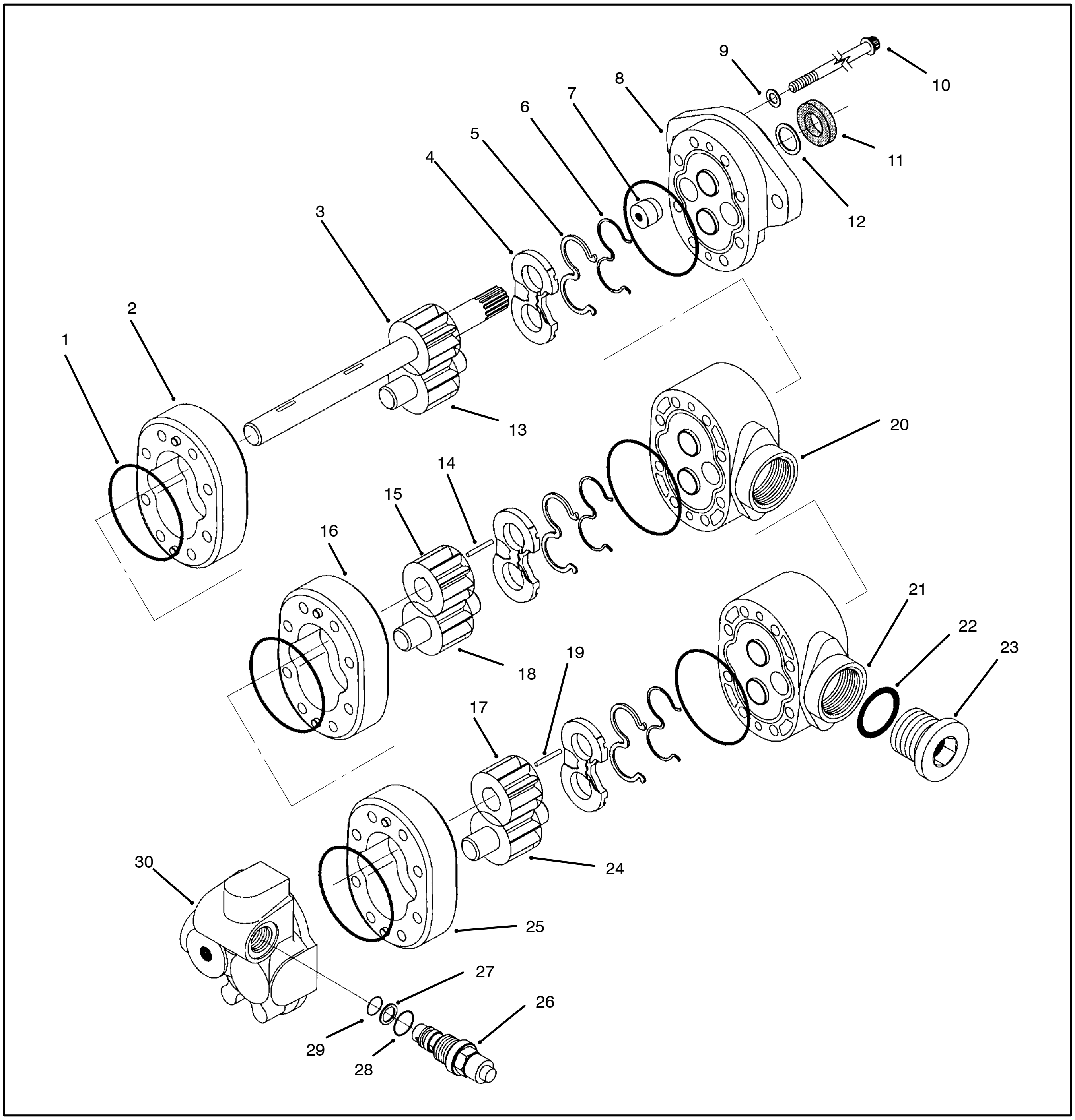


Figure 35

1. O-ring
2. Front Body
3. Drive Gear Assembly
4. Wearplate
5. Balance Pressure Seal
6. Backup Gasket
7. Plug
8. Front Plate Assembly
9. Copper Washer
10. Screw
11. Shaft Seal
12. Washer
13. Idler Gear Assembly
14. Key
15. Gear
16. Middle Body
17. Gear
18. Idler Gear
19. Key
20. Front Adapter Plate
21. Rear Adapter Plate
22. O-ring
23. Plug
24. Idler Gear
25. Rear Body
26. Relief Valve
27. Backup Washer
28. O-ring
29. O-ring
30. Backplate Assembly

Repair Information

Work in a clean area, cleanliness is extremely important when repairing hydraulic pumps. Before disconnecting the lines, clean port area of pump. Disconnect hydraulic lines, removing pump assembly from vehicle and plug ports. Thoroughly clean the outside of pump. After cleaning then remove port plugs and drain oil.

Disassembly (Fig. 35)

1. Scribe a line, at an angle, across front plate (8), bodies (2, 16, 25), adapter plates (20, 21) and backplate (30). This will assure proper reassembly.

Note: To maintain maximum pump efficiency, keep body, gears and wear plates for each section together. **DO NOT** mix parts between different sections.

2. Clamp pump in vise, shaft end up.

3. Remove the eight cap screws (10).

4. Remove pump from vise, hold pump in hands and bump shaft against wooden block to separate front pump sections. Front body (2) will remain with either front plate (8) or front adapter plate (20).

5. Place front idler gear (13) into gear pocket and tap with soft face hammer until the front body separates. Now remove idler gear from front plate or adapter plate.

6. Remove plug (7) from front plate.

7. Remove front adapter plate (20) from body by tapping on the adapter plate with a plastic hammer or rawhide mallet.

8. Remove idler gear (18), slip fit gear (15), and key (14).

9. Remove backplate (30) from body by tapping on backplate with plastic hammer or rawhide mallet.

10. Remove rear idler gear (24), slip fit gear (17) and key (19).

11. Remove drive gear assembly (3) from adapter plate.

12. Place rear idler gear assembly (24) back into gear pocket and tap protruding end with soft face hammer to remove rear body (25) from the backplate assembly or the rear adapter plate.

13. Remove the wear plates (4) from front plate (8), front adapter plate (20), and rear adapter plate (21).

14. Remove O-rings (1) from front plate, adapter plates, and backplate.

15. Remove backup gaskets (6) and balance pressure seals (5) from front plate and adapter plates by prying out with a sharp tool.

16. Remove shaft seal (11) and washer (12) from front plate by prying with a screw driver.

17. Remove plug (23) and washer (22) from rear adapter plate.

18. Remove relief valve (26) from backplate assembly.

19. Remove O-ring (29), backup washer (27), and O-ring (28) from relief valve.

Inspect Parts for Wear General

1. Clean and dry all parts.

2. Remove nicks and burrs from all parts with emery cloth.

Gear Assembly Inspection

1. Check spline drive shaft for twisted or broken teeth or check keyed drive shaft for broken or chipped keyway. Also check for broken keyway, on drive shaft, that drives the slip fit gear of the rear pump.

2. Inspect both the drive gear and idler gear shafts at bushing points and seal area for rough surfaces and excessive wear.

3. Replace gear assembly if shaft measures less than .873 in. (22.17mm) in bushing area.

Note: One gear assembly may be replaced separately; shafts and gears are available as assemblies only. The slip fit gear is available separately.

4. Inspect gear face for scoring and excessive wear.

5. Replace gear assembly if gear width is below 1.181 in. (30.00 mm).

6. Assure that snap rings are in grooves on either side of drive and idler gears.

7. If edge of gear teeth are sharp, break edge with emery cloth.

Front Plate, Backplate and Adapter Plates Inspection

1. Oil groove in bushings in front plate, backplate and adapter plates should be in line with dowel pin holes and 180 degrees apart. This positions the oil grooves closest to respective dowel pin holes.

2. Replace the backplate, front plate or adapter plates if I.D. of bushings exceed .879in. (22.33mm).

Note: Bushings are not available as separate items.

3. Bushings in front plate and backup gasket side of adapter plates should be flush with face of plate.

4. Check for scoring on face of backplate or adapter plates. Replace if wear exceeds .0015 in. (0.038mm).

Body Inspection

1. Check bodies inside gear pockets for excessive scoring or wear.

2. Replace bodies if I.D. of gear pockets exceeds 2.1 in. (53.54mm).

General Information

It is important that the relationship of the backplate, adapter plates, bodies, wear plate and front plate is correct. You note two half moon cavities in the body which must face away from the front plate or adapter plate. Note: The smaller half moon port cavity must be on the pressure side of the pump. The side of wear plate with mid section cut out must be on suction side of pump. Suction side of backplate or adapter plate is always the side with larger port boss.

Assembly (Fig. 35)

1. Replace the wear plates, bearing seals, backup gaskets, shaft seal and o-rings as new parts.

2. Install O-rings (1) in groove of front plate, adapter plates, and backplate with a small amount of petroleum jelly to hold in place.

3. Tuck backup gaskets (6) in front plate and adapter plates with open part of “V” section down.

4. Place balance pressure seals (5) in groove in front plate and adapter plates.

5. Place plug (7) into pocket of front plate.

6. Apply a thin coat of petroleum jelly to both milled gear pockets of front body (2). Slip body onto front plate with half moon port cavities in body facing away from front plate.

Note: The small half moon port cavity must be on the pressure side of pump.

7. Place wear plate (4) on top of backup gasket (6) with bronze face up. The side with the mid section cut away must be on suction side of pump.

8. Dip drive gear assembly (3) and idler gear assembly (13) into clean oil. Slip both gear assemblies into gear pocket of front body and into front plate bushings.

9. Place wear plate (4) on top of backup gasket (6) with bronze face up. The side with the mid section cut away must be on suction side of pump.

10. Install front adapter plate in place on front body. Check positioning marks.

11. Install middle body onto front adapter plate and install wear plate (4).

12. Install key (14) in slot of drive gear shaft (3). Dip slip fit gear (15) in clean oil and slip on shaft and into gear pocket of middle body. Check key for proper alignment.

13. Dip idler gear (18) in clean oil and install in gear pocket of middle body.

14. Install rear adapter plate in place on middle body. Check positioning mark on all sections of pump.

15. Install rear body onto adapter plate and install wear plate (4).

16. Install key (19) in slot of drive gear shaft assembly. Dip slip fit gear (17) in clean oil and slip on shaft and into gear pocket of rear body. Check key for proper location.

17. Dip rear idler gear (24) in clean oil and install in gear pocket of rear body.

18. Position backplate over shafts until dowel pins in body are engaged.

19. Secure with cap screws (10). Tighten cap screws evenly in a crisscross pattern to 25 to 28 ft-lbs. (34 to 38 Nm).

20. Place washer (12) over drive shaft into housing. Liberally oil shaft seal (11) with clean oil and install over drive shaft carefully so that rubber sealing lips are not cut.

21. Place 1-3/8” O.D. sleeve over shaft and press in shaft seal (11) .200 in. (5.08 mm) below front surface of front plate.

22. Install key on keyed shaft.

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Hydraulic System

Wheel Motor

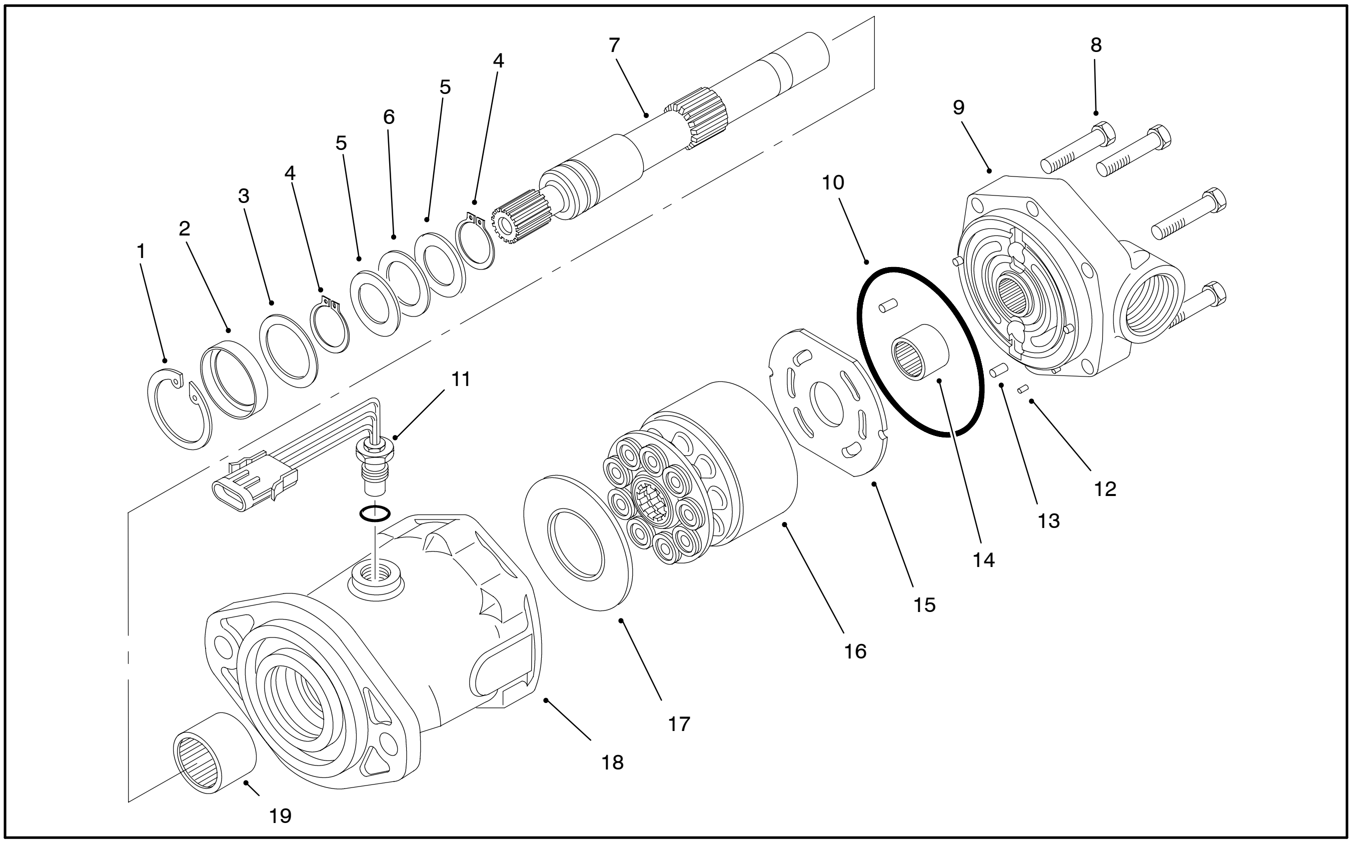


Figure 36

1. **Retaining Ring**
2. **Shaft Seal**
3. **Washer**
4. **Retaining Ring**
5. **Thrust Race**
6. **Thrust Bearing**
7. **Splined Drive Shaft**
8. **Screw**
9. **Backplate Assembly**
10. **O-ring**
11. **Speed Pickup Sensor (RH wheel motor only)**
12. **Dowel Pin**
13. **Dowel Pin**
14. **Needle Bearing**
15. **Valve Plate**
16. **Rotating Kit**
17. **Camplate Insert**
18. **Housing**
19. **Needle Bearing**

Cleanliness is extremely important when repairing these motors. Work in a clean area. Before disconnecting the lines, clean port area of motor. Disconnect hydraulic lines, removing motor assembly from vehicle and plug ports. Thoroughly clean the outside of the motor. After cleaning, remove port plugs and drain oil.

Disassembly (Fig. 36)

1. Clamp the drive shaft end of the piston motor in a protected jaw vise with the cap screws up. Remove the six cap screws (8) from the motor assembly.

2. Use a mallet and tap the backplate (9) to loosen and remove from housing.

3. Remove valve plate (15) and O-ring (10) from backplate. It is not necessary to remove roll pins in backplate.

4. Remove motor from vise and remove rotating assembly (16) from motor housing.

5. Remove the camplate insert (17) from housing (18). Use caution not to mar the finish that makes contact with pistons.

6. Remove retaining ring (1) from housing. Press shaft (7) from housing (18) and remove shaft seal (2), and washer (3).

7. Remove retaining ring (4) from shaft and remove thrust washers (5) and thrust bearing (6).

8. Discard the shaft seals and o-ring, and replace with new items upon reassembly.

Inspection

1. Check the condition of the needle bearing (14) in backplate (10) and replace if necessary.

2. Inspect valve plate (15) on the bronze side next to the piston block for wear. A smooth surface is required. **Do not lap valve plate bronze surface.** Replace valve plate if any wear exists.

3. Inspect the piston block surface that makes contact with valve plate. This surface should be smooth and free of deep scratches. **Do not lap piston block.**

4. The pistons should move freely in the piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.

5. Examine the O.D. of the pistons for finish condition. They should not show wear or deep scratches. Inspect the shoes for a snug fit on the ball end of the pistons and a flat smooth surface that comes in contact with the camplate. **Do not lap piston shoes.**

6. Examine the spider for wear in the pivot area

7. Examine the pivot to insure smoothness and no signs of wear.

8. The polished finish on the shoe surface of the camplate insert (17) should show no signs of scoring.

9. Inspect the shaft (7) for wear in the seal, bearing and spline areas.

10. Inspect thrust bearing (6) and washers (5) for wear.

11. Check the condition of the needle bearing (19) and replace if necessary.

Assembly (Fig. 36)

1. Clean all parts in suitable solvent and lubricate all critical moving parts before reassembly.

2. If necessary, install new needle bearing (19) with numbered end of the bearing outward.

3. Install retaining ring (4). Install thrust washer (5), thrust bearing (6), and second thrust washer (5). Secure with second retaining ring (4).

4. Install shaft in housing. Install washer (3), new shaft seal (2), and retaining ring (1).

5. Install camplate insert (17) with the lettering side of insert to the front of the housing. Use petroleum jelly to hold in place during assembly.

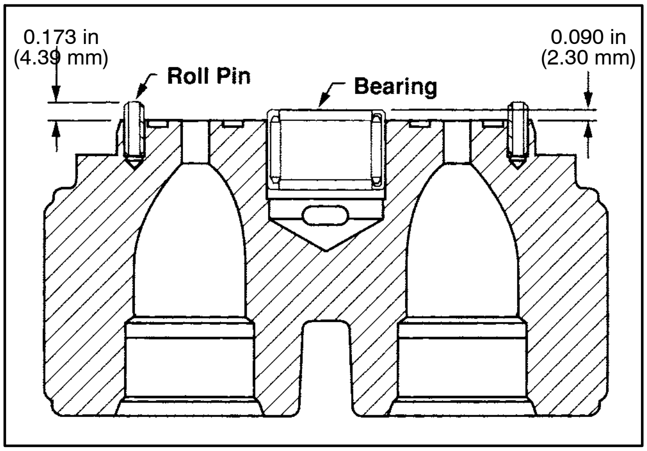


Figure 37

6. Clamp motor assembly in a protected jaw vise with the open end of the housing up.

7. If roll pins were removed, reinstall with opening of roll pin oriented away from bearing within 5 degrees of bearing center line (Fig. 37).

8. To replace bearing (14) in backplate, install bearing with number end of bearing facing up, next to valve plate (Fig. 37).

9. Apply small amount of petroleum jelly to the steel side of valve plate (15) to hold in place for installation. Place the valve plate in position onto the backplate with steel side against backplate, and the bronze colored side against piston block.

10. Placing new O-ring (10) onto backplate, place backplate assembly onto housing assembly. Make sure valve plate stays in position.

11. Insert the cap screws (8) and tighten to 15 to 18 ft-lbs. (20.3 to 24.4 Nm) in a criss-cross pattern.

12. Install speed sensor in R.H. wheel motor. See **Speedometer Sensor Installation** in Repairs section of Chapter 5 - Electrical System.

13. Fill case half full of hydraulic oil and install on vehicle.

4WD Rear Axle Motor

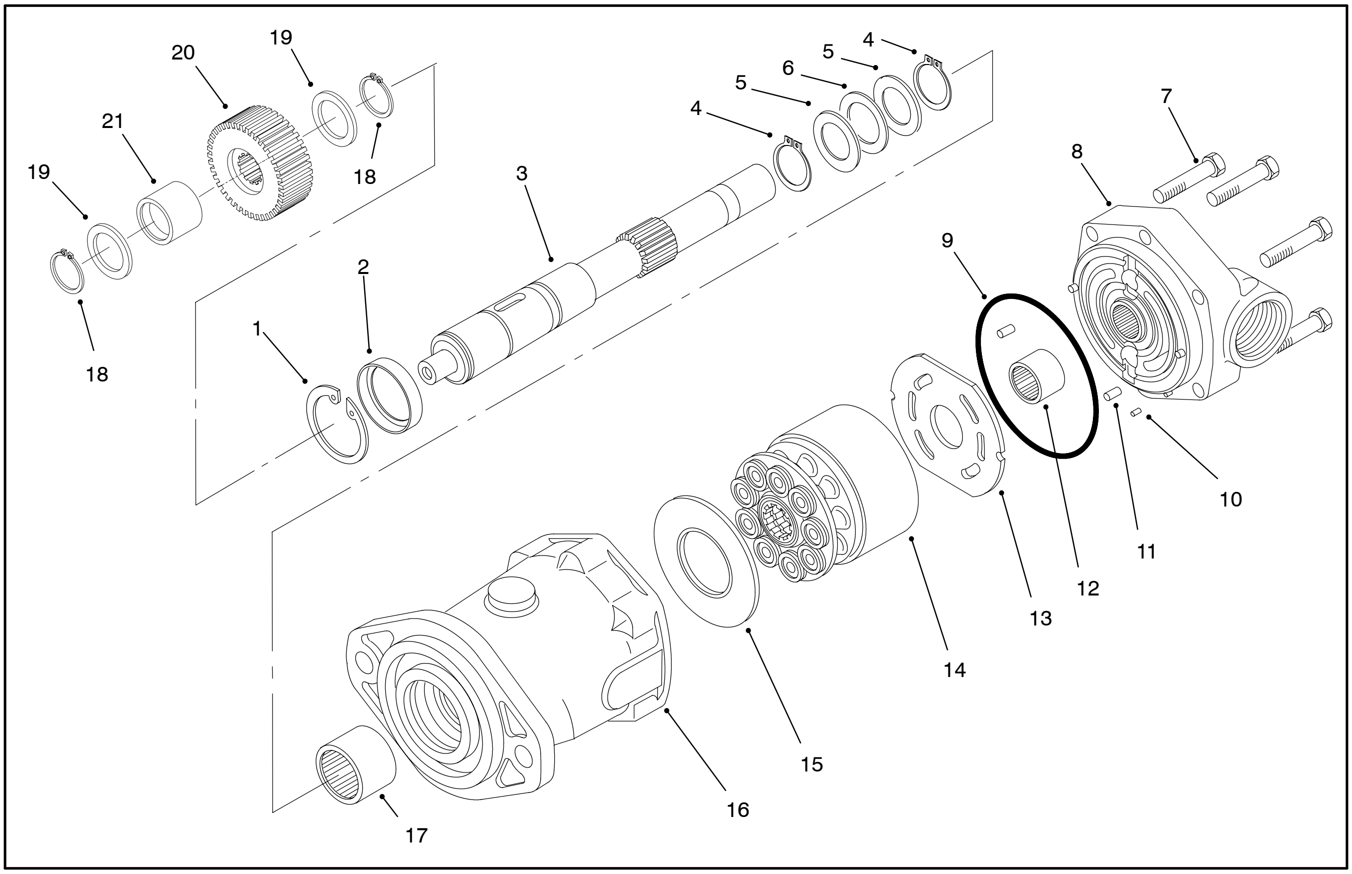


Figure 38

1. **Retaining Ring**
2. **Spacer**
3. **Shaft**
4. **Retaining Ring**
5. **Thrust Race**
6. **Thrust Bearing**
7. **Screw**
8. **Backplate Assembly**
9. **O-ring**
10. **Dowel Pin**
11. **Dowel Pin**
12. **Needle Bearing**
13. **Valve Plate**
14. **Rotating Kit**
15. **Camplate Insert**
16. **Housing**
17. **Needle Bearing**
18. **Retaining Ring**
19. **Thrust Washer**
20. **Drive Gear**
21. **Overrunning Clutch**

Cleanliness is extremely important when repairing these motors. Work in a clean area. Before disconnecting the lines, clean port area of motor. Disconnect hydraulic lines, removing motor assembly from vehicle and plug ports. Thoroughly clean the outside of the motor. After cleaning, remove port plugs and drain oil.

Disassembly (Fig. 38)

1. Remove the retaining rings, thrust washers, and drive gear from the motor shaft. Remove and discard the O-ring from the motor housing.

2. Clamp the drive shaft end of the piston motor in a protected jaw vise with the cap screws up. Remove the six cap screws (7) from the motor assembly.

3. Use a mallet and tap the backplate (8) to loosen and remove from housing.

4. Remove valve plate (13) and O-ring (9) from backplate. It is not necessary to remove roll pins in backplate.

5. Remove motor from vise and remove rotating assembly (14) from motor housing.

6. Remove the camplate insert (15) from housing (16). Use caution not to mar the finish that makes contact with pistons.

7. Remove retaining ring (1) from housing. Press shaft (3) from housing (16) and remove spacer (2).

8. Remove shaft (3) from housing.

9. Remove retaining ring (4) from shaft and remove thrust washers (5) and thrust bearing (6).

10. Discard the shaft seals and o-ring, and replace with new items upon reassembly.

Inspection

1. Check the condition of the needle bearing (12) in backplate (8) and replace if necessary.

2. Inspect valve plate (13) on the bronze side next to the piston block for wear. A smooth surface is required. **Do not lap valve plate bronze surface.** Replace valve plate if any wear exists.

3. Inspect the piston block surface that makes contact with valve plate. This surface should be smooth and free of deep scratches. **Do not lap piston block.**

4. The pistons should move freely in the piston block bore. If they are sticky in the bore, examine the bore for scoring or contamination.

5. Examine the O.D. of the pistons for finish condition. They should not show wear or deep scratches. Inspect the shoes for a snug fit on the ball end of the pistons and a flat smooth surface that comes in contact with the camplate. **Do not lap piston shoes.**

6. Examine the spider for wear in the pivot area.

7. Examine the pivot to insure smoothness and no signs of wear.

8. The polished finish on the shoe surface of the camplate insert (11) should show no signs of scoring.

9. Inspect the shaft (3) for wear in the seal, bearing and spline areas.

10. Inspect thrust bearing (6) and washers (5) for wear.

11. Check the condition of the needle bearing (17) in housing (16) and replace if necessary.

Assembly (Fig. 38)

1. Clean all parts in suitable solvent and lubricate all critical moving parts before reassembly.

2. If necessary, install new needle bearing (17) with numbered end of the bearing outward.

3. Install retaining ring (4). Install thrust washer (5), thrust bearing (6), and second thrust washer (5). Secure with second retaining ring (4).

4. Install shaft in housing. Install new shaft seal (2), and retaining ring (1).

5. Install camplate insert (15) with the lettering side of insert to the front of the housing. Use petroleum jelly to hold in place during assembly.

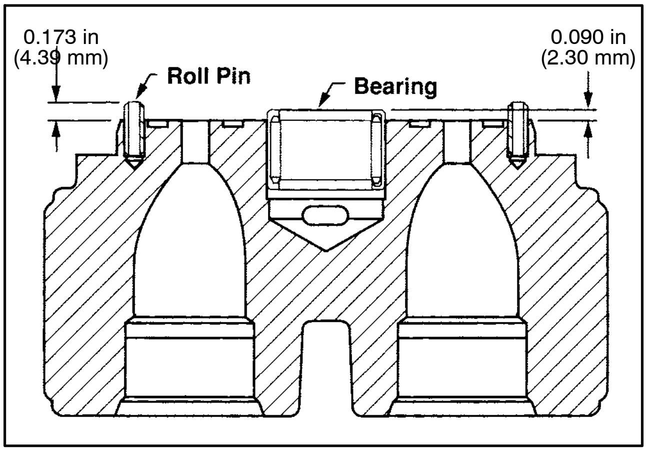


Figure 39

6. Clamp motor assembly in a protected jaw vise with the open end of the housing up.

7. If roll pins were removed, reinstall with opening of roll pin oriented away from bearing within 5 degrees of bearing center line (Fig. 39).

8. To replace bearing (12) in backplate, install bearing with number end of bearing facing up, next to valve plate (Fig. 39).

9. Apply small amount of petroleum jelly to the steel side of valve plate (13) to hold in place for installation. Place the valve plate in position onto the backplate with steel side against backplate, and the bronze colored side against piston block.

10. Placing new O-ring (9) onto backplate, place backplate assembly onto housing assembly. Make sure valve plate stays in position.

11. Insert the cap screws (7) and tighten to 15 to 18 ft-lbs. (20.3 to 24.4 Nm) in a criss-cross pattern.

12. Install the retaining rings, thrust washers, and drive gear on the motor shaft.

Note: A one-way overrunning clutch is pressed into the inner bore of the drive gear. When installing the drive gear on the motor shaft, make sure the lettering on the clutch faces the motor housing.

13. Place a new O-ring on the motor housing. Fill case half full of hydraulic oil and install on vehicle.

Hydraulic System

Reel Motor (Barnes)

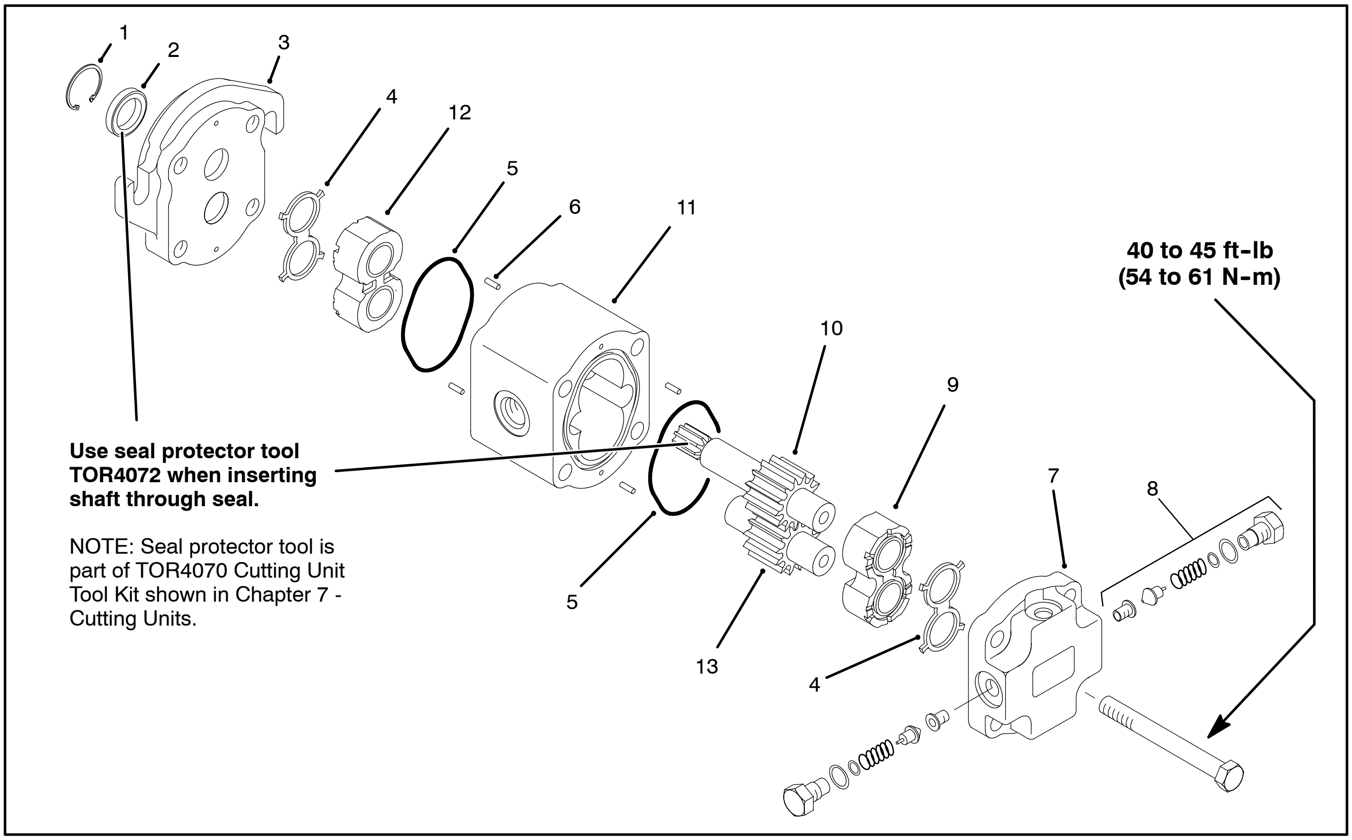


Figure 40

1. **Retaining Ring**
2. **Shaft Seal**
3. **Flange**
4. **E-Seal**
5. **O-ring**
6. **Dowel Pin**
7. **Valve Block**
8. **Adjusting Valve**
9. **Rear Bearing Block**
10. **Drive Gear**
11. **Gear Housing**
12. **Front Bearing Block**
13. **Idler Gear**

Removal

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

2. Disconnect hydraulic lines. Put caps or plugs on fittings and hoses to prevent contamination. Tag hydraulic lines for proper reassembly.

3. Loosen motor mounting nuts (Fig. 41).

4. Rotate motor clockwise so motor flanges clear studs and pull motor out.

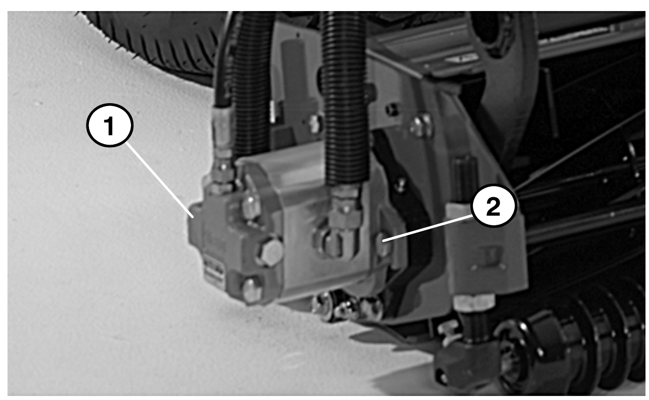


Figure 41

1. **Reel motor**
2. **Motor mounting nut**

Installation

1. Place motor into position on mounting studs. Rotate motor counterclockwise so motor flanges lock to studs.

2. Tighten motor mounting nuts.

3. Remove caps or plugs from fittings and hoses. Connect hydraulic lines lines to the motor.

Adjusting Valve (Cross-over Relief Valve) Service

Note: The adjusting valve (#8 Fig. 40) must be replaced as a complete assembly. Disassemble parts for cleaning and inspection only.

1. Disassemble the adjusting valve parts. **DO NOT** attempt to remove the valve seat. It is installed with thread locking compound at the factory.

2. Inspect adjusting valve bore and seat in valve block.

3. Inspect spring for damage.

4. Clean and air dry all parts. Apply hydraulic oil to parts and install in the same order they were removed.

Disassembly (Fig. 40)

Note: Parts must be replaced as a kit. Gears, gear housing and bearing blocks cannot be serviced separately. Replace complete motor if these parts are damaged or severely worn. Refer to your Parts Catalog for more information on available reel motor kits.

IMPORTANT: The motor is "run-in" at the factory to obtain precise parts tolerances. Keep housing, gears and bearings for each motor together. DO NOT mix parts between different motors.

1. Plug ports and wash exterior of motor with cleaning solvent.

2. Draw a line across seam areas on flange, gear housing and valve block with a scribe or marker to ensure proper reassembly.

IMPORTANT: Use caution when clamping in a vise to avoid distorting any parts.

3. Secure the flange end of the motor in a vise with the drive shaft pointing down.

4. Remove the four capscrews.

5. Put your hand on the case and gently tap case with a soft face hammer to loosen the sections. Be careful not to drop parts or disengage gear mesh.

6. Remove valve block.

7. Remove gear housing. Make sure rear bearing block remains on drive and idler gear shafts.

8. Remove rear bearing block from drive and idler gear shafts.

9. Before removing gear set, apply marking dye to mating teeth to retain "timing". Motor efficiency may be affected if the teeth are not installed in the same position during reassembly.

10. Remove idler gear.

11. Remove drive gear and shaft slowly until drive end is through shaft seal.

12. Remove front bearing block.

13. Wash all parts in cleaning solvent. Check all parts for burrs, scoring, nicks and other damage. If gears, housing or bearing blocks are damaged or severely worn, entire motor should be replaced.

Seal Replacement (Motor Disassembled)

1. Put flange on a clean, flat surface with shaft seal facing up. Remove retaining ring.

2. Remove shaft seal, being careful not to scratch seal bore in flange. Scratches in seal bore could cause leakage. Make sure seal bore is clean.

3. Put new shaft seal (part number side up) in seal bore and press seal into bore until seal reaches bottom of bore. Uniform pressure must be applied to face of shaft seal to prevent damage to seal and misalignment in seal bore.

4. Install retaining ring with sharp edge facing out.

E-seal Replacement

1. Put bearing block on a clean, flat surface with E-seal facing up. Remove E-seal. Clean E-seal groove.

2. Apply a light coating of grease or petroleum jelly in E-seal groove and on back (flat) side of new E-seal. Put E-seal, flat side up, into groove in bearing block.

3. Repeat for other bearing block.

O-ring Replacement

1. Remove dowel pins and O-rings from gear housing. Clean O-ring grooves.

2. Apply a light coating of grease or petroleum jelly to O-ring grooves in gear housing and install new O-rings in each groove.

Assembly (Fig. 40)

1. Put flange on a flat surface with shaft seal facing down. Make sure back side of flange is free of contamination.

2. Put front bearing block, seal side down, on flange.

3. Apply a light coating of oil to exposed face of bearing block. Put tape or seal protector tool (TOR4072) over splined end of drive shaft. Insert drive shaft through bearing block and shaft seal.

4. Put idler gear on bearing block. Apply a light coating of oil to back face of drive and idler gears.

5. Put rear bearing block, seal side up, on drive and idler gear shafts.

6. Install the two front dowel pins in the flange.

7. Carefully install gear housing over rear bearing block and slide gear housing down over the gears and front bearing block. Make sure the markings put on the flange and housing earlier line up.

8. The rear bearing block should sit just below back face of gear housing. If bearing block sits higher that rear face of housing, remove gear housing and check that E-seal or O-ring did not shift out of place during assembly.

9. Install remaining two dowel pins in rear of gear housing, then put end cover on back of motor.

10. After motor has been assembled, tighten capscrews by hand. Tighten the capscrews evenly in a crossing pattern to **40 to 45 ft-lb (54 to 61 N-m)**.

11. Put a small amount of hydraulic oil in port on motor and rotate driveshaft one revolution. Protect the shaft if using a pliers. If drive shaft binds, disassemble motor and repeat assembly process.

Reel Motor (Bosch)

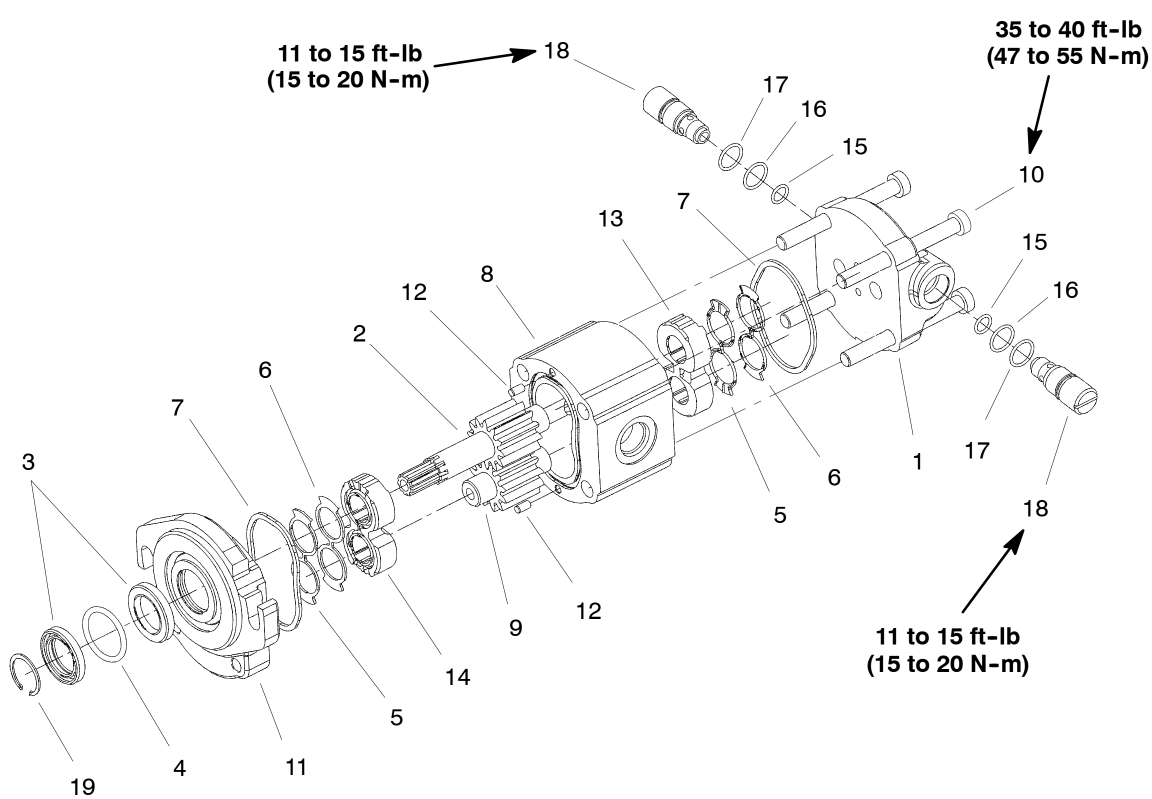


Figure 42

1. Rear Cover
2. Drive Gear
3. Seal
4. Washer (if used)
5. Pressure Seal
6. Back-up Ring
7. O-ring
8. Body
9. Idler Gear
10. Cap Screw (4 used)
11. Front Flange
12. Dowel Pin
13. Rear Bearing Block
14. Front Bearing Block
15. O-ring
16. O-ring
17. Back-up Ring
18. Relief Cartridge
19. Retaining Ring

Disassembly (Fig. 42)

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, body and rear cover to allow correct component alignment during assembly.

IMPORTANT: Avoid using excessive clamping pressure on the motor flange to prevent damage.

3. Clamp front flange of motor in a vise with the shaft end down. Use of a vise with soft jaws is recommended.

4. Loosen cap screws that secure rear cover.

5. Remove motor from vise and remove cap screws.

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

IMPORTANT: Mark the relative positions of the gear teeth and the bearing blocks 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. Place motor on its side and push on the rear bearing block to remove bearing block and gear set.

8. Carefully remove and discard o-rings, pressure seals and back-up rings from motor. Do not cause any damage to the machined grooves during the removal process.

IMPORTANT: Make sure to not damage the counter bore when removing the shaft seals from the front flange.

9. Position front flange with seal side up. Remove retaining ring, shaft seals and washer (if equipped).

10. Remove relief valves from rear cover. Discard sealing washers.

11. Wash all parts in cleaning solvent. Check all parts for burrs, scoring, nicks and other damage. If gears, housing or bearing blocks are damaged or severely worn, entire motor should be replaced.

Assembly (Fig. 42)

NOTE: When assembling the motor, check the marker line made during disassembly to make sure parts are properly aligned during assembly.

1. Lubricate new o-rings, pressure seals, back-up gaskets and seal grooves with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install new shaft seals and washer (if equipped) into front flange. Install retaining ring making sure that it is seated in flange groove.

3. Install lubricated pressure seals into the machined grooves of the bearing blocks and follow by carefully placing the back-up rings into the grooves.

4. Install lubricated o-rings to the body.

5. Lubricate gear faces and bearing surfaces of drive gear, idler gear and bearing blocks with clean hydraulic oil. Carefully assemble bearing blocks and gears noting identification marks made during disassembly.

6. Position the motor body on its side. Carefully slide bearing block and gear assembly into the body cavity using identification marks made during disassembly.

7. Remove any excess lubrication from mating surfaces of body, rear cover and front flange. Make sure that these surfaces are clean and dry.

8. Install dowel pins in body.

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

9. Gently slide the rear cover onto the assembly using marker line for proper location.

10. Position the motor with rear cover downwards. Carefully slide the front flange onto the assembly using marker line for proper location. Take care to not damage the seal during front flange installation. Firm hand pressure should be sufficient to engage the dowel pins.

11. Install the four (4) cap screws and hand tighten.

IMPORTANT: Avoid using excessive clamping pressure on the motor front flange to prevent damage.

12. Place motor front flange in a vise and alternately torque the cap screws from **35 to 40 ft-lb (47 to 55 N-m)**.

13. Lubricate and install new sealing washers on relief valves. Install relief valves into rear cover ports and torque from **11 to 15 ft-lb (15 to 20 N-m)**.

14. Put a small amount of hydraulic oil in port on motor and rotate shaft one revolution. Protect the shaft if using a pliers. If shaft binds, disassemble motor and repeat assembly process.

15. Remove motor from vise.

Hydraulic Control Manifolds

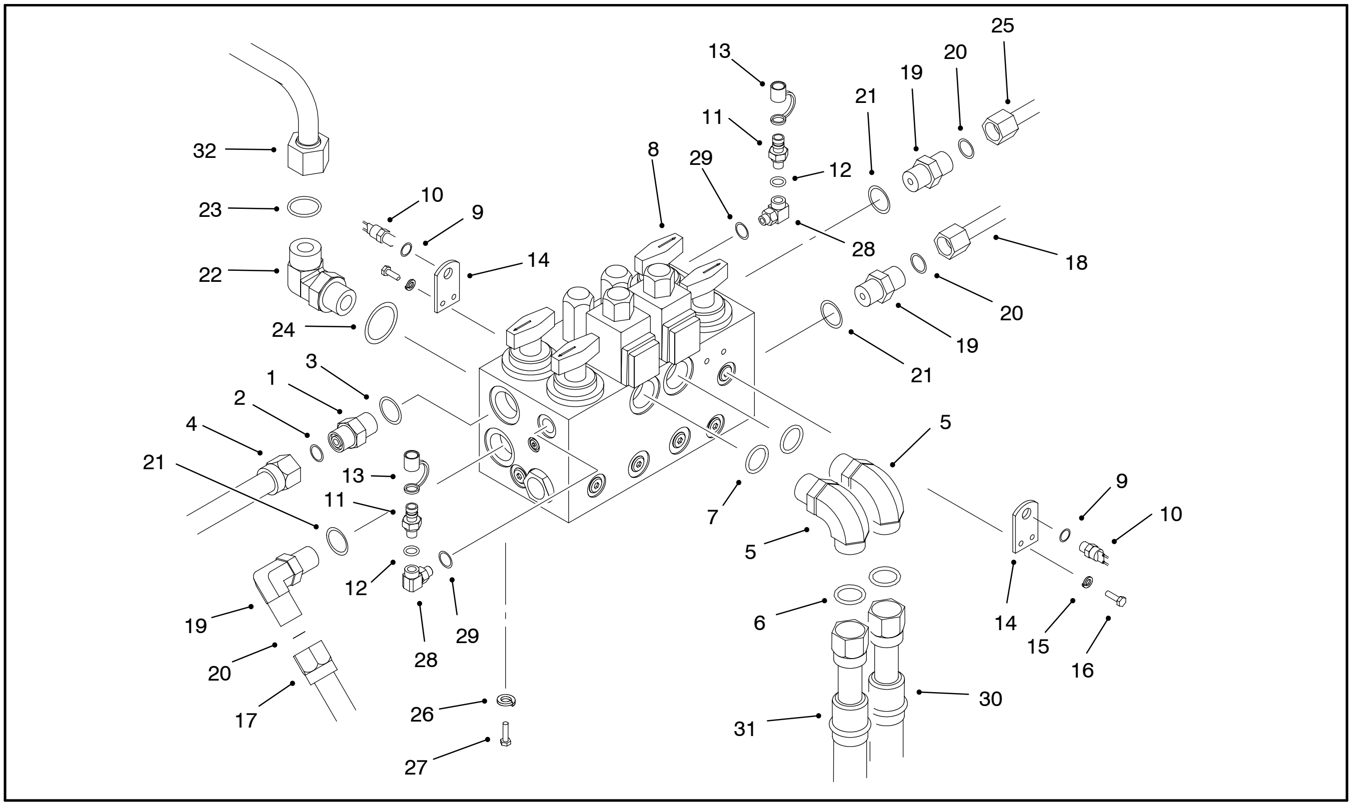


Figure 43
(Reel Manifold)

1. Straight Hydraulic Fitting
2. O-ring
3. O-ring
4. Hydraulic Tube
5. 90° Hydraulic Fitting
6. O-ring
7. O-ring
8. Control Manifold
9. Flat Washer
10. Safety Switch
11. Test Port Fitting
12. O-ring
13. Test Port Cap
14. Switch Bracket
15. Lock Washer
16. Cap Screw
17. Hydraulic Tube
18. Hydraulic Tube
19. Straight Hydraulic Fitting
20. O-ring
21. O-ring
22. 90° Hydraulic Fitting
23. O-ring
24. O-ring
25. Hydraulic Tube
26. Lock Washer
27. Cap Screw
28. 90° Hydraulic Fitting
29. O-ring
30. Hydraulic Hose
31. Hydraulic Hose
32. Hydraulic Tube

Reel Manifold Removal

Note: The ports on the manifold are marked for easy identification of components. Example: R1 is the reel circuit relief valve and P1 is a gear pump connection port. (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port).

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

1. Disconnect all electrical connectors from solenoid valves and switches.

2. Disconnect all hydraulic tubes and hoses.

3. Remove hydraulic manifold from the frame (Fig. 43).

Reel Manifold Installation

1. Install manifold to the frame.

2. Connect all hydraulic tubes and hoses.

3. Connect electrical connectors to all solenoid valves and switches (see Hydraulic Valve Solenoids in Chapter 5 - Electrical System).

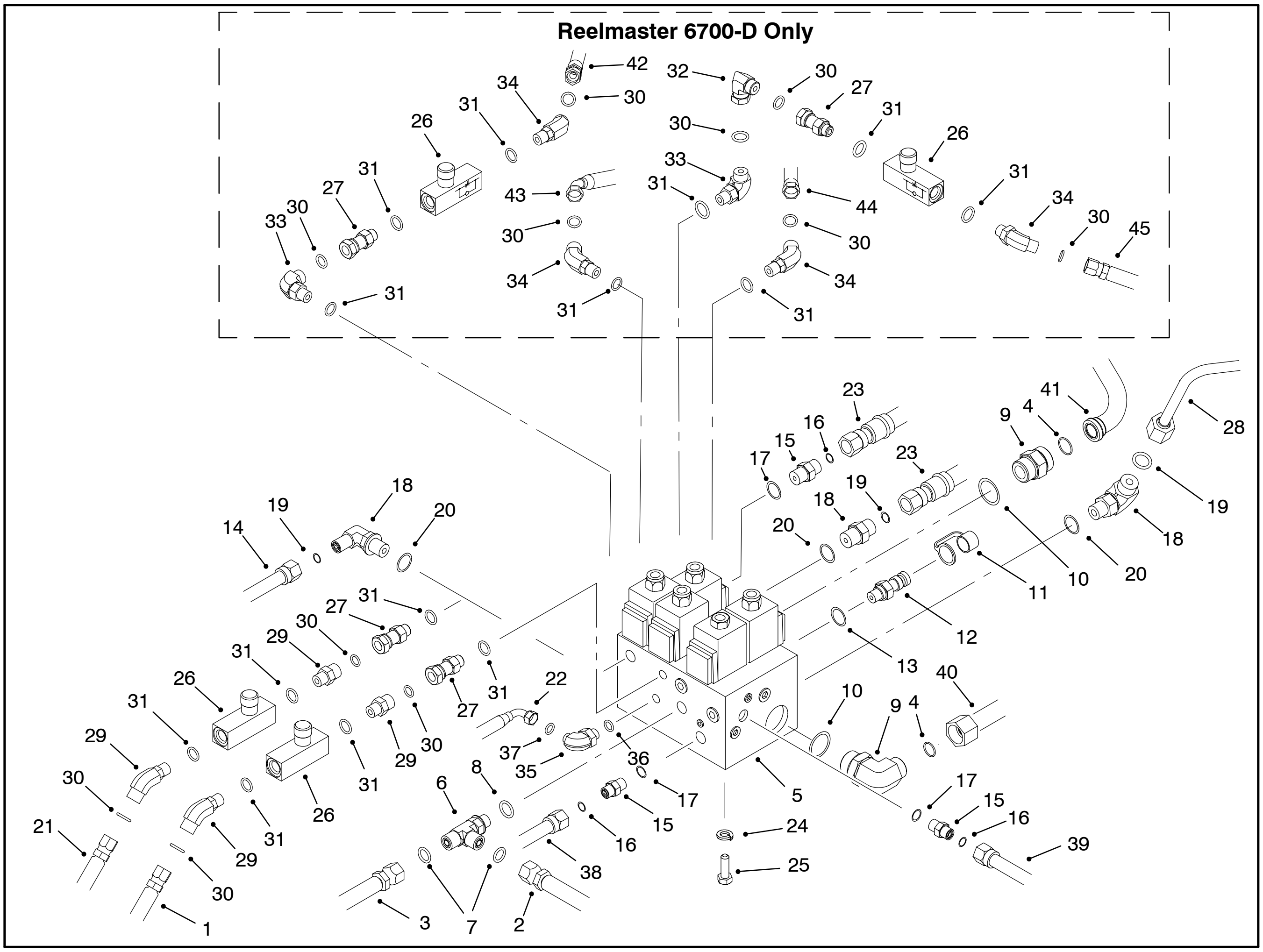


Figure 44
(Lift Manifold)

1. **Hydraulic Hose**
2. **Hydraulic Hose**
3. **Hydraulic Hose**
4. **O-ring**
5. **Lift Manifold**
6. **Hydraulic Tee Fitting**
7. **O-ring**
8. **O-ring**
9. **90° Hydraulic Fitting**
10. **O-ring**
11. **Test Port Cap**
12. **Test Port Fitting**
13. **O-ring**
14. **Hydraulic Tube**
15. **Straight Hydraulic Fitting**
16. **O-ring**
17. **O-ring**
18. **Straight Hydraulic Fitting**
19. **O-ring**
20. **O-ring**
21. **Hydraulic Hose**
22. **Hydraulic Hose**
23. **Hydraulic Hose**
24. **Lock Washer**
25. **Cap Screw**
26. **Flow Control Valve**
27. **Straight Hydraulic Fitting**
28. **Hydraulic Tube**
29. **45° Hydraulic Fitting**
30. **O-ring**
31. **O-ring**
32. **90° Hydraulic Fitting**
33. **90° Hydraulic Fitting**
34. **45° Hydraulic Fitting**
35. **90° Hydraulic Fitting**
36. **O-ring**
37. **O-ring**
38. **Hydraulic Tube**
39. **Hydraulic Tube**
40. **Hydraulic Tube**
41. **Hydraulic Tube**
42. **Hydraulic Hose**
43. **Hydraulic Hose**
44. **Hydraulic Hose**
45. **Hydraulic Hose**

Lift Manifold Removal and Installation (Fig. 44)

Note: The ports on the manifold are marked for easy identification of components. Example: R1 is the reel circuit relief valve and P1 is a gear pump connection port. (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port).

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

1. Disconnect all electrical connectors from solenoid valves (see Hydraulic Valve Solenoids in Chapter 5 - Electrical System).

2. Disconnect all hydraulic tubes and hoses.

3. Remove hydraulic manifold from the frame.

4. Install lift manifold in reverse order.

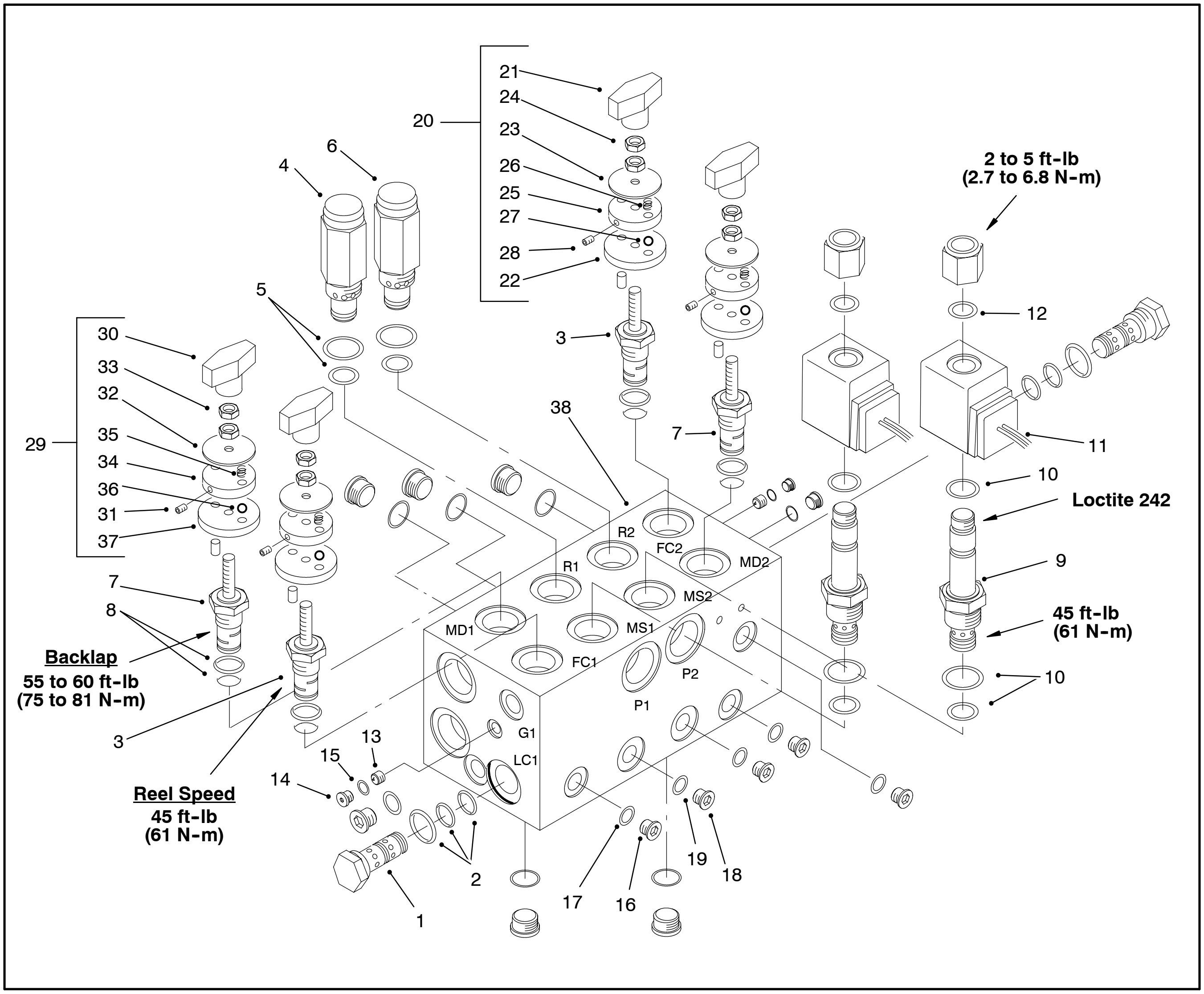


Figure 45
(Reel Manifold For Units With Serial No. Below 260000500)

1. **Logic Cartridge**
2. **Seal Kit**
3. **Rotary Cartridge Valve (flow control)**
4. **Relief Cartridge Valve (3000 psi)**
5. **Seal Kit**
6. **Relief Cartridge Valve (2000 psi)**
7. **Rotary Cartridge Valve (4 way)**
8. **Seal Kit**
9. **Cartridge Valve (N.O.)**
10. **Seal Kit**
11. **Solenoid (20 watt)**
12. **Solenoid Seal**
13. **Orifice Plug**
14. **Plug**
15. **O-ring**
16. **Plug**
17. **O-ring**
18. **Plug**
19. **O-ring**
20. **Detent Kit**
21. **Knob**
22. **Locating Plate**
23. **Indicator Plate**
24. **Jam Nut**
25. **Detent Plate**
26. **Detent Spring**
27. **Detent Ball**
28. **Set Screw**
29. **Detent Kit**
30. **Knob**
31. **Locating Plate**
32. **Indicator Plate**
33. **Jam Nut**
34. **Detent Plate**
35. **Detent Spring**
36. **Detent Ball**
37. **Set Screw**

Note: The ports on the manifold(s) are marked for easy identification of components. Example: R1 is the reel circuit relief valve and P1 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

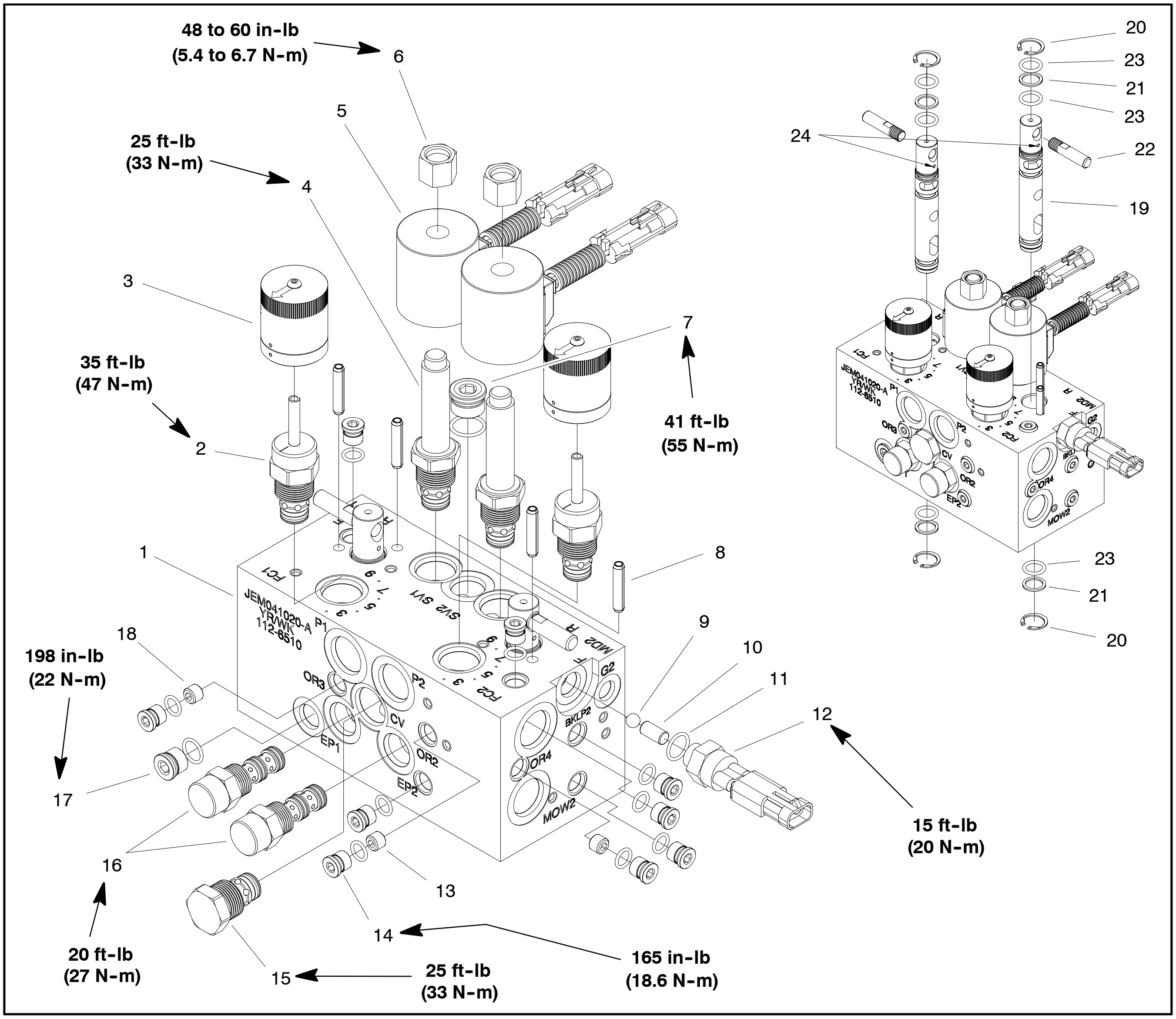


Figure 47
(Reel Manifold For Units With Serial No. Above 260000500)

1. **Reel Manifold**
2. **Rotary Cartridge Valve (FC1 & FC2)**
3. **Rotary Handle**
4. **Solenoid Relief Valve (SV1 & SV2)**
5. **Solenoid**
6. **Nut**
7. **Plug (Zero Leak #8)**
8. **Spring Pin (4 Used)**
9. **Ball**
10. **Dowel Pin**
11. **O-ring**
12. **Backlap Switch (NO) (2 Used)**
13. **Orifice (.063) (OR1 & OR2)**
14. **Plug (Zero Leak #4) (14 Used)**
15. **Check Valve (CV)**
16. **Logic Cartridge (EP1 & EP2)**
17. **Plug (Zero Leak #6) (11 Used)**
18. **Orifice (.007) (OR3 & OR4)**
19. **Mow/Backlap Spool (2 Used)**
20. **Retaining Ring**
21. **Backup Ring**
22. **Spool Handle**
23. **O-ring**
24. **Spool Orientation Dot**

Note: The ports on the manifold(s) are marked for easy identification of components. Example: R1 is the reel circuit relief valve and P1 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

Note: The mow control manifold shown in Figure 47 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 to provide 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. When installing plugs into the control manifold, torque plugs to the values identified in Figure 47.

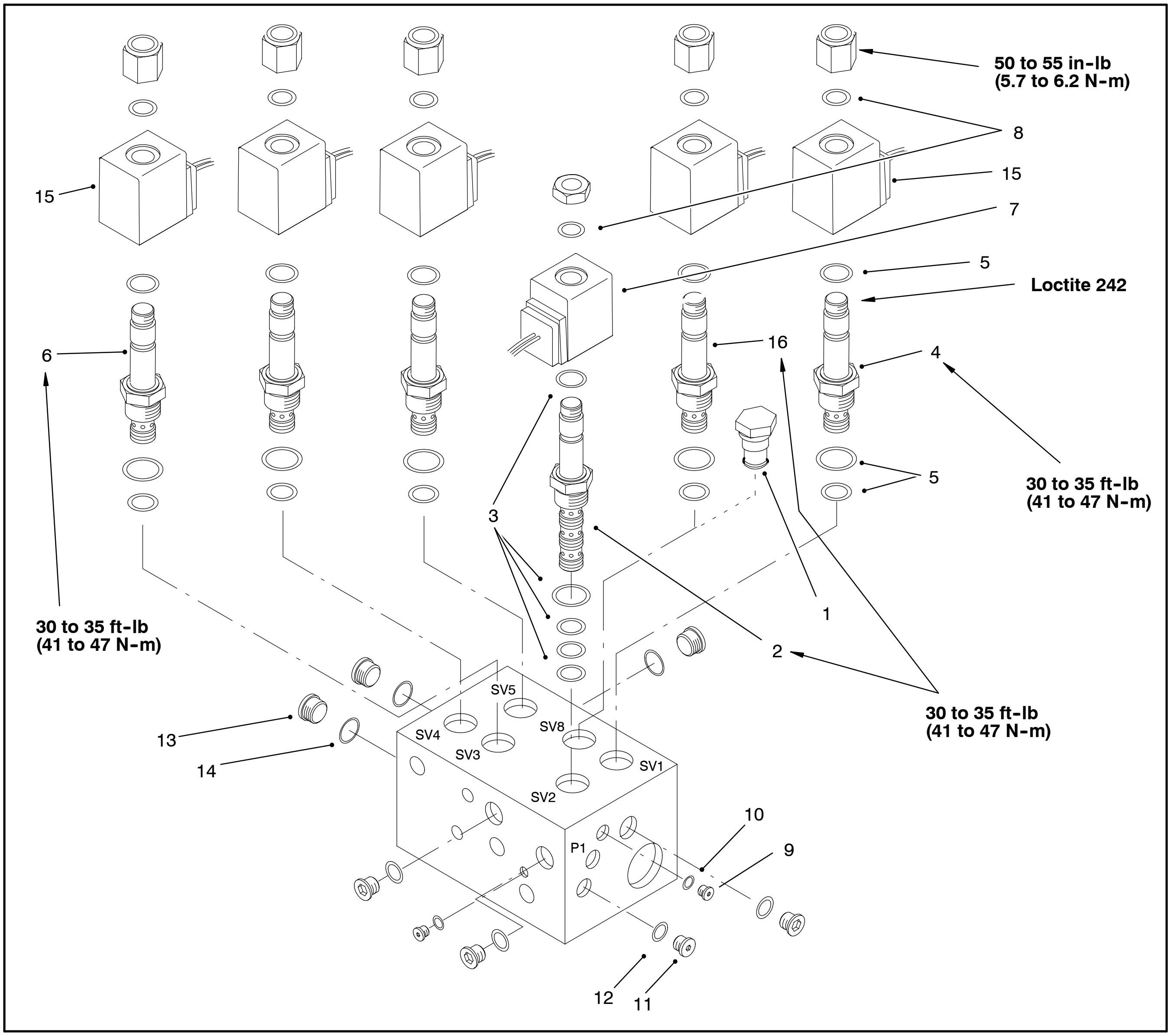


Figure 48
(Lift Manifold For Units With Serial No. Below 280000000 (RM6500-D Shown))

1. **Plug (unit serial no. 210000001 - 219999999)**
2. **Cartridge Valve (4 way)**
3. **Seal Kit**
4. **Cartridge Valve (N.O.)**
5. **Seal Kit**
6. **Cartridge Valve (N.C.)**
7. **Solenoid (28 watt)**
8. **Solenoid Seal**
9. **Plug**
10. **O-ring**
11. **Plug**
12. **O-ring**
13. **Plug**
14. **O-ring**
15. **Solenoid (20 watt)**
16. **Cartridge Valve (Check 1 way) (unit serial no. 220000001 & up)**

Note: The ports on the manifold(s) are marked for easy identification of components. Example: P1 and P2 are the gear pump connection ports (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

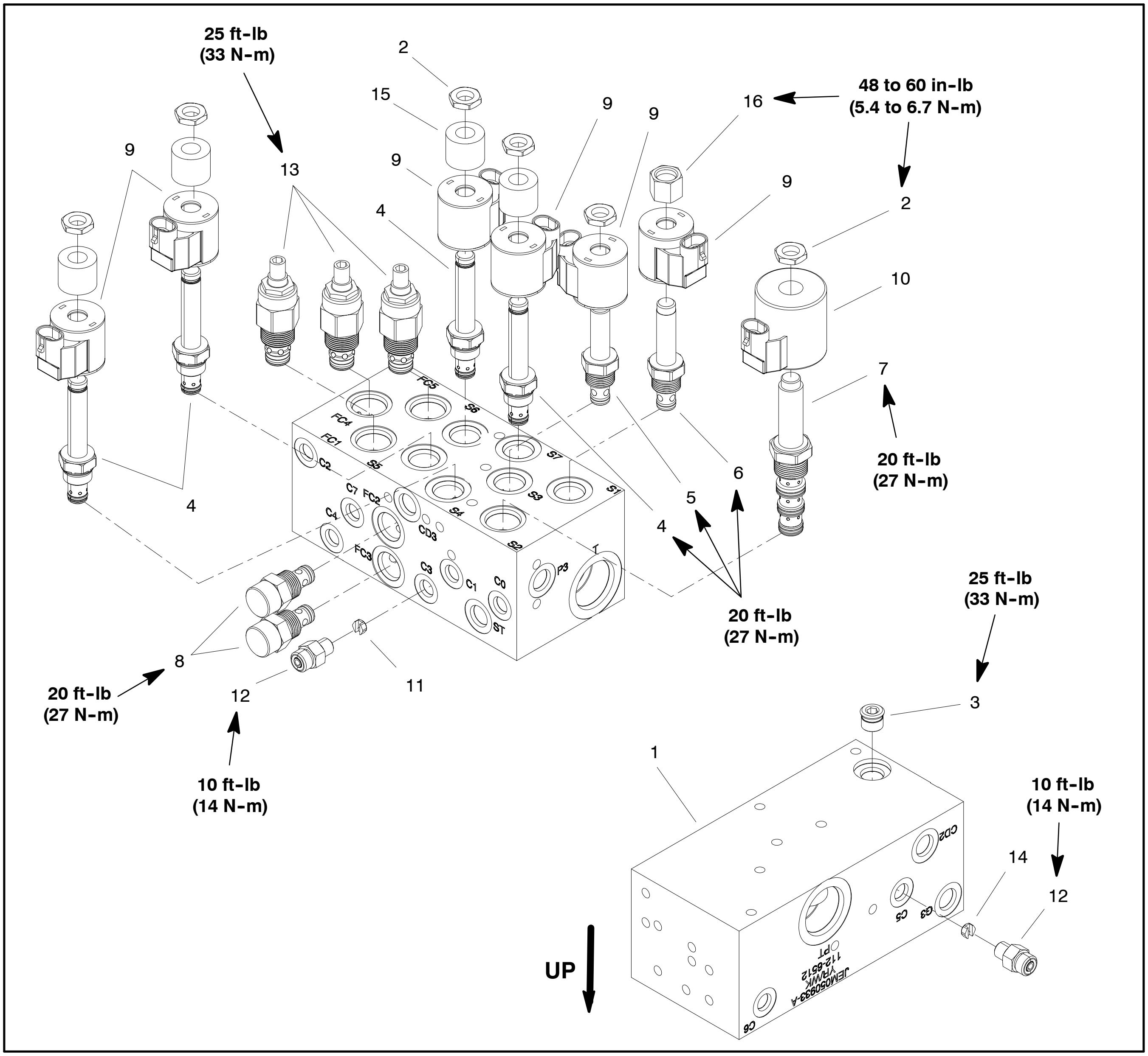


Figure 49
(Lift Manifold For RM6500-D Units With Serial No. Above 280000000)

1. **Lift manifold block**
2. **Nut**
3. **NWD-6 plug**
4. **Solenoid blocking valve (4 used)**
5. **Solenoid valve (S3)**
6. **Solenoid valve (S1)**
7. **Solenoid valve (S2)**
8. **Flow control valve (2 used)**
9. **Solenoid coil (6 used)**
10. **Solenoid coil**
11. **Orifice (.063)**
12. **Straight fitting (2 used)**
13. **Flow control (3 used)**
14. **Orifice (.100)**
15. **Solenoid coil spacer**
16. **Nut**

Note: The ports on the manifold(s) are marked for easy identification of components. Example: S1 is a solenoid valve and P3 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The lift control manifold shown in Figure 49 uses a zero leak plug (item 3). This plug has a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plug also has an o-ring to provide 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. When installing plug into the control manifold, torque plug **25 ft-lb (33 N-m)**.

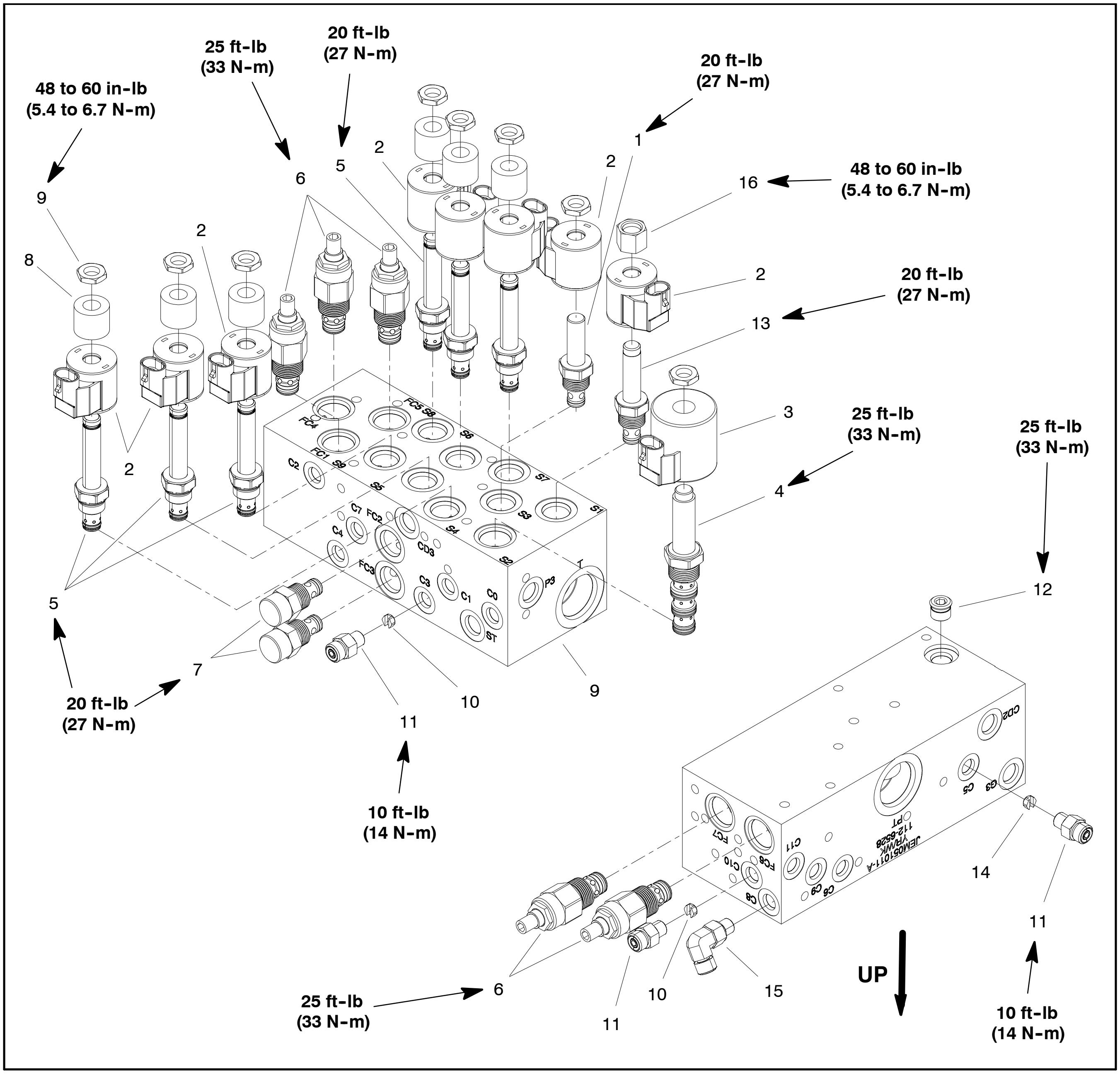


Figure 50
(Lift Manifold For RM6700-D Units With Serial No. Above 280000000)

1. **Solenoid valve (S3)**
2. **Solenoid coil (8 used)**
3. **Solenoid coil**
4. **Solenoid valve (S2)**
5. **Solenoid blocking valve (6 used)**
6. **Flow control valve (5 used)**
7. **Flow control valve (2 used)**
8. **Solenoid coil spacer**
9. **Lift manifold block**
10. **Orifice (.063)**
11. **Straight fitting (3 used)**
12. **NWD-6 plug**
13. **Solenoid valve (S1)**
14. **Orifice (.100)**
15. **90° hydraulic fitting**
16. **Nut**

Note: The ports on the manifold(s) are marked for easy identification of components. Example: S1 is a solenoid valve and P3 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The lift control manifold shown in Figure 50 uses a zero leak plug (item 12). This plug has a tapered sealing surface on the plug head that is designed to resist vibration induced plug loosening. The zero leak plug also has an o-ring to provide 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. When installing plug into the control manifold, torque plug **25 ft-lb (33 N-m)**.

Solenoid Operated, Relief and Logic Cartridge Valves

1. Make sure the manifold is clean before removing the cartridge valve and seal kit.

Note: Solenoid valves used in mow manifold (Fig. 45) and lift manifold (Fig. 47) have an O-ring on each side of coil.

2. For solenoid valves, remove nut securing solenoid to the cartridge valve. Slide solenoid and O-rings (if equipped) off the valve.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

3. Remove cartridge valve with a deep socket wrench. Remove seal kit from valve.

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

5. Cleaning cartridge valves:

A. For non-solenoid operated valves:
Submerge valve in clean mineral spirits to flush out contamination. If valve design allows, use a probe to push the internal spool in and out 20 to 30 times to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Clean and dry cartridge with compressed air.

B. For solenoid operated valves:
Temporarily install solenoid on cartridge valve and connect a 12 volt power source to the solenoid. While energized, flush out any contamination with a non-flammable aerosol brake cleaner. De-energize the solenoid. Repeat the flush while energized procedure 5 or 6 times. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Remove solenoid.

6. Reinstall the cartridge valve:

A. Lubricate new O-rings and backup rings of seal kit with clean hydraulic oil and install. The O-ring and backup ring must be arranged properly on the cartridge valve for proper operation and sealing.

B. Thread spool valve carefully into port. The valve should go in easily without binding.

IMPORTANT: Use care when handling the cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction.

C. Torque cartridge valve using a deep socket to specification shown in manifold illustration.

Note: On manifolds shown in Figures 45 and 47, solenoids have an O-ring on each side of the coil. Also, on these manifolds, apply Loctite 242 or equivalent to the threads of the valve before installing the coil nut.

7. For solenoid valves, install solenoid coil and O-rings (if equipped) to the cartridge valve. Torque nut to specification shown in manifold illustration.

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

Rotary Cartridge Valves

1. Remove knob assembly (reel manifold shown in Figure 45):

A. Unscrew and remove knob. Remove both jam nuts.

B. Slide off indicator plate being careful not to lose springs. Remove spring.

C. Loosen set screw and slide detent plate off the cartridge valve stem.

D. Remove locating plate with pin from the cartridge valve stem and manifold.

2. Remove rotary handle (reel manifold shown in Figure 46) (Fig. 48):

A. Loosen two (2) set screws that secure handle cap.

B. Remove screw and then lift handle cap from valve.

C. Locate and retrieve detent pin, compression spring, bushing and lip seal. The sleeve bearing should stay in the cap.

D. Loosen two (2) set screws that secure handle base to flow control valve and remove base.

3. Make sure manifold is clean before removing the cartridge valve. Remove the valve and seal kit.

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

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

B. If 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.

5. If necessary, 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. Clean and dry with compressed air.

6. Reinstall the rotary cartridge valve:

Note: Mow manifold (Fig. 45) uses two types of manual rotary cartridge valves: flow control (reel speed - size 10) and 4-way directional control (backlap - size 12). Installation torque values are different for each type.

A. Lubricate new O-ring and backup ring of seal kit with clean hydraulic oil and install. The O-ring and backup ring of seal kit must be arranged properly on the cartridge valve for proper operation and sealing.

B. Thread valve carefully into the port. The valve should go in easily without binding. Torque valve to specification shown in manifold illustration.

7. Install knob assembly (reel manifold shown in Fig. 45):

A. Install locating plate so that the pin seats into the locating hole.

B. Turn the threaded cartridge valve stem carefully clockwise until it stops.

C. Face detent plate counterbore down. Thread detent plate down onto the valve stem until it is stopped by the locating plate. Turn detent plate back counterclockwise 1/4 turn.

D. Center one detent plate hole over a locating plate indentation. Drop a ball into each hole, then drop a spring into each hole.

