Part No. 03113SL (Rev F)

Service Manual

(Model 04357)

Greensmaster® 3150

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Greensmaster 3150.

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

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

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

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

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

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Table Of Contents

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Chapter 1

Safety

Table of Contents

Safety Instructions

The GREENSMASTER 3150 was tested and certified by Toro for compliance with national and international standards as specified in the Operator's Manual. 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.

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 all controls and know how to stop quickly. Copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Never allow children to operate the machine. Never allow adults to operate it without proper instructions.

3. Become familiar with the controls, and know how to stop the engine quickly.

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.

5. Always wear substantial shoes. Do not operate machine while wearing sandals, tennis shoes or sneakers. Do not wear loose fitting clothing which could get caught in moving parts and cause personal injury.

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

7. Make sure work area is clear of objects which might be picked up and thrown by the reels.

8. Do not carry passengers on the machine. Keep everyone, especially children and pets, away from the areas of operation.

9. Gasoline (fuel) is highly flammable; handle it carefully.

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

    B. Add fuel before starting the engine. Never remove the cap of the fuel tank or add fuel while the engine is running or when the engine is hot.

    C. Refuel outdoors only and do not smoke while refuelling.

    D. Fill fuel tank to a level no higher than to the bottom of fuel tank filler neck. **Do not overfill.**

    E. Replace all fuel tanks and container caps securely.

    F. If fuel is spilled, do not attempt to start the engine but move the machine away from the area of spillage and avoid creating any source of ignition until fuel vapors have dissipated.

    G. Wipe up any spilled fuel.

While Operating

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

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

12. Check the safety interlock switch daily for proper operation; see Verify Interlock System Operation in Chapter 5 – Electrical System. Replace any malfunctioning switches before operating the machine.

13. To start the engine:

A. Sit on the seat, make sure cutting units are disengaged.

B. Verify that functional control lever is in neutral.

C. Verify that parking brake is set.

D. Proceed to start engine.

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

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

B. Watch for holes or other hidden hazards.

C. Do not drive close to sand traps, ditches, creeks or other hazards.

D. Reduce speed when making sharp turns. Avoid sudden stops and starts.

E. Before backing up, look to the rear to be sure no one is behind the machine.

F. Watch out for traffic when near or crossing roads. Always yield the right–of–way.

G. Apply the service brakes when going downhill to keep forward speed slow and to maintain control of the machine.

15. Keep hands, feet and clothing away from moving parts and the reel discharge area. The grass baskets must be in place during operation of the reels or thatchers for maximum safety. Shut the engine off before emptying the baskets.

16. The GREENSMASTER 3150 has a maximum sound pressure level of 84 dB(A) at the operator's ear. Ear protectors are recommended, for prolonged exposure, to reduce the potential of permanent hearing damage.

17. Raise the cutting units when driving from one work area to another.

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

19. If a cutting unit strikes a solid object or vibrates abnormally, stop immediately, turn engine off, wait for all motion to stop and inspect for damage. A damaged reel or bedknife must be repaired or replaced before operation is continued.

20. Before getting off the seat:

A. Make sure cutting units are disengaged.

B. Verify that functional control lever is in neutral.

C. Set the parking brake.

D. Stop the engine and remove key from ignition switch.

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

22. Operator must be skilled and trained in how to drive on hillsides. Avoid wet slopes. 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.

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

24. **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.

25. Whenever machine is left unattended, make sure cutting units are fully raised and reels are not spinning, key is removed from ignition switch and parking brake is set.

Maintenance and Service

26. Before servicing or making adjustments to the machine, stop the engine, remove key from switch to prevent accidental starting of the engine.

27. Be sure entire machine is in good operating condition. Keep all nuts, bolts, screws and hydraulic fittings tight.

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

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

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

31. To reduce potential fire hazard, keep the engine area free of excessive grease, grass, leaves and accumulation of dirt. Never wash a warm engine or electrical connections with water.

32. Check all fuel lines for tightness and wear on a regular basis, and tighten or repair as needed.

33. If the engine must be running to perform a maintenance adjustment, keep hands, feet, clothing and any other parts of the body away from the cutting units, attachments and any moving parts. Keep everyone away.

34. Do not overspeed the engine by changing governor settings. To assure safety and accuracy, have an Authorized Toro Distributor check maximum engine speed with a tachometer. Maximum governed engine speed should be 2850 $\pm$ 50 RPM.

35. Engine must be shut off before checking oil or adding oil to the crankcase.

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

37. At the time of manufacture, the GREENSMASTER 3150 conformed to safety standards in effect for riding mowers. To make sure of optimum performance and continued safety certification of the machine, use genuine TORO replacement parts and accessories. Replacement parts and accessories made by other manufacturers could be dangerous, and such use could void the product warranty of The Toro Company.

38. When changing attachments, tires, or performing other service, use correct blocks, hoists, and jacks. Make sure machine is parked on a solid level floor such as a concrete floor. Prior to raising the machine, remove any attachments that may interfere with the safe and proper raising of the machine. Always chock or block wheels. Use jack stands or 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, which may result in personal injury.

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the traction unit and the cutting units of the Greensmaster 3150. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in your Parts Catalog and Operator's Manual. Order replacement decals from your Authorized Toro Distributor.

Chapter 2

Product Records and Maintenance

Product Records and Maintenance

Table of Contents

Product Records

Insert a copy of the Operator's Manual and Parts Catalog for your Greensmaster 3150-D at the end of this chapter. Additionally, if any optional equipment or accessories have been installed to your machine, insert the Installation Instructions, Operator's Manuals and Parts Catalogs for those options at the end of this chapter.

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

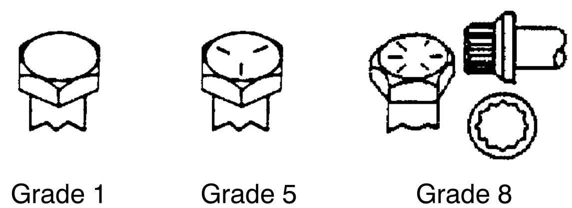
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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.

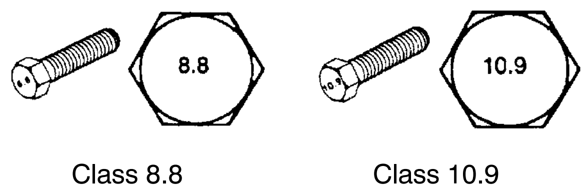
The standard method of verifying torque shall be performed by marking a line on the fastener (head or nut) and mating part, then back off fastener 1/4 of a turn. Measure the torque required to tighten the fastener until the lines match up.

Fastener Identification



Inch Series Bolts and Screws

Figure 1



Metric Bolts and Screws

Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

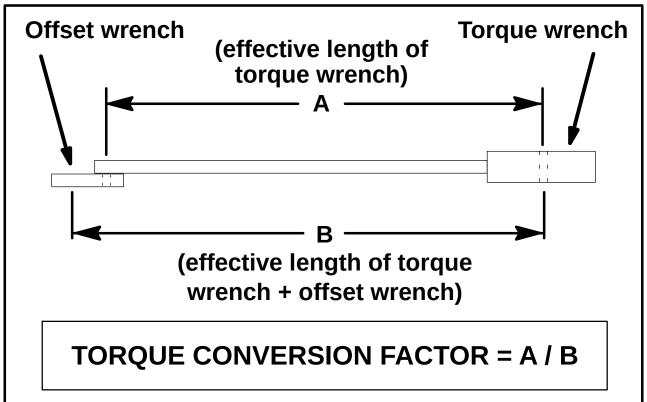


Figure 3

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

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

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

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

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

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

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

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

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

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)

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

Maintenance

Maintenance procedures and recommended service intervals for the Greensmaster 3150 are covered in the Traction Unit Operator's Manual. Maintenance procedures and recommended service intervals for the Greensmaster Cutting Units are covered in the Cutting Unit Operator's Manual. Refer to these publications when performing regular equipment maintenance. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

Chapter 3

Engine

Table of Contents

Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the engine used in the Greensmaster 3150.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton Repair Manual for 4-Cycle V-Twin Cylinder OHV Head Engines. 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 Briggs & Stratton Vanguard V-Twin OHV engines are supplied through your local Briggs and Stratton dealer or 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	Briggs and Stratton Vanguard V-Twin OHV, air cooled, gas engine with cast iron cylinder sleeves Model 350447
Fuel	Unleaded Regular Gasoline (85 Pump Octane Minimum)
Low Idle (no load)	1650 $\pm$ 100 RPM
High Idle (no load)	2850 $\pm$ 50 RPM
Engine Oil	SAE 30 SG, SH, or SJ
Crankcase Oil Capacity qt. (liters)	1.75 (1.65) with filter

Service and Repairs

Fuel Tank

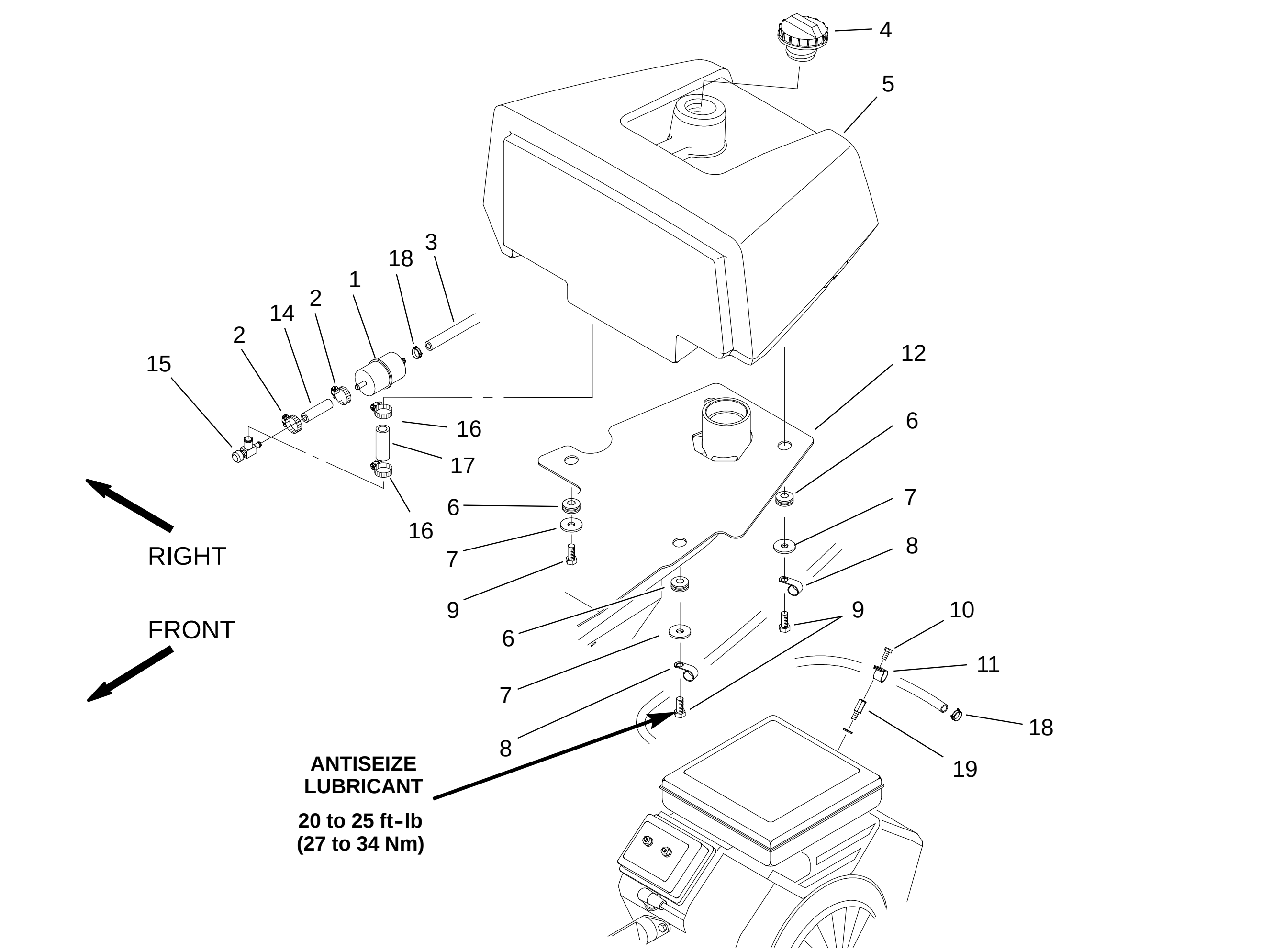


Figure 4

1. Fuel filter
2. Hose clamp
3. Fuel hose (filter to engine)
4. Fuel cap
5. Fuel Tank
6. Grommet
7. Flat washer
8. Hose support clamp
9. Cap screw
10. Cap screw
11. Hose support clamp
12. Vehicle frame
13. Not used
14. Fuel hose (shut-off valve to filter)
15. Fuel shut-off valve
16. Hose clamp
17. Fuel hose (tank to shut-off valve)
18. Hose clamp
19. Spacer

Fuel Tank Removal (Fig. 4)

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

CAUTION

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

DANGER

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

2. Drain fuel tank (5) as follows:

   A. Close fuel shut-off valve (15).

   B. Disconnect fuel hose (14) at the fuel shut-off valve and drain any fuel trapped in the fuel filter and fuel hose into a suitable container.

   C. Install one end of a spare length of fuel hose to the fuel shut-off valve, and place the other end of the hose into a suitable container for draining the tank.

   D. Drain fuel tank completely by opening the fuel shut off valve.

   E. Remove the spare length of fuel hose from the fuel shut-off valve.

3. If machine is equipped with a fuel evaporative control system, disconnect vent hose from fuel vent valve (Fig. 5).

4. Remove four cap screws (9), flat washers (7) and grommets (6) securing the fuel tank to the vehicle frame (12). Remove the fuel tank from the vehicle frame.

Fuel Tank installation (Fig. 4)

1. Position fuel tank (5) on the vehicle frame (12).

   A. Apply antiseize lubricant to the threads of the four cap screws (9).

   B. Secure the fuel tank to the vehicle frame with four grommets (6), flat washers (7) and cap screws (9). Make sure the fuel hose support clamps (8) are positioned correctly.

   C. Torque cap screws from **20 to 25 ft-lb (27 to 34 Nm)**.

2. Connect fuel hose (14) to the fuel shut-off valve (15) with hose clamp (2).

3. If machine is equipped with a fuel evaporative control system, connect vent hose to fuel vent valve (Fig. 5).

4. Open fuel shut-off valve (15) and fill fuel tank with fuel (see Filling Fuel Tank in the Traction Unit Operator's Manual). Check all fuel hoses and tank for leaks.

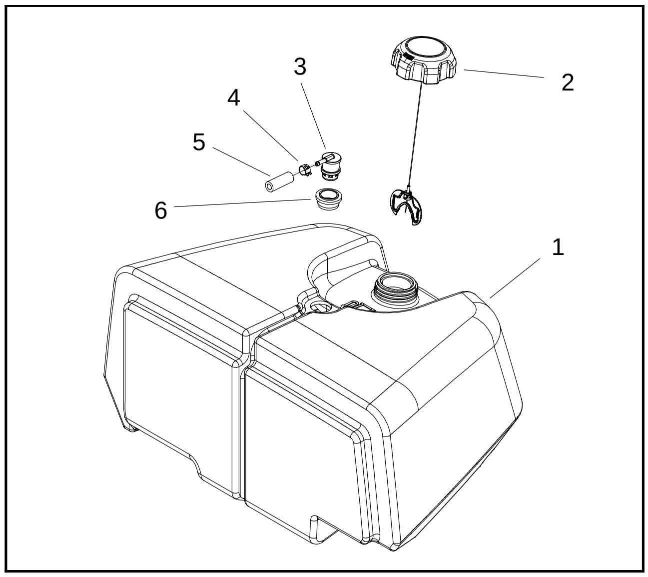


Figure 5

1. **Fuel tank**
2. **Fuel cap**
3. **Fuel vent valve**
4. **Hose clamp**
5. **Vent hose**
6. **Grommet**

Engine

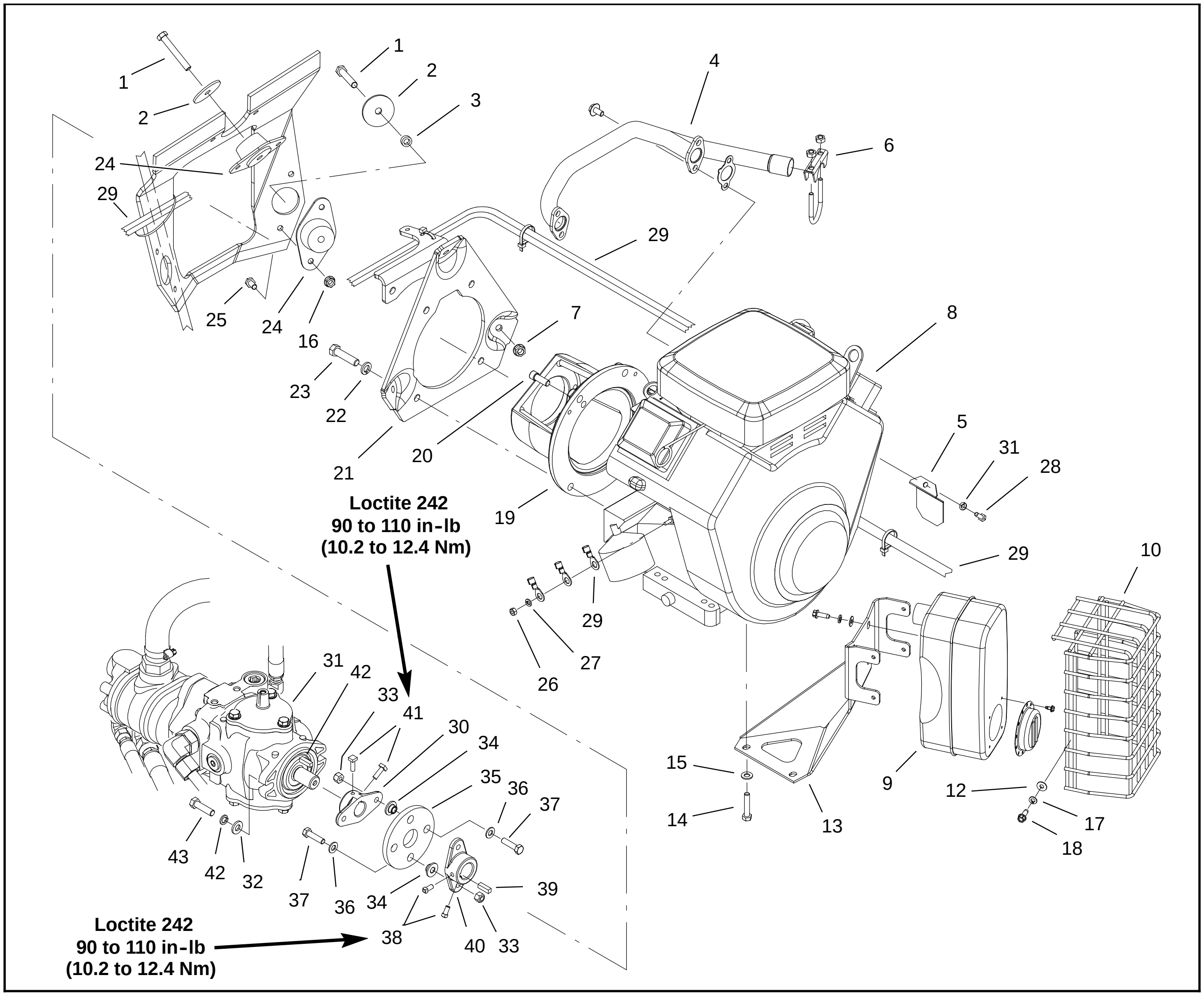


Figure 6

1. **Cap screw (3 used)**
2. **Flat washer (3 used)**
3. **Spacer (3 used)**
4. **Exhaust manifold**
5. **Regulator shield**
6. **Muffler clamp**
7. **Hex nut (3 used)**
8. **Engine assembly**
9. **Muffler**
10. **Muffler shield**
11. **Ground wires**
12. **Flat washer**
13. **Muffler support bracket**
14. **Cap screw (4 used)**
15. **Flat washer (4 used)**
16. **Hex flange nut**
17. **Lock washer**
18. **Screw**
19. **Pump adapter**
20. **Screw (2 used)**
21. **Engine mount plate**
22. **Lock washer (2 used)**
23. **Cap screw (2 used)**
24. **Engine mount (3 used)**
25. **Cap screw**
26. **Hex nut**
27. **Spring washer**
28. **Cap screw**
29. **Engine wire harness**
30. **Pump hub**
31. **Hydraulic pump assembly**
32. **Hardened washer**
33. **Lock nut**
34. **Coupling spacer**
35. **Rubber coupling**
36. **Flat washer**
37. **Cap screw**
38. **Square head set screw**
39. **Key**
40. **Engine hub**
41. **Square head set screw**
42. **Lock washer**
43. **Cap screw**
44. **Key**

Engine Removal (Fig. 6)

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

2. Disconnect negative (–) battery cable from battery.

CAUTION

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

DANGER

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

3. Close shut–off valve on fuel tank. Disconnect fuel supply hose at the fuel pump. Drain any fuel trapped in the fuel filter and fuel hose into a suitable container.

4. If machine is equipped with a fuel evaporative control system, disconnect system hose(s) from engine (see Fuel Evaporative Control System (Serial Number Above 310000365) in this section).

5. Disconnect engine wiring harness (29), choke control cable, throttle control cable, and ground wires (11) at the engine.

6. Loosen the two set screws (38) securing the engine hub (40) to the engine shaft.

7. Support the hydraulic pump assembly and remove the two cap screws (43) lock washers (42) and hardened washers (32) securing the pump to the pump adapter (19). **Do Not** disconnect the hydraulic hoses or neutral control linkage from the pump.

8. Support the engine assembly and remove the three engine mount flange nuts (7), cap screws (1), flat washers (2), and spacers (3).

9. Carefully move the engine away from the hydrostat until the crankshaft clears the engine hub. Remove the engine from the machine. Locate and retrieve key from crankshaft.

Engine Installation (Fig. 6)

1. Apply antiseize lubricant to bore of engine hub. Place key into slot on the engine crankshaft.

IMPORTANT: Make sure to not damage engine, fuel hose, hydraulic hoses, electrical harness and wires, control cables, or other parts while installing the engine. Make sure engine hub is in position before installing the engine mount cap screws.

2. Align the engine hub (30) with the engine shaft and key (42). Slide crankshaft into hub and move engine until the engine mount plate (21) is aligned with the three engine mounts (24). Take care to not damage the hydrostat coupler during engine installation.

3. Install the three engine mount flange nuts (7), cap screws (1), flat washers (2), and spacers (3). Torque cap screws from **27 to 33 ft–lb (36 to 45 Nm)**.

4. Mount the hydraulic pump assembly to the pump adapter (19) using two cap screws (43) lock washers (42) and hardened washers (32). Torque cap screws from **27 to 33 ft–lb (36 to 45 Nm)**.

5. Position engine hub on crankshaft to best align the rubber coupling.

6. Apply Loctite #242 (or equivalent) to threads of engine hub set screws (38). Secure hub to crankshaft with two set screws. Torque set screws from **90 to 110 in–lb (10.2 to 12.4 Nm)**.

7. Connect the engine wiring harness (29) and ground wires (11) to the engine.

8. Connect and adjust the choke and throttle control cables (see Traction Unit Operator's Manual).

9. Connect fuel supply hose to the fuel pump and secure with hose clamp.

10. If machine is equipped with a fuel evaporative control system, connect system hose(s) to engine (see Fuel Evaporative Control System (Serial Number Above 310000365) in this section).

11. Secure negative (–) battery cable to battery.

12. Open shut–off valve on fuel tank and fill fuel tank with fuel. Check fuel hose for leaks.

13. Check and adjust oil level in engine.

14. Start the engine and check for proper engine operation.

Fuel Evaporative Control System (Serial Number Above 310000365)

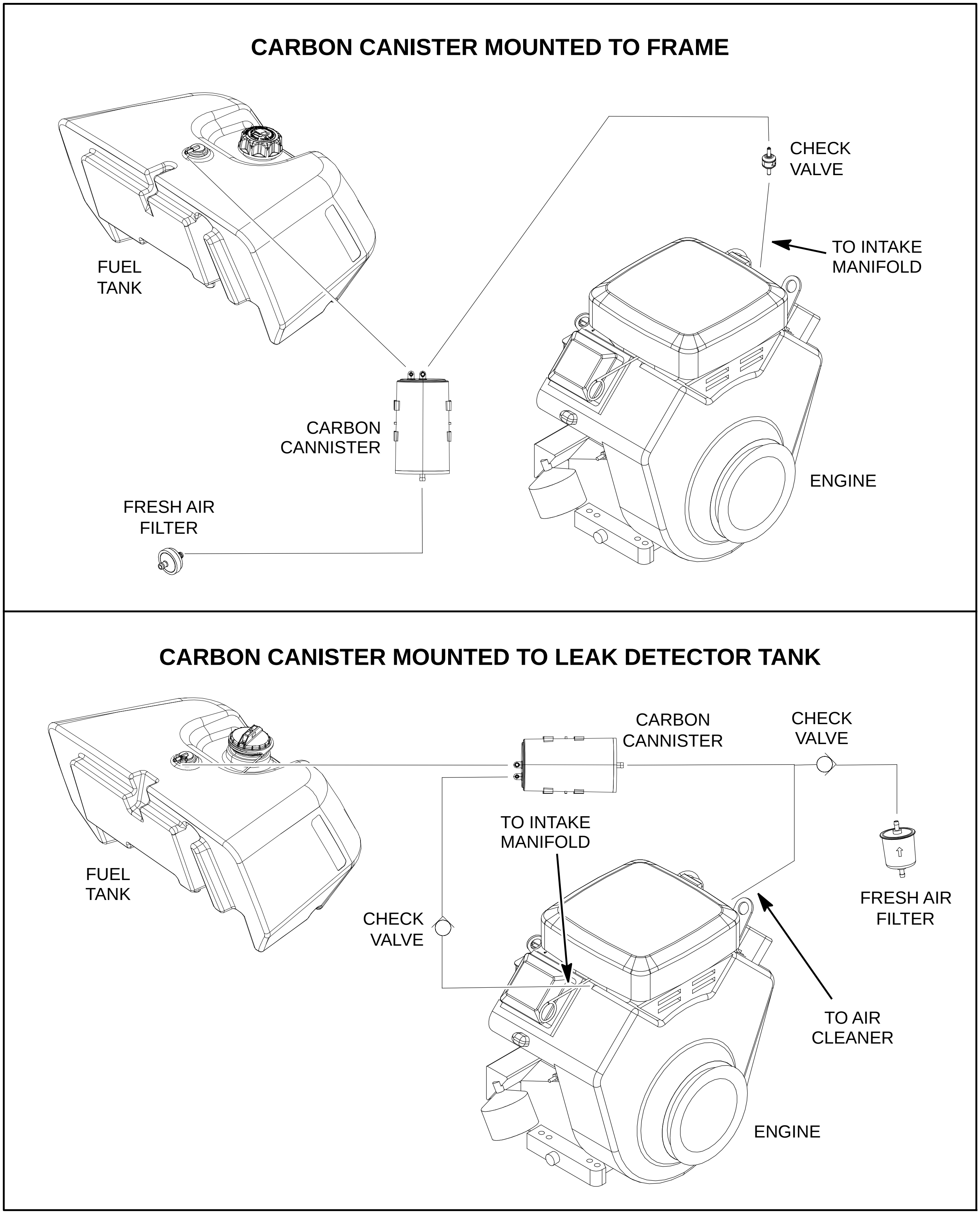


Figure 7

Greensmaster 3150 machines with serial number above 310000365 are equipped with a fuel evaporative control system (EVAP) designed to collect and store evaporative emissions from the fuel tank. The EVAP uses a carbon cannister to collect these evaporative emissions. Fuel vapors from the fuel tank are vented to the canister where they are stored. Vapors from the canister are consumed when the engine is running which purges the canister.

The fuel tank on these Greensmaster 3150 machines uses a non-vented fuel cap. To connect the tank to the evaporative control system, a fuel vent valve is positioned in the top of the tank that allows tank venting through the carbon cannister.

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

Greensmaster 3150 machines have used two (2) locations for the carbon canister. Components used in the evaporative control system on these systems have some differences besides the canister location. Figure 7 illustrates the components used in the evaporative control system.

Machines with a frame mounted carbon canister include a single engine connection at the engine intake manifold that is used to connect the evaporative system to the engine. These machines use an inline check valve between the carbon cannister and the engine intake manifold fitting. Evaporative control system components for these machines are shown in Figure 8.

Machines with a carbon canister mounted to the top of the leak detector tank include two (2) connections to the engine: one to the intake manifold and the second to the air cleaner base. Venting hose assemblies (purge hose assembly and t-hose assembly) include check valves in two (2) locations. Evaporative control system components for these machines are shown in Figure 9.

Note: On machines with the canister mounted to the leak detector tank, the purge hose assembly (item 5 in Fig. 9) and tee hose assembly (item 10 in Fig. 9) both include a check valve as a component of the hose assembly. The check valve is not available as a separate part. To ensure proper operation of check valves, do not attempt to remove them from the hose assembly. If either of these hose assemblies is removed, make sure that they are correctly installed to ensure proper operation of the evaporative control system.

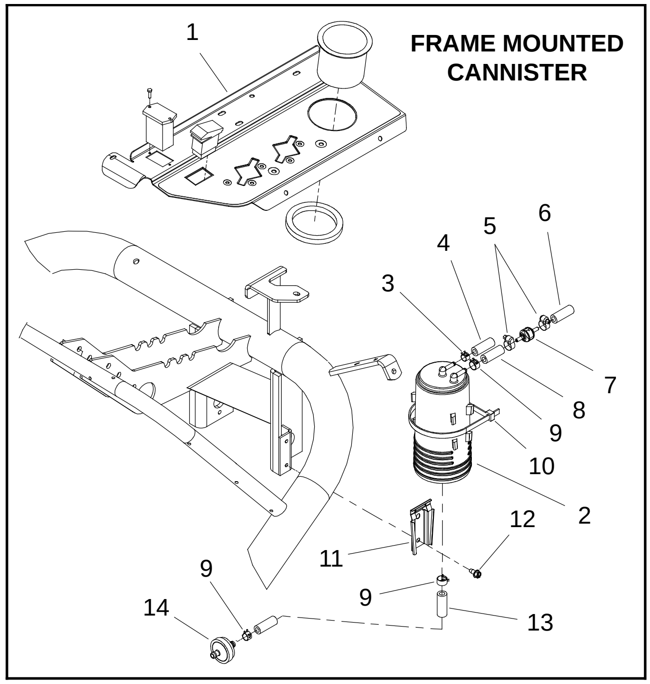


Figure 8

1. Control panel
2. Carbon cannister
3. Hose clamp
4. Hose (to fuel tank valve)
5. Hose clamp (2 used)
6. Hose (to intake manifold)
7. Check valve
8. Hose
9. Hose clamp (2 used)
10. Cable tie
11. Bracket
12. Screw (2 used)
13. Hose
14. Fresh air filter

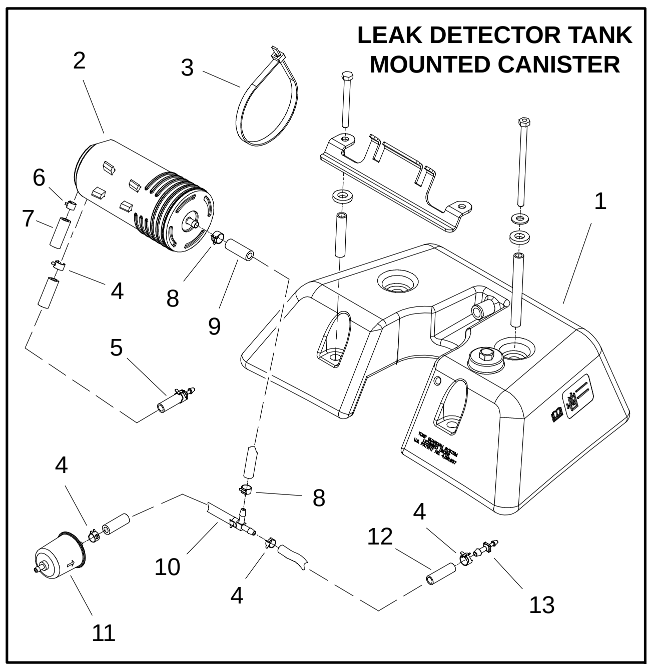


Figure 9

1. Leak detector tank
2. Carbon cannister
3. Cable tie (2 used)
4. Hose clamp
5. Purge hose assembly
6. Hose clamp
7. Hose (to fuel tank valve)
8. Hose clamp
9. Hose (to t-fitting)
10. T-hose assembly
11. Fresh air filter
12. Hose (to air cleaner)
13. Barbed fitting

Disassembly

DANGER

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

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

2. Remove components as needed using Figure 8 or 9 as a guide.

A. On machines with frame mounted carbon canister, if check valve (item 7 in Fig. 8) is removed, note direction of arrow on valve body for assembly purposes.

B. On machines with the carbon canister mounted to the leak detector tank, if either purge hose assembly (item 5 in Fig. 9) or T–hose assembly (item 10 in Fig. 9) is to be removed, label ends of hose for assembly purposes. Both of these assemblies include a check valve so direction of installation is important for correct operation of the evaporative control system. The check valve is not available as a separate part so hose assembly replacement is necessary if the check valve or hose is faulty. To ensure proper operation of check valves, do not attempt to remove the check valve from the hose assembly.

Assembly

1. Install all removed components using Figure 8 or 9 as a guide.

A. On machines with frame mounted carbon canister, if check valve (item 7 in Fig. 8) was removed, make sure that arrow on valve body points toward engine.

B. On machines with the carbon canister mounted to the leak detector tank, if either purge hose assembly (item 5 in Fig. 9) or T–hose assembly (item 10 in Fig. 9) was removed, make sure that installation is correct.

C. Make sure that evaporative system fuel hoses are not kinked after installation. Also, secure all hoses with hose clamps.

Hydraulic System

Table of Contents

Specifications

Item	Description
Hydrostatic Transmission (P3) Maximum Flow Charge Pressure (R4)	Variable displacement piston pump 14.8 GPM (55.8 LPM) @ 2800 RPM and 98 % Efficiency 100 to 150 PSI (6.9 to 10.4 bar)
Gear Pump Front Section to Reel Circuit (P1) Maximum Flow Rear Section to Steering and Lift Circuits (P2) Maximum Flow	2 stage positive displacement gear type pump 6.9 GPM (26.1 LPM) @ 2800 RPM and 98 % Efficiency 3.7 GPM (13.9 LPM) @ 2800 RPM and 98 % Efficiency
Wheel Motors (Front)	Orbital rotor motor
Wheel Motor (Optional Rear)	Orbital rotor motor
Reel Motor	Gear motor
Steering Control Valve	Distributor valve with rotary meter
Implement (Steering and Lift) Relief Pressure (R5)	1150 PSI (79.4 bar) over Charge Pressure
Hydraulic Manifold Relief Valves Mow Circuit (R1) Cutting Unit Lower (R2)	 2400 PSI (166 bar) 300 PSI (21.0 bar) over Charge Pressure
Hydraulic Filter	5 Micron spin-on cartridge type
Hydraulic Oil	See Operator's Manual
Hydraulic Reservoir	Reservoir (with leak detector) capacity 8.5 gal. U.S. (32.0 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 and maintenance. These conditions can cause hose damage and deterioration. Some hoses are more susceptible to these conditions than others. Inspect all machine hydraulic hoses frequently for signs of deterioration or damage:

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 8. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance).

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

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

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

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

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

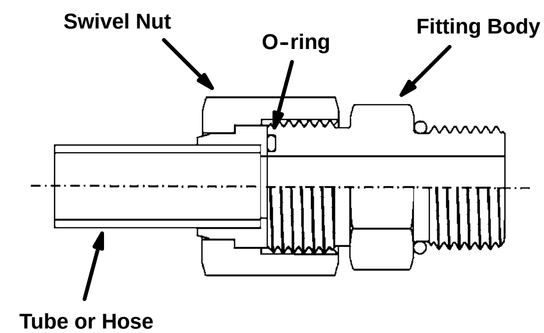


Figure 6

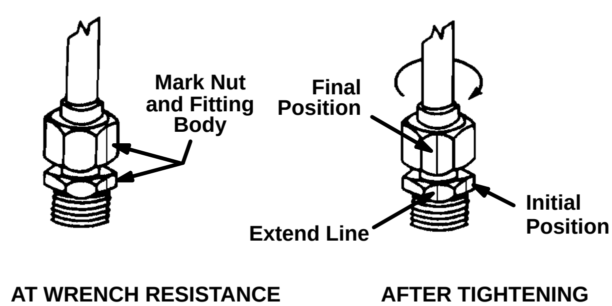


Figure 7

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

Figure 8

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

Non-Adjustable Fitting (Fig. 9)

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

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

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

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

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 10.

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

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

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

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

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

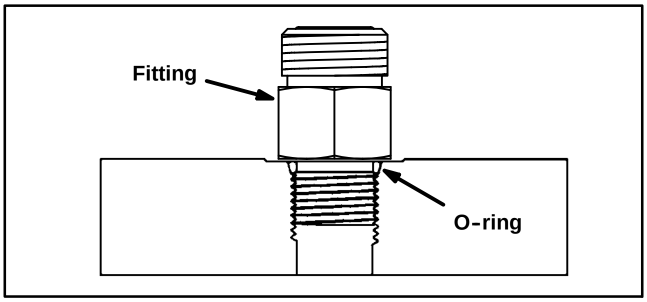


Figure 9

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

Figure 10

Adjustable Fitting (Fig. 11)

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

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

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

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 12).

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

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

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

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the fitting to the recommended installation torque shown in Figure 10. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 - Product Records and Maintenance).

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

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

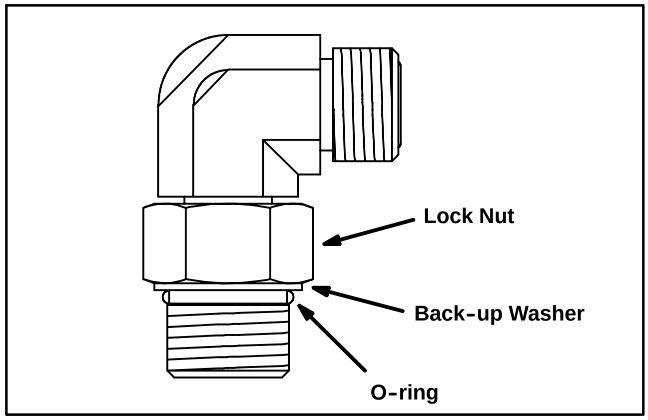


Figure 11

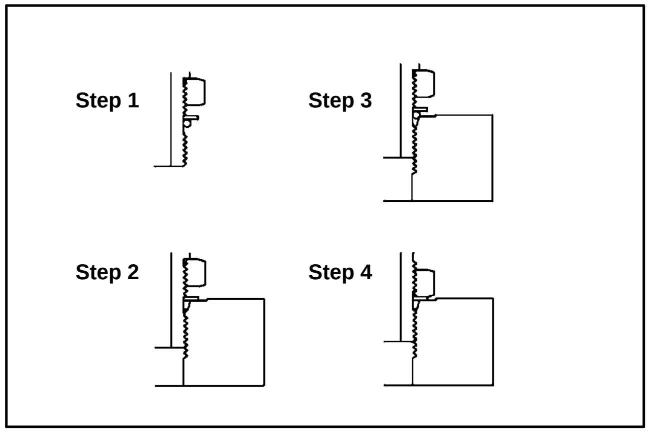
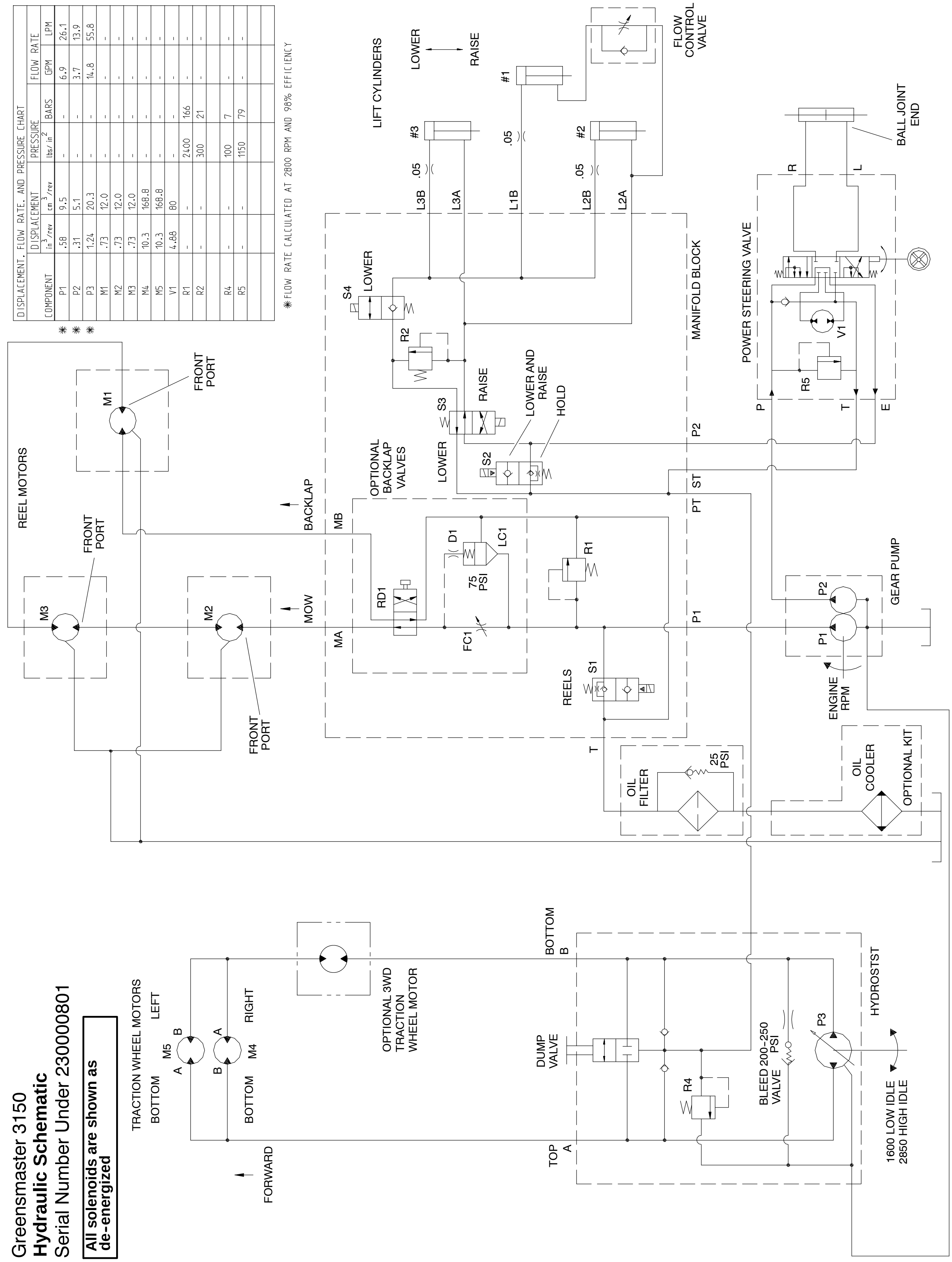


Figure 12

Hydraulic Schematics



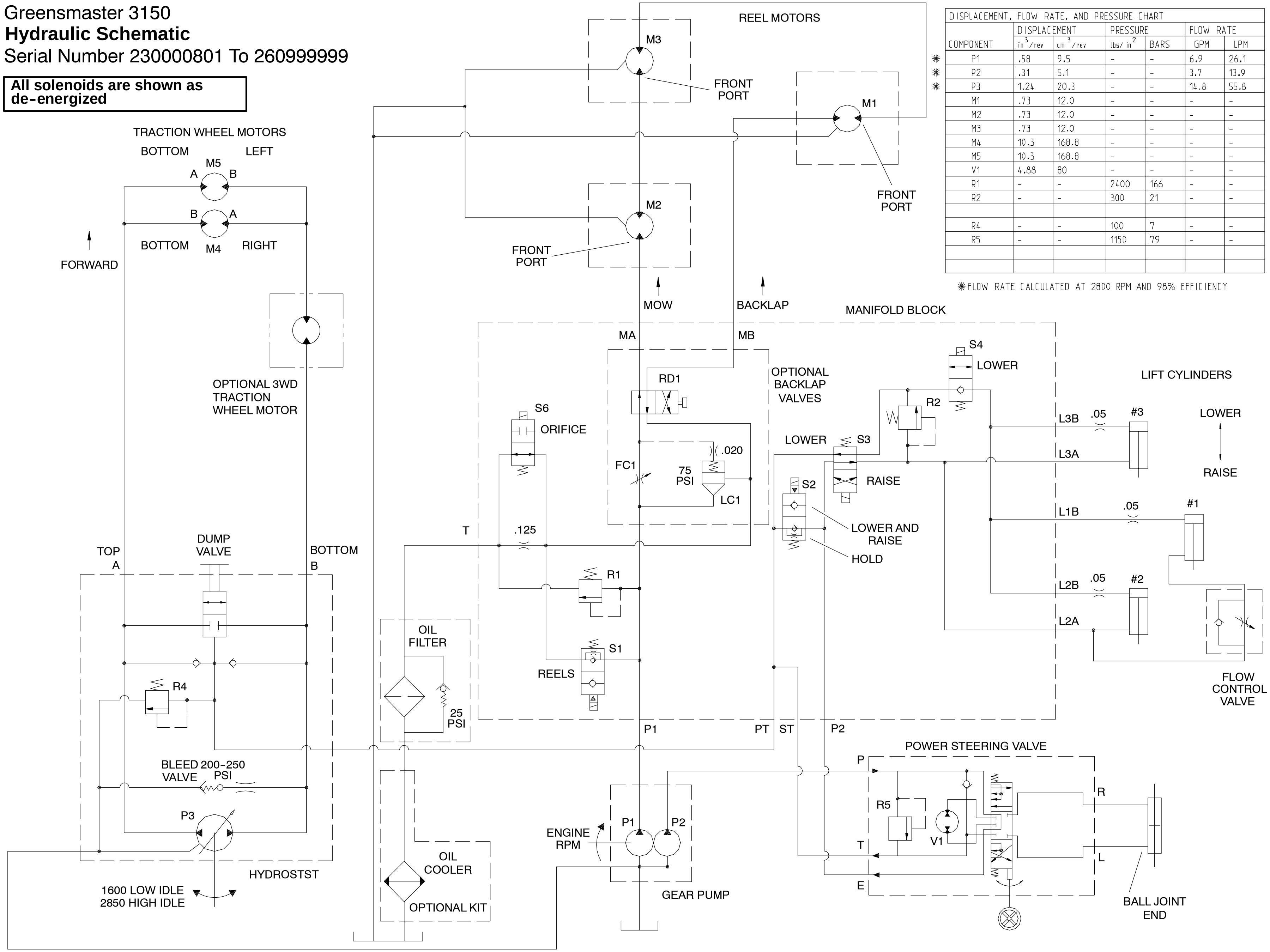
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT in^3/rev	DISPLACEMENT cm^3/rev	PRESSURE lbs/in^2	PRESSURE BARS	FLOW RATE GPM	FLOW RATE LPM
* P1	.58	9.5	-	-	6.9	26.1
* P2	.31	5.1	-	-	3.7	13.9
* P3	1.24	20.3	-	-	14.8	55.8
M1	.73	12.0	-	-	-	-
M2	.73	12.0	-	-	-	-
M3	.73	12.0	-	-	-	-
M4	10.3	168.8	-	-	-	-
M5	10.3	168.8	-	-	-	-
V1	4.88	80	-	-	-	-
R1	-	-	2400	166	-	-
R2	-	-	300	21	-	-
R4	-	-	100	7	-	-
R5	-	-	1150	79	-	-

* FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY

Greensmaster 3150
Hydraulic Schematic
Serial Number 230000801 To 260999999

All solenoids are shown as de-energized



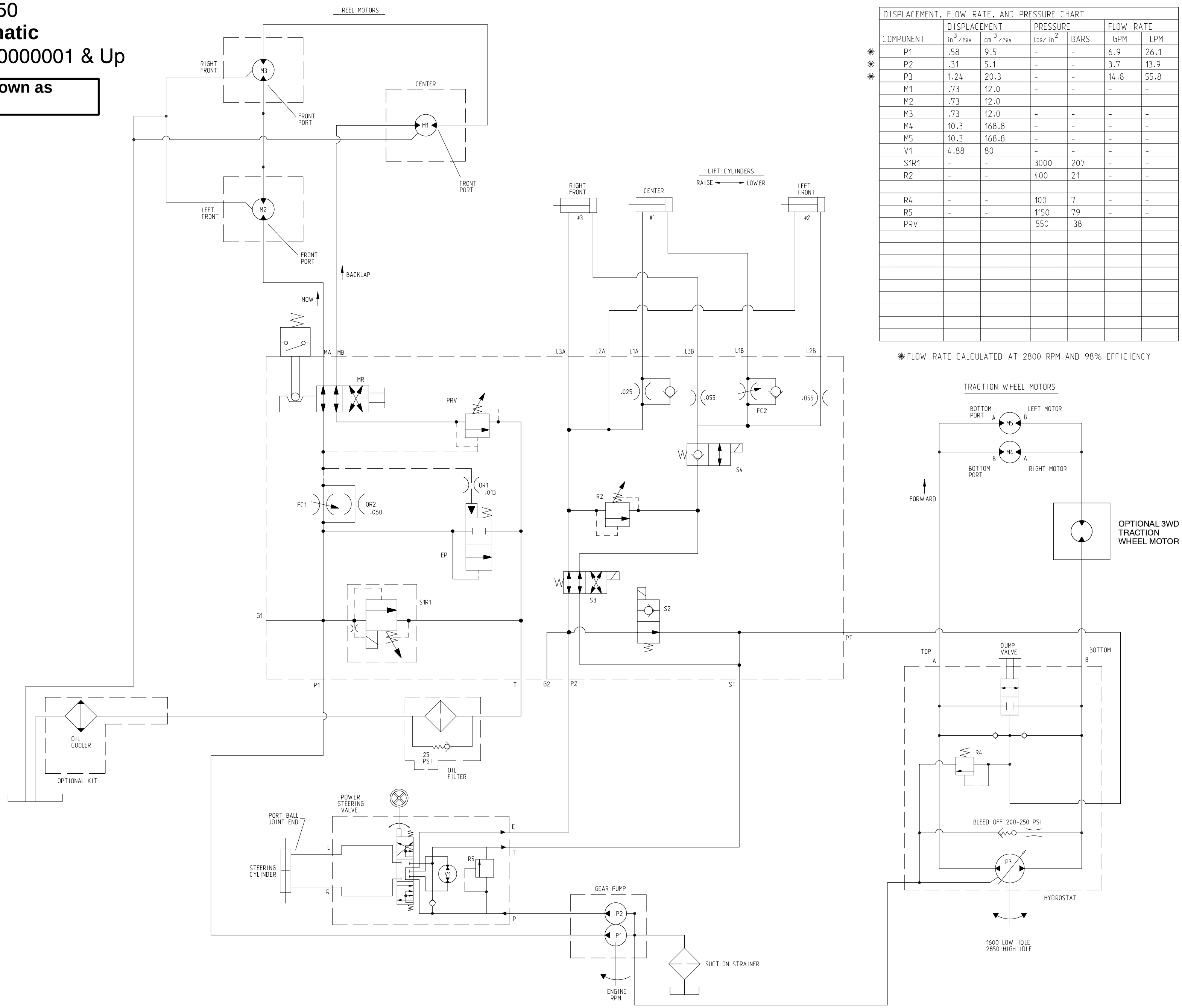
DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT in^3/rev	DISPLACEMENT cm^3/rev	PRESSURE lbs/in^2	PRESSURE BARS	FLOW RATE GPM	FLOW RATE LPM
* P1	.58	9.5	-	-	6.9	26.1
* P2	.31	5.1	-	-	3.7	13.9
* P3	1.24	20.3	-	-	14.8	55.8
M1	.73	12.0	-	-	-	-
M2	.73	12.0	-	-	-	-
M3	.73	12.0	-	-	-	-
M4	10.3	168.8	-	-	-	-
M5	10.3	168.8	-	-	-	-
V1	4.88	80	-	-	-	-
R1	-	-	2400	166	-	-
R2	-	-	300	21	-	-
R4	-	-	100	7	-	-
R5	-	-	1150	79	-	-

* FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY

Greensmaster 3150
Hydraulic Schematic
Serial Number 270000001 & Up

All solenoids are shown as de-energized

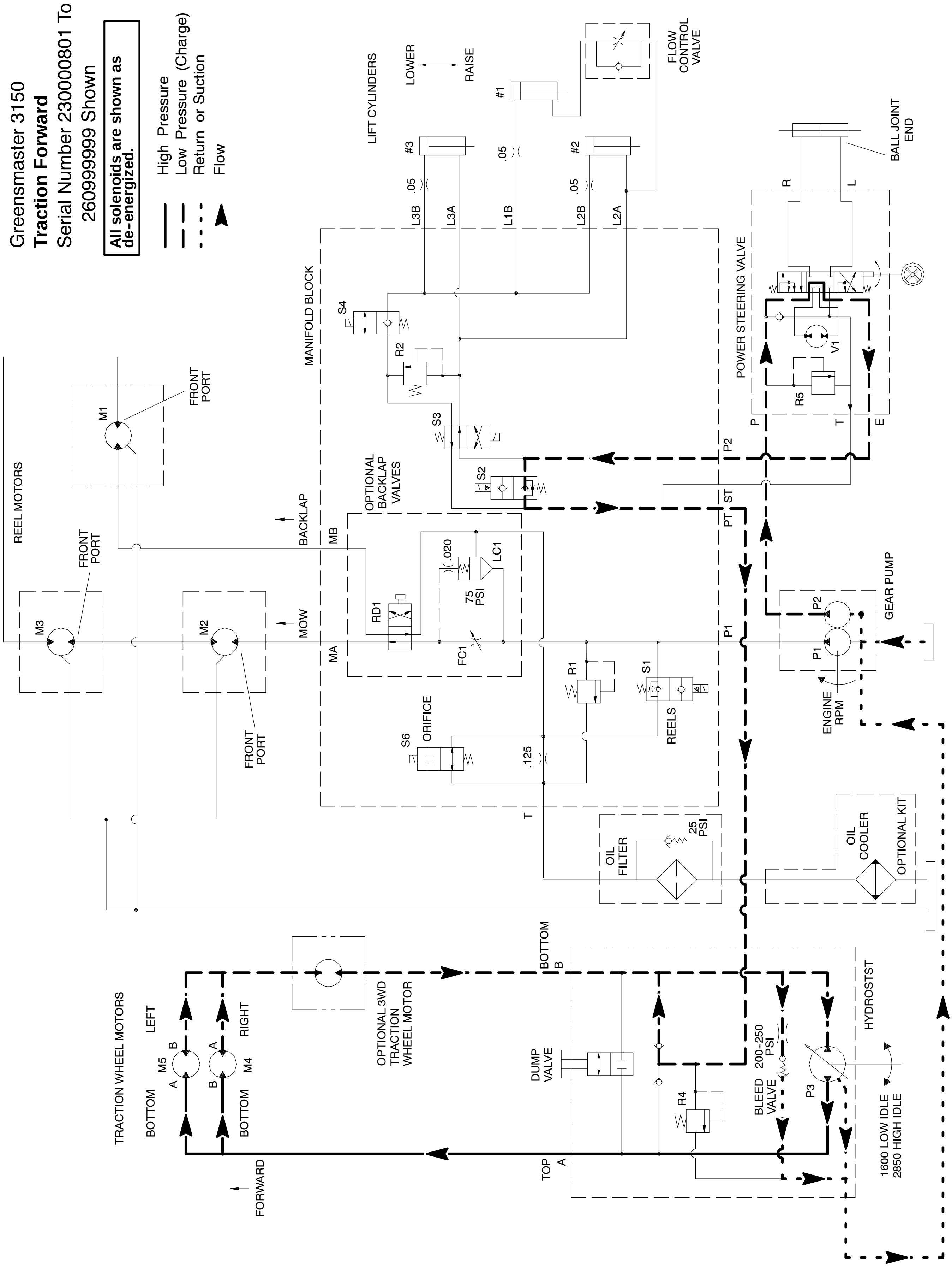


DISPLACEMENT, FLOW RATE, AND PRESSURE CHART							
		DISPLACEMENT		PRESSURE		FLOW RATE	
	COMPONENT	in^3/rev	cm^3/rev	lbs/in^2	BARS	GPM	LPM
✳	P1	.58	9.5	-	-	6.9	26.1
✳	P2	.31	5.1	-	-	3.7	13.9
✳	P3	1.24	20.3	-	-	14.8	55.8
	M1	.73	12.0	-	-	-	-
	M2	.73	12.0	-	-	-	-
	M3	.73	12.0	-	-	-	-
	M4	10.3	168.8	-	-	-	-
	M5	10.3	168.8	-	-	-	-
	V1	4.88	80	-	-	-	-
	S1R1	-	-	3000	207	-	-
	R2	-	-	400	21	-	-
	R4	-	-	100	7	-	-
	R5	-	-	1150	79	-	-
	PRV			550	38		

✳ FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY

Hydraulic System

Hydraulic Flow Diagrams



Traction Forward and Reverse

Forward

The hydrostat is driven directly by the engine. The traction circuit of the hydraulic system acts essentially as a closed loop. Taking its suction directly from the return side of the wheel motors of the traction circuit, the hydrostat supplies oil flow to the wheel motors through the supply side of the traction circuit.

With the engine running and traction pedal in the neutral position, the hydrostat supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the linkage from the pedal positions the swash plate in the hydrostat so oil flows out the top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the forward direction.

Oil flowing out of the wheel motors returns to the bottom port of the hydrostat and is continuously pumped out the top port.

Hydraulic oil is supplied to the traction circuit from the gear pump (P2) though the steering control valve and back through the charge circuit check valves. This oil replaces oil losses from flow through the internal case drain, internal bleed valve, and small amounts of leakage. Charge circuit pressure is maintained by the charge relief valve (R4) that is attached to the hydrostat back plate.

Reverse

The traction circuit operates essentially the same in reverse as it does in the forward direction. However, the flow through the circuit is reversed.

With the engine running and traction pedal in the neutral position, the hydrostat supplies no flow to the wheel motors. When the traction pedal is pressed to the reverse position, the linkage from the pedal positions the swash plate in the hydrostat so oil flows out the bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the reverse direction.

Oil flowing out of the wheel motors returns to the top port of the hydrostat and is continuously pumped out the bottom port.

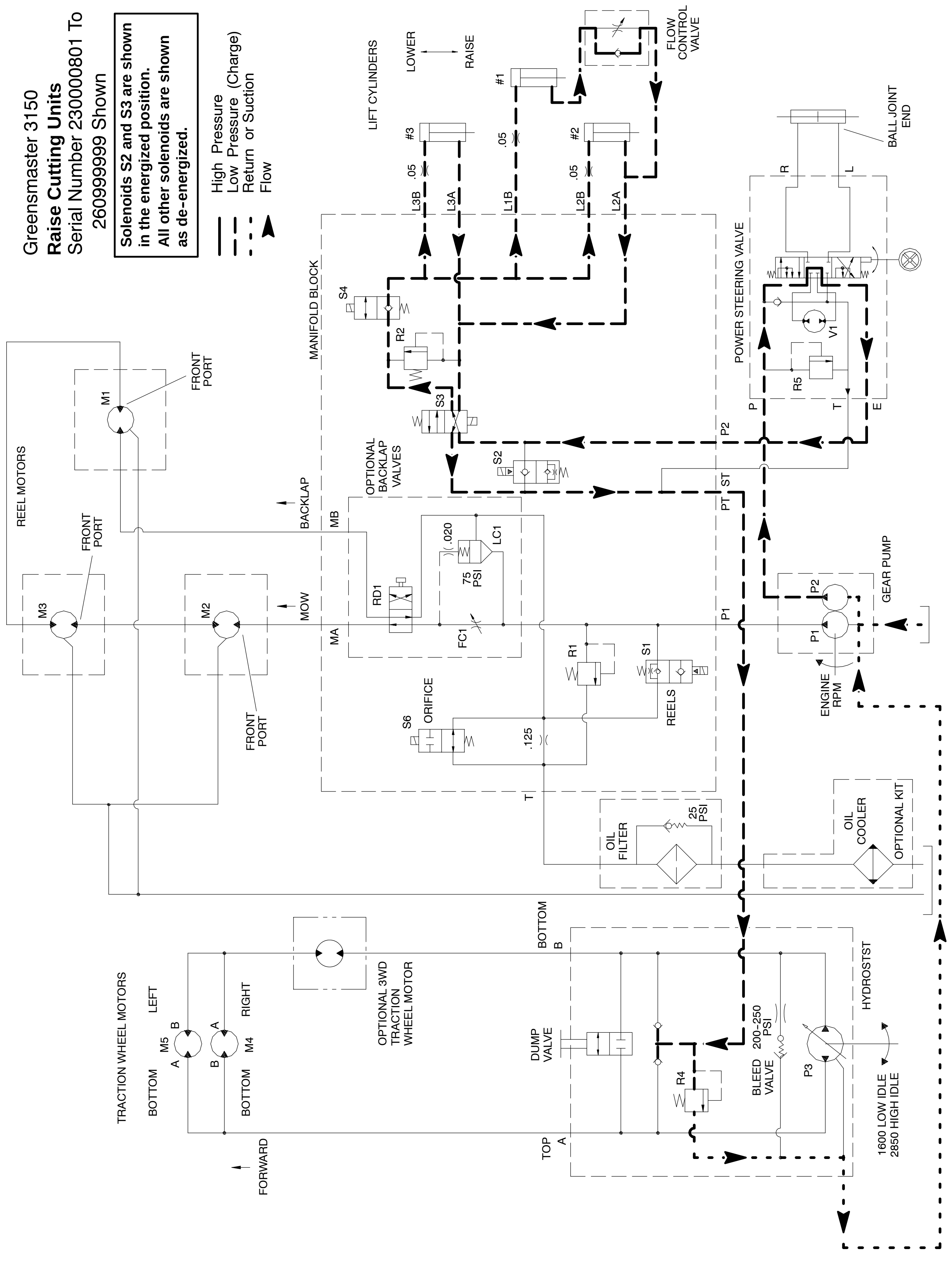
The charge circuit functions the same in reverse as it did in the forward direction.

Traction Circuit Cooling

The traction circuit is cooled by a bleed off circuit in the hydrostat. The bleed off circuit includes an internal bleed valve which allows about 1 gpm of hydraulic oil to pass from the reverse side of the hydrostat while operating the traction unit in the forward direction. The internal bleed valve closes when operating the traction in the reverse direction.

Note: The bleed valve threads into the hydrostat back plate. Access to the bleed valve requires removal of the back plate from the hydrostat.

Note: While operating the traction unit in the reverse direction under light loads, a slight surge in ground speed may be experienced.


Greensmaster 3150
Raise Cutting Units
Serial Number 230000801 To 260999999 Shown
Solenoids S2 and S3 are shown in the energized position. All other solenoids are shown as de-energized.
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDERS
LOWER
RAISE
FLOW CONTROL VALVE
#1
#2
#3
.05
L3B
L3A
L1B
L2B
L2A
BALL JOINT END
R
L
MANIFOLD BLOCK
S4
R2
S3
S2
POWER STEERING VALVE
V1
R5
P
T
E
P2
ST
PT
P1
REEL MOTORS
M1
M2
M3
FRONT PORT
BACKLAP
MOW
MB
MA
OPTIONAL BACKLAP VALVES
RD1
.020
LC1
75 PSI
FC1
R1
S1
S6
ORIFICE
.125
REELS
T
GEAR PUMP
ENGINE RPM
OIL FILTER
25 PSI
OIL COOLER
OPTIONAL KIT
BOTTOM
B
TOP
A
TRACTION WHEEL MOTORS
LEFT
RIGHT
M5
M4
FORWARD
OPTIONAL 3WD TRACTION WHEEL MOTOR
DUMP VALVE
R4
200–250 PSI
BLEED VALVE
P3
HYDROSTST
1600 LOW IDLE
2850 HIGH IDLE

Raise and Lower Cutting Units (Serial Number Under 260999999)

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure for raising and lowering the cutting units, for the steering circuit, and for maintaining 100 to 150 PSI (6.9 to 10.0 bar) to the low pressure side of the traction circuit (charge pressure). The gear pump (P2) takes its suction from the hydraulic reservoir. Maximum circuit pressure is limited by relief valve (R5) which is located in the steering control valve.

During cutting unit hold (not raising or lowering) conditions, flow from the gear pump is by–passed through the steering control valve and solenoid valve (S2) directly to the hydrostat and the charge relief valve (R4). Flow then returns to the hydraulic reservoir.

Raise Cutting Units

When the cutting units are to be raised, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to energized solenoid valve (S3), which directs flow to de–energized solenoid valve (S4) and the lift cylinders. Hydraulic pressure against the cylinder pistons moves their shafts causing the cutting units to raise. At the same time, the pistons push the hydraulic fluid out of the lift cylinders and back through solenoid valves (S3) to the hydrostat.

When the solenoid valves de–energize, spring action returns the valves to their original position and by–passes flow back to the hydrostat stopping lift cylinder movement. The lift cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

Note: On traction units with serial number from 230000801 to 260999999, solenoid valve (S6) is energized when the cutting units are raised. This forces the return flow from the reel motors through the .125” orifice, putting back pressure on the reel circuit, and preventing the reels from rotating when raised.

Lower Cutting Units

Circuit operation for lowering the lift cylinders is similar to raising them. However, the solenoid valve (S3) remains de–energized and solenoid valve (S4) is energized. Flow is reversed to and from the lift cylinders, lowering the cutting units.

When the cutting units are to be lowered, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to de–energized solenoid valve (S3), which directs flow to the lift cylinders. Hydraulic pressure against the cylinder pistons moves their shafts causing the cutting units to lower. At the same time, the pistons push the hydraulic fluid out of the lift cylinders to energized solenoid valve (S4). Flow continues back through solenoid valves (S3) to the hydrostat. Flow into the flow control valve is slowed by the variable orifice to allow the rear cutting unit to lower after the front units.

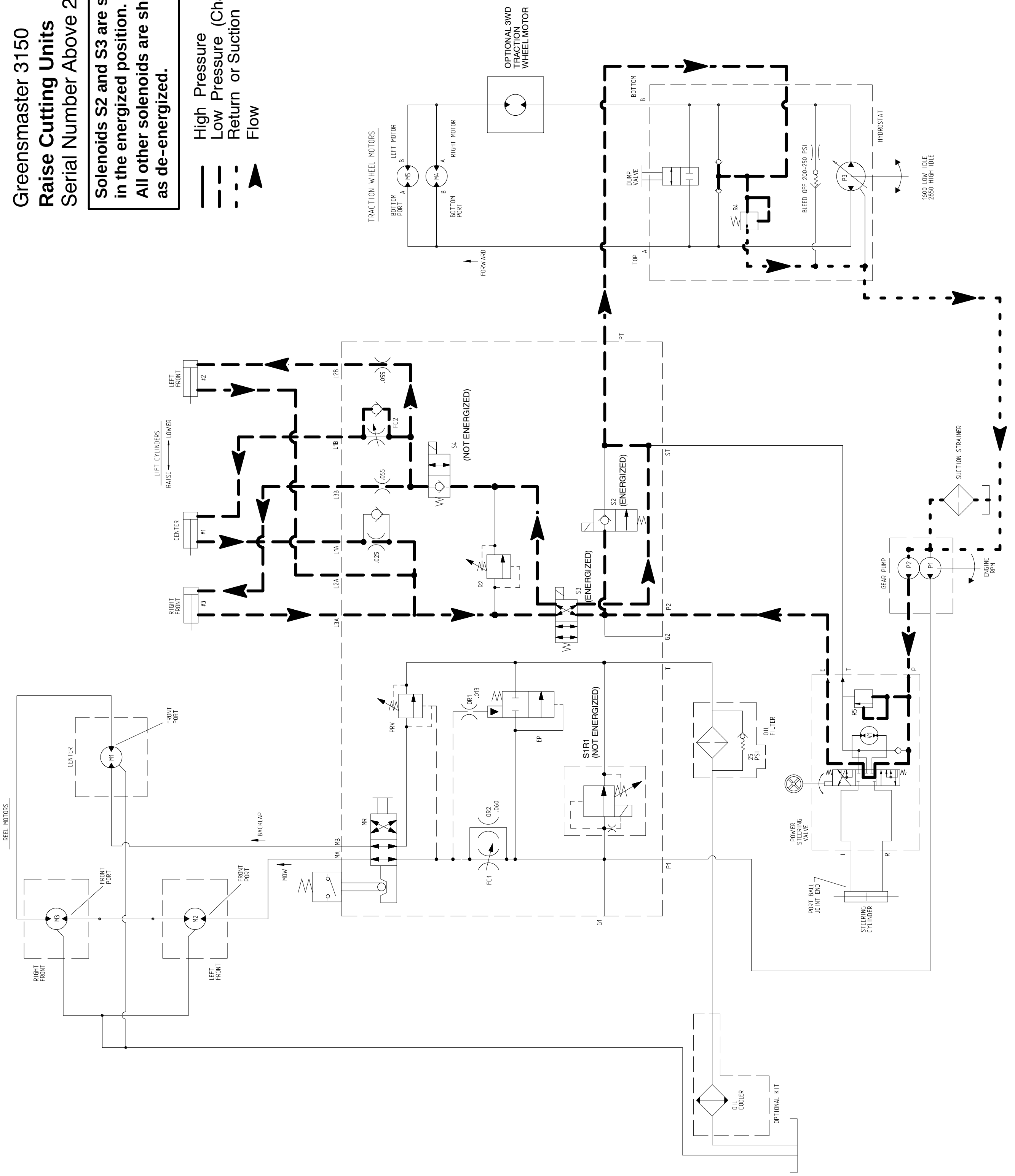
To control pressure while lowering cutting units, the system is equipped with adjustable relief valve (R2) in the hydraulic manifold.

When the solenoid valves de–energize, spring action returns the valves to their original position and by–passes flow back to the hydrostat stopping lift cylinder movement.

Greensmaster 3150
Raise Cutting Units
Serial Number Above 270000000

Solenoids S2 and S3 are shown in the energized position. All other solenoids are shown as de-energized.

High Pressure
Low Pressure (Charge)
Return or Suction
Flow



Raise and Lower Cutting Units (Serial Number Above 270000000)

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure for raising and lowering the cutting units, for the steering circuit and for maintaining 100 to 150 PSI (6.9 to 10.0 bar) to the low pressure side of the traction circuit (charge pressure). The gear pump (P2) takes its suction from the hydraulic reservoir. Maximum circuit pressure is limited by relief valve (R5) which is located in the steering control valve.

During cutting unit hold (not raising or lowering) conditions, flow from the gear pump (P2) is by-passed through the steering control valve and de-energized solenoid valve (S2) directly to the hydrostat and the charge relief valve (R4). Flow then returns to the hydraulic reservoir.

Raise Cutting Units

When the cutting units are to be raised, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to energized solenoid valve (S3), which directs flow to de-energized solenoid valve (S4) and the lift cylinders. Hydraulic pressure against the cylinder pistons moves their shafts causing the cutting units to raise. At the same time, the pistons push the hydraulic fluid out of the lift cylinders and back through energized solenoid valve (S3) to the hydrostat. Raise speed for the front cutting units is controlled by a .055 orifice. A .025 orifice in the return line for the center cutting unit allows a slight delay in raising that cutting unit.

When solenoid valves (S2) and (S3) de-energize, spring action returns the valves to their original position and by-passes flow back to the hydrostat stopping lift cylinder movement. The lift cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

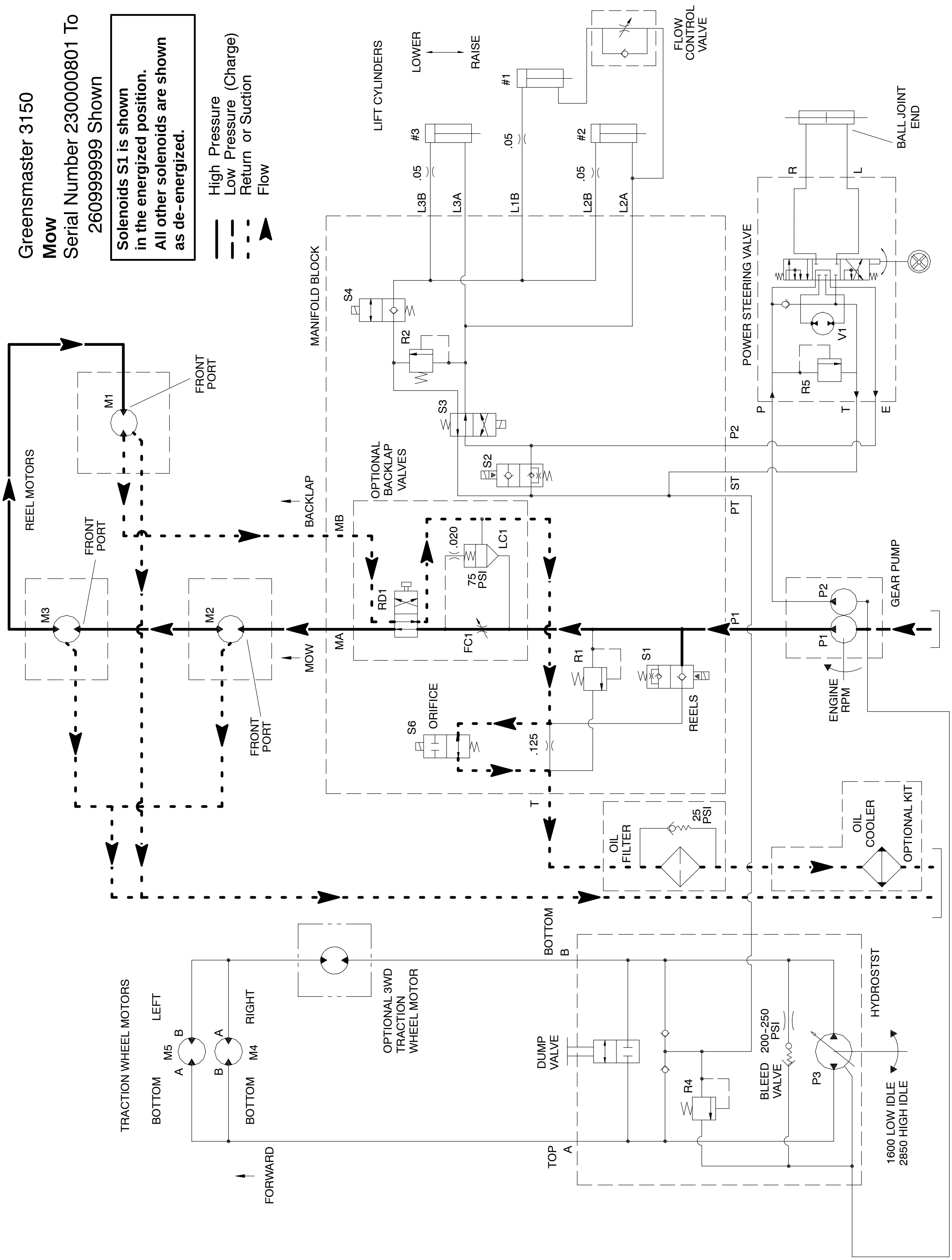
Lower Cutting Units

Circuit operation for lowering the lift cylinders is similar to raising them. However, the solenoid valve (S3) remains de-energized and solenoid valve (S4) is energized. Flow is reversed to and from the lift cylinders, lowering the cutting units.

When the cutting units are to be lowered, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to de-energized solenoid valve (S3), which directs flow to the lift cylinders. Hydraulic pressure against the cylinder pistons moves their shafts causing the cutting units to lower. At the same time, the pistons push the hydraulic fluid out of the lift cylinders to energized solenoid valve (S4). Flow continues back through solenoid valves (S3) to the hydrostat. Lower speed for the front cutting units is controlled by the .055 orifice. A .025 orifice and adjustable flow control valve for the center cutting unit allows a slight delay in lowering that cutting unit.

To control pressure while lowering the cutting units, the system is equipped with adjustable relief valve (R2) in the hydraulic manifold.

When solenoid valves (S2) and (S4) de-energize, spring action returns the valves to their original position and by-passes flow back to the hydrostat stopping lift cylinder movement.



Greensmaster 3150
Mow
Serial Number 230000801 To 260999999 Shown
Solenoids S1 is shown in the energized position. All other solenoids are shown as de-energized.
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDERS
LOWER
RAISE
#1
#2
#3
.05
FLOW CONTROL VALVE
BALL JOINT END
L3B
L3A
L1B
L2B
L2A
MANIFOLD BLOCK
S4
R2
S3
S2
P2
ST
PT
P1
R
L
POWER STEERING VALVE
V1
R5
P
T
E
REEL MOTORS
M1
M2
M3
FRONT PORT
BACKLAP
MOW
OPTIONAL BACKLAP VALVES
MB
MA
RD1
.020
LC1
75 PSI
FC1
R1
S1
REELS
S6
ORIFICE
.125
GEAR PUMP
ENGINE RPM
OIL FILTER
25 PSI
OIL COOLER
OPTIONAL KIT
TRACTION WHEEL MOTORS
LEFT
RIGHT
M5
M4
A
B
BOTTOM
OPTIONAL 3WD TRACTION WHEEL MOTOR
FORWARD
DUMP VALVE
R4
BLEED VALVE
200–250 PSI
P3
HYDROSTST
1600 LOW IDLE
2850 HIGH IDLE
TOP

Mow and Backlap (Serial Number Under 260999999)

The gear pump (P1) is directly coupled to the hydrostat which is driven directly by the engine. Taking its suction directly from the hydraulic reservoir, the gear pump (P1) supplies oil flow to the hydraulic manifold block and to the cutting reel motors. Maximum circuit pressure is limited by relief valve (R1) which is located in the hydraulic manifold.

With the engine running and the Functional Control and Raise/Lower/Mow levers positioned so the reels **will not** turn (see Operator's Manual), solenoid valve (S1) is de-energized. (S1) by-passes flow from the gear pump (P1) directly to the hydraulic reservoir.

Mow

With the engine running and the Functional Control and Raise/Lower/Mow levers positioned so the reels **will** turn (see Operator's Manual), solenoid valve (S1) is energized. Gear pump (P1) flow is routed out manifold port (MA), and to the reel motors that are connected in series. Oil flows through the left (M2), right (M3), and then rear reel motor (M1) as it turns the motors in the mow direction. The oil then returns through the manifold block, oil filter and then to the reservoir.

Note: On traction units with serial number from 230000801 to 260999999, solenoid valve (S6) is energized when the cutting units are raised. This forces the return flow from the reel motors through the .125" orifice, putting back pressure on the reel circuit, and stopping the reels from rotating.

On machines with backlap capabilities, flow through the manifold block when in mow is somewhat different. Oil flow from manifold port (P1) flows through the reel speed control valve (FC1). Flow across the speed control valve is pressure compensated by the logic cartridge valve (LC1). The logic cartridge valve maintains a pressure differential of 75 PSI (5.2 bar) across the speed control valve. Any excess flow above what the speed control valve is set for is by-passed to the reservoir through the logic cartridge valve. With the backlap valve (RD1) in the **mow** position, oil flows through the backlap valve, out manifold port (MA), and to the reel motors that are connected in series.

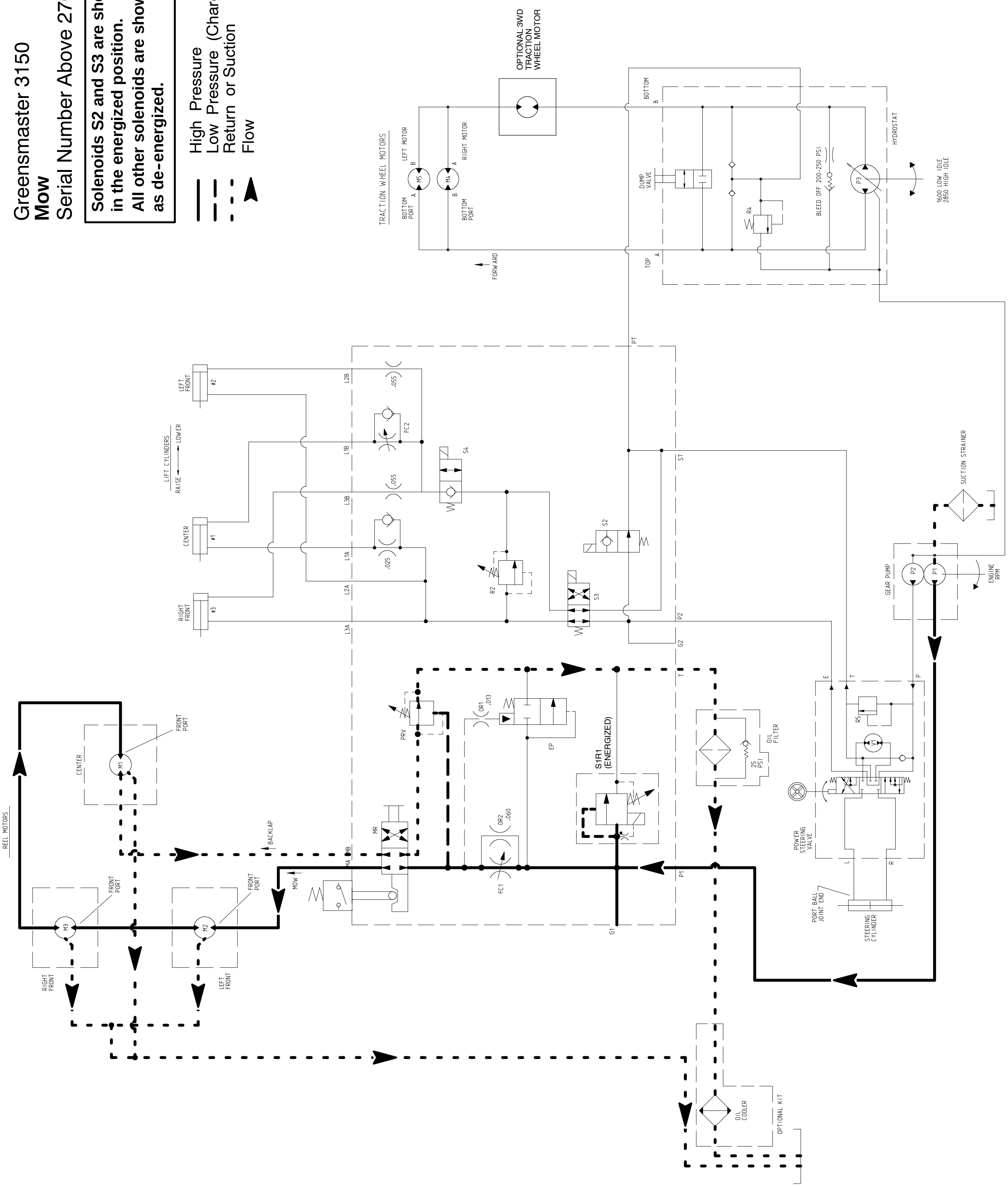
Oil flows through the left (M2), right (M3), and then rear reel motor (M1) as it turns the motors in the mow direction. The oil then returns through the manifold block, oil filter and then to the reservoir.

Backlap

On machines with backlap capabilities, backlapping operation is the same as mowing operation, except for the position of the backlap valve (RD1). When the backlap valve (RD1) is in the **backlap** position, oil flows through the rear (M1), right (M3), and then left (M2) reel motor as it turns the motors in the backlap direction.

Greensmaster 3150
Mow
Serial Number Above 270000000

Solenoids S2 and S3 are shown in the energized position. All other solenoids are shown as de-energized.



Mow and Backlap (Serial Number Above 270000000)

The gear pump (P1) is directly coupled to the hydrostat which is driven directly by the engine. Taking its suction directly from the hydraulic reservoir, the gear pump (P1) supplies oil flow to the hydraulic manifold block and to the cutting reel motors. Maximum circuit pressure is limited by solenoid relief valve (S1R1) which is located in the hydraulic manifold.

With the engine running and the Functional Control and Raise/Lower/Mow levers positioned so the reels **will not** turn (see Operator's Manual), solenoid relief valve (S1R1) in the hydraulic manifold is de-energized. The de-energized (S1R1) by-passes flow from the gear pump (P1) to the oil filter and hydraulic reservoir. Additionally, manifold pressure reducing valve (PRV) will remain seated to prevent the reel motors (and reels) from rotating.

Mow

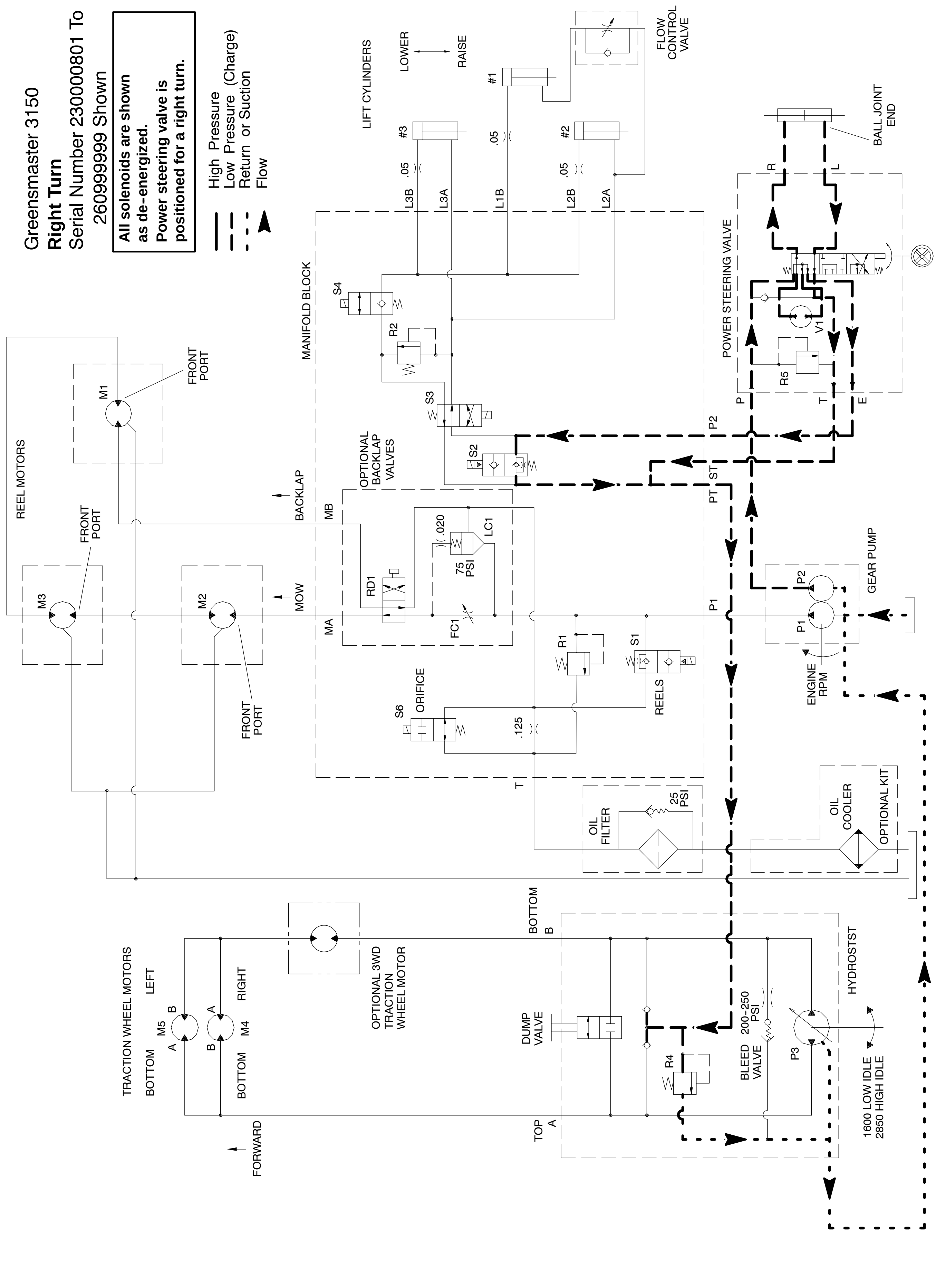
With the engine running and the Functional Control and Raise/Lower/Mow levers positioned so the reels **will** turn (see Operator's Manual), solenoid relief valve (S1R1) is energized. In the energized position, this valve directs oil flow to the reel motors and also functions as the mow circuit relief valve.

Oil flow from manifold port (P1) flows through the reel speed control valve (FC1). Flow across the speed control valve is pressure compensated by the logic cartridge valve (EP). The logic cartridge valve maintains a pressure differential of 75 PSI (5.2 bar) across the speed control valve. Any excess flow above the speed control valve setting is by-passed to the reservoir through the logic cartridge valve. With the backlap valve (MR) in the **mow** position, oil flows through the backlap valve, out manifold port (MA), and to the reel motors that are connected in series. Oil flows through the left (M2), right (M3), and then rear reel motor (M1) as it turns the motors in the mow direction.

When in the **mow** position, manifold pressure reducing valve (PRV) will shift allowing oil to return to the reservoir through the manifold block and oil filter.

Backlap

Backlapping operation is the same as mowing operation, except for the position of the backlap valve (MR). When the backlap valve (MR) is in the **backlap** position, oil flows through the rear (M1), right (M3), and then left (M2) reel motor as it turns the motors in the backlap direction.



Greensmaster 3150
Right Turn
Serial Number 230000801 To 260999999 Shown
All solenoids are shown as de-energized. Power steering valve is positioned for a right turn.
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDERS
LOWER
RAISE
FLOW CONTROL VALVE
BALL JOINT END
MANIFOLD BLOCK
POWER STEERING VALVE
REEL MOTORS
FRONT PORT
OPTIONAL BACKLAP VALVES
BACKLAP
MOW
GEAR PUMP
ENGINE RPM
ORIFICE
REELS
OIL FILTER
25 PSI
OIL COOLER
OPTIONAL KIT
TRACTION WHEEL MOTORS
LEFT
RIGHT
BOTTOM
TOP
OPTIONAL 3WD TRACTION WHEEL MOTOR
DUMP VALVE
BLEED VALVE
200–250 PSI
HYDROSTST
1600 LOW IDLE
2850 HIGH IDLE
FORWARD
75 PSI

Right and Left Turn

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure to the power steering valve for turning the rear wheel, for raising and lowering the cutting units, and for maintaining 100 to 150 PSI (6.9 to 10.0 Bar) to the low pressure side of the traction circuit (charge pressure). The gear pump (P2) takes its suction from the hydraulic reservoir. Maximum circuit pressure is limited by relief valve (R5).

With the steering wheel in the neutral position (rear wheel positioned straight ahead) and the engine running, the spool valve is in the center position. Flow enters the steering control valve at Port (P) and goes through the spool valve, by-passing the steering cylinder. Flow leaves the control valve out port (E) and continues through solenoid valve (S2) to the hydrostat.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at Port (P) goes through the spool and is routed to two places. First, most of the flow through the valve is by-passed out port (E) back through solenoid valve (S2) to the hydrostat. Second, the remainder of the flow is drawn through the rotary meter (V1) and out port (R). Pressure moves the piston in the direction for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve and out port (T). The returning flow passes through the manifold block (using ports ST and PT) and on to the hydrostat.

The steering wheel and steering control valve return to the neutral position when turning is complete.

Left Turn

When a left turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at Port (P) goes through the spool and is routed to two places. First, most of the flow through the valve is by-passed out port (E) back through solenoid valve (S2) to the hydrostat. Second, the remainder of the flow is drawn through rotary meter (V1) and out port (L). Pressure moves the piston in the direction for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve and out port (T). The returning flow passes through the manifold block (using ports ST and PT) and on to the hydrostat.

The steering wheel and steering control valve return to the neutral position when turning is complete.

Special Tools

Order these special tools from your Toro Distributor.

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 the Testing section of this chapter.

Figure 13

Hydraulic Tester (Pressure and Flow) – TOR214678

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

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

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

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

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

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

Figure 14

O–Ring Kit – 16–3799

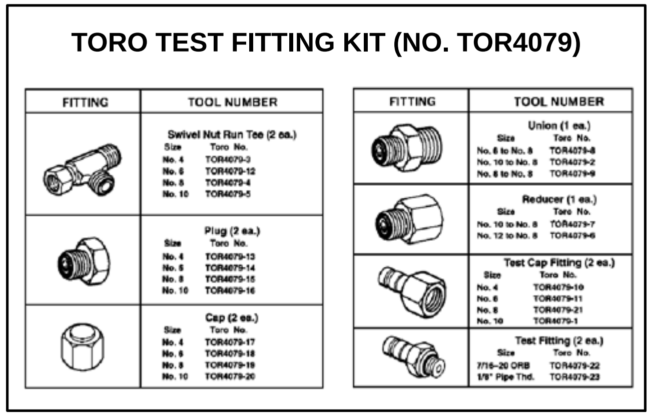
The O–ring kit includes O–rings in a variety of sizes for face seal and port seal hydraulic connections. It is recommended that O–rings be replaced whenever a hydraulic connection is loosened.

Figure 15

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.



TORO TEST FITTING KIT (NO. TOR4079)

FITTING	TOOL NUMBER
	Swivel Nut Run Tee (2 ea.) Size / Toro No. No. 4 TOR4079-3 No. 6 TOR4079-12 No. 8 TOR4079-4 No. 10 TOR4079-5
	Plug (2 ea.) Size / Toro No. No. 4 TOR4079-13 No. 6 TOR4079-14 No. 8 TOR4079-15 No. 10 TOR4079-16
	Cap (2 ea.) Size / Toro No. No. 4 TOR4079-17 No. 6 TOR4079-18 No. 8 TOR4079-19 No. 10 TOR4079-20

FITTING	TOOL NUMBER
	Union (1 ea.) Size / Toro No. No. 6 to No. 8 TOR4079-8 No. 10 to No. 8 TOR4079-2 No. 6 to No. 8 TOR4079-9
	Reducer (1 ea.) Size / Toro No. No. 10 to No. 8 TOR4079-7 No. 12 to No. 8 TOR4079-6
	Test Cap Fitting (2 ea.) Size / Toro No. No. 4 TOR4079-10 No. 6 TOR4079-11 No. 8 TOR4079-21 No. 10 TOR4079-1
	Test Fitting (2 ea.) Size / Toro No. 7/16–20 ORB TOR4079-22 1/8" Pipe Thd. TOR4079-23

Figure 16

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 17

Wheel Hub Puller – TOR4097

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

Figure 18

Hydraulic System

Troubleshooting

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.

Problem	Possible Cause
Hydraulic oil leaks from system.	Fitting(s), hose(s), or tube(s) are loose or damaged. O–ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams.	Oil level in reservoir is low. Hydraulic system has wrong type of oil. The pump suction line has an air leak.
Hydraulic system operates hot.	Oil level in reservoir is low, or inlet filter is loose or clogged. Oil is contaminated or too light. Parking brake is applied or incorrectly adjusted. Hydrostat by–pass valve is open or defective. Working load of machine may require use of oil cooler. Oil cooler (if installed) is damaged or plugged. By–pass relief is stuck open or air flow is obstructed. Charge pressure is low. Wheel motor(s) or reel motor(s) are worn or damaged. Traction pump (P3) is worn or damaged (see Traction Drive Hydrostat (P3) Flow Test).
Neutral is difficult to find, or unit operates in one direction only.	External control linkage is misadjusted, disconnected, binding, or damaged. Traction pump (P3) is worn or damaged (see Traction Drive Hydrostat (P3) Flow Test).
Traction response is sluggish.	Hydraulic oil is very cold. Parking brake is applied or incorrectly adjusted. Hydrostat by–pass valve is open or defective. Charge pressure is low. Traction pump (P3) or wheel motor(s) are worn or damaged (see Traction Drive Hydrostat (P3) Flow and Wheel Motor Efficiency Tests).

Problem	Possible Cause
No traction exists in either direction.	Parking brake is applied or incorrectly adjusted. Oil level in reservoir is low. Hydrostat by-pass valve is open. Charge pressure is low. Wheel motor(s) are worn or damaged (see Wheel Motor Efficiency Test). Traction pump (P3) is worn or damaged (see Traction Drive Hydrostat (P3) Flow Test).
Wheel motor will not turn.	Brakes are binding. Key on wheel motor shaft is sheared or missing. Wheel motor is damaged.
Wheel motor will not hold load in neutral.	Make up fluid from charge pump is not available. Hydrostat ball check valves are damaged.
Reel motor drive pump is noisy (cavitation).	Reservoir oil level is low. Hydraulic pump suction line is restricted. Hydraulic pump suction line has an air leak.
Reels will not turn.	Solenoid valve S1 is stuck open (not shifting to its energized position). An electrical problem exists (see Chapter 5 - Electrical System). Relief valve R1 is stuck open (see Mow Circuit Relief Valve (R1) Pressure Test). LC1 logic valve (when Backlap Kit is installed) is stuck open. Gear pump P1 is damaged (see Gear Pump (P1) Flow Test).
Reel speed is erratic.	A cutting unit problem exists (see Cutting Unit chapter). Hydraulic manifold reel circuit cartridge is leaking or damaged. Hydraulic manifold orifice is plugged.
Reel speed is low.	A cutting unit problem exists (see Cutting Unit chapter). Hydraulic manifold reel circuit cartridge is leaking or damaged. Excessive internal wear in reel motor exists (see Reel Motor Case Drain Flow Test).

Problem	Possible Cause
Cutting units will not lift or lift slowly.	Engine speed is too low. Reservoir oil level is low. Lift cylinder linkage is binding or broken. Lift cylinder bushings bind. Charge circuit pressure is low (see Charge Relief Valve (R4) Pressure Test). Implement relief valve (R5) is leaking or damaged (see Implement Relief Valve (R5) Pressure Test). Solenoid valve (S2) is leaking or damaged (not shifting to its energized position). Relief valve (R2) is leaking or damaged (see Lower Cutting Units Relief Valve (R2) Pressure Test). Lift cylinders leak internally. Spool in steering control valve is hung up (see Steering Control Valve Test). Gear pump (P2) is worn or damaged (see Gear Pump (P2) Flow Test).
Cutting units raise, but will not stay up.	Solenoid valve (S4) is leaking or damaged. Lift cylinders leak internally.
Steering wheel is hard to turn.	Steering control valve has insufficient oil flow. Emergency steering ball in steering control valve is missing or damaged.
Regular adjustments to steering wheel are necessary because of difficulty of driving in a straight line.	Leaf springs in steering control valve are worn or broken. Gear wheel set in steering control valve is worn. Steering cylinder is seized or its piston seals are worn (see Steering Control Valve Test).
Steering wheel will not return to the neutral position.	Spool and sleeve are sticking to steering control housing assembly (see Steering Control Valve Test).
Steering wheel can turn on its own.	Leaf springs in steering control valve are broken or stuck. Spool and sleeve are sticking to steering control housing assembly (see Steering Control Valve Test).
Backlash results when turning steering wheel.	Cardan shaft fork is worn or broken. Leaf springs in steering control valve are worn or broken. Splines on the steering column are worn.

Problem	Possible Cause
Rear wheel shimmies when the steering wheel is turned.	Air is in the steering cylinder. Mechanical connections to the wheel or wheel bearing are worn.
The steering wheel can be turned without the rear wheel turning.	The steering cylinder is worn. The gear set in the steering control valve is worn.
Steering response is too slow and heavy when trying to turn quickly.	Oil supply to the steering control valve is insufficient.
Turning steering wheel turns machine in the opposite direction.	Hoses to the steering cylinder are reversed.
Steering force (possibly to one side only) is insufficient.	Hydraulic flow to steering control valve is low. Steering relief valve (R5) is leaking or damaged.

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, improper adjustments, solenoid valve operation, or electrical connections/circuits 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.

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.

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.

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. To prevent hydraulic system contamination, 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. Engine speed will affect test accuracy. Check pump speed with a phototac when performing hydraulic tests.

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

5. When using tester with pressure and flow capabilities, completely open load valve 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.

11. Record the results of all performed hydraulic tests.

Hydraulic Testing

1. Use the Hydraulic Schematic, Hydraulic Flow Diagrams, and the Troubleshooting section found in this Chapter to assist in problem identification and solution.

2. Hydraulic system problems (e.g. low hydraulic oil level, contaminated oil, incorrect engine speed) will affect the entire hydraulic system.

3. For traction related problems (e.g. machine will not go up an incline), use the following Tests:

   A. Traction Drive Hydrostat (P3) Flow.

   B. Wheel Motor Efficiency.

   C. Charge Relief Valve (R4) Pressure.

4. Problems with steering or lift/lower circuit, use the following tests:

A. Charge Relief Valve (R4) Pressure.

B. Gear Pump (P2) Flow and Implement Relief Valve (R5) Pressure.

C. Lower Cutting Units Relief Valve (R2) Pressure.

D. Steering Control Valve.

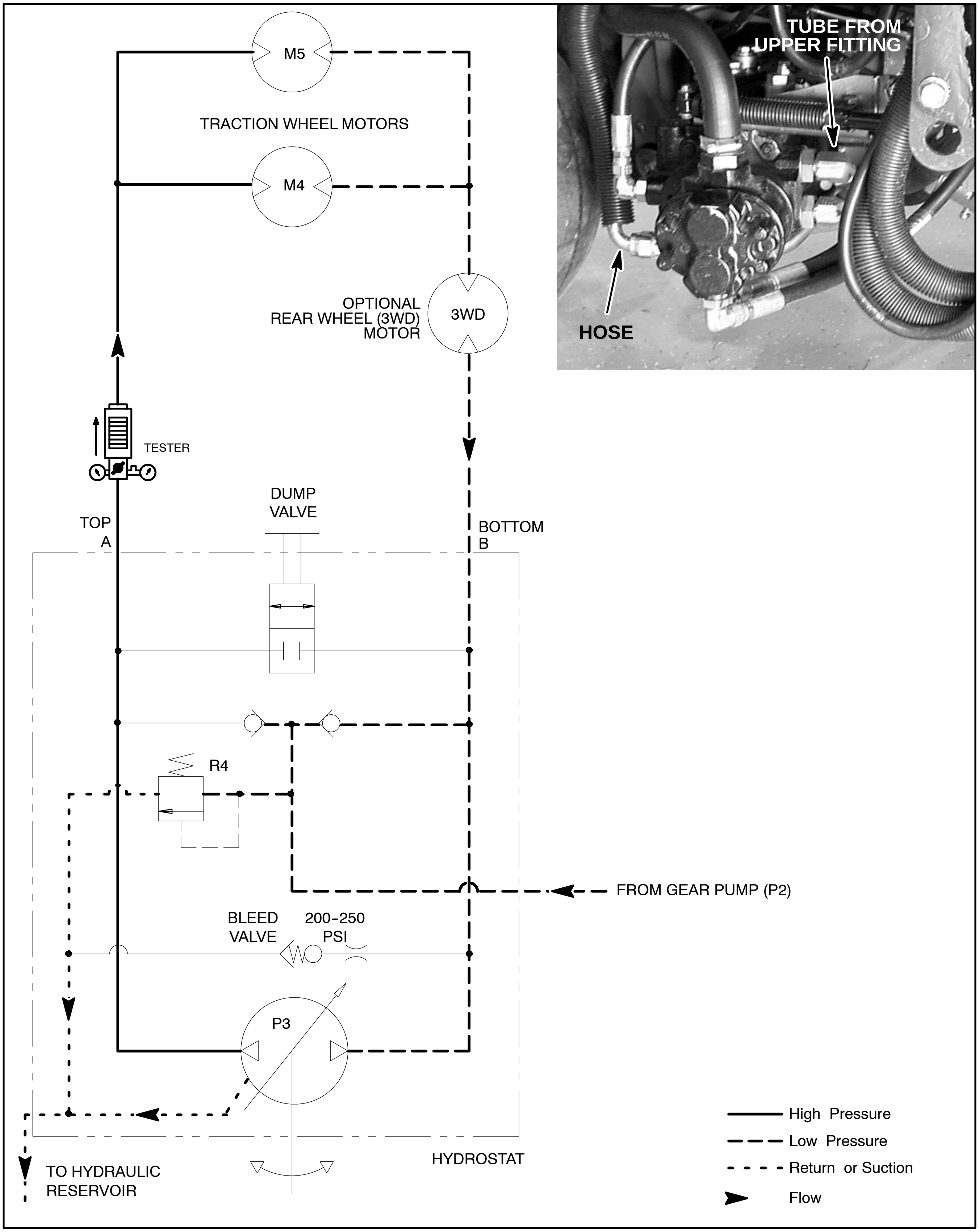
5. Issues with cutting system, use the following tests:

A. Gear Pump (P1) Flow.

B. Mow Circuit Relief Valve (R1) Pressure.

C. Reel Motor Case Drain Flow.

Traction Drive Hydrostat (P3) Flow Test (Using Tester with Flowmeter and Pressure Gauge)



Procedure for Traction Drive Hydrostat (P3) Flow Test:

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

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

2. Park machine on a level surface with the cutting units lowered and off. Make sure engine is off. Make sure the hydraulic tank is full.

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. Make sure the transmission is adjusted to the neutral position (see the Traction Unit Operator's manual).

4. Block up front wheels off the ground (also rear wheel if machine is equipped with 3WD) to allow flow through the traction circuit.

5. Disconnect hydraulic hose from the hydraulic tube that connects to the upper hydraulic fitting on the front side of the hydrostat (Fig. 23).

6. Install tester in series with the pump and the disconnected hose. **Make sure flow control valve on the tester is fully open.**

7. Make sure functional lever is in the transport position.

8. Start engine and move throttle to full speed **(2850 ± 50 RPM)** position.

CAUTION

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

9. Slowly push traction pedal into fully forward position.

Note: Make sure transport speed is properly adjusted. See Adjusting the Transport Speed in the traction unit Operator's Manual for additional information.

10. Slowly close flow control valve until pressure gauge reads **1000 PSI (69 bar)**.

11. Observe flow gauge. TESTER READING should be a minimum flow of **12.5 GPM**. Record test results.

12. Release traction pedal, open control valve on tester, and turn off engine.

13. If specifications are not met consider the following:

A. The traction pedal and/or traction speed may need adjustment (see the Traction Unit Operator's Manual).

B. The hydrostat needs to be repaired or replaced as necessary.

C. Make necessary repairs before performing additional tests.

14. If specifications are met, check wheel motor efficiency (see Wheel Motor Efficiency Test in this chapter).

15. If testing is complete, disconnect tester from hydraulic tube and hose. Reconnect hose to tube.

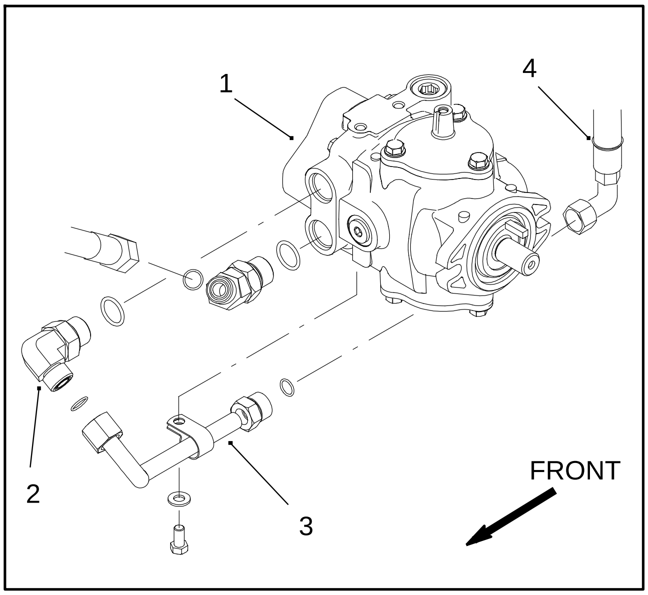
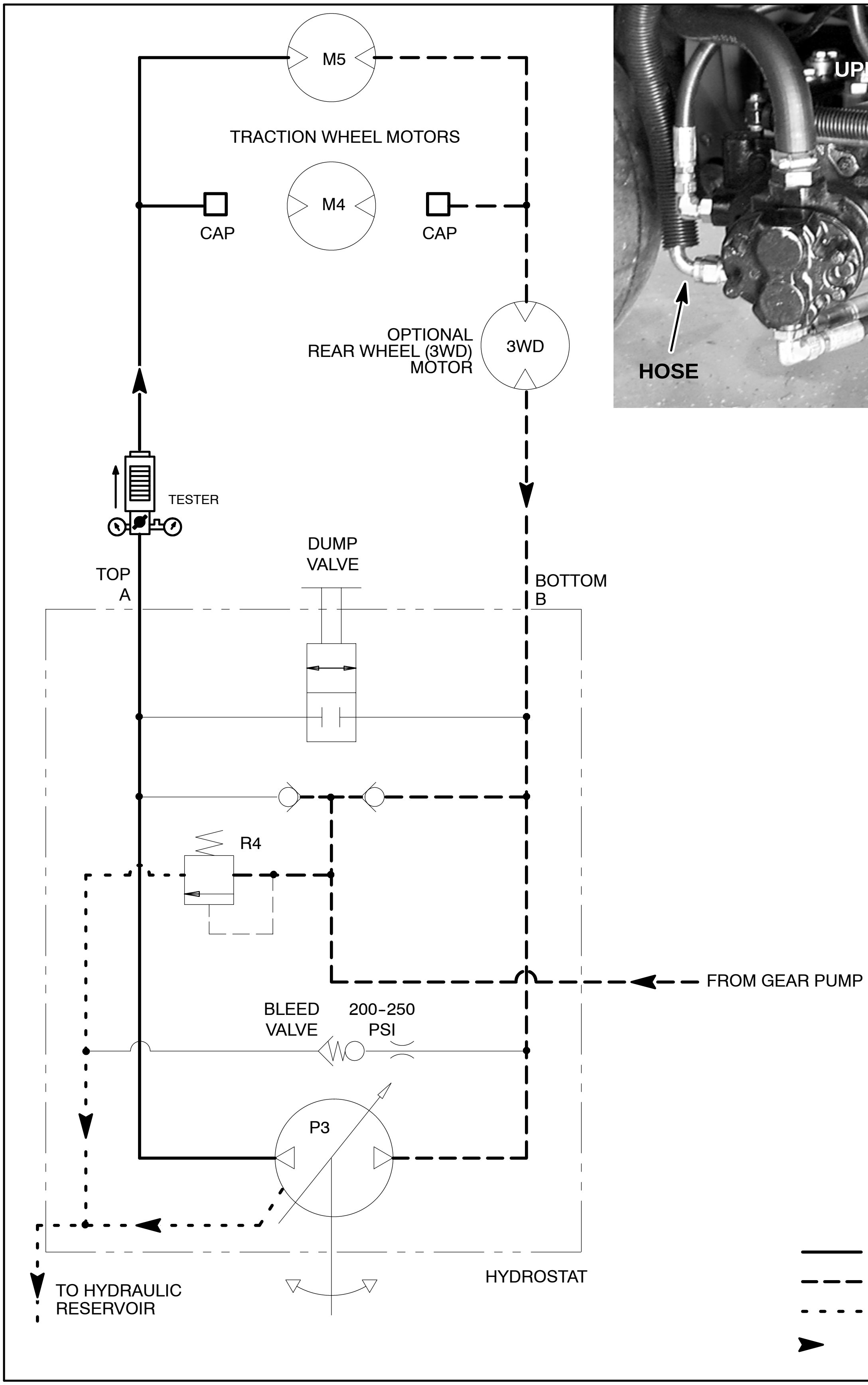


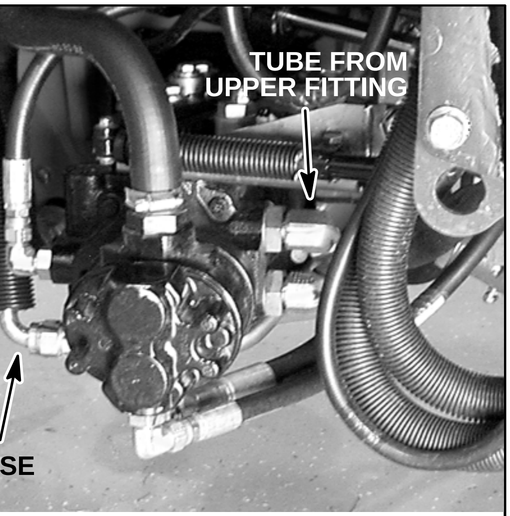
Figure 23

1. **Hydrostat**
2. **Upper fitting**
3. **Hydraulic tube**
4. **Hydraulic hose**

Hydraulic System

Wheel Motor Efficiency Test (Using Tester with Flowmeter and Pressure Gauge)





Procedure for Wheel Motor Efficiency Test:

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

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

3. Read Precautions for Hydraulic Testing.

4. Make sure the transmission is adjusted to the neutral position (see the Traction Unit Operator's Manual).

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

6. If machine has 3 wheel drive, block up the rear wheel off the ground to allow flow through the rear wheel motor.

7. Chock front wheel being tested to prevent rotation of the wheel. Make sure parking brake is on.

8. Disconnect hydraulic lines from front wheel motor that is **not** being tested. Cap the disconnected hydraulic lines and plug ports in wheel motor (see Special Tools).

