Service Manual

(Model 04383)

Greensmaster® 3250–D

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Greensmaster 3250–D (Model 04383).

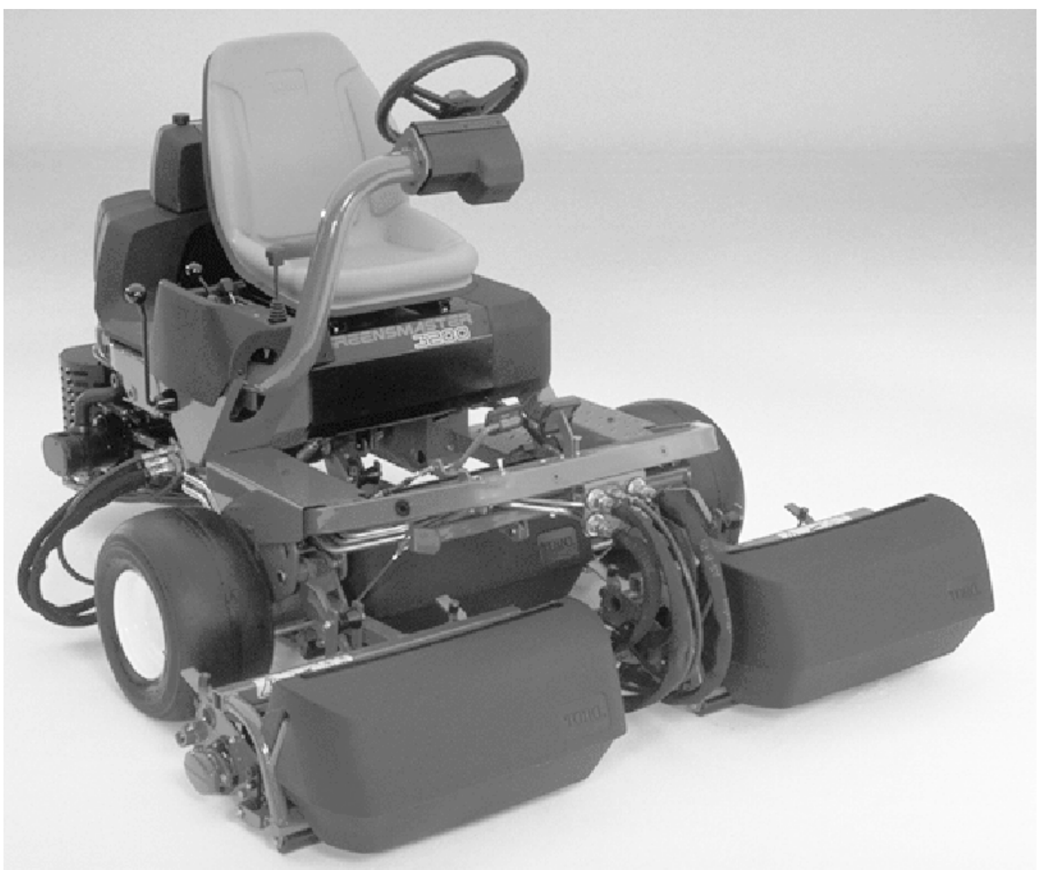
REFER TO THE TRACTION UNIT AND CUTTING UNIT OPERATOR'S MANUALS FOR OPERATING, MAINTENANCE AND ADJUSTMENT INSTRUCTIONS. Space is provided in Chapter 2 of this book to insert the Operator's Manuals and Parts Catalogs for your machine. Additional copies of the Operator's Manuals and Parts Catalog are available on the internet at www.Toro.com.

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

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

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

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



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Chapter 1

Safety

Safety

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Safety Instructions

The GREENSMASTER 3250-D 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.

The safety alert symbol means CAUTION, WARNING or DANGER — "personal safety instruction". Read and under stand the instruction because it has to do with safety. Failure to comply with the instruction may result in personal injury.

WARNING

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

Before Operating

1. Read and understand the contents of this 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. Diesel fuel is flammable; handle it carefully.

   A. Use an approved diesel container.

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

   C. Do not smoke while handling diesel fuel.

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

   E. 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 operation of the interlock switches 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 3250−D may exceed noise levels of 85 dB(A) at the operator position. 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 system 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 2750 $\pm$ 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 3250−D 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. Used 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. If any decal becomes illegible or damaged, install a new decal. Part numbers are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

Product Records and Maintenance

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Product Records

Insert a copy of the Operator's Manual and Parts Catalog for your Greensmaster 3250-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

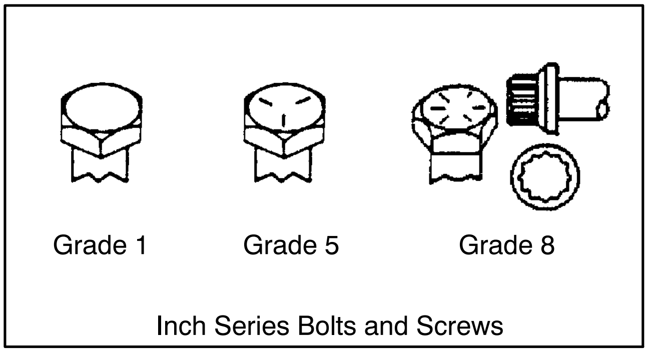

Figure 1

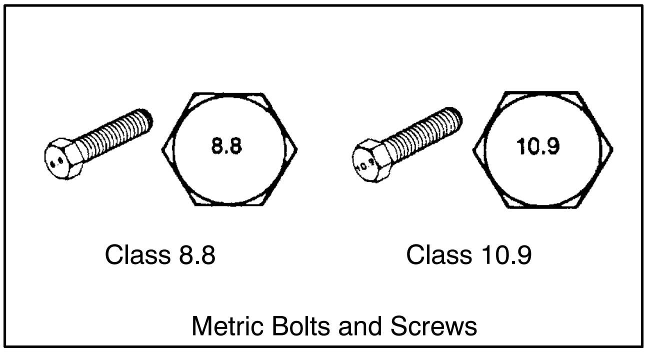

Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

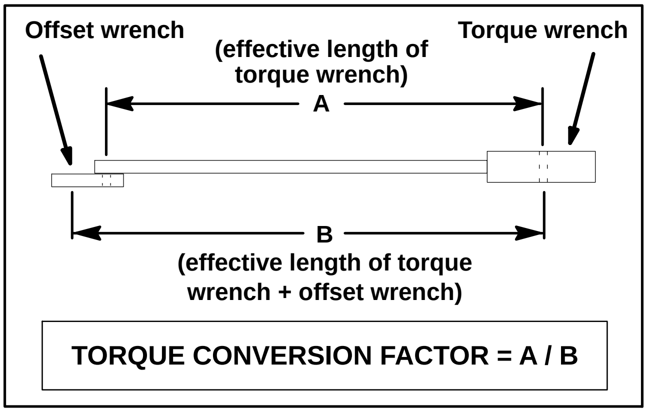

Figure 3

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

Thread Size	Grade 1, 5, & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs, & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in−lb	**in−lb**	**N−cm**	**in−lb**	**N−cm**	**in−lb**	**N−cm**
# 6 − 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non–lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

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

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

Maintenance

Maintenance procedures and recommended service intervals for the Greensmaster 3250–D are covered in the Operator's Manual. Refer to this publication when performing regular equipment maintenance.

Chapter 3

Engine

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Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the diesel engine used in the Greensmaster 3250.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Briggs & Stratton, Vanguard/ Daihatsu Repair Manual for 3−Cylinder, Water−Cooled, Diesel 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/ Daihatsu 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/Daihatsu, Water−cooled, Diesel, Model 522447
Number of Cylinders	3
Horsepower	Governed to 14.5 ± 0.5 HP @ 2600 RPM
Torque kg−m (ft−lb)	4.76 (34.5) @ 2300 RPM
Bore x Stroke mm (in.)	68 x 78 (2.68 x 3.07)
Total Displacement cc (cu. in.)	850 (51.8)
Compression Ratio	24.5:1
Firing Order	1− 2−3
Dry Weight (approximate) kg (lb.)	72 (159)
Fuel	No. 2 Diesel per ASTM D975
Fuel Capacity liters (gallons)	22.7 (6.0)
Fuel Injection Pump	VE (Bosch) type
Governor	All speed type
Low Idle (no load)	1500 ± 50 RPM
High Idle (no load)	2750 ± 50 RPM
Engine Oil	SAE 10W−30 CD, CE, CF, CF−4, or CG−4
Oil Pump	Gear Driven Trochoid Type
Crankcase Oil Capacity liters (U.S. qt.)	3.3 (3.5) with filter
Water Pump	Belt Driven Centrifugal Type
Cooling System Capacity liters (U.S. qt.)	3.1 (3.3)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 40 AMP

General Information

DANGER

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

Fuel Shutoff Valve

This valve should be shut when removing the engine or placing the unit in long term storage.

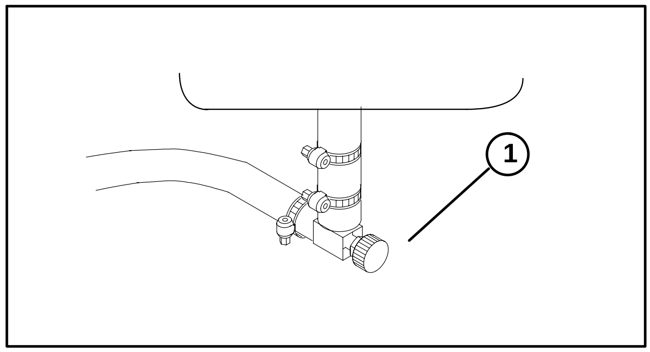

Figure 1

1. Fuel shut off (under the fuel tank)

Checking Engine Oil

IMPORTANT: Check level of oil every 8 operating hours or daily.

Crankcase capacity is approximately 3.5 qts. (3.3 L) with filter.

1. Position machine on a level surface.

2. Remove dipstick and wipe it with a clean rag. Push dipstick into the tube and make sure it is seated fully. Remove dipstick from tube and check level of oil. If oil level is low, remove filler cap from valve cover and add enough oil to raise level to FULL mark on dipstick. Add the oil slowly and check the level often during this process. DO NOT OVERFILL.

3. The engine uses any high-quality detergent oil having the American Petroleum Institute -API- “service classification” CD, CE, CF or CF−4 or CG−4 or higher. Recommended viscosity (weight) is SAE 10W30.

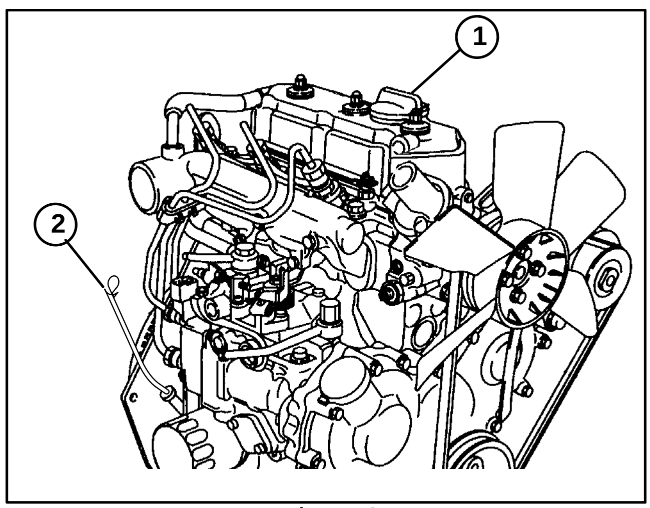

Figure 2

1. Fill cap **2. dipstick**

4. Install the filler cap and dipstick firmly in place.

Fill Fuel Tank

The engine runs on No. 2 diesel fuel. Fuel tank capacity is approximately 6.0 gallons (22.7 L).

1. Clean area around fuel tank cap.

2. Remove fuel tank cap.

3. Fill tank to about one inch below the top of tank, (bottom of the filler neck). **Do not overfill.** Install cap.

4. Wipe up any fuel that may have spilled to prevent a fire hazard.

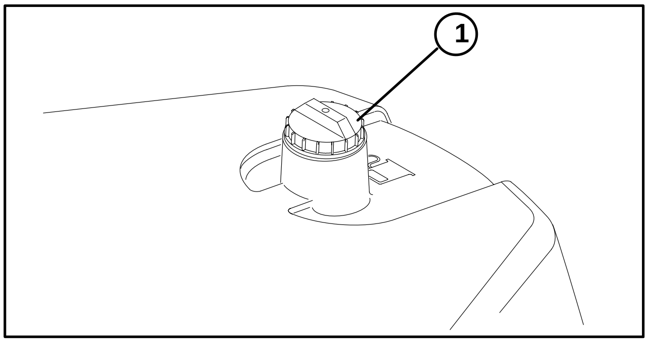

Figure 3
1. Fuel cap

Bleed Fuel System

1. Position machine on a level surface. Make sure fuel tank is at least half full.

2. Press primer button on top of fuel filter until resistance is felt.

Note: It may be necessary to operate the primer button up to 30 times or more after starting the engine.

3. Start engine and continue to operate primer button until engine runs smooth.

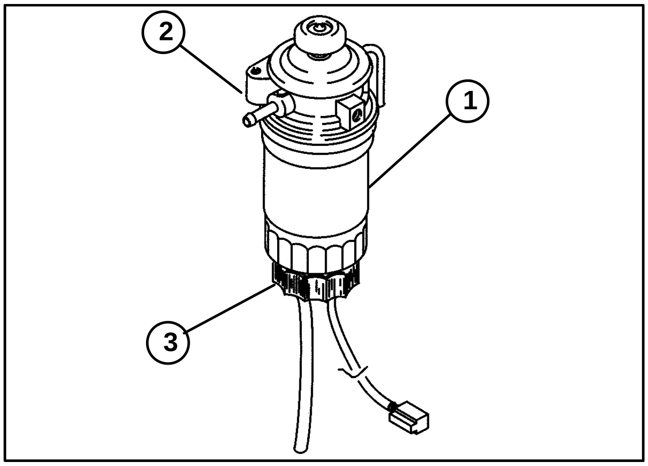

Figure 4
1. Fuel filter
2. Priming pump
3. Drain Plug

Check Cooling System

The cooling system is filled with a 50/50 solution of water and ethylene glycol antifreeze. Check level of the coolant at the beginning of each day before starting the engine. Capacity of cooling system is approximately 3.6 qts. (3.4 L).

> **CAUTION**
>
> **If engine has been running, pressurized hot coolant can escape when the radiator cap is removed and may cause burns.**

1. Park machine on a level surface.

2. Check coolant level. Coolant should be between lines on the reserve tank when engine is cold.

3. Install reserve tank cap.

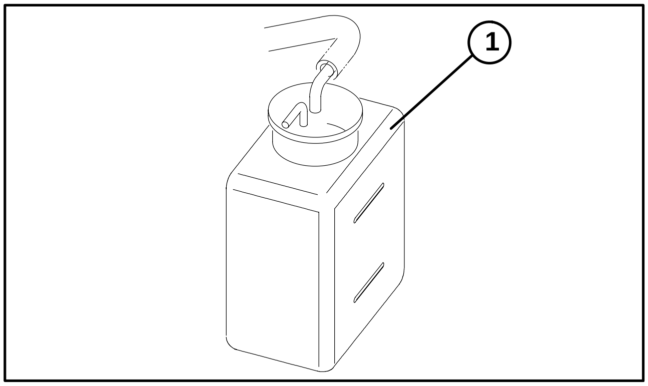

Figure 5
1. Reserve tank

4. If the coolant level is low, remove reserve tank cap and add a 50/50 mixture of water and permanent ethylene glycol antifreeze. **Do not overfill**.

Drain Water from Fuel Filter/Water Separator

Any water accumulation should be drained from the fuel filter/water separator before each use or when warning light glows.

1. Position machine on a level surface and stop the engine.

Note: Because the accumulated water will be mixed with diesel fuel, drain the fuel filter into a suitable container and dispose of properly.

2. Place a drain pan under the fuel filter.

3. Open the drain plug on the fuel filter/water separator approximately one turn and drain any accumulated water. If necessary, operate the priming pump to drain water. Tighten the plug after draining.

4. Start the engine and make sure the warning light goes out. Check for leaks.

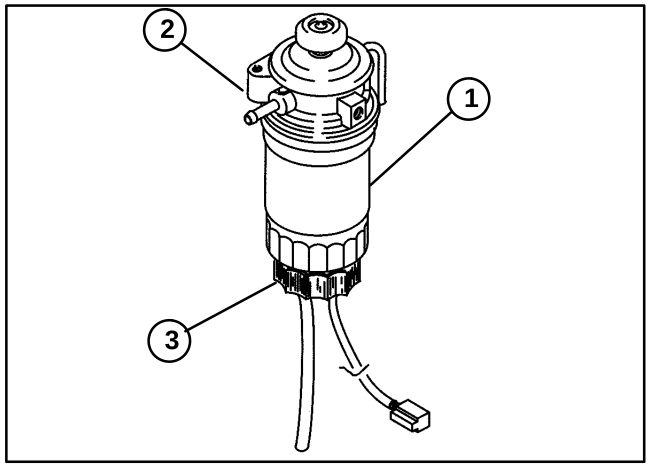

Figure 6

1. Fuel filter
2. Priming pump
3. Drain Plug

Adjustments

Adjust Alternator Belt

Make sure belt is properly tensioned to assure the proper operation of the machine and prevent unnecessary wear. On new belts, check tension after 8 hours of operation.

The engine belt should be tensioned so it deflects 0.20 inch (5 mm) with a 2 to 3 lbf (9 to 13 N) load applied midway between the crankshaft and alternator pulley.

1. Loosen bolts securing the alternator to the engine and adjusting bracket.

2. Adjust belt to proper tension and tighten bolts.

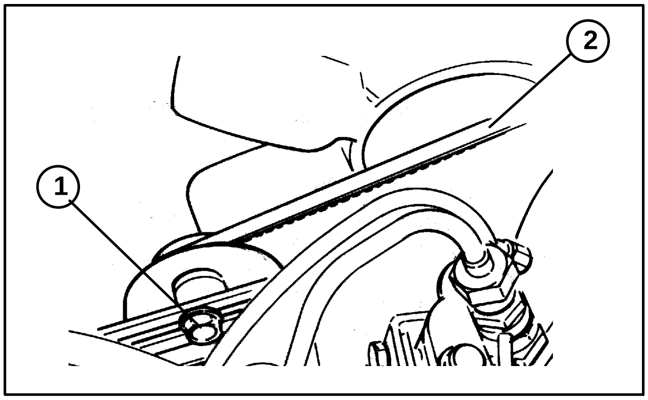

Figure 7

1. Bolt **2. Belt**

Adjust Throttle Control

Proper throttle operation is dependent upon proper adjustment of throttle control. Make sure throttle control is operating properly.

1. Move remote throttle control lever to **SLOW** position.

2. Loosen cable clamp screw securing cable to engine.

3. Move cable until speed control lever contacts idle speed screw

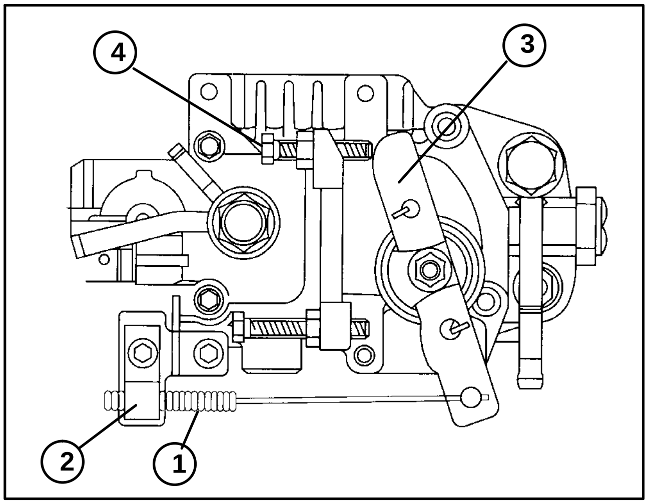

Figure 8

1. Throttle cable
2. Cable clamp
3. Speed control lever
4. Idle speed screw

Adjust Idle Speed (Fig. 8)

1. Move remote throttle control lever to **SLOW** position.

2. Loosen lock nut on idle speed screw.

3. Adjust idle speed screw to obtain **1500 RPM**.

4. Tighten lock nut.

Engine

Service and Repairs

Service Air Cleaner

Service air cleaner filter every 200 hours (more frequently in extreme dusty or dirty conditions).

1. Check air cleaner body and hoses for damage which could possibly cause an air leak. Replace air cleaner body if damaged.

2. Release latches securing the air cleaner cover to the air cleaner body. Separate cover from the body. Clean inside of air cleaner cover.

3. Gently slide filter out of the air cleaner body to reduce the amount of dust dislodged. Avoid knocking filter against the air cleaner body.

4. Inspect filter. Discard filter if damaged. Do not wash or reuse a damaged filter.

Washing Method

A. Prepare a solution of filter cleaner and water. Soak filter element for about 15 minutes. Refer to directions on the filter cleaner carton for complete information.

B. After soaking the filter for 15 minutes, rinse it with clear water. Maximum water pressure must not exceed 40 psi to prevent damage to the filter element. Rinse filter from the clean side to dirty to side.

C. Dry filter element using warm, flowing air that does not to exceed 160°F (71°C), or allow element to air−dry. Do not use a light bulb to dry the filter element because damage could result.

Compressed Air Method

CAUTION

Use eye protection such as goggles when using compressed air.

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

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

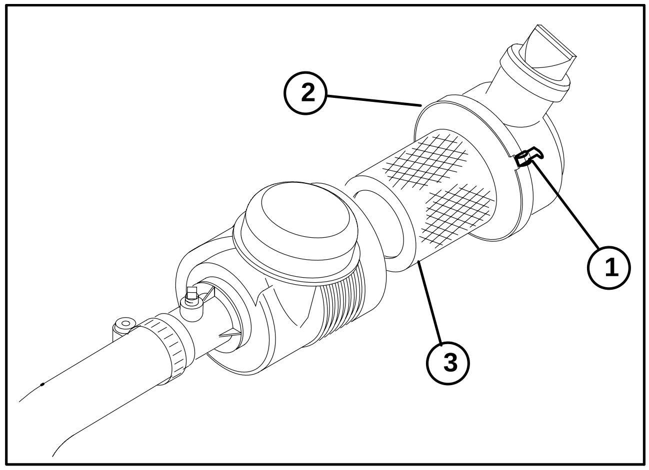

Figure 9

1. **Air cleaner latches**
2. **Dust cup**
3. **Filter**

5. Inspect new filter for shipping damage. Check sealing end of the filter. Do not install a damaged filter.

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

7. Reinstall cover and secure latches.

Change Engine Oil and Filter

Change oil and filter initially after the first 50 hours of operation, thereafter change oil every 50 hours and filter every 100 hours. However, change oil more frequently when engine is operated in extremely dusty or dirty conditions.

1. Remove drain plug letting the oil flow into the drain pan. When the oil stops flowing, install drain plug.

2. Remove oil filter. Apply a light coat of clean oil to the new filter gasket.

3. Screw filter on by hand until the gasket contacts the filter adapter. Tighten filter from 1/2 to 3/4 of a turn further. **Do not overtighten.**

4. Add oil to crankcase (see Check Engine Oil).

5. Dispose of oil properly.

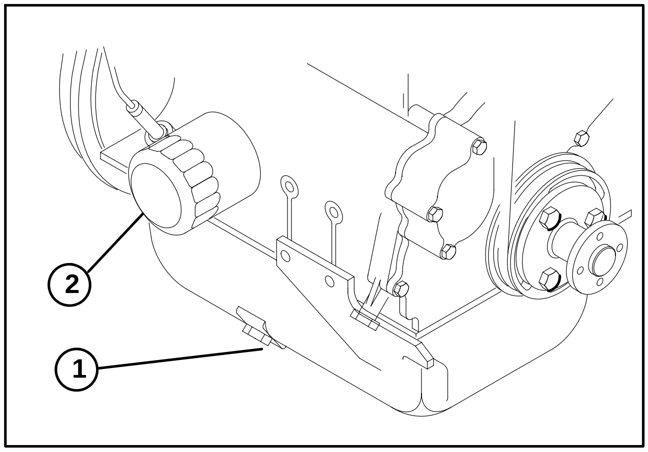

Figure 10

1. Drain plug **2. Oil filter**

Replace Fuel Filter

Change filter every 800 hours. Use the following procedures when replacement becomes necessary:

1. Close fuel shut−off valve.

DANGER

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

2. Clean area where filter canister mounts.

3. Disconnect sensor wire and remove drain plug.

4. Remove filter canister and clean mounting surface.

5. Lubricate gasket on filter canister with clean oil.

6. Install filter canister by hand until gasket contacts mounting surface, then rotate an additional 1/3 turn.

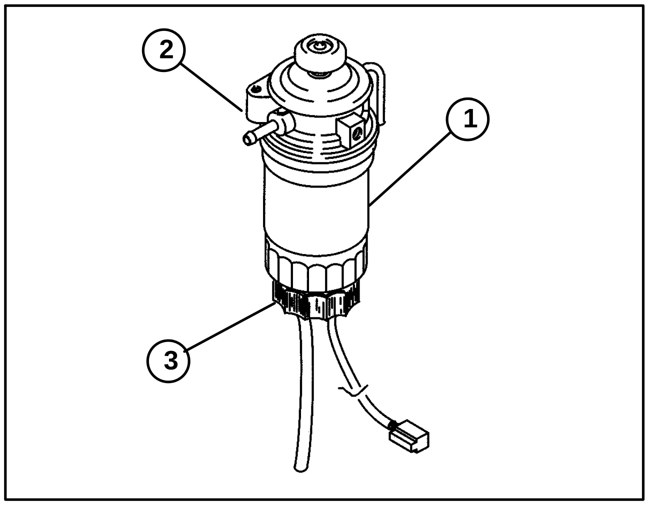

Figure 11

1. Fuel filter **3. Drain Plug**
2. Priming pump

7. Install drain plug with new o-ring. Connect sensor wire.

8. Push primer button until resistance is felt.

9. Start engine and check for leaks.

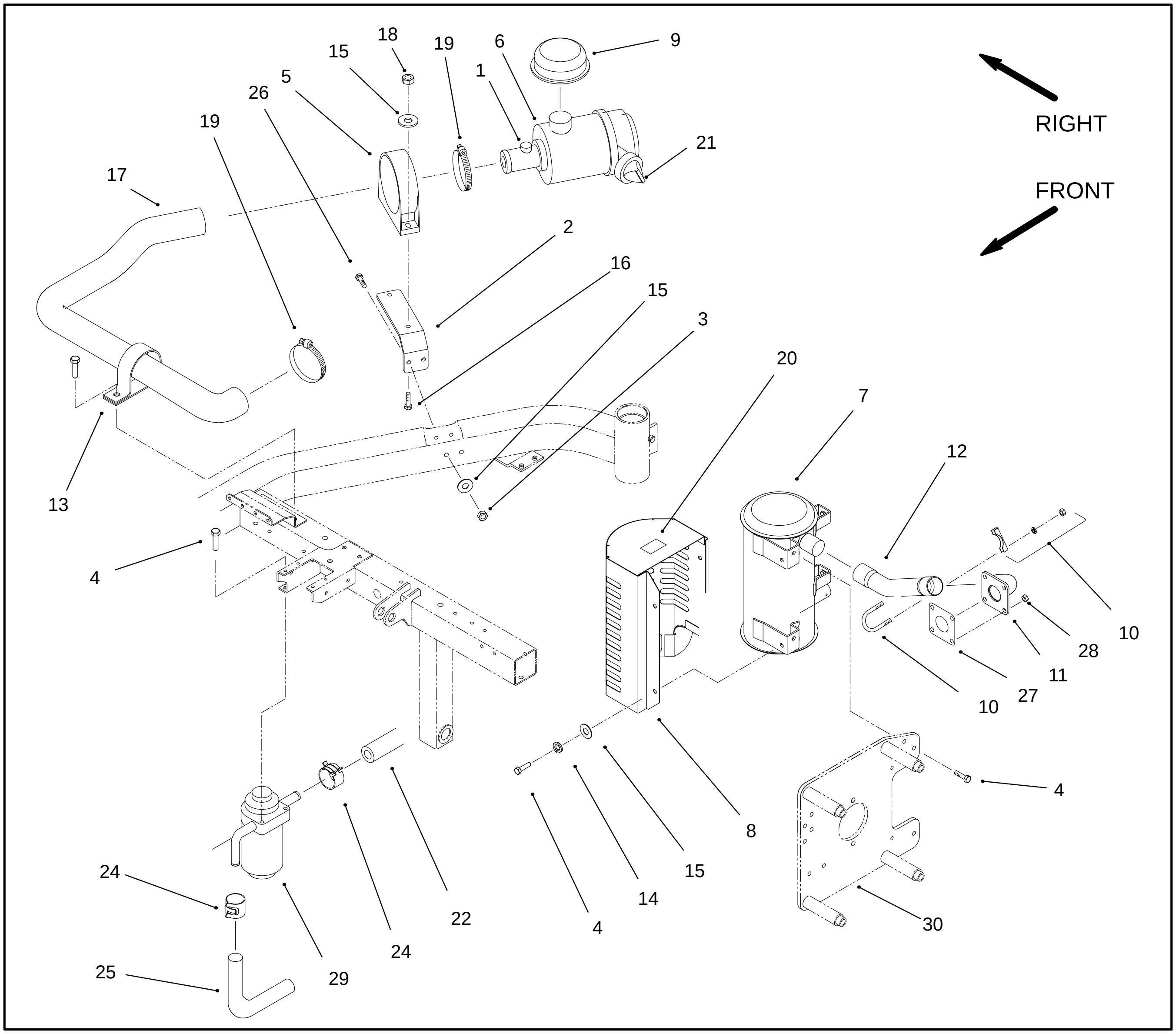

Figure 12

1. **Pipe plug**
2. **Air cleaner bracket**
3. **Lock nut**
4. **Cap screw**
5. **Mounting bracket**
6. **Air cleaner body**
7. **Muffler**
8. **Muffler shield**
9. **Air inlet hood**
10. **Clamp**
11. **Exhaust plate**
12. **Exhaust pipe**
13. **R−clamp**
14. **Washer**
15. **Flat washer**
16. **Cap screw**
17. **Air cleaner hose**
18. **Lock nut**
19. **Hose clamp**
20. **Decal**
21. **Vaculator valve**
22. **Fuel hose (to injector pump)**
23. **Not used**
24. **Hose clamp**
25. **Fuel hose (from fuel tank)**
26. **Cap screw**
27. **Exhaust gasket**
28. **Metric hex nut**
29. **Fuel filter/water separator**
30. **Pump plate**

Muffler Removal (Fig. 13)

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

CAUTION

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

2. Remove muffler shield (8) from from the muffler (7) by removing the four cap screws (4) securing the shield to the muffler.

3. Remove clamp (10) securing the exhaust pipe (12) to the muffler (7).

4. Remove two cap screws (4) securing the muffler (7) to the rear of the pump plate (30). Carefully separate muffler from the pump plate and exhaust pipe (12).

5. Further disassemble muffler as necessary.

Muffler Installation (Fig. 14)

1. Make sure the engine is off.

Note: Mount all fasteners before securing tightly to ensure a proper fit.

2. If the exhaust plate (11) was removed, install plate to exhaust manifold with a new gasket. Secure plate to the manifold with metric hex nuts (28).

3. If the exhaust pipe (12) was removed, install pipe to exhaust plate (11) with clamp (10).

4. Carefully attach muffler (7) to the exhaust pipe (12). Secure muffler (7) to the pump plate (30) with two cap screws (4).

5. Secure exhaust pipe (12) to the muffler (7) with clamp (10).

6. Secure muffler shield (8) to the muffler (7) with four cap screws (4).

Air Cleaner Removal (Fig. 15)

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

2. Loosen hose clamp (19), and disconnect air cleaner hose (17) from the air cleaner body (6).

3. Remove lock nut (18) from cap screw (16).

4. Remove air cleaner body (6) from the mounting bracket (5).

5. Further disassemble air cleaner as necessary.

Air Cleaner Installation (Fig. 16)

1. Make sure the engine is off.

2. If the air cleaner bracket (2) was removed, secure bracket to the frame with two cap screws (26), flat washers (15), flat washers (15), and lock nuts (3).

3. If the mounting bracket (5) was removed, secure bracket to the air cleaner bracket (2) with two cap screws (16) and lock nuts (18).

4. Carefully place air cleaner body (6) into the mounting bracket (5).

5. Reconnect air cleaner hose (17) to the air cleaner (6) and secure with hose clamp (19).

Radiator

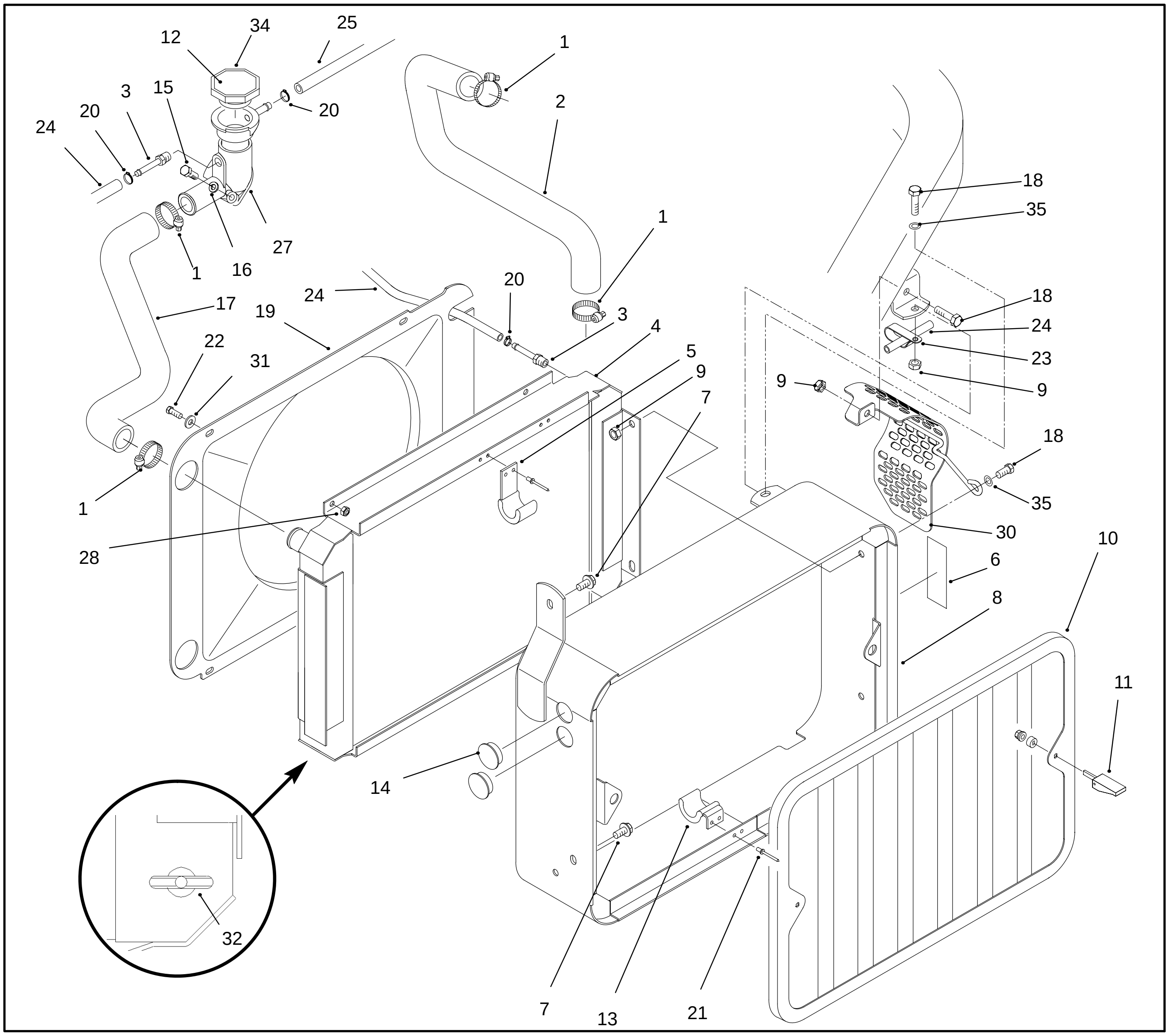

Figure 17

1. **Hose clamp**
2. **Radiator hose (to water pump)**
3. **Barb hose fitting**
4. **Radiator**
5. **Upper cooler bracket**
6. **Fan warning decal**
7. **Washer head screw**
8. **Radiator support assembly**
9. **Lock nut**
10. **Screen**
11. **Swell latch**
12. **Radiator cap decal**
13. **Lower cooler bracket**
14. **Plug**
15. **Cap screw**
16. **Lock spring washer**
17. **Radiator hose (from water jacket)**
18. **Cap screw**
19. **Fan shroud**
20. **Worm clamp**
21. **Pop rivet**
22. **Cap screw**
23. **Double hose clamp**
24. **Breather hose**
25. **Expansion tank hose**
26. **Not used**
27. **Thermostat housing**
28. **Lock nut**
29. **Not used**
30. **Alternator guard**
31. **Flat washer**
32. **Drain petcock**
33. **Not used**
34. **Radiator cap**
35. **Flat washer**

Radiator Removal (Fig. 17)

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

CAUTION

DO NOT open radiator cap or drain coolant if the engine or radiator is hot. Pressurized hot coolant can escape and cause burns.

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

2. Place a suitable container under the front end of the radiator. Open drain petcock (32) on the back of the radiator. Drain radiator completely and close petcock.

3. Remove screen (10) from radiator support (8).

4. If the hydraulic oil cooler is installed, drain hydraulic reservoir and remove oil cooler (see Engine Removal).

5. Remove the following hoses from the radiator:

   A. Loosen hose clamp (20) and disconnect breather hose (24).

   B. Loosen hose clamps (1) and disconnect radiator hoses (2 and 17).

6. Remove the following fasteners to remove the radiator support (8) from the frame:

   A. Lock nut (9) and cap screw (18) securing the alternator guard (29) to the frame tab. Cap screw (7) securing the lower radiator support to the frame.

   B. Cap screw (7) securing the upper radiator support tab to the frame. Lock nut (9), cap screw (18), and flat washer (30) securing the rear radiator support tab and double hose clamp (23) to the frame tab.

7. Remove the radiator support (8) from the frame and onto a workbench.

8. Remove four cap screws (18) and lock nuts (9) securing the radiator (4) to the radiator support (8). Slide radiator out of the support.

9. Remove four cap screws (22), lock nuts (28), and flat washers (31) securing the fan shroud (19) to the radiator (4). Separate the shroud from the radiator.

Radiator Installation (Fig. 17)

1. Secure fan shroud (19) to radiator (4) with four cap screws (22), lock nuts (28), and flat washers (31).

2. Slide radiator (4) into the radiator support (8). Secure radiator to support with four cap screws (18) and lock nuts (9). Also, install alternator guard (30) with washer (30) to the radiator support.

3. Position radiator support (8) to the frame.

   A. Secure rear radiator support tab and double hose clamp (23) to the frame with cap screw (18), flat washer (35), and lock nut (9). Secure upper radiator support tab to frame with cap screw (7).

   B. Secure lower portion of the radiator support to the frame with cap screw (7). Secure alternator guard (30) to the frame tab with cap screw (18) and lock nut (9).

4. Connect the following hoses to the radiator:

   A. Radiator hoses (2 and 17) with hose clamps (1).

   B. Breather hose (24) with hose clamp (20).

5. If the hydraulic oil cooler was installed, install oil cooler to the radiator (see Engine Removal). Fill the hydraulic reservoir (see Check Hydraulic System Fluid in Chapter 5 − Hydraulic System).

6. Install screen (10) to radiator support (8).

7. Fill radiator (4) with coolant (see Check Cooling System).

Fuel Tank

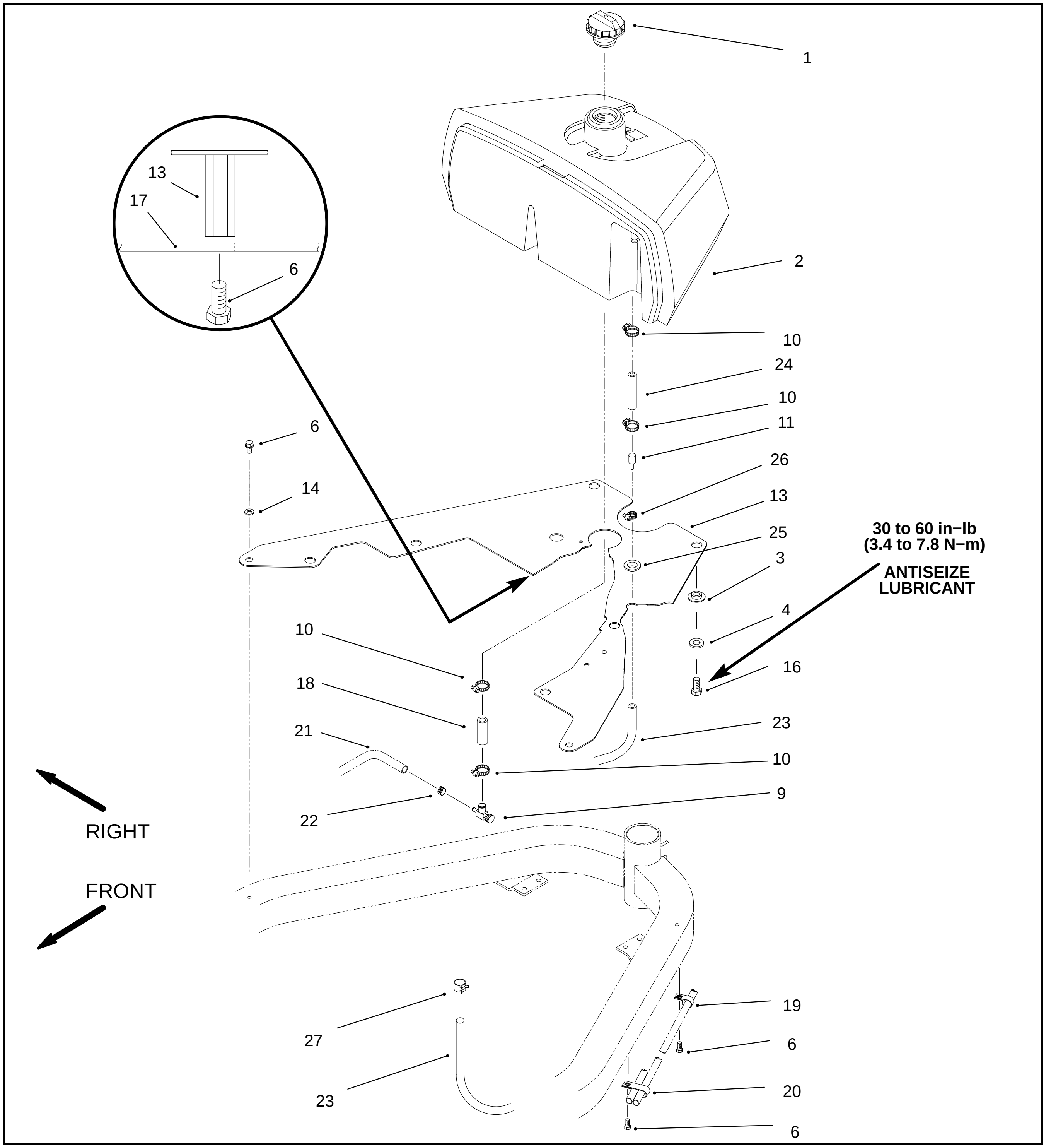

Figure 18

1. Fuel cap
2. Fuel tank
3. Grommet
4. Flat washer
5. Not used
6. Washer head screw
7. Not used
8. Not used
9. Fuel shut−off fitting
10. Hose clamp
11. Fuel fitting
12. Not used
13. Mounting plate
14. Flat washer
15. Not used
16. Cap screw
17. Support Bracket
18. Fuel hose
19. Clamp
20. Double hose clamp
21. Fuel hose (to fuel filter/water sep.)
22. Hose clamp
23. Fuel hose (from injector pump)
24. Fuel hose
25. Grommet
26. Worm clamp
27. Hose clamp

Fuel Tank Removal (Fig. 18)

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

DANGER

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

2. Drain fuel tank (2) as follows:

   A. Close fuel shut−off valve (9) below the fuel tank.

   B. Disconnect fuel hose (21) from the fuel shut−off valve (9). Place hose into a suitable container for draining the tank

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

3. Gain access to the fasteners securing the fuel tank (2) to the mounting plate (13) as follows:

   A. Remove three cap screws (6) and two flat washers (14) securing mounting plate to the frame and support bracket (17).

   B. Lift and support the mounting plate up from the rear of the machine.

4. Loosen hose clamp (26) and disconnect fuel hose (23) from fuel fitting (11).

5. Loosen hose clamp (10) and disconnect fuel hose (18) from fuel tank (2).

6. Remove three cap screws (16) and flat washers (4) securing the fuel tank (2) to the mounting plate (13). Remove the tank from the mounting plate being careful not to damage any fuel hoses.

Fuel Tank installation (Fig. 18)

1. Position fuel tank (2) to the mounting plate (13). Be careful not to damage any fuel hoses.

   A. Apply antiseize lubricant to the threads of the three cap screws (16).

   B. Secure fuel tank to the plate with three flat washers (4) and cap screws.

   C. Torque cap screws from 30 to 60 in−lb (3.4 to 7.8 N−cm).

2. Connect fuel hose (18) to the fuel tank with hose clamp (10).

3. Connect fuel hose (23) to fuel fitting (11) with hose clamp (26).

4. Install mounting plate (13) to the frame as follows:

   A. Position mounting plate to the frame. Make sure to align plate holes with frame holes and support bracket (28).

   B. Secure mounting plate to the frame and support bracket with two flat washers (14) and three cap screws (6).

5. Connect fuel hose (21) to the fuel shut−off valve (9).

6. Open fuel shut−off valve (9) below the fuel tank.

7. Fill fuel tank with fuel (see Fill Fuel Tank). Check fuel lines and tank for leaks.

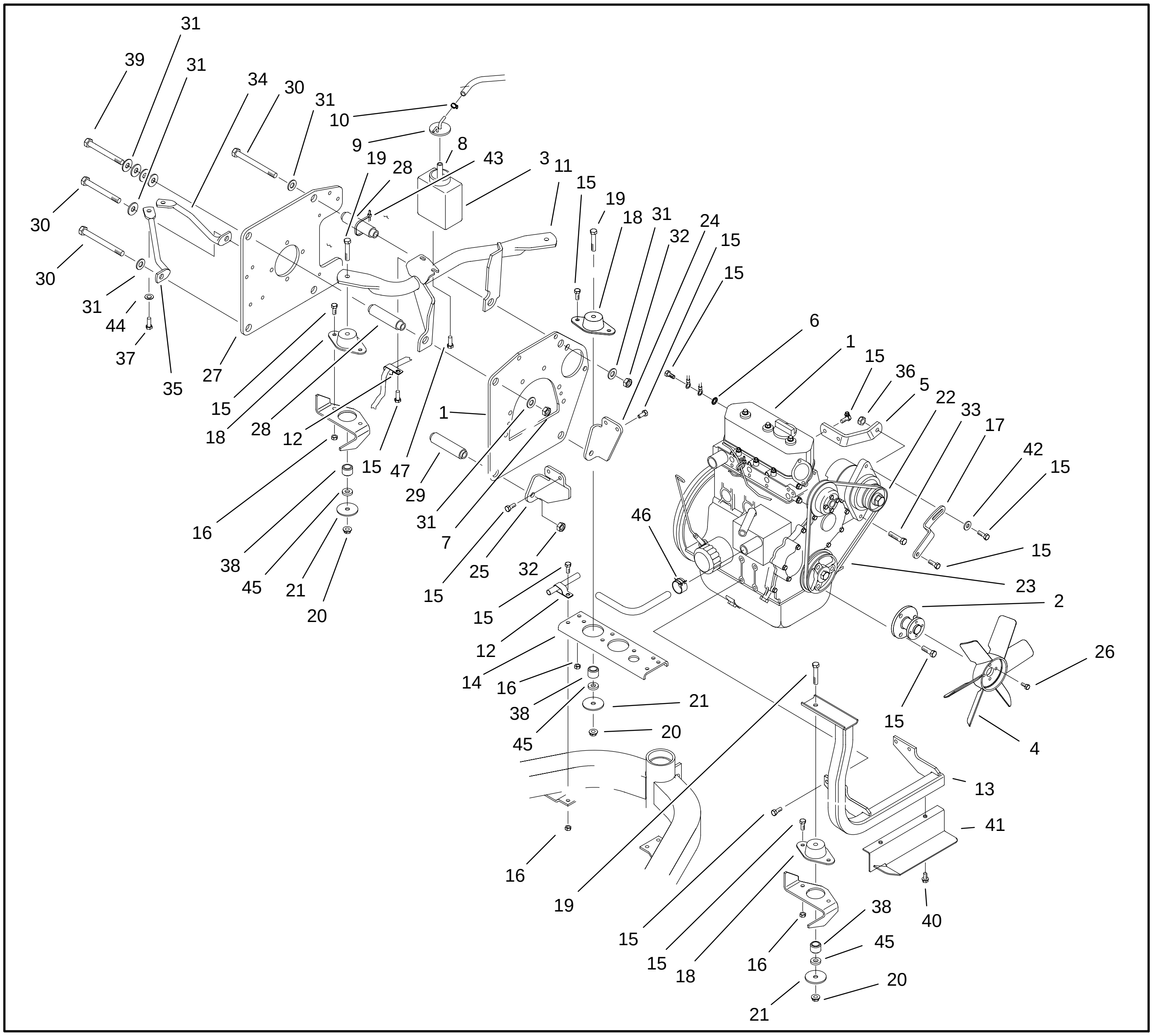

Figure 19

1. Daihatsu engine
2. Fan adapter
3. Overflow tank
4. Engine fan
5. Upper alternator bracket
6. Lock washer
7. Nut
8. Overflow tank hose
9. Overflow tank cap
10. Worm clamp
11. Rear engine mount
12. Double hose clamp
13. Front engine mount
14. Support bracket
15. Cap screw
16. Lock nut
17. Lower alternator bracket
18. Rubber mount
19. Cap screw
20. Flange lock nut
21. Flat washer
22. Alternator
23. V−belt
24. Engine bracket (LH)
25. Engine bracket (RH)
26. Cap screw
27. Pump plate
28. Upper spacer
29. Spacer
30. Cap screw
31. Thrust washer
32. Lock nut
33. Cap screw
34. Hydrostat support brace (LH)
35. Hydrostat support brace (RH)
36. Lock nut
37. Cap screw
38. Mount spacer
39. Cap screw
40. Washer head screw
41. Fan deflector
42. Flat washer
43. Cable tie
44. Flat washer
45. Washer
46. Hose clamp
47. Cap screw
48. Fuel hose (to fuel filter/water sep.)

Engine Removal

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

2. Release lockup handle, and pivot steering arm and steering wheel all the way forward. Lift seat forward to gain access to the engine.

3. Remove console shroud from the control panel.

4. Drain fuel tank (see Fuel Tank Removal):

CAUTION

The hydraulic fluid may be hot. To avoid possible burns, allow hydraulic system to cool before disconnecting any hoses.

5. Drain hydraulic reservoir as follows (Fig 20):

   A. Clamp pump inlet hose to prevent hydraulic tank from inadvertently draining.

   B. Loosen hose clamp, and remove pump inlet hose from the gear pump.

   C. Drain hydraulic tank completely into a suitable container by releasing the clamp from the hose. Plug hose and pump to prevent contamination.

CAUTION

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

6. Drain radiator (4) as follows (Fig. 17):

   A. Open drain petcock (32) on the back of the radiator. Drain radiator completely into a suitable container and close petcock.

   B. Disconnect expansion tank hose (25) and and radiator hose (17) at the thermostat housing (27). Disconnect radiator hose (2) at the water pump.

7. Disconnect hydraulic oil cooler if installed (Fig. 21).

   A. Disconnect tube and O−ring from hydraulic fitting on the hydraulic reservoir.

   B. Disconnect tube and O−ring from hydraulic fitting on the oil filter.

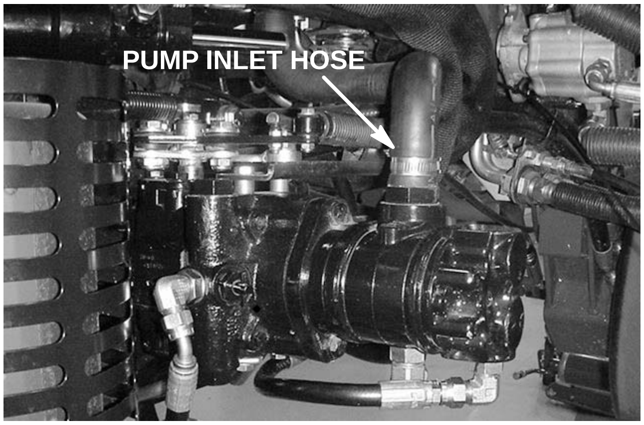

Figure 20

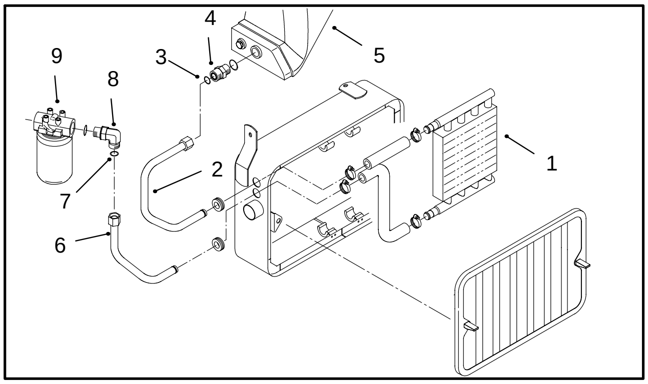

Figure 21

1. **Hydraulic oil cooler**
2. **Tube**
3. **O−ring**
4. **Hydraulic fitting**
5. **Hydraulic reservoir**
6. **Tube**
7. **O−ring**
8. **Hydraulic fitting**
9. **Oil filter**

8. Remove air cleaner as follows (Fig. 12):

   A. Disconnect air cleaner hose (17) at the engine air intake manifold.

   B. Disconnect mounting bracket (5) from the air cleaner bracket (2). Remove air cleaner and mounting bracket from the air cleaner bracket.

CAUTION

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

9. Remove muffler as follows (Fig. 12):

   A. Disconnect exhaust plate (11) from the exhaust manifold by removing four metric hex nuts (28).

   B. Remove two cap screws (4) securing the muffler (7) to the pump plate (30). Remove muffler with muffler shield (8) attached.

10. Remove fuel tank and hydraulic reservoir as follows:

A. Remove three cap screws (6) and two flat washers (14) securing tank mounting plate (13) to the support bracket (17) and frame (Fig. 18).

B. Disconnect hydraulic hose to power steering from from the hydraulic reservoir. Make sure hose to gear pump is disconnected at the pump (Fig. 22).

C. If the oil cooler is **not** installed, disconnect hydraulic hose from the hydraulic oil filter (Fig. 23).

D. Disconnect fuel hose (21) going to the fuel filter/ water separator at the fuel shut−off fitting (9) (Fig. 18). Disconnect double hose clamp (12) from fuel hose (48) and rear engine mount (11) near the over flow tank (Fig. 19).

E. Disconnect fuel hose from the injector pump that goes to the fuel tank (Fig. 24). Loosen clamps (19 and 20) to allow removal of the hose (Fig. 18).

F. Disconnect fuel hose coming from the fuel filter/ water separator at the injector pump inlet (Fig. 24).

G. Make sure cable ties and hose clamps securing hoses to the frame and supports are removed.

H. Lift mounting plate and tanks from the machine.

11. Loosen socket head screw securing the throttle cable to cable clamp. Disconnect cable from the cable clamp and speed control lever (Fig. 25).

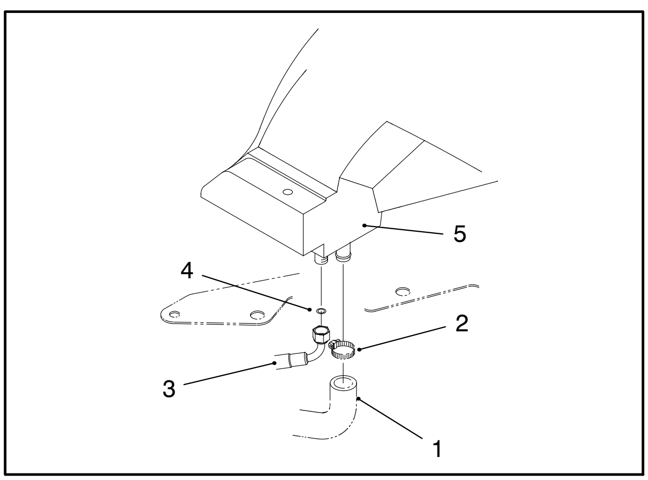

Figure 22

1. Hose (to gear pump)
2. Hose clamp
3. Hose (to power steering)
4. O−ring
5. Hydraulic reservoir

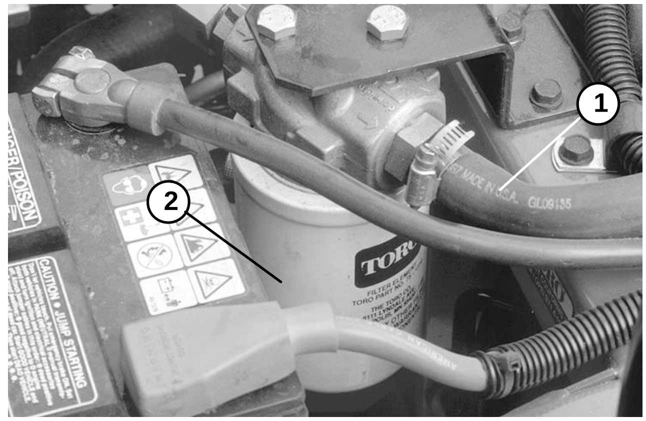

Figure 23

1. Hydraulic hose
2. Hydraulic oil filter

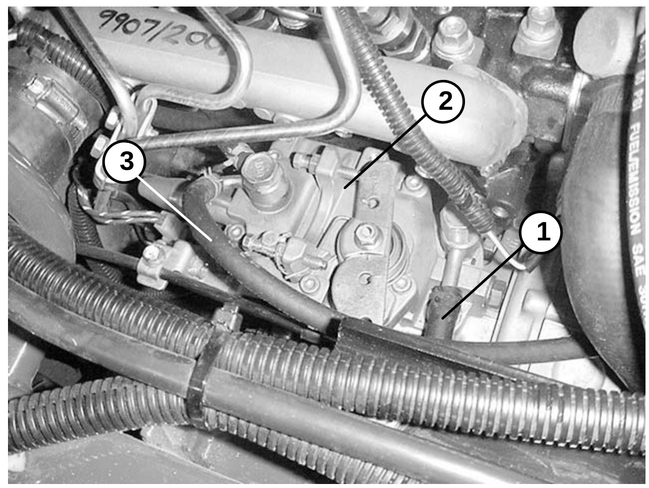

Figure 24

1. Hose (to fuel tank)
2. Injector pump
3. Hose (from fuel filter/water separator

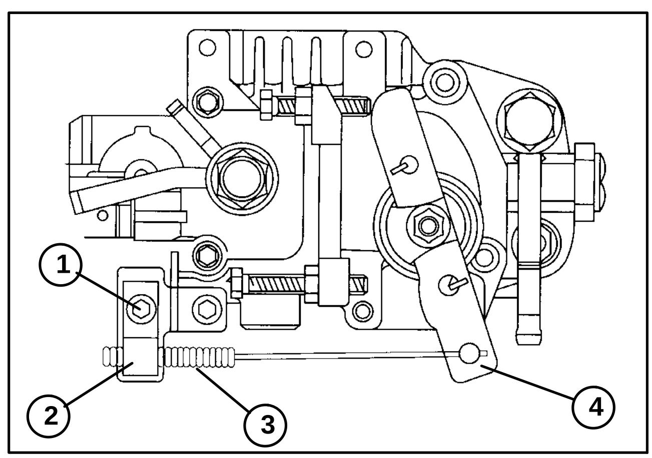

Figure 25

1. Socket head screw
2. Cable clamp
3. Throttle clamp
4. Speed control lever

12. Separate relief valve from the pump plate by removing both cap screws flat washers, and lock nuts (Fig. 26).

13. Separate hydrostat from the pump plate as follows:

A. Loosen both set screws securing the hydrostat shaft to the hub (Fig. 27).

CAUTION

Use caution when removing the traction control mechanism. The extension spring is under tension and may cause personal injury during removal.

B. Remove cap screw and flat washer securing pump lever and plate to the trunnion shaft (Fig. 28).

C. Remove cap screws and spacers securing the cable support bracket to the pump (Fig. 28).

D. Disconnect extension spring from the spring bracket. Remove traction control mechanism from the pump as a complete unit (Fig. 28).

E. Remove both locknuts, cap screws, and flat washers securing the hydrostat to the pump plate. Be careful not to lose the key (Fig. 27).

F. Swing hydrostat out from the machine and secure to prevent dropping.

14. Disconnect electrical connections from the following engine components:

A. The black (negative) battery cable and black wire harness ground on the hydrostat end of the engine block.

B. The red battery cable and red wire with plug on the starter solenoid. Both gray and one black wire from starter terminals.

C. The orange wire on the glow plug bus.

D. The blue/white wires and plug−in connector to the ETR solenoid (injection pump).

E. The yellow/red wire on the water temperature switch.

F. The white/red wire on the oil pressure switch.

G. Plug−in connector with white and green wires to the alternator. Also, grey wire with rubber cap.

15. Remove both hex washer head screws (40) securing the fan deflector (41) to the front engine mount (13) (Fig. 19).

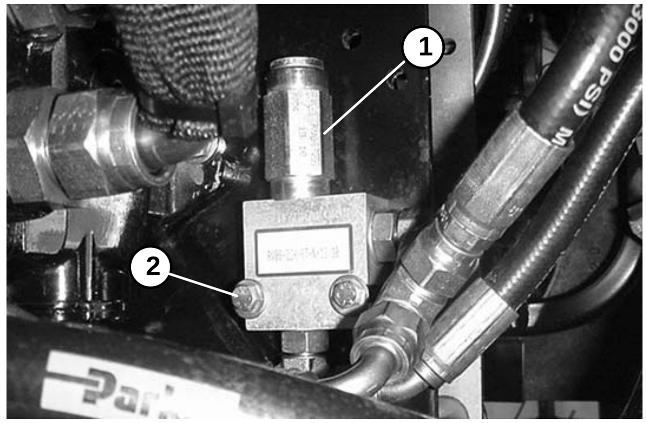

Figure 26

1. **Relief valve**
2. **Cap screw**

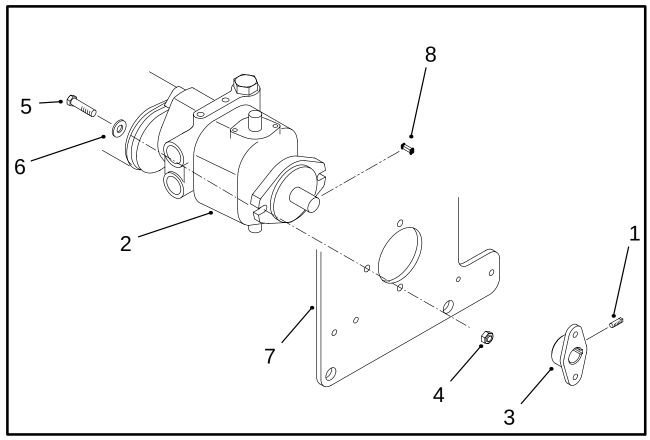

Figure 27

1. **Set screw**
2. **Hydrostat**
3. **Hub**
4. **Lock nut**
5. **Cap screw**
6. **Flat washer**
7. **Pump plate**
8. **Key**

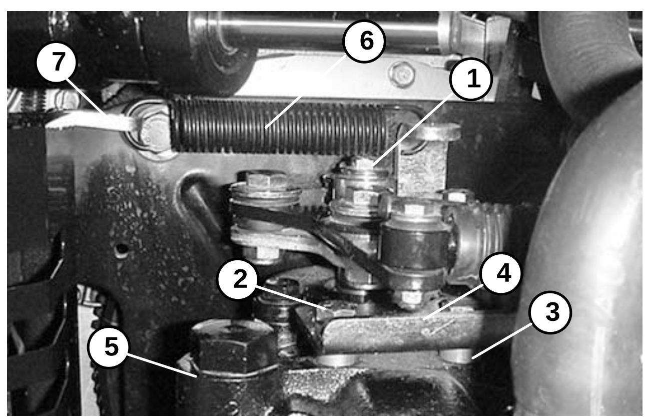

Figure 28

1. **Cap screw & flat washer**
2. **Cap screw**
3. **Spacer**
4. **Cable support bracket**
5. **Pump**
6. **Extension spring**
7. **Spring bracket**

16. Separate fan adapter (2) and fan (4) from engine crank shaft pulley for better clearance (Fig. 19).

17. Remove three flange lock nuts (20), flat washers (21), washers (45), and cap screws (19) securing the front engine mount (13) and rear engine mount (11) to the rubber mounts (18) (Fig. 19).

CAUTION

One person should operate the chain fall or hoist while the other person guides the engine out of the frame.

18. Remove engine from the frame.

A. Attach a short section of chain between both engine mounts

B. Connect hoist or chain fall to center of chain.

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

C. Slowly remove engine and mounts from the machine.

19. Remove engine mounts, backing plate, and pump plate as necessary to repair the engine (Fig. 19).

Engine Installation

1. If the pump plate, backing plate, or engine mounts were removed from the engine, install them to the engine using Figure 19 as a guide.

CAUTION

One person should operate the chain fall or hoist while the other person guides the engine into the frame.

2. Install engine to the frame.

A. Attach a short section of chain between both engine mounts.

B. Connect a hoist or chain fall at the center of the short section of chain.

IMPORTANT: Make sure not to damage engine, fuel and hydraulic lines, electrical harness, or other parts while installing the engine. Make sure fan adapter and fan are in position for installation before lowering the engine.

C. Lower engine and mounts into the machine.

3. Secure front engine mount (13) and rear engine mount (11) to the rubber mounts (18) with three cap screws (19), flat washers (21), washers (45), and flange lock nuts (20). Align mounts and tighten fasteners before releasing the engine from the chain fall (Fig. 19).

4. Install fan adapter (2) and fan (4) to the engine crank shaft pulley (Fig. 19).

5. Secure fan deflector (4) to the front engine mount (13) with both hex washer head screws (40) (Fig. 19).

6. Connect electrical connections to the following engine components:

A. The black (negative) battery cable and black wire harness ground on the hydrostat end of the engine block.

B. The red battery cable and red wire with plug to the starter solenoid. Both gray and one black wire to starter terminals.

C. The orange wire to the glow plug bus.

D. The blue/white wires and plug−in connector to the ETR solenoid (injection pump).

E. The yellow/red wire to the water temperature switch.

F. The white/red wire to the oil pressure switch.

G. Plug−in connector with white and green wires to the alternator. Also, grey wire with rubber cap.

7. Install hydrostat to the pump plate as follows:

CAUTION

Use caution when installing the extension spring. The spring is under tension and may cause personal injury during installation.

A. Apply antiseize lubricant to the key and install into hydrostat shaft. Slide shaft and key into hub (Fig. 27).

B. Secure hydrostat to the pump plate with both flat washers, cap screws, and locknuts. (Fig. 27).

C. Connect extension spring to the spring bracket while installing traction control mechanism from the pump as a complete unit (Fig. 28).

D. Secure cable support bracket to the pump with cap screws and spacers (Fig. 28).

E. Secure pump lever and plate to the trunnion shaft with cap screw and flat washer (Fig. 28).

F. Secure hydrostat shaft to the hub by tightening both set screws(Fig. 27).

8. Secure relief valve to the pump plate with both cap screws, flat washers, and lock nuts (Fig. 26).

9. Connect cable to the cable clamp and speed control lever. Loosen socket head screw securing the throttle cable to cable clamp. (Fig. 25).

10. Install air cleaner as follows (Fig. 22):

A. Secure air cleaner and bracket to the pump plate.

B. Connect hose leading to the radiator to the cleaner.

C. Route and connect hose, leading from the cleaner to the engine valve cover, to the valve cover and cleaner.

11. Install fuel tank and hydraulic reservoir as follows:

A. Position mounting plate and tanks onto the frame.

B. Connect fuel hose coming from the fuel filter/water separator at the injector pump inlet (Fig. 24).

C. Connect fuel hose to the injector pump that goes to the fuel tank (Fig. 24). Secure hoses to frame with clamps (19 and 20) (Fig. 18).

D. Connect double hose clamp (12) to fuel hose (48) and rear engine mount (11) near the over flow tank (Fig. 19). Connect fuel hose (21) going to the fuel filter/water separator at the fuel shut−off fitting (9) (Fig. 18).

E. If the oil cooler is **not** installed, Connect hydraulic hose to the hydraulic oil filter (Fig. 23).

F. Connect hydraulic hose to power steering at the hydraulic reservoir (Fig. 22).

G. Make sure hoses are secured to the frame and supports with cable ties and hose clamps.

H. Secure tank mounting plate (13) to the support bracket (17) and frame with three cap screws (6) and two flat washers (14) (Fig. 18).

12. Install muffler as follows (Fig. 12):

A. Position muffler to machine with muffler shield (8) attached.

B. Secure muffler (7) to the pump plate (30) with two cap screws (4).

C. Secure exhaust plate (11) to the exhaust manifold with four metric hex nuts (28).

13. Install air cleaner as follows (Fig. 12):

A. Install air cleaner and mounting bracket (5) to the air cleaner bracket (2). Secure mounting bracket to the air cleaner bracket.

B. Connect air cleaner hose (17) to the engine air intake manifold.

14. Connect hydraulic oil cooler if installed (Fig. 21).

A. Connect tube and O−ring to hydraulic fitting on the hydraulic reservoir.

B. Connect tube and O−ring to hydraulic fitting on the oil filter.

15. Connect hoses to radiator (4) as follows (Fig. 17):

A. Connect radiator hose (2) to the water pump.

B. Make sure drain petcock (32) on the back of the radiator is shut.

C. Connect expansion tank hose (25) and radiator hose (17) to the thermostat housing (27).

16. Connect remaining hydraulic reservoir as follows (Fig 20):

A. Remove plug from pump inlet hose.

B. Secure pump inlet hose to the gear pump with hose clamp.

C. Remove clamp from pump inlet hose that was used to prevent hydraulic tank from inadvertently draining.

17. Make sure all fuel hoses are connected properly (see Fuel Tank Installation).

18. Install console shroud to the control panel.

19. Make sure fuel shutoff valve is open. Fill fuel tank with fuel (see Fill Fuel Tank). Check tank and hoses for leaks.

20. Fill cooling system with coolant (see Check Cooling System). Check radiator and hoses for leaks.

21. Adjust alternator belt (see Adjust Alternator Belt).

22. Fill hydraulic reservoir with hydraulic oil (see Check Hydraulic System Fluid in Chapter 5 − Hydraulic System). Check reservoir and hoses for leaks.

23. Bleed fuel system (see Bleed Fuel System).

24. Adjust throttle control lever and cable (see Adjust Throttle Control).

Clean Radiator and Screen

To prevent the cooling system from overheating, the radiator screen and radiator must be kept clean. Check and clean screen and radiator daily. If necessary, clean any debris off these parts hourly. Clean these components more frequently in dusty and/or dirty conditions.

1. Release latches and remove radiator screen from the radiator support.

2. Remove fan shroud to access radiator corners.

3. If installed, lift oil cooler from supports.

CAUTION

Use eye protection such as goggles when using compressed air.

IMPORTANT: Air pressure should not exceed 40 psi (2.8 bar) because damage to the radiator fins may result.

4. Working from the fan side of the radiator, blow out radiator with compressed air. If installed, blow out oil cooler.

5. If installed, mount oil cooler to supports.

6. Clean screen. Reinstall fan shroud and screen to the radiator support. Secure latches.

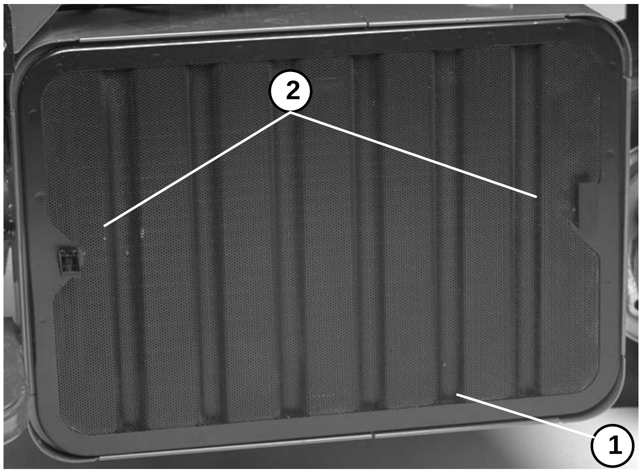

Figure 29

1. Screen **2. Latches**

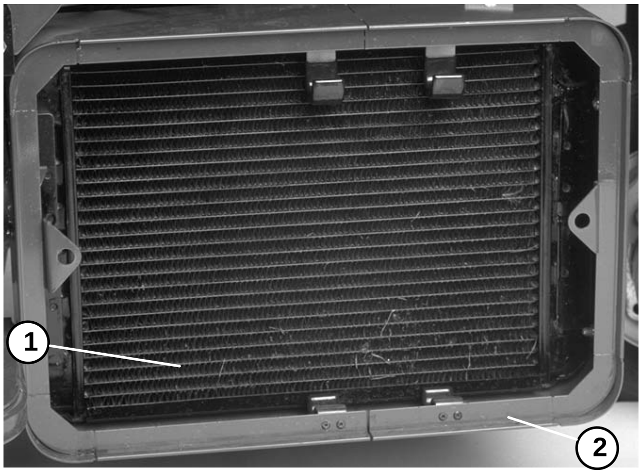

Figure 30

1. Radiator **2. Radiator support**

Engine

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Chapter 4

Hydraulic System

Table of Contents

Hydraulic System

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Specifications

Item	Description
Hydrostatic Transmission (P3) Maximum Pump Displacement (per revolution) Charge Pressure	Variable displacement piston pump 1.24 in^3 (20.3 cc) 100 to 150 PSI (6.9 to 10.3 bar)
Gear Pump Front Section (P1) (cutting reels) Displacement (per revolution) Rear Section (P2) (steering/lift) Displacement (per revolution)	2 section, positive displacement gear type pump 0.55 in^3 (9.0 cc) 0.31 in^3 (5.1 cc)
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) Machines with Serial Number Under 220999999 Machines with Serial Number Over 230000000	 1000 PSI (69.0 bar) over Charge Pressure 1150 PSI (79.3 bar) over Charge Pressure
Hydraulic Manifold Relief Valves Mow Circuit (R1) Cutting Unit Lower (R2) (Serial Number Under 220999999) Cutting Unit Lower (R2) (Serial Number Over 230000000)	 2400 PSI (166 bar) 150 PSI (10.3 bar) over Charge Pressure 400 PSI (27.6 bar) over Charge Pressure
Hydraulic Filter	5 Micron spin–on cartridge type
Hydraulic Oil	See Operator's Manual
Hydraulic Reservoir	Reservoir (without leak detector) capacity 5.5 gal. U.S. (20.8 L) Reservoir (with leak detector) capacity 8.1 gal. U.S. (30.7 L)

General Information

Operator's Manual

The Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for your Greensmaster 3250-D. Refer to that publication for additional information when servicing the machine.

Check Hydraulic System Fluid

The hydraulic system on the Greensmaster 3250-D is designed to operate on high quality hydraulic fluid. Refer to the Operator's Manual for hydraulic fluid recommendations.

IMPORTANT: Check level of hydraulic fluid before engine is first started and daily thereafter.

Note: If changing from one type of hydraulic fluid to another, be certain to remove all the old fluid from the system, as some fluids are incompatible with others.

IMPORTANT: Use only types of hydraulic fluids specified in the Operator's Manual. Other fluids may cause system damage.

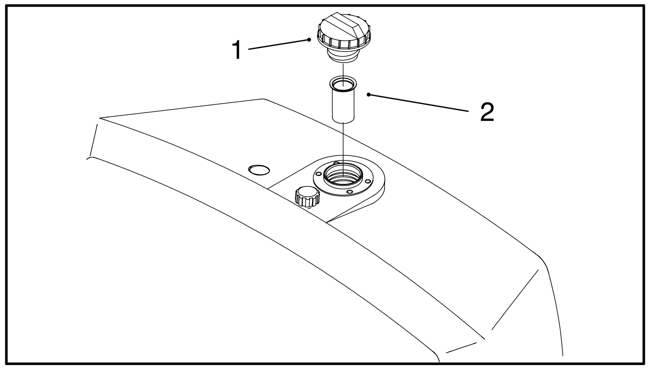


Figure 1

1. **Hydraulic oil cap**
2. **Filler screen**

Checking Fluid Level

Note: A red dye additive for the hydraulic system fluid is available in 2/3 oz bottles. One bottle is sufficient for 4 to 6 gallons of hydraulic fluid. Order Part No. 44-2500 from your Authorized Toro Distributor.

1. Position machine on a level surface. Make sure machine has cooled down so fluid is cold.

2. Remove cap from reservoir and check level of fluid. The fluid should be up to bottom of screen in filler neck.

IMPORTANT: To prevent system contamination, clean top of hydraulic fluid containers before puncturing. Make sure pour spout and funnel are clean.

3. If fluid level is low, slowly fill reservoir with appropriate hydraulic fluid until level reaches bottom of screen. **DO NOT OVERFILL.**

4. Install reservoir cap. Wipe up any fluid that may have spilled.

Towing Traction Unit

In case of emergency, the Greensmaster 3250-D can be towed for a short distance. However, Toro does not recommend this as a standard practice.

IMPORTANT: Do not tow the machine faster than 2 to 3 mph because drive system may be damaged. If machine must be moved a considerable distance, transport it on a truck or trailer.

1. Locate by-pass valve on the hydrostat. Rotate valve 90º.

2. Before starting engine, close by-pass valve by rotating it back 90º. Do not start engine when the valve is open.

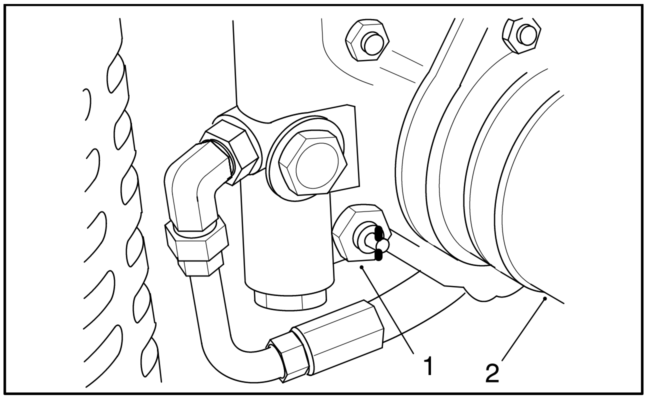


Figure 2

1. By-pass valve **2. Hydrostat**

Hydraulic System

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

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

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

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

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

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

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

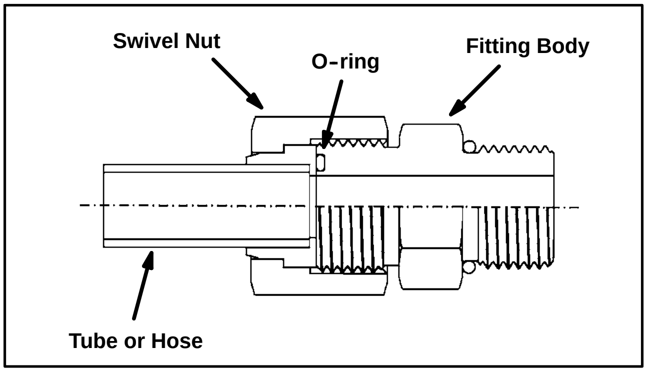


Figure 3

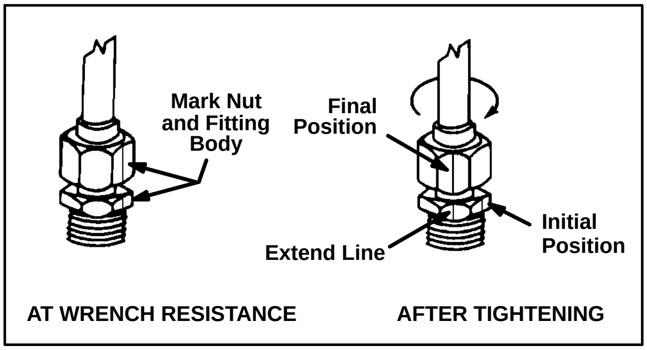


Figure 4

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

Figure 5

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

Non-Adjustable Fitting (Fig. 6)

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

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

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

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

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

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

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

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

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

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

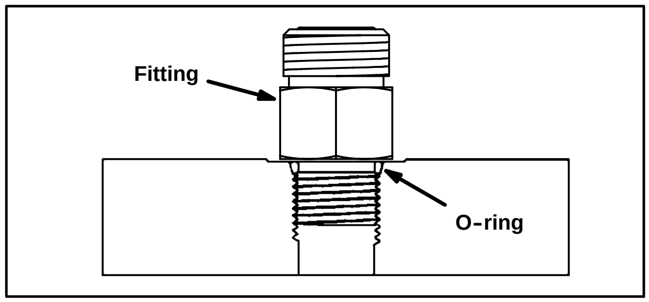


Figure 6

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

Figure 7

Adjustable Fitting (Fig. 8)

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

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

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

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

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

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

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

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

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

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

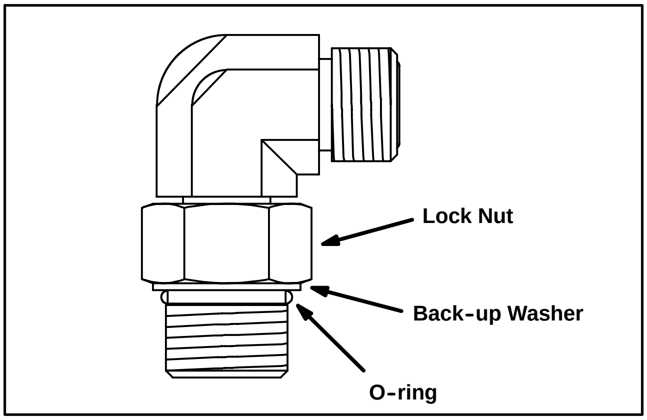


Figure 8

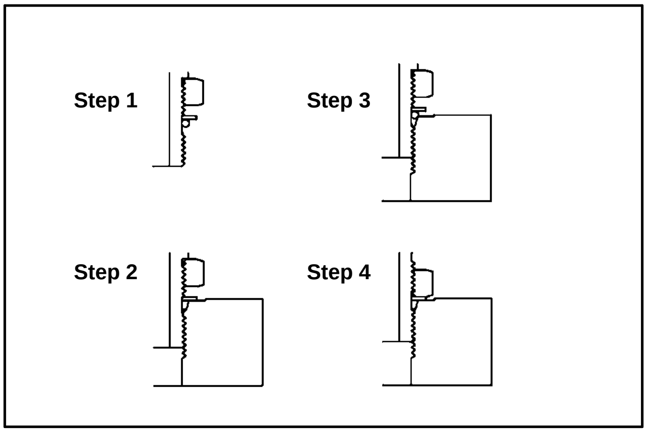


Figure 9

Hydraulic System

Hydraulic Schematics

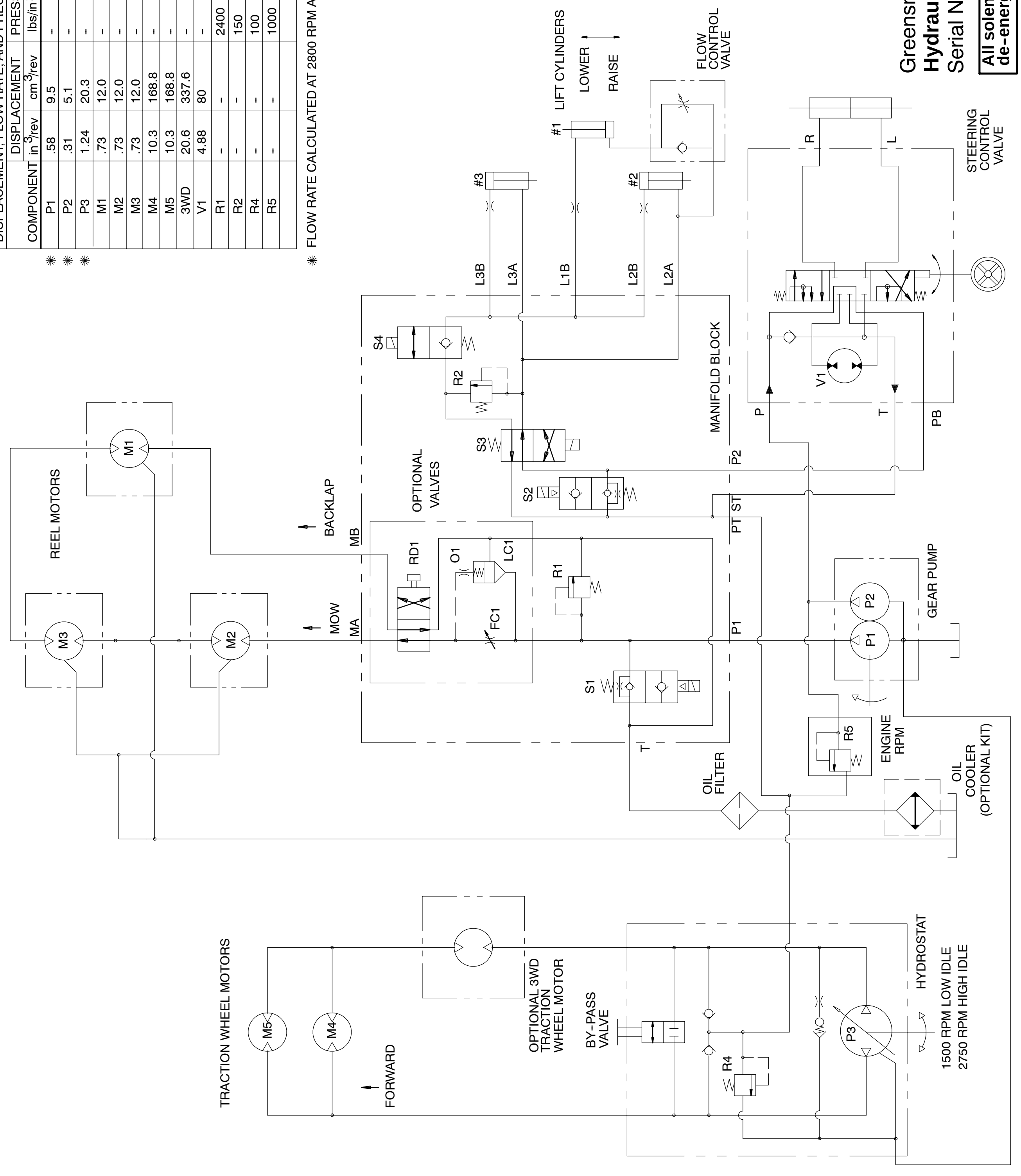
Greensmaster 3250-D
Hydraulic Schematic
Serial Number Under 220999999

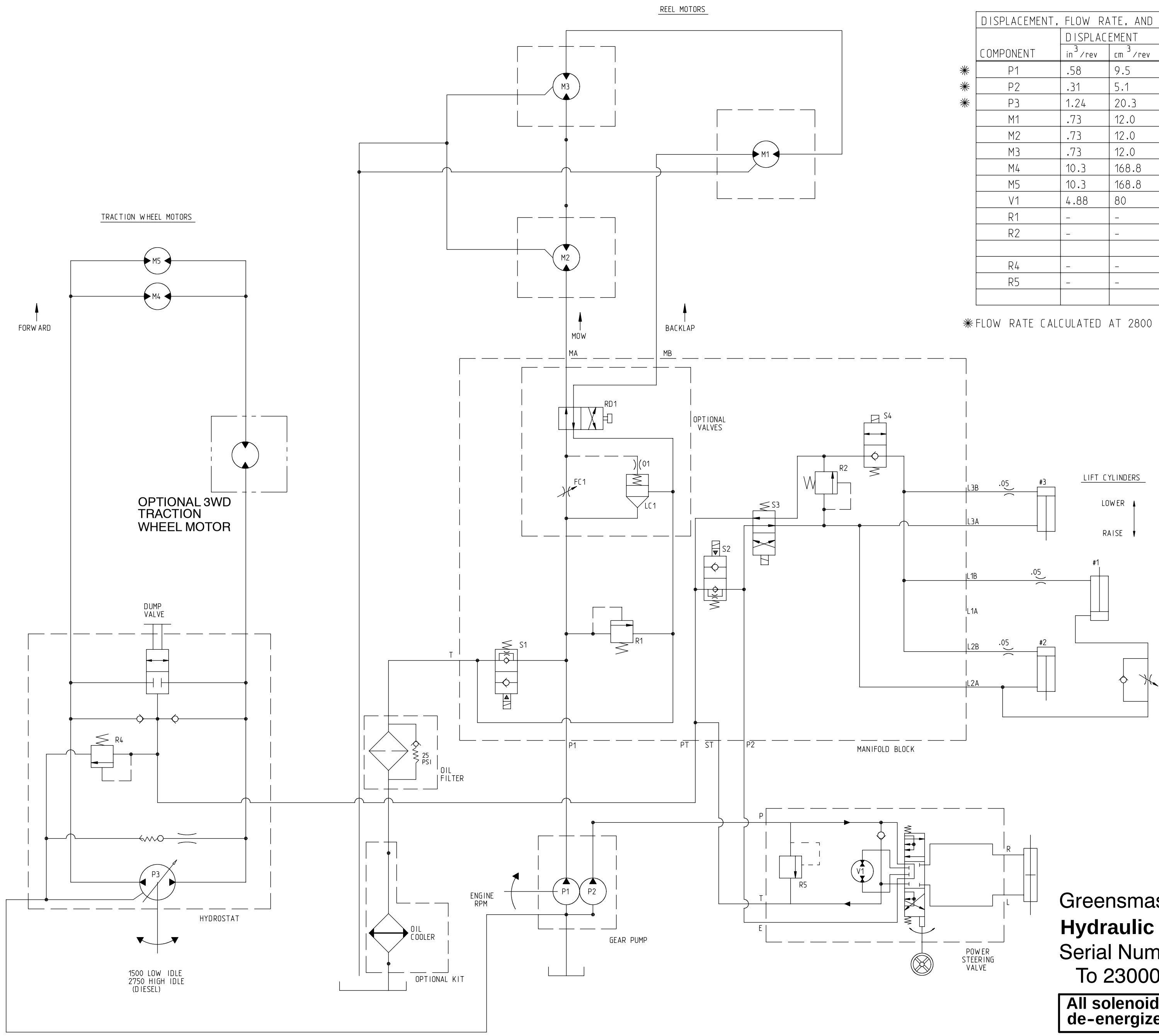
All solenoids are shown as de-energized

DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT in³/rev	DISPLACEMENT cm³/rev	PRESSURE lbs/in²	PRESSURE BARS	FLOW RATE GPM	FLOW RATE LPM
* P1	.58	9.5	-	-	5.9	22.4
* 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	-	-	-	-
3WD	20.6	337.6	-	-	-	-
V1	4.88	80	-	-	-	-
R1	-	-	2400	166	-	-
R2	-	-	150	10	-	-
R4	-	-	100	7	-	-
R5	-	-	1000	69	-	-

* FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY





DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

COMPONENT	DISPLACEMENT in³/rev	DISPLACEMENT cm³/rev	PRESSURE lbs/in²	PRESSURE BARS	FLOW RATE GPM	FLOW RATE LPM
* P1	.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 3250-D

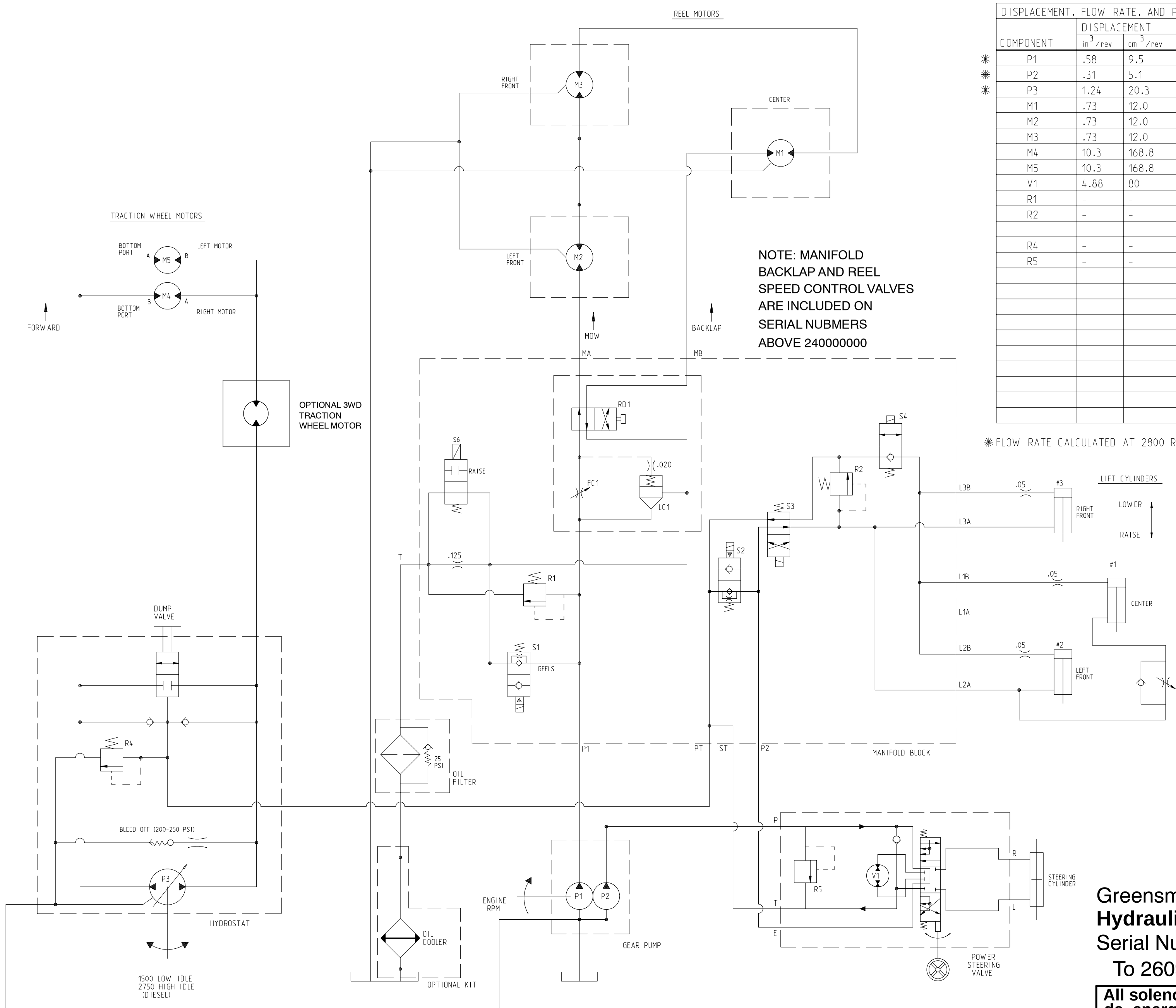
Hydraulic Schematic

Serial Number From 230000000
To 230001500

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	-	-	-	-
R1	-	-	2400	166	-	-
R2	-	-	400	21	-	-
R4	-	-	100	7	-	-
R5	-	-	1150	79	-	-

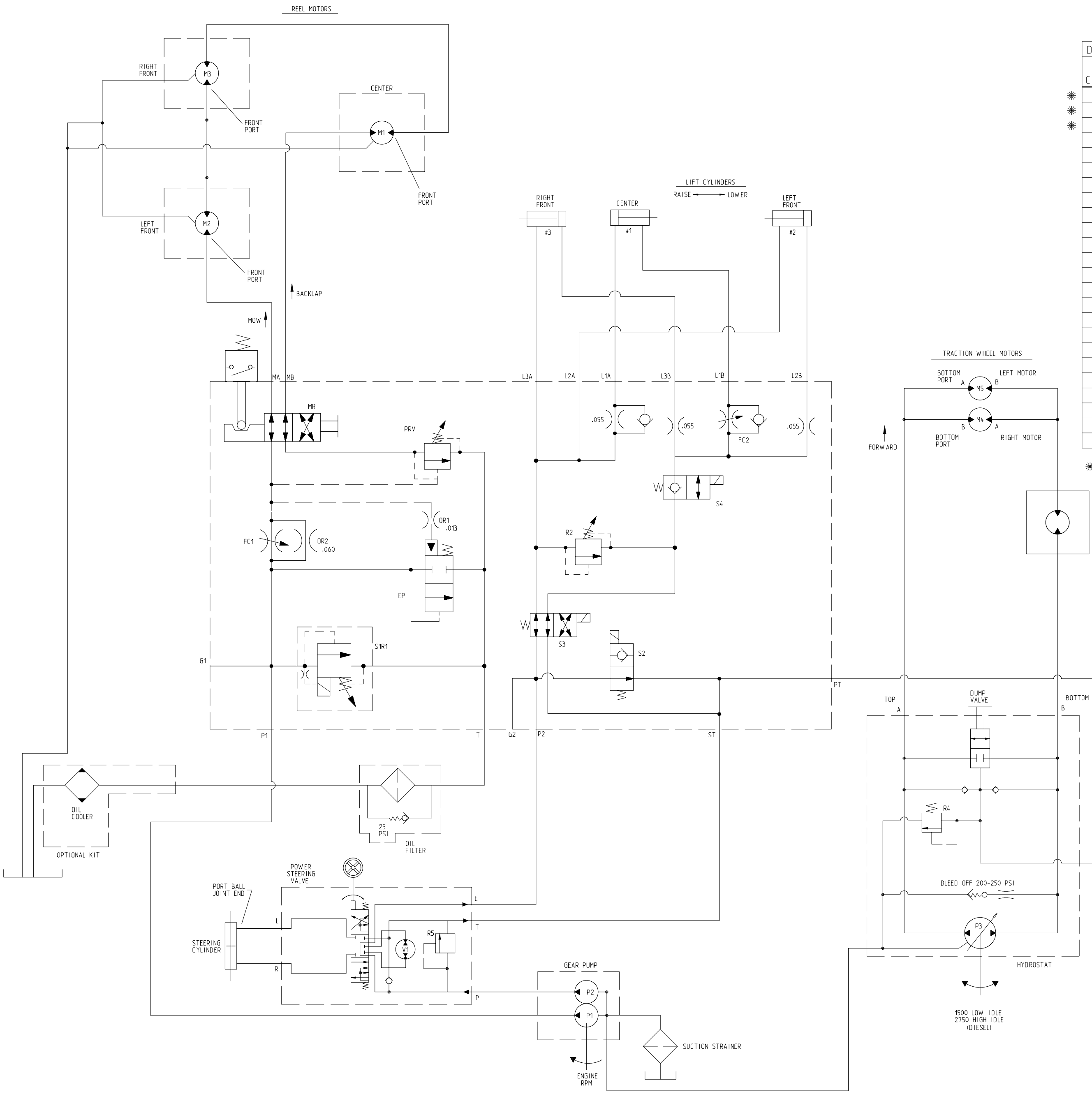
✳FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY



NOTE: MANIFOLD BACKLAP AND REEL SPEED CONTROL VALVES ARE INCLUDED ON SERIAL NUBMERS ABOVE 240000000

Greensmaster 3250–D
Hydraulic Schematic
Serial Number From 230001501
To 260999999

All solenoids are shown as de–energized



DISPLACEMENT, FLOW RATE, AND PRESSURE CHART

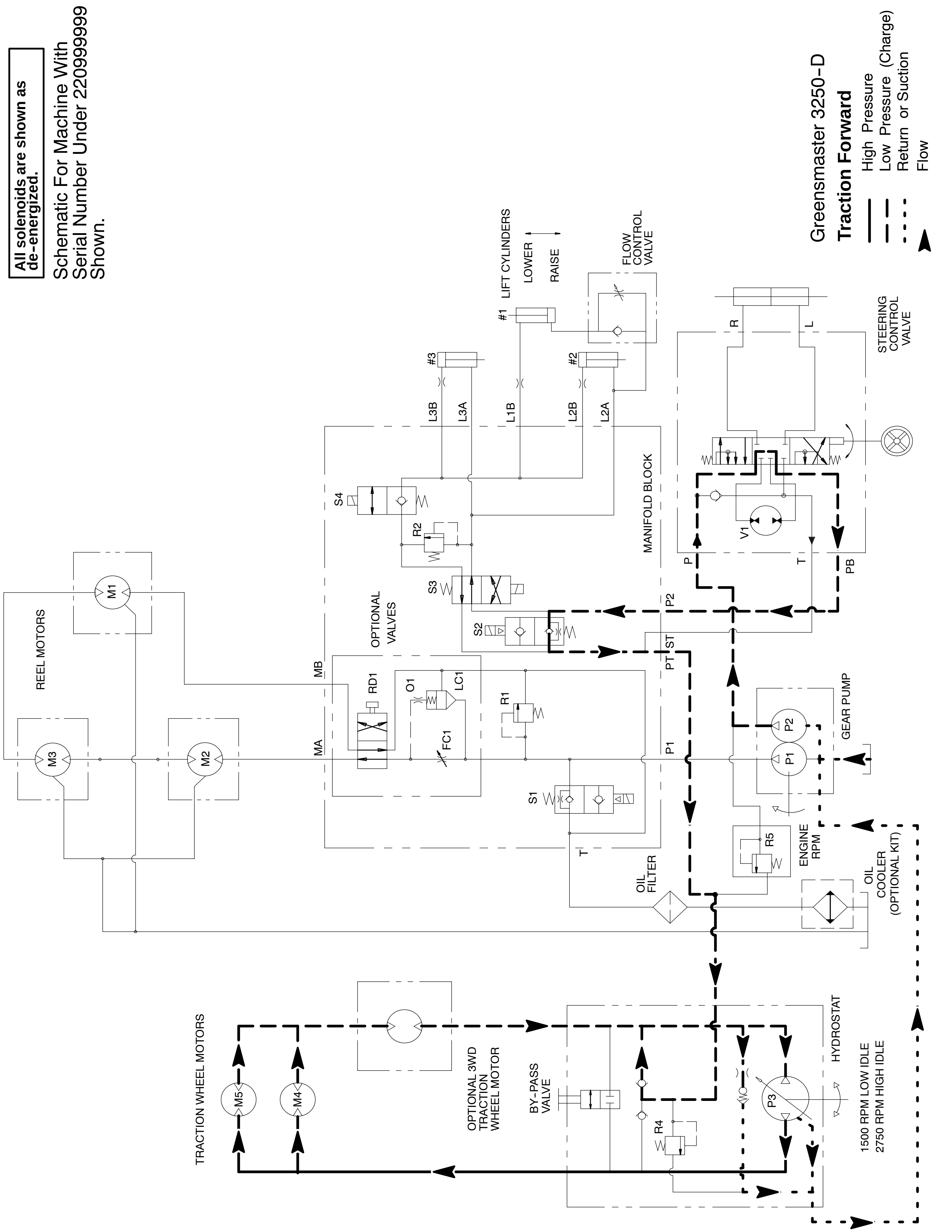
COMPONENT	DISPLACEMENT in^3/rev	DISPLACEMENT cm^3/rev	PRESSURE lbs/in^2	PRESSURE BARS	FLOW RATE GPM	FLOW RATE LPM
* P1	.58	9.5	-	-	6.9	26.1
* P2	.31	5.1	-	-	3.7	13.9
* P3	1.24	20.3	-	-	14.8	55.8
M1	.73	12.0	-	-	-	-
M2	.73	12.0	-	-	-	-
M3	.73	12.0	-	-	-	-
M4	10.3	168.8	-	-	-	-
M5	10.3	168.8	-	-	-	-
V1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

* FLOW RATE CALCULATED AT 2800 RPM AND 98% EFFICIENCY

Greensmaster 3250–D
Hydraulic Schematic
Serial Number Over 270000000

All solenoids are shown as de–energized

Hydraulic Flow Diagrams



Traction Forward and Reverse

Forward

The hydrostat (P3) 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 bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the forward direction.