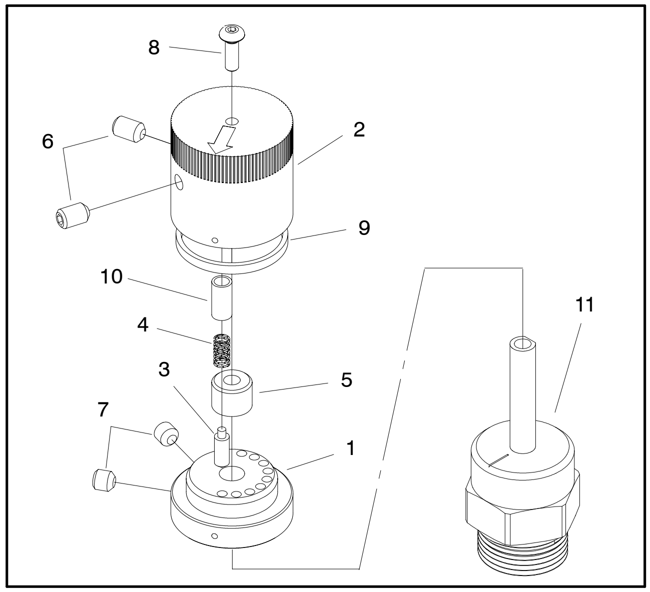


Figure 48

1. **Handle Base**
2. **Handle Cap**
3. **Detent Pin**
4. **Compression Spring**
5. **Bushing**
6. **Set Screw (2 used)**
7. **Set Screw (2 used)**
8. **Screw**
9. **Lip Seal**
10. **Sleeve Bearing**
11. **Flow Control Valve**

E. On the 2-position directional valve cartridge, place indicator plate over the detent plate. Make sure the arrow points directly at the number 1 on the locating plate.

F. On flow control cartridge valve cartridge, place indicator plate over the detent plate. Make sure the arrow points to the right at 45°.

G. While pushing down on the indicator plate and compressing the springs, thread down a jam nut. While tightening the set screw, tighten jam nut at the same time using a 7/16 - inch wrench.

H. Thread second jam nut all the way down the valve stem. Apply ”Loctite 242” or equivalent the valve stem threads. Screw knob all the way down until it hits the upper jam nut.

I. On 2-position directional cartridge valve cartridge, turn knob counterclockwise so the arrow is 90° with the back of the manifold. Simultaneously tighten upper jam nut and turn knob so it is tight and the arrow is pointing 45° to the right in line with the indicator plate.

J. On flow control valve cartridge, turn knob counterclockwise until the arrow points at the number ”5”. Simultaneously tighten upper jam nut and turn knob so it is tight and the arrow is pointing at the number ”1” on the locating plate.

8. Install rotary handle (reel manifold shown in Fig. 46) (Fig. 48):

A. Place handle base on flow control valve and position alignment mark on base with number 1 on manifold. Secure base with two (2) set screws. Apply a light coating of grease to chamfer on top of base to ease seal installation.

B. Make sure that sleeve bearing is in handle cap. If necessary, press sleeve bearing into cap. Install lip seal on cap with seal lip facing down.

C. Place bushing onto cartridge valve stem. Use a small amount of grease to keep bushing toward the top of the valve stem.

D. Place compression spring and detent pin into handle cap. Use a small amount of grease to hold detent pin in place.

E. Make sure that flow control valve is closed by rotating valve stem fully clockwise. During handle installation, DO NOT rotate valve stem or speed adjustment will be incorrect.

F. Press handle cap onto valve stem with arrow on cap pointing to number 9 on manifold. Make sure that detent pin and spring stay positioned in cap.

G. While pressing on the cap to keep the lip seal in place, rotate cap in a clockwise direction until the arrow on the cap aligns with number 1 on the manifold. By rotating the cap clockwise, the valve will remain closed. Install screw to retain cap.

H. Make sure that alignment marks on cap and base are in line and that arrow on cap is pointing to number 1 on manifold. Tighten two (2) set screws to secure handle cap.

Mow/Backlap Spools (Reel Manifold Shown in Fig. 46)

1. Remove spool from mow manifold (Fig. 46):

A. Remove backlap switch 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 mow/backlap spool. Raise mow/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. Visually inspect the spool and manifold port for damage to the sealing surfaces, damaged threads and contamination.

3. Install spool into mow manifold (Fig. 46):

A. Install o-rings and back-up ring to upper grooves on spool. Apply a light coating of grease to o-rings.

B. Carefully push 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 mow/backlap spool until upper retaining ring groove on spool is exposed on top of manifold. Install upper retaining ring.

D. Push mow/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. 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 15 ft-lb (20 N-m).

Lift Cylinders

Removal and Installation

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. Disconnect hydraulic hoses from lift cylinder.

3. Remove/install lift cylinders.

Front Center (#1)

A. Remove retaining ring from the cylinder rod end pin. Remove cylinder pin with remaining retaining ring and thrust washers from the lift arm and cylinder clevis (Fig. 49).

B. Remove self tapping screw from cylinder pin and carrier frame. Pull cylinder pin from carrier frame and cylinder clevis (Fig. 49).

C. Install in reverse order. Use a drop of medium strength thread locking compound to secure the self tapping screw.

Front Right or Front Left (#4 or 5)

A. Remove retaining ring from the cylinder rod end pin. Remove cylinder pin with remaining retaining ring and thrust washers from the lift arm and cylinder clevis (Fig. 50).

B. Remove self tapping screw from cylinder pin and carrier frame. Pull cylinder pin from carrier frame and cylinder clevis (Fig. 50).

C. Install in reverse order. Use a drop of medium strength thread locking compound to secure the self tapping screw.

Rear (#2 or 3)

A. Remove retaining ring from the cylinder rod end pin. Remove cylinder pin with remaining retaining ring and thrust washers from the lift arm and cylinder clevis (Fig. 51).

B. Remove retaining ring from the cylinder cap end pin. Remove cylinder pin with remaining retaining ring from the frame and cylinder clevis (Fig. 51).

C. Install in reverse order.

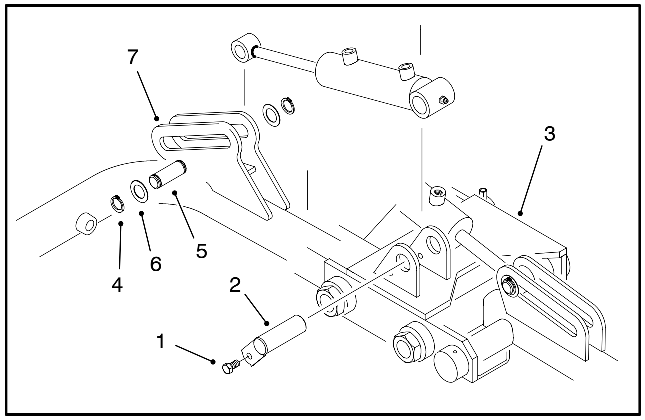


Figure 49

1. **Self Tapping Screw**
2. **Cylinder Pin**
3. **Carrier Frame**
4. **Retaining Ring**
5. **Cylinder Rod End Pin**
6. **Thrust Washer**
7. **Lift Arm**

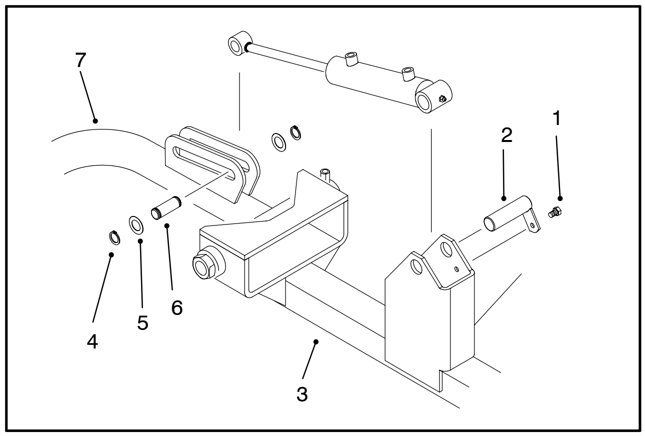


Figure 50

1. **Self Tapping Screw**
2. **Cylinder Pin**
3. **Carrier Frame**
4. **Retaining Ring**
5. **Cylinder Rod End Pin**
6. **Thrust Washer**
7. **Lift Arm**

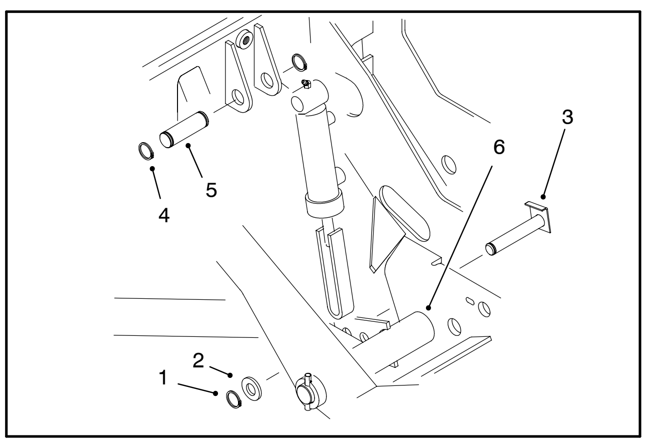


Figure 51

1. **Retaining Ring**
2. **Thrust Washer**
3. **Cylinder Rod End Pin**
4. **Retaining Ring**
5. **Cylinder Cap End Pin**
6. **Lift Arm**

Rear (6700-D #6 or 7 Only)

A. Remove both lock nuts and upper link plate. Remove upper link and rollers from the lift arm and cylinder clevis (Fig. 52).

B. Remove retaining ring from the cylinder cap end pin. Remove cylinder pin with remaining retaining ring from the frame and cylinder clevis (Fig. 52).

C. Install in reverse order. Use a drop of medium strength thread locking compound to secure the lock nuts.

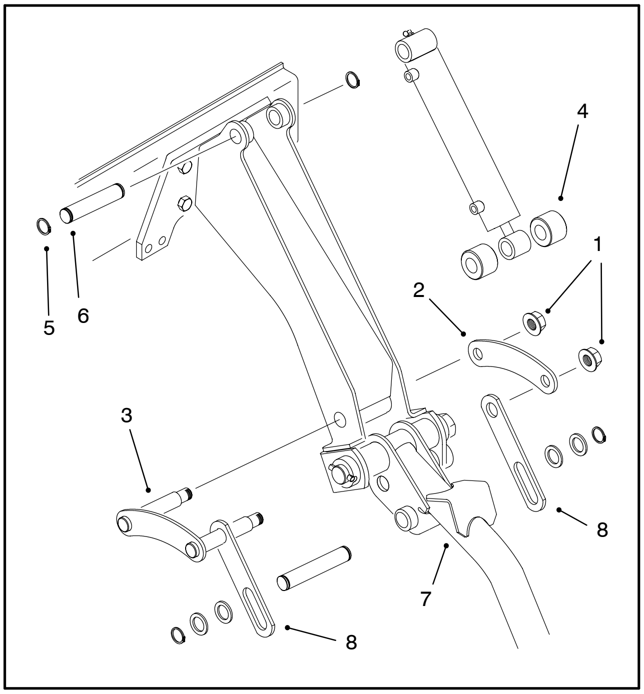


Figure 52

1. Lock Nut	**5. Retaining Ring**
2. Upper Link Plate	**6. Cylinder Cap End Pin**
3. Upper Link	**7. Lift Arm**
4. Roller	**8. Lower Link Plate**

Hydraulic System

Lift Cylinder Service

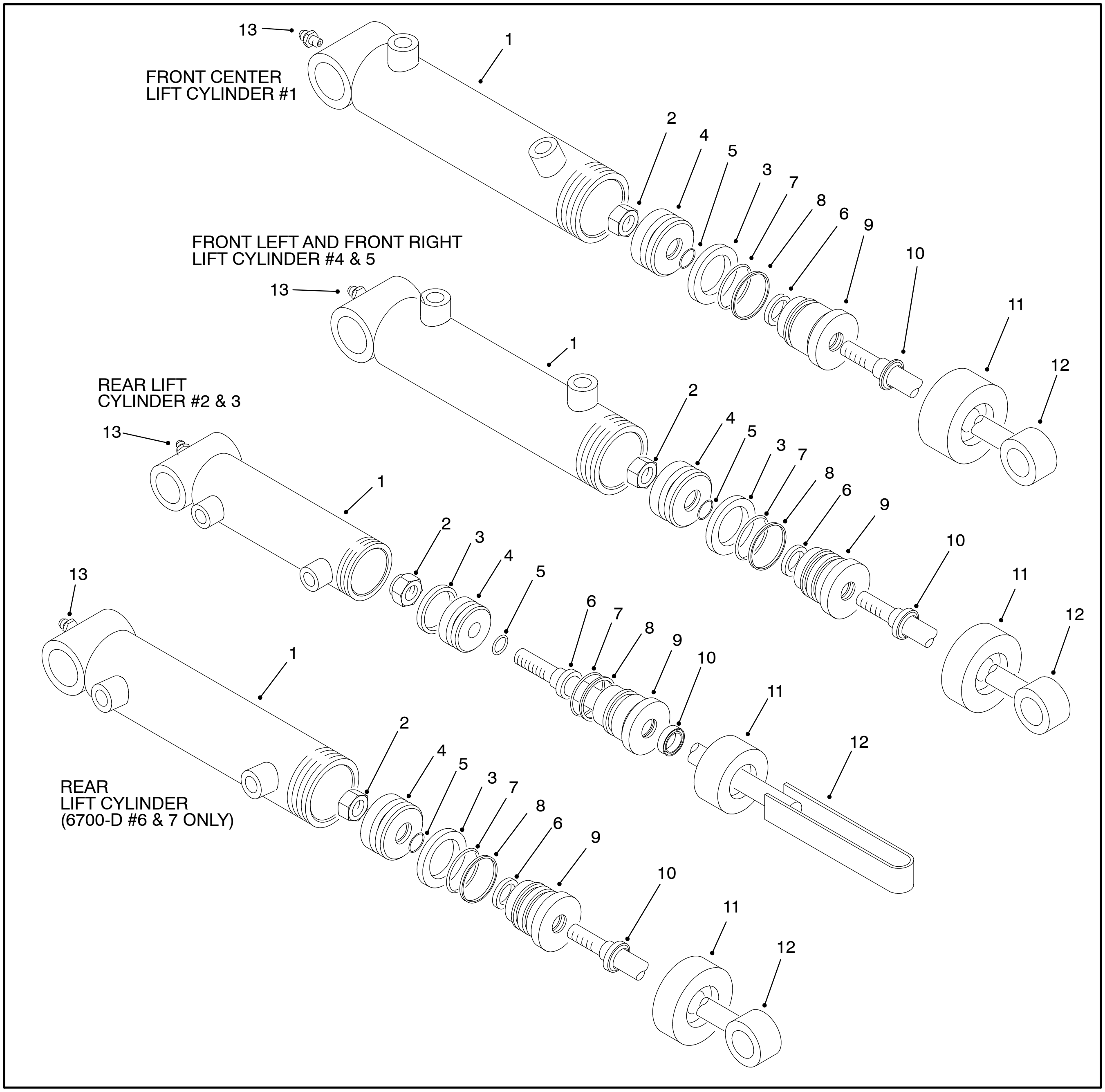


Figure 53

1. **Barrel with Clevis**
2. **Nut**
3. **Uni-ring**
4. **Piston**
5. **O-ring**
6. **Rod Seal**
7. **O-ring**
8. **Back-up Ring**
9. **Head**
10. **Dust Seal**
11. **Collar**
12. **Shaft with Clevis**
13. **Grease Fitting**

Disassembly (Fig. 53)

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's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder into a vice. Remove collar with a spanner wrench.

3. Extract shaft, head, and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

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

5. Remove Uni-ring and O-ring from the piston. Remove O-ring, back-up ring, rod seal, and dust seal from the head.

Assembly (Fig. 53)

1. Make sure all parts are clean before Assembly.

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

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

   B. Install dust seal, O-ring, back-up ring, and dust seal to the head.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

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

   A. Coat shaft with clean hydraulic oil.

   B. Slide head onto the shaft. Install rod seal onto shaft and into head.

Steering Cylinder (2WD)

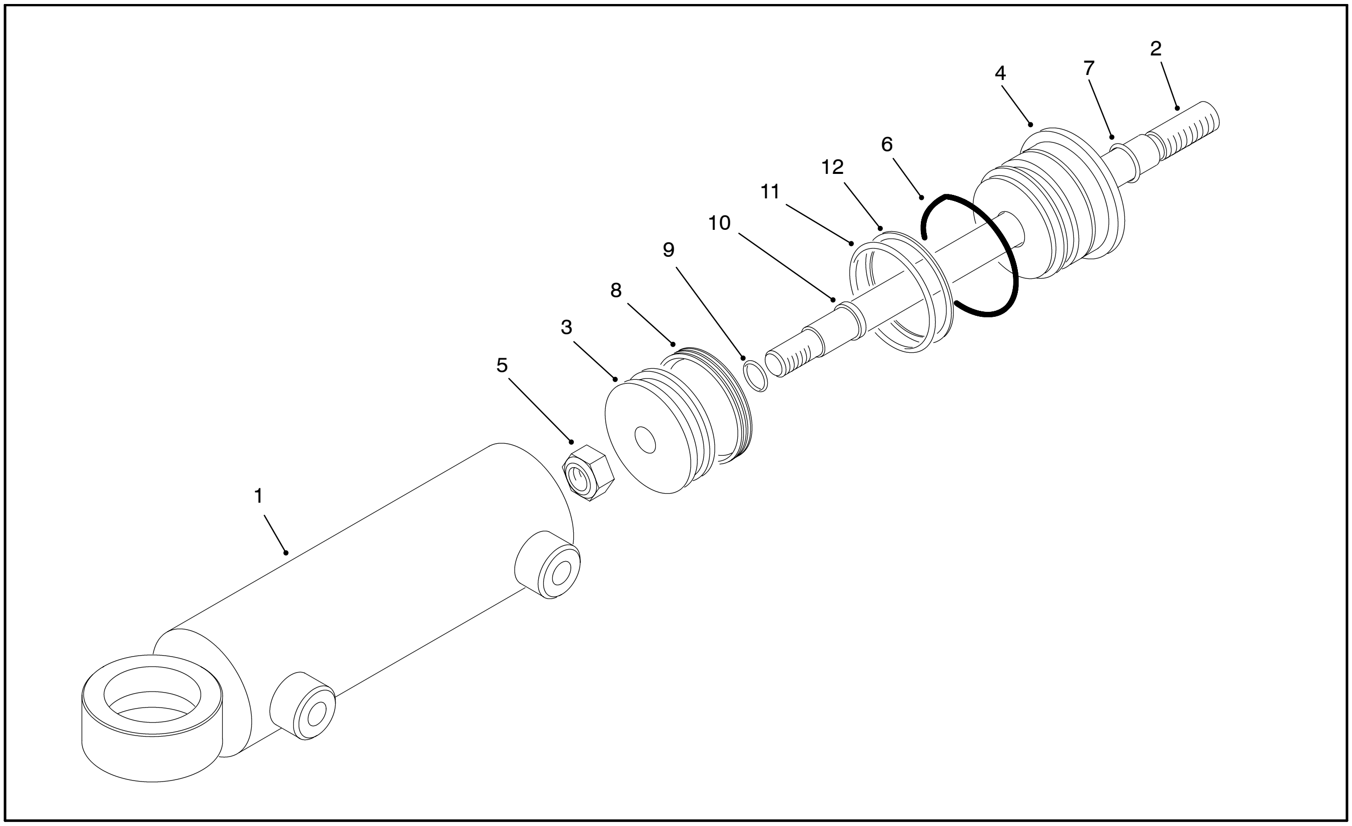


Figure 54

1. **Barrel with Clevis**
2. **Piston Rod**
3. **Piston**
4. **Gland**
5. **Nut**
6. **Retaining Ring**
7. **Dust Seal**
8. **Uni-ring**
9. **O-ring**
10. **Rod Seal**
11. **O-ring**
12. **Backup Ring**

Disassembly (Fig. 54)

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.

1. After removing cylinder, pump oil out of cylinder into a drain pan by SLOWLY moving rod and piston in and out of cylinder bore.

2. Plug ports and clean outside of cylinder.

3. Mount cylinder in a vise so piston rod end of cylinder is tilted up slightly. Do not close vise so firmly that cylinder tube could become distorted. Loosen gland.

4. Remove gland retaining ring.

5. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod, and head from cylinder barrel.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vise.

6. Securely mount piston, piston rod, and head into vise and remove nut.

7. Remove piston.

8. Remove all seals and O-rings.

9. Wash parts in a safe solvent. Dry parts with compressed air. DO NOT wipe them dry with a cloth or paper as lint and dirt may remain.

10. 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. 54)

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of oil on all new seals and O-rings. Install the new seal and O-rings.

2. Install piston onto piston rod with O-ring seal (item 9) and tighten hex nut.

3. Put a coating of oil on all cylinder parts to ease assembly.

4. Slide piston rod assembly into cylinder tube.

5. Install gland and retaining ring.

Steering Cylinder (4WD)

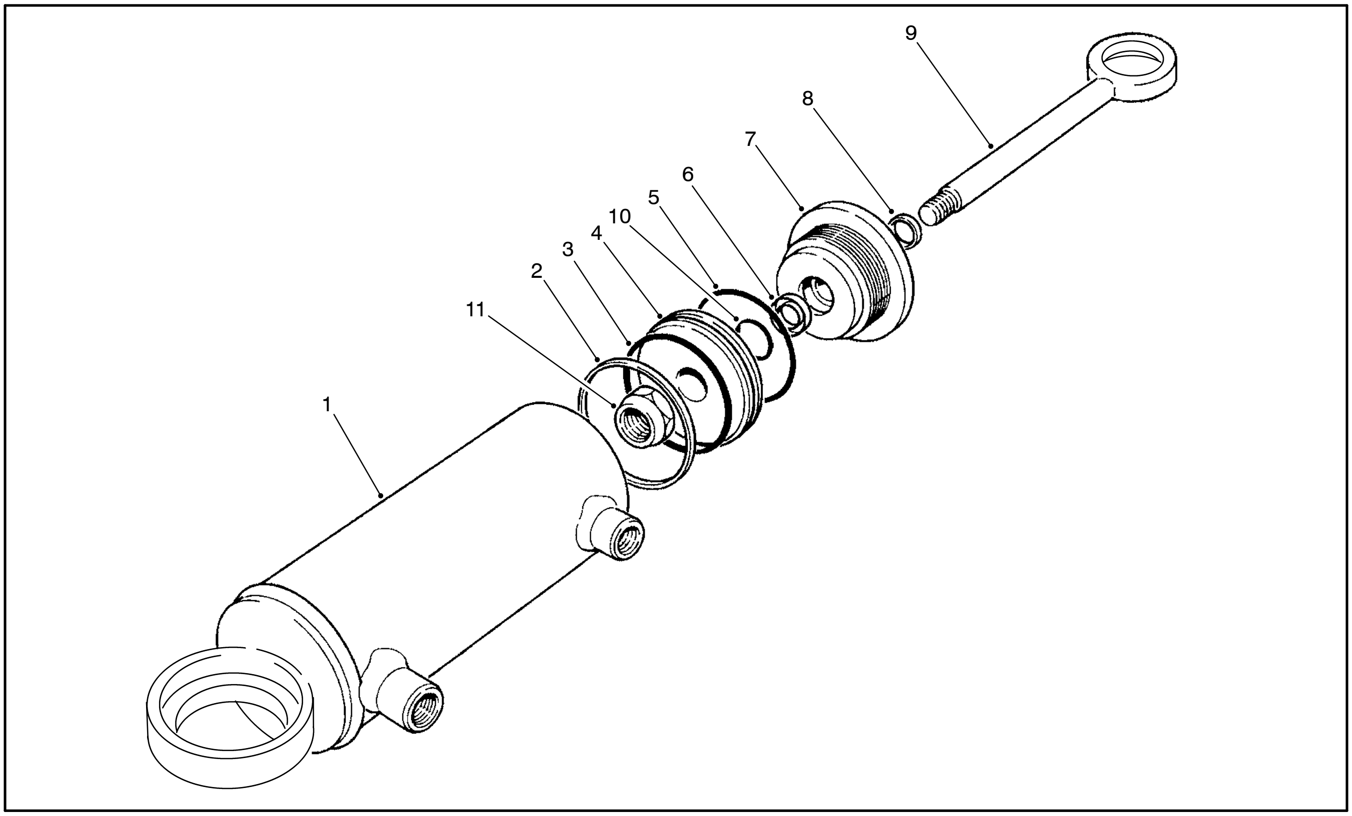


Figure 55

1. **Barrel with Clevis**
2. **PTFE Seal**
3. **O-ring**
4. **Piston**
5. **O-ring**
6. **U-cup**
7. **Gland**
8. **Wiper**
9. **Piston Rod Assembly**
10. **O-ring**
11. **Locknut**

Disassembly (Fig. 55)

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.

1. After removing cylinder, pump oil out of cylinder into a drain pan by SLOWLY moving rod and piston in and out of cylinder bore. Plug ports and clean outside of cylinder.

2. Mount cylinder in a vise so piston rod end of cylinder is tilted up slightly. Do not close vise so firmly that cylinder tube could become distorted. Loosen gland.

3. Grasp end of piston rod and use a twisting and pulling motion to carefully extract piston, piston rod, and head from cylinder barrel.

4. Securely mount piston, piston rod, and head into vise and remove nut. Remove piston.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

5. Remove all seals and O-rings.

6. Wash part in a safe solvent. Dry parts with compressed air. DO NOT wipe them dry with a cloth or paper as lint and dirt may remain.

7. 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. 55)

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of oil on all new seals, and O-rings. Install the new seal and O-rings.

2. Install piston onto piston rod with O-ring seal (10) and tighten hex nut.

3. Put a coating of oil on all cylinder parts to ease assembly.

4. Slide piston rod assembly into cylinder tube and install gland.

Power Steering

The Reelmaster® 6500-D/6700 is equipped with power steering. The power steering valve is enclosed in the steering tower at the front of the traction unit. As the steering wheel is turned, the steering valve meters hydraulic fluid to the double-acting steering cylinder on the rear axle and turns the wheels. Hydraulic fluid flow for power steering is supplied by section P3 of the hydraulic pump. The steering section of the pump has a built-in relief valve.

Note: Because the steering cylinder has different displacements when extended and retracted, the steering wheel will not return to its original position after making a turn.

Note: The steering system will operate with the engine off if necessary (with increased effort).

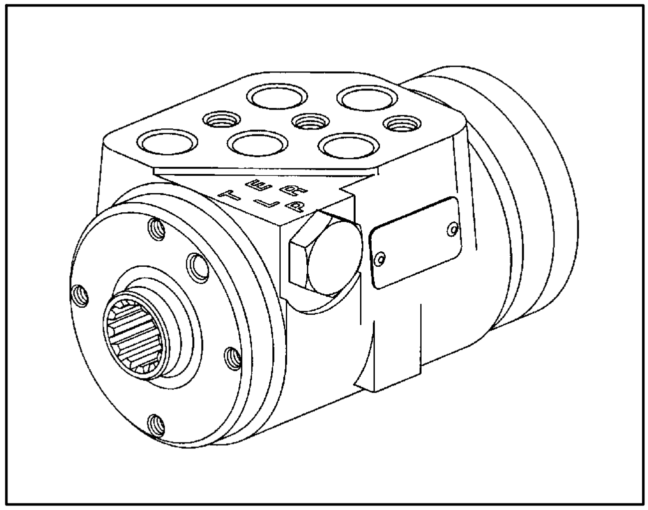


Figure 56

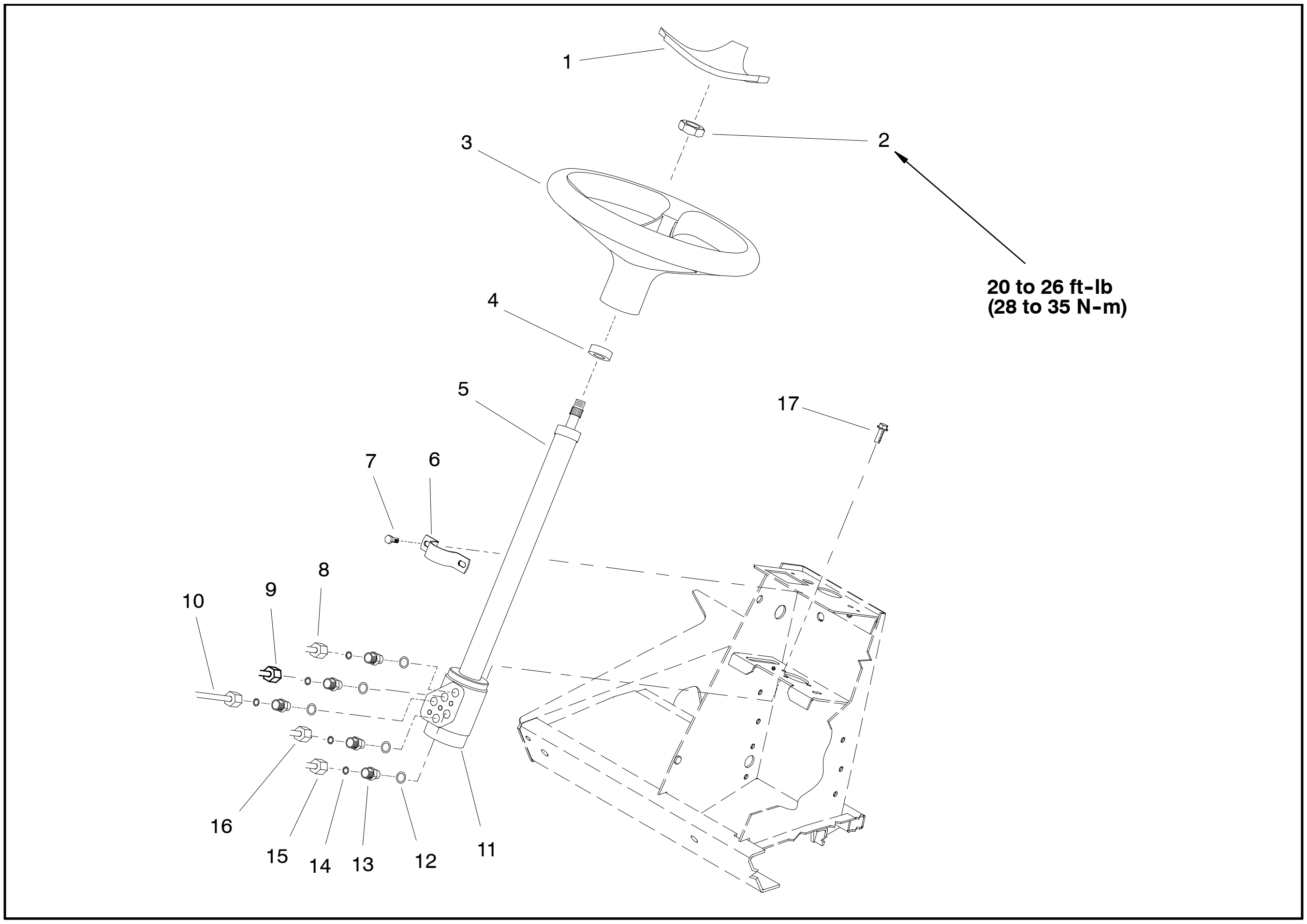


Figure 57

1. Steering wheel cover
2. Nut
3. Steering wheel
4. Dust cover
5. Steering column
6. Clamp
7. Flange head screw (2 used)
8. Hydraulic tube
9. Hydraulic tube
10. Hydraulic tube
11. Steering valve
12. O-ring
13. Hydraulic fitting (5 used)
14. O-ring
15. Hydraulic tube
16. Hydraulic tube
17. Flange head screw (3 used)

Steering Valve

Removal (Figs. 57 and 58)

1. Engage the parking brakes, lower the cutting units to the ground, turn the engine OFF and remove the key from the ignition switch.

2. Remove the front center cutting unit (see Chapter 7-Cutting Units in this manual).

3. Remove cap screws and cover from steering tower.

4. Clean outside of the steering valve and the area around the hydraulic fittings. Disconnect hydraulic lines from steering valve (Fig. 58). Put caps or plugs on all fittings and lines to prevent contamination.

Note: To ease reassembly, tag each of the lines to show their correct position on the steering cylinder.

5. Remove the steering wheel:

   A. Remove cover from center of steering wheel.

   B. Remove the lock nut that secures the steering wheel to the shaft.

   C. Pull the steering wheel and dust cover off the steering valve shaft.

Note: It may be necessary to use a jaw-type puller to remove the steering wheel from the steering shaft.

IMPORTANT: DO NOT hit the steering shaft with a hammer. This could damage the steering valve components.

6. Remove the clamp securing the steering column to the steering tower.

7. Remove three (3) flange head screws securing steering valve to steering tower.

8. Carefully move hydraulic lines to the side and pull steering valve and column out through bottom of steering tower.

Installation (Figs. 57 and 58)

1. Carefully feed the steering valve and column into the steering tower through the bottom.

2. Install three (3) flange head screws and the clamp securing steering valve to steering tower.

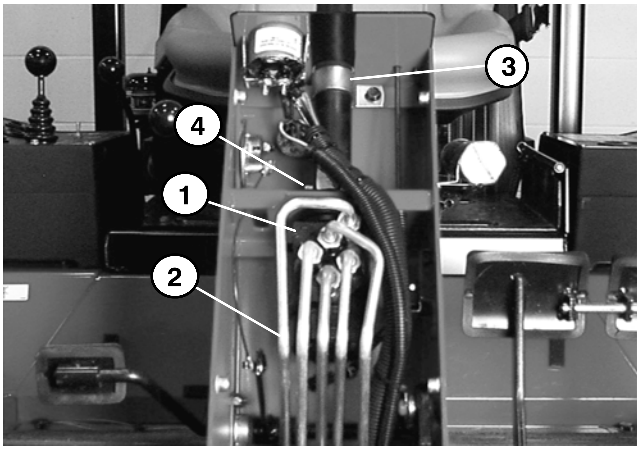


Figure 58

1. Steering Valve	**3. Clamp**
2. Hydraulic Line	**4. Flange Head Screw**

3. Install the steering wheel:

   A. Use the steering wheel to put the rear wheels in the straight ahead position.

   B. Slide the dust cover and the steering wheel onto the steering shaft and secure the steering wheel in place with the lock nut. Tighten the nut from 20 to 26 ft-lbs. (28 to 35 Nm).

   C. Install steering wheel cover.

4. Connect hydraulic lines. Bleed the hydraulic system and check hydraulic connections for leaks (see “Bleeding the Hydraulic System” in this section of this manual).

5. Check hydraulic connections for leaks.

6. Install cap screws and cover to steering tower.

7. Install the front center cutting unit (see Chapter 7-Cutting Units in this manual).

Steering Valve Service

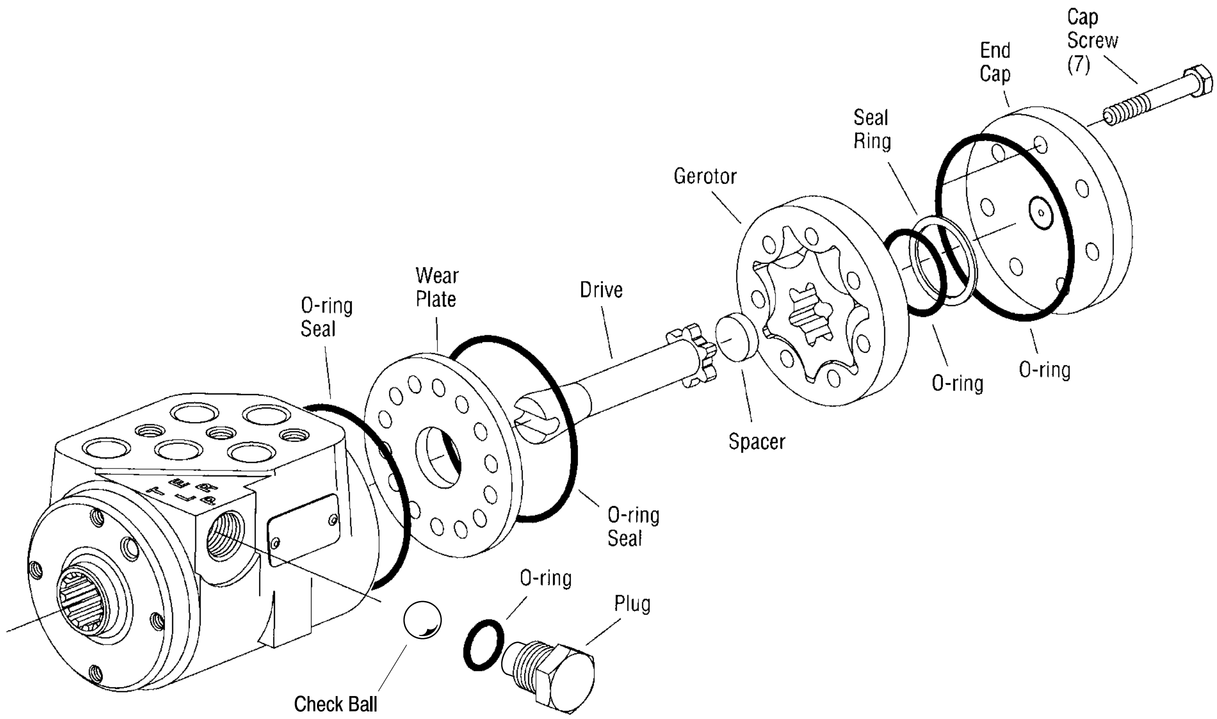


Figure 59

Disassembly

Note: Cleanliness is extremely important when repairing steering control units. Work in a clean area. Before disconnecting the hydraulic lines, clean the port area of the steering control unit. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior. During repairs, always protect machined surfaces.

1. Remove the seven capscrews and disassemble the steering control unit as shown (Fig. 59).

2. Remove the plug and check ball.

3. Slide the spool and sleeve from the housing (Fig. 60).

4. Remove the thrust bearing and bearing races.

5. Remove the quad seal.

6. Use a small blade screwdriver to carefully pry the dust seal from the housing. Be careful to not damage the dust seal seat.

7. Remove the pin that holds the spool and sleeve together (Fig. 61).

8. Carefully slide the spool out of the sleeve. The springs and retaining ring will stay with the spool as it is removed.

CAUTION

The centering springs are under tension. Remove the retaining ring carefully.

9. Remove the retaining ring and springs.

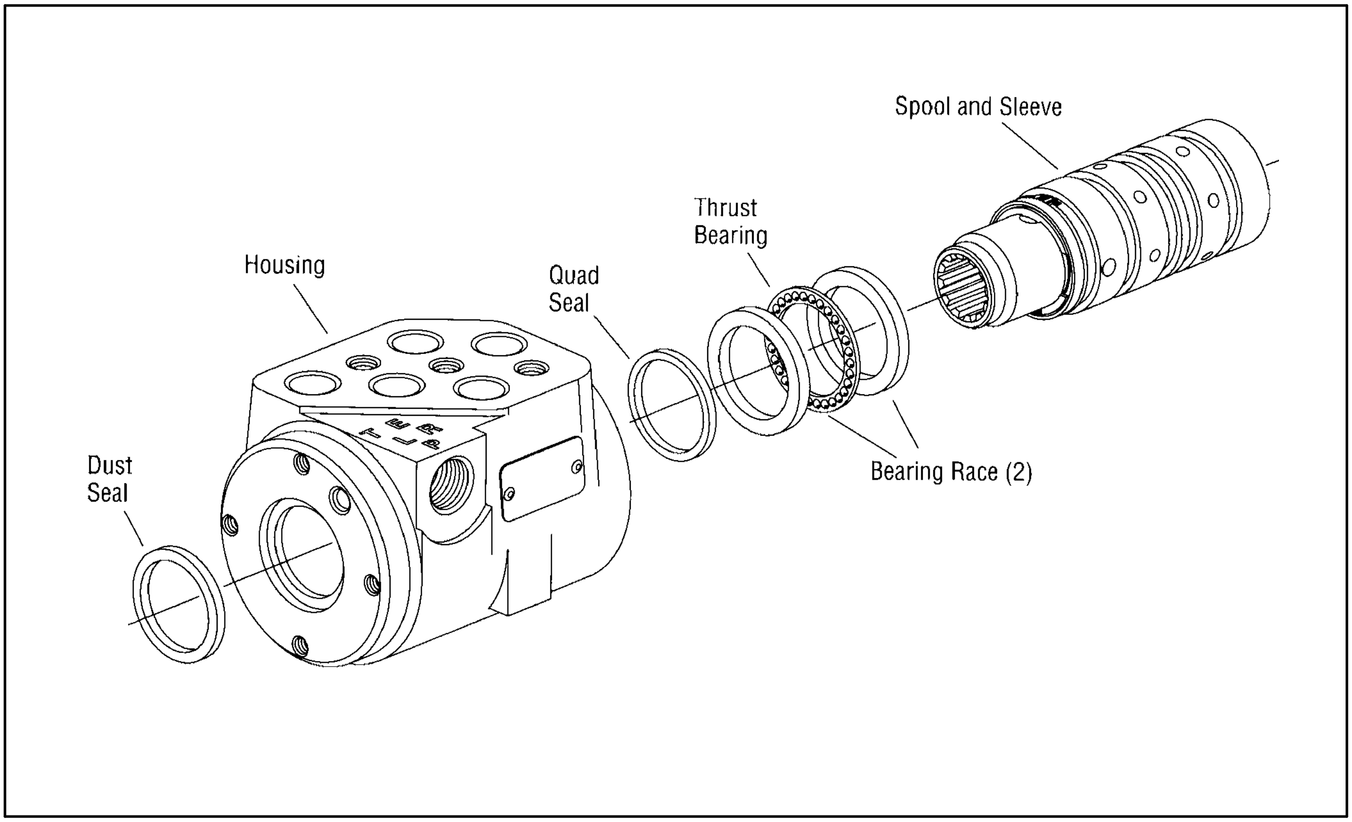


Figure 60

Assembly

Check all mating surfaces. Replace any parts with scratches or burrs that could cause leakage. Wash all metal parts in clean solvent. Blow them dry with pressurized air. Do not wipe parts dry with paper towels or cloth. Lint in a hydraulic system will cause damage.

Note: Always use new seals when reassembling the steering control unit.

IMPORTANT: During reassembly, lubricate the new seals with petroleum jelly. Also lubricate machined surfaces and bearings with clean hydraulic fluid.

1. Install the quad seal:

   A. Put one of the bearing races and sleeve into the housing.

   B. Together, the housing and bearing race create a groove into which the quad seal will be installed.

   C. Hold the bearing race tightly against the input end of the housing by pushing on the gerotor end of the sleeve.

   D. Fit the quad seal into its seat through the input end of the housing. Be sure the seal is not twisted.

   E. Remove the sleeve and bearing race.

2. Lubricate and install the dust seal (Fig. 62).

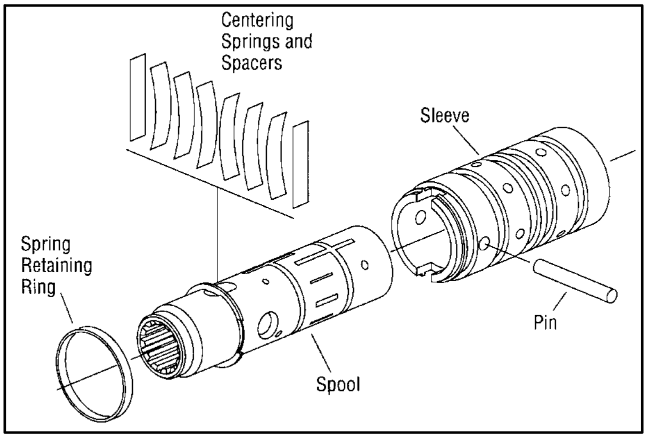


Figure 61

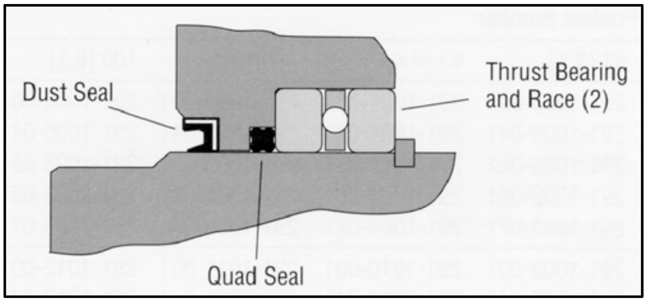


Figure 62

3. Install the centering springs in the spool (Fig. 61). It is best to install the two flat pieces first. Next, install the curved pieces, three at a time.

4. Fit the retaining ring over the centering springs.

5. Apply a light coating of clean hydraulic fluid to the spool and slide it into the sleeve. Be sure the centering springs fit into the notches in the sleeve.

6. Install the pin.

7. Apply a light coating of petroleum jelly to the inner edge of the dust and quad seals.

8. Put the thrust bearing and races into the housing. The thrust bearing goes between the two races (Fig. 60).

9. Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly and slide it into the housing.

IMPORTANT: Do not damage the dust or quad seals.

10. Clamp the housing in a vise (Fig. 63). Use just enough clamping force to hold the housing securely.

11. Lubricate and install a new o-ring seal in the groove in the housing.

12. Install the wear plate and align the holes in the wear plate with threaded holes in the housing.

Note: The holes in the wear plate are symmetrical.

13. Install the drive, making sure the slot in the drive engages the pin.

14. Lubricate and install a new o-ring seal in the groove in the wear plate.

15. Install the gerotor and align the screw holes.

16. Lubricate and install a new o-ring seal in the groove in the gerotor ring.

17. Lubricate and install a new o-ring and seal ring in the groove in the gerotor star.

18. Install the spacer.

19. Install the end cap and seven capscrews. Tighten the capscrews, in a crossing pattern, to a torque to 140 - 160 in-lb (16 - 18 Nm).

20. Remove the steering control unit from the vise.

21. Install the check ball and plug. Use a new o-ring and tighten the plug to 150 in-lb (17 Nm).

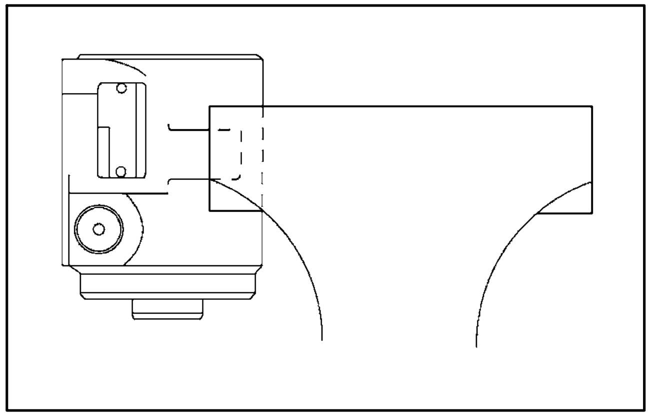


Figure 63

Solenoid Valve SV10 and SV11 Service (RM 6700-D Only)

Removal

Note: Solenoid valves SV10 and SV11 provide oil flow to the reel motors of cutting units #6 & 7 (see Hydraulic Schematics and Flow Diagrams in this section of this manual).

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

1. Make sure the area around the valve is clean before removing the valve.

2. Disconnect the electrical connector from the solenoid valve.

3. Disconnect all hydraulic tubes and hoses.

4. Remove solenoid valve from the frame.

Inspection (Fig. 64)

1. Remove solenoid coil nut and coil.

Note: Use care when handling the cartridge valve. Slight bending or distortion of the tube assembly can cause binding and valve malfunction.

2. Remove the adapter, tube assembly, and spool from the valve body. Record the spool orientation for correct reassembly.

3. Clean adapter, tube assembly, spool, and valve body in clean mineral spirits to flush out contamination. Clean and dry with compressed air.

CAUTION

Use eye protection such as goggles when using compressed air.

4. Visually inspect all ports for damage to the sealing surfaces, damaged threads, 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 sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

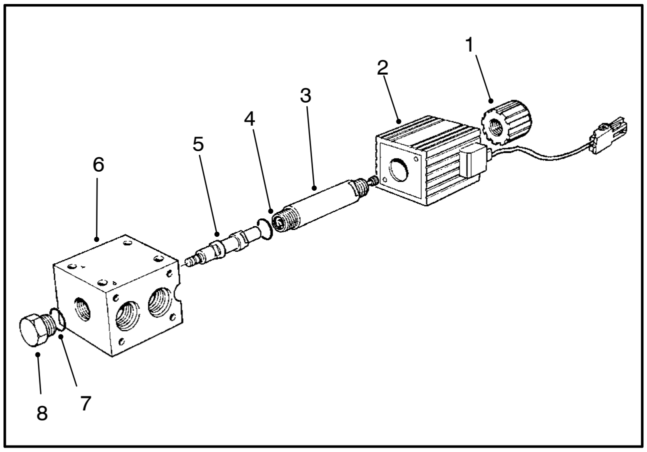


Figure 64

1. **Coil Nut**
2. **Solenoid Coil**
3. **Tube Assembly**
4. **O-ring**
5. **Spool**
6. **Valve Body**
7. **O-ring**
8. **Adapter**

5. Lubricate new O-rings of seal kit with clean hydraulic oil and install.

6. Install adapter and spool in valve body.

7. Thread tube assembly carefully into valve body.

8. Install solenoid coil. Apply ”Loctite 242” or equivalent to the threads of the coil nut and tighten to 15 in-lbs.

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

Installation

1. Install solenoid to the frame.

2. Connect all hydraulic tubes and hoses.

3. Connect electrical connector to solenoid valve (see Hydraulic Valve Solenoids in Chapter 5 - Electrical System).

Hydraulic System

Hydraulic Reservoir

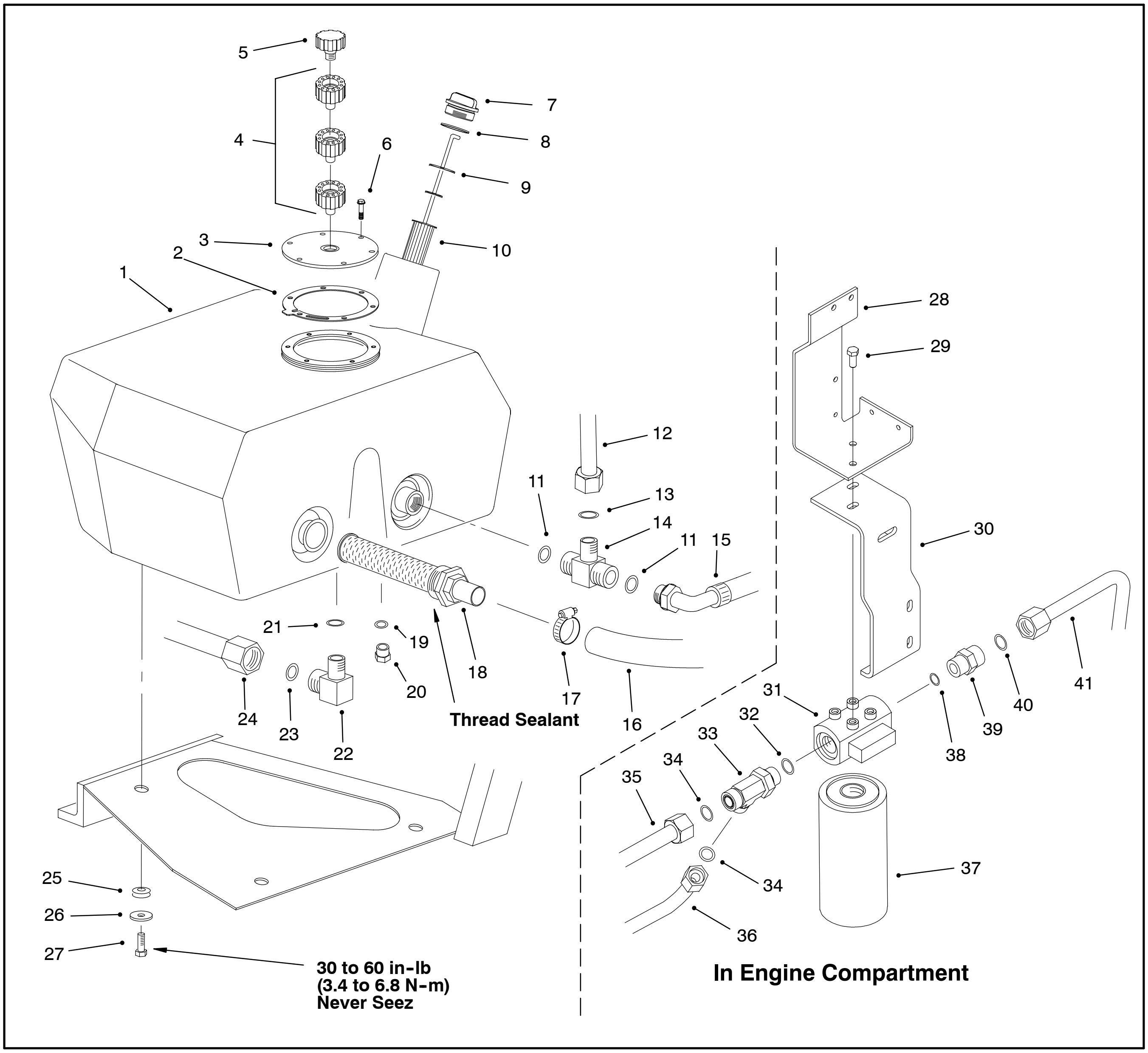


Figure 65

1. Hydraulic Reservoir
2. Gasket
3. Tank Cover
4. Breather Adapter
5. Tank Breather
6. Capscrew
7. Reservoir Cap
8. O-ring
9. Dipstick
10. Filler Screen
11. O-ring
12. Hydraulic Tube
13. O-ring
14. Tee Hydraulic Fitting
15. Hydraulic Hose
16. Suction Hose
17. Hose Clamp
18. Suction Strainer
19. O-ring
20. Plug
21. O-ring
22. 90° Hydraulic Fitting
23. O-ring
24. Hydraulic Tube
25. Grommet
26. Flat Washer
27. Capscrew
28. Support
29. Capscrew
30. Filter Bracket
31. Hydraulic Filter Head Assembly
32. O-ring
33. Tee Hydraulic Fitting
34. O-ring
35. Hydraulic Tube
36. Hydraulic Tube
37. Hydraulic Filter Element
38. O-ring
39. Straight Hydraulic Fitting
40. O-ring
41. Hydraulic Tube

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.

Note: The electrical harness does not have to be disconnected to remove the right fender and control console from the frame.

2. Remove right fender with control console attached enough to allow removal of the hydraulic reservoir.

3. Drain reservoir into a suitable container (see Change Hydraulic Fluid).

4. Remove oil tank.

Inspection

1. Clean hydraulic reservoir and suction strainer with solvent.

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

Installation (Fig. 65)

1. Install reservoir.

Note: When applying Permabond LH150 or equivalent to the threads of the suction strainer, do not apply sealant to the first thread.

2. Apply Permabond LH150 or equivalent to the threads of the suction strainer.

3. Using a wrench, turn strainer into port at least 1-1/2 to 2 full turns beyond finger tight, or until fully seated.

4. Apply Never Seez or equivalent to three cap screws securing the reservoir to the frame.

5. Fill reservoir with hydraulic fluid (see Change Hydraulic Fluid).

Hydraulic Oil Cooler

Removal (Fig. 66)

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

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.

2. Unlatch and remove rear screen.

3. Unscrew knobs and pivot oil cooler rearward.

4. Mark and disconnect the hydraulic hoses at the oil cooler.

5. Remove the capscrews and nuts securing the oil cooler to the cooler bracket and remove the oil cooler.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

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.

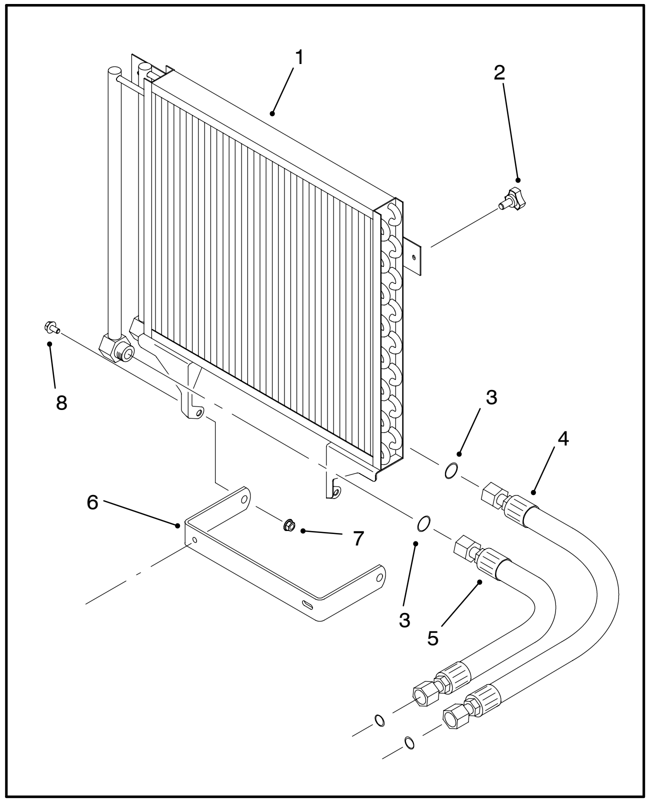


Figure 66

1. Oil Cooler	**5. Hydraulic Hose (IN)**
2. Knob	**6. Cooler Bracket**
3. O-ring	**7. Locknut**
4. Hydraulic Hose (OUT)	**8. Capscrew**

Installation (Fig. 66)

1. Carefully hold the oil cooler in position and attach the cooler to the cooler bracket.

2. Connect the hydraulic hoses.

3. Pivot oil cooler back into position and tighten knobs. Install rear screen and secure latches.

Chapter 5

Electrical System

Table of Contents

Special Tools

Order special tools from your Toro Distributor. Some tools may be listed in the Parts Catalog for the Reelmaster 6500-D or 6700-D. Some tools may also be available from a local supplier.

Digital Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage drop.

NOTE: Toro recommends the use of a DIGITAL multimeter when testing electrical circuits. The high impedance (internal resistance) of a digital meter will ensure that excess current is not allowed through the meter. Excess current can cause damage to a circuit that is not designed to carry it.

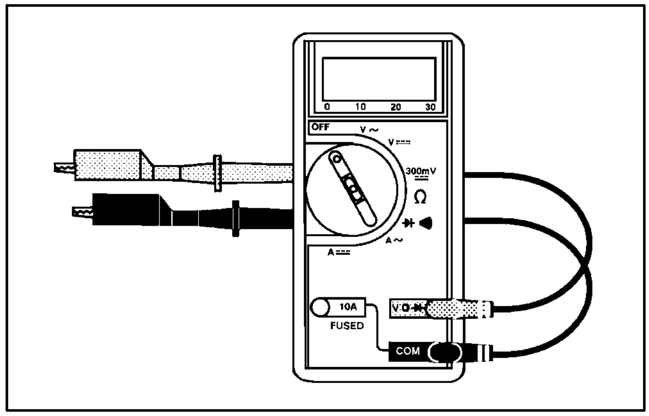


Figure 1

Inductive Ammeter (AC/DC Current Transducer - Hall Effect)

Use this tool, connected to a Digital multimeter for doing current draw tests. This tool can be useful when checking glow plug and starter circuits.

Skin-Over Grease

Special non-conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: **505-165**

Figure 2

Toro Automated Control Electronics™ Diagnostic Tools

Diagnostic ACE™ Display

The diagnostic display is connected to the wiring harness connector located inside the control console to help the user verfiy correct electrical functions of the machine (Fig. 3 and 4).

ACE Display (Toro Part No. 85-4750)

Note: ACE diagnostic display overlays may vary with specific unit model and serial numbers. Always use the overlay(s) supplied with your RM 6500-D/6700-D. Replacement English overlays, and overlays in Dutch, Finish, German, French, Danish, Japanese, Norwegian, Polish, Spanish, and Swedish are available. Refer to the specific RM 6500-D & 6700-D Parts Catalog.

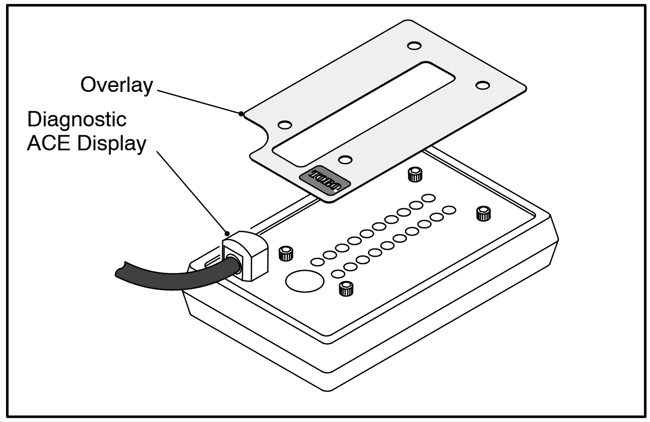


Figure 3

Figure 4

Data Log™ System

The data log system controller is connected to the wiring harness connector near the electronic controller. This device can record machine data while it is in operation to help your Toro Distributor diagnose intermittent problems.

Contact you local authorized Toro distributor for information on obtaining this service or device.

Figure 5

Troubleshooting

> **CAUTION**
>
> **Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.**

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics and Wire Harness and Electrical Connector Drawings in Chapter 8 – Electrical Drawings).

If the machine has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Understanding the Controllers (RM 6500-D/6700-D Models 03806, 03807, & 03808)

Primary Controller (#1)

Functions:

- Main controller for both the RM 6500-D & 6700-D.
- Contains primary logic program.
- Manages all functions of machine safety and sequencing of cutting units.
- "Supervisor" for the RM 6700-D secondary controller (#2).
- Connected to other controller and/or leak detector by the CAN bus (communication lines between devices).

Fault Identification/Operator Warning:

- Red diagnostic lamp on steering tower and green diagnostic lamp under control console.

Diagnostics:

- Do troubleshooting by connecting one of the following devices to the loopback connector:
  - Diagnostic ACE (with the correct overlay).
  - TOROPC and a personal computer (authorized Toro distributor only).
  - Data Log System.

Secondary Controller (#2) - RM6700-D Only

Functions:

- Manages the functions of #6 and #7 cutting units ONLY.
- Needs approval from primary controller (#1) before executing an operator request.
- Same part number as primary controller, but requires a different software program (on TOROPC disk).
- Connected to other controller and/or leak detector by the CAN bus.

Fault Identification/Operator Warning:

- Red diagnostic lamp on steering tower and green diagnostic lamp under control console.

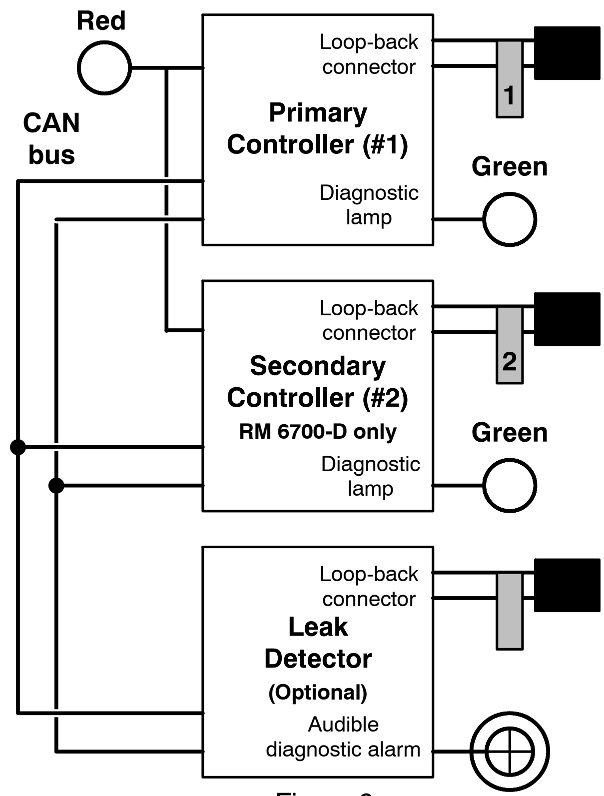


Figure 6

Diagnostics:

- Do troubleshooting by connecting one of the following devices to the loopback connector:
  - Diagnostic ACE (with the correct overlay).
  - TOROPC and a personal computer (authorized Toro distributor only).
  - Data Log System.

TurfDefender Leak Detector (Optional)

Functions:

- Warns operator of hydraulic leak with an audible alarm.
- Drop in retrofit for most existing machines.

Fault Identification/Operator Warning:

- Alerts operator to several potential problems with audible “beeps” and/or by cutting unit shut down.

Diagnostics:

- Do troubleshooting by connecting one of the following devices to the loopback connector:
  - Diagnostic ACE (with the correct overlay).
  - TOROPC and a personal computer (authorized Toro distributor only).

Understanding the Diagnostic Lamps

Red Diagnostic Lamp (located on steering tower)

Functions:

- ON
  - When glow plug circuit is energized.
- FLASHING
  - When electronic controller has sensed an output fault (for RM 6700-D, observe the green diagnotic lamps under control console to determine which controller is sensing the fault).
  - When the operator has exceeded the optional programmed speed limit.
  - When optional TurfDefender leak detector has detected a hydraulic leak.
- OFF
  - When monitored circuits are functioning properly.
  - When ACE Diagnostic Tool is connected.
  - When Loop-back connector is disconnected.
  - When there is no power to the electronic controller.
  - When the lamp bulb is burned out.
  - When no software is installed or the electronic controller is not functioning properly.

Diagnostics:

- Check electrical connections, input fuses and diagnostic light bulb to determine malfunction.
- Make sure loop-back connector is secured to wire harness connector.
- Connect ACE Diagnostic Tool and check controller input and output functions.
- Check optional TurfDefender leak detector (see Leak Detector Operation in this section of this manual).

Green Diagnostic Lamp (one per controller located under control console)

Functions:

- ON
  - When controller software is successfully loaded and all monitored circuits are functioning properly.
- FLASHING (Red diagnostic lamp also flashing)
  - When electronic controller has sensed an output fault.

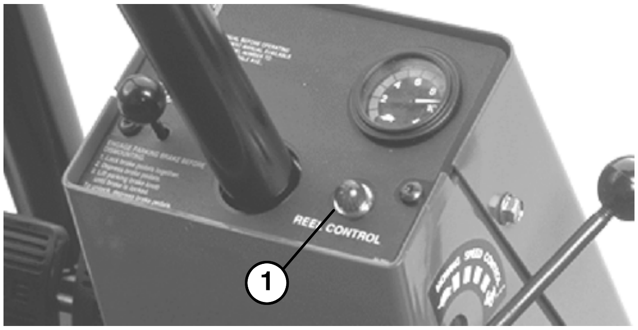


Figure 7
1. Red Diagnostic Light

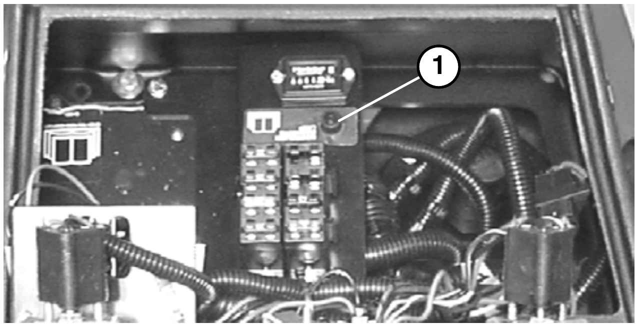


Figure 8
1. Green Diagnostic Light (RM 6500-D shown)

- FLASHING (Red diagnostic lamp not flashing - RM 6700-D)
  - When primary electronic controller or primary controller software is not functioning properly.
  - When CAN (Controller Area Network) Bus is not functioning properly.
- OFF
  - When ACE Diagnostic Tool is connected.
  - When Loop-back connector is disconnected.
  - When there is no power to the electronic controller.
  - When the lamp bulb is burned out.
  - When no software is installed or the electronic controller is not functioning properly.

Diagnostics:

- Check electrical connections, input fuses and diagnostic light bulb to determine malfunction.
- Connect ACE Diagnostic Tool and check controller input and output functions.
- Check optional TurfDefender leak detector (see Leak Detector Operation in this section of this manual).

Using the ACE™ Diagnostic Display

The primary electronic controller controls most machine functions. The controller determines what function is required for various input switches (i.e. seat sensor, key switch, etc.) and energizes the outputs to actuate solenoids or relays for the requested machine function.

For the electronic controller to control the machine as desired, each of the inputs, outputs must be connected and functioning properly. The primary electronic controller controls the functions of cutting units #1 through 5. On the RM 6700-D, the secondary electronic controller controls the functions of cutting units #6 and #7.

The Diagnostic ACE display is a tool to help the user verify correct electrical functions of the inputs and outputs used and controlled by the electronic controllers.

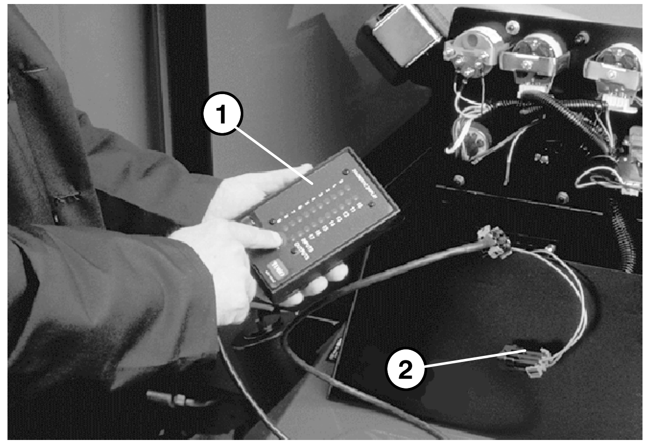


Figure 9

1. **Diagnostic ACE** 2. **Loop-back connector**

Checking Interlock Switches

The purpose of the interlock switches is to prevent the engine from cranking or starting unless the traction pedal is in NEUTRAL, the Enable/Disable switch is in DISABLE and the Lower Mow/Raise control is in the neutral position. The engine will stop when the traction pedal is depressed with operator off the seat. In addition, the engine will stop if the traction pedal is depressed and the parking brake is engaged.

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 operation of the switches daily to make sure the interlock system is operating properly. If a switch is defective, replace it before operating. Do not rely on safety switches entirely - use common sense!

Check Input & Output Functions

1. Park machine on a level surface, lower the cutting units, stop the engine, and engage the parking brake.

2. Open control panel cover.

A. For RM 6500-D: Locate wire harness with Loop-back connector labeled #1 for electronic controller.

Note: For checking optional TurfDefender leak detector, see Leak Detector Operation and Checking Leak Detector Operation in this section of this manual.

Carefully unplug loop back connector from harness connector.

Connect the Diagnostic ACE display connector to the harness connector. RM 6500-D overlay decal specific to the model and serial number of the unit being tested must be placed on the diagnostic tool.

B. For RM-6700-D: Locate wire harness and connectors labeled #1 (primary electronic controller) or #2 (secondary electronic controller).

Note: For checking optional TurfDefender leak detector, see Leak Detector Operation and Checking Leak Detector Operation in this section of this manual.

Carefully unplug loop-back connector from harness connectors.

Connect the Diagnostic ACE display connector to the correct harness connector. RM 6700-D overlay decals specific to the model and serial number of the unit being tested must be placed on the diagnostic tool. Overlay decal #1 must be used when checking primary controller (connector #1) and overlay decal #2 must be used when checking secondary controller (connector #2).

2. Turn the key switch to the ON position, but do not start machine.

Note: The **red** text on the overlay decal refers to input switches and the **green** text refers to outputs.

3. Check Input Functions (Interlock Switches)

A. The “inputs displayed” LED, on lower right column of the Diagnostic ACE, should be illuminated. If “outputs displayed” LED is illuminated, press the toggle button on Diagnostic ACE to change to “inputs displayed” LED. **Do not hold button**.

B. The Diagnostic ACE 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, engage traction pedal, etc.), and note that the appropriate LED on Diagnostic ACE will blink on and off when corresponding switch is closed. Repeat on each switch that is possible to be changed by hand.

C. If switch is closed and appropriate LED does not turn on, check all wiring and connections to switch and/or check switches with an ohm meter. Replace any defective switches and repair any defective wiring.

D. If each input switch is in the correct position and functioning correctly, but the input LED’s are not correctly illuminated, this indicates an controller problem. If this occurs, contact your Toro Distributor for assistance.

4. Check Output Functions

A. The “outputs displayed” LED, on lower right column of Diagnostic ACE, should be illuminated. If “inputs displayed” LED is illuminated, press the toggle button on the Diagnostic ACE to change the LED to “outputs displayed”.

Note: It may be necessary to toggle between “inputs displayed” and “outputs displayed” several times to do the following step. To toggle back and forth, press toggle button once. This may be done as often as required. **Do not hold button**.

B. Sit on seat and attempt to operate the desired function of the machine. The appropriate output LED’s should illuminate to indicate that the controller is turning on that function.

Note: If any output LED is blinking, this indicates an electrical problem with that OUTPUT. Repair and/or replace defective electrical parts immediately. To reset a blinking LED, turn the key switch “OFF”, then back “ON” and retest. Memory must also be cleared (see Clearing the Fault Memory in this section of this manual).

C. If no output LED’s are blinking, but 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. Verify correct switch function.

D. If the output LED’s are on as specified, but the machine does not function properly, this indicates a non-electrical problem. Repair as necessary.

Note: Due to electrical system constraints, the output LED’s for “START”, “PREHEAT” and “ETR/ALT” may not blink even though an electrical problem may exist for those functions. If the machine problem appears to be with one of these functions, be certain to check the electrical circuit with a volt/ohm meter to verify that no electrical problem exists to these functions.

E. If each output switch is in the correct position and functioning correctly, but the output LED’s are not correctly illuminated, this indicates an controller problem. If this occurs, contact your Toro Distributor for assistance.

IMPORTANT: The Diagnostic ACE 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 done using Diagnostic ACE, 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 ACE in dry, secure location in shop, not on machine.

Fault Memory and Retrieval

If the Controller senses a **fault** on one of the **output solenoids**, it will flash the machines diagnostic Lamp (red diagnostic lamp on steering tower or green diagnostic lamp under console) and store the fault into the controller memory. The fault can then be retrieved and viewed with the Diagnostic ACE hand held tool or a lap top/PC at anytime. The controller will store one (1) fault at a time and will not store another different fault until the first fault is cleared.

Retrieving Stored Faults

1. Rotate ignition key to **Off** position.

2. Connect the Hand held Diagnostic Tool to the desired Controller Loopback Connector (use the proper overlay).

3. Move the Joystick to the **Raise** position and hold.

4. Rotate ignition key to **On** position, and continue to hold the Joystick in **Raise** position until the top left Diagnostic Tool light comes on (approx. 2 seconds).

5. Release the Joystick to the center position.

6. Hand held Tool will now playback the fault retained in the Controller memory.

IMPORTANT: The display will show eight (8) individual records with the fault displayed on the 8th record. Each record will be displayed for 10 seconds. Be sure to have the Diagnostic Tool display on Outputs to see fault. The Problem circuit will be flashing. Records will repeat until key is turned off. Unit <u>will not start</u> in this mode.

Clearing the Fault Memory
(Diagnostic Tool not required)

1. Rotate ignition key to **Off** position.

2. Turn Backlap Switch to the **Front** or **Rear** Backlap position.

3. Turn the Reel Control Switch to **Enable** position.

4. Move the Joystick to the **Raise** position and hold.

5. Turn the ignition key to **On**, and continue to hold the Joystick in the **Raise** position until the Reel Control Lamp starts to flash (approx. 2 seconds).

6. Release the Joystick and turn the Key **Off**. **Memory is now cleared.**

7. Turn the Backlap Switch to **Off** and Enable Switch to **Disable** position.

TurfDefender Leak Detector

The TurfDefender™ is an electronic hydraulic fluid leak detection device that fits inside the hydraulic tank of your machine. It is a pressure based system which requires a sealed hydraulic tank to function properly. Very small changes to the oil level in the sealed tank result in a large movement of the leak detector's internal float. The TurfDefender's internal microprocessor analyzes the float movement and determines if there is a leak in the system.

- Turn ignition key to "ON" position start the system. The system will reset itself whenever the ignition key is moved to "OFF" position. Wait 5 seconds, then move key to "ON" position to restart the system.
- When machine is started, the alarm will give one short beep to indicate that everything is operating properly. If the alarm makes no noise at all, it should be checked.
- If the alarm gives 4 short beeps it means a system problem has been detected and it should be checked. If the TurfDefender™ is programmed with software revisions – A, B, C, D or E, the alarm will continue the 4 beep pattern for approximately 1.5 minutes, and then stop. If it is programmed with revision level F or above, the alarm will repeat the 4 beep pattern twice, and then cease to give further error indication until another fault is detected. In either case, once the ignition key is moved to the "OFF" position, all alarm reports will cease.

Note: The low or high oil level 4 beep signal may occur if machine is started on a slope. Move machine to a level surface, move ignition key to "OFF" position, wait 5 seconds, then move key to "ON" position to restart the system.

- If the alarm gives long continuous beeps while mowing and shuts off the cutting units, it means that a leak has been detected. On the Reelmaster traction unit, the red diagnostic lamp on the steering console will also blink indicating the Reelmaster electronic controller has shut off the cutting unit's.

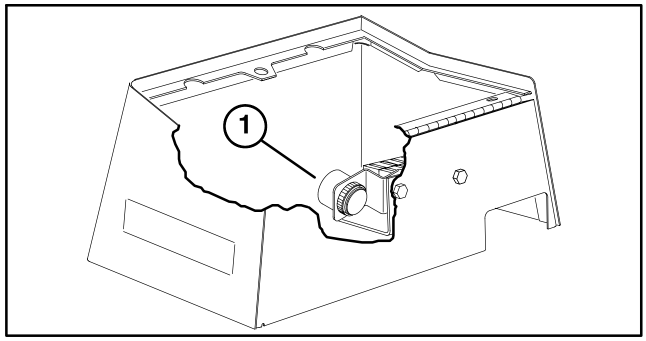


Figure 10
1. Alarm

Checking Leak Detector Operation

The operation of the TurfDefender™ should be checked if any of the following conditions occur:

Note: The hand held Diagnostic ACE can be used to identify many of the problems.

A. No beeps are heard when ignition switch is turned "ON".

B. Any time the machine gives a series of 4 short beeps.

C. False alarms are observed.

Note: The Diagnostic ACE may have to be connected before shutting off the ignition key in order to identify the problem.

WARNING

To identify some problems, engine may have to be running. To guard against possible personal injury, engage parking brake and keep hands, feet, face and other parts of the body away from moving parts.

Note: See Leak Detector Troubleshooting Guide in this section of this manual for additional information.

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

2. Open control panel cover.

Locate leak detector harness loopback connector with hydraulic symbol tag. Carefully unplug loopback connector from harness connector.

3. Connect the Diagnostic ACE display connector to the correct harness loopback connector. Install TurfDefender overlay decal (supplied with leak detector kit) onto Diagnostic ACE (Fig. 13).

4. The ignition key switch must be turned to the “ON” position.

Note: Red text on the overlay decal refers to inputs and green text refers to outputs.

5. The red “Inputs displayed” LED (Light Emitting Diode), on lower right column of the Diagnostic ACE, should be illuminated. If green “Outputs displayed” LED is illuminated, press and release the toggle button, on Diagnostic ACE, to change LED to “Inputs displayed”. Do not hold button down (Fig. 13).

If TurfDefender is functioning normally:

1. When the “Inputs displayed” LED is lit, the actual Float position (1 or 2 LED’s on left side) and “Oil level OK” LED (right side) - should be displayed (Fig. 14).

2. Press toggle button until green “Outputs displayed” LED is lit. “Valve ON”, “data line” and ”self diagnostic”LED’s should be lit steadily. “Alarm ON” LED may be displayed temporarily (about 5 seconds) (Fig. 15).

Note: If “data line” or ”self diagnostic” LED’s are blinking, there is a problem in the system.

If No beeps are heard:

1. Check alarm wires to make sure they are not disconnected, broken or “+” and “-” reversed.

2. Make sure TurfDefender 4-pin connector is plugged in.

3. Make sure TurfDefender 5 amp fuse (fuse block “B”, slot #3) is not blown.

4. Toggle “outputs displayed” on Diagnostic ACE display (Fig. 15).

- Alarm open circuit (LED blinking): Check/replace TurfDefender alarm or wires.
- Alarm short circuit (LED blinking): Check/replace TurfDefender alarm or wires.

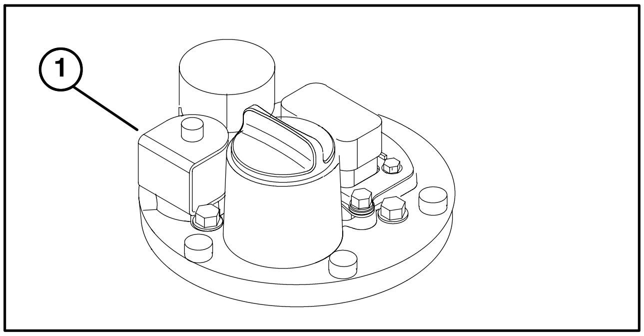


Figure 11

1. Electric solenoid valve

If 4 beeps are heard:

The most common cause for a 4 beep signal is from an improper oil level reading. Make sure machine is on a level surface when checking oil level. Since oil level will vary with temperature, it is best to check when cool.

1. When toggling “input”, a LED should display (Fig. 14) any of the following problems diagnosed by the TurfDefender:

- Oil level low: Position machine on a level surface and fill to proper level.
- Oil level high: Position machine on a level surface and remove excess oil until proper level is attained.
- Air leak in system: Assure tank cap is tight or check for leak in tank.

Note: Only large air leaks can be detected by hand held Diagnostic ACE. A leakdown test is required to identify small air leaks. Consult your Authorized Toro Distributor for assistance.

2. When toggling “output” a LED should display (Fig. 15) any of the following problems diagnosed by the TurfDefender:

- Valve open circuit (LED blinking): Check/replace TurfDefender electric solenoid valve or wires (Fig. 11).
- Valve short circuit (LED blinking): Check/replace TurfDefender electric solenoid valve or wires (Fig. 11).
- Self diagnostic LED Blinking: Internal circuit failure in TurfDefender. Consult your Authorized Toro Distributor for assistance.
- Data Line LED Blinking: Problem with communications between machine and leak detector; or problem with wires. Consult your Authorized Toro Distributor for assistance.
- Drip Drop LED Blinking: A slow oil leak (level drop) may be detected.

Note: If machine must be operable with leak detector disabled, unplug leak detector 4-pin connector from 4-pin connector of main harness. Do not unplug leak detector alarm.

If false alarms are observed:

1. Oil level may be low causing air to be drawn out of system. Check oil level.

2. Extremely hard left turns can cause oil to slosh to the right, exposing suction line and purging air out of system. Normal maneuvering should not cause this condition.

3. Air leak in system. Check to make sure cap is securely on tank. Contact your local authorized Toro Distributor for further assistance with air leak problem.

4. To check for a system problem, install hand held Diagnostic ACE, toggle input/output and check for any problems previously discussed.

Note: The system will reset itself whenever the ignition key is turned to “OFF” position. The hand held Diagnostic ACE must be connected and observed during a false alarm. Once the ignition key is turned to “OFF” position, the TurfDefender will reset itself.

5. Your Authorized Toro Distributor has equipment to analyze system problems.

IMPORTANT: The Diagnostic ACE displays must not be left connected to the machine. It is not designed to withstand the environment of the machine’s every day use. When done using Diagnostic ACE, disconnect them from the machine and reconnect loopback connectors to harness connectors. Machine will not operate without loopback connectors installed on harness. Store Diagnostic ACE in dry, secure location in shop, not on machine.