9. Disconnect hydraulic hose from the hydraulic tube that connects to the upper hydraulic fitting on the front side of the hydrostat.

10. Install flow tester in series with the pump and the disconnected hose (same tester connections as Traction Drive Hydrostat (P3) Flow Test). **Make sure the tester flow control valve is fully open.**

CAUTION

Use extreme caution when performing test. The wheel being tested will be trying to move the machine.

11. Start engine and move throttle to full speed **(2850 ± 50 RPM)**.

12. Slowly push traction pedal in **forward** direction until **1000 PSI (69 bar)** is displayed on the tester pressure gauge.

13. Wheel motor internal leakage will be shown on flow meter in GPM. Flow should be **less than 1.5 GPM** for the tested wheel motor.

14. Release traction pedal, rotate wheel being tested, and retest. Testing of wheel motor leakage in three different wheel positions will provide most accurate test results.

15. Release traction pedal and shut engine off. Record results of flow test.

16. If specification is not met, the tested wheel motor needs to be repaired or replaced as necessary.

17. Test second front wheel motor. Reconnect hydraulic lines to untested front wheel motor. Disconnect and cap hydraulic lines to tested front wheel motor. Complete steps 11 to 16 for the second front wheel motor.

18. If machine has 3 wheel drive, test rear wheel motor:

A. Both front wheel motors should have hydraulic lines connected. Block up both front wheels off the ground. Release parking brake so front wheels can turn freely.

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

C. Position rear wheel on the ground and chock rear wheel to prevent it from turning.

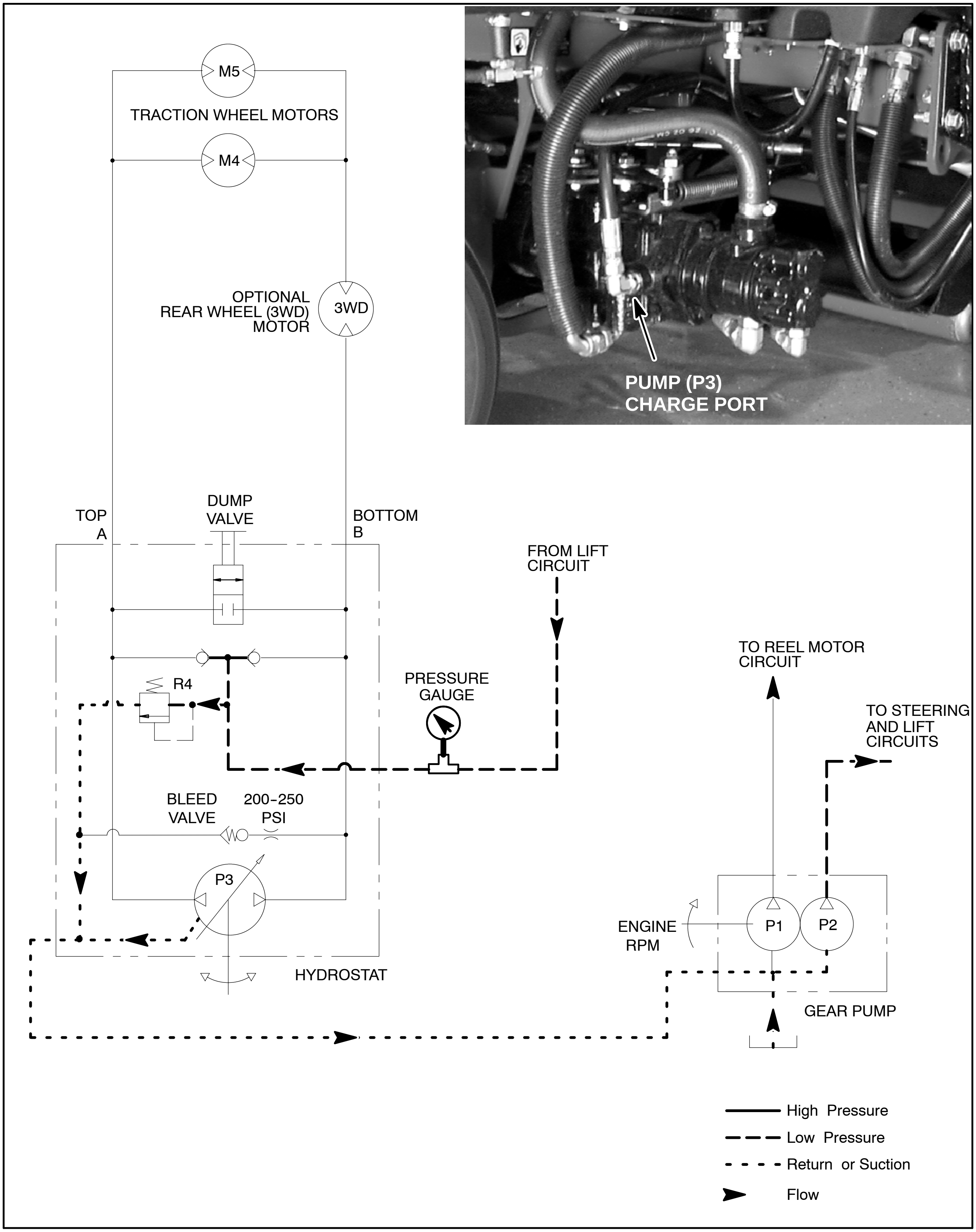
CAUTION

Use extreme caution when performing test. The rear wheel will be trying to move the machine.

D. Complete steps 11 to 16.

19. Disconnect tester from hydraulic tube and hose. Reconnect hose to tube.

Charge Relief Valve (R4) Pressure Test (Using Tester with Flowmeter and Pressure Gauge)



Procedure for <u>Charge Relief Valve (R4) Pressure</u> Test:

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

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. Disconnect hydraulic hose from the fitting in the charge port of piston pump P3 (traction pump section). Connect T-fitting and pressure gauge to the fitting and hose connection.

4. Make sure that traction pedal and lift control are in neutral and the parking brake is engaged.

5. Start engine and operate at full speed **(2850 ± 50 RPM)**.

6. Pressure gauge should read approximately **100 to 150 PSI (6.9 to 10.4 bar)**. Record test results.

7. Shut off engine.

8. If specification is not met, remove hydrostat back plate assembly that contains the charge relief valve (see Piston Pump Service in the Service and Repairs section of this chapter). Repair or replace relief valve components as necessary.

9. A dynamic charge pressure test can be performed as follows:

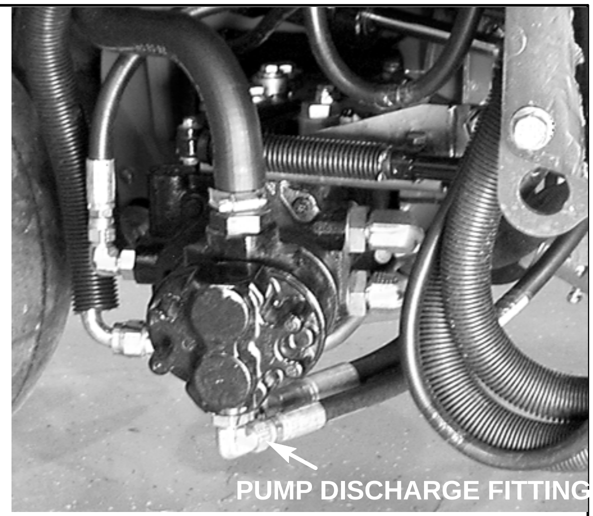
   A. With tester still connected, sit in the operator seat and press the traction pedal to forward.

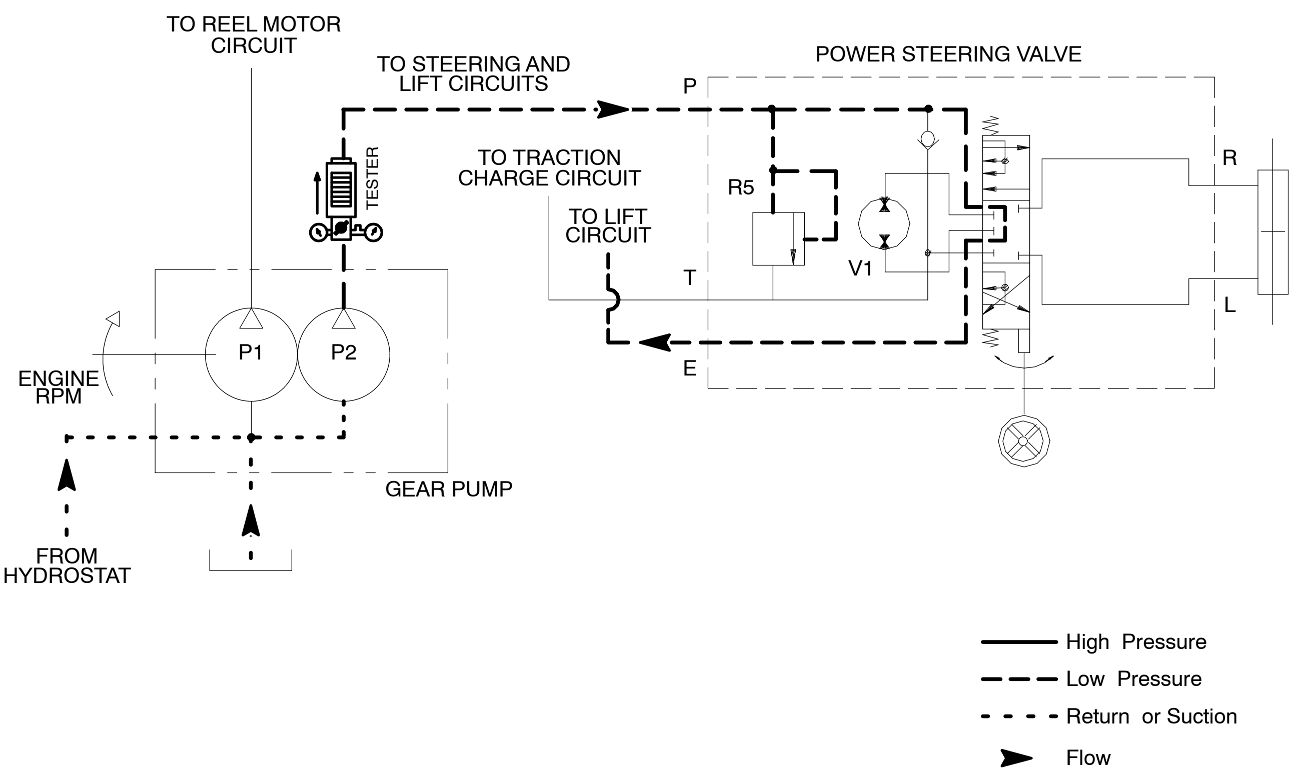
   B. While machine is moving, monitor the charge pressure reading on the pressure gauge.

   C. The charge pressure should drop no more than 15% from initial test reading (Step 6 above). A pressure drop of more than 15% indicates a traction circuit leak (e.g. a worn or damaged hydrostat and/or wheel motor). Further testing of the traction circuit should be completed (see Traction Drive Hydrostat (P3) Flow and Wheel Motor Efficiency Tests in this section).

10. When testing is complete, disconnect pressure gauge and T-fitting from the pump fitting and hose. Reconnect hose to the pump fitting.

Gear Pump (P2) Flow and Implement Relief Valve (R5) Pressure Tests (Using Tester with Flowmeter and Pressure Gauge)





Procedure for <u>Gear Pump (P2) Flow</u> Test:

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

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. Disconnect hydraulic hose from the discharge fitting of gear pump (P2) (end pump section).

4. Install tester in series with the gear pump and the disconnected hose. Make sure that tester flow arrow points from the pump discharge and toward the disconnected hose. **Make sure flow control valve on the tester is fully open.**

5. Make sure that traction pedal and lift control are in neutral and the parking brake is engaged.

6. Operate engine at full speed **(2850 ± 50 RPM)**.

7. Watch flow and pressure gauge carefully while slowly closing the flow control valve on the tester until the pressure gauge reads **800 PSI (55.2 bar)**.

8. **Minimum** flow gauge reading should be **3.1 GPM**. Record test results.

9. Open control valve on tester and shut off engine.

10. If specification is not met, check for restriction in the pump intake line. If no restriction is found, repair or replace gear pump (P2).

Procedure for <u>Implement Relief Valve (R5) Pressure</u> Test:

CAUTION

Do not allow pressure to exceed 1400 PSI (82.8 bar).

1. Measure and record charge relief valve (R4) pressure (see Charge Relief Valve (R4) Pressure Test in this section).

2. Use same tester connections as described above in Procedure for Gear Pump (P2) Flow Test (steps 3 and 4). **Fully open control valve on the tester.**

3. Start and run engine at full speed **(2850 ± 50 RPM)**.

4. Watch the pressure gauge on the tester and move the lift lever to the **raise** position. Momentarily hold the lift lever with the cutting units fully raised causing the relief valve (R5) to open. Record pressure at which the relief valve (R5) opens.

5. Open control valve on tester and shut off engine.

Note: The implement relief valve (R5) is in series with charge relief valve (R4). (R4) pressure will affect (R5) pressure.

6. Implement relief valve (R5) pressure should be **1050 to 1250 PSI (72.5 to 86.3 bar) higher than the charge relief valve (R4) pressure** (e.g. if the charge relief valve pressure is 100 PSI, the implement relief valve (R5) pressure should be 1150 to 1350 PSI).

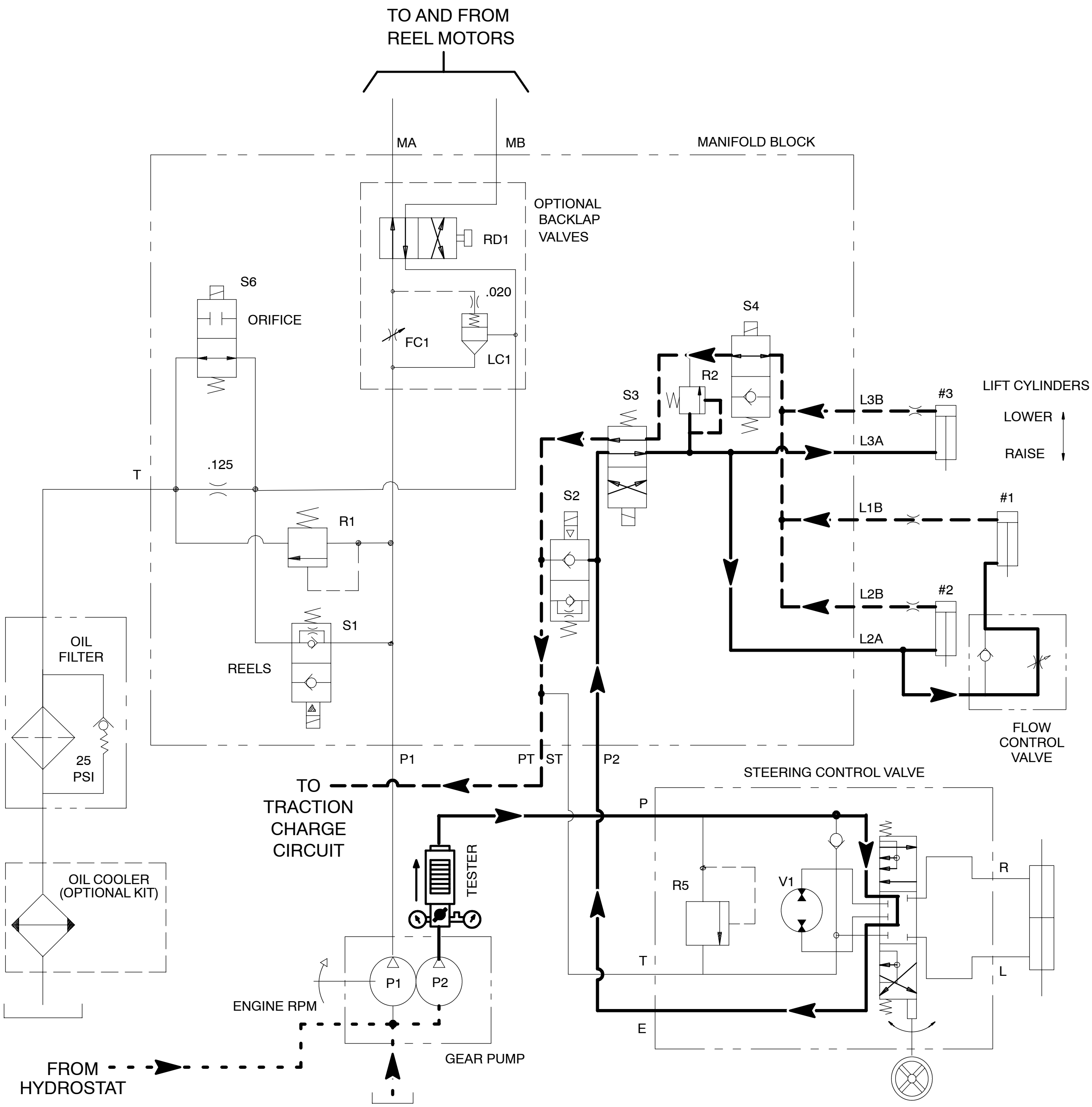
7. If relief valve (R5) pressure is incorrect, inspect relief valve (R5) located in the steering control valve (see Steering Control Valve Service in the Service and Repairs section of this Chapter). Clean relief valve or service steering control valve as needed.

IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading.

8. Relief Valve (R5) is also activated by the steering system. With tester still connected to gear pump P2, start engine and watch the pressure gauge. Turn the steering wheel completely in one direction and hold. Relief valve (R5) should open just after rear wheel gets to the full lock position. Relief pressure measured with the steering system should be similar to results in step 5.

Note: Lower Cutting Units Relief Valve (R2) Pressure can be measured with tester positioned as described in this check (see Lower Cutting Units Relief Valve (R2) Pressure Test in this section).

9. If testing is complete, disconnect tester from the pump and hose. Reconnect hose to the pump.



Serial Number 230000801 To
260999999 Shown

Procedure for Lower Cutting Units Relief Valve (R2) Pressure Test:

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

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. Measure and record charge relief valve (R4) pressure (see Charge Relief Valve (R4) Pressure Test in this section).

4. Use same tester connections as described in the Gear Pump (P2) Flow and Implement Relief Valve (R5) Pressure Test in this section. **Fully open control valve on the tester.**

5. Start engine and move throttle to full speed **(2850 ± 50 RPM)**. Make sure that cutting units are fully lowered and engage the cutting units.

Note: The LOWER function is electrically timed and automatically turns off after approximately six (6) seconds.

6. Watch pressure gauge carefully while moving the Raise/Lower – Mow Control lever to LOWER and note pressure that relief valve opens. Shut off engine and record test results.

Note: While performing this hydraulic test, if relief pressure cannot be determined within the LOWER function six (6) second timeframe, repeat this test procedure.

Note: The lower cutting units relief valve (R2) is in series with charge relief valve (R4). (R4) pressure will affect (R2) pressure.

7. The lower cutting units relief pressure (R2) should be **300 PSI (21.0 bar) higher than charge relief (R4) pressure** (e.g. if charge relief valve pressure is 100 PSI, the lower relief valve (R2) pressure should be 400 PSI).

8. If relief valve (R2) pressure is incorrect, adjust relief valve (R2) (Fig. 20 or 21) (see Adjust Manifold Relief Valves in the Adjustments section of this Chapter). Retest relief valve pressure after adjustment is performed.

9. If testing is complete, disconnect test gauge from gear pump and hose. Reconnect hose to hydraulic fitting on pump.

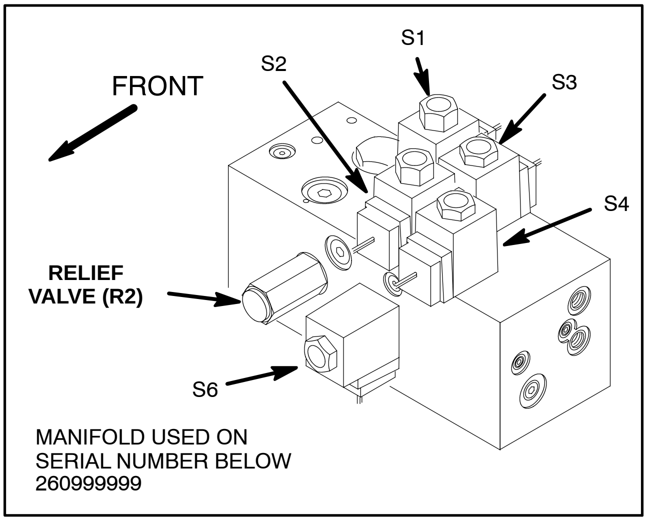


Figure 20

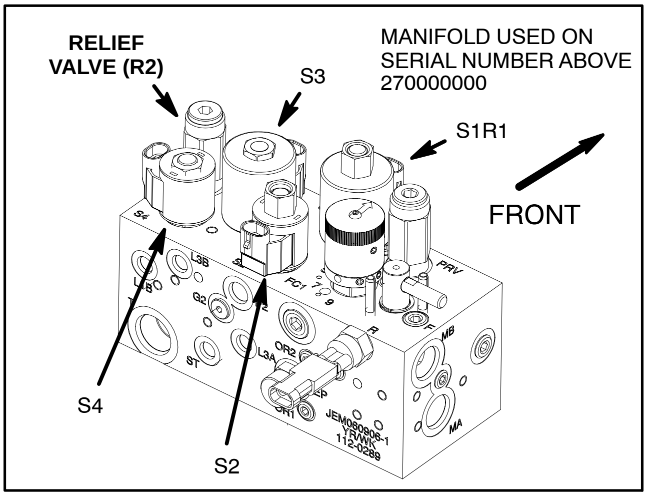
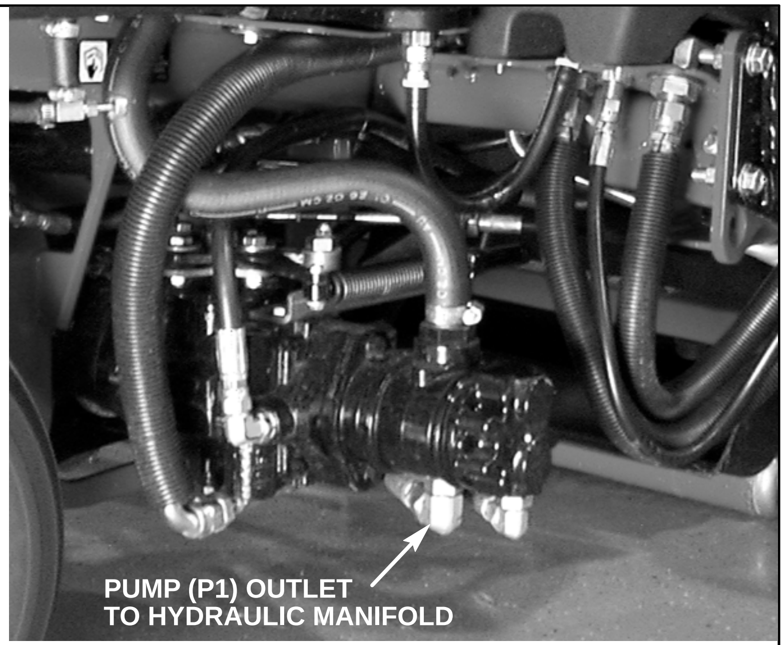
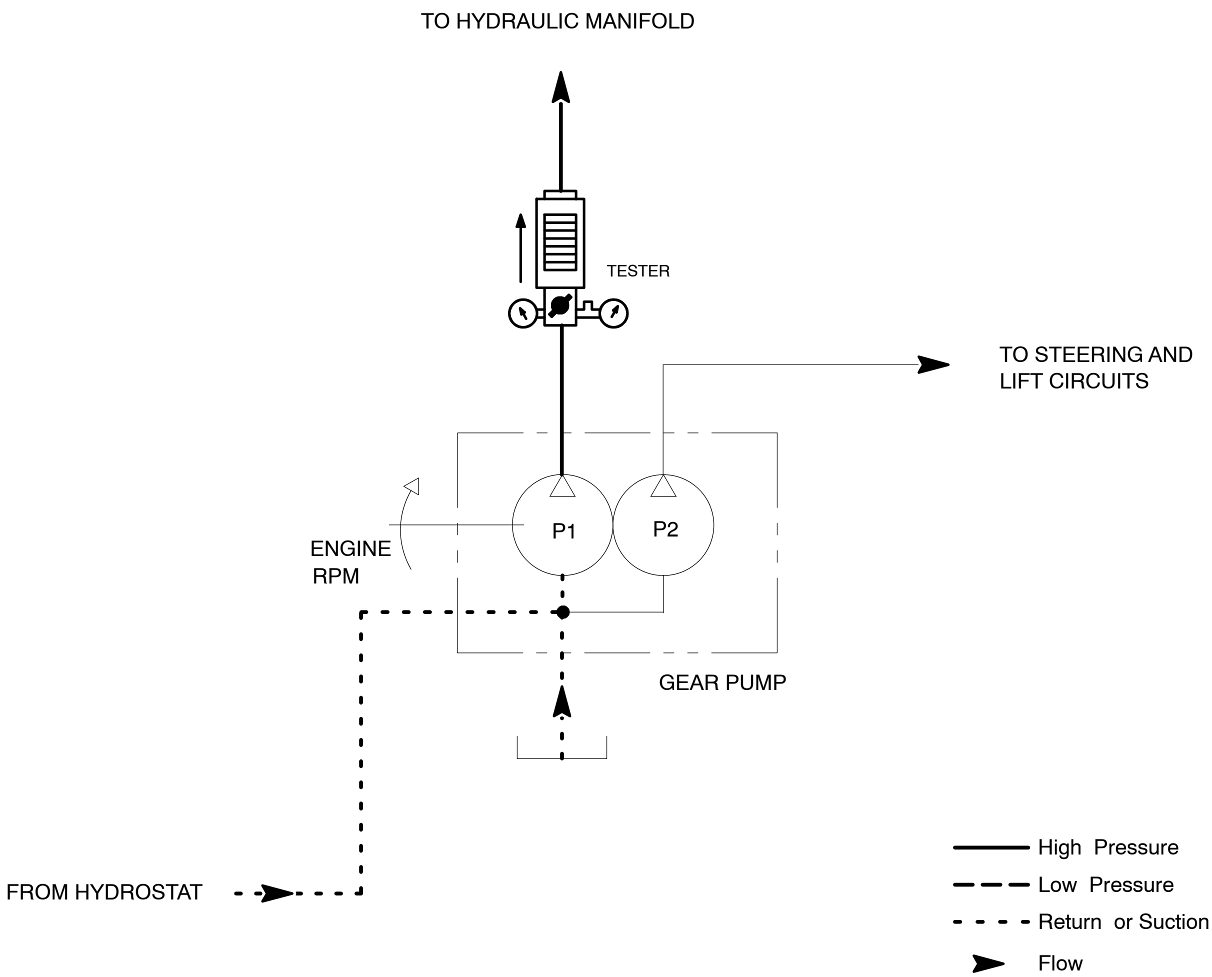


Figure 21

Gear Pump (P1) Flow Test (Using Tester with Flowmeter and Pressure Gauge)





Procedure for Gear Pump (P1) Flow Test:

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

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. On gear pump (P1) (reel drive), disconnect the hose that leads to port P1 on the hydraulic manifold.

4. Install tester in series with gear pump (P1) and the disconnected hose. **Make sure the flow control valve on the tester is fully open.**

5. On machines with backlap capabilities, make sure backlap knob on the manifold block is in the **mow** position and reel speed is set to maximum.

6. Make sure tester load valve is fully open before starting the engine.

CAUTION

Do not engage the cutting units when performing this test.

7. Start engine and move throttle to full speed **(2850 ± 50 RPM)**.

8. Watch pressure gauge carefully while slowly closing the flow control valve on the tester until **2000 PSI (138 bar)** is obtained.

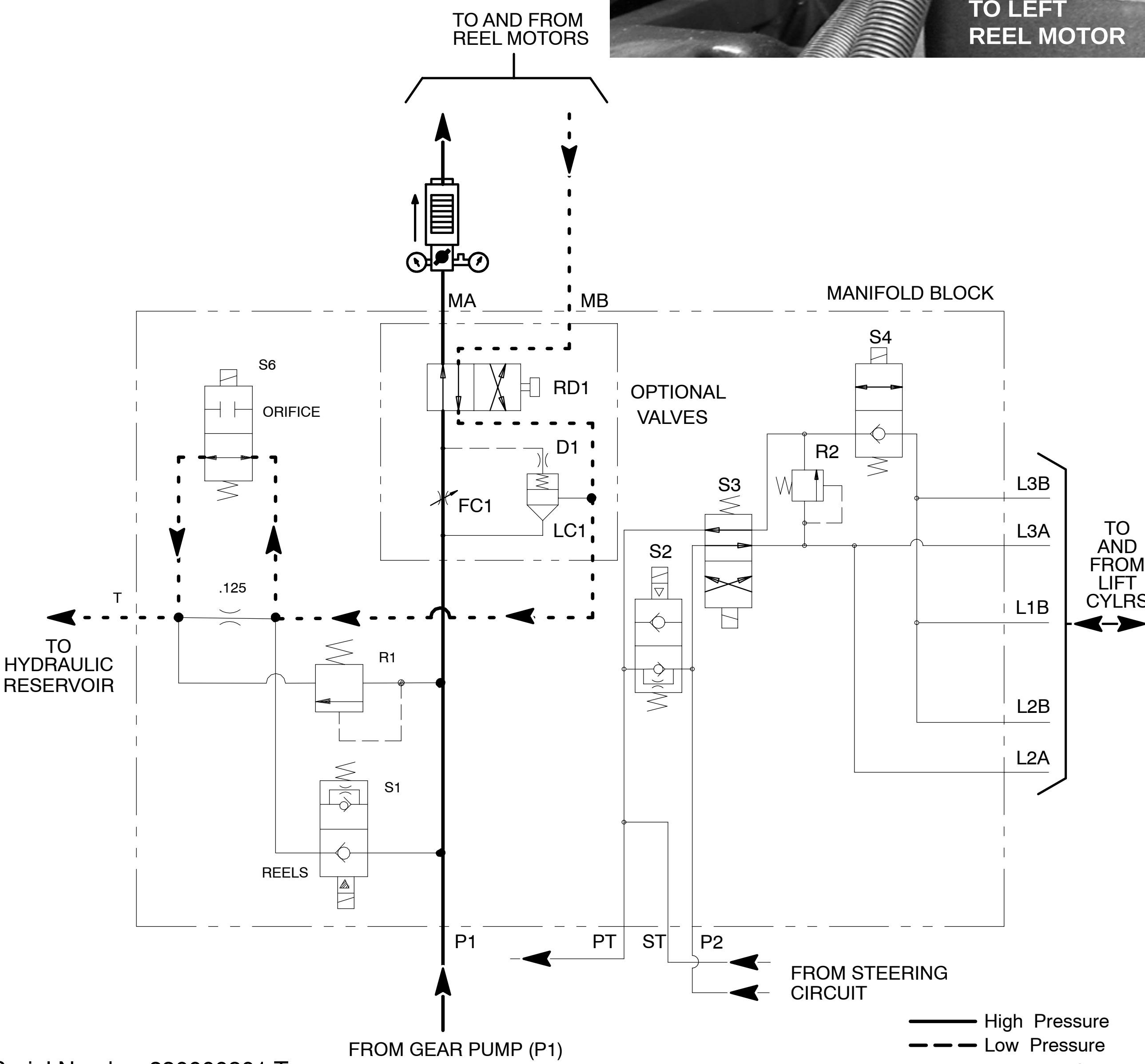
9. Flow indication should be **5.8 GPM** minimum. Record test results.

10. Open control valve on tester and shut off engine.

11. If flow was less than **5.8 GPM** or a pressure of **2000 PSI (138 bar)** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove pump and repair or replace as necessary.

12. If testing is complete, disconnect tester from gear pump and hose. Reconnect hose to the pump.

Mow Circuit Relief Valve (R1) Pressure Test (Using Tester with Flowmeter and Pressure Gauge)



Serial Number 230000801 To 260999999 Shown

Procedure for Mow Circuit Relief Valve (R1) Pressure Test:

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

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. Thoroughly clean and then disconnect hose connection on the bulkhead that leads to the left reel motor.

4. Install tester in series with the disconnected hose and bulkhead connection. **Make sure the flow control valve on the tester is fully open.**

5. To prevent reel damage, temporarily adjust bedknife on all cutting units to allow clearance between bedknife and reel (no contact).

6. On machines with backlap capabilities, make sure backlap knob on the hydraulic manifold is in the **mow** position. Make sure reel speed knob (FC1) is set to highest speed setting (fully open).

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

7. Start engine and move throttle to full speed **(2850 ± 50 RPM**. Engage the cutting units.

8. Watch pressure gauge carefully while slowly closing the flow control valve on the tester to fully closed.

9. On machines with serial number under 260999999, system pressure should be from **2160 to 2640 PSI (149 to 182.2 bar)**. **Note:** If a dethatching kit is installed, system pressure should be from **2700 to 3300 PSI (186.3 to 227.7 bar)**. Record test results.

A. If this specification **is** met, go to step 11.

B. If specification **is not** met, open control valve on tester, shut off engine and adjust relief valve (R1) (Fig. 22) (see Adjust Manifold Relief Valves in the Adjustments section of this Chapter). After adjustment, retest relief valve (R1) pressure.

10. On machines with serial number above 270000000, system pressure should be from **2700 to 3300 PSI (186.3 to 227.7 bar)**. Record test results.

A. If this specification **is** met, go to step 11.

B. If specification **is not** met, open control valve on tester, shut off engine and remove solenoid relief valve (S1R1) on manifold (Fig. 23). Clean or replace valve (see Hydraulic Manifold Service (Serial Number Above 270000000) in the Service and Repairs section of this chapter). Retest relief valve (R1) pressure.

11. Disengage cutting units. Open control valve on tester and shut off engine.

12. Disconnect tester from manifold and hose. Reconnect hose to the bulkhead connection.

13. Correctly readjust bedknife on all cutting units.

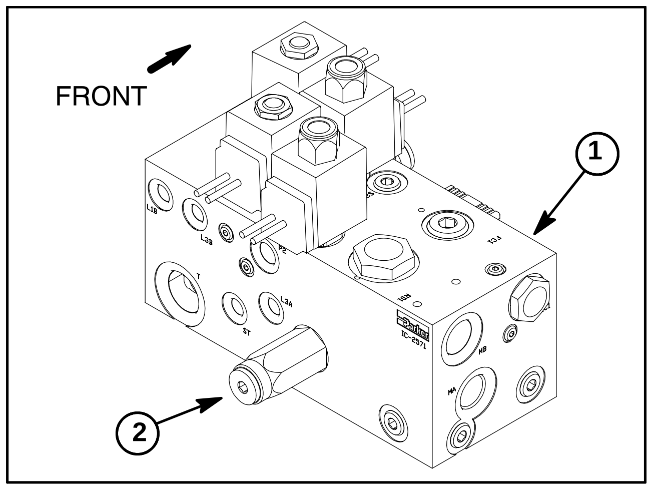


Figure 22

1. **Hydraulic manifold (serial number under 260999999)**
2. **Relief valve (R1)**

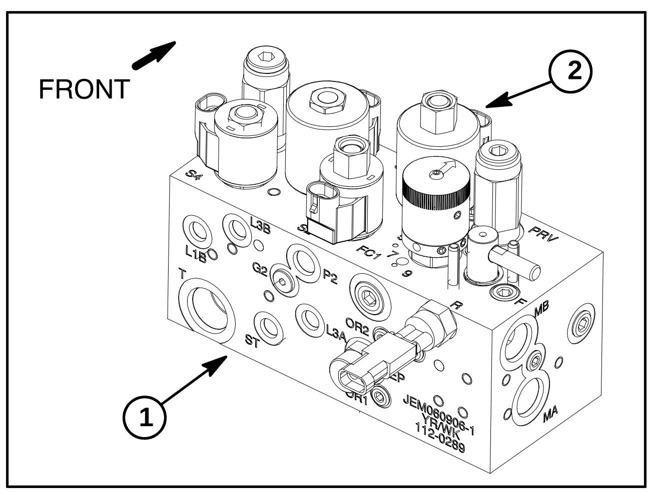
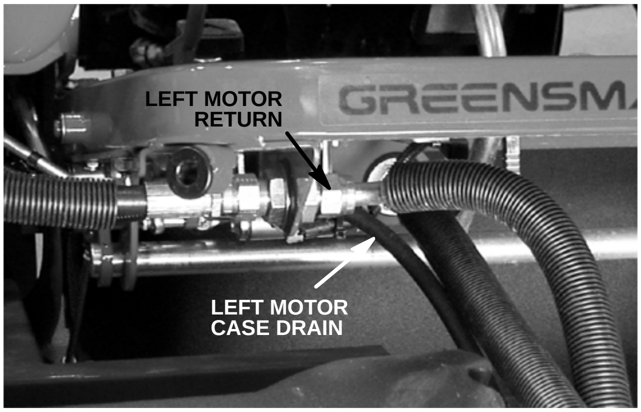


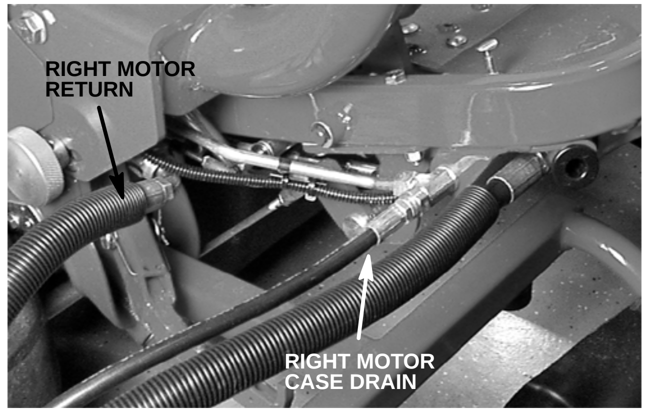
Figure 23

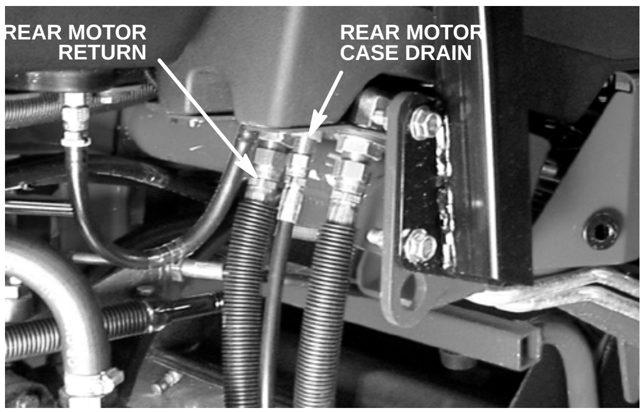
1. **Hydraulic manifold (serial number above 270000000)**
2. **Solenoid relief valve (S1R1)**

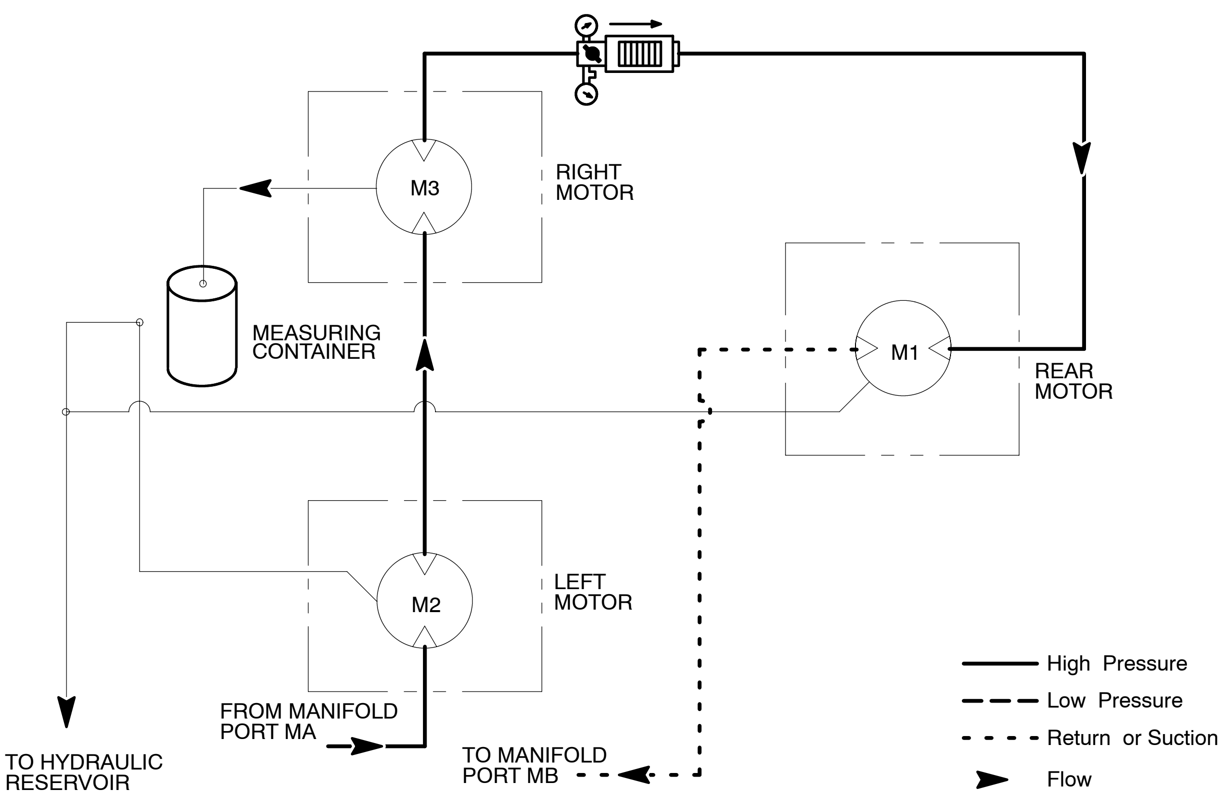
Hydraulic System

Reel Motor Case Drain Flow Test (Using Tester with Flowmeter and Pressure Gauge)









Procedure for Reel Motor Case Drain Flow Test:

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

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

3. For the suspected bad reel motor, disconnect return hose from motor.

4. Install tester in series with the reel motor and the disconnected return hose. **Make sure the flow control valve on the tester is fully open.**

5. If a back lap kit is installed, make sure backlap knob on the hydraulic manifold is in the **mow** position and reel speed is set to maximum.

6. Disconnect hose from case drain of the motor to be tested at the bulkhead fitting.

   A. Plug the bulkhead port.

   B. Leave the case drain hose from the motor open and place open end of disconnected hose into a drain pan.

7. One person should sit on the seat and operate the machine while another person reads the tester and measures case drain leakage. Make sure functional control lever is in **NEUTRAL**. Start engine and move the throttle to full speed **(2850 ± 50 RPM)**.

CAUTION

Keep away from reels during test to prevent personal injury from the rotating reel blades.

8. Engage reels by positioning the functional control lever to **MOW** position. While watching pressure gauge, slowly close flow control valve on the tester until a pressure of **1000 PSI (69 bar)** is obtained.

9. After achieving **1000 PSI (69 bar)**, place disconnected motor case drain hose into a container graduated in ounces or milliliters (Tool TOR4077: see Special Tools) and collect hydraulic fluid for **15 seconds** (Fig. 28). After **15 seconds**, remove hose end from container.

10. Disengage cutting units by positioning functional control lever to **NEUTRAL** position. Open control valve on tester and stop the engine.

11. Measure the amount of oil collected in the container. Record test results.

12. If case drain flow was greater than **16.0 ounces (473 milliliters) (0.5 GPM/1.9 LPM)** in **15 seconds**, repair or replace the reel motor as necessary.

13. Disconnect tester from motor and return hose. Reconnect hose to the pump.

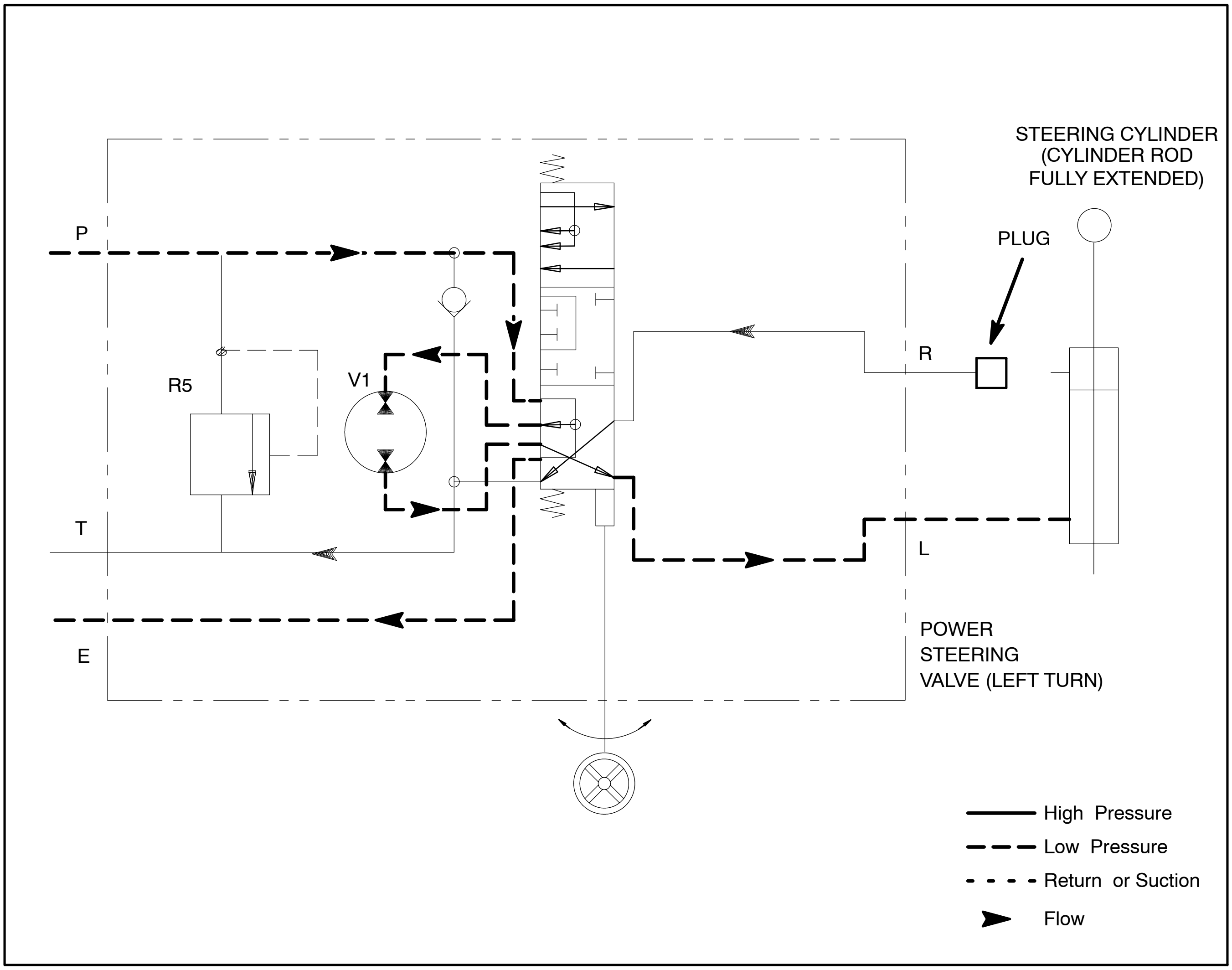
14. Remove plug from bulkhead fitting. Reconnect case drain hose to the bulkhead fitting. Test other reel motors as needed.

Figure 28

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

Figure 29

Steering Control Valve Test



Procedure for Steering Control Valve Test:

1. Make sure the hydraulic tank is full.

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

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

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

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

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

A. The steering wheel must go back immediately to the neutral position.

B. The steering wheel should **not** continue to turn.

Note: The steering wheel must be able to turn with no more than **45 in-lb (5.1 Nm)** of torque.

5. Perform the Implement Relief Valve (R5) Pressure and Gear Pump (P2) Flow tests to make sure that relief valve and gear pump are functioning correctly.

Note: This steering test procedure will be affected by incorrect rear tire pressure, binding in the hydraulic steering cylinder, extra weight on the vehicle, and/or binding of the steering fork assembly. Make sure that these items are checked before proceeding with any hydraulic testing procedure.

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

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

B. Turn the steering wheel all the way to the left (counterclockwise) so the steering cylinder rod is fully extended.

C. Turn engine off.

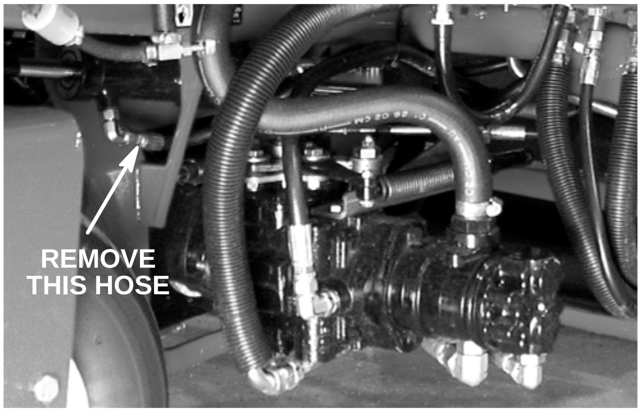


Figure 26

CAUTION

Before continuing further, read and become familiar with Precautions for Hydraulic Testing.

D. Read Precautions for Hydraulic Testing.

E. Remove hydraulic hose from the 90° fitting on the rod end of the steering cylinder. Plug the end of the hose.

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

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

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

Hydraulic System

Adjust Manifold Relief Valves (R1 and R2)

These relief valves are installed on the hydraulic manifold. Relief valve (R1) is in the mow circuit (machines with serial number under 260999999) and relief valve (R2) is the lower cutting units relief.

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.

1. Locate relief valve and remove cap from valve.

Note: An 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. After adjustment, retest pressure setting (see TESTING).

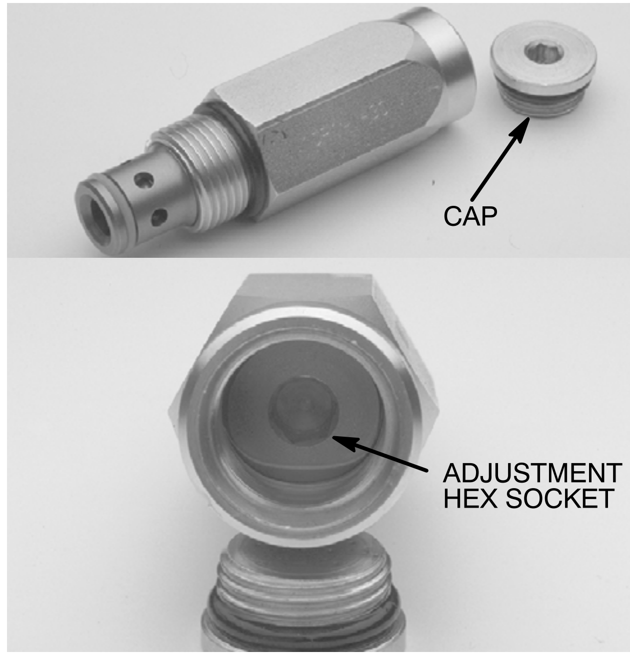


Figure 27

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

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

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

Gear Pump

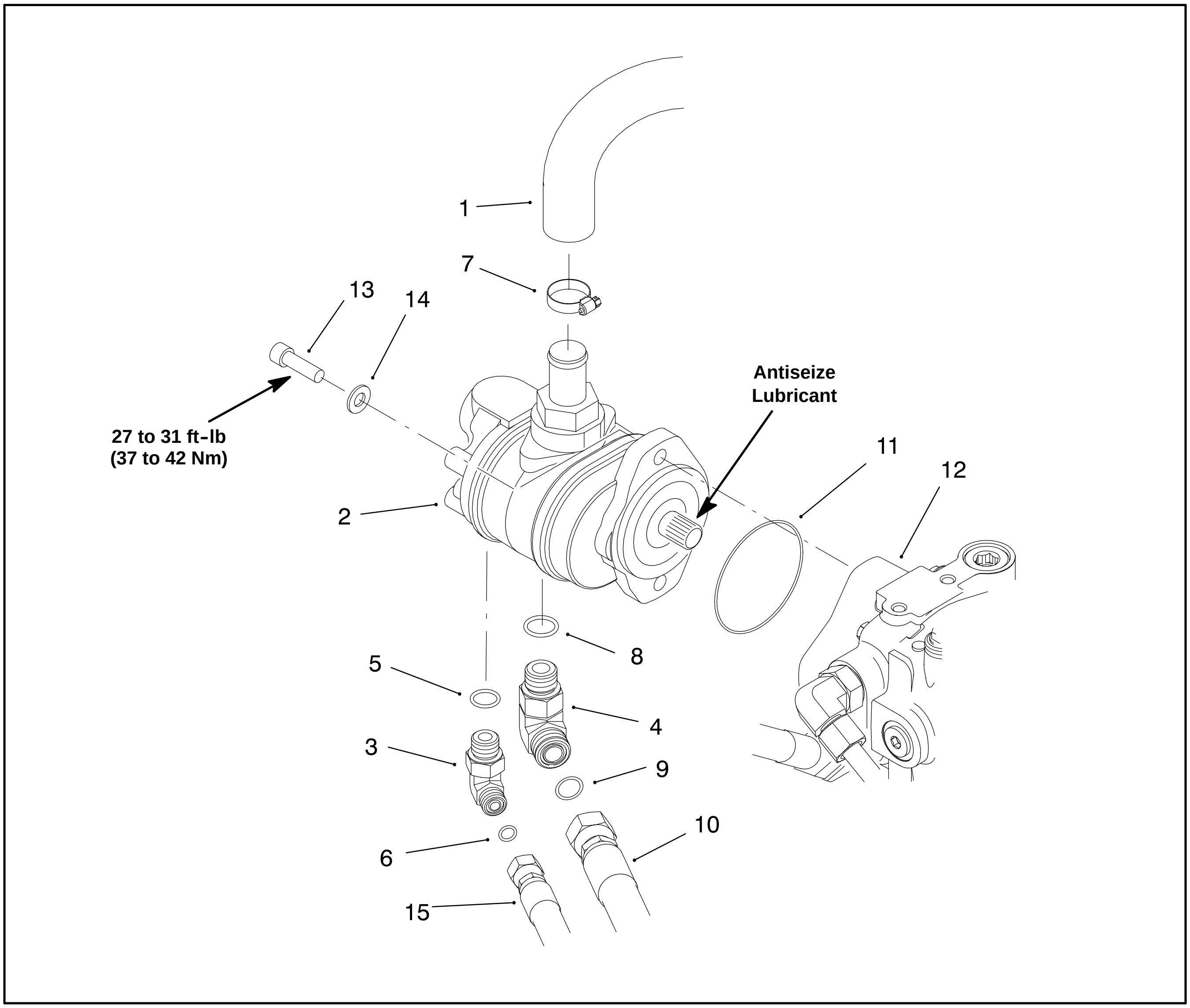


Figure 28

1. **Pump inlet hose**
2. **Gear pump**
3. **Hydraulic fitting**
4. **Hydraulic fitting**
5. **O-ring**
6. **O-ring**
7. **Hose clamp**
8. **O-ring**
9. **O-ring**
10. **Hydraulic hose**
11. **O-ring**
12. **Hydrostat**
13. **Hex socket screw**
14. **Flat washer**
15. **Hydraulic hose**

Removal (Fig. 28)

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

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

2. Clamp pump inlet hose to prevent draining the hydraulic tank.

3. Label all hose connections for reassembly purposes.

4. Loosen hose clamp, and remove pump inlet hose from the gear pump. Allow hydraulic oil to drain from hose into a suitable container.

5. Remove hydraulic hoses and O-rings from hydraulic fittings. Allow hydraulic oil to drain from hoses into a suitable container.

IMPORTANT: Note position of hydraulic fittings for reassembly purposes.

6. Remove hydraulic fittings and O-rings from the gear pump.

7. Support gear pump. Separate gear pump from the hydrostat by removing both hex socket head screws and flat washers. Remove O-ring from between the gear pump and hydrostat.

Installation (Fig. 28)

1. Make sure mounting and O-ring sealing surfaces on the gear pump and hydrostat are clean.

2. Replace all O-rings with new ones. Apply clean hydraulic oil to all O-rings.

3. Place O-ring on the gear pump.

4. Apply antiseize lubricant to gear pump shaft splines.

5. Position gear pump to the hydrostat so that the pump inlet is facing up.

6. Secure gear pump to the hydrostat with both hex socket head screws and flat washers. Torque screws from **27 to 31 ft-lb (37 to 42 Nm)**.

7. Inspect threads and sealing surfaces of hydraulic fittings and hydraulic hose connectors. Replace any damaged or worn fittings or connectors.

8. Install O-rings into gear pump. Install fittings and tighten to positions noted during removal.

9. Secure pump inlet hose and hose clamp to the gear pump. Tighten hose clamp.

10. Remove clamp from pump inlet hose to allow hydraulic oil flow to the gear pump.

Gear Pump Service

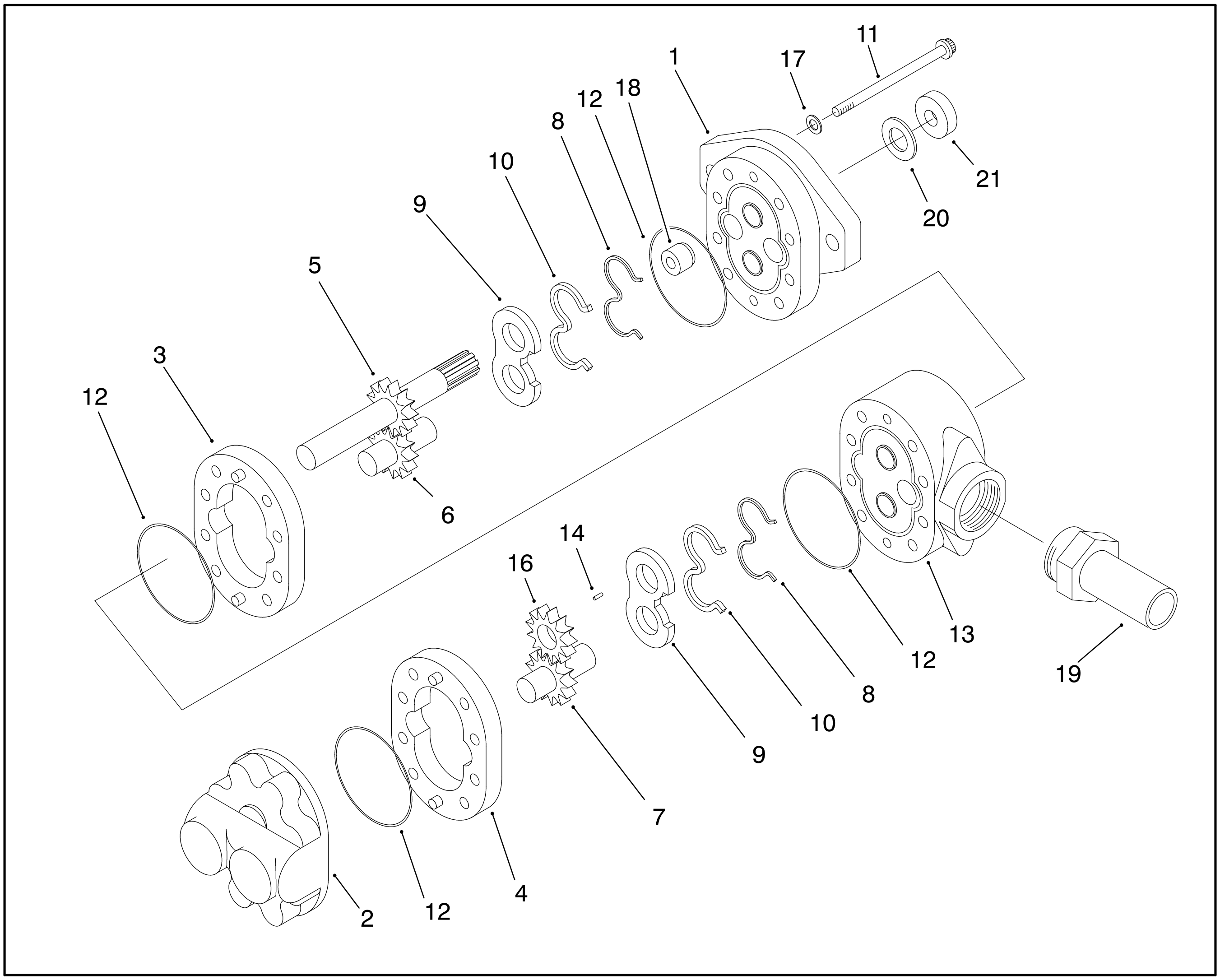


Figure 29

1. **Front plate**
2. **Back plate**
3. **Front body**
4. **Back body**
5. **Drive gear**
6. **Front idler gear**
7. **Back idler gear**
8. **Back-up gasket**
9. **Wear plate**
10. **Pressure seal**
11. **Cap screw**
12. **O-ring**
13. **Adapter plate**
14. **Key**
15. **Not used**
16. **Back gear**
17. **Washer**
18. **Plug**
19. **Suction fitting**
20. **Washer**
21. **Shaft seal**

Note: For repair of the gear pump, see Eaton Gear Pumps, Repair Information, Series 26, Model 26000, Multiple Gear Pumps at the end of this chapter.

Hydraulic System Start-up

Note: When initially starting the hydraulic system with new or rebuilt components such as motors, pumps, or lift cylinders, it is important that this start-up procedure be used. This procedure reduces the chance of damaging the system or its components from not purging the system of air.

1. After the hydraulic system components have been properly installed and if the traction pump was rebuilt or replaced, make sure traction pump housing is at least half full of clean hydraulic oil.

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

3. Make sure hydraulic reservoir is full. Add correct oil if necessary (see Check Hydraulic System Fluid). Drain, flush, and refill hydraulic system reservoir and change oil filter if component failure was severe or system is contaminated.

4. After repairs, check control linkage for proper adjustment, binding, or broken parts.

5. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**.

6. Disconnect both spark plug wires from spark plugs to prevent the engine from starting.

7. Turn ignition key switch and engage starter for ten (10) seconds to the prime pump. Return ignition switch to off and wait one minute to allow starter to cool. Repeat step a second time.

8. Reconnect spark plug wires to spark plugs.

9. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Start engine and run it at low idle. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in thirty (30) seconds, stop the engine and determine the cause.

CAUTION

Be careful when operating the cutting unit reels. Contact with the reel or other moving parts can result in personal injury.

10. After the hydraulic system starts to show signs of fill, accomplish the following:

   A. If a reel motor was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for ten (10) minutes in **both** directions.

   B. If a reel motor drive pump was replaced or rebuilt, run the cutting units at the minimum speed setting (under no load) for ten (10) minutes.

   C. If a traction pump or a wheel motor was replaced or rebuilt, run the traction unit so the wheels slowly turn for ten (10) minutes.

11. Operate the traction unit and cutting unit by gradually increasing their work load to full over a ten (10) minute period.

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

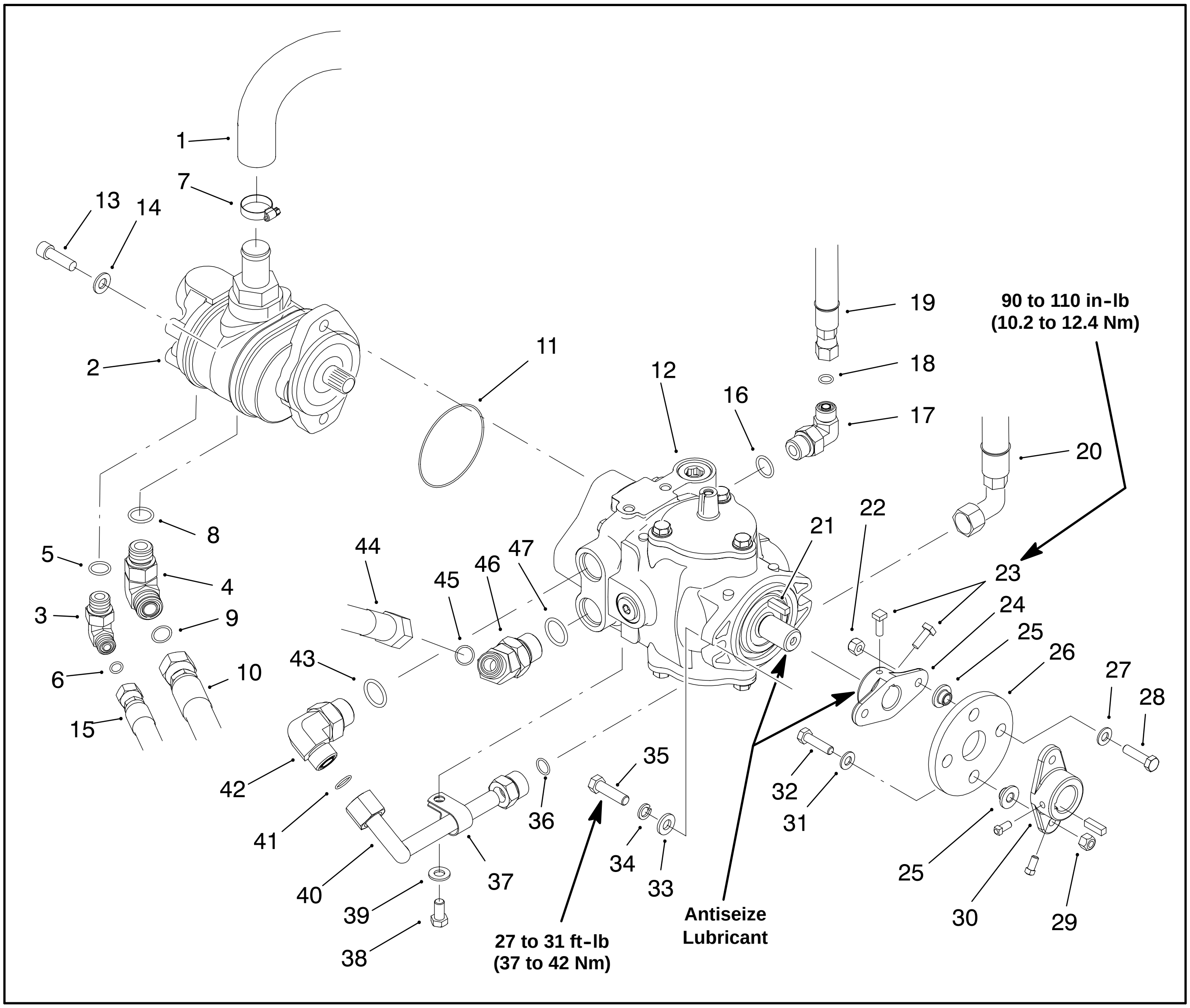


Figure 30

1. Pump inlet hose
2. Gear pump
3. 90º hydraulic fitting
4. 90º hydraulic fitting
5. O-ring
6. O-ring
7. Hose clamp
8. O-ring
9. O-ring
10. Hose assembly
11. O-ring
12. Hydrostat
13. Socket head screw
14. Flat washer
15. Hose assembly
16. O-ring
17. 90º hydraulic fitting
18. O-ring
19. Hose assembly
20. Hose assembly
21. Key
22. Lock nut
23. Square head set screw
24. Pump hub
25. Coupling spacer
26. Drive coupling
27. Flat washer
28. Cap screw
29. Lock nut
30. Engine hub
31. Flat washer
32. Cap screw
33. Flat washer
34. Lock washer
35. Cap screw
36. O-ring
37. Support clamp
38. Cap screw
39. Flat washer
40. Tube assembly
41. O-ring
42. 90º hydraulic fitting
43. O-ring
44. Hose assembly
45. O-ring
46. 45º hydraulic fitting
47. O-ring

Removal (Fig. 30)

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

CAUTION

Use caution when removing the lock nut from the pin. The extension spring is under tension and may cause personal injury during removal.

Note: The neutral system assembly can be removed from the hydrostat without complete disassembly.

2. Disconnect the extension spring (1) and damper (2) from the spring bracket and the neutral arm (Fig. 31).

3. Remove the cap screw and pivot washer from camplate shaft of hydrostat (Fig. 32).

4. Remove both cap screws securing the cable support assembly to the hydrostat (Fig. 32).

5. Lift and secure the neutral system assembly up and away from the hydrostat.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

6. Label all hose connections for reassembly purposes.

7. Clamp pump inlet hose (1) to prevent draining the hydraulic reservoir (Fig. 30).

8. Separate gear pump from the hydrostat (see Hydraulic Gear Pump Removal).

9. Plug suction port at the end of the gear pump to prevent possible leakage of hydraulic fluid (Fig. 33).

10. Pull gear pump (2) and connected hoses assemblies (10 and 15) away from the hydrostat (12) and secure (Fig. 30).

11. Remove hose assemblies (19, 20, and 44) and O–rings (18, 36, and 45) from the hydraulic fittings. Allow hoses to drain into a suitable container.

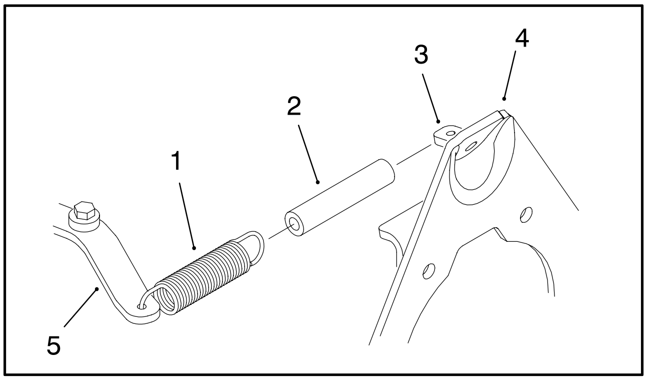


Figure 31

1. **Extension spring**
2. **Dampener hose**
3. **Spring bracket**
4. **Adapter plate**
5. **Neutral arm**

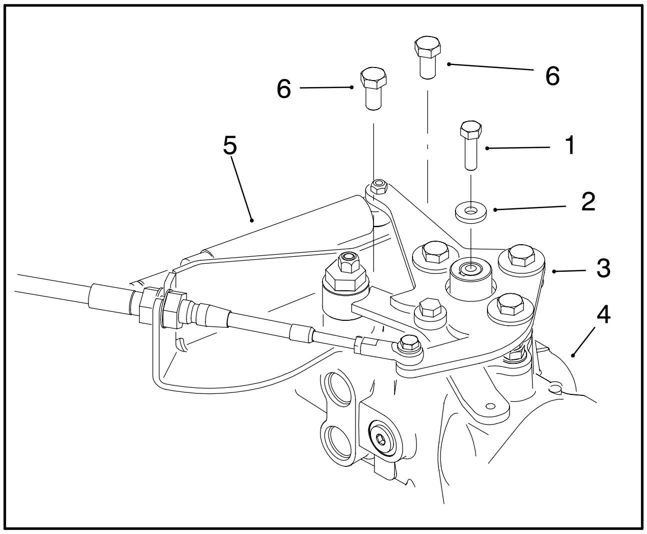


Figure 32

1. **Cap screw**
2. **Pivot washer**
3. **Pump lever assembly**
4. **Hydrostat**
5. **Cable support assembly**
6. **Cap screw**

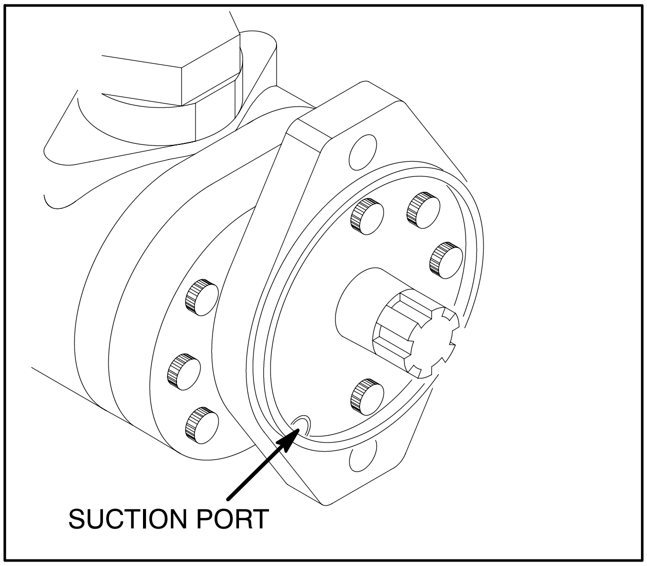


Figure 33

Hydraulic System

12. Loosen both set screws (23) on the pump hub (24) enough to allow the hydrostat shaft to be removed.

CAUTION

Support the hydrostat when removing its supporting fasteners to prevent it from falling and causing personal injury.

13. Remove both cap screws (35), lock washers (34), and flat washers (33).

14. Separate hydrostat from the pump adapter and pump hub (24). Remove key (21) from the hydrostat shaft.

Installation (Fig. 30)

1. Make sure the inside of the pump hub (24) is clean. Apply antiseize lubricant to both the hydrostat (12) shaft and the inside of the pump hub.

2. Coat key (21) with petroleum jelly and insert it into the hydrostat shaft. Position hydrostat to the pump adapter and pump hub (24). Slide the shaft into the hub with the key.

3. Secure the hydrostat to the pump adapter with both cap screws (35), lock washers (34), and flat washers (33). Torque screws from **27 to 31 ft-lb (37 to 42 Nm)**.

4. Torque both set screws (23) on the pump hub (24) from **90 to 110 in-lb (10.2 to 12.4 Nm)**.

5. Inspect threads and sealing surfaces of hydraulic fittings and hydraulic hose connectors. Replace any damaged or worn fittings or connectors.

6. Lubricate all new O-rings with clean hydraulic fluid.

7. Install O-rings (18, 36, and 45) and hose assemblies (19, 20, and 44).

IMPORTANT: Failure to remove the plug will cause excessive pressure in the hydrostat and damage seals.

8. Remove plug from the suction port on the gear pump (Fig. 33).

9. Install gear pump to the hydrostat (see Hydraulic Gear Pump Installation).

10. Remove clamp from pump inlet hose (1).

11. Install the neutral system cable support assembly to the hydrostat with cap screws (6) (Fig. 32). Torque screws from **27 to 31 ft-lb (37 to 42 Nm)**.

12. Position pump lever assembly onto the hydrostat camplate shaft and install the cap screw (1) and pivot washer (2) securing the pump lever assembly (Fig. 32)

13. Connect the extension spring (1) and damper (2) to the spring bracket and the neutral arm (Fig. 31).

14. Check neutral position of the traction pedal. If adjustment is required, see Adjust Transmission for Neutral in the Traction Unit Owners Manual.

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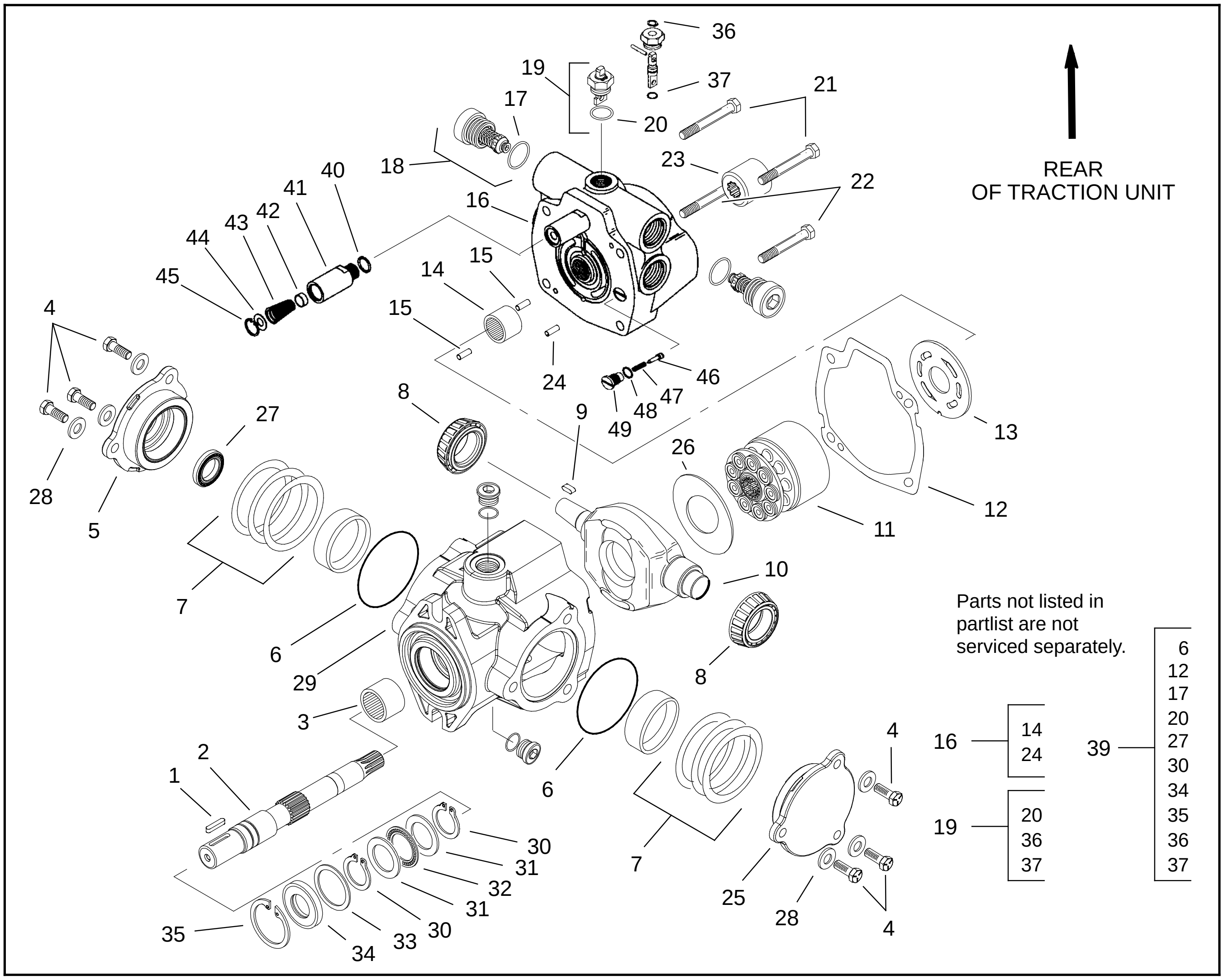

Figure 38

1. **Key**
2. **Drive shaft**
3. **Bearing**
4. **Cap screw**
5. **Cover plate**
6. **O-ring**
7. **Shim kit (for crush ring replacement)**
8. **Bearing cone**
9. **Key**
10. **Camplate**
11. **Rotating kit**
12. **Gasket**
13. **Valve plate**
14. **Bearing**
15. **Dowel pin**
16. **Back plate**
17. **O-ring**
18. **Check valve**
19. **Dump valve**
20. **O-ring**
21. **Cap screw**
22. **Cap screw**
23. **Coupler**
24. **Roll pin**
25. **Cover plate**
26. **Camplate insert**
27. **Shaft seal**
28. **Washer**
29. **Housing**
30. **Retaining ring**
31. **Bearing race**
32. **Thrust bearing**
33. **Washer**
34. **Shaft seal**
35. **Retaining ring**
36. **Retaining ring**
37. **O-ring**
38. **O-ring**
39. **Seal kit**
40. **O-ring**
41. **Charge relief housing**
42. **Charge relief poppet (R4)**
43. **Charge relief spring**
44. **Washer**
45. **Retaining ring**
46. **Bleed-off valve poppet**
47. **Bleed-off spring**
48. **O-ring**
49. **Cartridge**

Note: For repair of the hydrostat, see Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter.

IMPORTANT: The shims (7) are used to replace a crush ring in the cover plate (25). If the camplate (10), cover plate (25), or housing (29) is replaced during servicing, the old crush ring must be replaced using the procedure on the following page (see Piston Pump Crush Ring Replacement) in conjunction with the piston pump service manual.

Hydrostat Crush Ring Replacement

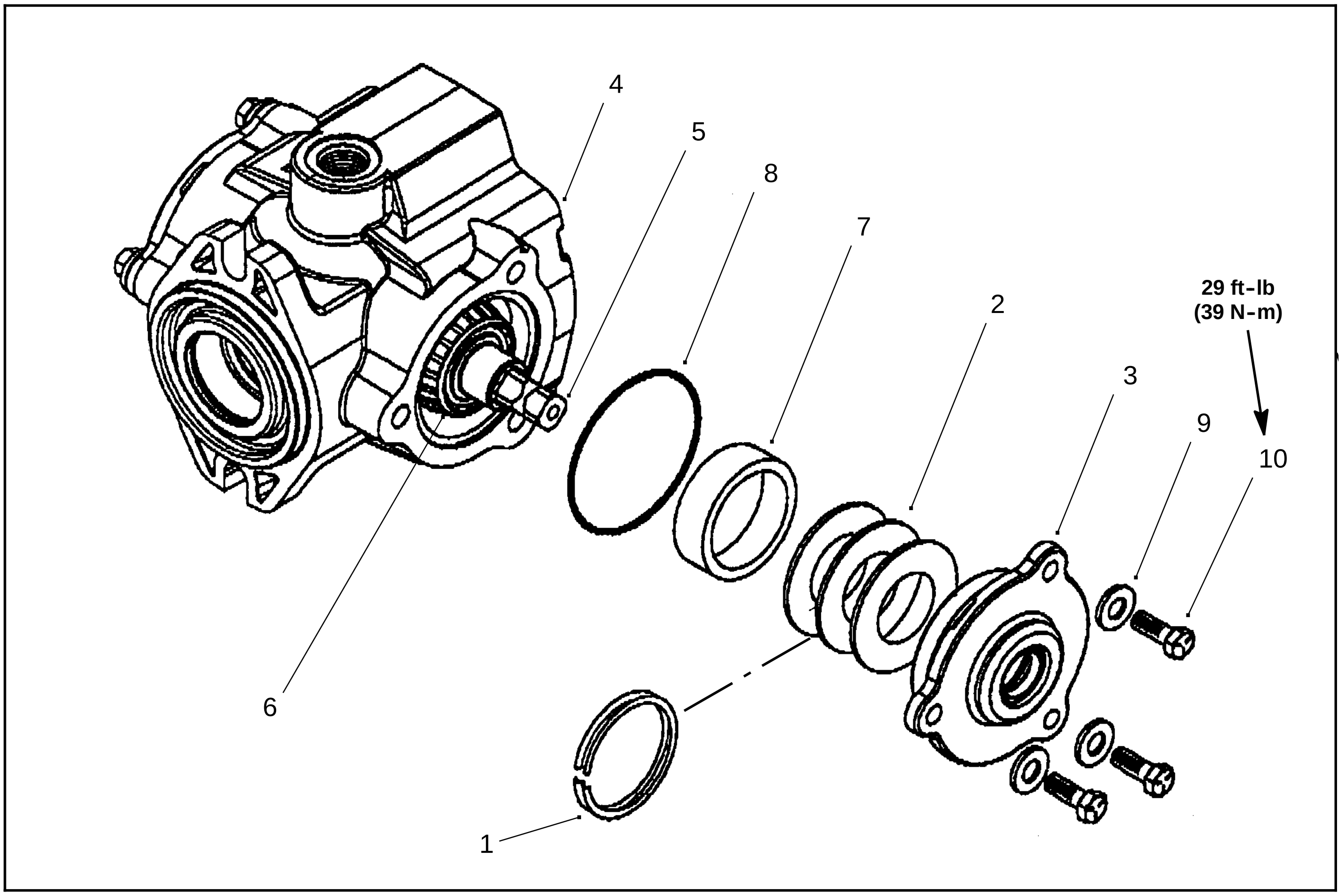

Figure 39

1. **Crush ring**
2. **Shims**
3. **Cover plate**
4. **Housing**
5. **Camplate (control shaft)**
6. **Bearing cone**
7. **Bearing cup**
8. **O-ring**
9. **Washers**
10. **Cap screws**

Piston Pump Crush Ring Replacement (Fig. 39)

Note: The shims replace the crush ring in the cover plate. If the camplate, cover plate, or housing is replaced during servicing of the pump, the old crush ring can not be used to make sure of proper preload.

1. Remove crush ring from the cover plate. Measure thickness of crush ring.

2. Stack shims to the thickness of the crush ring.

3. Insert shims into the cover plate in the same location that the crush ring was removed from.

4. Assemble housing sub assembly consisting of the housing, camplate, bearing cone, bearing cup, and cover plate (see Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter).

5. Install washers and cap screws to the cover plate and housing. Torque cap screws to **29 ft-lbs (39 Nm)**.

6. Check torque required to rotate control shaft. Torque should be **5 to 15 in-lbs (0.6 to 1.7 Nm)**.

   A. If torque is **too low**, add additional shims and repeat steps 3 through 6 until the specified torque is achieved.

   B. If torque is **too high**, remove shims and repeat steps 3 through 6 until the specified torque is achieved.

7. Complete assembly of the pump (see pump service manual at the end of this chapter).

Front Wheel Motors

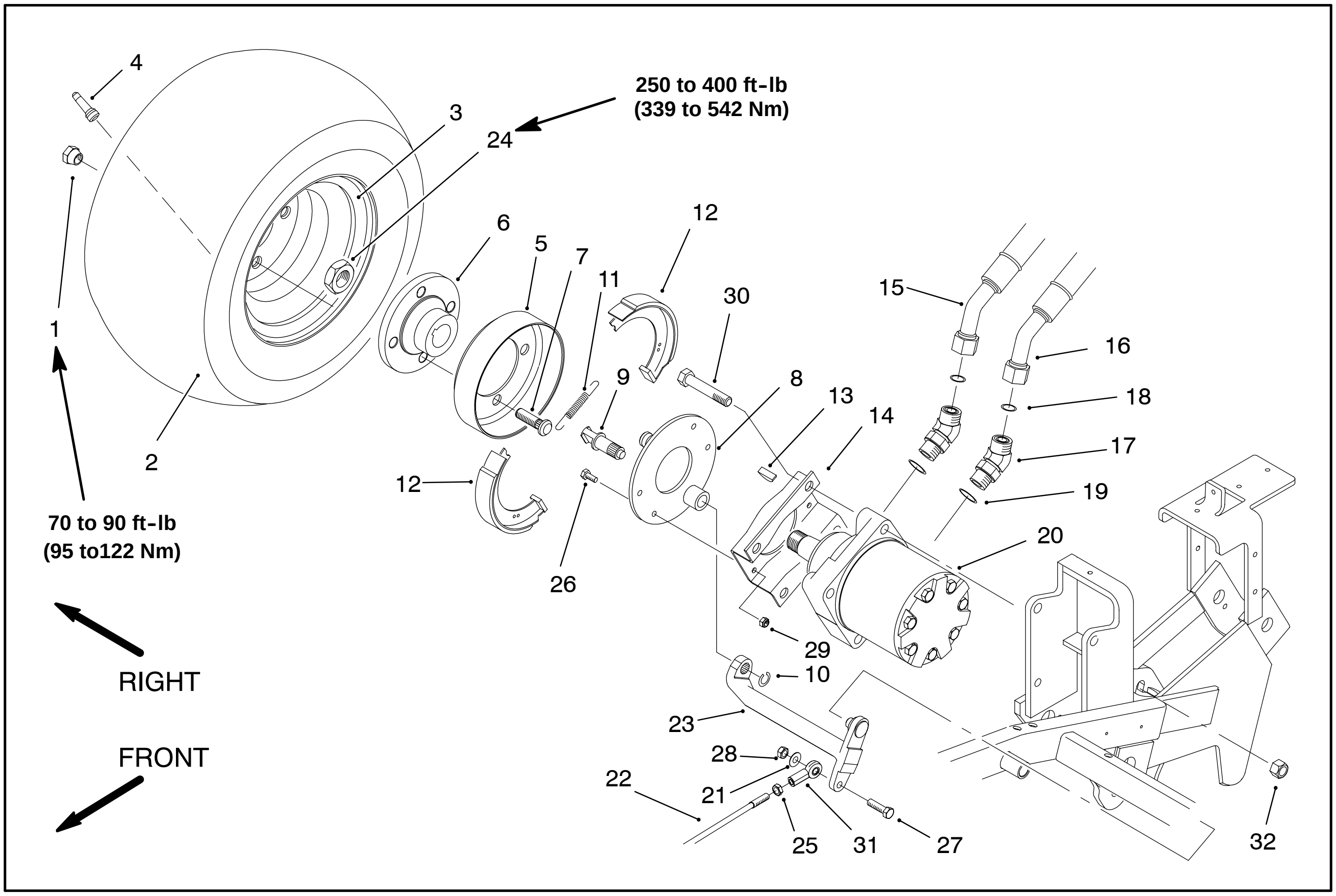

Figure 36

1. Lug nut	12. Brake shoe	23. Brake lever
2. Tire	13. Woodruff key	24. Lock nut
3. Rim	14. Brake bracket	25. Jam nut
4. Valve stem	15. Hydraulic hose	26. Cap screw
5. Brake drum	16. Hydraulic hose	27. Cap screw
6. Wheel hub	17. 45º hydraulic fitting	28. Lock nut
7. Drive stud	18. O-ring	29. Lock nut
8. Backing plate	19. O-ring	30. Cap screw
9. Brake cam	20. Hydraulic motor	31. Swivel clevis
10. Retaining ring	21. Flat washer	32. Lock nut
11. Return spring	22. Brake rod	

Front Wheel Motor Removal (Fig. 36)

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Chock front and rear of wheels not being lifted to prevent the machine from moving. Lift front wheel off the ground using a jack, and place blocks beneath the frame.

3. Remove lug nuts (1), tire (2), and rim (3) from drive studs (7). Loosen but do not remove lock nut (24) from hydraulic wheel motor (20) shaft.

IMPORTANT: DO NOT hit wheel hub (6) with a hammer during removal. Hammering may cause damage to the hydraulic wheel motor (20).

Note: The brake drum assembly consists of the wheel hub (6), brake drum (3), and drive stud (7).

4. Use wheel hub puller (see Special Tools) to free wheel hub assembly from motor shaft. Do not disassemble. Remove lock nut (24) and key (13) from the hydraulic wheel motor (20) shaft.

5. Remove retaining clip (10) from the brake cam (9) and brake lever (23). Separate lever from cam.

Note: The brake assembly consists of return spring (11), brake cam (9), brake shoes (12), backing plate (8), and retaining ring (10).

6. Remove brake assembly from the brake bracket (14) by removing four cap screws (26) and lock nuts (29) from the backing plate (8) and brake bracket. Do not disassemble.

7. Label all connections for reassembly purposes.

8. Disconnect both hose assemblies (15 or 16) and O-rings (18) from the both hydraulic fittings (17). Allow hoses to drain into a suitable container.

9. Remove hydraulic fittings (17) and O-rings (19) from the hydraulic wheel motor (20).

10. Remove four cap screws (30), and lock nuts (32) from brake bracket (14) and hydraulic wheel motor (20). Remove motor from the frame.

Front Wheel Motor Installation (Fig. 36)

1. Position hydraulic wheel motor (20) to the frame. Make sure ports of motor face the rear of the machine. Secure motor and brake bracket (14) to the frame with four cap screws (30), and lock nuts (32).

2. Remove caps or plugs from the hydraulic wheel motor (20). Lubricate new O-rings (19) with clean hydraulic fluid. Install O-rings and hydraulic fittings (17) to the motor and tighten.

3. Lubricate new O-rings (18) with clean hydraulic fluid. Install O-rings and hose assemblies (15 or 16) to the hydraulic fittings (17). Tighten hose connections.

Note: The brake assembly consists of return spring (11), brake cam (9), brake shoes (12), backing plate (8), and retaining ring (10).

4. Install brake assembly to the brake bracket (14) by securing the backing plate (8) to the brake bracket with four cap screws (26) and lock nuts (29).

5. Secure brake lever (23) to the brake cam (9) with the retaining clip (10).

IMPORTANT: DO NOT hit wheel hub (6) with a hammer during installation. Hammering may cause damage to the hydraulic wheel motor (20).

Note: The brake drum assembly consists of the wheel hub (6), brake drum (3), and drive stud (7).

6. Make sure that wheel hub bore and wheel motor shaft are thoroughly cleaned. Install key (13) to the hydraulic wheel motor (20) shaft. Slide brake drum assembly onto the motor shaft.

7. Secure lock nut (24) to the hydraulic wheel motor (20) shaft. Torque nut from **250 to 400 ft-lb (339 to 542 Nm)**.

8. Install the tire (2), and rim (3), to the brake drum assembly. Secure rim with lug nuts (1). Torque nuts from **70 to 90 ft-lb (95 to 122 Nm)**.

Rear Wheel Motor (Optional 3WD)

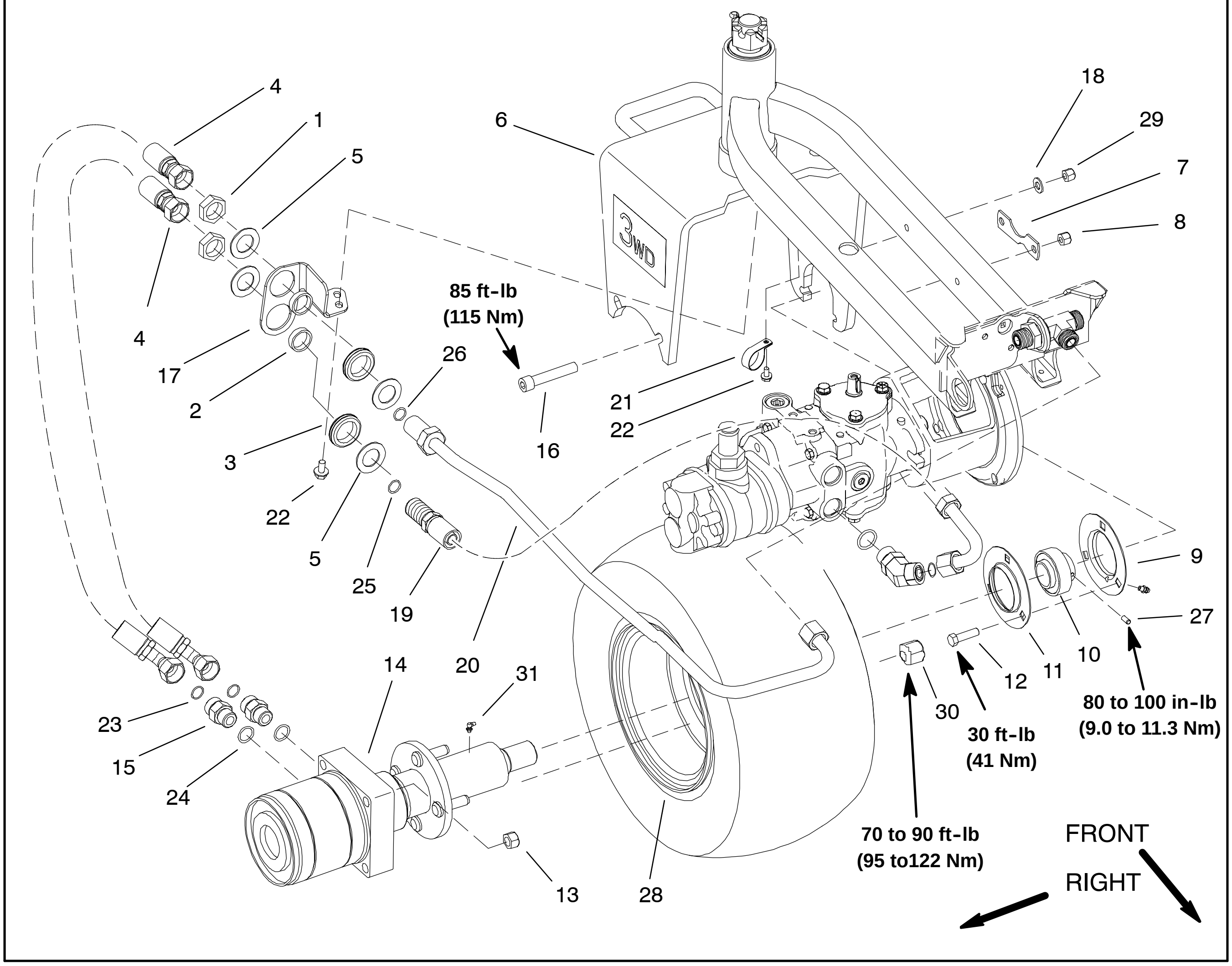

Figure 37

1. Lock nut
2. Spacer
3. Grommet
4. Hose assembly
5. Washer
6. Castor fork
7. Bearing tab
8. Lock nut
9. Bearing flangette (lube)
10. Bearing
11. Bearing flangette
12. Cap screw
13. Lock nut
14. Wheel motor & hub assembly
15. Adapter
16. Cap screw
17. Bracket
18. Flat washer
19. Hose assembly
20. Tube assembly
21. Clamp
22. Cap screw
23. O-ring
24. O-ring
25. O-ring
26. O-ring
27. Set screw
28. Wheel assembly
29. Lock nut
30. Lug nut
31. Grease fitting

Rear Wheel Motor (Optional 3WD) Removal (Fig. 37)

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Chock both front wheels to prevent the machine from moving. Lift rear wheel off the ground using a jack, and place blocks beneath the frame. Secure the rear wheel off the ground.

3. Label hoses for reassembly. Remove both hose assemblies (4) and O-rings (23) from the hydraulic fittings at the hydraulic motor and hub assembly (14). Allow hoses to drain into a suitable container.

CAUTION

Support wheel and motor and hub assembly during removal to prevent dropping and causing personal injury.

4. Remove wheel (28) and hydraulic motor and hub assembly from the castor fork (6) as follows:

   A. Remove cap screws (12) and lock nuts (8) securing flangettes (9 and 11) and bearing tab (8).

   B. Remove both socket head screws (16), flat washers (18), and lock nuts (29).

   C. Lower wheel and hydraulic motor and hub assembly from the castor fork.

5. Loosen both set screws (27) on bearing (10). Slide flangettes and bearing off the motor shaft.

6. Remove grease fitting (31) from the hydraulic motor and hub assembly. Remove four lug nuts (30) and wheel assembly from the hub drive studs.

Note: For disassembly of the hub from the rear wheel motor, see Rear Wheel (Optional 3WD) Disassembly instructions in Chapter 6 - Wheels and Brakes.

Rear Wheel Motor (Optional 3WD) Installation (Fig. 37)

Note: For assembly of the hub to the rear wheel motor, see Rear Wheel (Optional 3WD) Assembly instructions in Chapter 6 - Wheels and Brakes.

1. Make sure grease fitting (31) is removed from the hydraulic motor and hub assembly (14).

2. Secure wheel assembly (28) to the four drive studs of the hydraulic motor and hub assembly with four lug nuts (30). Torque nuts from **70 to 90 ft-lb (95 to 122 Nm)**.

3. Reinstall grease fitting (31) onto hydraulic motor and hub assembly so it points away from the wheel.

4. Slide flangette (11), bearing (10), and relube flangette (9) onto the motor shaft.

5. Position hydraulic motor and hub assembly, flangettes with bearing, and wheel into the castor fork (6). Make sure hose fittings on the motor face rearward.

6. Secure hydraulic motor and hub assembly loosely to the inside of the castor fork with both socket head screws (16), flat washers (18), and lock nuts (29).

7. Secure flangettes with bearing loosely to the inside of the castor fork with cap screws (12), bearing tab (7), and lock nuts (8).

   A. Position grease fitting on flangette downward.

   B. Torque socket head screws (16) to **85 ft-lb (115 Nm)**.

   C. Torque cap screws (12) to **30 ft-lb (41 Nm)**.

8. Apply loctite to both set screws (27). Torque set screws from **80 to 100 in-lb (9.0 to 11.3 Nm)**.

9. Install both hose assemblies (4) and new O-rings (23) to the hydraulic fittings at the hydraulic motor and hub assembly.

Wheel Motor Service

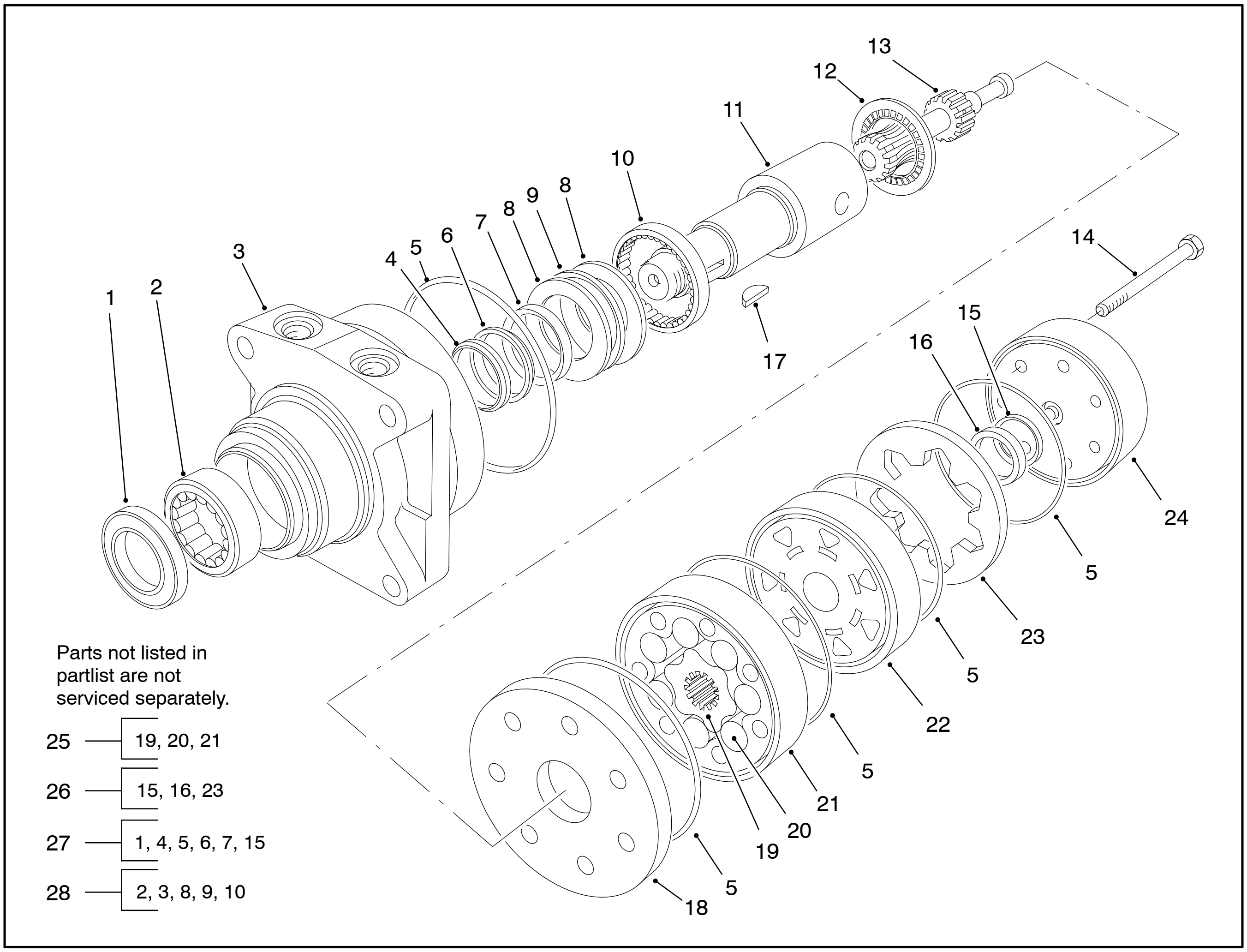

Figure 38

1. **Dirt seal**
2. **Bearing**
3. **Housing**
4. **Back-up washer**
5. **Seal rings**
6. **Back-up washer**
7. **Inner seal**
8. **Thrust washer**
9. **Thrust bearing**
10. **Bearing**
11. **Coupling shaft**
12. **Thrust bearing**
13. **Drive link**
14. **Cap screw**
15. **Commutator seal**
16. **Commutator**
17. **Woodruff key**
18. **Wear plate**
19. **Rotor**
20. **Vane**
21. **Stator**
22. **Manifold**
23. **Commutator ring**
24. **End cover**
25. **Rotor set**
26. **Commutator assembly**
27. **Seal kit**
28. **Housing assembly**

Note: For repair of the wheel motors, see the Ross Torqmotor ™ MG, MF, MP, MB, ME, and MJ Series Service Procedure (Service Manual 2704-003) at the end of this chapter.

Flush Hydraulic System

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

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

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Clean area around hydrostat and pump inlet hose. Clamp pump inlet hose. Remove inlet hose from hydrostat, release clamp, and drain reservoir into a suitable container. Drain hydraulic system while making sure lift cylinders, hoses, tube lines, and all other components are drained from low points while the system is warm. Discard filter (Fig. 39).

3. Clean oil filter mounting area. Remove filter and drain into a suitable container. Discard filter (Fig. 40).

4. Inspect and clean reservoir (see Inspecting Reservoir Parts).

5. Make sure filter mounting surface is clean. Apply hydraulic oil to gasket on the new filter. Screw filter on until gasket contacts mounting plate, then tighten filter half a turn.

Note: Use only hydraulic fluids (including biodegradable) specified in the Traction Unit Operator's Manual. Other fluids could cause system damage.

6. Reconnect all hydraulic hoses and lines that were disconnected prior to draining. Fill hydraulic reservoir.

7. Disconnect both engine spark plug wires from the spark plugs.

8. Turn ignition key switch and engage starter for ten (10) seconds to the prime pump. Return ignition switch to off and wait one minute to allow starter to cool. Repeat step a second time.

9. Connect both engine spark plug wires to the spark plugs.

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

11. Raise and lower cutting units several times.

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

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

14. Check condition of hydraulic oil. If the flushing fluid shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 14 again.

15. Assume normal operation and follow recommended maintenance intervals.

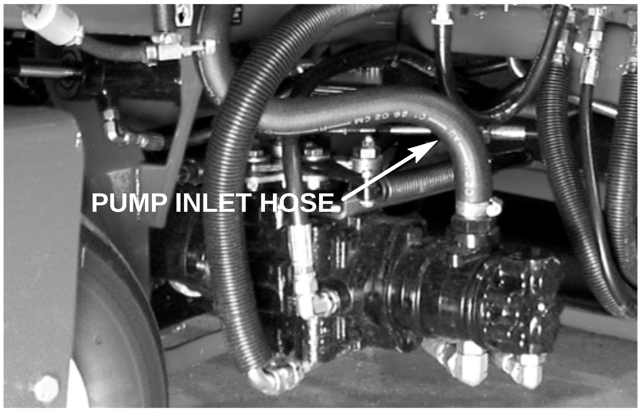

Figure 39

Figure 40

Hydraulic System

Reel Motors

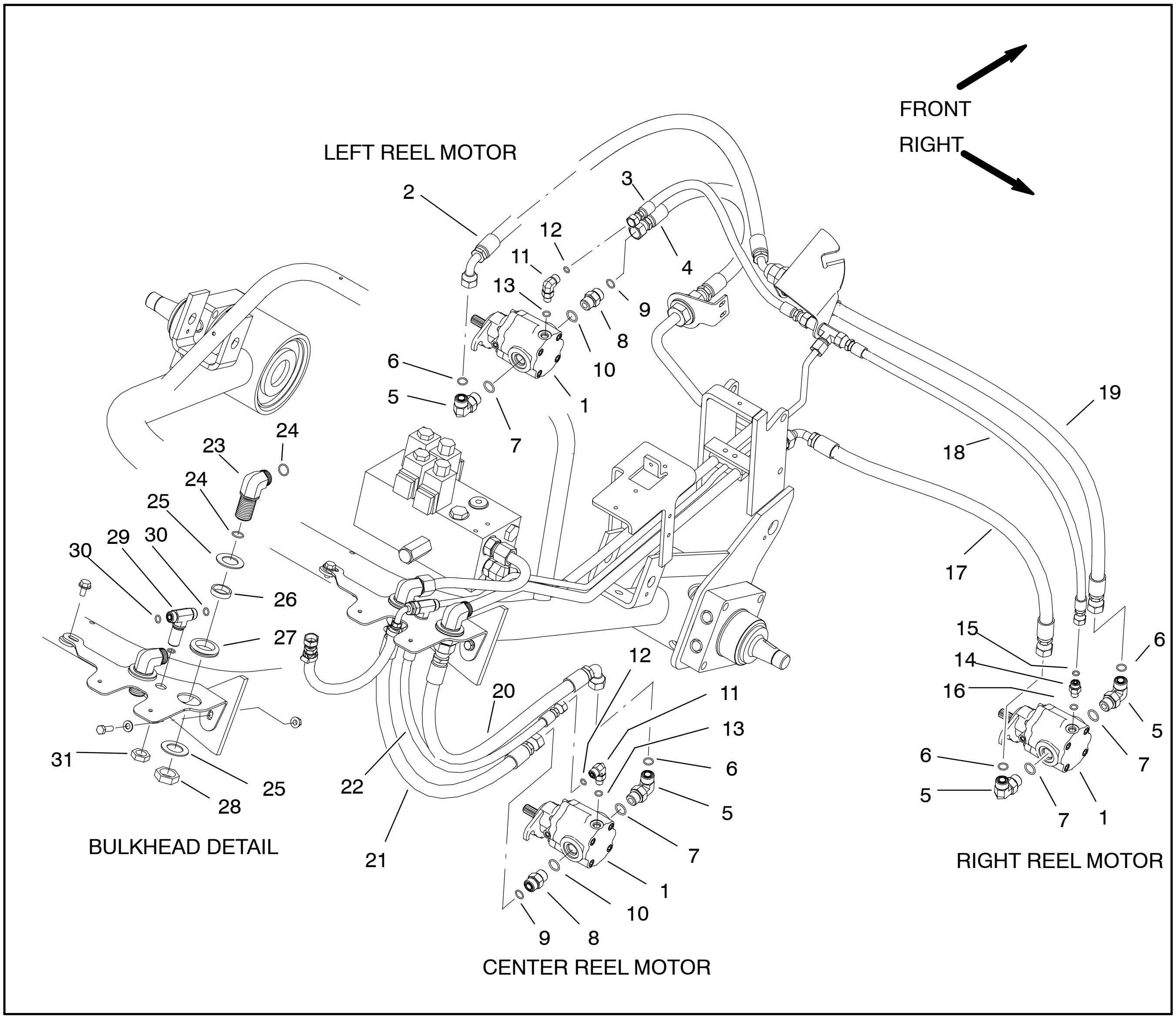

Figure 41

1. Reel motor
2. Hose assembly
3. Hose assembly
4. Hose assembly
5. 90º hydraulic fitting
6. O–ring
7. O–ring
8. Straight hydraulic fitting
9. O–ring
10. O–ring
11. 90º hydraulic fitting
12. O–ring
13. O–ring
14. Straight hydraulic fitting
15. O–ring
16. O–ring
17. Hose assembly
18. Hose assembly
19. Hose assembly
20. Hose assembly
21. Hose assembly
22. Hose assembly
23. 90º hydraulic fitting
24. O–ring
25. Washer
26. Spacer
27. Grommet
28. Bulkhead nut
29. Tee hydraulic fitting
30. O–ring
31. Bulkhead nut

Removal (Fig. 41)

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

> **CAUTION**
>
> **Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.**

2. Remove reel motor from the cutting unit (see Cutting Unit Removal and Installation in Chapter 7, 8, 9, or 10 – Cutting Units).

Note: The position of hydraulic fittings on the reel motor is critical to properly reconnecting hydraulic hoses.

3. Label all hose connections for reassembly purposes. Matchmark reel motor and all hydraulic fittings for reassembly purposes.

4. Remove hose connections from the hydraulic fittings on the reel motor. Allow hydraulic oil to drain from hoses into a suitable container. Put caps or plugs on ends of hoses to prevent contamination.

5. Remove hydraulic fittings and O–rings from the reel motor. Put caps or plugs in motor openings to prevent contamination.

Installation (Fig. 41)

1. Inspect threads and sealing surfaces of fittings. Replace any worn or damaged fittings.

2. Apply clean hydraulic oil to all O–rings.

3. Place O–ring on the face seal of a hydraulic fitting. Secure fitting to the reel motor. Make sure that the match marks are aligned. Repeat this step for the remaining fittings.

4. Inspect threads and sealing surfaces of connections. Replace any worn or damaged connections.

5. Install reel motor to the cutting unit (see Cutting Unit Removal and Installation in Chapter 7, 8, 9, or 10 – Cutting Units).

6. Secure hose connection to the proper hydraulic fitting on the reel motor. Repeat this step for the remaining hose connections.

