



Count on it.

Service Manual

Greensmaster[®] 3250-D

(Models 04384)

Revision History

Revision	Date	Description
--	2012	Initial Issue.
A	02/2018	Added revision history.
B	04/2018	Revised bedknife installation procedure, added Universal Groomer chapter.
C	06/2020	Added 2 schematics, 2 wire harnesses, reel restraining, universal groomer shaft repair

Reader Comments

The Toro Company Technical Assistance Center maintains a continuous effort to improve the quality and usefulness of its publications. To do this effectively, we encourage user feedback. Please comment on the completeness, accuracy, organization, usability, and readability of this manual by an e-mail to servicemanuals@toro.com

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NOTES



Service Manual

(Model 04384)

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 04384).

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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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE, SM-E3B SERIES	

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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 understand the instruction because it has to do with safety. Failure to comply with the instruction may result in personal injury.
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	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 the machine 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

1. Do not run the engine in a confined area without adequate ventilation. Exhaust fumes are hazardous and could be deadly.
2. Sit on the seat when starting and operating the machine.
3. 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.
4. 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.
5. Using the machine demands attention. 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.
6. 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.
7. 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.
8. Raise the cutting units when driving from one work area to another.
9. 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.
10. 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.
11. 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.
12. Traverse slopes carefully. Do not start or stop suddenly when traveling uphill or downhill.
13. 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.
14. 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.
15. **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.
16. 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

1. Before servicing or making adjustments to the machine, stop the engine, remove key from switch to prevent accidental starting of the engine.
2. Be sure entire machine is in good operating condition. Keep all nuts, bolts, screws and hydraulic fittings tight.
3. Make sure all hydraulic line connectors are tight, and all hydraulic hoses and lines are in good condition before applying pressure to the system.
4. 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.
5. 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.
6. 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.
7. Check all fuel lines for tightness and wear on a regular basis. Tighten or repair fuel lines as needed.
8. 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 bystanders away from the machine while performing maintenance.
9. 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 2710 ± 50 RPM.
10. Engine must be shut off before checking oil or adding oil to the crankcase.
11. If major repairs are ever needed or if assistance is desired, contact an Authorized Toro Distributor.
12. 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.
13. When changing attachments, tires or performing other service, use correct 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 appropriate jack stands to support the raised machine. If the machine is not properly supported by appropriate 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.

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.

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. Subtract 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

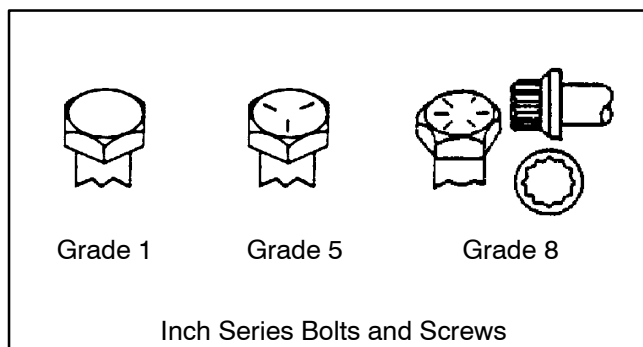


Figure 1

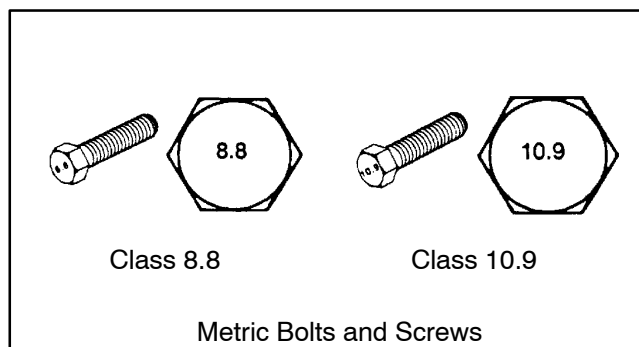


Figure 2

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.

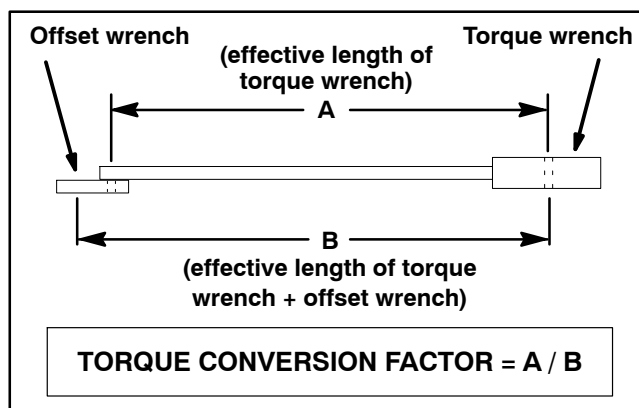


Figure 3

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

Product Records and Maintenance

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: 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.

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.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non-lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

$$\text{in-lb} \times 11.2985 = \text{N-cm}$$

$$\text{ft-lb} \times 1.3558 = \text{N-m}$$

$$\text{N-cm} \times 0.08851 = \text{in-lb}$$

$$\text{N-m} \times 0.7376 = \text{ft-lb}$$



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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE,
SM-E3B SERIES

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Specifications

Item	Description
Make / Designation	Kubota water-cooled, Diesel, Model D902-E3B
Number of Cylinders	3
Bore x Stroke	2.83" x 2.9" (72mm x 73.6mm)
Total Displacement	54.8 in ³ (898 cc)
Compression Ratio	24.0:1
Firing Order	1 (closest to gear case end) – 2 – 3 (closest to flywheel end)
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Injector Pump	Bosch MD Type Mini
Fuel Injection Nozzle	Bosch Throttle Type
Fuel Capacity	6.0 U.S. gallons (22.7 liters)
Governor	Centrifugal Mechanical
Low Idle (no load)	1500 ± 70 RPM
High Idle (no load)	2710 ± 50 RPM
Engine Oil	API CH-4, CI-4 or higher
Engine Oil Viscosity	See Operator's Manual
Oil Pump	Gear Driven Trochoid Type
Crankcase Oil Capacity	3.9 U.S. quarts (3.7 liters) with filter
Cooling System Capacity (including reserve tank)	3.4 U.S. quarts (3.2 liters)
Starter	12 VDC 1.2 KW
Alternator/Regulator	12 VDC 40 AMP
Dry Weight (approximate)	159 lbs (72 kg)


Diesel Engine

General Information

Information about specifications, maintenance, troubleshooting, testing and repair of the diesel engine used in the Greensmaster 3250-D is included in this chapter and the Kubota Workshop Manual, Diesel Engine, SM-E3B Series.

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

Service and repair parts for the Kubota engine that powers your Greensmaster 3250-D are supplied through your local Toro distributor. If no parts list is available, be sure to provide your distributor with the Toro model and serial number.

	DANGER
<p>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.</p>	

Operator's Manual

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

Fuel Shut-off Valve

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

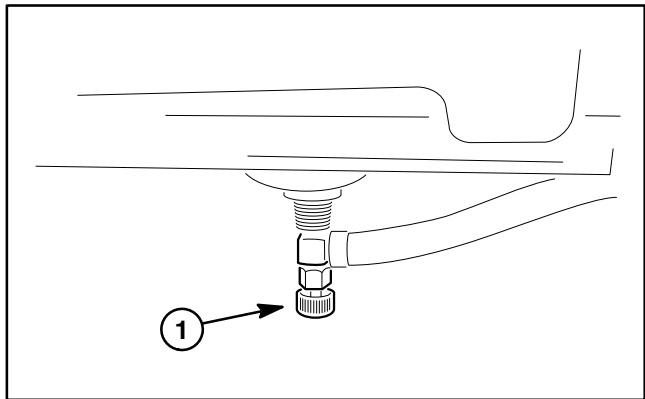


Figure 1

1. Fuel shut-off (under the fuel tank)

Adjustments

Adjust Throttle Control

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

NOTE: The throttle cable swivel should be positioned in the lowest hole in the speed control lever.

1. Move throttle control lever on control console to **FAST** position.
2. Check position of the engine speed control lever on fuel injection pump (Fig. 2). The speed control lever should be contacting the high speed screw when the throttle control lever is in the **FAST** position.
3. If necessary, throttle control can be adjusted by loosening cable jam nuts and repositioning control cable until speed control lever contacts high speed screw when the throttle control lever is in the **FAST** position (Fig. 3). Tighten cable jam nuts after adjustment has been completed.

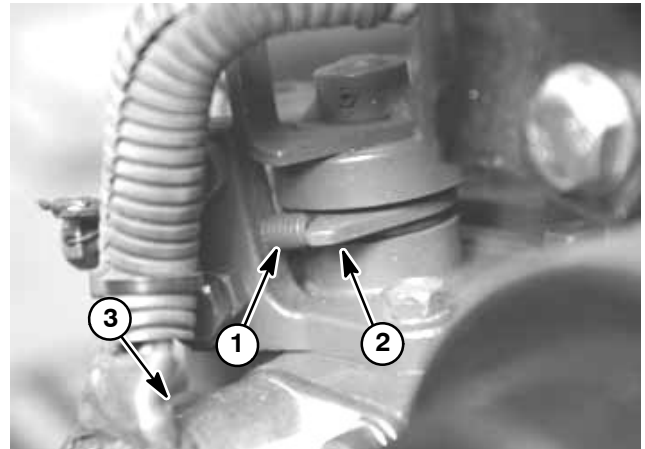


Figure 2

- | | |
|------------------------|------------------|
| 1. High speed screw | 3. Fuel solenoid |
| 2. Speed control lever | |

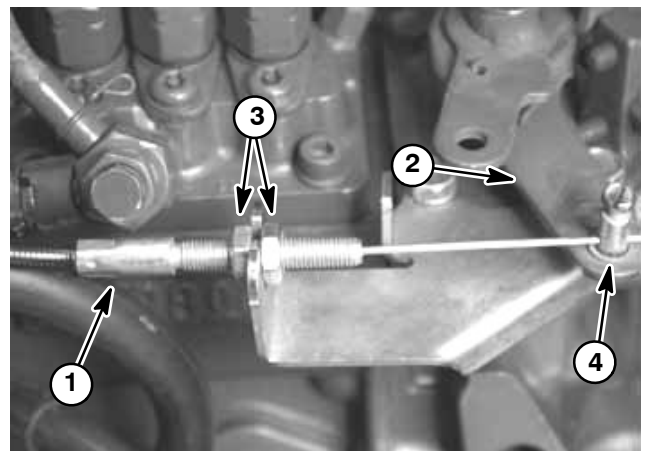


Figure 3

- | | |
|------------------------|--------------------------|
| 1. Throttle cable | 3. Cable jam nut |
| 2. Speed control lever | 4. Throttle cable swivel |

Service and Repairs

Air Cleaner

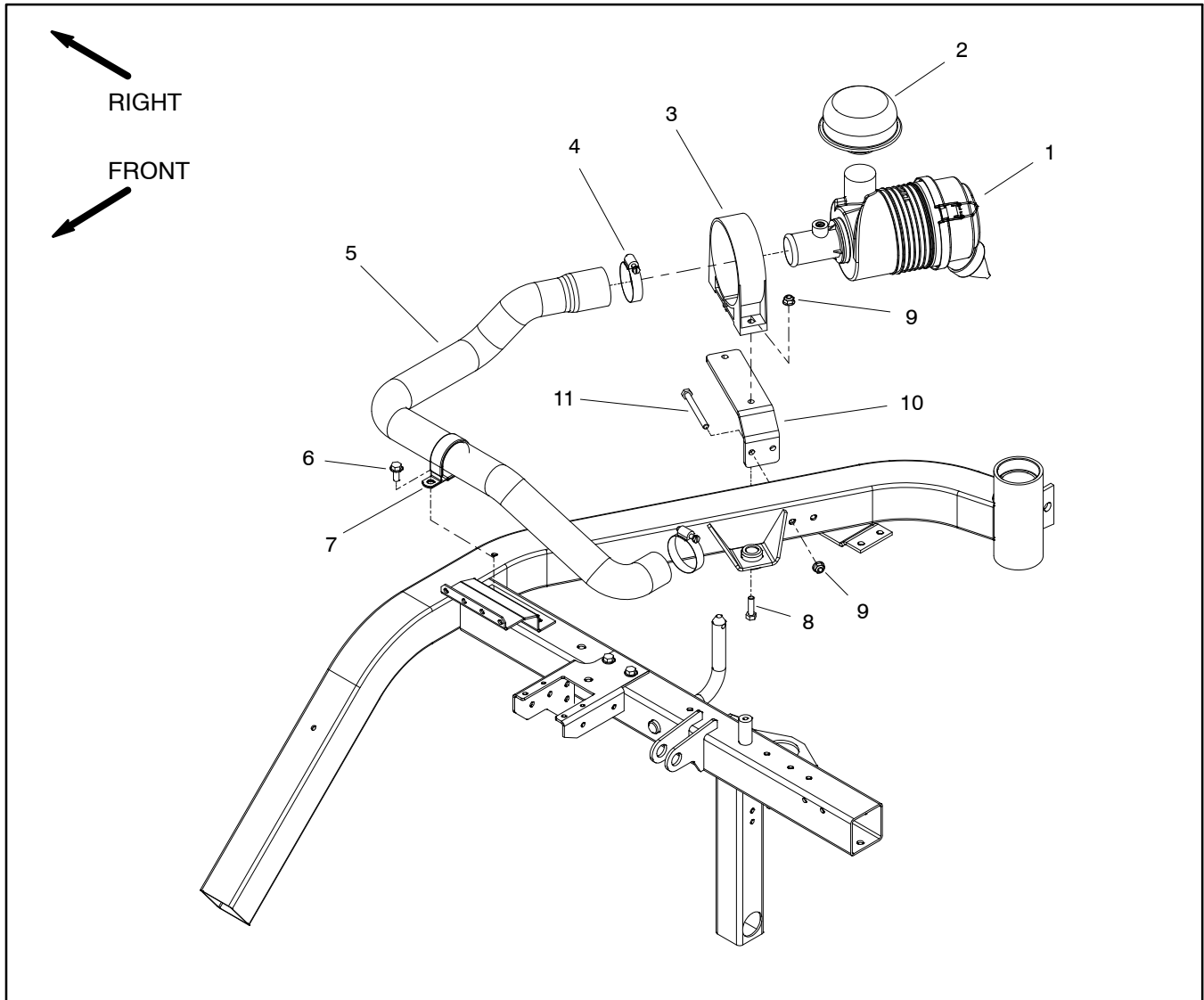


Figure 4

- 1. Air cleaner assembly
- 2. Air inlet hood
- 3. Mounting bracket
- 4. Hose clamp (2 used)

- 5. Air cleaner hose
- 6. Flange head screw
- 7. R-clamp
- 8. Cap screw (2 used)

- 9. Flange nut (4 used)
- 10. Air cleaner bracket
- 11. Cap screw (2 used)

Air Cleaner Removal (Fig. 4)

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. Remove air cleaner components as needed using Figure 4 as a guide.
3. Check air cleaner hose (item 5 in Fig. 4) for damage or wear. Replace hose if damage is found.
4. Disassemble air cleaner as necessary (Fig. 5).
5. Check air cleaner housing and cover for damage that could cause possible air leaks.

Air Cleaner Installation (Fig. 4)

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

1. Assemble air cleaner system using Figures 4 and 5 as guides.
 - A. If plug (item 5 in Fig. 5) was removed from air cleaner housing, apply sealant to threads of plug before assembly.
 - B. Make sure that vacuator valve on air cleaner assembly is pointed down after assembly.
 - C. Make sure that air intake hose (item 5 in Fig. 4) has clearance around it at all points after air cleaner installation is completed.

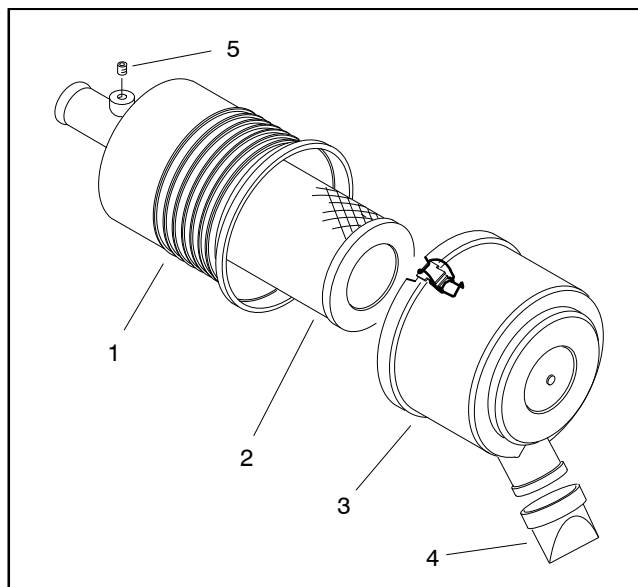


Figure 5

- | | |
|-------------------|-------------------|
| 1. Housing | 4. Vacuator valve |
| 2. Filter element | 5. Plug |
| 3. Cover | |

Exhaust System

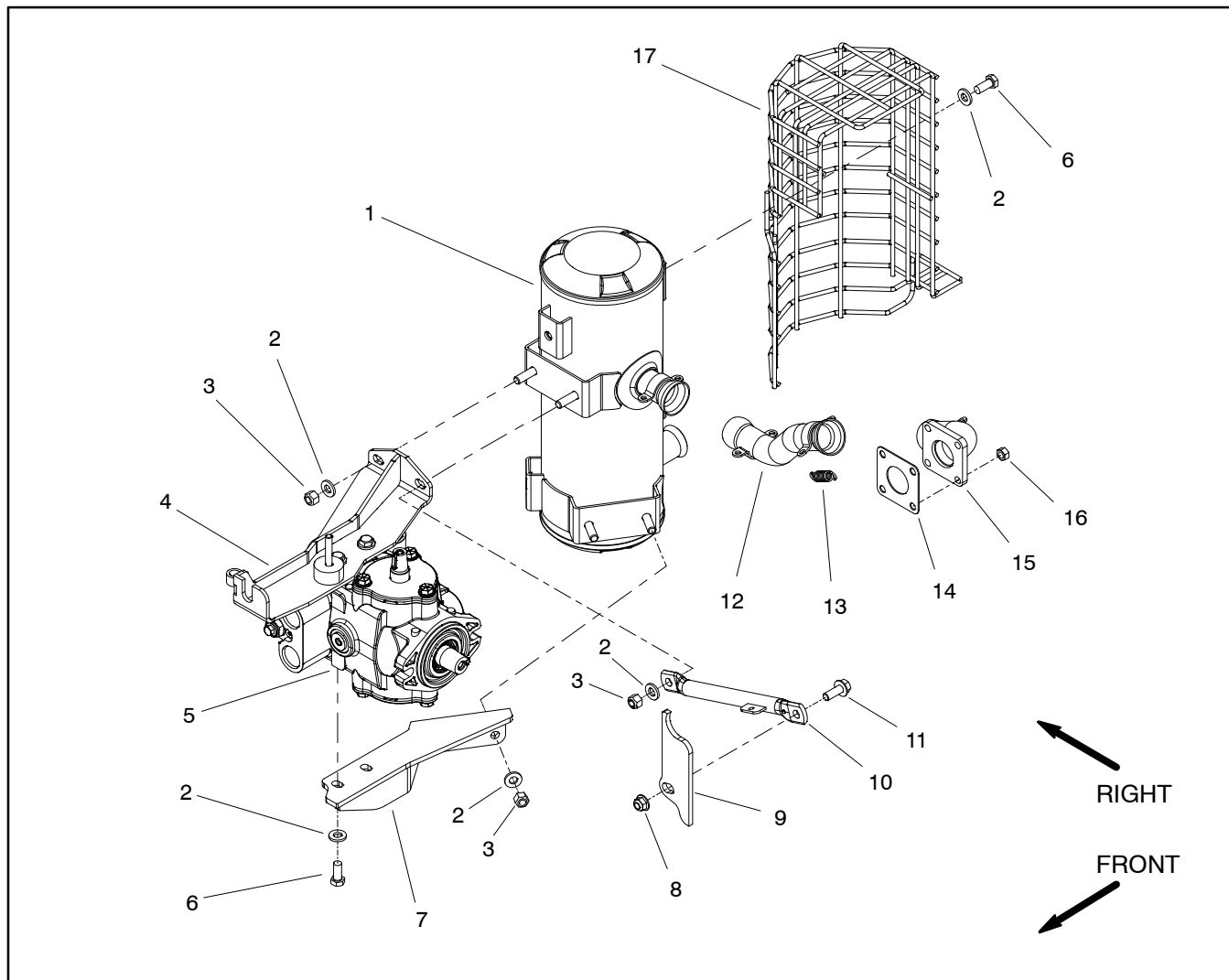


Figure 6

- 1. Muffer
- 2. Flat washer (10 used)
- 3. Lock nut (4 used)
- 4. Upper muffer mount
- 5. Piston pump
- 6. Cap screw (6 used)

- 7. Lower muffer mount
- 8. Flange nut
- 9. Engine mount
- 10. Exhaust support
- 11. Flange head screw
- 12. Exhaust pipe

- 13. Spring (4 used)
- 14. Exhaust gasket
- 15. Exhaust plate
- 16. Hex nut (4 used)
- 17. Muffer shield

Exhaust System Removal (Fig. 6)

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 exhaust system components as needed using Figure 6 as a guide.

Exhaust System Installation (Fig. 6)

1. Make sure the engine is off.

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

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

2. If exhaust gasket (item 14) was removed, place new exhaust gasket on the engine exhaust manifold.

NOTE: To ensure proper exhaust system sealing, mount all exhaust system components loosely before fully tightening any fastener.

3. Assemble all removed exhaust system components using Figure 6 as a guide.

4. After all exhaust components have been assembled, make sure that all fasteners are properly tightened.

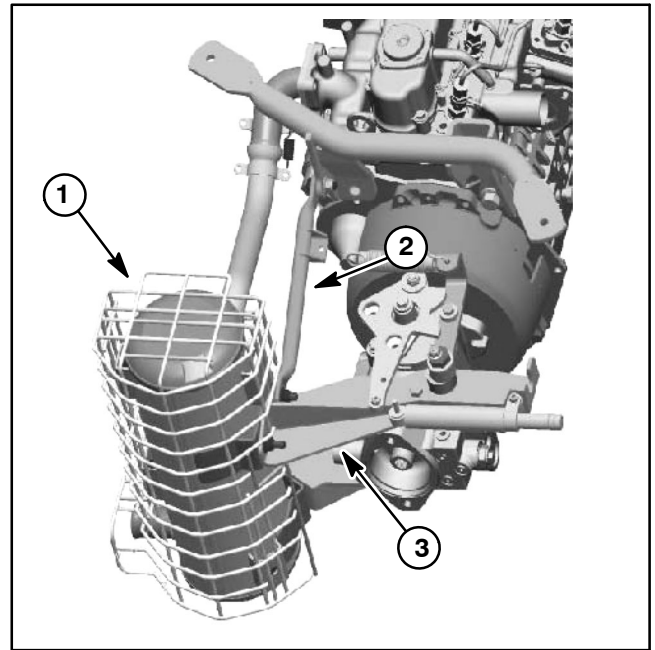


Figure 7

1. Muffler
2. Exhaust support
3. Upper muffler mount

Radiator

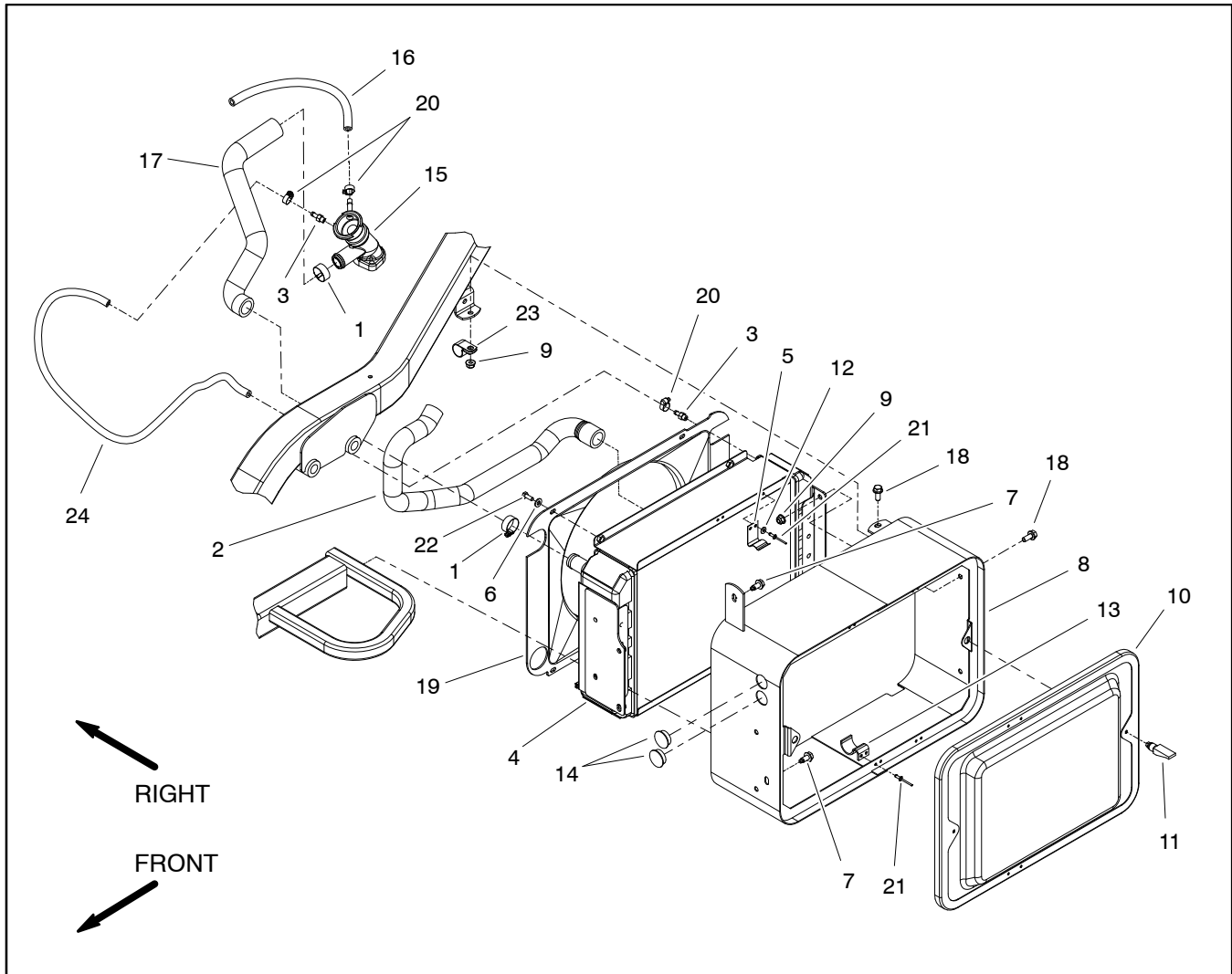



Figure 8

- | | | |
|-------------------------------|-----------------------------------|--------------------------------|
| 1. Hose clamp (4 used) | 9. Flange nut (5 used) | 17. Upper radiator hose |
| 2. Lower radiator hose | 10. Screen | 18. Flange head screw (5 used) |
| 3. Hose connector (2 used) | 11. Swell latch (2 used) | 19. Fan shroud |
| 4. Radiator | 12. Flat washer (2 used) | 20. Worm clamp (3 used) |
| 5. Upper cooler bracket | 13. Lower cooler bracket (2 used) | 21. Pop rivet (6 used) |
| 6. Flat washer (4 used) | 14. Plug (2 used) | 22. Cap screw (4 used) |
| 7. Washer head screw (2 used) | 15. Thermostat housing | 23. R-clamp |
| 8. Radiator support | 16. Hose (to coolant reservoir) | 24. Hose |


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

Radiator Removal (Fig. 8)

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. Place a suitable container under the front end of the radiator. Open drain petcock on the back of the radiator. Drain radiator completely and then close petcock.
3. Remove screen (item 10) from radiator support.

4. If machine is equipped with optional hydraulic oil cooler (Fig. 9), drain hydraulic reservoir and remove oil cooler (see Oil Cooler in the Service and Repairs section of Chapter 4 – Hydraulic System).

5. Remove the following hoses from the radiator:

A. Loosen hose clamp and disconnect breather hose (item 24) from fitting on radiator.

B. Loosen hose clamps and disconnect upper and lower radiator hoses (items 2 and 17).

6. Remove the radiator assembly (radiator, radiator support and fan shroud) from the machine:

A. Remove flange head screw (item 18) and flange nut (item 9) that secure upper rear corner of radiator support to frame.

B. Remove washer head screw (item 7) that secures the upper front radiator support tab to the frame.

C. Remove washer head screw (item 7) that secures the front of the radiator support to the footrest.

D. Carefully remove radiator assembly (radiator, radiator support and fan shroud) from machine.

7. Remove four (4) flange head screws (item 18) and flange nuts (item 9) securing the radiator support (item 8) to the radiator. Slide radiator out of the support.

8. Remove four (4) cap screws (item 22) and flat washers (item 31) that secure the fan shroud (item 19) to the radiator. Separate the shroud from the radiator.

Radiator Installation (Fig. 8)

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

2. Slide radiator into the radiator support (item 8). Secure support to radiator with four (4) flange head screws (item 18) and flange nuts (item 9).

3. Install the radiator assembly (radiator, radiator support and fan shroud) to the machine:

A. Carefully position radiator assembly (radiator, radiator support and fan shroud) to machine.

B. Secure upper rear corner of radiator support to frame with flange head screw (item 18) and flange nut (item 9).

C. Secure the upper front radiator support tab to the frame with washer head screw (item 7).

D. Secure the front of the radiator support to the footrest with washer head screw (item 7).

4. Connect the following hoses to the radiator:

A. Connect upper and lower radiator hoses (items 2 and 17) and secure with hose clamps.

B. Connect breather hose (item 24) to fitting on radiator and secure with hose clamp.

5. If machine is equipped with optional hydraulic oil cooler (Fig. 9), install oil cooler to the radiator (see Oil Cooler in the Service and Repairs section of Chapter 4 – Hydraulic System). Fill the hydraulic reservoir with new hydraulic oil.

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

7. Fill radiator with coolant. Check radiator and hoses for leaks.

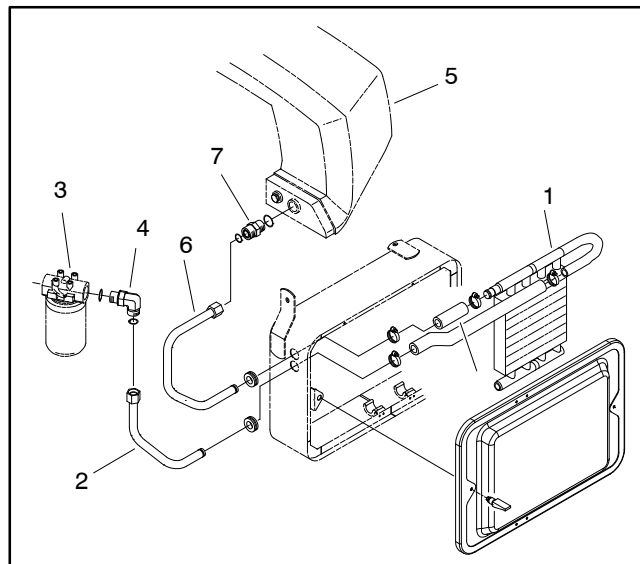


Figure 9

- | | |
|-------------------------|------------------------|
| 1. Hydraulic oil cooler | 5. Hydraulic reservoir |
| 2. Tube | 6. Tube |
| 3. Oil filter | 7. Hydraulic fitting |
| 4. Hydraulic fitting | |

Fuel Tank

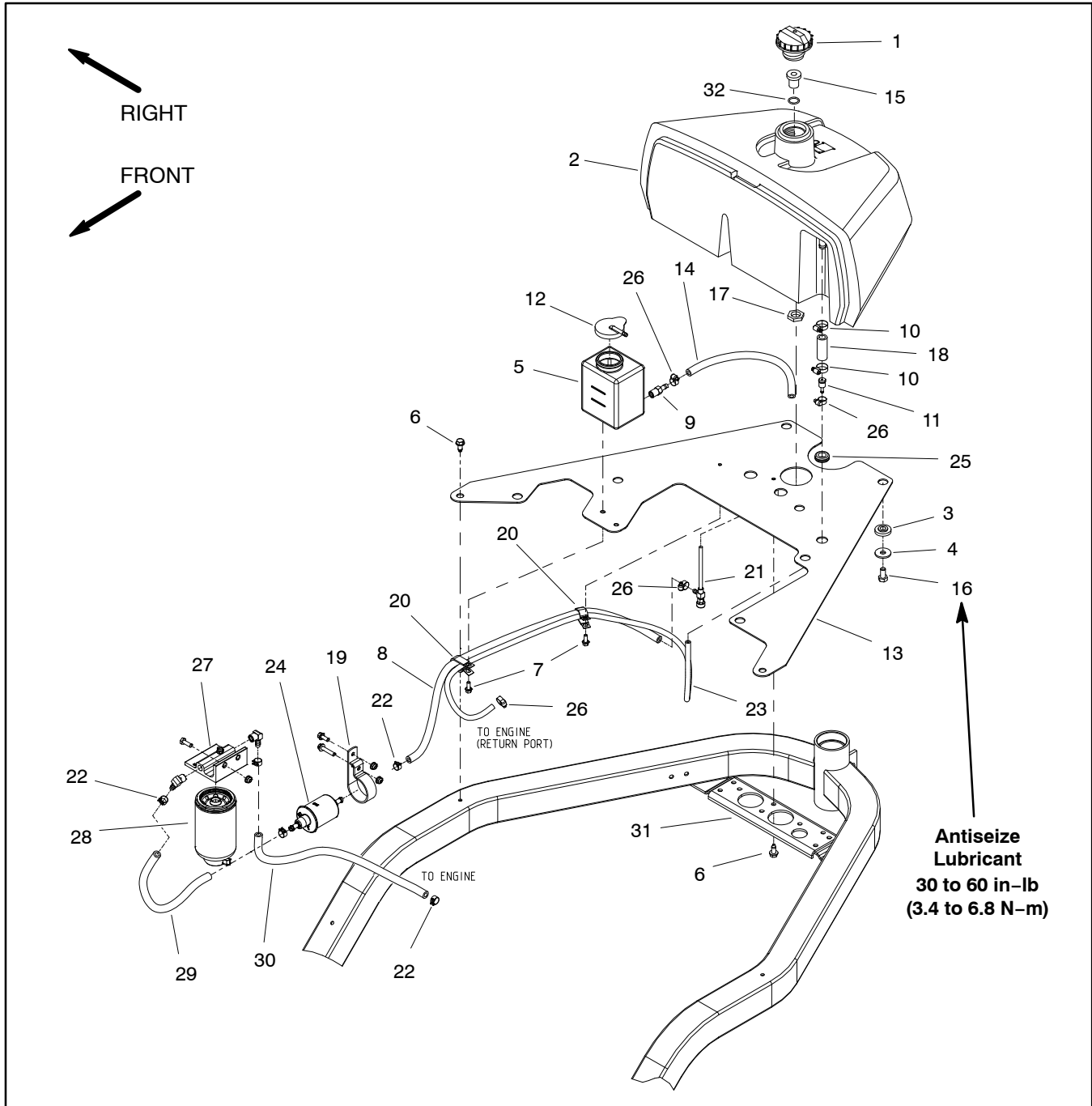



Figure 10

- | | | |
|-------------------------------|-------------------------|--------------------------------|
| 1. Fuel cap | 12. Cap | 23. Tank vent hose |
| 2. Fuel tank | 13. Mounting plate | 24. Fuel pump |
| 3. Flange bushing (3 used) | 14. Coolant hose | 25. Grommet |
| 4. Flat washer (3 used) | 15. Fitting | 26. Worm clamp (4 used) |
| 5. Overflow tank (coolant) | 16. Cap screw (3 used) | 27. Fuel filter/separator head |
| 6. Washer head screw (4 used) | 17. Nut | 28. Fuel filter/separator |
| 7. Flange head screw (3 used) | 18. Fuel hose | 29. Fuel hose |
| 8. Fuel hose | 19. Fuel pump bracket | 30. Fuel hose |
| 9. Straight fitting | 20. Hose clamp (2 used) | 31. Support bracket |
| 10. Hose clamp (2 used) | 21. Shut-off valve | 32. O-ring |
| 11. Fuel fitting | 22. Hose clamp (5 used) | |

Fuel Tank Removal (Fig. 10)

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:

- A. Close fuel shut-off valve on bottom of fuel tank.
- B. Disconnect fuel supply hose at the fuel filter inlet and drain any fuel trapped in the fuel filter and fuel hose into a suitable container.
- C. Place end of fuel hose into a suitable container for draining the tank.
- D. Drain fuel tank by opening the fuel shut-off valve.
- E. After draining the tank, connect fuel hose to fuel pump and secure with hose clamp.

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

- A. Remove three (3) washer head screws (item 6) that secure mounting plate to the frame and support bracket (item 31).
- B. Lift and support the mounting plate up from the rear of the machine.

4. Loosen hose clamp (item 26) and disconnect fuel hose (item 8) from shut-off valve on bottom of fuel tank.

5. Remove three (3) cap screws (item 16), flat washers (item 4) and flange bushings (item 3) that secure the fuel tank to the mounting plate (item 13).

6. Loosen hose clamp (item 26) and disconnect tank vent hose (item 23) from fuel fitting (item 11).

7. Carefully remove the fuel tank from the mounting plate.

8. If necessary, remove shut-off valve and fitting assembly from fuel tank (Fig. 11). The nut and fitting have left hand threads.

Fuel Tank Installation (Fig. 10)

1. Install fitting assembly and shut-off valve into fuel tank if they were removed from tank (Fig. 11). The nut and fitting have left hand threads.

2. Position fuel tank to the mounting plate, connect tank vent hose (item 23) to fuel fitting (item 11) and secure with hose clamp (item 26).

3. Secure fuel tank to mounting plate:

- A. Apply antiseize lubricant to the threads of the three (3) cap screws (item 16).

- B. Secure fuel tank to plate with three (3) cap screws (item 16), flat washers (item 4) and flange bushings (item 3). Torque cap screws from **30 to 60 in-lb (3.4 to 6.8 N-m)**.

4. Lower mounting plate (item 13) to the frame and secure with three (3) washer head screws (item 6).

5. Connect fuel hose (item 8) to shut-off valve on bottom of fuel tank. Secure hose with hose clamp (item 26).

6. Open fuel shut-off valve below the fuel tank.

7. Fill fuel tank with fuel. Check fuel lines and tank for leaks.

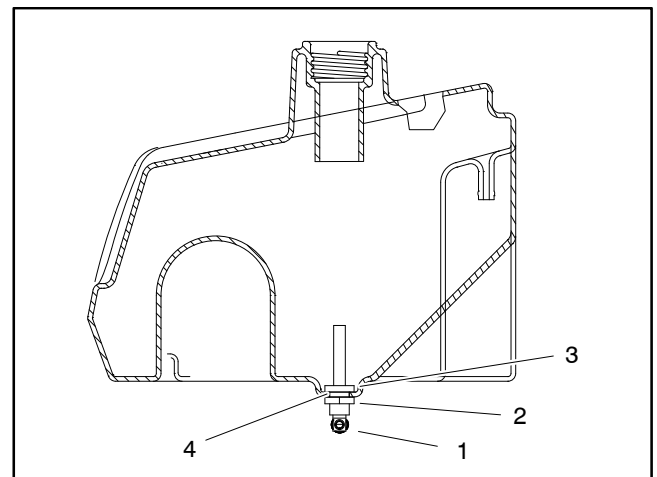


Figure 11

- | | |
|--------------------|------------------------|
| 1. Shut-off valve | 3. Fitting (LH thread) |
| 2. Nut (LH thread) | 4. O-ring |

Engine

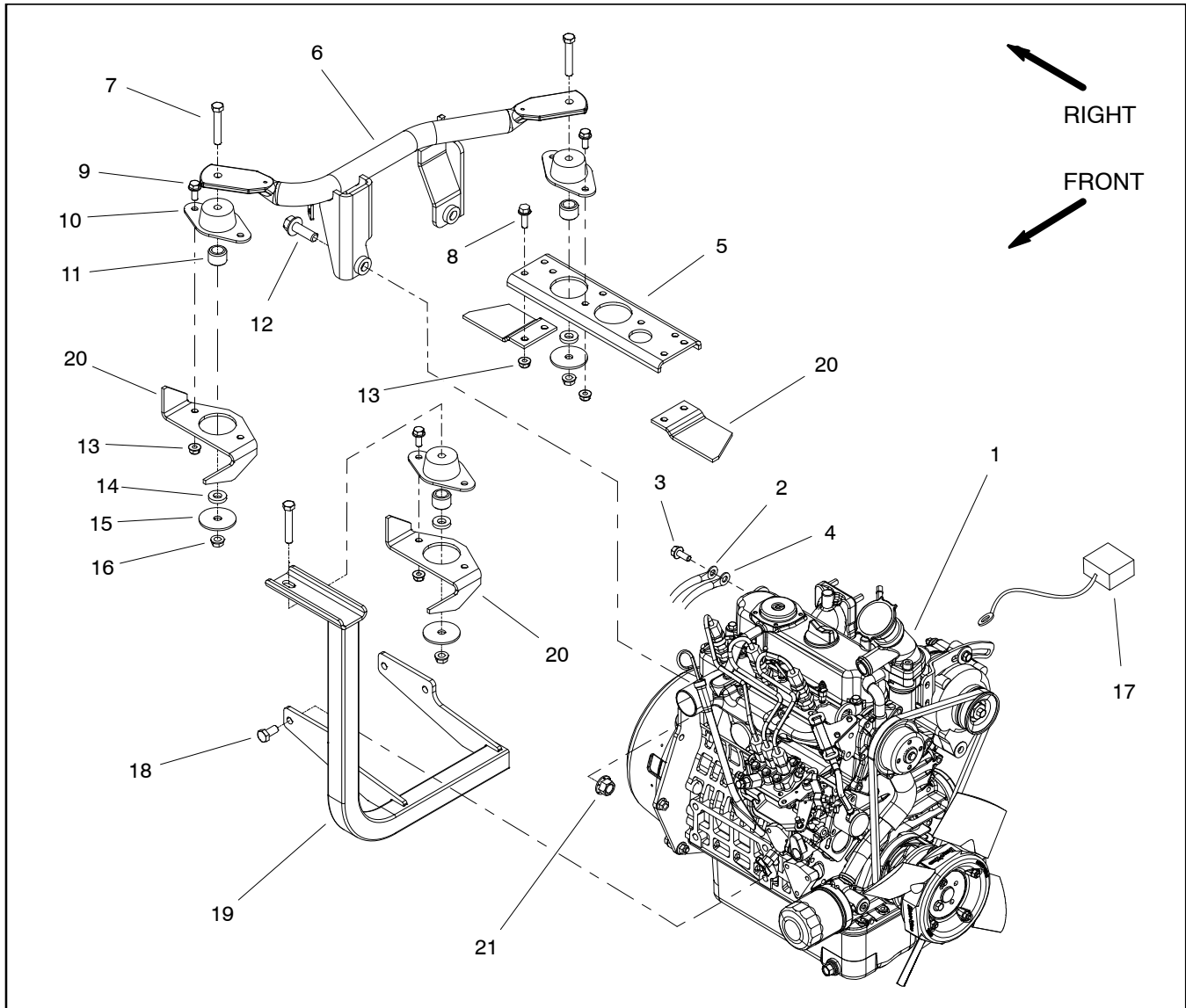
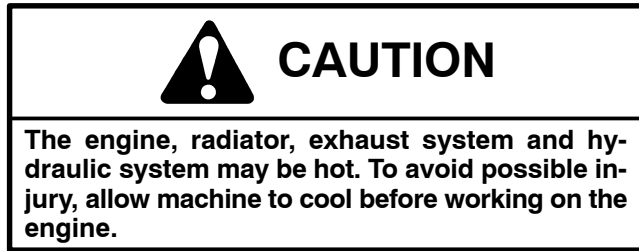


Figure 12

- | | | |
|-------------------------------|--------------------------------|--------------------------|
| 1. Engine assembly | 8. Flange head screw (4 used) | 15. Flat washer (3 used) |
| 2. Ground harness | 9. Flange head screw (6 used) | 16. Flange nut (3 used) |
| 3. Flange head screw | 10. Engine mount (3 used) | 17. Fusible link harness |
| 4. Negative (-) battery cable | 11. Mount spacer (3 used) | 18. Cap screw (4 used) |
| 5. Support bracket | 12. Flange head screw (2 used) | 19. Engine support |
| 6. Engine mount | 13. Flange nut (10 used) | 20. Frame bracket |
| 7. Cap screw (3 used) | 14. Washer (3 used) | 21. Lock nut (2 used) |

Engine Removal (Fig. 12)

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



2. Close fuel shut-off valve on fuel tank.
3. Remove air cleaner and air intake hose from machine (see Air Cleaner in this section).
4. Remove radiator from machine (see Radiator in this section).
5. Remove exhaust system from machine (see Exhaust System in this section).
6. Disconnect fuel supply hose from the injector pump and fuel return hose from the #3 injector (Fig. 13). Drain any fuel trapped in the hoses into a suitable container. Plug hoses and position them away from engine assembly.
7. Loosen screw that secures the throttle cable to swivel on injector pump speed control lever. Disconnect cable from swivel and cable bracket (Fig. 14). Position cable away from engine.
8. Disconnect wire harness connectors from engine components:

NOTE: Before disconnecting wire harness connectors, label all electrical leads for assembly purposes.

- A. Negative battery cable (item 4) and wire harness ground (item 2) that are secured to the engine at the lift hook above the bell housing.
- B. Fuel solenoid (Fig. 13).
- C. Glow plug bus (Fig. 13).
- D. Temperature sender (Fig. 15).
- E. Alternator connector and stud (Fig. 15).
- F. Starter motor solenoid and fusible link harness (Fig. 15).
- G. Oil pressure switch (near oil filter) (Fig. 15).

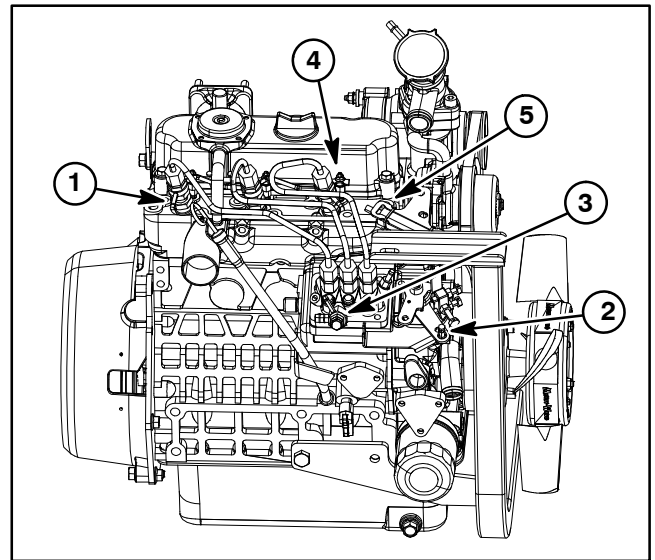


Figure 13

- | | |
|--------------------------|------------------|
| 1. Fuel return fitting | 4. Glow plug bus |
| 2. Throttle cable swivel | 5. Fuel solenoid |
| 3. Fuel supply fitting | |

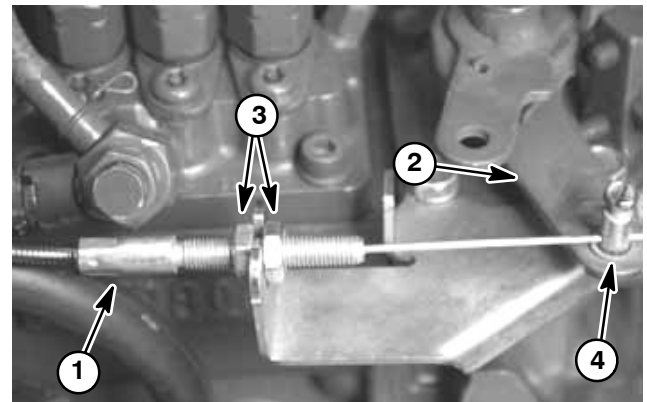


Figure 14

- | | |
|------------------------|--------------------------|
| 1. Throttle cable | 3. Cable jam nut |
| 2. Speed control lever | 4. Throttle cable swivel |

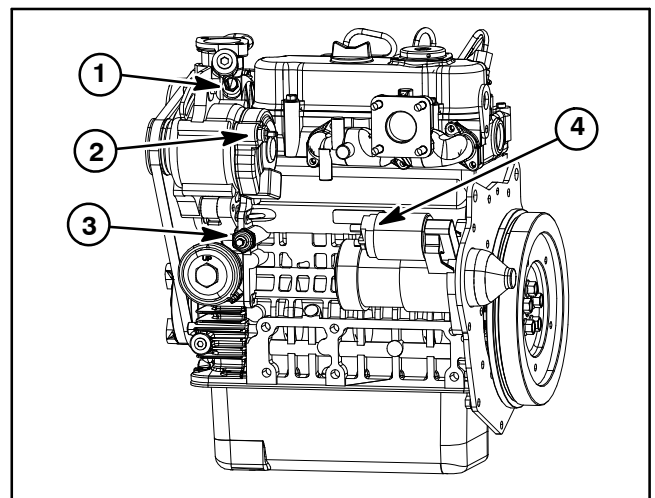


Figure 15

- | | |
|-----------------------|------------------------|
| 1. Temperature sender | 3. Oil pressure switch |
| 2. Alternator stud | 4. Starter solenoid |



CAUTION

Support the hydraulic pump assembly when removing its supporting fasteners to prevent it from falling and causing damage or personal injury.

9. Support hydraulic pump assembly to prevent it from moving during engine removal.

10. Remove two (2) cap screws and flat washers that secure hydraulic pump assembly to bell housing on engine (Fig. 16).



CAUTION

When removing engine assembly, make sure lift or hoist can safely support 190 lbs (86 kg).

11. Attach a suitable lift or hoist to engine. Support engine with lift or hoist to prevent engine from shifting or moving.

12. Remove fasteners that secure engine to machine:

A. Remove cap screw, mount spacer, washers and flange nut that secure engine support (item 19) to engine mount.

B. Remove two (2) cap screws (item 12) and lock nuts (item 22) that secure rear engine plate to engine mount (item 6).

IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness or other parts while removing the engine. Also, make sure that hydraulic pump assembly does not shift location during engine removal.

13. Slowly move the engine assembly away from the hydraulic pump assembly to allow the pump coupling to slide out of the engine coupling flange (Fig. 16). Once the engine has cleared the pump coupling, carefully remove the engine from the machine.

14. If necessary, remove engine support (item 19) from engine.

Engine Installation (Fig. 12)

1. Make sure that all removed engine components are correctly installed to the engine.

2. If engine support (item 19) was removed from engine, secure support to engine with removed fasteners.

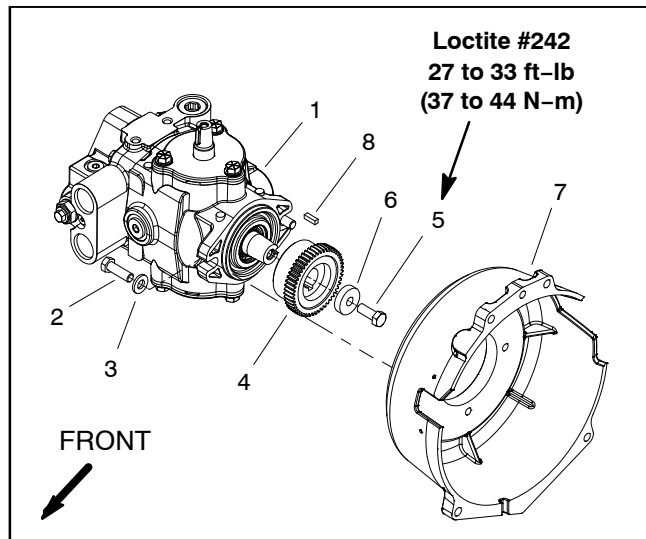


Figure 16

- | | |
|-------------------------|-----------------|
| 1. Piston pump | 5. Cap screw |
| 2. Cap screw (2 used) | 6. Spacer |
| 3. Flat washer (2 used) | 7. Bell housing |
| 4. Coupling | 8. Key |

3. Make sure that hydraulic pump assembly is well supported to prevent it from moving during engine installation.



CAUTION

When installing engine assembly, make sure lift or hoist can safely support 190 lbs (86 kg).

4. Attach a suitable lift or hoist to engine.

IMPORTANT: Make sure to not damage the engine, fuel hoses, hydraulic lines, electrical harness or other parts while installing the engine. Also, make sure that hydraulic pump assembly does not shift location during engine installation.

5. Slowly move the engine assembly toward the hydraulic pump assembly to allow the pump coupling to slide into the engine coupling flange (Fig. 16).

6. Secure hydraulic pump assembly to bell housing on engine with two (2) cap screws and flat washers (Fig. 16).

7. Secure engine to machine:

A. Secure engine support (item 19) to engine mount with cap screw, mount spacer, washers and flange nut.

B. Secure rear engine plate to engine mount (item 6) with two (2) cap screws (item 12) and lock nuts (item 22).

8. Connect all electrical harness connectors to engine using labels placed during engine removal.
9. Connect throttle cable to the swivel on injector pump speed control lever (Fig. 14). Adjust cable (see Adjust Throttle Control in the Adjustments section of this chapter).
10. Install exhaust system to machine (see Exhaust System in this section).
11. Install radiator to machine (see Radiator in this section).
12. Install air cleaner to machine (see Air Cleaner in this section). Make sure that all hose clamps are properly tightened.
13. Remove plugs placed during engine removal from fuel hoses. Connect fuel supply hose to the injector pump fitting and fuel return hose to the #3 injector fitting. Secure fuel hoses with hose clamps.
14. Open fuel shut-off valve on fuel tank. Check tank and hoses for leaks.
15. Fill cooling system with coolant. Check radiator and hoses for leaks.
16. Make sure that engine oil level is correct.
17. Make sure that alternator belt tension is properly adjusted.
18. Bleed fuel system.

Engine Bell Housing

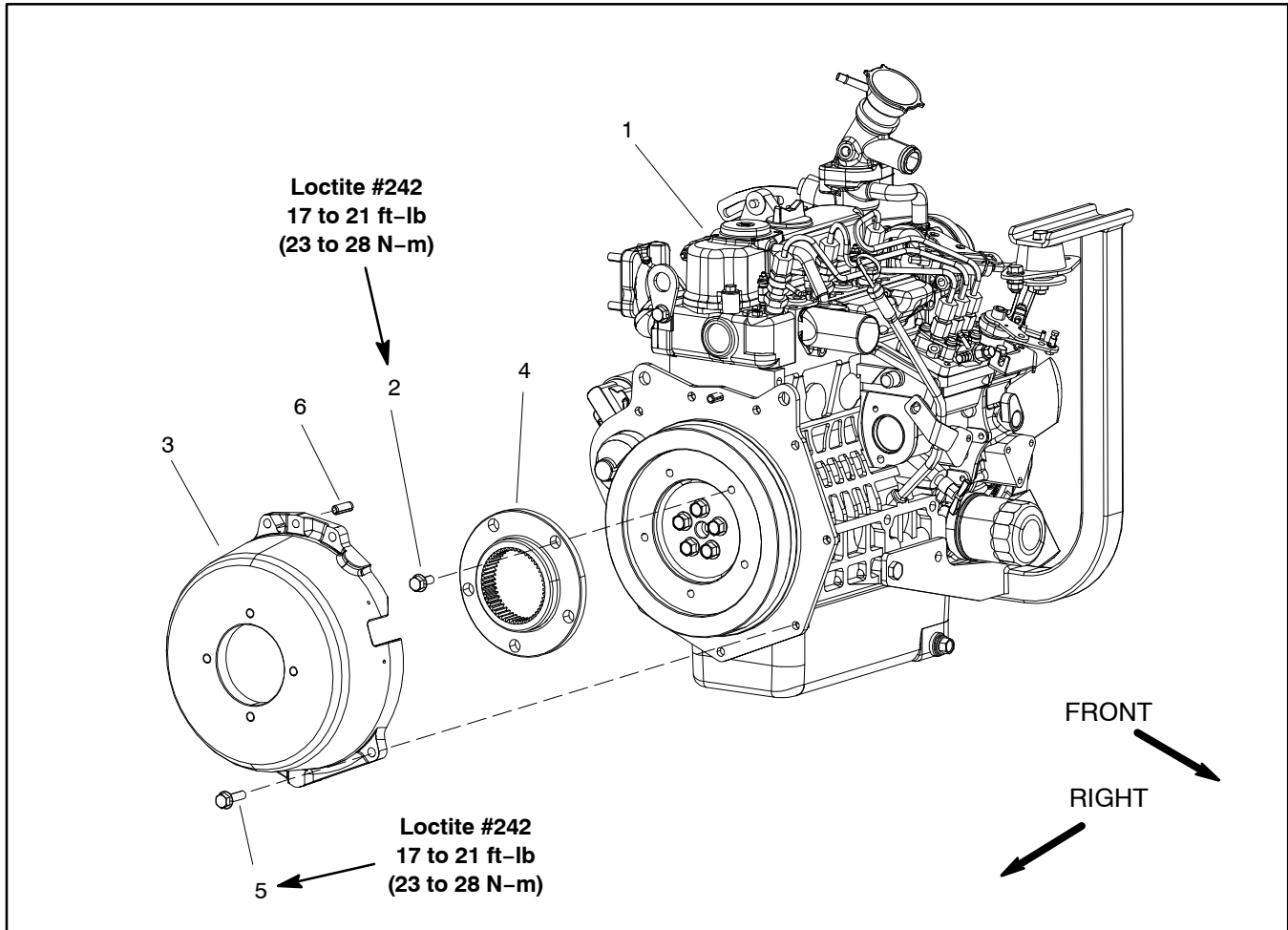


Figure 17

- | | | |
|-------------------------------|--------------------|-------------------------------|
| 1. Engine | 3. Bell housing | 5. Flange head screw (4 used) |
| 2. Flange head screw (5 used) | 4. Coupling flange | 6. Spring pin |

Removal (Fig. 17)

NOTE: The hydraulic pump assembly needs to be removed from engine before bell housing and coupling flange can be removed.

1. If engine is in machine, support engine from below to prevent it from shifting. Remove hydraulic pump assembly (see Piston (Traction) Pump Removal in the Service and Repairs section of Chapter 4 – Hydraulic System).
2. As necessary, remove bell housing and coupling flange from engine using Figure 17 as a guide.

Installation (Fig. 17)

1. If coupling flange was removed from engine flywheel, position flange to flywheel and align mounting holes. Apply Loctite #242 to threads of flange head screws (item 2). Secure coupling flange to flywheel with five (5) flange head screws. Tighten screws in a star pattern to a torque **17 to 21 ft-lb (23 to 28 N-m)**.
2. If bell housing was removed from engine, make sure that spring pin is secure in upper hole of bell housing. Apply Loctite #242 to threads of flange head screws (item 5). Position bell housing to flywheel plate and secure with five (5) flange head screws. Tighten screws in a star pattern to a torque **17 to 21 ft-lb (23 to 28 N-m)**.
3. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump Installation in the Service and Repairs section of Chapter 4 – Hydraulic System).



Hydraulic System

Hydraulic System

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Specifications

Item	Description
Piston (Traction) Pump Maximum Pump Displacement (per revolution) Charge Pressure	Variable displacement piston pump 1.24 in ³ (20.3 cc) 100 to 150 PSI (7 to 10 bar)
Gear Pump Front Section (cutting reels) Displacement (per revolution) Rear Section (steering/lift) Displacement (per revolution)	2 section, positive displacement gear pump 0.58 in ³ (9.5 cc) 0.33 in ³ (5.4 cc)
Front Wheel Motors Displacement (per revolution)	Orbital rotor motor 10.3 in ³ (169 cc)
Rear Wheel Motor (Optional 3WD Kit) Displacement (per revolution)	Orbital rotor motor 20.6 in ³ (337 cc)
Cutting Reel Motor Displacement (per revolution)	Gear motor 0.73 in ³ (12 cc)
Steering Valve	Distributor valve with rotary meter
Implement (Steering and Lift) Relief Pressure	1160 PSI (80 bar) above Charge Pressure
Hydraulic Manifold Relief Valves Mow Circuit (S1R1) Cutting Unit Lower (R2)	3000 PSI (207 bar) 400 PSI (28 bar) above Charge Pressure
Hydraulic Filter	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)

Hydraulic System

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. Do not overfill hydraulic reservoir.

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.

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.

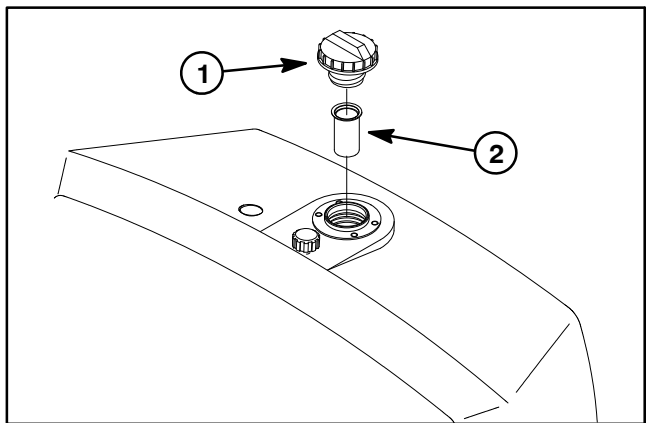


Figure 1

- 1. Hydraulic oil cap
- 2. Filler screen

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 rear side of the piston pump. Rotate valve 90° so the slot in the valve is vertical.
2. Before starting engine, close by-pass valve by rotating it back 90° so the slot in the valve is horizontal. Do not start engine when the valve is open.

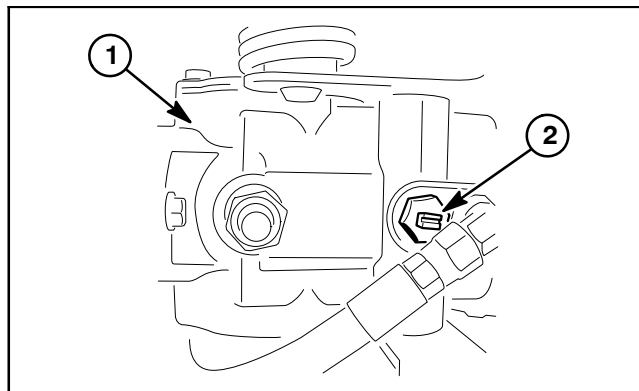


Figure 2

1. Piston pump

2. By-pass valve

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

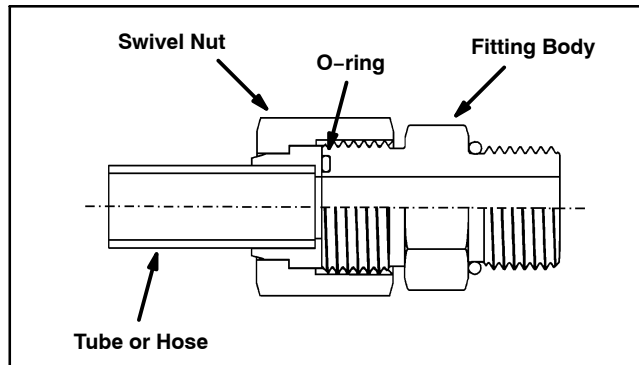


Figure 3

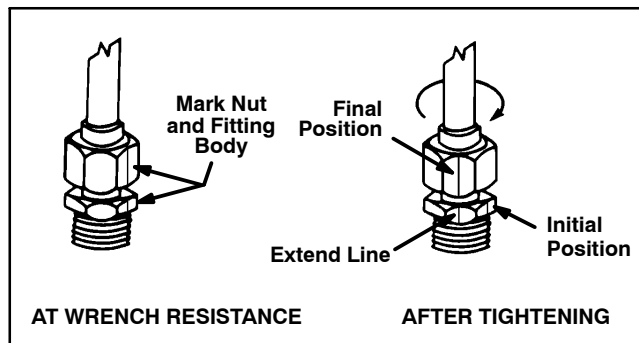


Figure 4

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

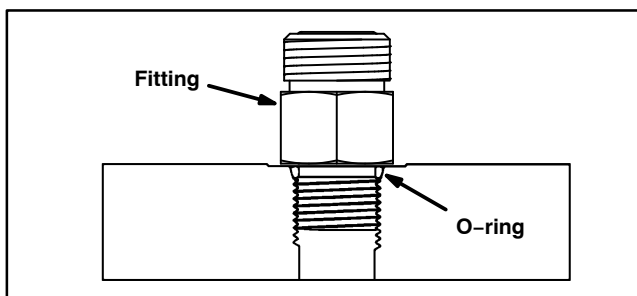


Figure 6

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

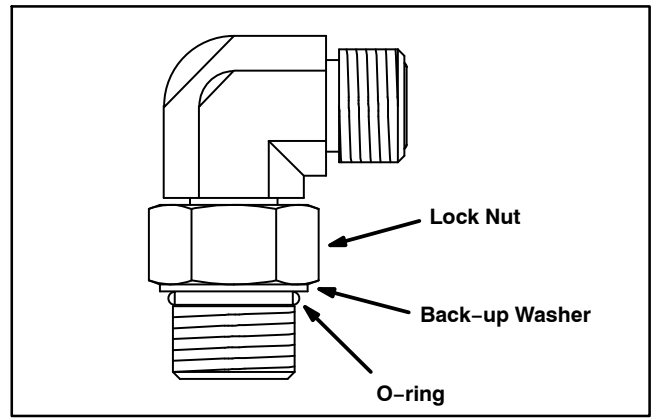


Figure 8

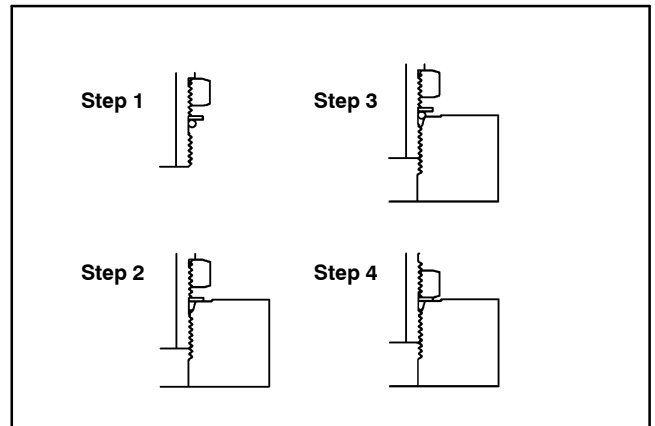
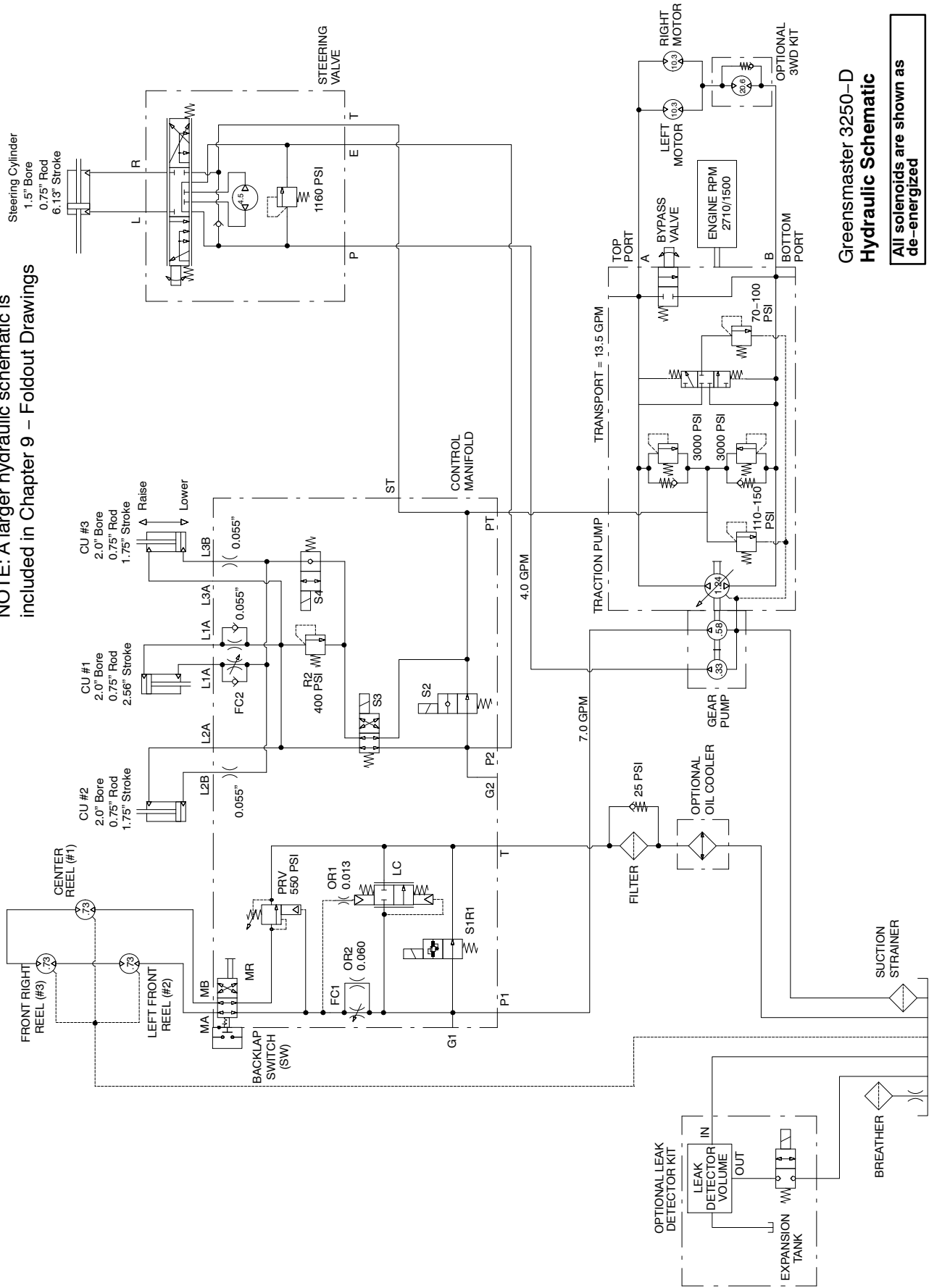


Figure 9

Hydraulic Schematic

NOTE: A larger hydraulic schematic is included in Chapter 9 – Foldout Drawings

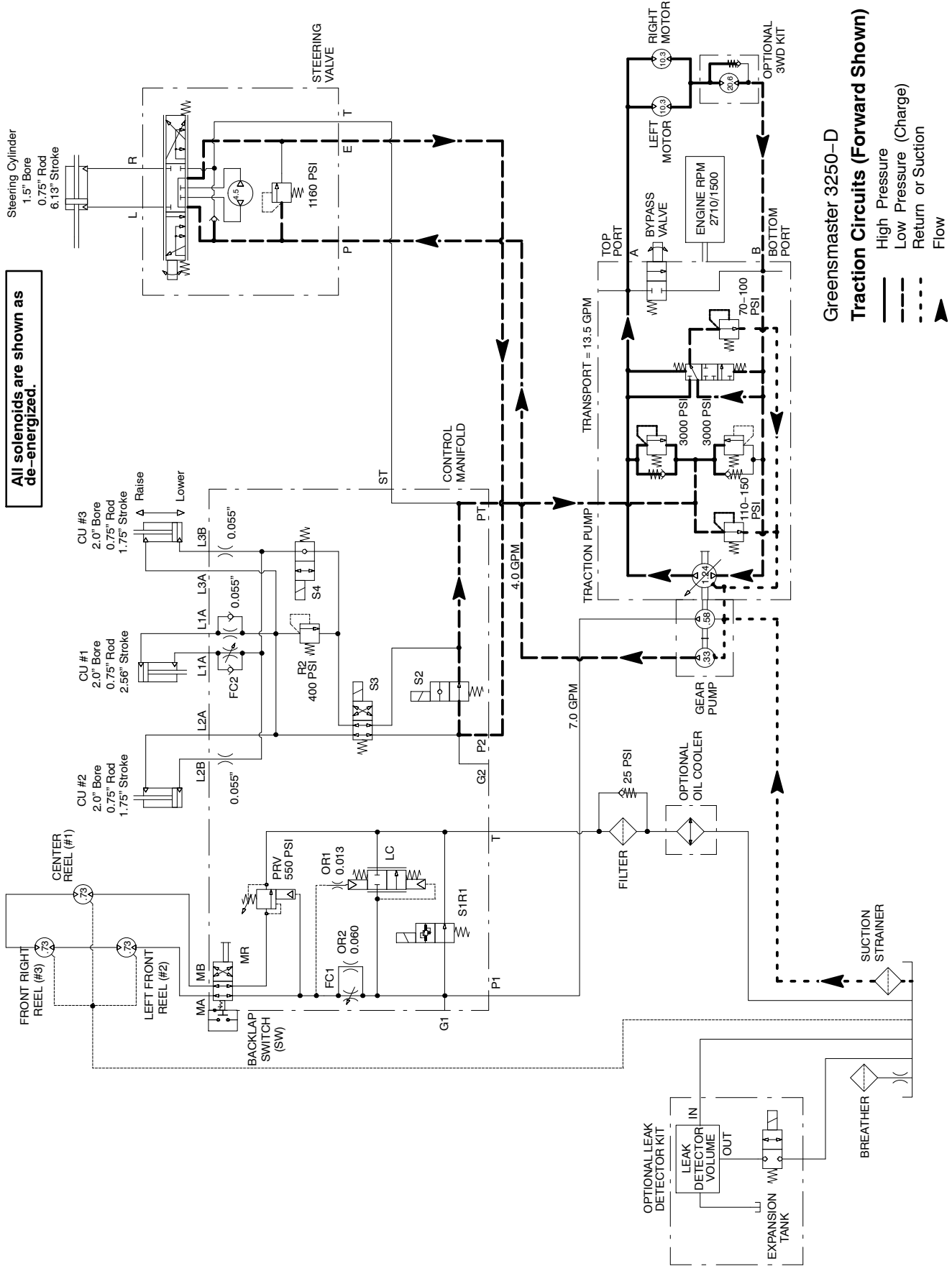


Greensmaster 3250-D Hydraulic Schematic

All solenoids are shown as de-energized

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Hydraulic Flow Diagrams



All solenoids are shown as de-energized.

Greensmaster 3250-D
Traction Circuits (Forward Shown)
 High Pressure
 Low Pressure (Charge)
 Return or Suction
 Flow

Traction Circuits

Forward

The piston (traction) pump 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 piston pump 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 piston pump 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 piston pump so oil flows out the top port of the pump. Oil flow out of the top port goes to the wheel motors and turns them in the forward direction.

Oil flowing out of the wheel motors returns to the bottom port of the piston pump and is continuously pumped out the top port as long as the traction pedal is pressed for the forward direction.

Hydraulic oil is supplied to the traction charge circuit from the rear gear pump section through the steering valve, control manifold and back through the charge circuit check valves in the piston (traction) pump. This oil replaces oil losses from flow through the internal case drain, shuttle valve and small amounts of traction circuit leakage. Charge circuit pressure is maintained by the charge relief valve that is attached to the piston pump 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 piston pump 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 piston pump so oil flows out the bottom port of the pump. Oil flow out of the bottom port goes to the wheel motors and turns them in the reverse direction.

Oil flowing out of the wheel motors returns to the top port of the piston pump and is continuously pumped out the bottom port as long as the traction pedal is pressed for the reverse direction.

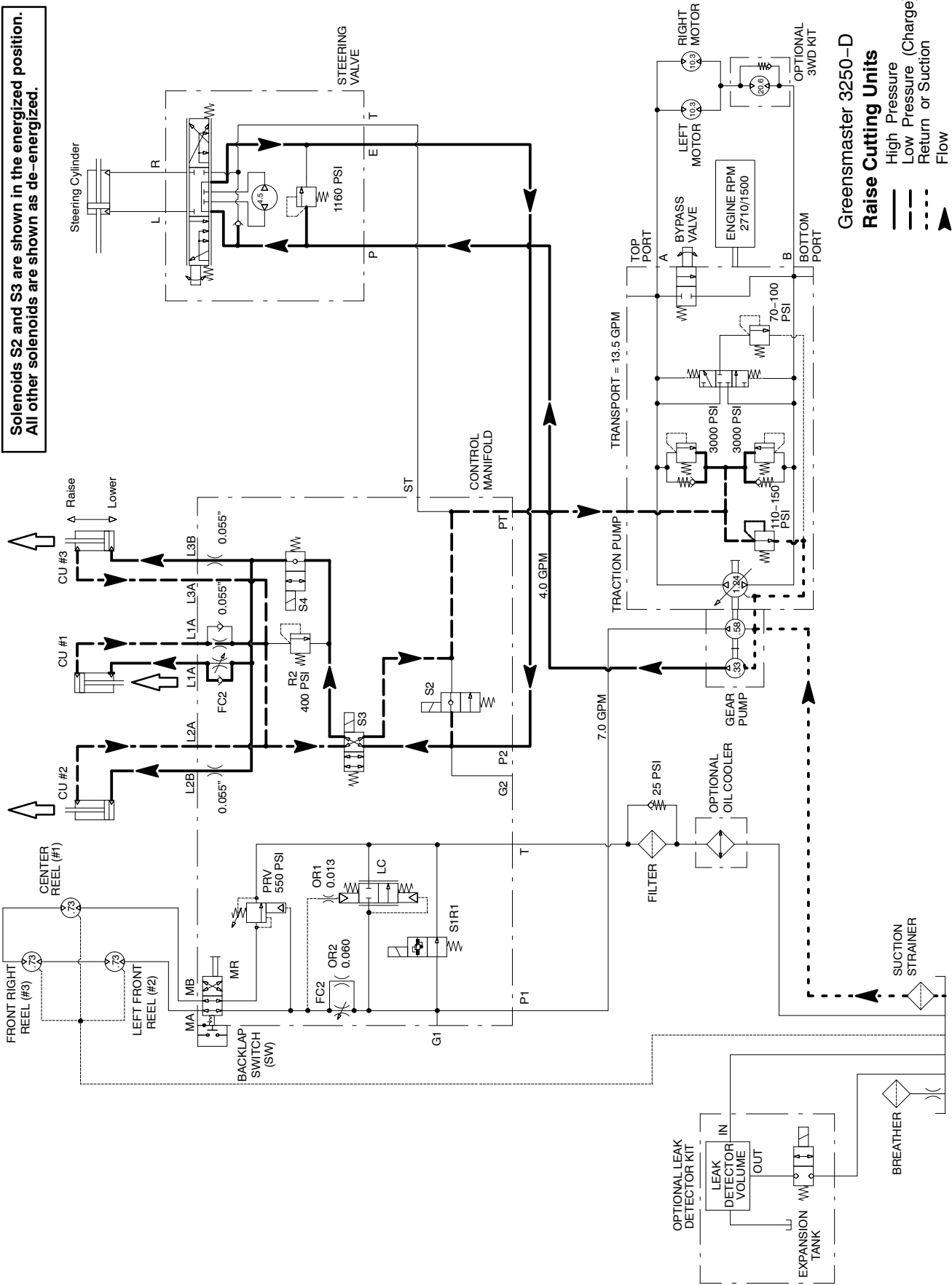
The charge circuit functions the same in reverse as it does in the forward direction.

Traction Circuit Cooling

The piston pump includes a shuttle valve that bleeds off a small amount of hydraulic fluid for cooling of the closed loop traction circuit. This valve allows a small amount of hydraulic oil to pass from the low pressure side of the traction circuit while operating the traction unit in either direction. A relief valve in the piston pump back plate prevents shuttle valve bleed off until the relief valve opens (70 to 100 PSI / 5 to 7 bar). The charge circuit replenishes oil that is bled from the traction circuit by the shuttle valve.

NOTE: The shuttle valve assembly is located in the piston pump back plate. Access to the shuttle valve requires removal of the back plate from the piston pump.

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



Raise and Lower Cutting Units

The tandem gear pump is directly coupled to the piston (traction) pump. The rear gear pump section supplies hydraulic flow for the steering circuit (priority flow), for raising and lowering the cutting units and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Maximum circuit pressure of 1160 PSI (80 bar) is limited by the relief valve located in the steering valve.

During cutting unit hold (not raising or lowering) conditions, flow from the gear pump (P2) is by-passed through the steering valve and de-energized solenoid valve (S2) in the hydraulic manifold directly to the traction charge circuit. Flow in excess of charge circuit requirements then returns to the gear pump inlet.

Raise Cutting Units

When the cutting units are to be raised, solenoid valve (S2) is energized and blocks flow directly to the traction charge circuit. 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 charge circuit. Raise speed for the front cutting units is controlled by a 0.055 orifice. A 0.055 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 traction charge circuit 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

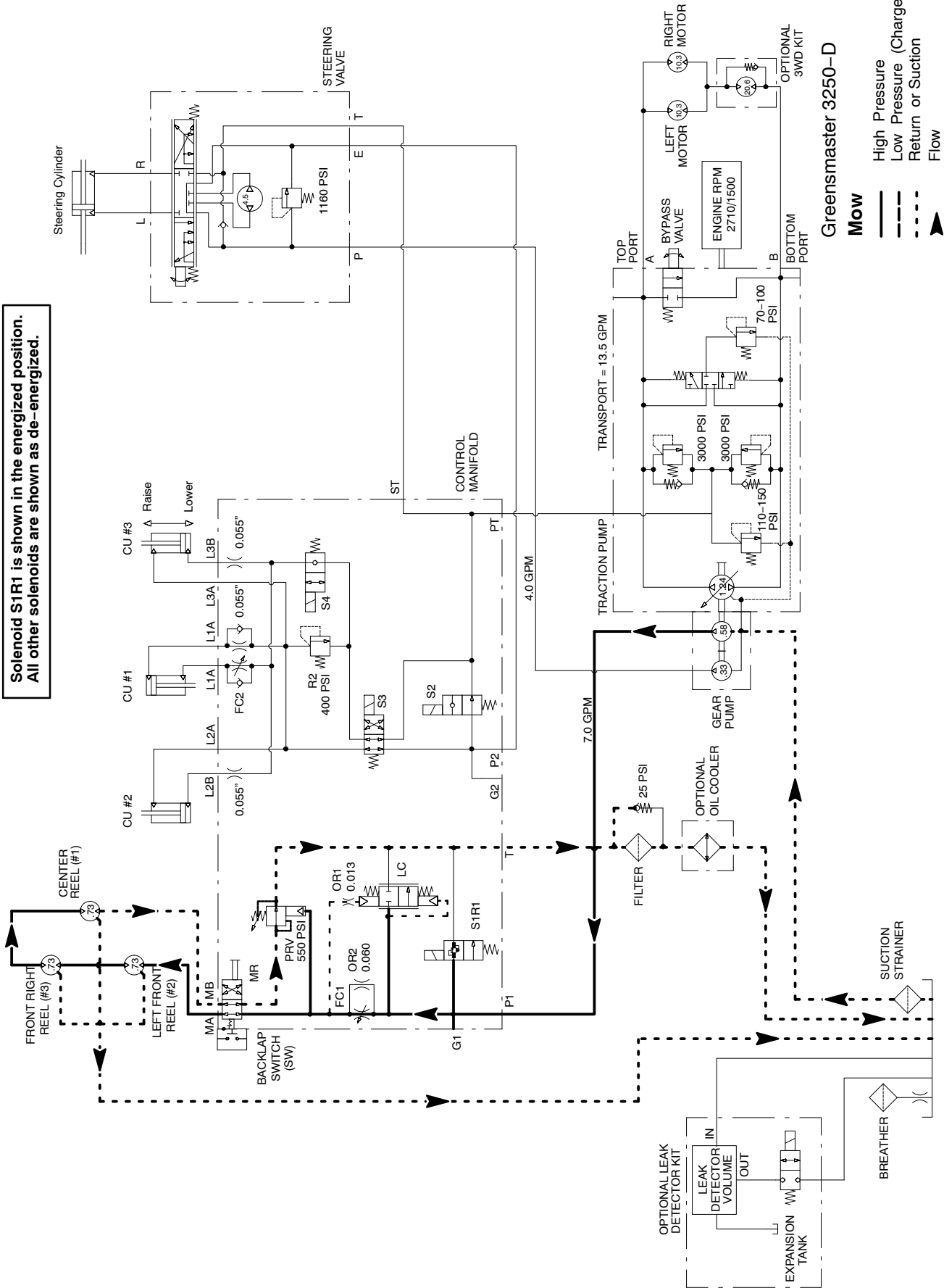
Circuit operation for lowering the lift cylinders is similar to raising them. However, the solenoid valve (S3) remains de-energized and solenoid valve (S4) is energized. Flow is reversed to and from the lift cylinders, lowering the cutting units.

When the cutting units are to be lowered, solenoid valve (S2) is energized and blocks flow directly to the traction charge circuit. 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 de-energized solenoid valve (S3) to the charge circuit. Lower speed for the front cutting units is controlled by the 0.055 orifice. A 0.055 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 traction charge circuit stopping lift cylinder movement.

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



Greensmaster 3250-D

Mow

- High Pressure
- - - Low Pressure (Charge)
- · - · - Return or Suction
- Flow

Mow and Backlap

The tandem gear pump is directly coupled to the piston (traction) pump. The front gear pump section supplies oil flow to the hydraulic manifold block and to the cutting reel motors. The gear pump takes its suction directly from the hydraulic reservoir. 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, solenoid relief valve (S1R1) in the hydraulic manifold is de-energized. The de-energized (S1R1) by-passes flow from the front section of the gear pump 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, 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.

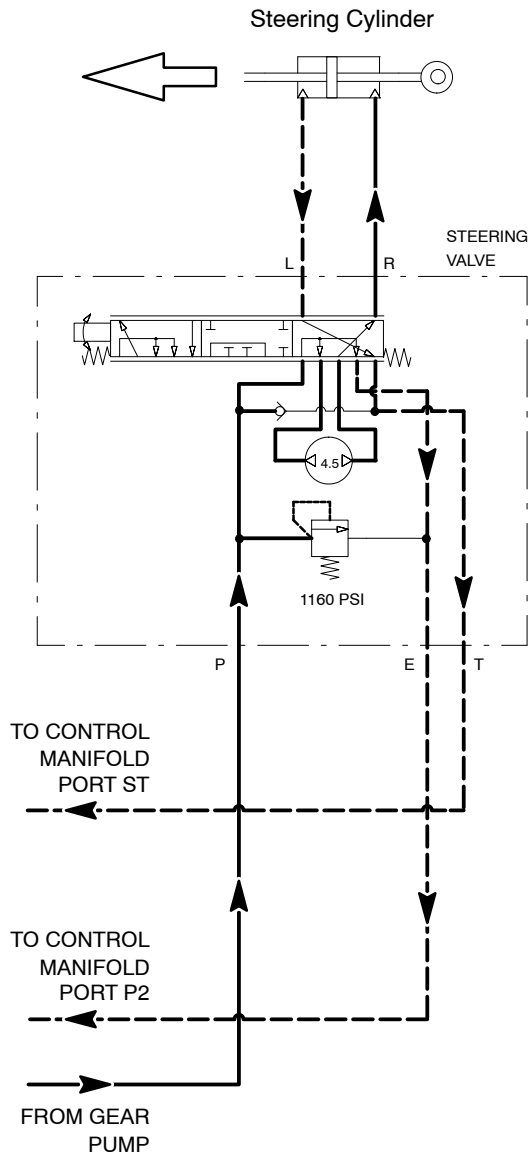
Oil flow from manifold port (P1) flows through the reel speed control valve (FC). Flow across the speed control valve is pressure compensated by the logic cartridge valve (LC). The logic cartridge valve maintains a pressure differential of 75 PSI (5.2 bar) across the speed control valve. Any excess flow 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, right and then center reel motor as it turns the motors in the mow direction.

When in the **mow** position, mow circuit pressure will cause the hydraulic manifold pilot piston to shift and open the pressure reducing valve (PRV). The shifted pressure reducing valve allows circuit oil to return to the reservoir through the manifold block and oil filter.

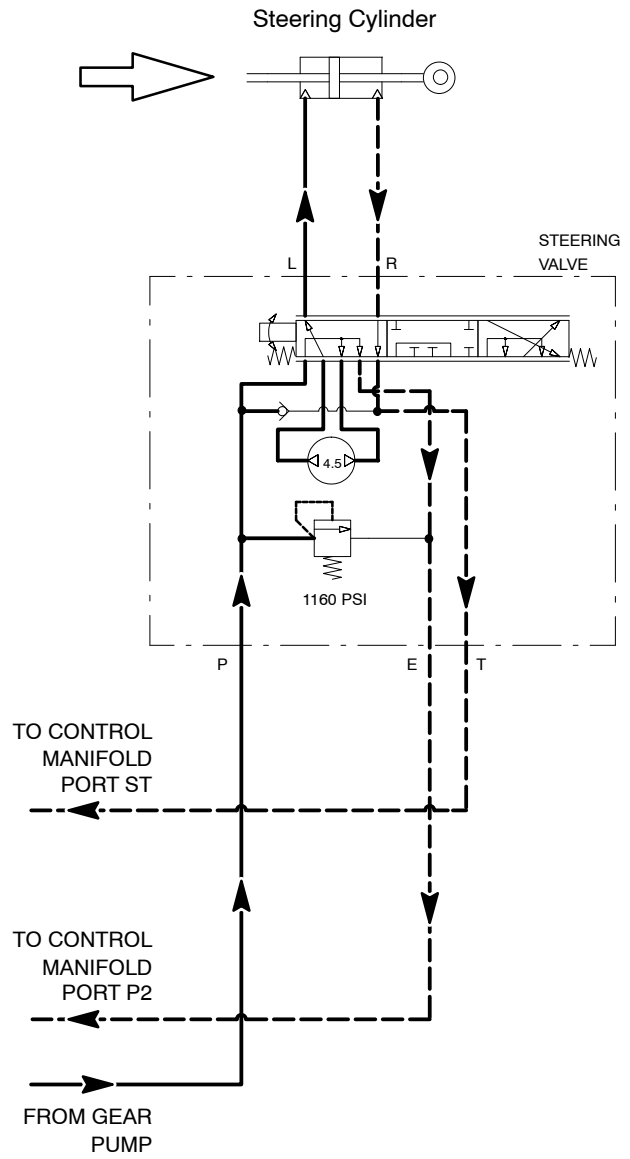
Backlap

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 center, right and then left reel motor as it turns the motors in the backlap direction.

RIGHT TURN



LEFT TURN



Greensmaster 3250-D

Right and Left Turn

- High Pressure
- - - Low Pressure (Charge)
- · - · - Return or Suction
- ▶ Flow

Right and Left Turn

The tandem gear pump is directly coupled to the piston (traction) pump. The rear gear pump section supplies hydraulic flow for the steering circuit (priority flow), for raising and lowering the cutting units and for the traction charge circuit. The gear pump takes its suction from the hydraulic reservoir. Maximum circuit pressure of 1160 PSI (80 bar) is limited by the relief valve located in the steering valve.

With the steering wheel in the neutral position and the engine running, the spool valve in the steering valve is in the center position. Pump flow enters the steering valve at Port (P) and goes through the spool valve, by-passing the steering cylinder. Flow leaves the steering valve out port (E) to be available for the raise/lower and traction charge circuits.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve in the steering valve so that flow goes through the bottom of the spool. Flow entering the steering 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 steering valve port (E) and is available for raising and lowering the cutting units and for the traction charge circuit. Second, the remainder of the flow is drawn through the steering valve rotary meter and out steering valve port (R). Pressure moves the steering cylinder piston to retract the cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then out steering valve port (T) and then to the traction charge circuit.

The steering valve returns 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 in the steering valve so that flow goes through the top of the spool. Flow entering the steering 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 steering valve port (E) and is available for raising and lowering the cutting units and for the traction charge circuit. Second, the remainder of the flow is drawn through the steering valve rotary meter and out steering valve port (L). Pressure moves the steering cylinder piston to extend the cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then out steering valve port (T) and then to the traction charge circuit.