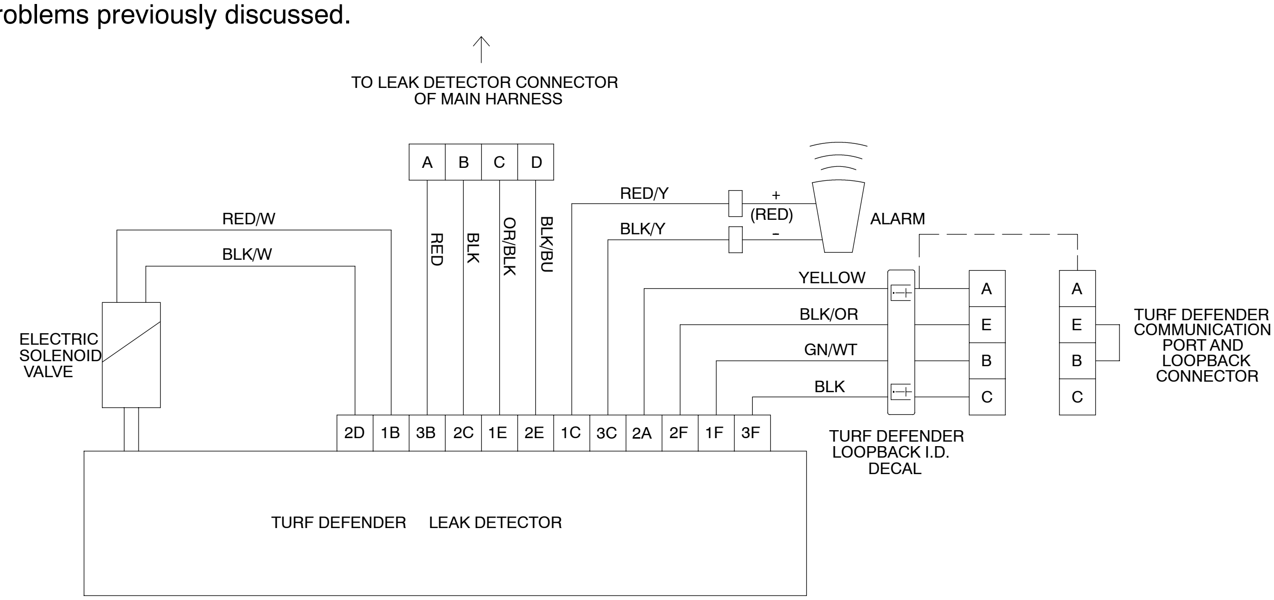
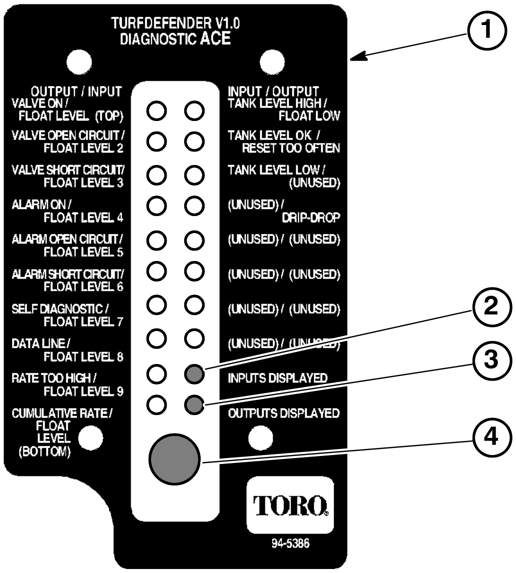


Figure 12

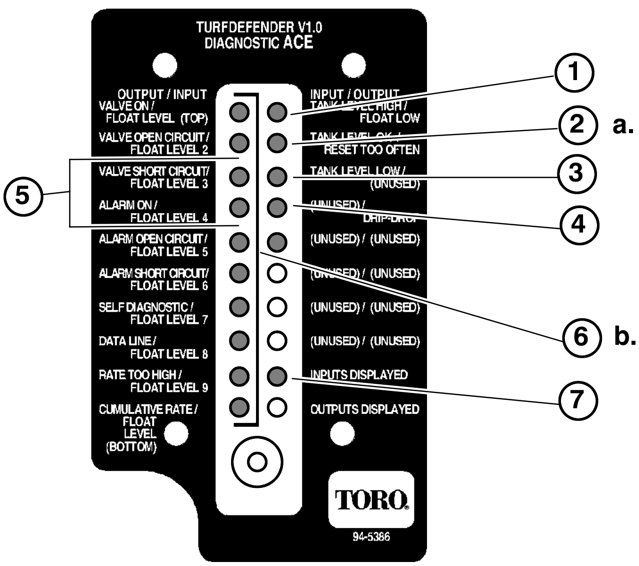
1. Electrical Schematic - Optional TurfDefender Leak Detector



Diagnostic ACE Display Functions

1. Overlay decal (English shown)
2. "Inputs Displayed" LED (Red)
3. "Outputs Displayed" LED (Green)
4. Toggle button

Figure 13

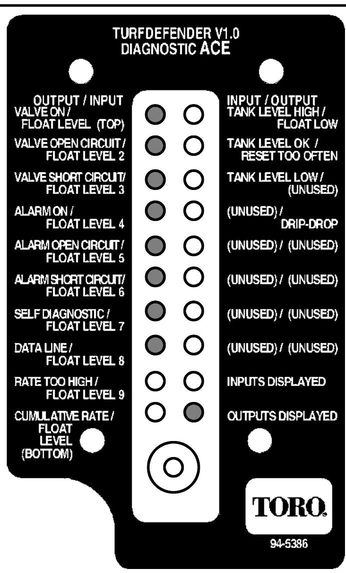


Using "Inputs Displayed" (Red Text)

1. LED lit if oil level is too high
2. LED lit if oil level is OK
3. LED lit if oil level is too low
4. LED lit if slow leak detected
5. Target oil level - Cold oil & cutting units raised
6. One or two LED's lit displaying relative position of the Turfdefender's internal float (any combination of 3, 3 or 4, or 4)
7. "Inputs Displayed" LED "ON" (Red)

Normal Operation:
a. "Oil Level OK" LED lit
b. 1 or 2 LED's lit on left column

Figure 14



Using "Outputs Displayed" (Green Text)

Normal Operation:
a. "Valve ON" LED lit steadily
b. "Self Diagnostic" LED lit steadily
c. "DATA LINE" LED lit steadily
d. "Alarm ON" LED lit temporarily

Problem Diagnosed:
The appropriate LED will blink to identify the problem

Figure 15

Electrical System

Leak Detector Troubleshooting Guide

The following is a quick guide to the most common problems likely to be encountered. The hand-held Diagnostic ACE is helpful for identifying specific problems

4-Beep Faults are Occurring

Oil level is incorrect	Check oil level on a level surface
Machine started on a slope (oil level error)	Try again on a level surface, add oil as required
Solenoid valve unplugged	Reconnect
Hydraulic tank cap is loose	Tighten
Reelmaster Electronic Controller has wrong programming installed	Contact an Authorized Toro Distributor

False-Alarms (continuous beeps but no leak) are Occurring

Hydraulic tank cap is loose	Tighten
Operator is making severe left turns	Slow down while turning
Operator jiggles traction while waiting	Leave pedal in Neutral while waiting
Solenoid valve not sealing	Check if loose; replace if defective
Reelmaster Electronic Controller has wrong programming installed	Contact an Authorized Toro Distributor

No Beep Occurs at Start-Up

Alarm wires are reversed or disconnected	Connect red to “+”, black to “-”
TurfDefender 4-pin connector is unplugged	Reconnect
TurfDefender fuse is blown	Replace

Oil Comes Out Vent

Excessive air bubbles in oil have caused float to elevate	Purge air by depressing float to bottom with a wire inserted through the vent hole Correct oil aeration

Starting Problems

Problem	Possible Causes
All electrical power is dead, including gauges.	The battery charge is low. The ignition switch or circuit wiring is faulty. The fusible link from the battery is faulty. The 20 ampere fuse to the ignition switch is open.
Starter solenoid clicks, but starter will not crank. **Note:** If the solenoid clicks, the problem is not in the interlock circuit wiring or the ECU.	Low battery charge. Loose or corroded battery cables. Loose or corroded ground. Faulty wiring at the starter. Loose starter mounting bolts. Faulty starter. Faulty starter solenoid.
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 or the neutral switch or circuit wiring is faulty. The cutting units are engaged. Faulty joystick switch (switch in the raised position). Faulty ignition switch or circuit wiring. Faulty circuit between controller and start relay. Start relay or circuit wiring is faulty. Start solenoid or starter is faulty.
Engine starts, but stops when the ignition switch is released from the START position.	The run (ETR) solenoid or circuit wiring is faulty. High temperature shutdown switch or circuit wiring is faulty.
Engine cranks, but does not start.	Engine is not cranking fast enough. Glow plugs not used or not functioning. Engine run (ETR) solenoid, circuit wiring, or fuel pump is faulty. The problem is not electrical (see Chapter 3 - Kubota Diesel Engine).
Start cranks, but should not when the traction is depressed.	The traction neutral switch is out of adjustment. The traction neutral switch or circuit wiring is faulty.

General Run and Transport Problems

Problem	Possible Causes
Engine continues to run, but should not, when the ignition switch is turned off.	The engine run (ETR) 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 sensor or circuit wiring is faulty. Traction neutral switch or circuit wiring is faulty.
The engine stops during operation, but is able to restart.	The parking brake is engaged. The seat sensor actuator is lifting off the seat switch. The seat sensor or circuit wiring is faulty. The ignition switch or circuit wiring is faulty.
The engine kills when the traction pedal is depressed.	The parking brake is engaged. The seat sensor actuator is lifting off the seat switch. The seat sensor or circuit wiring is faulty.
Battery does not charge.	Loose or broken wire(s). The fusible link to the battery is faulty. Alternator belt slipping. Faulty alternator or battery. Alternator warning lamp is faulty or burned out. Alternator warning lamp wiring loose, corroded, or damaged.

Cutting Unit Operating Problems

Problem	Possible Causes
The cutting units remain engaged, but should not, with no operator in the seat.	The seat sensor or circuit wiring is faulty.
Cutting units run, but should not, when raised. Units shut off with enable disable switch.	The front reels down sensor or circuit wiring is faulty.
Cutting units run, but should not, when raised. Units do not shut off with the enable disable switch.	Both the front reels down sensor or circuit wiring, and enable/disable switch or circuit wiring are faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
None of the cutting units operate in either direction. Units are able to raise and lower.	The seat sensor actuator is lifting off the seat switch. The seat sensor or circuit wiring is faulty. The enable/disable switch or circuit wiring is faulty. The front reels down sensor or circuit wiring is faulty. Ground circuit wiring to solenoids may be open. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Cutting units run, but should not, when lowered with enable/disable switch in the disable position.	The enable/disable switch or circuit wiring is faulty.
The front cutting units do not operate in either direction. Units are able to raise and lower. Rear cutting units operate.	Solenoid MSV1 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
The rear cutting units do not operate in either direction. Units are able to raise and lower. Front cutting units operate.	Solenoid MSV2 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
The rear cutting units #6 and/or #7 (RM 6700-D Only) do not operate in either direction. Units are able to raise and lower. Front cutting units and remaining rear cutting units operate.	Solenoid S10 and/or S11 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
None of the cutting units will lower.	Lower/mow switch on joystick or circuit wiring is faulty. Reel Enable/Disable Switch in middle position. Solenoid SV1 or circuit wiring is faulty. Solenoid SV8 (if equipped) or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Outer front cutting units #4 and 5 will not lower.	Flow divider FD1 solenoid (if equipped) or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).

Cutting Unit Operating Problems (Continued)

Problem	Possible Causes
None of the cutting units will raise.	Raise switch on joystick or circuit wiring is faulty. Solenoid SV1 or circuit wiring is faulty. Solenoid SV2 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Front center cutting unit #1 will not raise or lower, but the other cutting units will raise and lower.	Solenoid SV3 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Outer front cutting units #4 & 5 will not raise or lower, but the other cutting units will raise and lower.	Solenoid SV4 or circuit wiring is faulty. Flow divider FD1 solenoid (if equipped) or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Rear cutting units #2 & 3 will not raise or lower, but the other cutting units will raise and lower.	Solenoid SV5 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Rear cutting units #6 (RM 6700-D Only) will not raise or lower, but the other cutting units will raise and lower.	Solenoid SV6 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
Rear cutting units #7 (RM 6700-D Only) will not raise or lower, but the other cutting units will raise and lower.	Solenoid SV7 or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
The front cutting units do not backlap, but run in the forward direction instead.	Front cutting unit switch or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
The front cutting units do not backlap, but all cutting units run in the forward direction.	The front backlap switch or circuit wiring is faulty.
The rear cutting units do not backlap, but run in the forward direction instead.	The rear backlap switch or circuit wiring is faulty. A hydraulic problem exists (see Troubleshooting section of Chapter 4 - Hydraulic System).
The rear cutting units do not backlap, but all cutting units run in the forward direction.	The rear backlap switch or circuit wiring is faulty.

Electrical System Quick Checks

Battery Test (Open Circuit Test)

This is a simple test used to determine the condition of the battery at rest.

Tool required: Digital Multimeter - DC volts setting.

Test instructions: Set the multimeter to the DC Volts setting. The battery should be at a temperature of 60° to 100° F. The ignition key should be off and all accessories turned off. Connect the positive (+) Volt meter lead to the positive battery post and the negative (-) Voltmeter lead the the negative battery post.

Note: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

Voltage Measured	Battery Charge
12.6 V (or higher)	Fully charged (100%)
12.4 V	75% charged
12.2 V	50% charged
12.0 V	25% charged

Note: Regulated voltage will increase to approximately 13.5 Volts when the engine is running.

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 how much (amps) or what it is capable of.

Tool required: Digital Multimeter - DC volts setting.

Test instructions: Connect the positive (+) multimeter test lead on the positive Battery Post, and negative (-) lead on the negative Battery Post. Leave test leads connected and start engine and run at 2000 RPM minimum. Test results should be:

At least 1 volt over Open Circuit test results.	
Example: Open Circuit Test results	= 12.5v
Charging System Test results	= 13.5v
Difference	= +1.0 v

Voltage Drop Testing

This is a simple test that should be used to locate excess resistance in an electrical circuit.

Tool required: Digital Multimeter - DC volts setting.

Test instructions: Connect the positive (+) multimeter test lead to the power side (or most positive) of the component, circuit or connection. Connect the negative (-) multimeter test lead to the ground side (or least positive) of the component, circuit or connection. Turn on the circuit to be tested and read the voltage. Remember - when performing voltage drop tests the circuit must be complete and activated to locate the resistance!

Voltage Drop Specifications (Maximums)

High Amperage Circuits (>20 A.)	Low Amperage Circuits (<20 A.)
.4 volt feed side	.2 volt feed side
.4 volt ground side	.2 volt ground side

Glow Plug System Test

This is a fast, simple test that can help you determine a Glow Plug system's integrity and operation. The test should be run anytime hard starting (cold) is encountered on a diesel engine equipped with a Glow system. Remember - there are 2 types of Glow Plug systems that Toro uses:

1. Systems with resistors (Glow Plug Indicators) in series (Reelmaster 450/4500-D, Groundsmaster 325-D, etc.).

2. Systems without resistors (**Reelmaster 6500-D/ 6700-D**, Reelmaster 3500-D, Groundsmaster 455-D, Reelmaster 5100/5300-D, etc.).

Tool(s) required: Digital Multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect inductive Ammeter to the multimeter (refer to manufacturer's instructions). Set multimeter on Volts scale. With the key off (or Glow Switch in off position), place the inductive Ammeter around the main glow plug power supply wire(s) and read meter prior to activating Glow system. Adjust Meter to read zero (if applicable). Cycle the Glow Plug system at least two times (per instructions in Operator's Manual) and record the final results.

Typical specifications for systems without resistors:

# of Glow Plugs	Amps Draw (10%)
2	20 Amps
3	30 Amps
4	40 Amps
Individual Glow Plug resistance (all models) - .3-.4 Ohms (cold)	

Starting System Test

This is an excellent test to use when a "slow crank/no start" problem is encountered. It will tell you if the problem is due to an electrical open, short or high resistance in the starter circuit.

Note: The Battery condition and state of charge must checked before testing the starter system.

Tool(s) required: Digital Multimeter and/or Inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect inductive Ammeter to the multimeter (refer to manufacturers instructions). Set multimeter on Volts scale. With the key off place the inductive Ammeter around the main negative (-) Battery Cable and read meter prior to activating the Starter system. Adjust Meter to read zero (if applicable). Crank the engine for at least 3 seconds and record the results. Typical Starter System Draw for the Reelmaster 6500-D and 6700-D is **225 Amps at 65°F**.

If current draw is significantly higher than listed - check for shorted condition. If current draw is significantly lower than listed - check for high resistance.

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: For more component testing information, see the Kubota Workshop Manual, Diesel Engine, 05 Series at the end of Chapter 3 - Kubota Diesel Engines.

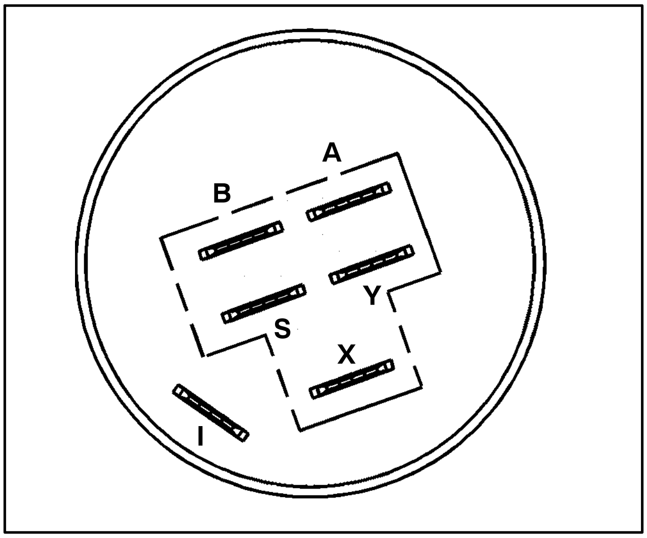
CAUTION

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 has three positions (OFF, RUN, and START). The terminals are marked as shown. The circuit wiring of the ignition switch is shown in the chart. 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.

POSITION	CIRCUIT
OFF	NONE
RUN	B + I + A, X + Y
START	B + I + S



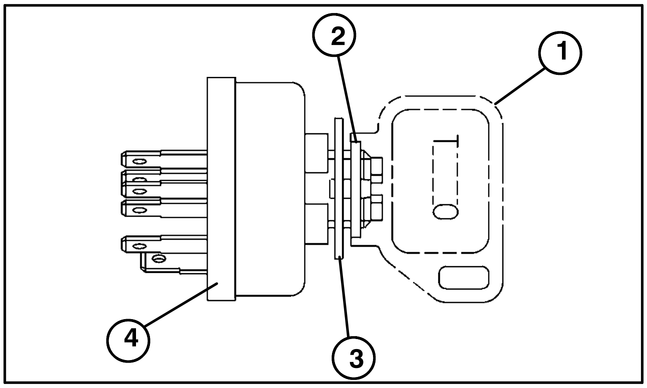


Figure 16

1. **Key**
2. **Hex nut**
3. **Lock washer**
4. **Ignition switch**

Glow and Start Relays

The glow relay and the start relay are mounted to the right side frame member below the operator's seat.

Note: Prior to taking small resistance readings with a digital multi meter, 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 from the measured value of the component you are testing.

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting).

   A. For the **glow** relay, resistance should be from 41 to 51 ohms (Fig. 17).

   B. For the **start** relay, resistance should be from 80 to 90 ohms (Fig. 18).

2. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should pick up making the sound of a sharp click.

   A. For the **glow** relay resistance between terminals 30 and 87 should be 1 ohm or less.

   B. For the **start** relay, resistance between terminals 30 and 87A should read as an open circuit.

3. Remove +12 VDC from terminal 85. The relay should drop out making the sound of a sharp click.

   A. For the **glow** relay resistance between terminals 30 and 87 should read as an open circuit.

   B. For the **start** relay, resistance between terminals 30 and 87A should be 1 ohm or less.

4. Disconnect voltage and leads from all terminals.

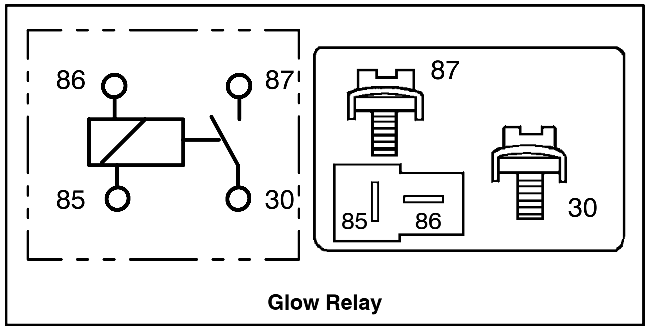


Figure 17

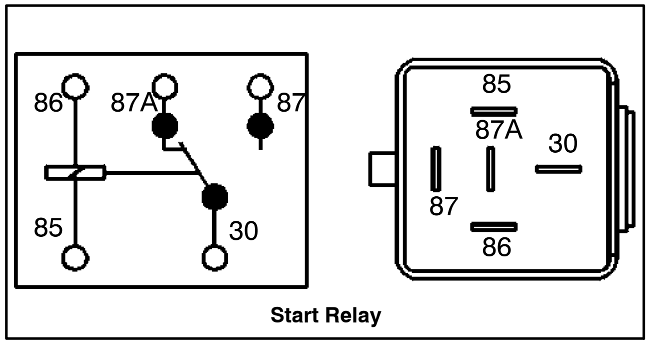


Figure 18

Fuses

The fuse blocks are located under the control panel and inside the control console.

Identification, Function, and Wiring

The fuses are held in two fuse blocks. Use Figure 20 to identify each individual fuse and its correct amperage. Each fuse holder has the following functions and wire connected to it.

Fuse 1A

A. Supplies power to Primary Electronic Controller terminals 1L and 1M.

B. Has blue/white wire (1L), green/black wire (1M) and red wire (battery).

Fuse 2A

A. Supplies power to ignition switch terminal B.

B. Has red/blue wire (B) and red wire (battery).

Fuse 3A

A. Supplies power to Primary Electronic Controller terminal 1J.

B. Has pink/black wire (1J) and red wire (battery).

Fuse 4A

A. Supplies power to Primary Electronic Controller terminal 1K.

B. Has red/black wire (1K) and red wire (battery).

Fuse 1B

A. Supplies power to harness splice SP11 that feeds ECU terminal 1A, red diagnostic indicator light, warning light cluster, and Electronic Controller communications port and loopback connector.

B. Has two yellow wires.

Fuse 2B

A. Supplies power to harness splice SP9 and SP10 that feeds the hour meter, temperature gauge, fuel gauge, speedometer, gear tooth sensor, light switch (optional), and Turf Defender Leak Detector (optional).

B. Has two orange wires.

Fuse 3B (When Optional Lighting is Installed)

A. Supplies power to light relay terminal 1.

B. Has two red wires.

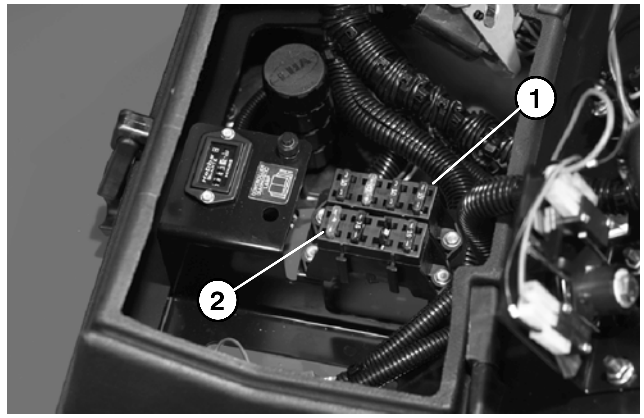


Figure 19

1. **Fuse block A**
2. **Fuse block B**

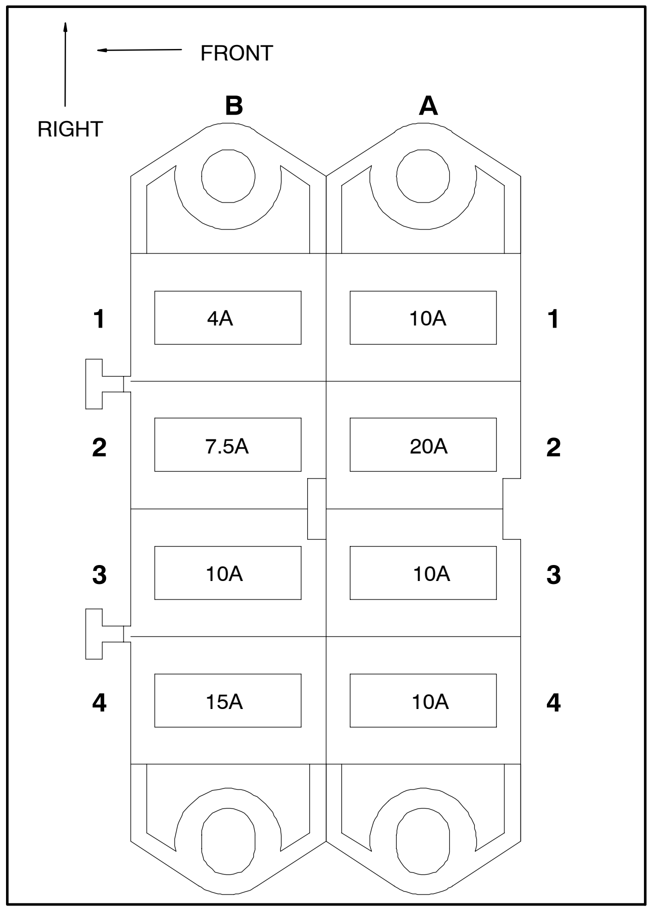


Figure 20

Fuse 4B

A. Supplies power to light Secondary Electronic Controller connector terminal B on RM 6700- D.

B. Has two red wires.

Hydraulic Valve Solenoids

These solenoids can be tested using the “Output Checks” feature of the ACE Diagnostic tool.

The solenoids can also be tested manually.

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

1. Make sure engine is off. Disconnect solenoid valve electrical connector.

2. Apply 12VDC source directly to the solenoid. Listen for solenoid to shift.

3. Remove 12VDC source from the solenoid. Listen for solenoid to return.

4. Measure resistance between the two connector terminals.

   A. The resistance for a 20 watt coil should be about 7.2 ohms.

   B. The resistance for a 28 watt coil should be about 5.1 ohms.

5. Install **new** solenoid if necessary.

   A. Make sure o-ring is installed at each end of the coil. Apply ”Loctite 242” or equivalent to threads on end of valve stem before installing nut.

   B. Tighten nut to a torque of 2 - 5 ft-lb (2.7 - 6.8 Nm). Over-tightening may damage the solenoid or cause the valve to malfunction.

Note: Each electrical harness connection for the valve solenoids has a colored power wire and black ground wire attached to it.

Solenoid	Power Wire Color
MSV1	Yellow/White
MSV2	Brown/White
SV1	Yellow/Black
SV2	Orange/Blue
SV3	Pink/Blue
SV4	Orange/Red
SV5	Black/Red
SV6	Yellow/Black
SV7	Yellow/White
SV8 (if equipped)	White/Black
FD1	Orange/Red

6. Reconnect electrical connector to the solenoid.

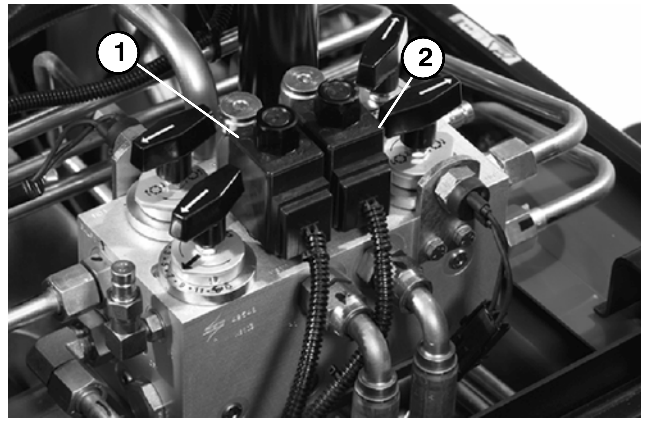


Figure 21

1. 20 watt solenoid (MSV1) **2. 20 watt solenoid (MSV2)**

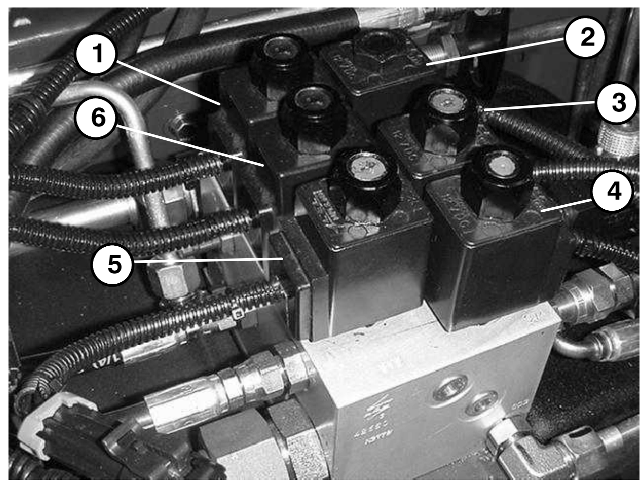


Figure 22

1. 20 watt solenoid (SV1)
2. 28 watt solenoid (SV2)
3. 20 watt solenoid (SV3)
4. 20 watt solenoid (SV4)
5. 20 watt solenoid (SV5)
6. 20 watt solenoid (SV8) (if equipped)

Hydraulic Valve Solenoid Functions

The list below identifies and describes the function of each valve solenoid on the hydraulic manifold. Each solenoid functions when energized.

Solenoid	Function
MSV1	Front reel circuit
MSV2	Rear reel circuit
SV1	Lower or lift any cutting units
SV2	Lift any cutting units
SV3	Lift/lower front, center cutting unit #1
SV4	Lift/lower front outer cutting units #4 & 5
SV5	Lift/lower rear cutting units #2 & 3
SV6	Lift/lower rear cutting unit #6 (6700-D only)
SV7	Lift/lower rear cutting unit #7 (6700-D only)
SV8	Lower any cutting units (if equipped)
FD1	Lift/lower front outer cutting units #4 & 5

High Temperature Warning and Shutdown Switch

The high temperature warning and shut down switch is located on the right side of the water flange that is attached to the front of the engine cylinder head. There is a green/white wire attached to the switch (Fig. 23).

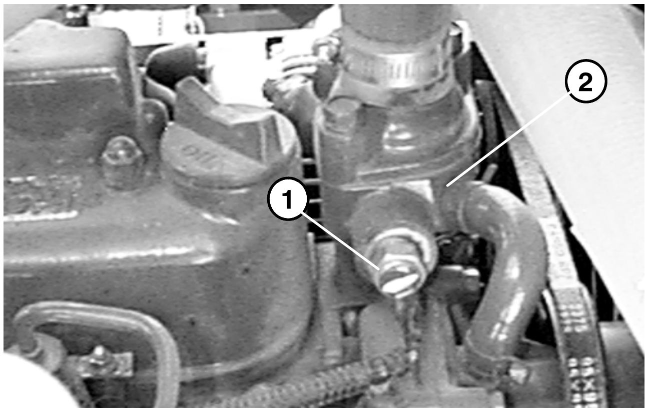


Figure 23

1. Temp. warning and shutdown switch
2. Water flange

CAUTION
Make sure engine is cool before removing the temperature switch.

1. Lower coolant level in the engine and remove the temperature switch.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 24).

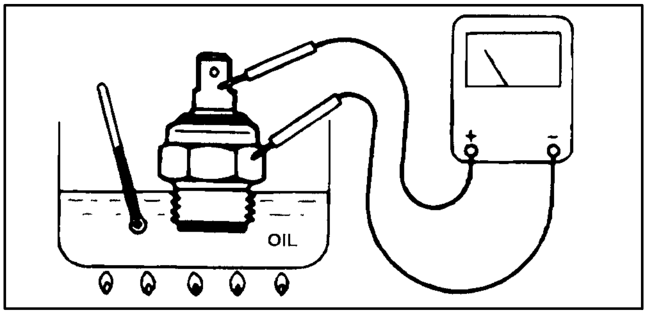


Figure 24

CAUTION
Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check continuity of the switch with a multimeter (ohms setting). The temperature switch is normally open and should close between 216 to 226°F (102 to 108°C).

4. Allow oil to cool while observing temperature. The temperature switch should open at about 208°F (98°C).

5. Replace switch if necessary.

6. Install sender to the water flange.

   A. Clean threads of water flange and sender thoroughly. Apply Permabond #LH150 sealant or equivalent to the threads of the water flange.

   B. Screw sender into the water flange and tighten.

   C. Connect green/white wire to sender. Apply skin-over grease to sender terminal.

7. Fill engine cooling system (see Check Cooling System in Chapter 3 - Kubota Diesel Engine).

Electrical System

Warning Light Cluster

Note: Individual light bulbs can be tested by removing them from the lighting cluster and applying 14 VDC to their wiring terminals.

Testing Cluster Removed from Connector.

1. Apply 14 VDC to pin D.
2. Ground pins F, A, and E.
3. Lamps 1, 2, and 3 should light.
4. Apply 14 VDC to pin B.
5. Ground pin C.
6. Lamp 4 should light.

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 when the oil pressure drops below 4 PSI (0.3 kg/cm^2).

1. Disconnect green/blue wire from the oil pressure switch.
2. Ground green/blue wire to the engine block.
3. Turn ignition switch to ON; the light should come on.
4. Turn ignition switch to OFF. Connect green/blue wire to the oil pressure switch.

High Temperature (Water) Shutdown Light

When the coolant temperature is above 221°F (105°C), the temperature light comes on as the high temperature shutdown switch and Electronic Control Unit (ECU) stop the engine.

Glow Light

The glow light comes on when the ignition switch is placed in RUN prior to placing the ignition switch in START, and stays light for 10 seconds while left in RUN.

Battery Light

The battery 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.

1. Turn ignition switch to ON; the light should come on.
2. Turn ignition switch to OFF: the light should go off.

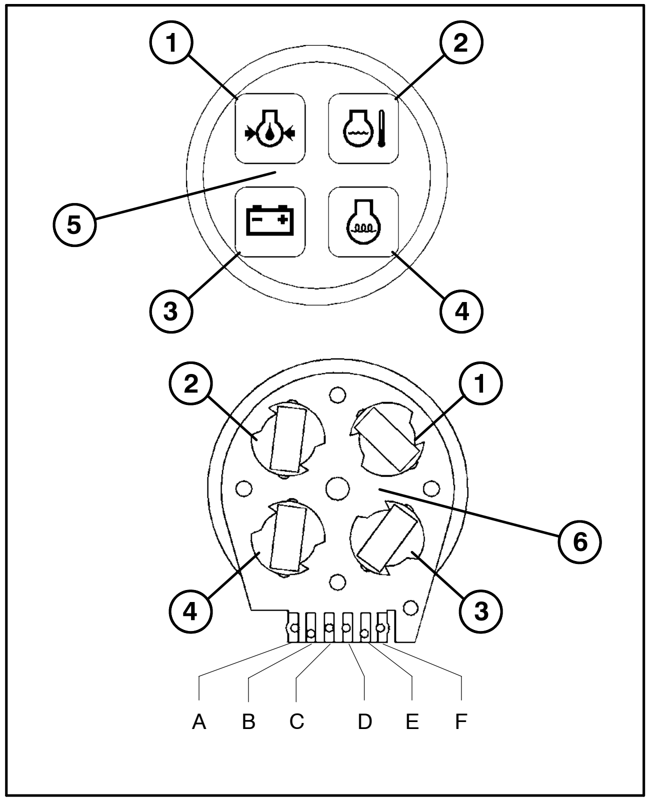


Figure 25

1. **Oil pressure (red)**
2. **Water temperature (red)**
3. **Battery (amber)**
4. **Glow plugs (amber)**
5. **Gauge front**
6. **Gauge back**

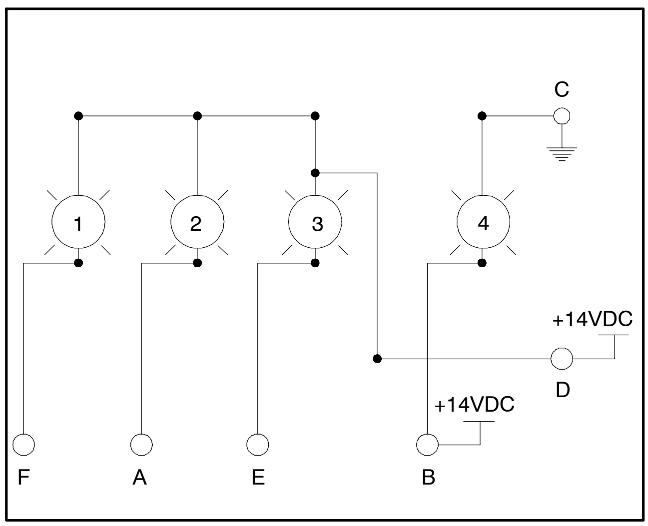


Figure 26

Run (ETR) Solenoid (Solenoid With 3 Wire Connector)

The solenoid must be energized for the engine to run. It is mounted on the engine block near the injection pump.

In Place Testing

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

1. Disconnect the connector from the solenoid.

2. Using a digital multimeter, touch one lead to the pin of the **black** wire and the other lead to the pin of the **orange**/**red** wire. The resistance of the **pull coil** should be about 0.33 ohms.

3. Using a digital multimeter, touch one lead to the pin of the **black** wire and the other lead to the pin of the **red**/**blue** wire. The resistance of the **hold coil** should be about 12.2 ohms.

4. Connect solenoid to the wiring harness.

Live testing

1. Disconnect connector from the solenoid.

Note: The solenoid may be removed from the engine or tested in place.

2. If the solenoid is removed from the engine, make sure that the solenoid plunger moves freely and is free of dirt, debris, and corrosion.

Note: When testing run solenoid, use test leads with at least 14 gauge wire.

3. Connect a positive (+) test lead from a 12 VDC source to the pins of the **red**/**blue** and **orange**/**red** wires.

4. Touch a negative (-) test lead from the 12 VDC source to the pin of the **black** wire. The solenoid should engage making an audible "click".

5. Remove positive (+) voltage from the pin of the **orange**/**red** wire. The solenoid should stay engaged.

6. Remove positive (+) voltage from the pin of the **red**/**blue** wire. The solenoid should release.

7. Reconnect the wires to the solenoid.

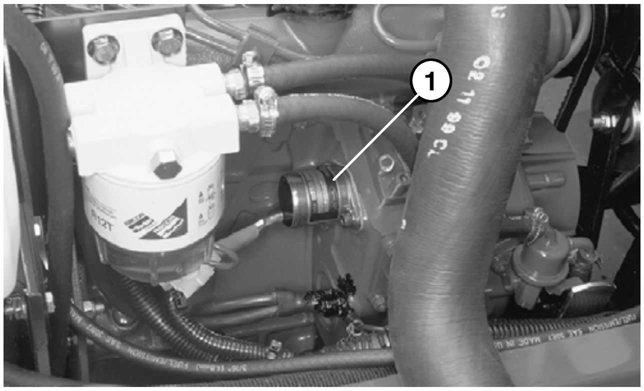


Figure 27
(shown with hydraulic filter & bracket removed)

7. **ETR solenoid**

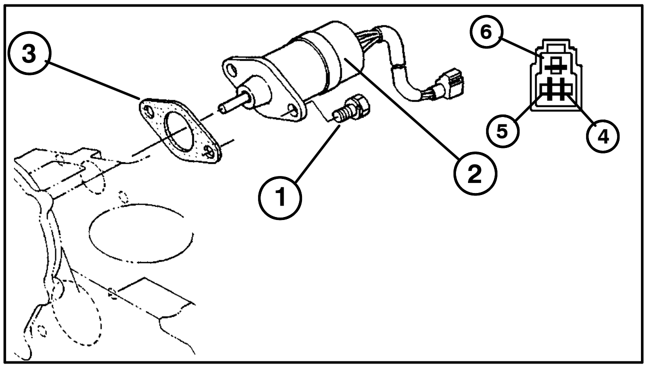


Figure 28

1. **Cap screw**
2. **Fuel stop solenoid**
3. **Gasket**
4. **Common (Black wire)**
5. **Hold coil (Red/blue wire)**
6. **Pull coil (Orange/red wire**

Electrical System

Run (ETR) Solenoid (Solenoid With 2 Wire Connector)

The run (ETR) solenoid must be energized for the engine to run. It is mounted on the engine block near the injection pump.

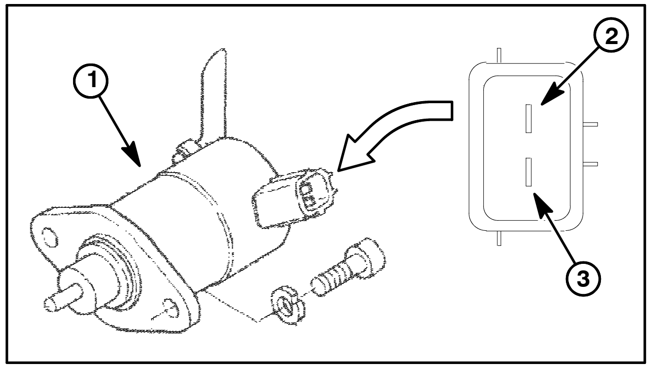


Figure 29

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

In Place Testing

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

1. Disconnect wire harness connector from solenoid.

2. Using a digital multimeter, touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 29). The resistance of the pull coil should be less than 1 ohm (but not zero).

3. Using a digital multimeter, touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 29). The resistance of the hold coil should be approximately 15 ohms.

4. Connect solenoid to the wiring harness.

Live testing

1. Disconnect wire harness connector from solenoid.

Note: The solenoid may be removed from the engine or tested in place.

2. If the solenoid is removed from the engine, make sure that the solenoid plunger moves freely and is free of dirt, debris and corrosion.

Note: When testing run solenoid, use test leads with at least 14 gauge wire.

3. Connect a positive (+) test lead from a 12 VDC source to the pull coil and hold coil terminals.

4. Touch a negative (–) test lead from the 12 VDC source to the fuel stop solenoid frame (ground) (Fig. 29). The solenoid should engage, making an audible “click,” and the plunger should retract.

5. Remove positive (+) voltage from the pull coil terminal. The solenoid should stay engaged.

6. Remove positive (+) voltage from the hold coil terminal. The solenoid should release.

7. Reconnect the wires to the solenoid.

Fuel Gauge Sender

The sender is located on top of the fuel tank under the right, front fender.

1. Remove blue/green wire and black ground wire from the sender.

2. Remove round head screws and lock washers from the sender and fuel tank.

3. Remove sender and gasket from the fuel tank. Clean any fuel from the sender.

Note: Before taking small resistance readings with a digital multimeter, short test leads together. The meter will display a small resistance value. This internal resistance of the meter and test leads should be subtract from the measured value of the component.

CAUTION

Make sure sending unit is completely dry (no fuel on it) before testing. Perform test away from the tank to prevent an explosion or fire from sparks.

4. Check resistance of the sender with a multimeter.

   A. Resistance with the float in the **full** position should be **27.5 to 39.5 ohms**.

   B. Resistance with the float in the **empty** position should be **240 to 260 ohms**.

5. Replace sender as necessary. Reinstall sender into fuel tank. Connect wires.

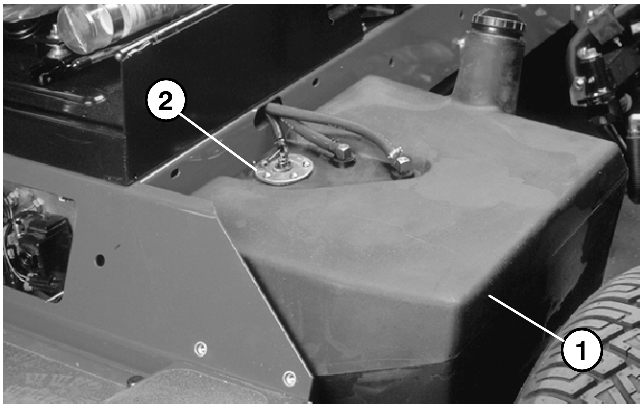


Figure 30

1. **Tank**
2. **Fuel sender**

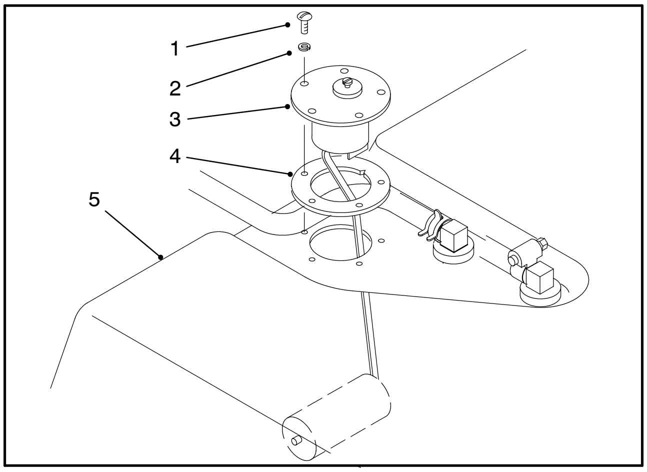


Figure 31

1. **Round head screw**
2. **Lock washer**
3. **Fuel sender**
4. **Gasket**
5. **Fuel tank**

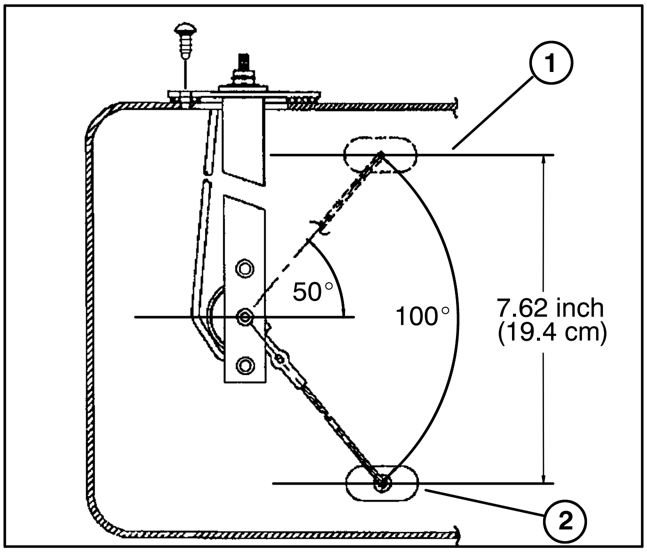


Figure 32

1. **Full position**
2. **Empty position**

Electrical System

Fuel Gauge

The fuel gauge can be tested using a new gauge as a substitute or by the use of a DC voltage source and a variable resistance box.

CAUTION

Make sure the voltage source is turned OFF before connecting it to the electrical circuit to avoid electrical shock and prevent damaging the gauge.

1. Connect fuel gauge to the variable resistance and DC voltage source (Fig. 33).

Note: When reading the gauge test point, there are two white dots on the gauge face below the edge of the glass cover for the each test point. For each variable resistance setting, the needle must be pointed between the two white dots.

2. Take test point readings (Fig. 34).

IMPORTANT: Allow circuit to warm up for at least 5 minutes before taking test readings.

A. Set variable resistance to 240 ohms. Apply a 14 ± 0.01 VDC to the circuit. The needle should point to the **left** edge of the **red area (empty)**.

B. Set variable resistance to 33 ohms. The needle should point to the **right** edge of the **green area (full)**.

3. Turn off the voltage source. Disconnect voltage source, gauge, and variable resistance.

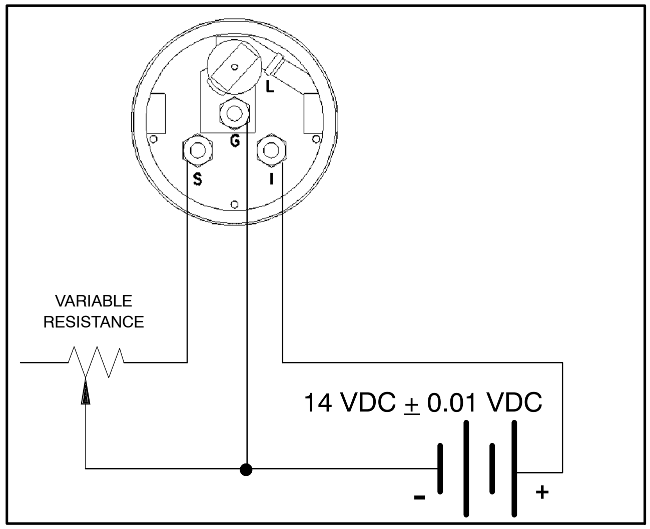


Figure 33

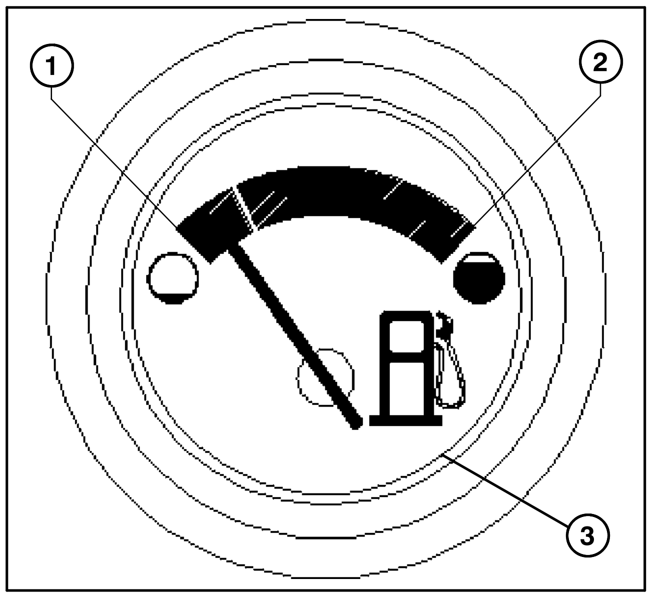


Figure 34

1. **Empty position**
2. **Full position**
3. **Glass face edge**

Temperature Sender

The sender is located on the left side of the water flange that is attached to the front of the engine cylinder head. There is a blue/white wire attached to the terminal of the switch (Fig. 35).

1. Lower coolant level in the engine and remove the high temperature sender.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 36).

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 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.

3. Check resistance of the sender with a multimeter (ohms setting) as the temperature increases.

   A. The meter should indicate from **54 to 78 ohms** at **200°F (93.3°C)**.

   B. Replace sender if specification is not met.

4. Install sender to the water flange.

   A. Clean threads of water flange and sender thoroughly. Apply Permabond #LH150 sealant or equivalent to the threads of the water flange.

   B. Screw sender into the water flange and tighten.

   C. Connect blue/white wire to sender. Apply skin-over grease to sender terminal.

5. Fill engine cooling system (see Check Cooling System in Chapter 3 - Kubota Diesel Engine).

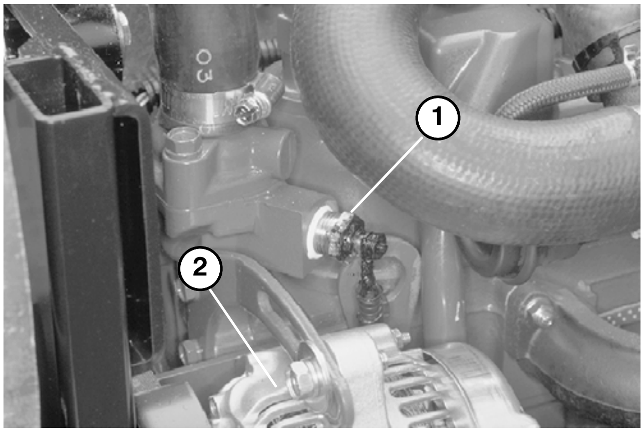


Figure 35

1. **Temperature sender** 2. **Alternator**

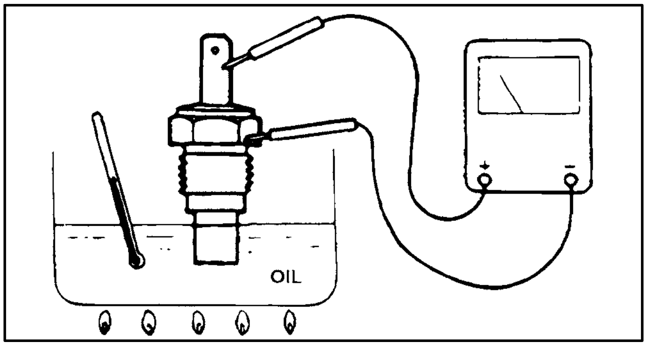


Figure 36

Temperature Gauge

The temperature gauge can be tested using a new gauge as a substitute or by the use of a DC voltage source and a variable resistance box.

CAUTION

Make sure the voltage source is turned OFF before connecting it to the electrical circuit to avoid electrical shock and prevent damaging the gauge.

1. Connect temperature gauge to the variable resistance and DC voltage source (Fig. 37).

Note: When reading the gauge test point, there are two white dots on the gauge face below the edge of the glass cover for the each test point. For each variable resistance setting, the needle must be pointed between the two white dots.

2. Take test point readings (Fig. 38).

IMPORTANT: Allow circuit to warm up for at least 5 minutes before taking test readings.

A. Set variable resistance to **71 ohms**. Apply a 14 ± 0.01 VDC to the circuit. The needle should point to the **middle of the green area** (80°C).

B. Set variable resistance to **38 ohms**. The needle should point **between the green and red area** (105°C).

3. Turn off the voltage source. Disconnect voltage source, gauge, and variable resistance.

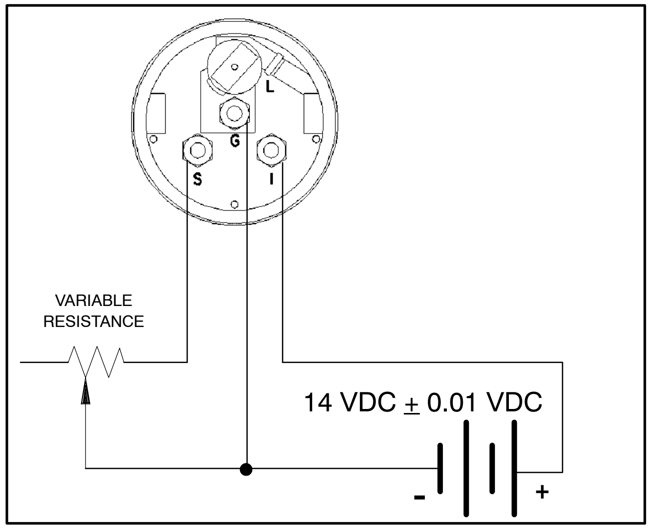


Figure 37

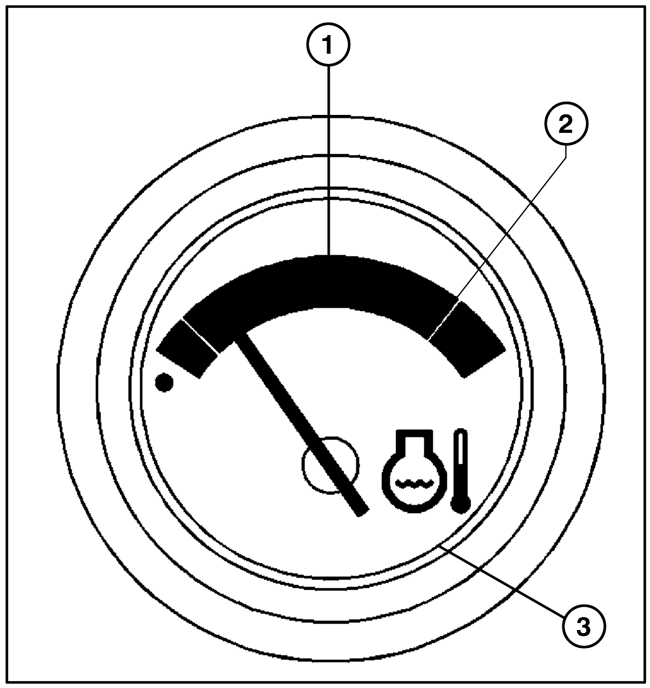


Figure 38

1. **Middle position**
2. **High temp position**
3. **Edge of glass cover**

Hour Meter

The meter is either located on the control panel or under the control panel inside the control console.

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 minutes.

4. Disconnect voltage source from the hour meter.

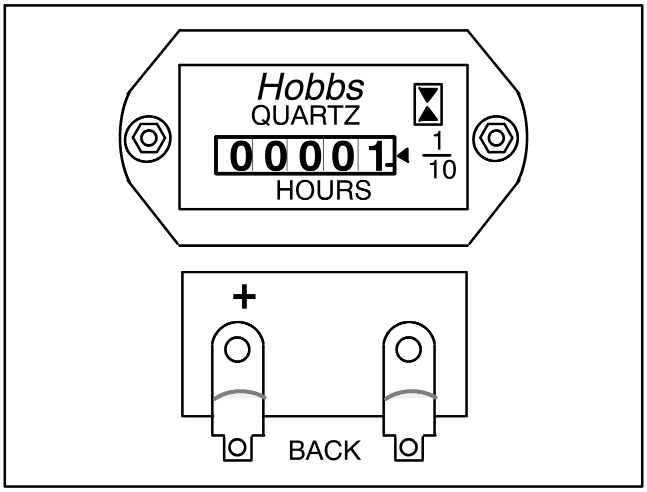


Figure 39

Electronic Controller(s)

The Toro electronic controller(s) sense the condition of various switches, such as the seat sensor, cutting unit down switches, traction neutral switch, etc., and directs power output to allow certain machine functions, such as engine run, cutting units engage, etc.

Because of the solid state circuitry built into the controller, there is no method to test it directly. The controller may be damaged if an attempt is made to test it with an electrical test device, such as a volt-ohm meter.

IMPORTANT: Before performing welding on the machine, disconnect both battery cables from the battery, disconnect both wire harness connectors from the electronic control unit and disconnect the terminal connector from the alternator to prevent damage to the electrical system.

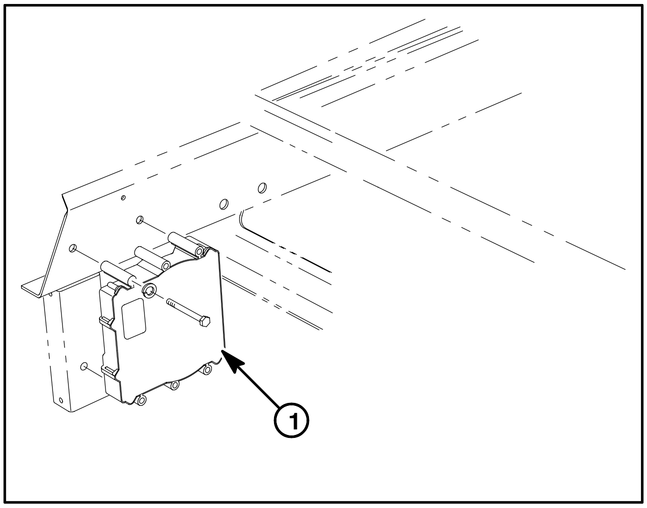


Figure 40

1. Primary Electronic Controller
(located below seat - RM 6500-D shown)

Parking Brake Switch

The parking brake switch is a proximity switch located inside the steering tower. When functioning properly, this feature kills the engine when the forward/reverse pedal is depressed and the parking brake is **On**.

The switch is closed to ground (orange/brown wire to black wire) when the parking brake is **Off**.

1. With the parking brake engaged, separate the terminal connector and measure resistance between the switch connector pins. Resistance should read as an open circuit.

2. Release the parking brake and measure resistance between the switch connector pins. Resistance should read as a closed circuit.

3. Adjust the position of the proximity switch as necessary to obtain the above results.

Engine Low Oil Pressure Switch

The switch is normally closed (NC) and opens with pressure.

The switch opens at approximately 8 psi.

1. Turn ignition key switch ON. Oil pressure lamp should be on.

If lamp is not on:

1. Disconnect wire from switch and touch wire to a good ground, such as the engine block.

2. If lamp comes on, replace switch.

3. If lamp does not come on check wiring between lamp and switch for continuity.

If lamp is on with engine running:

1. Shut off engine immediately.

2. Check switch by disconnecting wire with ignition switch in ON position. Light should go out.

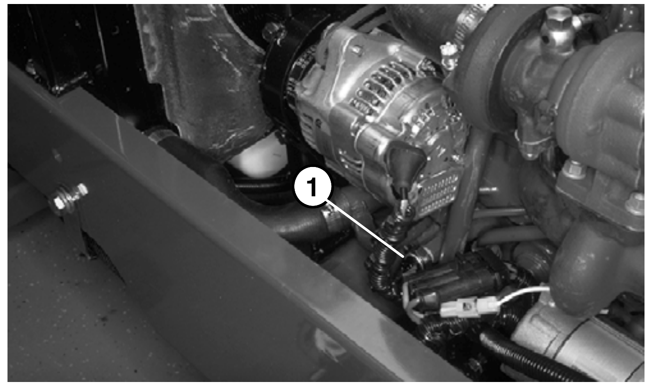


Figure 41
(shown with muffler removed)

1. **Engine oil low pressure switch**

3. If light is still on, check for short circuit in wiring.

4. Install test gauge in engine oil pressure switch port. Start engine and check for 30 psi minimum at 1500 rpm. If engine pressure is good, replace switch. If engine pressure is low, DO NOT operate the engine.

Speedometer Sensor

The sensor is located on the right side front wheel motor. It uses a magnetically biased Hall Effect integrated circuit. As the wheel motor turns in the planetary drive, the sensor accurately senses the movement of the wheel motor pistons passing by the sensor. The red connector wire is the positive lead, the black wire is the ground lead, and the gray wire is the signal output.

This sensor can be tested using the “Input Checks” feature of the ACE Diagnostic tool. Connect the diagnostic tool and rock the traction unit back and forth. The traction speed LED on the diagnostic tool should blink On and Off.

IMPORTANT: When replacing the sensor, see Speedometer Sensor Replacement in this section of this manual.

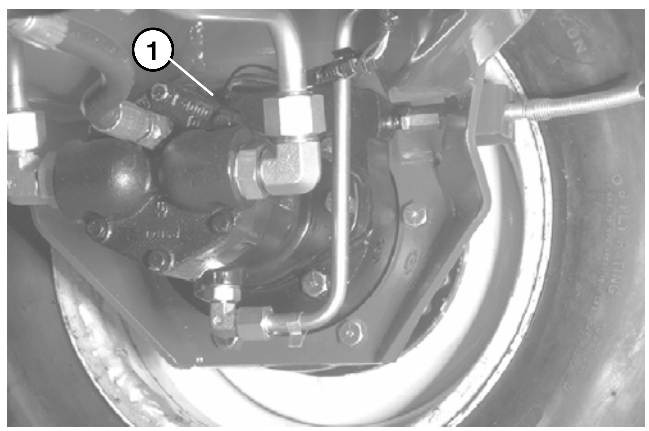


Figure 42

1. Speedometer sensor

Speedometer

The speedometer can be tested using a DC pulse generator.

CAUTION

Make sure the voltage source is turned OFF before connecting it to the electrical circuit to avoid electrical shock and prevent damaging the gauge.

1. Connect speedometer to the pulse generator and DC voltage source (Fig. 43).

2. Take test point readings.

   A. Set generator to **325.2 Hertz**. Apply signal to circuit. The needle should point to **4 MPH**.

   B. Set generator to **650.4 Hertz**. Apply signal to circuit. The needle should point to **8 MPH**.

   C. Set generator to **975.6 Hertz**. Apply signal to circuit. The needle should point to **12 MPH**.

3. Turn off the voltage source. Disconnect voltage source, gauge, and variable resistance.

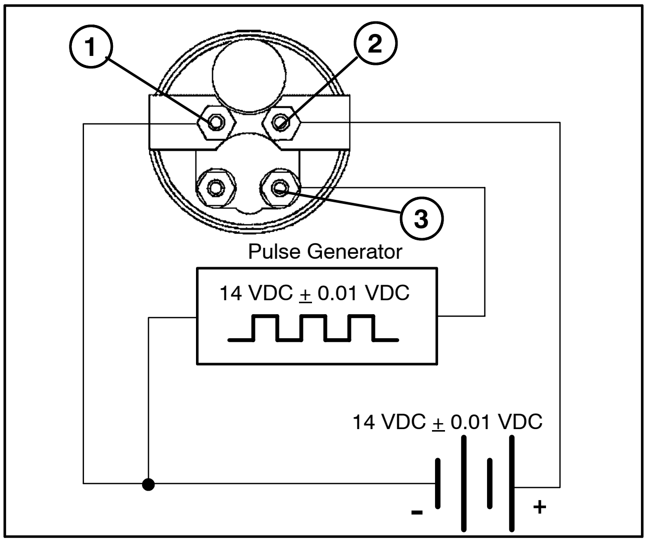


Figure 43

1. **Ground terminal**
2. **Ignition switch terminal**
3. **Temp sender terminal**

Reels Enable/Disable Switches

The reels enable/disable switches are attached to the instrument panel. The RM 6500-D and the RM 6700-D has one switch that controls cutting units #1 through 5. The RM 6700-D has two additional switches, one for cutting unit #6, and one for cutting unit #7 (Fig. 44).

The switch that controls cutting units #1 through 5 is a three position switch. Positioning the toggle back closes the switch between the back (brown wire) and center (black wire) terminals. Positioning the toggle forward closes the switch between the front (orange wire) and center terminals.

On the RM 6700-D, each of the additional switches used to control cutting unit #6 or #7 are dual position switches. Positioning the toggle back closes the switch between either the white (#6) or violet (#7) wire and the black wire terminals.

These switches can be tested using the “Input Checks” feature of the ACE Diagnostic tool.

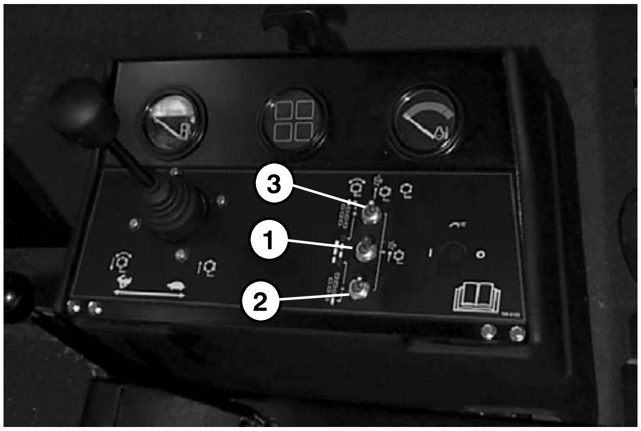


Figure 44

1. **Reel enable/disable switch (CU #1 - 5)**
2. **Reel enable/disable switch (RM 6700-D CU #6)**
3. **Reel enable/disable switch (RM 6700-D CU #7)**

Electrical System

Reel Backlap Switches

The front and rear backlap switches are attached to the reel hydraulic manifold block (Fig. 45). When the backlap control valve (MD1 or MD2) is in the **Backlap** position, the switch contacts close. This feature allows only one person to backlap any of the reels. The backlap switch circuit also prevents reels from raising during backlapping. When the backlap control valve (MD1 or MD2) is in the **Mow** position, the switch contacts open.

These switches can be tested using the “Input Checks” feature of the ACE Diagnostic tool.

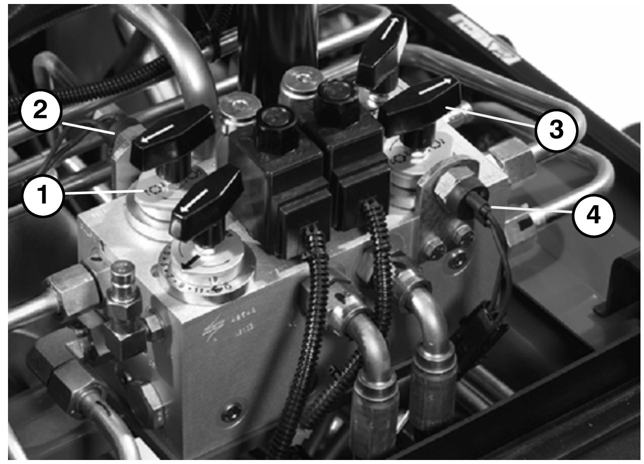


Figure 45

1. **Front backlap control valve (MD1)**
2. **Front backlap switch**
3. **Rear backlap control valve (MD2)**
4. **Rear backlap switch**

Traction Neutral Switch

The traction switch is normally closed and opens when traction pedal is depressed in either direction. The switch is located on the right side of the hydrostatic transmission.

This switch can be tested using the “Input Checks” feature of the ACE Diagnostic tool.

The switch can also be tested by disconnecting the wires from the switch terminals and connecting a continuity tester across the two terminals that had wires connected to them. With the engine turned off, slowly push the traction pedal in a forward and reverse direction while watching the continuity tester. There should be indications that the traction switch is opening and closing. Allow the traction pedal to return to neutral. There should be continuity across the terminals. See Chapter 4 - Hydraulic System in this manual for replacement and adjustment procedures.

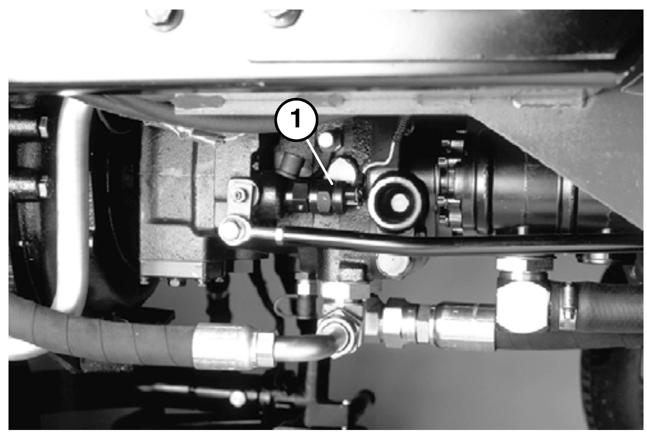


Figure 46

1. Traction neutral switch

Seat Sensor

The sensor consists of two parts. The reed switch is located on the lower bracket of the seat suspension mechanism and has a normally open contact. The switch actuator is located on the upper plate of the seat suspension mechanism and is made of a magnetic material. When the operator sits in the seat, the magnetic field of the actuator is positioned near the reed switch and the contact in the switch closes.

This sensor can be tested using the “Input Checks” feature of the ACE Diagnostic tool.

The sensor can also be tested manually.

1. Raise the seat to get access to the seat sensor wiring connector.

2. Disconnect the seat sensor wiring connector and install a continuity tester or ohm meter between the two leads of the seat sensor.

3. Lower the seat. The continuity tester should show no continuity.

Note: Make sure the compression spring holds the seat up off the seat sensor when there is no operator on the seat.

4. Have the operator sit on the seat, slowly depressing the seat sensor magnet. The continuity tester should show continuity as the seat approaches the bottom of its travel.

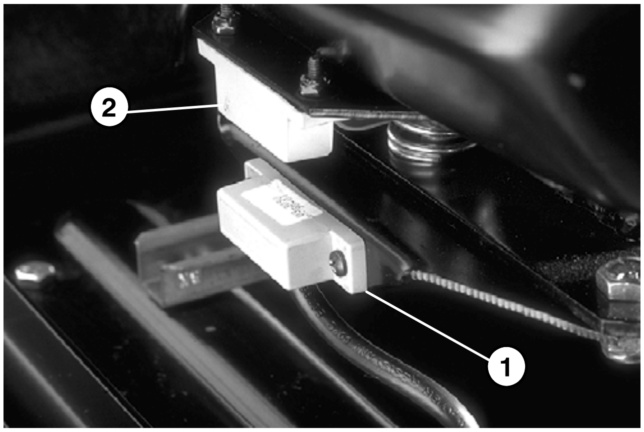


Figure 47

1. **Reed switch** 2. **Switch actuator**

Note: On machines with serial numbers above 230000001, a normally open seat switch is used instead of the seat sensor. This switch is mounted to the bottom of the seat cushion. When the operator sits in the seat, the switch closes. The seat switch can be tested using the “Input Checks” feature of the ACE Diagnostic tool. If necessary, continuity of the seat switch can be checked by unplugging the seat switch harness under the seat. With no pressure on the seat, there should be no continuity between the seat switch terminals. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

Joystick Raise and Lower/Mow Switches

Two micro switches for the joy stick are located in the lift control mechanism that is inside the control console. The rear switch on the mechanism is used to lower the reels and the front switch to raise them. A normally open contact closes when the joy stick is positioned to either lower or raise the reels.

These switches can be tested using the “Input Checks” feature of the ACE Diagnostic tool.

The switches can also be tested manually. Each switch has a electrical connector to make sure the normally closed contact on the switch is not used. The raise switch has violet and black wires connected to it and the lower switch has pink and black wires.

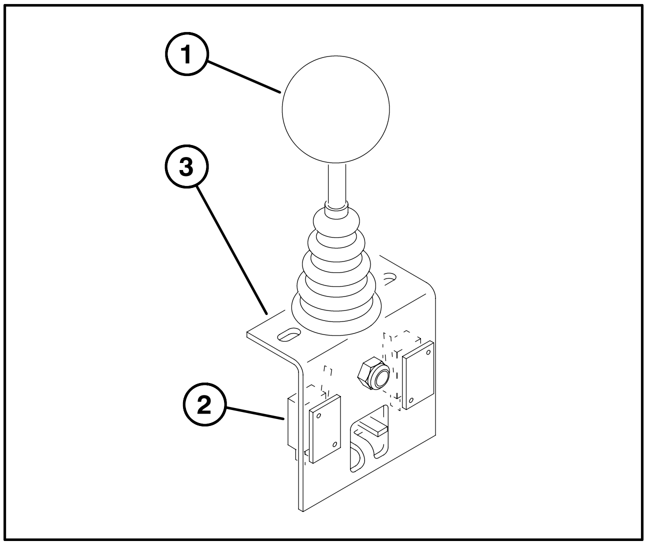


Figure 48

1. **Joy stick**
2. **Micro switch**
3. **Lift control mechanism**

Cutting Unit Down Sensor(s)

The cutting unit down switch is a normally open (NO) reed switch located on the left front lift arm that closes when the lift arm is in the lowered position. As the lift arm is lowered, a bracket on the lift arm comes close to the switch, causing the reed switch to close and complete the circuit.

This sensor can be tested using the "Input Checks" feature of the ACE Diagnostic tool.

The sensor can also be tested manually.

1. Disconnect the switch wire connector and install continuity tester or ohm meter between the two switch leads.

2. With the lift arm in the lowered position the tester should show continuity. With the lift arm in the raised position, the tester should show no continuity.

Note: When the Enable/Disable switch is in ENABLE, the controller uses inputs from this switch to turn the cutting units on and off. When raising the cutting units with the Enable/Disable switch in ENABLE, the cutting units lift part way to a "turn around" position.

Note: The Reelmaster 6700-D also has sensors on each rear lift arm (one for cutting unit #6 and one for #7).

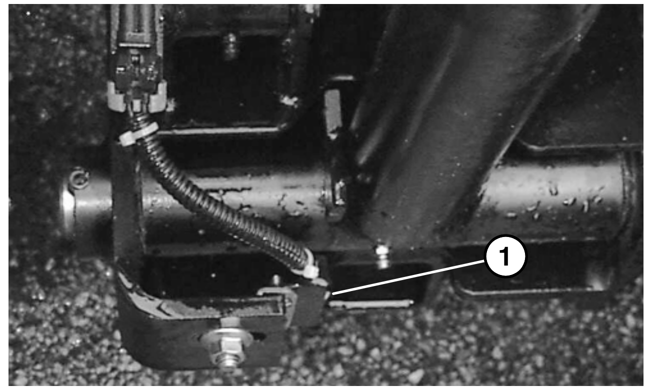


Figure 49

1. Cutting unit down switch
(front switch for units serial no 220000001 & up shown)

Adjustment

1. Move the lift arm toward the switch as far as it will move.

2. Move switch to lowest position on front lift arm. Note: for switch on RM 6700–D rear lift arm, move switch to highest position.

3. Adjust gap between switch and lift arm flag to .0625" (1.6 mm).

Cutting Unit #6 and #7 Reel On/Off Solenoids

These solenoids can be tested using the "Output Checks" feature of the ACE Diagnostic tool.

The solenoids can also be tested manually.

1. Disconnect the wire connector.

2. Connect a 12 volt battery so the positive (+) battery terminal is connected to colored solenoid lead. Connect the negative (-) battery terminal to black lead. The valve spool should retract completely as 12 VDC is applied between leads.

3. If valve spool does not operate properly check for binding or damage to valve.

4. If valve moves smoothly, but does not engage when 12 VDC is applied to solenoid leads, replace solenoid coil.

5. If valve still does not operate after replacing solenoid coil, replace the valve (see Chapter 4 - Hydraulic System in this manual).

Solenoid coil resistance:
3.5 Ohms (± 10%) at 77°F (25°C)

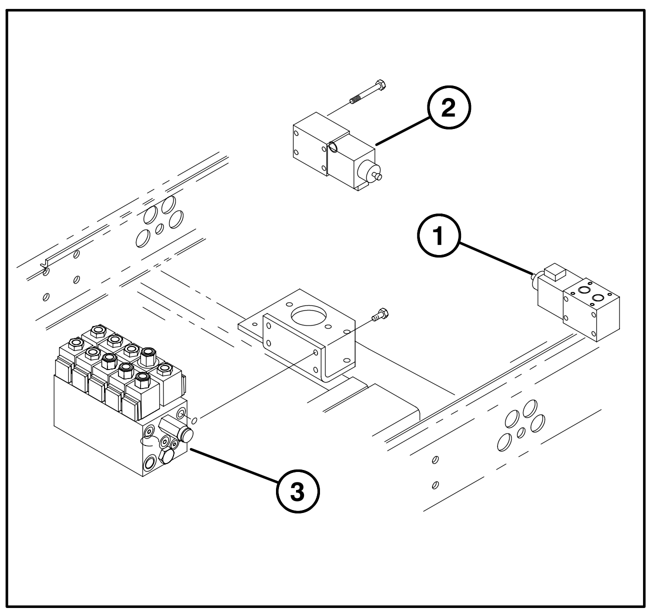


Figure 50
(Located on frame rails)

1. #6 reel solenoid (S10)
2. #7 reel solenoid (S11)
3. Rear valve block

Service and Repairs

NOTE: For more component repair information, see the Kubota Workshop Manual, Diesel Engine, 05 Series at the end of Chapter 3 - Kubota Diesel Engines.

Battery Storage

If the machine will be stored for more than 30 days

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

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

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

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

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

Battery Care

1. Battery electrolyte level must be properly maintained. The top of the battery must be kept clean. If the machine is stored in a location where temperatures are extremely high, the battery will run down 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 Grafo 112X (skin-over) grease (Toro Part No. 505-165) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on terminals to provide good electrical contact.

WARNING

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

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (-) cable first. Scrape clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with Grafo 112X (skin-over) grease (Toro Part No. 505-165) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

6. Maintain cell 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 extend. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid slashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity

Fully charged: 1.265 corrected to 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications

BCI Group Size 24:
650 CCA at 0° F (-17.8° C)
Reserve Capacity of 105 minutes at 80°F (26.7°C)

Dimensions (including terminal posts and caps)

Length	10.25 inches (26.0 cm)
Width	6.80 inches (17.3 cm)
Height	8.88 inches (20.5 cm)

Removal

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Open engine hood. Loosen battery retainer securing the battery to the frame.

2. Loosen nut on ground cable (-) post first and remove cable from battery. This should prevent short circuiting the battery, other components, or the operators hands.

3. Loosen nut on positive (+) cable post and remove cable from battery.

4. Make sure battery vent caps are on tightly.

5. Remove battery from the battery compartment to a service area to allow better access for service.

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

   A. Check for cracks. Replace battery if cracked or leaking.

   B. 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.

   C. 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.

   D. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

   E. 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 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

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

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

   B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100°F
Cell Gravity	1.245
100°F minus 80°F equals 20°F	
(37.7°C minus 26.7°C equals 11.0°C)	
20°F multiply by 0.004/10°F equals 0.008	
(11°C multiply by 0.004/5.5°C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80°F (26.7°C)	1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

3. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.

CAUTION

Follow the manufacturer's instructions when using a battery 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 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

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

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition and all accessories are **off**.

2. Make sure battery compartment is clean and repainted if necessary.

3. Make sure all battery cables and connections are in good condition and battery retainer has been repaired or replaced.

4. Place battery in its compartment. Make sure battery is level and flat. Connect positive cable connector onto positive battery post. Tighten cap screw and lock nut with two wrenches.

5. Secure battery retainer. Do not overtighten to prevent cracking or distorting the battery case.

6. Apply a light coat of skin-over grease on all battery posts and cable connectors to reduce corrosion after connections are made.

7. 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 unit's electrical system should be tested and repaired.

8. Connect negative (ground) cable connector to the negative battery post. Tighten cap screw and lock nut with two wrenches.

Charging

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

CAUTION

Follow the 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 open specific gravity or 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 manufacturer's battery charger instructions** or the following table.

3. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

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

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

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

6. Three 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 consecutive readings.

Speedometer Sensor Replacement

1. Thread locknut onto speed sensor to allow full exposure of sensor threads.

2. Center a motor piston with the center of the sensor port (see Sensor Port View in Figure 52 below). NOTE: Use a suitable tool to feel when a motor piston is in the center of the sensor port.

3. Lubricate O-ring on sensor.

4. Thread sensor into port until sensor contacts piston. Motor output shaft must rotate freely 360°.

5. Turn sensor out (counter-clockwise) until sensor orientation grooves are at a right angle + 3° to motor centerline, then back out sensor one full turn or 360°. Hold sensor at this position and tighten locknut to a torque of **75 - 125 in-lb (8.5 - 14.1 N-m)**.

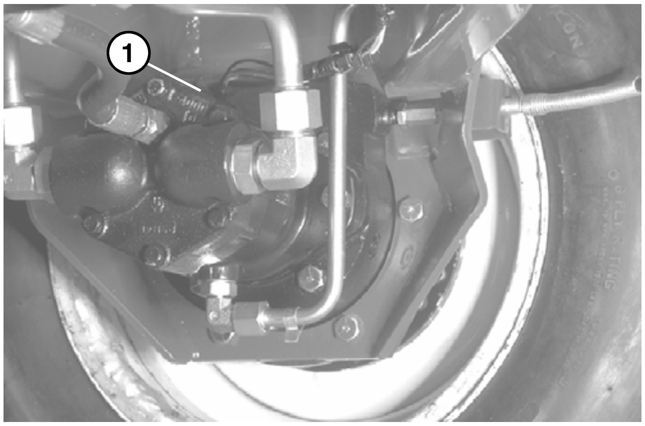


Figure 51

1. Speedometer sensor

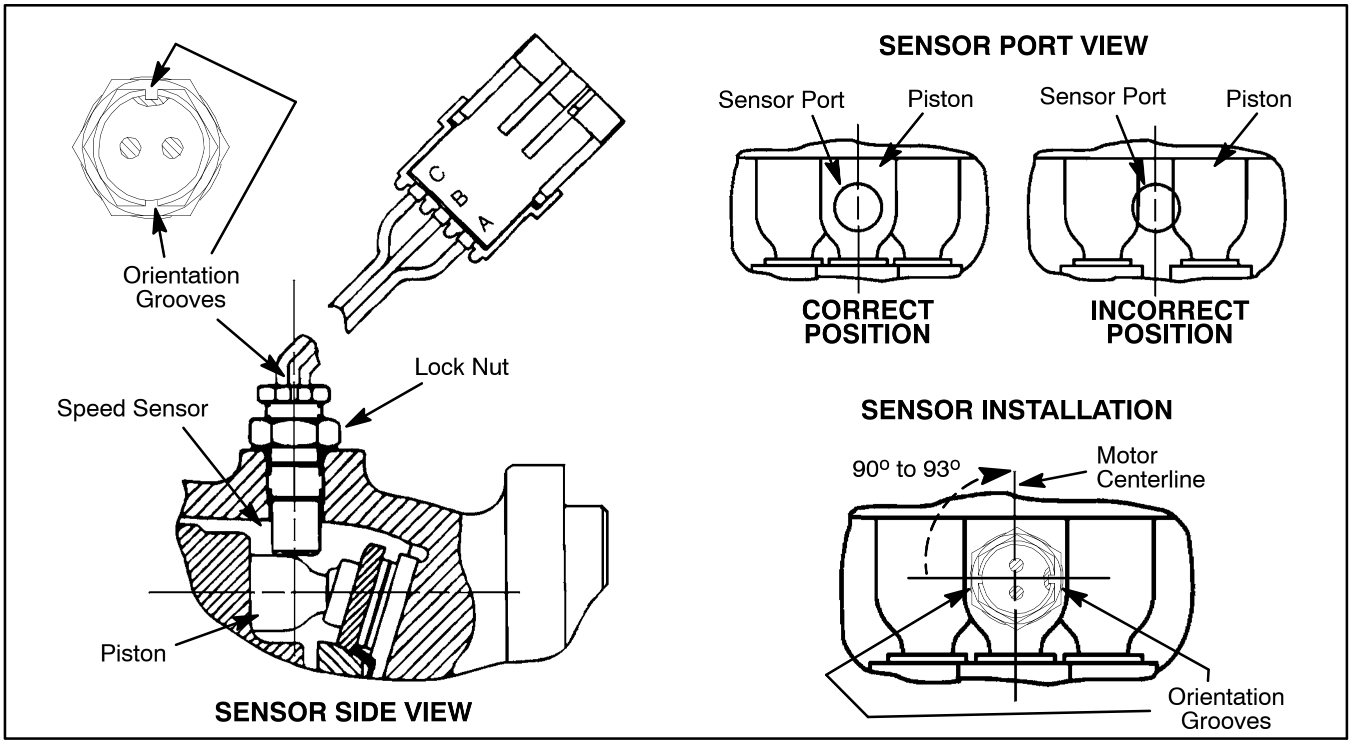


Figure 52

Electrical System

Installing Optional Lighting (customer supplied)

IMPORTANT: If optional lighting is to be added to the traction unit, use the following schematic and part numbers to prevent damage to the traction unit's electrical system.

