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TORO®

Count on it.

Service Manual

Reelmaster® 3100-D

Original Instructions (EN)

Revision History

Revision	Date	Description
--	1999	Initial Issue.
A	2002	Updated Engine chapter.
B	2003	Updated Hydraulics chapter.
C	2005	Updated Hydraulics chapter.
D	2007	Updated Engine chapter.
E	2009	Updated Engine chapter.
F	2011	Updated Hydraulics chapter.
G	2012	Updated DPA Cutting Units.
H	02/2018	Added revision history.
J	04/2018	Revised bedknife installation procedures, added Universal Groomer chapter.
K	03/2019	Updated Engine and Wheels & Brakes chapters.
L	12/2019	Updated Chapter 1 Safety Statements.
M	05/2020	Updated Electrical, DPA Cutting Unit, Universal Groomer chapters.

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

or Mail to:

Technical Publication Manager, Commercial
The Toro Company
8111 Lyndale Avenue South
Bloomington, MN 55420-1196
Phone: +1 952-887-8495

NOTES

Service Manual

Reelmaster® 3100-D

Preface

The purpose of this publication is to provide the service technician with information for troubleshooting, testing, and repair of major systems and components on the Reelmaster 3100-D.

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 Manual and Parts Catalog are available on the internet at www.Toro.com.

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

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

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

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

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Chapter 1

Safety

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General Safety Instructions

The REELMASTER 3100- 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 are dependent partially 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 by the operator or owner of the machine can result in injury. To reduce the potential for any injury, comply with the following safety instructions.

WARNING

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

Before Operating

1. Operate machine only after reading and understanding the contents of the Operator's Manual and viewing the Operator's Video. Copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Only trained operators who are skilled in slope operation and who have read the Operator's Manual and viewed the Operator's Video should operate the machine. Never allow children to operate the machine or adults to operate it without proper instructions.

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

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

5. Keep all shields, safety devices, and decals in place. Repair or replace damaged, malfunctioning, or illegible shields, safety devices, or decals before operating the machine.

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

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

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

9. Fill fuel tank with diesel fuel before starting engine. Avoid spilling any fuel. Since fuel is highly flammable, handle it carefully.

A. Use an approved fuel 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 not over one inch from the top of the tank (bottom of the filler neck). Do not overfill.

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 interlock switches daily for proper operation (see Chapter 5 - Electrical System). Do not rely entirely on safety switches: shut off engine before getting off seat. If a switch fails, replace it before operating the machine. The interlock system is for your protection, so do not bypass it.

4. Operator must be skilled and trained in how to drive on hillsides. Failure to use caution on slopes or hills may cause vehicle to tip or roll, possibly resulting in personal injury or death.

5. This triplex mower has a unique drive system for superior traction on hills. The uphill wheel will not spin out and limit traction like conventional triplexes. If operated on a side hill that is too steep, rollover may occur before losing traction.

6. Before backing up, look to the rear and assure no one is behind the machine. Watch out for traffic when near or crossing roads. Always yield the right of way.

7. Keep hands, feet and clothing away from moving parts and the deck discharge area.

8. Establish special procedures and work rules for unusual operating conditions (e.g. slopes, sand traps, water hazards). Survey the mowing site completely to determine which areas can be operated on safely. When performing this site survey, always use common sense and take into consideration the turf condition and the rollover risk. To perform a site survey, follow the procedure outlined in the Operator's Manual.

Stay alert for holes in terrain and other hidden hazards which can cause a sudden change in side hill angle. Use extreme caution when operating close to sand traps, ditches, creeks, steep hillsides, or other hazards. Reduce speed when making sharp turns. Do not turn on hills. Avoid sudden stops and starts. Use reverse pedal for braking. Cutting units should be lowered when going down slopes.

9. When starting the engine:

   A. Engage parking brake.

   B. Be sure traction pedal is in neutral and blade drive is in disengage position.

   C. After engine starts, release parking brake and keep foot off traction pedal. Machine must not move. If movement is evident, the neutral control linkage is incorrectly adjusted: therefore, shut engine off and adjust until machine does not move when traction pedal is released (see Adjust Transmission for Neutral).

10. Before backing up, look to the rear and assure no one is behind the machine. Watch out for traffic when near or crossing roads. Always yield the right of way.

11. Keep hands, feet and clothing away from moving parts and the reel discharge area. Grass baskets, if so equipped, must be in place during reel operation for maximum safety.

12. This product 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.

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

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

15. 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.

16. Before getting off the seat:

   A. Move traction pedal to neutral.

   B. Set the parking brake.

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

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

17. Whenever machine is left unattended, make sure 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 and remove key from switch to prevent accidental starting of the engine.

2. Check performance of all interlock switches daily. Do not defeat interlock system. It is for your protection.

3. To ensure entire machine is in good operating condition, frequently check and keep all nuts, bolts, screws and hydraulic fittings tight.

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

5. Keep body and hands away from pin hole leaks 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 injected 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.

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

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

8. To reduce potential fire hazard, keep the engine area free of excessive grease, grass, leaves and accumulation of dirt.

9. 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 and any moving parts. Keep everyone away.

10. 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.

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

12. To insure optimum performance and safety, 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.

Jacking Instructions

CAUTION

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

Use the following positions when jacking up the machine:

Jacking the Front End

1. If the front wheel motor is to be removed, position jack securely under the square tube of the lower frame as closely to the side plate as possible (Fig. 1).

2. If the front tire is to be removed, position the jack securely under the front wheel motor.

3. Use jack stands or hardwood blocks under the square tube or wheel motors to support the machine (Fig. 1).

Jacking the Rear End

1. The preferred method of lifting the rear end of the machine for removing the rear fork or the rear wheel motor:

A. Secure a chain fall or hoist to the rear casting (Fig 2).

B. Chock both front tires. Lift rear tire off the ground.

C. Use jack stands or hardwood blocks under the frame to support the machine (Fig. 3).

2. If the rear of the machine can not be lifted from above (Fig. 3),

IMPORTANT: Make sure jack is as close to the rear fork as possible when jacking the rear wheel.

A. Place jack securely under the rear wheel motor.

B. Chock both front tires. Jack rear tire off the ground.

C. Use jack stands or blocks under the frame to secure the machine.

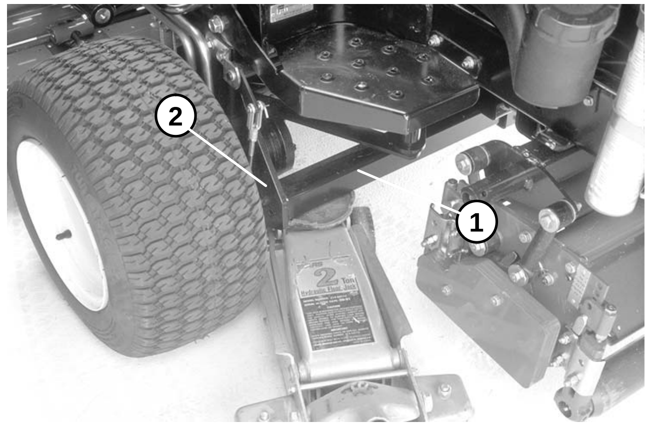

Figure 1

1. Square tube **2. Side plate**

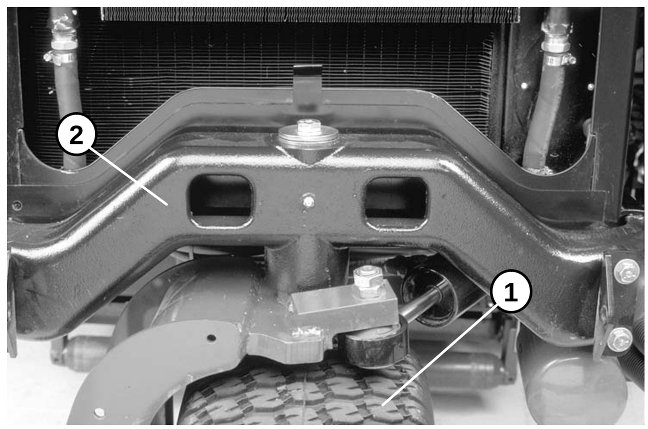

Figure 2

1. Rear tire **2. Rear casting**

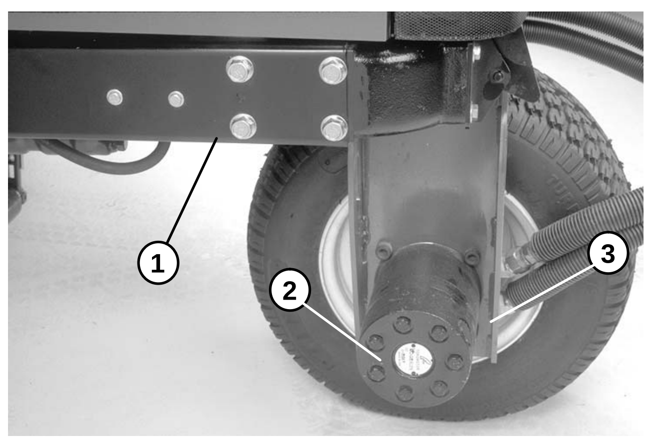

Figure 3

1. Frame **2. Rear wheel motor** **3. Rear fork**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Reelmaster 3100−D. If any decal becomes illegible or damaged, install a new decal. Part numbers for replacement decals are listed in your Parts Catalog. Order replacement decals from your Authorized Toro Distributor.

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Product Records and Maintenance

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Product Records

Insert Operator's Manual and Parts Catalog for your Reelmaster 3100-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 Reelmaster 3100-D are covered in the Operator's Manual. Refer to that publication when performing regular equipment maintenance.

Equivalents and Conversions

Decimal and Millimeter Equivalents

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

U.S.to Metric Conversions

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

Torque Specifications

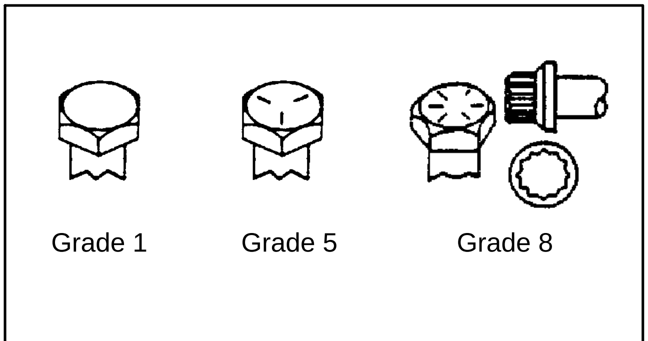
Recommended fastener torque values are listed in the following tables. For critical applications, as determined by Toro, either the recommended torque or a torque that is unique to the application is clearly identified and specified in this Service Manual.

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

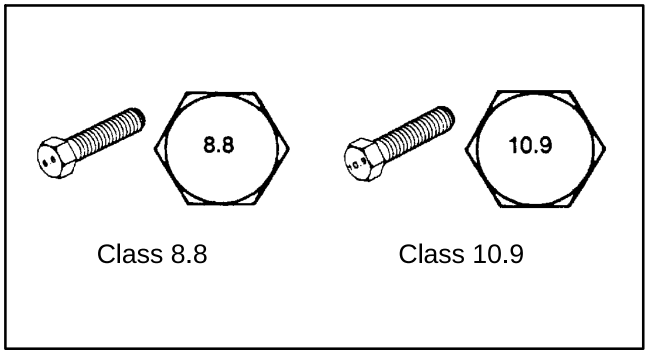
As noted in the following tables, torque values should be **reduced by 25% for lubricated fasteners** to achieve the similar stress as a dry fastener. Torque values may also have to be reduced when the fastener is threaded into aluminum or brass. The specific torque value should be determined based on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

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

Fastener Identification



Inch Series Bolts and Screws



Metric Bolts and Screws

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

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

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

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

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

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

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

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

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

Note: The nominal torque values listed above are based on 75% of the minimum proof load specified in SAE J1199. The tolerance is approximately ± 10% of the nominal torque value.

Other Torque Specifications

SAE Grade 8 Steel Set Screws

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

Wheel Bolts and Lug Nuts

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

** For steel wheels and non−lubricated fasteners.

Thread Cutting Screws (Zinc Plated Steel)

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

Thread Cutting Screws (Zinc Plated Steel)

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

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

Conversion Factors

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

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

Lubrication

Traction Unit

CAUTION

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

The traction unit has grease fittings that must be lubricated regularly with No. 2 General Purpose Lithium Base Grease. If machine is operated under normal conditions, lubricate bearings and bushings after every 50 hours of operation. Bearings and bushings must be lubricated daily when operating conditions are extremely dusty and dirty. Dusty and dirty operating conditions could cause dirt to get into the bearings and bushings, resulting in accelerated wear. Lubricate bearings and bushings immediately <u>after every</u> washing, regardless of the interval listed.

The traction unit bearings and bushings that must be lubricated are: rear cutting unit pivot (Fig. 4), front cutting unit pivot (Fig. 5), sideWinder cylinder ends (2) (model 03201 only) (Fig. 6), steering pivot (Fig. 7), rear lift arm pivot and lift cylinder (2) (Fig. 8), left front lift arm pivot and lift cylinder (2) (Fig. 9), right front lift arm pivot and lift cylinder (2) (Fig. 10), neutral arm assembly (Fig. 11), mow/transport slide (Fig. 12), belt tension pivot (Fig. 13) steering cylinder (Fig. 14).

Note: If desired, an additional grease fitting may be installed in other end of steering cylinder. Tire must be removed, fitting installed, greased, fitting removed and plug installed (Fig. 15).

IMPORTANT: Do not lubricate Sidewinder (model 03201) cross tube, bearing blocks are self lubricated.

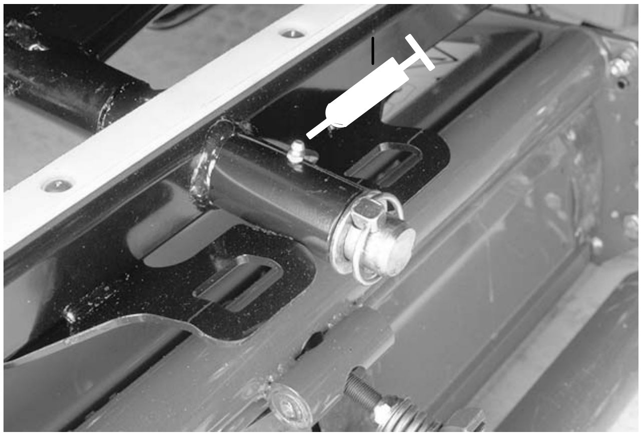


Figure 4

Figure 5

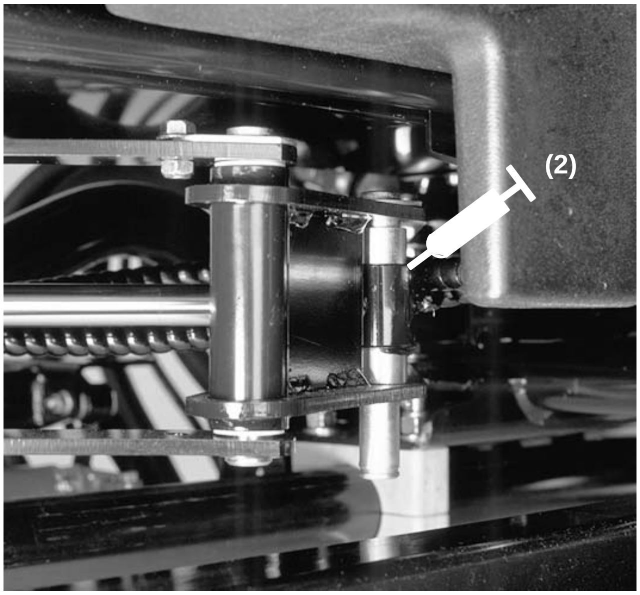


Figure 6

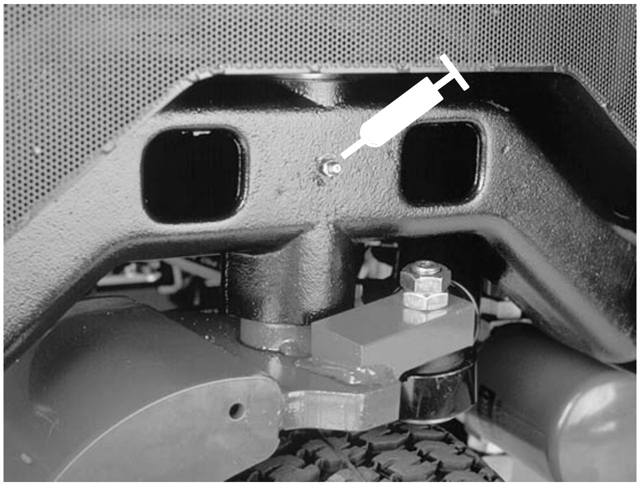


Figure 7

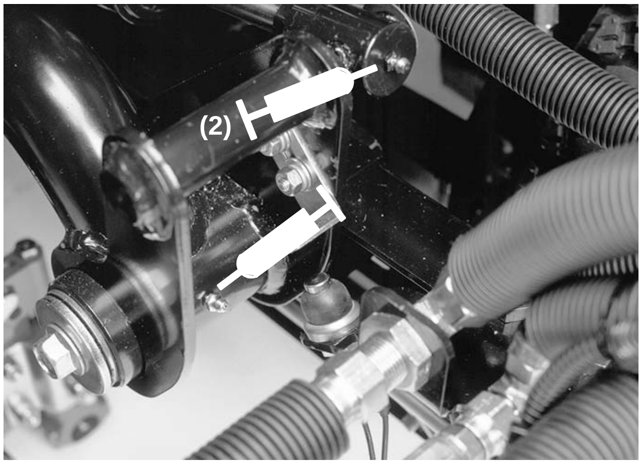
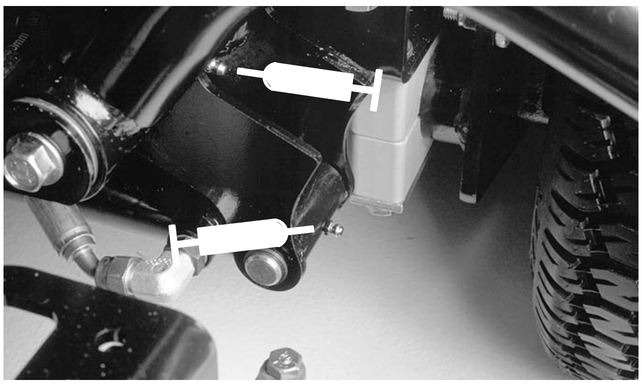


Figure 8



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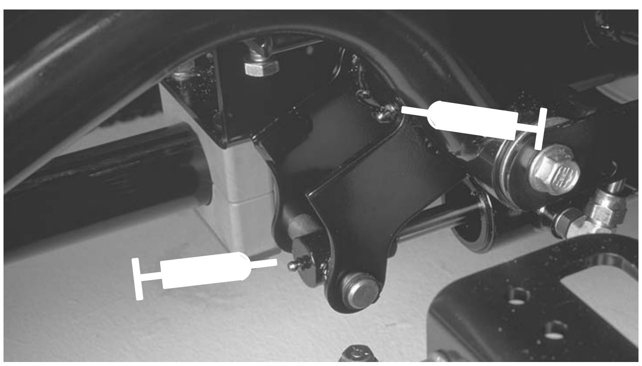

Figure 10

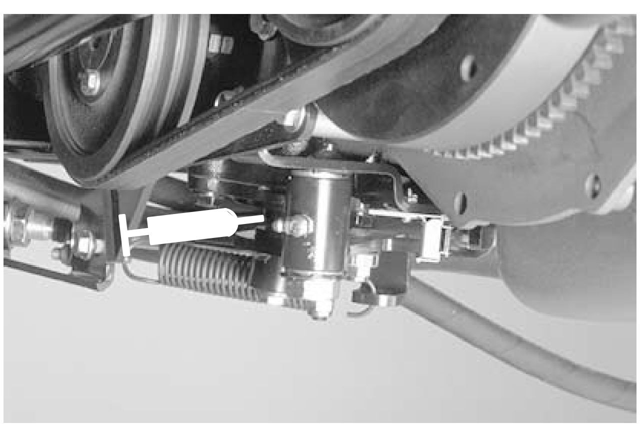

Figure 11

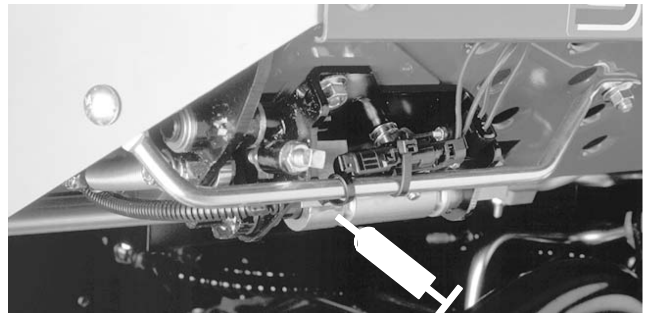

Figure 12

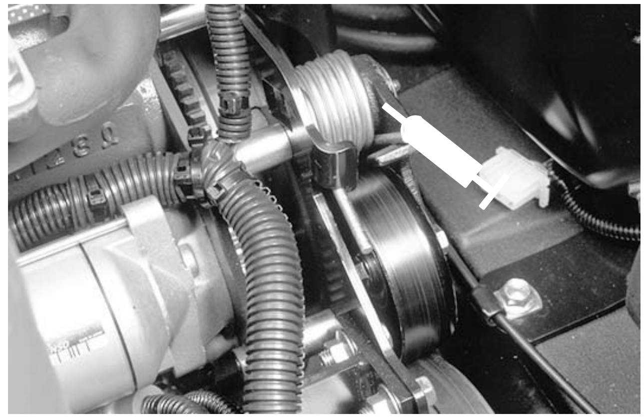

Figure 13

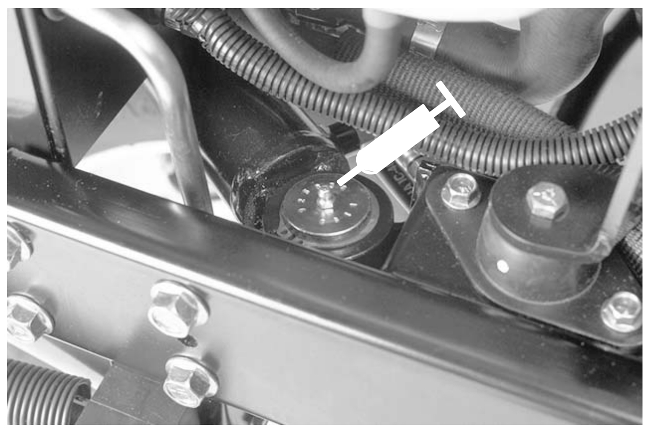

Figure 14

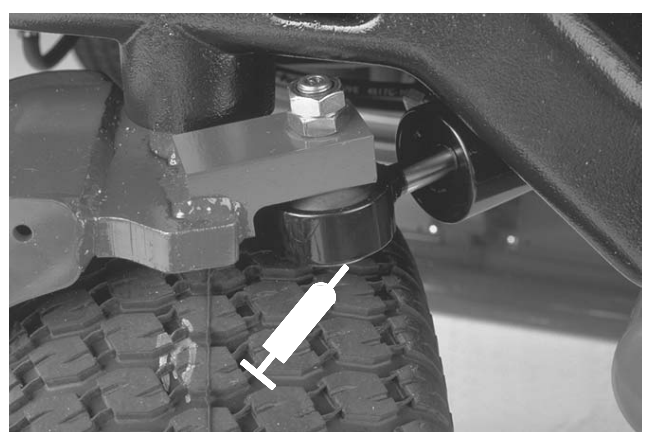

Figure 15 (See **Note**)

Cutting Units

Each cutting unit has (6) grease fittings (with optional front roller installed) that must be lubricated regularly with No. 2 General Purpose Lithium Base Grease.

The grease fitting locations and quantities areas follows: Bedknife adjuster (2), every 50 hours (Fig. 17); Reel bearings (2) and front and rear rollers (2 ea.) (Fig. 16).

Note: Lubricate only one reel bearing grease fitting on each end of cutting unit.

IMPORTANT: Lubricating cutting units immediately after washing. This helps to purge water out of bearings and increases bearing life.

1. Wipe each grease fitting with a clean rag.

IMPORTANT: Do not apply too much pressure or grease seals will be permanently damaged.

2. Apply grease until pressure is felt against handle.

3. Wipe excess grease away.

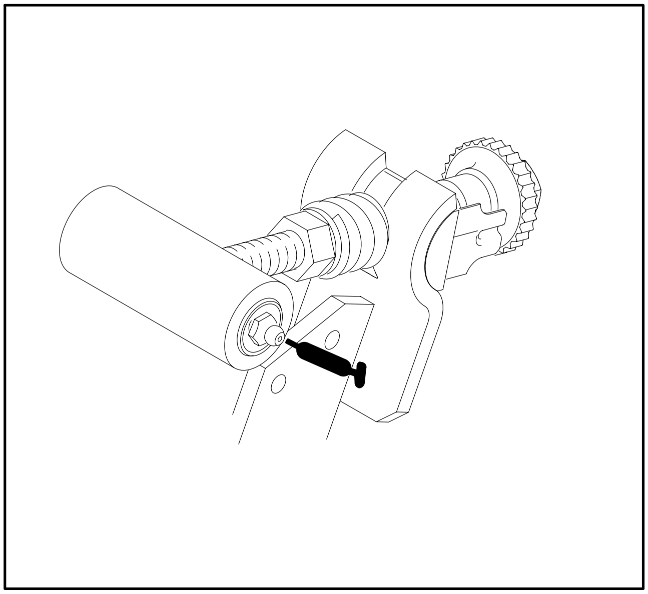

Figure 17
Grease every 50 operating hours.

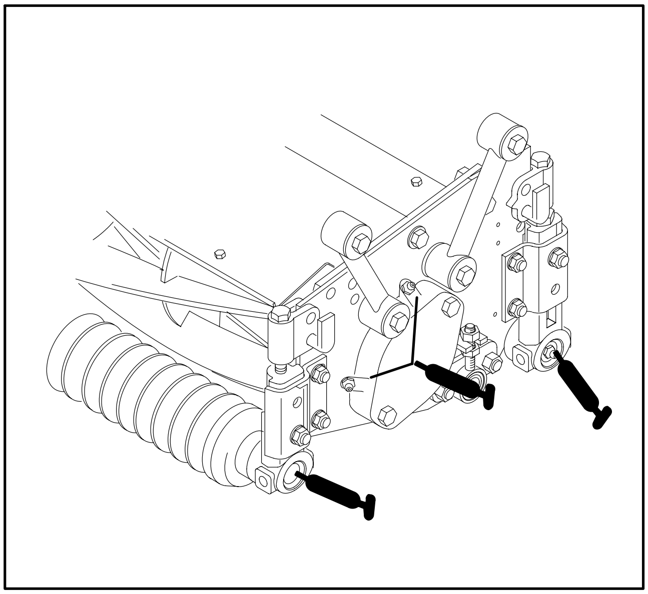

Figure 18
Grease every 8 operating hours.

Preparation for Seasonal Storage

Traction Unit

1. Clean traction unit, cutting units, and the engine thoroughly.

2. Check tire pressure. Inflate all tires to 14 to 18 psi (0.97 to 1.24 Bar).

3. Check all fasteners for looseness; tighten as necessary.

4. Lubricate all grease fittings and pivot points (see Lubrication).

5. Cover entire length of the Sidewinder (Model 03201) cross tube with a light oil to prevent rust. After storage, wipe off all oil.

6. Lightly sand and use touch−up paint on painted areas that are scratched, chipped, or rusted. Repair any dents in the metal body.

7. Service battery and cables as follows:

   A. Remove battery terminals from the battery posts (see Battery Service in Chapter 5 − Electrical System).

   B. Clean battery, terminals, and posts with a wire brush and baking soda solution.

   C. Coat cable terminals and battery posts with Grafo 112X skin−over grease (Toro Part No. 505-47) or petroleum jelly to prevent corrosion.

   D. Every 30 days, check battery electrolyte levels and fill battery as necessary (see Battery Care in Chapter 5 − Electrical System).

   E. Every 60 days, recharge battery slowly for 24 hours to prevent sulfate from forming on the battery plates (see manufacturer's instructions for battery charger).

Traction Unit

1. Drain engine oil from the oil pan and replace the drain plug.

2. Remove and discard oil filter. Install a new oil filter.

3. Refill oil pan with approximately 4.0 quarts (3.8 l) of SAE10W-30 motor oil.

4. Start engine and run at idle speed for approximately two minutes.

5. Stop engine.

6. Drain all fuel thoroughly from the fuel tank, fuel lines, and water/fuel separator (see Water/Fuel Separator and Fuel System in Chapter 3 − Kubota Diesel Engine).

7. Flush the fuel tank with fresh, clean diesel fuel (see Fuel System in Chapter 3 − Kubota Diesel Engine).

8. Re−secure all fuel system fittings.

9. Clean and service the air cleaner assembly (see Service Air Filter, Dust Cup, and Burp Valve in Chapter 3 − Kubota Diesel Engine).

10. Seal air cleaner inlet and the exhaust outlet with weatherproof tape.

11. Check anti−freeze protection and add as needed for expected minimum temperature in your area (see Check Cooling System in Chapter 3 − Kubota Diesel Engine).

Kubota Diesel Engine

Table of Contents

Introduction

This Chapter gives information about specifications, maintenance, troubleshooting, testing, and repair of the diesel engine used in the Reelmaster 3100−D.

Most repairs and adjustments require tools which are commonly available in many service shops. Special tools are described in the Kubota Workshop Manual, Diesel Engine, 05 Series. The use of some specialized test equipment is explained. However, the cost of the test equipment and the specialized nature of some repairs may dictate that the work be done at an engine repair facility.

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

Specifications

Item	Description
Make / Designation	Kubota, 4−Cycle, 3 Cylinder, Water Cooled, Diesel Engine
Horse Power	21.5 HP @ 2500 RPM
Bore mm (in.)	78.0 (3.07)
Stroke mm (in.)	78.4 (3.09)
Total Displacement cc (cu. in.)	1123 (68.53)
Torque N−m (ft−lb)	67.3 (49.6) @ 2000 RPM
Firing Order	1−2−3
Combustion Chamber	Spherical Type
Fuel	No. 2 Diesel Fuel (ASTM D975)
Fuel Capacity liters (gallons)	28.4 (7.5)
Fuel Injection Pump	Bosch MD Type Mini Pump
Governor	Centrifugal Mechanical
Low Idle (no load)	1400 ± 50 RPM
High Idle (no load)	2650 ± 50 RPM
Direction of Rotation	Counterclockwise (Viewed from Flywheel)
Compression Ratio	22:1
Injection Nozzles	Mini Nozzle (DNOPD)
Engine Oil	10W30 Detergent (API CD, CE, CF, CF−4, or CG−4)
Oil Pump	Trochoid Type
Crankcase Oil Capacity liters (U.S. qt.)	3.8 (4.0) with Filter
Starter	12 VDC, 1 KW
Alternator/Regulator	12 VDC 40 AMP
Dry Weight kilograms (U.S. lbs)	93.0 (205.0)
Coolant Capacity liters (U.S. qt.)	5.7 (6.0) with 0.9 (1.0) Reservoir

General Information

Check Engine Oil

The engine is shipped with oil in the crankcase. However, oil level must be checked before and after the engine is first started.

Crankcase holds about 4.0 qts. (3.8 l) with filter.

IMPORTANT: Check level of oil every 5 operating hours or daily. Change oil after every 50 hours of operation.

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

2. Remove dipstick and wipe it with a clean rag. Push dipstick down into dipstick tube and make sure it is seated fully. Pull dipstick out and check oil level. If oil level is low, add enough oil to raise level to the FULL mark on the dipstick.

3. If oil level is low, remove oil fill cap and gradually add small quantities of oil, checking level frequently, until the oil level reaches the FULL mark on the dipstick.

4. The engine uses any high- quality 10W30 detergent oil having the American Petroleum Institute - API - “service classification” CD, CE, CF CF- 4 or CG- 4.

5. Install oil fill cap and close hood.

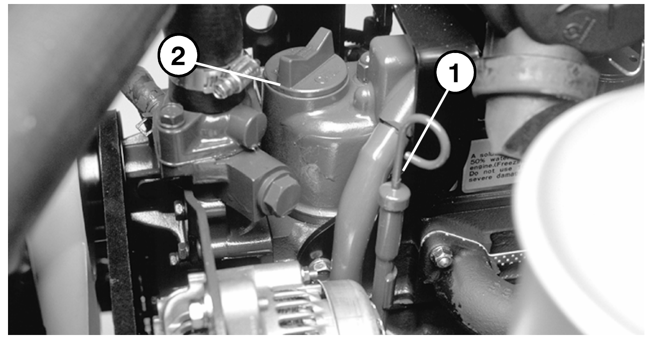

Figure 1

1. Dipstick **2. Oil fill cap**

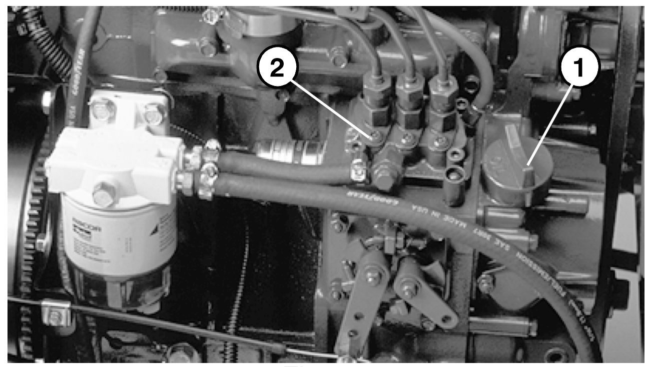

Figure 2

1. Oil fill cap **2. Injection pump**

Kubota Engine Workshop Manuals

The engine that powers your Reelmaster is a Kubota D1105 Tier 4 compliant engine. Kubota Engine Workshop Manuals are available for these engines. To ensure the correct engine workshop manual is used when servicing the engine in your machine, refer to the engine group code on the emission control information label “E” (emission) level.

1

Engine Group Code	”E” Emission Level and Workshop Manual
ES**	E2B
ET**	E3B
EF**	E4B

1. Engine Group Code

Fill Fuel Tank

> **DANGER**
>
> **Because diesel fuel is highly 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.**

IMPORTANT: Use No, 2 diesel fuel only for the engine. The fuel tank capacity is about 7.5 gallons (28.4 l).

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

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

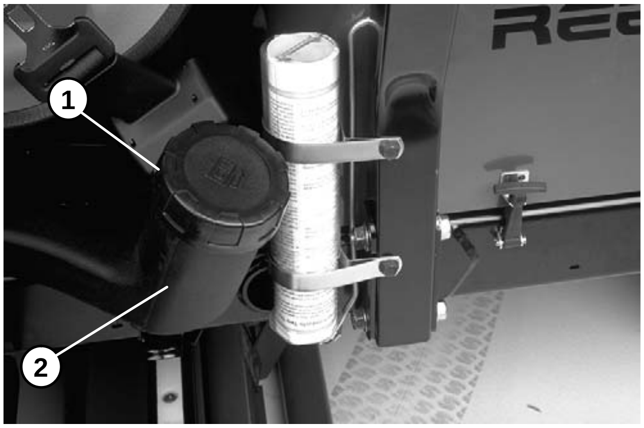

Figure 3

1. **Fuel tank cap** 2. **Fuel tank filler neck**

3. Fill fuel tank to the bottom of the filler neck. **Do not overfill.** Install cap to the neck.

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

Check Cooling System

The cooling system is filled with a 50/50 solution of water and permanent ethylene glycol anti−freeze. Check level of coolant at the beginning of each day before starting the engine. System capacity is about 6 quarts (5.7 l) with 1 quart (0.9 l) reservoir.

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

> **CAUTION**
>
> **If engine has been running, pressurized hot coolant can escape when the radiator cap is removed and cause burns. Open radiator cap only when the radiator and engine are cold (Fig. 4).**

2. Check level of coolant in the expansion tank. Coolant level should be between the marks on the side of tank.

3. If coolant level is low, remove expansion tank cap and replenish the system. **Do not overfill**.

4. Install expansion tank cap.

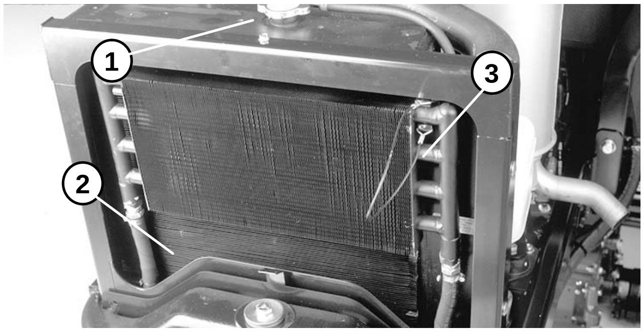

Figure 4

1. **Radiator cap** 3. **Oil cooler**
2. **Radiator**

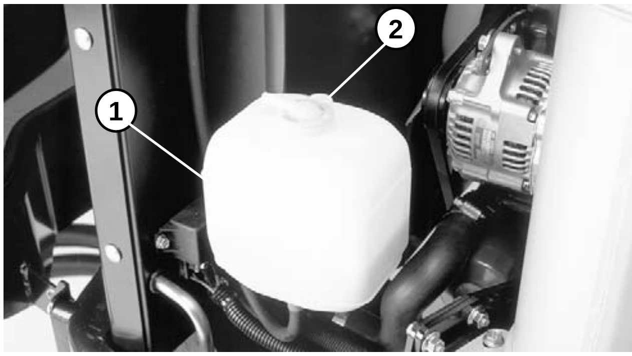

Figure 5

1. **Expansion tank** 2. **Cap**

Adjust Throttle Cable

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

2. Position throttle control lever all the way to the SLOW position so it stops against the control panel slot (Fig. 6).

3. Loosen cap screw securing the throttle cable to the swivel enough to loosen the cable (Fig. 7).

4. Hold speed control lever on the injection pump against the low idle stop. Tighten cable to the swivel with cap screw (Fig. 7).

5. Loosen screws securing throttle control lever to the control panel (Fig. 6).

6. Push throttle control lever all the way to the FAST position. Slide stop plate until it contacts throttle control lever, and tighten screws securing throttle control to control panel (Fig. 6).

Note: Attach spring scale where the throttle cable is attached to the control lever (Fig. 8).

7. If throttle control lever does not stay in position during operation, torque lock nut and cap screw used to tighten the friction disc from 40 to 55 in−lb (4.5 to 6.2 N−m). The force required to operate the throttle control lever should be from 30 to 45 lb (133 to 200 N). Torque fasteners as necessary (Fig. 8).