Oil flowing out of the wheel motors returns to the top port of the hydrostat and is continuously pumped out the bottom 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 top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the reverse direction.

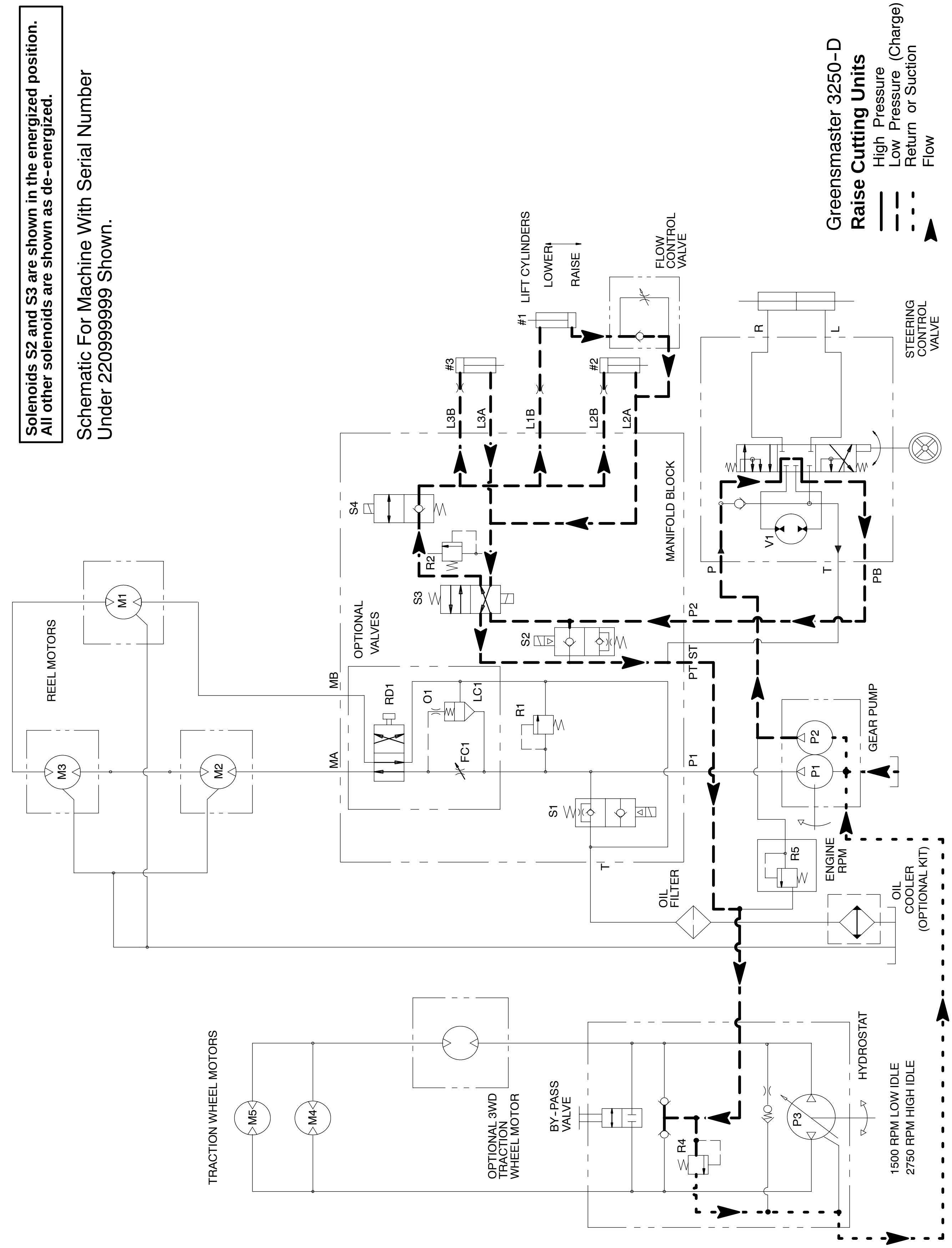
Oil flowing out of the wheel motors returns to the bottom port of the hydrostat and is continuously pumped out the bottom port.

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.


Solenoids S2 and S3 are shown in the energized position.
All other solenoids are shown as de-energized.
Schematic For Machine With Serial Number
Under 220999999 Shown.
Greensmaster 3250-D
Raise Cutting Units
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
REEL MOTORS
M1
M2
M3
OPTIONAL VALVES
MB
MA
RD1
O1
LC1
FC1
R1
S1
S2
S3
S4
R2
T
P1
PT
ST
P2
MANIFOLD BLOCK
L3B
L3A
L1B
L2B
L2A
#3
#1
#2
LIFT CYLINDERS
LOWER
RAISE
FLOW CONTROL VALVE
R
L
STEERING CONTROL VALVE
V1
P
T
PB
GEAR PUMP
P2
P1
ENGINE RPM
R5
OIL FILTER
OIL COOLER (OPTIONAL KIT)
TRACTION WHEEL MOTORS
M5
M4
OPTIONAL 3WD TRACTION WHEEL MOTOR
BY-PASS VALVE
R4
P3
HYDROSTAT
1500 RPM LOW IDLE
2750 RPM 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 10.3 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).

During conditions of not lifting or lowering cutting units, 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 (S4 and 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 numbers from 230000601 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.

Lower Cutting Units

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

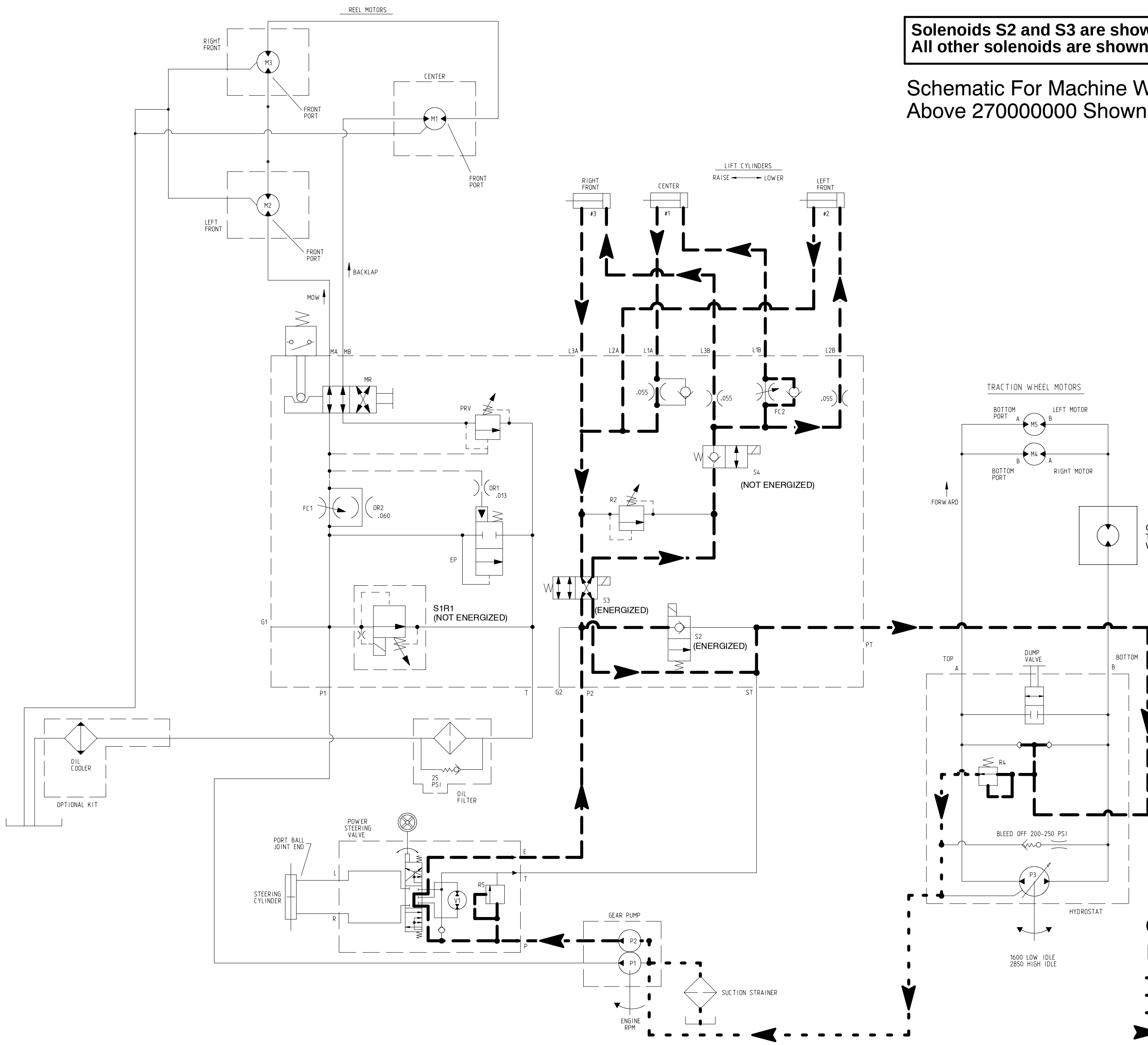
When the cutting units are to be lowered, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to de-energized solenoid valve (S3), which directs flow to energized solenoid valve (S4) and the lift cylinders. Hydraulic pressure against the cylinder pistons moves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

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

Schematic For Machine With Serial Number Above 270000000 Shown.



Greensmaster 3250–D

Raise Cutting Units

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 .055 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.

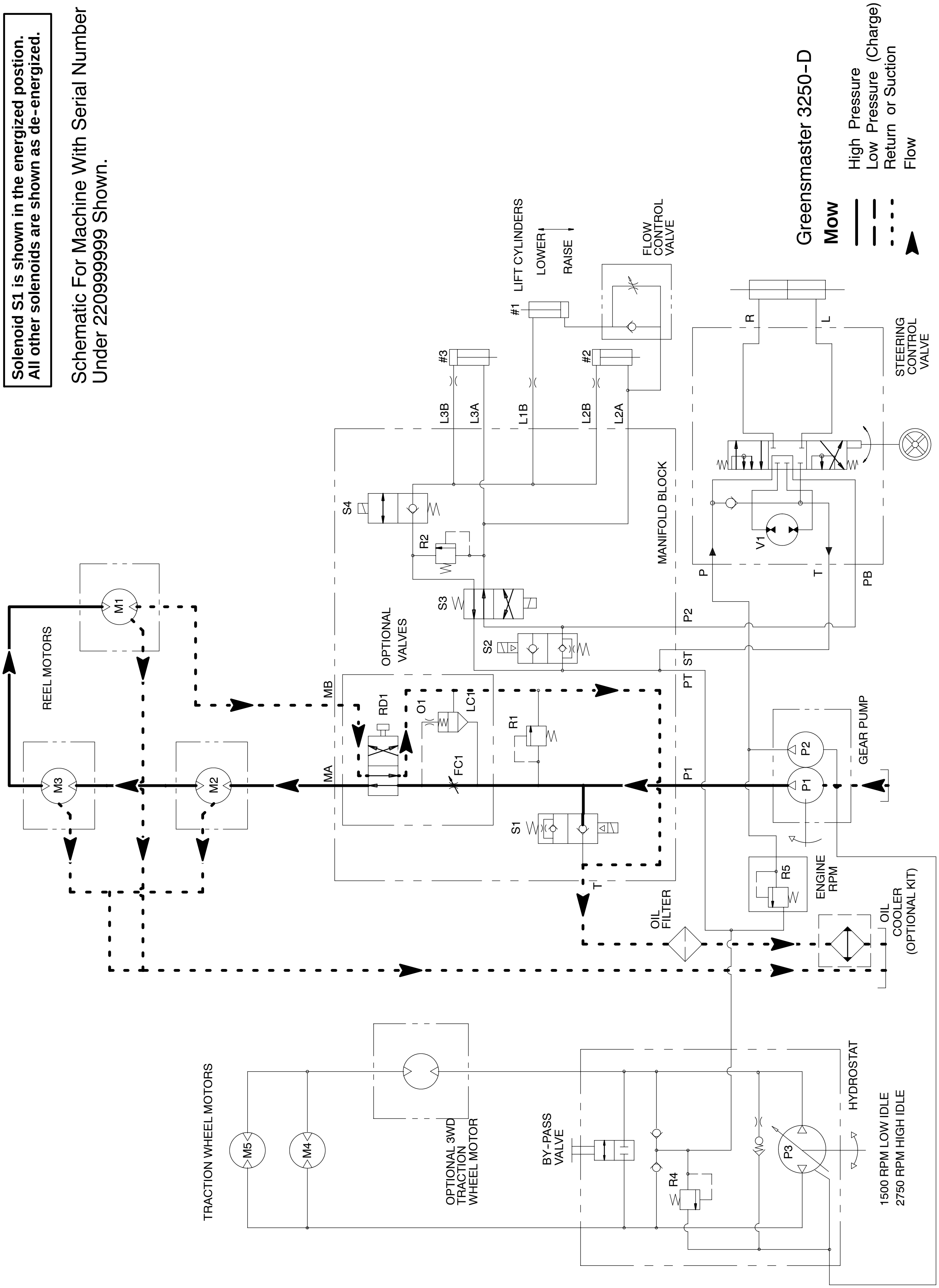
When the cutting units are to be lowered, solenoid valve (S2) is energized and blocks flow directly to the hydrostat. Flow is directed to de-energized solenoid valve (S3), which directs flow to the lift cylinders. Hydraulic pressure against the cylinder pistons moves their shafts causing the cutting 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 .055 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.

Solenoid S1 is shown in the energized postion.
All other solenoids are shown as de-energized.

Schematic For Machine With Serial Number Under 220999999 Shown.



Mow and Backlap (Serial Number Under 260999999)

The gear pump (P1) is directly coupled to the 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.

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. Flow is diverted to the reel motors. 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 numbers from 230000601 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 units with the optional backlap kit installed, flow through the manifold block is different. Oil flow from port (P1) flows through the 11 position 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 valve, out port (MA), and to the reel motors that are connected in series.

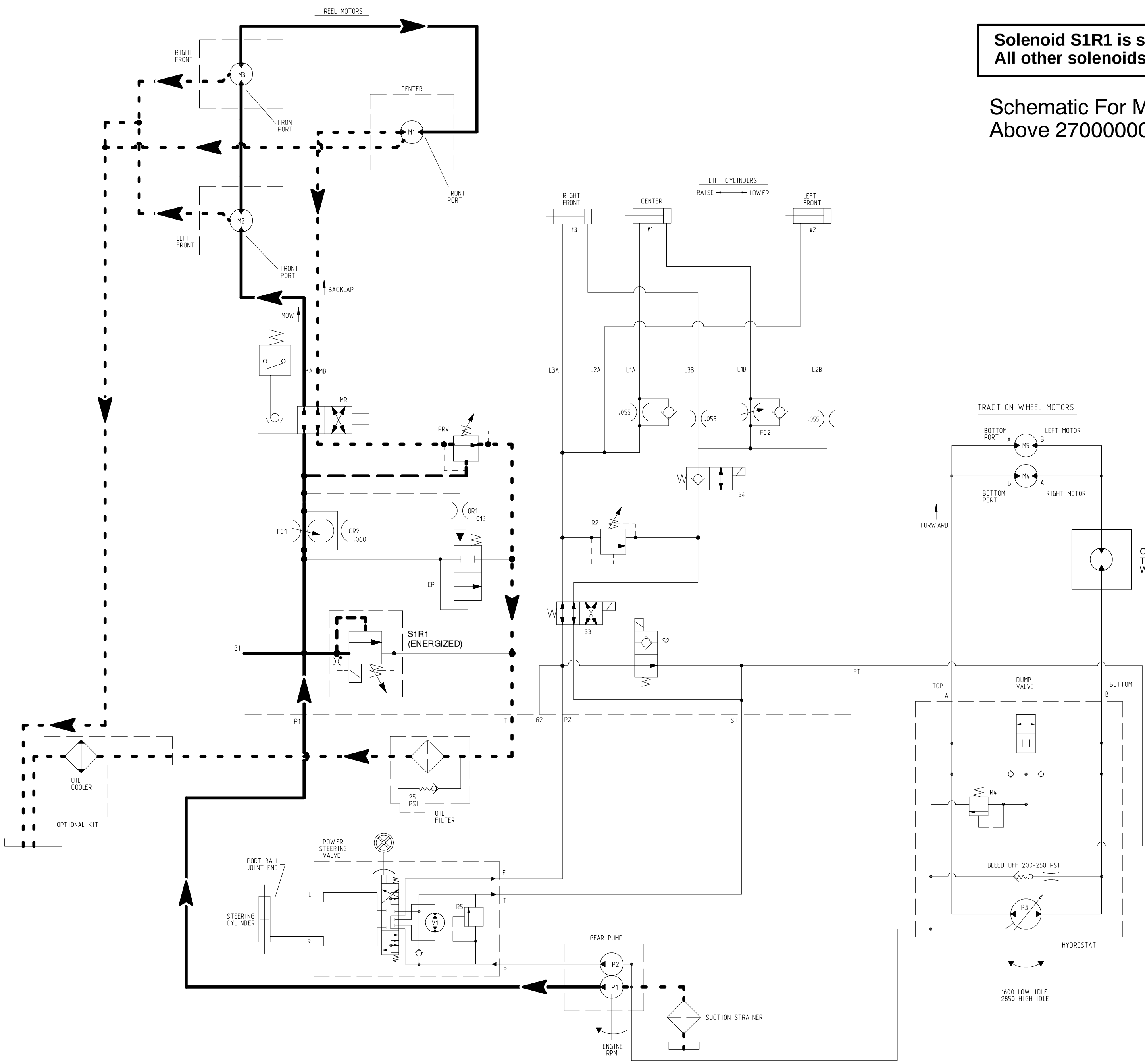
Oil flows through the left (M2), right (M3), and then rear reel motor (M1) as it turns the motors in the mow direction. The oil then returns through the manifold block and oil filter and then to the reservoir.

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 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.

Solenoid S1R1 is shown in the energized position.
All other solenoids are shown as de-energized.

Schematic For Machine With Serial Number Above 270000000 Shown.



Greensmaster 3250-D

Mow

High Pressure
Low Pressure (Charge)
Return or Suction
Flow

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

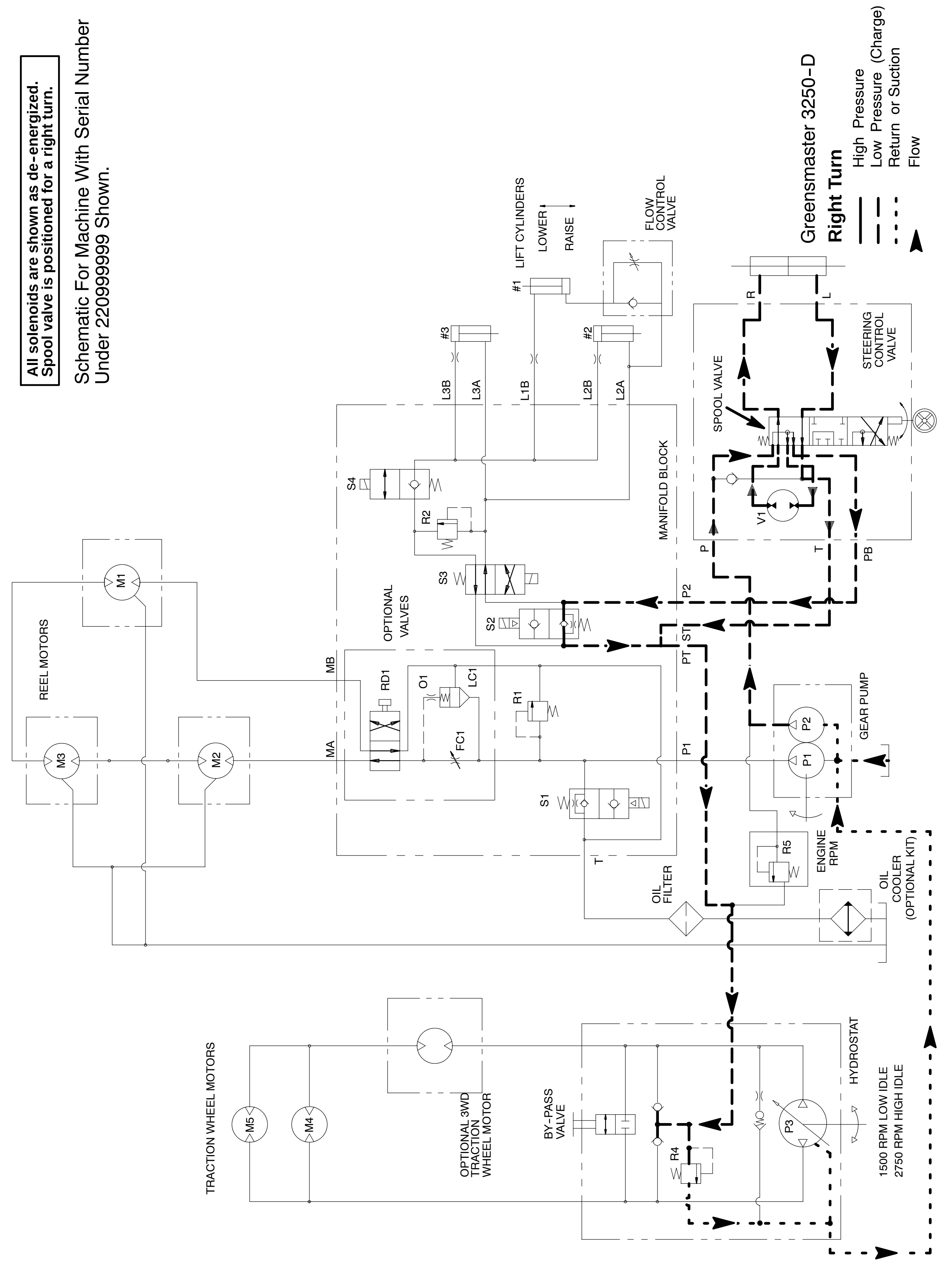
With the engine running and the Functional Control and Raise/Lower/Mow levers positioned so the reels **will** turn (see Operator's Manual), solenoid relief valve (S1R1) is energized. In the energized position, this valve directs oil flow to the reel motors and also functions as the mow circuit relief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


All solenoids are shown as de-energized.
Spool valve is positioned for a right turn.
Schematic For Machine With Serial Number Under 220999999 Shown.
Greensmaster 3250-D
Right Turn
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LIFT CYLINDERS
LOWER
RAISE
#1
#2
#3
FLOW CONTROL VALVE
L3B
L3A
L1B
L2B
L2A
S4
R2
S3
S2
MANIFOLD BLOCK
OPTIONAL VALVES
P2
ST
PT
P1
MB
MA
RD1
O1
LC1
FC1
R1
S1
T
REEL MOTORS
M1
M2
M3
SPOOL VALVE
STEERING CONTROL VALVE
R
L
P
T
PB
V1
GEAR PUMP
ENGINE RPM
R5
OIL FILTER
OIL COOLER (OPTIONAL KIT)
TRACTION WHEEL MOTORS
M4
M5
OPTIONAL 3WD TRACTION WHEEL MOTOR
BY-PASS VALVE
R4
P3
HYDROSTAT
1500 RPM LOW IDLE
2750 RPM HIGH IDLE

Right and Left Turn

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure to the steering control valve for turning the rear wheel, for raising and lowering the cutting units, and for maintaining 100 to 150 PSI (6.9 to 10.3 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 (PB) 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 (PB) back through solenoid valve (S2) to the hydrostat. Second, the remainder of the flow is drawn through 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 then out port (T) and 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 (PB) 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 then out port (T) and 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 Testing section of this chapter.

Figure 10

Hydraulic Tester (Pressure and Flow) – TOR214678

This tester requires O–ring face seal (ORFS) adapter fittings for use on this machine. Use hydraulic tester as recommended in Testing section of this chapter.

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 11

O–ring Kit – 16–3799

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

Figure 12

Hydraulic Test Fitting Kit - TOR4079

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

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

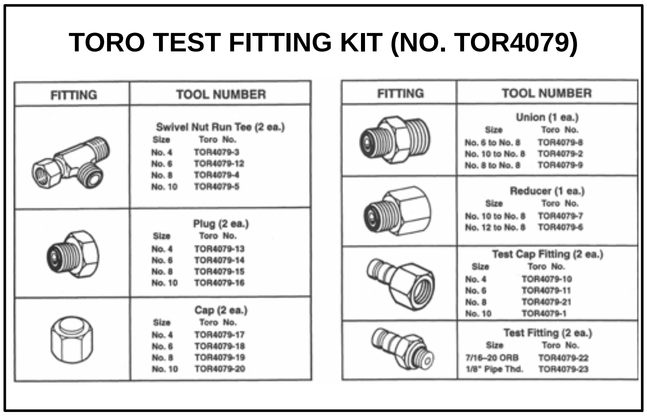


Figure 13

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 14

Wheel Hub Puller - TOR4097

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

Figure 15

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. One of the pump suction lines 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 brakes are incorrectly adjusted. Hydrostat by-pass valve is open or defective. Oil cooler (if installed) is damaged or plugged. By-pass relief is stuck open or air flow is obstructed. Working load of machine (e.g. use of verticutter) may require use of oil cooler. Charge pressure is low (see Charge Pressure Relief Valve (R4) Pressure Test). Wheel motor(s) or reel motor(s) are worn or damaged (see Wheel Motor Efficiency and Reel Motor Case Drain Flow Tests). 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 traction 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 brakes are incorrectly adjusted. Hydrostat by-pass valve is open or defective. Charge pressure is low (see Charge Pressure Relief Valve (R4) Pressure Test). 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 not released. Oil level in reservoir is low. Hydrostat by-pass valve is open. Charge pressure is low (see Charge Pressure Relief Valve (R4) Pressure Test). Traction pump (P3) or wheel motor(s) are worn or damaged (see Traction Drive Hydrostat (P3) Flow and Wheel Motor Efficiency Tests).
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. 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.	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.	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) in hydraulic manifold is leaking or damaged. Relief valve (R2) is stuck 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 damaged (see Gear Pump (P2) Flow Test).
Cutting units raise, but will not stay up.	Hydraulic manifold solenoid valve (S4) leaks. 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 in steering control valve is worn or broken. Leaf springs in steering control valve are worn or broken. Splines on the steering column are worn.
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.

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

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

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

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

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

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

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

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), consider performing the following hydraulic tests:
   Charge Pressure Relief Valve (R4) Pressure Test
   Wheel Motor Efficiency Test
   Traction Drive Hydrostat (P3) Flow Test

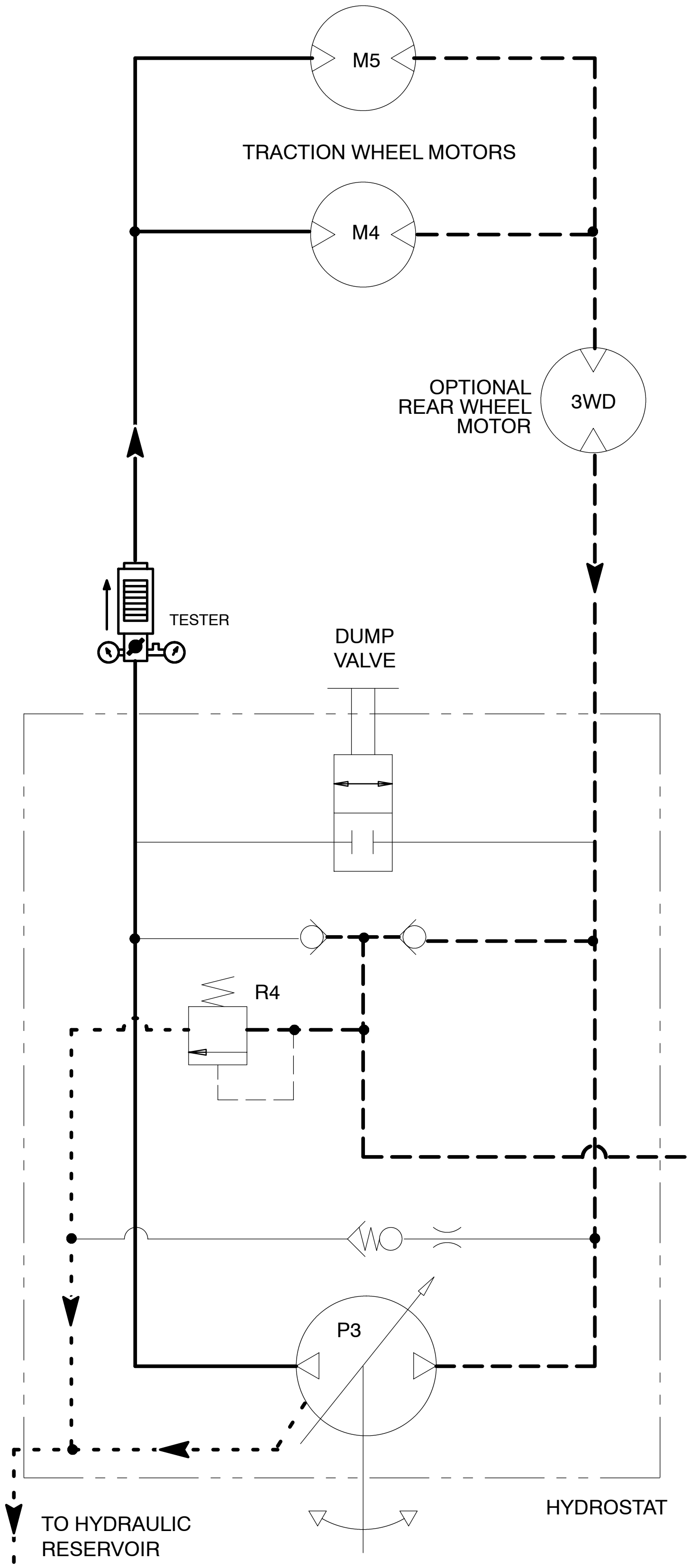
4. For problems with steering or lift/lower pressure, consider performing the following hydraulic tests:

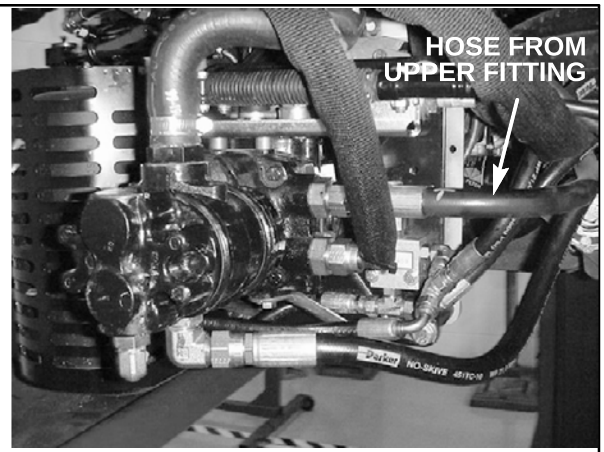
Charge Pressure Relief Valve (R4) Pressure Test
Lower Cutting Units Relief Valve (R2) Pressure Test
Implement Relief Valve (R5) Pressure Test
Gear Pump (P2) Flow Test
Steering Control Valve Test

5. For issues with the cutting system, consider performing the following hydraulic tests:

Mow Circuit Relief Valve (R1) Pressure Test
Reel Motor Case Drain Flow Test
Gear Pump (P1) Flow Test

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





Procedure for <u>Traction Drive Hydrostat (P3) Flow</u> 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 ten (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 that traction pedal is adjusted to the neutral position (see Traction Pedal in the Adjustments Section). Also, ensure that pump is at full stroke when traction pedal is pushed into fully forward position.

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 hose from the upper hydraulic fitting on the side of the hydrostat.

6. Install tester with pressure gauge and flow meter 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 **(2750 ± 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.

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 machine.

13. If specifications are not met consider the following:

A. The traction pedal and/or traction speed may need adjustment (see Traction Pedal in the Adjustments Section).

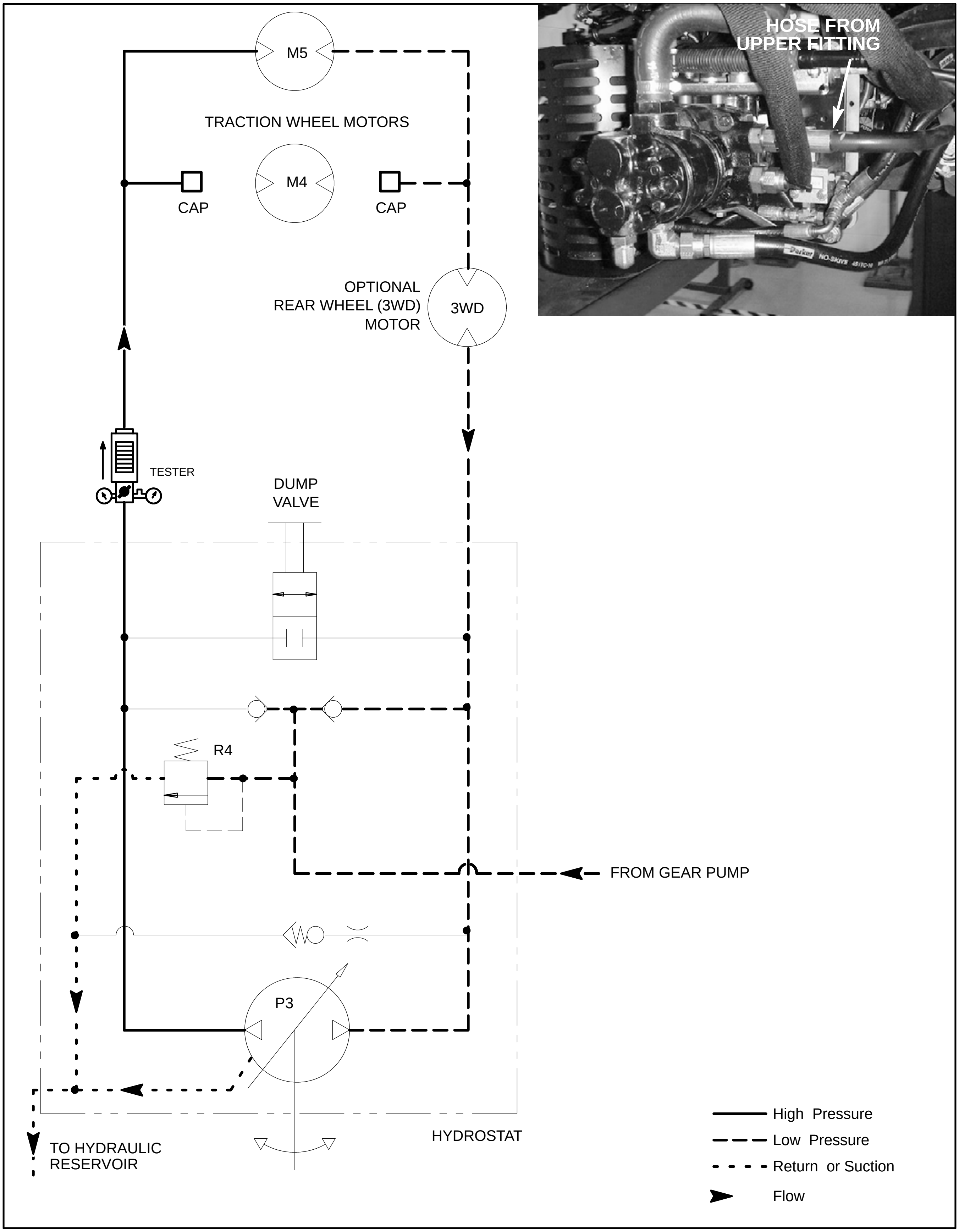
B. The hydrostat needs to be repaired or replaced as necessary.

C. Make necessary repairs before performing additional tests.

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

15. If testing is complete, disconnect tester from pump fitting and hose. Reconnect hose to pump fitting.

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



Procedure for <u>Wheel Motor Efficiency</u> 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 ten (10) minutes. Make sure the hydraulic tank is full.

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

3. Read Precautions for Hydraulic Testing.

4. Make sure that traction pedal is adjusted to the neutral position (see Adjust Traction Drive for Neutral in the Adjustments Section).

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 hose from the upper hydraulic fitting on the side of the hydrostat.

10. Install tester with pressure gauge and flow meter 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 **(2750 ± 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.

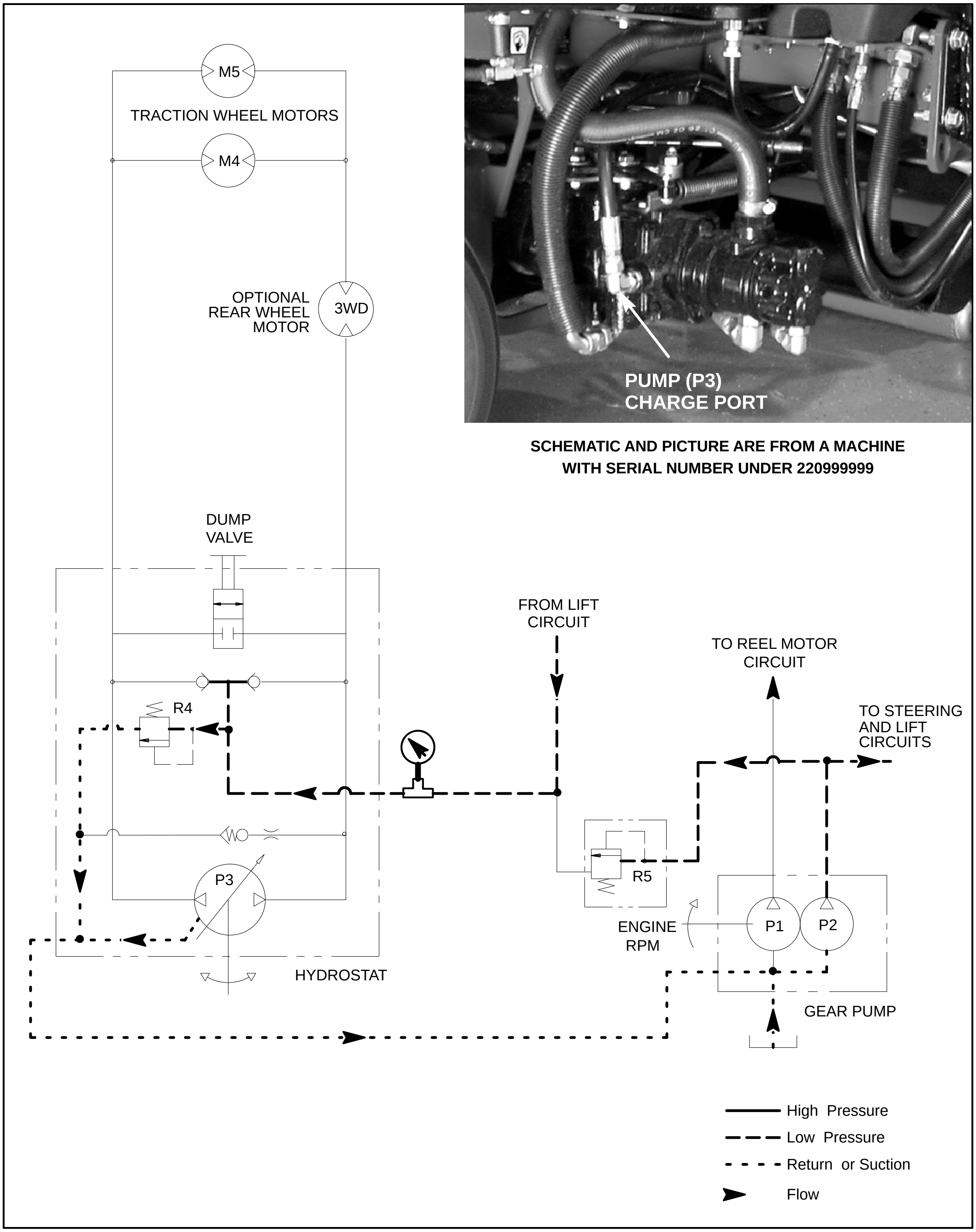
CAUTION

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 fitting and hose. Reconnect hose to pump connection.

Charge Relief Valve (R4) Pressure Test (Using Pressure Gauge)



SCHEMATIC AND PICTURE ARE FROM A MACHINE WITH SERIAL NUMBER UNDER 220999999

Procedure for Charge Relief Valve (R4) Pressure Test

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

2. Park machine on a level surface with the 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 **(2750 ± 50 RPM)**.

6. Pressure gauge should read approximately **100 to 150 PSI (6.9 to 10.3 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, start the engine and release the parking brake.

   B. Press the traction pedal to forward.

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

   D. The charge pressure should drop no more than 15% from initial test reading (Step 7 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)

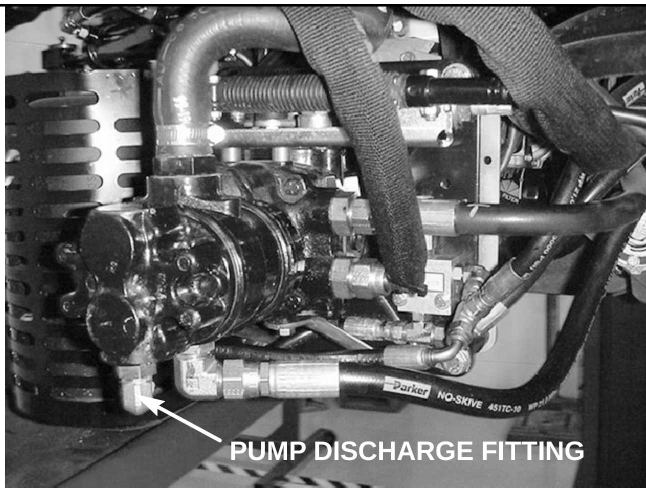
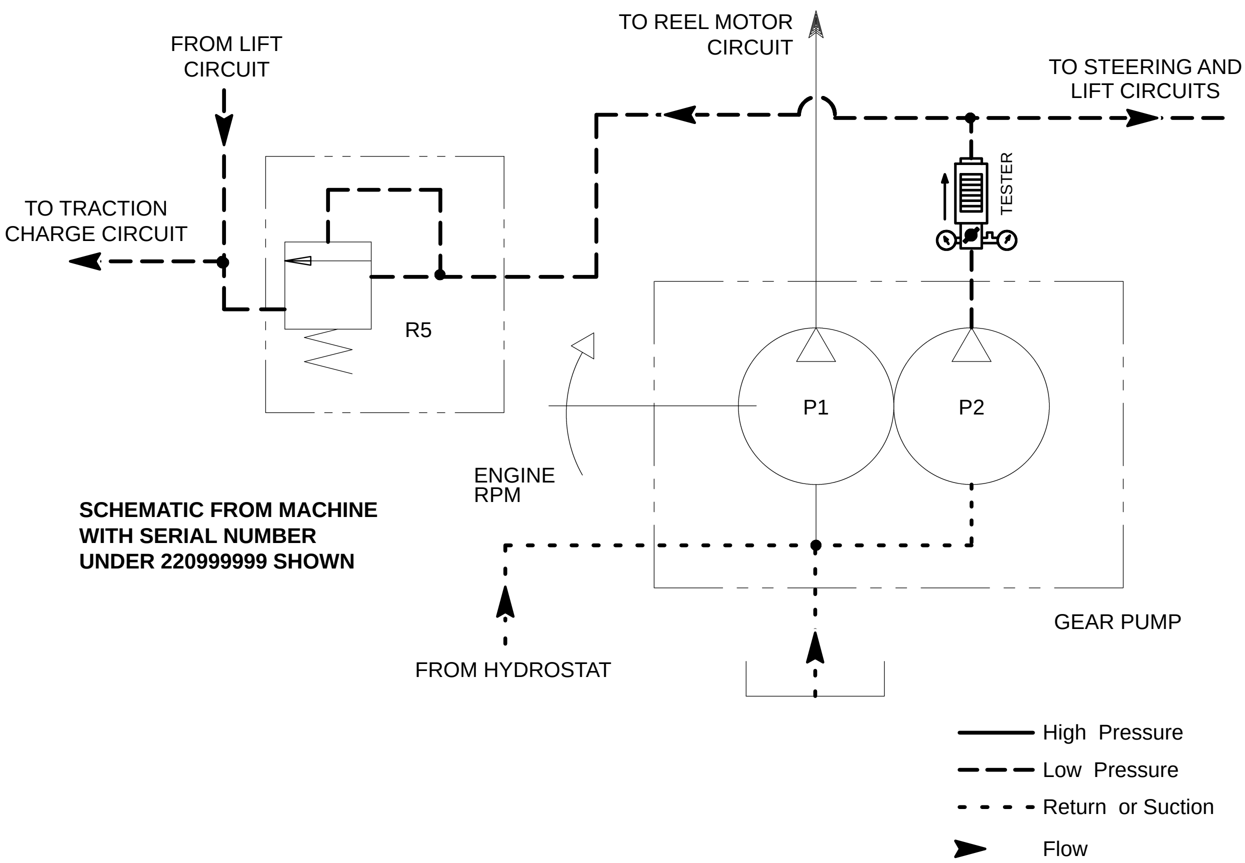


PHOTO SHOWS RELIEF VALVE (R5) AS USED IN MACHINES WITH SERIAL NUMBER UNDER 220999999



SCHEMATIC FROM MACHINE WITH SERIAL NUMBER UNDER 220999999 SHOWN

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 ten (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 (P2) (rear pump section), disconnect the hydraulic hose from the discharge fitting on the bottom of the pump.

4. Install tester with pressure gauge and flow meter in series with gear pump (P2) and the disconnected hose. **Make sure the 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 **(2750 ± 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 in Gear Pump (P2) Flow Test (see above). **Fully open control valve on the tester.**

3. Start and run engine at full speed **(2750 ± 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:

   A. For machines with serial number under 220999999, relief valve (R5) pressure should be **900 to 1100 PSI (62 to 76 bar) higher than the charge relief valve (R4) pressure** (e.g. if the charge relief valve pressure is 100 PSI (6.9 bar), the implement relief valve (R5) pressure should be 1000 to 1200 PSI (69 to 83 bar)).

   B. For machines with serial number over 230000000, relief valve (R5) pressure should be **1050 to 1250 PSI (73 to 86 bar) higher than the charge relief valve (R4) pressure** (e.g. if the charge relief valve pressure is 100 PSI (6.9 bar), the implement relief valve (R5) pressure should be 1150 to 1350 PSI (80 to 93 bar)).

7. If relief valve (R5) pressure is incorrect:

   A. For machines with serial number under 220999999, adjust implement relief valve (see Adjust Implement Relief Valve (R5) in the Adjustments section of this Chapter). Retest relief valve pressure if adjustment is performed.

   B. For machines with serial number over 230000000, 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.

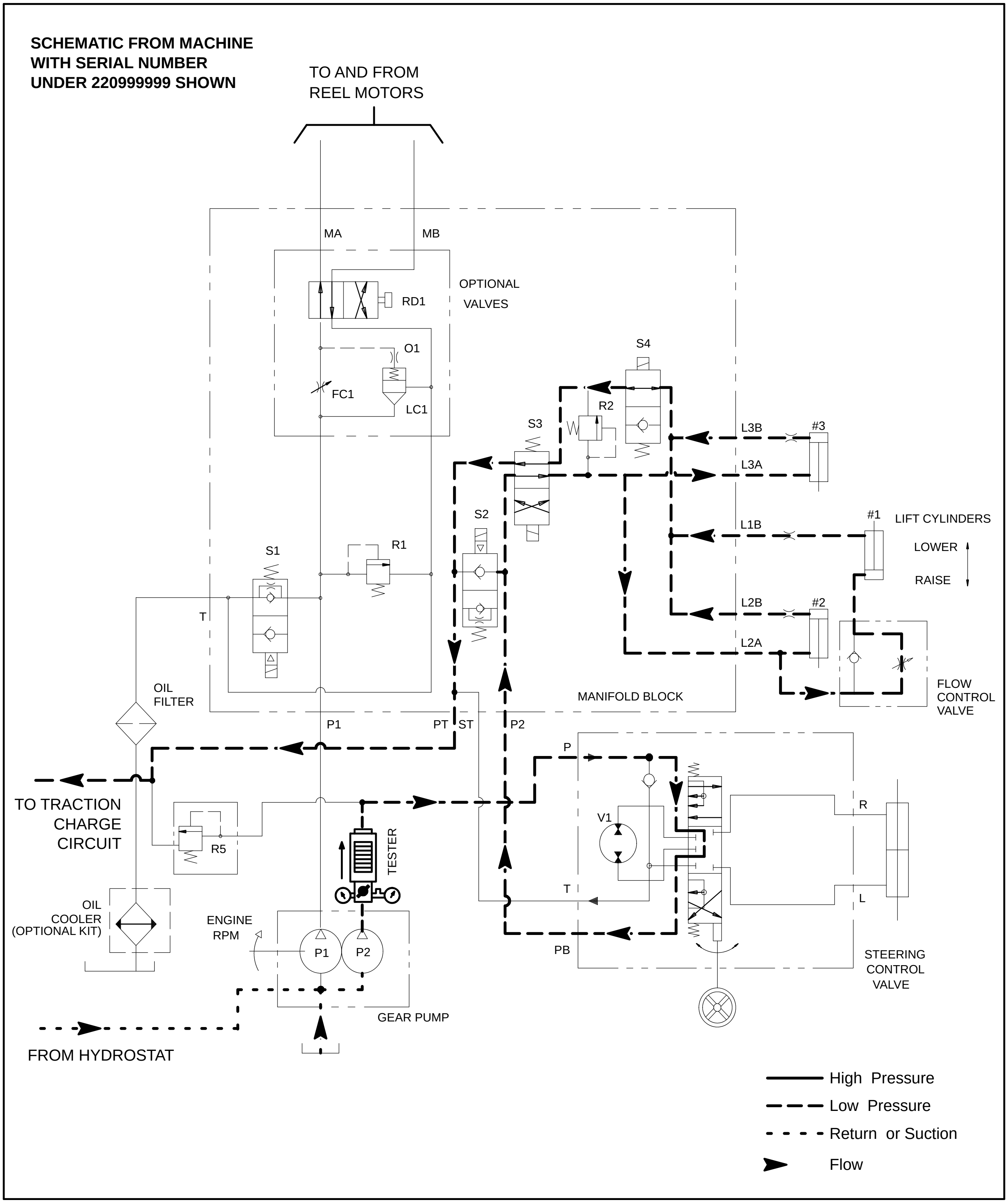
IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading.

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

Lower Cutting Units Relief Valve (R2) Pressure Test (Using Pressure Gauge)



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 ten (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 Gear Pump (P2) Flow Test. **Fully open control valve on the tester.**

5. Start engine and move throttle to full speed **(2750 ± 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 (R4) should be:

A. For machines with serial number under 220999999, relief pressure should be **150 PSI (10.3 bar) higher than charge relief (R4) pressure** (e.g. if charge relief valve pressure is 100 PSI (6.9 bar), the lower relief valve (R2) pressure should be approximately 250 PSI (17.2 bar)).

B. For machines with serial number over 230000000, relief pressure should be **400 PSI (27.6 bar) higher than charge relief (R4) pressure** (e.g. if charge relief valve pressure is 100 PSI (6.9 bar), the lower relief valve (R2) pressure should be approximately 500 PSI (34.5 bar)).

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

9. After testing is complete, disconnect tester from gear pump and hose. Reconnect hose to hydraulic fitting on pump.

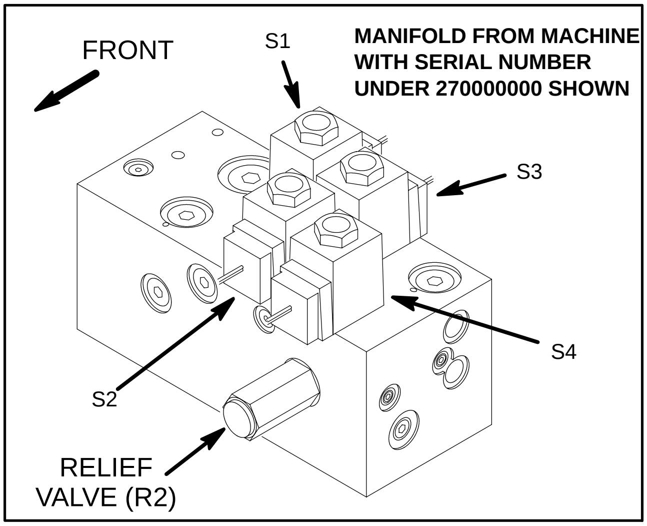


Figure 16

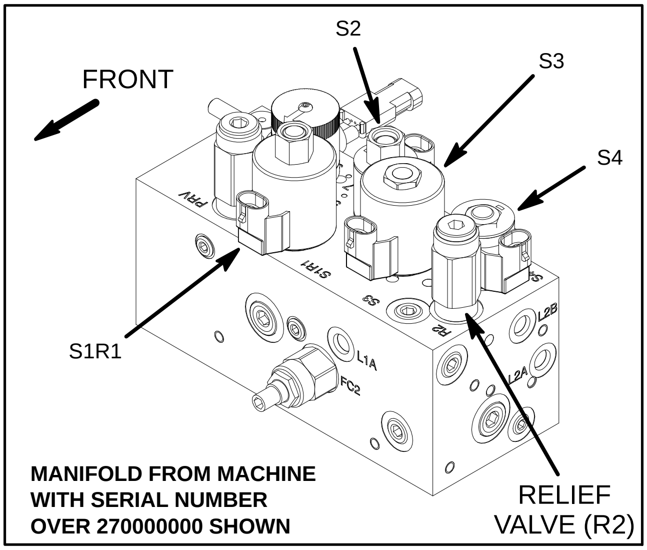
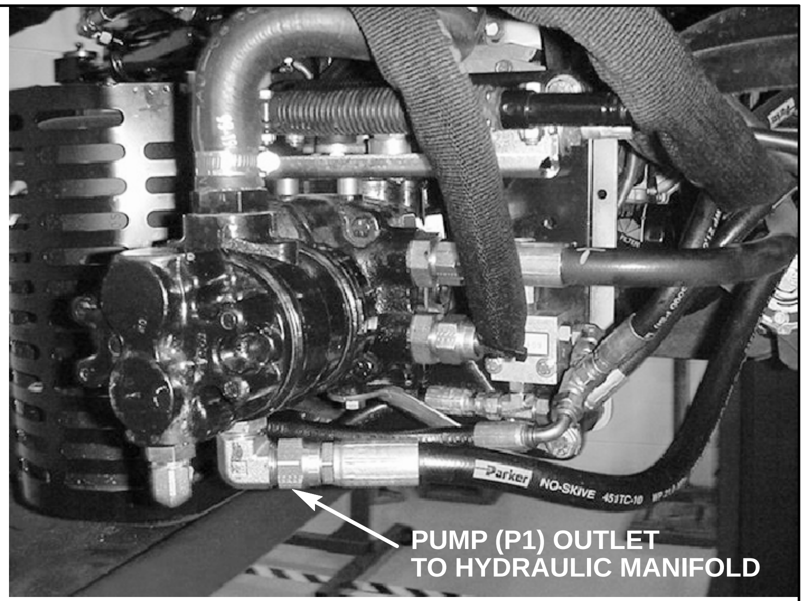
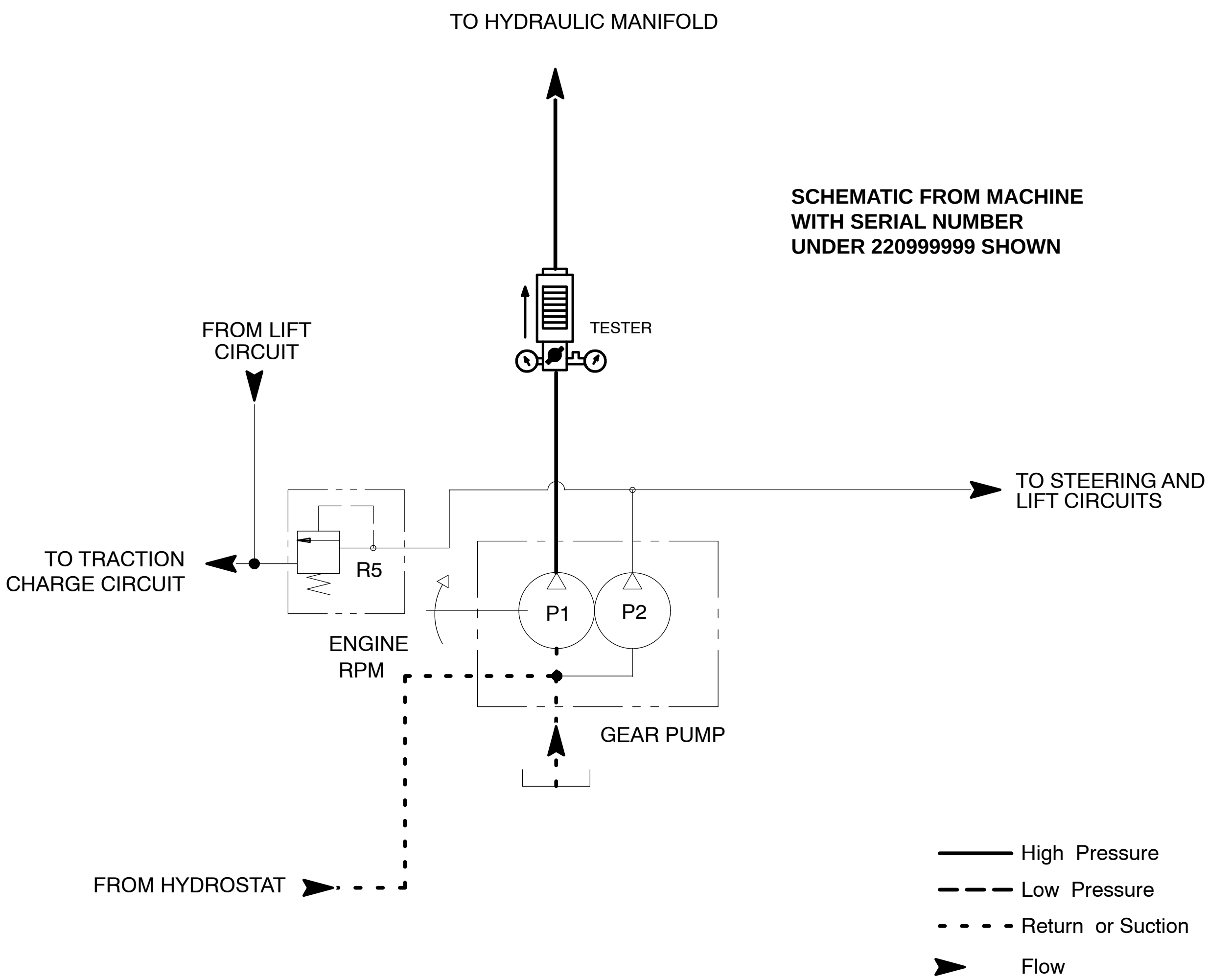


Figure 17

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

5. If a backlap kit is installed on the machine, 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 **(2750 ± 50 RPM)**.

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

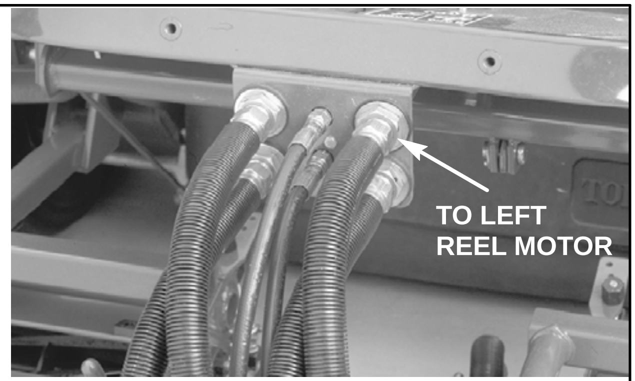
9. Flow indication should be **5.4 GPM** minimum. Record test results.

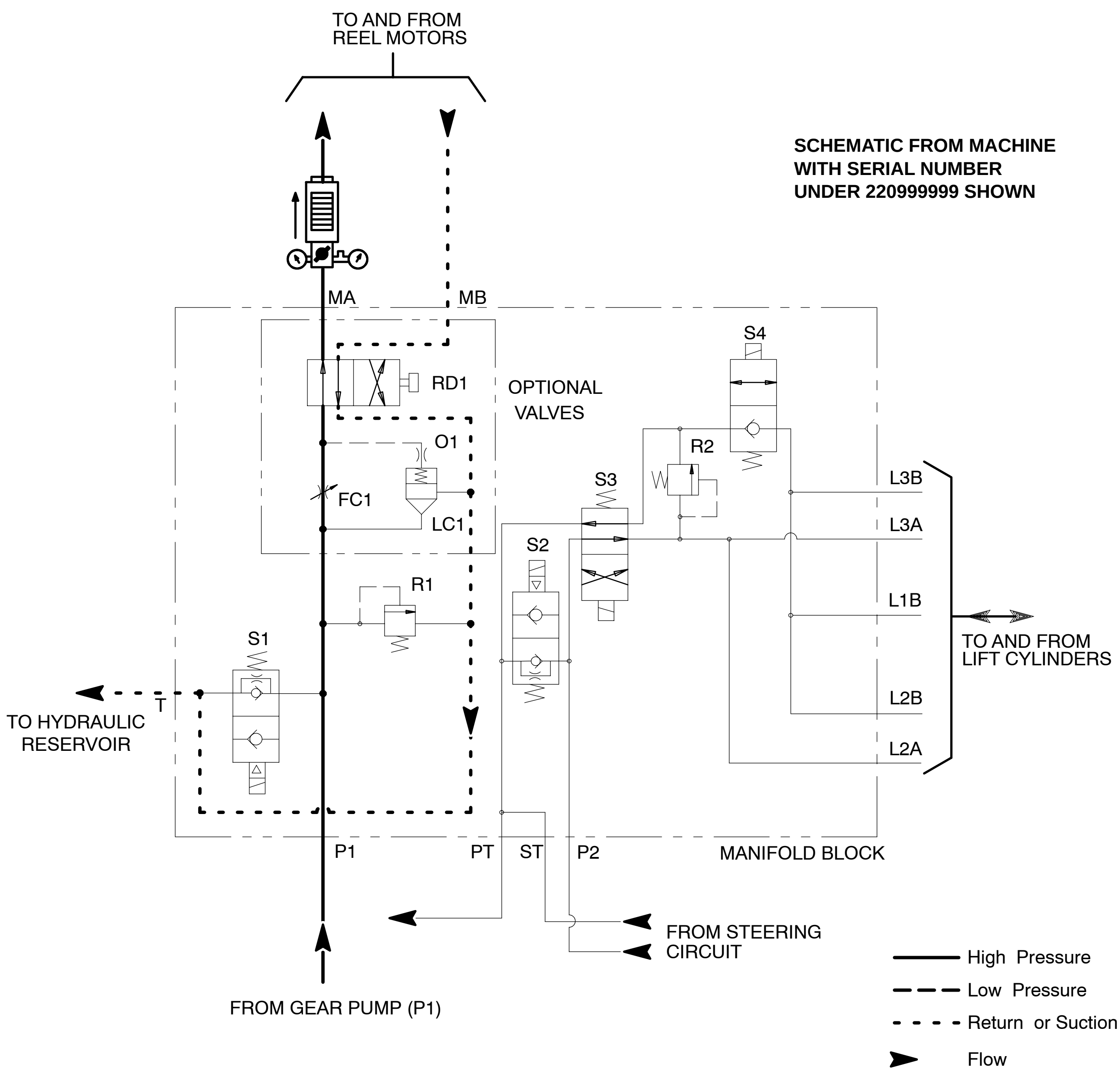
10. Open control valve on tester and shut off engine.

11. If flow was less than **5.4 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)





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 ten (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 hose connection on the bulkhead that leads to the left reel motor.

4. Install tester with pressure gauge and flow meter 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 to allow clearance between bedknife and reel (no contact).

6. If a backlap kit is installed, 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 **(2750 ± 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, shut off engine and adjust relief valve (R1) (Fig. 18) (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. 19). 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.

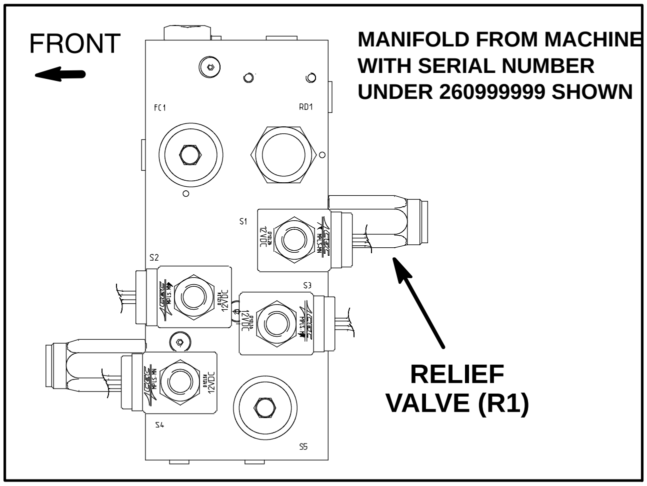


Figure 18

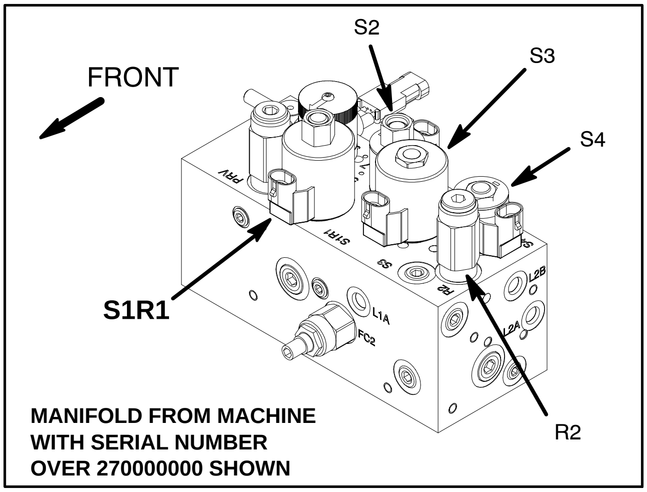
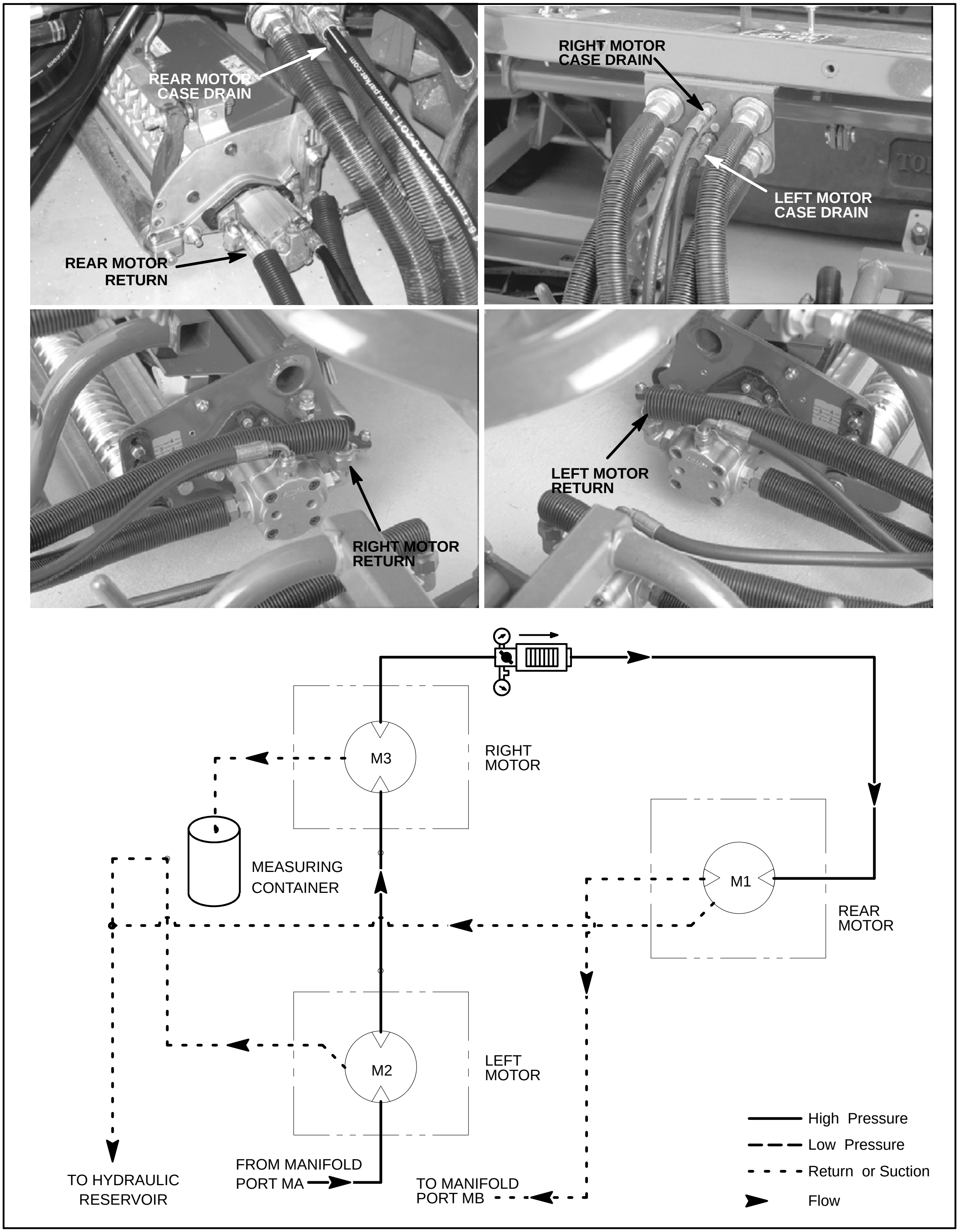


Figure 19

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 ten (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. The return hose is connected to the rear fitting on the reel motor.

4. Install tester with pressure gauge and flow meter 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 a second person measures case drain leakage. Make sure functional control lever is in **NEUTRAL**. Start engine and move the throttle to full speed **(2750 ± 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 (e.g. Toro #TOR4077) and collect hydraulic fluid for **15 seconds**. 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. Identify amount of oil collected in the container. Record test results.

12. If flow was greater than **16.0 ounces (473 milliliters) (.5 GPM/1.9 LPM)**, repair or replace the reel motor as necessary.

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

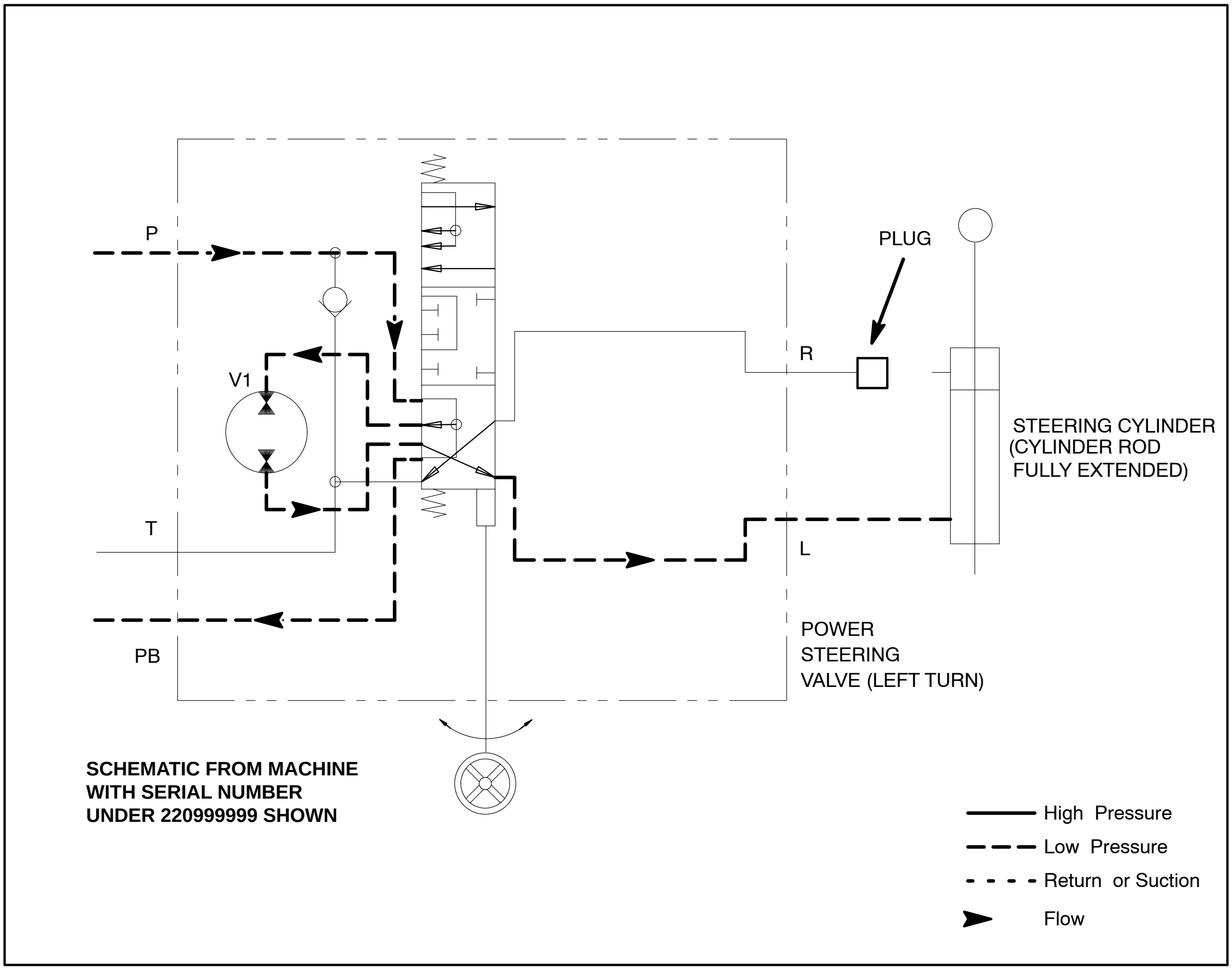
14. Remove plug from bulkhead fitting. Reconnect case drain hose to the bulkhead fitting.

15. Test other reel motors as needed.

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 20

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 ten (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 N-m)** of torque.

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.

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.

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 21

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).

Hydraulic System

Adjustments

Adjust Transmission for Neutral

If the machine "creeps" when the traction control pedal is in the neutral position, the neutral return mechanism must be adjusted.

1. Block up under the frame so one of the front wheels is off the floor. If machine is equipped with 3 wheel drive kit, raise and support rear wheel off the floor as well. Chock wheels not being lifted to prevent the machine from moving.

2. Start engine, move throttle to SLOW and check wheel that is off shop floor; wheel must not be rotating.

3. If the raised wheel is rotating, stop engine and proceed as follows:

A. Loosen both jam nuts securing traction control cable to bulkhead on hydrostat. Make sure jam nuts are loosened equally and sufficiently to allow adjustment.

B. Loosen nut securing eccentric to the top of the hydrostat.

C. Move functional control lever to neutral and throttle to slow. Start engine.

D. Rotate eccentric until creep does not occur in either direction. When the wheel stops rotating, tighten nut locking eccentric and adjustment. Verify adjustment with throttle in SLOW and FAST positions.

E. From each side of the bulkhead, tighten locknuts **evenly**, securing traction cable to the bulkhead. Do not twist cable.

Note: If cable tension exists when in neutral, machine may creep when the functional control lever is moved to the Mow or Transport position.

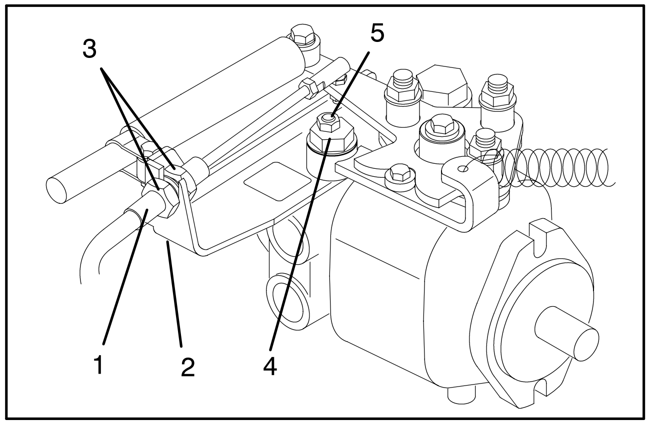


Figure 22

1. **Traction control cable**
2. **Bulkhead**
3. **Jam nuts**
4. **Eccentric**
5. **Lock nut**

Adjust Transport Speed

The traction pedal is adjusted for maximum transport speed at the factory, but an adjustment may be required if pedal reaches full stroke before it contacts pedal stop, or if a decrease in transport speed is desired.

1. Press down on traction pedal and see if pedal contacts stop before tension is felt on cable. If an adjustment is required:

A. Loosen flange head locknuts securing pedal stop to floor plate.

B. Adjust pedal stop so it contacts pedal rod before minimum tension is felt on the cable. Tighten nuts.

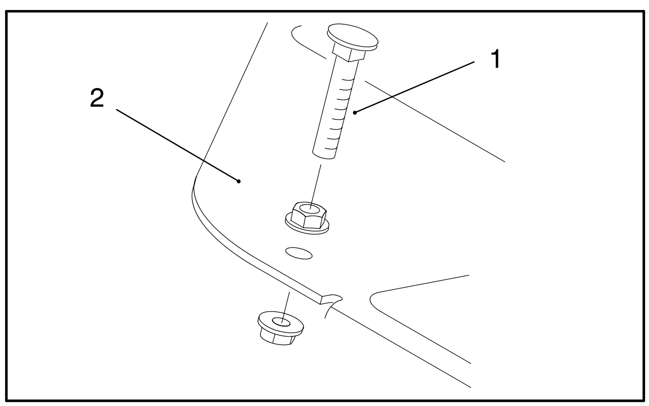


Figure 23

1. **Pedal stop**
2. **Floor plate**

Adjust Mowing Speed

The machine is adjusted at the factory, but speed may be varied if desired.

1. Loosen jam nut on trunnion cap screw located on the traction control assembly.

2. Loosen nut securing the lock and mow brackets on pedal pivot.

3. Rotate trunnion cap screw **clockwise to reduce** mowing speed or **counterclockwise to increase** mowing speed.

4. Tighten jam nut on the trunnion cap screw and nut on the lock and mow brackets to lock adjustment. Check adjustment and re-adjust as required.

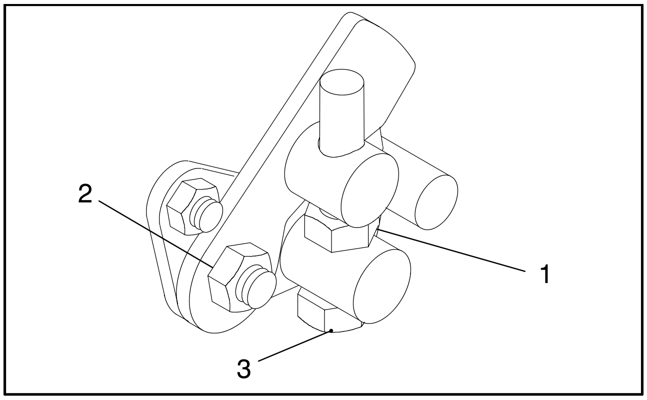


Figure 24

1. Jam nut
2. Nut
3. Trunnion cap screw

Adjust Cutting Unit Drop Speed

The machine's rear cutting unit lower circuit has a flow control valve which is preset at the factory to about 3 turns open. An adjustment may be required to compensate for differences in hydraulic oil temperatures, mowing speeds, etc. If an adjustment is required, proceed as follows:

Note: Allow hydraulic oil to reach full operating temperature before adjusting flow control valve.

1. Raise seat and locate flow control valve mounted to the hydraulic cylinder for the center pull frame.

2. Loosen set screw on the adjusting knob of the flow control valve.

3. If the center cutting unit is dropping too late, rotate knob 1/4 turn counterclockwise.

4. If the center cutting unit is dropping too early, rotate knob 1/4 turn clockwise.

5. After desired setting has been achieved, tighten set screw.

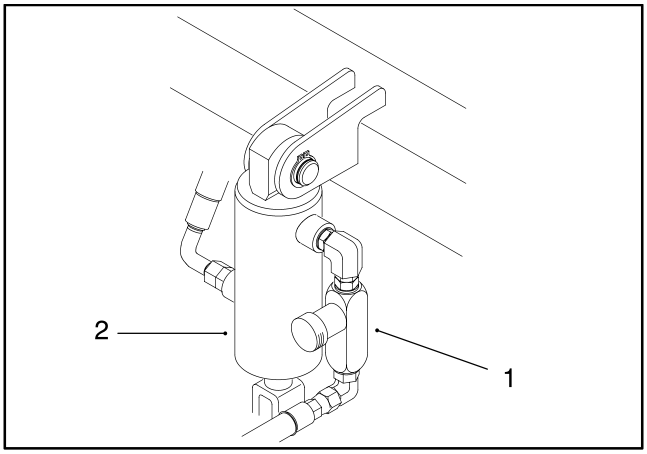


Figure 25

1. Flow control valve
2. Rear hydraulic cylinder

Hydraulic System

Adjust Implement Relief Valve (R5) (Machine Serial Number Under 220999999)

For machines with serial number under 220999999, the implement (lift/steering) relief valve (R5) (Figure 26) is adjustable. **Note:** The implement relief valve (R5) for machines with serial number over 230000000 is incorporated into the steering control valve and is not adjustable.

WARNING

Never adjust the relief valve with the hydraulic system pressurized. Hydraulic oil will 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.

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).

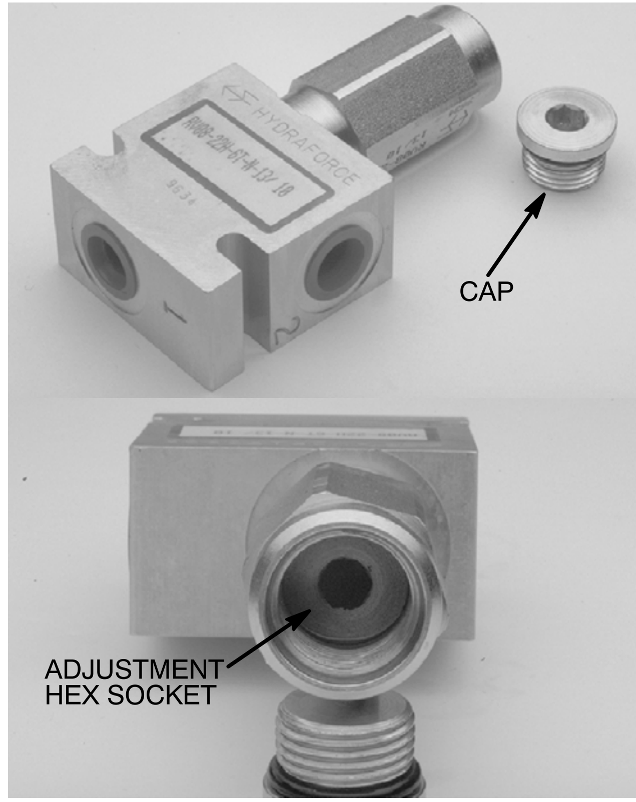


Figure 26

Adjust Manifold Relief Valves (R1 and R2)

These relief valves are installed on the hydraulic manifold. Relief valve (R1) is in the mow circuit 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).

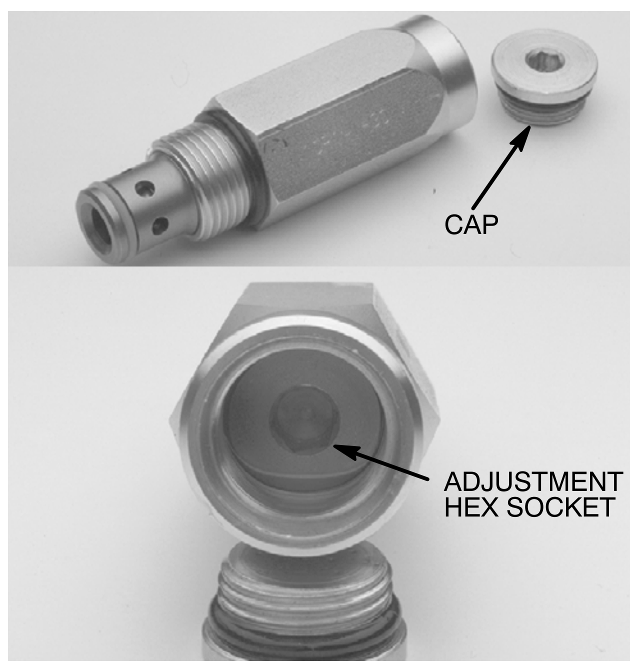


Figure 27

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

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

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

CAUTION

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

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

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

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

After Repair or Replacement of Components

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

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

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

4. Use proper tightening methods when installing hydraulic hoses and fittings (see Hydraulic Fitting Installation).

5. 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

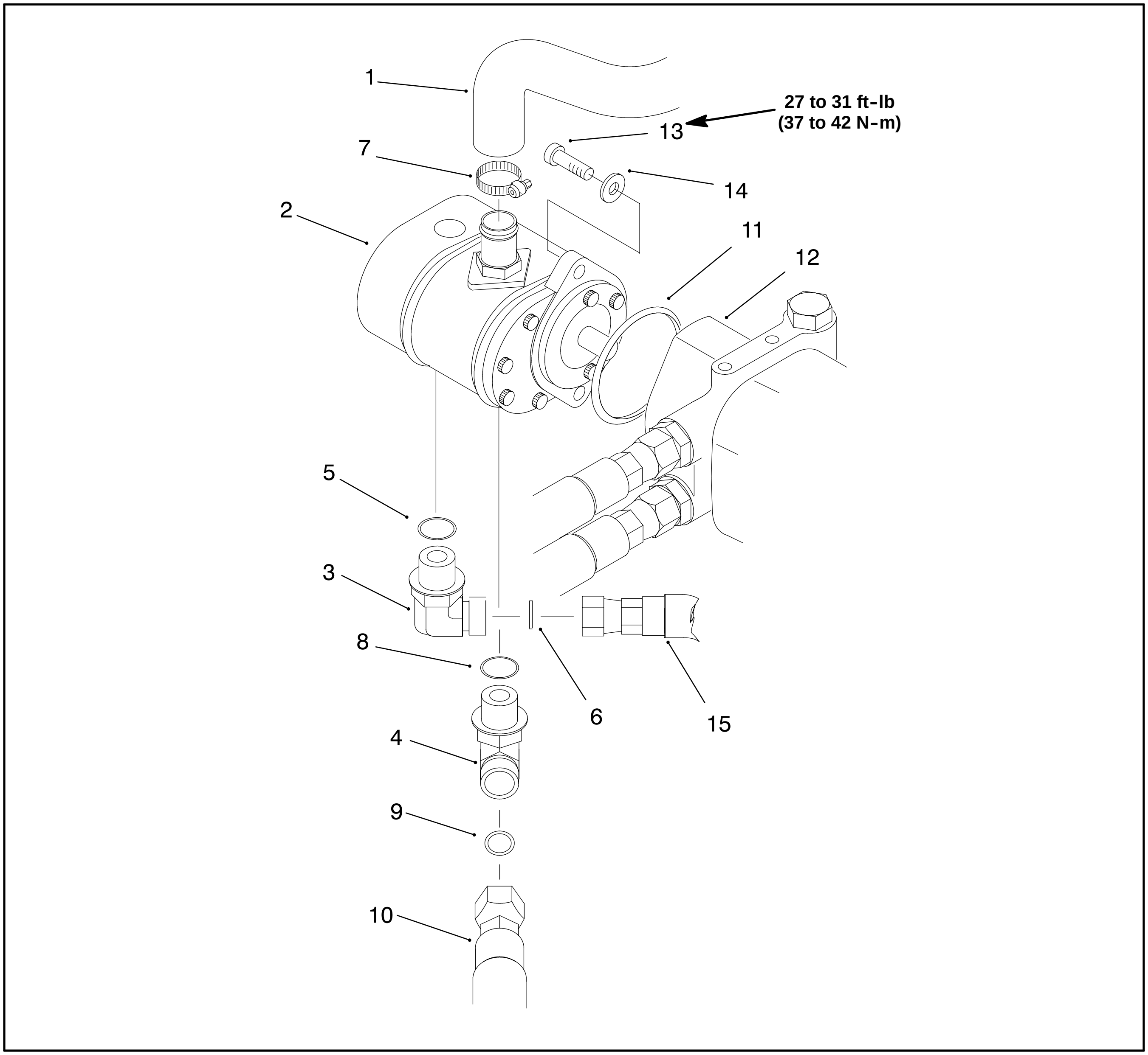


Figure 28

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

5. 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 N-m)**.

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

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

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

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

Gear Pump Service

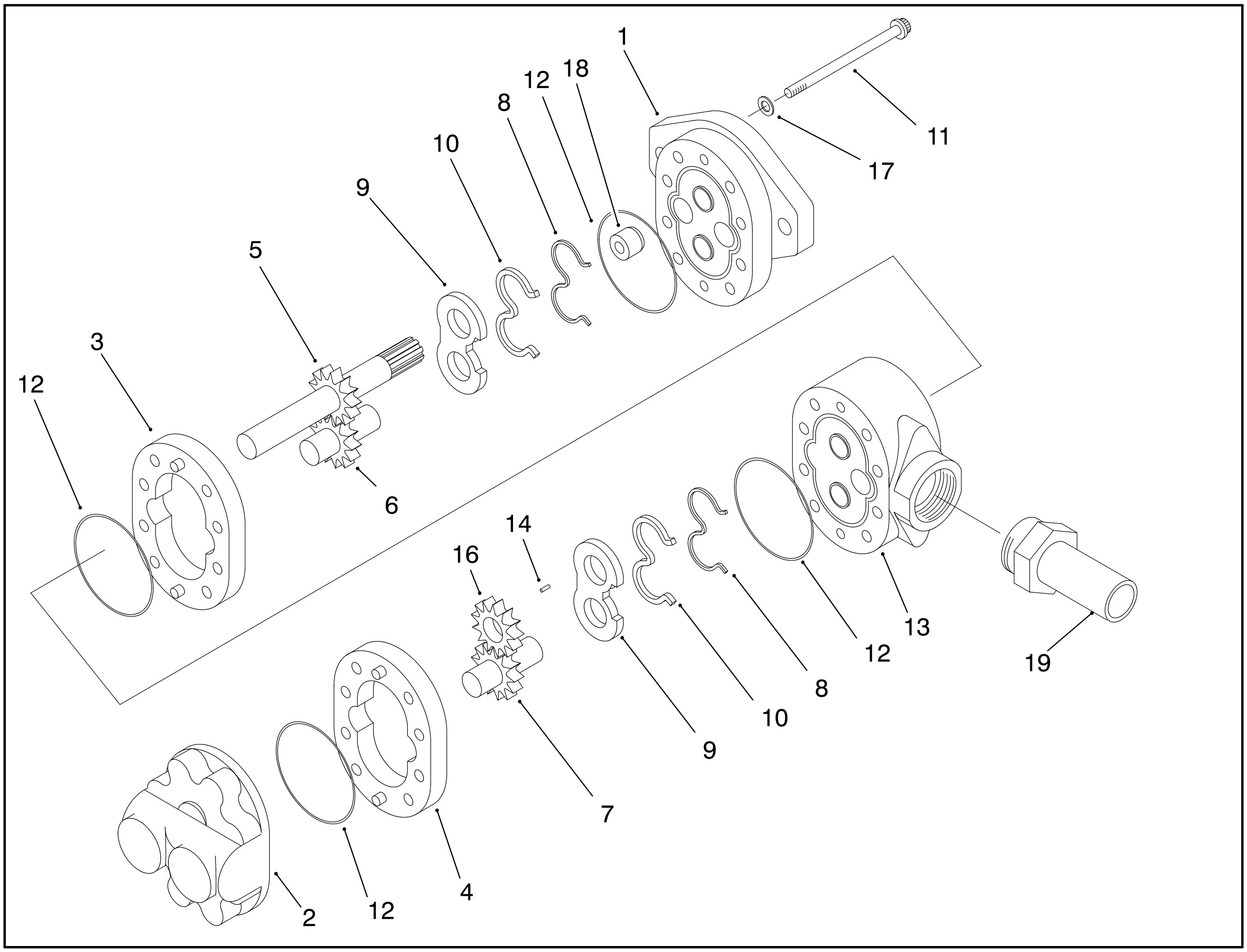


Figure 29

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**

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. Check control linkage for proper adjustment, binding, or broken parts.

5. Disconnect electrical connector to the fuel stop solenoid to prevent the engine from starting.

6. Make sure traction pedal is in **neutral** and the cutting unit switch is **off**. Turn ignition key switch; engage starter for ten (10) seconds to the prime pump. Allow the starter to cool and repeat this step again.

7. Reconnect electrical connector to the fuel stop solenoid.

8. 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 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.

9. 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.