Installation Instructions

1. Install a relay into the open connector under the control console.

Relay = Toro #70-1480 (Hella #87411 B)

2. Install the light switch.

Switch = Toro #75-1010 (Honeywell # 1TL1-2)

Note: A punch out is provided in the control console for light switch installation.

3. Crimp a ring or fork terminal onto each of the orange wires (J24 and J25) under the control console. Secure them to light switch terminals 2 & 3.

4. Splice power (+) wires from lights to red wire at J23.

5. Secure ground wires from lights to engine ground.

6. Install a 10 amp. fuse in fuse block at location shown on fuse block decal. Do not exceed fuse rating.

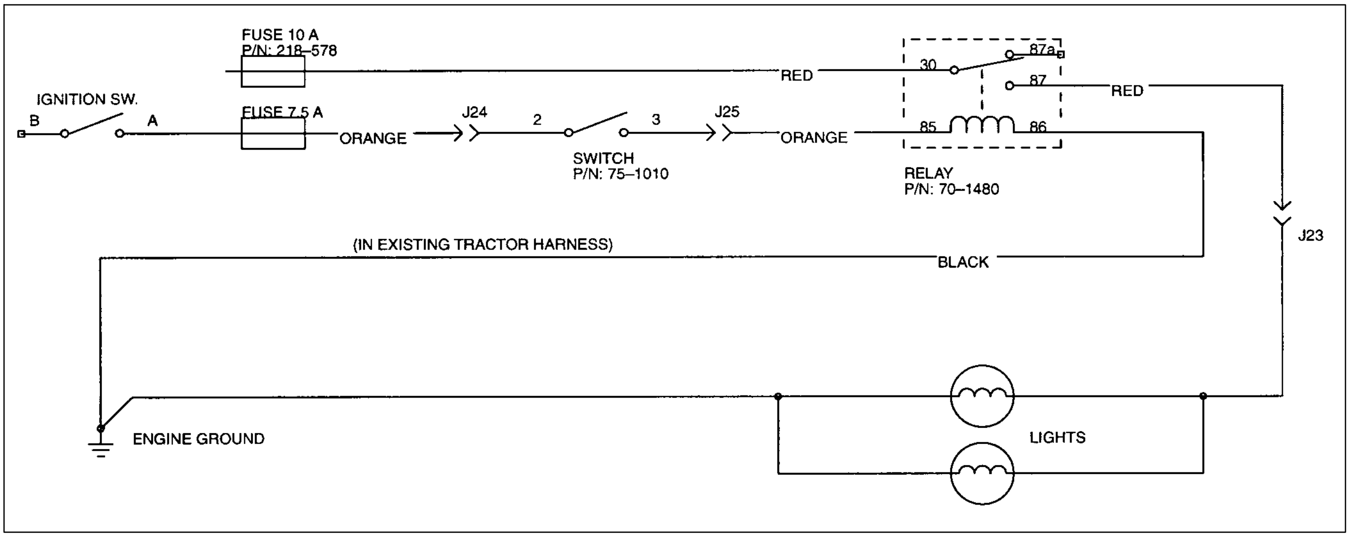


Figure 53

Optional Lighting Circuit (customer supplied)

Chapter 6

Axles, Planetaries and Brakes

Table of Contents

Specifications

Item	Specification
Front wheel lug nut torque	85 to 100 ft-lbs. (115 to 136 Nm)
Rear wheel lug nut torque	85 to 100 ft-lbs. (115 to 136 Nm)
Steering cylinder bolt torque	100 to 125 ft-lbs. (136 to 169 Nm)
Rear wheel toe-in	0.000 to 0.125 in. (0.0 to 3.0 mm)
Tire pressure (front and rear)	10 to 15 psi. (0.69 to 1.03 Bar)
Brake pedal free travel	0.5 to 1.0 in. (13 to 25 mm)
Planetary brake housing and wheel motor mounting screw torque	75 to 85 ft-lbs. (102 to 115 Nm)
Planetary gear drive lubricant Capacity (each wheel including brakes)	SAE 85W140 gear lube 16 oz. (473 cc)
Rear axle lubricant (4WD) Capacity	SAE 85W140 gear lube 80 oz. (2.4 L)

Changing Planetary Gear Drive Lubricant

Planetary gear drive lubricant should be changed every 800 hours of operation. There are 2 separate oil reservoirs (one for each front wheel) that require draining and refilling with SAE 85W-140 gear lube.

1. With machine on level surface, position wheel so the check/drain plug is at lowest position (Fig. 1).

2. Remove both plugs from the bottom of the brake housing and allow the oil to drain (Fig. 2).

3. When all of the oil has drained, install the bottom plug in the brake housing.

4. Position the wheel so that the plug hole is at the ten or two o'clock position on the planetary.

5. Slowly add approximately 16 oz. (0.5 l) of high quality SAE 85W-140 gear lube to the planetary fill hole (at the ten or two o'clock position) until the level is up to the bottom of the brake housing check hole. Install the plug.

6. Repeat the procedure on the opposite planetary/brake assembly.

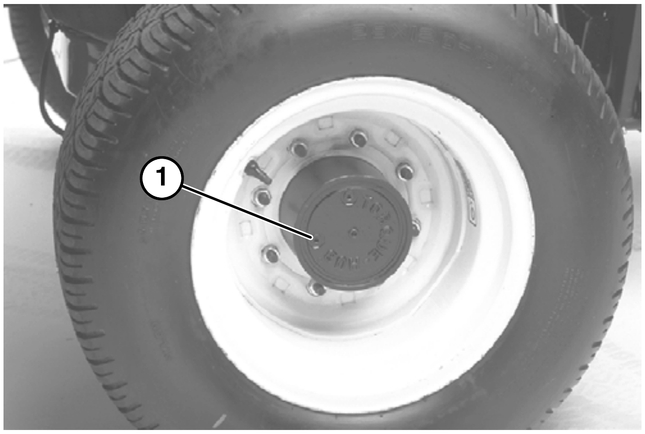


Figure 1

1. **Planetary Drive Housing drain plug (shown at 9 o'clock position)**

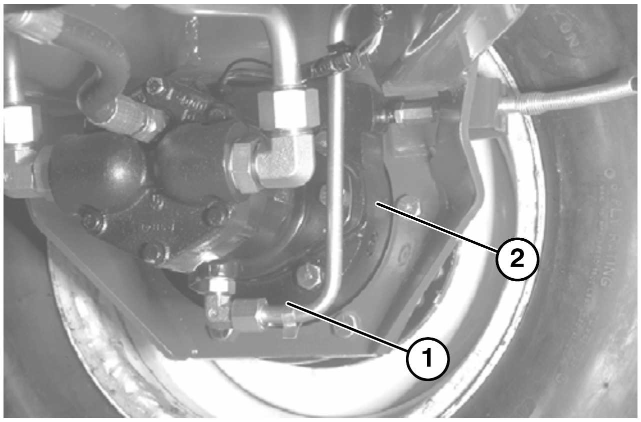


Figure 2

1. **Drain Plug Location** 2. **Check Plug Location**

Changing Rear Axle Lubricant

Rear axle lubricant should be changed every 800 hours of operation. Rear axle lubricant should be SAE 85W-140 gear lube.

1. Position machine on a level surface.

2. Clean area around the check plugs, drain plugs, and fill/vent plug (Fig. 3, 4, & 5).

3. Remove check plugs and fill/vent plug to allow easier rear axle draining.

4. Remove drain plugs and allow axle lubricant to drain into drain pans.

5. Reinstall all drain plugs after complete axle draining.

6. Slowly add lubricant through the fill/vent plug to bring the lubricant level up to the bottom of the axle support check plug hole (Fig. 4). As lubricant is added to fill/vent plug, right and left gear cases will fill as well.

7. When lubricant level is correct, install all check plugs and fill/vent plug.

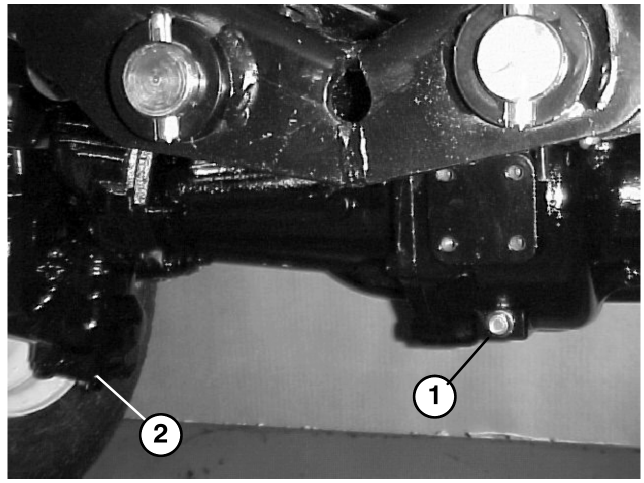


Figure 3

1. **Axle support drain plug**
2. **Gear case drain plug (right side shown)**

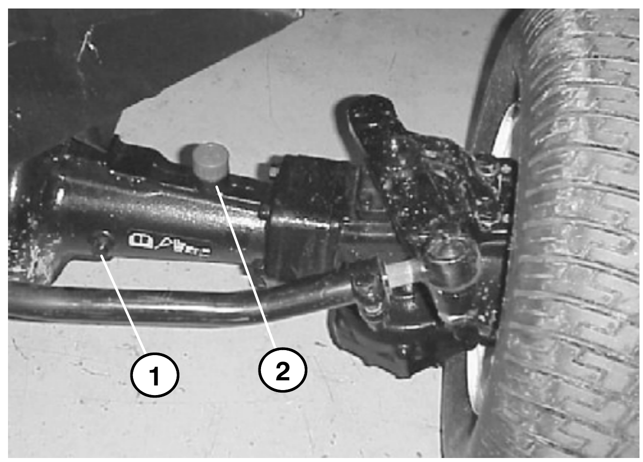


Figure 4

1. **Axle support check plug**
2. **Fill/vent plug**

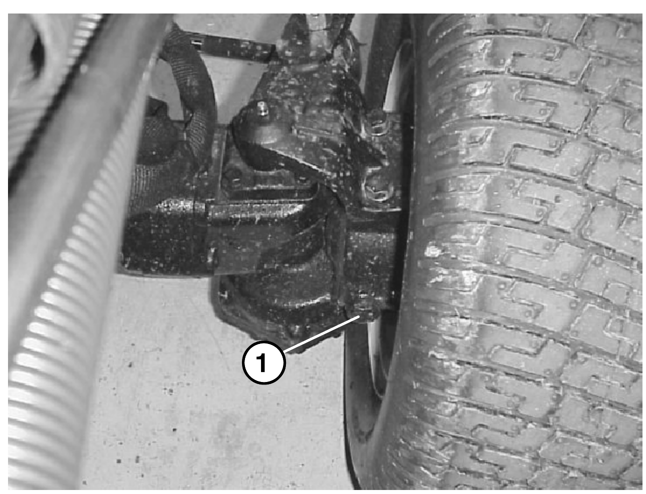


Figure 5

1. **Gear case check plug**

Adjustments

Service Brake Adjustment

Adjust the service brakes when there is more than 1 inch of “free travel” of the brake pedal, or when the brakes do not work effectively. Free travel is the distance the brake pedal moves before braking resistance is felt.

1. Disengage locking pin from brake pedals so both pedals work independently of each other.

2. To reduce free travel of brake pedals, tighten the brakes - loosen front nut on threaded end of brake cable. Then tighten rear nut to move cable backward until brake pedals have 1/2 to 1 inch of free travel. Tighten front nuts after brakes are adjusted correctly.

NOTE: Each brake cable should be loose and require 1/8 inch movement from floor plate opening to start movement of cable at clevis end.

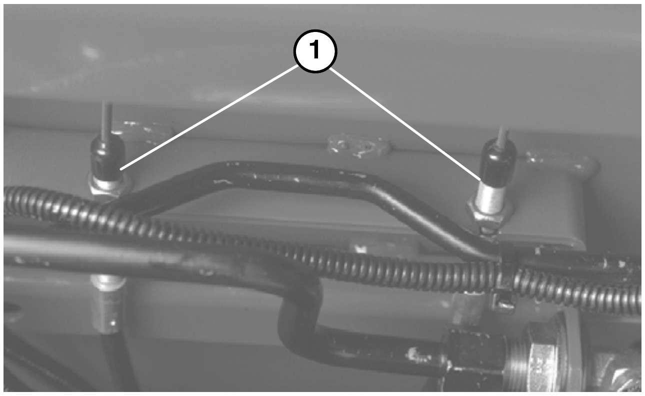


Figure 6

1. Brake Cables

Axles, Planetaries and Brakes

Rear Wheel Toe-in Adjustment

After every 800 operating hours or annually, check rear wheel toe-in.

To check toe-in, rotate the steering wheel so the rear wheels point straight ahead. Measure the center-to-center distance, at axle height, in front and rear of steering tires. Front measurement should be 1/4" (6.4 mm) less than the rear measurement. If toe-in is not within specifications, an adjustment is required.

2WD Traction Units

1. Loosen clamps at both ends of tie rod (Fig. 7).

2. Rotate tie rod to move front of tires inward or outward and measure toe-in.

3. Repeat step 2 if necessary.

4. Tighten tie rod clamps when adjustment is correct.

4WD Traction Units

1. Remove the cotter pin and slotted hex nut from either tie rod ball joint. Use a ball joint fork and remove the tie rod ball joint from the axle case support (Fig. 8).

2. Loosen clamps on both ends of tie rod.

3. Rotate the detached ball joint inward or outward one (1) complete revolution. Tighten the clamp at the loose end of the tie rod.

4. Rotate the entire tie rod assembly the same direction (inward or outward) one (1) complete revolution. Tighten the clamp at the connected end of the tie rod.

5. Install the ball joint in the axle case support and tighten the slotted hex nut finger tight and measure toe-in.

6. Repeat steps 2 - 5 if necessary.

7. Tighten ball joint hex nut and install a new cotter pin.

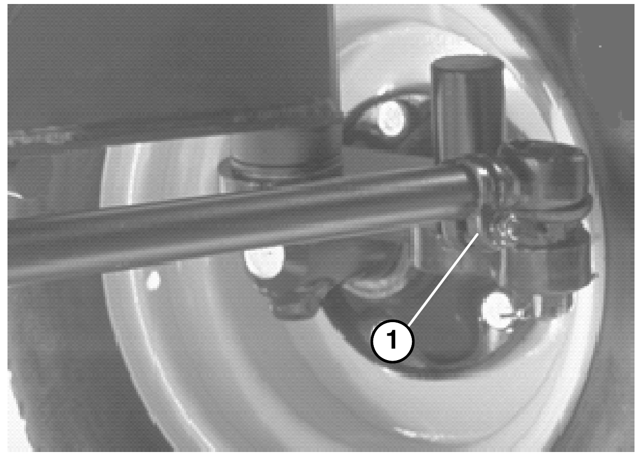


Figure 7

1. Tie Rod Clamps

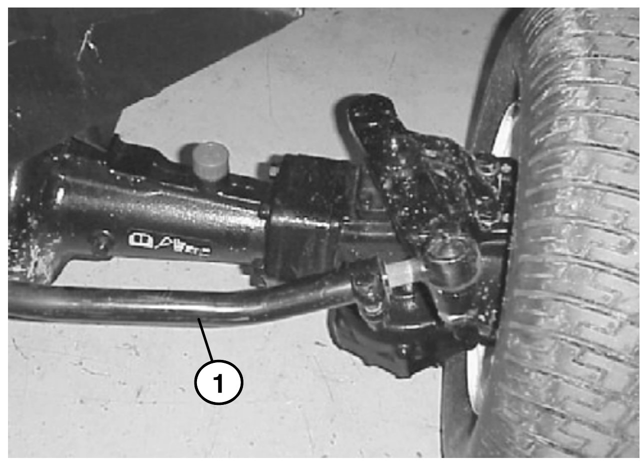


Figure 8

1. Tie rod

Planetary Wheel Drive Service

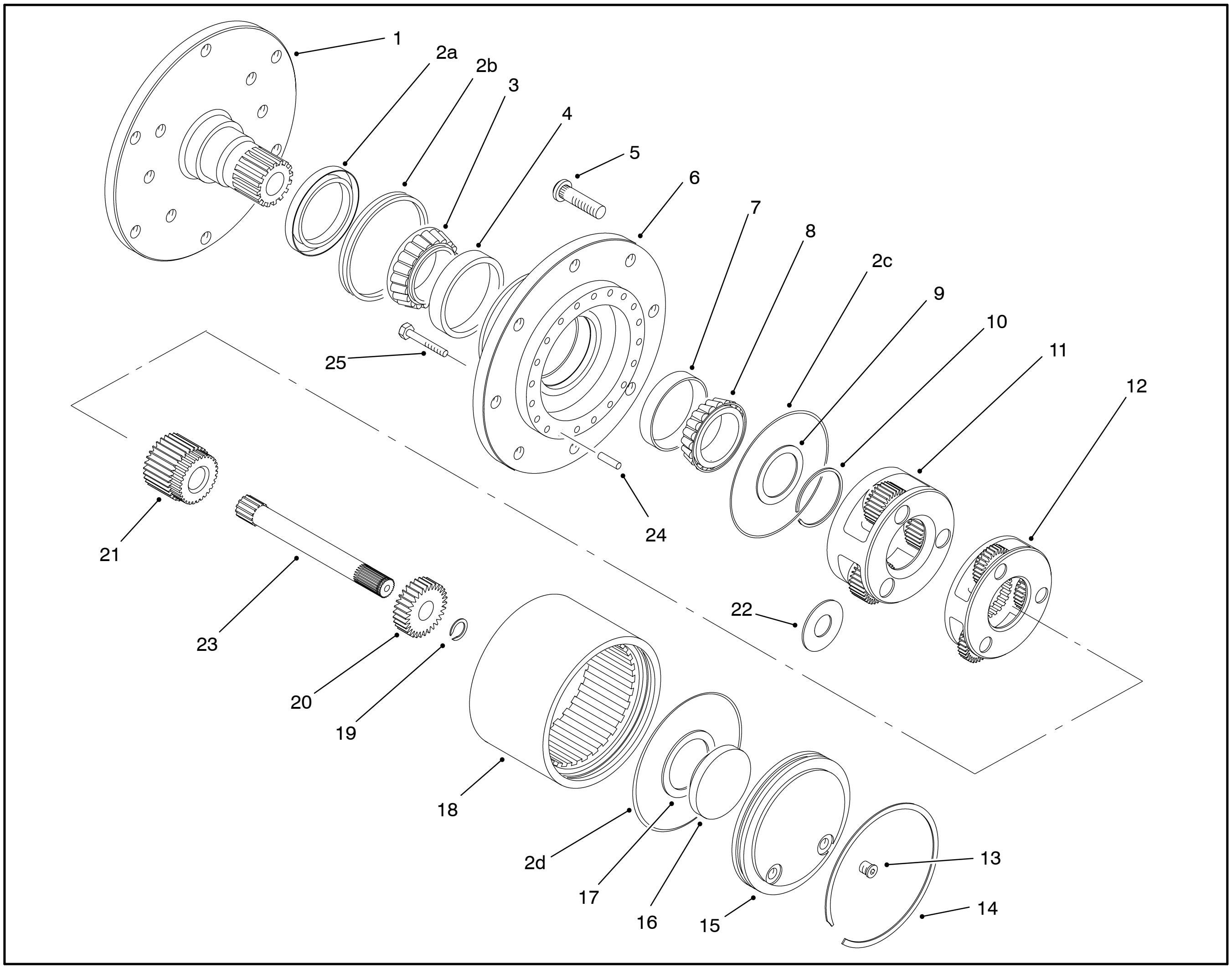


Figure 9

1. **Spindle**
2. **Seal Kit**
3. **Bearing Cone**
4. **Bearing Cup**
5. **Wheel Stud (8 used)**
6. **Housing**
7. **Bearing Cup**
8. **Bearing Cone**
9. **Thrust Washer**
10. **Retaining Ring**
11. **Secondary Carrier Assembly**
12. **Primary Carrier Assembly**
13. **Pipe Plug**
14. **Retaining Ring**
15. **Cover Plate**
16. **Input Spacer**
17. **Thrust Washer**
18. **Ring Gear**
19. **Retaining Ring**
20. **Sun Gear**
21. **Sun Gear**
22. **Thrust Washer**
23. **Input Shaft**
24. **Dowel Pin**
25. **Capscrew**

Disassembly (Fig. 9 & 10)

1. Remove retaining ring (14).

2. Remove cover plate (15).

3. Remove spacer (16) and washer (17).

4. Remove sun gear and input shaft assembly (19, 20 and 23).

5. Remove primary carrier assembly (12).

6. Remove sun gear (21).

7. Remove secondary carrier assembly (11).

Note: Washer (22) is inside carrier assembly.

Note: Steps 8 - 12 are necessary only if inspecting or replacing bearings and/or seals.

8. Remove capscrews (25) and remove ring gear (18).

9. Remove retaining ring (10) and thrust washer (9).

10. Use a puller to remove spindle (1) from housing (6). Remove bearing cone (8).

11. Remove and discard all seals.

12. If bearings will be replaced, use a puller to remove bearing cone (3) from spindle. Remove bearing cups (4 and 7) from housing (6).

Assembly (Fig. 9 & 10)

Note: Use a new seal kit when assembling planetary wheel drive.

1. Clean parts in solvent. Inspect parts for damage or excessive wear and replace as necessary.

2. Install lip seal (2a) to spindle (1).

3. Press bearing cups (4 and 7) into housing (6).

4. Press bearing cone (3) onto spindle (1).

5. Install seal (2b) to housing (6). Assemble housing (6) to spindle (1). Make sure seals are installed correctly (Fig. 10).

6. Press bearing cone (8) onto spindle and secure with thrust washer (9) and retaining ring (10).

7. Install seal (2c), then assemble ring gear (18) to housing (6) with capscrews (25).

8. Install secondary carrier assembly (11).

9. Install sun gear (21).

10. Install primary carrier assembly (12).

11. Assemble input shaft and sun gears (19, 20 and 23). Install input shaft assembly.

12. Install thrust washer (17) and input spacer (16).

13. Install seal (2d), then install cover (15). Secure cover with retaining ring (14).

14. Check operation of planetary wheel drive before installing on the tractor.

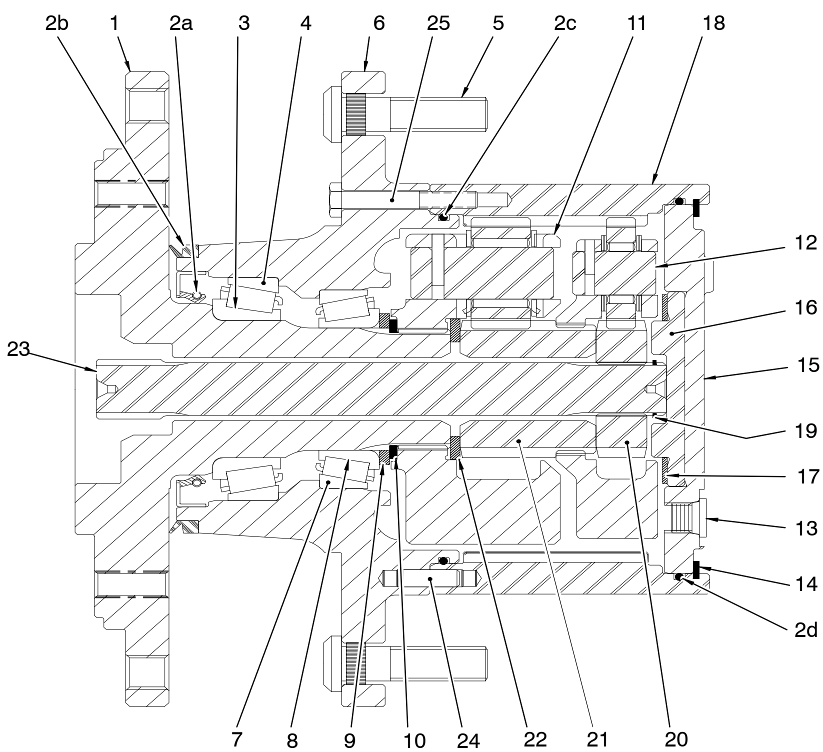


Figure 10

1. **Spindle**
2. **Seal Kit**
3. **Bearing Cone**
4. **Bearing Cup**
5. **Wheel Stud (8 used)**
6. **Housing**
7. **Bearing Cup**
8. **Bearing Cone**
9. **Thrust Washer**
10. **Retaining Ring**
11. **Secondary Carrier Assembly**
12. **Primary Carrier Assembly**
13. **Pipe Plug**
14. **Retaining Ring**
15. **Cover Plate**
16. **Input Spacer**
17. **Thrust Washer**
18. **Ring Gear**
19. **Retaining Ring**
20. **Sun Gear**
21. **Sun Gear**
22. **Thrust Washer**
23. **Input Shaft**
24. **Dowel Pin**
25. **Capscrew**

Brake Service

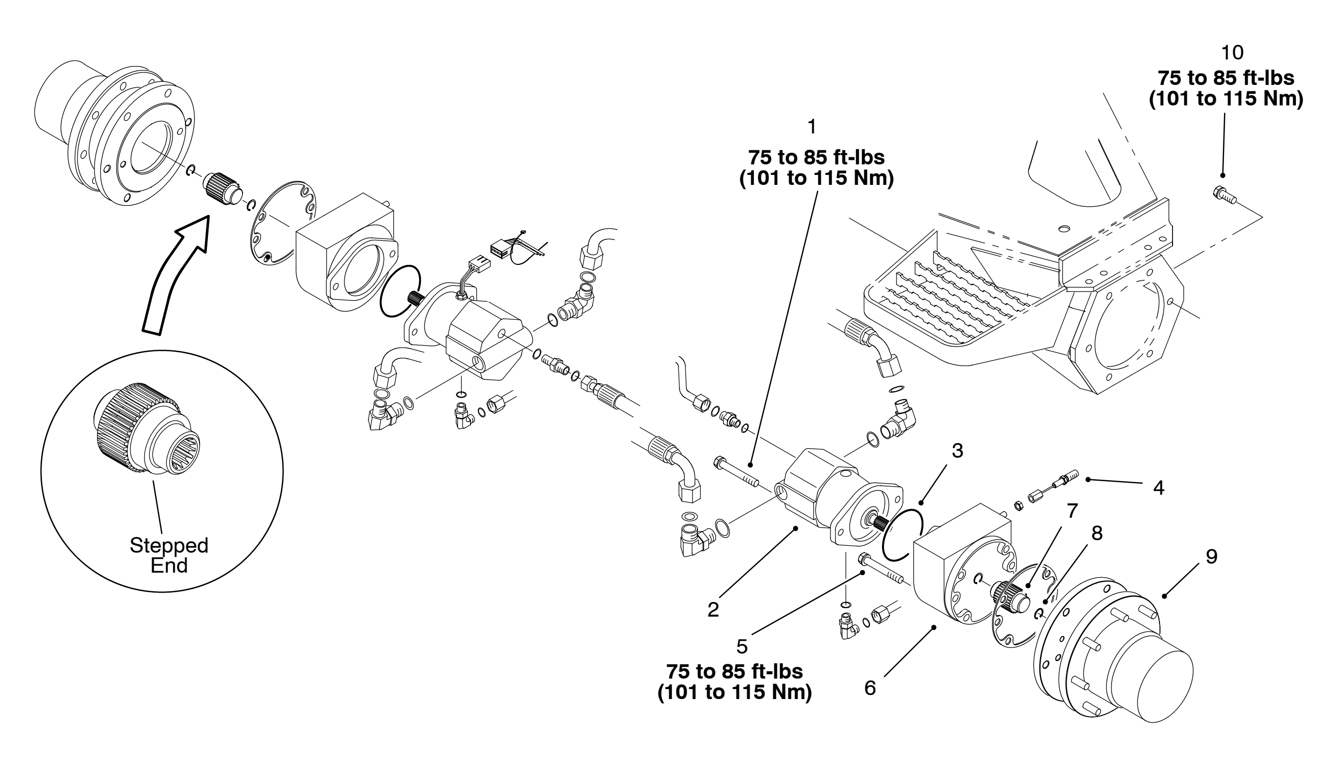


Figure 11

1. **Capscrew**
2. **Wheel Motor**
3. **O-ring**
4. **Brake Cable**
5. **Flange Head Screw**
6. **Brake Assembly**
7. **Splined Shaft**
8. **Retaining Ring**
9. **Planetary Wheel Drive**
10. **Flange Head Screw**

Removal (Fig. 11)

1. Drain oil from planetary wheel drive (9) and brake assembly (6).

2. Jack up front of machine and support with jack stands.

3. Remove wheel.

4. Remove wheel motor (2) (see Removing Hydraulic System Components in Chapter 4 - Hydraulic System in this manual).

5. Disconnect brake cable (4) from pull rod on brake.

6. Remove flange head capscrews (5) securing brake assembly to frame; be careful not to drop splined shaft as brake assembly is removed.

7. Remove splined shaft (7).

8. Complete brake inspection and repair as shown on next page.

Installation (Fig. 11)

1. Install splined shaft (7) into brake assembly. **Note:** The stepped end of the splined brake shaft must be aligned toward the wheel motor.

2. Install brake assembly onto frame, aligning splined shaft with input shaft on planetary wheel drive.

3. Install flange head screws (5) to secure brake assembly to frame. Tighten screws in a crossing pattern 75 to 85 ft-lb (101 to 115 Nm).

4. Install brake cable (4) to pull rod on brake assembly.

5. Install new o-ring (3) on wheel motor (2). Install wheel motor and tighten capscrews (1) to 75 to 85 ft-lb (101 to 115 Nm).

6. Make sure drain plug is installed in bottom of brake assembly. Fill planetary wheel drive with SAE 85W140 gear lube. Capacity is approximately 16 oz. per wheel (both planetary drive and brake housing).

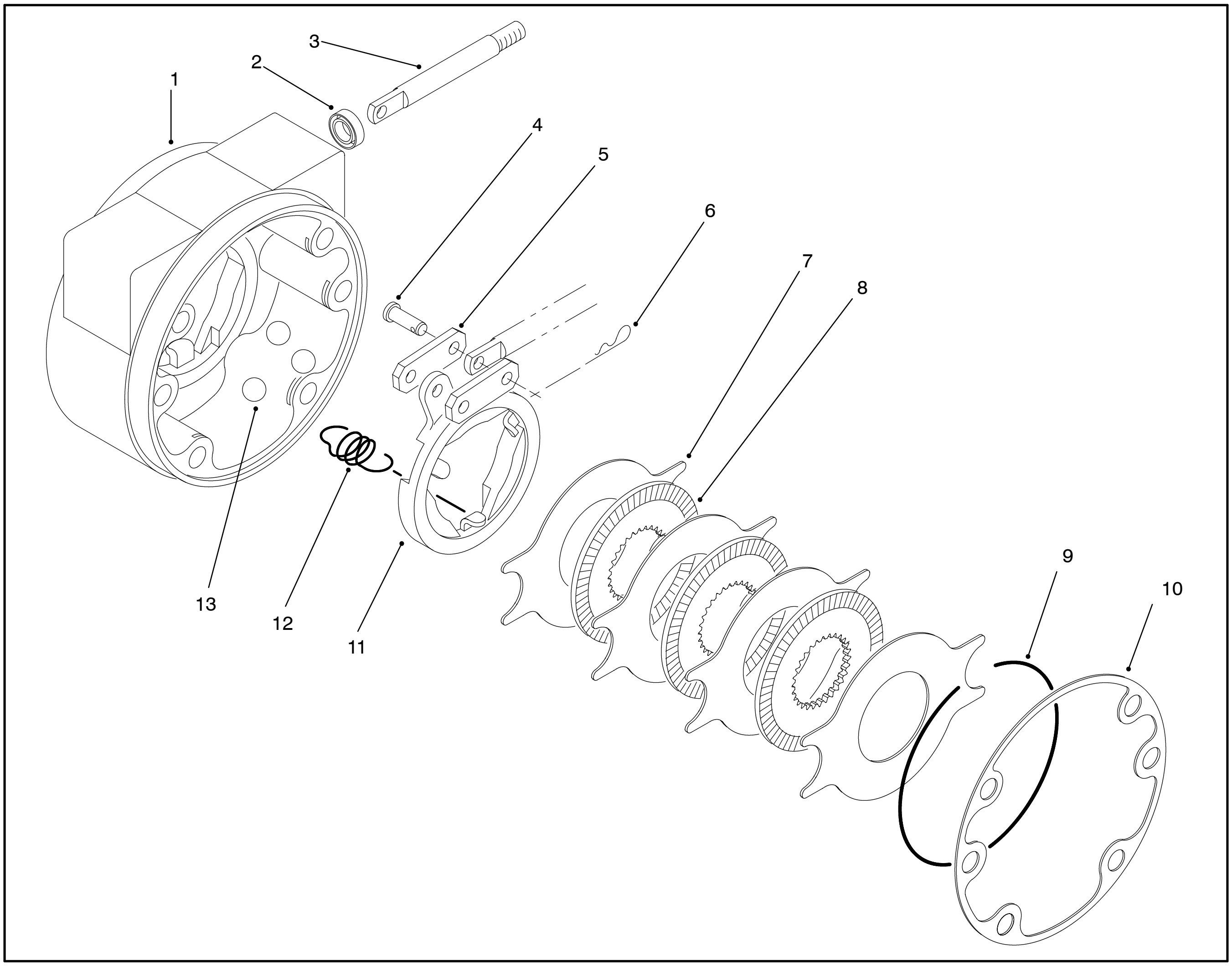


Figure 12

1. **Brake Housing - LH**
2. **Seal**
3. **Pull Rod**
4. **Clevis Pin**
5. **Link**
6. **Cotter Hair Pin**
7. **Stationary Disc**
8. **Rotating Disc**
9. **Retaining Ring**
10. **Gasket**
11. **Actuator**
12. **Extension Spring**
13. **Ball**

Inspection and Repair (Fig. 12)

1. Scrape gasket material (10) off of brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (9).

3. Remove stationary discs (7) and rotating discs (8).

4. Remove springs (12).

5. Remove actuator assembly (11, 6, 5, 4, 3).

6. Remove balls (13).

7. Remove balls (13).

8. Wash parts in cleaning solvent.

9. Inspect parts for wear or damage.

10. Reverse steps 2 - 6 to assemble brakes, installing new parts as necessary. Install a new seal (2).

11. Use a new gasket (10) when installing brake assembly.

Rear Axle Service (2WD)

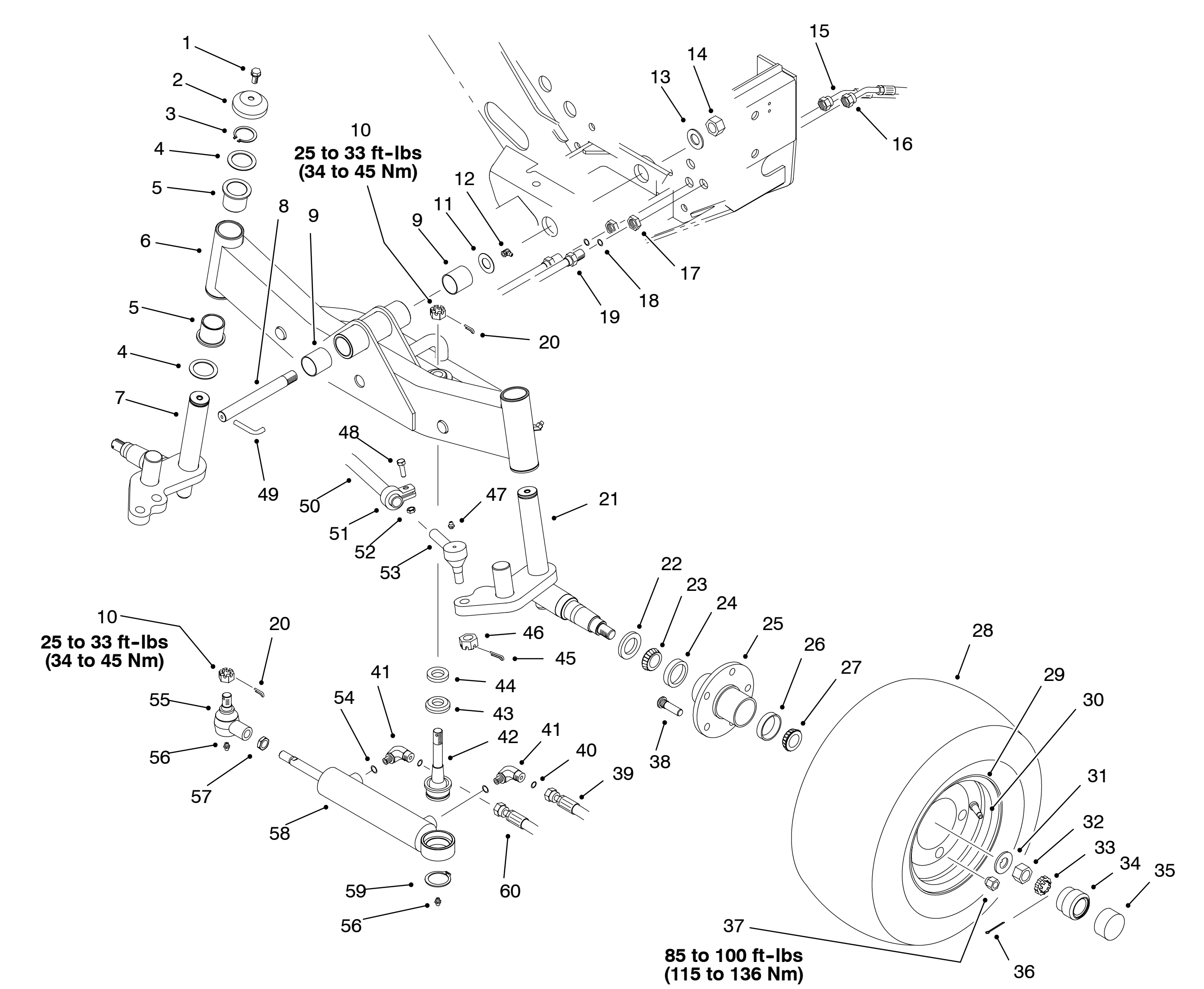


Figure 13

1. **Screw**
2. **Spindle Cap**
3. **Retaining Ring**
4. **Thrust Washer**
5. **Flange Bushing**
6. **Rear Axle Assembly**
7. **Spindle - RH**
8. **Axle Pivot Pin**
9. **Sleeve Bushing**
10. **Slotted Nut**
11. **Thrust Washer**
12. **Grease Fitting**
13. **Thrust Washer**
14. **Locknut**
15. **Hydraulic Hose**
16. **Hydraulic Hose**
17. **Nut**
18. **O-ring**
19. **Hydraulic Tube**
20. **Cotter Pin**
21. **Spindle - LH**
22. **Inner Seal**
23. **Inner Bearing Cone**
24. **Inner Bearing Cup**
25. **Hub**
26. **Outer Bearing Cup**
27. **Outer Bearing Cone**
28. **Tire**
29. **Rim**
30. **Valve Stem**
31. **Tab Washer**
32. **Nut**
33. **Retainer Nut**
34. **Bearing Buddy**
35. **Cap**
36. **Cotter Pin**
37. **Lugnut**
38. **Drive Stud**
39. **Hydraulic Hose**
40. **O-ring**
41. **90° Hydraulic Fitting**
42. **Ball Joint**
43. **Dust Seal**
44. **Spacer**
45. **Cotter Pin**
46. **Slotted Nut**
47. **Grease Fitting**
48. **Screw**
49. **Stop Pin**
50. **Tie Rod**
51. **Clamp**
52. **Locknut**
53. **Tie Rod End**
54. **O-ring**
55. **Ball Joint**
56. **Grease Fitting**
57. **Jam Nut**
58. **Hydraulic Cylinder**
59. **Retaining Ring**
60. **Hydraulic Hose**

Axle Pivot Bushings

The rear axle must be held in place snugly by the axle pin. Excessive movement of the axle, which is characterized by erratic steering, usually indicates worn bushings. To correct the problem, replace the bushings.

1. Disconnect the hydraulic hoses from the steering cylinder. Put caps or plugs on all the fittings and hoses to prevent contamination.

Note: To ease reassembly, tag each of the hoses to show their correct position on the steering cylinder.

2. Remove the locknut and thrust washer securing the end of the axle pivot pin to the chassis (Fig. 13).

3. Jack up the frame (just ahead of the rear wheels) until pressure is taken off the axle pivot pin. Support the machine with jack stands to prevent it from falling.

4. Pull the axle pivot pin out. This will release the rear axle and washer(s) from the frame. Carefully pull the entire axle and wheel assembly out from under the machine.

Note: Several washers may have been installed between the axle pivot tube and frame during manufacture. Make sure the same number of washers are installed during reassembly.

5. Use a drift punch and hammer to drive both bushings out of the axle. Clean the inside of the axle pivot tube to remove dirt and foreign material.

6. Apply grease to the inside and outside of the new bushing. Use an arbor press to install the bushings into the top and bottom of the axle pivot tube. Bushings must be flush with the axle tube.

7. Wipe the rear axle pivot pin with a rag to remove dirt and grease. Inspect the pin for wear or damage and replace as necessary.

8. Mount the axle to the frame with the axle pin. Install washer(s) and axle pivot pin. Secure the axle pivot pin in place with the thrust washer and jamnut.

9. Remove the jackstands and lower the machine to the floor.

10. Lubricate the rear axle pivot bushings through the grease fitting on the pivot pin.

11. Install the hydraulic hoses to the steering cylinder.

12. Check steering cylinder hydraulic connections for leaks.

Axle Spindle Bushings

The rear wheel spindles must fit snugly in the rear axle. Excessive movement of the spindle in the axle indicates that the bushings are probably worn and must be replaced.

1. Disconnect the hydraulic hoses from the steering cylinder. Put caps or plugs on the fittings and hoses to prevent contamination.

Note: To ease reassembly, tag each of the hoses to show their correct position on the steering cylinder.

2. Remove the jamnut and thrust washer securing the end of the axle pivot pin to the chassis (Fig. 13).

3. Jack up the frame (just ahead of the rear wheels) until pressure is taken off the axle pivot pin. Support the machine with jackstands to prevent it from falling.

4. Pull the axle pivot pin out. This will release the rear axle and washer(s) from the frame. Carefully pull the entire axle and wheel assembly out from under the machine.

Note: Several washers may have been installed between the axle pivot tube and frame during manufacture. Make sure the same number of washers are installed during reassembly.

5. Remove the cotter pin and castle nut securing the steering cylinder and/or tie rod end to the spindle arm.

6. Remove the capscrew, spindle cap, retaining ring, and washers that secure the wheel spindle into the axle tube. Slide the spindle, washer, and wheel assembly out of the axle tube to expose the bushings.

7. Use a punch and hammer to drive both bushings out of the axle tube. Clean the inside of the axle tube to remove any dirt and foreign material.

8. Apply grease to the inside and outside of the new bushings. Use an arbor press to install the bushings into the top and bottom of the axle tube. The bushings must be flush with the axle tube.

9. Wipe the spindle shaft with a rag to remove any dirt and grease. Inspect the spindles for wear and replace as necessary.

10. Install a washer onto the spindle shaft and push the shaft through the axle tube. Hold the wheel and spindle shaft assembly in place and install the thrust washer flat washer and retaining ring onto the end of the spindle shaft. Install the spindle cap and capscrew.

11. Connect steering cylinder and/or tie rod end to the spindle arm. Tighten the castle nut(s) to 25 to 33 ft-lbs. (34 to 45 Nm). and install new cotter pins.

12. Mount the axle to the frame with the axle pin. Install washer(s) and axle pivot pin. Secure the axle pivot pin in place with the thrust washer and jamnut.

13. Remove the jackstands and lower the machine to the floor.

14. Lubricate the steering spindles through the grease fittings on the rear axle.

15. Install the hydraulic hoses to the steering cylinder.

16. Check steering cylinder hydraulic connections for leaks.

Wheel Bearings

Rear wheel bearing buddies should be lubricated every 50 operating hours. Disassemble, clean, repack and adjust the rear wheel bearings after 800 hours of operation or once a year. Use No. 2 general purpose lithium grease containing E.P. additive. If operating conditions are extremely dusty and dirty, it may be necessary to perform this maintenance more often.

1. Jack up the rear of the machine until the tire is off the floor. Support the machine with jack stands or blocks to prevent it from falling.

2. Remove the dust cap and bearing buddy from the end of the wheel spindle (Fig. 14).

3. Remove the cotter pin, retainer, slotted nut, and washer. Slide the wheel off spindle shaft.

4. Pull the seal out of the wheel hub.

5. Remove the bearings from both sides of the wheel hub. Clean the bearings in solvent. Make sure the bearings are in good operating condition. Clean the inside of the wheel hub. Check the bearing cups for wear, pitting or other noticeable damage. Replace worn or damaged parts.

6. If bearing cups were removed from the wheel hub, press them into the hub until they seat against the shoulder.

7. Pack both bearings with grease. Install one bearing into the cup on inboard side of the wheel hub. Lubricate the inside of the new lip seal and press it into the wheel hub.

IMPORTANT: The lip seal must be pressed in so it is flush with the end of the hub. The lip of the seal must be toward the bearing.

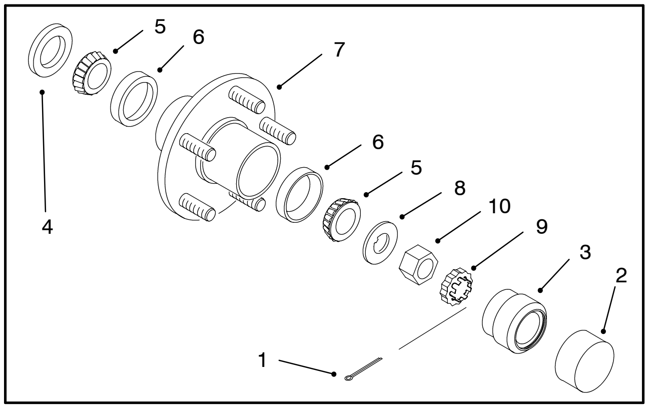


Figure 14

1. Cotter pin	**6. Bearing race**
2. Dust cap	**7. Wheel hub**
3. Bearing buddy	**8. Washer**
4. Seal	**9. Retainer**
5. Bearing cone	**10. Locknut**

8. Pack inside of wheel hub with some grease (not full). Install remaining bearing into the bearing cup.

9. Slide the wheel onto the spindle shaft and secure it in place with the flat washer and slotted nut. DO NOT tighten the nut or install the cotter pin.

10. Rotate the wheel by hand and tighten the slotted nut (Fig. 14) to 75 to 100 in-lb (8.5 to 11.3 Nm) to set the bearing. Then, loosen the nut until the hub has end play.

11. Rotate the wheel by hand and re-tighten the slotted nut to 15 to 20 in-lb (1.7 to 2.3 Nm).

12. If necessary rotate the slotted nut counterclockwise to align slot with cotter pin hole in spindle, and install retainer and cotter pin.

13. Remove jack stands or blocks and lower machine to floor.

14. Fill the inside of the bearing buddy with grease. Install bearing buddy and dust cap.

Rear Axle Service (4WD)

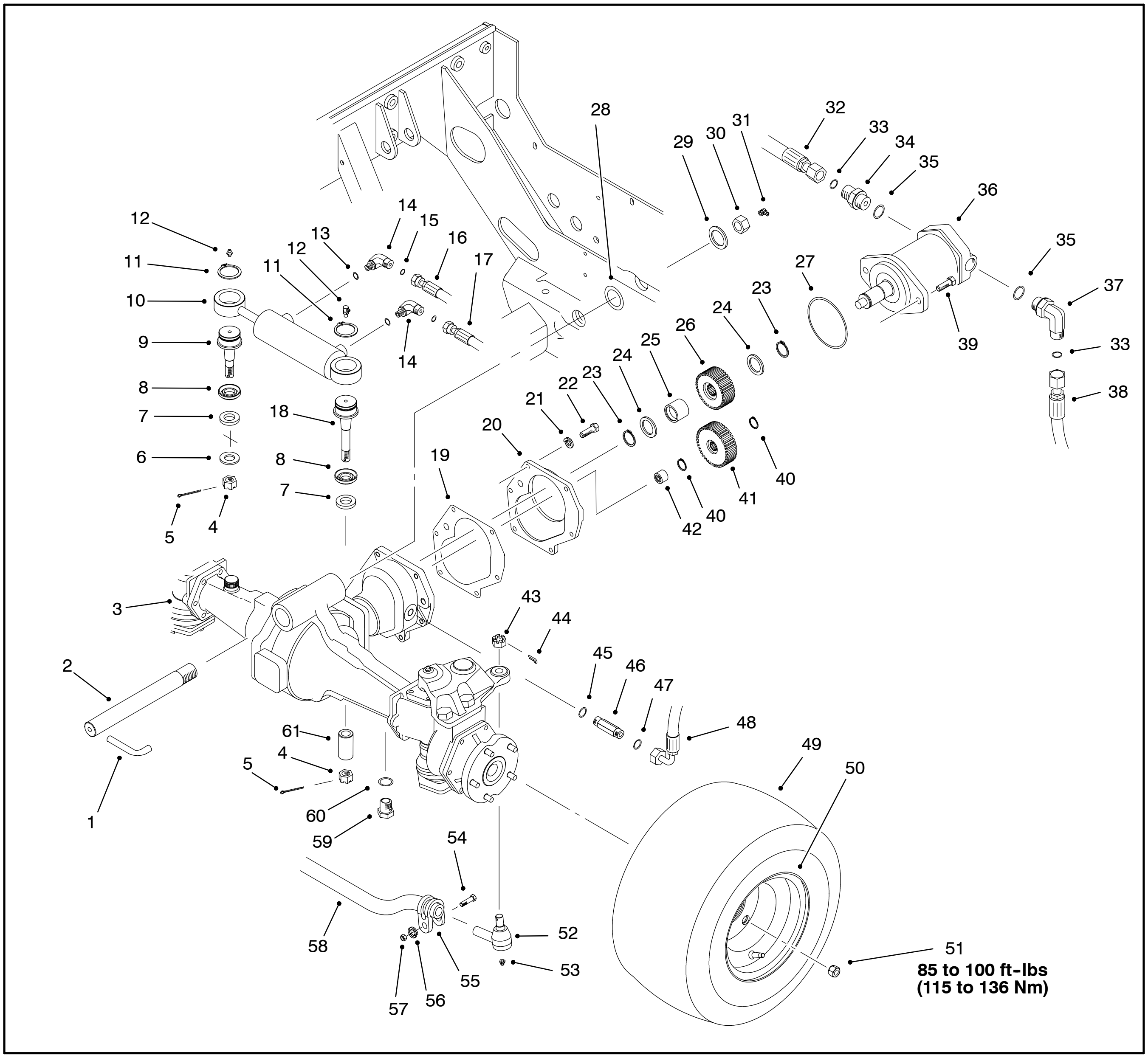


Figure 15

1. **Stop Pin**
2. **Axle Pivot Pin**
3. **Axle Assembly**
4. **Slotted Nut**
5. **Cotter Pin**
6. **Washer**
7. **Spacer**
8. **Dust Seal**
9. **Ball Joint**
10. **Hydraulic Cylinder**
11. **Retaining Ring**
12. **Grease Fitting**
13. **O-ring**
14. **90° Hydraulic Fitting**
15. **O-ring**
16. **Hydraulic Hose**
17. **Hydraulic Hose**
18. **Ball Joint**
19. **Gasket**
20. **Cover Plate**
21. **Lockwasher**
22. **Screw**
23. **Retaining Ring**
24. **Thrust Washer**
25. **One-Way Overrunning Clutch**
26. **Drive Gear**
27. **O-ring**
28. **Thrust Washer**
29. **Thrust Washer**
30. **Locknut**
31. **Grease Fitting**
32. **Hydraulic Hose**
33. **O-ring**
34. **Straight Hydraulic Fitting**
35. **O-ring**
36. **Hydraulic Motor**
37. **90° Hydraulic Fitting**
38. **Hydraulic Hose**
39. **Screw**
40. **Retaining Ring**
41. **Driven Gear**
42. **Bearing**
43. **Slotted Nut**
44. **Cotter Pin**
45. **O-ring**
46. **Straight Hydraulic Fitting**
47. **O-ring**
48. **Hydraulic Hose**
49. **Tire**
50. **Rim**
51. **Lugnut**
52. **Tie Rod End**
53. **Grease Fitting**
54. **Screw**
55. **Clamp**
56. **Washer**
57. **Locknut**
58. **Tie Rod**
59. **Plug**
60. **O-ring**
61. **Spacer**

Removal (Fig. 15)

1. Engage the parking brakes, lower the cutting units to the ground, turn the engine OFF and remove the key from the ignition switch.

2. Drain rear axle lubricant (see Changing Rear Axle Lubricant in this section of this manual).

3. Thoroughly clean the steering cylinder and rear axle drive motor hydraulic hose connections. Disconnect the hydraulic hoses and put caps or plugs on all the fittings and hoses to prevent contamination.

Note: To ease reassembly, tag each of the hoses to show their correct position.

4. Remove the retaining rings securing the rod end and the barrel end of the steering cylinder and remove the steering cylinder.

5. Remove the cotter pins and slotted hex nuts from the tie rod ball joints. Use a ball joint fork and remove the ball joints from the axle case supports.

6. Loosen the rear wheel lug nuts.

7. Remove the locknut and thrust washer securing the end of the axle pivot pin to the chassis.

8. Block the front wheels and jack up the frame (just ahead of the rear wheels) until the rear tire is about 1 in. (25 mm) above the floor. Support the machine with jack stands to prevent it from falling.

9. Remove rear wheels.

10. Support the rear axle from underneath and remove the axle pivot pin. This will release the rear axle and washer(s) from the frame, allowing the axle to be lowered and removed.

Note: Several washers may have been installed between the axle pivot tube and frame during manufacture. Make sure the same number of washers are installed in the same location during reassembly.

11. Wipe the rear axle pivot pin and pivot bushings with a rag to remove dirt and grease. Inspect the pin and bushings for wear or damage. Replace components as necessary.

Installation (Fig. 15)

1. Apply a thin coat of grease to the inside of the rear axle pivot bushings and move the rear axle assembly into position under machine frame.

2. Install washer(s) and axle pivot pin. Secure the axle pivot pin in place with the thrust washer and locknut.

3. Install the tie rod ball joints and check rear wheel toe-in (see Rear Wheel Toe-in Adjustment in this section of this manual). Tighten ball joint hex nuts and install new cotter pins.

4. Install steering cylinder and cylinder retaining rings.

5. Install rear wheels and lug nuts.

6. Remove the jackstands and lower the machine to the floor.

7. Tighten rear wheel lug nuts to 85 to 100 ft-lbs. (115 to 136 Nm).

8. Lubricate the rear axle pivot bushings through the grease fitting on the pivot pin.

9. Fill rear axle with lubricant (see Changing Rear Axle Lubricant in this section of this manual).

10. Install the hydraulic hoses to the steering cylinder and rear axle drive motor.

11. Check steering cylinder and rear axle hydraulic connections for leaks.

12. Check steering stop bolt adjustment on both side of rear axle. When the steering cylinder is fully extended (either direction), a gap of 1/16” (1.6 mm) should exist between bevel gear case casting and stop bolt on axle case. Figure 16 shows stop bolt location.

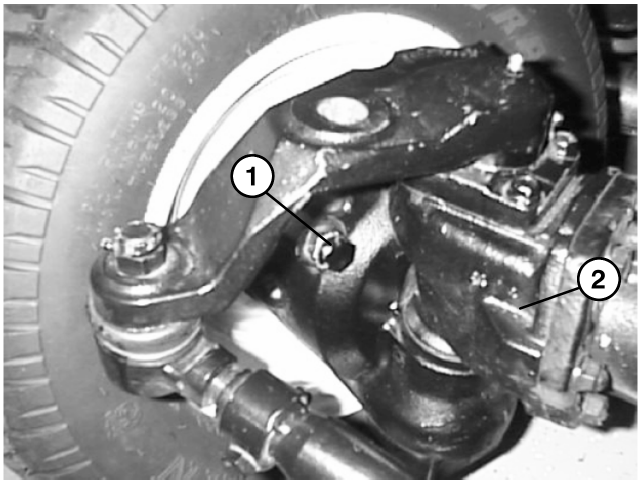


Figure 16

1. **Steering stop bolt** 2. **Bevel gear case (LH)**

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. 17).

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.

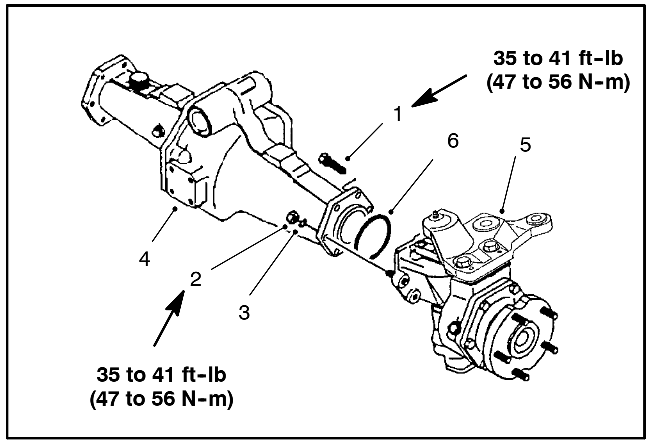


Figure 17

1. Cap screw
2. Lock nut
3. Lock washer
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. 18).

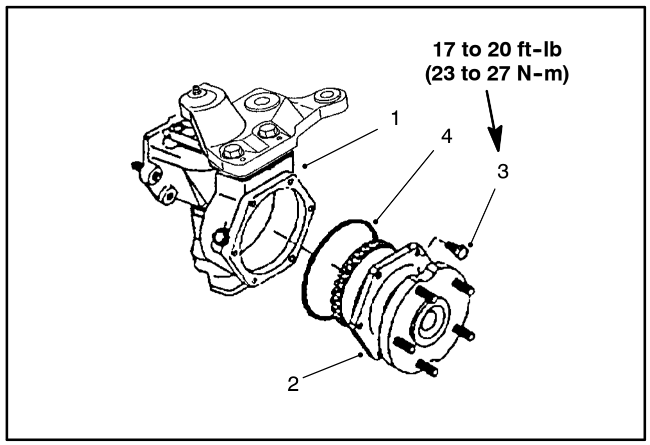


Figure 18

1. Axle case
2. Axle cover assembly
3. Mounting screw
4. O-ring

4. Remove the axle case support mounting screws, the axle case support, and the support shims (Fig. 19).

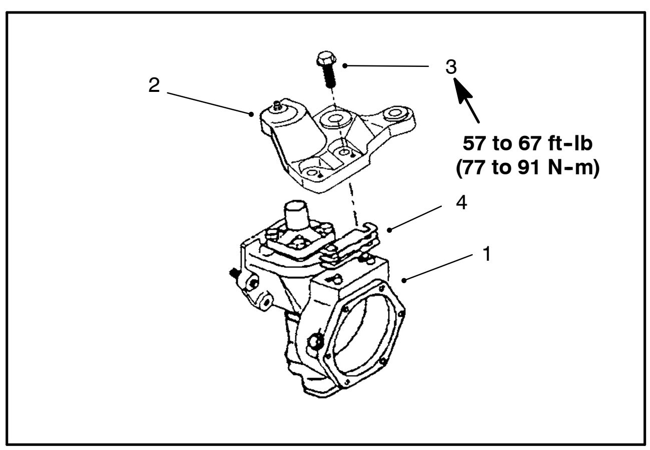


Figure 19

1. Axle case
2. Axle case support
3. Mounting screw
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. 20).

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. 20).

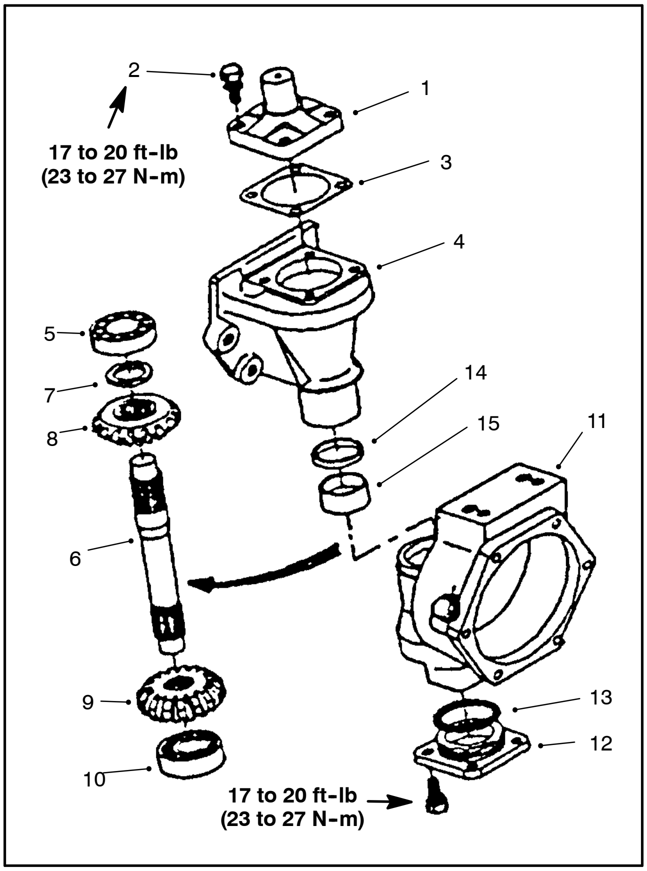


Figure 20

1. Knuckle pin
2. Mounting screw
3. Gasket
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. 21). Replace components as necessary.

BUSHING TO PIN CLEARANCE:
0.002 to 0.016 in. (0.05 to 0.40 mm)

KNUCKLE PIN O.D. (Factory Spec.):
0.982 to 0.983 in. (24.95 to 24.98 mm)

AXLE CASE SUPPORT BUSHING I.D.
(Factory Spec.):
0.984 to 0.987 in. (25.00 to 25.08 mm)

2. Inspect all gears, shafts, bearings, cases, and covers for damage and wear. Replace components as necessary.

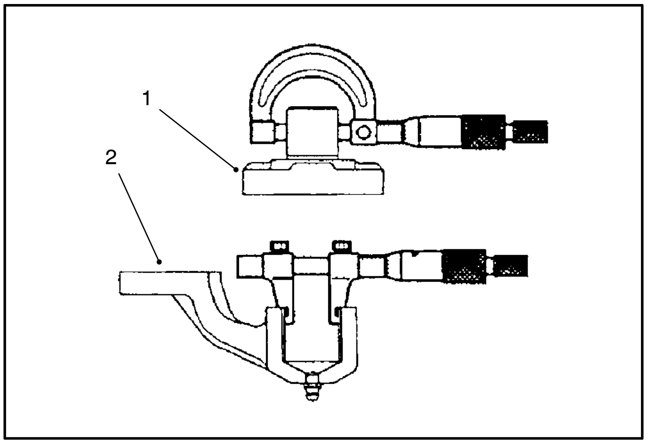


Figure 21

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. 22).

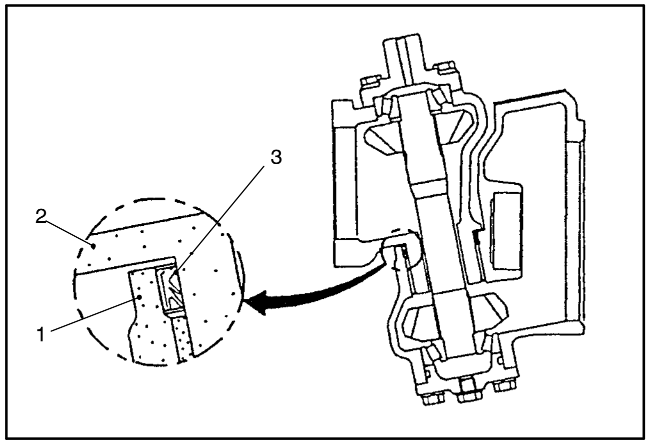


Figure 22

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. 23). Tighten cover screws to 17 to 20 ft-lbs. (23 to 27 Nm).

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. 23).

4. Install the knuckle pin. Use medium strength Loctite thread locker and tighten the knuckle pin mounting screws to 17 to 20 ft-lbs. (23 to 27 Nm).

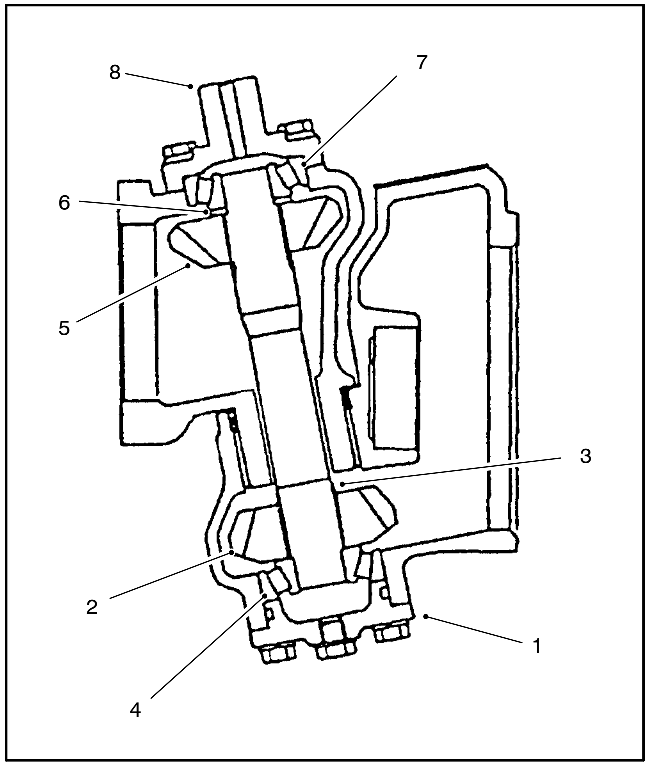


Figure 23

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. 24).

AXLE CASE ASSEMBLY ENDPLAY:
0.001 to 0.008 in. (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 in. (0.1 mm), 0.008 in. (0.2 mm), and 0.016 in. (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. 25).

UPPER BEVEL GEAR BACKLASH:
0.004 to 0.016 in. (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 in. (0.1 mm), 0.008 in. (0.2 mm), and 0.020 in. (0.5 mm) thickness.

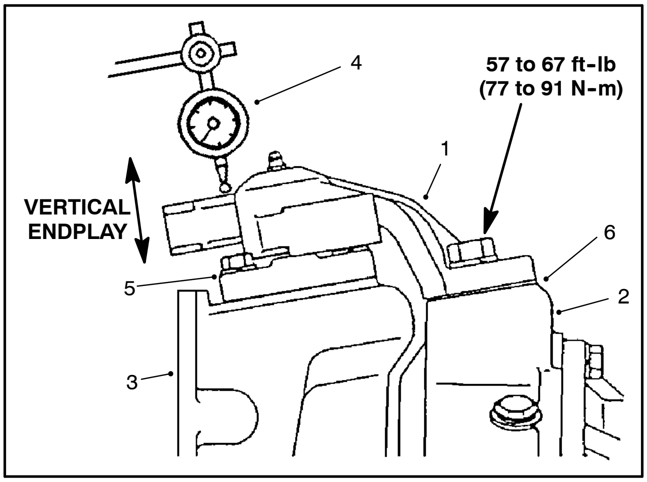


Figure 24

1. **Axle case support**
2. **Axle case**
3. **Bevel gearcase**
4. **Dial indicator**
5. **Knuckle pin**
6. **Support shim location**

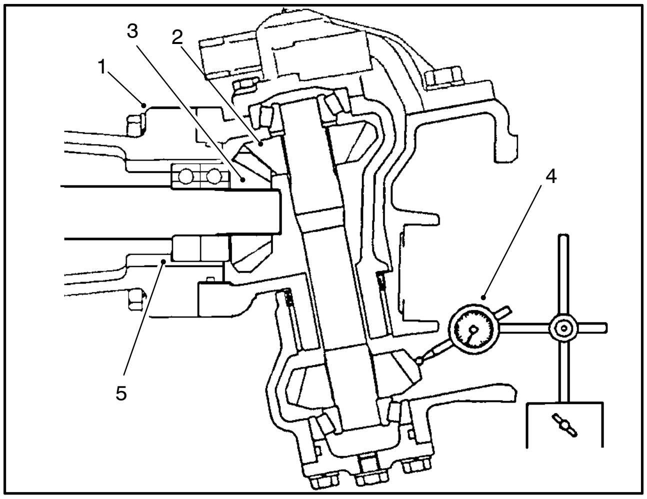


Figure 25

1. **Axle support**
2. **Upper bevel gear**
3. **Differential shaft gear**
4. **Dial indicator**
5. **Axle bearing shims**

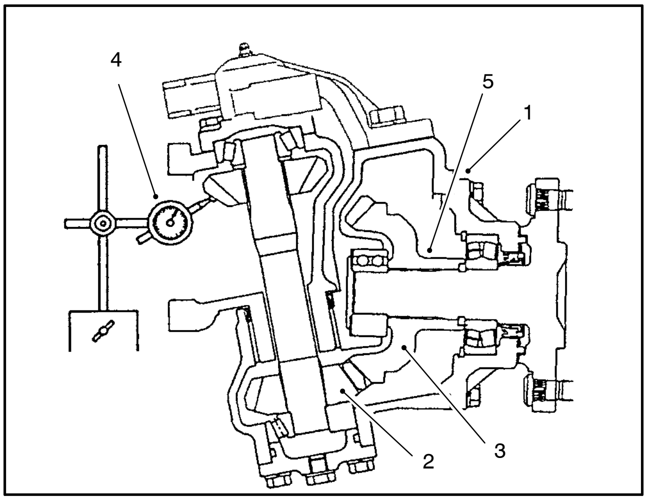


Figure 26

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. 26).

LOWER BEVEL GEAR BACKLASH:
0.004 to 0.016 in. (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 in. (0.2 mm), 0.012 in. (0.3 mm), and 0.020 in. (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. 17).

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 shafts 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. 27).

2. Mark and pull the differential shaft assembly from the axle support.

3. Remove the retaining ring and bevel gear (Fig 28).

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).

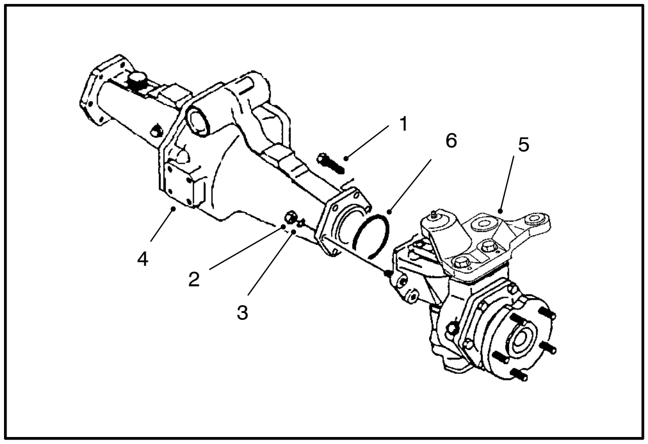


Figure 27

1. **Cap screw**
2. **Lock nut**
3. **Lock washer**
4. **Axle support**
5. **Bevel gear case/axle case assembly**
6. **O-ring**

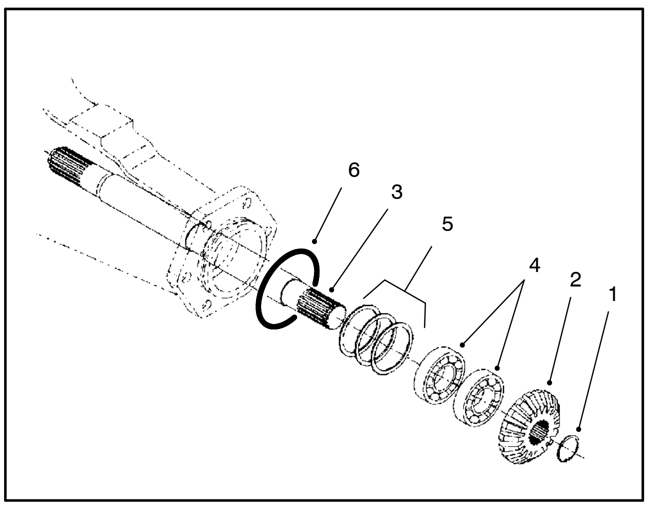


Figure 28

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. 29).

2. Use a bearing puller to remove the bearing and bevel gear as shown (Fig. 30).

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. 31).

2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Fig. 31).

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 to 17 to 20 ft-lbs. (23 to 27 Nm).

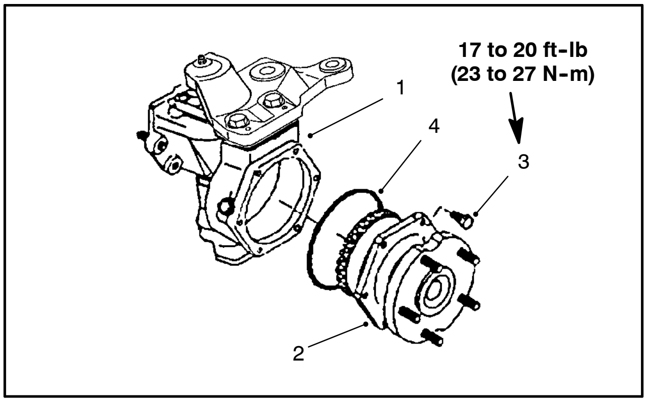


Figure 29

1. **Axle case**
2. **Axle cover assembly**
3. **Mounting screw**
4. **O-ring**

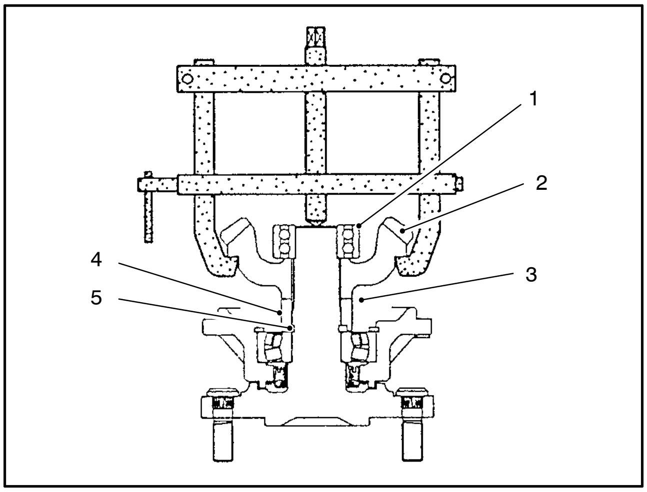


Figure 30

1. **Bearing**
2. **Bevel gear**
3. **Shims**
4. **Spacer**
5. **Retaining ring**

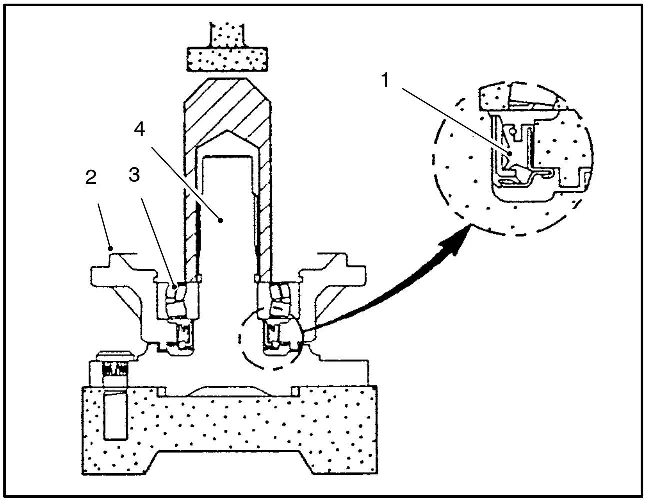


Figure 31

1. **Axle shaft seal**
2. **Axle cover**
3. **Bearing**
4. **Axle shaft**

Axles, Planetaries and Brakes

Input Shaft/Pinion Gear

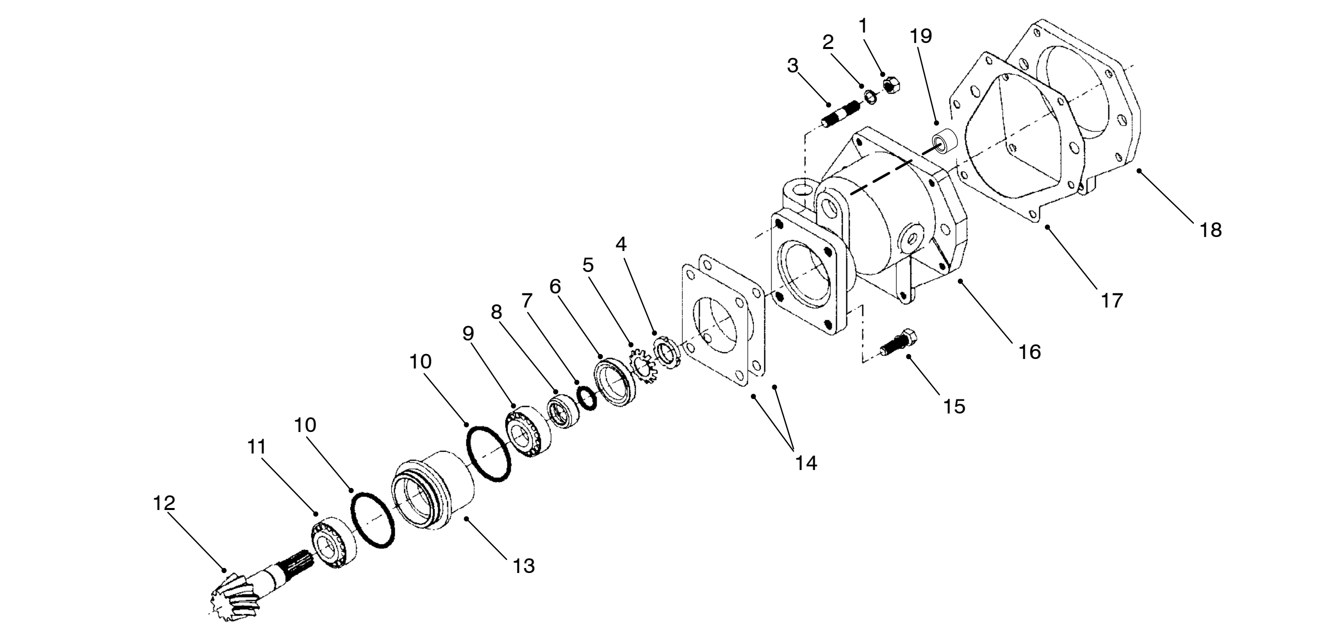


Figure 32

1. **Nut**
2. **Lockwasher**
3. **Stud**
4. **Locknut**
5. **Stake washer**
6. **Oil Seal**
7. **O-ring**
8. **Seal Collar**
9. **Inner Bearing**
10. **O-ring**
11. **Outer Bearing**
12. **Input Shaft/Pinion Gear**
13. **Bearing Case**
14. **Shim**
15. **Screw**
16. **Gear Case**
17. **Gasket**
18. **Cover Plate**
19. **Support Bearing**

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove the hydraulic motor from the axle assembly (Fig. 15).

2. Remove the cover plate, gasket, and gear case assembly from the axle assembly. Remove the gasket and any remaining gasket material.

3. Remove the retaining rings and the driven gear from the input shaft/pinion gear.

4. Remove input shaft/pinion gear assembly from the gear case. Remove the shims and bearing case O-rings.

5. Release the stake washer and remove the locknut. Remove and discard the stake washer.

6. Drive the input shaft/pinion gear out from the outer bearing cone and bearing case. Remove and discard the oil seal and O-ring.

7. Inspect all gears, shafts, bearings, spacers, and cases for damage and wear. Replace components as necessary.

Note: Replacement input shaft/pinion gears are only available in matched ring and pinion sets.

Installation

Note: When installing new bearing cones, 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 new O-ring with grease. Install O-ring in the oil seal collar, and install the collar. The seal should be installed with the garter spring towards the hydraulic motor (Fig. 33).

4. Install a new stake washer. Install the lock nut finger tight.

5. Set the bearing preload by securing the bearing case in a vise. Thread a M12 x 1.5 hex. hd. capscrew into the splined end of the input shaft/pinion gear and slowly tighten the locknut until 4.0 to 6.0 in-lbs. (0.4 to 0.7 Nm) of force is required to rotate the input shaft/pinion gear in the bearing case.

6. Secure the lock nut with the stake washer.

7. 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. 34).

DESIGN CONE CENTER DISTANCE
(distance from mating surface of axle support to end face of pinion gear):
1.870 $\pm$ 0.002 in. (47.5 $\pm$ 0.05 mm)

Note: Bearing case shims are available in 0.004 in. (0.1 mm) and 0.008 in. (0.2 mm) thickness.

8. 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 to 35 to 41 ft-lbs. (47 to 56 Nm).

9. Insert a screwdriver through the drain plug hole to hold ring gear and measure the pinion gear to ring gear backlash (Fig. 35).

PINION GEAR TO RING GEAR BACKLASH:
0.004 to 0.016 in. (0.10 to 0.40 mm)

10. Adjust backlash by increasing or reducing gear case shim thickness.

11. Check pinion gear to ring gear engagement (see Pinion Gear to Ring Gear Engagement in this section of this manual.

12. Place the correct combination of shims on the gear case. Tighten mounting nuts and screws to 35 to 41 ft-lbs. (47 to 56 Nm).

13. Install retaining rings and driven gear on input shaft/pinion gear.

14. If the drive gear (on drive motor shaft) was removed, install the retaining rings, thrustwashers, and drive gear on the motor shaft.

Note: A one-way overrunning clutch is pressed into the inner bore of the drive gear. When installing the drive gear on the motor shaft, make sure the lettering on the clutch faces the motor housing.