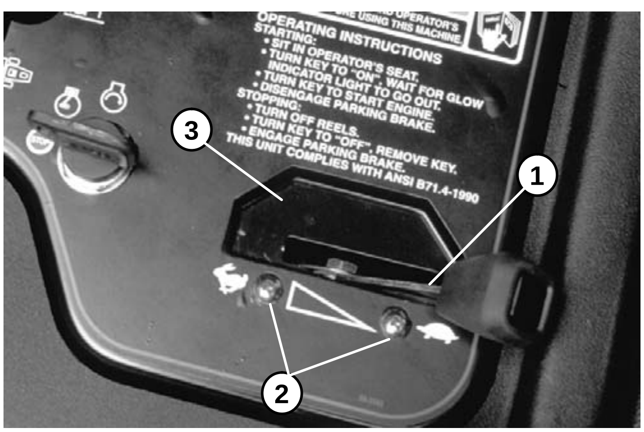

Figure 6

1. **Throttle control lever**
2. **Screws**
3. **Stop plate**

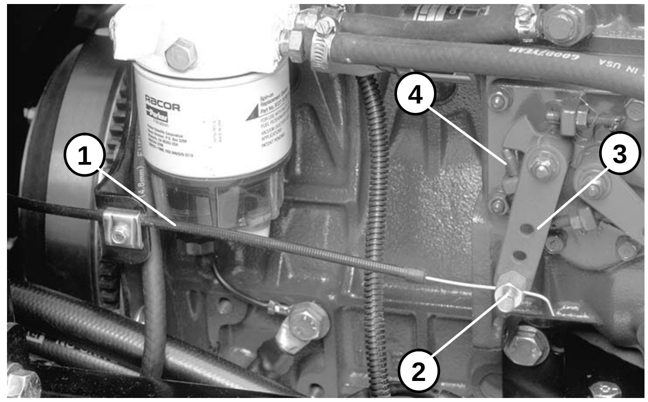

Figure 7

1. **Throttle cable**
2. **Swivel**
3. **Speed control lever**
4. **Low idle stop**

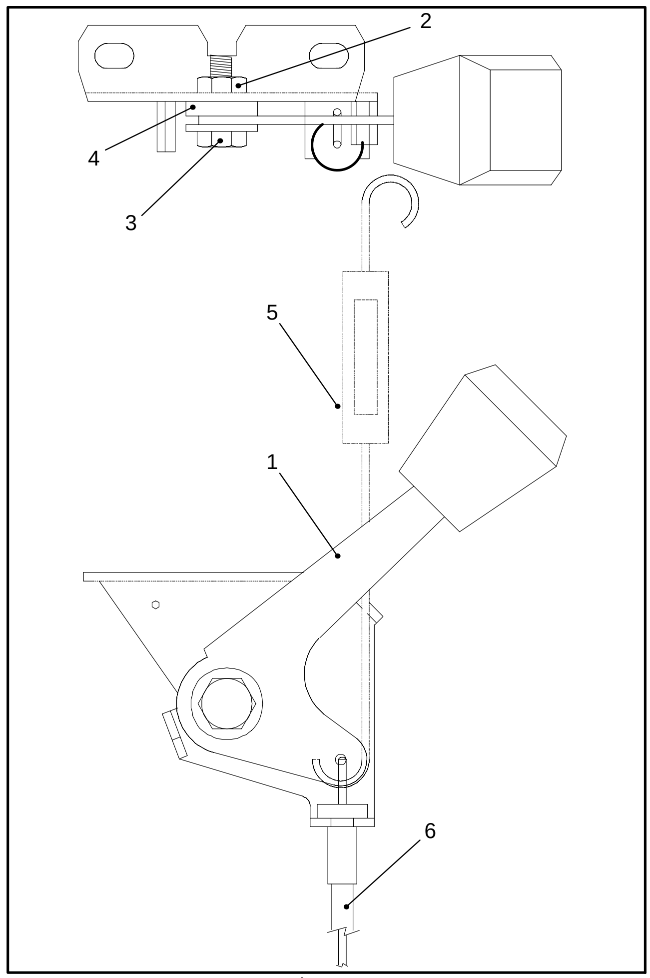

Figure 8

1. **Control lever**
2. **Lock nut**
3. **Cap screw**
4. **Friction disc**
5. **Spring scale**
6. **Throttle cable**

Adjust Alternator/Fan Belt

Condition and tension of all belts should be checked after the first 10 hours of operation and every 100 operating hours thereafter.

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

2. Open hood.

3. Check belt tension by depressing belt midway between the alternator and crankshaft pulleys with 22 lb. of force (98 N). Belt should deflect 7/16 inch (11 mm). If deflection is incorrect, proceed to step 4. If correct, continue operation.

4. Loosen bolt securing brace to engine and bolt securing alternator to brace.

5. Insert pry bar between alternator and engine. Position alternator out from engine to increase belt tension.

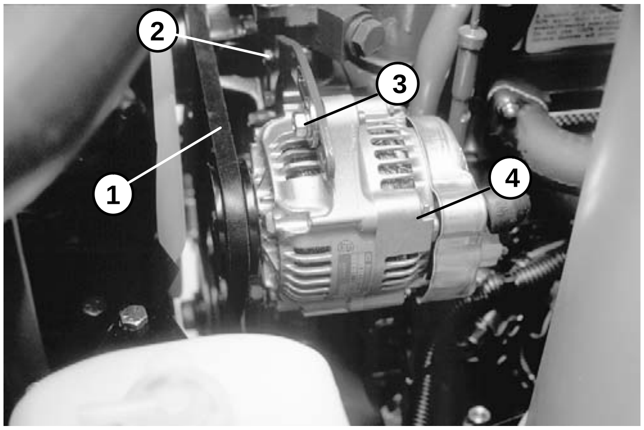

Figure 9

1. **Belt**
2. **Bolt**
3. **Bolt**
4. **Alternator**

6. When proper tension is achieved, tighten alternator and brace bolts to secure the adjustment.

Kubota Diesel Engine

Service and Repairs

Change Engine Oil and Filter

Change oil and filter initially after the first 50 hours of operation, thereafter change oil every 50 hours and filter every 100 hours.

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

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

3. Remove oil filter. Apply light coat of clean oil to the new filter seal before screwing filter on. **Do not over−tighten filter.**

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

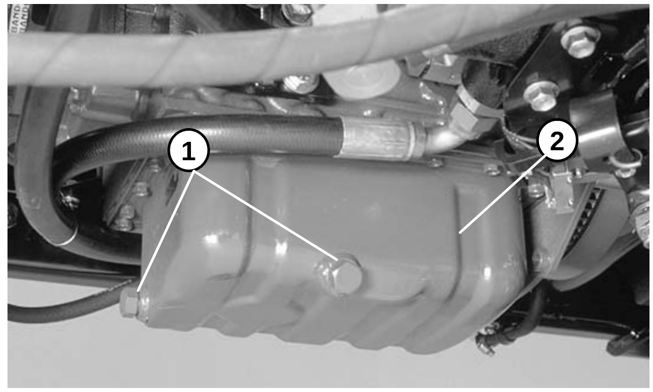

Figure 10

1. **Drain plug**
2. **Drain pan**

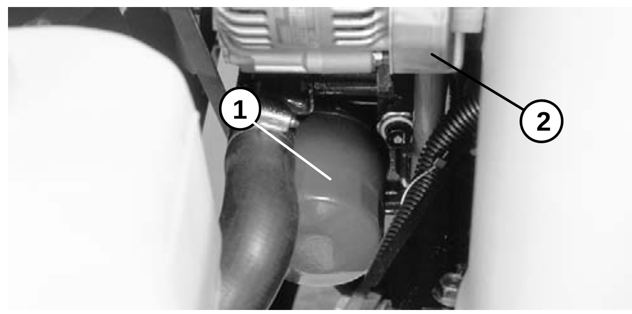

Figure 11

1. **Oil filter**
2. **Alternator**

Replace Traction Belt

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

2. Insert nut driver or small piece of pipe onto the end of the torsion spring of the idler pulley.

CAUTION

Be careful when removing or applying tension from or to the torsion spring of the idler pulley. The spring is under heavy load and may cause personal injury.

3. Push down and forward on the spring end to unhook the spring from the pump mounting plate.

4. Remove V−belt from the engine flywheel and hydrostat pulleys.

5. Install new V−belt onto the engine flywheel and hydrostat pulleys.

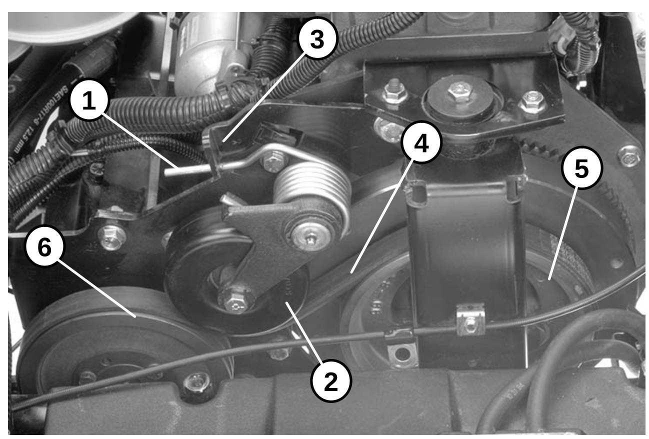

Figure 12

1. **Torsion spring**
2. **Idler pulley**
3. **Pump mounting plate**
4. **V−belt**
5. **Fly wheel pulley**
6. **Hydrostat pulley**

6. Insert nut driver or small piece of pipe onto the end of the torsion spring of the idler pulley.

7. Push down and back on the spring end to get the spring under the pump mounting plate notch. Then release on the spring slowly to lock it into place.

Bleed Fuel System

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

2. Make sure fuel tank is at least half full. Gain access to the engine.

> **DANGER**
>
> **Because diesel fuel is highly 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.**

3. Open air bleed screw on the fuel injection pump.

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

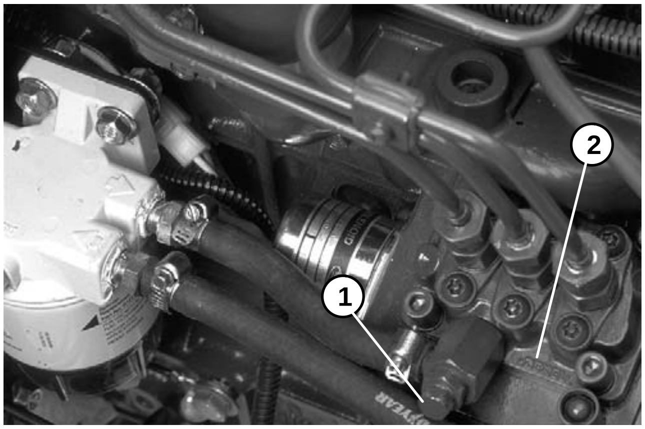

Figure 13

1. **Air bleed screw**
2. **Injection pump**

4. Turn key in ignition switch to the ON position. The electric fuel pump will begin operation and force air out around the air bleed screw. Leave key in the ON position until a solid stream of fuel flows out around the air bleed screw. Tighten screw and turn key to OFF.

Bleed Air from Fuel Injectors

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

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

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

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

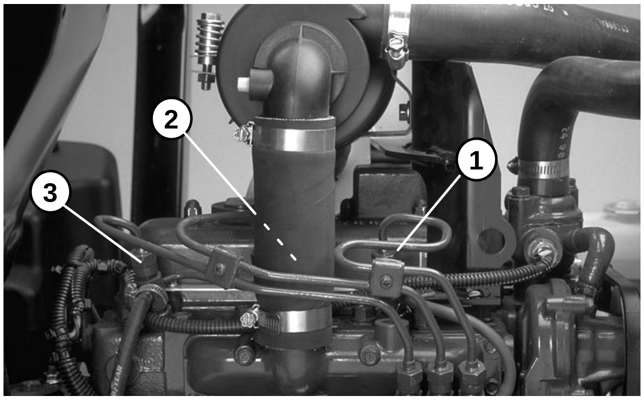

Figure 14

1. **No. 1 injector nozzle**
2. **No. 2 injector (behind hose)**
3. **No. 3 injector nozzle**

3. Move throttle to FAST position.

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

5. Repeat steps on the remaining injector nozzles.

Muffler and Air Cleaner

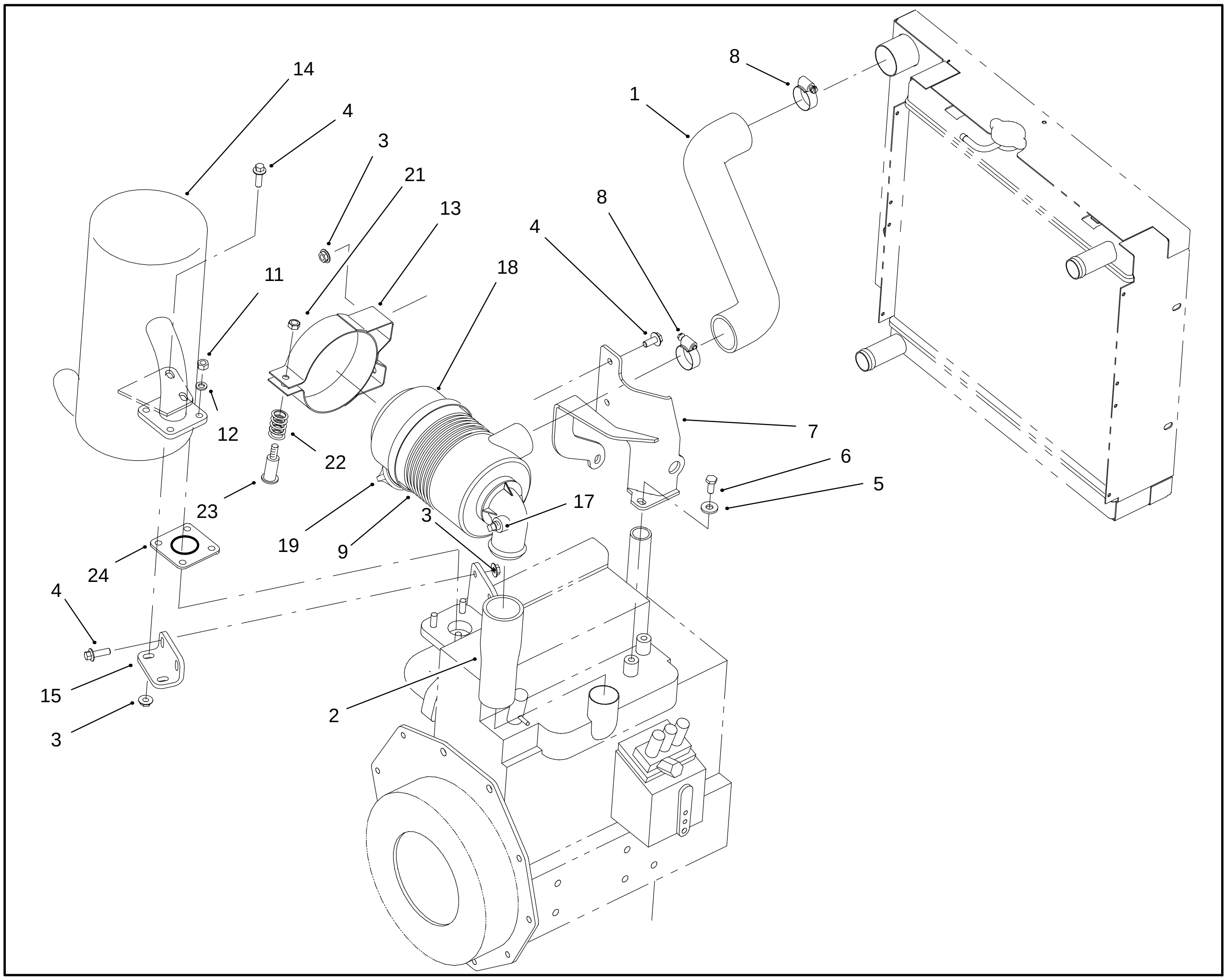

Figure 15

1. **Air inlet hose (upper)**
2. **Air inlet hose (lower)**
3. **Flange nut**
4. **Flange head screw**
5. **Flat washer**
6. **Cap screw**
7. **Air filter bracket**
8. **Hose clamp**
9. **Air cleaner body**
10. **Not used**
11. **Hex nut**
12. **Lock washer**
13. **Mounting band assembly**
14. **Muffler**
15. **Muffler bracket**
16. **Not used**
17. **Plug**
18. **Filter cover**
19. **Burp valve**
20. **Filter element (inside 9 & 18)**
21. **Lock nut**
22. **Compression spring**
23. **Bolt**
24. **Gasket**

Muffler Removal

CAUTION

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

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

2. Open engine hood to gain access to engine.

3. Remove both flange head nuts and screws securing the muffler plate to the muffler bracket (Fig. 16).

4. Remove four hex nuts and lock washers from the exhaust manifold studs. Separate muffler flange from the exhaust manifold. Remove muffler from the machine (Fig. 17).

5. Remove gasket from exhaust manifold or muffler flange. Replace gasket if damaged or torn (Fig. 15).

Muffler Installation

Note: If a new gasket is to be installed, make sure muffler flange and exhaust manifold sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Place gasket on the exhaust manifold (Fig. 15).

2. Secure muffler flange to the exhaust manifold with four lock washers and hex nuts (Fig. 17).

IMPORTANT: Finger tighten all nuts before securing the muffler plate to the muffler bracket so there is no preload on the exhaust manifold.

3. Secure muffler plate to the muffler bracket with both flange head screws and nuts (Fig. 16).

4. Close engine hood.

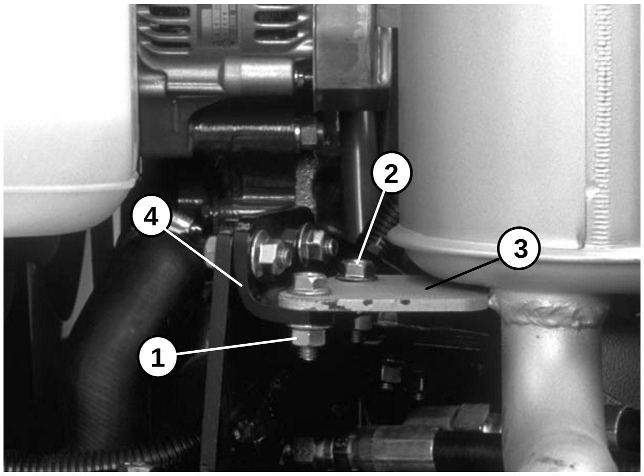

Figure 16

1. **Flange head nut**
2. **Flange head screw**
3. **Muffler plate**
4. **Muffler bracket**

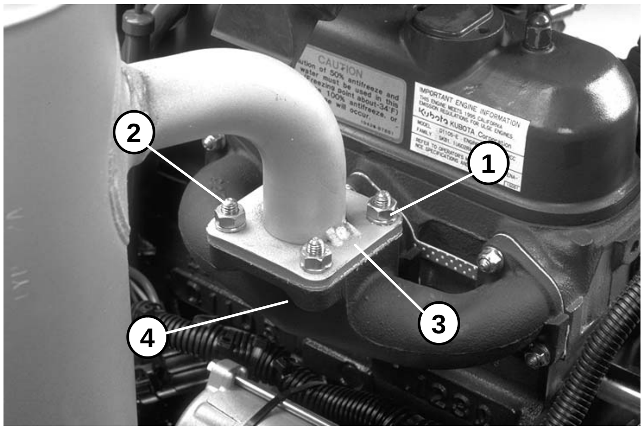

Figure 17

1. **Hex nut & lock washer**
2. **Stud**
3. **Muffler flange**
4. **Exhaust manifold**

Check Air Filter, Dust Cup, & Burp Valve

The air cleaner body, air filter, dust cup, and burp valve should be check daily prior to operation.

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

2. Check air cleaner body for damage that could cause possible air leaks. Make sure dust cup seals completely to the air cleaner body.

3. Check burp valve and dust cup for damage.

4. Make sure air hoses connecting the air cleaner to the engine and radiator are secured tightly and free of possible air leaks.

Service Air Filter, Dust Cup, & Burp Valve

The air cleaner filter should be serviced ever 50 hours, and more frequently in extreme dusty conditions.

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

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

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

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

IMPORTANT: Do not over service the air filter element; damage may result.

Washing Method

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

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

C. Dry filter element using warm, flowing air (160^{o}F maximum), or allow element to air−dry. Do not use a light bulb to dry the filter element because damage could result.

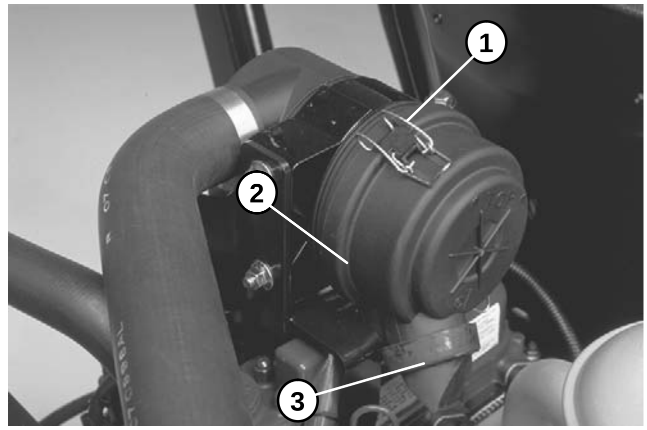

Figure 18

1. **Latch**
2. **Dust cup**
3. **Burp valve**

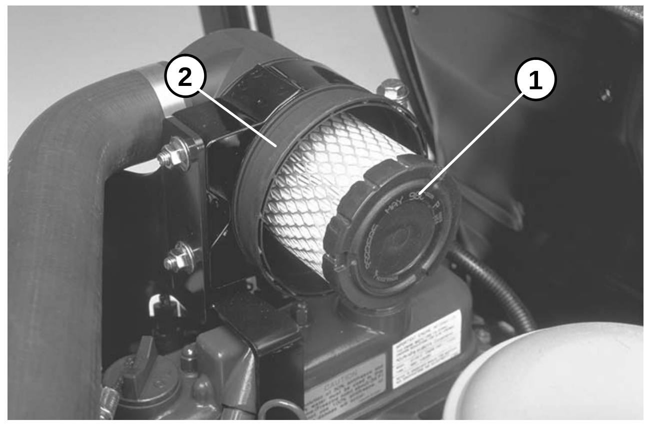

Figure 19

1. **Filter element**
2. **Body**

Compressed Air Method

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

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

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

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

7. Reinstall cover and secure latches. Make sure cover is positioned with TOP side up.

Water/Fuel Separator

DANGER

Because diesel fuel is highly 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.

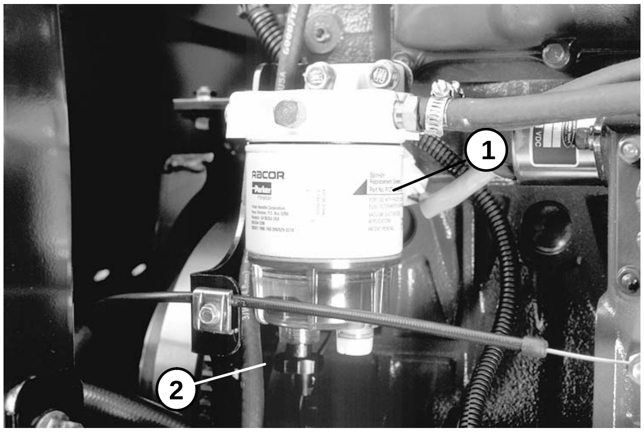

Figure 20

1. **Filter element**
2. **Drain valve**

Draining

Drain water and other contaminants from the water/fuel separator daily.

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

2. Place a suitable container under the fuel/water separator.

3. Loosen drain valve on the bottom of the separator base.

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

Filter Element Replacement

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

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

3. Place a suitable container under the fuel/water separator.

4. Unscrew filter element from base and filter head. Discard element.

5. Lubricate gasket on new filter element and O−ring with clean diesel fuel.

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

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

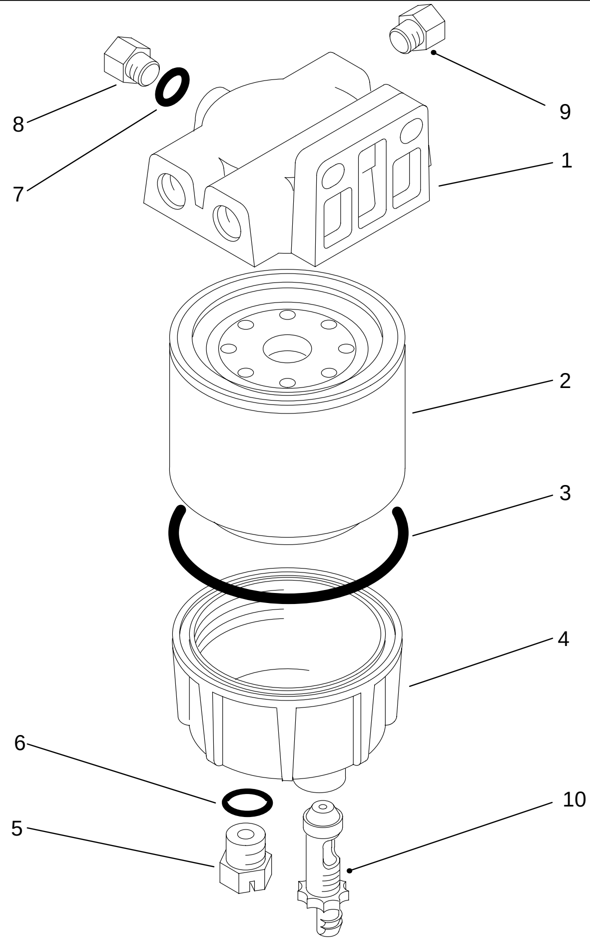

Figure 21

1. **Filter head**
2. **Filter element (spin on)**
3. **O−ring**
4. **Base**
5. **Plug**
6. **O−ring**
7. **O−ring**
8. **Plug**
9. **Pipe plug**
10. **Drain valve**

Kubota Diesel Engine

Fuel System

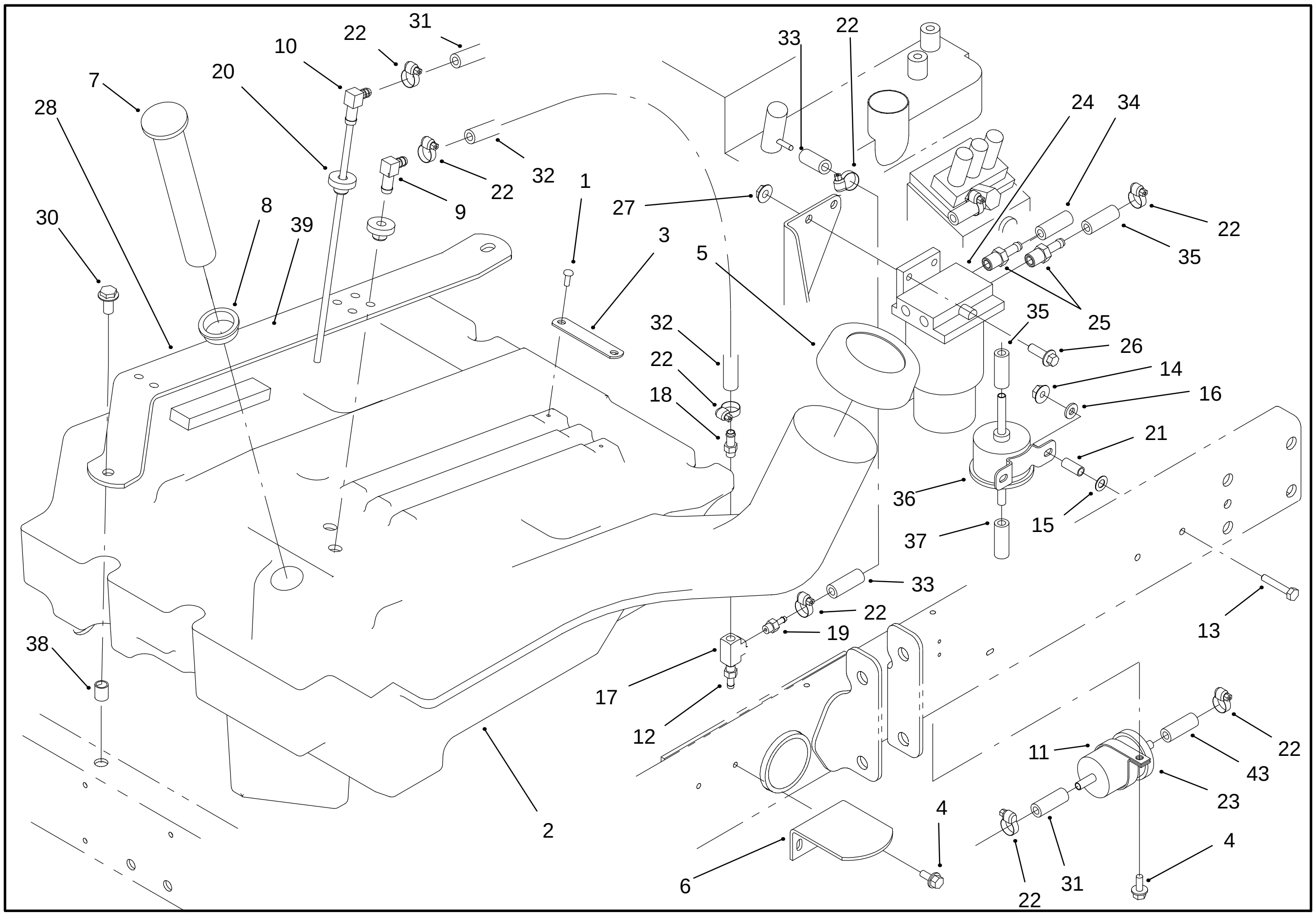

Figure 22

1. Cap screw
2. Fuel tank
3. Fuel hose strap
4. Cap screw
5. Fuel cap
6. Tank support
7. Fuel gauge
8. Grommet
9. Connector fitting
10. Stand pipe
11. R−clamp
12. Barb fitting
13. Cap screw
14. Flange hex nut
15. Lock washer
16. Flat washer
17. Tee fitting
18. Barb fitting
19. Barb fitting
20. Bushing
21. Spacer
22. Hose clamp
23. Fuel prefilter
24. Water/fuel separator
25. Fuel fitting
26. Flange head screw
27. Flange nut
28. Seat support strap
29. Foam
30. Hex flange head screw
31. Fuel hose
32. Fuel hose
33. Fuel hose
34. Fuel hose
35. Fuel hose
36. Fuel pump
37. Hose
38. Threaded insert
39. Seat support strap

DANGER

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

Check Fuel Lines and Connections

Check fuel lines and connections every 400 hours or yearly, whichever comes first.

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

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

Fuel Tank Removal (Fig. 22)

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

2. Siphon fuel from the tank into a suitable container.

3. Remove seat and seat support straps from the frame. Disconnect seat switch from the electrical harness (Fig. 23).

4. Remove fuel hose strap and both fuel hoses from the fuel tank. Pull tank from the machine (Fig. 24).

Drain and Clean Fuel Tank (Fig. 22)

Drain and clean the fuel tank every 2 years. Also, drain and clean the fuel tank if the fuel system becomes contaminated or if the machine is to be stored for an extended period.

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

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

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

Fuel Tank Installation (Fig. 22)

1. Position fuel tank into the machine.

2. Connect both fuel hoses to the tank and secure with hose clamps and fuel hose strap.

3. Connect seat switch to the electrical harness. Secure seat support straps and seat to the frame with hex flange head screws.

4. Fill fuel tank (see Fill Fuel Tank).

Replace Fuel Prefilter (Fig. 25)

Replace fuel prefilter after every 400 operating hours or yearly, whichever occurs first. The prefilter is located on the inside of the frame just below the water/fuel separator.

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

2. Remove cap screw securing the prefilter to frame.

3. Clamp both fuel hoses to the prefilter to prevent fuel spillage.

4. Loosen hose clamps at each end of the prefilter. Pull fuel hoses from the filter.

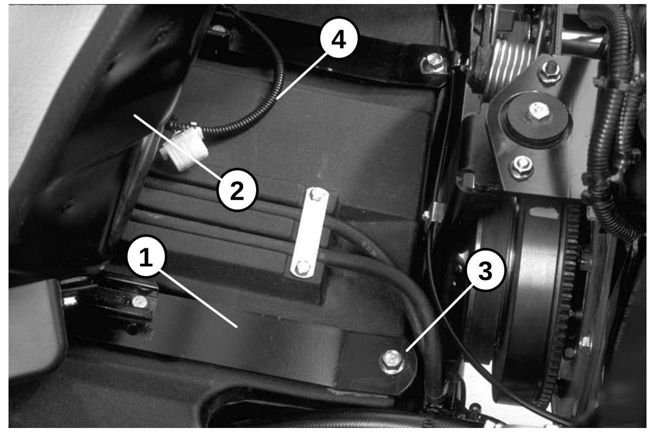

Figure 23

1. **Seat support strap**
2. **Seat**
3. **Hex flange head screw**
4. **Electrical harness**

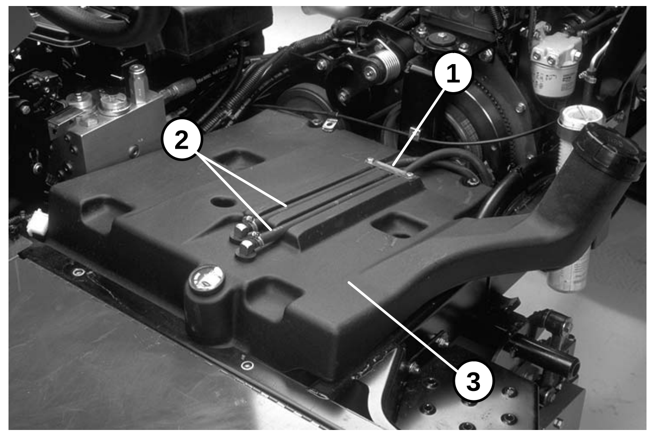

Figure 24

1. **Fuel hose strap**
2. **Fuel hoses**
3. **Fuel tank**

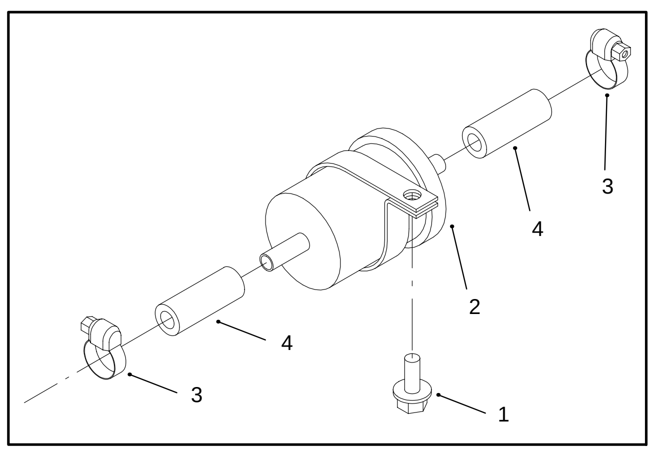

Figure 25

1. **Cap screw**
2. **Prefilter**
3. **Hose clamp**
4. **Fuel hose**

5. Secure new filter to fuel hoses with hose clamps. Make sure arrow on the side of the prefilter points towards the injection pump.

Radiator

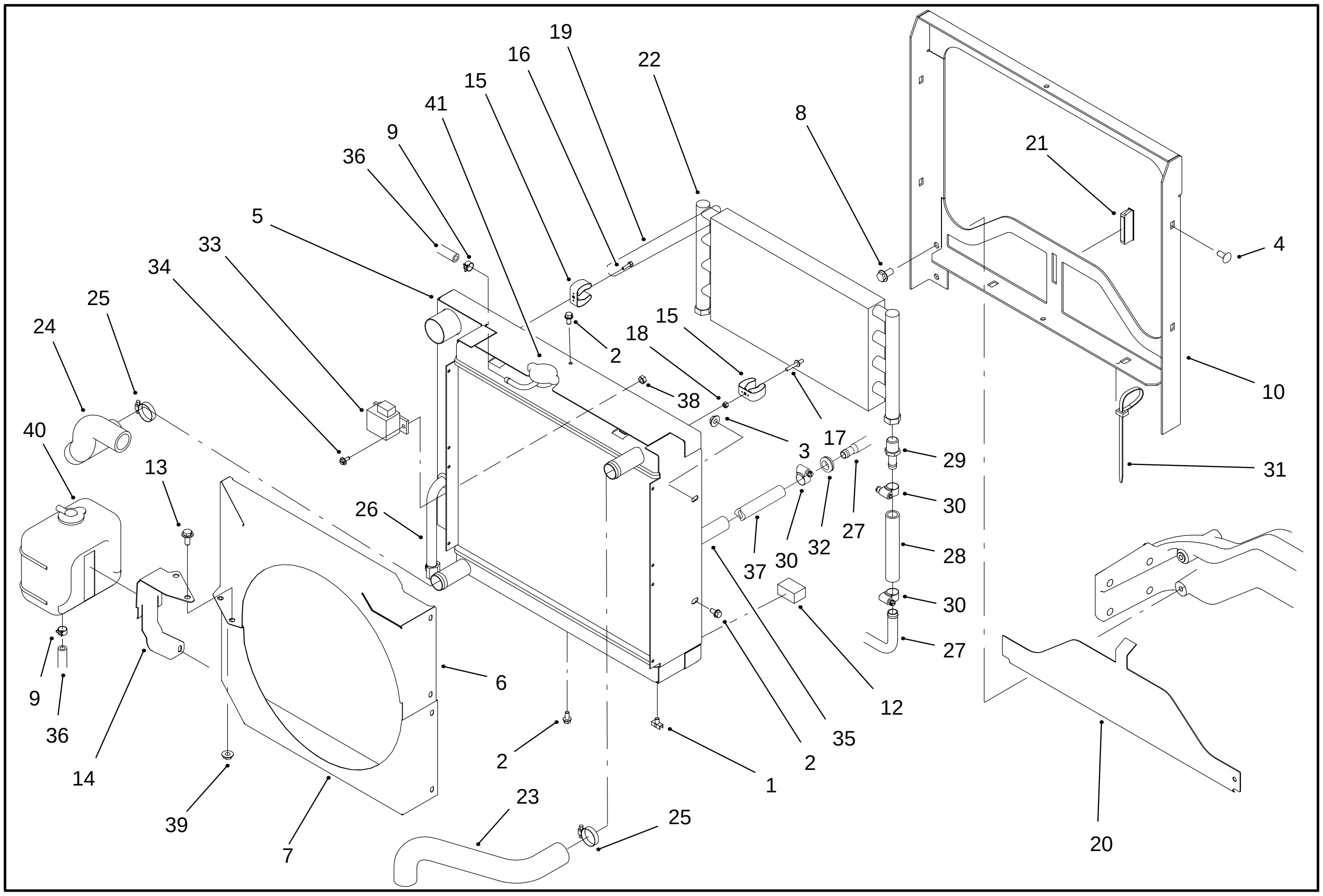

Figure 26

1. Drain cock valve
2. Flange head screw
3. Flange nut
4. Carriage bolt
5. Radiator
6. Fan shroud (top)
7. Fan shroud (bottom)
8. Flange head screw
9. Hose clamp
10. Radiator frame
11. Not used
12. Radiator seal
13. Flange head screw
14. Reservoir bracket
15. Clip spring
16. Philips pan head screw
17. Pop rivet
18. Lock nut
19. Lanyard
20. Screen frame (lower)
21. Magnetic catch
22. Oil cooler
23. Radiator hose (upper)
24. Radiator hose (lower)
25. Hose clamp
26. Hydraulic tube
27. Hydraulic tube
28. Hydraulic hose
29. Barb fitting
30. Hose clamp
31. Cable tie
32. Grommet
33. Glow plug relay
34. Thread forming screw
35. Sleeve
36. Coolant hose (reservoir)
37. Hose
38. Lock nut
39. Flange nut
40. Reservoir
41. Radiator cap

Removal

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

2. Open and remove engine hood from the machine.

CAUTION

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

3. Place a suitable container under the radiator to collect the coolant. Open drain cock valve, and completely drain the radiator.

4. Remove glow plug relay from the radiator assembly. position relay away from the radiator.

Note: Allow hydraulic components and hoses to drain into a suitable container. Plug all hydraulic tubes, hoses, and openings to prevent contamination.

5. Clean and disconnect the following connections:

A. Hydraulic hose and clamp on the lower left corner of the radiator leading to the hydraulic manifold.

B. Hydraulic tube from the oil cooler at the hydraulic oil filter head. Do not lose O−ring.

6. Remove oil cooler from the radiator assembly using Figure 26 as a guide.

7. Disconnect following hoses from the radiator:

A. Upper radiator hose to the water pump.

B. Lower radiator hose to the engine block.

C. Coolant hose to the reservoir.

D. Air hose to the air cleaner.

8. Remove reservoir and bracket from the top fan shroud.

9. Remove both fan shrouds from radiator assembly.

10. Remove flange head screws securing the top and bottom of the radiator frame to the radiator. Remove four carriage bolts and lock nuts securing the radiator to the radiator frame.