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

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

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

Toro Part Number: **TOR47009**



Figure 10

Hydraulic Tester (Pressure and Flow)

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.

Toro Part Number: **TOR214678**



Figure 11

O-ring Kit

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

Toro Part Number: **117-2727**



Figure 12

High Flow Hydraulic Filter Kit

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

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

Toro Part Number: **TOR6011**

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

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



Figure 13

Hydraulic Hose Kit

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

Toro Part Number: **TOR6007**

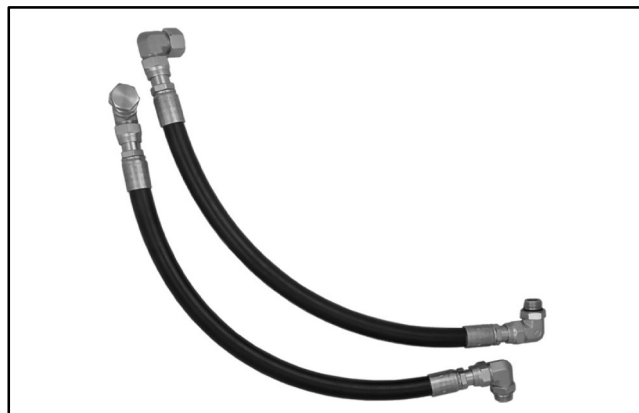


Figure 14

Hydraulic Test Fitting Kit

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

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

Toro Part Number: **TOR4079**








FITTING		TOOL NUMBER		FITTING		TOOL NUMBER	
	Swivel Nut Run Tee (2 ea.)					Union (1 ea.)	
	Size	Toro No.	Size	Toro No.		No. 6 to No. 8	TOR4079-8
	No. 4	TOR4079-3	No. 10 to No. 8	TOR4079-2		No. 8 to No. 8	TOR4079-9
	No. 6	TOR4079-12	No. 8 to No. 8	TOR4079-9			
No. 8	TOR4079-4				Reducer (1 ea.)		
No. 10	TOR4079-5	Size	Toro No.		No. 10 to No. 8	TOR4079-7	
		No. 12 to No. 8	TOR4079-6				
	Plug (2 ea.)					Test Cap Fitting (2 ea.)	
	Size	Toro No.	Size	Toro No.		No. 4	TOR4079-10
	No. 4	TOR4079-13	No. 6	TOR4079-11		No. 6	TOR4079-11
	No. 6	TOR4079-14	No. 8	TOR4079-21		No. 8	TOR4079-21
No. 8	TOR4079-15			No. 10	TOR4079-1		
No. 10	TOR4079-16						
	Cap (2 ea.)					Test Fitting (2 ea.)	
	Size	Toro No.	Size	Toro No.		7/16-20 ORB	TOR4079-22
	No. 4	TOR4079-17	1/8" Pipe Thd.	TOR4079-23			
	No. 6	TOR4079-18					
No. 8	TOR4079-19						
No. 10	TOR4079-20						

Figure 15

Measuring Container

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

Toro Part Number: **TOR4077**



Figure 16

Wheel Hub Puller

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

Toro Part Number: **TOR4097**



Figure 17

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.

General Hydraulic System Problems

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. Pump suction line has an air leak.
Hydraulic system operates hot.	Oil level in reservoir is low. Suction screen in reservoir is loose or clogged. Oil is contaminated or too light. Brakes are binding or are incorrectly adjusted. Piston pump 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. high ambient temperatures, use of verticutter) may require use of oil cooler. Charge pressure is low (see Charge Pressure Relief Valve Pressure Test). Wheel motor(s) or reel motor(s) are worn or damaged (see Wheel Motor Efficiency and Reel Motor Case Drain Flow Tests). Piston (traction) pump is worn or damaged (see Piston (Traction) Pump Flow Test).

Hydraulic System

Traction Circuit Problems

Problem	Possible Cause
Neutral is difficult to find or unit operates in one direction only.	<p>External traction control linkage is misadjusted, disconnected, binding or damaged.</p> <p>Piston (traction) pump is worn or damaged (see Piston (Traction) Pump Flow Test).</p>
Traction response is sluggish.	<p>Hydraulic oil is very cold.</p> <p>Brakes are binding or are incorrectly adjusted.</p> <p>Piston pump by-pass valve is open or defective.</p> <p>Charge pressure is low (see Charge Pressure Relief Valve Pressure Test).</p> <p>Piston pump relief valves are leaking or damaged.</p> <p>Piston (traction) pump or wheel motor(s) are worn or damaged (see Piston (Traction) Pump Flow and Wheel Motor Efficiency Tests).</p>
No traction exists in either direction.	<p>Brakes are binding or are incorrectly adjusted.</p> <p>Oil level in reservoir is low (other hydraulic circuits affected as well).</p> <p>Piston pump by-pass valve is open or defective.</p> <p>Charge pressure is low (see Charge Pressure Relief Valve Pressure Test).</p> <p>Piston (traction) pump or wheel motor(s) are worn or damaged (see Piston (Traction) Pump Flow and Wheel Motor Efficiency Tests).</p>
Wheel motor will not turn.	<p>Brakes are binding or are incorrectly adjusted.</p> <p>Key on wheel motor shaft is sheared or missing.</p> <p>Wheel motor is damaged.</p>
Wheel motor will not hold load in neutral.	<p>Make up fluid from charge pump is not available.</p> <p>Piston pump relief valves are leaking or damaged.</p>

NOTE: The piston pump used on Greensmaster 3250-D machines is equipped with relief valves for both the forward and reverse direction. Due to engine output, it is unlikely that traction pressure will reach relief valve settings. If, however, a piston pump relief valve is leaking or otherwise faulty, traction performance would be affected.

Mow Circuit Problems

Problem	Possible Cause
Gear pump is noisy (cavitation).	<p>Oil level in reservoir is low (other hydraulic circuits affected as well).</p> <p>Hydraulic pump suction line is restricted.</p> <p>Hydraulic pump suction line has an air leak.</p>
Reels will not turn.	<p>Solenoid valve S1R1 is stuck open or damaged.</p> <p>An electrical problem exists (see Chapter 5 – Electrical System).</p> <p>FC1 logic valve in control manifold is stuck open.</p> <p>PRV valve in control manifold is stuck closed.</p> <p>Pilot piston in control manifold is stuck or damaged.</p> <p>Front section of gear pump is worn or damaged (see Gear Pump (Front Section) Flow Test).</p>
Reel speed is erratic.	<p>Cutting unit problem exists (see Chapter 7 – DPA Cutting Units).</p> <p>Hydraulic manifold reel circuit cartridge is leaking or damaged.</p> <p>Hydraulic manifold orifice is plugged.</p>
Reel speed is low.	<p>Cutting unit problem exists (see Chapter 7 – DPA Cutting Units).</p> <p>Hydraulic manifold reel circuit cartridge is leaking or damaged.</p> <p>Excessive internal wear in reel motor exists (see Reel Motor Case Drain Flow Test).</p>

Lift/Lower Circuit Problems

Problem	Possible Cause
Cutting units will not lift or lift slowly.	<p>Engine speed is too low.</p> <p>Oil level in reservoir is low (other hydraulic circuits affected as well).</p> <p>Lift cylinder linkage is binding or broken.</p> <p>Lift cylinder bushings bind.</p> <p>Charge circuit pressure is low (see Charge Relief Valve Pressure Test).</p> <p>Implement relief valve is leaking or damaged (see Implement Relief Valve Pressure Test).</p> <p>Solenoid valve (S2) in hydraulic manifold is leaking or damaged.</p> <p>Relief valve (R2) is stuck, leaking or damaged (see Lower Cutting Units Relief Valve (R2) Pressure Test).</p> <p>Lift cylinders leak internally.</p> <p>Spool in steering valve is hung up (see Steering Valve Test).</p> <p>Gear pump (rear section) is worn or damaged (see Gear Pump (Rear Section) Flow Test).</p>
Cutting units raise, but will not stay up.	<p>Hydraulic manifold solenoid valve (S4) leaks.</p> <p>Lift cylinders leak internally.</p>

Steering Circuit Problems

Problem	Possible Cause
Steering wheel is hard to turn.	Steering valve has insufficient oil flow (charge and lift circuits affected as well). Emergency steering ball in steering 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 valve are worn or broken. Gear wheel set in steering valve is worn. Steering cylinder is seized or has worn piston seals (see Steering Valve Test).
Steering wheel will not return to the neutral position.	Spool and sleeve are sticking to steering valve housing assembly (see Steering Valve Test).
Steering wheel can turn on its own.	Leaf springs in steering valve are broken or stuck. Spool and sleeve are sticking to steering valve housing assembly (see Steering Valve Test).
Backlash results when turning steering wheel.	Cardan shaft fork in steering valve is worn or broken. Leaf springs in steering 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.
The steering wheel can be turned without the rear wheel turning.	The steering cylinder is worn. The gear set in the steering valve is worn.
Steering response is too slow and heavy when trying to turn quickly.	Oil supply to the steering valve is insufficient (charge and lift circuits affected as well).
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 power steering is low (charge and lift circuits affected as well). Implement relief valve in steering valve 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 hydraulic system 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 hydraulic test accuracy. Check pump speed with a phototac when performing hydraulic tests.

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

5. When using tester with pressure and flow capabilities, open the hydraulic tester load valve completely 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 all moving machine parts from contacting and damaging the hoses or tester.

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

9. Check control linkages for improper adjustment, binding components 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 hydraulic system 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 Pressure Test
- Wheel Motor Efficiency Test
- Piston (Traction) Pump Flow Test

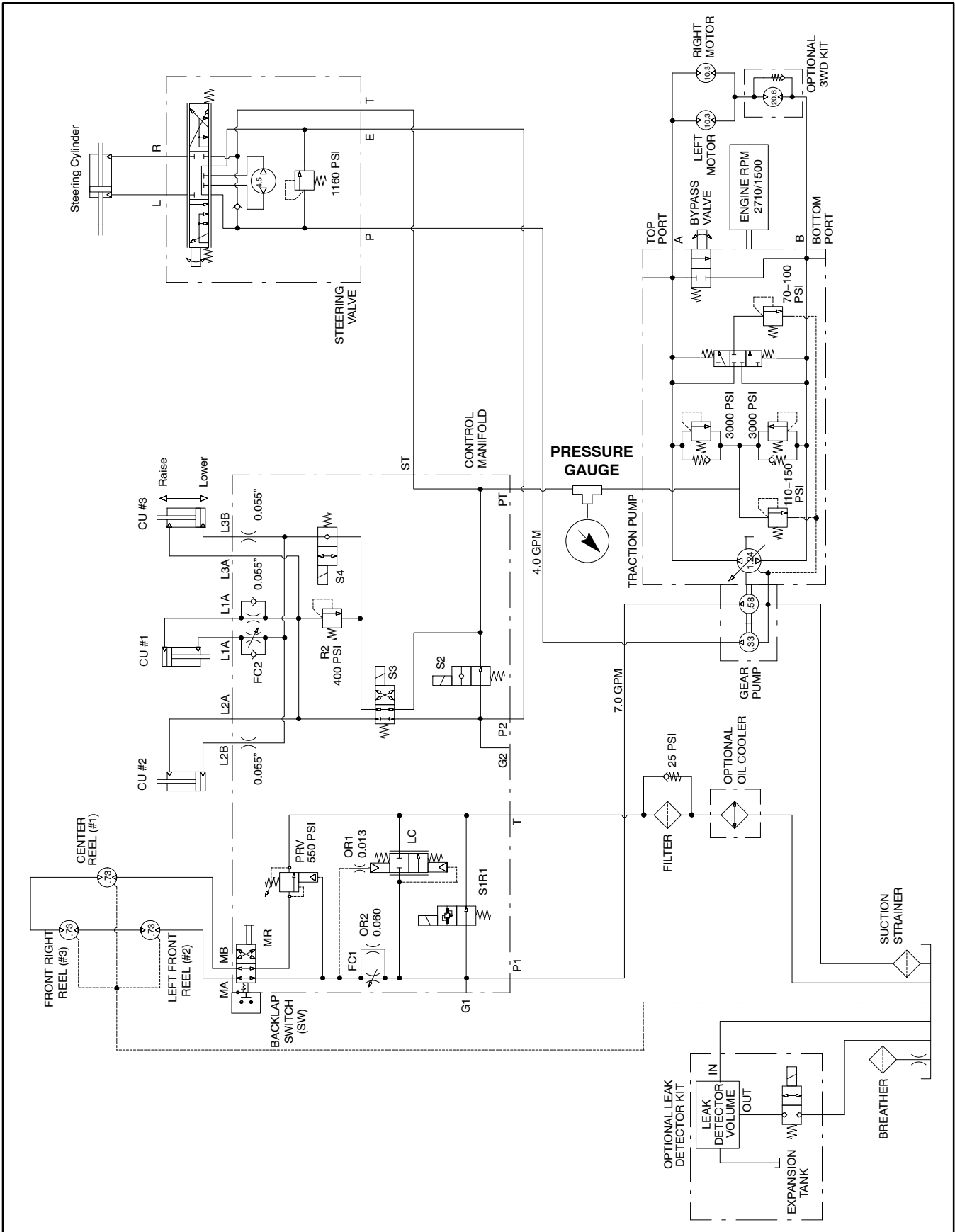
4. For problems with steering or lift/lower pressure, consider performing the following hydraulic tests:

- Charge Pressure Relief Valve Pressure Test
- Lower Cutting Units Relief Valve (R2) Pressure Test
- Implement Relief Valve Pressure Test
- Gear Pump (Rear Section) Flow Test
- Steering Valve Test

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

- Mow Circuit Relief Valve (S1R1) Pressure Test
- Reel Motor Case Drain Flow Test
- Gear Pump (Front Section) Flow Test

Charge Relief Valve Pressure Test (Using Pressure Gauge)



Procedure for Charge Relief Valve Pressure Test

The traction charge circuit is designed to replace loss of hydraulic fluid from the closed loop traction circuit. The charge relief valve pressure test will identify if charge pressure is correct.

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.



3. Install 1000 PSI (70 bar) pressure gauge with hydraulic hose attached to test port in the tee fitting on the bottom of the control manifold (Fig. 18).
4. Make sure that traction pedal, steering wheel and joystick are in the neutral position.
5. Start engine and run at low idle speed. Check for hydraulic leakage at pressure gauge and correct before proceeding with test.
6. Move throttle so engine is running at high idle speed (2710 ± 50 RPM).
7. Pressure gauge should read approximately **100 to 150 PSI (7 to 10 bar)**.
8. Shut off engine. Record test results.
9. If specification is not met, remove piston pump back plate assembly that contains the charge relief valve (see Piston (Traction) Pump Service in the Service and Repairs section of this chapter). Repair or replace relief valve components as necessary.

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

- A. Position machine so that a load can be placed on the traction system. For example, chain the machine to an immovable object or chock all drive wheels to prevent the machine from moving.
- B. With pressure gauge still connected, sit in the operator seat, start the engine and move throttle so engine is running at high idle speed. Move functional control lever to the transport position.
- C. While monitoring the pressure gauge, push the traction pedal in the appropriate direction (forward or reverse) to allow traction system load.
- D. The charge pressure should drop no more than 20% from no-load charge pressure measured in step 7 above (e.g. if charge pressure in step 8 is 125 PSI (9 bar), charge pressure in forward or reverse under load should be more than 100 PSI (7 bar)).
- E. If charge pressure is good under no load, but drops below specification when under traction load, the piston (traction) pump and/or wheel motors should be suspected of wear and inefficiency. When the pump and/or traction motor(s) are worn or damaged, the charge pump is not able to keep up with internal leakage in traction circuit components. Further testing of the traction circuit should be completed (see Piston (Traction) Pump Flow and Wheel Motor Efficiency Tests in this section).

11. When charge pressure testing is complete, disconnect pressure gauge from the test port and install dust cap.

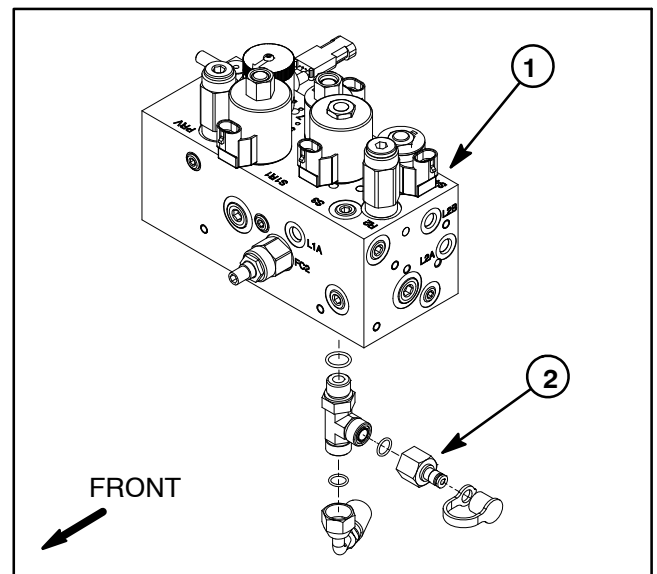
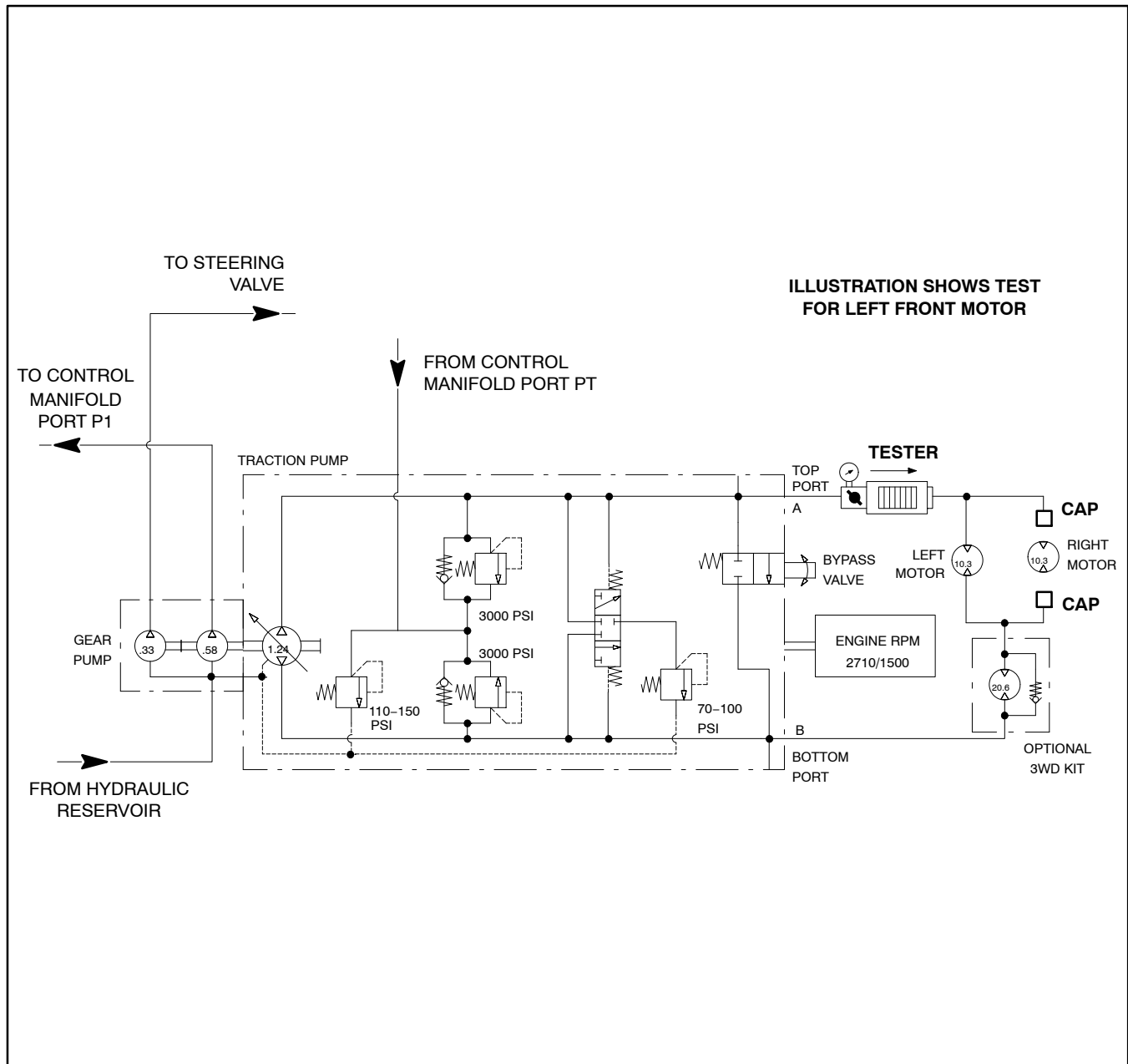


Figure 18

1. Control manifold
2. Test port

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



Procedure for Wheel Motor Efficiency Test

NOTE: Over a period of time, a wheel motor can wear internally. A worn motor may by-pass oil 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.



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 Unit Operator's Manual).

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

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

6. Chock front wheel being tested to prevent rotation of the wheel.

7. Thoroughly clean junction of hydraulic lines and fittings at the front wheel motor that is **not** being tested. Disconnect hydraulic lines from front wheel motor that is **not** being tested. Cap the disconnected hydraulic lines and plug ports in wheel motor.

8. Thoroughly clean junction of hydraulic hose and the upper hydraulic fitting on the front side of the piston pump (Fig. 19). Disconnect hose from the upper hydraulic fitting.

9. Install tester with pressure gauge and flow meter in series with the pump and the disconnected hose (same tester connections as Piston (Traction) Pump Flow Test). **Make sure the tester flow control valve is fully open.**



10. Start engine and move throttle to high idle speed (2710 ± 50 RPM).

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

12. 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.

13. Release traction pedal, rotate wheel being tested and retest. Testing of wheel motor leakage in three (3) different wheel positions will provide most accurate test results.

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

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

16. 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 10 to 15 for the second front wheel motor.

17. 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.

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.



D. Complete steps 10 to 15.

NOTE: The Piston (Traction) Pump Flow Test uses the same tester connections as this wheel motor efficiency test. If necessary, perform the piston pump flow test before removing the tester from the machine.

18. When wheel motor testing is completed, disconnect tester from hydraulic fitting and hose. Reconnect hose to piston pump fitting.

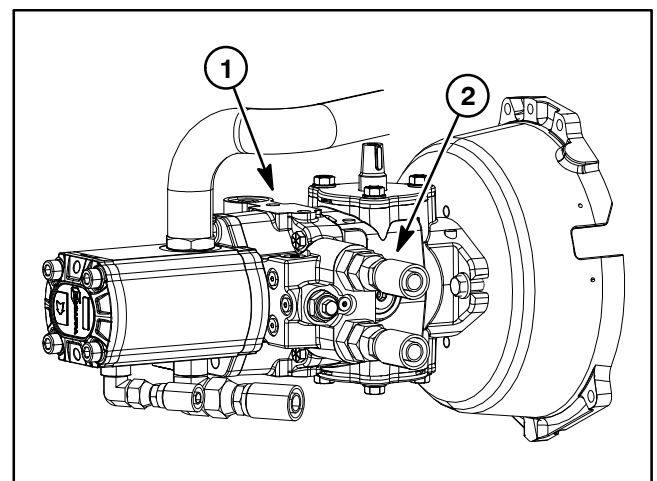
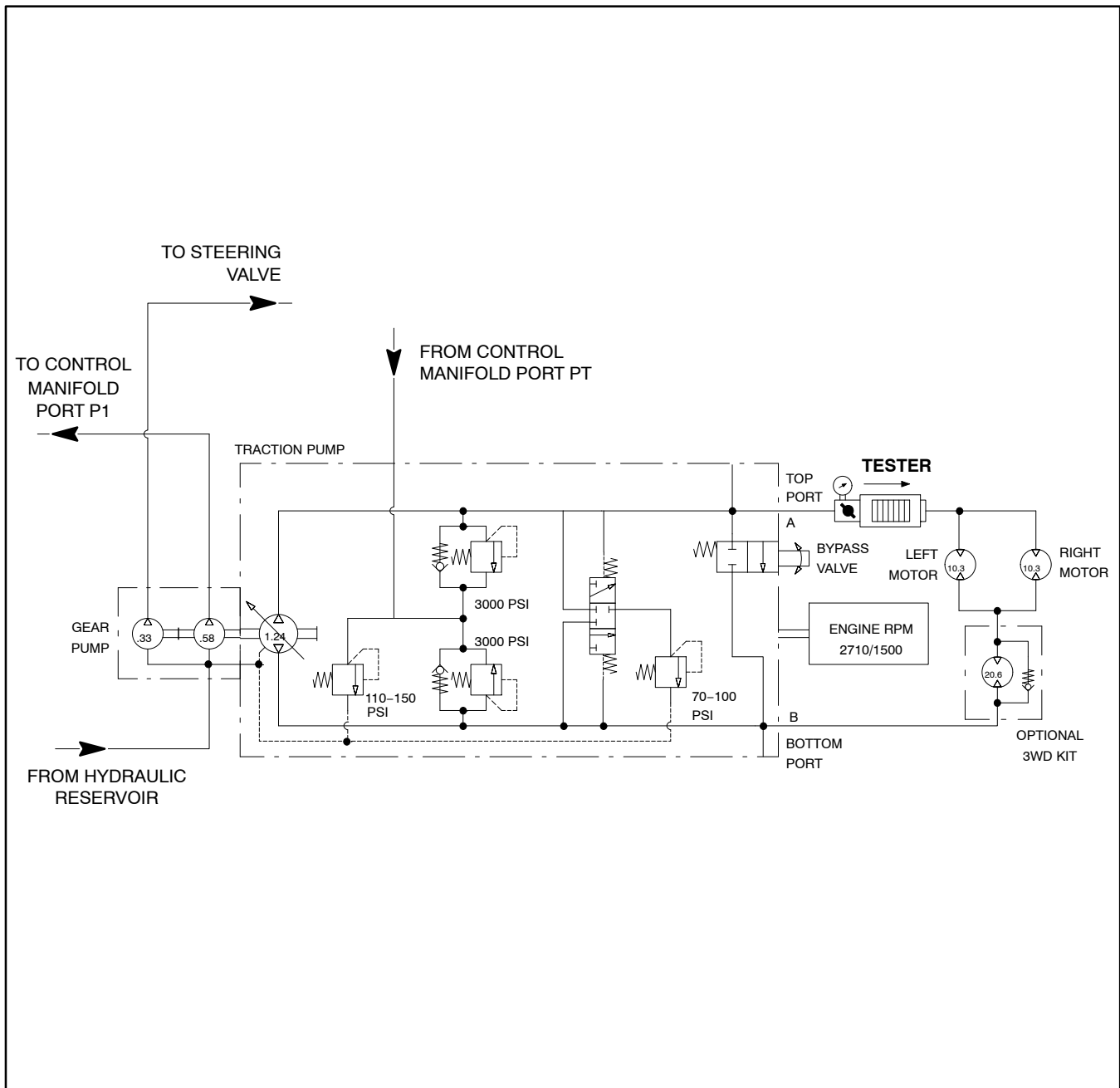


Figure 19

1. Piston pump

2. Upper hydraulic hose

Piston (Traction) Pump Flow Test (Using Tester with Flowmeter and Pressure Gauge)



Procedure for Piston (Traction) Pump Flow Test

This test measures piston 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 Unit Operator's Manual). Also, ensure that pump is at full stroke when traction pedal is pushed into fully forward position.

4. Raise and support machine so front wheels are off the ground to allow flow through the traction circuit. If machine is equipped with 3 wheel drive, raise and support machine so rear wheel is off the ground as well.

5. Thoroughly clean junction of hydraulic hose and the upper hydraulic fitting on the front side of the piston pump (Fig. 20). Disconnect hose from the upper hydraulic fitting.

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 high idle speed (**2710 ± 50 RPM**).

	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 tester flow control valve until pressure gauge reads **1000 PSI (69 bar)**.

11. Flow gauge reading for a piston pump in good condition should be approximately **13.8 GPM (52 LPM)**. Record test results.

12. Open control valve on tester, release traction pedal, and turn off machine.

13. If flow was less than **12 GPM (45 LPM)** or a pressure of **1000 PSI (69 bar)** cannot be obtained, consider the following:

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

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

C. Make necessary repairs before performing additional traction circuit tests.

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

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

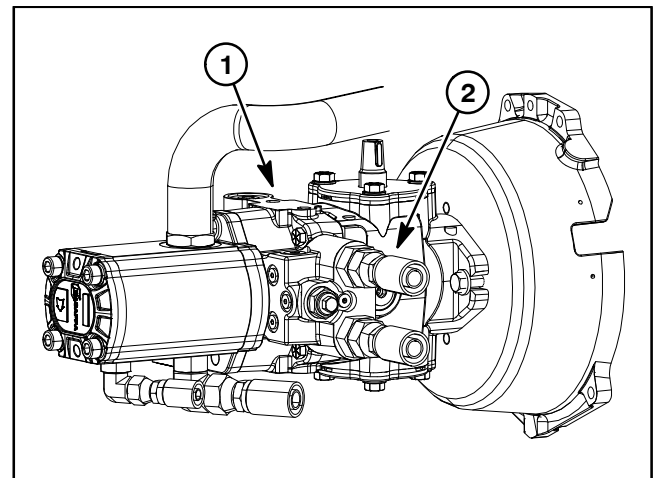
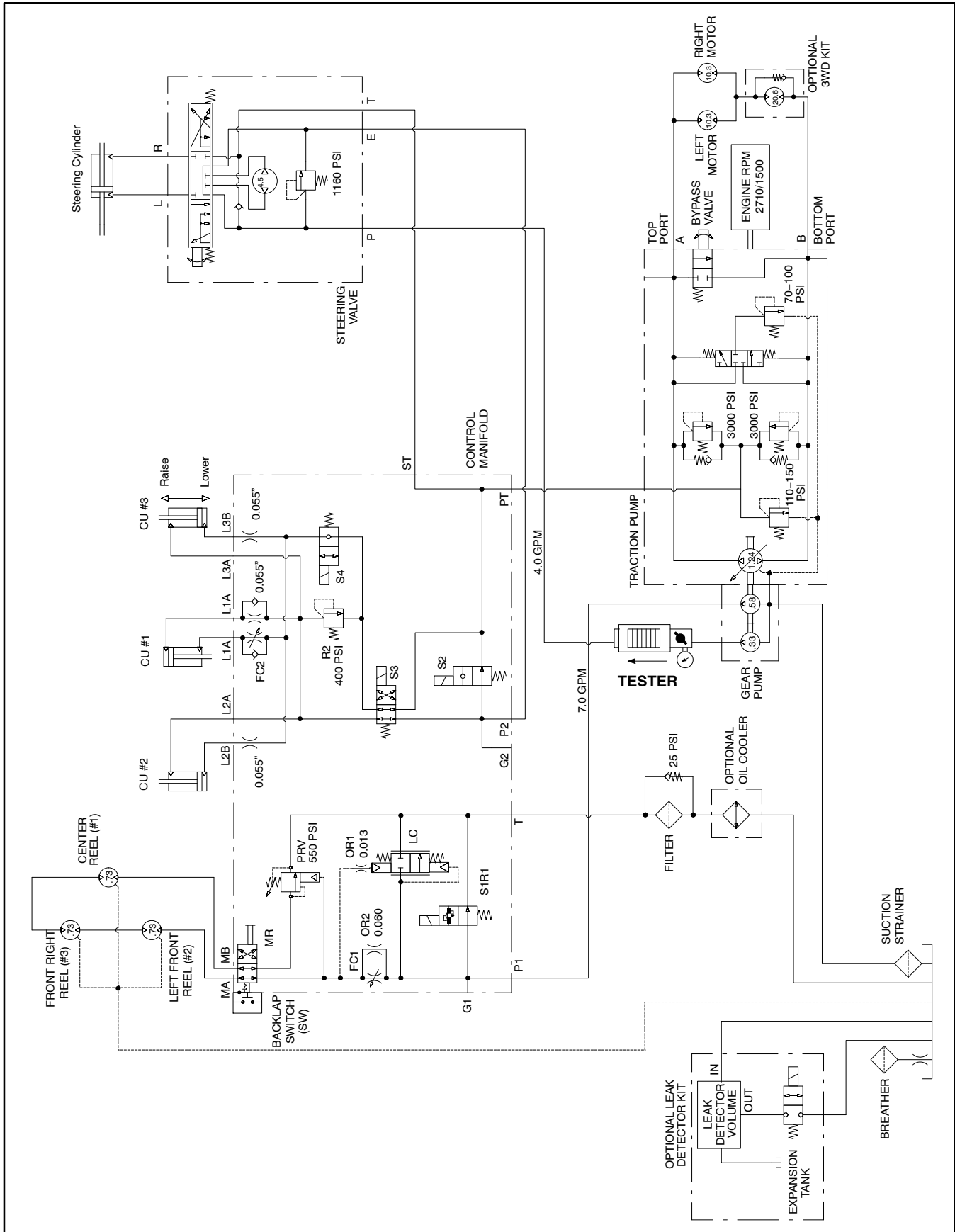


Figure 20

1. Piston pump

2. Upper hydraulic hose

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



Procedure for Gear Pump (Rear Section) 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.



3. Thoroughly clean junction of hydraulic hose and the hydraulic fitting in the rear gear pump section (Fig. 21). This hose leads to port P in the steering valve.
4. Disconnect the hose from the fitting in the rear gear pump section.
5. Install tester with pressure gauge and flow meter in series with the gear pump fitting and the disconnected hose. **Make sure flow control valve on the tester is fully open.**
6. Make sure that traction pedal and joystick control are in neutral and the parking brake is engaged.
7. Start engine and operate at high idle speed (2710 ± 50 RPM).

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

8. Watch tester flow and pressure gauge carefully while slowly closing the flow control valve on the tester until the pressure gauge reads **800 PSI (55 bar)**.

9. Flow gauge reading for a rear gear pump section in good condition should be approximately **3.6 GPM (13.6 LPM)**. Record test results.

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

11. If flow was less than **3.1 GPM (11.7 LPM)** or a pressure of **800 PSI (55 bar)** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove gear pump and repair or replace as necessary.

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

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

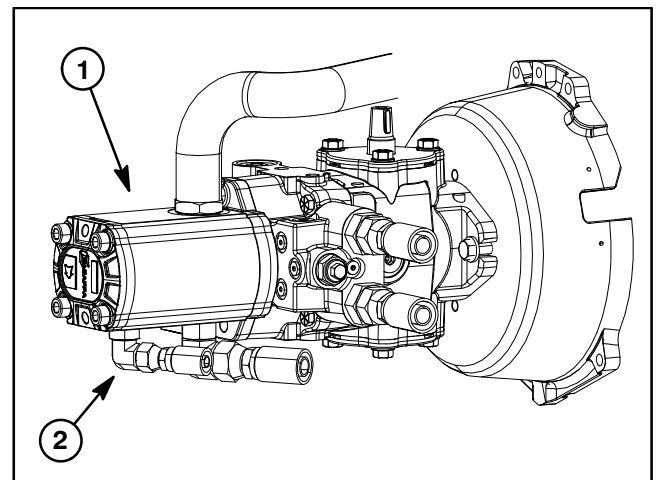
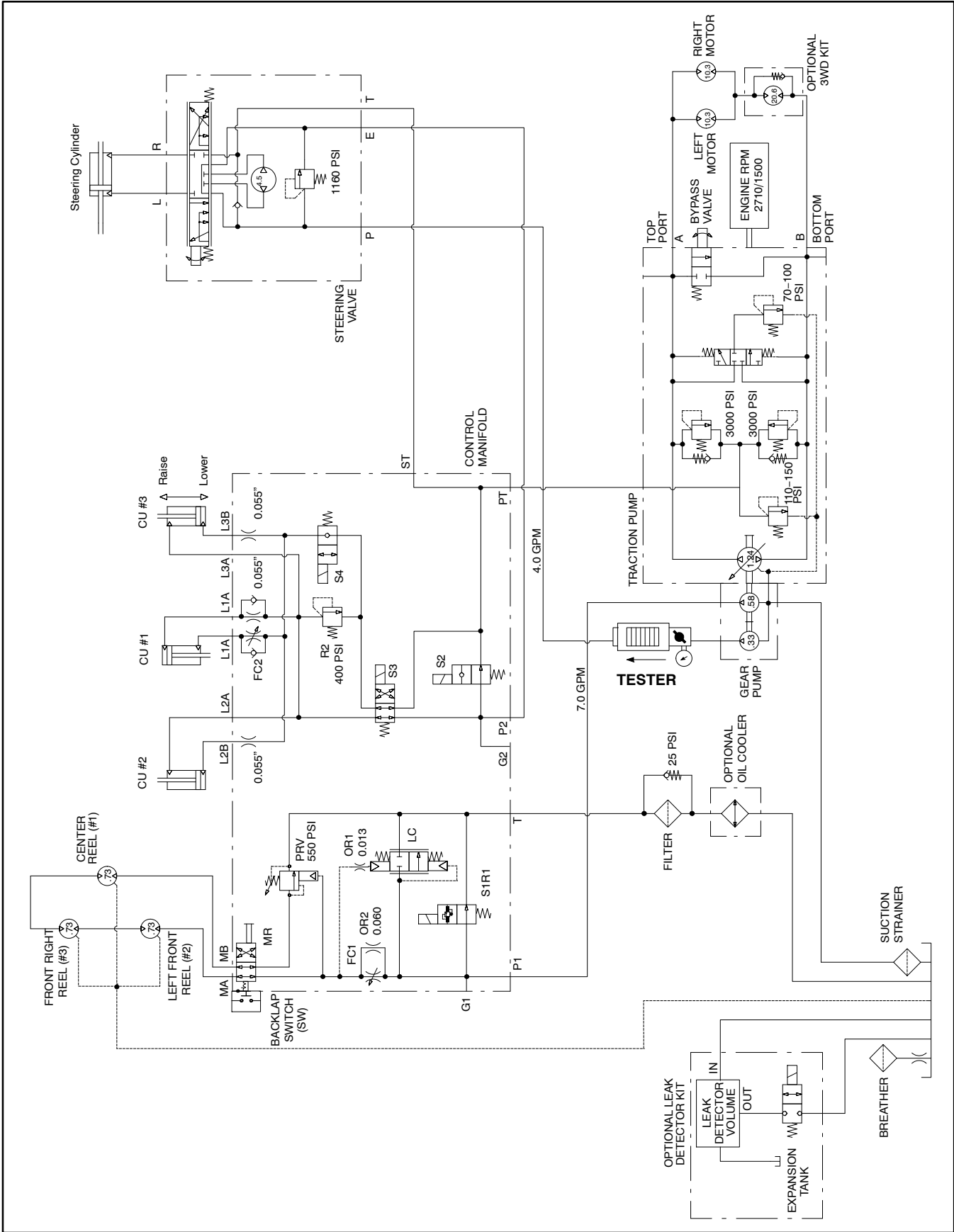


Figure 21

1. Gear pump

2. Rear section fitting

Implement Relief Valve Pressure Test (Using Pressure Gauge)

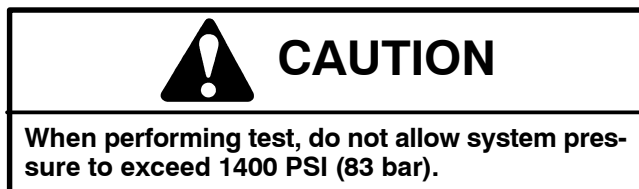


Procedure for Implement Relief Valve Pressure Test

1. Make sure hydraulic oil is at normal operating temperature by operating the machine for approximately ten (10) minutes.
2. Park machine on a level surface with the cutting units lowered. Make sure engine is off. Make sure the hydraulic tank is full.



3. Measure and record charge relief valve pressure (see Charge Relief Valve Pressure Test in this section).
4. Thoroughly clean junction of hydraulic hose and the hydraulic fitting in the rear gear pump section (Fig. 22). This hose leads to port P in the steering valve.
5. Disconnect the hose from the fitting in the rear gear pump section.
6. Install tester with pressure gauge and flow meter in series with the gear pump fitting and the disconnected hose (same connections as Gear Pump (Rear Section) Flow Test). **Make sure flow control valve on the tester is fully open.**
7. Start and run engine at full speed (2750 ± 50 RPM).



8. Watch the pressure gauge on the tester and move the joystick to the raise position. Momentarily hold the joystick with the cutting units fully raised causing the implement relief valve to open. Record pressure at which the relief valve opens.
9. Release joystick and shut off engine.

NOTE: The implement relief valve is in series with charge relief valve. Charge relief pressure will affect the implement relief pressure.

10. Implement relief valve 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 (7 bar), the implement relief valve pressure should be from 1150 to 1350 PSI (80 to 93 bar)).

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

11. The implement relief valve is also activated by the steering system. With tester still connected to gear pump outlet, start engine and watch the pressure gauge. Turn the steering wheel completely in one direction and hold. Relief valve 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 8 above.

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

NOTE: Gear Pump (Rear Section) Flow Test and Lower Cutting Units Relief Valve (R2) Pressure can be measured with tester positioned as described in this check (see Gear Pump (Rear Section) Flow Test and Lower Cutting Units Relief Valve (R2) Pressure Test in this section).

13. After testing is complete, remove pressure gauge from manifold test fitting.

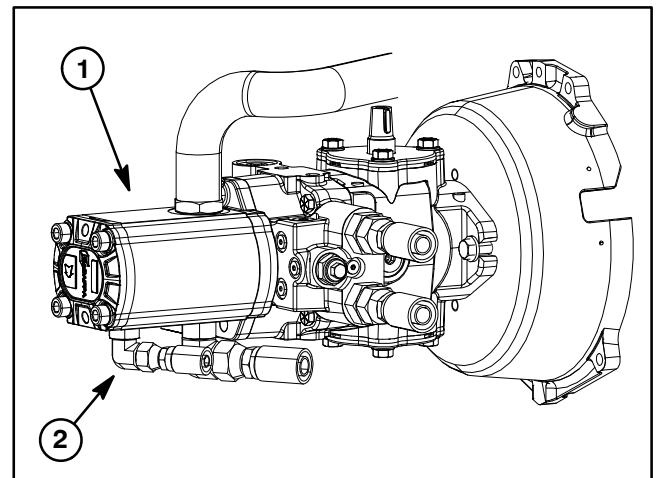
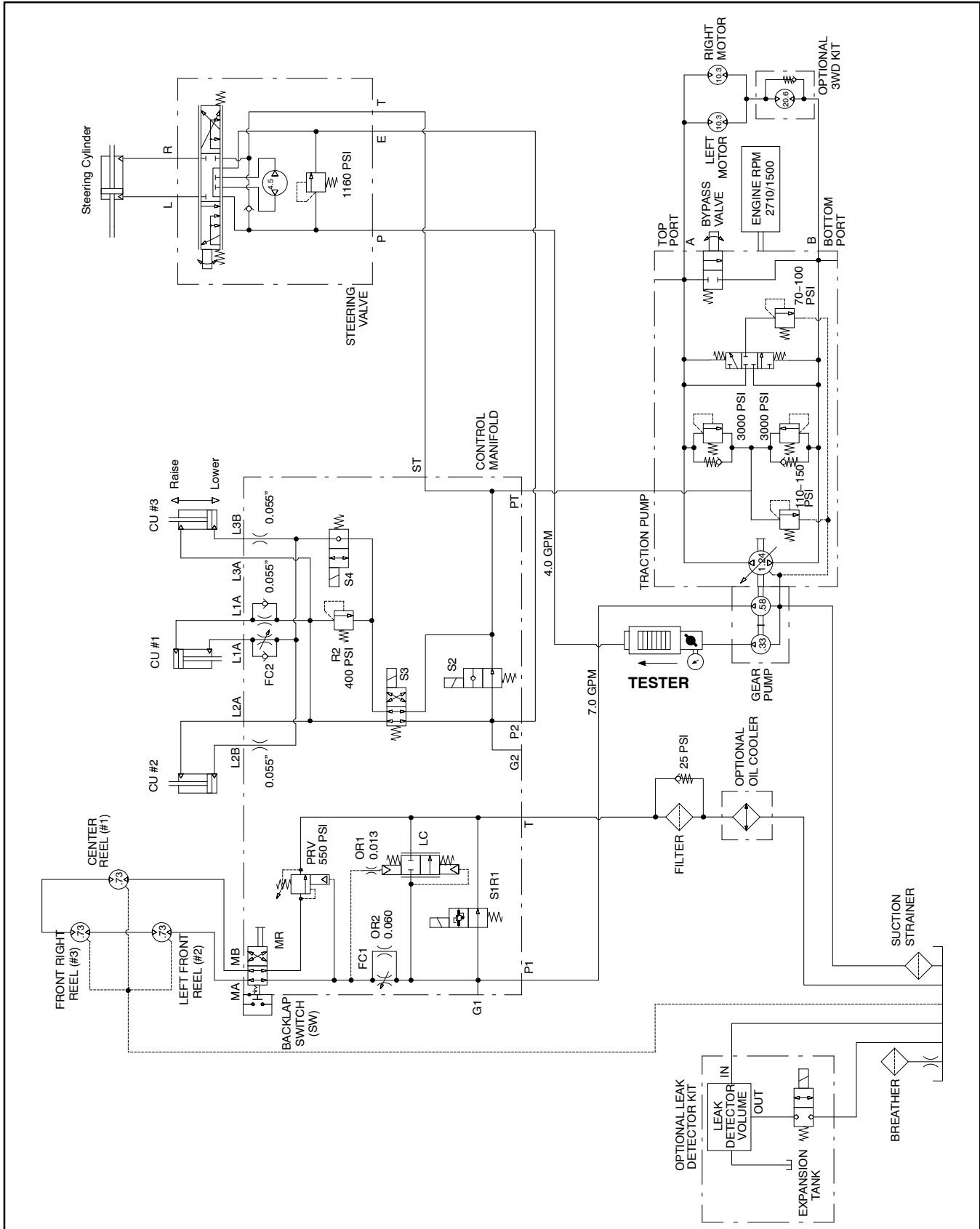


Figure 22

1. Gear pump
2. Rear section fitting

Lower Cutting Units Relief Valve (R2) Pressure Test (Using Tester with Flowmeter and 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. Make sure the hydraulic tank is full.



3. Measure and record charge relief valve pressure (see Charge Relief Valve Pressure Test in this section).
4. Thoroughly clean junction of hydraulic hose and the hydraulic fitting in the rear gear pump section (Fig. 23). This hose leads to port P in the steering valve.
5. Disconnect the hose from the fitting in the rear gear pump section.
6. Install tester with pressure gauge and flow meter in series with the gear pump fitting and the disconnected hose (same connections as Gear Pump (Rear Section) Flow Test). **Make sure flow control valve on the tester is fully open.**
7. Start engine and move throttle to full speed (**2710 ± 50 RPM**). Make sure that cutting units are fully lowered and then engage the cutting units.

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

8. Watch pressure gauge carefully while moving the joystick 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 is in series with the charge relief valve. Charge relief pressure will affect the lower cutting units relief pressure.

9. The lower cutting units relief valve pressure should be approximately **400 PSI (28 bar) higher than charge relief pressure** (e.g. if charge relief valve pressure is 100 PSI (7 bar), the lower relief valve pressure should be approximately 500 PSI (35 bar)).

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

NOTE: Gear Pump (Rear Section) Flow Test and Implement Relief Valve Pressure can be measured with tester positioned as described in this check (see Gear Pump (Rear Section) Flow Test and Implement Relief Valve Pressure Test in this section).

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

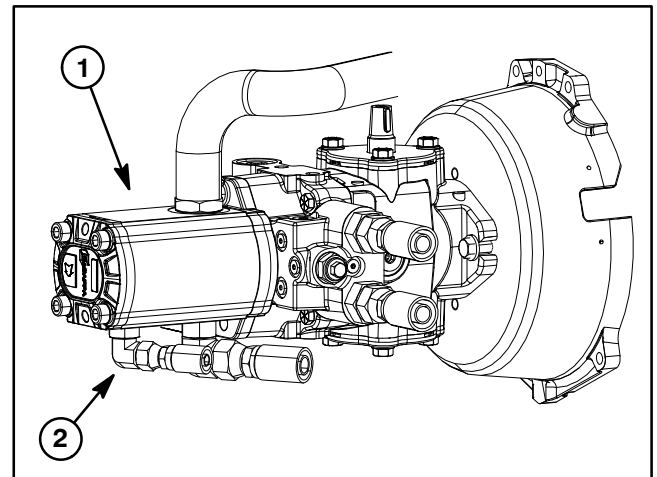
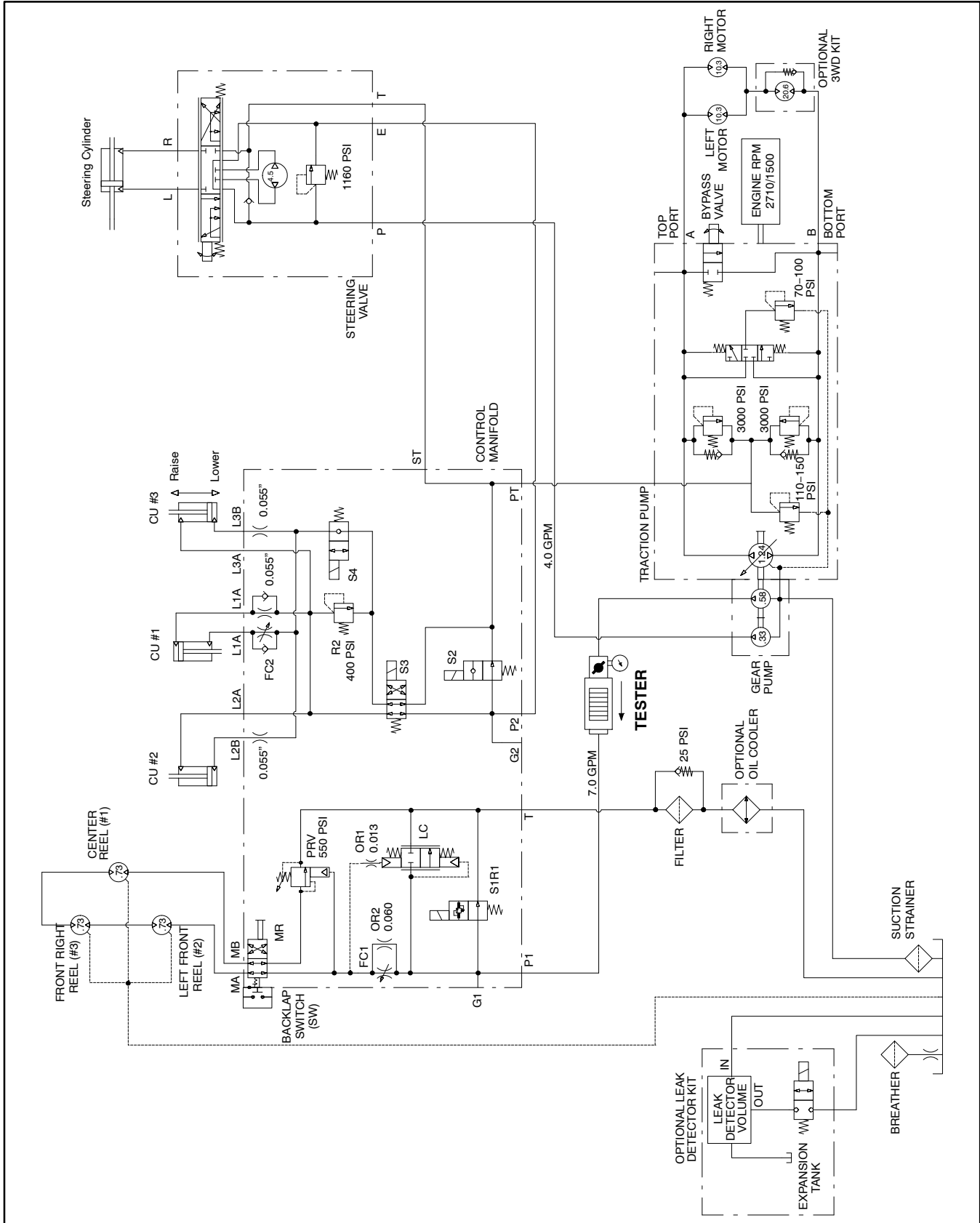


Figure 23

1. Gear pump
2. Rear section fitting

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



Procedure for Gear Pump (Front Section) 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.



3. Disconnect the hose from the fitting in the front gear pump section (Fig. 24). This hose leads to port P1 on the hydraulic manifold.
4. Install tester with pressure gauge and flow meter in series with front gear pump section fitting and the disconnected hose. **Make sure the flow control valve on the tester is fully open.**
5. Make sure that reel speed is set to highest speed setting (fully open) and that backlap knob on the hydraulic manifold is in the **mow** position.



6. Start engine and operate at high idle speed (2710 ± 50 RPM).

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

7. Watch pressure gauge carefully while slowly closing the flow control valve on the tester until **2000 PSI (138 bar)** is obtained.
8. Flow gauge reading for a gear pump section in good condition should be approximately **6.4 GPM (24.2 LPM)**. Record test results.
9. Once gear pump flow is recorded, open control valve on tester and shut off engine.
10. If flow was less than **5.5 GPM (20.8 LPM)** or a pressure of **2000 PSI (138 bar)** cannot be obtained, check for restriction in the gear pump intake line. If line is not restricted, remove gear pump and repair or replace as necessary.

11. When testing is complete, disconnect tester from gear pump fitting and hydraulic hose. Connect hose to pump fitting.

12. Adjust reel speed knob on mow control manifold to original setting.

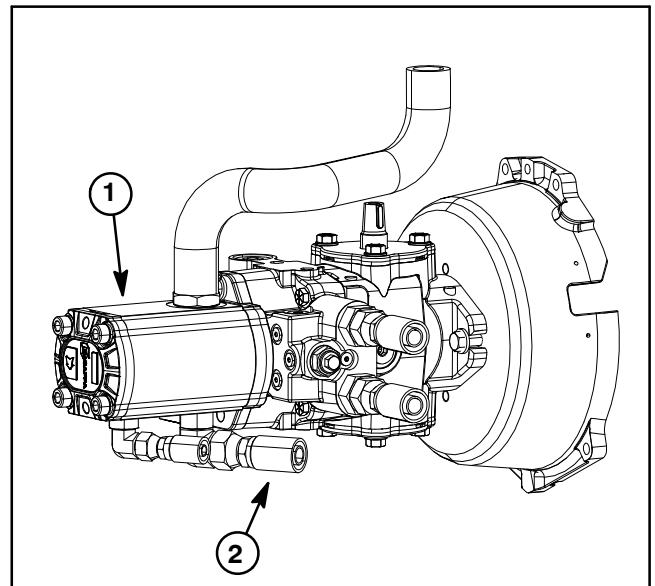
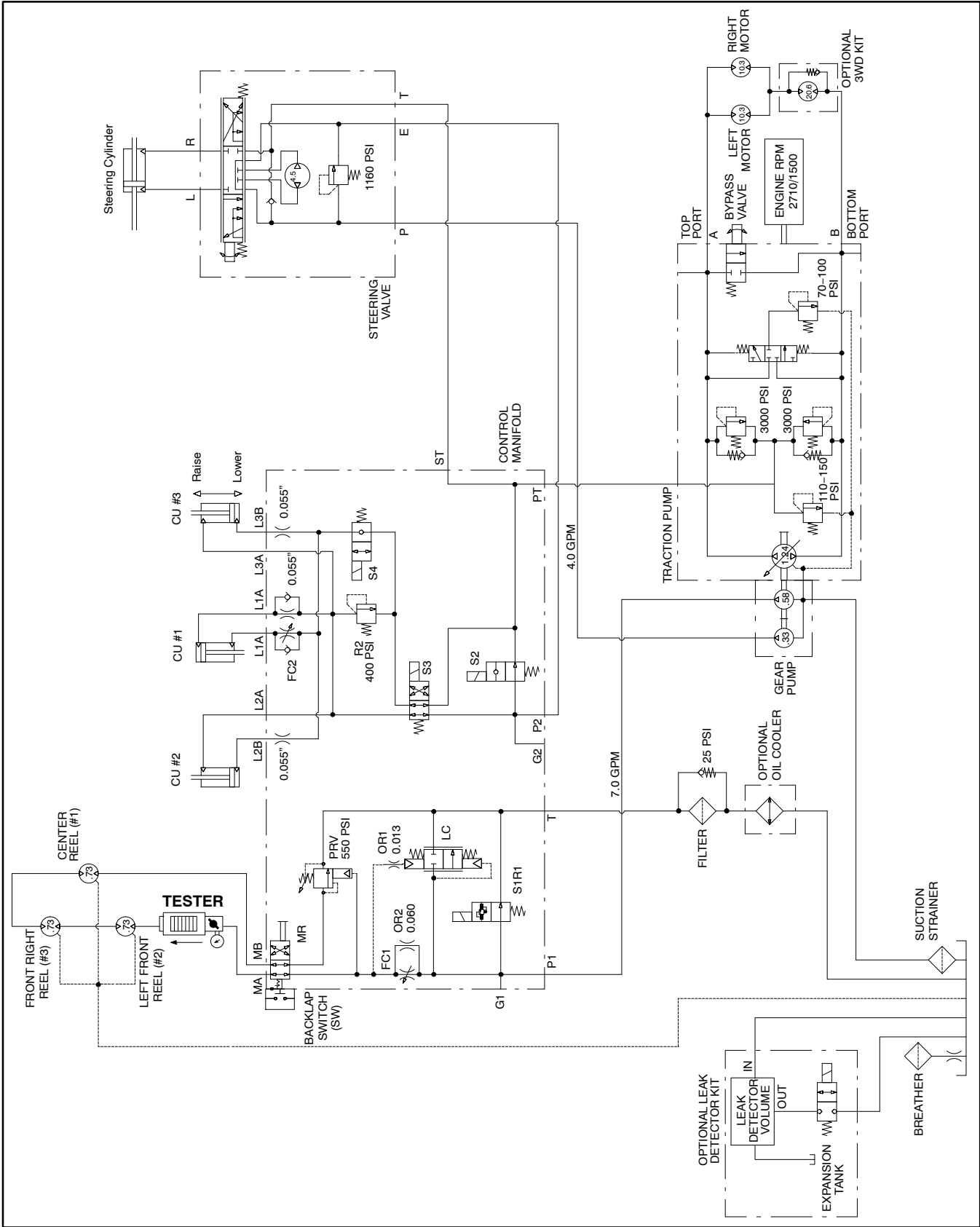


Figure 24

1. Gear pump
2. Front section hose

Mow Circuit Relief Valve (S1R1) Pressure Test (Using Tester with Flowmeter and Pressure Gauge)

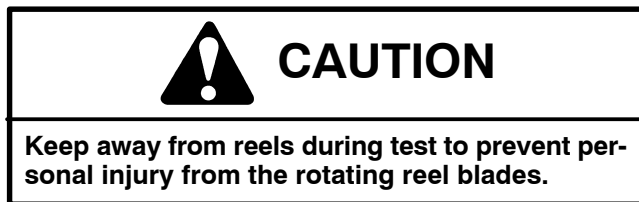


Procedure for Mow Circuit Relief Valve (S1R1) Pressure Test

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. Make sure the hydraulic tank is full.



3. Disconnect hose connection on the bulkhead that leads to the front port of the left front reel motor (Fig. 25).
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. Make sure that reel speed is set to highest speed setting (fully open) and that backlap knob on the hydraulic manifold is in the **mow** position.



7. Start engine and move throttle to high idle speed (**2710 ± 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. System pressure should be from **2700 to 3300 PSI (186 to 228 bar)** as relief valve (S1R1) opens. Record test results.

10. After recording relief pressure, disengage cutting units. Open control valve on tester and shut off engine.

- A. If relief valve pressure **is** correct, go to step 11.
- B. If relief valve pressure **is not** met, remove solenoid relief valve (S1R1) on hydraulic control manifold (Fig. 26). Clean or replace valve (see Hydraulic Manifold Service in the Service and Repairs section of this chapter). After valve service, retest relief valve (S1R1) pressure.

11. When testing is complete, disconnect tester from manifold and hydraulic hose. Reconnect hose to the bulkhead connection.

12. Correctly adjust bedknife.

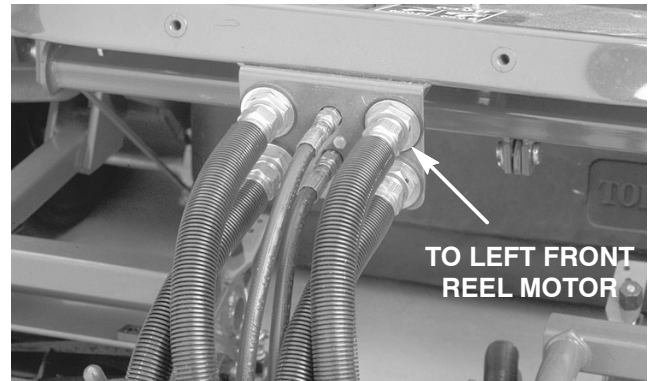


Figure 25

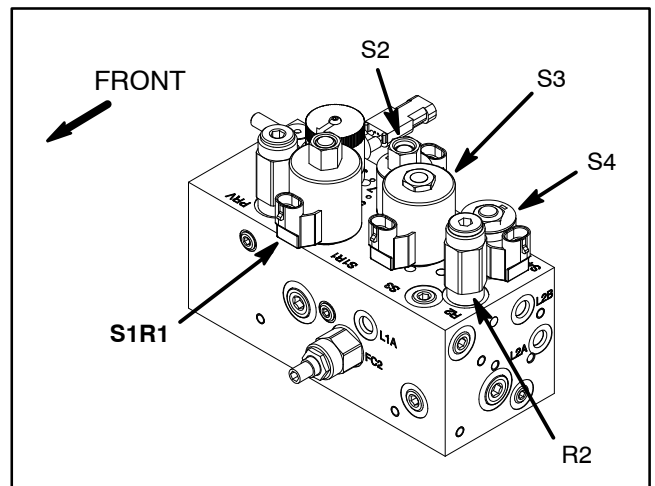
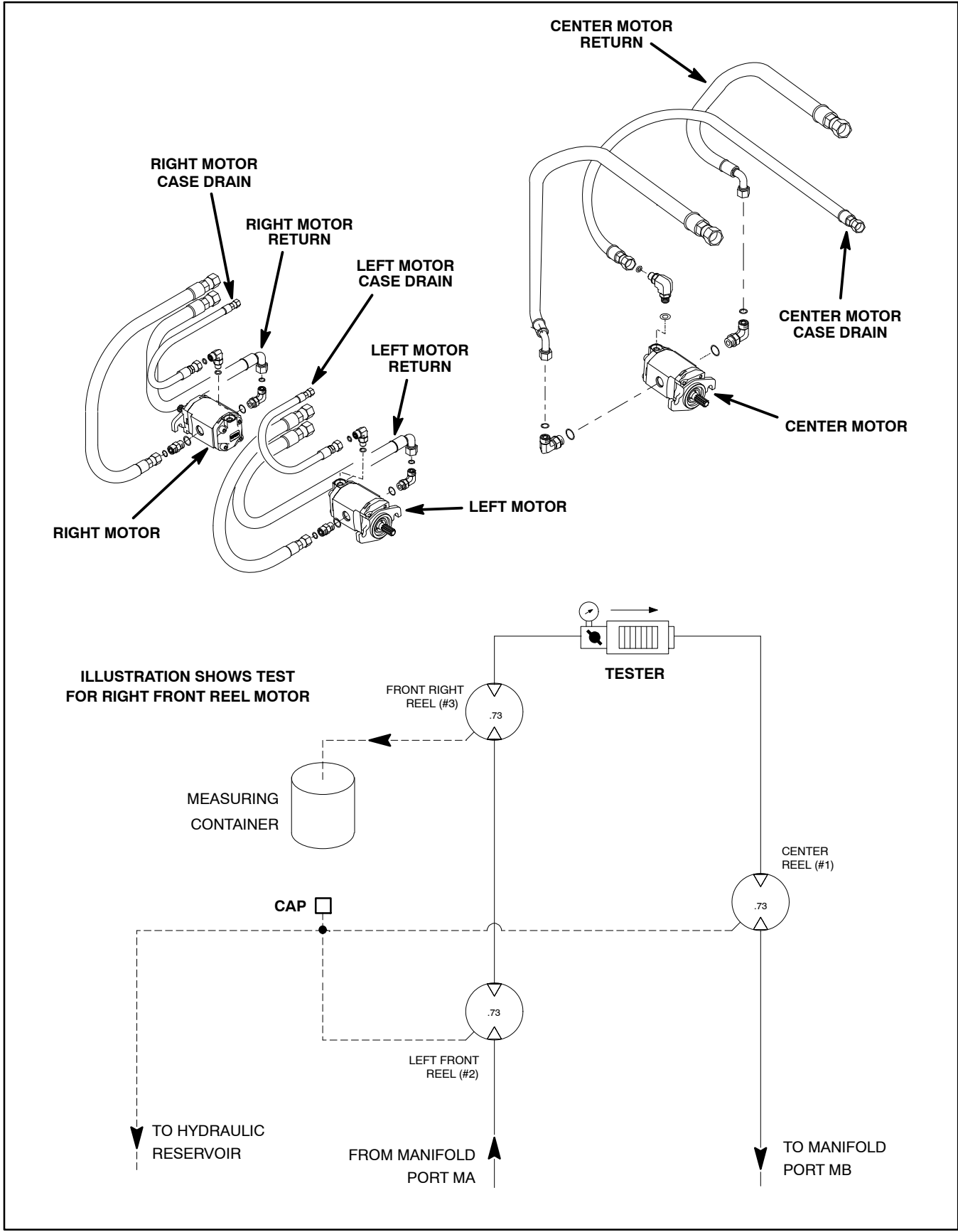


Figure 26

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

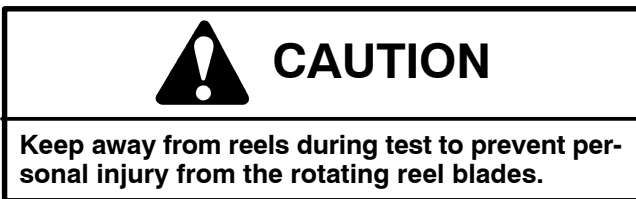


Procedure for Reel Motor Case Drain Flow Test

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.



3. For the suspected faulty cutting 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. Make sure that reel speed is set to highest speed setting (fully open) and that backlap knob on the hydraulic manifold is in the **mow** position.
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 high idle speed (**2710 ± 50 RPM**).



8. Move the functional control lever to **MOW** position and then engage reels with joystick. 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 **fifteen (15) seconds**. After **fifteen (15) seconds**, remove hose end from container.

10. Disengage cutting units, open control valve on tester and then 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) (0.5 GPM/1.9 LPM)**, repair or replace the reel motor as necessary.

13. When testing is complete, disconnect tester from cutting reel motor and return hose. Reconnect hose to the motor.

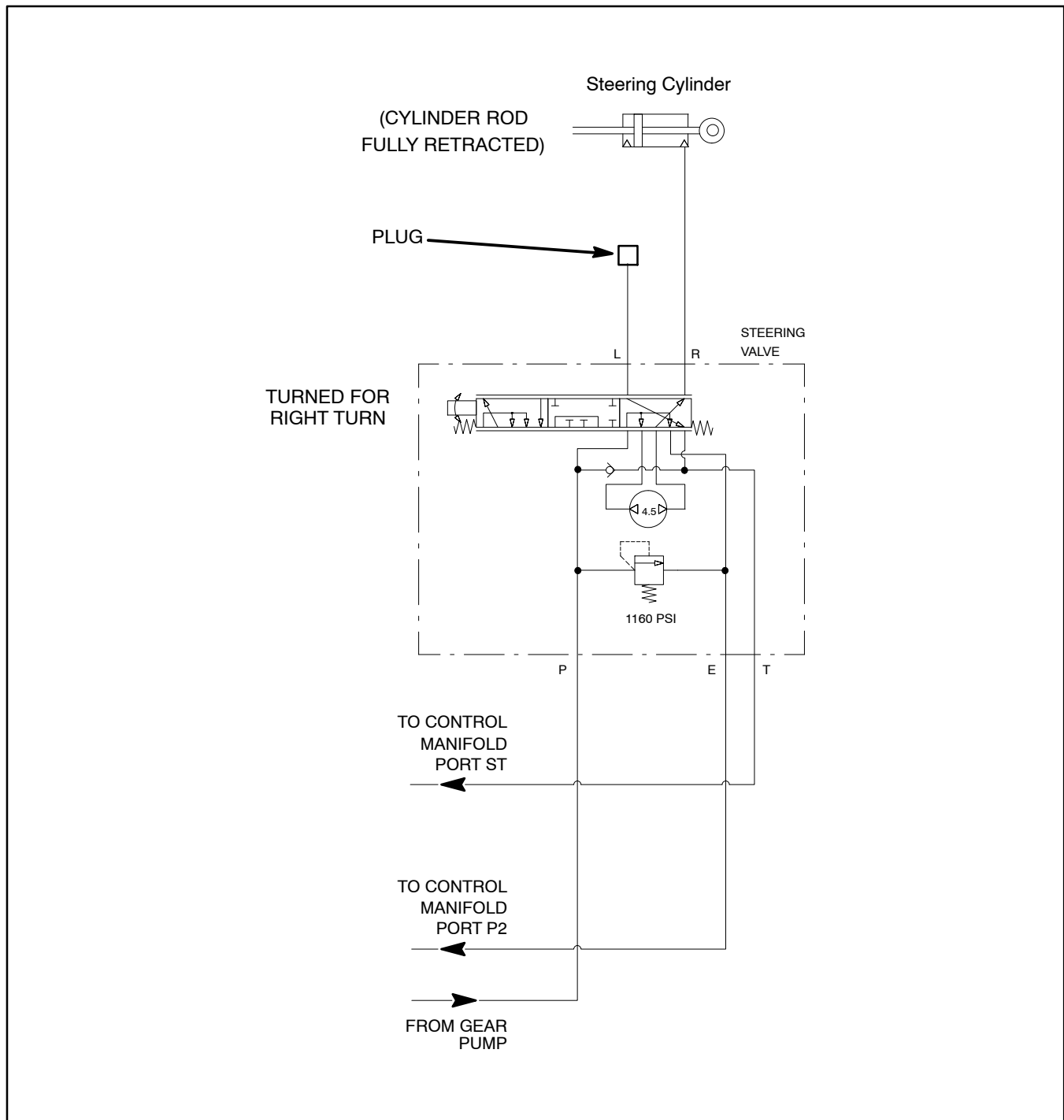
14. Remove plug from bulkhead fitting. Reconnect case drain hose to the bulkhead fitting.

15. Test other cutting 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 27

Steering Valve Test



Procedure for Steering 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 should be able to turn with no more than **45 in-lb (5.1 N-m)** of input 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 rear castor fork assembly. Make sure that these items are checked before proceeding with any hydraulic testing procedure.

5. Perform the Implement Relief Valve Pressure and Gear Pump (Rear Section) 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. Apply the parking brake.

B. Turn the steering wheel all the way for a right turn (clockwise) so that the steering cylinder rod is fully retracted.

C. Turn engine off.

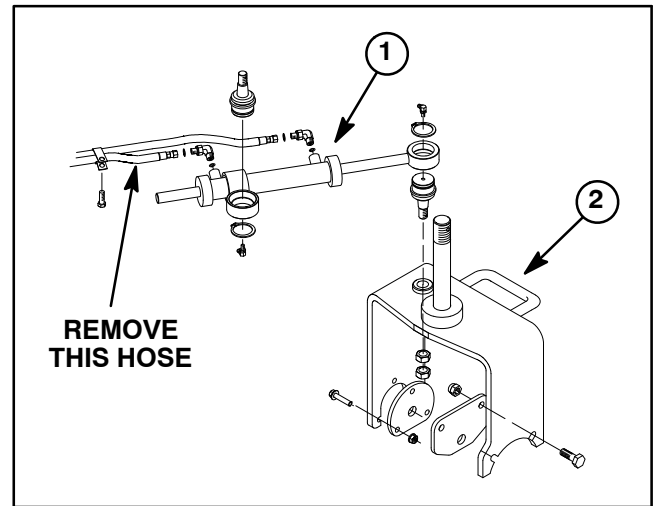


Figure 28

1. Steering cylinder

2. Rear caster fork



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 ball joint end of the steering cylinder (Fig. 28). Plug the end of the hose with a steel cap.

F. With the engine off, continue turning the steering wheel for a right turn (clockwise) with the steering cylinder fully retracted. Observe the open fitting on the steering cylinder as the steering wheel is turned. If oil comes out of the open fitting while turning the steering wheel for a right turn, the steering cylinder has internal leakage and must be repaired or replaced.

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


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

Adjustments

Adjust Manifold Relief Valve (R2)

The hydraulic manifold includes an adjustable relief valve in the lift circuit (Fig. 29). If adjustment to this valve is necessary, follow the following procedure.

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

**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 on control manifold.
2. Remove cap on relief valve with an allen wrench.
3. To **increase** pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.
4. To **decrease** pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.
5. Install and tighten cap on relief valve.
6. Recheck relief pressure and readjust as needed.

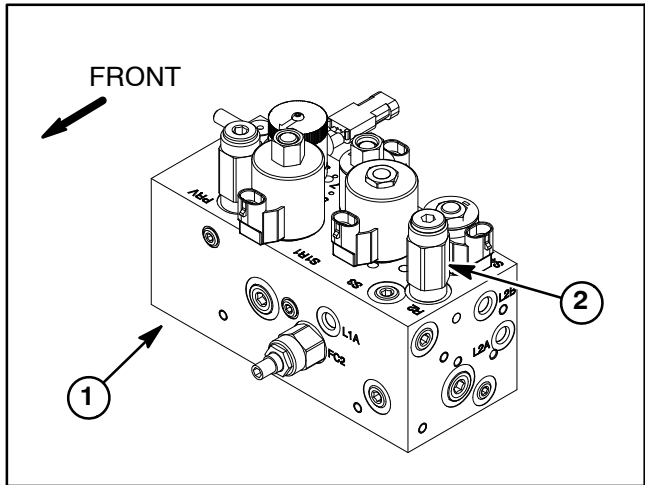


Figure 29

1. Hydraulic manifold 2. Relief valve (R2)

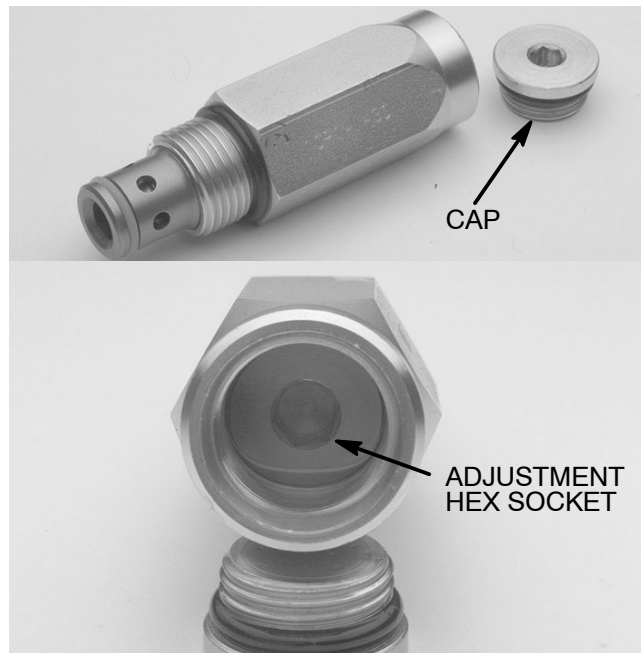


Figure 30

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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, hose 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

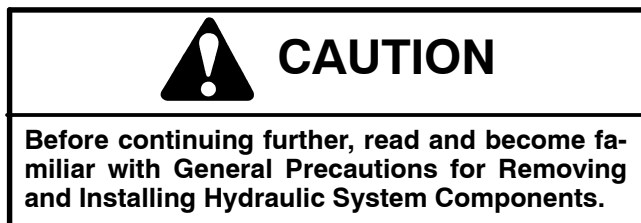
1. Check oil level in the hydraulic reservoir and add correct oil if necessary. Drain and refill hydraulic system reservoir. Also, change oil filter if component failure was severe or system is contaminated (see Flush Hydraulic System).
2. Lubricate O-rings and seals with clean hydraulic oil before installing 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 in this section).
7. Check for hydraulic oil leaks. Shut off engine and correct leaks if necessary. Check oil level in hydraulic reservoir and add correct oil if necessary.

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



2. Clean area around piston pump and pump inlet hose (Fig. 31). Clamp pump inlet hose. Remove hose from piston pump, release clamp and drain reservoir into a suitable container. Drain hydraulic system while making sure lift cylinders, hydraulic hoses, hydraulic tubes and all other components are drained from low points while the system is warm.

3. Clean hydraulic oil filter mounting area. Remove filter and drain into a suitable container. Discard filter.

4. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir in the Service and Repairs section of this chapter).

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 3/4 turn further.

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

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

7. Disconnect 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 prime the hydraulic pumps. Allow the starter to cool for sixty (60) seconds and then 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 hydraulic oil shows any signs of contamination, or if you are changing to biodegradable fluid, repeat steps 1 through 13 again.

15. Assume normal operation and follow recommended maintenance intervals.

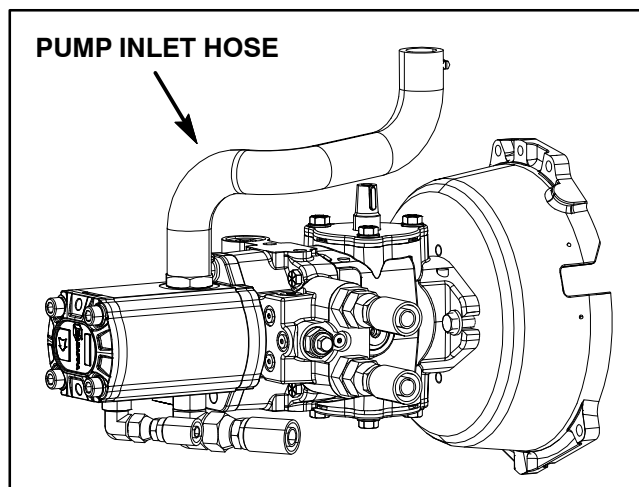


Figure 31

Filtering Closed-Loop Traction Circuit

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

1. Park machine on a level surface with engine stopped and key removed from ignition switch.
2. Raise machine so all driven wheels are off the ground. Support raised machine with appropriate jack-stands.

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

3. Thoroughly clean junction of hydraulic hose and **lower** fitting on side of piston pump (Fig. 32). Disconnect hose from lower pump fitting.
4. Connect Toro high flow hydraulic filter in series between piston pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect filter to machine. Make sure that fitting and hose connections are properly tightened.

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

5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required.
6. Start engine and run at idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.



CAUTION

All driven wheels will be off the ground and rotating during this operation. Make sure machine is well supported so it will not move and accidentally fall.

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

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

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

8. With engine running at high idle speed, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.
9. Shut engine off and remove key from ignition switch.
10. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect hydraulic hose to lower piston (traction) pump fitting. Make sure to properly tighten hose (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).
11. Lower machine to ground.
12. Check oil level in hydraulic reservoir and add correct oil if necessary.

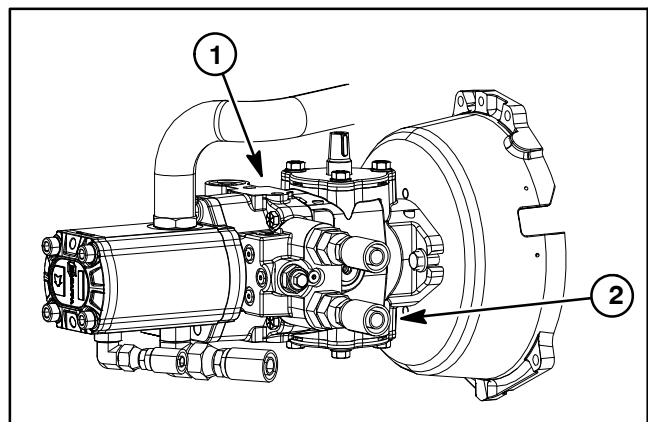


Figure 32

1. Piston pump

2. Lower hydraulic hose

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 piston (traction) pump was rebuilt or replaced, make sure piston 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 (refer to Operator's Manual for hydraulic oil recommendations). 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 functional control lever is in the neutral position. Turn ignition key switch to engage starter for ten (10) seconds to prime the pumps. Allow the starter to cool for sixty (60) seconds and then repeat this step again.
7. Reconnect electrical connector to the fuel stop solenoid.
8. Make sure functional control lever is in the neutral position. Start engine and run at low idle speed. 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 the gear pump or 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 piston (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 units 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.

Gear Pump

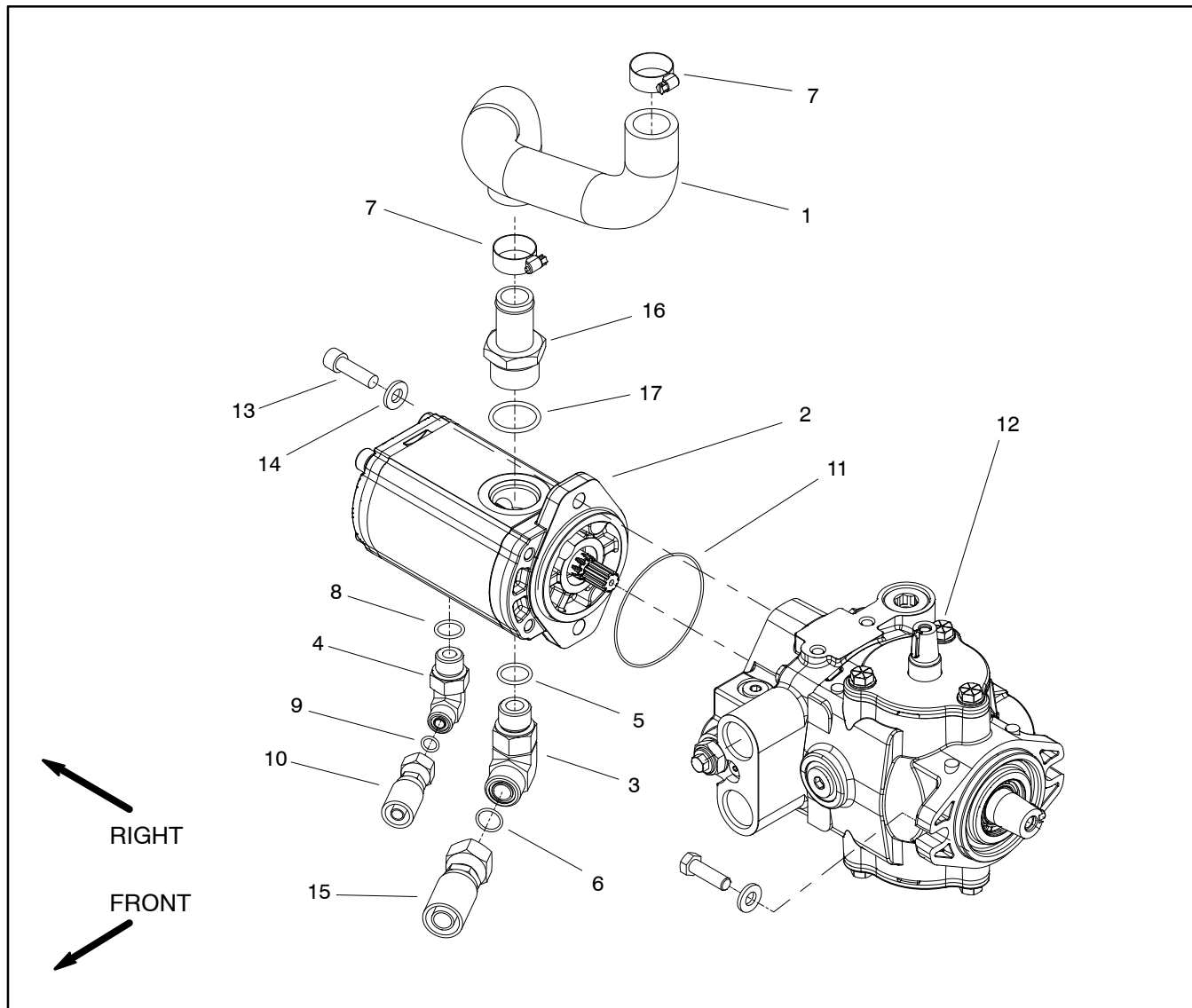
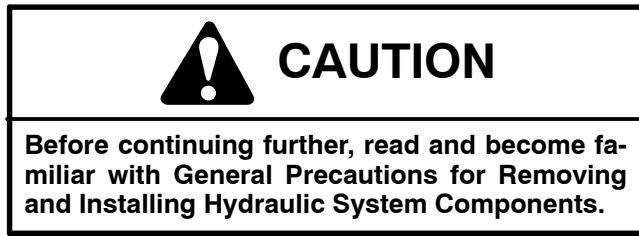


Figure 33

- | | | |
|----------------------|------------------------|--------------------------------|
| 1. Pump inlet hose | 7. Hose clamp (2 used) | 13. Socket head screw (2 used) |
| 2. Gear pump | 8. O-ring | 14. Flat washer (2 used) |
| 3. Hydraulic fitting | 9. O-ring | 15. Hydraulic hose |
| 4. Hydraulic fitting | 10. Hydraulic hose | 16. Hose connector |
| 5. O-ring | 11. O-ring | 17. O-ring |
| 6. O-ring | 12. Piston pump | |

Removal (Fig. 33)



1. Before removing any parts from the hydraulic system, park machine on a level surface, engage parking brake, lower cutting units and stop engine. Remove key from the ignition switch.
2. Label all hose connections for assembly purposes.
3. Clamp pump inlet hose to prevent draining the hydraulic tank.
4. Loosen hose clamp and remove pump inlet hose from the gear pump. Allow clamped hose to drain into a suitable container.
5. Disconnect hydraulic hoses from fittings on bottom of the gear pump. Allow hoses to drain into a suitable container. Plug hoses to prevent contamination.

IMPORTANT: Note position of hydraulic fittings for assembly purposes.

6. Mark hydraulic fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from gear pump.
7. Support gear pump to prevent it from shifting. Separate gear pump from the piston pump by removing both socket head screws and flat washers. Remove O-ring from between the gear pump and piston pump.

NOTE: A case drain exists in the piston (traction) pump and a suction port is near the input shaft of the gear pump (Fig. 34). When the gear pump is removed from the piston pump, plug piston pump case drain hole to prevent draining the piston pump.

8. Discard all removed O-rings.

Installation (Fig. 33)

1. Make sure mounting and O-ring sealing surfaces on the gear pump and piston pump are clean.
2. Lubricate and place new O-ring (item 11) on the gear pump.
3. Position gear pump to the piston pump so that the pump inlet is facing up.

4. Secure gear pump to the piston pump with two (2) socket head screws and flat washers.

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

6. Lubricate and place new O-rings onto gear pump hydraulic fittings. Install fittings into pump openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

7. Remove plugs that were placed during disassembly from hydraulic hoses.

8. Using labels placed during gear pump removal, lubricate new O-rings and connect hydraulic hoses to lower gear pump fittings. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

9. Install pump inlet hose to the hose connector on gear pump. Secure hose with hose clamp.

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

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

12. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

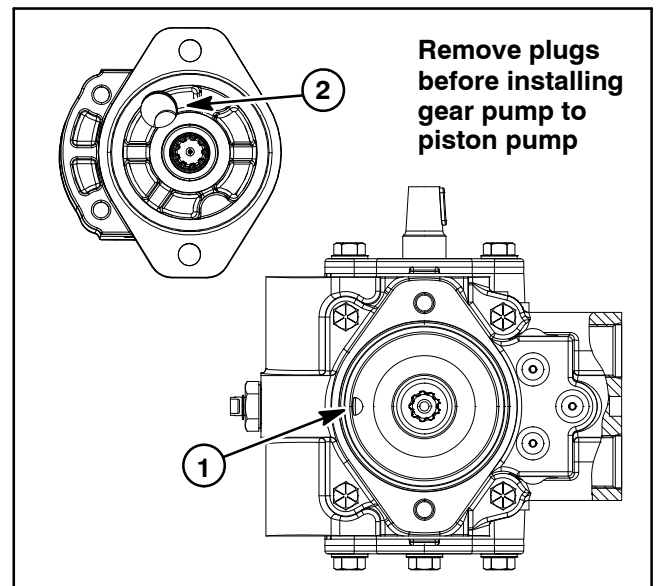


Figure 34

1. Piston pump case drain
2. Gear pump suction port

Gear Pump Service

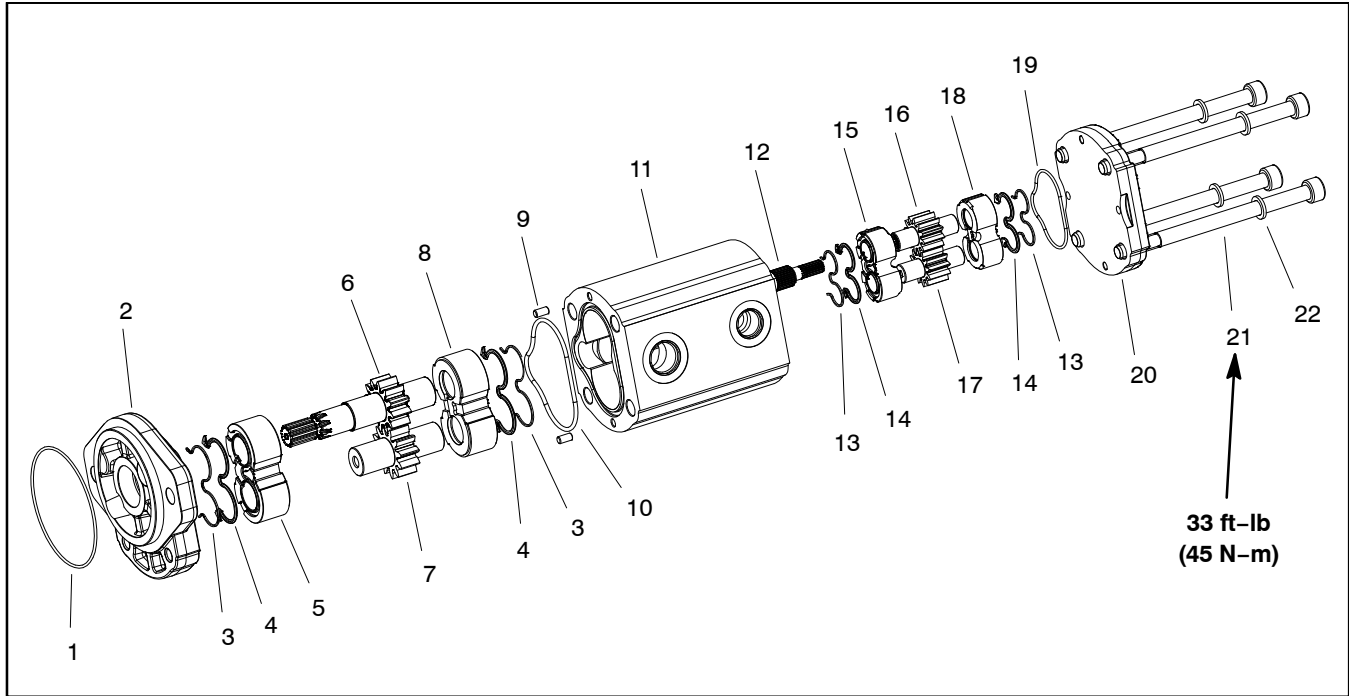


Figure 35

- | | | |
|------------------|-------------------|--------------------------------|
| 1. O-ring | 9. Dowel pin | 16. Drive gear |
| 2. Front cover | 10. O-ring | 17. Idler gear |
| 3. Back-up seal | 11. Housing | 18. Thrust plate |
| 4. Pressure seal | 12. Coupler | 19. O-ring |
| 5. Thrust plate | 13. Back-up seal | 20. End cover |
| 6. Drive shaft | 14. Pressure seal | 21. Socket head screw (4 used) |
| 7. Idler gear | 15. Thrust plate | 22. Washer (4 used) |
| 8. Thrust plate | | |

33 ft-lb
(45 N-m)

Gear Pump Disassembly (Fig. 35)

NOTE: Disassemble gear pump for cleaning, inspection and seal replacement only. Individual gears, housings and thrust plates are not available separately. If internal components are worn or damaged, the gear pump must be replaced as a complete assembly.