15. Use a new gasket and install the cover plate. Use a new O-ring and install the drive motor.

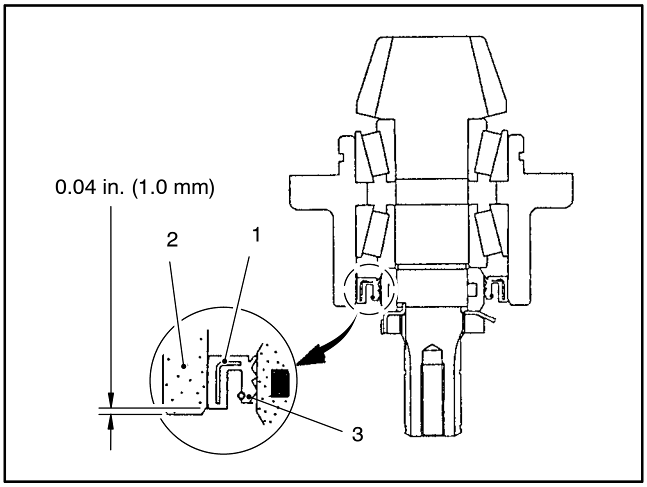


Figure 33
1. **Oil seal**
2. **Bearing case**
3. **Seal garter spring**

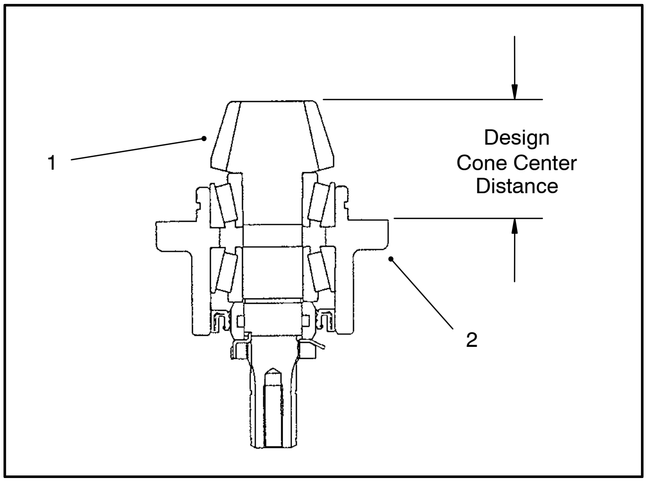


Figure 34
1. **Input shaft/pinion gear**
2. **Bearing case**

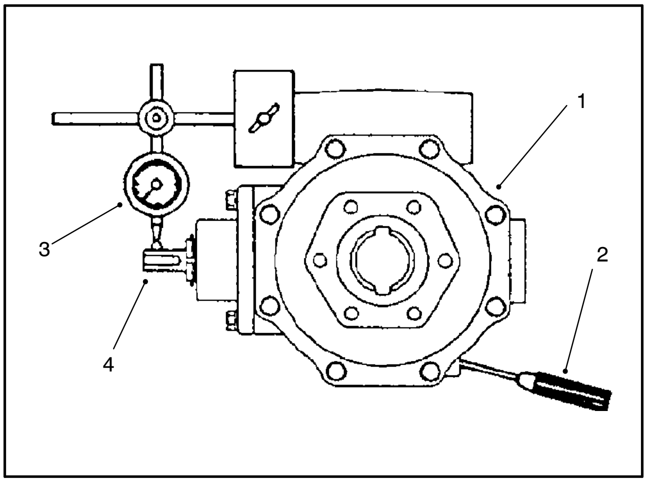


Figure 35
1. **Axle case**
2. **Screwdriver**
3. **Dial indicator**
4. **Input shaft/pinion gear**

Axles, Planetaries and Brakes

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. 36).

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. 37).

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. 38).

Note: Replacement ring gears are only available in matched ring and pinion sets.

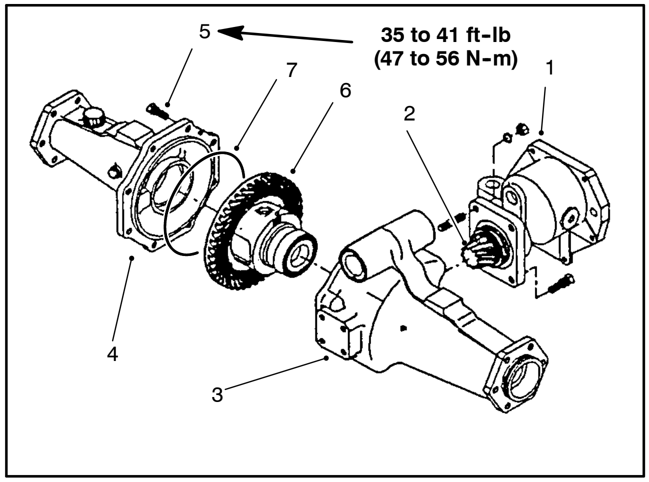


Figure 36

1. **Gear Case**
2. **Pinion Gear**
3. **Axle support (left)**
4. **Axle support (right)**
5. **Case screws**
6. **Differential gear**
7. **O-ring**

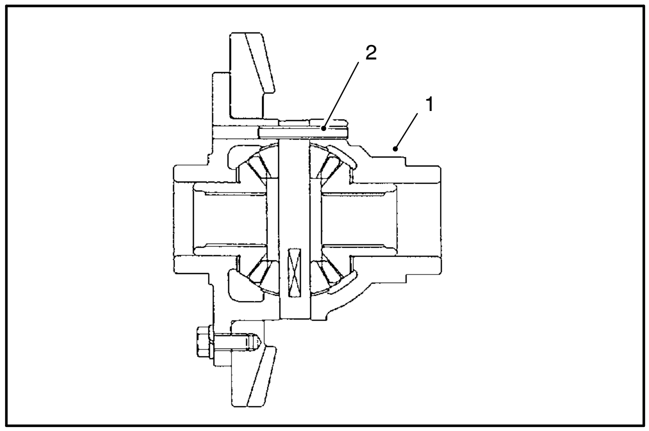


Figure 37

1. **Differential case**
2. **Spring pin**

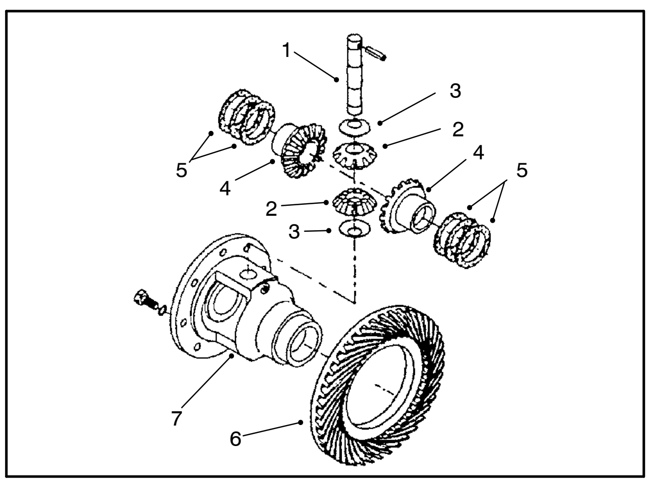


Figure 38

1. **Differential pinion shaft**
2. **Pinion gear**
3. **Pinion washer**
4. **Side gear**
5. **Side gear shims**
6. **Ring gear**
7. **Differential case**

Inspection

1. Measure the differential side gear O.D. and the differential case I.D. to determine the side gear to case clearance (Fig. 39). Replace components as necessary.

SIDE GEAR TO CASE CLEARANCE:
0.002 to 0.012 in. (0.05 to 0.30 mm)

SIDE GEAR O.D. (Factory Spec.):
1.335 to 1.337 in. (33.91 to 33.95 mm)

DIFFERENTIAL CASE I.D. (Factory Spec.):
1.339 to 1.341 in. (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. 40). Replace components as necessary.

PINION SHAFT TO PINION GEAR CLEARANCE:
0.001 to 0.010 in. (0.03 to 0.25 mm)

PINION SHAFT O.D. (Factory Spec.):
0.550 to 0.551 in. (13.97 to 13.10 mm)

PINION GEAR I.D. (Factory Spec.):
0.551 to 0.552 in. (13.10 to 14.02 mm)

3. Inspect all gears, shafts, bearings, cases, and covers for damage and wear. Replace components as necessary.

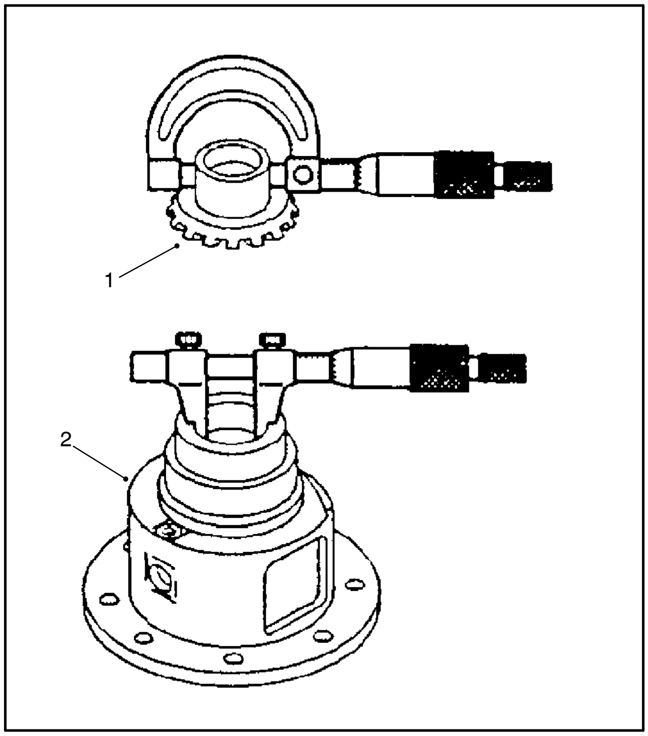


Figure 39

1. Side gear **2. Differential case**

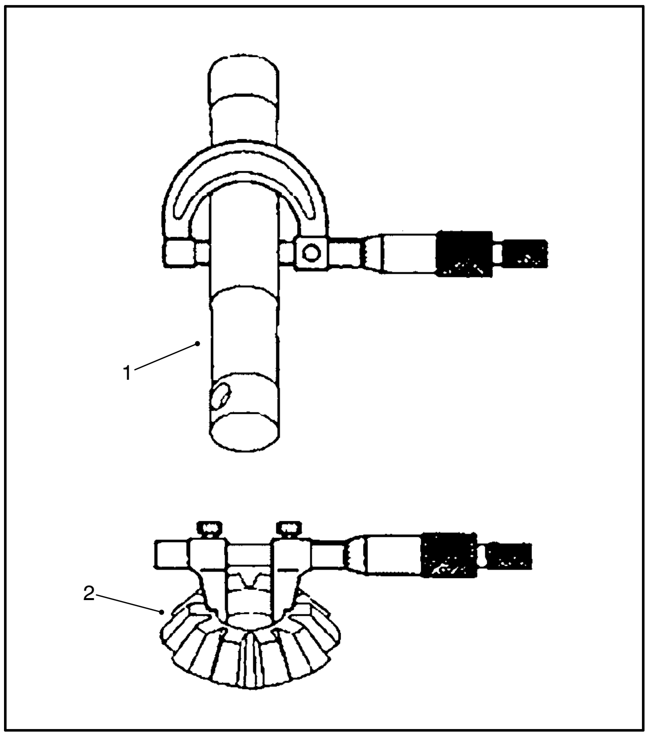


Figure 40

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. 41).

PINION GEAR TO SIDE GEAR BACKLASH:
0.004 to 0.016 in. (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 in. (1.10 mm), 0.047 in. (1.20 mm) and 0.051 in. (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. 42).

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.

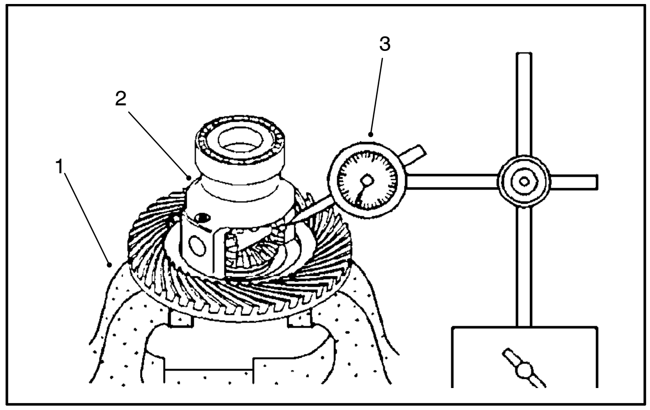


Figure 41

1. **Vise**
2. **Differential gear case**
3. **Dial indicator**

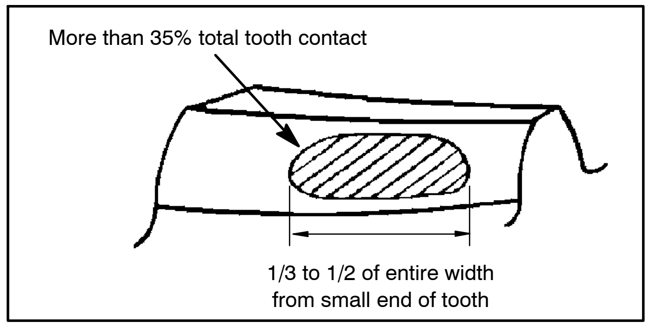


Figure 42

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. 43):

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. 44).

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. 45).

NOTE: Bearing case shims are available in 0.004 in. (0.10 mm) and 0.008 in. (0.20 mm) thickness.

NOTE: Differential bearing shims are available in 0.004 in. (0.10 mm), 0.008 in. (0.20 mm) and 0.016 in. (0.40 mm) thickness.

Study the different contact patterns (Figs. 46 and 47) 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.

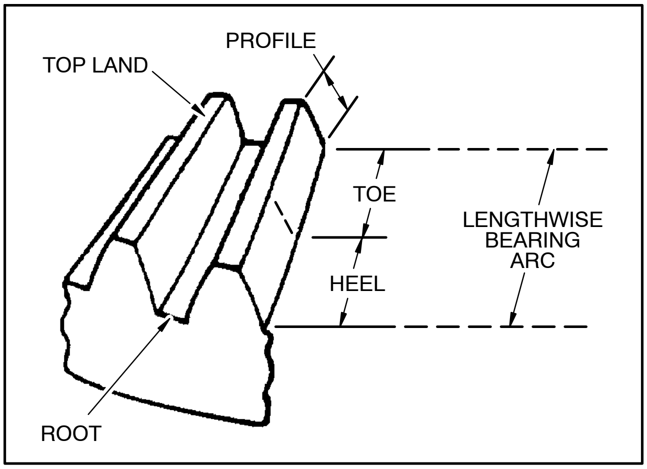


Figure 43

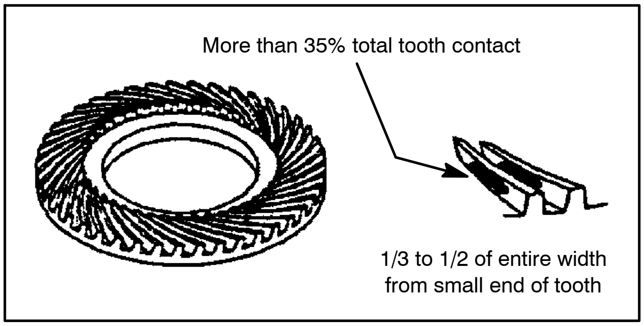


Figure 44

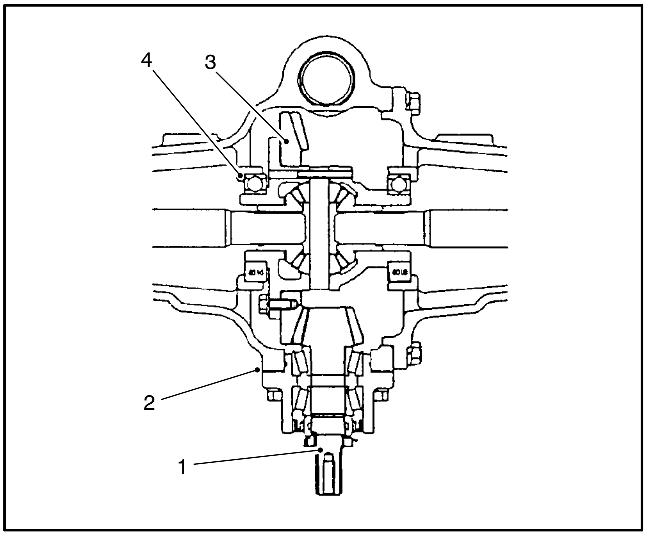


Figure 45

1. **Input shaft/pinion gear**
2. **Bearing case shims**
3. **Differential gear case**
4. **Differential bearing shims**

Axles, Planetaries and Brakes

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. 46):

   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. 47):

   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.

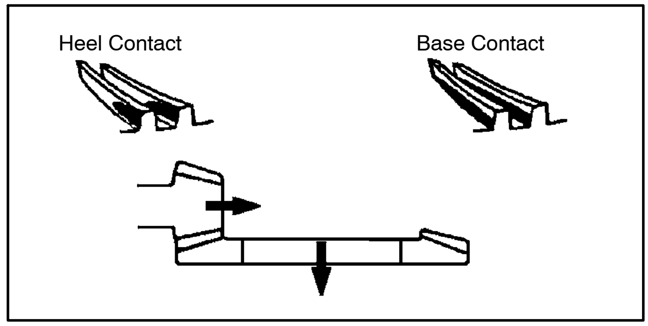


Figure 46

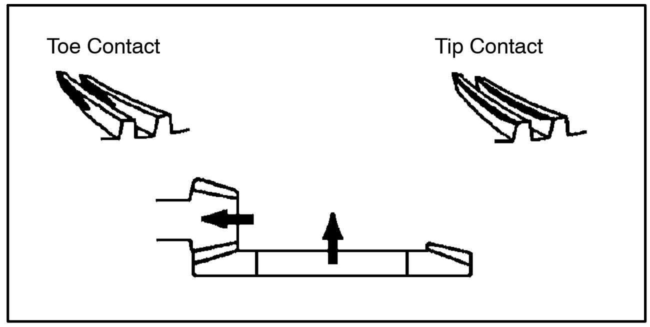


Figure 47

Chapter 7

Cutting Units

Table of Contents

Specifications

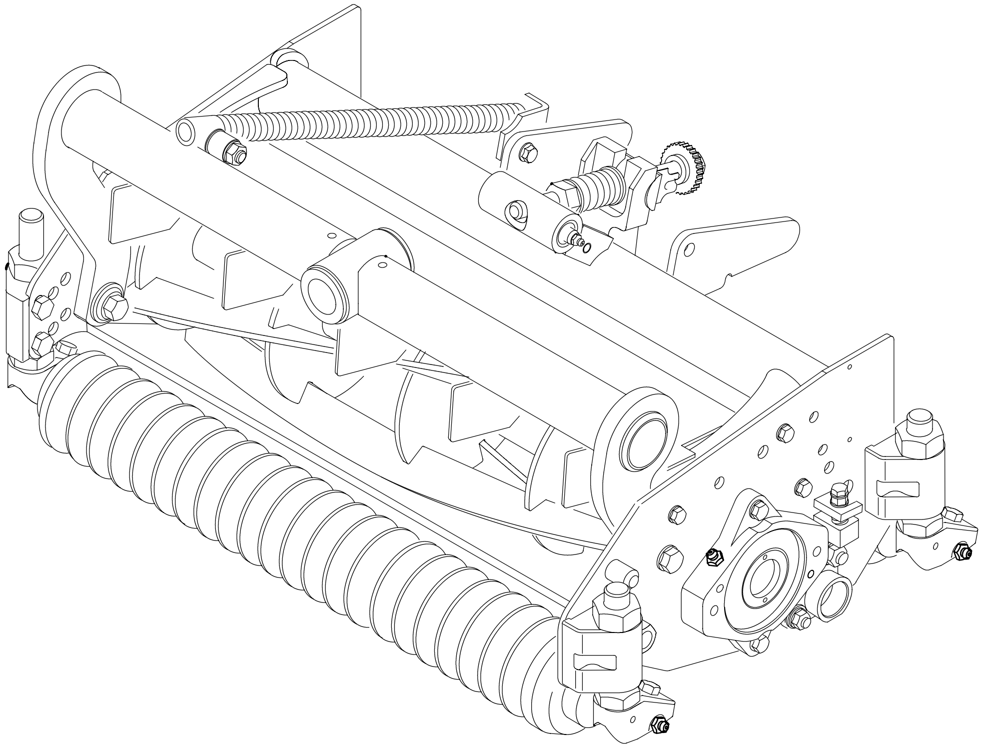


Figure 1

REEL CONSTRUCTION: Fairway reels. All welded. 5, 7 or 11 blades.

HEIGHT OF CUT RANGE:
- **5 Blade** - 1” to 1-3/4” (25-44 mm)
- **7 Blade** - 1/2” to 1” (13-25 mm)
- **11 Blade** - 3/8” to 3/4” (10-19 mm)

Note: Use bedknife Part No. 93-9774 for height-of-cuts below 1/2”.

REEL DIAMETER: 7 in. (178 mm).

POWER: Reel motors feature quick disconnect for removal or installation onto cutting unit. Cutting units can be driven from either end.

HEIGHT-OF-CUT & ROLLER ADJUSTMENT: Height-of-cut adjustment is made at the rear roller with quick locating pin and/or threaded micro-adjustment. Front roller position is adjustable to set cutting unit attitude.

BEDKNIFE AND BEDBAR ADJUSTMENT: Single point adjustment mechanism.

ROLLERS:
Front rollers: 3” (76 mm) diameter Wiehle rollers. Optional 3“ (76 mm) diameter full rollers, Part No. 93-3040, are available for the front position.
Rear rollers: 3” (76 mm) diameter full rollers. All rollers use the same heavy duty ball bearings with two conventional single lip seals and a Toro labyrinth seal to provide four sealing surfaces to protect the bearings.

ROLLER & SCRAPER KITS:

Rear Roller Brush Kit	Model 03875
Wiehle Roller Scraper	Part No. 100-9908
Rear Roller Scraper Kit	Part No. 100-9920
Shoulder Wiehle Roller	Part No. 100-9911
Shoulder Wiehle Scraper	Part No. 100-9913
Comb/Scraper Kit	Part No. 104-1845

Special Tools

Order special tools from your Toro distributor. Some tools may have been supplied with your machine or available as TORO parts. Some tools may also be available from a local supplier.

Gauge Bar Assembly

Use gauge bar to verify height of cut and bedknife attitude.

Toro P/N **98-1852**

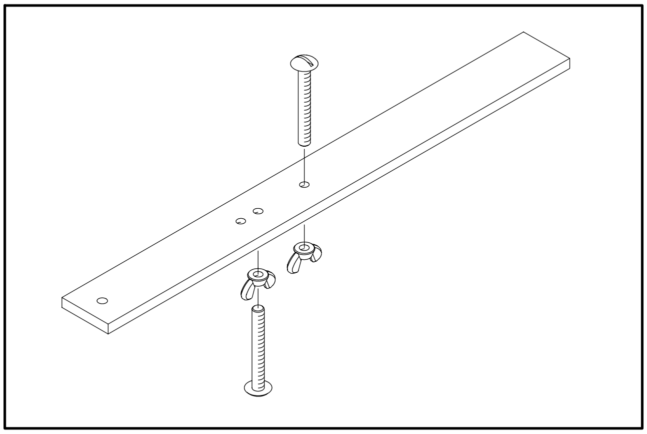


Figure 2

Angle Indicator

Use with Gauge Bar Assembly to verify bedknife attitude.

Toro P/N **99-3503**

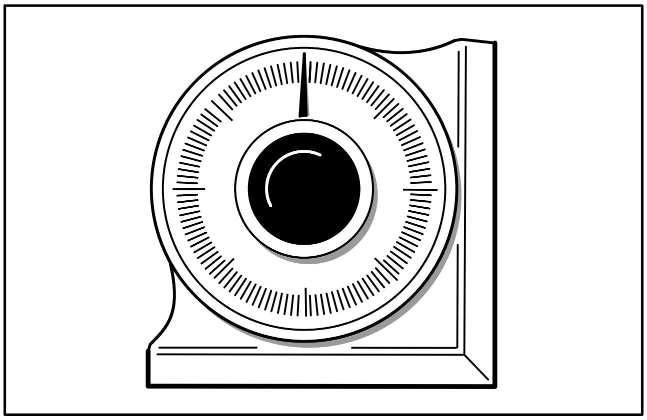


Figure 3

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Toro P/N **29-9100**

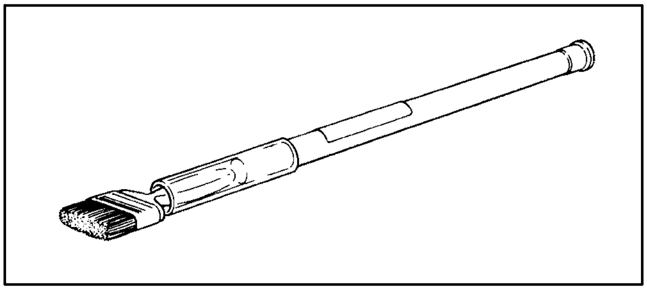


Figure 4

Bedknife Screw Tool - 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. Make sure bedbar threads are clean and use new screws. Tighten screws to a torque of 250 - 300 in.lb. (28 - 34 Nm) starting in the middle of the bedknife (Fig. 27).

Note: Remove all rust, scale and corrosion from bedbar surface before installing bedknife.

DO NOT use an air impact wrench with this tool.

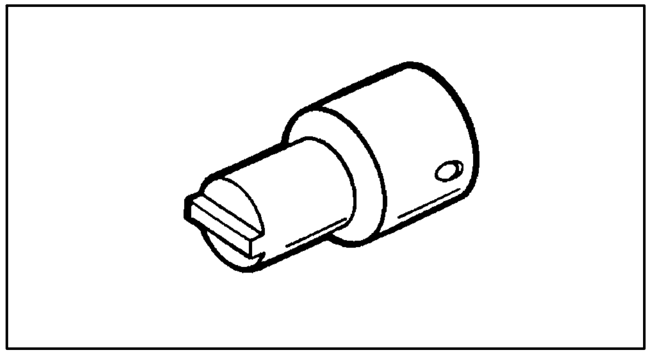


Figure 5

Reel Drive Shaft - TOR4074

Use reel drive shaft for rotating cutting reel when hydraulic motor is removed (backlapping or sharpening).

Note: This tool is included in Cutting Unit Tool Kit TOR4070.

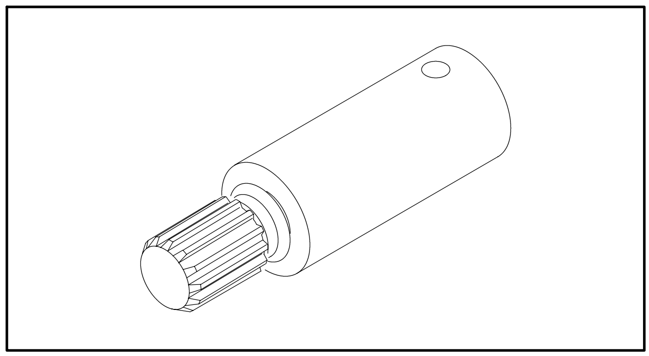


Figure 6

Cutting Unit Tool Kit - TOR4070

This tool kit includes special tools required for rebuilding the cutting unit and cutting unit drive motors.

TOR4064	Spanner Wrench
TOR4065	Inner Oil Seal Installer
TOR4066	Bearing Installer
TOR4067	Shaft Support Tool
TOR4068	Inner Seal Installer
TOR4869	Outer Seal Installer
TOR4071	Outer Oil Seal Installer
TOR4072	Reel Motor Shaft Seal Protector
TOR4073	Handle
TOR4074	Spline Insert Tool

Figure 7

Troubleshooting

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 machine. It is important to remember that the lower the height of cut, the more critical these factors are.

Remember that the "effective" or actual height of cut depends on cutting unit weight and turf conditions. Effective height of cut will be different than the bench set height of cut.

Factors That Can Affect Quality of Cut

Note: For additional information see Toro Commercial Products Aftercut Appearance Troubleshooting Aid. Part No. 00076SL.

Factor	Possible Problem/Correction
1. Reel speed and ground speed.	Adjust reel speed to settings shown on Reel Speed Settings Graph for correct number of reel blades (5, 7, or 11) and desired groundspeed (see Operator's Manual for more information). Slow down or speed up if reel control lamp comes on. All reels should rotate at same speed (within 150 RPM). All cutting units should have equal bedknife to reel contact. If checking RPM, do not run reel too long without cutting grass, or bedknife and/or reel may overheat and "rifle". See other items under Troubleshooting in Chapter 4 - Hydraulic System and Chapter 5 - Electrical System.
3. Tire pressure.	Check and inflate to specification if necessary. Must be equal in two front tires and two rear tires. NOTE: Correct tire size and inflation pressure is important on 4WD model to prevent scuffing of turf.
3. Reel bearing condition.	Replace bearings if worn or damaged. Do not over-tighten bearing retainer nut.
4. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded cutting edges or "rifling" cannot be corrected by tightening bedknife to reel contact. Grind reel to remove taper and/or rifling (grooved or wavy appearance). Grind bedknife to sharpen and/or remove rifling (Most common cause of rifling is bedknife to reel contact that is too tight). NOTE: New bedknife must be ground or backlapped after installing on bedbar.

Factor	Possible Problem/Correction
5. Bedknife to reel adjustment.	Check bedknife to reel contact daily. Bedknife must have light contact all across reel. No contact will cause cutting edges to become dull. Excessive contact accelerates wear; quality of cut may be adversely affected. Adjust so you paper can be pinched between reel and bedknife without tearing when inserted from the front, and cuts cleanly when inserted at a right angle (along entire length of bedknife). Slightly dull cutting edges may be corrected by backlapping, Excessively dull cutting edges must be corrected by grinding the reel and bedknife.
6. Front roller position.	Make sure front rollers on all cutting units are in the same position Make sure rollers are adjusted so bedknife has proper attitude for height of cut setting and turf conditions.
7. Rear roller parallel to reel.	Rear roller must be leveled so it is parallel with the reel before setting height of cut.
8. Height of cut.	Make sure all cutting units are set at same height of cut. Set with rear roller - must be equal at both ends of roller.
9. Roller scraper adjustment.	Install and/or adjust front and rear roller scrapers if grass clippings build up on rollers.
10. Stability of bedbar.	Check bedbar end bushings, adjuster pivot bushings and nylon flanged bushings for wear or damage. Check adjustment knob to make sure detent holds adjustment.
11. Number of reel blades.	Use cutting unit model with correct number of blades for clip frequency and optimum quality of cut range.
12. Cutting unit alignment and ground following.	Check lift arms and cutting unit pivot linkages for wear, damage or binding.
13. Roller condition.	All rollers should rotate freely. Replace bearings if they are worn, damaged, or have excessive radial play.

Set-up and Adjustments

IMPORTANT: Toro strongly recommends the use of a leveling plate when setting-up or adjusting any reel type cutting unit. The leveling plate will help to ensure accurate and consistent adjustments.

Note: Right and left ends of cutting unit is determined by standing in the operator's position (Fig. 8).

1. Check each end of the reel for grease. Grease should be visibly evident in the reel bearings and internal splines of reel shaft.

2. Insure that all nuts and bolts are securely fastened.

3. Make sure carrier frame suspension operates freely and does not bind when moved back and forth.

4. Set height of cut by completing the following steps in order:

   A. Adjust bedknife to reel.

   B. Adjust and level front and rear rollers.

   C. Set height-of-cut.

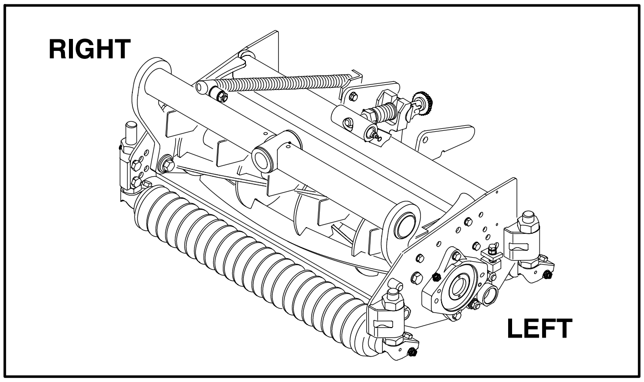


Figure 8

Cutting Units

Bedknife to Reel Adjustment

IMPORTANT: The reel and bedknife must be parallel to insure the cutting unit cuts grass across the bedknife, and the reel and bedknife wear evenly.

Note: Toro recommends light contact between the reel and bedknife. However, for dry and/or sparse conditions a .001-.002” (.03-.05 mm) clearance may be required to prevent heat buildup which can cause uneven wear in the reel and bedknife.

Note: A 3/4 inch (19 mm) wrench is needed to rotate bedknife adjustment knob. Each notch on the knob will move the bedknife 0.0005 inches (.013 mm) closer to the reel (Fig. 9).

1. Rotate cutting unit onto it’s back to gain access to reel and bedknife (Fig. 10).

2. While slowly rotating the reel in the mowing direction, turn the bedknife adjusting knob clockwise until you feel light contact between the reel and bedknife.

3. Insert a 1” (25 mm) wide piece of newspaper perpendicular to the bedknife, and then rotate the reel slowly in the mowing direction to see if the reel cuts the paper - do this on both ends of the bedknife (Fig. 10). If the paper does not cut cleanly, tighten the bedknife adjusting knob a maximum of 2 clicks, and check to see if paper is cut cleanly.

4. If paper is cut on both ends, the bedknife is parallel to the reel. If not proceed to step A.

Note: If reel makes contact on both sides of bedknife but still does not cut paper, cutting unit may need to be backlapped and/or reel and bedknife may need to be reground (see Backlapping or Bedknife Re-grinding in this section of this manual, or refer to Toro manual for Sharpening Reel and Rotary Mowers, Form No. 80–300PT).

A. Loosen the pivot hub lock nuts to allow movement of the pivot hub casting (Fig. 11).

B. If paper was not cut on the left side: loosen the bottom adjusting nut on the pivot hub, then turn the top adjusting nut clockwise to pull the pivot hub up. **OR** If paper was not cut on the right side: loosen the top adjusting nut on the pivot hub, then turn the bottom adjusting nut counterclockwise to push the pivot hub down (Fig. 11).

Note: To reduce thread play, always tighten the bottom adjusting nut last.

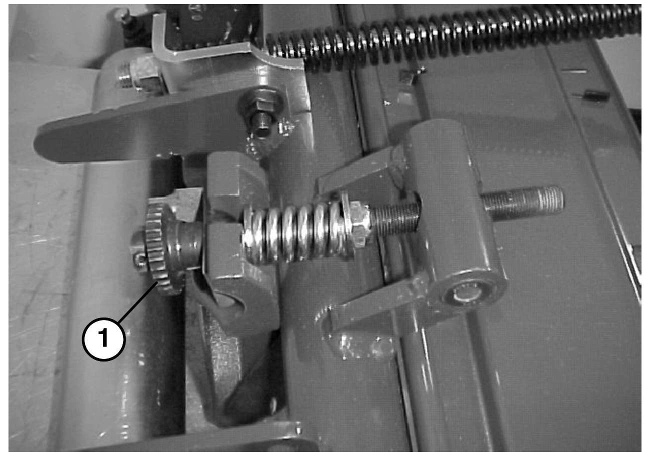


Figure 9

1. Bedknife Adjusting Knob

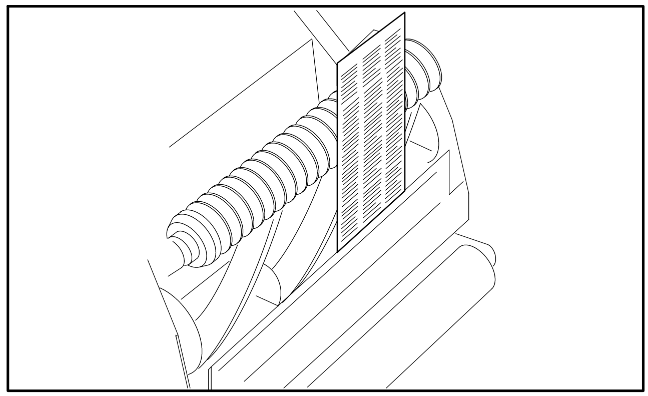


Figure 10

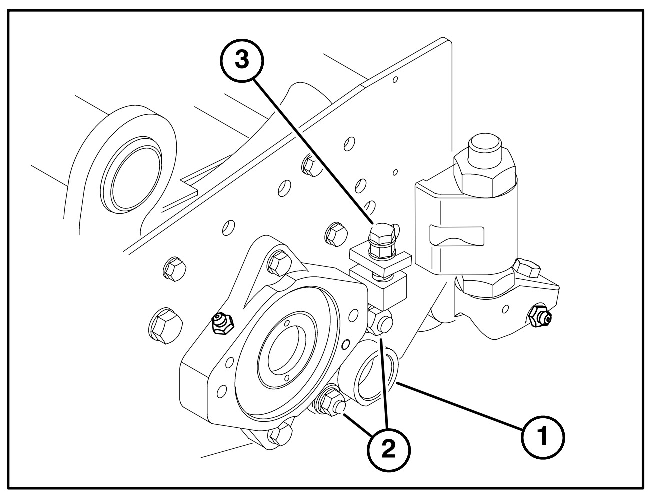


Figure 11

1. Pivot Hub
2. Pivot Hub Locknuts
3. Pivot Hub Adjusting Screw

C. Recheck reel to bedknife contact on both ends of the bedknife. If necessary, repeat step B.

Note: Reel to bedknife contact may become too tight or too loose after previous adjustment; therefore, turn bedknife adjustment knob, accordingly, for light contact.

D. Retighten pivot hub lock nuts.

Note: Recheck if paper cuts on both ends, to insure the bedknife did not move when re-tightening the pivot hub lock nuts.

Adjusting and Leveling Rollers

Cutting unit "attitude" has a significant impact on the performance of the cutting unit. Attitude refers to the angle of the bedknife relative to the ground (Fig.12).

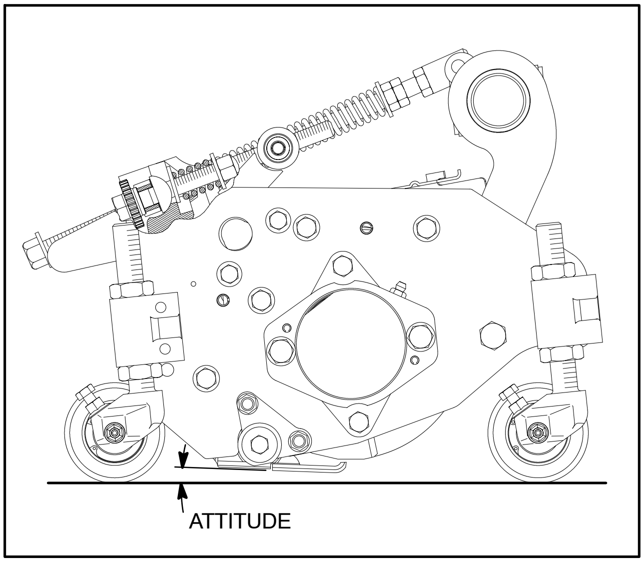


Figure 12

Adjustable front and rear roller brackets allow for variable adjustment of cutting unit attitude within the height-of-cut range. All cutting units on a given machine must be set to the same attitude, otherwise after-cut appearance could be negatively affected.

The best cutting unit attitude is dependent on your turf conditions and desired results. Experience with the cutting unit on your turf will determine the best setting to use. Cutting unit attitude can be adjusted throughout the cutting season to allow for various turf conditions.

In general, less aggressive attitudes (example: 2 degrees) are more appropriate for warm season grasses (Bermuda, Zoysia) while cool season grasses (Bluegrass, Rye) may require more aggressive attitudes (example: 6 degrees). More aggressive attitudes cut more grass off by allowing the spinning reel to pull more grass up into the bedknife. An angle that is too flat (attitude less than 1 degree) may allow the bedbar or other parts of the cutting unit to drag in the turf causing tufting. Therefore, minimum recommended attitude is 1 degree.

For setting consistent cutting unit attitude, Toro strongly recommends using a two-screw gauge bar, Toro part no. 98-1852 (Fig.13). The first screw is set for height-of-cut, and the second screw is set for cutting unit attitude. The second screw setting is an easy method of transferring cutting unit attitude to all cutting units on a machine.

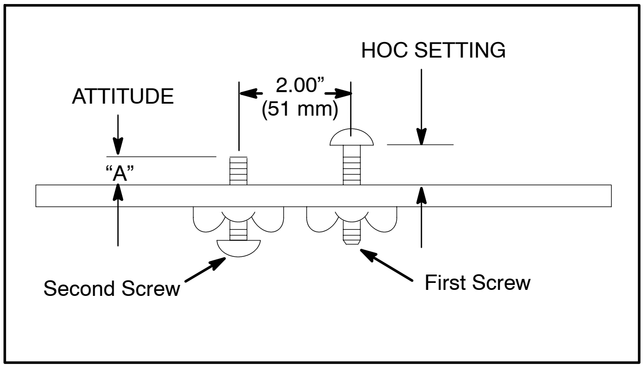


Figure 13

Note: The second screw setting will change throughout the life of the bedknife and reel due to wear, **even if the height-of-cut is not changed**.

Cutting Units

Checking or Adjusting Attitude (Used Cutting Units)

As a starting point for adjusting cutting unit attitude, the cutting unit may be set up using the dimensions from the New Cutting Unit Set Up Guide found in the Cutting Unit Operator's Manual. However, because of wear to the bedknife and reel, the following procedure must be used to ensure the correct attitude setting for reels that have been used for more than just a fews hours.

1. Rotate cutting unit backward to gain access to reel and bedknife.

2. Place an angle indicator, Toro Part No. 99–3503, on the bedknife and record the bedknife angle (Fig. 14).

3. Using a two-screw gauge bar, Toro Part No. 98-1852, set first screw to desired height-of-cut.

4. Place the gauge bar across front and rear rollers. The first screw head needs to fit snugly over edge of the bedknife,while the gauge bar contacts the front roller (Fig. 15).

Note: The rear roller does not have to contact the gauge bar.

5. Adjust second screw to contact bedknife. Move rear roller up, if needed.

6. Place an angle indicator on the gauge bar and record the gauge bar angle (Fig. 15).

7. Adjust the front roller to your desired cutting unit attitude:

Bedknife Angle (step 2.)
– Gauge Bar Angle (step 6.)
= Cutting Unit Attitude (degrees)

Note: Moving the front roller down will decrease your cutting unit attitude, while moving the front roller up will increase cutting unit attitude (Fig. 15).

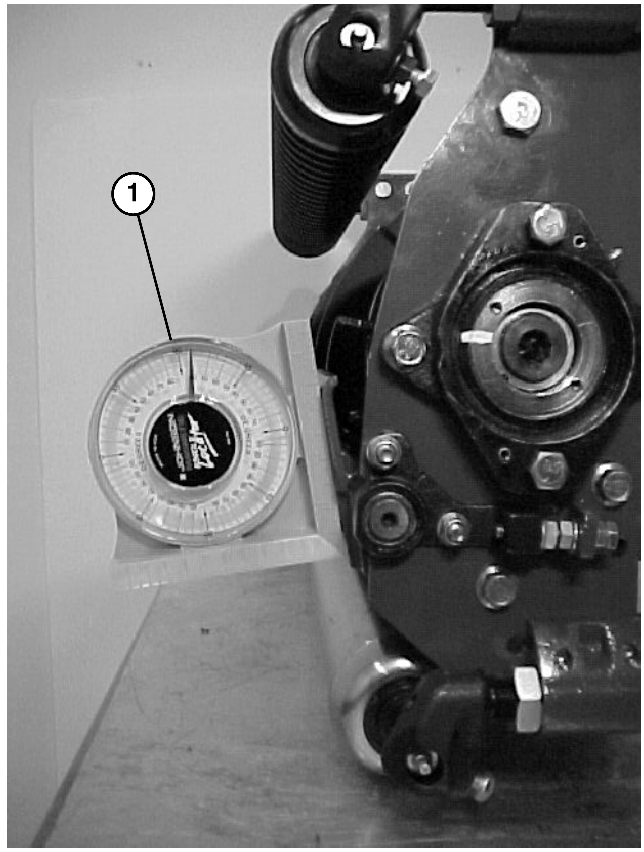


Figure 14

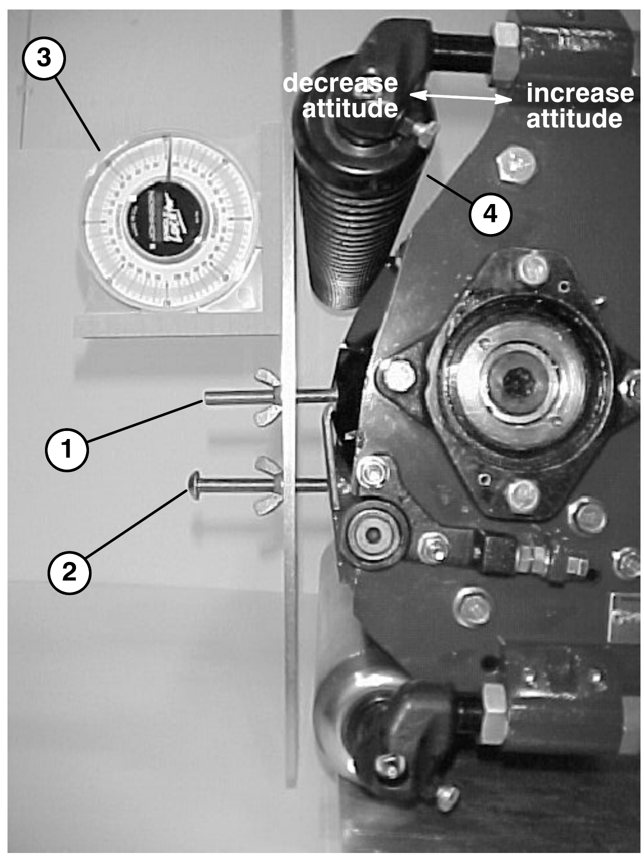


Figure 15

1. **First Screw**
2. **Second Screw**
3. **Gauge Bar Angle**
4. **Front Roller**

Leveling Front Roller

IMPORTANT: Toro strongly recommends the use of a leveling plate when setting-up or adjusting any reel type cutting unit. The leveling plate will help to ensure accurate and consistent adjustments. Contact your local Toro Distributor for ordering a leveling plate.

1. Position cutting unit on a flat surface.

Note: The bar thickness does not affect the adjustment. The recommended bars keep the cutting unit more balanced during the adjustment. Make sure the bar covers the full length of the reel blades and the outermost contact points between the reel and bar are equal distances from the center of the reel.

2. Position a straight, parallel sided bar under the reel blades and against the front edge of the bedknife (Fig. 16). For 1” (25 mm) height-of-cut or below, a 3/4” (19 mm) bar is recommended. For heights-of-cut above 1” (25 mm), a 1-1/4” (32 mm) bar is recommended. **Make sure bar covers the full length of the reel blades**.

3. Rock cutting unit forward (on reel blades and steel bar) until front roller contacts flat surface. Reel blades and bedknife must maintain contact with bar. Rear roller should not contact surface.

4. Use a piece of newspaper or visually check to see if any gap exists between front roller ends and flat surface (Fig. 17). **If needed, adjust front height-of-cut rods until both ends of roller are in contact with level surface**.

Note: If leveling the front roller causes the cutting unit attitude to be different from side to side by more than one degree, you may need to regrind the reel and/or bedknife to eliminate uneven wear.

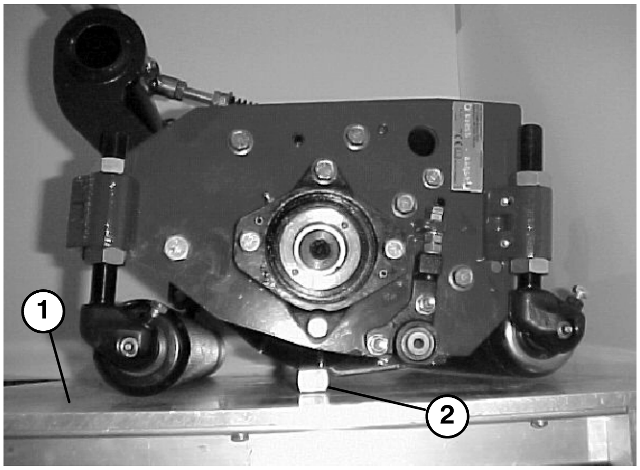


Figure 16

1. **Flat Surface (1” x 20” x 30”)**
2. **Bar Stock**

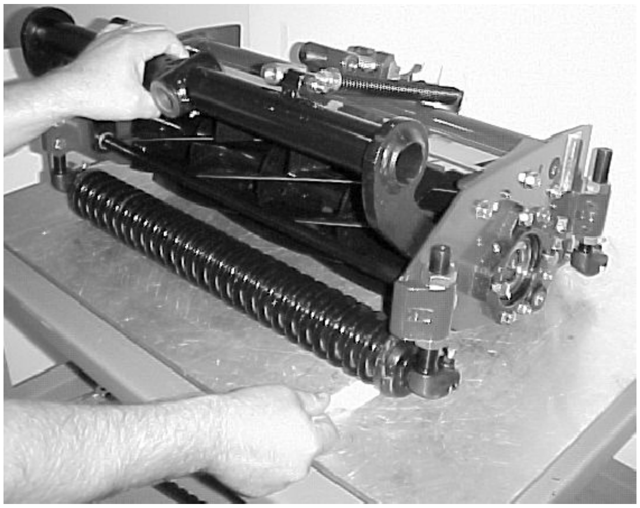


Figure 17

Cutting Units

Final Height of Cut Adjustment

1. Rotate the cutting unit vertical and place the gauge bar across front and rear rollers (Fig. 18).

2. Adjust rear roller until it contacts the gauge bar on both sides.

Note: Make sure gauge bar is in contact with the front roller at all times to keep desired height-of-cut.

3. Slide gauge bar toward the end of the cutting unit to remove. Gauge bar can now be utilized to set remaining cutting units on machine.

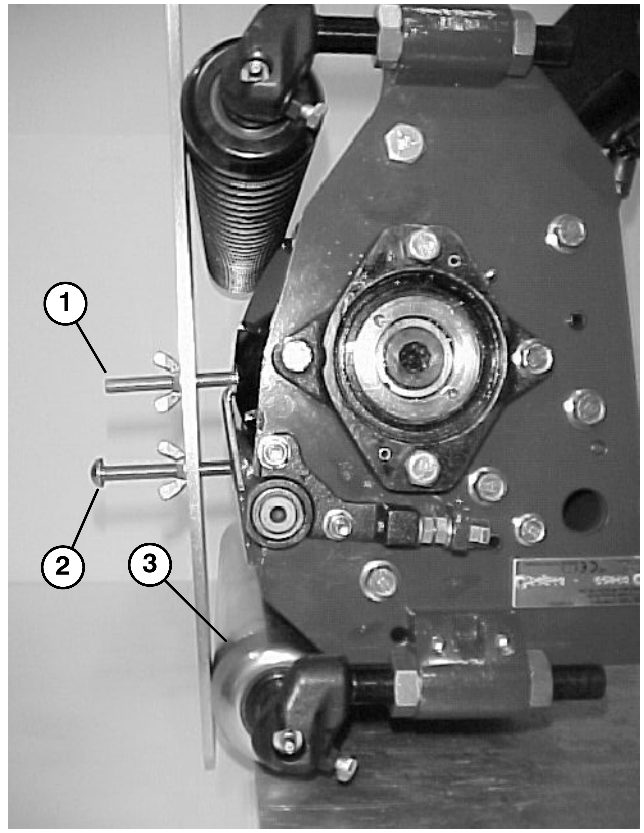


Figure 18

1. **First Screw**
2. **Second Screw**
3. **Rear Roller**

Front Grass Shield Adjustment

Adjust grass shield for desired grass clippings dispersion.

1. Position cutting unit on a flat level surface.

2. Loosen flange head capscrew (Fig. 19) securing shield to left side plate, move shield to desired angle and tighten screw.

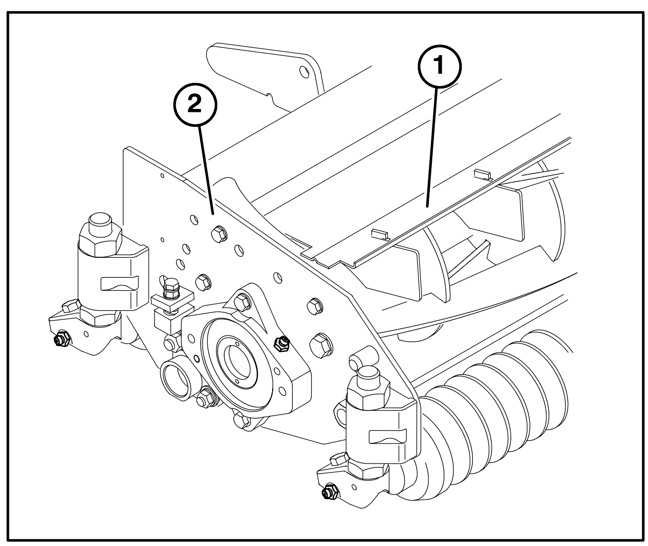


Figure 19

1. **Grass Shield**
2. **Capscrew**

Rear Shield Adjustment

Under most conditions, best dispersion is attained when rear shield is closed (front discharge). When conditions are heavy or wet, rear shield may be opened.

1. To open rear shield, loosen flange head capscrews securing shield to right side plate, rotate shield to open position and tighten screw.

Lift Chain Adjustment

The chain connecting carrier frame to cutting unit controls the amount of fore-aft rotation available, as well as the amount of ground clearance in transport and turn around. The chain has a total of 13 links. The chain is factory adjusted at the eleventh link, which will work well for most fairways.

On rougher ground, chain may be shortened to allow for more ground clearance. To allow greater rotation for areas with many contours, lengthen chain.

Note: The position of the screw within the link will affect the chain length.

Adjusting Turf Compensation Spring

The Turf Compensation Spring (Fig. 20), connecting carrier frame to cutting unit, controls the amount of fore-aft rotation available, as well as the amount of ground clearance in transport and turn around.

The Turf Compensation Spring also transfers weight from the front to rear roller. This helps to reduce a wave pattern in the turf, also known as bobbing.

IMPORTANT: Make spring adjustments with cutting unit mounted to traction unit and lowered to shop floor. Refer to Traction Unit Operator's Manual for mounting instructions.

1. Tighten lock nut on rear of spring rod until the gap (C) between rear of spring bracket and front of washer is 1” (26 mm) (Fig. 20).

2. Tighten hex nuts on front end of spring rod until the compressed length (A) of spring is 8” (203 mm) (Fig. 20).

Note: When cutting rough or undulating turf, increase compressed length (A) of spring to 8-1/2” (216 mm) and gap (C) between rear of spring bracket and front of washer to 1-1/2” (39 mm) (Fig. 20).

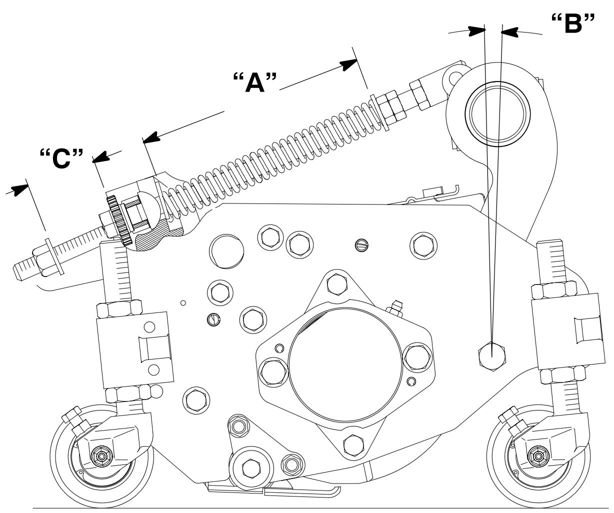


Figure 20

Note: As compressed spring length (A) **decreases**, weight transfer from front roller to rear roller **increases** and carrier frame/cutting unit rotation angle (B) **decreases**.

Note: As gap (C) between spring bracket and washer **increases**, cutting unit ground clearance **decreases** and carrier frame/cutting unit rotation angle (B) **increases**.

Adjusting Front Cutting Unit Travel

Additional downward travel of the front three cutting units may be desirable in highly contoured locations. If any of the front three cutting units lift off the ground when cresting a “hill”, the front carrier frame may be lowered by removing mounting bolts and repositioning frame in the bottom set of holes in the main frame.

Cutting Units

Daily Adjustments

Prior to each day's mowing, or as required, each cutting unit must be checked to verify proper bedknife-to-reel contact. **This must be performed even though quality of cut is acceptable.**

1. Lower cutting units onto a hard surface, shut off engine and remove key from ignition.

2. Slowly rotate reel in reverse direction listening for reel-to-bedknife contact. If no contact is evident, turn bedknife adjusting knob clockwise, one click at a time, until light contact is felt and heard.

3. If excessive contact is felt, turn bedknife adjusting knob counterclockwise, one click at a time until no contact is evident. Then turn bedknife adjusting knob one click at a time clockwise, until light contact is felt and heard.

IMPORTANT: Light contact is preferred at all times. If light contact is not maintained, bedknife / reel edges will not sufficiently self-sharpen and dull cutting edges will result after a period of operation. If excessive contact is maintained, bedknife/reel wear will be accelerated, uneven wear can result, and quality of cut may be adversely affected.

Note: As the reel blades continue to run against the bedknife a slight burr will appear on the front cutting edge surface the full length of the bedknife. If a file (or a light face grind) is occasionally run across the front edge to remove this burr, improved cutting edge sharpness can be obtained.

After extended running, a ridge will eventually develop at both ends of the bedknife. These notches must be rounded off or filed flush with cutting edge of bedknife to assure smooth operation.

Service and Repairs

Backlapping

DANGER

REELS MAY STALL WHILE BACKLAPPING. DO NOT ATTEMPT TO RESTART REELS BY HAND OR TOUCH REELS WHILE BACKLAPPING. STOP ENGINE AND TURN SPEED KNOB ONE POSITION TOWARD "13".

Note: When backlapping, the front units all operate together, and the rear units operate together.

1. Position the machine on a level surface, lower the cutting units, stop the engine, engage the parking brake, and move the Enable/Disable switch to disable position.

2. Unlock and raise the seat to expose controls.

3. Locate the reel speed selector knobs and backlap knobs (Fig. 21). Rotate the desired backlap knob(s) to the backlap position and the desired reel speed selector knob(s) to position "1".

Note: Backlapping speed may be increased by moving the reel speed selector knob toward "13". Each position will increase speed approximately 100 rpm. After changing selector, wait 30 seconds for the system to stabilize at the new speed.

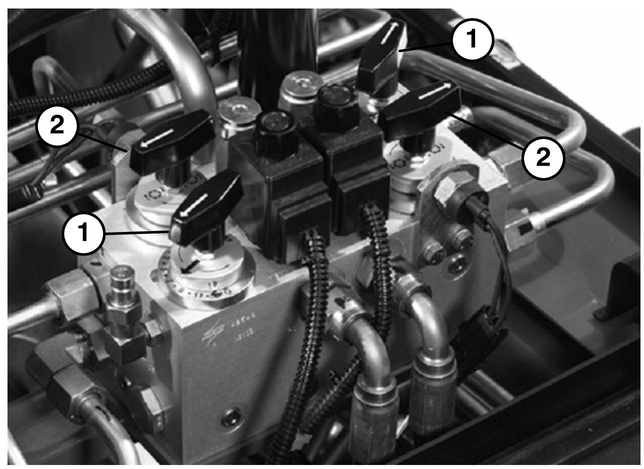


Figure 21

1. **Reel Speed Selector Knobs**
2. **Backlap Knobs**

4. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units which are to be backlapped.

5. Start engine and run at **idle speed**.

DANGER

TO AVOID PERSONAL INJURY, NEVER PLACE HANDS OR FEET IN REEL AREA WHILE ENGINE IS RUNNING. CHANGING ENGINE SPEED WHILE BACKLAPPING MAY CAUSE REELS TO STALL. NEVER CHANGE ENGINE SPEED WHILE BACKLAPPING. ONLY BACKLAP AT IDLE ENGINE SPEED. NEVER ATTEMPT TO TURN REELS BY HAND OR FOOT WHILE ENGINE IS RUNNING.

6. Select either front, rear, or both backlap knobs to determine which reels will be backlapped.

7. Move Enable/Disable switch to Enable position. Move Lower Mow/Lift control forward to start backlapping operation on designated reels.

8. Apply lapping compound with a long handle brush (see Special Tools). Never use a short handled brush (Fig. 22).

9. If reels stall or become erratic while backlapping, stop backlapping by moving the Lower Mow/Lift control lever rearward. Once the reels have stopped, move the desired reel speed selector knob(s) one position closer to “13”. Resume backlapping by moving the Lower Mow/ Lift control lever forward.

10. To make an adjustment to the cutting units while backlapping, turn reels OFF by moving the Lower Mow/ Raise lever rearward; move the Enable/Disable switch to Disable and turn the engine OFF. After adjustments have been completed, repeat steps 5-9.

11. Backlap until the reels can cut paper.

12. When the cutting unit is adequately sharpened, a burr will form on the front edge of the knife. Using a file, carefully remove the burr without dulling the cutting edge (Fig. 23).

13. Repeat procedure for all cutting units to be backlapped.

14. When backlap operation has been completed, return the backlap knobs to the forward flow position, lower seat and wash all lapping compound off cutting units. Adjust cutting unit reel to bedknife as needed.

Note: If the backlap knobs are not returned to the forward flow position after backlapping, the cutting units will not raise or function properly.

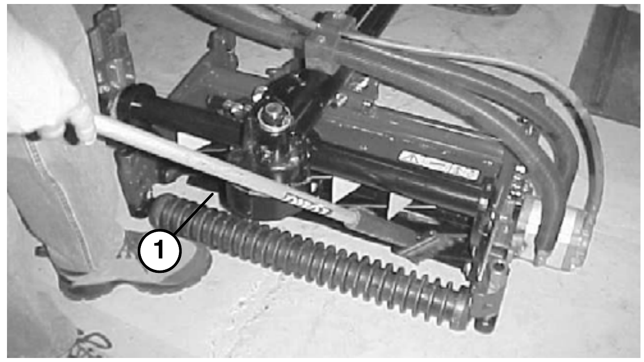


Figure 22

1. **Long Handle Brush**

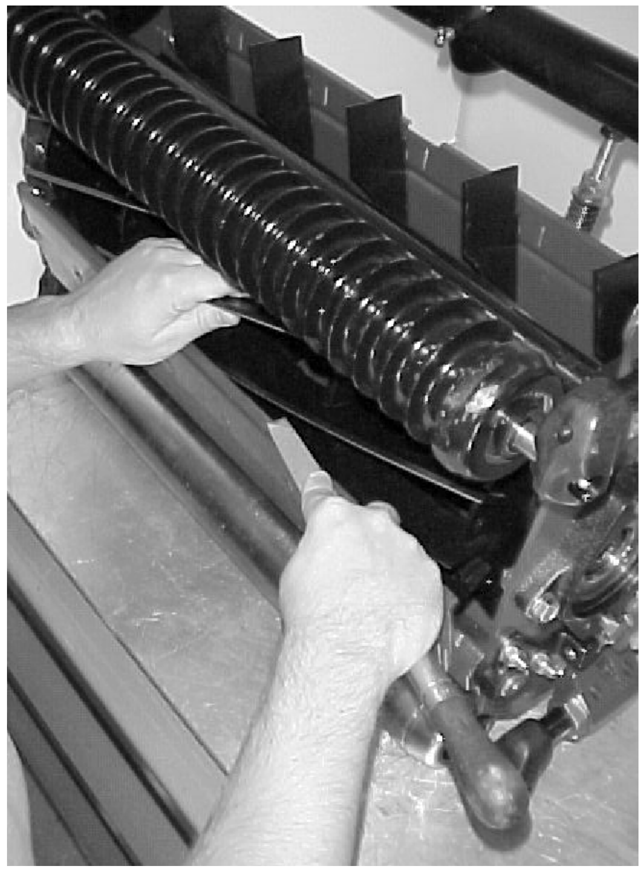


Figure 23

Cutting Units

Bedbar Removal and Installation

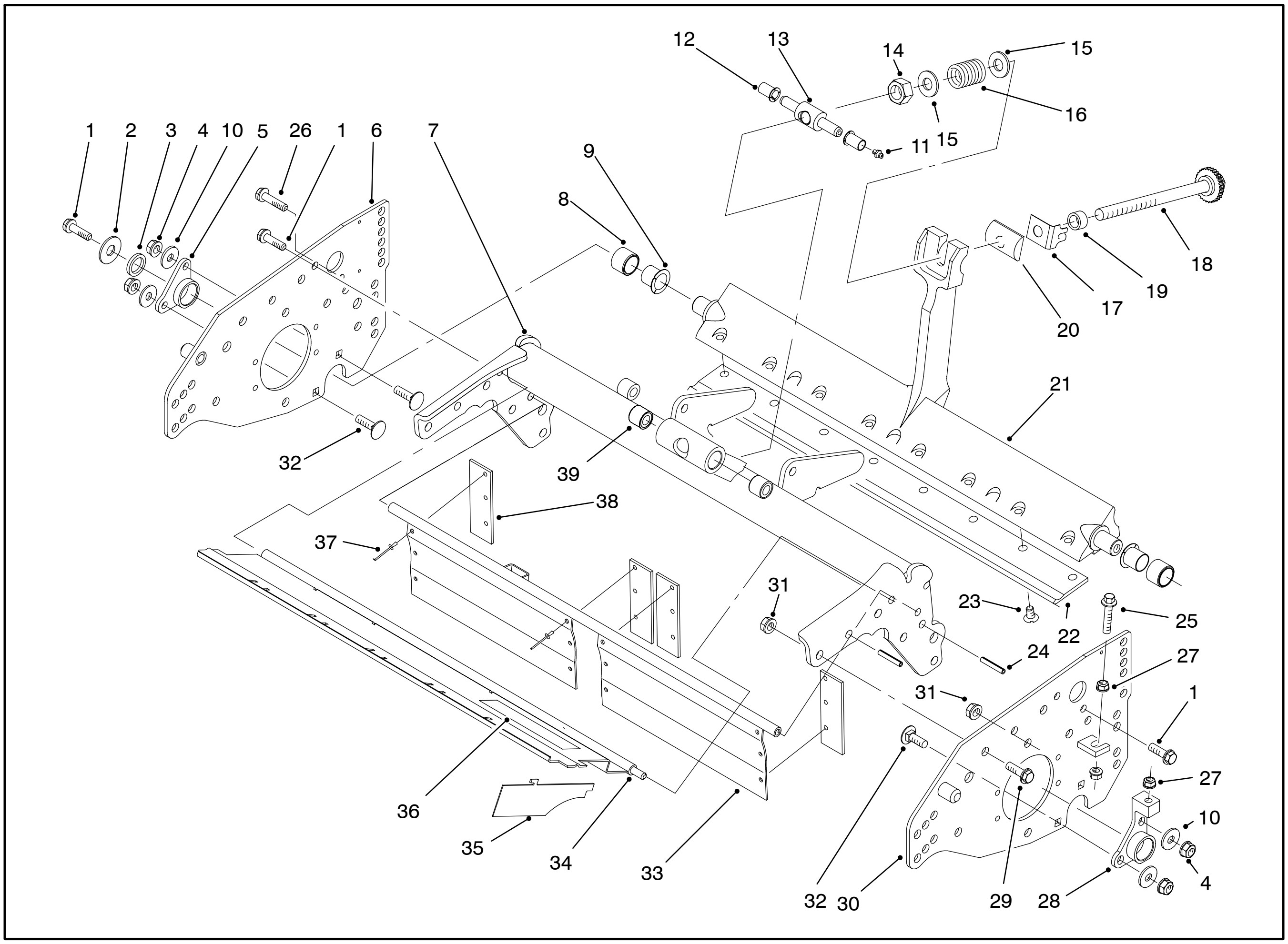


Figure 24

1. Screw
2. Washer
3. Quad Ring
4. Locknut
5. Pivot Hub - RH
6. Sideplate - RH
7. Reel Frame
8. Bushing Assembly
9. Flange Bushing
10. Flat Washer
11. Grease Fitting
12. Plastic Bushing
13. Adjustment Screw Pivot
14. Locknut
15. Washer
16. Compression Spring
17. Spring Arm
18. Bedbar Adjuster Assembly
19. Adjuster Spacer
20. Bedbar Adjustment Pivot
21. Bedbar
22. Bedknife
23. Special Screw
24. Roll Pin
25. Screw
26. Screw
27. Flange Nut
28. Pivot Hub - LH
29. Screw
30. Sideplate - LH
31. Locknut
32. Carriage Screw
33. Rear Grass Shield
34. Grass Shield Assembly
35. Grass Shield Deflector
36. Decal - Danger
37. Rivet
38. Side Flap
39. Bushing

Removal

6. Loosen bedknife adjusting knob to loosen bedknife to reel contact.

7. Loosen locknut on bedknife adjuster assembly and disengaging adjuster from bedbar (Fig. 25).

8. Remove bedbar leveling screw from L.H. side of cutting unit.

9. Remove fasteners securing L.H. and R.H. bedbar pivot hubs to frame.

10. Remove bedbar assembly.

11. Remove capscrew, washer and quad ring from R.H. end of bedbar.

12. Remove R.H. and L.H. pivot hubs from bedbar.

13. Sharpen or replace bedknife as necessary (see Bedknife Replacement and Grinding).

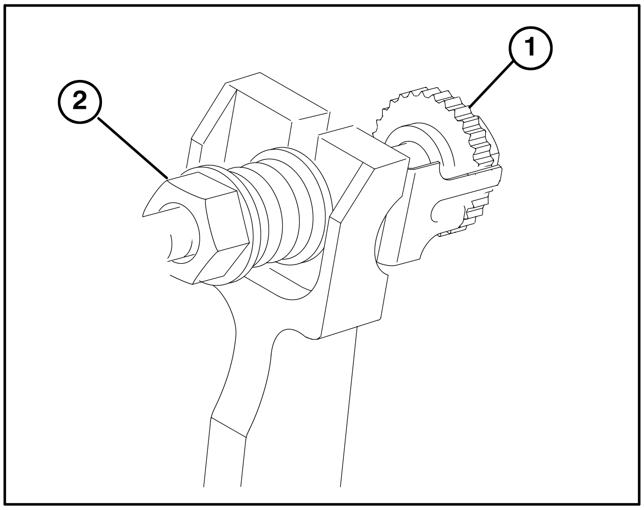


Figure 25

1. **Bedknife Adjusting Knob**
2. **Locknut**

Installation

1. Inspect bedbar end bushings and flange bushings for wear and replace if necessary.

2. Install R.H. and L.H. pivot hubs onto bedbar.

3. Install quad ring, washer and capscrew to R.H. end of bedbar.

4. Install bedbar onto cutting unit and secure pivot hubs to frame with fasteners removed in step 4 above.

5. Install bedbar leveling capscrew and nuts to L.H. side of cutting unit.

6. Install bedknife adjusting knob assembly. Tighten locknut to compress spring to dimension shown (Fig. 26).

7. Adjust bedknife to reel (see Bedknife to Reel Adjustment).

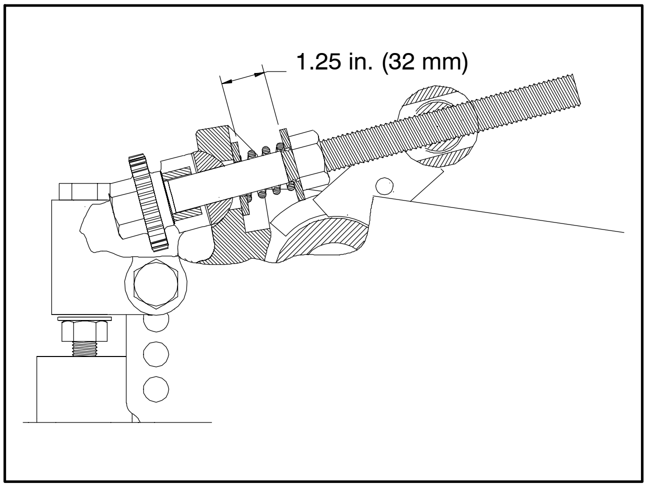


Figure 26

Bedknife Replacement and Regrinding

1. Remove bedbar from cutting unit.

2. Use bedknife screw tool TOR510880 to remove bedknife screws. Remove bedknife (Fig. 27).

3. Remove all rust, scale and corrosion from bedbar surface before installing new bedknife.

4. Install new bedknife:

A. Make sure bedbar threads are clean. If necessary, use 5/16–18 UNC 2A tap to clean threads.

B. Use new screws. Apply anti-seize lubricant to screw threads before installing.

C. Tighten screws to a torque of 250 - 300 in.lb. (28 - 34 Nm) working from the center toward each end of the bedbar. DO NOT use an impact wrench.

5. Since there can be variations in the mounting surface of the bedbar, a new bedknife will not be perfectly flat after it is installed. Because of this, it is necessary to backlap or grind a new bedknife after installing it to the bedbar. Follow the existing angle that was ground into the bedknife and grind only enough to make sure the top surface is true.

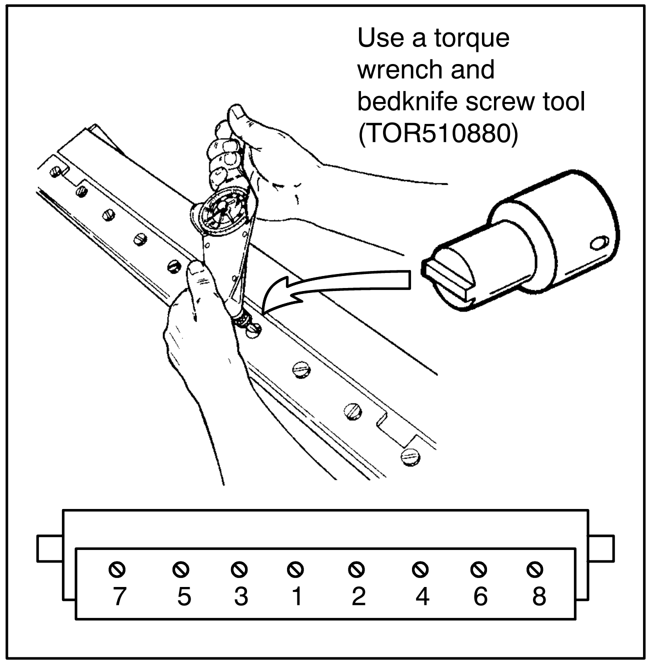


Figure 27

Regrinding Bedknife

Remove bedbar/bedknife assembly from cutting unit before attempting to regrind a used bedknife. Keep the bedknife fastened to the bedbar when grinding.

Note: When regrinding, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder.

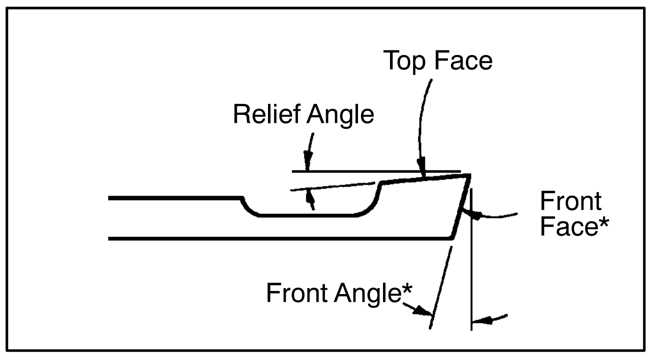


Figure 28

Bedknife Regrinding Specifications (Figs. 28 and 29)		
Bedknife	Relief Angle (Range)	Front Angle* (Range)
Highcut (Original)	5º	5º
Highcut (Later)	5º	10º
Lowcut	5º (3º – 6º)	60º (55º – 70º)
Lowcut (Extended)	10º (8º – 11º)	60º (58º – 64º)

*New Toro bedknives have a rounded front face and do not require a specific front angle. Front angle specifications are listed for regrinding the bedknife front face at customer's option.

Figure 29

Preparing Reel for Regrinding

1. Check to make sure reel bearings are in good condition and properly adjusted before regrinding the reel. Make sure the cutting unit frame and roller brackets are true and not bent or damaged from impacts with trees, posts or cart path edges.

2. Remove bedbar assembly.

3. Remove parts as necessary to mount the cutting unit in the grinder (e.g. front roller, brackets). Follow the grinding equipment manufacturers instructions for mounting the cutting unit.

Note: The cutting unit must be aligned so the grinding wheel will travel parallel to the reel shaft. This will result in the the reel being ground to the desired cylinder shape.

Note: When regrinding, be careful to not overheat the reel blades. Remove small amounts of material with each pass of the grinder.

4. After completing the regrinding process, do a complete set-up and adjustment procedure.

Reel Regrinding Specifications (Fig. 30)	
Nominal Reel Diameter	7″ (178 mm)
Service Limit Reel Diameter	6.2″ (158 mm)
Blade Relief Angle	30°
Relief Angle Range	20° - 40°
Blade Land Width	.060″ (1.5 mm)
Land Width Range	.050″ - .090″ (1.3 - 2.3 mm)
Service Limit Reel Taper	.060″ (1.5 mm)

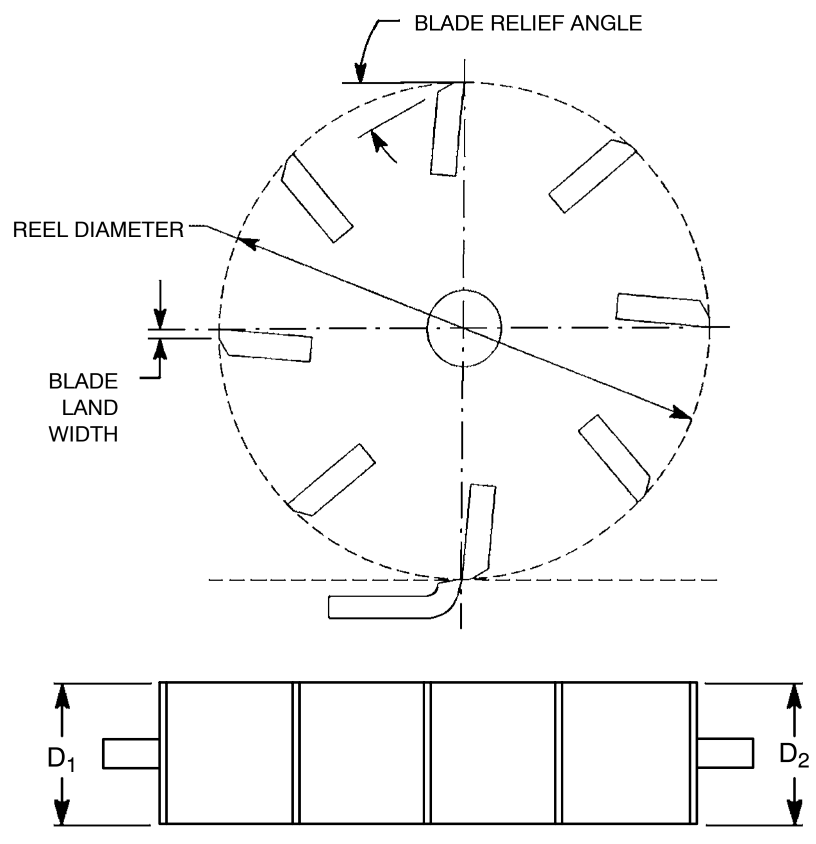


Figure 30

Reel and Reel Bearings

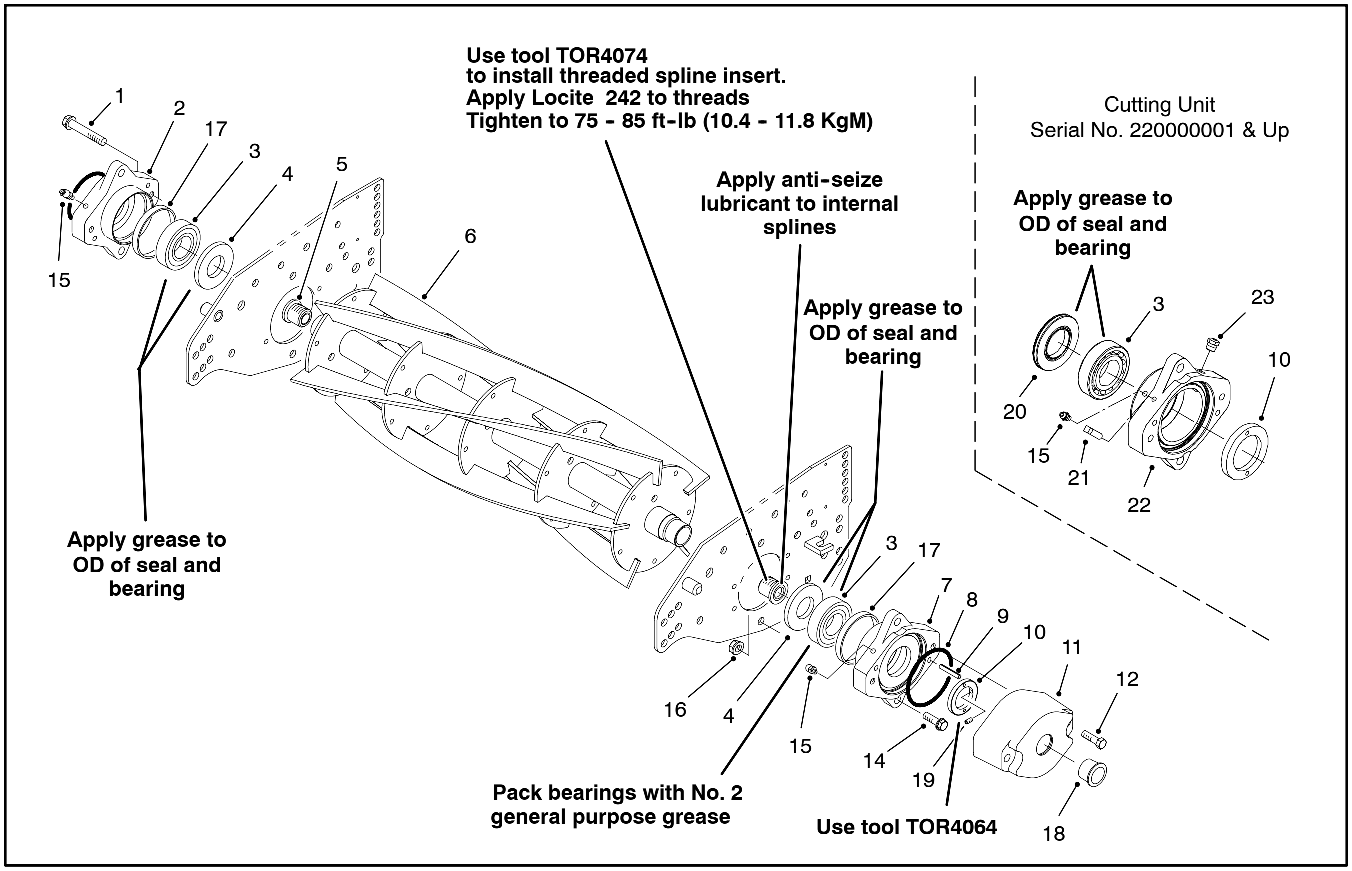


Figure 31

1. Screw
2. Bearing Housing - RH
3. Bearing
4. Grease Seal
5. Threaded Insert
6. Reel Assembly
7. Bearing Housing - LH
8. O-ring
9. Roll Pin
10. Bearing Adjustment Nut
11. End Weight
12. Screw
13. Cap Plug
14. Screw
15. Grease Fitting
16. Locknut
17. Bearing Ring
18. Plug
19. Set Screw - Hex. Socket Hd.
20. Grease Seal
21. Set Screw - Square Hd.
22. Bearing Housing - LH
23. Pressure Relief Fitting

Reel Bearing Adjustment

To insure long life of the reel bearings, periodically check if reel end play exists. The reel bearings can be checked and adjusted as follows:

Note: Bearing and bearing housing were preset at factory as indicated with a paint mark.

1. Loosen reel to bedknife contact by turning the bedknife adjusting knob counter-clockwise until no contact exists (Fig. 32).

2. Hold on to the reel shaft and try to move the reel assembly side to side (Fig. 33).

3. If reel end play exists, proceeded as follows:

A. Loosen set screw securing bearing adjustment nut to bearing housing located on the left side of the cutting unit (Fig. 34 and 35).

B. Using special spanner wrench TOR4064, slowly tighten the reel bearing adjustment nut until no end play of the reel exists. If adjustment nut does not eliminate reel end play, replace reel bearings.

Note: Reel bearings **do not** require pre-load. Over tightening reel bearing adjustment nut will damage reel bearings.