11. Remove oil cooler from the radiator. Pull radiator carefully from the radiator frame.

12. Plug any openings to prevent contamination.

Installation

1. Remove any plugs from the oil cooler used during the removal procedures.

2. Position radiator carefully to the radiator frame.

3. Secure radiator assembly to the radiator frame with four carriage bolts and lock nuts. Secure top and bottom of radiator to frame with flange head screws.

4. Secure both fan shrouds to the radiator assembly with flange head screws. Install oil cooler to the radiator.

5. Secure reservoir bracket and reservoir to the top fan shroud with both flange head screws and flange nuts.

6. Connect following hoses to the radiator:

A. Upper radiator hose to the water pump.

B. Lower radiator hose to the engine block.

C. Coolant hose to the reservoir.

D. Air hose to the air cleaner.

7. Remove all plugs from hydraulic tubes, hoses, and openings used during the removal procedures.

A. Install O−ring to the fitting on the hydraulic oil filter head. Connect hydraulic tube from the oil cooler to the filter head.

B. Secure hydraulic hose leading to the hydraulic manifold with the clamp to the lower left corner of the radiator.

8. Install oil cooler to the radiator assembly using Figure 26 as a guide.

9. Secure glow plug relay to the radiator assembly with both thread forming screws.

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

11. Install engine hood to the machine and close.

Clean Radiator and Oil Cooler (Fig. 4)

The radiator and oil cooler should be checked for dirt and debris daily, and hourly if conditions are extremely dusty and dirty.

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

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

2. Open engine hood.

3. Clean engine area thoroughly of all dirt and debris.

4. Remove lower shield. Unsnap oil cooler from spring clip. Pivot cooler out.

5. Clean both sides of oil cooler and radiator area thoroughly with water or compressed air.

6. Pivot oil cooler back and snap into position. Install lower shield. Close hood.

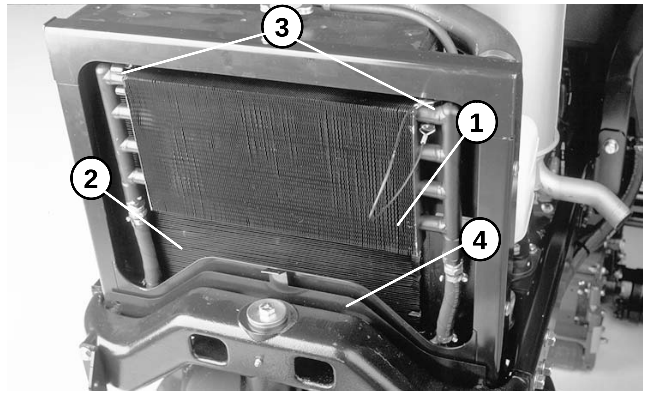

Figure 27

1. **Oil cooler**
2. **Radiator**
3. **Clip**
4. **Lower shield**

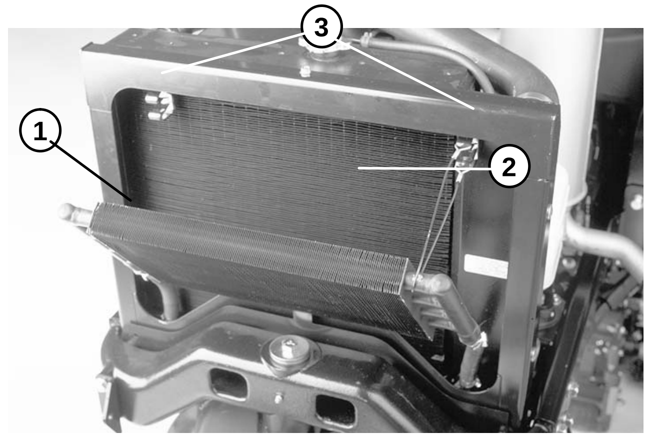

Figure 28

1. **Oil cooler**
2. **Radiator**
3. **Clip**

Kubota Diesel Engine

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Engine

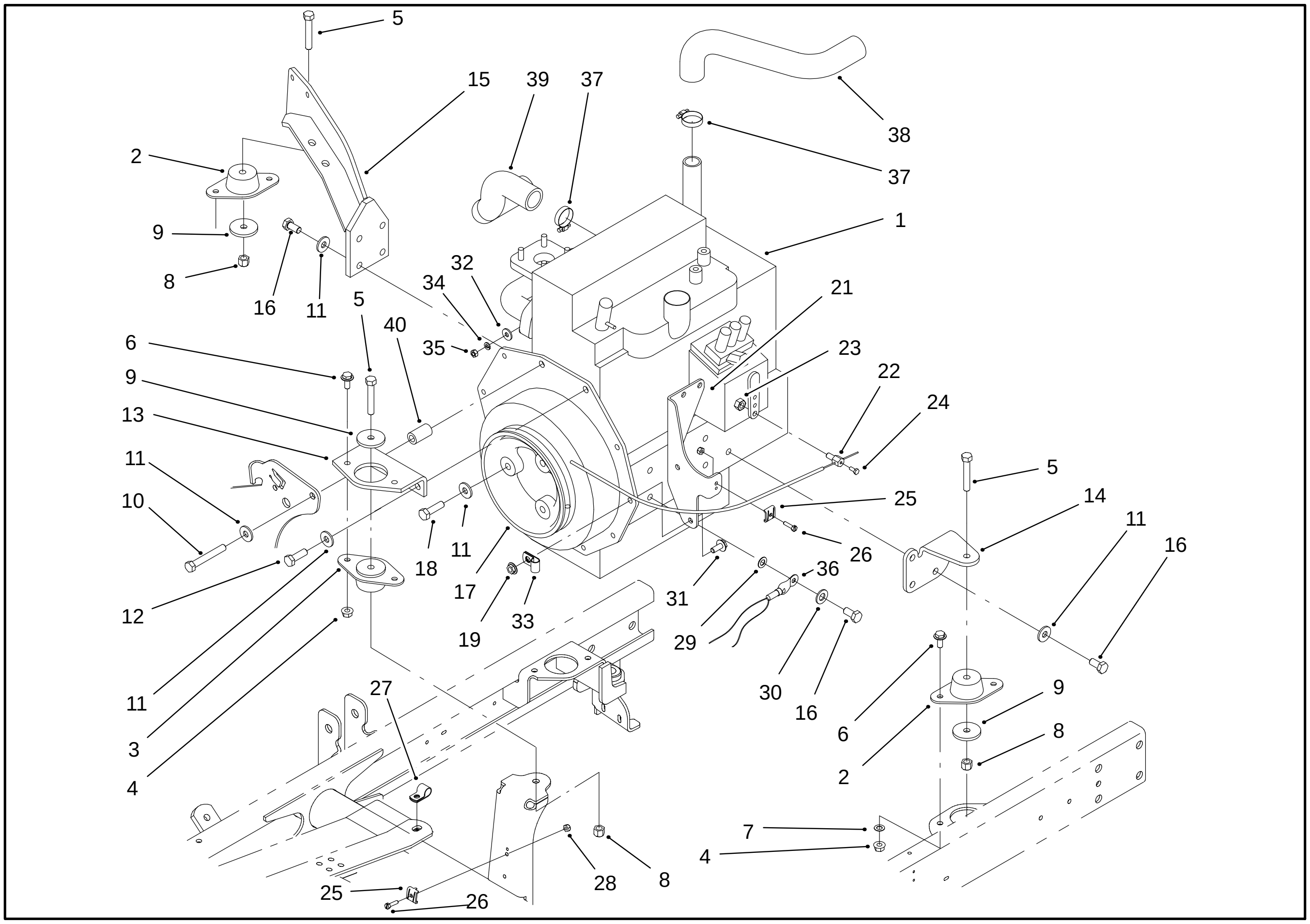

Figure 29

1. **Kubota engine**
2. **Engine mount**
3. **Engine mount**
4. **Flange nut**
5. **Cap screw**
6. **Hex flange head screw**
7. **External lock washer**
8. **Lock nut**
9. **Washer**
10. **Machine screw**
11. **Hardened washer**
12. **Cap screw**
13. **Engine mounting bracket (front)**
14. **Engine mounting bracket (LH)**
15. **Engine mounting bracket (RH)**
16. **Cap screw**
17. **Pulley**
18. **Bolt**
19. **Flange nut**
20. **Not used**
21. **Throttle & filter support**
22. **Throttle cable filter**
23. **Lock nut**
24. **Slotted hex head screw**
25. **Throttle cable clamp**
26. **Cap screw**
27. **R−clamp**
28. **Lock nut**
29. **Lock washer**
30. **Flat washer**
31. **Flange head screw**
32. **Flat washer**
33. **R−clamp**
34. **Lock washer**
35. **Hex nut**
36. **Wire harness**
37. **Hose clamp**
38. **Radiator hose (upper)**
39. **Radiator hose (lower)**
40. **Spacer**

Removal

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

2. Open and remove engine hood from the machine. Slide seat all the way forward.

3. Disconnect air hose from the air cleaner and radiator. Remove air cleaner from the engine.

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

5. Remove muffler from the exhaust manifold and muffler bracket (see Muffler Removal).

6. Drain radiator from the drain cock valve into a suitable container (see Radiator Removal). Disconnect coolant hoses from the water pump and engine block.

7. Remove reservoir and bracket from the top fan shroud. Remove top fan shroud from the radiator (see Radiator Removal).

8. Disconnect wire harness and electrical wires from the following:

A. Engine grounds to the battery and wire harness (Fig. 30).

B. Glow plug bus and fuel stop solenoid (Fig. 31).

C. High temperature warning switch (Fig. 32).

D. High temperature shutdown switch, alternator, and low oil pressure switch (Fig. 33).

9. Disconnect throttle cable from the support and swivel on the speed control lever (Fig. 30).

10. Disconnect fuel hose from the water/fuel separator Fig. 30) and front injector nozzle (Fig. 31).

11. Remove traction control cable from the neutral arm assembly on the piston pump. Remove all hydraulic hoses from the piston an gear pumps (see Piston Pump Removal in Chapter 4− Hydraulic System).

12. Remove cable ties securing the wire harness to the front lift tab and other engine parts (Fig. 31). Connect hoist or lift to the front and rear lift tabs (Fig. 31 and 32).

CAUTION

Make sure lift or hoist can support the total weight of the engine before removing the cap screws from the rear bracket and engine.

13. Remove flange nut, cap screw, and washer securing three engine mounts to the engine mounting brackets.

CAUTION

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

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

14. Remove engine slowly from the machine.

15. Separate hydrostat and pump mount plate from the engine as follows:

Note: The cap screw next to the torsion spring does not have a flat washer with it.

A. Remove traction belt from the engine fly wheel and hydrostat pulleys (see Traction Belt Replacement).

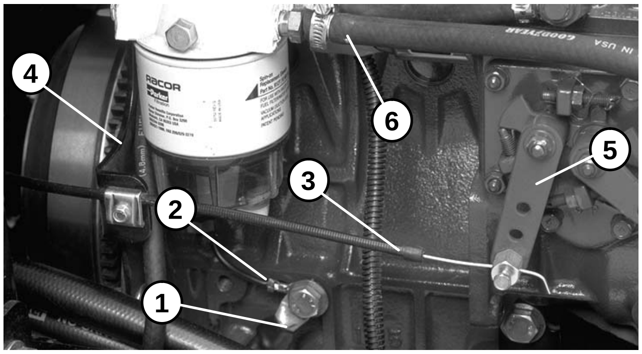

Figure 30

1. **Battery ground**
2. **Wire harness ground**
3. **Throttle cable**
4. **Support bracket**
5. **Speed control lever**
6. **Fuel hose**

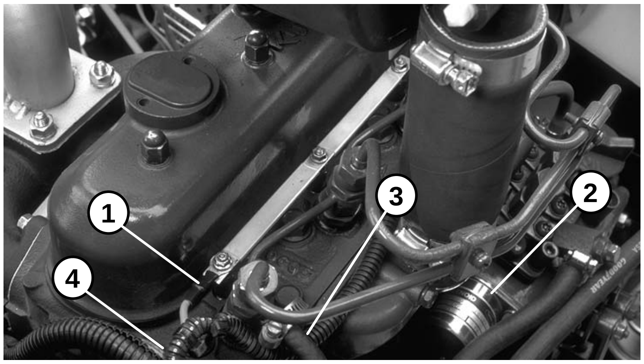

Figure 31

1. **Glow plug wire**
2. **Fuel stop solenoid**
3. **Fuel hose**
4. **Front lift tab**

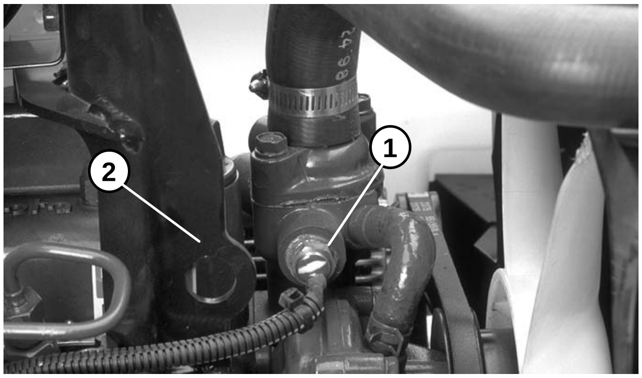

Figure 32

1. **Temp. warning switch**
2. **Rear lift tab**

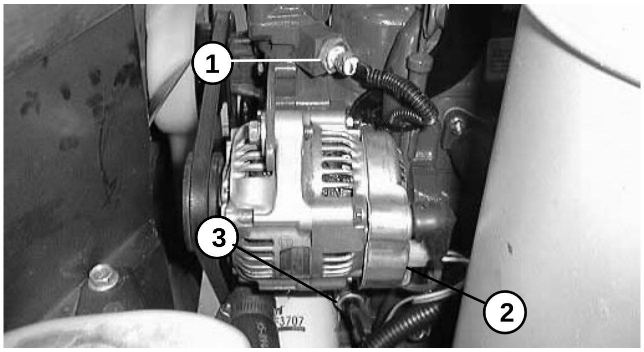

Figure 33

1. **Temp. shutdown switch**
2. **Alternator**
3. **Low oil press. switch**

B. Remove five cap screws, four washers, and five spacers securing the pump mount plate to the engine (Fig. 34).

C. Remove four cap screws and hardened washers securing the right engine mounting bracket and hydrostat to the engine.

Installation

1. Install hydrostat and pump mount plate to the engine as follows:

A. Secure right engine mounting bracket and hydrostat to the engine four hardened washers and cap screws.

Note: Do not install flat washer with cap screw near the torsion spring to prevent the spring from binding.

B. Secure pump mount plate to the engine with five spacers, four washers, and five cap screws (Fig. 34).

C. Install traction belt to the engine fly wheel and hydrostat pulleys (see Traction Belt Replacement).

2. Connect hoist or lift to the front and rear lift tabs (Fig. 31 and 32).

CAUTION

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

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

3. Position engine slowly into the machine.

4. Secure all three engine mounts to the engine mounting brackets with cap screw, washer, and flange nut.

5. Secure wire harness to the front lift tab and the engine with cable ties (Fig. 31).

6. Install all hydraulic hoses to the piston and gear pumps. Install traction control cable to the neutral arm assembly on the piston pump (see Piston Pump Installation in Chapter 4− Hydraulic System).

7. Connect fuel hose to the water/fuel separator (Fig. 30) and front injector nozzle (Fig. 31).

8. Install top fan shroud to the radiator. Install reservoir and bracket to the top fan shroud (see Radiator Installation).

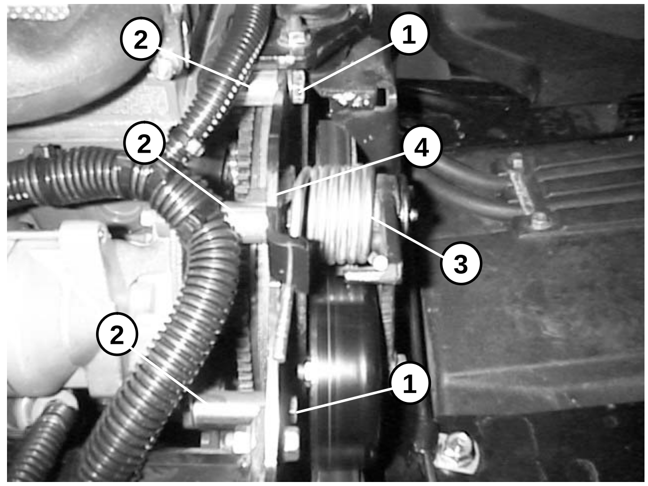

Figure 34

1. **Cap screw**
2. **Spacer**
3. **Torsion spring**
4. **Pump mount plate**

9. Connect wire harness and electrical wires to the following:

A. Engine grounds to the battery and wire harness (Fig. 30).

B. Glow plug bus and fuel stop solenoid (Fig. 31).

C. High temperature warning switch (Fig. 32).

D. High temperature shutdown switch, alternator, and low oil pressure switch (Fig. 33).

10. Connect coolant hoses to the water pump and engine block. Make sure drain cock valve is closed. Fill radiator with coolant (see Check Cooling System).

11. Install muffler to the exhaust manifold and muffler bracket (see Muffler Installation).

12. Connect throttle cable to the support and swivel on the speed control lever (Fig. 30).

13. Connect both battery cables at the battery (see Battery Service in Chapter 5 − Electrical system).

14. Install air cleaner to the engine. Connect air hose to air cleaner and radiator.

15. Adjust throttle cable (see Adjust Throttle Cable).

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

17. Install engine hood to the machine. Close and latch hood.

18. Adjust traction drive for neutral (see Adjust traction Drive for Neutral in Chapter 4− Hydraulic System).

Chapter 4

Hydraulic System

Table of Contents

Specifications

Item	Description
Piston Pump (Hydrostat) Maximum Operating Pressure Charge Pressure Traction Circuit Relief Pressure (Forward Only)	Variable displacement piston pump 3000 PSI (207 bar) 100 to 150 PSI (6.9 to 10.0 bar) 3000 PSI (207 bar)
Gear Pump Maximum Operating Pressure	2 stage positive displacement gear type pump 3000 PSI (207 bar)
Wheel Motors (Front) Maximum Operating Pressure	Orbital rotor motor 2000 PSI (138 bar)
Wheel Motors (Rear) Maximum Operating Pressure	Orbital rotor motor 3000 PSI (207 bar)
Hydraulic Manifold Relief Pressure	3000 PSI (207 bar)
Reel Motor Cross−over Relief Pressure Maximum Operating Pressure	Gear motor 1500 PSI (103 bar) 2250 PSI (155 bar)
Steering Control Valve Maximum Operating Pressure Implement (Steering and Lift) Relief Valve Pressure	Distributor valve with rotary meter 1800 PSI (124 bar) 1000 PSI (69 bar)
Hydraulic Filter	10 Micron spin−on cartridge type
Hydraulic Oil	See Check Hydraulic System Fluid in General Information section
Hydraulic Reservoir	3.5 gal. U.S. (13.2 L)

General Information

Hydraulic Hoses

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

When replacing a hydraulic hose, be sure that the hose is straight (not twisted) before tightening the fittings. This can be done by observing the imprint on the hose. Use two wrenches; hold the hose straight with one and tighten the hose swivel nut onto the fitting with the other.

WARNING

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

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

Hydraulic Fitting Installation

O−Ring Face Seal

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

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

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

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

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

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

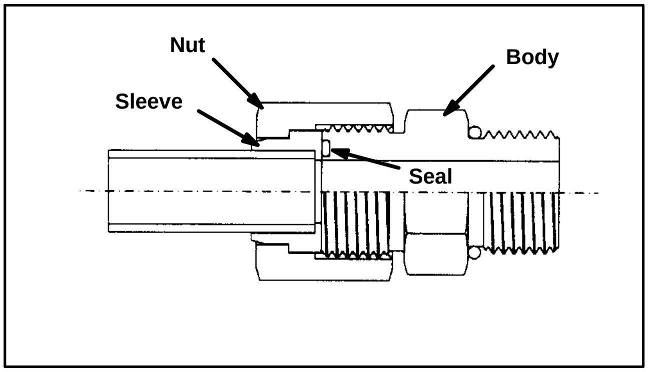

Figure 1

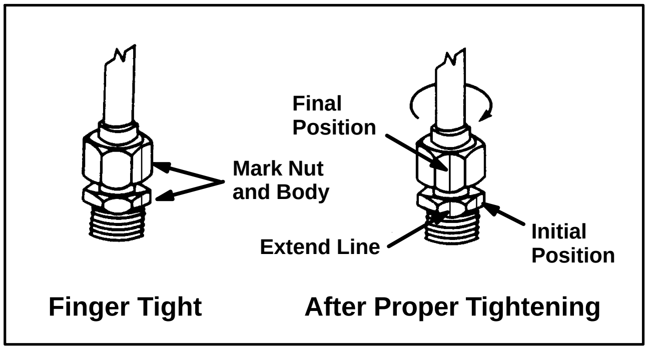

Figure 2

Hydraulic System

SAE Straight Thread O−Ring Port − Non−adjustable

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

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

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

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

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

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

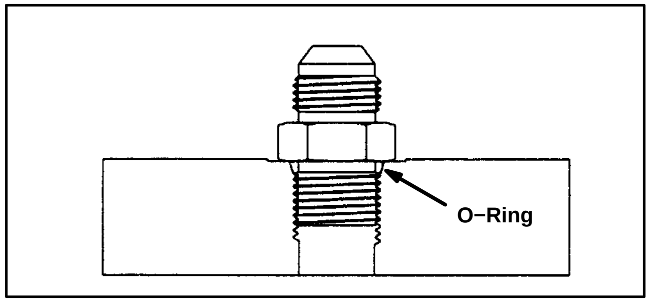

Figure 3

SAE Straight Thread O−Ring Port − Adjustable

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

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

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

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

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

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

7. Hold the fitting in the desired position with a wrench and turn the jam nut with another wrench to the correct flats from finger tight (F.F.F.T.) (Step 4).

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

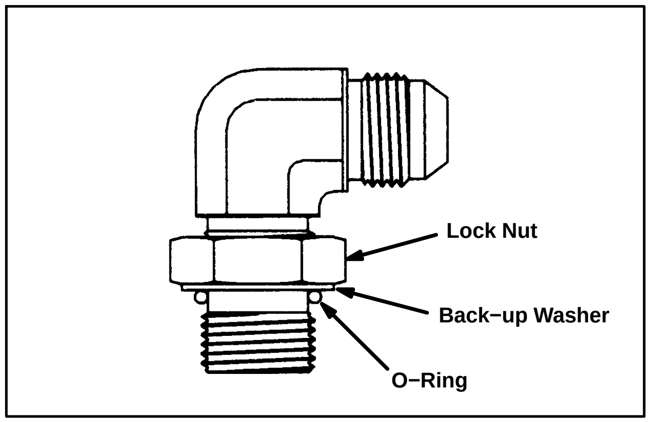

Figure 4

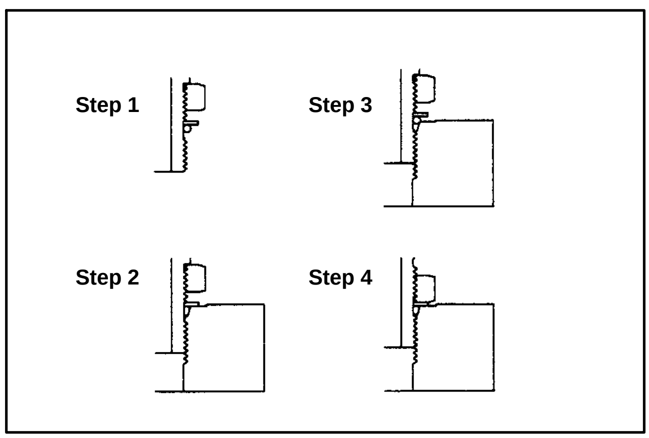

Figure 5

Towing Traction Unit

In case of emergency, the Reelmaster can be towed for a short distance. However, Toro does not recommend this as a standard procedure.

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 (more than a few feet), transport it on a truck or trailer.

1. Locate by−pass valve on pump and rotate it 90º.

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

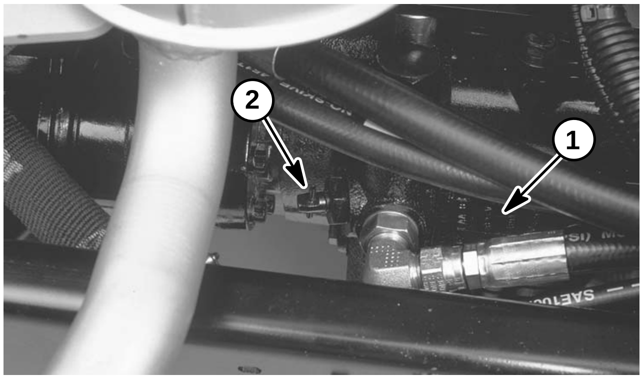

Figure 6

1. **Hydrostat** 2. **By−pass valve**

Check Hydraulic System Fluid

The hydraulic system that drives the reels is designed to operate on anti−wear hydraulic fluid. The machines reservoir is filled at the factory with approximately 3.5 gallons (13.2 liters) of DTE 15M hydraulic fluid. **Check level of the hydraulic fluid before the engine is first started and daily thereafter.**

IMPORTANT: Use only types of hydraulic fluids specified. Other fluids could 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 (15 to 23 liters) of hydraulic fluid. Order Part No. 44−2500 from your Authorized Toro Distributor.

1. Position machine on a level surface, lower cutting units, and stop engine.

2. Clean area around filler neck and cap of the hydraulic tank. Remove cap from the filler neck.

3. Remove dipstick from the filler neck and wipe it with a clean rag. Insert dipstick into the filler neck; then remove it and check level of the fluid. Fluid level should be within 1/4 inch (6 mm) of the mark on the dipstick.

4. If level is low, add appropriate fluid to raise the level to full mark.

5. Install dipstick and cap onto the filler neck.

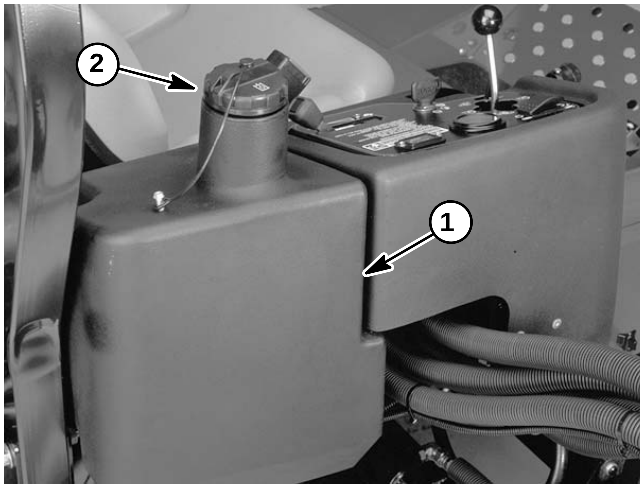

Figure 7

1. **Hydraulic Tank** 2. **Cap**

Hydraulic System

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the Reelmaster 3100−D hydraulic system, all pressure in the hydraulic system must be relieved. Park machine on a level surface with the cutting units lowered and off. Turn key switch to OFF and allow engine to stop.

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

To relieve cutting system pressure, turn key switch to ON (engine not running). Move PTO switch to engage which will energize the solenoid valve on hydraulic manifold to relieve circuit pressure. Move PTO switch to disengage, return key switch to OFF and remove key from the ignition switch.

NOTE: Moving steering wheel with engine off may unseat implement relief valve. If steering or lift circuits appear weak or inoperative after machine is returned to service, repeat relieving hydraulic system pressure procedure.

Traction Circuit (Closed Loop) Component Failure

The Reelmaster 3100−D traction circuit is a closed loop system that includes the hydrostat and two (2) wheel motors. If a component in the traction circuit should fail, debris and contamination from the failed component will circulate throughout the traction circuit. This contamination can damage other components in the circuit so it must be removed to prevent additional component failure.

If a component failure occurs in the traction circuit, it is critical that the entire traction circuit be disassembled, drained and thoroughly cleaned to ensure that all contamination is removed from the circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional component failure.

An additional step for removing all traction circuit contamination would be to temporarily install a high pressure hydraulic oil filter (see Special Tools) into the circuit. The filter could be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. hydrostat or wheel motor). The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

Once the filter has been placed in the traction circuit, place the machine on jack stands and operate the traction circuit to allow oil flow through the circuit. With the machine raised off the ground, the traction circuit will have maximum oil flow at minimum pressure to minimize damage from any remaining contamination. The filter will remove contamination from the closed loop traction circuit during operation. Remove the filter from the machine after contamination has been removed from the traction circuit.

IMPORTANT: When operating the traction system with the high pressure filter installed, make sure that flow is always directed through the filter (e.g. do not press the traction pedal in the reverse direction if the filter is placed for forward direction flow). If flow is reversed, debris from the filter will re−enter the traction circuit.

Hydraulic System

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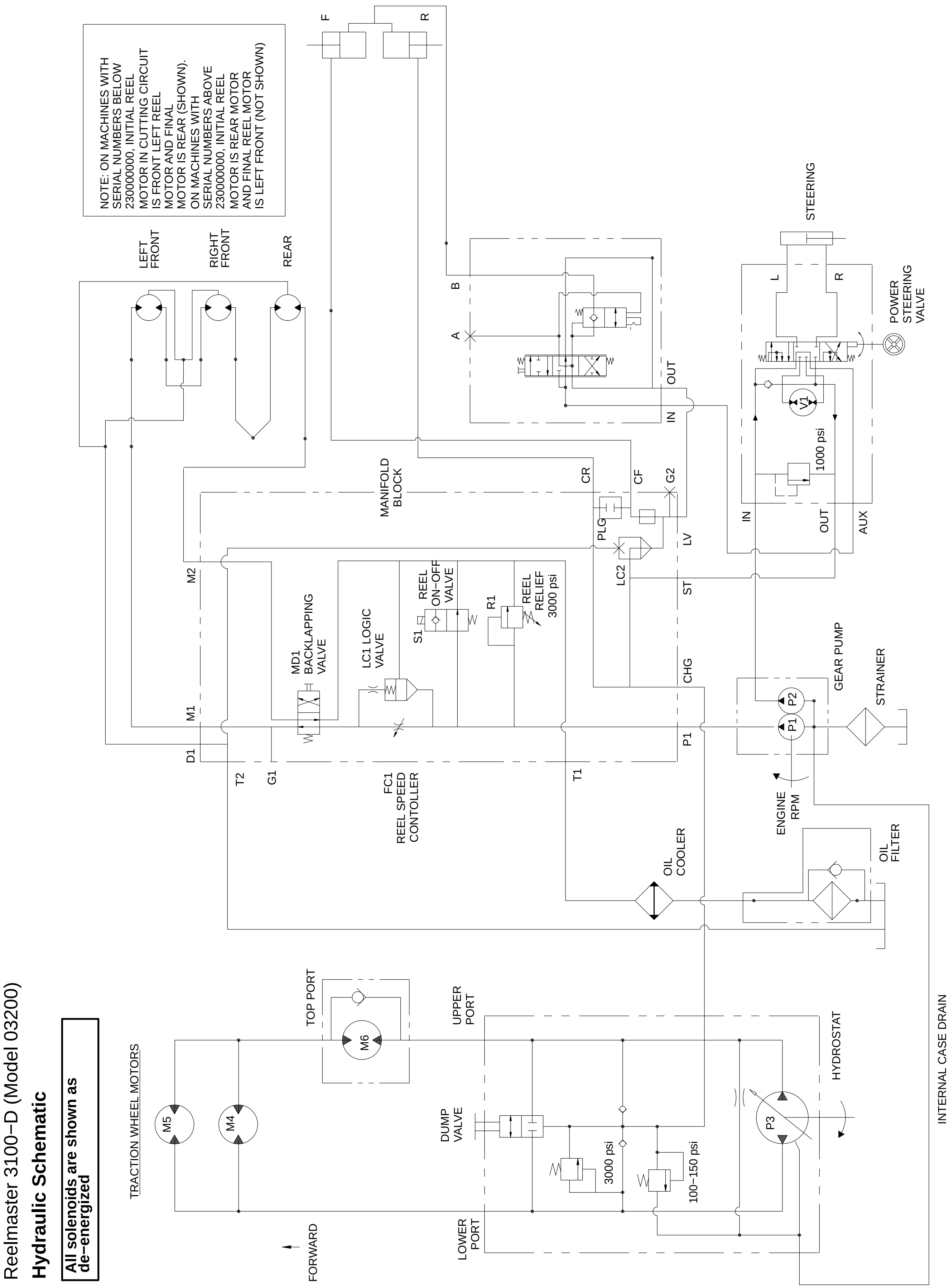
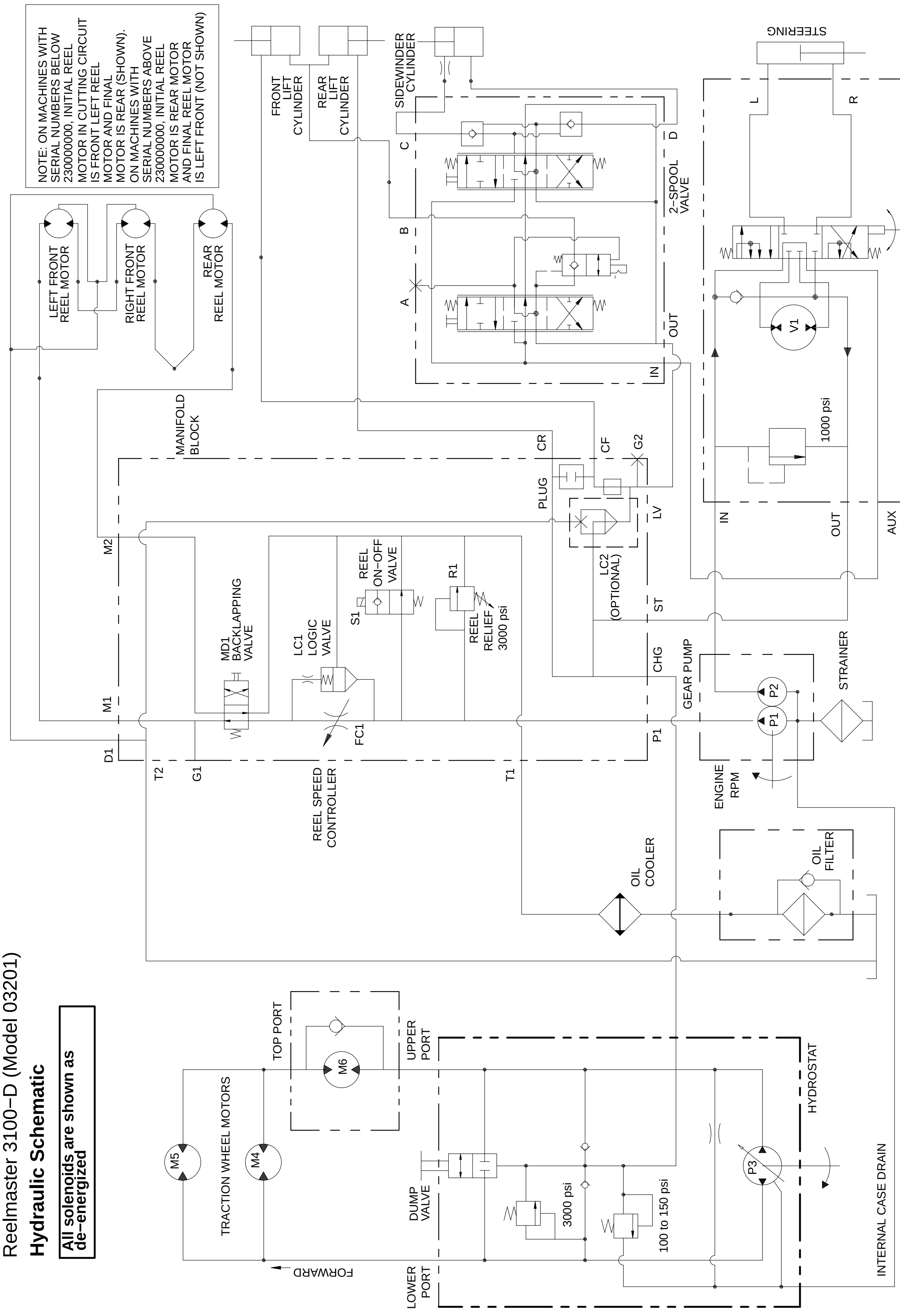
Hydraulic Schematics



Reelmaster 3100−D (Model 03201)

Hydraulic Schematic

All solenoids are shown as de−energized

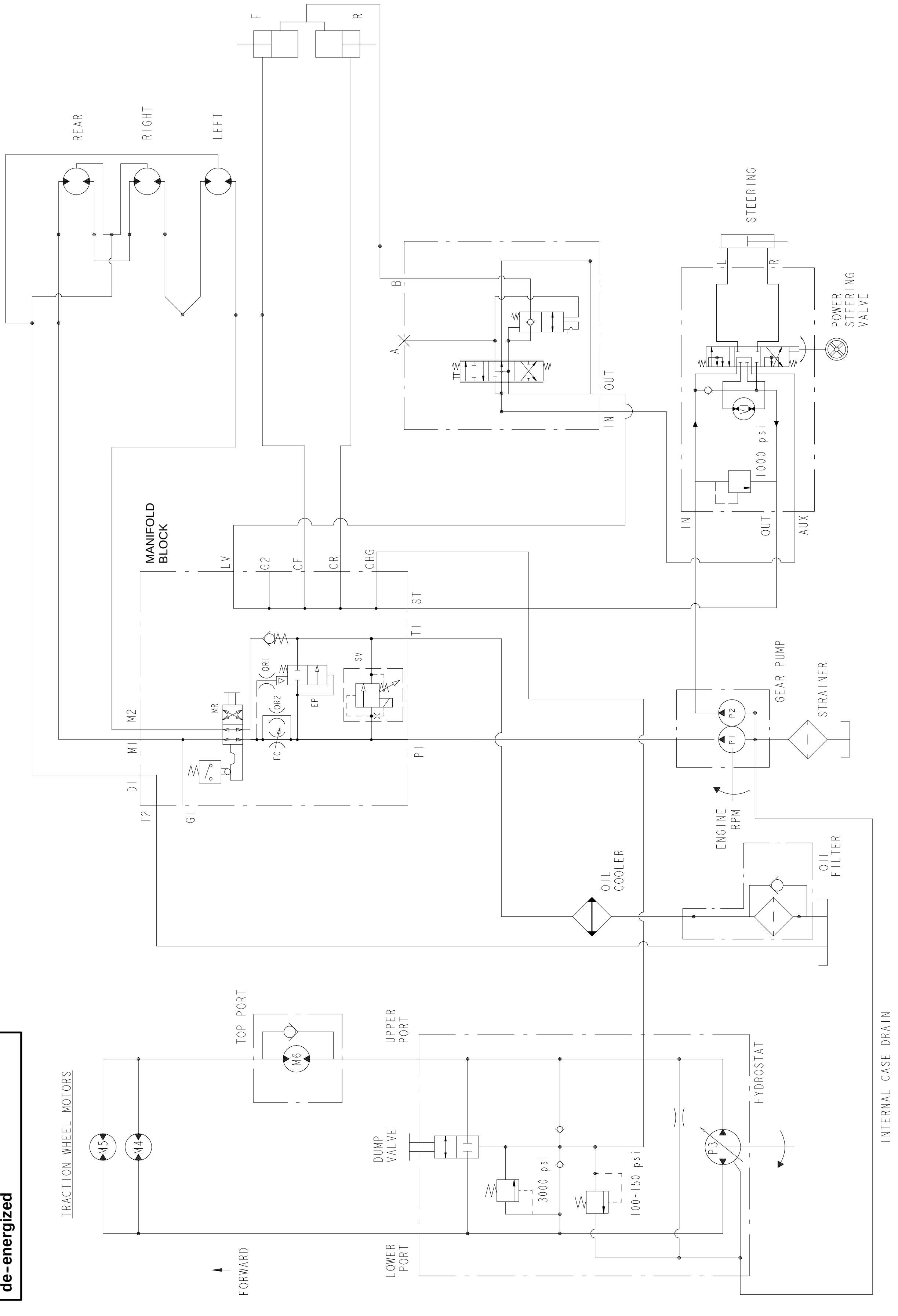


Hydraulic System

Reelmaster 3100–D (Models 03206 and 03170)