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

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

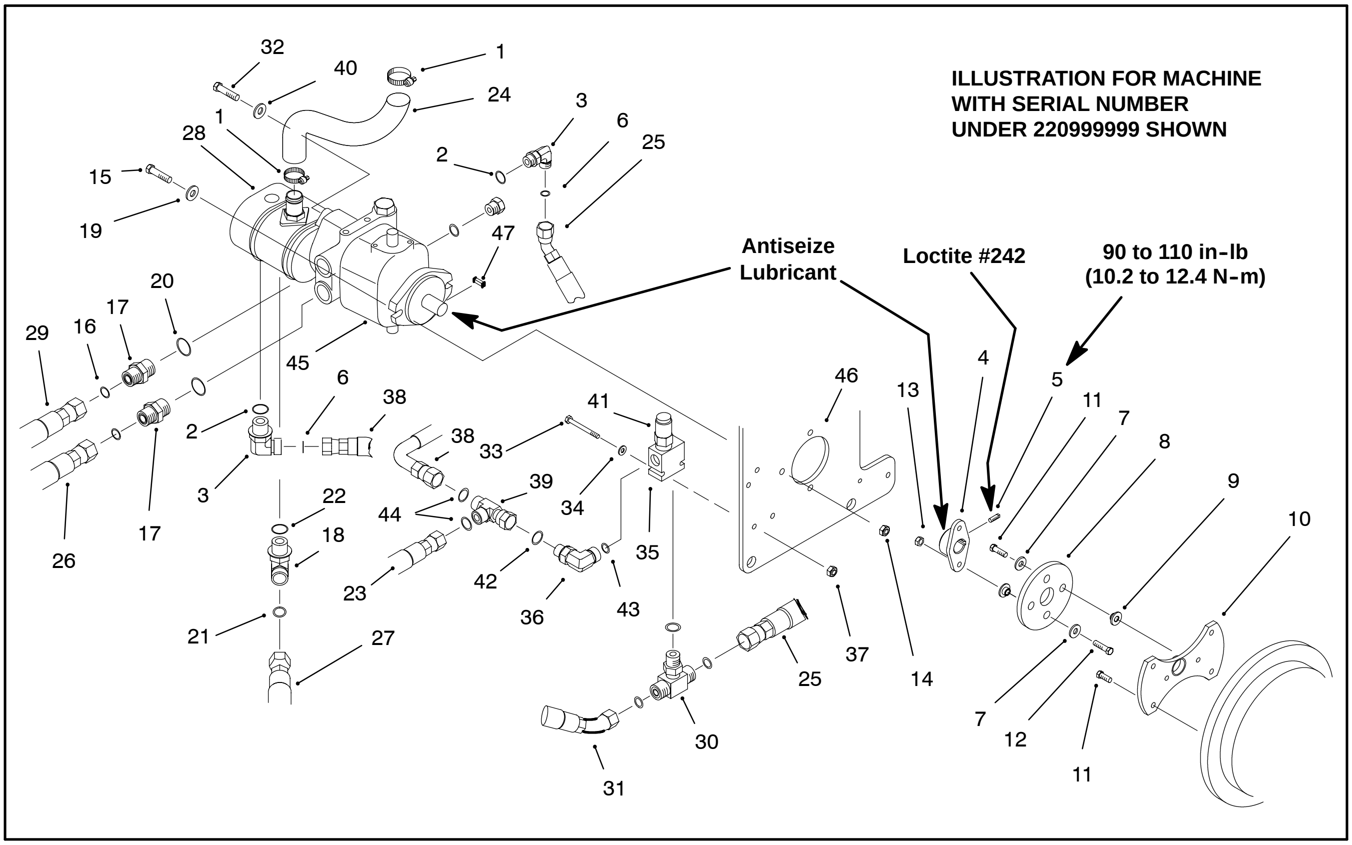


Figure 30

1. **Hose clamp**
2. **O-ring**
3. **90º hydraulic fitting**
4. **Pump hub**
5. **Square head screw**
6. **O-ring**
7. **Flat washer**
8. **Drive coupling**
9. **Coupling spacer**
10. **Pump Adapter**
11. **Cap screw**
12. **Cap screw**
13. **Lock nut**
14. **Lock nut**
15. **Cap screw**
16. **O-ring**
17. **Hydraulic fitting**
18. **90º hydraulic fitting**
19. **Flat washer**
20. **O-ring**
21. **O-ring**
22. **O-ring**
23. **Hose assembly**
24. **Pump inlet hose**
25. **Hose assembly**
26. **Hose assembly**
27. **Hose assembly**
28. **Gear pump**
29. **Hose assembly**
30. **Hydraulic T-fitting**
31. **Hose assembly**
32. **Hex socket head screw**
33. **Cap screw**
34. **Flat washer**
35. **Relief valve base**
36. **90º hydraulic fitting**
37. **Lock nut**
38. **Hose assembly**
39. **Hydraulic T-fitting**
40. **Flat washer**
41. **Relief valve cartridge (R5)**
42. **O-ring**
43. **O-ring**
44. **O-ring**
45. **Hydrostat**
46. **Pump plate**
47. **Key**

Note: On machines with serial number over 230000000, the relief valve cartridge (R5) (item 41) is incorporated into the steering control valve.

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. Remove extension spring from the spring bracket (Fig. 31).

3. Disconnect extension spring from the neutral arm. Remove cap screw and pivot washer from camplate shaft of hydrostat (Fig. 32).

4. Remove both cap screws securing the cable support of the neutral system assembly to the hydrostat. Lift and secure neutral system assembly away from the hydrostat (Fig. 33).

CAUTION

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

5. Label all hose connections for reassembly purposes.

6. Clamp pump inlet hose (24) to prevent draining the hydraulic reservoir.

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

8. Plug suction port at the end of the gear pump to prevent possible leakage of hydraulic fluid (Fig. 34).

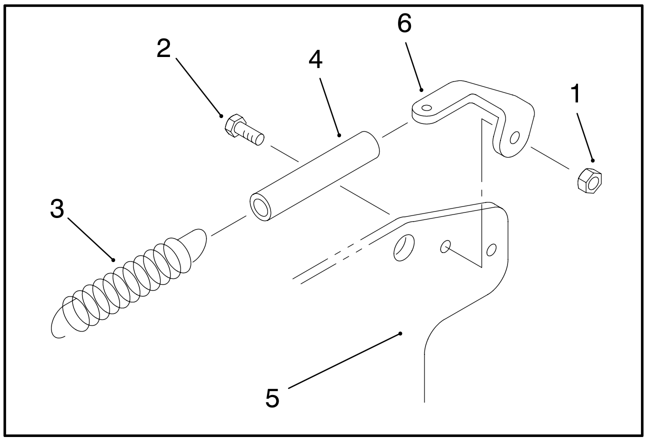


Figure 31

1. **Lock nut**
2. **Cap screw**
3. **Extension spring**
4. **Dampener hose**
5. **Jam nut**
6. **Spring bracket**

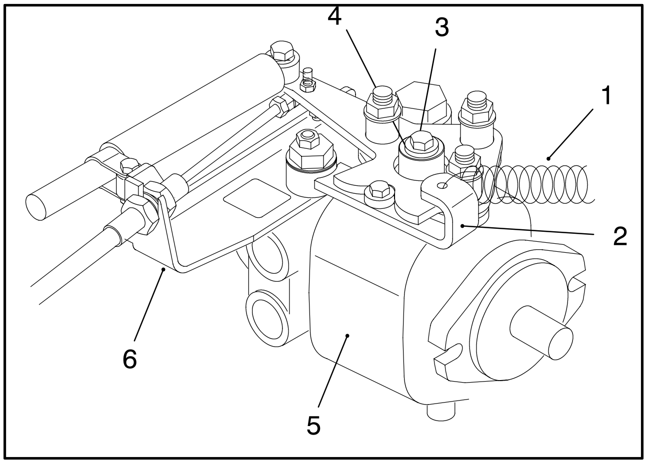


Figure 32

1. **Extension spring**
2. **Neutral arm**
3. **Cap screw**
4. **Pivot washer**
5. **Hydrostat**
6. **Cable support**

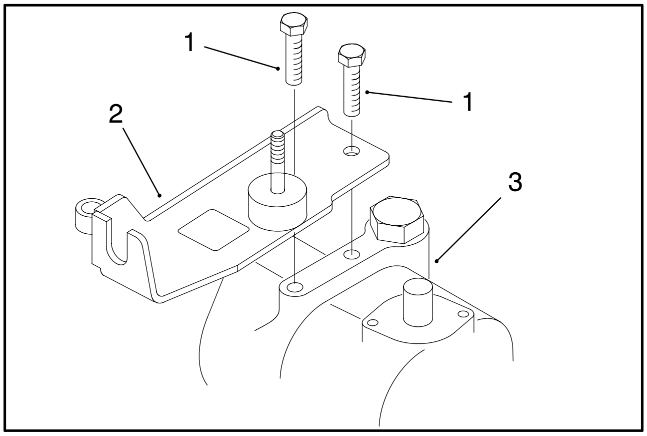


Figure 33

1. **Cap screw**
2. **Cable support**
3. **Hydrostat**

Hydraulic System

9. Pull gear pump (28) and connected hoses assemblies (27 and 38) away from the hydrostat (45) and secure.

10. Remove hose assemblies (25, 26, and 29) and O-rings (6 and 16) from the hydraulic fittings (3 and 17). Allow hoses to drain into a suitable container.

11. Remove hydraulic fittings (3 and 17) and O-rings (2 and 20) from the hydrostat (45).

12. Loosen both set screws (5) on the pump hub (4) enough to allow the hydrostat (45) 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 lock nuts (14), cap screws (15), and flat washers (19) from the hydrostat (45) flange and pump plate (46).

14. Separate hydrostat (45) from the pump plate (46) and pump hub (4). Remove key (47) from the hydrostat shaft.

Installation (Fig. 30)

1. Make sure the inside of the pump hub (4) is clean. Apply antiseize lubricant to both the hydrostat (45) shaft and the inside of the pump hub.

2. Coat key (47) with petroleum jelly and insert it into the hydrostat (45) shaft. Position hydrostat to the pump plate (46) and pump hub (4). Slide the shaft into the hub with the key.

3. Secure the hydrostat (45) to the pump plate (46) with both cap screws (15), flat washers (19), and lock nuts (14).

4. Apply Loctite #242 (or equivalent) to threads of both square head screws (5). Install screws (5) in pump hub (4) to secure hub to pump shaft. Torque screws from **90 to 110 in-lb (10.2 to 12.4 N-m)**.

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

6. Install new O-rings (2 and 20) and hydraulic fittings (3 and 17) to the hydrostat.

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

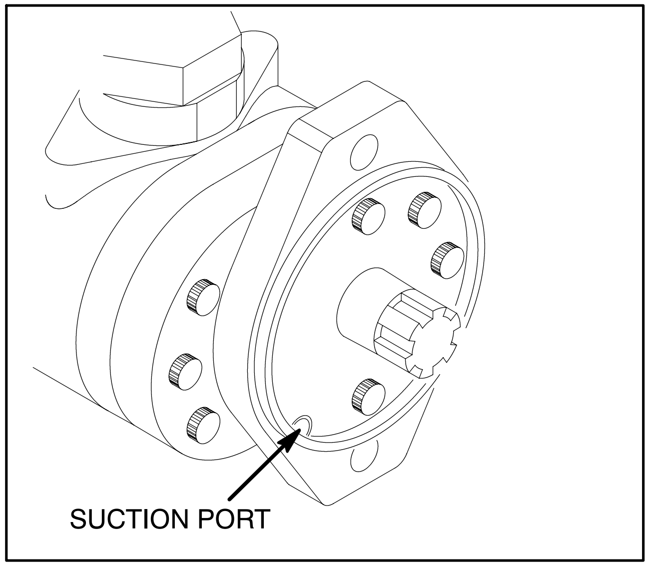


Figure 34

8. Install O-rings (6 and 16) and hose assemblies (25, 26, and 29) to the hydrostat (45) and hydraulic fittings (3 and 17).

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

9. Remove plug from the suction port on the gear pump (Fig. 34).

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

11. Remove clamp from pump inlet hose (24).

12. Position neutral system assembly to the hydrostat (45). Secure assembly to the hydrostat by securing the cable support to the hydrostat with both cap screws (Fig. 33).

13. Fasten and tighten cap screw and pivot washer to the camplate shaft of the hydrostat. Connect extension spring to the neutral arm (Fig. 32).

14. Connect extension spring with dampener to the spring bracket (Fig. 31).

15. Check neutral position of the traction pedal. If adjustment is required, see Adjust Transmission for Neutral.

Piston Pump Service

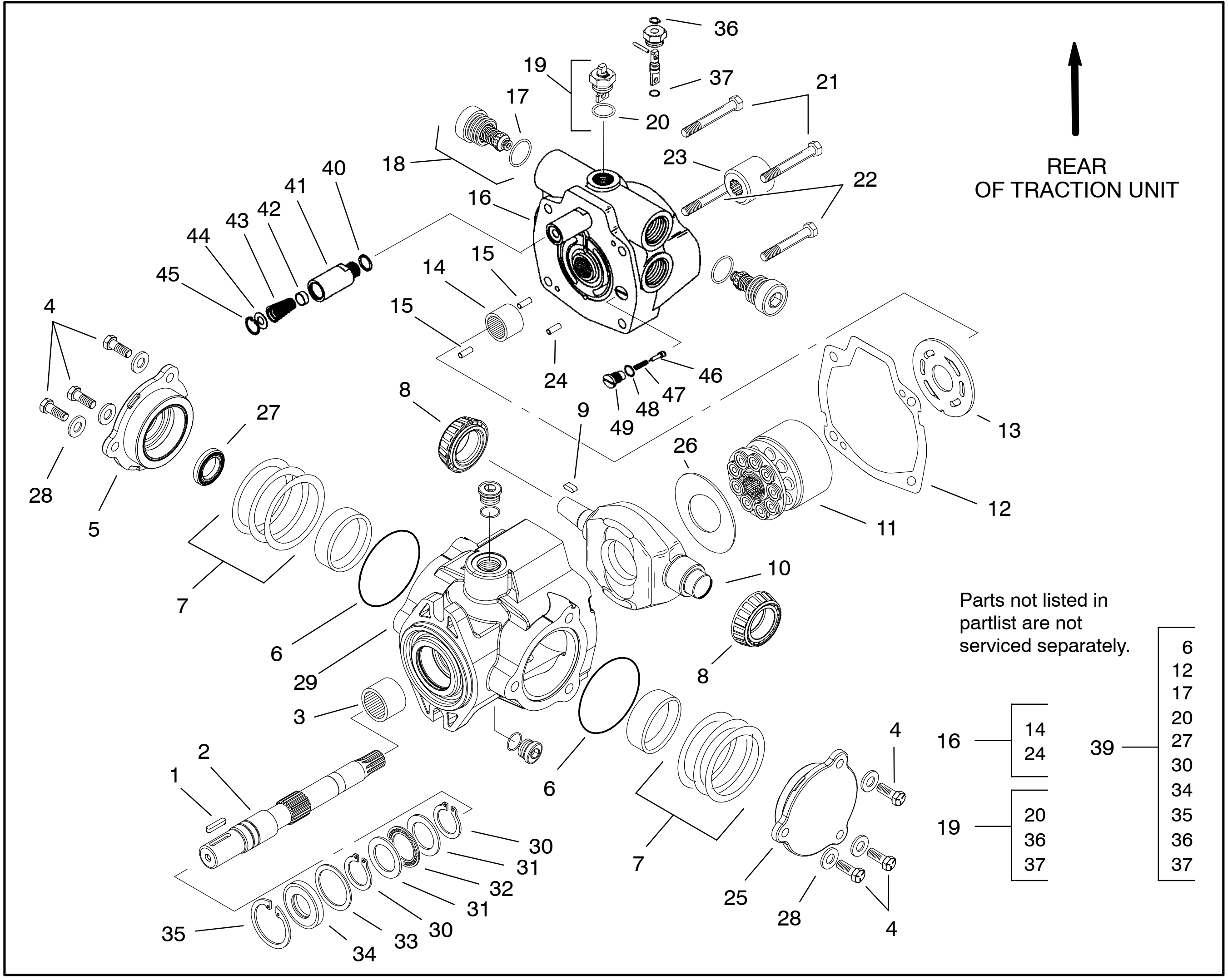


Figure 35

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 piston pump, 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 (Piston Pump Crush Ring Replacement) on the following page in conjunction with the pump service manual.

Piston Pump Crush Ring Replacement

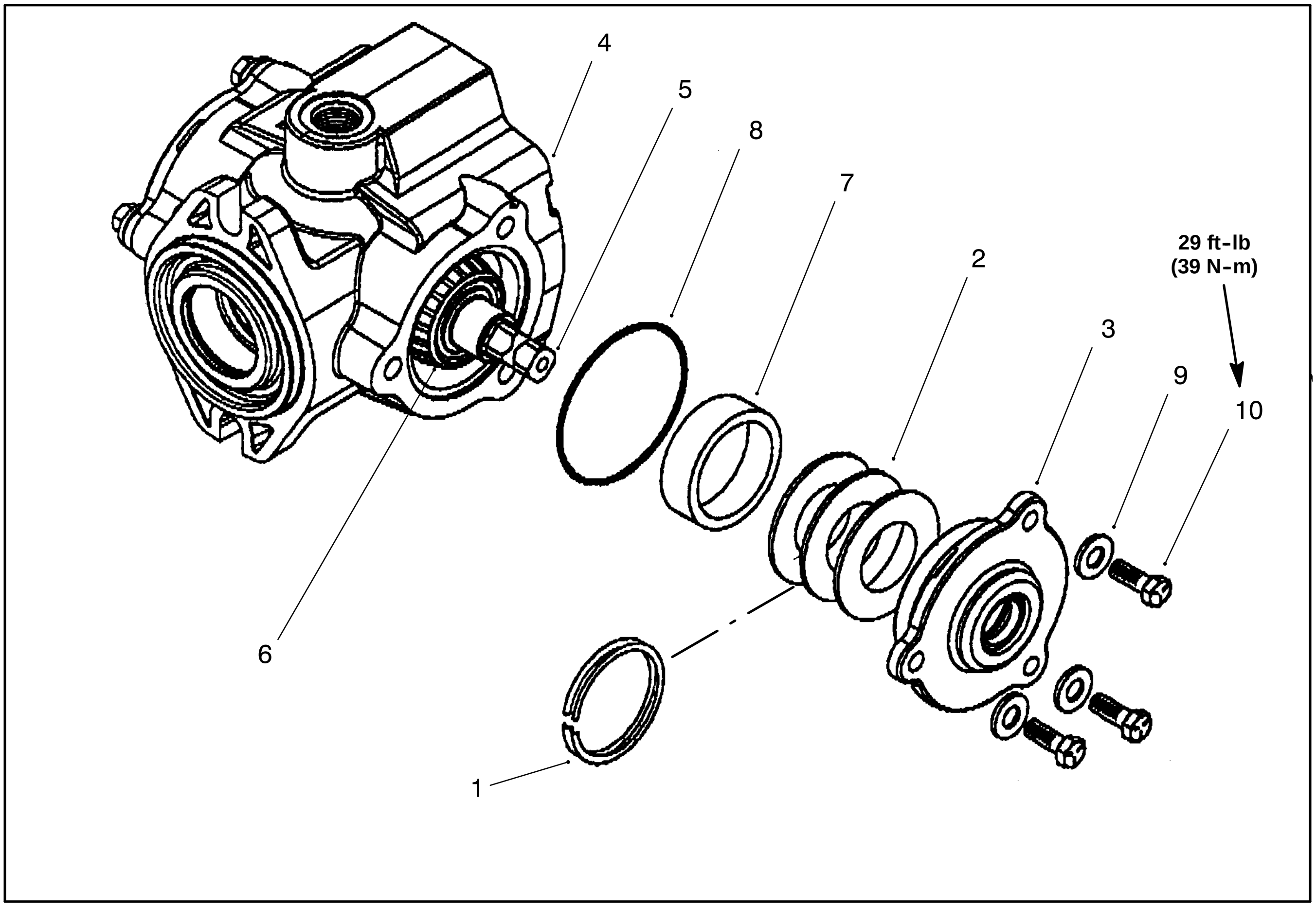


Figure 36

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**

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 N-m)**.

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

   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).

Change Hydraulic Oil and Filter

Change hydraulic filter initially after the first 50 operating hours, thereafter change hydraulic oil and filter after every 800 hours. Contaminated oil looks milky or black when compared to clean oil. If oil becomes contaminated, flush hydraulic system (see Flush Hydraulic System).

Note: If oil is not going to be drained, disconnect and plug hydraulic line going to filter.

1. Clean area around filter mounting area. Place drain pan under filter and remove filter. Allow hydraulic oil to drain completely.

2. Fill replacement filter with hydraulic fluid (see Check Hydraulic System Fluid), lubricate the sealing gasket and hand turn until gasket contacts filter head. Then tighten 3/4 turn further. Filter should now be sealed.

3. Fill hydraulic reservoir with approximately 5.5 gallons (8.1 gallons if machine is equipped with leak detector) of hydraulic oil (see Check Hydraulic System Fluid).

4. Start engine and run it at idle for 3 to 5 minutes to circulate the fluid and remove any air trapped in the system. Stop engine and recheck fluid level.

5. Dispose of hydraulic fluid properly.

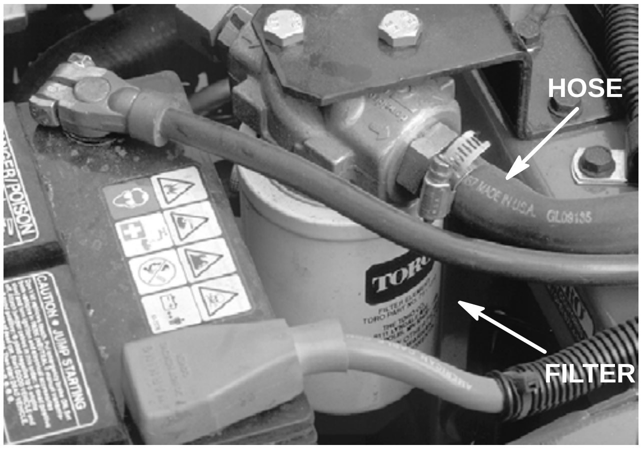


Figure 37

Hydraulic System

Wheel Motors

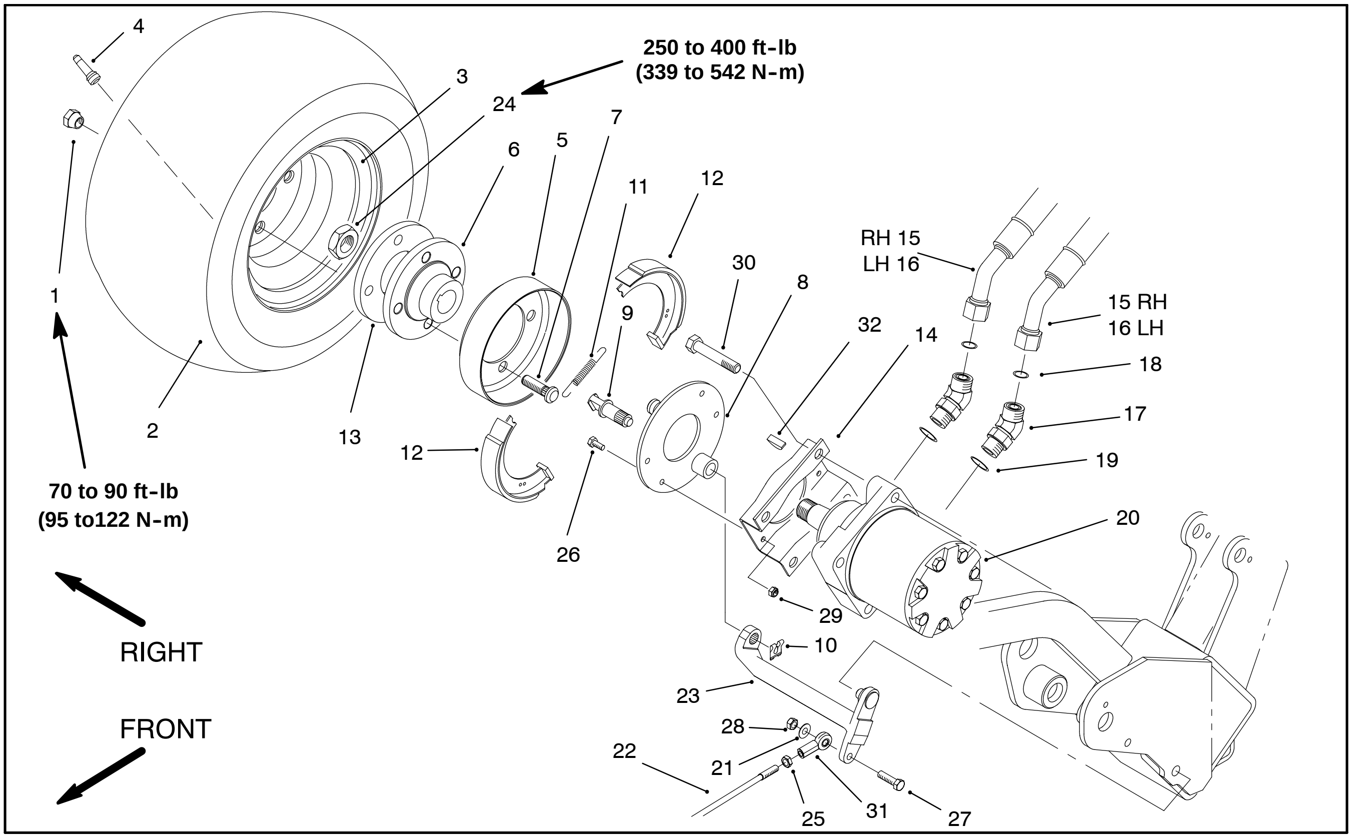


Figure 38

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 clip
11. Return spring
12. Brake shoe
13. Bearing plate
14. Brake bracket
15. Hydraulic hose
16. Hydraulic hose
17. 45° 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. Woodruff key

Front Wheel Motor Removal (Fig. 38)

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), and bearing plate (13) 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 or 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).

4. Use wheel hub puller (see Special Tools) to free wheel hub assembly from motor shaft. Do not disassemble hub assembly. Remove lock nut (24) and key (32) 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 clip (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) from brake bracket (14) and hydraulic wheel motor (20). Remove motor from the frame.

Front Wheel Motor Installation (Fig. 38)

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).

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 clip (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 removal or 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 (32) 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 N–m)**.

8. Install bearing plate (13) and 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 N–m)**.

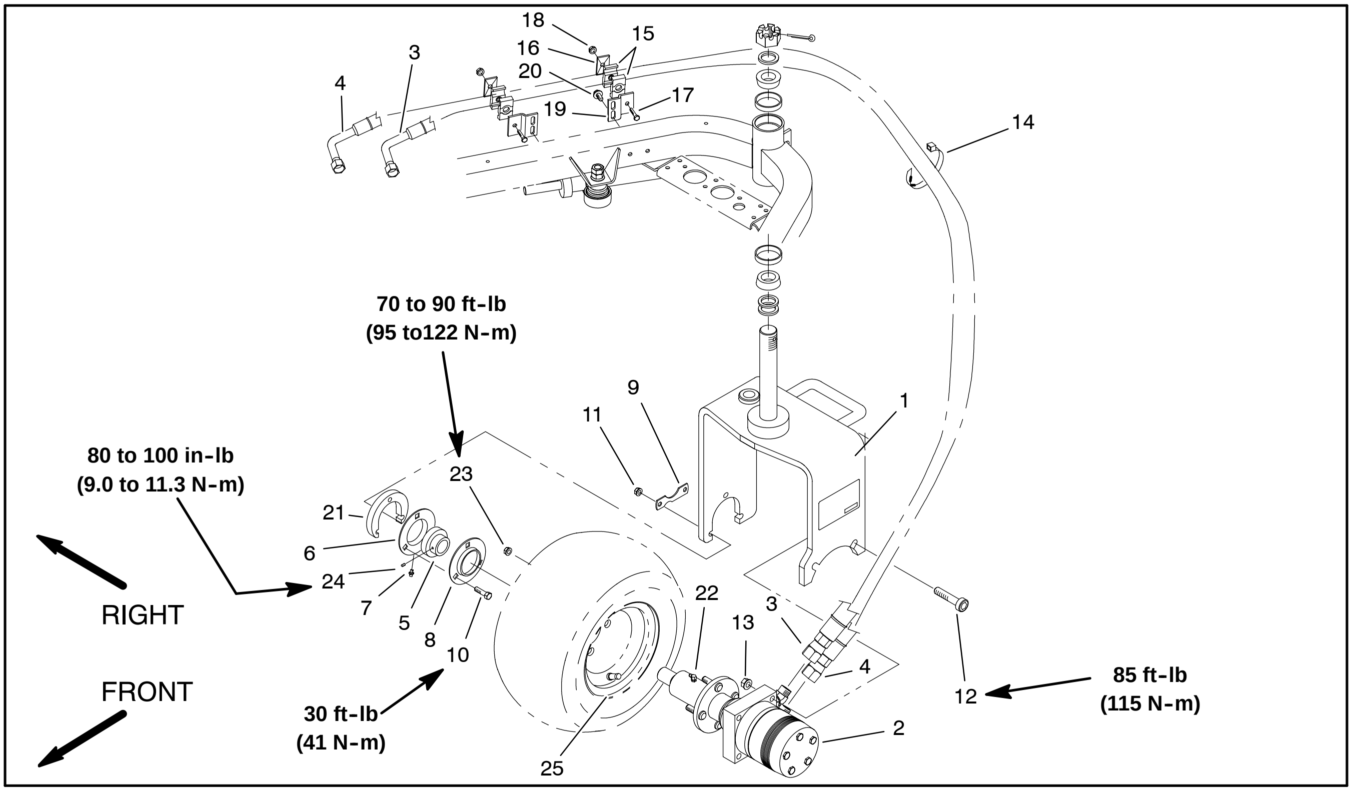


Figure 39

1. **Castor fork**
2. **Hub and motor assembly**
3. **Hydraulic hose**
4. **Hydraulic hose**
5. **Bearing**
6. **Relube flangette**
7. **Grease fitting**
8. **Standard flangette**
9. **Bearing tab**
10. **Cap screw**
11. **Lock nut**
12. **Hex socket head screw**
13. **Lock nut**
14. **Cable tie**
15. **Tube clamp**
16. **Cover plate**
17. **Cap screw**
18. **Lock nut**
19. **Clamp bracket**
20. **Hex washer head screw**
21. **Bearing adapter plate**
22. **Grease fitting**
23. **Lug nut**
24. **Set screw**
25. **Wheel**

Rear Wheel (3WD) Removal (Fig. 39)

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 hose assemblies (3 and 4) and O-rings from the hydraulic fittings on the hydraulic motor and hub assembly (2). 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 (25) and hydraulic motor and hub assembly (2) from the castor fork (1) as follows:

A. Remove cap screws (10) and lock nuts (11) securing flangettes (6 and 8) and bearing tab (8).

B. Remove both socket head screws (12) and lock nuts (13) from castor fork and motor.

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

5. Loosen both set screws (24) on bearing (5). Slide flangettes (6 and 8) and bearing (5) off the motor shaft.

6. Remove grease fitting (22) from the hydraulic motor and hub assembly (2). Remove four lug nuts (23) and wheel (25) from the hub drive studs.

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

Rear Wheel (3WD) Installation (Fig. 39)

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

1. Make sure grease fitting (22) is removed from the hydraulic motor and hub assembly (2).

2. Secure wheel (25) to the four drive studs of the hydraulic motor and hub assembly (2) with four lug nuts (23). Torque nuts from **70 to 90 ft–lb (95 to 122 N–m)**.

3. Reinstall grease fitting (22) onto hydraulic motor and hub assembly (2) so it points away from the wheel (25).

4. Install flangette (8), bearing (5), and relube flangette (6) onto the motor shaft.

5. Position hydraulic motor and hub assembly (2), flangettes (6 and 8) with bearing (5), and wheel (25) into the castor fork (1). Make sure hose fittings on the motor face the rear.

6. Secure hydraulic motor and hub assembly (2) loosely to the left inside of the castor fork (1) with both socket head screws (12) lock nuts (13).

7. Secure flangettes (6 and 8) with bearing (5) loosely to the right inside of the castor fork (1).

A. Position grease fitting (7) facing downward.

B. Torque socket head screws (12) to **85 ft–lb (115 N–m)**.

C. Install cap screws (10) and lock nuts (11) to flangettes. Torque cap screws (10) to **30 ft–lb (41 N–m)**.

8. Apply loctite to both set screws (24). Torque both screws from **80 to 100 in–lb (9.0 to 11.3 N–cm)**.

9. Install hose assemblies (3 and 4) and O–rings to the hydraulic fittings on the hydraulic motor and hub assembly (2).

Wheel Motor Service

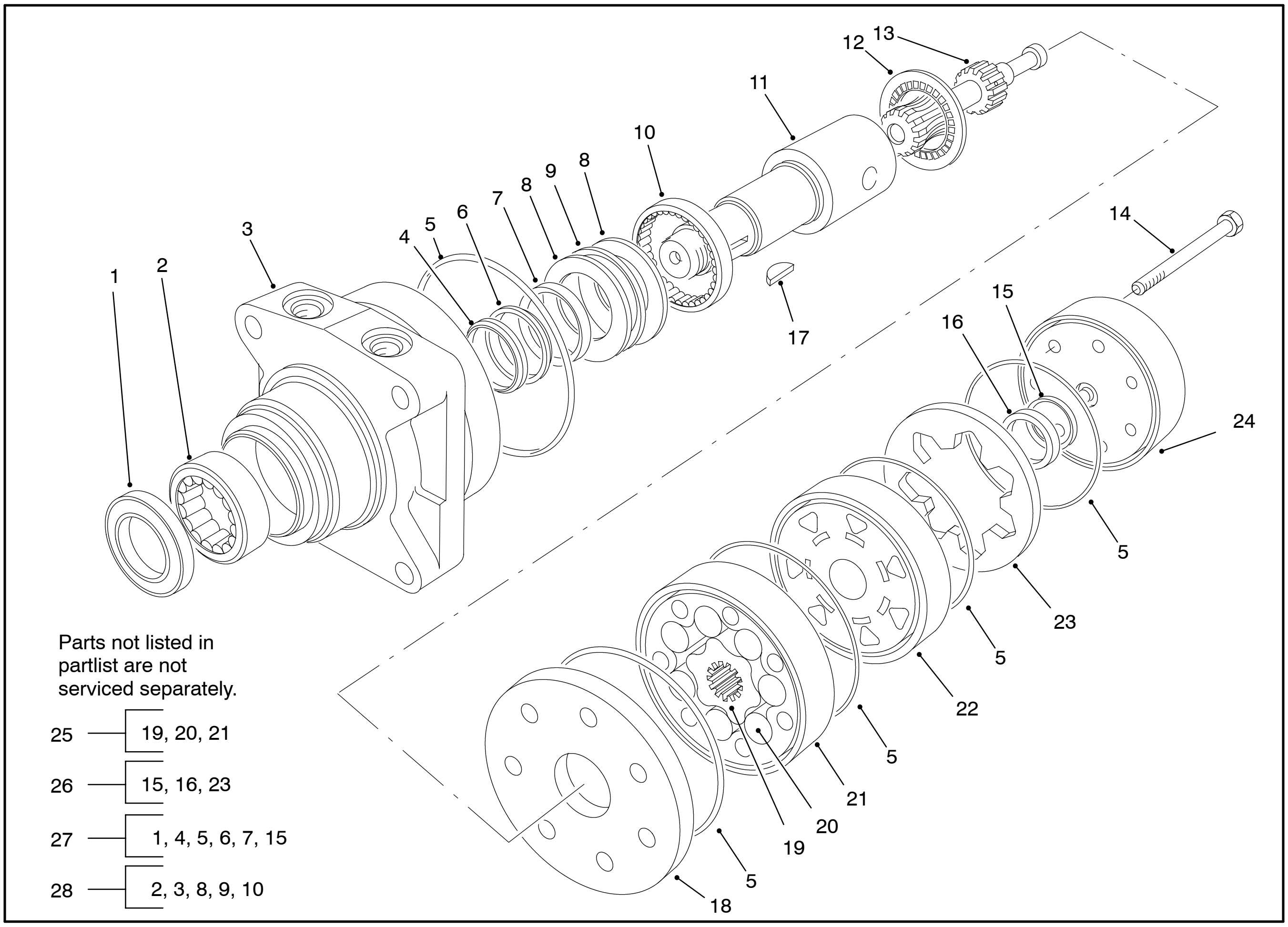


Figure 40

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.

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 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. 41).

3. Clean oil filter mounting area. Remove filter and drain into a suitable container. Discard filter (Fig. 42).

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 Checking Hydraulic System Fluid in General section. Other fluids could cause system damage.

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

7. Disconnect electrical connector to the fuel stop solenoid to prevent engine from starting on diesel engine.

8. Turn ignition key switch; engage starter for ten (10) seconds to the prime pump. Allow the starter to cool and repeat this step again.

9. Connect electrical connector to the fuel stop solenoid on diesel engine.

10. Start engine and let it idle at low speed for a minimum of two (2) minutes. Increase engine speed to high idle for 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.

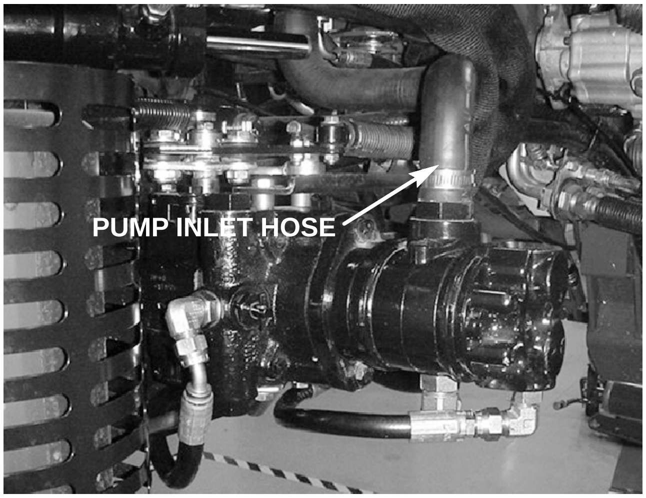


Figure 41

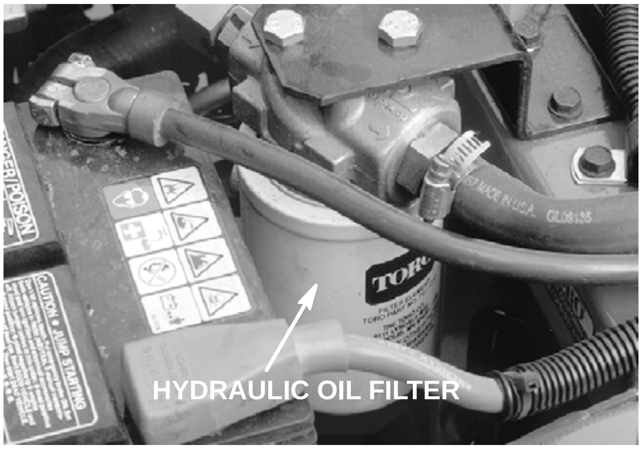


Figure 42

Hydraulic System

Implement Relief Valve (Machines with Serial Number Under 220999999)

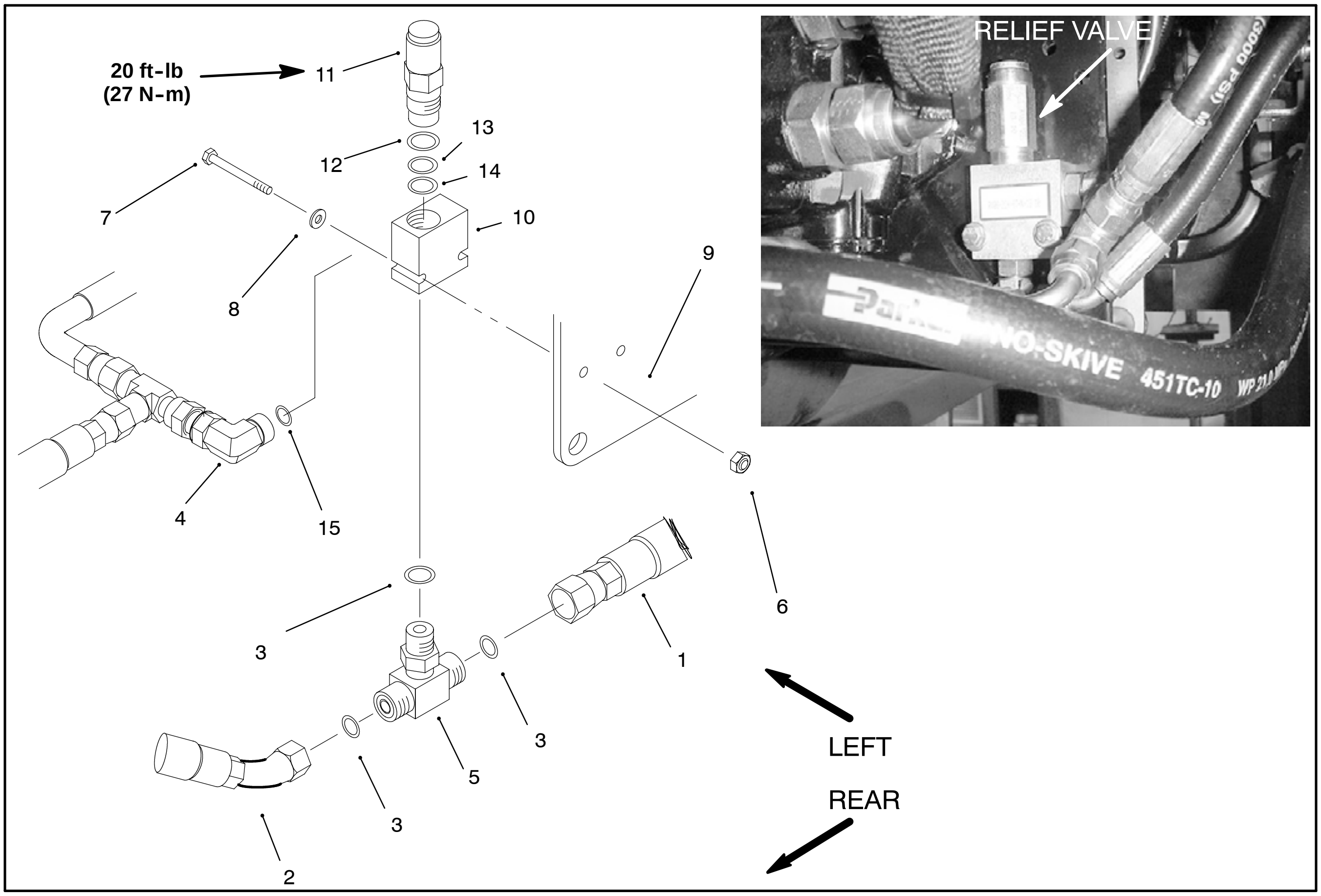


Figure 43

1. **Hose assembly**
2. **Hose assembly**
3. **O-ring**
4. **90º hydraulic fitting**
5. **Tee hydraulic fitting**
6. **Lock nut**
7. **Cap screw**
8. **Flat washer**
9. **Mounting plate**
10. **Relief valve body**
11. **Relief valve cartridge**
12. **O-ring**
13. **O-ring**
14. **Back-up ring**
15. **O-ring**

Removal

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 both hydraulic fittings. Allow hoses to drain into a suitable container.

4. Unscrew lock nuts from cap screws. Remove screws and flat washers from the relief valve body and mounting plate.

5. Remove tee fitting, 90º fitting, and O-rings from the relief valve body.

Installation

1. Lubricate new O-rings with clean hydraulic fluid. Install O-rings and hydraulic fittings to the valve body.

2. Secure valve body to the mounting plate with cap screws, flat washers, and lock nuts.

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

Disassembly

1. Unscrew relief valve cartridge from the relief valve body. Remove O-rings and back-up ring.

2. Inspect ports of the relief valve body for damaged sealing surfaces and threads and contamination.

3. Inspect relief valve cartridge 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 over heating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

4. Clean relief valve cartridge using clean mineral spirits to flush out any contamination. Submerge cartridge 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.

Reassembly

1. Lubricate new O-rings and back-up ring with clean hydraulic fluid. Install O-rings and back-up ring to the relief valve cartridge.

2. Screw relief valve cartridge into the relief valve body. Torque cartridge to **20 ft-lb (27 N-m)**.

3. Lubricate new O-rings with clean hydraulic fluid. Connect hydraulic fittings and O-rings to the relief valve body.

Reel Motors

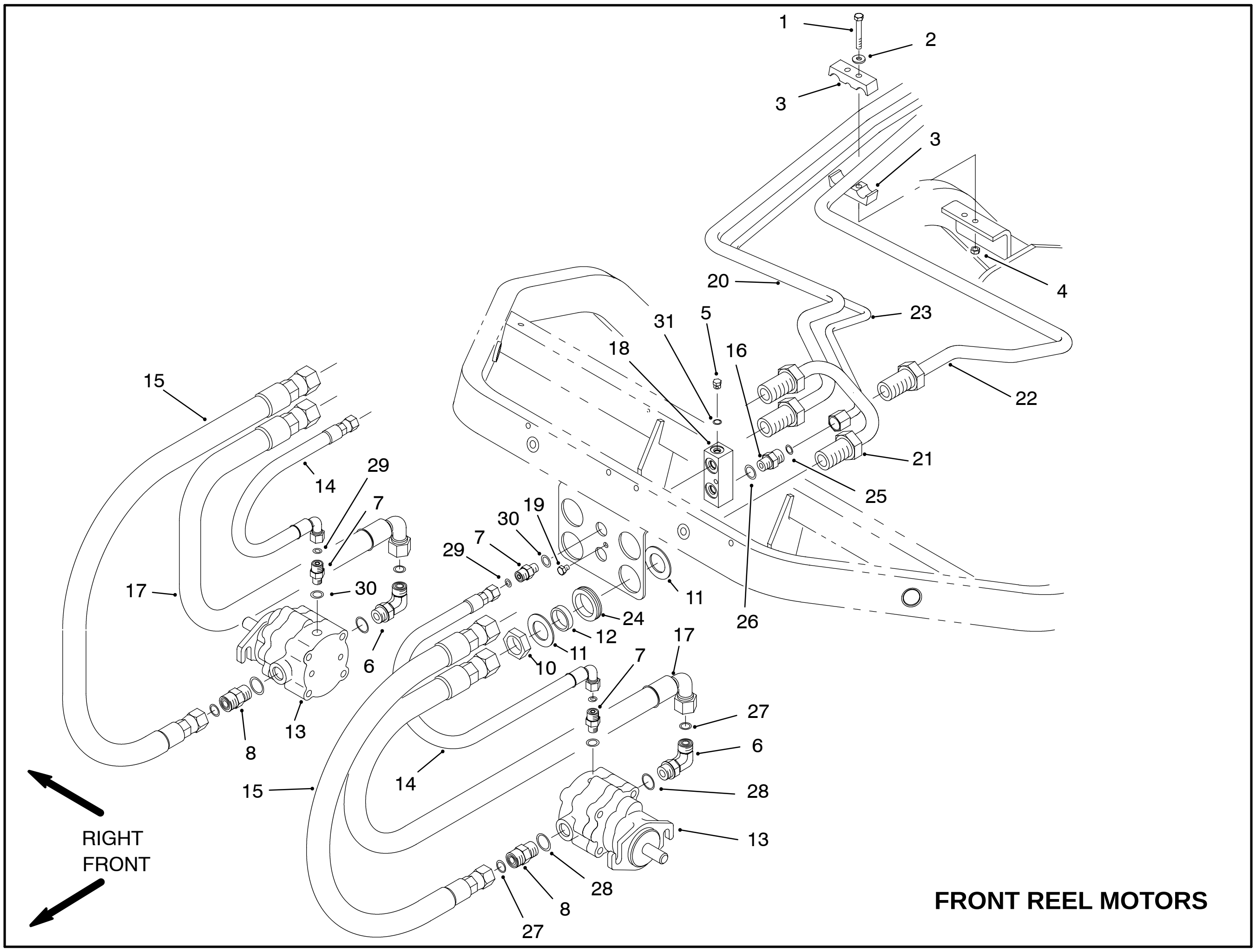


Figure 44

1. Cap screw	**12. Spacer**	**22. Hydraulic tube**
2. Flat washer	**13. Reel motor**	**23. Hydraulic tube**
3. Tube clamp	**14. Hose assembly**	**24. Rubber grommet**
4. Lock nut	**15. Hose assembly**	**25. O-ring**
5. Plug	**16. Hydraulic fitting**	**26. O-ring**
6. 90° Hydraulic fitting	**17. Hose assembly**	**27. O-ring**
7. Hydraulic fitting	**18. T-block**	**28. O-ring**
8. Hydraulic fitting	**19. Cap screw**	**29. O-ring**
9. Not used	**20. Hydraulic tube**	**30. O-ring**
10. Bulkhead nut	**21. Hydraulic tube**	**31. O-ring**
11. Washer		

Removal (Fig. 44 and 45)

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- 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.

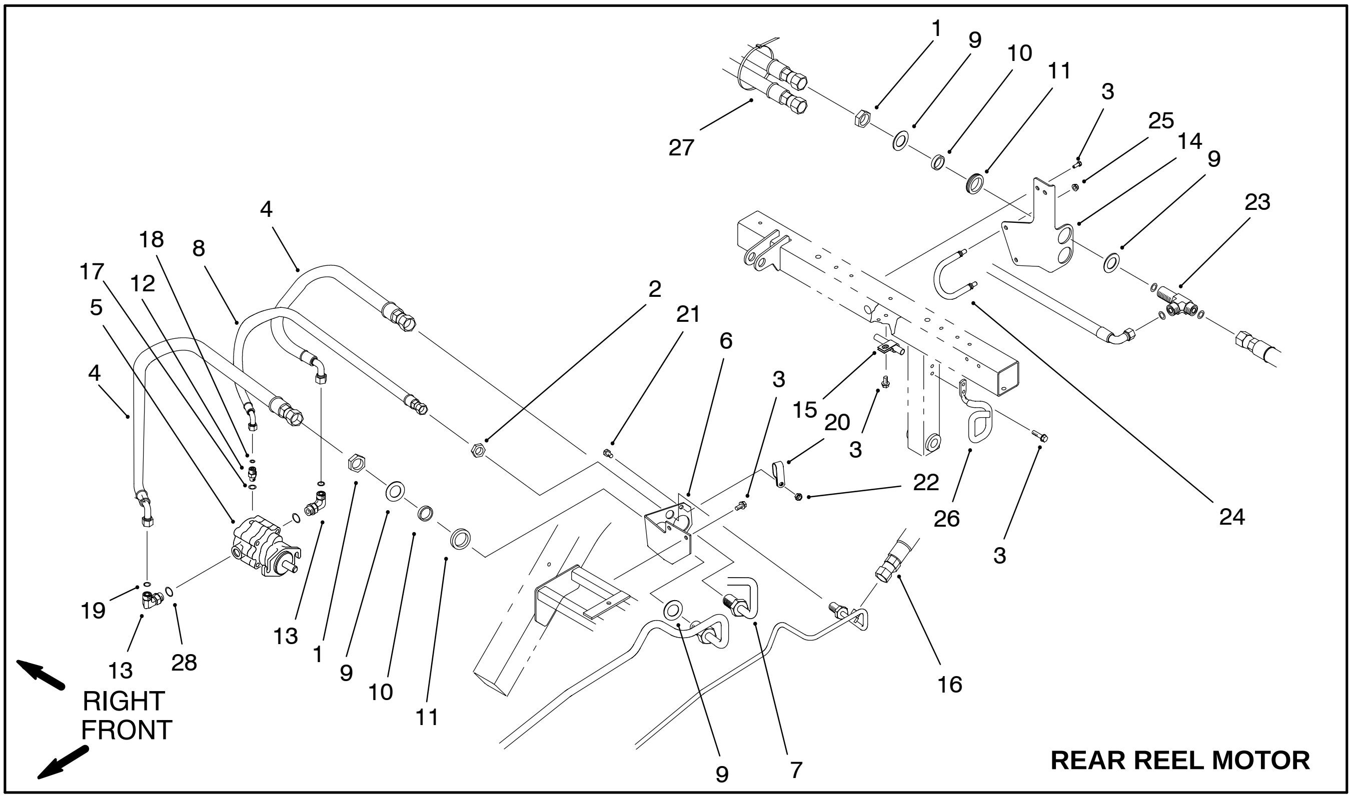


Figure 45

1. Bulkhead lock nut	**11. Grommet**	**20. Tube clamp**
2. Bulkhead lock nut	**12. Hydraulic straight fitting**	**21. Cap screw**
3. Hex washer head screw	**13. 90º Hydraulic fitting**	**22. Lock nut**
4. Hydraulic hose	**14. Hose bracket**	**23. Hydraulic T-fitting**
5. Reel motor	**15. Clamp**	**24. Hose retainer**
6. Bulkhead bracket	**16. Hydraulic hose**	**25. Lock nut**
7. Hydraulic tube	**17. O-ring**	**26. Hose retainer**
8. Hydraulic hose	**18. O-ring**	**27. Cable tie**
9. Washer	**19. O-ring**	**28. O-ring**
10. Spacer		

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. 44 and 45)

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- 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 (Serial Number Under 220999999)

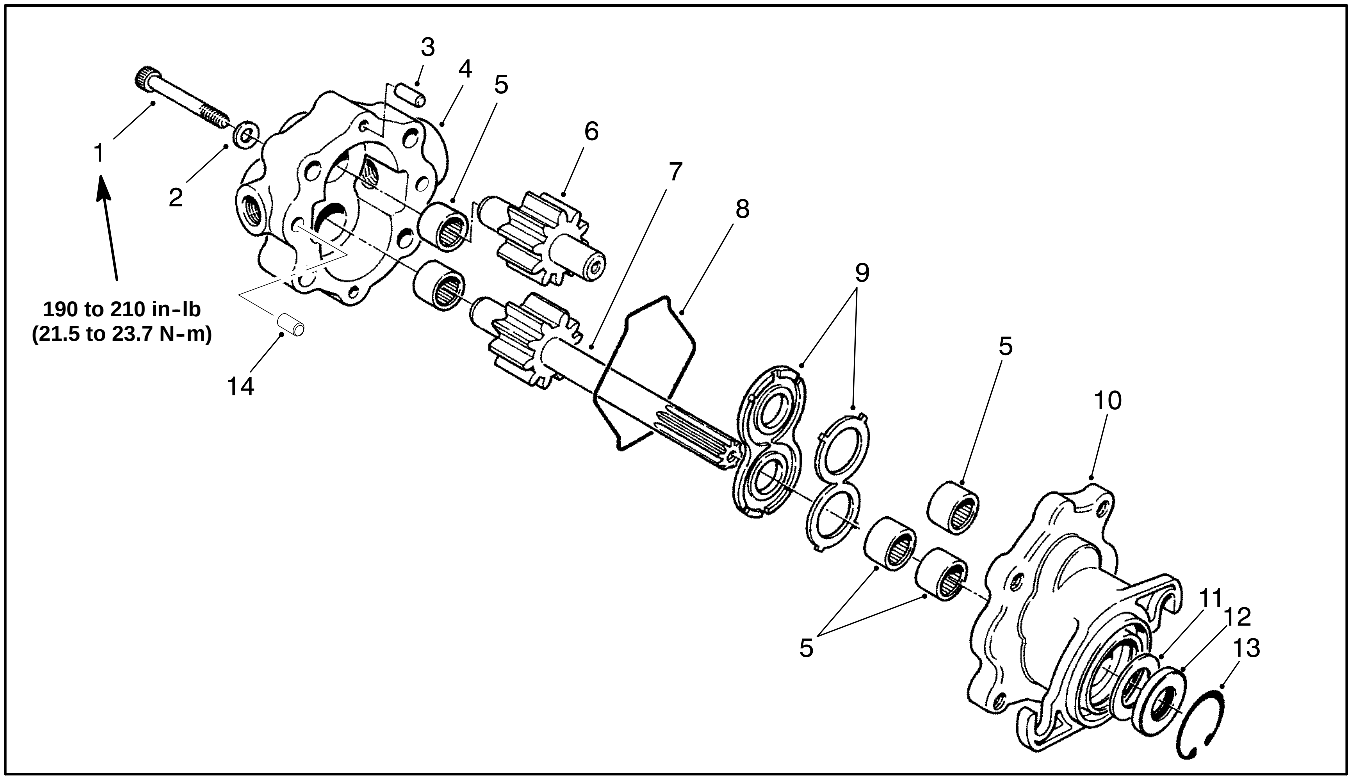


Figure 46

1. **Hex socket head screw**
2. **Washer**
3. **Dowel pin**
4. **Cover assembly**
5. **Needle bearing**
6. **Idler gear assembly**
7. **Drive shaft assembly**
8. **Seal ring**
9. **Load plate assembly**
10. **Body assembly**
11. **Spacer**
12. **Shaft seal**
13. **Retaining ring**
14. **Dowel pin**

Disassembly (Fig. 46)

1. Make sure caps or plugs are in motor openings to prevent contamination. Clean motor with solvent.

IMPORTANT: Use extreme caution when using a vise to hold the motor. Do not over tighten. Parts may be distorted.

2. Remove shaft seal as follows:

A. Remove retaining ring with retaining ring pliers.

B. Plug both motor ports (3/4-16 UNF-2B) with threaded plugs. Attach hydraulic hand pump to the external drain port (7/16-20 UNF-2B).

CAUTION

Point shaft seal away from face and body to prevent possible injury.

IMPORTANT: Do not chisel or pry the shaft seal out of its cavity. This could cause damage to the seal bore or shaft and/or mounting hub area.

C. Apply pressure gradually into the motor. The seal should “pop” easily out of the cavity.

D. Remove shaft seal and spacer from body assembly.

3. Remove hex socket head screws and washers from the cover assembly and body assembly.

4. Separate cover assembly from body assembly by tapping lightly on the drive shaft with a plastic hammer; do not pry apart.

5. Remove load plate assembly from the drive shaft and idler gear assemblies. Discard load plate assembly.

6. Remove seal ring from the body assembly. Discard seal ring.

Inspection (Fig. 46)

1. Remove all nicks and burrs from all parts with an emery cloth.

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive shaft and idler gear assemblies.

   A. Bushing points and seal areas should be free of excessive excessive wear and rough surfaces.

   B. Gear faces should be free of excessive scoring and wear.

   C. Gears should be free of excessive wear, nicks, and, missing or broken teeth. Break sharp edges with emery cloth.

   D. Replace if either shaft is visibly bent.

4. Inspect cover and body assemblies.

   A. Bearing needles should remain in cage and move freely. If needle bearing(s) need replacement, the entire assembly must be replaced.

   B. Sealing faces and gear pockets should be free of excessive scoring.

Assembly (Fig. 46)

1. Coat new seal ring lightly with petroleum jelly. Install seal ring into matching groove on the body assembly.

2. Apply a thin coat of petroleum jelly to both gear pockets of the cover assembly. Install dowel pins into body assembly.

Note: Make sure idler gear is installed into the gear pocket opposite the external drain port.

3. Dip idler gear and drive shaft assemblies into clean hydraulic oil. Install both assemblies into the cover assembly gear pockets. Make sure that both gears mesh.

4. Coat new load plate assembly lightly with petroleum jelly. Install load plate assembly onto idler gear and drive shaft assemblies. Make sure seal of assembly faces away from the gear face.

5. Slide body assembly over the idler gear and drive shaft assemblies onto the cover assembly. Make sure that none of the parts become displaced. Install hex socket head screws and washers. Hand tighten screws.

6. Rotate drive shaft to make sure gears mesh properly. Torque hex socket head screws from **190 to 210 in-lb (21.5 to 23.7 N-m)**.

7. Install new spacer onto the drive shaft and into the body assembly.

IMPORTANT: Use extreme care when installing the shaft seal to prevent damage to the seal.

8. Install new shaft seal as follows:

   A. Make sure that the bore of the body assembly is clean and free of burrs and nicks which could damage the seal.

   B. Lubricate lips of the seal generously with clean No. 2 multipurpose lithium base grease. Apply Loctite gasket eliminator 515 or equivalent to the outer edge of the metal case of the seal.

   C. Make sure metal case of shaft seal faces away from the motor. Use seal installer to press shaft seal squarely into the bore.

9. Install retaining ring into bore of the body assembly.

10. Lubricate motor generously with clean hydraulic oil.

Reel Motor Service (Serial Number Over 230000000)

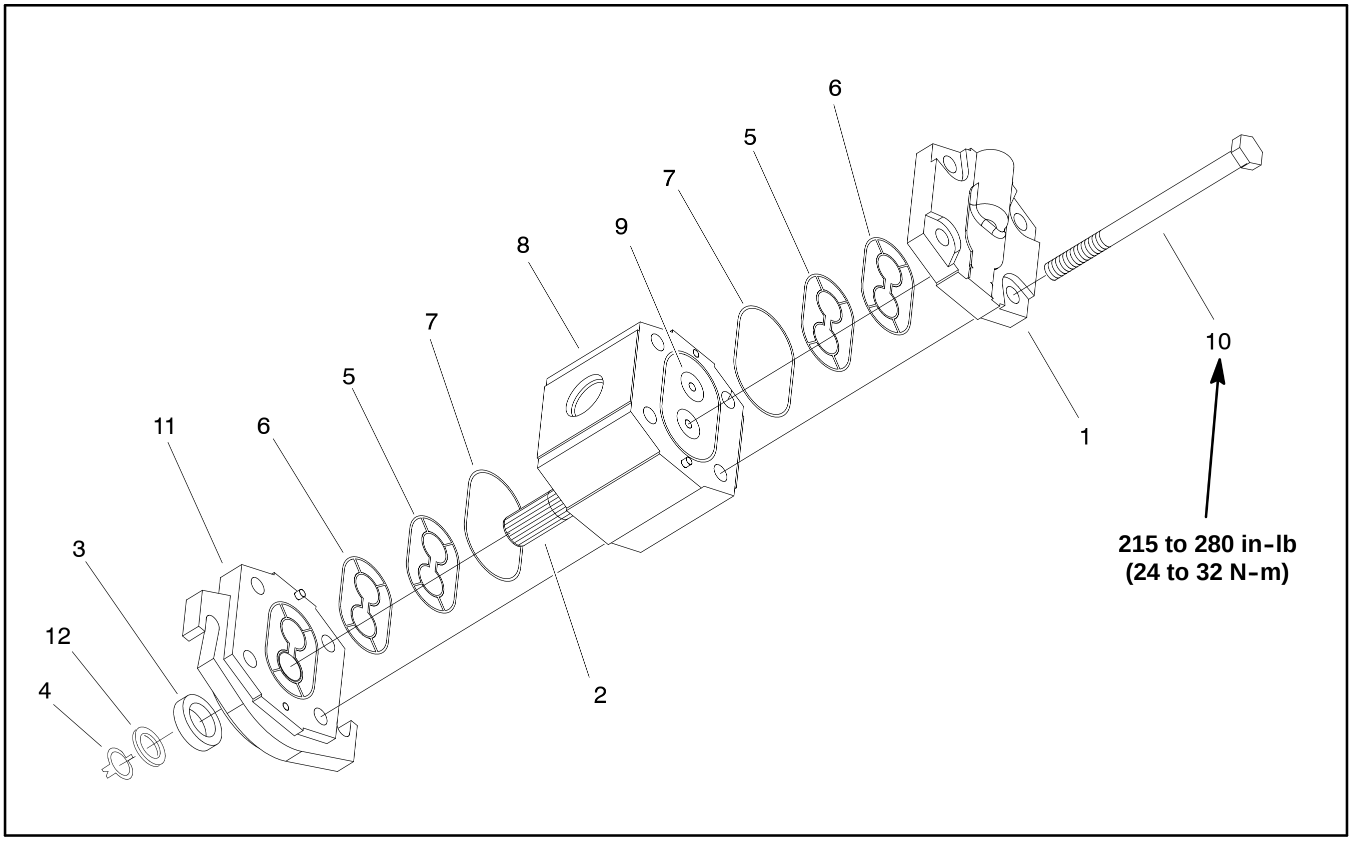


Figure 47

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. 48).

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.

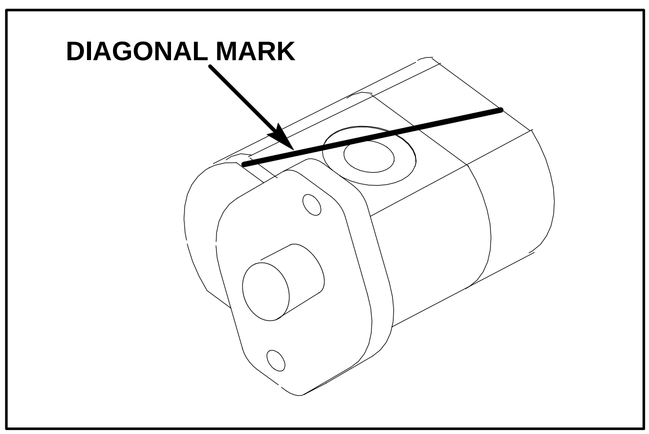


Figure 48

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

7. Place the motor on its side and push on the rear bearing block to remove the bearing block and gear set (Fig. 49).

8. Carefully remove and discard O-rings, pressure seals, and back-up rings (Fig. 50) 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.

3. Inspect drive gear, idler gear and bearing blocks (Fig. 51) 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.

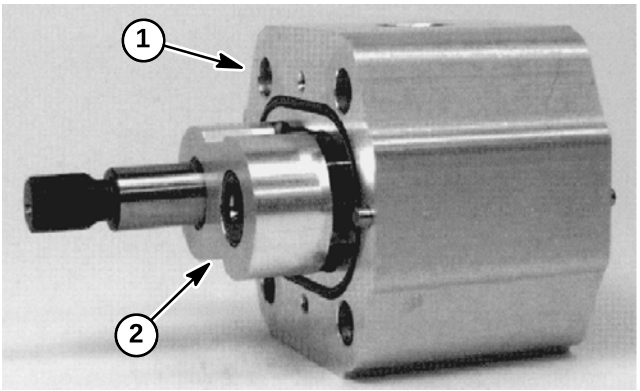


Figure 49

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

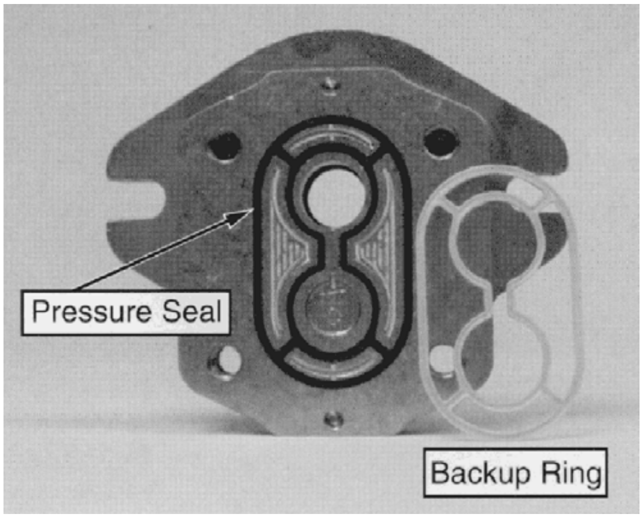


Figure 50

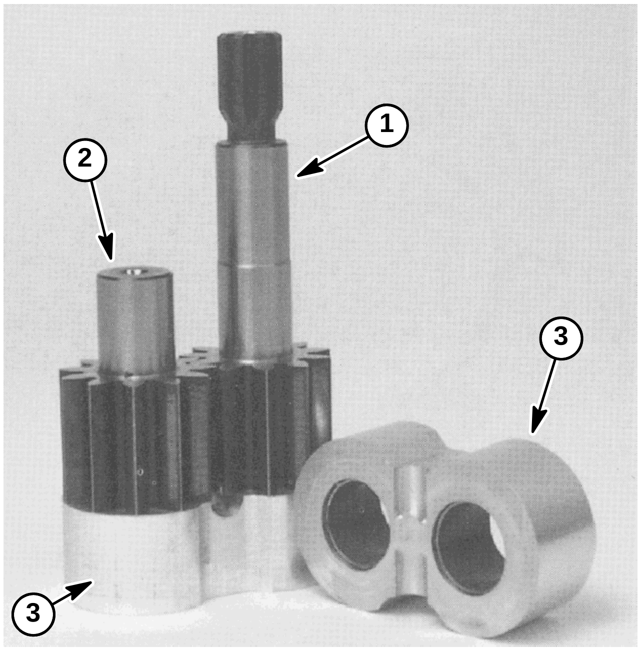


Figure 51

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

Hydraulic System

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 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 N-m)**.

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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Oil Cooler (If Equipped)

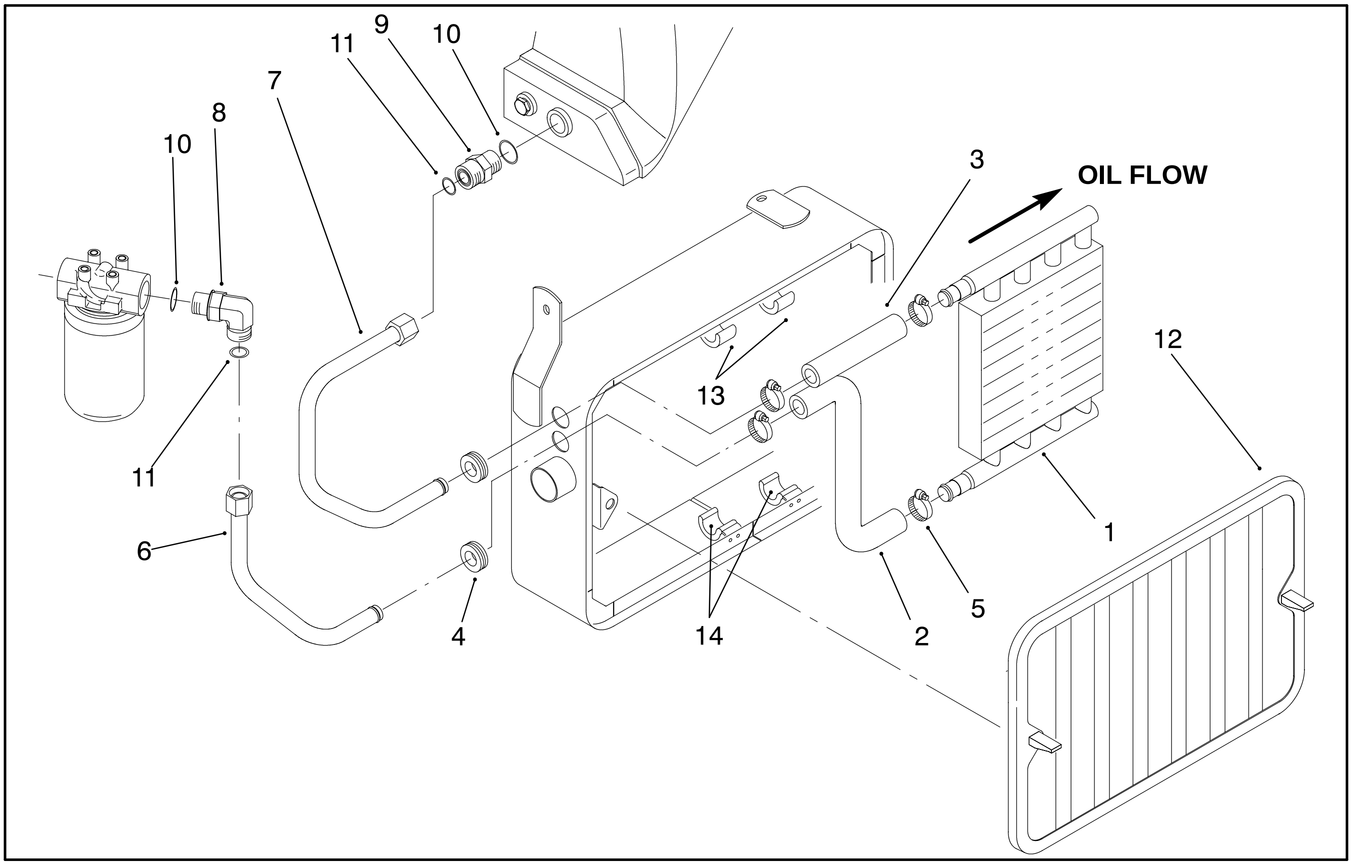

Figure 52

1. **Oil cooler**
2. **Lower formed hose**
3. **Upper formed hose**
4. **Grommet**
5. **Hose clamp**
6. **Tube assembly**
7. **Tube assembly**
8. **Hydraulic fitting**
9. **Hydraulic fitting**
10. **O-ring**
11. **O-ring**
12. **Radiator screen**
13. **Upper cooler bracket**
14. **Lower cooler bracket**

Removal (Fig. 52)

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.

CAUTION

The radiator and oil cooler may be hot. To avoid possible burns, allow the engine and cooling systems to cool before working on the oil cooler.

2. Clamp upper and lower formed hoses to prevent draining of the hydraulic system and tank.

3. Remove loosen hose clamps securing the formed hoses to the oil cooler.

4. Lift oil cooler up from the cooler brackets. Remove oil cooler from the formed hoses. Allow hoses and cooler to drain into a suitable container.

5. To clean the oil cooler, back flush with cleaning solvent. After the cooler is clean, make sure all solvent is drained from the cooler.

CAUTION

Use eye protection such as goggles when using compressed air.

6. Use compressed air in a direction opposite the oil flow to dry the cooler.

7. Plug ends of the oil cooler. Clean exterior of the cooler.

8. The oil cooler should be free of corrosion and excessive pitting of tubes.

Installation (Fig. 52)

1. Make sure formed hoses and openings of the oil cooler are clean.

2. Hang oil cooler onto cooler brackets while attaching the formed hoses to the cooler. Secure hoses by tightening the hose clamps.

3. Clean radiator screen and reinstall.

4. Remove clamps that where used to prevent drainage from the formed hoses.

5. Fill hydraulic tank (see Check Hydraulic System Fluid).

6. Start machine. Run machine at idle for 3 to 5 minutes to circulate hydraulic fluid and remove any air trapped in the system. Stop machine and recheck hydraulic tank level.

Lift Cylinders

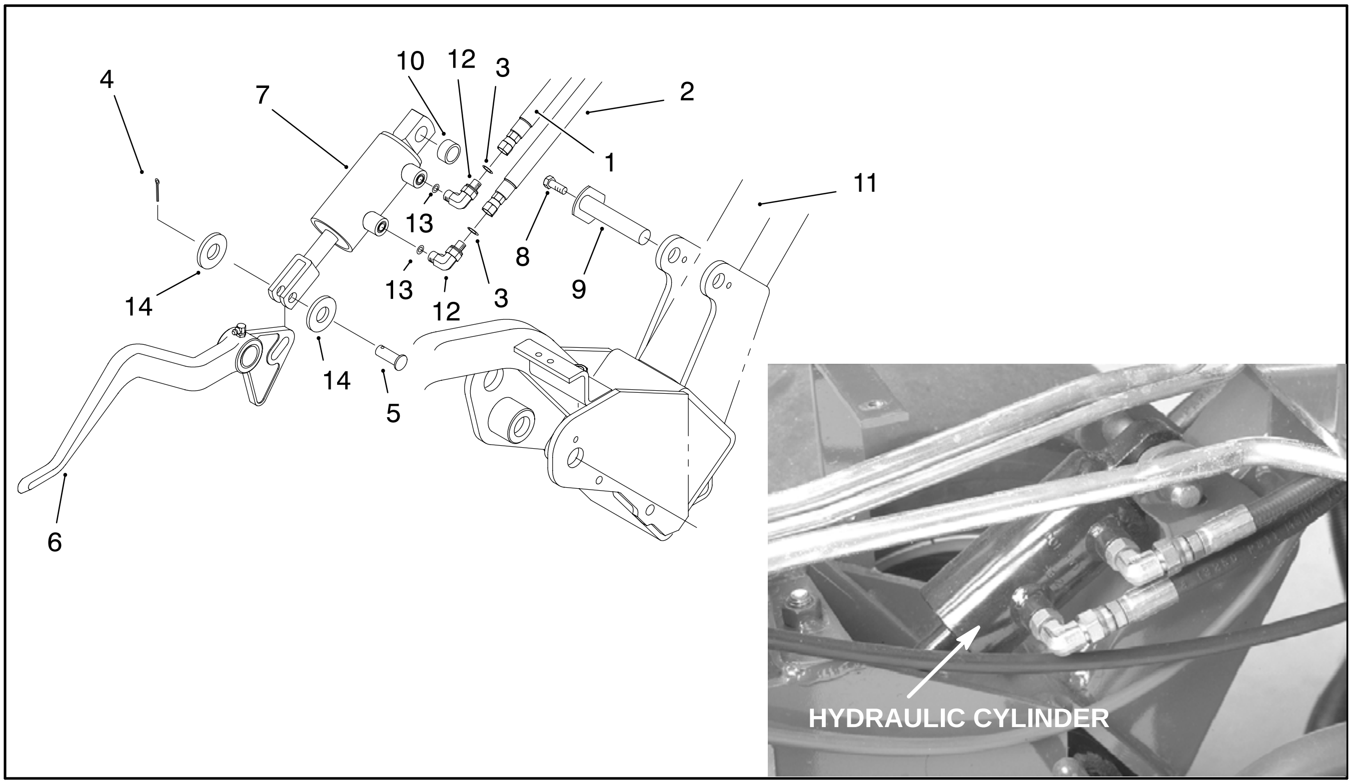

Figure 53

1. **Hose assembly**
2. **Hose assembly**
3. **O-ring**
4. **Cotter pin**
5. **Clevis pin**
6. **Lift arm**
7. **Hydraulic cylinder**
8. **Cap screw**
9. **Ram pivot pin**
10. **Spacer**
11. **Frame**
12. **90º Hydraulic fitting**
13. **O-ring**
14. **Washer**

Front Cylinder Removal (Fig. 53)

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. Allow hoses to drain into a suitable container.

4. Remove cotter pin from the clevis pin. Pull clevis pin with washers from the hydraulic cylinder and lift arm.

5. Support hydraulic cylinder to prevent it from dropping.

   A. Remove cap screw from the ram pivot pin.

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

   C. Remove hydraulic cylinder from the frame.

Front Cylinder Installation

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

2. Position clevis of the hydraulic cylinder to the lift arm. Insert clevis pin with washers through the cylinder clevis and secure with cotter pin.

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

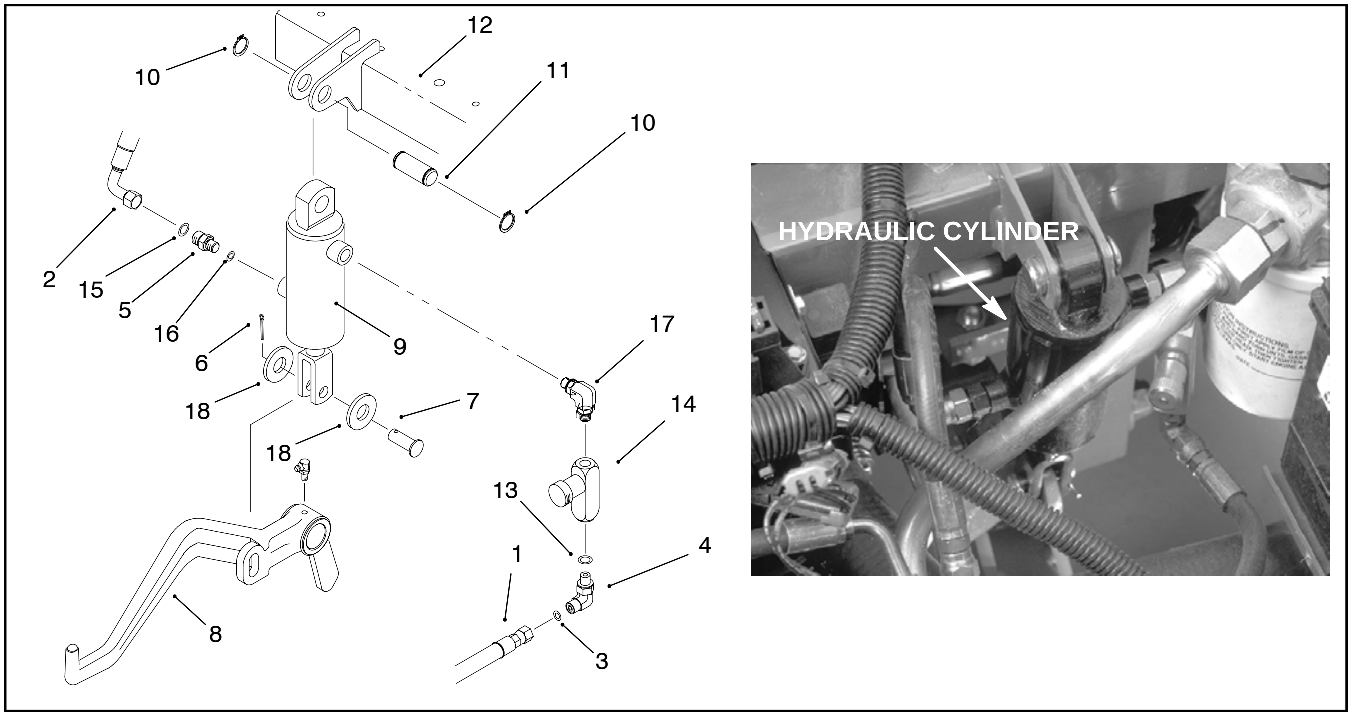

Figure 54

1. **Hose assembly**
2. **Hose assembly**
3. **O-ring**
4. **90º hydraulic fitting**
5. **Orificed hydraulic fitting**
6. **Cotter pin**
7. **Clevis pin**
8. **Lift arm**
9. **Hydraulic cylinder**
10. **Retaining ring**
11. **Cylinder pin**
12. **Frame**
13. **O-ring**
14. **Flow control valve (if equipped)**
15. **O-ring**
16. **O-ring**
17. **90º hydraulic fitting**
18. **Washer**

Rear Cylinder Removal (Fig. 54)

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-ring from the hydraulic fittings. Allow hoses to drain into a suitable container.

4. Remove cotter pin from the clevis pin. Pull clevis pin with washers from the hydraulic cylinder and lift arm.

5. Support hydraulic cylinder to prevent it from dropping.

   A. Remove a retaining ring from the cylinder pin.

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

   C. Remove hydraulic cylinder from the frame.

Rear Cylinder Installation

1. Position hydraulic cylinder tho the frame. Insert cylinder pin with retaining ring through the frame bracket and cylinder. Secure pin with retaining ring.

2. Position clevis of the hydraulic cylinder to the lift arm. Insert clevis pin with washers through the cylinder clevis and secure with cotter pin.

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

Lift Cylinder Service

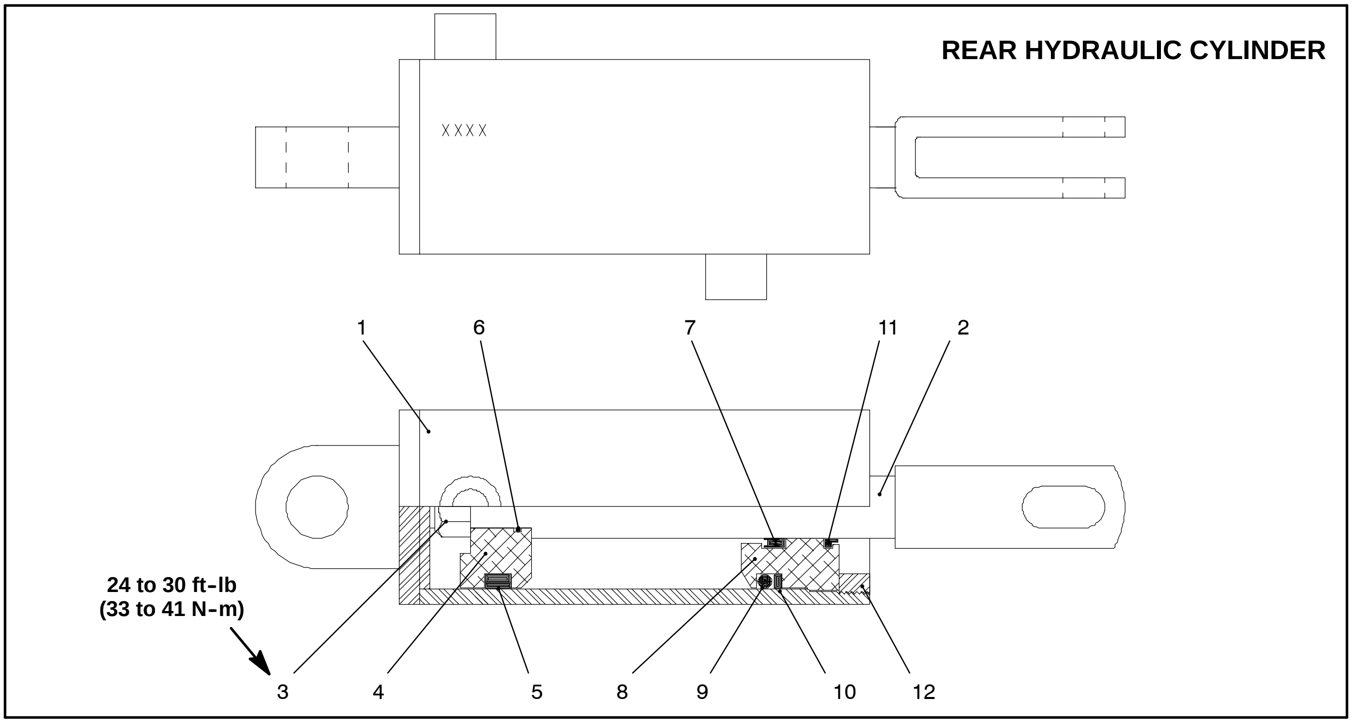

Figure 55

1. **Barrel**
2. **Shaft**
3. **Nut**
4. **Piston**
5. **Uni-ring**
6. **O-ring**
7. **Rod seal**
8. **Head**
9. **O-ring**
10. **Back-up ring**
11. **Dust seal**
12. **Internal collar**

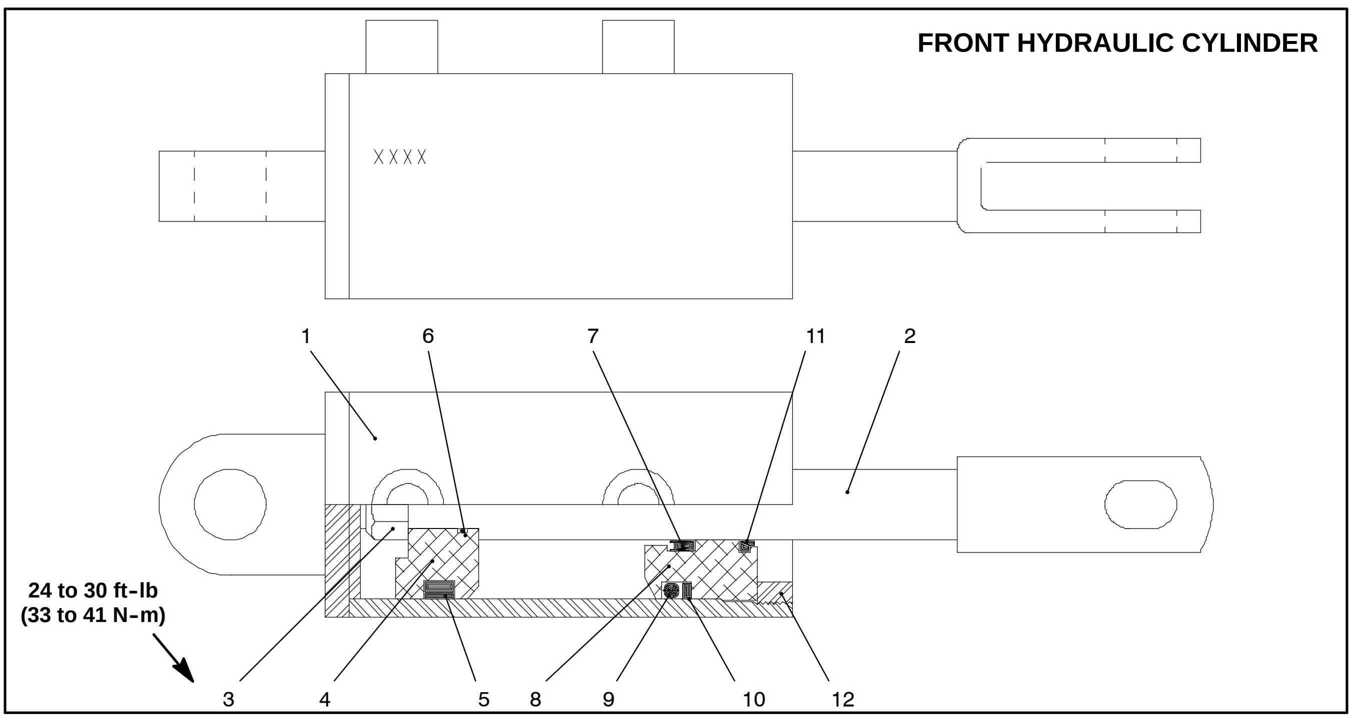

Figure 56

1. **Barrel**
2. **Shaft**
3. **Nut**
4. **Piston**
5. **Uni-ring**
6. **O-ring**
7. **Rod seal**
8. **Head**
9. **O-ring**
10. **Back-up ring**
11. **Dust seal**
12. **Internal collar**

Disassembly

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

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis 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 of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

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

Reassembly

1. Make sure all parts are clean before reassembly.

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

   A. Install Uni-ring and O-ring to the piston.

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

IMPORTANT: Do not clamp vise jaws against the shaft surface. Protect shaft surface before mounting in a vice.

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

   A. Coat shaft with with clean hydraulic oil.

   B. Slide head onto the 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 N-m)**.

   D. Remove shaft from the vise.

IMPORTANT: Prevent damage when clamping the hydraulic cylinder into a vise; clamp on the clevis 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.

Hydraulic Manifold

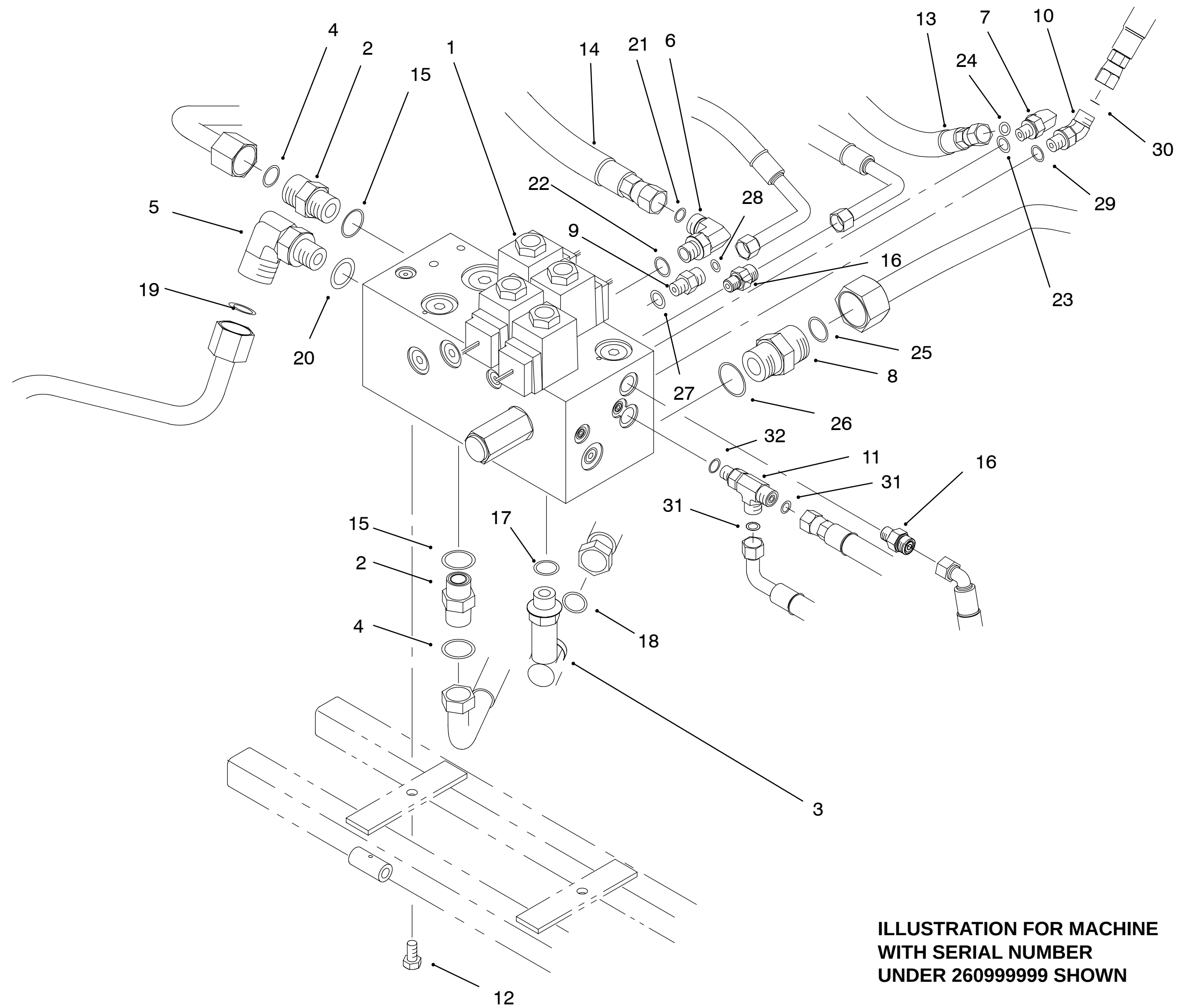

Figure 57

1. **Hydraulic manifold assembly**
2. **Hydraulic straight fitting**
3. **Hydraulic fitting**
4. **O-ring**
5. **90° Hydraulic fitting**
6. **90° Hydraulic fitting**
7. **90° Hydraulic fitting**
8. **Hydraulic straight fitting**
9. **Hydraulic straight fitting**
10. **45° Hydraulic fitting**
11. **Hydraulic T-fitting**
12. **Cap screw**
13. **Hydraulic hose**
14. **Hydraulic hose**
15. **O-ring**
16. **Orifice fitting**
17. **O-ring**
18. **O-ring**
19. **O-ring**
20. **O-ring**
21. **O-ring**
22. **O-ring**
23. **O-ring**
24. **O-ring**
25. **O-ring**
26. **O-ring**
27. **O-ring**
28. **O-ring**
29. **O-ring**
30. **O-ring**
31. **O-ring**
32. **O-ring**

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. 57)

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 a 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 assemblies and their respective O-rings from hydraulic fittings. Allow hoses to drain into a suitable container.

5. Remove both cap screws (12) 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 matchmarked to ensure it is oriented properly on the manifold.

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

Installation (Fig. 57)

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 matchmarks observed during removal.

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

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

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

Hydraulic Manifold Service (Serial Number Under 260999999)

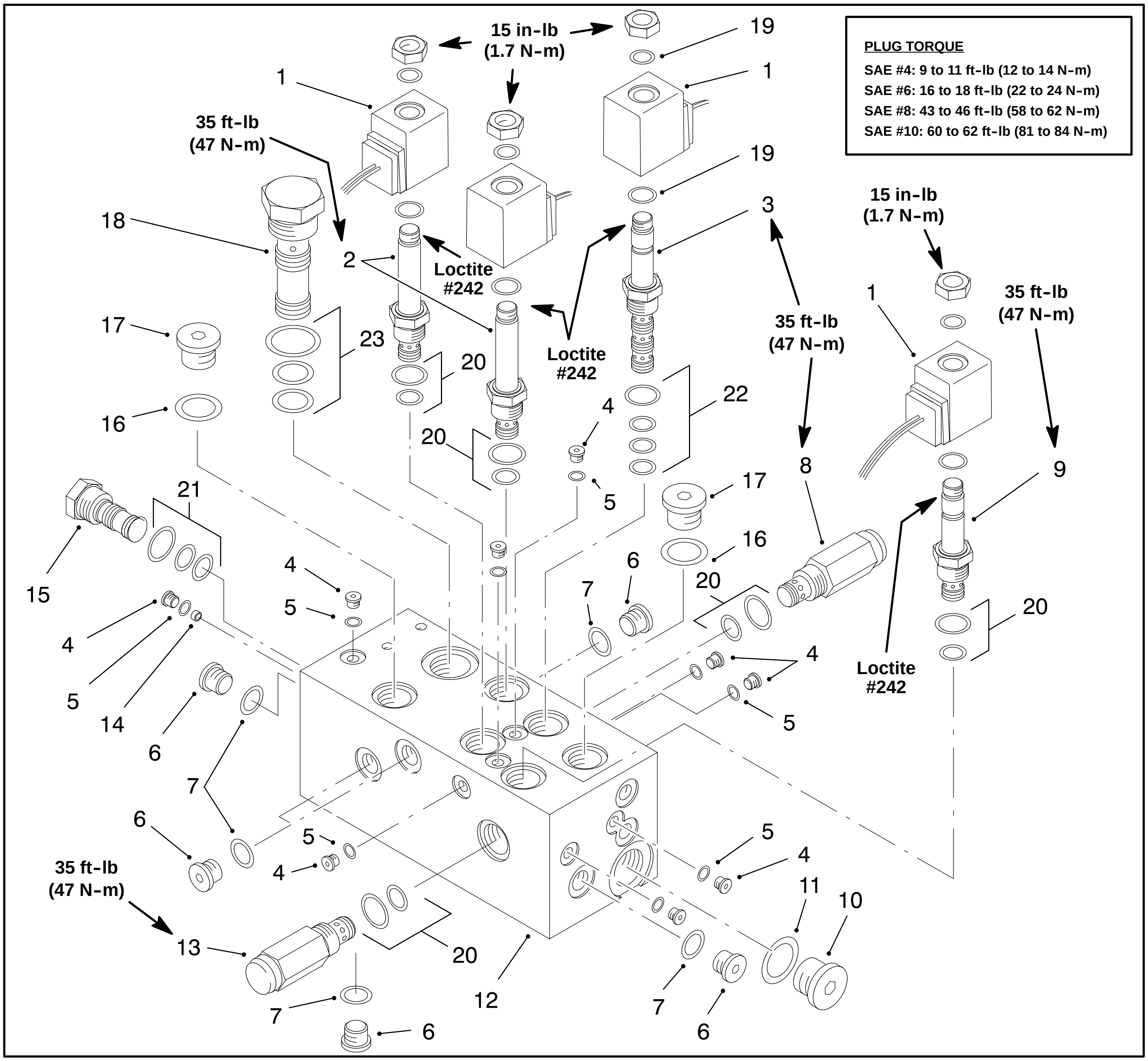

Figure 58

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. **Orifice plug (Port O1)**
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**

Note: Machines with serial number under 260999999 use a hydraulic manifold similar to the one illustrated in Figure 58. For serial numbers above 230001500, an additional solenoid operated cartridge (S6) is included in the manifold. For serial numbers above 240000000, reel speed and backup valves are included in the manifold (see Flow Control and Backlap Valves in this section).

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. 58)

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 N-m)**.

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 N-m)**.

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

Cartridge Relief Valves (Fig. 58)

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 N-m)**.