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

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

2. Use a marker to make a "V" across the front cover, housing and end cover for assembly purposes (Fig. 36).

IMPORTANT: Use caution when clamping gear pump in a vise to avoid distorting any pump components. Also, use a vise with soft jaws.

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

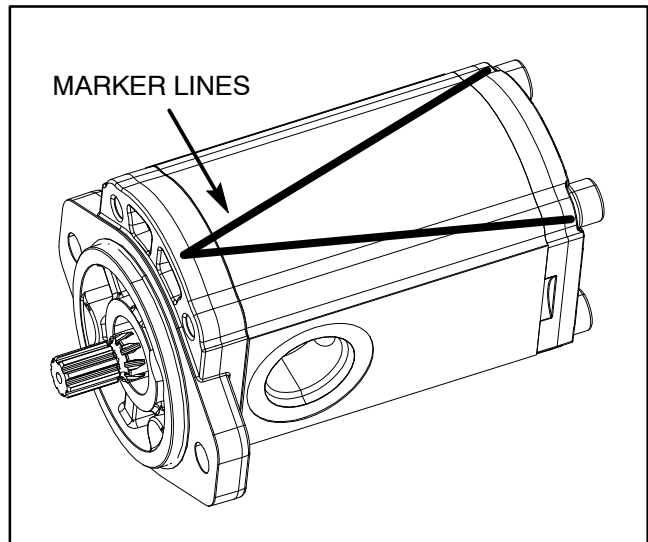


Figure 36

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

5. Remove pump from vise and remove fasteners.

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

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

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

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

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

Gear Pump Assembly (Fig. 35)

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

NOTE: Pressure and back-up seals fit in grooves machined into thrust plates. Body O-rings fit in grooves machined in housing.

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

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

4. Tighten the socket head screws evenly in a crossing pattern to a torque of **33 ft-lb (45 N-m)**.

Piston (Traction) Pump Neutral Assembly

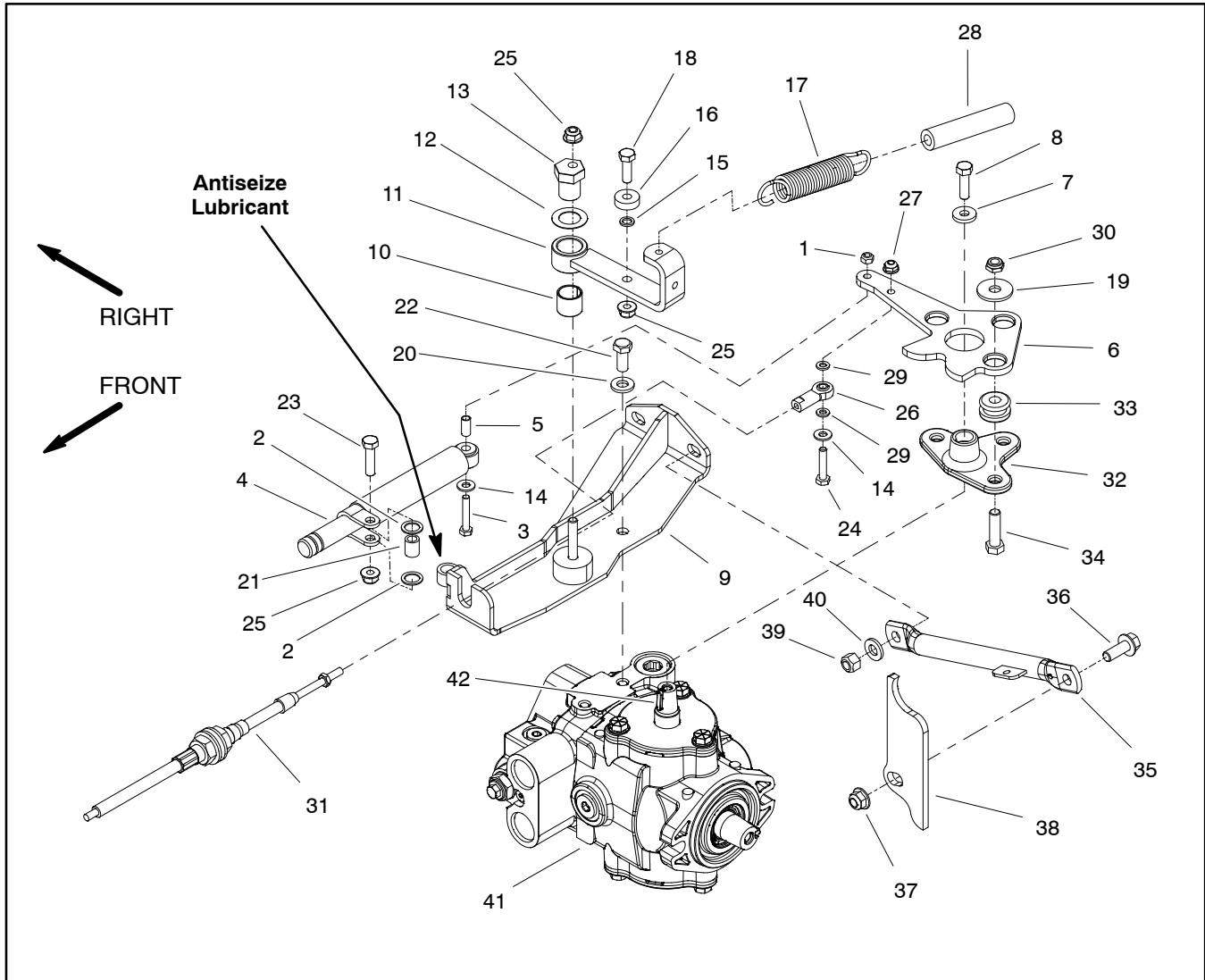



Figure 37

- | | | |
|--------------------------|-------------------------|---------------------------------------|
| 1. Lock nut | 15. Bearing spacer | 29. Flat washer (2 used) |
| 2. Nylon washer (2 used) | 16. Ball bearing | 30. Lock nut (3 used) |
| 3. Cap screw | 17. Extension spring | 31. Traction control cable |
| 4. Damper lever | 18. Cap screw | 32. Pivot plate |
| 5. Pivot spacer | 19. Washer (3 used) | 33. Mount (3 used) |
| 6. Pump lever | 20. Washer (2 used) | 34. Cap screw (3 used) |
| 7. Flat washer | 21. Pivot tube | 35. Exhaust support |
| 8. Cap screw | 22. Cap screw (2 used) | 36. Cap screw (3 used) |
| 9. Upper muffler mount | 23. Cap screw | 37. Flange nut |
| 10. Bushing | 24. Cap screw | 38. Engine mount |
| 11. Neutral arm | 25. Flange nut (3 used) | 39. Lock nut (2 used) (muffler mount) |
| 12. Thrust washer | 26. Cable ball joint | 40. Washer (2 used) (muffler mount) |
| 13. Traction stud | 27. Flange nut | 41. Piston pump assembly |
| 14. Flat washer (2 used) | 28. Dampener hose | 42. Key |

Disassembly (Fig. 37)

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

2. If necessary, remove muffler to allow disassembly of traction neutral assembly (Fig. 39). Refer to Exhaust System in the Service and Repairs section of Chapter 3 – Diesel Engine for additional information on muffler removal.


**CAUTION**

The extension spring (item 17) is under tension and may cause personal injury during removal. Use caution when removing the spring from the pump neutral assembly.

3. Remove components from traction neutral assembly as needed using Figure 37 as a guide.

Assembly (Fig. 37)

1. Install removed components to traction neutral assembly using Figure 37 as a guide along with the following:

**CAUTION**

The extension spring (item 17) is under tension and may cause personal injury during installation. Use caution when installing the spring to the pump neutral assembly.

A. If pivot plate (item 32) was removed from pump trunnion shaft, make sure that both trunnion shaft and plate bore are thoroughly cleaned before installing plate to shaft.

B. If damper lever (item 4) was removed, apply anti-seize lubricant to bore of muffler mount (item 9) during assembly.

C. Make sure that ball bearing (item 16) on neutral arm (item 11) is properly positioned in pump lever (item 6) after assembly.

2. Install muffler if it was removed (Fig. 39). Refer to Exhaust System in the Service and Repairs section of Chapter 3 – Diesel Engine for additional information on muffler installation.

3. After traction neutral assembly has been installed, make sure that the transmission is adjusted for the neutral position so that the machine does not move or creep when the traction pedal is in neutral.

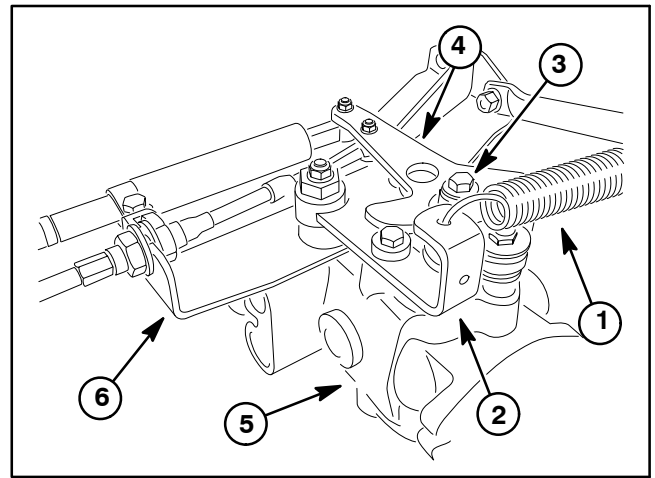


Figure 38

- | | |
|--------------------------|------------------------|
| 1. Extension spring | 4. Pup lever |
| 2. Neutral arm | 5. Piston pump |
| 3. Cap screw/flat washer | 6. Upper muffler mount |

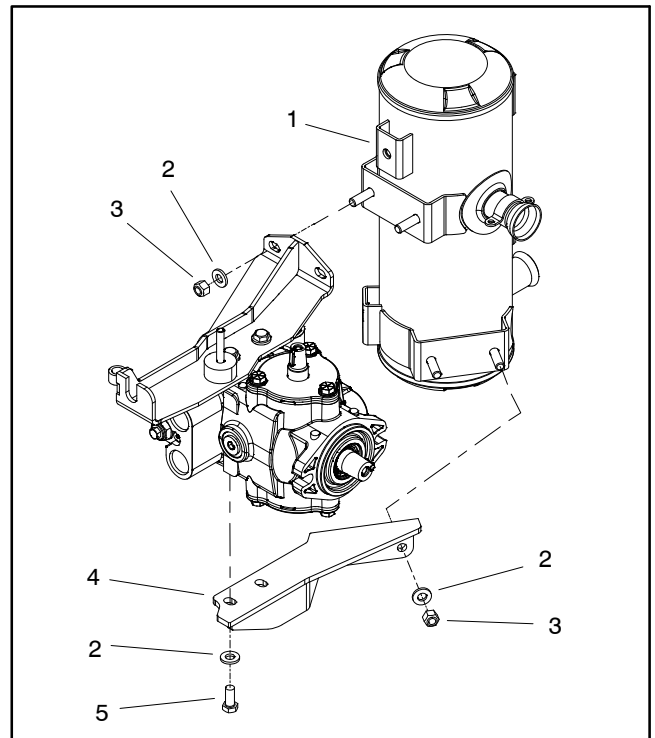


Figure 39

- | | |
|-------------------------|-----------------------|
| 1. Muffler | 4. Muffler bracket |
| 2. Flat washer (6 used) | 5. Cap screw (2 used) |
| 3. Lock nut (4 used) | |

Piston (Traction) Pump

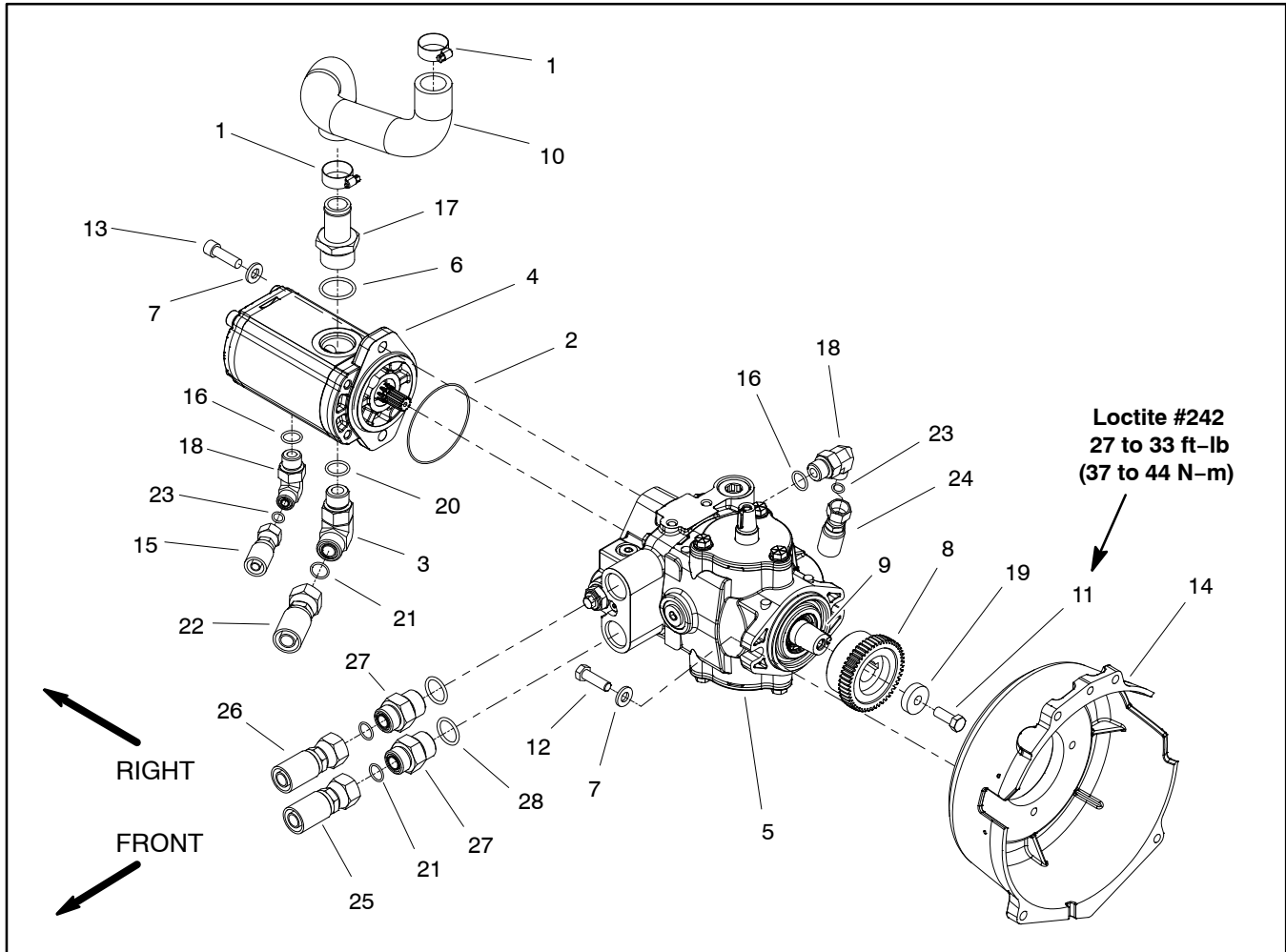


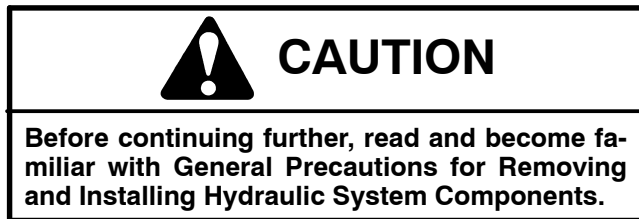
Figure 40

- | | | |
|--------------------------|------------------------------------|--------------------------------|
| 1. Hose clamp (2 used) | 11. Cap screw | 20. O-ring |
| 2. O-ring | 12. Cap screw (2 used) | 21. O-ring |
| 3. 90° hydraulic fitting | 13. Hex socket head screw (2 used) | 22. Hose assembly |
| 4. Gear pump | 14. Engine bellhousing | 23. O-ring |
| 5. Piston pump | 15. Hose assembly | 24. Hose assembly |
| 6. O-ring | 16. O-ring | 25. Hose assembly |
| 7. Flat washer (4 used) | 17. Hose connector | 26. Hose assembly |
| 8. Coupler | 18. 90° hydraulic fitting (2 used) | 27. Hydraulic adapter (2 used) |
| 9. Key | 19. Spacer | 28. O-ring |
| 10. Pump inlet hose | | |

NOTE: The complete piston (traction) and gear pump assembly can be removed from the machine with the neutral assembly attached to the piston pump. See Piston (Traction) Pump Neutral Assembly in this section for information regarding servicing the neutral assembly.

Piston Pump Removal (Fig. 40)

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



2. Remove muffler to allow pump removal (Fig. 43). Refer to Exhaust System in the Service and Repairs section of Chapter 3 – Diesel Engine for additional information on muffler removal.

3. Disconnect the traction control cable ball joint and jam nuts from the neutral arm. Position traction cable away from the pump assembly.

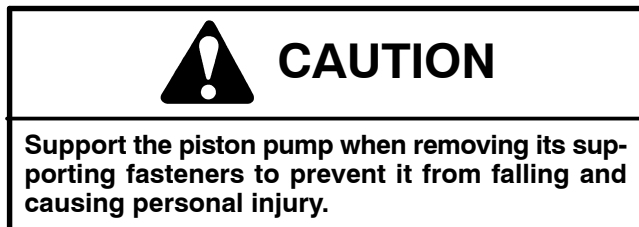
4. Thoroughly clean hydraulic hose ends and fittings on gear and piston (traction) pumps to prevent hydraulic system contamination.

5. Label all hydraulic hose connections on gear and piston pumps for assembly purposes.

6. Clamp pump inlet hose (item 10) to prevent draining the hydraulic reservoir.

7. Loosen hose clamp and remove inlet hose from the gear pump.

8. Disconnect hydraulic hoses from fittings on pump assembly. Allow hoses to drain into a suitable container. Plug hoses and fittings to prevent contamination.



9. Support pump assembly to prevent it from falling.

10. Remove two (2) cap screws (item 12) and flat washers (item 7) that secure pump assembly to bellhousing. Separate pump assembly from the pump mount and remove from machine.

11. If necessary, remove coupler (item 8) from pump input shaft. Locate and retrieve key (item 9).

12. Separate gear pump from the piston pump (see Gear Pump in this section).

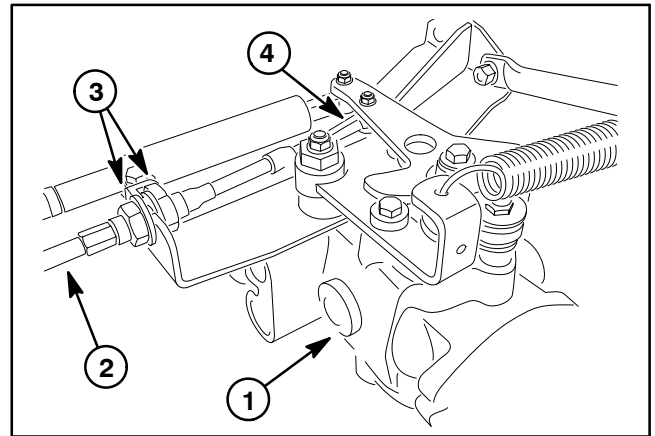


Figure 41

- | | |
|-------------------|---------------------|
| 1. Piston pump | 3. Jam nut (2 used) |
| 2. Traction cable | 4. Cable ball joint |

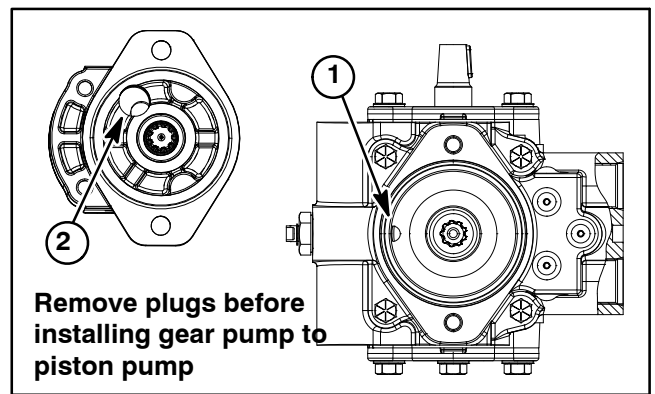


Figure 42

- | | |
|---------------------------|---------------------------|
| 1. Piston pump case drain | 2. Gear pump suction port |
|---------------------------|---------------------------|

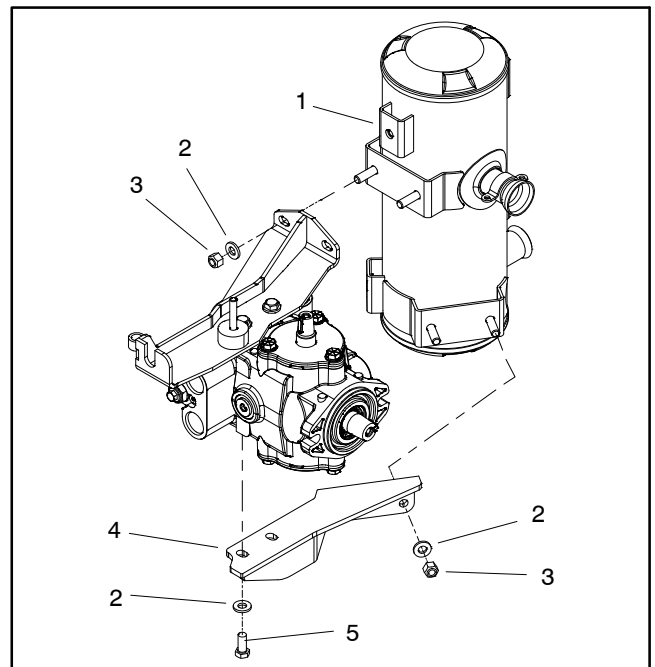


Figure 43

- | | |
|-------------------------|-----------------------|
| 1. Muffler | 4. Muffler bracket |
| 2. Flat washer (6 used) | 5. Cap screw (2 used) |
| 3. Lock nut (4 used) | |

IMPORTANT: If fittings are going to be removed from piston pump, note position of fittings for assembly purposes.

13. If fitting removal from piston pump is necessary, mark hydraulic fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from piston pump. Discard removed O-rings.

14. If necessary, remove the neutral assembly attached to the piston pump (see Piston (Traction) Pump Neutral Assembly in this section).

Piston Pump Installation (Fig. 40)

1. If any neutral assembly components were removed from piston pump, install them to pump (see Piston (Traction) Pump Neutral Assembly in this section).

2. Make sure the flange surfaces of the gear pump and piston pump are thoroughly clean.

IMPORTANT: A case drain exists in the piston (traction) pump and a suction port is near the input shaft of the gear pump (Fig. 42). Before the gear pump is installed to the piston pump, make sure that plugs placed in either of these ports are removed. Failure to remove plugs will cause excessive pressure in the piston pump and damage seals.

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

4. If removed, secure coupler to piston pump shaft:

A. Make sure that pump shaft and bore of coupler are thoroughly cleaned.

B. Position key (item 9) to pump shaft.

C. Apply Loctite #242 (or equivalent) to the threads of the cap screw used to secure coupler to pump shaft.

D. Slide coupler onto pump shaft and secure with spacer and cap screw. Torque cap screw from **27 to 33 ft-lb (37 to 44 N-m)**.

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

6. Lubricate and place new O-rings onto all removed hydraulic fittings. Install fittings into pump openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

7. Secure pump assembly to engine bellhousing:

A. Position pump assembly to bellhousing on engine and align pump coupler with flange coupler on engine flywheel.

B. Insert pump coupler into flange coupler and slide pump toward engine until pump flange is against bellhousing surface.

C. Secure pump assembly to bellhousing with two (2) cap screws (item 12) and flat washers (item 7).

8. Remove plugs that were placed during disassembly from hydraulic fittings and hoses.

9. Using labels placed during pump removal, lubricate new O-rings and connect hydraulic hoses to gear pump and piston pump fittings. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

10. Connect the traction control cable to the neutral arm:

A. Secure traction cable ball joint to neutral arm.

B. Secure control cable to neutral arm with cable jam nuts. Make sure that a lock washer is positioned on each side of the neutral arm.

11. Install muffler (Fig. 43). Refer to Exhaust System in the Service and Repairs section of Chapter 3 – Diesel Engine for additional information on muffler installation.

12. Make sure that gear pump inlet hose is installed to pump fitting and secured with hose clamp. Remove clamp from gear pump inlet hose.

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

14. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

15. Check neutral position of the traction pedal. If adjustment is required, refer to the Traction Unit Owners Manual.

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Piston (Traction) Pump Service

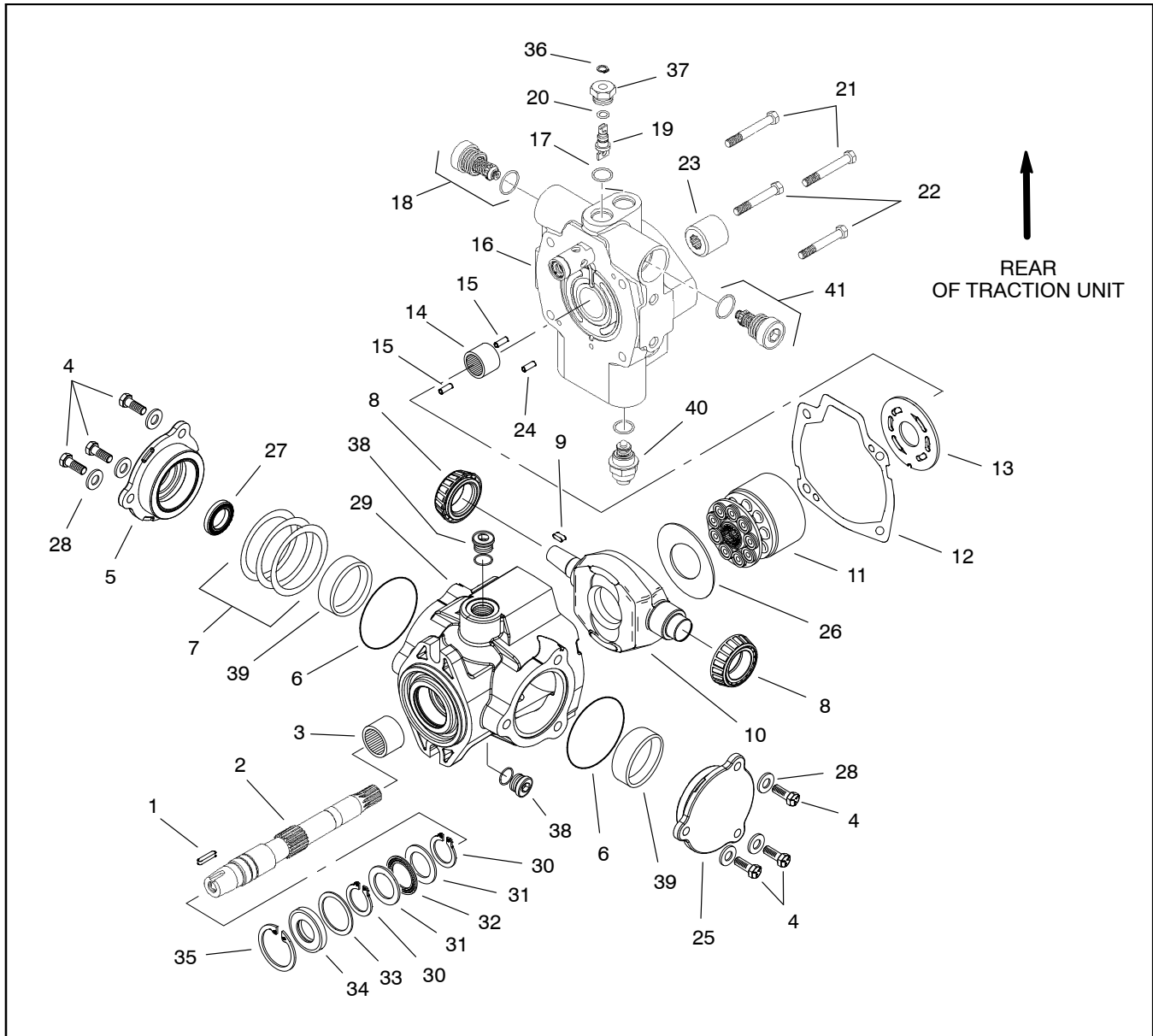


Figure 44

- | | | |
|--|--------------------------|--------------------------------------|
| 1. Key | 15. Dowel pin | 29. Housing |
| 2. Drive shaft | 16. Back plate | 30. Retaining ring |
| 3. Bearing | 17. O-ring | 31. Bearing race |
| 4. Cap screw (3 used per plate) | 18. Forward relief valve | 32. Thrust bearing |
| 5. Cover plate | 19. Bypass valve | 33. Washer |
| 6. O-ring | 20. O-ring | 34. Shaft seal |
| 7. Shim kit (for crush ring replacement) | 21. Cap screw (2 used) | 35. Retaining ring |
| 8. Bearing cone | 22. Cap screw (2 used) | 36. Retaining ring |
| 9. Key | 23. Coupler | 37. Plug |
| 10. Swash plate | 24. Roll pin | 38. Plug with O-ring (2 used) |
| 11. Rotating kit | 25. Cover plate | 39. Bearing cup |
| 12. Gasket | 26. Swash plate insert | 40. Shuttle relief valve with O-ring |
| 13. Valve plate | 27. Shaft seal | 41. Reverse relief valve |
| 14. Bearing | 28. Washer | |

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.

NOTE: The charge relief valve is attached to the piston pump back plate (shown in Fig. 45). The back plate must be removed to service the relief valve.

NOTE: The piston pump is equipped with relief valves (items 18 and 41) for both the forward and reverse direction. Due to engine output, it is unlikely that traction pressure will reach relief valve settings. If, however, a piston pump relief valve is leaking or otherwise faulty, traction performance would be affected.

IMPORTANT: The shim kit (item 7) is used to replace the original crush ring (not shown) in the cover plate (item 25). If the swash plate (item 10), cover plate (item 25) or housing (item 29) is replaced during servicing, the old crush ring must be replaced. For information on crush ring replacement, see Piston Pump Crush Ring Replacement in this section in conjunction with the piston pump service manual at the end of this chapter.

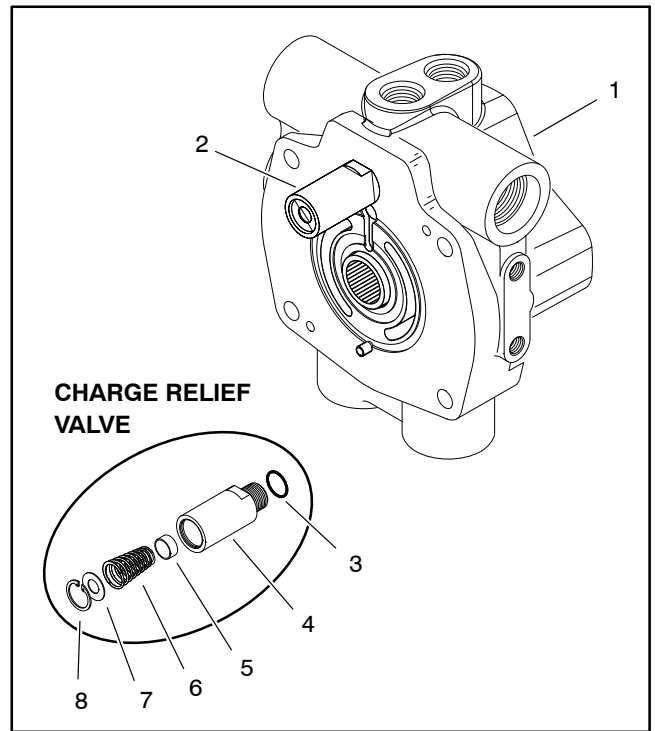


Figure 45

- | | |
|------------------------|-------------------|
| 1. Back plate | 5. Poppet |
| 2. Charge relief valve | 6. Spring |
| 3. O-ring | 7. Washer |
| 4. Housing | 8. Retaining ring |

Piston Pump Crush Ring Replacement

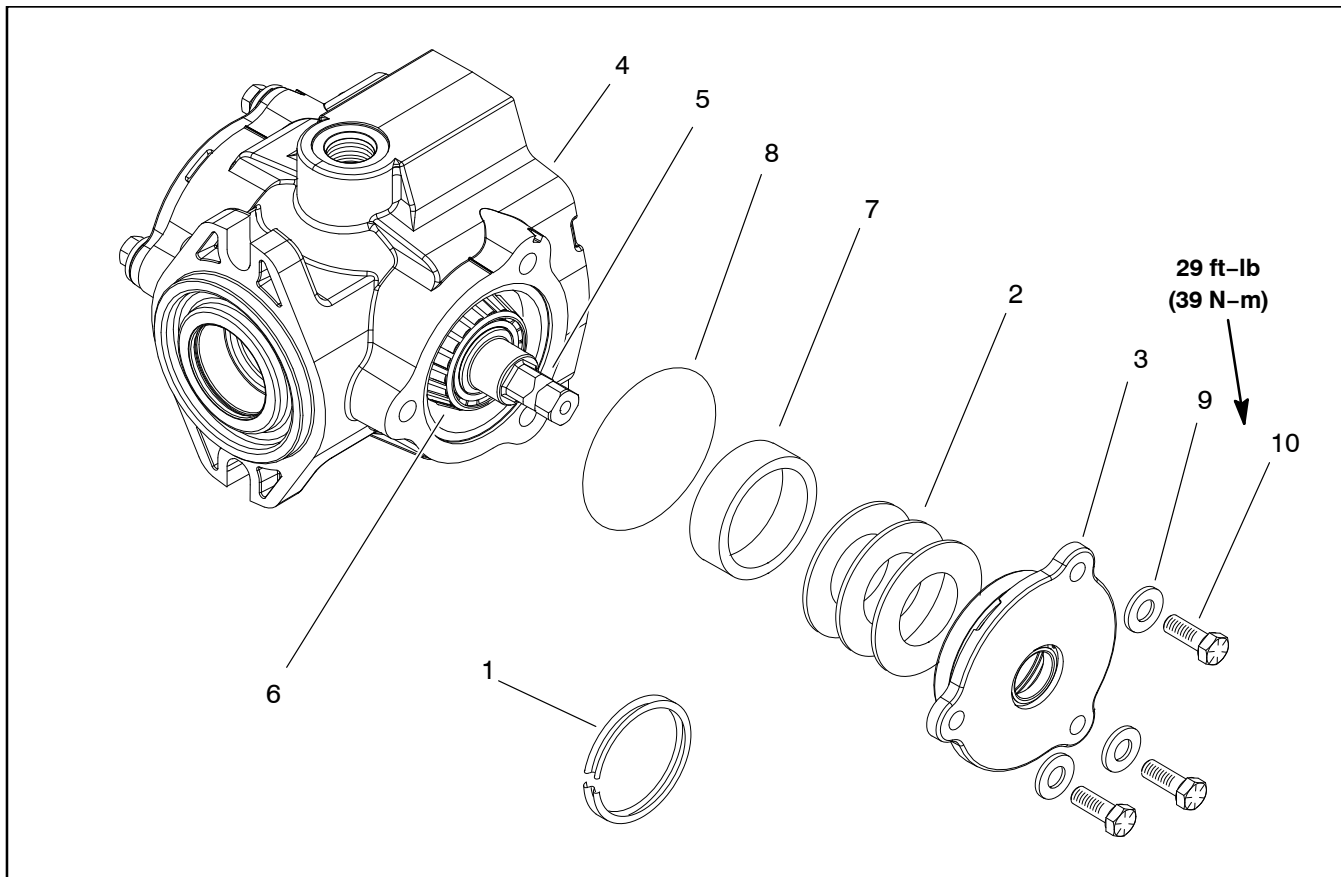


Figure 46

1. Crush ring
2. Shims
3. Cover plate
4. Housing

5. Swash plate (control shaft)
6. Bearing cone
7. Bearing cup

8. O-ring
9. Washer (3 used)
10. Cap screws (3 used)

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 Eaton, Medium Duty Piston Pump, Repair Information, Model 70160 Variable Displacement Piston Pump at the end of this chapter).

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Front Wheel Motors

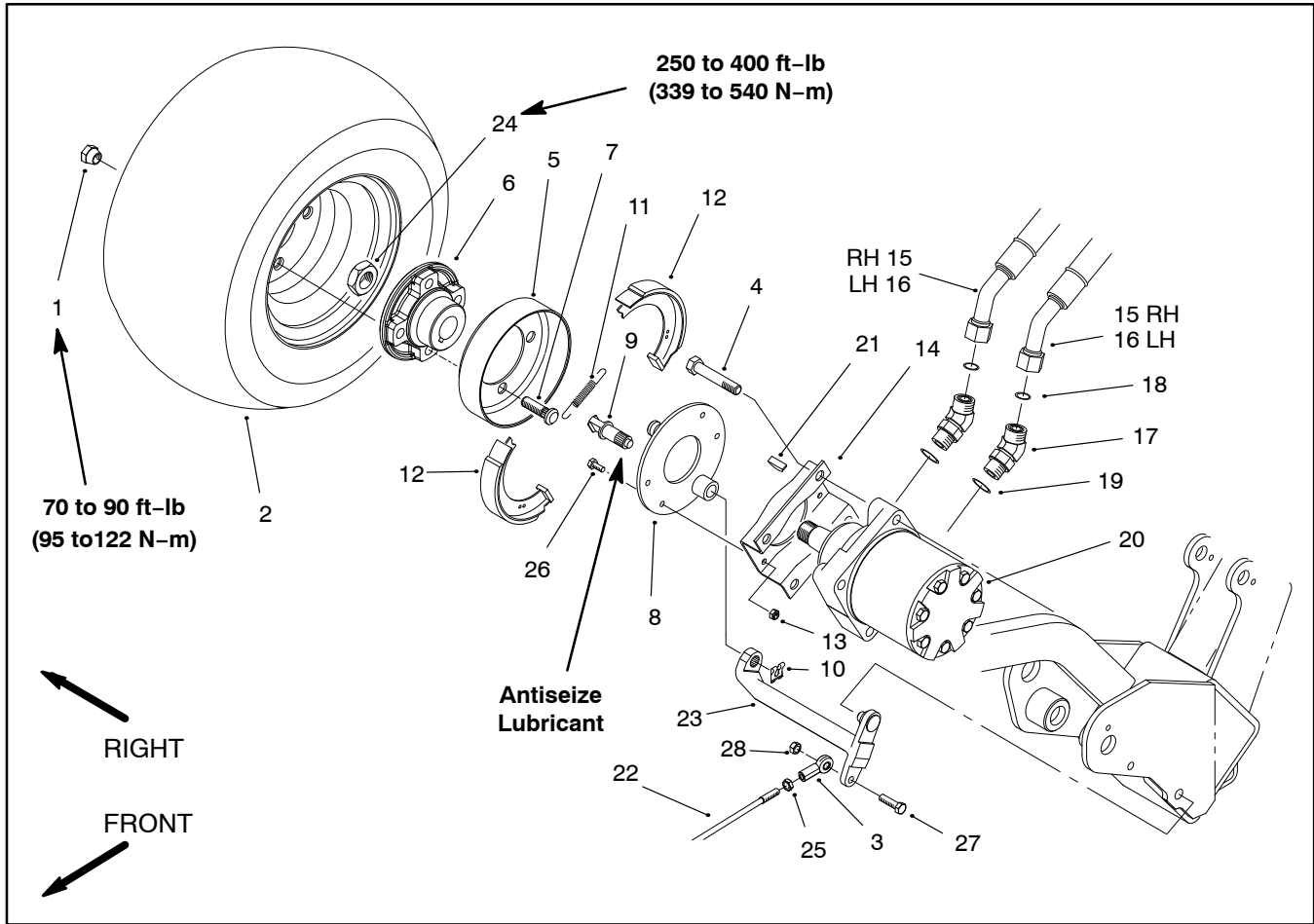
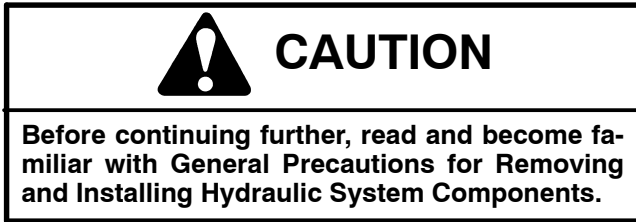


Figure 47

- | | | |
|----------------------------------|---------------------------------|----------------------------------|
| 1. Lug nut (4 used per wheel) | 11. Return spring | 20. Hydraulic motor |
| 2. Wheel assembly | 12. Brake shoe (2 used) | 21. Woodruff key |
| 3. Swivel clevis | 13. Lock nut (4 used per plate) | 22. Brake rod |
| 4. Cap screw (4 used per motor) | 14. Brake bracket | 23. Brake lever |
| 5. Brake drum | 15. Hydraulic hose | 24. Lock nut |
| 6. Wheel hub | 16. Hydraulic hose | 25. Jam nut |
| 7. Drive stud (4 used per wheel) | 17. 45° Hydraulic fitting | 26. Cap screw (4 used per plate) |
| 8. Backing plate | 18. O-ring | 27. Cap screw |
| 9. Brake cam | 19. O-ring | 28. Lock nut |
| 10. Retaining clip | | |

Front Wheel Motor Removal (Fig. 47)

1. Park the machine on a level surface, lower the cutting units and stop the engine. Remove key from the ignition switch.
2. Remove front wheel, brake drum assembly and brake assembly from machine (see Front Wheel and Brake in the Service and Repairs section of Chapter 6 – Chassis).



3. Label all wheel motor hydraulic connections for assembly purposes.
4. Disconnect both hose assemblies and O-rings from the hydraulic fittings on the wheel motor. Allow hoses to drain into a suitable container. Discard removed O-rings.
5. Mark wheel motor fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from motor. Discard removed O-rings.
6. Put caps or plugs on disconnected hoses and motor port openings to prevent contamination.
7. Remove four (4) cap screws (item 4) that secure brake bracket and hydraulic wheel motor to machine. Remove brake bracket and motor from the frame.

Front Wheel Motor Installation (Fig. 47)

1. Position hydraulic wheel motor and brake bracket (item 14) to the frame. Make sure ports of motor face the rear of the machine. Secure motor and brake bracket to the frame with four (4) cap screws (item 4).
2. Remove plugs from wheel motor ports. Lubricate and place new O-rings onto fittings. Install fittings into motor openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).
3. Remove caps from disconnected hydraulic lines.
4. Lubricate and position new O-rings to fittings on wheel motor. Use labels placed during the removal process to properly install hydraulic lines to wheel motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).
5. Install brake assembly, brake drum assembly and front wheel to machine (see Front Wheel and Brake in the Service and Repairs section of Chapter 6 – Chassis).



6. Make sure to properly torque lock nut from **250 to 400 ft-lb (339 to 540 N-m)** and wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.
7. Check oil level in hydraulic reservoir and add correct oil if necessary.
8. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

Rear Wheel Motor (If Equipped with 3WD)

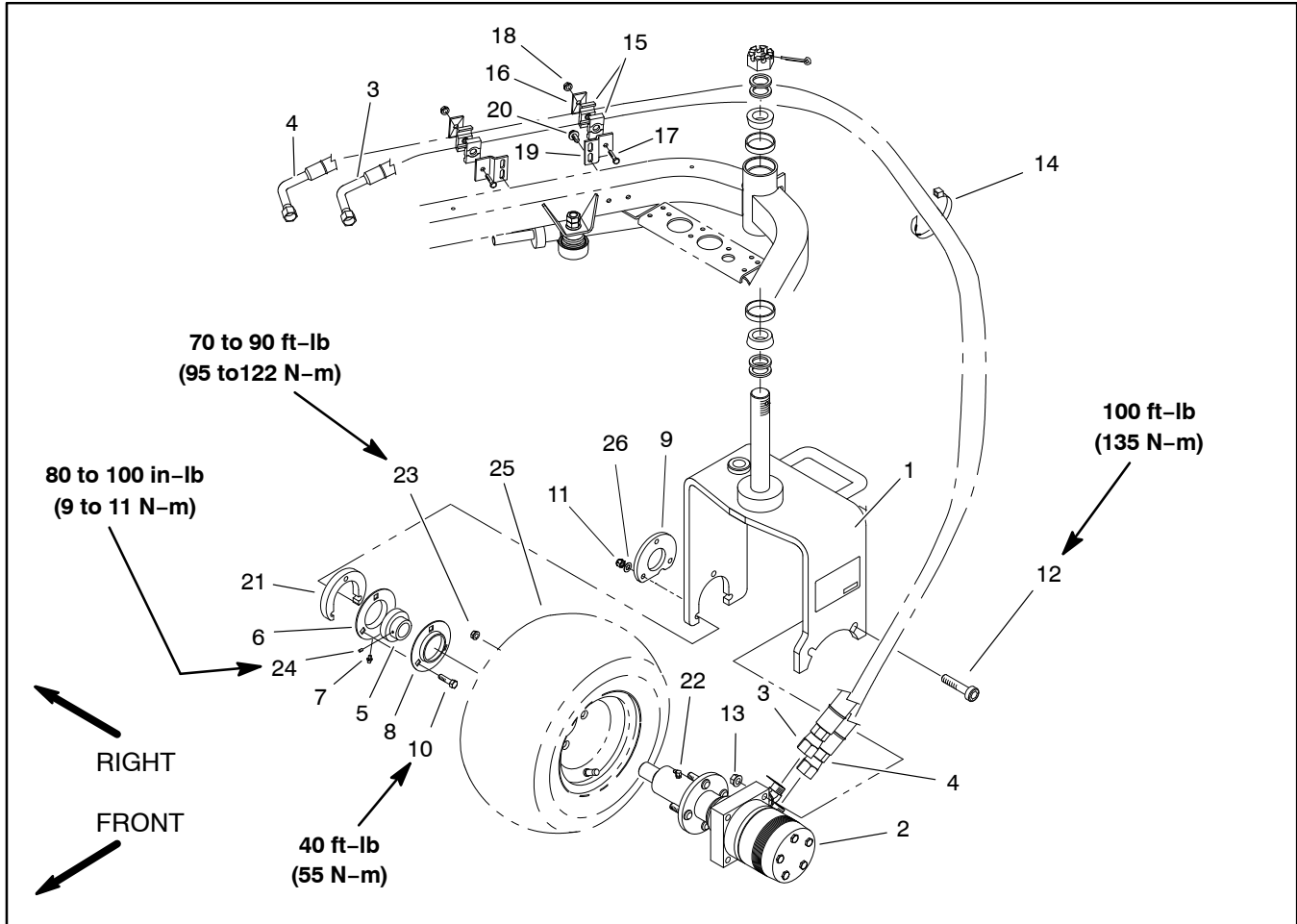


Figure 48

- | | | |
|---------------------------|--------------------------------|--------------------------------|
| 1. Castor fork | 10. Cap screw (3 used) | 19. Clamp bracket (2 used) |
| 2. Hub and motor assembly | 11. Lock nut (3 used) | 20. Washer head screw (4 used) |
| 3. Hydraulic hose | 12. Socket head screw (2 used) | 21. Bearing adapter plate |
| 4. Hydraulic hose | 13. Lock nut (2 used) | 22. Grease fitting |
| 5. Bearing | 14. Cable tie | 23. Lug nut (4 used) |
| 6. Relube flangette | 15. Tube clamp (4 used) | 24. Set screw (2 used) |
| 7. Grease fitting | 16. Cover plate (2 used) | 25. Wheel assembly |
| 8. Standard flangette | 17. Cap screw (2 used) | 26. Flat washer (3 used) |
| 9. Mount spacer | 18. Lock nut (2 used) | |

NOTE: For service of the hub and motor assembly (item 2) on machines equipped with 3WD, see Rear Wheel (If Equipped with 3WD) and Rear Wheel Hub and Motor Assembly (If Equipped with 3WD) in the Service and Repairs section of Chapter 6 – Chassis.

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Wheel Motor Service

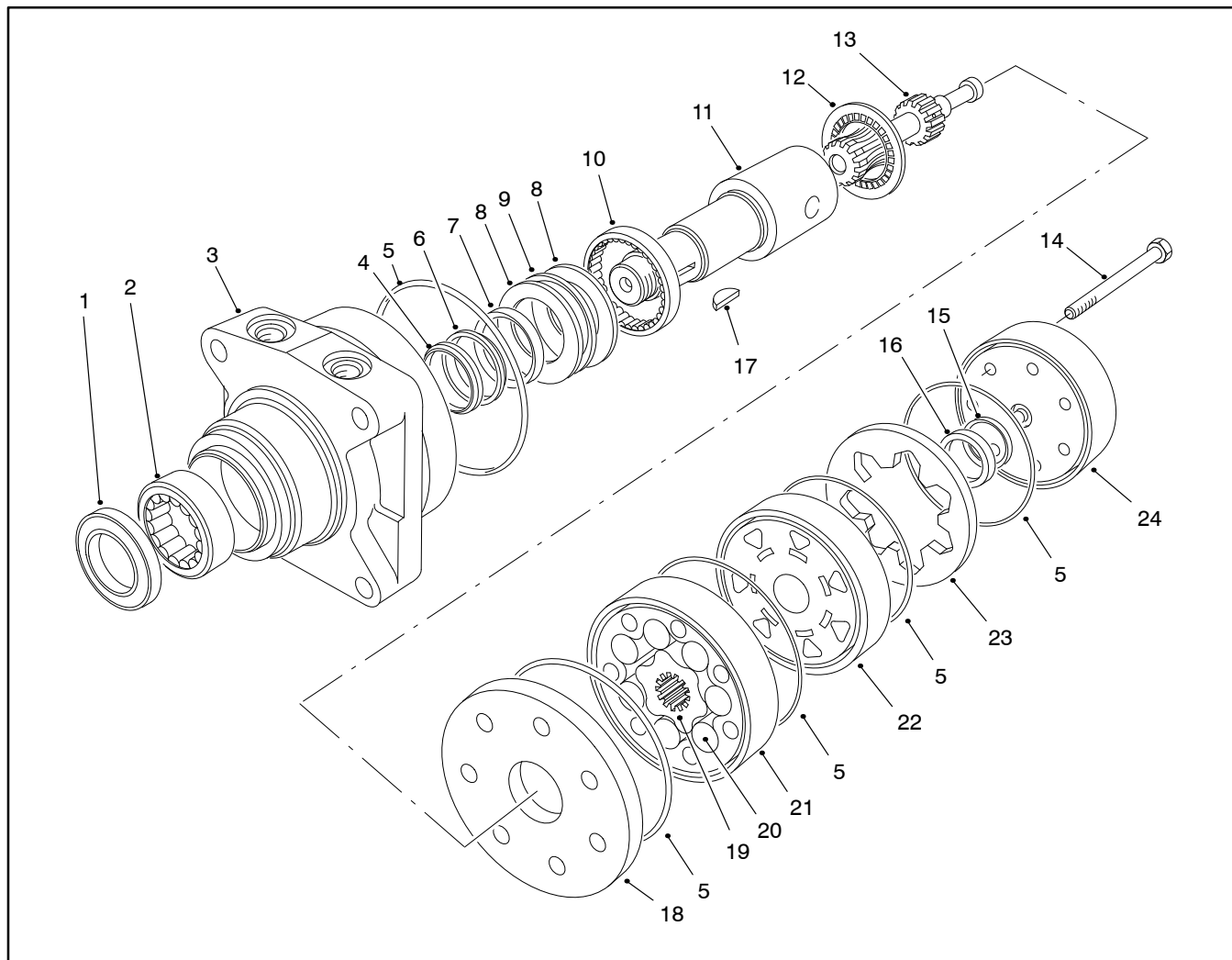


Figure 49

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

NOTE: For repair of the wheel motors, see the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series) at the end of this chapter.

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Cutting Reel Motors

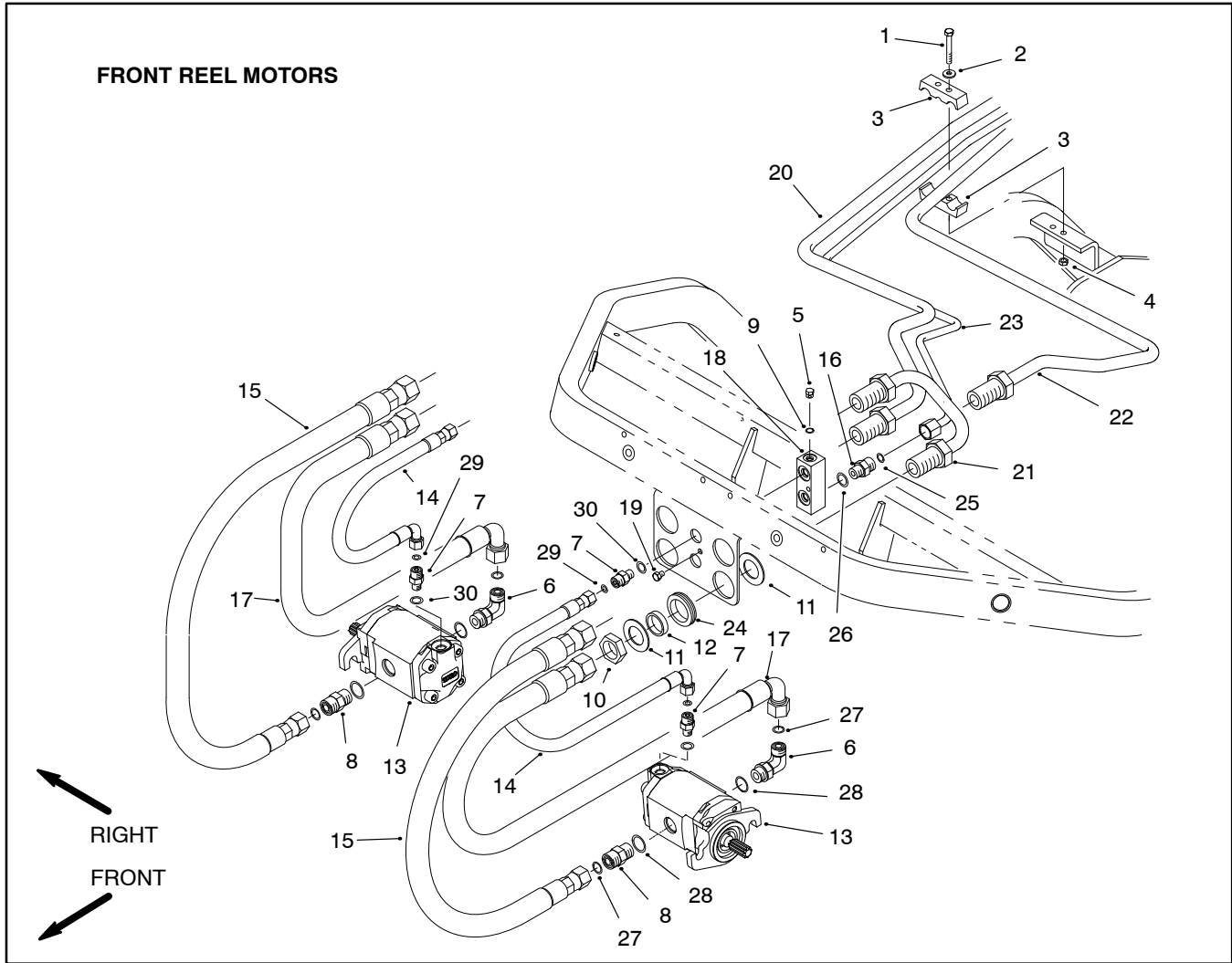


Figure 50

- | | | |
|--------------------------|-----------------------|--------------------|
| 1. Cap screw | 11. Washer | 21. Hydraulic tube |
| 2. Flat washer | 12. Spacer | 22. Hydraulic tube |
| 3. Tube clamp | 13. Reel motor | 23. Hydraulic tube |
| 4. Lock nut | 14. Hose assembly | 24. Rubber grommet |
| 5. Plug | 15. Hose assembly | 25. O-ring |
| 6. 90° Hydraulic fitting | 16. Hydraulic fitting | 26. O-ring |
| 7. Hydraulic fitting | 17. Hose assembly | 27. O-ring |
| 8. Hydraulic fitting | 18. T-block | 28. O-ring |
| 9. O-ring | 19. Cap screw | 29. O-ring |
| 10. Bulkhead nut | 20. Hydraulic tube | 30. O-ring |

Removal (Figs. 50 and 51)

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



CAUTION

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

2. Label hydraulic hoses for assembly purposes.

3. Disconnect hydraulic hoses from fittings on the reel motor. Allow hoses to drain into a suitable container. Cap or plug hoses and motor fittings to prevent contamination.

4. Loosen two (2) cap screws that secure the hydraulic reel motor to the cutting unit side plate. Rotate motor clockwise and remove motor from cutting unit.

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

5. If hydraulic fittings are to be removed from reel motor, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from motor. Discard removed O-rings.

6. Inspect threads and sealing surfaces of fittings and motor ports. Replace components if damage is found.

Installation (Figs. 50 and 51)

1. If fittings were removed from reel motor, lubricate and place new O-rings onto fittings. Install fittings into reel motor openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Coat spline shaft of the reel motor with No. 2 multi-purpose lithium base grease.

3. Rotate the motor clockwise so the motor flanges clear the cap screws in the cutting unit side plates. Align reel motor shaft splines with cutting reel insert splines. Slide motor shaft into reel insert.

4. Rotate the motor counterclockwise until the motor flanges are encircling the cap screws. Tighten two (2) cap screws to secure reel motor to cutting unit.

5. Remove caps and plugs from disconnected hydraulic hoses and motor fittings.

6. Using labels placed during reel motor removal, lubricate new O-rings and connect hydraulic hoses to reel motor. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

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

8. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

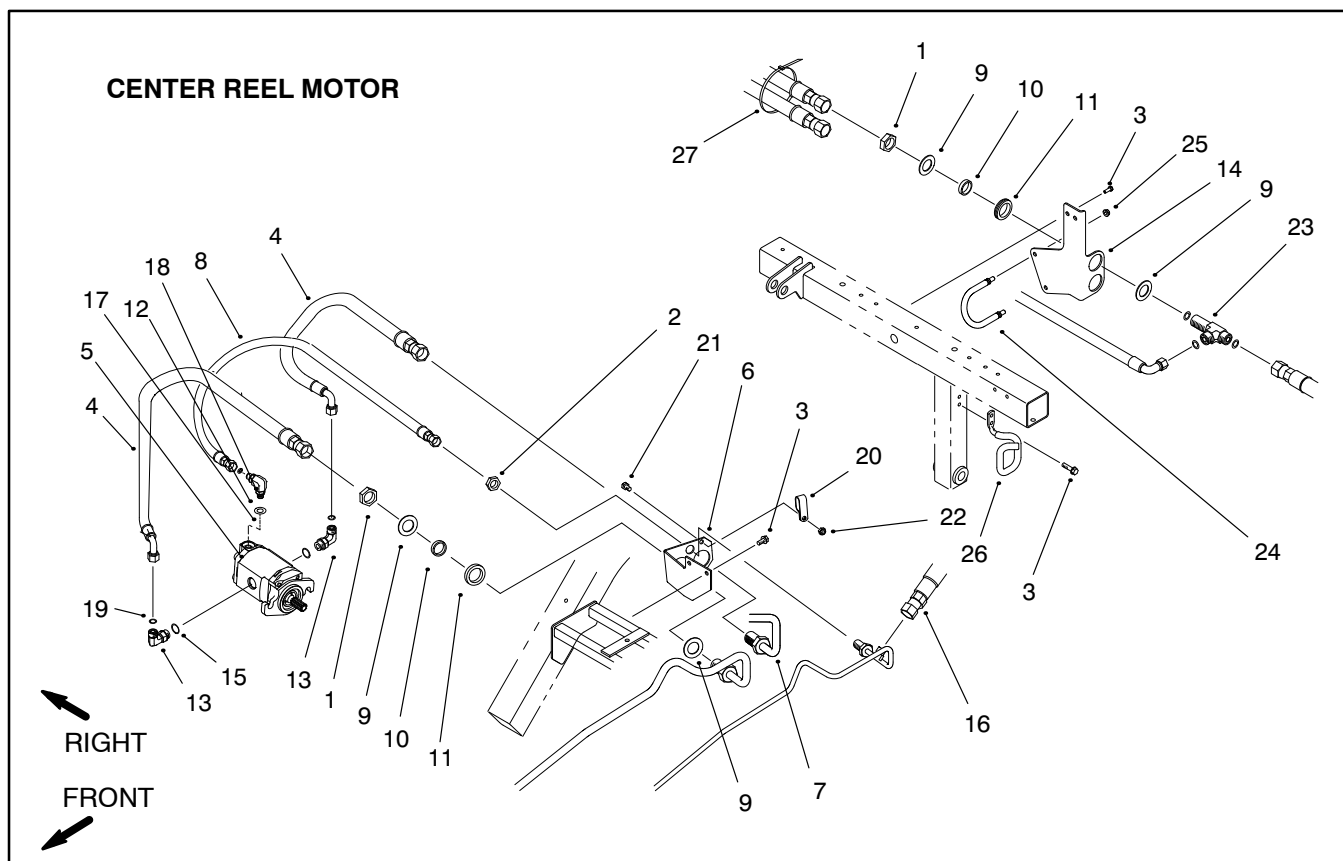


Figure 51

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

Reel Motor Service

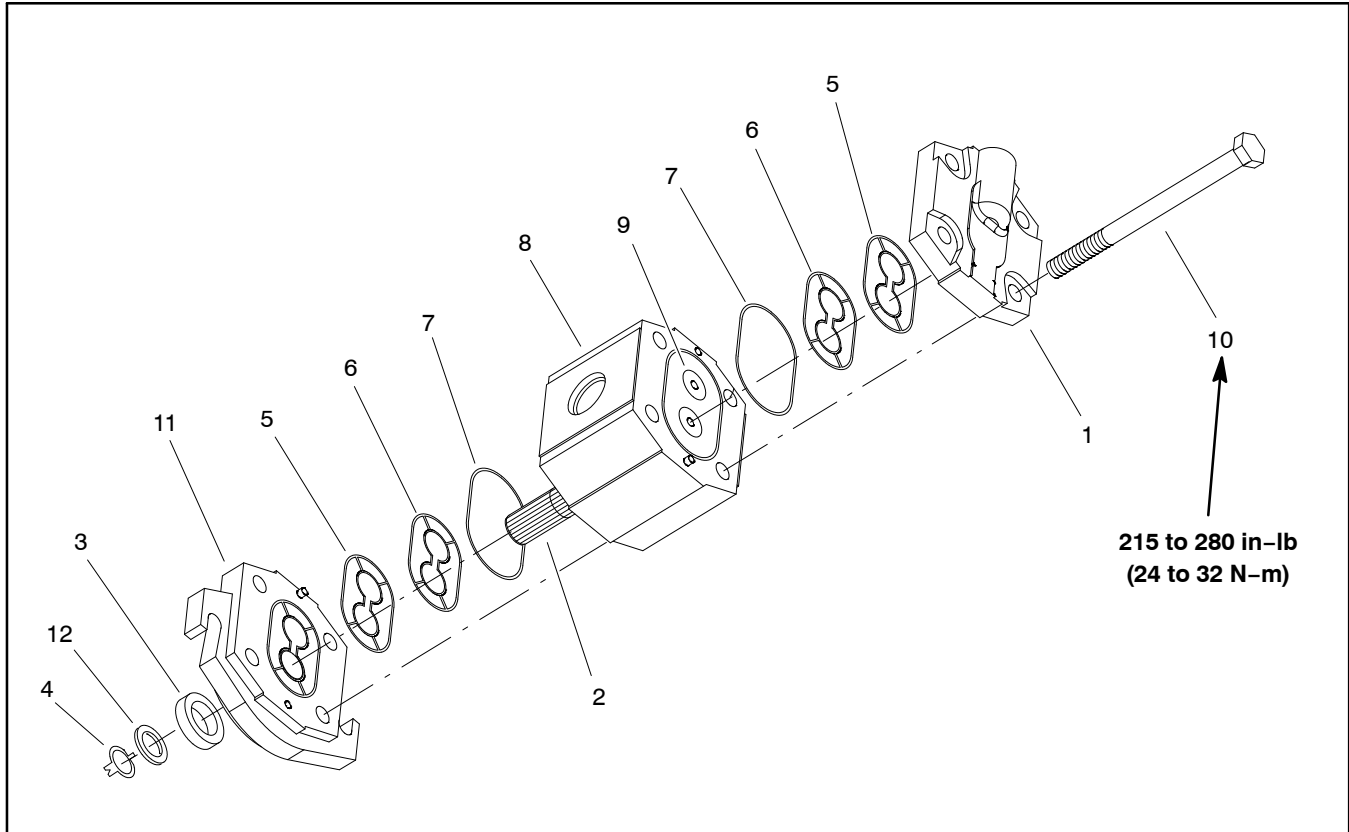


Figure 52

- 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 (4 used)
- 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. 53).

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.

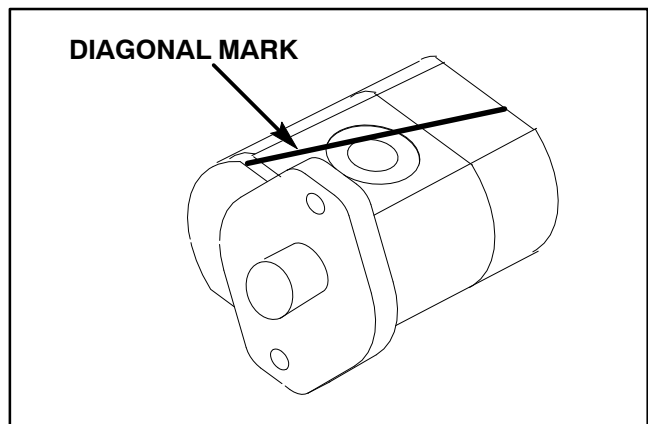


Figure 53

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

7. Place the motor on its side and push on the rear bearing block to remove the bearing block and gear set (Fig. 54).

8. Carefully remove and discard O-rings, pressure seals and back-up rings (Fig. 55) 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. 56) 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.

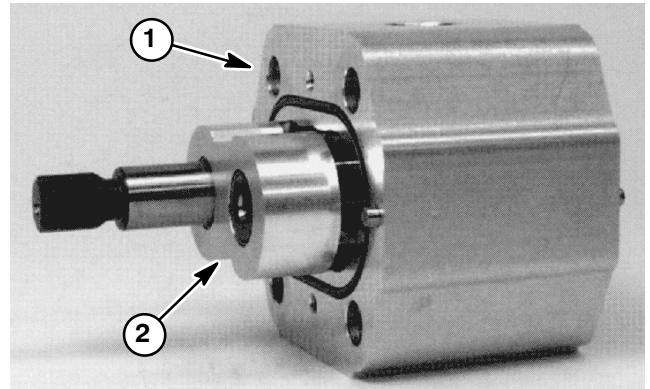


Figure 54

1. Motor body

2. Bearing block & gear set

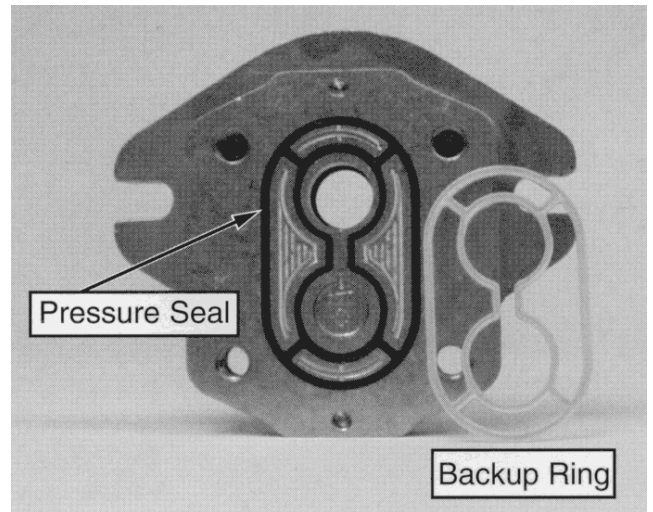


Figure 55

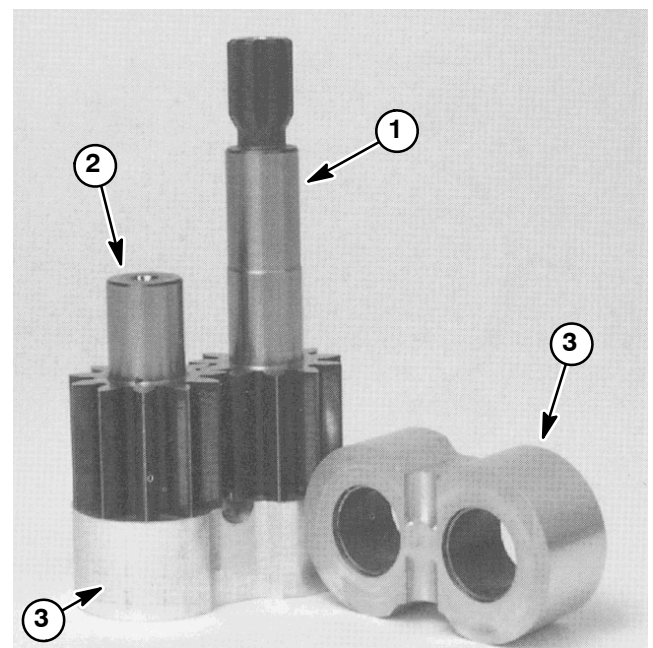


Figure 56

1. Drive gear
2. Idler gear

3. Bearing block

Assembly

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

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.

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Oil Cooler (If Equipped)

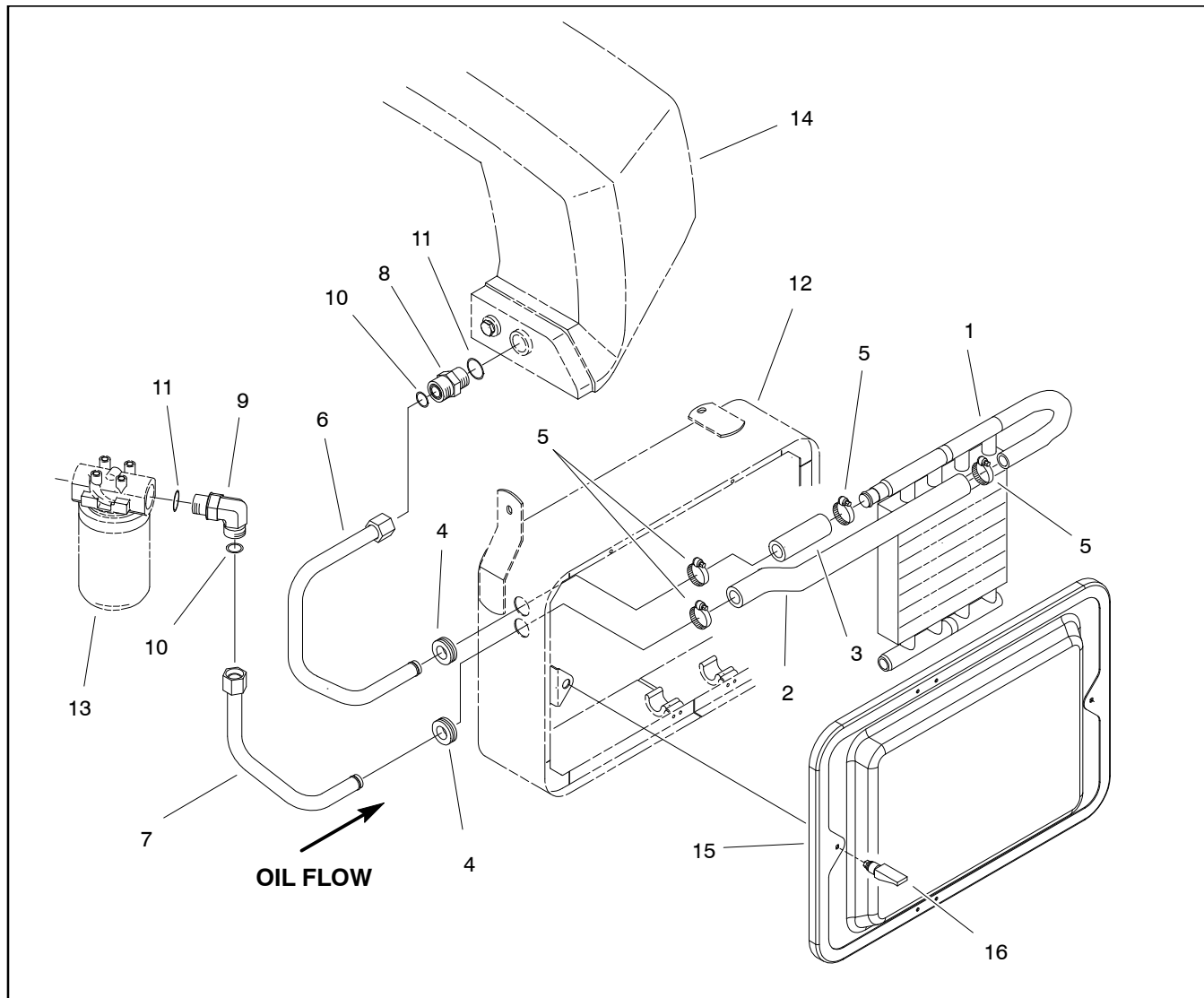


Figure 57

- | | | |
|------------------------|-------------------------------|----------------------|
| 1. Oil cooler | 7. Hydraulic tube | 12. Radiator support |
| 2. Lower formed hose | 8. Hydraulic straight fitting | 13. Hydraulic filter |
| 3. Upper formed hose | 9. 90° hydraulic fitting | 14. Hydraulic tank |
| 4. Grommet (2 used) | 10. O-ring | 15. Radiator screen |
| 5. Hose clamp (4 used) | 11. O-ring | 16. Latch (2 used) |
| 6. Hydraulic tube | | |

Removal (Fig. 57)

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



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. Remove radiator screen from radiator support.
3. Clamp upper and lower formed hoses (items 3 and 2) to prevent draining of the hydraulic system and tank.

4. Loosen hose clamps securing the formed hoses to the oil cooler.

5. Carefully pull oil cooler from the cooler brackets in the radiator support. Remove oil cooler from the formed hoses. Allow hoses and cooler to drain into a suitable container.

6. If it is necessary to replace hydraulic tube (item 6 or 7), formed hose (item 2 or 3) or to remove radiator from machine, drain oil from hydraulic reservoir and tubes:

A. Place a suitable drain pan under the ends of the formed hoses.

B. Remove clamps from hoses to allow hydraulic oil to drain from reservoir and hydraulic tubes.

C. Remove tubes, formed hoses or radiator as required.

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



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

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

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

Installation (Fig. 57)

1. If hydraulic tubes (item 6 or 7), formed hose (item 2 or 3) or radiator were removed, make sure that removed components are installed to machine before installing oil cooler.

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

3. Fit oil cooler onto cooler brackets in the radiator support while attaching the formed hoses to the cooler. Secure hoses by tightening the hose clamps.

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

5. Make sure that hydraulic tank is at correct level.

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, check for hydraulic leaks at oil cooler lines and recheck hydraulic tank level.

7. Make sure that radiator screen is clean and secure it to radiator support.

Lift Cylinders

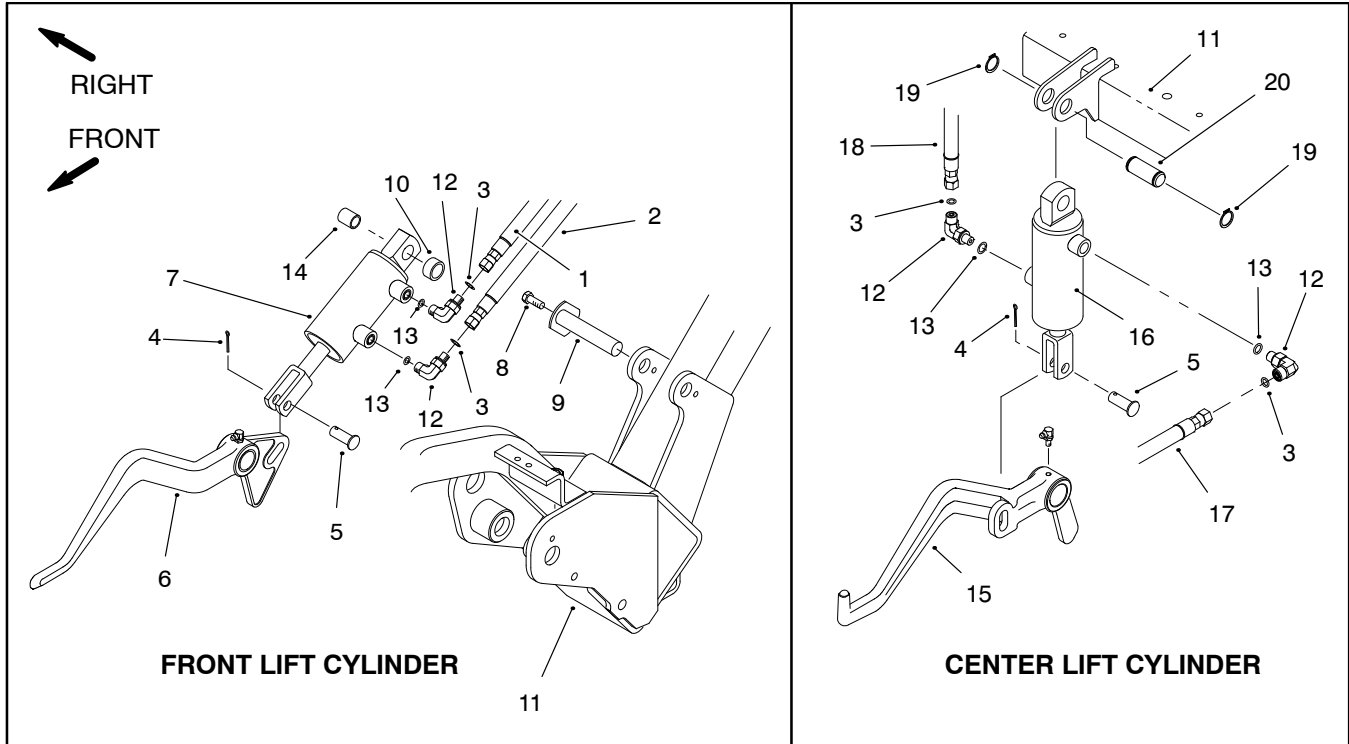


Figure 58

1. Hydraulic hose
2. Hydraulic hose
3. O-ring
4. Cotter pin
5. Clevis pin
6. Front lift arm
7. Front lift cylinder (2 used)

8. Washer head screw
9. Pivot pin
10. Spacer
11. Frame
12. 90° Hydraulic fitting
13. O-ring
14. Spacer

15. Center lift arm
16. Center lift cylinder
17. Hydraulic hose
18. Hydraulic hose
19. Retaining ring (2 used)
20. Cylinder pin

Lift Cylinder Removal (Fig. 58)

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



CAUTION

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

2. Label all hydraulic connections for assembly.
3. Disconnect hose assemblies and O-rings from the hydraulic fittings on the lift cylinder. Allow hoses to drain into a suitable container.
4. Remove cotter pin (item 4) from the clevis pin (item 5). Pull clevis pin from the lift cylinder and lift arm.
5. Support lift cylinder to prevent it from falling.

6. To remove front lift cylinder from frame:
 - A. Remove washer head screw (item 8) from the pivot pin (item 9).
 - B. Pull pivot pin from the frame, spacers (items 10 and 14) and lift cylinder. Locate and retrieve spacers.
 - C. Remove lift cylinder from the frame.

7. To remove center lift cylinder from frame:
 - A. Remove one retaining ring (item 19) from the cylinder pin (item 20).
 - B. Pull cylinder pin from the frame and lift cylinder.
 - C. Remove lift cylinder from the frame.

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

Lift Cylinder Installation (Fig. 58)

1. If fittings were removed from lift cylinder, lubricate and place new O-rings onto fittings. Install fittings into cylinder openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).
2. To secure front lift cylinder to frame:
 - A. Position front lift cylinder to frame.
 - B. Insert pivot pin (item 9) through the outer frame hole, thick spacer (item 14), lift cylinder, thin spacer (item 10) and inner frame hole until pin is flush with frame.
 - C. Secure pivot pin to frame with washer head screw (item 8).
3. To secure center lift cylinder to frame:
 - A. Position center lift cylinder to frame.
 - B. Make sure one retaining ring (item 19) is installed on the cylinder pin (item 20).
 - C. Align lift cylinder with frame mounts and insert cylinder pin.
 - D. Secure cylinder pin with second retaining ring.
4. Position clevis of the lift cylinder to the lift arm. Insert clevis pin (item 5) through the cylinder clevis and lift arm. Secure pin with cotter pin (item 4).
5. Using labels placed during cylinder removal, lubricate new O-rings and connect hydraulic hoses to cylinder. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).
6. Make sure that hydraulic tank is at correct level.
7. 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 Cylinder Service

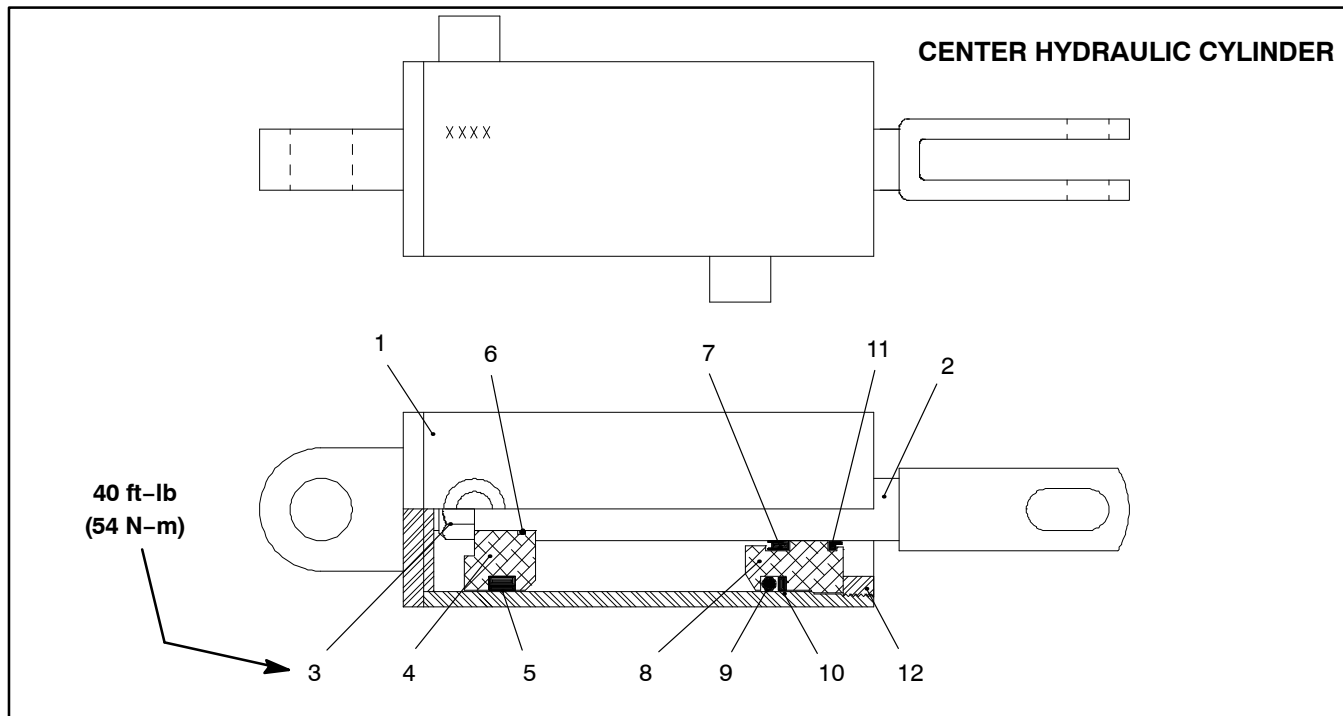


Figure 59

- 1. Barrel
- 2. Shaft
- 3. Nut
- 4. Piston

- 5. T seal
- 6. O-ring
- 7. Rod seal
- 8. Head

- 9. O-ring
- 10. Back-up ring
- 11. Dust seal
- 12. Internal collar

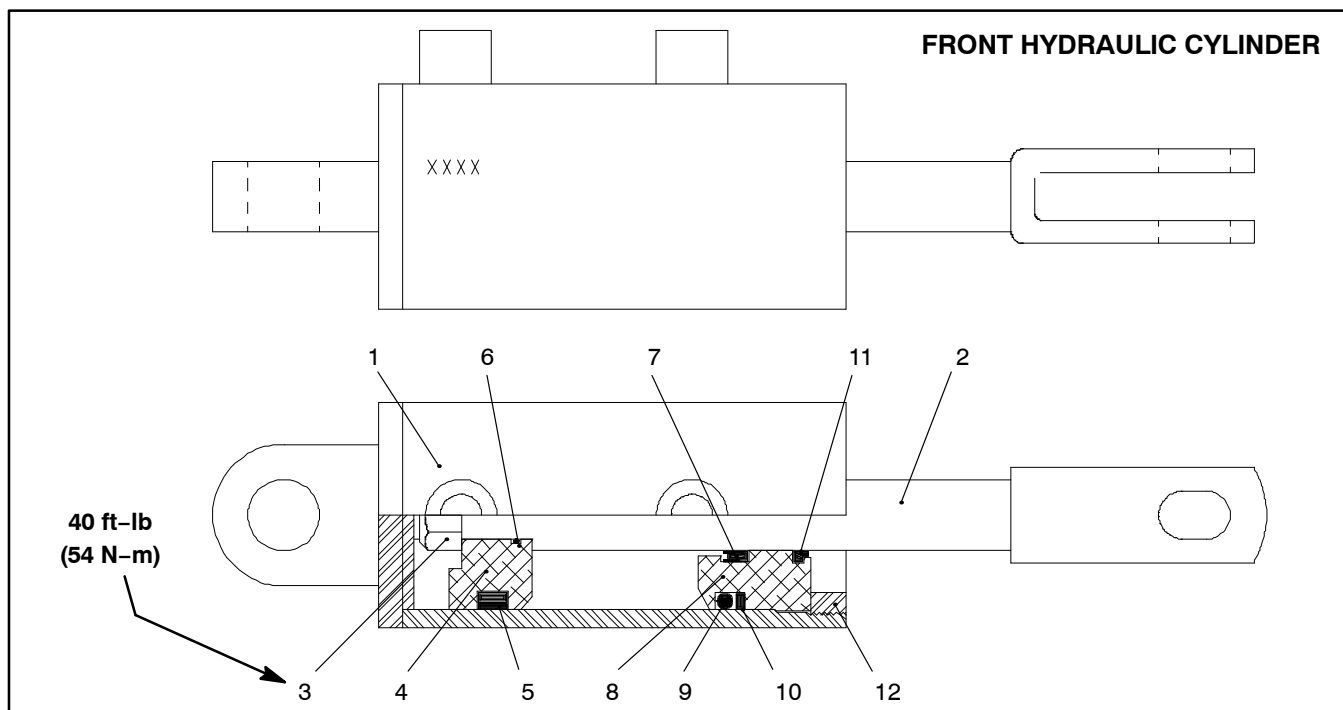


Figure 60

- 1. Barrel
- 2. Shaft
- 3. Nut
- 4. Piston

- 5. T seal
- 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 vise with soft jaws. 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 vise.

4. Mount shaft securely in a vise with soft jaws by clamping on the clevis of the shaft. Remove lock nut and piston from the shaft. Slide head off the shaft.

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



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

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

Assembly

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

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

A. Install T seal and O-ring to the piston.

B. Install rod 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 vise.

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

A. Coat shaft with with clean hydraulic oil.

B. Slide head onto the shaft.

C. Install piston and nut onto the shaft. Torque nut from **40 ft-lb (54 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 vise with soft jaws.

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

6. Clean threads of internal collar and 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

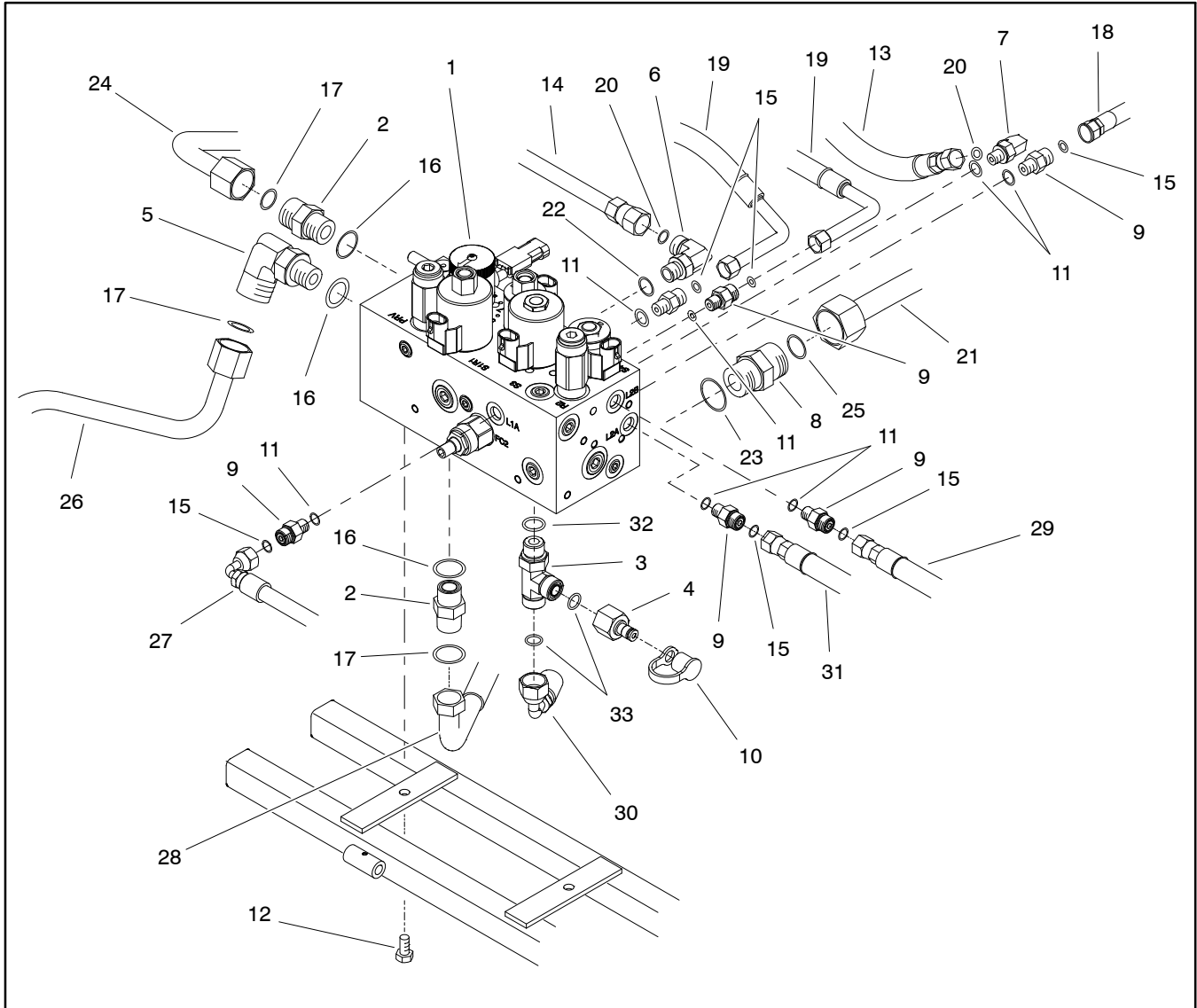


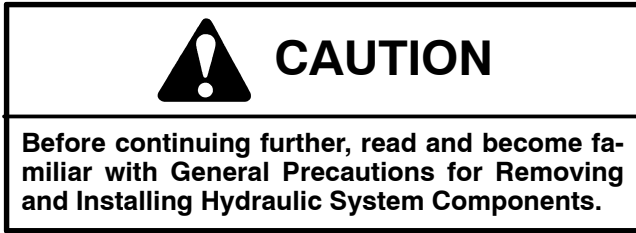
Figure 61

- | | | |
|--|-----------------------------|--------------------|
| 1. Hydraulic manifold assembly | 12. Cap screw (2 used) | 23. O-ring |
| 2. Hydraulic adapter (2 used) | 13. Hydraulic hose | 24. Hydraulic tube |
| 3. Hydraulic tee fitting | 14. Hydraulic hose | 25. O-ring |
| 4. Hydraulic test fitting | 15. O-ring | 26. Hydraulic tube |
| 5. 90° hydraulic fitting | 16. O-ring | 27. Hydraulic hose |
| 6. 90° hydraulic fitting | 17. O-ring | 28. Hydraulic hose |
| 7. 90° hydraulic fitting | 18. Hydraulic hose | 29. Hydraulic hose |
| 8. Hydraulic straight fitting | 19. Hydraulic hose (2 used) | 30. Hydraulic hose |
| 9. Hydraulic straight fitting (5 used) | 20. O-ring | 31. Hydraulic hose |
| 10. Dust cap | 21. Hydraulic tube | 32. O-ring |
| 11. O-ring | 22. O-ring | 33. 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 Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

Removal (Fig. 61)

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



2. Label all hydraulic connections and electrical connections for assembly purposes.

3. Disconnect wire harness connectors from manifold solenoid coils and backlap switch.

IMPORTANT: Before disconnecting any hydraulic hoses from the hydraulic fittings, make sure each hose is labeled to ensure it is connected 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 two (2) cap screws (item 12) that secure the hydraulic manifold to the frame. 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. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from manifold. Discard removed O-rings.