Reel Motor Service

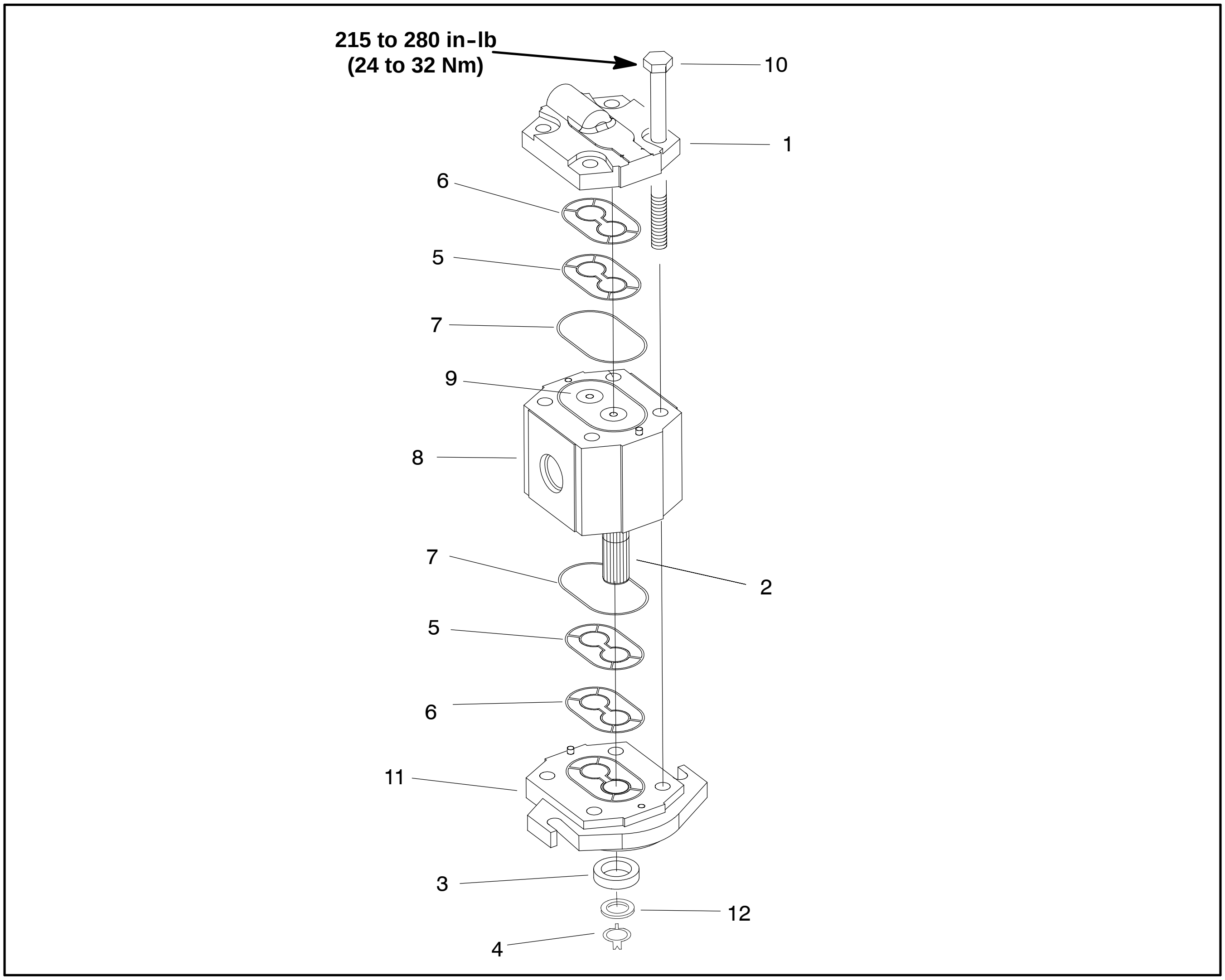

Figure 42

1. **Rear cover**
2. **Drive gear**
3. **Seal**
4. **Tab washer**
5. **Pressure seal**
6. **Back-up ring**
7. **O-ring**
8. **Body**
9. **Idler gear**
10. **Cap screw**
11. **Front flange**
12. **Washer (if equipped)**

Disassembly

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 or scribe to make a **diagonal** mark across the front flange, body, and rear cover for reassembly purposes (Fig. 43).

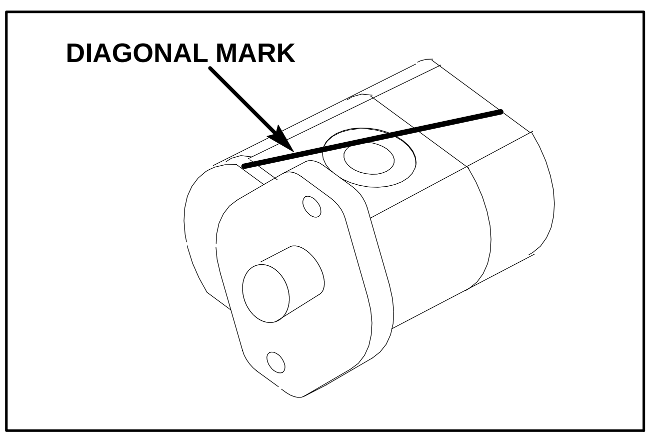

Figure 43

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

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

4. Loosen cap screws on the rear cover.

5. Take motor from the 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 re-assembled in the same position. Do not touch the gear surfaces as residue on hands may be corrosive to gear finish.

7. Place the motor on its side and push on the rear bearing block to remove the bearing block and gear set (Fig. 44).

8. Carefully remove and discard O–rings, pressure seals, and back–up rings (Fig. 45) from motor. Do not cause any damage to the machined grooves during the removal process.

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

9. Position front flange with seal side up. Remove shaft seal.

Inspection

1. Remove any nicks and burrs from all motor components with emery cloth.

⚠ CAUTION
Use eye protection such as goggles when using compressed air.

2. Clean all motor components with solvent. Dry all parts with compressed air.

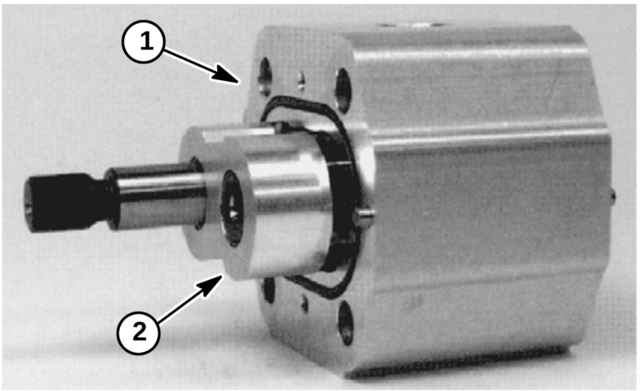

Figure 44

1. **Motor body**
2. **Bearing block & gear set**

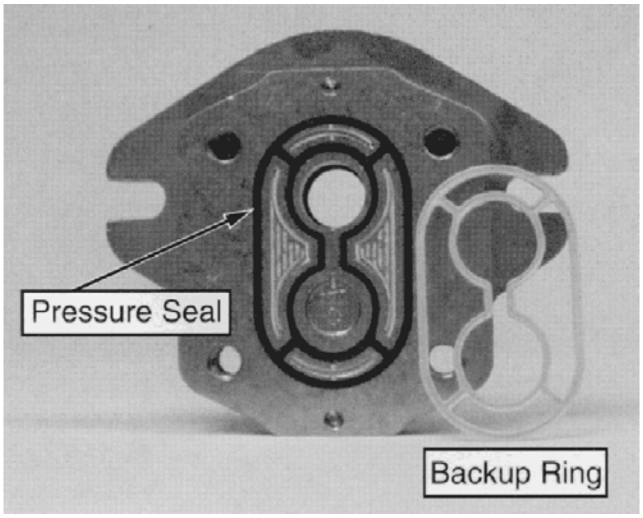

Figure 45

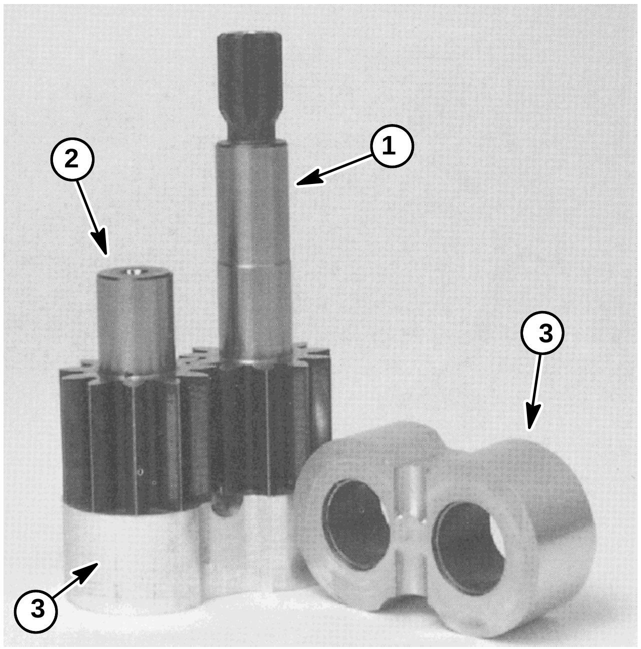

Figure 46

1. **Drive gear**
2. **Idler gear**
3. **Bearing block**

3. Inspect drive gear, idler gear and bearing blocks (Fig. 46) for the following:

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

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

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

D. Bearing areas of bearing blocks should not have excessive wear or scoring.

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

4. Inspect front flange and rear cover for damage or wear.

Reassembly

NOTE: When reassembling the motor, check the identification marks made during disassembly to make sure the parts are properly aligned during reassembly.

1. Lubricate 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 seal into front flange.

3. Install lubricated pressure seals into the grooves in the front flange and rear cover. Follow by carefully placing the back-up rings into the grooves.

4. Install new O-rings to the body.

5. Lubricate gear faces and bearing surfaces of drive gear, idler gear, and bearing blocks. 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 or scribe mark for proper location. Firm hand pressure should be sufficient to engage the dowel pins.

10. Position the motor with rear cover downwards. Carefully slide the front flange onto the assembly using marker or scribe mark for proper location.

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

IMPORTANT: Avoid using excessive clamping pressure on the motor housing to prevent distorting the housing.

12. Place motor front flange in a vise and alternately torque the cap screws from **215 to 280 in-lb (24 to 32 Nm)**.

13. 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.

14. Remove motor from vise.

Hydraulic System

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Lift Cylinders

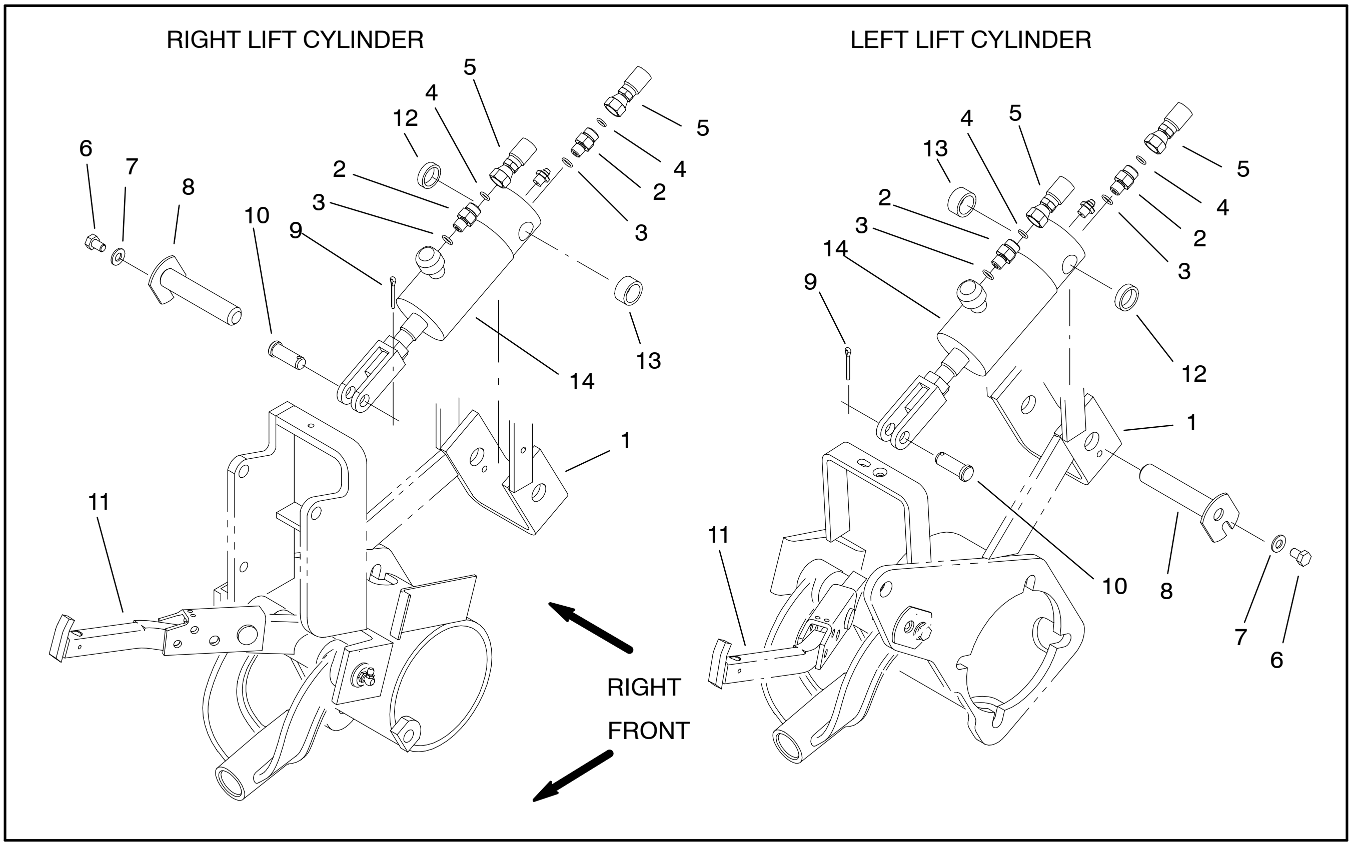

Figure 47

1. Frame	**6. Cap screw**	**11. Lift arm**
2. Straight hydraulic fitting	**7. Washer**	**12. Spacer**
3. O-ring	**8. Pivot pin**	**13. Spacer**
4. O-ring	**9. Cotter pin**	**14. Hydraulic cylinder**
5. Hose assembly	**10. Clevis pin**	

Front Cylinder Removal (Fig. 47)

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

> **CAUTION**
>
> **Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.**

2. Label all hydraulic connections for reassembly.

3. Disconnect hose assemblies and O-rings from the hydraulic fittings at the lift cylinder. Allow hoses to drain into a suitable container.

4. Remove cotter pin and clevis pin from the cylinder clevis.

5. Support hydraulic cylinder to prevent it from dropping.

   A. Remove cap screw and washer from the pivot pin.

   B. Pull pivot pin from the frame, spacers, and hydraulic cylinder.

   C. Remove hydraulic cylinder from the frame.

Front Cylinder Installation

1. Position hydraulic cylinder to the frame. Insert pivot pin through the frame bracket, spacers, and cylinder. Secure pin with cap screw and washer.

2. Position clevis of the hydraulic cylinder to the lift arm. Install clevis pin and cotter pin through cylinder clevis.

3. Connect hose assemblies and O-rings to the hydraulic fittings. Tighten hose connections.

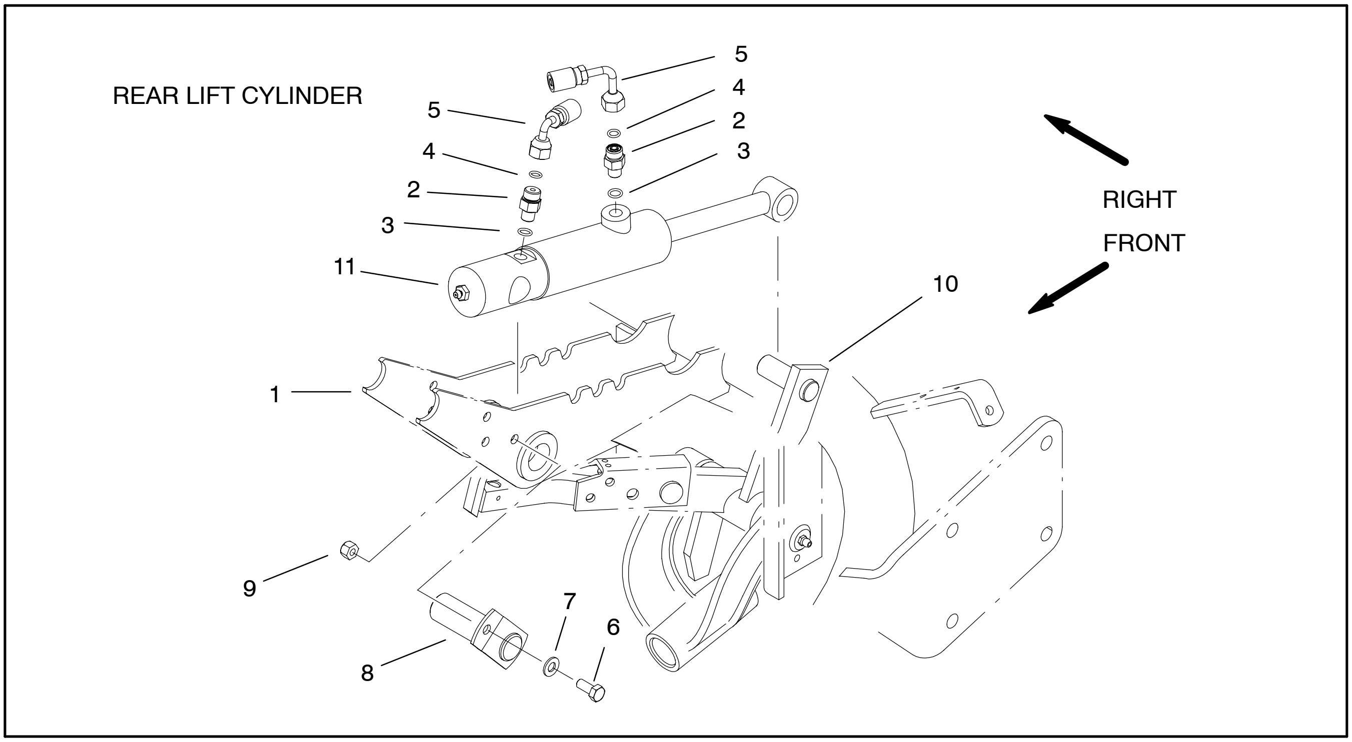

Figure 48

1. Frame	**5. Hose assembly**	**9. Lock nut**
2. Straight hydraulic fitting	**6. Cap screw**	**10. Lift arm**
3. O-ring	**7. Washer**	**11. Hydraulic cylinder**
4. O-ring	**8. Pivot pin**	

Hydraulic System

Rear Cylinder Removal (Fig. 48)

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Label all hydraulic connections for reassembly.

3. Disconnect hose assemblies and O-rings from the hydraulic fittings at the lift cylinder. Allow hoses to drain into a suitable container.

4. Support hydraulic cylinder to prevent it from dropping.

   A. Remove cap screw, washer, and lock nut from the pivot pin.

   B. Pull pivot pin from the frame and hydraulic cylinder.

   C. Remove hydraulic cylinder from the frame and lift arm.

Rear Cylinder Installation

1. Position rod end of the hydraulic cylinder on the lift arm.

2. Position hydraulic cylinder in the frame. Insert pivot pin through the frame brackets and lift cylinder. Secure pin with cap screw, lock nut and washer.

3. Connect hose assemblies and O-rings to the hydraulic fittings. Tighten hose connections.

Lift Cylinder Service (Serial Number Under 240000000)

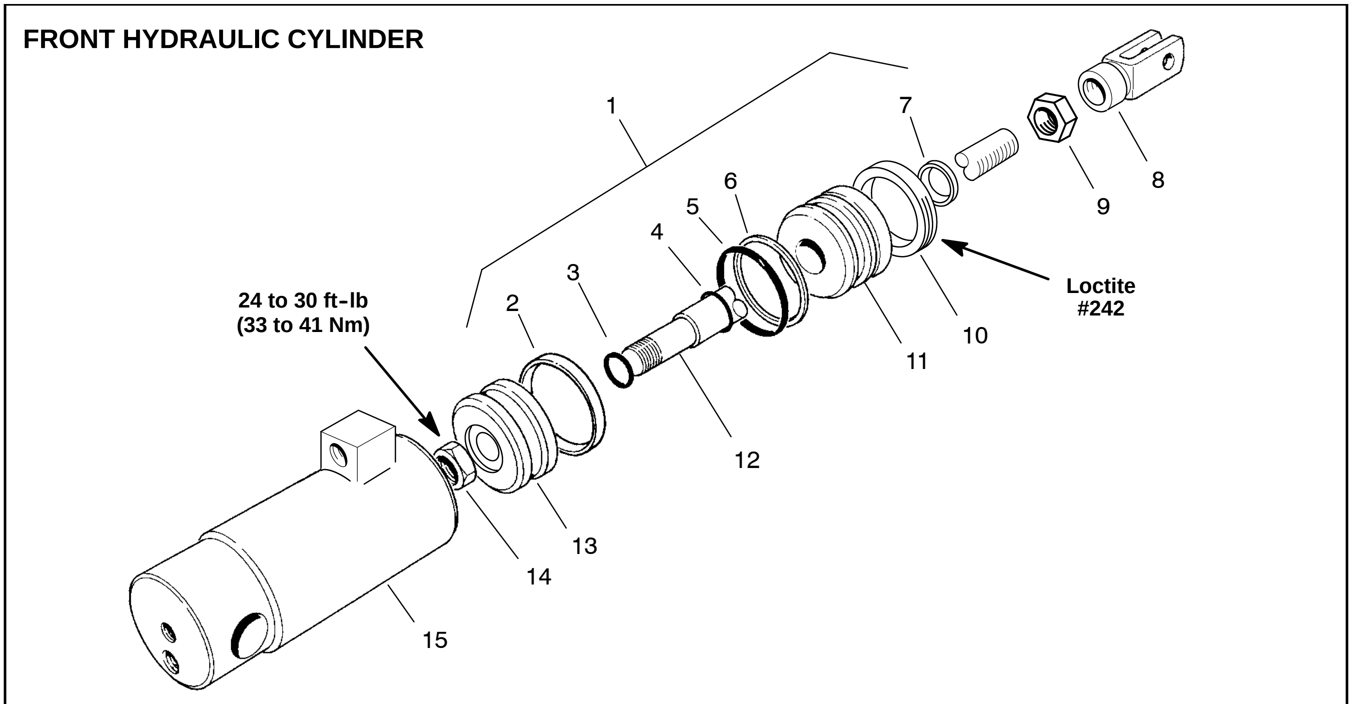

Figure 49

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

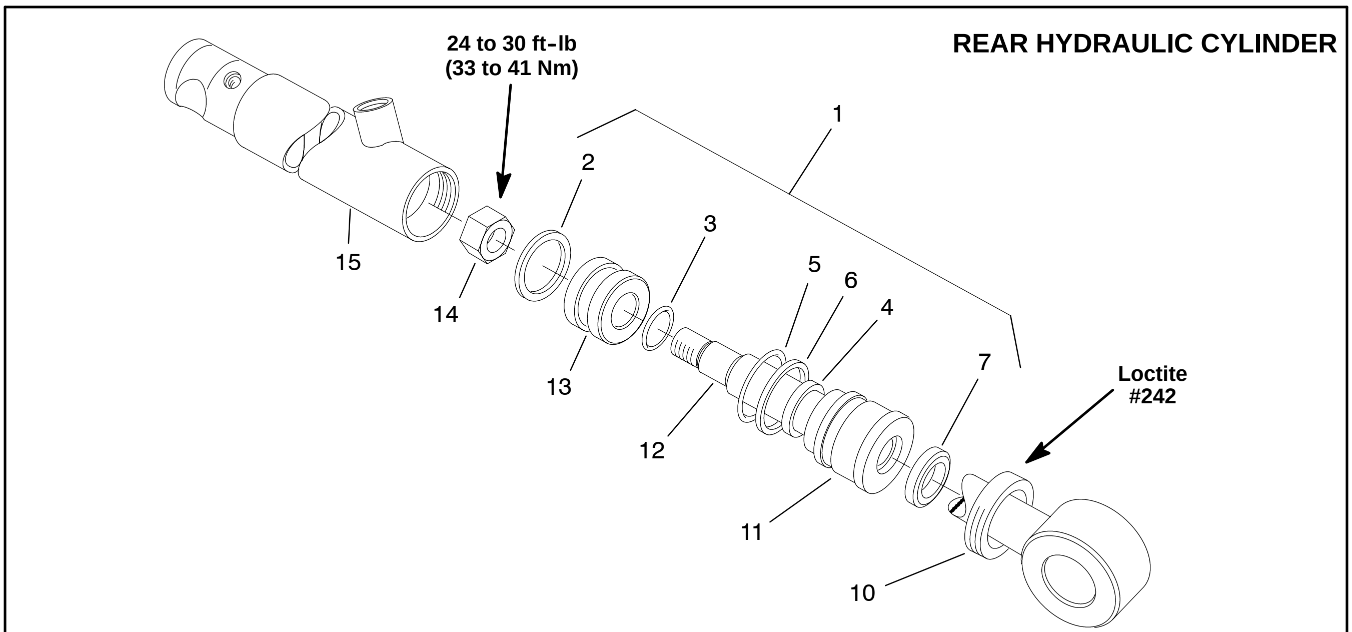

Figure 50

1. **Seal kit**
2. **T-seal**
3. **O-ring**
4. **Rod seal**
5. **O-ring**
6. **Back-up ring**
7. **Dust seal**
8. **Not used**
9. **Not used**
10. **Internal collar**
11. **Head**
12. **Rod**
13. **Piston**
14. **Lock nut**
15. **Barrel**

Disassembly (Figs. 49 and 50)

1. Remove the oil from the cylinder by slowly pumping the cylinder shaft while holding the cylinder over a drain pan. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the cap end only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder in a vice. Remove internal 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 or eye of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

5. Remove T-ring and O-ring from the piston. Remove O-ring, back-up ring, rod seal, and dust seal from the head.

CAUTION

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

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

7. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Inspect shaft, head, and piston for evidence of excessive scoring, pitting, or wear. Replace entire cylinder if internal components are found to be worn or damaged.

Reassembly (Figs. 49 and 50)

1. Make sure all parts are clean before reassembly.

2. Coat new O-rings, T-ring, rod seal, back-up ring, and dust seal with clean hydraulic oil.

A. Install T-ring and O-ring on the piston.

B. Install O-ring, back-up ring, and dust seal on 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 or eye of the shaft.

A. Coat shaft with clean hydraulic oil.

B. Slide head onto the shaft. Install rod seal onto shaft and into head.

C. Install piston and nut onto the shaft. Torque nut from **24 to 30 ft-lb (33 to 41 Nm)**.

D. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the cap end only. Do not close vise enough to distort the barrel.

4. Mount barrel in a vice.

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

6. Clean threads of internal collar and threads in cylinder barrel. Apply medium strength thread locking compound (e.g. Loctite #242) to threads of internal collar. Secure head in the barrel with internal collar using a spanner wrench. Tighten collar until snug and the outer end of the collar is flush with end of the barrel.

Lift Cylinder Service (Serial Number Above 240000000)

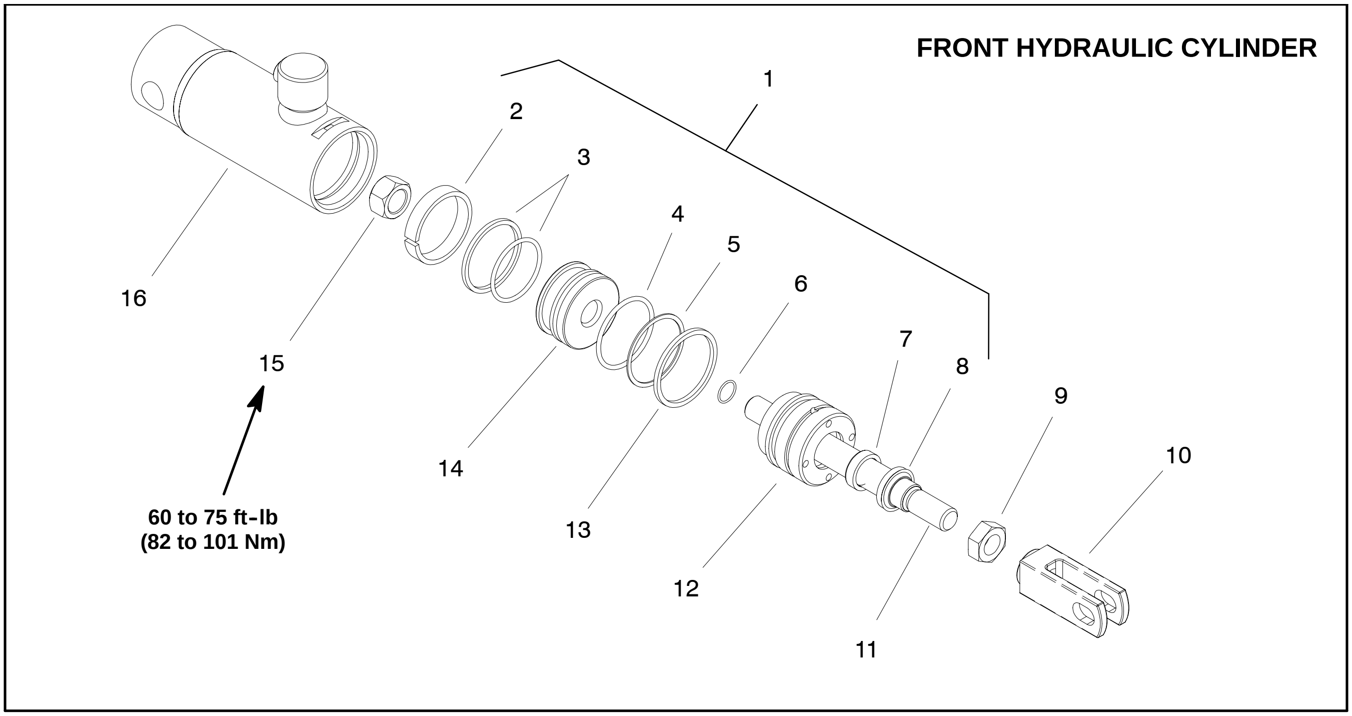

Figure 51

1. Seal kit
2. Wear ring
3. Seal with loader
4. O-ring
5. Back-up ring
6. O-ring
7. Seal
8. Wiper
9. Jam nut
10. Rod clevis
11. Rod
12. Head
13. Retaining ring
14. Piston
15. Lock nut
16. Barrel

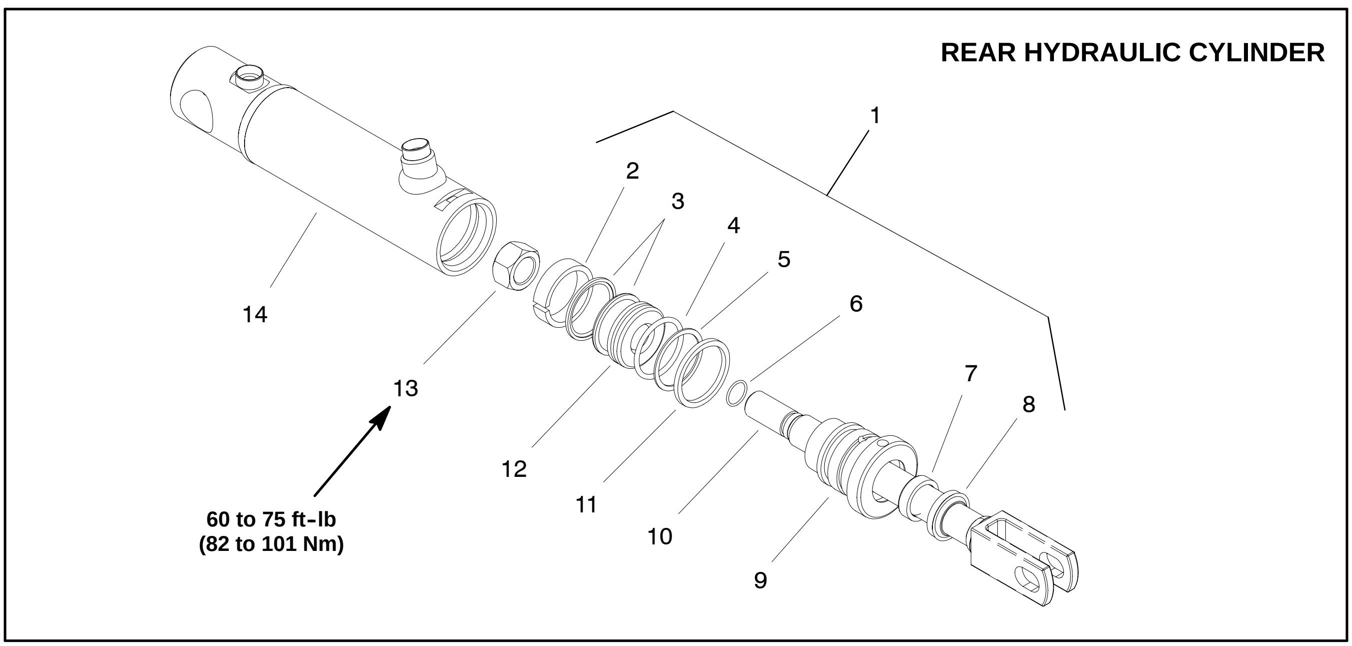

Figure 52

1. Seal kit
2. Wear ring
3. Seal with loader
4. O-ring
5. Back-up ring
6. O-ring
7. Seal
8. Wiper
9. Head
10. Rod
11. Retaining ring
12. Piston
13. Lock nut
14. Barrel

Disassembly (Figs. 51 and 52)

1. Remove the oil from the cylinder by slowly pumping the cylinder shaft while holding the cylinder over a drain pan. Plug both ports and clean the outside of the cylinder.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the cap end only. Do not close vise enough to distort the barrel.

2. Mount lift cylinder in a vice. Use of a vise with soft jaws is recommended.

3. Using a spanner wrench, rotate head clockwise until the edge of the retaining ring appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter-clockwise to remove retaining ring from barrel and head.

4. 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.

5. Mount shaft securely in a vise by clamping on the clevis or eye of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

6. Remove wear ring and seal with loader from the piston. Remove O-ring, back-up ring, seal, and wiper from the head. Remove O-ring from rod.

CAUTION

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

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

8. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Inspect shaft, head, and piston for evidence of excessive scoring, pitting, or wear. Replace entire cylinder if internal components are found to be worn or damaged.

Assembly (Figs. 51 and 52)

1. Make sure all parts are clean before reassembly.

2. Coat new seal kit components with clean hydraulic oil.

   A. Install wear ring and seal with loader on the piston.

   B. Install O-ring, back-up ring, and seal on the head.

   C. Install O-ring to groove in rod.

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 or eye of the shaft. Use of a vise with soft jaws is recommended.

   A. Coat shaft with clean hydraulic oil.

   B. Carefully slide head onto the shaft. Install wiper onto shaft and into head.

   C. Install piston and nut onto the shaft. Torque nut from **60 to 75 ft-lb (82 to 101 Nm)**.

   D. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the cap end only. Do not close vise enough to distort the barrel.

4. Mount barrel in a vice.

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

6. Secure head in barrel by installing retaining ring. Align retaining ring hole in the head with the access slot in the barrel. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Hydraulic Manifold

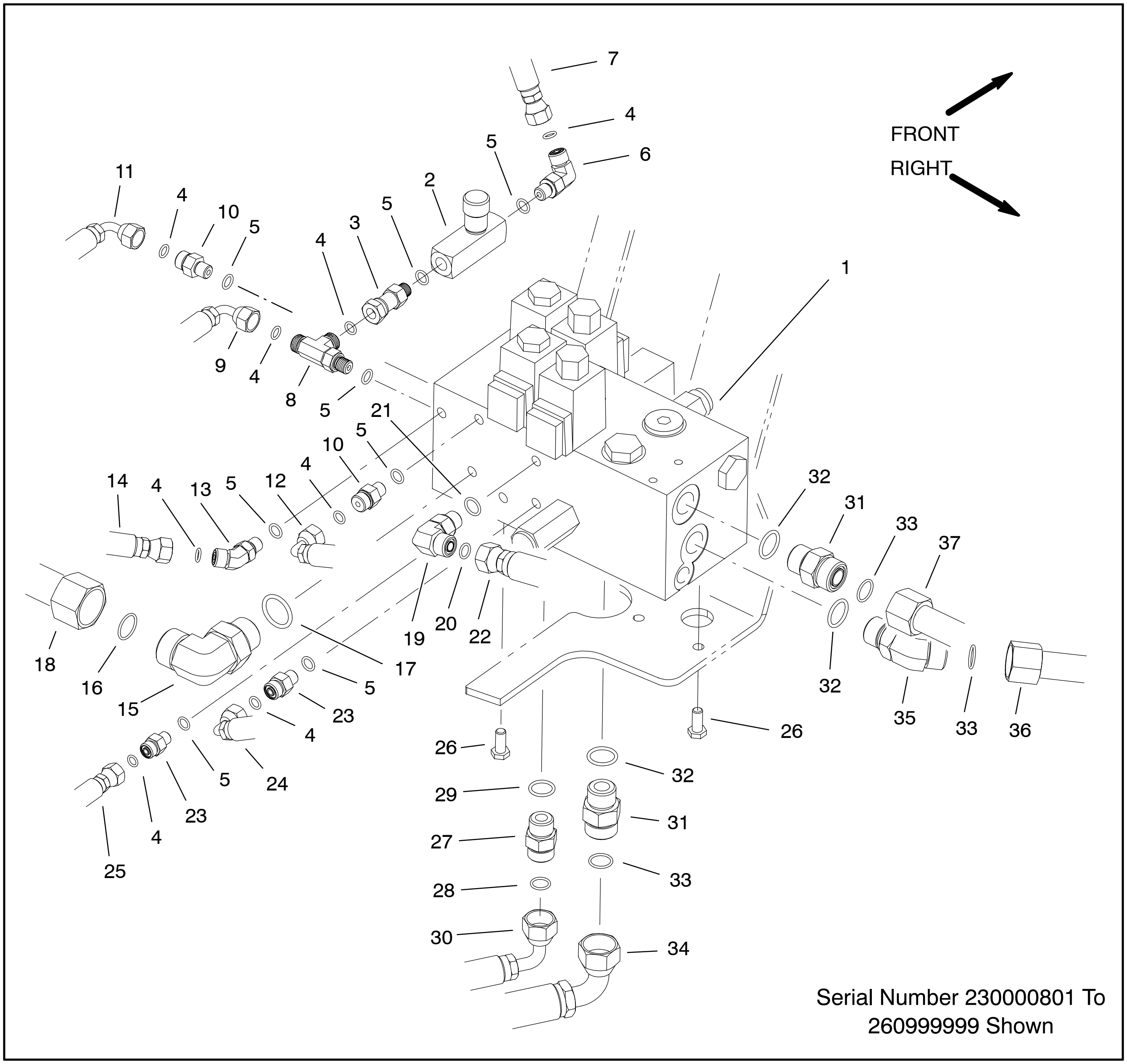

Figure 53

1. **Hydraulic manifold assembly**
2. **Flow control valve**
3. **Straight swivel hydraulic fitting**
4. **O-ring**
5. **O-ring**
6. **90° hydraulic fitting**
7. **Hose assembly**
8. **Tee hydraulic fitting**
9. **Hose assembly**
10. **Straight hydraulic fitting**
11. **Hose assembly**
12. **Hose assembly**
13. **45° hydraulic fitting**
14. **Hose assembly**
15. **90° hydraulic fitting**
16. **O-ring**
17. **O-ring**
18. **Tube assembly**
19. **90° hydraulic fitting**
20. **O-ring**
21. **O-ring**
22. **Hose assembly**
23. **Straight hydraulic fitting**
24. **Hose assembly**
25. **Hose assembly**
26. **Cap screw**
27. **Straight hydraulic fitting**
28. **O-ring**
29. **O-ring**
30. **Hose assembly**
31. **Straight hydraulic fitting**
32. **O-ring**
33. **O-ring**
34. **Hose assembly**
35. **45° hydraulic fitting**
36. **Tube assembly**
37. **Tube assembly**

Note: The ports on the manifold 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 Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

Removal (Fig. 53)

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Disconnect solenoid valve electrical connectors. If an optional backlap kit is installed, disconnect electrical connector to the ball switch.

3. Label all hydraulic connections and electrical connections for reassembly.

IMPORTANT: Before disconnecting any hydraulic hoses from the hydraulic fittings, make sure each hose is labeled to ensure it is reconnected to the correct manifold fitting/port.

4. Disconnect hose and tube assemblies and remove their respective O–rings from the hydraulic fittings. Allow hoses and tubes to drain into a suitable container.

5. Remove both cap screws (26) from the hydraulic manifold. Remove manifold assembly from the machine.

IMPORTANT: Before disconnecting any hydraulic fittings from the hydraulic manifold block, make sure the position of each fitting is observed and recorded to ensure proper installation.

6. Disconnect hydraulic fittings and O–rings from the manifold.

Installation (Fig. 53)

Note: Fitting orientation is determined by viewing the manifold assembly from the side with its solenoids facing up.

1. Install hydraulic fittings and their respective O–rings to the manifold assembly, and orient to position recorded during removal.

2. Position manifold assembly to the support frame. Secure assembly to the frame with both cap screws (26).

3. Connect hose assemblies and their respective O–rings to hydraulic fittings.

4. Connect solenoid valve electrical connectors. If an optional backlap kit is installed, connect electrical connector for the ball switch.

Hydraulic Manifold Service (Serial Number Under 260999999)

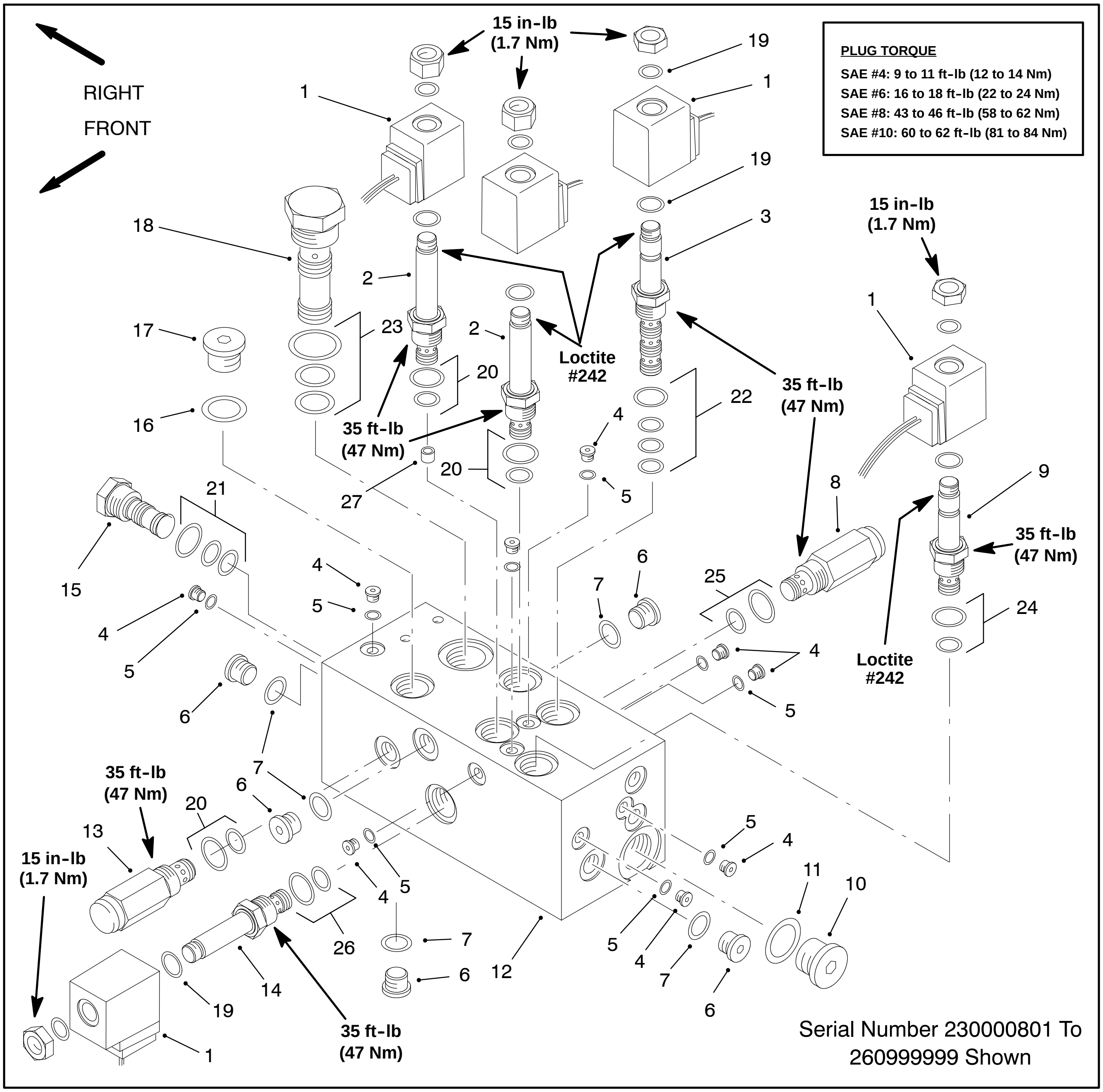

Figure 54

1. **20 watt solenoid**
2. **N.O. cartridge (Ports S1 & S2)**
3. **4Way/2Position cartridge (Port S3)**
4. **Plug (SAE #2)**
5. **O-ring**
6. **Plug (SAE #6)**
7. **O-ring**
8. **2400 PSI relief cartridge (Port R1)**
9. **N.C. cartridge (Port S4)**
10. **Plug (SAE #8)**
11. **O-ring**
12. **Manifold body**
13. **150 PSI relief cartridge (Port R2)**
14. **N.O. cartridge (Port S6)**
15. **Cavity plug (Port LC1)**
16. **O-ring**
17. **Plug (SAE #10)**
18. **Cavity plug (Port RD1)**
19. **Solenoid seal**
20. **Seal kit**
21. **Seal kit**
22. **Seal kit**
23. **Seal kit**
24. **Seal kit**
25. **Seal kit**
26. **Seal kit**
27. **Orifice (.125")**

Note: The ports on the manifold 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 Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

Solenoid Operated Cartridge Valves (Fig. 54)

1. Make sure the manifold is clean before removing the valve(s).

2. Remove nut securing solenoid to the cartridge valve. Slide solenoid and both O-rings off the valve.

Note: 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.

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

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

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

B. If spool valve (8) sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

6. Clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. 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. Use compressed air for cleaning.

7. 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.

Note: 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 **35 ft-lb (47 Nm)**.

D. Make sure a new O-ring is at each end of the solenoid coil. Install solenoid coil to the cartridge valve. Apply “Loctite 242” or equivalent to the threads of the valve. Torque nut to **15 in-lb (1.7 Nm)**.

E. If problems still exist, remove valve and clean again or replace valve.

Cartridge Relief Valves (Fig. 54)

1. Make sure the manifold is clean before removing the cartridge valve and seal kit.

2. Remove cartridge relief valve.

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

4. Visually inspect cartridge relief valve for damaged sealing surfaces and contamination.

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

B. If 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. Clean cartridge relief 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. Use compressed air for cleaning.

6. Reinstall the cartridge relief valve:

A. Lubricate new O-ring and backup ring 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 cartridge relief valve carefully into the applicable port. The valve should go in easily without binding. Torque valve to **35 ft-lb (47 Nm)**.

Hydraulic Manifold Service (Serial Number Above 270000000)

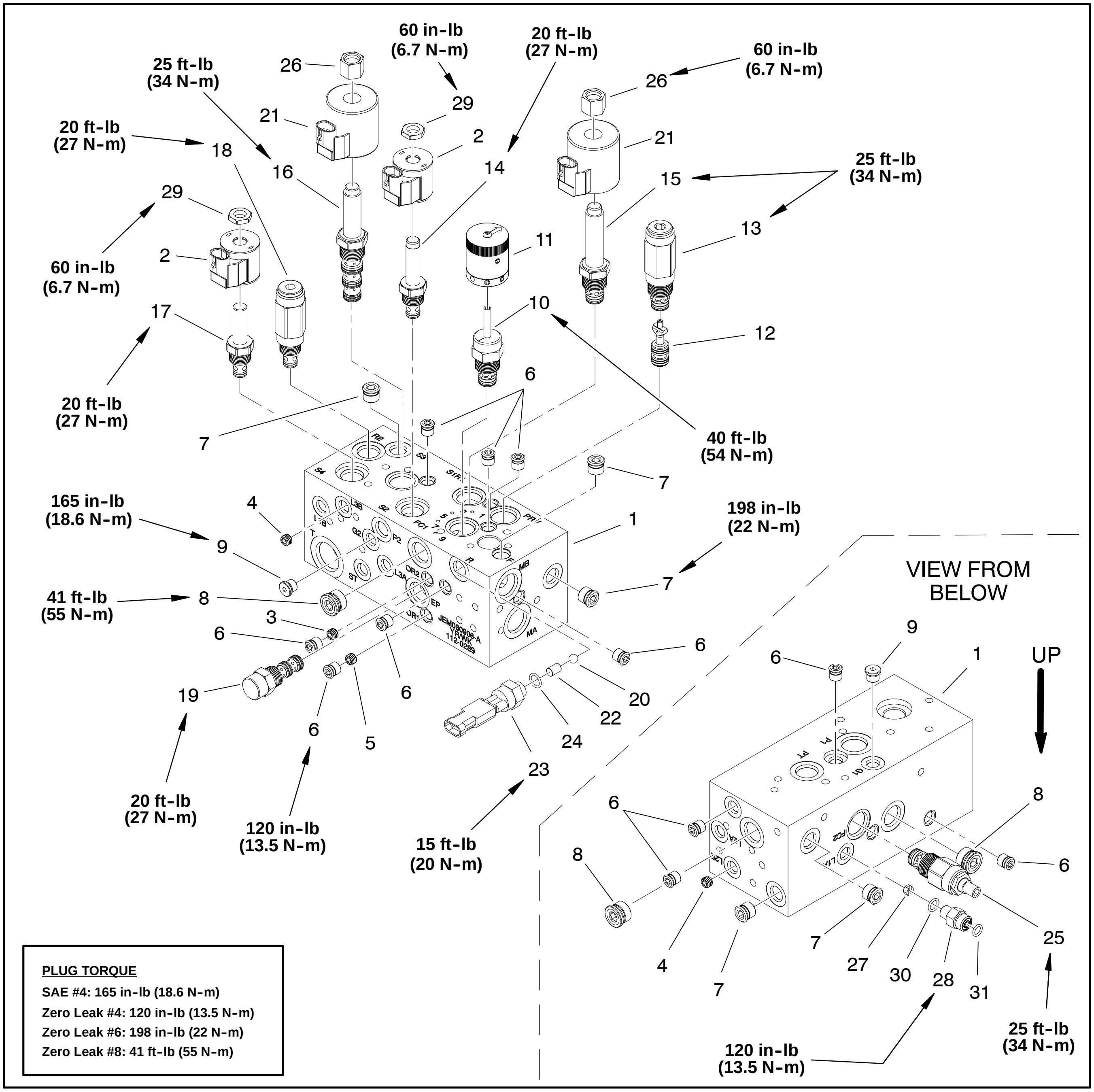

Figure 55

1. Manifold body
2. Solenoid coil
3. Flow control orifice (.060)
4. Orifice plug (.055) (2 used)
5. Flow control orifice (.013)
6. Plug (Zero Leak #4) (12 used)
7. Plug (Zero Leak #6) (5 used)
8. Plug (Zero Leak #8) (3 used)
9. Plug (SAE #4) (2 used)
10. Rotary cartridge valve (FC1)
11. Rotary handle assembly
12. Pilot piston
13. Relief cartridge valve (PRV)
14. Solenoid cartridge valve (S2)
15. Solenoid relief cartridge valve (S1R1)
16. Solenoid cartridge valve (S3)
17. Solenoid cartridge valve (S4)
18. Relief cartridge valve (R2)
19. Logic control cartridge valve (OR1)
20. Ball
21. Solenoid coil
22. Dowel pin
23. Ball switch (N.O.)
24. O-ring
25. Flow control cartridge valve (FC2)
26. Nut
27. Flow control orifice (.025)
28. Hydraulic fitting
29. Nut
30. O-ring
31. O-ring

NOTE: The ports on the hydraulic manifold are marked for easy identification of components. Example: FC1 is the flow control 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 hydraulic manifold shown in Figure 55 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 manifold, torque plugs to the values identified in Figure 55.

Solenoid Operated, Relief and Logic Control Cartridge Valves (Fig. 55)

1. Make sure the manifold is clean before removing the cartridge valve and seal kit.

2. If solenoid valve is to be removed from manifold, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid off the valve.

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

3. Make sure manifold is clean before removing the cartridge valve. Remove cartridge valve from manifold with a deep well socket. Note location of O–rings and backup rings on valve. Remove and discard removed 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. Contamination can become lodged in small valve orifices or seal areas causing valve 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 from cartridge.

6. Reinstall the cartridge valve into the manifold:

A. Lubricate new O-rings and backup rings of seal kit with clean hydraulic oil and install on cartridge. The O-rings and backup rings must be arranged properly on the cartridge valve for proper operation and sealing.

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

B. Lubricate threads on cartridge valve with clean hydraulic oil. Thread cartridge valve carefully into correct manifold port. The valve should go in easily without binding.

C. Torque cartridge valve using a deep well socket to specification shown in Figure 55.

7. For solenoid valve, slide solenoid coil onto the cartridge valve. Install and torque nut to **60 in–lb (6.7 N–m)**.

8. If problems still exist, remove valve and clean again or replace valve.

Rotary Cartridge Valves

1. Remove rotary handle from valve (Fig. 56):

   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.

IMPORTANT: Use care when removing the rotary cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

2. Make sure manifold is clean before removing the rotary cartridge valve. Remove cartridge valve from manifold with a deep well socket. Note location of O–rings and backup rings on valve. Remove and discard removed seal kit.

3. 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 valve 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.

4. 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.

5. Reinstall rotary cartridge valve into manifold port:

   A. Lubricate new O-rings and backup rings of seal kit with clean hydraulic oil and install. The O-rings and backup rings of seal kit must be arranged properly on the cartridge valve for proper operation and sealing.

IMPORTANT: Use care when installing the rotary cartridge valve. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

   B. Lubricate threads on cartridge valve with clean hydraulic oil. Thread rotary cartridge valve carefully into the manifold port. The valve should go in easily without binding. Torque valve to specification shown in Figure 55.

6. Install rotary handle (Fig. 56):

   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. 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.

   D. 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.

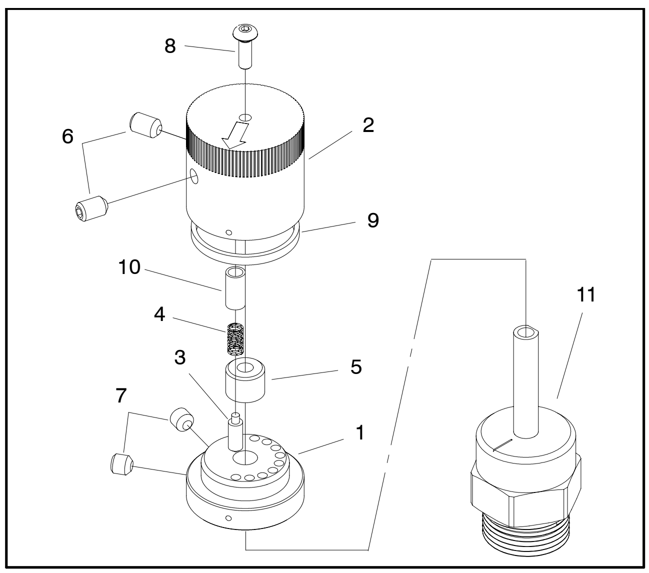

Figure 56

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**

Mow/Backlap Spool (Fig. 57)

1. Remove mow/backlap spool from manifold:

   A. Remove backlap switch from 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 lower O-ring and back-up ring are exposed on bottom of manifold. Remove lower O-ring and back-up ring from spool.

   D. Pull spool up and out of 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 and contamination.

3. Install mow/backlap spool into manifold:

   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 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. Install lower retaining ring to spool.

   D. Carefully raise mow/backlap spool until upper retaining ring groove on spool is exposed on top of manifold. Install upper retaining ring.

   E. If handle was removed from spool, position spool so handle location of spool is between stop pins in manifold. Apply Loctite 603 Retaining Compound (or equivalent) to threads on handle and install handle into spool.

   F. Place ball and dowel pin in backlap switch manifold port. Install new O-ring onto backlap switch. Thread backlap switch into port and torque **15 ft-lb (20 N-m)**.

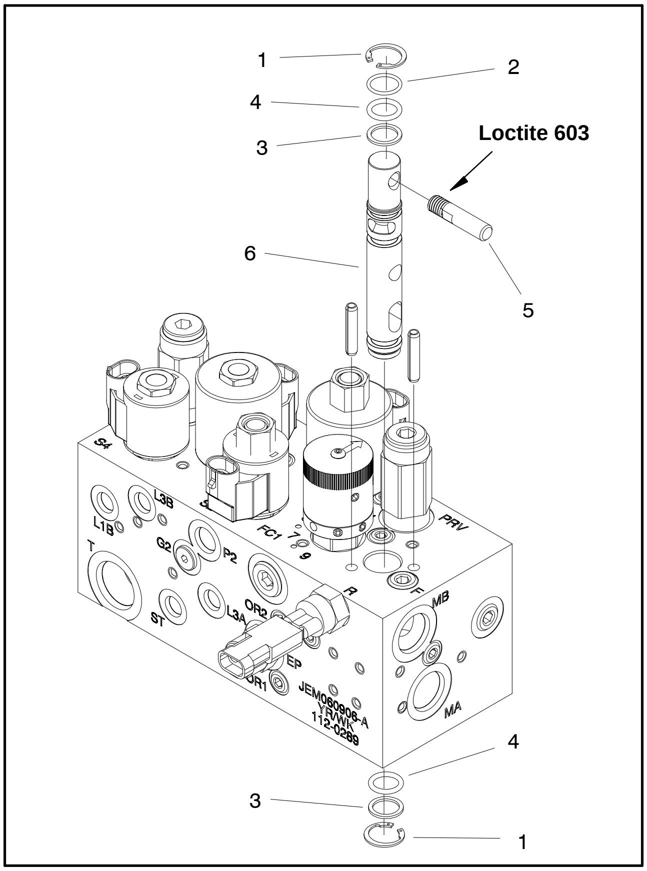

Figure 57

1. Retaining ring	**4. O-ring**
2. O-ring	**5. Spool handle**
3. Back-up ring	**6. Rotary spool**

Hydraulic System

Backlap Kit (Optional Kit For Serial Number Under 260999999)

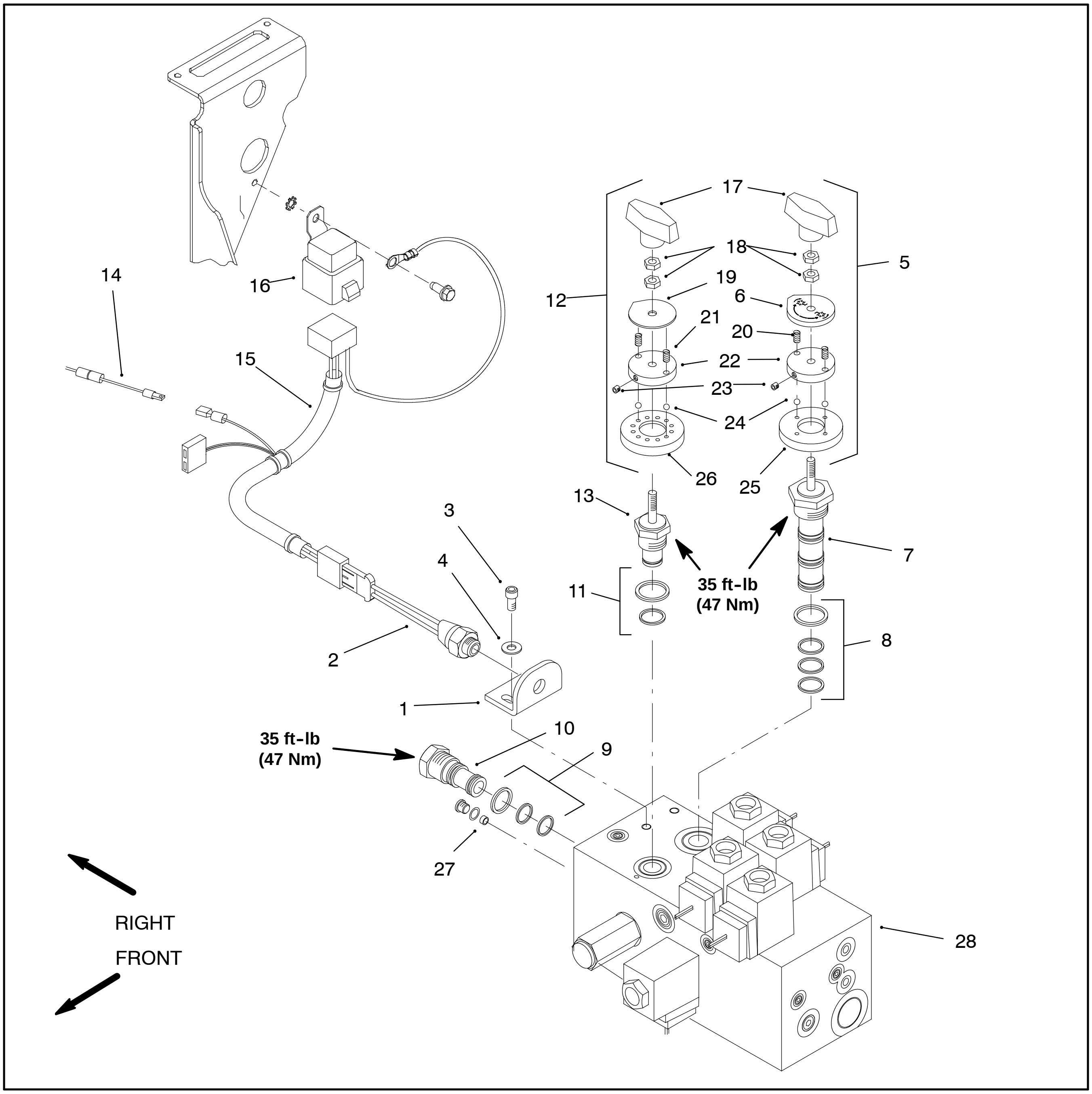

Figure 58

1. **Backlap bracket**
2. **N.O. ball switch**
3. **Socket head screw**
4. **Flat washer**
5. **Detent kit**
6. **Indicator kit**
7. **Directional cartridge valve (Port RD1)**
8. **Seal kit**
9. **Seal kit**
10. **Logic cartridge (Port LC1)**
11. **Seal kit**
12. **Detent kit**
13. **Flow control cartridge (Port FC1)**
14. **Jumper wire**
15. **Harness**
16. **Relay**
17. **Knob**
18. **Jam nut**
19. **Indicator plate**
20. **Spring**
21. **Spring**
22. **Detent plate**
23. **Set screw**
24. **Ball**
25. **Locating plate**
26. **Locating plate**
27. **Orifice (.020")**
28. **Manifold**

Note: The ports on the manifold are marked for easy identification of components. Example: LC1 is for the reel logic cartridge and RD1 is for the directional cartridge valve (see Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

Optional Backlap Kit Flow Control and Two Position Directional Valves (Fig. 58)

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

1. Remove knob assembly:

   A. Unscrew and remove knob (17). Remove both jam nuts (18).

   B. Slide off applicable indicator plate (6 or 19) being careful not to lose springs (20 or 21). Remove springs.

   C. Loosen set screw (23) and slide detent plate (22) off the applicable cartridge valve (7 or 13) stem.

   D. Remove the applicable locating plate with pin (25 or 26) from the cartridge valve stem and manifold (27).

2. Remove cartridge valve (7 or 13) and seal kit (8 or 11).

3. Visually inspect the port in the manifold (27) for damage to the sealing surfaces, damaged threads, and contamination.

4. Visually inspect cartridge valve (7 or 13) for damaged sealing surfaces 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 (7 or 13) 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. Use compressed air for cleaning.

6. Reinstall the cartridge valve (7 or 13):

   A. Lubricate new O-ring and backup ring of seal kit (8 or 11) with clean hydraulic oil and install. The O-ring and backup ring of seal kit must be arranged properly on the cartridge valve (7 or 13) for proper operation and sealing.

   B. Thread valve carefully into the applicable port (RD1 or FC1). The valve should go in easily without binding. Torque valve to **35 ft-lb (47 Nm)**.

7. Reinstall knob assembly:

   A. Install applicable locating plate (25 or 26) so that the pin seats into the locating hole.

   B. Turn the threaded cartridge valve (7 or 13) stem carefully clockwise until it stops.

   C. Face detent plate (22) 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 (24) into each hole, then drop a spring (20 or 21) into each hole.

   E. On flow control valve (7), place indicator plate (6) over the detent plate. Make sure the arrow points directly at the number 1 on the locating plate.

   F. On directional cartridge cartridge valve (13), place indicator plate (19) over the detent plate. Make sure the arrow points to the right at 45°.

   G. While pushing down on the indicator plate (6 or 19) and compressing the springs, thread down a jam nut (18). While tightening the set screw (23), 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 on the valve stem threads. Screw knob (17) all the way down until it hits the upper jam nut.

   I. On directional cartridge valve (7), turn knob (17) counterclockwise so the arrow is 90° with the back of the manifold (27). Simultaneously tighten upper jam nut (18) and turn knob so it is tight and the arrow is pointing 45° to the right in line with the indicator plate (6).

   J. On flow control cartridge valve (13), turn knob (17) counterclockwise until the arrow points at the number "5". Simultaneously tighten upper jam nut (18) and turn knob so it is tight and the arrow is pointing at the number "1" on the locating plate (19).

Optional Backlap Kit Logic Cartridge Valves (Fig. 58)

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

1. Remove logic cartridge valve (10) and seal kit (9).

2. Visually inspect the port in the manifold (27) for damage to the sealing surfaces, damaged threads, and contamination.

3. Visually inspect logic cartridge valve (10) for damaged sealing surfaces 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.

4. Clean logic cartridge valve (10) 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. Use compressed air for cleaning.

5. Reinstall logic cartridge valve (10):

   A. Lubricate new O-ring and backup ring of seal kit (9) 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 cartridge valve carefully into the port (LC1). The valve should go in easily without binding. Torque the valve to **35 ft-lb (47 Nm)**.

Rear Lift Cylinder Flow Control Valve (Serial Number Under 260999999)

Removal

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

> **CAUTION**
>
> **Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.**

2. Label all hydraulic connections for reassembly. Disconnect hose assembly and O–ring from the hydraulic fitting. Allow hose to drain into a suitable container.

3. Remove hydraulic fitting and O–ring from flow control valve. Remove valve and O–ring from hydraulic fitting. Put caps or plug on hydraulic cylinder fitting to prevent contamination.

Installation

1. Lubricate all new O–rings with clean hydraulic oil.

2. Install O–ring and hydraulic fitting to the flow control valve.

3. Install flow control valve and O–ring to the hydraulic fitting on the hydraulic cylinder. Make sure adjustment knob faces forward.

4. Install O–ring and hose assembly to the hydraulic fitting.

5. Adjust flow control valve as follows:

   A. Turn adjustment knob in fully clockwise, and then turn out counterclockwise 3 turns.

   B. Adjust knob no more than 1/2 turn in either direction until the number 8 is aligned with the dimple on the valve body. Lock adjustment knob by tightening set screw.

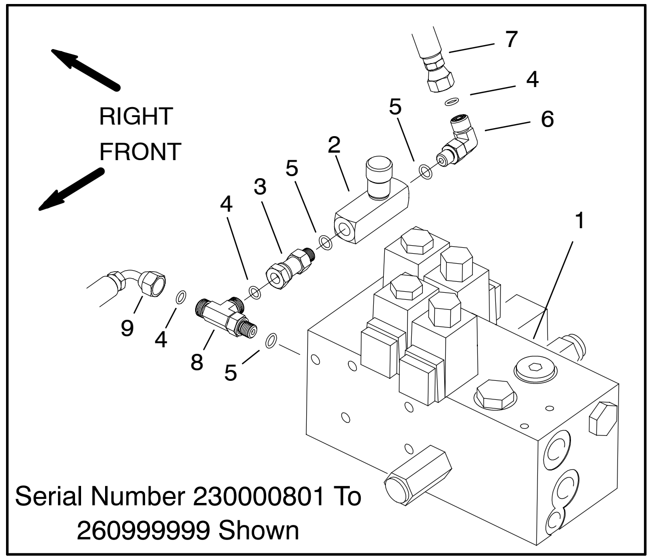

Figure 59

1. **Hydraulic manifold**
2. **Flow control valve**
3. **Straight hydraulic fitting**
4. **O–ring**
5. **O–ring**
6. **90º hydraulic fitting**
7. **Hydraulic hose**
8. **Hydraulic tee fitting**
9. **Hydraulic hose**

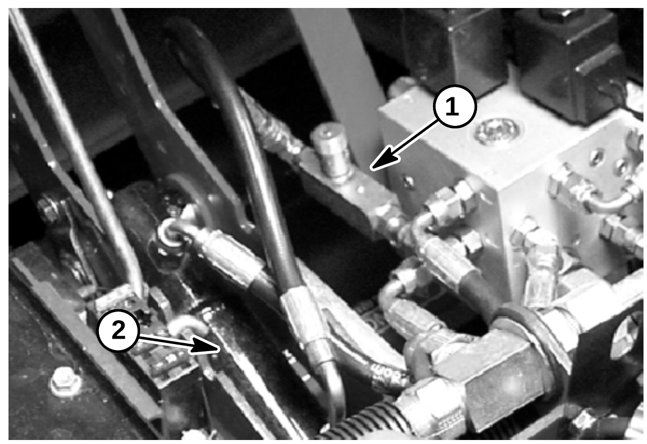

Figure 60

1. **Flow control valve**
2. **Hydraulic cylinder**

Figure 61

Steering Control Valve

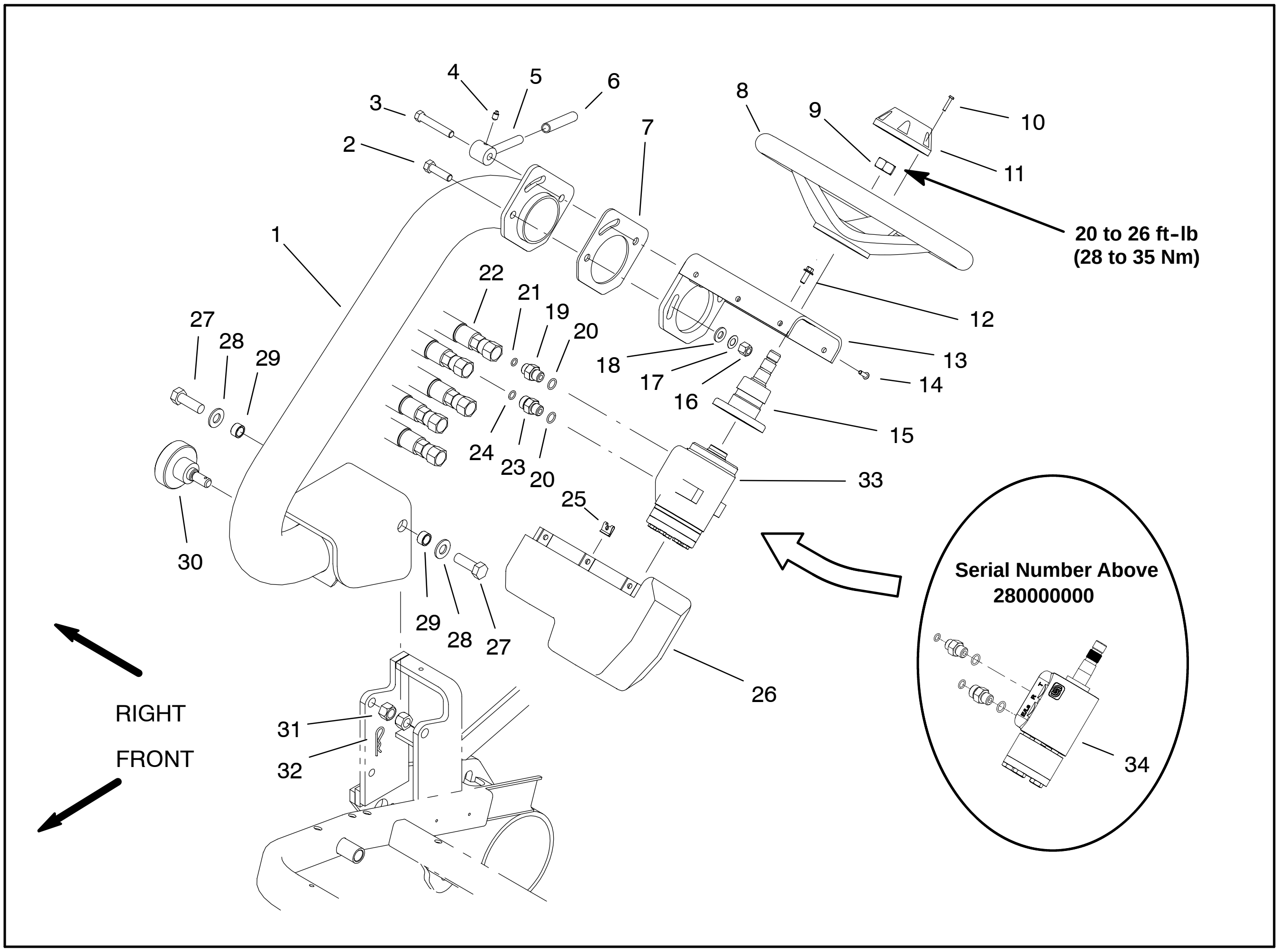

Figure 62

1. Steering arm
2. Cap screw (2 used)
3. Cap screw
4. Set screw
5. Lever
6. Handle
7. Friction plate
8. Steering wheel
9. Hex nut
10. Screw
11. Cover
12. Cap screw (4 used)
13. Steering mount
14. Cap screw (6 used)
15. Steering column (below 270999999)
16. Lock nut (2 used)
17. Lock washer (2 used)
18. Flat washer (2 used)
19. Straight hydraulic fitting
20. O-ring
21. O-ring
22. Hose assembly (5)
23. Straight hydraulic fitting
24. O-ring
25. Panel nut (6 used)
26. Steering valve cover
27. Cap screw (2 used)
28. Flat washer (2 used)
29. Spacer (2 used)
30. Knob
31. Lock nut (2 used)
32. Hair pin
33. Steering valve (below 270999999)
34. Steering valve (above 280000000)

Removal (Fig. 62)

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

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Remove screw (10) and steering wheel cover (11) from the steering wheel (8).

3. Remove steering wheel nut (9) and steering wheel from the steering column assembly.

4. Remove screws (14) and remove the steering valve cover (26).

5. Remove cap screws (12). Remove steering column (15) (if equipped) and steering control valve (33 or 34).

6. Cut and remove any cable ties from the hose assemblies. Label all hydraulic connections for reassembly.

7. Disconnect hose assemblies (22) and remove O-rings (21 and 24) from hydraulic fittings (19 and 23). Allow hoses to drain into a suitable container.

Note: Disconnect hydraulic hose assemblies (22) at the manifold block P2 or ST ports, at the steering cylinder, or at the hydraulic pump (Fig. 63) if necessary.

8. If necessary, remove hydraulic fittings and O-rings from steering control valve.

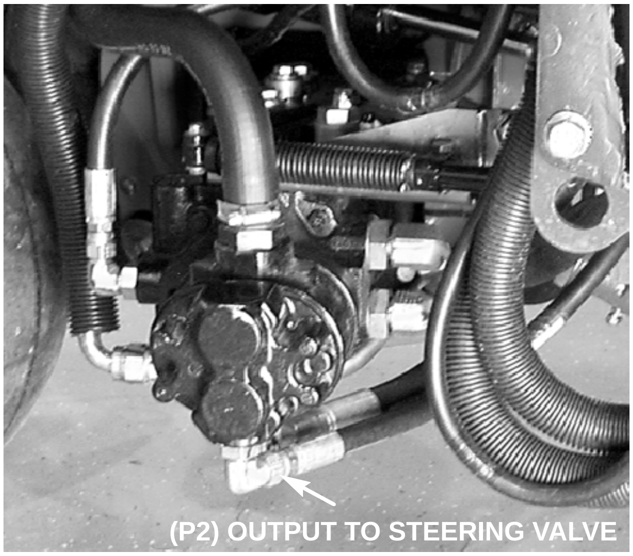

Figure 63

Installation (Fig. 62)

1. If removed, install hydraulic fittings (19 and 23) and O-rings (20) to the steering control valve (33 or 34).

2. Install hose assemblies (22) and O-rings (21 and 24).

Note: Connect any hydraulic hose assemblies (22) that may have been disconnected at the manifold block P2 or ST ports, at the steering cylinder, or at the hydraulic pump (Fig. 63) if necessary.

3. Install any cable ties removed from the hose assemblies.

4. Install steering column assembly (if equipped) and steering control valve (33 or 34) to steering mount with cap screws (12).

5. Install steering valve cover (26) with cap screws (14).

6. Install steering wheel (8) and nut (9). Torque nut from **20 to 26 ft-lb (28 to 35 Nm)**.

7. Secure steering wheel cover (11) with screw (10).

Steering Control Valve Service (Serial Number Below 270999999)

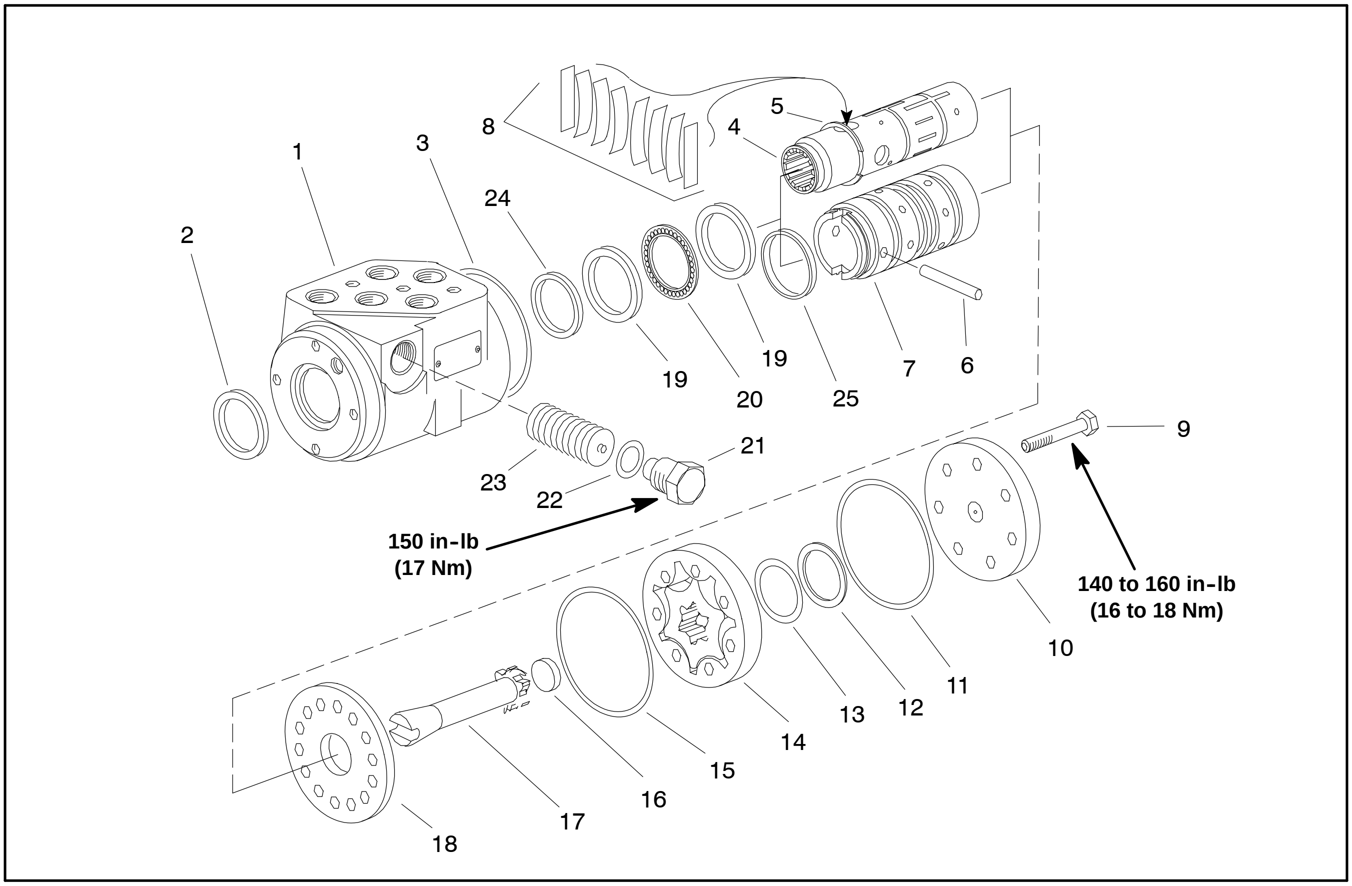

Figure 64

1. **Steering valve housing**
2. **Dust seal**
3. **O-ring**
4. **Spool**
5. **Spring retaining ring**
6. **Pin**
7. **Sleeve**
8. **Centering springs/spacers**
9. **Cap screw**
10. **End cap**
11. **O-ring**
12. **Seal ring**
13. **O-ring**
14. **Geroter**
15. **O-ring**
16. **Spacer**
17. **Geroter drive**
18. **Wear plate**
19. **Bearing race**
20. **Thrust bearing**
21. **Plug**
22. **O-ring**
23. **Relief valve (R5)**
24. **Quad seal**
25. **Ring**

Disassembly

NOTE: Cleanliness is extremely important when repairing hydraulic components. Work in a clean area. Before disassembly, drain the oil, then plug the ports and thoroughly clean the exterior. During repairs, always protect machined surfaces.

1. Remove the seven cap screws from the steering valve assembly.

2. Remove end cap, geroter, spacer, geroter drive, wear plate, seal ring, and O-rings from housing (Fig. 64).

3. Remove the plug and relief valve.

4. Slide the spool and sleeve assembly from the housing.

5. Remove the thrust bearing and bearing races (2).

6. Remove the quad seal.

7. Use a small blade screwdriver to carefully pry the dust seal from the housing. Be careful to not damage the dust seal seat in the housing.

8. Remove the pin that holds the spool and sleeve together.

9. Carefully slide the spool out of the sleeve. The centering springs and spring retaining ring will stay with the spool as it is removed.

CAUTION

The centering springs are under tension. Remove the retaining ring carefully.

10. Remove the spring retaining ring and centering springs from the spool.

Reassembly

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 and O–rings 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.

3. Install the centering springs in the spool. 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. 65).

IMPORTANT: Do not damage the dust or quad seals when installing the spool and sleeve assembly.

9. Apply a light coating of clean hydraulic fluid to the spool and sleeve assembly and slide carefully the assembly into the housing.

10. Clamp the housing in a vise. Use only 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 screw holes in the wear plate with threaded holes in the housing.

NOTE: The holes in the wear plate are symmetrical.

13. Install the geroter drive, making sure the slot in the drive engages the pin.

14. Lubricate and install new O-ring in wear plate groove.

15. Install the gerotor and align the screw holes.

16. Lubricate and install new o-ring in gerotor ring groove.

17. Lubricate and install new o-ring and seal ring in gerotor star groove.

18. Install the spacer.

19. Install the end cap and seven cap screws. Tighten the cap screws, in a crossing pattern, from **140 to 160 in-lb (16 to 18 Nm)**.

20. Remove the steering control unit from the vise.

21. Install the relief valve and plug. Tighten the plug to **150 in-lb (17 Nm)**.

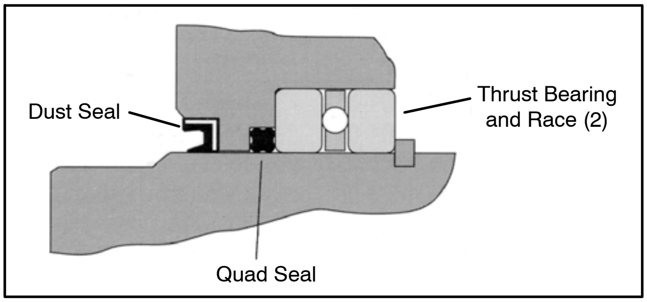

Figure 65

Hydraulic System

Steering Control Valve Service (Serial Number Over 280000000)

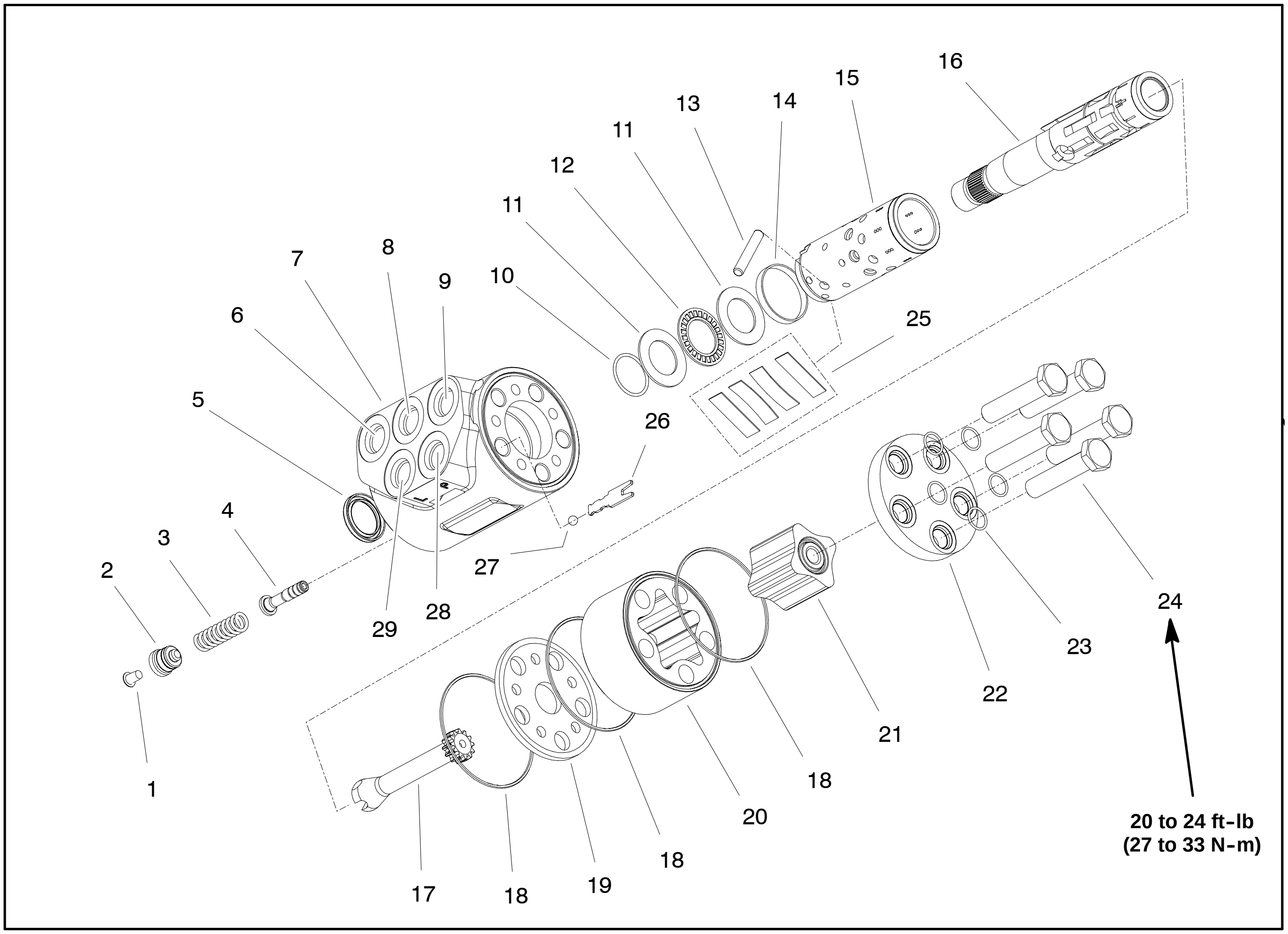

Figure 66

1. **Plug**
2. **Plug**
3. **Spring**
4. **Relief valve**
5. **Dust seal**
6. **T port**
7. **Housing**
8. **R port**
9. **E port**
10. **Shaft seal**
11. **Thrust washer**
12. **Bearing**
13. **Cross pin**
14. **Ring**
15. **Sleeve**
16. **Spool**
17. **Cardan shaft**
18. **O-ring**
19. **Distribution plate**
20. **Outer gearwheel**
21. **Inner gearwheel**
22. **End cover**
23. **O-ring (5 used)**
24. **Cap screw (5 used)**
25. **Spring set**
26. **Ball stop**
27. **Ball**
28. **P port**
29. **L port**

NOTE: For service of the steering control valve shown in Figure 66, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

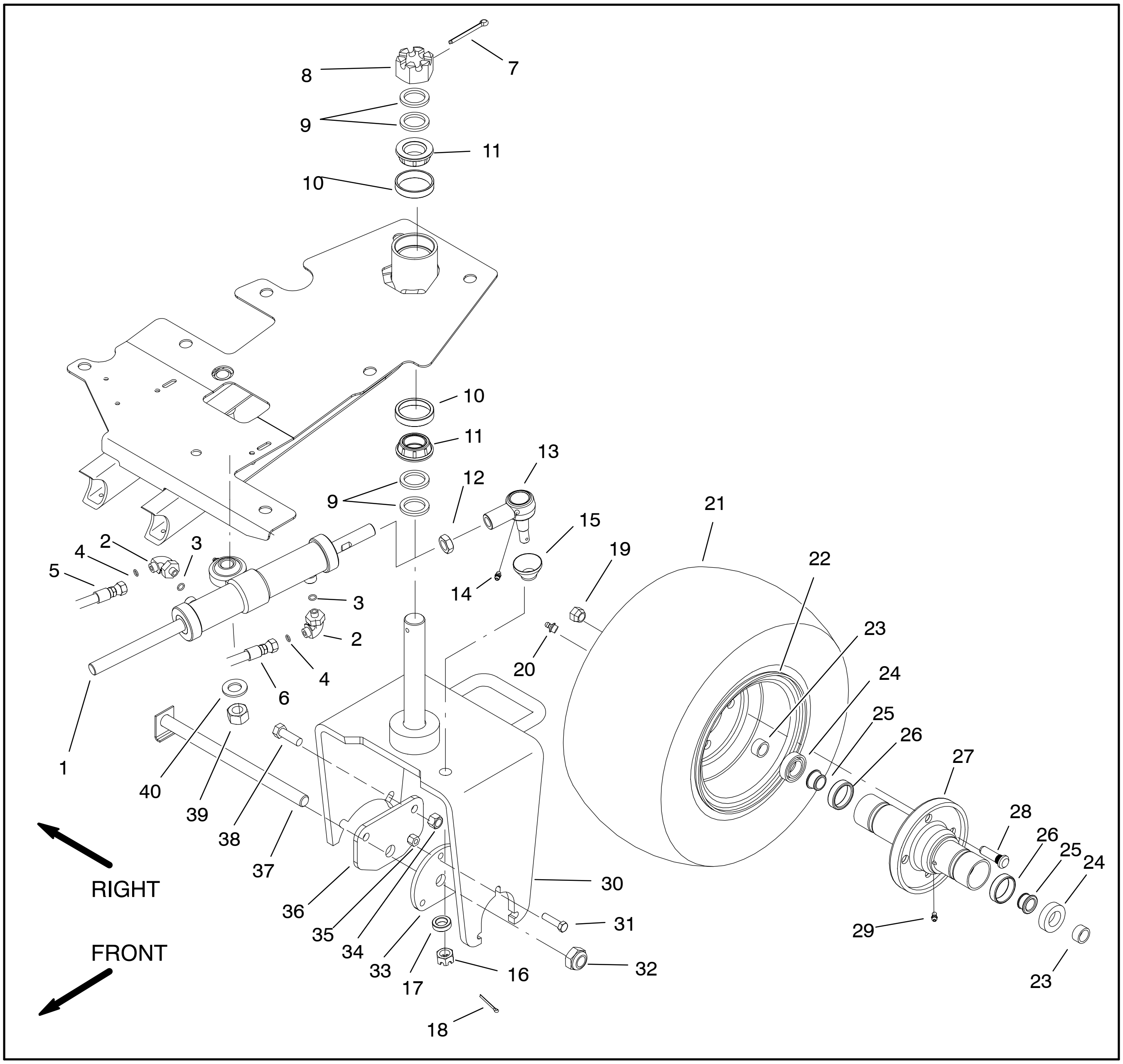

Figure 67

1. **Steering cylinder**
2. **90º hydraulic fitting**
3. **O–ring**
4. **O–ring**
5. **Hose assembly**
6. **Hose assembly**
7. **Cotter pin**
8. **Slotted hex nut**
9. **Washer**
10. **Bearing cup**
11. **Bearing cone**
12. **Jam nut**
13. **Rod end**
14. **Grease fitting**
15. **Dust seal**
16. **Slotted hex nut**
17. **Spacer**
18. **Cotter pin**
19. **Lug nut**
20. **Valve stem**
21. **Tire**
22. **Rim**
23. **Spacer**
24. **Seal**
25. **Bearing cone**
26. **Bearing cup**
27. **Hub**
28. **Drive stud**
29. **Grease fitting**
30. **Castor fork**
31. **Cap screw**
32. **Lock nut**
33. **Adapter plate**
34. **Lock nut**
35. **Lock nut**
36. **Motor plate**
37. **Castor bolt**
38. **Cap screw**
39. **Lock nut**
40. **Flat washer**

Removal (Fig. 71)

1. Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower cutting units, and stop engine.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Label all hose connections for reassembly purposes

3. Remove hose assemblies and O–rings from hydraulic fittings at the cylinder. Allow hoses to drain into a suitable container.

4. Remove lock nut and flat washer from barrel mounting stud. Remove steering cylinder from barrel stud.

5. Remove cotter pin, slotted hex nut and and spacer from rod end at rear wheel castor fork.

6. Remove steering cylinder from traction unit.

7. If rod end (13) is to be removed from cylinder rod, fully retract cylinder rod and measure distance from center of rod end to end of cylinder for assembly purposes (Fig. 72). Record measured distance. Loosen jam nut and then remove rod end and jam nut from cylinder rod.

Installation (Fig. 71)

1. If rod end (13) was removed from cylinder rod, fully retract cylinder shaft and thread rod end onto shaft so that distance is as measured during removal process (Fig. 72). Tighten jam nut to retain rod end.

2. Secure cylinder rod end to the castor fork with spacer, slotted hex nut, and cotter pin to rear wheel castor fork.

3. Install hydraulic fittings and O–rings to the steering cylinder.

4. Install steering cylinder over barrel mounting stud and secure with flat washer and lock nut.

5. Connect hydraulic hoses and O–rings to the hydraulic fittings. Tighten hose connections.

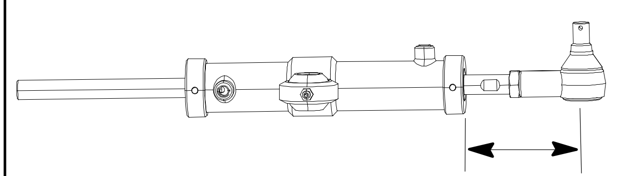

Figure 72

Hydraulic System

Steering Cylinder Service

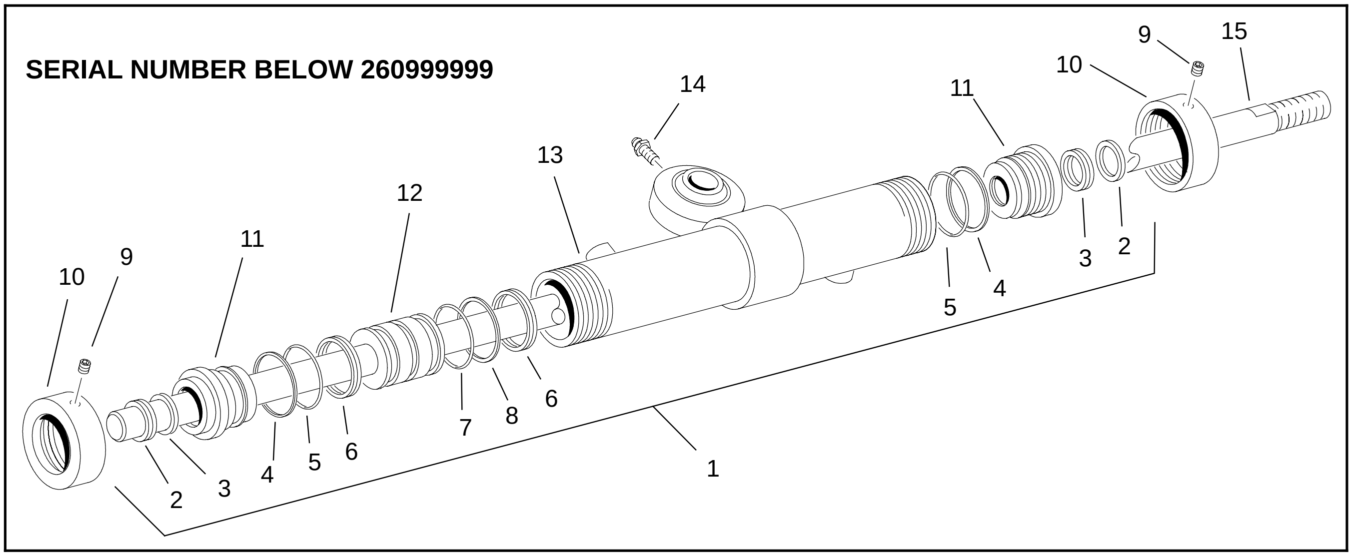

Figure 73

1. **Seal kit**
2. **Rod wiper**
3. **U-cup**
4. **Back-up ring**
5. **O-ring**
6. **Wear ring**
7. **O-ring**
8. **O-ring**
9. **Set screw**
10. **Threaded cap**
11. **Head**
12. **Piston**
13. **Barrel**
14. **Grease fitting**
15. **Rod**

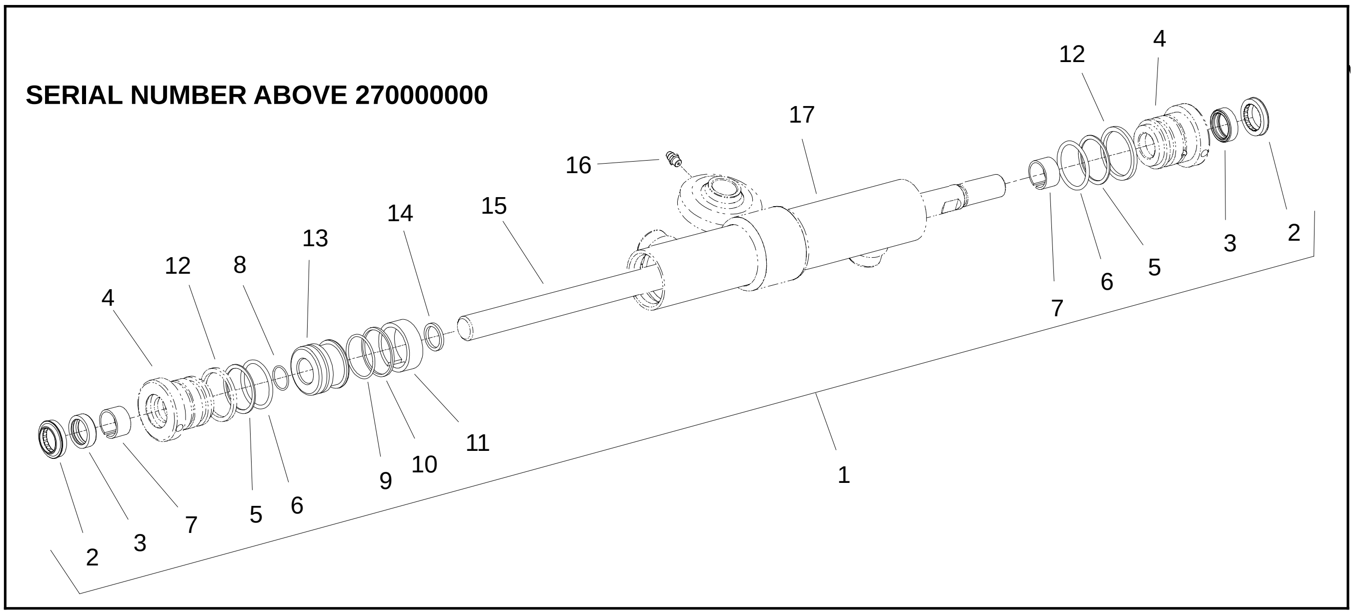

Figure 74

1. **Seal kit**
2. **Rod wiper**
3. **Seal**
4. **Head**
5. **Back-up ring**
6. **O-ring**
7. **Wear ring**
8. **O-ring**
9. **Back-up ring**
10. **Seal**
11. **Wear ring**
12. **Retaining ring**
13. **Piston**
14. **Retaining ring**
15. **Rod**
16. **Grease fitting**
17. **Barrel**

NOTE: On machines with serial number above 270000000 (Fig. 74), the steering cylinder design does not allow removal of the piston (item 13) from the rod. This cylinder design prevents replacing the O-ring on the inside of the piston (item 8). If a steering cylinder leak exists on either of the heads (items 4), all seals on the head can be replaced. The piston outer seals (items 9 and 10) and wear ring (item 11) can be replaced as well. If leakage or damage exists to the bore of the piston, steering cylinder replacement will be necessary.

Disassembly (Fig. 73 or 74)

IMPORTANT: To prevent damage when clamping cylinder barrel in a vise, clamp only on pivot end. Do not clamp the vise jaws against the shaft surface.

1. Pump oil out of cylinder into a drain pan by slowly moving rod in and out of cylinder bore. Plug ports and clean outside of cylinder.

2. Mount cylinder in a vise by clamping vise on center mounting location of cylinder. Do not close vise so firmly that cylinder barrel could become distorted.

3. Remove the heads from the barrel:

   A. For serial numbers below 260999999 (Fig. 73), loosen set screws and remove threaded cap from each end of the cylinder barrel.

   B. For serial numbers above 270000000 (Fig. 74), use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening. Rotate the head counter-clockwise to remove retaining ring from barrel and head.

   C. Grasp end of rod and use a twisting and pulling motion to carefully extract rod assembly and head from cylinder barrel. Remove head from other end of barrel.

4. For serial numbers below 260999999 (Fig. 73), loosen set screws that secure piston to shaft and carefully remove piston. Slide head and threaded cap from shaft. Piston for serial numbers above 270000000 (Fig. 74) is not removable from shaft.

5. Remove and discard all seals, back-up rings, and O-rings from both heads and piston.

CAUTION

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

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

7. Carefully inspect internal surface of barrel for damage (deep scratches, out-of-round, etc.). Inspect shaft, both heads, and piston for evidence of excessive scoring, pitting, or wear. Replace entire cylinder if internal components are found to be worn or damaged.

Assembly (Fig. 73 or 74)

NOTE: Due to steering cylinder design for serial numbers above 270000000, the seal kit may include components that cannot be accessed.

1. Use a complete repair kit when rebuilding the cylinder. Put a coating of clean hydraulic oil on all new seals, back-up rings, and O-rings.

2. Install new u-cup, rod wiper, back up ring, and O-ring onto each head. Position O-ring(s), piston ring, and both wear rings to the piston.

3. For serial numbers below 260999999 (Fig. 73), lubricate shaft and piston with clean hydraulic oil. Carefully slide piston onto shaft. Install thread locker on set screw threads and tighten two (2) set screws to secure piston to shaft.

4. Lubricate shaft and piston assembly with clean hydraulic oil and carefully slide shaft assembly into cylinder barrel.

5. Lubricate head assemblies with clean hydraulic oil and carefully slide them onto shaft and into barrel.

6. Secure heads to barrel:

   A. For serial numbers below 260999999 (Fig. 73), install and tighten threaded caps. Secure both caps to barrel with set screws.

   B. For serial numbers above 270000000 (Fig. 74), align retaining ring hole in the head with the access slot in the barrel. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

Leak Detector

Note: See Turf Guardian™ Leak Detector System in Chapter 5 – Electrical System of this manual for leak detector operation information.

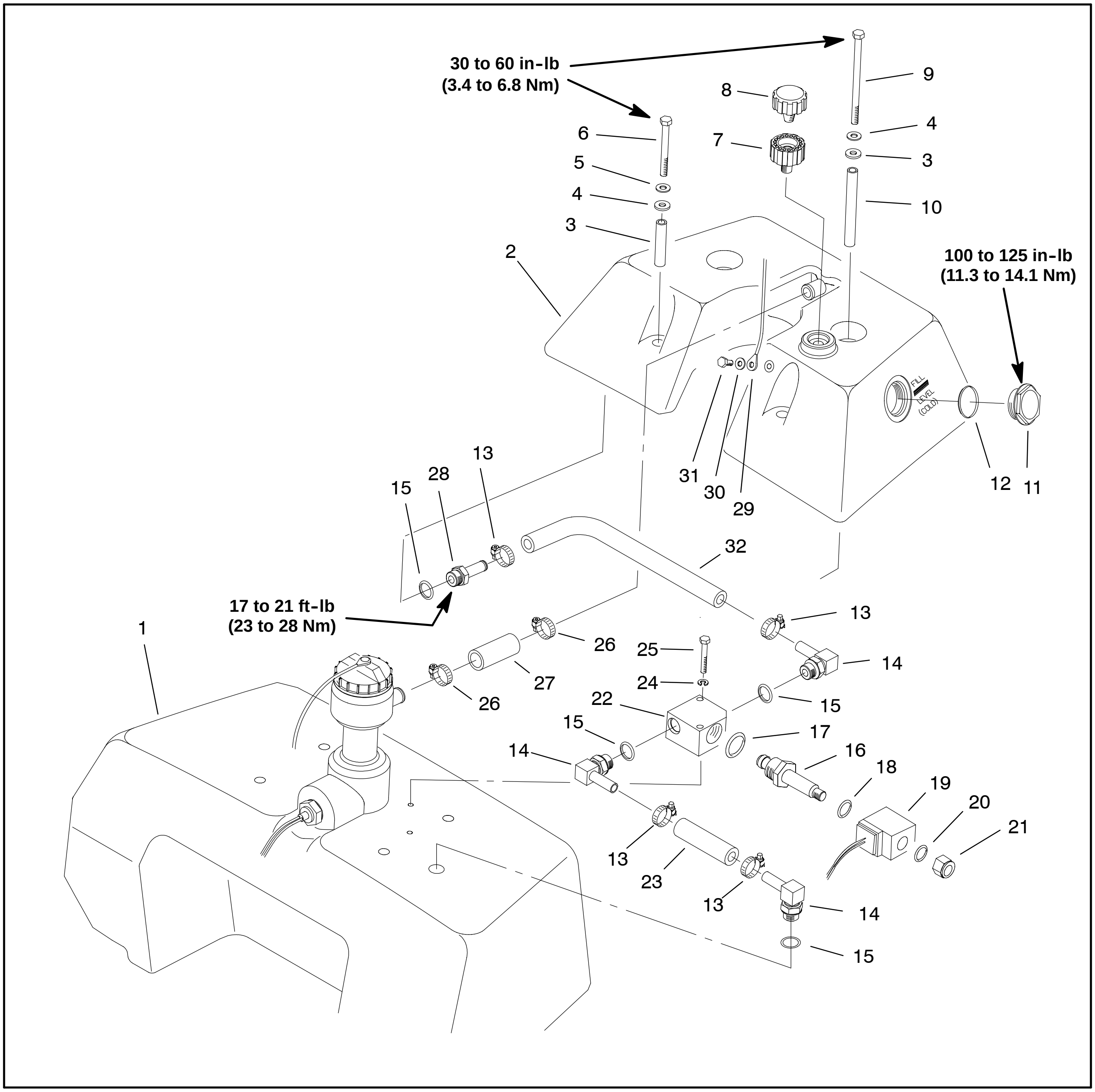

Figure 70

1. Hydraulic tank
2. Auxiliary tank
3. Spacer – short
4. Neoprene washer
5. Flat washer
6. Cap screw
7. Breather adapter
8. Breather cap
9. Cap screw
10. Spacer – long
11. Sight gauge
12. O–ring
13. Hose clamp
14. 90º barb fitting
15. O–ring
16. Valve spool
17. O–ring
18. O–ring
19. Solenoid
20. O–ring
21. Lock nut
22. Valve body
23. Tank hose
24. Lock washer
25. Cap screw
26. Hose clamp
27. Overflow hose
28. Straight barb fitting
29. Tether
30. Flat washer
31. Cap screw
32. Valve hose

Removal (Fig. 70)

1. Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower cutting units, and stop engine.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Place a clean container, large enough to collect 2 gallons (7.6 liters), under the hydrostat to collect hydraulic oil.

3. Clamp pump inlet hose to control drainage. Remove pump inlet hose from hydrostat. Release clamp from hose and drain about 2 gallons (7.6 liters) from the hydraulic tank (Fig. 71).

4. Clamp pump inlet hose to prevent draining additional hydraulic oil.

5. Remove cap screw (31) and flat washer(30) securing the tether (29) to the auxiliary tank.

6. Unplug leak detector harness from the main tractor harness.

7. Remove four cap screws (6 and 9), flat washers (4), neoprene washers (3), and spacers (3 and 10).

8. Loosen either hose clamp (26) and disconnect overflow hose (27).

9. Lift auxiliary tank slightly, loosen hose clamp (13), and disconnect valve hose (32) at valve fitting. Remove auxiliary tank assembly.

10. If valve removal is necessary, loosen hose clamp (13) and disconnect tank hose (23) at hydraulic tank fitting (14). Remove two cap screws (25) and lock washers (24) securing the valve assembly to the hydraulic tank and remove the valve assembly.

Disassembly and Inspection (Fig. 70)

1. The leak detector can be disassembled using the leak detector assembly drawing (Fig. 70) as a guide.

2. Inspect parts for the following:

   A. Leaking, cracked, or damaged auxiliary tank.

   B. Worn or leaking hydraulic hoses. Replace if necessary.

   C. Visibly worn or damaged parts.

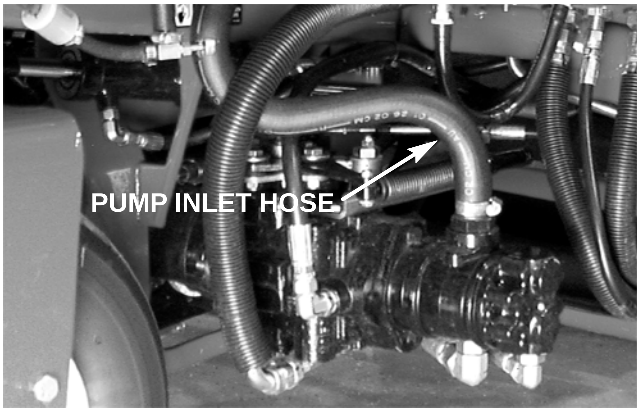

Figure 71

Assembly (Fig. 70)

1. Coat all O–rings with clean hydraulic oil.

2. Secure sight gauge (11) and new O–ring (12) to the auxiliary tank. Torque gauge from **100 to 125 in–lb (11.3 to 14.1 Nm)**.

3. Secure hydraulic barb fittings (28) and new O–ring (15) to the auxiliary tank. Torque fitting from **17 to 21 ft–lb (23 to 28 Nm)**.

4. Secure valve hose (32) to the barb fitting (28) with hose clamp (13).

5. Secure both hydraulic barb fittings (14) and O–rings (15) to the valve body (22)

Installation (Fig. 70)

1. Connect tank hose (23) and install valve assembly if previously removed.

2. Connect pump inlet hose to hydrostat (Fig. 71).

3. Connect overflow hose (27).

4. Position auxiliary tank over hydraulic tank and connect valve hose (32).

IMPORTANT: Do not over tighten cap screw. Threads in tank may become damaged.

5. Install four spacers (3 and 10), neoprene washers (3), flat washers (4), and cap screws 6 and 9). Tighten cap screws from **30 to 60 in–lb (3.4 to 6.8 Nm)**.

6. Connect leak detector harness to main wire harness.

7. Secure tether to the auxiliary tank with cap screw (31) and flat washer (30).

Note: Monitor hydraulic fluid level in sight glass. As air is removed from the hydraulic circuit, auxiliary tank may need to be topped off after initial fill.

8. Remove cap from main hydraulic tank and slowly fill to cold fill level mark next to sight gauge (11) on auxiliary tank.

9. Check leak detector with ignition key switch in **ON/ RUN** position. The buzzer should sound when leak detector test switch is held down for one (1) second.