Hydraulic Manifold Service (Serial Number Over 270000000)

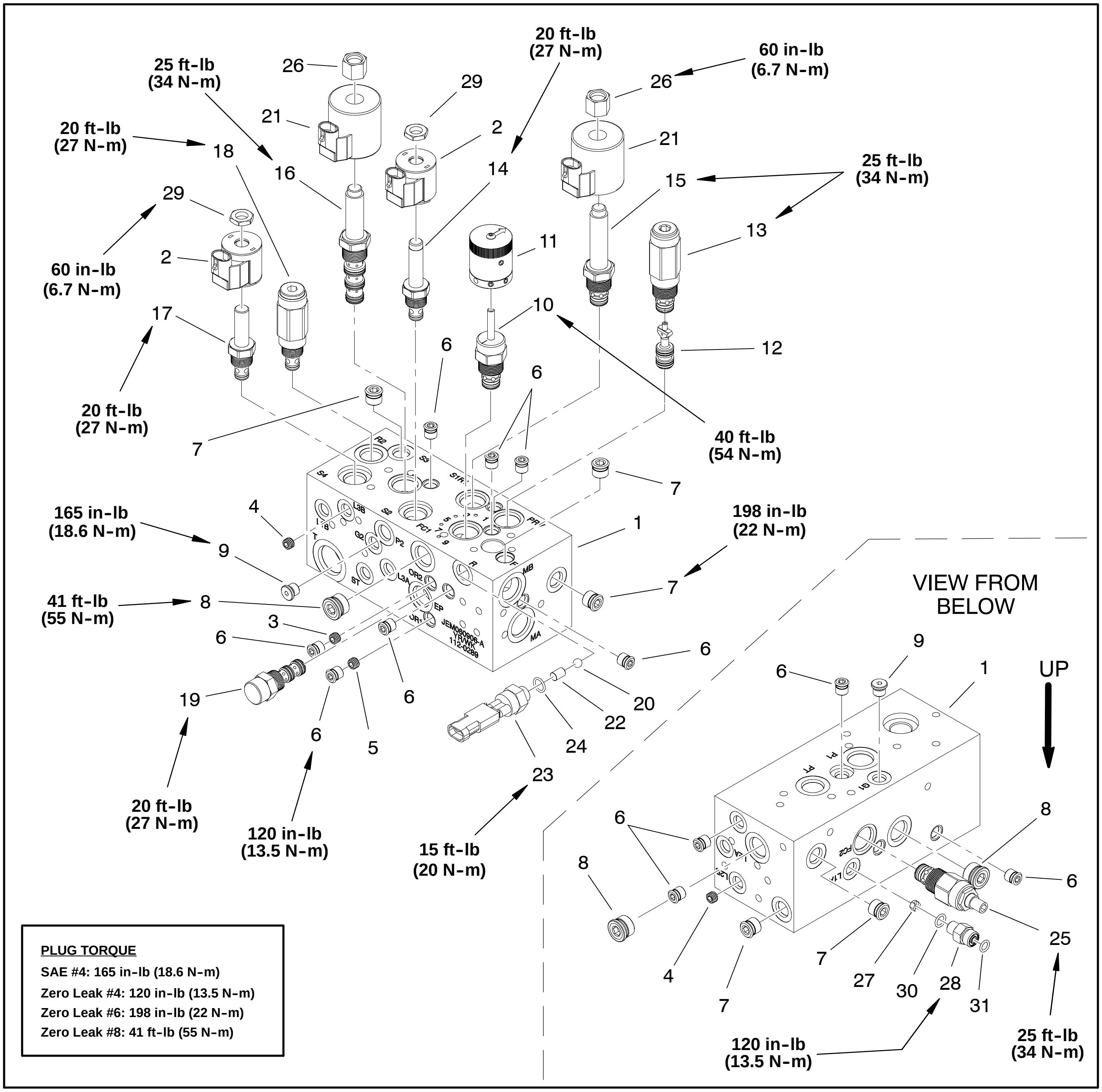

Figure 59

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 59 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 59.

Solenoid Operated, Relief and Logic Control Cartridge Valves

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 cartridge threads 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 59.

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. 60):

   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 cartridge threads with clean hydraulic oil. Thread rotary cartridge valve carefully into the manifold port. The valve should go in easily without binding. Torque valve with a deep well socket to **40 ft–lb (54 N–m)**.

6. Install rotary handle (Fig. 60):

   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.

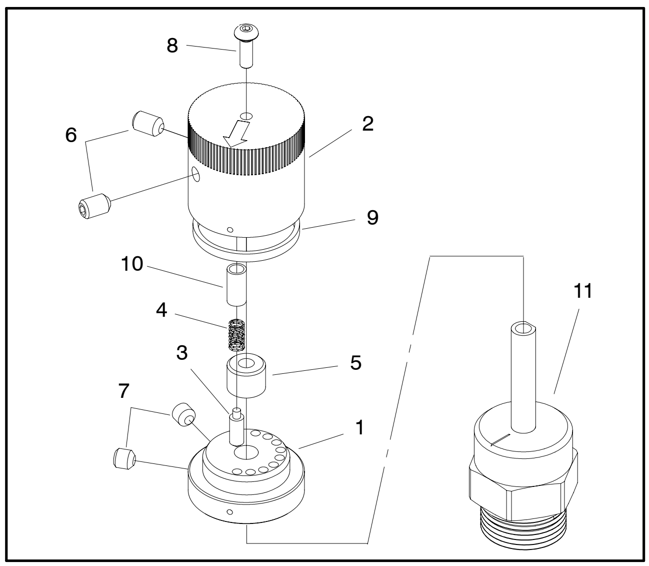

Figure 60

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. 61)

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)**.

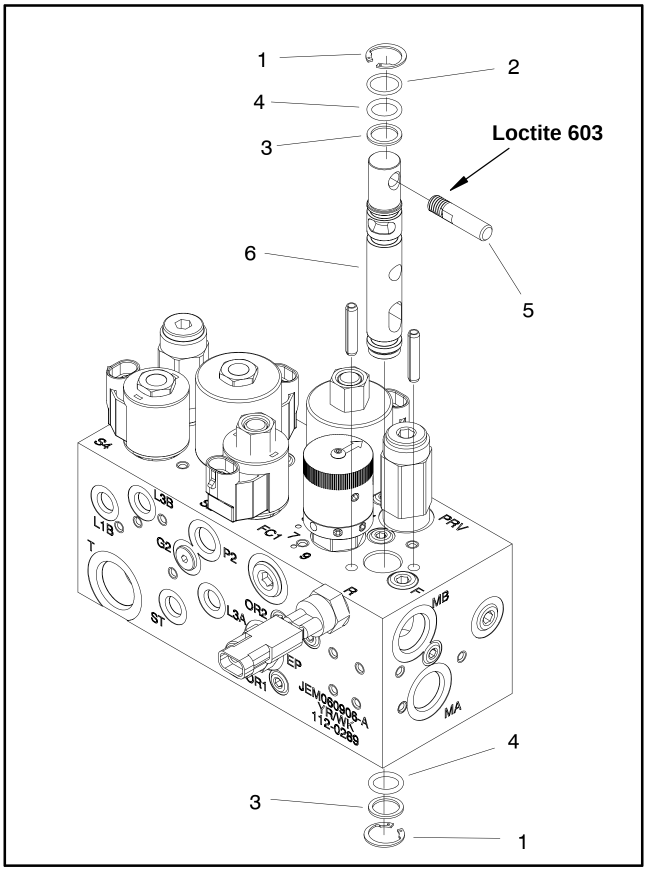

Figure 61

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

Hydraulic System

Flow Control and Backlap Valves (If Equipped on Serial Number Under 260999999)

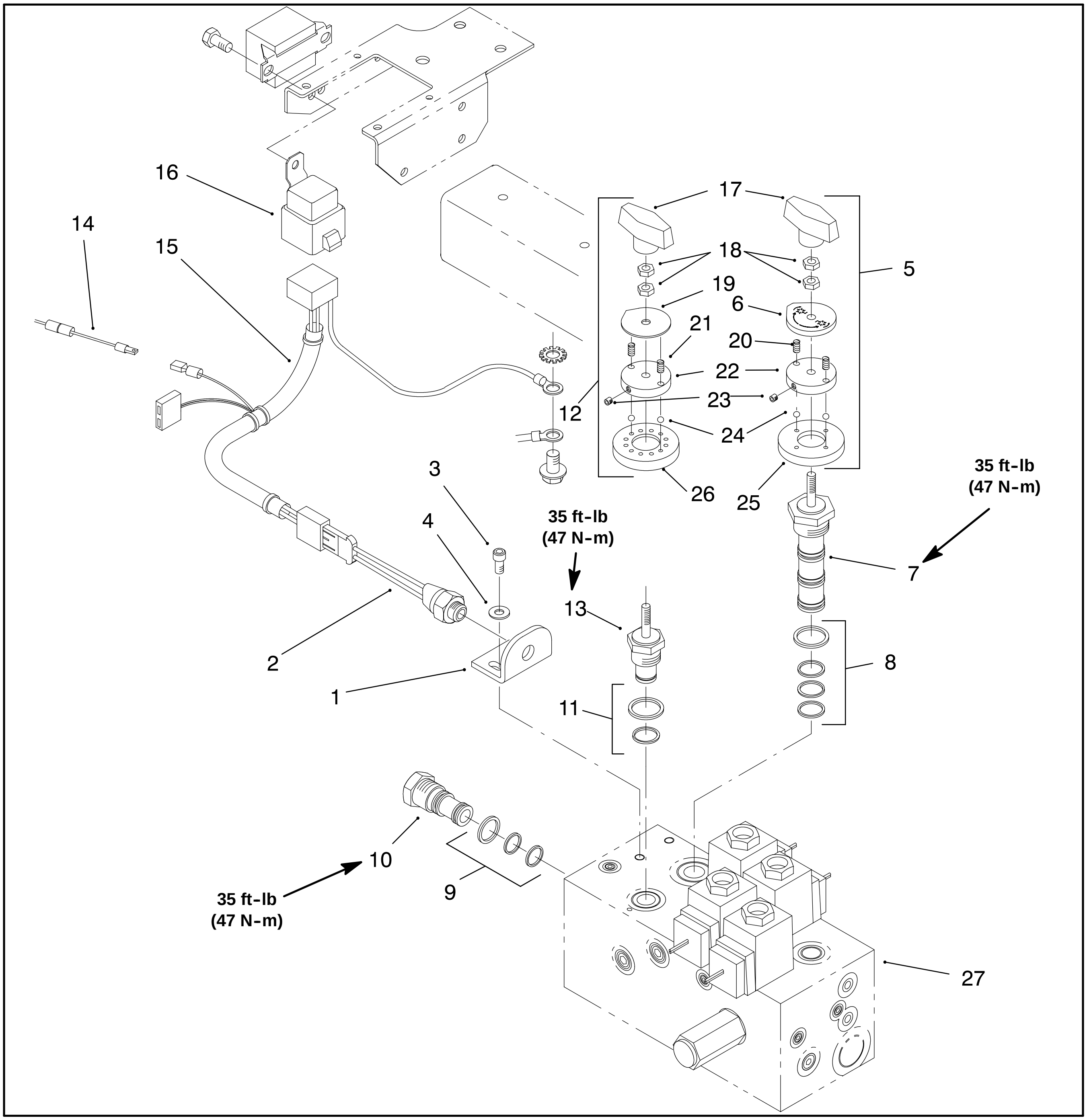

Figure 62

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. **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.

Flow Control and Two Position Directional Valves (Fig. 62)

> **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 N-m)**.

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).

Logic Cartridge Valves (Fig. 62)

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 N–m)**.

Rear Lift Cylinder Flow Control Valve

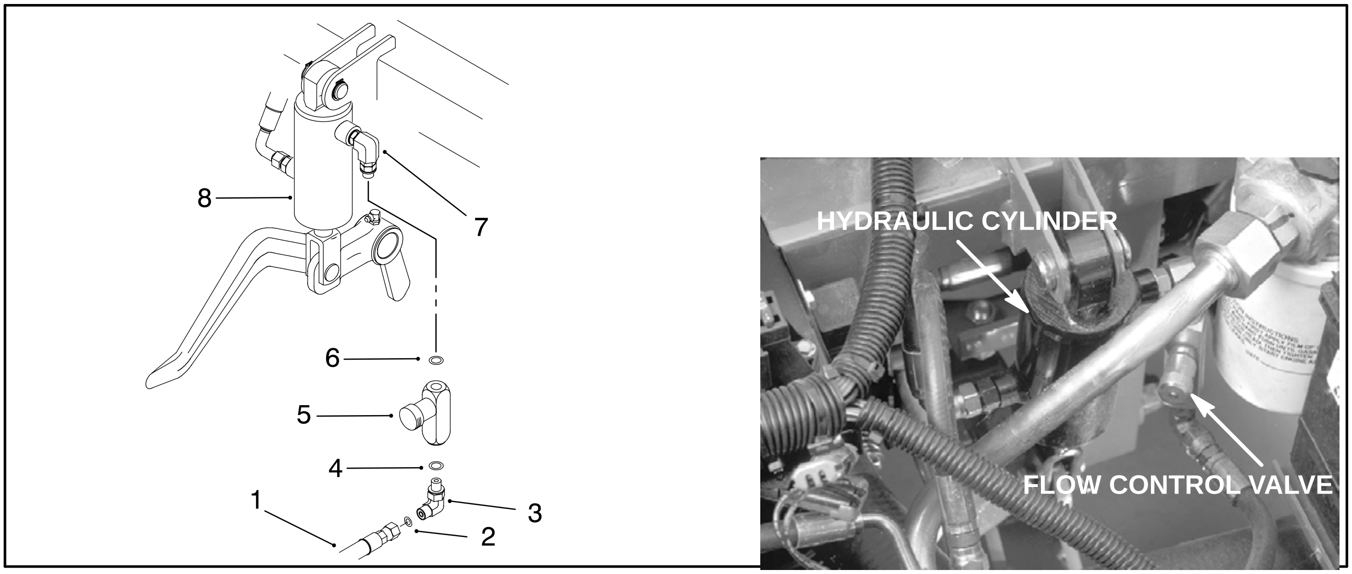

Figure 63

1. Hose assembly
2. O-ring
3. 90° Hydraulic fitting
4. O-ring
5. Flow control valve
6. O-ring
7. 90° Hydraulic fitting
8. Hydraulic cylinder

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.

Figure 64

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.

Steering Control Valve

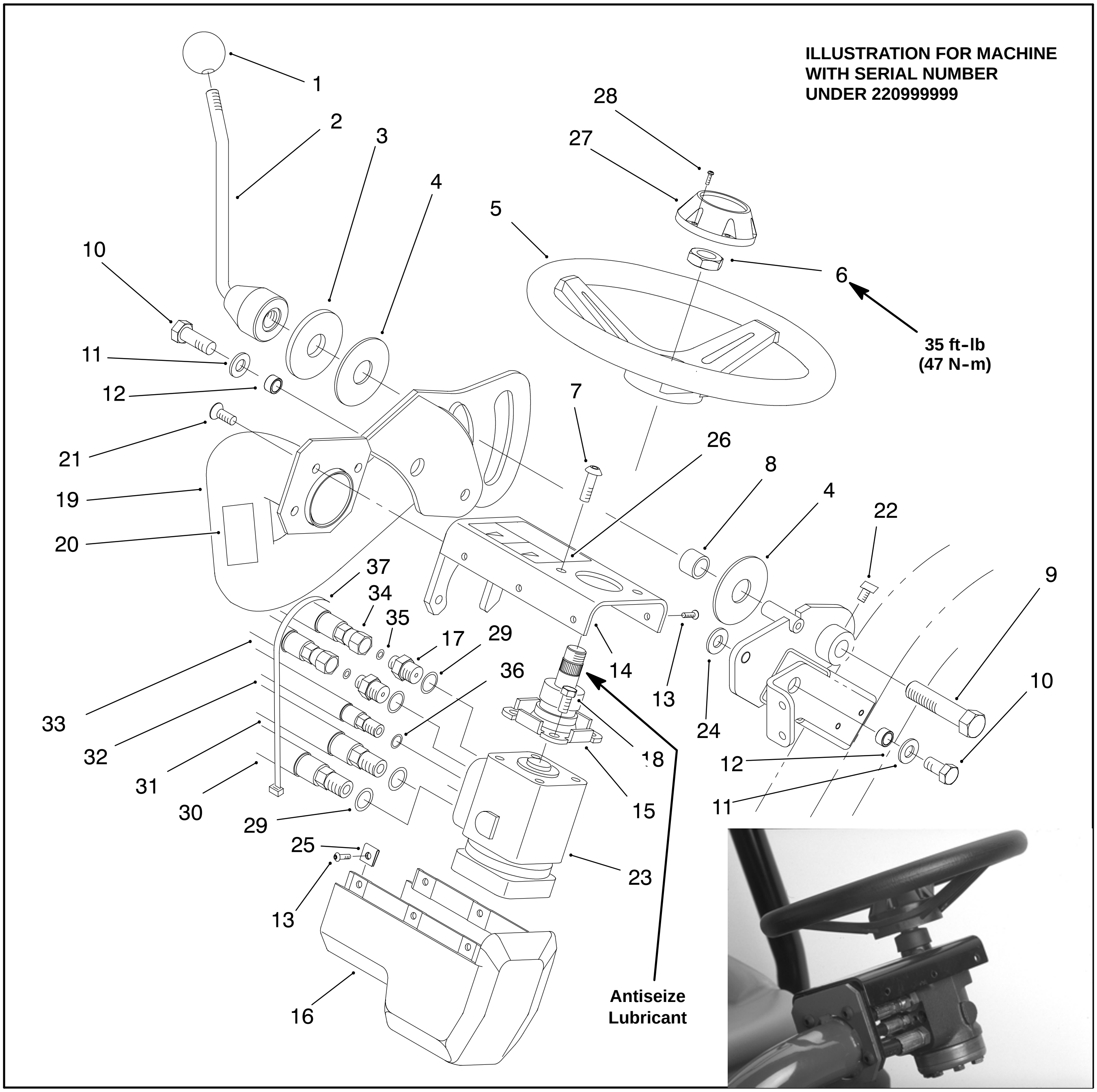

Figure 65

1. **Knob**
2. **Lockup handle**
3. **Lockup spacer**
4. **Friction disc**
5. **Steering wheel**
6. **Steering wheel nut**
7. **Socket head screw**
8. **Lockup spacer**
9. **Socket head screw**
10. **Cap screw**
11. **Flat washer**
12. **Bushing**
13. **Socket head screw (6 used)**
14. **Steering arm cover**
15. **Steering column assembly**
16. **Steering valve cover**
17. **Hydraulic fitting (2 used)**
18. **Cap screw**
19. **Steering arm**
20. **Decal**
21. **Socket head screw (3 used)**
22. **Square head screw**
23. **Steering control valve**
24. **Thrust washer**
25. **Speed nut (6 used)**
26. **Warning decal**
27. **Steering wheel cap**
28. **Screw**
29. **O-ring**
30. **Hose assembly**
31. **Hose assembly**
32. **Hose assembly**
33. **Hose assembly**
34. **Hose assembly**
35. **O-ring**
36. **O-ring**
37. **Cable tie**

Removal (Fig. 65)

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 (28) and steering wheel cap (27) from the steering wheel (5).

3. Remove steering wheel nut (6) from the steering column assembly (15).

4. Remove screws (13) from the speed nuts (25) and steering valve cover (16). Remove cover from the steering cover assembly (14).

5. Cut and remove cable tie (37) from the hose assemblies. Label all hydraulic connections for assembly purposes.

Note: Three different styles of steering control valve have been used on Greensmaster 3250–D machines. Figure 65 illustrates machines with serial number under 220999999. Machines with serial number from 230000000 to 270999999 use four hydraulic fittings on the control valve (Fig. 66). Machines with serial number above 280000000 use a control valve without a steering column (Fig. 67). Use appropriate illustration as a guide when removing steering control valve.

6. For hydraulic hoses that attach to fittings in steering control valve, disconnect hoses from fittings and remove O–rings. Allow hoses to drain into a suitable container.

7. For remaining hydraulic hose(s) that thread directly into control valve, disconnect opposite end of hose from fitting on hydraulic manifold or steering cylinder. Allow hose(s) to drain into a suitable container. Note routing of hydraulic hose(s) for assembly purposes.

8. Remove cap screws from the steering arm cover and steering control valve. Carefully pull control valve with attached hydraulic hose(s) free of the machine.

9. Remove hydraulic fittings and O–rings from the control valve. Remove hydraulic hose(s) and O–rings from the steering control valve.

10. If equipped, remove steering column assembly from the steering control valve.

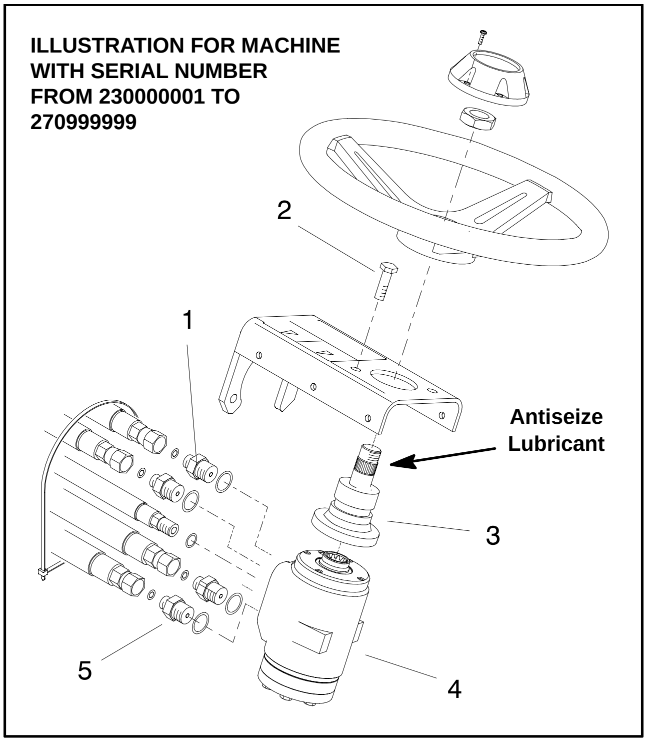

Figure 66

1. **Fitting (2 used)**
2. **Cap screw (4 used)**
3. **Steering column**
4. **Steering control valve**
5. **Fitting (2 used)**

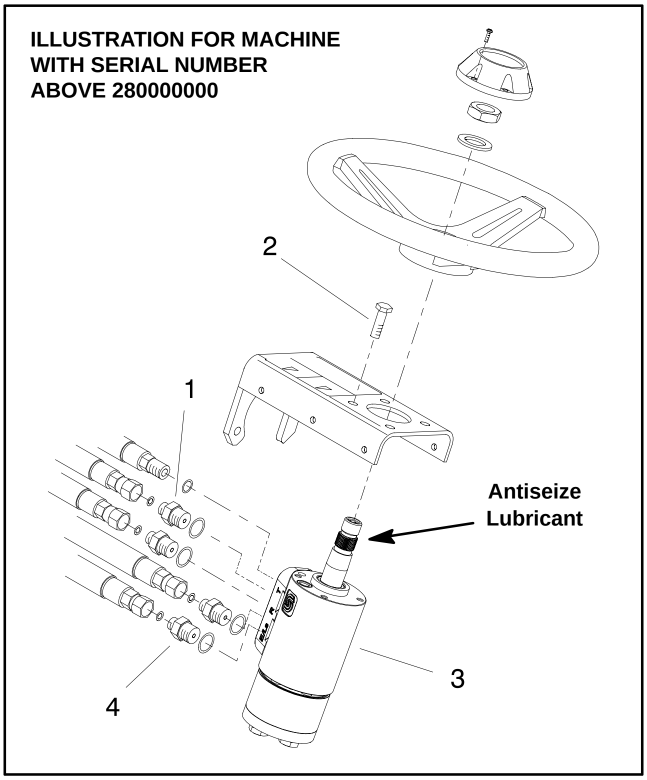

Figure 67

1. **Fitting (2 used)**
2. **Cap screw (4 used)**
3. **Steering control valve**
4. **Fitting (2 used)**

Installation (Fig. 65)

1. Install removed hose assemblies and O-rings to the steering control valve. Install removed hydraulic fittings and O-rings to the control valve.

2. Install steering column assembly to the steering control valve.

3. While routing hydraulic hoses to machine, position steering control valve into the steering cover assembly. Secure control valve to steering arm cover with cap screws.

4. For hydraulic hose(s) that thread directly into control valve, correctly connect opposite end of hose to fitting on hydraulic manifold or steering cylinder.

5. Connect remaining hoses to fittings in steering control valve.

6. Install cable tie to the hose assemblies.

7. Position steering valve cover (16) to the steering cover assembly (14). Secure cover to assembly with screws (13) and speed nuts (25).

8. Apply antiseize lubricant to splines of steering column. Install steering wheel and secure with nut. Torque nut to **35 ft-lb (47 N-m)**.

9. Secure steering wheel cap to the steering wheel with screw.

Hydraulic System

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Steering Control Valve Service (Serial Number Under 220999999)

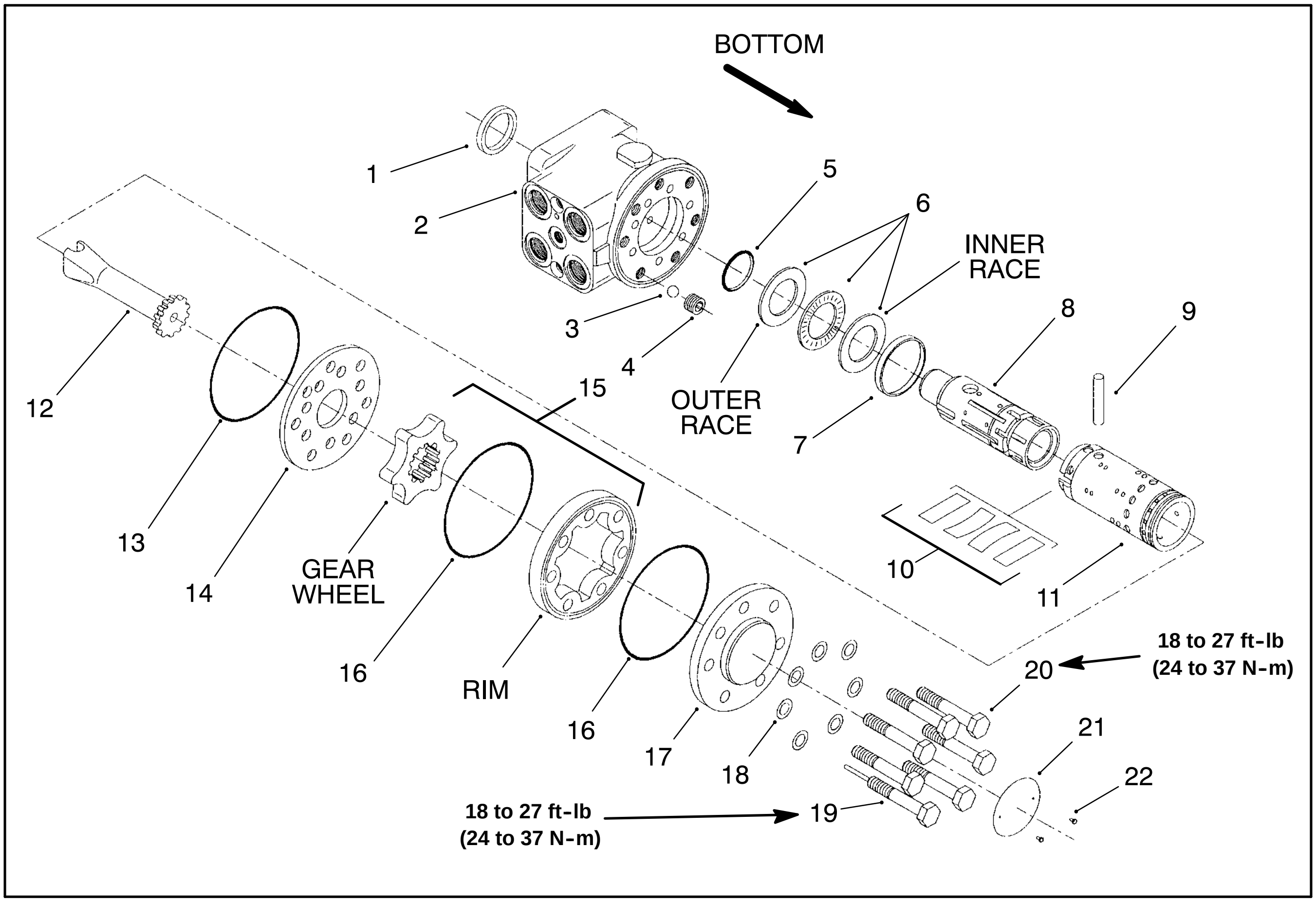

Figure 68

1. **Dust seal**
2. **Housing**
3. **Ball**
4. **Threaded bushing**
5. **O-ring/kin-ring**
6. **Bearing assembly**
7. **Ring**
8. **Spool**
9. **Cross pin**
10. **Spring set**
11. **Sleeve**
12. **Cardan shaft**
13. **O-ring**
14. **Distributor plate**
15. **Gear wheel set**
16. **O-ring**
17. **End cover**
18. **Washer**
19. **Special screw**
20. **Screw**
21. **Name plate**
22. **Drive screw**

Disassembly (Fig. 68)

1. Make sure caps or plugs are in motor openings to prevent contamination. Clean motor with solvent.

IMPORTANT: Use caution when using a vise to hold the control valve. Do not over tighten. Parts may become distorted.

2. Secure control valve in a vise with the screw heads up. Remove six screws, one special screw, and seven washers from the valve.

3. Slide end cover off the gear wheel set. Remove gear wheel set. Remove both O-rings from the rim.

4. Lift and remove cardan shaft from the control valve.

5. Remove distributor plate from the control valve and O-ring from housing.

6. Screw out threaded bushing from the control valve. Remove remove valve from the vise and shake out the ball.

Note: The cross pin can be seen through the open end of the spool.

7. Make sure cross pin is kept horizontal in the spool and sleeve. Remove sleeve, ring, and bearing from the housing by pressing the spool out the housing bottom (Fig. 69).

Note: The outer race of the bearing assembly may stick in the housing. Make sure race is removed from the housing.

8. Remove ring and bearing assembly from the spool.

Note: There is a small match mark on both the spool and sleeve near one of the slots for the spring. If the mark is not visible, match mark both the sleeve and spool before removing the springs (Fig. 70).

9. Use special screw to press out cross pin from the sleeve and spool (Fig. 69). Press spool carefully out of the sleeve.

10. Press springs out of their slots in the spool.

11. Remove dust seal and O-ring/kin-ring from the housing. Discard all seals, O-rings, and washers.

12. Remove all nicks and burrs from all parts with an emery cloth.

CAUTION

Use eye protection such as goggles when using compressed air.

13. Clean all parts with solvent. Dry all parts with compressed air.

Reassembly (Fig. 68)

1. Lubricate all parts, O-ring/kin-ring, dust seal, washers, and O-rings with clean hydraulic fluid.

2. Insert two flat springs into the slot of the spool. Insert two curved springs between the flat springs and press them into place (Fig. 71).

3. Install spool into the sleeve. Make sure match marks on each part are aligned. Press springs together and push them into slot in the sleeve. Line up springs and center them (Fig. 70 and 71).

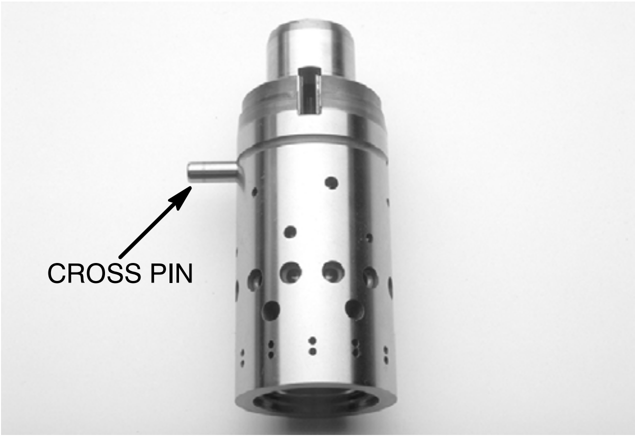

Figure 69

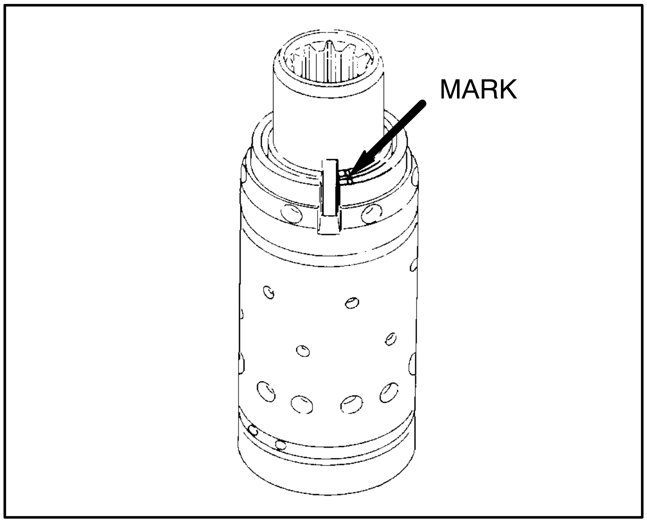

Figure 70

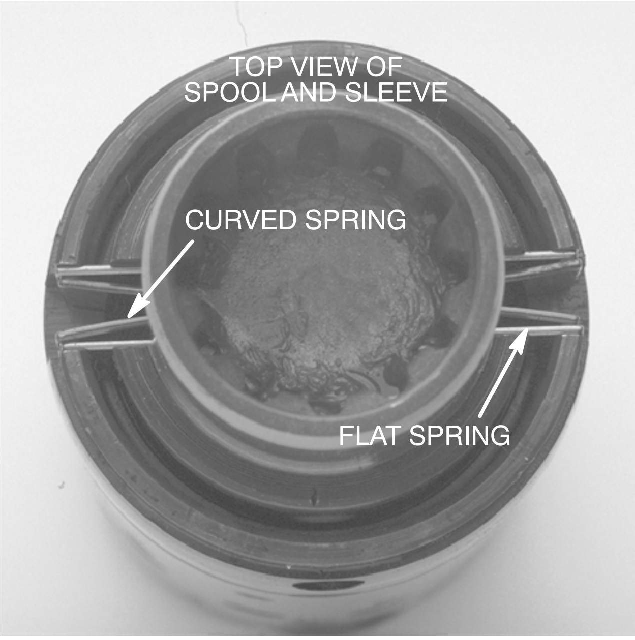

Figure 71

Hydraulic System

4. Install ring over the sleeve. Make sure ring is able to rotate free of the springs.

5. Insert cross pin into the spool and sleeve (Fig. 69).

6. Install bearing assembly onto the spool and sleeve (Fig. 72).

7. Coat new O-ring/kin-ring lightly with petroleum jelly. Install ring carefully into the inner bore of the housing so that they fit snuggly in place (Fig. 73 and 74).

Note: The cross pin should be held horizontal when inserting the spool and sleeve into the housing.

Note: The clearance between the sleeve and the housing bore is very tight. The heat from one's hand can cause the sleeve to expand enough so that it will not fit into the housing. Refrigerate the spool/sleeve assembly prior to installation. Insulate assembly from one's hand when installing.

8. Guide spool and sleeve into the housing carefully by using a light turning motion. Be careful not to damage the O-ring/kin-ring.

9. Place ball into the largest threaded hole. Secure ball into hole by threading in the bushing. Make sure the top of the bushing lies just bellow the surface of the housing (Fig. 74).

10. Coat new O-ring lightly with petroleum jelly. Install O-ring into groove on housing surface.

11. Mount distributor plate onto housing. Make sure channel holes in plate match the hole of the housing.

12. Insert cardan shaft carefully into the bore of the housing. Make sure shaft slot is parallel with the surface of the connection flange.

13. Coat both new O-rings lightly with petroleum jelly. Install O-rings into grooves on rim of gear wheel set. Place rim onto distributor plate.

IMPORTANT: The gear wheel fits into the cardan shaft from one direction only. The tooth base on the wheel should be positioned in relation to the shaft slot (Fig. 75).

14. Fit gear wheel onto cardan shaft and into the rim. Make sure holes in rim are aligned with holes in the housing.

15. Install end cover onto rim of gear wheel.

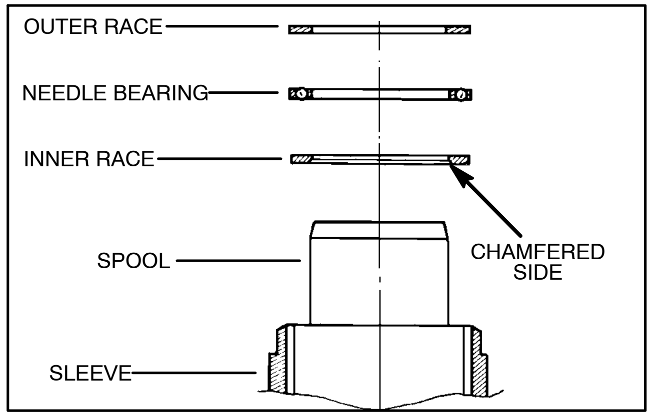

Figure 72

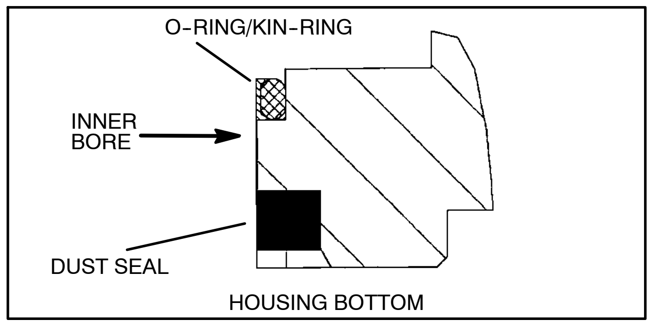

Figure 73

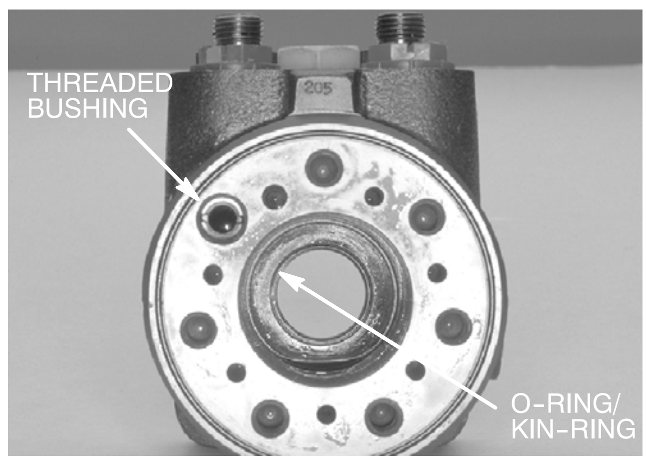

Figure 74

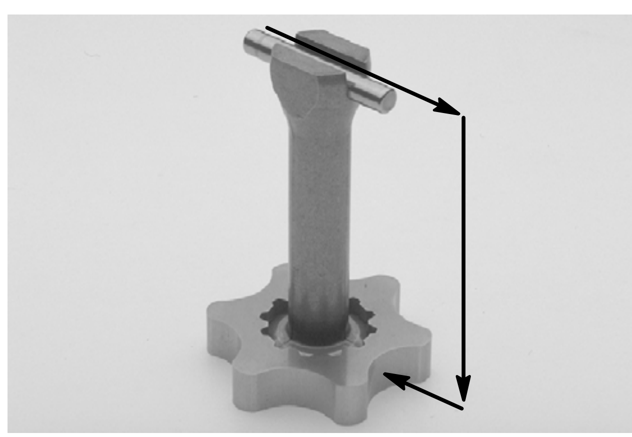

Figure 75

16. Secure special screw with new washer into the hole shown (Fig. 76 and 77).

17. Secure remaining screws with washers into control valve. Torque all screws in a criss-cross pattern from **18 to 27 ft-lb (24 to 37 N-m)**.

18. Install dust seal carefully into the housing.

Figure 76

Figure 77

Hydraulic System

Steering Control Valve Service (Serial Number From 230000000 to 270999999)

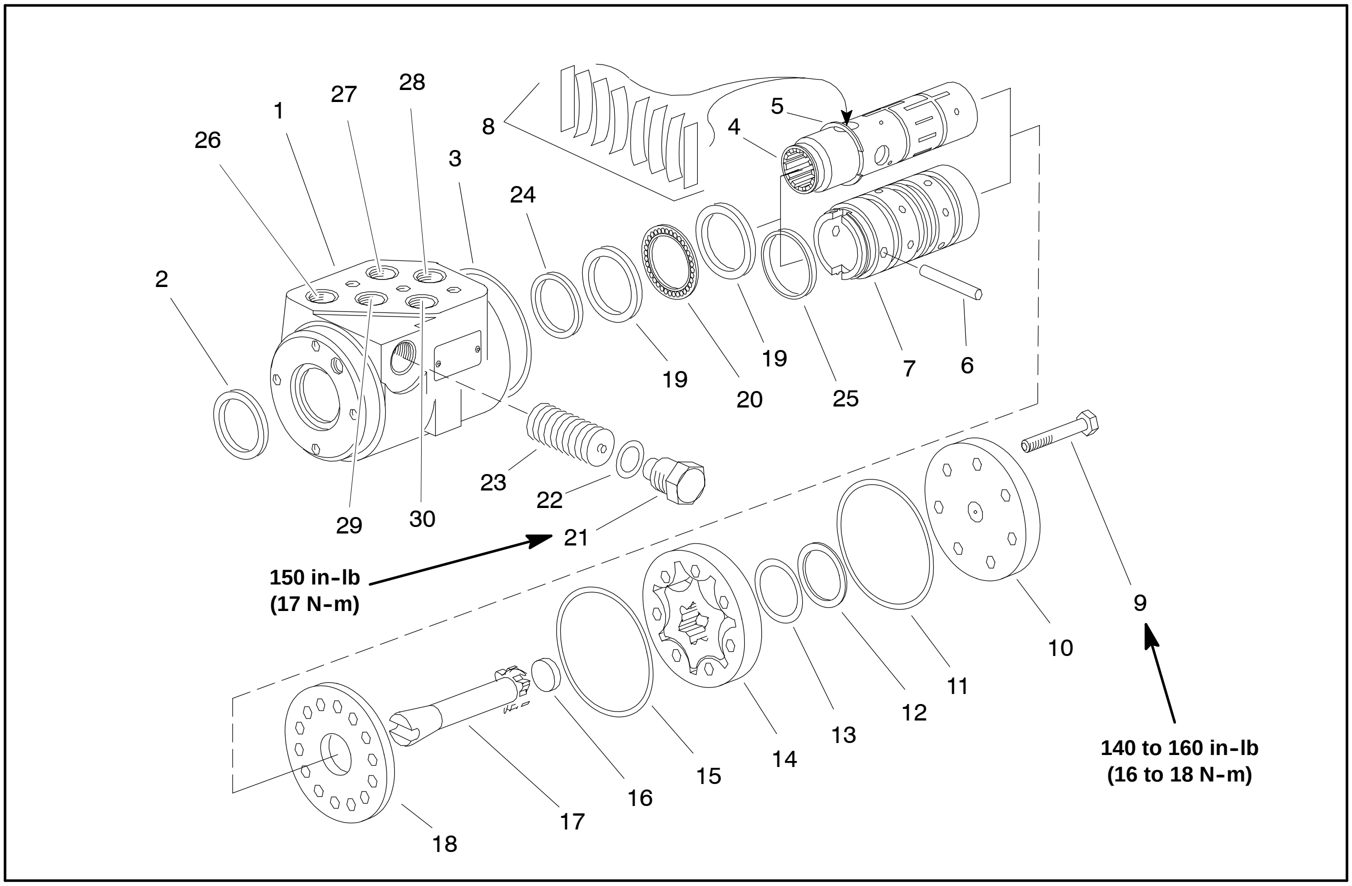

Figure 78

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**
26. **T port**
27. **E port**
28. **R port**
29. **L port**
30. **P port**

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. 78).

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. 79).

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 N–m)**.

20. Remove the steering control unit from the vise.

21. Install the relief valve and plug. Tighten the plug to **150 in-lb (17 N–m)**.

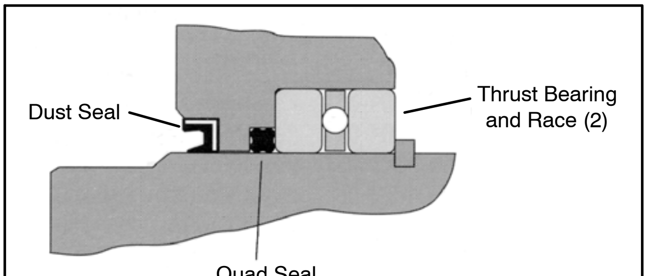

Figure 79

Hydraulic System

Steering Control Valve Service (Serial Number Over 280000000)

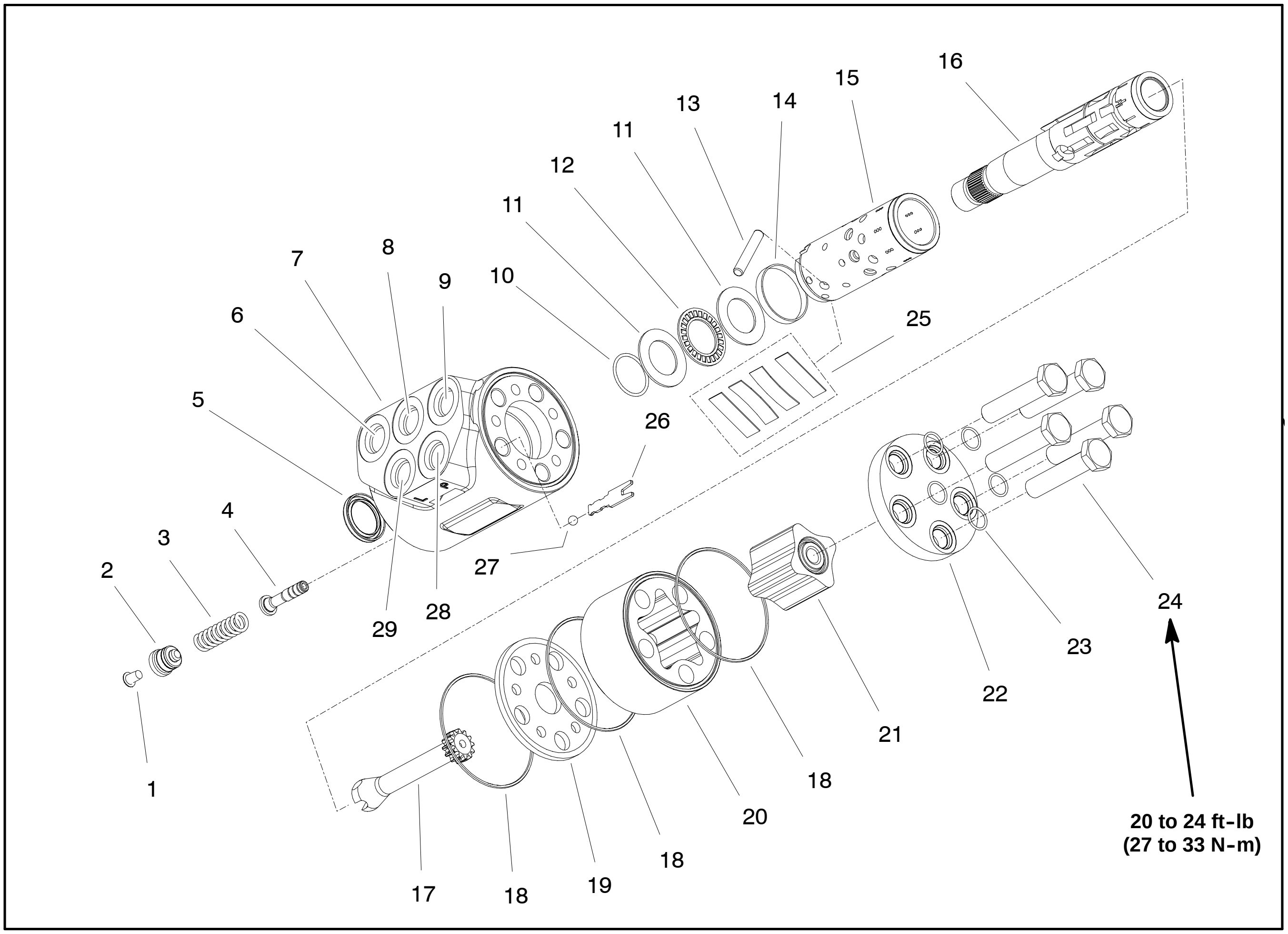

Figure 80

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 80, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

Hydraulic System

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Steering Cylinder

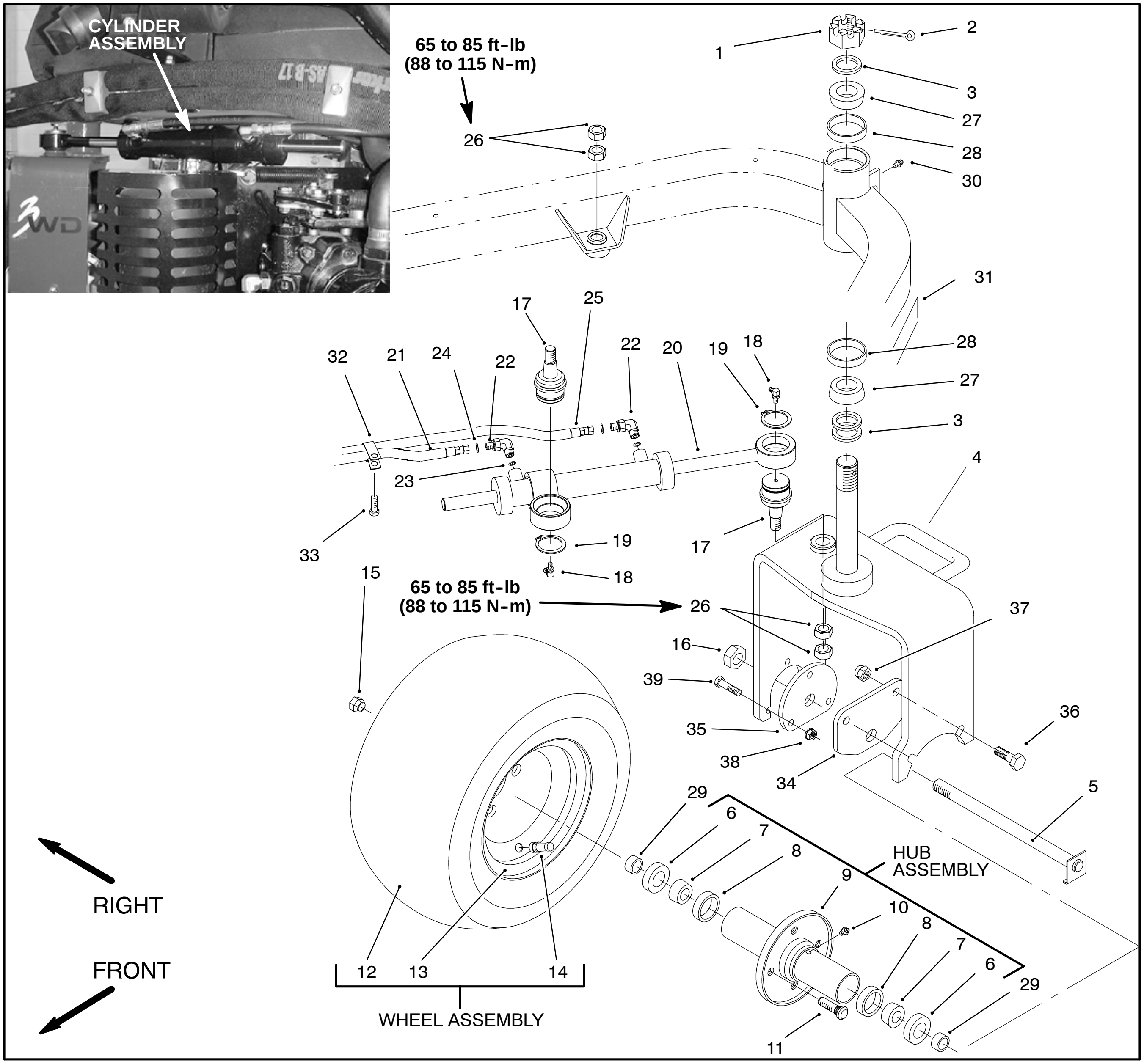


Figure 81

1. Slotted hex nut
2. Cotter pin
3. Steering washer
4. Castor fork
5. Bolt
6. Oil seal
7. Bearing cone
8. Bearing cup
9. Wheel hub
10. Grease fitting
11. Drive stud
12. Tire
13. Rim
14. Valve stem
15. Lug nut
16. Lock nut
17. Ball joint
18. Grease fitting
19. Retaining ring
20. Steering cylinder
21. Hydraulic hose
22. 90º Hydraulic fitting
23. O–ring
24. O–ring
25. Hydraulic hose
26. Jam nut
27. Bearing cone
28. Bearing cup
29. Rear spindle spacer
30. Grease fitting
31. Decal
32. Hose clamp
33. Hex washer head screw
34. Motor adapter plate
35. Adapter plate
36. Cap screw
37. Lock nut
38. Lock nut
39. Cap screw

Removal (Fig. 81)

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. Allow hoses to drain into a suitable container.

4. Gain access to front ball joint.

A. Remove three cap screws and flat washers securing the fuel tank base plate to frame. Two screws are on the top of the plate at the front corners of the tank. The third screw is in front of the castor fork and below the plate.

B. Tilt fuel tank base up by lifting at the right of the machine to gain access to the top of the jam nuts and ball joint. Prop up tank securely.

5. Remove both jam nuts from the ball joint. Rotate steering cylinder and detach ball joint from frame bracket.

6. Pivot steering cylinder out from the frame. Remove retaining ring from the rear of the cylinder. Remove cylinder from rear ball joint.

7. Remove front retaining ring and ball joint from the steering cylinder. Remove hydraulic fittings and O–rings from the cylinder.

CAUTION

Support rear wheel to prevent dropping and causing personal injury while removing hex nut. Use two people to remove steering cylinder.

8. If the rear ball joint needs to be removed, accomplish the following:

A. Block front wheels. Jack up rear wheel off the ground by the frame. Secure the frame with the wheel off the ground.

B. Remove lock nut, bolt, spacers, and wheel from the castor fork.

C. Remove jam nuts and ball joint from the castor fork.

Installation (Fig. 81)

1. If the rear ball joint was removed, accomplish the following:

A. Secure ball joint to the castor fork with jam nuts. Torque nuts from **65 to 85 ft–lb (88 to 115 N–m)**.

B. Install wheel to the castor fork by inserting the bolt through the fork, spacer, wheel, spacer, and fork. Secure bolt with lock nut.

C. Lower wheel to ground

2. Install hydraulic fittings and O–rings to the steering cylinder. Install front ball joint to the cylinder and secure with retaining ring.

3. Install steering cylinder to the rear ball joint. and secure with retaining ring.

4. Pivot steering cylinder into the frame. Rotate steering cylinder and install ball joint to the frame bracket. Secure ball joint to the bracket with jam nuts. Torque nuts from **65 to 85 ft–lb (88 to 115 N–m)**.

5. Lower fuel tank base to the frame. Secure base to the frame with the three cap screws and flat washers.

6. Connect hydraulic hoses and O–rings to the hydraulic fittings. Tighten hose connections.

Steering Cylinder Service

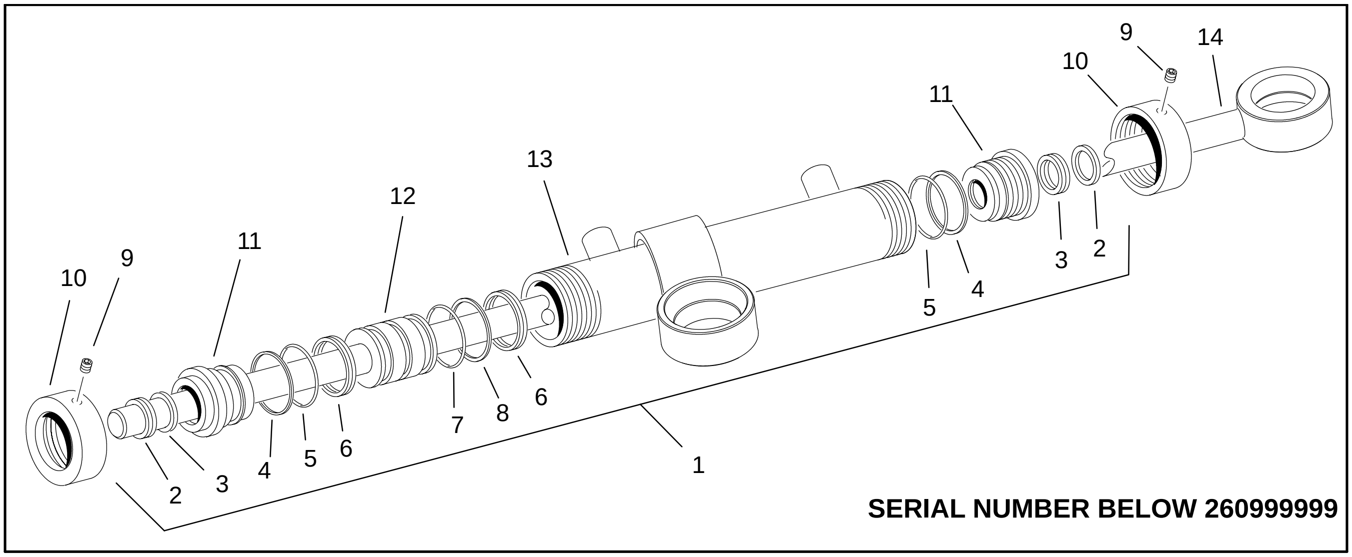


Figure 82

1. **Seal kit**
2. **Rod wiper**
3. **U-cup**
4. **Back-up ring**
5. **O-ring**
6. **Wear ring**
7. **Piston ring**
8. **O-ring**
9. **Set screw**
10. **Threaded cap**
11. **Head**
12. **Piston**
13. **Barrel**
14. **Rod**

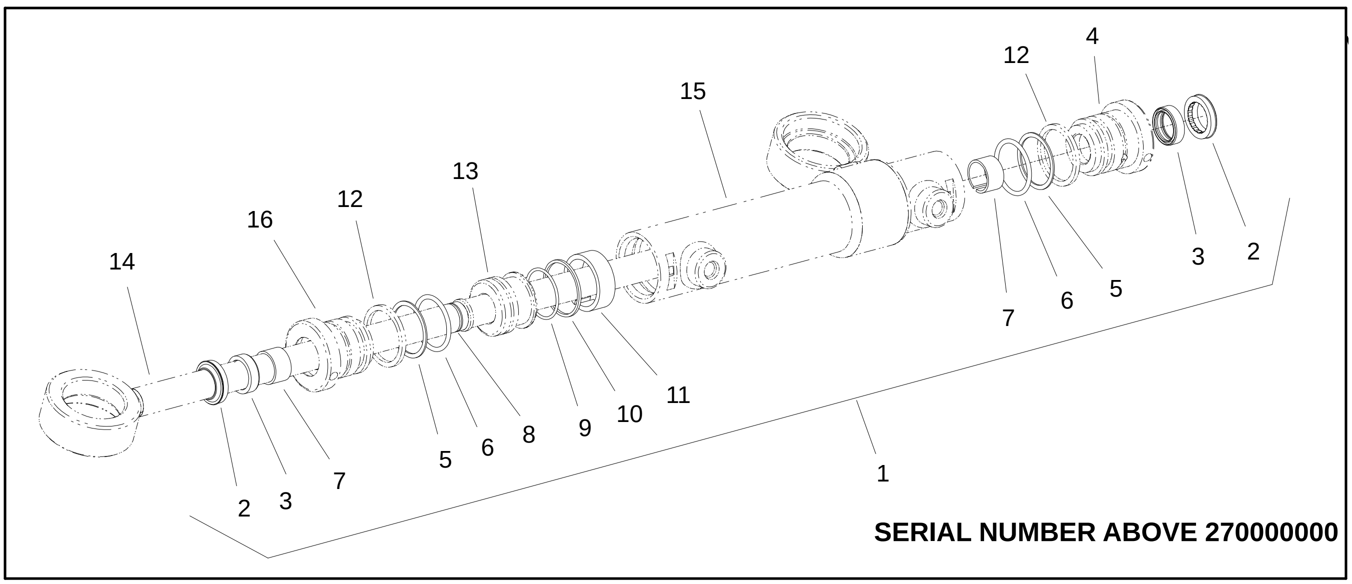


Figure 83

1. **Seal kit**
2. **Rod wiper**
3. **Seal**
4. **Head (non-ball joint end)**
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. **Rod**
15. **Barrel**
16. **Head (ball joint end)**

NOTE: On machines with serial number above 270000000 (Fig. 83), 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 and also the seals on the ball joint end head (item 16). If a steering cylinder leak exists on the non-ball joint end head (item 4), all seals on that 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 at other cylinder locations that cannot be disassembled, steering cylinder replacement will be necessary.

Disassembly (Figs. 82 and 83)

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 both heads from the barrel:

A. For serial numbers below 260999999, loosen set screws and remove threaded cap from each end of the cylinder barrel.

B. For serial numbers above 270000000, 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, 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 is not removable from shaft.

5. Remove and discard all accessible seals, back–up rings, and O–rings from piston and both heads.

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.). Replace entire cylinder if barrel is damaged. Inspect shaft, both heads, and piston for evidence of excessive scoring, pitting, or wear. Replace any damaged parts.

Assembly (Figs. 82 and 83)

NOTE: Due to steering cylinder design for serial numbers above 270000000, the seal kit may include several O–rings, backup rings and wear rings that cannot be accessed.

1. Put a coating of clean hydraulic oil on all new seals, back–up rings, and O–rings that are to be installed in cylinder.

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, lubricate shaft, ball joint end head and piston with clean hydraulic oil. Carefully slide ball joint end head and then piston onto shaft. Install thread locker on set screw threads and tighten two set screws to secure piston to shaft.

4. Lubricate shaft assembly with clean hydraulic oil and carefully slide shaft assembly into cylinder barrel.

5. Lubricate non–ball joint end head assembly with clean hydraulic oil and carefully slide it onto shaft and into barrel.

6. Secure heads to barrel:

A. For serial numbers below 260999999, install and tighten threaded caps. Secure both caps to barrel with set screws.

B. For serial numbers above 270000000, 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. Apply silicone sealer to barrel access slot.

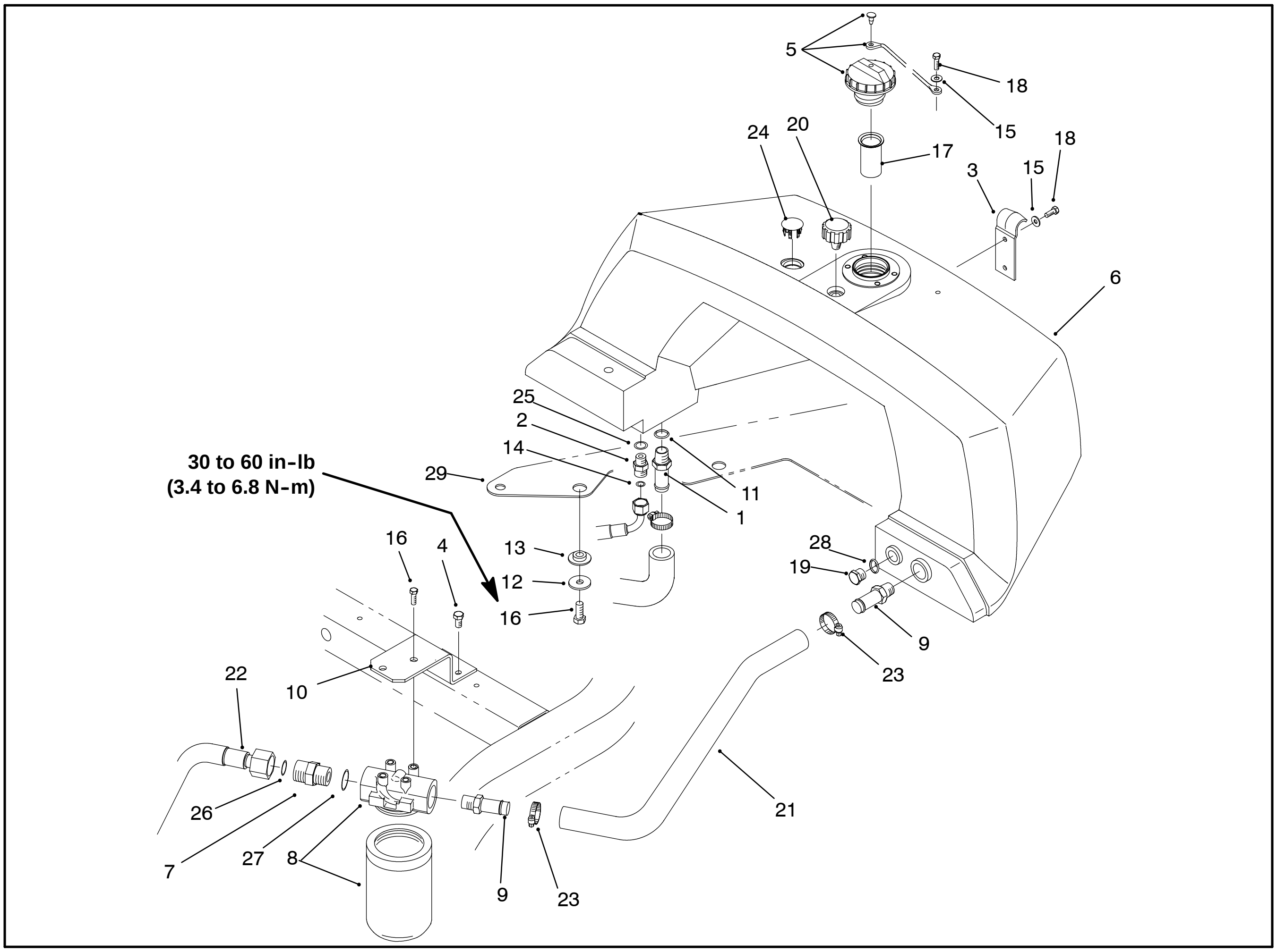


Figure 84

1. Hydraulic barb fitting
2. Hydraulic straight fitting
3. Fuel tank clamp
4. Hex washer head screw
5. Tank cap
6. Hydraulic tank
7. Hydraulic straight fitting
8. Oil filter assembly
9. Hydraulic barb fitting
10. Oil filter mount
11. O-ring
12. Flat washer
13. Grommet
14. O-ring
15. Flat washer
16. Cap screw
17. Filter screen
18. Cap screw
19. Plug
20. Air breather
21. Return hose
22. Tube assembly
23. Hose clamp
24. Serrated plug
25. O-ring
26. O-ring
27. O-ring
28. O-ring
29. Mounting plate

Removing Hydraulic Reservoir (Fig. 84)

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 suitable container under the hydrostat to collect hydraulic oil. Clamp pump inlet hose to prevent drainage. Remove pump inlet hose from hydrostat and direct to container. Release clamp from hose (Fig. 85).

3. Disconnect hose assembly from the hydraulic fitting welded to the reel motor case drain tube located below the right side of the frame. Allow hose to drain to a suitable container (Fig. 86).

4. Disconnect return hose (21) from hydraulic barb fitting (9). Allow hose to drain to a suitable container.

5. Remove cap screw and flat washer securing the console shroud to the hydraulic tank. Remove both cap screws and flat washers securing the console shroud to the lower panel (Fig. 87).

6. Remove three hex head screws and flat washers securing the mounting plate (29) to the frame. Two screws are located on the top of the plate at the front corners of the fuel tank. The third screw is in front of the castor fork and below the plate.

7. Tilt mounting plate (29) up by lifting at the rear of the machine. Prop up plate securely. Remove four cap screws (16) and flat washers (12) securing the hydraulic tank (6) to the mounting plate.

8. Remove hydraulic tank (6) from the mounting plate (29).

Inspecting Reservoir Parts (Fig. 84)

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.

4. Make sure cap screws are secure. If loose, remove and reinstall cap screws with “Loctite 242” or equivalent.

5. Make sure all bracket fasteners are tight.

Installing Hydraulic Reservoir (Fig. 84)

1. Place antiseize lubricant into all four inserts at the bottom of the hydraulic tank (6). Position tank onto the mounting plate (29).

2. Secure hydraulic tank to the mounting plate with four cap screws (16) and flat washers (12). Torque cap screws from **30 to 60 in-lb (3.4 to 6.8 N-m)**.

3. Secure mounting plate (29) to the frame with three hex head screws and flat washers Two screws go on the top of the plate at the front corners of the fuel tank. The third screw goes in front of the castor fork and below the plate.

4. Secure console shroud to the hydraulic tank with cap screw and flat washer, and to the lower panel with both cap screws and flat washers (Fig. 87).

5. Secure return hose (21) to hydraulic barb fitting (9) with hose clamp (23).

6. Secure pump inlet hose to hydrostat with hose clamp (Fig. 85).

7. Connect hose assembly to the hydraulic fitting welded to the reel motor case drain tube located below the right side of the frame (Fig. 86).

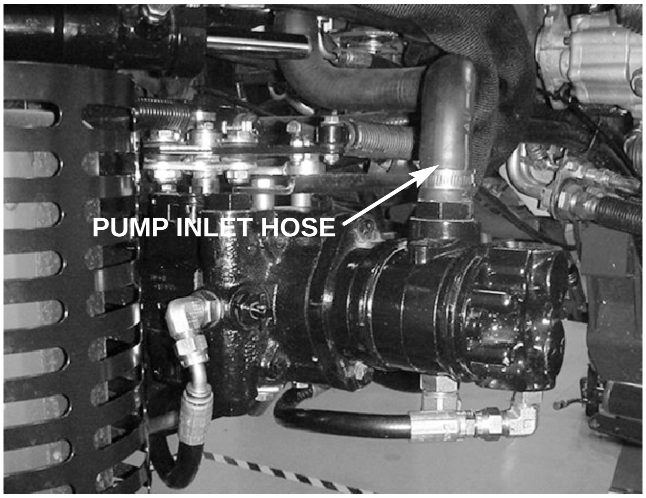


Figure 85

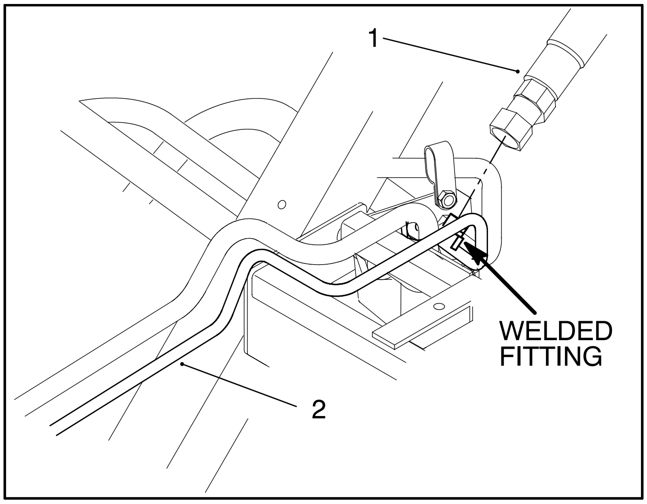


Figure 86

1. **Hose assembly** 2. **Case drain tube**

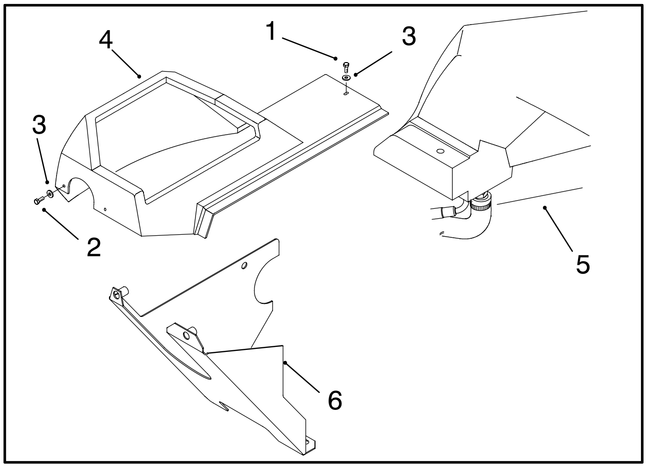


Figure 87

1. **Cap screw**
2. **Cap screw**
3. **Flat washer**
4. **Console shroud**
5. **Hydraulic tank**
6. **Lower panel**

Hydraulic System

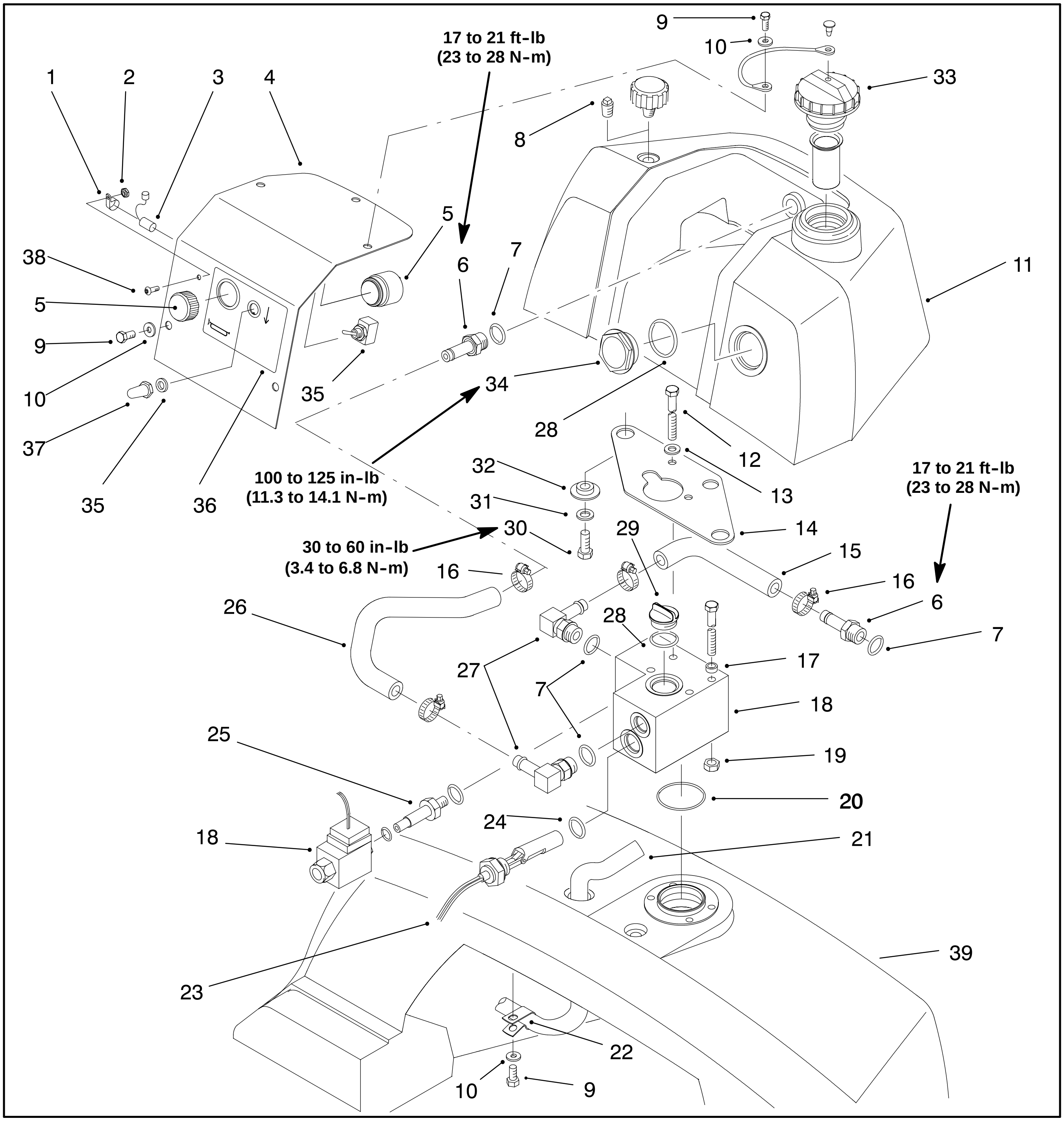


Figure 88

1. Clamp
2. Lock nut
3. Delay timer
4. Cover plate
5. Audio alarm assembly
6. Hydraulic barb fitting
7. O-ring
8. Pipe plug
9. Cap screw
10. Flat washer
11. Leak detection tank
12. Cap screw
13. Flat washer
14. Mounting plate
15. Formed outlet hose
16. Hose clamp
17. Idler washer
18. Valve assembly
19. Lock nut
20. O-ring
21. Leak detector harness
22. R-clamp
23. Oil level sensor
24. O-ring
25. Cartridge valve with O-ring
26. Formed inlet hose
27. Hydraulic barb fitting
28. O-ring
29. Plug
30. Cap screw
31. Flat washer
32. Grommet
33. Hydraulic oil cap
34. Sight gauge
35. Toggle switch
36. Leak detector decal
37. Toggle switch boot
38. Socket head screw
39. Hydraulic tank

Removal (Fig. 88)

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 clean container, large enough to collect 2 gallons (7.6 liters), under the oil filter assembly to collect hydraulic oil.

3. Crack open oil filter and allow at least 2 gallons (7.6 liters) of hydraulic oil to drain into the container, then tighten oil filter to stop drainage. Uncap hydraulic oil tank and allow enough time for the hydraulic oil to drain out of the leak detection tank into the hydraulic oil tank.

4. Remove five cap screws and flat washers securing the cover plate and cap tether to the leak detection tank. Remove cover plate from tank (Fig. 89).

5. Remove cap screw and flat washer securing R–clamp and leak detector harness to the underside of the hydraulic tank. Pull clamp free of harness (Fig. 90).

6. Unplug leak detector harness from 2–pin plug, with yellow/orange and black wires, on the main tractor harness. Pull leak detector harness out of the access hole on the hydraulic tank.

7. Loosen four cap screws securing the valve assembly to the fill neck on the hydraulic tank. Lift leak detection tank from the hydraulic tank. Remove O–ring from fill neck boss (Fig. 90).

Installation (Fig. 88)

1. Top off main hydraulic tank until fluid is visible at base of breather port. This will ensure that the maximum amount of air is purged from the main tank before installing the leak detector.

2. Make sure filler screen is placed in neck of auxiliary tank.

3. Make sure five capscrews and washers securing the cover plate to auxiliary hydraulic tank are removed with the cover plate (Fig. 89).

4. Clean mating surfaces of block and fill neck with a clean, dry rag. Carefully place new O–ring over fill neck boss (Fig. 90).

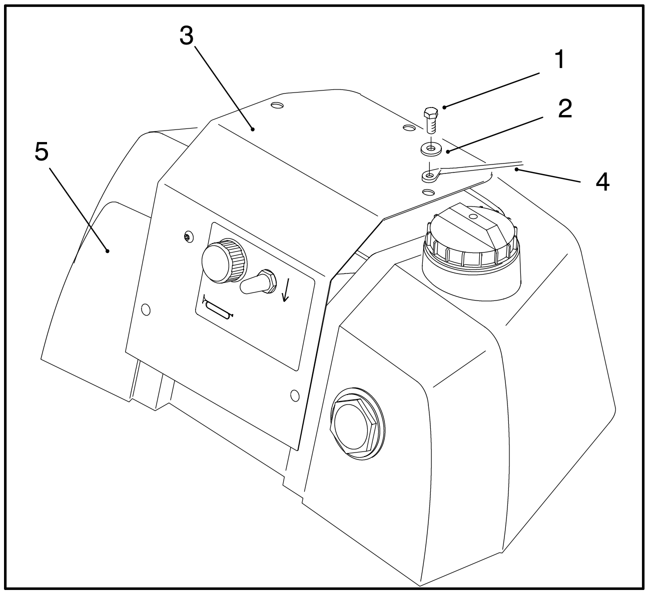


Figure 89

1. **Cap screw**
2. **Flat washer**
3. **Cover plate**
4. **Cap tether**
5. **Leak detection tank**

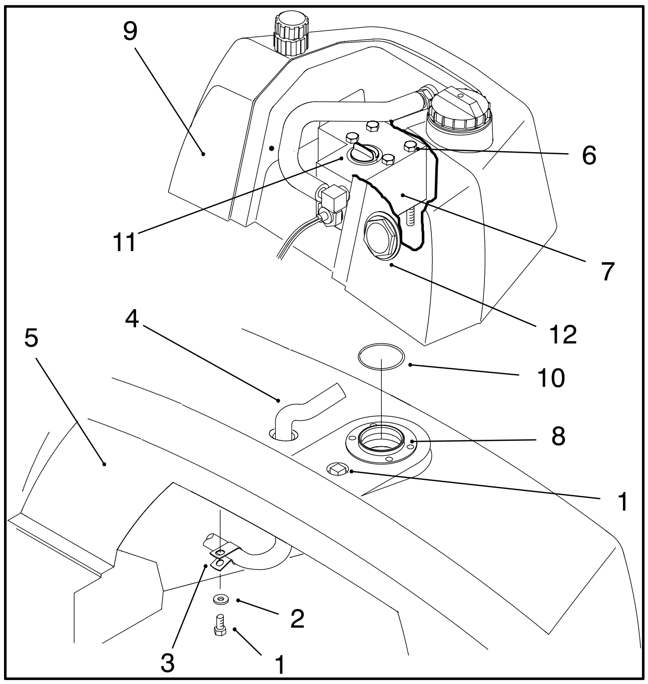


Figure 90

1. **Cap screw**
2. **Flat washer**
3. **R–ring**
4. **Leak detector harness**
5. **Hydraulic tank**
6. **Cap screw**
7. **Valve assembly**
8. **Fill neck**
9. **Leak detection tank**
10. **O–ring**
11. **Plug**
12. **Sight gauge**

5. Route wire harness through access hole in hydraulic tank. Align valve assembly with fill neck. Secure valve to hydraulic tank fill neck with four capscrews (Fig. 90).

Hydraulic System

IMPORTANT: Do not over tighten cap screw. Threads in tank may become damaged.

6. Locate plugged 2-pin connector with yellow/orange and black wires in main tractor harness. Attach leak detector harness. Secure leak detector harness to underside of leak detection tank with R-clamp and capscrew.

7. Remove plug from top of the valve assembly. Carefully fill float cavity to the top of the threads. Replace and tighten fill plug. Clean up any spilled oil (Fig. 90).

8. Before reattaching cover plate, test leak detector switch with ignition key switch in **ON/RUN** position. The buzzer should sound with toggle switch held down for 1 second.

9. If the buzzer fails to sound, check to see if the ignition key switch is in **ON/RUN** position, all connections are secure, and the test switch is held for 1 full second.

IMPORTANT: Do not over tighten cap screws. Threads in tank may become damaged.

10. Secure cover plate and cap tether to the leak detection tank with five cap screws and flat washers (Fig. 90).

Note: Monitor hydraulic fluid level in sight glass and as air is removed from the hydraulic circuit, auxiliary tank may need to be topped off after initial fill.

11. Fill leak detection tank to the top of sight gauge (Fig. 90).

IMPORTANT: If a leak occurs or oil is removed from the hydraulic system for service, the lost oil must be replaced. If a large amount of oil is lost, remove leak detection tank cover plate and follow steps 7 through 11 for refilling instructions. For small amounts of oil, simply add oil to auxiliary tank.

Disassembly and Inspection (Fig. 88)

1. The leak detector can be disassembled using the leak detector assembly drawing (Fig. 88) as a guide.

2. Clean tank and filler screen with solvent. Inspect parts for the following:

   A. Leaking, cracked, or damaged leak detection tank.

   B. Worn or leaking hydraulic hoses. Replace if necessary.

   C. Visibly worn or damaged parts.

Assembly (Fig. 88)

1. Coat all O-rings with clean hydraulic oil.

2. Secure sight gauge (34) and new O-ring (28) to the leak detection tank (11). Torque gauge from **100 to 125 in-lb (11.3 to 14.1 N-m)**.

3. Secure both hydraulic barb fittings (6) and new O-rings (7) to the leak detection tank. Torque both fittings from **17 to 21 ft-lb (23 to 28 N-m)**.

4. Apply antiseize lubricant to threaded holes on bottom of leak detection tank. Secure mounting plate (14) to tank with two grommets (32), flat washers (31), and cap screws (30). Torque both screws from **30 to 60 in-lb (3.4 to 6.8 N-m)**.

5. Secure formed inlet hose (26) to the hydraulic barb fitting (6) attached to the end of the tank with hose clamp (16). Secure formed outlet hose (15) to the hydraulic barb fitting (6) attached to the inner side of the tank with hose clamp (16).

6. Secure both hydraulic barb fittings (27) and O-rings (28) to the valve assembly (18). Secure oil level sensor (23) and O-ring (24) to the assembly. Secure cartridge valve with O-ring (25) to assembly. Hand tighten plug (29) and O-ring (28) to the assembly.

7. Position valve assembly (18) under the mounting bracket (14). Insert four cap screws (12) with two flat washers (13) and two idler washers (17) through the bracket and assembly. Hand tighten four M8-1.25 lock nuts to the cap screws.

8. Secure toggle switch (35) to cover plate (4) with nut, then secure toggle switch boot (37) to switch. Secure audio alarm (5) to plate with cap. Secure delay timer (3) to the plate with clamp (1), socket head screw (38), and lock nut (2).

9. Connect leak detector harness to the following:

   A. The connector with red and black wires to the delay timer (3).

   B. The black/white and black wires to the negative terminal of the audio alarm (5). Connect red and yellow wires to the positive terminal.

   C. The black and gray wires to the negative terminal of the toggle switch (35). Connect red and yellow wires to the positive terminal.

   D. The red/white and red wires to the positive terminal of the valve solenoid (18). Connect black wires to the negative terminal.

   E. The connector with yellow and gray wires to the oil level sensor (23).

10. Verify leak detector operation (see Leak Detector in Chapter 7 - Electrical System).

Chapter 5

Electrical System

Table of Contents

Electrical Schematics

The electrical schematic and other electrical drawings for the Greensmaster 3250−D are located in Chapter 8 − 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.

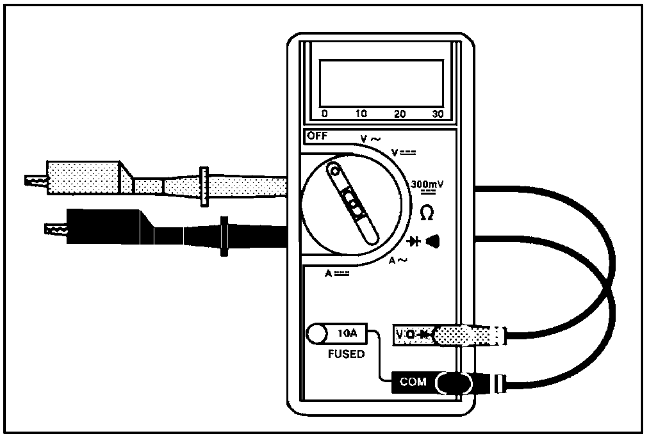


Figure 1

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

Electrical System

Troubleshooting

> **CAUTION**
>
> **Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.**

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Wiring Schematics section of this chapter).

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 R4 or R8 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. Fuselink 2 is open. Fuse block is faulty. 10 ampere fuse to the run relay is loose or blown. Diode D6, safety relay, or start relay is faulty. 15 ampere fuse to the ignition switch is loose or blown. The ignition switch is faulty. Starter solenoid is faulty. High temperature relay, run relay, and/or high temperature switch are faulty. Neutral sensor is out of adjustment or faulty. The ETR solenoid is 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. Diode D5 circuit is open. Run relay or high temperature relay is faulty. High temperature switch is shorted. ETR solenoid is faulty. Glow plugs are faulty. Engine or fuel system is malfunctioning (see Chapter 4 − Engine). Engine and fuel may be too cold.
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). Seat hinge, support pin, or spring binding is preventing the seat switch from closing. Seat switch is faulty or out of adjustment. 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/alternator is faulty. Fuselink 1 is open. Ignition switch is faulty. Battery is dead.
Engine kills during operation (operator sitting on seat).	Operator moved too far forward on the seat (seat switch not depressed). Engine overheated. 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.	Joy stick relay R7 is faulty or shorted. Solenoid valve S1 is faulty. Mow relay is faulty or shorted. Mow sensor is shorted.
Cutting units do not run when lowered with the Functional Control Lever in the MOW or NEUTRAL position.	Wiring to run/mow/backlap circuits (see Wiring Schematics) components is loose, corroded, or damaged. Fuse block or fuse is faulty. Solenoid valve S1 is faulty. Mow sensor and/or mow relay is faulty or grounded. Raise switch and/or joystick relay R7 is faulty or grounded.
Cutting units will not raise.	Wiring to run/mow/backlap circuits (see Wiring Schematics) components is loose, corroded, or damaged. Fuse block or fuse is faulty. Solenoid valve S3 and/or S2 is faulty. Diode D1 is open. Raise switch and/or raise relay is faulty or grounded.
Cutting units will not lower.	Wiring to run/mow/backlap circuits (see Wiring Schematics) components 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 is faulty. 6 second timer is faulty. Solenoid valve S2 or S4 is faulty. Lower relay 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. 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 a charging system has an output, but not its capacity.

Use a multimeter set to the DC volts setting. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead to the negative battery post. Leave the test leads connected and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle. Allow the battery to charge for at least three (3) minutes. Record the 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).

Note: See the **Briggs and Stratton Vanguard/Daihatsu Repair Manual for 3 Cylinder Water−Cooled Diesel Engines** for additional component testing information.

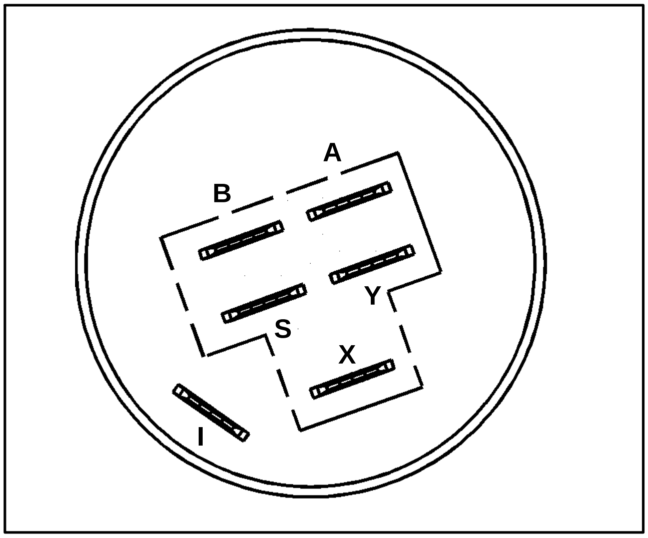
CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

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



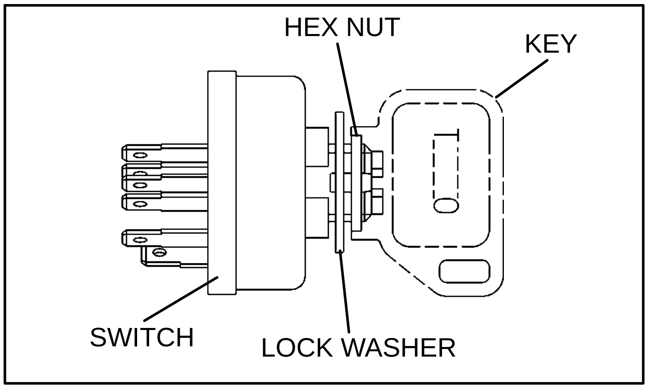


Figure 3

Safety Relays

Two styles of safety relays have been used on Greensmaster 3250−D machines. Later production machines (after serial number 250000000) have a different relay terminal arrangement than relays on earlier machines (Fig. 4). Relay operation is identical regardless of terminal layout.

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) lead to relay terminal 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 voltage from and multimeter leads from relay terminals.

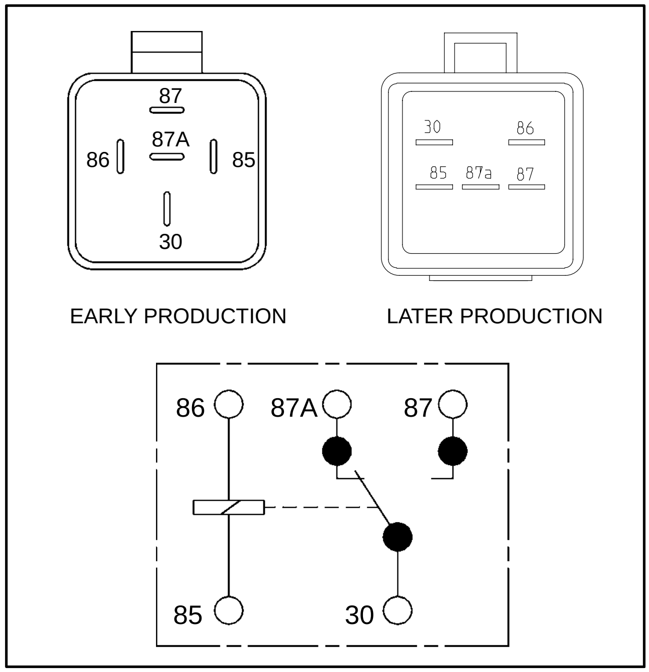


Figure 4

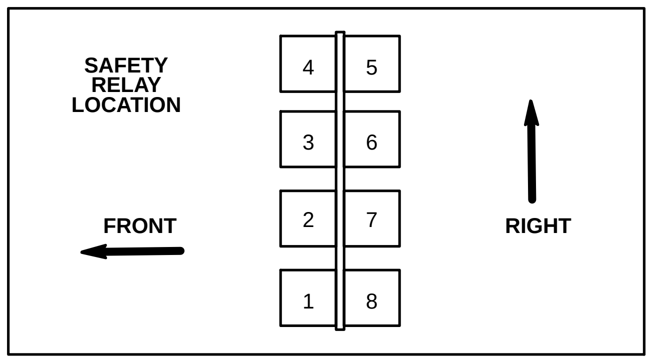


Figure 5

1. **Run relay**
2. **High temp relay**
3. **Mow relay**
4. **Start relay**
5. **Raise relay**
6. **Lower relay**
7. **Joystick relay**
8. **Safety (neutral) relay**

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. If the neutral switch or traction interlock switch is open when the operator raises out of the seat, the engine will stop. The switch and its electrical connector are located directly under the seat.

1. Make sure the engine 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.

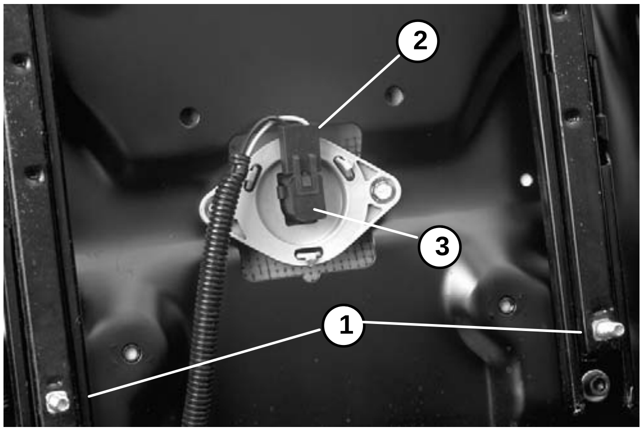


Figure 6

1. **Seat bolts**
2. **Electrical connector**
3. **Seat switch**

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.

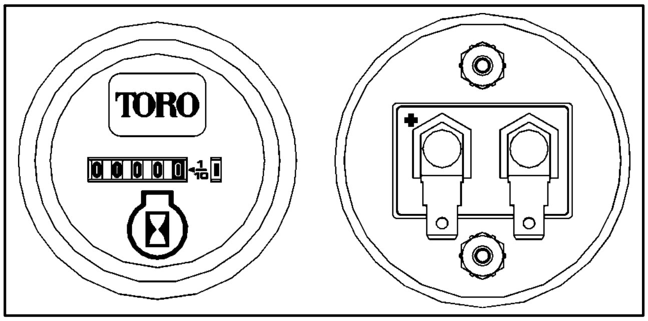


Figure 7

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. 8):

1. The top 10 ampere fuse supplies power to the run and mow relays.

2. The middle 10 ampere fuse supplies power to the raise and lower relays.

3. The bottom 15 ampere fuse supplies power to terminal B of the ignition switch.

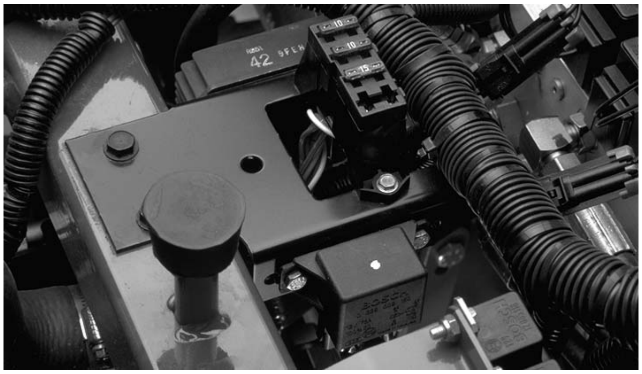


Figure 8

Functional Control Lever Reed Switches and Actuator

Both reed switches are normally open. 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 is off. Disconnect electrical connectors to both switches. Check continuity of both switches by connecting a multimeter (ohms setting) across the connector terminals.

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. 9).

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. 9).

4. The distance between the sensing end of each switch and the traction bracket should be 0.725 to 0.775 inch (18.4 to 19.7 mm) (Fig. 10).

5. To adjust or install actuator, place lever in neutral, position actuator in lever until the NEUTRAL switch just closes, and then rotate actuator two complete turns closer to switch.

6. When adjusting switches or actuator, tighten jam nuts 30º past finger tight.

7. After switch or actuator adjustment, check continuity of both switches and interlock operation (See Verify Interlock System Operation). Readjust switch or actuator if necessary.

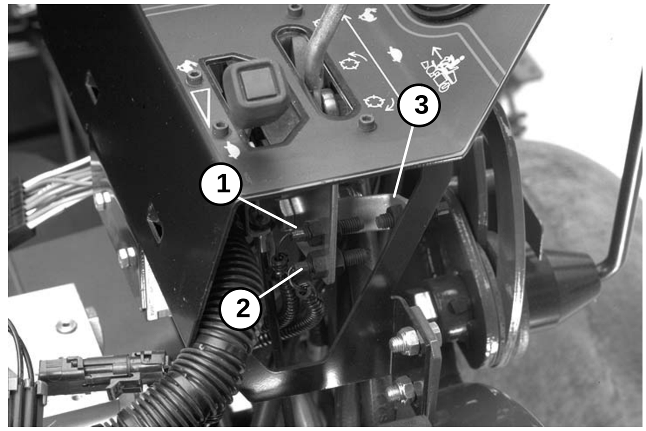


Figure 9

1. **Mow reed switch**
2. **Neutral reed switch**
3. **Actuator**

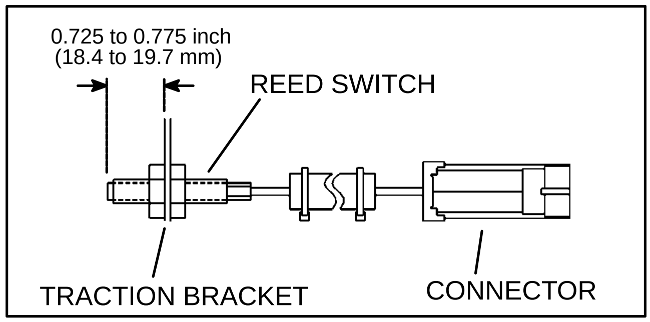


Figure 10

Backlap Switch (If Equipped)

The backlap switch is located on the hydraulic manifold (when the Backlap Kit is installed). The switch 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.

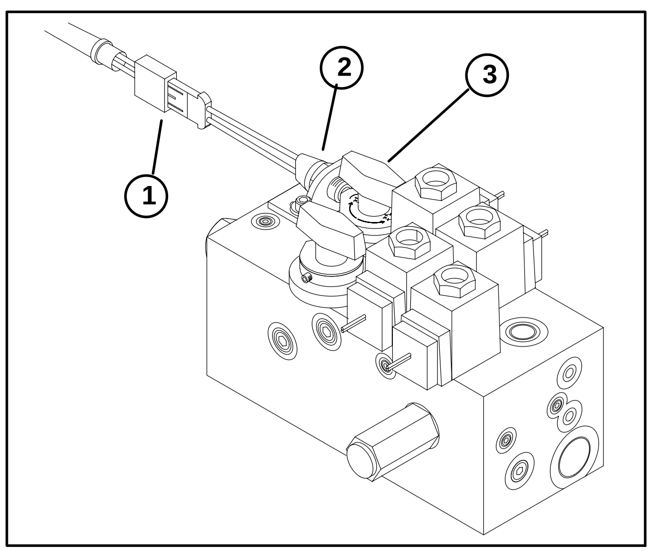


Figure 11

1. **Connector**
2. **Backlap switch**
3. **Backlap knob**

Leak Detector (Optional)

Operation

The leak detector system is designed to assist in the early detection of hydraulic oil system leaks. If the oil level in the main tank is lowered by 4 to 5 ounces, the level switch in the leak detection tank will close. After a 1 second delay, the alarm will sound alerting the operator. Expansion of oil from the normal heating of the hydraulic oil during machine operation will cause oil to transfer into the leak detection tank. The oil is allowed to return to the main tank when the ignition switch is turned off (see Fig. 12, 13, and 14).