Installation (Fig. 61)

1. If fittings were removed from manifold, lubricate and place new O-rings onto fittings. Install fittings into manifold openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Position manifold assembly to the support frame. Secure assembly to the frame with two (2) cap screws (item 12).

3. Using labels placed during manifold removal, lubricate new O-rings and connect hydraulic hoses to manifold. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

4. Connect wire harness connectors to manifold solenoid coils and backlap switch.

5. Make sure that hydraulic tank is at correct level.

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.

Hydraulic Manifold Service

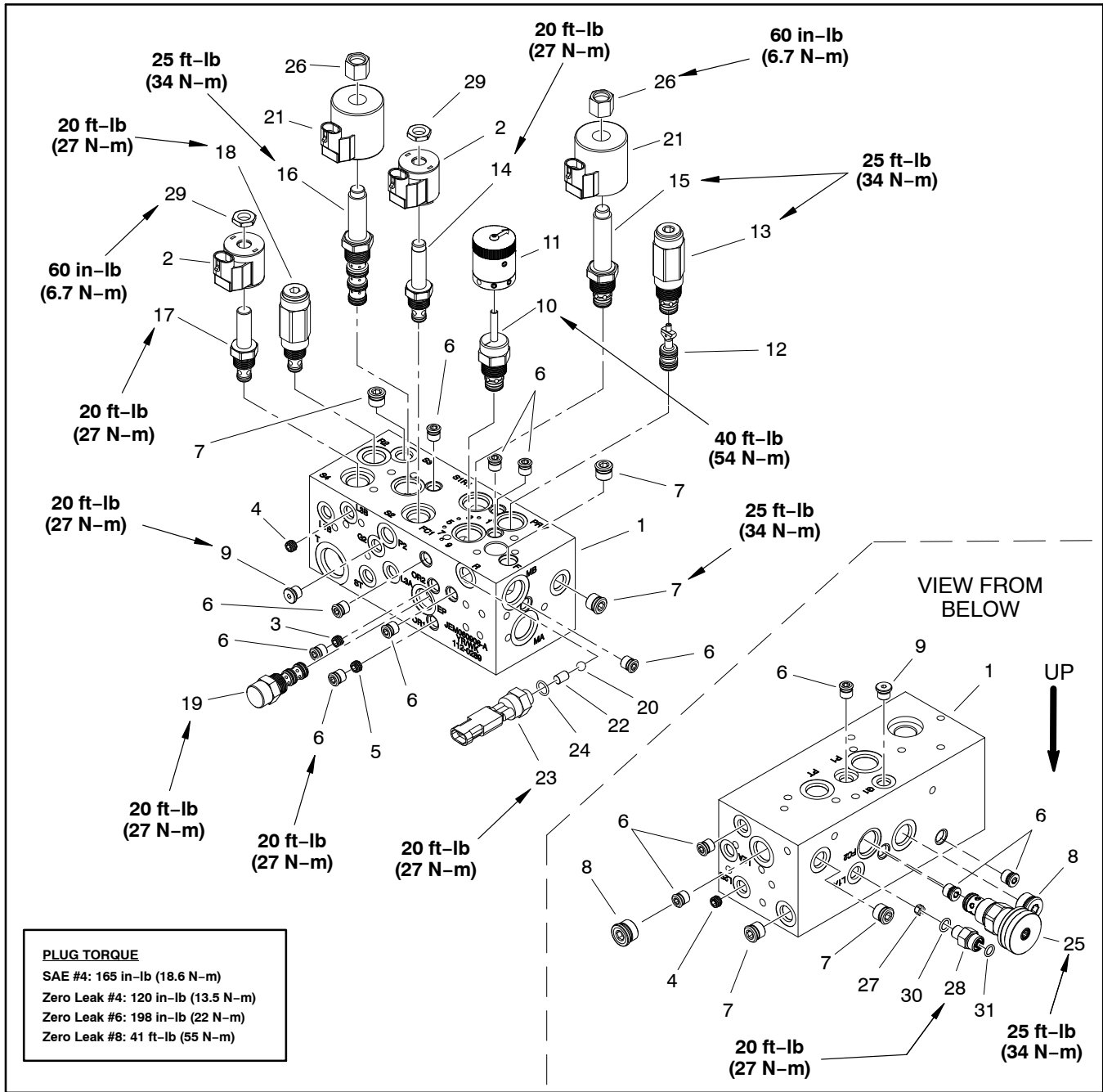


Figure 62

- | | | |
|--|---|---|
| <ol style="list-style-type: none"> 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 | <ol style="list-style-type: none"> 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 (LC) 20. Ball 21. Solenoid coil | <ol style="list-style-type: none"> 22. Dowel pin 23. Ball switch (N.O.) 24. O-ring 25. Flow control cartridge valve (FC2) 26. Nut 27. Flow control orifice (.055) 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 Schematic to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The hydraulic manifold shown in Figure 62 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 62.

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. 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.

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 DC 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 62.
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 Valve

1. Remove rotary handle from valve (Fig. 63):
 - 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 seals.
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.



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. 63):
 - 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.

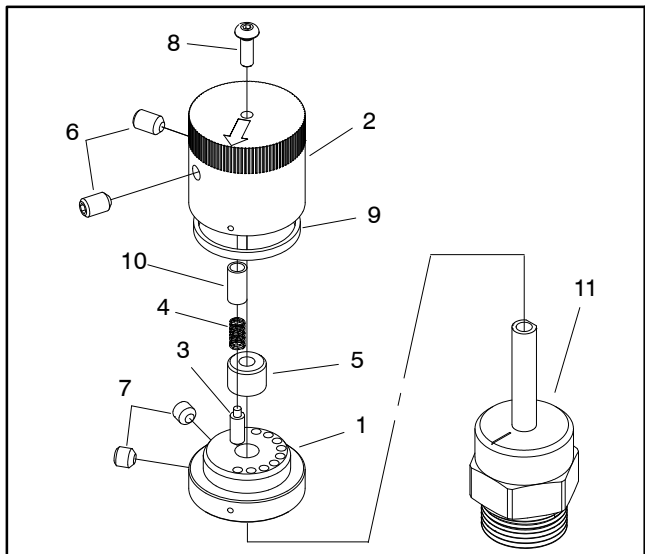


Figure 63

- | | |
|-----------------------|------------------------|
| 1. Handle Base | 7. Set Screw (2 used) |
| 2. Handle Cap | 8. Screw |
| 3. Detent Pin | 9. Lip Seal |
| 4. Compression Spring | 10. Sleeve Bearing |
| 5. Bushing | 11. Flow Control Valve |
| 6. Set Screw (2 used) | |

Mow/Backlap Spool (Fig. 64)

1. Make sure manifold is clean before removing the mow/backlap spool.

2. 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.

3. Visually inspect the spool and manifold port for damage to the sealing surfaces and contamination.

4. 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 switch **20 ft-lb (27 N-m)**.

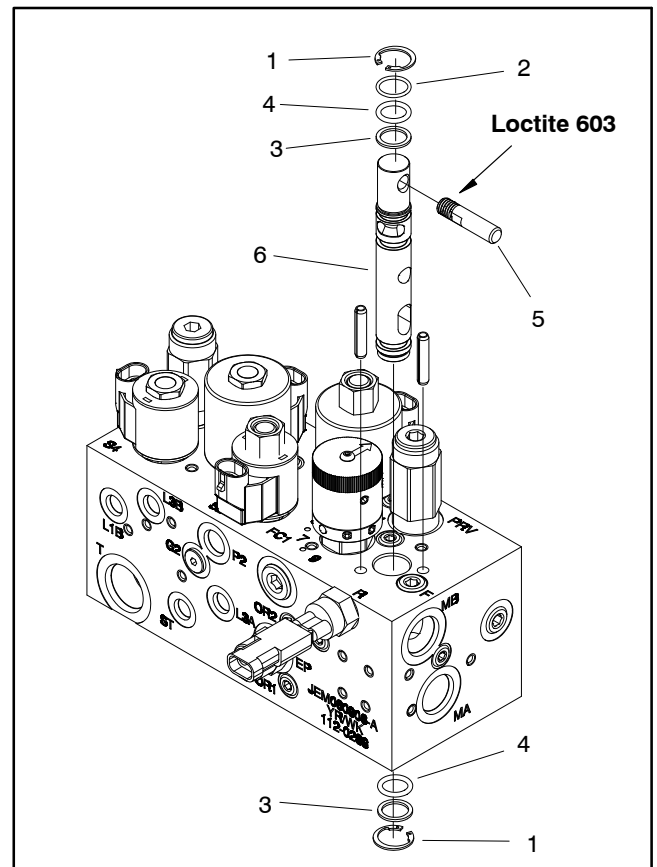


Figure 64

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

Steering Valve

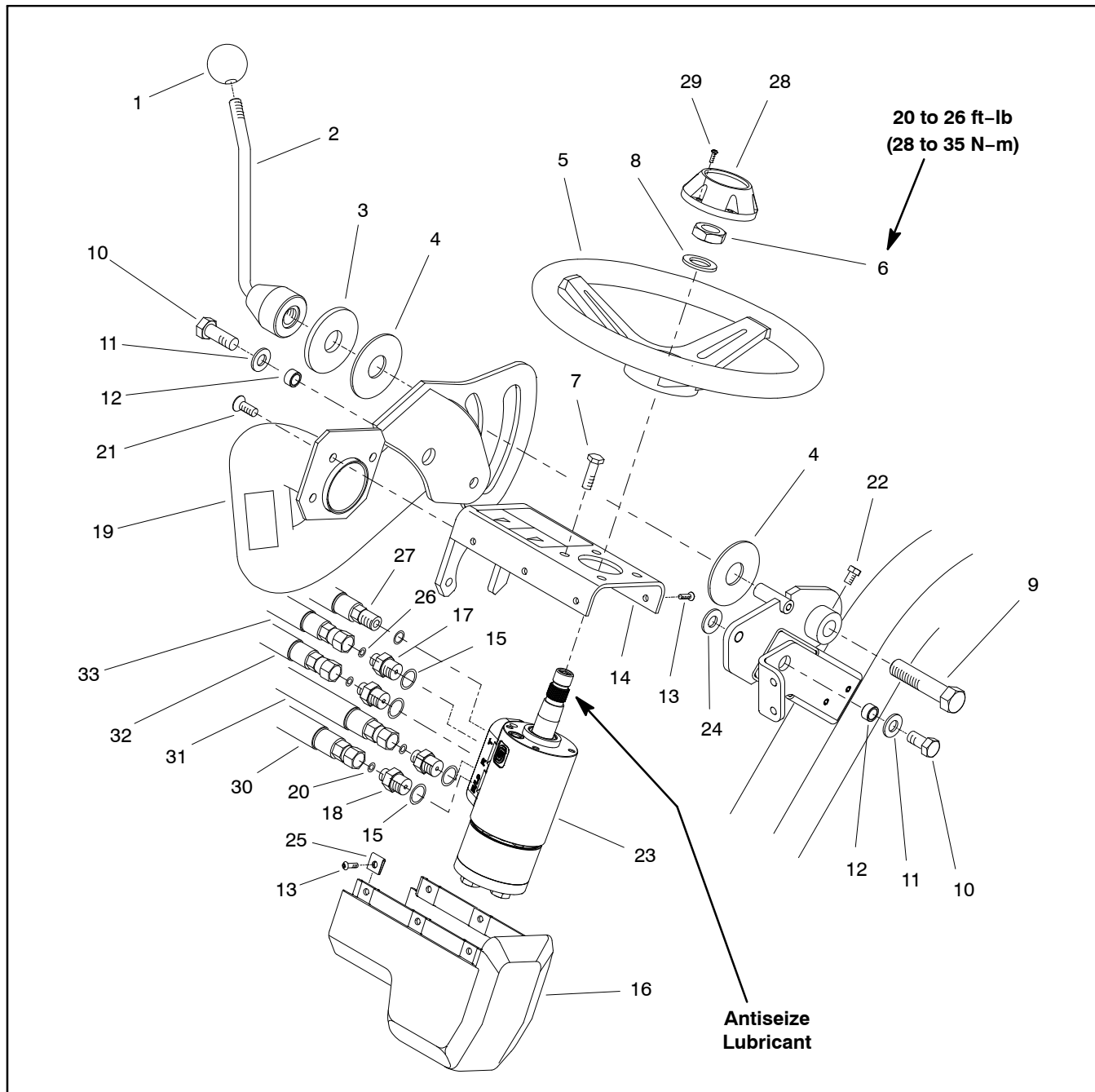
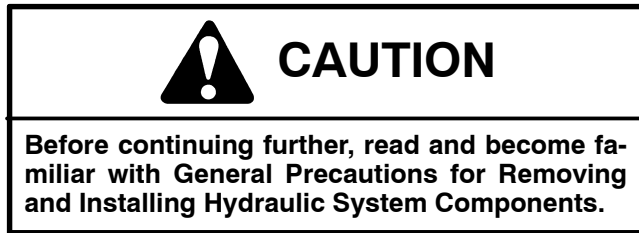


Figure 65

- | | | |
|-------------------------------|--------------------------------|------------------------|
| 1. Knob | 12. Bushing (2 used) | 23. Steering valve |
| 2. Lockup handle | 13. Socket head screw (6 used) | 24. Thrust washer |
| 3. Lockup spacer | 14. Steering mount | 25. Speed nut (6 used) |
| 4. Friction disc (2 used) | 15. O-ring | 26. O-ring |
| 5. Steering wheel | 16. Steering valve cover | 27. Hydraulic hose |
| 6. Steering wheel nut | 17. Hydraulic fitting (2 used) | 28. Steering wheel cap |
| 7. Flange head screw (4 used) | 18. Hydraulic fitting (2 used) | 29. Screw |
| 8. Flat washer | 19. Steering arm | 30. Hydraulic hose |
| 9. Cap screw | 20. O-ring | 31. Hydraulic hose |
| 10. Cap screw (2 used) | 21. Socket head screw (3 used) | 32. Hydraulic hose |
| 11. Flat washer (2 used) | 22. Square head screw | 33. Hydraulic hose |

Removal (Fig. 65)

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



2. Remove screw (item 29) and then steering wheel cap (item 28) from the steering wheel.

3. Remove nut (item 6) and flat washer (item 8) that secure steering wheel to steering valve.

4. Remove screws (item 13) that secure steering valve cover (item 16). Remove cover from the machine.

5. Label all hydraulic connections for assembly purposes.

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

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

8. Remove four (4) flange head screws (item 7) that secure steering valve to steering mount. Carefully pull steering valve with attached hydraulic hose from machine.

9. Remove hydraulic hose and O-ring from the steering valve.

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

11. Discard all removed O-rings from hoses and fittings.

Installation (Fig. 65)

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

2. Install new O-ring on hydraulic hose end that threads directly into steering valve. Install hose into steering valve port (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

3. While routing hydraulic hose to machine, position steering valve to steering mount. Secure steering valve to steering mount with four (4) flange head screws (item 7).

4. For hydraulic hose that threads directly into steering valve, correctly connect opposite end of hose to fitting on hydraulic manifold (ST port) (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Using labels placed during steering valve removal, lubricate new O-rings and connect hydraulic hoses to fittings in steering valve. Tighten hose connections (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

6. Position steering valve cover (item 16) to the steering mount (item 14). Secure cover to assembly with screws (item 13).

7. Install steering wheel to steering valve:

A. Apply antiseize lubricant to splines of steering valve shaft taking care to keep antiseize lubricant from tapered surface of shaft. Slide steering wheel onto steering valve.

B. Secure steering wheel to steering valve with flat washer and nut. Torque nut from **20 to 26 ft-lb (28 to 35 N-m)**.

C. Install steering wheel cap to steering wheel.

8. Check fluid level in hydraulic oil reservoir and adjust as required.

9. After assembly is completed, rotate steering wheel in both directions to verify that there are no leaks from hydraulic connections.

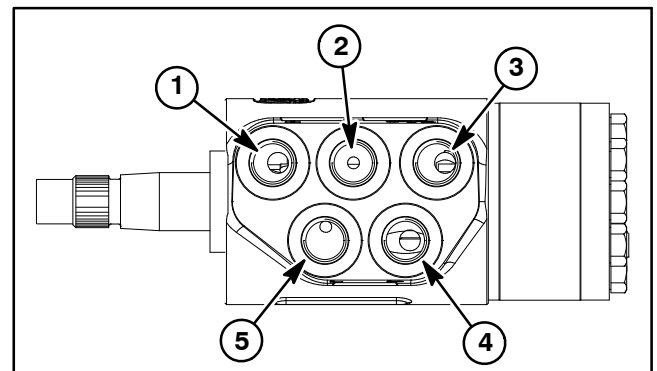


Figure 66

- | | |
|--------------|-----------|
| 1. T port | 4. P port |
| 2. R port | 5. L port |
| 3. E/Ls port | |

Steering Valve Service

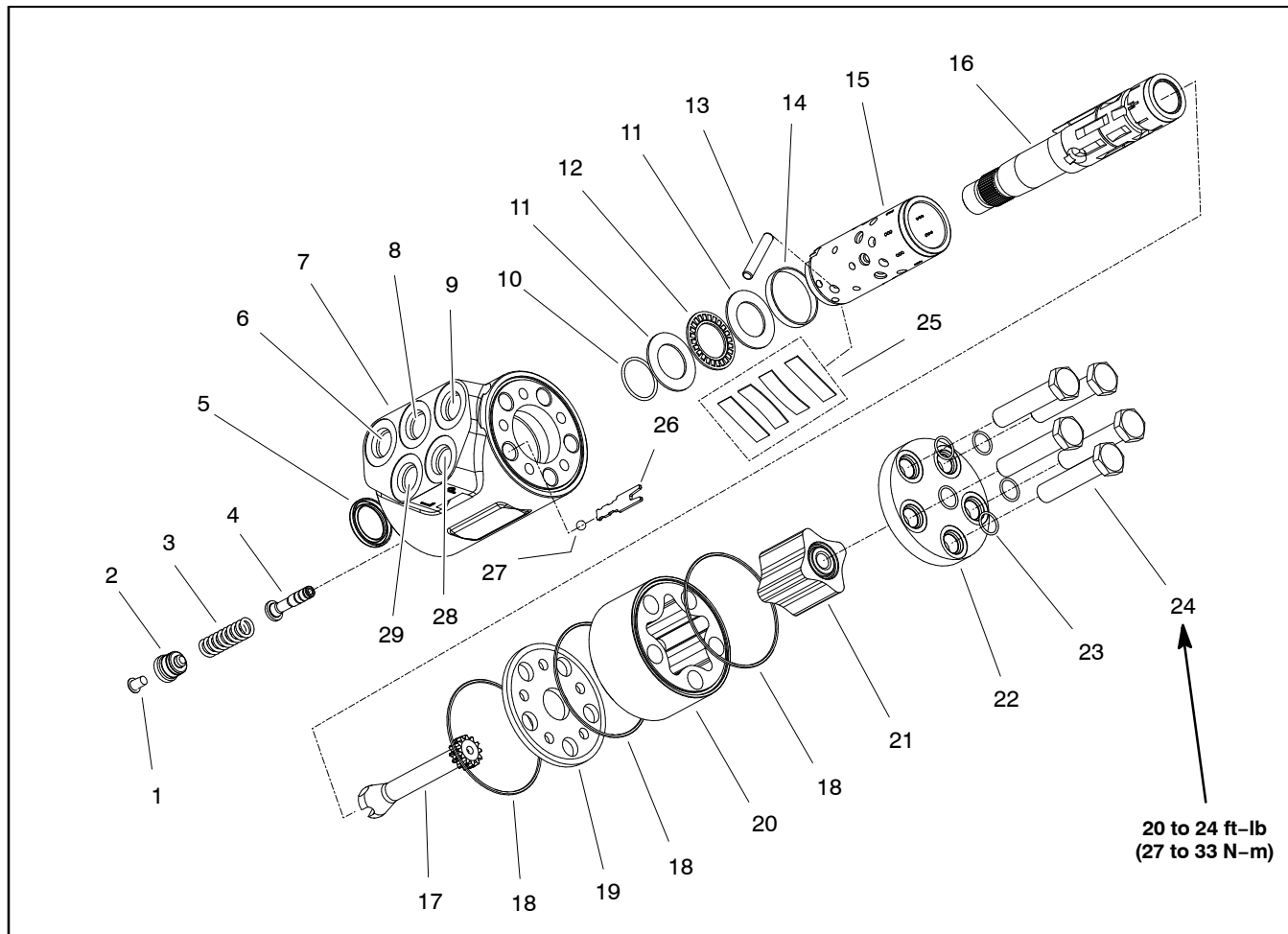


Figure 67

- | | | |
|-----------------|------------------------|------------------------|
| 1. Plug | 11. Thrust washer | 21. Inner gearwheel |
| 2. Plug | 12. Bearing | 22. End cover |
| 3. Spring | 13. Cross pin | 23. O-ring (5 used) |
| 4. Relief valve | 14. Ring | 24. Cap screw (5 used) |
| 5. Dust seal | 15. Sleeve | 25. Spring set |
| 6. T port | 16. Spool | 26. Ball stop |
| 7. Housing | 17. Cardan shaft | 27. Ball |
| 8. R port | 18. O-ring | 28. P port |
| 9. E port | 19. Distribution plate | 29. L port |
| 10. Shaft seal | 20. Outer gearwheel | |

NOTE: For service of the steering valve shown in Figure 67, see the Sauer/Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

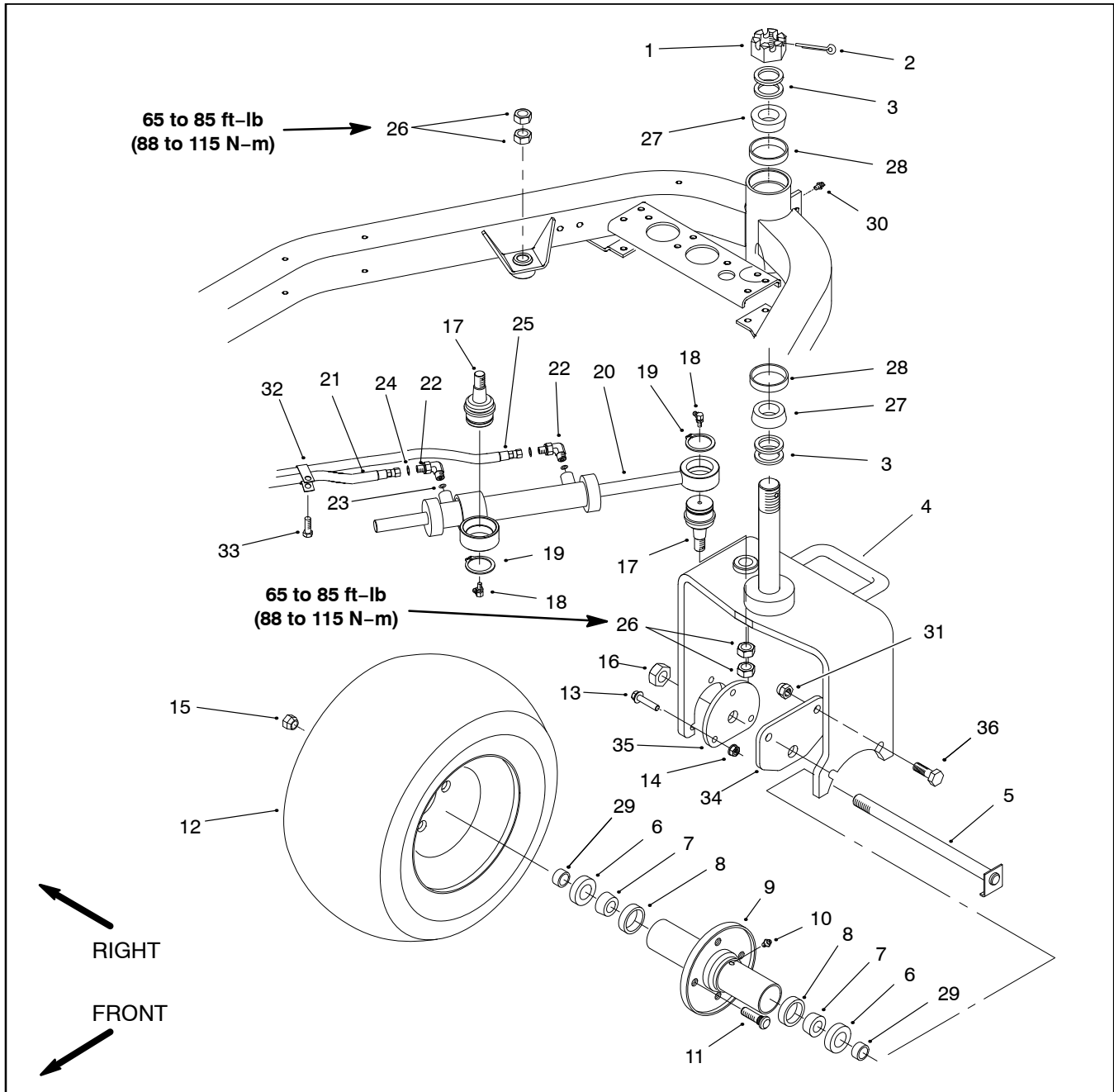
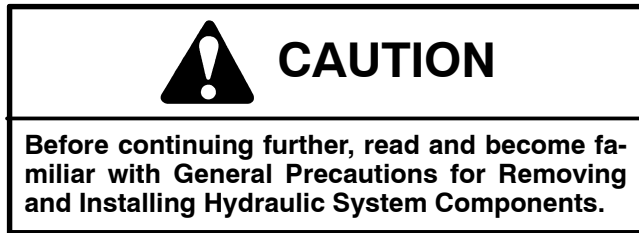


Figure 68

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

Removal (Fig. 68)

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



2. Label all hose connections for assembly purposes
3. Remove hose assemblies and O-rings from hydraulic fittings on steering cylinder. Allow hoses to drain into a suitable container.
4. Gain access to front steering cylinder ball joint.
 - A. Remove three (3) cap screws and flat washers securing the fuel tank base plate to frame. Two (2) 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 steering cylinder ball joint and jam nuts. Prop up tank securely.
5. Remove both jam nuts from the front cylinder 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 and machine.
7. If necessary, remove front retaining ring and ball joint from the steering cylinder.
8. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove hydraulic fittings and O-rings from cylinder. Discard removed O-rings.



9. 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. Support the frame with the rear wheel off the ground.
- B. Remove lock nut (item 16), bolt (item 5), rear spindle spacers (item 29) and rear wheel assembly from the castor fork.
- C. Remove jam nuts and steering cylinder ball joint from the castor fork.

Installation (Fig. 68)

1. If the rear ball joint was removed, install ball joint to castor fork:
 - 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 (item 5) through the castor fork, rear spindle spacers (item 29) and wheel assembly. Secure bolt with lock nut (item 16).
 - C. Lower rear wheel to ground
2. If fittings were removed from steering cylinder, lubricate and place new O-rings onto fittings. Install fittings into cylinder openings making sure that fitting orientation is as noted during removal. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).
3. If front ball joint was removed from the steering cylinder, press ball joint into cylinder and secure with retaining ring.
4. Press steering cylinder onto the installed rear ball joint and secure with retaining ring.
5. Pivot steering cylinder into the frame. Rotate steering cylinder and install front 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)**.
6. Lower fuel tank base to the frame. Secure base to the frame with the three (3) cap screws and flat washers.
7. Connect hydraulic hoses and new O-rings to the hydraulic fittings (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

Steering Cylinder Service

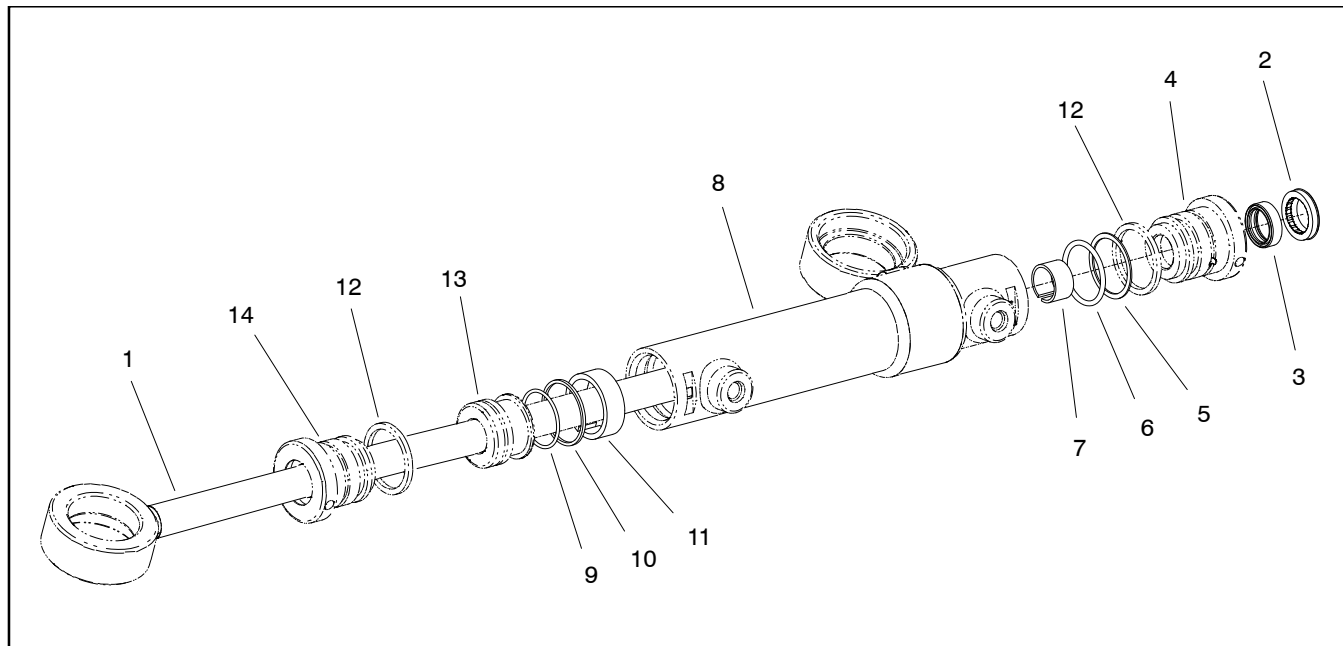


Figure 69

- | | | |
|------------------------------|-----------------|---------------------------|
| 1. Rod | 6. O-ring | 11. Wear ring |
| 2. Wiper | 7. Wear ring | 12. Retaining ring |
| 3. Seal | 8. Barrel | 13. Piston |
| 4. Head (non-ball joint end) | 9. Back-up ring | 14. Head (ball joint end) |
| 5. Backup ring | 10. Seal | |

NOTE: 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 14). 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 (Fig. 69)

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.

IMPORTANT: To prevent damage when clamping cylinder barrel in a vise, clamp only on ball joint location. Do not clamp the vise jaws against the cylinder barrel or rod surface.

2. Mount cylinder in a vise by clamping vise on barrel ball joint location of cylinder. Use of a vise with soft jaws is recommended.

3. Remove both heads from the barrel:

A. 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.

B. Grasp end of rod and use a twisting and pulling motion to carefully extract rod assembly (with ball joint end head) from cylinder barrel. Remove non-ball joint end head assembly from other end of barrel.

NOTE: Piston (item 13) and ball joint end head (item 14) are not removable from cylinder rod.

4. Remove and discard seals, back-up rings, wear rings and O-rings from non-ball joint end head. Also, remove seals (items 9 and 10) and wear ring (item 11) from piston.



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

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

Assembly (Fig. 69)

NOTE: The seal kit includes several O-rings, backup rings and wear rings that cannot be accessed on the Greensmaster 3250-D steering cylinder due to cylinder design.

1. Identify components from seal kit that are to be used in cylinder repair. Put a coating of clean hydraulic oil on all new seals, back-up rings and O-rings.

2. Install new seal, wiper, back up ring and O-ring onto non-ball joint end head (item 4). Position backup ring, seal and wear ring to the piston (item 13).

IMPORTANT: During cylinder assembly, pay careful attention to the retaining ring slots in the barrel to insure that the piston and head seals do not lodge in the slots.

3. Coat all internal cylinder parts with a light coat of clean hydraulic oil. Carefully slide rod assembly into the barrel being careful to not damage seals.

4. Lubricate non-ball joint end head (item 4) assembly with clean hydraulic oil and carefully slide it onto rod and into barrel.

5. Secure both heads to barrel:

A. Align retaining ring hole in the head with the access slot in the barrel.

B. Insert the retaining ring hook into the hole and rotate head clockwise until the retaining ring is completely pulled into the barrel and the ring ends are covered.

C. Apply silicone sealer to barrel access slot.

Hydraulic Reservoir

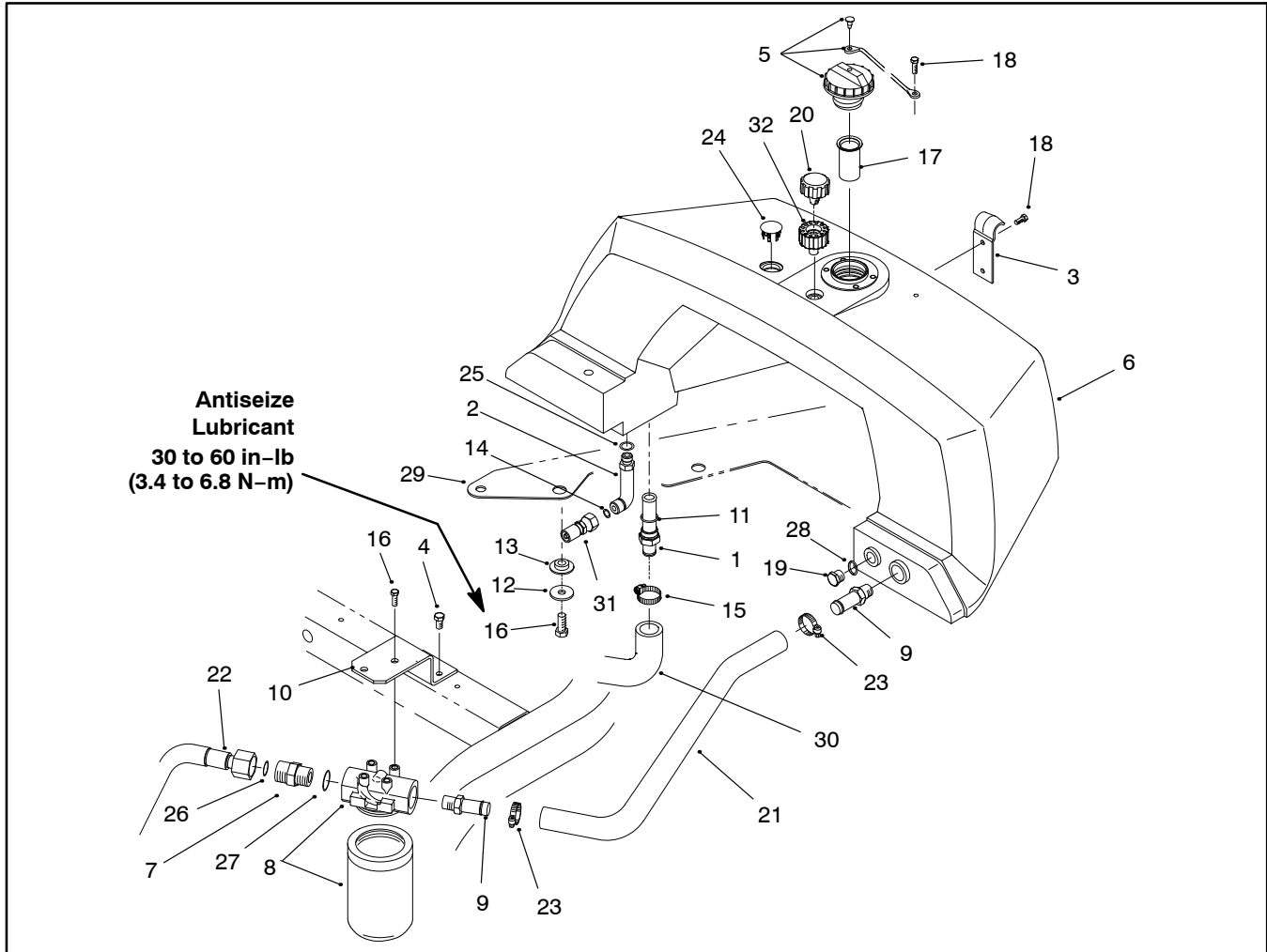


Figure 70

- | | | |
|-------------------------------|--------------------------|----------------------|
| 1. Strainer | 12. Flat washer (4 used) | 23. Hose clamp |
| 2. 90° hydraulic fitting | 13. Grommet (4 used) | 24. Serrated plug |
| 3. Fuel tank clamp | 14. O-ring | 25. O-ring |
| 4. Washer head screw (2 used) | 15. Hose clamp | 26. O-ring |
| 5. Tank cap | 16. Cap screw (4 used) | 27. O-ring |
| 6. Hydraulic tank | 17. Filter screen | 28. O-ring |
| 7. Hydraulic straight fitting | 18. Cap screw (3 used) | 29. Mounting plate |
| 8. Oil filter assembly | 19. Plug | 30. Hydraulic hose |
| 9. Hydraulic barb fitting | 20. Air breather | 31. Hydraulic hose |
| 10. Oil filter mount | 21. Return hose | 32. Breather adapter |
| 11. O-ring | 22. Tube assembly | |

Removing Hydraulic Reservoir (Fig. 70)

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

2. Place a suitable container under the gear pump to collect hydraulic oil. Clamp pump inlet hose to prevent drainage (Fig. 71). Remove pump inlet hose from gear pump and direct to container. Release clamp from hose to drain hydraulic tank.



CAUTION

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

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. 72).

4. Disconnect return hose (item 21) from barb fitting (item 9). Allow hose to drain into 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. 73).

6. Remove three (3) washer head screws that secure the mounting plate (item 29) to the frame. Two screws are located on the top of the plate at the front corners of the hydraulic tank. The third screw is in front of the castor fork and below the plate.

7. Tilt mounting plate assembly up by lifting at the rear of the machine. Prop up plate securely. Remove four (4) cap screws (item 16), flat washers (item 12) and grommets (item 13) securing the hydraulic tank to the mounting plate.

8. Remove hydraulic tank from the mounting plate.

Inspecting Reservoir Parts (Fig. 70)

1. Clean tank and filler screen with solvent.
2. Inspect tank for leaks, cracks or other damage.
3. Replace hydraulic hoses if worn or leaking.

Installing Hydraulic Reservoir (Fig. 70)

1. Place antiseize lubricant into all four (4) inserts at the bottom of the hydraulic tank. Position tank onto the mounting plate.

2. Secure hydraulic tank to the mounting plate with four (4) cap screws (item 16), flat washers (item 12) and grommets (item 13). Torque cap screws from **30 to 60 in-lb (3.4 to 6.8 N-m)**.

3. Secure mounting plate to the frame with three (3) washer head screws. 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. 73).

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

6. Secure pump inlet hose to gear pump with hose clamp (Fig. 71).

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. 72).

8. Fill hydraulic tank with new hydraulic oil.

9. Follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in this section).

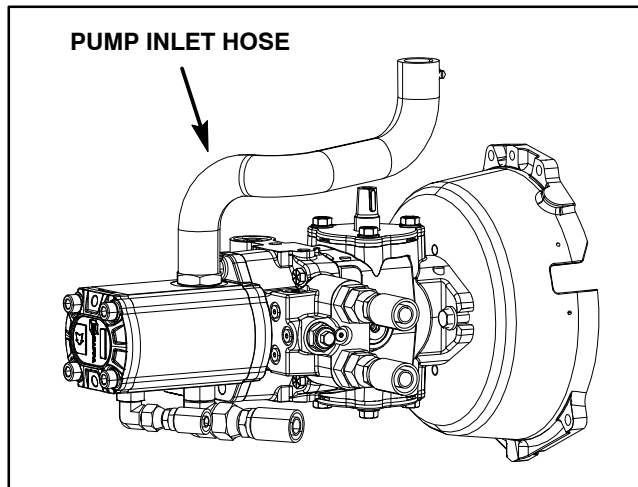


Figure 71

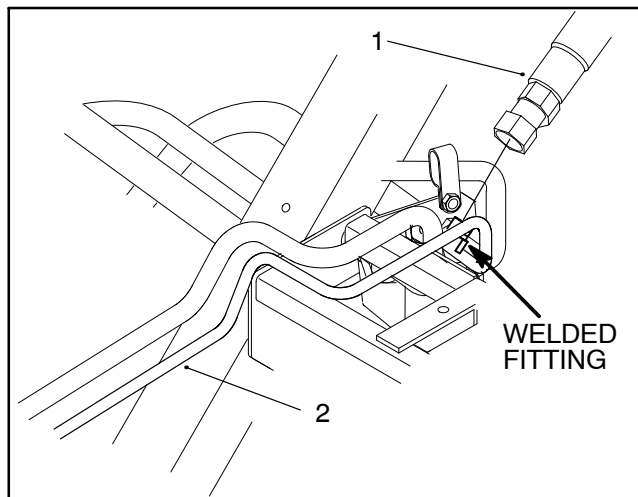


Figure 72

1. Hose assembly 2. Case drain tube

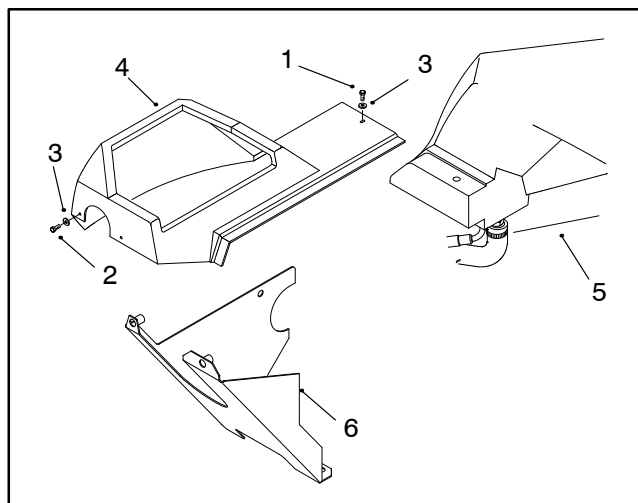


Figure 73

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

Turf Guardian™ Leak Detector System (If Equipped)

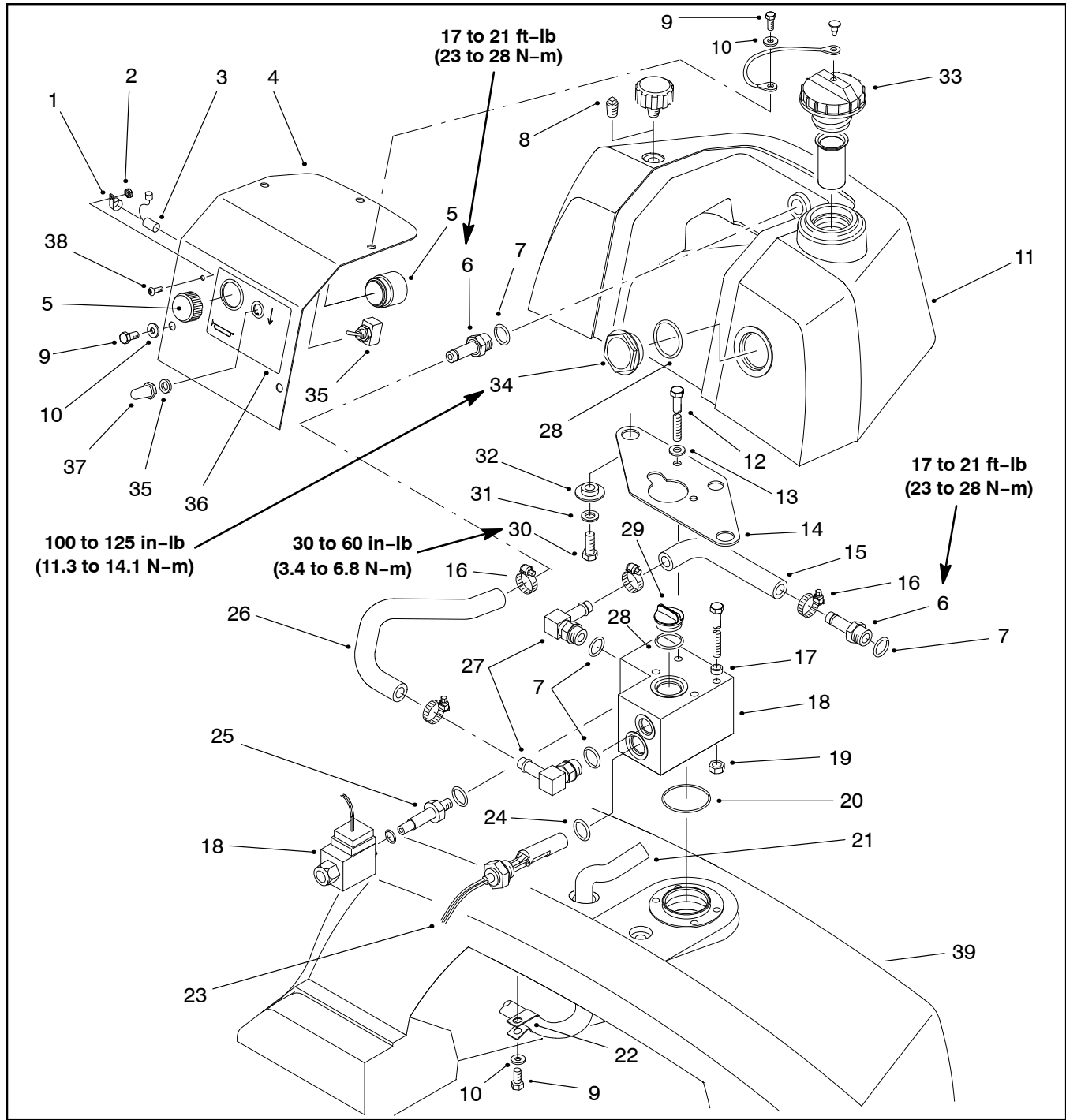
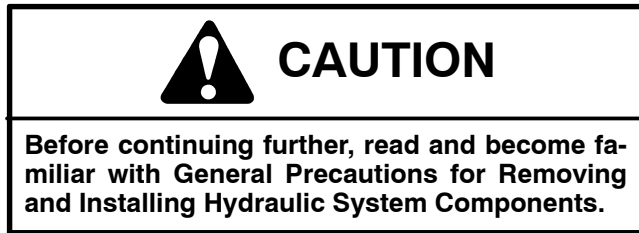


Figure 74

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

Removal (Fig. 74)

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



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 (5) cap screws and flat washers securing the cover plate and cap tether to the leak detection tank. Remove cover plate from tank (Fig. 75).

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. 76).

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 (4) 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. 76).

Installation (Fig. 74)

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 (5) cap screws and washers securing the cover plate to auxiliary hydraulic tank are removed with the cover plate (Fig. 75).

4. Clean mating surfaces of block and fill neck with a clean, dry rag. Carefully place new O-ring over fill neck boss (Fig. 76).

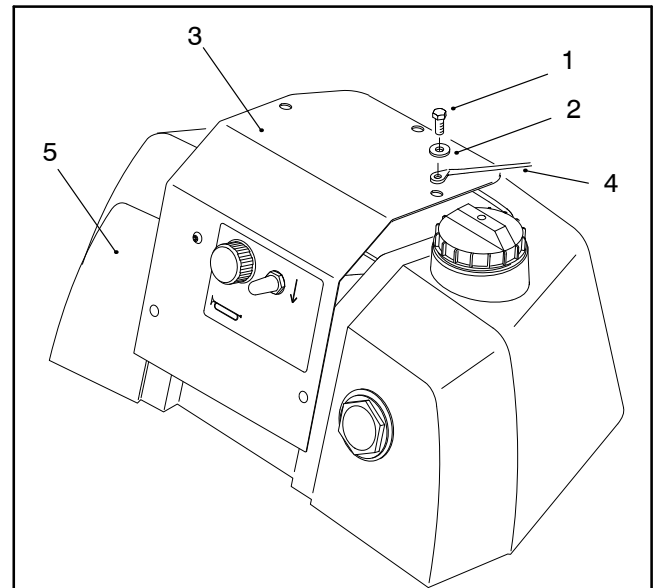


Figure 75

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

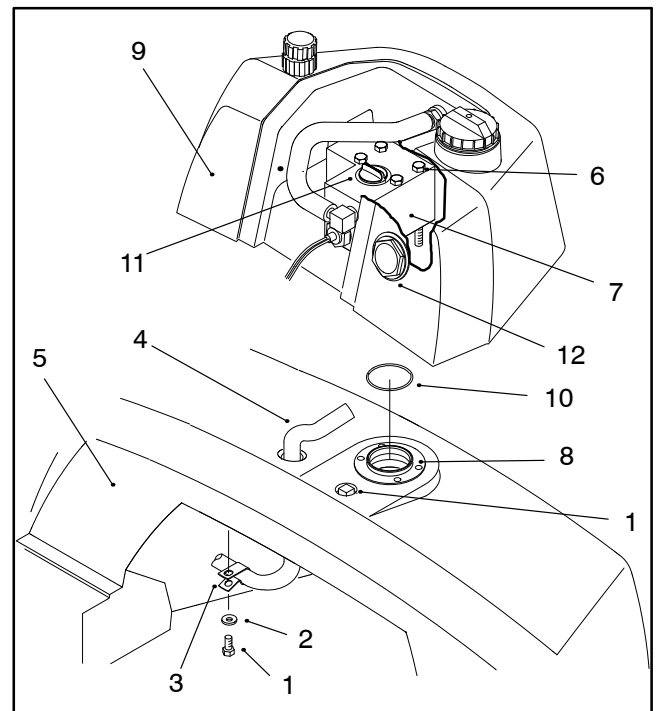


Figure 76

- | | |
|--------------------------|------------------------|
| 1. Cap screw | 7. Valve assembly |
| 2. Flat washer | 8. Fill neck |
| 3. R-ring | 9. Leak detection tank |
| 4. Leak detector harness | 10. O-ring |
| 5. Hydraulic tank | 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 (4) cap screws (Fig. 76).

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 cap screw.

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. 76).

8. Before attaching cover plate, test leak detector switch with ignition key switch in **ON/RUN** position. The buzzer should sound with toggle switch held down for one (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 one (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 (5) cap screws and flat washers (Fig. 76).

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. 76).

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. 74)

1. The leak detector can be disassembled using the leak detector assembly drawing (Fig. 74) 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. 74)

1. Coat all O-rings with clean hydraulic oil.

2. Secure sight gauge (item 34) and new O-ring (item 28) to the leak detection tank. Torque gauge from **100 to 125 in-lb (11.3 to 14.1 N-m)**.

3. Secure both hydraulic barb fittings (item 6) and new O-rings (item 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 (item 14) to tank with two (2) grommets (item 32), flat washers (item 31) and cap screws (item 30). Torque both screws from **30 to 60 in-lb (3.4 to 6.8 N-m)**.

5. Secure formed inlet hose (item 26) to the barb fitting (item 6) attached to the end of the tank with hose clamp. Secure formed outlet hose (item 15) to the hydraulic barb fitting (item 6) attached to the inner side of the tank with hose clamp.

6. Secure both hydraulic barb fittings (item 27) and O-rings to the valve assembly (item 18). Secure oil level sensor (item 23) and O-ring to the assembly. Secure cartridge valve (item 25) and O-ring to assembly. Hand tighten plug (item 29) and O-ring to the assembly.

7. Position valve assembly (item 18) under the mounting bracket (item 14). Insert four (4) cap screws (item 12) with two (2) flat washers (item 13) and two (2) idler washers (item 17) through the bracket and assembly. Hand tighten four (4) lock nuts to the cap screws.

8. Secure toggle switch (item 35) to cover plate (item 4) with nut, then secure toggle switch boot (item 37) to switch. Secure audio alarm (item 5) to plate with cap. Secure delay timer (item 3) to the plate with clamp (item 1), socket head screw (item 38) and lock nut (item 2).

9. Connect leak detector harness to the following:

- A. The connector with red and black wires to the delay timer (item 3).
- B. The black/white and black wires to the negative terminal of the audio alarm (item 5). Connect red and yellow wires to the positive terminal of the alarm.
- C. The black and gray wires to the negative terminal of the toggle switch (item 35). Connect red and yellow wires to the positive terminal or the switch.
- D. The red/white and red wires to the positive terminal of the solenoid valve coil (item 18). Connect black wires to the negative terminal.
- E. The connector with yellow and gray wires to the oil level sensor (item 23).

10. Verify leak detector operation (see Leak Detector in Chapter 5 – Electrical System).



Electrical System

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Electrical System

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General Information

Operator's Manual

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

Electrical Drawings

The electrical schematic and other electrical drawings for the Greensmaster 3250-D are located in Chapter 9 – Foldout Drawings.

Special Tools

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

Multimeter

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

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

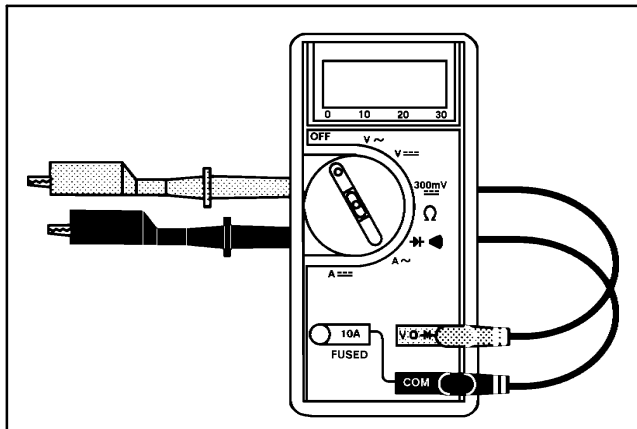


Figure 1

Skin-Over Grease

Special non-conductive grease which forms a light protective skin to help waterproof electrical switches and contacts.

Toro Part Number: **TOR50547**



Figure 2

Battery Terminal Protector

Aerosol spray that should be used on battery terminals to reduce corrosion problems. Apply terminal protector after the battery cable has been secured to the battery terminal.

Toro Part Number: **107-0392**



Figure 3

Dielectric Gel

Dielectric gel should be used to prevent corrosion of connection terminals. To ensure complete coating of terminals, liberally apply gel to both component and wire harness connector, plug connector to component, unplug connector, reapply gel to both surfaces and reconnect harness connector to component. Connectors should be thoroughly packed with gel for effective results.

Toro Part Number: **107-0342**



Figure 4

Battery Hydrometer

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



Figure 5

Troubleshooting



CAUTION

Remove all jewelry, especially rings and watches, before doing any electrical troubleshooting or testing. Disconnect the battery cables unless the test requires battery voltage.

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this machine (see electrical schematic and other electrical drawings in Chapter 9 – Foldout Drawings).

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 is discharged. 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 operation. Starter is faulty and causing an incomplete circuit for the solenoid.
Nothing happens when start attempt is made.	Functional control lever is not in the NEUTRAL position. Battery is discharged or faulty. Wiring to start circuit components is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings). Battery cables are loose or corroded. Battery ground to frame is loose or corroded. Fusible link harness at the engine starter motor has faulty link(s). Fuse F3 (15 ampere) is faulty. Start relay or circuit wiring is faulty. Start interlock relay or circuit wiring is faulty. Neutral sensor is out of adjustment or faulty. The ignition switch or circuit wiring is faulty. Starter solenoid or circuit wiring is faulty. Starter motor is faulty. High temperature relay, run relay and/or high temperature switch are faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks (but should not) with the functional control lever in the MOW or TRANSPORT position.	<p>Neutral sensor is out of adjustment.</p> <p>Neutral sensor or circuit wiring is faulty.</p> <p>Interlock relay or circuit wiring is faulty.</p>
Engine cranks, but does not start.	<p>Wiring to start circuits is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings).</p> <p>Run relay or circuit wiring is faulty.</p> <p>High temperature relay or circuit wiring is faulty.</p> <p>High temperature switch or circuit wiring is faulty.</p> <p>Fuel solenoid or circuit wiring is faulty.</p> <p>Glow plugs, glow relay or glow controller are faulty.</p> <p>Engine or fuel system is malfunctioning (see Chapter 3 – Diesel Engine).</p> <p>Engine and fuel may be too cold.</p>
Engine cranks (but should not) with the Functional Control Lever in the MOW or TRANSPORT position.	<p>Neutral sensor is out of adjustment or faulty.</p> <p>Neutral sensor circuit wiring is faulty.</p>

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.	<p>Operator is sitting too far forward on the seat (seat switch not depressed).</p> <p>Seat switch or circuit wiring is faulty.</p> <p>Parking brake switch or circuit wiring is faulty.</p>
Battery does not charge.	<p>Wiring to charging circuit components is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings).</p> <p>Voltage regulator/alternator is faulty.</p> <p>Fusible link harness at the engine starter motor has faulty link(s).</p> <p>Ignition switch is faulty.</p> <p>Battery is faulty.</p>
Engine kills during operation (operator sitting on seat).	<p>Operator moved too far forward on the seat (seat switch not depressed).</p> <p>Seat switch or circuit wiring is faulty.</p> <p>Parking brake switch or circuit wiring is faulty.</p> <p>Run relay or circuit wiring is faulty.</p> <p>Engine is overheated.</p> <p>Wiring to run circuit components is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings).</p>

Cutting Unit Operating Problems

Problem	Possible Causes
Cutting units run (but should not) when raised.	<p>Joystick relay or circuit wiring is faulty.</p> <p>Solenoid valve S1R1 or circuit wiring is faulty.</p> <p>Mow relay or circuit wiring is faulty.</p> <p>Mow sensor or circuit wiring is faulty.</p>
Cutting units do not run when lowered with the Functional Control Lever in the MOW or NEUTRAL position.	<p>Fuse F1 (10 ampere) or fuse block is faulty.</p> <p>Solenoid valve S1R1 or circuit wiring is faulty.</p> <p>Mow sensor or circuit wiring is faulty.</p> <p>Mow relay or circuit wiring is faulty.</p> <p>Joystick raise switch or circuit wiring is faulty.</p> <p>Joystick relay or circuit wiring is faulty.</p> <p>Wiring to run/mow/backlap circuit components is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings).</p>
Cutting units will not raise.	<p>Fuse F2 or fuse block is faulty.</p> <p>Solenoid valve S2 or circuit wiring is faulty.</p> <p>Solenoid valve S3 or circuit wiring is faulty.</p> <p>Diode D1–D or circuit wiring is open.</p> <p>Joystick raise switch or circuit wiring is faulty.</p> <p>Raise relay or circuit wiring is faulty.</p> <p>Wiring to run/mow/backlap circuits (see Electrical Schematic in Chapter 9 – Foldout Drawings) components is loose, corroded or damaged.</p>
Cutting units will not lower.	<p>Fuse F2 or fuse block is faulty.</p> <p>Diode D1–A or circuit wiring is open.</p> <p>Joystick raise switch or circuit wiring is faulty.</p> <p>Joystick lower switch or circuit wiring is faulty.</p> <p>Joystick relay or circuit wiring is faulty.</p> <p>6 second timer or circuit wiring is faulty.</p> <p>Solenoid valve S2, S4 or circuit wiring is faulty.</p> <p>Lower relay or circuit wiring is faulty.</p> <p>Wiring to run/mow/backlap circuit components is loose, corroded or damaged (see Electrical Schematic in Chapter 9 – Foldout Drawings).</p>

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 60° to 100° F (16° to 37° C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (-) meter lead the negative battery post.

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

Voltage Measured	Battery Charge Level
12.68 V (or higher)	Fully charged (100%)
12.45 V	75% charged
12.24 V	50% charged
12.06 V	25% charged
11.89 V	0% charged

Charging System Test

This is a simple test used to determine if a charging system is functioning. It will tell you if the charging system has an output, but not its capacity.

Use a digital multimeter set to DC volts. Connect the positive (+) multimeter lead to the positive battery post and the negative (-) multimeter lead to the negative battery post. Keep the test leads connected to the battery posts and record the battery voltage.

NOTE: Upon starting the engine, the battery voltage will drop and then should increase once the engine is running.

NOTE: Depending upon the condition of the battery charge and battery temperature, the battery voltage will increase at different rates as the battery charges.

Start the engine and run at high idle. Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

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

An example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.95 v
Difference	= +0.65 v

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of your Greensmaster 3250-D glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the


ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to RUN and record the multimeter results.

The Greensmaster 3250-D glow plug system should have a reading of approximately 27 amps total (nine (9) amps per glow plug). If low current reading is observed, one (or more) of the glow plugs is faulty.

Component Testing

For accurate resistance and/or continuity checks, electrically disconnect the component being tested from the circuit (e.g. unplug the ignition switch connector before doing a continuity check).

NOTE: For engine component testing information, refer to the Kubota Workshop Manual.


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 (3) positions (OFF, RUN and START). The terminals are marked as shown. The circuitry of the ignition switch is shown in the chart below. With the use of a multimeter (ohms setting), the switch functions may be tested to determine whether continuity exists between the various terminals for each position. Verify continuity between switch terminals.

POSITION	CIRCUIT
OFF	NONE
RUN	B + I + A, X + Y
START	B + I + S

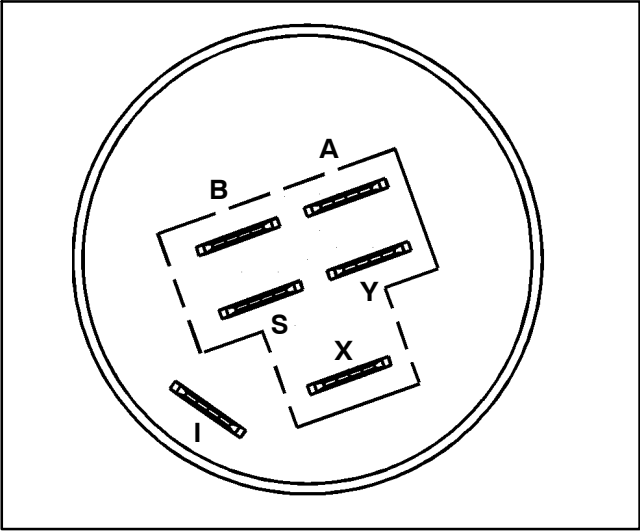


Figure 6

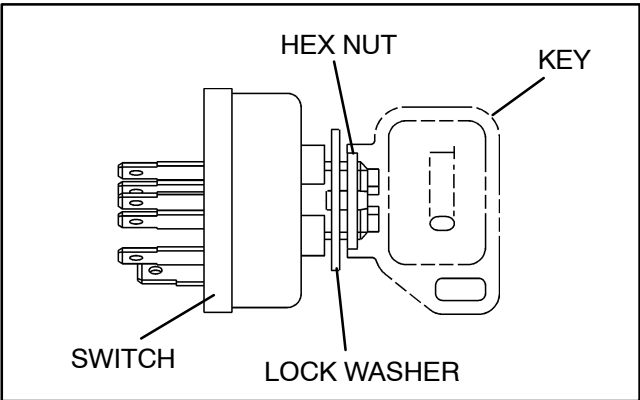


Figure 7

Electrical System

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. Fuse F1 (top) (10 ampere) supplies power to the run and mow relays.
2. Fuse F2 (10 ampere) supplies power to the raise and lower relays.
3. Fuse F3 (15 ampere) supplies power to terminal B of the ignition switch.
4. Fuse F4 is available for optional accessories. A maximum 15 ampere fuse should be used in this position.

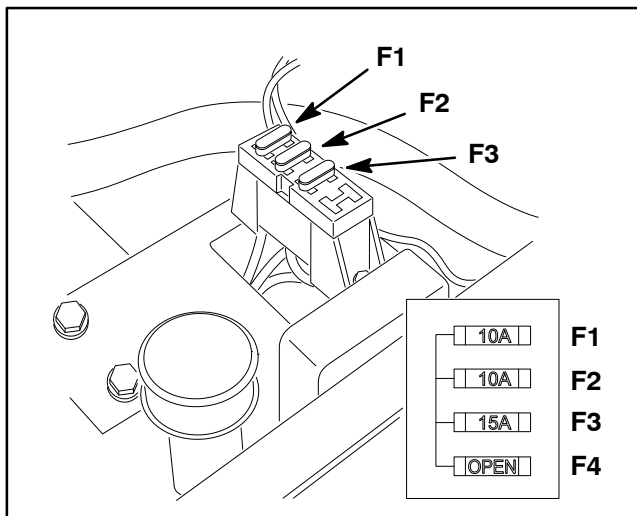


Figure 8

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 (6) minutes.
4. Disconnect the voltage source from the hour meter.

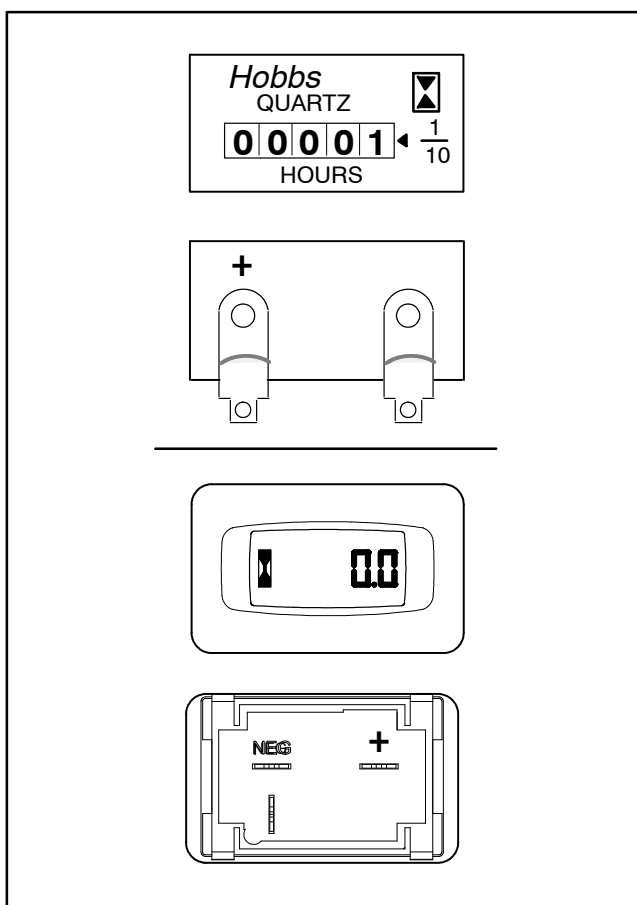


Figure 9

Warning Light Cluster

Glow Plug Indicator Light

The glow plug indicator light should come on when the ignition switch is placed in the RUN position prior to placing the ignition switch in START. The light should stay lit for approximately six (6) seconds while the ignition switch is left in the RUN position.

High Temperature Warning Light

If the engine coolant temperature reaches **220°F (105°C)** (approximate), the high temperature warning light will come on and the engine will shut down.

To test the high temperature warning light and circuit wiring, turn ignition switch to the RUN position and ground the wire attached to high temperature warning switch located on the engine water pump housing (see High Temperature Warning Switch in this section). The high temperature warning light should illuminate when the wire is grounded.

Engine Oil Pressure Light

The engine oil pressure light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with the engine running if the engine oil pressure drops to an unsafe level.

IMPORTANT: If the oil pressure indicator light is illuminated with the engine running, shut off the engine immediately.

To test the oil pressure light and circuit wiring, ground the wire attached to oil pressure switch located on the engine near the oil filter. Turn ignition switch to the RUN position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

Charge Indicator Light

The charge indicator light should come on when the ignition switch is in the RUN position with the engine not running. Also, it should illuminate with an improperly operating charging circuit while the engine is running.

Testing Indicator Lights

1. Remove console cover from console assembly to gain access to indicator lights (see Control Console Disassembly in the Service and Repairs section of Chapter 7 – Chassis).
2. Apply 12 VDC to terminals 1A and 2A (Fig. 11) and ground terminals 1B and 2B (Fig. 11).
3. Both indicator lights should illuminate.

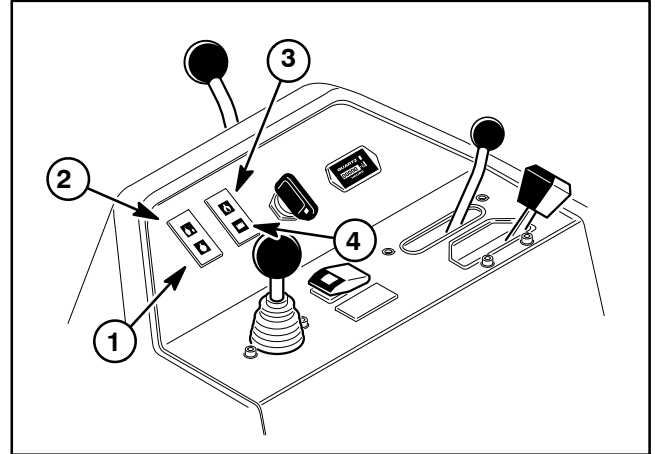


Figure 10

- | | |
|------------------------|------------------------|
| 1. Glow plug indicator | 3. Engine oil pressure |
| 2. High temperature | 4. Charge indicator |

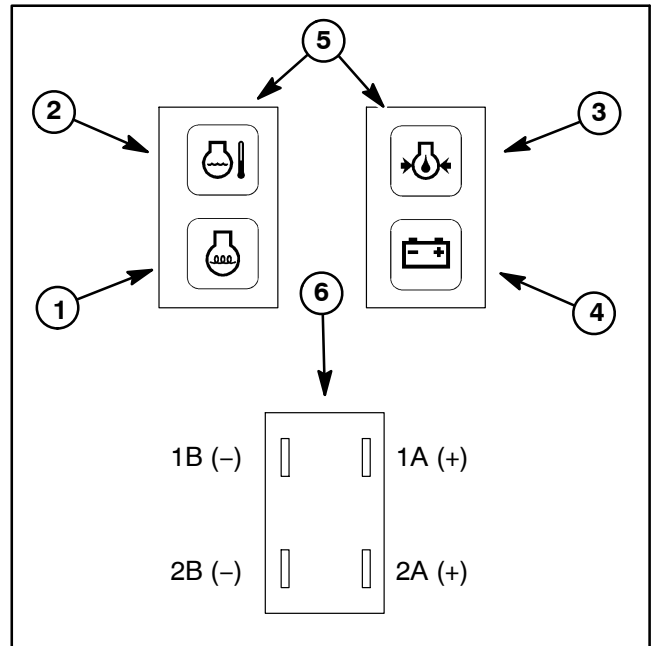


Figure 11

- | | |
|------------------------|--------------------------|
| 1. Glow plug indicator | 4. Charge indicator |
| 2. High temperature | 5. Indicator light front |
| 3. Engine oil pressure | 6. Indicator light back |

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.

Testing

1. Make sure the engine is off. Remove seat from the support assembly by removing four (4) lock nuts from the seat bolts.
2. Disconnect wire harness connector from the seat switch.
3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch 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. Replace seat switch if testing determines that it is faulty.
7. When switch testing is complete, connect wire harness electrical connector to switch. Reinstall seat.

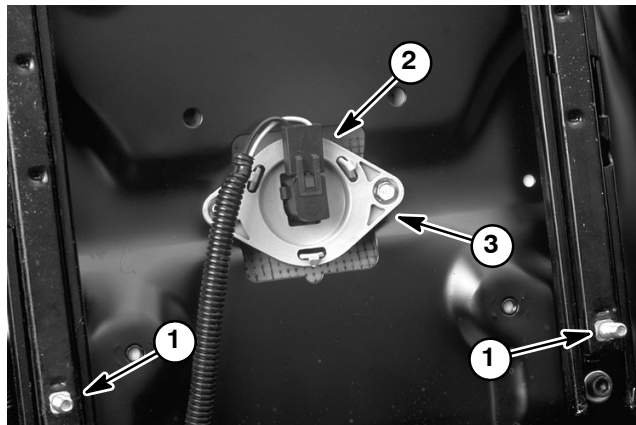


Figure 12

- | | |
|-------------------------|----------------|
| 1. Seat bolts | 3. Seat switch |
| 2. Electrical connector | |

Lower Reels Time Delay

The lower reels time delay is a solid state timer. Upon the application of power, the load is energized and the time delay is started. After six (6) seconds the load is de-energized. The time delay is attached to a bracket under the control console (Fig. 13).

Testing

1. Connect voltmeter across test load and test load to timer. Connect 12VDC source to timer and load. Make sure to observe polarity. After six (6) seconds, there should be no voltage across the load.
2. When testing is completed, disconnect timer from 12VDC source and test load.

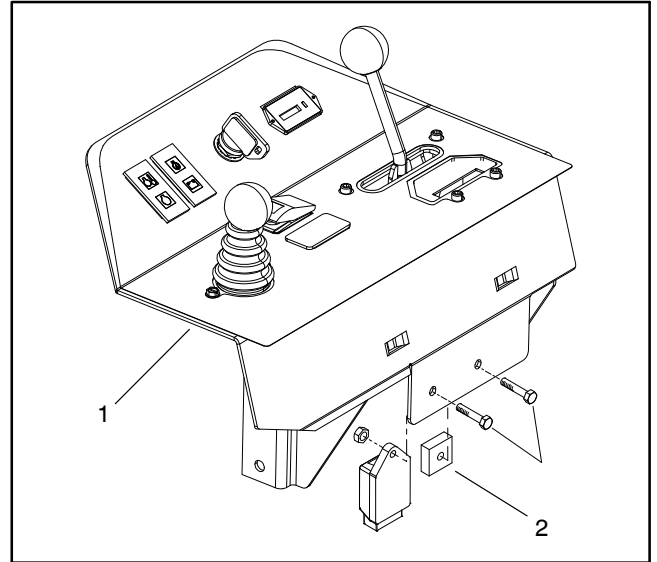


Figure 13

1. Console

2. Time delay

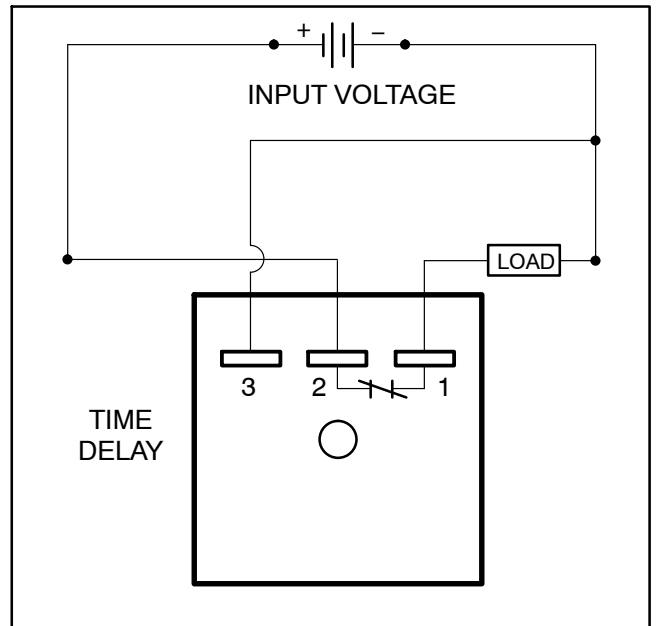


Figure 14

Diode Circuit Boards

The Greensmaster 3250-D electrical system uses two (2) diode circuit boards that are inserted into wire harness connectors. Each of these circuit boards contain four (4) diodes. The diodes are used for circuit protection from inductive voltage spikes and for safety circuit logic.

Apply dielectric grease (Toro part number 107-0342) to circuit board contacts whenever the circuit board is installed into the wire harness.

NOTE: The Greensmaster 3250-D does not use diodes D1-B or D2-B.

Diode D1-A allows current flow to solenoid S2 when the lower relay is energized. It also prevents current flow to solenoid S4 when the raise relay is energized.

Diode D1-C prevents a negative spike from damaging the mow sensor and backlap switch by allowing a ground path for the mow relay when it de-energizes.

Diode D1-D allows current flow to solenoid S2 when the raise relay is energized. It also prevents current flow to solenoid S4 when the lower relay is energized.

Diode D2-A 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 D2-C maintains current flow to the joystick relay after the momentary lower switch of the joystick opens.

Diode D2-D 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) with the parking brake released (parking brake sensor closed).

Testing

The circuit board diodes can be individually tested using a digital multimeter (ohms setting) and the table to the right. If any of the diodes on the circuit board are damaged, the diode circuit board must be replaced.

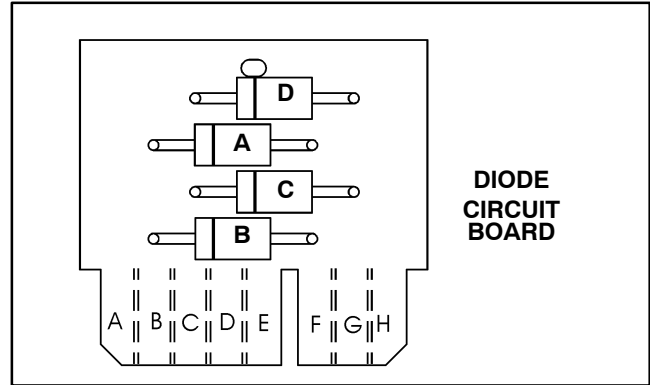


Figure 15

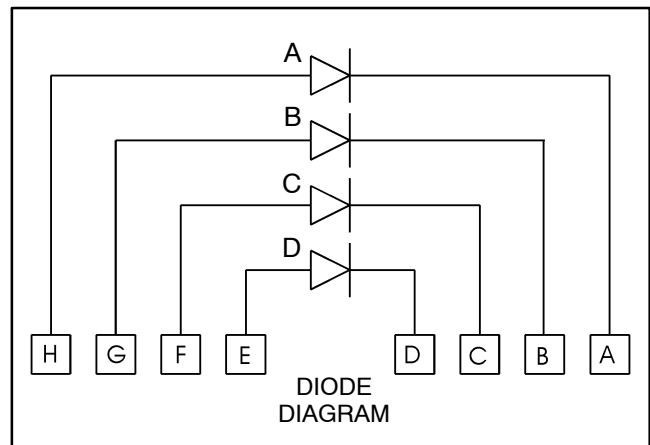


Figure 16

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

Solenoid Valve Coils

The Greensmaster hydraulic control manifold uses several hydraulic solenoid valve coils for system control. When the solenoid coils are energized, hydraulic valve shift occurs to control hydraulic circuit flow. Testing of the coils can be done with the coil installed on the hydraulic valve.

Testing

1. Determine solenoid coil(s) that is to be tested and locate coil on hydraulic manifold (Fig. 17). Disconnect harness electrical connector from solenoid valve coil.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter test leads together. The meter may display a small resistance value (usually 0.5 ohms or less). This resistance is due to the internal resistance of the meter and test leads. Subtract this value from the measured value of the solenoid coil being testing.

NOTE: Solenoid coil resistance should be measured with solenoid at approximately 68°F (20°C). Resistance may be slightly different than listed at different temperatures. Typically, a failed solenoid coil will either be shorted (very low or no resistance) or open (infinite resistance).

2. Using a multimeter (ohms setting), measure resistance between the two (2) connector terminals on the solenoid valve coil. The resistance for the solenoid coils is identified below:

Solenoid Valve Coil	Resistance
S1R1 and S3	7.1 ohms
S2 and S4	8.6 ohms

3. If solenoid coil resistance is incorrect, replace solenoid coil (refer to control manifold service procedures in the Service and Repairs section of Chapter 4 – Hydraulic System).

NOTE: To assist in troubleshooting, identical solenoid valve coils can be exchanged. If the problem follows the exchanged coil, an electrical problem likely exists with the coil. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. switch, circuit wiring, hydraulic problem). The control manifold S1R1 coil is the same as the manifold S3 coil. The manifold S2 and S4 coils are identical.

4. After coil testing is completed, connect wire harness electrical connector to the solenoid valve coil.

5. Secure all machine components that were removed to access hydraulic manifold.

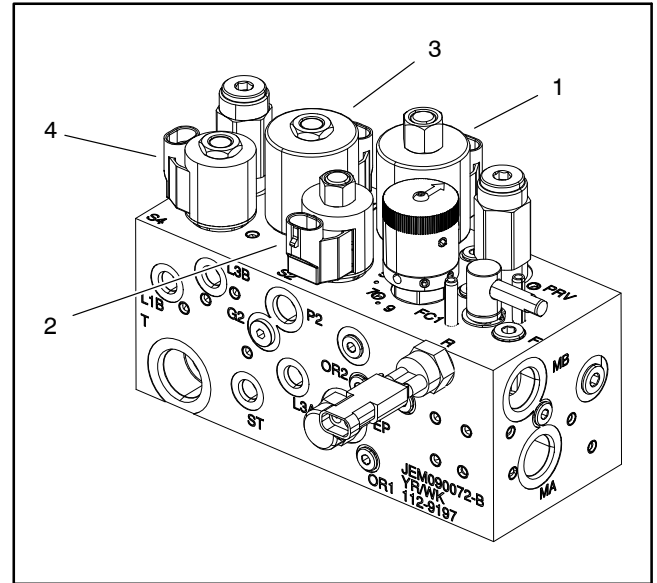


Figure 17

- 1. Solenoid S1R1
- 2. Solenoid S2
- 3. Solenoid S3
- 4. Solenoid S4

Neutral and Mow Sensors

The neutral and mow sensors are used to determine when the functional control lever is in the NEUTRAL or MOW position. These sensors are identical and are normally open reed sensors. They close when the actuator comes in close proximity to the sensor. The sensors are attached to the functional control lever bracket under the console panel (Fig. 18). The actuator is attached to the functional control lever.

Testing

1. Make sure the engine is off. Disconnect electrical connectors to both sensors. Check continuity of both sensors by connecting a multimeter (ohms setting) across the connector terminals.

2. Place the functional control lever in the NEUTRAL position. The NEUTRAL sensor should be closed (continuity) and the MOW sensor should be open (Fig. 18).

3. Place the functional control lever in the MOW position. The NEUTRAL sensor should be open and the MOW sensor should be closed (continuity) (Fig. 18).

4. The distance between the sensing end of each sensor and the traction bracket should be from 0.725 to 0.775 inch (18.4 to 19.7 mm) (Fig. 19).

5. To adjust or install actuator, place functional control lever in the NEUTRAL position. Position actuator in lever until the NEUTRAL sensor just closes and then rotate actuator two (2) complete turns closer to the NEUTRAL sensor.

6. When adjusting the sensors or actuator, torque jam nuts from **40 to 60 in-lb (4.5 to 6.7 N-m)**.

7. After sensor or actuator adjustment, check continuity of both sensors and interlock operation (See Verify Interlock System Operation in the Service and Repairs section of this chapter). Readjust sensor or actuator if necessary.

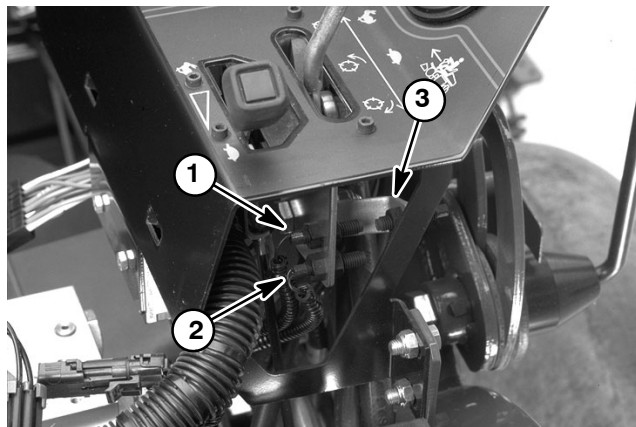


Figure 18

- 1. Mow sensor
- 2. Neutral sensor
- 3. Actuator

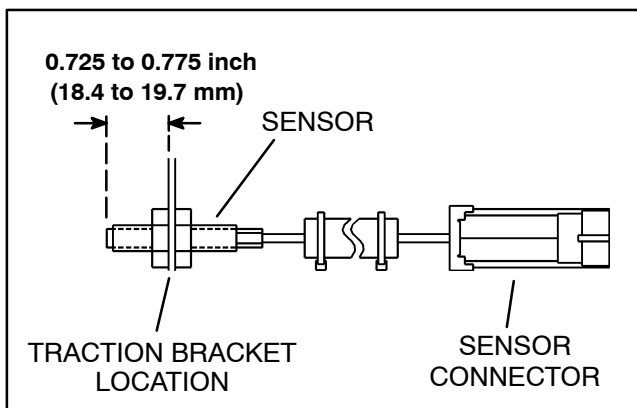


Figure 19

Parking Brake Sensor

The parking brake sensor is normally closed and opens when the operator applies the parking brake. If the functional control lever is moved out of the NEUTRAL position and the parking brake is applied, the engine will stop running. The sensor and its electrical connector are located directly under the operator floor plate (Fig. 20).

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.
2. Disconnect electrical connector from the parking brake sensor.
3. Check the continuity of the sensor by connecting a multimeter (ohms setting) across the connector terminals.
4. With the parking brake applied, there **should not be** continuity across the sensor terminals.
5. Release the parking brake. There **should be** continuity across the sensor terminals.
6. Replace parking brake sensor if testing determines that it is faulty.
7. After testing is completed, connect sensor electrical connector. Reset the parking brake.

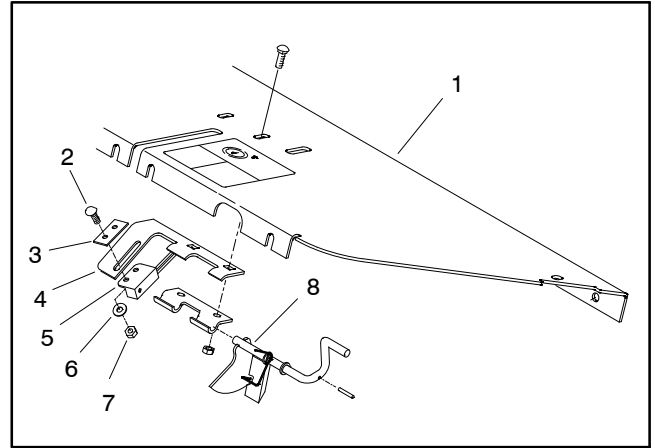


Figure 20

- | | |
|----------------------|-------------------------|
| 1. Floor plate | 5. Parking brake sensor |
| 2. Flange head screw | 6. Flat washer |
| 3. Switch plate | 7. Lock nut |
| 4. Switch bracket | 8. Brake latch |

Backlap Switch

The backlap switch is a normally open ball switch that is in the normal, open state when the backlap lever is in the mow position. When the backlap lever is in the backlap position, the switch closes. The backlap switch is attached to the front of the hydraulic control manifold located under the operator seat (Fig. 21).

Testing

1. Park machine on level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch.
2. Make sure ignition switch is in the OFF position.
3. Raise operator seat to allow access to hydraulic control manifold. Locate the backlap switch on the front of the manifold. Disconnect the wire harness electrical connector from the backlap switch.
4. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.
5. With the ignition switch in the OFF position, turn the backlap lever to the backlap position while watching the multimeter. Continuity should be made as the switch closes.
6. Turn the backlap lever to the mow position while watching the multimeter. Continuity should be broken as the switch opens.
7. If the backlap switch is faulty, replace switch. Make sure that dowel and ball are placed in the manifold port before installing new switch in manifold. Torque switch to **20 ft-lb (27 N-m)**.
8. If the backlap switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 9 – Foldout Drawings).
9. After testing is completed, connect wire harness electrical connector to the backlap switch. Lower operator seat.

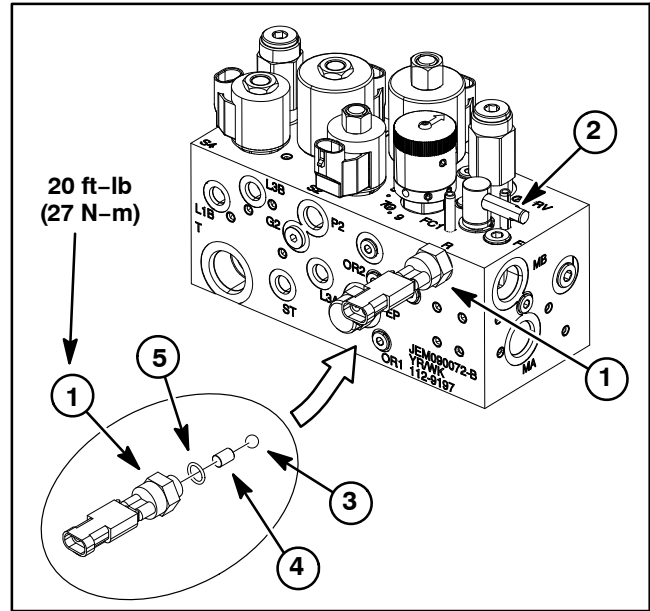


Figure 21

- | | |
|-------------------|-----------|
| 1. Backlap switch | 4. Dowel |
| 2. Backlap lever | 5. O-ring |
| 3. Ball | |

Joystick Raise and Lower Switches

The joystick raise and lower switches are located on the joystick assembly that is attached to the control console. The rear switch is used to lower the cutting units and the front switch to raise them (Fig. 22). The switches are identical and are shown in Figure 23.

Testing

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

2. Remove console cover from console assembly to gain access to joystick switches.

3. Make sure ignition switch is in the OFF position. Disconnect wire harness connectors from joystick switches.

4. Check the continuity of the raise switch by connecting a multimeter (ohms setting) across the switch connector terminals as follows:

A. With the joystick in the neutral position, continuity should only exist between the common and NC terminals.

B. With the joystick in the raise position, continuity should only exist between the common and NO terminals.

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

A. With the joystick in the neutral position, continuity should only exist between the common and NC terminals.

B. With the joystick in the lower position, continuity should only exist between the common and NO terminals.

6. Replace joystick switch if necessary.

7. After switch testing is completed, connect the harness connectors to the joystick switches. Install console cover.

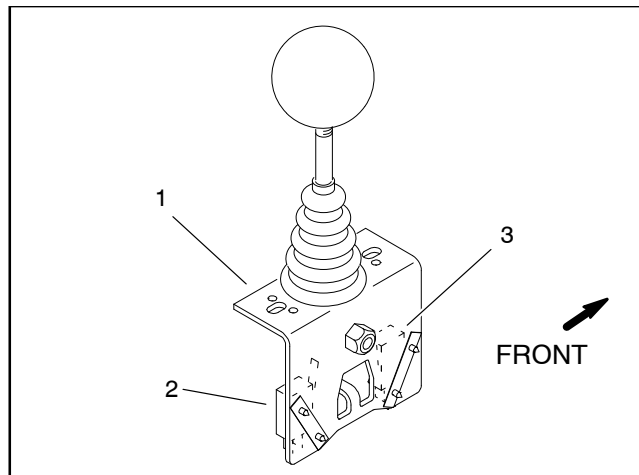


Figure 22

- 1. Joystick assembly
- 2. Raise switch
- 3. Lower switch

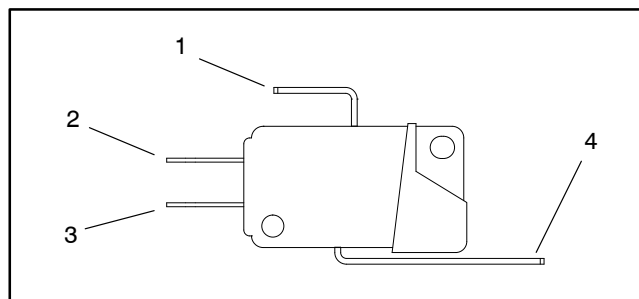


Figure 23

- 1. Common terminal
- 2. NO terminal
- 3. NC terminal
- 4. Switch lever

Safety Relays

Several safety relays are used on Greensmaster 3250-D machines. The relays are attached to frame brackets under the operator seat (Figs. 24 and 25). A tag on the wire harness connector can be used to identify the relays.