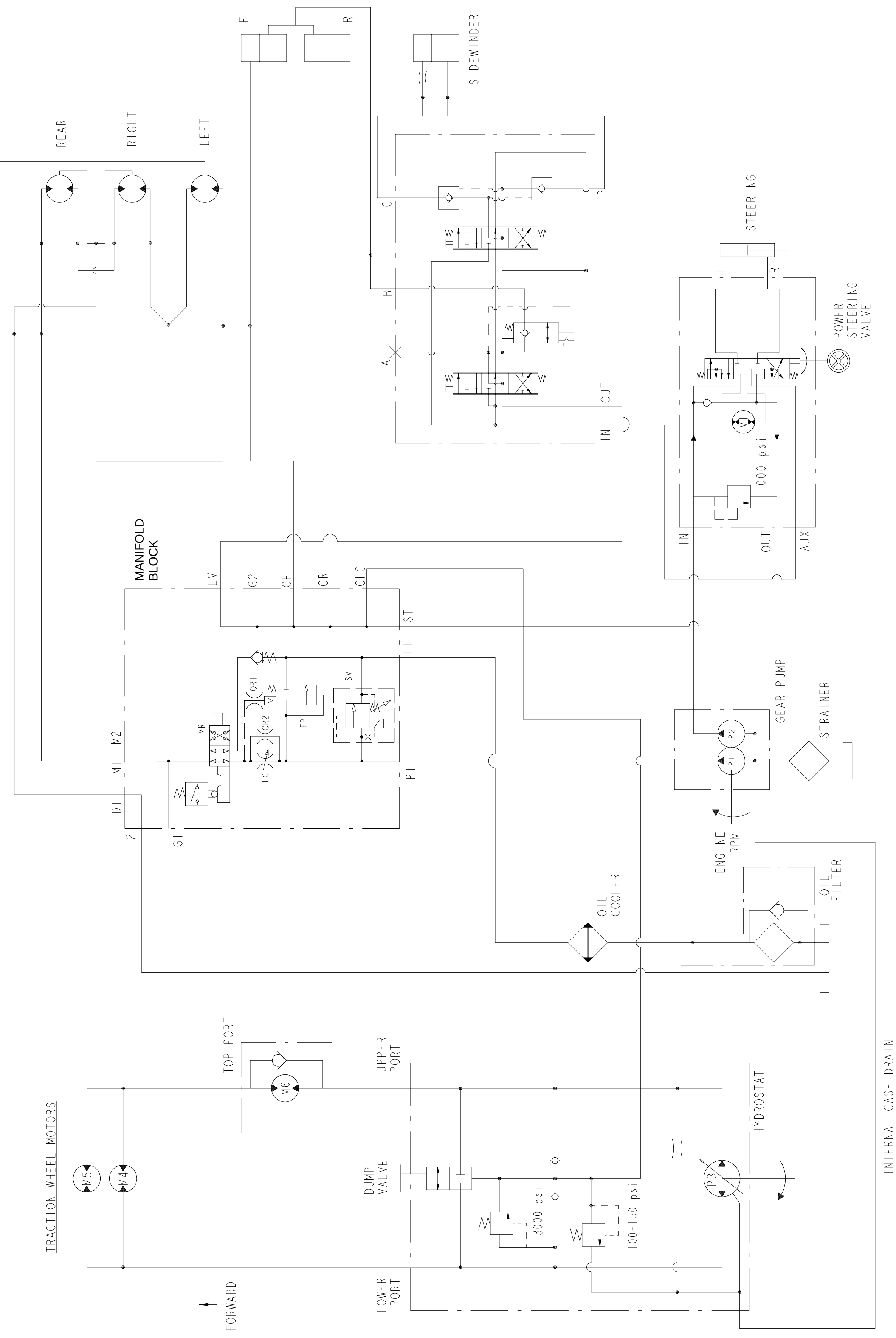
Hydraulic Schematic

All solenoids are shown as de–energized



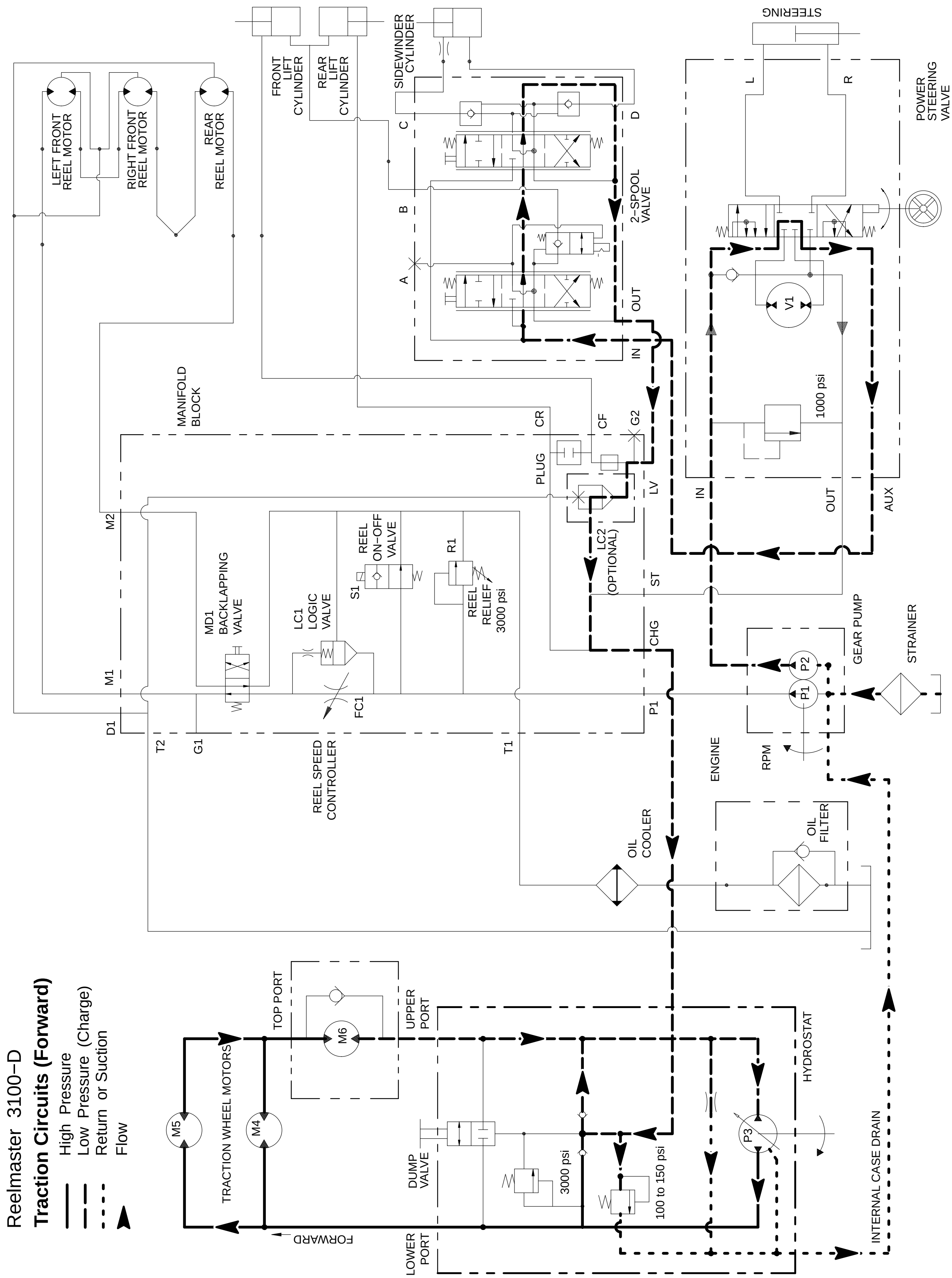
Reelmaster 3100–D (Models 03207 and 03171)
Hydraulic Schematic

All solenoids are shown as de–energized



Hydraulic System

Hydraulic Flow Diagrams



Traction Circuits

Forward

The traction circuit of the hydraulic system consists of a hydrostat connected in a closed loop circuit to three orbital vane wheel motors.

The engine drives traction pump (P3) indirectly through pulleys and a V−belt. The traction pump is a variable displacement piston pump. The traction pedal connects through a cable to the trunnion shaft and swash plate of the pump. With the engine running and the traction pedal in the neutral position, P3 supplies no flow to the wheel motors. When the traction pedal is pressed to the forward position, the cable from the pedal positions the swash plate in the traction pump so oil flows out of the lower port. Oil flow out of the lower port goes to the wheel motors and turns them in the forward direction. Oil flowing out of the wheel motors returns to upper port of the hydrostat and is continuously pumped out of the lower port.

The rear wheel motor has a small check valve across its ports that allows the rear motor to over run during tight turns in the forward direction.

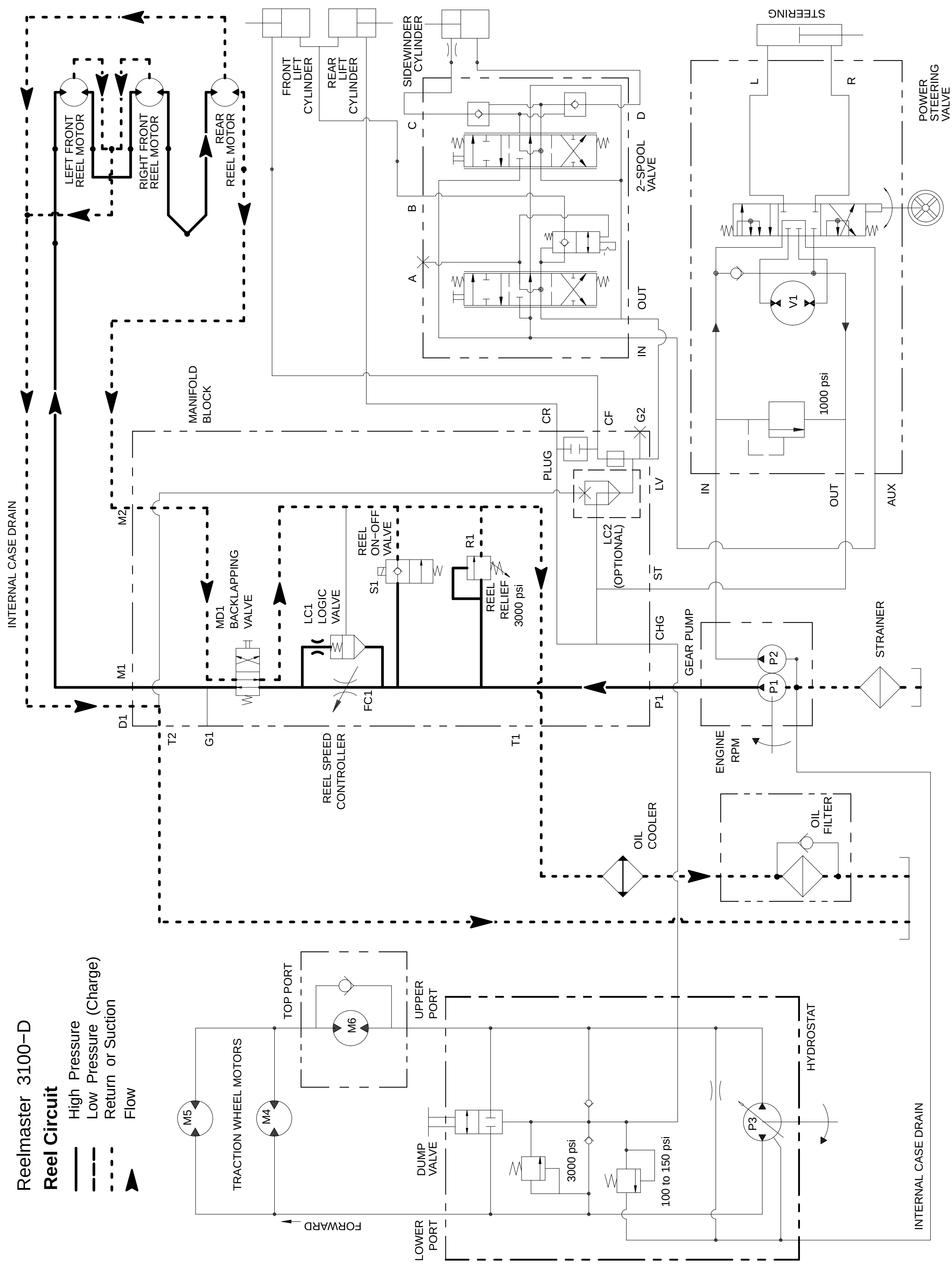
The traction pump uses a small amount of hydraulic fluid for internal lubrication. Fluid is designed to leak across pump parts into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop circuit that must be replenished.

The charge pump (P2) is a fixed displacement gear pump. It is driven directly off the traction pump. The pump replenishes the closed loop circuit with fluid from the hydraulic tank. The charge relief valve supplies sufficient head so that charge pump flow is guided to the low pressure side of the traction circuit through one of two check valves. Pump flow in excess of replenishment requirements is relieved through the charge relief valve back to the gear pump inlet.

Reverse

The traction circuit operates essentially the same in reverse as it does in forward. However, there are a few differences in operation.

When the reverse traction pedal is depressed, the cable from the pedal positions the swash plate in the traction pump so oil flows out of the upper port. Oil flow out of the upper port goes to the wheel motors and turns them in the reverse direction. Oil flowing out of the wheel motors returns to the lower port of the hydrostat and is continuously pumped out of the upper port. Oil by−passes the rear motor in reverse because of the check valve inside the rear motor.



Reelmaster 3100−D
Reel Circuit
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LEFT FRONT REEL MOTOR
RIGHT FRONT REEL MOTOR
REAR REEL MOTOR
FRONT LIFT CYLINDER
REAR LIFT CYLINDER
SIDEWINDER CYLINDER
STEERING
L
R
POWER STEERING VALVE
V1
1000 psi
IN
OUT
AUX
2−SPOOL VALVE
A
B
C
D
OUT
IN
MANIFOLD BLOCK
CR
CF
G2
PLUG
LV
LC2 (OPTIONAL)
ST
CHG
GEAR PUMP
P1
P2
STRAINER
ENGINE RPM
M2
M1
D1
T2
G1
T1
MD1 BACKLAPPING VALVE
LC1 LOGIC VALVE
REEL ON−OFF VALVE
S1
R1
REEL RELIEF 3000 psi
FC1
REEL SPEED CONTROLLER
INTERNAL CASE DRAIN
OIL COOLER
OIL FILTER
TOP PORT
UPPER PORT
M6
M5
M4
TRACTION WHEEL MOTORS
DUMP VALVE
3000 psi
100 to 150 psi
P3
HYDROSTAT
LOWER PORT
FORWARD
INTERNAL CASE DRAIN

Reel Circuit

Mow

The gear pump (P1) is directly coupled to the the hydrostat which is driven by the engine. Taking its suction directly from the hydraulic tank, the gear pump supplies oil flow to the manifold block and to the reel motors.

Solenoid valve (S1) is de−energized with the engine running when either the reels on/off switch is OFF, the cutting units are up, or the transport/mow switch is in TRANSPORT. S1 by−passes flow from the reel motors directly to the hydraulic reservoir.

Solenoid valve (S1) is energized with the engine running when the reels on/off switch is ON, the cutting units are down, and the transport/mow switch is in MOW. Flow is diverted to the reel motors.

Oil flows from port (P1) across the logic cartridge valve (LC1). The logic cartridge valve maintains a pressure differential of 75 PSI (5.2 bar) across the speed control valve. Any excess flow above what the speed control valve is set for, is by−passed to the reservoir through the logic cartridge valve. With the backlapping valve (MD1) in the **mow** position, oil flows through the valve, out port (M1), and to reel motors that are connected in series.

On machines with serial numbers below 230000000 (Fig. 8), oil flows through the left front, right front, and then rear reel motors as it turns the motors in the mow direction. The oil then returns into manifold block port (M2) and then to the hydraulic tank.

On machines with serial numbers above 230000000 (Fig. 9), oil flows through the rear, right front, and then left front reel motors as it turns the motors in the mow direction. The oil then returns into manifold block port (M2) and then to the hydraulic tank.

Backlap

Backlapping operation is the same as mowing operation, except for the position of the backlap valve (MD1). When the backlap valve is in the **backlap** position on machines with serial numbers below 230000000, oil flows through the rear, right front, and then left front reel motors (Fig. 8) as it turns the motors in the backlap direction.

On machines with serial numbers above 230000000 (Fig. 9), when the backlap valve is in the **backlap** position, oil flows through the left front, right front, and then rear reel motors

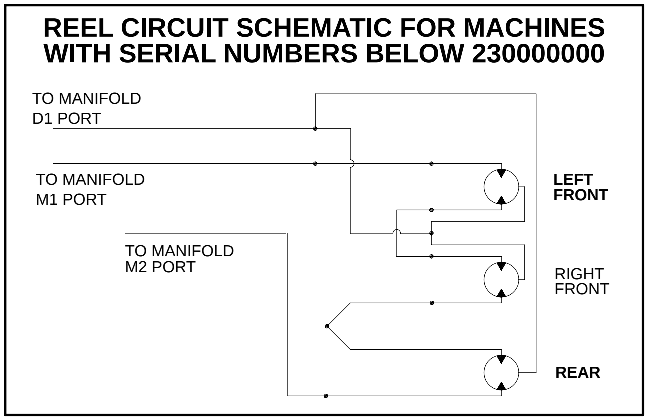


Figure 8

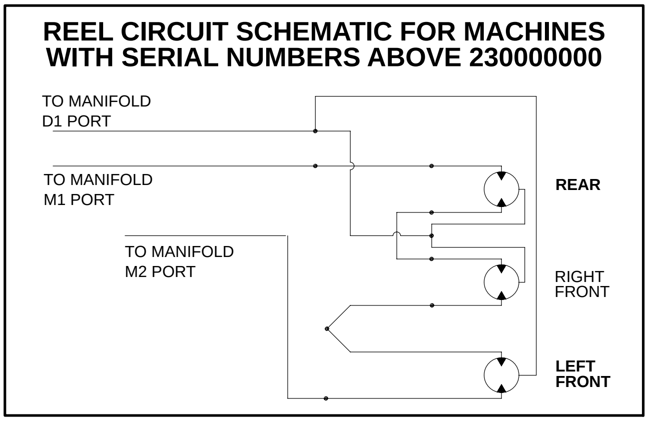
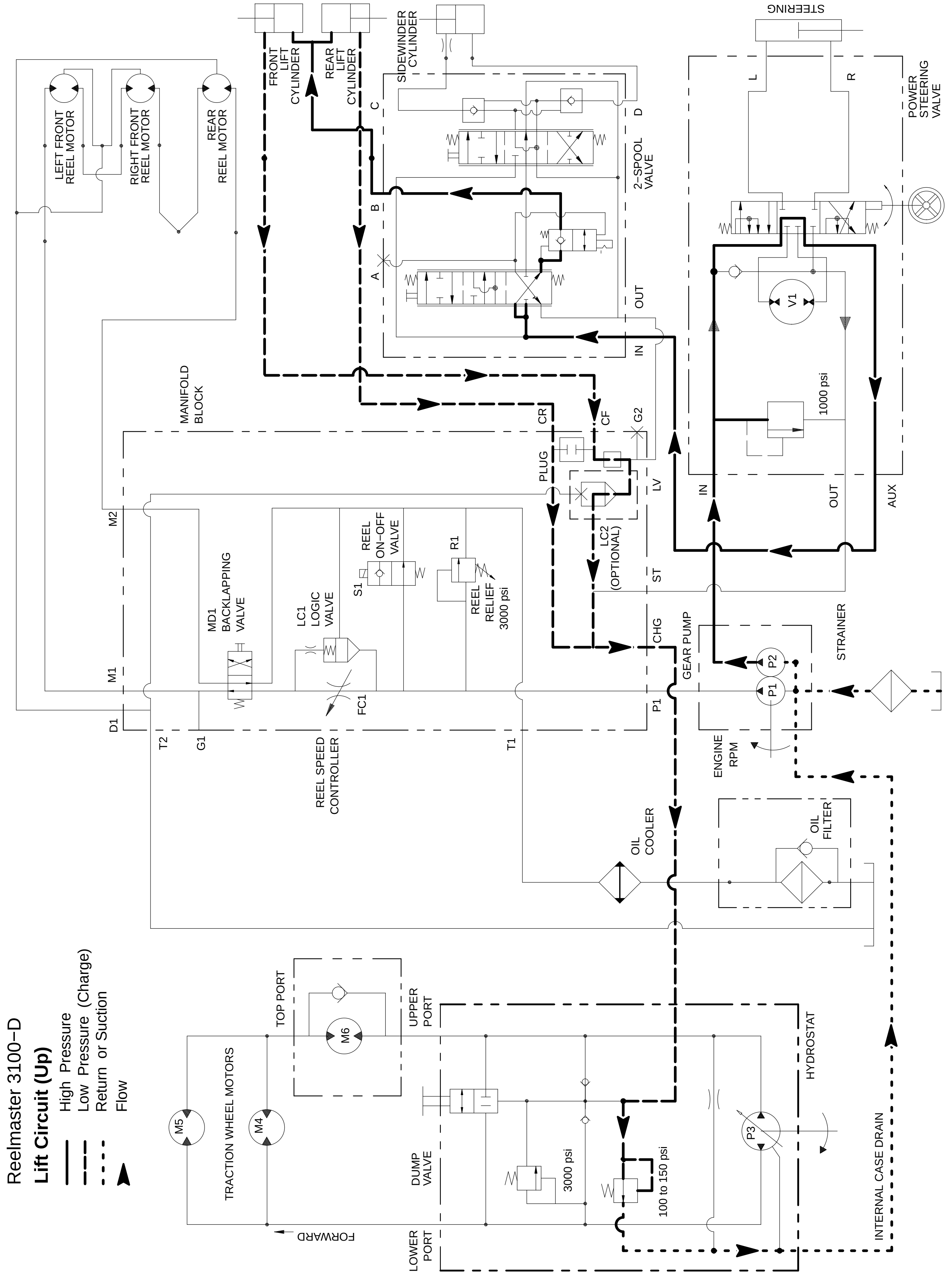


Figure 9

Hydraulic System



Reelmaster 3100−D
Lift Circuit (Up)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LEFT FRONT REEL MOTOR
RIGHT FRONT REEL MOTOR
REAR REEL MOTOR
FRONT LIFT CYLINDER
REAR LIFT CYLINDER
SIDEWINDER CYLINDER
STEERING
L
R
POWER STEERING VALVE
V1
1000 psi
C
D
2−SPOOL VALVE
B
A
OUT
IN
MANIFOLD BLOCK
CR
CF
G2
PLUG
LV
LC2 (OPTIONAL)
ST
CHG
M2
MD1 BACKLAPPING VALVE
LC1 LOGIC VALVE
S1
REEL ON−OFF VALVE
R1
REEL RELIEF 3000 psi
M1
D1
T2
G1
FC1
REEL SPEED CONTROLLER
T1
P1
IN
OUT
AUX
GEAR PUMP
P2
P1
STRAINER
ENGINE RPM
OIL COOLER
OIL FILTER
TOP PORT
M6
UPPER PORT
HYDROSTAT
M5
M4
TRACTION WHEEL MOTORS
DUMP VALVE
3000 psi
100 to 150 psi
P3
INTERNAL CASE DRAIN
FORWARD
LOWER PORT

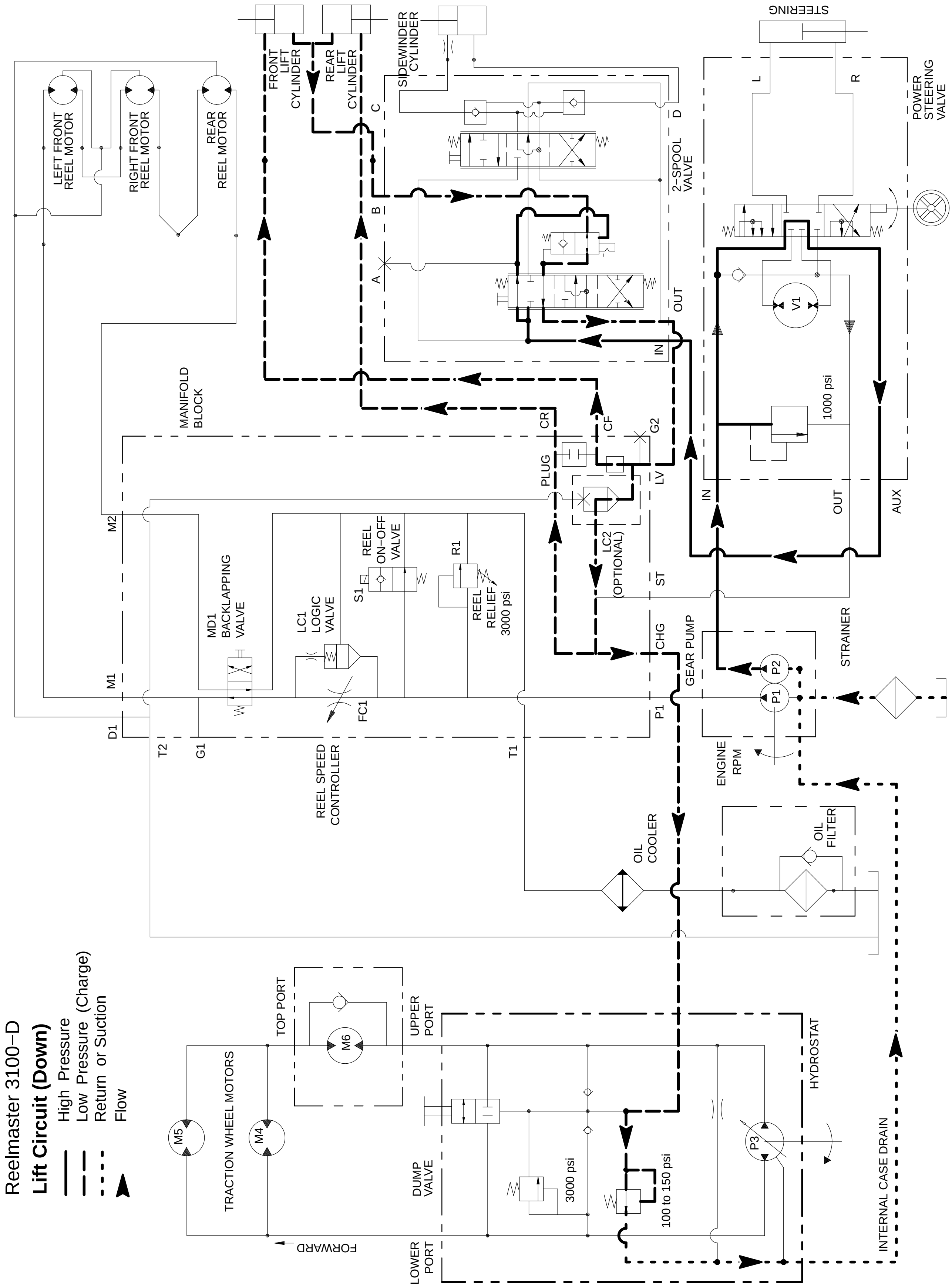
Lift Circuit (Up)

Raise Cutting Units

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure (charge pressure) for raising and lowering the cutting units, operating the sidewinder unit, and maintaining 100 to 150 PSI (6.9 to 10.0 bar) to the low pressure side of the traction circuit. The pump takes its suction from the hydraulic reservoir.

During conditions of not lifting or lowering cutting units, flow from the gear pump is by−passed through the power steering valve, 2−spool valve, and hydraulic manifold directly to the hydrostat and the charge relief valve. Flow then returns to the hydraulic tank.

When the cutting units are to be raised, the 2−spool valve is positioned by moving the cutting unit shift lever to RAISE. Flow is directed to cap ends of 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 the hydraulic manifold to the hydrostat. When the cutting unit shift lever is released, spring action returns the valve to its original position and by−passes flow back to the hydrostat stopping lift cylinder movement. The cylinder position is locked in place, since there is no complete circuit of flow to and from the lift cylinders.


Reelmaster 3100−D
Lift Circuit (Down)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
FRONT LIFT CYLINDER
REAR LIFT CYLINDER
SIDEWINDER CYLINDER
STEERING
LEFT FRONT REEL MOTOR
RIGHT FRONT REEL MOTOR
REAR REEL MOTOR
2−SPOOL VALVE
POWER STEERING VALVE
MANIFOLD BLOCK
MD1 BACKLAPPING VALVE
LC1 LOGIC VALVE
REEL ON−OFF VALVE
R1
REEL RELIEF 3000 psi
S1
FC1
LC2 (OPTIONAL)
REEL SPEED CONTROLLER
1000 psi
V1
GEAR PUMP
P1
P2
STRAINER
ENGINE RPM
OIL COOLER
OIL FILTER
TRACTION WHEEL MOTORS
M4
M5
M6
TOP PORT
UPPER PORT
LOWER PORT
DUMP VALVE
3000 psi
100 to 150 psi
P3
HYDROSTAT
INTERNAL CASE DRAIN
FORWARD

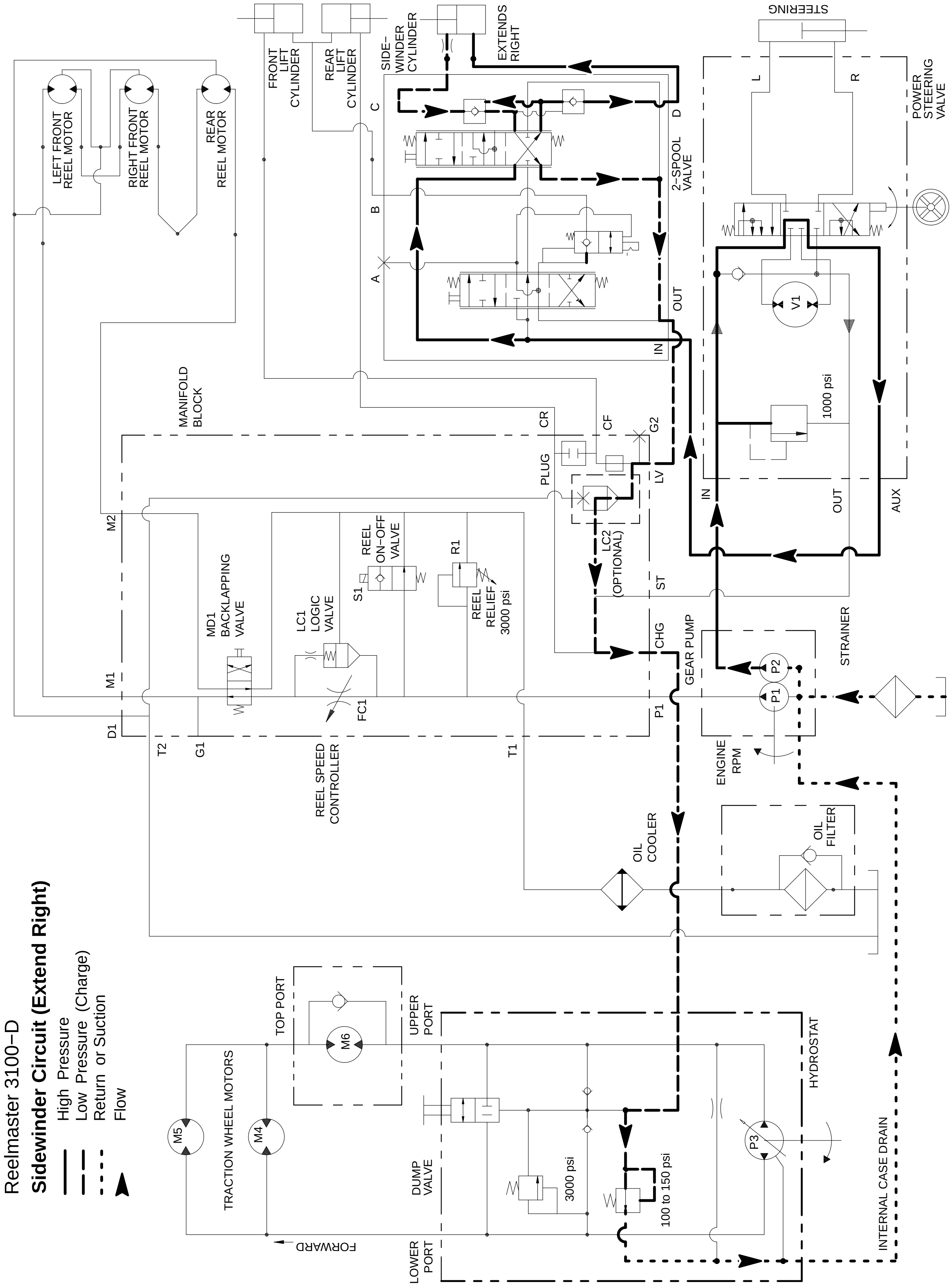
Lift Circuit (Down)

Lower Cutting Units

Circuit operation for lowering the cutting units is similar to raising them. However, pressure is relieved from the lift cylinders, and this action allows them to lower.

During conditions of not lifting or lowering cutting units, flow from the gear pump is by−passed through the power steering valve, 2−spool valve, and hydraulic manifold directly to the hydrostat and the charge relief valve. Flow then returns to the hydraulic tank.

When the cutting units are to be lowered, the 2−spool valve is positioned by moving the cutting unit shift lever to LOWER. Pressure from gear pump (P2) is used to shift the pilot valve in the 2−spool valve. This shifting of the pilot valve allows hydraulic pressure to relieve from the cap end of the lift cylinders. Flow from the cap end of the lift cylinders causes the cutting units to lower. At the same time, the fluid relieved from the cap end of the lift cylinders goes into the rod end of the cylinders and back through the hydraulic manifold to the hydrostat. When the cutting unit shift lever is released, spring action returns and detents the valve into the float position while by−passing flow back to the hydrostat. The pilot valve then shifts to its original position and stops lift cylinder movement. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.



Reelmaster 3100−D
Sidewinder Circuit (Extend Right)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LEFT FRONT REEL MOTOR
RIGHT FRONT REEL MOTOR
REAR REEL MOTOR
FRONT LIFT CYLINDER
REAR LIFT CYLINDER
SIDE-WINDER CYLINDER
EXTENDS RIGHT
STEERING
POWER STEERING VALVE
2-SPOOL VALVE
MANIFOLD BLOCK
MD1 BACKLAPPING VALVE
LC1 LOGIC VALVE
REEL ON-OFF VALVE
S1
R1
REEL RELIEF 3000 psi
FC1
REEL SPEED CONTROLLER
LC2 (OPTIONAL)
PLUG
GEAR PUMP
STRAINER
ENGINE RPM
OIL COOLER
OIL FILTER
1000 psi
V1
TRACTION WHEEL MOTORS
TOP PORT
UPPER PORT
LOWER PORT
DUMP VALVE
3000 psi
100 to 150 psi
HYDROSTAT
INTERNAL CASE DRAIN
FORWARD

Sidewinder Circuit

The gear pump (P2) is directly coupled to the hydrostat through gear pump (P1). It supplies hydraulic pressure (charge pressure) for raising and lowering the cutting units, operating the sidewinder unit, and maintaining 100 to 150 PSI (6.9 to 10.0 bar) to the low pressure side of the traction circuit. The pump takes its suction from the hydraulic reservoir.

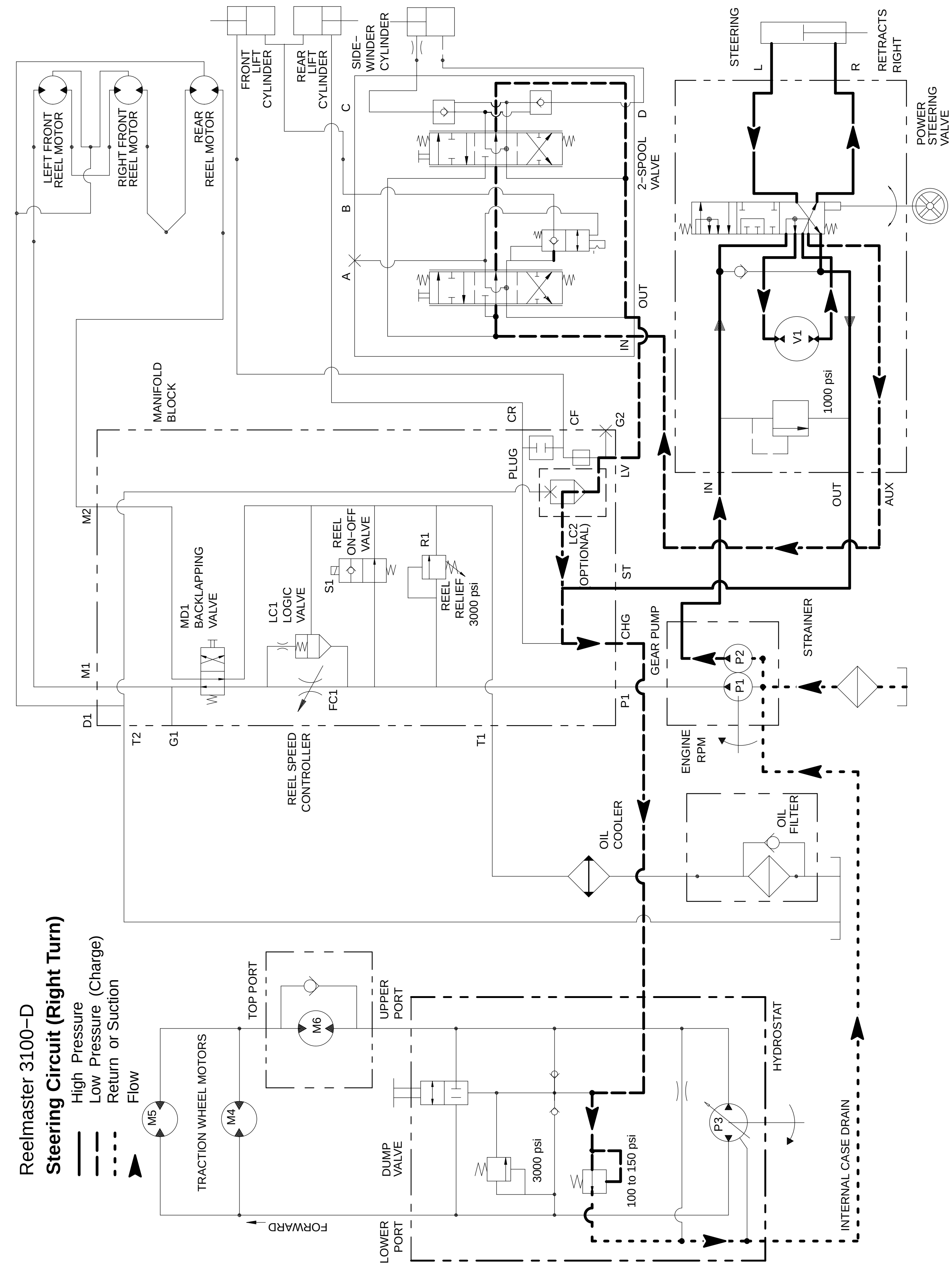
During conditions of not lifting or lowering the cutting units, flow from the gear pump is by−passed through the power steering valve, 2−spool valve, and hydraulic manifold directly to the hydrostat and the charge relief valve. Flow then returns to the hydraulic tank.