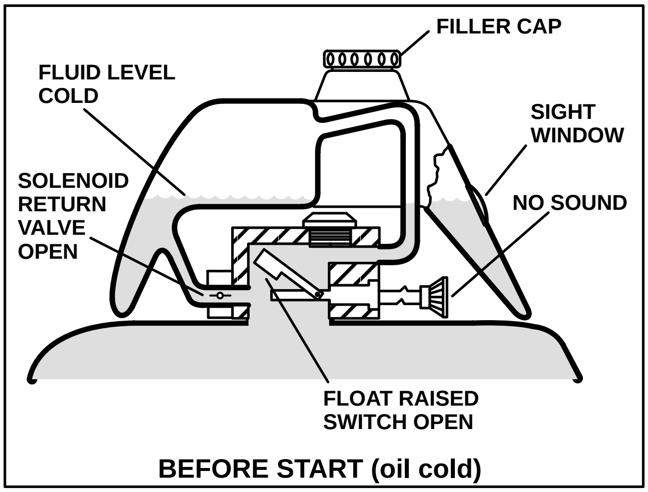


Figure 12

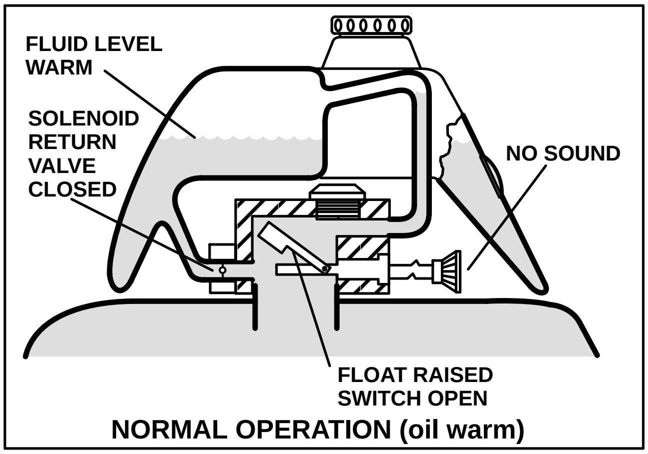


Figure 13

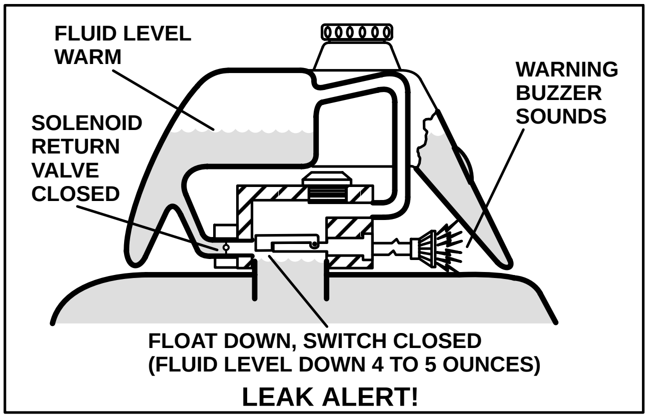


Figure 14

Test Operation

1. Place ignition switch in the ON position. DO NOT START ENGINE. Move leak detector switch downward and hold. After the one second time delay elapses, the alarm should sound.

2. Release leak detector switch.

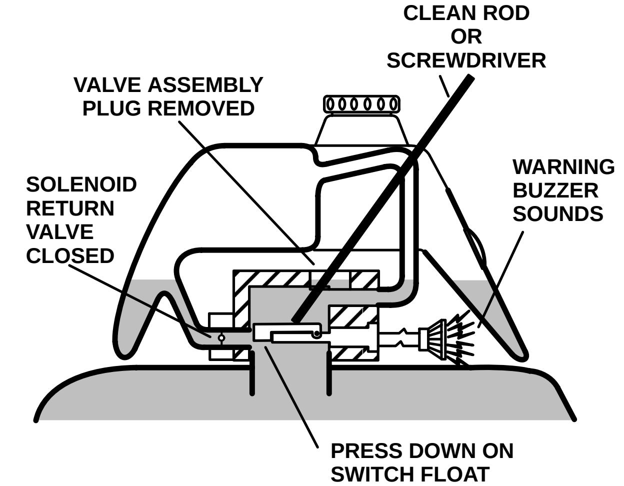
3. Remove cover plate from leak detector. Remove plug from valve assembly.

4. Insert clean rod or screw driver into valve assembly and gently push down on switch float (Fig. 15). Alarm should sound after one second delay.

5. Release float; alarm should stop sounding.

6. If alarm fails to stop sounding, turn ignition switch to OFF position. Locate solenoid on leak detector. Swap solenoid wires and repeat steps 4 and 5.

7. Install plug to valve assembly and cover plate to tank. Move ignition switch to OFF position.



TESTING SWITCH FLOAT

Figure 15

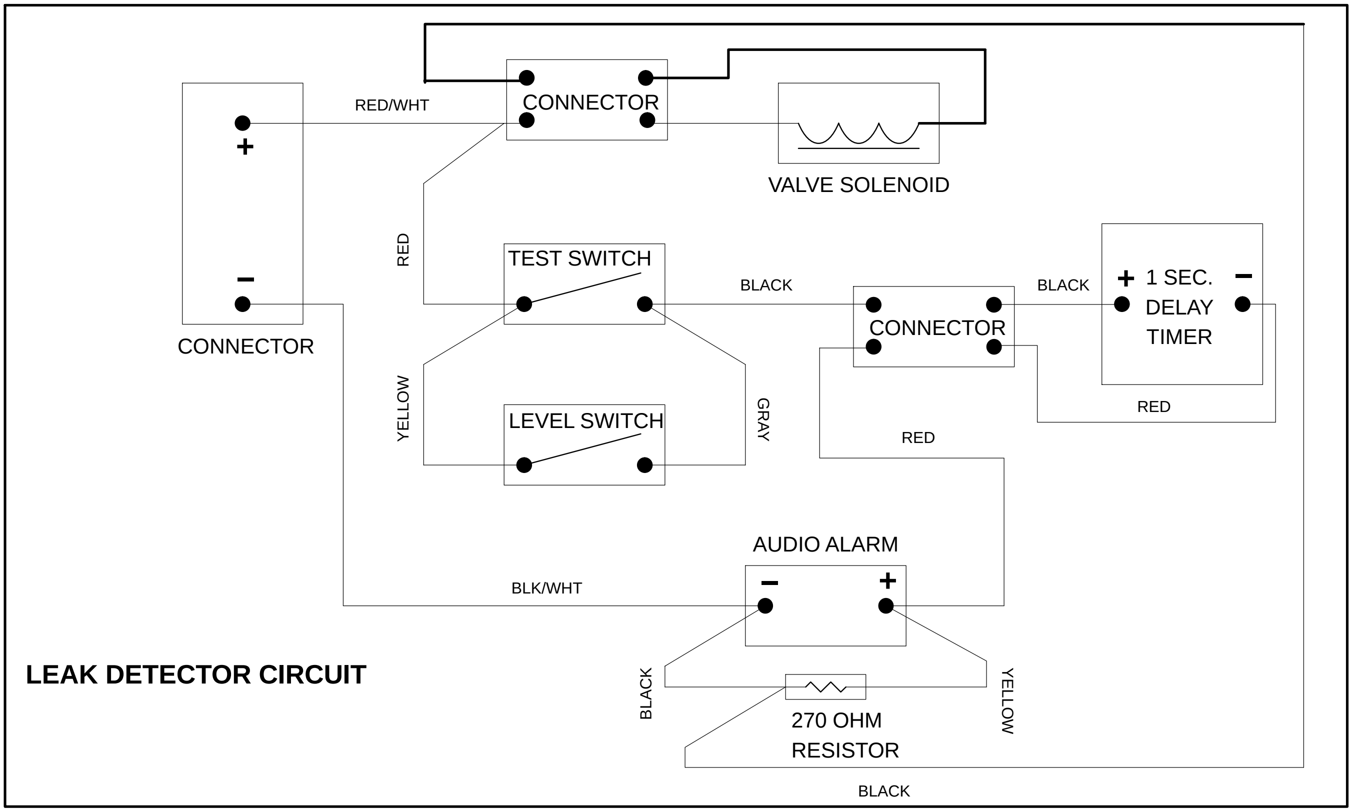


Figure 16

Components can be tested by isolating them from the rest of the circuit and individually testing the suspected component.

Delay Timer

This is a solid state device with no moving parts. Upon the application of power, the time delay is initiated. At the completion of the 1 second delay, the audio alarm becomes energized. When power is removed the timer is reset.

1. Isolate timer from the circuit. Connect 12VDC source in series with voltmeter to connector of timer. Make sure to observe polarity.

2. The voltmeter should jump from 0 to 12VDC after the 1 second delay. Remove voltage source from the timer. Reconnect timer to the circuit.

Audio Alarm

1. Isolate alarm from the circuit. Connect 12VDC source to terminals. Make sure to observe polarity.

2. Alarm should sound. Remove voltage source from the alarm. Reconnect alarm to the circuit.

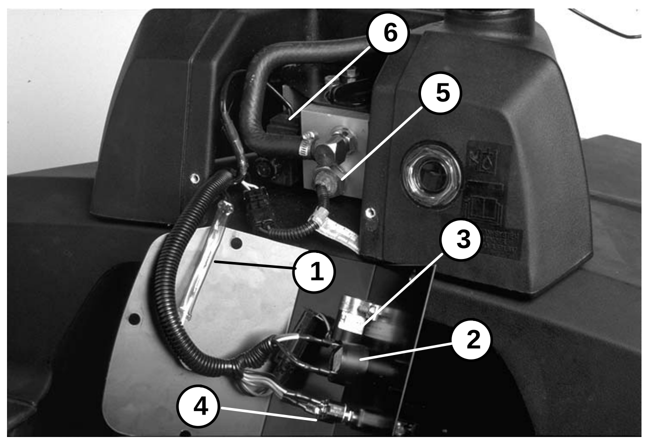


Figure 17

1. 270 ohm resistor
2. Audio alarm
3. Delay timer
4. Toggle switch
5. Level detector
6. Valve solenoid

Valve Solenoid

1. Isolate solenoid from the circuit. Connect multimeter (Ohms setting) to connector. Make sure to observe polarity.

2. Resistance should about 7.2 ohms.

Warning Light Cluster

Two styles of warning light clusters have been used on the Greensmaster 3250–D. On machines with serial number below 250000000, the four warning lights are included in one component (Fig. 18). On machines with serial number above 250000000, the four warning lights are included in two components (Fig. 20).

Note: Individual light bulbs can be tested by removing them from the light cluster and applying 12 VDC to their wiring terminals.

Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running when the oil pressure drops below 4 PSI (0.3 kg/cm^2).

1. Disconnect white/red wire from the oil pressure switch.

2. Ground white/red wire to the engine block.

3. Turn the ignition switch to ON; the light should come on.

4. Turn the ignition switch to OFF. Connect white/red wire to the oil pressure switch.

High Temperature (Water) Shutdown Light

When the coolant temperature is above 238ºF (114ºC), the temperature light comes on as the high temperature shutdown switch and relay stopped the engine. The ignition switch must be in either the ON or START position for the light to come on.

Glow Light

The glow light comes on when the ignition switch is placed in RUN prior to placing the ignition switch in START, and stays lit for approximately ten (10) seconds while left in RUN.

Battery Light

The battery light should come on when the ignition switch is in ON with the engine not running, or with an improperly operating charging circuit while the engine is running.

1. Turn ignition switch to ON; the light should come on.

2. Turn ignition switch to OFF.

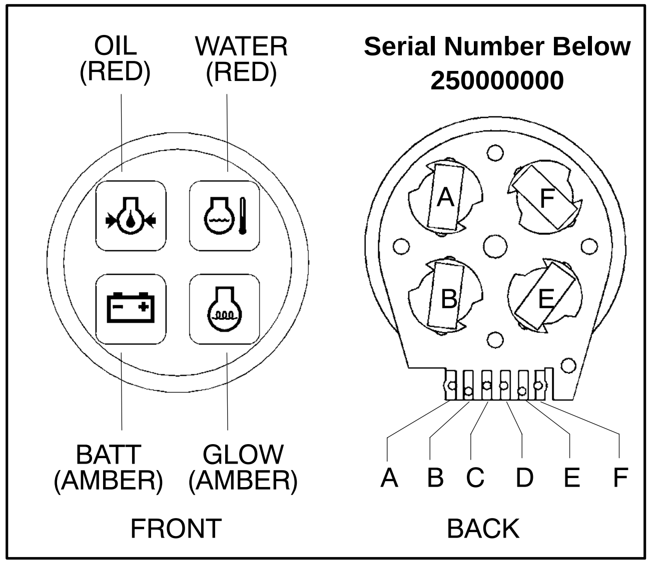


Figure 18

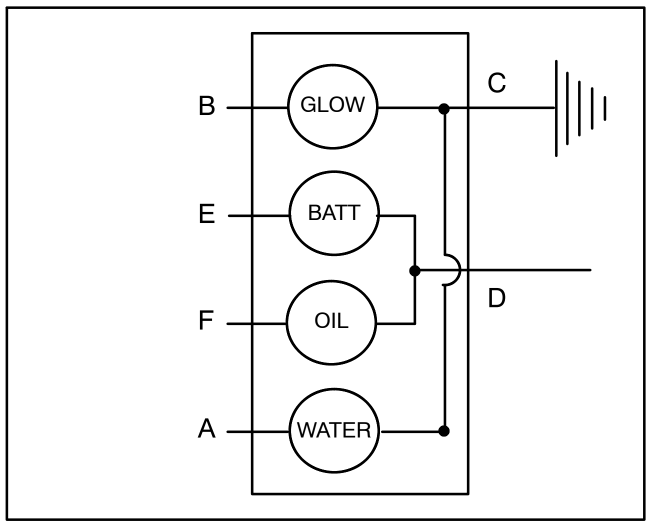


Figure 19

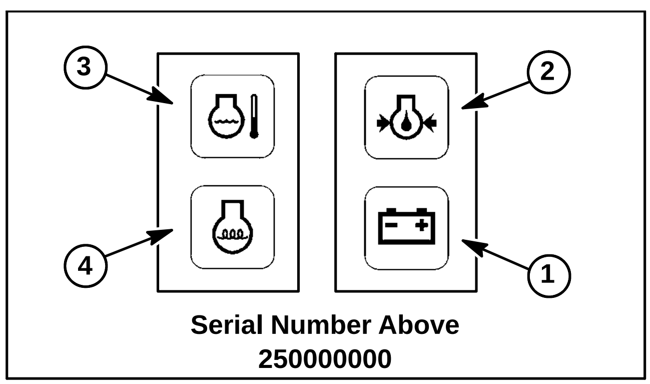


Figure 20

1. **Battery light**
2. **Oil pressure light**
3. **High temperature light**
4. **Glow light**

High Temperature Shutdown Switch

The high temperature shutdown switch is located on the water pump, which is located on the rear end of the engine block. The high temperature shutdown switch has a yellow/red wire connected to it (Fig. 20).

CAUTION

Make sure engine is cool before removing the temperature switch.

1. Lower coolant level in the engine and remove the temperature switch.

2. Put switch in a container of oil with a thermometer and slowly heat the oil (Fig. 21).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Check continuity of the switch with a multimeter (ohms setting). The high temperature shutdown switch is normally open and should close at about 238°F (114°C).

4. Allow oil to cool while observing temperature. The high temperature shutdown switch should open at about 232°F (111°C).

5. Replace switch if necessary.

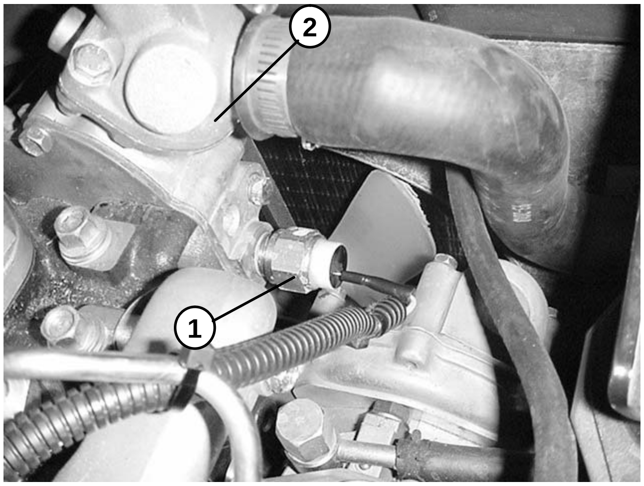


Figure 20

1. **Temperature switch** 2. **Water pump**

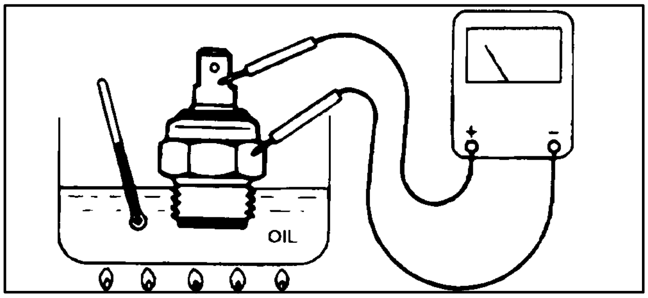


Figure 21

Electrical System

Oil Pressure Switch

The switch is located on the front cylinder head above the injection pump and governor assembly. It is a normally closed switch and opens with pressure.

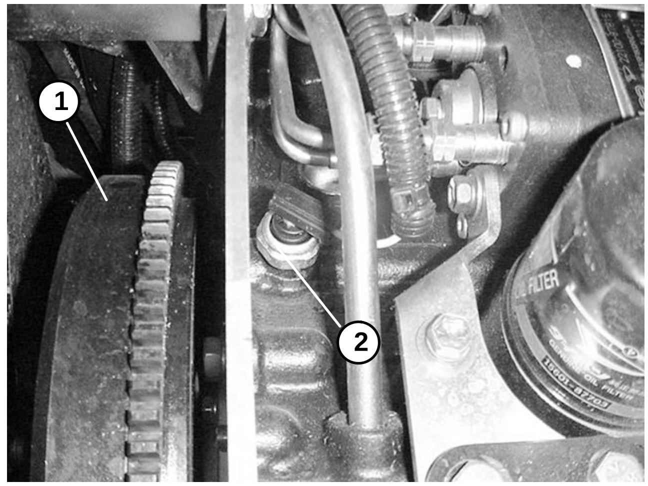


Figure 22

1. Flywheel
2. Oil pressure switch

Testing with the engine off

1. Turn the ignition switch to ON. The oil pressure lamp should be on.

2. If the lamp is not on, disconnect the white/red wire from the switch and ground it to the engine block.

3. If the lamp comes on the switch is bad.

4. If the lamp does not come on after step 2, check the indicating circuit (see Electrical Schematic in Chapter 8 − Electrical Diagrams).

Testing with the engine on

1. If the lamp is on with the engine running, shut off the engine **immediately**.

2. Disconnect the white/red wire from the switch.

3. Turn the ignition switch to ON. The oil pressure lamp should go out.

4. If the light is still on, check for short circuiting in the indication circuit (see Circuit Drawings in Chapter 8 − Electrical Diagrams).

5. Return ignition switch to OFF and connect the white/red wire to the switch.

6. Remove switch and install test gauge in the oil pressure switch port.

7. Start the engine and check for a **minimum** of **14 psi** at **1000 RPM**. If the engine oil pressure is low, shut off the engine **immediately**.

8. Shut off the engine and remove the test gauge.

9. If the engine oil pressure is good, replace the switch.

Lower Reels Time Delay

This is a solid state timer. 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.

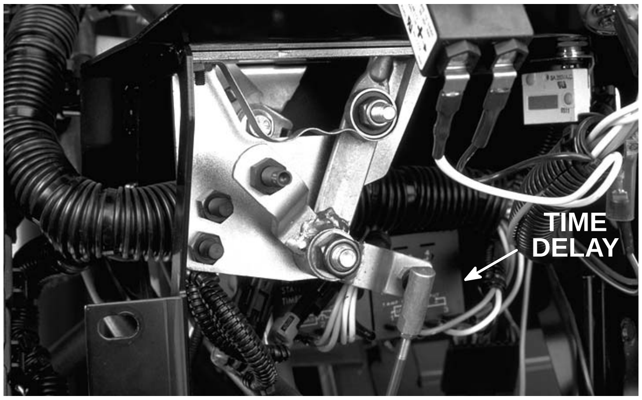


Figure 23

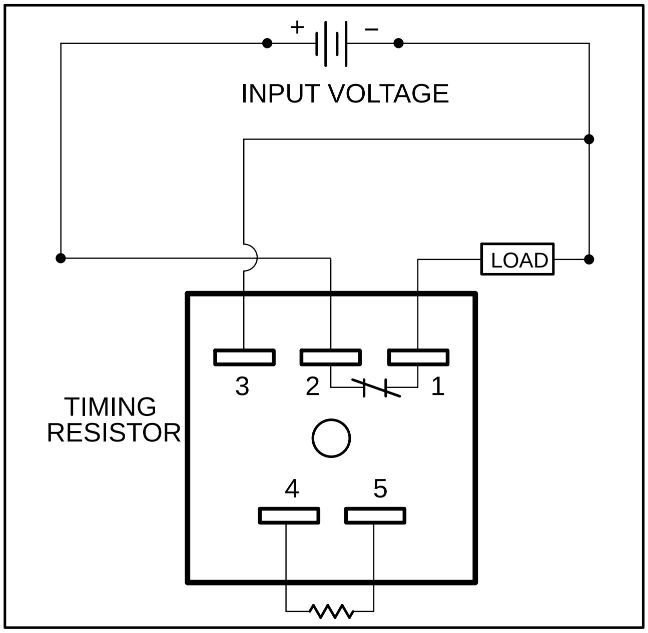


Figure 24

Electrical System

Diode Circuit Boards

Each circuit board contains four diodes. The diodes are used for circuit protection from inductive voltage spikes and for safety circuit logic. Diode D8 is not used.

Diode D1

This diode prevents current flow to solenoid S3 when solenoids S2 and S4 are energized through lower relay R6.

Diode D2

This diode prevents current flow to solenoid S4 when solenoids S2 and S3 are energized through Raise relay R5.

Diode D3

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 D4

This component is not used.

Diode D5

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 D6

Prevents a negative spike from damaging the Neutral Sensor and Seat switch by allowing a ground path for the Run relay when it de−energizes.

Diode D7

Maintains current flow to the Joystick relay after the momentary Lower switch of the Joystick opens.

Diode D8

This component is not used.

Testing

The diodes can be individually tested using a digital multimeter (ohms setting) and the table to the right.

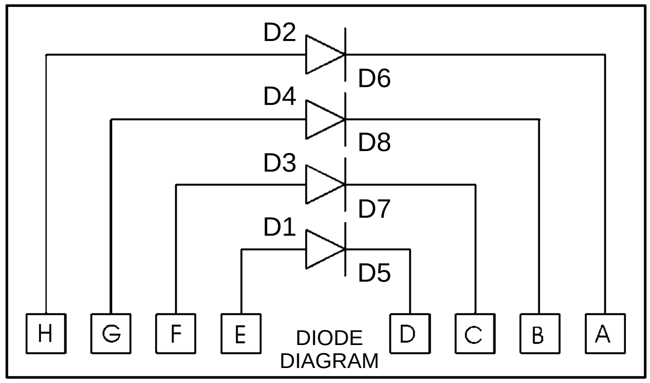


Figure 25

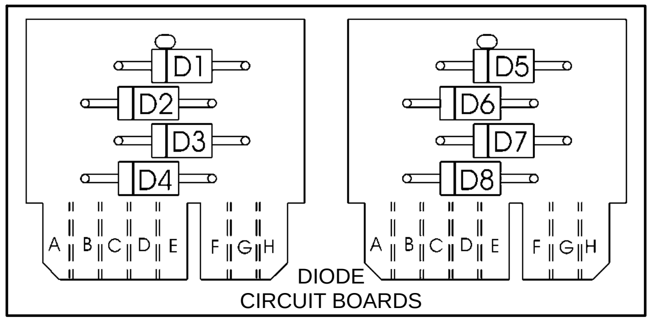


Figure 26

Red Lead (+) on Terminal	Black Lead (−) on Terminal	Continuity
H	A	YES
A	H	NO
G	B	YES
B	G	NO
F	C	YES
C	F	NO
E	D	YES
D	E	NO

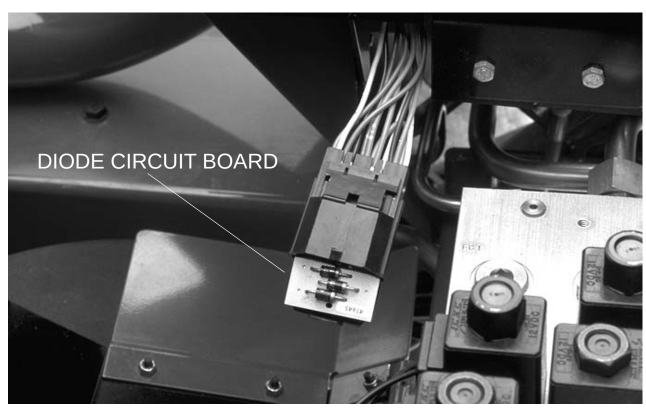


Figure 27

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 is off. Disconnect solenoid valve electrical connector.

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 29. The coil resistance for machines with serial numbers above 270000000 is identified in Figure 30.

4. Replace solenoid if necessary. Reconnect solenoid valve electrical connector.

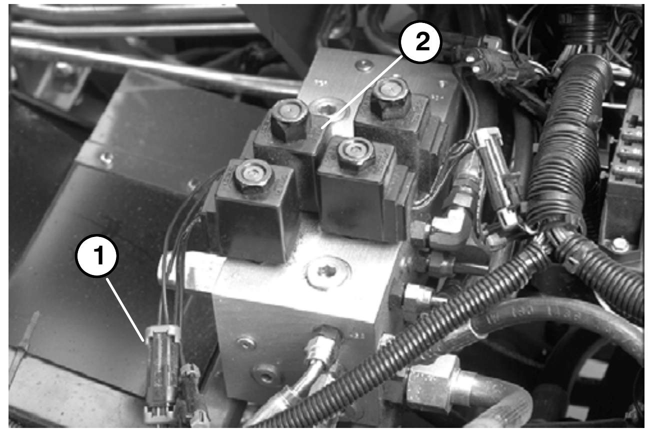


Figure 28

1. **Electrical connector**
2. **Solenoid**

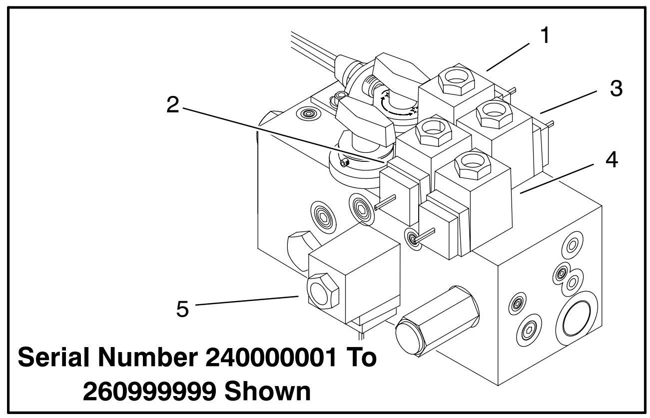


Figure 29

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)**

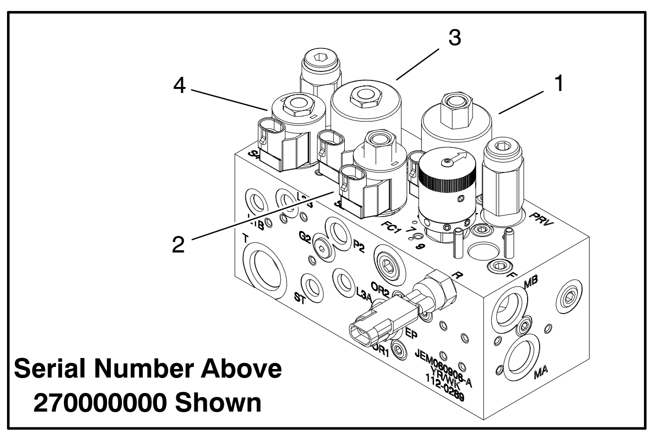


Figure 30

1. **Solenoid S1R1 (7.1 ohm)**
2. **Solenoid S2 (8.6 ohm)**
3. **Solenoid S3 (7.1 ohm)**
4. **Solenoid S4 (8.6 ohm)**

Glow Relay

When energized, the glow relay allows electrical current to the engine glow plugs.

Two styles of glow relays have been used on the Greensmaster 3250-D. On machines with serial number below 250000000, two of the four relay connections are secured with screws (Fig. 33). Machines with serial number above 250000000 use relays that are connected to the wire harness with a four wire connector (Fig. 34).

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 41 to 51 ohms.

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 and multimeter leads from relay terminals.

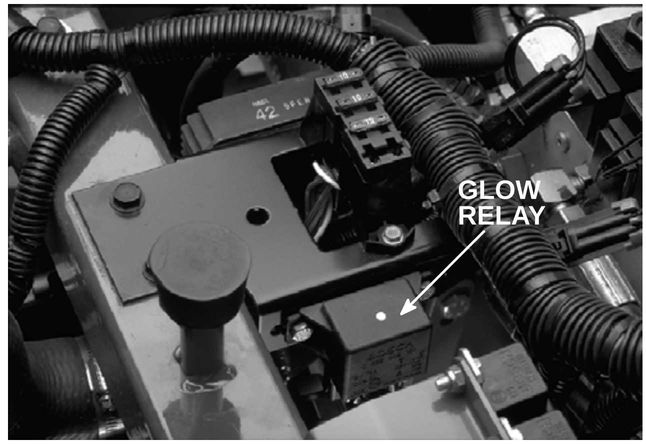


Figure 32

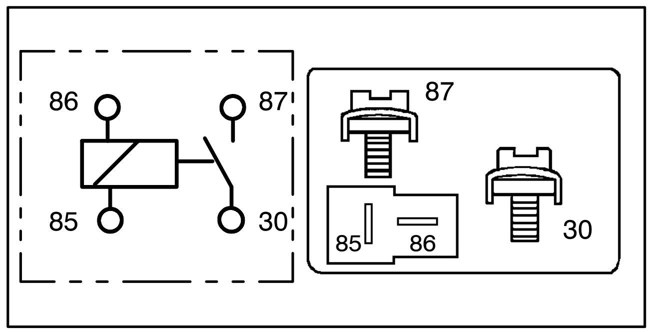


Figure 33

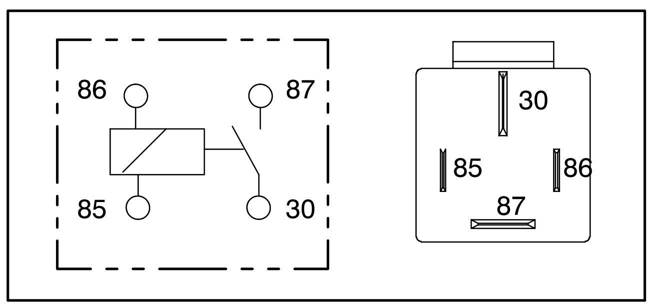


Figure 34

Service and Repairs

Note: See the **Briggs and Stratton Vanguard/Daihatsu Repair Manual for 3 Cylinder Water−Cooled Diesel Engines** for more component repair information.

Verify Interlock System Operation

CAUTION

The interlock switches are for the operator's protection; do not disconnect them. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches 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, 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.

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 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications

BCI Group Size 26:
Type 26 SMF−5
530 Amp Cranking Performance at 0° F (−17.8° C)
85 Minute Reserve Capacity at 80°F (26.7°C)

Figure 34

1. **Cap screw & washer** 2. **Battery retainer**

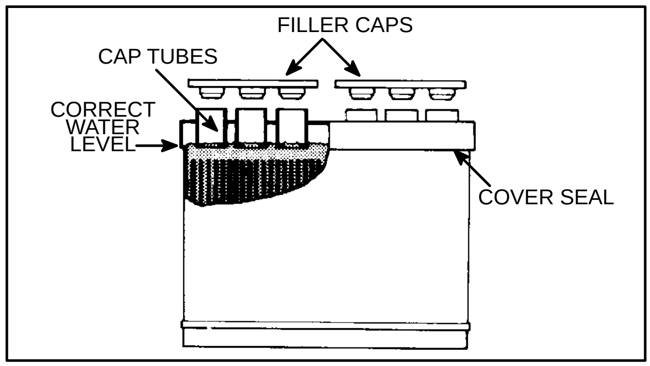


Figure 35

Removal (Fig. 34 and 35)

IMPORTANT: Be careful not to damage terminal posts or cable connectors when removing the battery cables.

1. Remove cap screw, washer, 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.

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.

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 washer and cap screw. Do not overtighten to prevent cracking or distorting the battery case (Fig. 34).

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.

TORO

Chapter 6

Chassis

Table of Contents

Chassis

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 N−m)

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

Adjustments

Brake Adjustment

CAUTION

Before and after adjusting the brakes, always check the brakes in a wide open area that is flat and free of other persons and obstructions.

Note: The brake adjustment rods are located on each side of the machine. Adjust each brake equally.

1. While driving the machine, depress the brake pedal. Both wheels should lock equally.

2. Park machine on a level surface. Make sure engine is off.

3. Remove cotter pin and clevis pin from the clevis and brake pedal tab.

4. Loosen jam nut on the brake rod.

5. Adjust clevis for proper amount of free travel.

   A. Loosen clevis by exposing more threads on the brake rod to decrease free travel of the brake pedal.

   B. Tighten clevis by exposing fewer threads on the brake rod to increase free travel of the brake pedal.

6. Assemble clevis to the brake pedal by installing clevis pin and cotter pin.

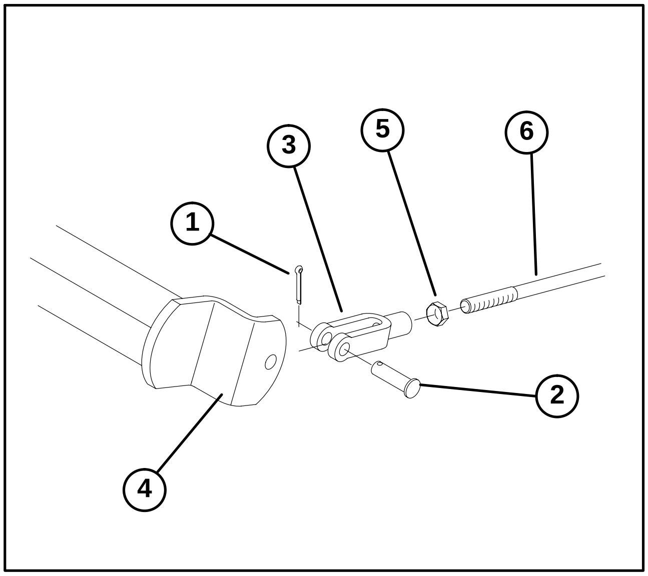


Figure 2

1. **Cotter pin**
2. **Clevis pin**
3. **Clevis**
4. **Brake pedal tab**
5. **Jam nut**
6. **Brake rod**

7. Check the amount of free travel of the brake pedal when the adjustment is complete. There should be from1/2 to 1 inch (1.3 to 2.5 cm) of travel before the brake shoes make contact with the brake drums. Readjust brake if necessary to achieve this setting.

8. Drive the machine and depress the brake pedal. **Both wheels should lock equally.** Readjust brake if necessary.

Chassis

Rear Wheel (2WD)

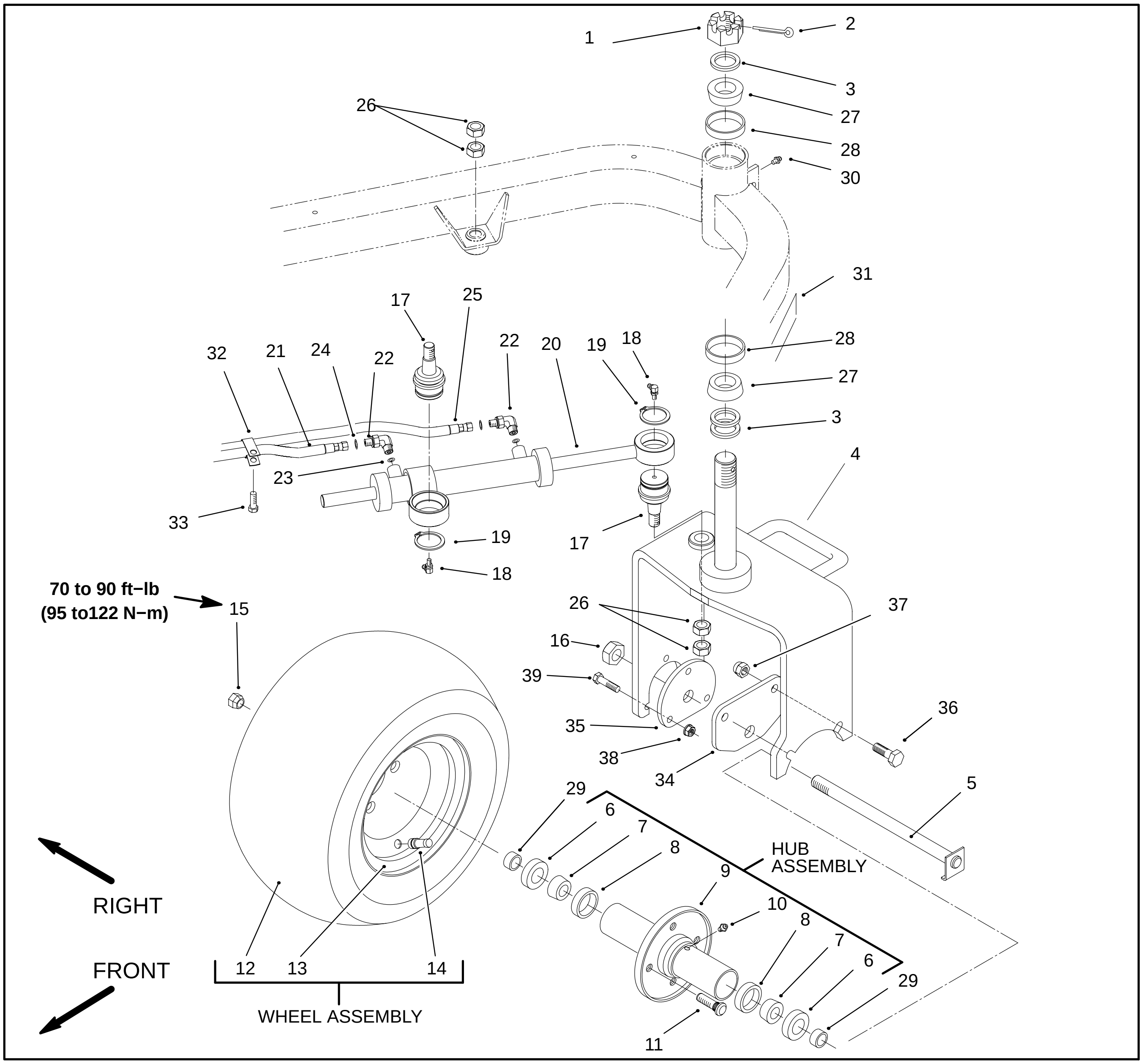


Figure 3

1. Slotted hex nut
2. Cotter pin
3. Steering washer
4. Castor fork
5. Bolt
6. Oil seal
7. Bearing cone
8. Bearing cup
9. Wheel hub
10. Grease fitting
11. Drive stud
12. Tire
13. Rim
14. Valve stem
15. Lug nut
16. Lock nut
17. Ball joint
18. Grease fitting
19. Retaining ring
20. Steering cylinder
21. Hydraulic hose
22. 90° Hydraulic fitting
23. O−ring
24. O−ring
25. Hydraulic hose
26. Jam nut
27. Bearing cone
28. Bearing cup
29. Rear spindle spacer
30. Grease fitting
31. Decal
32. Hose clamp
33. Hex washer head screw
34. Motor adapter plate
35. Adapter plate
36. Cap screw
37. Lock nut
38. Lock nut
39. Cap screw

Removal (Fig. 3)

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 (12), rim (13), and valve stem (14) with cap. The hub assembly consists of the wheel hub (9), oil seals (6), bearing cones (7), bearing cups (8), grease fitting (10), and drive studs (11).

3. Remove lock nut (16) from bolt (5). Pull bolt from both adapter plates (35 and 34), rear spindle spacers (29), and the wheel and hub assemblies.

4. Remove wheel and hub assemblies from the castor fork (4).

5. If damage to the bearings in the castor fork pivot housing is suspected, remove castor fork (4) from the frame as follows:

A. Remove three hex head screws and flat washers securing the fuel tank base plate to the frame. The two screws are located on the top of the plate at the front corners of the tank. The third screw is in front of the castor fork and below the plate.

B. Tilt fuel tank base up by lifting at the rear of the machine to gain access to the top of the castor fork. Prop up tank securely.

C. Remove both jam nuts (26) securing the ball joint (17) to the castor fork (4).

CAUTION

Support castor fork (4) while removing the slotted hex nut (1) to prevent the fork from dropping and causing personal injury.

D. Remove cotter pin (2) and slotted hex nut (1) from the castor fork (4) shaft. Lower castor fork from the frame and make sure ball joint (17) releases from the shaft ring of the steering cylinder (20).

E. Inspect bearing cones (27) and bearing cups (28) for damage, and replace if necessary.

F. Remove bearing cones (27) and bearing cups (28) from the castor fork pivot housing on the frame.

6. Remove lug nuts (15) from the drive studs (11) of the wheel hub (9). Separate wheel and hub assemblies.

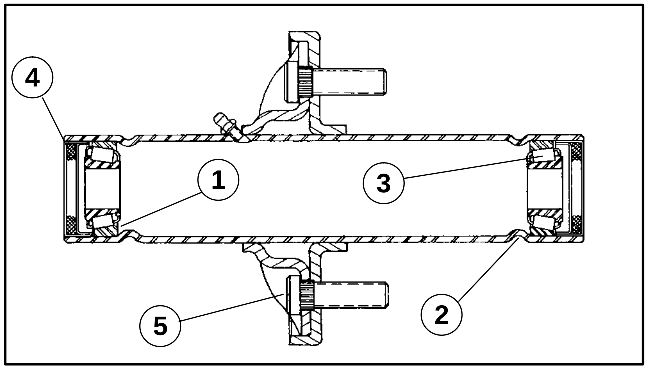


Figure 4

1. **Bearing cup**
2. **Wheel hub**
3. **Bearing cone**
4. **Shaft seal**
5. **Drive stud**

Disassembly (Fig. 3)

1. If drive studs (11) are bent or damaged, press studs from the wheel hub (9).

2. Pull oil seals (6), bearing cones (7), and bearing cups (8) from the wheel hub (9).

Assembly (Fig. 4)

1. Press new bearing cups into the wheel hub with the thick edges towards the inside.

2. Install new bearing cones into the wheel hub. Press new shaft seals into the hub with the lip of the seals facing towards the inside.

3. If removed. press new drive stud (11) into the wheel hub (9).

Installation (Fig. 3)

1. Slide wheel assembly onto the drive studs (11). Tighten lug nuts (15) to the drive studs (11) evenly in a crossing pattern to a torque of 70 to 90 ft−lb (95 to 122 N−m).

2. If the bearings in the castor fork pivot housing were removed, install castor fork (4) to the frame as follows:

A. Press new bearing cups (28) into the castor fork pivot housing with the thick side of the cups facing each other.

B. Pack both bearing cones (27) with No. 2 multipurpose lithium base grease. Place two steering washers (3) onto the castor fork (4) shaft. Place bearing cone on top of washers with the thick edge touching the washers.

C. Insert castor fork shaft up through the pivot housing and bearing cups.

Chassis

D. Place second bearing cone on the castor fork shaft with the wide edge up. Place remaining steering washer on top of the bearing cone.

E. Run slotted hex nut (1) onto castor fork shaft until drag is felt while rotating the castor fork. Back−off hex nut to align the hole to the slot. Install and secure cotter pin (2) into the shaft.

F. Secure ball joint (17) to the castor fork (4) with both jam nuts (26). Torque 65 to 85 ft−lbs (88 to 115 N−m).

G. Secure fuel tank base plate to the frame with three hex head screws and flat washers. The two screws and flat washers go on the top of the plate at the front corners of the tank. The third screw goes through support from under the plate.

3. Install wheel and hub assemblies into the castor fork (4). Insert bolt (5) into motor adapter plate (34) mounting hole. Install a spacer (29), and slide bolt through the wheel and hub assemblies.

4. Install another spacer (29) onto the bolt (5). Route the bolt through the adapter plate (35) mounting hole.

5. Position bent lip of the bolt (5) head under the bottom edge of the motor adapter plate (34). Install and tighten locknut (16) to secure wheel to the castor fork. Do not overtighten locknut, the wheel must rotate freely.

6. Wipe grease fitting (10) clean on hub (9) and pivot housing. Pump grease into hub until grease is seen exiting at both oil seals (6). Pump grease into pivot housing until grease is seen exiting at both ends of the housing. Wipe up excess grease.

Rear Wheel (3WD)

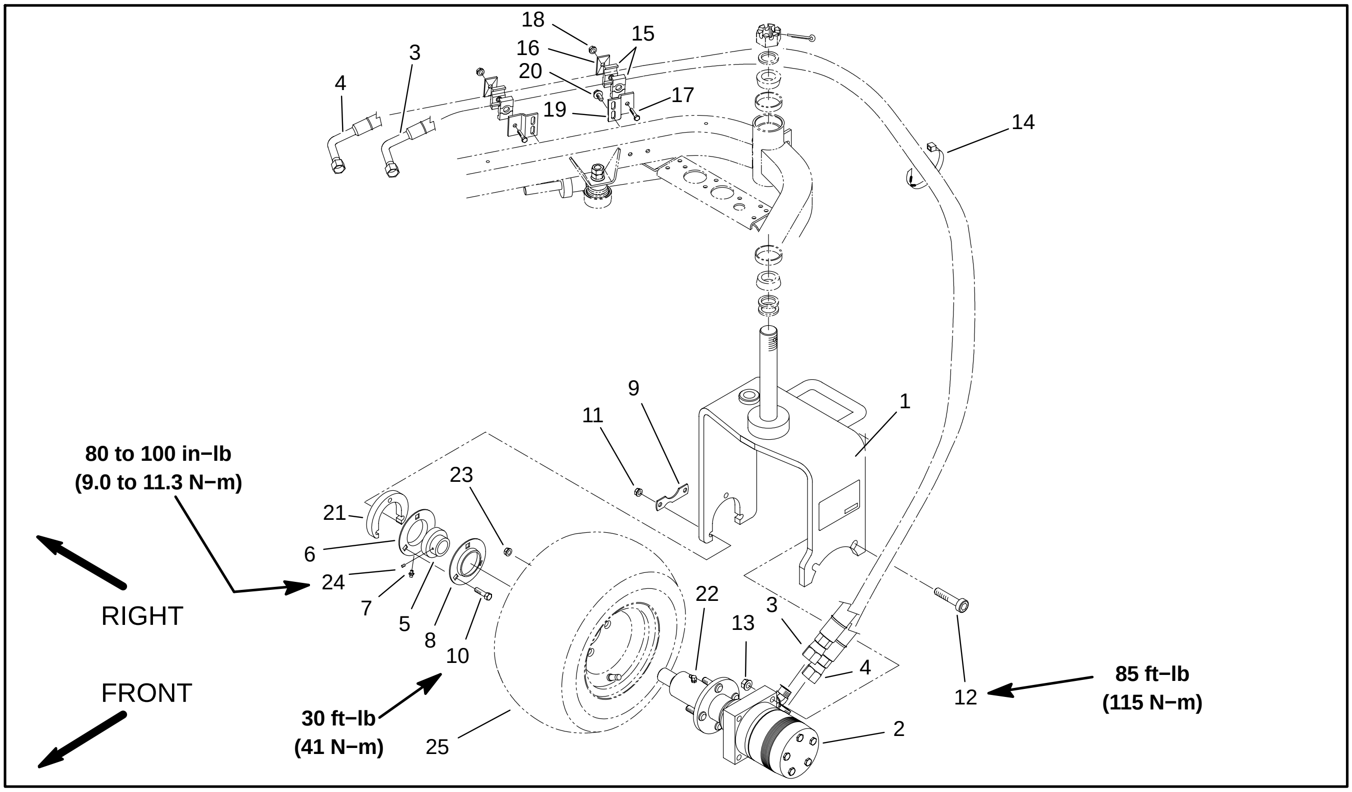


Figure 5

1. Castor fork	**10. Cap screw**	**18. Lock nut**
2. Hub and motor assembly	**11. Lock nut**	**19. Clamp bracket**
3. Hydraulic hose	**12. Hex socket head screw**	**20. Hex washer head screw**
4. Hydraulic hose	**13. Lock nut**	**21. Bearing adapter plate**
5. Bearing	**14. Cable tie**	**22. Grease fitting**
6. Relube flangette	**15. Tube clamp**	**23. Lug nut**
7. Grease fitting	**16. Cover plate**	**24. Set screw**
8. Standard flangette	**17. Cap screw**	**25. Wheel/tire assembly**
9. Bearing tab		

Removal (Fig. 5)

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 (25) and motor and hub assembly (2) to prevent dropping them and causing personal injury while removing hex head screws (10) and socket head screws (12).

3. Remove wheel (25) and hydraulic motor and hub assembly (2) from the castor fork (1) as follows:

A. Remove hex head screws (10) and lock nuts (11) securing flangettes (6 and 8) and bearing tab (9).

B. Remove both socket head screws (12) and lock nuts (13) securing the hydraulic motor and hub assembly to the castor fork (1).

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

4. Loosen set screws (24) on bearing (5). Pull flangettes (6 and 8) and bearing from the hydraulic motor shaft.

5. Remove grease fitting (22) from the hydraulic motor and hub assembly (2). Remove four lug nuts (23) and wheel (25) from the hub drive studs.

6. If the castor fork (1) requires removal, see Rear Wheel (2WD) Removal.

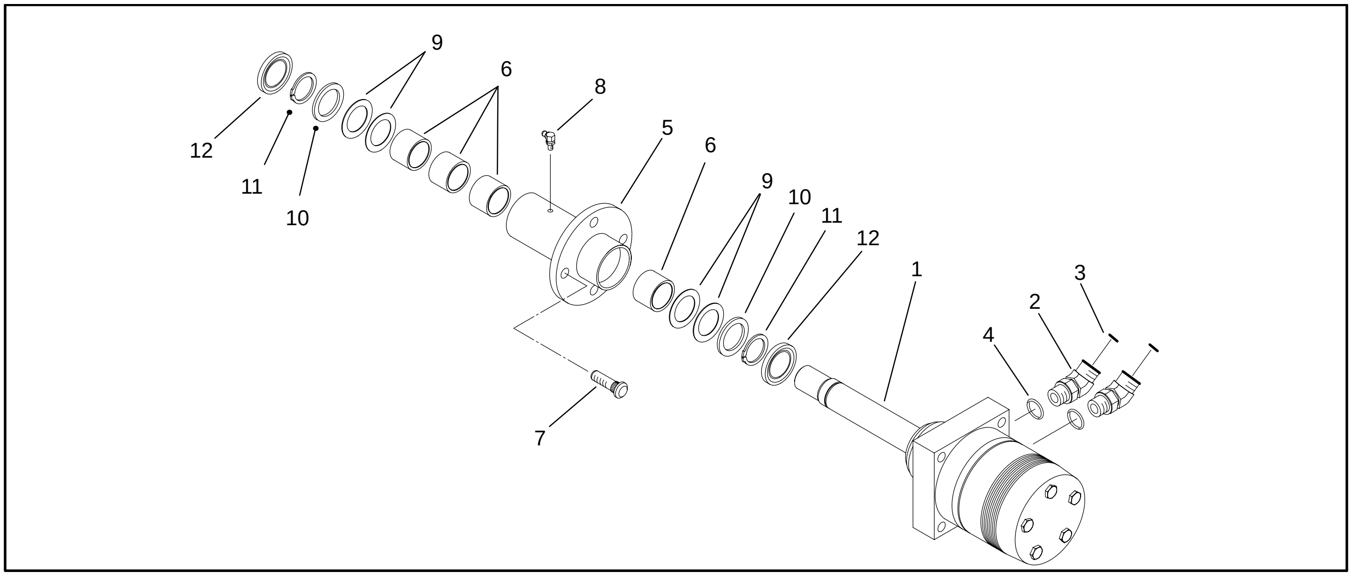


Figure 6

1. **Hydraulic motor**
2. **45° Hydraulic fitting**
3. **O−ring**
4. **O−ring**
5. **Hub**
6. **Clutch roller bearing**
7. **Drive stud**
8. **Grease fitting**
9. **Thrust washer**
10. **Washer**
11. **Snap ring**
12. **Grease seal**

Disassembly (Fig. 6)

1. Remove grease seal (12) and snap ring (12) from the long end of hub (5).

2. Remove washer (10), two thrust washers (9), and hub (5) from the hydraulic motor (1) shaft. Remove remaining two thrust washers (9), washer (10), snap ring (11), and grease seal (12) from the shaft.

3. If drive studs (7) are bent or damaged, press studs from the wheel hub (5).

4. Press clutch roller bearings (6) from the hub (5).

Assembly (Fig. 6)

1. If drive studs (7) were removed, press new studs into the wheel hub (5).

2. Press roller clutch bearings (6) into the hub (5) as follows (Fig. 7):

Note: Arrow on the side of the clutch roller bearings (6) must point to the long side of the end of the hub (5).

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 seal (12) with No. 2 multipurpose lithium base grease. Slide seal onto motor shaft past groove closest to the motor. Install snap ring (11) into groove.

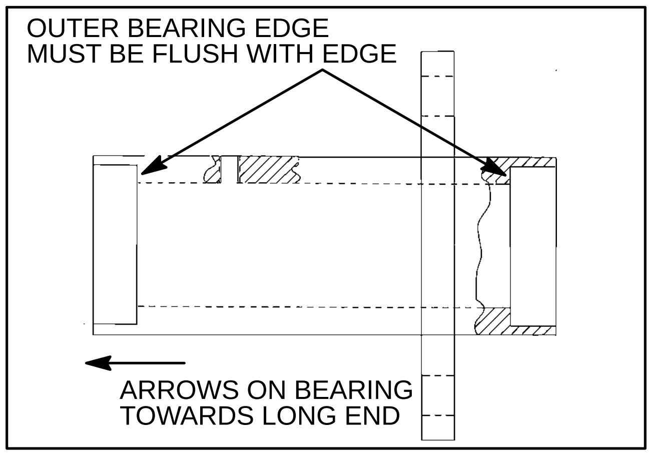


Figure 7

4. Slide flat washer (10) and two thrust washers (9) onto the motor shaft. Slide hub (5) onto the shaft with the short side first.

5. Slide remaining thrust washers (9) and flat washer (10) onto the motor shaft. Install remaining snap ring (11) into the shaft groove. Slide new grease seal (12) onto motor shaft.

IMPORTANT: The hub (5) should spin freely in the forward direction, but lock on the hydraulic motor (1) shaft when it is spun in the reverse direction.

6. Press grease seals (12) into the hub (5) so they are flush with the end of the hub.

Installation (Fig. 5)

1. Secure wheel (25) to the four drive studs of the hydraulic motor and hub assembly (2) with four lug nuts (23). Torque nuts from **70 to 90 ft−lb (95 to 122 N−m)**.

2. Reinstall grease fitting (22) into hydraulic motor and hub assembly (2) so it points away from the wheel (25).

3. Install flangette (8), bearing (5), and relube flangette (6) onto the motor shaft.

4. Position hydraulic motor and hub assembly (2), flangettes (6 and 8) with bearing (5), and wheel (25) into the castor fork (1). Make sure hose fittings on the motor face to the rear.

5. Secure hydraulic motor and hub assembly (2) loosely to the left inside of the castor fork (1) with both socket head screws (12) lock nuts (13).

6. Secure flangettes (6 and 8), bearing (5), and adapter plate (21) loosely to the right inside of the castor fork (1) with cap screws (10), bearing tab (9), and lock nuts (11).

   A. Position grease fitting (7) facing downward.

   B. Torque both socket head screws (12) to **85 ft−lb (115 N−m)**.

   C. Torque both cap screws (10) to **30 ft−lb (41 N−m)**.

7. Apply loctite to both set screws (24). Torque both screws from **80 to 100 in−lb (9 to 11 N−m)**.

Front Wheel and Brake

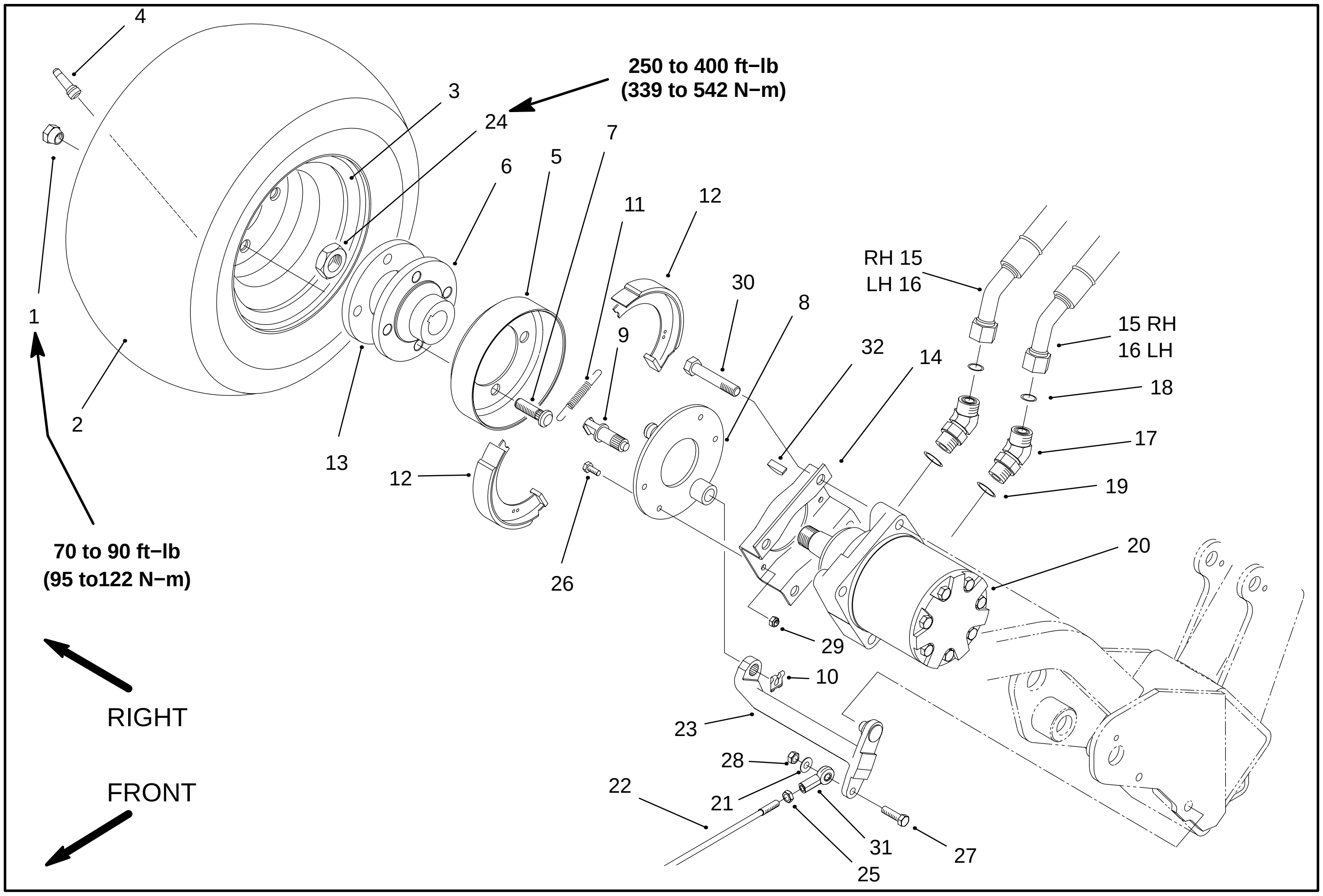


Figure 8

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 clip**
11. **Return spring**
12. **Brake shoe**
13. **Bearing plate**
14. **Brake bracket**
15. **Hydraulic hose**
16. **Hydraulic hose**
17. **45° 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. **Woodruff key**

Removal (Fig. 8)

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), and bearing plate (13). 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 or installation. Hammering may cause damage to the hydraulic wheel motor (20).

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 (32) from the hydraulic wheel motor (20) shaft.

5. Remove return springs (11) from brake shoes (12). Remove brake shoes from backing plate (8).

6. Remove retaining clip (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.

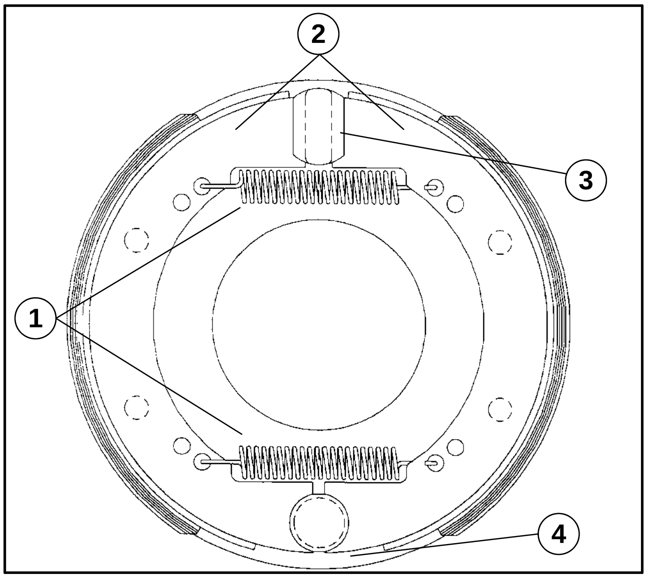


Figure 9

1. **Return spring**
2. **Brake shoe**
3. **Brake cam**
4. **Backing plate**

Installation (Fig. 8 and 9)

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).

3. Install brake cam (9) into the backing plate (8) and brake lever (23). Secure cam to the lever with the retaining clip (10).

4. Make sure that wheel hub bore and wheel motor shaft are thoroughly cleaned. Install key (32) 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 N-m)**.

6. Install bearing plate (13) and 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 N-m)**.

7. Check and adjust brakes (see Brake Adjustment).

Front Lift Arms

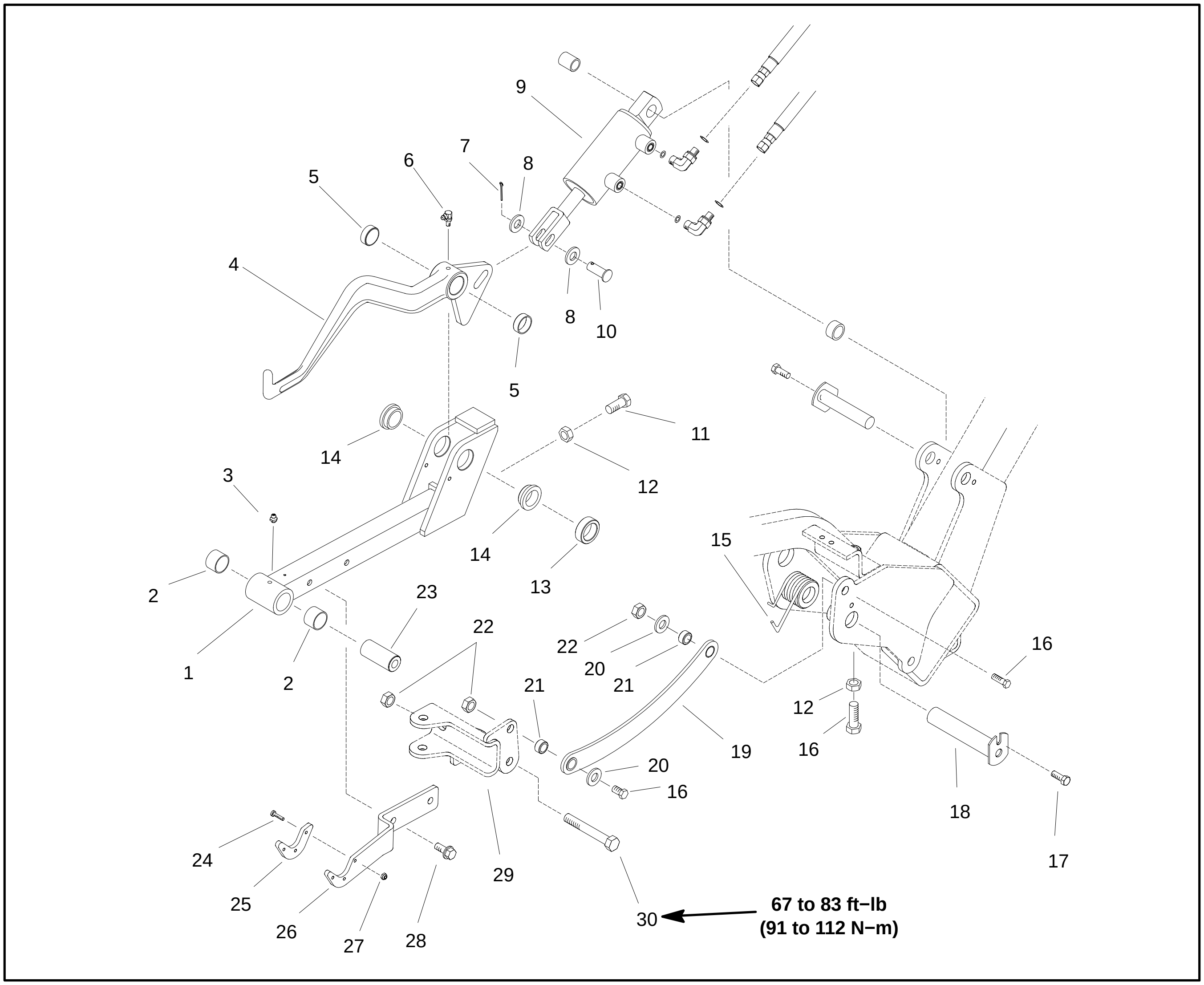


Figure 10

1. **Front lift frame**
2. **Bushing**
3. **Grease fitting**
4. **Lift arm**
5. **Bushing**
6. **Grease fitting**
7. **Cotter pin**
8. **Flat washer**
9. **Lift cylinder**
10. **Clevis pin**
11. **Cap screw**
12. **Jam nut**
13. **Carrier spacer**
14. **Flange bushing**
15. **Torsion spring**
16. **Cap screw**
17. **Washer head screw**
18. **Pin**
19. **Link bracket**
20. **Flat washer**
21. **Spacer tube**
22. **Lock nut**
23. **Pull frame spacer**
24. **Phillips head screw (3 used)**
25. **Wear pad**
26. **Transport plate**
27. **Lock nut (3 used)**
28. **Cap screw (2 used)**
29. **Clevis**
30. **Cap screw**

Disassembly (Fig. 10)

1. Park machine on a level surface. Make sure engine is off and brake is set.

2. Remove cutting unit from front lift arm (see Operator's Manual).

3. Disassemble front lift arm as needed using Figures 10 and 11 as guides.

Assembly (Fig. 10)

1. Assemble front lift arm using Figures 10 and 11 as guides.

   A. If clevis (item 29) was removed from front lift frame, torque cap screw from 67 to 83 ft−lb (91 to 112 N−m).

   B. If pull frame (item 1 in Fig. 11) was removed from clevis on lift frame, torque cap screw from 67 to 83 ft−lb (91 to 112 N−m).

2. Attach cutting unit to lift arm (see Operator's Manual).

3. Check that when raised to the transport position, the cutting units are secured by the transport plate. If necessary, loosen two cap screws (item 28) and reposition transport plate.

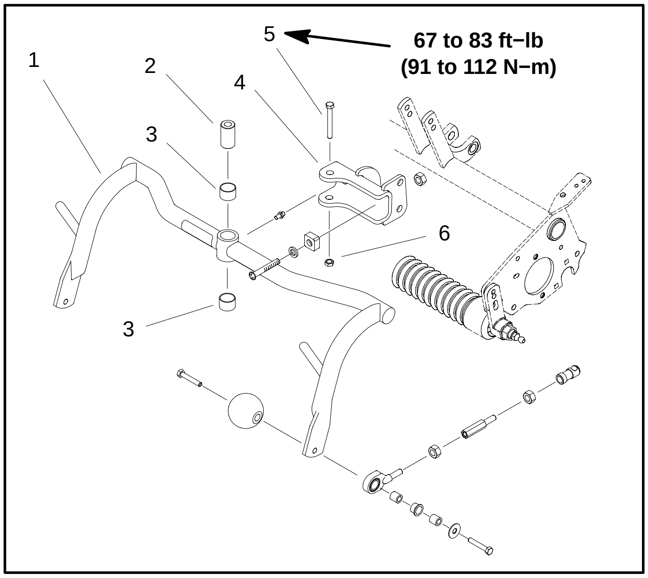


Figure 11

1. **Pull frame**
2. **Pivot spacer**
3. **Bushing**
4. **Clevis**
5. **Cap screw**
6. **Lock nut**

Chassis

Center Lift Arm

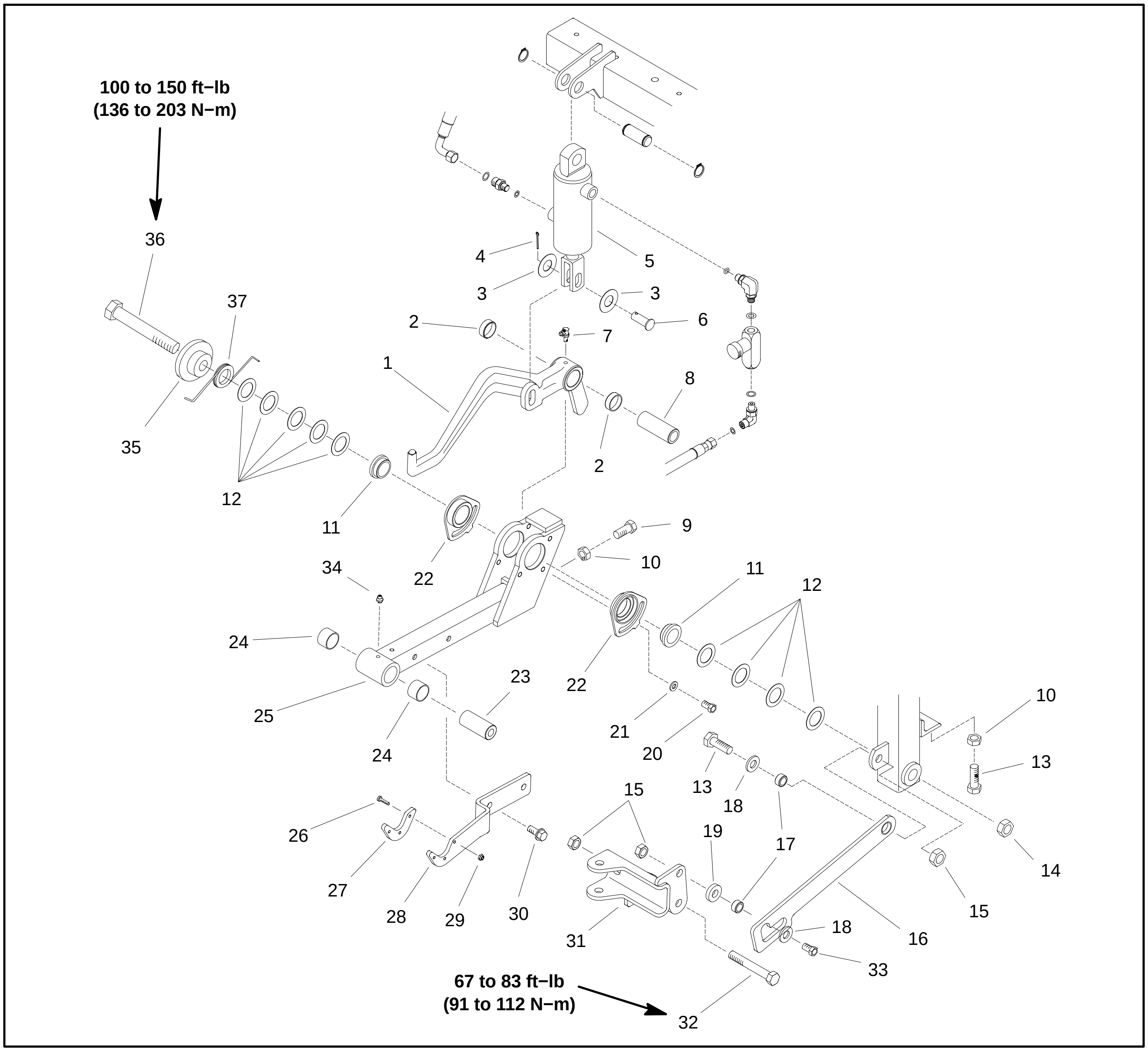


Figure 12

1. **Center lift arm**
2. **Bushing**
3. **Flat washer**
4. **Cotter pin**
5. **Lift cylinder**
6. **Clevis pin**
7. **Grease fitting**
8. **Pivot tube**
9. **Cap screw**
10. **Jam nut**
11. **Flange bushing**
12. **Thrust washer**
13. **Cap screw**
14. **Lock nut**
15. **Lock nut**
16. **Link bracket**
17. **Spacer tube**
18. **Flat washer**
19. **Spacer**
20. **Cap screw (2 used)**
21. **Flat washer**
22. **Eccentric bushing**
23. **Pull frame spacer**
24. **Bushing**
25. **Lift frame**
26. **Phillips screw (3 used)**
27. **Wear pad**
28. **Transport plate**
29. **Lock nut (3 used)**
30. **Cap screw (2 used)**
31. **Clevis**
32. **Cap screw**
33. **Cap screw**
34. **Grease fitting**
35. **Spring guide**
36. **Cap screw**
37. **Torsion spring**

Disassembly (Fig. 12)

1. Park machine on a level surface. Make sure engine is off and brake is set.

2. Remove center cutting unit from lift arm (see Operator's Manual).

3. Disassemble center lift arm as needed using Figures 12 and 13 as guides.

Assembly (Fig. 10)

1. If lift frame (item 25) was removed from machine:

   A. Adjust eccentric bushings (item 22) as needed so that lift frame is level when the lift frame is in the raised position.

   B. Install thrust washers (item 12) as needed so that lift frame is centered between the front wheel mounts when the lift frame is in the raised position.

2. Assemble center lift arm using Figures 12 and 13 as guides.

   A. If clevis (item 31) was removed from center lift frame, torque cap screw from 67 to 83 ft−lb (91 to 112 N−m).

   B. If pull frame (item 1 in Fig. 13) was removed from clevis on lift frame, torque cap screw from 67 to 83 ft−lb (91 to 112 N−m).

3. Attach cutting unit to lift arm (see Operator's Manual).

4. Check that when raised to the transport position, the cutting unit is secured by the transport plate. If necessary, loosen two cap screws (item 30) and reposition transport plate.

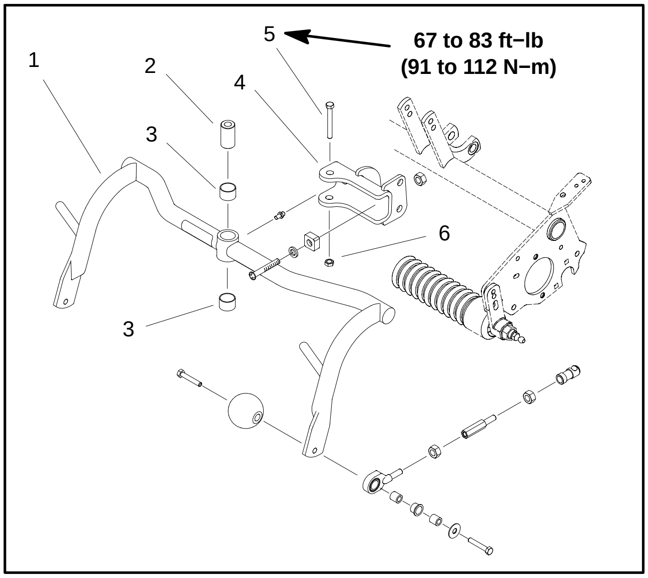


Figure 13

1. **Pull frame**
2. **Pivot spacer**
3. **Bushing**
4. **Clevis**
5. **Cap screw**
6. **Lock nut**

Chassis

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SPA and 4−Bolt Cutting Units

Table of Contents

SPA and 4−Bolt Cutting Units

Introduction

There are two different types of cutting units covered in this chapter: the Single Point Adjust and 4−Bolt Adjust. Both units are similar in design and construction. However, each unit has different bedbars with different methods of bedknife adjustment (see Specifications).

Maintenance procedures for both cutting units are the same, except where noted. If a chapter subheading does not specify a particular type of cutting unit, the procedure can be used for both types of units. A particular unit may be illustrated, but the component parts and maintenance procedures are the same for each type of unit.

Specifications

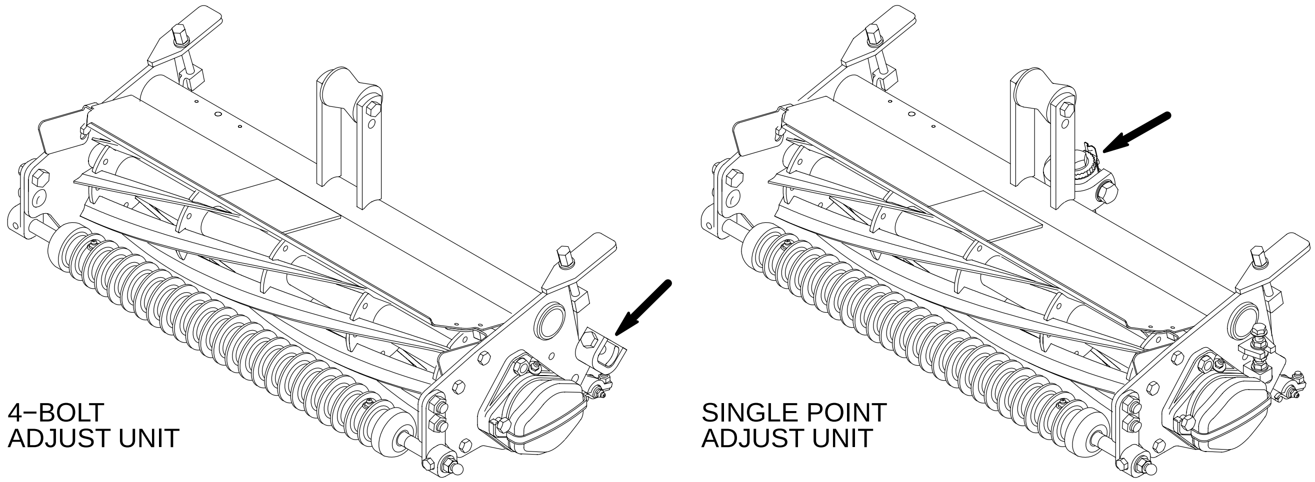


Figure 14

Height−of−Cut (HOC): Cutting height is adjusted on the rear roller by two vertical screws and held by two locking capscrews. Bench HOC range is 3/32 inch (2.4mm) to 1−1/32 inches (26mm). Cutting units will deliver differing effective height−of−cuts depending on their configuration. In fact, effective cutting height may be influenced by the following factors; turf conditions, roller profiles, cutting unit attitude, cutting unit accessories, weight of cutting units and bedknife profile. Therefore bench setting a cutting unit does not equal the effective (actual) height of cut you achieve. You need to determine how to adjust your cutter on the bench to achieve a comparable height of cut to a cutting unit of a different configuration, model or brand.

Reel Construction: Reels are 5 inches (13cm) in diameter, 21 inches (53.3 cm) in length. High carbon steel blades are welded to 5 stamped steel spiders and heat treated to RC 48−54 hardness. The reel is ground for diameter, concentricity, and back grind.

Reel Bearings: Two double row ball bearings, (30 mm I.D.) are press fitted onto the reel shaft. An inverted seal pressed onto reel shaft. Bearing side load maintained by a wave washer, 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. The floating coupler may be moved to the other end when the cutting unit is used on the tractor front right position.

Frame Construction: Single top tube is welded to two sideplates. A bolt−in cross rod acts to set the front frame width and stiffen the assembly. The lift straps have a replaceable roller that may be moved to change transport height.

Bedknife: Replaceable, 13−screw, single edged, high carbon steel bedknife austempered to RC 48−55, fastened to a machined cast iron bedbar. Tournament bedknife is standard.

Bedknife Adjustment (Single Point Adjust): A single control screw has detents corresponding to 0.0007 inch (0.018 mm) bedknife movement for each indexed position. A linear adjustment on the bedbar left end allows leveling of bedknife to reel blades. A centered lever arm regulates knife to reel contact with two rubber bushings acting as pivots.

Bedknife Adjustment (4−Bolt Adjust): Two opposing screws on each end of the bed bar are used to level and regulate bedknife to reel contact.

Front Roller: Standard front roller is a 2.5 inch (6.4 cm) diameter full radius Wiehle. The right bracket has an eccentric shoulder bolt to provide leveling. A second eccentric may be added to the left bracket for increased leveling range. Roller has a through shaft with greaseable ball bearings.

Rear Roller: Standard rear roller is a 2 inch *(5.2* cm) diameter smooth steel roller. Roller has a through shaft with greaseable ball bearings.

Counterbalance Weight: The end of cutting unit opposite the reel motor has a weight with a spin flange like the reel motors for easy installation. The weight seals the bearing area and balances the reel motor's weight during cutting.

Lift Roller Position

The cutting unit comes with its lift roller installed in the top position. The position of the roller may be changed as follows:

1. Remove hex head screw and lock nut from the lift roller and frame.

2. Position lift roller to the proper hole on the frame. Insert hex head screw through the frame and roller.

   Lower Hole − for increased transport height.

   Upper Hole − standard transport height so the cutting unit is level when it touches down upon lowering.

3. Secure hex head screw with the lock nut.

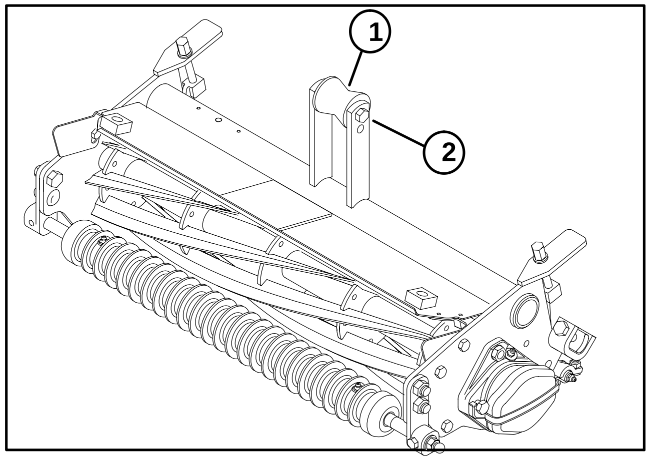


Figure 15

1. Lift roller **2. Hex head screw**

Special Tools

Order special tools from your Toro Distributor.

Some tools may have been supplied with your mower or available as TORO parts. Some tools may also be available from a local supplier.

Gauge Bar Assembly

Used to verify height-of-cut. Toro Part No. 13-8199.

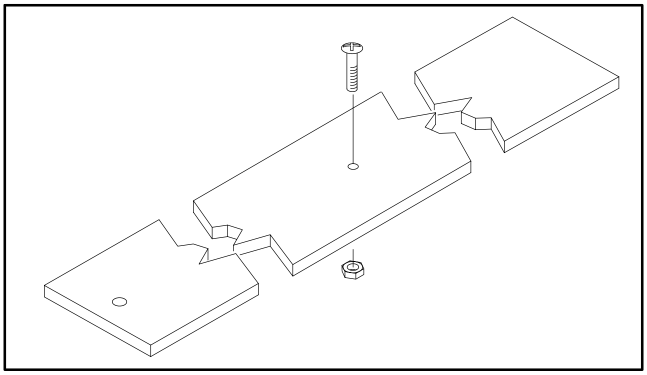


Figure 3

Backlapping Brush Assembly – TOR299100

Used to apply lapping compound to cutting units while keeping the operator's hands at a safe distance from the rotating reel.

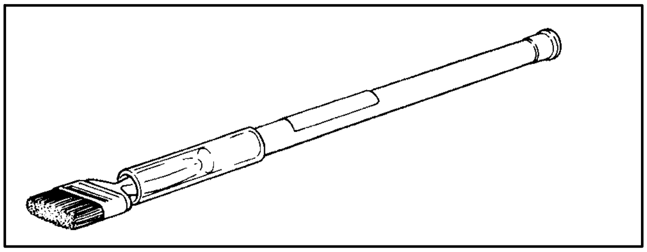


Figure 4

Bedknife Screw Tool – TOR510880

This screwdriver-type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

DO NOT use and air or manual impact wrench with this tool so damage to the bedbar will be prevented.

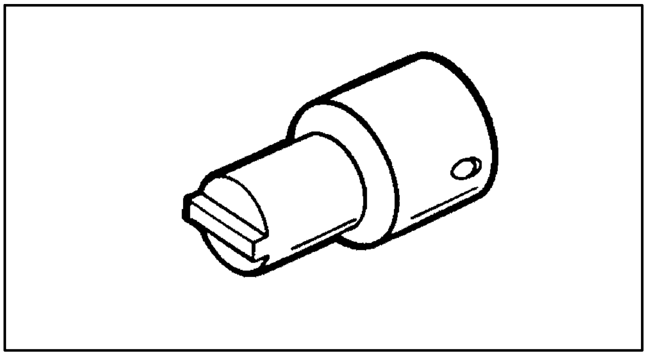


Figure 5

Bearing Replacement Tool Kit − TOR238900A

The puller is used to remove the bearings from the Wiehle Rear Roller kit (Model 04488) rollers **only**. A driving tube is used to install bearings into the roller. A drill bushing is used to drill into bearing shafts without a removal hole.

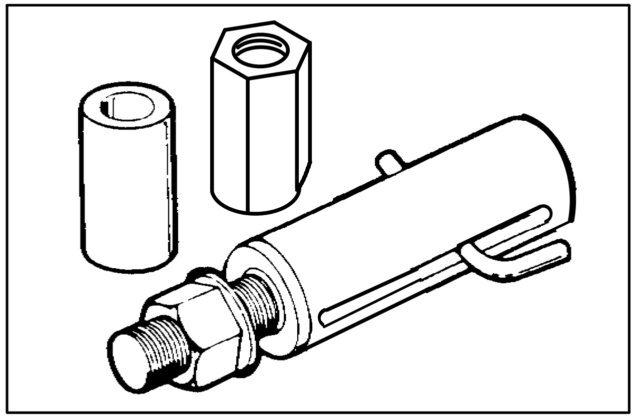


Figure 19

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 No. 2410−30.

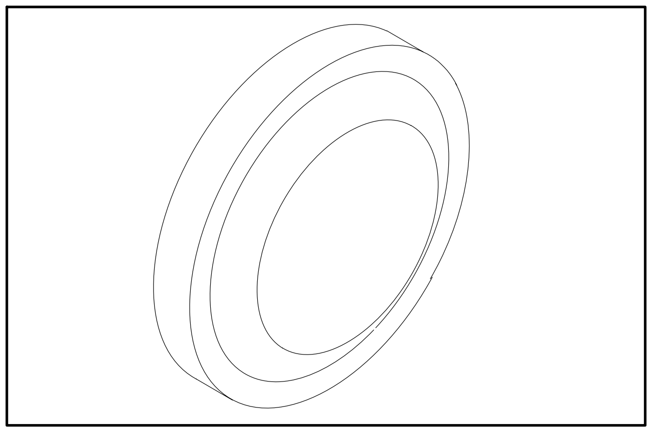


Figure 20

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 and Service and Repairs sections for detailed adjustments 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 General section in Chapter 6 − Wheels and Brakes.
Governed engine speed	Check maximum governed engine speed. Adjust engine to specifications if necessary. See Adjustments section in Chapter 3 − Engine.
Reel bearing condition	Check bearings for wear and replace if necessary. Make sure bearing housings are secured properly. Keep bearings well lubricated. See Reel and Bearing Removal and Installation.
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.**
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). Slightly dull cutting edges may be corrected by backlapping (see Backlapping). Excessively dull cutting edges must be corrected by grinding the reel and bedknife (see Preparing Reel for Grinding).

Factor	Possible Problem/Correction
Bedknife attitude	Set attitude (angle) as recommended. See Leveling Front Roller to Reel and Attitude Adjustments.
Rear roller adjustment	Check and adjust as necessary. The rear roller must be leveled so it is parallel with the reel for proper height−of−cut setting. See Height−of−Cut Adjustment.
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.
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.
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. Grease roller as recommended and repair bearings as necessary. See Roller Bearing Replacement in Service and Repairs section.
Reel speed	All reels must rotate at the same speed (within 100 rpm). All cutting units must have equal bedknife to reel, front roller to reel, attitude, and height−of−cut adjustments. Check reel speed setting if a backlap/variable reel speed kit is installed. See Adjustments in this chapter and Troubleshooting in Chapter 4 − Hydraulic System.
Traction speed	Check maximum governed engine speed. Adjust engine to specifications if necessary. See Adjustments section in Chapter 3 − Engine. Check traction pedal adjustment. See Adjusting Transport and Mowing Speed, and Troubleshooting in Chapter 4 − Hydraulic System.
Cutting Unit drop speed and sequence	Center cutting unit must drop after front cutting units. See Troubleshooting in Chapter 4 − Hydraulic System.

Adjustments

Daily Adjustments (Single Point Adjust Cutting Units)

Prior to each day's mowing, or as required, each cutting unit must be checked to verify proper bedknife−to−reel contact. **This must be performed even though quality of cut is acceptable.**

1. Lower cutting units onto a hard surface, shut off engine, and remove the key from the ignition switch.

2. Slowly rotate reel in the reverse direction listening for reel−to−bedknife contact. If no contact is evident, turn bedknife adjusting knob clockwise, one click at a time, until light contact is felt and heard.

3. If excessive contact is felt, turn bedknife adjusting knob counterclockwise, one click at a time, until no contact is evident. Then turn bedknife adjusting knob clockwise, one click at a time, until light contact is felt and heard.

IMPORTANT: Light bedknife−to−reel contact is preferred at all times. If light contact is not maintained, bedknife and reel edges will not sufficiently self−sharpen, and dull cutting edges will result after a period of operation. Excessive contact can cause accelerated and/or uneven bedknife and reel wear. Thus, quality of cut may be adversely affected.

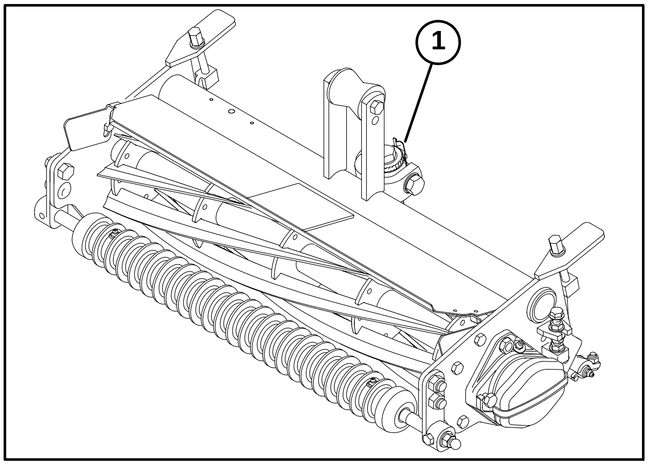


Figure 21
1. Adjuster

Note: As the reel blades continue to run against the bedknife, a slight burr will appear on the front cutting edge surface for the full length of the bedknife. If a file is occasionally run across the front edge to remove this burr, quality of cut will improve. If this burr is not removed, the quality of cut will appear as if it was cut with a dull reel (grass will appear torn or ripped).

After extended running, a ridge will eventually develop at both ends of the bedknife. These ridges must be rounded off or filed flush with the cutting edge of the bedknife to assure smooth operation.

Daily Adjustments (4−Bolt Adjust Cutting Units)

Prior to each day's mowing, or as required, each cutting unit must be checked to verify proper bedknife−to−reel contact. **This must be performed even though quality of cut is acceptable.**

1. Lower cutting units onto a hard surface, shut off engine, and remove the key from the ignition switch.

2. Slowly rotate reel in the reverse direction listening for reel−to−bedknife contact. If no contact is evident, adjust bedknife to reel (see Bedknife to Reel Adjustment (4−bolt Adjust Cutting Units)).

3. If excessive contact is felt, adjust bedknife (see Bedknife to Reel Adjustment (4−bolt Adjust Cutting Units)).

IMPORTANT: Light bedknife to reel contact is preferred at all times. If light contact is not maintained, bedknife and reel edges will not sufficiently self−sharpen, and dull cutting edges will result after a period of operation. Excessive contact can cause accelerated and/or uneven bedknife and reel wear. Thus, 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 can be obtained.

After extended running, a ridge will eventually develop at both ends of the bedknife. These notches must be rounded off or filed flush with the cutting edge of the bedknife to assure smooth operation.

Adjust Bedknife Parallel to Reel (Single Point Adjust Cutting Units)

1. If the cutting unit is not removed from the machine, remove reel motor from the cutting unit and cutting unit from lift arm (see Cutting Unit Removal and Installation).

2. Position cutting unit on a level surface.

3. Make sure reel contact is removed by turning the bedknife adjuster counterclockwise (Fig. 9).

4. Position cutting unit with the front roller up (Fig. 10).

   A. On either end of the front side of the reel, insert a long strip of newspaper between the reel and bedknife.

   B. While slowly rotating the reel forward, turn bedknife adjuster clockwise, one click at a time, until the paper is pinched lightly all the way across the reel. A slight drag should result when the paper is pulled. This drag should be the same for the entire length of the bedknife.

   C. If equal adjustment is not obtained for the entire length of bedknife, proceed to steps 5. through 8.

5. Loosen both flange lock nuts secured to the frame tab (Fig. 9). Also, loosen both flange lock nuts securing the pivot hub to the frame (Fig. 10).

6. Rotate flange lock nuts, on the top and bottom of the frame tab, clockwise or counterclockwise to raise or lower the end of the bedbar, as required. Do not loosen the bottom flange nut tightened against the pivot hub. Tighten both flange lock nuts against the frame tab to secure the adjustment adjustment (Fig. 9).

7. Check adjustments by repeating steps 3. and 4. After the adjustments are accomplished, make sure of the following (Fig. 10):

   A. The reel can pinch the paper when inserted from the front.

   B. The reel can cut the paper when inserted at a right angle. It should be possible to cut the paper with minimum contact between the bedknife and the reel blades.

   C. Should the reel be unable to cut the paper, it will be necessary to either backlap or regrind the cutting unit to achieve the sharp edges needed for precision cutting. Refer to the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for additional information.

8. When light contact on the paper is evident at each end of the bedknife, tighten flange lock nuts to securely retain the pivot hub (Fig. 10).

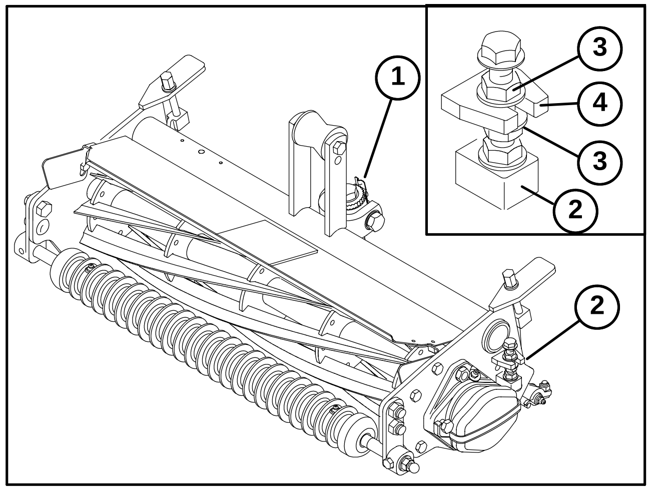


Figure 9

1. **Adjuster**
2. **Pivot hub (LH)**
3. **Flange lock nut**
4. **Frame tab**

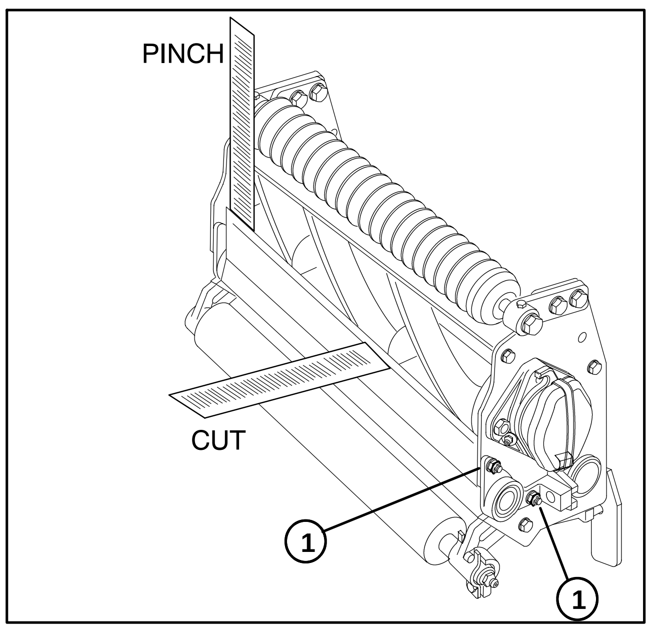


Figure 10

1. **Flange lock nut**

Adjust Bedknife Parallel to Reel (4-Bolt Adjust Cutting Units)

1. If the cutting unit is not removed from the machine, remove reel motor from the cutting unit and cutting unit from lift arm (see Cutting Unit Removal and Installation).

IMPORTANT: Use only a 13mm wrench, 3 to 6 inches (7.5 to 15 cm) in length, when adjusting the hex head screws. A longer wrench will provide too much leverage and may cause distortion of the mounting plate (Fig. 11).

2. Make sure reel contact is removed by loosening the top hex head screw on each side of cutting.

3. Position cutting unit with the front roller up (Fig. 11).

   A. On either end of the front side of the reel, insert a long strip of newspaper between the reel and bedknife.

   B. While slowly rotating the reel forward, adjust top and bottom hex head screws until the paper is pinched lightly all the way across the reel. A slight drag should result when the paper is pulled. This drag should be the same for the entire length of the bedknife.

4. After adjusting bedknife to reel, make sure that both top and bottom adjusting screws are secured against the bedbar tabs on each end of the cutting unit (Fig. 11).

5. After the adjustment is accomplished, make sure of the following (Fig. 12):

   A. The reel can pinch the paper when inserted from the front.

   B. The reel can cut the paper when inserted at a right angle. It should be possible to cut the paper with minimum contact between the bedknife and the reel blades.