Relay Testing

1. Disconnect wire harness connector from relay that is to be tested.

NOTE: Use illustration in Figure 26 to identify relay terminals.

2. 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.

3. 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.

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

5. 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.

6. When testing is complete, disconnect voltage and multimeter leads from relay terminals.

7. Replace relay if testing determines that it is faulty.

8. Connect wire harness connector to relay.

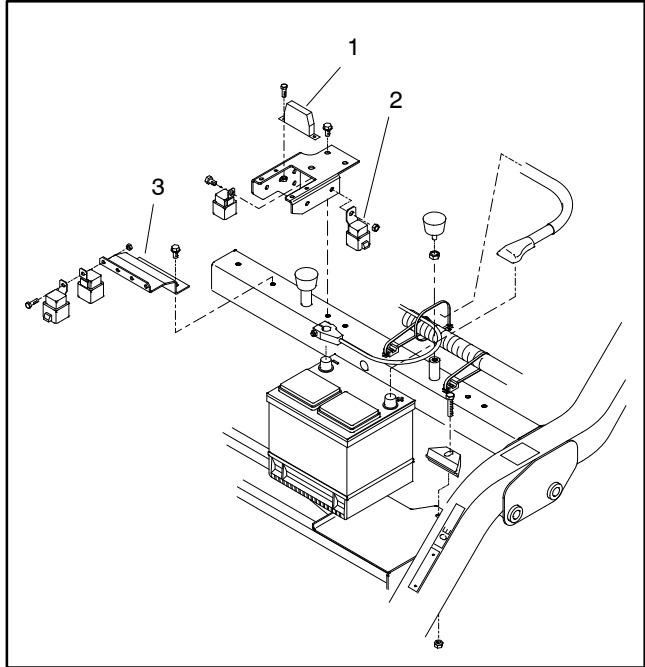


Figure 24

- 1. Fuse block
- 2. Backlap relay
- 3. Relay bracket

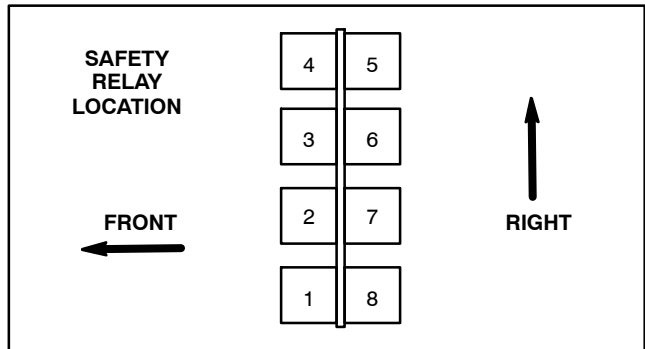


Figure 25

- 1. Run relay
- 2. High temp relay
- 3. Mow relay
- 4. Start relay
- 5. Raise relay
- 6. Lower relay
- 7. Joystick relay
- 8. Start interlock relay

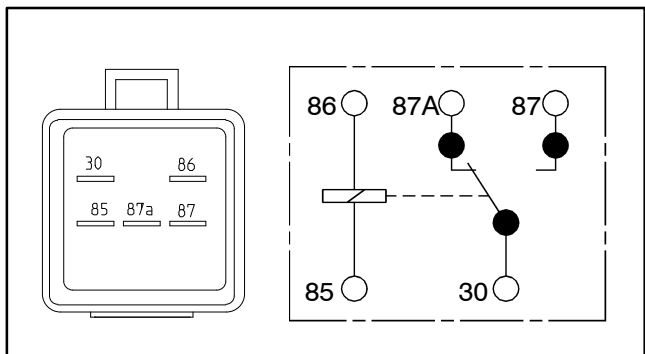


Figure 26

Glow Relay

When energized by the glow plug controller, the glow relay allows electrical current to the engine glow plugs. The glow relay is attached to a frame bracket near the fuse block (Fig. 27) and is connected to the wire harness with a four (4) wire connector (Fig. 28).

Relay Testing

1. Disconnect wire harness connector from glow relay.
2. To allow easier access to relay terminals, either loosen fasteners that secure relay to bracket or remove relay from bracket.
3. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 41 to 51 ohms.
4. 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.
5. When testing is complete, disconnect voltage and multimeter leads from relay terminals.
6. Replace glow relay if testing determines that it is faulty.
7. Connect wire harness connector to glow relay.
8. Secure glow relay to bracket.

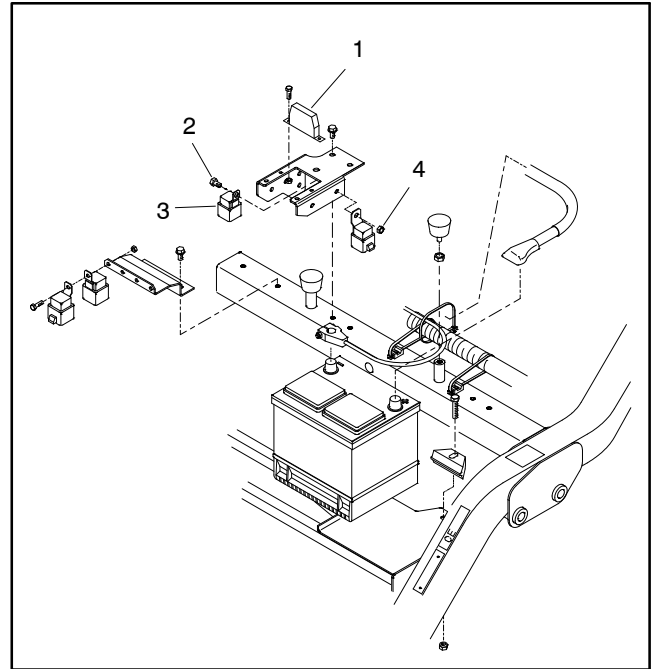


Figure 27

- | | |
|---------------|---------------|
| 1. Fuse block | 3. Glow relay |
| 2. Cap screw | 4. Lock nut |

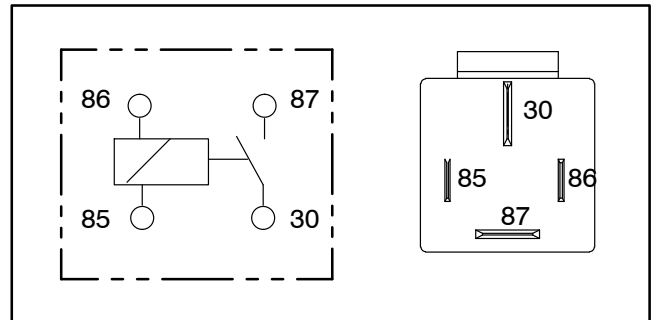


Figure 28

Fusible Links

The electrical system on Greensmaster 3250-D machines includes a harness with three (3) fusible links for machine circuit protection (Fig. 29). The fusible link harness is connected to the engine starter motor B+ terminal. The fusible link harness connects the machine wire harness to the positive (+) battery terminal.

An additional fusible link is included in the wire harness. This fusible link connects the starter terminal to the engine fuel solenoid pull coil.

If any of these links should fail, current to the protected circuit will cease. Refer to the electrical schematic and wire harness drawings in Chapter 9 – Foldout Drawings for additional circuit information.

Testing

Make sure that ignition switch is OFF. Disconnect negative (-) battery cable from battery terminal and then disconnect positive (+) cable from battery (see Battery Service in the Service and Repairs section of this chapter). Locate fusible link harness and unplug fusible link connector from wire harness. Use a multimeter to make sure that continuity exists between the fusible link terminals. If a fusible link is open, replace the fusible link harness.

After testing is complete, make sure that fusible link is securely attached to engine component and wire harness. Connect positive battery cable to battery terminal first and then connect negative cable to battery.

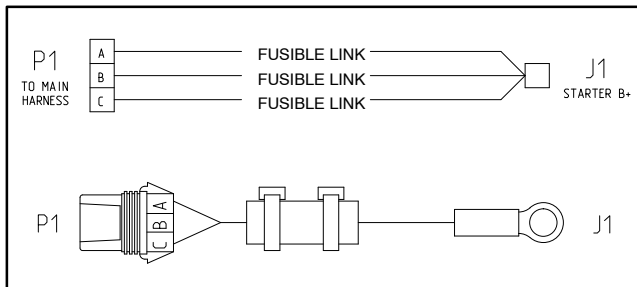


Figure 29

Glow Controller

The glow controller is attached to a bracket under the control console (Fig. 30).

NOTE: When troubleshooting the glow controller, refer to electrical drawings in Chapter 9 – Foldout Drawings.

Controller Operation

1. When the ignition switch is initially placed in the RUN position, the glow controller energizes the glow plugs for six (6) seconds. The console glow plug indicator light will also be illuminated for six (6) seconds.

2. When the ignition switch is turned to the START position, the glow plugs will energize as long as the switch is held in START. The console glow plug indicator light will also be illuminated.

3. When the ignition switch is released from the START to the RUN position, the glow plugs will de-energize and the console glow plug indicator light will remain off.

Controller Checks

1. Make sure there is electrical power from the battery.

2. Disconnect the wire harness electrical connector from the engine fuel stop solenoid to prevent the engine from starting.

3. Place ignition switch in the RUN position. Verify the following while in the RUN position:

A. Glow plug indicator light is illuminated.

B. Glow relay is energized.

C. Glow plugs are energized.

D. Glow plug indicator light goes out and glow plugs de-energize after approximately six (6) seconds.

4. Place ignition switch in the START position. Verify the following while in the START position:

A. Glow plug indicator light is not illuminated.

B. Glow relay is energized.

C. Glow plugs are energized.

D. Electrical power exists at terminal 1 of the glow controller.

NOTE: If there is no electrical power at terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform Step 4 again (see Chapter 9 – Foldout Drawings).

5. If any of the conditions in Step 3 are not met or electrical power to terminal 1 exists and any of the other conditions in Step 4 are not met:

A. Verify continuity of the circuitry from the battery to the glow relay and glow plugs (see Chapter 9 – Foldout Drawings).

B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow plug indicator light, glow relay and ground (see Chapter 9 – Foldout Drawings).

C. Repair or replace components as necessary.

6. After testing is completed, connect wire harness electrical connector to the fuel stop solenoid.

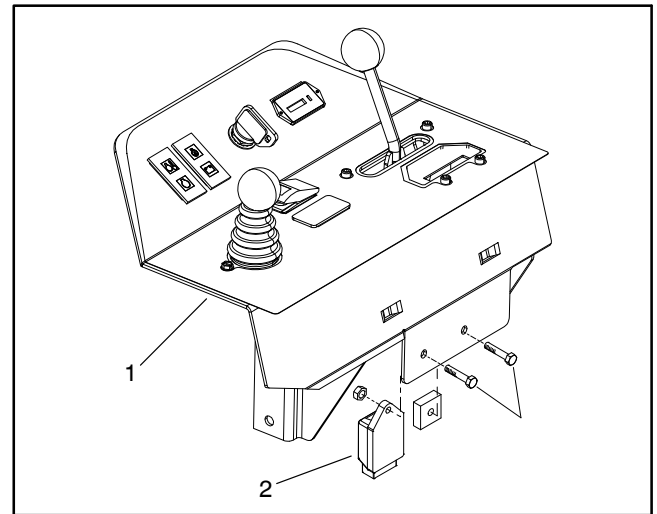


Figure 30

1. Console

2. Glow controller

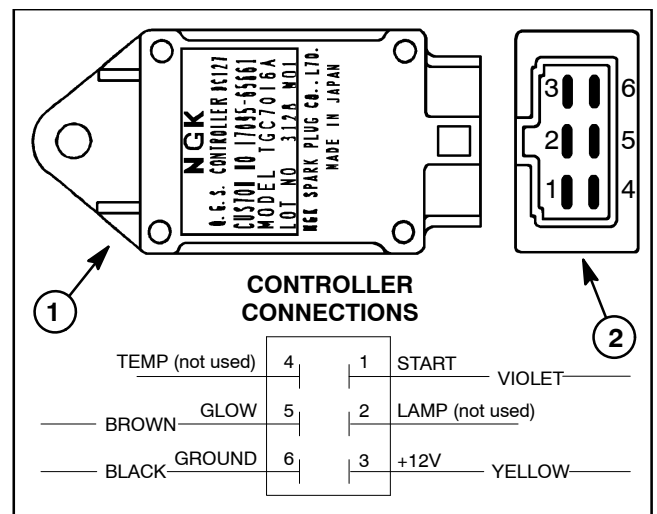


Figure 31

1. Controller top view

2. Controller end view

High Temperature Shutdown Switch

The high temperature shutdown switch is located on the thermostat housing near the alternator (Fig. 32). The high temperature shutdown switch has a yellow/red wire connected to it.



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. 33).



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 approximately 220°F (105°C).
4. Replace switch if necessary.

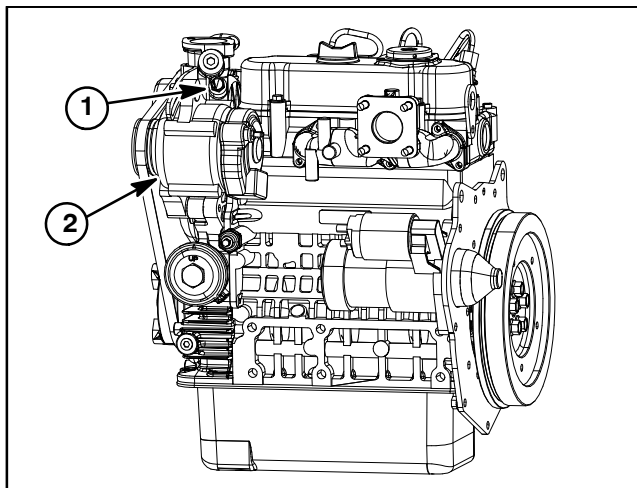


Figure 32

1. Temperature switch 2. Alternator

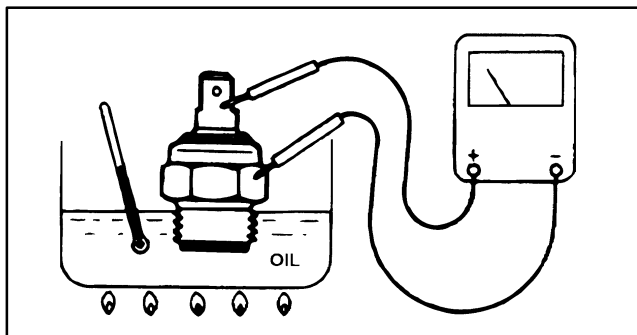


Figure 33

Oil Pressure Switch

The engine oil pressure switch is located on the engine near the alternator (Fig. 34). The oil pressure switch is a normally closed switch that opens with pressure.

The oil pressure switch should open at approximately 7 PSI (48.3 kPa).

Testing

NOTE: Refer to Kubota Workshop Manual, Diesel Engine, 05–E3B Series for information regarding engine lubrication system and testing.

1. Turn the ignition switch to the RUN position. The oil pressure indicator light on the control panel should be illuminated.
2. If the indicator light is not illuminated, open hood to gain access to engine.
3. If the indicator light is not illuminated, locate oil pressure switch on engine and disconnect the wire harness connector from the switch.
4. With the ignition switch in the RUN position, ground the disconnected wire to the engine block.
5. If the indicator light comes on, the oil pressure switch is faulty. Replace oil pressure switch.
6. If the indicator light does not come on after step 5, check the oil pressure indicator light and circuit wiring (see Indicator Lights in this section).
7. After testing is completed, connect the wire harness connector to the oil pressure switch.

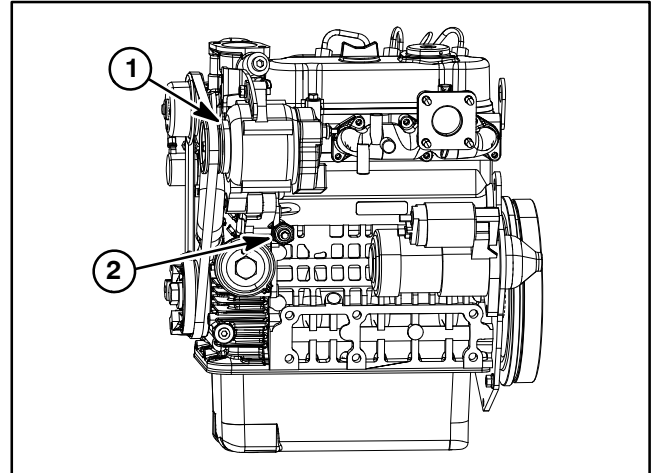


Figure 34

1. Alternator

2. Oil pressure switch

Fuel Pump

The fuel pump on Greensmaster 3250-D machines is secured to the radiator assembly with an r-clamp (Fig. 35). The fuel pump is energized when the ignition switch is in either the RUN or START position.

IMPORTANT: When testing fuel pump, make sure that pump is not operated without fuel.



DANGER

Because diesel fuel is flammable, use caution when handling it. Do not smoke while testing the fuel pump. Do not test fuel pump while engine is hot. Make sure that there is adequate ventilation when testing. Always wipe up any spilled fuel before starting the engine.

Fuel Pump Capacity Test

1. Park machine on a level surface, lower cutting units, stop engine and engage parking brake.
2. Disconnect machine fuel supply hose from the fuel pump outlet (Fig. 35).
3. Make sure fuel hose attached to the fuel pump inlet is free of obstructions. Also, make sure that fuel shut-off valve on fuel tank is open.
4. For fuel pump testing, place section of fuel hose on fuel pump outlet and secure in place with hose clamp. Place other end of fuel hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

IMPORTANT: When testing the fuel pump, **DO NOT** turn ignition switch to **START**.

5. Collect fuel in the graduated cylinder by turning ignition switch to the RUN position. Allow pump to run for fifteen (15) seconds, then turn ignition switch to OFF.
6. Fuel collected in the graduated cylinder should be approximately 16 fl oz (475 ml) after fifteen (15) seconds.
7. Replace fuel pump if necessary.
8. Remove fuel hose from pump outlet and install machine fuel supply hose to the pump outlet. Make sure to secure fuel hose with hose clamp.
9. Bleed the fuel system.

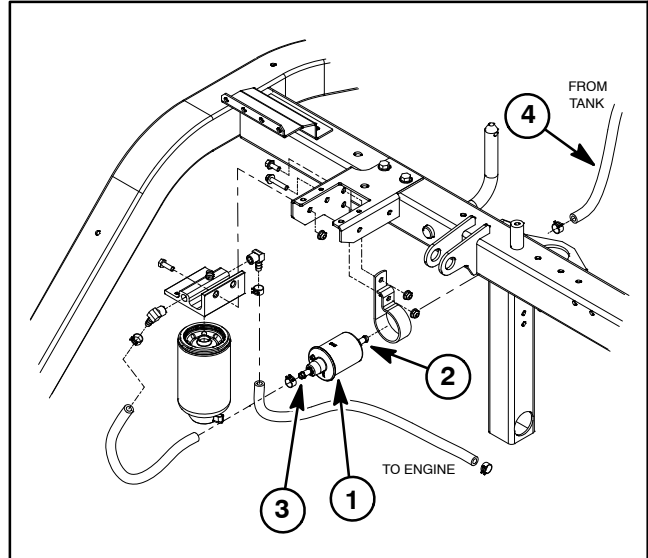


Figure 35

- | | |
|--------------------|--------------------------|
| 1. Fuel pump | 3. Fuel pump outlet |
| 2. Fuel pump inlet | 4. Fuel hose (from tank) |

Fuel Pump Specifications

Pump Capacity	64 fl oz/min (1.9 l/min)
Pressure	7 PSI (48.3 kPa)
Current Draw	2.0 amp

Fuel Solenoid

The fuel solenoid used on Greensmaster 3250-D machines must be energized for the diesel engine to run. The fuel solenoid is mounted to the injection pump on the engine (Fig. 36). The fuel solenoid is energized when the ignition switch is in either the RUN or START position.

The fuel solenoid includes two (2) coils for operation: the pull coil and the hold coil. When the ignition switch is turned to START, the fuel solenoid pull coil is energized and the solenoid plunger retracts. Once the plunger is retracted, the hold coil will keep it retracted for continued engine operation. When the solenoid is de-energized, the plunger extends to shut off fuel supply to the engine causing the engine to stop running.

NOTE: A fusible link in the machine wire harness protects the fuel solenoid pull coil circuit. If this link should fail, the fuel solenoid will not function and the engine will not run. Refer to electrical drawings in Chapter 10 – Foldout Drawings when troubleshooting the fuel solenoid.

NOTE: See Kubota Workshop Manual, Diesel Engine, SM-E3B Series for information regarding fuel solenoid testing procedure.

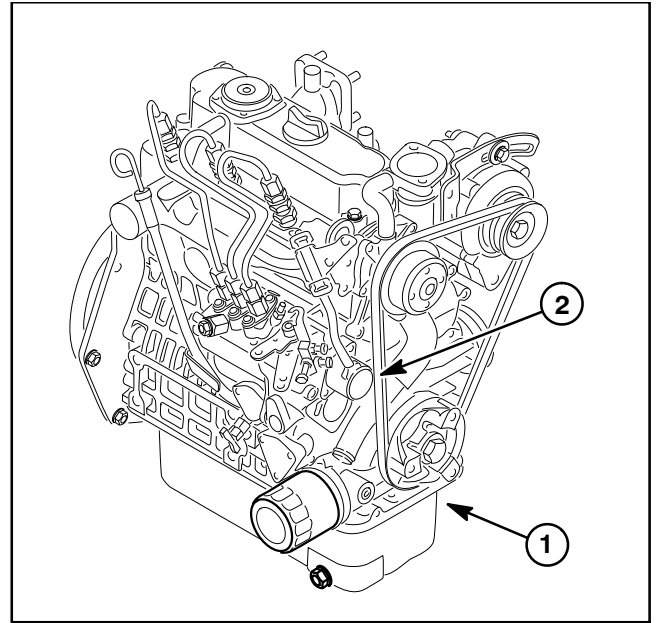


Figure 36

1. Engine assembly
2. Fuel stop solenoid

Turf Guardian™ Leak Detector System (If Equipped)

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 Figs. 37, 38 and 39).

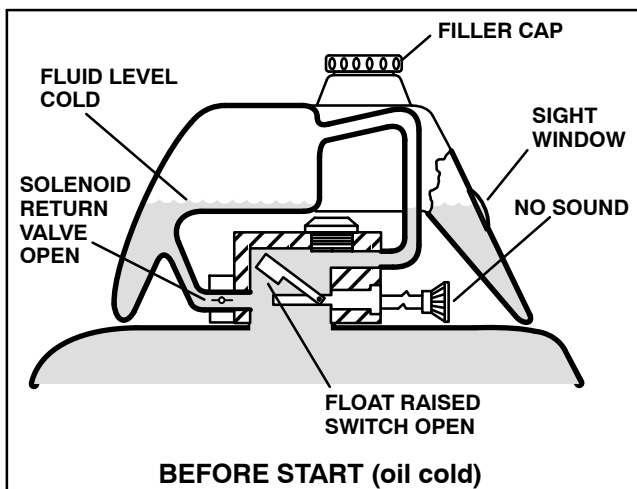


Figure 37

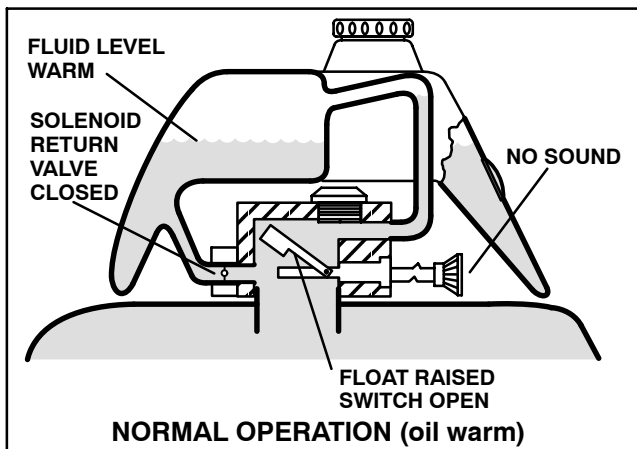


Figure 38

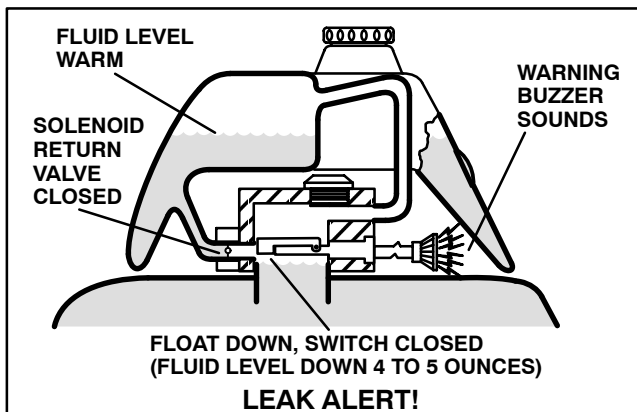


Figure 39

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. 40). Alarm should sound after one (1) 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.

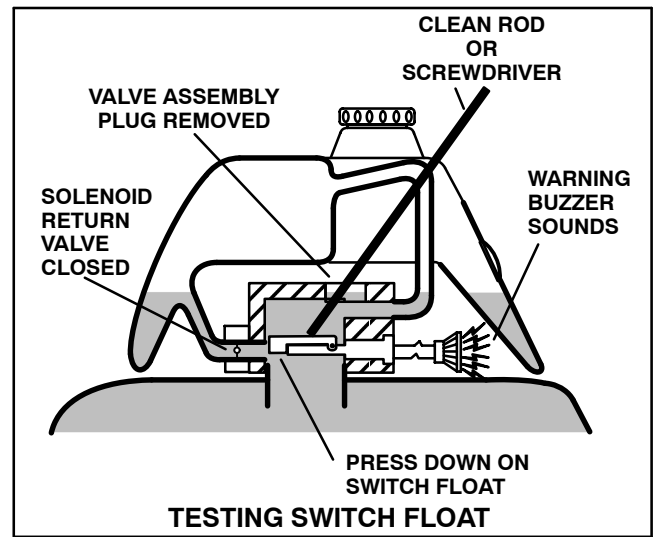


Figure 40

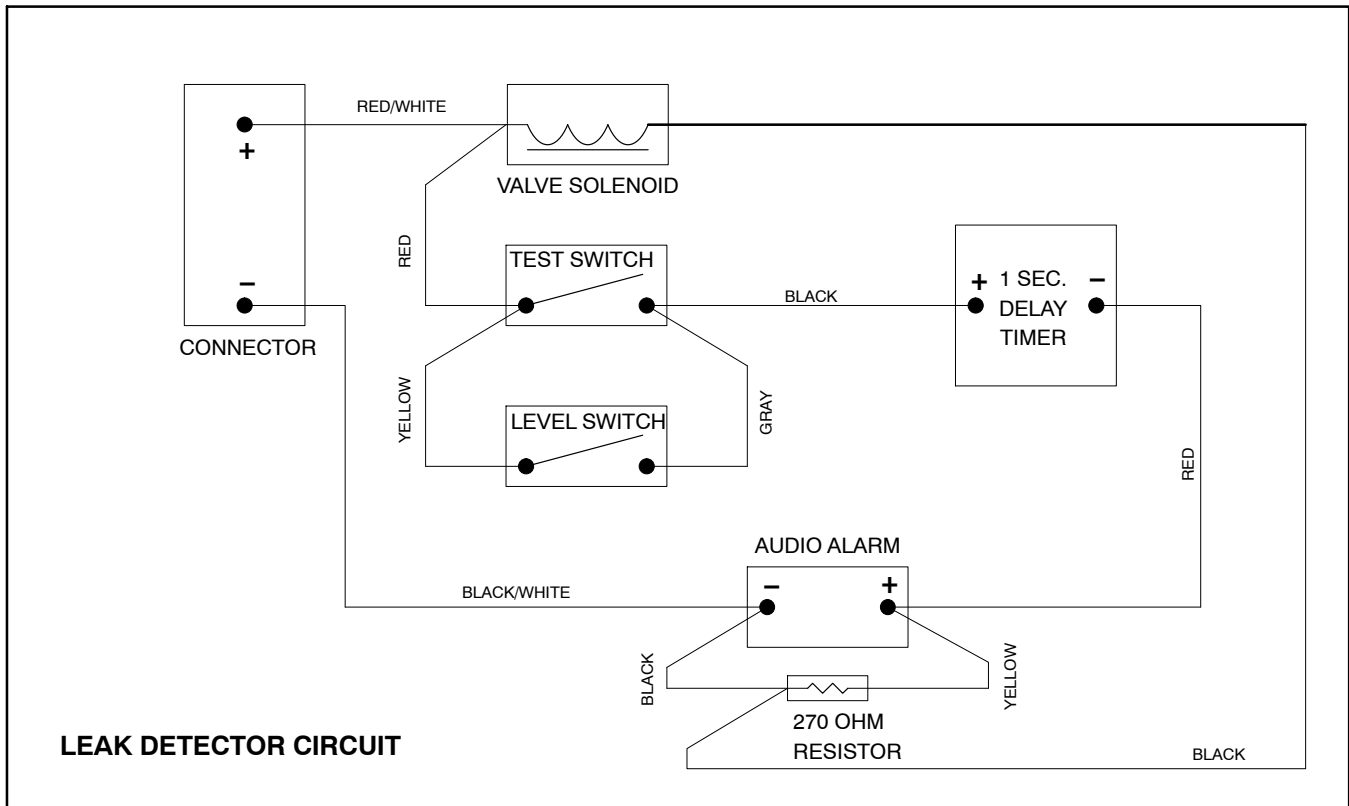


Figure 41

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 one (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 one (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.

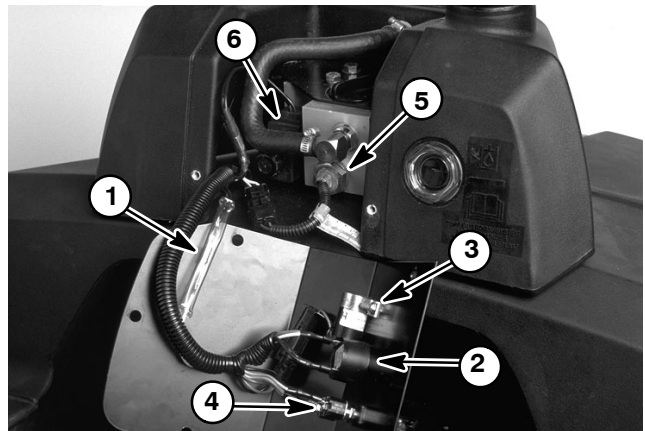


Figure 42

- | | |
|---------------------|-------------------|
| 1. 270 ohm resistor | 4. Toggle switch |
| 2. Audio alarm | 5. Level detector |
| 3. Delay timer | 6. Valve solenoid |

Valve Solenoid Coil

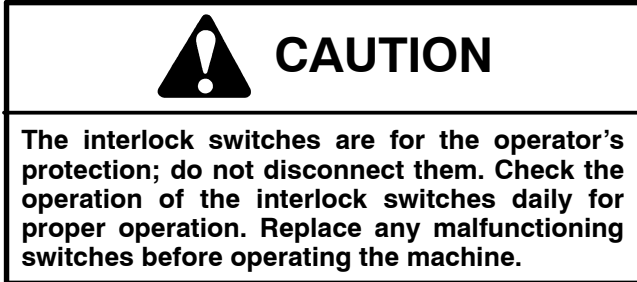
1. Isolate solenoid coil from the circuit. Connect multi-meter (Ohms setting) to solenoid coil connector. Make sure to observe polarity.
2. Resistance of solenoid coil should be approximately 7.2 ohms.

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Service and Repairs

NOTE: See the Kubota Workshop Manual for engine component repair information.

Verify Interlock System Operation



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 joystick 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 Storage

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

1. Make sure ignition switch is in the OFF position. Remove the battery and charge it fully (see Battery Service in this section).
2. Either store battery on a shelf or on the machine.
3. Leave cables disconnected if the battery is stored on the machine.
4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.
5. To help prevent the battery from freezing during storage, make sure it is fully charged (see Battery Service in this section).

Battery Care


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

**WARNING**

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

2. Keep top of battery clean by washing periodically with a brush dipped in baking soda (sodium bicarbonate) solution. Flush top surface with water after cleaning. Do not remove the fill caps while cleaning.

3. Battery cables must be tight on battery terminals to provide good electrical contact.

**WARNING**

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

4. If corrosion occurs at battery terminals, disconnect battery cables. Always disconnect negative (-) cable first. Clean cable clamps and terminals separately. Reconnect battery cables with positive (+) cable first. Coat terminals with battery terminal protector (see Special Tools in this chapter) or a light coat of grease to reduce corrosion after connections are made.

5. Check battery electrolyte level every twenty five (25) operating hours and every thirty (30) days if machine is in storage.

6. Maintain battery cell level with distilled or demineralized water. Do not fill cells above the fill line.

Battery Service

The battery is the heart of the electrical system. With regular and proper service, battery life can be extended. Additionally, battery and electrical component failure can be prevented.

Battery Specifications

BCI Group Size 26
540 Amp Cranking Performance at 0°F (-17.8°C)
80 Minute Reserve Capacity at 80°F (26.7°C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240



CAUTION

When working with batteries, use extreme caution to avoid splashing or spilling electrolyte. Electrolyte can destroy clothing and burn skin or eyes. Always wear safety goggles and a face shield when working with batteries.

Battery Removal (Fig. 43)

IMPORTANT: Be careful to not damage terminal posts or cable connectors when removing the battery cables.

1. Disconnect the ground cable (-) first to prevent short circuiting the battery, other components or the operators hands. Disconnect the positive (+) cable.
2. Remove flange head screw, lock nut and battery retainer.
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.

Battery Inspection and Maintenance

1. Check for cracks caused by overly tight or loose hold-down clamp. Replace battery if cracked and leaking.
2. 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.

3. Check for signs of wetness or leakage on the top of the battery which might indicate a loose or missing filler cap, overcharging, loose terminal post or overfilling. Also, check the battery case for dirt and oil. Clean the battery with a solution of baking soda and water, then rinse it with clean water.

4. Check that the cover seal is not broken away. Replace the battery if the seal is broken or leaking.

5. Check the electrolyte level in each cell. If necessary, fill all cells with distilled water to the bottom of the cap tubes. Charge at 15 to 25 amps for fifteen (15) minutes to allow sufficient mixing of the electrolyte.

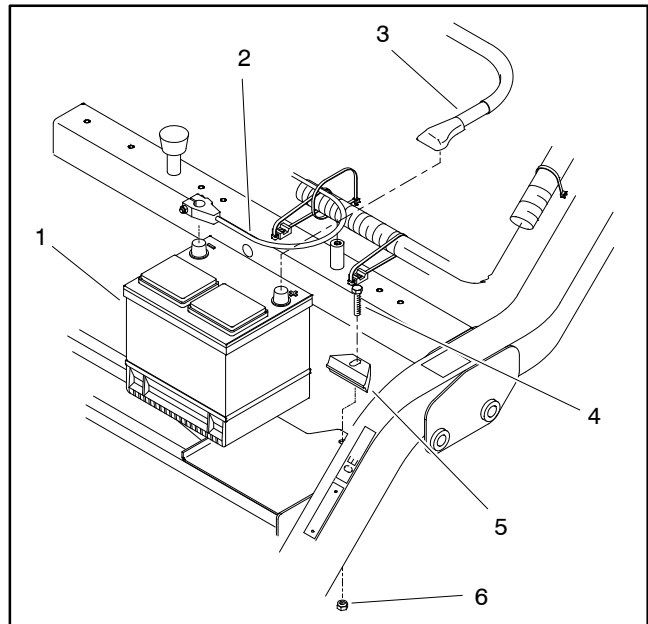


Figure 43

- | | |
|-----------------------|----------------------|
| 1. Battery | 4. Flange head screw |
| 2. Negative (-) cable | 5. Battery retainer |
| 3. Positive (+) cable | 6. Flange nut |

Battery Testing

1. Conduct a hydrometer test of the battery electrolyte.

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

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

B. Temperature correct each cell reading. For each 10°F (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 (see Battery Charging below) or until the specific gravity of all cells is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

2. Perform a high-discharge test with an adjustable load tester.

This is one of the most reliable means of testing a battery as it simulates the cold-cranking test. A commercial battery load tester is **required** to perform this test.



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 fifteen (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 270 amps (one half the battery Cranking Performance Specification) to the battery for fifteen (15) seconds.

G. Take a battery voltage reading at fifteen (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	
	70°F (and up)	21.1°C (and up)
9.6	60°F	15.6°C
9.5	50°F	10.0°C
9.4	40°F	4.4°C
9.3	30°F	-1.1°C
9.1	20°F	-6.7°C
8.9	10°F	-12.2°C
8.7	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.

Battery Installation (Fig. 43)

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 battery cables battery retainer are in good condition.
4. 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 as this will damage the battery. Tighten cable clamp fasteners with two (2) wrenches.
5. Install and secure battery retainer with flange head screw and flange nut. Do not overtighten to prevent cracking or distorting the battery case.
6. Connect a digital multimeter (set to amps) between the negative battery post and the negative (-) 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.
7. Connect the negative (ground) cable connector to the negative battery post. Tighten cable clamp fasteners with two (2) wrenches.
8. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

Battery Charging

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

	CAUTION
<p>Follow the manufacturer's instructions when using a battery charger.</p>	


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
<p>Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15°C) before connecting to a charger.</p>	
<p>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.</p>	

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 (3) hours prior to the end of the charging, measure the specific gravity of a battery cell once per hour. The battery is fully charged when the cells are gassing freely at a low charging rate and there is less than a 0.003 change in specific gravity for three (3) consecutive readings.



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Specifications

Item	Description
Front tire pressure, 19 x 10.50 x 8 (2 ply)	8 to 12 PSI (55 to 83 kPa)
Rear tire pressure, 19 x 10.50 x 8 (2 ply)	8 to 15 PSI (55 to 103 kPa)
Wheel lug nut torque	70 to 90 ft-lb (95 to 122 N-m)

General Information

Operator's Manual

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

Special Tools

Wheel Hub Puller

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

Toro Part Number: **TOR4097**



Figure 1

Service and Repairs

Front Wheel and Brakes

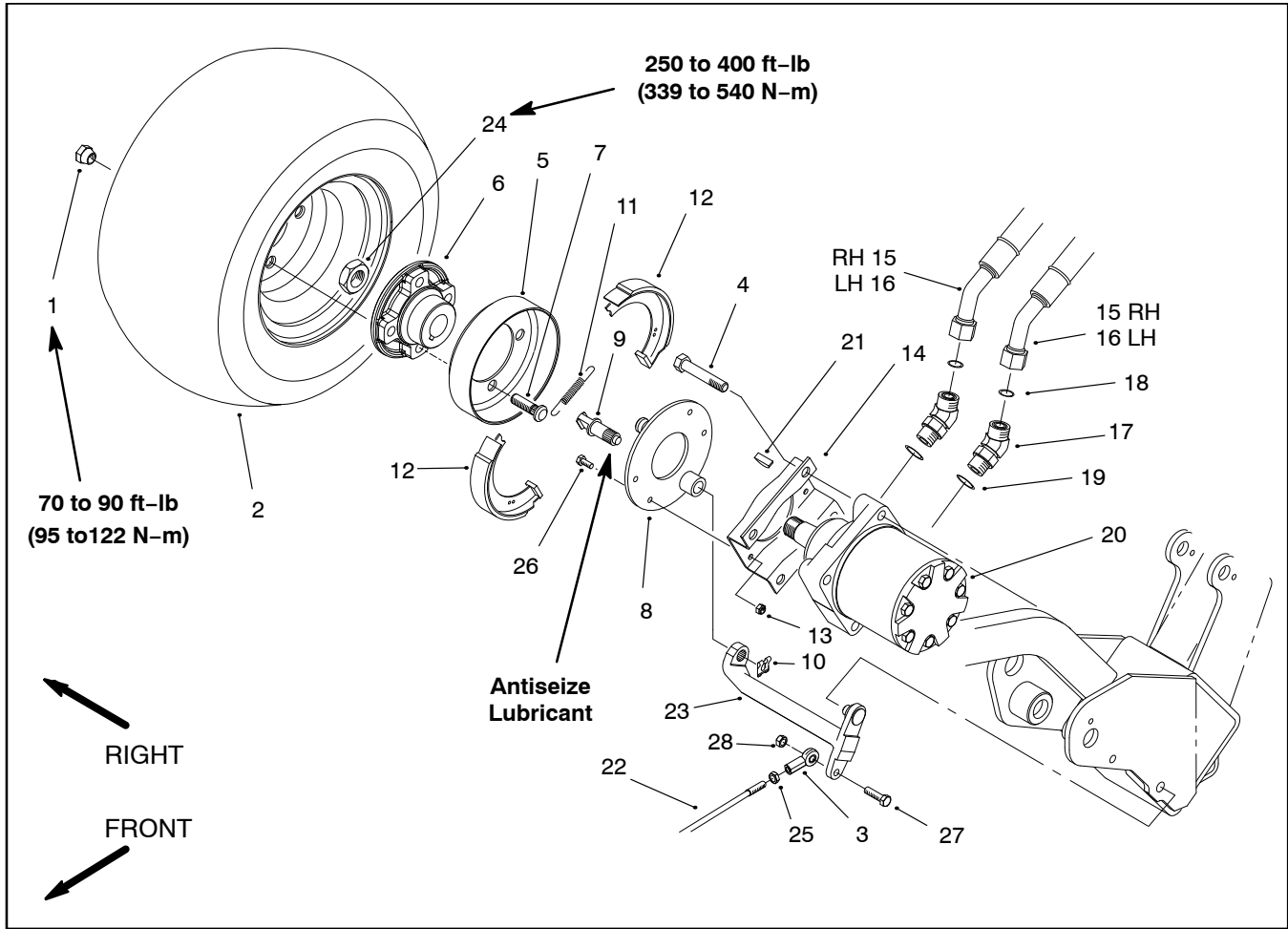


Figure 2

- | | | |
|----------------------------------|---------------------------------|----------------------------------|
| 1. Lug nut (4 used per wheel) | 11. Return spring (2 used) | 20. Hydraulic motor |
| 2. Wheel assembly | 12. Brake shoe (2 used) | 21. Woodruff key |
| 3. Swivel clevis | 13. Lock nut (4 used per plate) | 22. Brake rod |
| 4. Cap screw (4 used per motor) | 14. Brake bracket | 23. Brake lever |
| 5. Brake drum | 15. Hydraulic hose | 24. Lock nut |
| 6. Wheel hub | 16. Hydraulic hose | 25. Jam nut |
| 7. Drive stud (4 used per wheel) | 17. 45° Hydraulic fitting | 26. Cap screw (4 used per plate) |
| 8. Backing plate | 18. O-ring | 27. Cap screw |
| 9. Brake cam | 19. O-ring | 28. Lock nut |
| 10. Retaining clip | | |

Removal (Fig. 2)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.
2. Loosen, but do not remove, lug nuts (item 1) and lock nut (item 24). Loosen lock nut at least two (2) turns.
3. 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 appropriate jackstands beneath the frame to support the raised machine.

4. Remove lug nuts and wheel assembly from drive studs.

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

NOTE: The brake drum assembly consists of the wheel hub (item 6), brake drum (item 5) and drive studs (item 7).

5. Make sure that lock nut (item 24) on wheel motor shaft is loosened at least two (2) turns. Use hub puller (see Special Tools in this chapter) to loosen brake drum assembly from wheel motor.

6. Remove lock nut and brake drum assembly. Locate and retrieve woodruff key (item 21).

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

8. Remove return springs (item 11) from brake shoes (item 12). Remove brake shoes from backing plate.

9. If needed, remove brake cam (item 9) from the backing plate.

10. If necessary, remove four (4) cap screws (item 26), lock nuts (item 13) and backing plate (item 8) from the brake bracket (item 14).

11. Parts should be clean and free of rust. Inspect brake shoes (item 12) and brake drum (item 5) contact surfaces for excessive wear. Replace any worn or damaged parts.

12. If wheel hub (item 6), brake drum (item 5) or drive studs (item 7) need replacement, press four (4) drive studs from wheel hub and separate hub from brake drum.

Installation (Figs. 2 and 3)

1. If wheel hub was separated from brake drum, position hub to drum and secure by pressing four (4) drive studs through hub. Make sure that studs are pressed fully into hub.

2. If backing plate (item 8) was removed, secure backing plate to the brake bracket (item 14) with four (4) cap screws (item 26) and lock nuts (item 13).

3. Insert brake cam (item 9) into the backing plate if it was removed.

4. Position both brake shoes (item 12) on the backing plate. Insert return springs (item 11) into the holes of both brake shoes.

5. Apply antiseize lubricant to spline area of brake cam. Slide brake lever (item 23) onto brake cam and secure with retaining clip (10). Make sure that brake lever pivot is inserted into machine frame during assembly.

6. Make sure that wheel hub bore and wheel motor shaft are thoroughly cleaned. Install woodruff key (item 21) to the wheel motor shaft. Slide brake drum assembly over shaft and key.

7. Secure brake drum assembly to motor shaft with lock nut (item 24).

8. Install front wheel and secure with four (4) lug nuts. Tighten lug nuts evenly in a crossing pattern.

**WARNING**

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

9. Lower machine to ground. Torque lock nut from **250 to 400 ft-lb (339 to 540 N-m)** and wheel lug nuts from **70 to 90 ft-lb (95 to 122 N-m)**.

10. Check and adjust brakes.

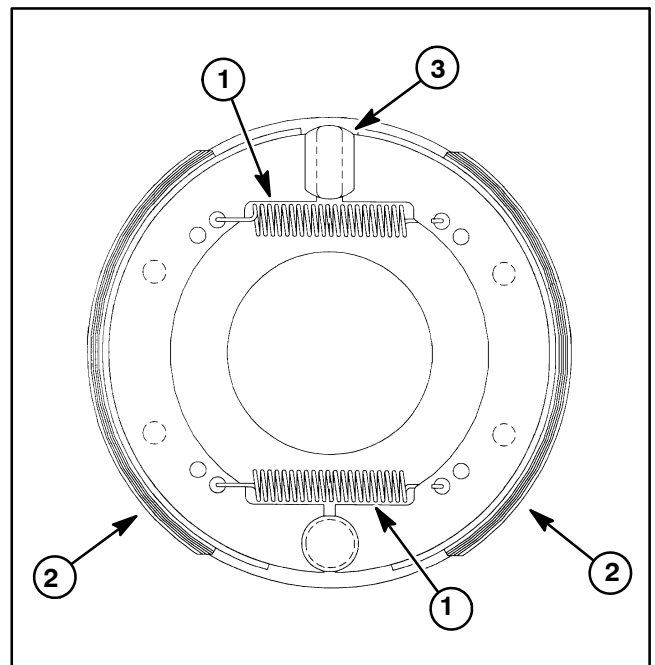


Figure 3

- 1. Return spring
- 2. Brake shoe
- 3. Brake cam

Rear Wheel (2WD)

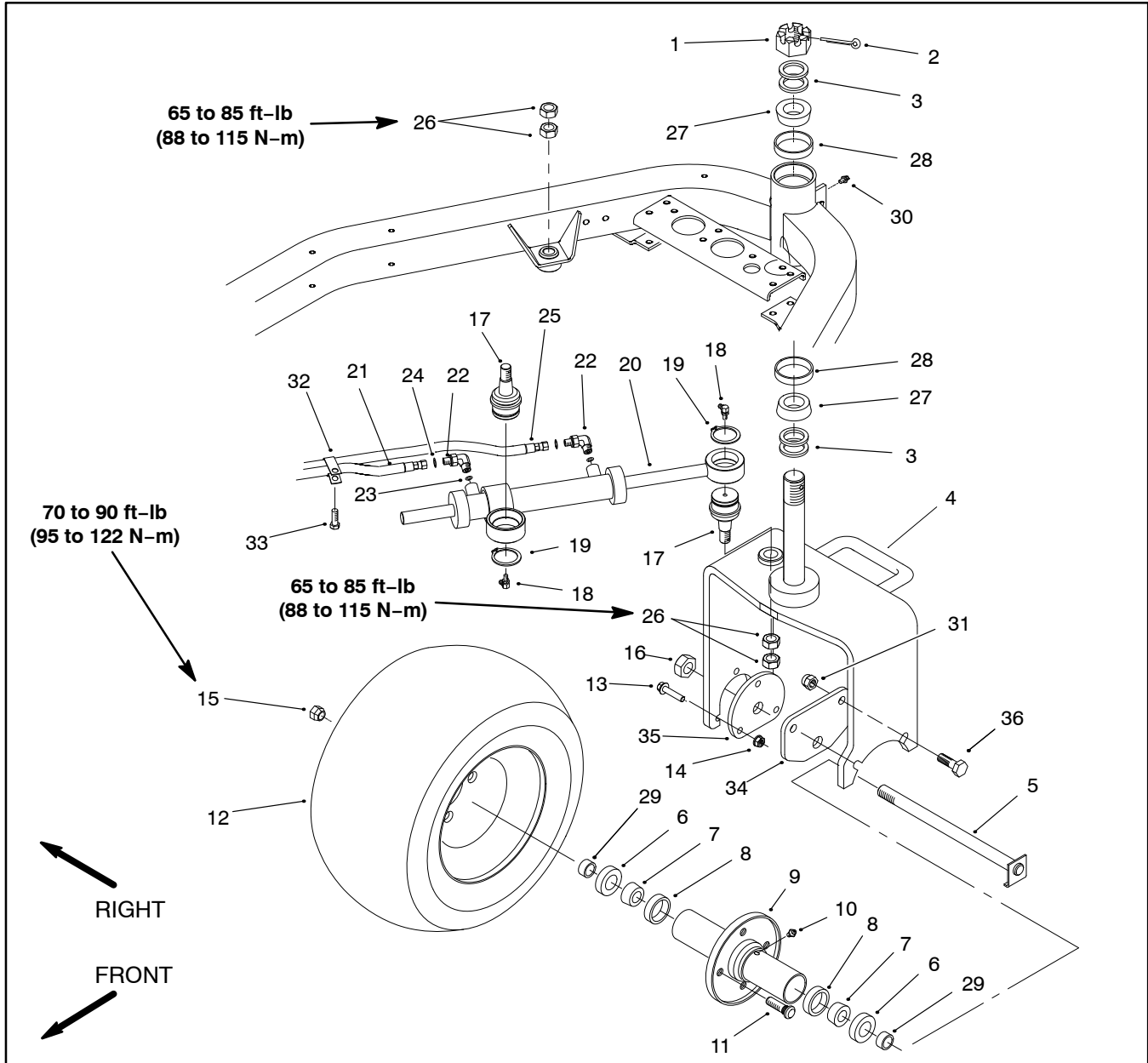


Figure 4

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

Removal (Fig. 4)

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

2. Chock both front wheels to prevent the machine from moving.

3. Use a jack or hoist to lift rear wheel off the ground and then place appropriate jackstands beneath the frame to support the raised machine.

4. Remove lock nut (item 16) from bolt (item 5). Pull bolt from both adapter plates (items 35 and 34), two (2) rear spindle spacers (item 29) and the wheel and hub assembly.

5. Remove wheel and hub assembly from the castor fork.

6. If necessary, remove four (4) lug nuts (item 15) from the drive studs (item 11). Separate wheel and hub assemblies.

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

Wheel Hub Disassembly (Fig. 5)

NOTE: The wheel hub assembly consists of the wheel hub, oil seals, bearing cones, bearing cups, grease fitting and drive studs (Fig 5).

1. If drive studs are bent or damaged, press studs from the wheel hub.

2. Pull oil seals, bearing cones and bearing cups from the wheel hub.

Wheel Hub Assembly (Fig. 5)

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 oil seals into the hub with the lip of the seals facing towards the inside.

3. If removed, press new drive studs into the wheel hub fully to the shoulder of the stud flange.

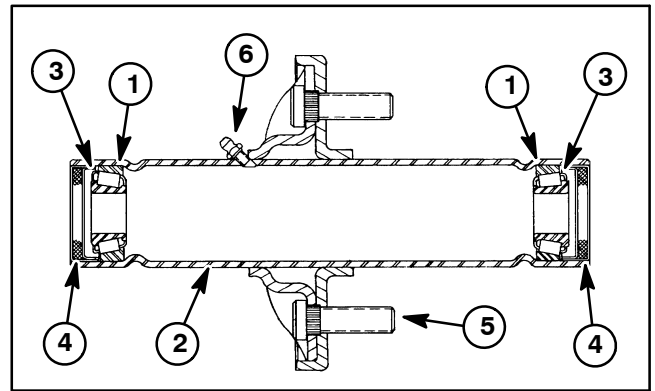


Figure 5

- | | |
|--------------------------|------------------------|
| 1. Bearing cup (2 used) | 4. Shaft seal (2 used) |
| 2. Wheel hub | 5. Drive stud (4 used) |
| 3. Bearing cone (2 used) | 6. Grease fitting |

Installation (Fig. 4)

1. Slide wheel assembly onto the drive studs. Secure wheel to wheel hub assembly with four (4) lug nuts (item 15). Torque lug nuts evenly in a crossing pattern to a torque from **70 to 90 ft-lb (95 to 122 N-m)**.

2. Install wheel and hub assembly into the castor fork. Insert bolt (item 5) into motor adapter plate (item 34) mounting hole. Install a spindle spacer (item 29) and slide bolt through the wheel and hub assembly.

3. Install second spindle spacer onto the bolt. Route the bolt through the adapter plate (item 35) mounting hole.

4. Position bent lip of the bolt head under the bottom edge of the motor adapter plate. Install and tighten lock nut (item 16) to secure wheel to the castor fork. Do not overtighten lock nut, the wheel must rotate freely.

5. Lower machine to ground.

6. Clean grease fitting (item 10) on hub. Pump grease into hub until grease is seen exiting at both hub oil seals (item 6). Wipe up excess grease.

Rear Wheel (If Equipped with 3WD)

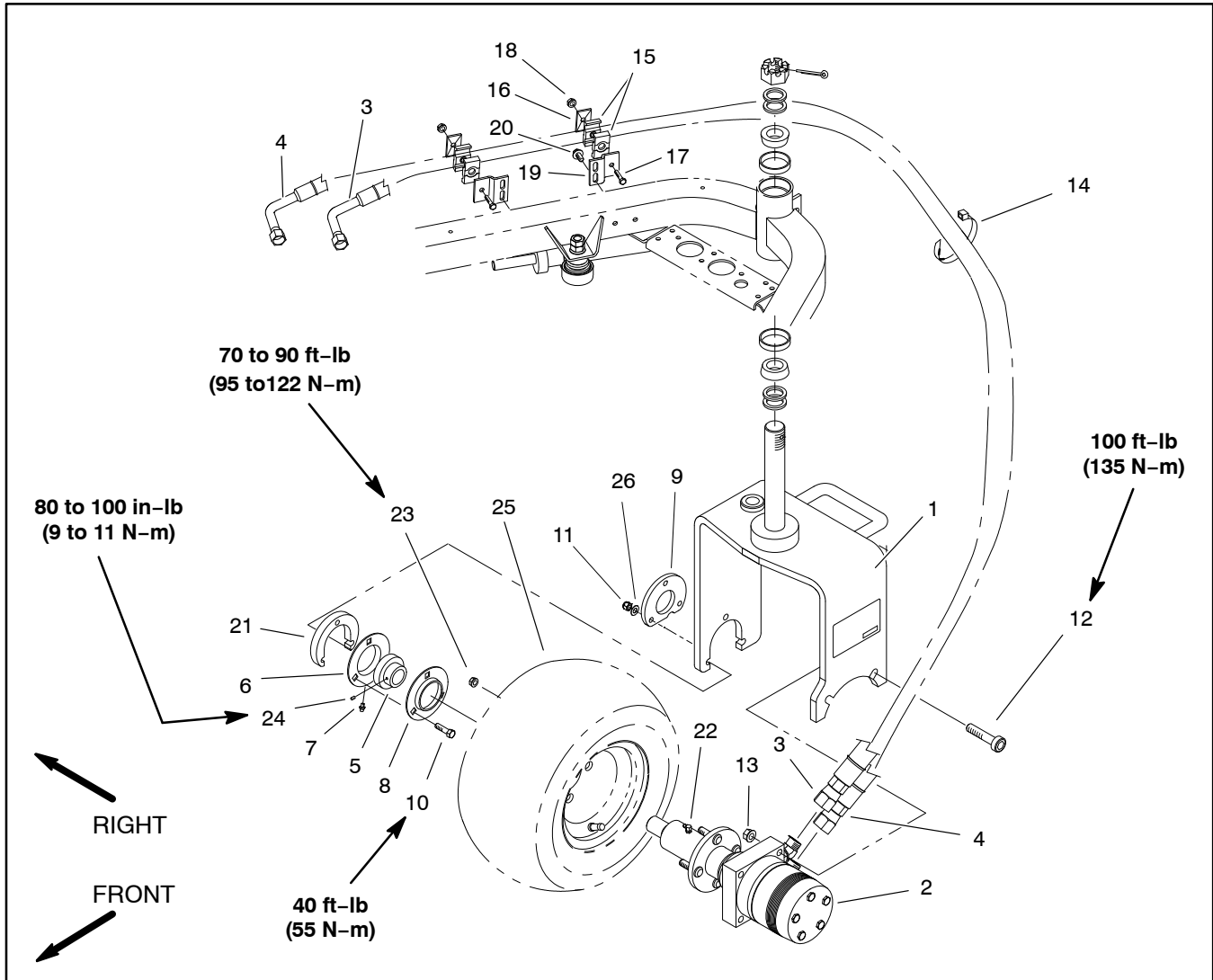
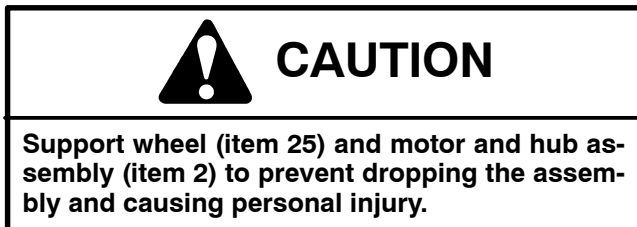


Figure 6

- | | | |
|---------------------------|--------------------------------|--------------------------------|
| 1. Castor fork | 10. Cap screw (3 used) | 19. Clamp bracket (2 used) |
| 2. Hub and motor assembly | 11. Lock nut (3 used) | 20. Washer head screw (4 used) |
| 3. Hydraulic hose | 12. Socket head screw (2 used) | 21. Bearing adapter plate |
| 4. Hydraulic hose | 13. Lock nut (2 used) | 22. Grease fitting |
| 5. Bearing | 14. Cable tie | 23. Lug nut (4 used) |
| 6. Relube flange | 15. Tube clamp (4 used) | 24. Set screw (2 used) |
| 7. Grease fitting | 16. Cover plate (2 used) | 25. Wheel assembly |
| 8. Standard flange | 17. Cap screw (2 used) | 26. Flat washer (3 used) |
| 9. Mount spacer | 18. Lock nut (2 used) | |

Removal (Fig. 6)

1. Park the machine on a level surface, engage the parking brake, lower the cutting units and stop the engine. Remove key from the ignition switch.
2. Loosen, but do not remove, lug nuts (item 23).
3. Chock both front wheels to prevent the machine from moving.
4. Use a jack or hoist to lift rear wheel off the ground and then place appropriate jackstands beneath the frame to support the raised machine.



5. Remove wheel (item 25) and hub and hydraulic motor assembly (item 2) from the castor fork as follows:
 - A. Support rear wheel assembly to prevent it from falling.
 - B. Remove three (3) cap screws (item 10) and lock nuts (item 11) that secure flangettes (items 6 and 8), bearing adapter plate (item 21) and mount spacer (item 9) to castor fork.
 - C. Remove both socket head screws (item 12) and lock nuts (item 13) securing the hydraulic motor and hub assembly to the castor fork.
 - D. Carefully lower wheel, hub and motor assembly from the castor fork.
 - E. Position wheel, hub and motor assembly so that wheel can be removed. Take care to not damage hydraulic hoses.
6. Loosen set screws (item 24) on bearing (item 5). Slide flangettes (items 6 and 8) and bearing from the hydraulic motor shaft.
7. Remove grease fitting (item 22) from the hub assembly.
8. Remove four (4) lug nuts (item 23) and wheel assembly from the hub drive studs.

NOTE: If wheel hub and motor assembly need to be serviced, see Rear Wheel Hub and Motor Assembly in this section. If castor fork removal is necessary, see Rear Castor Fork in this section.

Installation (Fig. 6)

1. Slide wheel assembly onto the drive studs. Secure wheel to wheel hub assembly with four (4) lug nuts (item 23). Torque lug nuts evenly in a crossing pattern to a torque from **70 to 90 ft-lb (95 to 122 N-m)**.
2. Reinstall grease fitting (item 22) into hub assembly so it points away from the wheel.
3. Install flangette (item 8), bearing (item 5) and relube flangette (item 6) onto the motor shaft.
4. Carefully position hydraulic motor and hub assembly, flangettes with bearing and wheel into the castor fork. Make sure hose fittings on the motor face to the rear.
5. Secure hydraulic motor and hub assembly loosely to the left inside of the castor fork with both socket head screws (item 12) and lock nuts (item 13).
6. Position relube flangette so that grease fitting (item 7) faces downward.
7. Secure flangettes (items 6 and 8), bearing (item 5) and adapter plate (item 21) loosely to the right inside of the castor fork with cap screws (item 10), mount spacer (item 9) and lock nuts (item 11).
8. Torque both socket head screws (item 12) to **100 ft-lb (135 N-m)**.
9. Torque cap screws (item 10) to **40 ft-lb (55 N-m)**.
10. Apply loctite to both set screws (item 24). Torque both screws from **80 to 100 in-lb (9 to 11 N-m)**.
11. Lower machine to ground.
12. If the hydraulic system was opened, follow Hydraulic System Start-up procedures (see Hydraulic System Start-up in the Service and Repairs section of Chapter 4 – Hydraulic System).

Rear Wheel Hub and Motor Assembly (If Equipped with 3WD)

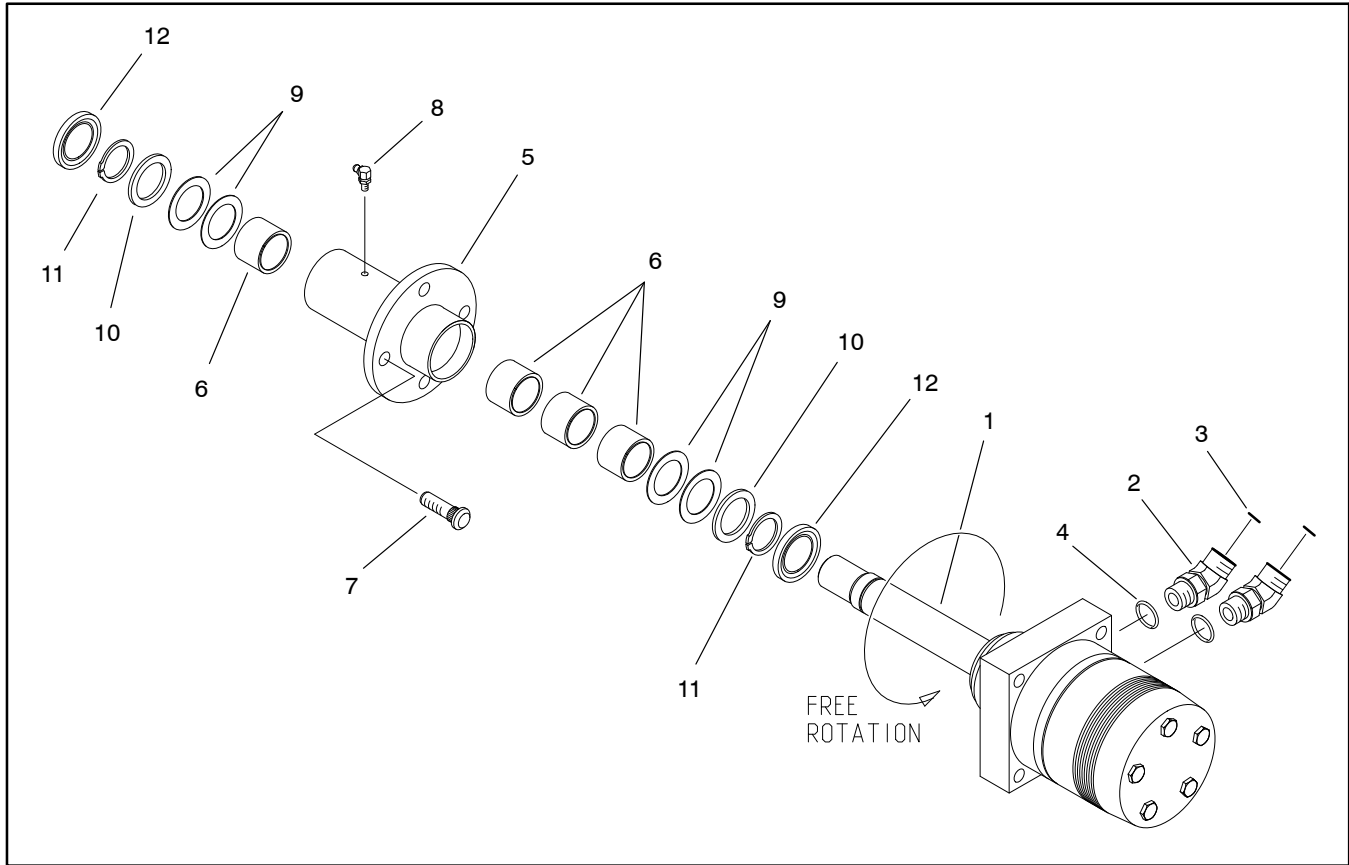


Figure 7

- | | | |
|--------------------------|-----------------------------------|---------------------------|
| 1. Hydraulic motor | 5. Hub | 9. Thrust washer (4 used) |
| 2. 45° Hydraulic fitting | 6. Clutch roller bearing (4 used) | 10. Washer (2 used) |
| 3. O-ring | 7. Drive stud (4 used) | 11. Snap ring (2 used) |
| 4. O-ring | 8. Grease fitting | 12. Grease seal (2 used) |

Disassembly (Fig. 7)

The following procedures assume the rear wheel hub and motor assembly has been removed from the machine (see Rear Wheel (If Equipped with 3WD) in this section).



CAUTION

Before continuing further, read and become familiar with General Precautions for Removing and Installing Hydraulic System Components in the Service and Repairs section of Chapter 4 – Hydraulic System.

1. Thoroughly clean junction of hydraulic hoses and fittings on hydraulic motor (Fig. 8).
2. Label hydraulic hoses that connect to rear wheel motor for assembly purposes. Remove hose assemblies and O-rings from the hydraulic fittings on the hydraulic motor. Allow hoses to drain into a suitable container.

3. Place rear wheel hub and motor assembly on a clean workbench.
4. Remove grease seal (item 12) and snap ring (item 11) from the long end of hub.
5. Remove washer (item 10), two (2) thrust washers (item 9) and hub (item 5) from the hydraulic motor shaft.
6. Remove remaining two (2) thrust washers (item 9), washer (item 10), snap ring (item 11) and grease seal (item 12) from the shaft.
7. If drive studs (item 7) are bent or damaged, press studs from the wheel hub and discard.
8. If necessary, press clutch roller bearings (item 6) from the hub. Discard removed bearings.
9. If rear wheel motor needs to be serviced, see Wheel Motor Service in the Service and Repairs section of Chapter 4 – Hydraulic System.

Assembly (Fig. 7)

1. If removed, press new drive studs (item 7) into the wheel hub fully to the shoulder of the stud flange.
2. If removed, press roller clutch bearings (item 6) into the hub as follows (Fig. 9):

NOTE: Arrow on the side of the clutch roller bearings must point to the long side end of the hub (Fig. 9).

A. Press three (3) roller bearings into flange end of the hub. The outer edge of the third bearing must be flush with the recessed edge within the hub.

B. Press final roller bearing into opposite end of hub. The outer edge of the bearing must be flush with the recessed edge within the hub.

C. Installed bearings must not interfere with grease fitting hole.

3. Grease inner edge of the new grease seal (item 12) with #2 multi-purpose lithium base grease. Slide seal onto motor shaft past groove closest to the motor housing. Install snap ring (item 11) into shaft groove.

4. Slide flat washer (item 10) and two (2) thrust washers (item 9) onto the motor shaft. Slide hub (item 5) onto the shaft with the short side first.

5. Slide remaining thrust washers (item 9) and flat washer (item 10) onto the motor shaft. Install remaining snap ring (item 11) into the shaft groove. Slide new grease seal (item 12) onto motor shaft.

IMPORTANT: The hub should spin freely in the forward direction, but lock on the hydraulic motor shaft when it is spun in the reverse direction.

6. Press grease seals (item 12) into the hub so they are flush with the end of the hub.

7. Position rear wheel hub and motor assembly to rear castor fork of machine.

8. Lubricate and position new O-rings to fittings on hydraulic motor. Use labels placed during the removal process to properly install hydraulic hoses to motor fittings (see Hydraulic Hose and Tube Installation in the General Information section of Chapter 4 – Hydraulic System).

9. Install rear wheel hub and motor assembly to rear castor fork of machine (see Rear Wheel (If Equipped with 3WD) in this section).

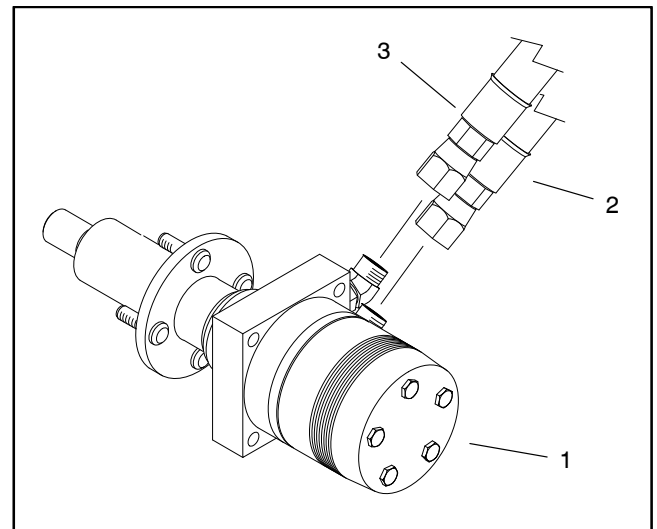


Figure 8

1. Hub and motor assembly
2. Hydraulic hose
3. Hydraulic hose

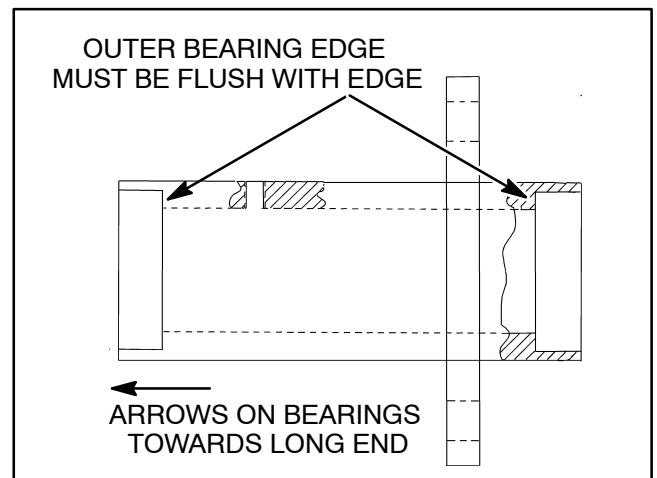


Figure 9

Rear Castor Fork

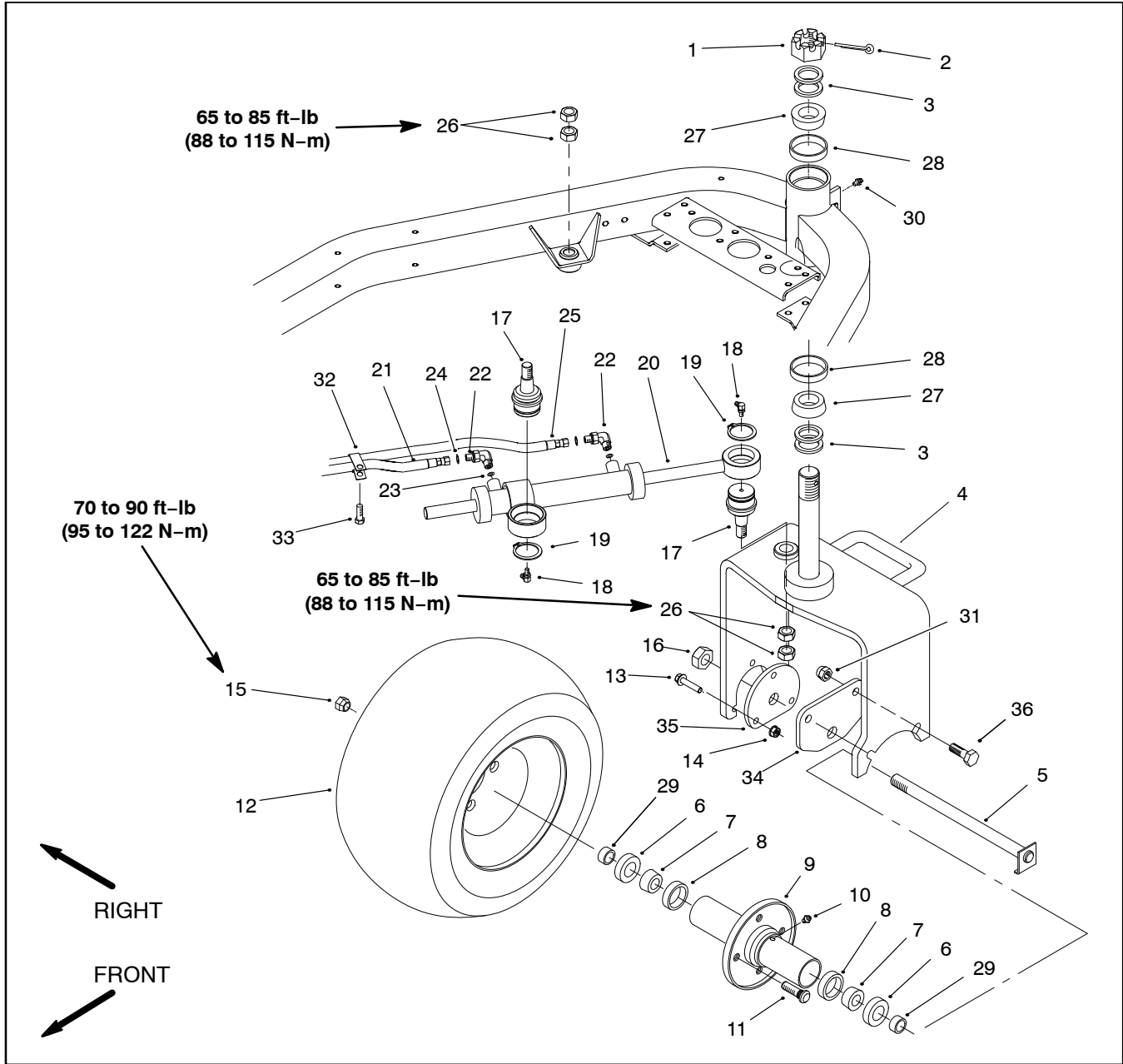


Figure 10

- | | | |
|--|---|--|
| <ul style="list-style-type: none"> 1. Slotted hex nut 2. Cotter pin 3. Steering washer (4 used) 4. Castor fork 5. Bolt 6. Oil seal 7. Bearing cone 8. Bearing cup 9. Wheel hub 10. Grease fitting 11. Drive stud (4 used) 12. Wheel assembly | <ul style="list-style-type: none"> 13. Flange head screw (3 used) 14. Lock nut (3 used) 15. Lug nut (4 used) 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 | <ul style="list-style-type: none"> 25. Hydraulic hose 26. Jam nut (4 used) 27. Bearing cone 28. Bearing cup 29. Rear spindle spacer 30. Grease fitting 31. Lock nut (2 used) 32. Hose clamp 33. Hex washer head screw 34. Motor adapter plate 35. Adapter plate 36. Cap screw (2 used) |
|--|---|--|

Removal (Fig. 10)

1. Park machine on a level surface. Make sure engine is off. Engage parking brake and block front wheels.
2. Jack up and secure the rear wheel off the ground.
3. Remove rear wheel assembly from the castor fork (see Rear Wheel (2WD) or Rear Wheel (If Equipped with 3WD) in this section).
4. Remove three (3) hex head screws and flat washers securing the fuel tank base plate to the frame. Two (2) of these 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.
5. 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.
6. Remove both jam nuts (item 26) securing the steering cylinder ball joint (item 17) to the castor fork.



7. Support the castor fork to prevent it from falling.
8. Remove cotter pin (item 2) and slotted hex nut (item 1) from the castor fork shaft. Lower castor fork from frame and steering cylinder ball joint (item 17).
9. Remove bearing cones (item 27) and steering washers (item 3) from the castor fork and frame. Note location of washers for assembly purposes.
10. Inspect upper and lower bearing cups (item 28) in frame for damage and replace if necessary.

Installation (Fig. 10)

1. If bearing cups (item 28) were removed from frame, press new cups into the castor fork pivot housing with the thick side of the cups facing each other. Make sure that cups are pressed fully to shoulder of frame housing.
2. Pack both bearing cones (item 27) with #2 multi-purpose lithium base grease.
3. Place two (2) steering washers (item 3) onto the castor fork shaft. Place lower bearing cone on top of washers with the thick edge touching the washers.
4. Insert castor fork shaft up through the frame pivot housing and bearing cups.
5. Place upper bearing cone on the castor fork shaft with the wide edge up. Place two (2) steering washers on top of the bearing cone.
6. Thread slotted hex nut (item 1) onto castor fork shaft until drag is felt while rotating the castor fork. Back-off hex nut to align shaft hole with a slot in the nut. Install and secure cotter pin (item 2) to the shaft.
7. Secure steering cylinder ball joint (item 17) to the castor fork with both jam nuts (item 26). Torque jam nuts from **65 to 85 ft-lbs (88 to 115 N-m)**.
8. Secure fuel tank base plate to the frame with three (3) hex head screws and flat washers.
9. Install rear wheel to castor fork (see Rear Wheel (2WD) or Rear Wheel (If Equipped with 3WD) in this section).
10. Lower machine to the ground.
11. Clean grease fitting (item 30) on frame pivot housing. Pump grease into pivot housing until grease is seen exiting at both ends of the housing. Wipe up excess grease.

Front Lift Arms

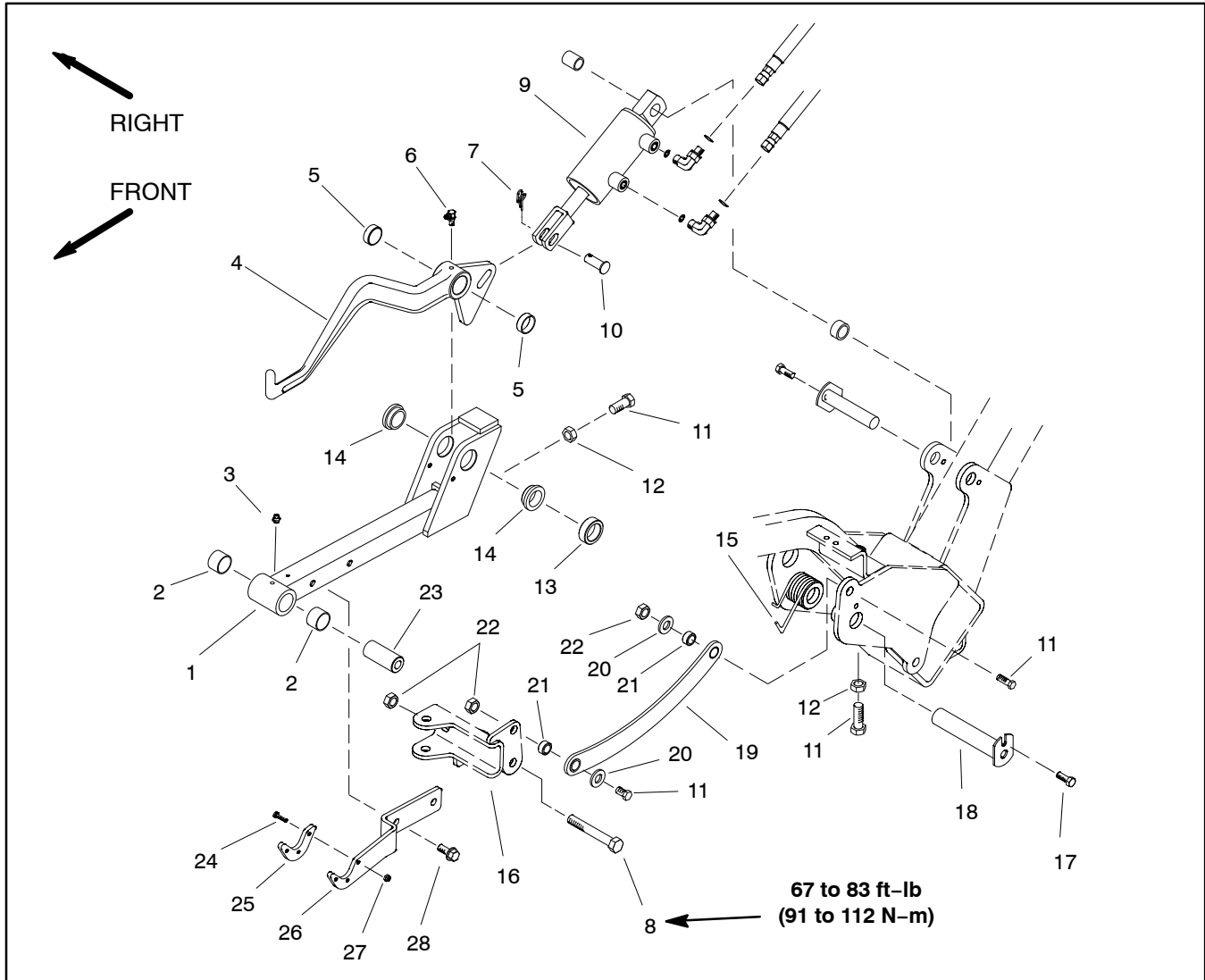


Figure 11

- | | | |
|---------------------|-----------------------|----------------------------------|
| 1. Front lift frame | 11. Cap screw | 20. Flat washer |
| 2. Bushing | 12. Jam nut | 21. Spacer tube |
| 3. Grease fitting | 13. Carrier spacer | 22. Lock nut |
| 4. Lift arm | 14. Flange bushing | 23. Pull frame spacer |
| 5. Bushing | 15. Torsion spring | 24. Phillips head screw (3 used) |
| 6. Grease fitting | 16. Clevis | 25. Wear pad |
| 7. Cotter pin | 17. Washer head screw | 26. Transport plate |
| 8. Cap screw | 18. Pin | 27. Lock nut (3 used) |
| 9. Lift cylinder | 19. Link bracket | 28. Cap screw (2 used) |
| 10. Clevis pin | | |

Disassembly

1. Park machine on a level surface. Make sure engine is off and parking brake is engaged.
2. Remove cutting unit from front lift arm.
3. Disassemble front lift arm as needed using Figures 11 and 12 as guides.

Assembly

1. Assemble front lift arm using Figures 11 and 12 as guides.

A. If clevis (item 16 in Fig. 11) 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. 12) 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.
3. Check that when raised to the transport position, the cutting units are secured by the transport plate. If necessary, loosen two (2) cap screws (item 28 in Fig. 11) and reposition transport plate.

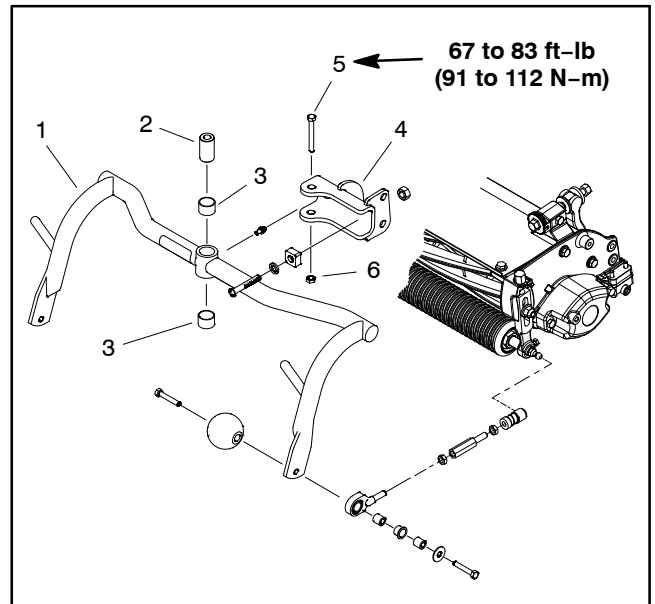


Figure 12

- | | |
|-----------------|--------------|
| 1. Pull frame | 4. Clevis |
| 2. Pivot spacer | 5. Cap screw |
| 3. Bushing | 6. Lock nut |

Center Lift Arm

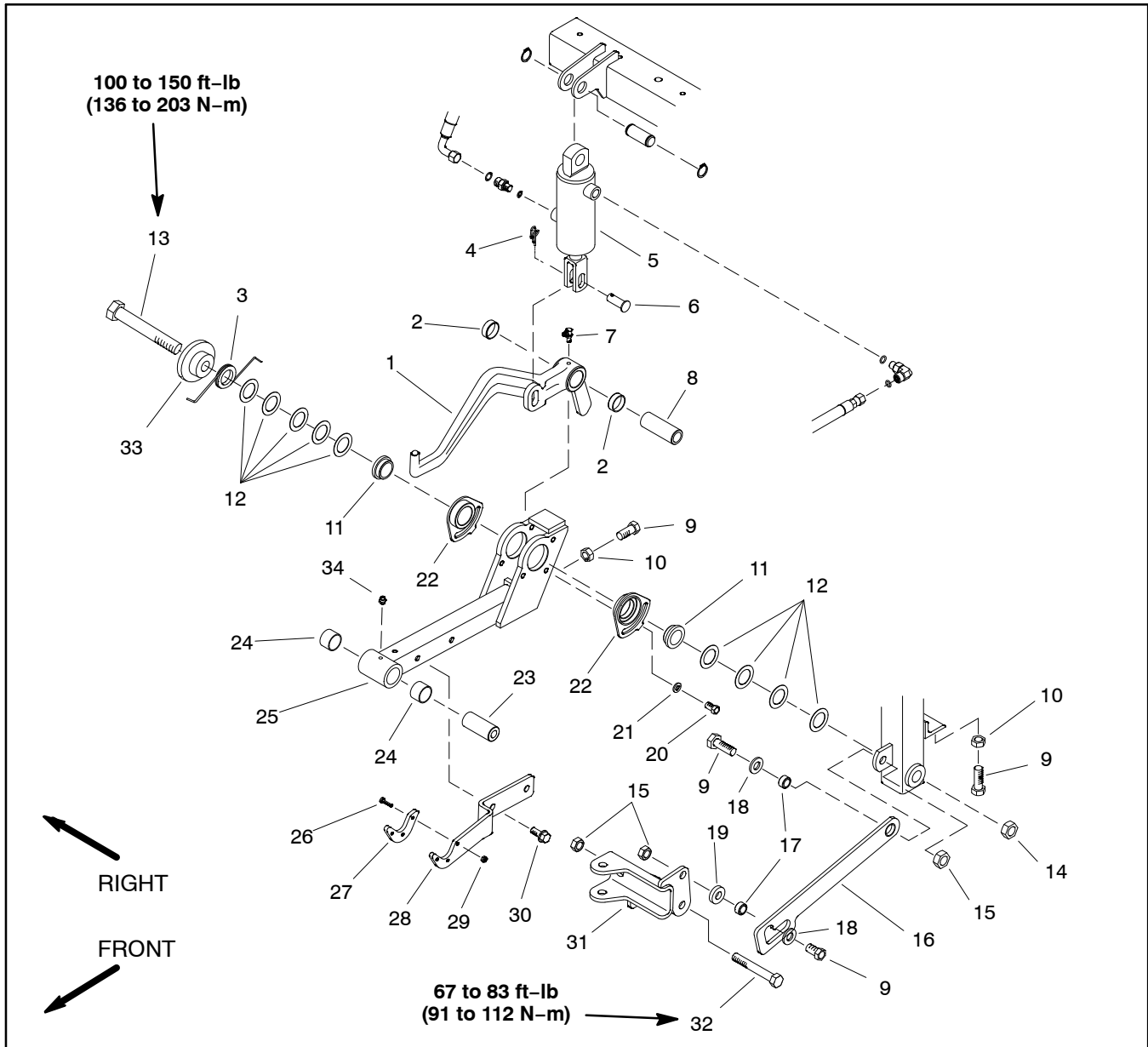


Figure 13

- | | | |
|--------------------|------------------------|-----------------------------|
| 1. Center lift arm | 13. Cap screw | 24. Bushing |
| 2. Bushing | 14. Lock nut | 25. Lift frame |
| 3. Torsion spring | 15. Lock nut | 26. Phillips screw (3 used) |
| 4. Cotter pin | 16. Link bracket | 27. Wear pad |
| 5. Lift cylinder | 17. Spacer tube | 28. Transport plate |
| 6. Clevis pin | 18. Flat washer | 29. Lock nut (3 used) |
| 7. Grease fitting | 19. Spacer | 30. Cap screw (2 used) |
| 8. Pivot tube | 20. Cap screw (2 used) | 31. Clevis |
| 9. Cap screw | 21. Flat washer | 32. Cap screw |
| 10. Jam nut | 22. Eccentric bushing | 33. Spring guide |
| 11. Flange bushing | 23. Pull frame spacer | 34. Grease fitting |
| 12. Thrust washer | | |

Disassembly

1. Park machine on a level surface. Make sure engine is off and parking brake is engaged.
2. Remove center cutting unit from lift arm.
3. Disassemble center lift arm as needed using Figures 13 and 14 as guides.

Assembly

1. If lift frame (item 25 in Fig. 13) was removed from machine:

A. Adjust eccentric bushings (item 22 in Fig. 13) as needed so that lift frame is level when the lift frame is in the raised position.

B. Install thrust washers (item 12 in Fig. 13) 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 13 and 14 as guides.

A. If clevis (item 31 in Fig. 13) 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. 14) 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.
4. Check that when raised to the transport position, the cutting unit is secured by the transport plate. If necessary, loosen two (2) cap screws (item 30 in Fig. 13) and reposition transport plate.