Shift Sidewinder Right

When the sidewinder is to be shifted right, the 2−spool valve is positioned by moving the cutting unit shift lever to RIGHT. Flow is directed to the cap end of the sidewinder cylinder. Hydraulic pressure against the cylinder piston moves the rod causing the sidewinder cylinder to extend right. At the same time, the piston pushes the hydraulic fluid out of the cylinder, back through the spool and hydraulic manifold, and to the hydrostat. When the cutting unit shift lever is released, spring action returns the valve to its original position and by−passes flow back to the hydrostat and stopping cylinder movement. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.

Shift Sidewinder Left

When the sidewinder is to be shifted left, the 2−spool valve is positioned by moving the cutting unit shift lever to LEFT. Flow is directed to the rod end of the sidewinder cylinder. Hydraulic pressure against the cylinder piston moves the rod causing the sidewinder to retract left. At the same time, the piston pushes the hydraulic fluid out of the cylinder, back through the spool and hydraulic manifold, and to the hydrostat. When the cutting unit shift lever is released, spring action returns the valve to its original position and by−passes flow back to the hydrostat stopping cylinder movement. The cylinder position is locked in place since there is no complete circuit of flow to and from the lift cylinders.


Reelmaster 3100−D
Steering Circuit (Right Turn)
High Pressure
Low Pressure (Charge)
Return or Suction
Flow
LEFT FRONT REEL MOTOR
RIGHT FRONT REEL MOTOR
REAR REEL MOTOR
FRONT LIFT CYLINDER
REAR LIFT CYLINDER
SIDE−WINDER CYLINDER
STEERING
RETRACTS RIGHT
L
R
POWER STEERING VALVE
C
D
B
A
2−SPOOL VALVE
OUT
IN
V1
1000 psi
MANIFOLD BLOCK
CR
CF
G2
PLUG
LV
LC2 (OPTIONAL)
ST
M2
M1
D1
T2
G1
T1
P1
MD1 BACKLAPPING VALVE
LC1 LOGIC VALVE
S1
REEL ON−OFF VALVE
R1
REEL RELIEF 3000 psi
FC1
REEL SPEED CONTROLLER
CHG
GEAR PUMP
P1
P2
STRAINER
ENGINE RPM
IN
OUT
AUX
OIL COOLER
OIL FILTER
TOP PORT
M6
UPPER PORT
LOWER PORT
TRACTION WHEEL MOTORS
M5
M4
FORWARD
DUMP VALVE
3000 psi
100 to 150 psi
P3
HYDROSTAT
INTERNAL CASE DRAIN

Steering Circuit

The gear pump (P2) is directly coupled to the hydrostat. It supplies hydraulic pressure to the power steering valve for turning the rear wheel and maintaining 100 to 150 PSI (6.9 to 10.0 Bar) to the low pressure side of the traction circuit. The pump takes its suction from the hydraulic reservoir.

With the steering wheel in the neutral position (rear wheel positioned straight ahead), the engine running, and the spool valve is in the center position, flow enters the steering control valve at the IN port and goes through the spool valve by−passing the rotary meter (V1) and steering cylinder. Flow leaves the control valve through the OUT port to the hydrostat.

Right Turn

When a right turn is made with the engine running, the turning of the steering wheel positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the IN port goes through the spool and is routed to two places. First, most of the flow through the valve is by−passed out the AUX port back through the 2−spool valve to the hydrostat. Second, the remainder of the flow is drawn through rotary meter (V1) and out port (R). Pressure retracts the piston for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the OUT port and to the hydrostat.

The steering control 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 so that flow goes through the bottom of the spool. Flow entering the steering control valve at the IN port goes through the spool and is routed to two places. As in a right turn, most of the flow through the valve is by−passed out the AUX port back through the 2−spool valve to the hydrostat. Also like a right turn, the remainder of the flow is drawn through rotary meter (V1) but goes out port (L). Pressure extends the piston for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount of the turning on the steering wheel. Fluid leaving the cylinder flows back through the spool valve then through the OUT port and to the hydrostat.

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

Special Tools

Order these special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

Toro Part Number: **TOR47009**

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

Figure 10

Hydraulic Tester (Pressure and Flow)

Toro Part Number: **TOR214678**

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

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

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

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

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

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

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

Figure 11

Hydraulic Test Fitting Kit

Toro Part Number: **TOR4079**

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

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

Figure 12

Measuring Container

Toro Part Number: **TOR4077**

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

Figure 13

O-Ring Kit

Toro Part Number: **16-3799**

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

Figure 14

Hydraulic System

Wheel Hub Puller

Toro Part Number: **TOR4097**

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

Figure 15

High Flow Hydraulic Filter Kit

Toro Part Number: **TOR6011**

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. hydrostat or wheel motor), the high flow hydraulic filter can be installed in the traction circuit. The filter will ensure that contaminates are removed from the closed loop and thus, do not cause additional component damage.

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

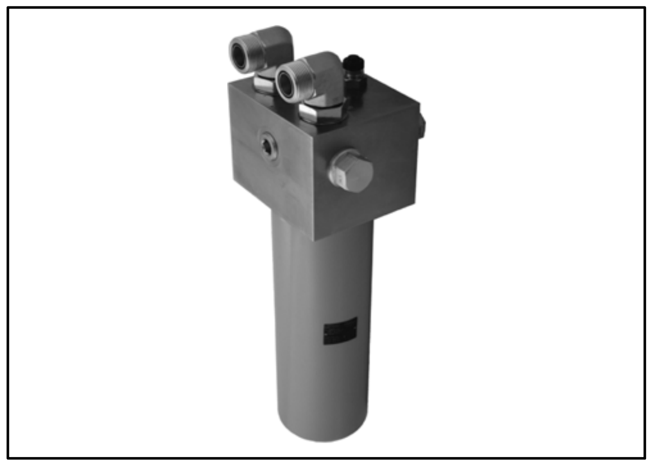


Figure 16

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

Hydraulic Hose Kit

Toro Part Number: **TOR6007**

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

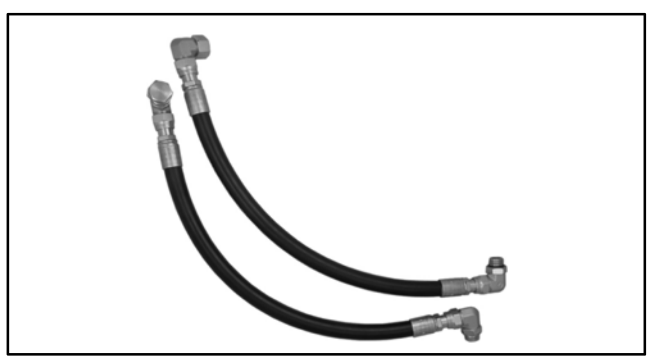


Figure 17

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Troubleshooting

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

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

Problem	Possible Cause
Hydraulic oil leaks from system.	Fitting(s), hose(s), or tube(s) are loose or damaged. O−ring(s) or seal(s) are missing or damaged.
Hydraulic fluid foams.	Oil level in reservoir is low. Hydraulic system has wrong type of oil. One of the pump suction lines has an air leak.
Hydraulic system operates hot.	Transmission pressure is high due to load or brakes applied. Oil level in reservoir is low, or inlet filter is loose or clogged. Oil is contaminated or too light. Heat exchanger (if equipped) is damaged or plugged. By−pass relief is stuck open or air flow is obstructed. Charge pressure is low. Towing by−pass valve is open or defective. Wheel motor(s) or reel motor(s) are worn or damaged. Traction pump is worn or damaged.
Neutral is difficult to find, or unit operates in one direction only.	External control linkage is misadjusted, disconnected, binding, or damaged. Traction pump is worn or damaged.
Traction response is sluggish.	Charge pressure is low. Hydraulic oil is very cold. Towing by−pass valve is open or worn. Brake is not released. Traction pump or wheel motor(s) are worn or damaged.
No traction exists in either direction.	Brake is not released. Oil level in reservoir is low. Towing by−pass valve is open. Charge pressure is low. Traction pump or wheel motor(s) are worn or damaged. Traction pump drive belt loose or broken.
Wheel motor will not turn.	Internal parts in wheel motor are damaged. Brakes are binding. Key on wheel motor shaft is sheared or missing.

Problem	Possible Cause
Wheel motor will not hold load in neutral.	Make up fluid from charge pump is not available. Hydrostat ball check valves are damaged.
Reel motor drive pump is noisy (cavitation).	Reservoir oil level is low. Suction line is restricted. Suction line has an air leak.
Reels will not turn.	Solenoid valve S1 is stuck open. An electrical problem exists (See Chapter 5−Electrical System). Relief valve R1 is stuck open. LC1 logic valve is stuck open. Gear pump P1 is damaged.
Reel speed is erratic.	Reel to bedknife adjustment is too tight. Orifice for LC1 is obstructed. Reel bearing(s) are damaged.
Reel(s) turn too slowly.	Reel section of pump (P1) is inefficient (see Testing). Reel motor has internal leakage or malfunctioning cross−over relief valve (see Testing). Reel bearing(s) are damaged.
Cutting units will not lift or lift slowly.	Engine speed is too low. Charge (gear) pump is damaged. Lift cylinder linkage is binding or broken. Lift cylinder bushings are binding. Reservoir oil level is low. Charge pump pressure or flow is insufficient. Implement relief valve (1000 PSI) is stuck open. Lift cylinders leak internally. Steering control valve is defective.
Cutting units raise, but will not stay up.	Lift cylinders leak internally. Check valve within the lift valve leaks.
Steering Problems.	See Ross Troubleshooting Guide in the Hydraguide ™ Hydrostatic Steering System HGF Series Service Procedure at the end of this chapter.
Turning steering wheel turns machine in the opposite direction.	Hoses to the steering cylinder are reversed.

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Testing

The most effective method for isolating problems in the hydraulic system is by using hydraulic test equipment such as pressure gauges and flow meters in the circuits during various operational checks (See the Special Tools section in this Chapter).

Before Performing Hydraulic Tests

IMPORTANT: All obvious areas such as oil supply, filter, binding linkages, loose fasteners, or improper adjustments must be checked before assuming that a hydraulic component is the source of the problem.

Precautions for Hydraulic Testing

CAUTION

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

CAUTION

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

WARNING

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

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

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

WARNING

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

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

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

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

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

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

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

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

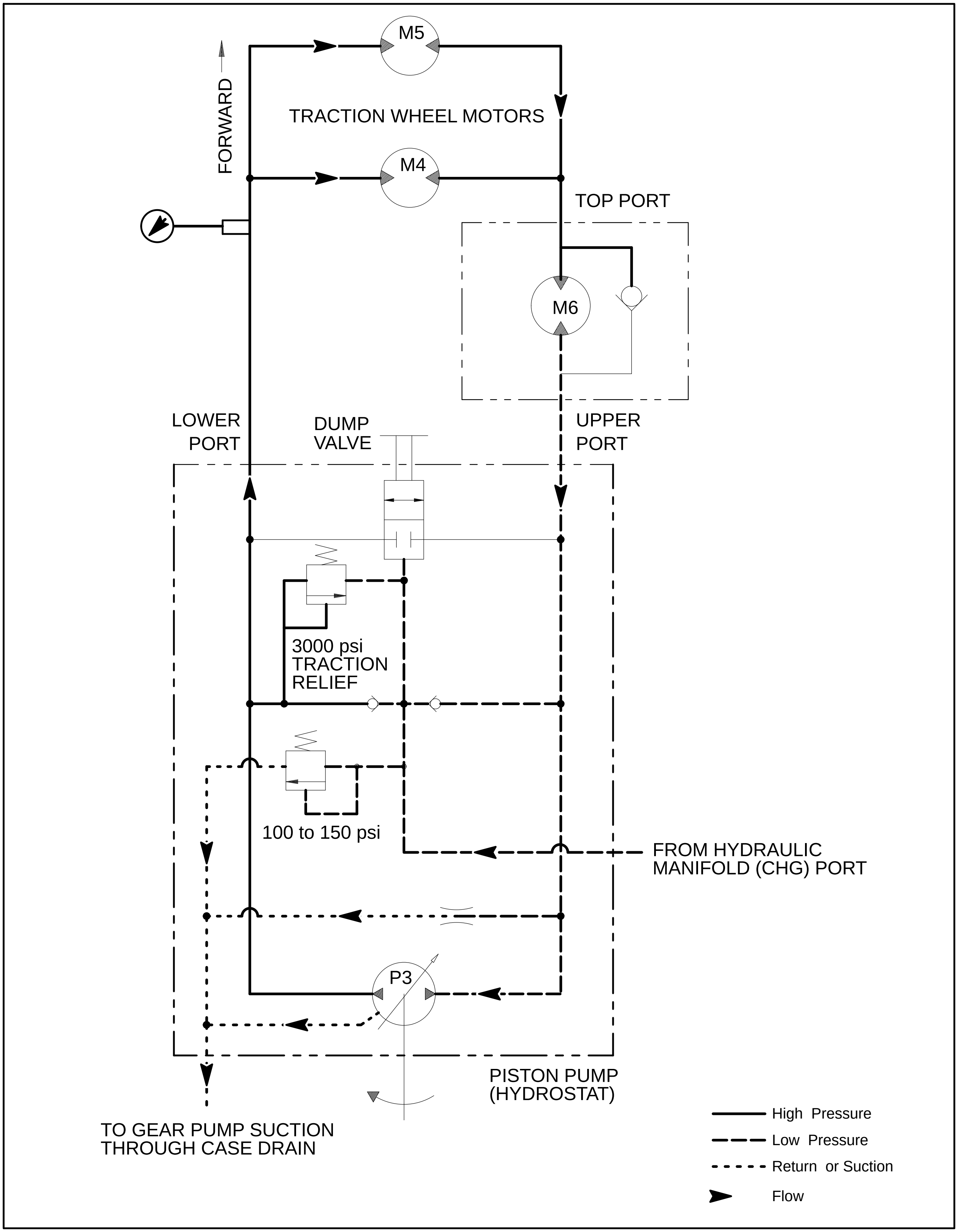
10. All hydraulic tests should be made with the hydraulic oil at normal operating temperature.

11. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Working Pressure, Charge Relief Valve Pressure, Piston Pump (P3) Flow & Traction Relief Pressure and/or Wheel Motor Efficiency Tests.

12. If a cutting circuit problem exists, consider performing one or more of the following tests: Reel Circuit Pressure, Manifold Relief Valve (R1) Pressure, Reel Motor Cross−over Relief Pressures, Gear Pump (P1) Flow and/or Reel Motor Efficiency Tests.

13. If a steering or lift circuit problem exists, consider performing one or more of the following tests: Lift and Steering Control Valve Relief Pressure, Gear Pump (P2) Flow and/or Steering Control Valve Tests.

Traction Circuit Working Pressure Test (Using Pressure Gauge)



Procedure for Traction Circuit Working Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

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

WARNING

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

5. Connect test gauge with a hydraulic hose attached to the test port. Make sure hose is long enough so the operator can read it while driving the machine (Fig. 17).

6. Start engine and move throttle to full speed **(2650 ± 50 RPM)**.

CAUTION

Do not operate sidewinder while performing test. The test gauge hose may get hit by the sidewinder carrier and rupture, and cause personnel injury.

7. Drive machine in the **forward** direction. Observe test gauge.

A. Pressure while transporting the machine over a flat, level surface should be about **500 PSI**.

B. Pressure driving the machine up a steep hill should be about **2500 PSI** but can reach relief settings (3000 PSI).

C. Pressure while mowing should range between **1000 to 2000 PSI** and will vary with terrain.

8. Release traction pedal and turn off machine.

9. Disconnect test gauge and hose from the test port (Fig. 17).

10. If specification is not met, the hydrostat needs to be repaired or replaced as necessary.

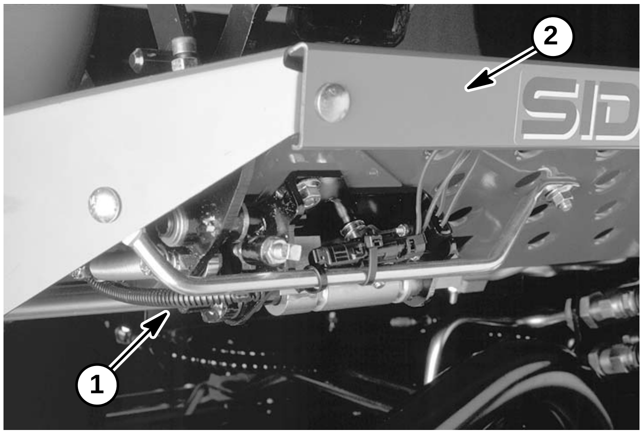
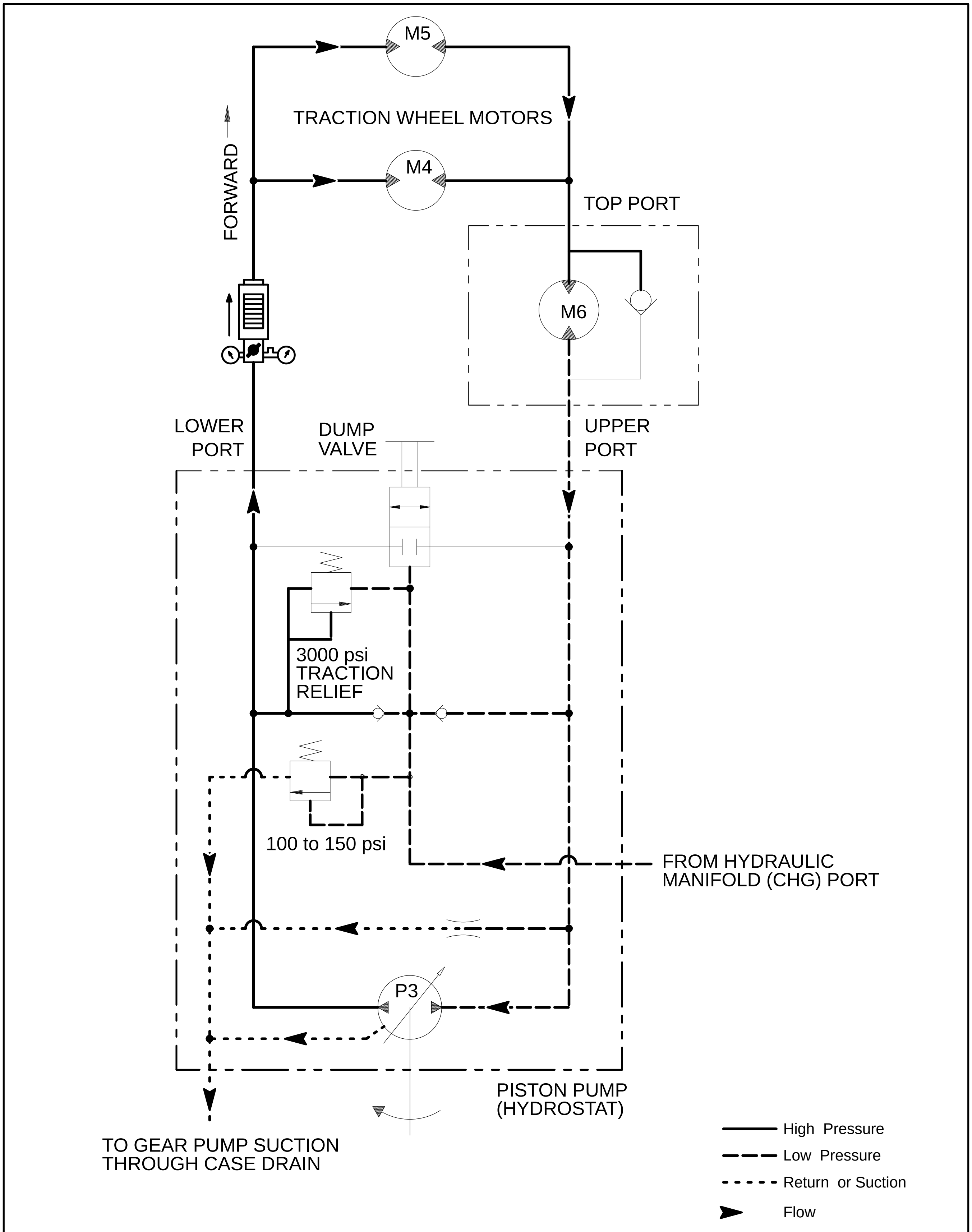


Figure 17

1. **Test port**
2. **Floor plate**

Hydraulic System

Piston Pump (P3) Flow and Traction Relief Pressure Test (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Piston Pump (P3) Flow and Traction Relief Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

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

WARNING

One front wheel and the rear wheel will be off the ground during testing. Make sure machine is supported so it will not move and accidentally fall to prevent injuring anyone under machine.

5. Block up one front traction wheel and the rear wheel off the floor to allow flow through the traction circuit; disconnect brake linkage to this wheel (see Wheels and Brakes − Chapter 7).

6. Chock remaining front wheel to prevent movement of the machine. Apply parking brake.

7. Attach a heavy chain to the rear of the machine frame and something immovable in the shop.

8. Disconnect hose from the lower hydraulic fitting on the bottom of the hydrostat.

NOTE: An alternate testing location would be at the hydraulic hose connection to the hydraulic tube under the left floor plate.

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

10. Start engine and move throttle to full speed **(2650 ± 50 RPM)**.

CAUTION

Use extreme caution when taking gauge readings. The front tire on the ground will be trying to move the machine forward.

11. Slowly push traction pedal fully to **forward** position.

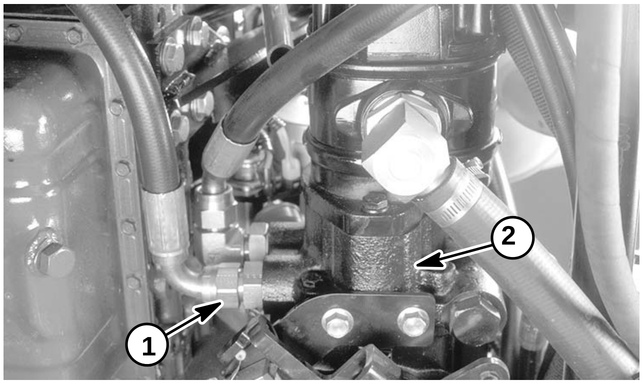


Figure 18

1. Lower hydraulic fitting 2. Piston pump

12. Verify traction relief valve setting by closing flow control valve. System pressure should be from **3000** to **3125 PSI** as the relief valve lifts. If pressure can not be met or is exceeded with traction pedal fully depressed, release traction pedal and open flow control valve fully.

13. If specification is not met consider the following:

A. The traction belt may be worn and slipping (see Replace Traction Belt).

B. The relief valve leaks or is faulty and needs replacement.

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

14. If the traction relief valve tests out properly, verify pump flow as follows:

A. Push traction pedal in the forward direction until pressure gauge reads **1000 PSI**. Verify with a phototac that the **pump speed** is **2350 RPM** (engine speed approximately 2000 RPM).

B. Observe flow gauge. TESTER READING should be approximately **12.5 GPM**.

15. Release traction pedal and turn off machine.

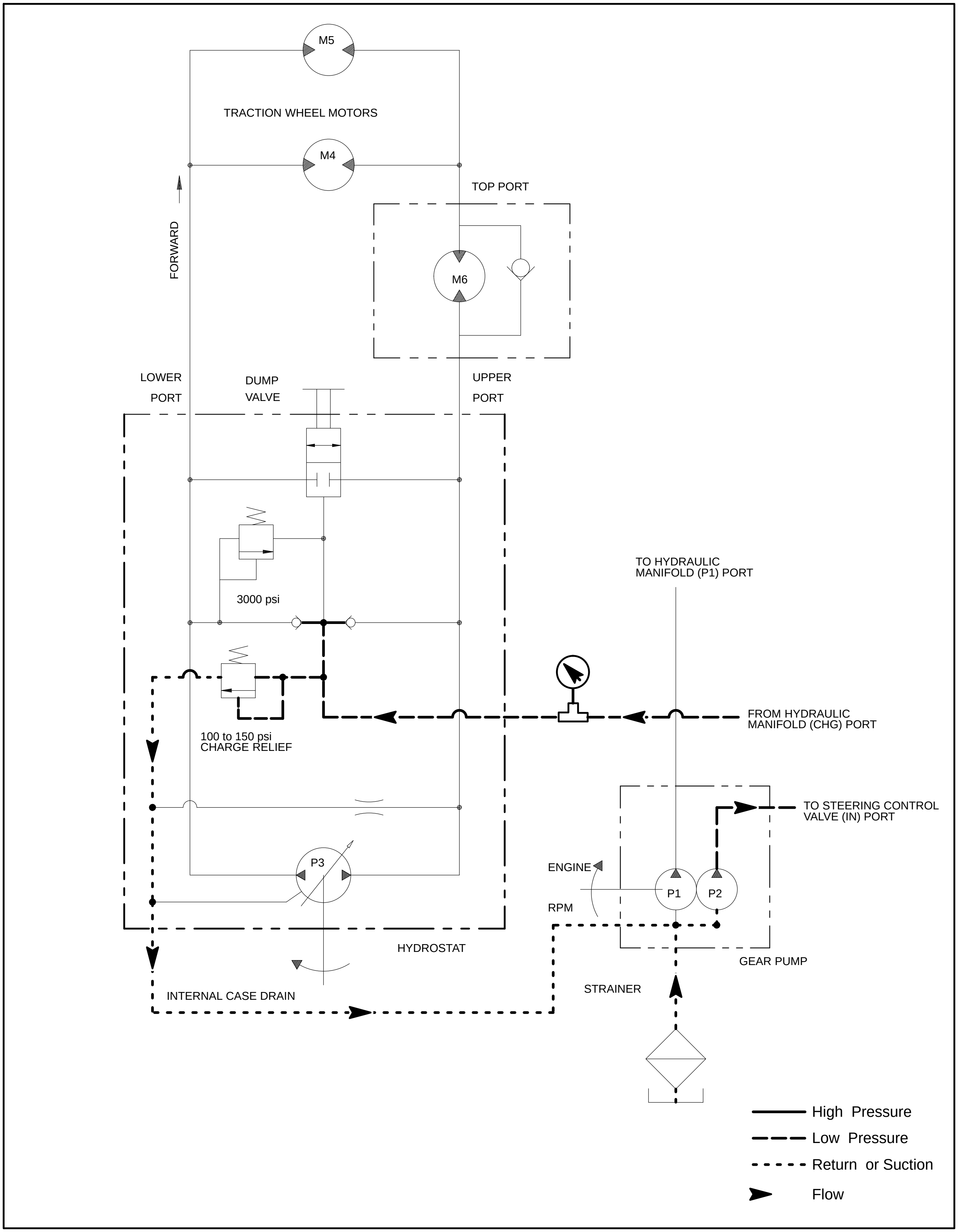
NOTE: If pressure is good under no load, but drops below specification when under traction load, the piston pump and/or wheel motor(s) should be suspected of wear. When a pump and/or motor is worn or damaged, the charge pump is not able to keep up with internal leakage in the traction circuit (See Charge Relief Valve Pressure Test).

16. If specifications are not met, the hydrostat needs to be repaired or replaced as necessary.

17. Disconnect tester from hydraulic fitting and hose. Reconnect hose to pump connection.

18. Reconnect brake linkage to wheel (see Wheels and Brakes − Chapter 7).

Charge Relief Valve Pressure Test (Using Pressure Gauge)



Procedure for Charge Relief Valve Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

WARNING

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

4. Disconnect hose to the rear 90º hydraulic fitting on the piston pump coming from the hydraulic manifold port (CHG). Connect T−connector and gauge to the fitting and hose connection.

5. Operate engine at full speed **(2650 ± 50 RPM)**.

6. Make sure that traction pedal is in neutral and the parking brake is engaged.

7. Pressure gauge should read from **100 to 150 PSI**.

8. If charge relief pressure specification is not met, consider the following:

A. The piston pump charge relief valve is faulty. Repair or replace the piston pump charge relief valve (see Piston Pump Service in the Service and Repairs section).

B. Gear pump (P2) is faulty (steering and lift circuits are also affected).

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

A. With T−connector and pressure gauge still connected, sit in the operator seat and press the traction pedal to forward.

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

C. The charge pressure should drop no more than 15% from initial test reading (Step 7 above). A pressure drop of more than 15% indicates a traction circuit leak (e.g. a worn or damaged piston pump and/or wheel motor).

10. Shut off engine.

11. Disconnect gauge and T−connection from the 90º hydraulic fitting and hose connection. Reconnect hose to the hydrostat.

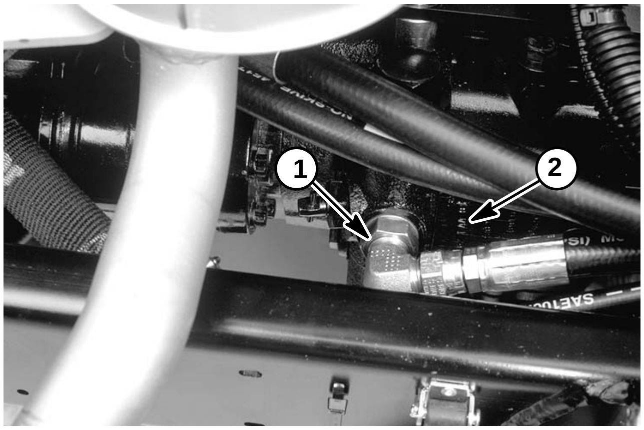
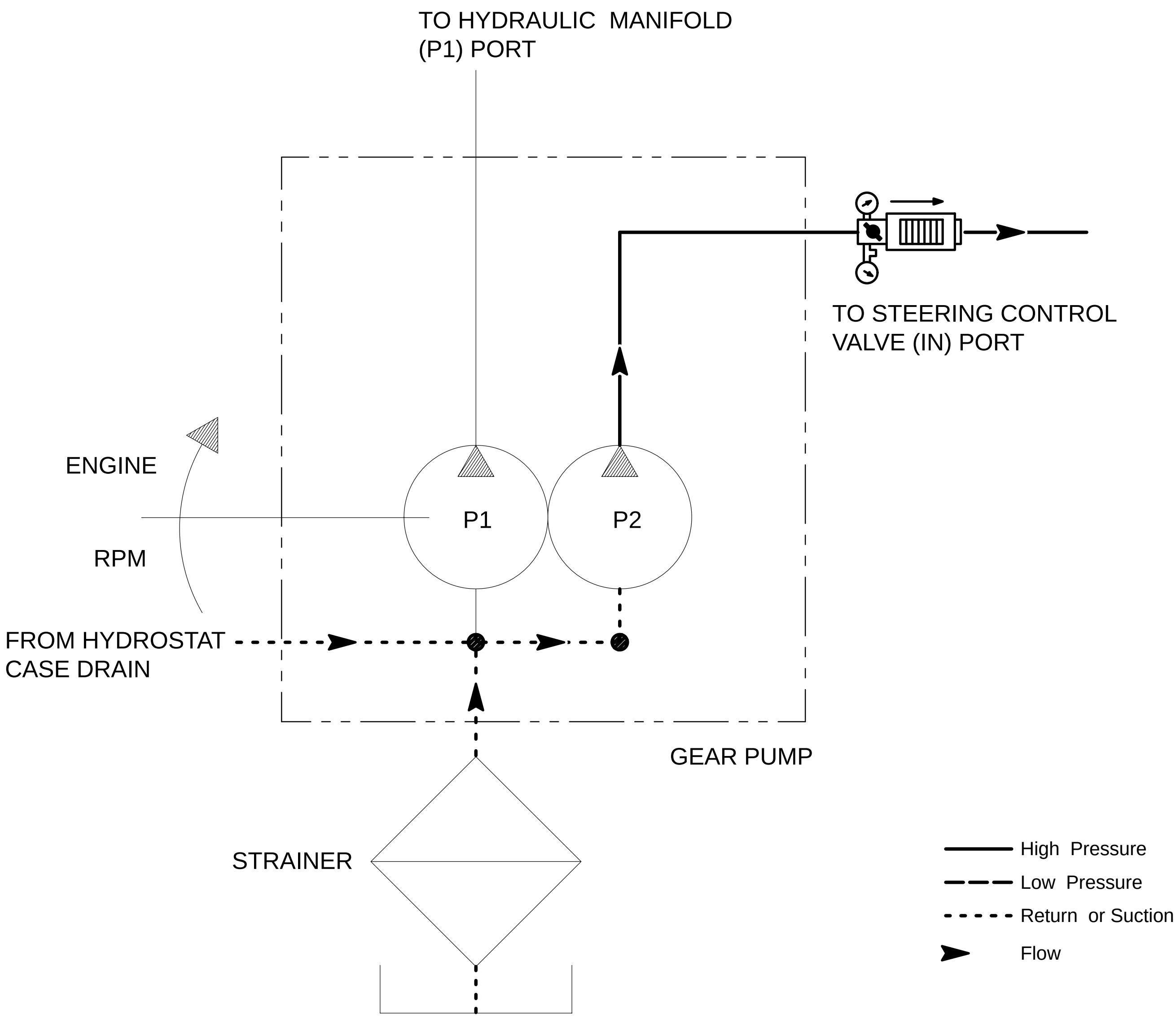


Figure 19

1. Rear 90º hydraulic fitting
2. Piston pump

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



Procedure for Gear Pump (P2) Test:

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

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

3. Read Precautions for Hydraulic Testing.

WARNING

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

4. Disconnect hose connection on the reel gear pump leading to the steering control valve.

5. Install tester in series with reel drive pump and the disconnected hose leading to the steering control valve.

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

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

7. Start engine and move throttle to full speed **(2650 ± 50 RPM)**. **Do not engage the cutting units**.

8. Watch pressure gauge carefully while slowly closing the flow control valve until **800 PSI** is obtained. Verify with a phototac that the **pump speed** is **3100 RPM**.

9. Flow indication should be **3.6 GPM** minimum.

10. Shut off engine.

NOTE: If necessary, Steering and Lift Relief Pressure Test can be conducted with tester as placed for this test.

11. If flow was less than **3.6 GPM** or a pressure of **800 PSI** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove pump and repair or replace as necessary.

12. Disconnect tester from gear pump fitting and hose. Reconnect hose to the pump.

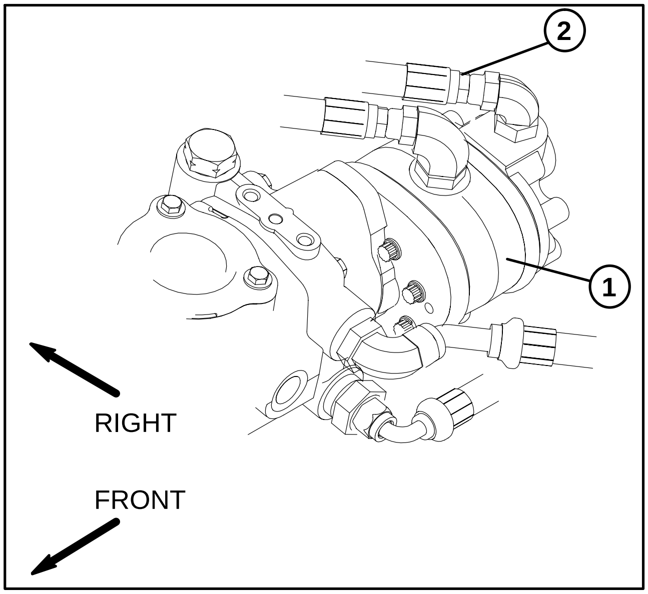


Figure 20

1. Gear pump
2. To steering control valve

Hydraulic System

Wheel Motor Efficiency Test (Using Tester with Pressure Gauges and Flow Meter)

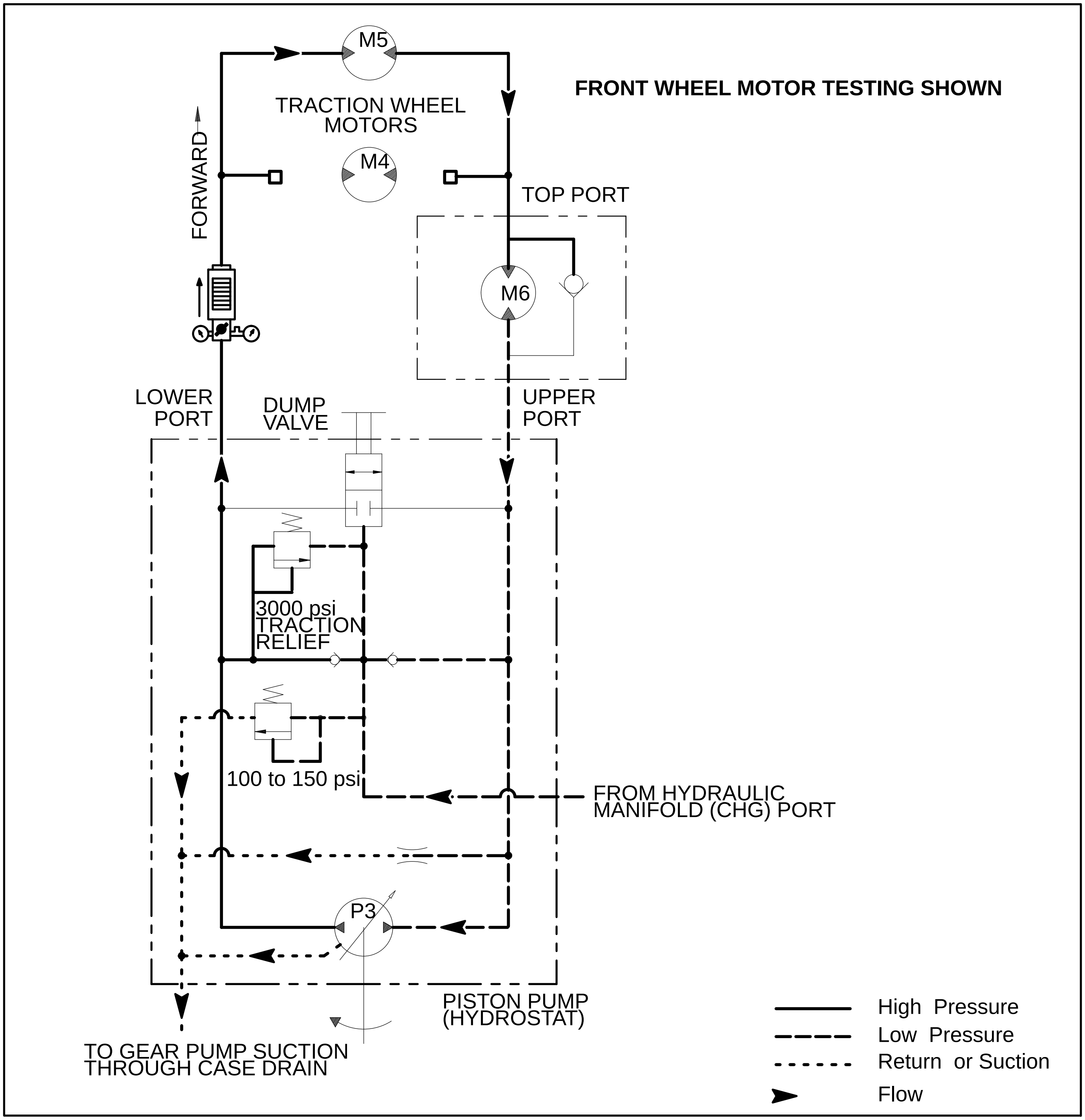


Figure 21

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

Procedure for Wheel Motor Efficiency Test:

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

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

3. Read Precautions for Hydraulic Testing.

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

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

WARNING

The rear wheel will be off the ground during front wheel motor testing. Make sure machine is supported so it will not move and accidentally fall to prevent injuring anyone under machine.

6. Block up the rear wheel off the ground to allow flow through the traction circuit.

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

WARNING

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

8. Disconnect hydraulic lines from front wheel motor that is **not** being tested. Cap disconnected hydraulic lines and plug ports in motor to prevent contamination.