   C. Should the reel be unable to cut the paper, it will be necessary to either backlap or regrind the cutting unit to achieve the sharp edges needed for precision cutting. Refer to the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for additional information.

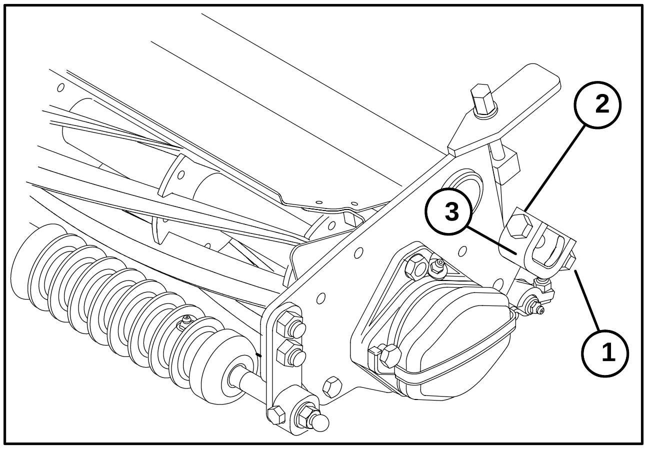


Figure 11

1. **Bottom hex head screw**
2. **Top hex head screw**
3. **Mounting plate**

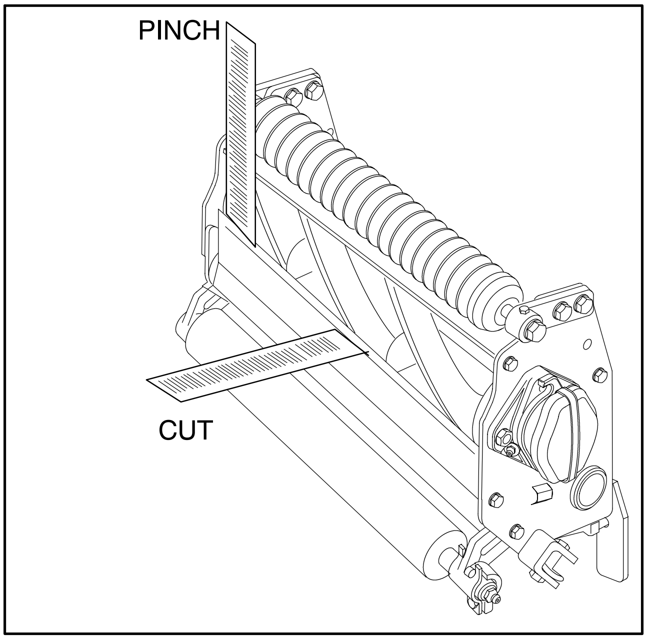


Figure 12

Adjust and Level Front Roller to Reel

1. If the cutting unit is not removed from the machine, remove reel motor from the cutting unit and cutting unit from lift arm (see Cutting Unit Removal and Installation).

Note: Make sure leveling plate covers the full length of reel blades. Three blades must contact the plate.

2. Position cutting unit on a cutting leveling plate or a known flat and level surface.

3. Position a 1/4−inch or thicker bar stock under the reel blades and against the front face of the bedknife.

Note: Make sure both front brackets are in the same hole (see Attitude Adjustment).

4. Loosen both lock nuts securing the right front bracket.

Note: The right front bracket is secured to the frame with an eccentric bolt, while the left front bracket is secured with a shoulder bolt. The eccentric bolt has an offset, which when rotated, acts as an eccentric (cam) to raise or lower the roller. On the bolt head there is an identification dot which denotes the offset of the bolt. The dot indicates in which direction the right end of roller moves when bolt is turned.

5. While holding reel securely on plate and maintaining pressure on front roller, rotate upper right roller mounting bolt. This mounting bolt has an offset, which when rotated, acts as an eccentric (cam) to raise or lower the roller. On the bolt head there is an I.D. dot which denotes the offset of the bolt. The dot indicates in which direction right end of roller moves when bolt is turned.

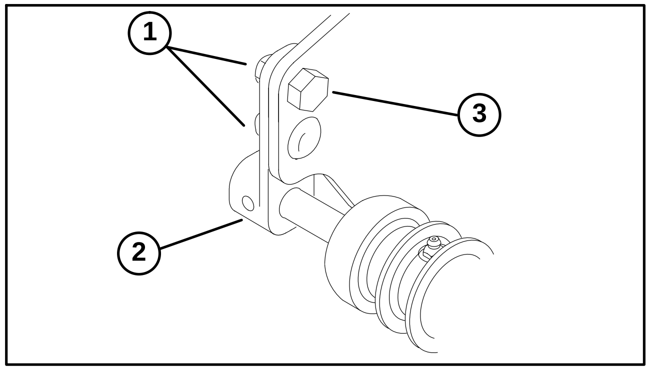


Figure 26

1. **Lock nuts**
2. **Right front roller bracket**
3. **Eccentric bolt**

Note: If additional adjustment is required, replace shoulder bolt on the left front bracket with another eccentric bolt (see cutting unit parts catalog for current part number). Make sure both front roller brackets are in the same hole.

6. Verify roller is level. Insert a piece of paper or 0.003 inch (0.076 mm) feeler gauge under each end of the roller.

7. When the roller is level, tighten lock nuts securely.

Adjust Attitude

There are four positions for the front roller brackets.

Position 1: The **least aggressive position** is used for very soft and tender turf, or the highest height−of−cut (Fig. 27).

Height−of−Cut (HOC) Range − 1/8 to 1−1/32 inch (3.2 to 26mm)

Note: The top frame hole and top bracket hole will yield Position 2 (standard position).

Position 2: The **standard position** is used for most conditions (Fig. 28).

HOC Range − 3/32 to 15/16 inch (2.4 to 24mm)

Position 3: A **more aggressive** position is used on firm turf (Fig. 29).

HOC Range − 3/32 to 13/16 inch (2.4 to 21mm)

Position 4: The **most aggressive position** is used only on very firm greens or at the lowest height−of−cut (Fig. 30).

HOC Range − 3/32 to 3/4 inch (2.4 to 19mm)

Note: A more aggressive setting will increase grass removal and provide a cleaner cut, but may cause increased scalping and marking.

Note: A more aggressive setting will be required to compensate for reel wear.

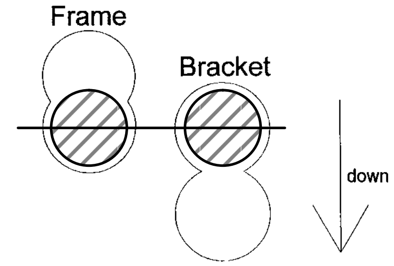
Adjusting Attitude

Note: The top of the right front bracket is secured to the frame with an eccentric bolt, while the left front bracket is secured with a shoulder bolt (Fig. 31).

1. If the cutting unit is not already removed from the machine, remove reel motor from the cutting unit and cutting unit from lift arm (see Cutting Unit Removal and Installation).

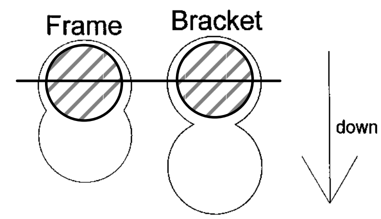
2. Remove lock nuts from the eccentric (shoulder) bolt and carriage bolt securing both front brackets.

3. Remove eccentric (shoulder) bolt and carriage bolt from both front brackets and the side plates.



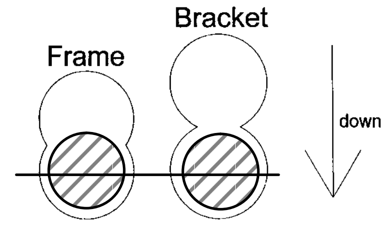
POSITION 1

Figure 27



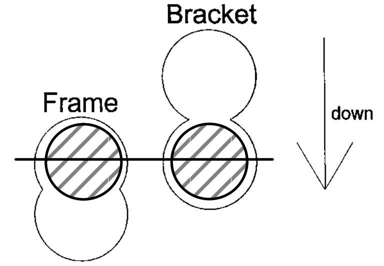
POSITION 2

Figure 28



POSITION 3

Figure 29



POSITION 4

Figure 30

SPA and 4−Bolt Cutting Units

4. Position **both** front brackets as follows:

Note: The top side plate hole and top bracket hole should yield **Position 2** (standard setting).

A. Insert eccentric bolt (shoulder bolt) through one of the two positions in the figure 8 hole in the frame and one of the top holes of the front bracket (Fig. 31) so the point on the bracket is at the desired position.

B. Screw lock nut onto the eccentric bolt (shoulder bolt).

C. Insert carriage screw through the bottom hole of the frame and front bracket. Secure carriage screw and eccentric bolt (shoulder bolt) with lock nuts.

5. Level front roller to the reel (see Adjust and Level Front Roller to Reel).

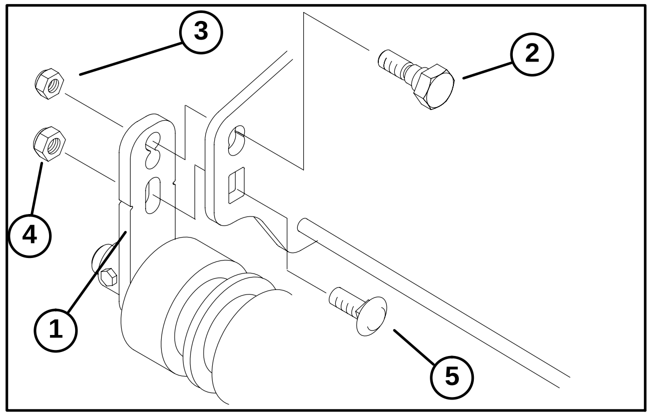


Figure 31

1. **Front bracket**
2. **Eccentric (shoulder) bolt**
3. **Lock nut**
4. **Lock nut**
5. **Carriage screw**

Adjust Top Shield Height

Note: The top shield can be raised for extremely wet conditions.

1. Loosen cap screws and nuts securing top shield to each side plate.

2. Adjust top shield to desired position and secure fasteners.

3. Repeat above steps for the remaining cutting units.

IMPORTANT: The top shield must be adjusted every time the top shield is adjusted.

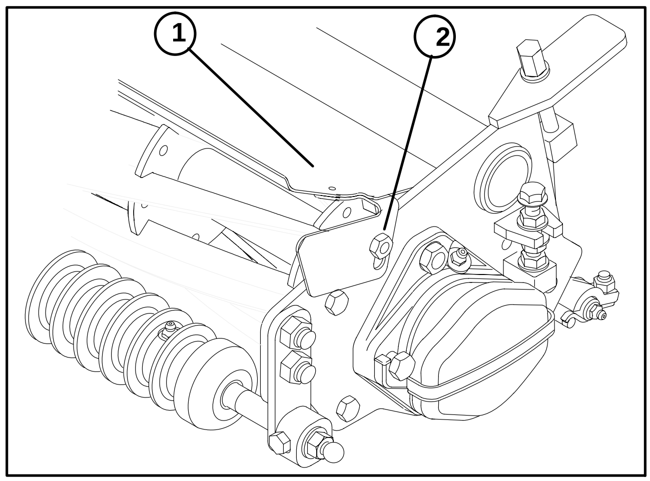


Figure 32

1. **Top shield**
2. **Lock nut**

Adjust Top Bar

Adjust top bar, which is located on the rear bottom of the top shield, to make sure clippings are cleanly discharged from the reel.

IMPORTANT: The top bar is adjustable to compensate for changes in turf conditions. The bar should be adjusted closer to the reel when turf is extremely wet. When turf conditions are dry, adjust the top bar further away from the reel.

1. Loosen screws securing the top bar to the top shield.

Note: Make sure gap between the bar and reel is the same for the entire length of the reel.

2. Insert 0.060 inch (1.52 mm) feeler gauge between the top of the reel and top bar. Tighten all screws.

3. Repeat above steps on remaining cutting units.

Adjust Height−of−Cut

Note: Cutting units will deliver differing effective height−of−cuts depending on their configuration. In fact, effective cutting height may be influenced by any of the following factors: turf conditions, roller profiles, cutting unit attitude, cutting unit accessories, weight of cutting units, and bedknife profile. Therefore benchsetting a cutting unit does not equal the effective (actual) height−of−cut you achieve. You need to determine how to adjust your cutter on the bench to achieve a comparable height−of−cut to a cutting unit of a different configuration, model, or brand.

1. If the cutting unit is not already removed from the machine, remove reel motor from the cutting unit and cutting unit from lift arm (see Cutting Unit Removal and Installation).

2. Verify that front roller is level and bedknife to reel contact is correct (see Adjust Bedknife to Reel, and see Adjust and Level Front Roller to Reel).

3. Turn cutting unit over (90°) and rest it on the rear roller and top rear tabs. Loosen locknuts on the capscrews retaining the rear roller brackets.

4. On gauge bar (Part no. 13−8199), set head of screw to desired height−of−cut. This measurement is from bar face to underside of screw head.

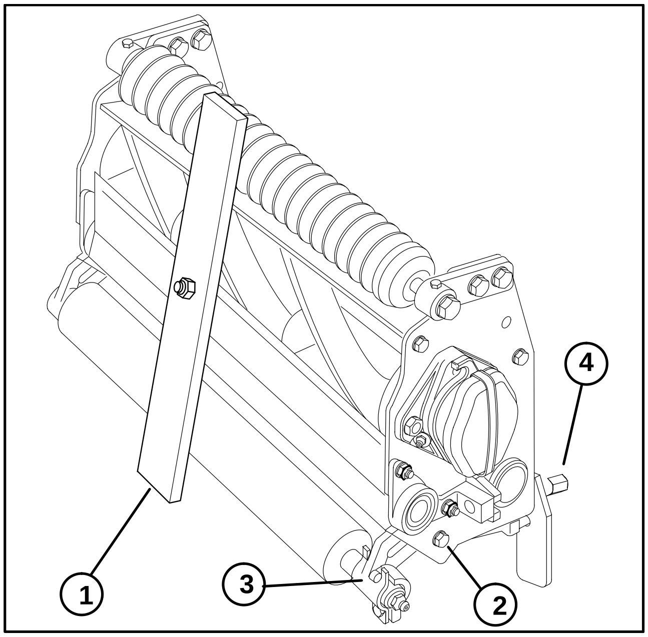


Figure 33

1. **Gauge bar**
2. **Cap screw**
3. **Rear roller bracket**
4. **Height−of−cut adjuster**

5. Place bar across the front and rear rollers. Adjust rear roller with height−of−cut adjuster until the underside of screw head engages the bedknife cutting edge.

6. Repeat procedure on each end of bedknife. Tighten lock nuts to secure rear roller brackets on each end.

Adjust Rear Roller Scraper

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

2. Loosen flange nuts securing both bracket assemblies to the hex head screws on each roller bracket.

3. Adjust flange nuts up or down until bottom edge of scraper is the same height as the top edge of the cutting unit bedknife at each end or the same as the height−of−cut setting.

Note: If scraper is not adjusted correctly it will not properly clean roller, will ruffle the grass or leave large clumps on the grass.

4. Move scraper in or out to ensure the edge is flush with the full length of the roller. Tighten top flange nuts to secure the adjustment.

IMPORTANT: Thoroughly wash cutting unit after each use. Pull scraper away from the roller when washing. Failure to follow this practice may result in pitting of the roller.

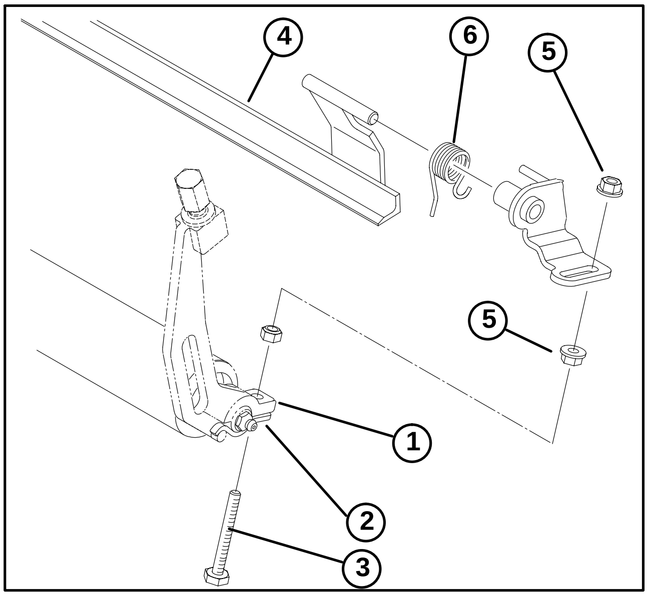


Figure 34

1. **Flange nuts**
2. **Bracket assembly**
3. **Hex head screw**
4. **Scraper**
5. **Lock nut**
6. **Spring**

SPA and 4−Bolt Cutting Units

Adjust Front Roller Brush/Scraper

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

2. Loosen socket head screws securing the clamp blocks to the roller shaft.

Note: Secure one end of the brush assembly at a time to simplify the following steps.

3. Adjust aggressiveness of the brush/scraper as follows:

   A. Bristles touching the adjusting gauge bar gives you an aggressive setting.

   B. Adjusting the brush assembly so it is midway between the adjusting gauge bar and the cutting edge of the bedknife will provide a medium setting.

   C. Adjusting the brush assembly so it is even with the cutting edge of the bedknife will provide a light setting.

4. Tighten socket head screws securing clamp blocks to roller shaft.

5. Adjust jam nuts on each scraper rod until there is a clearance of approximately 1/32 inch (0.8 mm) between the scraper and roller. Make sure scraper is parallel to the roller.

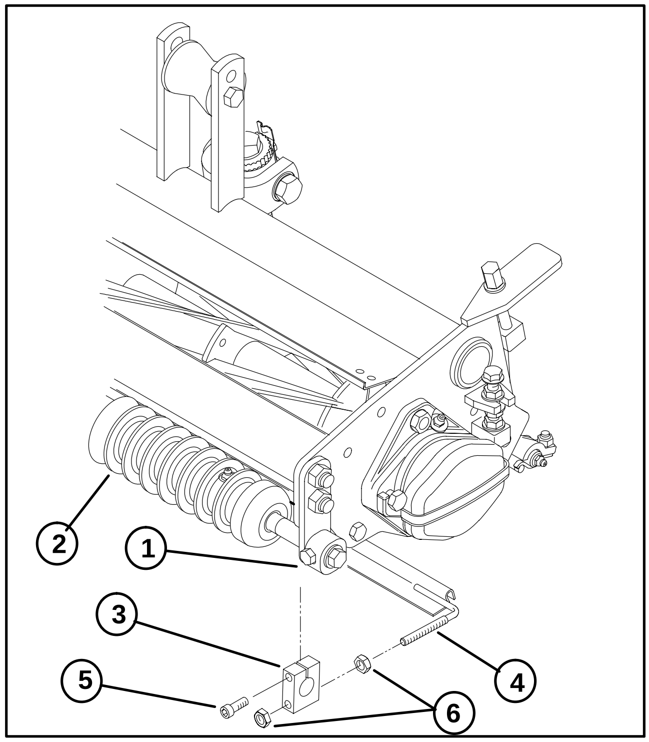


Figure 35

1. Front roller bracket
2. Front roller
3. Clamp block
4. Scraper rod
5. Socket head screw
6. Jam nut

Cutting Unit Removal and Installation

IMPORTANT: When sharpening, setting height-of-cut, or performing other 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 bearing housing. Rotate motor clockwise, and remove motor (Fig. 36).

4. Place protective plastic cap (see Special Tools) into the hole in the bearing housing from which the hydraulic motor was removed.

5. Slide sleeve back on each ball joint receiver. Remove receiver from each unit's ball studs (Fig. 37).

6. For the front cutting units, slide cutting unit lift roller off the lift arm while siding the cutting unit from the pull frame (Fig. 37).

IMPORTANT: Do not operate the lift system when the rear cutting unit is in the service position. Damage could result to the pull frame and clevis assembly.

7. For the rear cutting unit: (Fig. 38).

   A. Slide cutting unit lift roller off the lift arm.

   B. Lift carrier frame by hand until the anti-scalp rollers clear the brake linkage.

   C. Lift up on the slotted link and rotate the pull frame into the wire hook (service position). Pull cutting unit from the machine.

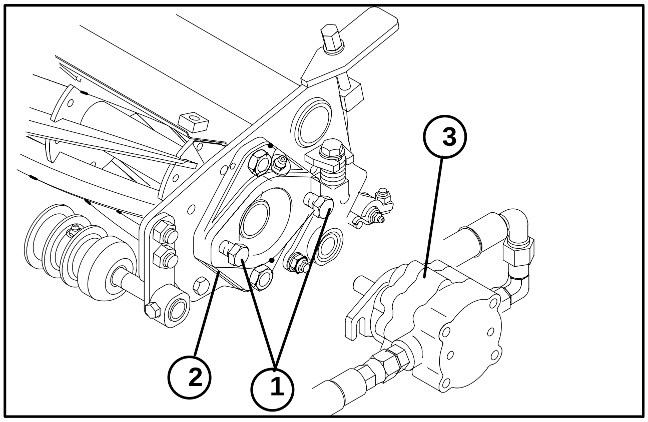


Figure 36

1. **Flange head screws**
2. **Bearing housing**
3. **Hydraulic motor**

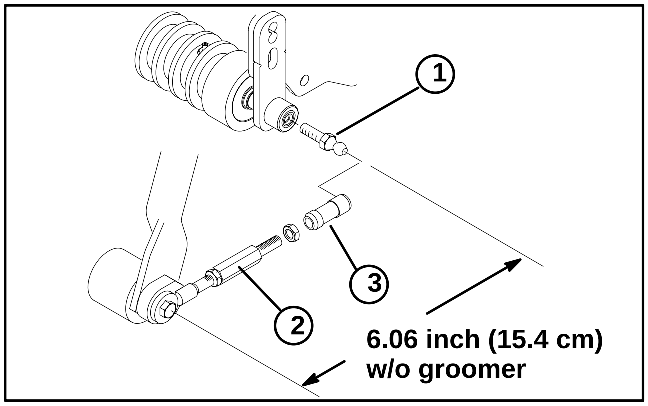


Figure 37

1. **Shoulder bolt**
2. **Front roller bracket**
3. **Carrier frame**

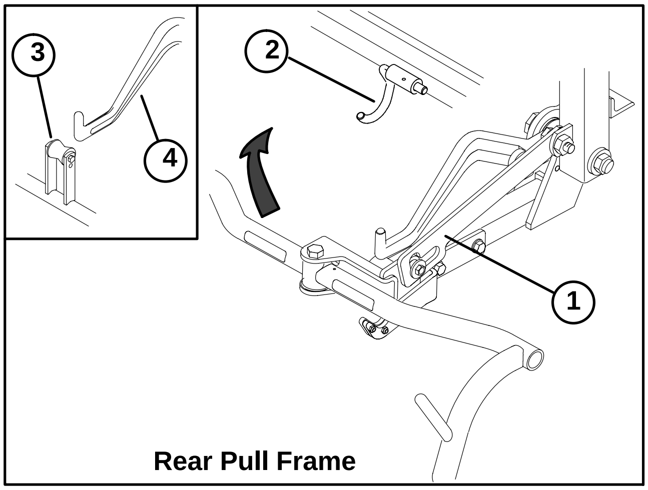


Figure 38

1. **Slotted Link**
2. **Wire hook**
3. **Lift roller**
4. **Lift arm**

Installation

Note: New cutting units are shipped with the counter weight mounted to left end and drive coupler mounted in the right end of cutting unit.

1. If a cutting unit is to be mounted in the right front position, proceed as follows (Fig. 39):

A. Remove both flange head screws and lockwashers securing the counter weight to the left end of cutting unit. Remove counter weight.

B. Remove snap ring securing the drive coupler in the right bearing housing. Remove drive coupler.

C. Apply No. 2 multipurpose lithium base grease to the inside of the drive coupler. Install drive coupler into the left end of the reel shaft with the snap ring.

Note: On units without plastic spacers (Toro P/N 104−2067), spacers can be installed to help direct grease into the bearings and reduce the amount of grease used.

D. Install plastic spacer into the bearing housing.

E. Install counter weight to the right end of the cutting unit with the flange head screws and lockwashers. Move RH end screws to the left end.

2. Make sure ball studs are threaded into each end of the cutting unit front roller (Fig. 37).

3. On the front cutting units, slide cutting unit under the pull frame while hooking the lift roller onto lift arm (Fig. 38).

IMPORTANT: Do not operate lift system when the rear cutting unit is in the service position. Damage could result to the pull frame and clevis assembly.

Note: When installing cutting units with groomers, and groomer carton label does not read "with extension brackets," Groomer Extension Kit, part no. 99−4255, is required.

4. On the rear cutting unit, rotate and latch unit into into the service position (Fig. 38).

A. Lower the suspension system completely (cylinders extended).

B. Lift the carrier frame by hand until the anti-scalp rollers clear the brake linkage.

C. Lift up on the slotted link and rotate the pull frame into the wire hook.

D. With the cutting unit in position, release the wire hook and rotate the pull frame to operating position. The slotted link locks automatically.

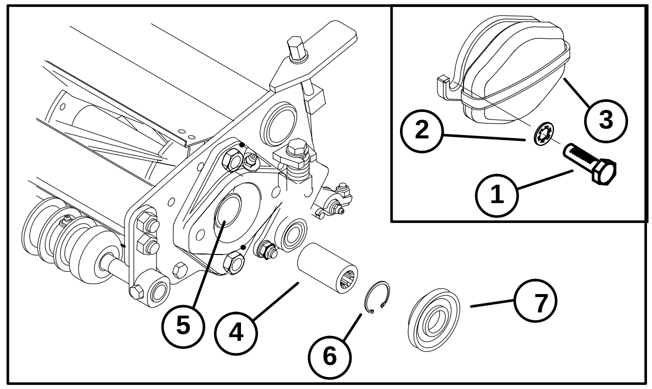


Figure 39

1. **Flange head screw**
2. **Lock washer**
3. **Counter weight**
4. **Drive coupler**
5. **Left end of reel shaft**
6. **Snap ring**
7. **Plastic spacer**

5. Slide sleeve back on each ball joint receiver and hook onto cutting unit ball studs (Fig. 37).

6. Mount basket onto carrier frame.

7. Adjust pull links until there is 1/4 to 3/8 inch (6.4 to 9.5 mm) clearance between the lip of the basket and the reel blades. Make sure the basket lips are equidistant from the reel blades all the way across the reel blades.

8. Install hydraulic motor to bearing housing as follows (Fig. 36).

A. Coat spline shaft of the motor with clean No. 2 multipurpose lithium base grease.

B. Assemble the mounting capscrews for the reel drive motor to each cutting unit. Leave approximately 1/2 inch (12.7 mm) of threads exposed on each mounting cap screw.

C. Install motor by rotating the motor clockwise so the motor flanges clear the flange head screws.

D. Rotate the motor counterclockwise until the motor flanges are encircling the flange head screws. Tighten flange head screws.

E. Using a hand pump grease gun, fill cavity in the bearing housing of cutting unit with No. 2 general purpose grease.

Backlapping (Units without 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 coupling at right end of cutting unit. If coupling is in the left end of cutting unit, move coupling the right end for backlapping.

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).

5. If the splined coupling was moved from the left side of the cutting unit for backlapping, replace the coupling to the left side.

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.

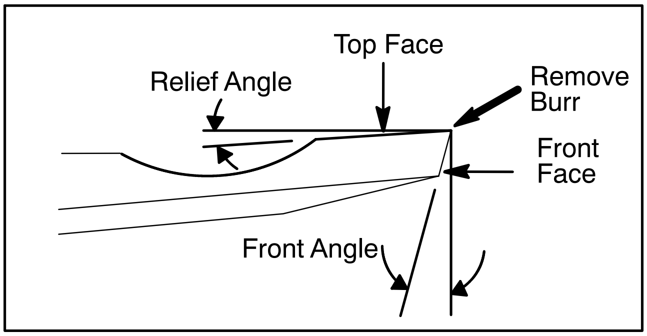


Figure 27

SPA and 4–Bolt Cutting Units

Backlapping (Units with 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 Parallel Adjustment).

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.

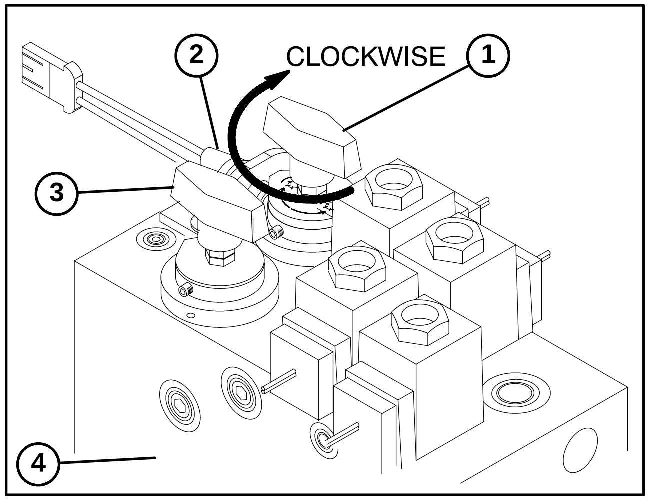


Figure 28

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).

Rollers and Bedbar Assembly (Single Point Adjust Cutting Units)

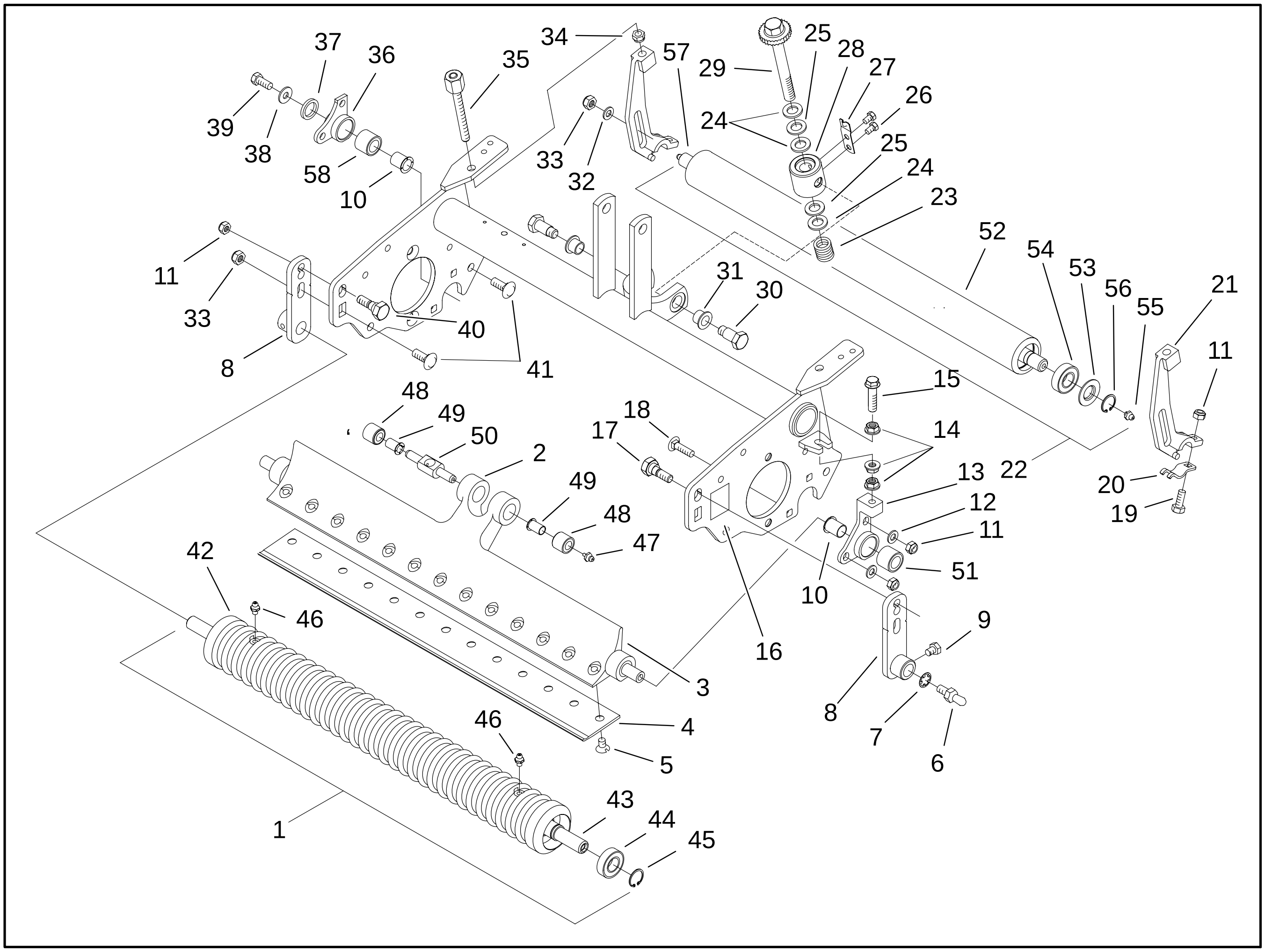


Figure 42

1. Front roller assembly
2. Bedbar and bushing
3. Bedbar
4. Bedknife
5. Special screw
6. Ball stud
7. Lock washer
8. Front bracket
9. Cap screw
10. Flanged bushing
11. Lock nut
12. Flat washer
13. Pivot hub (LH)
14. Flange head nut
15. Cap screw
16. Bracket position decal
17. Shoulder bolt
18. Carriage screw
19. Cap screw
20. Height−of−cut tab
21. Height−of−cut adjustment bracket
22. Roller assembly
23. Compression spring
24. Thrust washer
25. Nylon thrust washer
26. Cap screw
27. Spring arm
28. Pivot housing
29. Single point adjuster
30. Pivot screw
31. Plastic bushing
32. Flat washer
33. Lock nut
34. Lock nut
35. Height−of−cut adjuster
36. Pivot hub (RH)
37. Quad−ring
38. Flat washer
39. Hex head flange screw
40. Eccentric bolt
41. Carriage screw
42. Wiehle roller
43. Roller shaft
44. Ball bearing
45. Retaining ring
46. Lube fitting
47. Grease fitting
48. Rubber brush
49. Nylon brush
50. Bedbar pivot
51. Bushing
52. Roller tube
53. Lube fitting
54. Bearing
55. Shield washer
56. Retaining ring
57. Roller shaft
58. Bushing

Rear Roller and Height−of−Cut Adjuster Removal and Installation

Note: Figure 42 shows the Rollers and Bedbar Assembly for a Single Point Adjust (SPA) cutting units. Both the SPA and 4−Bolt cutting units a similar in construction. Roller and Height−of−Cut (H−O−C) Adjuster replacement procedures are the same for each unit.

Removal (Fig. 42)

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

2. To remove the cutting unit, remove reel motor from the cutting unit and the cutting unit from the lift arm (see Cutting Unit Removal and Installation). Place cutting unit on a level working surface.

3. Remove rear roller as follows:

   A. Remove cap screw (19) and lock nut (11) from both H−O−C adjustment brackets (21).

   B. Remove height−of−cut tab (20) from both H−O−C adjustment brackets.

   C. Tilt back of the cutting unit up, and remove rear roller (22) from both H−O−C adjustment brackets.

4. If the height−of−cut adjusters (35) or H−O−C adjustment brackets (21) need removing, remove them as follows:

   A. Remove lock nut (33), flat washer (32), and carriage screw (41) from the H−O−C adjustment bracket and frame.

   B. Unscrew H−O−C adjuster from the top block of the H−O−C adjustment bracket.

   C. Unscrew locking nut (34) from the H−O−C adjuster. Slide adjuster from the frame tab.

Installation (Fig. 42)

1. Place cutting unit on a level working surface.

2. If the H−O−C adjusters (35) or H−O−C adjustment brackets (21) were removed, reinstall brackets as follows:

   A. Apply Loctite 242 or equivalent to the threads of the H−O−C adjusters about 1/4 inch (6 mm) below the hex.

   B. Place H−O−C adjuster through the holes of the frame tabs. Screw locking nut onto the adjuster, and run to the bottom of the frame tab. Make sure adjuster is free to rotate with no end play.

   C. Position H−O−C adjustment bracket on the inside of the frame. Screw H−O−C adjuster into the H−O−C adjustment bracket until the top of the bracket is 0.68 inch (18 mm) from the bottom of the frame tab.

   D. Insert carriage screws (41) through the H−O−C adjustment bracket and frame. Secure bracket and screw with flat washer (32) and lock nut (32).

3. Reinstall rear roller as follows:

   A. Tilt back of the cutting unit up, and position rear roller shaft (57) under each H−O−C adjustment bracket (21). Lower unit and brackets onto the roller shafts.

   B. Attach height−of−cut tab (20) to both H−O−C adjustment brackets so the tab is below the roller shaft.

   C. Make sure roller is centered on the cutting unit. Secure height−of−cut tab to the H−O−C adjustment bracket with cap screw (19) and lock nut (11).

4. If the H−O−C adjustment brackets (21) were removed, verify height−of−cut (see Adjust Height−of−Cut).

5. Reinstall reel motor to the cutting unit and the cutting unit to lift arm (see Cutting Unit Removal and Installation).

Front Roller Removal and Installation

Removal

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

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. If removing the cutting unit, remove reel motor from the cutting unit and the cutting unit from lift arm (see Cutting Unit Removal and Installation). Place cutting unit on a level working surface.

3. Remove cap screws securing the roller shafts to each front bracket (Fig. 43).

Note: The right front bracket is secured to the frame with an eccentric bolt and carriage screw, while the left front bracket is secured with a shoulder bolt and carriage screw (Fig. 43).

4. On either end of the roller, remove eccentric bolt (shoulder bolt), carriage screw, and lock nuts securing the front bracket to the frame (Fig. 43).

5. Remove the front brackets and roller from the cutting unit. Remove the front brackets from the roller shaft (Fig. 43).

6. If the front roller position is to be changed, the remaining front bracket may be removed from the frame using step 4.

Installation

1. Place cutting unit on a level working surface.

2. Determine desired attitude for cutting unit (see Attitude Adjustment).

3. If both front brackets were removed, position bracket as follows (Fig. 43):

   A. Insert eccentric bolt (shoulder bolt) through the top hole on the frame and one of the top holes of the front bracket so the point on the bracket is at the desired position number on the decal (Fig. 44).

   B. Screw lock nut onto the eccentric bolt (shoulder bolt) to hold front bracket in place.

   C. Insert carriage screw through the bottom hole of the frame and front bracket. Secure screw and eccentric bolt (shoulder bolt) with lock nuts.

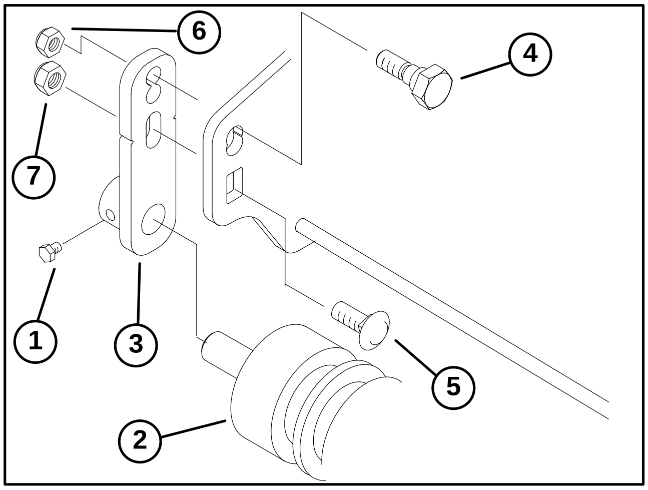


Figure 43

1. **Cap screw**
2. **Roller**
3. **Front bracket**
4. **Eccentric (shoulder) bolt**
5. **Carriage screw**
6. **Lock nut**
7. **Lock nut**

Figure 44

4. Place roller shaft into the front bracket. Slide second front bracket on the other end of roller. Secure bracket as in step 3. (Fig. 43).

5. Apply Loctite 242 or equivalent to the cap screw threads. Center roller in the front brackets and secure into place with the cap screws (Fig. 43).

6. Level front roller to the reel (see Adjust and Level Front Roller to Reel, also see Adjust Attitude).

Bearing Replacement for Standard Rear Roller

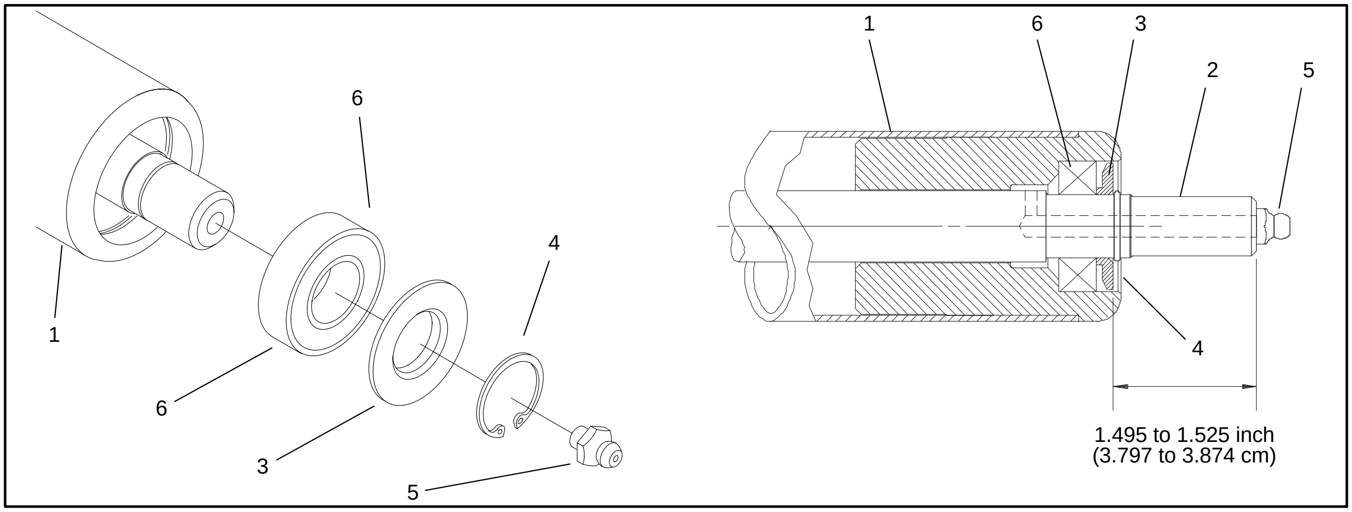


Figure 45

1. **Roller tube**
2. **Shaft**
3. **Shield washer**
4. **Retaining Ring**
5. **Grease fitting**
6. **Bearing**

Removal

1. Clean inside of the roller tube around the shaft and shield washer. Both ends of the roller tube should be free of dirt and debris.

2. Secure roller tube in a vise keeping it level.

3. Remove both grease fittings from the shaft before removing the bearings to prevent damage to fittings.

4. Remove retaining rings from both ends of the roller tube.

5. Use a soft hammer to pound the shaft, shield washer, and bearing out of the roller tube. Remove shield washer and bearing from the shaft.

6. Pull remaining shield washer and bearing from the roller tube.

Installation

IMPORTANT: Replace both bearings with new bearings since both bearings may be damaged during removal.

1. Clean inside of roller tube around bearing recess. Both ends inside the roller tube should be free of dirt and debris.

2. Press bearing into the roller tube with the seal side facing out.

   A. Install shield washer onto the shaft.

   B. Make sure dimension of 1.495 to 1.525 inch (3.797 to 3.874 cm) between washer and the end of shaft is maintained.

   C. Make sure outer surface of the washer does not overlap the retaining ring groove.

3. Apply antiseize lubricant to the bearing ends of the shaft. Insert shaft through the roller tube and bearing inner race.

4. Press second bearing into the roller tube and onto the shaft with the seal side facing out.

   A. Install shield washer onto the shaft.

   B. Make sure dimension of 1.495 to 1.525 inch (3.797 to 3.874 cm) between washer and the end of shaft is maintained.

   C. Make sure outer surface of the washer does not overlap the retaining ring groove.

5. Install both retaining rings so the side with the sharp edges faces the end of the shaft.

6. Make sure roller tube spins freely with no bearing end play.

7. Install grease fittings. Lubricate bearings with No. 2 general purpose lithium base grease until the grease appears from each shield washer. Wipe off excess grease from each shield washer.

Bearing Replacement for Standard Front and Full Front Rollers

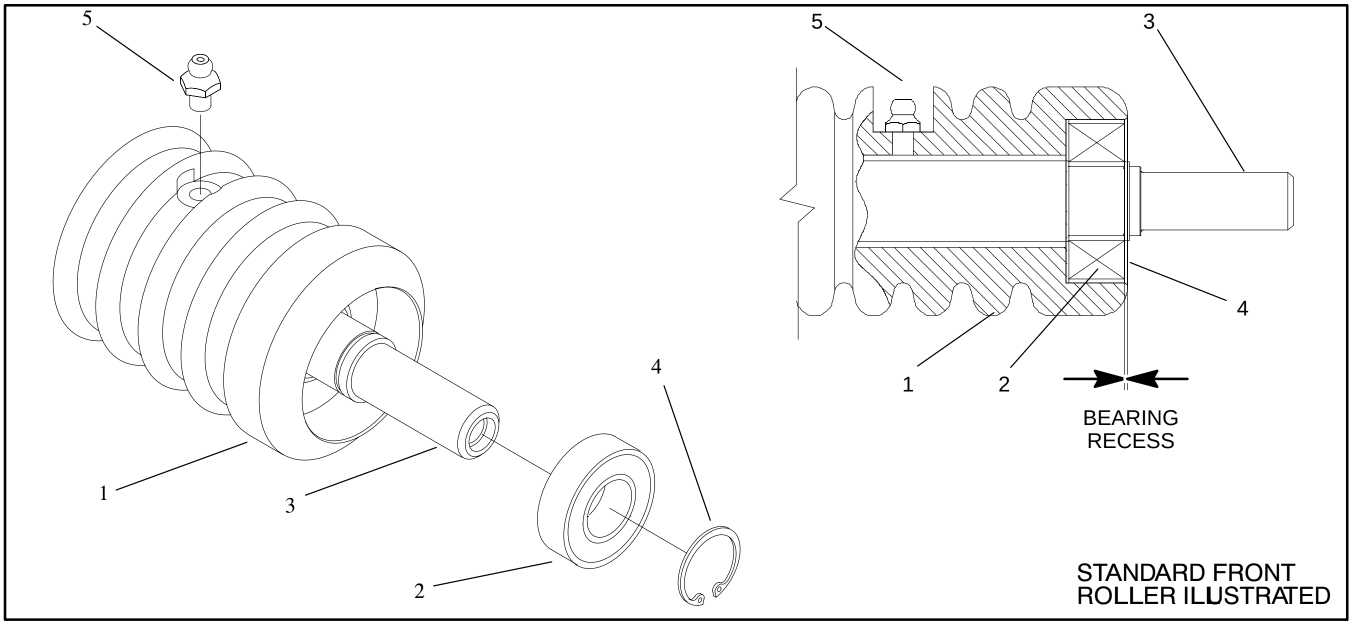


Figure 46

1. **Roller tube**
2. **Bearing**
3. **Shaft**
4. **Retaining Ring**
5. **Grease fitting**

Removal

1. Clean inside of roller tube around the shaft and bearing. Both ends of the roller tube should be free of dirt and debris.

2. Secure roller tube tube in a vise keeping it level.

3. Remove retaining rings from the both ends of the shaft.

4. Use a soft hammer to pound the shaft and bearing out of the roller tube. Remove bearing from the shaft.

5. Pull remaining bearing from the roller tube.

Installation

IMPORTANT: Replace both bearings with new bearings since both bearings may be damaged during removal.

1. Clean inside of roller tube around bearing recess. Both ends inside the roller tube should be free of dirt and debris.

2. Press bearing into the roller tube with the seal side facing outward. **Make sure bearing is recessed from the end of the roller tube as described in the following table.**

Roller Type	TORO P/N	BEARING RECESS
Standard Front Roller	99−4211	0.02 to 0.04 in (0.51 to 1.02 mm)
Full Front (Model No. 04486)	94−3478	0.21 to 0.25 in (5.3 to 6.3 mm)

3. Apply antiseize lubricant to the bearing ends of the shaft. Insert shaft through the roller tube and bearing inner race.

4. Press second bearing into the roller tube and onto the shaft with the seal side facing out. Make sure bearing is recessed from the end of the roller tube as described in the table above.

5. Install both retaining rings so the concave side faces the bearing. Make sure retaining ring is seated in the groove.

6. Make sure roller spins freely with no bearing end play.

7. Install grease fittings. Lubricate bearings with No. 2 general purpose lithium base grease until the grease appears from each bearing seal. Wipe off excess grease from each seal.

Bearing Replacement for Wiehle Rear Roller

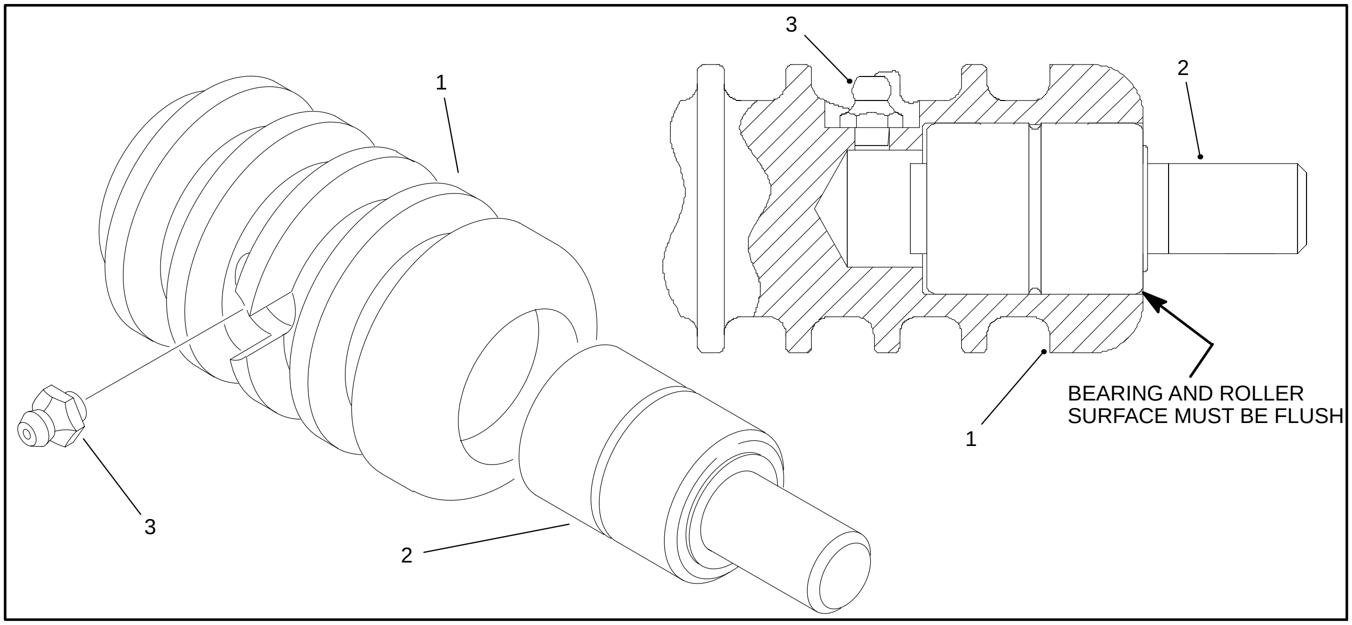


Figure 47

1. **Wiehle roller**
2. **Machine bearing**
3. **Grease fitting**

Note: This procedure is for the Wiehle Rear Roller Kit (Model 04488) only. The Toro part number for the roller is 94−8150.

Remove Bearings

Note: Use bearing replacement tool kit to remove the roller bearings (see Special Tools).

Note: It is recommended to replace bearings at both ends of the roller tube after bearing failure.

1. If a hole does not go through the bearing shaft, use drill bushing (supplied with bearing replacement kit) to drill a hole through the bearing shaft.

2. Remove machine bearing with bearing puller.

3. Clean roller bearing cavity of Wiehle roller and remove any rust with a crocus cloth.

4. Repeat above steps for the other machine bearing.

Install New Bearings

1. Make sure bearing cavity of Wiehle roller is clean and free of dirt. Apply No. 2 multipurpose lithium based grease to the outside diameter of the machine bearing.

2. Press machine bearing into roller tube so that the outside surface of the bearing is flush with the end of the roller tube.

3. Repeat above steps for the other machine bearing.

4. Grease both bearings with No. 2 multipurpose lithium based grease until grease appears at the seal of the bearing. Wipe off excess grease from each seal.

5. Make sure roller spins freely with no bearing end play.

Bedbar Removal and Installation (Single Point Adjust Cutting Units)

Removal

1. Remove rear roller (see Rear Roller Removal and Installation).

2. Loosen both flange lock nuts securing the hex head flange screw to the frame tab (Fig. 48).

3. Remove hex head flange screw (39), flat washer (38), and quad ring (37) from the bedbar (3) on the right side of the unit (Fig. 42).

4. Remove both pivot screws (30) from the pivot housing (28) and frame. Replace plastic bushings (31) if worn or damaged (Fig. 42).

5. Remove both lock nuts and flat washers from each carriage screw securing the pivot hubs to the frame (Fig. 48 and 49).

6. Remove carriage screws (18) from the pivot hubs (13 and 36) and frame. Remove bedbar (3) from the cutting unit (Fig. 42).

7. Remove both pivot hubs (13 and 36) from the bedbar (3). Replace bushings (10, 51, and 58) if they are worn or damaged (Fig. 42).

Installation

1. Apply antiseize lubricant to both bedbar pins. Tap pivot hub (13) to the bedbar pin on the left side of the bedbar (3) with a soft hammer. Tap pivot hub (36) to the bedbar pin on the right side of the bedbar with a soft hammer (Fig. 42).

2. Position bedbar (3) to the cutting unit. Insert carriage screws (18) through the frame and pivot hubs (13 and 36) on each side of the frame (Fig. 42).

3. Secure carriage screws with flat washers and lock nuts (Fig. 48 and 49).

4. Secure pivot housing (28) to the frame with both pivot screws (30) (Fig. 42).

5. Secure quad ring (37) and flat washer (38) to the right bedbar pin with the hex head flange screw (39) (Fig. 42).

6. Reinstall rear roller (see Rear Roller Removal and Installation).

7. Adjust bedbar to reel, and tighten both flange lock nuts securing the cap screw to the frame tab (see Adjust Bedknife to Reel).

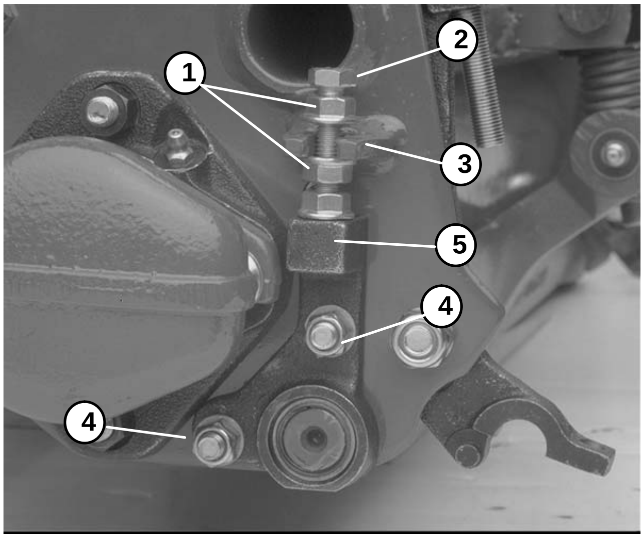


Figure 48

1. Flange lock nut
2. Hex head flange screw
3. Frame tab
4. Lock nuts & flat washer
5. Pivot hub (LH)

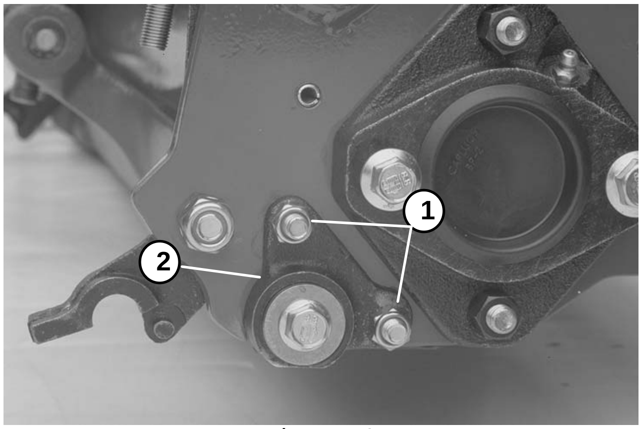


Figure 49

1. Lock nut & flat washer
2. Pivot hub (RH)

SPA and 4−Bolt Cutting Units

Bedknife Adjuster Service (Single Point Adjust Cutting Unit)

Removal (Fig. 42)

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 both pivot screws (30) from the pivot housing (28). Replace plastic bushings (31) if worn or damaged.

3. Unscrew adjuster (29) from the bedbar pivot (50).

Disassembly (Fig. 50)

1. Remove compression spring, adjuster, thrust washers, and nylon thrust washers from the pivot housing.

2. If the spring arm is damaged, remove it from the pivot housing by removing both hex head screws.

Assembly (Fig. 50)

1. If the spring arm was removed, apply Loctite 242 or equivalent to the threads of both hex head screws. Secure spring arm to the pivot housing with both hex head screws.

2. Place thrust washer, new nylon thrust washer, and second thrust washer onto the adjuster. Insert adjuster through the pivot housing.

3. Slide nylon thrust washer onto adjuster. Slide thrust washer onto adjuster and over nylon washer. Slide compression spring onto adjuster.

Installation (Fig. 42)

1. Place antiseize lubricant onto the threads of the adjuster (Fig. 50).

2. Screw adjuster (29) into bedbar pivot (50) enough to align holes of the frame bracket and pivot housing (28).

3. Place pivot screws (30) through bushings (31) in the frame bracket and into the pivot housing (28). Tighten screws into the pivot housing.

4. Adjust bedbar to reel (see Adjust Bedknife to Reel).

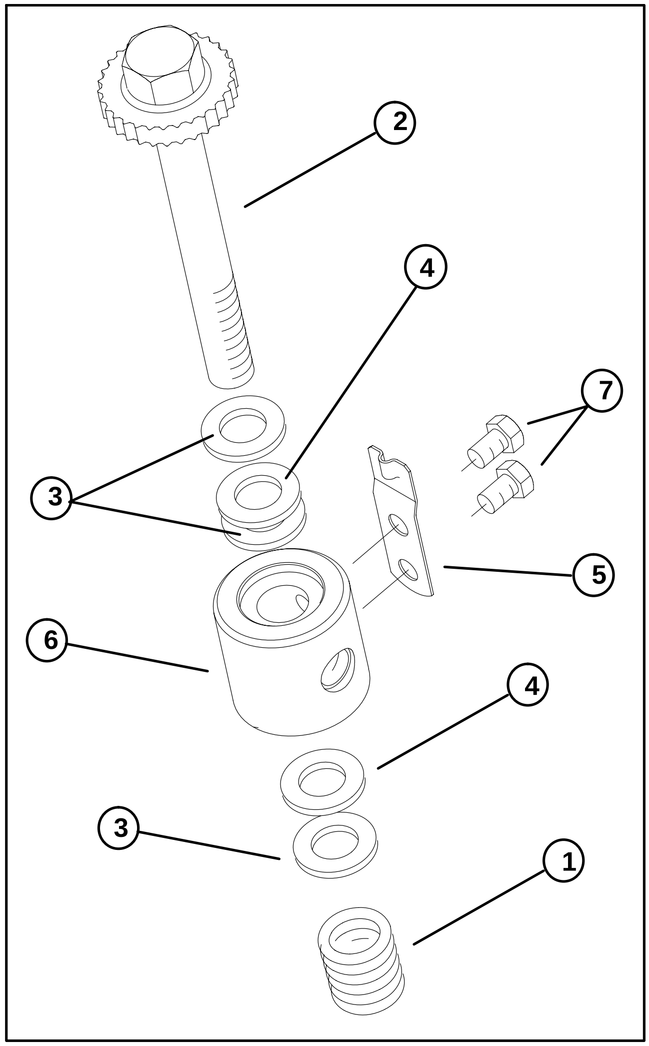


Figure 50

1. Compression spring
2. Adjuster
3. Thrust washer
4. Nylon thrust washer
5. Spring arm
6. Pivot housing
7. Hex head screw

Rollers and Bedbar Assembly (4−Bolt Adjust Cutting Units)

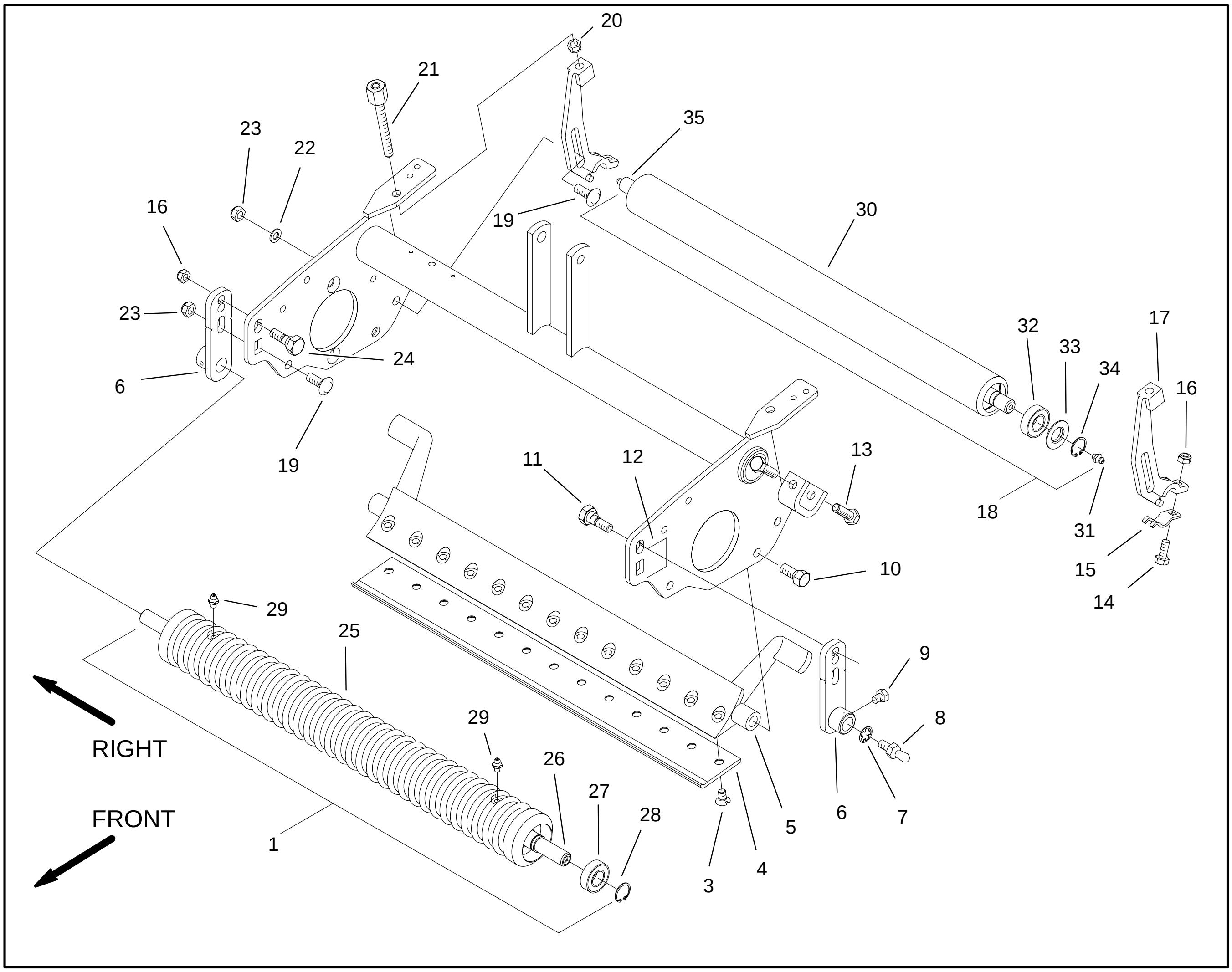


Figure 51

1. Front roller assembly
2. Not used
3. Special screw (13 used)
4. Bedknife
5. Bedbar
6. Front bracket
7. Lock washer
8. Ball stud
9. Cap screw
10. Wheel bolt
11. Shoulder bolt
12. Bracket position decal
13. Cap screw
14. Cap screw
15. Height−of −cut collar
16. Lock nut
17. Height−of−cut adj. bracket (rear)
18. Rear roller assembly
19. Carriage screw
20. Lock nut
21. Height−of−cut adjuster
22. Flat washer
23. Lock nut
24. Eccentric bolt
25. Wiehle roller
26. Roller shaft
27. Bearing
28. Retaining ring
29. Grease fitting
30. Roller tube
31. Grease fitting
32. Bearing
33. Shield washer
34. Retaining ring
35. Roller shaft

SPA and 4−Bolt Cutting Units

Bedbar Removal and Installation (4−Bolt Adjust Cutting Units)

Removal

1. Position cutting unit on a clean level surface to allow access to the bedbar and rear roller.

2. Remove rear roller (see Rear Roller Removal and Installation).

Note: The top hex head screws should remain in the adjustment brackets. This will allow for an easier adjustment of the bedbar when it is reinstalled (Fig. 52).

3. Remove bottom hex head screw from each bedbar adjustment bracket located on both sides of the frame (Fig. 52).

4. Remove both wheel bolts (10) from each end of the bedbar (5) and frame (Fig. 51).

5. Remove bedbar (5) from the cutting unit (Fig. 51).

Installation

1. Apply antiseize lubricant to the threads of both wheel bolts (10) (Fig. 51).

2. Position bedbar (5) to the cutting unit. Insert wheel bolts (10) through the frame and screw into the bedbar (Fig. 51).

3. Torque both wheel bolts (10) from 20 to 40 ft−lbs (27 to 54 N−m).

4. Start bottom hex head screws into the bottom of the adjustment brackets. Keep bedknife away from the reel while running up both screws to contact the bedbar ears (Fig. 52).

5. Reinstall rear roller (see Rear Roller Removal and Installation).

6. Adjust bedbar to reel (see Adjust Bedknife to Reel).

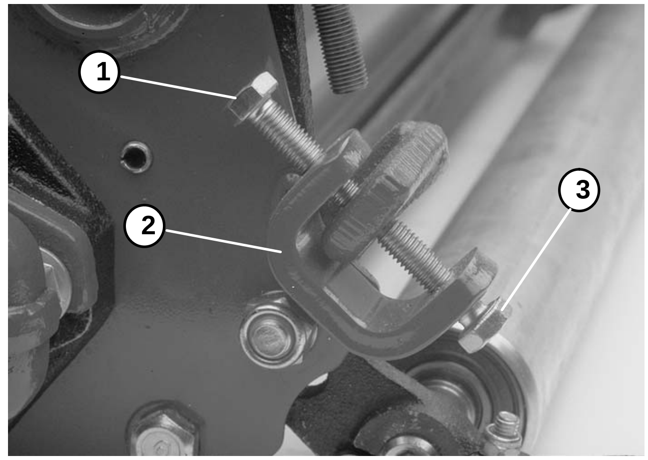


Figure 52

1. **Top hex head screw**
2. **Adjustment bracket**
3. **Bottom hex head screw**

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. 40).

3. Use scraper to remove all rust, scale and corrosion from bedbar surface before installing bedknife.

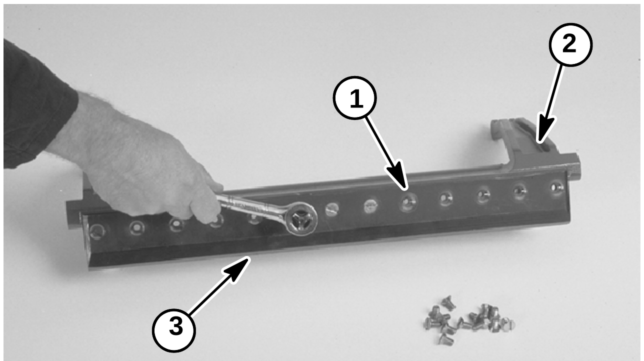


Figure 40

1. **Screw**
2. **Bedbar**
3. **Bedknife**

Replacement

1. Make sure bedbar threads are clean. Use new screws. Apply anti-seize lubricant 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 (230 to 288 kg-cm)**. Use a torquing pattern working from the center toward each end of the bedknife (Fig. 41).

3. Install bedbar to frame (see Bedbar Installation).

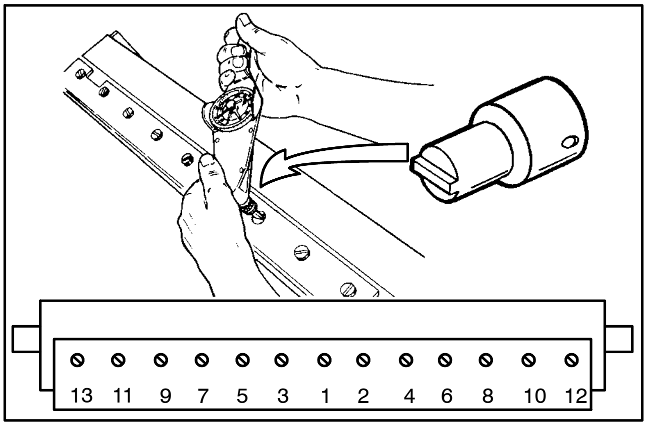


Figure 41

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. 38).

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. Refer to Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for additional bedknife grinding information.

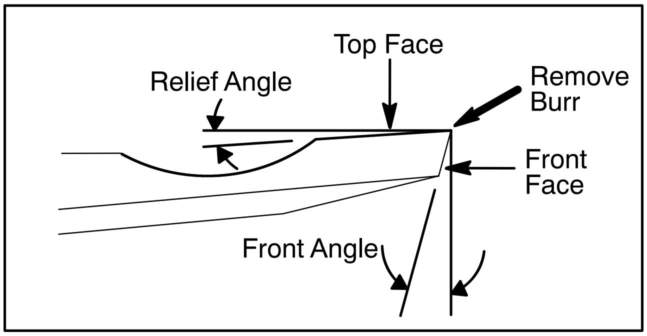


Figure 42

Bedknife Grinding Specifications (Fig. 42)	
Standard bedknife relief angle	3° (see Fig. 43)
Extended bedknife relief angle	7° (see Fig. 43)
Front Angle	13°
Front Angle Range	13° to 17°

3. Reinstall bedbar to cutting unit (see Bedbar Installation).

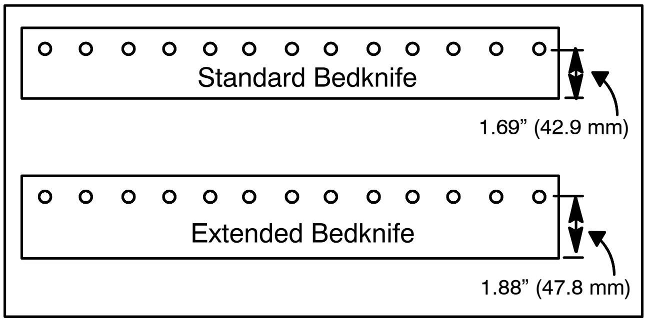


Figure 43

SPA and 4-Bolt Cutting Units

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 additional 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 Adjustments section).

Reel Grinding Specifications	
Nominal Reel Diameter	5 in (126 mm)
Service Limit Reel Diameter	4.5 in (114 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)
Max. Reel Taper	0.040 in (1.0 mm)

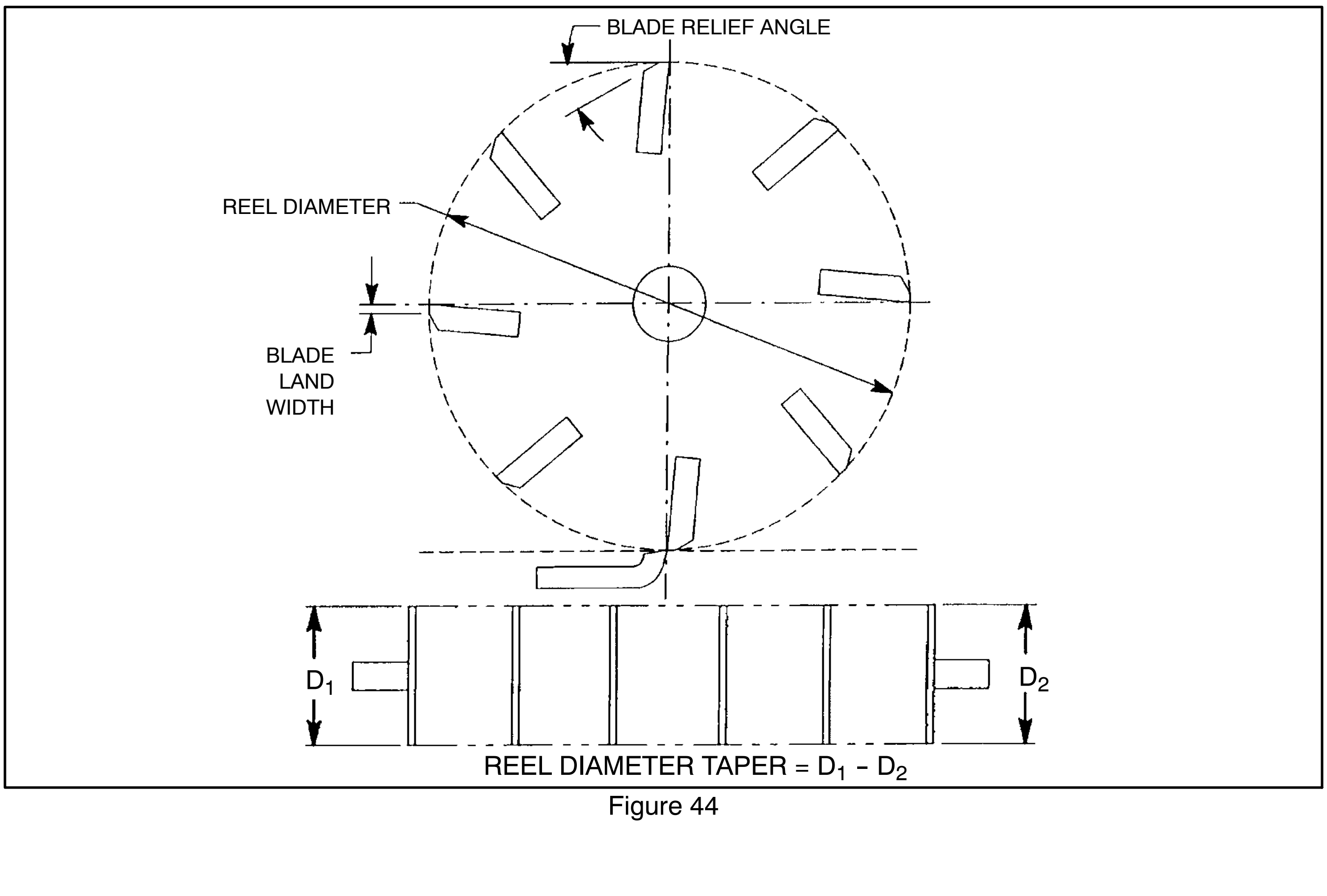


Figure 44

Reel Assembly

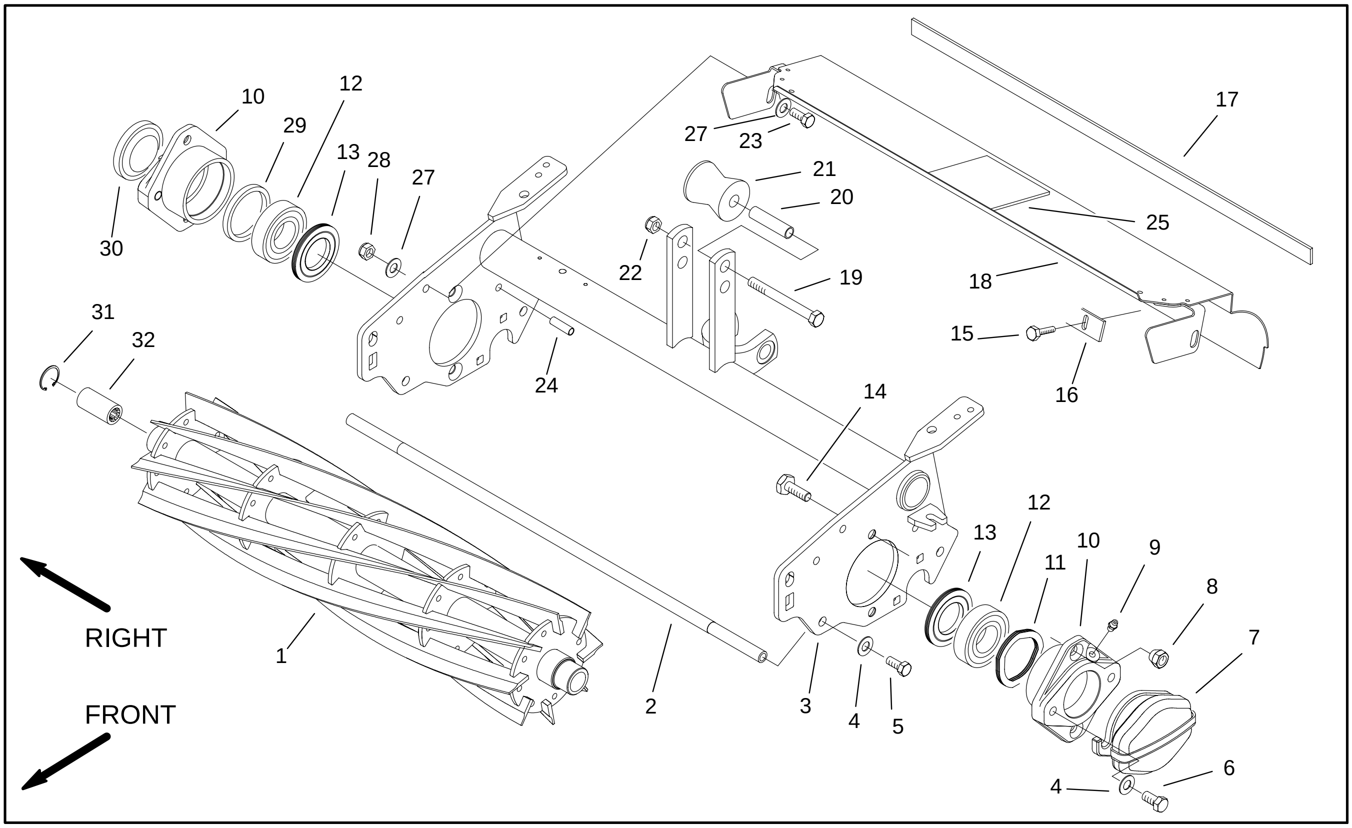


Figure 58

1. Reel
2. Shield rod
3. Reel frame
4. Flat washer
5. Cap screw
6. Hex head flange screw
7. Counter weight
8. Tapered lock nut
9. Lube fitting
10. Bearing housing
11. Flat wire spring
12. Bearing
13. Grease seal
14. Tapered screw
15. Hex washer head screw
16. Cut−off bar
17. Seal strip
18. Rear shield
19. Cap screw
20. Roller spacer
21. Lift roller
22. Lock nut
23. Cap screw
24. Roll pin
25. Pad
26. Not used
27. Flat washer
28. Lock nut
29. Spacer
30. Plastic cap
31. Retaining ring
32. Splined coupler

Note: Figure 58 shows the reel assembly for a Single Point Adjust (SPA) cutting unit. Both the SPA and 4−Bolt cutting units a similar in construction with the exception of reel and reel frame. Reel and bearing replacement procedures are the same for each unit.

Note: The counterweight (7) and splined coupler (32) are not installed on the same side of the cutting unit. The coupler would be installed on the side of the unit accepting the hydraulic motor. The counterweight would be on the side opposite the motor.

Reel and Bearing Removal and Installation

Removal (Fig. 58)

1. Remove reel motor from the cutting unit and the cutting unit from lift arm (see Cutting Unit Removal and Installation).

2. Place cutting unit on a level working surface.

3. Remove shield rod (2) from frame by removing both cap screws (5) and flat washers (4).

4. Remove front roller from the cutting unit (see Front Roller Removal and Installation).

IMPORTANT: Place strips of wood below the reel to prevent the reel from dropping out of the cutting unit when the bearing housings are removed.

5. Remove both bearing housings (10) by removing the tapered lock nuts (8) and tapered screws (14) securing the housings to the frame. Pull both housings away from the frame and away from the reel ends.

6. Remove reel (1) with the bearings (12) and grease seals (13) from the cutting unit.

7. Remove bearing spacer (29) and flat wire spring (11) from their bearing housings (10). Clean inside of each housing. Both housings should be free of dirt and debris.

Note: If bearings (12) are removed from the reel (1), replace grease seals (13).

8. If necessary, remove bearings (12) and grease seals (13) from the reel (1) as follows (see Inspection below):

   A. Prevent damage to bearings by pulling on the inner bearing race.

   B. Use bearing puller to remove bearings and seals.

Inspection

1. Inspect splined coupler (32) as follows (Fig. 58):

   A. Remove retaining ring (31) and drive coupler from the reel shaft (1).

   B. Clean drive coupler. Coupler should be free of dirt and debris.

   C. Drive coupler should be free of bending and distortion. Check splines for excessive cracks and distortion. Replace coupler if necessary.

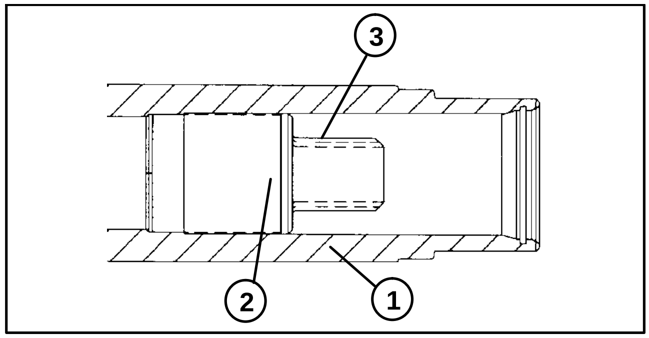


Figure 59

1. **Reel shaft**
2. **Drive adapter**
3. **Adapter spline**

2. Inspect reel (1) as follows:

   A. Check reel shaft for bending and distortion by placing the shaft ends in V−blocks. Replace reel if necessary.

   B. Check reel blades for bending or cracking. Replace reel if necessary.

   C. Check drive adapter inside of reel shaft. Adapter should be free of bending and distortion. Check splines for excessive cracks and distortion. Replace reel if necessary (Fig. 59).

   D. Check service limit of reel diameter (see Reel Grinding Specifications in Preparing Reel for Grinding).

3. Inspect bearings (12) and grease seals (13) as follows (Fig. 58):

   A. Seals must be free of cracks and tears. Replace seals as necessary.

   B. Bearing roller balls must be free of deformation and scoring. Replace bearing if necessary.

   C. Bearing must spin freely and have minimal axial play. Replace bearing if necessary.

4. Using a hand pump grease gun, fill cavity in the bearing housing of cutting unit with No. 2 general purpose grease.

Installation (Fig. 58)

Note: If bearings (12) where removed, grease seals (13) should be replaced. Both bearings should be replaced as a set.

1. If bearings (12) and grease seals (13) were removed from the reel shaft (1), install seals and bearings to the shaft as follows:

A. Pack both bearings with No. 2 multipurpose lithium base grease.

B. Clean bearing surfaces of reel shaft. Apply anti-seize lubricant to both bearing surfaces (Fig. 60).

IMPORTANT: Pressing the seal too far onto the reel shaft will cause the seal to spread, and not allow it to be tight on the shaft (Fig. 60).

C. With the lip side of the seal facing the reel spider, press seal onto each end of the reel shaft (Fig. 60).

D. Press bearing onto each end of the reel shaft (Fig. 60).

IMPORTANT: Do not install the flat wire spring (11) into the right bearing housing. Damage to the spring may result as well as increased noise and poor quality of cut.

2. Install right bearing housing (10) as follows:

A. Insert bearing housing (10) into the right sideplate of the frame so that the grease fitting (9) is facing up.

B. Apply Loctite 242 or equivalent to the threads of the two tapered screws (14).

C. Insert both tapered screws (14) through the side plate and bearing housing (10). Start tapered nuts (8) onto screws.

D. Place bearing spacer (29) into the bearing housing (10).

3. Position reel (1) into the cutting unit frame. Slide end of reel into bearing housing (10) while keeping the bearing (12) straight.

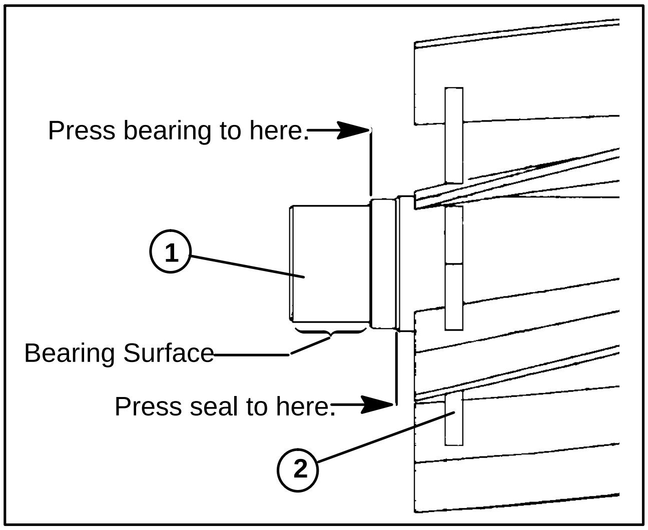


Figure 60

1. **Reel shaft bearing** 2. **Reel spider**

4. Install left bearing housing (10) as follows:

A. Insert bearing housing (10) into the left sideplate of the frame over the bearing (12). Make sure the grease fitting (9) is facing up.

B. Apply Loctite 242 or equivalent to the threads of the two tapered screws (14).

C. Insert both tapered screws (14) through the side plate and bearing housing (10). Start tapered nuts (8) onto the screws.

D. Place flat wire spring (11) into the bearing housing (10).

5. Reinstall shield rod (2) to the frame. Secure rod with both flat washers (4) and cap screws (5).

6. Tap both bearing housings (10) with a soft hammer to seat bearings (12). Tighten tapered nuts (8) to secure housings.

7. Insert drive coupler (32) into end of reel shaft (1) to accept hydraulic reel motor. Make sure splines of coupler mesh with those of the drive adapter. Secure coupler with retaining ring (31) (Fig. 58 and 59).

Rear Roller Scraper Removal and Installation

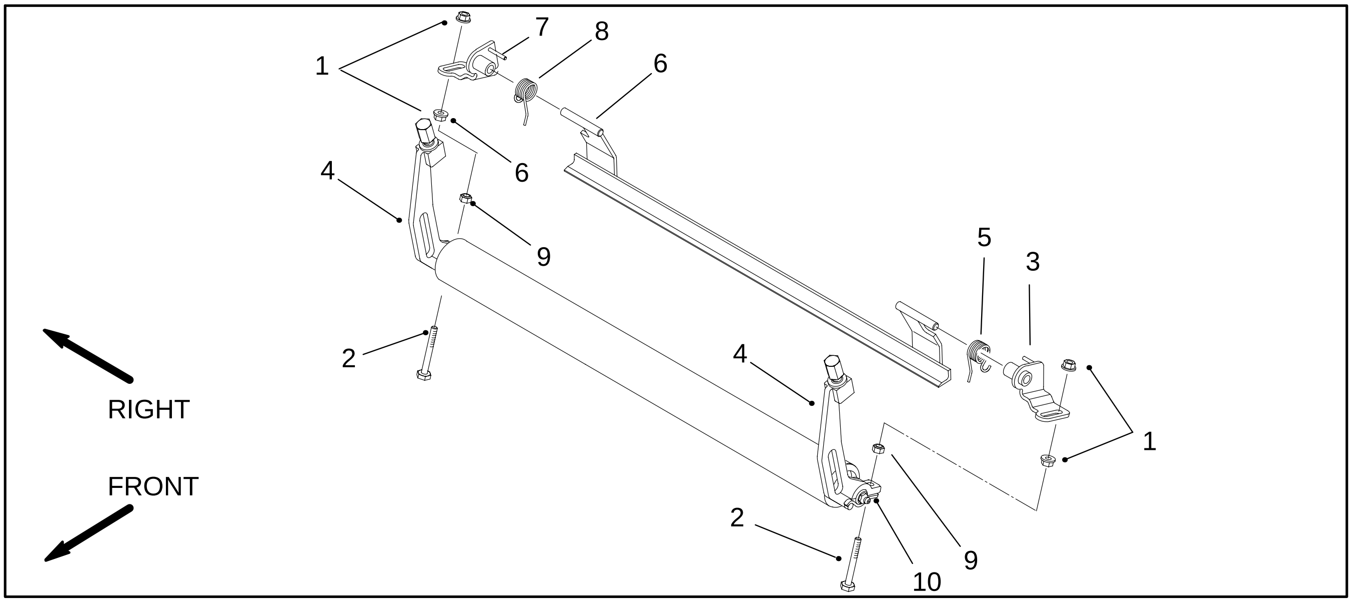


Figure 61

1. **Flange head nut**
2. **Hex head screw**
3. **Bracket (LH)**
4. **Height−of−cut adjustment bracket**
5. **Torsion spring (LH)**
6. **Scraper**
7. **Bracket (RH)**
8. **Torsion spring (RH)**
9. **Lock nut**
10. **Height−of−cut tab**

Removal

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

2. Remove flange head nut from the hex head screw securing the bracket (LH) to the height−of−cut (H−O−C) adjustment bracket.

3. Remove bracket (LH) and torsion spring (LH) from the scraper and hex head screw. Pull scraper from the bracket (RH).

4. Remove torsion spring (RH) from bracket (RH).

5. Remove flange head nut from the hex head screw securing the bracket (RH) to the (H−O−C) adjustment bracket. Remove bracket (RH) from the hex head screw.

6. If the rear roller scraper is to be permanently removed,

   A. Remove remaining flange head nut, lock nut, and hex head screw from the H−O−C adjustment bracket and collar.

   B. Insert carriage screws (M8−1.25 x 20) through both H−O−C adjustment brackets and collars to secure the rear roller to the brackets. Secure screws with lock nuts.

Installation

1. If the rear roller scraper was not previously installed, remove carriage bolt and nut securing the rear of each roller collar to roller bracket.

2. Insert a 8mm hex head screw through holes in height−of−cut tab and H−O−C adjustment bracket and secure with a locknut (Fig 61).

Note: If screw does not fit through holes in roller collar and roller bracket, enlarge holes with a 0.328 inch (8.33 mm) diameter drill.

3. Thread flange nut (flange up) onto each hex head screw.

4. Insert bracket (LH) onto the hex head screw on left H−O−C adjustment bracket; loosely secure with a flange head nut.

5. Slide torsion spring (LH) with hook outward onto bracket (LH) and position hook around bracket (LH).

6. Insert left end of scraper into the hole in the bracket (LH). Place end of torsion spring (LH) behind scraper.

7. Repeat procedure on right end of scraper while loosely securing bracket (RH) to hex head screw on the right H−O−C adjustment bracket.

8. Adjust roller scraper to the roller (see Adjust Rear Roller Scraper).

Front Roller Brush/Scraper Removal and Installation

Removal

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

2. Loosen and remove cap screws securing each end of the roller shaft to the front roller brackets.

3. Remove capscrews and locknuts securing the left front roller bracket to the side plate.

4. Remove front roller from both roller brackets

5. Slide clamp block off each end of the roller shaft.

Note: If the front roller brush/scraper is not to be reinstalled, proceed to steps 6 and 7.

6. Reinstall roller to cutting unit with left front roller bracket and fasteners previously removed.

7. Level front roller and set Height−of−Cut (see Adjust and Level Front Roller to Reel, and Adjust Height−of−Cut).

Installation

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

2. Loosen caps crews securing each end of the roller shaft to the front roller brackets.

3. Remove cap screws and locknuts securing the left front roller bracket to the side plate.

4. Slide clamp block onto each end of the roller shaft. Position clamp blocks on roller shaft so the slot is up and the threaded portion of hole is toward the rear.

5. Thread nut onto each scraper rod.

6. Insert both scraper rods through each clamp block. Loosely secure scraper rods to clamp blocks with a nut.

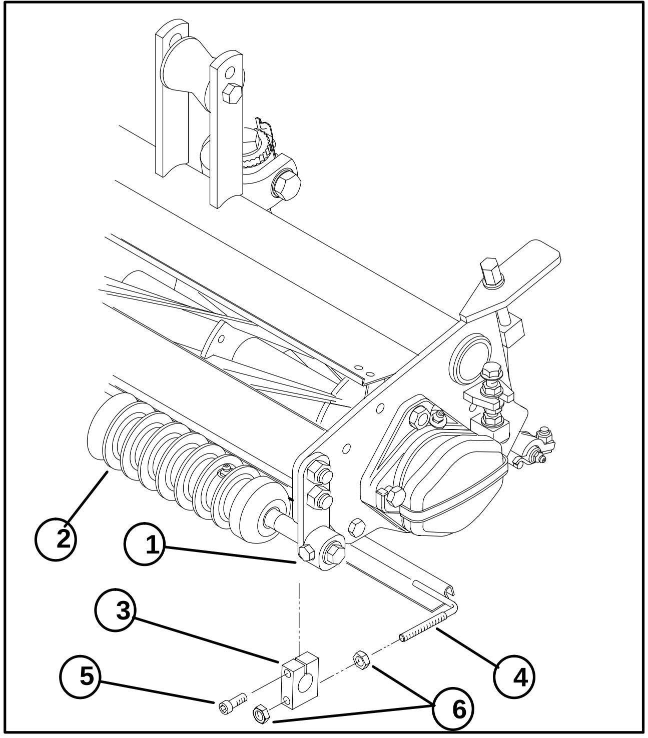


Figure 62

1. **Front roller bracket**
2. **Front roller**
3. **Clamp block**
4. **Scraper rod**
5. **Socket head screw**
6. **Jam nut**

7. Partially thread a socket head screw into the front of each clamp block.

Note: Brush/scraper must be positioned with the scraper to the rear of roller and with the brush downward.

8. Reinstall roller and brush/scraper to the cutting unit with the front roller bracket and fasteners previously removed.

9. Level front roller and set Height−of−Cut. Refer to Cutting Unit Operator's Manual for adjustment procedures.

10. Adjust brush/scraper (see Adjust Front Roller Brush/Scraper).

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Chapter 7.1

Dual Point Adjust Cutting Units

Table of Contents

DPA Cutting Units

Specifications

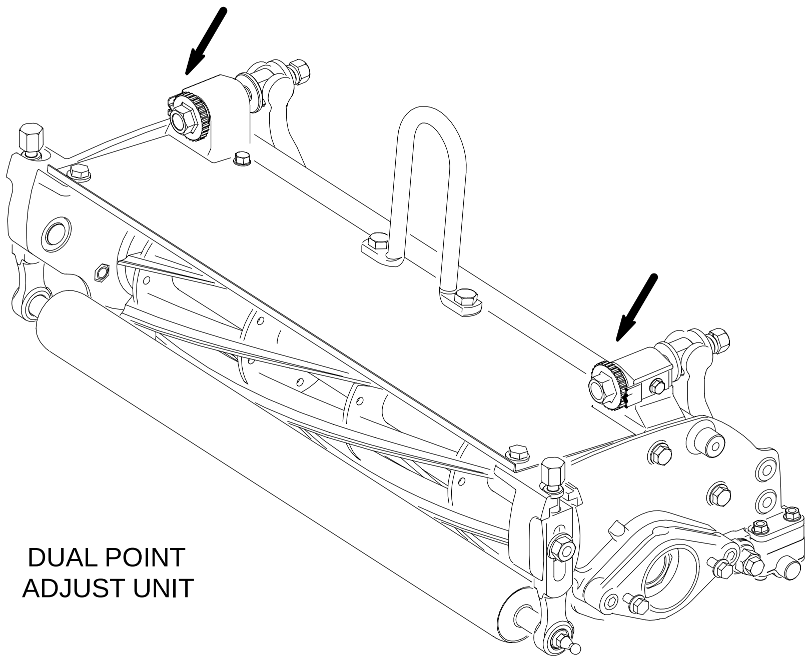

Figure 1

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.

Some tools may have been supplied with your mower or available as TORO parts. Some tools may also be available from a local supplier.

Gauge Bar Assembly

Used to verify height-of-cut.

Toro Model Number: **13-8199**

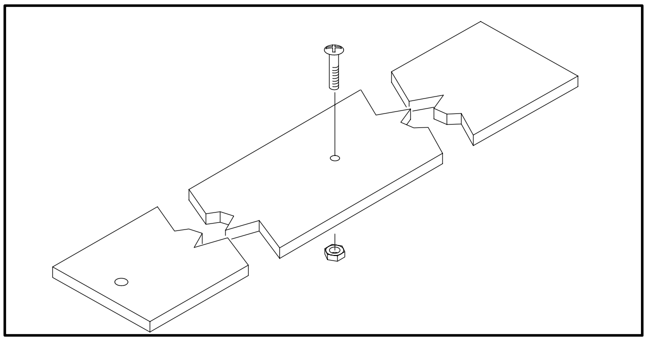

Figure 2

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 Model Number: **TOR299100**

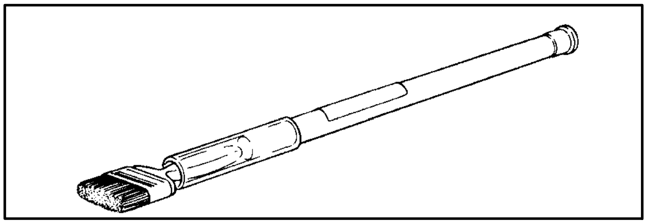

Figure 3

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 Model Number: **TOR510880**

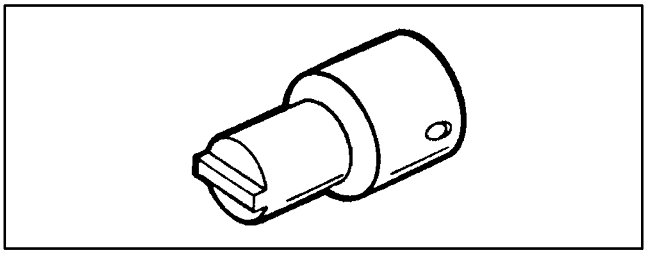

Figure 4

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

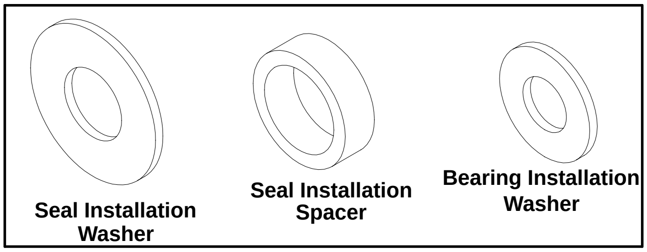

Figure 5

DPA Cutting Units

Bearing and Seal Installer (TOR4105)

Used to install bearings and seals into front and rear rollers that have a threaded roller shaft.

NOTE: TOR4105 is an alternative to using washers and spacers listed above.