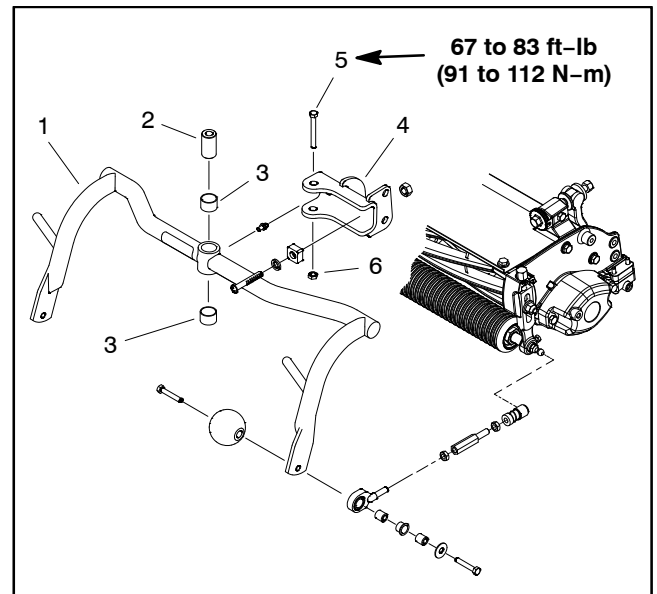


Figure 14

- | | |
|-----------------|--------------|
| 1. Pull frame | 4. Clevis |
| 2. Pivot spacer | 5. Cap screw |
| 3. Bushing | 6. Lock nut |

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DPA Cutting Units

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Specifications

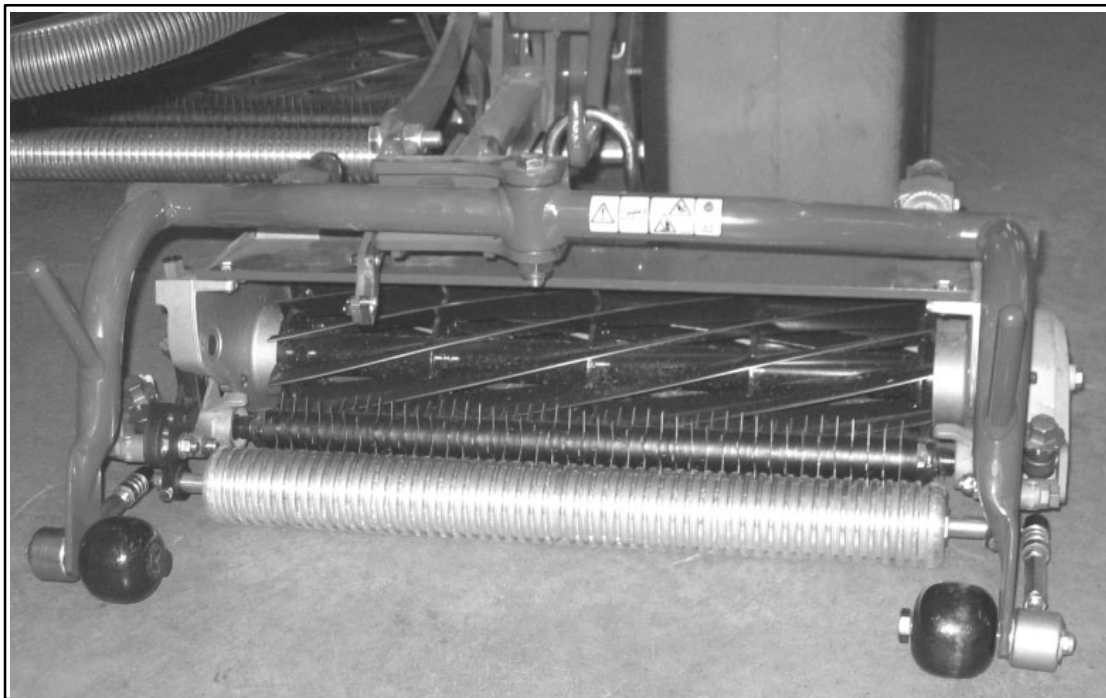


Figure 1

Frame Construction: Precision machined die cast aluminum cross member with two (2) bolt-on cast aluminum side plates.

Reel Construction: Reels are 21 inches (53.3 cm) in length and 5 inch (12.7 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in 8, 11 and 14 blade configurations.

Reel Bearings: Two (2) sealed stainless steel, deep groove ball bearings support the reel shaft with inboard seal for protection.

Reel Drive: The reel weldment shaft is a 1.350 inch (34.3 mm) diameter tube with a drive insert threaded into the left end. The reel drive insert has an internal eight (8) tooth spline.

Height-of-Cut (HOC): Cutting height is adjusted on the front roller by two (2) vertical screws. Effective HOC may vary depending on turf conditions, type of bedknife, roller type and installed attachments.

Bedknife: Replaceable, single edged, high carbon steel bedknife is fastened to a machined cast iron bedbar with thirteen (13) screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw adjustment to the reel; detents corresponding to 0.0007 inch (0.018 mm) bedknife movement for each indexed position.

Front and Rear Rollers: Greaseless through-shaft front and rear rollers are used with the Greensmaster 3250-D DPA cutting units. All greens rollers use the same heavy duty ball bearing and seal package.

Counterbalance Weight: A cast iron weight mounted opposite to the hydraulic reel motor balances the cutting unit.

Cutting Unit Weight (Approximate):

8 Blade	65 lb (30 kg)
11 Blade	68 lb (31 kg)
14 Blade	71 lb (32 kg)

Options:

Refer to Cutting Unit Operator's Manual for available options for your Greensmaster 3250-D DPA cutting unit.

General Information

Cutting Unit Operator's Manual

The Cutting Unit Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the DPA cutting units on your Greensmaster 3250-D machine. Additionally, if optional kits have been installed on the cutting units (e.g. rear roller brush), the installation instructions for the kit includes set-up and operation information. Refer to those publications for additional information when servicing the cutting units.

Supporting Cutting Unit when Servicing

Whenever the cutting unit has to be tipped to expose the bedknife or cutting reel, support the rear of the cutting unit to make sure the nuts on the back of the bedbar adjuster screws are not resting on the work surface.

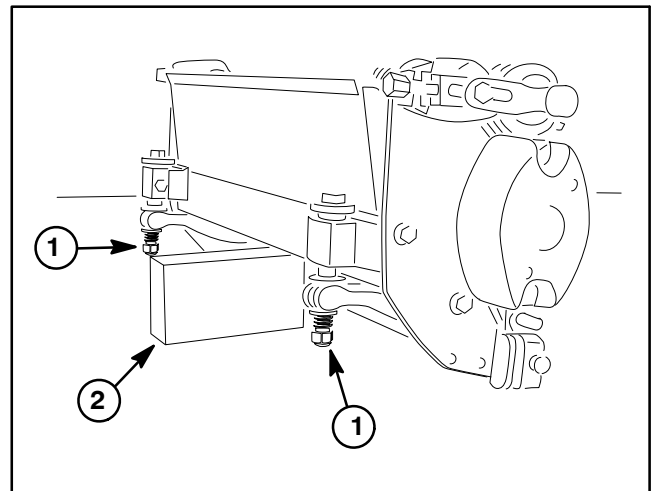


Figure 2

1. Nut

2. Support

Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some of these tools may have been supplied with your machine or are available as Toro parts.

Gauge Bar Assembly

Use gauge bar to verify height-of-cut adjustment.

Toro Part Number: **108-6715**

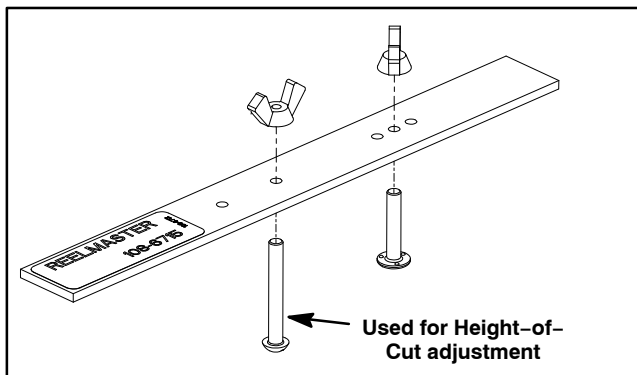


Figure 3

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: To prevent damage to the bedbar, DO NOT use an air or manual impact wrench with this tool.

Toro Part Number: **TOR510880**

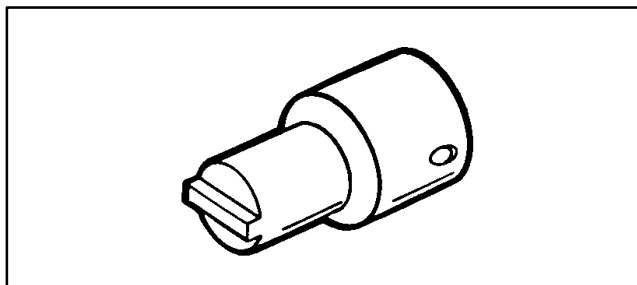


Figure 4

Handle Assembly

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

Toro Part Number: **29-9100**

Components for the handle assembly are available individually as follows:

- Brush 36-4310
- Handle 29-9080
- Handle cap 2410-18

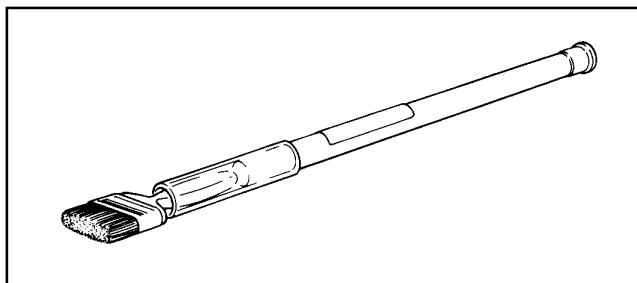


Figure 5

Roller Bearing Installation Tools

Washers and spacer used to install bearings and seals into front and rear rollers (Fig. 6).

Seal installation washer: 107-8133
Seal installation spacer: 107-3505
Bearing installation washer: 104-6126

As an alternative to using washers and spacers listed above, a special tool set is available that can be used for roller bearing and seal installation (Fig. 7).

Toro Part Number: **TOR4105**

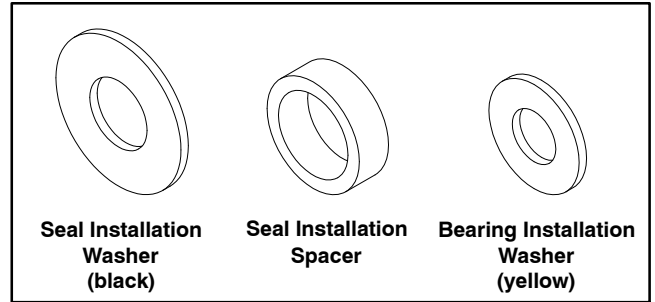


Figure 6



Figure 7

Diameter/Circumference Measuring Tape

Spring steel measuring tape for accurately measuring the circumference and outside diameter of cutting reel and other spherical components. Tape calibration is in fixed inch readings (no adjustments).

Toro Part Number: **TOR6023**



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

Bedknife Top Angle Indicator and Mount

Toro Part Numbers: **131-6828** and **131-6829**

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed these service tools for accurately measuring the top grind angle on all bedknives.

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar.

1. Place the angle indicator on the bottom side of the bedknife with the digital display facing you as shown (Fig. 10).
2. Press the Alt Zero button on the angle indicator.
3. Remove the angle indicator and place the angle-indicator mount on the edge of the bedknife so the face of the magnet is flat against the top of the bedknife (Fig. 11).
4. Place the angle indicator on the mount with the digital display facing you as shown (Fig. 11). The angle displayed on the indicator is the current bedknife top angle.

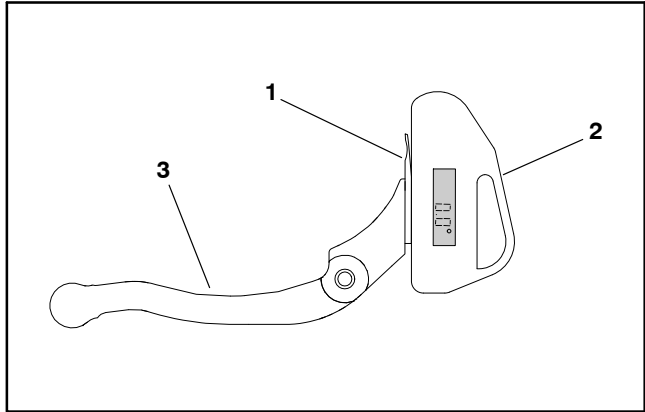


Figure 10

- | | |
|--------------------|-----------|
| 1. Bedknife | 3. Bedbar |
| 2. Angle indicator | |

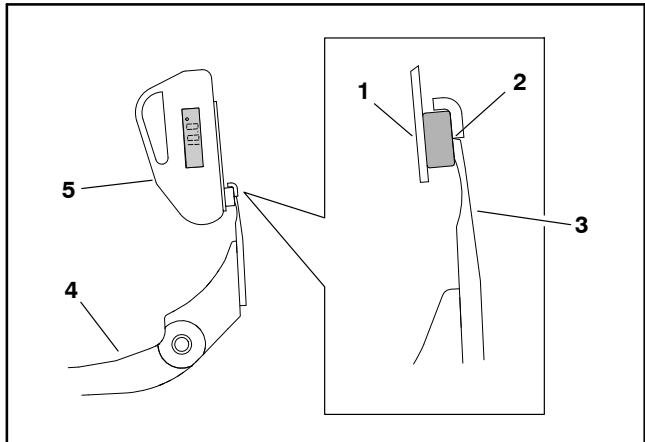


Figure 11

- | | |
|--------------------------|--------------------|
| 1. Angle indicator mount | 4. Angle indicator |
| 2. Magnet | 5. Bedbar |
| 3. Bedknife | |

Reel Thread Repair Taps

15/16-16 Right-Hand Thread – Toro Part No. **137-0926**

15/16-16 Left-Hand Thread – Toro Part No. **137-0927**

Use to clean or repair the internal threads of cutting unit reels.



Figure 12

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the cutting unit. It is important to remember that the lower the height-of-cut, the more critical these factors are.

Refer to the Cutting Unit’s Operator’s Manual for detailed cutting unit adjustment procedures. For cutting unit repair information, refer to the Service and Repairs section of this chapter.

NOTE: For additional information regarding cutting unit troubleshooting, see **Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL)**.

Factor	Possible Problem/Correction
Tire pressure	<p>Check tire pressure of all traction unit tires. Adjust tire pressure as necessary.</p> <p>See the Traction Unit Operator’s manual.</p>
Governed engine speed	<p>For best cutting performance and appearance, engine should be run at maximum governed speed during machine operation. Check maximum governed engine speed. Adjust engine to specifications if necessary.</p> <p>See Chapter 3 – Diesel Engine.</p>
Reel speed	<p>All cutting reels must rotate at the same speed (within 100 rpm) (see Troubleshooting in Chapter 4 – Hydraulic System).</p> <p>All cutting units must have equal bedknife to reel and height-of-cut adjustments.</p> <p>Make sure that reel speed selection is correct (see Reel Speed Chart in Traction Unit Operator’s Manual).</p>
Reel bearing condition	<p>Check reel bearings for wear and replace if necessary.</p> <p>See Reel Assembly Service in the Service and Repairs section of this chapter.</p>
Bedknife to reel adjustment	<p>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).</p>

DPA Cutting Units

Factor	Possible Problem/Correction
Reel and bedknife sharpness	<p>A reel and/or bedknife that has rounded cutting edges or “rifling” (grooved or wavy appearance) cannot be corrected by tightening the bedknife to reel contact. Grind cutting reel to remove taper and/or rifling. Grind bedknife to sharpen and/or remove rifling.</p> <p>The most common cause of rifling is bedknife to reel contact that is too tight.</p> <p>Dull cutting edges must be corrected by grinding the bedknife and cutting reel (see Preparing Reel for Grinding in the Service and Repairs section of this chapter).</p> <p>A new bedknife must be ground flat (within 0.002”) after installation to the bedbar. Backlapping may be required to properly mate the reel and bedknife after installation into the cutting unit.</p> <p>NOTE: On cutting units equipped with optional bedknives, slightly dull cutting edges may be corrected by backlapping (see Backlapping in the Service and Repairs section of this chapter).</p>
Rear roller adjustment	<p>Adjust the rear roller brackets to correct position depending on the height-of-cut range desired.</p> <p>See Rear Roller Adjustment in the Cutting Unit Operator’s Manual.</p>
Height-of-cut	<p>“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.</p> <p>See Height-of-Cut Adjustment in the Cutting Unit Operator’s Manual.</p>
Proper bedknife selection for height-of-cut desired	<p>If the bedknife is incorrect for effective height-of-cut, poor quality of cut will result.</p> <p>See Cutting Unit Operator’s Manual for bedknife options.</p>
Stability of bedbar	<p>Make sure bedbar pivot bolts are seated securely. Check condition of the bushings in the side plates.</p> <p>See Bedbar Removal and Installation in the Service and Repairs section of this chapter.</p>
Number of reel blades	<p>Use correct number of reel blades for clip frequency and optimum height-of-cut range.</p>

Factor	Possible Problem/Correction
Roller condition and roller type	<p>Make sure rollers rotate freely. Repair roller bearings as necessary.</p> <p>See Roller Service in the Service and Repairs section of this chapter.</p> <p>Refer to Cutting Unit Operator's Manual for roller options.</p>
Cutting unit accessories	<p>A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to Operator's Manual for a listing of available accessories.</p>

Set Up and Adjustments

Characteristics



CAUTION

Never install or work on the cutting units or cutting unit suspension with the engine running. Always stop engine and remove key first.

The dual knob bedknife-to-reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self-sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping.

In addition, the rear roller positioning system allows for various height-of-cut ranges and aggressiveness of cut selections.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.
2. Determine desired height-of-cut range and install rear roller mounting shim(s) accordingly.
3. Adjust the height-of-cut.

See Cutting Unit Operator's Manual for cutting unit adjustment procedures for your Greensmaster 3250-D machine.

Leveling Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled or as the cutting reel wears, a limited amount of side plate adjustment is possible to make sure that the cutting unit is properly aligned.

1. Place the assembled cutting unit on a surface plate.
2. Make sure that bedknife is properly adjusted to cutting reel.
3. Using the surface plate, check if rear roller is level to cutting reel by using a 0.005" (0.13 mm) shim at each end of rear roller. If the shim will pass under the roller at one end but not the other, a frame adjustment should be made.
4. Loosen, but do not remove, the two (2) shoulder bolts that secure the side plate to the frame opposite the side that is not level (Fig. 13).
5. Adjust the position of the side plate to parallel the rear roller and cutting reel. Then, tighten the shoulder bolts to a torque from **210 to 240 in-lb (24 to 27 N-m)**.
6. After tightening the side plate, recheck the rear roller. If necessary, loosen and adjust second side plate.
7. After leveling rear roller, complete cutting unit set-up and adjustment sequence.

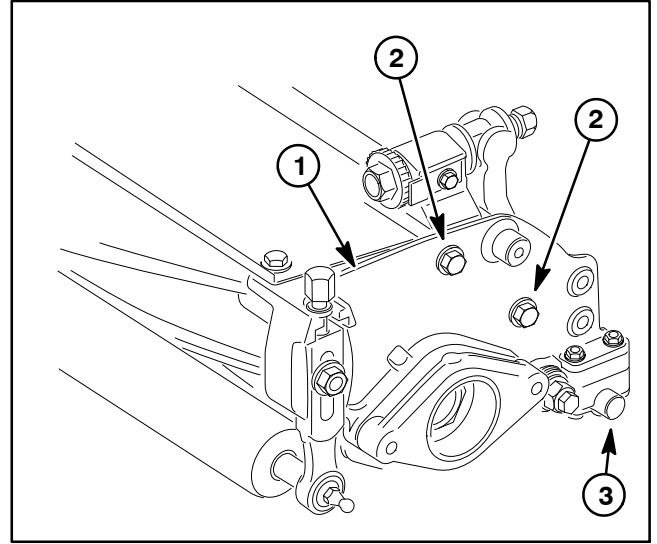


Figure 13

1. Side plate
2. Shoulder bolt
3. Rear roller

Service and Repairs

Backlapping



DANGER

TO AVOID PERSONAL INJURY OR DEATH:

- Never place hands or feet in the reel area while the engine is running.
- When backlapping, run engine at idle speed only.
- While backlapping, the reels may stall and then restart.
- Do not attempt to restart reels by hand or foot.
- Do not adjust reels while the engine is running.
- If a reel stalls, stop engine before attempting to clear the reel.
- Reel motors are connected in series: rotating one motor causes rotation in other motors.

NOTE: Additional instructions and procedures on backlapping are available in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

1. Position the machine on a level surface, lower the cutting units, stop the engine and engage the parking brake.
2. Raise the operator seat to access hydraulic mow manifold.
3. Locate the reel speed control and backlap lever on the hydraulic mow manifold (Fig. 14). Rotate the reel speed control to position “1” and the backlap lever to the R (backlap) position.
4. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units which are to be backlapped.
5. Start engine and run at low idle speed.
6. Use joystick on the control console to engage the cutting units.

IMPORTANT: To prevent damage to the reel, do not rotate the backlap lever from the backlap position to the mow position while the engine is running.

7. Apply lapping compound to cutting unit blades with a long handle brush (see Special Tools in this chapter) (Fig. 15). Never use a short handled brush to apply lapping compound.

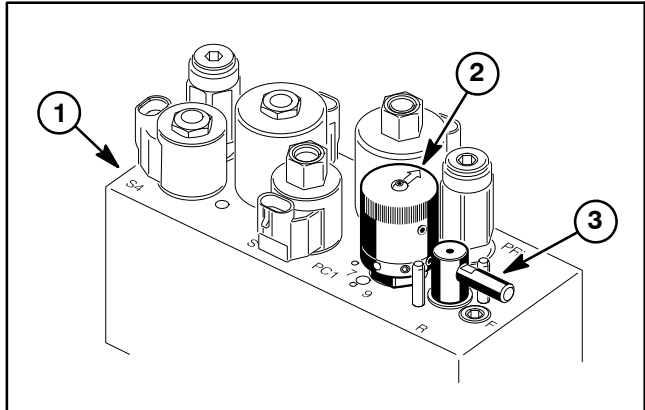


Figure 14

1. Hydraulic manifold
2. Reel speed control
3. Backlap lever

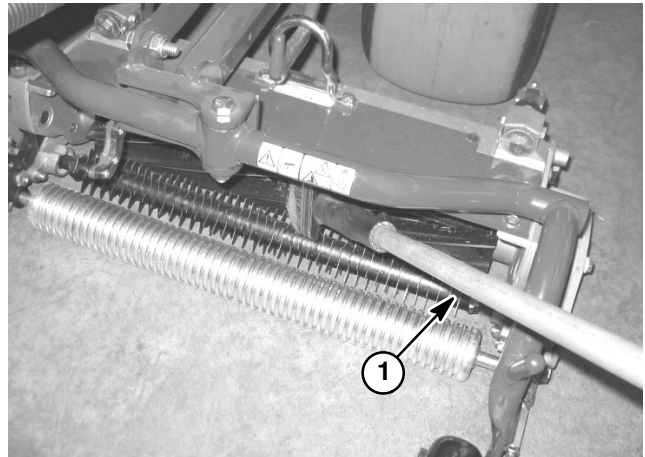


Figure 15

1. Long Handle Brush



DANGER

Reels may stall while backlapping. Do not attempt to restart reels by hand or touch reels while backlapping. Stop engine and turn reel speed adjustment knob one position toward “9.”

8. If reels stall or become erratic while backlapping, stop backlapping by disengaging the PTO with the joystick. Once the reels have stopped, move the reel speed selector knob one position closer to “9.” Resume backlapping by engaging the PTO with the joystick.

9. To make an adjustment to the cutting units while backlapping, disengage the PTO with the joystick and turn the engine OFF. Wait for all machine movement to stop. After adjustments have been completed, repeat steps 5 through 8.

10. When the backlapping operation is completed, stop the engine and remove the key from the ignition switch. Run a file across the front face of the bedknife. This will remove any burrs or rough edges that may have built up on the cutting edge.

11. Repeat procedure for all cutting units to be backlapped.

12. When backlap operation has been completed, return the backlap lever to the F (mow) position, set reel speed control to desired speed, lower operator seat and wash all lapping compound off cutting units. Adjust cutting unit reel to bedknife as needed.

NOTE: If the backlap lever is not returned to the F (mow) position after backlapping, the cutting units will not function properly.

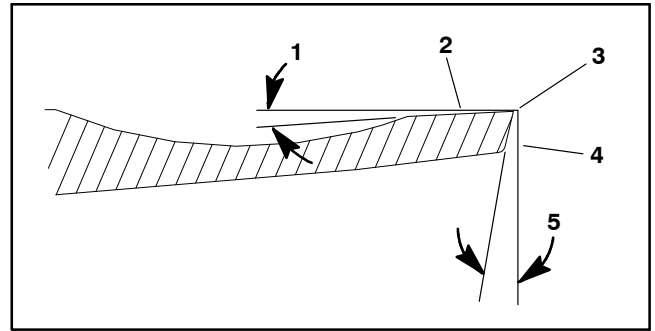


Figure 16

- | | |
|----------------|------------------|
| 1. Top angle | 4. Front surface |
| 2. Top surface | 5. Front angle |
| 3. Remove burr | |

Bedbar Assembly

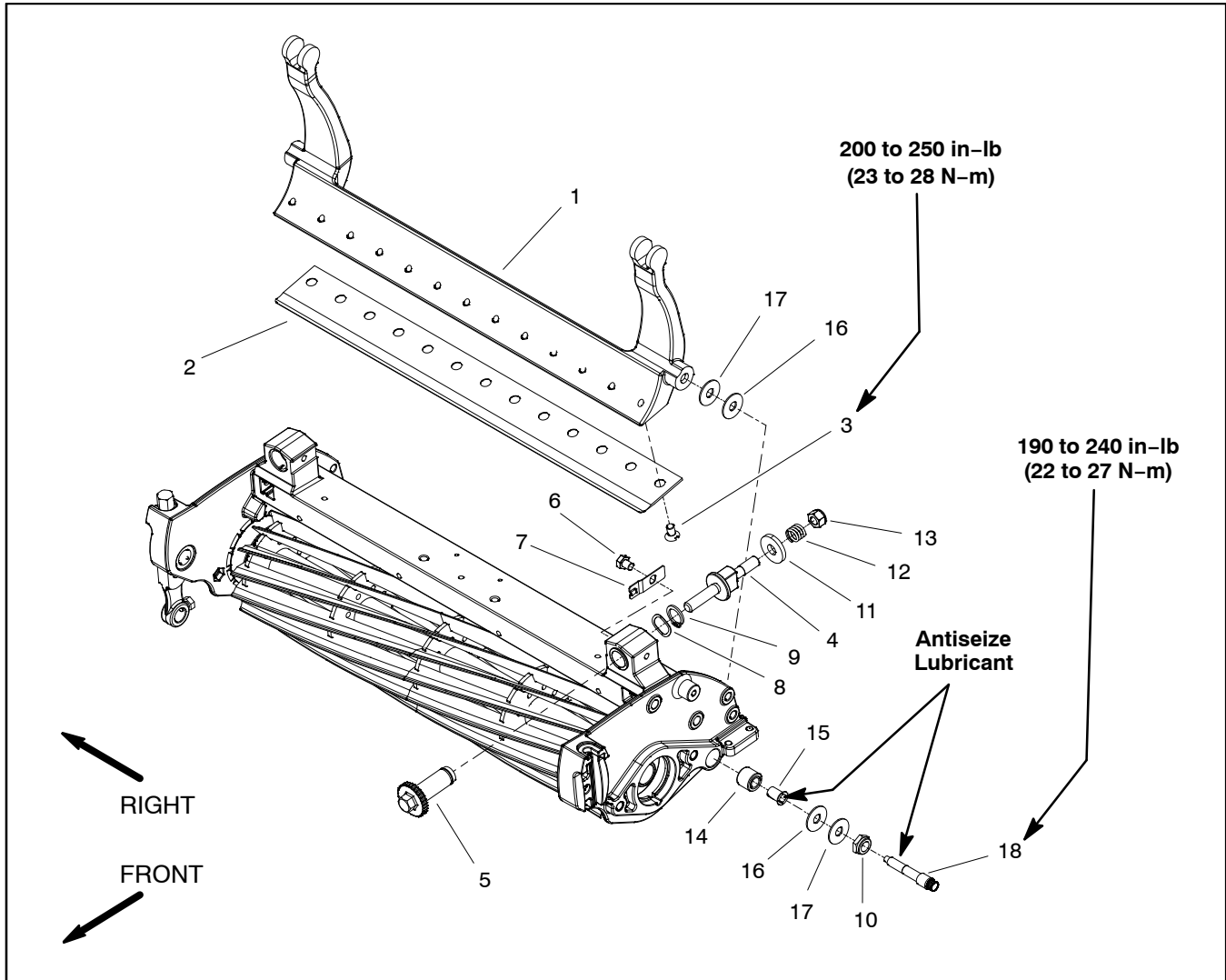


Figure 17

- | | | |
|-----------------------------------|---------------------------------|--------------------------------|
| 1. Bedbar | 7. Detent (2 used) | 13. Lock nut (2 used) |
| 2. Bedknife | 8. Wave washer (2 used) | 14. Rubber bushing (2 used) |
| 3. Screw (13 used) | 9. Retaining ring (2 used) | 15. Nylon bushing (2 used) |
| 4. Bedbar adjuster screw (2 used) | 10. Lock nut (2 used) | 16. Plastic washer (4 used) |
| 5. Bedbar adjuster shaft (2 used) | 11. Washer (2 used) | 17. Metal washer (4 used) |
| 6. Cap screw (2 used) | 12. Compression spring (2 used) | 18. Bedbar pivot bolt (2 used) |

Bedbar Removal (Fig. 17)

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

2. Remove the cutting unit from the machine and place cutting unit on a flat work area.

3. Tip the cutting unit to expose the bedknife. Support the rear of the cutting unit (see Supporting Cutting Unit when Servicing in the General Information section of this chapter).

4. Loosen the lock nuts (item 13) on the end of each bedbar adjuster assembly until washer (item 11) is loose.

5. Loosen the lock nuts (item 10) on each bedbar pivot bolt (item 18).

6. Remove two (2) bedbar pivot bolts (item 18), four (4) metal washers (item 17) and four (4) plastic washers (item 16) from the cutting unit side plates.



CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

7. Remove bedbar assembly from cutting unit.

8. Inspect nylon bushings (item 15) and rubber bushings (item 14) in side plates for wear or damage. Remove bushings and replace if necessary.

Bedbar Installation (Fig. 17)

1. If rubber bushing was removed from either cutting unit side plate, apply grease to outside surface of new bushing and install into side plate. The bushing should be installed flush with the inside of the side plate (Fig. 18).

2. If removed, install the nylon bushings (item 15) with flange facing outward. Apply antiseize lubricant to inside of flange bushing.

3. Apply antiseize lubricant to the bedbar threads and the shoulder area of each bedbar pivot bolt (Fig. 18).

IMPORTANT: When installing washers (items 16 and 17), make sure that plastic washers are positioned on either side of the cutting unit sideplate (Fig. 18).

4. Slide one (1) metal washer (item 17) and then one (1) plastic washer (item 16) onto each bedbar pivot bolt.



CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

5. Position bedbar into cutting unit. Make sure that the top of each bedbar arm is between washer (item 11) and adjuster screw flange (item 4).

6. Position one (1) metal washer (item 17) and one (1) plastic washer (item 16) between bedbar and each cutting unit side plate (Fig. 18).

7. Install the bedbar pivot bolt assemblies. Make sure that plastic washers are not caught on the threads of the pivot bolts. Torque each bedbar pivot bolt from **190 to 240 in-lb (22 to 27 N-m)**.

8. Tighten both lock nuts (item 10) until outside washers do not have any endplay but still can be rotated. Do not over tighten the lock nuts as this can distort the side plates and affect reel bearing adjustment. When the lock nut is correctly tightened, there may be a gap at the inside washers.

9. Tighten the lock nut (item 13) on each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen lock nut 1/2 turn.

10. Adjust cutting unit (see Cutting Unit Operator's Manual).

11. Install cutting unit to machine.

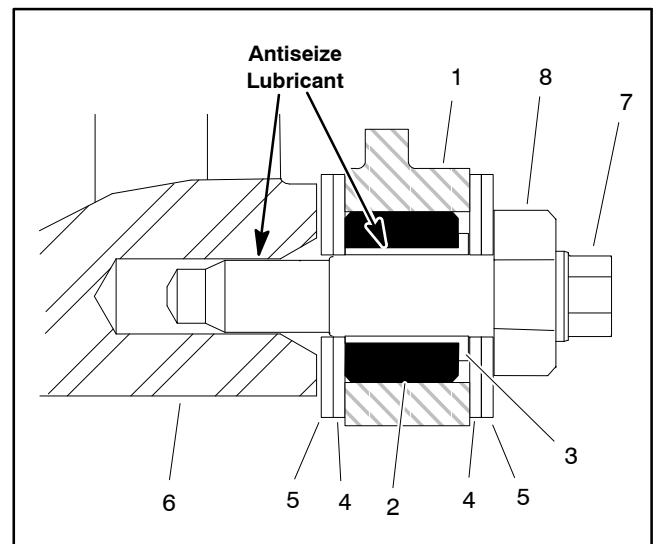


Figure 18

- | | |
|---------------------------|----------------------|
| 1. Cutting unit sideplate | 5. Metal washer |
| 2. Rubber bushing | 6. Bedbar |
| 3. Nylon bushing | 7. Bedbar pivot bolt |
| 4. Plastic washer | 8. Lock nut |

Bedknife Replacement and Grinding

Bedknife Removal

1. Remove bedbar from cutting unit (see Bedbar Removal in this section).
2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools in this chapter). Discard screws. Remove bedknife from the bedbar (Fig. 19).
3. See bedknife grinding information on the following pages.

Bedknife Installation

1. Use scraper to remove all rust, scale and corrosion from bedbar surface. Lightly oil bedbar surface before installing bedknife.
2. Make sure that screw threads in bedbar (5/16-18UNC-2A) are clean.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

3. Use new screws to secure bedknife to bedbar. Apply antiseize lubricant to the threads of new screws. Do not apply antiseize lubricant to the taper of the screw heads.
4. Install all screws but do not tighten.
5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to **10 in-lb (1 N-m)**.
6. Working from the center of the bedknife toward each end (Fig. 20), tighten screws from **200 to 250 in-lb (23 to 28 N-m)**.
7. After installing bedknife to bedbar, grind bedknife.

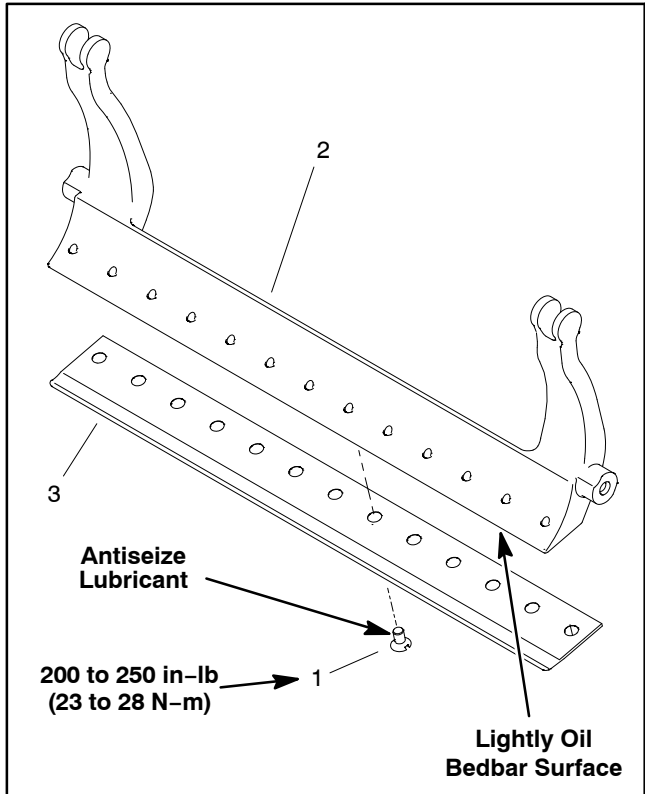


Figure 19

- | | |
|---------------|-------------|
| 1. Screw (13) | 3. Bedknife |
| 2. Bedbar | |

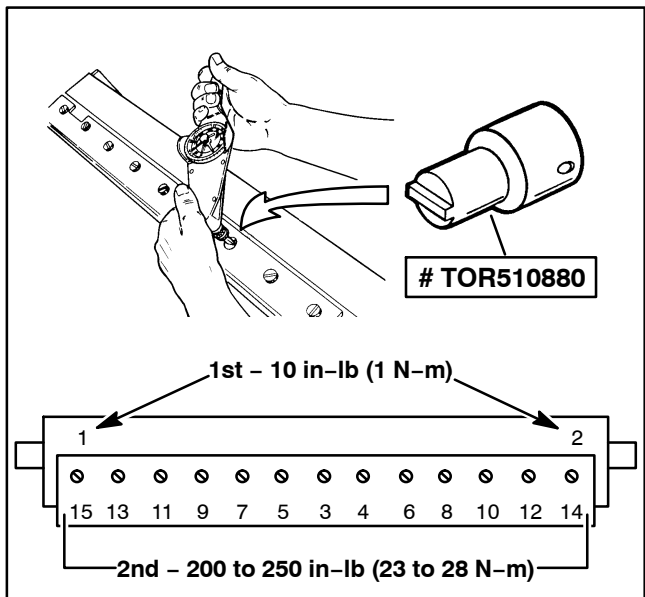


Figure 20

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided (Fig. 21). Grind only enough so the top surface of the bedknife is true (Fig. 22).

IMPORTANT: Do Not grind the bedknife below its service limit (Fig 23). Operating the cutting unit with the bedknife below the service limit may result in poor after-cut appearance and reduce the structural integrity of the bedknife.

The bedknife service limit occurs when the reel contacts the back of the bedknife scallop during operation. Check for reel contact marks at the back of the bedknife scallop prior to grinding. The bedknife service limit may also occur when the bottom of the bedknife scallop is reached when grinding the bedknife.

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

NOTE: EdgeMax[®] bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to the Angle Indicator and Magnetic Mount in the Special Tools section of this Chapter.

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.

2. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Installation in this section).

NOTE: Always adjust the cutting unit after grinding the reel and/or bedknife; refer to the Cutting Unit Operator's Manual. If a properly adjusted cutting unit does not cut paper cleanly after grinding, the grind angle may be incorrect. To extend the cutting unit performance by allowing the reel and the bedknife to hold their edge longer, an additional adjustment may be required after the first few minutes of operation as the reel and bedknife conform to each other.

Bedknife Grinding Specifications (see Fig. 22)	
Standard bedknife relief angle	3° minimum
Fairway bedknife relief angle	3° minimum
Extended bedknife relief angle	7° minimum
Front Angle Range	13° to 17°

Figure 21

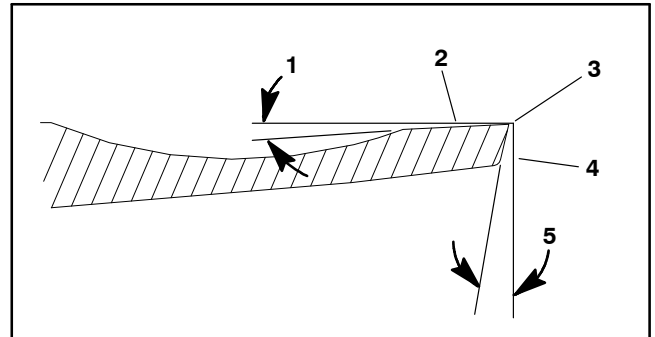


Figure 22

1. Top angle
2. Top surface
3. Remove burr (without dulling sharp corner)
4. Front surface
5. Front angle

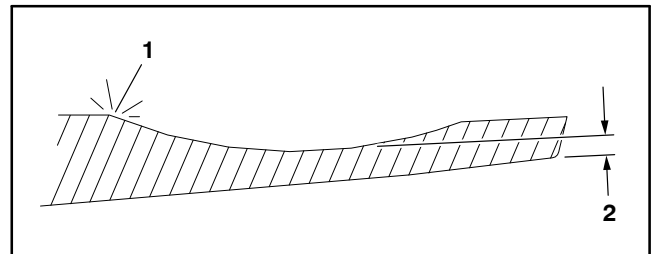


Figure 23

1. Service limit (reel contacts back of bedknife scallop during operation)
2. Service limit (bottom of bedknife scallop reached when grinding)

Bedbar Adjuster Service

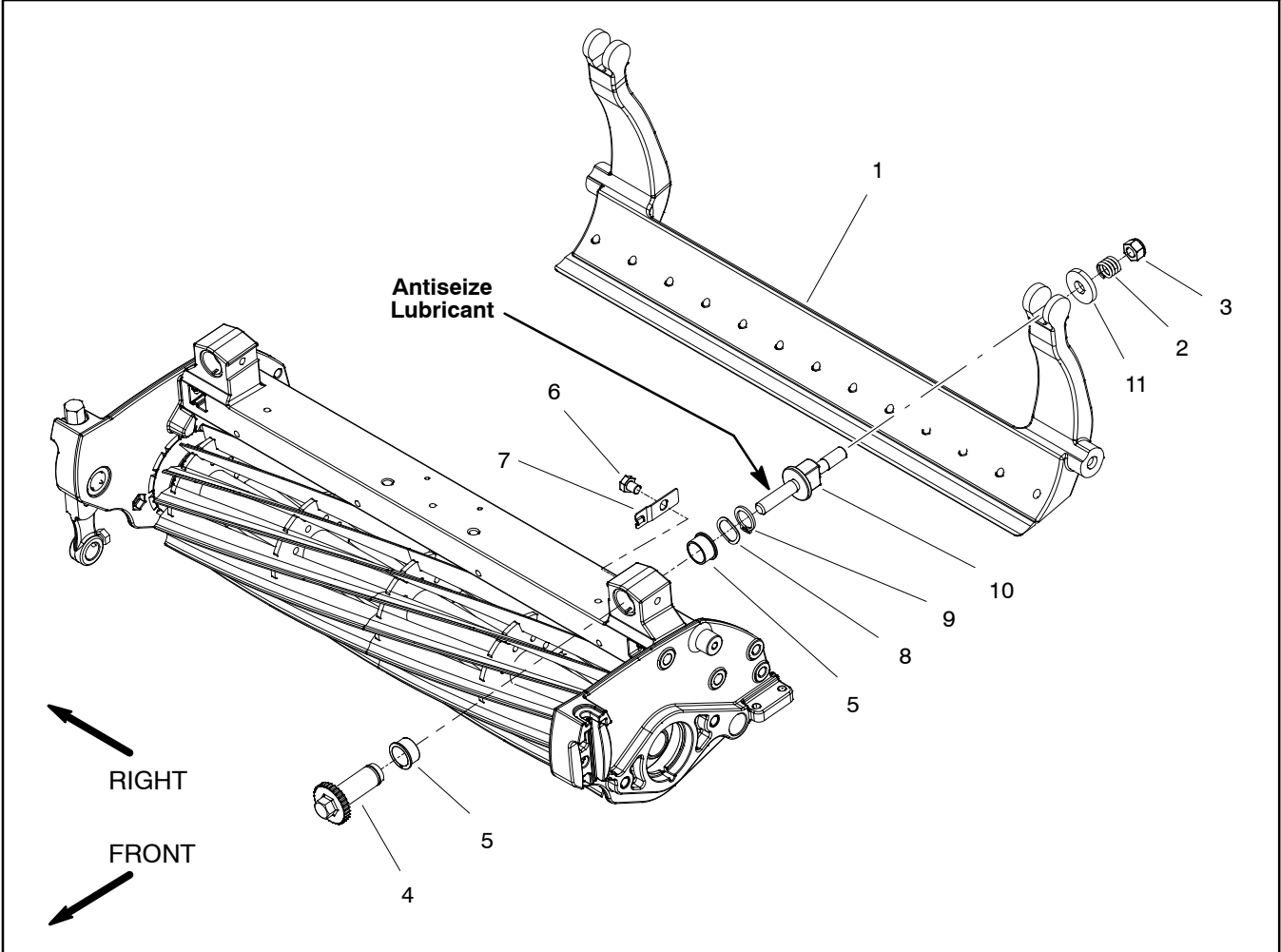


Figure 24

- 1. Bedbar assembly
- 2. Compression spring
- 3. Lock nut
- 4. Bedbar adjuster shaft
- 5. Flange bushing
- 6. Cap screw
- 7. Detent
- 8. Wave washer
- 9. Retaining ring
- 10. Bedbar adjuster screw
- 11. Washer

Removal (Fig. 24)

1. Remove lock nut (item 3), compression spring (item 2) and washer (item 11) from bedbar adjuster screw.
2. Remove bedbar (see Bedbar Removal in this section).

NOTE: Bedbar adjuster shaft (item 4) has left-hand threads.

3. Unscrew bedbar adjuster shaft (item 4) from the bedbar adjuster screw (item 10).
4. Remove retaining ring (item 9) and wave washer (item 8) from adjuster shaft and remove adjuster shaft from cutting unit frame.
5. Inspect flange bushings (item 5) in cutting unit side plate and remove if necessary.
6. If detent (item 7) is damaged, remove it from cutting unit side plate by removing the cap screw (item 6).

Installation (Fig. 24)

1. If detent (item 7) was removed, secure detent to cutting unit side plate with cap screw.
2. If flange bushings (item 5) were removed, align key on bushing to slot in frame and install bushings.
3. Slide adjuster shaft (item 4) into flange bushings in cutting unit side plate. Secure adjuster shaft with wave washer (item 8) and retaining ring (item 9).

NOTE: Bedbar adjuster shaft (item 4) has left-hand threads.

4. Apply antiseize lubricant to threads of bedbar adjuster screw that fit into adjuster shaft. Thread bedbar adjuster screw (item 10) into adjuster shaft.
5. Install bedbar (see Bedbar Installation in this section).
6. Install washer (item 11), spring (item 2) and lock nut (item 3) onto adjuster screw. Tighten the lock nut on each bedbar adjuster assembly until the compression spring is fully compressed, then loosen lock nut 1/2 turn.
7. Adjust cutting unit (see Cutting Unit Operator's Manual).

Reel Assembly

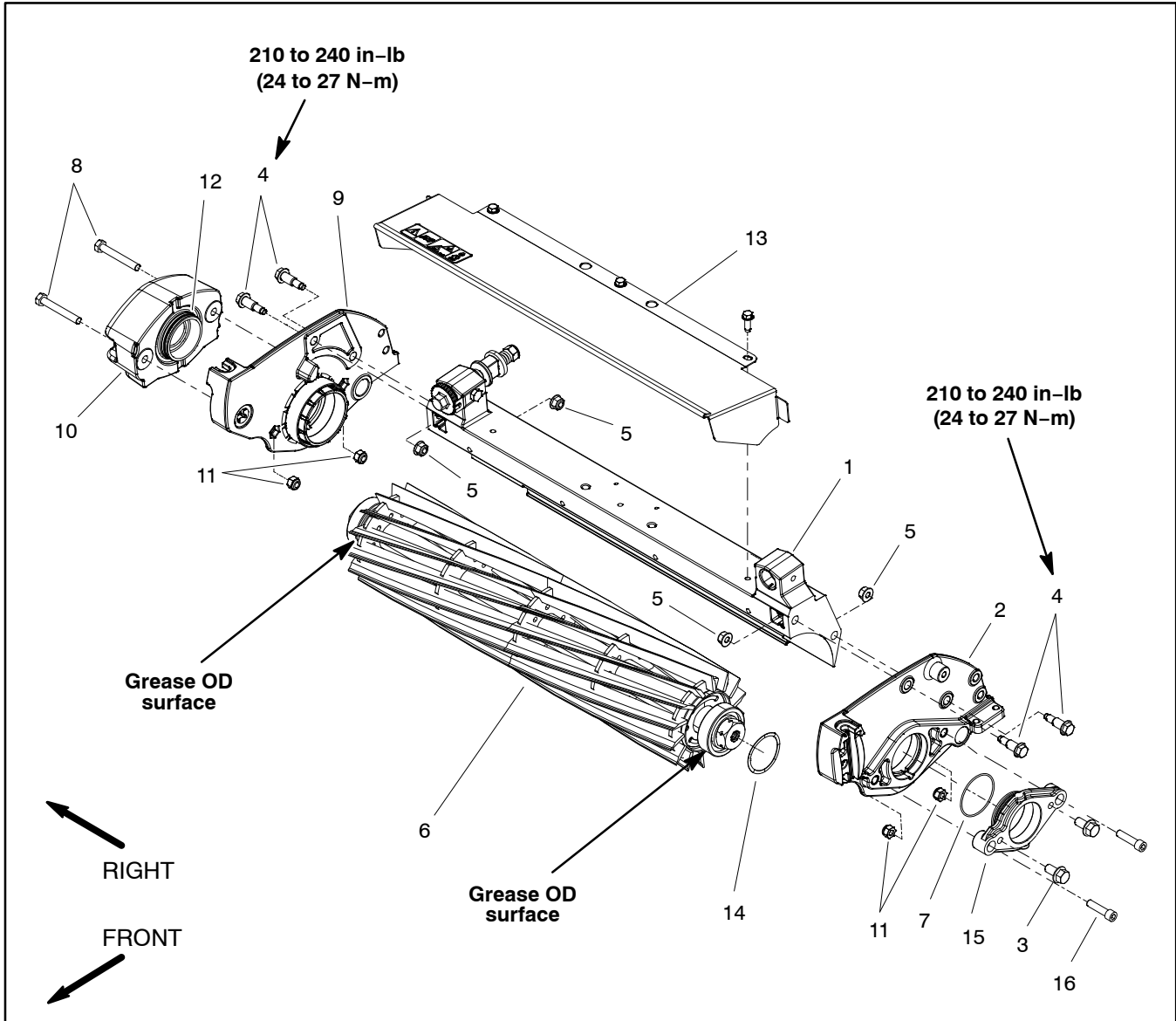


Figure 25

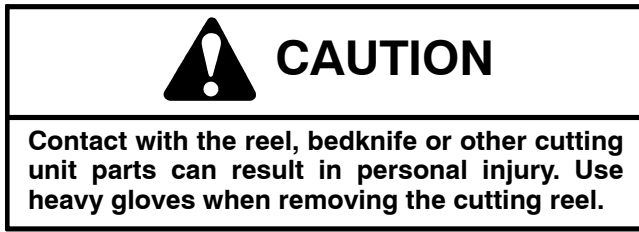
- | | | |
|--|-----------------------|--------------------------------|
| 1. Crossmember | 7. O-ring | 12. O-ring |
| 2. LH side plate | 8. Cap screw (2 used) | 13. Grass shield |
| 3. Flange head screw (2 used) | 9. RH side plate | 14. Flat wire spring |
| 4. Shoulder bolt (2 used per side plate) | 10. Weight | 15. Reel motor adapter |
| 5. Flange nut (2 used per side plate) | 11. Hex nut (4 used) | 16. Socket head screw (2 used) |
| 6. Cutting reel assembly | | |

NOTE: This section provides the procedure for removing and installing the cutting reel assembly (cutting reel, flocked seals, reel bearings, bearing lock screw and reel nut) from the cutting unit. Refer to Reel Assembly Service later in this section for information on servicing the cutting reel assembly.

NOTE: Removal of the cutting reel requires removal of the LH side plate from the cutting unit crossmember. The RH side plate does not have to be removed from the frame when using the following procedure.

NOTE: Figure 25 shows components when the hydraulic reel motor is on the left side of the cutting unit.

Reel Assembly Removal (Fig. 25)



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

2. Remove the cutting unit from the machine and place cutting unit on a flat work area.

3. If cutting unit is equipped with an optional groomer or rear roller brush, remove drive components for those options from cutting unit. See Service and Repairs section of Chapter 8 – Groomer for information on groomer. See Rear Roller Brush in this section for information on rear roller brush.

4. Remove two (2) cap screws and nuts that secure weight (item 10) to the side plate. Remove weight from the cutting unit. Remove and discard O-ring from weight.

IMPORTANT: If the reel bearings or seals are being replaced, the reel nuts must be removed. Use the following procedure to restrain the reel and loosen the reel nuts before removing the rollers.

5. Loosen the reel nuts (Fig. 26):

A. Tip up the cutting unit to access the bottom of the reel.

B. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move (Fig. 27).

IMPORTANT: To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

C. Move the pry bar against the weld side of the reel support plate closest to the reel nut being loosened.

IMPORTANT: The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The reel nut on the right end of the cutting reel has a silver finish and has right-hand threads (Fig. 26).

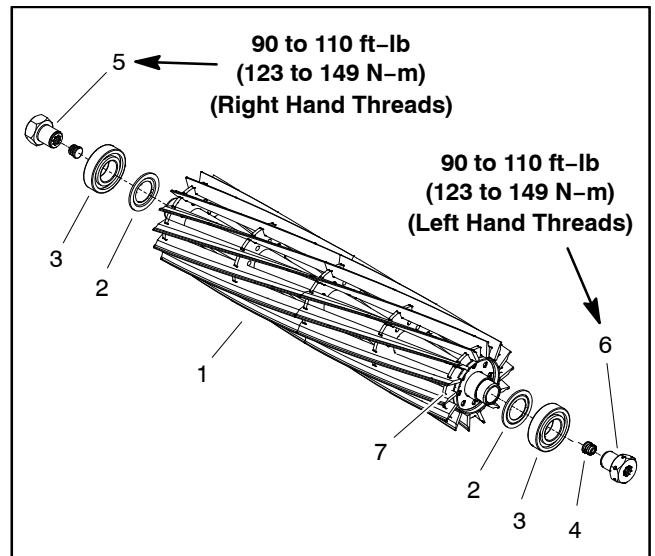


Figure 26

- | | |
|--------------------------|--------------------------|
| 1. Cutting reel | 5. Bearing lock screw |
| 2. Flocked seal (2 used) | 6. Reel nut (LH threads) |
| 3. Bearing (2 used) | 7. Reel groove location |
| 4. Plug (2 used) | |

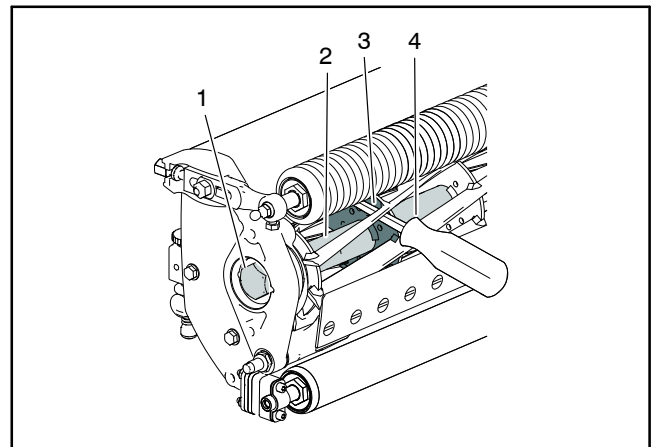


Figure 27

- | | |
|---------------|-----------------------------|
| 1. Reel nut | 3. Support plate, weld side |
| 2. Reel shaft | 4. Pry bar |

D. Rest the handle of the pry bar against the front roller and loosen the reel nut closest to the pry bar.

E. Position the pry bar in the same manner on the opposite end of the reel and loosen the remaining reel nut.

F. Tip the cutting unit back onto its rollers.

6. Remove the bedbar pivot bolt and washers from the LH side plate. Note location of plastic and steel washers for assembly purposes (see Bedbar Removal in this section).

7. Loosen fasteners that secure front and rear rollers to LH side plate (see Front Roller Removal and Rear Roller Removal in this section).

8. Support cutting reel to prevent it from shifting or falling.
9. Remove shoulder bolts (item 4) and flange nuts (item 5) that secure the LH side plate to the cutting unit crossmember. Remove the LH side plate from the reel shaft, rollers, bedbar and cutting unit crossmember.
10. Carefully slide the cutting reel assembly (with flocked seals, reel bearings and reel nuts) from the RH side plate.

Reel Assembly Installation (Fig. 25)

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates for wear or damage and replace components if needed.
2. Make sure that flocked seals, reel bearings and reel nuts are properly positioned on cutting reel (see Reel Assembly Service in this section). Apply thin coat of grease to outside of bearings on cutting reel to ease reel installation.



3. Position the cutting unit on a flat work area. The rollers, bedbar and cutting unit crossmember should be attached to RH side plate.
4. Carefully slide the cutting reel assembly (with flocked seals, reel bearings and reel nuts) into the RH side plate. Make sure that bearing is fully seated into side plate.
5. Place flat wire spring into bearing bore of LH side plate. Carefully slide the LH side plate onto the cutting reel assembly, front roller and rear roller. Make sure that side plate is fully seated onto bearing on reel shaft.
6. Install shoulder bolts (item 4) and flange nuts (item 5) to secure the LH side plates to the crossmember. Torque the shoulder bolts from **210 to 240 in-lb (24 to 27 N-m)**.
7. Secure front and rear rollers to LH side plate (see Front Roller Installation and Rear Roller Installation in this section).
8. Secure the bedbar assembly to LH side plate (see Bedbar Installation in this section). Make sure that plastic and steel washers are properly positioned.

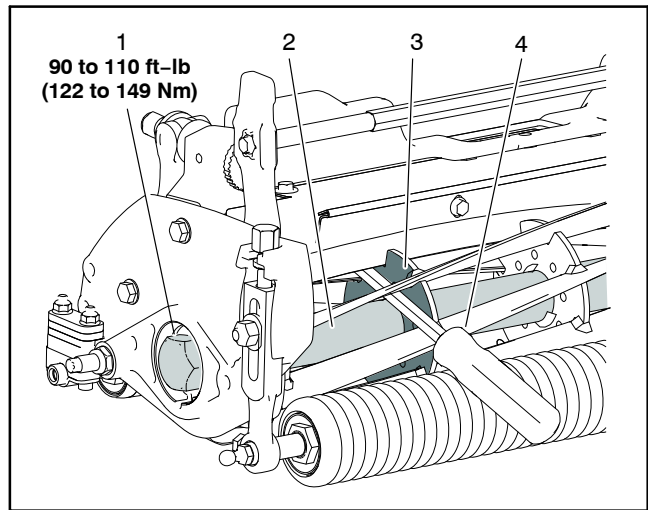


Figure 28

- | | |
|----------------------|-----------------------------|
| 1. Reel nut (2 each) | 3. Support plate, weld side |
| 2. Reel shaft | 4. Pry bar |

9. Tighten the reel nuts (Fig. 26):

A. Insert a long-handled pry bar (3/8 x 12 inch with a screwdriver handle recommended) through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move (Fig. 28).

IMPORTANT: To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

B. Move the pry bar against the weld side of the reel support plate closest to the reel nut being tightened.

IMPORTANT: The reel nut on the left end of the cutting reel has a black finish and has left-hand threads. The reel nut on the right end of the cutting reel has a silver finish and has right-hand threads (Fig. 26).

C. Rest the handle of the pry bar against the front roller and tighten the reel nut closest to the pry bar. Tighten the reel nut from **90 to 110 ft-lb (123 to 149 N-m)**.

D. Position the pry bar in the same manner on the opposite end of the reel and tighten the remaining reel nut.

E. Fill the reel nut splines with high temp Mobil XHP-222 grease or equivalent.

10. Thoroughly fill spline area of reel nuts with grease.
11. Adjust cutting unit (see Cutting Unit Operator's Manual).

NOTE: The parallel position of the rear roller to the cutting reel is controlled by the precision machined cross-member and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in the Set-Up and Adjustments section of this Chapter).

12. Install new O-ring (item 12) on weight (item 10). Secure weight to side plate with two (2) cap screws and nuts.

13. If cutting unit is equipped with optional groomer or rear roller brush, install components for those options to cutting unit. See Service and Repairs section of Chapter 8 – Groomer for information on groomer. See Rear Roller Brush in this section for information on rear roller brush.

14. Install cutting unit to the machine.

Reel Assembly Service

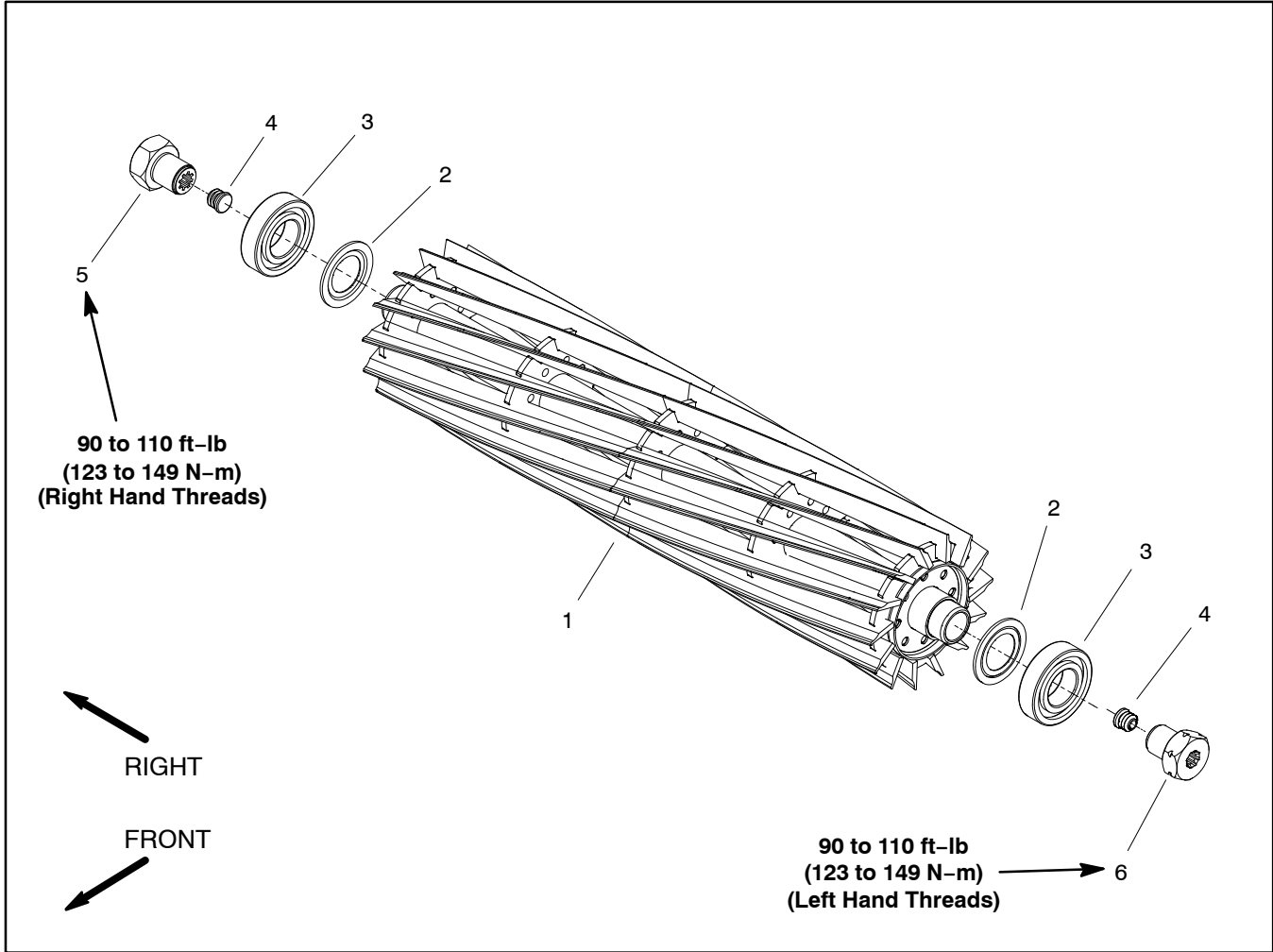


Figure 29

- 1. Cutting reel
- 2. Flocked seal (2 used)
- 3. Bearing (2 used)
- 4. Plug (2 used)
- 5. Reel nut (RH thread)
- 6. Reel nut (LH thread)

NOTE: The reel nuts (items 5 and 6) are different. The reel nut with left hand threads (item 6) has a black finish and has notches on the head. The reel nut with right hand threads (item 5) has a zinc finish and does not have notches on the head.

Disassembly of Cutting Reel (Fig. 29)

1. Remove reel nuts (items 5 and 6) from cutting reel. The black reel nut (item 6) has LH threads and is installed in end of reel shaft identified with a groove that is just inside of reel spider (Fig. 30).
2. Slide bearings from reel shaft.
3. Note orientation of flocked seals for assembly purposes. Remove seals from reel shaft.

Inspection of Cutting Reel (Fig. 29)

1. Inspect reel bearings to insure that they spin freely and have minimal axial play.
 - A. Check the reel shaft for bending and distortion by placing the shaft ends in V-blocks.
 - B. Check the reel blades for bending or cracking.
 - C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).
 - D. Check threads in ends of reel shaft.
3. Check the splines in the reel nuts (items 5 and 6) for excessive wear or distortion. Replace reel nuts if damage is evident.

Assembly of Cutting Reel (Fig. 29)

1. If bearings and/or flocked seals were removed from reel shaft, discard removed components and replace.

IMPORTANT: The flocked seal should be installed so the flocked side of the seal is toward the bearing location.

2. Slide flocked seals (flocked side orientated toward bearing location) and bearings fully onto reel shaft. Bearings and seals should bottom on reel shaft shoulder.
3. Install reel nuts (items 5 and 6) into reel shaft to secure bearings. Black reel nut (item 6) has LH threads and should be installed in end of reel shaft identified with a groove that is just inside of reel spider (Fig. 30).

NOTE: Installation torque for reel nuts is from **90 to 110 ft-lb (123 to 149 N-m)**. It is easiest to torque these items after the cutting reel is installed in the cutting unit frame (see Reel Assembly Removal and Installation in this section).

4. Thoroughly fill spline area of reel nuts with grease.

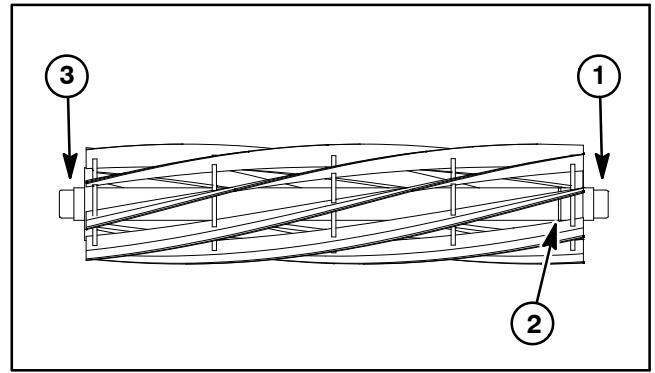


Figure 30

1. LH threads
2. Groove

3. RH threads

Preparing Reel for Grinding

NOTE: Before grinding a cutting reel, make sure that all cutting unit components are in good condition. Depending on type of grinder used, faulty cutting unit components can affect grinding results.

NOTE: When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

1. Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications (see Reel Grinding Specifications chart to the right). Additional reel grinding information can be found in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

2. After completing the reel grinding process, adjust cutting unit (see Cutting Unit Operator's Manual).

Reel Grinding Specifications	
Reel Diameter (New)	5.06 in (128.5 mm)
Service Limit - Reel Diameter	4.50 in (114.3 mm)
Reel Shaft Diameter (OD)	1.375 in (34.9 mm)
Blade Relief Angle	30°
Blade Relief Angle Range	28° to 32°
Blade Land Width	0.040 in (1.0 mm)
Blade Land Width Range	0.030 to 0.050 in (0.8 to 1.2 mm)
Service Limit - Reel Diameter Taper	0.010 in (0.25 mm)

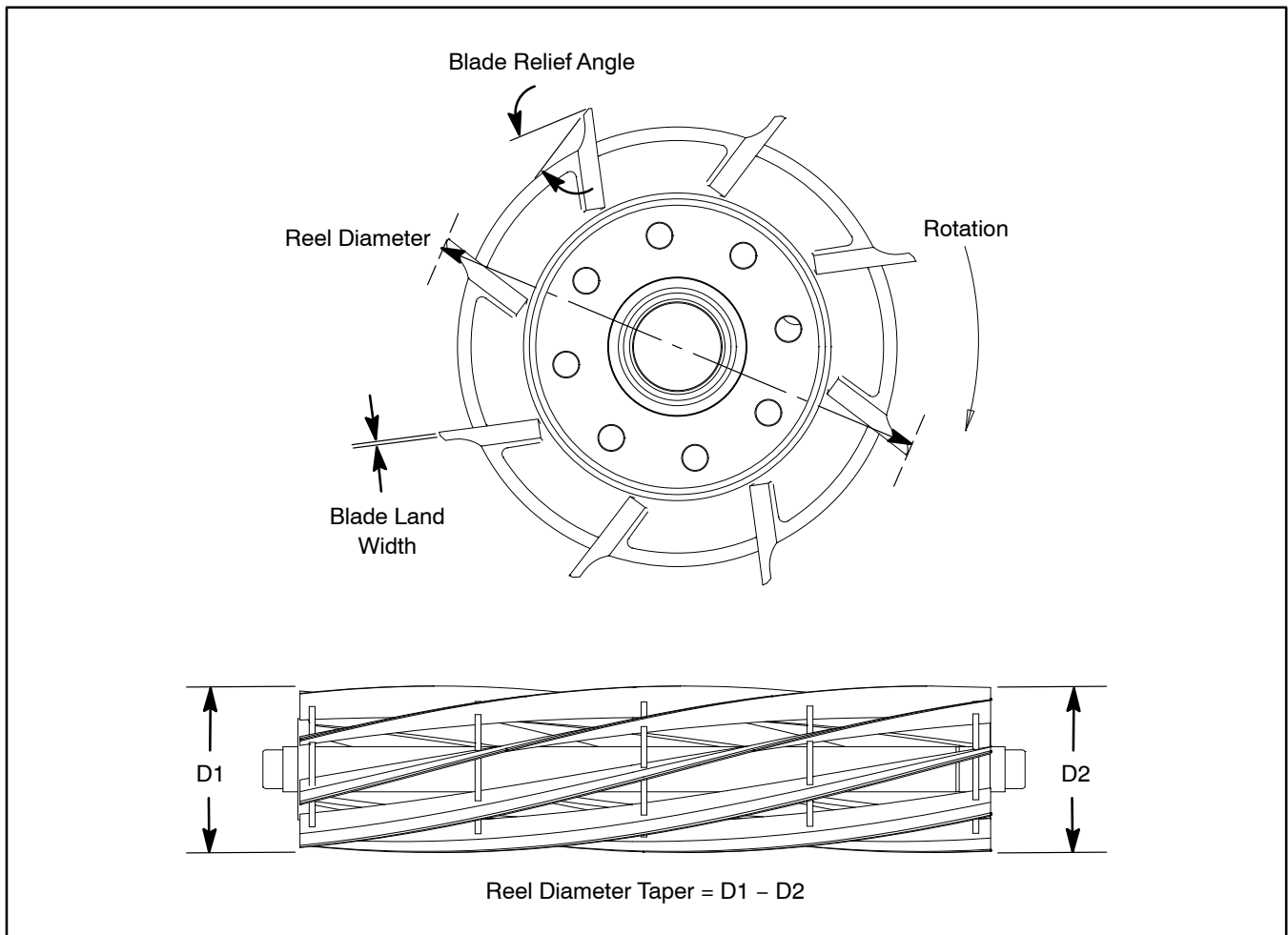


Figure 31

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Front Roller

Removal (Fig. 32)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.
2. Remove the cutting unit from the machine and place on a level working surface. Use appropriate support to raise front roller from work surface.
3. Loosen cap screw (item 1) that secures the front roller shaft to each front height-of-cut arm.
4. On one of the height-of-cut arms, remove HOC nut (item 7), HOC washer (item 6) and plow bolt (item 4) that secure HOC arm to the cutting unit side plate. Remove the HOC arm from the cutting unit.
5. Slide the front roller assembly from the remaining HOC arm on the cutting unit.
6. If necessary, remove the second HOC arm from the cutting unit.

Installation (Fig. 32)

1. Place cutting unit on a level working surface and use appropriate support to support front of cutting unit.
2. Inspect condition of HOC screws (item 5) in both HOC arms. If necessary, apply antiseize lubricant to threads of new HOC screw. Thread new HOC screw into HOC arm.

NOTE: When assembling HOC arms to side plates, make sure that ring on HOC screw fits into the notch on the side plate.

3. If both HOC arms were removed from cutting unit side plate, position one of the arms to side plate. Secure arm to side plate with plow bolt (item 4), HOC washer (item 6) and HOC nut (item 7). Tab on HOC washer should be positioned into HOC arm slot and orientated down toward the roller.
4. Slide front roller shaft into arm attached to the cutting unit. Slide second HOC arm onto the other end of roller shaft. Secure second arm to cutting unit side plate with plow bolt (item 4), HOC washer (item 6) and HOC nut (item 7).

5. Center front roller to the cutting reel and secure to HOC arms with cap screws (item 1).

6. Adjust cutting unit (see Cutting Unit Operator's Manual).

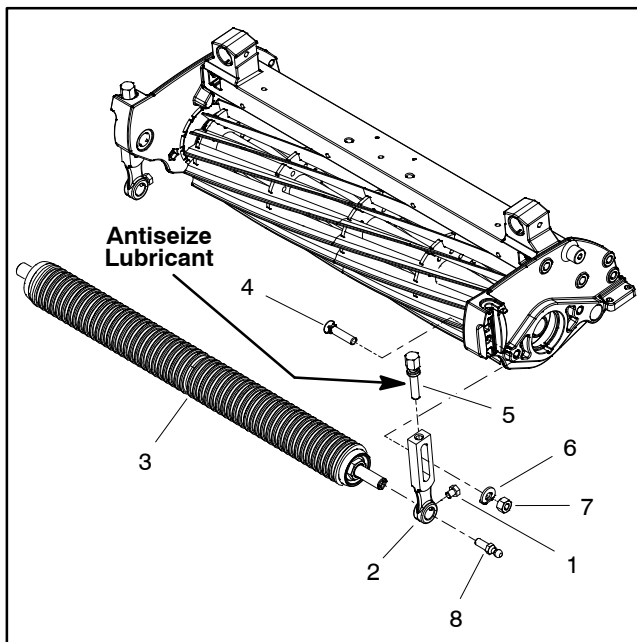


Figure 32

- | | |
|--------------------------|---------------|
| 1. Cap screw | 5. HOC screw |
| 2. HOC arm | 6. HOC washer |
| 3. Front roller assembly | 7. HOC nut |
| 4. Plow bolt | 8. Ball stud |

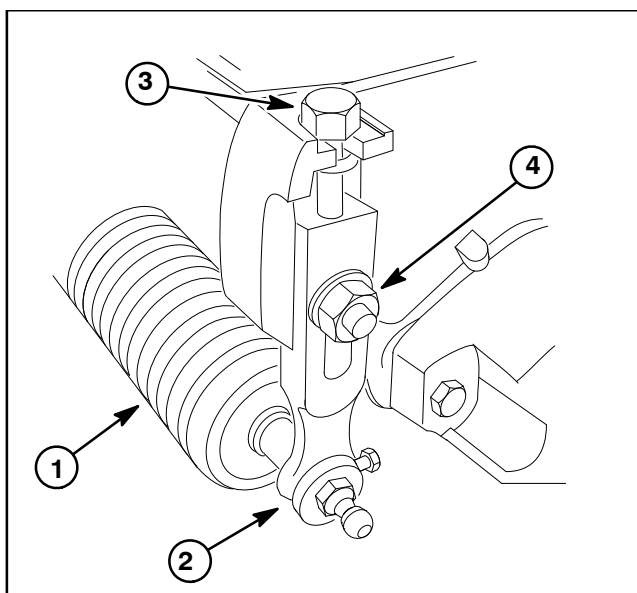


Figure 33

- | | |
|--------------------------|---------------------|
| 1. Front roller assembly | 3. HOC screw |
| 2. HOC arm | 4. HOC washer & nut |

Rear Roller

Removal (Fig. 34)

1. Position machine on a clean and level surface, lower cutting units, stop engine, engage parking brake and remove key from the ignition switch.
2. Remove the cutting unit from the machine and place on a level working surface. Place support blocks under bedbar to raise rear roller from work surface.
3. Loosen two (2) flange nuts that secure the rear roller shaft to each rear roller shaft retainer.
4. On one of the rear roller shaft retainer assemblies:

NOTE: On cutting units equipped with optional High Height of Cut Kit, there will be additional roller shims installed between roller height spacer and cutting unit side plate.

A. Note quantity and location of roller shims for assembly purposes.

B. Remove flange nuts and socket head screws that secure shaft retainer, roller height spacer and roller shims to the cutting unit side plate.

C. Remove the shaft retainer, height spacer and roller shims from the rear roller and cutting unit.

5. Slide the rear roller assembly from the remaining rear roller retainer assembly on the cutting unit.
6. If necessary, remove the second rear roller retainer assembly from the cutting unit.

Installation (Fig. 34)

1. Place cutting unit on a level working surface.

NOTE: Refer to Cutting Unit Operator's Manual for number of roller shims required for various height of cut settings.

2. If both rear roller retainer assemblies were removed from cutting unit, position shaft retainer, roller height spacer and roller shims to one of the side plates. Install two (2) carriage screws and flange nuts to retain assembly in position but do not fully tighten flange nuts.

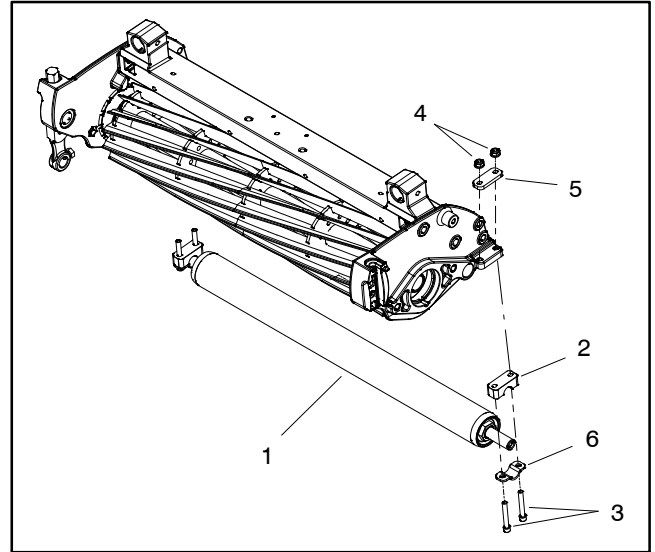


Figure 34

- | | |
|-------------------------|-------------------|
| 1. Rear roller assembly | 4. Flange nut |
| 2. Roller height spacer | 5. Roller shim |
| 3. Socket head screw | 6. Shaft retainer |

3. Slide rear roller shaft into the retainer assembly attached to the cutting unit. Slide second rear roller shaft retainer, roller height spacer and roller shims onto the other end of roller shaft. Secure second retainer assembly to cutting unit side plate with two (2) carriage screws and flange nuts. Do not fully tighten flange nuts.
4. Center rear roller to the cutting reel and secure in place by tightening four (4) flange nuts.
5. Adjust cutting unit (see Cutting Unit Operator's Manual).

Roller Service

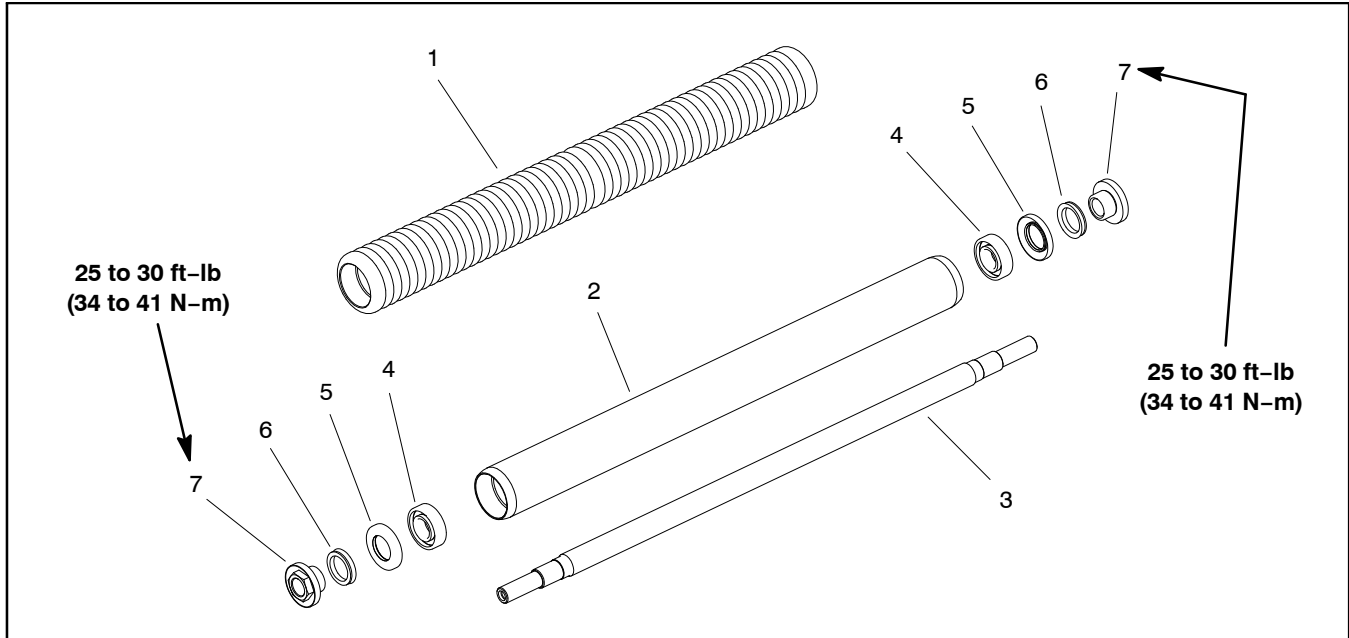


Figure 35

- | | | |
|------------------|-----------------|---------------------|
| 1. Wiehle roller | 4. Ball bearing | 6. V-ring |
| 2. Smooth roller | 5. Seal | 7. Bearing lock nut |
| 3. Roller shaft | | |

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 screw 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.

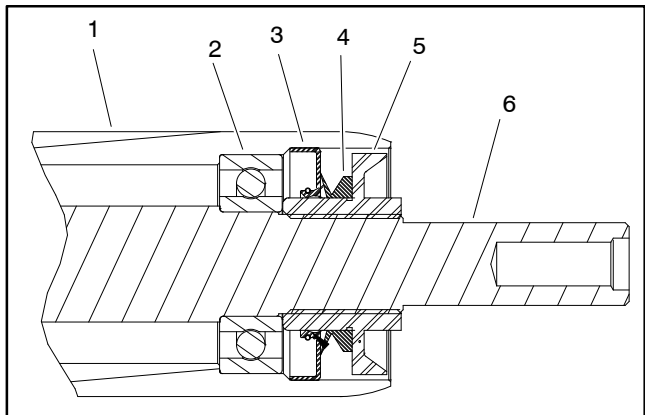


Figure 36

- | | |
|-----------------|---------------------|
| 1. Roller | 4. V-ring |
| 2. Ball bearing | 5. Bearing lock nut |
| 3. Seal | 6. Roller shaft |

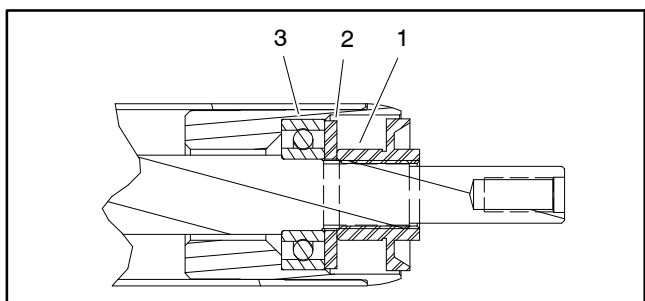


Figure 37

- | | |
|--------------------------|------------|
| 1. Bearing lock nut | 3. Bearing |
| 2. Black assembly washer | |

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. 37).

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. 38).

6. Carefully install seals onto bearing lock nuts. Pack the back of the seal 75 to 90% full with #2 grease (Fig. 38).

7. Install a nut with seal onto each end of the roller shaft. Tighten nuts until they bottom against bearings (Fig. 39). Remove nuts from roller shaft.

8. Position an assembly spacer and yellow assembly washer (see Special Tools) on each end of roller shaft (Fig. 40). 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.

10. Lubricate lips of installed seals with #2 grease.

11. Carefully slide a dry V-ring onto each bearing lock nut. The V-rings should be installed without any lubrication.

NOTE: If original bearing lock nut(s) are being used, apply Loctite #242 (or equivalent) to threads of lock nut(s).

12. Install bearing lock nut with V-ring onto each end of the roller shaft. Torque lock nuts from **25 to 30 ft-lb (34 to 41 N-m)**.

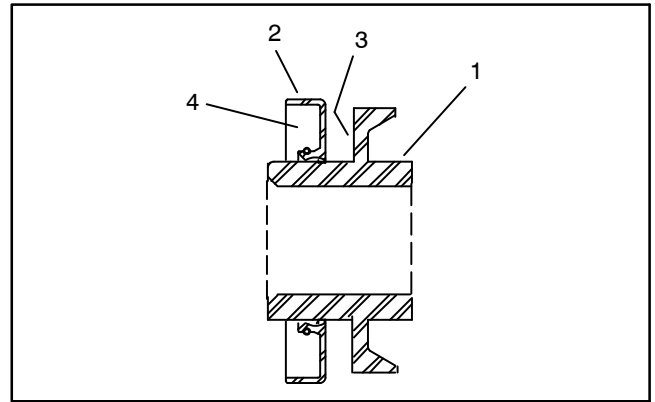


Figure 38

- | | |
|---------------------|-----------------------|
| 1. Bearing lock nut | 3. Grease nut surface |
| 2. Seal | 4. Pack with grease |

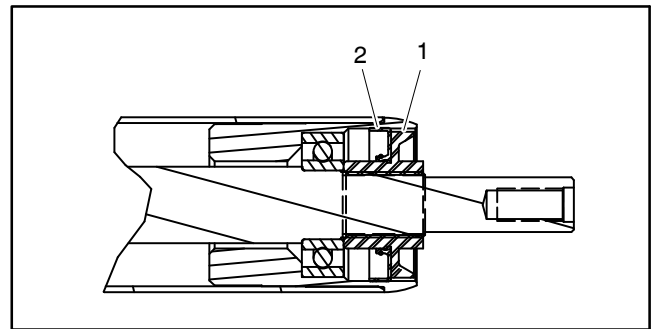


Figure 39

- | | |
|---------------------|---------|
| 1. Bearing lock nut | 2. Seal |
|---------------------|---------|

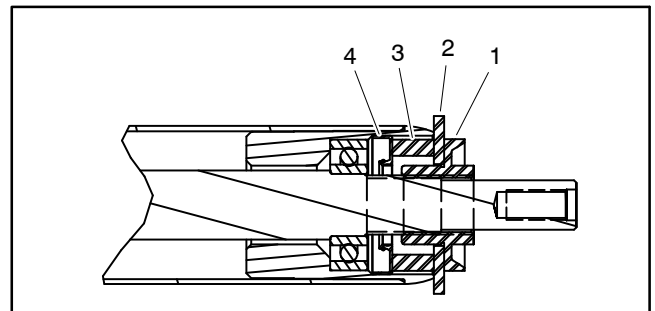


Figure 40

- | | |
|---------------------------|--------------------|
| 1. Bearing lock nut | 3. Assembly spacer |
| 2. Yellow assembly washer | 4. Seal |

Rear Roller Brushes (Optional)

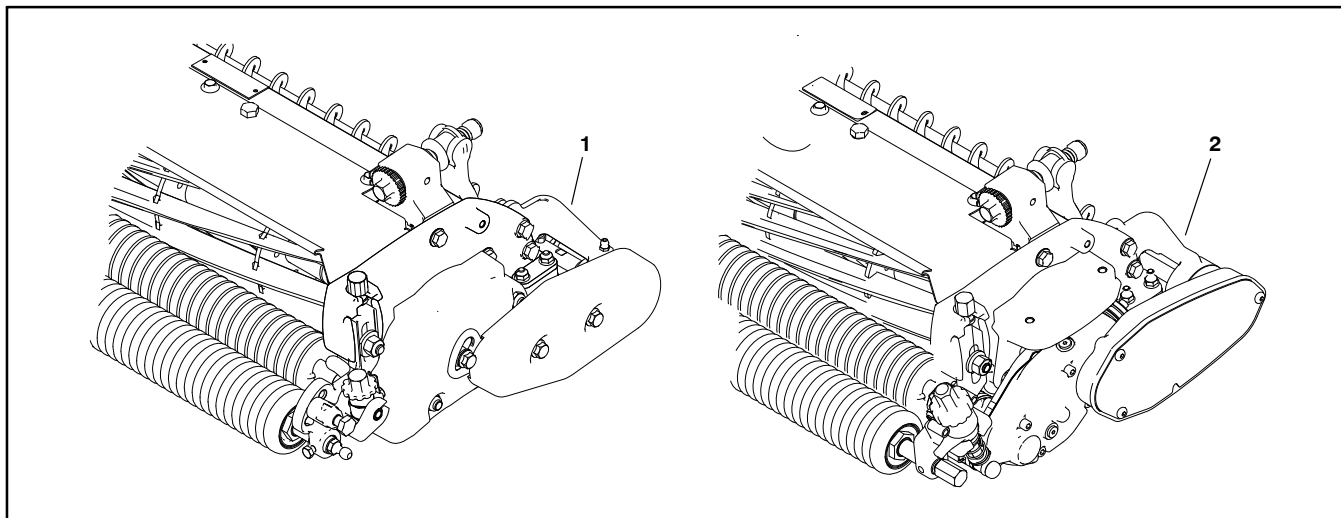


Figure 41

1. Rear roller brush for cutting units with or without a belt driven groomer
2. Rear roller brush for cutting units with or without a universal groomer

There are two different types of rear roller brush kits for Greensmaster 3250-D cutting units. The earlier type of kit is designed to fit on cutting units with or without a belt driven groomer. A later type of kit is designed to fit on cutting units with or without a universal groomer. Please take a moment to determine which type of rear roller brush kit is installed on the cutting unit as the service information is different for each rear roller brush type.

Note: The *Installation Instructions* for the rear roller brush kit has detailed information regarding assembly and adjustment. Use the *Installation Instructions* along with this *Service Manual* when servicing the rear roller brush.