10. If the buzzer fails to sound, check to see if all connections are secure.

11. Verify leak detector operation.

Hydraulic Reservoir

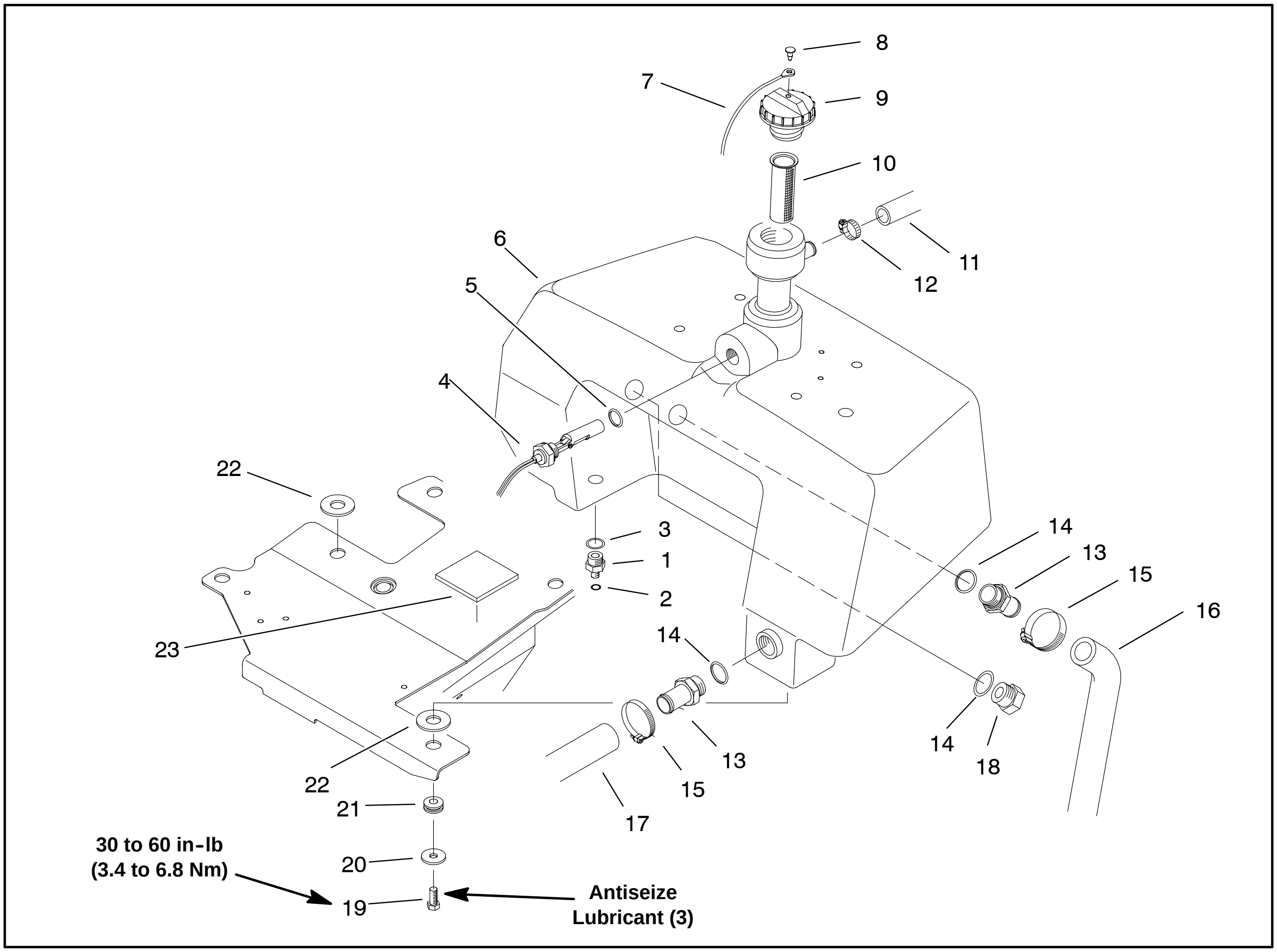

Figure 72

1. **Straight hydraulic fitting**
2. **O-ring**
3. **O-ring**
4. **Oil level sensor**
5. **O-ring**
6. **Hydraulic tank**
7. **Tether**
8. **Pin**
9. **Tank cap**
10. **Filler screen**
11. **Overflow hose**
12. **Hose clamp**
13. **Hydraulic barb fitting**
14. **O-ring**
15. **Hose clamp**
16. **Return hose**
17. **Pump inlet hose**
18. **Plug (early units only)**
19. **Cap screw**
20. **Flat washer**
21. **Grommet**
22. **Spacer**
23. **Tank pad**

Removing Hydraulic Reservoir (Fig. 72)

1. Before removing any parts from the hydraulic system, park machine on a level surface, set brake, lower cutting units, and stop engine.

CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components.

2. Remove leak detector assembly (see Leak Detector Removal in this chapter of this manual).

3. Drain remaining hydraulic oil from hydraulic tank through pump inlet hose into a suitable container.

4. Unplug oil level sensor harness connector.

5. Disconnect hose assembly from the reel motor case drain fitting located below the right side of the frame. Allow hose to drain to a suitable container (Fig. 73).

6. Disconnect return hose (16) from hydraulic barb fitting at tank. Allow hose to drain into a suitable container.

7. Remove three cap screws (19), flat washers (20), and spacers (22) securing the hydraulic tank (6) to the vehicle frame.

8. Remove hydraulic tank.

9. Remove fittings and oil level sensor from hydraulic tank if necessary.

Inspecting Reservoir Parts (Fig. 72)

1. Clean tank and filler screen with solvent.

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

3. Replace hydraulic hoses if worn or leaking.

Installing Hydraulic Reservoir (Fig. 72)

1. Install all removed fittings into hydraulic tank.

2. If oil level sensor was removed from tank, install sensor in tank making sure that arrow on sensor is pointing down (Fig. 74).

3. Position tank onto the vehicle frame.

4. Apply antiseize lubricant to threads of three cap screws (19). Secure hydraulic tank to the vehicle frame with three cap screws, flat washers (20), and spacers (22). Torque cap screws from **30 to 60 in-lb (3.4 to 6.8 Nm)**.

5. Secure return hose (16) to hydraulic barb fitting at tank.

6. Secure pump inlet hose to hydrostat with hose clamp (Fig. 73).

7. Connect hose assembly to reel motor case drain fitting located below the right side of the frame (Fig. 73).

8. Connect oil level sensor harness connector.

9. Install leak detector assembly (see Leak Detector Installation in this chapter of this manual).

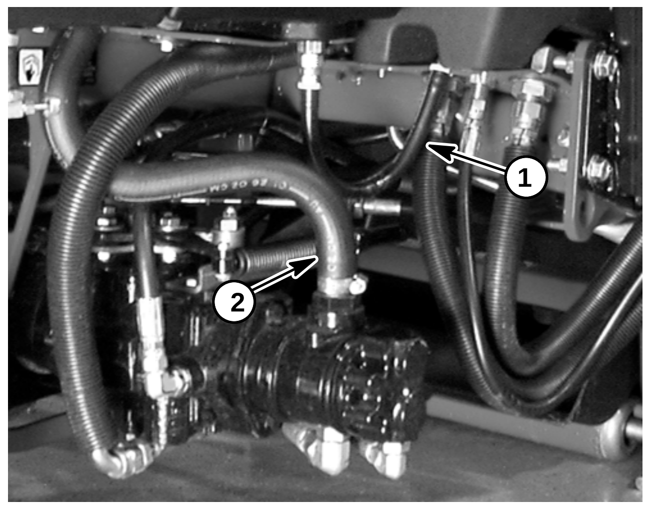

Figure 73

1. **Reel motor case drain** 2. **Pump inlet hose**

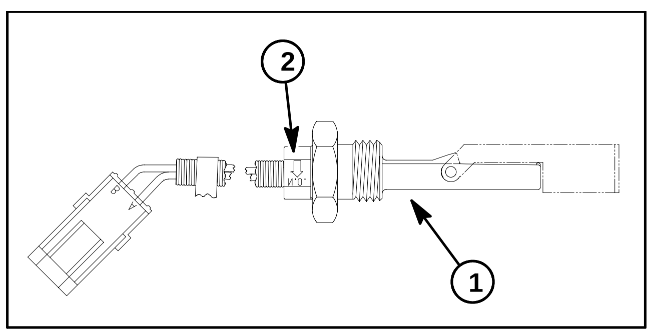

Figure 74

1. **Oil level sensor** 2. **Sensor arrow**

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Chapter 5

Electrical System

Table of Contents

Electrical System

Electrical Schematics

The electrical schematics and other electrical drawings for the Greensmaster 3150 are located in Chapter 11 – Electrical Diagrams.

Special Tools

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

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

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

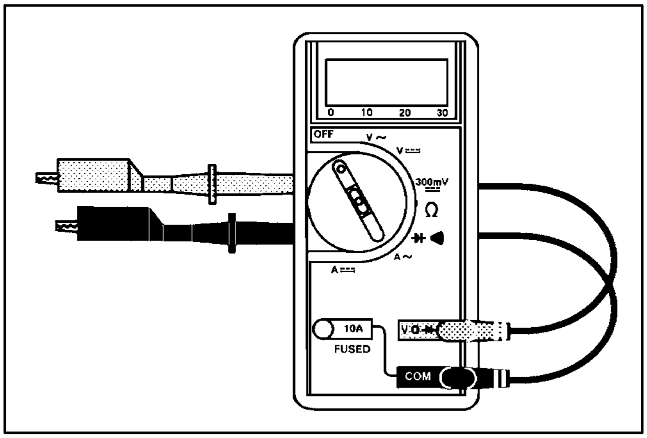


Figure 1

Skin-Over Grease

Special non-conductive grease which forms a light protective skin which helps waterproof electrical switches and contacts.

Toro Part Number: **505-165**

Figure 2

Battery Terminal Protector

Aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after the battery cable has been secured to the battery terminal.

Toro Part Number: **107-0392**

Figure 3

Turf Guardian™ Leak Detector System Operation

Before Start-Up (Cold Oil)

With ignition switch Off, solenoid valve is open. Before start-up, hydraulic fluid is at level mark of sight gauge (oil cold). Float is in raised position, keeping alarm circuit open.

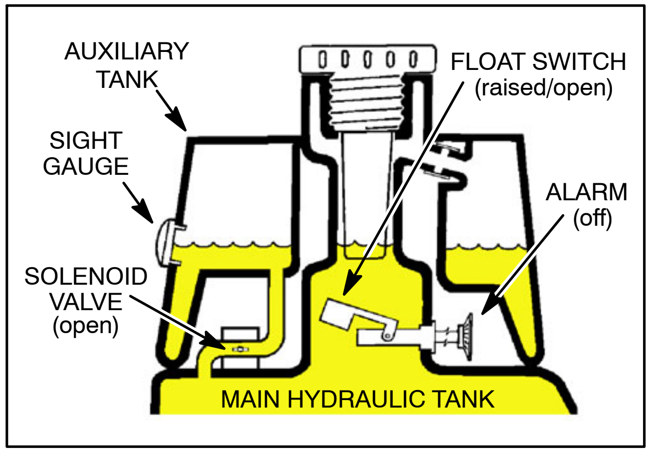


Figure 4

Normal Operation (Warm Oil)

When ignition switch is turned On, solenoid valve closes. During normal operation, hydraulic fluid expands, causing it to overflow into auxiliary tank. The float stays in the raised position keeping alarm circuit open.

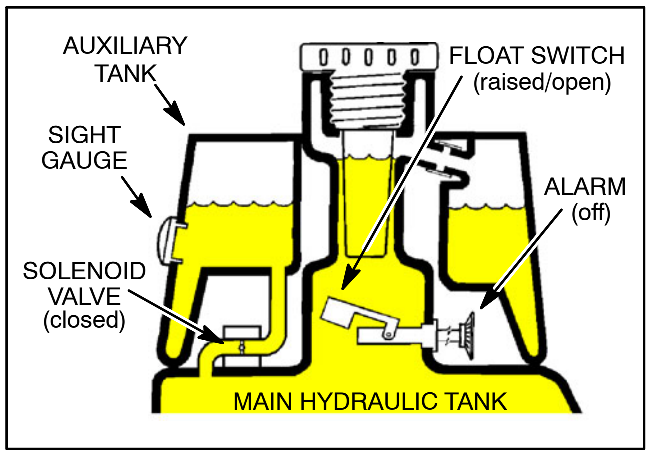


Figure 5

Leak Alert!

If hydraulic fluid leaks during operation, the fluid level in the main hydraulic tank drops. This causes the float to lower, closing the alarm circuit. The alarm will sound after a one second time delay.

Note: During normal operation, with cutting units lowered, approximately 5 oz (148 ml) of hydraulic fluid will leak before the float closes the alarm circuit and activates the alarm.

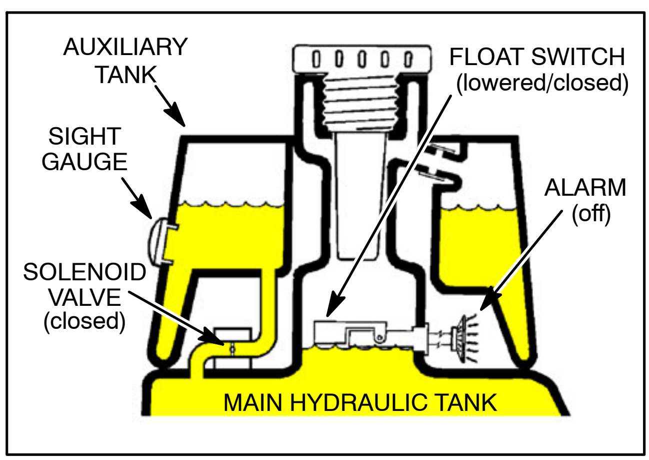


Figure 6

Troubleshooting

CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical trouble-shooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Chapter 11 – Wiring Schematics in this manual).

If the machine has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	Possible Causes
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Battery charge is low. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Wiring at starter is faulty. Starter solenoid is faulty. Starter mounting bolts are loose or not supplying a sufficient ground for solenoid. Starter is faulty and causing an incomplete circuit for the solenoid. Relay K2 has intermittent ground.
Nothing happens when start attempt is made.	Battery is dead. Wiring to the start circuit (see Wiring Schematics) components is loose, corroded, or damaged. Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Starter solenoid fusible link is open. Fuse block is faulty. 20 ampere fuse F1 is loose or blown. Diode D1–B, or start safety relay is faulty. The ignition switch is faulty. Starter solenoid is faulty. Neutral sensor is out of adjustment or faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Wiring to start circuits (see Wiring Schematics) is loose, corroded, or damaged. Wiring to engine is (see Wiring Schematics) is loose, corroded, or damaged. Diode D1–A circuit is open. Engine or fuel system is malfunctioning (see Chapter 4 – Engine). Kill relay K1 is faulty or grounded. Engine and fuel may be too cold. Fuel solenoid is faulty.
Engine cranks (but should not) with the Functional Control Lever in the MOW or TRANSPORT position.	Neutral sensor is out of adjustment, faulty, or short circuited.

General Run and Transport Problems

Problem	Possible Causes
Engine kills when the Functional Control Lever is in the MOW or TRANSPORT position with the operator in the seat.	Operator is sitting too far forward on the seat (seat switch not depressed). Parking brake is set. Parking brake switch is faulty. Seat switch is faulty. Seat switch wiring is loose, corroded, or damaged.
Battery does not charge.	Wiring to the charging circuit (see Wiring Schematics) components is loose, corroded, or damaged. Voltage regulator is loose or not grounded to engine. Voltage regulator/alternator is faulty. Alternator fusible link is open. Ignition switch is faulty. Battery is faulty.
Engine kills during operation (operator sitting on seat).	Operator moved too far forward on the seat (seat switch not depressed). Wiring to the run circuits (see Wiring Schematics) components became broken or disconnected.

Cutting Unit Operating Problems

Problem	Possible Causes
Cutting units run (but should not) when raised.	Joystick relay K3 is faulty or shorted. Solenoid valve S1 is faulty. Mow relay K4 is faulty or shorted. Mow switch is shorted.
Cutting units do not run when lowered with the Functional Control Lever in the MOW position.	Wiring to run/mow/backlap circuits components (see Wiring Schematics) is loose, corroded, or damaged. Fuse block or fuse is faulty. Solenoid valve S1 is faulty. Mow switch and/or mow relay K4 is faulty or grounded. Raise or lower switch and/or joystick relay K3 is faulty or grounded.
Cutting units will not raise.	Wiring to raise circuit components (see Wiring Schematics) is loose, corroded, or damaged. Fuse block or fuse is faulty. Solenoid valve S3 and/or S2 is faulty. Diode D3 is open. Raise switch and/or raise relay K6 is faulty or grounded.
Cutting units will not lower.	Wiring to lower circuit components (see Wiring Schematics) is loose, corroded, or damaged. Fuse block or fuse is faulty. Diode D2 is open. Raise switch is faulty. Lower switch is faulty. Joystick relay K3 is faulty. 6 second delay timer is faulty. Solenoid valve S2 or S4 is faulty. Lower relay K5 is faulty.

Electrical System Quick Checks

Battery Test

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

Set the multimeter to the DC volts setting. The battery should be at a temperature of 60º to 100º F (15.5º to 37.8º C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead 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 Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (–) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Start the engine and run at high idle **(3200 RPM)**. Allow the battery to charge for at least 3 minutes. Record the battery voltage.

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

An example of a charging system that is functioning:

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

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).

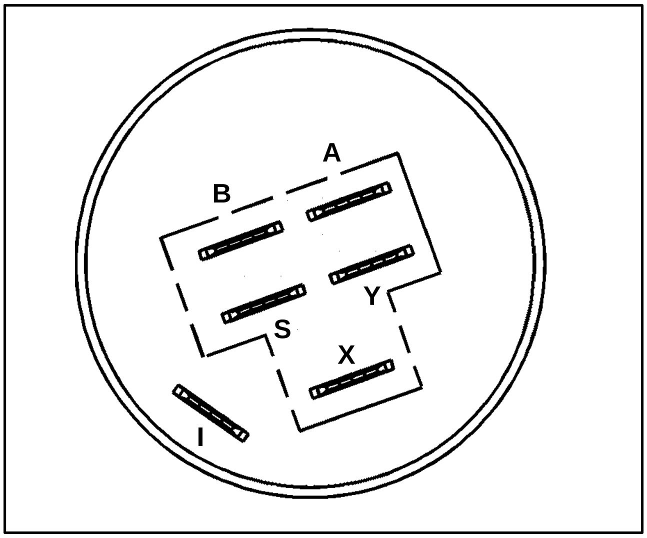
CAUTION

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 circuitry 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



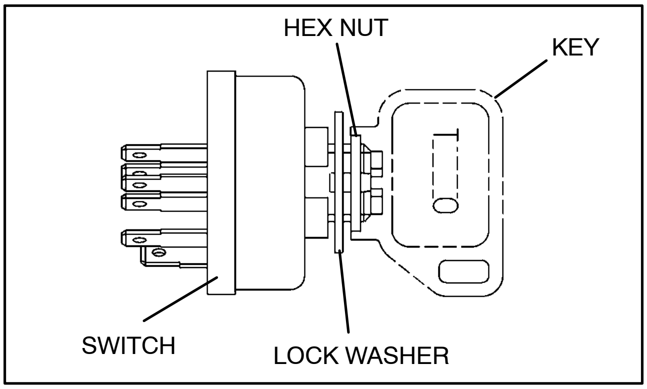


Figure 7

Hour Meter

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 the voltage source from the hour meter.

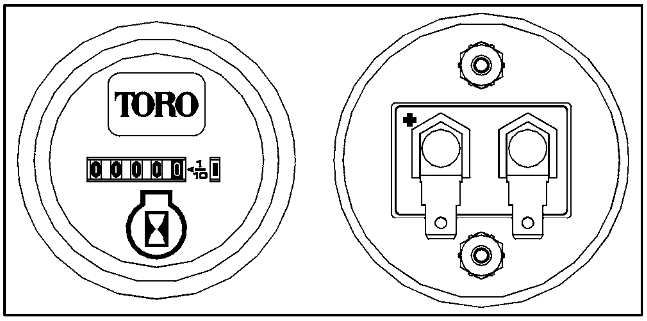


Figure 8

Relays

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 80 to 90 ohms. There should be continuity between terminals 87A and 30.

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

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

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

5. Disconnect ground, voltage and multimeter leads from relay terminals.

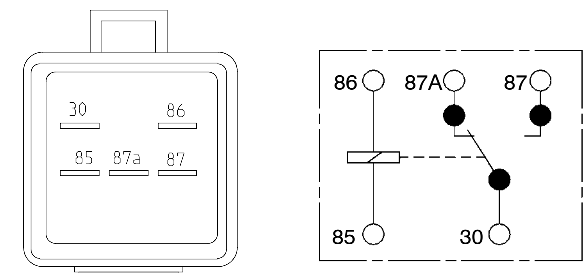


Figure 9

Solenoid Valve Coils

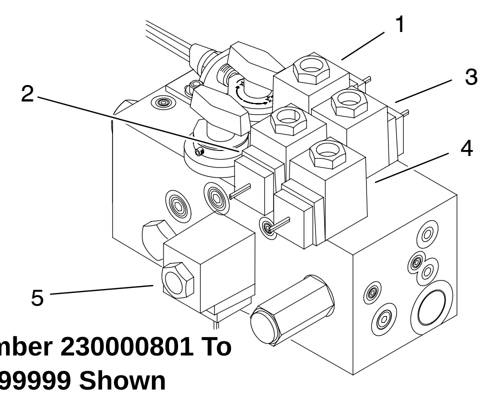
Note: Prior to taking small resistance readings with a digital multimeter, short the test leads together. The meter will display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from from the measured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

1. Make sure engine and ignition switch is Off. Disconnect solenoid valve electrical connector from machine wire harness.

2. Apply 12VDC source directly to the solenoid. Listen for solenoid to switch on. Remove voltage source from solenoid.

3. Measure resistance between the two solenoid coil connector terminals. The coil resistance for machines with serial numbers under 260999999 is identified in Figure 10. The coil resistance for machines with serial numbers above 270000000 is identified in Figure 11.

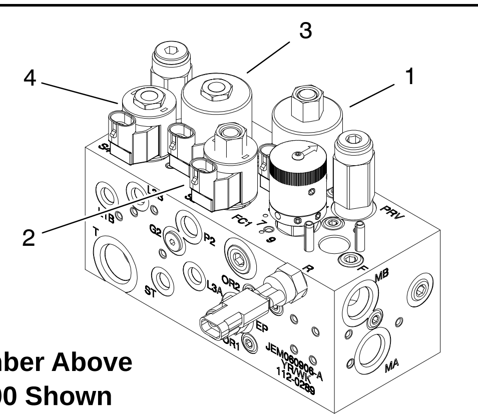
4. Replace solenoid if necessary. Reconnect solenoid valve electrical connector to machine wire harness.



Serial Number 230000801 To 260999999 Shown

Figure 10

1. **Solenoid S1 (7.2 ohm)**
2. **Solenoid S2 (7.2 ohm)**
3. **Solenoid S3 (7.2 ohm)**
4. **Solenoid S4 (7.2 ohm)**
5. **Solenoid S6 (8.1 ohm)**



Serial Number Above 270000000 Shown

Figure 11

1. **Solenoid S1R1 (7.1 ohm)**
2. **Solenoid S2 (8.6 ohm)**
3. **Solenoid S3 (7.1 ohm)**
4. **Solenoid S4 (8.6 ohm)**

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the Functional Control Lever is moved out of neutral (neutral switch opens) and the operator raises out of the seat, the engine magneto will ground and the engine will stop. The switch and its electrical connector are located directly under the seat.

1. Make sure the engine and ignition switch is Off. Remove seat from the support assembly by removing four lock nuts from the seat bolts.

2. Disconnect electrical connector from the seat switch.

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

4. With no operator in the seat, there should be no continuity between the terminals.

5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

6. Connect switch electrical connector. Reinstall seat.

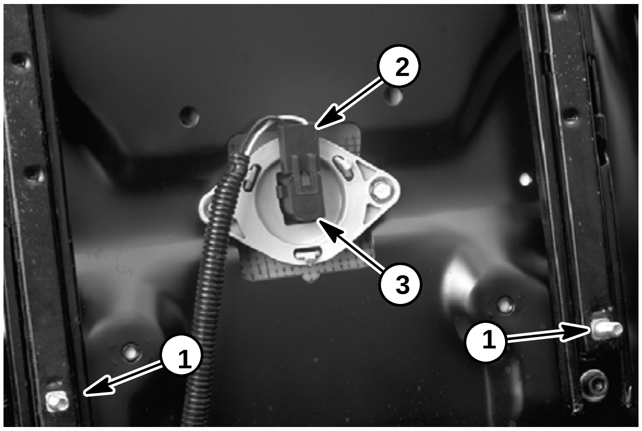


Figure 12

1. **Seat bolts**
2. **Electrical connector**
3. **Seat switch**

Fuse Block

Fuses can be removed to check continuity. The test meter should read **less than 1 ohm**.

Fuses supply power to the following (Fig. 13):

1. The 20 amp fuse (F1) supplies power to the run and mow relays.

2. The 10 amp fuse (F2) supplies power to the light/test switch and the optional light circuit.

3. The 10 amp fuse (F3) supplies power to the engine fuel solenoid and the seat and parking brake interlock switches.

4. The 10 amp fuse (F4) supplies power to leak detector solenoid and the joystick raise and lower switches.

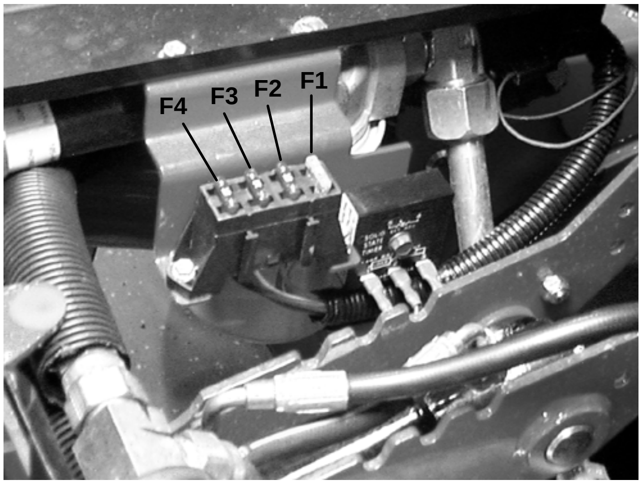


Figure 13

Electrical System

Neutral and Mow Switches

The neutral and mow switches are normally open reed switches. They close when the actuator comes in close proximity to the switch. These switches are used to sense the Functional Control Lever in either the NEUTRAL or MOW position.

1. Make sure the engine and ignition switch is Off. Disconnect electrical connectors to both switches and move the functional control lever to TRANSPORT. Check continuity of both switches by connecting a multimeter (ohms setting) across the connector terminals. There should be no continuity across either switch.

2. Place the Functional Control Lever in the NEUTRAL position. The NEUTRAL reed switch should have continuity and the MOW switch should be open (Fig. 14).

3. Place the Functional Control Lever in the MOW position. The NEUTRAL reed switch should be open and the MOW switch should have continuity (Fig. 14).

4. If the neutral or mow switches do not satisfy any of the tests described in steps 1, 2, or 3, adjust the switches as follows:

   A. The distance between the sensing end of each switch and the mounting bracket should be 0.725 to 0.775 inch (18.4 to 19.7 mm) (Fig. 15).

   B. To adjust or install actuator, place lever in neutral, position actuator in lever until the NEUTRAL switch just closes, and then rotate the actuator two complete turns closer to switch.

   C. When adjusting switches or actuator, tighten jam nuts 30^{o} past finger tight.

   D. After switch or actuator adjustment, repeat the tests described in steps 1, 2, or 3. If either switch does not satisfy any one of the tests, replace the switch.

5. Connect electrical connectors and check interlock operation (See Verify Interlock System Operation in this chapter of this manual).

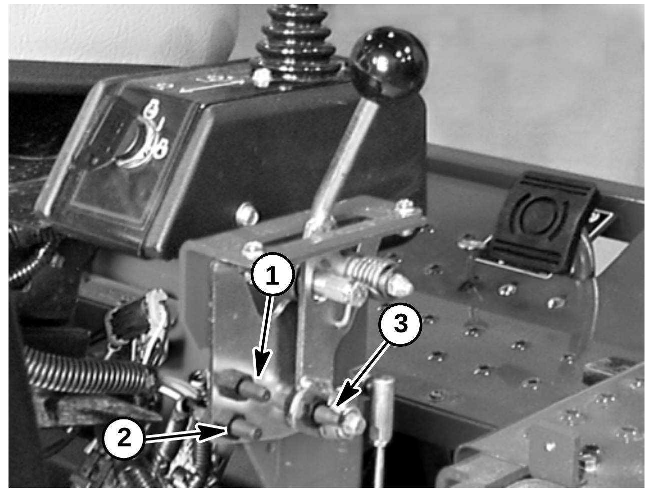


Figure 14

1. **Mow reed switch**
2. **Neutral reed switch**
3. **Actuator**

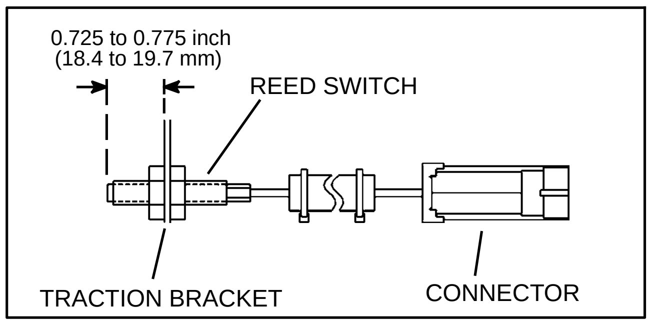


Figure 15

Parking Brake Sensor

The parking brake sensor is normally closed and opens when the operator sets the parking brake. If the Functional Control Lever is moved out of neutral (neutral switch opens) and the parking brake brake is set, the engine magneto will ground and the engine will stop. The sensor and its electrical connector are located directly under the operator foot panel.

1. Park machine on a level surface. Make sure the engine and ignition switch is Off. Set brake and block front wheels.

2. Disconnect electrical connector from the parking brake sensor.

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

4. With the parking brake set, there should be no continuity across the switch terminals.

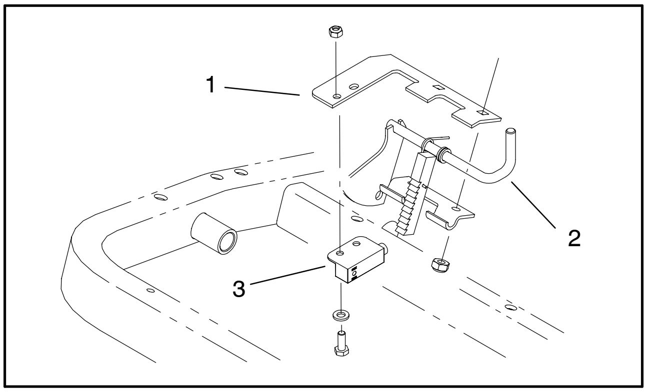


Figure 16

1. Mounting plate
2. Latch assembly
3. Parking brake sensor

5. Release the parking brake. There should be continuity across the switch terminals.

6. Connect switch electrical connector. Reset the parking brake.

Electrical System

Joystick Raise and Lower Switches

The joystick raise and lower switches are located on the lift control mechanism. The rear switch is used to lower the reels and the front switch to raise them (Fig. 17). The switches are identical and are shown in Figure 18.

1. Make sure the engine and ignition switch is Off. Remove the plastic cover and disconnect the harness connectors from the switches.

2. Check the continuity of the raise switch by connecting a multimeter (ohms setting) across the switch connector terminals as follows:

   A. With the joystick in the rest position, continuity should only exist between the common and NC terminals (blue and green/black wires).

   B. With the joystick in the raise position, continuity should only exist between the common and NO terminals (blue and green/gray wires).

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

   A. With the joystick in the rest position, continuity should only exist between the common and NC terminals (open terminal and green/black wires).

   B. With the joystick in the lower position, continuity should only exist between the common and NO terminals (green/black and gray/black wires).

4. After testing, connect the harness connectors to the joystick switches, and reinstall the plastic cover.

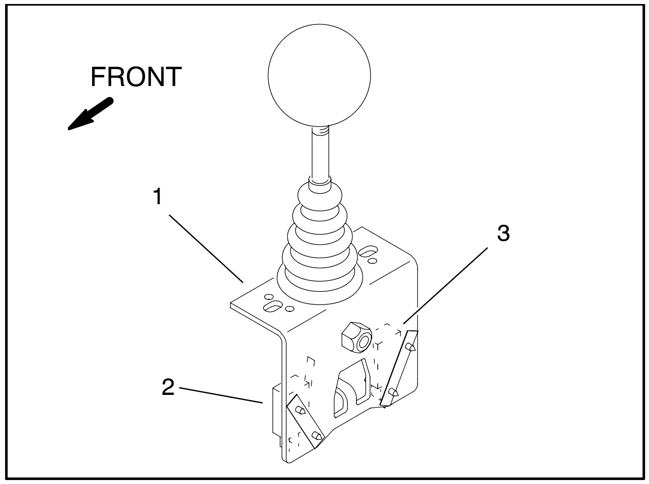


Figure 17

1. **Joystick assembly**
2. **Raise switch**
3. **Lower switch**

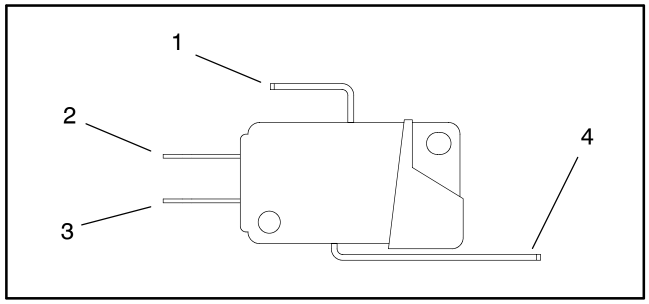


Figure 18

1. **Common terminal**
2. **NO terminal**
3. **NC terminal**
4. **Switch lever**

Backlap Switch (If Equipped)

The backlap switch is located on the hydraulic manifold (when the Backlap Kit is installed). It is normally open and closes when the backlap knob is turned to the backlap position.

1. With the engine off, disconnect electrical connector.

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

3. Turn the backlap knob clockwise to the backlap position while watching the multimeter. Continuity should be made as the switch closes.

4. Turn the backlap knob counterclockwise to the mow position while watching the multimeter. Continuity should be broken as the switch opens.

5. Reconnect the electrical connector.

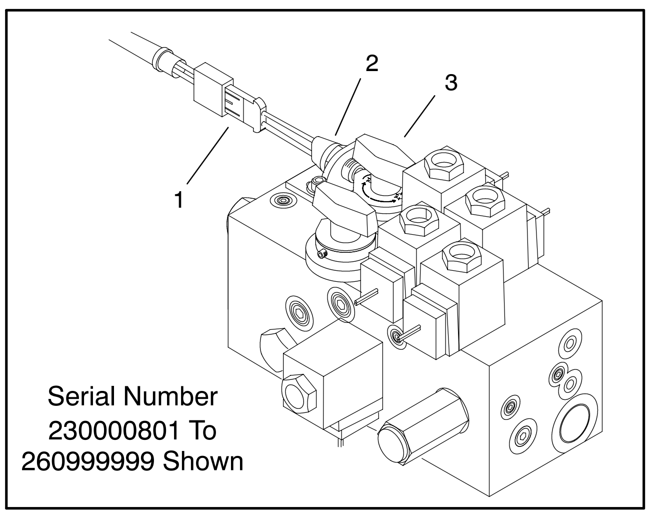


Figure 19

1. **Connector**
2. **Backlap switch**
3. **Backlap knob**

Lower Reels Time Delay

This is a solid state timer used to energize solenoid valve S4 long enough to fully retract the cutting unit lift cylinders, making sure the cutting units are fully lowered. Upon the application of power, the load is energized and the time delay is started. After 6 seconds the load is de-energized.

1. Connect voltmeter across test load and test load to timer. Connect 12VDC source to timer and load. Make sure to observe polarity. After 6 seconds, there should be no voltage across the load.

2. Disconnect timer from 12VDC source and test load.

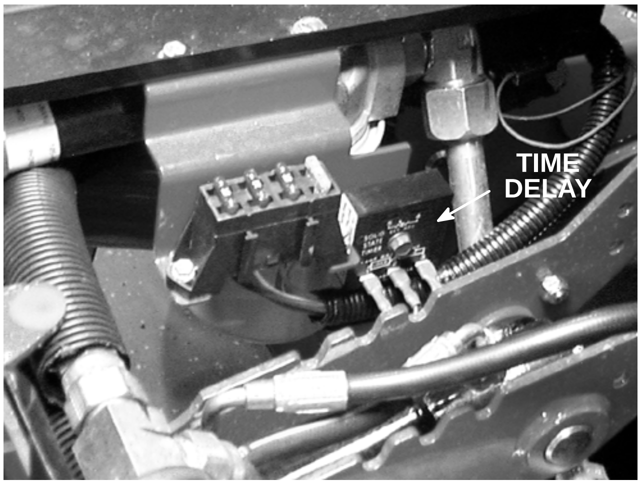


Figure 20

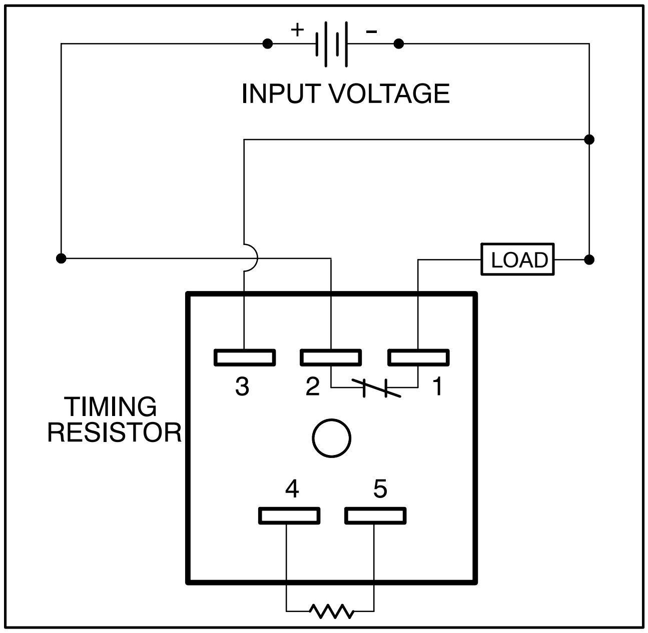


Figure 21

Leak Detector Alarm and Delay Timer

To prevent the leak detector system from sounding false alarms during normal operation. the alarm circuit includes a one second delay timer.

1. Turn ignition switch to On (do not start the engine), then move leak detector test switch rearward and hold. After a one second time delay the alarm should sound.

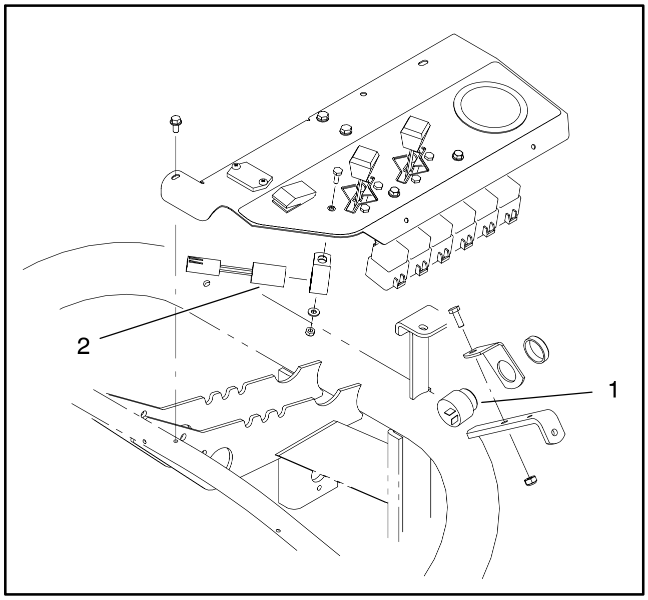


Figure 22

1. Alarm **2. Delay timer**

Leak Detector Float Switch

The leak detector float switch closely monitors the hydraulic fluid level in the main hydraulic tank. The switch contacts are open when the float is in the raised position, and closed when the float is in the lowered position.

1. If the float switch is connected to the main harness, remove hydraulic tank cap and screen from filler neck of hydraulic tank. Turn ignition switch to On (do not start the engine). Insert a clean rod or screw driver into filler neck and gently push down on switch float. Alarm should sound after a one second time delay.

2. If the float switch is removed or disconnected from the main harness, connect a continuity tester across the float switch wire terminals. Current should flow across the terminals only when the float is pushed down. There should be no current flow across the terminals when the float is in the raised position.

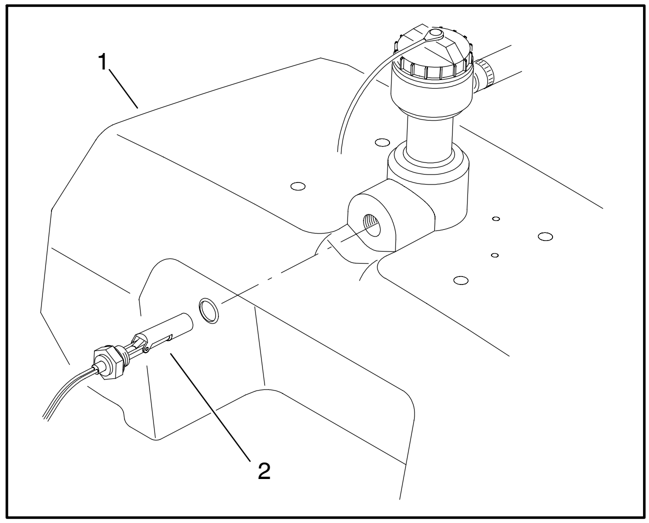


Figure 23

1. Main hydraulic tank **2. Float switch**

Leak Detector Solenoid Valve

The leak detector solenoid valve is a normally open valve that allows hydraulic fluid to flow from the auxiliary tank to the main hydraulic tank while the ignition is Off. This feature fills the main hydraulic tank with fluid from the auxiliary tank prior to starting the unit. The valve closes when the ignition is On and during unit operation.

1. Disconnect the wiring connector at the valve solenoid.

2. Connect 12 vdc power across the solenoid terminals. The valve spool should retract completely.

3. If valve does not retract smoothly or does not retract completely, replace or rebuild the valve (see Solenoid Operated Cartridge Valves in this chapter of this manual).

4. To check the valve supply power, set the ignition switch to On (do not start the engine). Connect a DC voltmeter across the main harness leads for the solenoid valve, 12 volts should be present.

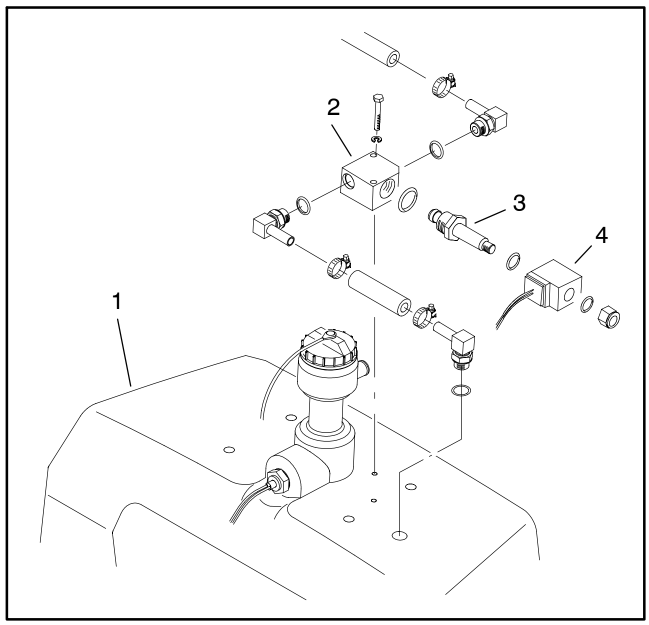


Figure 24

1. Main hydraulic tank **3. Valve spool**
2. Valve body **4. Solenoid**

Diodes

The main wiring harness contains six diodes. Diodes D2 and D3 are connected to the harness at separate locations. Diodes D1-A, D1-B, D1-C, and D1-D are connected to the main harness by a small four position circuit board located near the front of the left side control panel. The diodes are used for circuit protection from inductive voltage spikes and for safety circuit logic.

Diode D1-A

Allows the engine to start only with the Functional Control Lever in NEUTRAL (neutral sensor closed). Also, it allows the engine to continue to run with either the Functional Control Lever in NEUTRAL (Neutral Sensor closed) or the operator sitting in the seat (Seat switch closed).

Diode D1-B

Prevents a negative spike from damaging the Neutral Sensor and Seat switch by allowing a ground path for the Start Safety relay (K2) when it de-energizes.

Diode D1-C

Maintains current flow to the Joystick relay after the momentary Lower switch of the Joystick opens.

Diode D1-D

Prevents a negative spike from damaging the Mow and Backlap switches by allowing a ground path for the mow relay when it de-energizes.

Diode D2

This diode prevents current flow to solenoid S4 when solenoids S2 and S3 are energized through Raise relay R5.

Diode D3

This diode prevents current flow to solenoid S3 when solenoids S2 and S4 are energized through lower relay R6.

Testing

The diodes can be individually tested using a digital multimeter (ohms setting) and the table to the right.

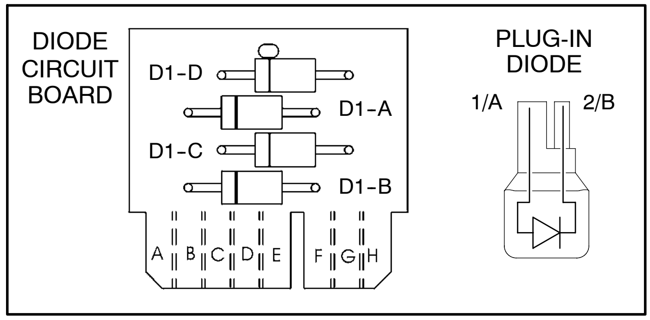


Figure 25

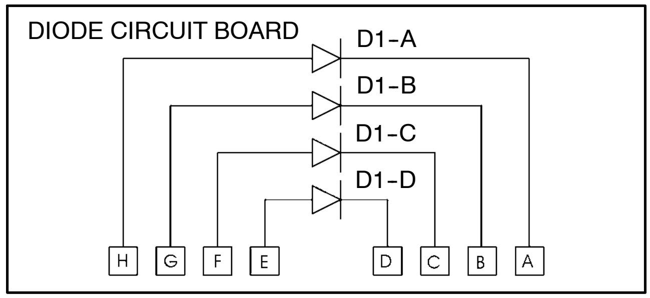


Figure 26

Type	Red (+)	Black (-)	Continuity
Circuit Board	H	A	YES
	A	H	NO
	G	B	YES
	B	G	NO
	F	C	YES
	C	F	NO
	E	D	YES
	D	E	NO
Plug-In	1/A	2/B	YES
	2/B	1/A	NO

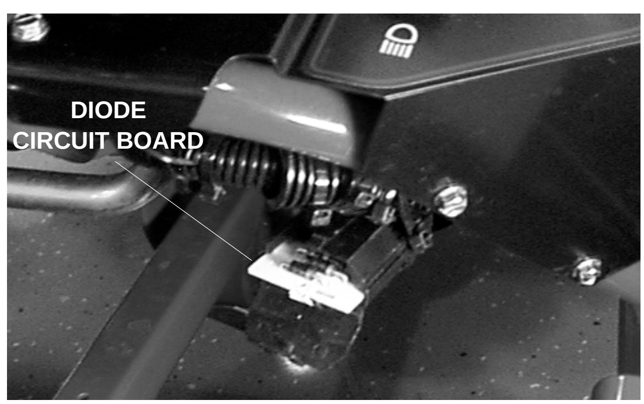


Figure 27

Verify Interlock System Operation

CAUTION

The interlock switches are for the operator's protection; do not disconnect them. Check the operation of the switches daily to assure the interlock system is operating. If a switch is defective, replace it before operating the machine.

The purposes of the interlock switches are to:

A. Prevent the engine from cranking or starting unless the Functional Control Lever is in NEUTRAL.

B. Prevent operating the traction pedal with the Functional Control Lever in NEUTRAL.

C. Shut off the engine if the operator leaves the seat without the Functional Control Lever in NEUTRAL.

D. Shut off the reels if the Functional Control Lever is moved to NEUTRAL or TRANSPORT.

1. Sit on the seat, engage parking brake, and move Functional Control Lever to NEUTRAL. Try to depress traction pedal. If the pedal does not depress, the interlock system is operating correctly. Correct problem if not operating properly.

2. Sit on the seat, engage parking brake, keep traction pedal in neutral, and place Functional Control Lever in MOW or TRANSPORT. Try to start the engine. If the engine does not crank, the interlock system is operating correctly. Correct problem if not operating properly.

3. Sit on the seat and start engine. Move Functional Control Lever to MOW. Raise off the seat. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

4. Sit on the seat and start engine. Move Functional Control Lever to TRANSPORT. Raise off the seat. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

5. Sit on the seat, engage parking brake, keep traction pedal in neutral, and place Functional Control Lever in NEUTRAL. Start the engine. Move Raise / Lower – Mow Control Lever forward to lower the cutting units. If the units do not start rotating, the interlock system is operating correctly. Correct problem if not operating properly.

6. Sit on the seat and set the parking brake. Start the engine and move the functional control lever to MOW. If the engine stops, the interlock system is operating correctly. Correct problem if not operating properly.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80ºF (26.7ºC)
Discharged: less than 1.240

Battery Specifications
BCI Group Size U1
300 Amp Cranking Performance at 0º F (-17.8º C)
28 Minute Reserve Capacity at 80ºF (26.7ºC)

Removal (Fig. 28 and 29)

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Remove wing nuts, and battery retainer.

2. Disconnect the ground cable (-) first to prevent short circuiting the battery, other components, or the operators hands. Disconnect the positive (+) cable.

3. Make sure that the filler caps are on tightly.

4. Remove battery from the battery compartment to a service area. This will minimize possible battery damage and allow better access for inspection and service.

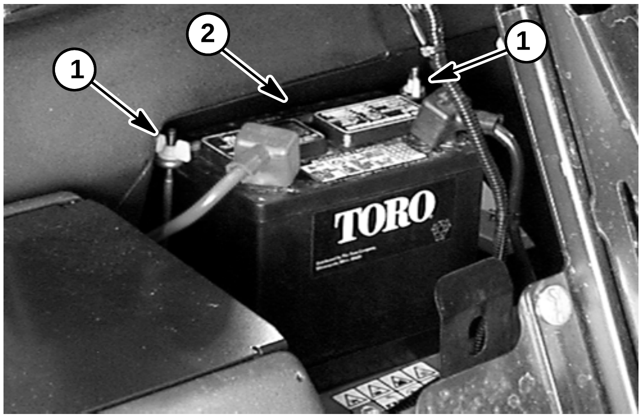


Figure 28

1. Wing nut
2. Battery retainer

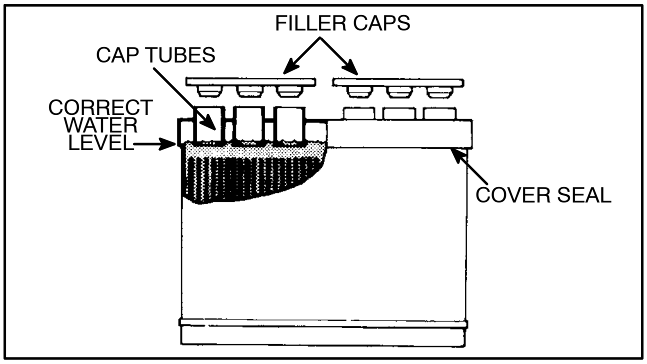


Figure 29

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

A. Check for cracks caused by overly tight or loose hold-down clamp. Replace battery if cracked and leaking.

B. Check battery terminal posts for corrosion. Use a terminal brush or steel wool to clean corrosion from the battery terminal posts.

IMPORTANT: Before cleaning the battery, tape or block the 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 the 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 to the bottom of the cap tubes. 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.

Electrical System

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
	ADD (20° above 80°F)	0.008
	Correction to 80°F	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 12.0 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 the 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 the ignition switch and all accessories are off.

2. Make sure the battery compartment is clean and repainted if necessary.

3. Make sure all battery cables and connection are in good condition and that the battery hold down clamp has been repaired or replaced.

4. Lift seat and place the battery in its compartment. Make sure battery is level and flat. Push the positive cable connector onto positive battery post. Do not hammer; this will damage the battery. Tighten bolts with two wrenches.

5. Secure battery retainer to the battery with the two wing nuts. Do not overtighten to prevent cracking or distorting the battery case (Fig. 28).

6. Apply a light coat of 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 the negative (ground) cable connector to the negative battery post.

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.

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

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

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

3. **Following the 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.

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.

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TORO

Chapter 6

Wheels and Brakes

Table of Contents

Wheels and Brakes

Specifications

Item	Description
Front tire pressure, 19 x 10.50 x 2 ply	8 to 12 PSI, (0.55 to 0.83 bar)
Rear tire pressure, 19 x 10.50 x 2 ply	8 to 15 PSI, (0.55 to 1.04 bar)
Wheel lug nut torque	70 to 90 ft-lb, (95 to 122 Nm)

Special Tools

Wheel Hub Puller – TOR4097

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

Figure 1

Service and Repairs

Rear Wheel (2WD)

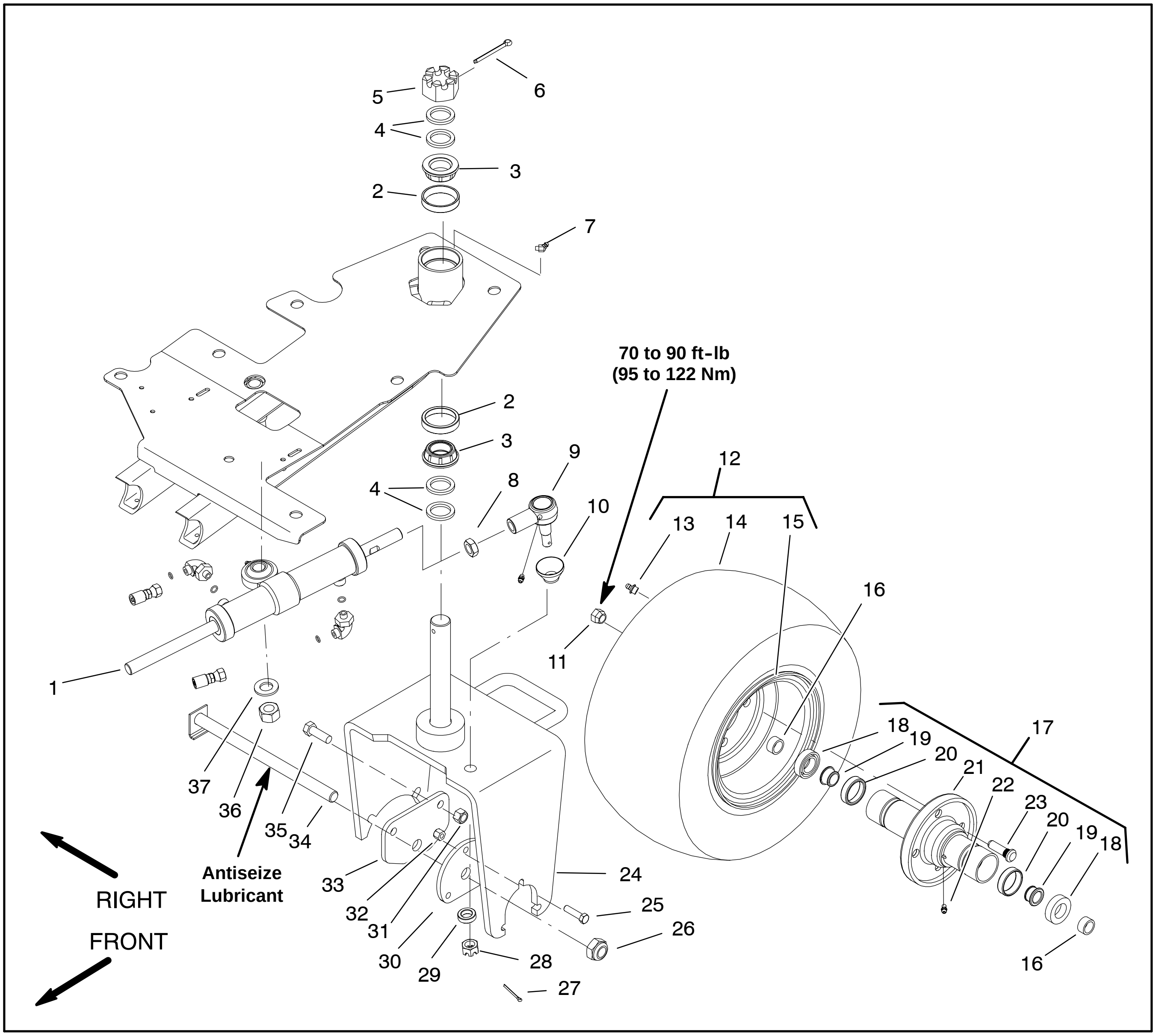


Figure 2

1. **Steering cylinder**
2. **Bearing cup**
3. **Bearing cone**
4. **Washer**
5. **Slotted hex nut**
6. **Cotter pin**
7. **Grease fitting**
8. **Jam nut**
9. **Rod end**
10. **Dust seal**
11. **Lug nut**
12. **Wheel assembly**
13. **Valve stem**
14. **Tire**
15. **Rim**
16. **Spacer**
17. **Hub assembly**
18. **Seal**
19. **Bearing cone**
20. **Bearing cup**
21. **Hub**
22. **Grease fitting**
23. **Drive stud**
24. **Castor fork**
25. **Cap screw**
26. **Lock nut**
27. **Cotter pin**
28. **Slotted hex nut**
29. **Spacer**
30. **Adapter plate**
31. **Lock nut**
32. **Lock nut**
33. **Motor adapter plate**
34. **Castor bolt**
35. **Cap screw**
36. **Lock nut**
37. **Washer**

Removal (Fig. 2)

1. Park machine on a level surface. Make sure engine is off. Set brake and block front wheels.

2. Jack up and secure the rear wheel off the ground.

Note: The wheel assembly consists of the tire (14), rim (15), and valve stem (13) with cap. The hub assembly consists of the wheel hub (21), oil seals (18), bearing cones (19), bearing cups (20), grease fitting (22), and drive studs (23).

3. Remove lock nut (26) from the castor bolt (34). Support the rear wheel assembly and pull the castor bolt from both adapter plates (30 and 33).

4. Remove the spacers (16), and the wheel and hub assemblies from the castor fork (24).

5. If damage to the castor fork bearings is suspected, remove the castor fork (24) from the frame as follows:

A. Remove cotter pin (27) and slotted hex nut (28) securing the steering cylinder rod end (9) to the castor fork.

B. Release the steering cylinder rod end from the castor fork.

C. Remove the four hex head screws and flat washers securing the fuel tank to the frame.

D. Tilt rear of fuel tank up to gain access to the top of the castor fork. Support fuel tank securely.

CAUTION

Support the castor fork while removing the slotted hex nut (5) to prevent the fork from dropping and causing personal injury.

E. Remove cotter pin (6) and slotted hex nut (5) from the castor fork shaft. Lower castor fork from the frame.

F. Clean and inspect bearing cones (3) and bearing cups (2) for damage, and replace if necessary.

6. Remove lug nuts (11) from the drive studs (23) of the wheel hub assembly (17). Separate wheel and hub assemblies.

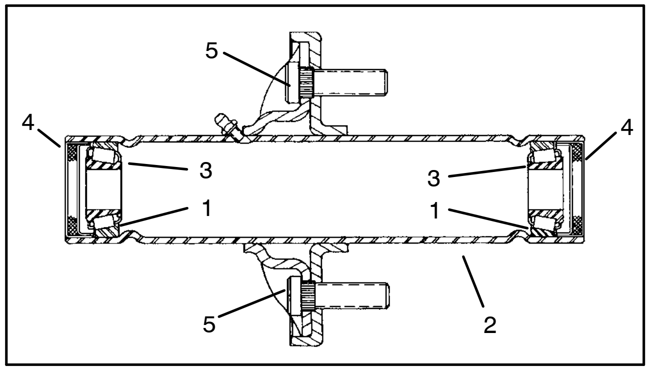


Figure 3

1. **Bearing cup**
2. **Wheel hub**
3. **Bearing cone**
4. **Shaft seal**
5. **Drive stud**

Disassembly (Fig. 2)

1. If drive studs (23) are bent or damaged, press studs from the wheel hub (21).

2. Remove oil seals (18). Clean and inspect bearing cones (19) and bearing cups (20) for damage, and replace if necessary.

Assembly (Fig. 3)

1. Pack bearing cones (19) with No. 2 multipurpose lithium base grease and Install bearing cones into the wheel hub.

2. Grease inner edge of the new shaft seals (18) with No. 2 multipurpose lithium base grease. Install new shaft seals (18) into the hub with the lip of the seals facing towards the inside.

3. If removed. press new drive stud (23) into the wheel hub (21).

Installation (Fig. 2)

1. Slide wheel assembly onto the drive studs (23). Tighten lug nuts (11) to the drive studs evenly in a cris–cross pattern to a torque of **70 to 90 ft–lb (95 to 122 Nm)**.

2. If the bearings in the castor fork pivot housing were removed, install castor fork (24) to the frame as follows:

A. Press new bearing cups (2) into the castor fork pivot housing with the thick side of the cups facing towards the inside.

B. Pack bearing cones (3) with No. 2 multipurpose lithium base grease.

C. Coat castor fork shaft with antiseize lubricant and place two steering washers (4) onto the castor fork shaft. Slide lower bearing cone onto castor fork shaft with the wide edge of the bearing against the washers.

D. Insert castor fork shaft up through the pivot housing and bearing cups.

E. Place second bearing cone on the castor fork shaft with the wide edge up. Place remaining steering washers on top of the bearing cone.

F. Install slotted hex nut (5) onto castor fork shaft until drag is felt while turning the castor fork. Back–off hex nut to align the hole in the castor fork shaft to the nearest slot. Install and secure cotter pin (6).

G. Install steering cylinder rod end (9) to the castor fork with spacer (29), slotted hex nut (28), and a new cotter pin (27).

H. Remove fuel tank support and lower tank onto frame. Apply antiseize lubricant to the threads of the four cap screws and secure fuel tank to the frame with cap screws and flat washers. Make sure the fuel hose support clamps are positioned correctly.

I. Torque cap screws from **20 to 25 ft–lb (27 to 34 Nm)**.

3. Insert spacers (16) in wheel hub assembly. Position and support wheel and hub assembly between adapter plates (30 and 33).

4. Coat castor bolt (34) with antiseize lubricant and slide castor bolt into motor adapter plate (33), right side spacer (16), wheel and hub assembly, left side spacer (16), and adapter plate (30).

5. Position bent lip of the castor bolt (34) head under the bottom edge of the motor adapter plate (33). Install and tighten locknut (26). Do not overtighten locknut, make sure the wheel rotates freely.

6. Wipe grease fittings (7 and 22) clean. Pump grease into grease fitting (22) until grease is seen exiting at both oil seals (18). Pump grease into grease fitting (7) until grease is seen exiting at both ends of the pivot housing. Wipe up excess grease.

Rear Wheel (Optional 3WD)

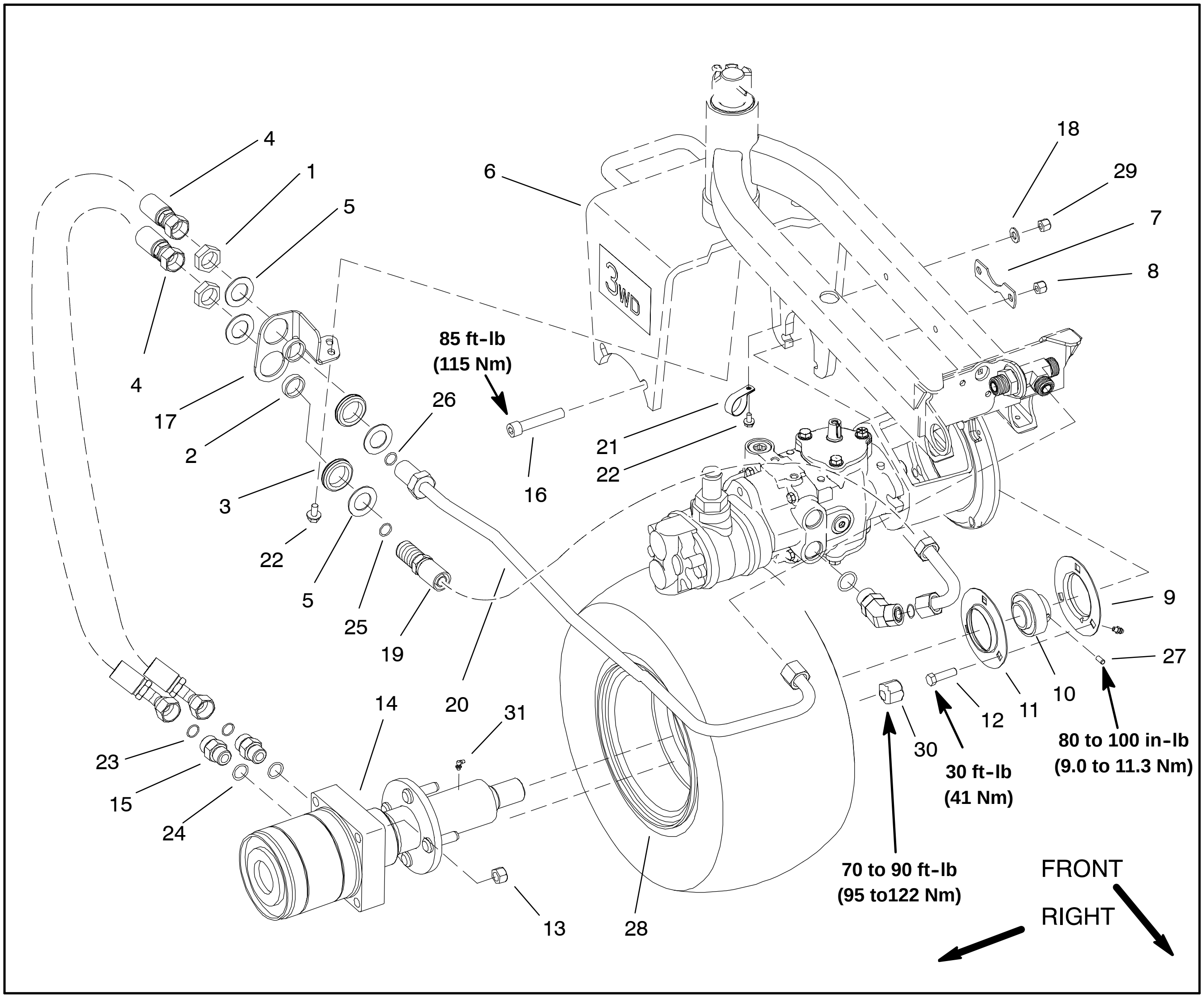


Figure 4

1. **Lock nut**
2. **Spacer**
3. **Grommet**
4. **Hose assembly**
5. **Washer**
6. **Castor fork**
7. **Bearing tab**
8. **Lock nut**
9. **Bearing flangette (lube)**
10. **Bearing**
11. **Bearing flangette**
12. **Cap screw**
13. **Lock nut**
14. **Wheel motor & hub assembly**
15. **Adapter**
16. **Cap screw**
17. **Bracket**
18. **Flat washer**
19. **Hose assembly**
20. **Tube assembly**
21. **Clamp**
22. **Cap screw**
23. **O-ring**
24. **O-ring**
25. **O-ring**
26. **O-ring**
27. **Set screw**
28. **Wheel assembly**
29. **Lock nut**
30. **Lug nut**
31. **Grease fitting**

Removal (Fig. 4)

1. Park machine on a level surface. Make sure engine is off. Set brake and block front wheels.

2. Jack up and secure the rear wheel off the ground.

CAUTION

Support wheel (28) and motor and hub assembly (14) to prevent dropping them and causing personal injury while removing cap screws (12) and socket head screws (16).

3. Remove wheel (28) and hydraulic motor and hub assembly (14) from the castor fork (6) as follows:

A. Remove cap screws (12), lock nuts (8 and 29), and flat washer (18) securing flangettes (9 and 11) and bearing tab (7).

B. Remove both socket head screws (16) and lock nuts (13) securing the hydraulic motor and hub assembly to the castor fork.

C. Lower wheel and hydraulic motor and hub assembly from the castor fork.

4. Loosen set screws (27) on bearing (10). Pull flangettes (9 and 11) and bearing from the hydraulic motor shaft.

5. Remove grease fitting (31) from the hydraulic motor and hub assembly (14). Remove four lug nuts (30) and wheel (28) from the hub drive studs.

6. If damage to the castor fork bearings is suspected, remove the castor fork (6) from the frame See Rear Wheel (2WD) Removal in this chapter of this manual for additional information.

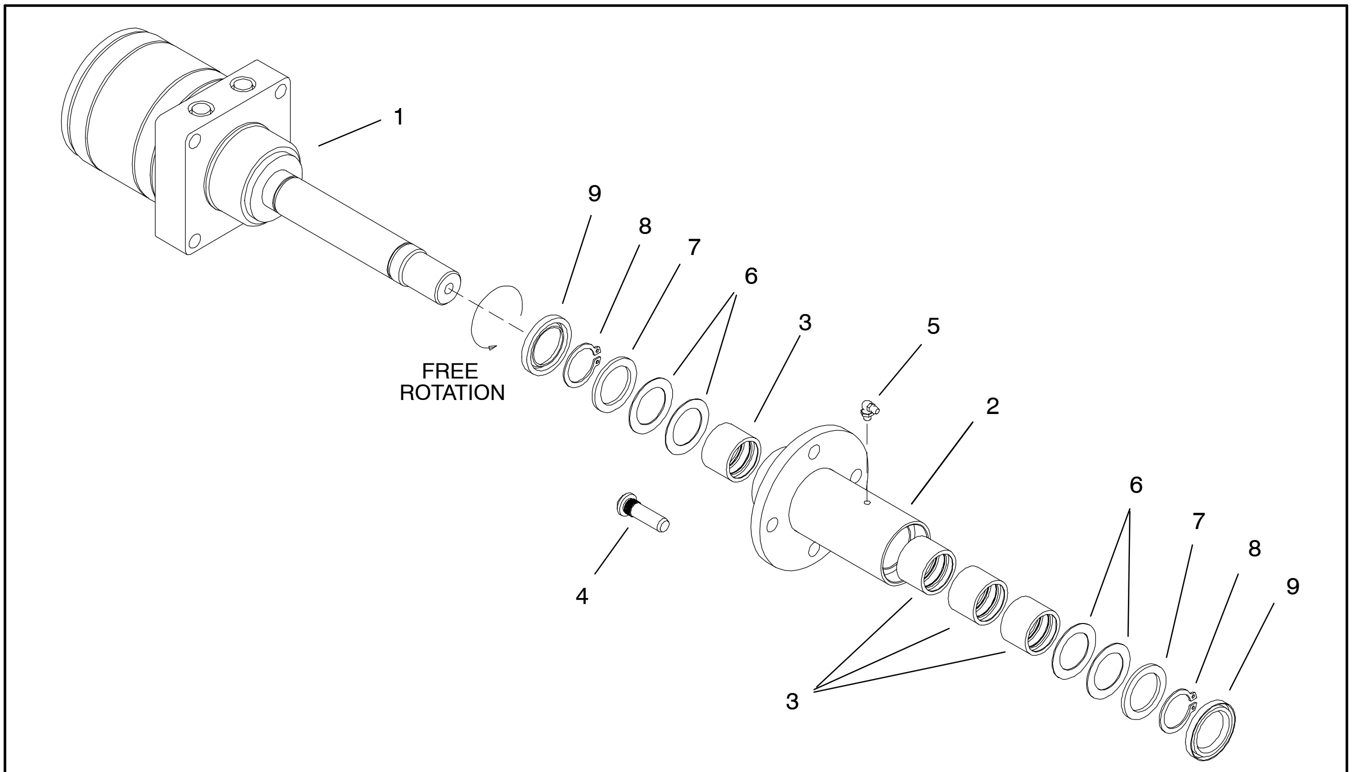


Figure 5

1. **Hydraulic motor**
2. **Hub**
3. **Clutch roller bearing**
4. **Drive stud**
5. **Grease fitting**
6. **Thrust washer**
7. **Washer**
8. **Snap ring**
9. **Grease seal**

Wheels and Brakes

Disassembly (Fig. 5)

1. Remove grease seal (9) and snap ring (18) from the long end of hub (2).

2. Remove washer (7), two thrust washers (6), and hub (2) from the hydraulic motor shaft. Remove remaining two thrust washers (6), washer (7), snap ring (8), and grease seal (9) from the shaft.

3. If drive studs (4) are bent or damaged, press studs from the wheel hub (2).

4. Press clutch roller bearings (3) from the hub (2).

Assembly (Fig. 5)

1. If drive studs (4) were removed, press new studs into the wheel hub (2).

2. Press roller clutch bearings (3) into the hub (2) as follows (Fig. 6):

Note: Arrow on the side of the clutch roller bearings (3) must point to the long side of the end of the hub (2).

A. Press two bearings into each end of the hub.

B. The outer edge of the outer bearings must be flush with the recessed edge within the hub.

C. Center bearings must not interfere with grease fitting hole.

3. Grease inner edge of the new grease seals (9) with No. 2 multipurpose lithium base grease. Slide one seal onto motor shaft past groove closest to the motor. Install snap ring (8) into groove.

4. Slide flat washer (7) and two thrust washers (6) onto the motor shaft. Slide hub (2) onto the shaft with the short side first.

5. Slide remaining thrust washers (6) and flat washer (7) onto the motor shaft. Install remaining snap ring (8) into the shaft groove. Slide remaining new grease seal (9) onto motor shaft.

IMPORTANT:The hub (2) should spin freely in the forward direction, but lock on the hydraulic motor shaft when it is spun in the reverse direction.

6. Press grease seals (9) into the hub (2) so they are flush with the end of the hub.

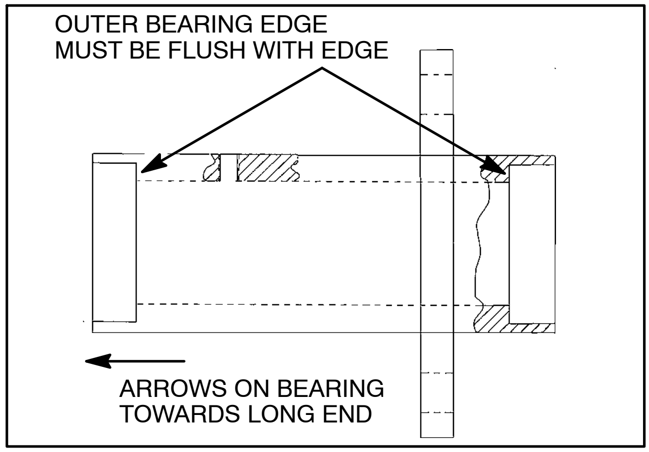


Figure 6

Installation (Fig. 4)

1. Secure wheel (28) to the four drive studs of the hydraulic motor and hub assembly (14) with four lug nuts (30). Torque nuts from **70 to 90 ft-lb (95 to 122 Nm)**.

2. Reinstall grease fitting (31) into hydraulic motor and hub assembly (14) so it points away from the wheel.

3. Install flangette (11), bearing (10), and relube flangette (9) onto the motor shaft.

4. Position hydraulic motor and hub assembly (14), flangettes (9 and 11) with bearing (10), and wheel (28) into the castor fork. Make sure hose fittings on the motor face to the rear.

5. Secure hydraulic motor and hub assembly (14) loosely to the left inside of the castor fork with both socket head screws (16) lock nuts (13).

6. Secure flangettes (9 and 11), and bearing (10) loosely to the right inside of the castor fork with cap screws (12), bearing tab (7), lock nuts (8 and 29), and flat washer (18).

A. Position flangette grease fitting facing downward.

B. Torque socket head screws (16) to **85 ft-lb (115 Nm)**.

C. Torque cap screws (12) to **30 ft-lb (41 Nm)**.

7. Apply loctite to both set screws (27). Torque set screws from **80 to 100 in-lb (9 to 11 Nm)**.

Front Wheel and Brake

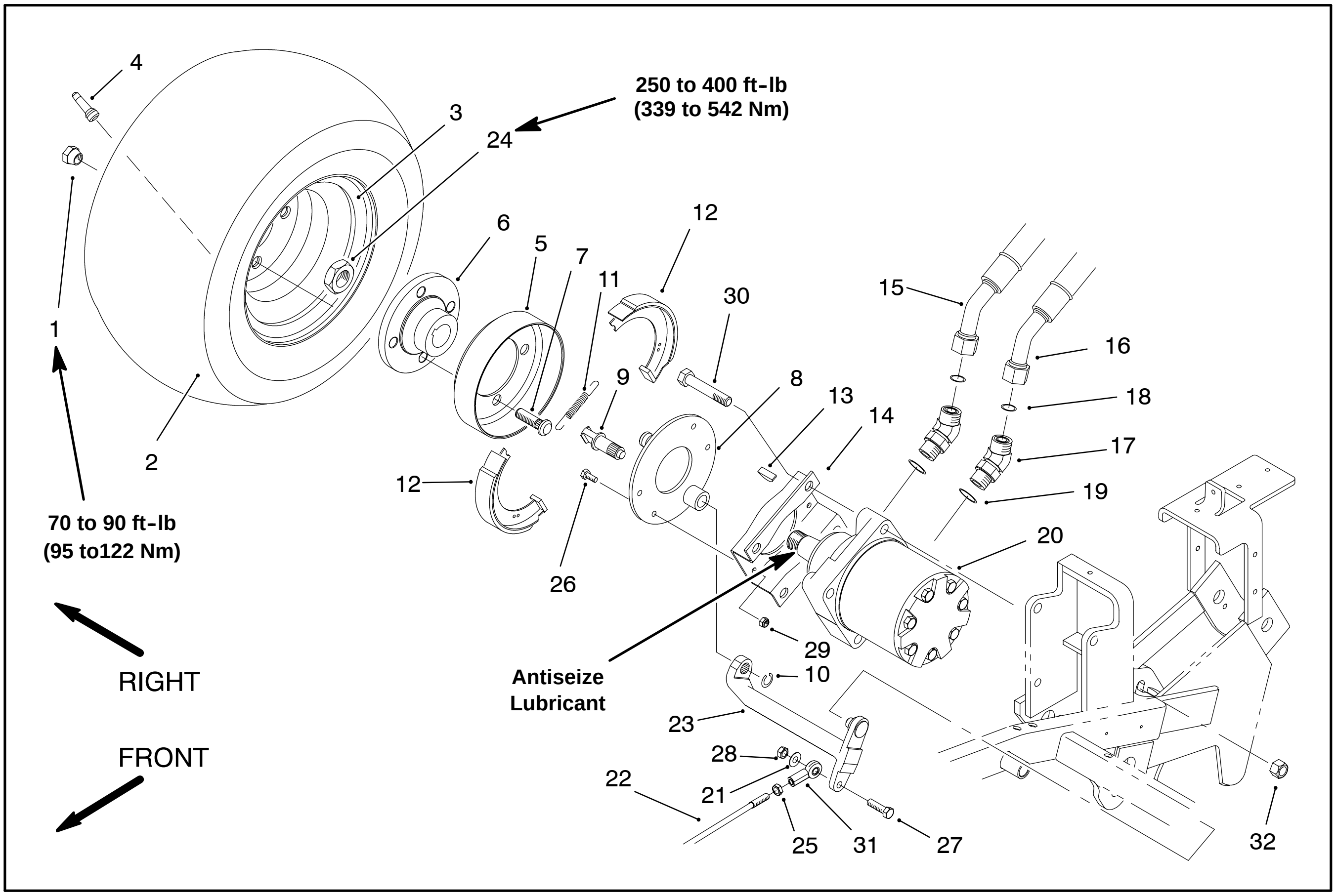


Figure 7

1. Lug nut
2. Tire
3. Rim
4. Valve stem
5. Brake drum
6. Wheel hub
7. Drive stud
8. Backing plate
9. Brake cam
10. Retaining ring
11. Return spring
12. Brake shoe
13. Woodruff key
14. Brake bracket
15. Hydraulic hose
16. Hydraulic hose
17. 45º Hydraulic fitting
18. O-ring
19. O-ring
20. Hydraulic motor
21. Flat washer
22. Brake rod
23. Brake lever
24. Lock nut
25. Jam nut
26. Cap screw
27. Cap screw
28. Lock nut
29. Lock nut
30. Cap screw
31. Swivel clevis
32. Lock nut

Wheels and Brakes

Removal (Fig. 7)

1. Park machine on a level surface. Make sure engine is off. Make sure brake is in the OFF position.

2. Block front and rear of wheels not being jacked up. Lift front wheel off the ground using a jack, and place blocks beneath the frame under the hydraulic wheel motor (20).

3. Remove lug nuts (1), tire (2) and rim (3). Loosen but do not remove lock nut (24) from hydraulic wheel motor shaft.

IMPORTANT: DO NOT hit wheel hub (6) with a hammer during removal or installation. Hammering may cause damage to the hydraulic wheel motor.

4. Use wheel hub puller (see Special Tools) to free wheel hub (6) and brake drum (5) assembly from motor shaft. Remove lock nut (24), wheel hub and brake drum assembly and key (13) from the hydraulic wheel motor shaft.

5. Remove return springs (11) from brake shoes (12). Remove brake shoes from backing plate (8).

6. Remove retaining ring (10) and brake cam (9) from the brake lever (23) and backing plate (8).

7. Remove four cap screws (26), lock nuts (29), and backing plate (8) from the brake bracket (14).

8. Parts should be clean and free of rust. Inspect brake shoe (12) and brake drum (5) contact surfaces for excessive wear. Replace any worn or damaged parts.

Installation (Fig. 7 and 8)

1. Secure backing plate (8) to the brake bracket (14) with the four hex head screws (26) and lock nuts (29).

2. Position both brake shoes (12) on the backing plate (8). Insert return springs (11) into the holes of both brake shoes (12).

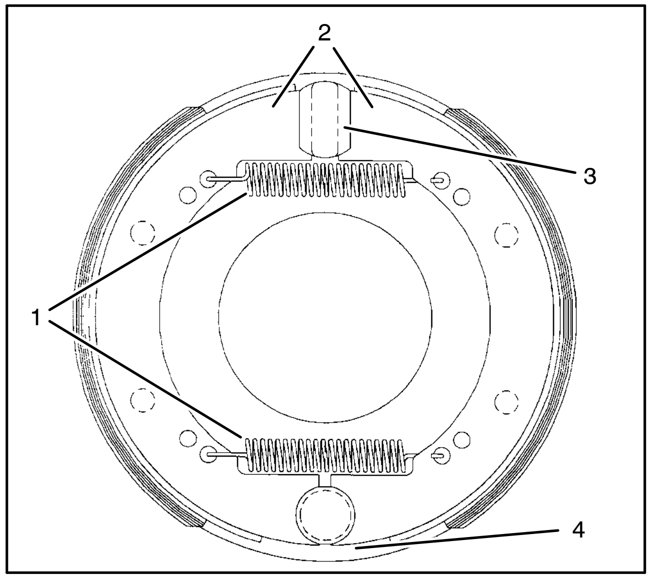


Figure 8

1. Return spring
2. Brake shoe
3. Brake cam
4. Backing plate

3. Install brake cam (9) into the backing plate (8) and brake lever (23). Secure cam to the lever with the retaining ring (10).

4. Make sure that wheel hub bore and wheel motor shaft are thoroughly cleaned. Install key (13) to the hydraulic wheel motor (20) shaft. Slide hub over shaft and key.

5. Secure wheel hub (6) to motor shaft with lock nut (24). Torque nut from **250 to 400 ft-lb (339 to 542 Nm)**.

6. Install rim (3) onto the wheel hub (6). Secure rim with lug nuts (1) to the wheel hub (7) drive studs. Tighten lug nuts evenly in a crossing pattern to a torque from **70 to 90 ft-lb (95 to 122 Nm)**.

7. Check and adjust brakes (see Brake Adjustment in the traction unit Operator’s Manual).

Chapter 7

4 Bolt Adjust Cutting Units

Table of Contents

Specifications

Height-of-Cut : 3/16 (0.1875) in. to 11/16 (0.6875) in.

Clip Frequency and Optimum Height of Cut Range:

Model No	Clip (max.)	Optimum Height of Cut Range
04408	0.25 in.	3/16 to 5/16 in.
04406	0.18 in.	1/8 to 7/32 in.

Roller Adjustment:
Front: Micrometer hand adjustment with bolted clamp lock (1 turn = 0.025 in. height of cut change).
Rear: Pivot arm change on slot in side plate with locking nuts for paralleling roller to reel and adjusting bedknife attitude.

Bedknife to Reel Adjustment: Bedknife adjusts against reel with opposed screw adjustment on each end of bedbar.

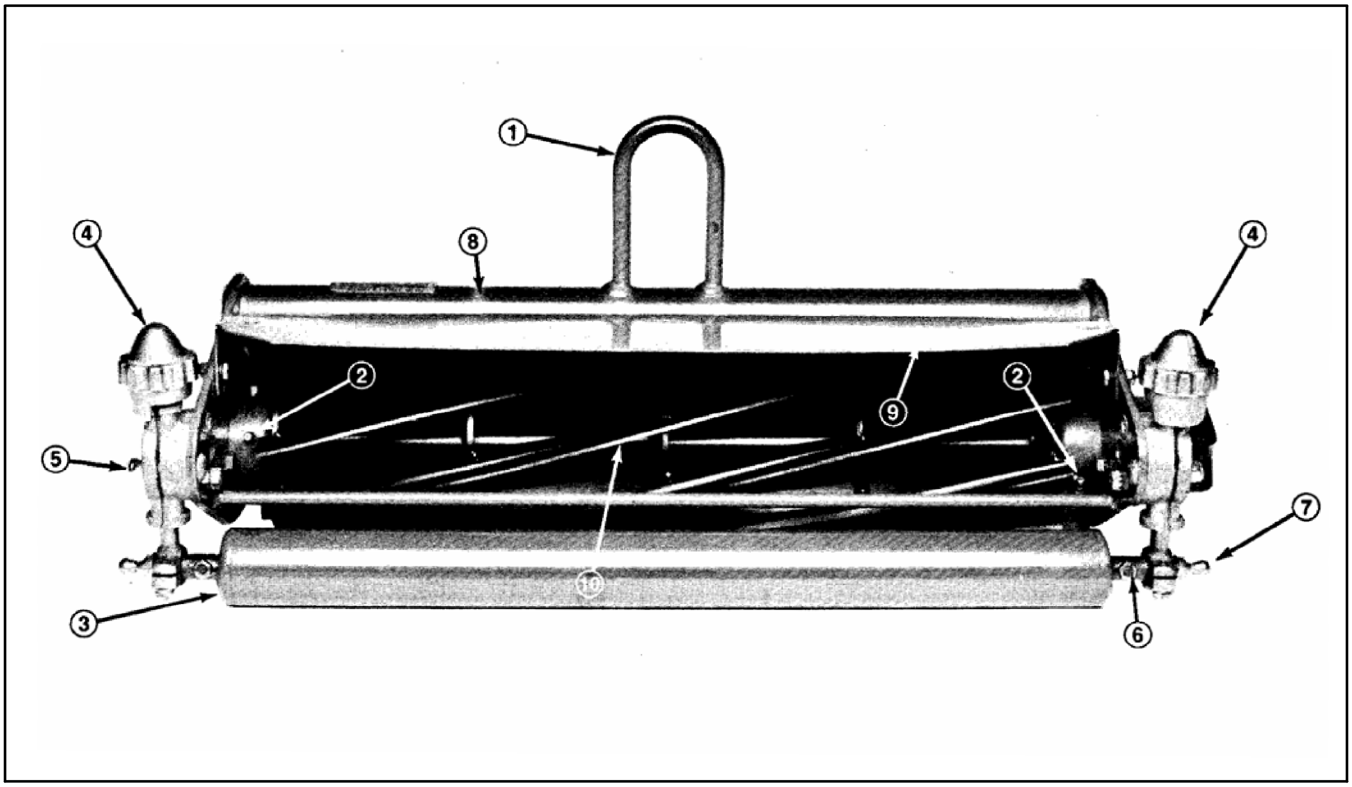
Reel Speed: 1940 rpm (engine speed 2800 rpm).

Bedknife Screw Torque: 200 to 250 in-lb.

Reel Splined Drive Nut Torque: 40 to 60 ft-lbs.

Reel Bearing Rolling Torque: 7 in-lb. max.

Front or Rear Roller Run-Out: 0.014 in. max.



1. **Lift bail**
2. **Grease fittings - reel bearings**
3. **Grease fittings - roller**
4. **Height of cut adjustment knob (2)**
5. **Height of cut adjustment locknut**
6. **Scraper adjusting nut (4)**
7. **Pull rod studs (2)**
8. **Grass shield**
9. **Adjustable grass shield bar**
10. **Reel**

Special Tools

NOTE: Order special tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*. Some tools may be listed in the Greensmaster 3000 or 3000-D Parts Catalog. Some tools may also be available from a local supplier.

Roller Bearing Replacement Tool

Puller is used to remove bearings from front and rear rollers. Driving tubes are used to install bearings into rollers. Refer to instructions supplied with tool. Used on swaged, full and wiehle rollers.

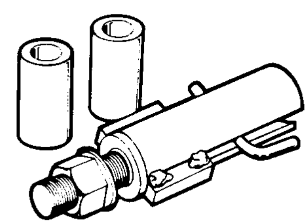


Figure 1

Plastic Plug

Insert plug in cutting unit bearing housing in place of reel motor when sharpening or grinding the reel.

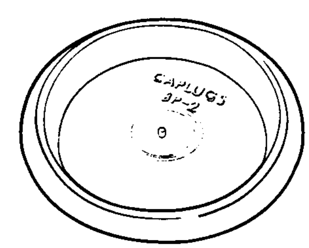


Figure 2

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel assembly.

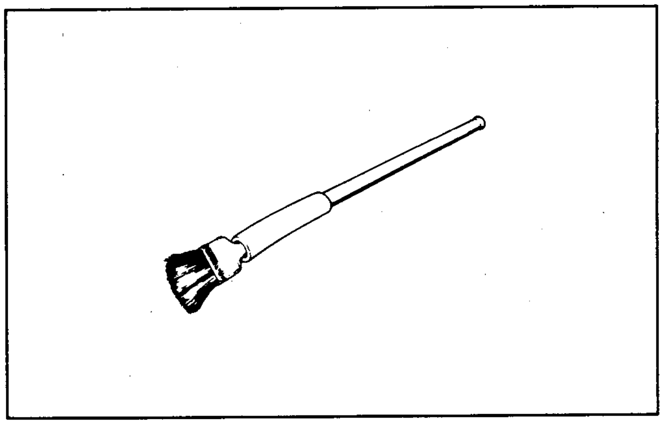


Figure 3

Bedknife Screw Tool

Fits Toro bedknife attaching screws. Use with torque wrench to secure bedknife to bedbar. With clean bedbar threads and new screws, tighten to a torque of 200 in-lb.

NOTE: Remove all rust, scale and corrosion from bedbar surface before installing bedknife.

DO NOT use an air impact wrench with this tool.

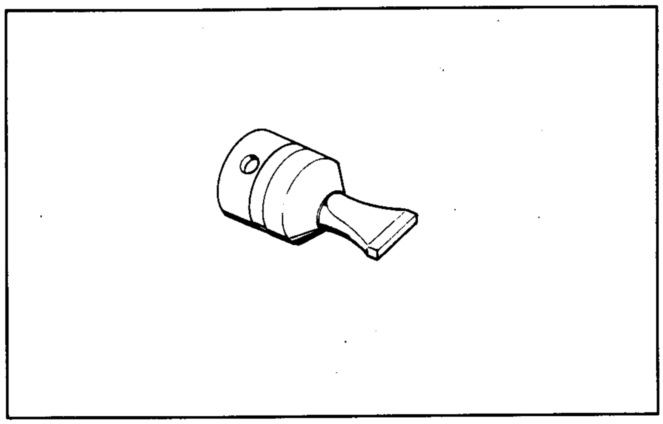


Figure 4

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. See the Adjustments and Repairs sections for detailed adjustment and repair information.

Factors Affecting Quality of Cut

Factor	Possible Problem/Correction
1. Tire pressure.	Check tire pressure adjust to specification if necessary. Must be equal in two front tires.
2. Engine governed speed.	Check maximum governed engine speed. Adjust to specification if necessary - affects reel speed.
3. Reel bearing condition/adjustment.	Check and adjust to specification. Replace bearings if worn or damaged. Bearing cones must be installed square to bearing housing - make sure there is no "flash", paint or other foreign material in housing before installing new bearing cone.
4. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded edge cannot be corrected by tightening bedknife to reel contact. Grind reel to remove taper (cone shape) and/or rifling (grooved or ribbed 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 after installing on bedbar to match bedknife to bedbar.
5. Bedknife to reel contact.	Reel must have light contact all across bedknife. No contact will dull the cutting edges. Excessive contact accelerates wear; quality of cut may be adversely affected. Adjust, backlap or grind if necessary.
6. Bedknife attitude.	Adjust rear roller brackets to proper location in slots of side plate. (See Leveling Rear Roller to Reel in the Adjustments section.)
7. Rear roller parallel to reel.	Check and adjust as necessary to avoid mismatch between cutting units.
8. Height of cut.	All cutting units set at same height of cut. Set with front roller – must be equal at both ends of roller. Bench set height of cut and actual (effective) height of cut are different. Effective height of cut depends on cutting unit weight, cutting unit accessories and turf conditions.
9. Proper bedknife for height of cut.	If bedknife is too thick for effective height of cut, poor quality of cut will result.
10. Front roller scraper and comb Adjustment.	Set scraper 1/32 in. clearance from roller. Set comb the same on all cutting units for height of cut and turf conditions. Must be same height at both ends of comb.

Factor	Possible Problem/Correction
11. Stability of bedbar.	Make sure bed bar pivot bolts are securely seated (maximum 40 ft-lb.) Make sure opposing bedknife adjustment screws are tight. To prevent distortion of the adjustment screw mounting plate and bedbar breakage, do not over-tighten the screws.
12. Number of reel blades.	Use cutting unit model with correct number of blades for clip frequency and optimum height of cut range. (Variable speed traction kit can be used to adjust clip frequency.)
13. Cutting unit alignment and pull frame ground following.	Check pull frame alignment on all cutting units. Adjust or repair as necessary. Check lift arms, pull frames for binding, bushing wear or damage. Repair if necessary.
14. Roller condition	All rollers must rotate freely. Grease when needed or repair bearings if necessary.
15. Reel speed.	All reels must rotate at same speed (within 100 rpm). All cutting units must have equal bedknife to reel contact and reel bearing adjustment before checking. Do not run the reel to long or it may get hot and rifle when no grass is being cut. See Troubleshooting in Chapter 5 - Hydraulic System.
16. Traction speed.	Check maximum governed engine speed. Adjust to specification if necessary. See Troubleshooting in Chapter 5 - Hydraulic System Install Variable Speed Traction Kit if necessary to control traction speed in varying conditions or with different attachments. Will allow change in traction speed while maintaining full engine rpm and reel motor rpm.
17. Cutting drop speed and sequence.	Center cutting unit must drop after front cutting unit. (See Troubleshooting in Chapter 5 - Hydraulic System.

Set Up and Adjustments

Adjustment Summary and Check List

DETAILED ADJUSTMENT INSTRUCTIONS FOLLOW THIS SUMMARY AND CHECK LIST. Study this information and refer to it often to get maximum life and performance from the cutting units.

Daily Performance Checks

NOTE: It is not necessary to remove the cutting units from the traction unit to perform these daily checks. It is recommended that mowers be washed after each use. Always remove key from ignition switch when working on the machine.

1. Purge all water and debris from all of the bearings by greasing them. Use No. 2 multi-purpose lithium base grease.

2. Visually check for sharp reel and bedknife.

- Remove burrs, nicks, and rounded edges.

3. Lower cutting units to the ground (setting on both rollers). Remove reel motor and rotate the reel backwards by hand. Light contact between the bedknife and reel should be felt and heard.

- It should be possible to pinch newspaper when inserted form the front and cut paper when inserted at a right angle (along entire length of bedknife).
- It should be possible to cut paper with minimum bedknife to reel contact. Should excessive reel drag be evident you must back lap or grind the cutting unit.
- No contact will dull the cutting edges.
- Excessive contact accelerates wear, and quality of cut may be adversely affected.

Weekly Checks

1. Check reel bearing adjustment and bearing condition.

2. Make sure bed bar pivot bolts are securely seated (maximum 40 ft-lb.).

3. Using a gauge bar, verify correct height of cut setting and adjust as necessary.

Monthly Adjustments

NOTE: Remove cutting unit from traction unit before doing these checks and adjustments (See Cutting Unit Removal and Installation in the Repairs section of this chapter.)

1. Visually check for sharp reel and bedknife. Backlap or grind reel and bedknife if necessary.

2. Adjust rear roller for proper bedknife angle and parallel to reel.

3. Adjust front roller scraper to be 1/32 in. from roller.

4. Set comb or brush adjustment for desired action on grass.

- Light, medium, or aggressive setting.

5. Check grass shield adjustment.

- 4-3/4 in. from crossbar - normal.
- Dry grass - lower shield.
- Wet grass - raise shield.

6. Set top bar (cut-off bar) adjustment.

- 0.060 in. from reel - normal.

7. Lower cutting units to the ground (setting on both rollers), remove reel motor and adjust bedknife to reel contact.

8. Using a gauge bar, set the height of cut adjustment.

Special Notes

1. A "rifled" reel and/or bedknife must be corrected by grinding.

2. If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft *spline nut* to a torque of 40 to 60 ft-lb, then adjust reel bearings.

Reel Bearing Service and Adjustment

1. Adjust the bedknife so it is not in contact with the reel.

2. Reel bearing drag should not exceed 7 in-lb. This can be measured with a torque wrench (Fig. 5). If bearing drag does not meet above specification, adjust the reel bearings.

NOTE: If you do not have an inch-pound torque wrench, do steps 1 - 3 under Reel Bearing Adjustment below.

Reel Bearing Adjustment

1. Remove the mounting nuts from the counterbalance end cap and remove end cap from the mounting studs (Fig. 6).

2. Remove bolt mounted on the end of reel shaft. This will make it possible for a large socket wrench to be mounted on the reel bearing adjusting nut inside the side plate.

CAUTION

Do not use your hand to prevent reel from turning while servicing; this can result in personal injury. Use a 1/2 in. thick x 3 in. wide x 8 in. long piece of hardwood inserted into front of cutting unit between reel blades.

NOTE: If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft spline nut on right hand end of reel shaft to a torque of 40 to 60 ft-lb, then adjust reel bearings.

3. Loosen large reel bearing adjustment nut (Fig. 7). Tighten nut until all reel shaft end play is removed, then tighten an additional 1/16 to 1/8 turn. Be certain to remove all end play, but do not overtighten.

NOTE: Adjustment nut must have enough resistance against reel shaft threads to retain bearing adjustment. Replace adjustment nut if necessary.

4. Install bolt into end of reel shaft and check rolling torque with an inch-pound torque wrench (Fig. 7). Reel bearing rolling torque should not exceed 7 in-lb. Repeat setps 2 and 3 if necessary.

5. If bearings require replacement, see Reel Removal and Bearing Replacement in the Repairs section of this chapter.

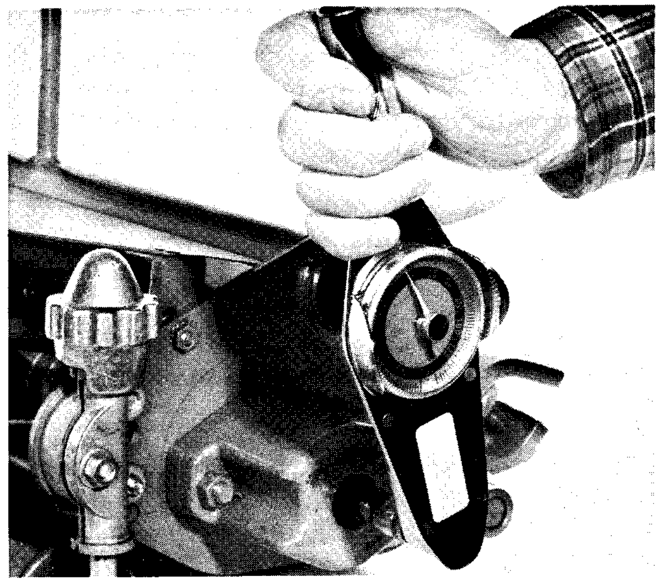


Figure 5

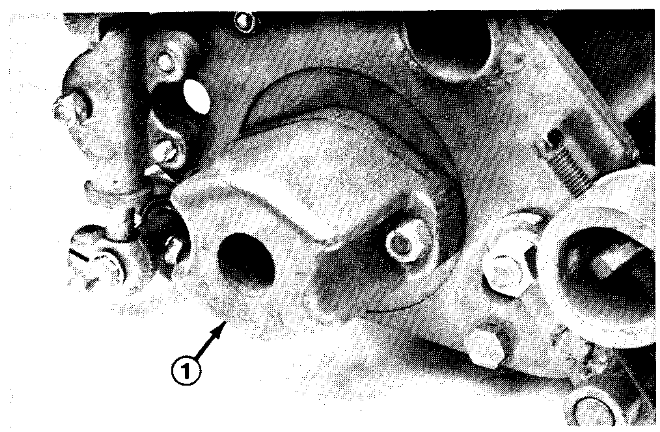


Figure 6

1. Counterbalance end cap

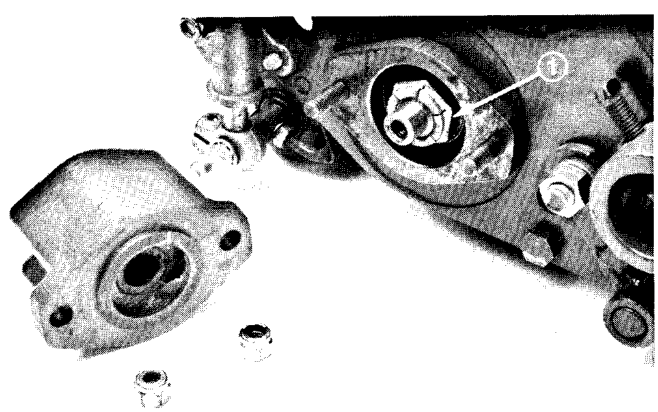


Figure 7

1. Reel bearing adjustment nut

Bedknife To Reel Adjustment

IMPORTANT: For adjusting bedknife to reel, use a 3/8 in. open end wrench that is 3 to 6 in. in length. A longer wrench will provide too much leverage and may cause distortion of the adjustment screw mounting plate or bedbar breakage.

1. To move bedbar closer to reel blades, loosen bottom screw on each side of cutting unit (Fig. 8), then tighten top adjustment screw on each side of cutting unit (Fig. 9). To move bedknife away from reel blades, loosen top screw on each side of cutting unit (Fig. 8), then tighten bottom adjustment screw on each side of cutting unit (Fig. 9).

2. After adjusting bedknife to reel, make sure that both the top and the bottom adjustment screws are secured at both ends of cutting unit (Fig. 8, 9).

3. After adjustment, check to see if reel can pinch paper when inserted from the front, and cut paper when inserted at a right angle (Fig. 10). It should be possible to cut paper with minimum contact between the bedknife and reel blades.

IMPORTANT: If excessive bedknife to reel contact is maintained, bedknife and reel wear will be accelerated. Uneven wear can result, and quality of cut may be adversely affected.

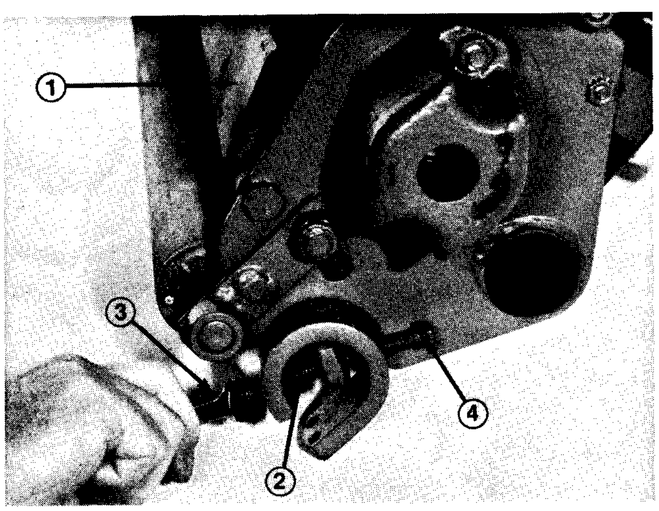


Figure 8

1. Bedknife
2. Bottom adjustment screw
3. 3/8 inch wrench
4. Top adjustment screw

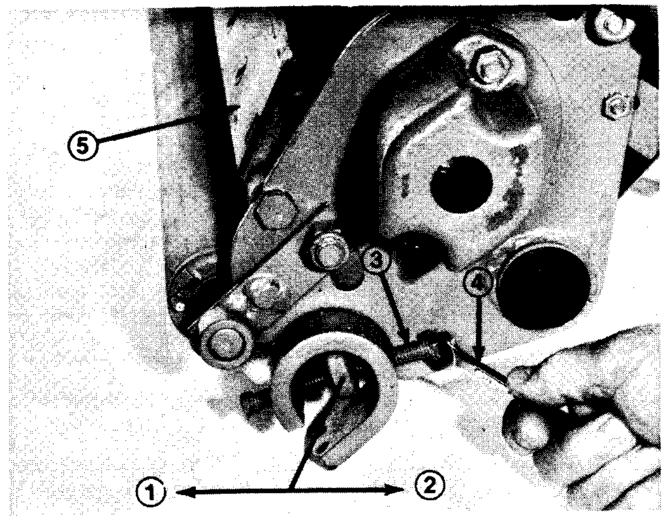


Figure 9

1. Bedknife closer to reel
2. Bedknife further from reel
3. Top adjustment screw
4. 3/8 inch wrench
5. Bedknife

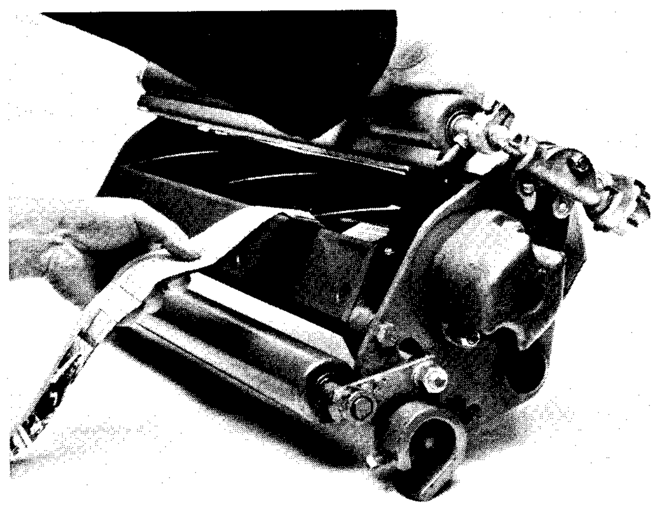


Figure 10

Leveling Rear Roller To Reel

1. Loosen rear roller brackets. Adjust one bracket and tighten the nut on the capscrew. See the table below for the proper adjustment. Leave bracket on the other side mounted loosely (Fig. 11).

Height of Cut	Distance from bottom of rear roller bracket (not bolt) to bottom of slot
1/8 (0.125) in. or below	1/16 (0.0625) in.
5/32 (0.156) to 1/8 (0.125) in.	1/8 (0.125) in.
1/4 (0.25) in. or above	center bracket in slot

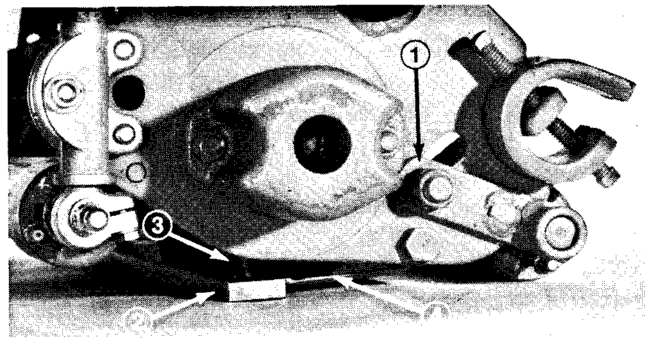


Figure 11

1. Rear roller bracket
2. 1/4 inch (6 mm) steel plate
3. Reel blades
4. Bedknife

NOTE: Position of rear roller bracket determines bedknife angle. Recommendations for rear roller bracket position in above chart are designed to give the best rear roller position (and bedknife angle) for different heights of cut.

IMPORTANT: Rear roller bracket position must be identical on all three (3) cutting units so bedknifes are at the same angle. If bedknifes are not at the same angle there will be a difference in the appearance of the cut grass (mismatch) for each cutting unit.

2. Place a 1/4 inch (6 mm) or thicker plate under the reel blades and against the cutting edge of the bedknife (Fig. 11).

NOTE: Be sure the plate covers the full length of reel blades.

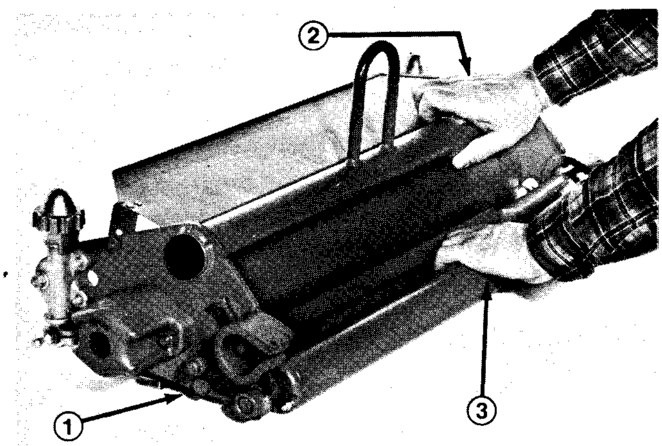


Figure 12

1. Unit on level surface
2. Hold unit securely
3. Push down on roller

3. With cutting unit reel blades positioned on the plate, hold cutting unit securely and push down on the rear roller assembly until it contacts the working surface across the full length of the roller (Fig. 12).

4. Tighten nut on rear roller bracket that was not tightened in step 1 to secure roller in place.

Height Of Cut

Height of cut, as measured in the turf and on the cutting unit is different. The grass prevents the cutting unit from settling all the way to the ground line as the machine moves across the turf. Because of this, the actual (effective) height of cut is higher than the bench set height of cut.

Machine conditions, such as cutting unit weight, roller type, bedknife thickness, speed of travel and clip, influence effective height of cut. Turf conditions, such as grass type, grass density, and amount of thatch also influence effective height of cut.

Changing the machine (such as adding a wiehle roller) will increase penetration into the turf and lower the effective height of cut. Changing from a heavier single point adjust cutting unit to a lighter 4-bolt adjust cutting unit will reduce penetration into the turf and raise the effective height of cut.

Height of Cut Adjustment

IMPORTANT: Lower heights of cut are limited by thickness of bedknife. Select proper bedknife for desired height of cut. If bedknife is too thick for height of cut, poor quality of cut will result and excessive pressure from turf on bottom of bedknife can cause "rifling" of bedknife and reel.

1. To adjust height of cut, cutting unit should be turned over and the locknuts on each end of the cutting unit securing the height of cut adjusting knob loosened (Fig. 13).

2. On gauge bar (Part No. 1-8789), set head of screw to desired height of cut. This measurement is from bar face to underside of screw head.

3. Put the bar across the front and rear rollers and adjust the height of cut knob until the underside of the screw head engages the bedknife cutting edge (Fig. 10).

IMPORTANT: Do step 3 on each end of the bedknife. Tighten height of cut adjustment locknuts on both ends.

Changing To A Different Type of Cutting Unit or Adding Cutting Unit Accessories

When changing to a different type of cutting unit or adding cutting unit accessories, it is recommended that you change only one cutting unit, and keep the other two existing cutting units on the machine.

1. Set the new cutting unit to a height of cut approximately 1/16 (0.06) in. higher than the old cutting unit.

2. Do a mowing test and compare results between the new cutting unit and old cutting units.

3. Adjust the new cutting unit to match the cut of the old cutting units.

4. The other two cutting units can now be replaced. Adjust these two new cutting units so they are the same as the other new cutting unit that was tested.

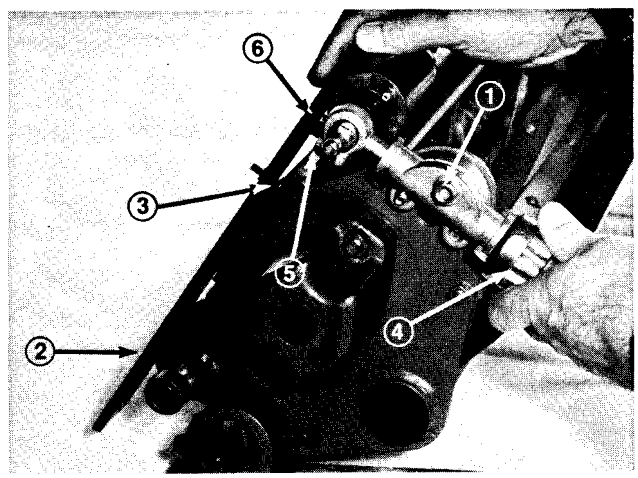


Figure 13

1. Height of cut knob locknut
2. Gauge bar (1-8789)
3. Gauge bar screwhead
4. Height of cut knob
5. Roller shaft clamp bolt
6. Comb assembly

Front Roller Scraper Adjustment

The front roller scraper should be adjusted so there is a clearance of approximately 1/32 of an inch between the scraper and roller (Fig. 14).