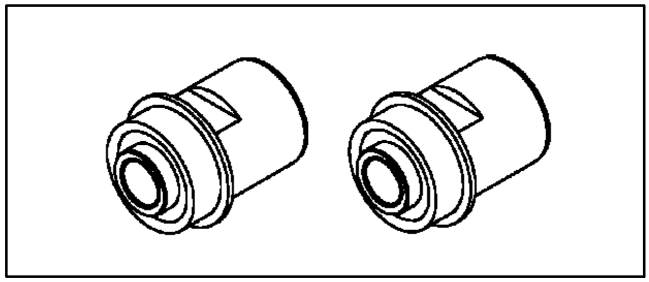

Figure 6

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**

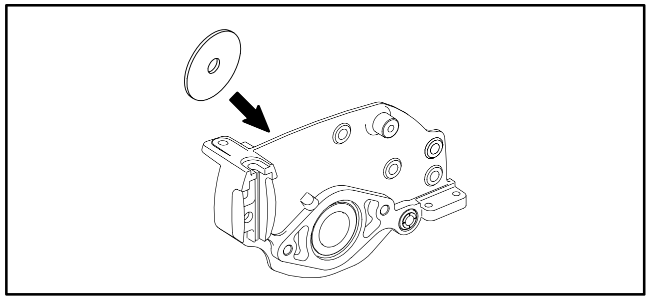

Figure 7

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**

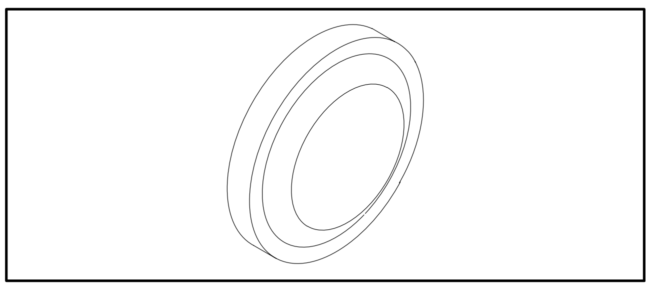

Figure 8

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 Vanguard/Diahatsu Repair Manual.
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 3250−D.

Service and Repairs

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).

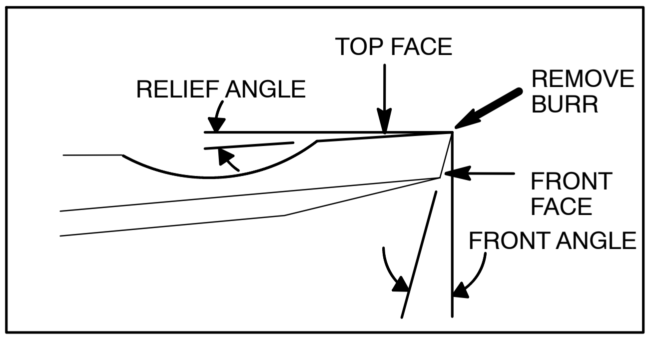

Figure 10

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.

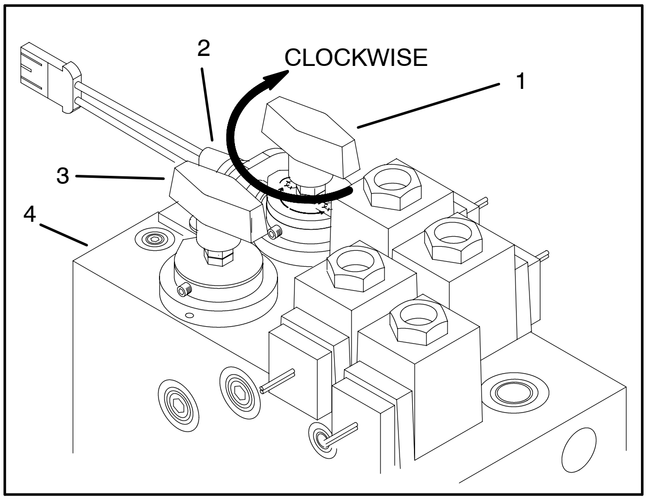

Figure 11

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

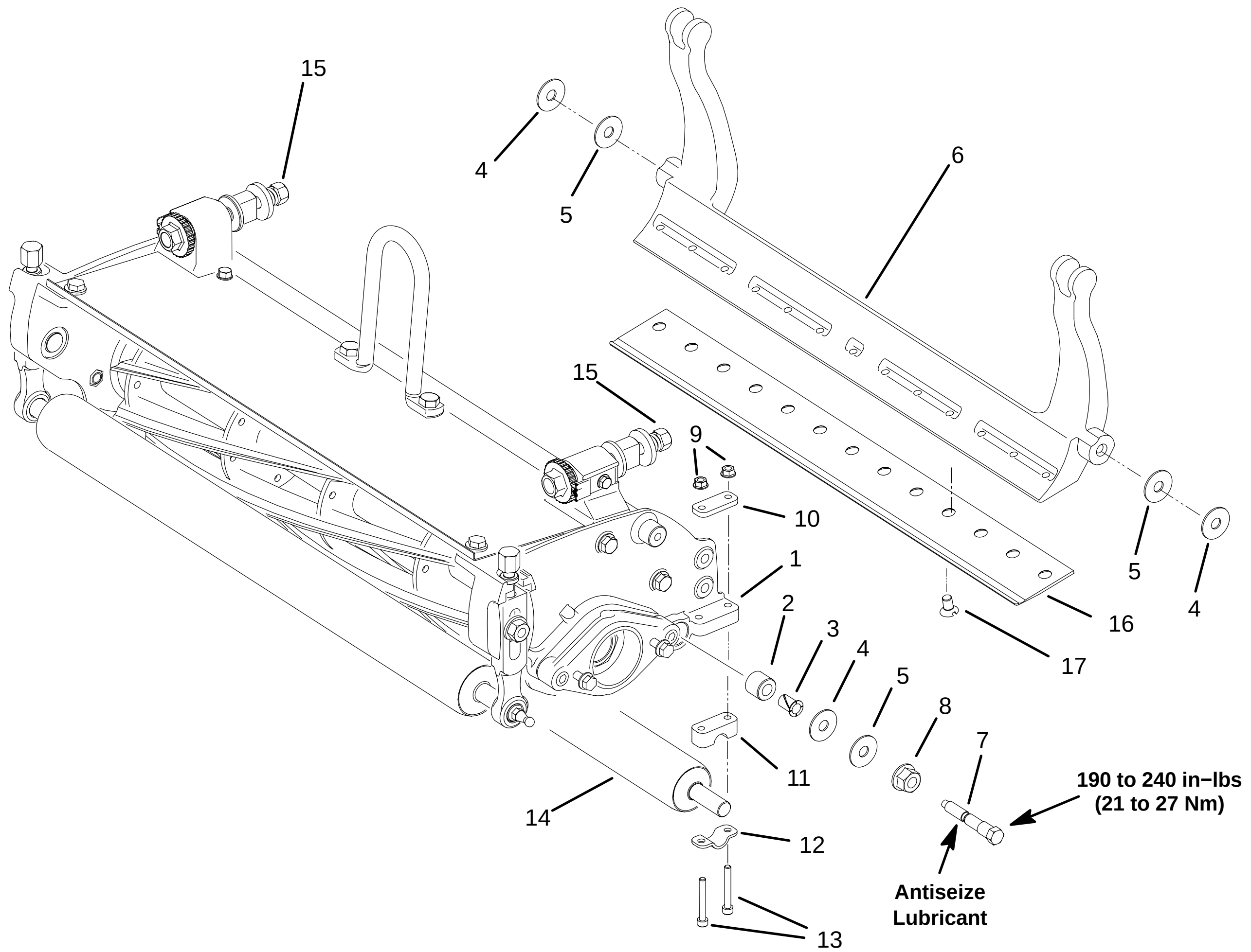

Figure 12

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).

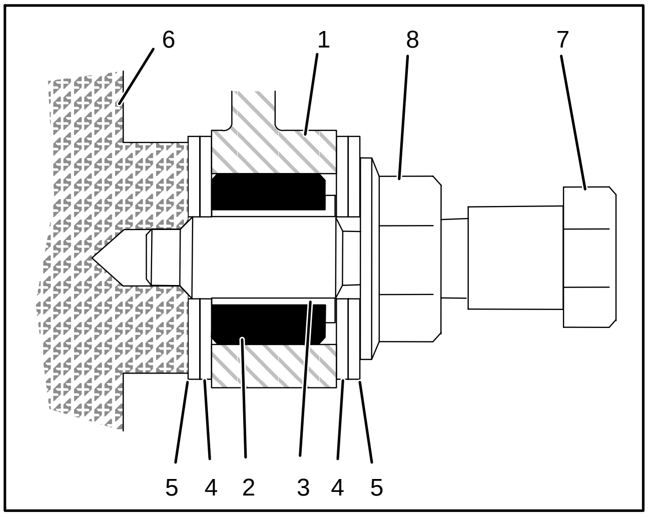

Figure 13

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).

DPA Cutting Units

Bedbar Adjuster Service

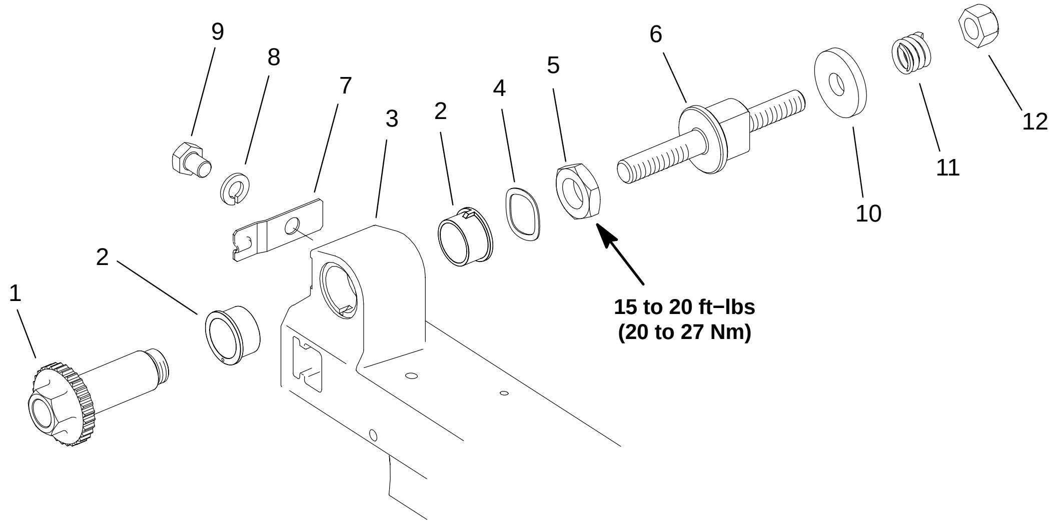

Figure 14

1. **Adjuster shaft**
2. **Flange bushing**
3. **Cutting unit frame**
4. **Wave washer**
5. **Jam nut**
6. **Adjuster screw**
7. **Detent**
8. **Lock washer**
9. **Cap screw**
10. **Washer**
11. **Spring**
12. **Lock nut**

Removal (Fig. 14)

1. Remove bedbar (see Bedbar Removal in this section of this manual).

2. Remove locknut (12), spring (11), and washer (10) from adjuster screw.

3. Unscrew adjuster (6) from the adjuster shaft (1).

4. Remove jam nut (5) and wave washer (4) from adjuster shaft and remove adjuster shaft from cutting unit frame.

5. Inspect flange bushings (2) and remove 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, install the cap screw (9) and 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. Apply antiseize lubricant on internal threads of adjuster shaft (1) and slide into flange bushings in cutting unit frame.

4. Install wave washer (4). Apply Loctite 242 or equivalent to the threads of the jam nut (5). Tighten jam nut from **15 to 20 ft−lbs. (20 to 27 Nm)**.

5. Screw adjuster (6) into adjuster shaft.

6. Install washer (10), spring (11), and lock nut (12) onto adjuster screw.

7. Install bedbar (see Bedbar Installation in this section of this manual).

8. 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-lbs. (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. Refer to Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for bedknife grinding information.

Bedknife Grinding Specifications (see Fig. 17)	
Bedknife relief angle	3°
Front Angle	13°
Front Angle Range	13° to 17°

3. Reinstall bedbar to cutting unit (see Bedbar Installation).

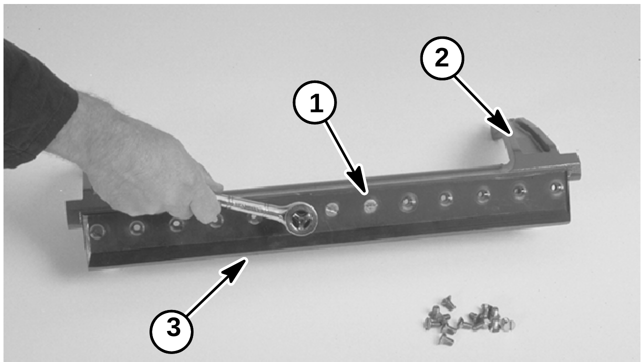

Figure 15

1. **Screw**
2. **Bedbar**
3. **Bedknife**

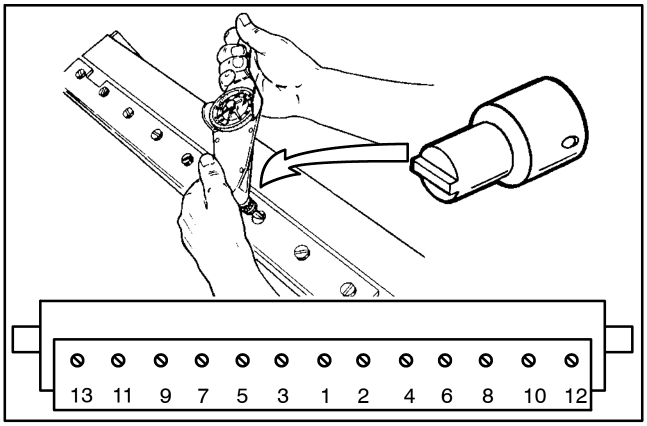

Figure 16

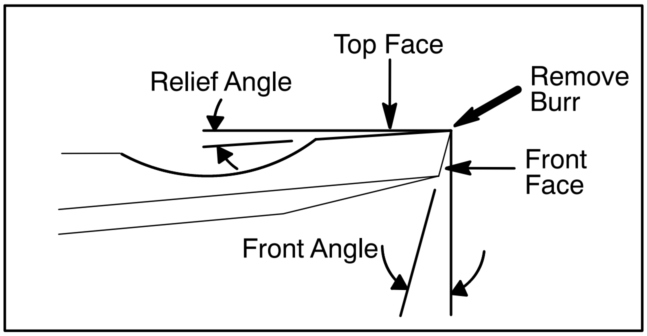

Figure 17

DPA Cutting Units

Reel Assembly

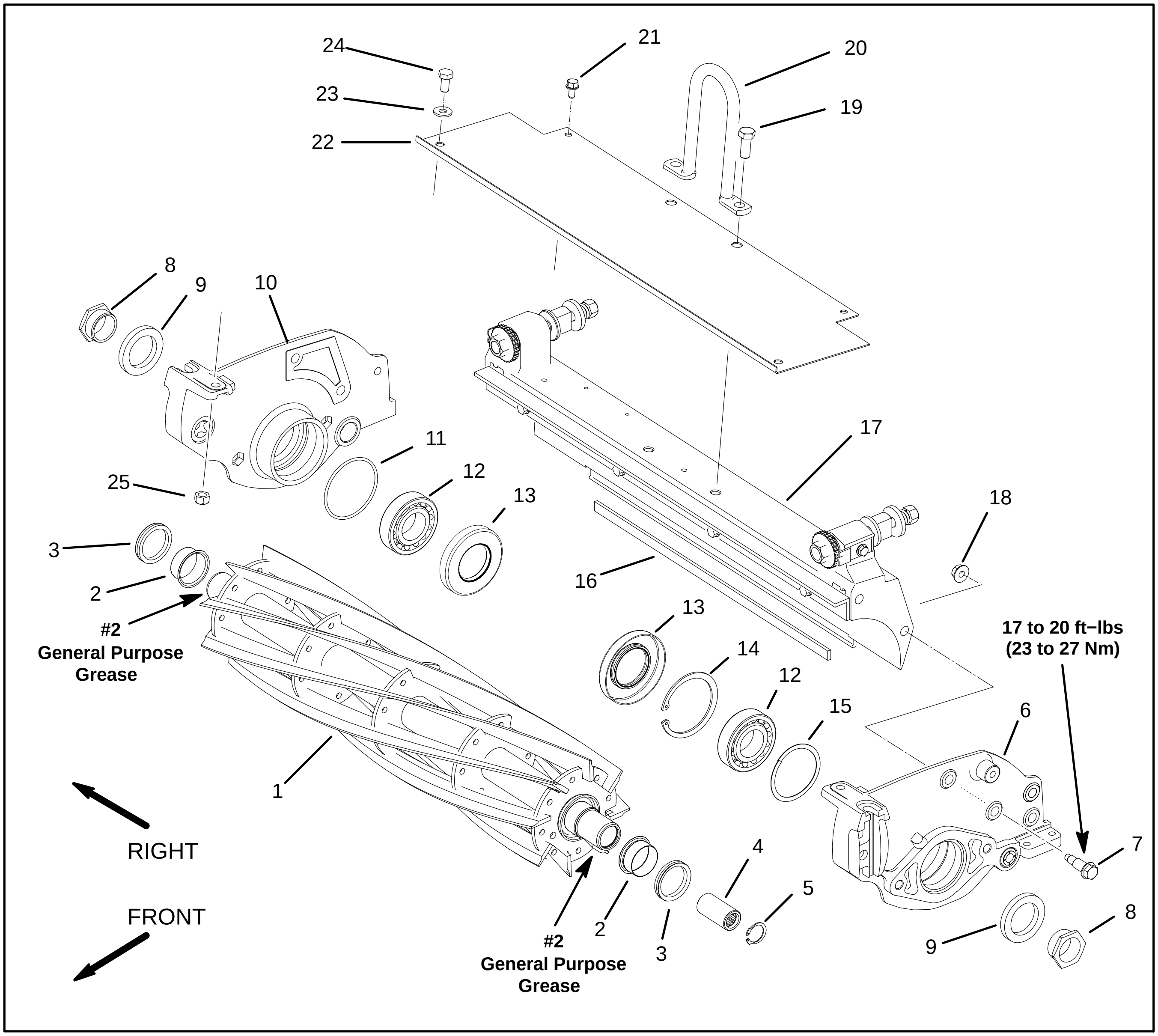

Figure 18

1. **Reel**
2. **Speedi sleeve**
3. **V−ring**
4. **Drive coupler**
5. **Retaining ring**
6. **Left side plate assembly**
7. **Shoulder bolt**
8. **Bearing lock nut**
9. **Outer grease seal**
10. **Right side plate assembly**
11. **O−ring**
12. **Bearing**
13. **Inner grease seal**
14. **Retaining ring**
15. **Wave washer**
16. **Seal strip**
17. **Frame assembly**
18. **Flange nut**
19. **Cap screw**
20. **Lift hook**
21. **Cap screw**
22. **Grass shield**
23. **Washer**
24. **Cap screw**
25. **Lock nut**

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.

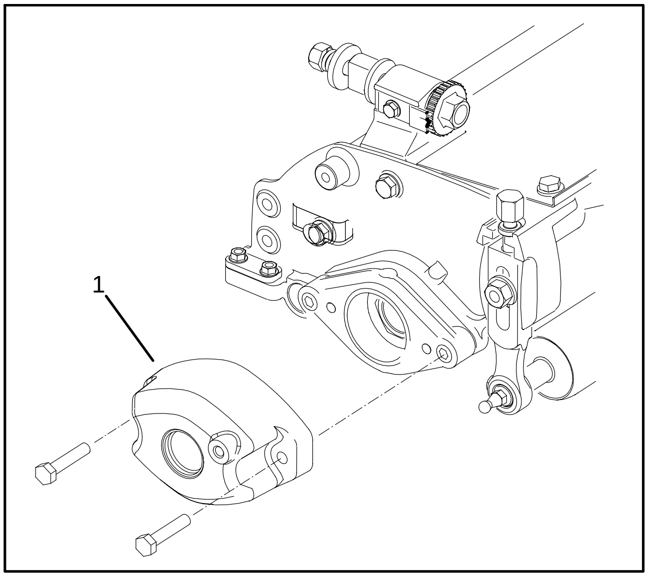

Figure 19

1. Counter weight

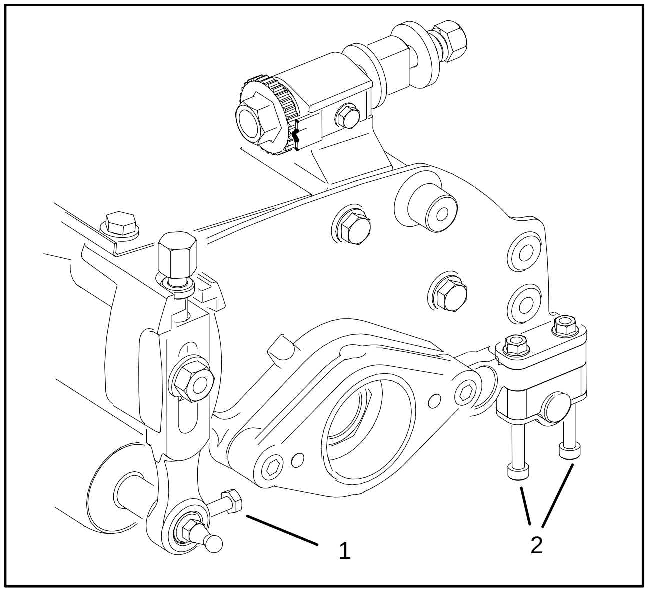

Figure 20

1. Front roller set screw **2. Rear roller saddle strap screws**

DPA 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. 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.

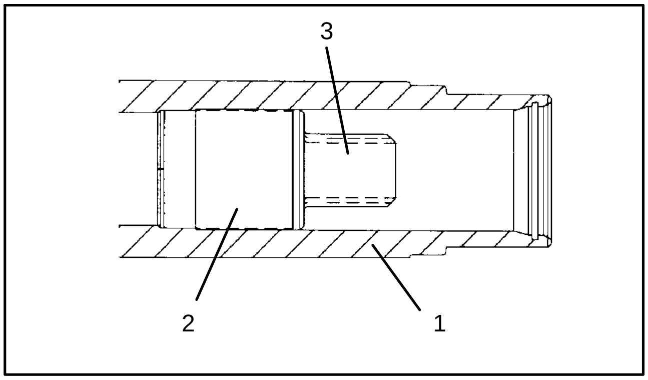

Figure 21

1. **Reel shaft**
2. **Drive adapter**
3. **Adapter spline**

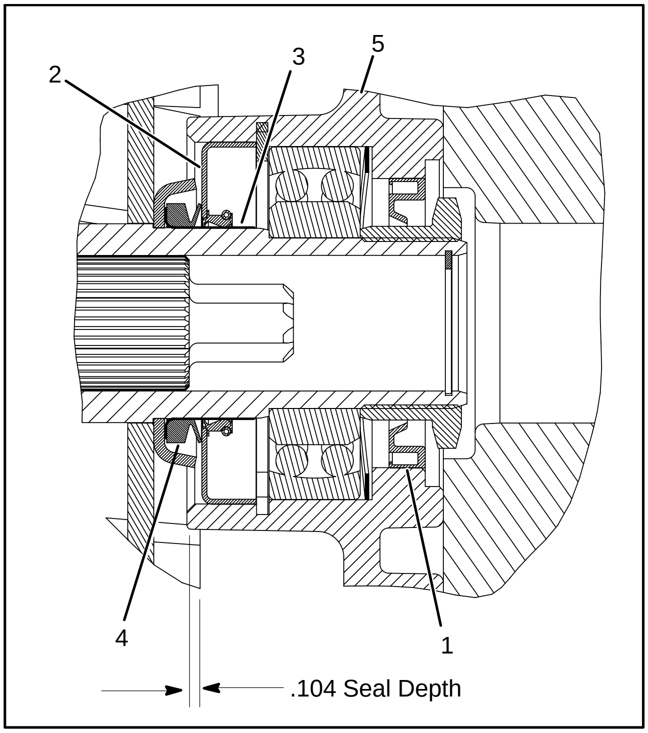

Figure 22

1. **Outer seal**
2. **Inner seal**
3. **Speedi sleeve**
4. **V-ring**
5. **Left side plate**

DPA 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.

10. Install the front roller (see Front Roller Installation in this chapter).

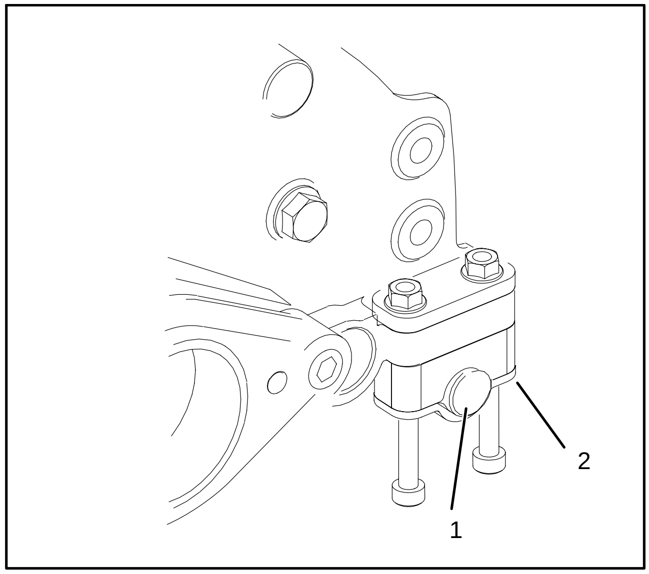

Figure 23

1. **Rear roller** 2. **Saddle clamp**

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)**

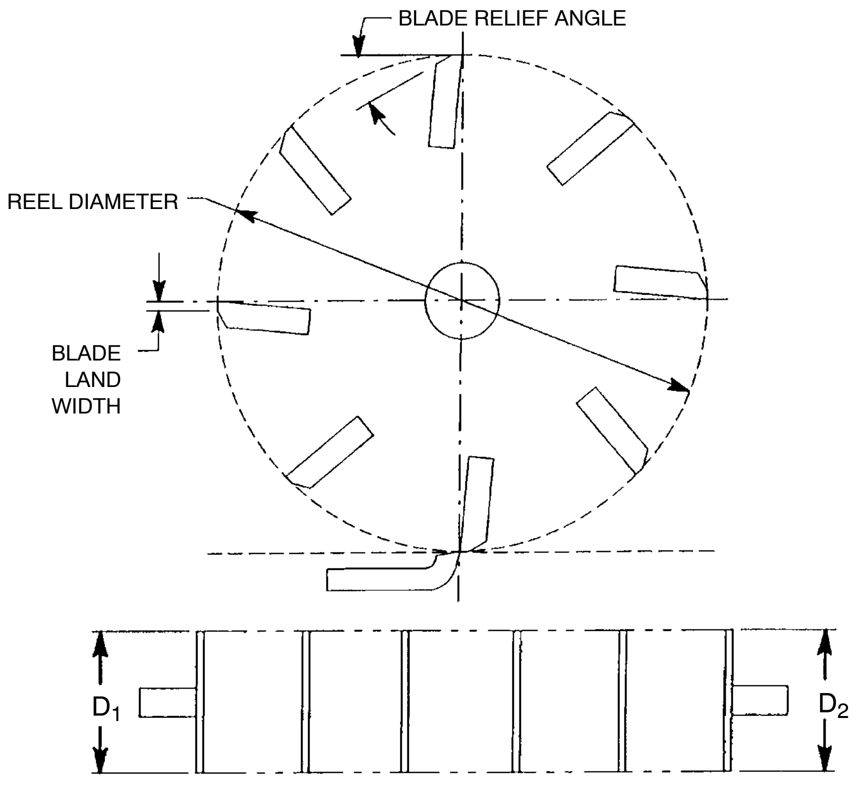

Figure 24

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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.

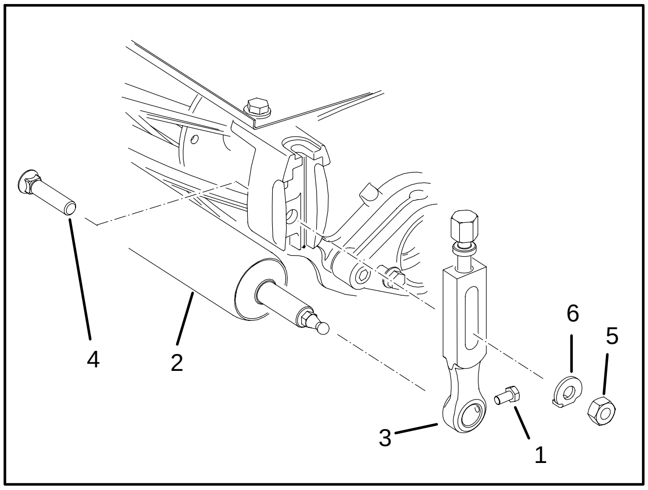

Figure 25

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).

Roller Service (Roller Shaft with Circlip)

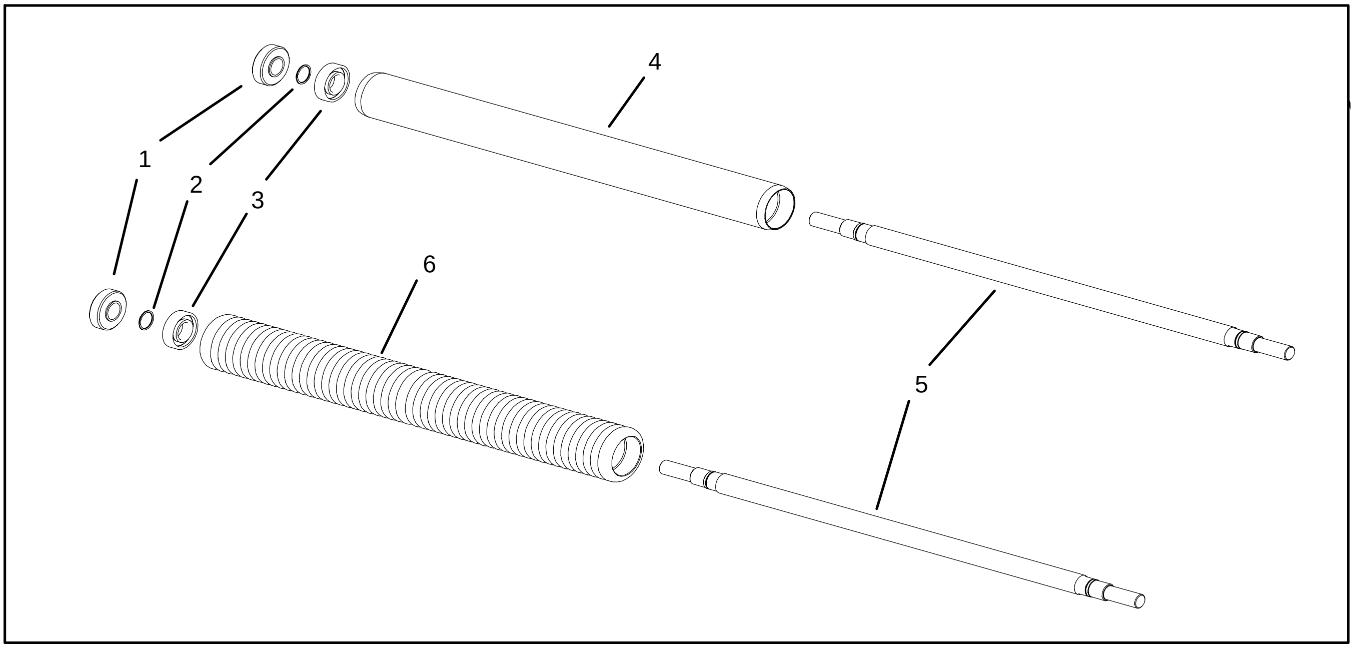

Figure 26

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 x 3 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.

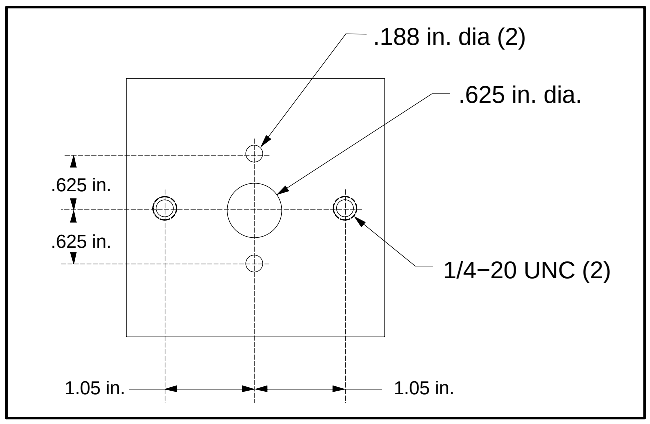

Figure 27

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).

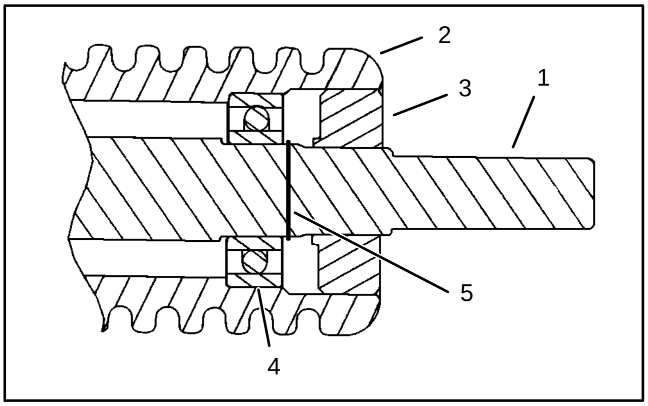

Figure 28

1. Roller shaft
2. Roller body
3. Seal
4. Bearing
5. Spiral retaining ring

DPA Cutting Units

Roller Service (Threaded Roller Shaft)

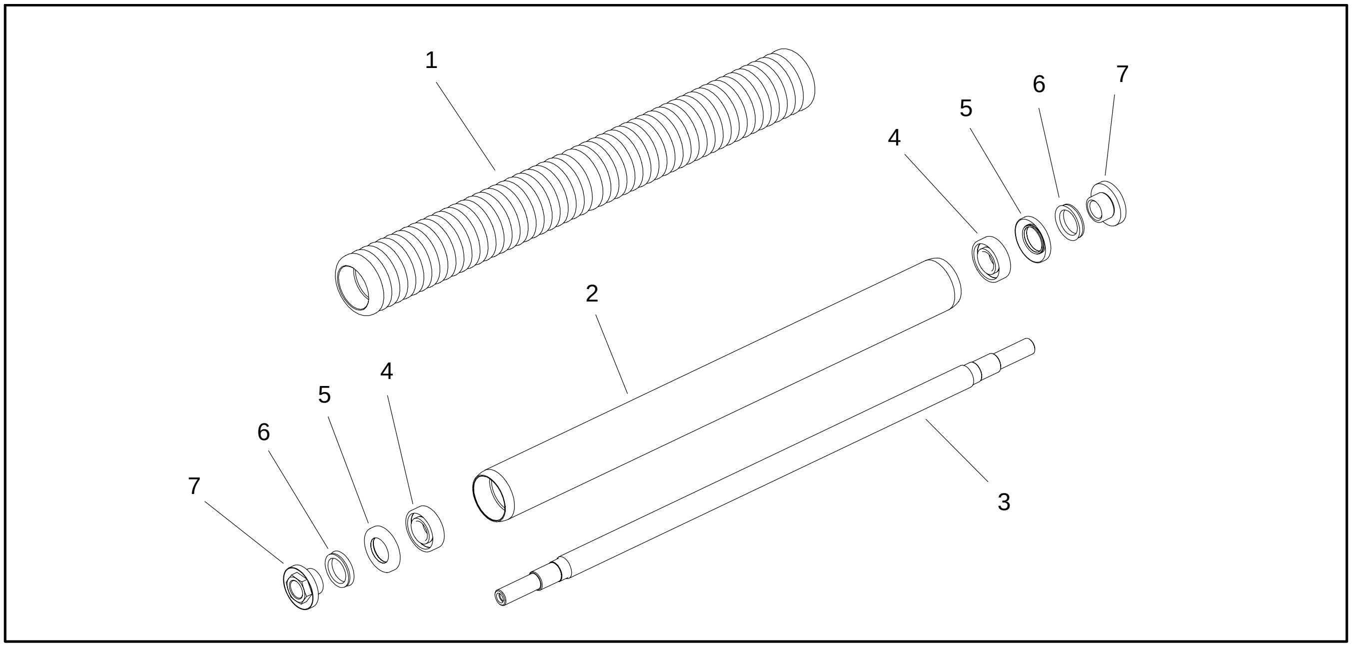

Figure 29

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.

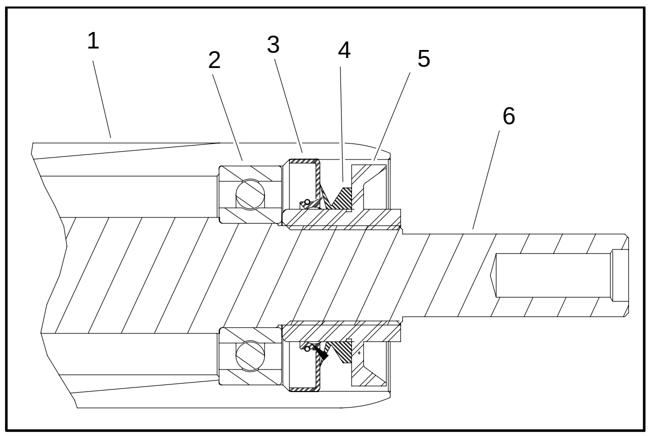

Figure 30

1. **Roller**
2. **Ball bearing**
3. **Seal**
4. **V−ring**
5. **Bearing lock nut**
6. **Roller shaft**

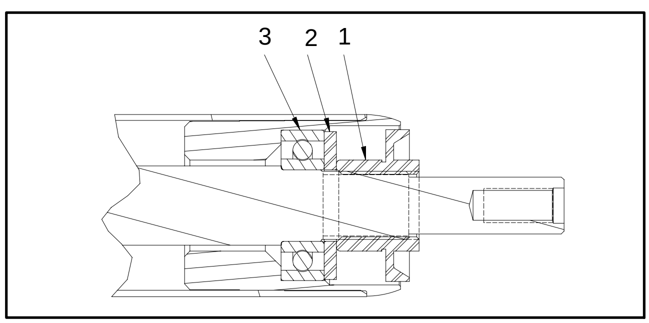

Figure 31

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−lbs. (34 to 41 N−m)**.

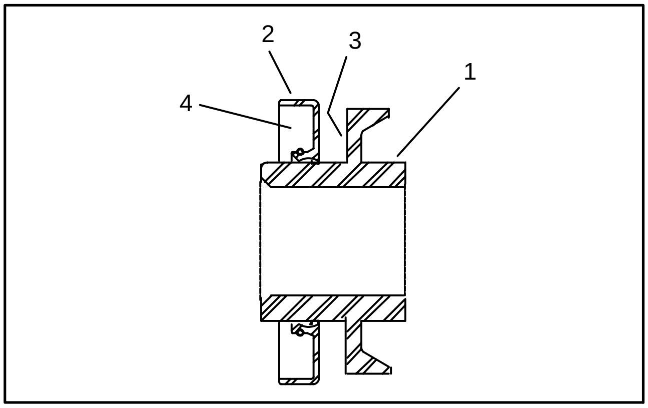

Figure 32

1. **Bearing lock nut**
2. **Seal**
3. **Grease nut surface**
4. **Pack with grease**

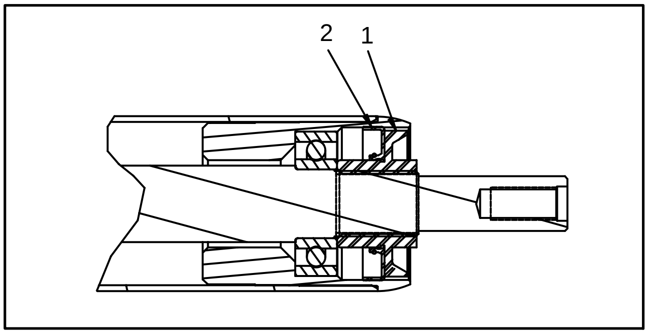

Figure 33

1. **Bearing lock nut**
2. **Seal**

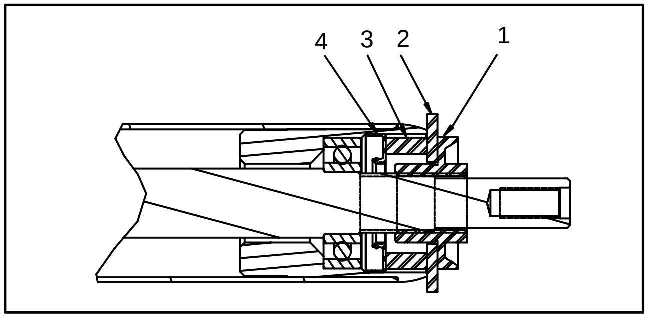

Figure 34

1. **Bearing lock nut**
2. **Yellow assembly washer**
3. **Assembly spacer**
4. **Seal**

DPA Cutting Units

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Chapter 7.2

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.

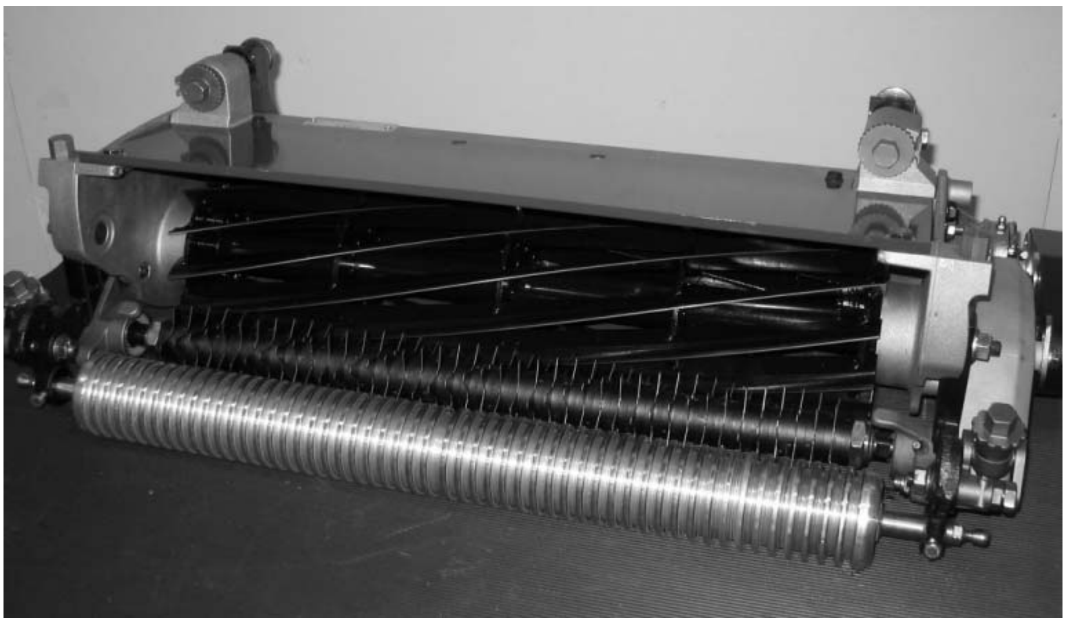
REEL CONSTRUCTION: 2.375 inch (6 cm) diameter, 41 steel blades with 1/2 inch blade spacing. Blade spacing can be adjusted to 1/4 inch or 3/4 inch by altering the position of blade spacers on the groomer.

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.



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).

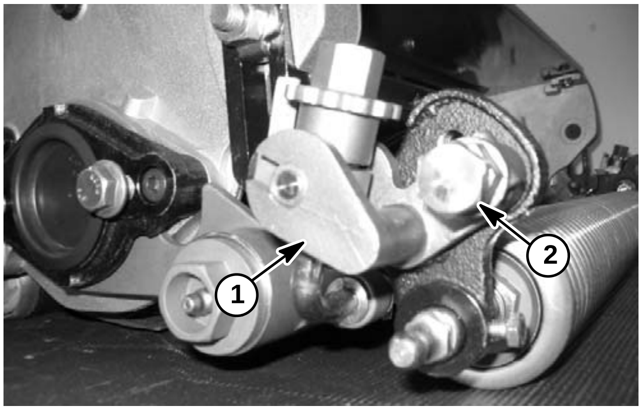


Figure 1

1. **Lift arm**
2. **Lock screw (transport)**

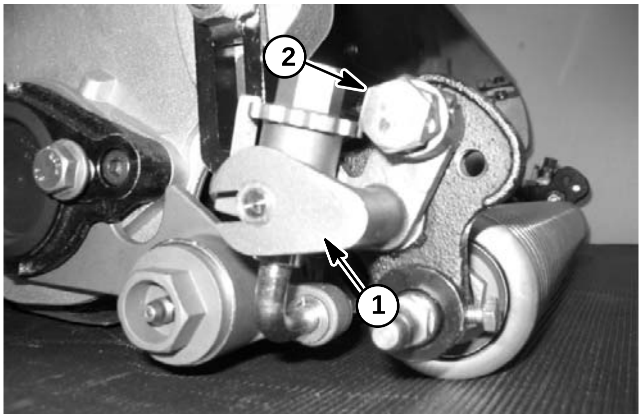


Figure 2

1. **Lift arm**
2. **Lock screw (grooming)**

Groomer (DPA Cutting Unit)

Troubleshooting

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 3250−D.

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.

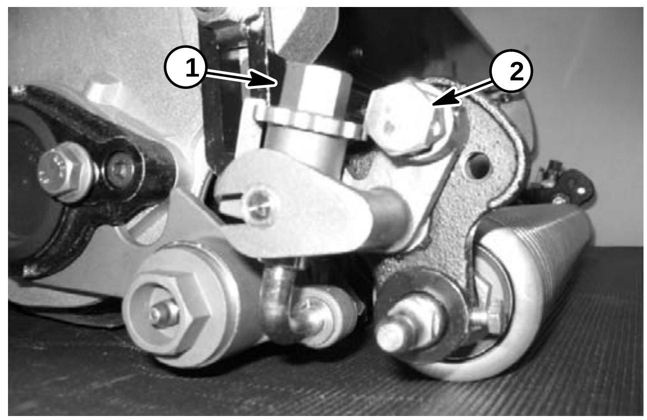


Figure 3

1. Height adjustment knob **2. Lock screw (lowered)**

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.

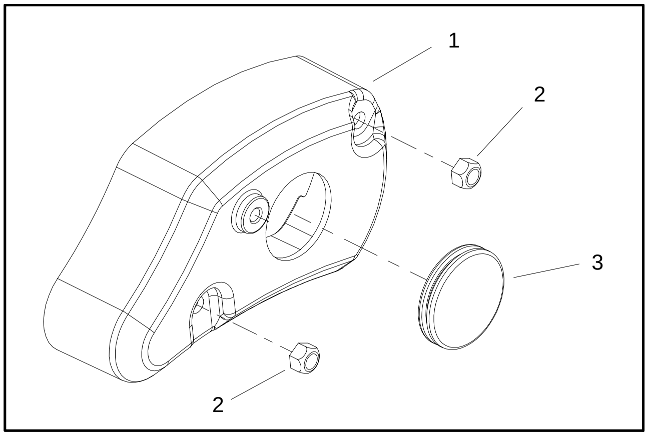


Figure 4

1. Groomer belt cover
2. Lock nut
3. Cap

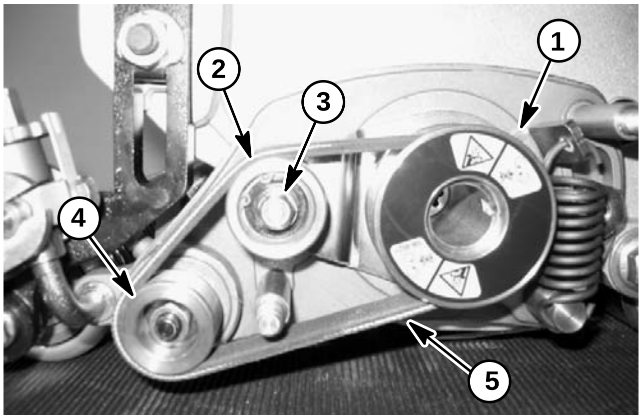


Figure 5

1. Drive pulley
2. Idler pulley
3. Idler pulley nut
4. Driven pulley
5. Groomer drive belt

Groomer Reel

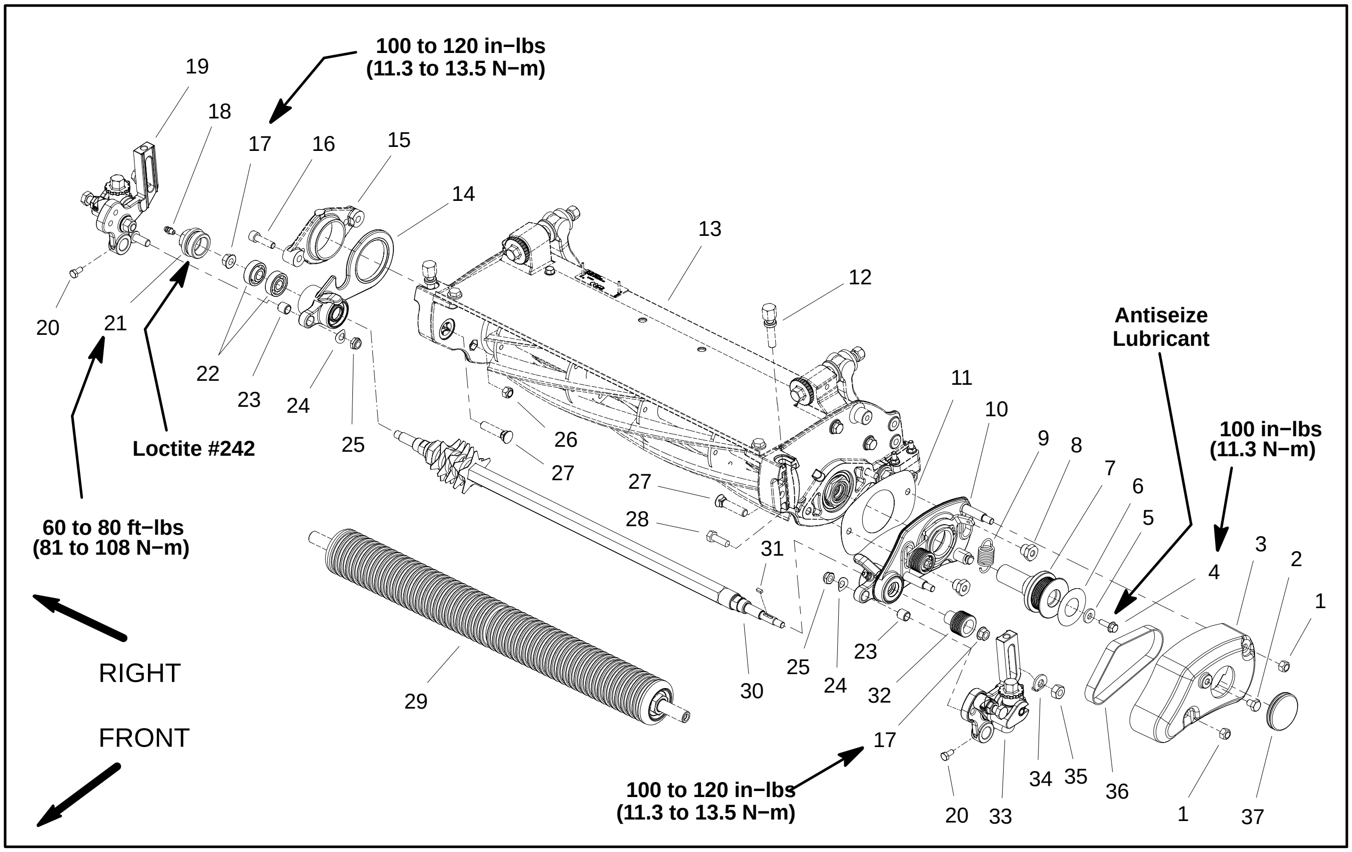


Figure 6

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 7.1 − Dual Point Adjust 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.

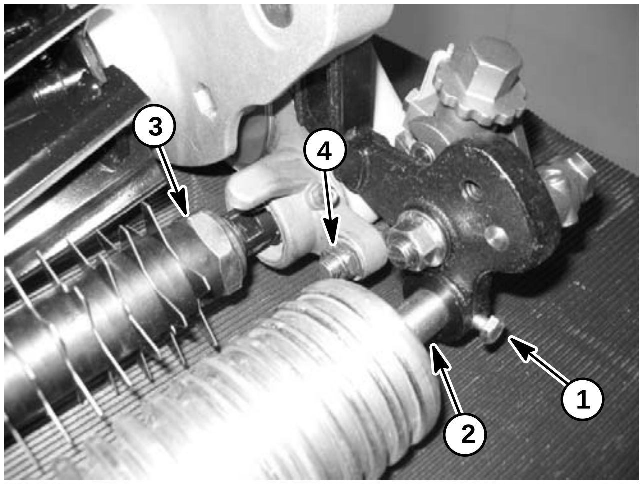


Figure 7

1. **Cap screw**
2. **Front roller shaft**
3. **Groomer shaft assembly**
4. **Locknut/spring washer**

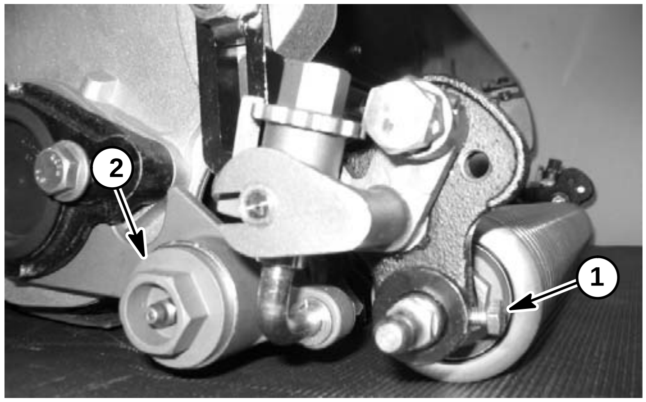


Figure 8

1. **Roller retaining cap screw**
2. **Cap plug**

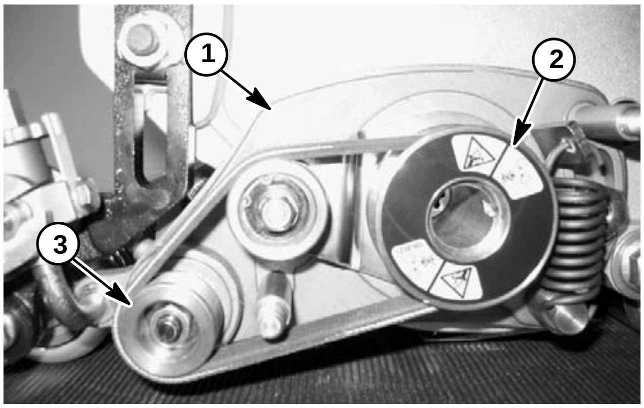


Figure 9

1. **Drive side plate**
2. **Drive pulley**
3. **Driven pulley**

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).

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−lbs. (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−lbs. (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 antiseize 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 Chapter 7.1 − Dual Point Adjust 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 spacers against a 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 spacers between blades (Fig. 10).

3. When all blades have been installed, place final 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−lbs. (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).

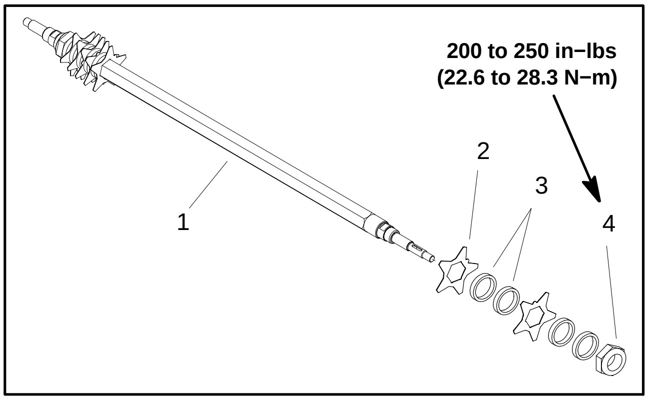


Figure 10

1. **Groomer reel shaft**
2. **Groomer blade**
3. **Spacer**
4. **Lock nut**

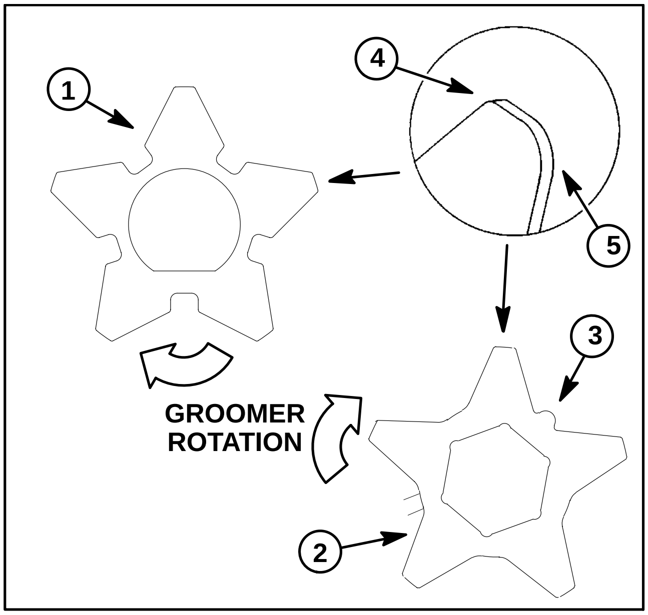


Figure 11

1. **Groomer blade (D shaft)**
2. **Blade (hex shaft)**
3. **Location mark**
4. **Sharp edge**
5. **Dull (rounded) edge**

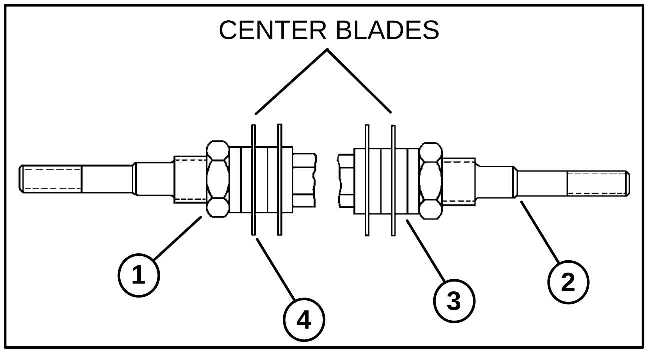


Figure 12

1. **Lock nut**
2. **Shaft**
3. **Spacer**
4. **Blade**

Groomer Reel Bearing Replacement

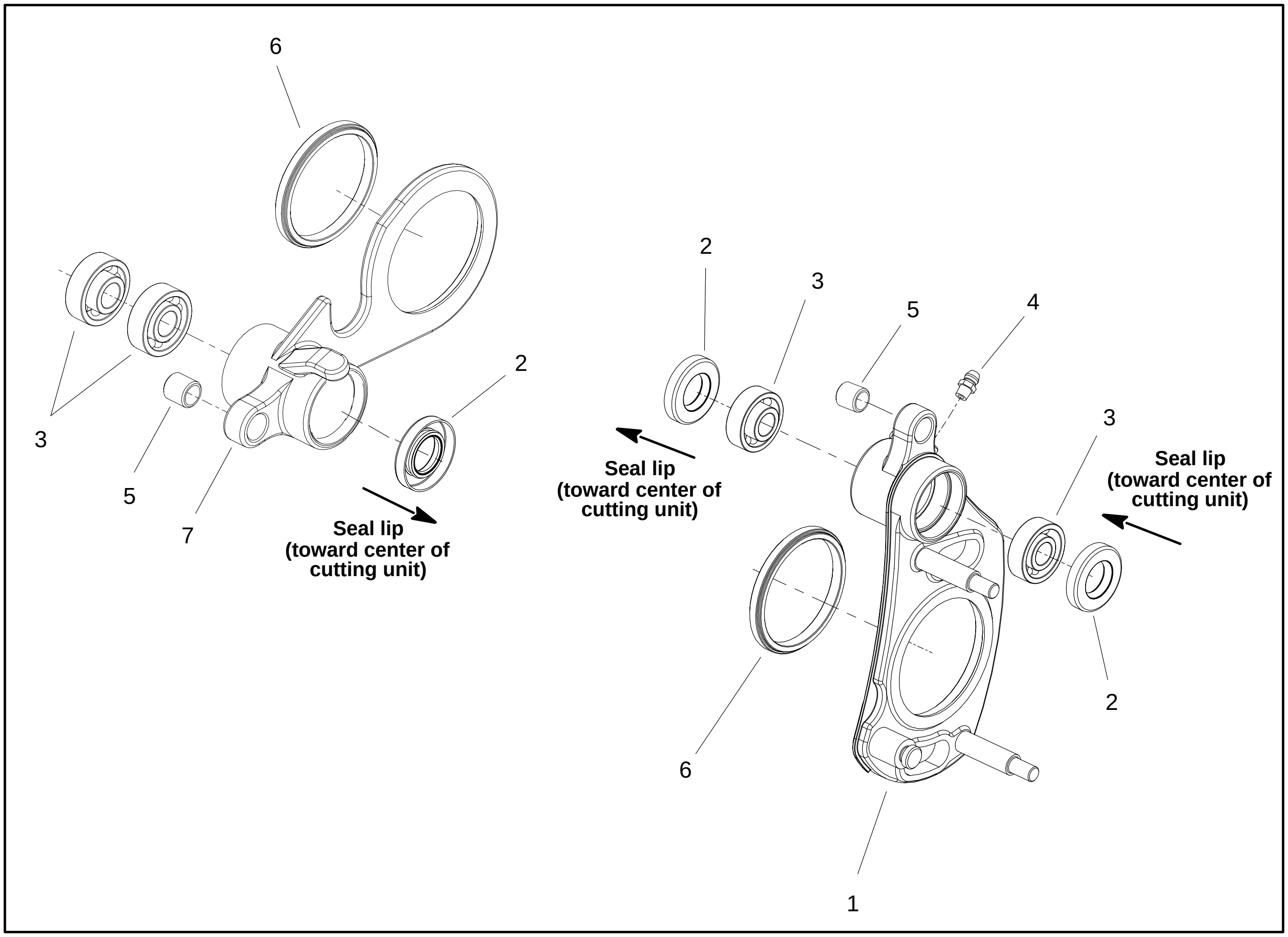


Figure 13

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 Chapter 7.1 − Dual Point Adjust 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 antiseize 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 Chapter 7.1 − Dual Point Adjust 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.

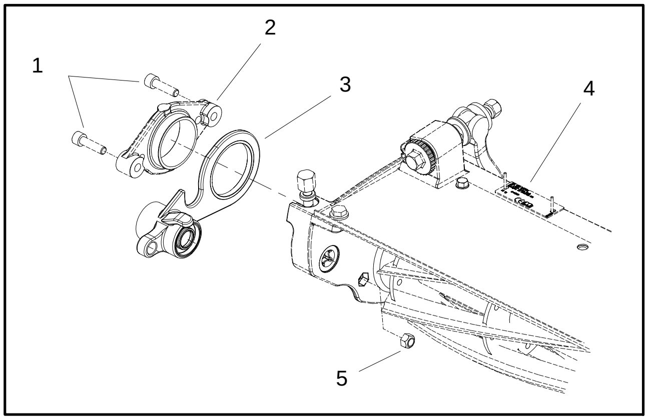


Figure 14

1. **Socket head screw**
2. **Motor mount**
3. **Groomer side plate (RH)**
4. **Cutting unit**
5. **Lock nut (2 used)**

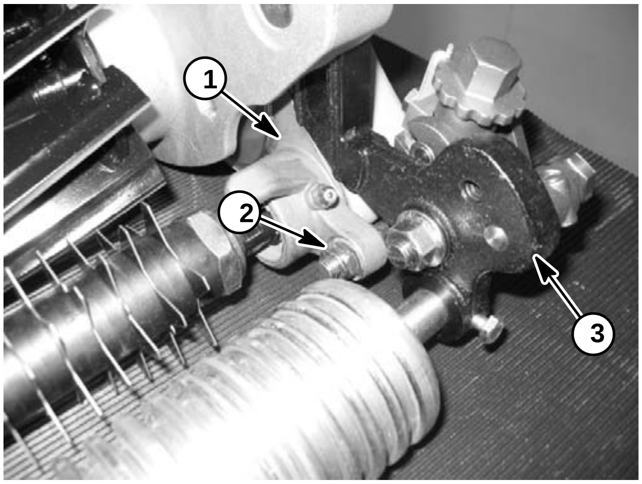


Figure 15

1. **LH groomer side plate**
2. **Lock nut/spring washer**
3. **LH groomer arm**

Groomer (DPA Cutting Unit)

Idler Assembly

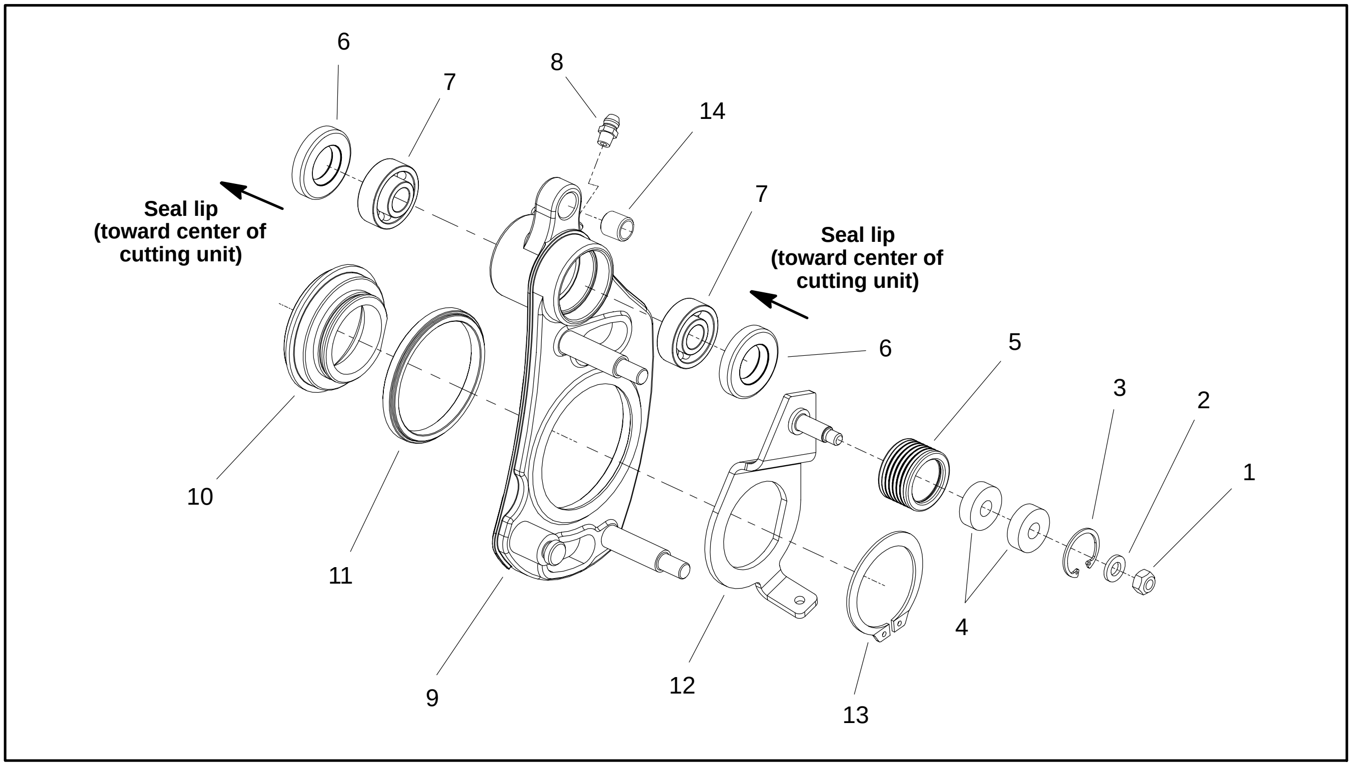


Figure 16

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.

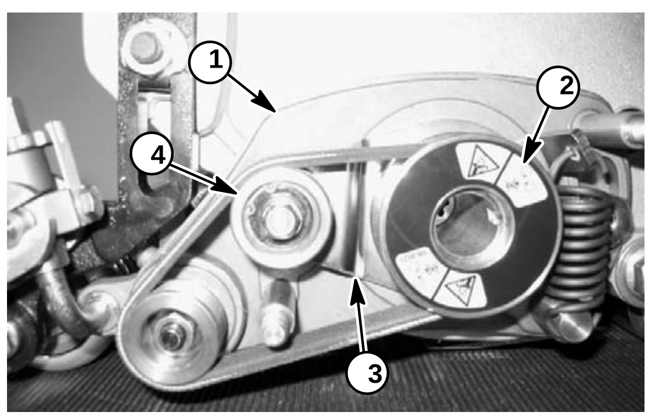


Figure 17

1. **Groomer side plate**
2. **Drive pulley**
3. **Idler bracket**
4. **Idler pulley w/bearings**

Lift Arm Assembly

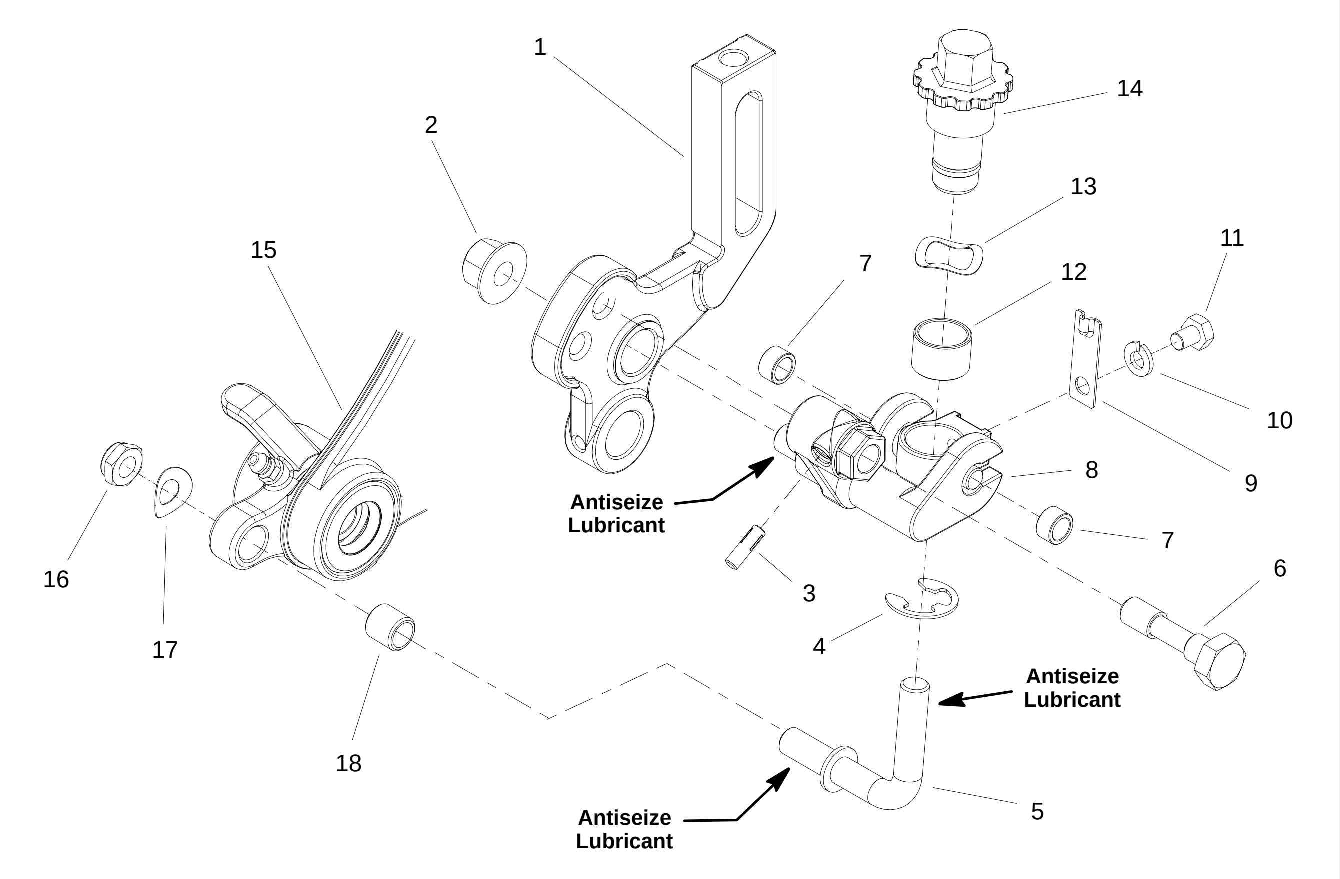


Figure 18

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 antiseize 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

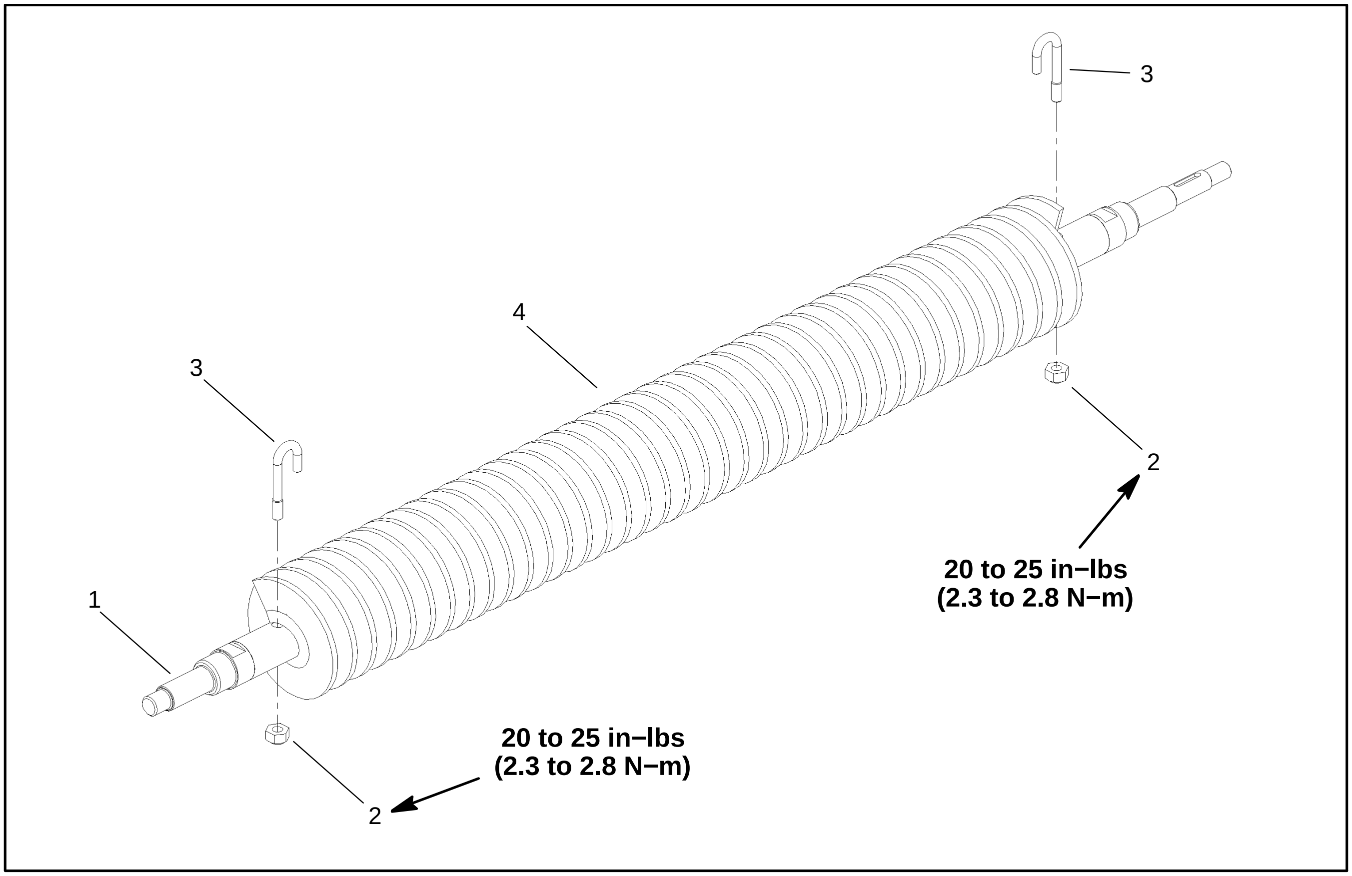


Figure 19

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−lbs. (2.3 to 2.8 N−m)**.

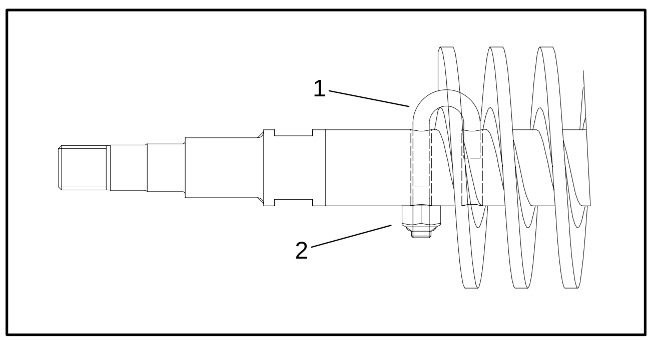


Figure 20

1. **J−bolt**
2. **Lock nut**

Chapter 8

Electrical Diagrams

Table of Contents

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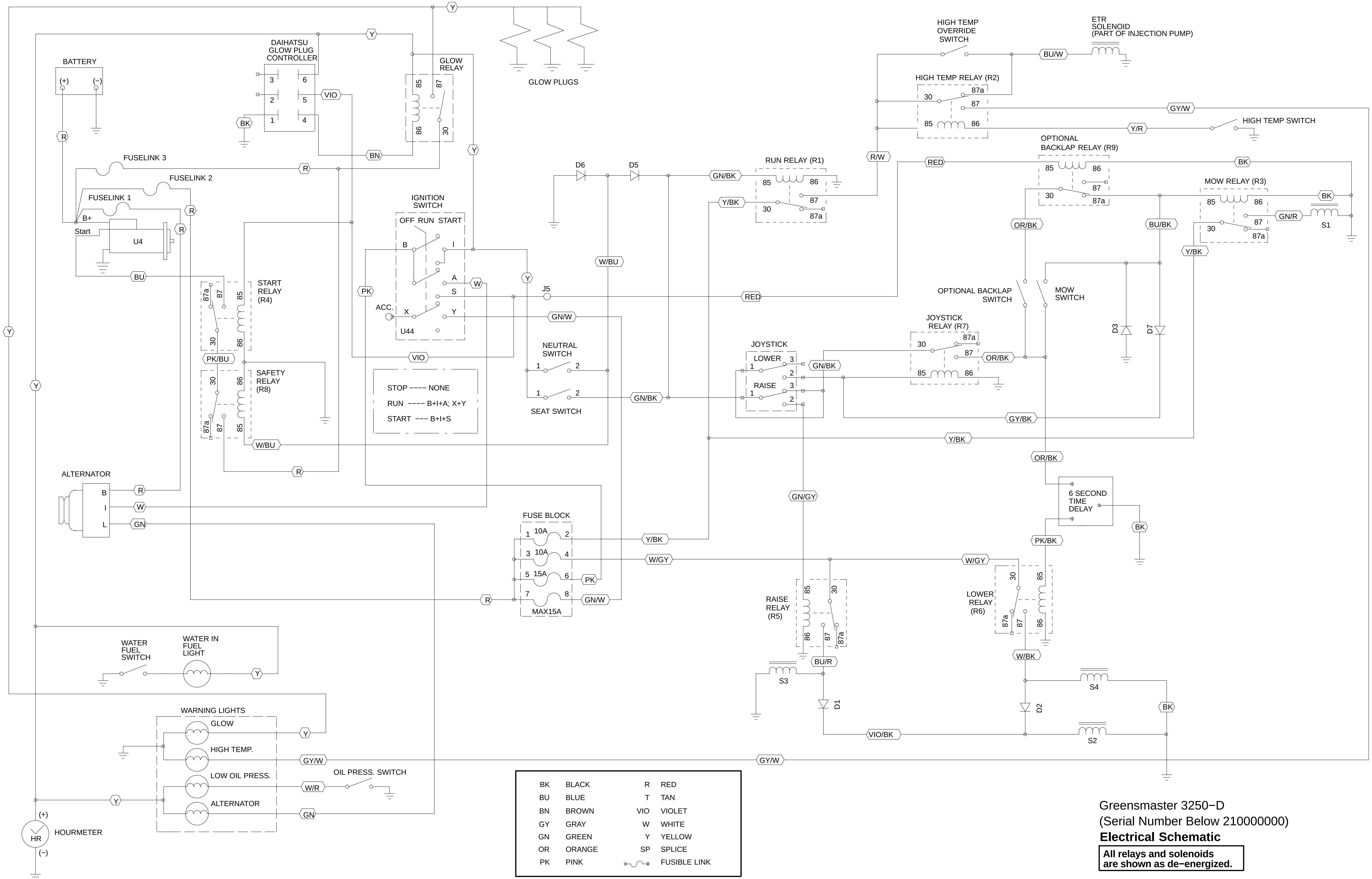
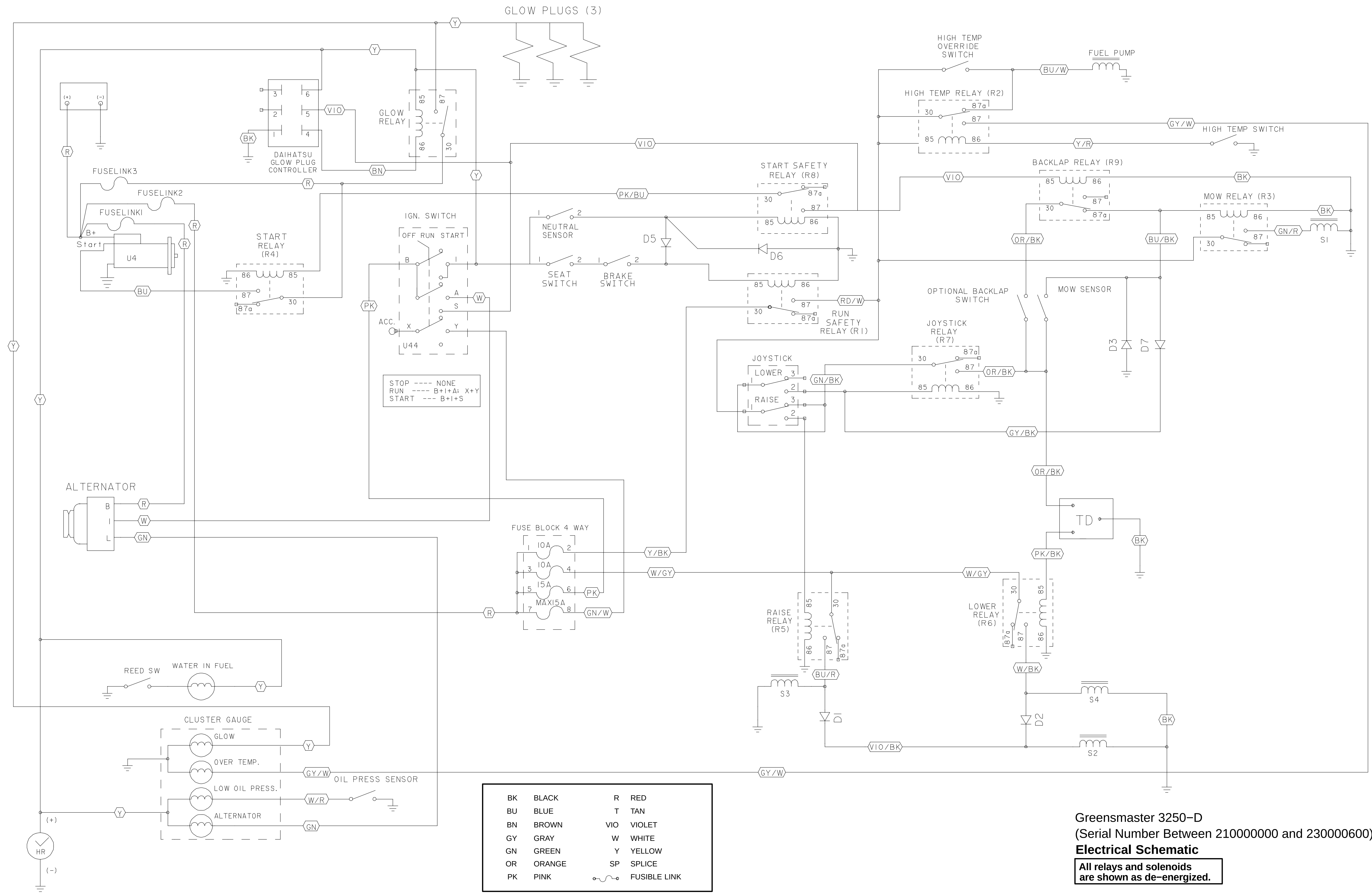


BK	BLACK	R	RED
BU	BLUE	T	TAN
BN	BROWN	VIO	VIOLET
GY	GRAY	W	WHITE
GN	GREEN	Y	YELLOW
OR	ORANGE	SP	SPLICE
PK	PINK		FUSIBLE LINK

Greensmaster 3250−D
(Serial Number Below 210000000)

Electrical Schematic

All relays and solenoids are shown as de−energized.



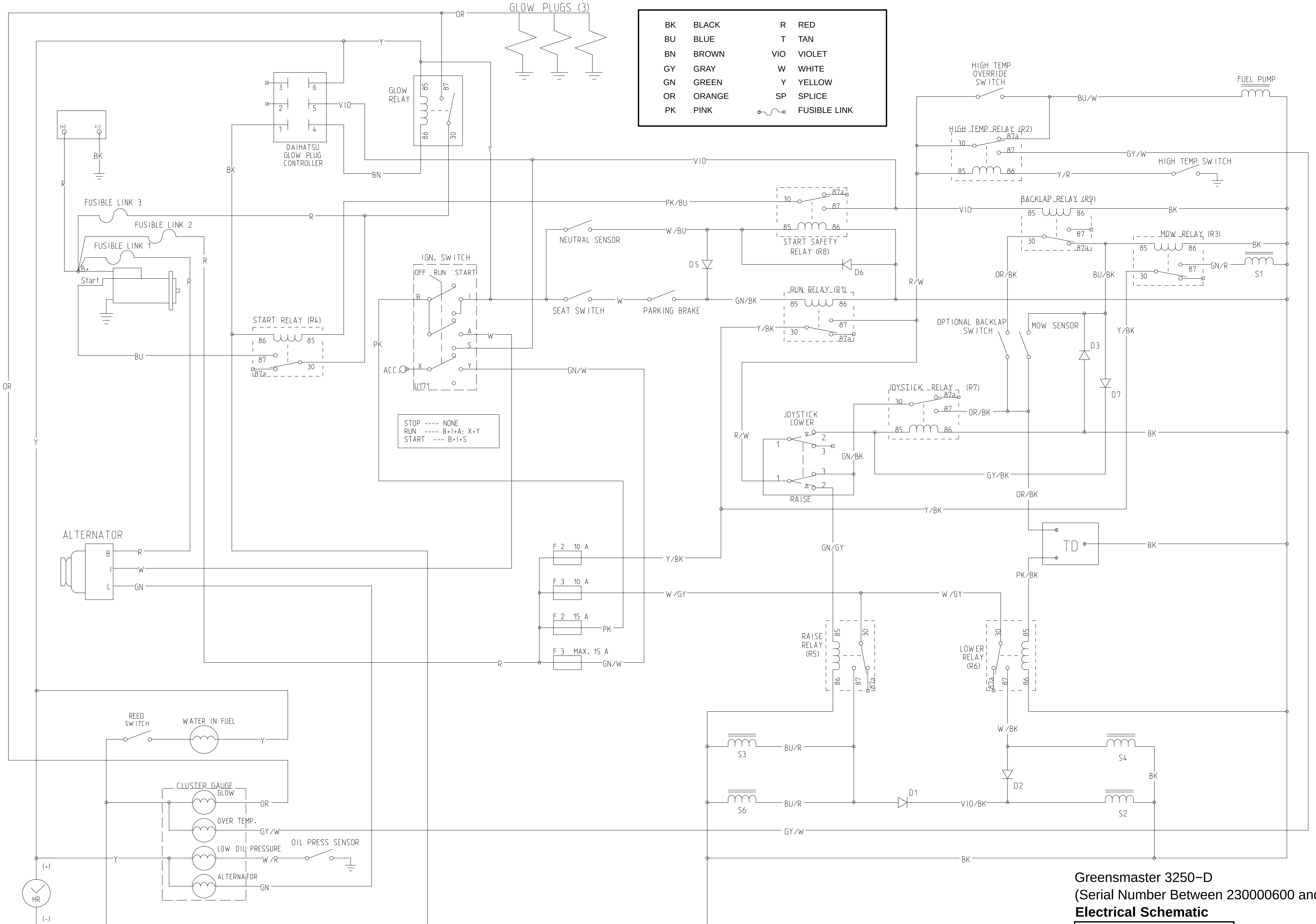
BK	BLACK	R	RED
BU	BLUE	T	TAN
BN	BROWN	VIO	VIOLET
GY	GRAY	W	WHITE
GN	GREEN	Y	YELLOW
OR	ORANGE	SP	SPLICE
PK	PINK		FUSIBLE LINK

Greensmaster 3250−D

(Serial Number Between 210000000 and 230000600)

Electrical Schematic

All relays and solenoids are shown as de−energized.

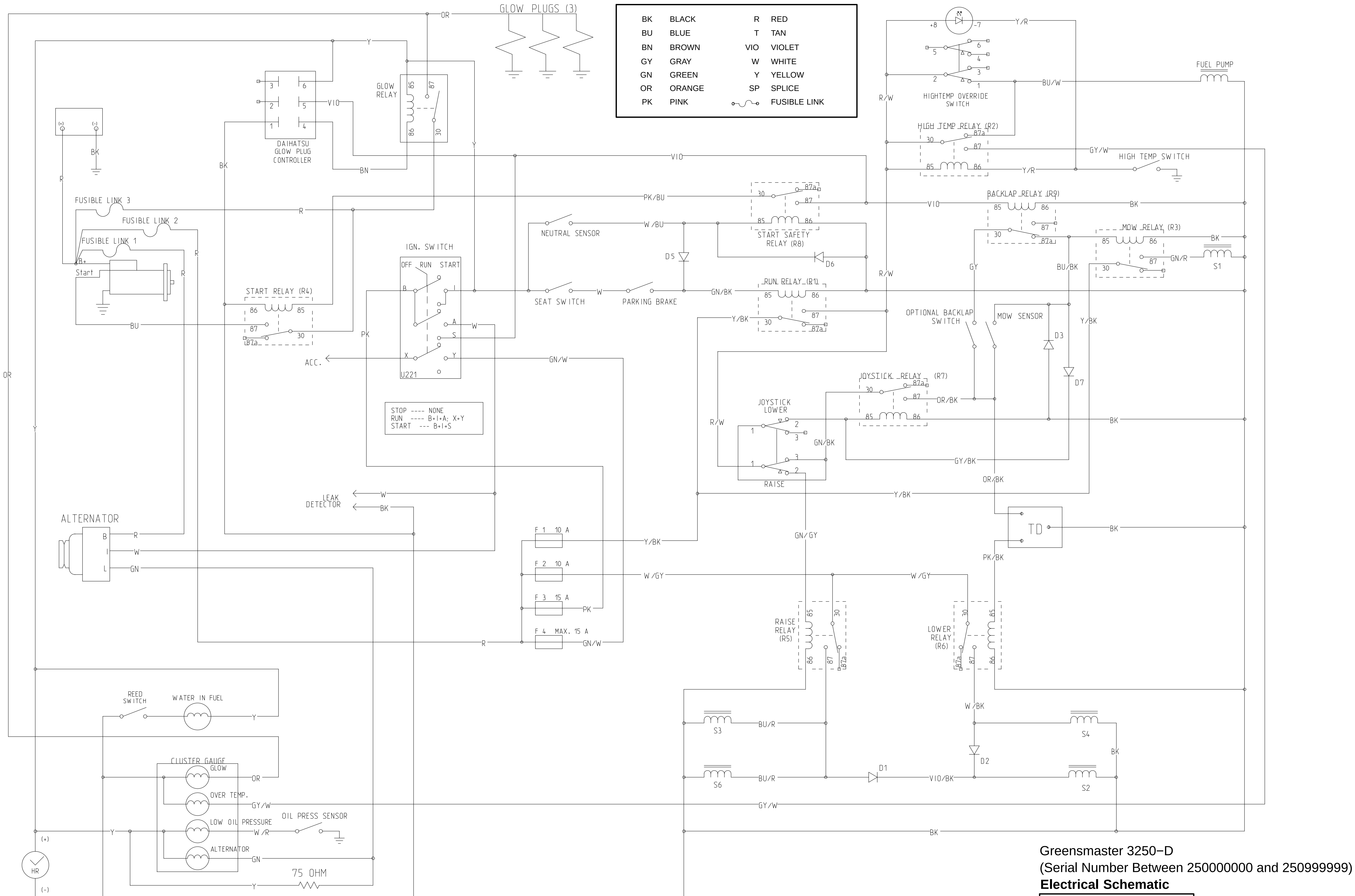


Greensmaster 3250−D

(Serial Number Between 230000600 and 240999999)

Electrical Schematic

All relays and solenoids are shown as de−energized.

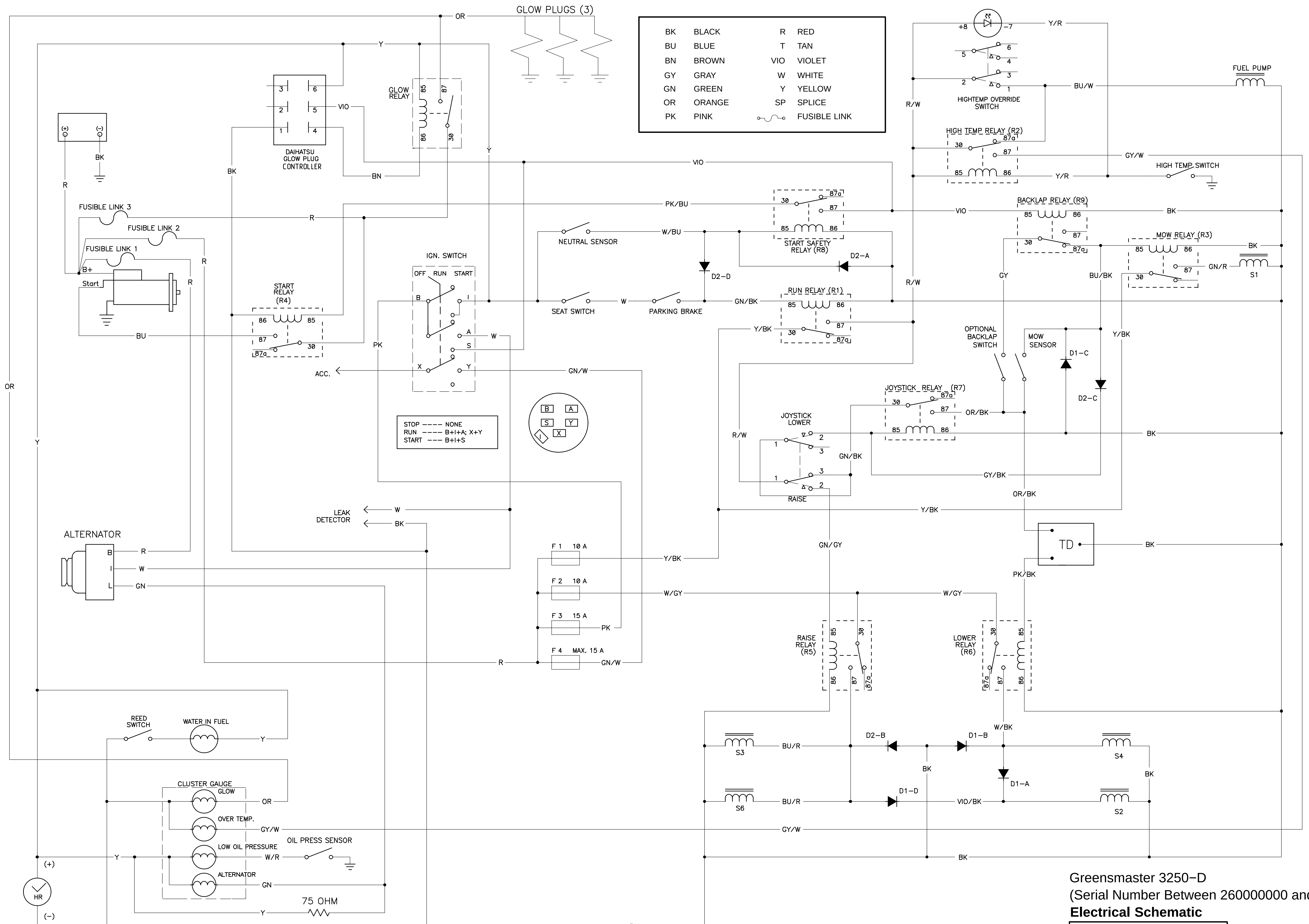


BK	BLACK	R	RED
BU	BLUE	T	TAN
BN	BROWN	VIO	VIOLET
GY	GRAY	W	WHITE
GN	GREEN	Y	YELLOW
OR	ORANGE	SP	SPLICE
PK	PINK		FUSIBLE LINK

Greensmaster 3250−D
(Serial Number Between 250000000 and 250999999)

Electrical Schematic

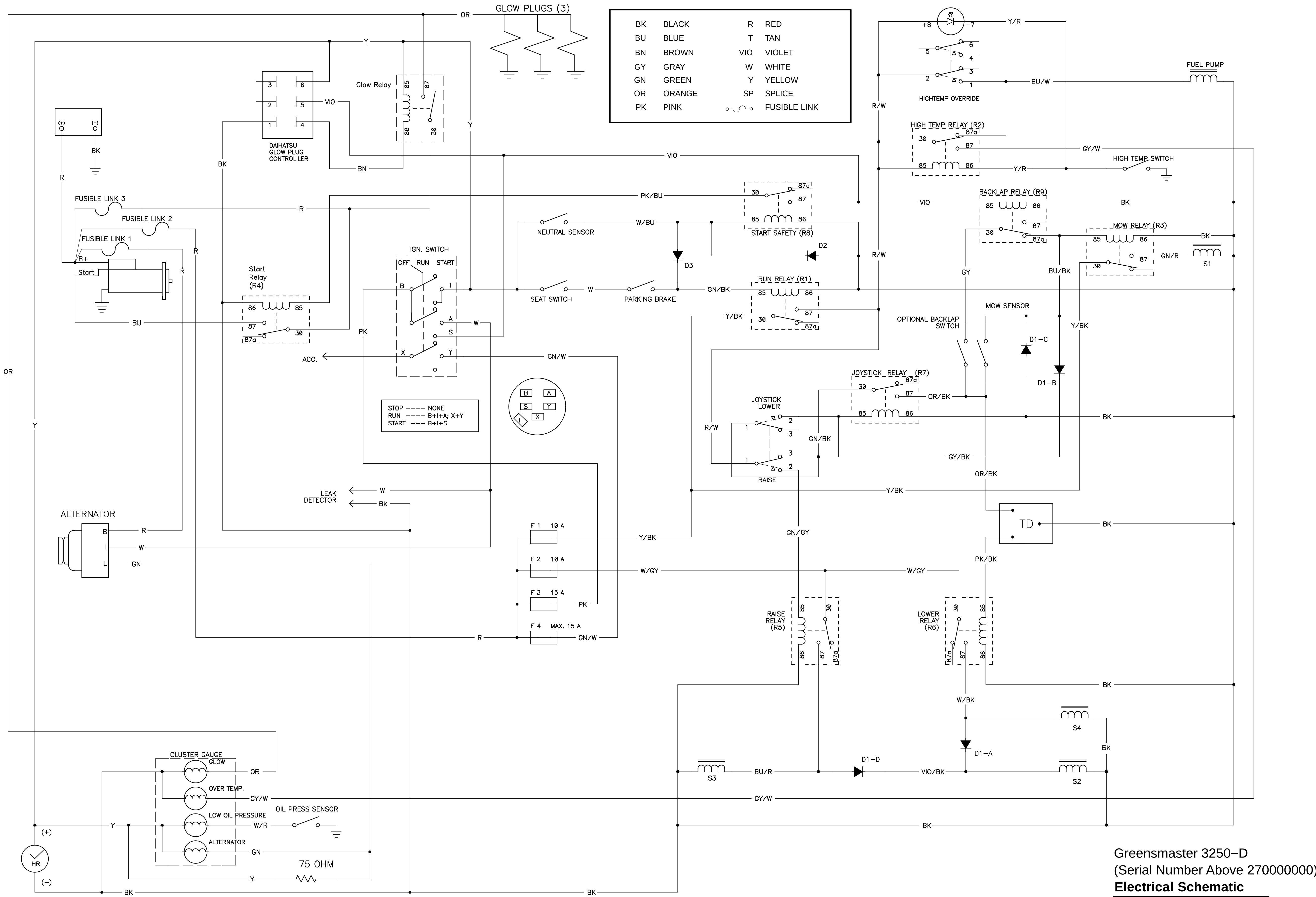
All relays and solenoids are shown as de−energized.