Servicing the Rear Roller Brush (with or without a belt driven groomer)

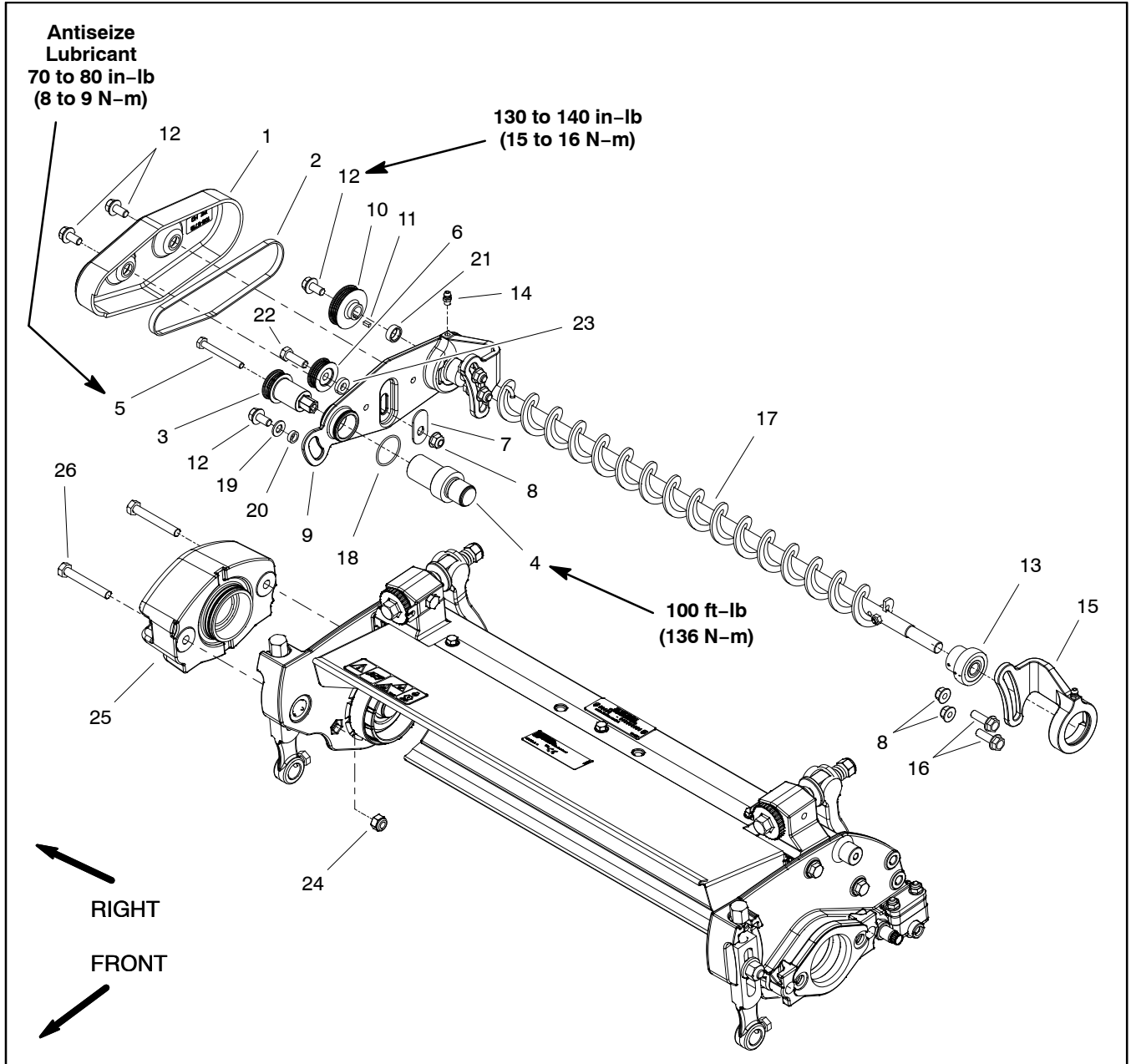


Figure 42

- | | | |
|--------------------------|--------------------------------------|------------------------|
| 1. Cover | 10. Driven pulley | 19. Flat washer |
| 2. Drive belt | 11. Square key | 20. Bearing spacer |
| 3. Drive pulley | 12. Threadlock screw (4 used) | 21. Spacer |
| 4. Pulley driver | 13. Roller bearing assembly (2 used) | 22. Cap screw |
| 5. Cap screw | 14. Grease fitting (2 used) | 23. Bearing spacer |
| 6. Idler pulley assembly | 15. LH brush support | 24. Hex nut (2 used) |
| 7. Cover plate | 16. Flange head screw (4 used) | 25. Weight |
| 8. Flange nut (5 used) | 17. Brush assembly | 26. Cap screw (2 used) |
| 9. Drive plate | 18. O-ring | |

Drive components for the rear roller brush are located on the opposite side of the cutting unit from the hydraulic cutting reel motor. Figure 42 shows components used when the brush drive is on the right side of the cutting unit.



CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

Replacing the Roller Brush Element

1. Remove the cutting unit from the machine and place it on a level work surface.
2. Loosen the set screw in the bearing locking collar on right side of brush shaft.
3. Using the blind hole in the bearing locking collar as an impact point, unlock the collar by striking it with a punch in the opposite direction of brush rotation.
4. Remove the RH brush support, bearing and locking collar.
5. Remove the brush element from the shaft.
6. Slide the new brush element onto the shaft while rotating the brush.
7. Install the J-bolts and lock nuts making sure the threaded portion of the J-bolts are installed on the outside of the brush element. Tighten the lock nuts from **2.3 to 2.8 N·m (20 to 25 in-lb)**.
8. Install the RH bearing support.
9. Tighten the bearing locking collar.
 - A. Slide the locking collars outward onto the bearing collars. Rotate the locking collars by hand in the direction of normal brush rotation until the collars are tight on the shaft.
 - B. Using the blind hole in the bearing locking collar as an impact point, lock the collar by striking it with a punch in the normal direction of the brush rotation.
 - C. Tighten the set screw in the locking collar.

IMPORTANT: If brush to roller contact is incorrect, brush operation will be adversely affected.

10. Check that the roller brush is parallel to the rear roller within **0.25 mm (0.010 inch) clearance to light contact**. Adjust the roller support or drive plate as necessary.

Replacing the Drive Belt

1. Remove the cover.
2. Loosen the idler pulley assembly from the drive plate to relieve the belt tension.

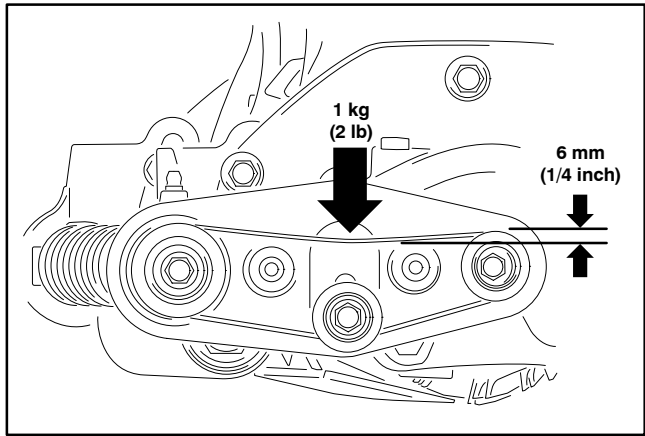


Figure 43

3. Replace the drive belt making sure that the belt and the pulley grooves are aligned and the belt is centered in the pulleys.
4. Push down on the idler pulley and secure it to the drive plate. Make sure the cover plate (item 7 in Fig. 42) is positioned to prevent debris from entering the drive area.
5. The drive belt should deflect approximately **6 mm (1/4 inch) when 1 kg (2 lb)** of force is applied to the belt halfway between the pulleys. Adjust the idler puller as necessary.

Drive and Support Components

Refer to Fig. 42 for this procedure.

1. Disassemble the roller brush components as necessary. Retrieve and discard the drive plate O-ring.
2. Clean and inspect all components for wear or damage and replace as necessary.
3. If the pulley driver (item 4 in Fig. 42) requires replacement (machines without a belt driven groomer):
 - A. Tip up the cutting unit to access the bottom of the reel to remove the pulley driver.
 - B. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT: To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- C. Move the pry bar against the welded side of the reel support plate closest to the rear roller brush pulley driver.

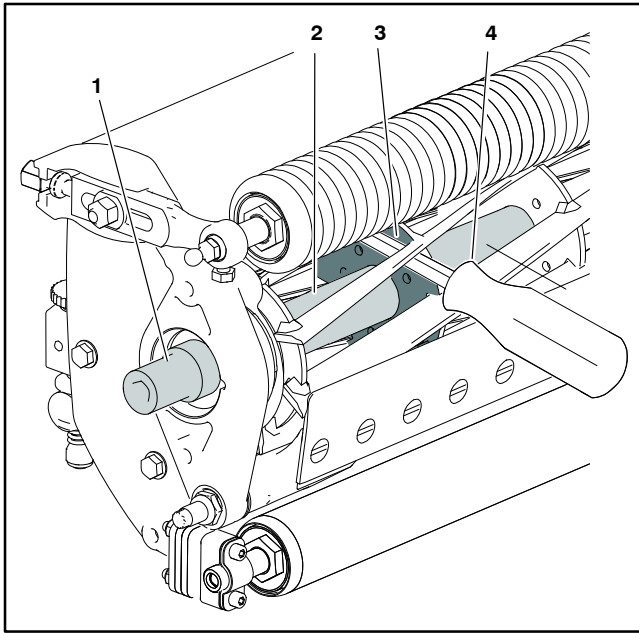


Figure 44

- | | |
|------------------|---------------------------------|
| 1. Pulley driver | 3. Welded side of support plate |
| 2. Reel shaft | 4. Pry bar |

IMPORTANT: The pulley driver and drive adapter have left-hand threads. Turn the pulley driver or drive adapter clockwise to loosen.

D. Rest the handle of the pry bar against the front roller and loosen the pulley driver.

E. Tip the cutting unit back onto its rollers.

F. Clean the threads in the end of the reel shaft. A left-hand thread tap is available to clean or repair the threads if necessary; refer to Reel Thread Repair Taps in the Special Tools section of this chapter.

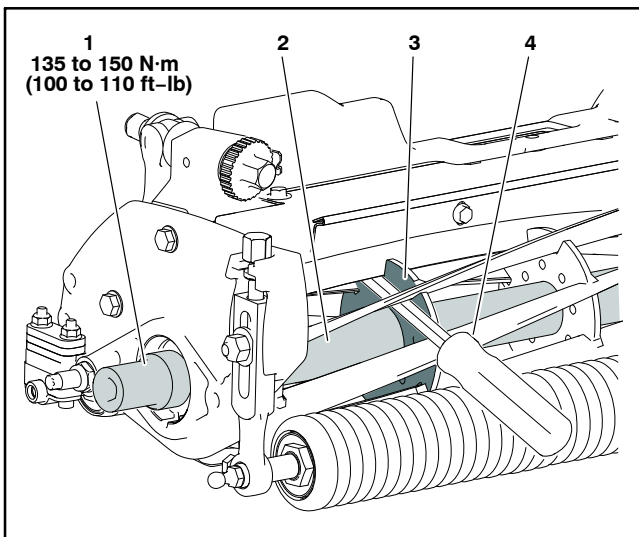


Figure 45

- | | |
|------------------|---------------------------------|
| 1. Pulley driver | 3. Welded side of support plate |
| 2. Reel shaft | 4. Pry bar |

G. To install the pulley driver, insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

H. Move the pry bar against the weld side of the reel support plate closest to the pulley driver.

IMPORTANT: The pulley driver and drive adapter have left-hand threads. Turn the pulley driver or drive adapter counterclockwise to tighten.

I. Rest the handle of the pry bar against the front roller and tighten the pulley driver from **135 to 150 N·m (100 to 110 ft-lb)**.

4. For machines without a belt driven groomer, install the counterweight.

Note: The screws used to secure the cover, driven pulley and the front of the drive plate have a locking feature to prevent the screws from loosening. If the original screws are being re-used, apply a medium strength thread locker (Loctite #242 or equivalent).

5. For machines with a belt driven groomer, apply a light coating of grease to a new drive plate O-ring and install the O-ring and the drive plate.

6. Install the roller brush with the bearings and locking collars loose on the brush shaft.

7. Install the driven pulley and key. Tighten the flange head screw from **15 to 16 N·m (130 to 140 in-lb)**.

8. Install the brush support.

9. Install the drive pulley. Apply anti-seize lubricant the cap screw threads and tighten from **8 to 9 N·m (70 to 80 in-lb)**.

IMPORTANT: The brush drive belt may fail prematurely if the pulleys are not properly aligned.

10. Using a straight edge, move the roller brush as necessary to align the pulleys.

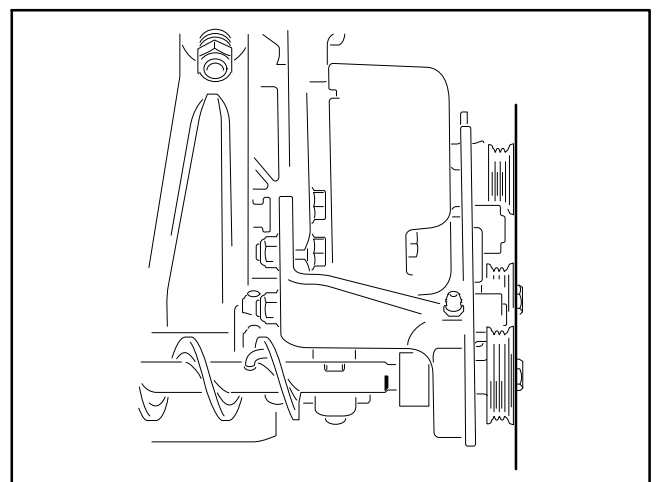


Figure 46

11. Tighten the roller brush bearing locking collars.

A. Slide the locking collars outward onto the bearing collars. Rotate the locking collars by hand in the direction of normal brush rotation until the collars are tight on the shaft.

B. Using the blind hole in the bearing locking collar as an impact point, lock each collar by striking it with a punch in the normal direction of the brush rotation.

C. Tighten the set screw in the locking collars to secure the bearing assembly to the brush shaft.

D. Check the brush assembly for end-play and adjust the bearings if necessary.

IMPORTANT: If brush to roller contact is incorrect, brush operation will be adversely affected.

12. Check that the roller brush is parallel to the rear roller within **0.25 mm (0.010 inch) clearance to light contact**. Adjust the roller support or drive plate as necessary.

13. Install and adjust the drive belt and install the cover.

14. Lubricate the grease fittings on the brush support and the drive plate until grease is visible. Wipe up any excess grease.

Servicing the Rear Roller Brush (with or without a universal groomer)

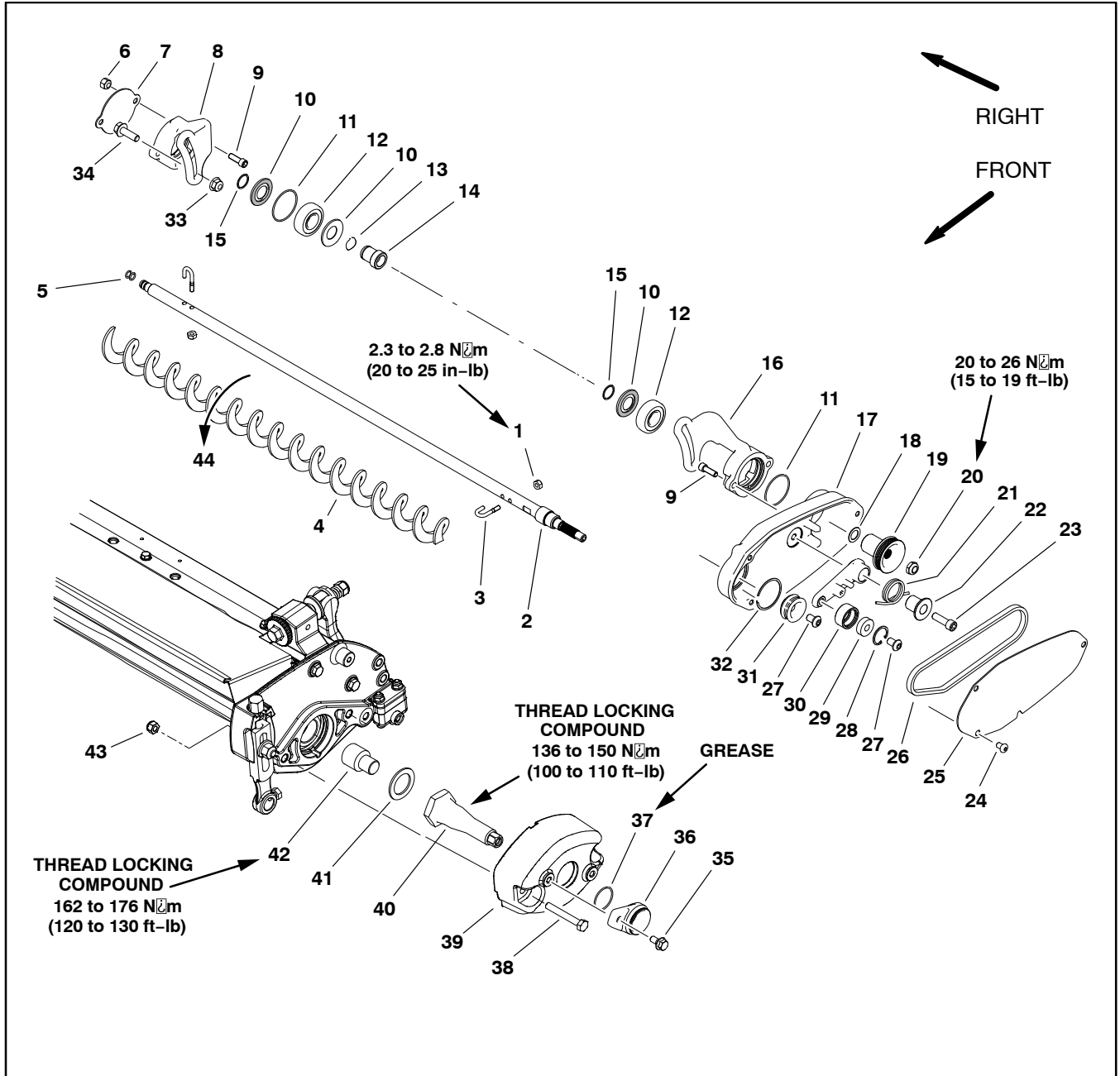


Figure 47
(shown without Universal Groomer installed)

- | | | |
|-------------------------------|--------------------------------|---|
| 1. Lock nut (2 used) | 16. Bearing bracket LH | 31. Drive pulley |
| 2. Brush shaft | 17. Drive housing | 32. Retaining ring |
| 3. J-bolt (2 used) | 18. Spacer (as required) | 33. Flange nut (4 used) |
| 4. Brush element | 19. Driven pulley | 34. Flange head screw (4 used) |
| 5. O-ring (2 used) | 20. Lock nut | 35. Flange head screw |
| 6. Lock nut (2 used) | 21. Torsion spring | 36. Adapter housing
(used without groomer) |
| 7. Cover | 22. Idler bushing | 37. O-ring |
| 8. Bearing bracket RH | 23. Socket head screw | 38. Cap screw (2 used) |
| 9. Socket head screw (4 used) | 24. Socket head screw (3 used) | 39. Weight |
| 10. Flocked seal (3 used) | 25. Cover | 40. Drive shaft (used without groomer) |
| 11. O-ring (2 used) | 26. Drive belt | 41. Shim (used without groomer) |
| 12. Bearing (2 used) | 27. Socket head screw (2 used) | 42. Drive adapter (used without groomer) |
| 13. Retaining ring | 28. Retaining ring | 29. Bearing |
| 14. Collar | 30. Idler pulley | 43. Lock nut (2 used) |
| 15. Retaining ring (2 used) | | 44. Direction of brush rotation |

Drive components for the rear roller brush are located on the opposite side of the cutting unit from the hydraulic cutting reel motor. Figure 47 shows components used when the brush drive is on the left side of the cutting unit.



CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

Replacing the Roller Brush Element

Refer to Fig. 47 for this procedure.

1. Remove the cutting unit from the machine and place it on a level work surface.
2. Remove the RH bearing bracket assembly.
3. Remove the brush element from the shaft.
4. Slide the new brush element onto the shaft while rotating the brush.
5. Install the J-bolts and lock nuts making sure the threaded portion of the J-bolts are installed on the outside of the brush element. Tighten the lock nuts from **2.3 to 2.8 N·m (20 to 25 in-lb)**.
6. Apply a thin coating of grease to the O-rings on the brush shaft and install the RH bearing bracket.

IMPORTANT: If brush to roller contact is incorrect, brush operation will be adversely affected.

7. Check that the roller brush is parallel to the rear roller within **0.25 mm (0.010 inch) clearance to light contact**. Adjust the bearing brackets as necessary.

Drive and Support Components

Refer to Fig. 47 for this procedure.

1. Disassemble the roller brush components as necessary. Retrieve and discard the adapter housing O-ring (machines without a universal groomer).
2. Clean and inspect all components for wear or damage and replace as necessary.
3. If the drive shaft and drive adapter (items 40 or 42) require replacement (machines without a universal groomer):

A. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.

IMPORTANT: To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

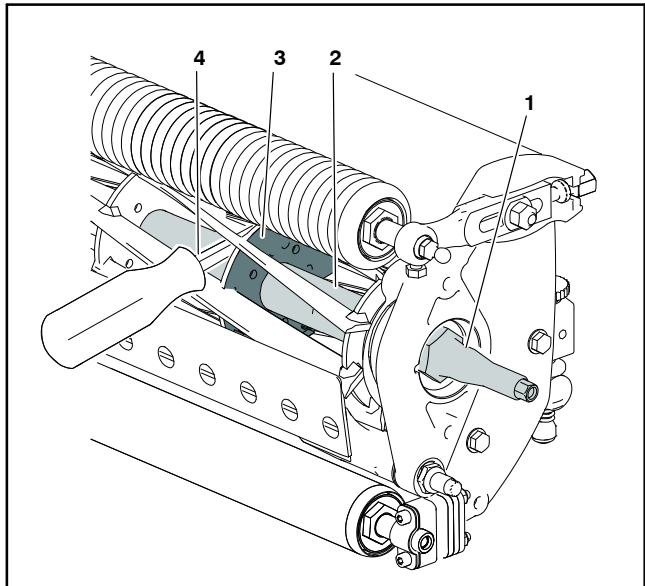


Figure 48

- | | |
|-------------------------|--|
| 1. Drive shaft assembly | 3. Unwelded side of reel support plate |
| 2. Reel shaft | 4. Pry bar |

B. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

C. Move the pry bar against the weld side of the reel support plate closest to the rear roller brush drive shaft.

IMPORTANT: The drive shaft and drive adapter have left-hand threads. Turn the drive shaft or drive adapter clockwise to loosen.

D. Rest the handle of the pry bar against the front roller and use the large hex (1.375 inch) to loosen the drive shaft assembly.

E. For groomer gear boxes installed on the left side of the cutting unit, retrieve the shim (item 41 in Fig. 47).

F. Tip the cutting unit back onto its rollers.

G. Clean the threads in the end of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to Reel Thread Repair Taps in the Special Tools section of this chapter.

H. For groomer gear boxes installed on the left side of the cutting unit, install the shim. Assemble the drive shaft and drive adapter (machines without a universal groomer) with a medium strength thread locking compound (Loctite 243 or equivalent) and tighten from **150 to 163 N·m (110 to 120 ft-lb)**.

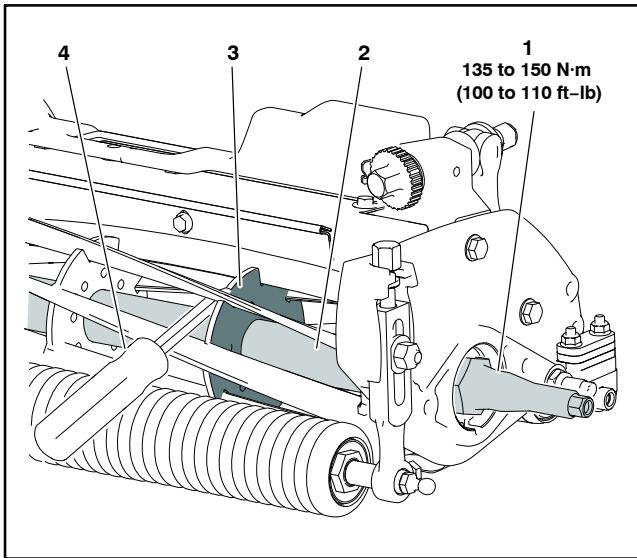


Figure 49

- | | |
|-------------------------|--|
| 1. Drive shaft assembly | 3. Unwelded side of reel support plate |
| 2. Reel shaft | 4. Pry bar |

I. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

J. Move the pry bar against the weld side of the reel support plate closest to the drive shaft assembly.

IMPORTANT: The drive shaft and drive adapter have left-hand threads. Turn the drive shaft or drive adapter counterclockwise to tighten.

K. Rest the handle of the pry bar against the front roller. Use the large hex (1.375 inch) and tighten the drive shaft from **135 to 150 N·m (100 to 110 ft·lb)**.

4. For units without a universal groomer, install the counterweight.

Note: The screw used to secure the adapter housing has a locking feature to prevent the screw from loosening. If the original screw is being re-used, apply a medium strength thread locker (Loctite #242 or equivalent).

5. Install and apply a light coating of grease to a new O-ring and install the adapter housing (machines without a universal groomer).

6. Install the drive housing and LH bearing bracket.

7. Apply a thin coating of grease to the O-rings on the brush shaft and fit the RH bearing bracket over the brush shaft.

Note: Install all flocked seals with the flocked surface against the bearing.

8. Install a flocked seal and the retaining ring onto the brush shaft.

9. Install the brush and RH bearing bracket assembly.

10. Install the drive pulley.

IMPORTANT: The brush drive belt may fail prematurely if the pulleys are not properly aligned.

11. Using a straight edge, determine the number of spacers necessary under the driven pulley to align the pulleys. Tighten the lock nut securing the driven pulley from **20 to 26 N·m (15 to 19 ft·lb)**.

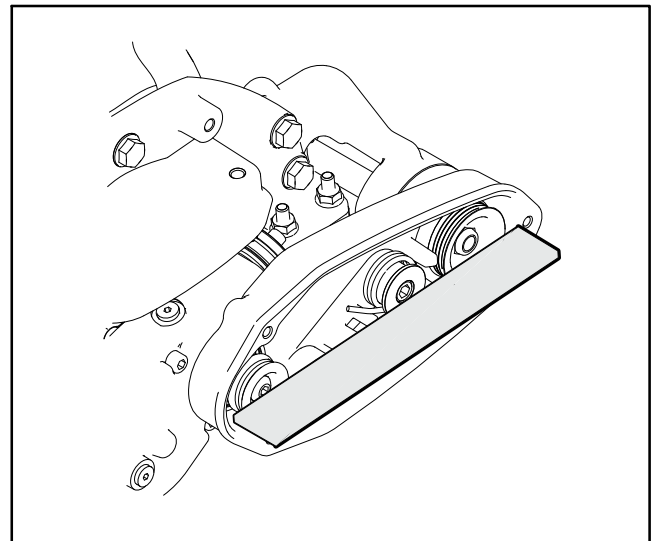


Figure 50
(shown with universal groomer installed)

12. Install and adjust the drive belt and install the cover.

IMPORTANT: If brush to roller contact is incorrect, brush operation will be adversely affected.

13. Check that the roller brush is parallel to the rear roller within **0.25 mm (0.010 inch) clearance to light contact**. Adjust the bearing brackets as necessary.

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Belt Driven Groomer (Optional)

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Specifications

Belt Driven Groomer (Optional)

Item	Description
Grooming reel diameter	6 cm (2.375 inches)
Groomer blade type	<p>Spring Steel: 42 steel blades with 1/2 inch blade spacing.</p> <p>Carbide: 42 steel blades with 1/2 inch blade spacing.</p> <p>Thin blade: 82 steel blades with 1/4 inch blade spacing.</p> <p>A soft or stiff groomer brush can be installed in place of the grooming reel.</p>
Groomer mounting	The groomer is mounted to the cutting unit side plates. The drive assembly for the grooming reel is located on the opposite side of the cutting unit from the hydraulic cutting reel motor.
Groomer height setting	<p>Mowing: 0.8 to 15.7 mm (0.030 to 0.620 inch).</p> <p>HOC range: 1.5 to 19.1 mm (0.060 to 0.750 inch).</p>
Width-of-groomer	49.2 cm (19.38 inches).
Height adjustment knob	Allows a 0.003 inch (0.08 mm) increment of height adjustment for each click of the adjuster.
Quick-up feature	Allows grooming reel to be raised above the height/depth adjustment for no grooming reel action while mowing.
Groomer drive	The groomer drive assembly is attached to the right side of the cutting unit.

General Information

Installation Instructions

The *Installation Instructions* for the groomer provides information regarding the set-up, operation, general maintenance procedures, and maintenance intervals for the groomer assembly on your Greensmaster machine. Refer to the *Installation Instructions* for additional information when servicing the groomer assembly.

Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT

Improper or overaggressive use of the groomer (e.g., too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. Read and understand the groomer operation instructions before operating or testing the groomer performance.

It is important to remember that the same factors that affect quality of cut also affect grooming performance.

Variables that Affect the Use and Performance of the Groomer:

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting—number of cuttings per week and how many passes per cutting.
4. The height-of-cut.
5. The grooming depth.
6. The type of grass.
7. The amount of time that a groomer reel has been in use on a particular turf area.
8. The amount of traffic on the turf.
9. The overall turf management program—irrigation, fertilizing, weed control, coring, over-seeding, sand dressing, disease control, and pest control.
10. Stress periods for turf—high temperatures, high humidity, and unusually high traffic.

Troubleshooting

Problem	Possible Causes	Correction
The groomer reel does not rotate.	Seized grooming reel or idler bearing(s) in groomer side plate(s).	Identify and replace faulty bearing(s).
	Broken or damaged drive belt idler spring.	Replace idler .
	The groomer drive 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 is set too aggressively.	Refer to groomer Installation Instructions for groomer set-up information.
	The groomer reel blades are bent, damaged, or missing.	Repair or replace the blades if necessary.
	The groomer reel shaft is bent or damaged.	Replace the groomer reel shaft.
	Grooming depth is not equal on both ends of the groomer reel.	Adjust the depth if necessary. Check and adjust the cutting unit set up (level bed knife to reel, level rear roller to reel, set the height-of-cut, etc.).

Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some of these tools may have been supplied with your machine, are available as Toro parts, or may also be available from a local tool supplier.

Reel Thread Repair Taps

**15/16–16 Right-Hand Thread –
Toro Part No. 137–0926**

**15/16–16 Left-Hand Thread – Toro
Part No. 137–0927**

Use to clean or repair the internal
threads of cutting unit reels.

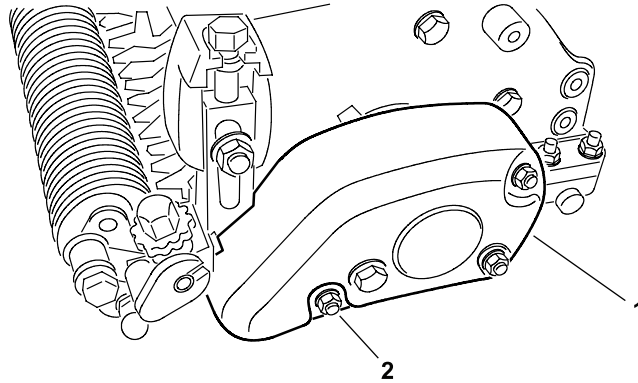


Service and Repairs

The groomer drive assembly is located on the opposite side of the cutting unit from the cutting unit hydraulic motor.

Replacing the Groomer Drive Belt

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, stop the engine, engage the parking brake and remove the key from the ignition switch.
2. If equipped, remove rear roller brush from cutting unit; refer to Servicing the Rear Roller Brush (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual.

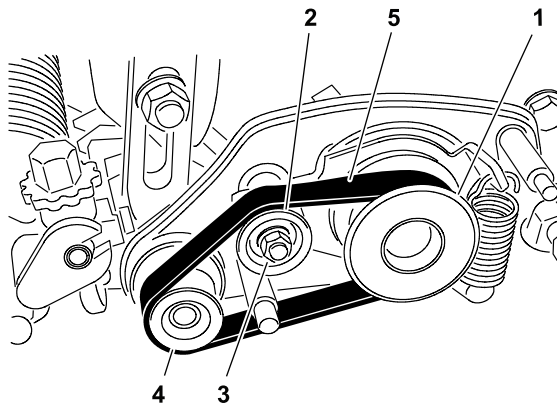


g229353

Figure 1

1. Groomer drive cover
2. Lock nut (3 each)

-
3. Remove the three lock nuts that secure the groomer drive cover, then remove the cover.



g229352

Figure 2

1. Drive pulley
2. Idler pulley
3. Idler pulley nut
4. Driven pulley
5. Groomer drive belt

-
4. Pivot the idler pulley by placing a 12 mm wrench on the pulley nut and rotating the idler bracket to relax the belt tension. Slip the groomer drive belt off the pulleys and carefully release the idler bracket.

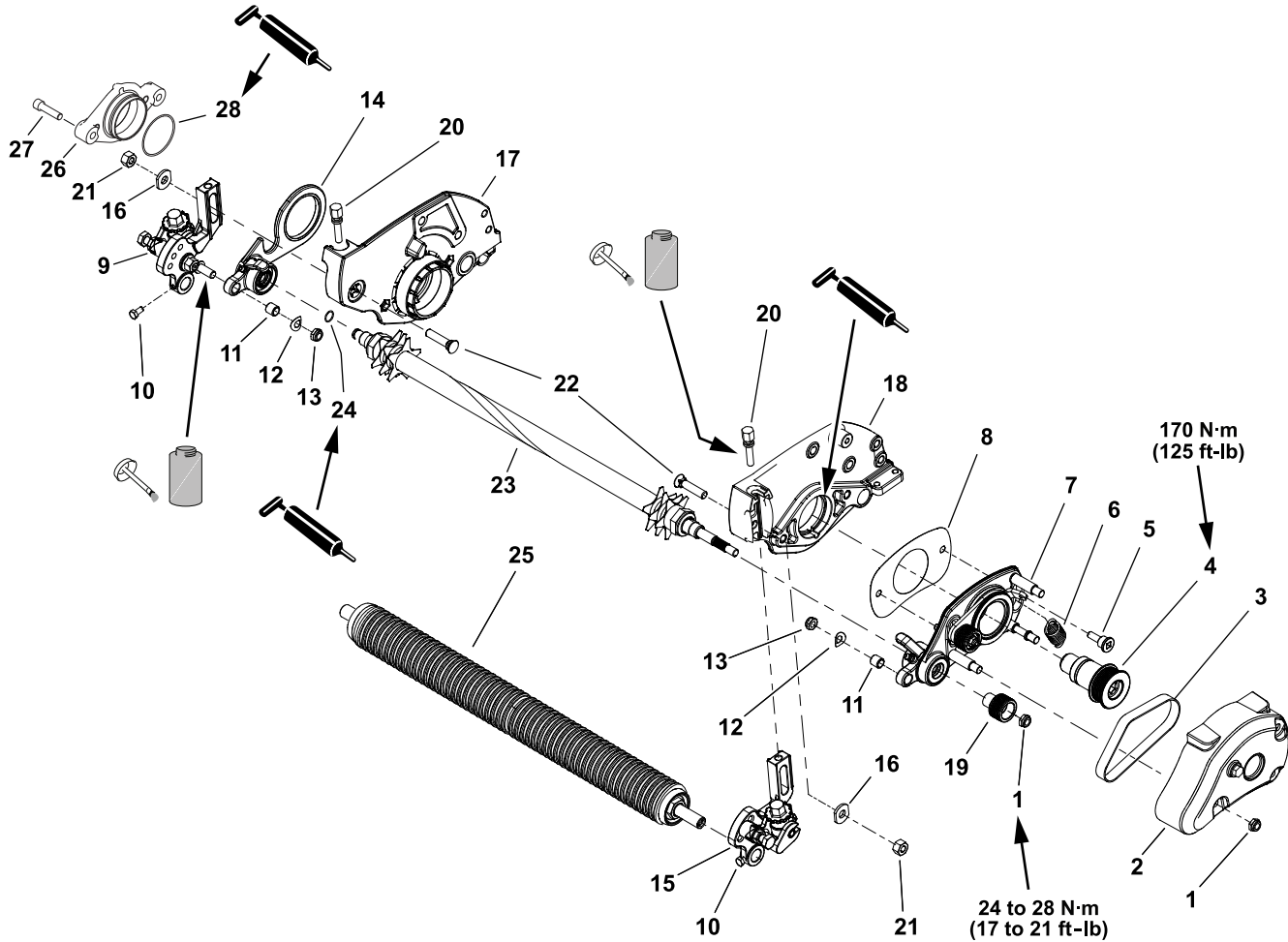
Replacing the Groomer Drive Belt (continued)

IMPORTANT

Make sure that the drive belt is centered on the pulleys and correctly aligned with pulley grooves after installation.

5. Install a new drive belt to the drive pulley, idler pulley and the driven pulley observing correct belt routing.
6. Secure the belt cover to the machine with three lock nuts.
7. If equipped, install the rear roller brush to the cutting unit; refer to Servicing the Rear Roller Brush (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual.

The Groomer Plate Assemblies



g229416

Figure 3

- | | | |
|---------------------------|-------------------------------------|--------------------------------|
| 1. Lock nut (4 each) | 11. Bushing (2 each) | 21. Lock nut (2 each) |
| 2. Drive cover | 12. Spring washer (2 each) | 22. Plow bolt (2 each) |
| 3. Drive belt | 13. Lock nut (2 each) | 23. Grooming reel assembly |
| 4. Drive pulley | 14. Support plate assembly | 24. O-ring |
| 5. Shoulder bolt (2 each) | 15. Groomer arm – LH | 25. Front roller assembly |
| 6. Extension spring | 16. Tabbed washer (2 each) | 26. Motor adapter |
| 7. Drive plate assembly | 17. Cutting unit side plate – RH | 27. Socket head screw (2 each) |
| 8. Shim | 18. Cutting unit side plate – LH | 28. O-ring |
| 9. Groomer arm – RH | 19. Driven pulley | |
| 10. Pinch bolt (2 each) | 20. Height adjustment bolt (2 each) | |

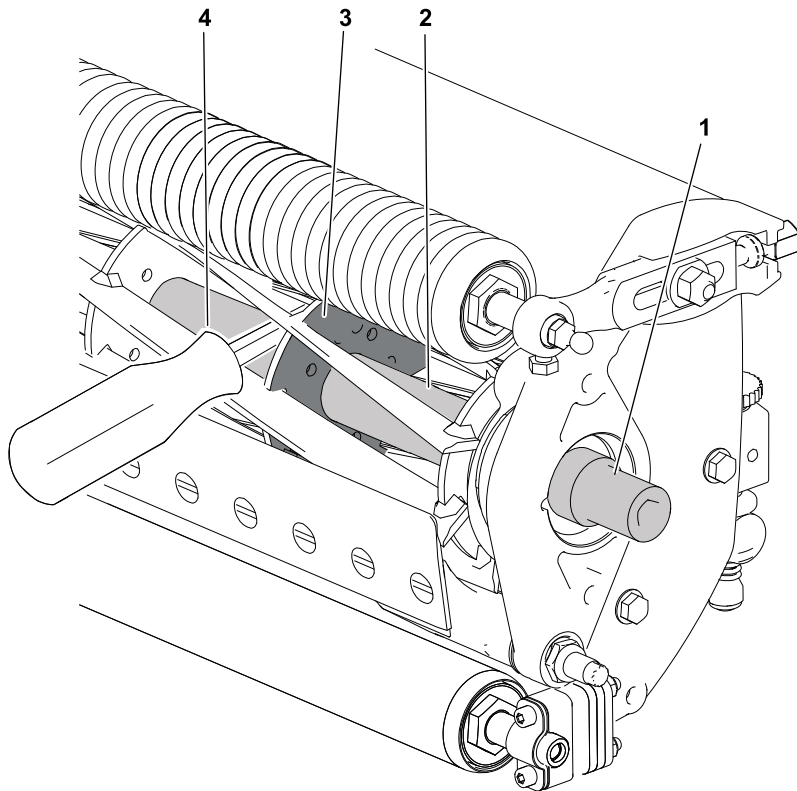
Removing the Drive Plate

Refer to [Figure 3](#) for this procedure.

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, stop the engine, engage the parking brake and remove the key from the ignition switch.
2. Remove the cutting unit from the machine and place cutting unit on a flat work surface.
3. If equipped, remove rear roller brush from cutting unit; refer to Servicing the Rear Roller Brush (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual.

Removing the Drive Plate (continued)

4. Remove the groomer drive cover and drive belt.
5. Loosen and remove the drive pulley from the cutting reel:
 - A. Tip up the cutting unit to access the bottom of the reel.



g325691

Figure 4

- | | |
|-----------------|--|
| 1. Drive pulley | 3. Unwelded side of reel support plate |
| 2. Reel shaft | 4. Pry bar |

-
- B. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- C. Move the pry bar against the weld side of the reel support plate closest to the drive pulley.

IMPORTANT

If the groomer drive assembly is installed on the left side of the cutting unit, the drive pulley has left-hand threads. Turn the pulley driver or drive adapter clockwise to loosen. If the groomer drive assembly is installed on the right side of the cutting unit, the drive pulley has right-hand threads. Turn the pulley driver or drive adapter counterclockwise to loosen.

- D. Rest the handle of the pry bar against the front roller and loosen the drive pulley.
 - E. Tip the cutting unit back onto its rollers.
 - F. Clean the threads in the end of the reel shaft. A left-hand thread tap and right-hand thread tap is available to clean or repair the threads if necessary; refer to [Reel Thread Repair Taps \(page 8–5\)](#).
6. Loosen pinch bolts that secure the front roller shaft to the groomer arms.

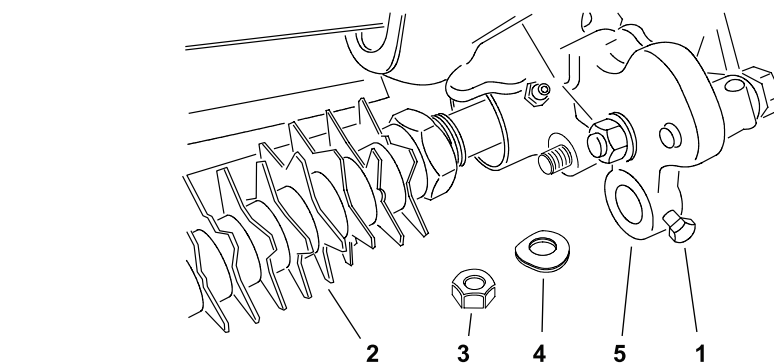


Figure 5

- | | | |
|-----------------|------------------|---------------------|
| 1. Pinch bolt | 3. Lock nut | 5. Groomer arm – LH |
| 2. Groomer reel | 4. Spring washer | |

7. Remove the lock nut and spring washer that secure the LH groomer arm to the drive plate assembly.
- Note:** To speed cutting unit setup after installing the groomer reel, do not change the height adjustment bolt or the groomer adjuster setting.
8. Remove the lock nut, special washer and plow bolt that secure the LH groomer arm assembly to the cutting unit side plate.
9. Remove the LH groomer arm and the front roller from the cutting unit.
10. Using the flats provided on the groomer reel shaft to prevent the groomer reel from turning, remove the locknut that secures the driven pulley to the groomer reel and remove the driven pulley.

Removing the Drive Plate (continued)

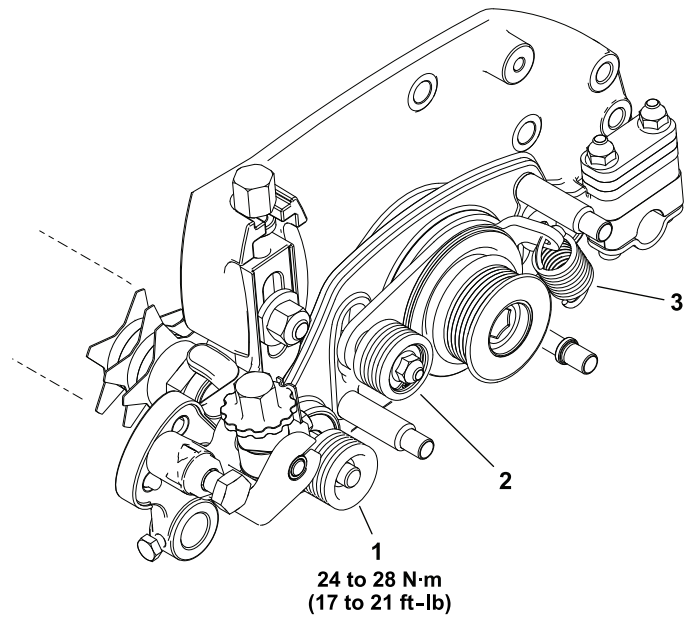


Figure 6

1. Driven pulley
2. Idler pulley
3. Idler arm extension spring

11. Remove the idler arm extension spring.
12. Remove the two shoulder bolts that secure the drive plate assembly to the cutting unit and remove the groomer drive plate assembly. Locate and retrieve the shim.
13. Inspect the seals, bushings and bearings in the drive plate, support plate and groomer arms for wear or damage. Replace components as needed.

Removing the Support Plate

Refer to [Figure 3](#) for this procedure.

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, stop the engine, engage the parking brake and remove the key from the ignition switch.
2. Remove the cutting unit from the machine and place cutting unit on a flat work surface.
3. If equipped, remove rear roller brush from cutting unit; refer to Servicing the Rear Roller Brush (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual.
4. Loosen pinch bolts that secure the front roller shaft to the groomer arms.

Removing the Support Plate (continued)

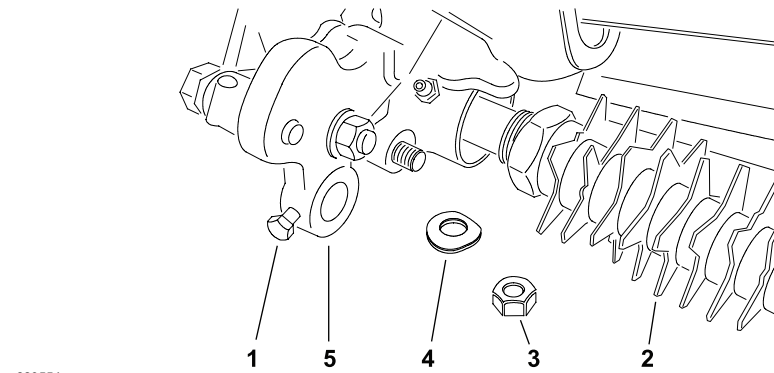
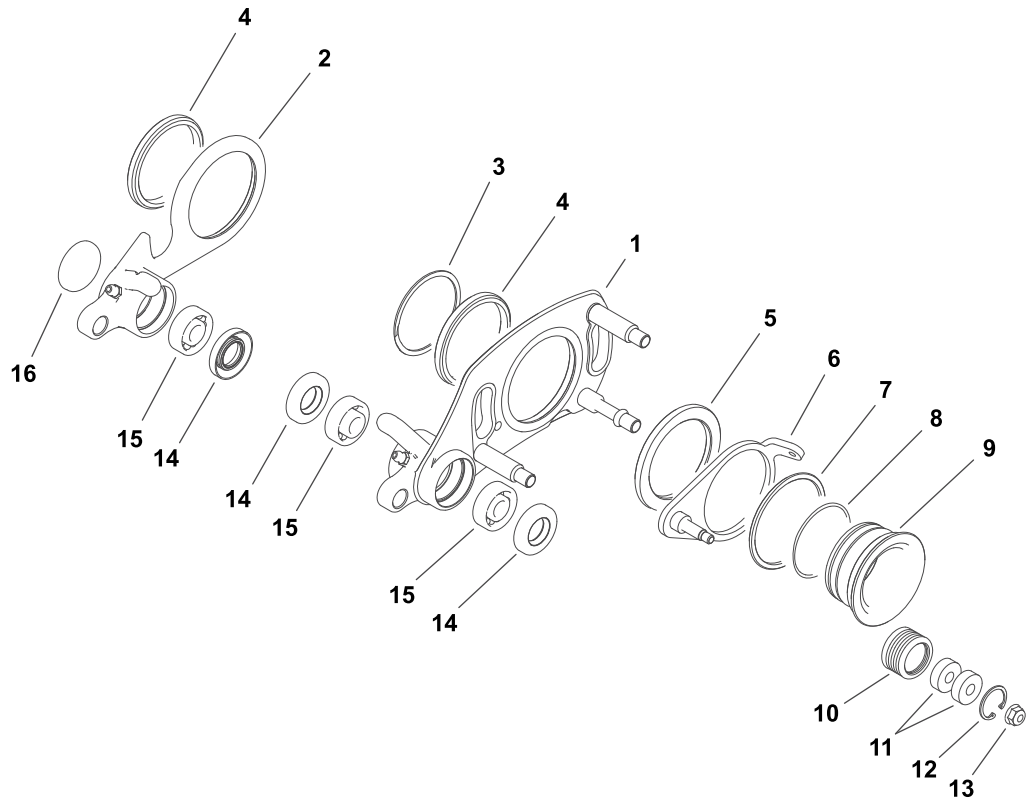


Figure 7

- | | |
|-----------------|---------------------|
| 1. Pinch bolt | 4. Spring washer |
| 2. Groomer reel | 5. Groomer arm – RH |
| 3. Lock nut | |
-
5. Remove the lock nut and spring washer that secure the RH groomer arm to the drive plate assembly.
Note: To speed cutting unit setup after installing the groomer reel, do not change the height adjustment bolt or the groomer adjuster setting.
 6. Remove the lock nut, tabbed washer and plow bolt that secure the RH groomer arm assembly to the cutting unit side plate.
 7. Remove the RH groomer arm and the front roller from the cutting unit.
 8. Remove the motor adapter and support plate.

Servicing the Drive and Support Plates



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Figure 8

- | | |
|---------------------|----------------------------|
| 1. Drive plate | 9. Reel hub |
| 2. Support plate | 10. Idler pulley |
| 3. Retaining ring | 11. Bearing (2 each) |
| 4. Bushing (2 each) | 12. Retaining ring |
| 5. Spacer | 13. Flange nut |
| 6. Idler arm | 14. Shaft seal (3 each) |
| 7. Spacer | 15. Shaft bearing (3 each) |
| 8. O-ring | 16. Expansion plug |

1. Remove the retaining ring and separate the reel hub, spacers and idler arm from the drive plate.
2. Replace idler pulley bearings if necessary.
3. Remove and discard the O-ring and the groomer shaft seals.

Note: Remove the expansion plug from the support plate to access the groomer shaft bearing.
4. Remove and discard the groomer shaft bearings.
5. Clean and inspect bearing bores in the drive and support plates. Inspect the drive and support plate bushings and replace as necessary.

Servicing the Drive and Support Plates (continued)

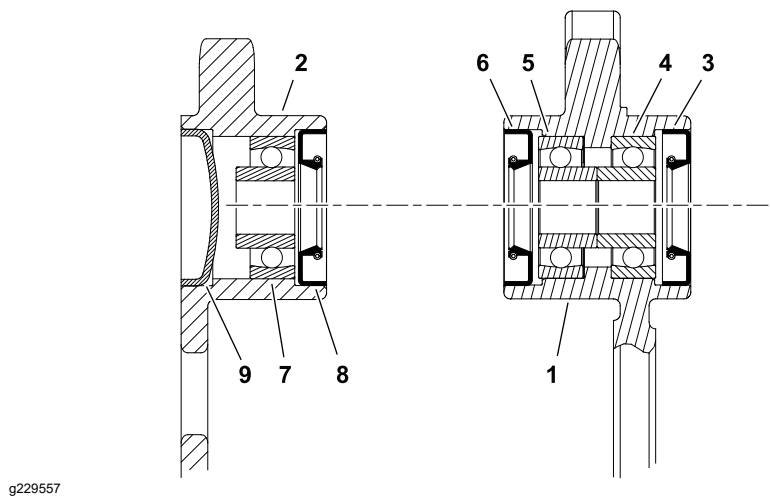


Figure 9

- | | |
|---------------------|---------------------|
| 1. Drive plate | 6. Inner shaft seal |
| 2. Support plate | 7. Bearing |
| 3. Outer shaft seal | 8. Seal |
| 4. Outer bearing | 9. Expansion plug |
| 5. Inner bearing | |

IMPORTANT

Bearings should be installed with extended inner races toward center of plate. Apply pressure equally to inner and outer bearing races when installing bearings. Seals should be installed with the face of the seal toward the outside of the plate.

6. Install new groomer shaft bearings and seals:
 - A. Press the outer bearing fully to the shoulder of the drive plate bore. Install the outer shaft seal as shown.
 - B. Press the inner bearing into the drive plate until the inner race contacts the outer bearing. Install the inner shaft seal as shown.
 - C. Press the bearing into the support plate until it is flush with shoulder of the bearing bore. Install the shaft seal and the expansion plug as shown.
7. Assemble the reel hub, spacers and idler arm to the drive plate and install the retaining ring.
8. Install a new O-ring on the reel hub.

Installing the Support Plate

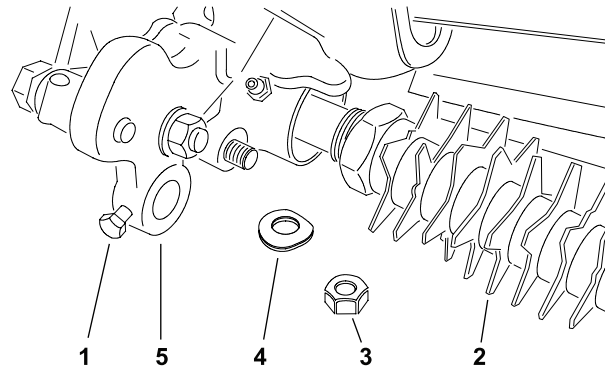
Refer to [Figure 3](#) for this procedure.

1. Fit the support plate over the motor adapter.
2. Apply a light coating of grease to the support plate end of the groomer reel shaft and to the seal lip in the support plate.
3. Apply a light coating of grease to the O-ring on the motor adapter and the pilot bore of the cutting unit side plate.
4. Carefully fit the support plate and motor adapter onto the groomer shaft and into the pilot bore of the cutting unit side plate. Secure the motor adapter to

Installing the Support Plate (continued)

the cutting unit side plate with two socket head screws and lock nuts. Make sure the groomer reel and the support plate rotate freely after installation.

5. Insert the front roller into the LH groomer arm.
6. Install the RH groomer arm:
 - A. Apply anti-seize lubricant to the shoulder of the groomer arm lift rod.
 - B. Position the groomer arm over the front roller, through the support plate bushing and against the cutting unit side plate. Make sure the cutting unit side plate fits between the height adjustment bolt head and shoulder.
 - C. Secure the groomer arm to the cutting unit side plate with the plow bolt, special washer and lock nut.



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Figure 10

- | | |
|-----------------|---------------------|
| 1. Pinch bolt | 4. Spring washer |
| 2. Groomer reel | 5. Groomer arm – RH |
| 3. Lock nut | |

-
- D. Secure the groomer arm to the drive plate with the spring washer and lock nut.
 7. Center the front roller in the cutting unit and tighten both pinch bolts.
 8. If equipped, install rear roller brush to cutting unit; refer to *Servicing the Rear Roller Brush* (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual).
 9. Check and adjust cutting unit height-of-cut and groomer height settings; refer to the *Cutting Unit Operators Manual* and the *Groomer Installation Instructions*.
 10. Lubricate the groomer bearings; refer to the *Groomer Installation Instructions*.

Note: After greasing the groomer bearings, operate the groomer for 30 seconds, stop the machine and wipe any excess grease from the groomer shaft and seals.

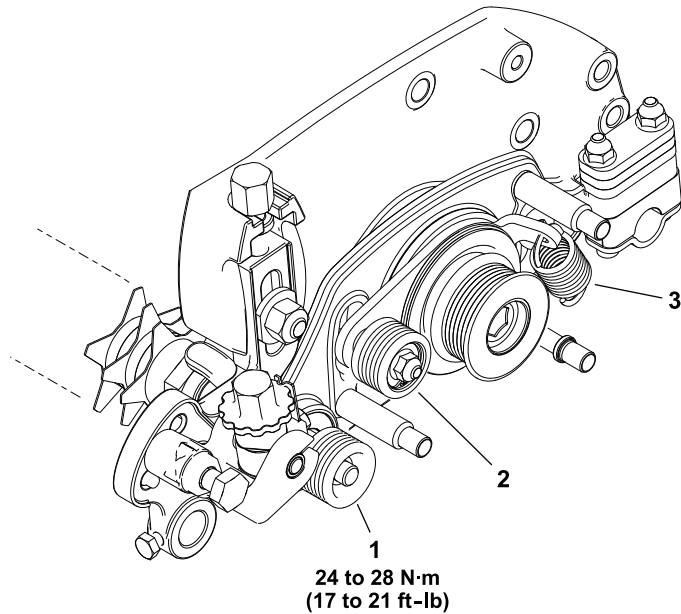
Installing the Drive Plate

Refer to [Figure 3](#) for this procedure.

1. Make sure that all drive plate bearings, bushings and seals are in good condition and properly installed.
2. Apply a light coating of grease to the drive end of the groomer reel shaft and to the seal lips in the drive plate.
3. Position the shim on the drive plate assembly.
4. Apply a light coating of grease to the O-ring on the drive plate pivot hub and the pilot bore of the cutting unit side plate.

Installing the Drive Plate (continued)

5. Carefully fit the drive plate assembly onto the groomer shaft and into the pilot bore of the cutting unit side plate. Secure the drive plate to the cutting unit side plate with two shoulder bolts. Make sure the groomer reel, the drive plate and the idler arm rotate freely after installation.
6. Install the idler arm extension spring.



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Figure 11

- | | |
|------------------|-------------------------------|
| 1. Driven pulley | 3. Idler arm extension spring |
| 2. Idler pulley | |



7. Install the driven pulley and lock nut onto the grooming reel shaft. Using the flats provided on the groomer reel shaft to prevent the groomer reel from turning, tighten the locknut from **24 to 28 N·m (17 to 21 ft-lb)**.
8. Insert the front roller into the RH groomer arm.
9. Install the LH groomer arm:
 - A. Apply anti-seize lubricant to the shoulder of the groomer arm lift rod.
 - B. Position the groomer arm over the front roller, through the drive plate bushing and against the cutting unit side plate. Make sure the cutting unit side plate fits between the height adjustment bolt head and shoulder.
 - C. Secure the groomer arm to the cutting unit side plate with the plow bolt, special washer and lock nut.

Installing the Drive Plate (continued)

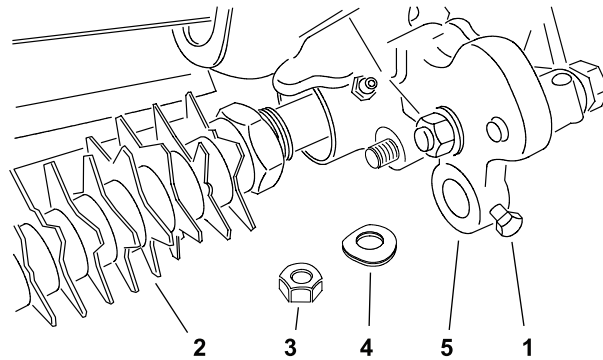


Figure 12

- | | | |
|-----------------|------------------|---------------------|
| 1. Pinch bolt | 3. Lock nut | 5. Groomer arm – LH |
| 2. Groomer reel | 4. Spring washer | |

D. Secure the groomer arm to the drive plate with the spring washer and lock nut.

10. Center the front roller in the cutting unit and tighten both pinch bolts.

11. Install the drive pulley:

A. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

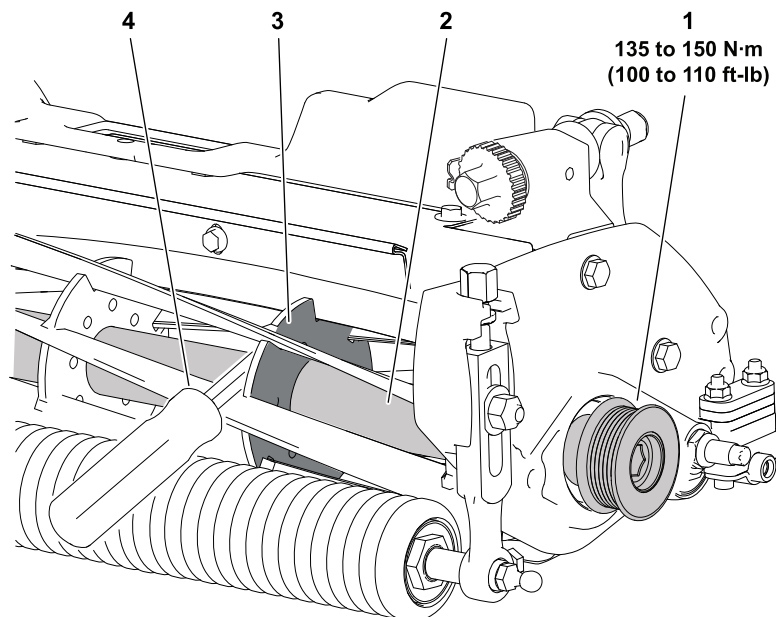


Figure 13

- | | |
|-----------------|--|
| 1. Drive pulley | 3. Unwelded side of reel support plate |
| 2. Reel shaft | 4. Pry bar |

B. Move the pry bar against the weld side of the reel support plate closest to the drive pulley.

IMPORTANT

If the groomer drive assembly is installed on the left side of the cutting unit, the drive pulley has left-hand threads. Turn the drive pulley counterclockwise to tighten. If the groomer drive assembly is installed on the right side of the cutting unit, the drive pulley has right-hand threads. Turn the drive pulley clockwise to tighten.



C. Rest the handle of the pry bar against the front roller and tighten the drive pulley from **135 to 150 N·m (100 to 110 ft-lb)**.

12. Install the groomer drive belt and drive cover.
13. If equipped, install rear roller brush to cutting unit; refer to Servicing the Rear Roller Brush (with or without a belt driven groomer in Chapter 7 – DPA Cutting Unit in this manual.
14. Check and adjust cutting unit height-of-cut and groomer height settings; refer to the *Cutting Unit Operators Manual* and the *Groomer Installation Instructions*.
15. Lubricate the groomer bearings; refer to the *Groomer Installation Instructions*.

Note: After greasing the groomer bearings, operate the groomer for 30 seconds, stop the machine and wipe any excess grease from the groomer shaft and seals.

The Groomer Reel

Removing the Groomer Reel

1. Remove the groomer drive plate; refer to [Removing the Drive Plate \(page 8–8\)](#).
2. Carefully pull the grooming reel from the support plate on the right side of the cutting unit.
3. Retrieve and discard the O-ring from the support plate end of the groomer reel shaft.

Servicing the Groomer Reel

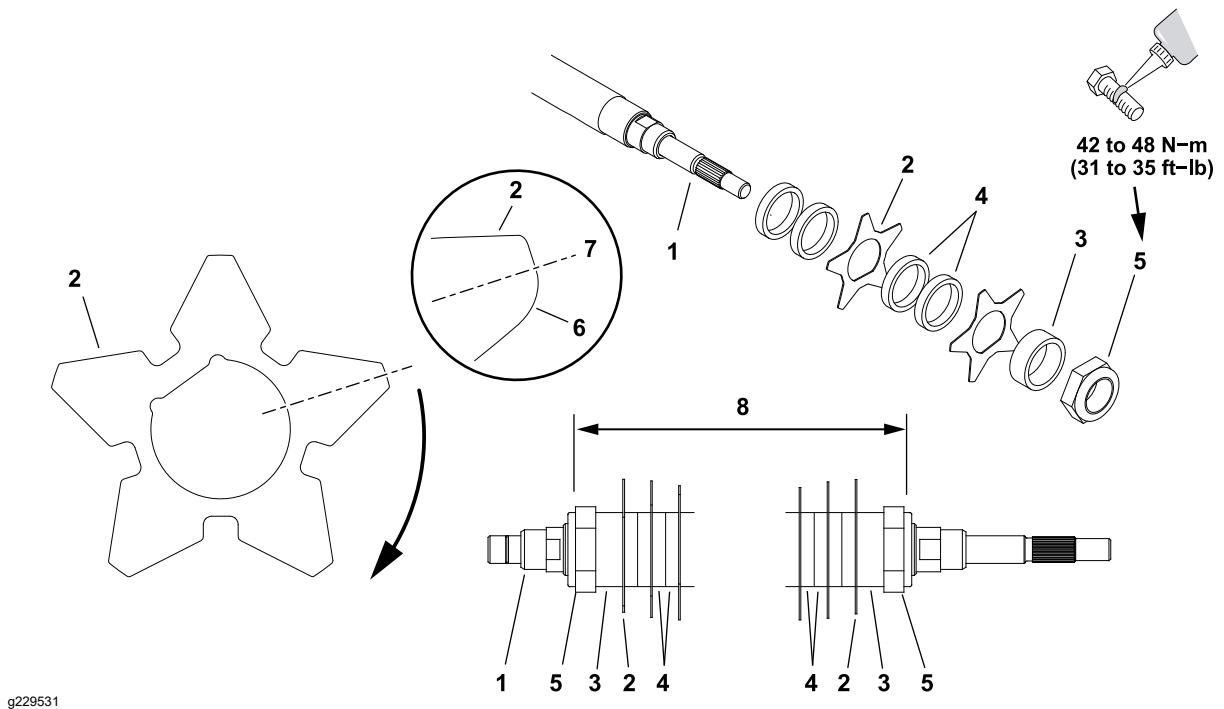


Figure 14

- | | | |
|----------------------------|----------------------------|----------------------|
| 1. Groomer reel shaft | 4. Spacer – thin (82 each) | 7. Midpoint |
| 2. Groomer blade (42 each) | 5. Locknut (2 each) | 8. Centered on shaft |
| 3. Spacer – thick (2 each) | 6. Rounded edge | |

Inspect the groomer reel blades frequently for any damage and wear. Straighten the bent blades. Either replace the worn blades or reverse the individual blades to put the sharpest blade edge forward. The blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance: refer to [Figure 14](#).

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the groomer reel from the cutting unit; refer to [Removing the Groomer Reel \(page 8–19\)](#).
3. Remove the lock nut from either end of the groomer reel shaft.
4. Remove the blades and from the groomer shaft. If necessary, remove second lock nut from the shaft.
5. Inspect and replace worn or damaged components.
6. Assemble the groomer reel as follows:

Servicing the Groomer Reel (continued)

Note: New lock nuts have an insert to prevent the lock nut from loosening. If a used lock nut is being installed, apply a medium strength thread locker (Loctite #242 or equivalent) to the threads of the lock nut.

- A. Install a lock nut on one end of the groomer reel shaft.
- B. Install a single 12 mm (0.46 inch) spacer against the lock nut. Then, place the first blade against the spacer installed.

Note: For standard 13 mm (1/2 inch) spacing, fit two 5.6 mm (0.22 inch) spacers between each blade.

- C. Install the remaining spacers and blades in an alternating manner making sure that all blades are separated by one or more spacers.
- D. When all the blades have been installed, install the second lock nut onto the shaft. Center the blades and spacers on the shaft by adjusting the lock nuts.



- E. Use the flats provided on the groomer reel shaft to prevent the shaft from rotating and tighten the second lock nut to **42 to 48 N·m (31 to 35 ft-lb)**. After tightening the lock nut, spacers should not be free to rotate and the groomer blades should be centered on the shaft.

7. Install the groomer reel back onto the cutting unit; refer to [Installing the Groomer Reel \(page 8–20\)](#).

Installing the Groomer Reel

1. Make sure that all support plate bearings, bushings and seals are in good condition and properly installed.
2. Install a new O-ring on the support plate end of the groomer reel shaft.
3. Apply a light coat of grease to the O-ring, the support plate end of the groomer reel shaft and to the seal lip in the support plate.
4. Carefully fit the groomer reel into the support plate.
5. Install the groomer drive plate; refer to [Installing the Drive Plate \(page 8–15\)](#).

The Groomer Arm Assemblies

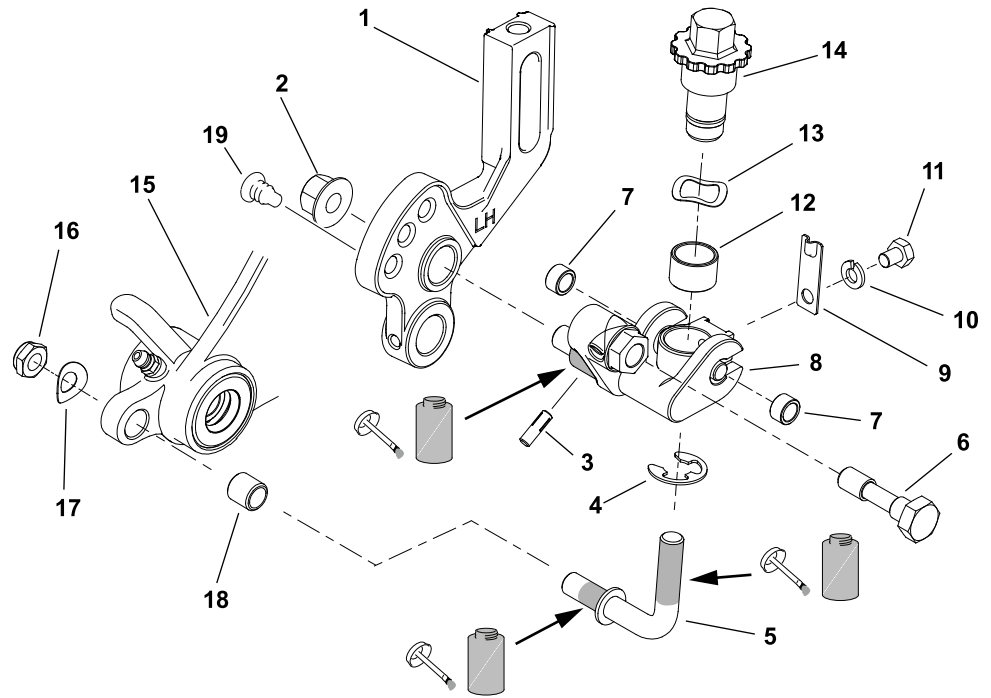


Figure 15

- | | |
|----------------------|-------------------|
| 1. Groomer arm – LH | 11. Cap screw |
| 2. Flange nut | 12. Bushing |
| 3. Grooved pin | 13. Wave washer |
| 4. E-ring | 14. Adjuster |
| 5. Lift rod | 15. Drive plate |
| 6. Lock screw | 16. Lock nut |
| 7. Bushing (2 each) | 17. Spring washer |
| 8. Lift arm assembly | 18. Bushing |
| 9. Detent spring | 19. Plastic plug |
| 10. Lock washer | |

The right side and left side groomer arms and lift arm assemblies are unique, the remaining components are the same on both sides of the groomer.

Removing the Groomer Arms

1. Loosen pinch bolts that secure the front roller shaft to the groomer arms.
2. Remove the lock nut and spring washer that secure the either groomer arm to the plate assembly.
3. Remove the lock nut, special washer and plow bolt that secure the groomer arm to the cutting unit side plate.
4. Remove the groomer arm and the front roller from the cutting unit.
5. Repeat the procedure for the remaining groomer arm.
6. Disassemble the groomer arm as necessary. Clean and inspect all components and replace items as necessary.

Installing the Groomer Arms

1. Paying attention to the orientation of the components for either the left side or the right side application, assemble the groomer arm as necessary.

Installing the Groomer Arms (continued)

- A. Install the lock screw before installing the grooved pin. The grooved pin is used to retain the lock screw.
- B. Apply anti-seize lubricant to the threads of the lift rods before installing the adjusters.
2. Apply anti-seize lubricant to the shoulder of the groomer arm lift rods and the shoulder of the lift arm studs.
3. Position either groomer arm through the drive plate bushing and against the cutting unit side plate. Make sure the cutting unit side plate fits between the height adjustment bolt head and shoulder.
4. Secure the groomer arm to the cutting unit side plate with the plow bolt, special washer and lock nut.
5. Secure the groomer arm to the plate with the spring washer and lock nut.
6. Insert the front roller into the installed groomer arm.
7. Repeat the procedure for the remaining groomer arm.
8. Center the front roller in the cutting unit and tighten both pinch bolts.

The Grooming Brushes (Optional)

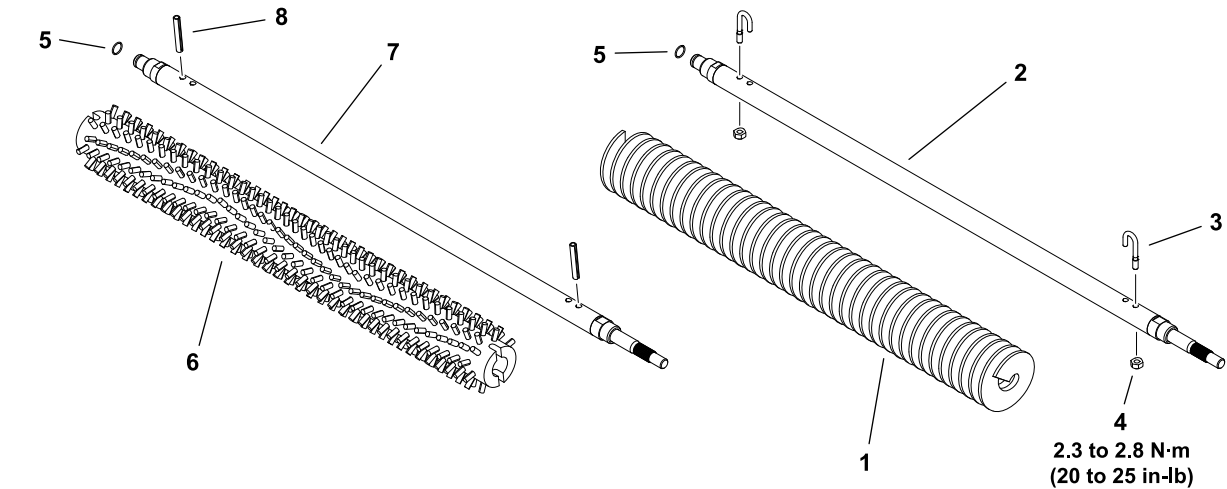


Figure 16

- | | | |
|-----------------------|----------------------|-------------------------|
| 1. Spiral brush | 4. Lock nut (2 each) | 7. Grooming brush shaft |
| 2. Spiral brush shaft | 5. O-ring | 8. Roll pin (2 each) |
| 3. J-bolt (2 each) | 6. Grooming brush | |

The optional grooming brush attaches to the groomer in place of the groomer reel. The grooming brush is removed and installed from the groomer in the same manner as the groomer reel; refer to [The Groomer Reel \(page 8–19\)](#).

The grooming brush elements or shafts can be serviced separately.

To remove the spiral grooming brush from the shaft, remove the lock nut and J-bolt from both ends of the brush assembly and slide the brush from the shaft. When assembling the spiral brush to the shaft, make sure that the J-bolts are installed with the threaded portion on the outside of the brush (as shown) and tighten the lock nuts from **2.3 to 2.8 N·m (20 to 25 in-lb)**.



Universal Groomer (Optional)

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Specifications

Universal Groomer

Item	Description
Grooming reel diameter	6 cm (2.375 inches)
Groomer blade type	Spring Steel: 40 steel blades with 1/2 inch blade spacing. Carbide: 40 steel blades with 1/2 inch blade spacing. Thin blade: 81 steel blades with 1/4 inch blade spacing. The groomer brush can be installed in place of grooming reel.
Groomer mounting	The groomer is mounted to the cutting unit side plates. The drive assembly for the grooming reel is located on the opposite side of the cutting unit from the hydraulic cutting reel motor.
Groomer height setting	Mowing: 0.8 to 15.7 mm (0.030 to 0.620 inch). HOC range: 1.5 to 19.1 mm (0.060 to 0.750 inch).
Width-of-groomer	54.6 cm (21.5 inches).
Height adjustment knob	Allows a 0.003 inch (0.08 mm) increment of height adjustment for each click of the adjuster.
Quick-up feature	Allows grooming reel to be raised above the height/depth adjustment for no grooming reel action while mowing.
Groomer drive	The groomer drive assembly is attached to the right side of the cutting unit.

General Information

Installation Instructions

The *Installation Instructions* for the groomer provides information regarding the set-up, operation, general maintenance procedures, and maintenance intervals for the groomer assembly on your Greensmaster machine. Refer to the *Installation Instructions* for additional information when servicing the groomer assembly.

Troubleshooting

Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT

Improper or overaggressive use of the groomer (e.g., too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. Read and understand the groomer operation instructions before operating or testing the groomer performance.

It is important to remember that the same factors that affect quality of cut also affect grooming performance.

Variables that Affect the Use and Performance of the Groomer:

1. The growing season and weather conditions.
2. General turf conditions.
3. The frequency of grooming/cutting—number of cuttings per week and how many passes per cutting.
4. The height-of-cut.
5. The grooming depth.
6. The type of grass.
7. The amount of time that a groomer reel has been in use on a particular turf area.
8. The amount of traffic on the turf.
9. The overall turf management program—irrigation, fertilizing, weed control, coring, over-seeding, sand dressing, disease control, and pest control.
10. Stress periods for turf—high temperatures, high humidity, and unusually high traffic.

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
The groomer reel does not rotate.	The groomer drive is in neutral.	Engage the groomer drive to forward or reverse.
	The groomer drive gears are damaged or seized.	Repair the groomer drive.
The turf is damaged or has uneven grooming.	The groomer is set too aggressively.	Refer to groomer Installation Instructions for groomer set-up information.
	The groomer reel blades are bent, damaged, or missing.	Repair or replace the blades if necessary.
	The groomer reel shaft is bent or damaged.	Replace the groomer reel shaft.
	Grooming depth is not equal on both ends of the groomer reel.	Adjust the depth if necessary. Check and adjust the cutting unit set up (level bed knife to reel, level rear roller to reel, set the height-of-cut, etc.).

Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some of these tools may have been supplied with your machine, are available as Toro parts, or may also be available from a local tool supplier.

Reel Thread Repair Taps

**15/16–16 Right-Hand Thread –
Toro Part No. 137–0926**

**15/16–16 Left-Hand Thread – Toro
Part No. 137–0927**

Use to clean or repair the internal threads of cutting unit reels.



Drive Shaft Removal Tool

Toro Part No. 137–0920

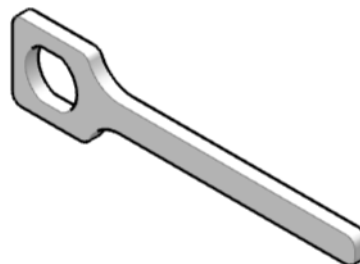
Use to remove the optional Universal Groomer drive shaft from the reel if the drive shaft hex is damaged.



Adapter Wrench

Toro Part No. 137-0921

Use to hold the optional Universal Groomer drive shaft securely when removing or installing the drive adapter.



Syringe – 50cc (2 ounce)

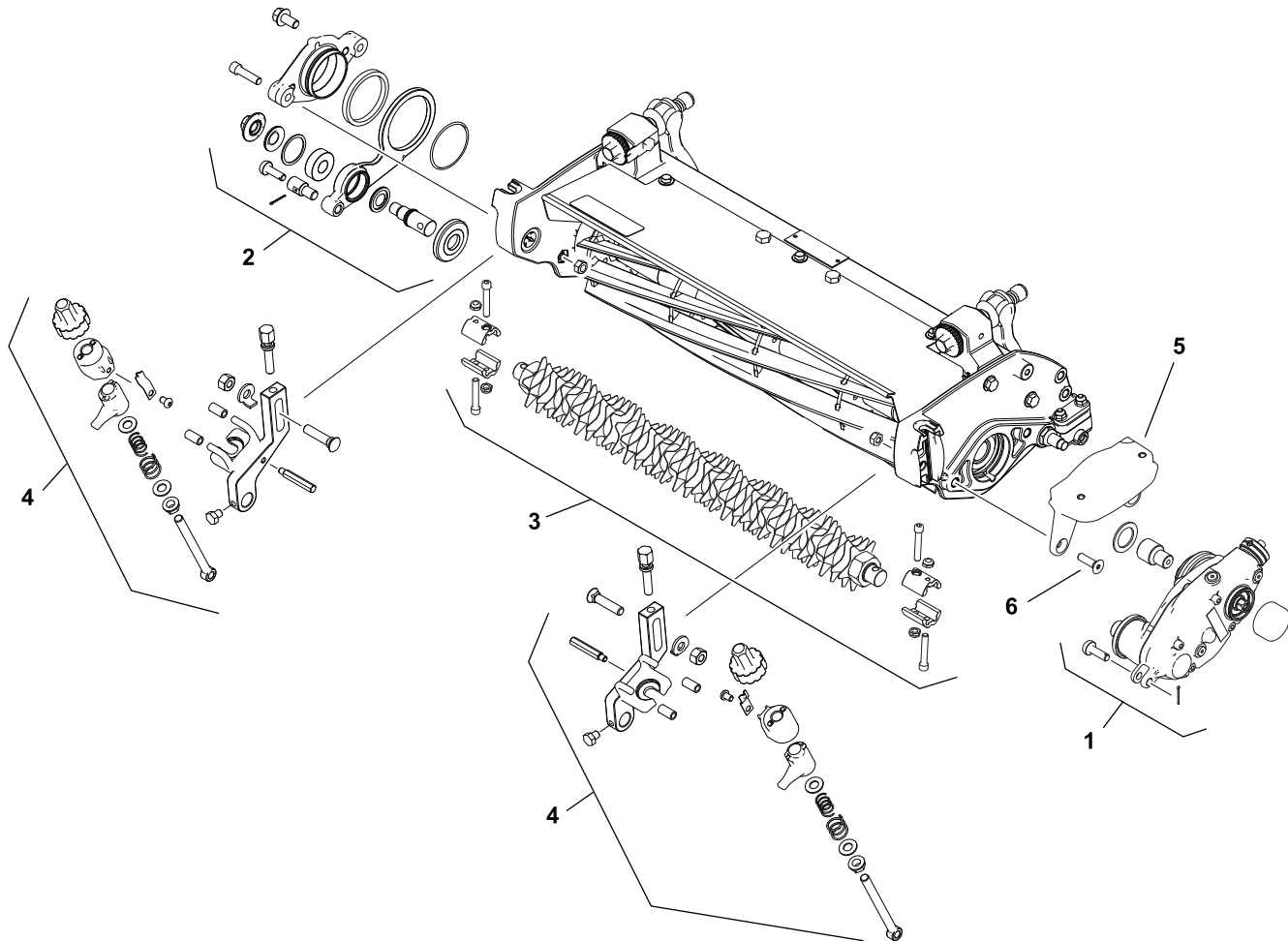
Toro Part No. 137-0872

Aids in accurately filling the optional
Universal Groomer gear box with
oil.



Service and Repairs

The groomer gear box assembly is located on the opposite side of the cutting unit from the cutting unit hydraulic motor.



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Figure 17

- | | | |
|----------------------|--------------------------------------|-----------------------------|
| 1. Gear box assembly | 3. Groomer reel | 5. Weight |
| 2. Idler assembly | 4. Height adjuster assembly (2 each) | 6. Flat head screw (2 each) |



CAUTION



Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

The Gear Box Assembly

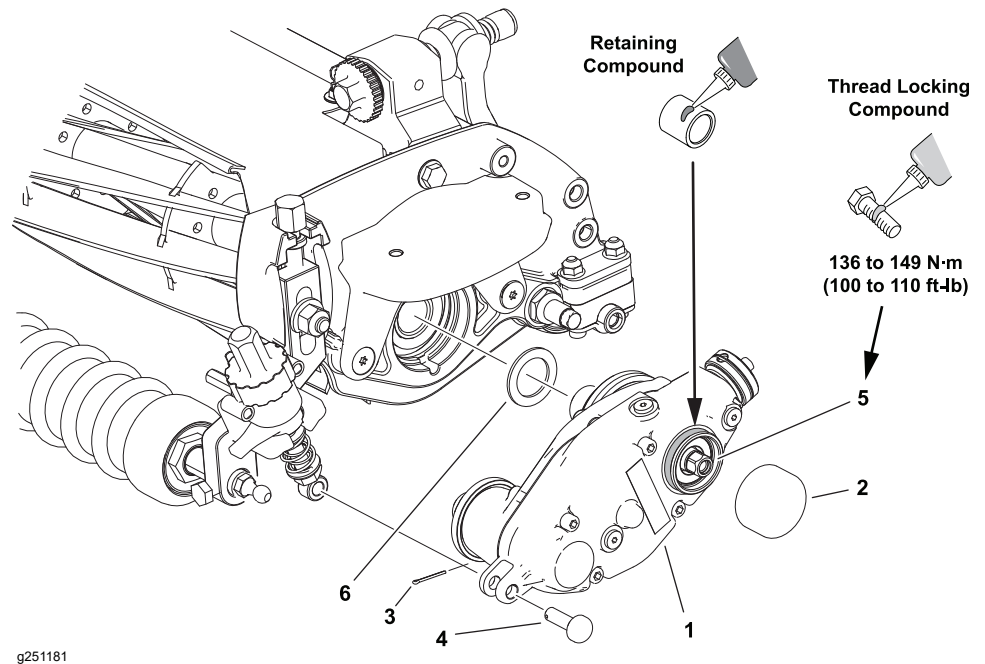


Figure 18

- | | |
|----------------------|--|
| 1. Gear box assembly | 4. Clevis pin |
| 2. Drive shield | 5. Input shaft |
| 3. Cotter pin | 6. Shim (left side groomer drive only) |

The groomer gear box assembly is located on the opposite side of the cutting unit from the cutting unit hydraulic motor.

Removing the Gear Box Assembly

IMPORTANT

The groomer gear boxes for front left and center (rear) cutting units are installed on the left side of the cutting unit. Groomer gear boxes installed on the left side of the cutting unit use a left hand thread; turn the input shaft (rear roller brush drive shaft) clockwise to remove the gear box.

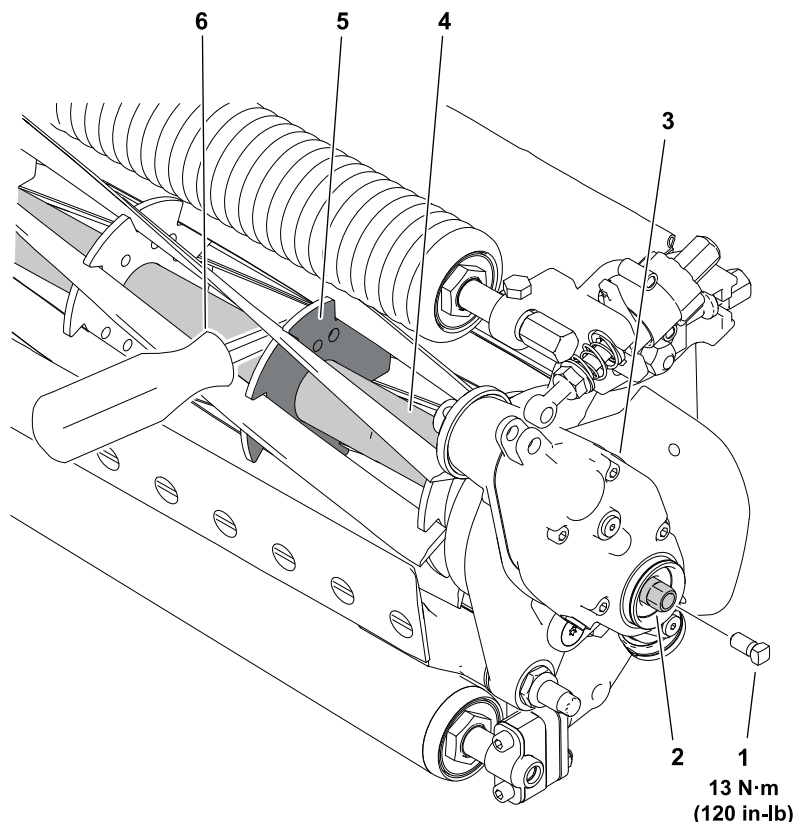
The groomer gear box for the front right cutting unit is installed on the right side of the cutting unit. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread; turn the input shaft (rear roller brush drive shaft) counterclockwise to remove the gear box.

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the groomer reel assembly; refer to [Removing the Groomer Reel \(page 8–19\)](#).
3. Remove the drive shield, or, if the cutting unit is equipped with an optional powered rear roller brush, remove the rear roller brush drive assembly to service the groomer; refer to Rear Roller Brush (Optional) in Chapter 7 – DPA Cutting Units.

Removing the Gear Box Assembly (continued)



4. Install a 5/16–18 X 5/8 inch square head set screw (Toro p/n 1-803022) in the end of the drive shaft and tighten to **13 N·m (120 in-lb)**; refer to [Figure 19](#).
5. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the groomer gear box. Discard the cotter pin.
6. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.



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Figure 19

- | | |
|---|--|
| 1. 5/16–18 X 5/8 inch square head set screw | 4. Reel shaft |
| 2. Input shaft assembly | 5. Unwelded side of reel support plate |
| 3. Groomer gear box assembly | 6. Pry bar |

-
7. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

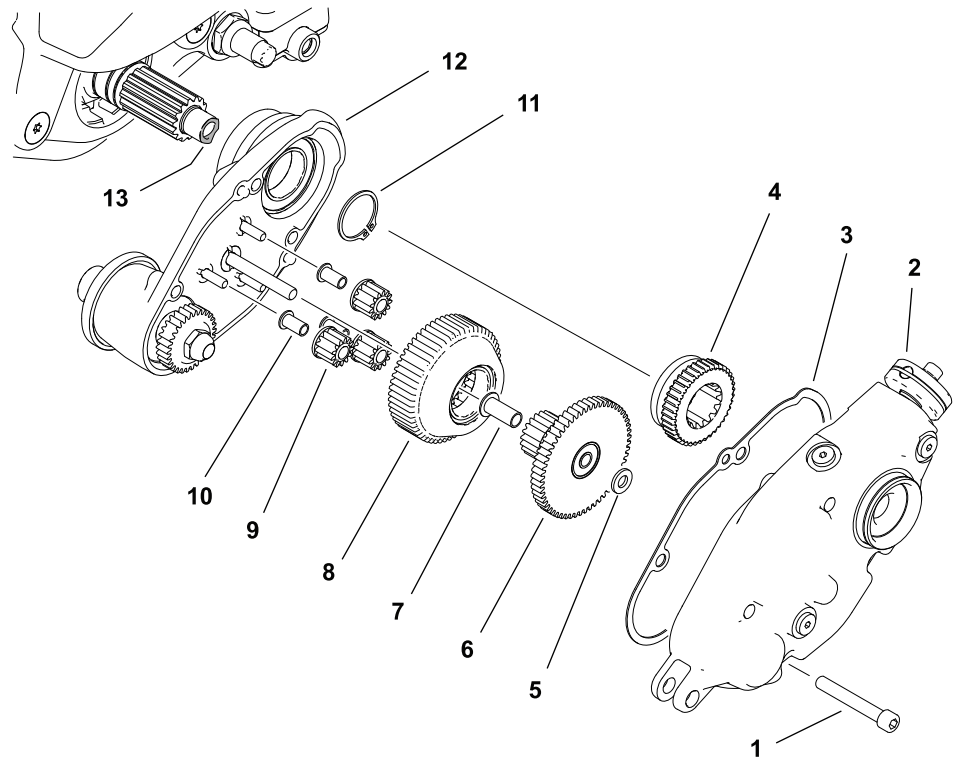
To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

8. Move the pry bar against the weld side of the reel support plate closest to the groomer gear box.

IMPORTANT

You must use a 6-point socket with a heavy wall to remove the gear box from the reel. Do not use an impact wrench. Groomer gear boxes installed on the left side of the cutting unit use a left hand thread; turn the drive shaft clockwise to remove the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread; turn the drive shaft counterclockwise to remove the gear box.

9. Rest the handle of the pry bar against the front roller and turn the drive shaft clockwise to loosen it from the reel. Continue to unscrew the drive shaft and remove the gear box from the cutting unit.
10. For cutting units with the groomer drive assembly on the left side, retrieve the shim (item 6 in [Figure 18](#)).
11. If the hex head on the end of the drive shaft is damaged during removal:
 - A. Remove the drain/fill plug and drain the oil from the gear box.



g324508

Figure 20

- | | |
|-------------------------------|-------------------------------|
| 1. Socket head screw (4 each) | 8. Sun gear |
| 2. Gear box cover assembly | 9. Planet gear (3 each) |
| 3. Cover gasket | 10. Flange bushing (3 each) |
| 4. Driven gear | 11. Retaining ring |
| 5. Thrust washer | 12. Gear box housing assembly |
| 6. Ring gear | 13. Damaged drive shaft |
| 7. Flange bushing | |

- B. Remove the 4 socket-head screws and remove the gear box cover assembly and driven gear. Remove and discard the cover gasket.

Removing the Gear Box Assembly (continued)

- C. Slide the thrust washer, ring gear and bushing from the gear box housing.
- D. Slide the sun gear, and planet gears and bushings from the pins on the gear box housing.
- E. Remove the retaining ring from the drive shaft.
- F. Slide the groomer housing assembly from the drive shaft.
- G. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.