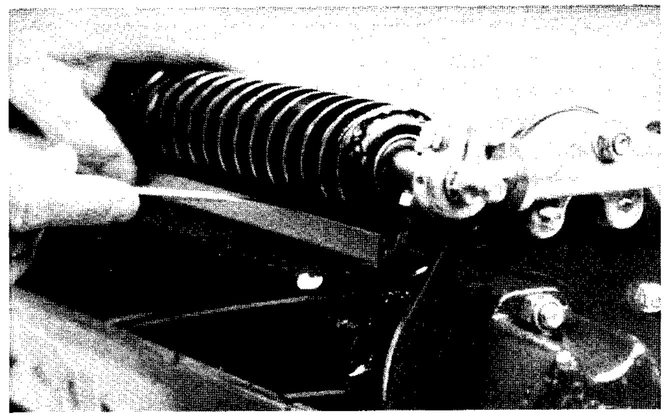


Figure 14

Comb Adjustment

1. Make sure rear roller is in the desired height of cut position. Loosen the bolts anchoring the front roller shaft (Fig. 15). Rotate the shaft.

2. To adjust the aggressiveness of the comb teeth (Fig. 15), proceed as follows:

A. Teeth touching the adjusting gauge bar gives an **aggressive** setting.

B. Adjustment of the comb assembly so it is midway between the adjusting gauge bar and the cutting edge of the bedknife gives a **medium** setting.

C. Adjusting the comb assembly so it is even with the cutting edge of the bedknife gives a **light** setting.

NOTE: Securing one end of the comb assembly at a time simplifies the above procedure.

3. Tighten the roller shaft bolts.

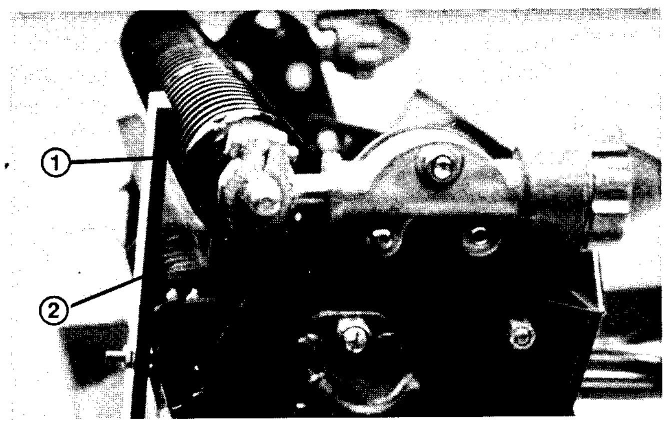


Figure 15

1. Roller shaft clamp bolt **2. Comb teeth**

Shield Height Adjustment

Adjust shield to get proper grass clipping discharge into basket:

1. Set cutting unit in normal cutting position and measure distance from top of front crossbar to shield at each end of cutting unit (Fig. 16).

2. Height of shield from crossbar for normal cutting conditions should be 4 3⁄4 inches. Loosen cap-screws and nuts securing shield to each side-plate, adjust shield to correct height and tighten fasteners (Fig. 16).

3. Repeat adjustment on remaining cutting units and adjust top bar. (See Top Bar Adjustment in this section of the book.)

NOTE: Shield can be lowered in dry grass conditions (clippings fly over top of baskets) or raised to allow for heavy wet grass conditions (clippings build up on rear edge of basket.

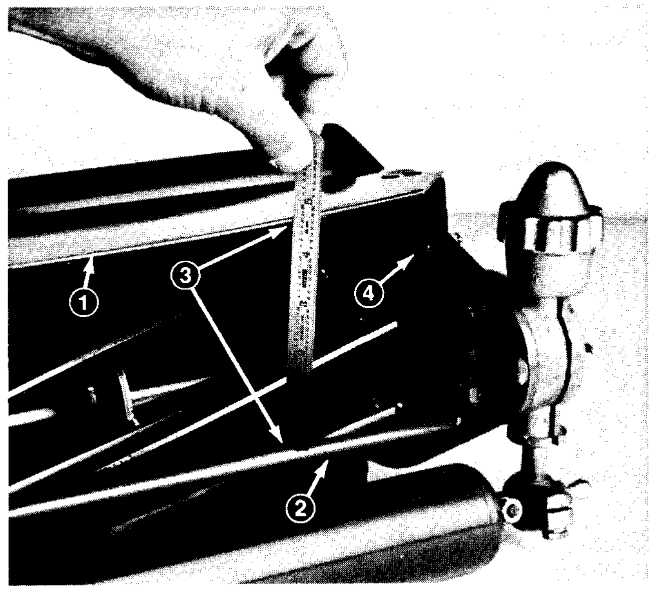


Figure 16

1. Shield
2. Front crossbar
3. 4-3/4 inches (12.1 cm)
4. Shield fasteners

Top (Cut Off) Bar Adjustment

Adjust top bar to make sure clippings are cleanly discharged from reel area:

1. Loosen screws securing top bar (Fig. 17). Insert 0.060 inch feeler gauge between top of reel and bar and tighten screws (Fig. 17). Make sure bar and reel are equal distance apart across complete reel.

2. Repeat settings on remaining cutting units.

NOTE: Bar is adjustable to compensate for changes in turf conditions. Bar should be adjusted closer to reel when turf is extremely wet. By contrast, adjust bar further away from reel when turf conditions are dry. Bar should be parallel to reel for optimum performance and should be adjusted whenever shield height is adjusted or whenever reel is sharpened on a reel grinder.

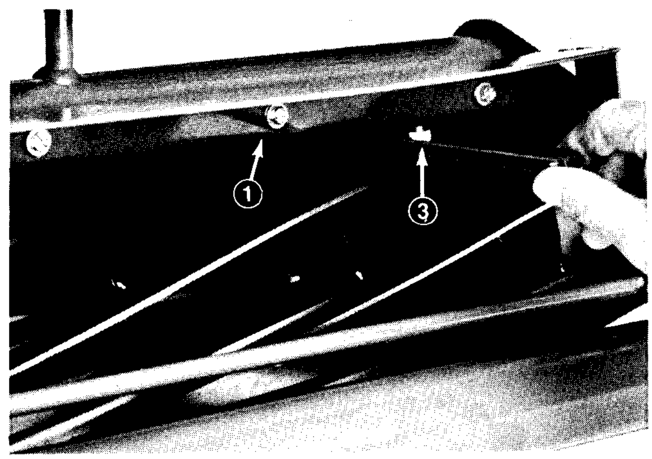


Figure 17

1. Top bar
2. Bar mounting screws
3. Feeler gauge

Pull Frame Adjustment

1. Put the basket on the pull frame.

2. Level baskets to cutting unit by loosening nut at one end of pull frame roller. Loosen bolt and move roller shaft in slot as necessary. Tighten bolt.

3. Loosen the jam nuts on the pull arms and adjust the ball sockets until there is 1/4 in. to 1/2 in. (6 to 13 mm) clearance between the lip of the basket and the reel blades (Fig. 18a). This prevents grass clippings from dropping on the ground.

4. Make sure the basket lips are the same distance from the reel blades at both ends of the reel. If the basket is too close to the reel, it is possible for the reel to contact the basket at the instant the cutting unit is raised off the ground.

5. Make sure each of the three (3) cutting units track straight with the traction unit:

A. On a smooth, level surface, draw a straight line on the floor (Fig. 18b). Push traction unit forward (removing slack from pull arms) so center of each front wheel is on top of the line. Use a plumb bob or square to make sure each wheel is centered on the line.

B. Measure from each end of cutting unit front roller to chalk line. Distance from each end of roller to line must be equal within 3/16 (0.187) in.

C. Loosen jam nuts on pull arms and adjust ball sockets so distance from each end of roller to line is within 3/16 (0.187) in.

NOTE: If a cutting unit cannot be adjusted to track correctly with the traction unit, the pull frame, or lift arm is damaged and/or the lift arm and pull frame bushings are worn and must be replaced.

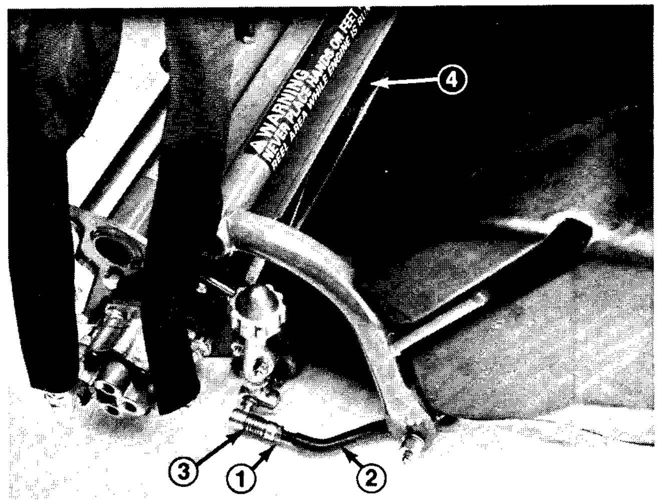


Figure 18a

1. Jam nut
2. Pull arm
3. Ball joint - adjust for clearance
4. 1/4 - 1/2 in. (6 - 13 mm) clearance

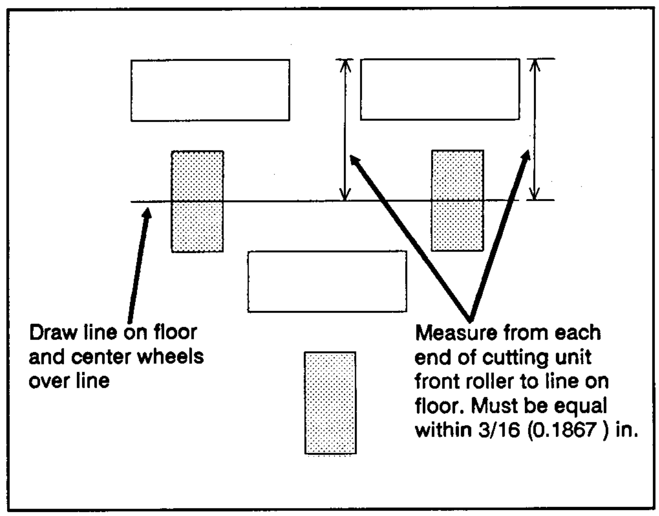


Figure 18b

Cutting Unit Removal and Installation

Remove cutting unit from traction unit before doing adjustments or repairs.

1. Remove basket from pull frame.

2. Loosen reel motor mounting nuts (Fig. 19). Rotate the motor clockwise so motor flanges clear studs and pull motor off of cutting unit.

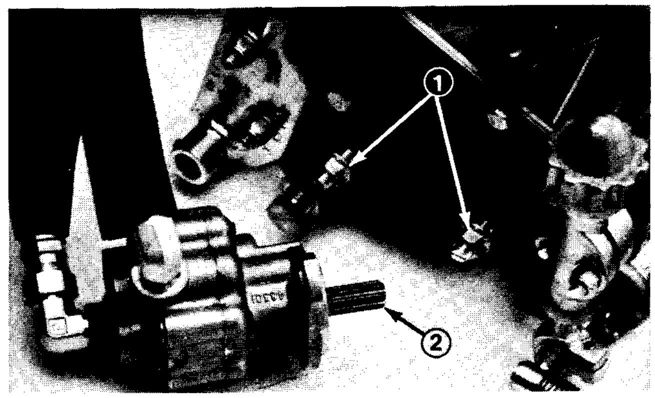


Figure 19

1. Motor mount nuts
2. Motor shaft

3. Slide the sleeve back on the ball joint and disconnect the pull arm from each side of the cutting unit (Fig. 20).

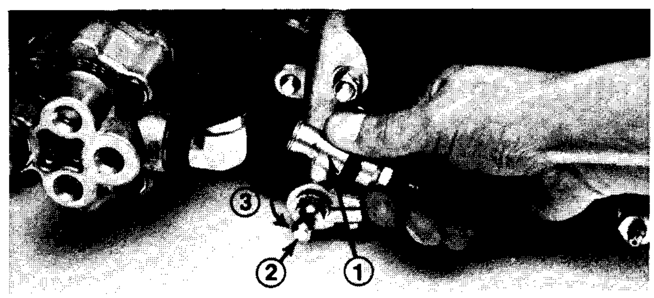


Figure 20

1. Slide back to mount
2. Ball stud
3. Swing up to remove, down to install

4. Slide cutting unit out from under pull frame, disengaging the lift arm from the lift bail (Fig. 21).

5. Reverse steps 1 - 4 to install the cutting unit.

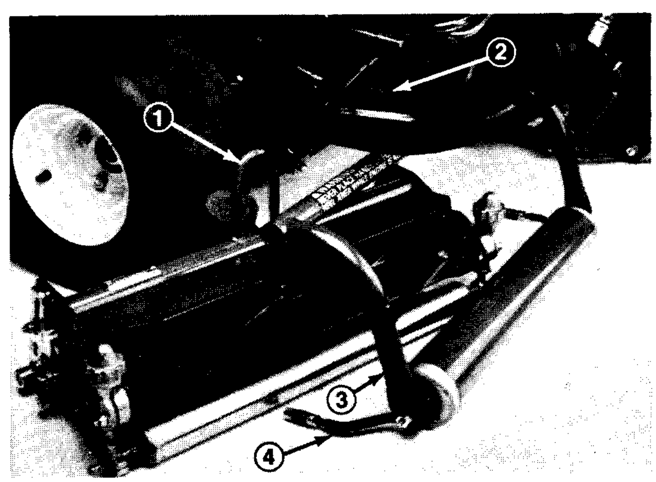


Figure 21

1. Lift bail
2. Lift arm
3. Pull frame
4. Pull arm

Reel Lapping

Check reel bearing adjustment and correct if necessary before backlapping. Connect a lapping machine to the cutting unit with an extension coupler, and a 9/16 socket. The 9/16 socket can be positioned onto the capscrew on the reel shaft inside the counter-balance weight on the end of the cutting unit (Fig. 22). Backlap according to procedures in the Toro publication "Sharpening Reel & Rotary Mowers, Form No. 80-300-PT.

NOTE: For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

CAUTION

Be careful when lapping the reel because contact with the reel or other moving parts can result in personal injury.

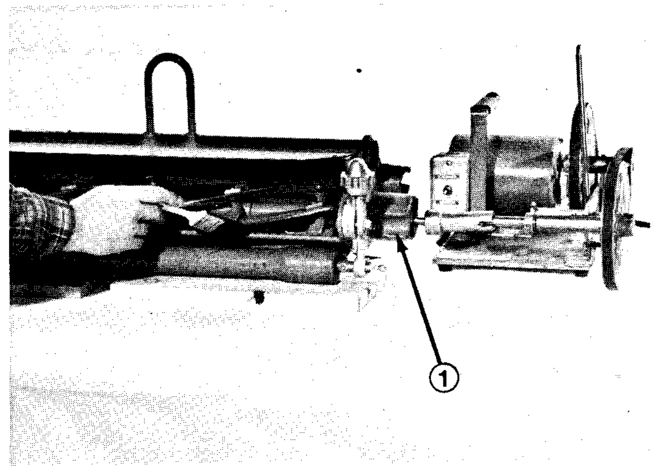


Figure 22

1. Counterbalance weight

Bedbar Removal and Installation

1. Remove rear roller assembly.

2. Remove capscrew and nut anchoring the rear roller height-of-cut bracket to the side plate on both ends of the cutting unit (Fig. 23).

3. Loosen allen set screws securing the roller shaft (Fig. 23).

4. Remove the rear roller height-of-cut brackets from both side plates.

5. Remove the bedbar mounting bolts from each end of the cutting unit (Fig. 23). Then loosen the bedknife adjusting screws at each end of the cutting unit (Fig. 23). The bedknife assembly can then be removed by rotating it away from the reel.

IMPORTANT: When installing the bedbar assembly, be sure to position the center portion of the grass shield over the rear edge of the bedbar (Fig. 24). Securely seat the (2) bedbar pivot bolts to a maximum torque of 40 ft-lbs. Always check reel bearing adjustment after installing bedbar.

NOTE: For proper grinding of bedknife follow procedures in the Toro publication "Sharpening Reel & Rotary Mowers", Form No. 80-300-PT.

6. Reverse steps 1 - 5 to install the bedbar.

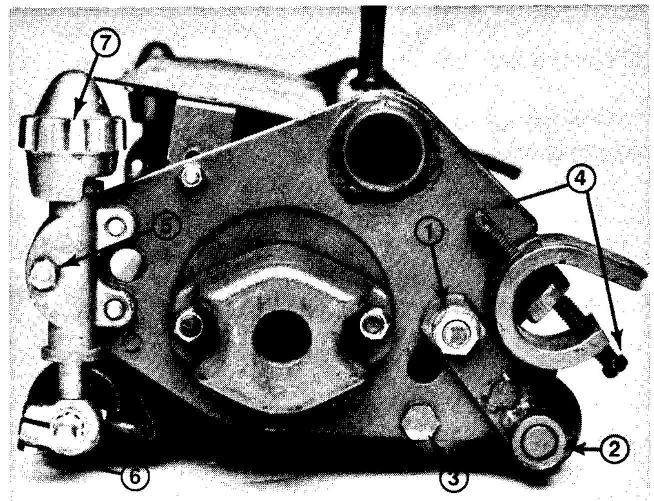


Figure 23

1. **Rear roller height of cut bracket**
2. **Allen set screw**
3. **Bedbar mounting bolts**
4. **Bedknife adjusting screws**
5. **Height of cut rod locknuts**
6. **Roller shaft clamp bolts**
7. **Height of cut adjustment knob**

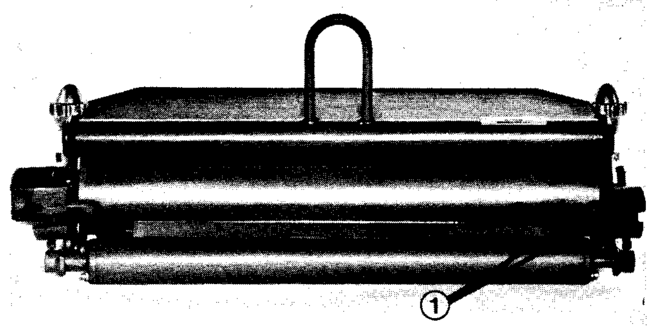


Figure 24

1. **Bedbar under lip of shield**

Bedknife Replacement

1. Remove bedbar.

2. Remove bedknife screws and remove bedknife.

3. Remove all rust, scale, and corrosion from bedbar surface before installing the bedknife.

4. Install new bedknife with new bedknife screws (57-4910). Apply clean SAE 30 oil to the screws before installing screws. Tighten the screws to a torque of 200 to 250 in-lb. working from the center toward each end of the bedbar (Fig. 25).

5. Grind the new bedknife to match it to the bedbar.

Note: For proper grinding of bedknife, follow procedures in the Toro publication "Sharpening Reel and Rotary Mowers", Form No. 80-300-PT.

6. Install the bedbar.

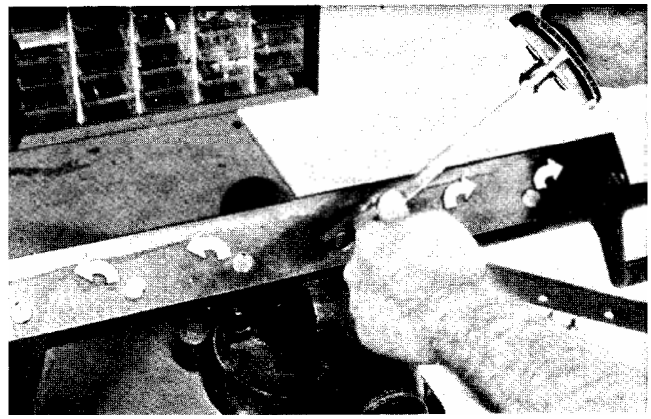


Figure 25

Preparing Reel for Grinding

IMPORTANT: Adjust reel bearings before grinding reel. (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter).

1. Remove bedbar.

Note: Some reel grinders may require rear roller assembly be mounted to the cutting unit for proper support in reel grinder. Rear roller must be parallel to reel shaft to remove taper when grinding.

2. If necessary, remove front roller assembly.

   A. Loosen the locknuts securing height of cut adjusting rods at both ends of the cutting unit and the roller shaft clamp bolts (Fig. 26).

   B. Turn height of cut adjustment knobs until they are disconnected from the height of cut adjusting rods (Fig. 26). The roller assembly can then be removed from the cutting unit by pulling evenly on both sides.

For proper grinding of reel, follow procedures in the Toro publication "Sharpening Reel and Rotary Mowers", Form No. 80-300-PT.

3. Install bedbar. After grinding, assemble cutting unit, and do all adjustments. Backlap if necessary to get desired fit between reel and bedknife.

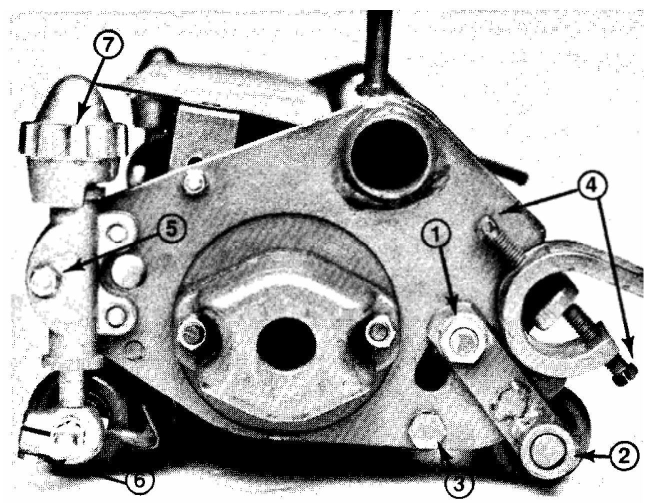


Figure 26

1. **Rear roller height of cut bracket**
2. **Allen set screw**
3. **Bedbar mounting bolts**
4. **Bedknife adjusting screws**
5. **Height of cut rod locknuts**
6. **Roller shaft clamp bolts**
7. **Height of cut adjustment knob**

Reel Removal and Bearing Replacement

1. Remove the front and rear roller assembly. Remove bedbar.

2. Remove counterbalance end cap from left hand side of cutting unit (Fig. 27). Remove large bearing adjustment nut from left hand end of reel shaft (Fig. 27) and special spline nut from opposite end of reel shaft.

3. Remove machine screws securing bearing housing on each end of cutting unit (Fig. 28). Machine screw heads will have to be cut off before screw can be completely removed:

A. Unscrew machine screw approximately two turns.

B. Cut head off of machine screw.

C. Use a screw driver to back out remaining part of screw from side plate (outwards, not inwards towards reel). If machine screw does not have a screw driver slot, use a pliers to back out screw.

IMPORTANT: Remove grease fittings from bearing housing at each end of cutting unit. Note that the straight fitting is on the right end, and 90° fitting at the left end (when viewed in the direction of travel).

4. Use a plastic headed hammer to rotate bearing housing slightly, install bolts from outside of housing and turn bolts alternately against side plate to remove bearing housing (Fig. 29). Bearing housing will slip out of side plates and reel assembly can be removed as soon as bearing housings are disassembled from side plates.

5. Before installing reel, install new special machine screws from inside of frame to secure bearing housing.

6. If necessary, install new bearings and seals:

A. Remove outer seal (in counterbalance weight), bearing cup, bearing cone and inner seal.

B. Bearing housing must be completely free of paint and foreign material before installing bearing cup. If necessary, remove any "flash" from bearing housing that may interfere with accurate seating of bearing. Install new inner seal. Install bearing cup.

C. Install bearing housing to frame. Pack bearing cone with grease and install over reel shaft into bearing cup. Install outer seal (in counterbalance weight).

7. After installing reel, tighten spline nut to 40 - 60 ft-lb, then adjust bearings (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter.)

8. Install bedbar. Install front and rear roller assembly.

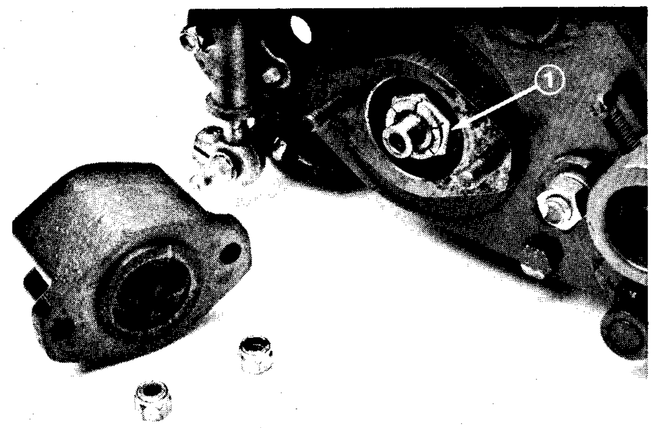


Figure 27

1. Reel bearing adjustment nut

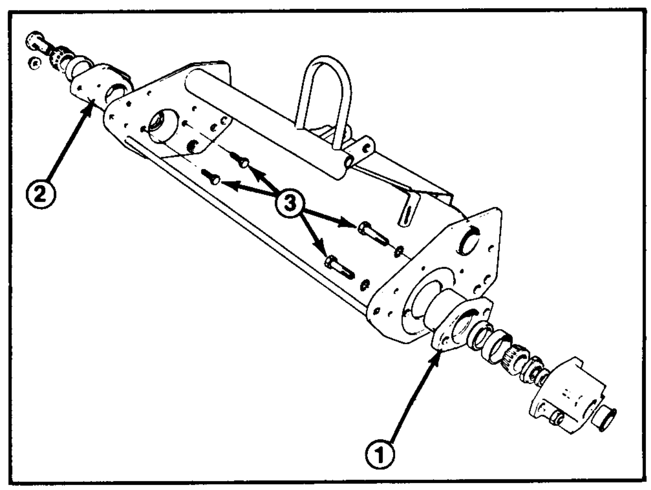


Figure 28

1. Left reel bearing housing **3. Machine screws**
2. Right reel bearing housing

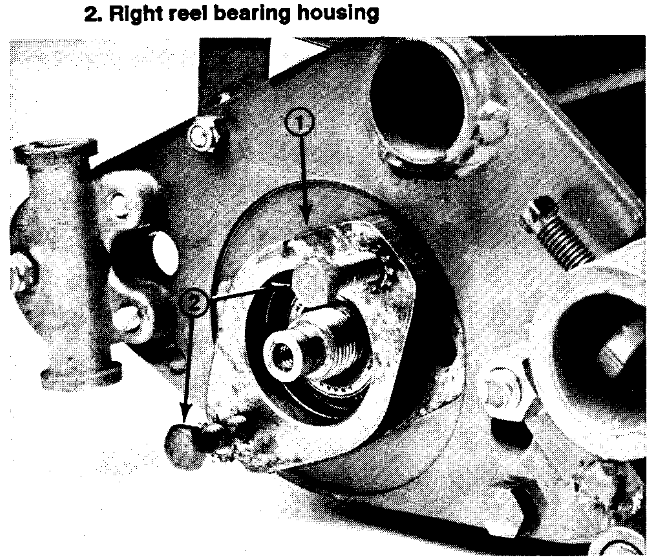


Figure 29

1. Bearing housing - rotate slightly
2. Bearing housing mount bolts - thread against side plate to remove housing

Lift Bail Replacement

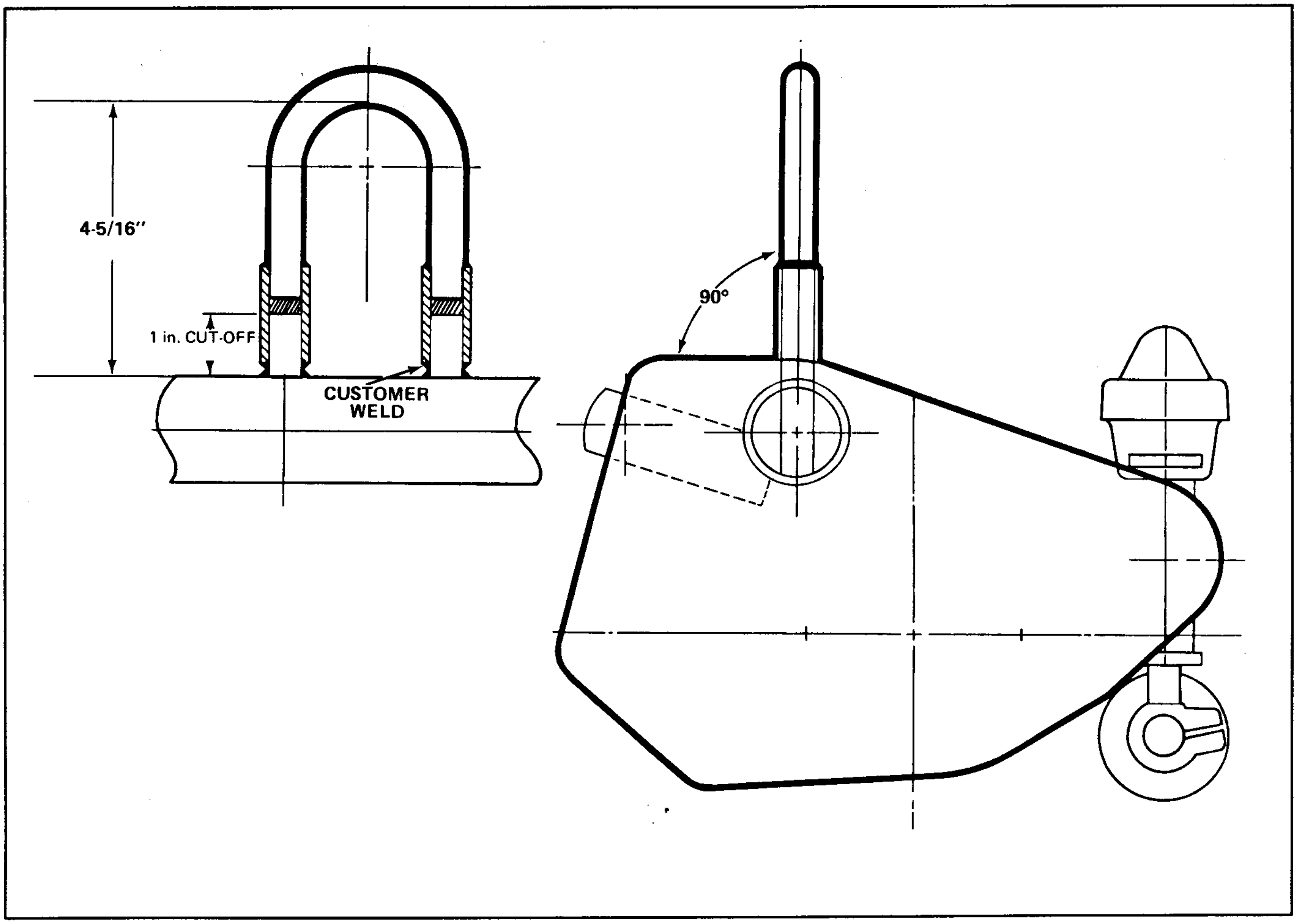


Figure 30

1. Use a saw to cut the lift bail off of the cutting unit. Make the cut 1 inch from the horizontal frame tube (Fig. 30).

2. Use a grinder to remove burrs from the stubs of the lift bail remaining on the cutting unit.

3. Install the repair lift bail (Part No. 71-1600).

4. Support the lift bail so the bottom radius is 4 5⁄16 inches from the top of the horizontal frame tube. Make sure the lift bail is square to the side frame.

5. Weld all around the bottom of the repair lift bail with mild steel rod, both sides.

Chapter 8

Single Point Adjust Cutting Units

Table of Contents

Specifications

Height-of-Cut : 3/32 (0.094) in. to 3/4 (0.75) in.

Clip Frequency and Optimum Height of Cut Range:

Model No	Clip (max.)	Optimum Height of Cut Range
04468	0.25 in.	3/16 to 5/16 in.
04450	0.18 in.	1/8 to 7/32 in.

Roller Adjustment:
Front: Micrometer hand adjustment with bolted clamp lock (1 turn = 0.025 in. height of cut change).
Rear: Roller brackets allow adjustment for different heights of cut. Screw adjustment for leveling.

Bedknife to Reel Adjustment: Bedknife adjusts against reel with positive adjustment control knob located at center of bedbar. Adjustment knob contains detent with .001 in. movement of bedknife for each indexed position. Pivot point at top of bedbar is greaseable.

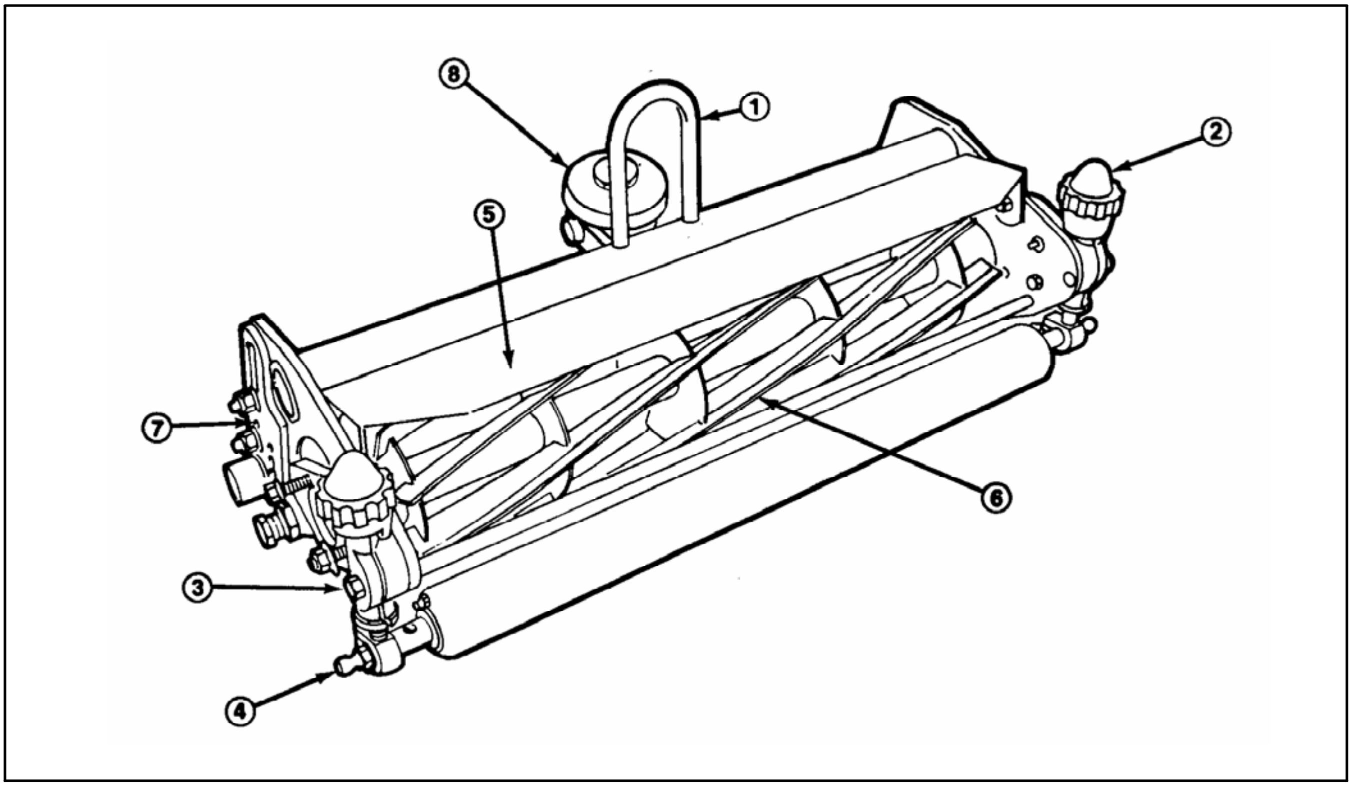
Reel Speed: 1940 rpm (engine speed 2800 rpm).

Bedknife Screw Torque: 200 to 250 in-lb.

Reel Splined Drive Nut Torque: 40 to 60 ft-lbs.

Reel Bearing Rolling Torque: 7 in-lb. max.

Front or Rear Roller Run-Out: 0.014 in. max.



1. **Lift bail**
2. **Height of cut adjustment knob**
3. **Height of cut adjustment locknut**
4. **Pull rod studs**
5. **Grass shield**
6. **Reel**
7. **Heignt of cut brackets (2)**
8. **Bedknife adjusting knob**

Special Tools

NOTE: Order special tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*. Some tools may be listed in the Greensmaster 3000 or 3000-D Parts Catalog. Some tools may also be available from a local supplier.

McLube

Aerosol or liquid lubricant. Apply to bedbar pivot and bedbar pivot bolts.

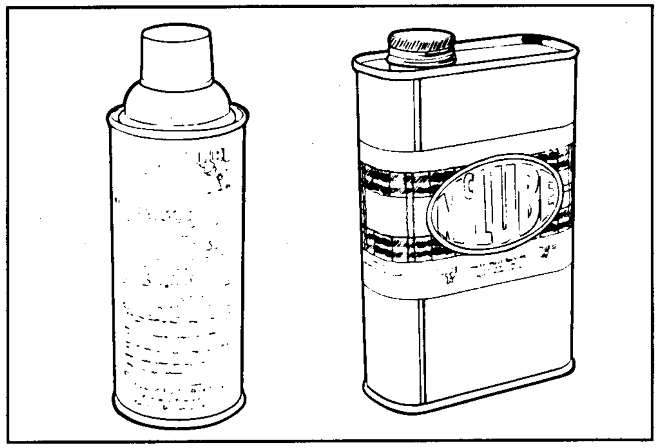


Figure 1

Roller Bearing Replacement Tool

Puller is used to remove bearings from front and rear rollers. Driving tubes are used to install bearings into rollers. Refer to instructions supplied with tool. Used on swaged, full and wiehle rollers.

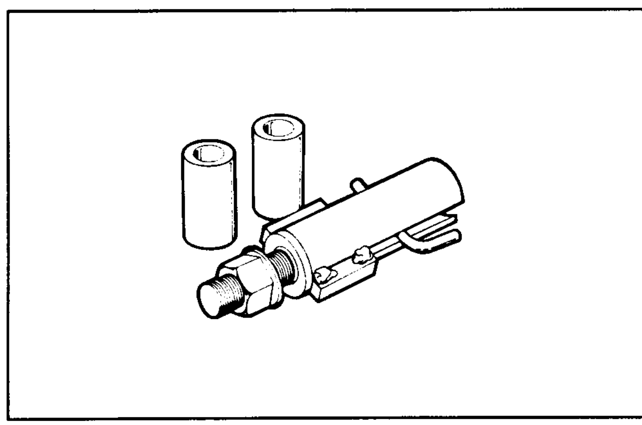


Figure 2

Plastic Plug

Insert plug in cutting unit bearing housing in place of reel motor when sharpening or grinding the reel.

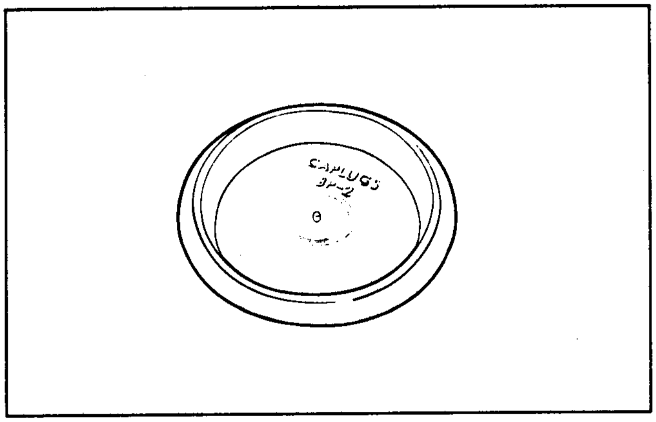


Figure 3

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel assembly.

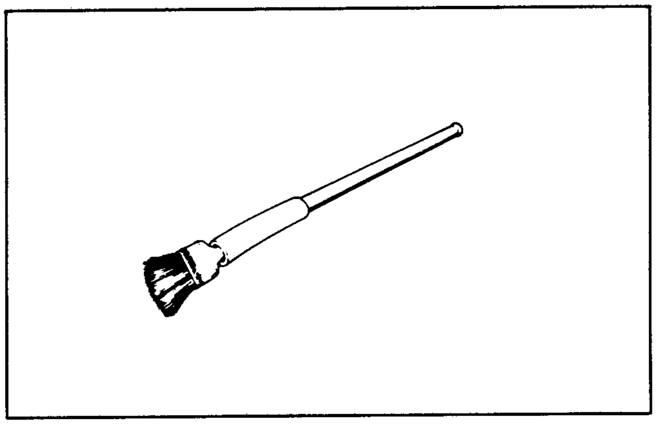


Figure 4

Bedknife Screw Tool

Fits Toro bedknife attaching screws. Use with torque wrench to secure bedknife to bedbar. With clean bedbar threads and new screws, tighten to a torque of 200 in-lb.

NOTE: Remove all rust, scale and corrosion from bedbar surface before installing bedknife.

DO NOT use an air impact wrench with this tool.

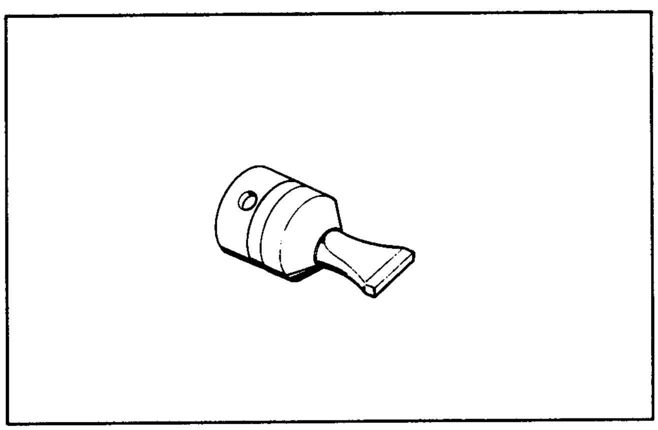


Figure 5

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. See the Adjustments and Repairs sections for detailed adjustment and repair information.

Factors Affecting Quality of Cut

Factor	Possible Problem/Correction
1. Tire pressure.	Check tire pressure and adjust if necessary. Must be equal in both front tires.
2. Engine governed speed.	Check maximum governed engine speed. Adjust to specification if necessary – affects reel speed.
3. Reel bearing condition/adjustment.	Check and adjust to specification. Replace bearings if worn or damaged. Bearing cones must be installed square to bearing housing - make sure there is no "flash", paint or other foreign material in housing before installing new bearing cone.
4. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded edge <u>cannot</u> be corrected by tightening bedknife to reel contact. Grind reel to remove taper (cone shape) and/or rifling (grooved or ribbed 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 after installing on bedbar to match bedknife to bedbar.
5. Bedknife parallel to reel.	Check and adjust as necessary.
6. Bedknife to reel contact.	Check before operating with cutting unit on ground. Remove reel motor and rotate reel by hand. <u>Turn adjusting knob one (1) click at a time until first contact between reel and bedknife is felt or heard, then tighten one (1) more click to get light contact</u>. No contact dulls cutting edges. Excessive contact increases wear.
7. Bedknife attitude (rear roller bracket hole position).	Set to recommendations in chart on Page 9 - 12.
8. Rear roller parallel to reel.	Check and adjust as necessary.
9. Height of cut.	All cutting units set at same height of cut. Set with front roller – must be equal at both ends of roller. <u>Bench set height of cut and actual (effective) height of cut are different.</u> Effective height of cut depends on cutting unit weight, cutting unit accessories and turf conditions.
10. Proper bedknife for height of cut.	If bedknife is too thick for effective height of cut, poor quality of cut will result.
11. Front roller scraper and comb adjustment.	Set scraper for 1/32 in. clearance from roller. Set comb the same on all cutting units for height of cut and turf conditions. Must be same height at both ends of comb.

Factor	Possible Problem/Correction
12. Stability and position of bedbar.	Make sure bedbar bolt plastic washers are snug against bedbar. Bedbar must pivot without binding. Check bedbar end bushings, pivot bushings and nylon flange bushings for wear or damage and replace if necessary. Make sure proper bushings are installed in each location (bedbar end bushings are different). Check adjustment knob to make sure detent holds adjustment. Repair if necessary. With adj. knob/pivot assembly removed, pivot set screws installed, and frame on level surface, measure from flat surface up to end of each setscrew. If not within 1/16 in. of each other, bend ears on cutting unit frame to line up screws. Check to make sure adj. knob/pivot assembly is centered in bedbar arm yoke and frame ears so that an equal gap exists on each side of pivot housing before pivot screws are installed. Make sure bedknife adj. knob/pivot assembly is held firmly in place between frame supports.Tighten pivot screws if necessary.
13. Number of reel blades.	Use cutting unit model with correct number of blades for clip frequency and optimum height of cut range. (Variable speed traction kit can be used to adjust clip frequency.)
14. Cutting unit alignment and pull frame ground following.	Check pull frame alignment on all cutting units. Adjust or repair as necessary. Check pull frames and lift arms for damage, binding or bushing wear. Repair if necessary.
15. Roller condition	All rollers must rotate freely. Grease when needed or repair bearings if necessary.
16. Reel speed.	All reels must rotate at same speed (within 100 rpm). All cutting units must have equal bedknife to reel contact and reel bearing adjustment before checking. Do not run the reel to long or it may get hot and rifle when no grass is being cut. See Troubleshooting in Chapter 5 - Hydraulic System.
17. Traction speed.	Check maximum governed engine speed. Adjust to specification if necessary. See Troubleshooting in Chapter 5 - Hydraulic System Install Variable Speed Traction Kit if necessary to control traction speed in varying conditions or with different attachments. Will allow change in traction speed while maintaining full engine rpm and reel motor rpm.
18. Cutting drop speed and sequence.	Center cutting unit must drop after front cutting unit. (See Troubleshooting in Chapter 5 - Hydraulic System.

Set Up and Adjustments

Adjustment Summary and Check List

DETAILED ADJUSTMENT INSTRUCTIONS FOLLOW THIS SUMMARY AND CHECK LIST. Study this information and refer to it often to get maximum life and performance from the cutting units.

Daily Performance Checks

NOTE: It is not necessary to remove the cutting units from the traction unit to perform these daily checks. It is recommended that mowers be washed after each use. Always remove key from ignition switch when working on the machine.

1. Purge all water and debris from all of the bearings by greasing them. Use No. 2 multi-purpose lithium base grease.

2. Visually check for sharp reel and bedknife.

   - Remove burrs, nicks, and rounded edges.

3. Lower cutting units to ground (setting on both rollers) and remove reel motor. Rotate the reel by hand. TURN ADJUSTING KNOB ONE (1) CLICK AT A TIME UNTIL FIRST CONTACT BETWEEN REEL AND BEDKNIFE IS FELT AND HEARD THEN TIGHTEN ONE (1) MORE CLICK TO GET LIGHT CONTACT *.

   - No contact will dull the cutting edges.
   - Excessive contact accelerates wear; quality of cut may be adversely affected.

   * It is best to make the reel to bedknife adjustment in the morning, immediately before each day of mowing.

Weekly Checks

1. Check reel bearing adjustment and bearing condition.

2. Make sure bed bar bolt "plastic washers" are SNUG against the bedbar.

3. Make sure bedknife adjustment knob/pivot assembly is held FIRMLY in place between frame supports.

4. Using a gauge bar, verify the correct height of cut setting.

Monthly Adjustments

NOTE: Remove cutting unit from traction unit.

1. Parallel bedknife to reel.

   - Use newspaper as a feeler gauge.
   - Dot on eccentric bolt must face rear of mower.
   - Turn S.P.A. adjustment knob to hold paper on right-hand end of bedknife.
   - Turn eccentric (left) bedbar bolt to hold paper on left-hand end of bedknife.
   - Hold eccentric bedbar bolt while securing locknut.

2. Adjust rear roller parallel to reel; eccentric bolt faces to rear.

3. Adjust the front roller scraper to be 1/32 in. from roller.

4. Set comb or brush adjustment for desired action on grass.

   - Light, medium, or aggressive setting.

5. Check grass shield adjustment.

   - 4-3/4 in. from crossbar - normal.
   - Dry grass - lower shield.
   - Wet grass - raise shield.

6. Set top bar (cut-off bar) adjustment.

   - 0.060 in. from reel - normal.

7. Set cutting unit on ground (setting on both rollers) and remove reel motor. Adjust bedknife to reel contact.

8. Use a gauge bar to set the height of cut.

Special Notes

1. Replace the bedbar bushings and nylon flange bushings every two years.

2. A "rifled" reel and/or bedknife must be corrected by grinding.

3. After extended running, notches 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.

4. If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft *spline nut* on right hand end of reel shaft to a torque of 40 to 60 ft-lb, then adjust reel bearings.

Bedknife to Reel Contact

NOTE: The single knob bedknife-to-reel adjustment system simplifies the adjustment procedure needed to get the best mowing performance. The precise adjustment possible with the single knob/bedbar design gives the necessary control to provide a continual self-sharpening action – thus maintaining sharp cutting edges, assuring good quality-of-cut, and greatly reducing the need for routine backlapping. In addition, the rear roller positioning system permits optimum bedknife attitude and location for varying heights-of-cut and turf conditions.

IMPORTANT: Bedknife to reel contact must be checked and adjusted every day even though quality of cut is acceptable.

1. Shut off engine and remove key. Lower cutting units to the ground.

2. Remove grass baskets.

3. On each cutting unit, loosen (2) flange nuts securing reel motor to cutting unit. Twist motor clockwise to disengage from cutting unit and remove motor.

4. Slowly rotate reel, listening for reel-to-bedknife contact. If no contact is evident, TURN BEDKNIFE ADJUSTING KNOB CLOCKWISE, ONE (1) CLICK AT A TIME, UNTIL FIRST CONTACT IS FELT AND HEARD THEN TIGHTEN ONE (1) MORE CLICK TO GET LIGHT CONTACT (Fig. 6).

5. If contact is felt, turn bedknife adjusting knob counterclockwise, one (1) click at a time until no contact is evident. Turn bedknife adjusting knob one (1) click at a time clockwise, until first contact is felt and heard then tighten one (1) more click to get light contact.

6. Install hydraulic motor to cutting unit.

IMPORTANT: LIGHT CONTACT MUST BE MAINTAINED AT ALL TIMES. If light contact is not maintained, bedknife and reel edges will not self-sharpen sufficiently. This will result in dull cutting edges 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 is occasionally run across the front edge to remove this burr, improved cutting performance can be obtained.

NOTE: After extended running, notches 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.

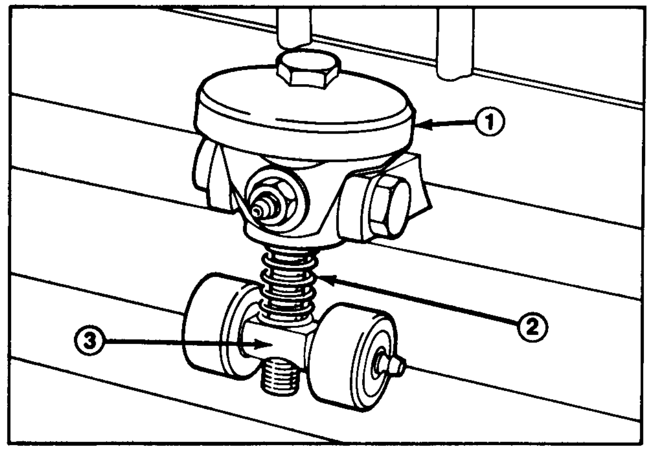


Figure 6a
(Tool-adjustable knob)

1. Bedknife adjusting knob
2. Compression spring
3. Pivot bar

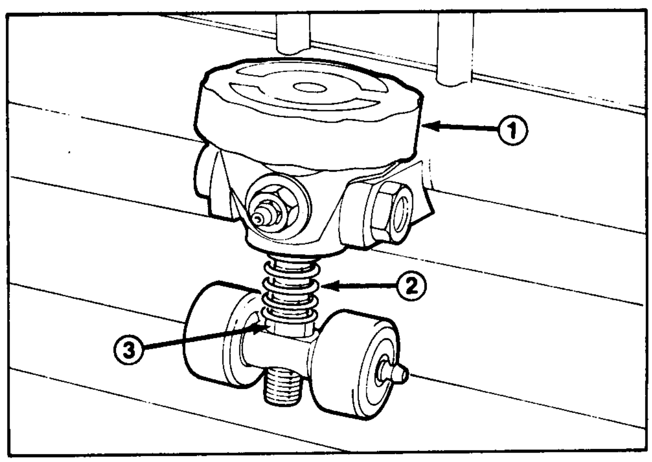


Figure 6b
(Hand-adjustable knob)

1. Bedknife adjusting knob
2. Compression spring
3. Locknut (left-hand thread)

Reel Bearing Service and Adjustment

1. First, make sure bedknife to reel contact is removed by turning bedknife adjustment knob counterclockwise (Fig. 6).

2. Reel bearing rolling torque should not exceed 7 in-lb. Measure with an inch-pound torque wrench (Fig. 7). If bearing drag does not meet above specifications, adjust reel bearings.

NOTE: If you do not have an inch-pound torque wrench, do steps 1 - 3 under Reel Bearing Adjustment below.

Reel Bearing Adjustment

1. Remove mounting nuts from counterbalance end cap and remove end cap from mounting studs (Fig. 7).

2. Remove bolt mounted on the end of reel shaft. This will make it possible for a large socket wrench to be mounted on the reel bearing adjusting nut inside the side plate.

CAUTION

Do not use your hand to prevent reel from turning while servicing; this can result in personal injury. Use a 1/2 in. thick x 3 in. wide x 8 in. long piece of hardwood inserted into front of cutting unit between reel blades.

NOTE: If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft *spline nut* on right hand end of reel shaft to a torque of 40 to 60 ft-lb, then adjust reel bearings.

3. Tighten the large reel bearing adjustment nut (Fig. 7) until all reel shaft end play is removed, then tighten an additional 1/16 to 1/8 turn. Be certain to remove all end play, but do not over-tighten.

NOTE: Adjustment nut must have enough resistance against reel shaft threads to retain bearing adjustment. Replace adjustment nut if necessary.

4. Install bolt into end of reel shaft and check rolling torque with an inch-pound torque wrench. Reel bearing rolling torque, should not exceed 7 in-lb. Repeat steps 2 and 3 if necessary.

5. If bearings require replacement, see Reel Removal and Bearing Replacement in the Repairs section of this chapter.

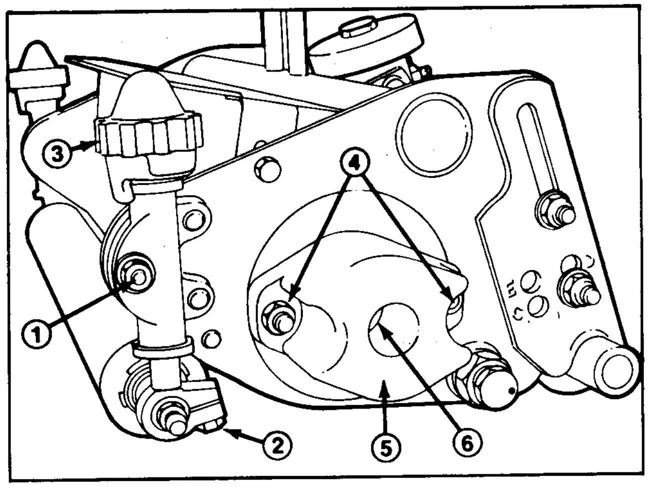


Figure 7

1. **Height of cut locknut**
2. **Roller shaft clamp bolt**
3. **Height of cut knob**
4. **End cap mounting nuts**
5. **Counterbalance end cap**
6. **Reel bearing adjustment nut**

Parallel Bedknife to Reel

1. Remove mower from traction unit and position on a level work surface. Make sure reel contact is removed by turning bedknife adjustment knob counterclockwise.

2. On right-hand end of reel, insert a long strip of newspaper between front side of reel and bedknife. While slowly rotating reel forward, turn bedknife adjusting knob (Fig. 8) clockwise, one click at a time, until paper is pinched lightly, which results in a slight drag when paper is pulled.

3. Check for light contact at other end of reel using paper. If light contact is not evident at both ends, bedknife is not parallel to reel, proceed to step 4.

4. Loosen jam nut on left hand bedbar pivot bolt so bolt can be turned. Left hand pivot bolt (eccentric bolt) has offset thread which, when rotated, acts as a cam to raise or lower the bedbar. Identification dot on bolt head denotes offset of bolt. When dot is in up position (Fig. 9) left end of bedbar is raised. As bolt is turned clockwise and dot is lowered, so is left end of bedbar. Identification dot must be positioned within rear (180°) position when adjusting.

5. Rotate left hand (eccentric) pivot bolt to raise or lower bedbar as required.

6. Check adjustments by repeating steps 2 and 3.

7. After getting light contact on paper at each end of bedknife, tighten left hand jam nut while holding pivot bolt in position. Check to make sure pivot bolt did not get out of adjustment when turning jam nut. Adjust again if necessary.

NOTE: If the reel has worn so you cannot get the bedknife parallel to the reel by turning the eccentric bolt, the reel will require grinding to remove taper. The reel normally wears faster on the lead-in side, which results in the described taper.

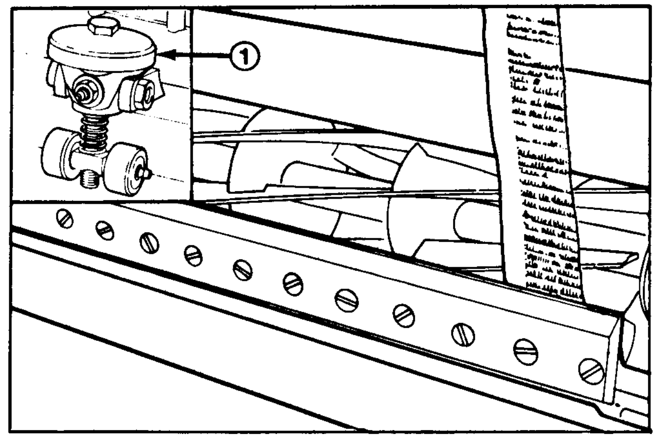


Figure 8

1. Bedknife adjusting knob

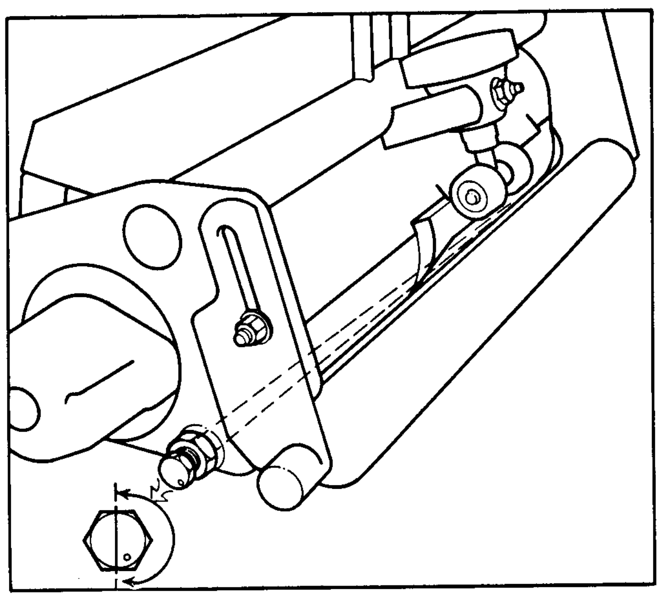


Figure 9

Leveling Rear Roller to Reel

1. Put cutting unit on a flat, level surface.

2. Assemble rear height of cut brackets to desired position, by loosening top capscrew and nut and removing bottom nut on right and left hand sides of cutting unit (Fig. 10).

3. Slide bolts thru each bracket until brackets can be realigned with appropriate mounting hole. See table for proper position on brackets.

NOTE: The different rear roller bracket positioning holes (B thru E) are designed to optimize bedknife location for different heights of cut.

Rear Roller Bracket Hole Position – 8 Blade Cutting Units

Height of cut 3/16 (.187) in. and below use the **B** position
Height of cut 5/32 (.156) in. and above Use the **C** position
Height of cut between 5/32 (.156) and 3/16 (.187) in., try **C** first; if not satisfactory, use **B**

NOTE: For Height of Cut 5/32 (.156) in. and lower use 3/32 in. (tournament) bed knife. Tournament bed knife should not be necessary with the rear roller in the C position.

Rear Roller Bracket Hole Position – 11 Blade Cutting Units

Height of cut 3/16 (.187) in. and below use the **B** position
Height of cut 5/32 (.156) in. and above Use the **C** position
Height of cut between 5/32 (.156) and 3/16 (.187) in., try **B** first; if not satisfactory, use **C**

NOTE: For Height of Cut 3/16 (.187) in. and lower use 3/32 in. (tournament) bed knife. Tournament bed knife should not be necessary with the rear roller in the C position.

NOTE: The "B" hole position normally is the best rear roller location for most low (3/32" - 1/8") cutting conditions.

It may be necessary to change from the above suggested ranges in certain turf conditions.

4. After putting bracket into correct height-of-cut hole position make sure right hand rear roller bracket capscrews are tightened securely (Fig. 11).

5. Left hand rear roller bracket capscrews are to be tightened only enough to remove excessive looseness in assembly, but allow bracket to slide freely on side plate.

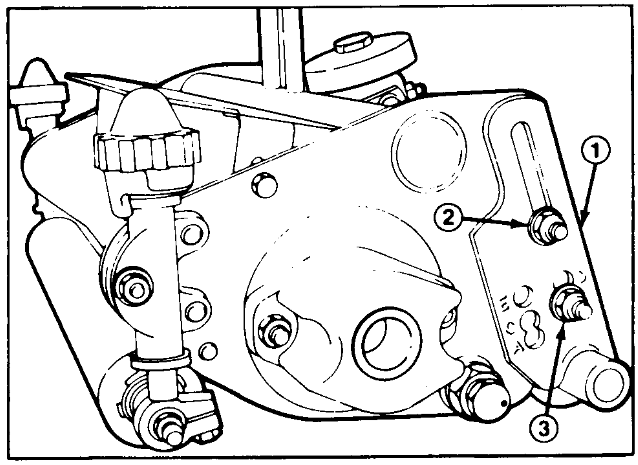


Figure 10

1. Rear height of cut bracket 3. Bottom nut
2. Top capscrew and nut

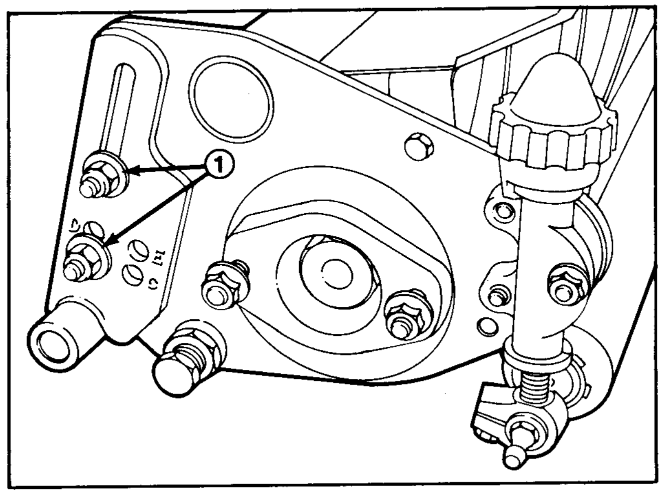


Figure 11

1. Right rear roller bracket capscrews

6. Position a 1/4 inch or thicker plate under the reel blades and against the front face of the bed-knife (Fig. 12).

NOTE: Make sure plate covers full length of reel blades, and (3) blades contact plate (8 blade reel).

7. While holding reel securely on plate, level roller by rotating lower left roller pivot bolt. The pivot bolt has an offset thread which when rotated, acts as a cam to raise or lower the roller. On the bolt head there is an identification dot (Fig. 13) which denotes the offset of the bolt. Dot indicates in which direction left end of roller moves when bolt is turned.

8. To verify if roller is level, try inserting a piece of paper under each end of roller.

9. When roller is level, tighten left capscrew and pivot bolt securely. Hold the eccentric pivot bolt while tightening the nut to keep the proper roller position.

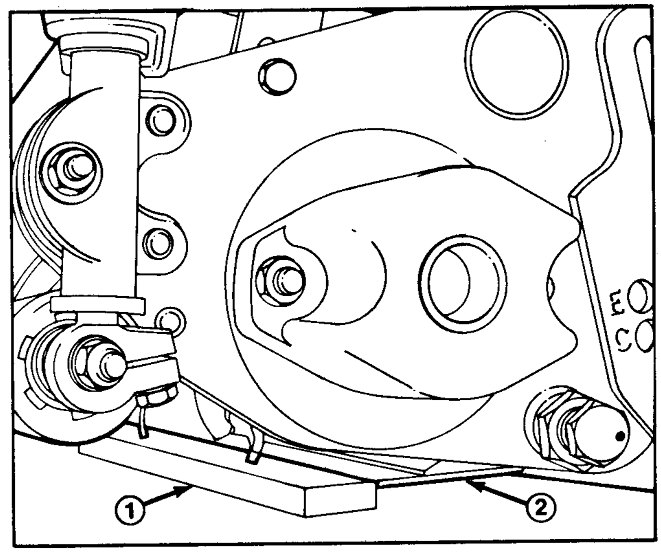


Figure 12

1. 1/4" plate
2. Bedknife

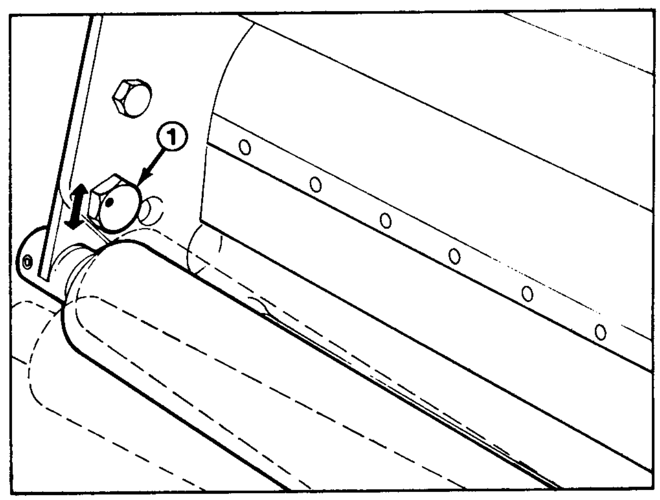


Figure 13

1. Pivot bolt

Height of Cut

Height of cut, as measured in the turf and on the cutting unit is different. The grass prevents the cutting unit from settling all the way to the ground line as the machine moves across the turf. Because of this, the actual (effective) height of cut is higher than the height of cut setting on the cutting unit (bench set height of cut) (Fig. 14).

Machine conditions, such as cutting unit weight, roller type, bedknife thickness, speed of travel and clip frequency, influence effective height of cut. Turf conditions, such as grass type, grass density, and amount of thatch also influence effective height of cut.

Changing the machine (such as adding a wiehle roller, or changing from a 4-bolt adjust cutting unit to a heavier single point adjust cutting unit) will increase penetration into the turf and lower the effective height of cut.

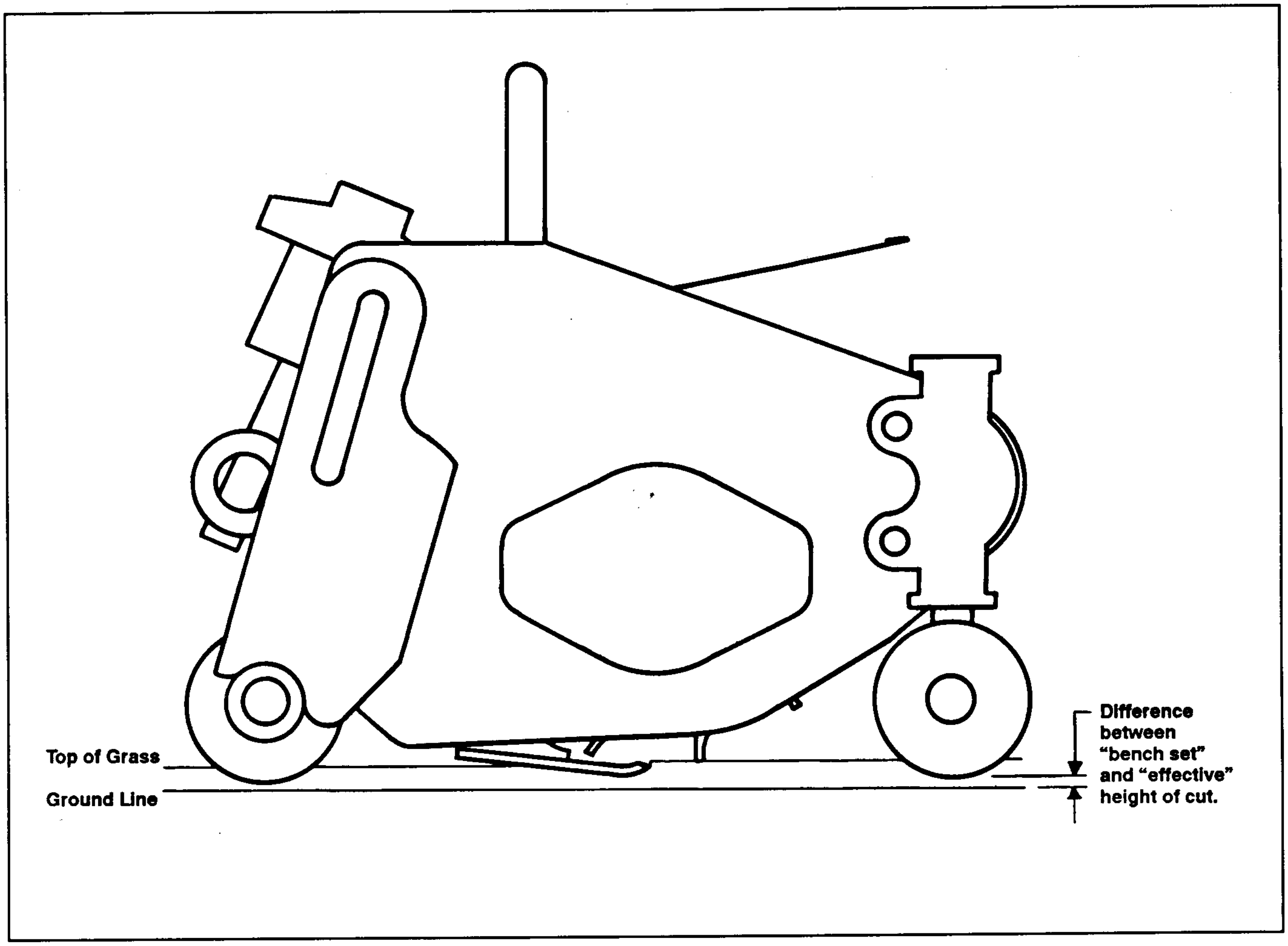


Figure 14

Height of Cut Adjustment

IMPORTANT: Lower heights of cut are limited by thickness of bedknife. Select proper bedknife for desired height of cut. If bedknife is too thick for height of cut, poor quality of cut will result and excessive pressure from turf on bottom of bedknife can cause "rifling" of bedknife and reel.

1. Make sure that rear roller brackets are in correct hole positions for desired height of cut and that rear roller is level. Also, check that bedknife to reel contact is correct.

2. Turn cutting unit over and loosen locknuts securing front roller adjusting screws to height of cut brackets (Fig. 15).

3. On gauge bar (Part No. 1-8789), set head of screw to desired height of cut. This measurement is from bar face to underside of screw head.

4. Place bar across front and rear rollers and adjust height of cut knob until underside of screw head engages bedknife cutting edge (Fig. 14). Check and adjust on each end of bedknife, then tighten height of cut adjustment locknuts on each end.

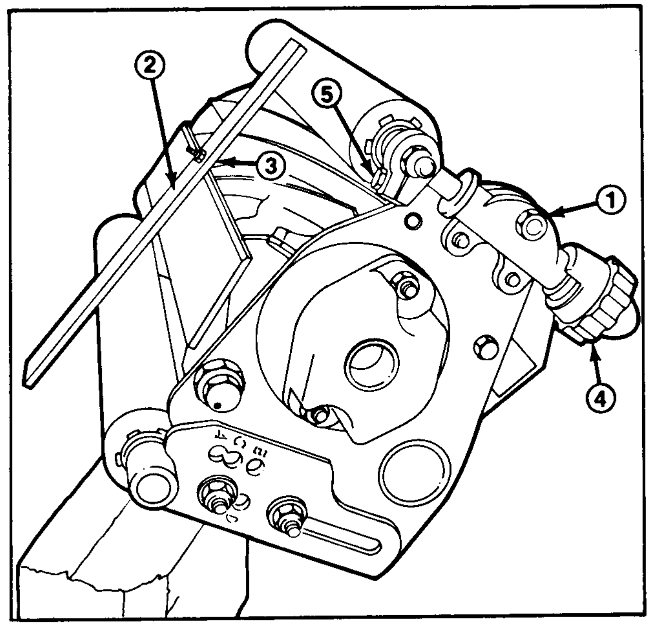


Figure 15

1. Height of cut knob locknut
2. Gauge bar (1-87891)
3. Gauge bar screw head
3. Height of cut knob
5. Roller shaft clamp bolt

Changing To A Different Type of Cutting Unit or Adding Cutting Unit Accessories

When changing to a different type of cutting unit or adding cutting unit accessories, it is recommended that you change only one cutting unit, and keep the other two existing cutting units on the machine.

1. Set the new cutting unit to a height of cut approximately 1/16 (0.06) in. higher than the old cutting unit.

2. Do a mowing test and compare results between the new cutting unit and old cutting units.

3. Adjust the new cutting unit to match the cut of the old cutting units.

4. The other two cutting units can now be replaced. Adjust these two new cutting units so they are the same as the other new cutting unit that was tested.

Front Roller Scraper Adjustment

The front roller scraper should be adjusted so there is a clearance of approximately 1/32 of an inch between the scraper and roller (Fig. 16).

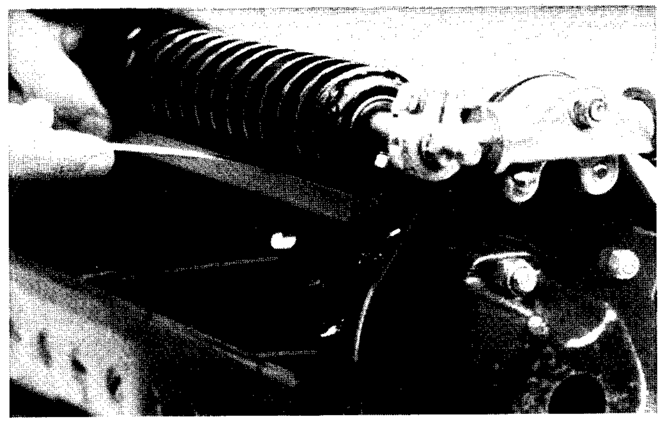


Figure 16

Comb Adjustment

1. Make sure rear roller is in the desired height of cut position. Loosen the bolts anchoring the front roller shaft (Fig. 17). Rotate the shaft.

2. To adjust the aggressiveness of the comb teeth (Fig. 17), proceed as follows:

   A. Teeth touching the adjusting gauge bar give an **aggressive** setting.

   B. Teeth midway between the adjusting gauge bar and the cutting edge of the bedknife give a **medium** setting.

   C. Teeth even with the cutting edge of the bedknife give a **light** setting.

NOTE: Securing one end of the comb assembly at a time simplifies the above procedure.

3. Tighten the roller shaft bolts.

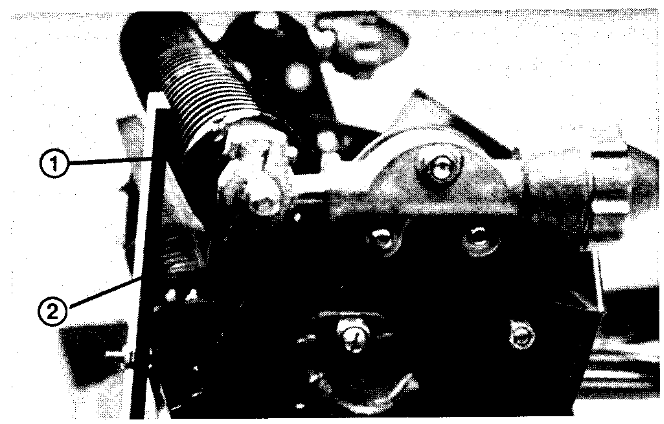


Figure 17

1. Roller shaft clamp bolt **2. Comb teeth**

Shield Height Adjustment

Adjust shield to get proper grass clipping discharge into basket:

1. Set cutting unit in normal cutting position and measure distance from top of front crossbar to shield at each end of cutting unit (Fig. 18).

2. Height of shield from crossbar for normal cutting conditions should be 4-3/4 inches. Loosen capscrews and nuts securing shield to each side plate, adjust shield to correct height and tighten fasteners (Fig. 18).

3. Repeat adjustment on remaining cutting units and adjust top bar. (See Adjusting Top Bar in this section of the book.)

NOTE: Shield can be lowered in dry grass conditions (clippings fall over top of baskets) or raised to allow for heavy wet grass conditions (clippings build up on rear edge of baskets).

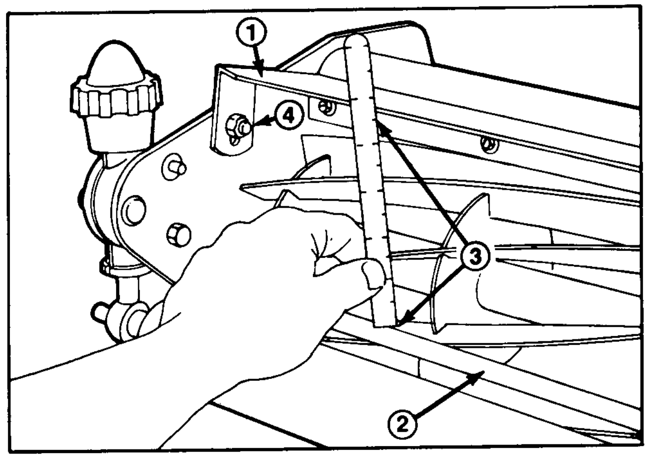


Figure 18

1. Shield
2. Front crossbar
3. 4-3/4 inches
4. Shield fasteners

Top (Cut-Off) Bar Adjustment

Adjust top bar to make sure clippings are cleanly discharged from reel area:

1. Loosen screws securing top bar (Fig. 19). Insert 0.060 inch feeler gauge between top of reel and bar and tighten screws. Make sure bar and reel are equal distance apart across complete reel.

2. Repeat settings on remaining cutting units.

NOTE: Bar is adjustable to compensate for changes in turf conditions. Bar should be adjusted closer to reel when turf is extremely wet. By contrast, adjust bar further away from reel when turf conditions are dry. Bar should be parallel to reel to get optimum performance and should be adjusted whenever shield height is adjusted or whenever reel is Sharpened on a reel grinder.

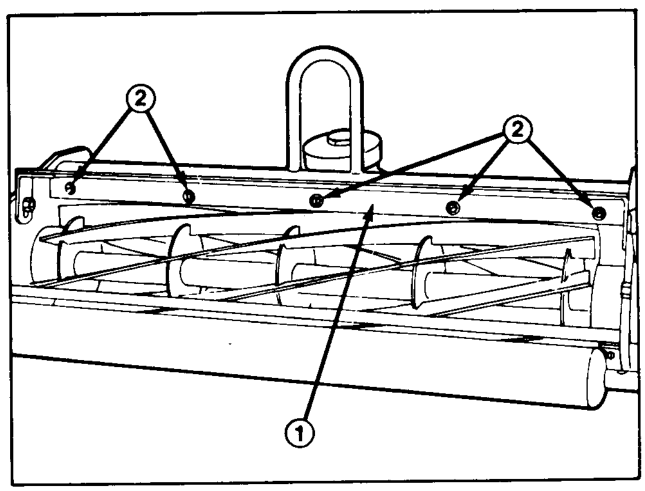


Figure 19

1. Top bar **2. Bar mounting screws**

Pull Frame Adjustment

1. Put the basket on the pull frame.

2. Level baskets to cutting unit by loosening nut at one end of pull frame roller. Loosen bolt and move roller shaft in slot as necessary. Tighten bolt.

3. Loosen the jam nuts on the pull arms and adjust the ball sockets until there is 1/4 in. to 1/2 in. (6 to 13 mm) clearance between the lip of the basket and the reel blades (Fig. 20). This prevents grass clippings from dropping on the ground.

4. Make sure the basket lips are the same distance from the reel blades at both ends of the reel. If the basket is too close to the reel, it is possible for the reel to contact the basket at the instant the cutting unit is raised off the ground.

5. Make sure each of the three (3) cutting units track straight with the traction unit:

A. On a smooth, level surface, draw a straight line on the floor (Fig. 20b). Push traction unit forward (removing slack from pull arms) so center of each front wheel is on top of the line. Use a plumb bob or square to make sure each wheel is centered on the line.

B. Measure from each end of cutting unit front roller to chalk line. Distance from each end of roller to line must be equal within 3/16 (0.187) in.

C. Loosen jam nuts on pull arms and adjust ball sockets so distance from each end of roller to line is within 3/16 (0.187) in.

NOTE: If a cutting unit cannot be adjusted to track correctly with the traction unit, the pull frame, or lift arm is damaged and/or the lift arm and pull frame bushings are worn and must be replaced.

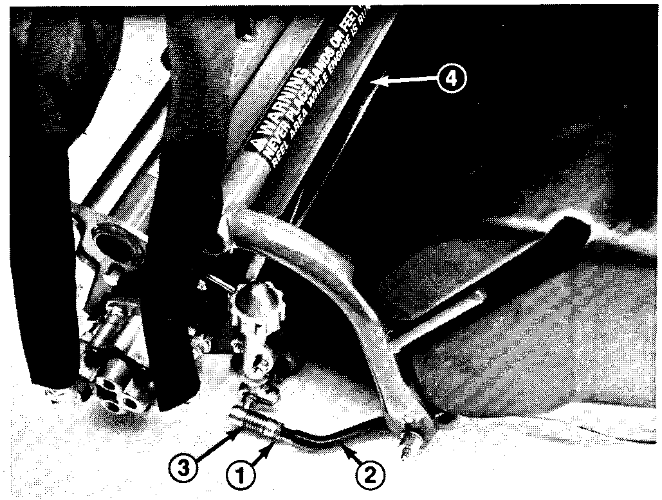


Figure 20a

1. Jam nut
2. Pull arm
3. Ball joint - adjust for clearance
4. 1/4 - 1/2 in. (6 - 13 mm) clearance

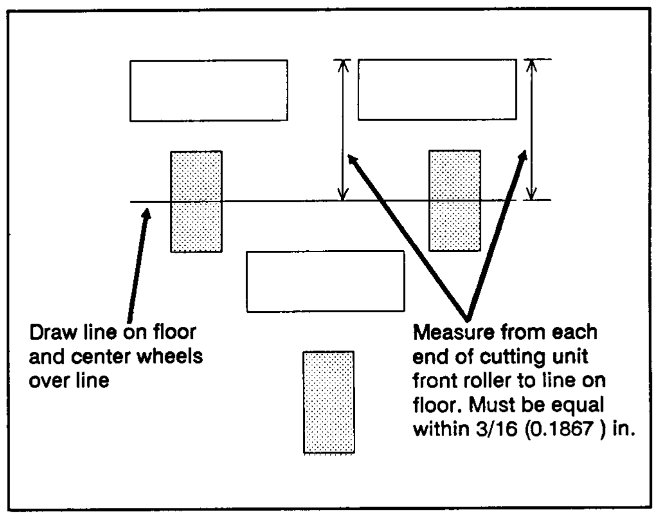


Figure 20b

Cutting Unit Removal and Installation

Remove cutting unit from traction unit before doing adjustments or repairs.

1. Remove basket from pull frame.

2. Loosen reel motor mounting nuts (Fig. 21). Rotate the motor clockwise so motor flanges clear studs and pull motor off of cutting unit.

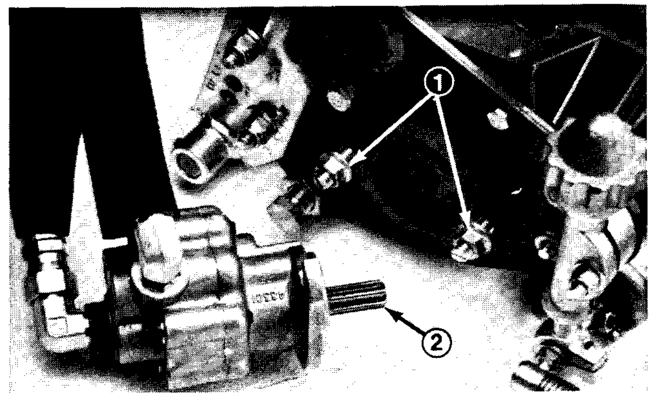


Figure 21

1. Motor mount nuts
2. Motor shaft

3. Slide the sleeve back on the ball joint and disconnect the pull arm from each side of the cutting unit (Fig. 22).

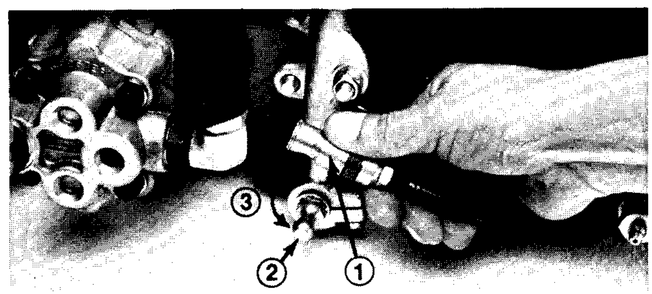


Figure 22

1. Slide back to mount
2. Ball stud
3. Swing up to remove, down to install

4. Slide cutting unit out from under pull frame, disengaging the lift arm from the lift bail (Fig. 23).

5. Reverse steps 1 - 4 to install the cutting unit.

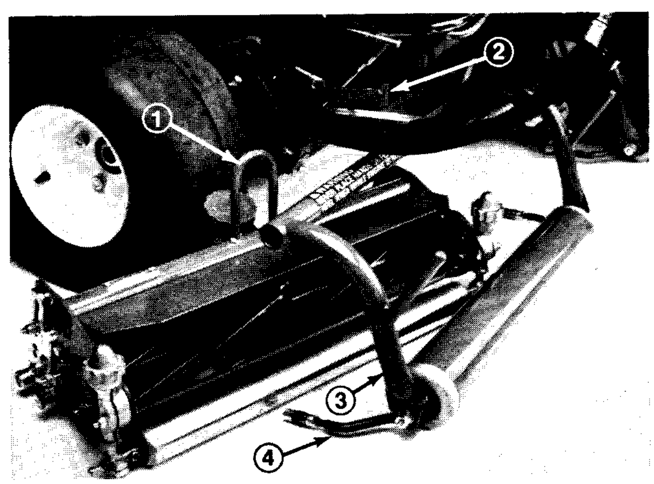


Figure 23

1. Lift bail
2. Lift arm
3. Pull frame
4. Pull arm

Reel Lapping

Check reel bearing adjustment and correct if necessary before backlapping. Connect lapping machine to cutting unit with an extension coupler, and a 9/16 in. socket. The 9/16 in. socket can be installed onto the capscrew on the reel shaft inside the counter-balance weight on the end of the cutting unit. Backlap according to procedures in the Toro publication "Sharpening Reel & Rotary Mowers" Form No. 80-300-PT.

NOTE: For a better cutting edge, run a file across front face of bedknife when lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

CAUTION

Be careful when lapping the reel because contact with the reel or other moving parts can result in personal injury.

Bedbar Removal and Installation

1. Loosen pivot screws securing bedknife pivot assembly to reel frame supports (Fig. 24).

2. Rotate adjustment knob and pivot assembly clockwise (left hand thread) until it is unthreaded from bedbar pivot (Fig. 24).

3. Loosen jam nuts retaining right and left bedbar pivot bolts. Remove pivot bolts (Fig. 24).

IMPORTANT: Note position of plastic washer and steel washer on right end of bedbar, and plastic washer on left end of bedbar for reinstallation.

4. Slide bedbar down and out from under cutting unit. Do not misplace washers.

5. Replace and/or grind bedknife to renew cutting edges.

NOTE: For proper grinding of bedknife, follow procedures in the Toro publication, "Sharpening Reel and Rotary Mowers", Form No. 80-300-PT.

6. Adjust the reel bearings. (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter.)

7. Grind the reel to remove any taper and renew cutting edges. (See Preparing Cutting Unit for Reel Grinding in this section of the book.)

8. Check size of hole in bedbar end bushings every time bedbar is removed. Insert flange bushing into rubber bushing (Fig. 25). Insert clean shoulder bolt into flange bushing/rubber bushing assembly. If bolt slides easily into bushing, replace all four bedbar bushings. (See Bedbar Bushing Replacement in this section of the book.)

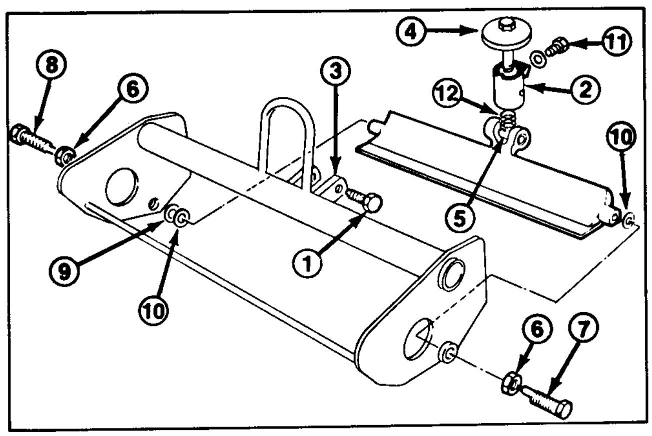


Figure 24

1. **Pivot screw**
2. **Bedknife pivot ass'y**
3. **Frame supports**
4. **Adjustment knob**
5. **Bedbar pivot**
6. **Jam nuts**
7. **Left bedbar pivot bolt**
8. **Right bedbar pivot bolt**
9. **Steel washer**
10. **Plastic washer**
11. **Spring arm retaining capscrew**
12. **Compression spring**

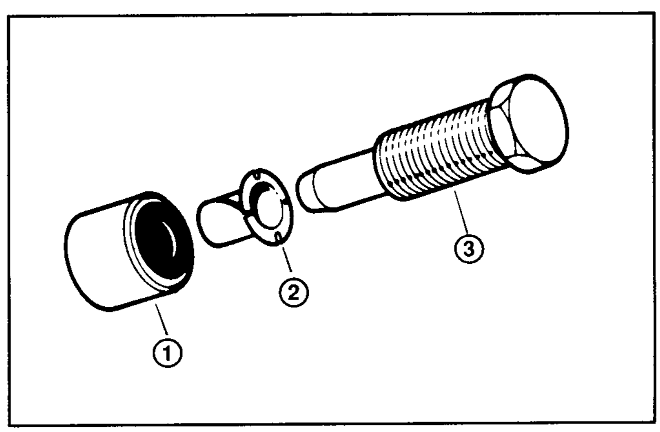


Figure 25

1. **Rubber bushing**
2. **Flange bushing**
3. **Shoulder (pivot) bolt**

9. With frame on level surface and pivot set screws installed, measure from flat surface up to end of each setscrew (Fig. 26). If not within 1/16 in. of each other, carefully bend frame supports to line up screws. Remove pivot set screws. Measure distance between frame pivot supports (Fig. 26). If dimension is not between 1-9/16 in. and 1-5/8 in., carefully bend supports until correct.

10. To install bedbar, slide it into into position between side plates, making sure each end of bedbar is under shield (Fig. 27).

IMPORTANT: Always use McLUBE (Toro Part No. 505-35) on bedbar pivot and pivot bolts.

11. Install jam nut on eccentric pivot bolt. Put plastic washer between left side of bedbar and side plate. Thread pivot bolt into side frame until distance from top of pivot bolt to side plate is 1-5/16 in. with identification dot toward the rear (Fig. 28). Do not tighten jam nut.

12. Install jam nut on straight pivot bolt. Put plastic washer and steel washer between right side of bedbar and side plate with plastic washer closest to bedbar. Thread pivot bolt into side plate. Adjust right-hand pivot bolt until left end of bedbar firmly seats against side plate, clamping the plastic washer snugly. This removes end-play from bedbar. Bedbar must pivot without binding. Hold right-hand pivot bolt to keep it from moving and tighten jam nut.

IMPORTANT: Apply NEVER-SEEZ or equivalent to the threads of the handle assembly.

13. Thread adjustment knob and pivot assembly into flat side of bedbar pivot (left-hand thread). Make sure there is an equal gap between each side of pivot assembly housing and frame supports (Fig. 29). Adjust (before installing pivot screws) by sliding bedbar pivot sideways.

IMPORTANT: On hand-adjustable type knobs, check to make sure die spring is compressed to 13/16 in. by tightening locknut (left-hand thread) (Fig. 6b).

14. If equipped with hex head type pivot screws, tighten pivot screws to 60 ft-lb. If equipped with hex socket head set screws and jam nuts, tighten set screws finger tight then tighten an additional 1/2 turn (total - not each). Tighten jam nuts.

15. Secure spring arm to pivot assembly. If spring arm is adjustable, adjust upward until a solid clicking sound is achieved when adjusting knob is turned.

16. Level bedknife to reel. Level rear roller to reel. Set height of cut. If necessary, backlap to get desired fit between reel and bedknife.

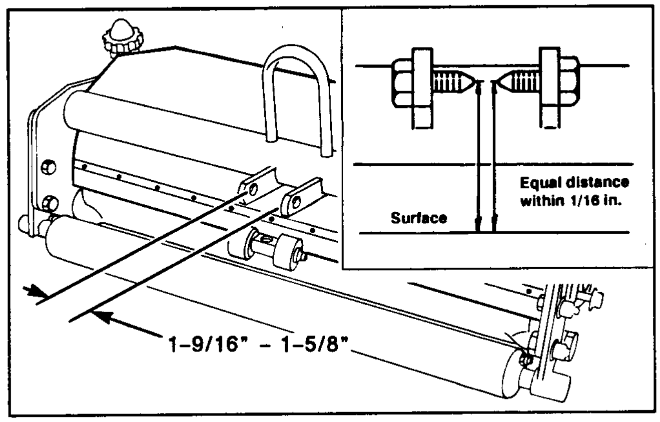


Figure 26

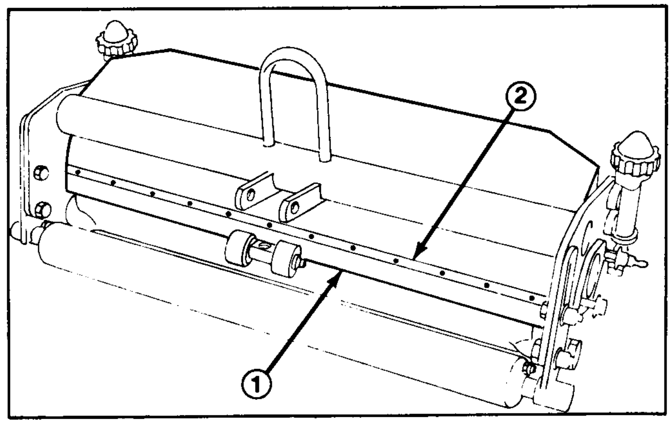


Figure 27

1. Bedbar
2. Shield

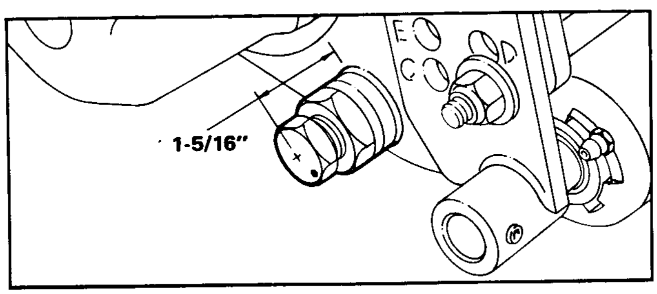


Figure 28

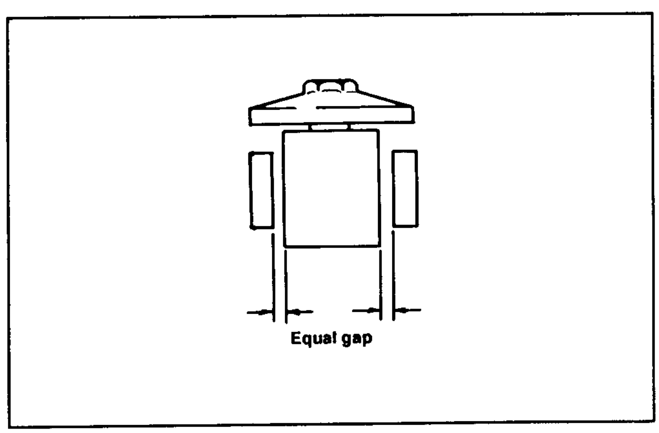


Figure 29

Bedbar Bushing Replacement

NOTE: Only after making sure that all normal cutting unit adjustments are correct, should the bushings be suspected as causing quality of cut problems.

The bedbar end bushings and pivot bushings (Fig. 30) contain rubber and are exposed to severe conditions. It is recommended to replace these bushings and the plastic flange bushings every two years.

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Remove bedbar end bushings with a punch and hammer (Fig. 31). Alternate from one side to other on bushing (there are two slots in bedbar bushing boss).

IMPORTANT: Apply NEVER-SEEZ or equivalent to outside surface of bedbar end bushings and pivot bushings before installing in bedbar.

3. Press end bushings into bedbar far enough so plastic sleeve collar is below bedbar end face (Fig. 32).

NOTE: Bedbar end bushings have less rubber and more steel which is visible than bedbar pivot bushings. Do not use bedbar end bushings in the pivot area as they are too rigid.

4. Use an arbor press to remove bedbar pivot bushings (Fig. 33). DO NOT hammer on pivot boss of bedbar without support. You will break the casting.

5. Press center pivot bushings into place (Fig. 33). DO NOT hammer on pivot boss of bedbar without support. You will break the casting.

6. Do steps 5 - 16 under Bedbar Removal and Installation in this section of the book.

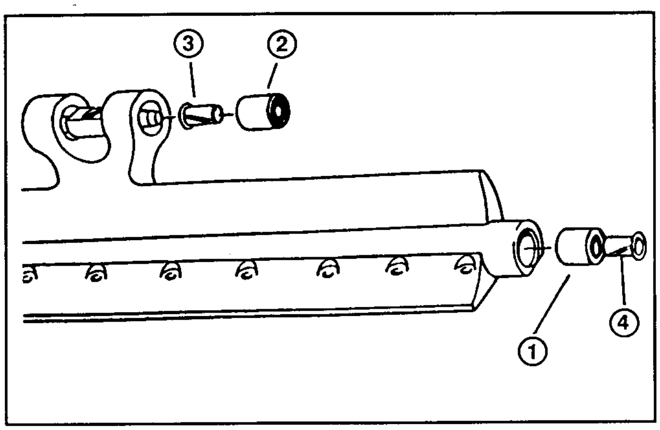


Figure 30

1. Bedbar end bushing (2)
2. Bedbar pivot bushing (2)
3. Flange bushing (4)

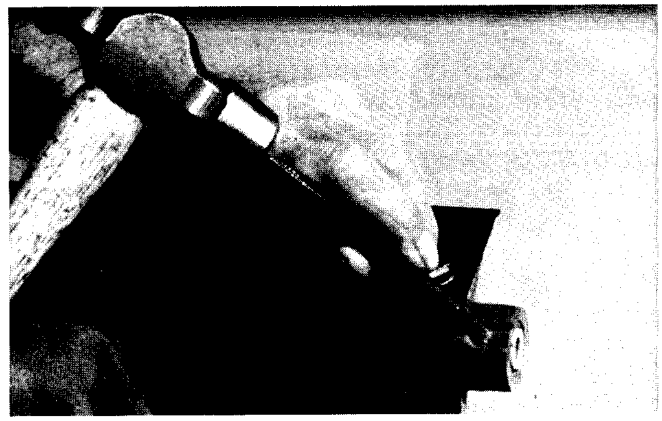


Figure 31

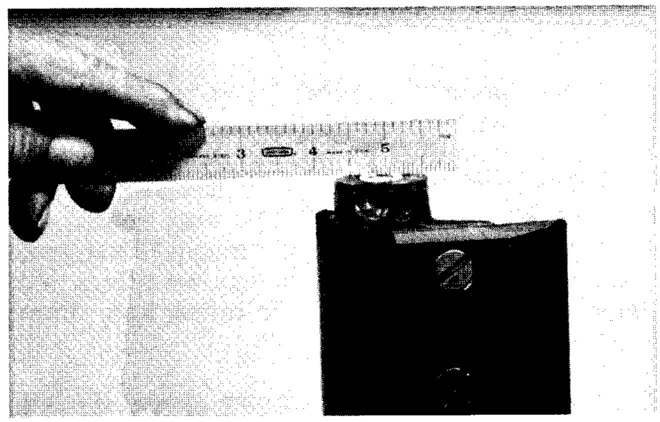


Figure 32

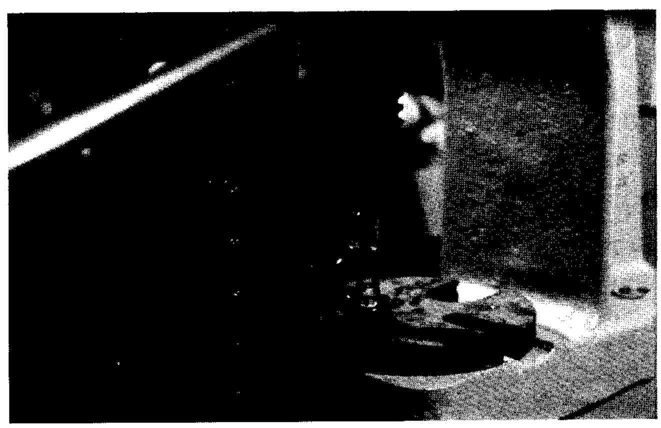


Figure 33

Bedknife Replacement

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Remove bedknife screws and remove bedknife.

3. Remove all rust, scale, and corrosion from bedbar surface before installing the bedknife.

4. Install new bedknife with new bedknife screws (57-4910). Apply clean SAE 30 oil to the screws before installing screws. Tighten the screws to a torque of 200 to 250 in-lb. working from the center toward each end of the bedbar (Fig. 34).

5. Grind the new bedknife to match it to the bedbar.

Note: For proper grinding of bedknife, follow procedures in the Toro publication “Sharpening Reel and Rotary Mowers”, Form No. 80-300-PT.

6. Do steps 6 - 16 under Bedbar Removal and Installation in this section of the book.

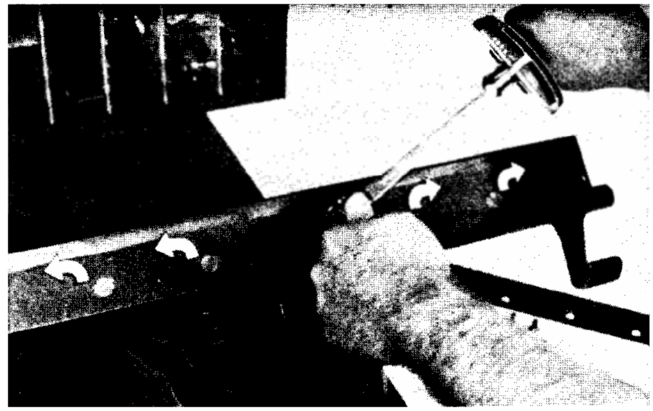


Figure 34

Preparing Reel for Grinding

IMPORTANT: Adjust reel bearings before grinding reel. (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter).

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

Note: Some reel grinders may require rear roller assembly be mounted to the cutting unit for proper support in reel grinder. Rear roller must be parallel to reel shaft to remove taper when grinding.

2. Raise or remove front roller assembly.

   A. Loosen the locknuts securing height of cut adjusting rods at both ends of the cutting unit and the roller shaft clamp bolts (Fig. 35).

   B. Turn height of cut adjustment knobs to raise roller out of way or remove roller if necessary.

For proper grinding of reel, follow procedures in the Toro publication “Sharpening Reel and Rotary Mowers”, Form No. 80-300-PT.

3. Do steps 8 - 16 under Bedbar Removal and Installation in this section of the book. After grinding, assemble cutting unit, check bearing adjustment and adjust top shield and bar. Backlap if necessary to get desired fit between reel and bedknife.

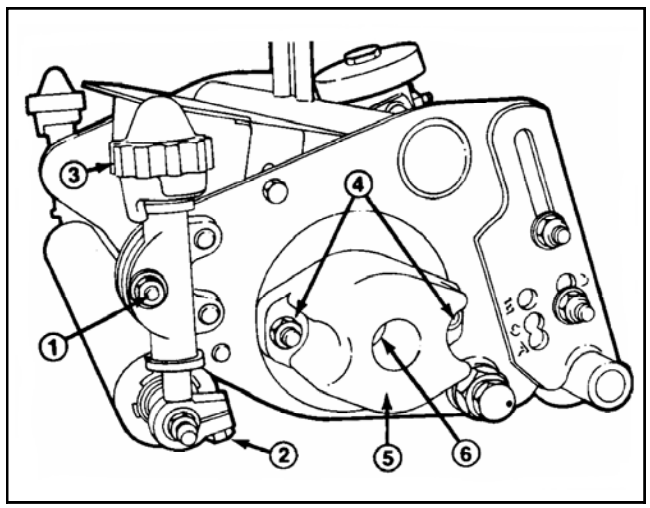


Figure 35

1. **Height of cut locknut**
2. **Roller shaft clamp bolt**
3. **Height of cut knob**
4. **End cap mounting nuts**
5. **Counterbalance end cap**
6. **Reel bearing adjustment nut**

Reel Removal and Bearing Replacement

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Remove counterbalance end cap from left hand side of the cutting unit (Fig. 35). Remove large bearing adjustment nut from one end of reel shaft (Fig. 35) and special spline nut at opposite end of reel shaft.

3. Remove machine screws securing bearing housing on each end of cutting unit (Fig. 36). The machine screw heads will have to be cut off before the screw can be completely removed:

A. Unscrew machine screw approximately two turns.

B. Cut off machine screw head.

C. Back out remaining part of screw from side plate with a screw driver (outwards, not inwards towards reel). If machine screw does not have a screw driver slot, use a pliers to back out screw.

IMPORTANT: Remove grease fittings from bearing housing at each end of cutting unit. Note that the straight fitting is on the right end, and 90° fitting at the left end (when viewed in the direction of travel).

3. Use a soft face hammer to rotate bearing housing slightly. Install bolts from outside of housing and turn bolts alternately against side plate to remove bearing housing (Fig. 37). Bearing housing will slip out of side plates. Reel can be removed as soon as bearing housings are disassembled from side plates.

4. Before installing reel, install new special machine screws from inside of frame to secure bearing housings.

5. If necessary, install new bearings and seals:

A. Remove outer seal (in counterbalance weight), bearing cup, bearing cone and inner seal.

B. Bearing housing must be completely free of paint and foreign material before installing bearing cup. If necessary remove any "flash" from bearing housing that may interfere with accurate seating of bearing. Install new inner seal. Install bearing cup.

C. Install bearing housing to frame. Pack bearing cone with grease and install over reel shaft into bearing cup. Install new outer seal in counterbalance weight).

6. After installing reel, tighten spline nut to a torque of 40 to 60 ft-lb, then adjust bearings (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter.)

7. Do steps 5 - 16 under Bedbar Removal and Installation in this section of the book.

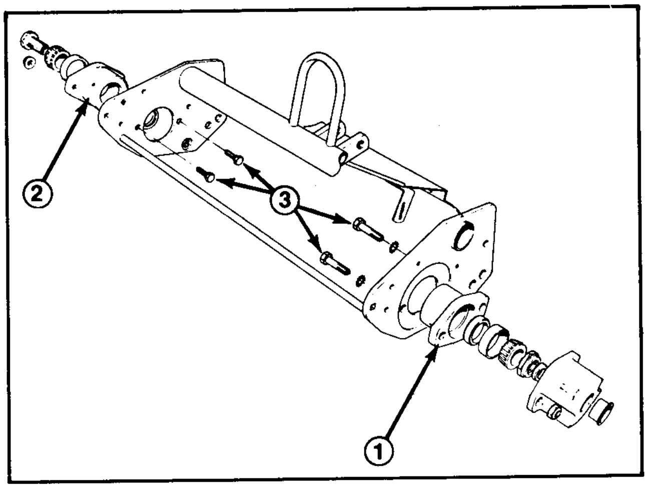


Figure 36

1. Left reel bearing housing
2. Right reel bearing housing
3. Machine screws

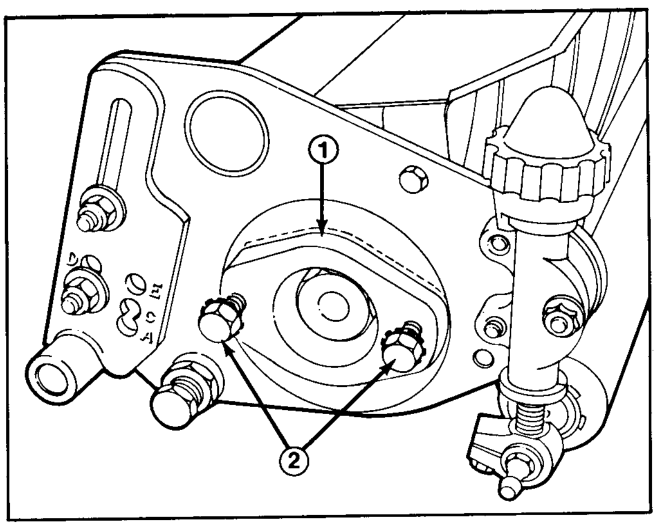


Figure 37

1. Bearing housing
2. Bolt

Bedknife Adjustment Knob Bearing Service

1. Turn bedknife adjustment knob counterclockwise to remove bedknife to reel contact.

2. Remove two (2) pivot screws (Fig. 38).

3. Rotate adjustment knob and pivot assembly clockwise (left-hand thread) until it is unthreaded from the bedbar pivot.

4. If necessary, remove locknut securing die spring to shaft (Fig. 6b). Slide pivot housing off adjustment knob threaded shaft (Fig. 38).

5. Pull inner races from pivot housing. Pull bearings from pivot housing. Check condition of inner races and bearings and replace if necessary.

6. Install new o-ring on each race if necessary.

7. Install bearings and races in pivot housing. Slide pivot housing onto shaft of knob.

8. Install spring over adjusting knob threaded shaft and thread adjustment knob and pivot assembly into flat side of bedbar pivot. Make sure there is an equal gap between each side of pivot assembly housing and frame supports (Fig. 29). Adjust (before installing pivot screws) by sliding bedbar pivot sideways.

IMPORTANT: On hand-adjustable type knobs, check to make sure die spring is compressed to a dimension of 13/16 in. by tightening locknut (left-hand thread) (Fig. 6b).

9. If equipped with hex head type pivot screws, tighten pivot screws to 60 ft-lb. If equipped with hex socket head set screws and jam nuts, tighten set screws finger tight then tighten 1/2 turn more (total - not each). Tighten jam nut.

10. Adjust bedknife to reel contact.

NOTE: If quality of cut has deteriorated or the reel and bedknife have become "rifled" , you must grind the reel and bedknife to remove rifle pattern.