9. Disconnect hose from the lower hydraulic fitting on the bottom of the hydrostat (Fig. 22).

NOTE: An alternate testing location would be at the hydraulic hose connection to the hydraulic tube under the left floor plate.

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

11. Start engine and move throttle to full speed **(2650 ± 50 RPM)**.

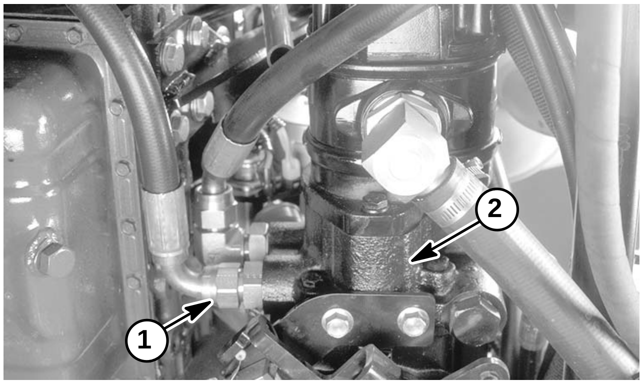


Figure 22

1. **Lower hydraulic fitting** 2. **Piston pump**

CAUTION

Use extreme caution when performing test. The front tire on the ground will be trying to move the machine forward.

12. Slowly push traction pedal in **forward** direction until 1000 PSI is displayed on the pressure gauge.

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

14. If specifications are not met, the tested wheel motor needs to be repaired or replaced as necessary.

15. If remaining front wheel motor requires testing, complete steps 5 to 14 for the remaining motor.

16. If rear wheel motor requires testing:

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

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

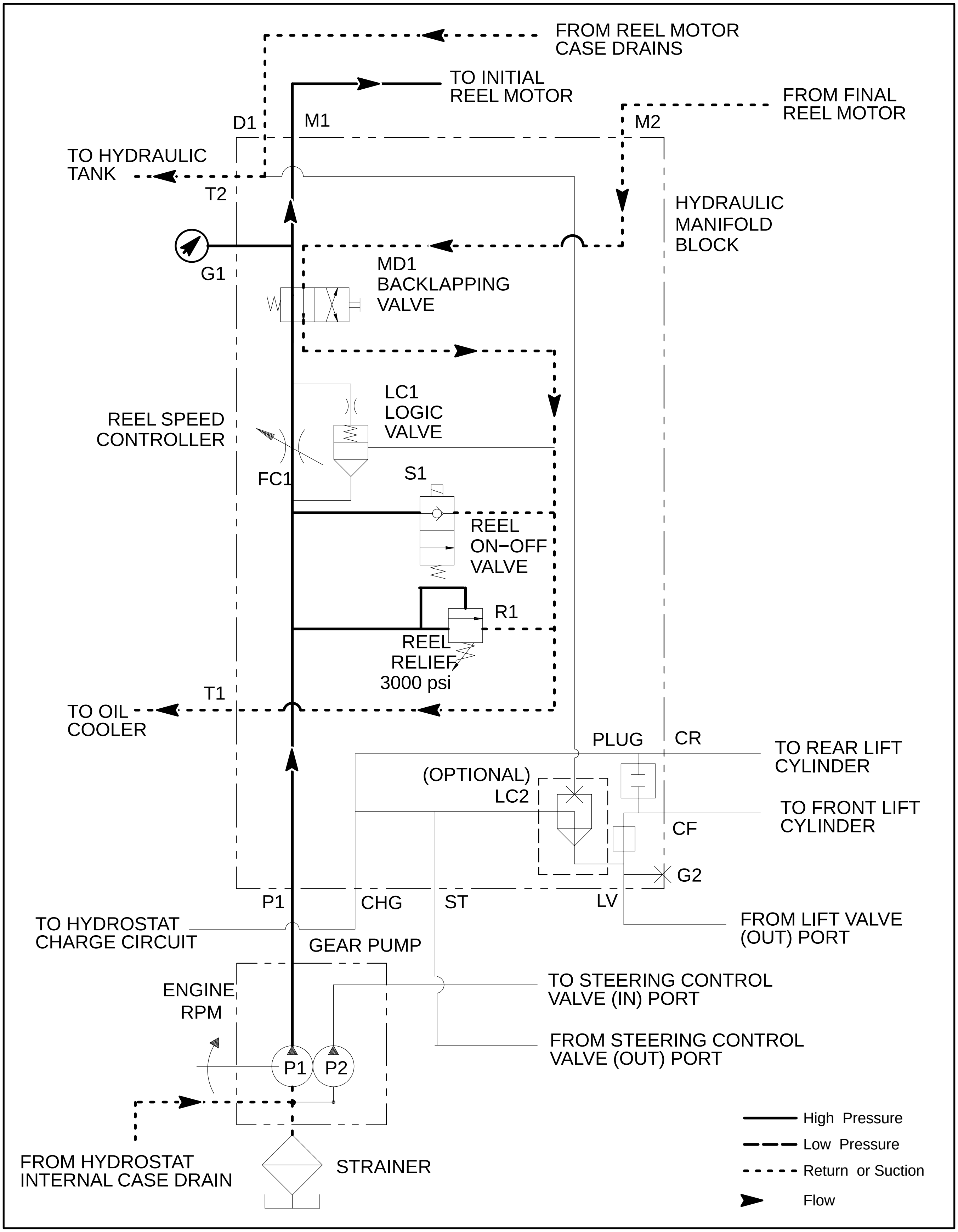
C. Position rear wheel on the ground and chock rear wheel to prevent it from turning.

D. Complete steps 9 to 13.

E. If specifications are not met, check the relief valve in the rear wheel motor for damage. If relief valve is not damaged, wheel motor needs to be repaired or replaced.

17. Disconnect tester from hydraulic fitting and hose. Reconnect hose to pump connection.

Reel Circuit Pressure Test (Using Pressure Gauge)



Procedure for Reel Circuit Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

WARNING

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

4. Remove plug from hydraulic manifold test port (G1).

5. Install pressure test gauge with hydraulic hose attached into the test port.

6. Make sure backlap knob on the hydraulic manifold is in the **mow** position. Make sure reel speed knob is set for typical mowing conditions.

CAUTION

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

7. Start engine and move throttle to full speed **(2650 ± 50 RPM)**. Engage the cutting units.

8. Watch pressure gauge carefully while mowing with the machine.

9. Reel circuit pressure should be about **600 PSI**.

10. Disengage cutting units. Shut off engine.

11. Disconnect test gauge with hose from manifold block. Reconnect plug to the hydraulic manifold test port (G1).

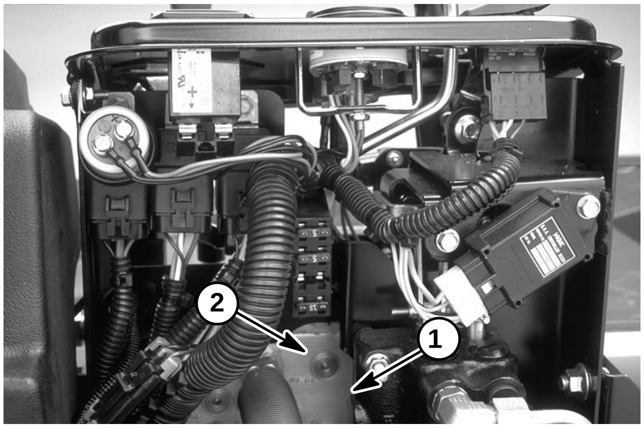
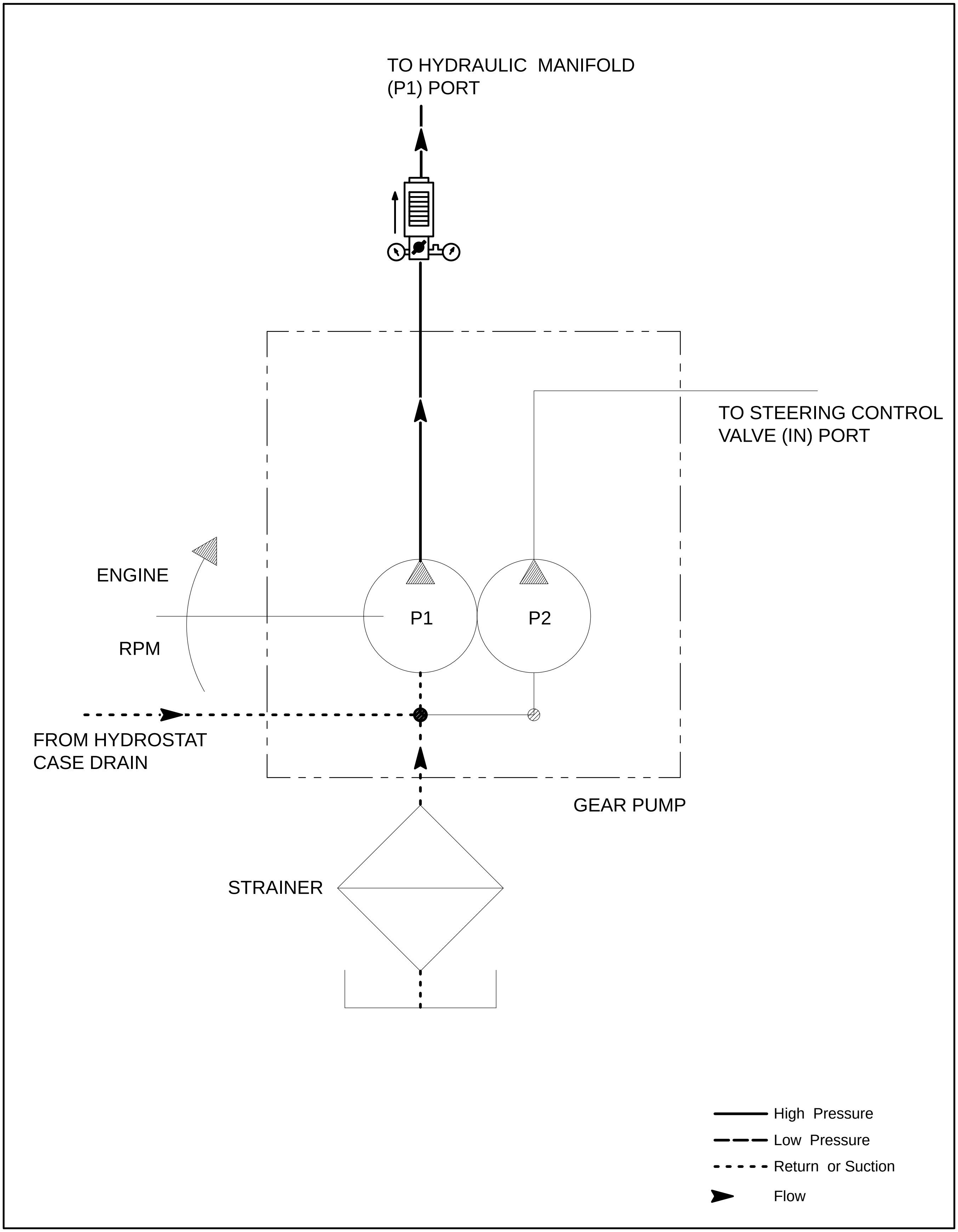


Figure 23

1. **Hydraulic manifold**
2. **Test port (G1)**

Hydraulic System

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



Procedure for Gear Pump (P1) Flow Test:

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

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

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

3. Read Precautions for Hydraulic Testing.

WARNING

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

4. Disconnect hose connection on the reel gear pump leading to port (P1) on the hydraulic manifold.

5. Install tester in series with reel drive pump and the disconnected hose leading to port (P1) of the hydraulic manifold.

6. Make sure backlap knob on the hydraulic manifold is in the **mow** position and reel speed is set to maximum.

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

8. Start engine and move throttle to full speed **(2650 ± 50 RPM)**. **Do not engage the cutting units**.

IMPORTANT: In this test, the hydraulic tester is positioned before the manifold relief valve. Pump damage can occur if the oil flow is fully restricted by fully closing the tester flow control valve. Do not close tester valve fully when performing test.

9. Watch pressure gauge carefully while slowly closing the flow control valve until **2000 PSI** is obtained. Verify with a phototac that the **pump speed** is **3100 RPM**.

10. Flow indication should be **5.7 GPM** minimum.

11. Shut off engine.

12. Disconnect tester from gear pump fitting and hose. Reconnect hose to the pump.

13. If flow was less than **5.7 GPM** or a pressure of **2000 PSI** cannot be obtained, check for restriction in the pump intake line. If line is not restricted, remove pump and repair or replace as necessary.

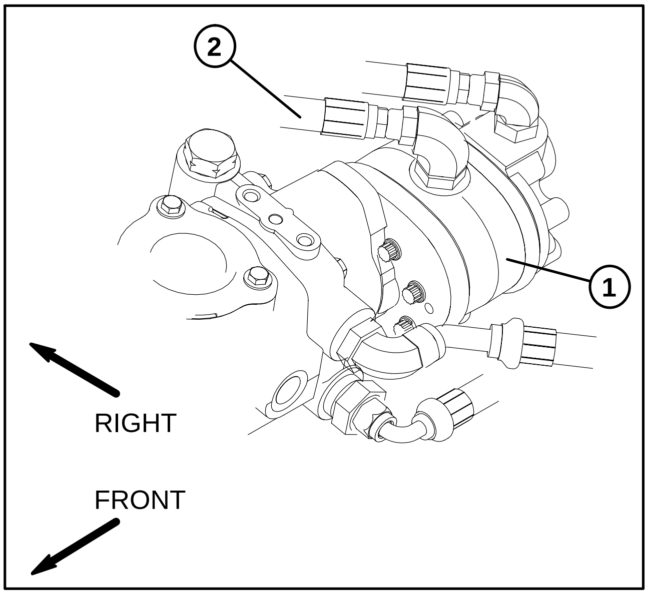
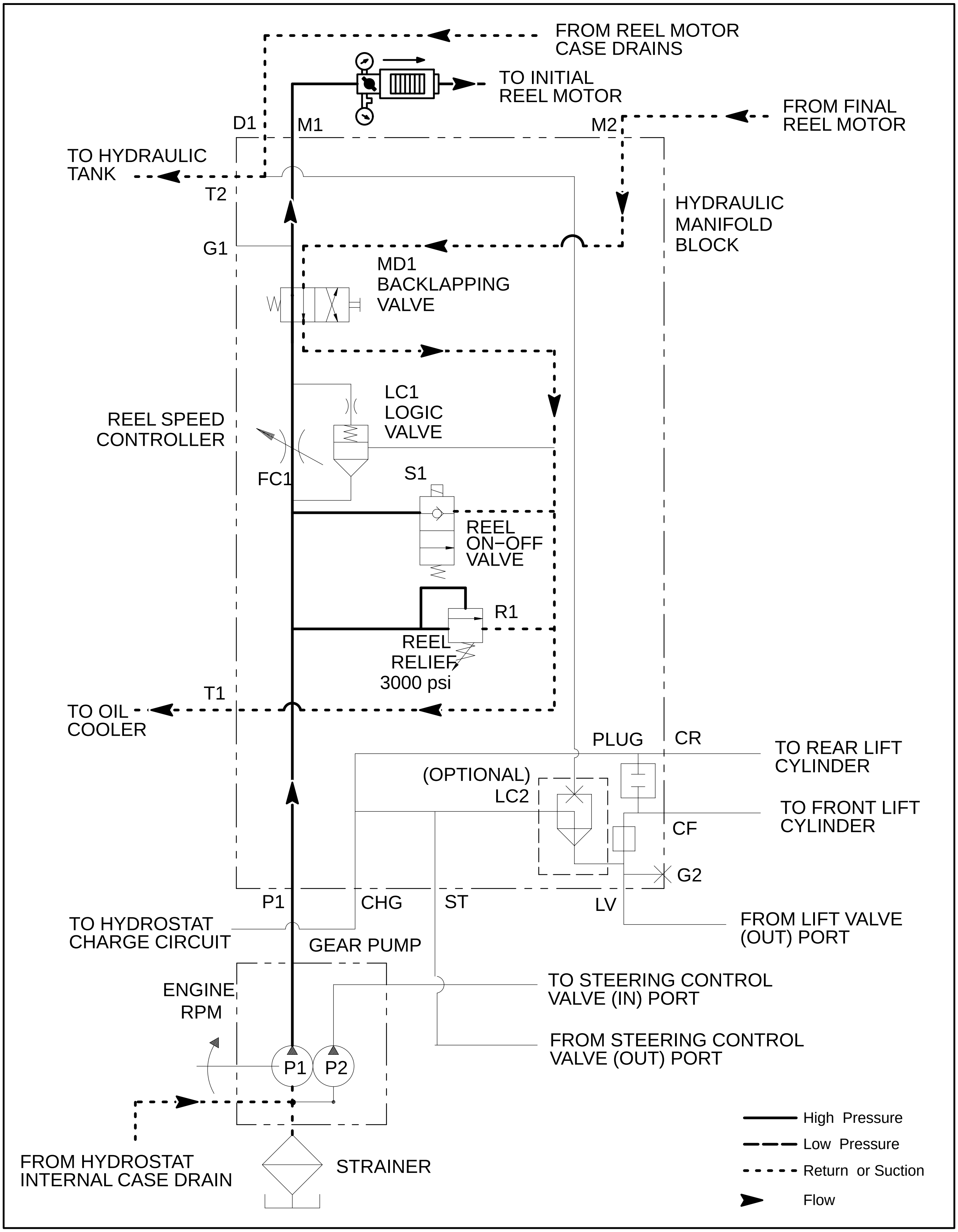


Figure 24

1. Gear pump
2. To manifold port (P1)

Hydraulic System

Manifold Relief Valve (R1) Pressure Test (Using Tester with Pressure Gauges and Flow Meter)



Procedure for Manifold Relief Valve (R1) Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

4. Make sure reel speed adjuster knob (FC1) is set to the highest speed setting (fully open).

WARNING

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

5. Disconnect hose connection from hydraulic fitting on manifold port (M1).

6. Install tester in series with the hose and hydraulic fitting. Make sure the flow control valve on tester is fully open.

7. Make sure backlap knob on the hydraulic manifold is in the **mow** position. Make sure reel speed knob is set to maximum.

CAUTION

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

8. Start engine and move throttle to full speed **(2650 ± 50 RPM)**. Engage the cutting units.

9. Watch pressure gauge carefully while slowly closing the flow control valve to fully closed.

10. System pressure should be from **2700 to 3300 PSI** as the relief valve lifts.

   A. If specification is **not** met, shut off engine and adjust relief valve (see Adjusting Manifold Relief Valve). Return to Step 6.

   B. If this specification is met, go to Step 11.

11. Disengage cutting units. Shut off engine.

12. Disconnect tester from manifold and hose. Reconnect hydraulic hose to manifold fitting for port (M1).

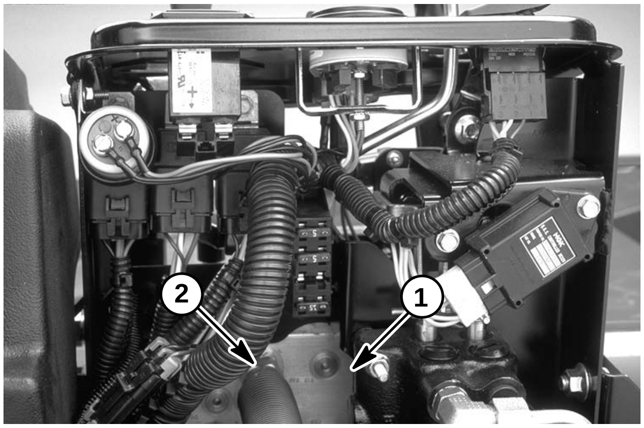
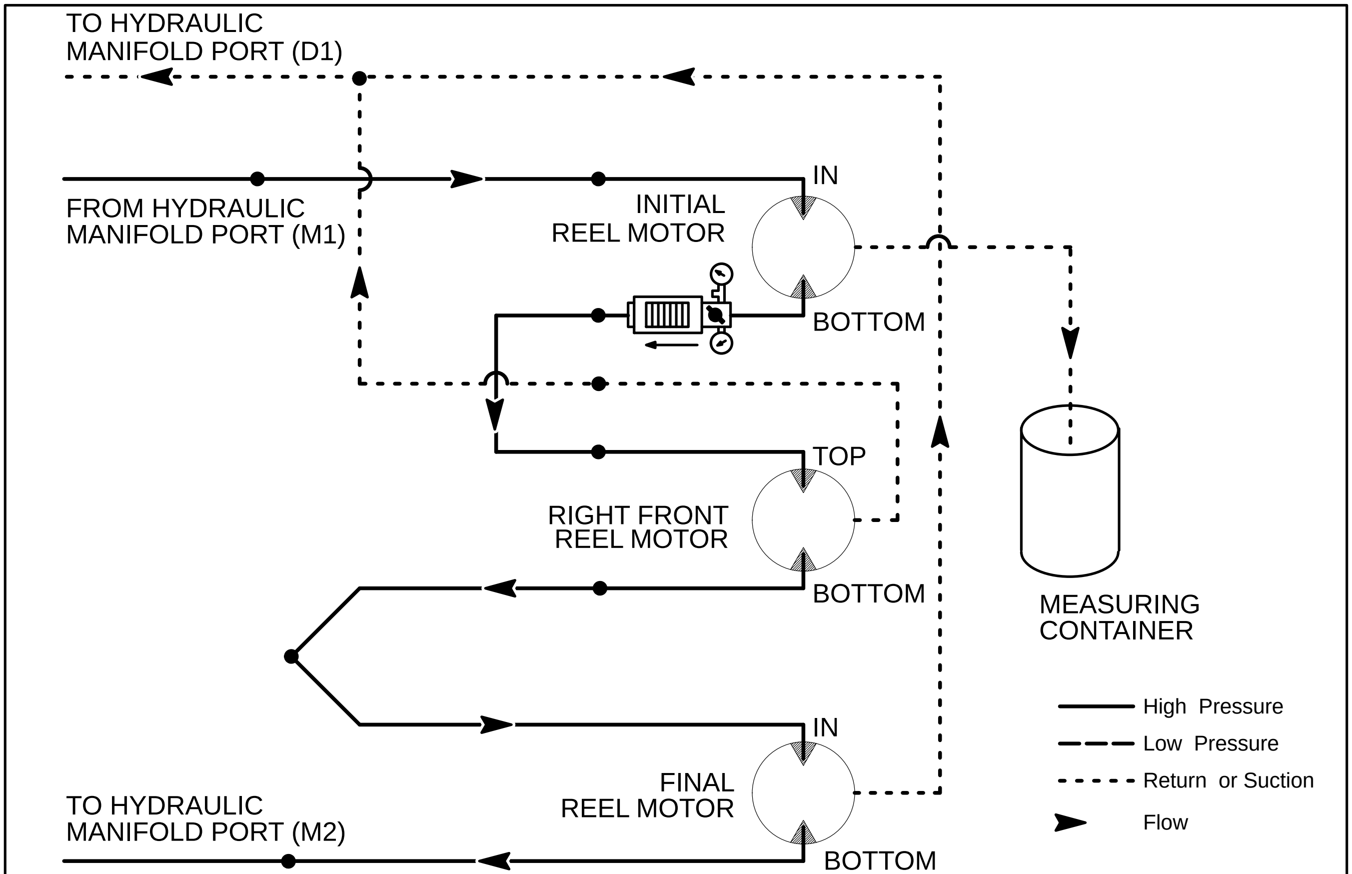


Figure 25

1. **Hydraulic manifold**
2. **Hydraulic fitting (M1)**

Hydraulic System

Reel Motor Efficiency − Case Drain Test (Using Tester with Pressure Gauges and Flow Meter)



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

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

NOTE: One way to find a possibly bad reel motor is to have another person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings, and may cause marcelling (or a washboard appearance) on the turf.

NOTE: On machines with Serial Numbers below 230000000, the initial reel motor in the cutting circuit is the left front and the final reel motor drives the rear cutting unit. On machines with Serial Numbers above 230000000, the initial motor is the rear reel motor and the final reel motor is the left front.

Procedure for Reel Motor Efficiency: Case Drain Test:

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

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

3. Read Precautions for Hydraulic Testing.

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

4. For the suspected bad motor, disconnect return hose from the motor (Cross Over Relief Test Fig. 30 and 31).

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

6. Make sure backlap knob on the hydraulic manifold is in the **mow** position and reel speed is set to maximum.

7. Disconnect hose from case drain at the bulkhead T−fitting (Fig. 26, Fig. 27, and 28). Plug the T−fitting. Put case drain hose into suitable container for collecting case drain leakage.

8. One person should sit on the seat and operate the machine while another person reads the tester and measures case drain leakage. Make sure traction pedal is in **NEUTRAL**. Start engine and move the throttle to full speed **(2650 ± 50 RPM)**.

CAUTION

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

9. Engage reels by positioning the cutting unit drive switch to the **ENGAGE** position. While watching pressure gauges, slowly close flow control valve until a pressure of **1200 PSI** is obtained.

10. Collect hydraulic fluid for **15** seconds by putting the case drain hose into a 1 quart container graduated in ounces (1 liter container graduated in milliliters).

11. Stop cutting units by positioning the cutting unit drive switch to the **DISENGAGE** position. Stop engine.

12. Measure amount of oil collected in the container. Divide number of ounces collected by **32** to get gallons per minute (Divide number of milliliters collected by **250** to get liters per minute).

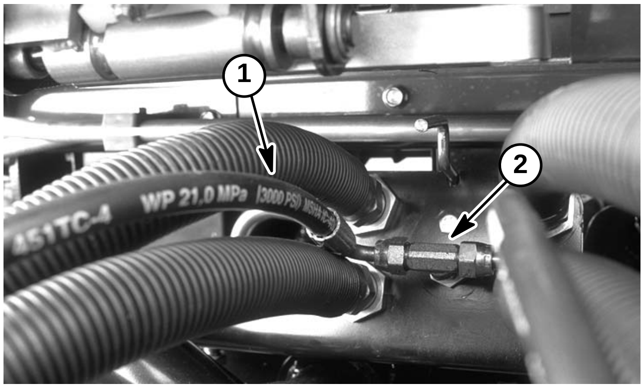


Figure 26

1. **Case drain (right motor)** 2. **Hydraulic T−fitting**

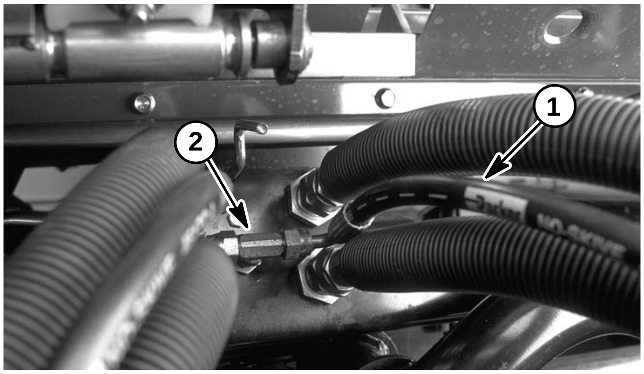


Figure 27

1. **Case drain (left motor)** 2. **Hydraulic T−fitting**

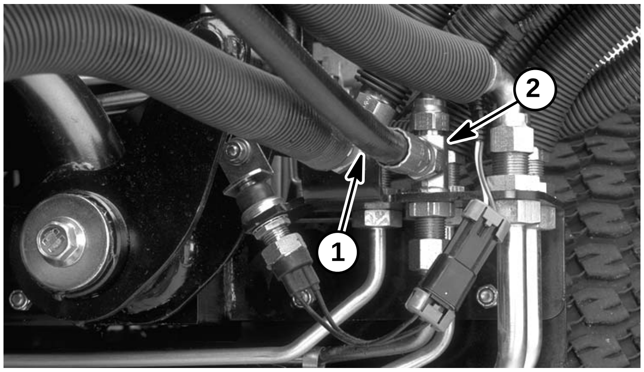


Figure 28

1. **Case drain (rear motor)** 2. **Hydraulic T−fitting**

13. If flow was greater than **0.7 GPM (2.6 LPM)**, repair or replace the reel motor as necessary.

14. Disconnect tester from motor and hose. Reconnect hydraulic hoses.

15. Repeat test with other motors as needed.

Reel Motor Cross−over Relief Pressures Test (Using Pressure Gauge)

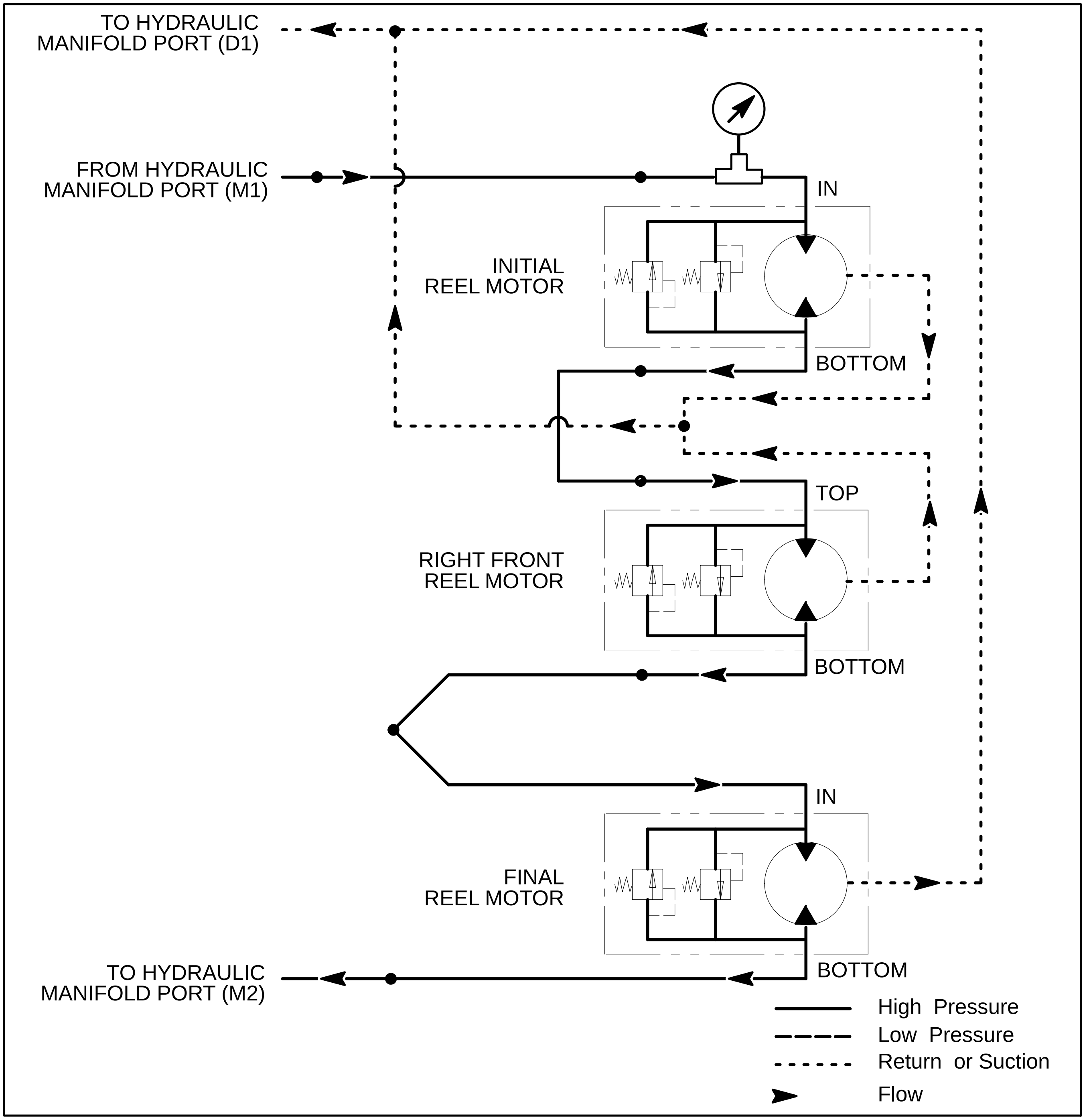


Figure 29

NOTE: One way to find a possibly bad reel motor is to have another person observe the machine while mowing in dense turf. A bad motor will run slower, produce fewer clippings, and may cause marcelling (or a washboard appearance) on the turf.

NOTE: On machines with Serial Numbers below 230000000, the initial reel motor in the cutting circuit is the left front and the final reel motor drives the rear cutting unit. On machines with Serial Numbers above 230000000, the initial motor is the rear reel motor and the final reel motor is the left front.

Procedure for Cross−over Relief Pressures Test:

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

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

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil.

3. Clean hydraulic fittings on suspected faulty reel motor. Disconnect pressure inlet hose from fitting for the **mow** direction of flow.

A. Top 90º fitting for the front reel motors.

B. Center fitting for the rear reel motor.

4. Install T−connector with 5000 PSI pressure gauge between the motor inlet fitting and the disconnected hose.

5. Put a block of wood between the blades of the cutting unit being tested to prevent the reel from rotating.

6. Make sure backlap knob on the hydraulic manifold is in the **mow** position.

7. One person should sit on the seat and operate the machine while another person reads the gauge. Start engine and set throttle to full speed **(2650 ± 50 RPM)**.

CAUTION

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

CAUTION

Do not allow system pressure to exceed 1800 PSI. Shut off unit to prevent an over pressure condition.

8. Engage cutting units. System pressure should be from **1350 to 1650 PSI** as the cross−over relief valve lifts.

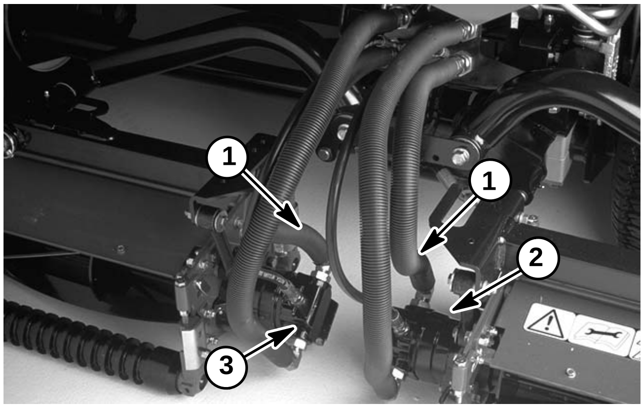


Figure 30

1. **Pressure inlet hose**
2. **Left reel motor**
3. **Right reel motor**

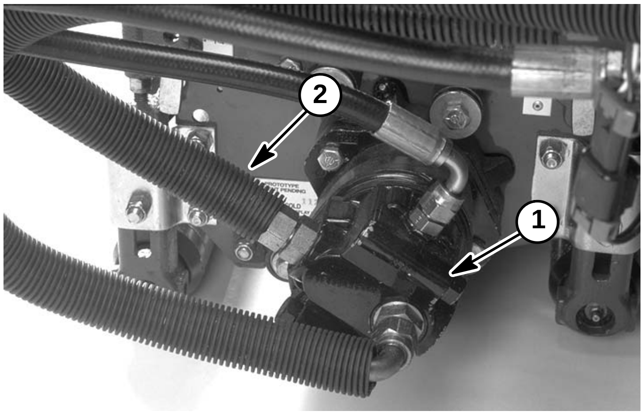


Figure 31

1. **Rear reel motor**
2. **Pressure inlet hose**

9. Disengage cutting units and stop engine. If specifications **are not** met, replace cross−over relief. If specifications **are** met, remove block of wood from cutting unit and repeat test on other reels in **mow** direction.

IMPORTANT: Each reel motor has two cross−over relief valves. Test reliefs in the backlap direction only if a problem is expected. After testing cross−over reliefs in the backlap direction, make sure the reel motor couplings are torqued (see Reel Motor Removal and Installation in the Service and Repairs section of Chapter 7 − Cutting Units).

10. Clean suspected reel motor hydraulic fittings. Disconnect pressure inlet hose from fitting for the **backlap** direction of flow.

A. Bottom 90º fitting for the front reel motors.

B. Bottom 90º fitting for the rear reel motor.

11. Install T−connector with 5000 PSI pressure gauge between the motor fitting and the disconnected hose.

Hydraulic System

12. Make sure backlap knob on the hydraulic manifold is in the **backlap** position.

13. One person should sit on the seat and operate the machine while another person reads the gauge. Start engine and move the throttle to full speed **(2650 ± 50 RPM)**.

CAUTION

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

CAUTION

Do not allow system pressure to exceed 1800 PSI. Shut off unit to prevent an over pressure condition.

14. Engage cutting units. System pressure should be from **1350 to 1650 PSI** as the relief valve lifts.

15. Disengage cutting units and stop engine. If specifications are not met, the cross−over relief needs replacing. Remove block of wood from cutting unit and repeat test on other reels in the same direction of flow.

16. Remove test gauge and reconnect hose to motor. Adjust bedknife to reel on all cutting units (see Adjustment section of Chapter 7 − Cutting Units).

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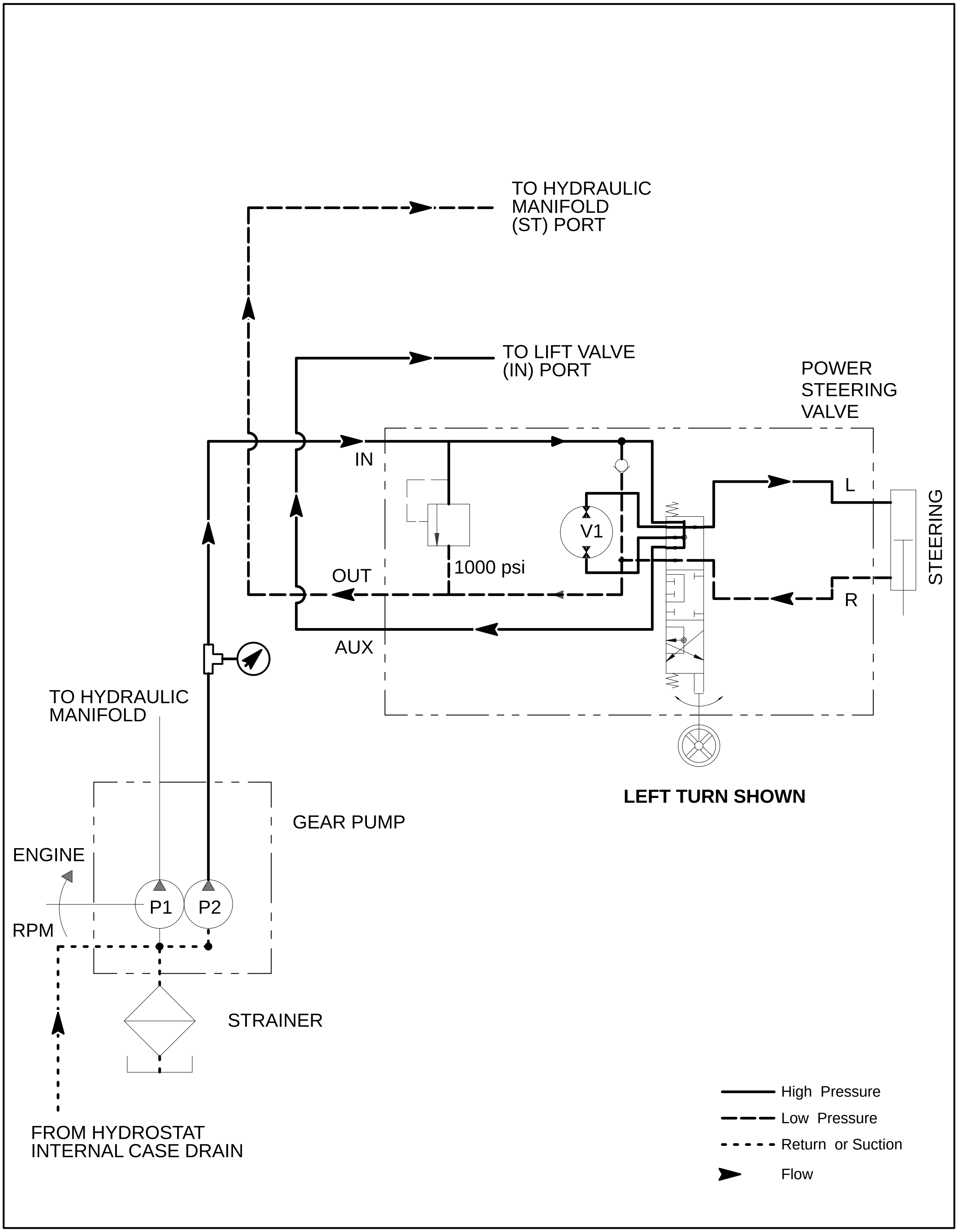
Lift and Steering Control Valve Relief Pressure Test (Using Pressure Gauge)



Procedure for Lift and Steering Control Valve Relief Pressure Test:

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

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

3. Read Precautions for Hydraulic Testing.

WARNING

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

4. Disconnect hose connection on gear pump (P2) leading to the steering control valve (Fig.32).

5. Install T−connector with test gauge in series with the discharge of the gear pump and the disconnected hose leading to the steering control valve.