4. Retighten set screw securing bearing adjustment nut to bearing housing.

A. For socket head set screw (Fig. 34), tighten set screw one-half turn beyond initial contact minimum.

B. For square head set screw (Fig. 35), tighten set screw to a torque of 25 - 35 in-lb (29 - 40 KgCm).

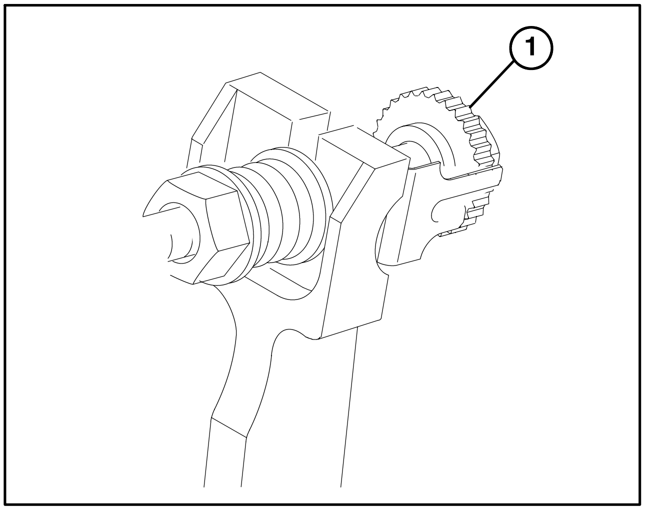


Figure 32

1. Bedknife Adjusting Knob

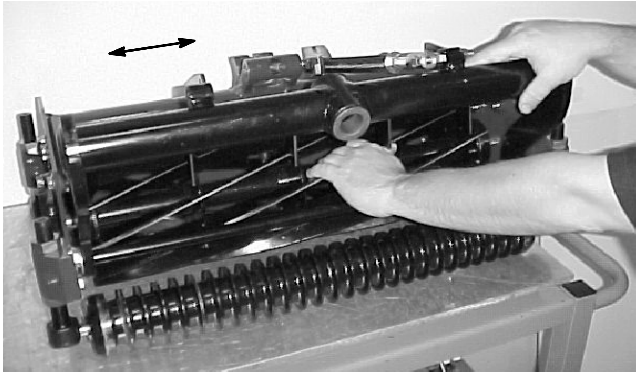


Figure 33

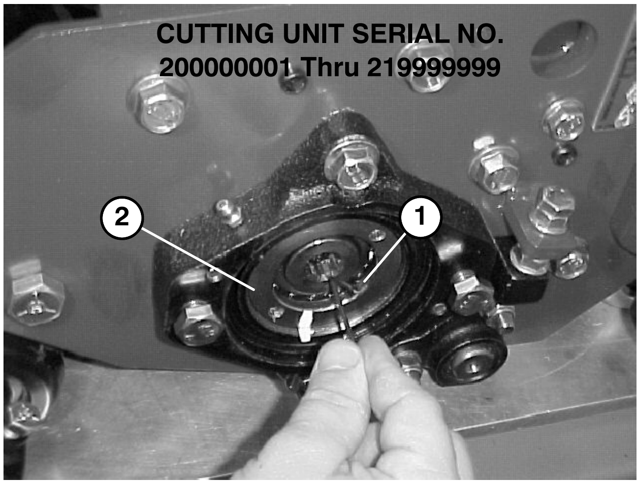


Figure 34

1. Set Screw
2. Bearing Adjustment Nut

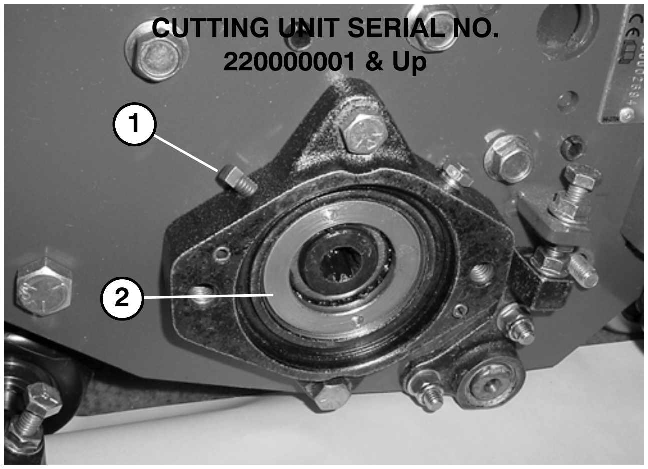


Figure 35

1. Set Screw
2. Bearing Adjustment Nut

Reel Removal

1. Remove weight from cutting unit.

2. Remove bedbar assembly.

3. Remove front roller assembly.

4. Loosen set screw and remove bearing adjustment nut from L.H. bearing housing.

5. Use a hammer and punch to drive out roll pins from L.H. bearing housing. Remove L.H. bearing housing. It is not necessary to remove the R.H. bearing housing.

6. Carefully slide the cutting reel with bearing and seal from the R.H. bearing housing and remove from cutting unit frame.

Inspection

1. Replace reel if diameter has decreased to the service limit (see Reel Grinding Specifications).

2. Replace reel if blades are bent or cracked.

3. Inspect reel shaft splined inserts and replace if worn or damaged.

The splined inserts are installed with thread locking compound (Loctite 242 or equivalent). One side is L.H. threads and the other R.H. threads (the side of the reel with R.H. threads has an identification groove on outer surface of flange). To remove or install threaded spline inserts, use tool TOR4074. Before installing inserts into reel shaft, clean all threads and apply Loctite 242 or equivalent to threads. Install and tighten insert to a torque of 75 - 85 ft-lb (10.4 - 11.8 KgM).

4. Inspect reel bearings and seals. To replace seals and bearings:

A. Use a bearing puller tool to remove the bearings from the reel shaft. Remove the seals. NOTE: If bearings and seals are removed from reel shaft, discard and replace removed components.

IMPORTANT: The seals should be installed so the metal side of the seal is toward the bearing location.

B. Install new seals on the reel shaft pressing on the steel surface of the seal. Make sure seals are installed square to shaft and are pressed fully to reel shaft shoulder.

C. Pack bearings with No. 2 general purpose grease before installing. Install bearings on reel shaft by pressing equally on inner and outer bearing race. Bearings should bottom on reel shaft shoulder.

D. Apply a film of grease to outside diameter of seals and bearings.

Reel Installation

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

1. Set cutting unit frame in a vertical position so R.H. bearing housing is down. Install reel into R.H. bearing housing.

2. Install L.H. bearing housing onto bearing and seal on cutting reel. Install roll pins to position L.H. bearing housing to side plate. Secure bearing housing with screws and lock nuts.

3. Place cutting unit in a horizontal position.

4. Hit end of reel shaft with a brass hammer to make sure that R.H. reel bearing is seated on shoulder of R.H. bearing housing.

5. Apply a film of grease to outside diameter of bearing adjustment nut. Install adjustment nut into L.H. bearing housing and use special spanner wrench TOR4064 to tighten the adjustment nut approximately 1/4 turn past first contact with the bearing.

Note: Reel bearings **do not** require pre-load. Over tightening reel bearing adjustment nut will damage reel bearings.

6. Loosen the bearing adjustment nut and then tighten adjustment nut to a torque of 15 - 17 in-lb (17 - 19 KgCm).

7. Apply thread locking compound (Loctite 242 or equivalent) to threads of set screw. Tighten set screw to secure bearing adjustment nut.

A. For socket head set screw (Fig. 34), tighten set screw one-half turn beyond initial contact minimum.

B. For square head set screw (Fig. 35), tighten set screw to a torque of 25 - 35 in-lb (29 - 40 KgCm).

8. Install front roller assembly.

9. Install bedbar assembly.

10. Apply anti-seize lubricant to internal splines of splined couplers.

11. Install weight assembly to cutting unit.

Roller and Frame Service

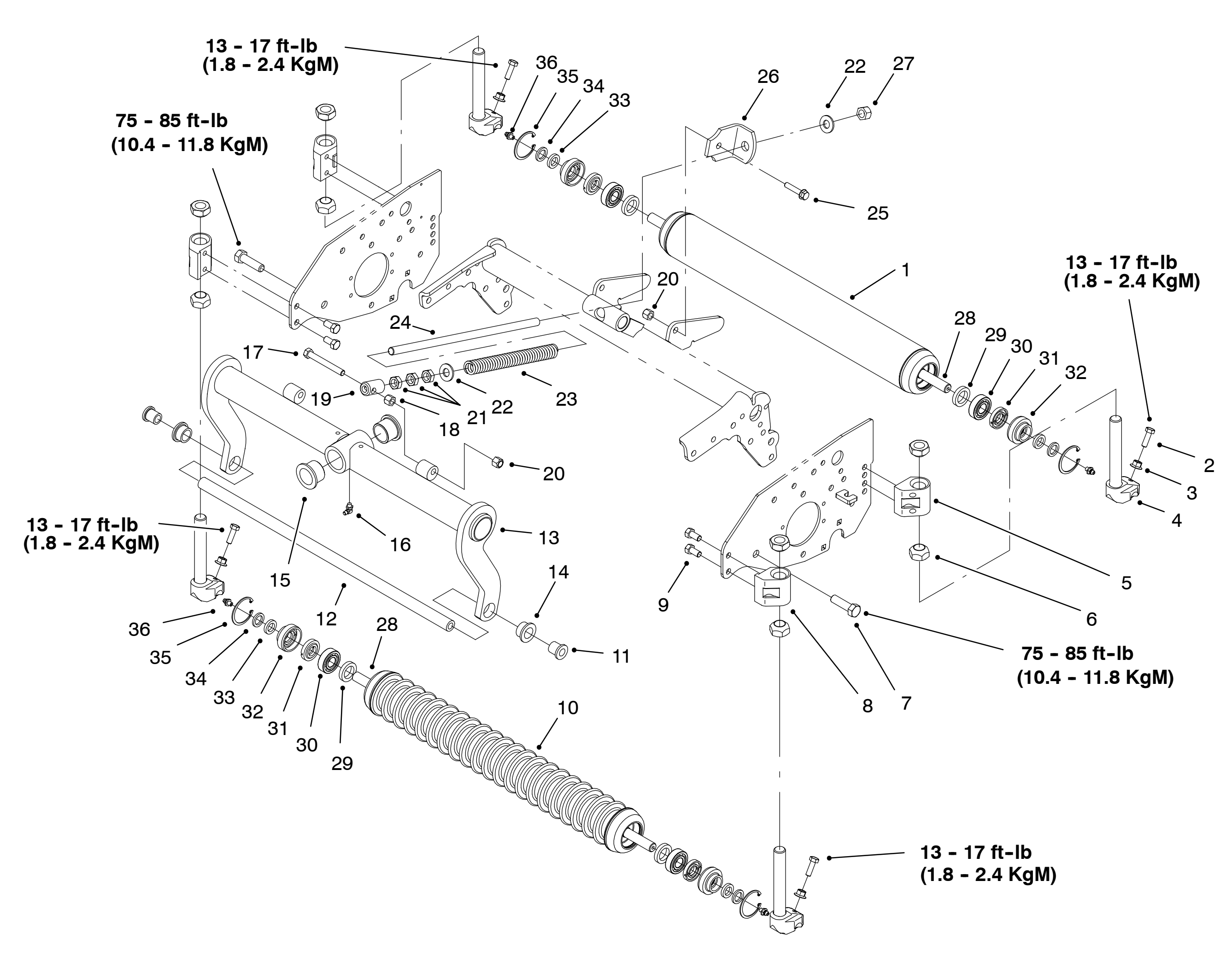


Figure 36

1. Rear Roller
2. Screw
3. Nut
4. Support Rod
5. Rear HOC Bracket
6. Cone Nut
7. Screw
8. Front HOC Bracket
9. Screw
10. Front Roller
11. Frame Spacer
12. Support Rod
13. Carrier Frame
14. Bushing
15. Bushing
16. Grease Fitting
17. Screw
18. Nut
19. Spring Tube
20. Nut
21. Nut
22. Thrust Washer
23. Compression Spring
24. Spring Rod
25. Capscrew
26. Spring Bracket
27. Nut
28. Roller Shaft
29. Oil Seal
30. Ball Bearing
31. Inner Seal
32. Outer Seal
33. Oil Seal
34. Roller Washer
35. Retaining Ring
36. Grease Fitting

Cutting Units

Roller Bearing and Seal Replacement

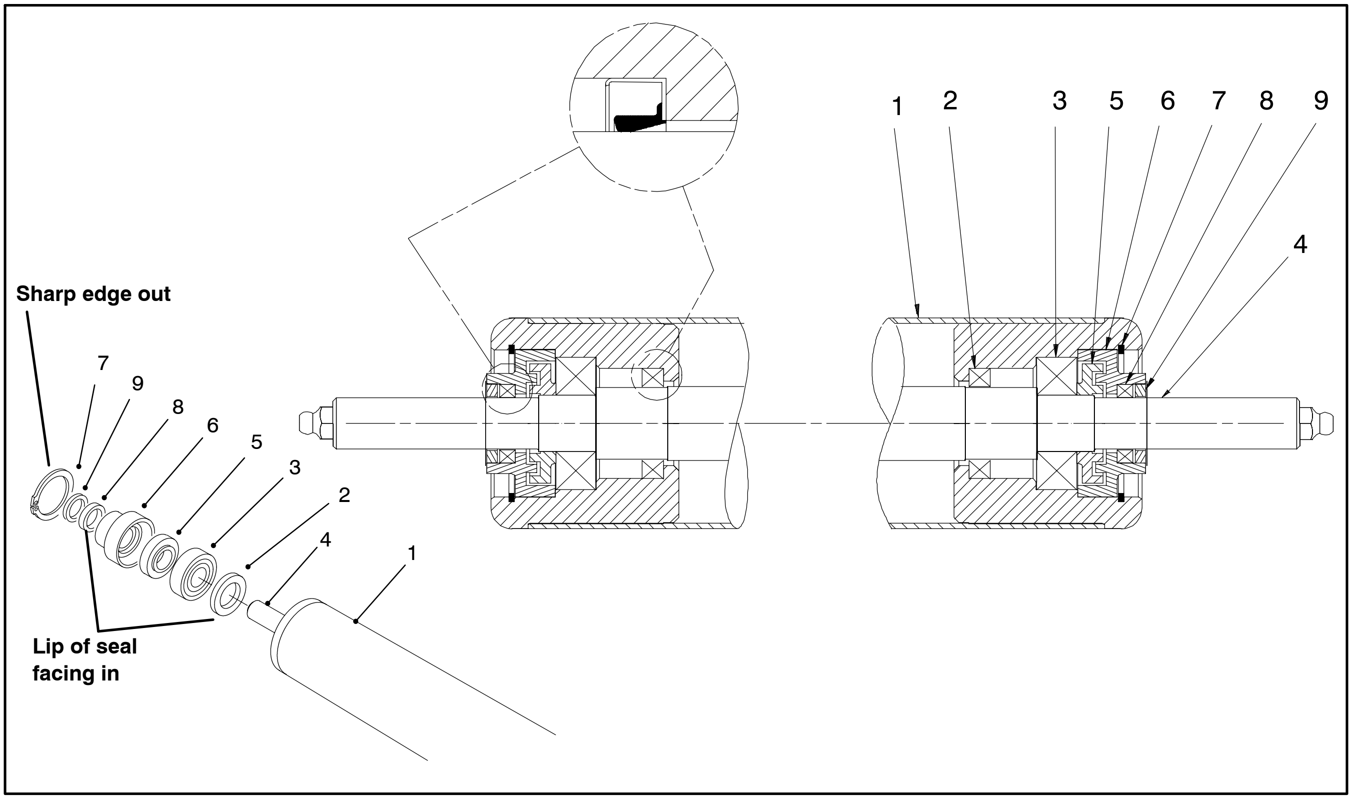


Figure 37

1. **Roller**
2. **Inner Oil Seal**
3. **Bearing**
4. **Roller Shaft**
5. **Inner Seal**
6. **Outer Seal**
7. **Retaining Ring**
8. **Outer Oil Seal**
9. **Washer**

Note: Bearing and seal configurations are the same for both the front and rear rollers.

Removal

1. Remove retaining ring from both ends of roller.

2. Hit end of roller shaft with a soft face hammer to remove seals and bearing from one end of roller. Hit other end of roller shaft to remove seals and bearing from other end of roller. Be careful not to drop roller shaft.

3. Discard seals and bearings.

Installation

Note: A soft face hammer can be used with the special tools to assemble the roller, however use of a press is recommended.

1. Use installation tool TOR4065 and handle TOR4073 to install inner oil seal into each end of roller.

2. Install bearings:

A. Use tool TOR4066, 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.

C. Put roller in a vertical position and support shaft and 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 washer.

8. Put opposite end of roller facing up and support bottom end with tool TOR4067. Repeat steps 3 - 7.

9. Use a hand operated grease grease gun and No. 2 general purpose lithium base grease to lubricate bearings until grease appears at washer. Wipe off excess grease.

Cutting Unit Installation

Cutting unit models 03860, 03861, and 03862 can be installed at any of the mounting locations on the traction unit. Figure 1 shows the orientation of the hydraulic drive motor for each of the five locations. For any of the locations requiring the motor to be mounted on the right end of the cutting unit, install a counter weight on the left end of the cutting unit. For the locations requiring the motor to be mounted on the left end, install a counter weight on the right end of the cutting unit.

Note: Counterweight mounting capscrews are shipped installed on the right bearing housing of the cutting units. The capscrews on left bearing housing are to be used for securing the hydraulic motor.

1. Remove cutting units from cartons. Assemble and adjust per Cutting Unit Operator's Manual.

2. Remove protective plugs from each end of cutting unit.

3. Lubricate and install a large O-ring into bearing housing groove on each end of cutting unit (Fig. 39 & 41).

Note: Lubricate internal splines of cutting unit reels shafts with grease before installing cutting unit motors.

4. Install a counter weight onto appropriate end of each cutting unit with capscrews provided (Fig. 39).

5. Thoroughly grease the cutting unit reel bearings prior to installation on the traction unit. Grease should be evident at the inboard reel seals (see Lubrication in this section of this manual).

6. Insert a thrust washer onto horizontal shaft of pivot knuckle as shown (Fig. 40).

7. Insert the horizontal shaft of the pivot knuckle into the mounting tube of the carrier frame.

8. Secure pivot knuckle to carrier frame with a thrust washer, flat washer and a flange head capscrew.

9. Insert a thrust washer onto vertical shaft of pivot knuckle.

10. Insert the vertical shaft of the pivot knuckle into lift arm pivot hub (Fig. 40). Guide the pivot knuckle in place between the two rubber centering bumpers in the under side of the lift arm steering plate.

11. Insert the lynch pin into the cross hole on the pivot knuckle shaft (Fig. 40).

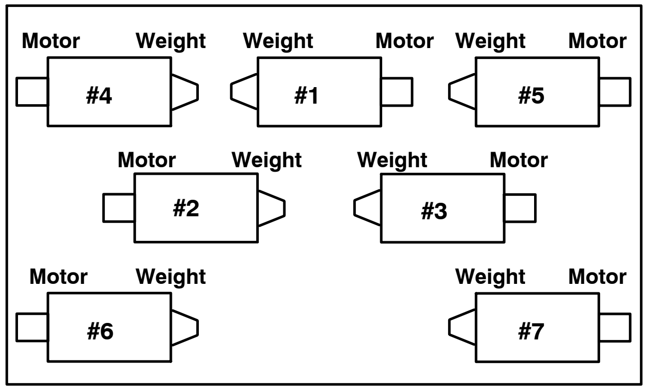


Figure 38

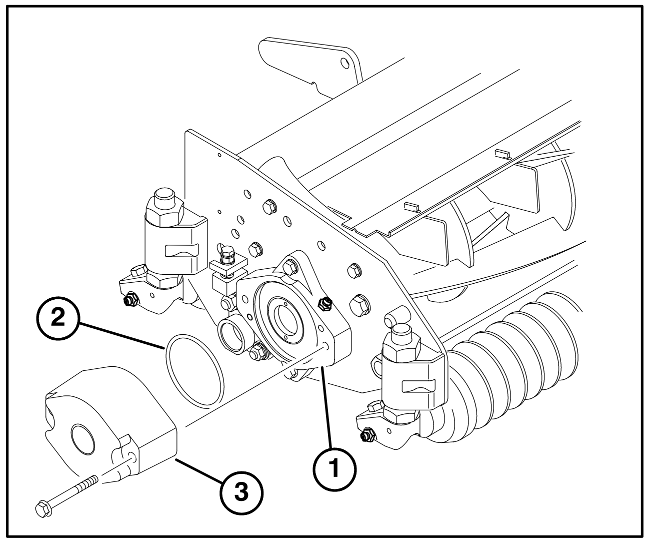


Figure 39

1. Bearing Housing
2. O-ring
3. Counterweight

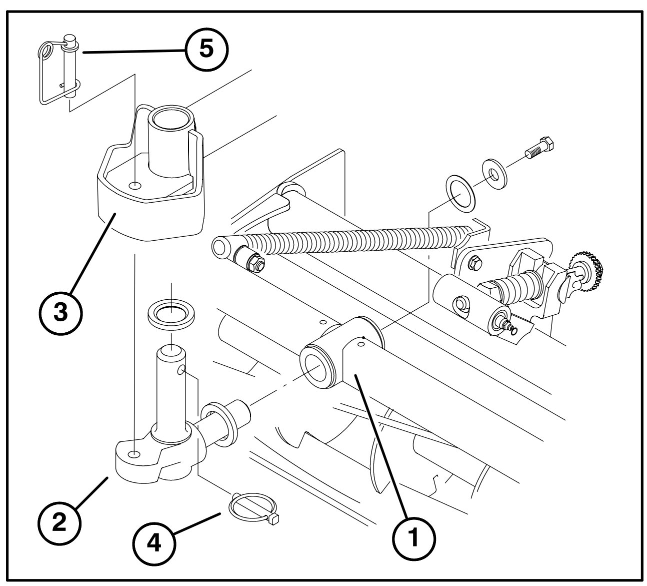


Figure 40

1. Carrier Frame
2. Pivot Knuckle
3. Lift Arm Steering Plate
4. Lynch Pin
5. Steering Pin

12. Insert steering pin into the pivot knuckle if you wish to keep cutting units locked in a straight line during operation. If no steering pin is used, the cutting units will steer themselves as the traction unit turns (Fig. 40).

13. Hook spring wire around bottom of steering pin (Fig. 40).

14. Mount the motor to the drive end of the cutting unit and secure with two capscrews provided (Fig. 41).

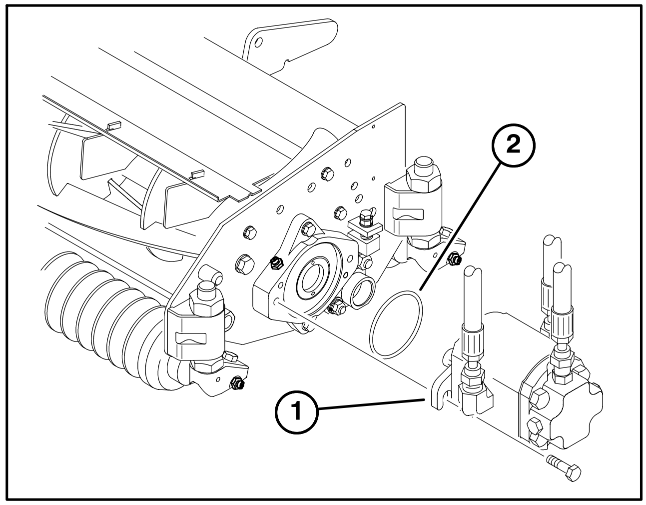


Figure 41

1. Motor
2. O-ring

Lubrication

Each cutting unit has seven grease fittings that must be lubricated regularly with No. 2 General Purpose Lithium Base Grease (Fig. 42).

IMPORTANT: Lubricating cutting units immediately after washing helps purge water out of bearings and increases bearing life.

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

2. The grease fitting locations and quantities are as follows:

   A. Two at front roller ends

   B. Two at rear roller ends

   C. Two at reel bearings

   Note: The reel bearing grease fittings for cutting units serial number 220000001 and up are on the inside of the cutting unit frame. These cutting units also have a pressure relief fitting on the bearing housings.

   Note: Apply grease to reel bearing cavities until a small amount is evident at the inboard reel seal or at the pressure relief fitting.

   D. Bedknife adjuster

3. Wipe each grease fitting with a clean rag.

4. Apply grease until pressure is felt against handle.

5. Wipe excess grease away.

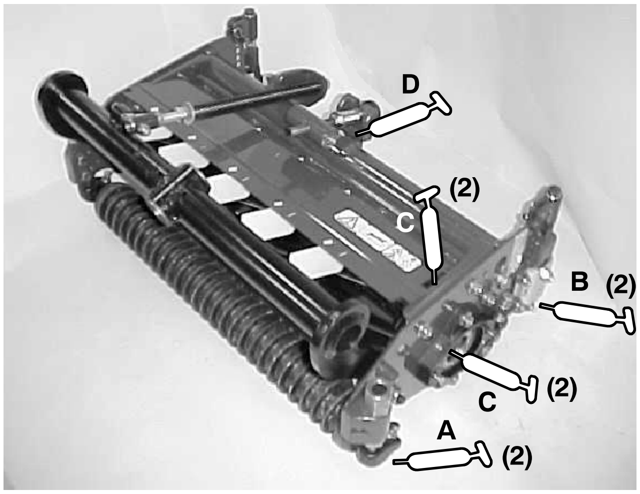


Figure 42

Cutting Units

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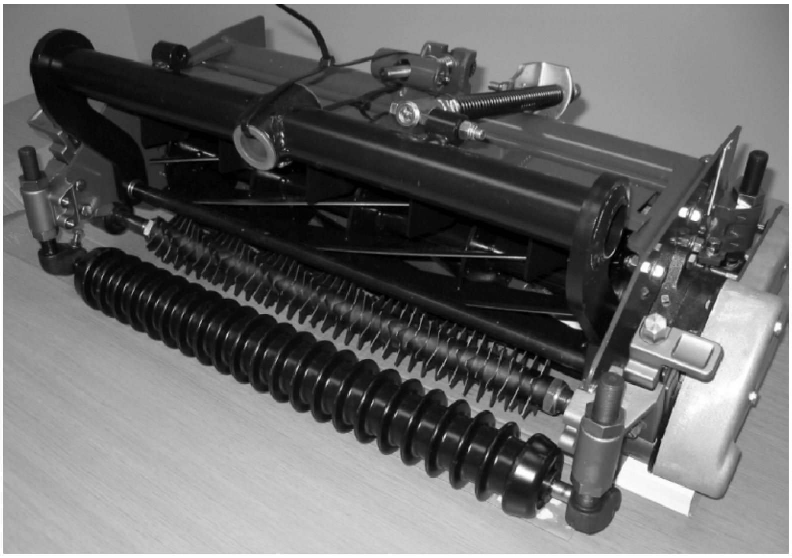
Chapter 7.1

Groomer

Table of Contents



Factors Affecting Grooming

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.

It is important to remember that factors affecting quality of cut also affect grooming performance.

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 OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER 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 and disease and pest control.

10. Stress periods for turf - high temperatures, high humidity, unusually high traffic.

Groomer

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
No rotation of the groomer reel.	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 belt is worn, broken or damaged.	If the belt slips, it probably is worn and must be replaced. Repair or replace belt if necessary. A broken or worn belt could be the result of improper belt routing or seized bearings in groomer assembly.
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 and remove the key from the ignition switch before working on 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 reel is set to the desired height-of-cut (see Cutting Unit Operator's Manual).

3. Loosen two (2) height adjustment lock nuts that retain groomer height adjustment (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 height adjustment screw 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.

6. Tighten two (2) lock nuts to secure groomer height adjustment (Fig. 1).

Note: If grooming operation is not desired, loosen lock nuts on front of HOC assembly (Fig. 1), fully raise groomer and tighten lock nuts to secure groomer in raised position. To resume grooming operation, loosen lock nuts on front of HOC assembly, fully lower groomer and tighten lock nuts.

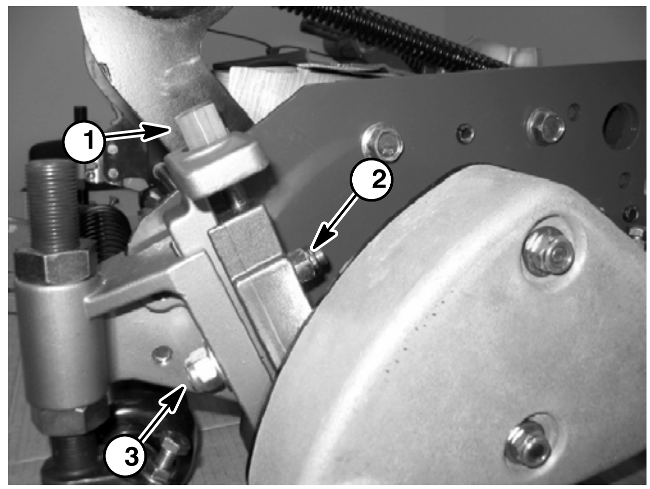


Figure 1

1. **Height adjustment screw**
2. **Height adjustment lock nut**
3. **Groomer raise/lower lock nut**

Service and Repairs

Groomer 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.

2. Remove two (2) flange nuts that secure groomer belt cover, then remove cover (Fig. 2).

3. Lift idler pulley to relax belt tension. Slip groomer drive belt off pulleys (Fig. 3). Carefully release idler pulley.

4. Install new drive belt to drive pulley, idler pulley and driven pulley observing correct belt routing (Fig. 3). Make sure that idler pulley is above groomer drive belt after belt installation.

5. Install belt cover and secure with two (2) flange nuts.

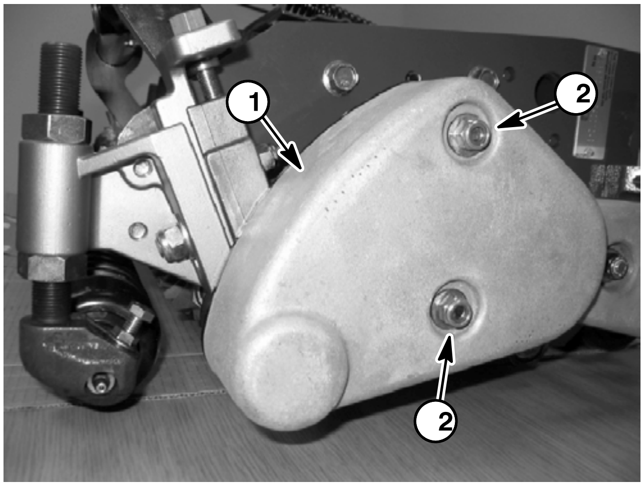


Figure 2

1. **Groomer belt cover**
2. **Flange nut**

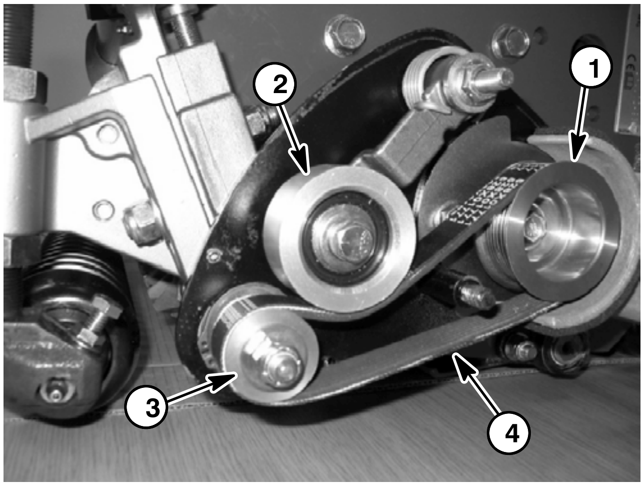


Figure 3

1. **Drive pulley**
2. **Idler pulley**
3. **Driven pulley**
4. **Groomer drive belt**

Groomer Reel

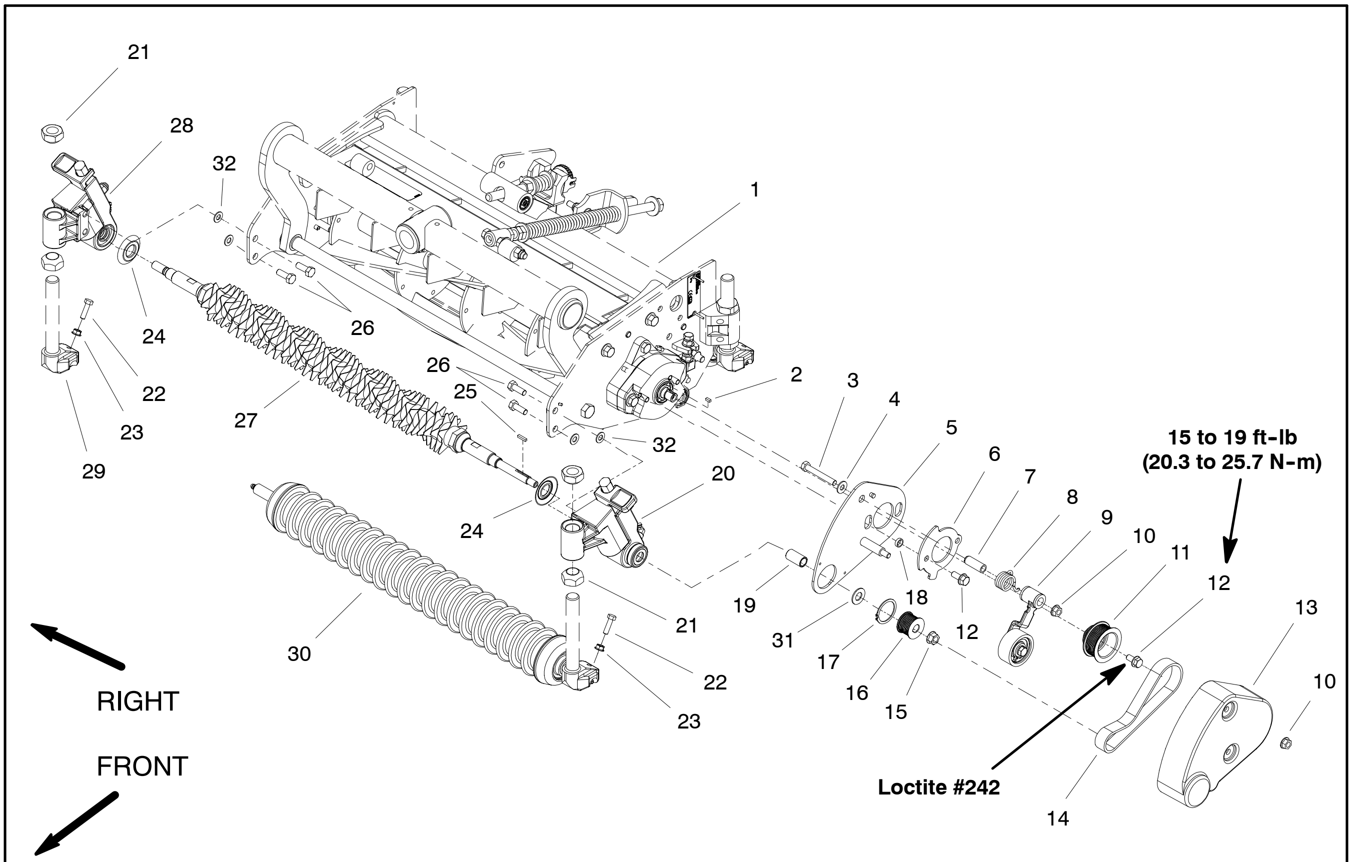


Figure 4

1. Groomer reel assembly
2. Square key
3. Cap screw
4. Flat washer
5. Groomer plate
6. Retaining plate
7. Idler arm spacer
8. Torsion spring
9. Idler assembly
10. Flange nut (3 used)
11. Drive pulley
12. Flange head screw (3 used)
13. Groomer belt cover
14. Groomer drive belt
15. Flange nut
16. Driven pulley
17. Retaining ring
18. Retaining plate spacer (2 used)
19. Pulley spacer
20. HOC assembly (drive side)
21. Cone nut
22. Cap screw
23. Flange nut
24. Seal guard
25. Square key
26. Cap screw (4 used)
27. Groomer reel assembly
28. HOC assembly (non-drive side)
29. Roller support rod
30. Front roller
31. Flat washer
32. Flat washer (4 used)

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 4 shows the groomer reel drive on the left side of the cutting unit.

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. Remove groomer belt cover (item 13) and groomer drive belt (item 14) from groomer drive (see Groomer Belt Replacement in this section).

3. Loosen flange nuts (item 23) and cap screws (item 22) that secure front roller shaft to roller support rods (Fig. 5). Remove front roller from cutting unit.

Note: To prevent groomer shaft from turning when removing driven pulley, use wrench on shaft flats to hold shaft.

4. Remove the flange nut (item 15) that secures driven pulley (item 16) to groomer shaft. Remove driven pulley from shaft. Locate and retrieve square key (item 25) and washer (item 31) that locates pulley on shaft.

5. Slide pulley spacer (item 19) from shaft.

6. Remove two (2) cap screws (item 26) that secure height of cut assembly (non-drive side) to the cutting unit side plates (Fig. 6). Support groomer to prevent it from falling. Slide height of cut assembly from groomer. Locate and retrieve two (2) flat washers (item 32).

7. Carefully pull the groomer reel from the height of cut assembly (drive side).

8. Inspect seals, bushings and bearings in height of cut assemblies for wear or damage (see Groomer Height of Cut Assembly in this section). Replace components as needed.

Installation

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. Apply a light coating of grease to seal lips in height of cut assemblies. Make sure that seals, bushings and bearings in height of cut assemblies are properly positioned.

3. Make sure that seal guards (item 24) are positioned correctly on groomer shaft (see Groomer Reel Service in this section). The seal lip should be toward the end of the groomer shaft. Apply a film of grease onto seal lip.

4. Carefully slide drive end of the groomer reel into the height of cut assembly (drive side) taking care not to damage seals in height of cut assembly.

5. Carefully position height of cut assembly (non-drive side) onto groomer shaft taking care not to damage seals in height of cut assembly. Position two (2) flat washers (item 32) and then height of cut assembly to the cutting unit frame. Secure with two (2) cap screws (item 26).

6. Install front roller into roller support rods. Center front roller and secure roller with flange nuts (item 23) and cap screws (item 22).

7. Slide pulley spacer (item 19) and washer (item 31) onto groomer shaft.

8. Place square key (item 25) in shaft key slot and then slide driven pulley onto groomer shaft.

Note: To prevent groomer shaft from turning when securing driven pulley, use wrench on shaft flats to hold shaft.

9. Secure driven pulley to groomer shaft with flange nut (item 15).

10. Install groomer drive belt and belt cover to side of cutting unit (see Groomer Belt Replacement in this section).

11. Check that seal guards just touch height of cut assembly (Fig. 6). Reposition seal guard(s) if necessary.

12. Lubricate groomer bearings (see Groomer Reel Kit Installation Instructions).

Note: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

13. Check groomer reel height and mower height-of-cut settings. Adjust as needed.

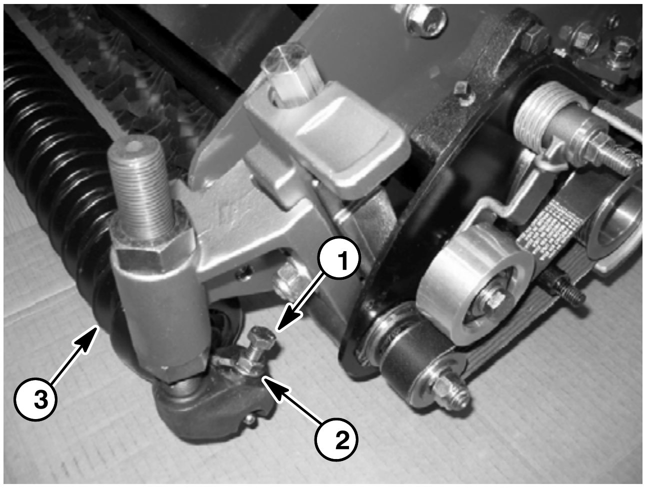


Figure 5

1. **Cap screw**
2. **Flange nut**
3. **Front roller**

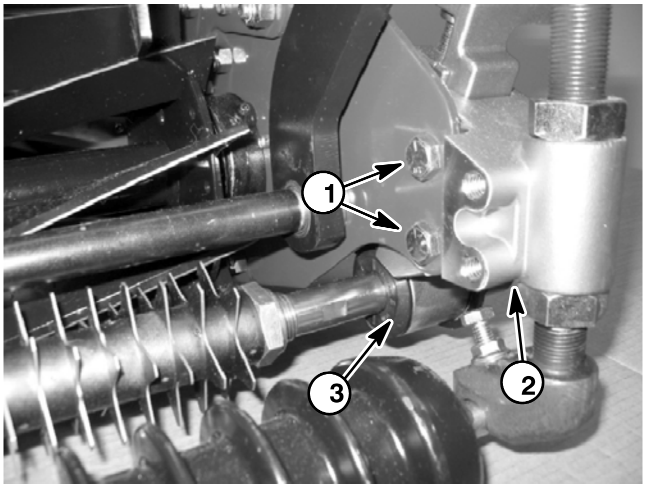


Figure 6

1. **Cap screw**
2. **Height of cut assembly**
3. **Seal guard**

Groomer

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. 7). Blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

Disassembly (Fig. 8)

1. Remove groomer reel from cutting unit (see Groomer Reel Removal in this section).

2. Remove seal guards from groomer reel.

3. Remove lock nut from either end of the shaft (Fig. 8).

4. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

Assembly (Fig. 8)

1. Install lock nut on drive end of groomer shaft. Place first spacer and then first blade on shaft. Adjust location of lock nut so first blade is 6.850” (174 mm) from drive end of groomer shaft (Fig. 9).

2. Alternately install remaining spacers and blades making sure that all blades are separated by a spacer. Additionally, rotate location mark on each installed blade one flat of the shaft, either in a clockwise or counterclockwise direction. The direction of location mark rotation must remain constant on the shaft.

3. When all blades have been installed, place final spacer on shaft and then thread second lock nut onto the shaft.

4. Using wrench on shaft flats to prevent shaft from turning, torque second lock nut from 200 to 250 in-lb (22.6 to 28.3 N-m). After torquing lock nut, spacers should **not** be free to rotate.

5. Place seal guards on groomer shaft. Position seal guard on drive end of shaft (with key slot) 3.570” (90.7 mm) from shaft end. Position seal guard on non-drive end of shaft 1.740” (44.2 mm) from shaft end (Fig. 9).

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).

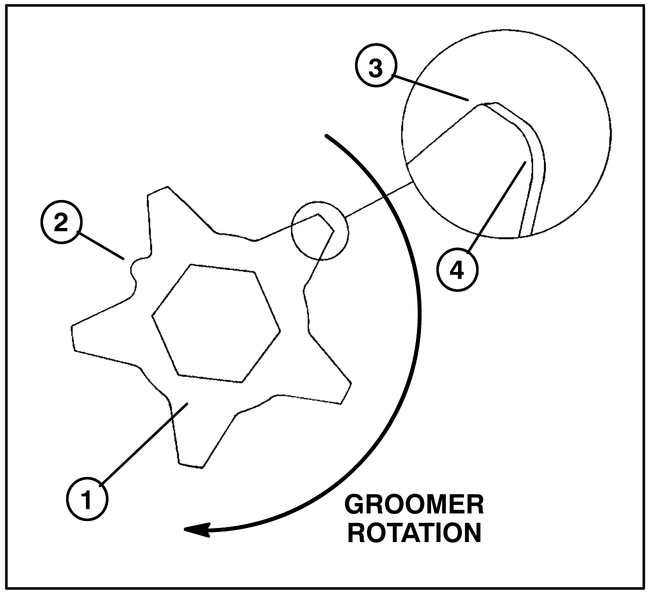


Figure 7

1. **Groomer blade**
2. **Location mark**
3. **Sharp edge**
4. **Dull (rounded) edge**

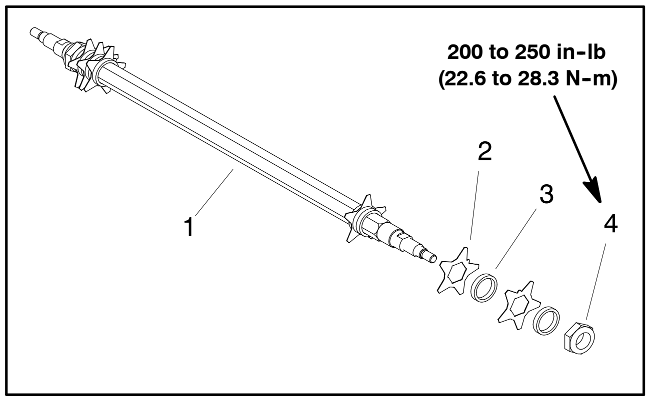


Figure 8

1. **Groomer reel shaft**
2. **Groomer blade (41 used)**
3. **Spacer (42 used)**
4. **Lock nut (2 used)**

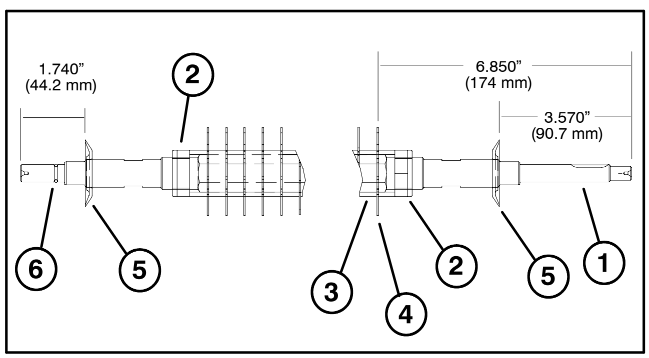


Figure 9

1. **Groomer shaft**
2. **Lock nut**
3. **Spacer (42 used)**
4. **Blade (41 used)**
5. **Seal guard**
6. **O-ring**

Idler Assembly

The drive side plate assembly groomer kit incorporates the idler system for tensioning the groomer drive belt. A torsion spring is used to maintain proper belt tension.

Removal (Fig. 10)

1. Remove groomer belt cover and drive belt from groomer drive side of cutting unit (see Groomer Reel Removal in this section).

CAUTION

Be careful when removing or installing the idler pulley torsion spring. The spring is under heavy load and may cause personal injury.

2. Insert nut driver or small piece of pipe onto the torsion spring end that is retained on the groomer plate. Lift the spring end up and out to unhook the spring from the groomer plate anchor post.

3. Retain cap screw (item 1) while loosening flange nut that secures idler assembly to groomer plate. Remove idler assembly. Make sure to locate and retrieve idler arm spacer and torsion spring.

4. Disassemble idler assembly as needed using Figure 11 as a guide.

Installation (Fig. 10)

1. Assemble idler using Figure 11 as a guide.

2. Position idler assembly, spacer and torsion spring to cap screw (item 1) and groomer plate. Secure idler assembly with flange nut.

3. Insert nut driver or small piece of pipe onto the torsion spring end. Lift the spring end out and up and hook the spring to the groomer plate anchor post.

4. Install drive belt and belt cover to right side of cutting unit (see Groomer Reel Installation in this section).

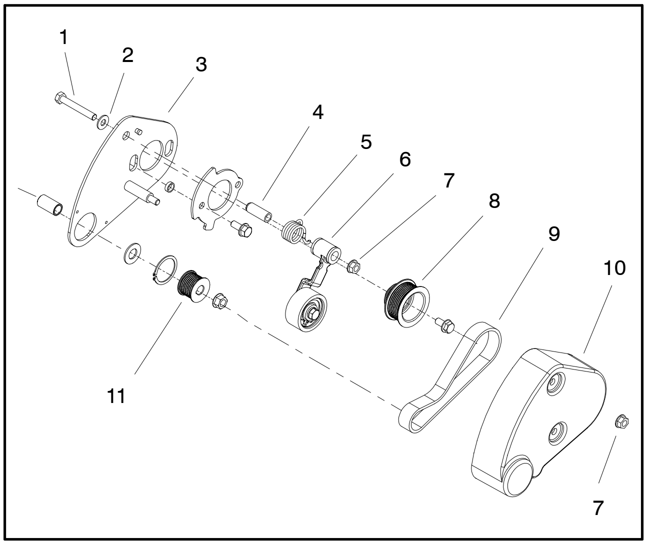


Figure 10

1. **Cap screw**
2. **Flat washer**
3. **Groomer plate**
4. **Idler arm spacer**
5. **Torsion spring**
6. **Idler assembly**
7. **Flange nut**
8. **Drive pulley**
9. **Groomer drive belt**
10. **Groomer belt cover**
11. **Driven pulley**

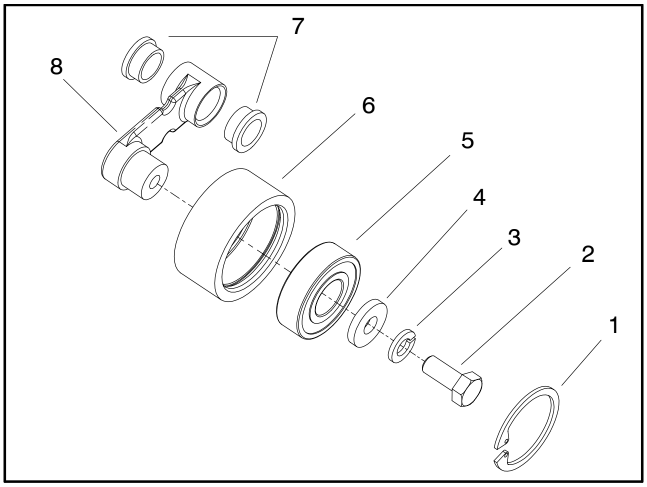


Figure 11

1. **Retaining ring**
2. **Cap screw**
3. **Lock washer**
4. **Flat washer**
5. **Bearing**
6. **Idler pulley**
7. **Flange bushing**
8. **Idler arm**

Groomer Drive

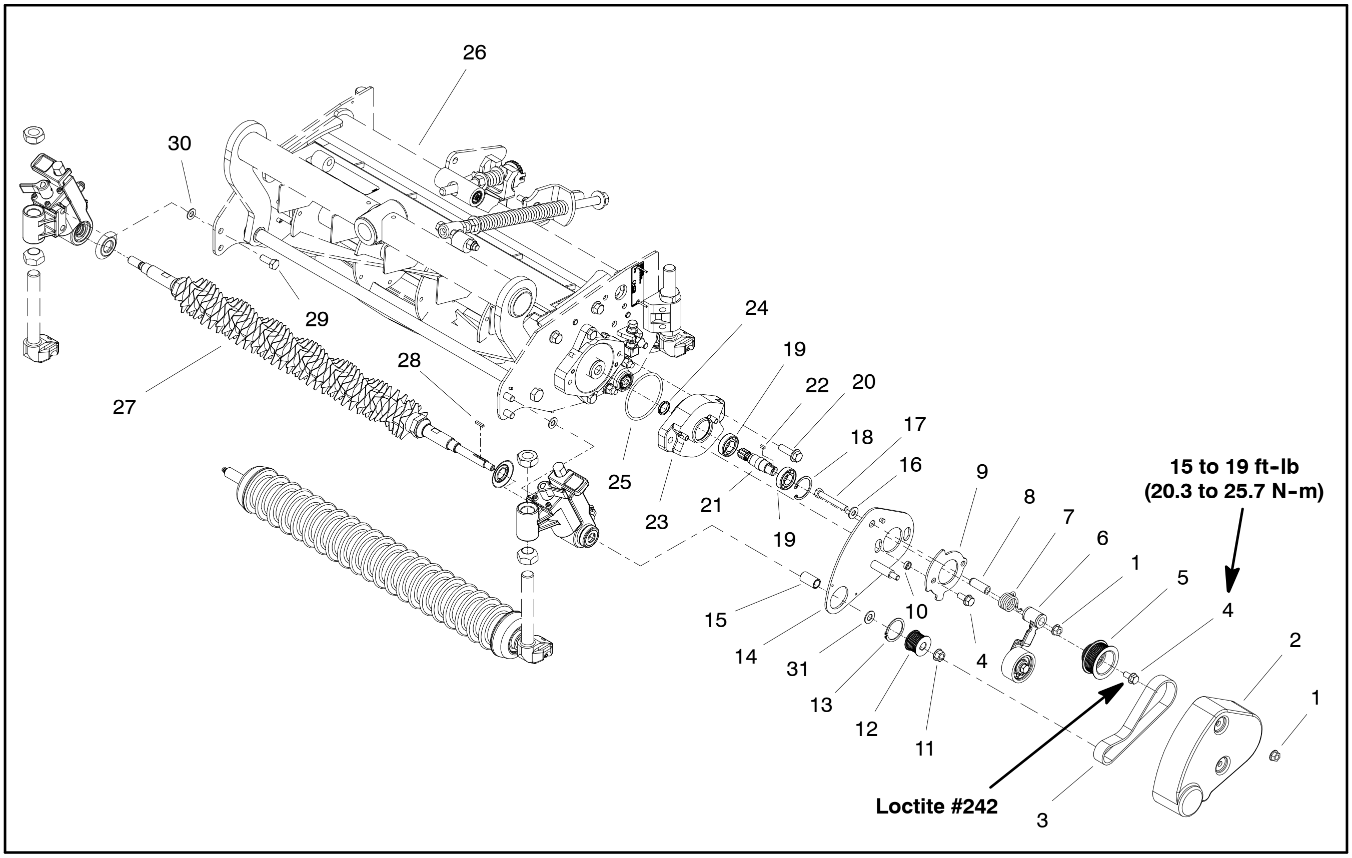


Figure 12

1. **Flange nut**
2. **Groomer belt cover**
3. **Groomer drive belt**
4. **Flange head screw (3 used)**
5. **Drive pulley**
6. **Idler assembly**
7. **Torsion spring**
8. **Idler arm spacer**
9. **Retaining plate**
10. **Retaining plate spacer (2 used)**
11. **Flange nut**
12. **Driven pulley**
13. **Retaining ring**
14. **Groomer plate**
15. **Pulley spacer**
16. **Flat washer**
17. **Cap screw**
18. **Retaining ring**
19. **Bearing**
20. **Flange head screw (2 used)**
21. **Drive shaft**
22. **Square key**
23. **Drive housing**
24. **Oil seal**
25. **O-ring**
26. **Cutting unit**
27. **Groomer reel assembly**
28. **Square key**
29. **Cap screw (4 used)**
30. **Flat washer (4 used)**
31. **Flat washer**

Note: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 12 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 12)

1. Remove groomer belt cover (item 2) and groomer drive belt (item 3) from groomer drive (see Groomer Belt Replacement in this section).

Note: If cutting unit is equipped with powered rear roller brush, removal of roller brush drive covers (Fig. 13) will be necessary to service groomer drive.

Note: To prevent groomer shaft from turning when removing driven pulley, use wrench on shaft flats to hold shaft.

2. Remove the flange nut (item 11) that secures driven pulley (item 12) to groomer shaft. Remove driven pulley from shaft. Locate and retrieve square key (item 28) that locates pulley on shaft.

3. Remove retaining ring (item 13).

4. Remove flange head screw (item 4) that secures drive pulley. Pull drive pulley from cutting unit. Locate and retrieve square key (item 22) from drive shaft.

5. Remove two (2) flange head screws (item 4) that secure retaining plate (item 9) and groomer plate (item 14) to housing.

6. Remove retaining plate and groomer plate from cutting unit. Locate and retrieve two (2) spacers (item 10) from slots in groomer plate.

7. Remove two (2) flange head screws (item 20) that secure drive housing to cutting unit side plate.

8. Slide drive housing assembly from cutting unit. Locate and retrieve o-ring (item 25).

9. Remove shaft and bearings from housing (Fig. 14):

A. Remove retaining ring (item 18) from housing.

B. Slide shaft from housing. Bearings should remain on shaft.

C. Press bearings from shaft.

D. Remove oil seal (item 24) from housing.

Assembly (Fig. 12)

1. Install shaft and bearings into housing (Fig. 14):

A. Install bearings on shaft by pressing on the inner bearing race.

B. Pack area between bearings with grease.

C. Apply grease to lip of new seal. Install seal into housing with the flat face of the seal toward the bearings.

D. Slide shaft assembly into housing taking care to not damage oil seal.

E. Install retaining ring to secure shaft in housing.

2. Position o-ring (item 25) on housing assembly. Slide housing to cutting unit making sure to align drive shaft splines with cutting reel. Secure housing to cutting unit with two (2) flange head screws (item 20).

3. Position retaining plate and groomer plate to cutting unit. Place two (2) spacers (item 10) in groomer plate slots.

4. Secure retaining plate (item 9) and groomer plate (item 14) to housing with two (2) flange head screws (item 4).

5. Place square key (item 22) in drive shaft slot and slide drive pulley onto shaft.

6. Apply Loctite #242 (or equivalent) to threads of flange head screw (item 4). Secure drive pulley with flange head screw. Torque screw from 15 to 19 ft lbs (20.3 to 25.7 N-m).

7. Install retaining ring (item 13) to secure groomer plate to height of cut assembly.

8. Make sure that pulley spacer (item 15) and washer (item 31) are positioned on groomer shaft. Place square key (item 28) in groomer shaft slot and slide driven pulley onto shaft.

Note: To prevent groomer shaft from turning when installing driven pulley, use wrench on shaft flats to hold shaft.

9. Install and tighten flange nut (item 11) to secure driven pulley (item 12) to groomer shaft.

10. Install groomer drive belt (item 3) and groomer belt cover (item 2) to cutting unit (see Groomer Belt Replacement in this section).

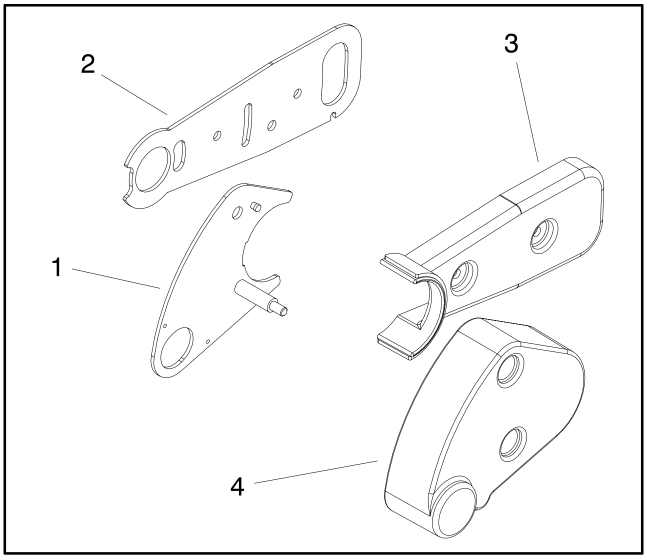


Figure 13

1. **Groomer plate**
2. **Brush plate**
3. **Brush drive cover**
4. **Drive cover**

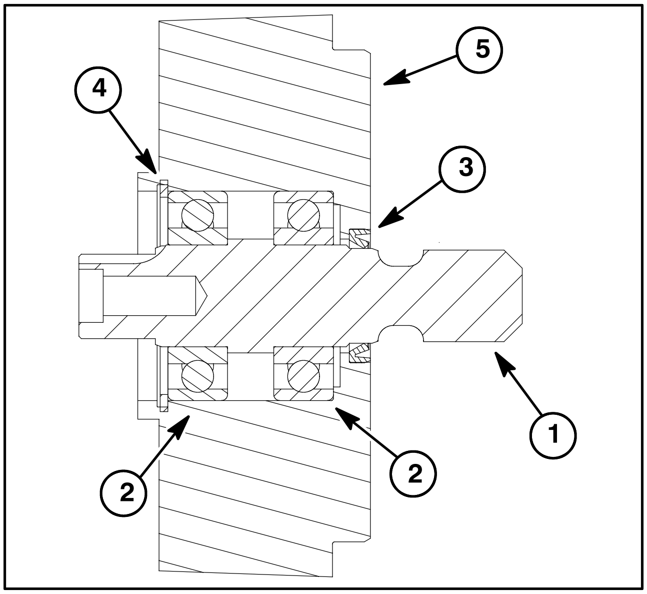


Figure 14

1. **Drive shaft**
2. **Bearing**
3. **Oil seal**
4. **Retaining ring**
5. **Drive housing**

Groomer

Groomer Height of Cut Assembly

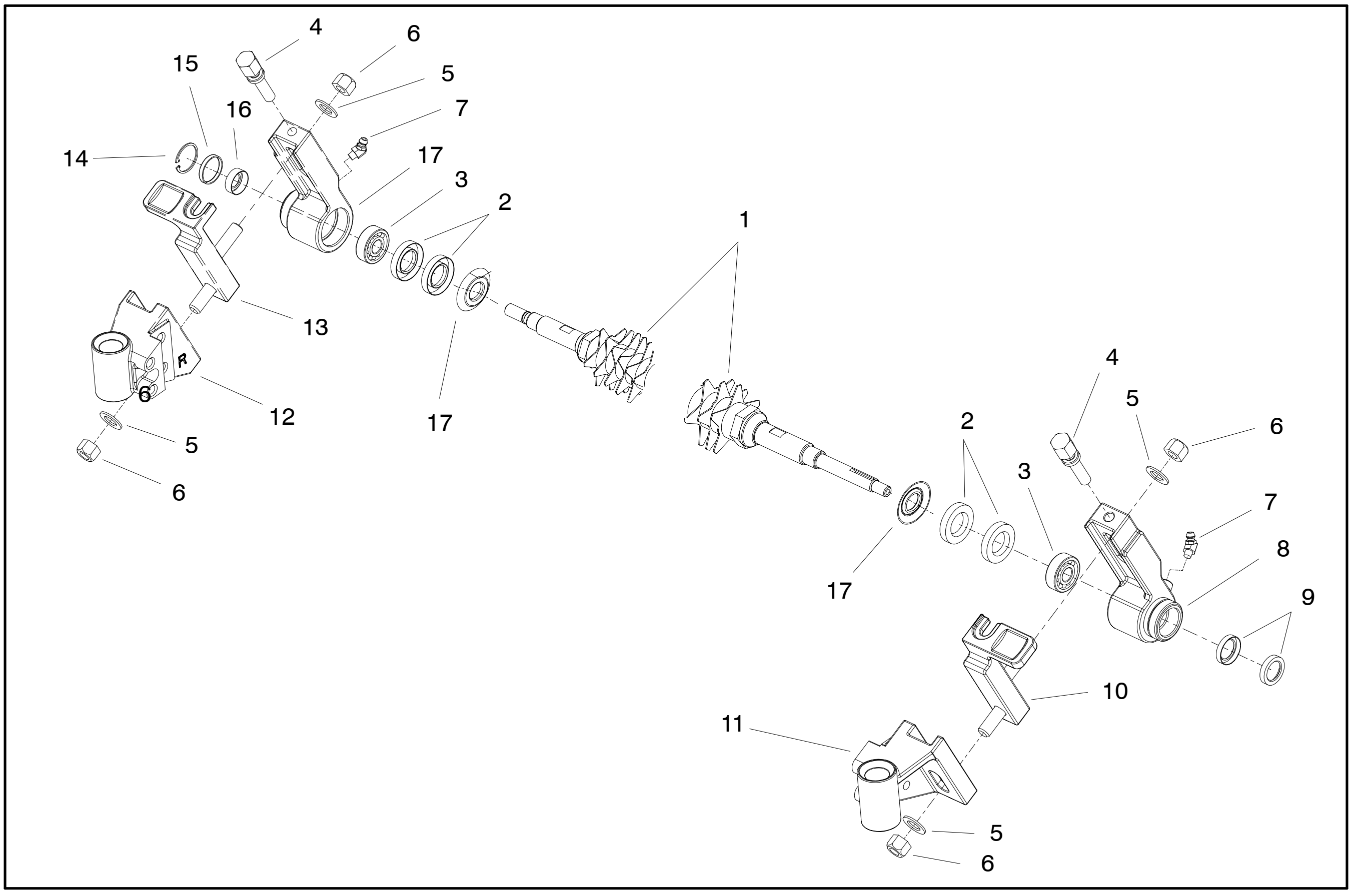


Figure 15

1. **Groomer reel assembly**
2. **Grease seal**
3. **Bearing**
4. **Height of Cut screw**
5. **Washer**
6. **Lock nut**
7. **Grease fitting**
8. **Bearing housing**
9. **Grease seal**
10. **Adjustment bracket**
11. **Height of Cut bracket**
12. **Height of Cut bracket**
13. **Adjustment bracket**
14. **Retaining ring**
15. **Plug**
16. **Grease seal**
17. **Seal guard**

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 groomer height of cut assembly from cutting unit (see Groomer Reel Removal in this section).

2. Disassemble groomer height of cut assembly using Figure 15 as a guide.

Assembly (Fig. 15)

1. If bearing housing were disassembled, install bearings and grease seals noting proper orientation of components as shown in Figure 16.

2. Assemble groomer height of cut assembly using Figure 15 as a guide.

3. Install groomer height of cut assembly onto cutting unit (see Groomer Reel Installation in this section).

4. Check groomer reel height and mower height-of-cut settings. Adjust as needed.

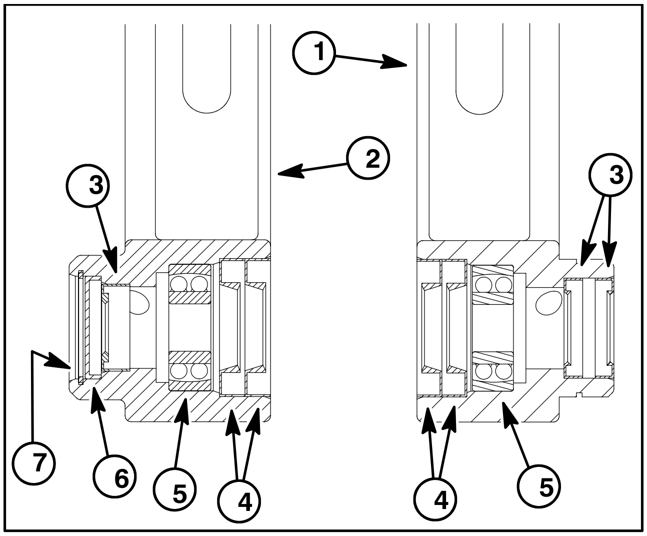


Figure 16

1. **Drive side housing**
2. **Non-drive side housing**
3. **Grease seal**
4. **Grease seal**
5. **Bearing**
6. **Plug**
7. **Retaining ring**

Chapter 7.2

DPA Cutting Units

Table of Contents

Specifications

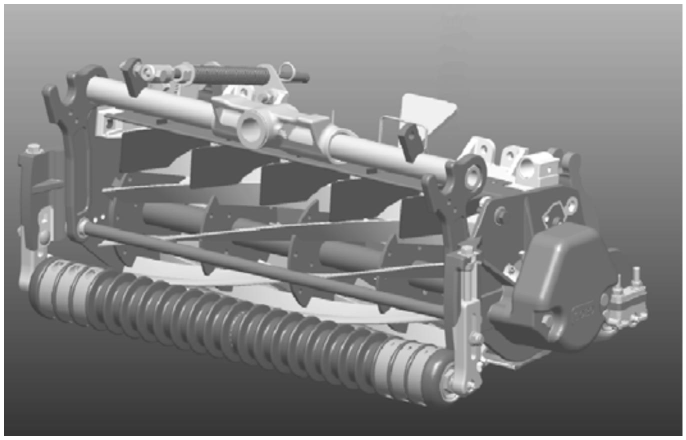


Figure 1

Frame Construction: Precision machined die cast aluminum cross member with two (2) bolt-on cast ductile iron side plates.

Reel Construction: Reels are 22 inches (55.9 cm.) in length and 7 inch (17.8 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in both 8 and 11 blade configurations.

Reel Bearings: Two (2) double row, self-aligning ball bearings support the 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.

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, high carbon steel EdgeMax™ bedknife is fastened to a machined cast iron bedbar with eight (8) screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw adjustment to the reel; detents corresponding to 0.0009 inch (0.023 mm) bedknife movement 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 ball bearings with Toro's patented labyrinth seal design.

Counterbalance Weight: A cast iron weight mounted opposite to the hydraulic drive motor balances the cutting unit.

Cutting Unit Weight:

8 Blade, 7" reel	**145 lb. (66 kg)**
11 Blade, 7" reel	**151 lb. (69 kg)**

Options:
Refer to Cutting Unit Operator's Manual 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. groomer, 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 for servicing Toro Commercial Products 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. Also used for depth adjustment of optional groomer.

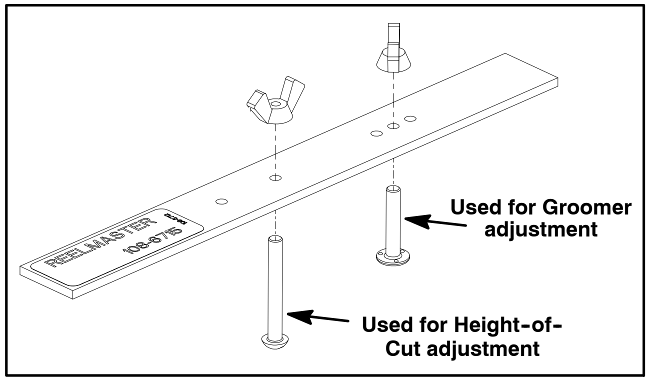


Figure 2

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.

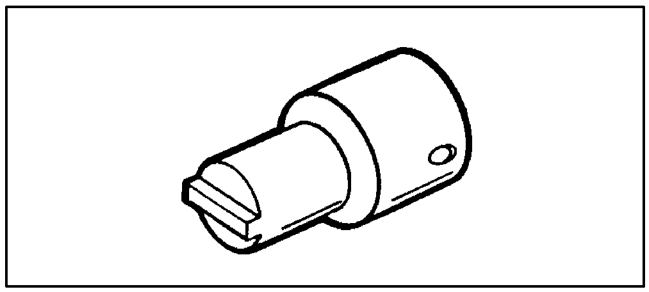


Figure 3

Handle Assembly

Toro Part Number: **29-9100**

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

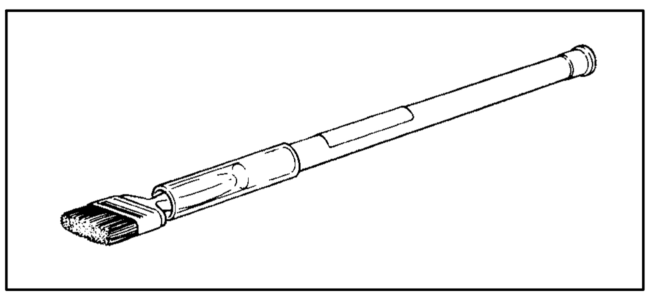


Figure 4

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.

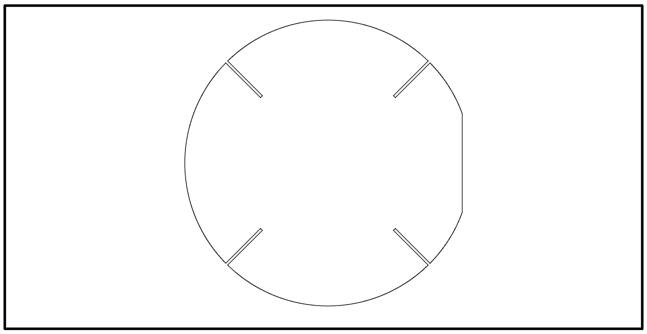


Figure 5

Cutting Unit Kickstand

Toro Part Number: **110-4088-03**

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.

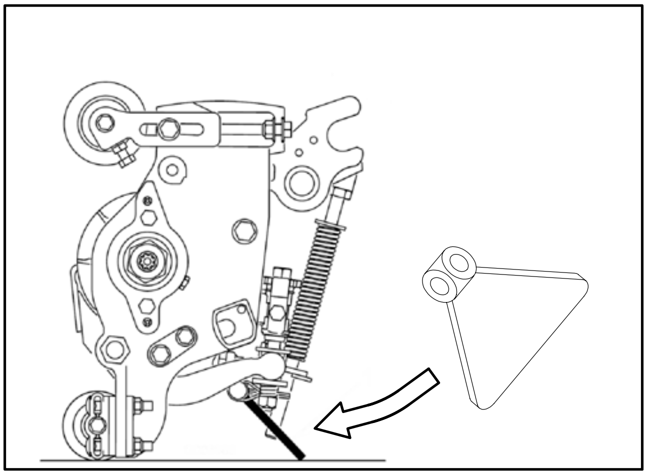


Figure 6

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. This tool is also included in the Cutting Unit Tool Kit (TOR4070).

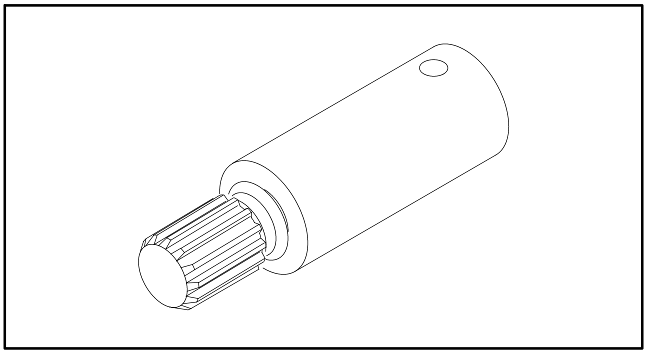


Figure 7

DPA Cutting Units

Cutting Unit Tool Kit

Toro Part Number: **TOR4070**

This tool kit includes special tools required for rebuilding the cutting unit and cutting unit drive motor on the Reelmaster 6500-D/6700-D series of machines.

TOR4064	Spanner Wrench (not used on DPA)
TOR4065	Inner Oil Seal Installer
TOR4066	Bearing Installer
TOR4067	Shaft Support Tool
TOR4068	Inner Seal Installer
TOR4869	Outer Seal Installer
TOR4071	Outer Oil Seal Installer
TOR4072	Reel Motor Shaft Seal Protector
TOR4073	Handle
TOR4074	Spline Insert Tool (9 tooth)

Figure 8

Rear Roller Bearing and Seal Installation Tools

These tools are used to assemble the cutting unit roller that has greasable bearings and a bearing nut used to retain the bearings.

115-0852	Inner Seal Tool
115-0853	Bearing/Outer Seal Tool
107-8133	Bearing Installation Washer

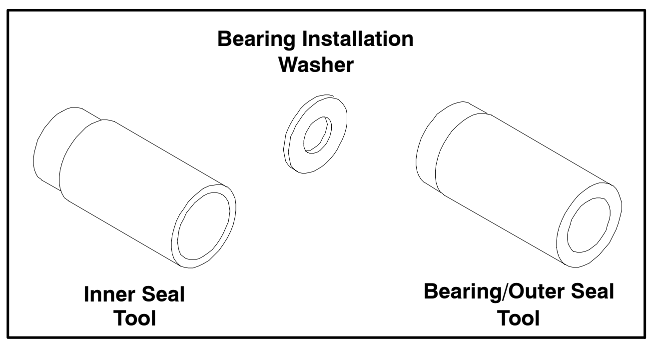


Figure 9

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

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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 Removal and Installation 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.
Turf compensation spring adjustment	Refer to Traction Unit Operator’s Manual for adjustment procedure.
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.

Set Up and 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.

DPA Cutting Units

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. 11)

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 a rear roller brush, refer to Rear Roller Brush (Optional) in the Service and Repairs section of this chapter. If cutting unit is equipped with a groomer, refer to Chapter 8 - Groomer.

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 **25 in-lb (2.8 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 #242 (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 to cutting unit.

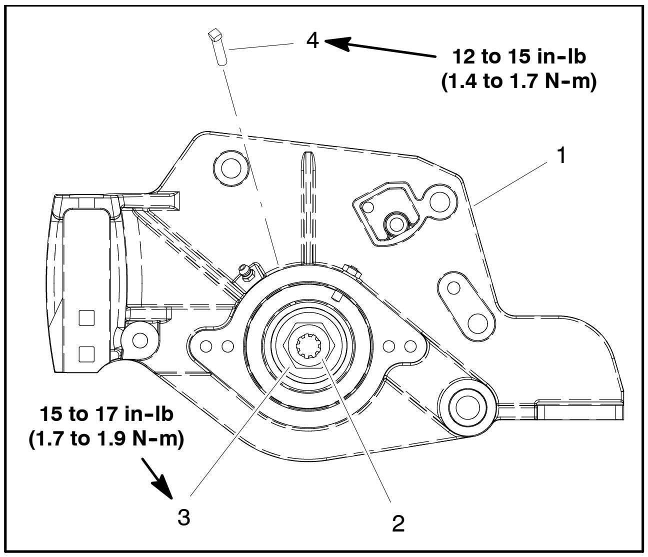

Figure 11

1. LH side plate
2. Threaded insert
3. Bearing adjuster nut
4. Set screw

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. Using the surface plate, check if rear roller is level to cutting reel by using a 0.005” (0.13 mm) shim at each end of rear roller. If the shim will pass under the roller at one end but not the other, a frame adjustment should be made.

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. 12).

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. 13).

8. After leveling rear roller, complete cutting unit set-up and adjustment sequence.

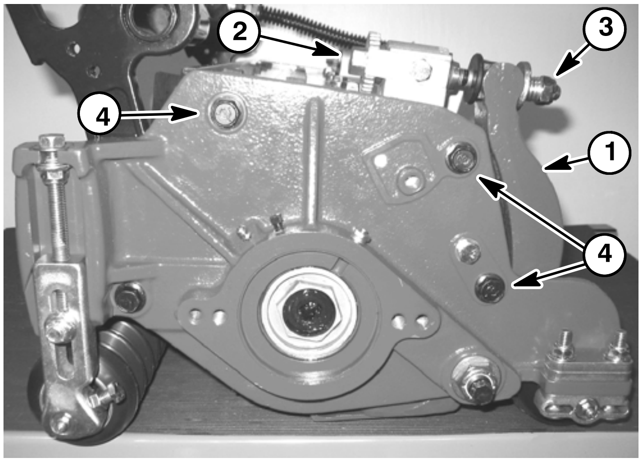

Figure 12

1. **Bedbar**
2. **Bedbar adjuster screw**
3. **Spring tension lock nut**
4. **Shoulder bolt**

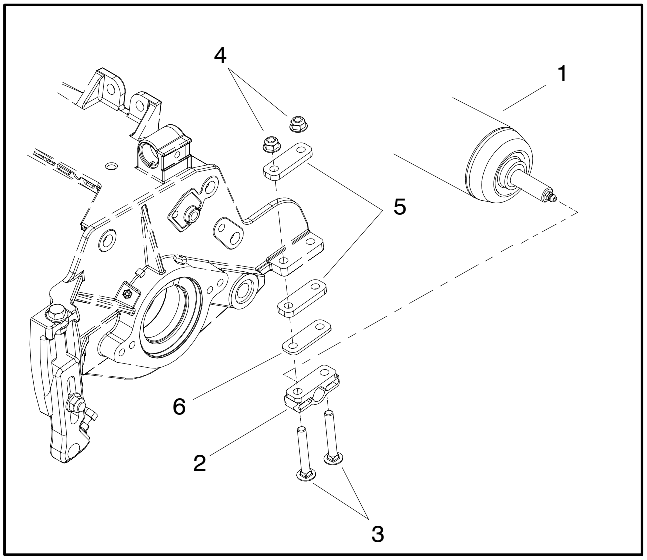

Figure 13

1. **Rear roller assembly**
2. **Rear roller bracket**
3. **Carriage screw**
4. **Flange nut**
5. **Roller shim**
6. **0.010” shim (if needed)**

DPA Cutting Units

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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 Removal and Installation 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.

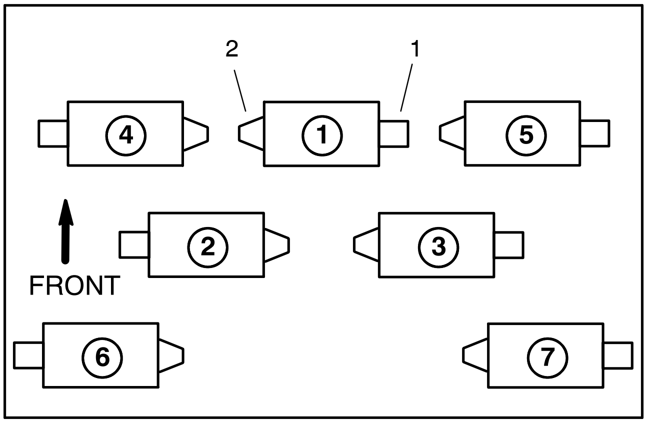

Figure 14

1. **Reel motor location** 2. **Weight location**

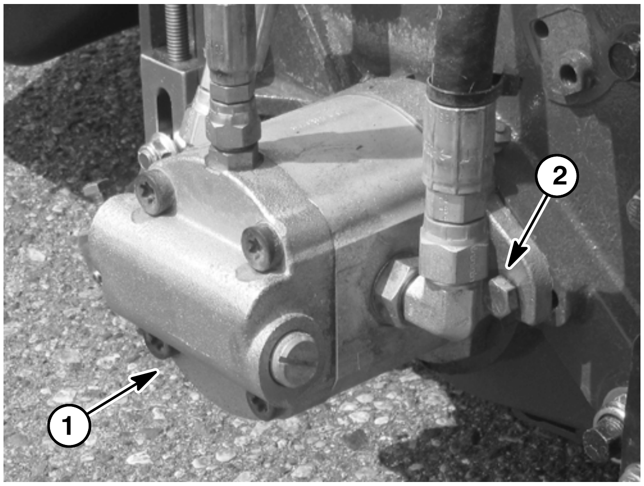

Figure 15

1. **Hydraulic reel motor** 2. **Cap screw**

Installation

Note: Refer to Figure 14 for correct placement of cutting unit reel motors and weights.

1. Coat spline shaft of the reel motor with No. 2 multipurpose 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 counterclockwise until the motor flanges are encircling the cap screws. Tighten two (2) cap screws to secure reel motor to cutting unit.

Backlapping

DANGER

TO AVOID PERSONAL INJURY OR DEATH:

- **Never place hands or feet in the reel area while the engine is running.**
- **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.**

Note: Additional instructions and procedures on backlapping are available in the **Toro Service Training Book, Sharpening Reel and Rotary Mowers (part no. 80300SL)**.

Note: When backlapping, the front units all operate together, and the rear units operate together.

1. Position the machine on a level surface, lower the cutting units, stop the engine, move the Enable/Disable switch to disable position, and engage the parking brake.

2. Unlock and raise the seat to expose controls.

3. Locate the reel speed selector knobs and backlap levers (or knobs) (Fig. 16). Rotate the desired backlap lever(s) to the backlap position and the desired reel speed selector knob(s) to position "1."

Note: Backlapping speed may be increased by moving the reel speed selector knob toward "13." Each position will increase speed approximately 100 rpm. After changing selector, wait 30 seconds for the system to stabilize at the new speed.

4. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units which are to be backlapped.

5. Start engine and run at **idle speed**.

6. Move Enable/Disable switch to Enable position. Move Lower Mow/Lift control forward to start backlapping operation on designated reels.

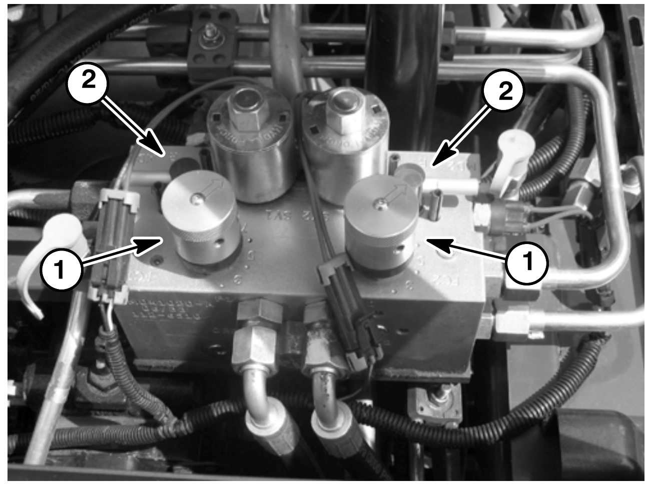

Figure 16

1. Reel Speed Selector Knobs
2. Backlap Levers

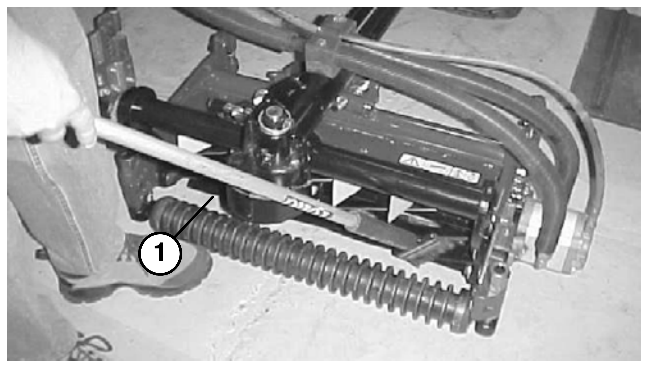

Figure 17

1. Long Handle Brush

7. Apply lapping compound with a long handle brush (see Special Tools) (Fig. 17). Never use a short handled brush.

DANGER

Reels may stall while backlapping. Do not attempt to restart reels by hand or touch reels while backlapping. Stop engine and turn reel speed adjustment knob one position toward "13."