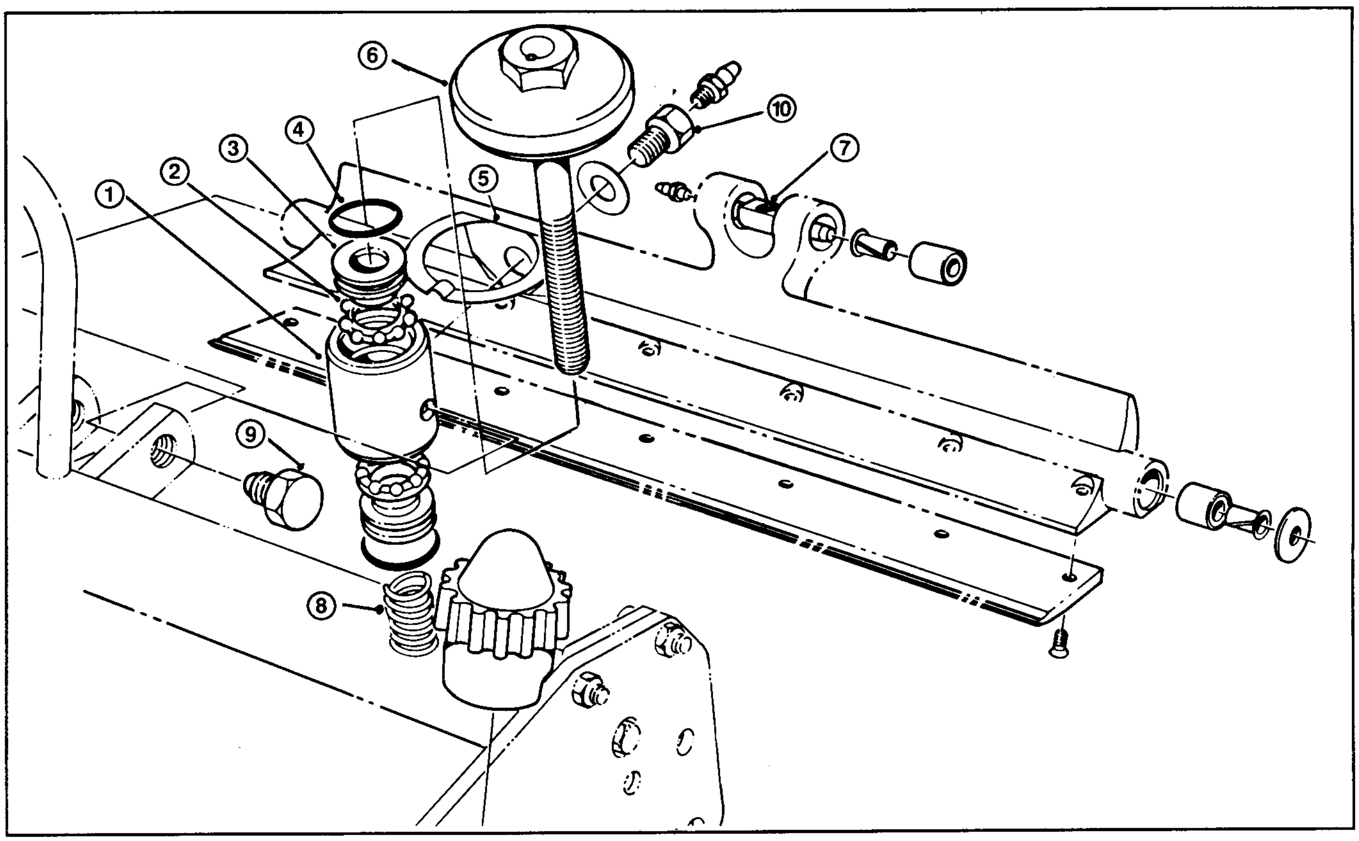


Figure 38

1. Pivot housing
2. Bearing (2)
3. Inner race (2)
4. O-ring (2)
5. Spring arm
6. Adjustment knob
7. Bedbar pivot
8. Spring
9. Pivot screw (2)
10. Spring arm bolt

Lift Bail Replacement

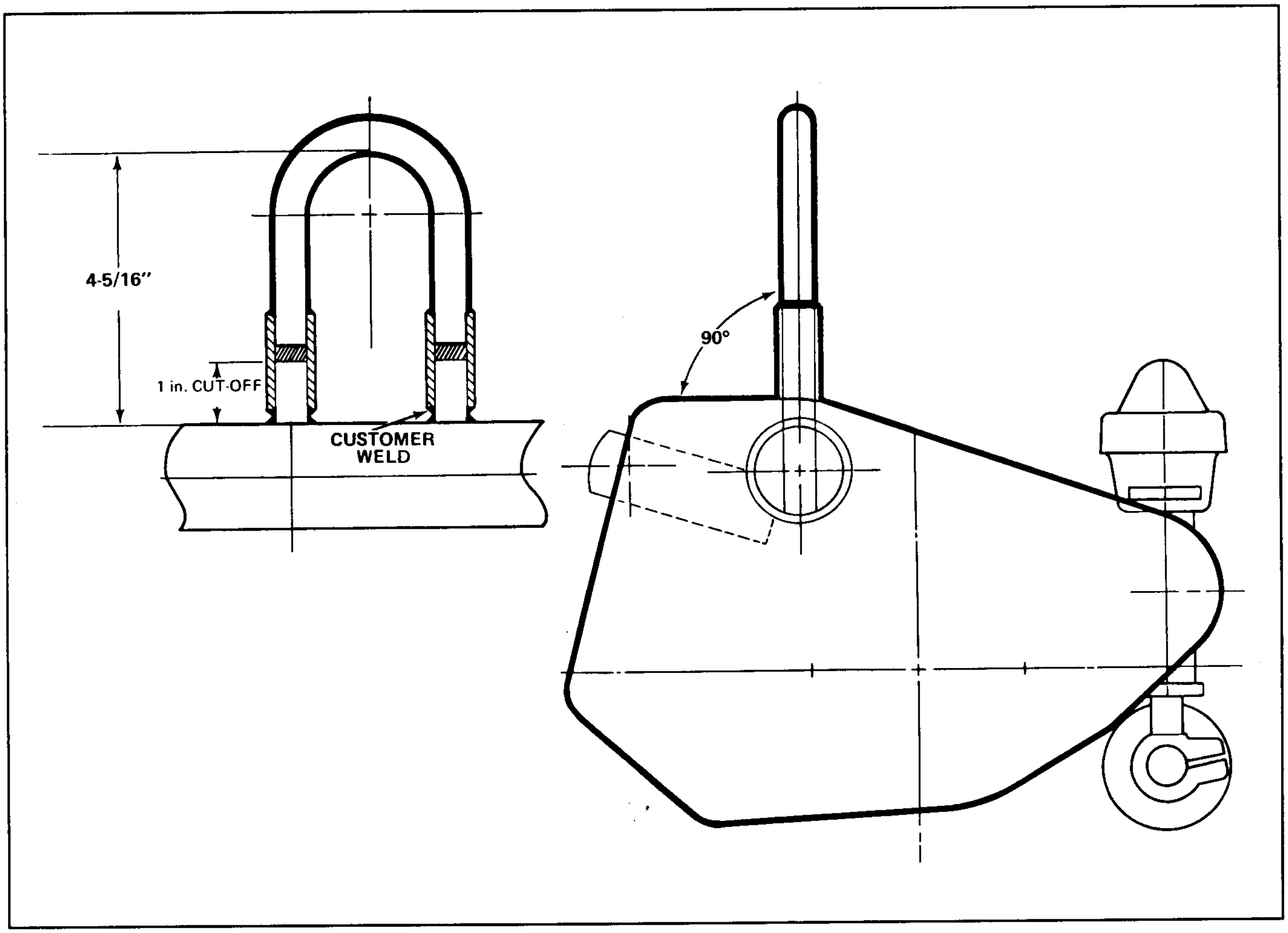


Figure 39

1. Use a saw to cut the lift bail off of the cutting unit. Make the cut 1 inch from the horizontal frame tube (Fig. 38).

2. Use a grinder to remove burrs from the stubs of the lift bail remaining on the cutting unit.

3. Install the repair lift bail (Part No. 71-1600).

4. Support the lift bail so the bottom radius is 4 5⁄16 inches from the top of the horizontal frame tube. Make sure the lift bail is square to the side frame.

5. Weld all around the bottom of the repair lift bail with mild steel rod, both sides.

Chapter 9

Grooming Reel Cutting Units

Table of Contents

Introduction

See **Chapter 7 - 4 Bolt Adjust Cutting Units** for specific information about 4 Bolt Adjust Cutting Units equipped with Grooming Reels. Specific information for 4-Bolt Adjust Cutting Units (i.e., bedknife to reel adjustment, bedbar removal and installation, and leveling rear roller to reel) is not covered in this chapter.

Specifications

Height-of-Cut : 3/32 (0.094) in. to 3/4 (0.75) in.

Clip Frequency and Optimum Height of Cut Range:

Model No	Clip (max.)	Optimum Height of Cut Range
04460 (8 blade reel)	0.25 in.	3/16 to 5/16 in.
04465 (11 blade reel)	0.18 in.	1/8 to 7/32 in.

Roller Adjustment:
Front: Micrometer hand adjustment with bolted clamp lock (1 turn = 0.025 in. height of cut change).
Rear: Roller brackets allow adjustment for different heights of cut. Screw adjustment for leveling.

Bedknife to Reel Adjustment: Bedknife adjusts against reel with positive adjustment control knob located at center of bedbar. Adjustment knob contains detent with .001 in. movement of bedknife for each indexed position.

Groomer Reel Depth: 0.18 in. max. below height of cut.

Groomer Reel Raised Height: 5/16 (0.312) in. from grooming reel height/depth adjustment.

Reel Speed: 1940 rpm (engine speed 2800 rpm).

Groomer Reel Speed: 3200 rpm.

Bedknife Screw Torque: 200 to 250 in-lb.

Reel Splined Drive Nut Torque: 40 to 60 ft-lbs.

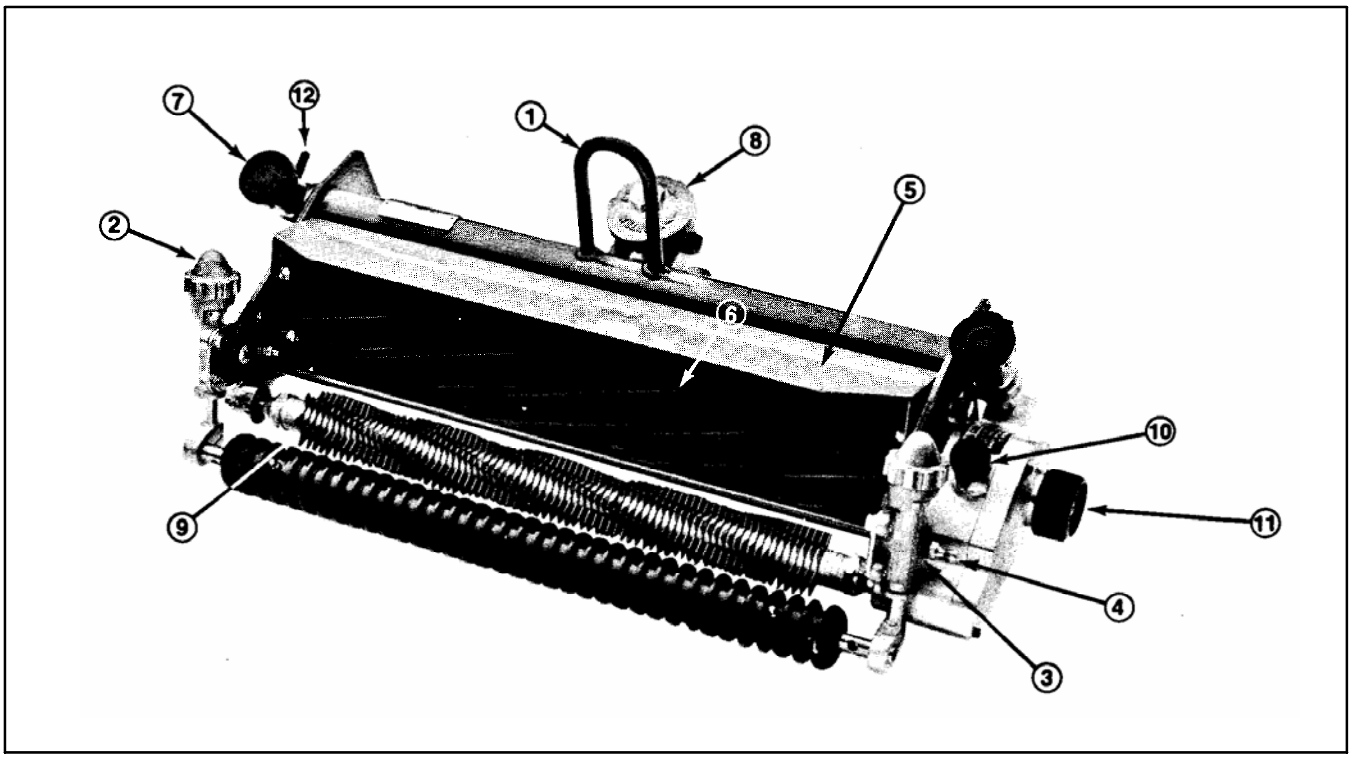
Reel Bearing Rolling Torque: 7 in-lb. max.

Front or Rear Roller Run-Out: 0.014 in. max.

Groomer Reel Drive Belt Tension: 1/4 in. deflection when a force of 5 - 10 lb. is applied midway between drive pulley and driven pulley.

Clutch Adapter Torque: 170 to 210 in-lb.

Clutch Assembly Locknut Torque: 140 in-lb. (removing all end play).



1. **Lift bail**
2. **Height of cut adjustment knob (2)**
3. **Height of cut adjustment locknut (2)**
4. **Pull rod studs (2)**
5. **Grass shield**
6. **Reel**
7. **Groomer micro adjust locknut (2)**
8. **Bedknife adjusting knob**
9. **Groomer reel**
10. **Groomer clutch snubber**
11. **Clutch engage/disengage knob**
12. **Groomer quick up/down lever**

Special Tools

NOTE: Order special tools from the *TORO SPECIAL TOOLS AND APPLICATIONS GUIDE (COMMERCIAL PRODUCTS)*. Some tools may be listed in the Greensmaster 3000 or 3000-D Parts Catalog. Some tools may also be available from a local supplier.

McLube

Aerosol or liquid lubricant. Apply to bedbar pivot and bedbar pivot bolts.

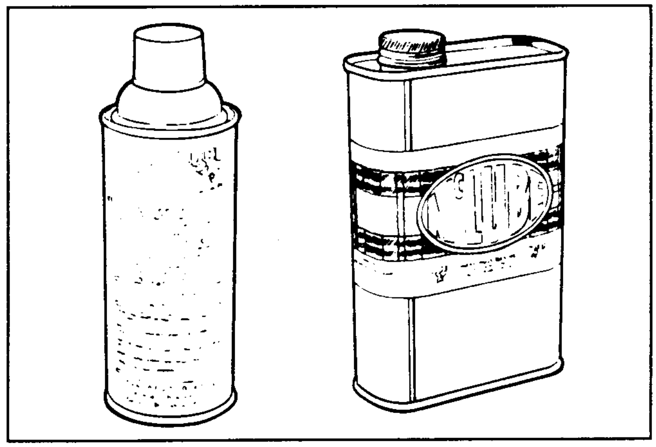


Figure 1

Roller Bearing Replacement Tool

Puller is used to remove bearings from front and rear rollers. Driving tubes are used to install bearings into rollers. Refer to instructions supplied with tool. Used on swaged, full and wiehle rollers.

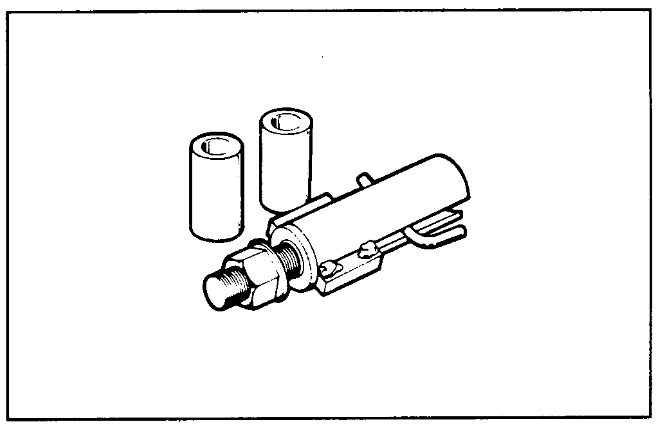


Figure 2

Plastic Plug

Insert plug in cutting unit bearing housing in place of reel motor when sharpening or grinding the reel.

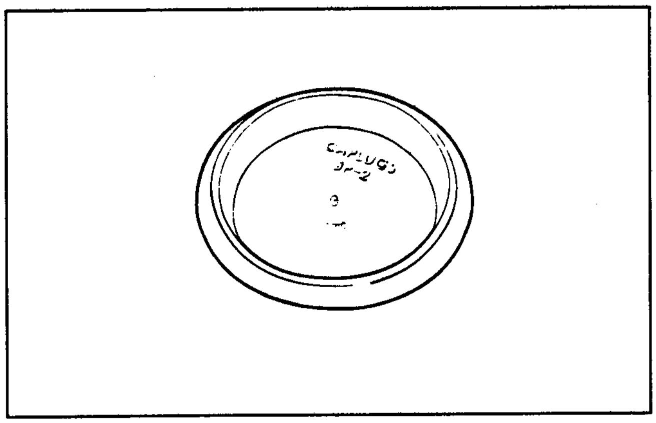


Figure 3

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel assembly.

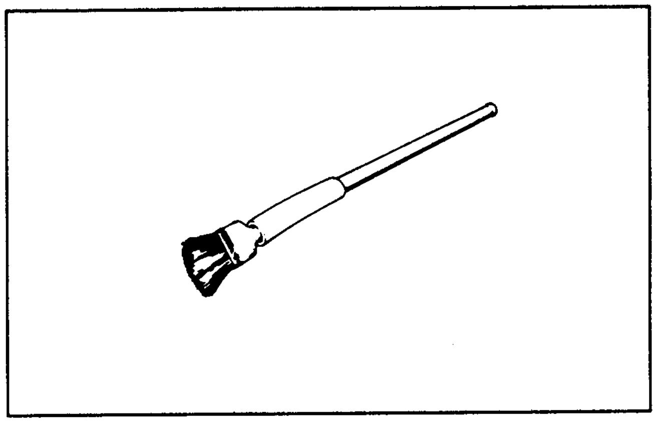


Figure 4

Bedknife Screw Tool

Fits Toro bedknife attaching screws. Use with torque wrench to secure bedknife to bedbar. With clean bedbar threads and new screws, tighten to a torque of 200 in-lb.

NOTE: Remove all rust, scale and corrosion from bedbar surface before installing bedknife.

DO NOT use an air impact wrench with this tool.

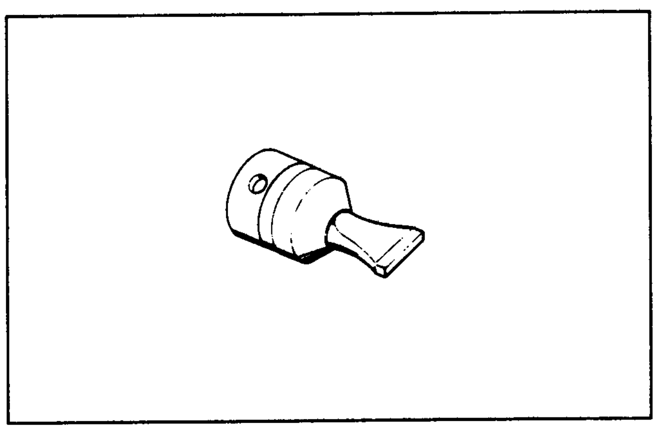


Figure 5

Factors Affecting Quality of Cut

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. See the Adjustments and Repairs sections for detailed adjustment and repair information.

Factor	Possible Problem/Correction
1. Tire pressure.	Check tire pressure adjust to specification if necessary. Must be equal in both front tires.
2. Engine governed speed.	Check maximum governed engine speed. Adjust if necessary – affects reel speed, traction speed and clip frequency.
3. Reel bearing condition/adjustment.	Check and adjust to specification. Replace bearings if worn or damaged. Bearing cones must be installed square to bearing housing - make sure there is no "flash", paint or other foreign material in housing before installing new bearing cone.
4. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded edge cannot be corrected by tightening bedknife to reel contact. Grind reel to remove taper (cone shape) and/or rifling (grooved or ribbed 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 after installing on bedbar to match bedknife to bedbar.
5. Bedknife parallel to reel.	Check and adjust as necessary.
6. Bedknife to reel contact.	Check before operating with cutting unit on ground. Rotate the reel backwards by hand. Turn adjusting knob one (1) click at a time until first contact between reel and bedknife is felt or heard, then tighten one (1) more click to get light contact. No contact will dull the cutting edges. Excessive contact accelerates wear.
7. Bedknife attitude (rear roller bracket hole position).	Set to recommendations in chart on Page 10 - 14.
8. Rear roller parallel to reel.	Check and adjust as necessary.
9. Height of cut.	All cutting units set at same height of cut. Set with front roller – must be equal at both ends of roller. Bench set height of cut and actual (effective) height of cut are different. Effective height of cut depends on cutting unit weight, cutting unit accessories and turf conditions.
10. Proper bedknife for height of cut.	If bedknife is too thick for effective height of cut, poor quality of cut will result.

Factor	Possible Problem/Correction
11. Stability and position of bedbar.	Make sure bedbar bolt plastic washers are snug against bedbar. Bedbar must pivot without binding. Check bedbar end bushings and pivot bushings for wear or damage and replace if necessary. Make sure proper bushings are installed in each location (bedbar end bushings are different from pivot bushings). Check adjustment knob to make sure detent holds adjustment. Repair if necessary. With adj. knob/pivot assembly removed, pivot screws installed, and frame on level surface, measure from flat surface up to end of each setscrew. If not within 1/16 in. of each other, bend ears on cutting unit frame to line up screws. Check to make sure adj. knob/pivot assembly is centered in bedbar arm yoke and frame ears so that an equal gap exists on each side of pivot housing before pivot screws are installed. Make sure bedknife adj. knob/pivot assembly is held firmly in place between frame supports.Tighten pivot screws if necessary.
12. Number of reel blades.	Use cutting unit model with correct number of blades for clip frequency and optimum height of cut range. (Variable speed traction kit can be used to adjust clip frequency.)
13. Cutting unit alignment and pull frame ground following.	Check pull frame alignment on all cutting units. Adjust or repair as necessary. Check pull frames and lift arms for damage, binding and bushing wear. Repair if necessary.
14. Roller condition	All rollers must rotate freely. Grease when needed or repair bearings if necessary.
15. Reel speed.	All reels must rotate at same speed (within 100 rpm). All cutting units must have equal bedknife to reel contact and reel bearing adjustment before checking. Do not run the reel to long or it may get hot and rifle when no grass is being cut. See Troubleshooting in Chapter 5 - Hydraulic System.
16. Traction speed.	Check maximum governed engine speed. Adjust to specification if necessary. See Troubleshooting in Chapter 5 - Hydraulic System Install Variable Speed Traction Kit if necessary to control traction speed in varying conditions or with different attachments. Will allow change in traction speed while maintaining full engine rpm and reel motor rpm.
17. Cutting drop speed and sequence.	Center cutting unit must drop after front cutting unit. (See Troubleshooting in Chapter 5 - Hydraulic System.

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 green to green on the same golf course. It is important to inspect the turf frequently and vary the grooming practice with the need.

It is important to remember that Factors Affecting Quality of Cut also affect grooming performance.

IMPORTANT: Improper or over-aggressive use of the groomer reel (i.e., too deep or too frequent grooming) may cause unnecessary stress on the turf, leading to severe turf damage. Use the groomer cautiously. READ AND UNDERSTAND THE OPERATOR'S MANUAL BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

Variables That Affect The Use and Performance of Grooming Reels:

1. Time or year (i.e., growing season) and weather patterns.

2. General turf conditions.

3. Frequency of grooming/cutting - how many cuttings per week and how many passes per cutting.

4. Grooming reel blade spacing.

5. Height of cut. NOTE: Because of weight difference, "bench set height of cut" should be approximately 0.020 to 0.040 in. higher on groomer equipped cutting units to get the same "effective height of cut" as cutting units without groomer reels.

6. Grooming depth.

7. How long grooming reel has been in use on a particular turf area.

8. Type of grass.

9. Overall turf management program (i.e., irrigation, fertilizing, weed, disease and pest control, coring, overseeding, sand dressing, etc.).

10. Amount of traffic on turf.

11. Stress periods for turf (i.e., high temperatures, high humidity, unusually high traffic).

Grooming Reel Mechanical Problems

Problem	Possible Cause/Correction
1. Groomer rotates when in raised position with clutch disengaged.	Normal condition - the groomer may still rotate in raised position (with minimal force) when clutch disengaged because of friction in the clutch assembly. This condition may change over a period of time. Clutch not fully disengaged. Make sure clutch knob set screws are tight against flats on release disk and does not allow knob to slip. IMPORTANT: When engaging or disengaging clutch, be sure to push snubber down and turn knob all the way (will come to a firm stop) Clutch pulley bearing seized. Replace bearing. Clutch damaged or assembled incorrectly. Repair or replace clutch if necessary.
2. Clutch is engaged but does not provide power to groomer reel.	Clutch not fully engaged. Make sure clutch knob set screws are tight against flats on release disk and does not allow knob to slip. IMPORTANT: When engaging or disengaging the clutch, be sure to push the snubber down and turn the knob all the way (it will come to a firm stop) Clutch damaged or assembled incorrectly. Repair or replace clutch if necessary. Belt is out of adjustment. If belt has slipped. it will probably be damaged and must be replaced. Belt broken or damaged. Repair or replace belt if necessary. A broken or worn belt could be the result of improper belt adjustment or seized groomer reel bearings.
3. Turf damage or uneven grooming.	Bent, damaged or missing groomer blades. Replace blades if necessary. Bent or damaged groomer reel shaft. Replace groomer shaft. Grooming depth not equal on both ends of groomer reel. Adjust if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height of cut, etc.)
4. Groomer reel does not raise completely to transport position – quick-up levers do not rotate completely to rear or have free play.	Groomer reel interfering with cutting unit frame side plate. Check side plate for proper cut-out and modify if necessary. Incorrect front roller extension plate installed. Single Point Adjust and 4-Bolt Adjust cutting units require different front roller extension plates.

Adjustment Summary and Check List

DETAILED ADJUSTMENT INSTRUCTIONS FOLLOW THIS SUMMARY AND CHECK LIST. Study this information and refer to it often for maximum life and performance of cutting units.

Daily Performance Checks

NOTE: It is not necessary to remove the cutting units from the traction unit to perform these daily checks. It is recommended that mowers be washed after each use. Always remove key from ignition switch when working on the machine.

1. Purge all water and debris from all bearings by greasing them. Use No. 2 multi-purpose lithium base grease.

2. Visually check for sharp reel and bedknife.

- Remove burrs, nicks, and rounded edges.

3. Visually check groomer reel for wear and damage.

- Straighten bent blades.
- Replace worn blades or reverse groomer reel to put sharpest blade edge forward.
- Make sure right and left shaft end nuts are tight.

4. Lower cutting units to the ground (setting on both rollers) and remove reel motor. Rotate the reel by hand. TURN ADJUSTING KNOB ONE (1) CLICK AT A TIME UNTIL FIRST CONTACT BETWEEN REEL AND BEDKNIFE IS FELT AND HEARD THEN TIGHTEN ONE (1) MORE CLICK TO GET LIGHT CONTACT *.

- No contact will dull the cutting edges.
- Excessive contact accelerates wear; quality of cut may be adversely affected.

* It is best to make the reel to bedknife adjustment in the morning, immediately before each day of mowing.

Weekly Checks

1. Check reel bearing adjustment and bearing condition.

2. Make sure bed bar bolt "plastic washers" are SNUG against the bedbar.

3. Make sure bedknife adjustment knob/pivot assembly is held FIRMLY in place between frame supports.

4. Use a gauge bar to check height of cut setting.

5. Use a gauge bar to check groomer depth setting.

Monthly Adjustments

NOTE: Remove cutting unit from traction unit.

1. Parallel bedknife to reel.

- Use newspaper as a feeler gauge.
- Dot on eccentric bolt must face rear of mower.
- Turn bedknife adjustment knob to hold paper on right-hand end of bedknife.
- Turn eccentric (left) bedbar bolt to hold paper on left-hand end of bedknife.
- Hold eccentric bedbar bolt while securing locknut.

2. Adjust rear roller parallel to reel; eccentric bolt faces to rear.

3. Check grass shield adjustment.

- 4-3/4 in. from crossbar - normal.
- Dry grass - lower shield.
- Wet grass - raise shield.

4. Set top bar (cut-off bar) adjustment.

- 0.060 in. from reel - normal.

5. Set cutting unit on ground (setting on both rollers) and remove reel motor. Adjust bedknife to reel contact.

6. Use a gauge bar to check height of cut and adjust as necessary.

7. Use a gauge bare to check groomer depth and adjust as necessary.

Special Notes

1. Replace bedbar bushings and nylon flange bushings every two years.

2. A "rifled" reel and/or bedknife must be corrected by grinding.

3. After extended running, notches will develop at both ends of bedknife. These notches must be rounded off or filed flush with cutting edge of bedknife to assure smooth operation.

4. If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft *spline nut* on right hand end of reel shaft to a torque of 40 to 60 ft-lb., then adjust reel bearings.

Bedknife to Reel Contact

NOTE: The single knob bedknife-to-reel adjustment system simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with the single knob/bedbar design gives the necessary control to provide a continual self-sharpening action – thus maintaining sharp cutting edges, assuring good quality-of-cut, and greatly reducing the need for routine backlapping. In addition, the rear roller positioning system permits optimum bedknife attitude and location for varying heights-of-cut and turf conditions.

IMPORTANT: Bedknife to reel contact must be checked and adjusted every day even though quality of cut is acceptable.

1. Shut off engine and lower cutting units to ground. Remove the key.

2. Remove grass baskets.

3. Make sure the groomer reel is in the raised position. Raise the groomer reel by rotating the right and left quick up levers so they face to the rear (Fig. 6.)

4. Make sure the groomer reel is disengaged. Push the clutch snubber down and turn the clutch knob clockwise to disengage the clutch (Fig. 6).

IMPORTANT: When engaging or disengaging the clutch, be sure to turn the knob all the way (it will come to a firm stop). Failure to do so could cause damage to the clutch.

5. On each cutting unit, loosen (2) flange nuts securing reel motor to cutting unit. Twist motor clockwise to disengage from cutting unit and remove motor.

6. Slowly rotate reel, listening for reel-to-bedknife contact. If no contact is evident, TURN BEDKNIFE ADJUSTING KNOB CLOCKWISE, ONE (1) CLICK AT A TIME, UNTIL FIRST CONTACT IS FELT AND HEARD, THEN TIGHTEN ONE (1) MORE CLICK TO GET LIGHT CONTACT (Fig. 7).

7. If contact is felt, turn bedknife adjusting knob counterclockwise, one (1) click at a time until no contact is evident. Turn bedknife adjusting knob one (1) click at a time clockwise, until first contact is felt and heard, then tighten one (1) more click to get light contact.

8. Install hydraulic motor to cutting unit.

IMPORTANT: LIGHT CONTACT MUST BE MAINTAINED AT ALL TIMES. If light contact is not maintained, bedknife and reel edges will not self-sharpen sufficiently. This will result in dull cutting edges 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 is occasionally run across the front edge to remove this burr, improved cutting performance can be obtained.

NOTE: After extended operation, notches 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.

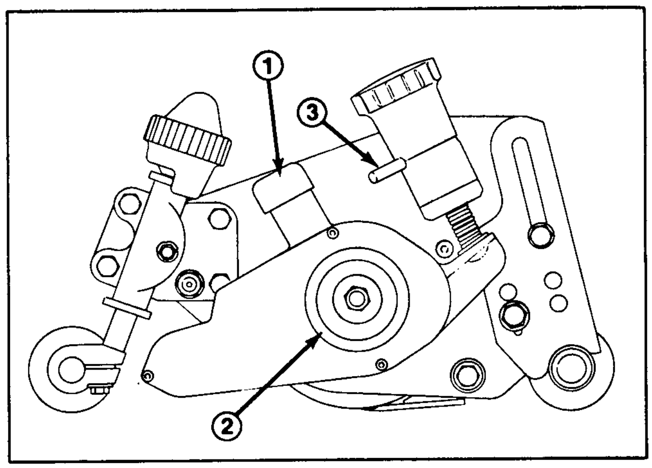


Figure 6

1. Clutch snubber
2. Clutch knob
3. Quick up lever (2)

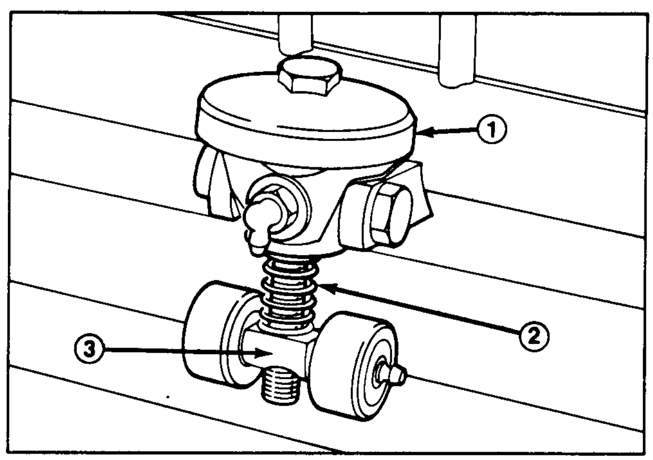


Figure 7

1. Bedknife adjusting knob
2. Compression spring
3. Pivot bar

Reel Bearing Service and Adjustment

1. Remove bedknife to reel contact by turning bedknife adjustment knob counterclockwise (Fig. 7).

2. Loosen two (2) set screws and remove clutch knob (Fig. 6). Remove groomer reel housing cover from left side of cutting unit (Fig. 8). Loosen idler pulley and remove drive belt. (Fig. 9).

3. Reel bearing rolling torque should not exceed 7 in-lb. Measure with a torque wrench at the spline nut on the right-hand end of the reel shaft.

NOTE: If bearing drag does not meet above specification or if you do not have an inch-pound torque wrench, do remaining steps in this procedure.

4. Remove nut and washer from clutch adapter shaft. Pull clutch assembly off adapter shaft (Fig. 9). Remove clutch adapter from reel shaft (Fig. 10).

CAUTION

Do not use your hand to prevent reel from turning while servicing; this can result in personal injury. Use a 1/2 in. thick x 3 in. wide x 8 in. long piece of hardwood inserted into front of cutting unit between reel blades.

NOTE: If reel bearings will not hold adjustment during operation, loosen adjustment nut, tighten reel shaft *spline nut* on right hand end of reel shaft to a torque of 40 to 60 ft-lb, then adjust reel bearings.

5. Loosen large reel bearing adjustment nut (Fig. 10). Tighten nut until all reel shaft end play is removed, then tighten an additional 1/16 to 1/8 turn. Be certain to remove all end play, but do not over-tighten. Rolling torque should not exceed 7 in-lb.

NOTE: Adjustment nut must have enough resistance against reel shaft threads to retain bearing adjustment. Replace adjustment nut if necessary.

6. If bearings require replacement, see Reel Removal and Bearing Replacement in the Repairs section of this chapter.

7. Install clutch adapter on reel shaft (Fig. 10) and tighten to a torque of 170 - 210 in-lb.

8. Hold belt on drive pulley and slide clutch on clutch adapter while sliding belt on driven pulley. Install washer and nut (removed in step 4) on clutch adapter shaft and tighten nut to a torque of 7 - 10 ft-lb. Adjust drive belt tension before installing cover. (See Groomer Reel Drive Belt Adjustment in this section of the book.)

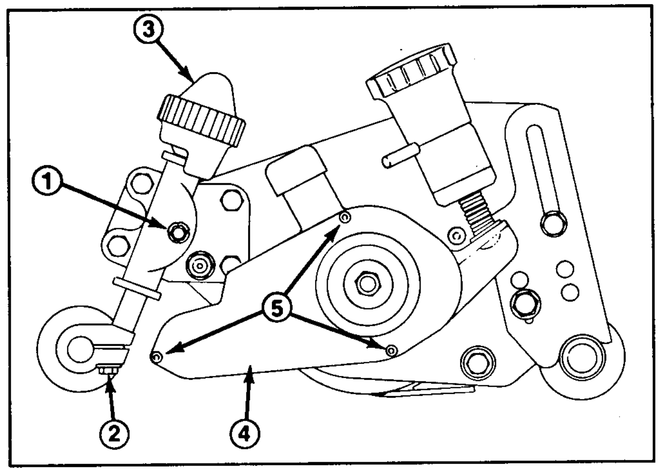


Figure 8

1. **Height of cut locknut**
2. **Roller shaft clamp bolt**
3. **Height of cut knob**
4. **Grooming reel cover**
5. **Cover screws & washers**

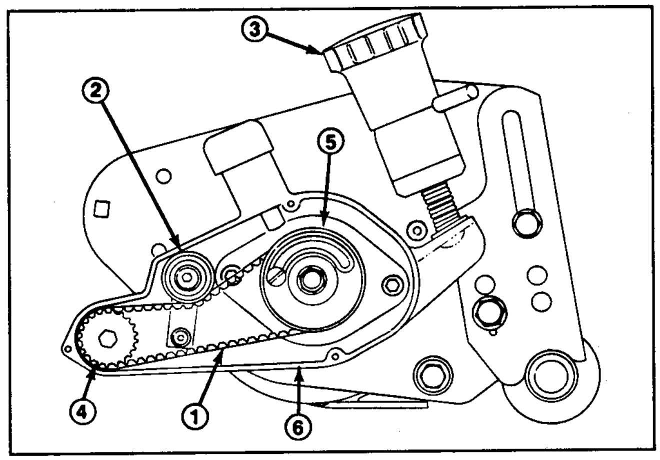


Figure 9

1. **Drive belt**
2. **Drive belt idler pulley**
3. **Grooming reel adjustment knob assembly**
4. **Groomer driven pulley**
5. **Clutch assembly**
6. **Groomer reel housing**

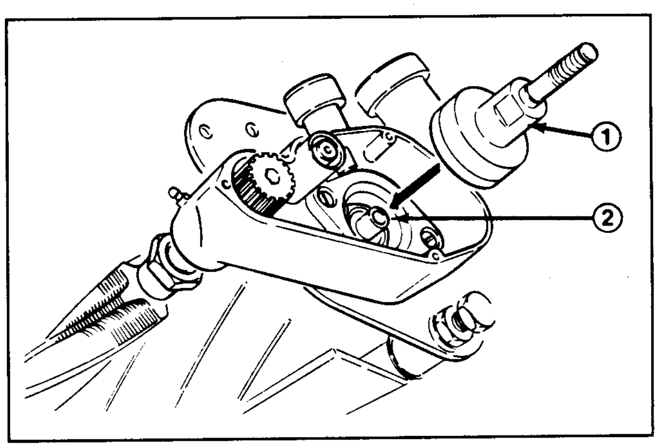


Figure 10

1. **Clutch adapter shaft**
2. **Reel shaft and bearing adjustment nut**

Parallel Bedknife to Reel

1. Remove mower from traction unit and put on a level work surface. Make sure reel contact is removed by turning bedknife adjustment knob counterclockwise.

2. On right-hand end of reel, insert a long strip of newspaper between the reel and bedknife. While slowly rotating reel forward, turn bedknife adjusting knob (Fig. 11) clockwise, one click at a time, until paper is pinched lightly resulting in a slight drag when paper is pulled.

3. Check for light contact at other end of reel using paper. If light contact is not evident at both ends, bedknife is not parallel to reel, proceed to step 4.

4. Loosen jam nut on left hand bedbar pivot bolt so bolt can be turned. Left hand pivot bolt (eccentric bolt) has offset thread which, when rotated, acts as a cam to raise or lower the bedbar. Identification dot on bolt head denotes offset of bolt. When dot is in up position (Fig. 12) left end of bedbar is raised. As bolt is turned clockwise and dot is lowered, so is left end of bedbar. Identification dot must be positioned within rear (180°) position when adjusting.

5. Rotate left hand (eccentric) pivot bolt to raise or lower bedbar as required.

6. Check adjustments by repeating steps 2 and 3.

7. After getting light contact on paper at each end of bedknife, hold left-hand pivot bolt in position and tighten jam nut. Make sure pivot bolt did not get out of adjustment when turning jam nut. Adjust again if necessary.

NOTE: If the reel has worn so you cannot get the bedknife parallel to the reel by turning the eccentric bolt, the reel will require grinding to remove taper. The reel normally wears faster on the lead-in side, which results in the described taper.

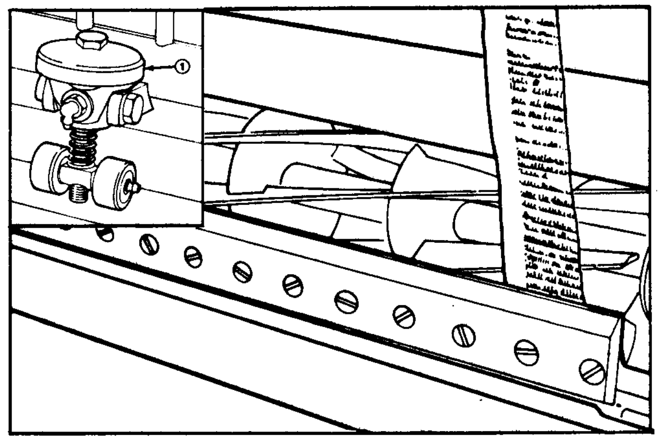


Figure 11

1. Bedknife adjusting knob

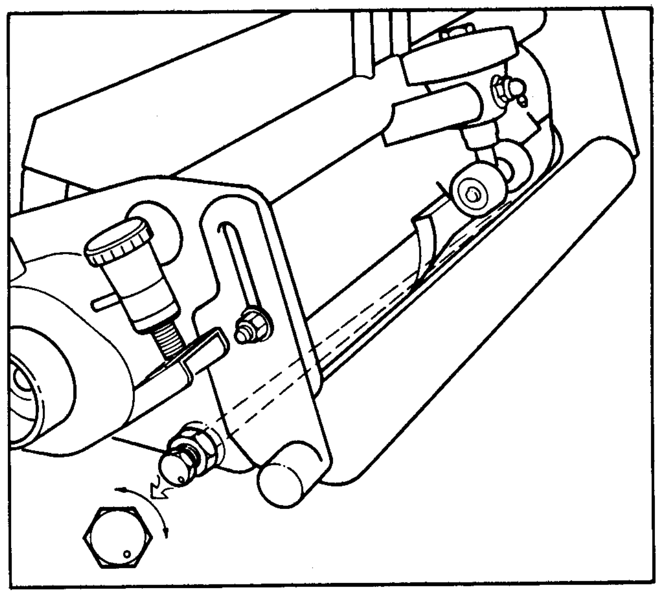


Figure 12

Leveling Rear Roller to Reel

1. Put cutting unit on a flat, level surface.

2. Assemble rear height of cut brackets to desired position, by loosening top capscrew and nut and removing bottom nut on right and left hand sides of cutting unit (Fig. 13).

3. Slide bolts thru each bracket until brackets can be realigned with appropriate mounting hole. See table for proper position on brackets.

NOTE: The different rear roller bracket positioning holes (B thru E) are designed to optimize bedknife location for different heights of cut.

Rear Roller Bracket Hole Position – 8 Blade Cutting Units
Height of cut 3/16 (.187) in. and below use the **B** position Height of cut 5/32 (.156) in. and above Use the **C** position Height of cut between 5/32 (.156) and 3/16 (.187) in., try **C** first; if not satisfactory, use **B**
NOTE: For Height of Cut 5/32 (.156) in. and lower use 3/32 in. (tournament) bed knife. Tournament bed knife should not be necessary with the rear roller in the C position.

Rear Roller Bracket Hole Position – 11 Blade Cutting Units
Height of cut 3/16 (.187) in. and below use the **B** position Height of cut 5/32 (.156) in. and above Use the **C** position Height of cut between 5/32 (.156) and 3/16 (.187) in., try **B** first; if not satisfactory, use **C**
NOTE: For Height of Cut 3/16 (.187) in. and lower use 3/32 in. (tournament) bed knife. Tournament bed knife should not be necessary with the rear roller in the C position.

NOTE: The "B" hole position normally is the best rear roller location for most low (3/32" - 1/8") cutting conditions.

It may be necessary to change from the above suggested ranges in certain turf conditions.

4. After putting bracket into correct height-of-cut hole position make sure right hand rear roller bracket capscrews are tightened securely (Fig. 14).

5. Left hand rear roller bracket capscrews are to be tightened only enough to remove excessive looseness in assembly, but allow bracket to slide freely on side plate.

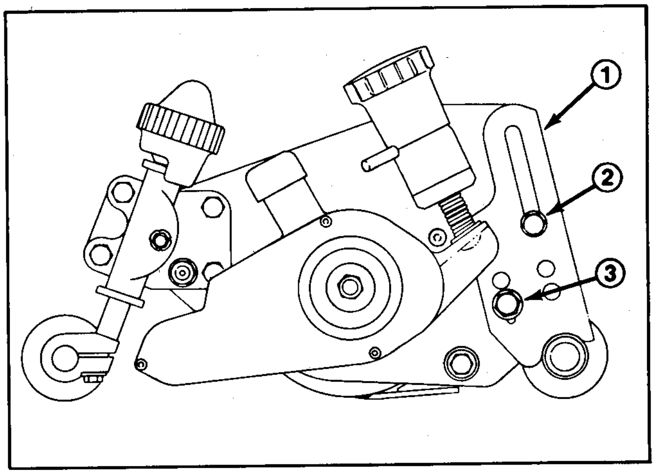


Figure 13

1. Rear height of cut bracket 3. Bottom nut
2. Top capscrew and nut

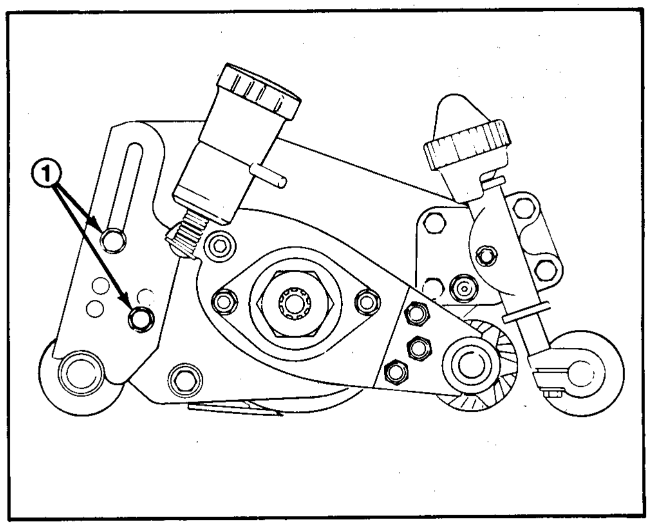


Figure 14

1. Right rear roller bracket capscrews

6. Position a 1/4 inch or thicker plate under the reel blades and against the front face of the bed-knife (Fig. 15).

NOTE: Make sure plate covers full length of reel blades, and (3) blades contact plate (8 blade reel).

7. While holding reel securely on plate, level roller by rotating lower left roller pivot bolt. The pivot bolt has an offset thread which when rotated, acts as a cam to raise or lower the roller. On the bolt head there is an identification dot (Fig. 16) which denotes the offset of the bolt. Dot indicates in which direction left end of roller moves when bolt is turned.

8. To verify if roller is level, try inserting a piece of paper under each end of roller.

9. When roller is level, tighten left capscrew and pivot bolt nuts securely. Hold the eccentric pivot bolt while tightening the nut to keep the proper roller position.

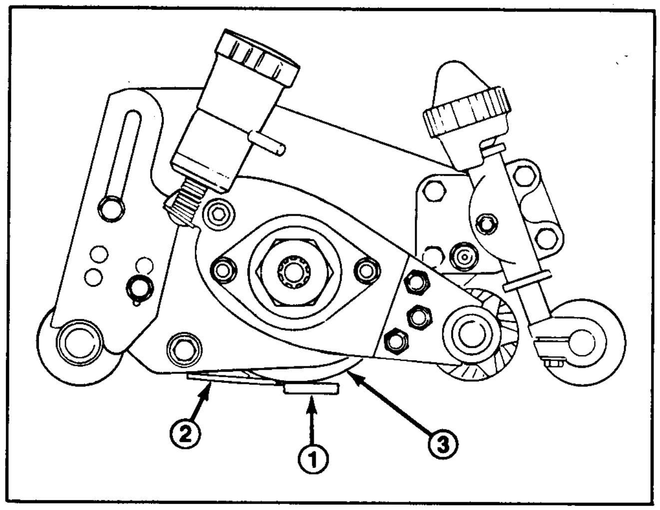


Figure 15

1. 1/4" plate
2. Bedknife
3. Reel

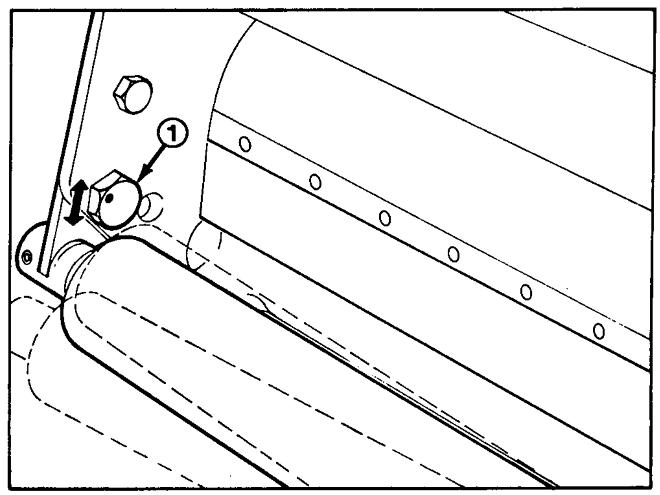


Figure 16

1. Pivot bolt

Height of Cut

Height of cut, as measured on the cutting unit and in the turf is different. The grass prevents the cutting unit from settling all the way to the ground line as the machine moves across the turf. Because of this, the actual (effective) height of cut is higher than the height of cut setting on the cutting unit (bench set height of cut) (Fig. 17).

Machine conditions, such as cutting unit weight, roller type, bedknife thickness, speed of travel and clip frequency, influence effective height of cut. Turf conditions, such as grass type, grass density, and amount of thatch also influence effective height of cut.

Changing the machine (such as adding a wiehle roller, or changing to a heavier grooming reel cutting unit) will increase penetration into the turf and lower the effective height of cut.

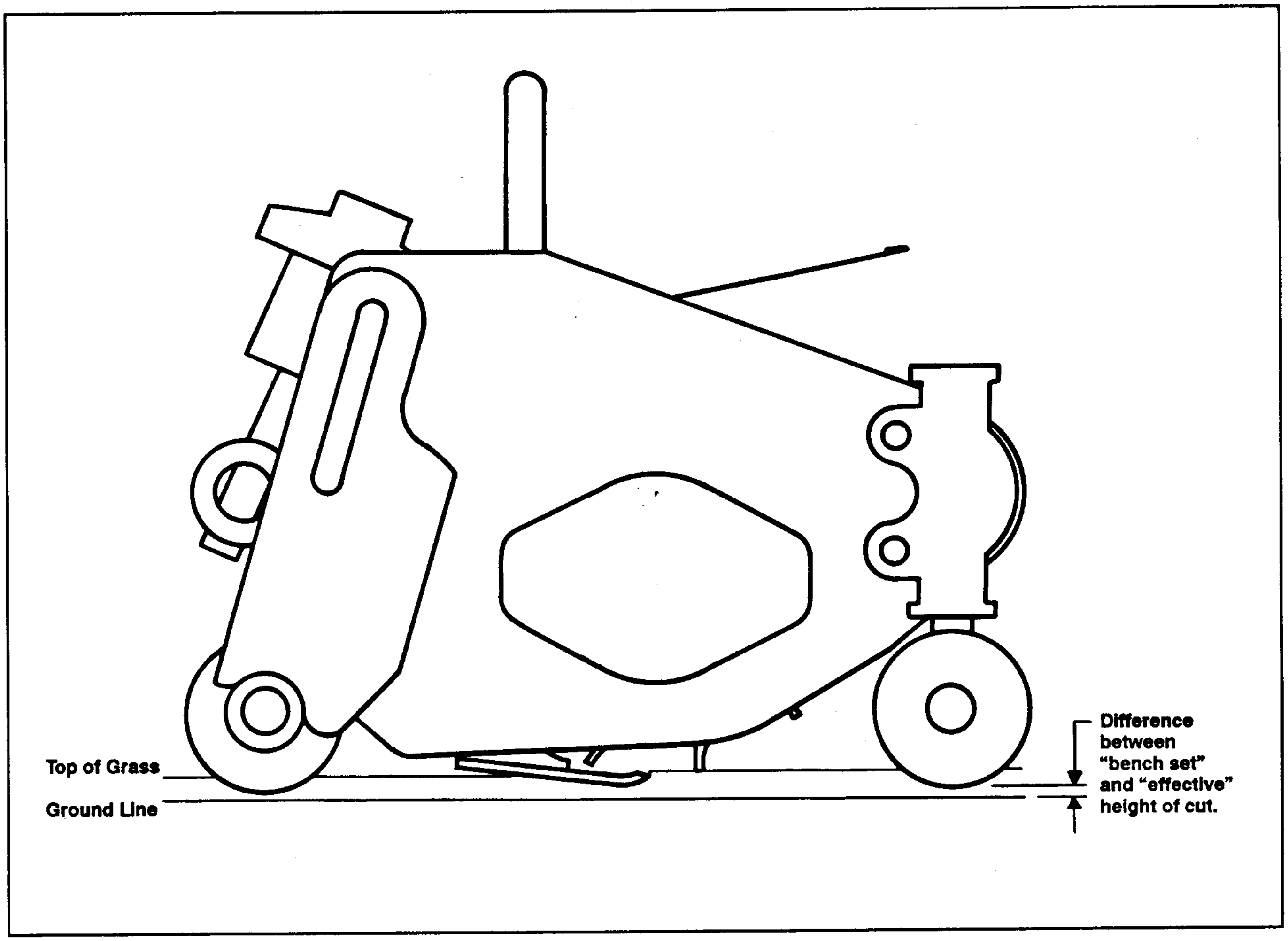


Figure 17

Height of Cut Adjustment

IMPORTANT: Lower heights of cut are limited by thickness of bedknife. Select proper bedknife for desired height of cut. If bedknife is too thick for height of cut, poor quality of cut will result and excessive pressure from turf on bottom of bedknife can cause "rifling" of bedknife and reel.

NOTE: Because of weight difference, "bench set height of cut" should be approximately 0.020 to 0.040 in. higher on grooming reel cutting units to get the same "effective height of cut" as cutting units without groomers.

1. Make sure that rear roller brackets are in correct hole positions for desired height of cut and that rear roller is level. Also, check that bedknife to reel contact is correct.

2. Turn cutting unit over and loosen locknuts securing front roller adjusting screws to height of cut brackets (Fig. 18).

3. On gauge bar (Part No. 1-8789), set head of screw to desired height of cut. This measurement is from bar face to underside of screw head.

4. Place bar across front and rear rollers and adjust height of cut knob until underside of screw head engages bedknife cutting edge (Fig. 18). Check and adjust on each end of bedknife, then tighten height of cut adjustment locknuts on each end.

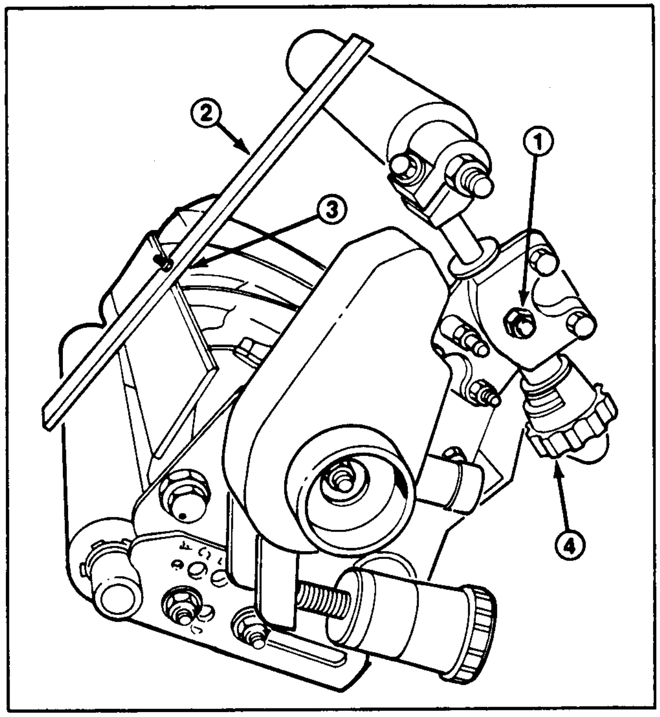


Figure 18

1. **Height of cut knob locknut**
2. **Gauge bar (1-8789)**
3. **Screw head over bedknife**
4. **Adjustment knob**

Changing To A Different Type of Cutting Unit or Adding Cutting Unit Accessories

When changing to a different type of cutting unit or adding cutting unit accessories, it is recommended that you change only one cutting unit, and keep the other two existing cutting units on the machine.

1. Set the new cutting unit to a height of cut approximately 1/16 (0.06) in. higher than the old cutting unit.

2. Do a mowing test and compare results between the new cutting unit and old cutting units.

3. Adjust the new cutting unit to match the cut of the old cutting units.

4. The other two cutting units can now be replaced. Adjust these two new cutting units so they are the same as the other new cutting unit that was tested.

Groomer Reel Depth Adjustment

1. Adjust cutting unit height of cut before doing groomer reel depth adjustment.

2. Hold clutch snubber down and rotate the clutch clockwise to disengage the clutch (Fig. 6). Rotate both quick up levers to lower the grooming reel into grooming position.

3. Hold a straight bar securely against the front and rear rollers on one side of the cutting unit (Fig. 19). While holding the bar in place, lift and turn the micro adjustment knob until the groomer blade just touches the bar (rotating the groomer reel by hand will assist in determining if blades are lightly touching the bar).

4. Repeat step 3 on the opposite side of the cutting unit, then check the adjustment on the other side again. Adjust again if necessary.

5. Each notch on the micro adjustment knob equals approximately 0.007 in. of groomer height/depth. Divide the desired height/depth setting of the groomer reel by 0.007 to determine how many notches to turn the micro adjustment knob. Make sure each knob is turned the same number of notches. Turn counterclockwise to raise groomer reel and clockwise to lower.

   Example: Desired groomer setting of 1⁄32 (0.03125) in. higher than bottom of rollers:

   0.03125 ÷ 0.007 = 4.46 (4 or 5 notches)

6. Rotate both quick up levers to raise the grooming reel into transport position. Make sure the clutch is disengaged.

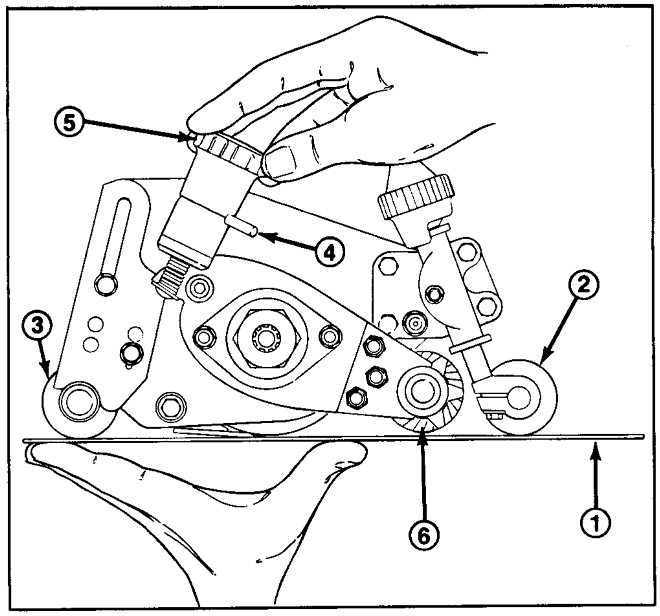


Figure 19

1. **Bar**
2. **Front roller**
3. **Rear roller**
4. **Quick up lever (2)**
5. **Micro adjustment knob (2)**
6. **Groomer reel touching bar**

Shield Height Adjustment

Adjust shield to get proper grass clipping discharge into basket:

1. Set cutting unit in normal cutting position and measure distance from top of front crossbar to shield at each end of cutting unit (Fig. 20).

2. Height of shield from crossbar for normal cutting conditions should be 4-3/4 inches. Loosen capscrews and nuts securing shield to each side plate, adjust shield to correct height and tighten fasteners (Fig. 20).

3. Repeat adjustment on remaining cutting units and adjust top bar. (See Adjusting Top Bar in this section of the book.)

NOTE: Shield can be lowered in dry grass conditions (clippings fall over top of baskets) or raised to allow for heavy wet grass conditions (clippings build up on rear edge of baskets).

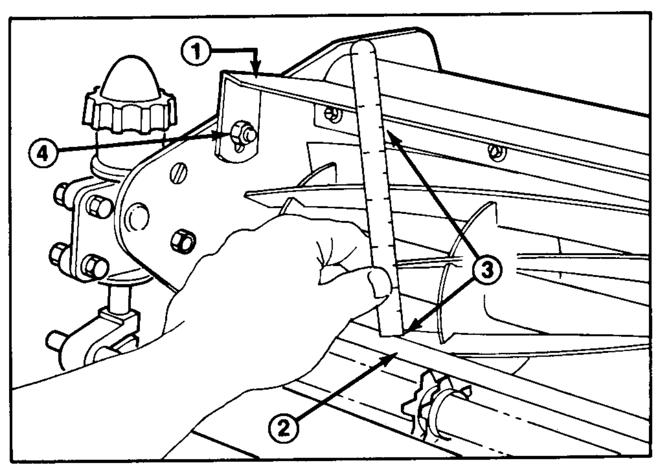


Figure 20

1. **Shield**
2. **Front crossbar**
3. **4-3/4 inches**
4. **Shield fasteners**

Top (Cut Off) Bar Adjustment

Adjust top bar to make sure clippings are cleanly discharged from reel area:

1. Loosen screws securing top bar (Fig. 21). Insert 0.060 inch feeler gauge between top of reel and bar and tighten screws. Make sure bar and reel are equal distance apart across complete reel.

2. Repeat settings on remaining cutting units.

NOTE: Bar is adjustable to compensate for changes in turf conditions. Bar should be adjusted closer to reel when turf is extremely wet. By contrast, adjust bar further away from reel when turf conditions are dry. Bar should be parallel to reel to get optimum performance and should be adjusted whenever shield height is adjusted or whenever reel is sharpened on a reel grinder.

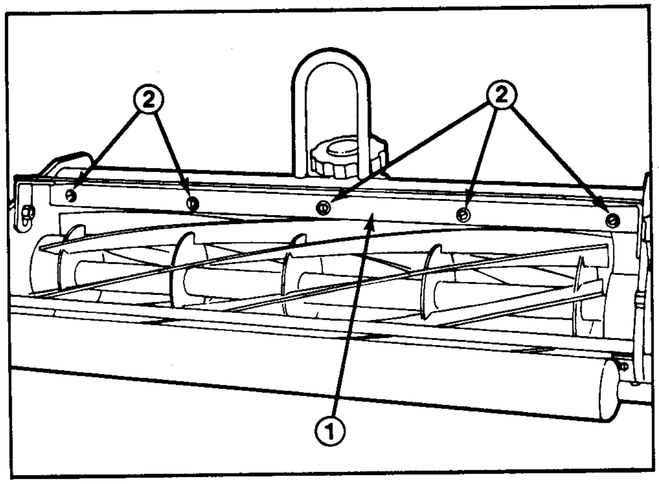


Figure 21

1. Top bar
2. Bar mounting screws

Groomer Reel Drive Belt Adjustment

1. Loosen two (2) set screws and remove clutch knob (Fig. 6). Remove groomer reel housing cover from left side of cutting unit (Fig. 8).

2. Apply 5-10 lb. of force on the belt midway between the pulleys to check tension on the drive belt. There should be 1/4 inch belt deflection. If deflection is not 1/4 inch, loosen the idler pulley pivot screw (Fig. 22). Pivot the idler to get proper tension and tighten the allen head screw to a torque of 7-10 ft-lb.

3. Install groomer reel housing cover. Install clutch knob and tighten two (2) set screws against flats on release disk.

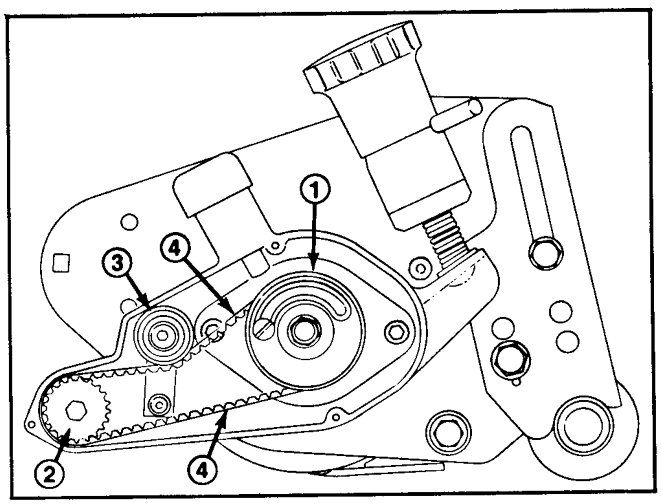


Figure 22

1. Drive pulley and clutch assembly
2. Driven pulley
3. Drive belt (backside) idler pulley
4. Drive belt

Pull Frame Adjustment

1. Put the basket on the pull frame.

2. Level baskets to cutting unit by loosening nut at one end of pull frame roller. Loosen bolt and move roller shaft in slot as necessary. Tighten bolt.

3. Loosen the jam nuts on the pull arms and adjust the ball sockets until there is 1/4 in. to 1/2 in. (6 to 13 mm) clearance between the lip of the basket and the reel blades (Fig. 23a). This prevents grass clippings from dropping on the ground.

4. Make sure the basket lips are the same distance from the reel blades at both ends of the reel. If the basket is too close to the reel, it is possible for the reel to contact the basket at the instant the cutting unit is raised off the ground.

5. Make sure each of the three (3) cutting units track straight with the traction unit:

   A. On a smooth, level surface, draw a straight line on the floor (Fig. 23b). Push traction unit forward (removing slack from pull arms) so center of each front wheel is on top of the line. Use a plumb bob or square to make sure each wheel is centered on the line.

   B. Measure from each end of cutting unit front roller to chalk line. Distance from each end of roller to line must be equal within 3/16 (0.187) in.

   C. Loosen jam nuts on pull arms and adjust ball sockets so distance from each end of roller to line is within 3/16 (0.187) in.

NOTE: If a cutting unit cannot be adjusted to track correctly with the traction unit, the pull frame, or lift arm is damaged and/or the lift arm and pull frame bushings are worn and must be replaced.

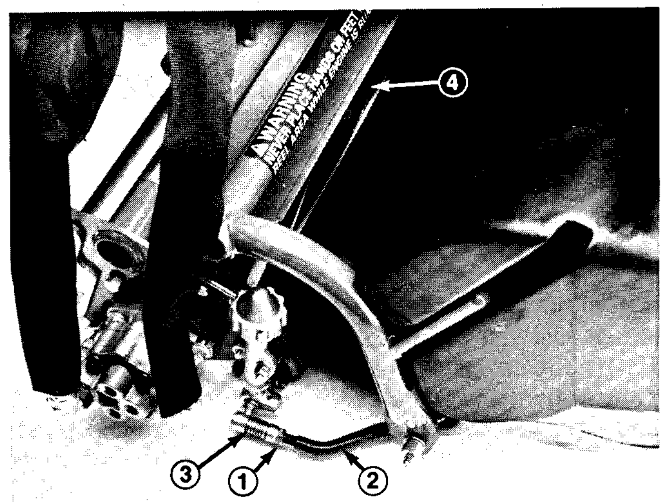


Figure 23a

1. Jam nut
2. Pull arm
3. Ball joint - adjust for clearance
4. 1/4 - 1/2 in. (6 - 13 mm) clearance

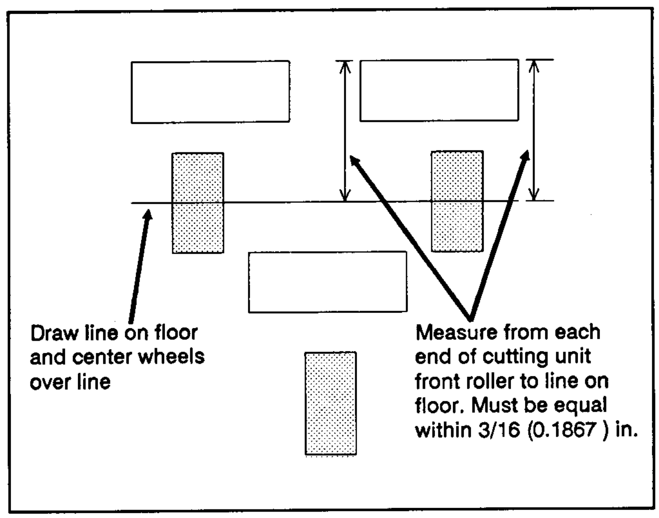


Figure 23b

1. Jam nut
2. Pull arm
3. Ball joint - adjust for clearance
4. 1/4 - 1/2 in. clearance

Repairs

Cutting Unit Removal and Installation

Remove cutting unit from traction unit before doing adjustments or repairs.

1. Remove basket from pull frame.

2. Loosen reel motor mounting nuts (Fig. 24). Rotate the motor clockwise so motor flanges clear studs and pull motor off of cutting unit.

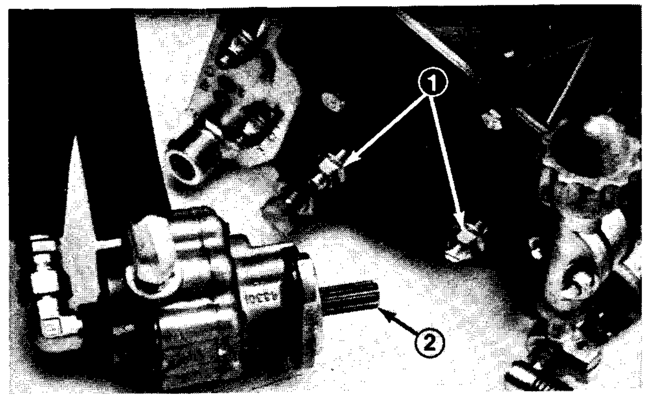


Figure 24

1. Motor mount nuts
2. Motor shaft

3. Slide the sleeve back on the ball joint and disconnect the pull arm from each side of the cutting unit (Fig. 25).

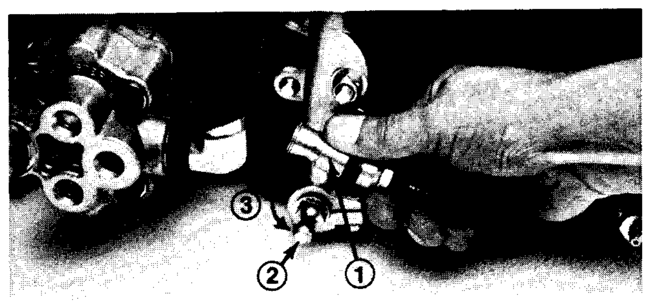


Figure 25

1. Slide back to mount
2. Ball stud
3. Swing up to remove, down to install

4. Slide cutting unit out from under pull frame, disengaging the lift arm from the lift bail (Fig. 26).

5. Reverse steps 1 - 4 to install the cutting unit.

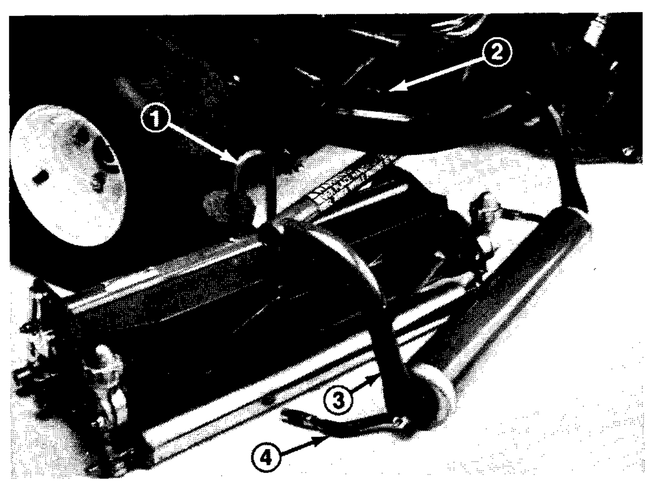


Figure 26

1. Lift bail
2. Lift arm
3. Pull frame
4. Pull arm

Reel Lapping

Check reel bearing adjustment and correct if necessary before backlapping. Make sure bedknife is parallel to reel. On groomer equipped cutting units, backlap by using a length of 3/8 in. square stock inserted into the center hole in the reel shaft on the reel drive motor end of the cutting unit. Attach a socket, extension and backlapping machine. Backlap according to procedures in the Toro publication "Sharpening Reel & Rotary Mowers" Form No. 80-300-PT.

NOTE: For a better cutting edge, run a file across front face of bedknife when lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

CAUTION

Be careful when lapping the reel because contact with the reel or other moving parts can result in personal injury.

Bedbar Removal and Installation

1. Loosen pivot screws securing bedknife pivot assembly to reel frame supports (Fig. 27).

2. Rotate adjustment knob and pivot assembly clockwise (left hand thread) until it is unthreaded from bedbar pivot (Fig. 27).

3. Loosen jam nuts retaining right and left bedbar pivot bolts. Remove pivot bolts (Fig. 27).

IMPORTANT: Note position of plastic washer and steel washer on right end of bedbar, and plastic washer on left end of bedbar for reinstallation.

4. Slide bedbar down and out from under cutting unit. Do not misplace washers.

5. Replace and/or grind bedknife to renew cutting edges.

NOTE: For proper grinding of bedknife, follow procedures in the Toro publication, "Sharpening Reel and Rotary Mowers", Form No. 80-300-PT.

6. Adjust the reel bearings. (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter.)

7. Grind the reel to remove any taper and renew cutting edges. (See Preparing Cutting Unit for Reel Grinding in this section of the book.)

8. Check size of hole in bedbar end bushings every time bedbar is removed. Insert flange bushing into rubber bushing (Fig. 28). Insert clean shoulder bolt into flange bushing/rubber bushing assembly. If bolt slides easily into bushing, replace all four bedbar bushings. (See Bedbar Bushing Replacement in this section of the book.)

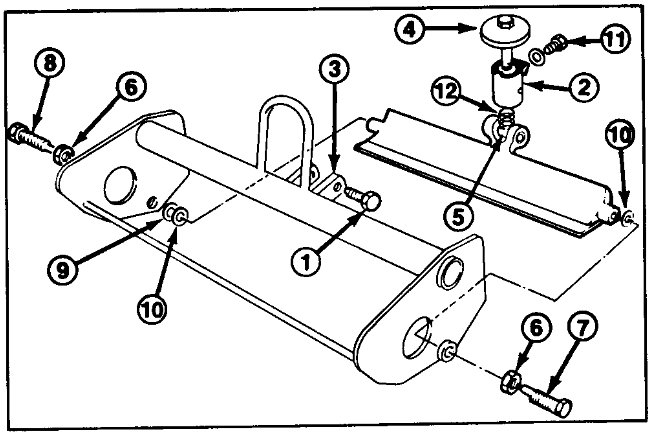


Figure 27

1. **Pivot screw**
2. **Bedknife pivot ass'y**
3. **Frame supports**
4. **Adjustment knob**
5. **Bedbar pivot**
6. **Jam nuts**
7. **Left bedbar pivot bolt**
8. **Right bedbar pivot bolt**
9. **Steel washer**
10. **Plastic washer**
11. **Spring arm retaining capscrew**
12. **Compression spring**

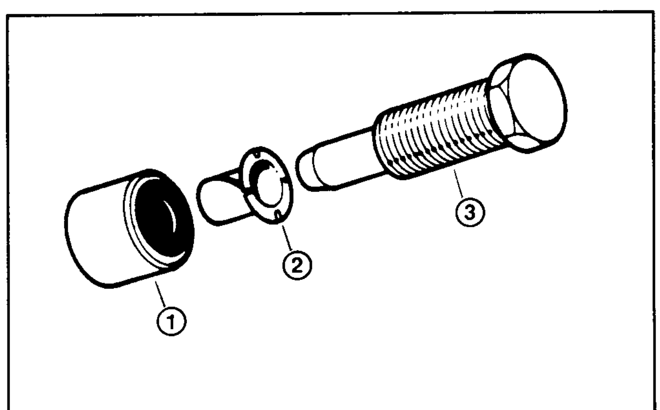


Figure 28

1. **Rubber bushing**
2. **Flange bushing**
3. **Shoulder (pivot) bolt**

9. With frame on level surface and pivot set screws installed, measure from flat surface up to end of each setscrew (Fig. 29). If not within 1/16 in. of each other, carefully bend frame supports to line up screws. Remove pivot set screws. Measure distance between frame pivot supports (Fig. 29). If dimension is not between 1-9/16 in. and 1-5/8 in., carefully bend supports until correct.

10. To install bedbar, slide it into position between side plates, making sure each end of bedbar is under shield (Fig. 30).

IMPORTANT: Always use McLUBE (Toro Part No. 505-35) on bedbar pivot and pivot bolts.

11. Install jam nut on eccentric pivot bolt. Put plastic washer between left side of bedbar and side plate. Thread pivot bolt into side frame until distance from top of pivot bolt to side plate is 1-5/16 in. with identification dot toward the rear (Fig. 31). Do not tighten jam nut.

12. Install jam nut on straight pivot bolt. Put plastic washer and steel washer between right side of bedbar and side plate with plastic washer closest to bedbar. Thread pivot bolt into side plate. Adjust right-hand pivot bolt until left end of bedbar firmly seats against the plastic washer and side plate, clamping the plastic washer snugly. This removes end-play from bedbar. Bedbar must pivot without binding. Hold right-hand pivot bolt to keep it from moving and tighten jam nut.

IMPORTANT: Apply NEVER-SEEZ or equivalent to the threads of the handle assembly.

13. Thread adjustment knob and pivot assembly into flat side of bedbar pivot (left-hand thread). Make sure there is an equal gap between each side of pivot assembly housing and frame supports (Fig. 32). Adjust (before installing pivot screws) by sliding bedbar pivot sideways.

IMPORTANT: On hand-adjustable knobs, check to make sure die spring is compressed to 13/16 in. by tightening locknut (left-hand thread).

14. If equipped with hex head type pivot screws, tighten pivot screws to 60 ft-lb. If equipped with hex socket head set screws and jam nuts, tighten set screws finger tight, then tighten an additional 1/2 turn (total - not each). Tighten jam nuts.

15. Secure spring arm to pivot assembly. If spring arm is adjustable, adjust upward until a solid clicking sound is achieved when adjusting knob is turned.

16. Level bedknife to reel. Level rear roller to reel. Set height of cut. If necessary, backlap to get desired fit between reel and bedknife.

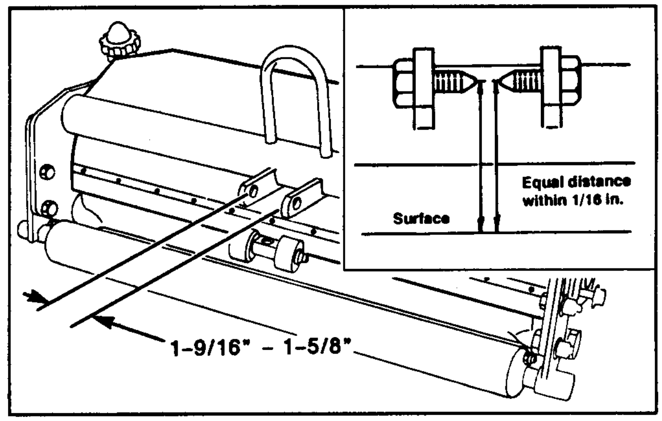


Figure 29

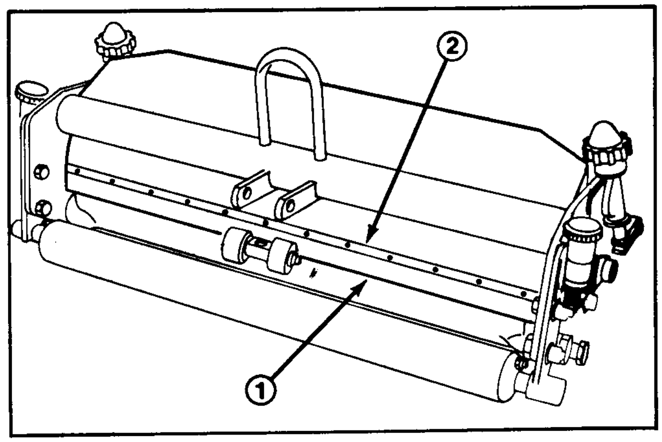


Figure 30

1. Bedbar
2. Shield

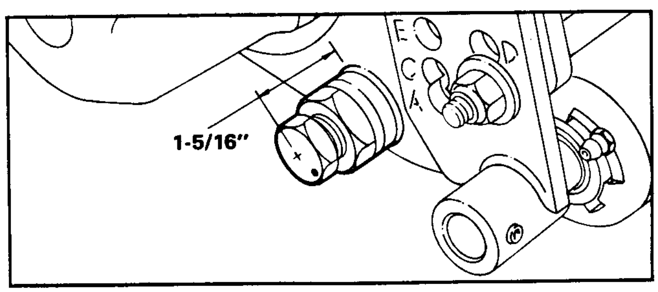


Figure 31

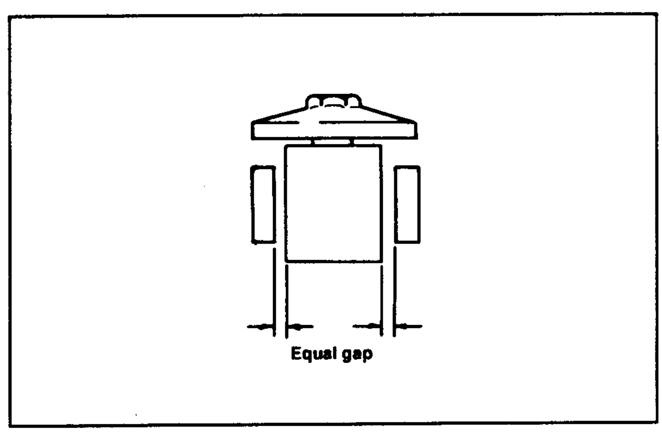


Figure 32

Bedbar Bushing Replacement

NOTE: Only after making sure that all normal cutting unit adjustments are correct, should the bushings be suspected as causing quality of cut problems.

The bedbar end bushings and pivot bushings (Fig. 33) contain rubber and are exposed to severe conditions. It is recommended to replace these bushings and the plastic flange bushings every two years.

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Remove bedbar end bushings with a punch and hammer (Fig. 34). Alternate from one side to other on bushing (there are two slots in bedbar bushing boss).

IMPORTANT: Apply "Never-Seez" or equivalent to outside surface of bedbar end bushings and pivot bushings before installing in bedbar.

3. Press end bushings into bedbar far enough so plastic sleeve collar is below bedbar end face (Fig. 35).

NOTE: Bedbar end bushings have less rubber and more steel which is visible than bedbar pivot bushings. Do not use bedbar end bushings in the pivot area as they are too rigid.

4. Use an arbor press to remove bedbar pivot bushings (Fig. 36). DO NOT hammer on pivot boss of bedbar without support. You will break the casting.

5. Press center pivot bushings into place (Fig. 36). DO NOT hammer on pivot boss of bedbar without support. You will break the casting.

6. Do steps 5 - 16 under Bedbar Removal and Installation in this section of the book.

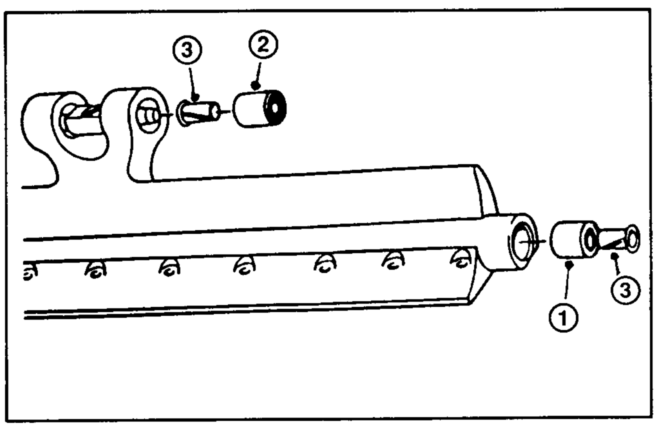


Figure 33

1. Bedbar end bushing (2)
2. Bedbar pivot bushing (2)
3. Flange bushing (4)

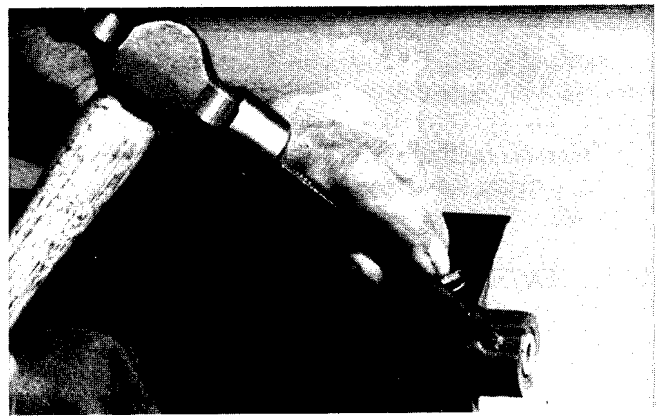


Figure 34

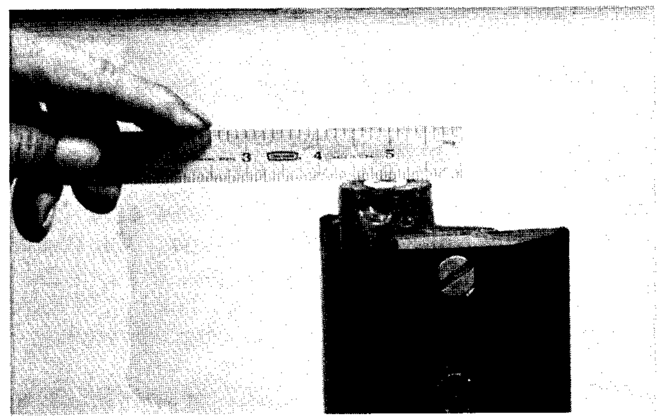


Figure 35

Figure 36

Bedknife Replacement

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Remove bedknife screws and remove bedknife.

3. Remove all rust, scale, and corrosion from bedbar surface before installing the bedknife.

4. Install new bedknife with new bedknife screws (57-4910). Apply clean SAE 30 oil to the screws before installing screws. Tighten the screws to a torque of 200 to 250 in-lb. working from the center toward each end of the bedbar (Fig. 37).

5. Grind the new bedknife to match it to the bedbar.

Note: For proper grinding of bedknife, follow procedures in the Toro publication “Sharpening Reel and Rotary Mowers”, Form No. 80-300-PT.

6. Do steps 6 - 16 under Bedbar Removal and Installation in this section of the book.

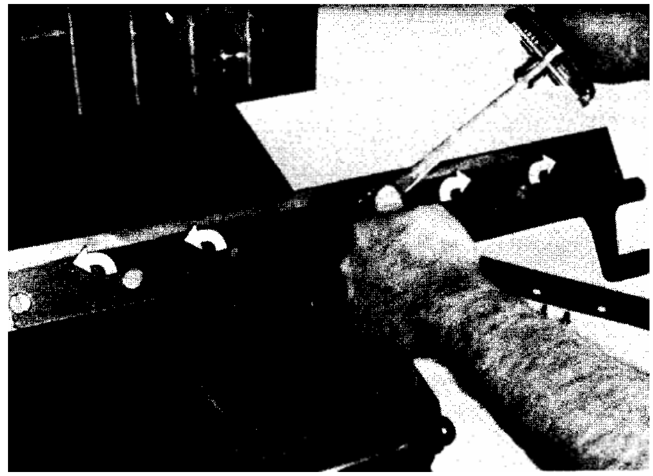


Figure 37

Preparing Reel for Grinding

IMPORTANT: Adjust reel bearings before grinding reel. (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter).

1. Do steps 1 - 6 under Bedbar Removal and Installation in this section of the book.

Note: Some reel grinders may require rear roller assembly be mounted to the cutting unit for proper support in reel grinder. Rear roller must be parallel to reel shaft to remove taper when grinding.

2. Raise or remove front roller assembly.

   A. Loosen the locknuts securing height of cut adjusting rods at both ends of the cutting unit and the roller shaft clamp bolts (Fig. 38).

   B. Turn height of cut adjustment knobs to raise roller out of way or remove roller if necessary.

For proper grinding of reel, follow procedures in the Toro publication “Sharpening Reel and Rotary Mowers”, Form No. 80-300-PT.

3. Do steps 8 - 16 under Bedbar Removal and Installation in this section of the book. After grinding, assemble cutting unit, check bearing adjustment and adjust top shield and bar. Backlap if necessary to get desired fit between reel and bedknife.

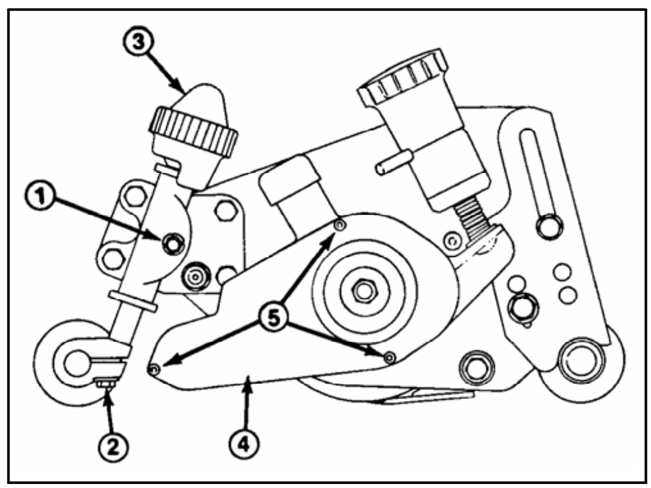


Figure 38

1. **Height of cut locknut**
2. **Roller shaft clamp bolt**
3. **Height of cut knob**
4. **Grooming reel cover**
5. **Cover screws and washers**

Reel Removal and Bearing Replacement

1. Do steps 1 - 4 under Bedbar Removal and Installation in this section of the book.

2. Loosen two (2) set screws and remove clutch knob. Remove groomer reel housing cover from left side of cutting unit (Fig. 39).

3. Remove grooming reel adjustment knob assembly from groomer housing (Fig. 40).

CAUTION

Adjustment knob assembly is spring loaded.

4. Loosen idler pulley (Fig. 40). Remove nut and washer from clutch adapter shaft. Pull clutch assembly off adapter shaft and slide belt off driven pulley. Remove clutch adapter from reel shaft (Fig. 49).

5. Remove driven pulley from groomer shaft (left-hand thread) (Fig. 40).

6. Remove two (2) locknuts and flat head socket screws to remove bearing adapter and left side groomer housing (Fig. 41).

7. Remove locknut from the right end of groomer reel shaft to remove groomer reel. Remove grooming reel adjustment knob assembly from right side groomer plate assembly (Fig. 42).

8. Remove two (2) flange locknuts (reel motor mounting nuts). Remove two (2) inside locknuts. Use a stud removal tool or double nuts to remove special studs. Remove groomer bearing adapter and right side groomer plate (Fig. 42).

9. Remove bearing adjustment locknut from left end of reel shaft. Remove spline nut from right end of reel shaft.

IMPORTANT: Remove grease fittings from bearing housing at each end of cutting unit. Note that the straight fitting is on the right end, and 90° fitting at the left end (when viewed in the direction of travel).

10. Use a soft face hammer to rotate each bearing housing slightly. Install bolts from outside of housings and turn bolts alternately against side plate to remove bearing housings (Fig. 43). Bearing housings will slip out of side plates. Reel can be removed as soon as bearing housings are disassembled from side plates.

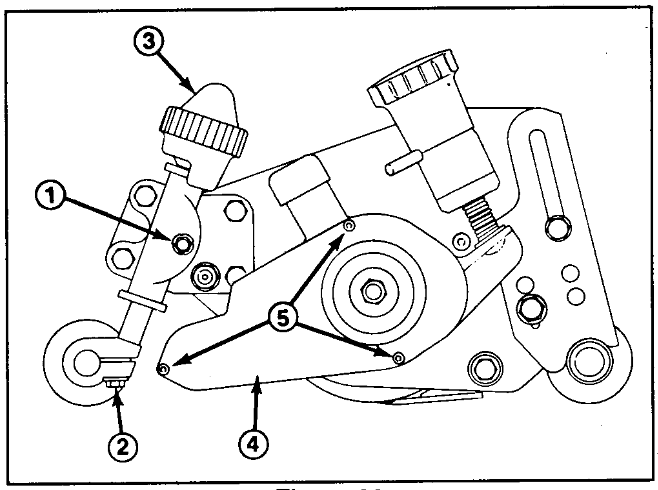


Figure 39

1. Height of cut locknut
2. Roller shaft clamp bolt
3. Height of cut knob
4. Grooming reel cover
5. Cover screws & washers

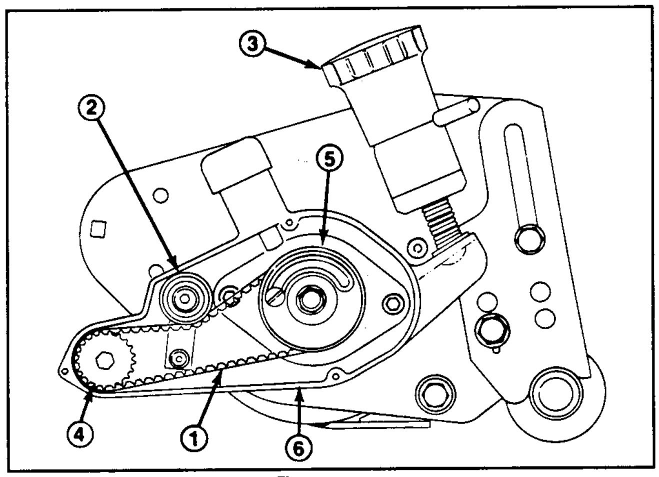


Figure 40

1. Drive belt
2. Drive belt idler pulley
3. Grooming reel adjustment knob assembly
4. Groomer driven pulley
5. Clutch assembly
6. Groomer reel housing

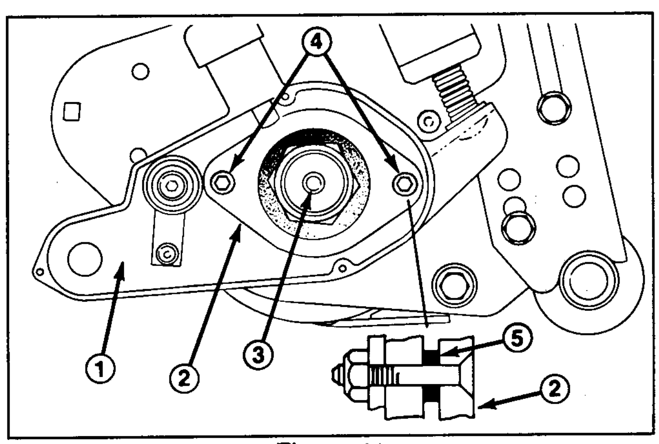


Figure 41

1. Left side groomer housing
2. Bearing adapter
3. Reel bearing adjustment nut
4. Flat head screws
5. Spacer

11. If necessary, install new bearings and seals:

A. Remove bearing cup, bearing cone and inner seal.

B. Bearing housing must be completely free of paint and foreign material before installing bearing cup. If necessary remove any "flash" from bearing housing that may interfere with accurate seating of bearing. Install inner seal. Install bearing cup.

C. Install bearing housing to frame. Pack bearing cone with grease and install over reel shaft into bearing cup.

12. After installing reel, tighten spline nut to 40 - 60 ft-lb, then adjust bearings (See Reel Bearing Service and Adjustment in the Adjustments section of this chapter.)

13. Install right side groomer plate assembly and bearing adapter. Use a stud installation tool or double nuts to tighten two (2) special studs to 17 - 21 ft-lb. Make sure a spacer is installed over each stud between groomer bearing adapter and reel bearing housing. Tighten two (2) inside locknuts to 23 - 27 ft-lb. Install two (2) flange locknuts (reel motor mounting nuts). (Fig. 42).

14. Install grooming reel adjustment knob assembly to right side groomer plate assembly (Fig. 42). Install groomer reel shaft to right side groomer plate assembly and install locknut on right end of groomer shaft.

15. Install left side groomer housing and bearing adapter (Fig. 41). Install two (2) flat head socket screws and tighten to 17 - 21 ft-lb. Make sure a spacer is installed over each flat head socket screw between groomer bearing adapter and reel bearing housing. Install two (2) locknuts and tighten to 23 - 27 ft-lb.

16. Install groomer reel driven pulley to groomer reel shaft (left-hand thread) and tighten to 29 - 35 ft-lb (Fig. 40).

17. Install clutch adapter on reel shaft and tighten to 170 - 210 in-lb (Fig. 49). Hold belt on drive pulley and slide clutch assembly on clutch adapter while sliding belt onto driven pulley (Fig. 40). Install washer and nut (removed in step 4) on clutch adapter shaft. Use a block of wood to keep reel from rotating and tighten nut to a torque of 7 - 10 ft-lb.

18. Install grooming reel adjustment knob assembly to left side groomer housing (Fig. 40).

19. Adjust belt tension. (See Groomer Reel Drive Belt Adjustment in the Adjustments section of this book.) Install groomer reel housing cover (Fig. 39). Install clutch knob and tighten two (2) set screws against flats of clutch release disk.

20. Do steps 5 - 16 under Bedbar Removal and Installation in this section of the book.

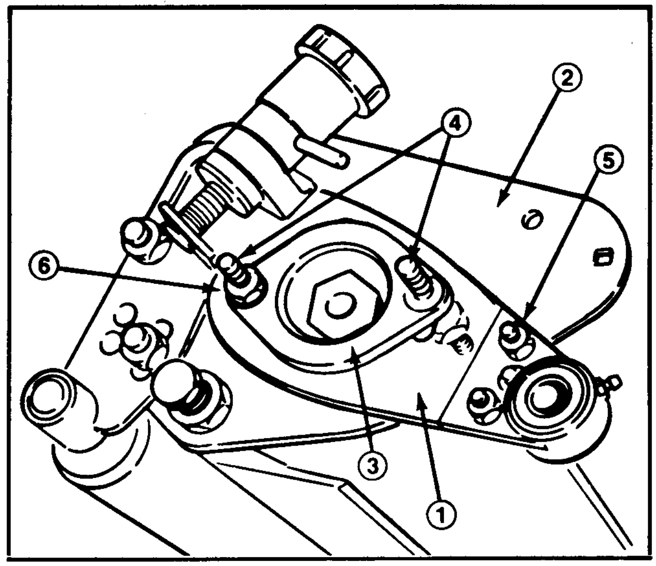


Figure 42

1. **Right side groomer plate ass'y**
2. **Right reel frame plate**
3. **Groomer bearing adapter**
4. **Special stud (2)**
5. **Inside locknut (2)**
6. **Flange locknut (2)**

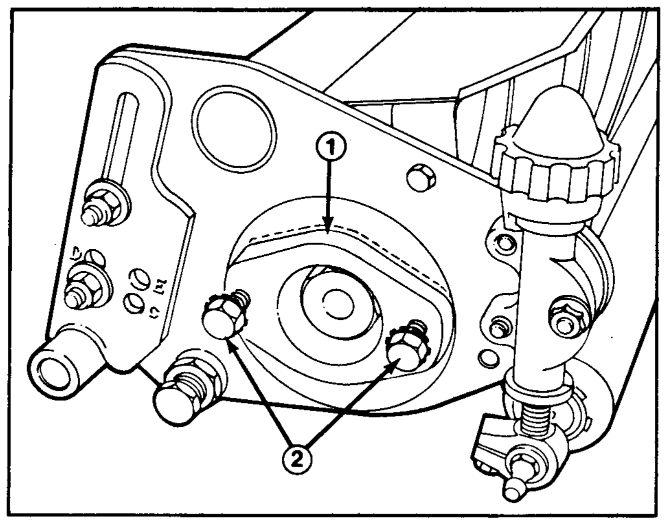


Figure 43

1. **Bearing housing**
2. **Bolt**

Groomer Reel Blade Service

Inspect grooming reel blades frequently for damage and wear. Straighten bent blades with a pliers. Either replace worn blades or reverse the grooming reel shaft to put the sharpest blade edge forward (Fig. 44). (See Groomer Reel Removal and Installation in this section of the book.). During blade inspection procedures, check to make sure the right and left blade shaft end nuts are tight.

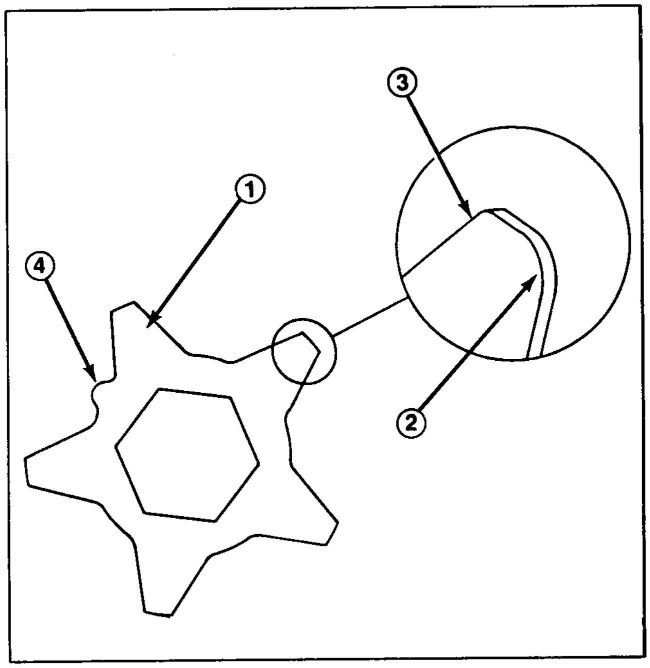


Figure 44

1. **Grooming blade**
2. **Dull rounded edge**
3. **Sharp edge**
4. **Location mark**

Groomer Reel Drive Belt Replacement

1. Loosen two (2) set screws and remove clutch knob (Fig. 6). Remove groomer reel housing cover from left side of cutting unit (Fig. 39).

2. Loosen the backside idler pulley pivot screw (Fig. 45). Pivot idler to loosen and remove belt.

3. Install the belt. The belt should have a deflection of 1/4 in. when 5 - 10 lb. of force is applied midway between the pulleys. Pivot the idler to get proper tension and tighten the allen head screw to a torque of 7 - 10 ft-lb.

4. Install groomer reel housing cover. Install clutch knob and tighten two (2) set screws against flats on release disk.

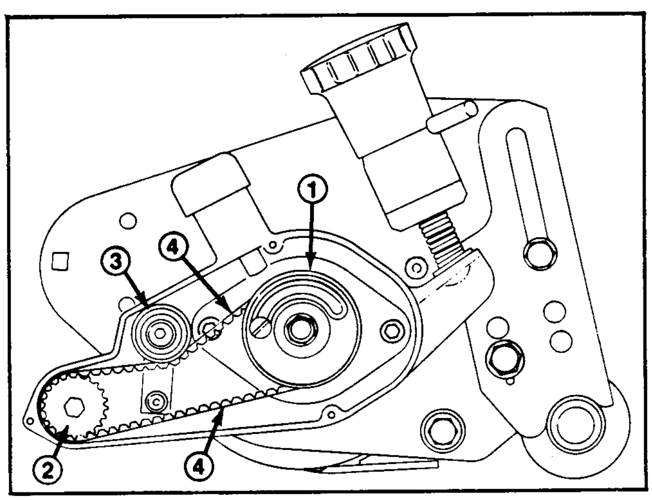


Figure 45

1. **Drive pulley and clutch assembly**
2. **Driven pulley**
3. **Drive belt (backside) idler pulley**
4. **Drive belt**

Groomer Reel Removal and Bearing Service

1. Loosen two (2) set screws and remove clutch knob (Fig. 6). Remove groomer reel housing cover from left side of cutting unit (Fig. 39).

2. Loosen the backside idler pulley pivot screw (Fig. 45). Pivot idler to loosen and remove belt.

3. Remove groomer driven pulley from groomer reel shaft (left-hand thread) (Fig. 45).

4. Remove locknut from right end of groomer reel shaft (Fig. 46a).

5. Remove three (3) screws and nuts securing bearing housing to right side groomer plate (Fig. 46a). Remove right side bearing bracket from groomer reel shaft. Remove groomer reel shaft from bearing support in left side groomer housing (Fig. 46b).

6. Check condition of groomer shaft bearings and replace if necessary (Fig. 47). Bearings must be installed with seal facing out on each side of bearing housing. For each groomer housing (R.H. and L.H.), install outer bearing and spacer first. Install inner bearing so it is flush with the housing (Fig. 47)

7. To replace groomer reel blades, remove locknut on each end of groomer reel shaft. Remove blades and spacers. Install new blades and previously removed spacers. Install locknut on each end of groomer shaft to secure blades and spacers.

NOTE: Spacers are available for 1/4 in. (76 blades) or 3/4 in. (26 blades) blade spacing.

8. Reverse steps 1 - 5 to install groomer reel. Check drive belt tension before installing cover. (See Groomer Reel Drive Belt Replacement in this section of the book.)

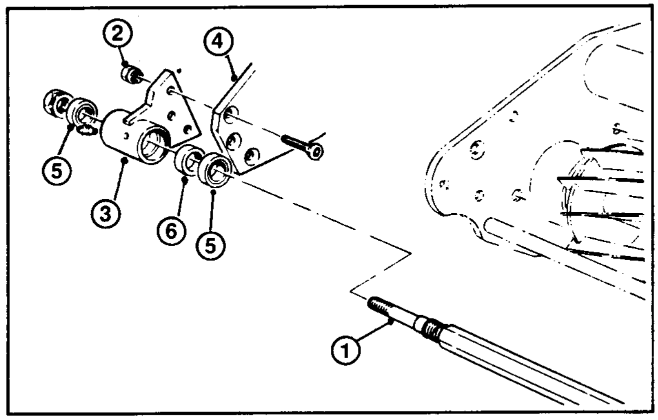


Figure 46a

1. Groomer reel shaft
2. Locknut
3. R.H. groomer housing
4. R.H. groomer plate
5. Bearing
6. Bearing spacer

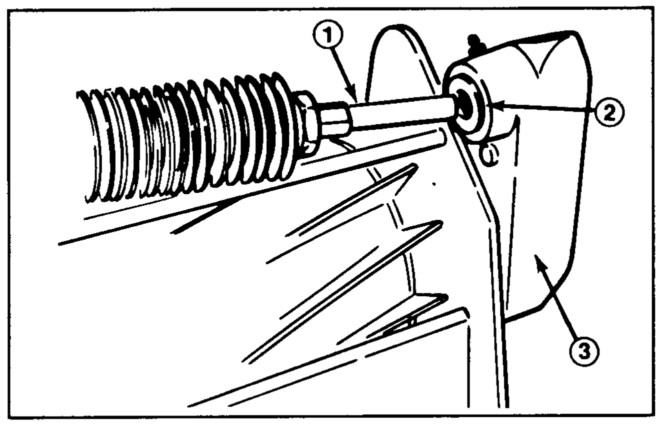


Figure 46b

1. Groomer reel shaft
2. Bearing
3. L.H. groomer housing

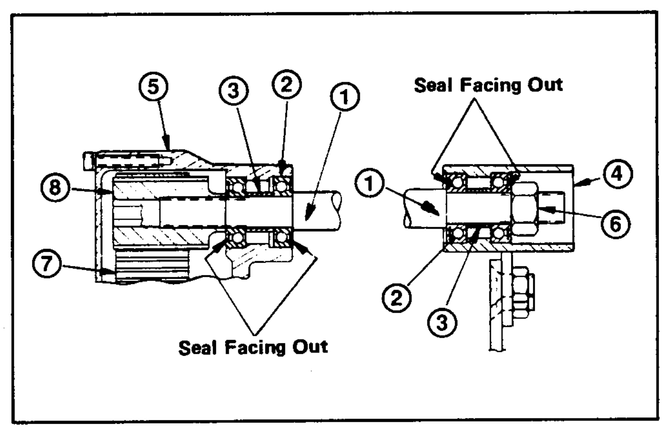


Figure 47

1. Groomer reel shaft
2. Bearing (4)
3. Bearing spacer (2)
4. R.H. groomer housing
5. L.H. groomer housing
6. Locknut
7. Belt
8. Driven gear

Groomer Reel Clutch Service

CAUTION

Do not use your hand to prevent reel from turning while servicing; this can result in personal injury. Use a 1/2 in. thick x 3 in. wide x 8 in. long piece of hardwood inserted into front of cutting unit between reel blades.

Removal and Disassembly

1. Loosen two (2) set screws and remove clutch knob (Fig. 51). Remove groomer reel housing cover from left side of cutting unit (Fig. 39).

2. Loosen idler pulley pivot screw (Fig. 45). Pivot idler to loosen belt.

3. Remove nut and washer from clutch adapter shaft (Fig. 51). Pull clutch assembly off adapter shaft and slide belt off driven pulley.

5. Remove clutch adapter from reel shaft if necessary (Fig. 49).

6. To disassemble clutch, remove special screw and clutch pin (Fig. 51).

IMPORTANT: The special screw and clutch pin were assembled using "Loctite 271". It will be necessary to apply heat to these parts before disassembly.

7. Check condition of roller bearing and needle bearing (Fig. 51). Replace bearings if worn or damaged.

Installation and Assembly (New Clutch Assembly)

1. Loosen two (2) set screws and remove clutch knob from new clutch assembly (Fig. 48). Use a block of wood to keep the reel from rotating and remove nut and washer from clutch adapter shaft (Fig. 48)

2. Pull clutch adapter out of new clutch assembly and install on reel shaft. Tighten clutch adapter to a torque of 170 - 210 in-lb.

3. Hold belt on drive pulley of clutch and slide clutch on clutch adapter while sliding belt on driven pulley.

IMPORTANT: If clutch has come apart since nut and washer were removed in step 1, make sure belleville washers are installed as shown in Figure 50.

4. Install washer and nut (removed in step 1) on clutch adapter shaft and tighten nut to a torque of 7 - 10 ft-lb.

5. Adjust belt tension. (See Groomer Reel Drive Belt Adjustment in the Adjustments section of this book.) Install groomer reel housing cover (Fig. 39). Install clutch knob and tighten two (2) set screws against flats of clutch release disk.

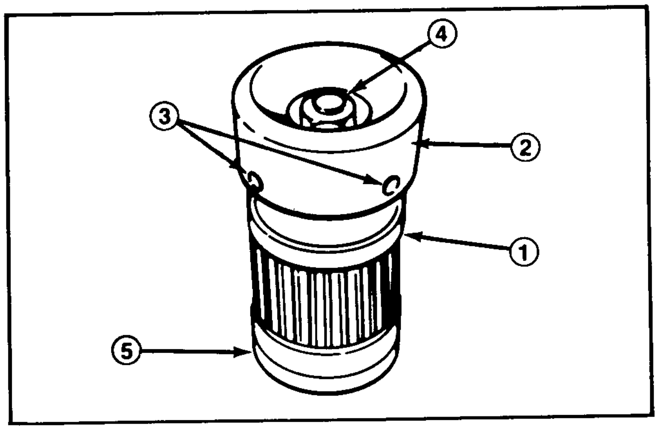


Figure 48

1. **Belt drive clutch assembly**
2. **Clutch engage / disengage knob**
3. **Allen head set screw (2)**
4. **Nut and washer**
5. **Clutch adapter shaft**

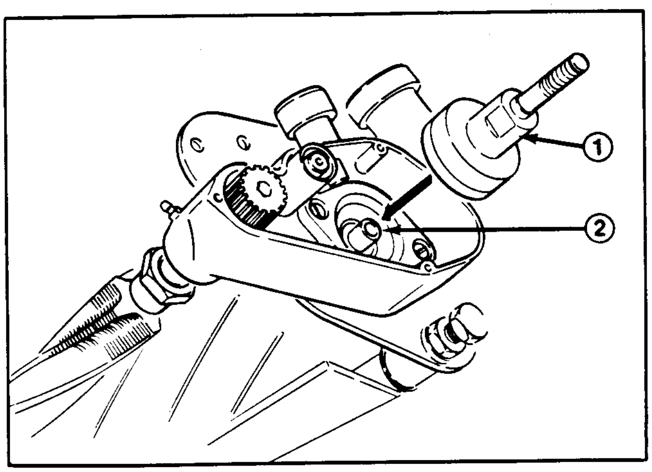


Figure 49

1. **Clutch adapter shaft**
2. **Reel shaft**

Installation and Assembly (Disassembled Clutch)

1. Pack bearings and area inside clutch body with No. 2 multi-purpose lithium base grease.

IMPORTANT: When assembling clutch, make sure belleville washers are installed correctly (Fig. 50).

2. Apply thick coating of grease to special screw (do not get on threads) and cam surface of clutch release disk. Apply "Loctite 271" or equivalent to threads of special screw before assembling to clutch pin. Assemble so clutch pin is 0.240 - 0.260 in. out from face of clutch body when pin is in fully extended position.

3. Install clutch adapter to reel shaft (Fig. 49). Tighten clutch adapter to a torque of 170 - 210 in-lb.

4. Hold belt on drive pulley of clutch and slide clutch on clutch adapter while sliding belt on driven pulley. Install washer and nut on clutch adapter shaft and tighten nut to a torque of 7 - 10 ft-lb.

5. Adjust belt tension. Install groomer reel housing cover (Fig. 39). Install clutch knob and tighten two (2) set screws against flats of clutch release disk.