6. Make sure steering wheel is positioned so the rear wheel points directly ahead.

7. Start engine and move throttle to full speed **(2650 ± 50 RPM)**. Engage the cutting units.

CAUTION

Do not allow pressure to exceed 1500 PSI.

IMPORTANT: Hold steering wheel at full lock only long enough to get a system pressure reading. Holding the steering wheel against the stop for an extended period will damage the steering control valve.

8. Watch pressure gauge carefully while turning the steering wheel completely in one direction and holding at full lock briefly.

9. System pressure should be from **845 to 995 PSI** as the relief valve lifts. Return steering wheel to the center position. If specification is **not** met, shut off engine and replace relief valve in steering control valve (see Steering Control Valve Service).

10. Disconnect T−connector with test gauge from gear pump (P2) fitting and hose. Reconnect hydraulic hose to pump.

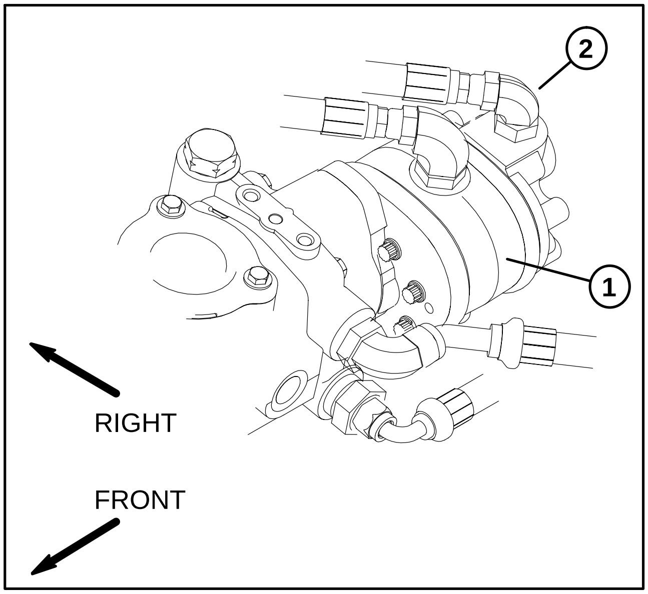
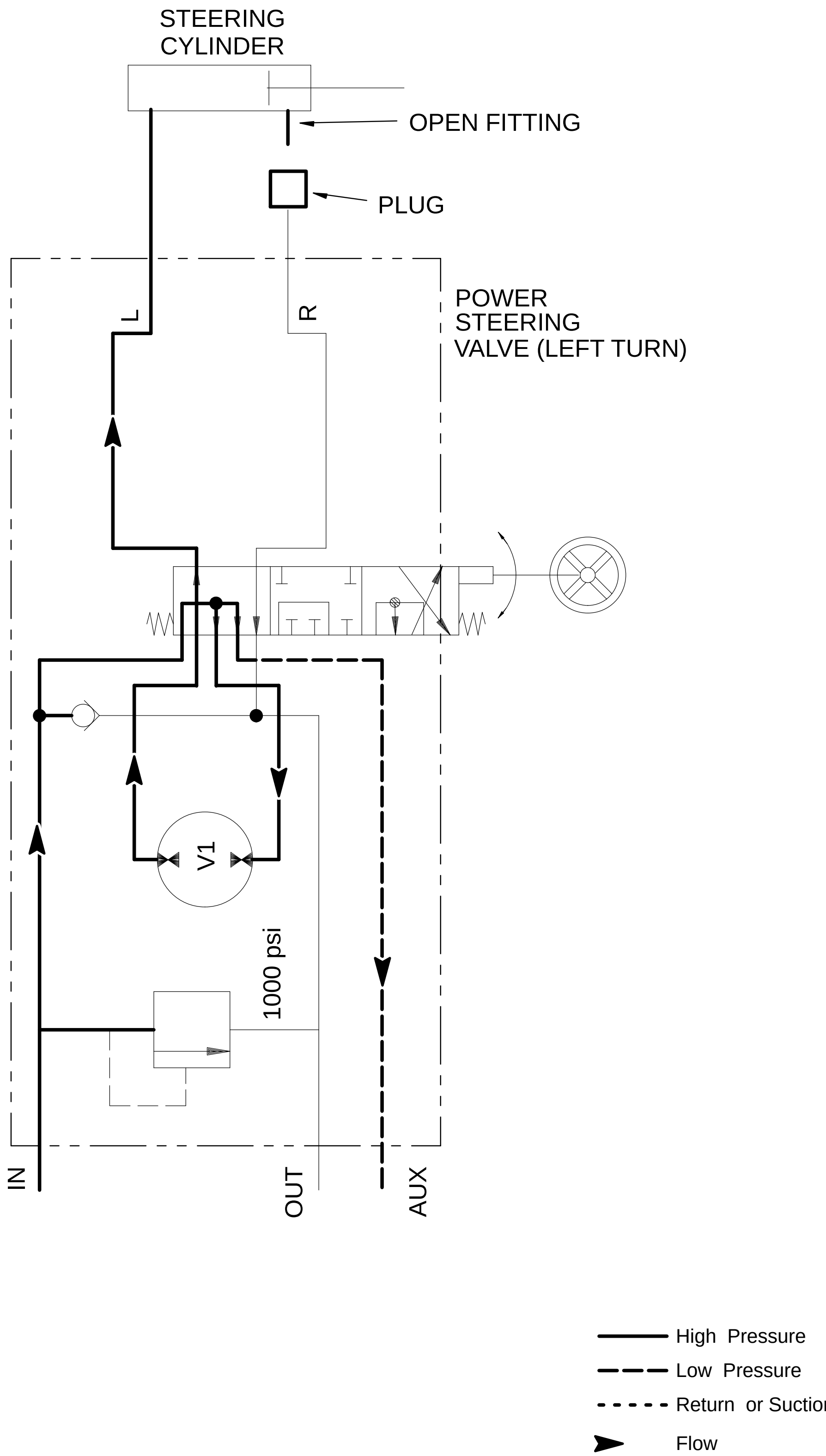


Figure 32

1. Gear pump
2. To steering control valve


STEERING CYLINDER
OPEN FITTING
PLUG
POWER STEERING VALVE (LEFT TURN)
L
R
V1
1000 psi
IN
OUT
AUX
High Pressure
Low Pressure
Return or Suction
Flow

Procedure for Steering Control Valve Test:

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

2. Perform the Lift and Steering Control Valve Relief Pressure and Gear Pump (P2) Flow tests to make sure that pump and relief valve are functioning correctly.

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

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 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.

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

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

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

C. Turn engine off.

D. Read Precautions for Hydraulic Testing.

WARNING

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

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

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

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

6. If steering problem exists and steering cylinder tested acceptably, steering control requires service (see Steering Control Valve and Steering Control Valve Service).

Adjust Traction Drive for Neutral

1. Park the machine on a level surface and turn the engine off.

WARNING

One front wheel and rear wheel must be raised off the ground or the machine will move during adjustment. Make sure machine is supported so it will not accidentally fall injuring anyone under machine.

2. Raise one front wheel and rear wheel off floor and place support blocks under frame.

3. Loosen locknut on traction adjustment cam.

WARNING

Engine must be running so final adjustment of the traction adjustment cam can be performed. To guard against possible personal injury, keep hands, feet, face and other parts of the body away from the muffler, other hot parts of the engine, and other rotating parts.

4. Start engine and rotate cam hex in both directions to determine mid position of neutral span.

5. Tighten locknut securing adjustment.

6. Stop engine.

7. Remove support blocks and lower the machine to the shop floor. Test drive the machine to make sure it does not creep.

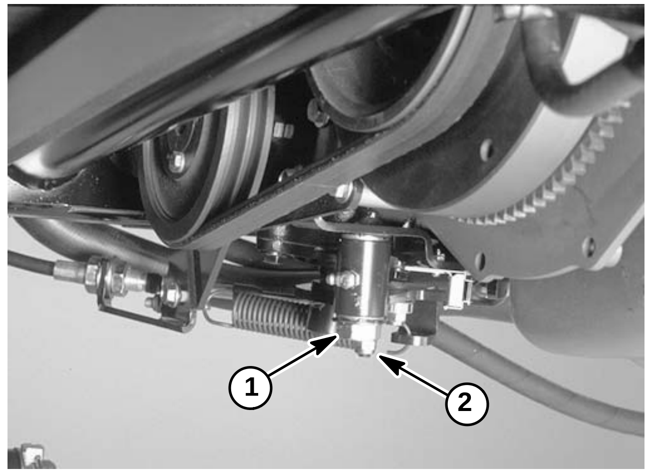


Figure 33

1. **Adjustment cam**
2. **Lock nut**

Adjust Manifold Relief Valve (R1)

The hydraulic reel circuit is equipped with a relief valve. This valve is preset at the factory to 3000 PSI. However, an adjustment may be required if the setting proves to be incorrect after testing (see TESTING). If an adjustment is required proceed as follows:

WARNING

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

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

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

NOTE: A 1/8−turn of the adjustment socket will make a measurable change in relief pressure.

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

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

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

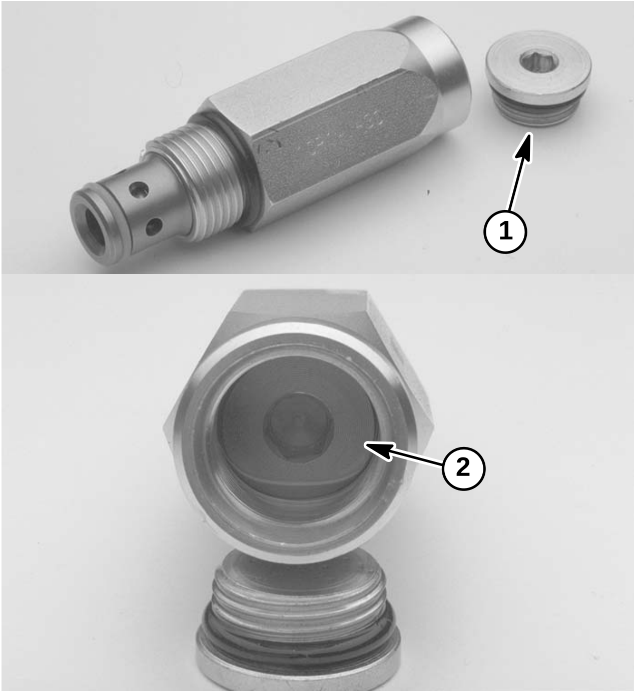


Figure 34

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

Hydraulic System

Service and Repairs

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Components

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

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

WARNING

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

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

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

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

After Repair or Replacement of Components

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

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

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

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

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

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

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

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

Change Hydraulic Fluid

Change hydraulic fluid after every 400 operating hours, under normal conditions. If fluid becomes contaminated, the system must be flushed. Contaminated fluid looks milky or black when compared to clean oil.

1. Turn engine off and raise hood.

2. Disconnect hydraulic hose from filter head or remove hydraulic filter and let hydraulic fluid flow into drain pan. When hydraulic fluid stops draining, connect the hydraulic hose or install new hydraulic filter.

3. Fill hydraulic tank with approximately 3.5 gallons (13.2 liters) of hydraulic fluid. Refer to Check Hydraulic Fluid.

IMPORTANT: Use only recommended hydraulic fluids to fill hydraulic tank. Other fluids could cause system damage.

4. Install hydraulic tank cap. Start engine and use all hydraulic controls to distribute hydraulic fluid throughout the system. Also check for leaks. Then stop the engine.

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

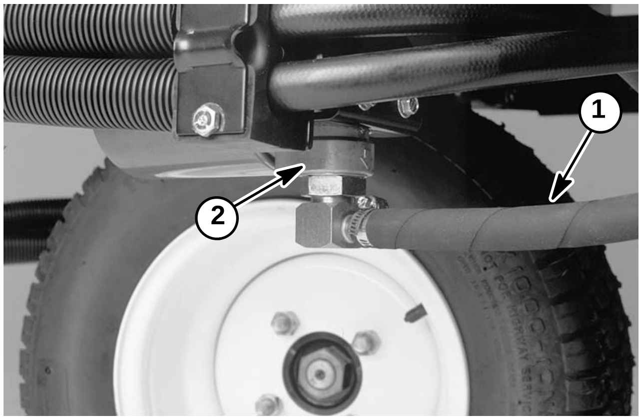


Figure 35

1. **Hydraulic hose**
2. **Filter head**

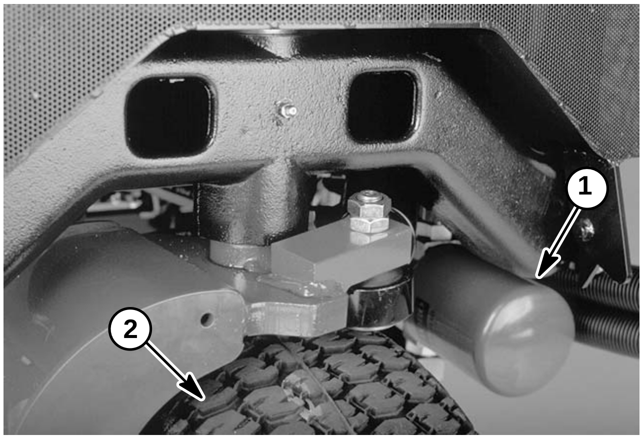


Figure 36

1. **Hydraulic oil filter**
2. **Rear wheel**

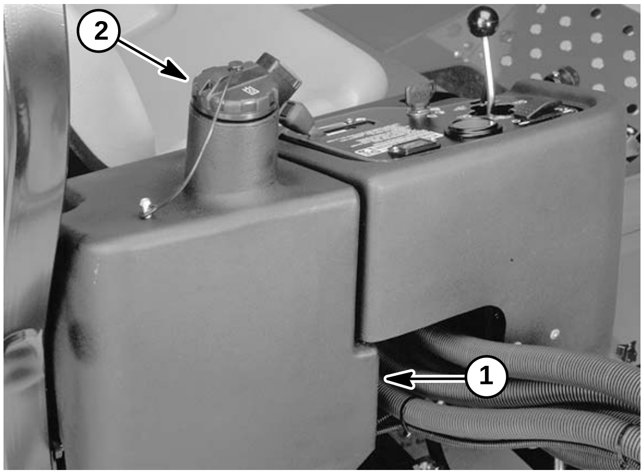


Figure 37

1. **Hydraulic tank**
2. **Cap**

Replace Hydraulic Oil Filter

The hydraulic system filter must be changed initially, after the first 10 hours of operation, and thereafter every 200 hours of operation or yearly, whichever comes first. The hydraulic oil must be changed every 400 hours of operation or yearly, whichever comes first.

Use a genuine Toro oil filter for replacement.

IMPORTANT: Use of any other filter may void the warranty on some components.

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

2. Clamp hose leading to the oil filter head from the hydraulic tank to prevent draining the hydraulic tank.

3. Clean area around filter mounting surface. Place drain pan under filter and remove filter. Properly dispose of filter.

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

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

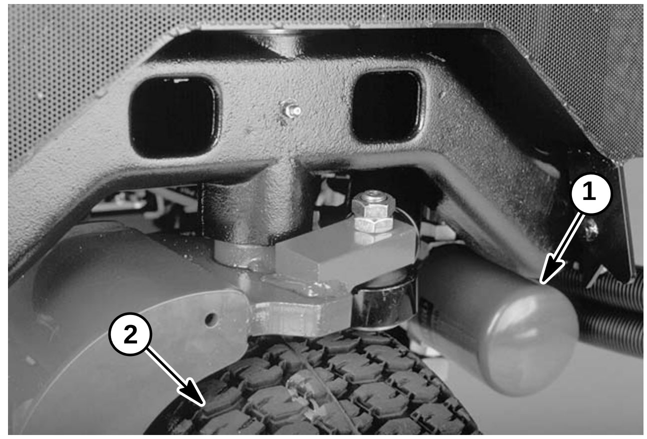


Figure 38

1. **Hydraulic oil filter** 2. **Rear wheel**

6. Remove clamp from hydraulic hose. Check and adjust hydraulic oil level in hydraulic tank.

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

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

Replace Traction Belt

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

2. Insert nut driver or small piece of pipe onto the end of the torsion spring of the idler pulley.

CAUTION

Be careful when removing or applying tension from or to the torsion spring of the idler pulley. The spring is under heavy load and may cause personal injury.

3. Push down and forward on the spring end to unhook the spring from the pump mounting plate.

4. Remove V−belt from the engine flywheel and hydrostat pulleys.

5. Install new V−belt onto the engine flywheel and hydrostat pulleys.

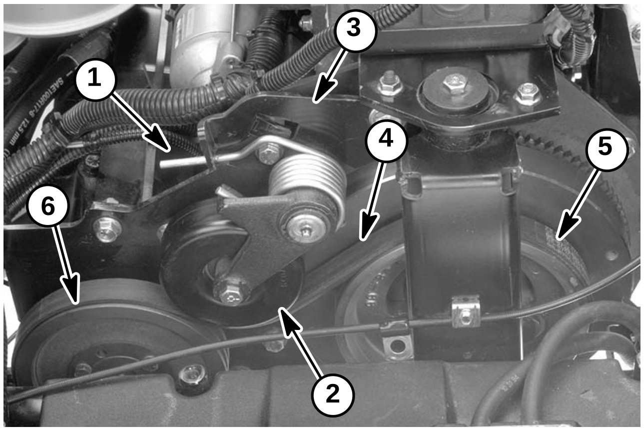


Figure 39

1. **Torsion spring**
2. **Idler pulley**
3. **Pump mounting plate**
4. **V−belt**
5. **Fly wheel pulley**
6. **Hydrostat pulley**

6. Insert nut driver or small piece of pipe onto the end of the torsion spring of the idler pulley.

7. Push down and back on the spring end to get the spring under the pump mounting plate notch. Then release on the spring slowly to lock it into place.

Check Hydraulic Lines and Hoses

WARNING

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

Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings, weather deterioration and chemical deterioration. Make all necessary repairs before operating.

Hydraulic System

Flush Hydraulic System

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

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

IMPORTANT: If a component failure occurred in the traction circuit, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

1. Park machine on a level surface. Lower cutting units, stop engine, and engage parking. 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. See Relieving Hydraulic System Pressure in the General Information section.

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

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

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

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

5. Inspect and clean hydraulic oil tank (see Hydraulic Tank Inspection).

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

NOTE: Use only hydraulic fluids specified in Check Hydraulic System Fluid. If changing to biodegradable fluid, use Toro Biodegradable Hydraulic Fluid for this step. Other fluids may cause system damage.

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

8. Disconnect electrical connector from fuel stop solenoid.

9. Turn ignition key switch; engage starter for 10 seconds to the prime hydrostat. Repeat this step again.

10. Connect electrical connector to fuel stop solenoid.

11. Start engine and let it idle at low speed **(1750 ± 50 RPM)** for a minimum of 2 minutes. Increase engine speed to high idle **(2650 ± 50 RPM)** for minimum of 1 minute under no load.

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

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

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

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

16. Assume normal operation and follow recommended maintenance intervals.

Charge Hydraulic System

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

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

1. Park machine on a level surface, and turn the engine off.

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

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

4. Make sure hydraulic tank is full. Add correct oil if necessary (see Change Hydraulic Fluid).

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

6. Check control cable to the hydrostat for proper adjustment, binding, or broken parts.

7. Make sure traction pedal and the lift control lever are in the **neutral** position. Turn ignition key switch; engage starter for **fifteen (15) seconds** to prime the traction and charge pumps.

8. Reconnect fuel stop solenoid lead.

WARNING

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

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

10. Make sure traction pedal and lift control lever are in **neutral**. Start engine and run it at low idle of **1800 RPM**. The charge pump should pick up oil and fill the hydraulic system. If there is no indication of fill in 30 seconds, stop the engine and determine the cause.

11. After the hydraulic system starts to show signs of fill, actuate lift control lever until the lift cylinder rod moves in and out several times. If the cylinder rod does not move after 10 to 15 seconds, or the pump emits abnormal sounds, shut the engine off immediately and determine cause or problem. Inspect for the following:

    A. Loose filter or suction lines.

    B. Loose or faulty coupler on the pump.

    C. Blocked suction line.

    D. Faulty charge relief valve.

    E. Faulty charge pump.

12. If cylinder moves in 10 to 15 seconds, proceed to step 13.

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

    A. If the wheel rotates in the wrong direction, stop engine, remove lines from rear of pump, and reverse the connections.

    B. If the wheel rotates in the proper direction, stop engine and adjust the spring adjusting pin lock nut.

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

15. Check operation of the traction interlock switch (see Check Interlock System in Chapter 5 − Electrical Systems).

16. Lower machine to ground. Remove chocks from front wheel.

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

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

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

Hydraulic Tank and Hydraulic Oil Filter

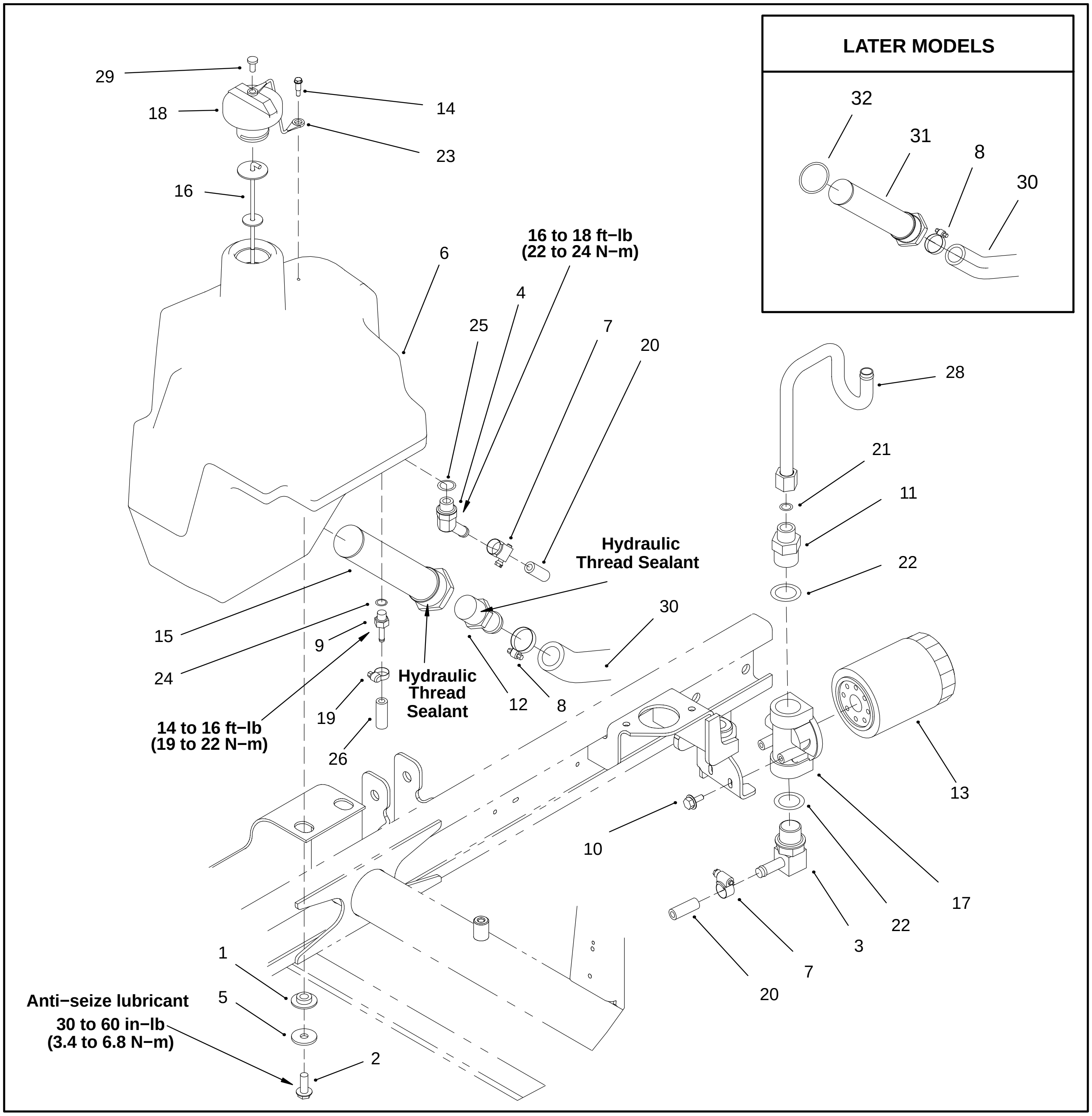


Figure 40

1. **Grommet (4 used)**
2. **Flange head screw (4 used)**
3. **Barb fitting**
4. **Barb fitting**
5. **Flat washer (4 used)**
6. **Hydraulic tank**
7. **Hose clamp**
8. **Hose clamp**
9. **Hydraulic fitting (straight)**
10. **Flange head screw (2 used)**
11. **Hydraulic fitting (straight)**
12. **Hydraulic fitting (suction)**
13. **Oil filter element**
14. **Shoulder screw**
15. **Suction strainer**
16. **Dipstick**
17. **Filter head**
18. **Hydraulic tank cap**
19. **Hose clamp**
20. **Hydraulic hose**
21. **O−ring**
22. **O−ring**
23. **Tether**
24. **O−ring**
25. **O−ring**
26. **Hose**
27. **Not used**
28. **Hydraulic tube**
29. **Plug**
30. **Suction hose**
31. **Suction strainer**
32. **O−ring**

Hydraulic Tank Removal

1. Drain hydraulic tank (see Change Hydraulic Fluid).

2. Remove hydraulic tank from machine using Figures 40 and 41 as guides.

Hydraulic Tank Inspection

1. Clean hydraulic tank and suction strainer with solvent.

2. Inspect hydraulic tank for leaks, cracks, or other damage.

Hydraulic Tank Installation

1. On early production machines, assemble suction strainer and fitting:

NOTE: When applying hydraulic thread sealant to the threads of fitting and the suction strainer, do not apply sealant to the first thread.

A. Apply hydraulic thread sealant to the threads of the hydraulic fitting (suction). Secure fitting to the suction strainer.

B. Apply hydraulic thread sealant to the threads of the suction strainer.

2. Apply anti−seize lubricant to four flange head screws. Secure hydraulic tank to machine with flange head screws. Torque flange head screws from 30 to 60 in−lb (3.4 to 6.8 N−m).

3. Using a wrench, turn suction strainer into tank port at least 1−1/2 to 2 full turns beyond finger tight.

4. Complete hydraulic tank installation using Figures 40 and 41 as guides.

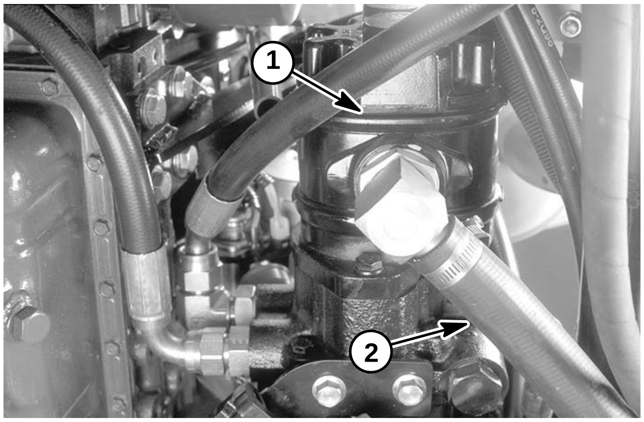


Figure 41

1. **Gear pump**
2. **Suction hose**

Hydraulic System

Front Wheel Motors

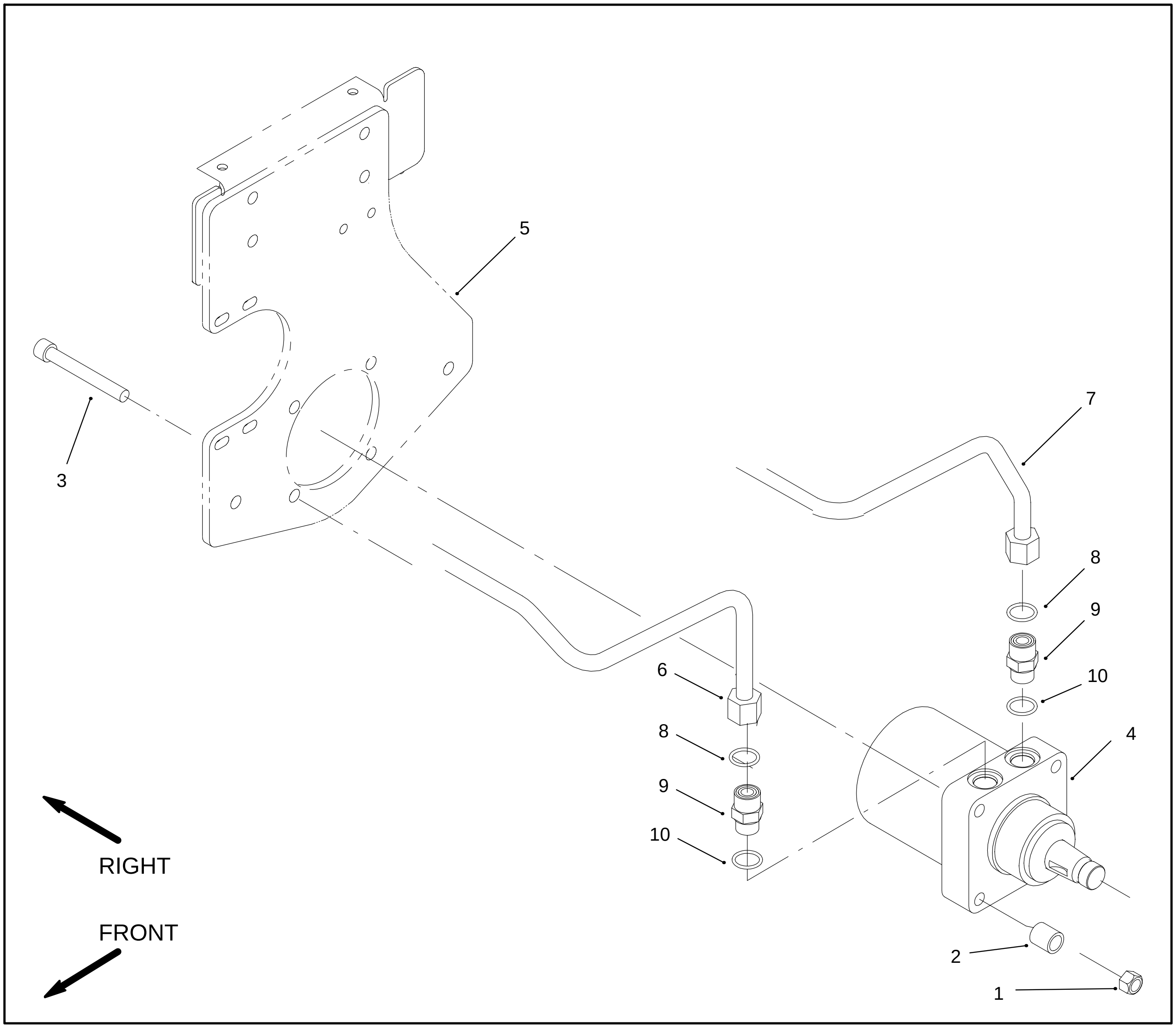


Figure 42

1. **Lock nut**
2. **Spacer**
3. **Socket head screw**
4. **Hydraulic motor**
5. **Frame**
6. **Hydraulic tube**
7. **Hydraulic tube**
8. **O−ring**
9. **Hydraulic fitting**
10. **O−ring**

Removal

WARNING

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

1. Remove tire and wheel rim, wheel hub, and brake drum from the hydraulic motor. Remove brake assembly, brake bracket, and wheel shield from the frame (see Front Wheel and Brake Removal in Chapter 6 − Wheels, Brakes, and Miscellaneous).

2. Remove wheel motor from frame using Figure 42 as guide.

Installation

1. Install wheel motor to frame using Figure 42 as guide.

2. Install wheel shield, brake bracket, and brake assembly to the frame. Install brake drum, wheel hub, and tire and wheel rim to the hydraulic motor (see Front Wheel and Brake Installation in Chapter 6 − Wheels, Brakes, and Miscellaneous).

Rear Wheel Motor

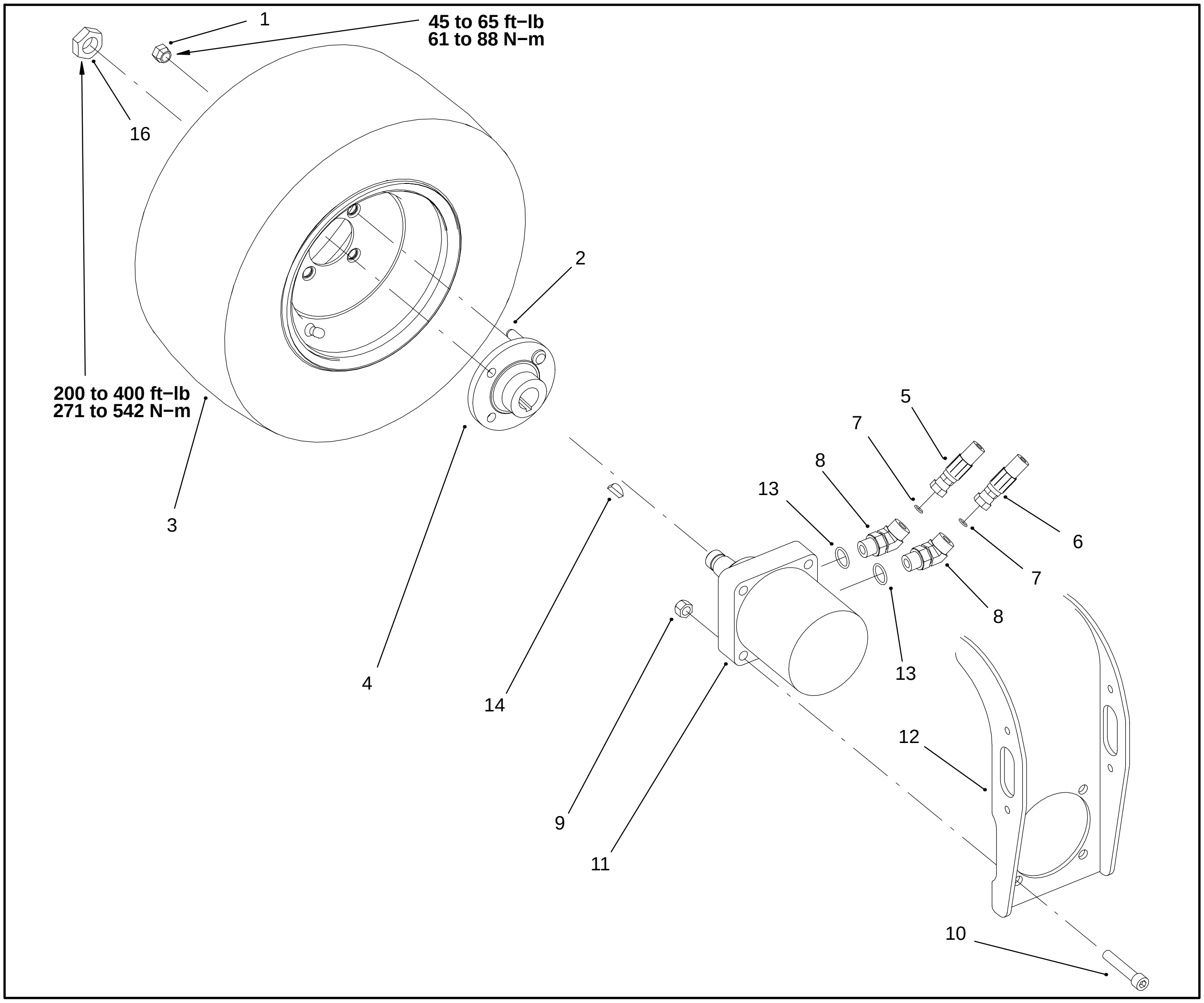


Figure 43

1. **Lug nut**
2. **Drive stud**
3. **Tire and rim**
4. **Wheel hub**
5. **Hydraulic hose**
6. **Hydraulic hose**
7. **O−ring**
8. **45º hydraulic fitting**
9. **Lock nut**
10. **Socket head screw**
11. **Hydraulic motor**
12. **Rear fork**
13. **O−ring**
14. **Woodruff key**

Rear Wheel Removal

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

WARNING

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

2. Jack up rear of machine enough to allow the removal of the rear wheel.

3. Remove rear tire and rim assembly from machine.

4. Remove rear wheel motor with wheel hub attached from the rear fork using Figure 43 as guide.

5. Secure wheel hub in a vise. Loosen but do not remove lock nut that secures wheel hub to wheel motor.

IMPORTANT: DO NOT hit wheel hub, wheel hub puller or wheel motor with a hammer during wheel hub removal or installation. Hammering may cause damage to the wheel motor.

6. Using hub puller (see Special Tools), loosen wheel hub from wheel motor.

7. Remove wheel hub and motor from vise. Remove lock nut and hub from motor shaft. Locate and retrieve woodruff key.

8. If hydraulic fittings are to be removed from wheel motor, mark fitting orientation to allow correct assembly.

Rear Wheel Installation

1. If hydraulic fittings were removed, install fittings to reel motor using marks made during the removal process to properly orientate fittings.

2. Thoroughly clean wheel motor shaft and wheel hub taper.

3. Clamp wheel hub in a vise. Install woodruff key into the wheel motor shaft. Slide motor shaft into hub and secure with lock nut. Torque lock nut from 250 to 350 ft−lb (339 to 474 N−m). Remove wheel motor and hub from vise.