8. If reels stall or become erratic while backlapping, stop backlapping by moving the Lower Mow/Lift control lever rearward. Once the reels have stopped, move the desired reel speed selector knob(s) one position closer to "13." Resume backlapping by moving the Lower Mow/Lift control lever forward.

9. To make an adjustment to the cutting units while backlapping, turn reels OFF by moving the Lower Mow/ Raise lever rearward; move the Enable/Disable switch to Disable and turn the engine OFF. After adjustments have been completed, repeat steps 5-8.

10. When the backlapping operation is completed, run a file across the front face of the bedknife. This will remove any burrs or rough edges that may have built up on the cutting edge.

11. Repeat procedure for all cutting units to be backlapped.

12. When backlap operation has been completed, return the backlap levers (or knobs) to the forward flow position, lower seat and wash all lapping compound off cutting units. Adjust cutting unit reel to bedknife as needed.

Note: If the backlap levers (or knobs) are not returned to the forward flow position after backlapping, the cutting units will not raise or function properly.

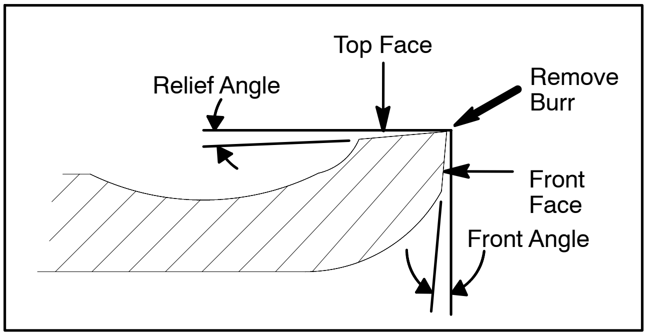

Figure 18

Bedbar Assembly

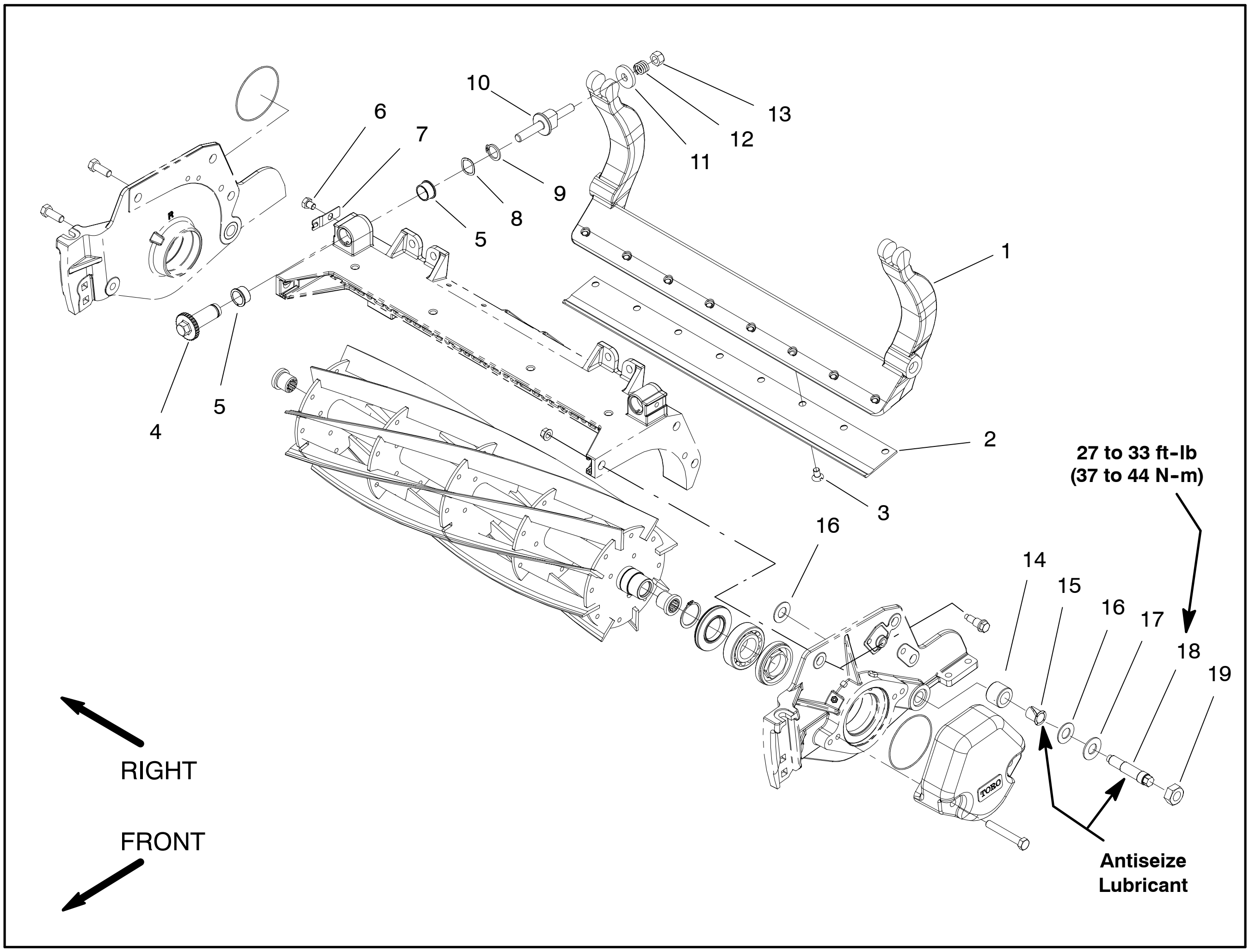

Figure 19

1. Bedbar
2. Bedknife
3. Screw (8 used)
4. Bedbar adjuster shaft (2 used)
5. Flange bushing (4 used)
6. Cap screw (2 used)
7. Detent (2 used)
8. Wave washer (2 used)
9. Retaining ring (2 used)
10. Bedbar adjuster screw (2 used)
11. Washer (2 used)
12. Compression spring (2 used)
13. Lock nut (2 used)
14. Rubber bushing (2 used)
15. Flange bushing (2 used)
16. Plastic washer (4 used)
17. Metal washer (2 used)
18. Bedbar pivot bolt (2 used)
19. Lock nut (2 used)

Bedbar Removal (Fig. 19)

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 13) on the end of each bedbar adjuster assembly until washer (item 11) is loose.

4. Loosen the lock nuts (item 19) on each bedbar pivot bolt (item 18).

5. Remove two (2) bedbar pivot bolts (item 18), two (2) metal washers (item 17) and four (4) plastic washers (item 16) 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 15) and rubber bushings (item 14) in side plates for wear or damage. Remove bushings and replace if necessary.

Bedbar Installation (Fig. 19)

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. 20).

2. If removed, install the flange bushings (item 15) 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 (item 17) and one plastic washer (item 16) 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 11) and adjuster screw flange (item 10).

6. Position a plastic washer (item 16) between bedbar and each cutting unit side plate (Fig. 20).

7. Install the bedbar pivot bolt assemblies. Make sure that plastic washers are not caught on the threads of the pivot bolts. Tighten each bedbar pivot bolt from **27 to 33 ft-lbs (37 to 44 N-m)**.

8. Tighten both lock nuts (item 19) until outside metal washer just stops rotating. Do not over tighten the lock nuts as this can distort the side plates and affect reel bearing adjustment. The plastic washer between the bedbar and side plate should be loose.

9. Tighten the lock nut (item 13) 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.

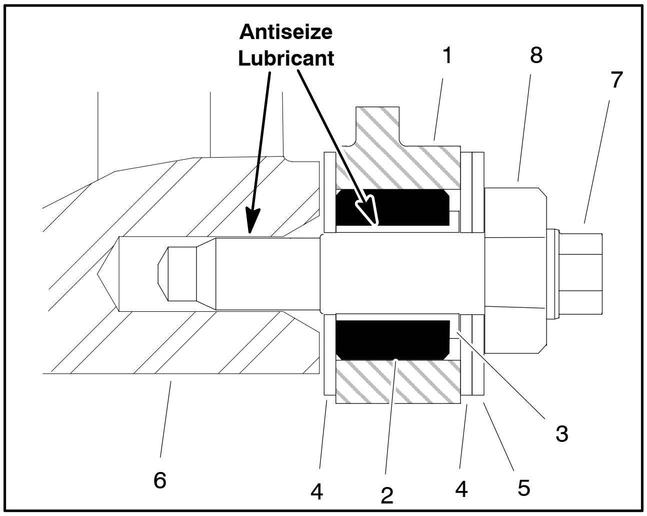

Figure 20

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**

DPA Cutting Units

Bedbar Adjuster Service

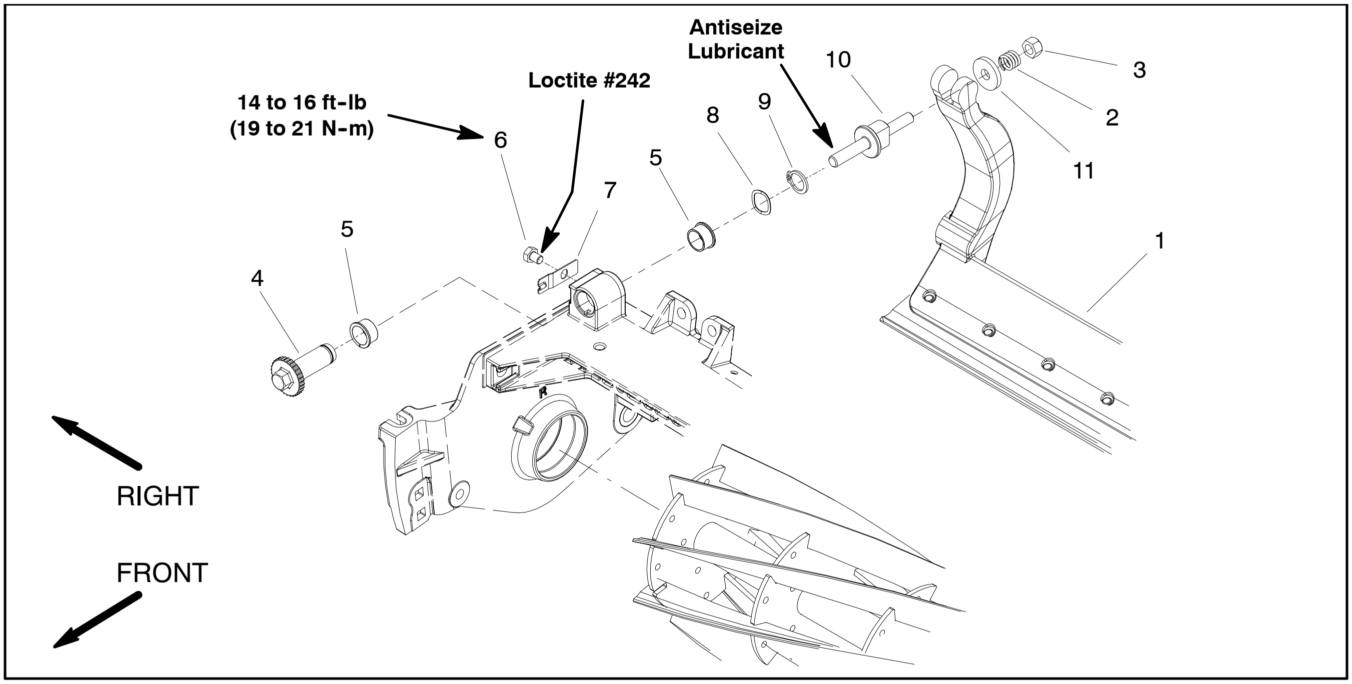

Figure 21

1. Bedbar assembly
2. Compression spring
3. Lock nut
4. Bedbar adjuster shaft
5. Flange bushing
6. Cap screw
7. Detent
8. Wave washer
9. Retaining ring
10. Bedbar adjuster screw
11. Washer

Removal (Fig. 21)

1. Remove lock nut (item 3), compression spring (item 2) and washer (item 11) from bedbar adjuster screw (item 10).

2. Remove bedbar (see Bedbar Removal in this section).

Note: Bedbar adjuster shaft (item 4) has left-hand threads.

3. Unscrew bedbar adjuster shaft (item 4) from the bedbar adjuster screw.

4. Remove retaining ring (item 9) and wave washer (item 8) from adjuster shaft and remove adjuster shaft from cutting unit frame.

5. Inspect flange bushings (item 5) in cutting unit side plate and remove if necessary.

6. If detent (item 7) is damaged, remove it from cutting unit side plate by removing the cap screw (item 6).

Installation (Fig. 21)

1. If detent (item 7) was removed, apply Loctite #242 (or equivalent) to threads of cap screw (item 6) and secure detent to cutting unit side plate with cap screw. Torque cap screw from **14 to 16 ft-lb (19 to 21 N-m)**.

2. Secure detent to the cutting unit side plate with cap screw. Torque cap screw from **14 to 16 ft-lb (19 to 21 N-m)**.

3. If flange bushings (item 5) were removed, align key on bushing to slot in frame and install bushings.

4. Slide adjuster shaft (item 4) into flange bushings in cutting unit side plate. Secure adjuster shaft with wave washer (item 8) and retaining ring (item 9).

Note: Bedbar adjuster shaft (item 4) has left-hand threads.

5. Apply antiseize lubricant to threads of bedbar adjuster screw that fit into adjuster shaft. Thread bedbar adjuster screw (item 10) into adjuster shaft.

6. Install bedbar (see Bedbar Installation in this section).

7. Install washer (item 11), spring (item 2) and lock nut (item 3) onto adjuster screw. Tighten the lock nut on each bedbar adjuster assembly until the compression spring is fully compressed, then loosen lock nut 1/2 turn.

8. Adjust cutting unit (see Cutting Unit Operator's Manual).

Bedknife Replacement and Grinding

Bedknife Removal

1. Remove bedbar from cutting unit (see Bedbar Removal in this section).

2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools). Discard screws. Remove bedknife from the bedbar (Fig. 22).

Bedknife Installation

1. Use scraper to remove all rust, scale and corrosion from bedbar surface and lightly oil surface before installing bedknife.

2. Make sure that screw threads in bedbar (5/16-18UNC-2A) are clean. Apply antiseize lubricant to the threads of new screws. Take care to keep antiseize lubricant from taper on screw heads.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

3. Use new screws to secure bedknife to bedbar. Install all screws but do not tighten fully. Then, using a torque wrench and bedknife screw tool, torque screws from **200 to 250 in-lb (23 to 28 N-m)**. Use a torquing pattern working from the center toward each end of the bedknife (Fig. 23).

4. After installing bedknife to bedbar, grind bedknife.

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, a new bedknife will not be perfectly flat after it is installed to the bedbar. Because of this, it is necessary to grind a new bedknife after installing it to the bedbar. Follow the existing angle that was ground into the bedknife and grind only enough to make sure the top surface of the bedknife is true (Fig. 24).

Note: 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.**

1. Use **Toro Service Training Book, Sharpening Reel and Rotary Mowers (part no. 80300SL)** and grinder manufacturer's instructions for bedknife grinding information.

Bedknife Grinding Specifications (see Fig. 24)	
Bedknife Relief Angle	3° to 7°
Bedknife Front Angle	3° to 7°
Minimum Bedknife Lip Height	0.190" (4.8 mm)

2. After grinding bedknife, check lead-in chamfer on bedknife (see Cutting Unit Operator's Manual).

3. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Installation in this section).

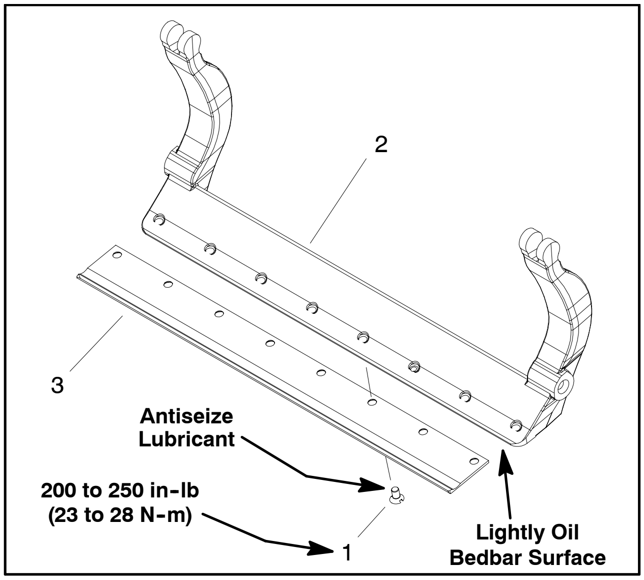

Figure 22

1. **Screw (8 used)**
2. **Bedbar**
3. **Bedknife**

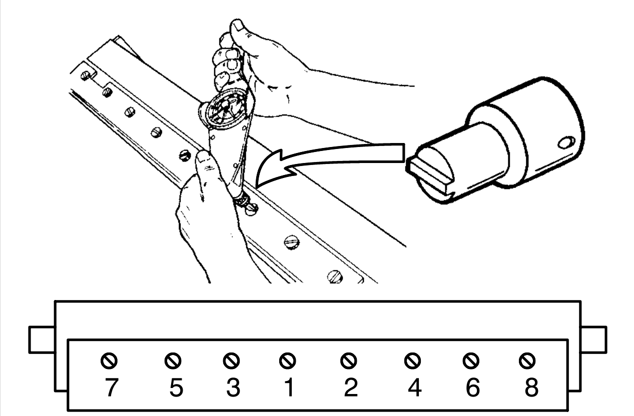

Figure 23

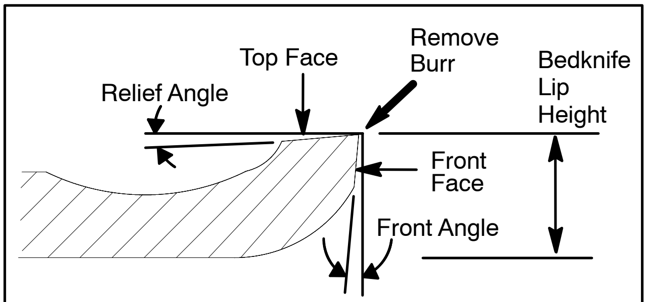

Figure 24

Reel Assembly Removal and Installation

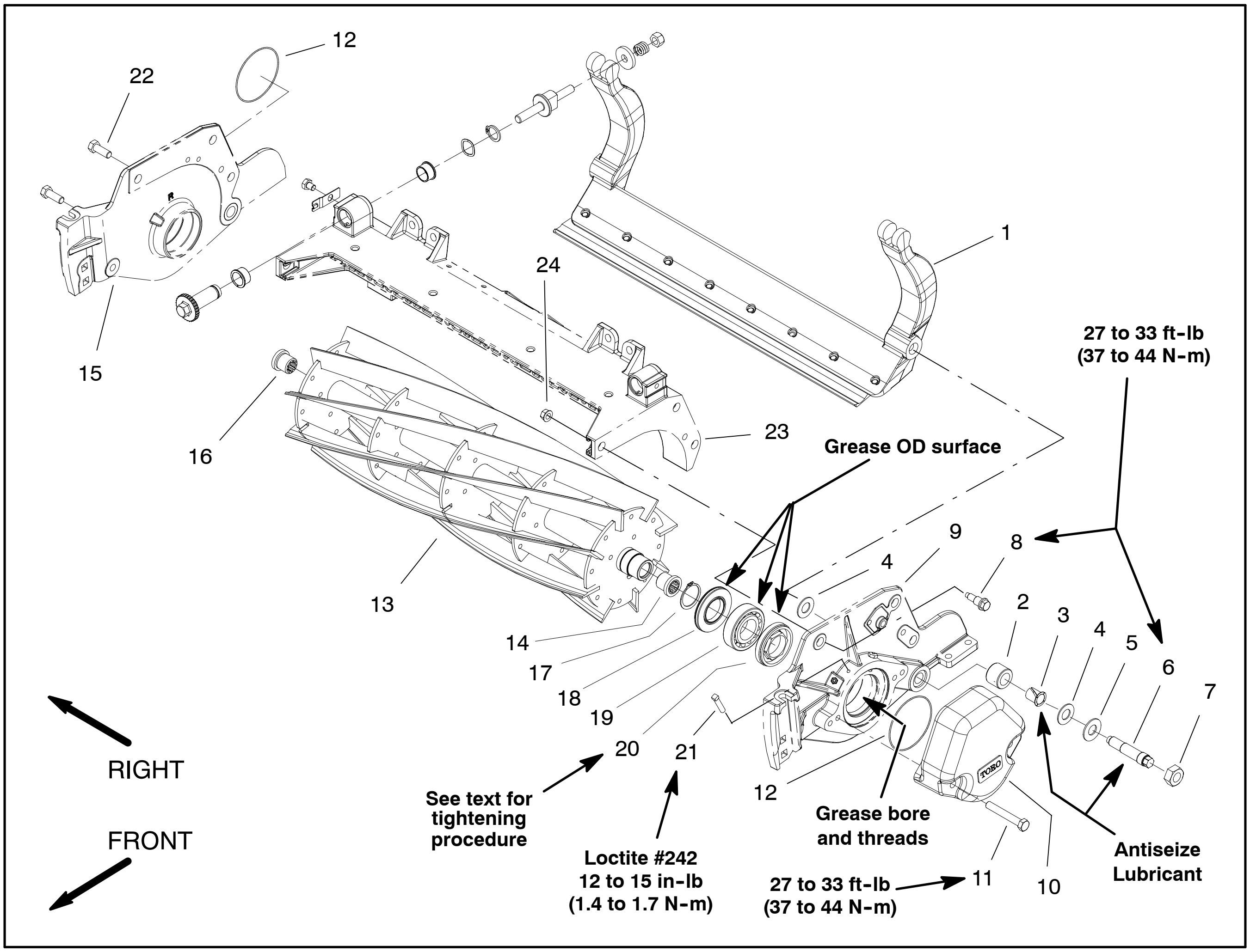

Figure 25

1. **Bedbar assembly**
2. **Rubber bushing (2 used)**
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. **Shoulder bolt (3 used per side plate)**
9. **LH side plate**
10. **Weight**
11. **Cap screw (2 used)**
12. **O-ring**
13. **Cutting reel**
14. **Spline insert (LH thread)**
15. **RH side plate**
16. **Spline insert (RH thread)**
17. **Retaining ring (2 used)**
18. **Grease seal (2 used)**
19. **Bearing (2 used)**
20. **Bearing adjuster nut**
21. **Set screw**
22. **Cap screw (2 used)**
23. **Cutting unit frame**
24. **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. 25)

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 on LH side plate (as shown in Figure 25), remove the two (2) cap screws securing the counter weight to the side plate. Remove counter weight from the cutting unit. Remove and discard 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 8 - 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. 26).

8. Remove flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 26).

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 8) and flange nuts (item 24) that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft, rollers, bedbar 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 slide 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).

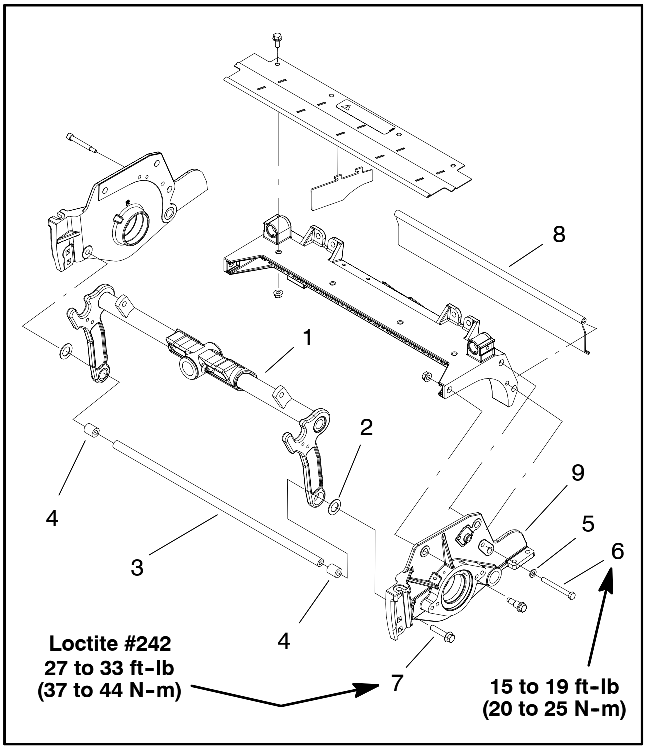

Figure 26

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. 25)

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.

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.

3. 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. On LH side plate, loosen set screw (item 21) and back-off (loosen) bearing adjuster nut (item 20) 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 8) and flange nuts (item 24) 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 #242 (or equivalent) to threads of flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 26). 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. 26). 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 (item 21) is loose in LH side plate to allow bearing adjuster nut movement. With the cutting unit and reel in a horizontal position, torque the bearing adjuster nut (item 20) **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).

13. Apply Loctite #242 (or equivalent) to threads of set screw (item 21) 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)**.

14. 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 Set-Up and Adjustments section of this Chapter).

15. 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 8 - Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

16. If counterweight was removed from cutting unit, install new o-ring (item 12) on counter weight. Secure counter weight to cutting unit side plate with two (2) cap screws. Torque screws from **27 to 33 ft-lbs (37 to 44 N-m)**.

17. 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.

18. Install cutting unit to the machine.

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Reel Assembly Service

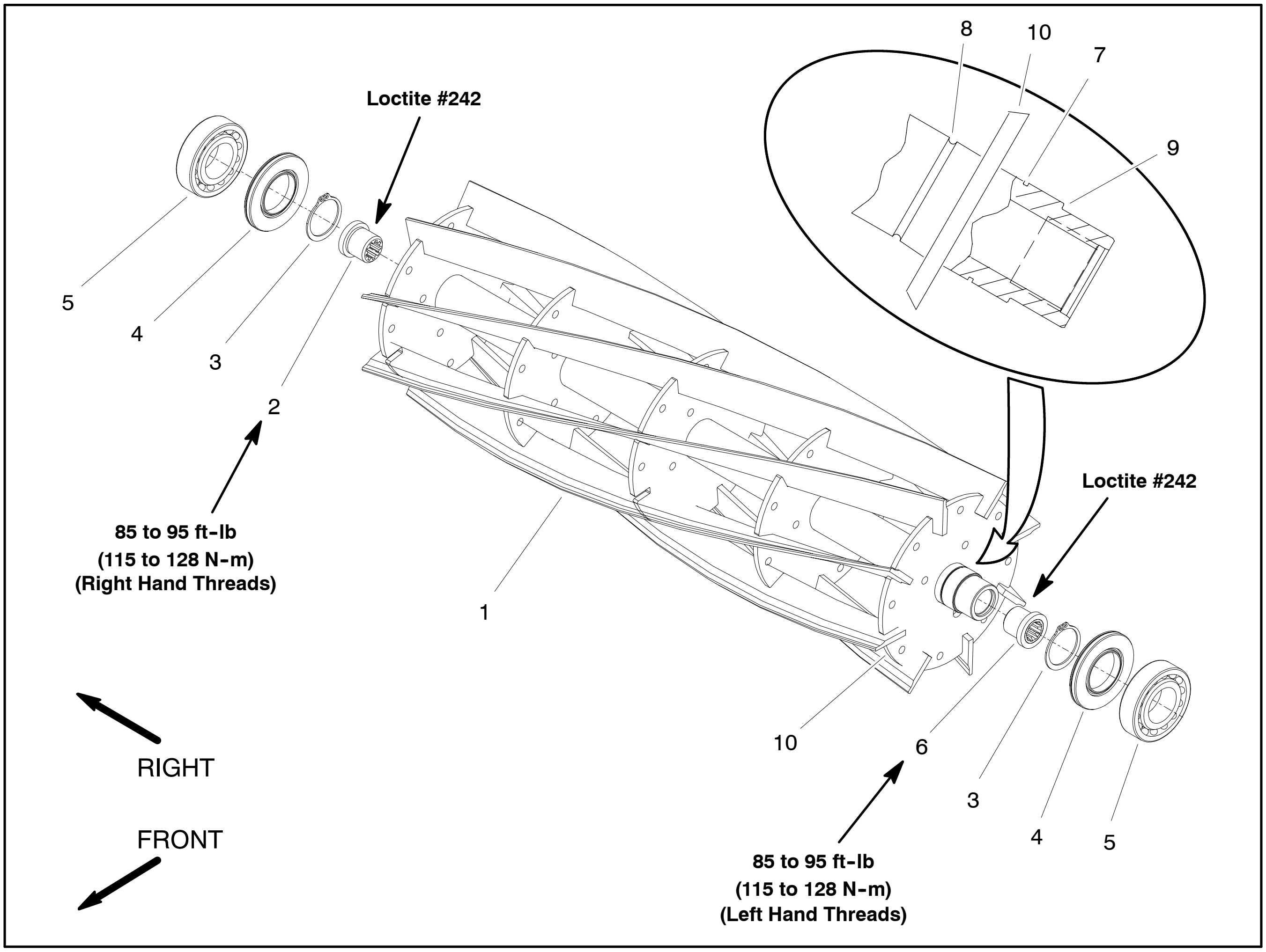

Figure 27

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. 27)

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 #242 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 approximately 2" from the end identifies the reel end that has LH threads (see illustration in Fig. 27).

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 #242 (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. 27)

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. Pack bore of reel shaft with Mobil High Temperature HP (or equivalent) grease.

Preparing Reel for Grinding

Note: 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.

Note: When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

1. Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications (see Reel Grinding Specifications chart to the right). Additional reel grinding information can be found in Toro Service Training Book, Sharpening Reel and Rotary Mowers (part no. 80300SL).

2. After completing the reel grinding process, adjust cutting unit (see Cutting Unit Operator's Manual).

Reel Grinding Specifications	
Reel Diameter (New)	7.06 in (179.3 mm) for 7" reel
Service Limit - Reel Diameter	6.26 in (159.0 mm) for 7" reel
Blade Relief Angle	25º
Blade Relief Angle Range	20º to 30º
Blade Land Width	0.060 in (1.5 mm)
Blade Land Width Range	0.050 to 0.070 in (1.3 to 1.8 mm)
Service Limit - Reel Diameter Taper	0.010 in (.25 mm)

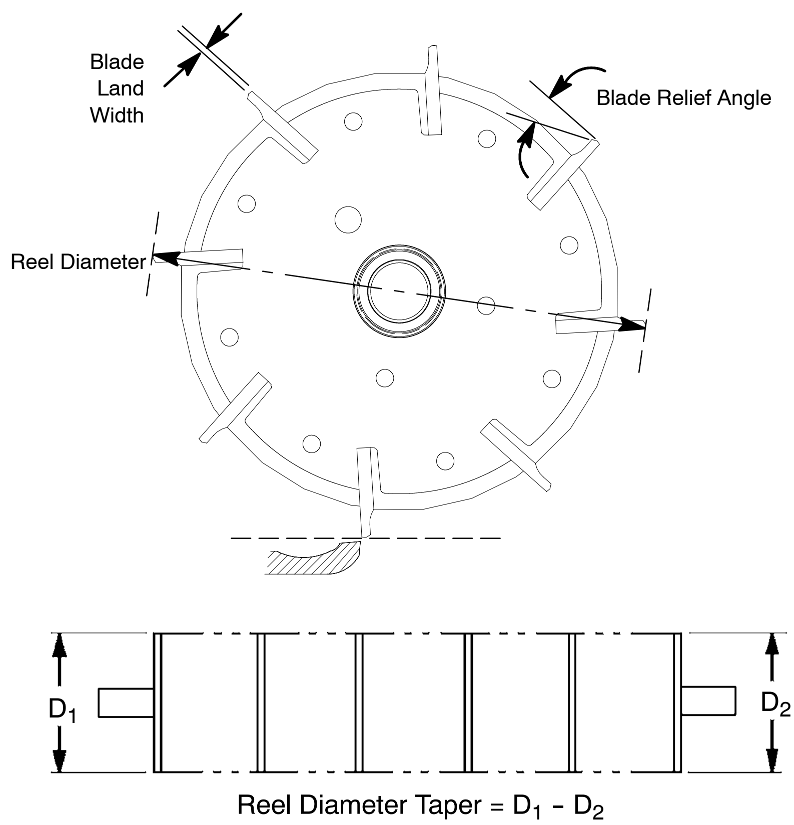

Figure 28

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Front Roller

Removal (Fig. 29)

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.

Installation (Fig. 29)

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 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.

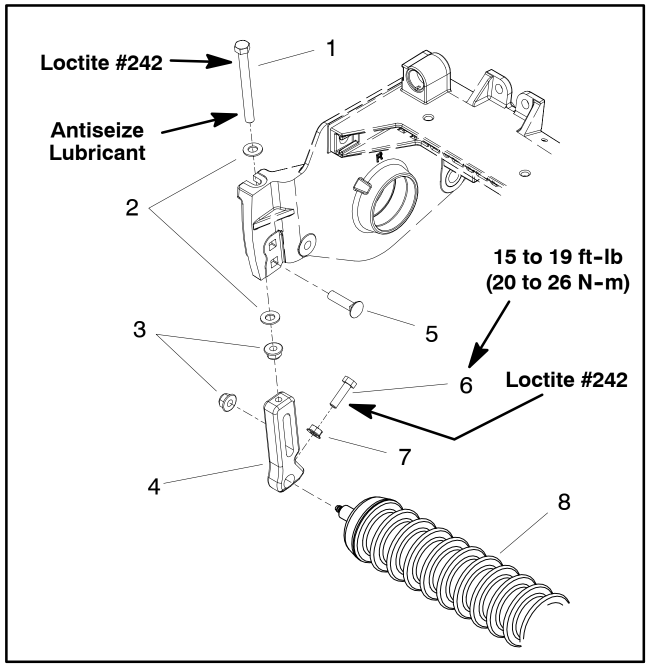

Figure 29

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**

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 #242 (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 #242 (or equivalent) to threads of two (2) cap screws (item 6). Center front roller to the cutting reel and secure 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. 30)

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. 30)

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 Set-up and 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.

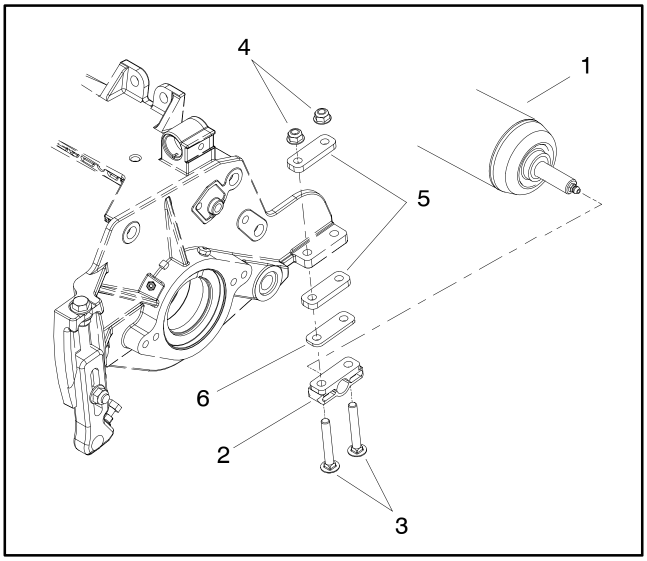

Figure 30

1. **Rear roller assembly**
2. **Rear roller bracket**
3. **Carriage screw**
4. **Flange nut**
5. **Roller shim**
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)

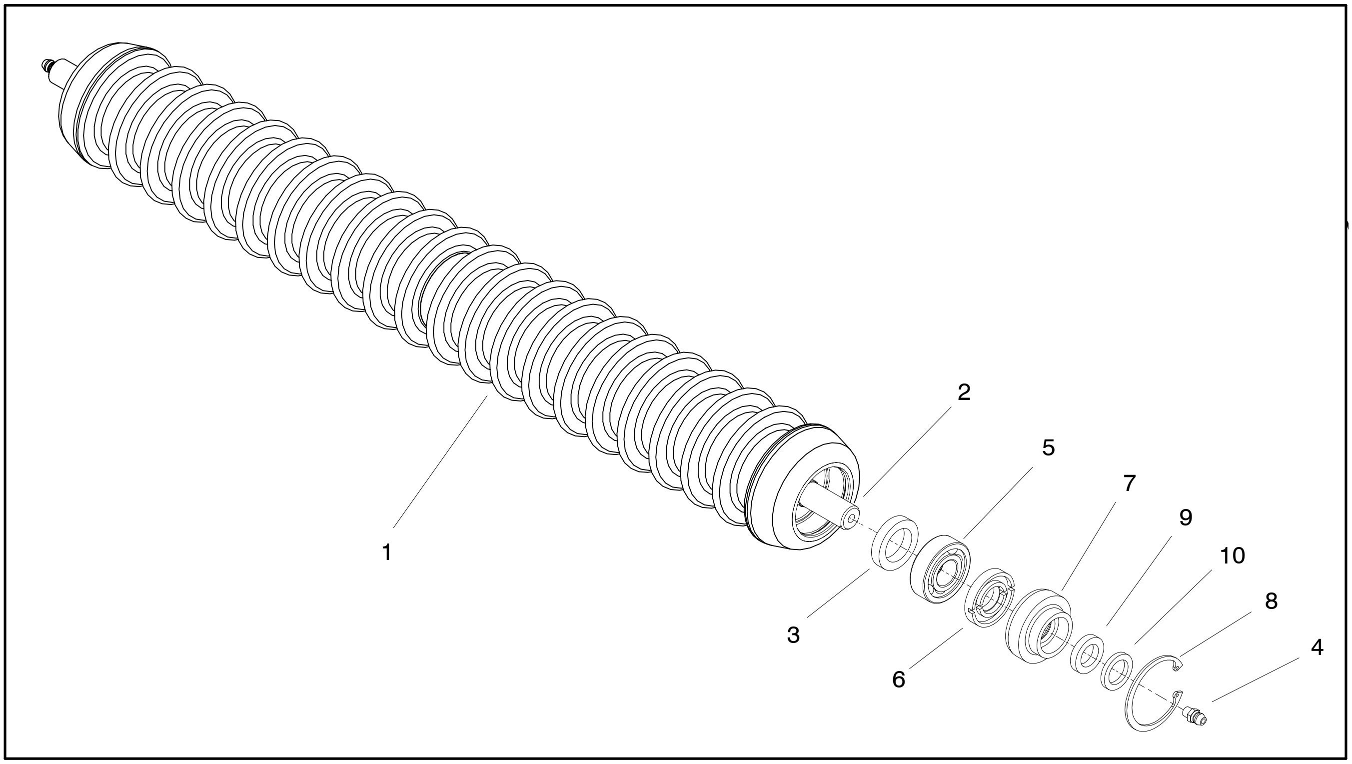

Figure 31

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. 31). The second design uses a bearing lock nut to retain bearings and seals (Fig. 33).

Removal (Figs. 31 and 32)

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.

Installation (Figs. 31 and 32)

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.

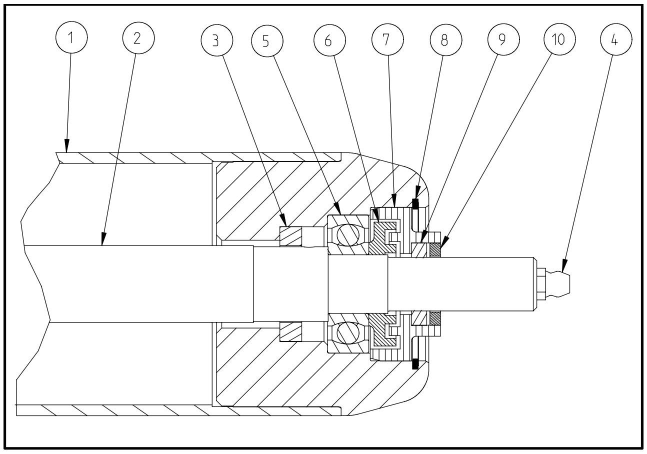

Figure 32

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

DPA Cutting Units

Roller Service (Greasable Bearings with Bearing Nut)

Disassembly (Fig. 33)

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. 33)

1. Install 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. 34). 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. 35). 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. 36). 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.

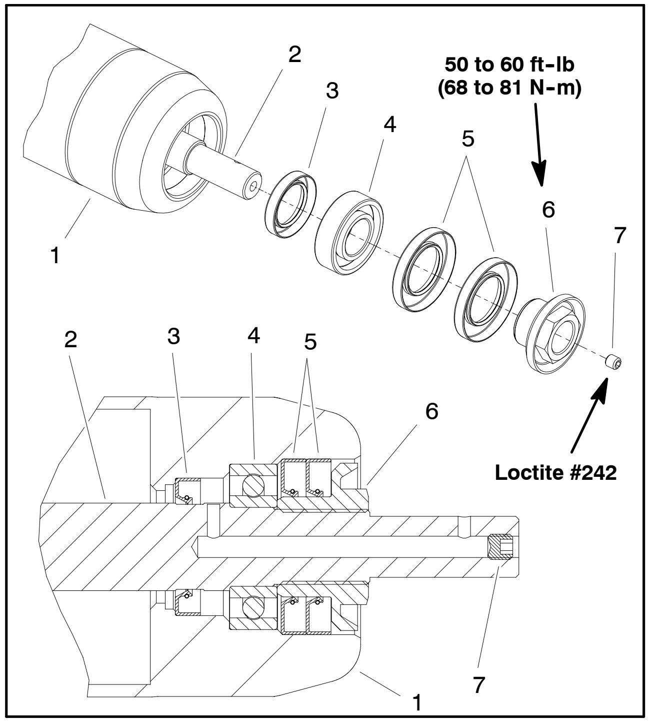

Figure 33

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing lock nut**
7. **Set screw**

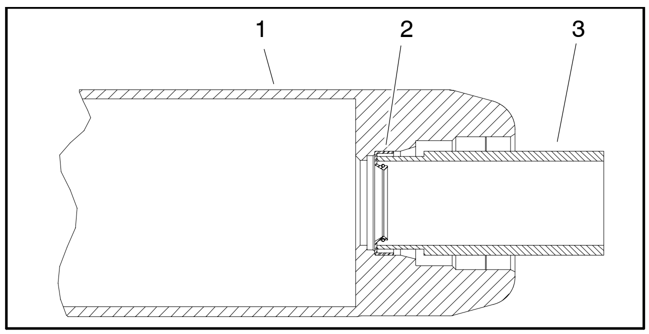

Figure 34

1. **Roller tube**
2. **Inner seal**
3. **Inner seal tool**

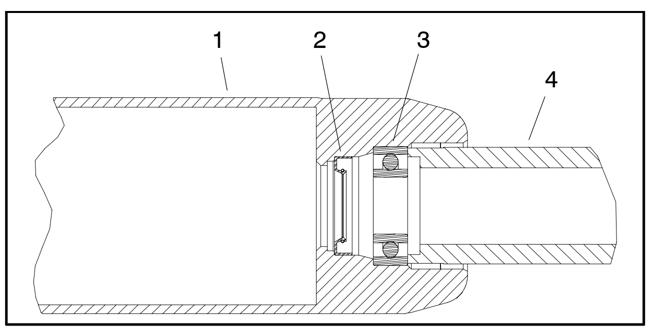

Figure 35

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Washer**
5. **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. 37). 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. 38). 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 #242 (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 lock nuts from **50 to 60 ft-lb (68 to 81 N-m)**.

7. If set screw was removed from either end of roller shaft, apply Loctite #242 (or equivalent) to threads of removed set screw and install into roller shaft. Tighten set screw until it bottoms in shaft and is recessed in shaft.

IMPORTANT: When roller assembly is installed to cutting deck, make sure that grease groove in each roller mount aligns with the grease hole in each end of roller shaft.

NOTE: After roller is installed to cutting deck, 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-lbs (0.68 N-m) resistance.

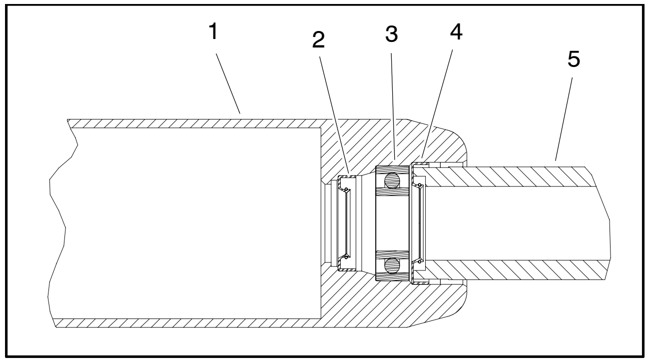

Figure 36

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Outer seal**
5. **Bearing/outer seal tool**

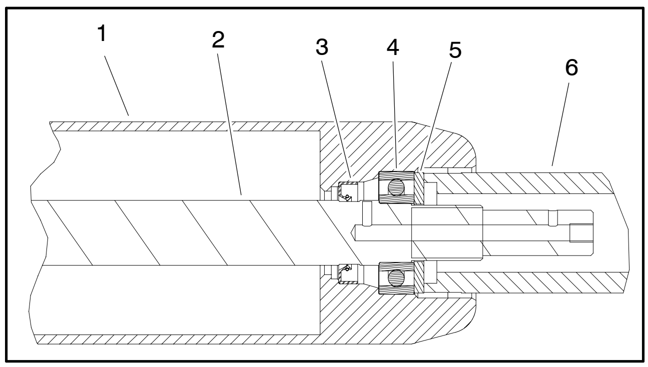

Figure 37

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Washer**
6. **Bearing/outer seal tool**

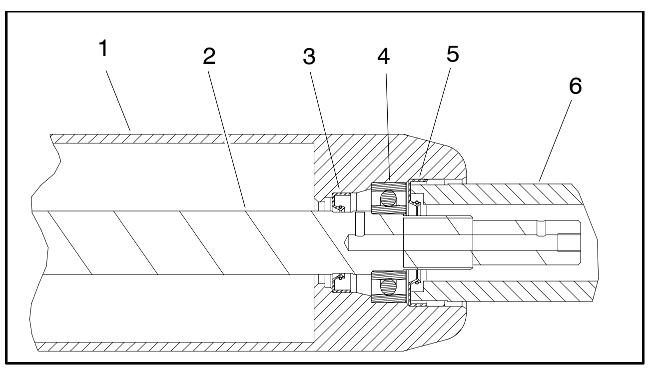

Figure 38

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing/outer seal tool**

DPA Cutting Units

Rear Roller Brush (Optional)

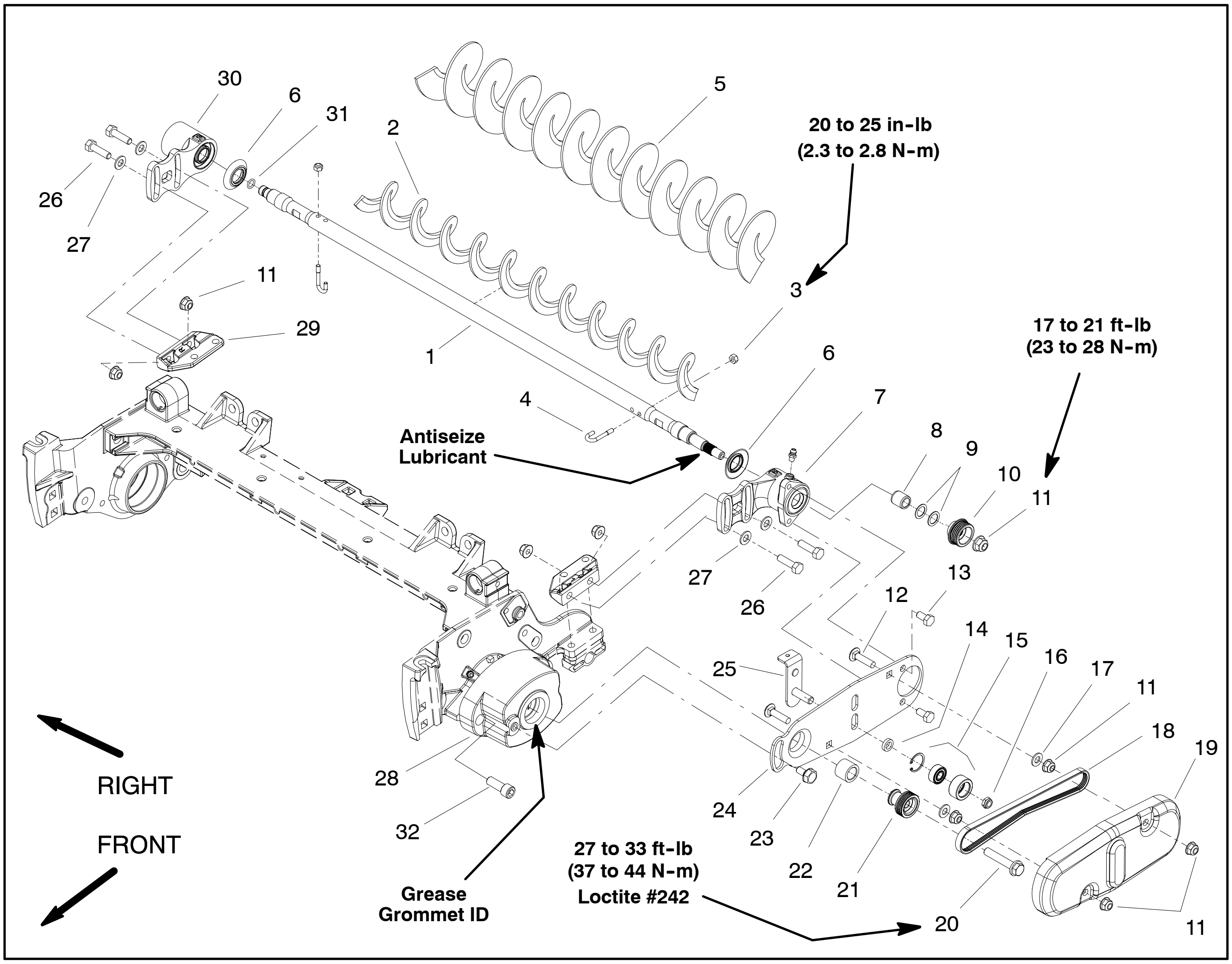

Figure 39

1. **Roller brush shaft**
2. **Roller brush**
3. **Lock nut (2 used)**
4. **J-bolt (2 used)**
5. **High HOC roller brush (optional)**
6. **Excluder seal (2 used)**
7. **Brush bearing housing (drive)**
8. **Spacer**
9. **Flat 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 (2 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. **Brush bearing housing (non-drive)**
31. **O-ring**
32. **Socket head screw (2 used)**

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 39 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.

Note: Early production roller brush shafts and driven pulleys were equipped with a square key. Later production components are shown in Figure 39.

Disassembly (Fig. 39)

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 30) 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 39 as a guide.

Assembly (Fig. 39)

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. 40). 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 41.

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.

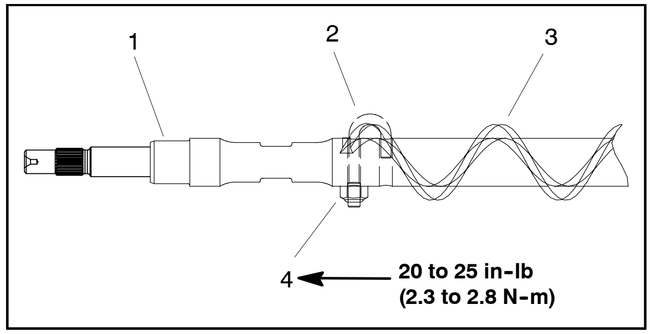

Figure 40

1. **Roller brush shaft**
2. **J-bolt**
3. **Roller brush**
4. **Lock nut**

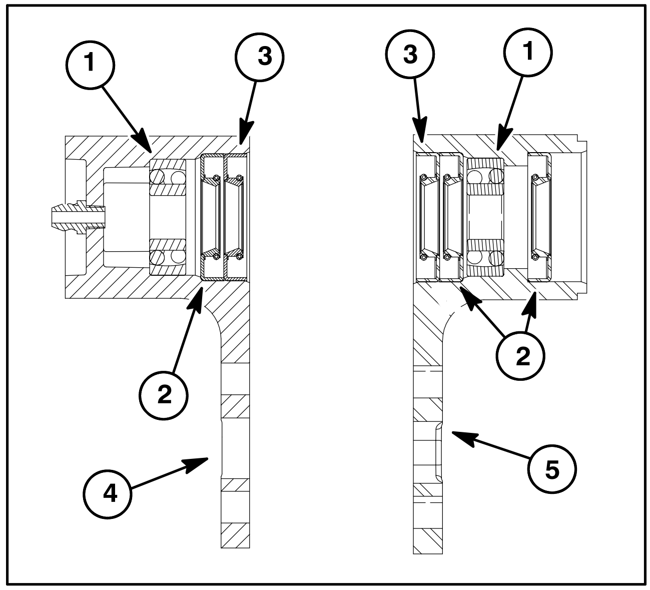

Figure 41

1. **Bearing**
2. **Inner grease seal**
3. **Outer grease seal**
4. **Housing (non-driven)**
5. **Housing (driven)**

DPA Cutting Units

3. If drive bearing housing was disassembled, install new components noting proper orientation as shown in Figures 42 and 43.

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 (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 pivot hub bore taking care to not damage the grease seal. Install retaining ring (item 5) to secure bearing in pivot hub.

4. Assemble roller brush components using Figure 39 as a guide.

A. Apply a light coating of grease to inner diameter of the grommet in drive bearing housing.

B. Apply Loctite #242 (or equivalent) to threads of flange head screw (item 20) that secures drive pulley to drive shaft.

C. Torque flange head screw (item 20) that secures drive pulley to drive shaft from **27 to 33 ft-lb (37 to 44 N-m)**.

D. Apply antiseize lubricant to splines of roller brush shaft before sliding driven pulley onto shaft.

E. Torque flange nut (item 11) that secures driven pulley to roller brush shaft from **17 to 21 ft-lb (23 to 28 N-m)**.

F. Check alignment of pulleys with a straight edge placed along the outer face of the driven pulley (Fig. 44). 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 washer(s) (item 9) until drive and driven pulleys are aligned within 0.030" (0.76 mm).

G. Position excluder seals on brush shaft so that seals just touch bearing housings.

H. To tension drive belt, make sure idler pulley lock nut is loose. Lift up on idler plate tab with 15 lbs of force for a new belt (10 lbs of force for a used belt) and tighten pulley lock nut. Refer to decal on brush plate (Fig. 45).

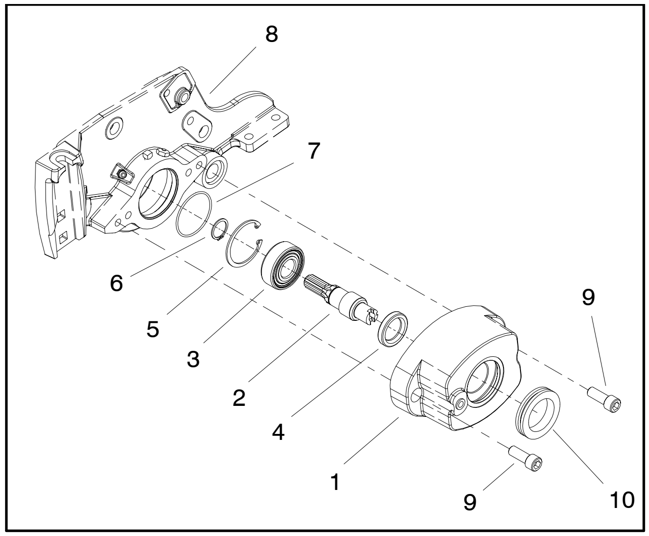

Figure 42

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**

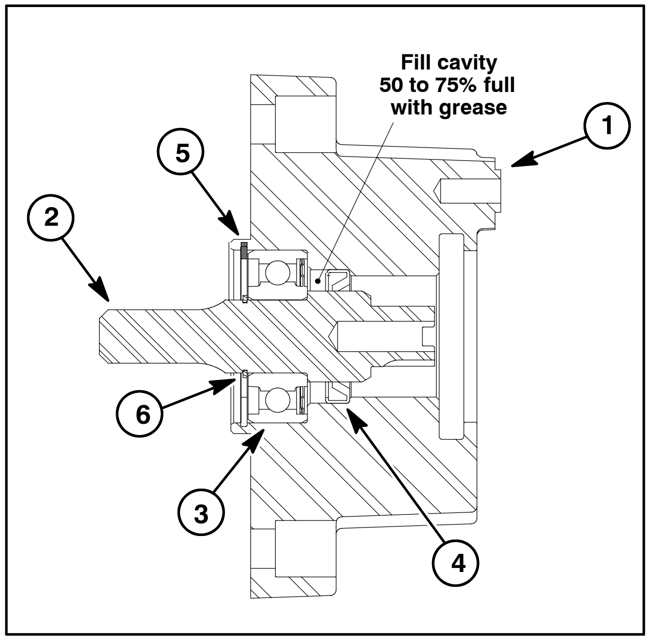

Figure 43

1. **Bearing housing**
2. **Drive shaft**
3. **Ball bearing**
4. **Grease seal**
5. **Retaining ring**
6. **Snap ring**

5. Check that roller brush has light contact with rear roller (Fig. 46). If contact is incorrect, brush operation will be adversely affected. Also make sure that brush shaft is parallel with rear roller.

6. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

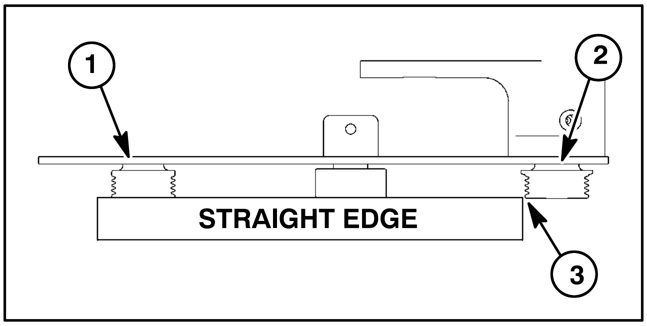

Figure 44

1. **Driven pulley**
2. **Drive pulley**
3. **Check for alignment**

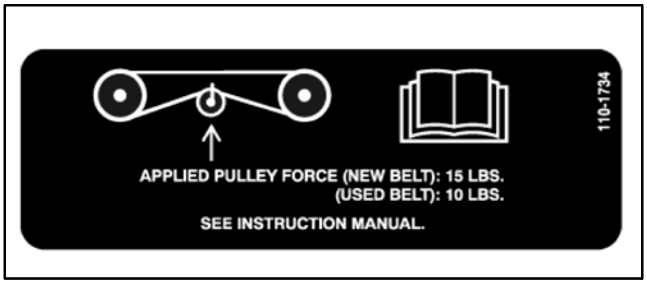

Figure 45

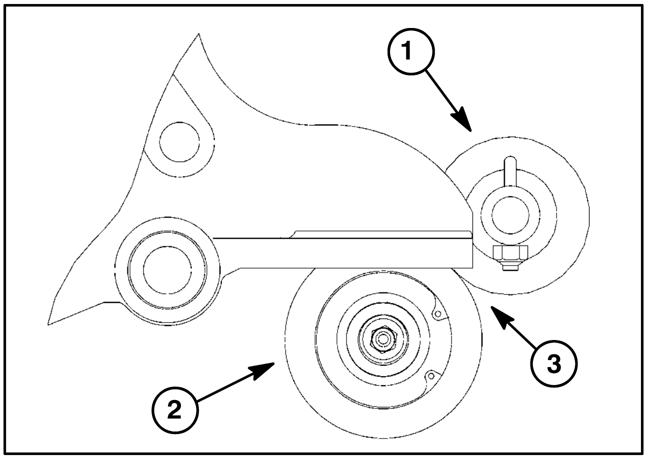

Figure 46

1. **Rear roller brush**
2. **Rear roller**
3. **Light contact**

DPA Cutting Units

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Chapter 7.3

DPA Groomer

Table of Contents

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 those 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.

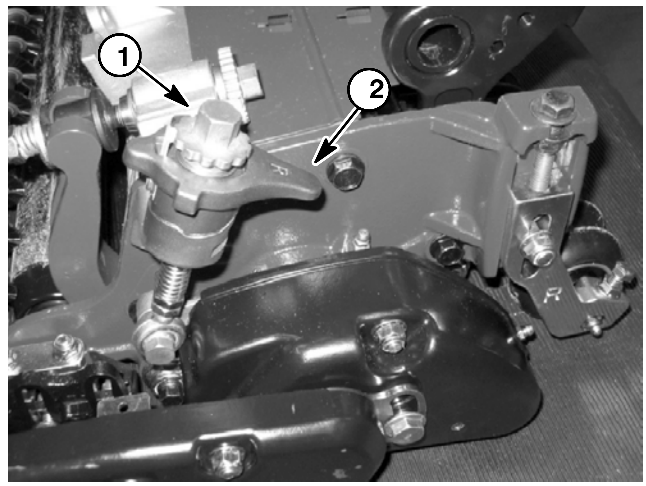

Figure 1

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 7.2 - DPA 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.

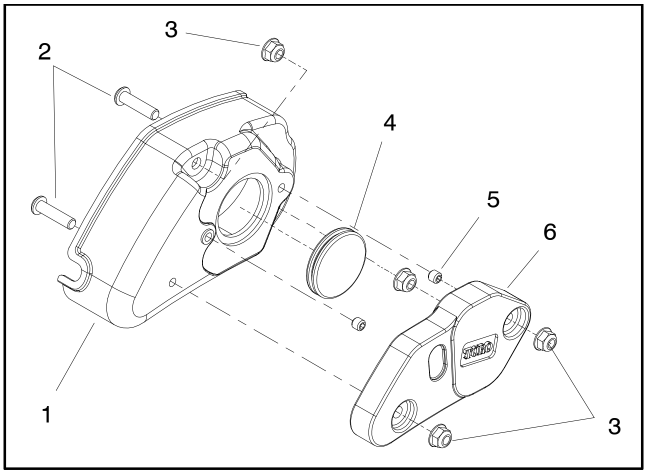

Figure 2

1. Groomer cover
2. Socket head screw
3. Flange nut
4. Rubber grommet
5. Set screw
6. Groomer weight

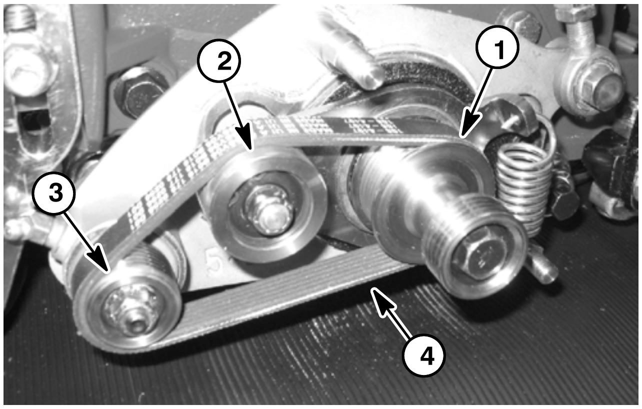

Figure 3

1. Drive pulley
2. Idler pulley
3. Driven pulley
4. Groomer drive belt

DPA Groomer

Groomer Plate Assembly

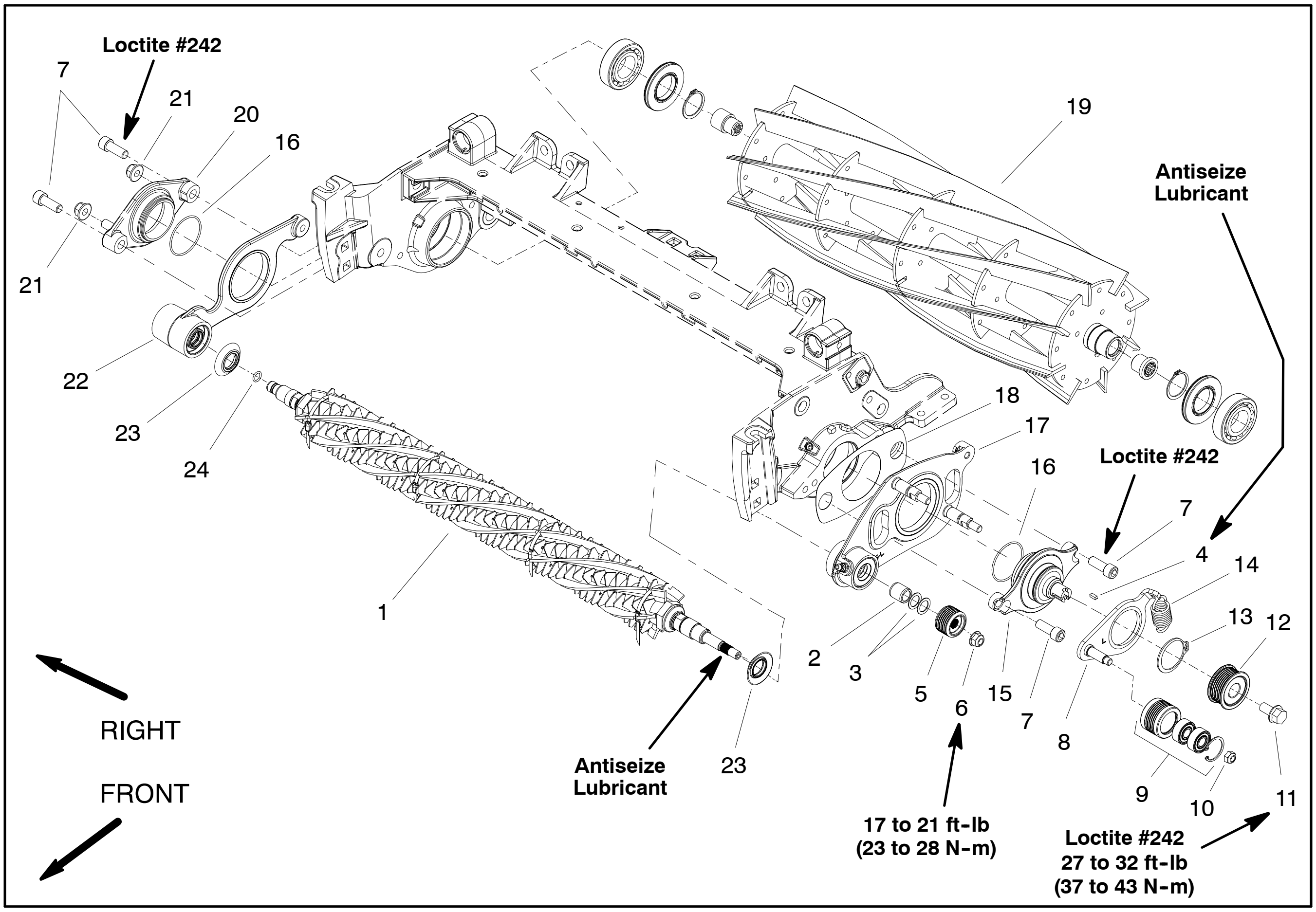

Figure 4

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.

Note: Early production groomer shafts and driven pulleys were equipped with a square key. Later production components are shown in Figure 4.

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 7.2 - DPA 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. Slide driven pulley from 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 7.2 - DPA 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)**.

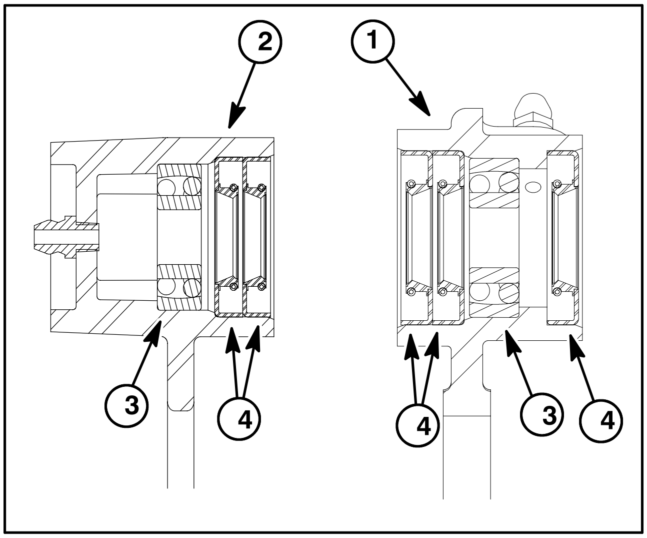

Figure 5

1. **Drive side groomer plate**
2. **Non-drive groomer plate**
3. **Bearing**
4. **Grease seal**

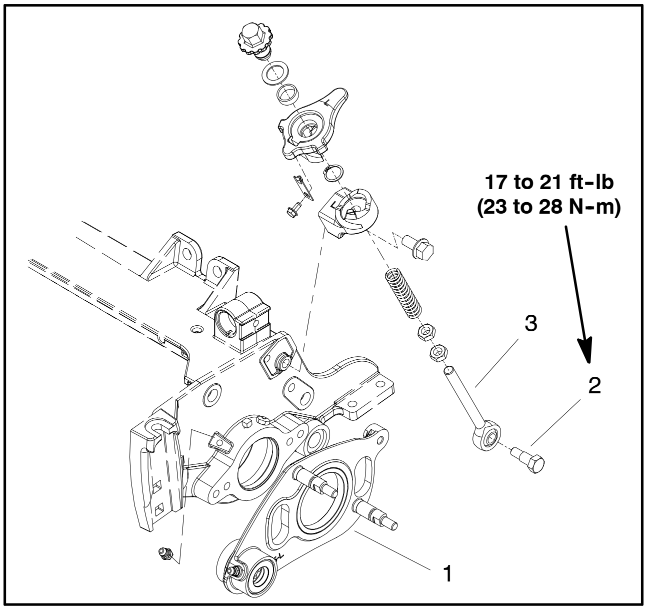

Figure 6

1. **Groomer plate**
2. **Shoulder bolt**
3. **Quick-up ball joint rod**

DPA Groomer

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 7.2 - DPA 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 key (item 4) that locates drive pulley to pivot hub shaft. Position key into shaft slot.

NOTE: To prevent cutting reel from turning when installing drive pulley, block cutting reel with piece of wood.

G. Apply Loctite #242 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. Apply antiseize lubricant to splines of groomer shaft and slide driven pulley onto groomer shaft. 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 from groomer shaft and installing or removing washer(s) (item 3) between driven 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.

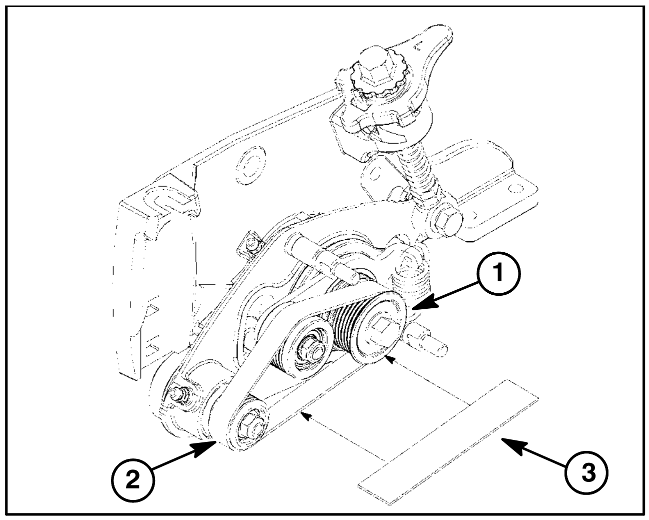

Figure 7

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

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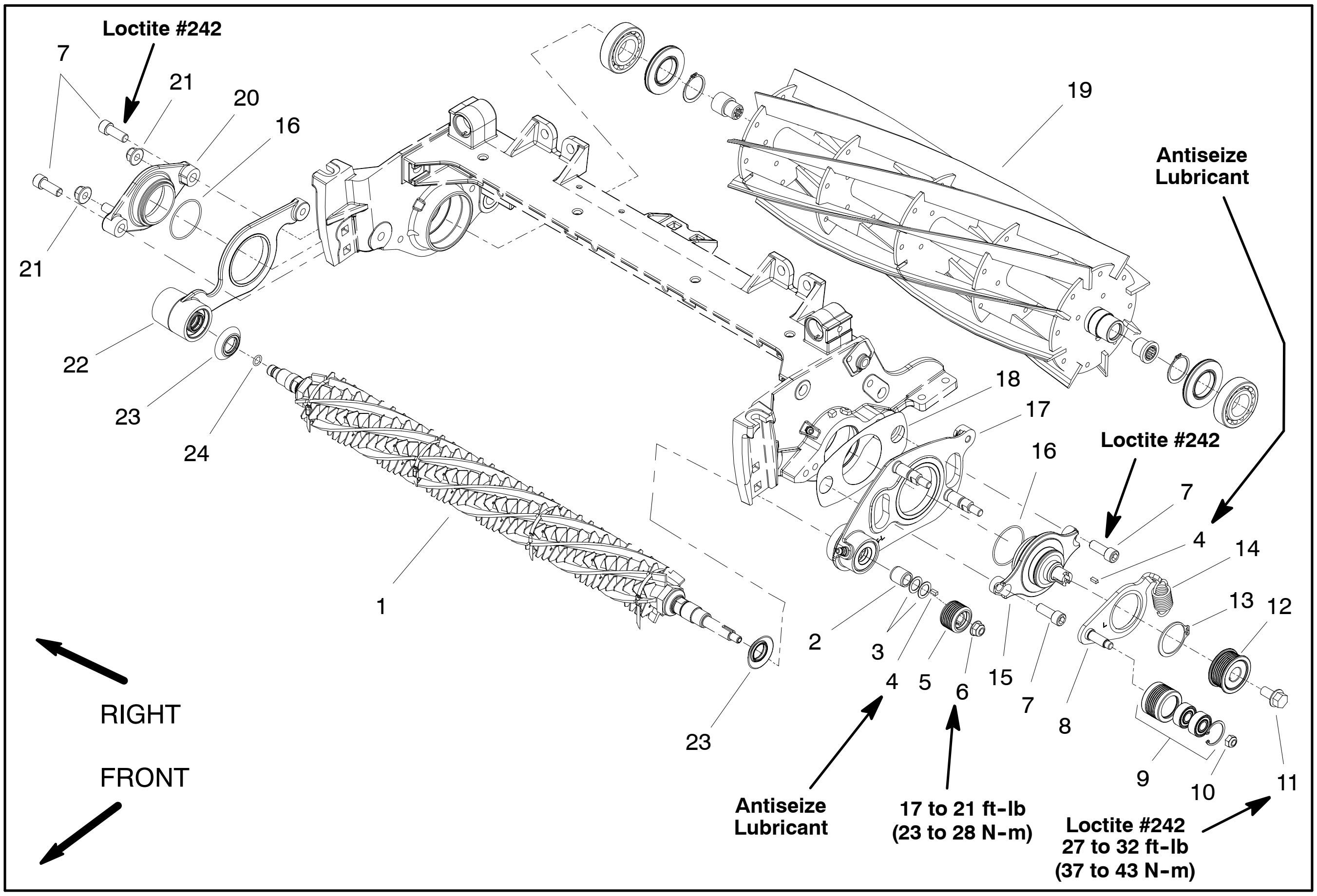

Figure 8

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 7.2 - DPA 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.

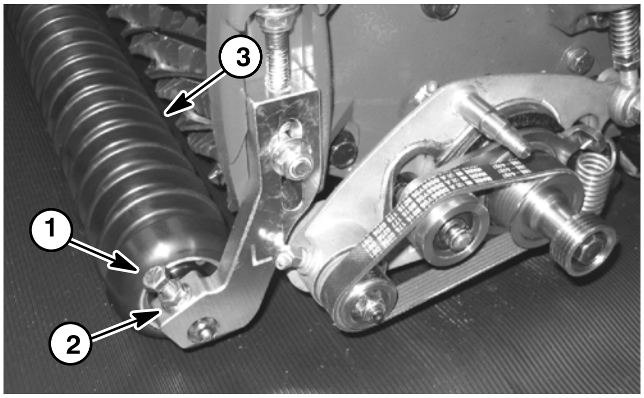

Figure 9

1. **Cap screw**
2. **Flange nut**
3. **Front roller**

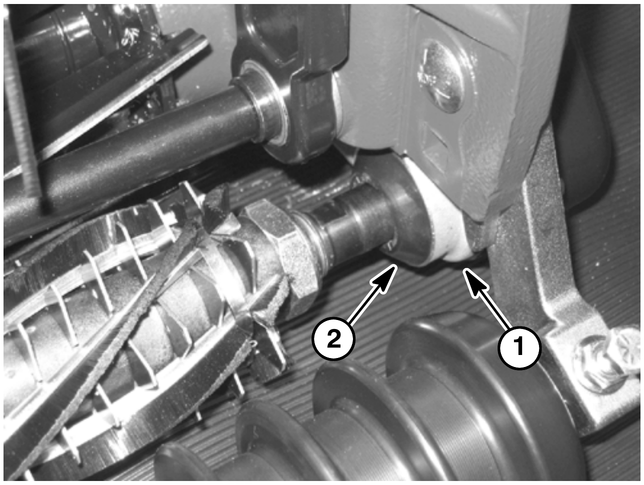

Figure 10

1. **Groomer plate**
2. **Excluder seal**

DPA Groomer

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.

Disassembly (Fig. 12)

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. Remove o-ring from non-drive end of groomer shaft

4. If groomer reel is equipped with broomer kit (Fig. 13), remove straps and broomer brushes from reel.

5. Remove lock nut from either end of the shaft (Fig. 12).

6. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

Assembly (Fig. 12)

1. Install lock nut on drive end of groomer shaft. Place first spacer and then first blade on shaft.

Note: Early production groomer shafts were hex shaped. Later production shafts have a D-shaped cross-section. When installing groomer blades on earlier, hex shaped shafts, rotate location mark on each installed blade one flat of the shaft, either in a clockwise or counterclockwise direction. The direction of location mark rotation must remain constant on the shaft.

2. Alternately install remaining spacers and blades making sure that all blades are separated by a spacer.

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.

5. If groomer reel is equipped with broomer kit (Fig. 13), 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.

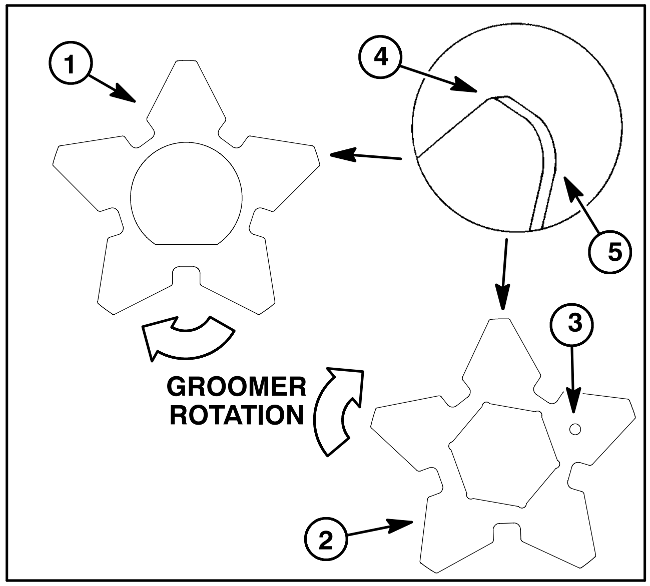

Figure 11

1. **Groomer blade (D shaft)**
2. **Blade (hex shaft)**
3. **Location mark**
4. **Sharp edge**
5. **Dull (rounded) edge**

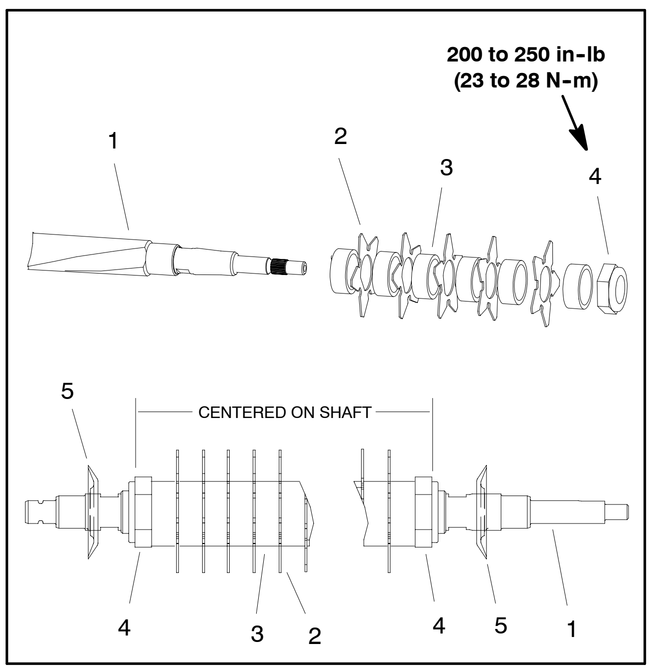

Figure 12

1. **Groomer reel shaft**
2. **Groomer blade (42 used)**
3. **Spacer (43 used)**
4. **Lock nut (2 used)**
5. **Excluder seal**

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).

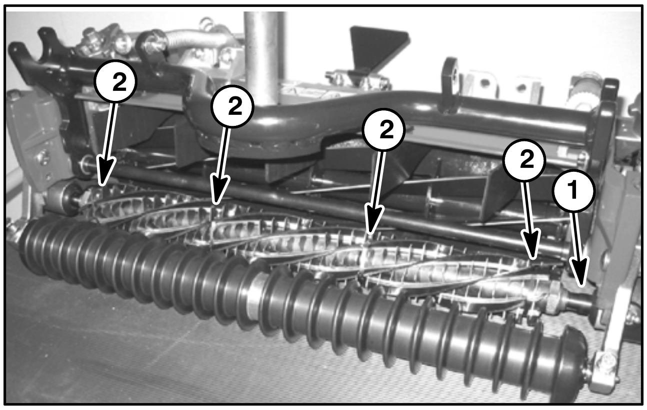

Figure 13

1. **Groomer shaft**
2. **Broomer strap**

DPA Groomer

Groomer Pivot Hub

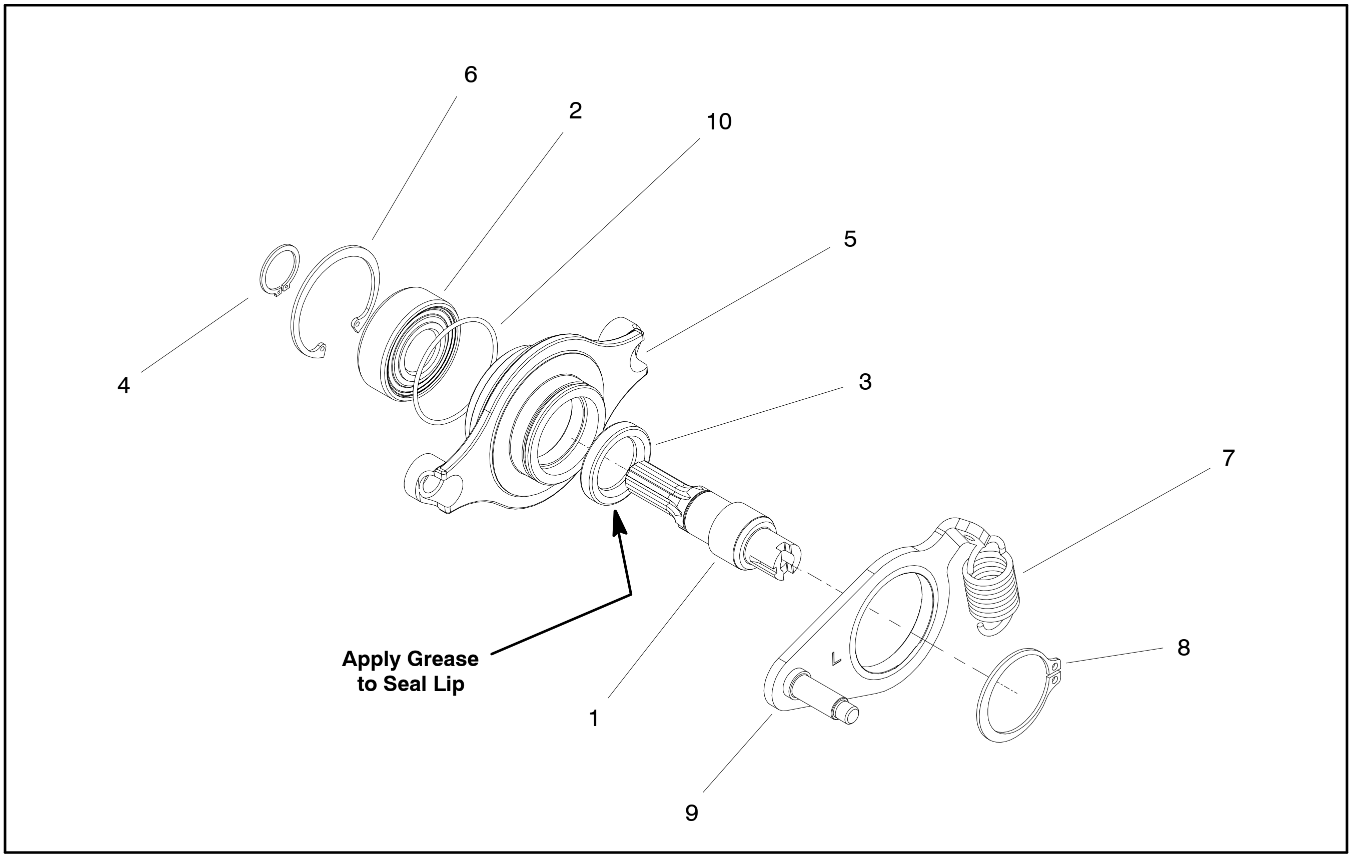

Figure 14

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 14 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 14)

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. 14)

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. 15).