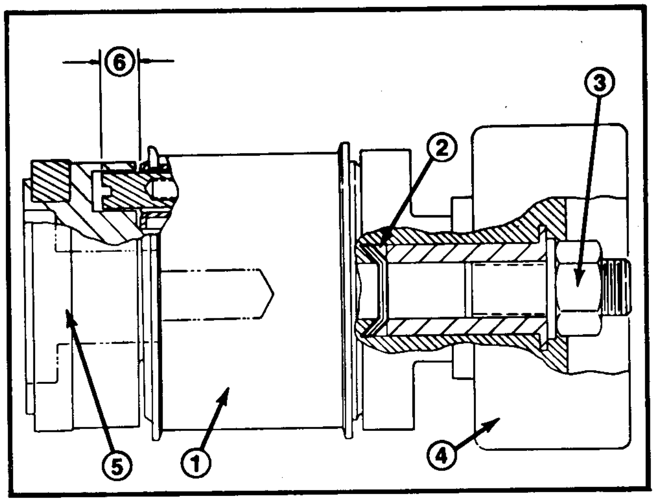


Figure 50

1. **Clutch body/drive pulley**
2. **Belleville washer (2)**
3. **Nut and washer**
4. **Clutch engage/disengage knob**
5. **Clutch adapter**
6. **0.250 in. ± 0.10 (pin extended)**

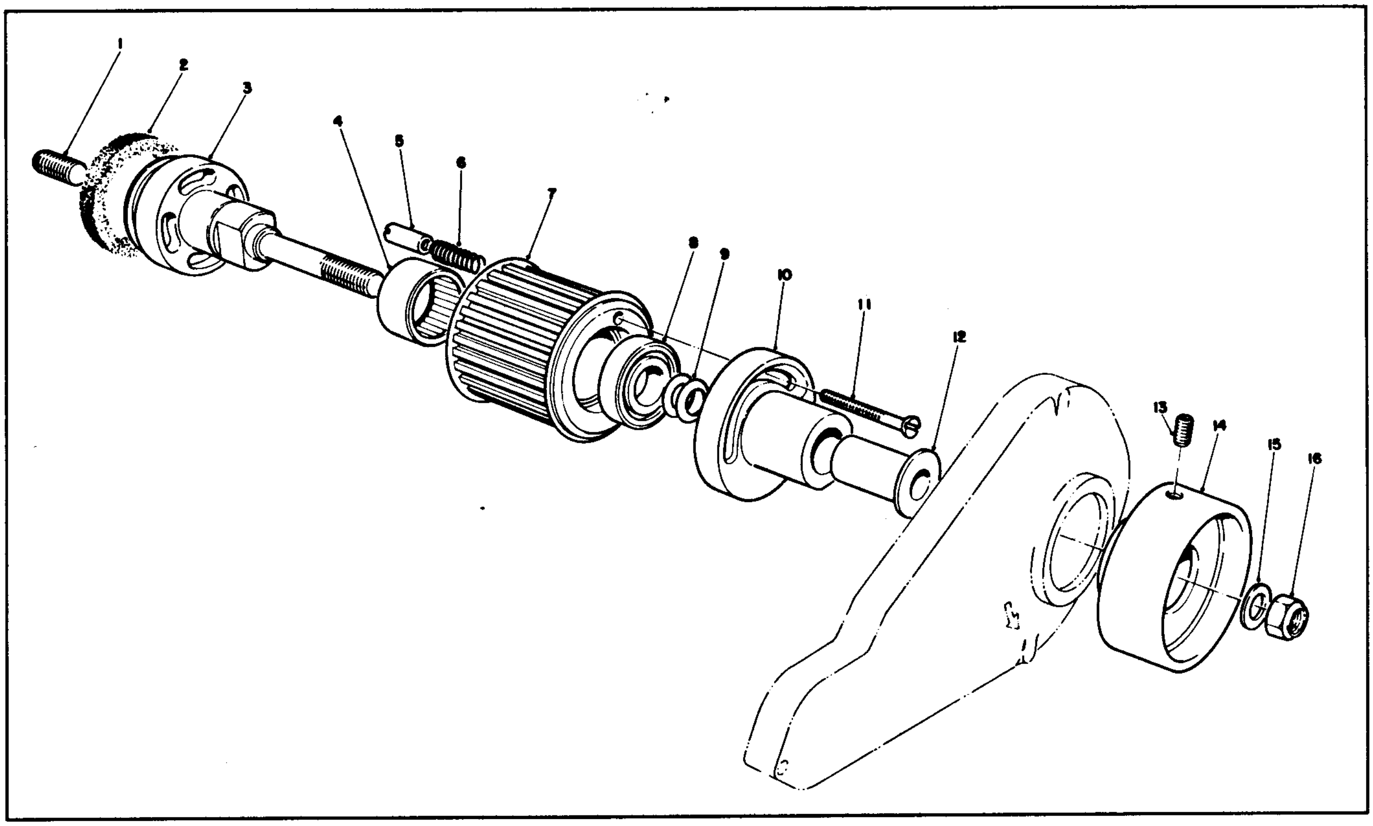


Figure 51

1. **Set screw**
2. **Felt seal**
3. **Clutch adapter**
4. **Needle bearing**
5. **Clutch pin**
6. **Compression spring**
7. **Clutch body/drive pulley**
8. **Roller bearing**
9. **Belleville washer (2)**
10. **Clutch release disk**
11. **Special screw**
12. **Flange bushing**
13. **Set screw**
14. **Clutch knob**
15. **Flat washer**
16. **Lock nut**

Bedknife to Reel Adjustment Knob Bearing Service

1. Turn bedknife adjustment knob counterclockwise to remove bedknife to reel contact.

2. Remove two (2) pivot screws (Fig. 38).

3. Rotate adjustment knob and pivot assembly clockwise (left-hand thread) until it is unthreaded from the bedbar pivot.

4. If necessary, remove locknut securing die spring to shaft (Fig. 6b). Slide pivot housing off adjustment knob threaded shaft (Fig. 38).

5. Pull inner races from pivot housing. Pull bearings from pivot housing. Check condition of inner races and bearings and replace if necessary.

6. Install new o-ring on each race if necessary.

7. Install bearings and races in pivot housing. Slide pivot housing onto shaft of knob.

8. Install spring over adjusting knob threaded shaft and thread adjustment knob and pivot assembly into flat side of bedbar pivot. Make sure there is an equal gap between each side of pivot assembly housing and frame supports (Fig. 29). Adjust (before installing pivot screws) by sliding bedbar pivot sideways.

IMPORTANT: On hand-adjustable type knobs, check to make sure die spring is compressed to a dimension of 13/16 in. by tightening locknut (left-hand thread) (Fig. 6b).

9. If equipped with hex head type pivot screws, tighten pivot screws to 60 ft-lb. If equipped with hex socket head set screws and jam nuts, tighten set screws finger tight then tighten 1/2 turn more (total - not each). Tighten jam nut.

10. Adjust bedknife to reel contact.

NOTE: If quality of cut has deteriorated or the reel and bedknife have become "rifled" , you must grind the reel and bedknife to remove rifle pattern.

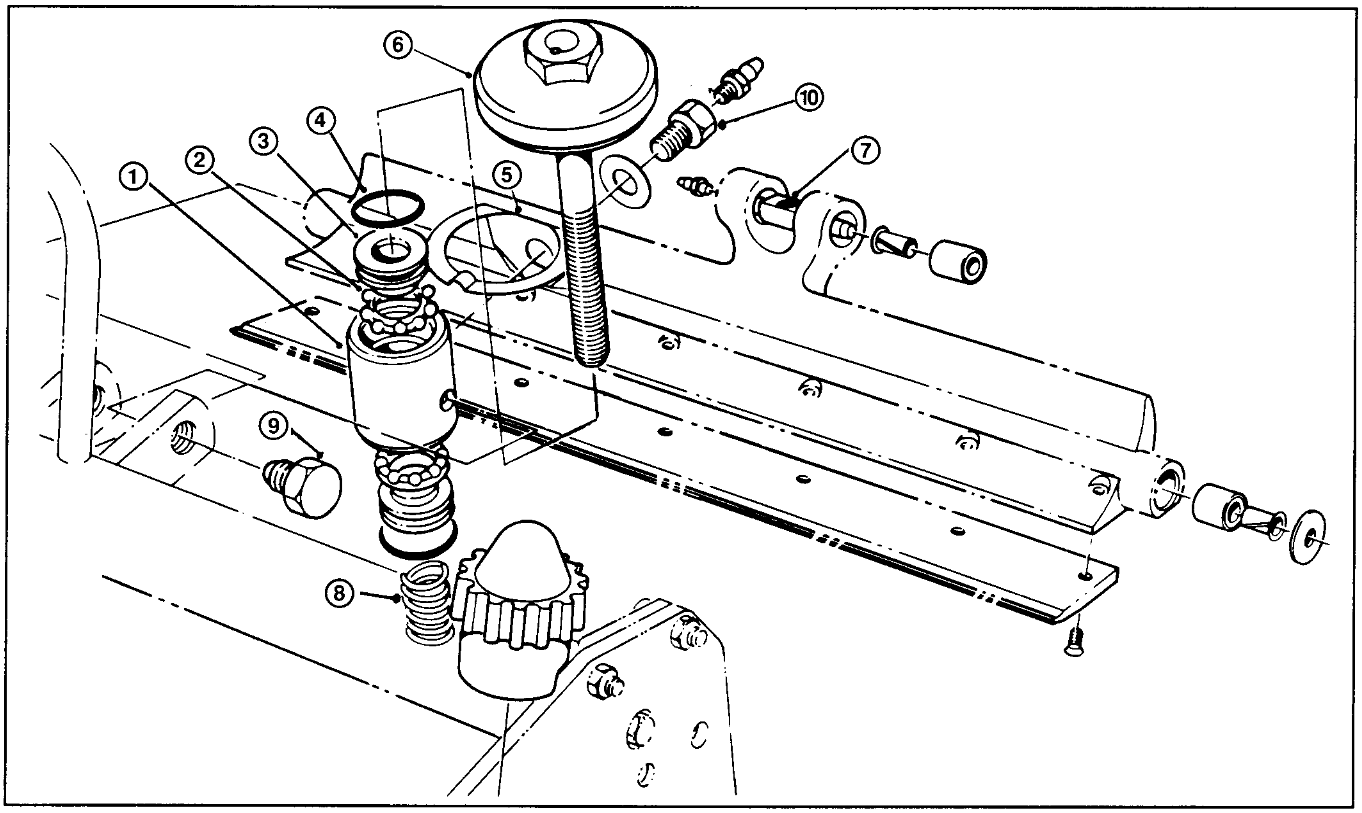


Figure 52

1. Pivot housing
2. Bearing (2)
3. Inner race (2)
4. O-ring (2)
5. Spring arm
6. Adjustment knob
7. Bedbar pivot
8. Spring
9. Pivot screw (2)
10. Spring arm retaining capscrew

Lift Bail Replacement

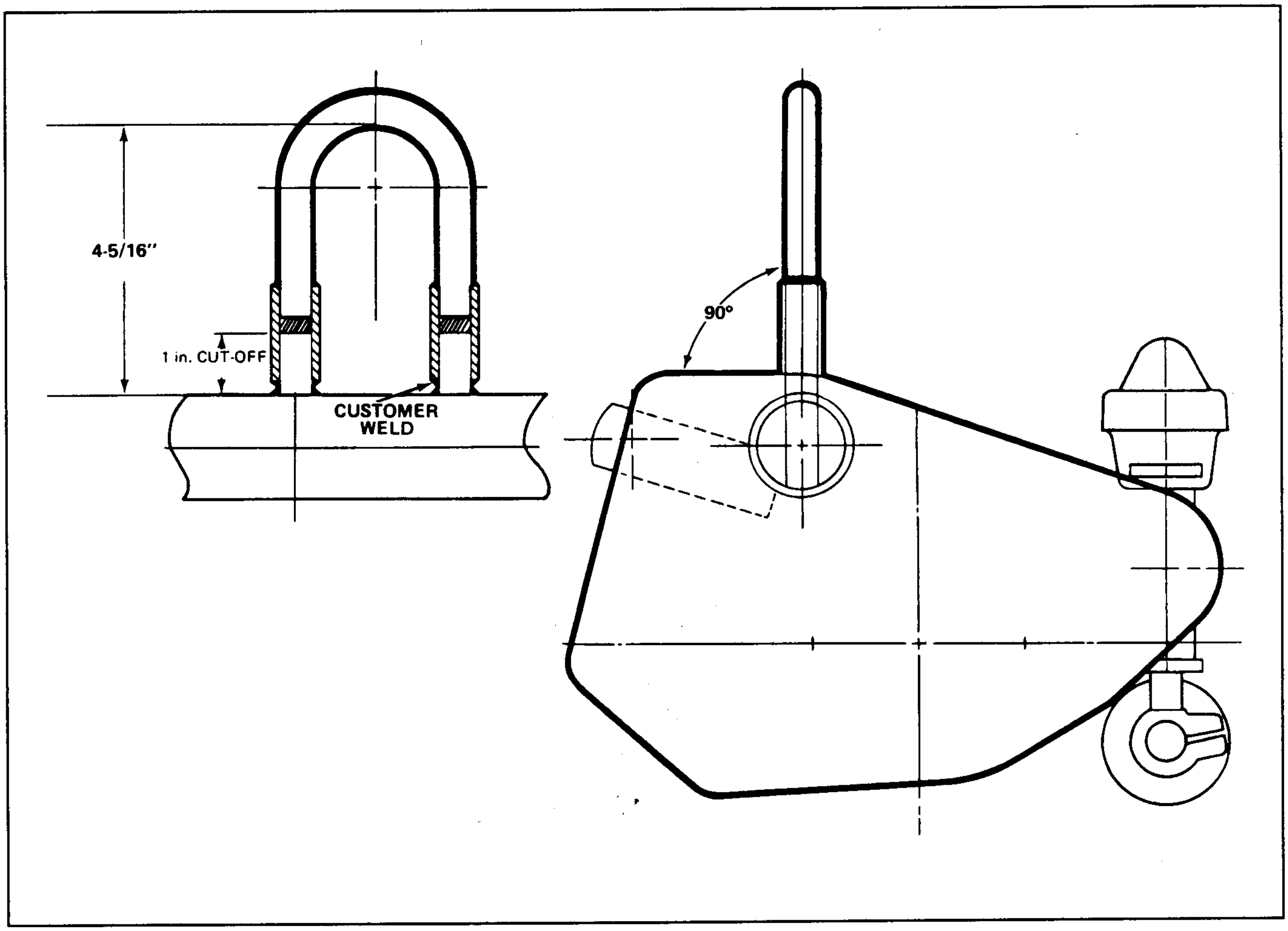


Figure 53

1. Use a saw to cut the lift bail off of the cutting unit. Make the cut 1 inch from the horizontal frame tube (Fig. 53).

2. Use a grinder to remove burrs from the stubs of the lift bail remaining on the cutting unit.

3. Install the repair lift bail (Part No. 71-1600).

4. Support the lift bail so the bottom radius is 4 5⁄16 inches from the top of the horizontal frame tube. Make sure the lift bail is square to the side frame.

5. Weld all around the bottom of the repair lift bail with mild steel rod, both sides.

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Chapter 10

Dual Point Adjust Cutting Units

Table of Contents

Cutting Units

Specifications

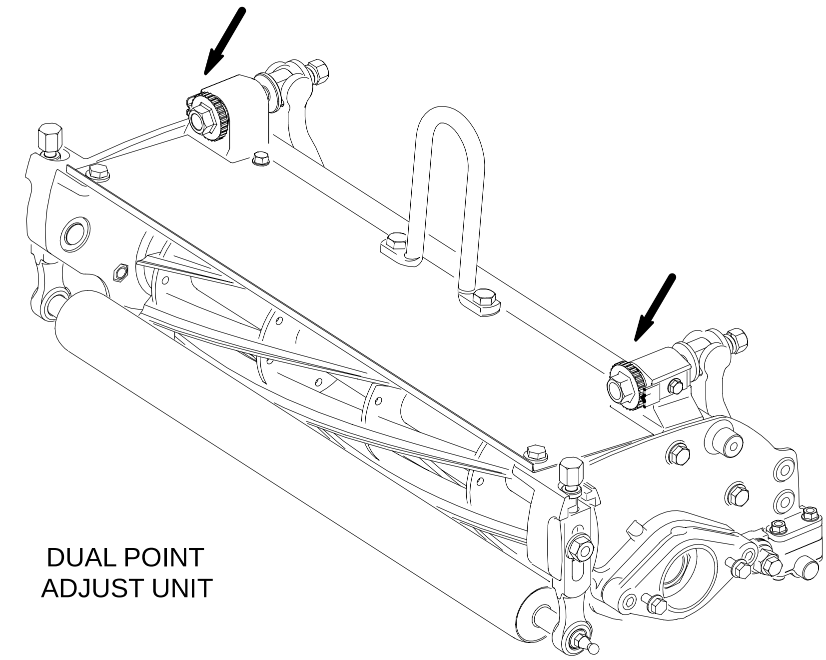

Figure 1

Height−of−Cut (HOC): Cutting height is adjusted on the front roller by two vertical screws and held by two locking capscrews. Standard bench height of cut range is .062 inch (1.6 mm) to .375 inches (9.5 mm) depending on type of bedknife installed. Bench height of cut range with the High Height of Cut Kit installed is .285 inch (7 mm) to 1 inch (25 mm). Effective HOC may vary depending on turf conditions, type of bedknife, rollers and attachments installed.

Reel Construction: Reels are 5 inches (13 cm.) in diameter, 21 inches (53.3 cm.) in length. High strength low alloy steel blades are thru hardened and impact resistant. Reels are available in 8 and 11 blade configurations.

Reel Bearings: Two double row self−aligning ball bearings, 30 +/−.1 mm inside diameter slip fit onto reel shaft with lock nut. Additional inboard and outboard seals for added protection. Reel position maintained by a wave washer with no adjusting nut.

Reel Drive: The reel weldment shaft is a 1.375 inch diameter tube with drive inserts permanently pressed in both ends. A replaceable floating coupler with an internal eight tooth spline is factory installed on the right end, and held in place by a snap ring.

Frame Construction: Precision machined die cast aluminum cross member with two bolt−on die−cast aluminum side plates.

Bedknife: Replaceable single edged, high carbon steel bedknife is fastened to a machined cast iron bedbar with 13 screws. Tournament bedknife is standard.

Bedknife Adjustment: Dual screw adjustment to the reel; detents corresponding to .0007 inch (.018 mm) bedknife movement for each indexed position.

Front Roller: A variety of sealed bearing and through−shaft front rollers are available for use with these cutting units. The front roller brackets control the height-of-cut by using two vertical adjustment screws, and are held in position by a horizontal locking screw.

Rear Roller: Steel full, 2 inch (5.1 cm.) diameter with sealed bearings and through−shaft. The rear roller has two positions, allowing user to change the cutting unit attitude and the behind center distance of bedknife from reel center line.

Counterbalance Weight: A cast iron weight mounted opposite to the drive motor balances the cutting unit.

Grass Shield: Non−adjustable shield with adjustable cut−off bar to improve grass discharge from reel in dry conditions.

Maximum Reel Speed: 2200 RPM

Weight:	8 Blade	72 lb. (32 kg)
	11 Blade	75 lb. (34 kg)

Special Tools

Order Special Tools from your Toro Distributor.

Gauge Bar Assembly

Used to verify height-of-cut.

Toro Part Number: **13-8199**

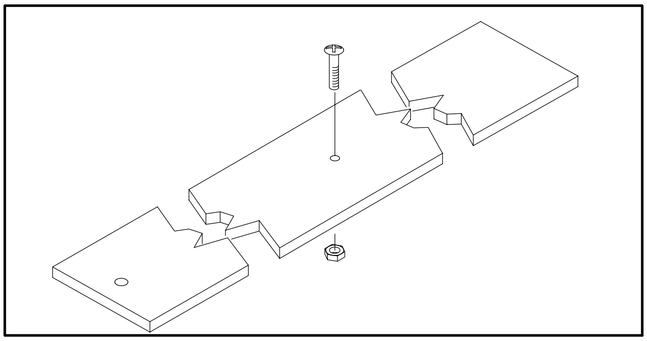

Figure 2

Backlapping Brush Assembly

Used to apply lapping compound to cutting units while keeping the operator's hands at a safe distance from the rotating reel.

Toro Part Number: **TOR299100**

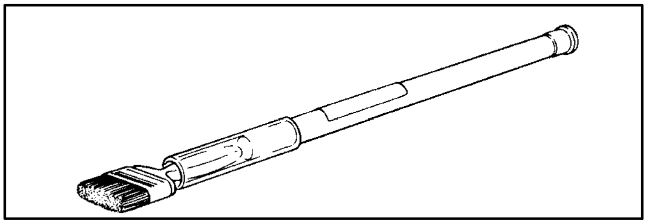

Figure 3

Bedknife Screw Tool

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: DO NOT use and air or manual impact wrench with this tool so damage to the bedbar will be prevented.

Toro Part Number: **TOR510880**

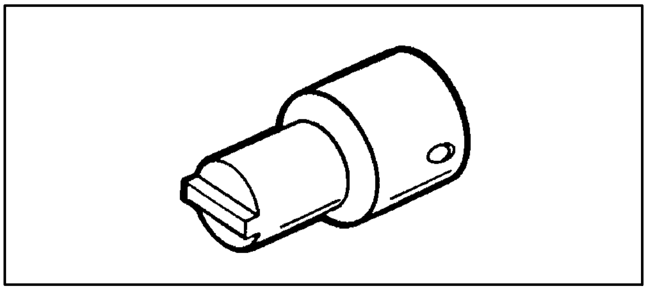

Figure 4

Roller Bearing Installation Tools

Washers and spacer used to install bearings and seals into front and rear rollers that have a threaded roller shaft.

Seal installation washer (black): # 107-8133
Seal installation spacer: # 107-3505
Bearing installation washer (yellow): # 104-6126

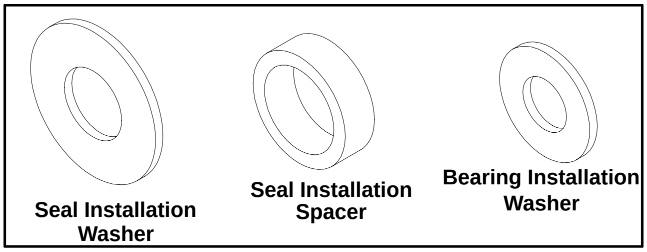

Figure 5

Cutting Units

Bearing and Seal Installer

Used to install bearings and seals into front and rear rollers that have a threaded roller shaft.

Toro Part Number: **TOR4105**

NOTE: TOR4105 is an alternative to using washers and spacers listed above.

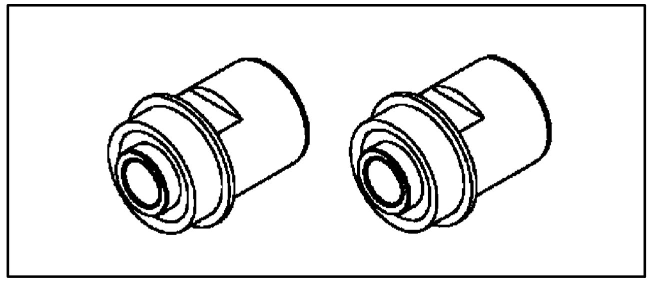

Figure 6

Inner Grease Seal Installation Washer

Inner grease seal installation washer Toro Part Number 104-0532

This washer is used when replacing the reel bearing inner grease seal. It enables pressing the grease seal to a depth of .104 in. (2.64 mm) below the surface of the cutting unit side plate.

Toro Part Number: **104-0532**

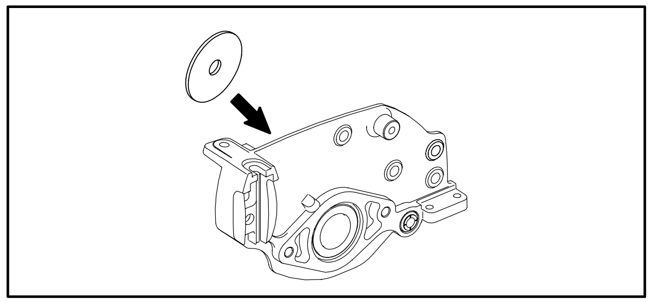

Figure 7

Plastic Plug

This cap is used for placement into the bearing housing when the reel motor is removed. It prevents dirt and debris from entering the housing.

Toro Part Number: **2410-30**

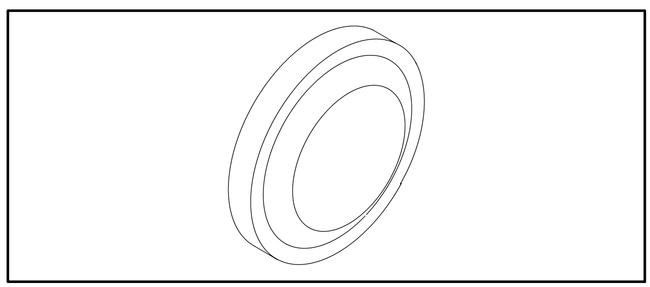

Figure 8

Turf Evaluator Tool

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)

Toro Model Number: **04399**

Figure 9

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 cutting unit. It is important to remember that the lower the height−of−cut, the more critical these factors are. See Adjustments in the Cutting Unit Operator’s Manual and the Service and Repairs section in this chapter of this manual for detailed adjustment and repair information.

For additional information regarding cutting unit troubleshooting, see Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL).

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
Tire pressure	Check pressure of all tires. Pressure must be equal on both front tires. Adjust pressure as necessary. See Chapter 6 − Wheels and Brakes.
Governed engine speed	Check maximum governed engine speed. Adjust engine to specifications if necessary. See Maintenance section in the Traction Unit Operator’s Manual, and/or the Briggs & Stratton Repair Manual for 4-cycle V-Twin Cylinder OHV Head Engines
Reel speed	All reels must rotate at the same speed (within 100 rpm). All cutting units must have equal bedknife to reel and height−of−cut adjustments. Check reel speed setting if an optional backlap/variable reel speed kit is installed. See Troubleshooting in Chapter 4 − Hydraulic System in this manual.
Reel bearing condition	Check bearings for wear and replace if necessary. See Reel and Bearing Removal and Installation in this chapter of this manual.
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 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. **A new bedknife must be ground or backlapped after installation to the bedbar.**

Factor	Possible Problem/Correction
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). Slightly dull cutting edges may be corrected by backlapping (see Backlapping in this chapter of this manual). Excessively dull cutting edges must be corrected by grinding the reel and bedknife (see Preparing Reel for Grinding in this chapter of this manual).
Rear roller adjustment	Adjust the rear roller brackets to hi or low 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 too thick for effective height−of−cut, poor quality of cut will result.
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 this chapter of this manual.
Number of reel blades	Use correct number of blades for clip frequency and optimum height−of−cut range.
Cutting unit alignment and pull frame ground following	Check pull frames and lift arms for damage, binding, or bushing wear. Repair if necessary.
Roller condition	Make sure rollers rotate freely. Repair bearings as necessary. See Roller Bearing Replacement in the Service and Repairs section in this chapter of this manual.
Cutting Unit drop speed and sequence	Rear cutting unit must drop after front cutting units. See Rear Lift Cylinder Flow Control Valve in Chapter 4 − Hydraulic System in this manual.

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 two height-of-cut ranges.

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 accordingly.

3. Adjust the height-of-cut.

4. Adjust the cut-off bar.

See Cutting Unit Operator’s Manual for adjustment procedures for the cutting units on the Greensmaster 3150.

Hydraulic Reel Motor

IMPORTANT: When performing maintenance procedures on the cutting units, store the cutting unit reel motors in support tubes on the frame to prevent damage to the hoses. Do not raise suspension to transport position when the reel motors are in the holders in the traction unit frame. Damage to the motors or hoses could result.

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 basket from carrier frame.

3. Loosen flange head screws that secure the hydraulic motor to the motor adapter plate. Rotate motor clockwise, and remove motor.

4. Place protective plastic cap (see Special Tools) into the hole in the motor adapter plate.

Inspection

1. Check reel drive coupler splines for wear. Replace if necessary (see Reel Removal and Installation in this chapter of this manual).

Installation

1. Coat spline shaft of the motor with clean No. 2 multipurpose lithium base grease.

2. Install the flange head screws for the reel drive motor into the motor adapter plate and leave approximately 1/2 inch (12.7 mm) of threads exposed on each screw.

3. Install motor by rotating the motor clockwise so the motor flanges clear the flange head screws.

4. Rotate the motor counterclockwise until the motor flanges are encircling the flange head screws. Tighten flange head screws.

Backlapping (Units without Optional Backlap/Variable Reel Speed Kit)

CAUTION

Be careful when backlapping the reel because contact with the reel or other moving parts can result in personal injury.

1. Remove reel motors from the cutting units and cutting units from the lift arms and pull frame (see Cutting Unit Removal and Installation).

2. Connect the backlapping machine to the cutting unit by inserting a piece of 3/8–inch socket extension drive into the splined reel drive coupling.

3. Attach backlap motor or drive to the socket extension.

4. Follow instructions and procedures for backlapping in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

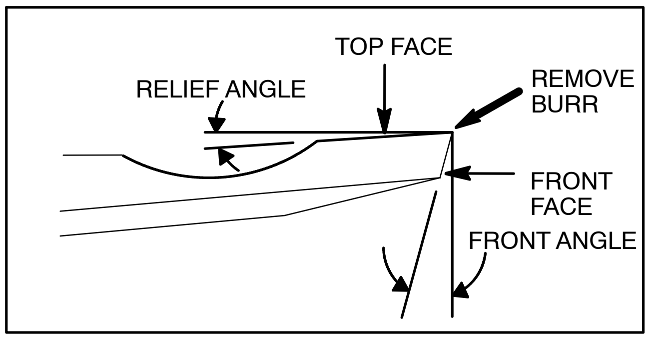

Figure 10

Note: For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

Backlapping (Units with Optional Backlap/Variable Reel Speed Kit)

DANGER

TO AVOID PERSONAL INJURY OR DEATH:

- **Never place hands or feet in the reel area while the engine is running.**
- **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, moving one motor moves the other two.**

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. Move functional control lever to the Neutral/Backlap position.

IMPORTANT: Do not attempt to rotate the directional valve knob when the machine or reels are running.

3. Raise seat and rotate directional valve knob fully clockwise to the backlap position.

4. Rotate flow control valve knob to position 6.

5. On all cutting units, make initial reel to bedknife adjustments appropriate for backlapping (see Bedknife to Reel Adjustment in Cutting Unit Operator's Manual).

6. Start engine and move Raise / Lower - Mow control forward to start the reels.

7. Rotate flow control valve knob to position 1.

8. Apply lapping compound with a long handled brush (see Special Tools).

CAUTION

Be careful when backlapping the reel because contact with the reel or other moving parts can result in personal injury.

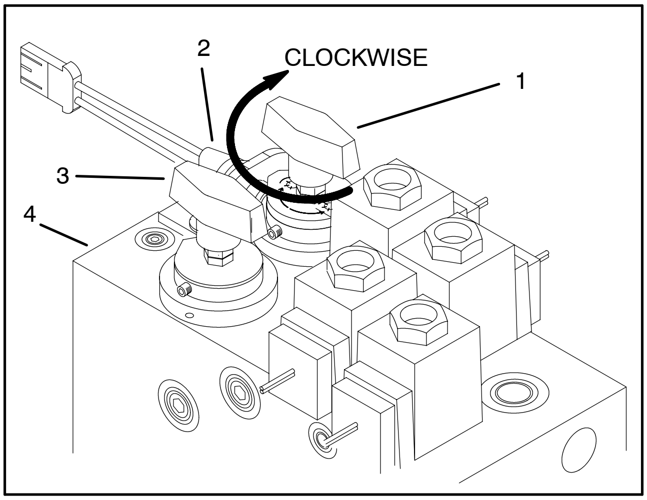

Figure 11

1. **Directional valve knob**
2. **Ball switch**
3. **Flow control valve knob**
4. **Hydraulic manifold**

9. To make an adjustment to the cutting units while backlapping, turn reels OFF by moving the RAISE/ LOWER-MOW control to the RAISE position. Shut off engine. After the adjustments have been completed, repeat steps 4 through 6.

10. When the backlap operation is completed, shut off engine and rotate directional valve knob counter-clockwise fully (90° from the backlap position) to forward position. Also, rotate flow control valve knob to position 13 for height-of-cut settings of a 1/4 inch or below.

Note: For additional settings, refer to the instructions on the decal that is located on the underside of the seat support.

11. Wash all lapping compound off the cutting units.

12. For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

Note: Additional instructions and procedures on backlapping are available in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

Bedbar Assembly

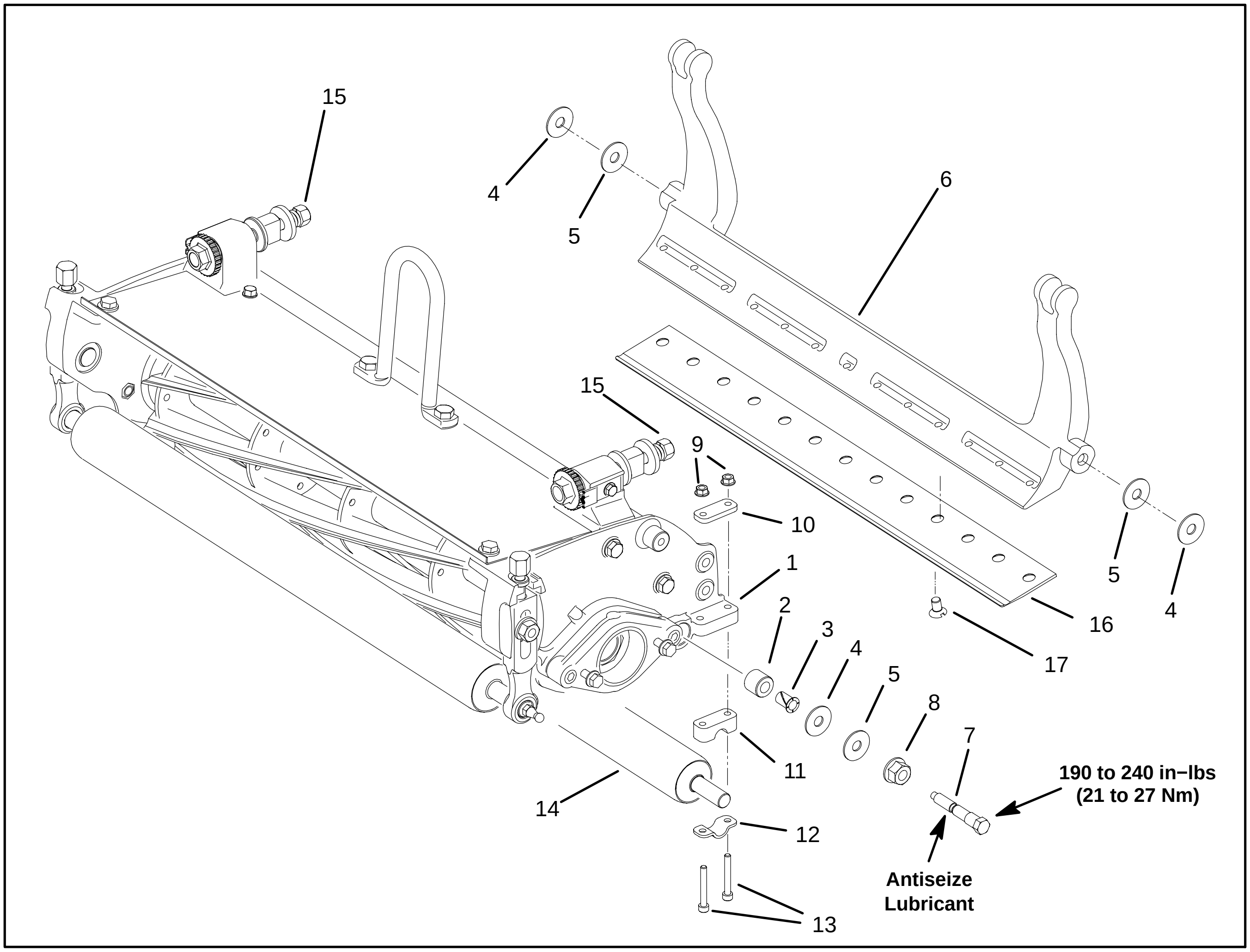

Figure 12

1. Side plate
2. Rubber bushing
3. Flange bushing
4. Washer (plastic)
5. Washer (metal)
6. Bedbar
7. Bedbar pivot bolt
8. Flange nut
9. Flange nut
10. Shim
11. Spacer
12. Retainer
13. Cap screw
14. Rear roller assembly
15. Lock nut
16. Bedknife
17. Bedknife screw

Bedbar Removal and Installation

Removal (Fig. 12)

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 basket from the cutting unit carrier frame.

3. Disconnect the drive motor from the cutting unit.

4. Disconnect the cutting unit from the pull link.

5. Unhook the cutting unit from the lift arm and slide the cutting unit out from under the carrier frame.

6. Loosen the two lock nuts (15) on the end of each bedbar adjuster assembly.

7. Loosen the two flange nuts (8) on each bedbar pivot bolt (7).

8. Remove the two bedbar pivot bolts (7), and each of the washers (4 and 5) from the outside of the cutting unit side plates.

9. Remove the bedbar (6) and each of the washers (4 and 5) from the inside of the cutting unit side plates.

10. Inspect flange bushings (3) and remove if necessary.

11. Inspect rubber bushings (2) and remove if necessary.

Installation (Fig. 12)

1. If either rubber bushing (2) was removed from the side plate, install a new bushing. The bushing should be installed flush with the inside of the side plate (Fig. 13).

2. Install the flange bushings (3) with flange facing outward.

3. Thread the flange nuts (8) all the way up to the head of each bedbar pivot bolt (7) and apply antiseize lubricant to the threads of each bedbar pivot bolt (7).

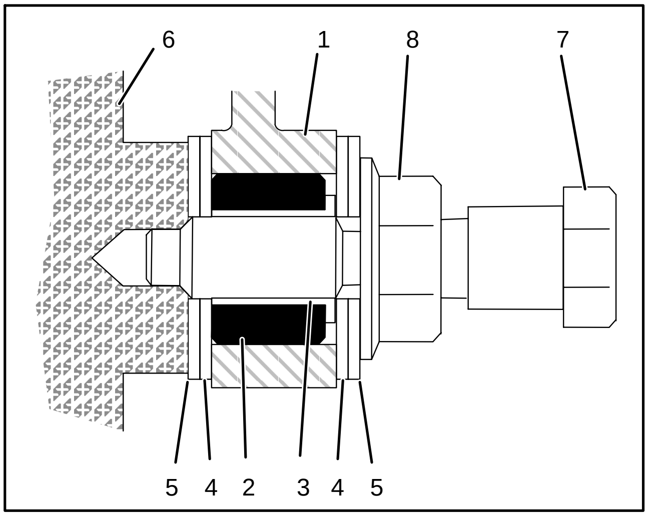

Figure 13

1. **Sideplate**
2. **Rubber bushing**
3. **Flange bushing**
4. **Washer (plastic)**
5. **Washer (metal)**
6. **Bedbar**
7. **Bedbar pivot bolt**
8. **Flange nut**

4. Slide one metal washer (5) and one plastic washer (4) onto each bedbar pivot bolt. The metal washer (5) must contact the flange nut (8) (Fig. 13).

5. Position bedbar (6) into cutting unit. Slide the top of the bedbar arms between washers on each adjuster assembly.

6. Position one metal washer (5) and one plastic washer (4) between bedbar and each side plate. The metal washer (5) must contact the bedbar (Fig. 13).

7. Install the bedbar pivot bolt assemblies. Tighten each bedbar pivot bolt from **190 to 240 in−lbs (21 to 27 Nm)**.

8. Tighten both flange nuts (8) to remove end play at the outer washers. Do not over tighten the flange nuts or distort the side plates.

9. Tighten the lock nut (15) 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).

Bedbar Adjuster Service

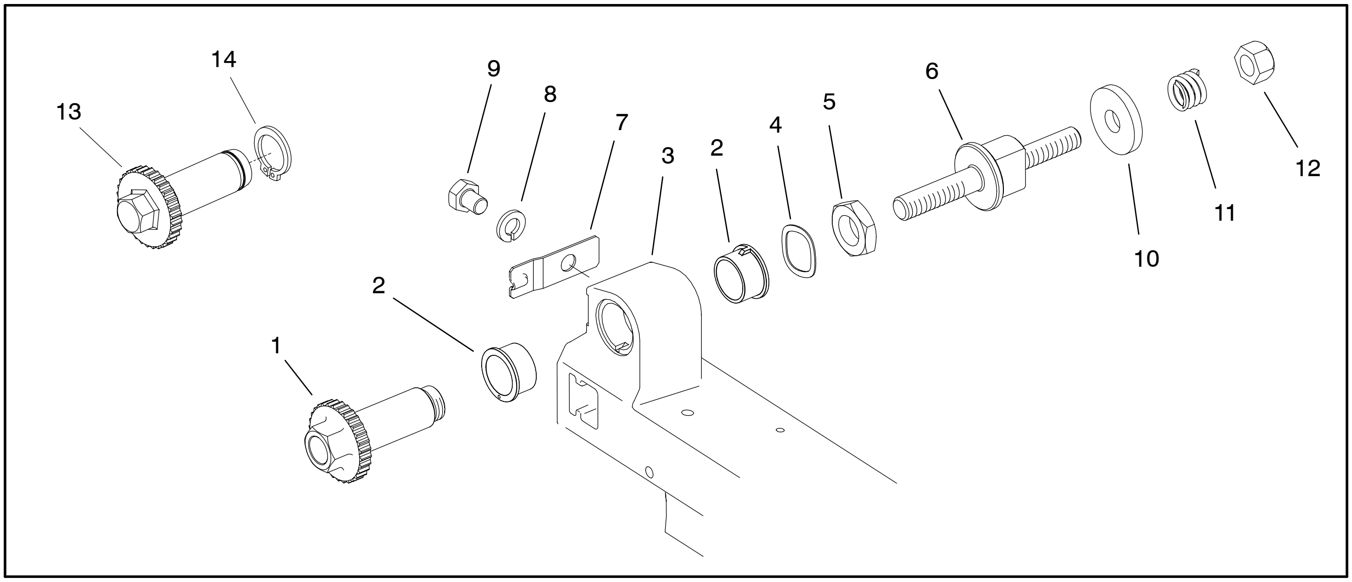

Figure 14

1. Adjuster shaft (early production)
2. Flange bushing
3. Cutting unit frame
4. Wave washer
5. Jam nut (early production)
6. Adjuster screw
7. Detent
8. Lock washer
9. Cap screw
10. Washer
11. Spring
12. Lock nut
13. Adjuster shaft (later production)
14. Retaining ring (later production)

Removal (Fig. 14)

1. Remove bedbar (see Bedbar Removal in this section of this manual).

2. Remove lock nut (12), spring (11), and washer (10) from adjuster screw.

3. Unscrew adjuster screw (6) from adjuster shaft.

4. Remove adjuster shaft from cutting unit frame:

   A. On early production cutting units, remove jam nut (5) and wave washer (4) from adjuster shaft (1). Slide adjuster shaft from frame.

   B. On later production cutting units, remove retaining ring (14) and wave washer (4) from adjuster shaft (13). Slide adjuster shaft from frame.

5. Inspect flange bushings (2) and remove from cutting unit frame if necessary.

6. If the detent (7) is damaged, remove it from the cutting unit frame by removing the cap screw (9) and lock washer (8).

Installation (Fig. 14)

1. If the detent (7) was removed, secure detent to the cutting unit frame with cap screw and lock washer.

2. If flange bushings (2) were removed, align key on bushing to slot in frame and install bushings.

3. Slide adjuster shaft (1 or 13) into flange bushings in cutting unit frame.

4. Install wave washer (4) onto adjuster shaft.

5. Secure adjuster shaft to cutting unit frame:

   A. On early production cutting units, apply Loctite 242 (or equivalent) to the threads of the jam nut (5). Install jam nut onto adjuster shaft and torque nut from **15 to 20 ft-lbs (20 to 27 Nm)**.

   B. On later production cutting units, install retaining ring (14) to adjuster shaft (13). Make sure that ring is fully seated into shaft groove.

6. Apply antiseize lubricant to threads of adjuster screw (6) and install into adjuster shaft.

7. Install washer (10), spring (11), and lock nut (12) onto adjuster screw.

8. Install bedbar (see Bedbar Installation in this section of this manual).

9. Adjust cutting unit (see Cutting Unit Operator's Manual).

Bedknife Replacement and Grinding

Removal

1. Remove bedbar from frame (see Bedbar Removal).

2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools). Discard screws. Remove bedknife from the bedbar (Fig. 15).

3. Use scraper to remove all rust, scale and corrosion from bedbar surface before installing bedknife.

Replacement

1. Make sure bedbar threads are clean. Use new screws. Apply clean SAE 30 oil to the screws before installing.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

2. Using a torque wrench and bedknife screw tool, tighten screws to a torque of **200 to 250 in-lb (22 to 28 Nm)**. Use a torquing pattern working from the center toward each end of the bedknife (Fig. 16).

3. Install bedbar to frame (see Bedbar Installation).

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. 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 (Fig. 17).

1. Remove bedbar from the cutting unit (see Bedbar Removal).

Note: When grinding, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder.

2. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for bedknife grinding information.

Bedknife Grinding Specifications	
Bedknife relief angle	3° (see Fig. 17)
Front Angle	13°
Front Angle Range	13° to 17°

3. Reinstall bedbar to cutting unit (see Bedbar Installation).

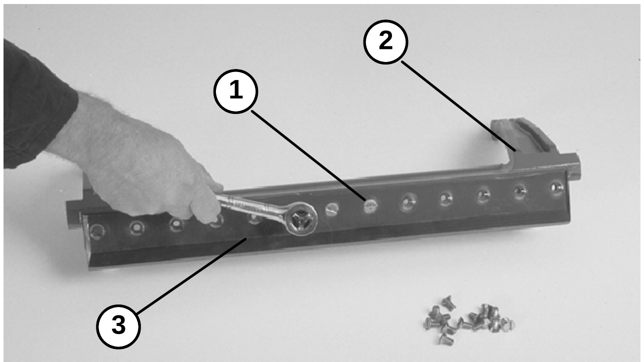

Figure 15

1. **Screw**
2. **Bedbar**
3. **Bedknife**

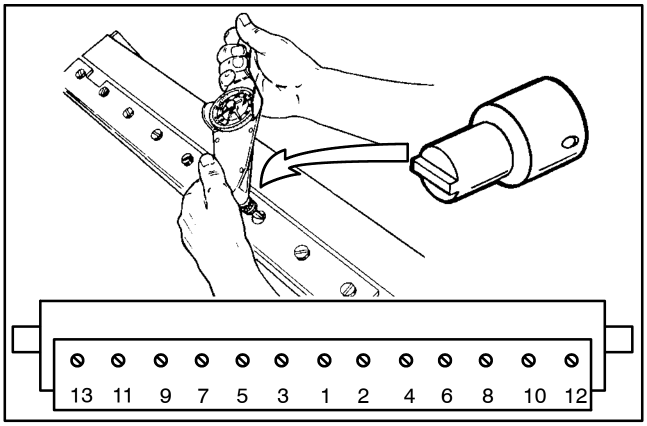

Figure 16

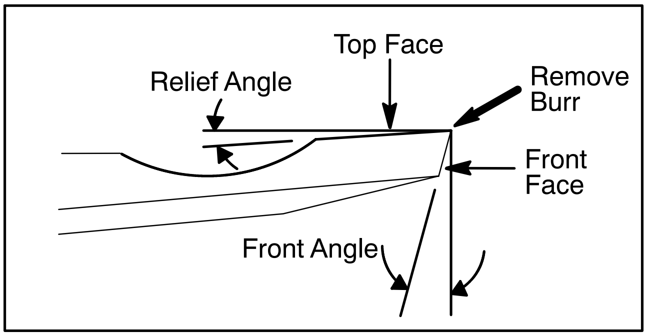

Figure 17

Reel Assembly

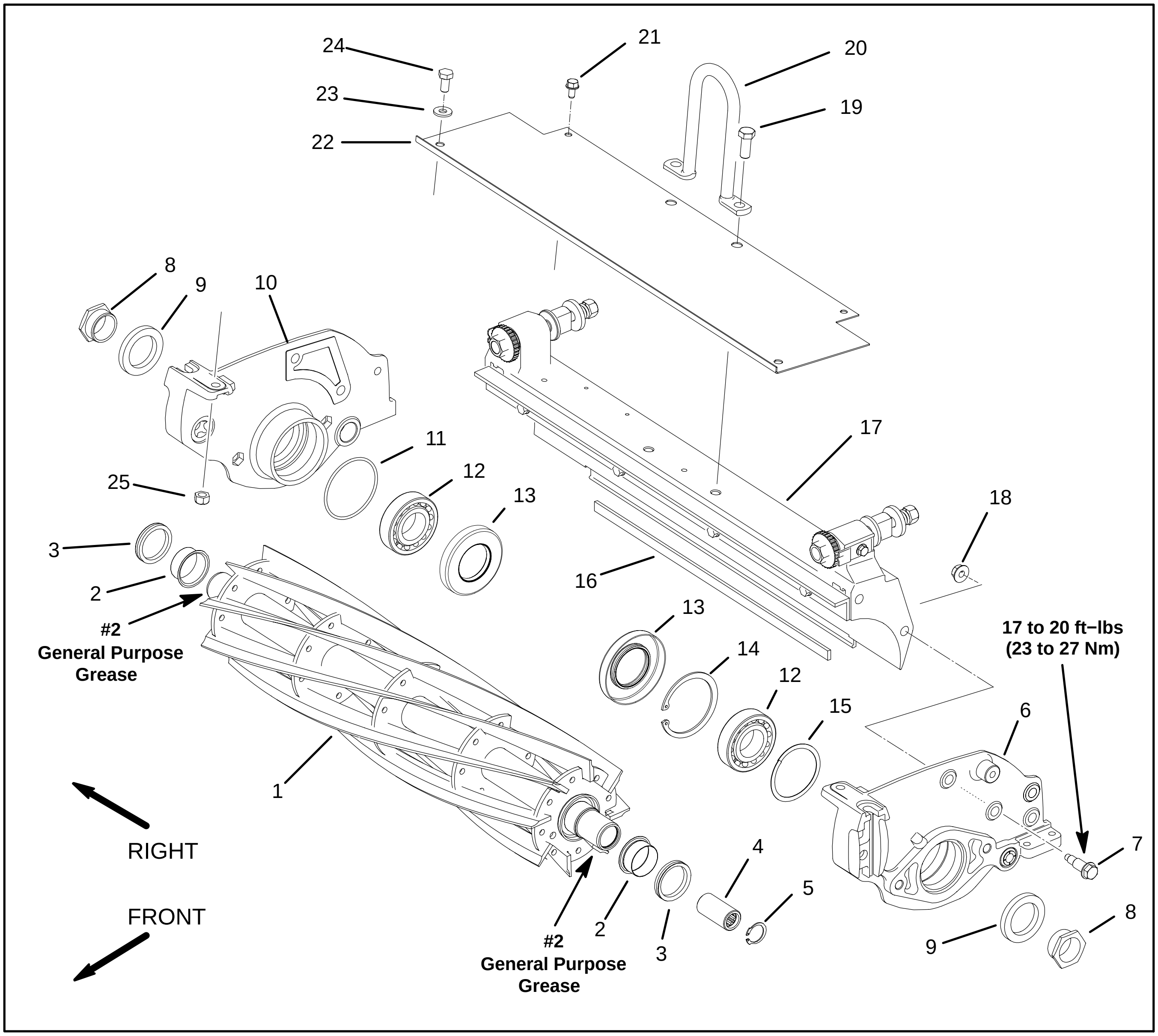

Figure 18

1. Reel	**10. Right side plate assembly**	**18. Flange nut**
2. Speedi sleeve	**11. O−ring**	**19. Cap screw**
3. V−ring	**12. Bearing**	**20. Lift hook**
4. Drive coupler	**13. Inner grease seal**	**21. Cap screw**
5. Retaining ring	**14. Retaining ring**	**22. Grass shield**
6. Left side plate assembly	**15. Wave washer**	**23. Washer**
7. Shoulder bolt	**16. Seal strip**	**24. Cap screw**
8. Bearing lock nut	**17. Frame assembly**	**25. Lock nut**
9. Outer grease seal		

Reel Removal (Fig. 18)

1. Remove reel motor from the cutting unit (see Hydraulic Reel Motor Removal in this chapter).

2. Remove the 2 capscrews securing the counter weight to the side plate (Fig. 19). Remove the counter weight.

3. Remove the bedbar assembly (see Bedbar Removal in this chapter).

Note: Depending on tools available, it may be necessary to remove the reel motor adapter plate before removing the left end bearing lock nut (8).

4. Remove the reel bearing lock (8) nut from each end of the reel shaft.

5. Loosen the setscrews securing the front roller to the height of cut arms (Fig. 20). Do not remove the set screws.

6. Loosen the saddle strap screws and flange nuts securing the rear roller to the the side plates (Fig. 20). Do not remove the screws and nuts.

7. Remove the capscrew (24), washer (23) and lock nut (25) securing each end of the grass shield to the side plates. These are the only capscrews that must to be removed. The grass shield and the lift hook do not need to be removed.

8. Remove the 2 shoulder bolts (7) securing the right hand side plate to the cutting unit frame. Remove the side plate from the reel shaft and roller shafts.

9. Remove the 2 shoulder bolts (7) securing the left hand side plate to the cutting unit frame. Remove the side plate from the reel shaft and the roller shafts.

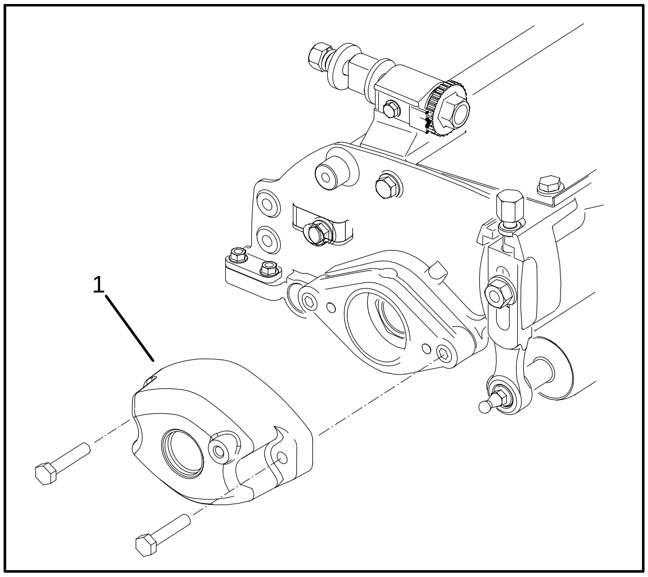

Figure 19

1. **Counter weight**

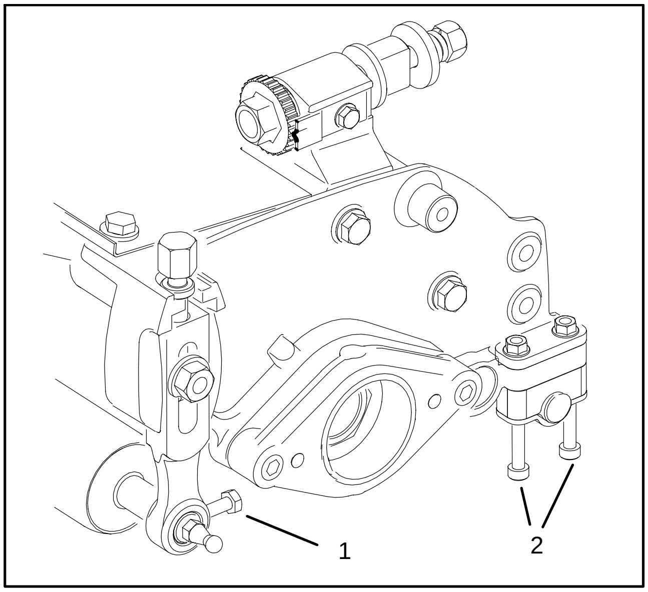

Figure 20

1. **Front roller set screw**
2. **Rear roller saddle strap screws**

Cutting Units

Left Side Plate Service (Fig. 18)

1. Remove the inner grease seal (13) and outer grease seal (9) from the side plate (6).

2. Remove the retaining ring (14) securing the bearing in the side plate. Remove the bearing (12). Inspect the bearing to insure that it spins freely and has minimal axial play. The bearing balls must be free of deformation and scoring. Replace the bearing if necessary.

3. Remove the wave washer (15).

4. Remove all grease from the side plate bore.

5. Insert the wave washer (15) into the side plate.

Note: Replacement Seal Kit (Toro Part No. 106-6937) is available for side plate service of dual point adjust cutting units.

6. Pack the bearing (12) with Mobil High Temperature HP or equivalent grease. Insert the bearing into the side plate against the wave washer.

7. Press the retaining ring (14) into the groove, slightly compressing the bearing and wave washer.

8. Pack the cavity of the inner seal (13) with Mobil High Temperature HP or equivalent grease.

9. Using inner grease seal installation washer (Toro Part Number 104-0532) press the inner seal (13) into the side plate until the washer is flush with the outer edge of the side plate bore. Remove the washer. When properly installed, the seal should be positioned .104 in. below the inner edge of the side plate bore.

10. Press the outer seal (9) into the side plate until it is flush with the the outer edge of the side plate bore.

IMPORTANT: The outer grease seal (9) should be installed so the lip is facing out. This helps keep contamination from entering, and allows grease to vent or purge out if necessary (Fig. 22).

11. Fill remaining voids, behind inner grease seal (13) and outer grease seal (9) lips with Mobil High Temperature HP or equivalent grease.

Right Side Plate Service (Fig. 18)

1. Remove the inner grease seal (13) and outer grease seal (9) from the side plate (10).

2. Remove the bearing (12). Inspect the bearing to insure that it spins freely and has minimal axial play. The bearing balls must be free of deformation and scoring. Replace the bearing if necessary.

3. Remove the O−ring (11) from the groove in the side plate bore.

4. Remove all grease from the side plate bore.

Note: Replacement Seal Kit (Toro Part No. 106-6937) is available for side plate service of dual point adjust cutting units.

5. Insert the O−ring (11) into the groove in the side plate. Apply a light coating of grease onto the O−ring, after it is installed.

6. Pack the bearing (12) with Mobil High Temperature HP or equivalent grease. Insert the bearing into the side plate until it is against the bottom of the bore.

7. Pack the cavity of the inner seal (13) with Mobil High Temperature HP or equivalent grease.

8. Using inner grease seal installation washer (Toro Part Number 104-0532) press the inner seal (13) into the side plate until the washer is flush with the outer edge of the side plate bore. Remove the washer. When properly installed, the seal should be positioned .104 in. (2.6 mm) below the inner edge of the side plate bore.

9. Press the outer seal (9) into the side plate until it is flush with the the outer edge of the side plate bore.

IMPORTANT: The outer grease seal (9) should be installed so the lip is facing out. This helps keep contamination from entering, and allows grease to vent or purge out if necessary (Fig. 22).

10. Fill remaining voids, behind inner grease seal (13) and outer grease seal (9) lips with Mobil High Temperature HP or equivalent grease.

Reel Service (Fig. 18)

Note: Install new reel components on each end of the reel shaft that mates with newly serviced side plate components.

1. Remove the retaining ring (5) and the drive coupler (4) from the end of the reel shaft.

2. Remove the V−ring (3) from the reel shaft.

3. Using a flat blade screw driver or similar tool, remove the speedi sleeve (2) from the reel shaft.

Note: Replacement Seal Kit (Toro Part No. 106-6937) is available for reel service of dual point adjust cutting units.

4. Inspect the reel shaft as follows:

   A. Check the reel shaft for bending and distortion by placing the shaft ends in V−blocks. Replace the reel if necessary.

   B. Check the reel blades for bending or cracking Replace the reel if necessary.

   C. Check the drive adapter inside of the reel shaft (Fig. 21). The adapter should be free of bending and distortion. Check the splines for excessive cracks or distortion. Replace the reel if necessary.

   D. Check the service limit of the reel diameter. Replace the reel if necessary.

5. Using an appropriate I.D. tube or sleeve, press the speedi sleeve onto the reel shaft until it bottoms out on the spider cup (Fig. 22).

IMPORTANT: Do not nick or scratch the Speedi sleeve surface as seal failure could result.

6. Slide the V−ring onto the reel shaft with the thick shoulder of the V−ring facing inward (Fig. 22).

7. Fill the drive coupling (4) 1/2 to 1/3 full with Mobil High Temperature HP or equivalent grease. Also, coat the outside of the drive coupling with grease.

8. Install the retaining ring (5). Make sure it is seated into the groove.

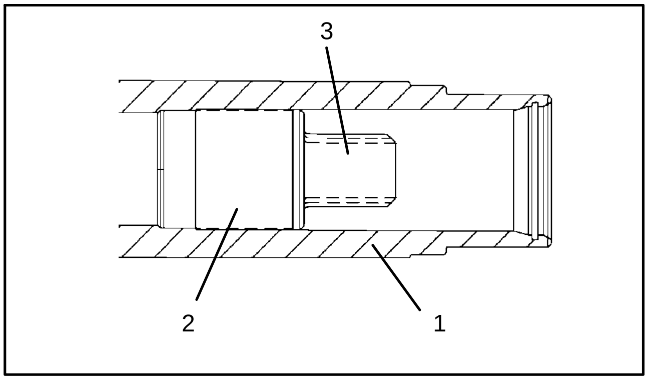

Figure 21

1. **Reel shaft**
2. **Drive adapter**
3. **Adapter spline**

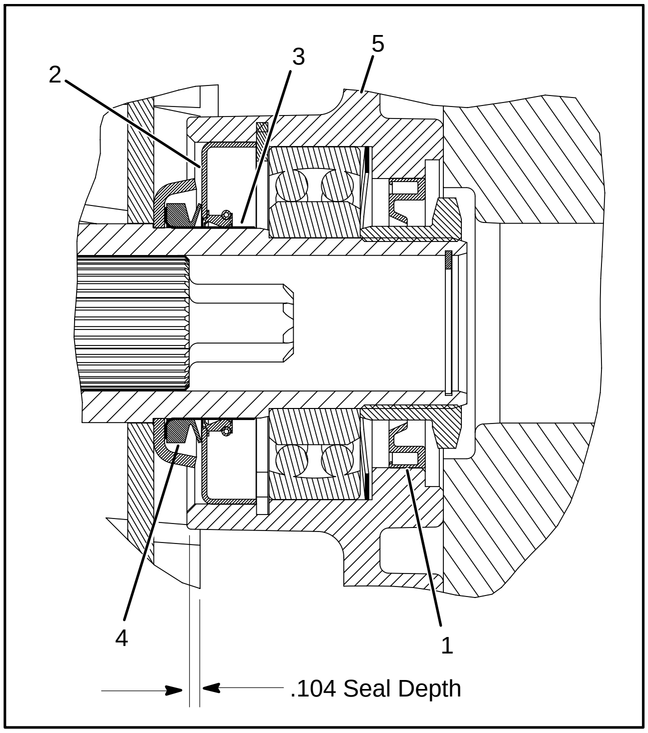

Figure 22

1. **Outer seal**
2. **Inner seal**
3. **Speedi sleeve**
4. **V-ring**
5. **Left side plate**

Cutting Units

Reel Installation (Fig. 18)

IMPORTANT: Wipe any excess grease from the inner grease seals (13) where the reel shaft V−rings (3) make contact. The V−rings should run dry.

1. Slide the left hand side plate (6) onto the reel shaft. Make sure the reel shaft threads do not damage the grease seals in the side plate.

2. Apply a film of No. 2 general purpose grease to the reel shaft threads and install the left side reel bearing locknut (8).

3. Slide the right hand side plate (10) onto the reel shaft. Make sure the reel shaft threads do not damage the grease seals in the side plate.

4. Apply a film of No. 2 general purpose grease to the reel shaft threads and install the right side reel bearing locknut (8).

5. Mount the frame assembly (17) to the side plates with the four shoulder bolts (7). Torque the shoulder bolts to **17 to 20 ft-lbs. (23 to 27 Nm).**

6. Secure the grass shield (22) to the side plates with two capscrews (24), washers (23), and lock nuts (25).

7. Torque the reel bearing locknuts (8) to **50 to 60 ft-lbs. (68 to 81 Nm).**

8. Install the bedbar assembly (see Bedbar Installation in this chapter).

9. Install the rear roller as follows (Fig. 23):

   A. On one of the saddle clamps, remove one of the screws and nuts securing it to the side plate.

   B. Install rear roller into saddle clamps and loosely secure it with the screw and nut previously removed.

   C. Center the roller between side plates. Tighten the saddle clamp screws and nuts to secure the roller.

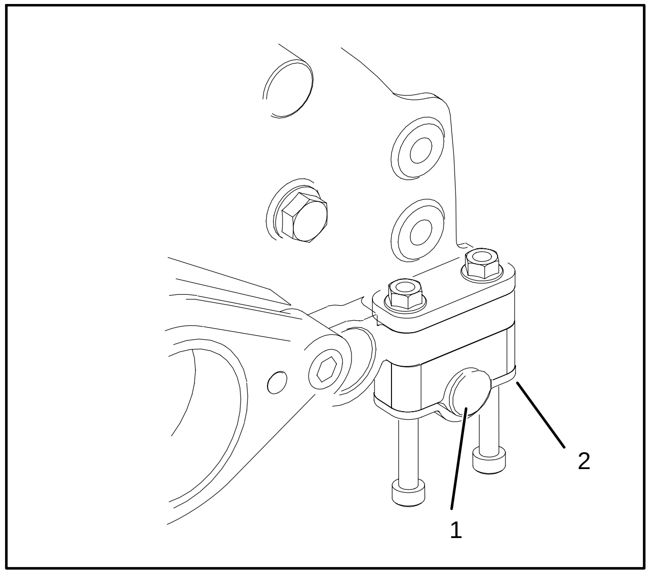

Figure 23

1. Rear roller **2. Saddle clamp**

10. Install the front roller (see Front Roller Installation in this chapter).

11. Adjust the cutting unit. See the Cutting Unit Operator's Manual for adjustment procedures.

Note: The parallel position of the rear roller to the reel is controlled by the precision machined components of the assembled cutting unit. Only a limited amount of adjustment is possible if necessary due to tapered reel wear. To adjust:

A. Place the assembled cutting unit on a surface plate.

B. Loosen each bedbar adjuster assembly, both cap screws (24), and all four shoulder bolts (7).

C. Adjust the cutting unit and tighten the shoulder bolts (7) to a torque of **17 to 20 ft-lbs. (23 to 27 Nm).**

D. Tighten the cap screws (24).

E. Tighten each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen lock nut 1/2 turn.

Note: For severely tapered reels, a .010 in. (.254 mm) shim (Toro Part No. 106-6923) is available for the rear roller mount.

Preparing a Reel for Grinding

Note: Check to make sure the reel bearings are in good condition before grinding a reel.

1. Remove bedbar assembly (see Bedbar Removal and Installation).

2. Remove parts as necessary to mount cutting unit into grinder (e.g., front roller, front roller brackets).

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 grinding, be careful to not overheat the reel blades. Remove small amounts of material with each pass of the grinder.

3. Refer to Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for reel grinding information.

4. After completing the grinding process:

   A. Install parts removed to mount cutting unit into grinder.

   B. Install bedbar assembly (see Bedbar Removal and Installation).

   C. Complete cutting unit set-up and adjustment sequence (see Cutting Unit Operator's Manual).

Reel Grinding Specifications	
Nominal Reel Diameter	5.06 in (128.5 mm)
Service Limit - Reel Diameter	**4.56 in (118.8 mm)**
Blade Relief Angle	30°
Relief Angle Range	20° to 40°
Blade Land Width	0.040 in (1.0 mm)
Land Width Range	0.030 to 0.060 in (0.7 to 1.5 mm)
Service Limit - Reel Taper	**0.040 in (1.0 mm)**

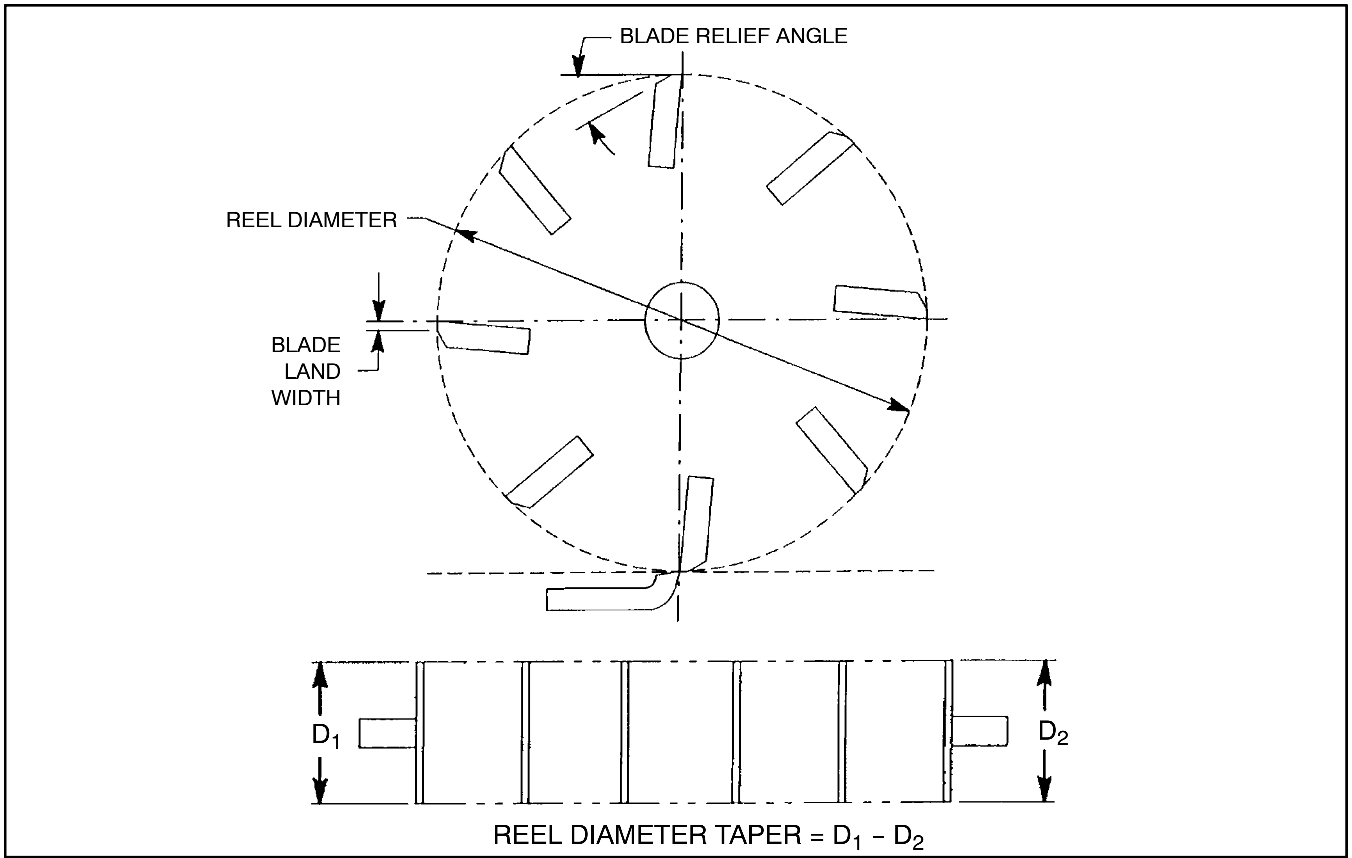

Figure 24

Cutting Units

Front Roller Removal and Installation

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.

Note: The front roller can be removed with the cutting unit either attached to the lift arm or removed from the lift arm. Determine your maintenance needs.

2. Loosen cap screws securing the roller shafts to each front bracket.

3. Remove the lock nut, tab washer, and carriage screw securing one of the front roller brackets to the cutting unit frame assembly.

4. Remove the front bracket and slide the roller and shaft from the cutting unit. Remove the remaining front roller bracket if necessary.

Installation (Fig. 25)

1. Place cutting unit on a level working surface.

2. If both front roller brackets were removed:

   A. Insert carriage screw through the cutting unit side plate and front bracket. Secure carriage screw and roller bracket with tab washer and lock nut.

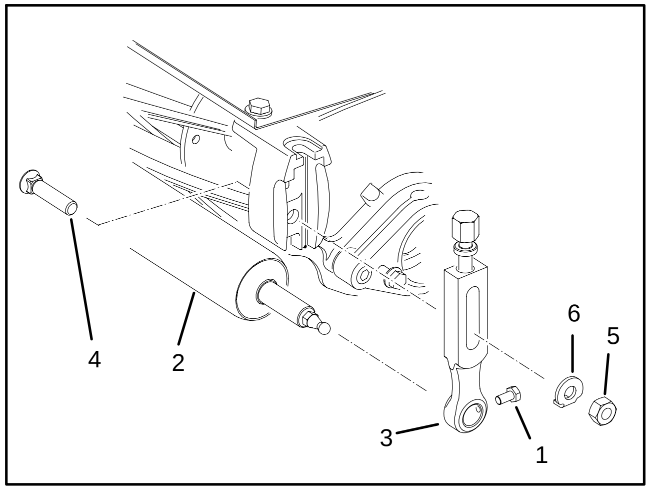

Figure 25

1. Cap screw
2. Roller assembly
3. Front roller bracket
4. Carriage screw
5. Lock nut
6. Tab washer

3. Slide roller shaft into the front bracket attached to the cutting unit. Slide second front bracket on the other end of roller. Secure bracket with carriage screw, tab washer, and lock nut.

4. Apply Loctite 242 or equivalent to the cap screw threads. Center roller in the front brackets and secure into place with the cap screws.

5. Adjust cutting unit height−of−cut (see Cutting Unit Operator’s Manual).

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Cutting Units

Roller Service (Roller Shaft with Circlip)

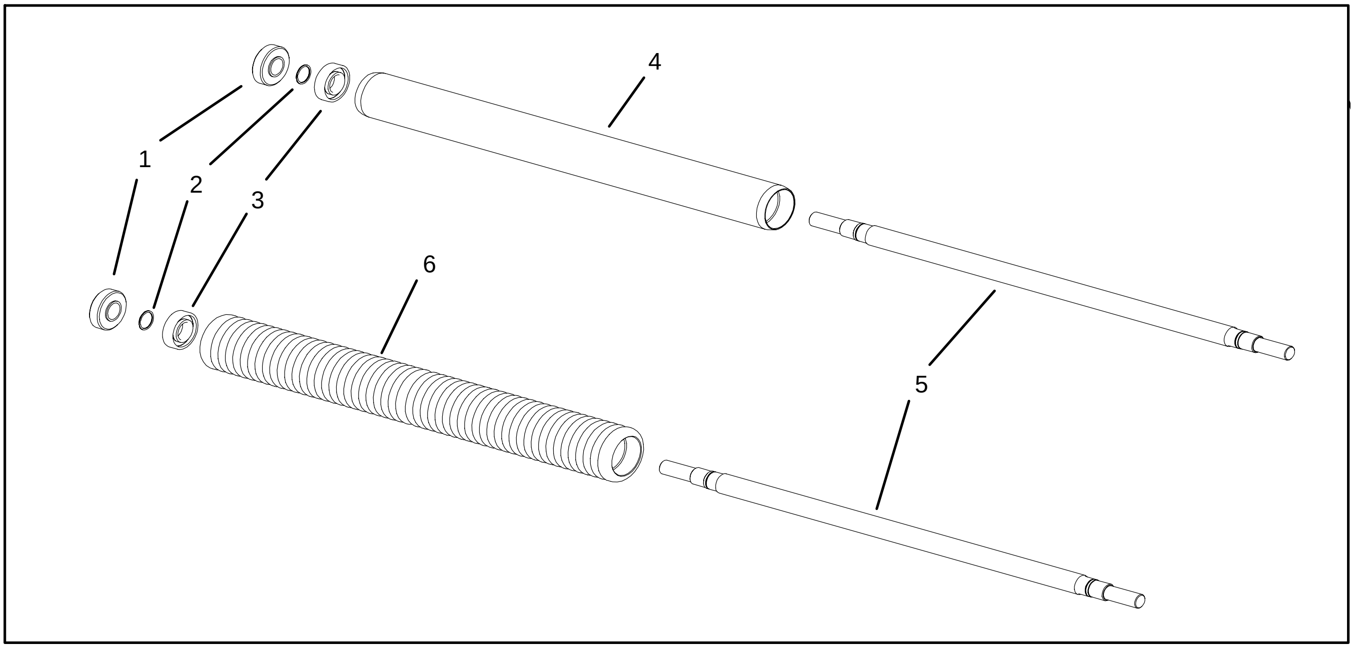

Figure 26

1. **Roller seal**
2. **Spiral retaining ring**
3. **Roller bearing**
4. **Rear roller body**
5. **Roller shaft**
6. **Front roller body**

Seal Removal

1. Make a seal removal tool from a 1/4 x3 x 3 in (.63 x 7.6 x 7.6 cm) piece of steel as shown (Fig. 27).

2. Slide seal removal over roller end of roller shaft.

3. Use the tool as a template to locate, mark, and drill two 7/64 in. diameter holes in the outer face of the seal.

4. Thread two No. 8 x 3/4 in long (.164 in. diameter) self-tapping screws through the seal removal tool and into the drilled holes in the seal.

5. Thread two 1/4−20 x 1 in. long cap screws into the seal removal tool.

6. Alternately tighten the cap screws to pull the seal from the roller body.

Note: Seals will be destroyed during removal. Do not re-use seals that have been removed from the roller.

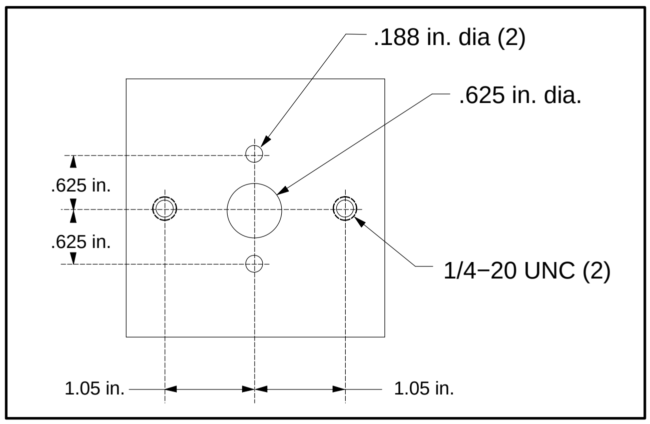

Figure 27

Seal Installation

1. Apply a thin film of clean oil to the inner lip of the seal and slide the seal over the end of the roller shaft.

2. Press the seal squarely into the roller body. The seal face should be flush with the end of the roller body when correctly installed.

Bearing Removal

Note: Replace both roller bearings as a set after a bearing failure.

1. Remove the roller seals (see Roller Seal Removal in this chapter of this manual).

2. Remove both spiral retaining rings from the roller shaft.

Note: Roller bearings have a press fit into the roller body and a slip fit on the roller shaft.

3. Loosely secure roller body in a vise. Lightly tap one end of the roller shaft with a plastic hammer to drive the shaft and one of the bearings from the roller body.

4. Use the roller shaft to remove the remaining bearing.

5. Clean roller bearing cavity and remove any rust or corrosion with an abrasive cloth.

6. Inspect bearings, roller shaft, spiral retaining rings, and roller body for wear or damage. Replace components as necessary.

Bearing Installation

1. Pressing against the outer race of the bearing only, drive one bearing all the way into either end of the roller body (Fig. 28).

2. Slide roller shaft through roller body and installed bearing.

3. Install spiral retaining ring against installed bearing.

4. Slide the remaining bearing onto the roller shaft. Pressing against the outer race of the bearing only, drive the remaining bearing all the way into the end of the roller body (Fig. 28).

5. Install remaining spiral retaining ring.

6. Install new seals (see Roller Seal Installation in this chapter of this manual).

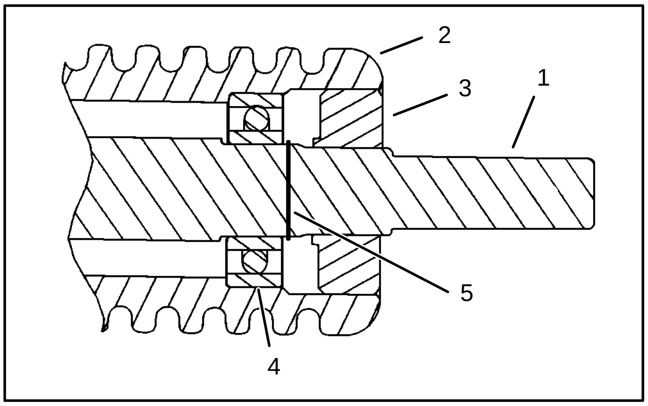

Figure 28

1. **Roller shaft**
2. **Roller body**
3. **Seal**
4. **Bearing**
5. **Spiral retaining ring**

Cutting Units

Roller Service (Threaded Roller Shaft)

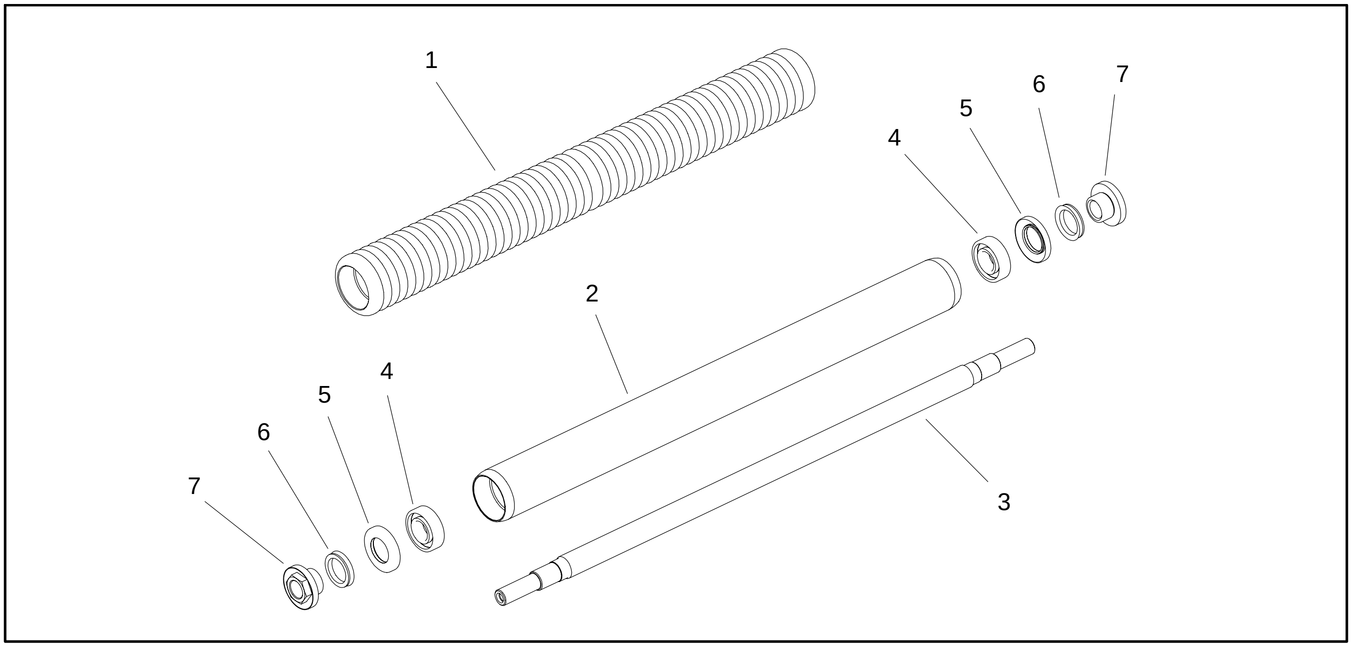

Figure 29

1. **Wiehle roller**
2. **Smooth roller**
3. **Roller shaft**
4. **Ball bearing**
5. **Seal**
6. **V−ring**
7. **Bearing lock nut**

Disassembly

1. To hold roller shaft for bearing lock nut removal, install a 3/8−24 UNF 2B screw into threaded end of roller shaft and secure in place with jam nut. While retaining shaft, remove bearing lock nut from each end of roller shaft.

2. Remove v−ring from each end of roller.

3. Carefully inspect seating surface and threads of bearing lock nuts. Replace lock nut if any damage is found.

4. Loosely secure roller assembly in bench vise and lightly tap one end of roller shaft until seal and bearing are removed from roller cavity. Remove second seal and bearing from roller cavity by tapping on shaft.

5. Clean bearing cavity in roller and remove any rust with crocus cloth.

Assembly

1. Place roller shaft into roller.

Note: If bearing lock nuts are being replaced, use original lock nuts for assembly purposes, if possible. This will preserve the patch lock feature in the new lock nuts. Use the new nuts only after new bearings and seals have been installed.

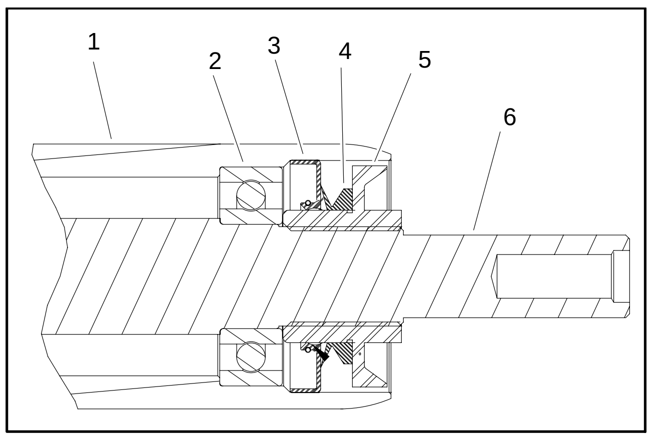

Figure 30

1. **Roller**
2. **Ball bearing**
3. **Seal**
4. **V−ring**
5. **Bearing lock nut**
6. **Roller shaft**

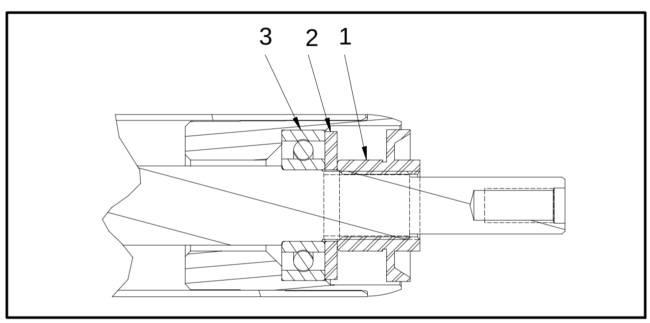

Figure 31

1. **Bearing lock nut**
2. **Black assembly washer**
3. **Bearing**

Note: Special tool TOR4105 (see Special Tools) can be used instead of washers and spacer when installing bearings and seals in roller.

2. Position a new bearing, black assembly washer (see Special Tools) and original lock nut onto each end of the roller shaft (Fig. 31).

3. Tighten nuts until the bearings are seated into each end of the roller.

4. Remove nut and black assembly washer from each end of the roller.

IMPORTANT: Failure to grease bearing lock nut before seal installation may result in seal damage.

5. Apply a coating of grease to the nut surface to prevent seal damage during seal installation (Fig. 32).

6. Carefully install seals onto bearing lock nuts. Pack the back of the seal 75 to 90% full with #2 grease (Fig. 32).

7. Install a nut with seal onto each end of the roller shaft. Tighten nuts until they bottom against bearings (Fig. 33). Remove nuts from roller shaft.

8. Position an assembly spacer and yellow assembly washer (see Special Tools) on each end of roller shaft (Fig. 34). Thread nut onto each end of shaft.

9. Tighten each nut until the yellow assembly washers bottom out against the roller housing. Remove nuts, assembly washers and assembly spacers from roller shaft.

Note: If original bearing lock nut(s) are being used, apply Loctite #242 (or equivalent) to threads of lock nut(s).

10. Insert a V−ring onto each bearing lock nut.

11. Lubricate lips of installed seals with #2 grease.

12. Install bearing lock nut with V−ring onto each end of the roller shaft. Torque lock nuts from **25 to 30 ft−lb (34 to 41 Nm)**.

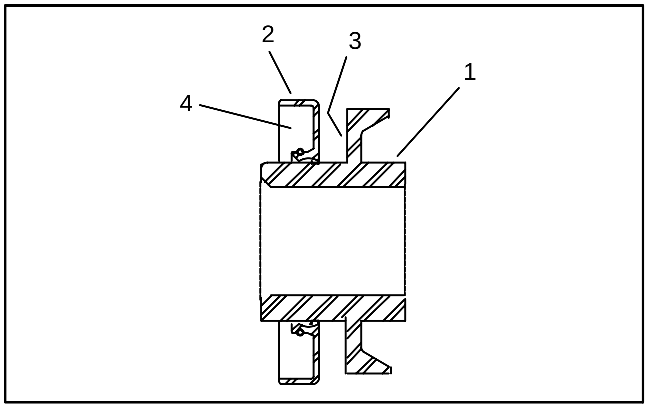

Figure 32

1. **Bearing lock nut**
2. **Seal**
3. **Grease nut surface**
4. **Pack with grease**

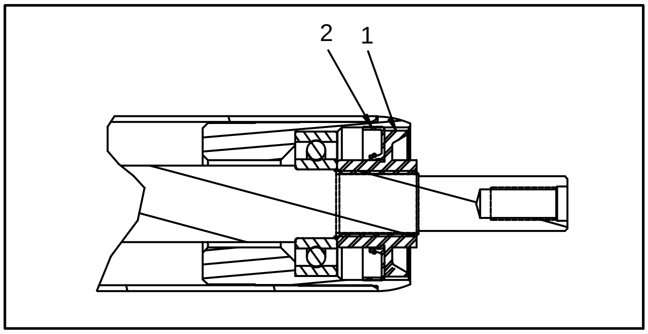

Figure 33

1. **Bearing lock nut**
2. **Seal**

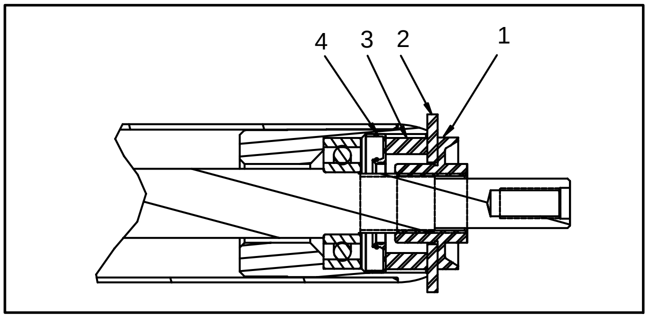

Figure 34

1. **Bearing lock nut**
2. **Yellow assembly washer**
3. **Assembly spacer**
4. **Seal**

Cutting Units

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Chapter 10.1

Groomer (DPA Cutting Unit)

Table of Contents

Specifications

MOUNTING: The groomer is mounted to the Dual Point Adjust (DPA) cutting reel bearing housings and frame.

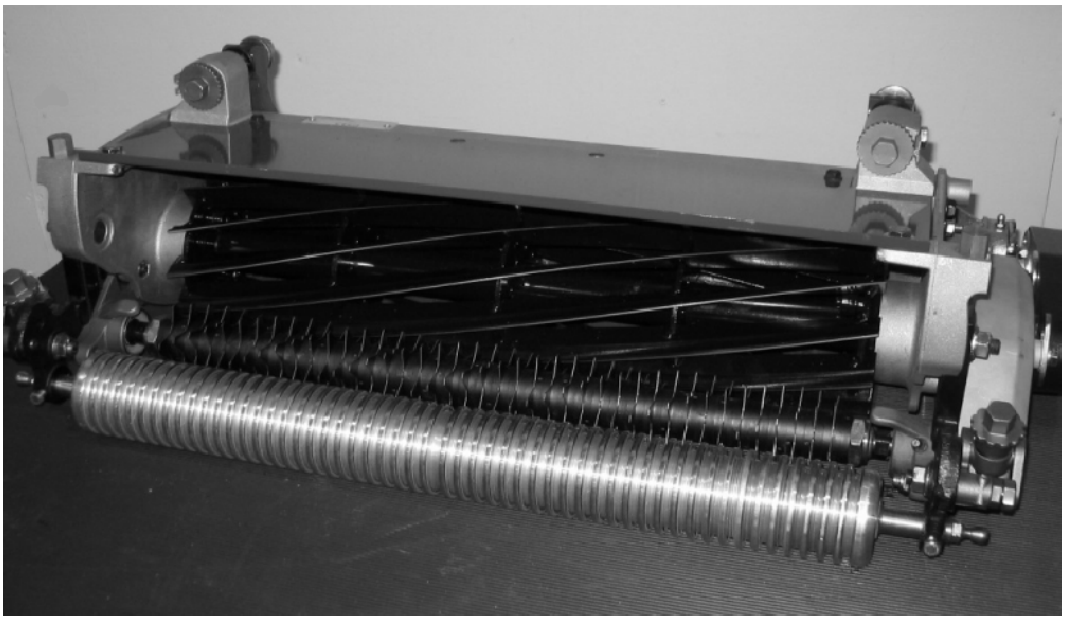
REEL CONSTRUCTION: 2.375 inch (6 cm) diameter, 41 steel blades with 1/2 inch blade spacing. Blade spacing can be adjusted to 1/4 inch or 3/4 inch by altering the position of blade spacers on the groomer.

GROOMER PENETRATION: From .410 inch (10.4 mm) above ground level to 0.125 inch (3.2 mm) below ground level, at mowing HOC range of .062 to .296 inch (1.6 to 7.5 mm).

WIDTH-OF-GROOMER: 19 inches (48.3 cm).

HEIGHT ADJUSTMENT KNOB: Allows a 0.003 inch (0.08 mm) increment of height adjustment for each click of the adjuster.

UP-DOWN FEATURE: At lower height of cut settings, allows groomer reel to be raised above the height/depth adjustment for no groomer reel action while cutting. At higher height of cut settings, groomer may have to be in the raised position for effective groomer operation.



General Information

Groomer Position

IMPORTANT: Before changing groomer position, make certain that the reel drive is in the disengaged position and that the cutting reel is not rotating.

To place the groomer reel in the raised, non-grooming position, remove the lock screw and rotate the lift arm to raise the groomer reel. Install the lock screw to retain the groomer reel in the non-grooming position (Fig. 1).

To place the groomer reel in the lowered, grooming position, remove the lock screw and rotate the lift arm to lower the groomer reel. Install the lock screw to retain the groomer reel in the grooming position (Fig. 2).

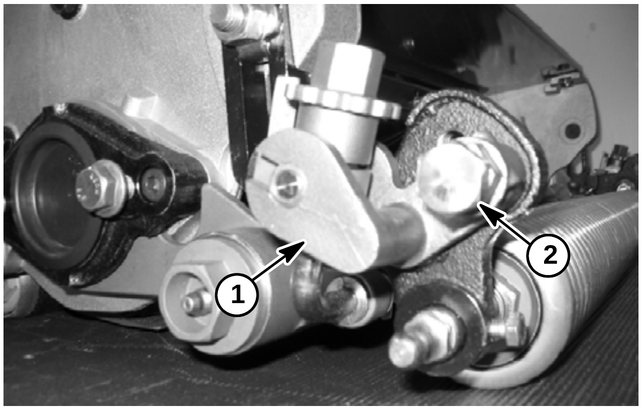


Figure 1

1. **Lift arm**
2. **Lock screw (transport)**

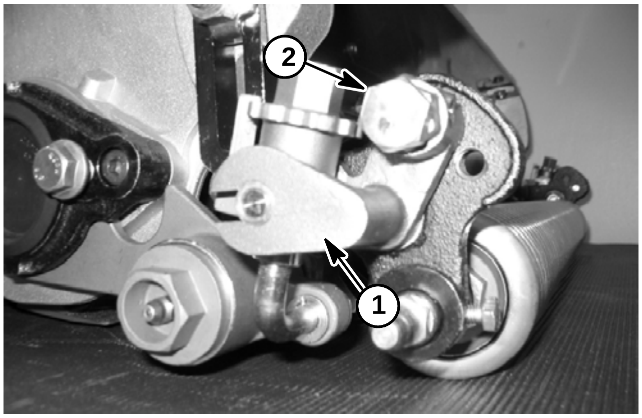


Figure 2

1. **Lift arm**
2. **Lock screw (grooming)**

Groomer (DPA Cutting Unit)

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 green to green. 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 reel, such as too deep or 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 Grooming Reels:

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 blade spacing on the groomer reel.

5. The height–of–cut.

6. The grooming depth.

7. The type of grass on the green.

8. The amount of time that a groomer reel has been in use on a particular turf area.

9. The amount of traffic on the turf.

10. The overall turf management program – irrigation, fertilizing, weed control, coring, overseeding, sand dressing and disease and pest control.

11. Stress periods for turf – high temperatures, high humidity, unusually high traffic.

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
The groomer reel rotates when it is in the raised, transport position.	The groomer reel should rotate whenever the cutting reel is engaged.	Normal operation.
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 cutting unit with the engine running. Always stop the engine and remove the key from the ignition switch before working on the mower.

Note: See Cutting Unit Operator's Manual for adjustment procedures for the cutting units on the Greensmaster 3150.

Height/Depth of Groomer 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 for cutting unit adjustment procedures).

3. Position the groomer reel to the lowered, grooming position (Fig. 3).

Note: Improper or over-aggressive use of the groomer reel (i.e. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe greens 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. Lift and turn height adjustment knob to raise or lower the blade tip (Fig. 3). Each notch on the adjustment knob changes the groomer height approximately 0.003 inch (0.08 mm).

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.

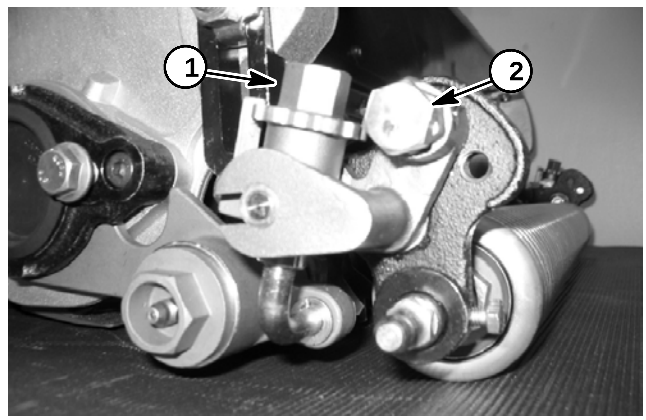


Figure 3

1. **Height adjustment knob** 2. **Lock screw (lowered)**

Service and Repairs

Groomer Belt Replacement

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. If equipped, remove rotating rear roller brush from cutting unit.

3. Remove two (2) lock nuts that secure groomer belt cover, then remove cover (Fig. 4).

4. Pivot idler pulley by placing a 12mm wrench on pulley nut and rotating idler bracket to relax belt tension. Slip groomer drive belt off pulleys (Fig. 5). Carefully release idler bracket.

5. Install new drive belt to drive pulley, idler pulley and driven pulley observing correct belt routing (Fig. 5).

6. Secure belt cover to housing with two (2) lock nuts (Fig. 4).

7. If equipped, install rotating rear roller brush to cutting unit.

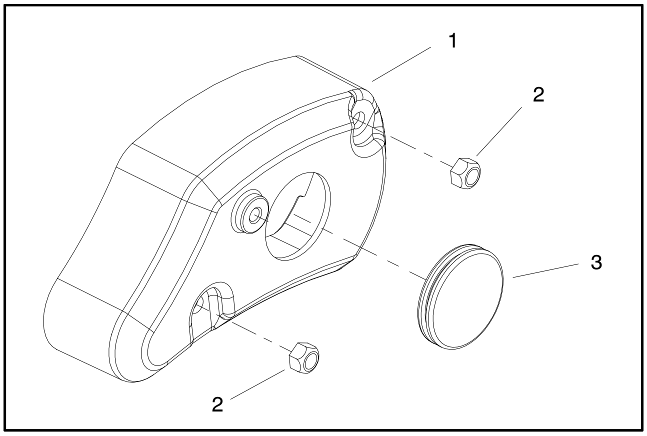


Figure 4

1. **Groomer belt cover**
2. **Lock nut**
3. **Cap**

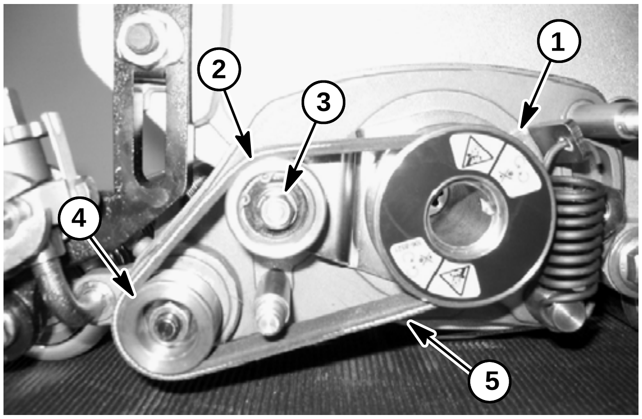


Figure 5

1. **Drive pulley**
2. **Idler pulley**
3. **Idler pulley nut**
4. **Driven pulley**
5. **Groomer drive belt**

Groomer (DPA Cutting Unit)

Groomer Reel

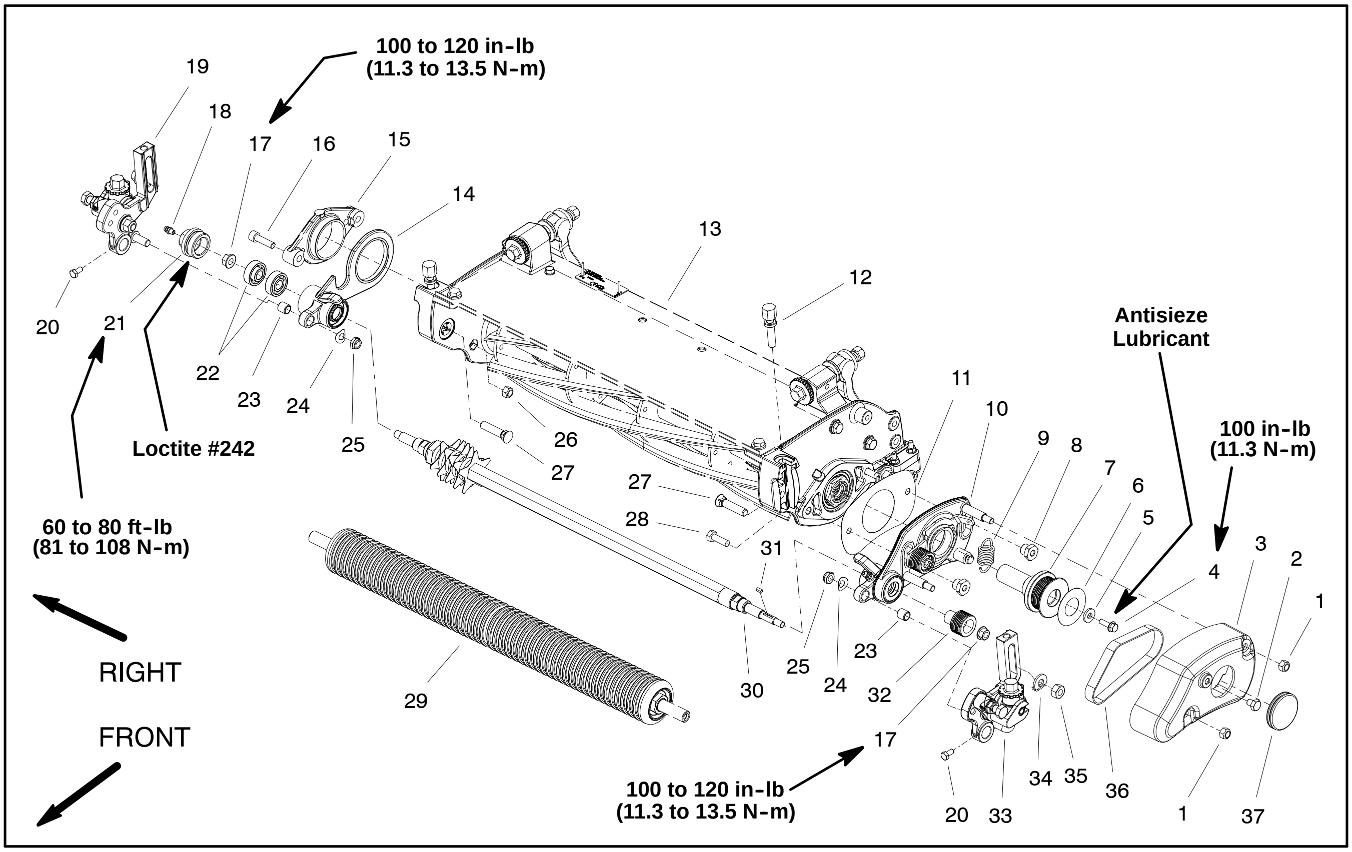


Figure 6

1. **Lock nut (2 used)**
2. **Cap screw**
3. **Groomer belt cover**
4. **Flange head screw**
5. **Washer**
6. **Decal**
7. **Drive pulley**
8. **Shoulder nut (2 used)**
9. **Spring**
10. **Drive side plate (LH shown)**
11. **Groomer shim**
12. **Height-of-cut screw (2 used)**
13. **Cutting reel assembly**
14. **Non-drive side plate (RH shown)**
15. **Reel motor mount**
16. **Allen head screw (2 used)**
17. **Flange nut (2 used)**
18. **Grease fitting**
19. **Non-drive groomer arm assembly**
20. **Cap screw**
21. **Cap plug**
22. **Bearing**
23. **Bushing (2 used)**
24. **Spring washer (2 used)**
25. **Lock nut (2 used)**
26. **Lock nut (4 used)**
27. **Plow bolt (2 used)**
28. **Cap screw (2 used)**
29. **Front roller assembly**
30. **Groomer reel assembly**
31. **Square key**
32. **Driven pulley**
33. **Drive groomer arm assembly**
34. **Tab washer**
35. **Lock nut**
36. **Groomer drive belt**
37. **Cap**

Remove the groomer reel to reverse the shaft, replace individual blades or replace the shaft. The shaft can be reversed so that the sharpest edge of the groomer blades are forward.

Note: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 6 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 hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of Chapter 10 - DPA Cutting Units).

3. If equipped, remove rotating rear roller brush from cutting unit.

4. Remove groomer belt cover (item 3) and groomer drive belt (item 36) from groomer drive side of mower (see Groomer Belt Replacement in this section).

5. Loosen cap screws (item 20) that secure front roller shaft to groomer arms (Figs. 7 and 8).

6. Remove lock nut (item 25) and spring washer (item 24) that secure drive side groomer arm lift rod to drive side plate (Fig. 7).

7. Remove lock nut (item 35), tab washer (item 34) and plow bolt (item 27) that secure drive side groomer arm assembly to drive side plate. Do not change height-of-cut screw adjustment. Remove drive side groomer arm assembly from cutting unit.

8. Remove front roller assembly from cutting unit.

Note: To prevent groomer shaft from turning when removing driven pulley, use wrench on shaft flats to hold shaft.

9. Remove the flange nut (item 17) that secures driven pulley (item 32) to groomer shaft. Remove driven pulley from shaft. Locate and retrieve square key (item 31) that locates pulley on shaft.

Note: To prevent cutting reel from turning when removing drive pulley, block reel with piece of wood.

10. Remove flange head screw (item 4) and washer (item 5) that secure drive pulley (item 7) to the cutting reel shaft. Slide drive pulley from cutting reel.

11. Remove two shoulder nuts (item 8) that secure the groomer drive side plate (item 10) to the cutting unit frame. Remove the groomer drive side plate assembly.

12. Remove the cap plug (item 21) from non-drive side plate (Fig. 8).

13. Remove the flange nut that secures the groomer shaft to the non-drive side plate.

14. Pull the groomer reel from the non-drive side plate.

15. Inspect seals, bushings and bearings in side plates for wear or damage. 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 RH and LH side plates. Make sure that seals, bushings and bearings are properly positioned in side plates.

3. Carefully place groomer reel assembly into the non-drive side plate bearings taking care not to damage seal in side plate. Thread flange nut (item 17) onto the shaft threads but **do not tighten**.

4. Make sure that groomer shim (item 11) is installed on groomer drive side of cutting unit.

5. Carefully place drive side plate onto groomer shaft taking care not to damage seals in side plate. Position side plate to the cutting unit frame and secure with two shoulder nuts (item 8).

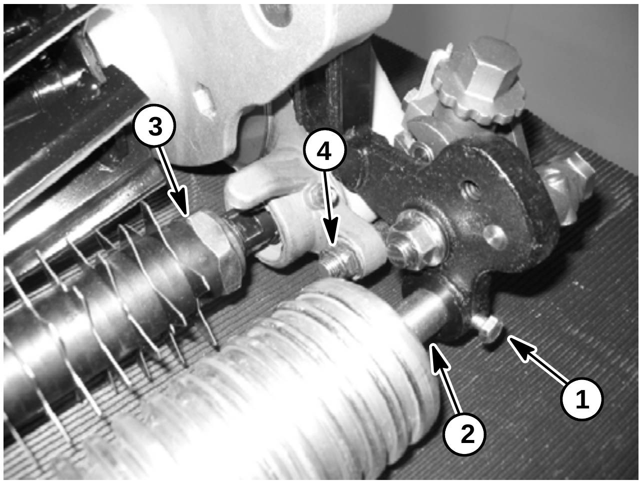


Figure 7

1. **Cap screw**
2. **Front roller shaft**
3. **Groomer shaft assembly**
4. **Locknut/spring washer**

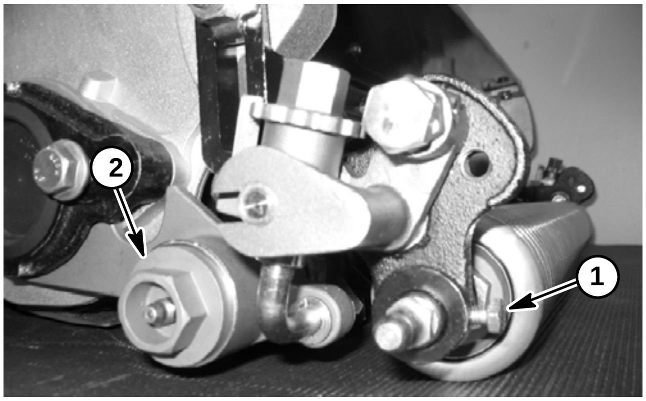


Figure 8

1. **Roller retaining cap screw**
2. **Cap plug**

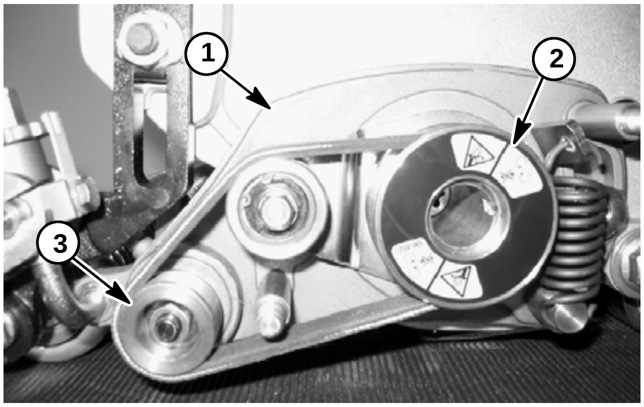


Figure 9

1. **Drive side plate**
2. **Drive pulley**
3. **Driven pulley**

Groomer (DPA Cutting Unit)

6. Apply grease to drive pulley splines and pulley hub taking care not to get grease on belt surface. Slide drive pulley onto the reel shaft.

7. Apply anti-seize lubricant to threads of flange head screw (item 4) used to attach drive pulley to reel shaft. Secure drive pulley to reel with washer (item 5) and flange head screw.

8. Place square key (item 31) in groomer shaft slot and install driven pulley onto the groomer shaft. Thread flange nut (item 17) onto the shaft threads.

9. Secure groomer reel by holding the flange nut (item 17) on one end of the reel and tightening the flange nut on the other end of groomer shaft. Torque flange nuts from 100 to 120 in-lb (11.3 to 13.6 N-m).

10. Apply Loctite #242 (or equivalent) to threads of cap plug (item 21). Install cap plug into non-drive side plate and torque cap plug from 60 to 80 ft-lb (81 to 108 N-m) (Fig. 8).

11. Insert front roller into non-drive side groomer arm.

12. Position drive side groomer arm to front roller, groomer drive side plate and cutting unit frame. Secure groomer arm to cutting unit with carriage bolt, tab washer and flange nut.

13. Apply antisieze lubricant to threads of lift arm assembly stud on groomer arm. Install spring washer (item 24) and lock nut (item 25) to secure drive side groomer arm assembly to groomer side plate (Fig. 7).

14. Center front roller and tighten cap screws (item 20) to secure roller (Figs. 7 and 8).

15. Install groomer drive belt and belt cover to side of cutting unit (see Groomer Belt Replacement in this section).

16. Install hydraulic reel motor onto cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of Chapter 10 - DPA Cutting Units).

17. If equipped, install rotating rear roller brush to cutting unit.

18. 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.