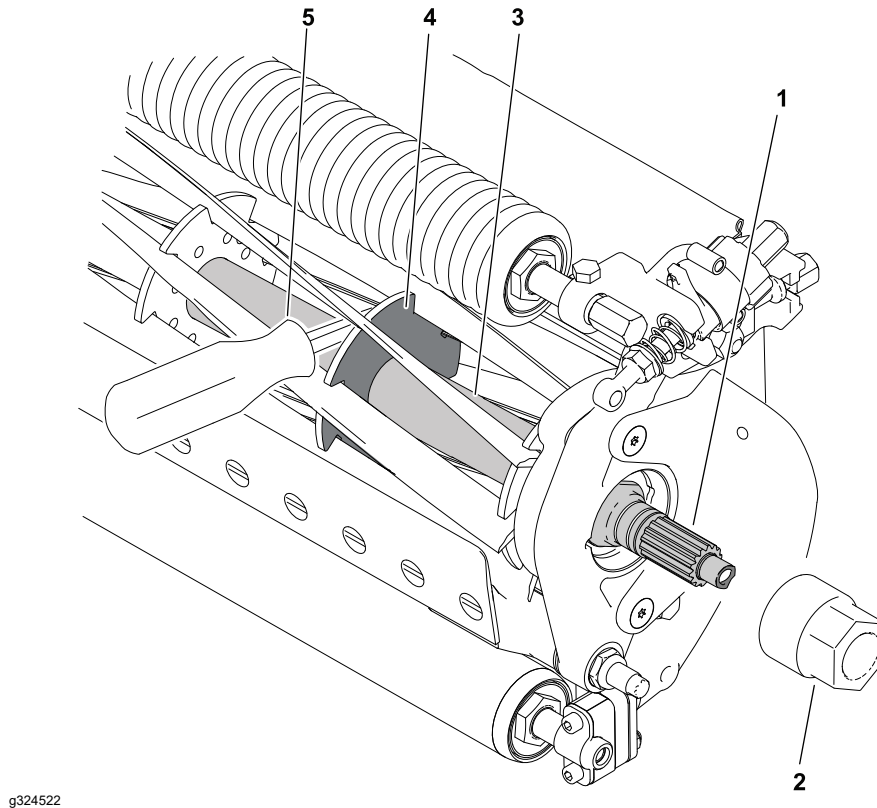


Figure 21

- 1. Damaged input shaft assembly
- 2. Drive shaft removal tool
- 3. Reel shaft
- 4. Unwelded side of reel support plate
- 5. Pry bar

-
- H. Insert a long-handled pry bar (3/8 x 12 inch with screwdriver handle recommended) through the bottom of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

IMPORTANT

To avoid grinding the reel, do not contact the cutting edge of any blade with the pry bar as this may damage the cutting edge and/or cause a high blade.

- I. Move the pry bar against the weld side of the reel support plate closest to the drive shaft assembly.

Removing the Gear Box Assembly (continued)

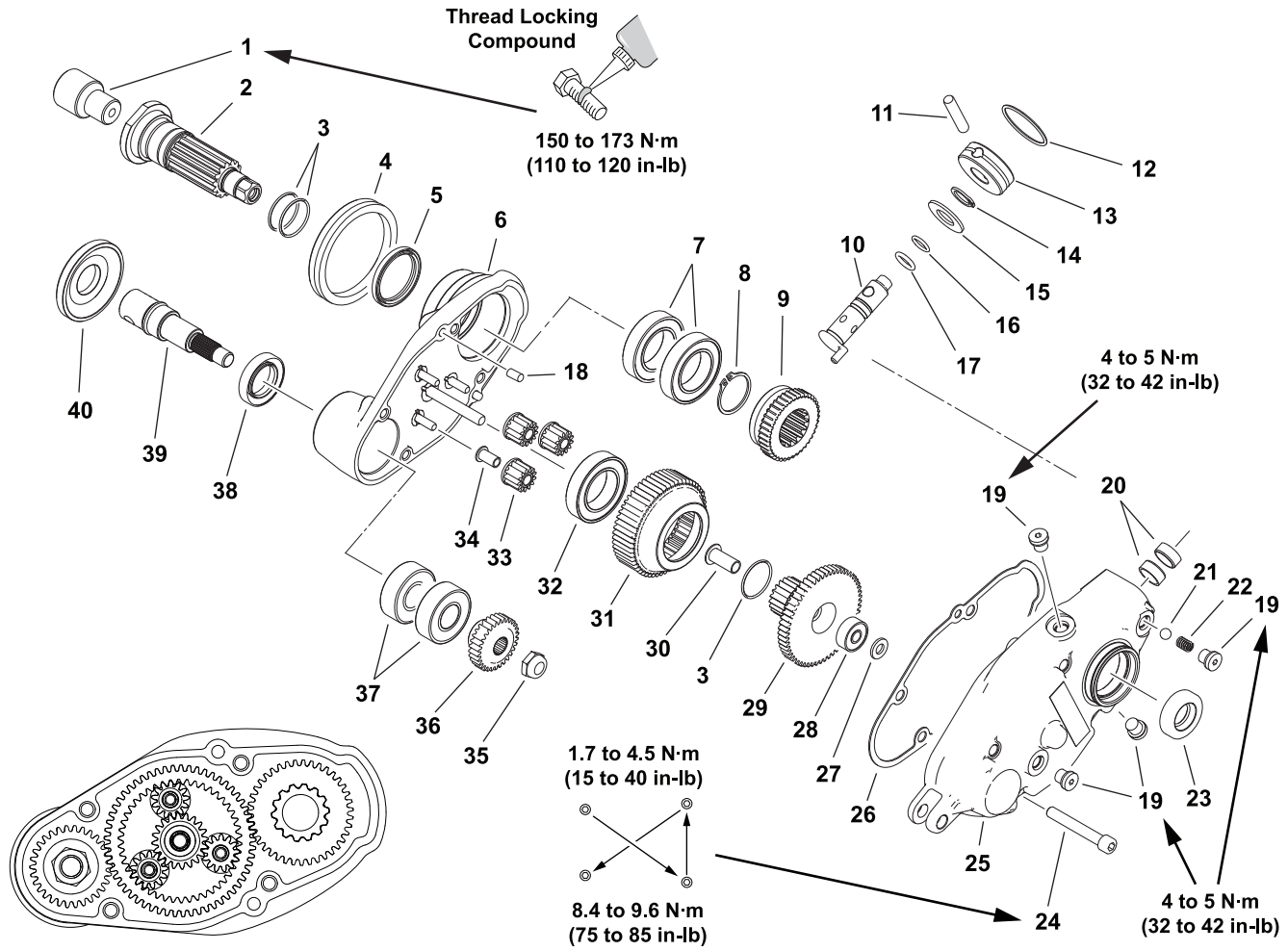
- J. Use the drive shaft removal tool on the large flats of the drive shaft assembly; refer to [Drive Shaft Removal Tool \(page 9–6\)](#).

IMPORTANT

The drive shaft for groomer gear boxes installed on the left side of the cutting unit use a left hand thread; turn the drive shaft clockwise to loosen. The drive shaft for groomer gear boxes installed on the right side of the cutting unit use a right hand thread; turn the drive shaft counterclockwise to loosen.

- K. Rest the handle of the pry bar against the front roller and turn the drive shaft clockwise to loosen it from the reel.
12. For cutting units with the groomer drive assembly on the left side, retrieve the shim (item 6 in [Figure 18](#)).
13. Tip the cutting unit back onto its rollers.
14. Clean the threads in the end of the reel shaft. A right-hand thread and left-hand thread tap is available to clean or repair the threads if necessary; refer to [Reel Thread Repair Taps \(page 9–6\)](#).

Servicing the Gear Box



g251182

Figure 22

- | | | |
|--------------------------|-------------------------------|-----------------------------|
| 1. Drive adapter | 15. Thrust washer | 29. Ring gear |
| 2. Input shaft | 16. O-ring | 30. Flange bushing |
| 3. O-ring (3 each) | 17. O-ring | 31. Sun gear |
| 4. V-ring | 18. Dowel pin (2 each) | 32. Bearing |
| 5. Oil seal | 19. Drain/fill plug (4 each) | 33. Planet gear (3 each) |
| 6. Groomer housing | 20. Straight bushing (2 each) | 34. Flange bushing (3 each) |
| 7. Ball bearing (2 each) | 21. Detent ball | 35. Locknut |
| 8. Retaining ring | 22. Detent spring | 36. Driver gear |
| 9. Driven gear | 23. Oil seal | 37. Bearing (2 each) |
| 10. Actuator shaft | 24. Socket-head screw(4 each) | 38. Oil seal |
| 11. Pin | 25. Groomer cover | 39. Driven shaft |
| 12. O-ring | 26. Gasket | 40. Shield |
| 13. Knob | 27. Thrust washer | |
| 14. Retaining ring | 28. Ball bearing | |

Servicing the Gear Box (continued)

1. Remove the drain/fill plug and drain the oil from the gear box.
2. Remove the 4 socket-head screws and separate the gear box cover and housing. Remove and discard the cover gasket.
3. Slide the sun gear, ring gear, and planet gears from the pins on the gear box housing.
4. Continue to disassemble the gear box as necessary.
5. If the drive adapter requires replacement, apply medium strength thread locking compound (Loctite 243 or equivalent) to the internal threads of the drive shaft and the larger threads of the drive adapter (reel end). Allow the thread locking compound to cure for 15 minutes before continuing this procedure.



CAUTION



Use the large 1.375 inch flats on the drive shaft to prevent the drive shaft from rotating during drive adapter removal and installation. DO NOT use the 0.5 inch hex head on the drive shaft for drive adapter removal or installation as drive shaft damage may occur.



Note: A special tool is available to hold the drive shaft if necessary; refer to [Adapter Wrench \(page 9–6\)](#).

6. Tighten the drive adapter from **150 to 163 N·m (110 to 120 ft-lb)**.
7. Carefully clean all the gasket material from the gear box housing and cover.
8. Inspect the V-ring, seals, bearings, gears, and bushings in the gear box assembly. Replace the damaged or worn components as necessary.
9. If the sun gear, ring gear, or the gear box housing bearings are replaced, press the bearings all the way to shoulder into the part.
10. If the flange bushings are replaced, ensure that the flange bushing is fully seated against the part.
11. Assemble the gearbox.
 - Ensure that all the retaining rings and O-rings are fully seated in the ring groove during assembly.
 - Lubricate the seal lips and O-rings before installing the shafts.
 - Lubricate the planet gear and sun gear pins in the gear box housing with the gear oil prior to installing the gears.
12. Clean the gasket surface on the gear box housing and cover with the solvent and install new gasket.
13. Fit the gear box cover over dowel pins and install the 4 socket-head screws. Tighten the screws from **1.7 to 4.5 N·m (15 to 40 in-lb)**. In an alternating cross pattern, tighten the screws from **8.4 to 9.6 N·m (75 to 85 in-lb)**.
14. Fill the gear box with 80W–90 gear oil and tighten the drain/fill plug from **4 to 5 N·m (32 to 42 in-lb)**.

The gear box oil capacity is **50 ml (1.7 fluid ounces)**.
15. Operate the groomer gear box by hand to check for proper operation prior to installation.

Installing the Gear Box Assembly

Refer to [Figure 18](#) for this procedure.

1. Apply medium strength thread locking compound (Loctite 243 or equivalent) to the threads in the reel and allow the thread locking compound to cure for 15 minutes before continuing this procedure.
2. For cutting units with the groomer drive assembly on the left side, fit the shim (item 6 in [Figure 18](#)) over the input shaft.
3. Insert a long-handled pry bar through the front of the cutting unit. The pry bar should pass between the top of the reel shaft and the backs of the reel blades so that the reel will not move.

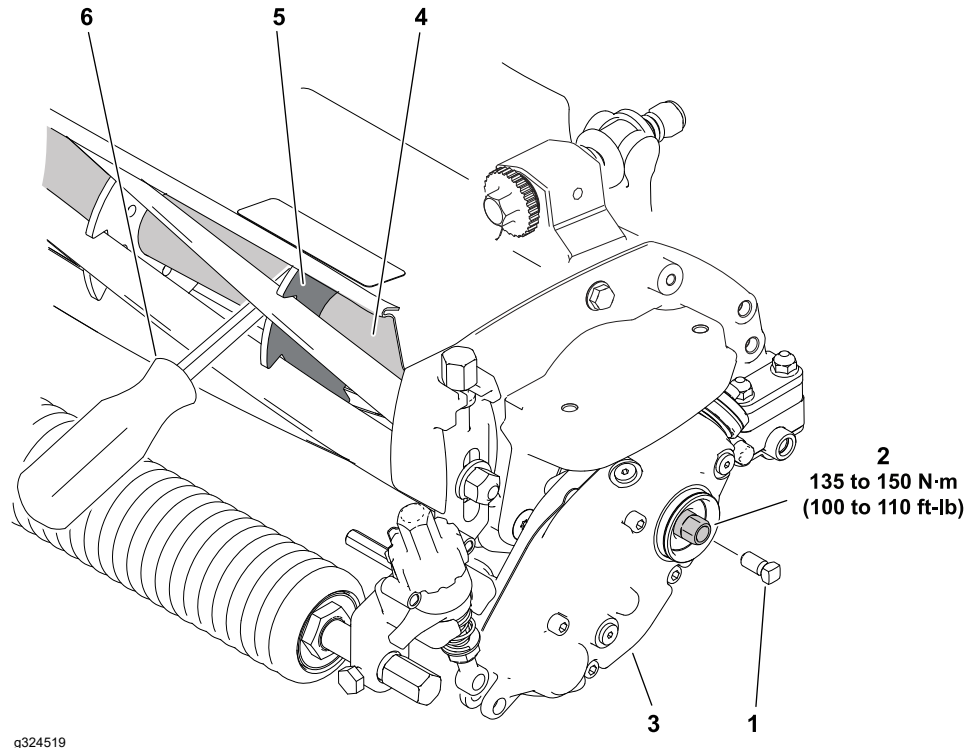


Figure 23

- | | |
|---|--|
| 1. 5/16–18 X 5/8 inch square head set screw | 4. Reel shaft |
| 2. Input shaft assembly | 5. Unwelded side of reel support plate |
| 3. Groomer gear box assembly | 6. Pry bar |

-
4. Move the pry bar against the weld side of the reel support plate closest to the gear box assembly and rest the handle of the pry bar against the front roller.

IMPORTANT

Groomer gear boxes installed on the left side of the cutting unit use a left hand thread; turn the drive shaft counterclockwise to install the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread; turn the drive shaft clockwise to install the gear box.

5. Position the gear box assembly against the cutting unit and turn the drive shaft assembly counterclockwise until it is seated against the reel.

IMPORTANT

You must use a 6-point socket with a heavy wall to install the gear box to the reel. Do not use an impact wrench.



6. Tighten the drive shaft assembly from **135 to 150 N·m (100 to 110 ft-lb)**.
7. Remove the square head set screw from the end of the drive shaft.
8. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the groomer gear box.
9. Apply a retaining compound (Loctite 609 or equivalent) to the lip of the drive housing and install the drive shield, or, if the cutting unit is equipped with an optional powered rear roller brush, install the rear roller brush drive assembly; refer to Rear Roller Brush (Optional) in Chapter 7 – DPA Cutting Units.
10. Install the groomer reel assembly; refer to [Installing the Groomer Reel \(page 9–22\)](#).

The Idler Assembly

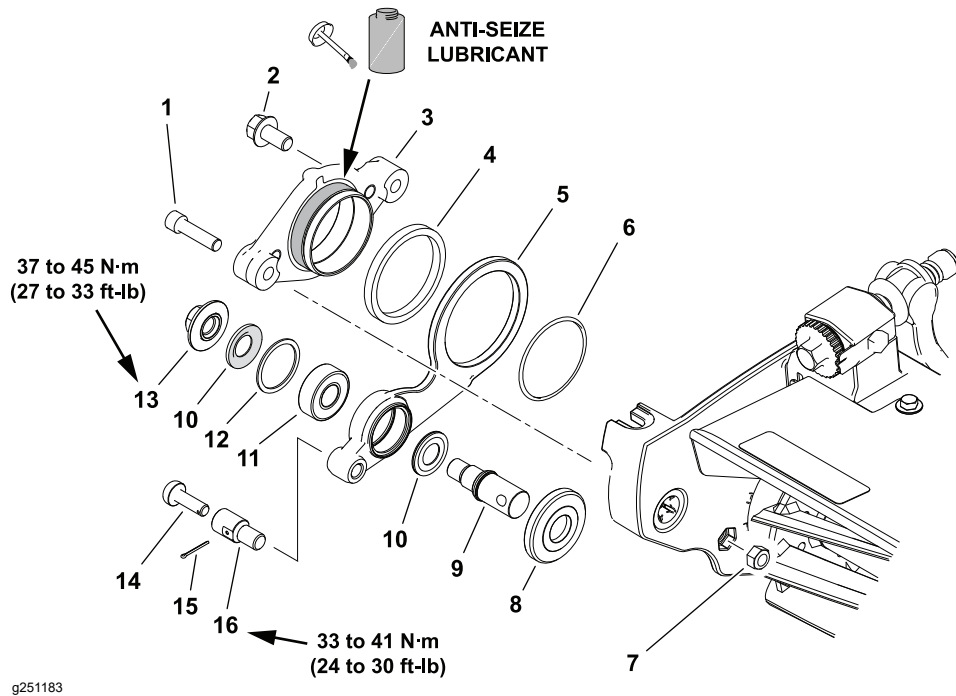


Figure 24

- | | |
|-------------------------------|---------------------------|
| 1. Socket-head screw (2 each) | 9. Stub shaft |
| 2. | 10. Flocked seal (2 each) |
| 3. Motor adapter | 11. Bearing |
| 4. Bushing | 12. Retaining ring |
| 5. Idler arm | 13. Flange nut |
| 6. O-ring | 14. Clevis pin |
| 7. Lock nut (2 each) | 15. Cotter pin |
| 8. Shield | 16. Collar |

The groomer idler assembly is located on the opposite side of the groomer gear box.

Removing the Idler Assembly

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the reel motor from the cutting unit.
3. Remove the groomer reel assembly; refer to [Removing the Groomer Reel \(page 9–20\)](#).
4. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the idler arm. Discard the cotter pin.
5. Remove the two socket-head screws that secure the motor adapter to the cutting unit, and remove the adapter and idler assembly. Retrieve and discard the O-ring and lock nuts.
6. Inspect the shields, bearing, and bushing in the idler assembly. Replace any components that are worn or damaged.

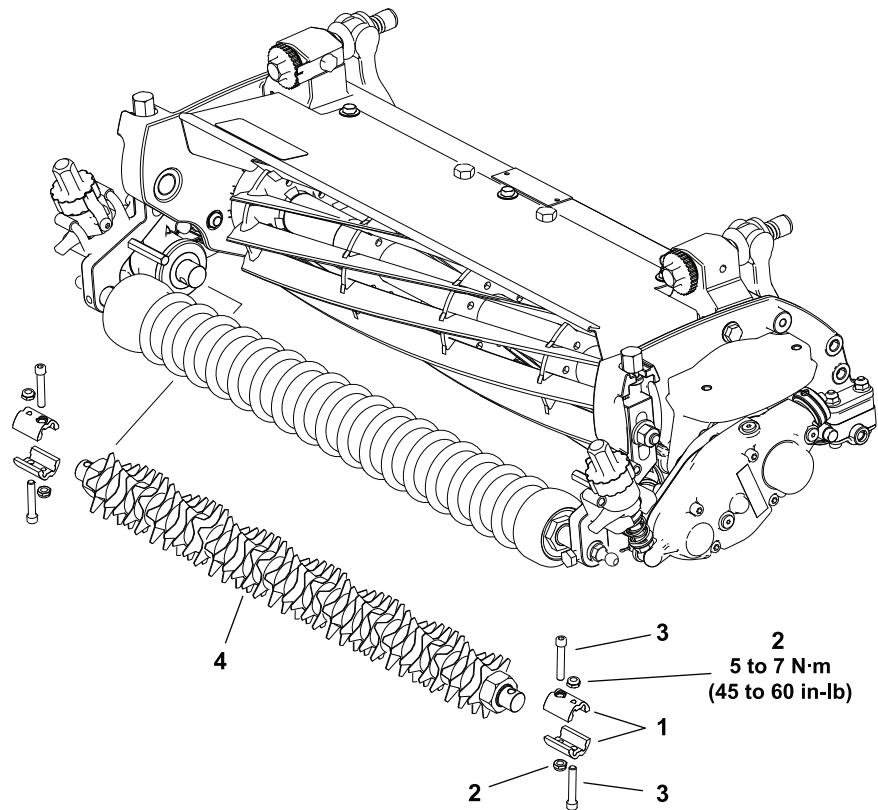
Installing the Idler Assembly

1. If the shields, bearing, or bushing was removed from the idler arm:

Installing the Idler Assembly (continued)

- A. Press the bushing into a groomer plate until the bushing is centered in the idler arm bore.
 - B. Press the bearing into the idler arm so that the bearing contacts the shoulder in idler arm bore and install the bearing retaining ring.
 - C. Install the bearing shields with the flocked side of the shield toward the bearing.
 - D. Insert the stub shaft through the shields and bearing. Use the through hole in the shaft to prevent the shaft from rotating and tighten the flange nut from **37 to 45 N·m (27 to 33 ft-lb)**.
 - E. If the collar was removed from the idler arm, install the collar and tighten from **33 to 41 N·m (24 to 30 ft-lb)**.
2. Fit a new O-ring to the motor adapter.
 3. Apply anti-seize lubricant to the outside diameter of the motor adapter and position the idler arm over the adapter.
 4. Use new lock nuts and secure the motor adapter and idler arm to the cutting unit side plate.
 5. Install the clevis pin and a new cotter pin to secure the height adjustment rod to the front of the idler arm.
 6. Install the reel motor.

The Groomer Reel



g228732

Figure 25

- | | |
|-------------------------|------------------|
| 1. Shaft clamp (4 each) | 3. Bolt (4 each) |
| 2. Jam nut (4 each) | 4. Groomer reel |

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer reel can be reversed to provide additional blade life.

Removing the Groomer Reel

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.



CAUTION



Contact with the reel or other cutting unit parts can result in personal injury.

Use heavy gloves when handling the groomer reel.

2. Carefully remove the 4 jam nuts, 4 bolts, and 4 shaft clamps that secure the groomer reel to the output and stub shafts.
3. Lift the groomer reel from the cutting unit.
4. Inspect the shields, stub shaft, driven shaft and shaft bearings for wear or damage and replace components as necessary; refer to [The Gear Box Assembly \(page 9–9\)](#) and [The Idler Assembly \(page 9–18\)](#).

Servicing the Groomer Reel

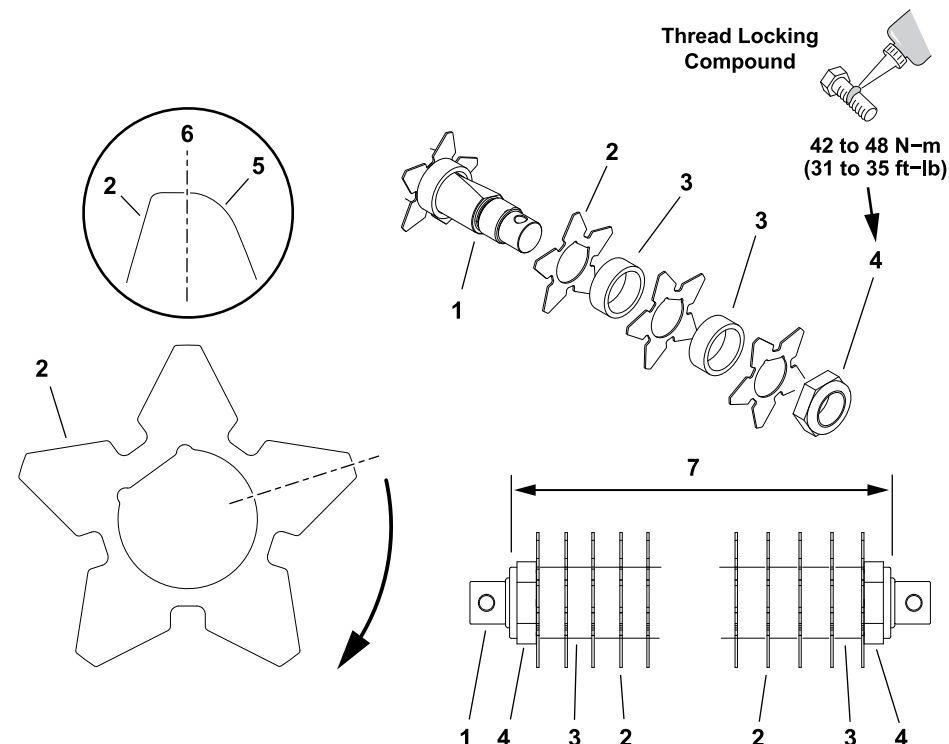


Figure 26

- | | |
|----------------------------|----------------------|
| 1. Groomer reel shaft | 5. Rounded edge |
| 2. Groomer blade (40 each) | 6. Midpoint |
| 3. Spacer (39 each) | 7. Centered on shaft |
| 4. Locknut (2 each) | |

Inspect the groomer reel blades frequently for any damage and wear. Straighten the bent blades. Either replace the worn blades or reverse the individual blades to put the sharpest blade edge forward. The blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance: refer to [Figure 26](#).

1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the groomer reel from the cutting unit; refer to [Removing the Groomer Reel \(page 9–20\)](#).
3. Remove the lock nut from either end of the groomer reel shaft.
4. Remove the blades and from the groomer shaft. If necessary, remove second lock nut from the shaft.
5. Inspect and replace worn or damaged components.
6. Assemble the groomer reel as follows:

Note: New lock nuts have an adhesive patch to prevent the lock nut from loosening. If a used lock nut is being installed, apply a medium strength thread locker (Loctite #242 or equivalent) to the threads of the lock nut.

 - A. Install a lock nut on one end of the groomer reel shaft.
 - B. Install a groomer blade against the lock nut.
 - C. Install the remaining spacers and blades in an alternating manner making sure that all blades are separated by a spacer.

Servicing the Groomer Reel (continued)

- D. When all the blades have been installed, install the second lock nut onto the shaft. Center the blades and spacers on the shaft by adjusting the lock nuts.
 - E. Use the through holes in shaft to prevent the shaft from rotating and tighten the second lock nut to **42 to 48 N·m (31 to 35 ft-lb)**. After tightening the lock nut, spacers should not be free to rotate and the groomer blades should be centered on the shaft.
7. Install the groomer reel back onto the cutting unit; refer to [Installing the Groomer Reel \(page 9–22\)](#).

Installing the Groomer Reel

1. Position the cutting unit on a level surface. If the cutting unit is attached to the traction unit, set the parking brake, and remove the key from the key switch.
2. Position the groomer reel between the groomer driven and stub shafts.
3. Secure the groomer reel to the cutting unit with the 4 jam nuts, 4 bolts, and 4 shaft clamps. Tighten the bolts from **5 to 7 N·m (45 to 60 in-lb)**.
4. Check the groomer reel height and mower height-of-cut settings and adjust as necessary.

The Height Adjuster Assembly

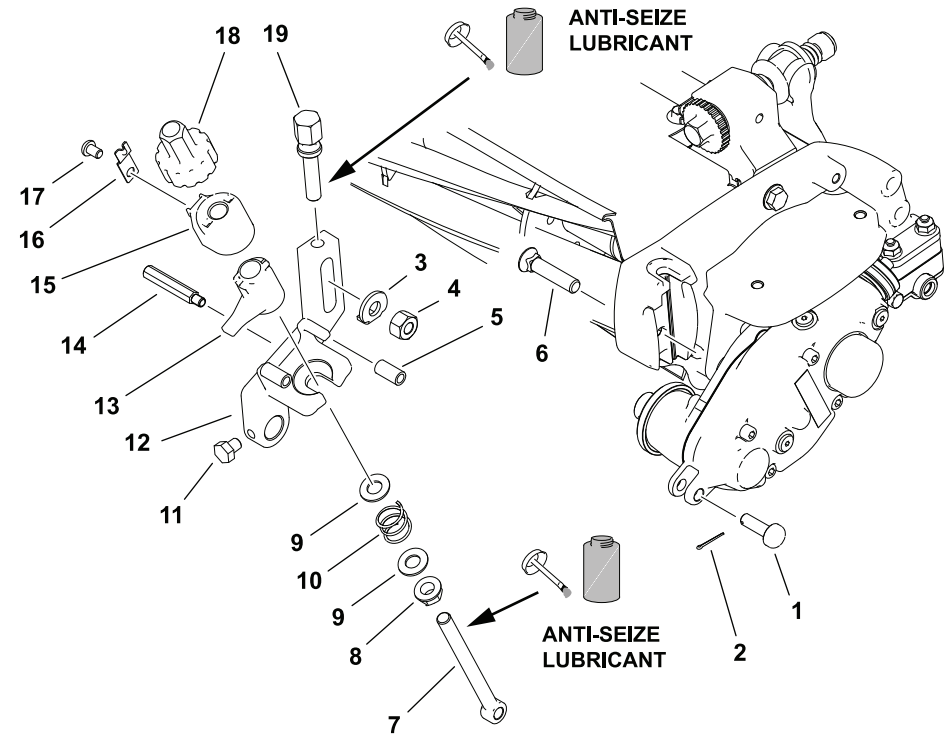


Figure 27

- | | |
|--------------------------|----------------------------|
| 1. Clevis pin | 11. Pinch bolt |
| 2. Cotter pin | 12. Height-of-cut bracket |
| 3. Tabbed washer | 13. Quick up lever |
| 4. Lock nut | 14. Groomer pin |
| 5. Bumper | 15. Quick up cover |
| 6. Plow bolt | 16. Detent spring |
| 7. Height adjustment rod | 17. Button-head screw |
| 8. Flange nut | 18. Height adjuster knob |
| 9. Washer (2 each) | 19. Height adjustment bolt |
| 10. Compression spring | |

Note: Early universal groomers used 2 compression springs on non-adjustable height adjustment rods. Retrofitting the assemblies on each side of the cutting unit with new compression springs, height adjustment rods, and adding flange nuts to enable spring adjustment is recommended; refer to [Figure 27](#).

Disassembling the Height Adjuster

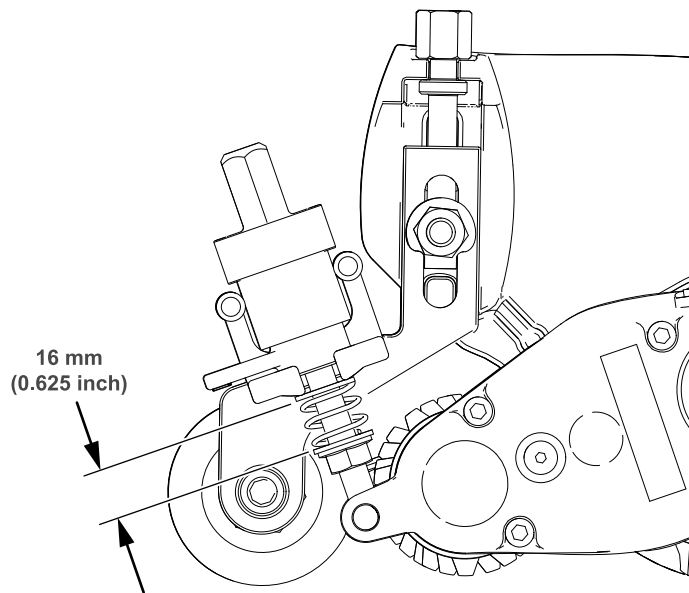
1. Park the machine on a clean and level surface, lower the cutting units completely to the ground, set the parking brake, and remove the key from the key switch.
2. Remove the cutting unit from the machine.
3. Remove the cotter pins and clevis pins that secure the height adjustment rods to the groomer gear box and idler arm. Discard the cotter pins.
4. Loosen the pinch bolts that secure the front roller to the height-of-cut brackets.
5. Remove the hex nuts, tabbed washers and plow bolts that secure the height-of-cut brackets to the cutting unit side plates, and remove the height adjusters and front roller from the cutting unit.

Disassembling the Height Adjuster (continued)

6. Disassemble the height adjuster assembly as necessary.
7. Replace components that are worn or damaged.

Assembling the Height Adjuster

1. Apply anti-seize lubricant to the upper threads of the adjustment rod and lower threads of the height adjusters. Assemble the height adjuster assembly.
2. If both the height adjusters are removed, fit 1 height adjuster assembly to the cutting unit side plate and secure it with a plow bolt, tabbed washer and lock nut. Tighten the lock nut finger tight.
3. Position front roller between the height adjuster assemblies and secure the remaining height adjuster assembly to the cutting unit side plate with a plow bolt, tabbed washer and lock nut. Tighten the lock nut finger tight.
4. center the front roller between the height-of-cut brackets and tighten the front roller pinch bolts
5. Install new cotter pins and clevis pins and secure the height adjustment rods to the groomer gear box and idler arm.
6. Adjust the cutting unit height-of-cut; refer to *Cutting Unit Operators Manual*.
7. Check the groomer reel height and adjust as necessary.



g229170

Figure 28

8. Adjust the flange nuts on the groomer height adjustment rods until the springs are compressed to **16 mm (0.625 inch)**.

The Grooming Brush (Optional)

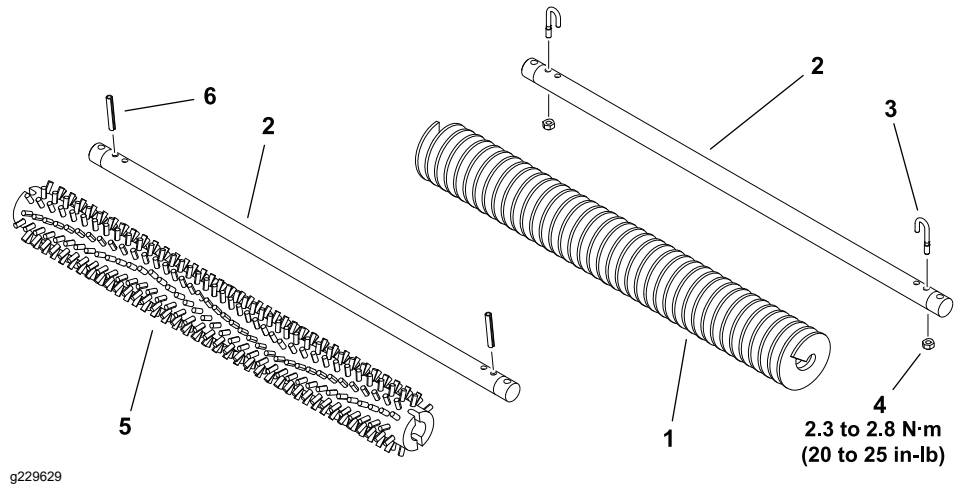


Figure 29

- | | |
|--------------------|----------------------|
| 1. Spiral brush | 4. Lock nut (2 each) |
| 2. Brush shaft | 5. Grooming brush |
| 3. J-bolt (2 each) | 6. Roll pin (2 each) |

The optional grooming brush attaches to the groomer in place of the groomer reel. The grooming brush is removed and installed from the groomer in the same manner as the groomer reel; refer to [The Groomer Reel \(page 9–20\)](#).

The grooming brush element or shaft can be serviced separately.

To remove the spiral grooming brush from the shaft, remove the lock nut and J-bolt from both ends of the brush assembly and slide the brush from the shaft. When assembling the spiral brush to the shaft, make sure that the J-bolts are installed with the threaded portion on the outside of the brush and tighten the lock nuts from **2.3 to 2.8 N·m (20 to 25 in-lb)**.



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Electrical Drawing Designations

Note: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g., SP01 is splice number 1).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
BK	BLACK
BR or BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
VIO	VIOLET
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on the Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g., R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

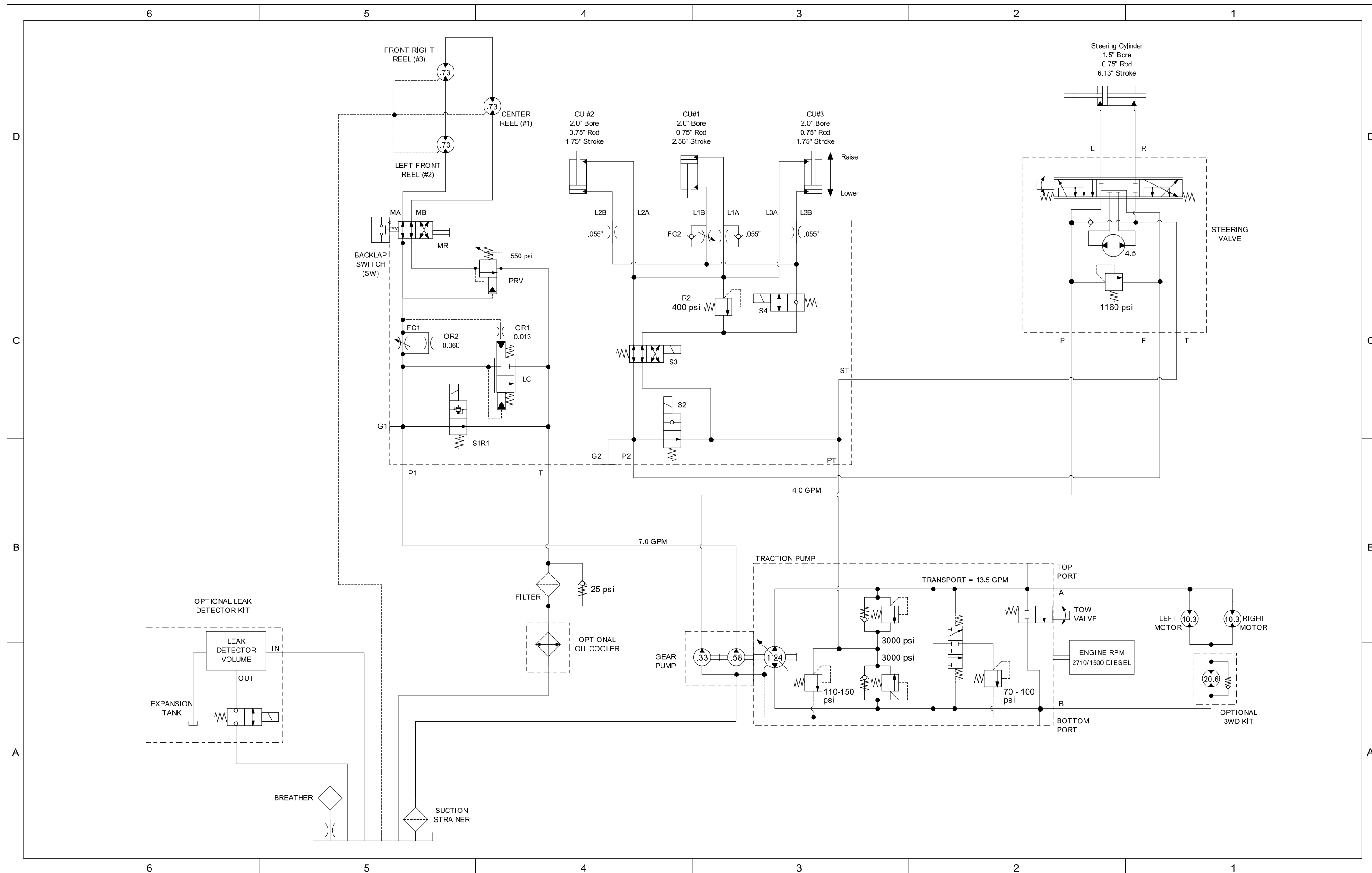
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

- 16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator
- 050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

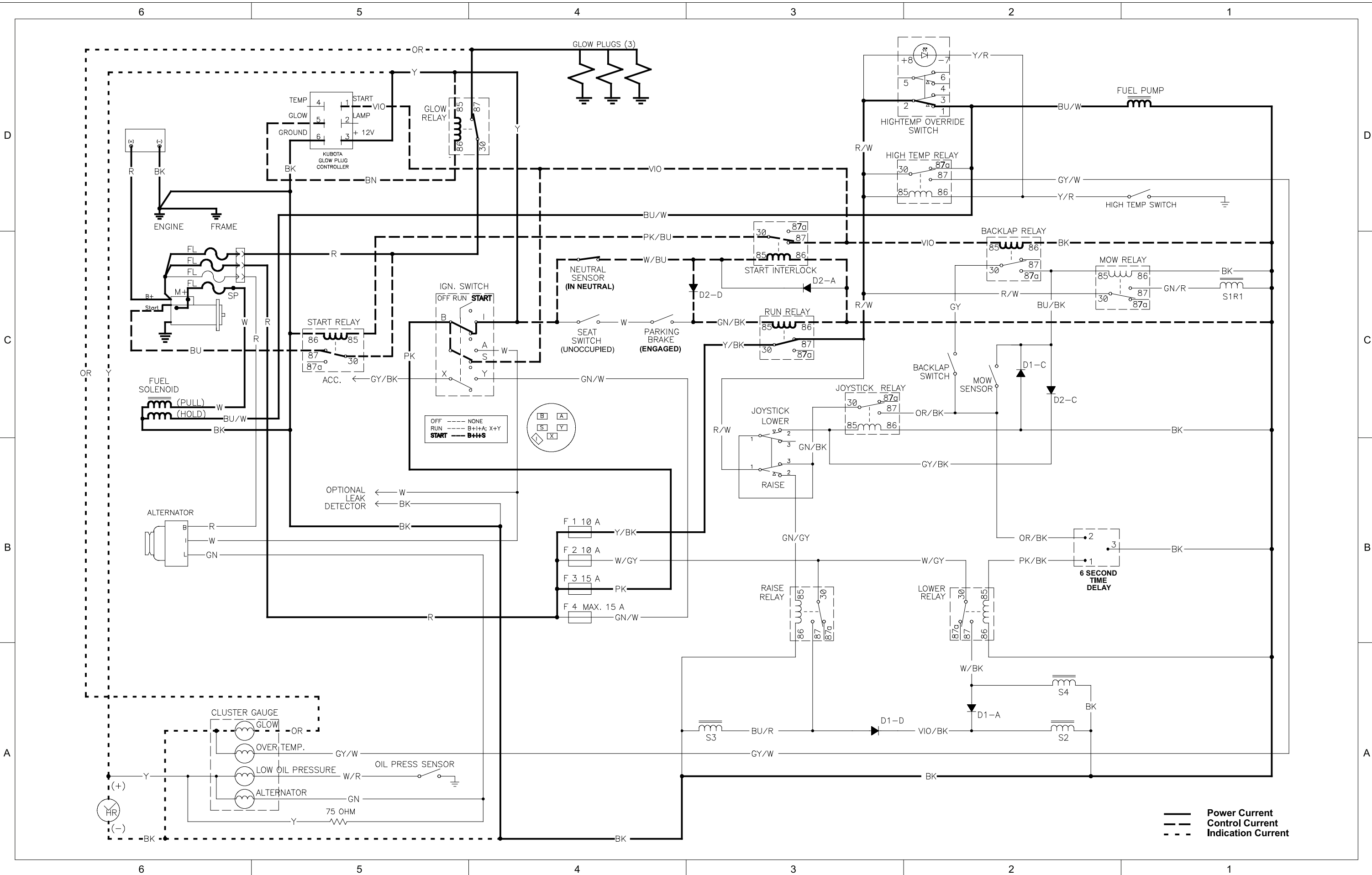
AWG Equivalents for Metric Wire		
Diagram Label	Metric Size	AWG Equivalent
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA

Hydraulic Schematic

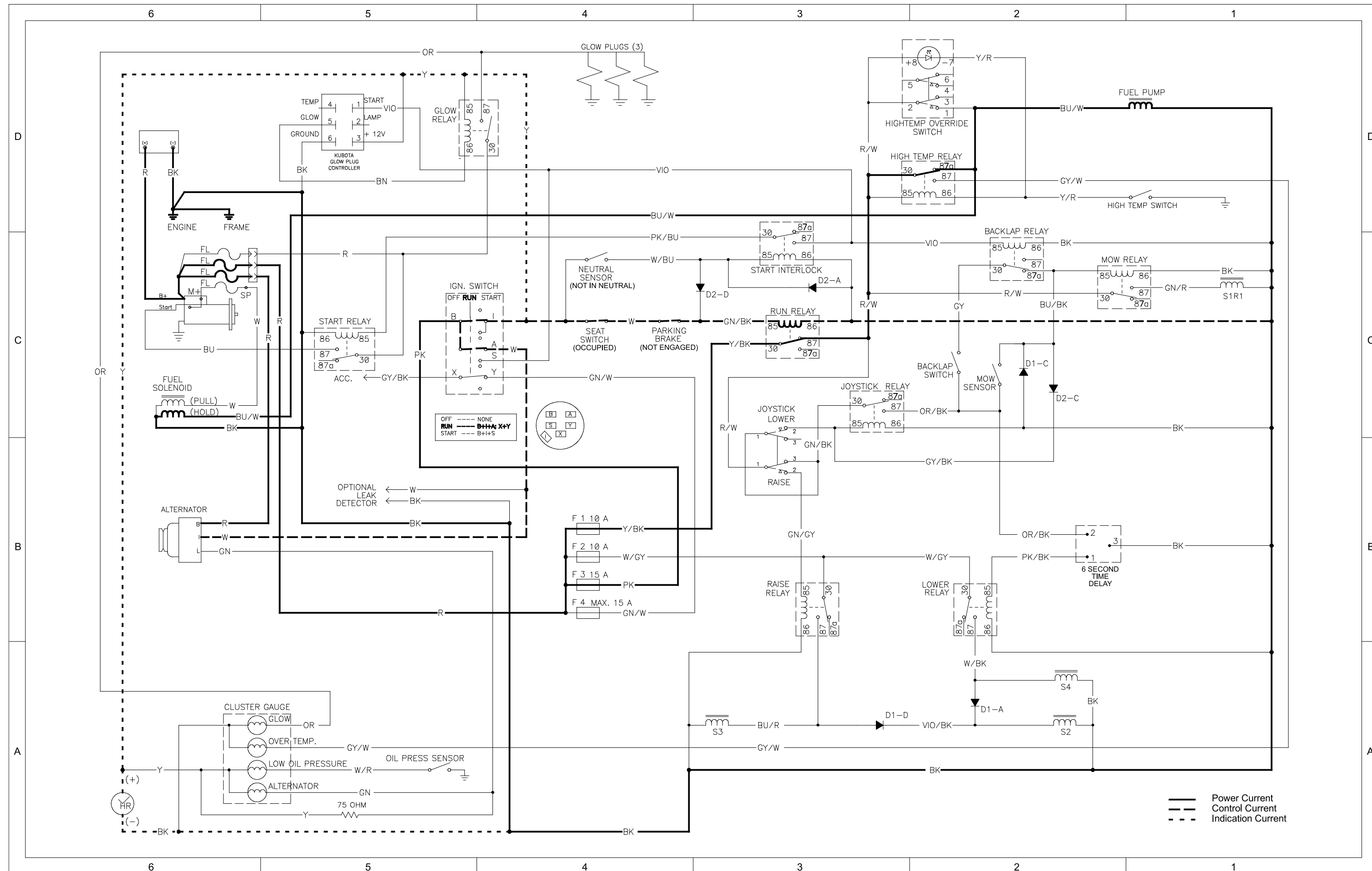


g327656

Electrical Circuit Diagrams – Crank Circuits (typical)

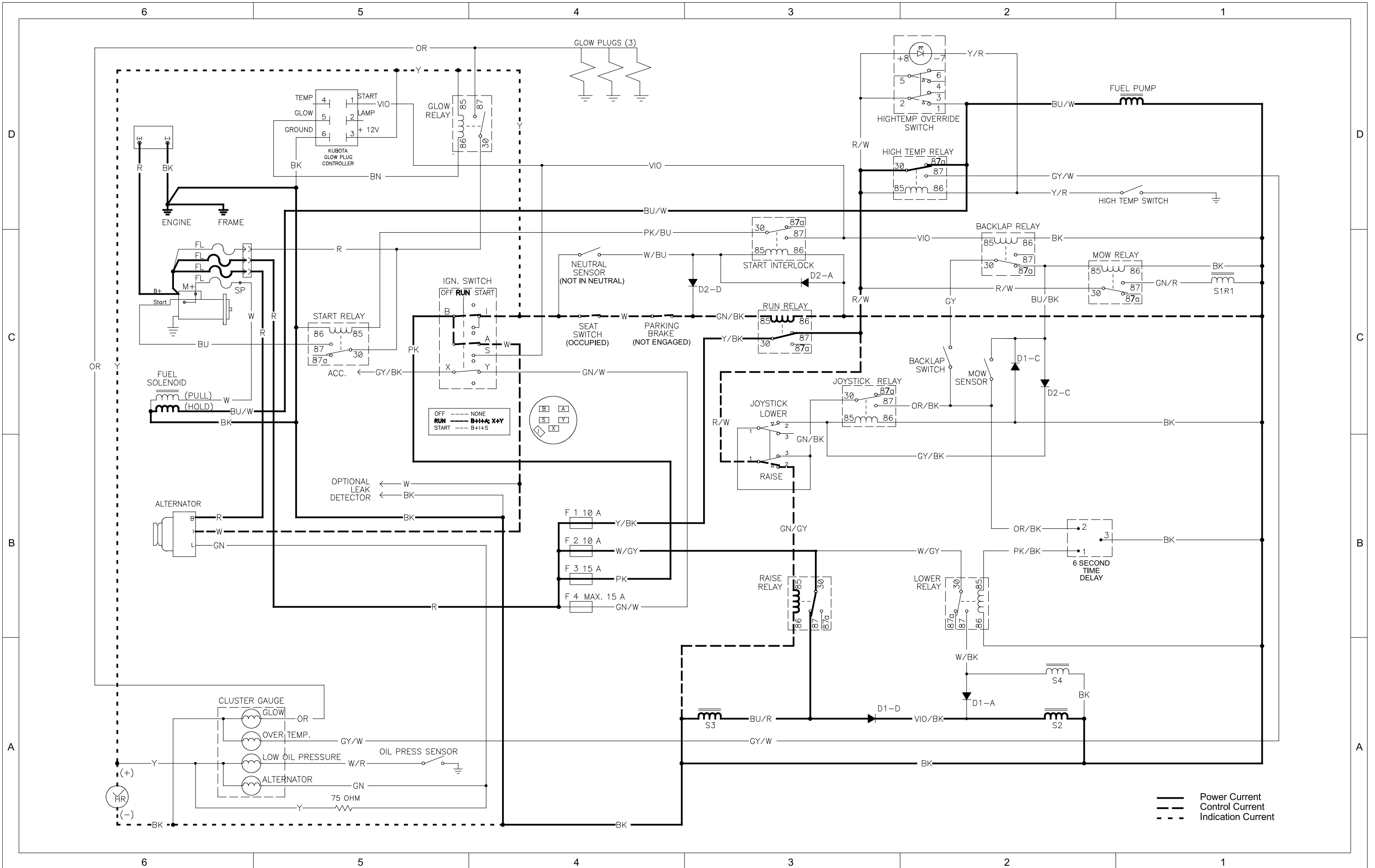


Electrical Circuit Diagrams – Run Circuits (typical)



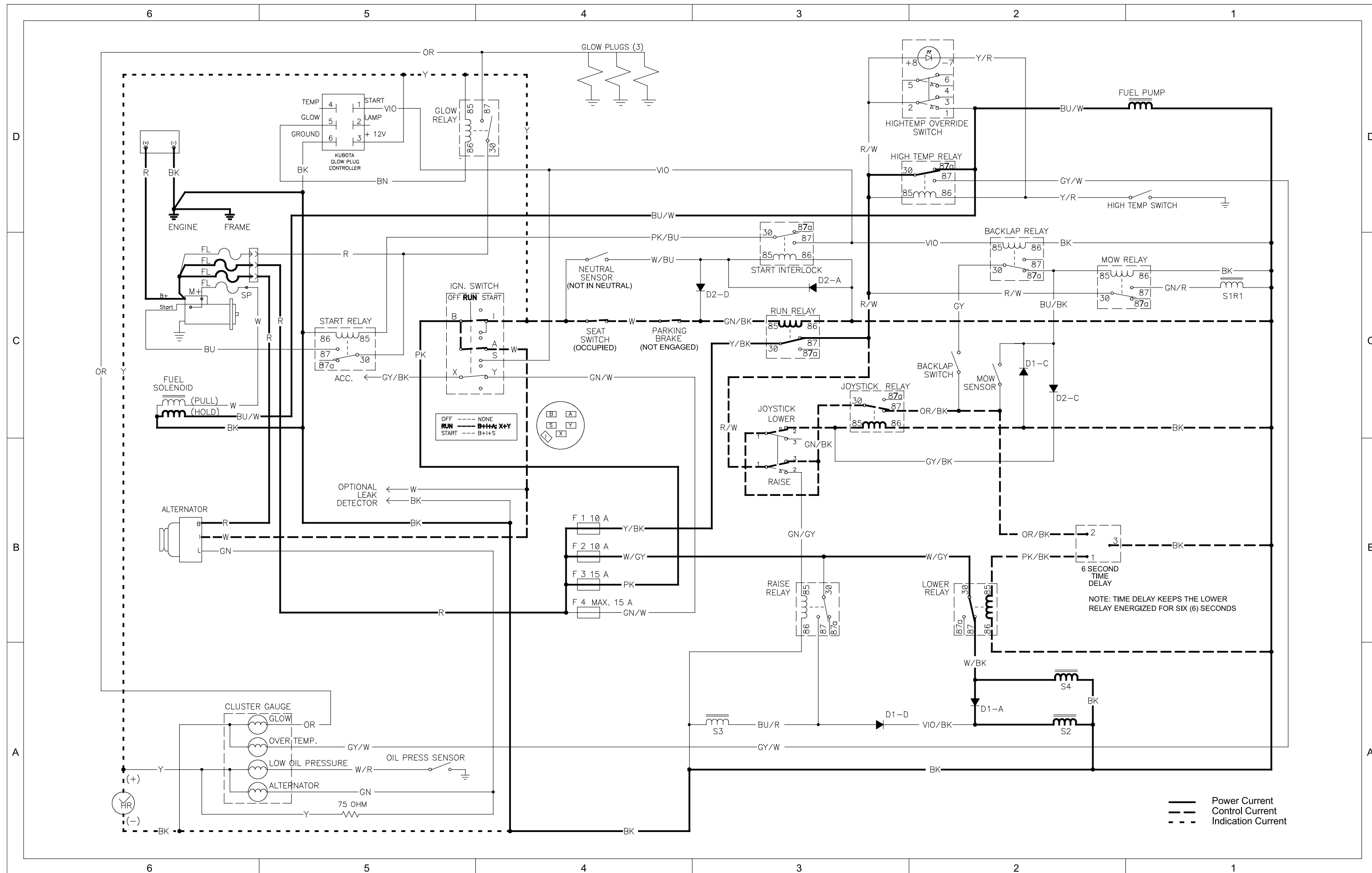
g327662

Electrical Circuit Diagrams – Raise Cutting Units Circuits (typical)



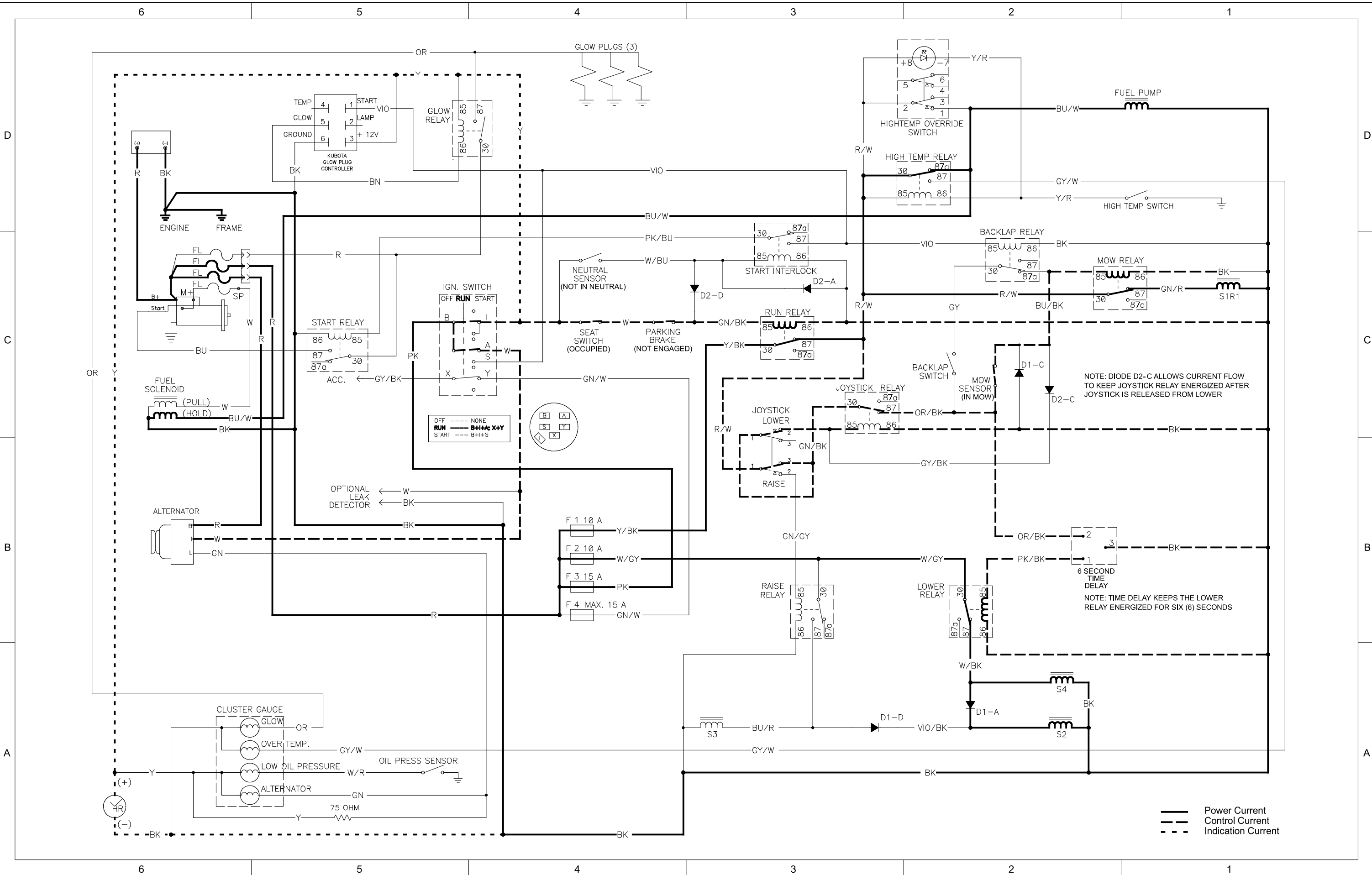
g327661

Electrical Circuit Diagrams – Lower Cutting Units Circuits (typical)

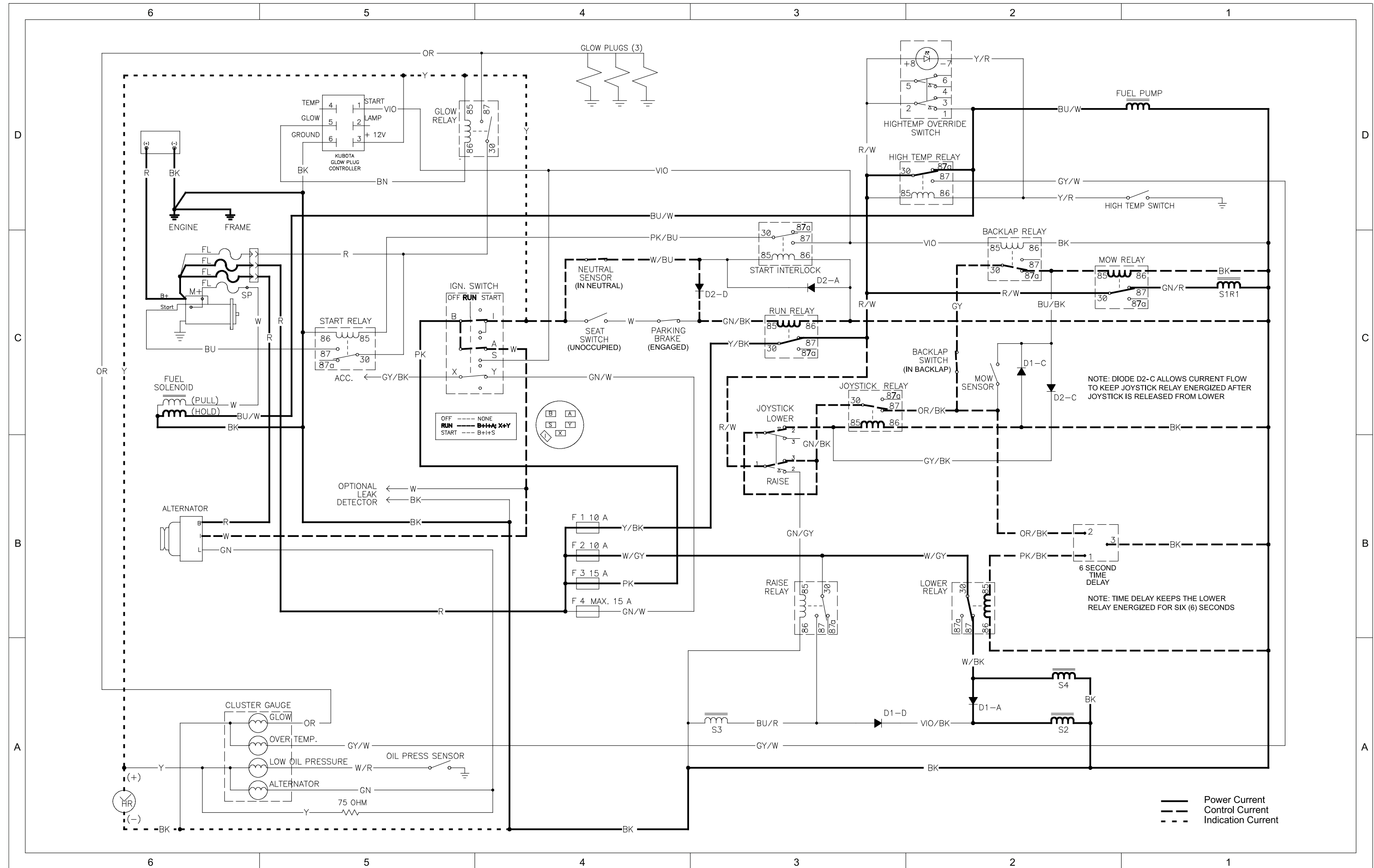


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Electrical Circuit Diagrams – Mow Circuits (typical)

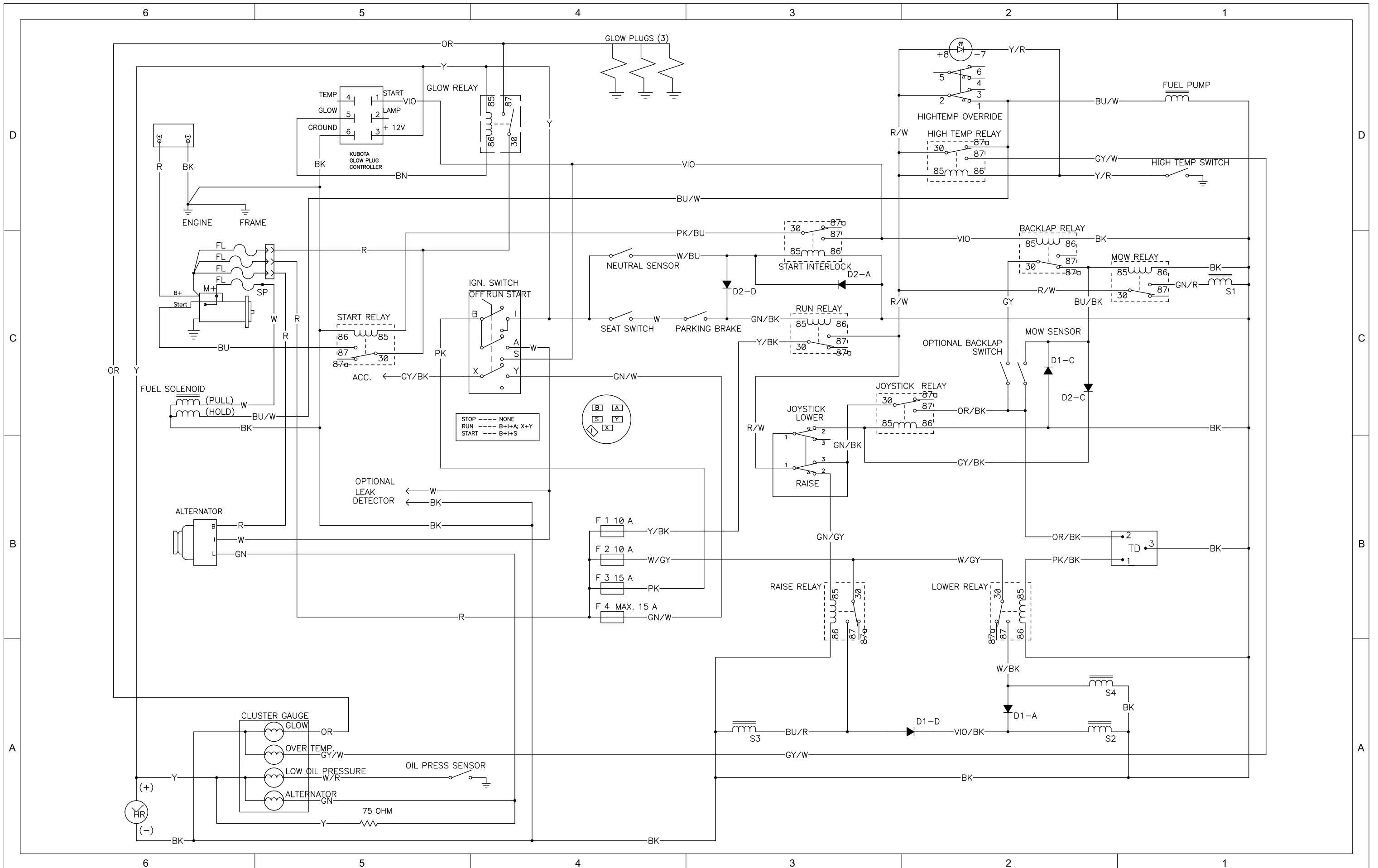


Electrical Circuit Diagrams – Backlap Circuits (typical)

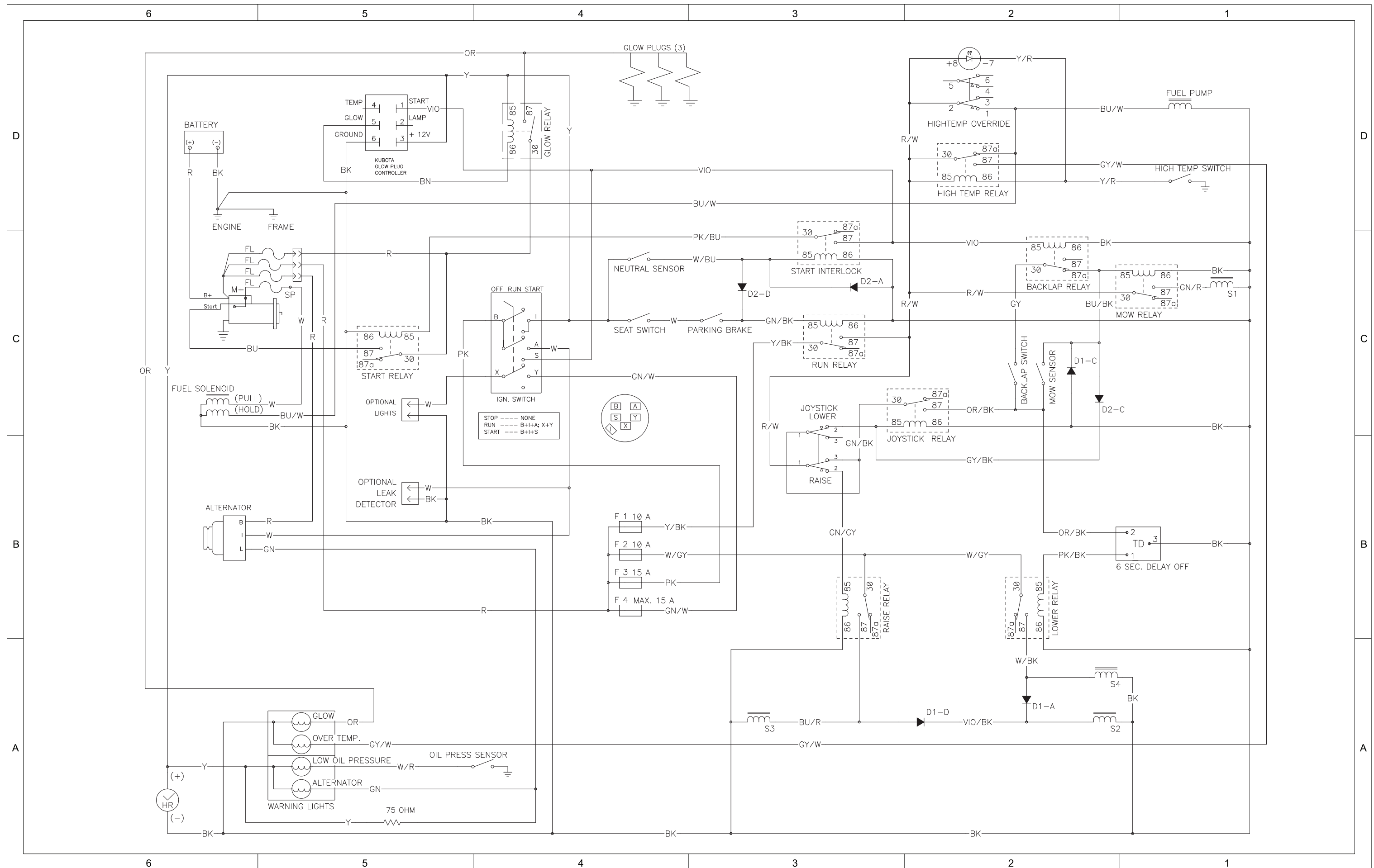


g327657

Electrical Schematic (serial numbers before 31500000)

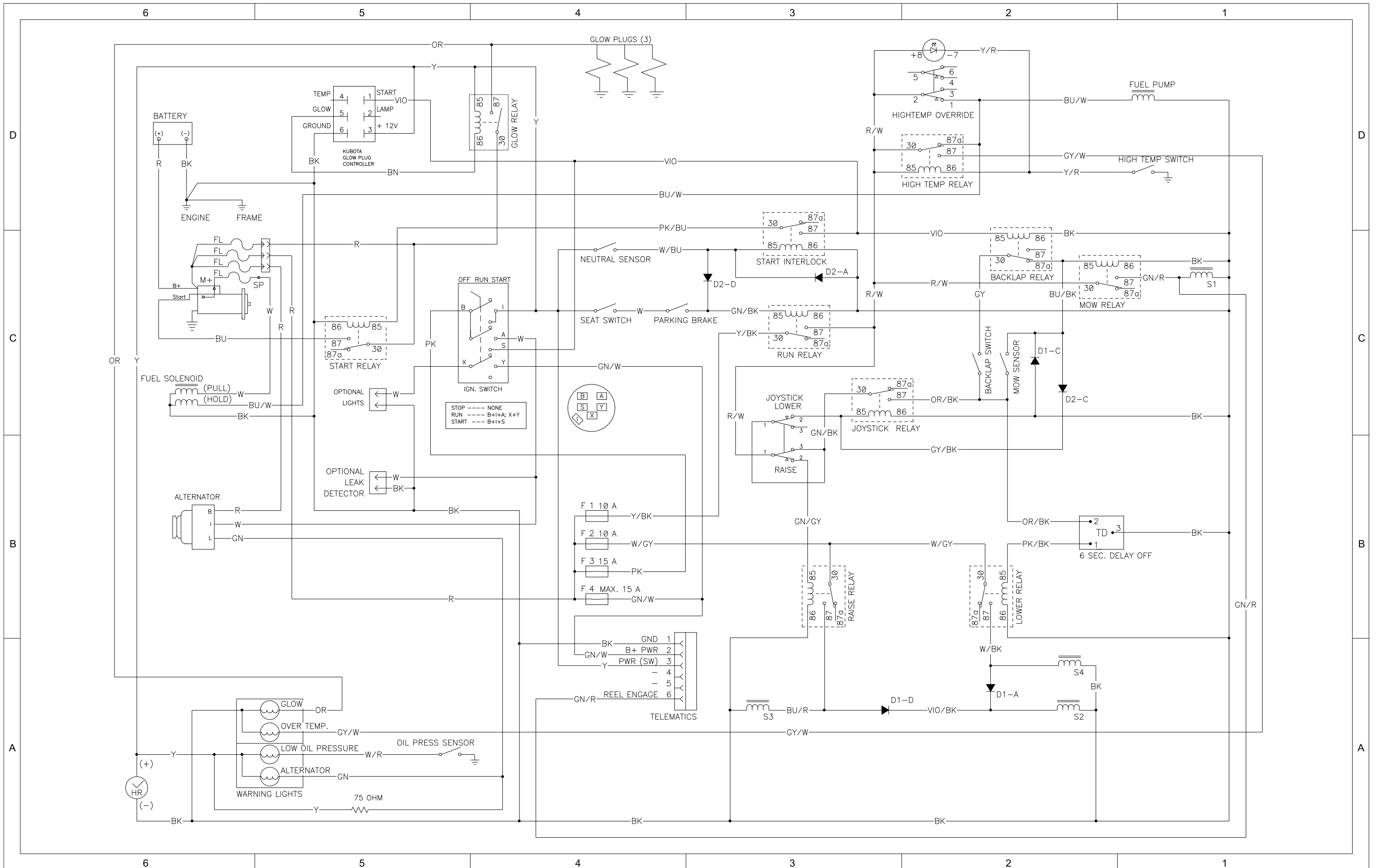


Electrical Schematic (serial numbers 31500000 to 407100000)

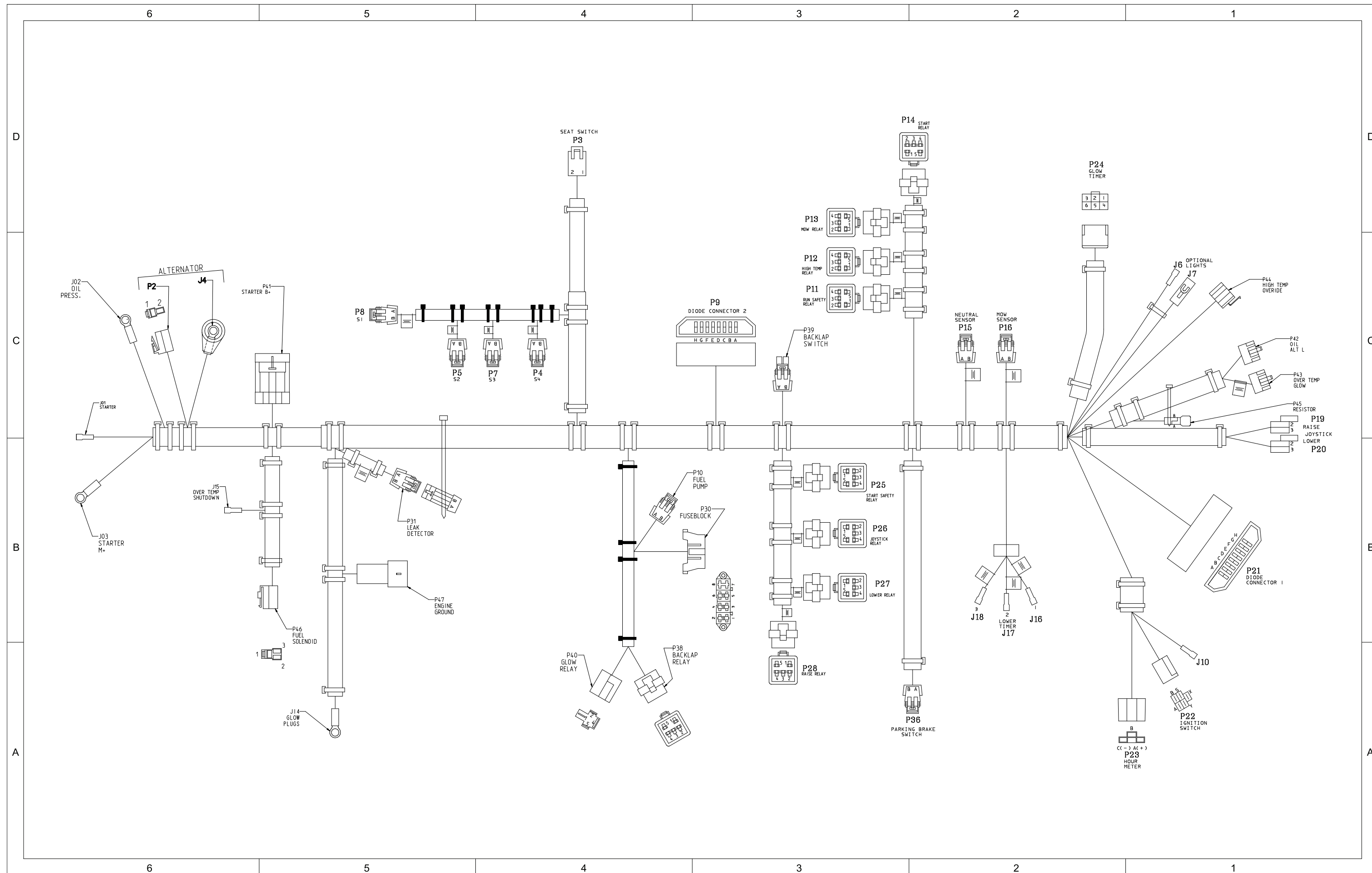


g327665

Electrical Schematic (serial numbers above 407100000)

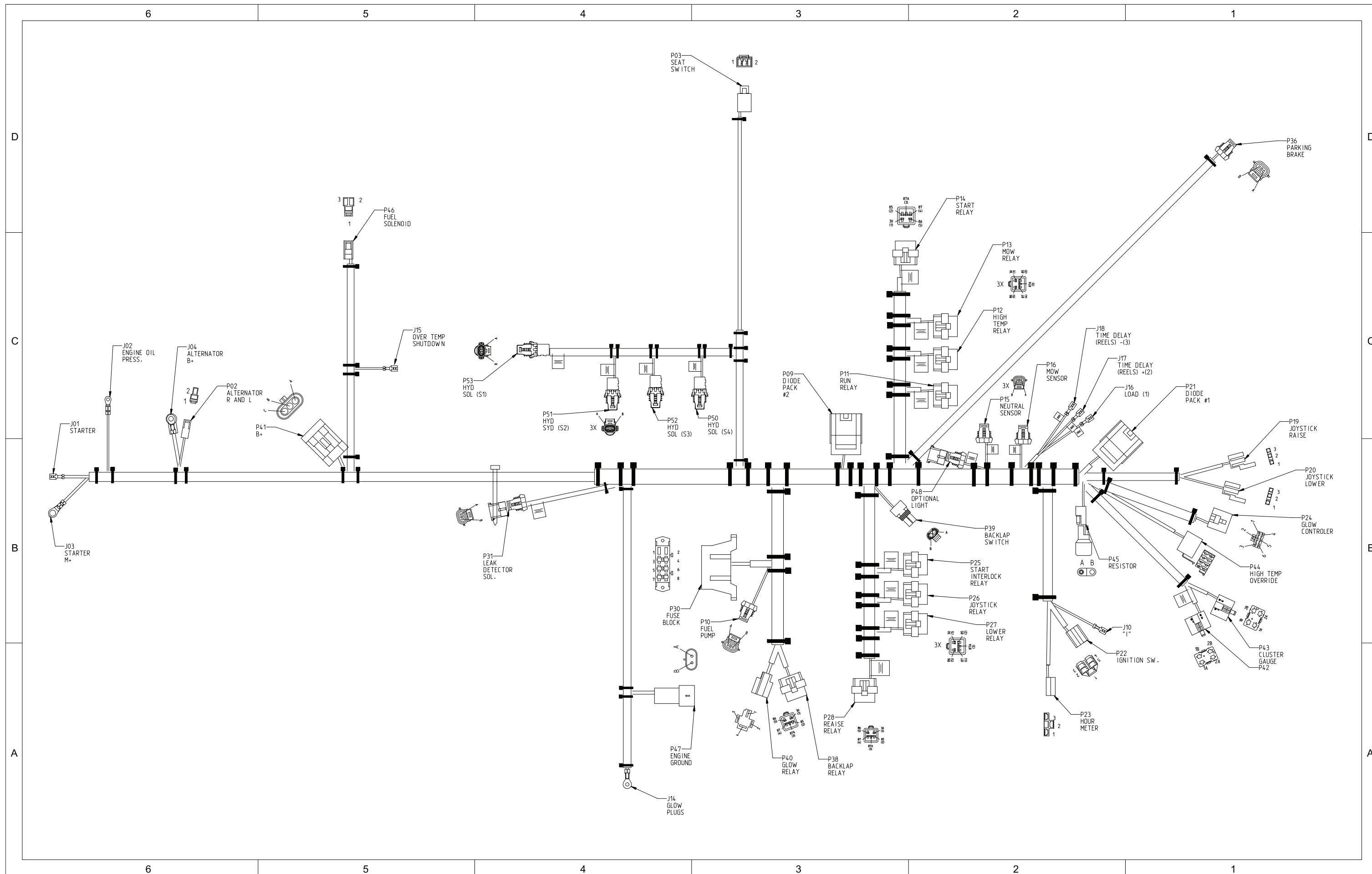


Main Wire Harness Drawing (serial numbers below 315000000)



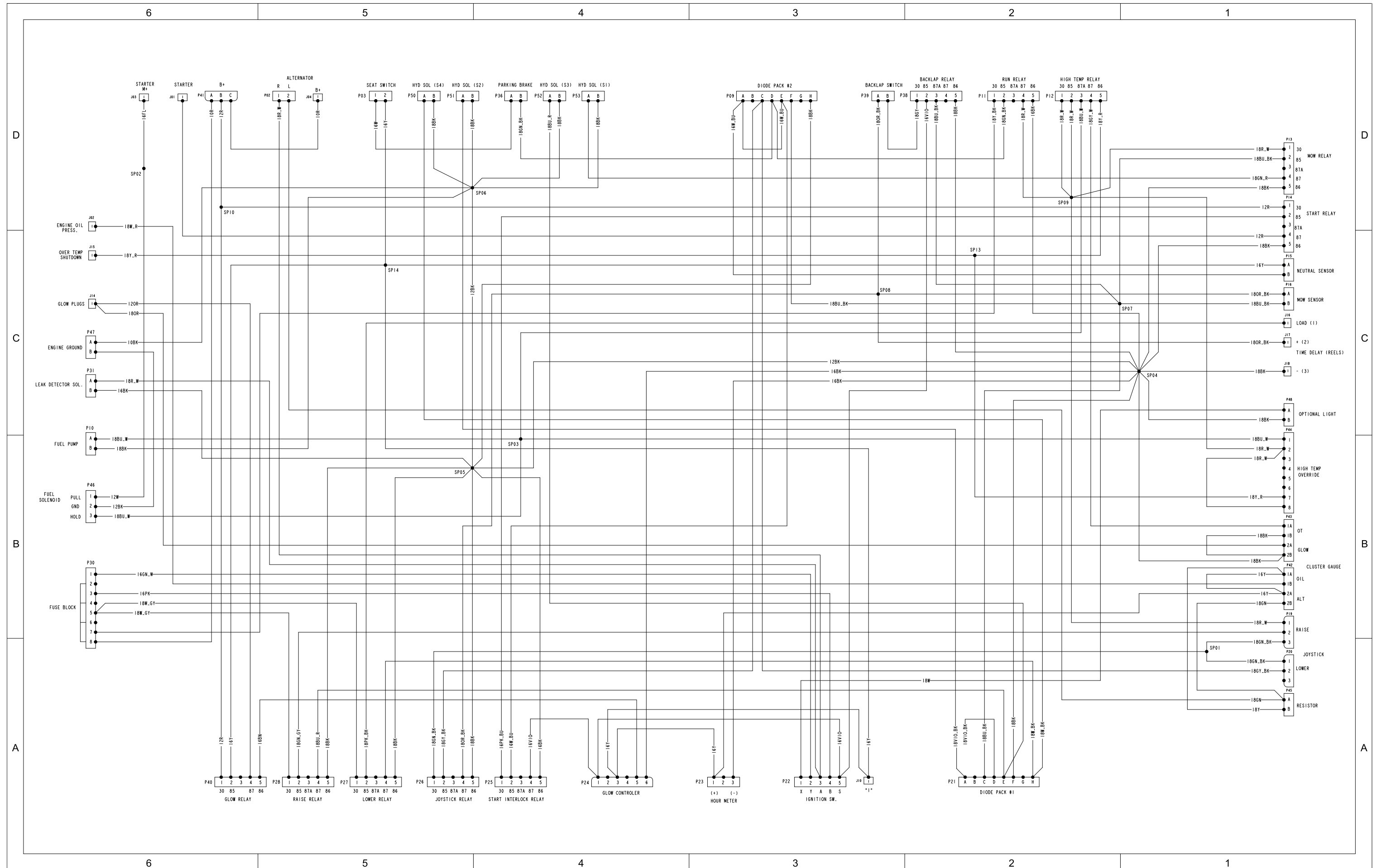
g327750

Main Wire Harness Drawing (serial numbers 31500000 to 407100000)

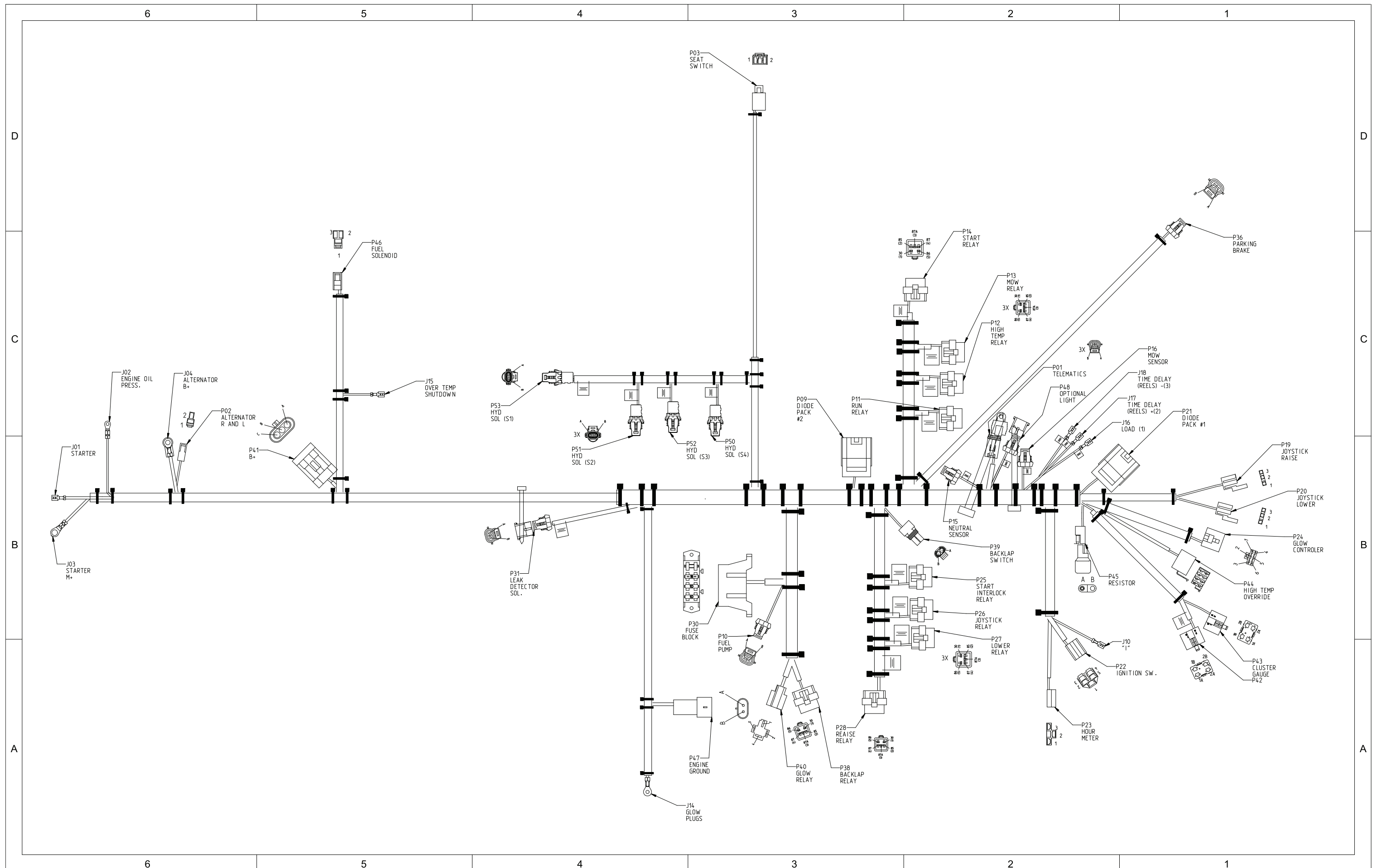


g327989

Main Wire Harness Diagram (serial numbers 31500000 to 40710000)

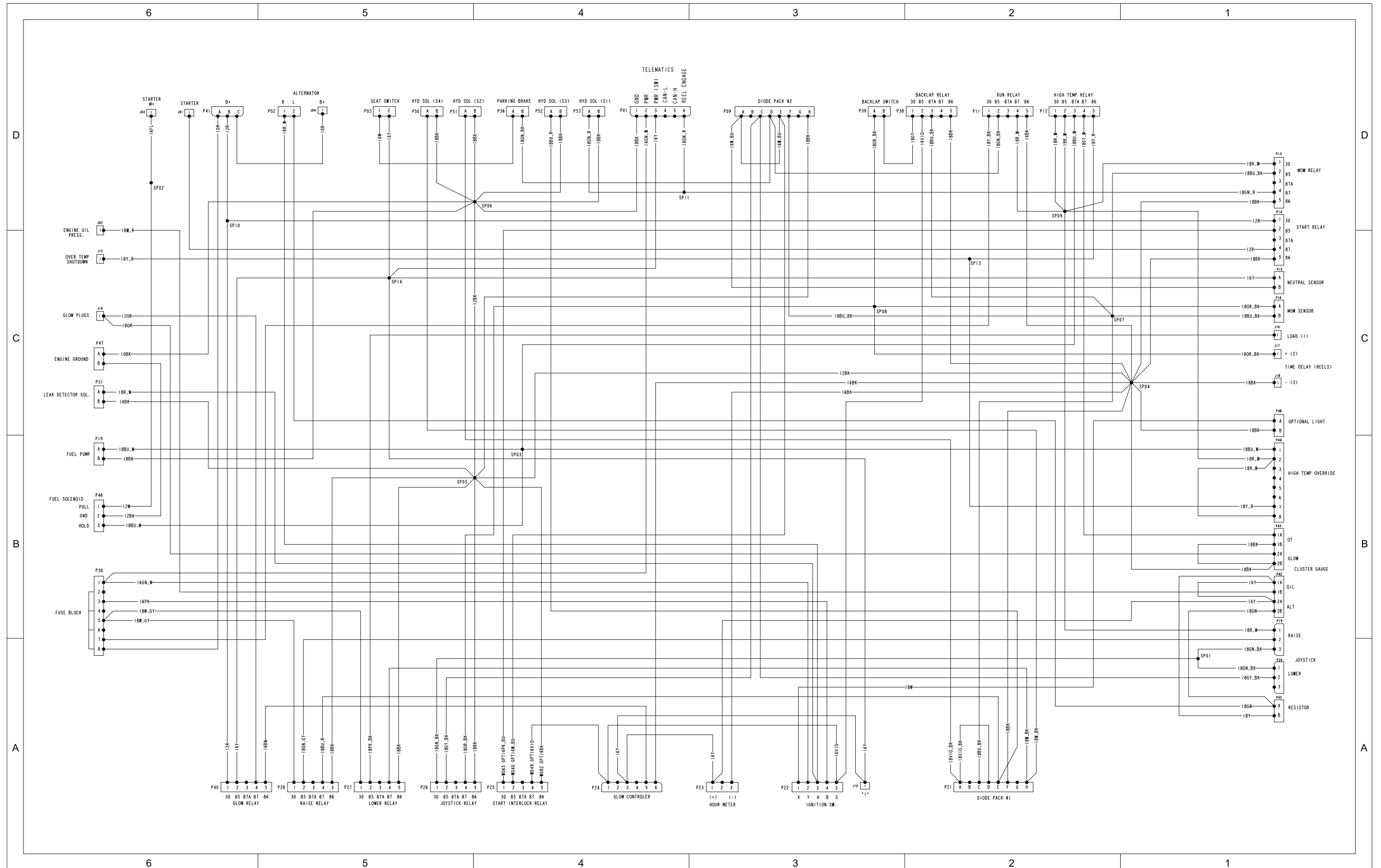


Main Wire Harness Drawing (serial numbers above 407100000)



g327991

Main Wire Harness Diagram (serial numbers above 407100000)





Count on it.