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).

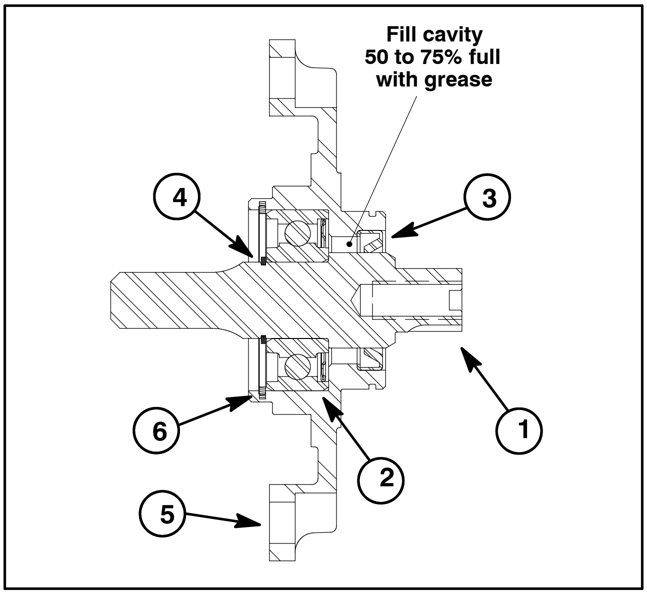

Figure 15

1. **Drive shaft**
2. **Bearing**
3. **Oil seal**
4. **Retaining ring**
5. **Pivot hub**
6. **Retaining ring**

DPA Groomer

Height Adjuster Assembly

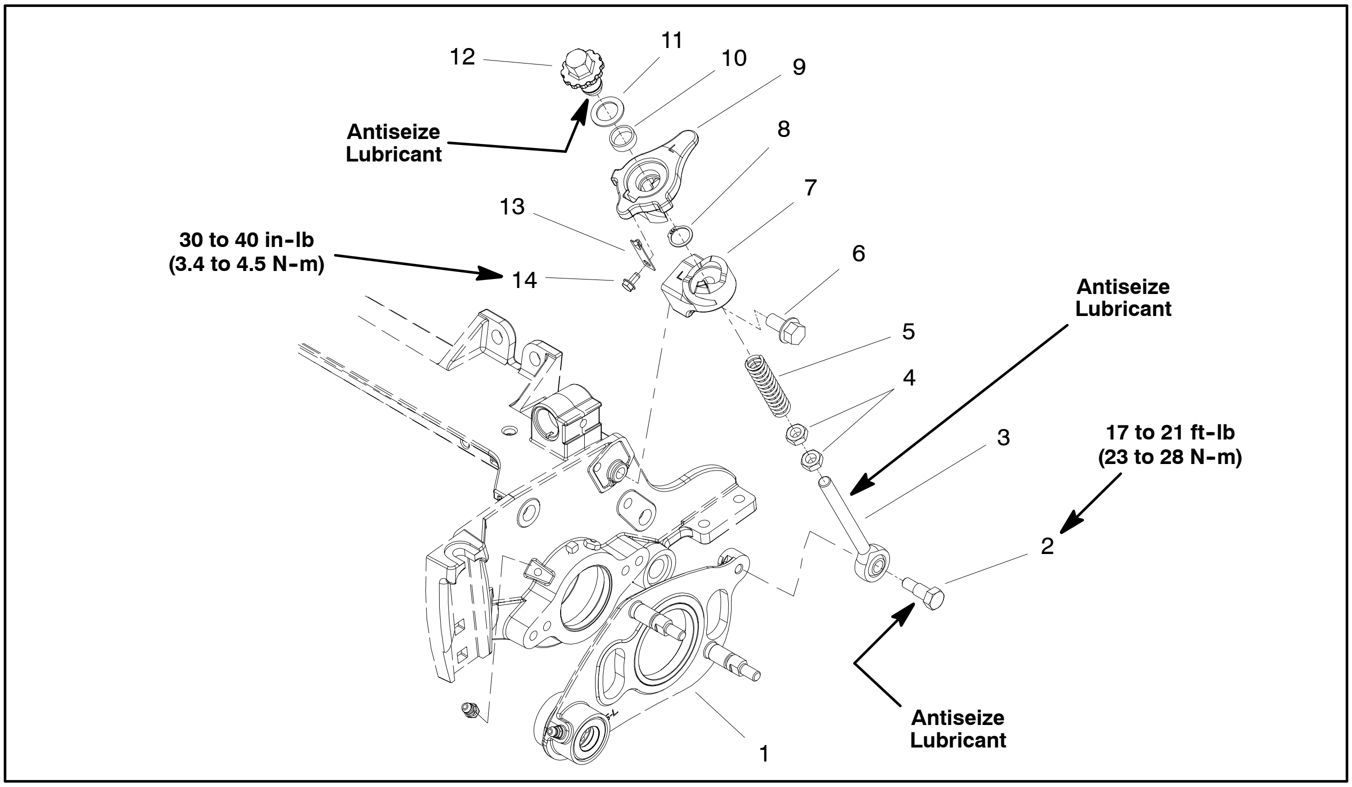

Figure 16

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 16 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 16)

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 16 as a guide.

3. Clean all components and inspect for wear or damage. Replace all worn or damaged components.

Assembly (Fig. 16)

1. Assemble height adjuster using Figure 16 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 8

Electrical Diagrams

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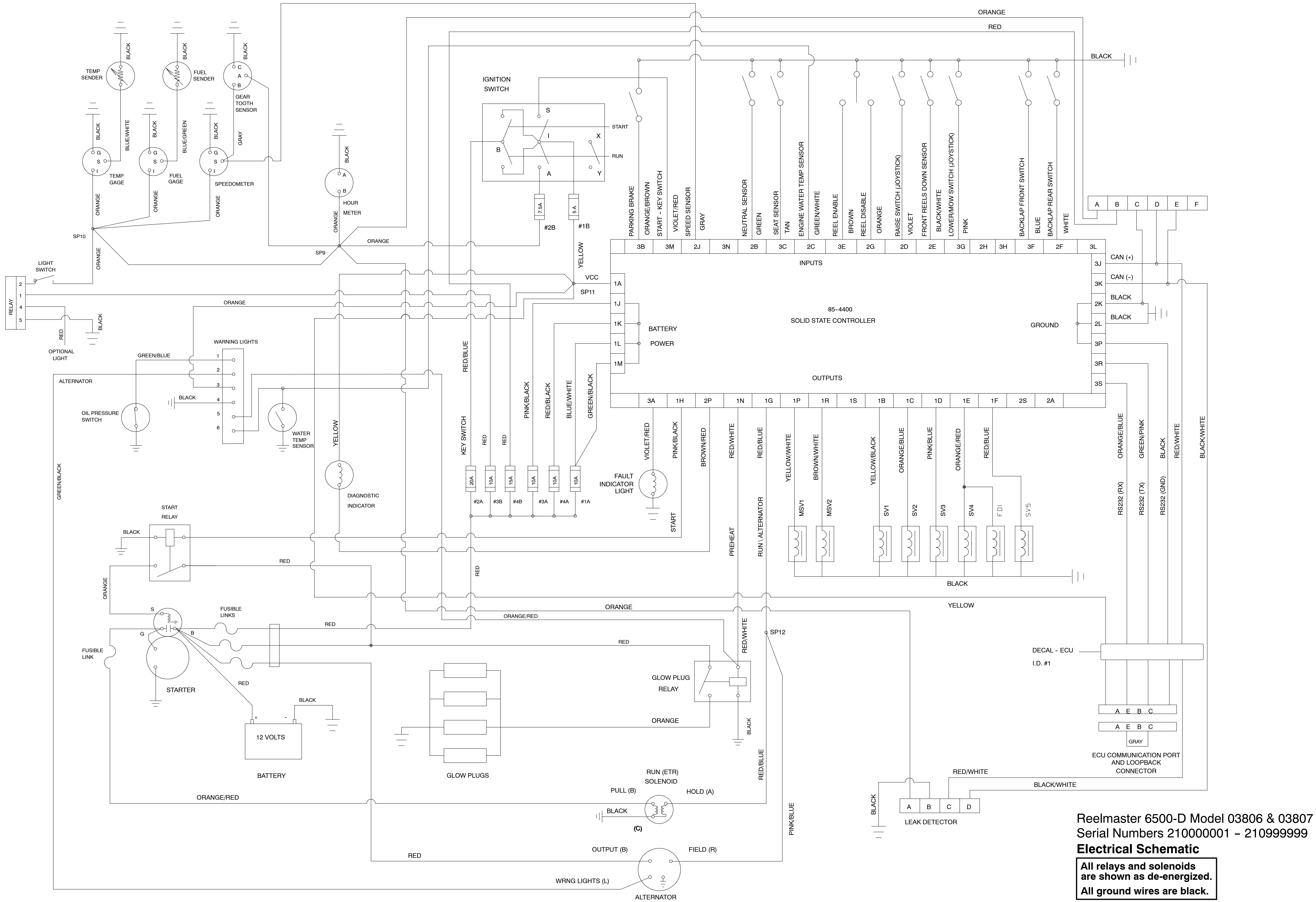
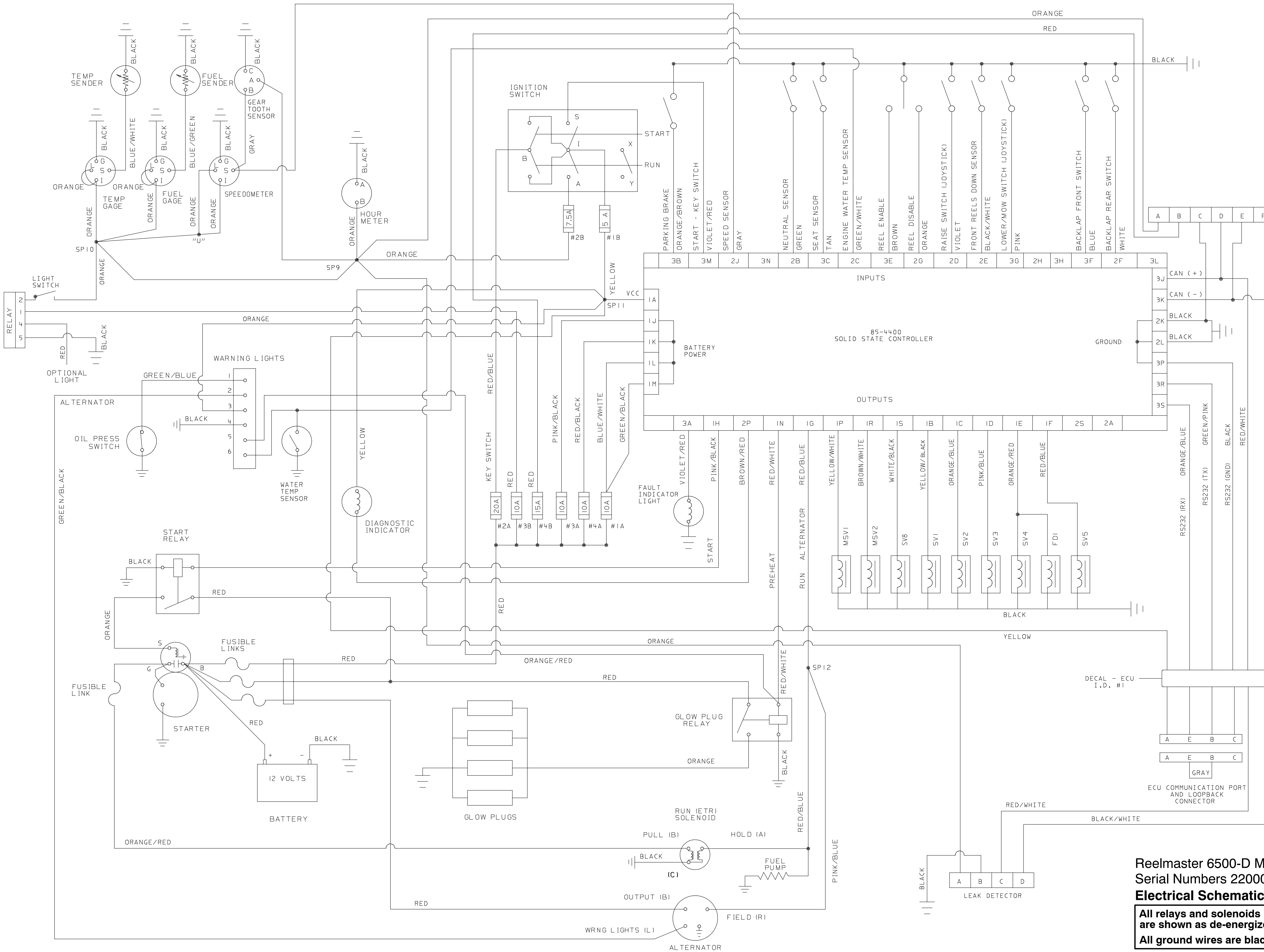


Reelmaster 6500-D Model 03806 & 03807
Serial Numbers 210000001 – 210999999
Electrical Schematic

All relays and solenoids are shown as de-energized.
All ground wires are black.



Reelmaster 6500-D Model 03806 & 03807
Serial Numbers 220000001 & Up
Electrical Schematic

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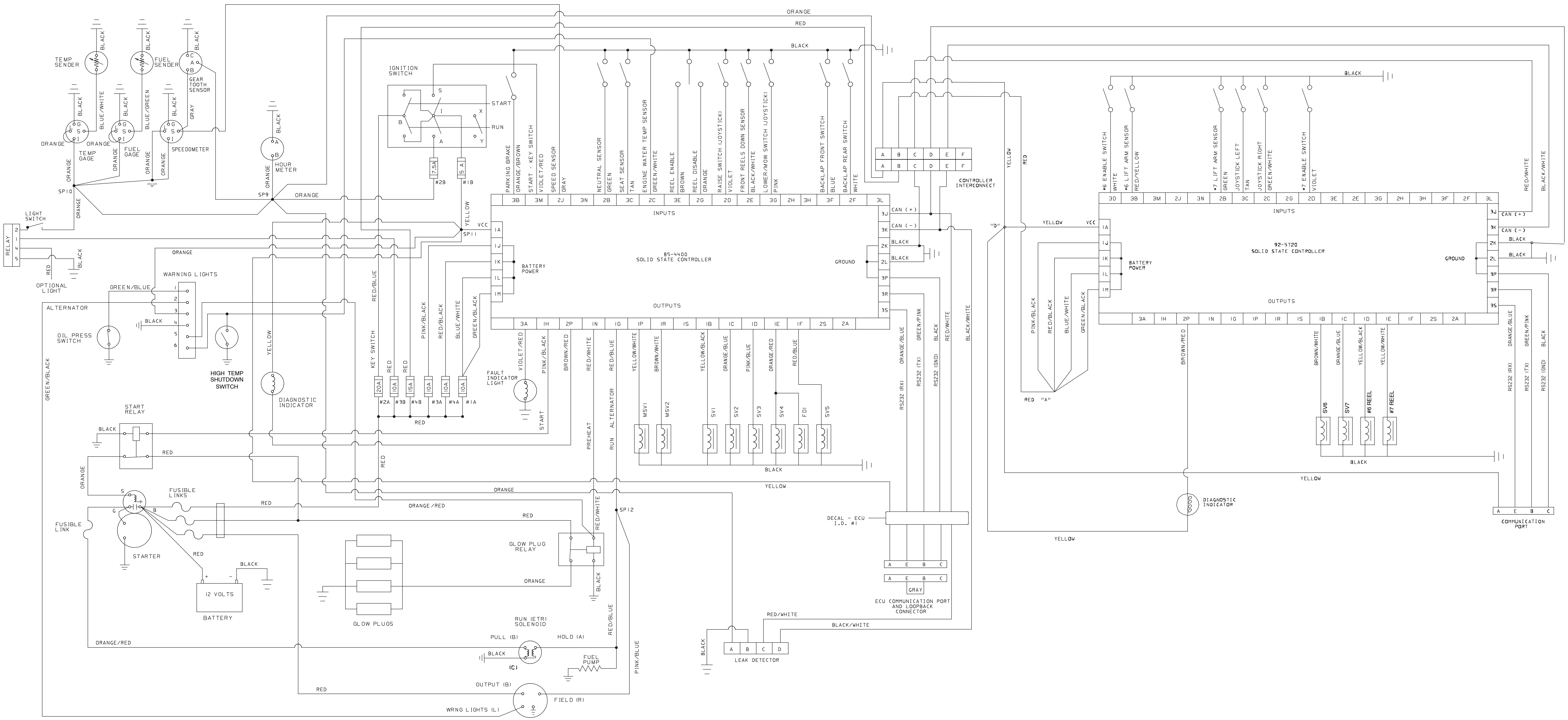
All ground wires are black.



Reelmaster 6700-D Model 03808
Serial Numbers 210000001 – 210999999
Electrical Schematic

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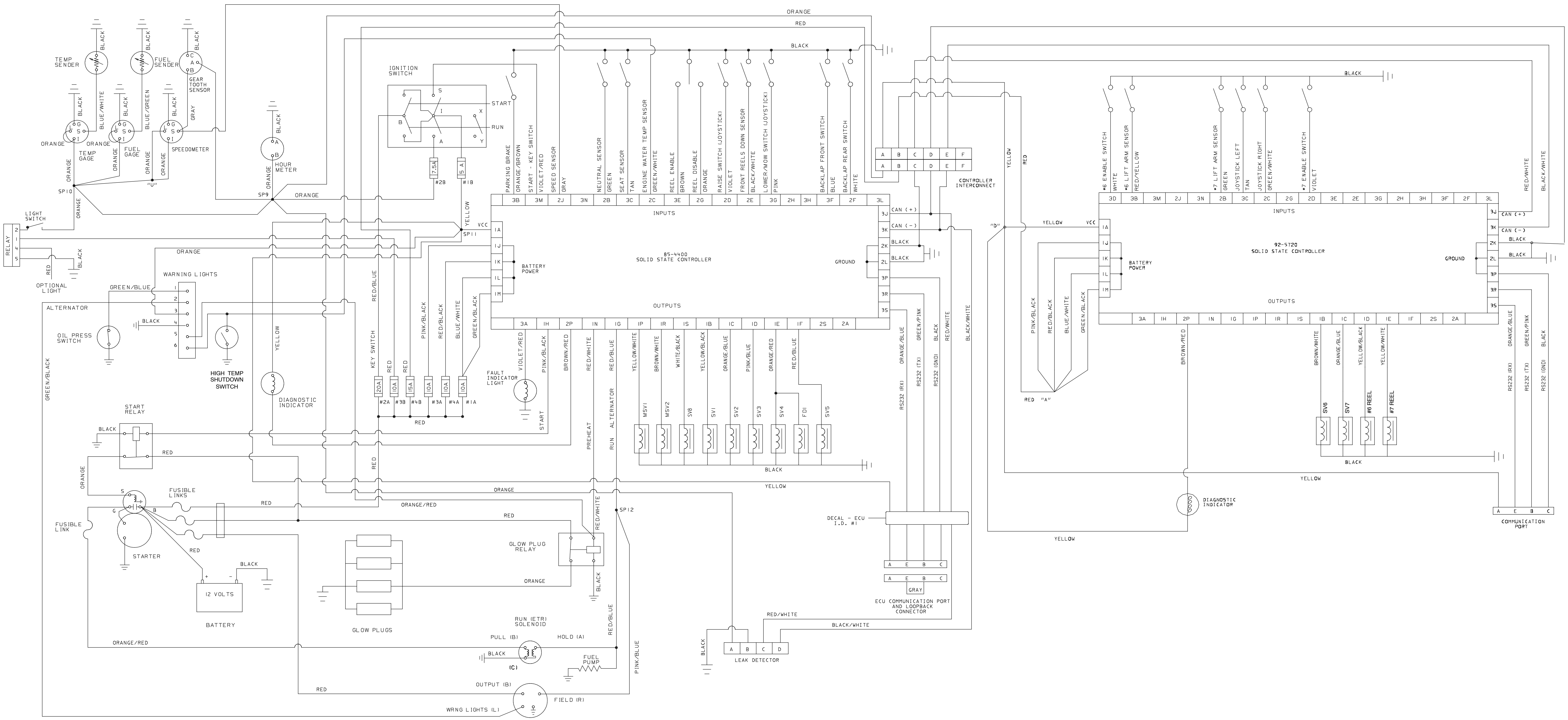
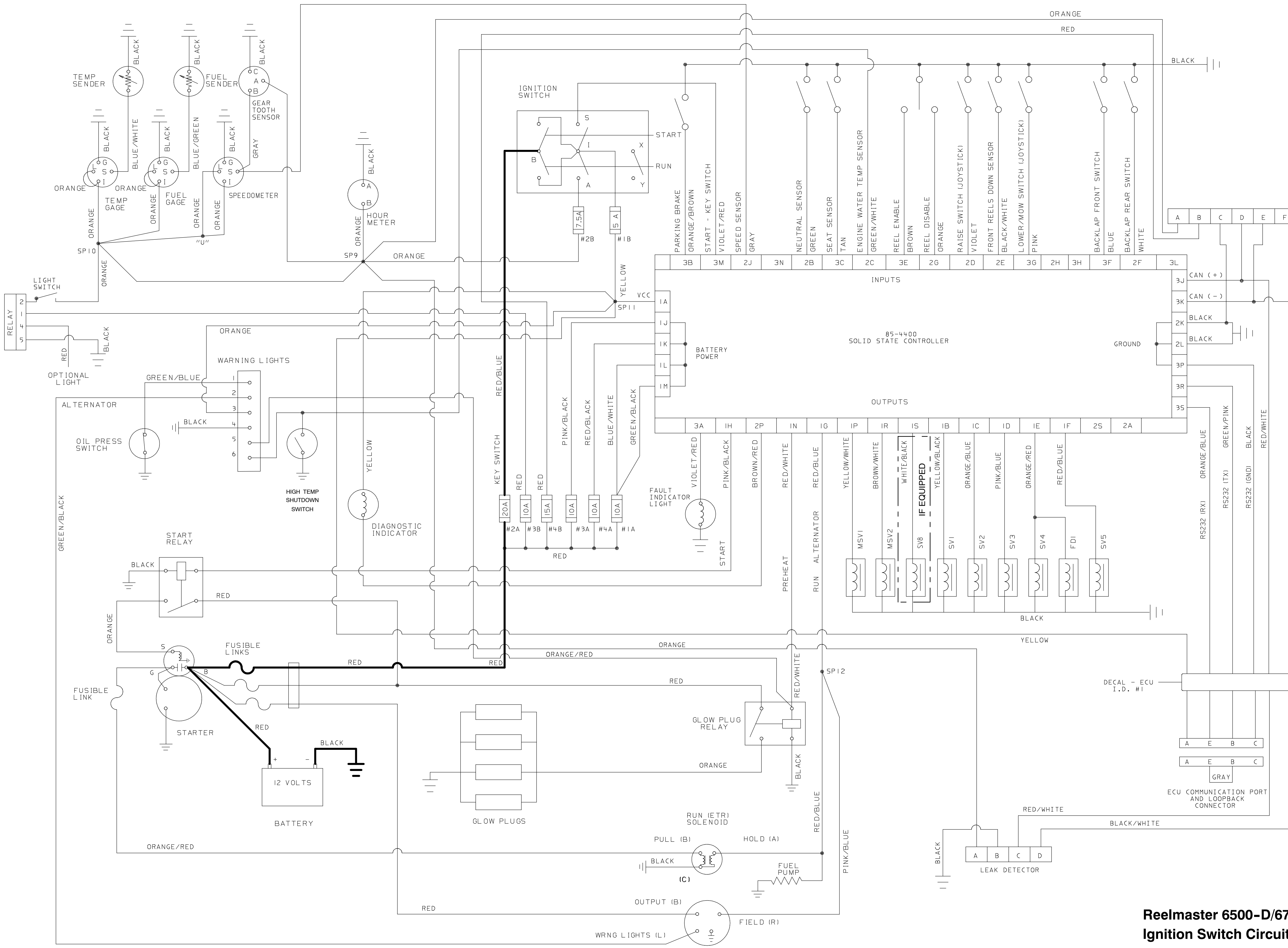
All ground wires are black.

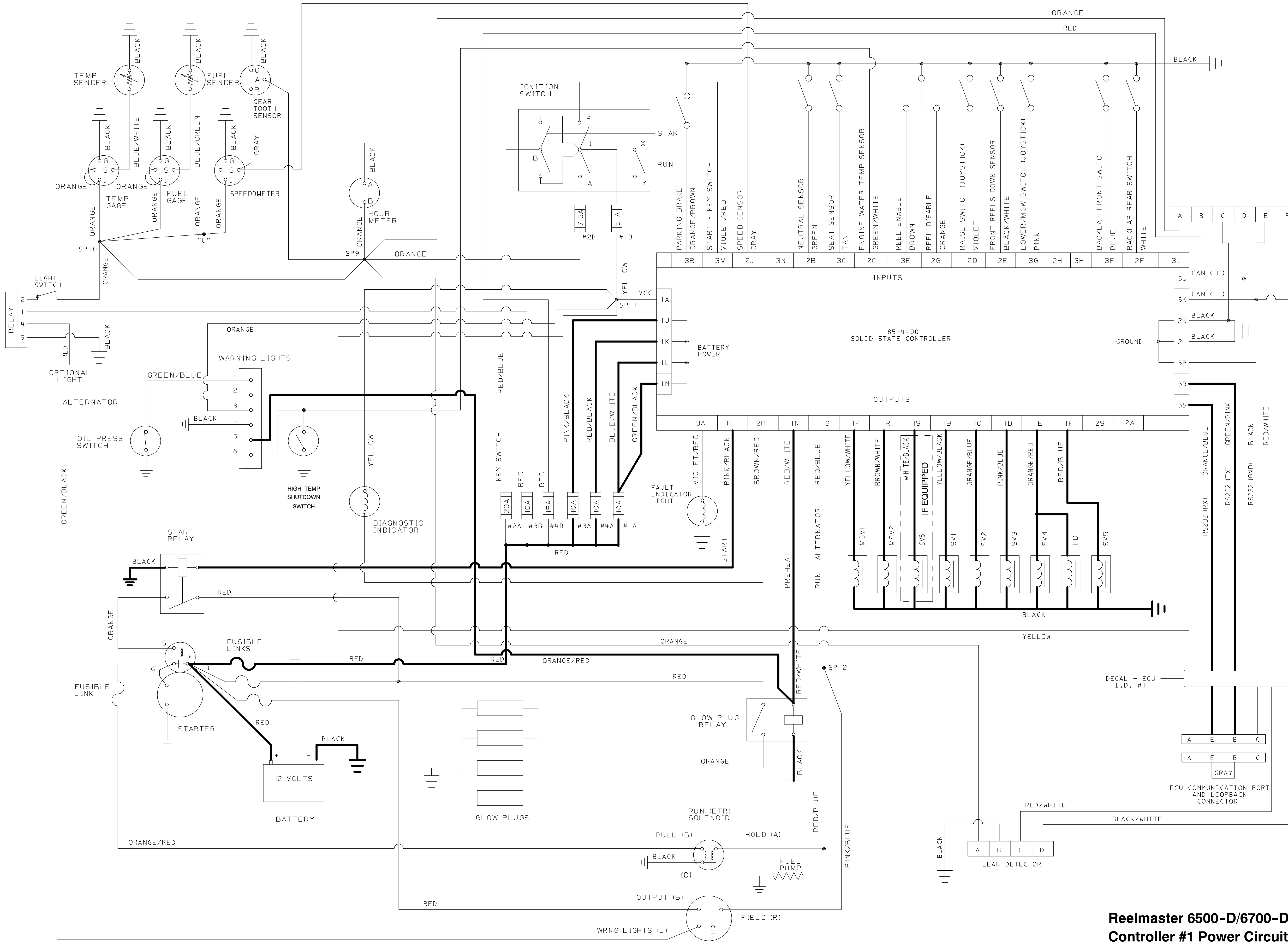


Reelmaster 6700-D Model 03808
Serial Numbers 220000001 & Up
Electrical Schematic

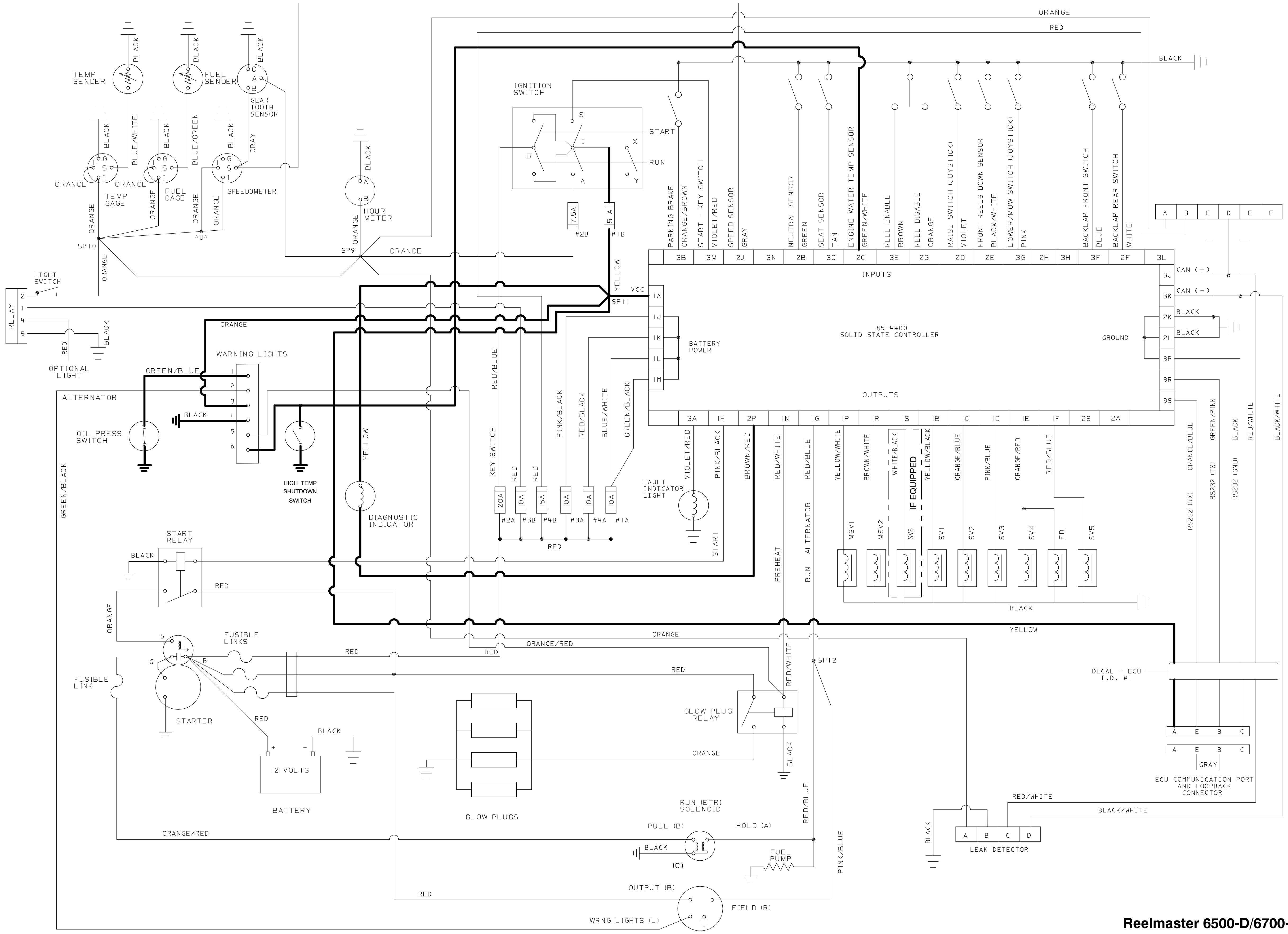
All relays and solenoids are shown as de-energized.
All ground wires are black.



Reelmaster 6500-D/6700-D
Ignition Switch Circuit (20 Amp Fuse)

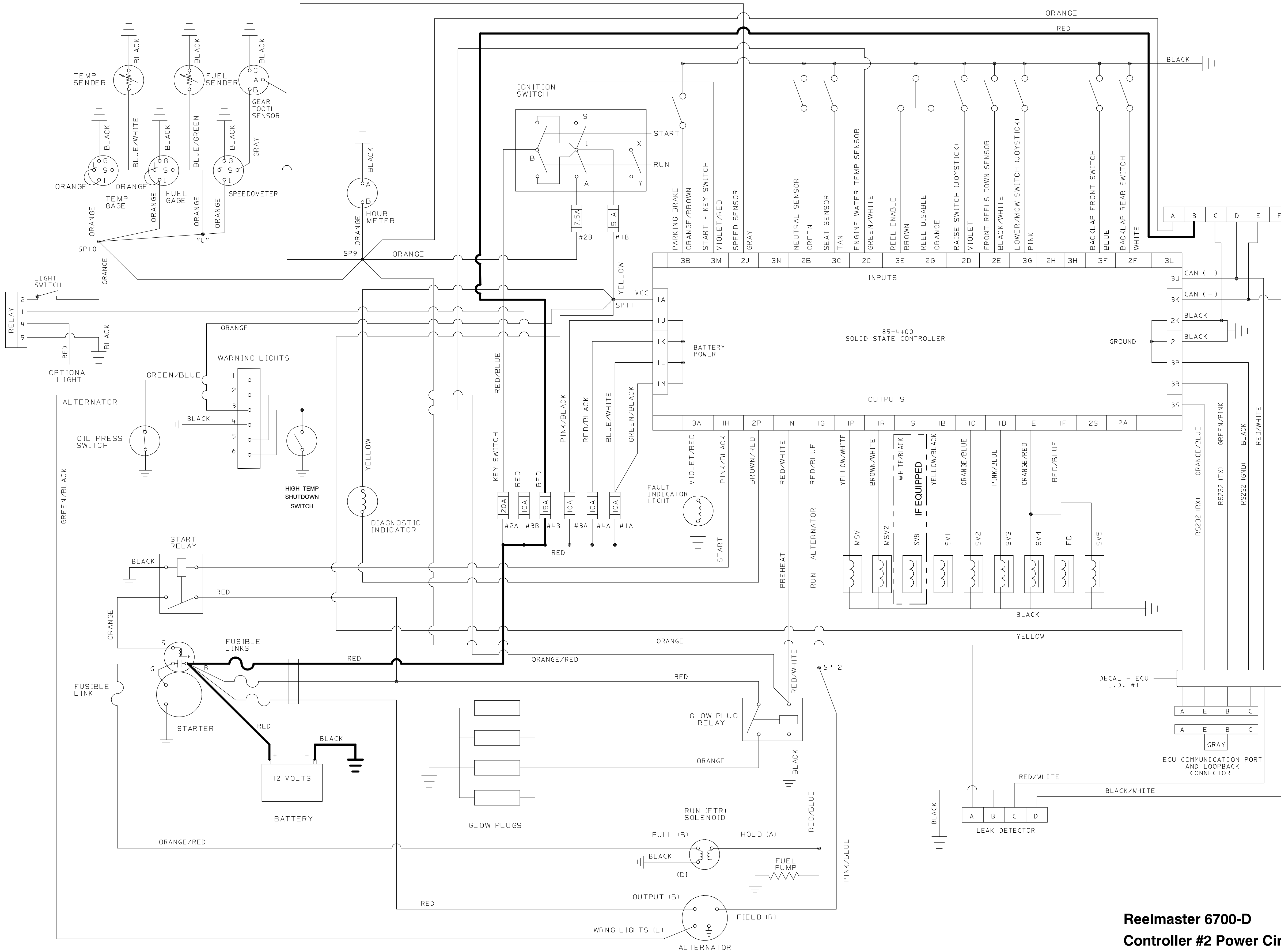


Reelmaster 6500-D/6700-D
Controller #1 Power Circuit (10 Amp Fuses)



Reelmaster 6500-D/6700-D

Controller #1 Logic Circuit (5 Amp Fuse)



Reelmaster 6700-D

Controller #2 Power Circuit (15 Amp Fuse)

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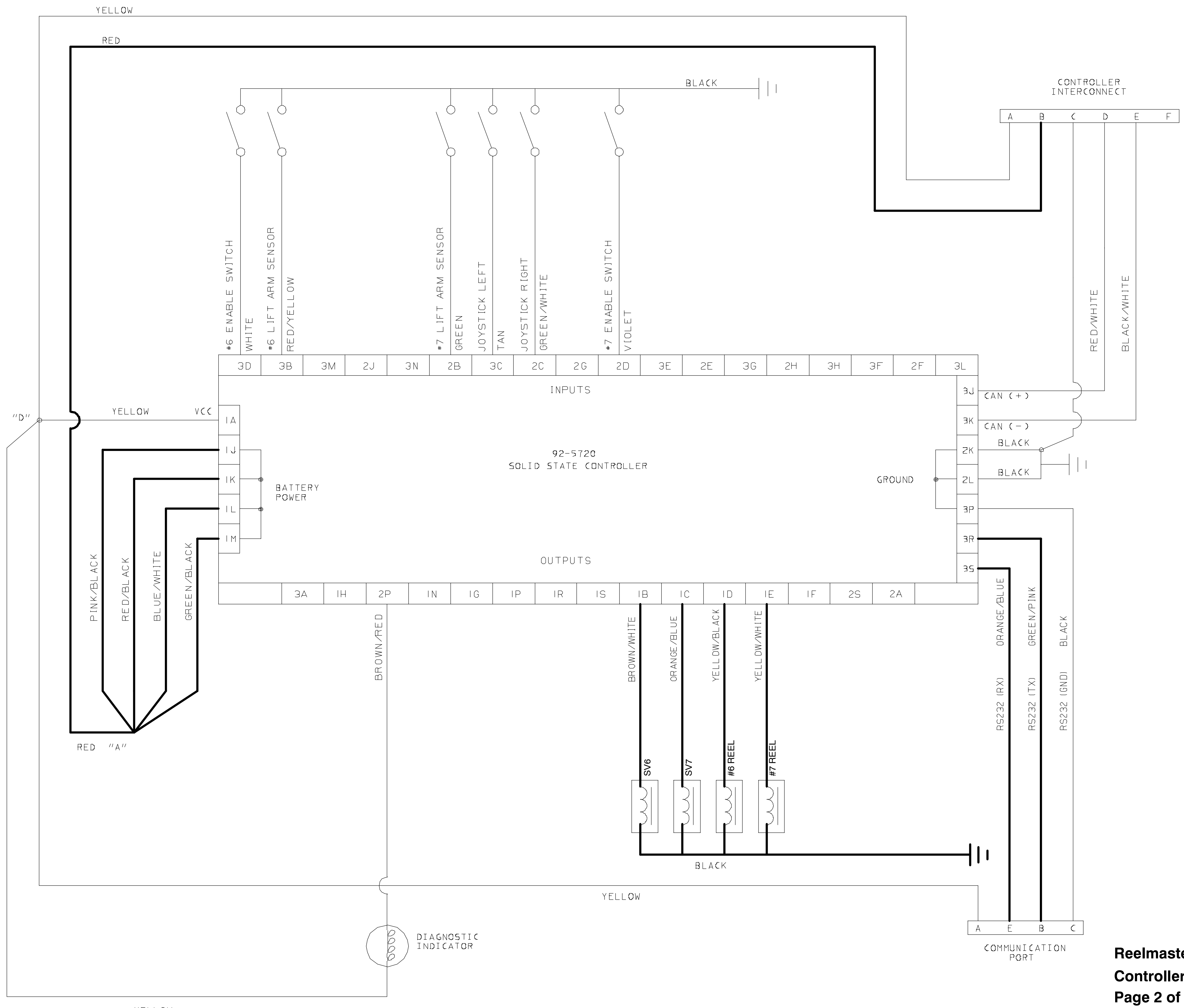

Reelmaster 6700-D

Controller #2 Power Circuit (15 Amp Fuse)

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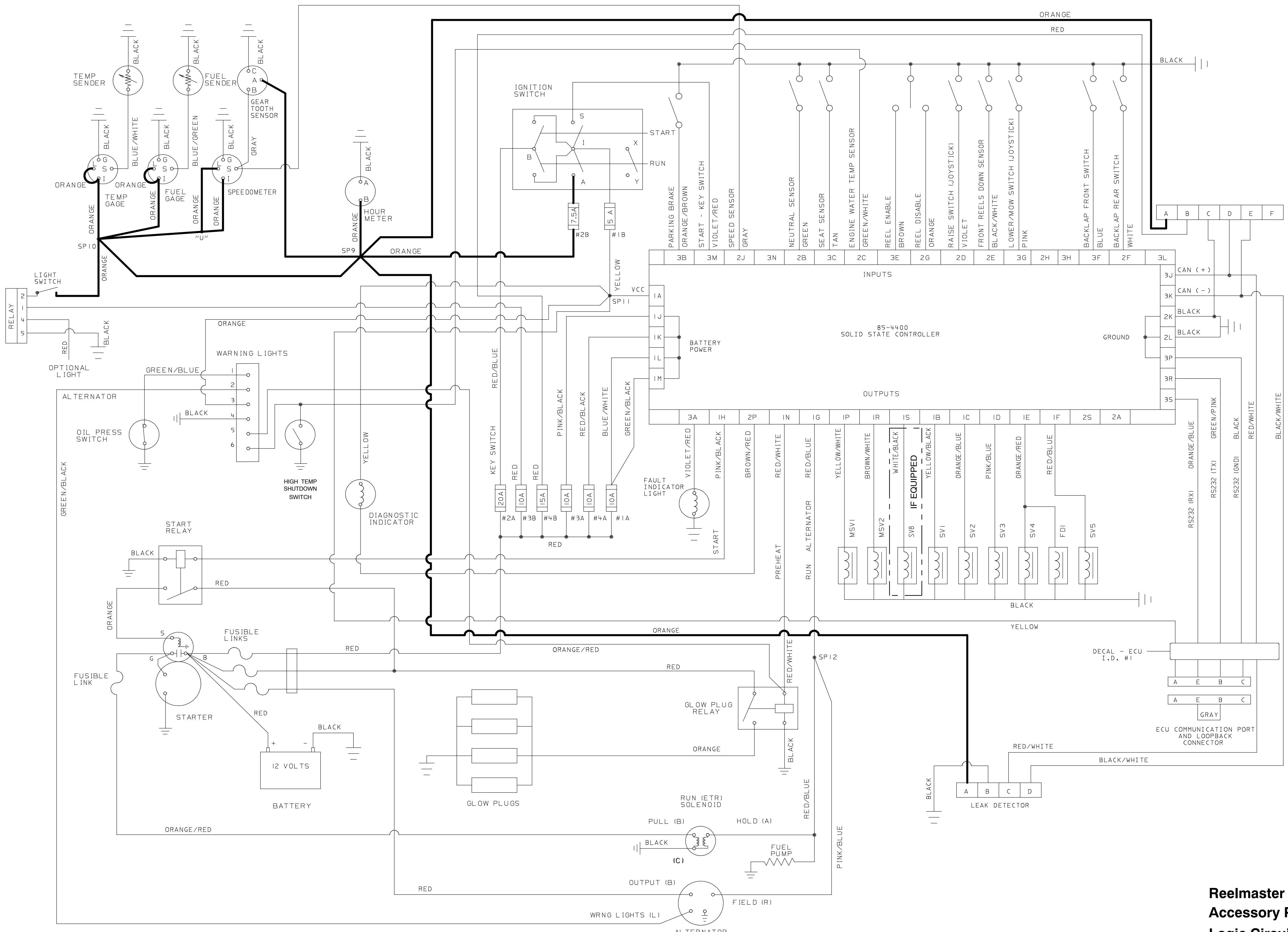
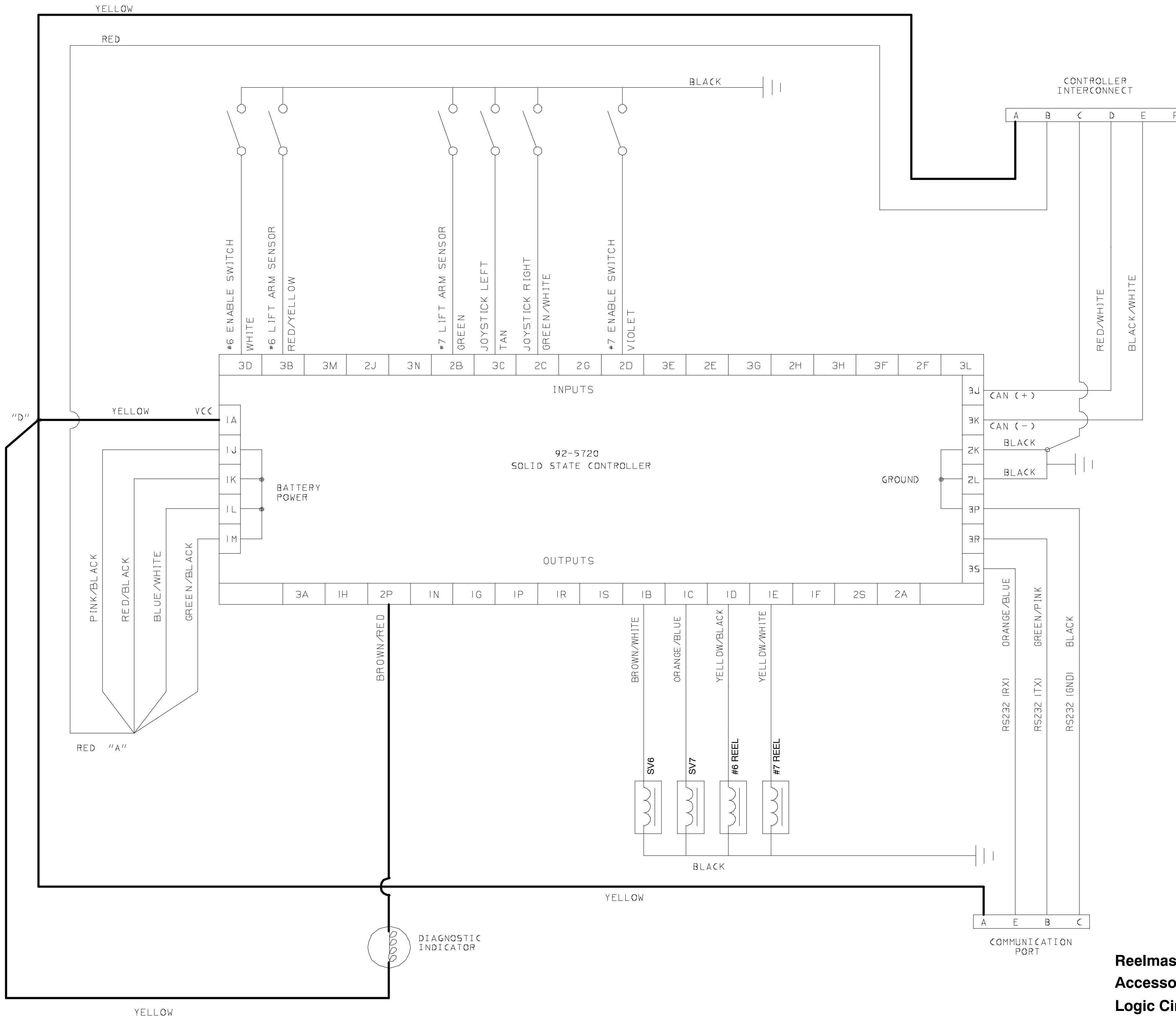


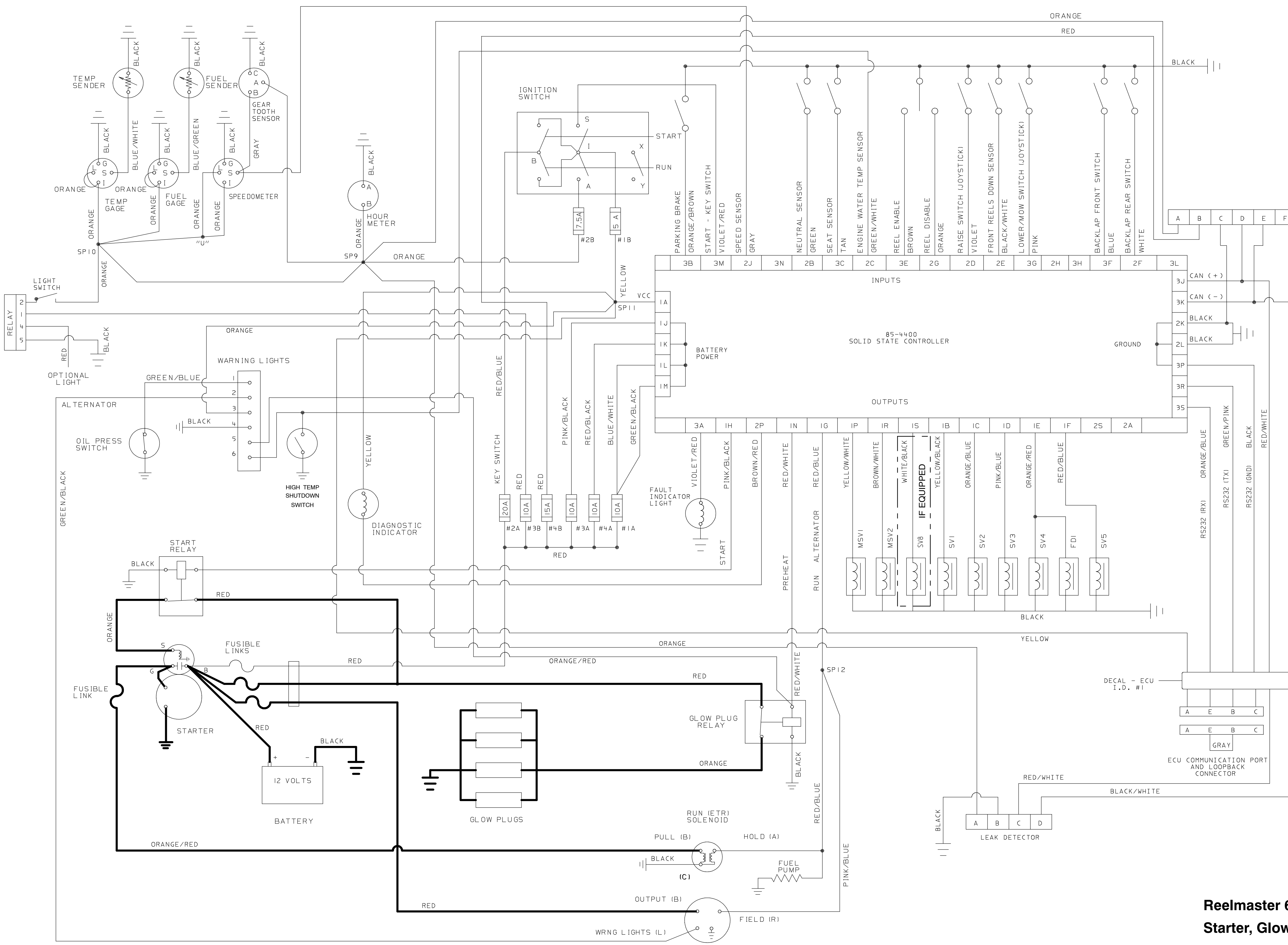
Reelmaster 6500-D/6700-D
Accessory Power and Controller #2
Logic Circuit (7.5 Amp Fuse) Page 1 of 2



Reelmaster 6500-D/6700-D

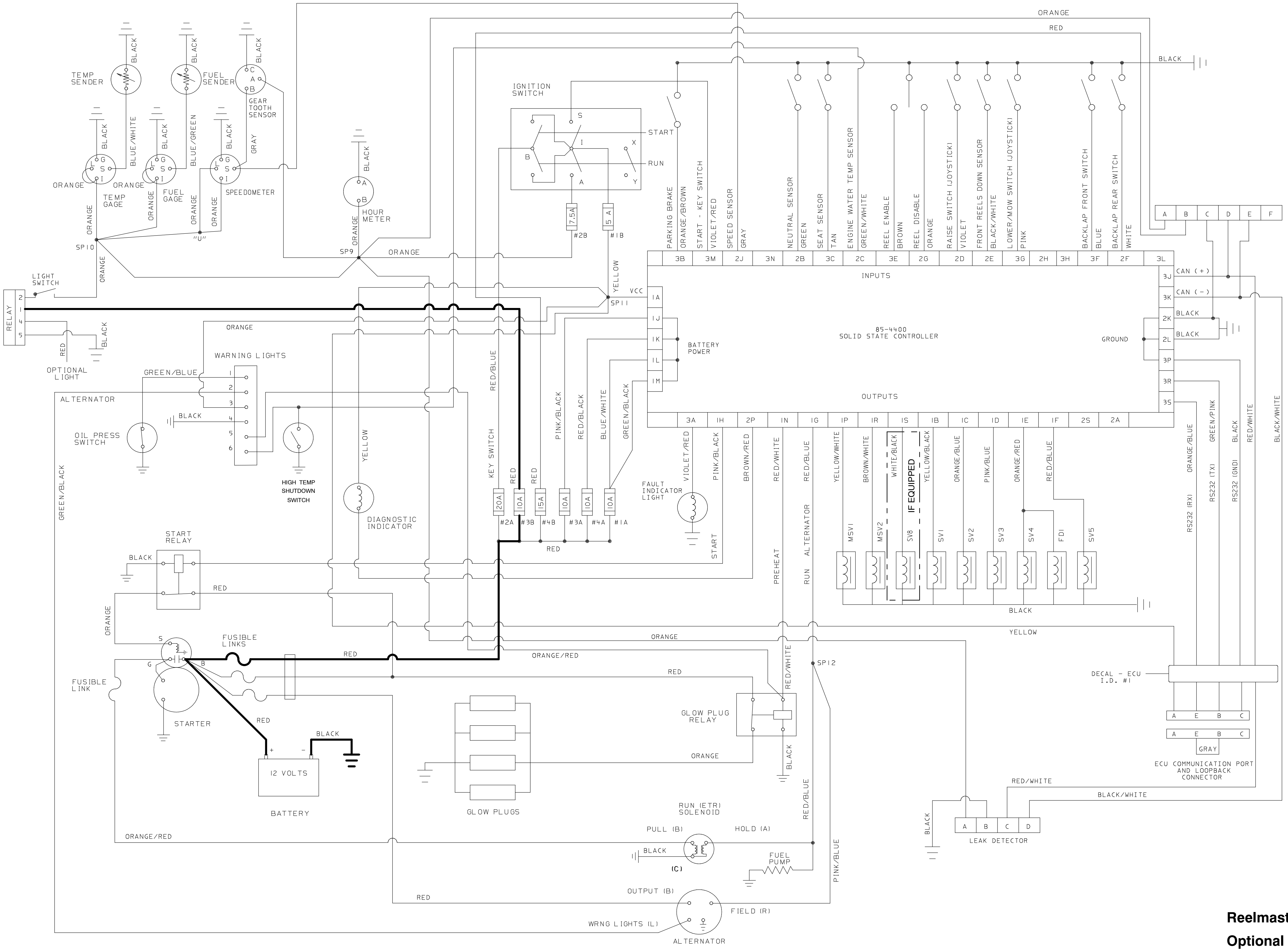
Accessory Power and Controller #2

Logic Circuit (7.5 Amp Fuse) Page 2 of 2



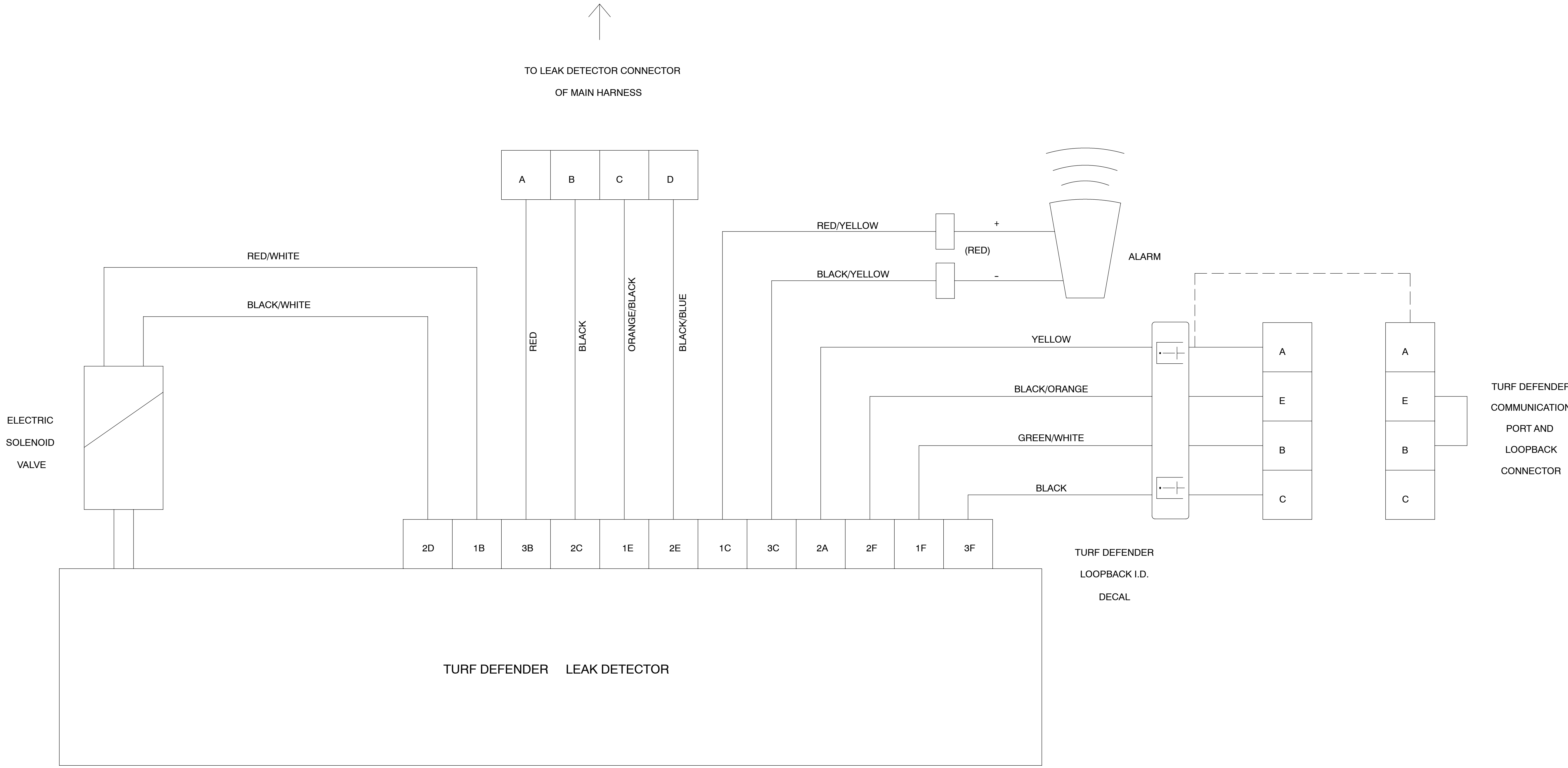
Reelmaster 6500-D/6700-D

Starter, Glow Plugs, and Alternator Circuits (Fusible Links)

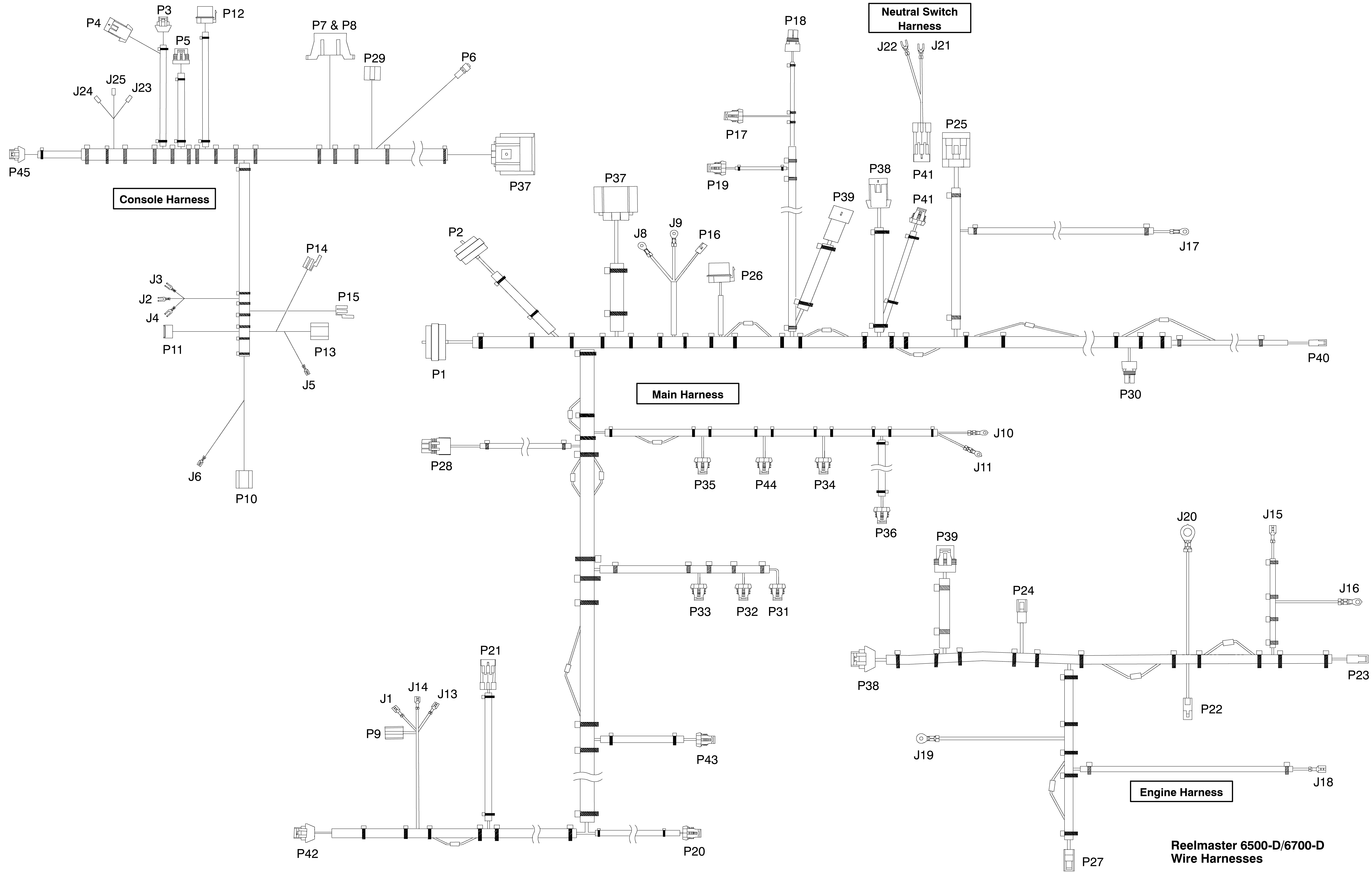


Reelmaster 6500-D/6700-D

Optional Lighting Circuit (10 Amp Fuse)

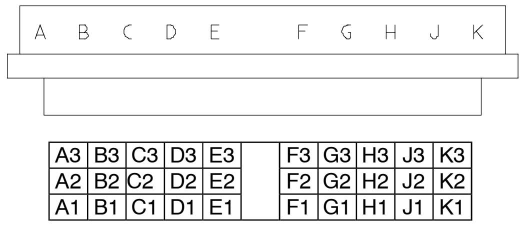


Reelmaster 6500-D/6700-D
Optional TurfDefender Leak Detector



Reelmaster 6500-D/6700-D
Wire Harnesses

P1

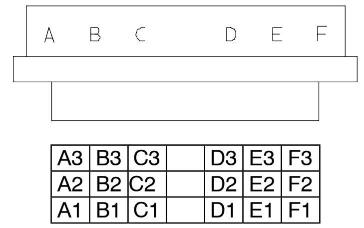


30 Pin Connector

Located under the operator's seat
Plugged into the Primary (#1) Electronic Controller

Cavity	Wire	Cavity	Wire
A1	Yellow	F1	Red/Blue
A2	Open	F2	White
A3	Violet/Red	F3	Blue
B1	Yellow/Black	G1	Red/Blue
B2	Green	G2	Orange
B3	Orange/Brown	G3	Pink
C1	Orange/Blue	H1	Pink/Black
C2	Green/White	H2	Open
C3	Tan	H3	Open
D1	Pink/Blue	J1	Pink/Black
D2	Violet	J2	Gray
D3	Open	J3	Red/White
E1	Orange/Red	K1	Red/Black
E2	Black/White	K2	Black
E3	Brown	K3	Black/White

P2

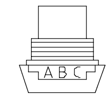


18 Pin Connector

Located under the operator's seat
Plugged into the Primary (#1) Electronic Controller

Cavity	Wire
A1	Blue/White
A2	Black
A3	Open
B1	Green/Black
B2	Open
B3	Violet/Red
C1	Red/White
C2	Open
C3	Open
D1	Yellow/White
D2	Brown/Red
D3	Black
E1	Brown/White
E2	Open
E3	Green/Pink
F1	Open
F2	Open
F3	Orange/Blue

P3

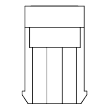


Communications Port

Located in the control console

Cavity	Wire
A	Orange
B	Green/Pink
C	Black
D	Open
E	Orange/Blue
F	Open

P4

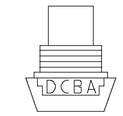


Loop-Back connector

Located in the control console

Wire Color Gray

P5

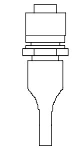


Leak Detector

Located in the control console

Cavity	Wire
A	Orange
B	Black
C	Red/White
D	Black/White

P6

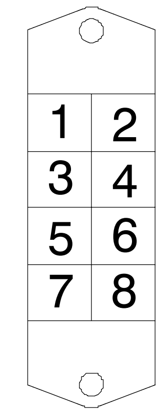


Diagnostic Light (Green)

Located in the control console

Wire Color
Brown/red
Yellow

P7



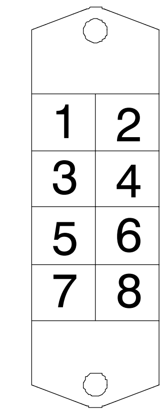
1 2	10 AMP
3 4	20 AMP
5 6	10 AMP
7 8	10 AMP

Fuse Block A

Located in the control console

Cavity	Wire
1	Red
2	Blue/White Green/Black
3	Open
4	Red/Blue
5	Open
6	Pink/Black
7	Red
8	Red/Black

P8



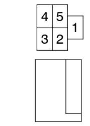
1 2	4 AMP
3 4	7.5 AMP
5 6	10 AMP
7 8	15 AMP

Fuse Block B

Located in the control console

Cavity	Wire
1	Yellow
2	Yellow
3	Orange
4	Orange
5	Open
6	Red
7	Red
8	Red

P9

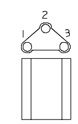


Ignition Switch

Located in the control console or steering tower

Cavity	Wire
1	Open
2	Open
3	Orange
4	Red/Blue
5	Violet/Red

P10

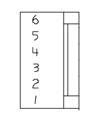


Temp Gauge

Located in the control console

Cavity	Wire
1	Orange
2	Black
3	Blue/White

P11

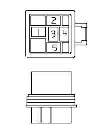


Warning light cluster

Located under the control console

Cavity	Wire
1	Green/Blue
2	Green/Black
3	Orange
4	Black
5	Orange/Red
6	Green/White

P12

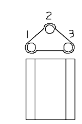


Optional Light Relay

Located under the control console

Cavity	Wire
1	Red
2	Orange
3	Open
4	Red
5	Black

P13

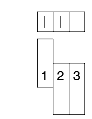


Fuel Gauge

Located under the control console

Cavity	Wire
1	Orange
2	Black
3	Blue/Green

P14

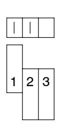


Joystick Lower

Located under the control console

Cavity	Wire
1	Black
2	Pink
3	Open

P15

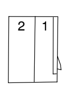


Joystick Raise

Located under the control console.

Cavity	Wire
1	Black
2	Violet
3	Open

P16

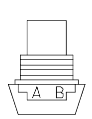


Glow Plug Relay

Located under the operators seat

Cavity	Wire
1	Red/White Orange/Red
2	Black

P17

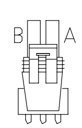


MVS2 Sonenoid

Located on reel manifold

Cavity	Wire
A	Brown/White
B	Black

P18

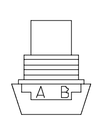


Rear Reel Backlap Switch

Located on reel manifold

Cavity	Wire
A	White
B	Black

P19

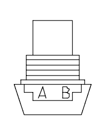


MSV1 Solenoid

Located on reel manifold

Cavity	Wire
A	Yellow/White
B	Black

P20

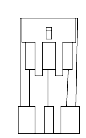


Front Lift Arm Sensor

Located on left hand front lift arm

Cavity	Wire
A	Black/White
B	Black

P21

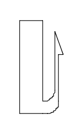


Parking Brake Switch

Located in steering tower

Cavity	Wire
A	Orange/Brown
B	Black

P22

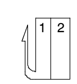


Starter

Located on "S" terminal of the starter

Wire Color Orange

P23

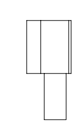


Alternator

Located on the RH side on the engine

Cavity	Wire
1	Red/Blue
2	Green/Black

P24

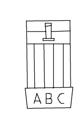


Starter

Located on Starter ground terminal

Wire Color Fusible Link

P25

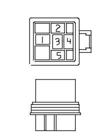


Starter Battery (+)

Located on the RH side of the engine, By the starter

Cavity	Wire
A	Red
B	Red
C	Red

P26

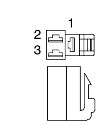


Start Relay

Located under the operators seat

Cavity	Wire
1	Red
2	Pink/Black
3	Open
4	Orange
5	Black

P27

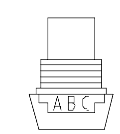


Run Solenoid

Located on LH side of engine

Cavity	Wire
1	Orange/Red
2	Black
3	Red/Blue

P28

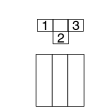


Speedometer Sensor

Located on RH side front wheel motor

Cavity	Wire
A	Orange
B	Gray
C	Black

P29



Hour Meter

Located in the control console

Cavity	Wire
1	Orange
2	Open
3	Black

Reelmaster 6500-D/6700-D
Electrical Connector Drawing

P30
Front Reel Backlap Switch

Located on reel manifold

Cavity	Wire
A	Blue
B	Black

P31
SV2 Solenoid

Located on lift manifold

Cavity	Wire
A	Orange/Blue
B	Black

P32
SV3 Solenoid

Located on lift manifold

Cavity	Wire
A	Pink/Blue
B	Black

P33
SV4 Solenoid

Located on lift manifold

Cavity	Wire
A	Orange/Red
B	Black

P34
SV1 Solenoid

Located on lift manifold

Cavity	Wire
A	Yellow/Black
B	Black

P35
SV5 Solenoid

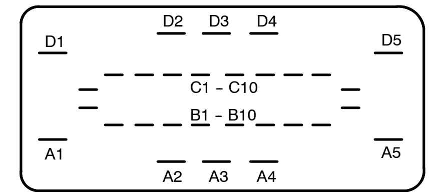
Located on lift manifold

Cavity	Wire
A	Red/Blue
B	Black

P36
Seat Switch

Located under operators seat

Cavity	Wire
A	Tan
B	Black

P37


Console Harness Connector
Located under the operator's seat

Cavity	Wire	Cavity	Wire
A1	Orange	C1	Pink
A2	Red	C2	Red/White
A3	Red/Black	C3	Black/White
A4	Black	C4	Blue/White
A5	Brown/Red	C5	Green/Black
B1	Orange	C6	Brown
B2	Green/White	C7	Green/Pink
B3	Blue/White	C8	Orange/Blue
B4	Green/Blue	C9	Yellow
B5	Green Black	C10	Orange
B6	Orange/Red	D1	Yellow
B7	Blue/Green	D2	Open
B8	Pink/Black	D3	Open
B9	Red/Black	D4	Open
B9	Violet	D5	Open

P38
Engine Harness Connector

Located on the RH side of engine

Cavity	Wire
A	Green/Black
B	Red/Blue
C	Green/White
D	Green/Blue
E	Orange
F	Blue/White

P39
Engine Harness Connector

Located on the RH side of engine

Cavity	Wire
A	Orange
B	Black

P40
Fuel Pump

Located on the LH side of the engine

Cavity	Wire
1	Red/Blue
2	Black

P41
Neutral Switch Harness Connector

Located near the hydrostatic pump

Cavity	Wire
A	Green
B	Black

P42
Speedometer

Located in the steering tower

Cavity	Wire
A	Orange
B	Black
C	Gray
D	Orange
E	Black
F	Open

P43
FD1 Solenoid (if equipped)

Located below operator's floor panel

Cavity	Wire
A	Orange/Red
B	Black

P44
SV8 Solenoid (if equipped)

Located on lift manifold

Cavity	Wire
A	White/Black
B	Black

P45
Secondary (#2) Electronic Controller Harness Connector

Located under the control console

Cavity	Wire
A	Orange
B	Red
C	Black
D	Red/White
E	Black/White
F	Open

J1
Ignition Switch "I"

Located in the control console or steering tower

Wire Color Yellow

J2
Reels Enable

Located under the control console

Wire Color Orange

J3
Reels Enable

Located under the control console

Wire Color Black

J4
Reels Enable

Located under the control console

Wire Color Brown

J5
Fuel Gauge Light

Located under the control console

Wire Color Orange

J6
Temp Gauge Light

Located under the control console

Wire Color Black

J8
Glow Plug Relay

Located under the operators seat

Wire Color Orange

J9
Glow Plug Relay

Located under the operators seat

Wire Color Red

J10
Fuel Sender (+)

Located on Fuel tank. LH side of machine

Wire color Blue/Green

J11
Fuel Sender (-)

Located on Fuel tank. LH side of machine

Wire color Black

J13
Diagnostic Light (Red)

Located in steering column

Wire Color Violet/Red

J14
Diagnostic Light (Red)

Located in steering column

Wire Color Violet/Red

J15
Engine Oil Pressure Switch

Located on LH side of engine

Wire Color Blue

J16
Engine Coolant Temp Sensor

Located on the LH side of the engine

Wire Color Blue/White

J17
Alternator

Located on the RH rear side of the engine

Wire Color Red

J18
Engine High Temp Warning/Shutdown Switch

Located on the LH side of the engine

Wire Color Green/White

J19
Glow Plugs

Located on the LH rear of the engine

Wire Color Orange

J20
Ground

Located near the front RH side engine mount

Wire Color Black

J21
Neutral Sensor

Located on the hydrostatic pump

Wire Color Green

J22
Neutral Sensor

Located on the hydrostatic pump

Wire Color Black

J23
To Optional Lights

Located in control console

Wire Color Red

J24
Optional Light Switch

Located in control console

Wire Color Orange

J25
Optional Light Switch

Located in control console

Wire Color Orange

30 Pin Connector

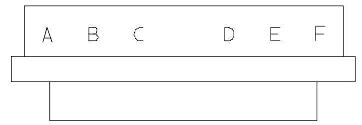
A3	B3	C3	D3	E3	F3	G3	H3	J3	K3
A2	B2	C2	D2	E2	F2	G2	H2	J2	K2
A1	B1	C1	D1	E1	F1	G1	H1	J1	K1

30 Pin Connector

Located under the operator's seat
Plugged into the Secondary (#2) Electronic Controller

Cavity	Wire	Cavity	Wire
A1	Yellow	F1	Open
A2	Open	F2	Open
A3	Open	F3	Open
B1	Orange/Blue	G1	Open
B2	Green	G2	Open
B3	Red/Yellow	G3	Open
C1	Brown/White	H1	Open
C2	Green/White	H2	Open
C3	Tan	H3	Open
D1	Yellow/Black	J1	Pink/Black
D2	Violet	J2	Open
D3	White	J3	Red/White
E1	Yellow/White	K1	Red/Black
E2	Open	K2	Black
E3	Open	K3	Black/White

18 Pin Connector

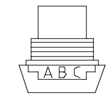


A3	B3	C3	D3	E3	F3
A2	B2	C2	D2	E2	F2
A1	B1	C1	D1	E1	F1

18 Pin Connector

Located under the operator's seat
Plugged into the Secondary (#2) Electronic Controller

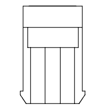
Cavity	Wire
A1	Blue/White
A2	Black
A3	Open
B1	Green/Black
B2	Open
B3	Open
C1	Open
C2	Open
C3	Open
D1	Open
D2	Brown/Red
D3	Black
E1	Open
E2	Open
E3	Green/Pink
F1	Open
F2	Open
F3	Orange/Blue



Communications Port #2

Located in the control console

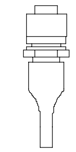
Cavity	Wire
A	Yellow
B	Green/Pink
C	Black
D	Open
E	Orange/Blue
F	Open



Loop-Back connector #2

Located in the control console

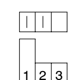
Wire Color
Gray



Diagnostic Light #2 (Green)

Located in the control console

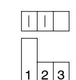
Wire Color
Brown/Red
Yellow



Joystick #6 & #7 Lower

Located under the control console

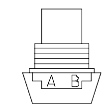
Cavity	Wire
1	Black
2	Tan
3	Open



Joystick #6 & #7 Raise

Located under the control console.

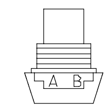
Cavity	Wire
1	Black
2	Green/White
3	Open



SV6 Solenoid

Located on lift manifold

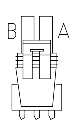
Cavity	Wire
A	Brown/White
B	Black



SV7 Solenoid

Located on lift manifold

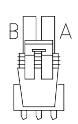
Cavity	Wire
A	Orange/Blue
B	Black



S10 Solenoid

Located on right side of frame

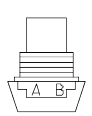
Cavity	Wire
A	Black
B	Yellow/Black



S11 Solenoid

Located on left side of frame

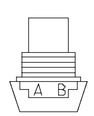
Cavity	Wire
A	Black
B	Yellow/White



#6 Lift Arm Sensor

Located on right side rear lift arm

Cavity	Wire
A	Red/Yellow
B	Black

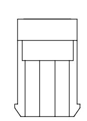


#7 Lift Arm Sensor

Located on left side rear lift arm

Cavity	Wire
A	Green
B	Black

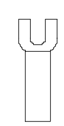
P45



Secondary (#2) Electronic Controller Harness Connector

Located under the control console

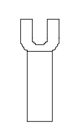
Cavity	Wire
A	Yellow
B	Red
C	Black
D	Red/White
E	Black/White
F	Open



#6 Reel Enable

Located under the control console

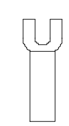
Wire Color
White



#6 Reel Enable

Located under the control console

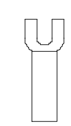
Wire Color
Black



#7 Reel Enable

Located under the control console

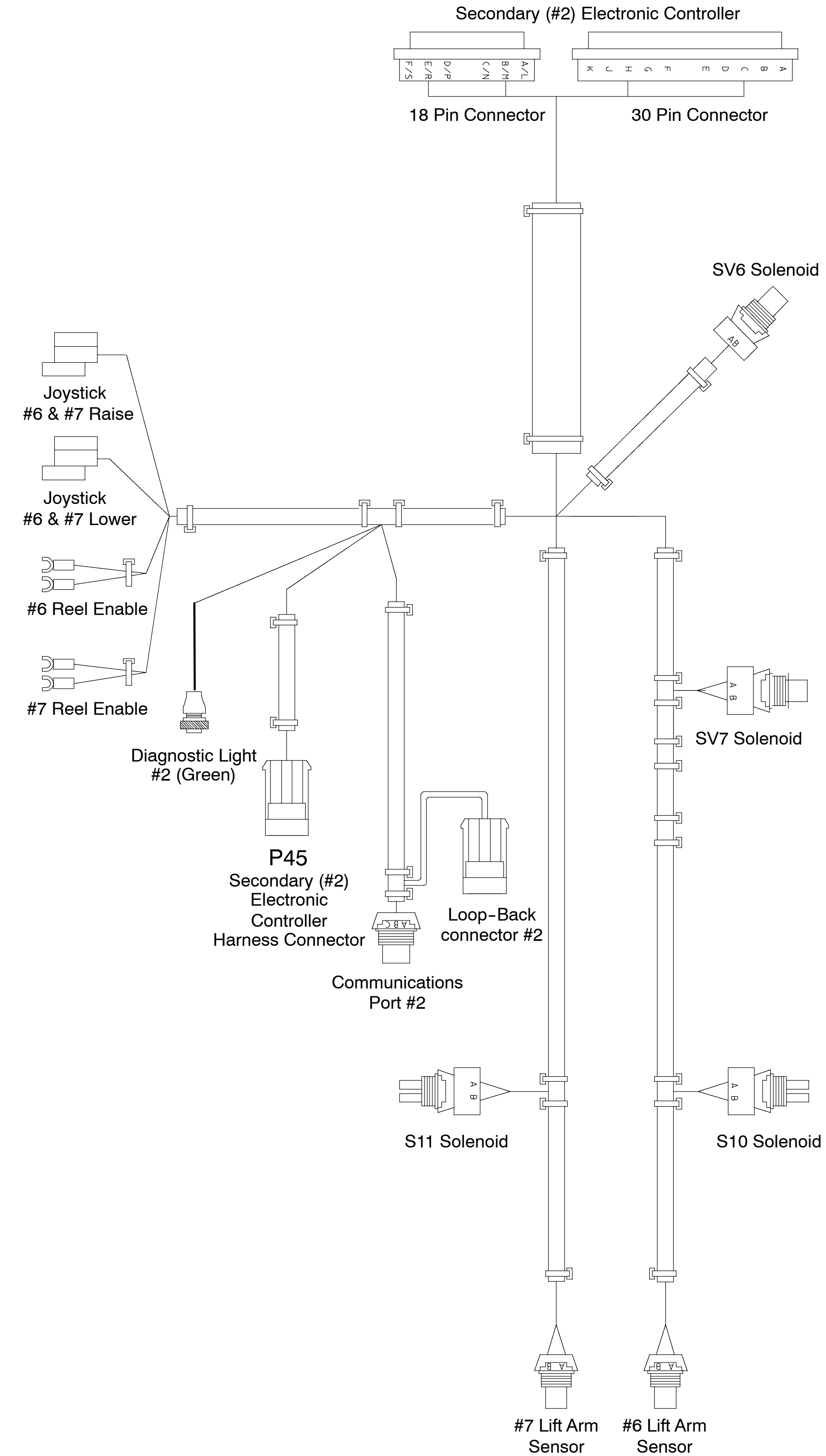
Wire Color
Violet



#7 Reel Enable

Located under the control console

Wire Color
Black



Reelmaster 6700-D
Secondary (#2) Electronic Controller Harness and Electrical Connector Drawing