19. Check groomer reel height and mower height-of-cut settings. Adjust as needed.

Groomer Reel Service

Disassembly (Fig. 10)

Inspect groomer reel blades frequently for damage and wear. Straighten bent blades with a pliers. Either replace worn blades or reverse worn blades on the groomer shaft to put the sharpest blade edge forward (Fig. 11). Blades that are rounded to the midpoint of the blade tip must be replaced or reversed for best groomer performance.

1. Remove groomer reel (see Groomer Reel Removal in this section).

2. Remove lock nut from either end of the shaft (Fig. 10).

3. Remove spacers and blades as necessary.

Assembly (Fig. 10)

1. Start by placing two (2) spacers against the lock nut installed on one end of groomer shaft. Then, place first blade against spacers (Fig. 10).

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. For 1/2 inch (1.3 cm) spacing, make sure there are two (2) spacers between blades (Fig. 10).

3. When all blades have been installed, place final two (2) spacers on shaft and then thread lock nut onto the shaft.

4. Position lock nuts to allow blades and spacers to be centered on the shaft (Fig. 12). Torque lock nuts from 200 to 250 in-lb (22.6 to 28.3 N-m) so spacers are **not** free to rotate.

5. Install groomer reel back on cutting unit (see Groomer Reel Installation in this section).

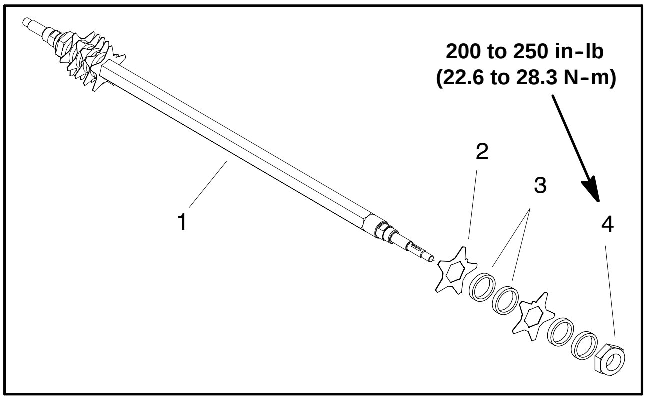


Figure 10

1. **Groomer reel shaft**
2. **Groomer blade**
3. **Spacer**
4. **Lock nut**

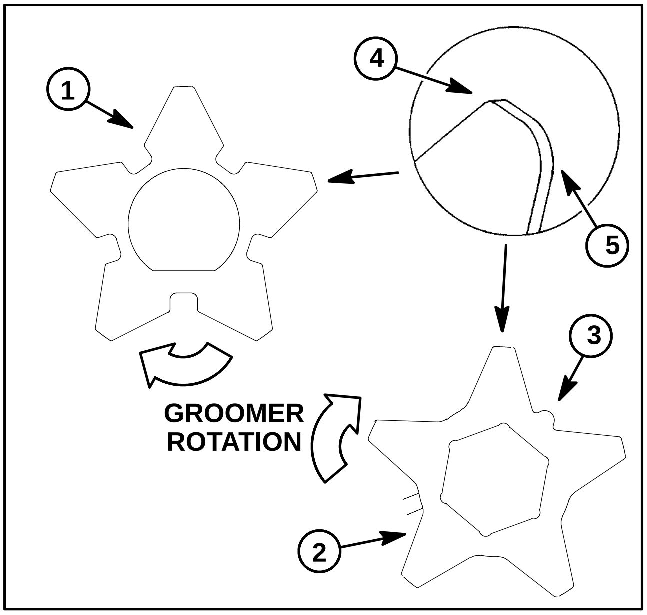


Figure 11

1. **Groomer blade (D shaft)**
2. **Blade (hex shaft)**
3. **Location mark**
4. **Sharp edge**
5. **Dull (rounded) edge**

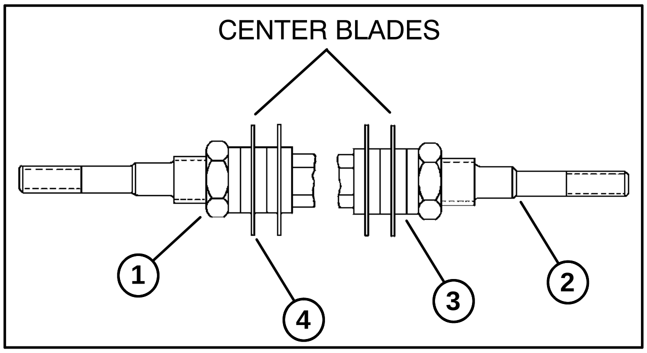


Figure 12

1. **Lock nut**
2. **Shaft**
3. **Spacer**
4. **Blade**

Groomer (DPA Cutting Unit)

Groomer Reel Bearing Replacement

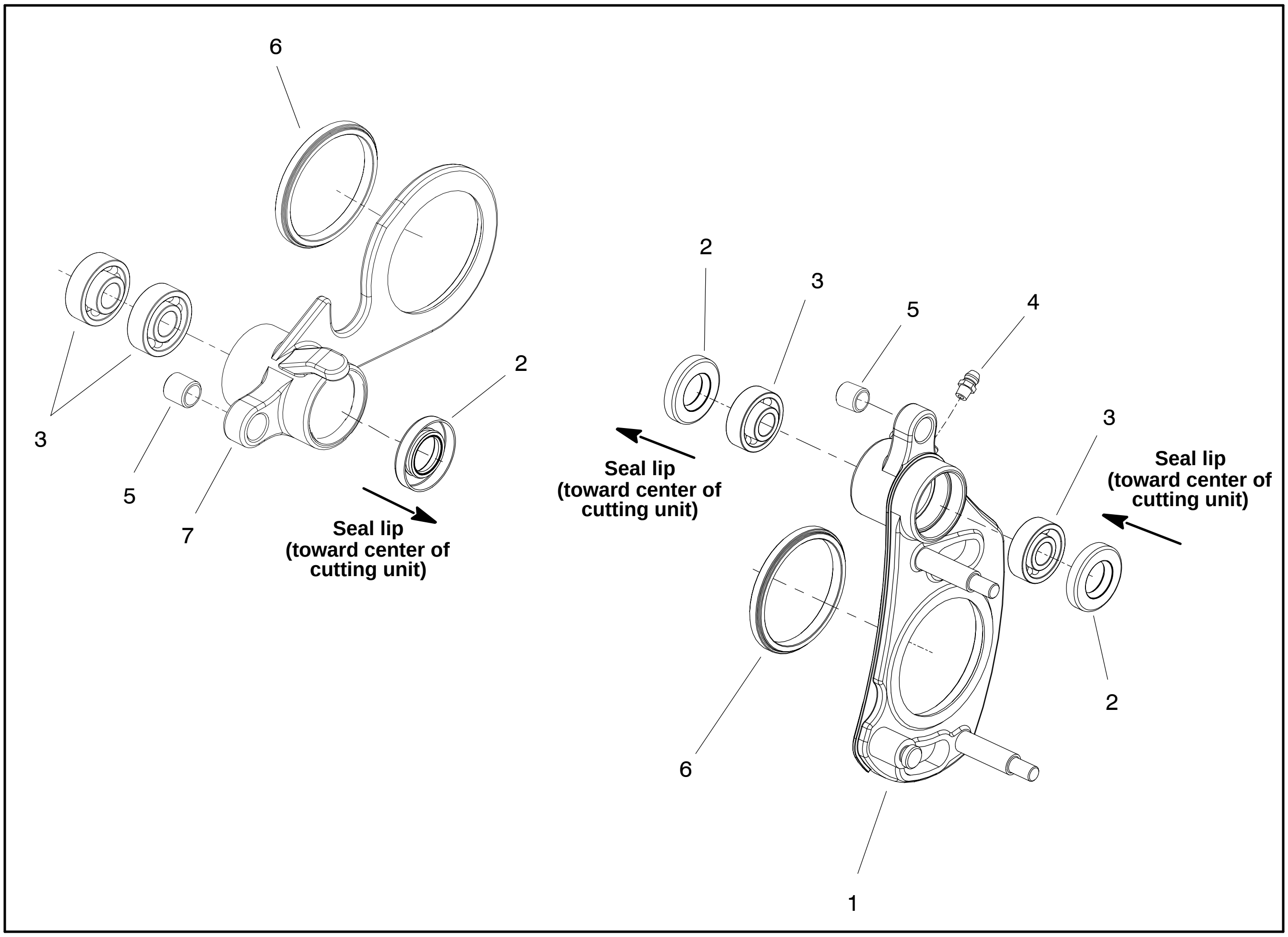


Figure 13

1. Drive side plate (LH shown)
2. Oil seal
3. Groomer reel bearing
4. Grease fitting
5. Bushing
6. Side plate bushing
7. Non-drive side plate (RH shown)

Note: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 13 shows the groomer reel drive from the left side of the cutting unit.

Bearing Removal

1. Remove front roller, drive side groomer side plate and groomer reel from cutting unit (see Groomer Reel Removal in this section).

2. Remove non-drive groomer side plate from cutting unit:

A. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of Chapter 10 - DPA Cutting Units).

B. Remove two (2) socket head screws and lock nuts that secure motor mount to cutting unit (Fig. 14). Remove motor mount from cutting unit.

C. Remove lock nut and spring washer that secure groomer arm lift rod to non-drive groomer side plate (Fig. 15). Remove non-drive groomer side plate from mower.

3. Remove bearings in **both** side plate assemblies (Fig. 13):

A. Remove seals from groomer side plates. Discard seals.

B. Push bearings out of side plate housings. Bearings in drive side plate are a press fit. Bearings in non-drive side plate are slip fit. Discard bearings.

Bearing Installation

1. Install new bearings in **both** side plate assemblies (Fig. 13):

   A. Slide new bearings into non-drive side plates. Position extended inner race of bearings toward center of side plate housing.

   B. Press new bearings into drive side plates applying pressure to outer bearing race only. Position extended inner race of bearings toward center of side plate housing.

   C. Install new seals into side plates. **Note:** Seals should be installed so the lip side of the seal will face the center of the cutting reel. When bearings are greased, grease will purge from inner seals.

2. Install non-drive groomer side plate to cutting unit:

   A. Position non-drive groomer side plate to cutting unit making sure that groomer arm lift rod is positioned through bushing in side plate.

   B. Apply antisieze lubricant to threads of lift arm assembly stud. Place spring washer and lock nut on lift rod threads (Fig. 15). Tighten lock nut.

   C. Position motor mount to groomer side plate (Fig. 14). Secure motor mount and groomer side plate to cutting unit with two (2) socket head screws and lock nuts.

   D. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of Chapter 10 - DPA Cutting Units).

3. Install groomer reel and drive side groomer side plate (see Groomer Reel Installation in this section).

4. 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.

5. Check and adjust groomer reel height and mower height-of-cut settings.

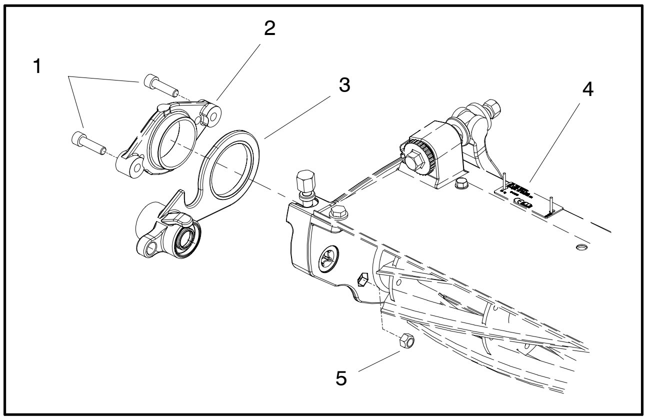


Figure 14

1. **Socket head screw**
2. **Motor mount**
3. **Groomer side plate (RH)**
4. **Cutting unit**
5. **Lock nut (2 used)**

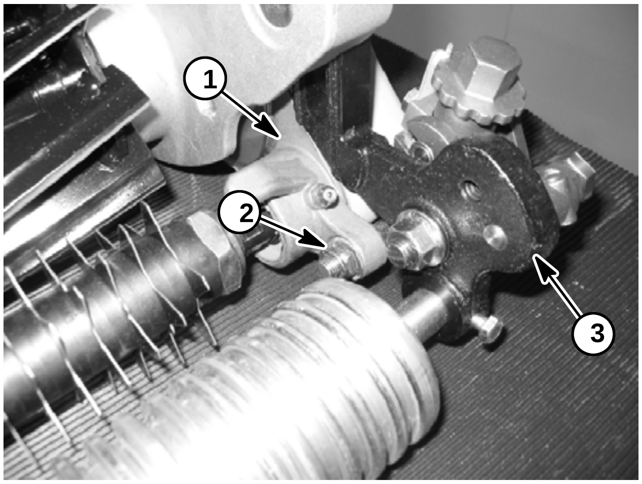


Figure 15

1. **LH groomer side plate**
2. **Lock nut/spring washer**
3. **LH groomer arm**

Groomer (DPA Cutting Unit)

Idler Assembly

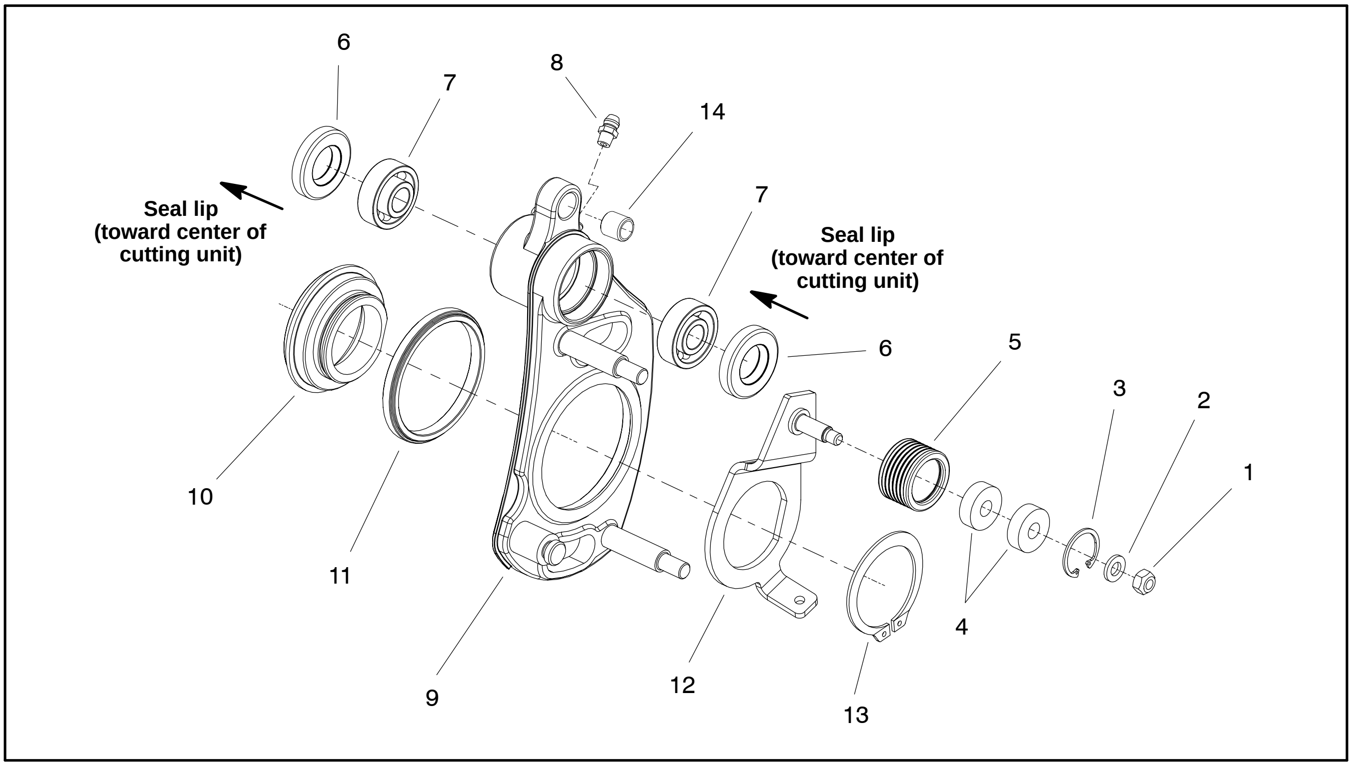


Figure 16

1. Lock nut
2. Flat washer
3. Retaining ring
4. Idler bearing
5. Idler pulley
6. Seal
7. Bearing
8. Grease fitting
9. Groomer drive side plate (LH shown)
10. Pivot hub
11. Side plate bushing
12. Idler bracket
13. Retaining ring
14. Bushing

The groomer drive side plate assembly incorporates the idler system for tensioning the groomer drive belt. The idler system uses a spring to maintain proper belt tension.

Note: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 16 shows the groomer reel drive from the left side of the cutting unit.

Removal

1. Remove groomer belt cover, drive belt and drive pulley from groomer drive side of mower (see Groomer Reel Removal in this section).

2. Using Figures 16 and 17 as guides, remove idler bracket, idler pulley and/or idler bearings as needed.

Installation

1. Reassemble components using Figures 16 and 17 as guides.

Note: When properly installed, the idler pulley should move freely from side to side on the idler bracket pin.

2. Install drive pulley, drive belt and belt cover to right side of mower (see Groomer Reel Installation in this section).

3. Check and adjust groomer reel height and mower height-of-cut settings.

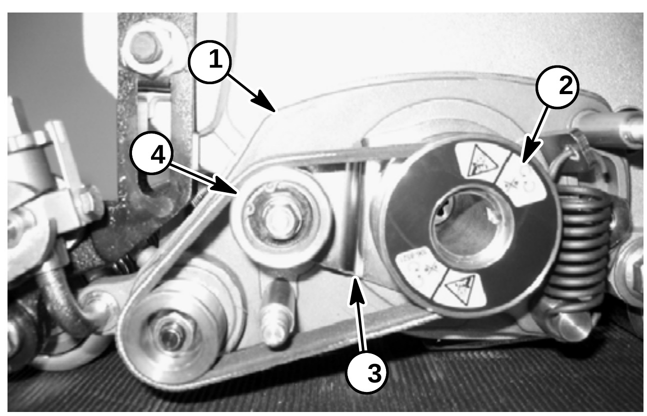


Figure 17

1. Groomer side plate
2. Drive pulley
3. Idler bracket
4. Idler pulley w/bearings

Lift Arm Assembly

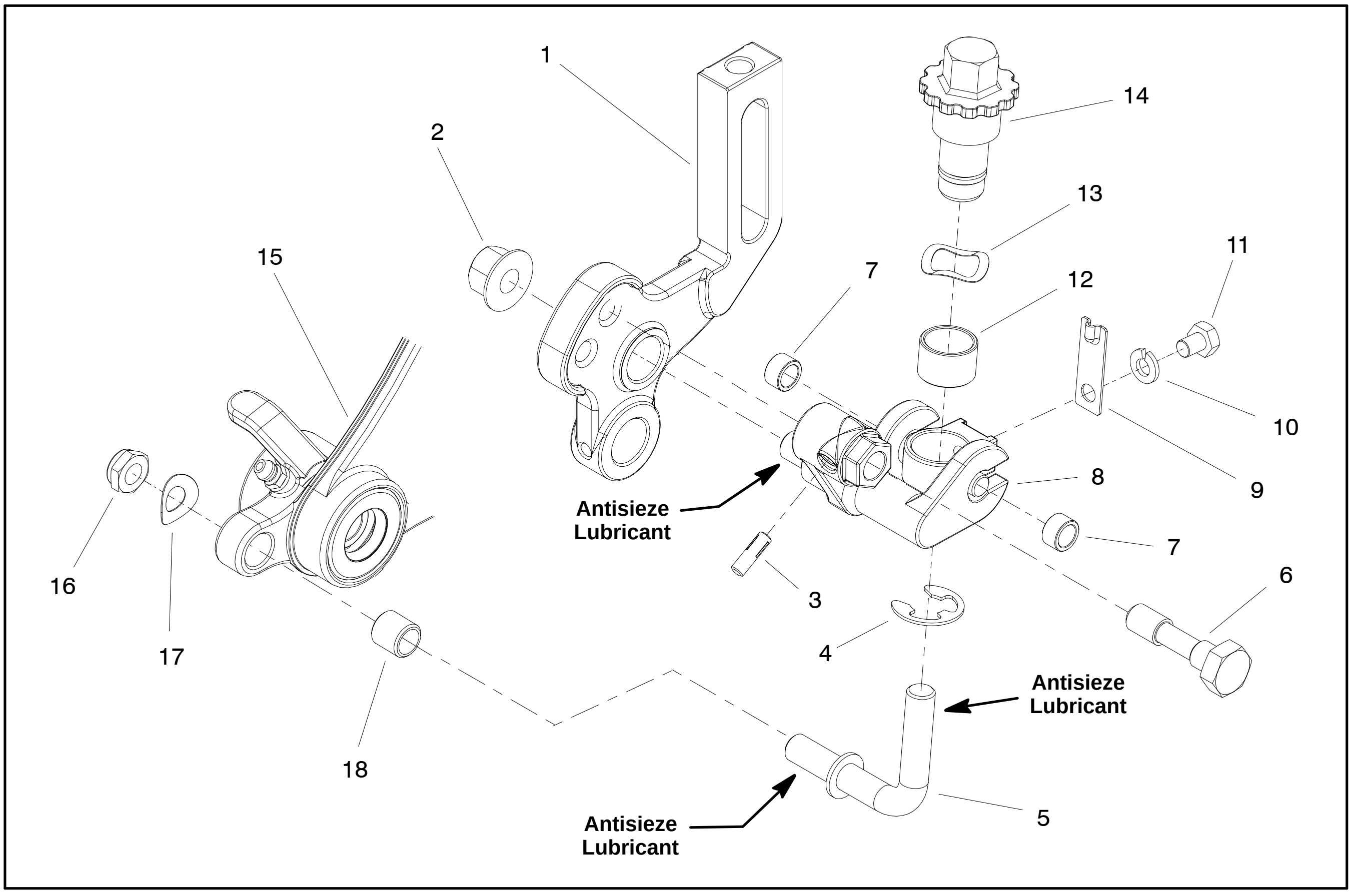


Figure 18

1. **HOC groomer arm (LH shown)**
2. **Flange nut**
3. **Grooved pin**
4. **E-ring**
5. **Groomer lift rod**
6. **Lock screw**
7. **Bushing**
8. **Lift arm assembly (LH shown)**
9. **Detent spring**
10. **Spring washer**
11. **Cap screw**
12. **Bushing**
13. **Wave washer**
14. **Groomer adjuster**
15. **Side plate (LH shown)**
16. **Lock nut**
17. **Spring washer**
18. **Bushing**

Disassembly

1. Remove flange nut (item 2) that secures lift arm to HOC groomer arm. Remove lock nut (item 16) and spring washer (item 17) that secure lift arm to side plate. Loosen lock screw (item 6) completely.

2. Remove lift arm from cutting unit.

3. Disassemble lift arm using Figure 18 as a guide.

Note: Right and left side HOC groomer arms (item 1) and lift arm assemblies (item 8) are different; other components shown in Figure 18 are the same on both sides of cutting unit.

Note: Grooved pin (item 3) is used to retain lock screw (item 6) to lift arm assembly.

Assembly

1. Assemble lift arm using Figure 18 as a guide.

2. Apply antisieze lubricant to threads of groomer lift rod (item 5) and lift arm assembly stud (item 8).

3. Install lift arm onto cutting unit. Secure with flange nut (item 2) and lock nut (item 16) with spring washer (item 17).

4. Secure groomer in raised or lowered position with lock screw (item 6).

5. Check and adjust groomer reel height and mower height-of-cut settings.

Groomer Brush

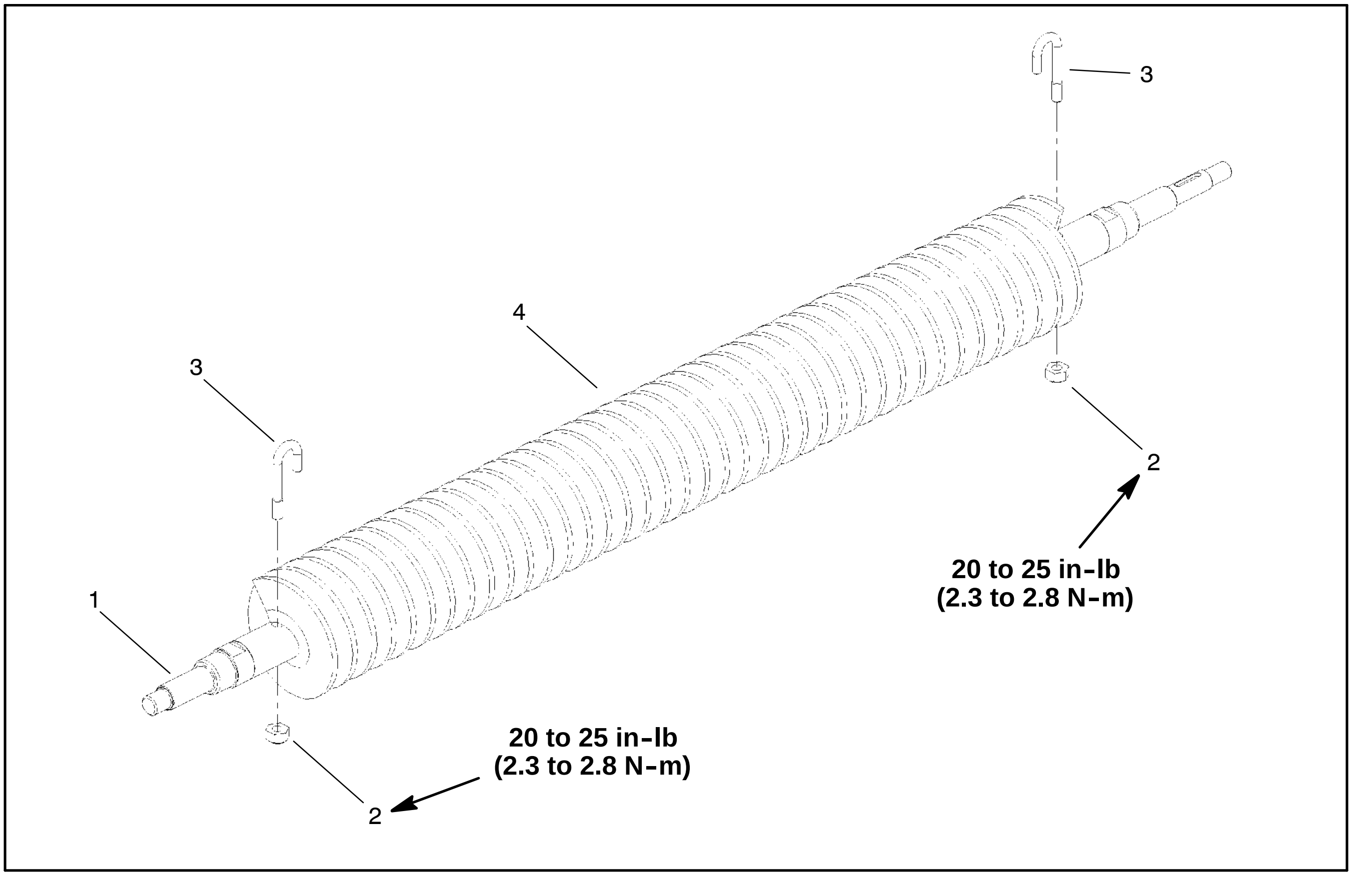


Figure 19

1. **Groomer brush shaft**
2. **Lock nut**
3. **J–bolt**
4. **Groomer brush**

The groomer brush attaches to the groomer drive in place of the groomer reel. Removal and installation of the groomer brush uses the same procedure as removal and installation of the groomer reel (see Groomer Reel in this section).

To remove the groomer brush from the shaft, remove the lock nut and J–bolt from both ends of the brush and slide the brush from the shaft. When assembling the brush to the shaft, secure the assembly with J–bolts and lock nuts. Make sure that the J–bolts are installed with the threaded portion on the outside of the brush (Fig. 20). Torque lock nuts from 20 to 25 in–lb (2.3 to 2.8 N–m).

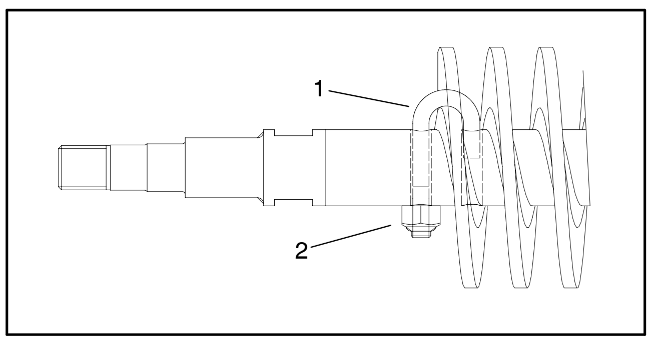


Figure 20

1. **J–bolt**
2. **Lock nut**

Chapter 11

Electrical Diagrams

Table of Contents

Electrical Diagrams

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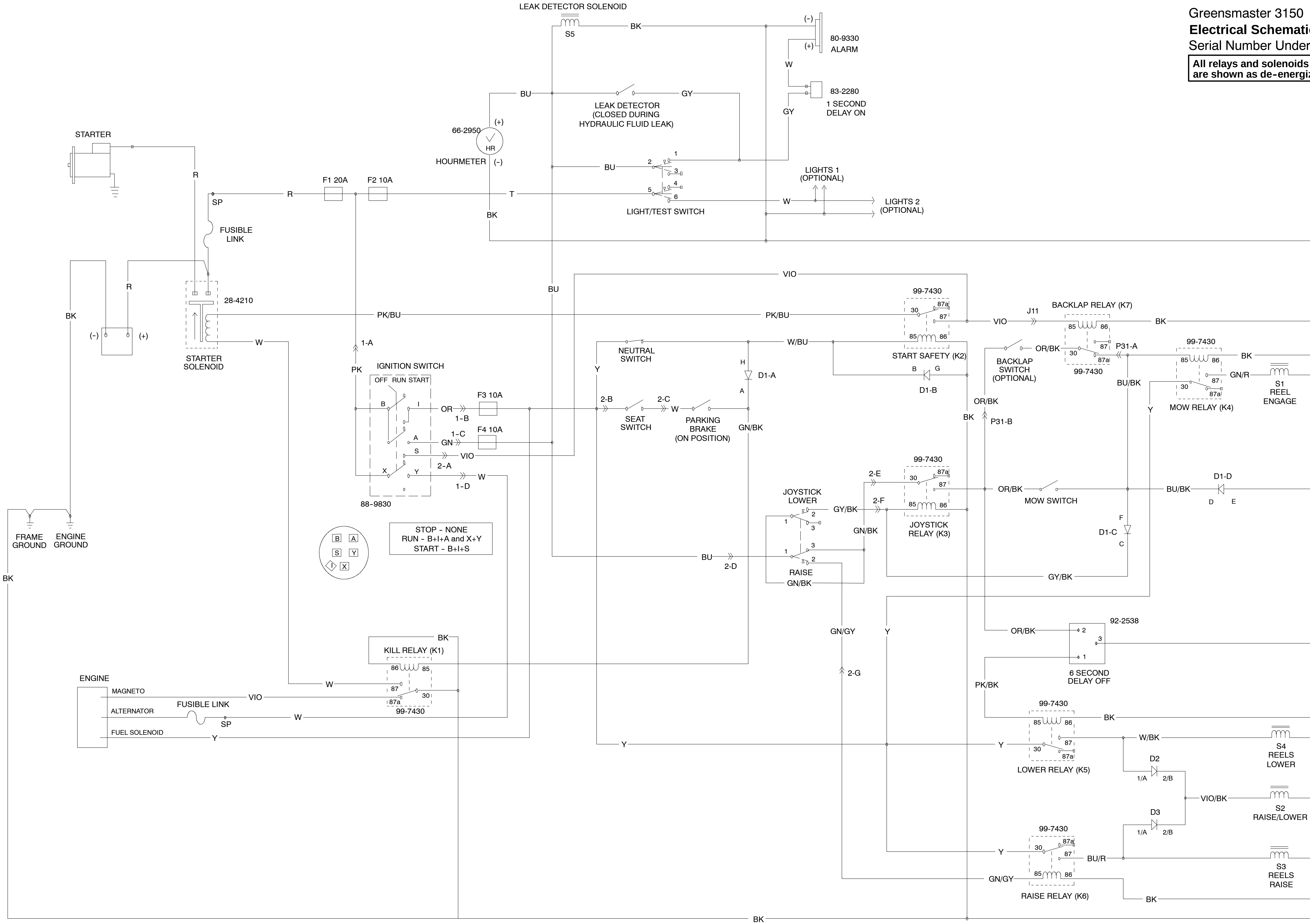
Greensmaster 3150

Electrical Schematic

Serial Number Under 230000801

All relays and solenoids are shown as de-energized.



Greensmaster 3150

Electrical Schematic

Serial Number 230000801 To 250999999

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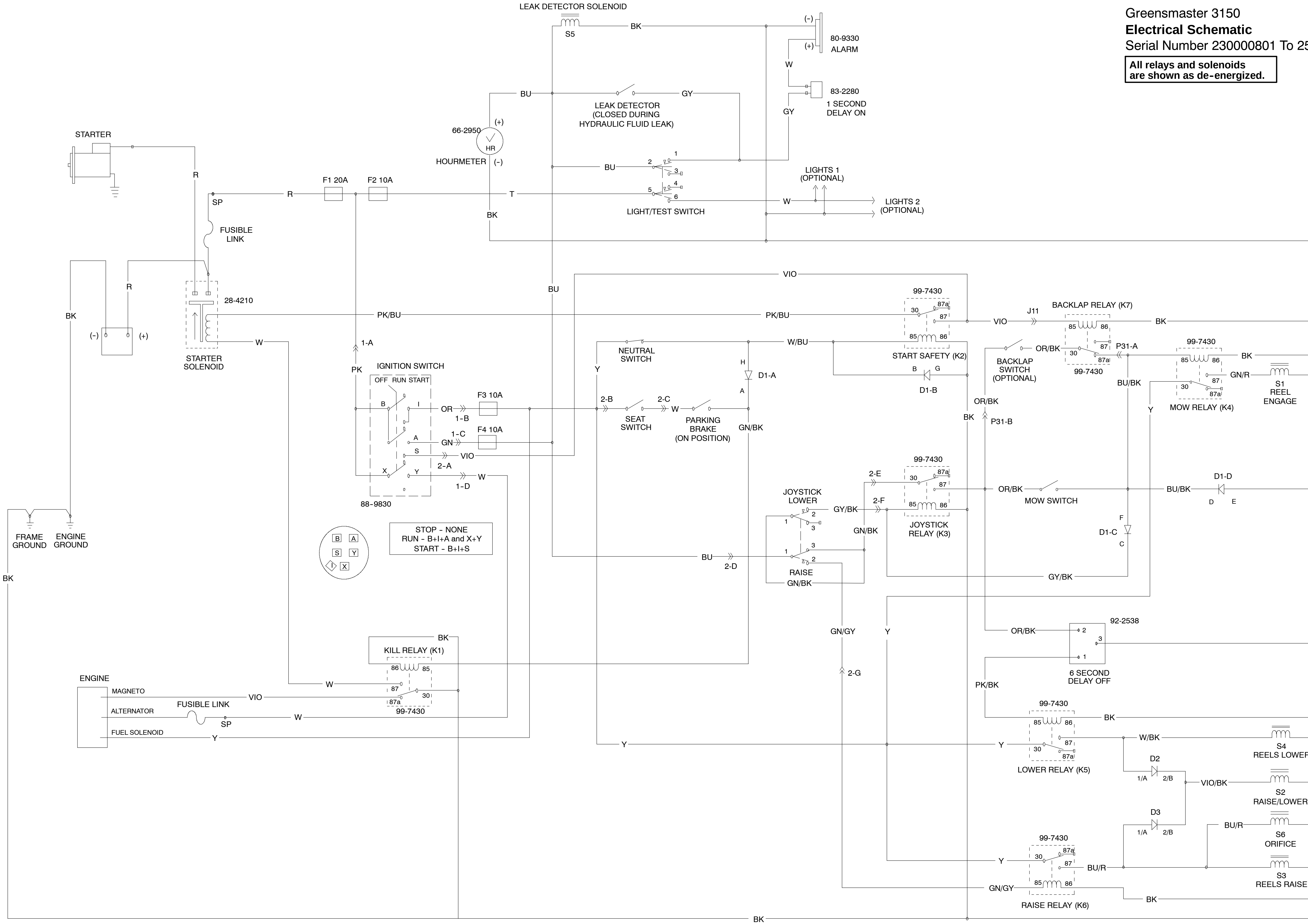

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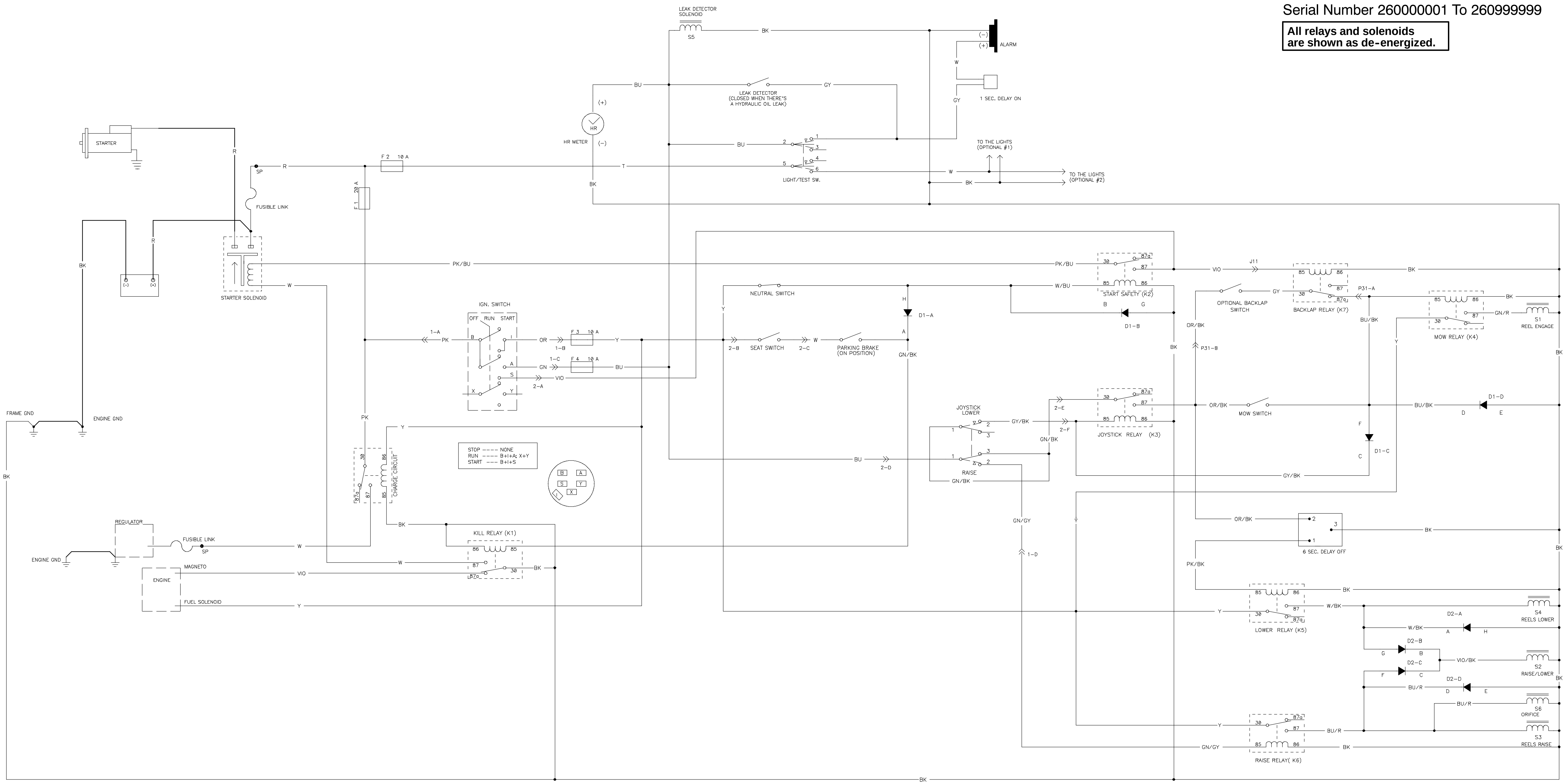
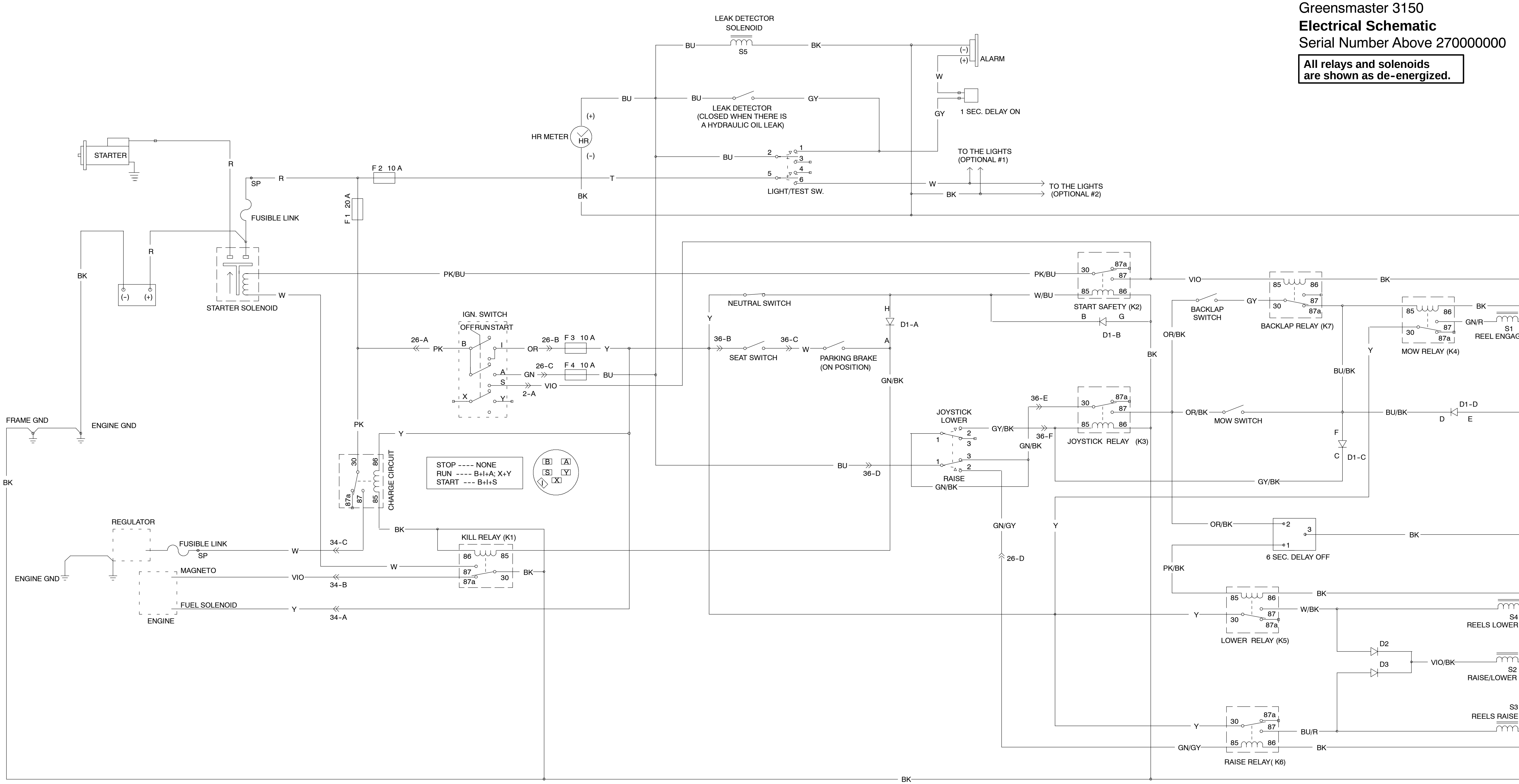


Greensmaster 3150
Electrical Schematic
Serial Number Above 270000000

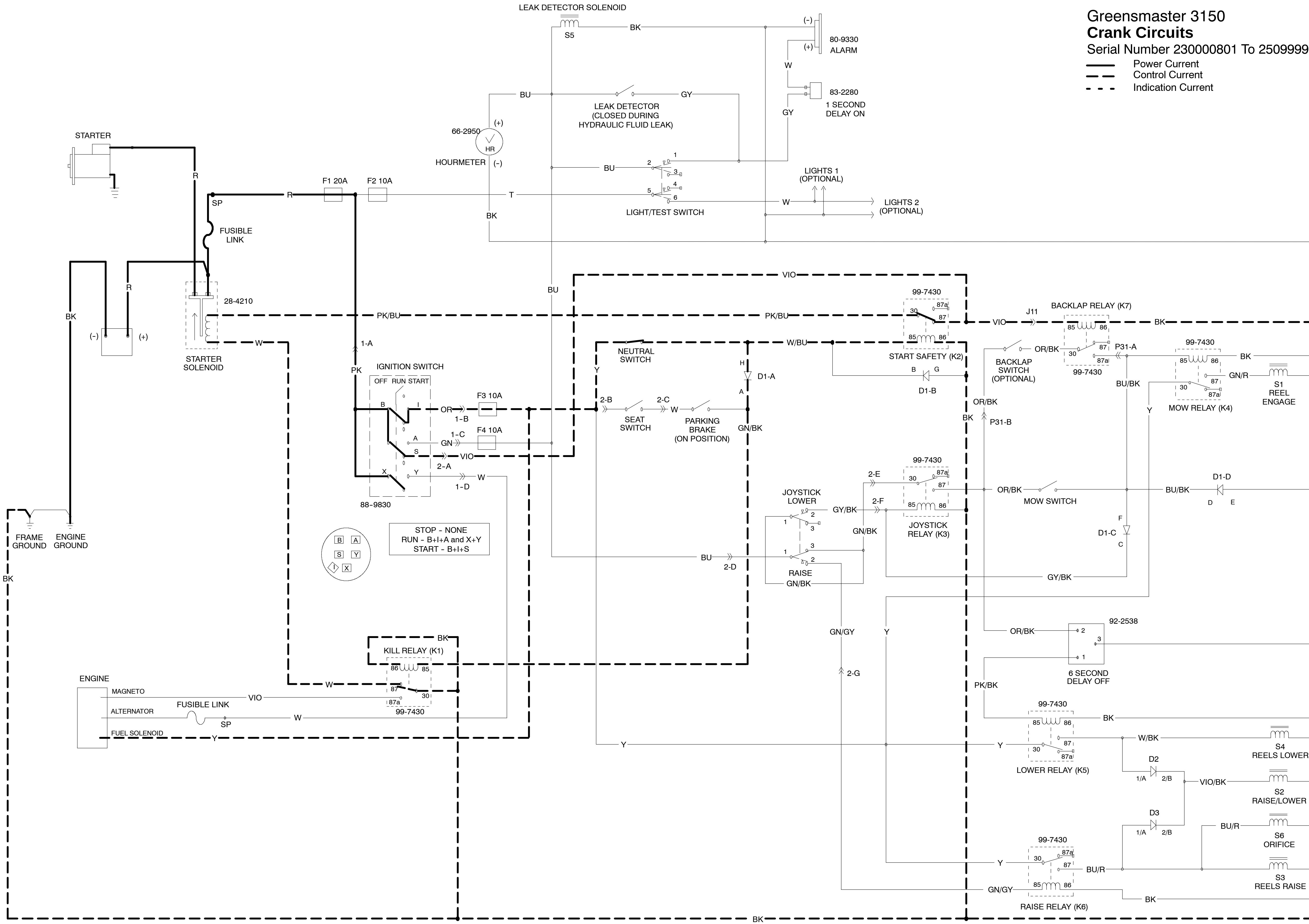
All relays and solenoids are shown as de-energized.



Greensmaster 3150

Crank Circuits

Serial Number 230000801 To 250999999 Shown



Greensmaster 3150
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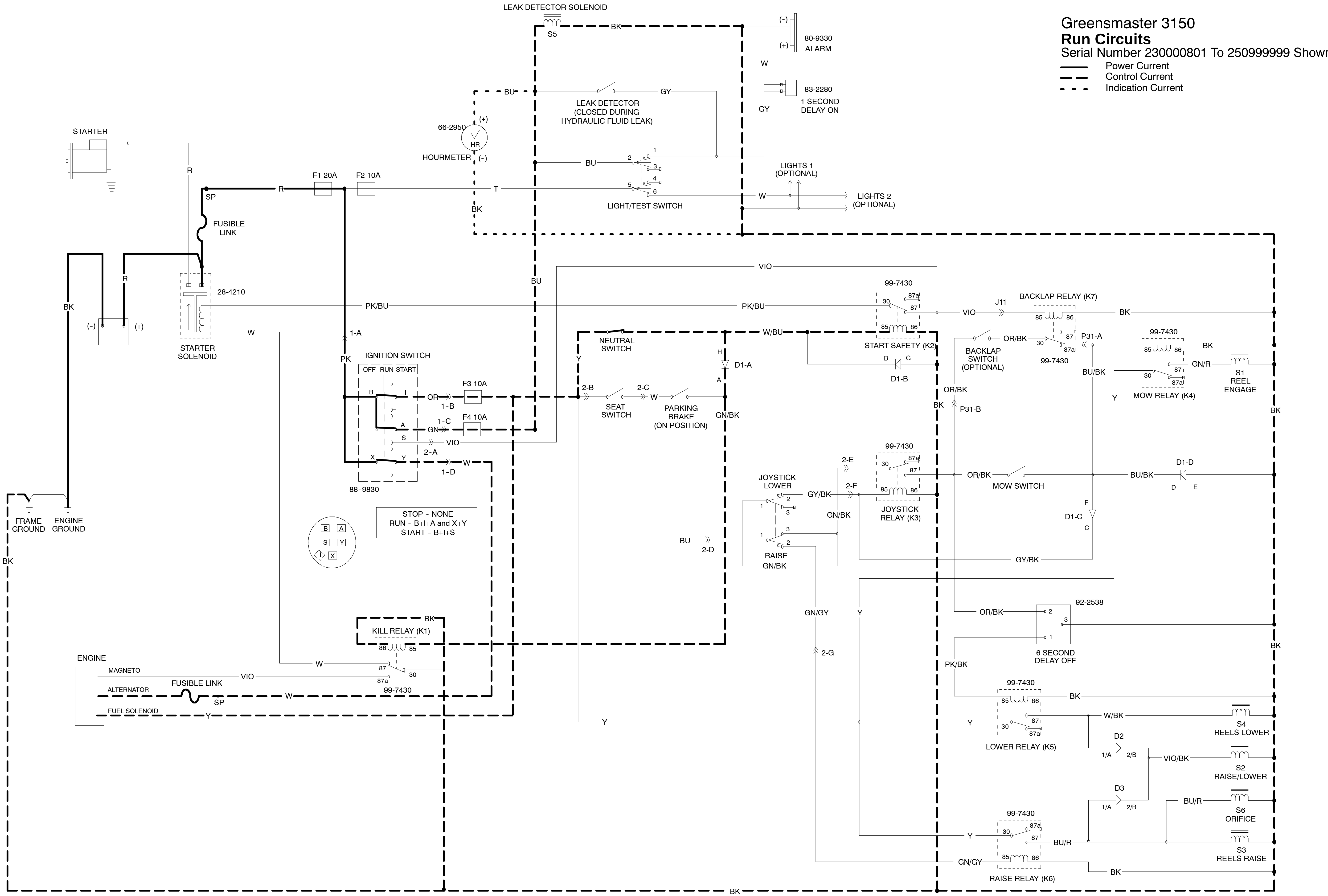

Greensmaster 3150
Raise Reels Circuits
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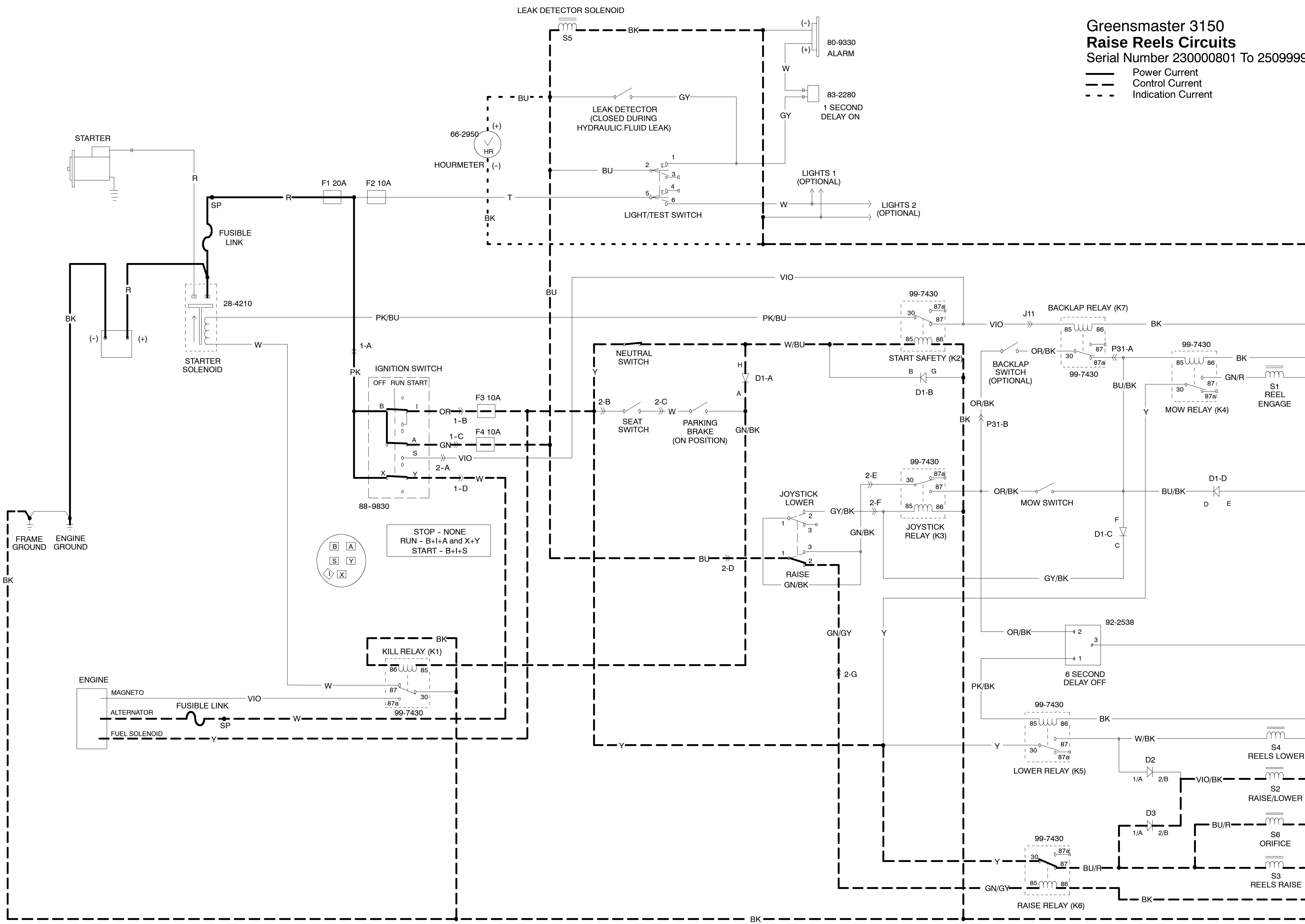
Power Current
Control Current
Indication Current

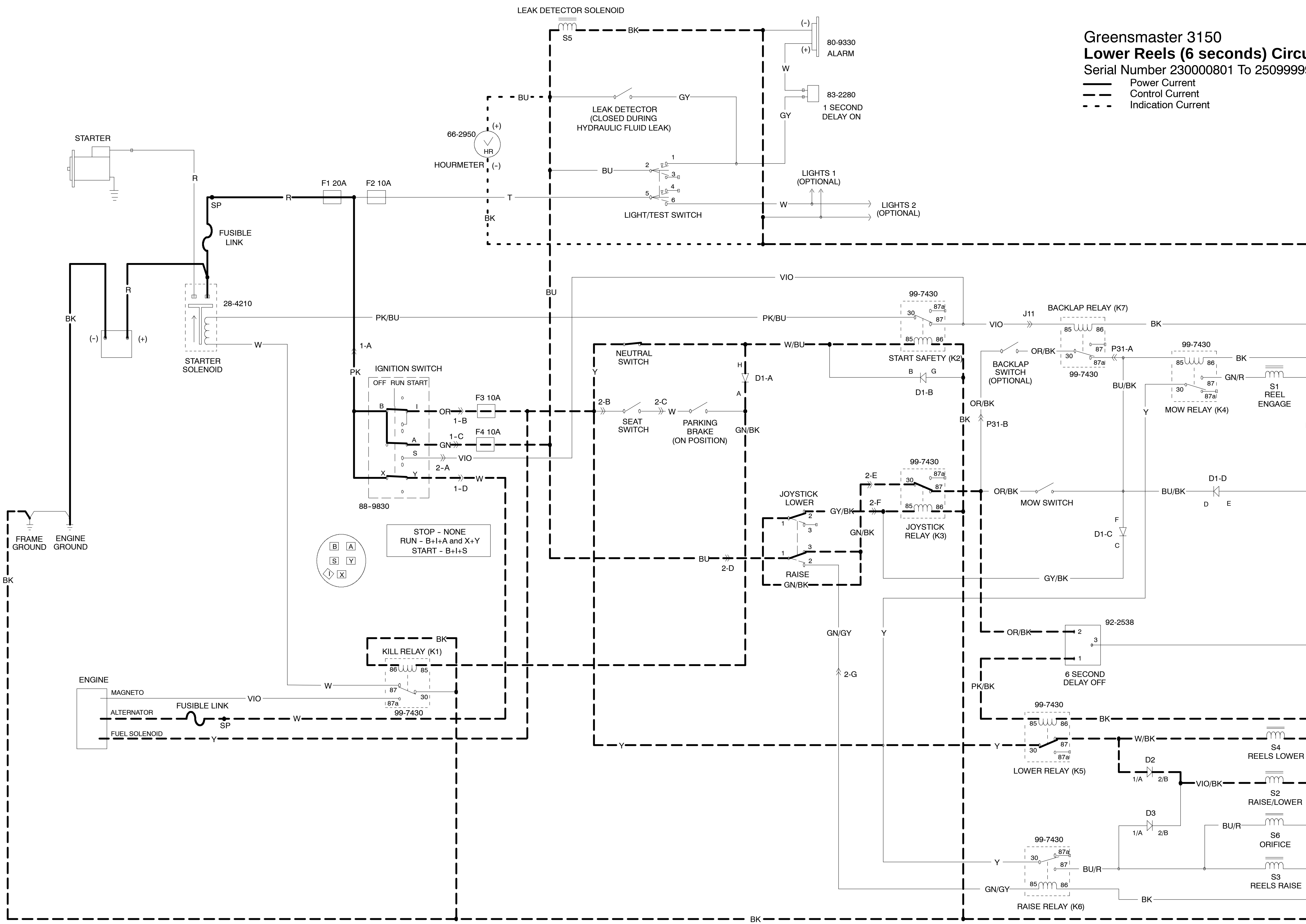


Greensmaster 3150

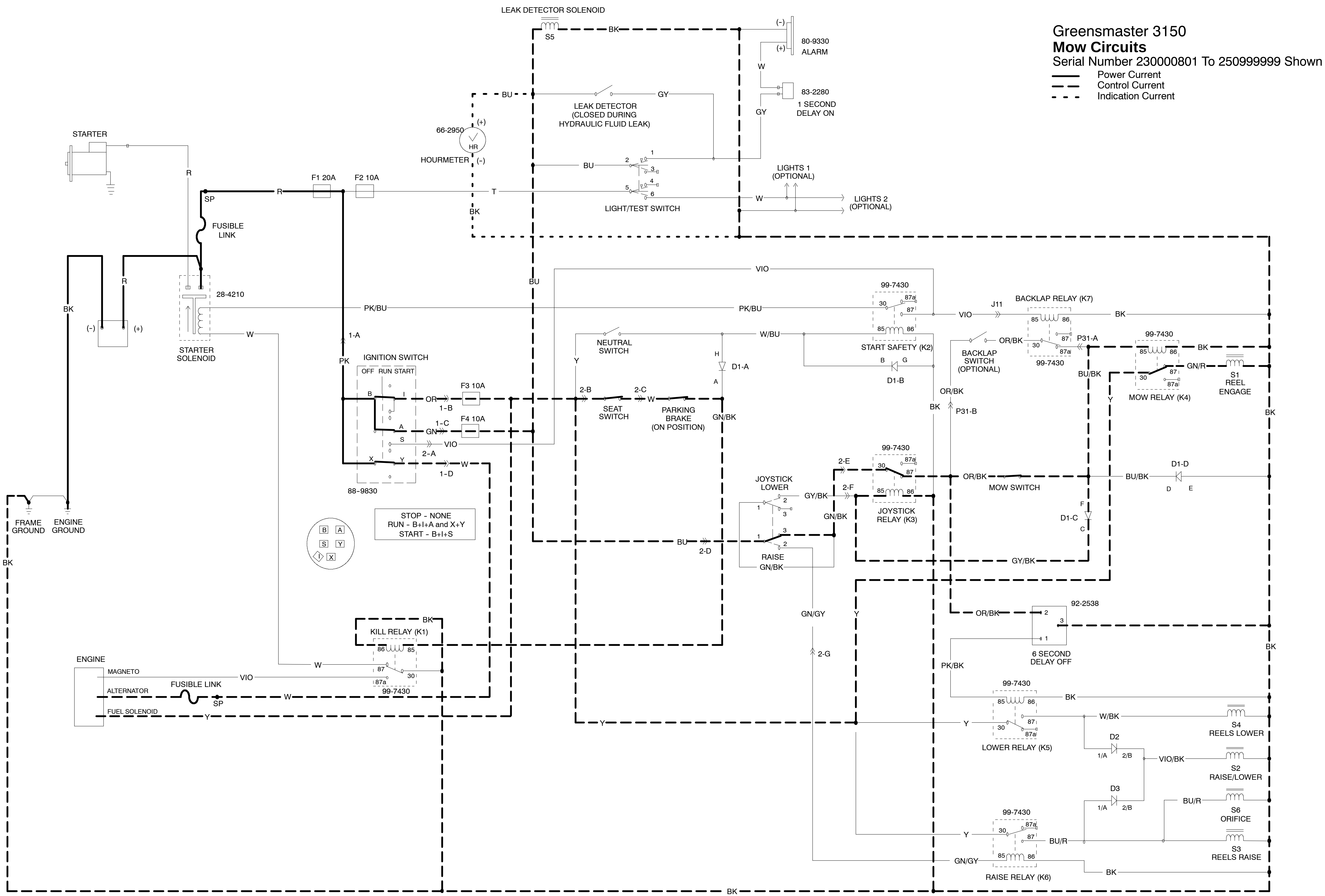
Lower Reels (6 seconds) Circuits

Serial Number 230000801 To 250999999 Shown

Power Current
Control Current
Indication Current

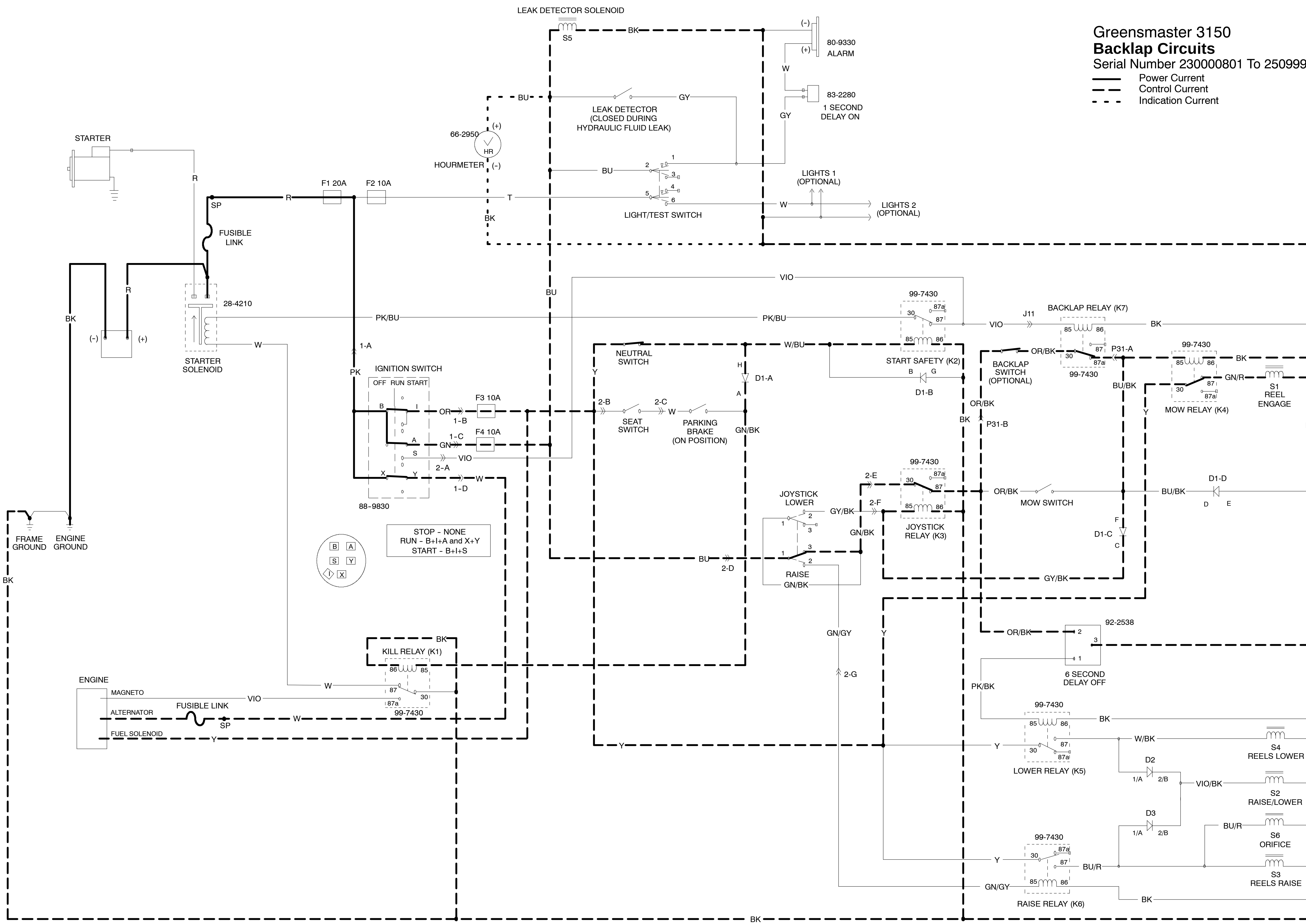


Greensmaster 3150
Mow Circuits
Serial Number 230000801 To 250999999 Shown



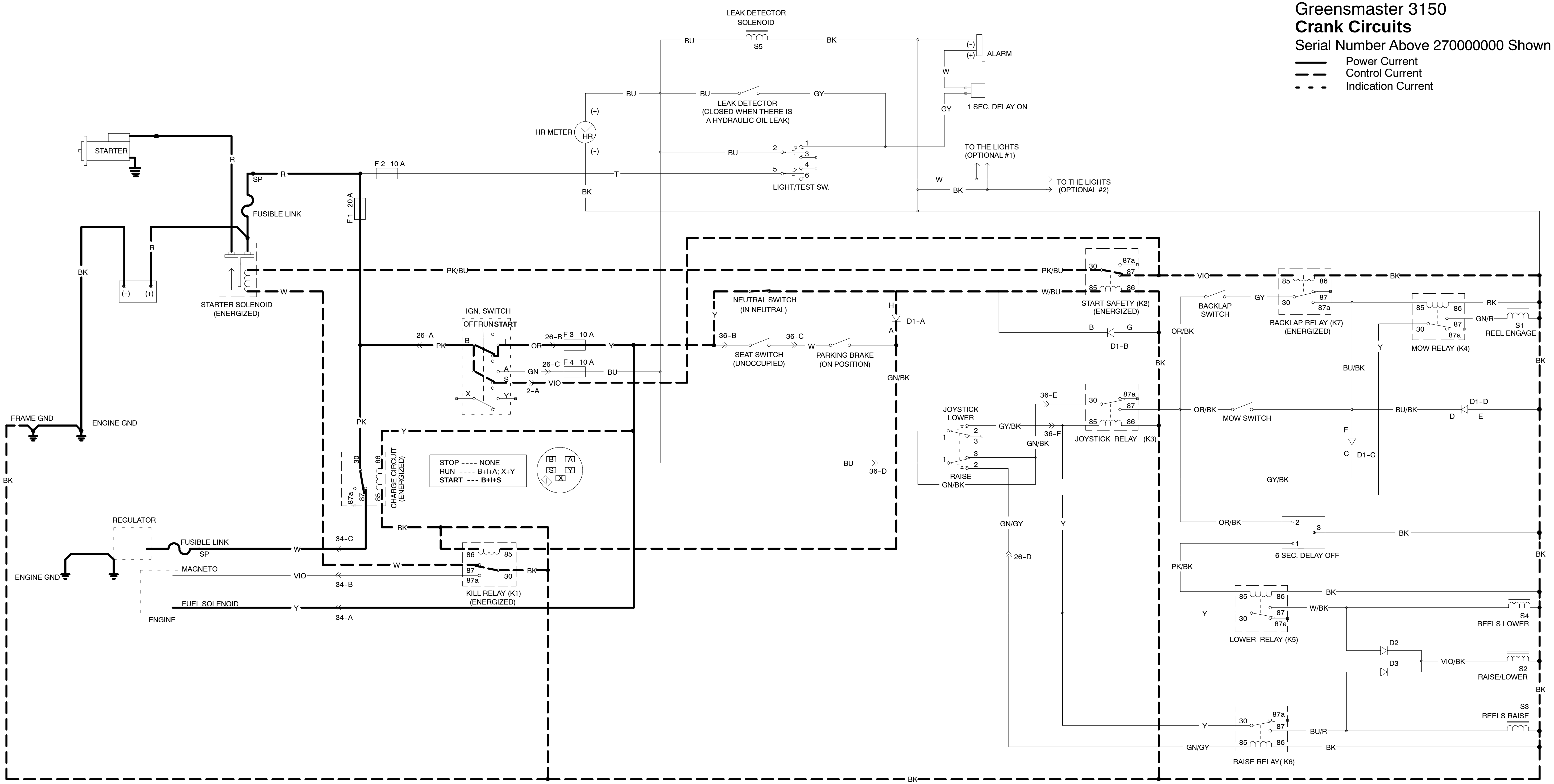
Greensmaster 3150
Backlap Circuits
Serial Number 230000801 To 250999999 Shown

Power Current
Control Current
Indication Current



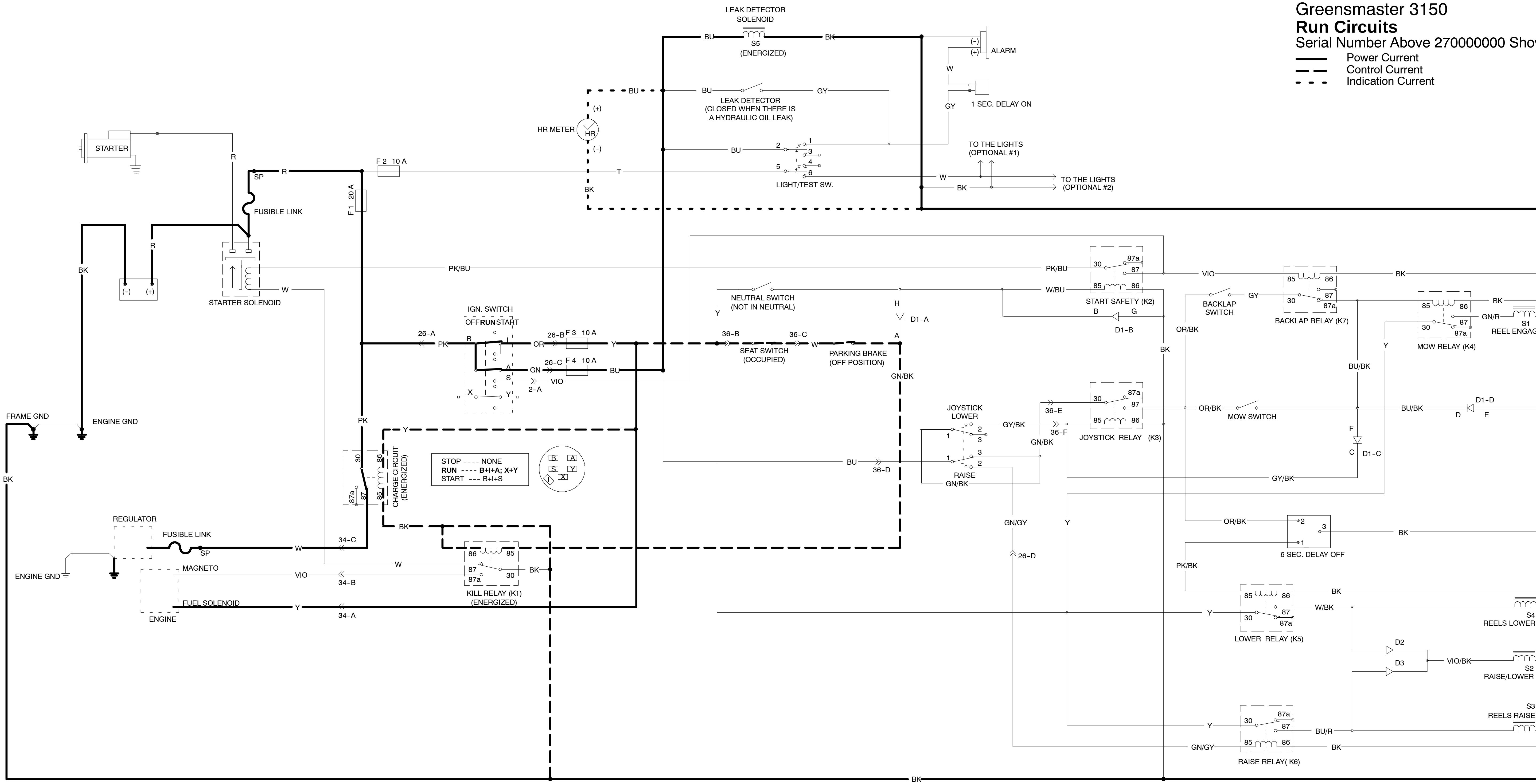
Greensmaster 3150
Crank Circuits
Serial Number Above 270000000 Shown

Power Current
Control Current
Indication Current



Greensmaster 3150
Run Circuits
Serial Number Above 270000000 Shown

- Power Current
- Control Current
- Indication Current



Greensmaster 3150

Raise Reels Circuits

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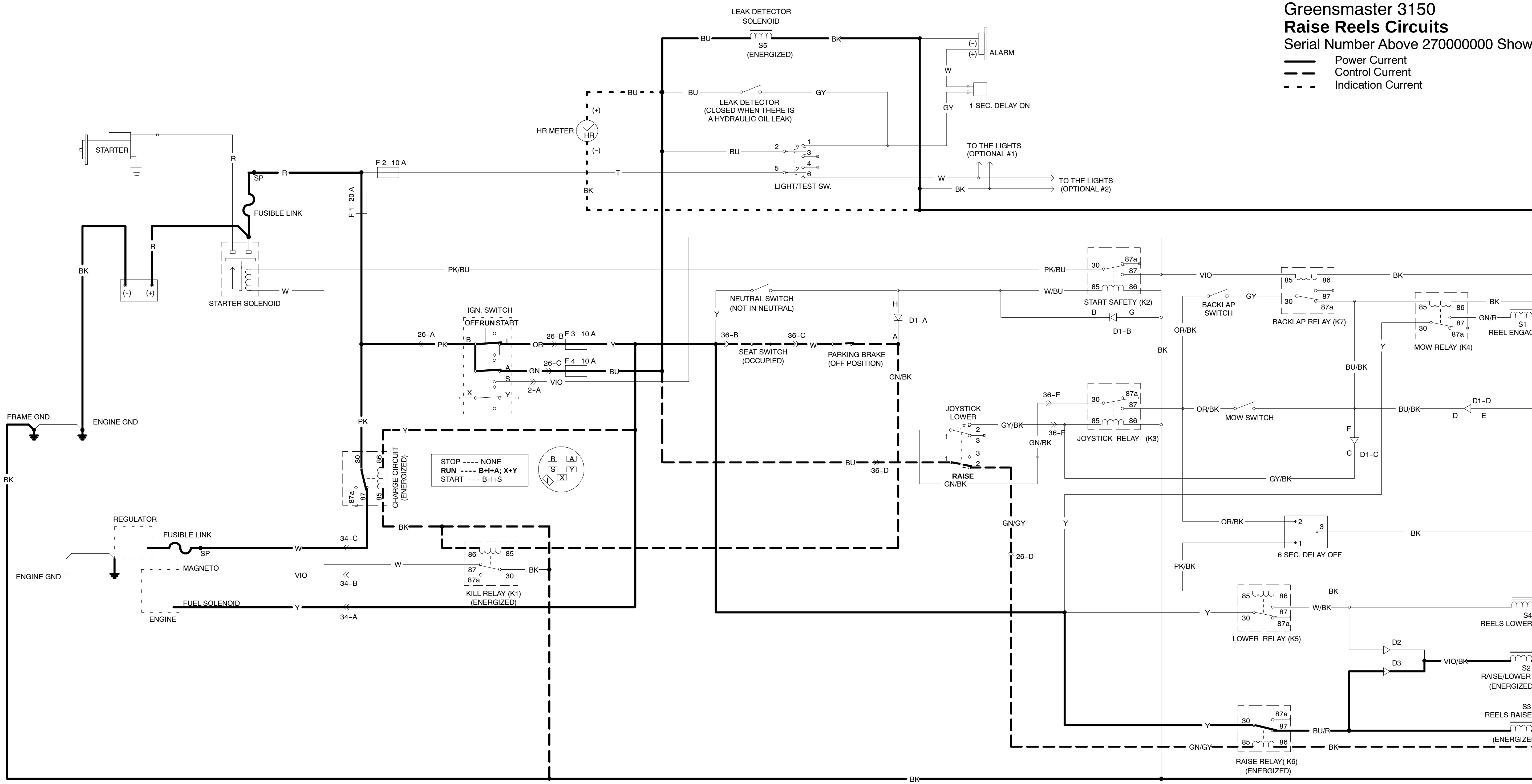

Greensmaster 3150
Lower Reels (6 seconds) Circuits
Serial Number Above 270000000 Shown

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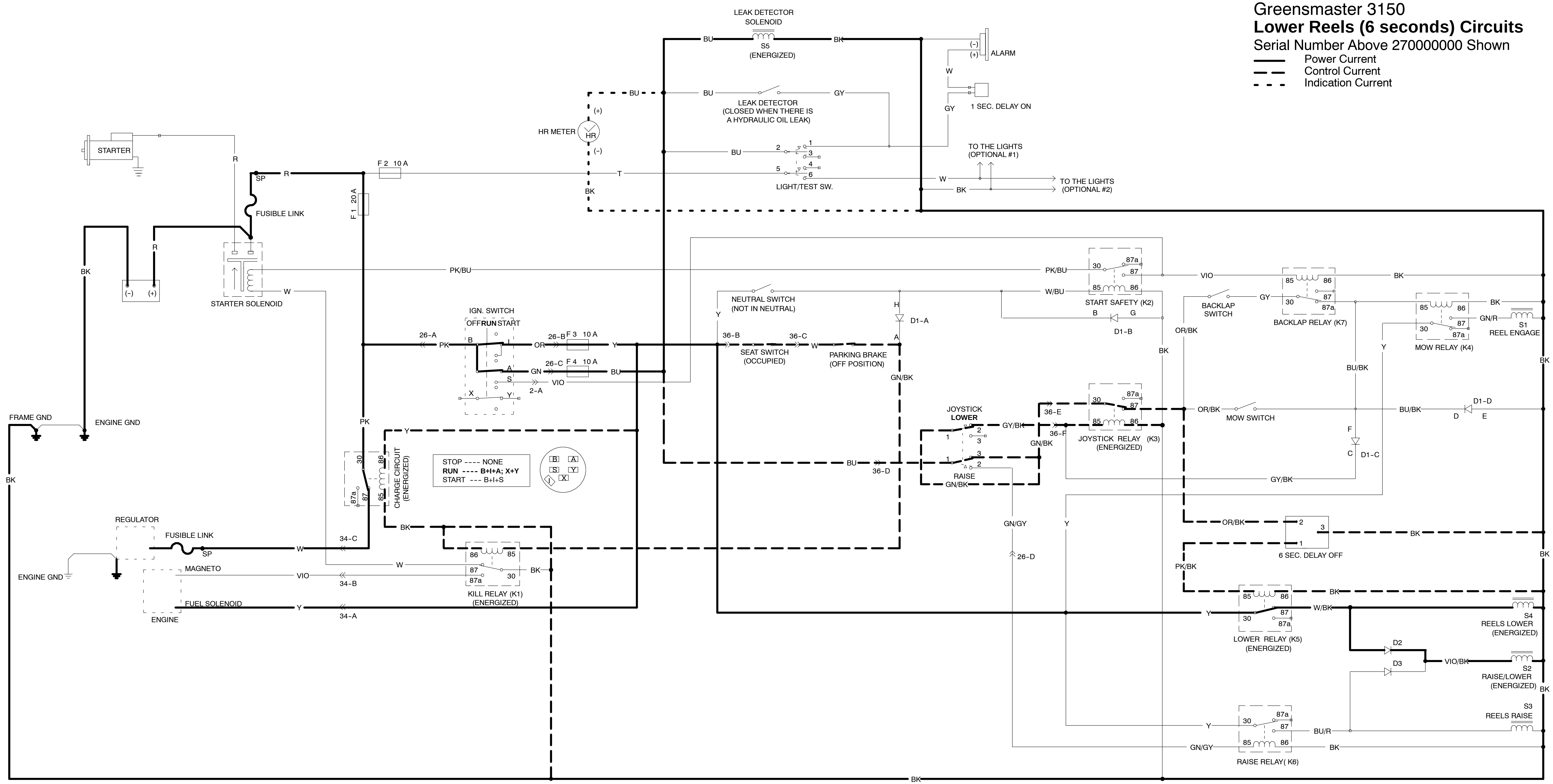
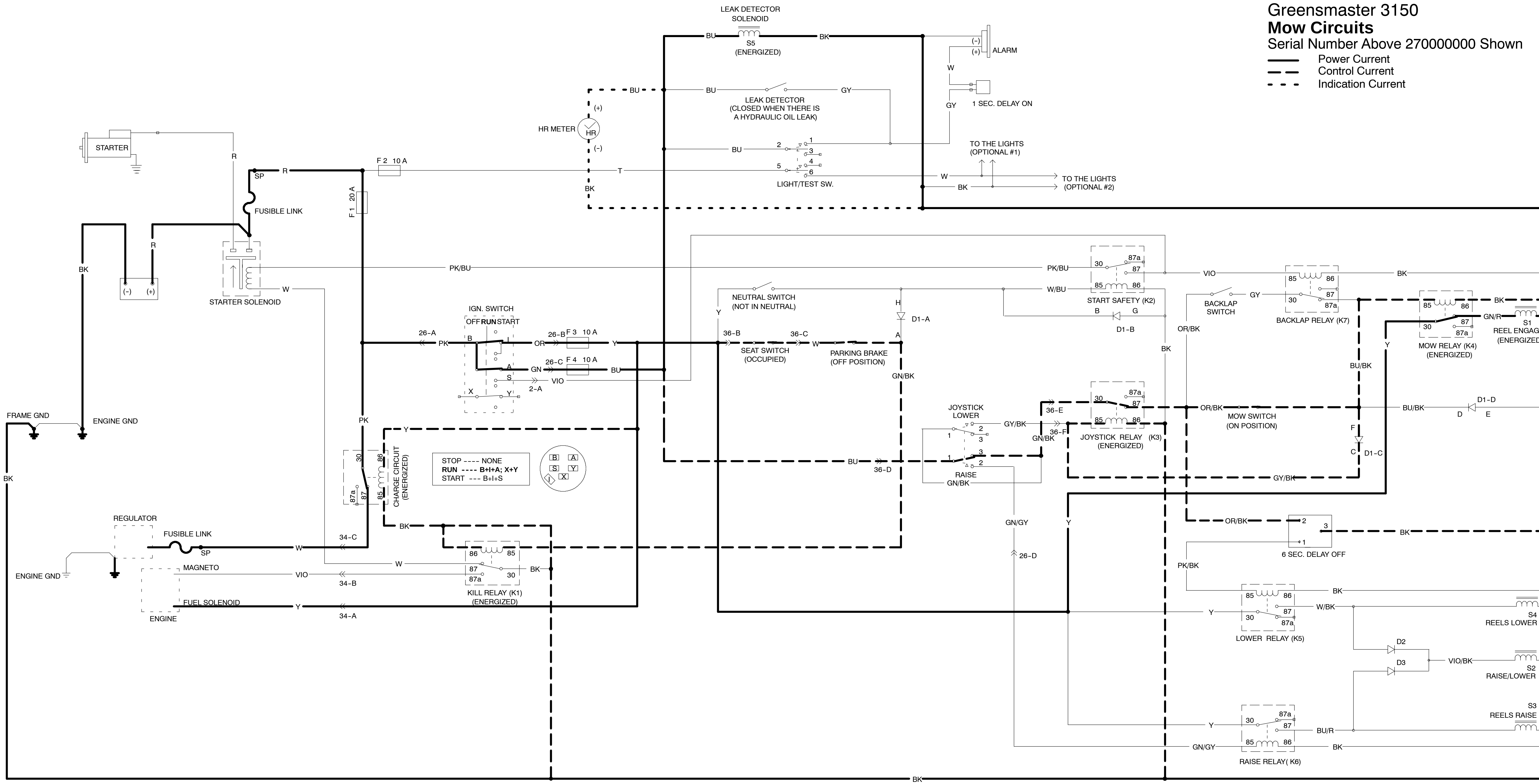
Control Current
Indication Current



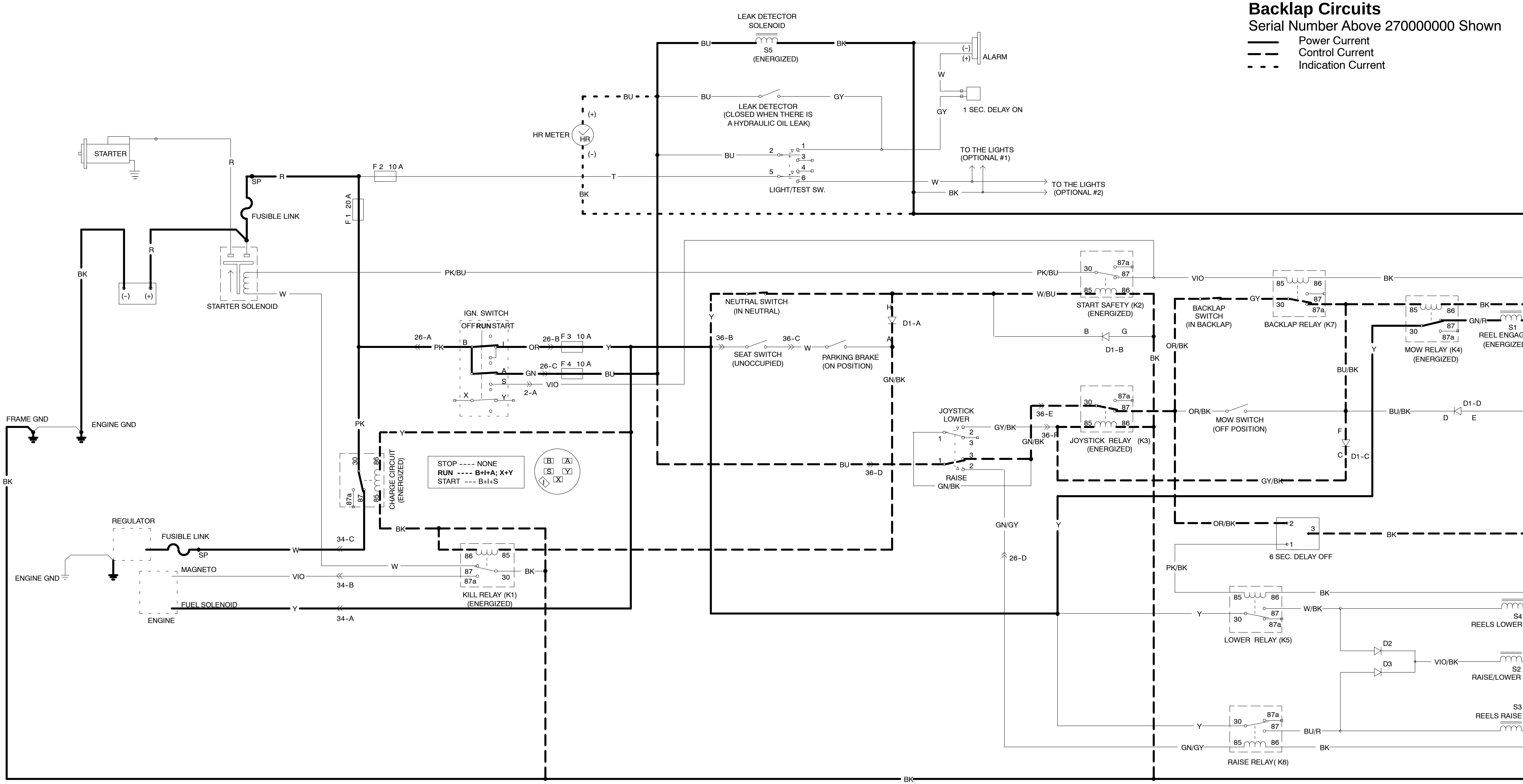
Greensmaster 3150
Mow Circuits
Serial Number Above 270000000 Shown

Power Current — solid line
Control Current — long dashed line
Indication Current — short dashed line



Greensmaster 3150
Backlap Circuits
Serial Number Above 270000000 Shown

Power Current
Control Current
Indication Current



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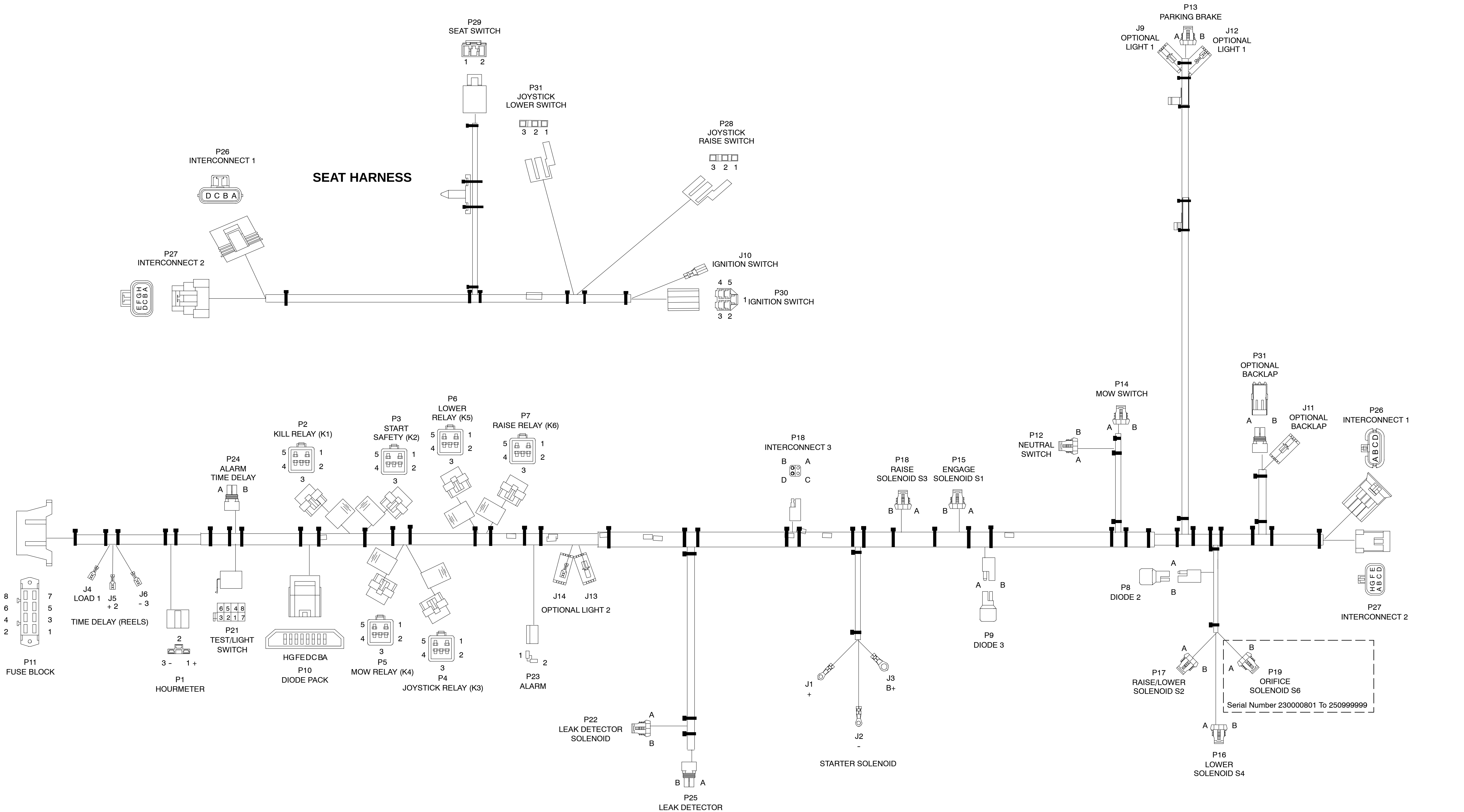
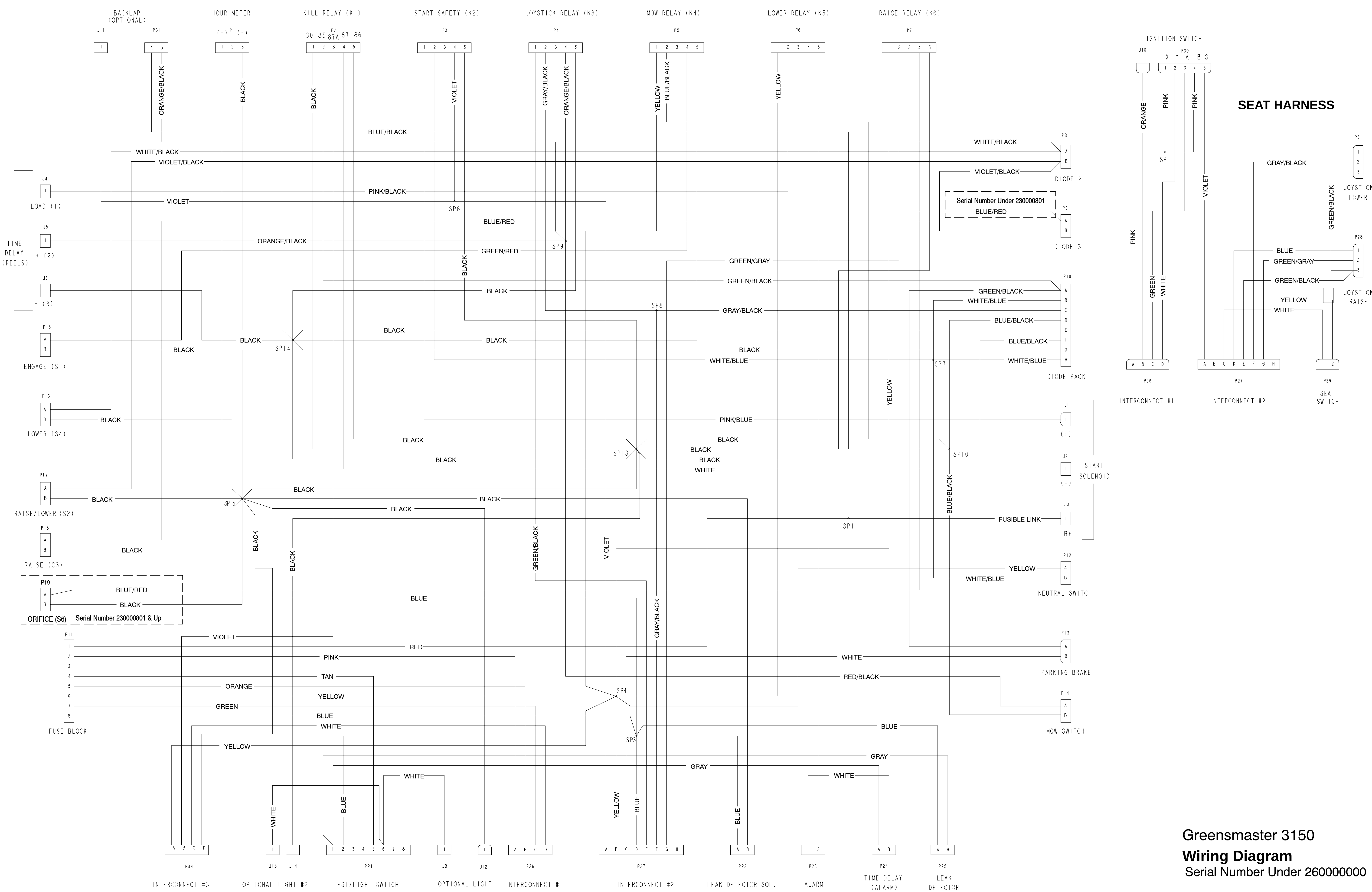


Greensmaster 3150
Electrical Harness Drawing
Serial Number Under 260000000



Greensmaster 3150

Wiring Diagram

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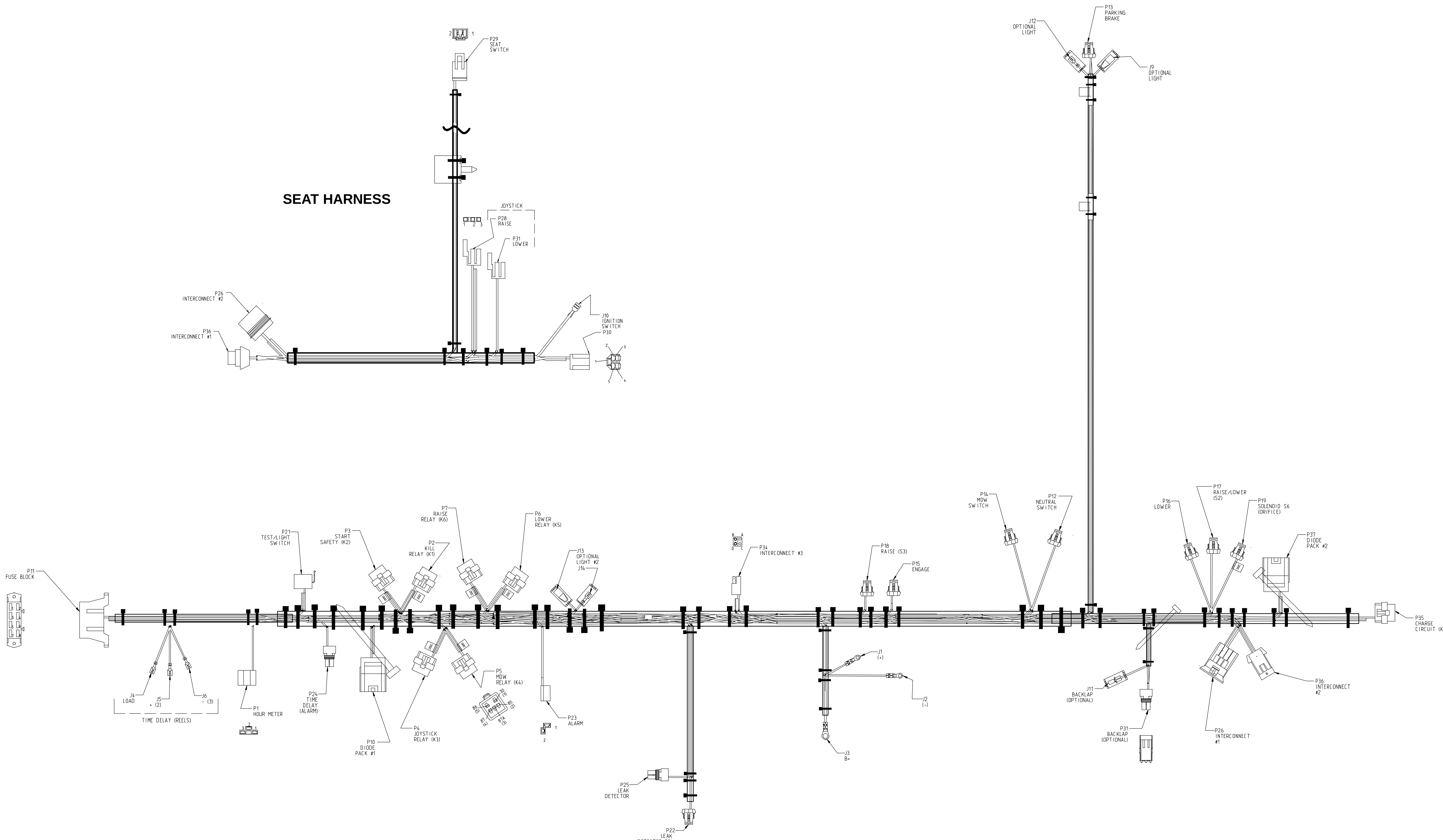
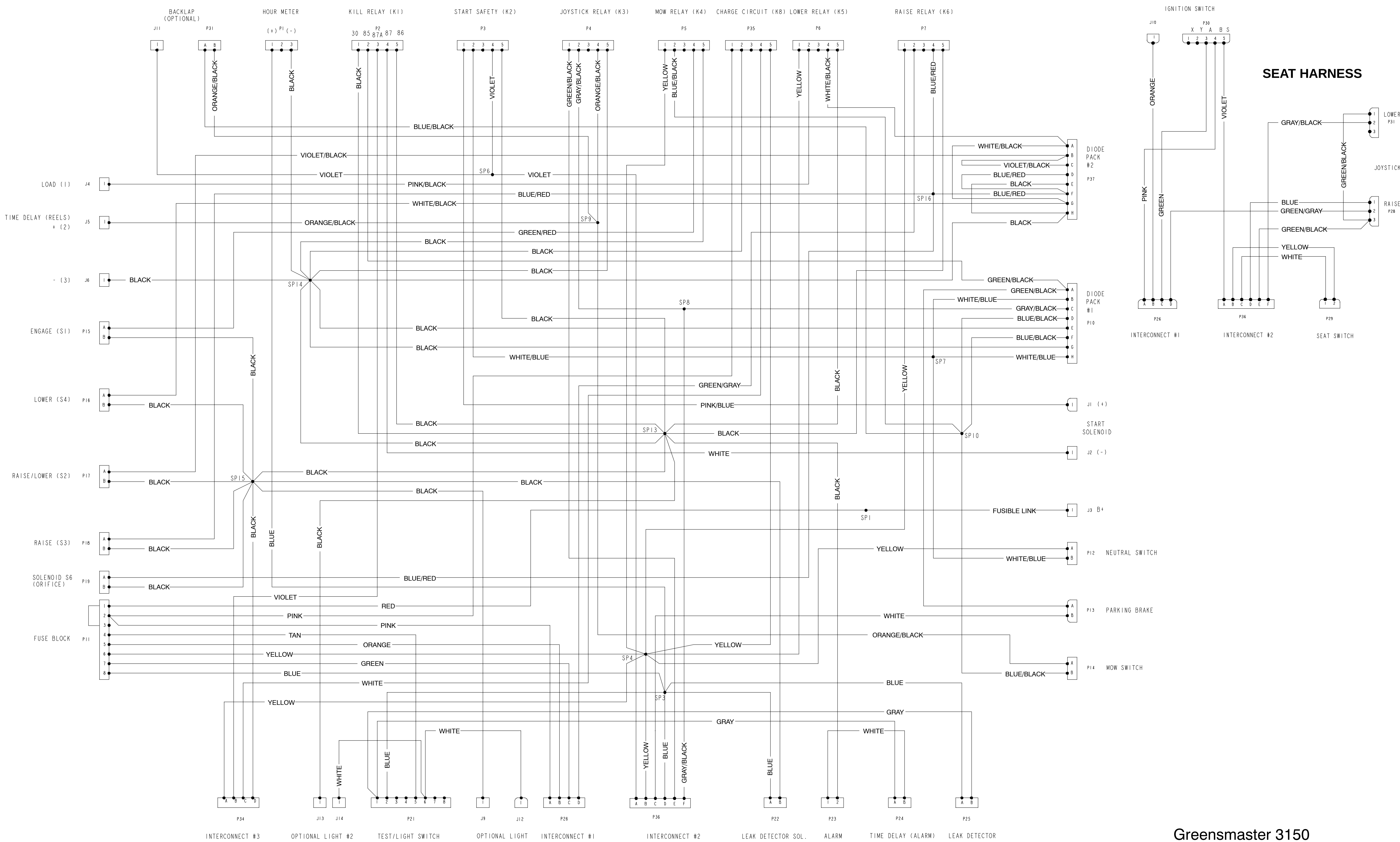


Greensmaster 3150

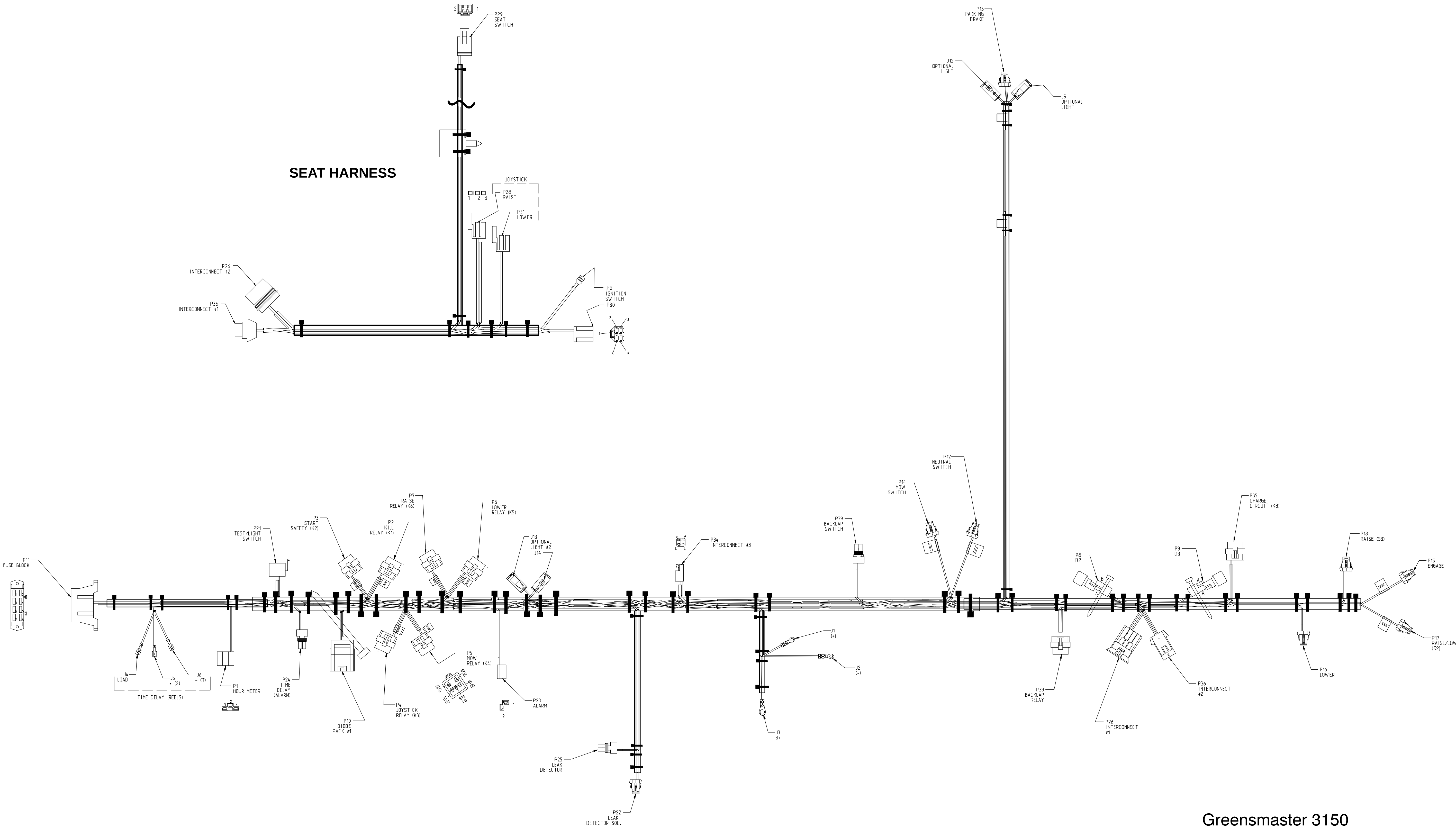
Electrical Harness Drawing

Serial Number 260000001 To 260999999



Greensmaster 3150
Wiring Diagram
Serial Number 260000001 To 260999999

SEAT HARNESS



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Electrical Harness Drawing
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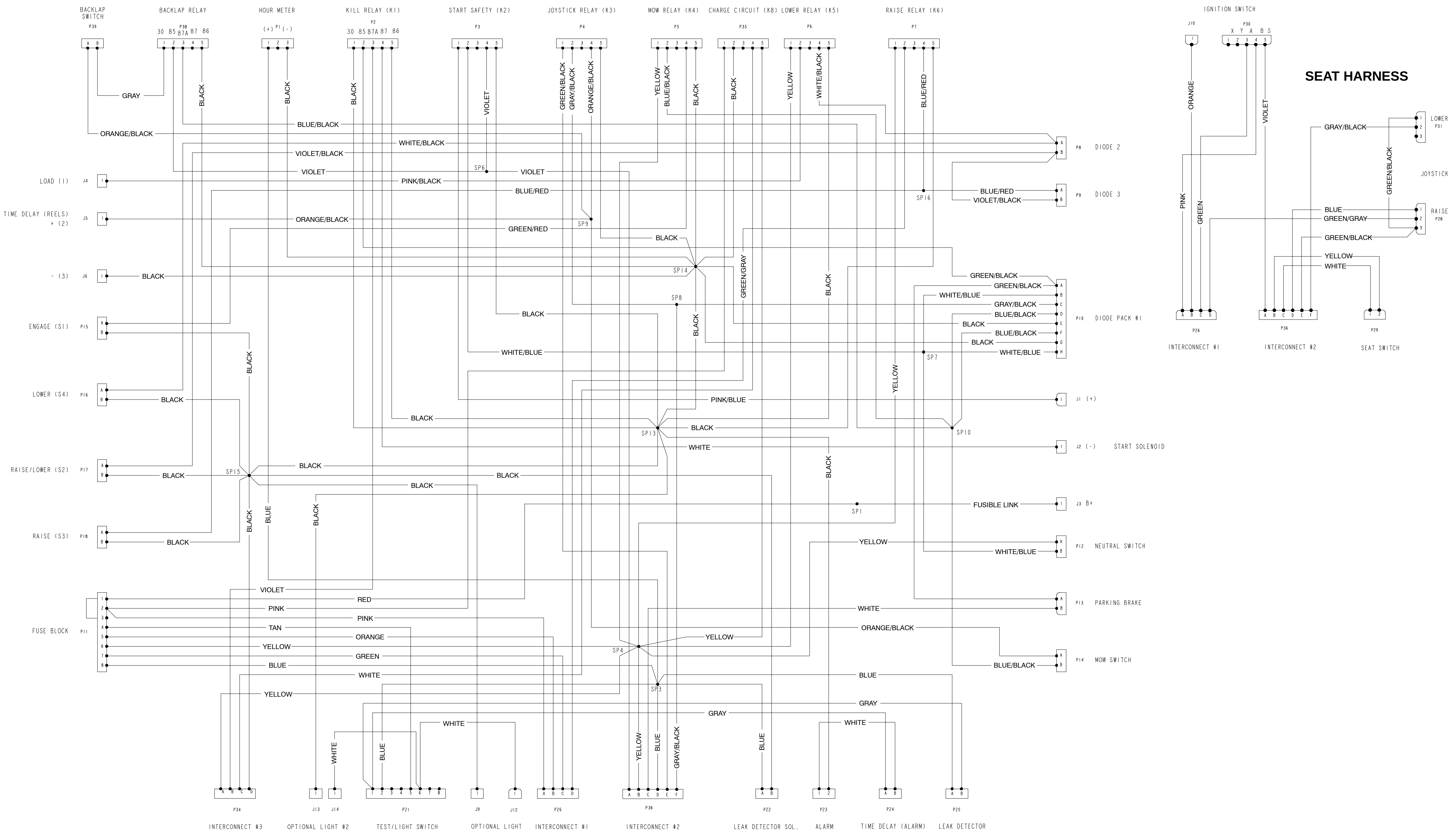

Greensmaster 3150
Wiring Diagram
Serial Number Above 270000000

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