Greensmaster 3250−D
(Serial Number Between 260000000 and 260999999)

Electrical Schematic

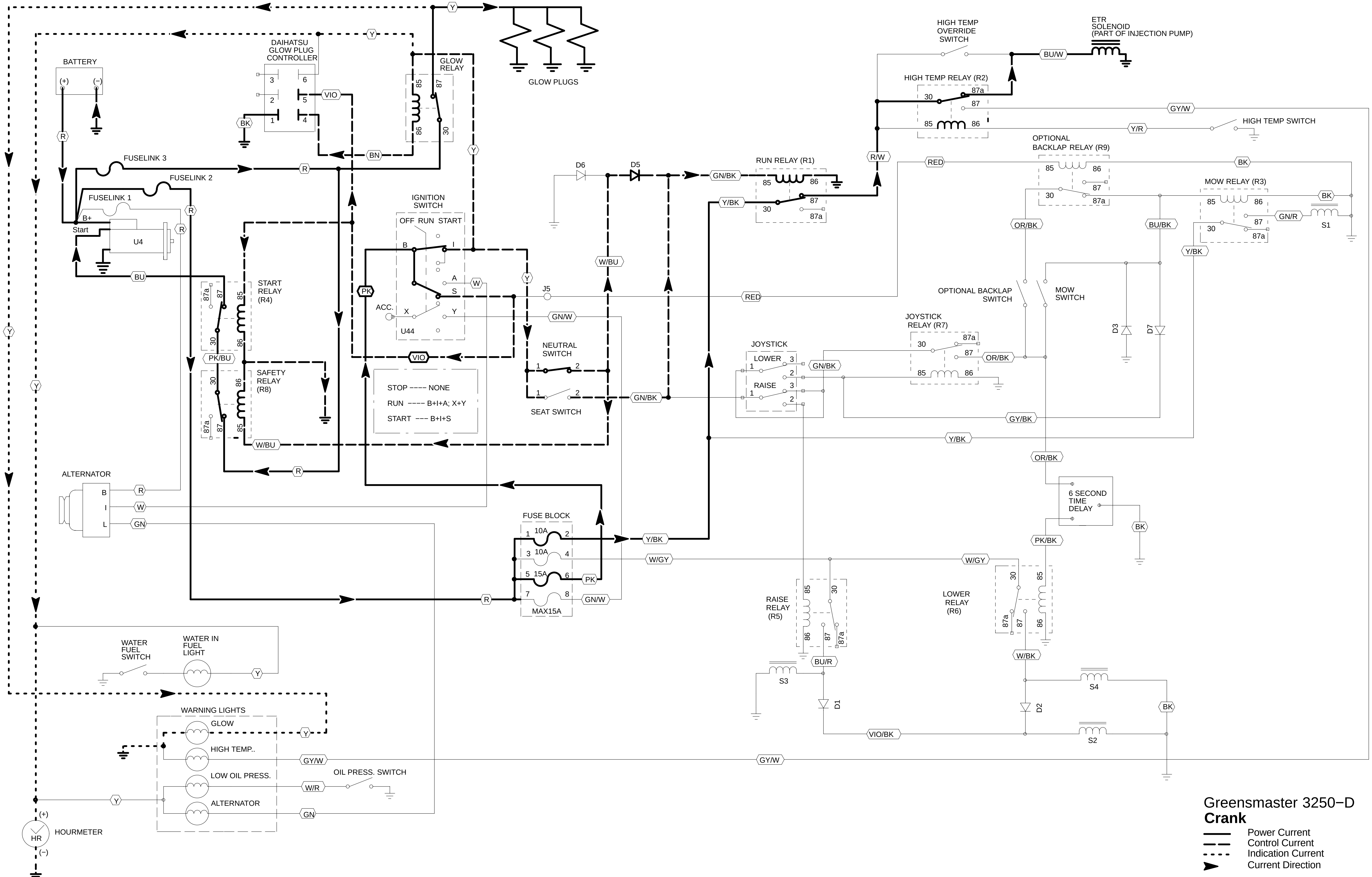
All relays and solenoids are shown as de−energized.



Greensmaster 3250−D
(Serial Number Above 270000000)

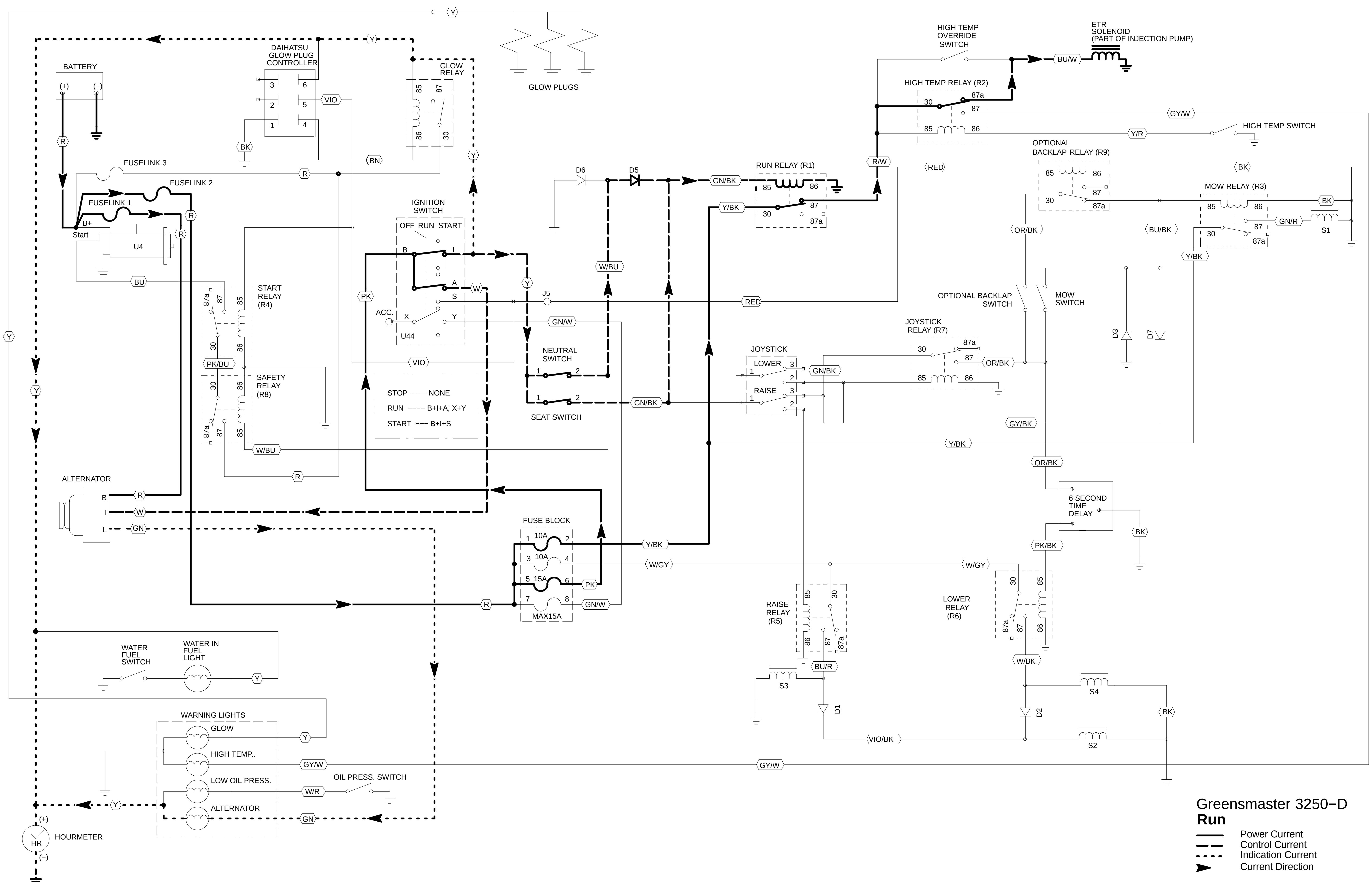
Electrical Schematic

All relays and solenoids are shown as de−energized.



Greensmaster 3250−D
Crank

Power Current
Control Current
Indication Current
Current Direction



Greensmaster 3250−D

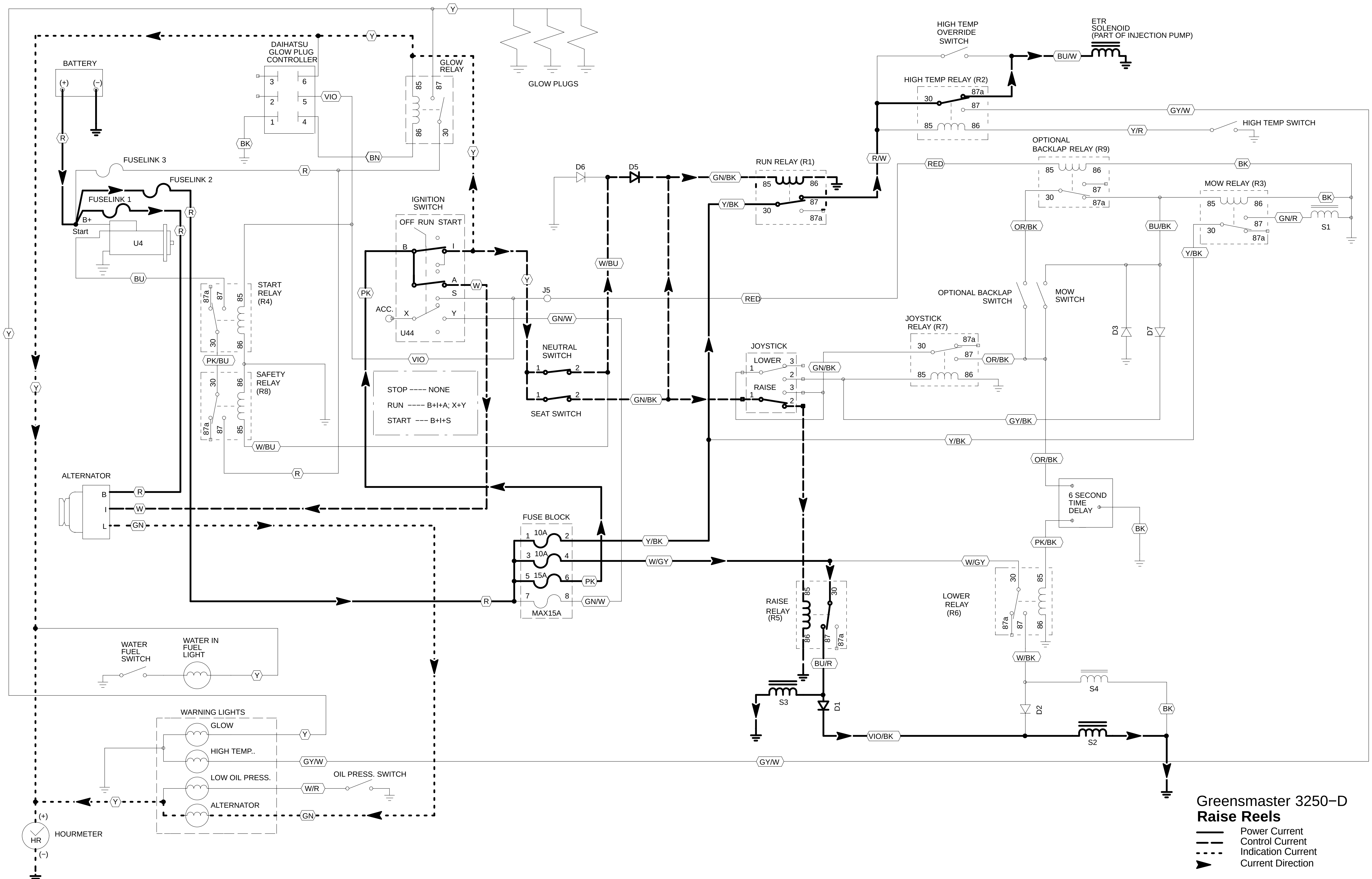
Run

Power Current

Control Current

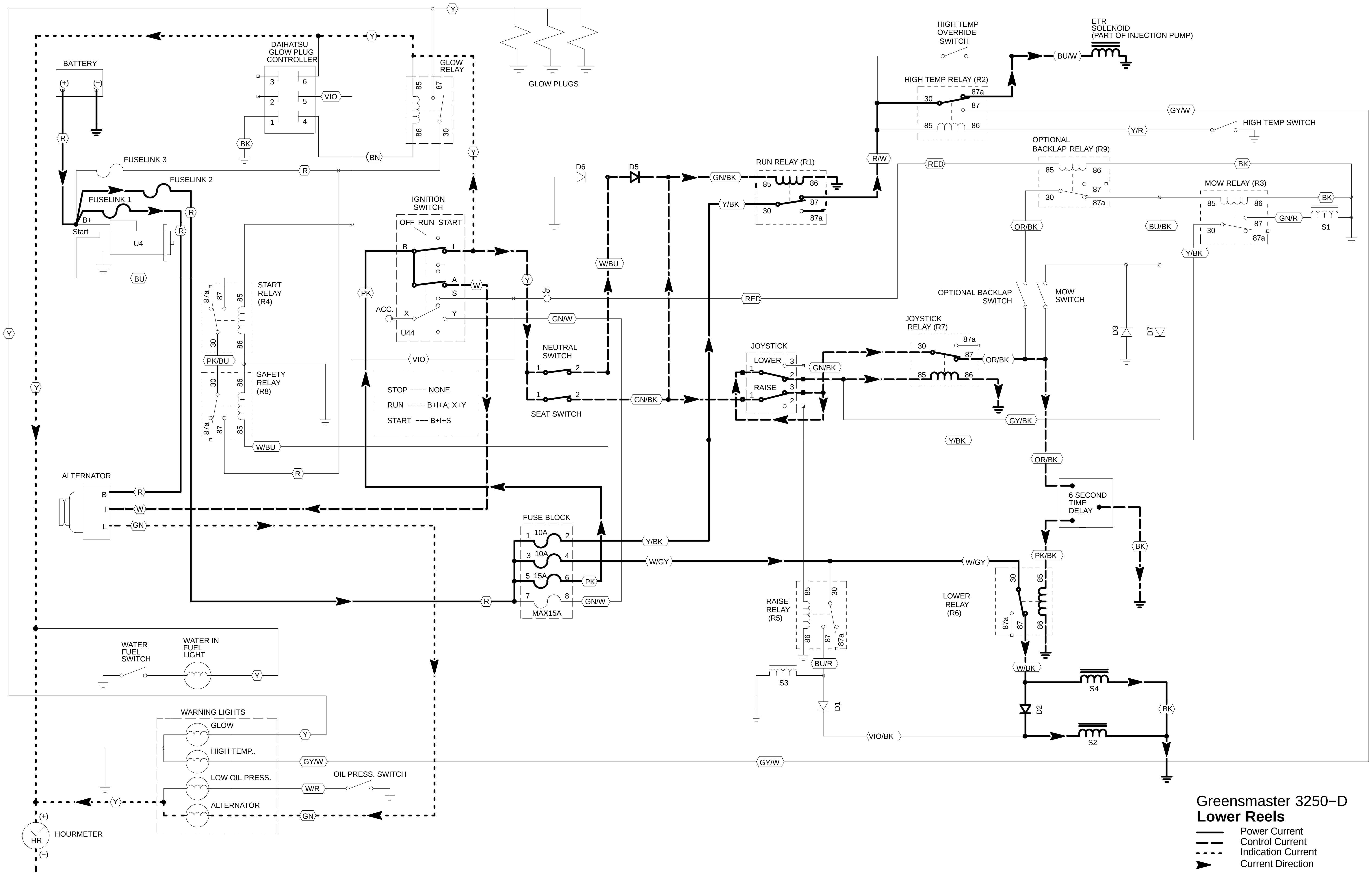
Indication Current

Current Direction



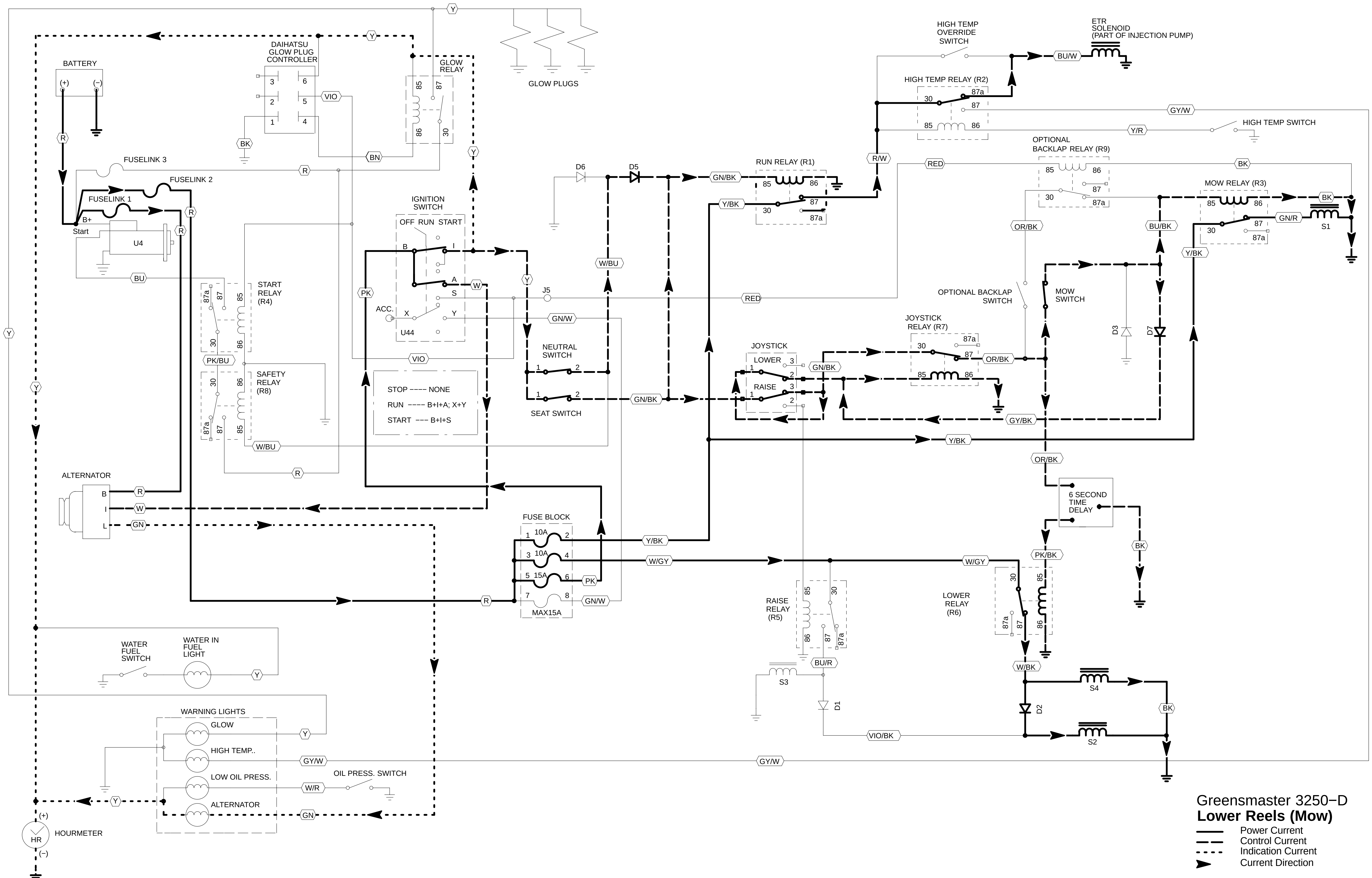
Greensmaster 3250−D
Raise Reels

Power Current
Control Current
Indication Current
Current Direction



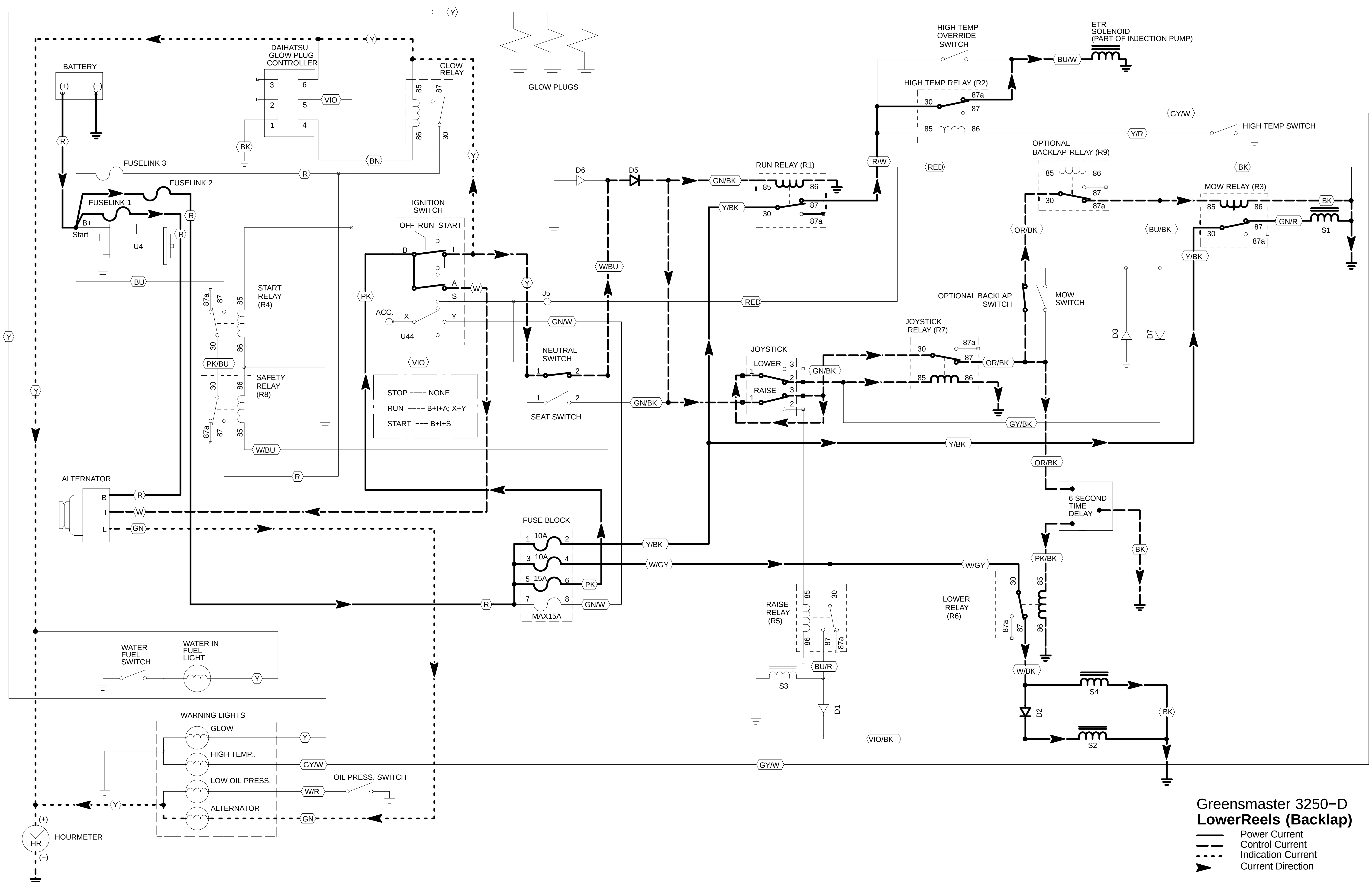
Greensmaster 3250−D
Lower Reels

Power Current
Control Current
Indication Current
Current Direction



Greensmaster 3250−D
Lower Reels (Mow)

Power Current
Control Current
Indication Current
Current Direction



Greensmaster 3250−D
LowerReels (Backlap)

Power Current
Control Current
Indication Current
Current Direction

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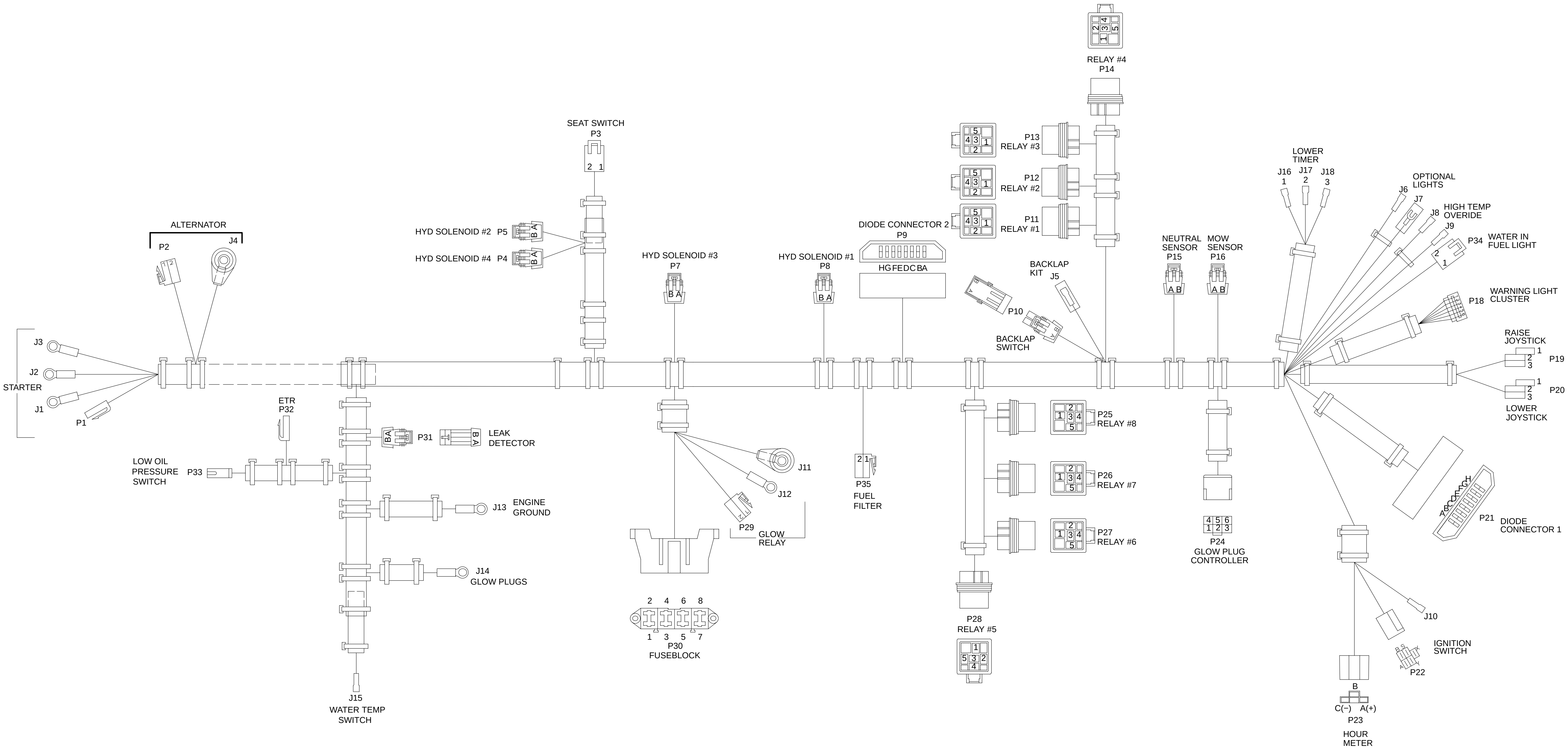
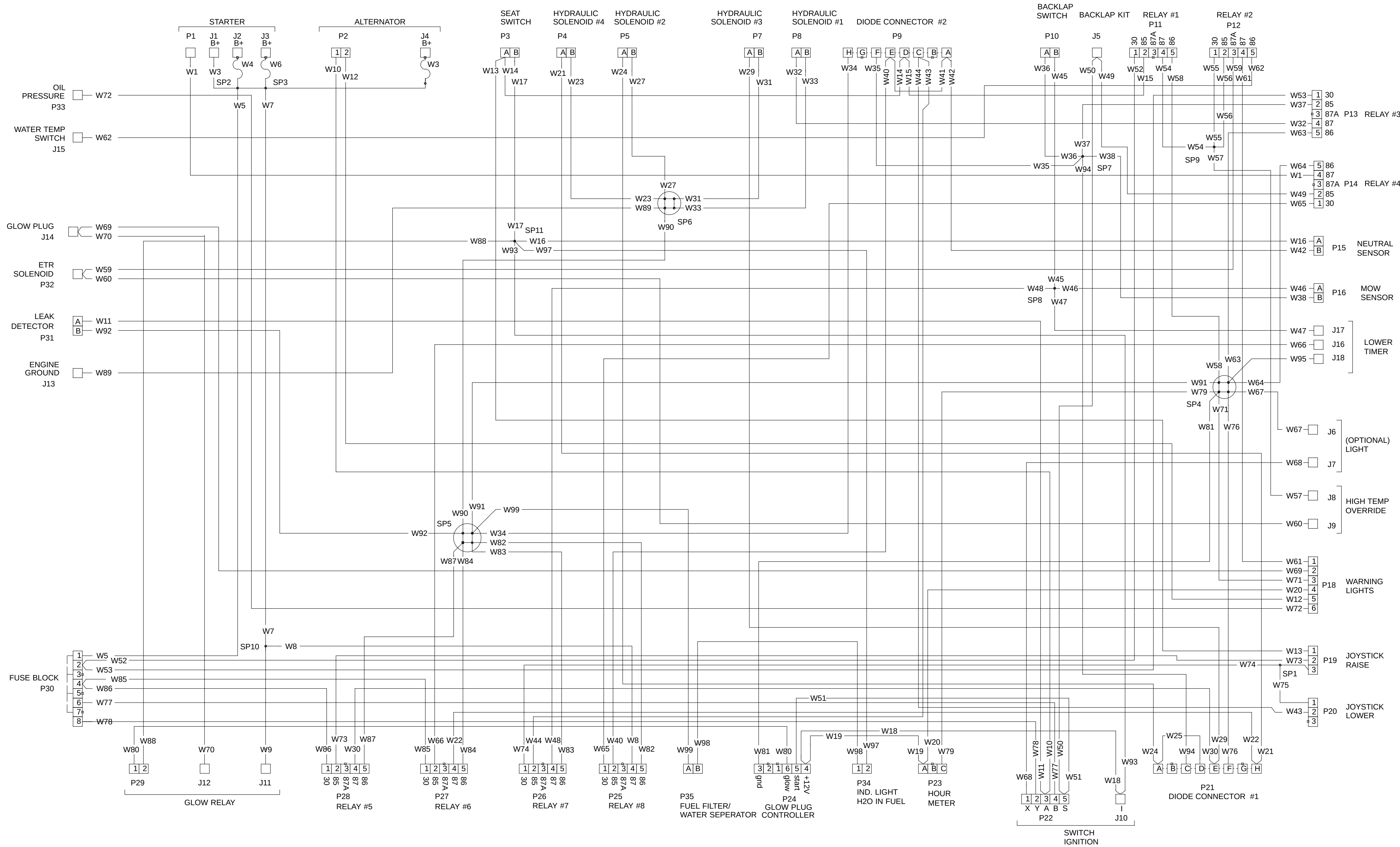


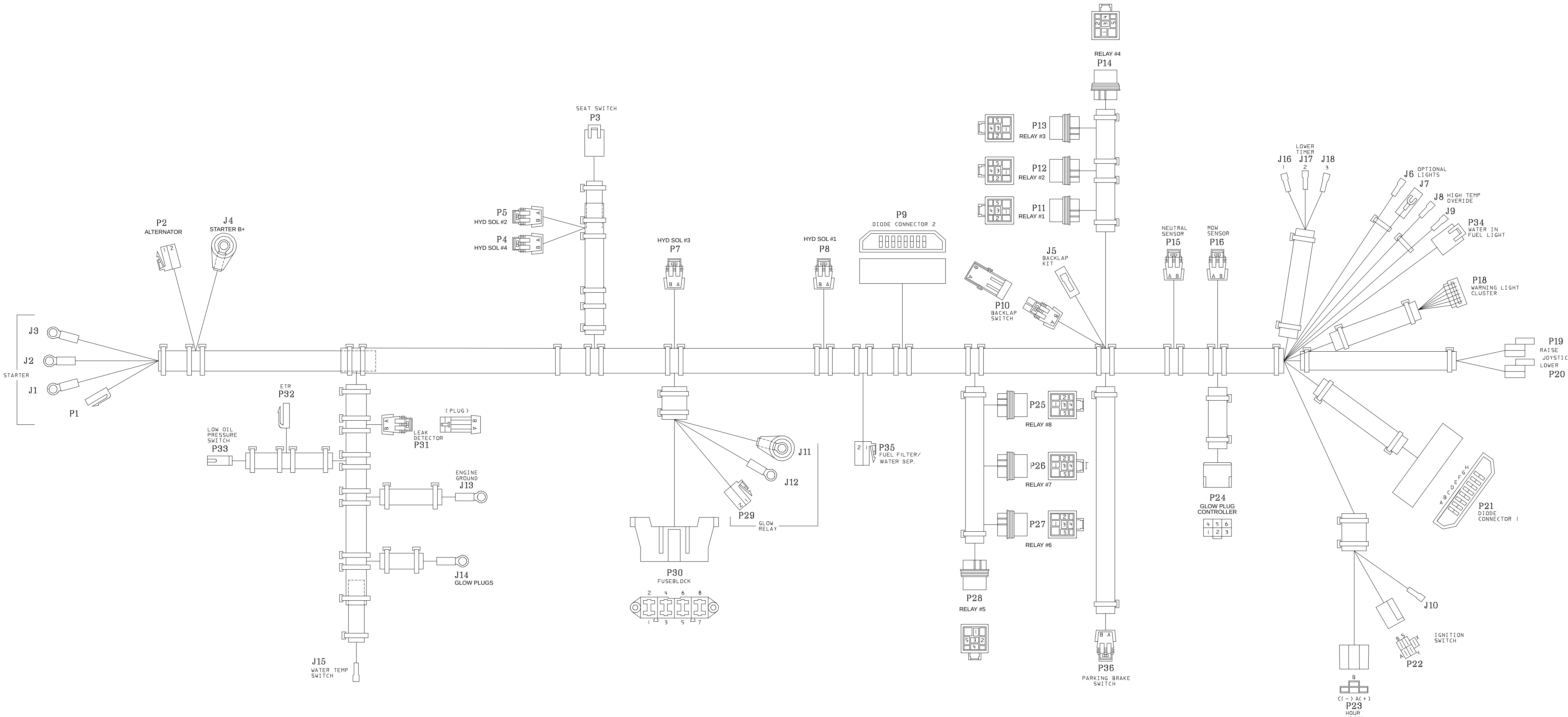
Greensmaster 3250−D
(Serial Number Below 210000000)
Electrical Harness Drawing



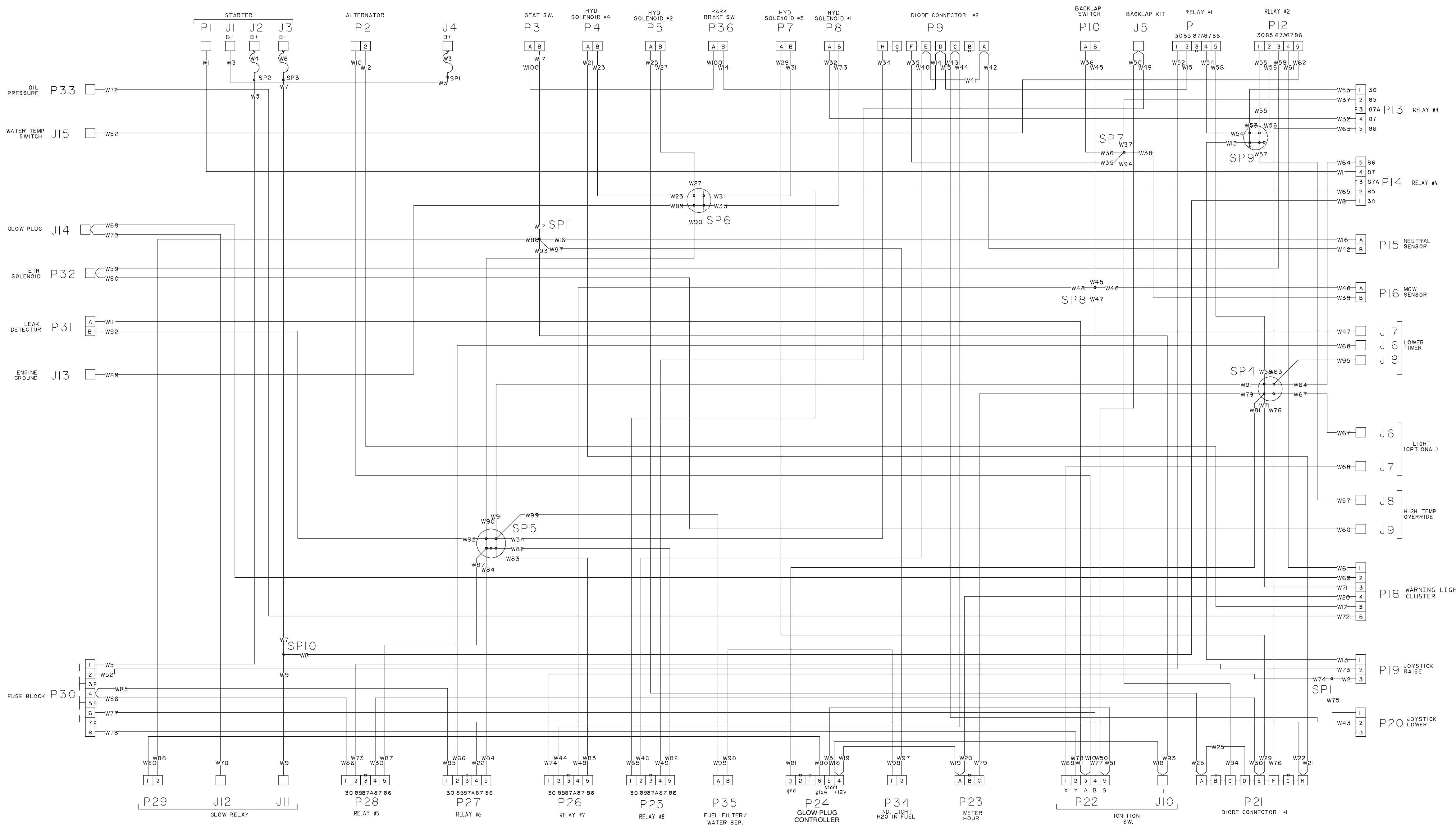
WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1	P14-4
W2	GRN/BLK	SP1	P19-3
W3	FUSIBLE LINK	J1	J4
W4	FUSIBLE LINK	SP2	J2
W5	RED	SP2(W4)	P30-1
W6	FUSIBLE LINK	J3	SP3(W7)
W7	RED	SP3(W6)	SP10(3)
W8	RED	P25-4	SP10(3)
W9	RED	SP10(3)	J11
W10	WHITE	P2-1	P22-3(2)
W11	WHITE	P31-A	P22-3
W12	GREEN	P2-2	P18-5
W13	GRN/BLK	P3-1(2)	P19-1
W14	GRN/BLK	P3-1	P9-D
W15	GRN/BLK	P9-D(2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4(2)	J10(2)
W19	YELLOW	P24-4(2)	P23-A
W20	YELLOW	P23-A(2)	P18-4
W21	WHT/BLK	P4-A	P21-H(2)
W22	WHT/BLK	P27-4	P21-H(2)
W23	BLACK	P4-B	SP6(6)
W24	VIO/BLK	P5-A	P21-A(2)
W25	VIO/BLK	P21-A(2)	P21-D(2)
W27	BLACK	P5-B	SP6(6)
W29	BLU/RED	P7-A	P21-E(2)
W30	BLU/RED	P28-4	P21-E(2)
W31	BLACK	SP6(6)	P7-B
W32	GRN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(6)
W34	BLACK	P9-H	SP5(9)
W35	BLU/BLK	P9-F	SP7(5)
W36	BLU/BLK	P10-A	SP7(5)
W37	BLU/BLK	P13-2	SP7(5)
W38	BLU/BLK	P16-B	SP7(5)
W40	WHT/BLU	P25-2	P9-E(2)
W41	WHT/BLU	P9-E(2)	P9-A(2)
W42	WHT/BLU	P9-A(2)	P15-B
W43	GRY/BLK	P9-C(2)	P20-2
W44	GRY/BLK	P26-2	P9-C(2)
W45	ORG/BLK	P10-B	SP8(4)
W46	ORG/BLK	P16-A	SP8(4)
W47	ORG/BLK	J17	SP8(4)
W48	ORG/BLK	P26-4	SP8(4)
W49	VIOLET	P14-5	J5(2)
W50	VIOLET	P22-5	J5(2)
W51	VIOLET	P24-5	P22-5(2)
W52	YEL/BLK	P30-2(2)	P11-1
W53	YEL/BLK	P30-2	P13-1
W54	RED/WHT	P11-4	SP9(4)
W55	RED/WHT	P12-1	SP9(4)
W56	RED/WHT	P12-2	SP9(4)
W57	RED/WHT	J8	SP9(4)
W58	BLACK	P11-5	SP4(10)
W59	BLU/WHT	P32(2)	P12-3
W60	BLU/WHT	P32(2)	J9
W61	GRY/WHT	P12-4	P18-1
W62	YEL/RED	J15	P12-5
W63	BLACK	P13-5	SP4(10)
W64	BLACK	P14-2	SP4(10)
W65	PNK/BLU	P25-1	P14-1
W66	PNK/BLK	P27-2	J16
W67	BLACK	SP4(10)	J6
W68	GRY/BLK	P22-1	J7
W69	ORANGE	J14(2)	P18-2
W70	ORANGE	J14	J12
W71	BLACK	P18-3	SP4(10)
W72	WHT/RED	P33	P18-6
W73	GRN/GRY	P28-2	P19-2
W74	GRN/BLK	P26-1	SP1
W75	GRN/BLK	P19-3(2)	SP1
W76	BLACK	P21-F	SP4(10)
W77	PINK	P30-6	P22-4
W78	GRN/WHT	P30-8	P22-2
W79	BLACK	P23-C	SP4(10)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(10)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHT/GRY	P30-4(2)	P27-1
W86	WHT/GRY	P30-4	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(6)
W90	BLACK	SP5(9)	SP6(6)
W91	BLACK	SP4(10)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLU/BLK	P21-C	SP7(5)
W95	BLACK	SP4(10)	J18
W96	BLACK	SP5(9)	SP6(7)
W97	YELLOW	SP11(5)	P34-2
W98	GREEN	P34-1	P35-2
W99	BLACK	SP5(9)	P35-1

Greensmaster 3250–D
(Serial Number Below 210000000)
Wiring Diagram



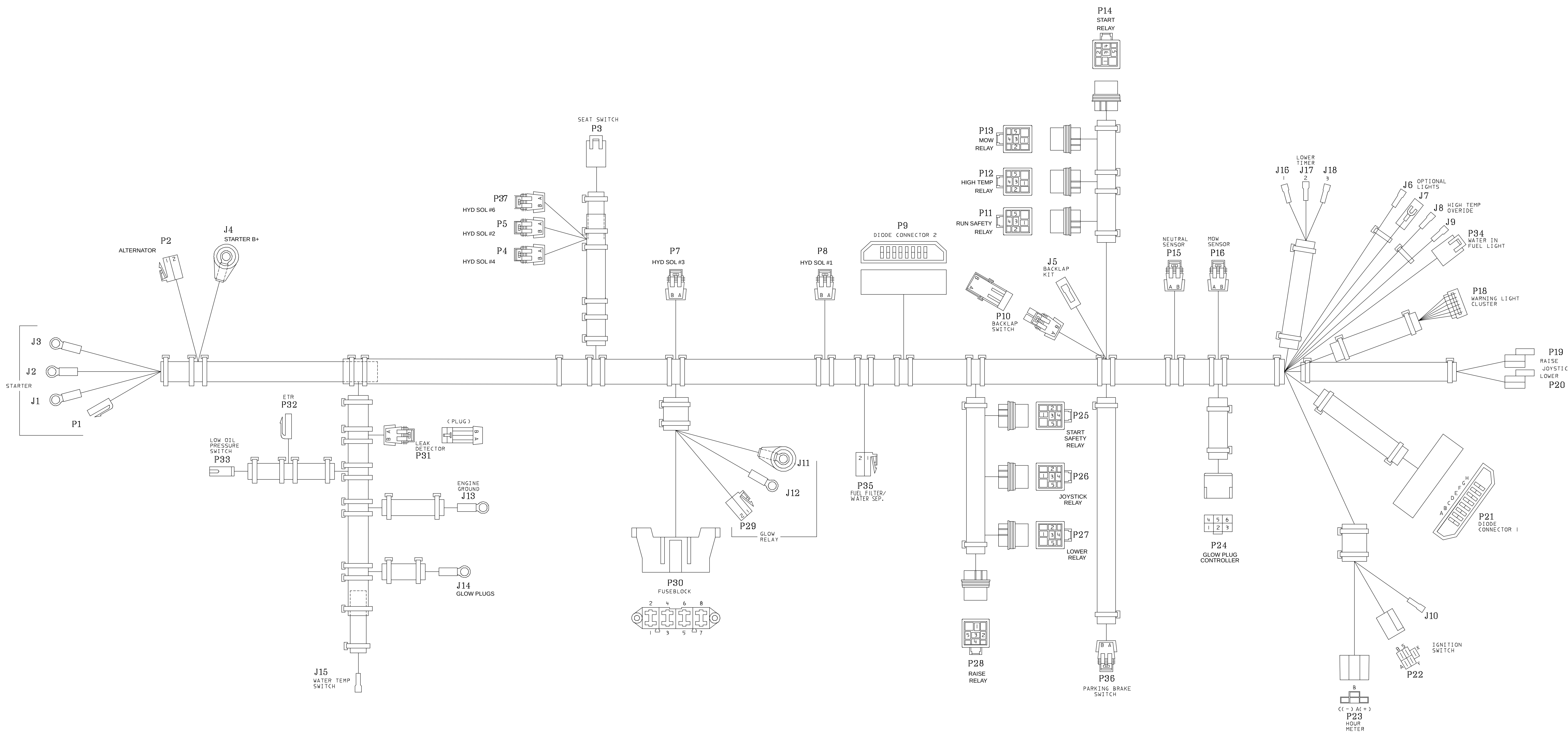
Greensmaster 3250−D
(Serial Number Between 210000000 and 230000600)
Electrical Harness Drawing



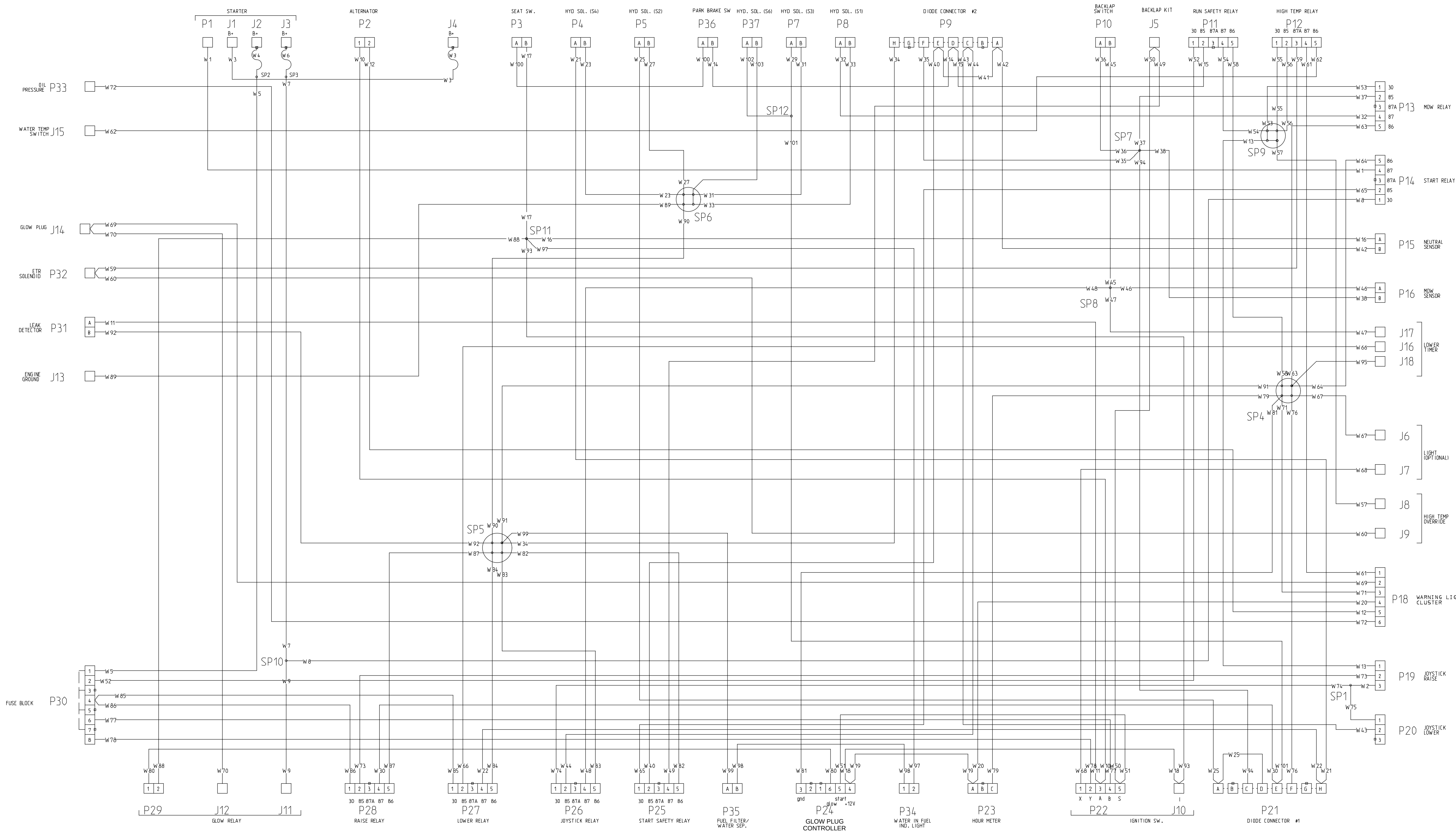
WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1	P14-4
W2	GRN/BLK	SP1	P19-3
W3	FUSIBLE LINK	J1	J4
W4	FUSIBLE LINK	SP2	J2
W5	RED	SP2(W4)	P30-1
W6	FUSIBLE LINK	J3	SP3(W7)
W7	RED	SP3(W6)	SP10(3)
W8	RED	P14-1	SP10(3)
W9	RED	SP10(3)	J11
W10	WHITE	P2-1	P22-3(2)
W11	ORANGE	P31-A	P22-3
W12	GREEN	P2-2	P18-5
W13	RED/WHT	SP9(6)	P19-1
W14	LT GRN/BLK	P36-B	P9-D(2)
W15	GRN/BLK	P9-D(2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4(2)	J10(2)
W19	YELLOW	P24-4(2)	P23-A
W20	YELLOW	P23-A(2)	P18-4
W22	WHT/BLK	P27-4	P21-H(2)
W23	BLACK	P4-B	SP6(6)
W24	VIO/BLK	P5-A	P21-A(2)
W25	VIO/BLK	P21-A(2)	P21-D(2)
W27	BLACK	P5-B	SP6(6)
W29	BLU/RED	P7-A	P21-E(2)
W30	BLU/RED	P28-4	P21-E(2)
W31	BLACK	SP6(6)	P7-B
W32	GRN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(6)
W34	BLACK	P9-H	SP5(9)
W35	BLU/BLK	P9-F	SP7(5)
W36	BLU/BLK	P10-A	SP7(5)
W37	BLU/BLK	P13-2	SP7(5)
W38	BLU/BLK	P16-B	SP7(5)
W40	WHT/BLU	P25-2	P9-E(2)
W41	WHT/BLU	P9-E(2)	P9-A(2)
W42	WHT/BLU	P9-A(2)	P15-B
W43	GRY/BLK	P9-C(2)	P20-2
W44	GRY/BLK	P26-2	P9-C(2)
W45	ORG/BLK	P10-B	SP8(4)
W46	ORG/BLK	P16-A	SP8(4)
W47	ORG/BLK	J17	SP8(4)
W48	ORG/BLK	P26-4	SP8(4)
W49	VIOLET	P25-4	J5(2)
W50	VIOLET	P22-5	J5(2)
W51	VIOLET	P24-5	P22-5(2)
W52	YEL/BLK	P30-2(2)	P11-1
W53	RED/WHT	SP9(6)	P13-1
W54	RED/WHT	P11-4	SP9(6)
W55	RED/WHT	P12-1	SP9(6)
W56	RED/WHT	P12-2	SP9(6)
W57	RED/WHT	J8	SP9(6)
W58	BLACK	P11-5	SP4(10)
W59	BLU/WHT	P32(2)	P12-3
W60	BLU/WHT	P32(2)	J9
W61	GRY/WHT	P12-4	P18-1
W62	YEL/RED	J15	P12-5
W63	BLACK	P13-5	SP4(10)
W64	BLACK	P14-2	SP4(10)
W65	PNK/BLU	P25-1	P14-2
W66	PNK/BLK	P27-2	J16
W67	BLACK	SP4(10)	J6
W68	GRY/BLK	P22-1	J7
W69	ORANGE	J14(2)	P18-2
W70	ORANGE	J14	J12
W71	BLACK	P18-3	SP4(10)
W72	WHT/RED	P33	P18-6
W73	GRN/GRY	P28-2	P19-2
W74	GRN/BLK	P26-1	SP1
W75	GRN/BLK	P20-1	SP1
W76	BLACK	P21-F	SP4(10)
W77	PINK	P30-6	P22-4
W78	GRN/WHT	P30-8	P22-2
W79	BLACK	P23-C	SP4(10)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(10)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHT/GRY	P30-4(2)	P27-1
W86	WHT/GRY	P30-4	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(6)
W90	BLACK	SP5(9)	SP6(6)
W91	BLACK	SP4(10)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLU/BLK	P21-C	SP7(5)
W95	BLACK	SP4(10)	J18
W97	YELLOW	SP11(5)	P34-2
W98	GREEN	P34-1	P35-2
W99	BLACK	SP5(9)	P35-1
W100	WHT	P3-A	P36-A

Greensmaster 3250−D
(Serial Number Between 210000000 and 230000600)
Wiring Diagram



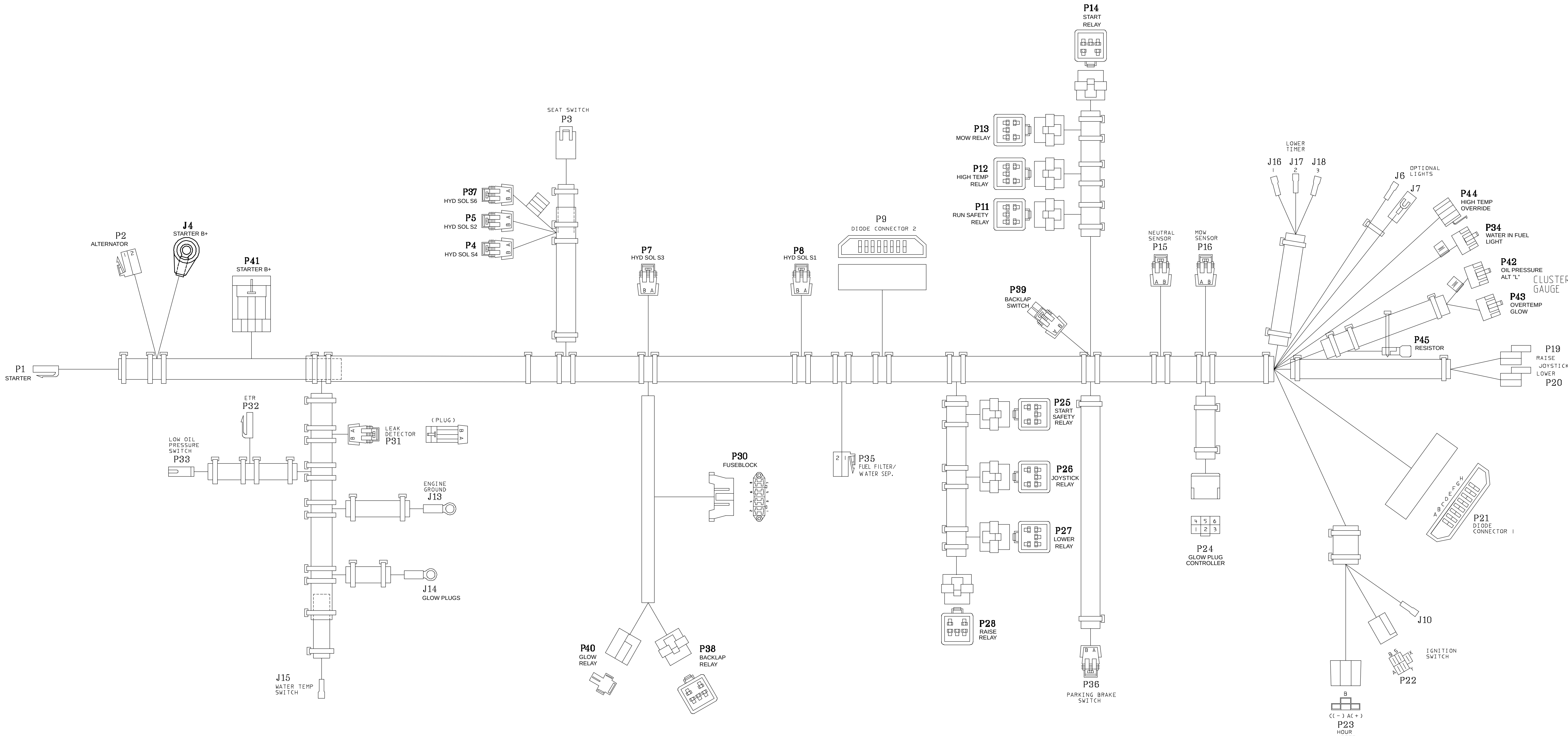
Greensmaster 3250−D
(Serial Number Between 230000600 and 240999999)
Electrical Harness Drawing



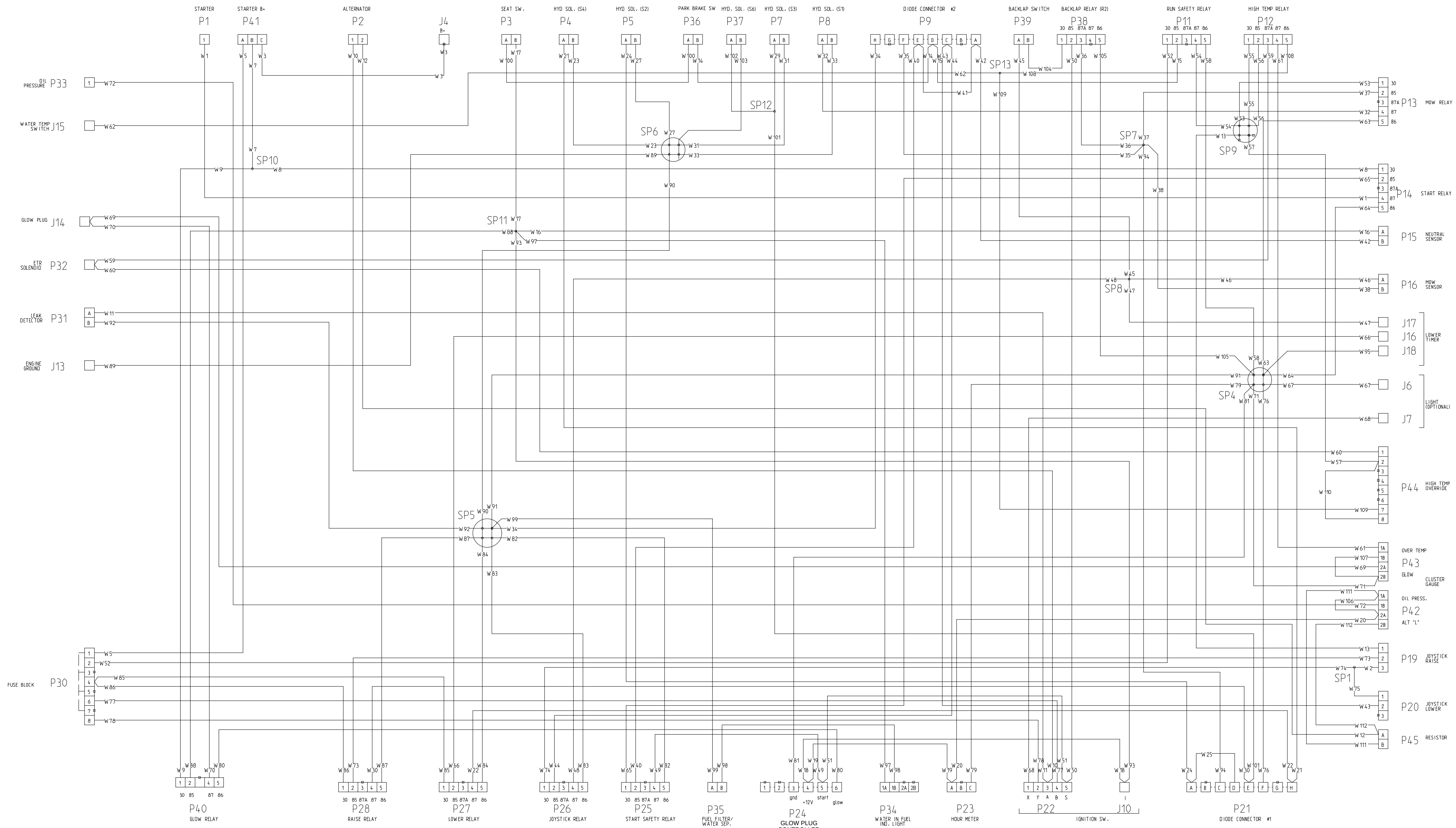
WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1	P14-4
W2	GRN/BLK	SP1	P19-3
W3	FUSIBLE LINK	J1	J4
W4	FUSIBLE LINK	SP2	J2
W5	RED	SP2(W4)	P30-1
W6	FUSIBLE LINK	J3	SP3(W7)
W7	RED	SP3(W6)	SP10(3)
W8	RED	P14-1	SP10(3)
W9	RED	SP10(3)	J11
W10	WHITE	P2-1	P22-3(2)
W11	ORANGE	P31-A	P22-3
W12	GREEN	P2-2	P18-5
W13	RED/WHT	SP9(6)	P19-1
W14	LT GRN/BLK	P36-B	P9-D(2)
W15	GRN/BLK	P9-D(2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4(2)	J10(2)
W19	YELLOW	P24-4(2)	P23-A
W20	YELLOW	P23-A(2)	P18-4
W22	WHT/BLK	P27-4	P21-H(2)
W23	BLACK	P4-B	SP6(6)
W24	VIO/BLK	P5-A	P21-A(2)
W25	VIO/BLK	P21-A(2)	P21-D(2)
W27	BLACK	P5-B	SP6(6)
W29	BLU/RED	P7-A	SP12(3)
W30	BLU/RED	P28-4	P21-E(2)
W31	BLACK	SP6(6)	P7-B
W32	GRN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(6)
W34	BLACK	P9-H	SP5(9)
W35	BLU/BLK	P9-F	SP7(5)
W36	BLU/BLK	P10-A	SP7(5)
W37	BLU/BLK	P13-2	SP7(5)
W38	BLU/BLK	P16-B	SP7(5)
W40	WHT/BLU	P25-2	P9-E(2)
W41	WHT/BLU	P9-E(2)	P9-A(2)
W42	WHT/BLU	P9-A(2)	P15-B
W43	GRY/BLK	P9-C(2)	P20-2
W44	GRY/BLK	P26-2	P9-C(2)
W45	ORG/BLK	P10-B	SP8(4)
W46	ORG/BLK	P16-A	SP8(4)
W47	ORG/BLK	J17	SP8(4)
W48	ORG/BLK	P26-4	SP8(4)
W49	VIOLET	P25-4	J5(2)
W50	VIOLET	P22-5	J5(2)
W51	VIOLET	P24-5	P22-5(2)
W52	YEL/BLK	P30-2(2)	P11-1
W53	RED/WHT	SP9(6)	P13-1
W54	RED/WHT	P11-4	SP9(6)
W55	RED/WHT	P12-1	SP9(6)
W56	RED/WHT	P12-2	SP9(6)
W57	RED/WHT	J8	SP9(6)
W58	BLACK	P11-5	SP4(10)
W59	BLU/WHT	P32(2)	P12-3
W60	BLU/WHT	P32(2)	J9
W61	GRY/WHT	P12-4	P18-1
W62	YEL/RED	J15	P12-5
W63	BLACK	P13-5	SP4(10)
W64	BLACK	P14-2	SP4(10)
W65	PNK/BLU	P25-1	P14-2
W66	PNK/BLK	P27-2	J16
W67	BLACK	SP4(10)	J6
W68	GRY/BLK	P22-1	J7
W69	ORANGE	J14(2)	P18-2
W70	ORANGE	J14	J12
W71	BLACK	P18-3	SP4(10)
W72	WHT/RED	P33	P18-6
W73	GRN/GRY	P28-2	P19-2
W74	GRN/BLK	P26-1	SP1
W75	GRN/BLK	P20-1	SP1
W76	BLACK	P21-F	SP4(10)
W77	PINK	P30-6	P22-4
W78	GRN/WHT	P30-8	P22-2
W79	BLACK	P23-C	SP4(10)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(10)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHT/GRY	P30-4(2)	P27-1
W86	WHT/GRY	P30-4	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(6)
W90	BLACK	SP5(9)	SP6(6)
W91	BLACK	SP4(10)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLU/BLK	P21-C	SP7(5)
W95	BLACK	SP4(10)	J18
W97	YELLOW	SP11(5)	P34-2
W98	GREEN	P34-1	P35-2
W99	BLACK	SP5(9)	P35-1
W100	WHT	P3-A	P36-A
W101	BLU/RED	SP12(3)	P21-E(2)
W102	BLU/RED	SP12(3)	P37-A
W103	BLK	SP6	P37-B

Greensmaster 3250–D
(Serial Number Between 230000600 and 240999999)
Wiring Diagram

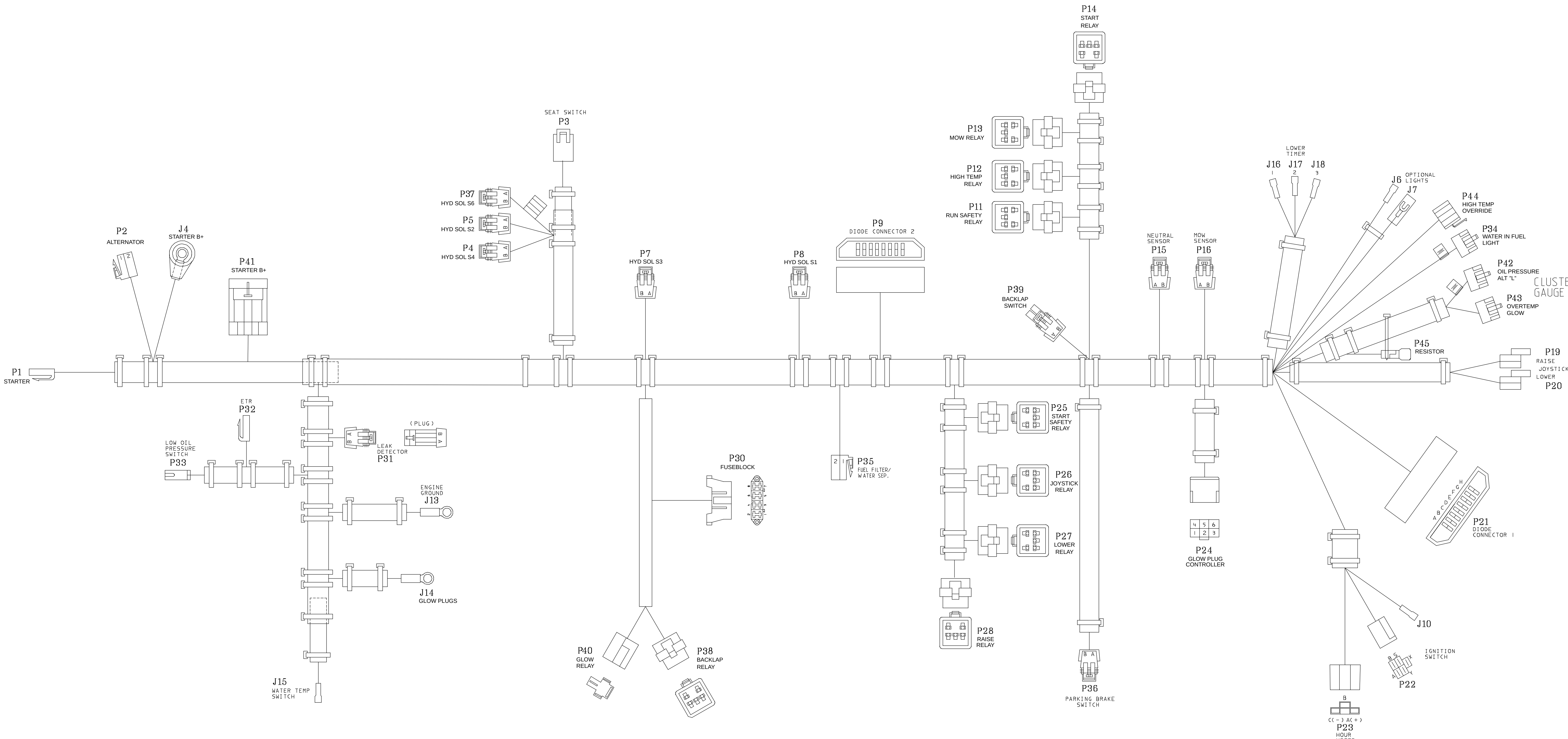


Greensmaster 3250−D
(Serial Number Between 250000000 and 250999999)
Electrical Harness Drawing

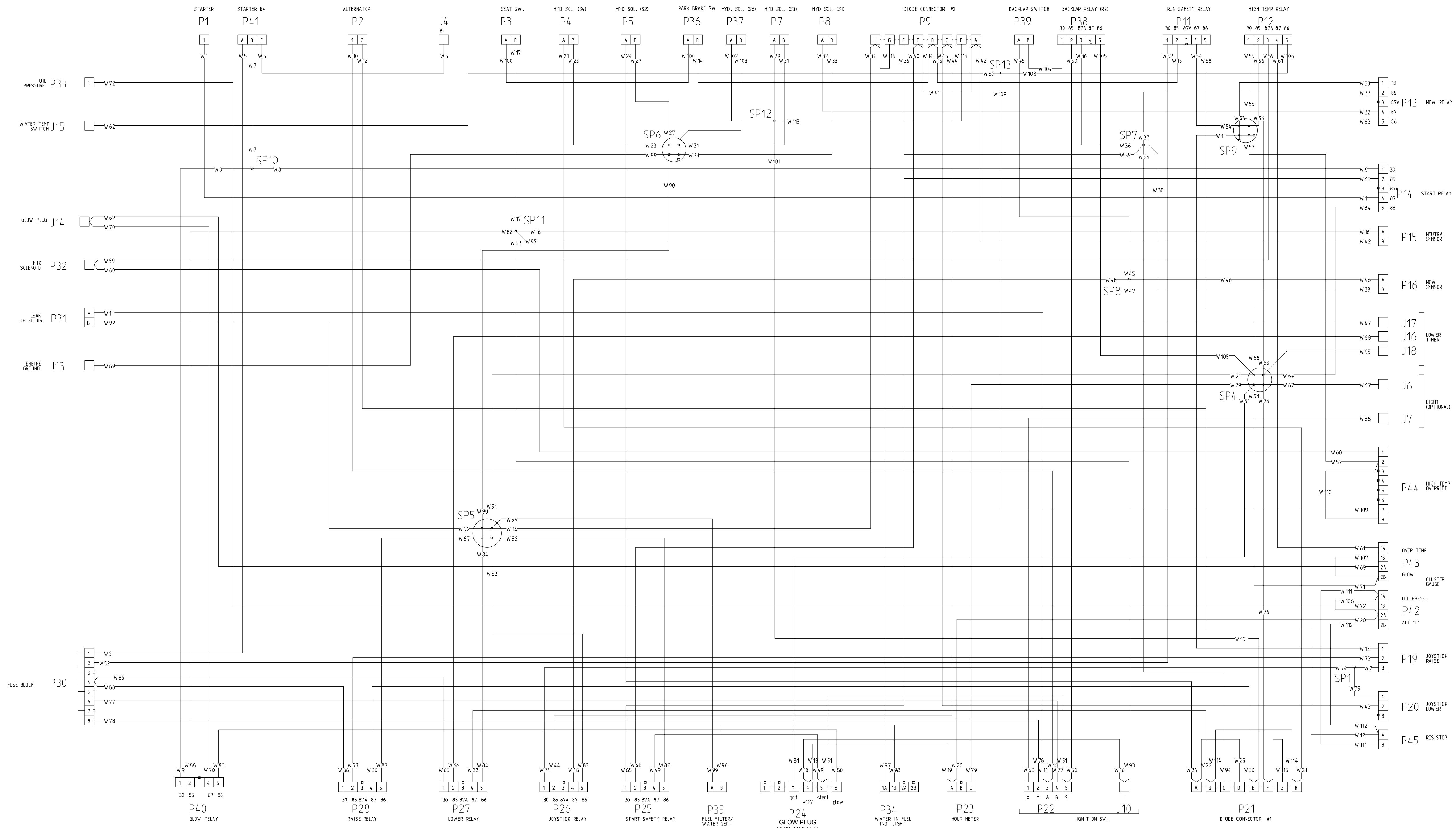


WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1-1	P14-4
W2	GREEN/BLACK	SP1	P19-3
W3	RED	P41-C	J4
W4	NOT USED		
W5	RED	P41-A	P30-1
W6	NOT USED		
W7	RED	P41-B	SP10(3)
W8	RED	P14-1	SP10(3)
W9	RED	SP10(3)	P14-1
W10	WHITE	P2-1	P22-3(2)
W11	ORANGE	P31-A	P22-3
W12	GREEN	P2-2	P45-A (2)
W13	RED/WHITE	SP9 (6)	P19-1
W14	GREEN/BLACK	P36-B	P9-D (2)
W15	GREEN/BLACK	P9-D (2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4 (2)	J10(2)
W19	YELLOW	P24-4 (2)	P23-A
W20	YELLOW	P23-A(2)	P42-2A (2)
W21	WHITE/BLACK	P21-H(2)	P4-A
W22	WHITE/BLACK	P27-4	P21-H(2)
W23	BLACK	P4-B	SP6(7)
W24	VIOLET/BLACK	P5-A	P21-A(2)
W25	VIOLET/BLACK	P21-A(2)	P21-D(2)
W26	NOT USED		
W27	BLACK	P5-B	SP6(7)
W28	NOT USED		
W29	BLUEE/RED	P7-A	SP12 (3)
W30	BLUEE/RED	P28-4	P21-E(2)
W31	BLACK	SP6(7)	P7-B
W32	GREEN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(7)
W34	BLACK	P9-H	SP5(9)
W35	BLUE/BLACK	P9-F	SP7(5)
W36	BLUE/BLACK	P38-3	SP7(5)
W37	BLUE/BLACK	P13-2	SP7(5)
W38	BLUE/BLACK	P16-B	SP7(5)
W39	NOT USED		
W40	WHITE/BLUE	P25-2	P9-E(2)
W41	WHITE/BLUE	P9-E(2)	P9-A(2)
W42	WHITE/BLUE	P9-A(2)	P15-B
W43	GRAY/BLACK	P9-C (2)	P20-2
W44	GRAY/BLACK	P26-2	P9-C (2)
W45	ORANGE/BLACK	P39-A	SP8(4)
W46	ORANGE/BLACK	P16-A	SP8(4)
W47	ORANGE/BLACK	J17	SP8(4)
W48	ORANGE/BLACK	P26-4	SP8(4)
W49	VIOLET	P25-4	P24-5(2)
W50	VIOLET	P22-5	P38-2
W51	VIOLET	P24-5(2)	P22-5(2)
W52	YEL/BLACK	P30-2(2)	P11-1
W53	RED/WHITE	SP9 (6)	P13-1
W54	RED/WHITE	P11-4	SP9(4)
W55	RED/WHITE	P12-1	SP9(4)
W56	RED/WHITE	P12-2	SP9(4)
W57	RED/WHITE	P44-2 (2)	SP9(4)
W58	BLACK	P11-5	SP4(11)
W59	BLUE/WHITE	P32(2)	P12-3
W60	BLUE/WHITE	P32(2)	P44-1
W61	GRAY/WHITE	P12-4	P43-1A
W62	YELLOW/RED	J15	SP13
W63	BLACK	P13-5	SP4(11)
W64	BLACK	P14-5	SP4(11)
W65	PINK/BLUE	P25-1	P14-2
W66	PINK/BLACK	P27-2	J16
W67	BLACK	SP4(11)	J6
W68	GRAY/BLACK	P22-1	J7
W69	ORANGE	J14(2)	P43-2A
W70	ORANGE	J14	J12
W71	BLACK	P43-2B (2)	SP4(11)
W72	WHITE/RED	P33	P42-1B
W73	GRN/GRAY	P28-2	P19-2
W74	GREEN/BLACK	P26-1	SP1
W75	GREEN/BLACK	P20-1	SP1
W76	BLACK	P21-F	SP4(11)
W77	PINK	P30-6	P22-4
W78	GRN/WHITE	P30-8	P22-2
W79	BLACK	P23-C	SP4(11)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(11)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHITE/GRAY	P30-4 (2)	P27-1
W86	WHITE/GRAY	P30-4 (2)	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(7)
W90	BLACK	SP5(9)	SP6(7)
W91	BLACK	SP4(11)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLUE/BLACK	P21-C	SP7(5)
W95	BLACK	SP4(11)	J18
W96	NOT USED		
W97	YELLOW	SP11(5)	P34-1A
W98	GREEN	P34-1B	P35-2
W99	BLACK	SP5(9)	P35-1
W100	WHITE	P3-A	P36-A
W101	BLUEE/RED	SP12 (3)	P21-E (2)
W102	BLUEE/RED	SP12 (3)	P37-A
W103	BLACK	SP6(7)	P37-B
W104	GRAY	P39-B	P38-1
W105	BLACK	P38-5	SP4(11)
W106	YELLOW	P42-1A (2)	P42-2A (2)
W107	BLACK	P43-1B	P43-2B
W108	YELLOW/RED	SP13	P12-5
W109	YELLOW/RED	SP13	P44-7
W110	RED/WHITE	P44-2 (2)	P44-8
W111	YELLOW	P45-B	P42-1A (2)
W112	GREEN	P45-A (2)	P42-2B



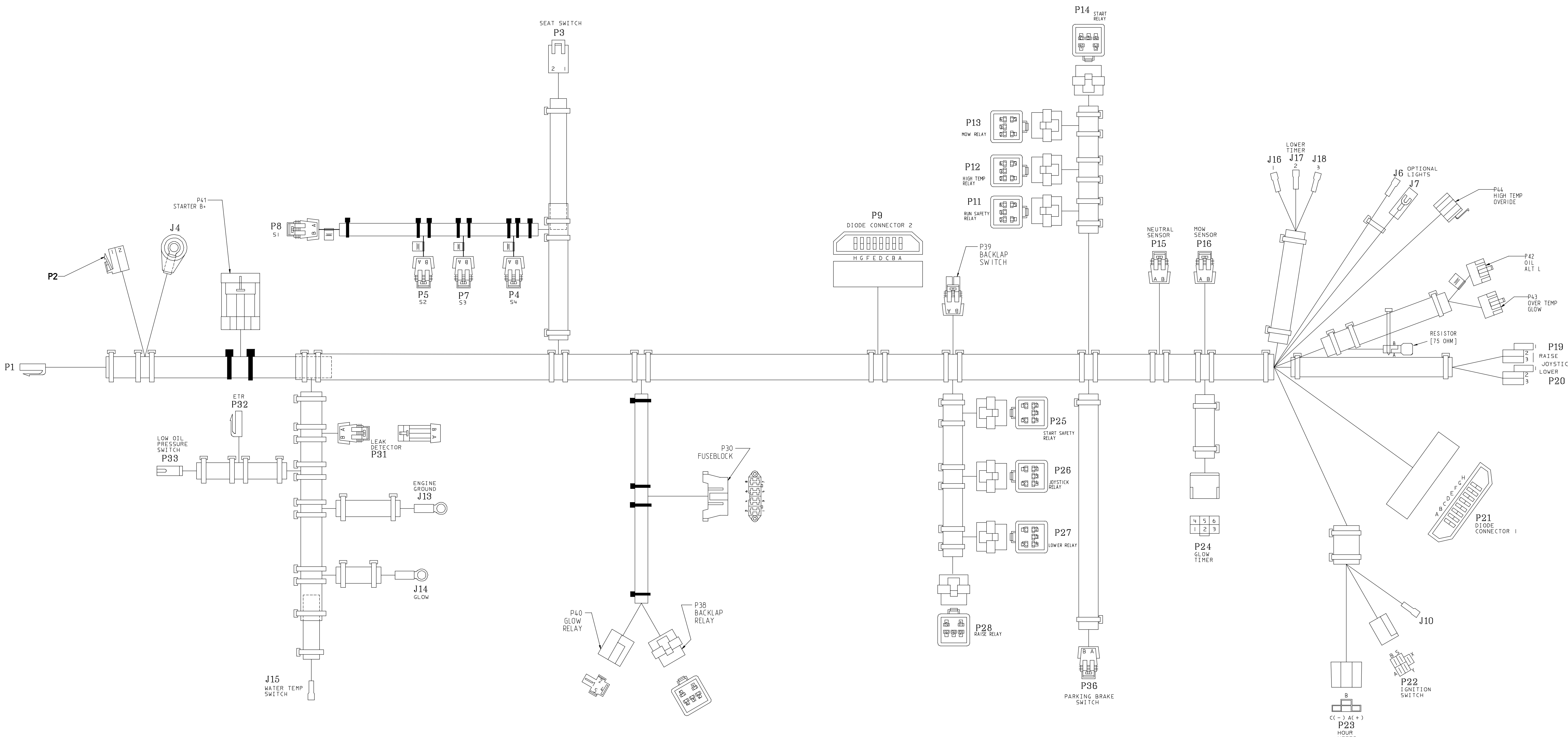
Greensmaster 3250−D
(Serial Number Between 260000001 and 260999999)
Electrical Harness Drawing



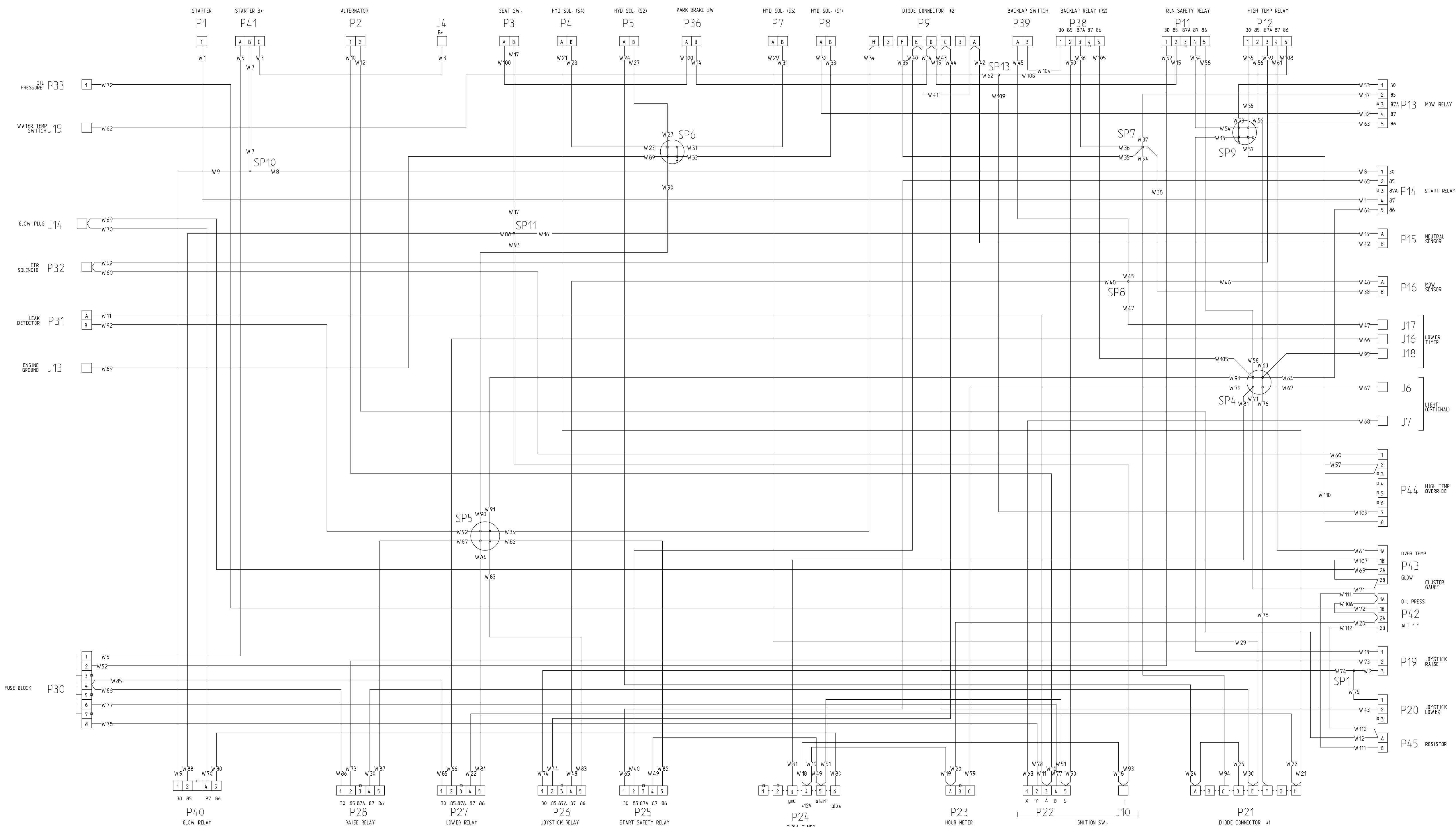
WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1	P14-4
W2	GRN/BLK	SP1	P19-3
W3	RED	P41-C	J4
W4	NOT USED		
W5	RED	P41-A	P30-1
W6	NOT USED		
W7	RED	P41-B	SP10(3)
W8	RED	P14-1	SP10(3)
W9	RED	SP10(3)	P14-1
W10	WHITE	P2-1	P22-3(2)
W11	WHITE	P31-A	P22-3
W12	GREEN	P2-2	P45-A (2)
W13	RED/WHITE	SP9 (6)	P19-1
W14	GREEN/BLACK	P36-B	P9-D (2)
W15	GREEN/BLACK	P9-D (2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4 (2)	J10(2)
W19	YELLOW	P24-4 (2)	P23-A
W20	YELLOW	P23-A(2)	P42-2A (2)
W21	WHITE/BLACK	P21-H (2)	P4-A
W22	WHITE/BLACK	P27-4	P21-B (2)
W23	BLACK	P4-B	SP6(7)
W24	VIOLET/BLACK	P5-A	P21-A(2)
W25	VIOLET/BLACK	P21-A(2)	P21-D(2)
W26	NOT USED		
W27	BLACK	P5-B	SP6(7)
W28	NOT USED		
W29	BLUE/RED	P7-A	SP12 (4)
W30	BLUE/RED	P28-4	P21-E(2)
W31	BLACK	SP6(7)	P7-B
W32	GREEN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(7)
W34	BLACK	P9-H (2)	SP5(9)
W35	BLUE/BLACK	P9-F	SP7(5)
W36	BLUE/BLACK	P38-3	SP7(5)
W37	BLUE/BLACK	P13-2	SP7(5)
W38	BLUE/BLACK	P16-B	SP7(5)
W39	NOT USED		
W40	WHITE/BLUE	P25-2	P9-E(2)
W41	WHITE/BLUE	P9-E(2)	P9-A(2)
W42	WHITE/BLUE	P9-A(2)	P15-B
W43	GRAY/BLACK	P9-C (2)	P20-2
W44	GRAY/BLACK	P26-2	P9-C (2)
W45	ORANGE/BLACK	P39-A	SP8(4)
W46	ORANGE/BLACK	P16-A	SP8(4)
W47	ORANGE/BLACK	J17	SP8(4)
W48	ORANGE/BLACK	P26-4	SP8(4)
W49	VIOLET	P25-4	P24-5(2)
W50	VIOLET	P22-5	P38-2
W51	VIOLET	P24-5(2)	P22-5(2)
W52	YEL/BLACK	P30-2(2)	P11-1
W53	RED/WHITE	SP9 (6)	P13-1
W54	RED/WHITE	P11-4	SP9(4)
W55	RED/WHITE	P12-1	SP9(4)
W56	RED/WHITE	P12-2	SP9(4)
W57	RED/WHITE	P44-2 (2)	SP9(4)
W58	BLACK	P11-5	SP4(11)
W59	BLUE/WHITE	P32(2)	P12-3
W60	BLUE/WHITE	P32(2)	P44-1
W61	GRAY/WHITE	P12-4	P43-1A
W62	YELLOW/RED	J15	SP13
W63	BLACK	P13-5	SP4(11)
W64	BLACK	P14-5	SP4(11)
W65	PINK/BLUE	P25-1	P14-2
W66	PINK/BLACK	P27-2	J16
W67	BLACK	SP4(11)	J6
W68	GRAY/BLACK	P22-1	J7
W69	ORANGE	J14(2)	P43-2A
W70	ORANGE	J14	J12
W71	BLACK	P43-2B (2)	SP4(11)
W72	WHITE/RED	P33	P42-1B
W73	GRN/GRAY	P28-2	P19-2
W74	GREEN/BLACK	P26-1	SP1
W75	GREEN/BLACK	P20-1	SP1
W76	BLACK	P21-F (2)	SP4(11)
W77	PINK	P30-6	P22-4
W78	GREEN/WHITE	P30-8	P22-2
W79	BLACK	P23-C	SP4(11)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(11)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHITE/GRAY	P30-4 (2)	P27-1
W86	WHITE/GRAY	P30-4 (2)	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(7)
W90	BLACK	SP5(9)	SP6(7)
W91	BLACK	SP4(11)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLUE/BLACK	P21-C	SP7(5)
W95	BLACK	SP4(11)	J18
W96	NOT USED		
W97	YELLOW	SP11(5)	P34-1A
W98	GREEN	P34-1B	P35-2
W99	BLACK	SP5(9)	P35-1
W100	WHITE	P3-A	P36-A
W101	BLUE/RED	SP12 (4)	P21-E (2)
W102	BLUE/RED	SP12 (4)	P37-A
W103	BLACK	SP6(7)	P37-B
W104	GRAY	P39-B	P38-1
W105	BLACK	P38-5	SP4(11)
W106	YELLOW	P42-1A (2)	P42-2A (2)
W107	BLACK	P43-1B	P43-2B
W108	YELLOW/RED	SP13	P12-5
W109	YELLOW/RED	SP13	P44-7
W110	RED/WHITE	P44-2 (2)	P44-8
W111	YELLOW	P45-B	P42-1A (2)
W112	GREEN	P45-A (2)	P42-2B
W113	BLUE/RED	SP12 (4)	P9-B
W114	WHITE/BLACK	P21-B (2)	P21-H (2)
W115	BLACK	P21-F (2)	P21-G
W116	BLACK	P9-H (2)	P9-G

Greensmaster 3250–D
(Serial Number Between 260000001 and 260999999)
Wiring Diagram



Greensmaster 3250−D
(Serial Number Above 270000000)
Electrical Harness Drawing



WIRE LIST

DESIGNATOR	COLOR	ROUTE FROM	TO
W1	RED	P1-1	P14-4
W2	GREEN/BLACK	SP1	P19-3
W3	RED	P41-C	J4
W4	NOT USED		
W5	RED	P41-A	P30-1
W6	NOT USED		
W7	RED	P41-B	SP10(3)
W8	RED	P14-1	SP10(3)
W9	RED	SP10(3)	P14-1
W10	WHITE	P2-1	P22-3(2)
W11	WHITE	P31-A	P22-3
W12	GREEN	P2-2	P45-A (2)
W13	RED/WHITE	SP9 (6)	P19-1
W14	GREEN/BLACK	P36-B	P9-D (2)
W15	GREEN/BLACK	P9-D (2)	P11-2
W16	YELLOW	SP11(5)	P15-A
W17	YELLOW	P3-2	SP11(5)
W18	YELLOW	P24-4 (2)	J10(2)
W19	YELLOW	P24-4 (2)	P23-A
W20	YELLOW	P23-A(2)	P42-2A (2)
W21	WHITE/BLACK	P21-H (2)	P4-A
W22	WHITE/BLACK	P27-4	P21-H (2)
W23	BLACK	P4-B	SP6(7)
W24	VIOLET/BLACK	P5-A	P21-A(2)
W25	VIOLET/BLACK	P21-A(2)	P21-D(2)
W26	NOT USED		
W27	BLACK	P5-B	SP6(7)
W28	NOT USED		
W29	BLUE/RED	P7-A	P21-E (2)
W30	BLUE/RED	P28-4	P21-E(2)
W31	BLACK	SP6(7)	P7-B
W32	GREEN/RED	P8-A	P13-4
W33	BLACK	P8-B	SP6(7)
W34	BLACK	P9-H	SP5(9)
W35	BLUE/BLACK	P9-F	SP7(5)
W36	BLUE/BLACK	P38-3	SP7(5)
W37	BLUE/BLACK	P13-2	SP7(5)
W38	BLUE/BLACK	P16-B	SP7(5)
W39	NOT USED		
W40	WHITE/BLUE	P25-2	P9-E(2)
W41	WHITE/BLUE	P9-E(2)	P9-A(2)
W42	WHITE/BLUE	P9-A(2)	P15-B
W43	GRAY/BLACK	P9-C (2)	P20-2
W44	GRAY/BLACK	P26-2	P9-C (2)
W45	ORANGE/BLACK	P39-A	SP8(4)
W46	ORANGE/BLACK	P16-A	SP8(4)
W47	ORANGE/BLACK	J17	SP8(4)
W48	ORANGE/BLACK	P26-4	SP8(4)
W49	VIOLET	P25-4	P24-5(2)
W50	VIOLET	P22-5	P38-2
W51	VIOLET	P24-5(2)	P22-5(2)
W52	YEL/BLACK	P30-2(2)	P11-1
W53	RED/WHITE	SP9 (6)	P13-1
W54	RED/WHITE	P11-4	SP9(4)
W55	RED/WHITE	P12-1	SP9(4)
W56	RED/WHITE	P12-2	SP9(4)
W57	RED/WHITE	P44-2 (2)	SP9(4)
W58	BLACK	P11-5	SP4(11)
W59	BLUE/WHITE	P32(2)	P12-3
W60	BLUE/WHITE	P32(2)	P44-1
W61	GRAY/WHITE	P12-4	P43-1A
W62	YELLOW/RED	J15	SP13
W63	BLACK	P13-5	SP4(11)
W64	BLACK	P14-5	SP4(11)
W65	PINK/BLUE	P25-1	P14-2
W66	PINK/BLACK	P27-2	J16
W67	BLACK	SP4(11)	J6
W68	GRAY/BLACK	P22-1	J7
W69	ORANGE	J14(2)	P43-2A
W70	ORANGE	J14	J12
W71	BLACK	P43-2B (2)	SP4(11)
W72	WHITE/RED	P33	P42-1B
W73	GRN/GRAY	P28-2	P19-2
W74	GREEN/BLACK	P26-1	SP1
W75	GREEN/BLACK	P20-1	SP1
W76	BLACK	P21-F	SP4(11)
W77	PINK	P30-6	P22-4
W78	GREEN/WHITE	P30-8	P22-2
W79	BLACK	P23-C	SP4(11)
W80	BROWN	P29-1	P24-6
W81	BLACK	P24-3	SP4(11)
W82	BLACK	P25-5	SP5(9)
W83	BLACK	P26-5	SP5(9)
W84	BLACK	P27-5	SP5(9)
W85	WHITE/GRAY	P30-4 (2)	P27-1
W86	WHITE/GRAY	P30-4 (2)	P28-1
W87	BLACK	P28-5	SP5(9)
W88	YELLOW	P29-2	SP11(5)
W89	BLACK	J13	SP6(7)
W90	BLACK	SP5(9)	SP6(7)
W91	BLACK	SP4(11)	SP5(9)
W92	BLACK	P31-B	SP5(9)
W93	YELLOW	J10(2)	SP11(5)
W94	BLUE/BLACK	P21-C	SP7(5)
W95	BLACK	SP4(11)	J18
W100	WHITE	P3-A	P36-A
W104	GRAY	P39-B	P38-1
W105	BLACK	P38-5	SP4(11)
W106	YELLOW	P42-1A (2)	P42-2A (2)
W107	BLACK	P43-1B	P43-2B
W108	YELLOW/RED	SP13	P12-5
W109	YELLOW/RED	SP13	P44-7
W110	RED/WHITE	P44-2 (2)	P44-8
W111	YELLOW	P45-B	P42-1A (2)
W112	GREEN	P45-A (2)	P42-2B

Greensmaster 3250−D
(Serial Number Above 270000000)
Wiring Diagram

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