4. Install wheel motor to the rear fork using Figure 43 as guide.

5. Install tire and rim assembly to machine.

6. Lower the machine to the ground.

7. Torque rear wheel lug nuts from 45 to 65 ft−lb (61 to 88 N−m).

8. Make sure hydraulic tank is full. Add correct oil if necessary (see Operator's Manual).

Wheel Motor Service

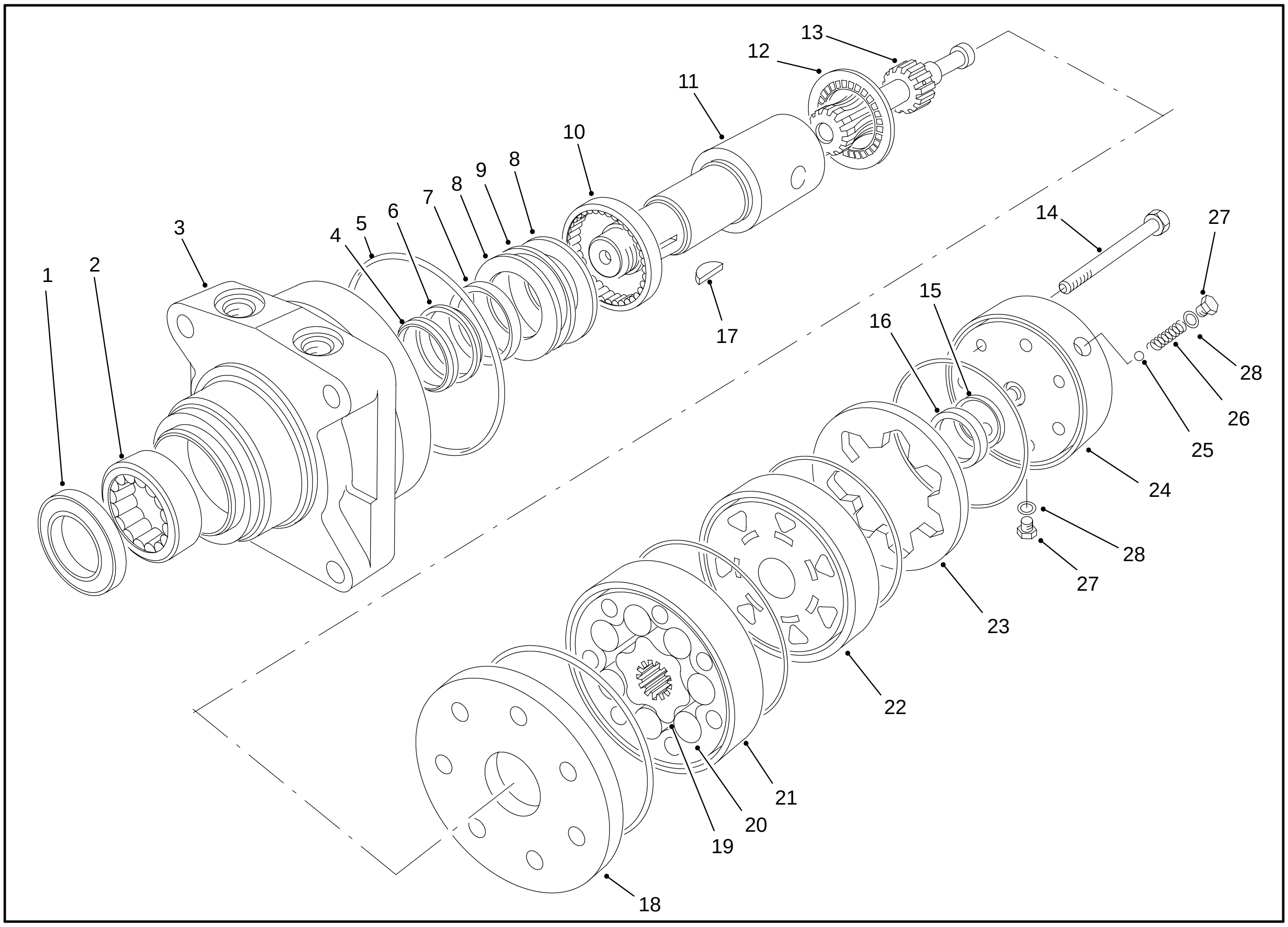


Figure 45

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

NOTE: The three wheel motors used on the Reelmaster 3100-D are similar in construction but do have some differences. The right front and left front motors are the same basic design but the right side motor has a reverse timed manifold to allow correct rotation direction for forward and reverse. The end cover of the rear motor has a check valve consisting of a ball and spring, and both front motors lack this feature. The wheel motor shown in Figure 45 is a rear motor.

IMPORTANT: If a wheel motor failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

NOTE: Machines with serial numbers below 260999999 use a Ross Torqmotor™ in all three positions. Machines with serial numbers above 270000000 use a Ross Torqmotor ™ in the rear and two Parker Torqmotors™ in the front positions. For repair of Ross wheel motors, see the Ross Torqmotor ™ MG, MF, ME, and MJ Series Service Procedure at the end of this chapter. For repair of Parker wheel motors, see the Parker Torqmotor™ Service Procedure (TC, TB, TE, TJ, TF, TG, TH and TL Series) at the end of this chapter.

Hydraulic System

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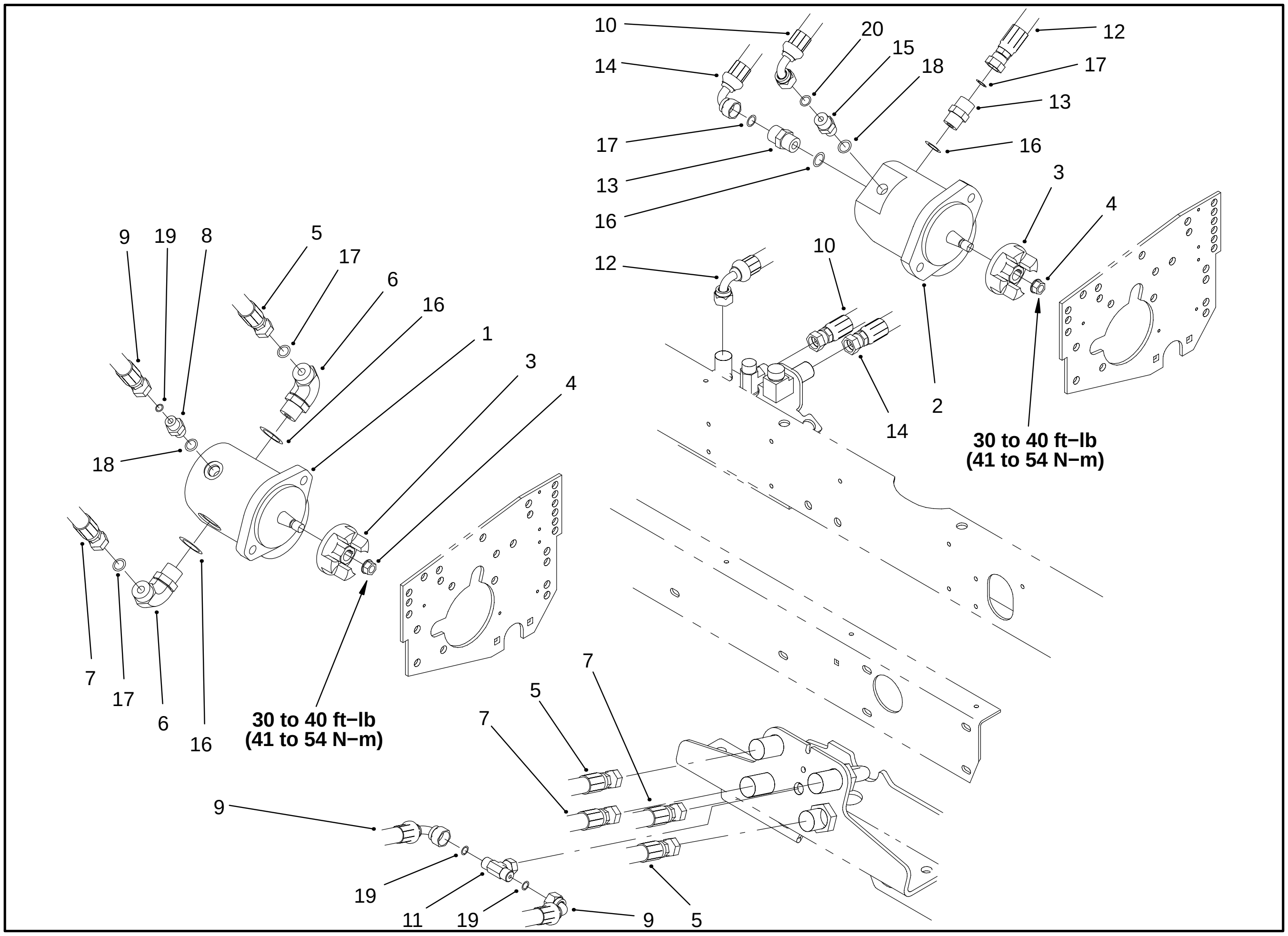

Figure 45

1. **Hydraulic motor (front)**
2. **Hydraulic motor (rear)**
3. **Reel motor coupler**
4. **Flange nut**
5. **Hydraulic hose**
6. **90º hydraulic fitting**
7. **Hydraulic hose**
8. **Hydraulic straight fitting**
9. **Hydraulic hose**
10. **Hydraulic hose**
11. **Hydraulic tee fitting**
12. **Hydraulic hose**
13. **Hydraulic straight fitting**
14. **Hydraulic hose**
15. **Hydraulic straight fitting**
16. **O−ring**
17. **O−ring**
18. **O−ring**
19. **O−ring**
20. **O−ring**

Removal

NOTE: Note position of hydraulic fittings when removing from the reel motors. Position is critical to properly reconnecting hydraulic hoses.

1. Remove reel motor from the cutting unit (see Reel Motor Removal and Installation in Chapter 7 − Cutting Units).

WARNING

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

2. Remove hydraulic hoses from reel motors using Figure 45 as a guide.

3. If hydraulic fittings are to be removed from reel motor, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to reel motor using marks made during the removal process to properly orientate fittings.

2. Install reel motor to the cutting unit (see Cutting Unit Removal and Installation in Chapter 7− Cutting Units).

3. Install hydraulic hoses to reel motors using Figure 45 as a guide.

Reel Motor Service (Eaton)

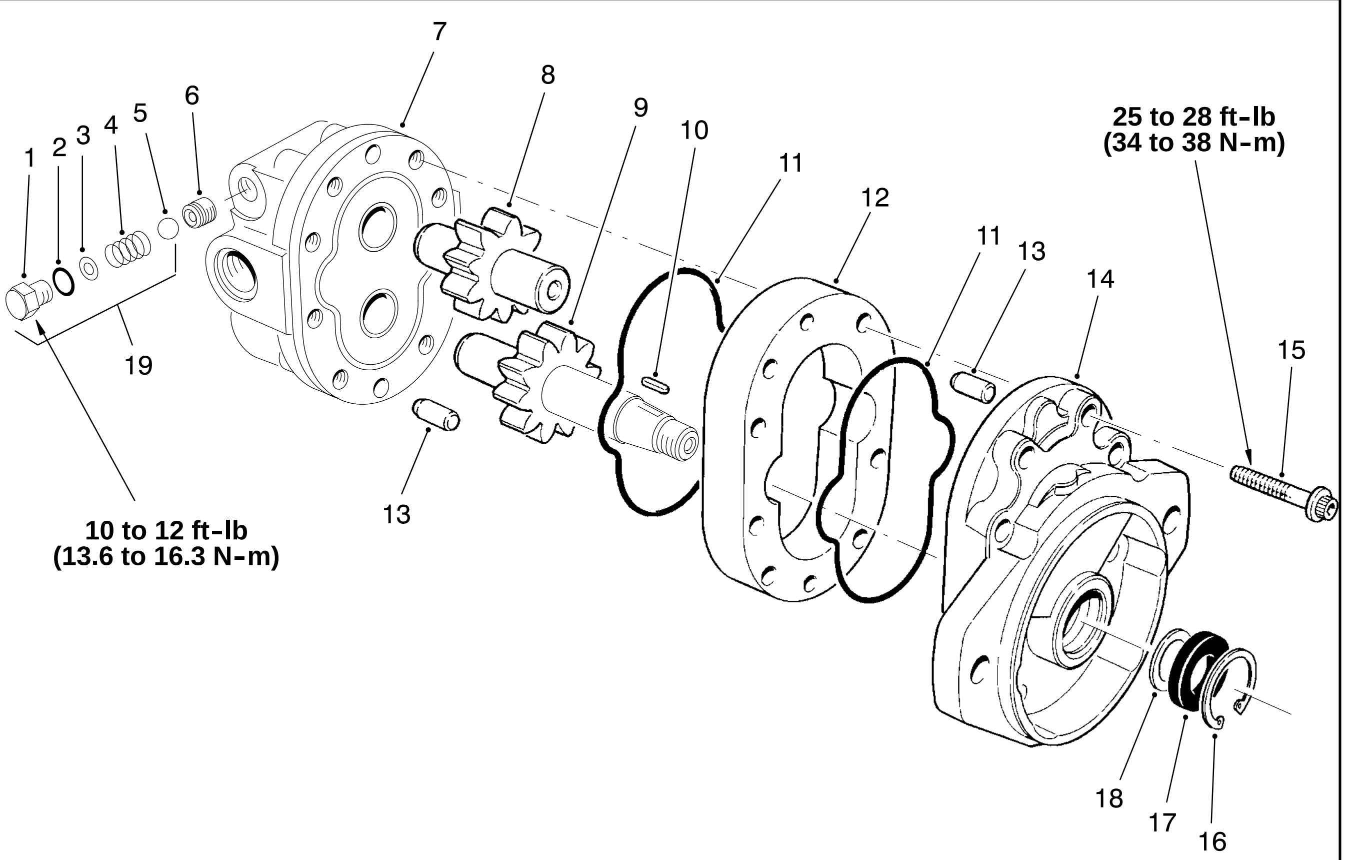

Figure 46

1. **Plug**
2. **O-ring**
3. **Shim**
4. **Spring**
5. **Ball**
6. **Relief valve seal**
7. **Backplate**
8. **Idler gear assembly**
9. **Drive gear assembly**
10. **Key**
11. **O-ring**
12. **Body**
13. **Alignment pin**
14. **Frontplate**
15. **Cap screw**
16. **Retaining ring**
17. **Oil seal**
18. **Backup washer**
19. **Relief valve assembly (items 1 thru 6)**

Disassembly (Fig. 46)

1. Make sure key is removed from the drive gear shaft.

2. Matchmark frontplate, body, and backplate to assure proper reassembly.

3. Secure the motor in a vise with the drive shaft up.

4. Remove all cap screws used to assemble motor.

5. Remove the motor from the vise. Remove the frontplate from the body. A wooden block or soft face hammer might be used to gently tap the motor when freeing the frontplate.

6. Remove alignment pin from the body. Remove drive gear and idler gear from the body.

7. Remove body from the backplate. Remove O-rings from the body and backplate.

8. Remove alignment pin from the backplate.

9. Remove retaining ring, oil seal, and backup washer from the frontplate.

IMPORTANT: Do not remove the relief valve assembly unless testing shows it to be faulty. The relief valve assembly must be replaced as a complete unit. Both relief valve seals are sealed in place with thread sealant; do not remove them.

10. Remove plug, O-ring, shim, spring, and ball from the backplate.

Inspection (Fig. 46)

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive gear shaft for a broken or chipped keyway.

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

5. Replace drive gear or idler gear if the shaft diameter in the bushing area measures less than 0.748 in. (19.0 mm). A single gear may be replaced separately.

6. The drive gear and idler gear face should be free of excessive scoring and wear.

7. Replace drive gear or idler gear if gear width is less than 1.140 in. (29.96 mm).

8. Make sure that retaining rings are in the grooves on both sides of the gear for both the drive gear and idler gear.

9. Break sharp edges of gear teeth with emery cloth.

10. Replace backplate and frontplate if bushing inside diameters exceed 0.755 in. (19.2 mm). The bushings are not available as replacement items.

11. The face of the backplate and frontplate should be free of excessive scoring. Replace if scoring a depth of 0.0015 in. (0.038 mm).

12. Replace body if the inside diameter of the gear pockets exceeds 1.713 in. (43.5 mm).

13. Make sure both plugs are secure if they or the backplate is not being replaced.

Reassembly (Fig. 46)

1. If replacing the relief valve assembly, install ball, spring, shim, O−ring, and plug into the backplate. Hand tighten plug and then torque from 10 to 12 ft−lb (13.6 to 16.3 N−m).

2. Coat O−ring lightly with petroleum jelly and install in groove on the front plate.

3. Apply a thin coat of petroleum jelly to both gear pockets of the body. Install alignment pin into body.

4. Align matchmarks and slip body onto front plate until alignment pin is engaged.

5. Dip idler gear and drive gear into clean hydraulic oil and slip into front plate bushings.

6. Coat O−ring lightly with petroleum jelly and install in groove on the back plate.

7. Install alignment pin into back plate.

8. Align matchmarks and slip back plate over gear shafts onto body until alignment pin is engaged.

9. Hand tighten cap screws. Torque cap screws in a crisscross pattern from 25 to 28 ft−lb (33.9 to 38.0 N−m).

10. Place washer over the drive shaft into the front plate housing. Apply a liberal coat of hydraulic oil to the oil seal. Install oil seal over the drive shaft being careful not to cut the rubber seal lips.

11. Place 1−1/16 inch O.D. sleeve over the drive shaft and press in the oil seal until the retaining ring groove appears.

12. Press retaining ring into the housing using the sleeve until it seats in the groove.

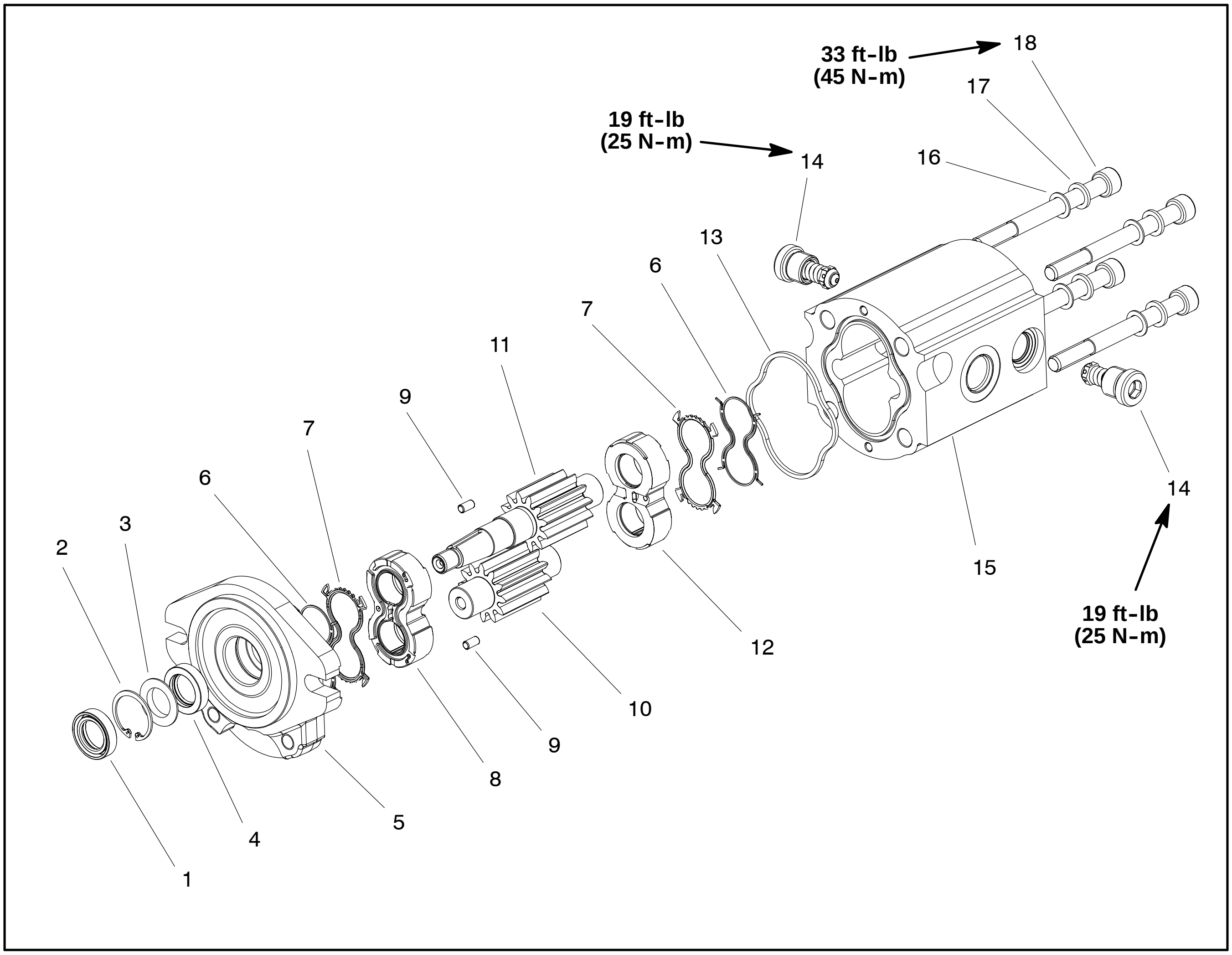

Figure 46.1

1. Dust seal	**7. Back-up gasket**	**13. O-ring**
2. Retaining ring	**8. Front wear plate**	**14. Relief valve**
3. Flange washer	**9. Dowel pin**	**15. Body**
4. Shaft seal	**10. Idler gear**	**16. Washer (4 used)**
5. Front flange	**11. Drive shaft**	**17. Lock washer (4 used)**
6. Pressure seal	**12. Rear wear plate**	**18. Cap screw (4 used)**

Disassembly (Fig. 46.1)

1. Plug motor ports and clean the outside of the motor thoroughly. After cleaning, remove plugs and drain any oil out of the motor.

2. Use a marker to make a **diagonal** line across the front flange and body for assembly purposes (Fig. 46.2).

IMPORTANT: Prevent damage when clamping the reel motor into a vise; clamp on the front flange only. Also, use a vise with soft jaws.

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

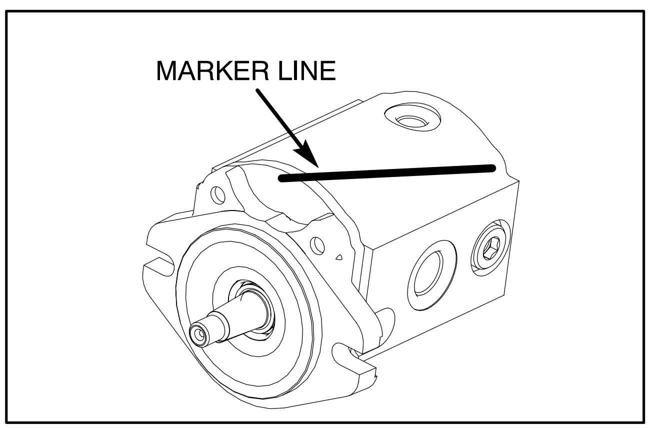

Figure 46.2

4. Loosen cap screws from the rear cover.

5. Remove motor from the vise. Turn motor so that the shaft end is facing down. Remove cap screws.

6. Carefully remove body. Lift body straight up to remove. Make sure the rear wear plate remains on the drive and idler gear shafts. Remove and discard O-rings from the body. Locate and retrieve dowel pins.

IMPORTANT: Note position of the open and closed side of the wear plates before removing. Also, identify wear plates (front and rear) with a marker for proper assembly.

7. Carefully remove rear wear plate, idler gear, drive shaft and front wear plate from the front flange.

8. Remove and discard back-up gaskets and pressure seals from wear plates.

9. Turn front flange over, with seal side up.

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

10. Carefully remove dust seal, retaining ring, flange washer and shaft seal from the front flange (Fig. 46.3). Discard seals.

Inspection

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect drive gears and idler gears for the following (Fig. 46.4):

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

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

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

4. Inspect wear plates for the following:

   A. Bearing areas should not have excessive wear or scoring.

   B. Face of wear plates that are in contact with gears should be free of wear, roughness or scoring.

   C. Thickness of wear plates should be equal.

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

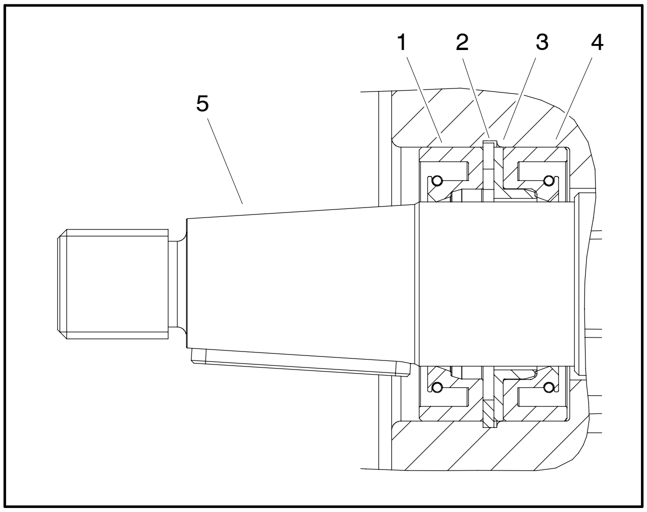

Figure 46.3

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Drive shaft**

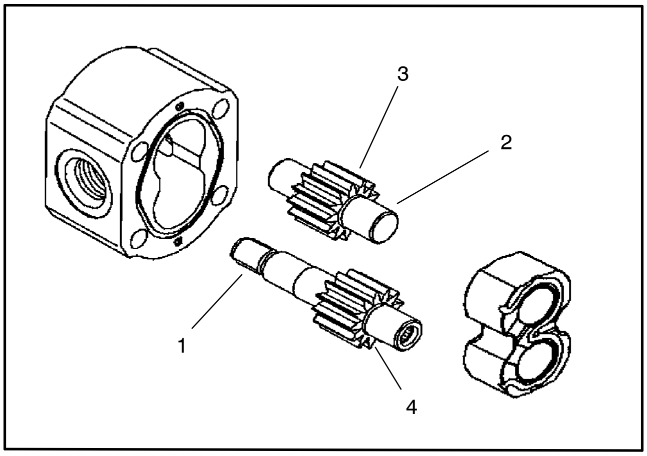

Figure 46.4

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

Assembly (Fig. 46.1)

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

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

2. Install new seals into front flange (Fig. 46.3):

   A. Press shaft seal into front flange until it reaches the bottom of the bore.

   B. Install flange washer into front flange and then install retaining ring into the groove of the front flange.

   C. Install new dust seal into front flange.

3. Place front flange, seal side down, on a flat surface.

4. Install the pressure seals, flat side outward, into the grooves in the wear plates. Follow by carefully placing the backup gaskets, flat side outward, between the pressure seals and the grooves in the wear plate.

5. Apply a light coating of petroleum jelly to the exposed side of the front flange.

6. Lubricate the drive shaft with clean hydraulic oil. Insert the drive end of the drive shaft through the wear plate with the pressure seal side down and the open side of the pressure seal pointing to the inlet side of the motor. Carefully install shaft into front flange.

7. Lubricate the idler gear shaft with clean hydraulic oil. Install idler gear shaft into the remaining position in the front wear plate. Apply a light coating of clean hydraulic oil to gear faces.

8. Install rear wear plate with pressure seal side up and open side of the pressure seal pointing to the inlet side of the motor.

9. Apply a light coating of petroleum jelly to new O-ring and O-ring groove in the body. Install new O-ring to the body.

10. Install locating dowel pins in body. Align marker line on the body and front flange.

IMPORTANT: Do not dislodge seals during installation.

11. Gently slide the body onto the assembly. Firm hand pressure should be sufficient to engage the dowel pins.

12. Install the four (4) cap screws with washers and hand tighten.

IMPORTANT: Prevent damage when clamping the reel motor in a vise; clamp on the front flange only. Also, use a vise with soft jaws.

13. Place front flange of the motor into a vise with soft jaws and alternately torque the cap screws 33 ft-lb (45 N-m).

14. Remove motor from vise.

15. Place a small amount of clean hydraulic oil in the inlet of the motor and rotate the drive shaft away from the inlet one revolution. If any binding is noted, disassemble the motor and check for assembly problems.

Hydraulic System

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Oil Cooler

Removal

CAUTION

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

1. Remove oil cooler using Figures 47 and 48 as guides.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Back flush oil cooler with cleaning solvent. After cooler is clean, make sure all solvent is drained from the cooler.

2. Dry inside of oil cooler using compressed air in the opposite direction of the oil flow.

3. Plug both ends of oil cooler. Clean exterior of cooler. Make sure fins are clear of dirt and debris.

4. The oil cooler should be free of corrosion, cracked tubes, and excessive pitting of tubes.

Installation

1. If removed, apply hydraulic thread sealant to the barb fitting threads before installing.

2. Install oil cooler using Figures 47 and 48 as guides.

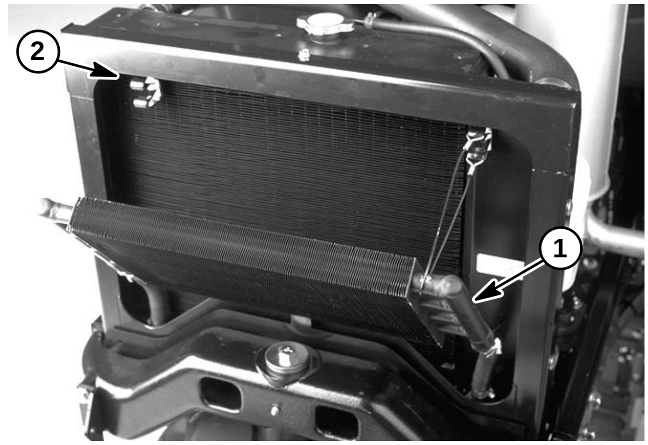

Figure 47

1. **Oil cooler**
2. **Clip**

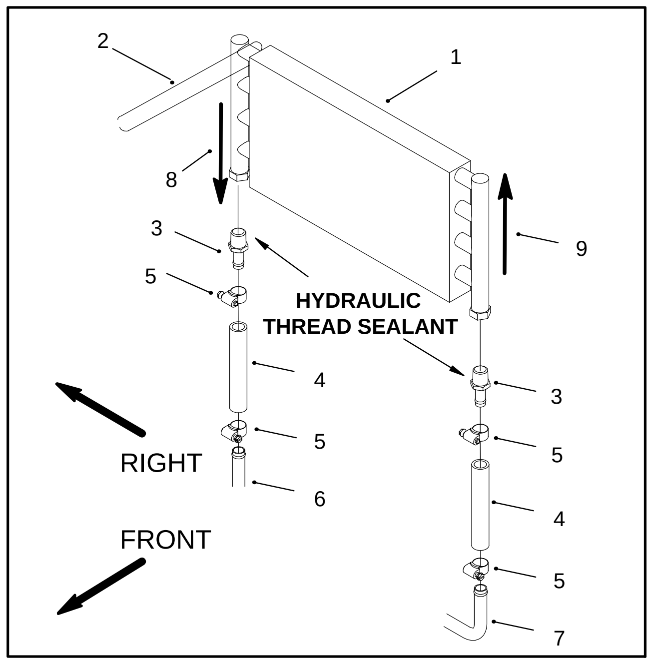

Figure 48

1. **Oil cooler**
2. **Lanyard**
3. **Barb fitting**
4. **Hydraulic hose**
5. **Hose clamp**
6. **Hydraulic tube**
7. **Hydraulic tube**
8. **Flow to filter**
9. **Flow from manifold**

Hydraulic Manifold

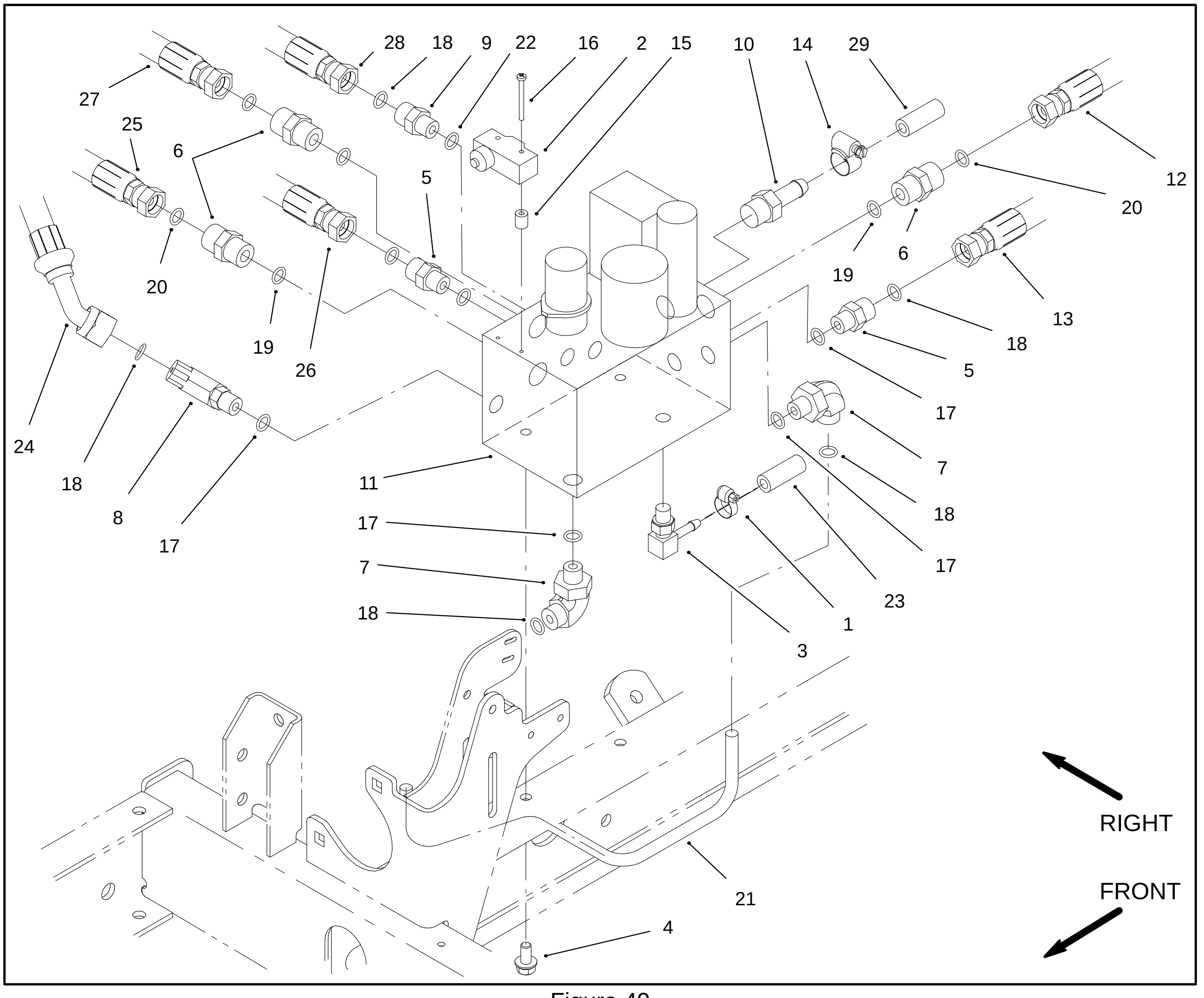

Figure 49

1. **Hose clamp**
2. **Micro switch**
3. **Barb fitting**
4. **Flange head screw**
5. **Straight hydraulic fitting**
6. **Straight hydraulic fitting**
7. **90º hydraulic fitting**
8. **45º hydraulic fitting**
9. **Straight hydraulic fitting**
10. **Barb fitting**
11. **Hydraulic manifold**
12. **Hydraulic hose**
13. **Hydraulic hose**
14. **Hose clamp**
15. **Spacer**
16. **Philips pan head screw**
17. **O−ring**
18. **O−ring**
19. **O−ring**
20. **O−ring**
21. **Hydraulic tube**
22. **O−ring**
23. **Hose**
24. **Hydraulic hose**
25. **Hydraulic hose**
26. **Hydraulic hose**
27. **Hydraulic hose**
28. **Hydraulic hose**
29. **Hose**

Removal

NOTE: The ports on the manifold are marked for easy identification of components. Example: R1 is the reel circuit relief valve and P1 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

1. Remove hydraulic manifold from the machine using Figure 49 as guide.

2. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to manifold using marks made during the removal process to properly orientate fittings.

2. Install hydraulic manifold to the frame using Figure 49 as guide.

Hydraulic System

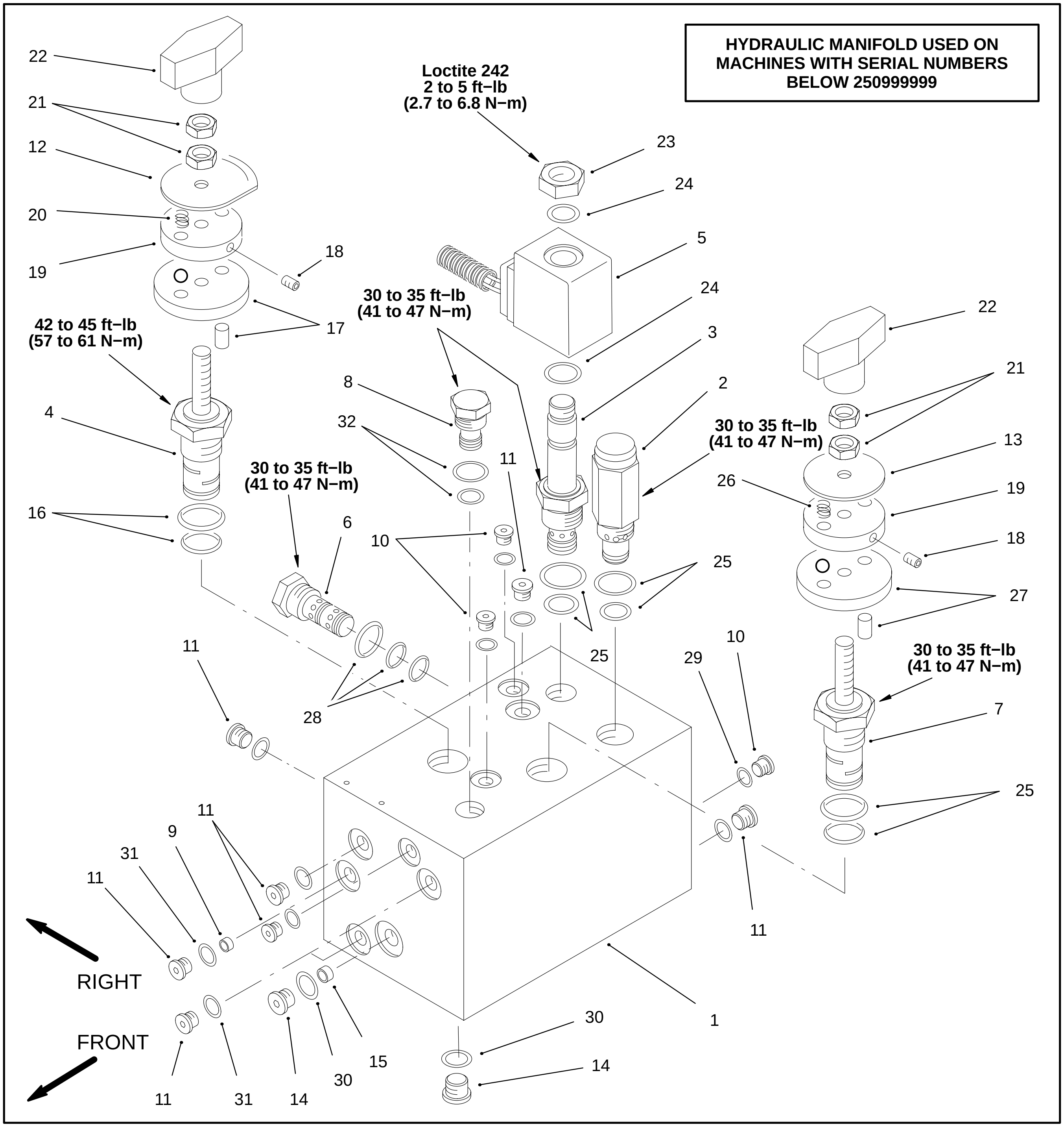

Figure 50

1. **Manifold body**
2. **Relief valve cartridge**
3. **Solenoid operated cartridge valve**
4. **Rotary cartridge valve (directional)**
5. **Solenoid coil**
6. **Logic control cartridge**
7. **Rotary cartridge valve (flow control)**
8. **Cartridge cavity plug**
9. **Orifice plug**
10. **Plug (SAE−2)**
11. **Plug (SAE−4)**
12. **Indicator plate**
13. **Indicator plate**
14. **Plug (SAE−6)**
15. **Plug**
16. **Seal kit**
17. **Locating plate**
18. **Set screw**
19. **Detent plate**
20. **Compression spring**
21. **Jam nut**
22. **Knob**
23. **Nut**
24. **O−ring**
25. **Seal kit**
26. **Compression spring**
27. **Locating plate**
28. **Seal kit**
29. **O−ring**
30. **O−ring**
31. **O−ring**

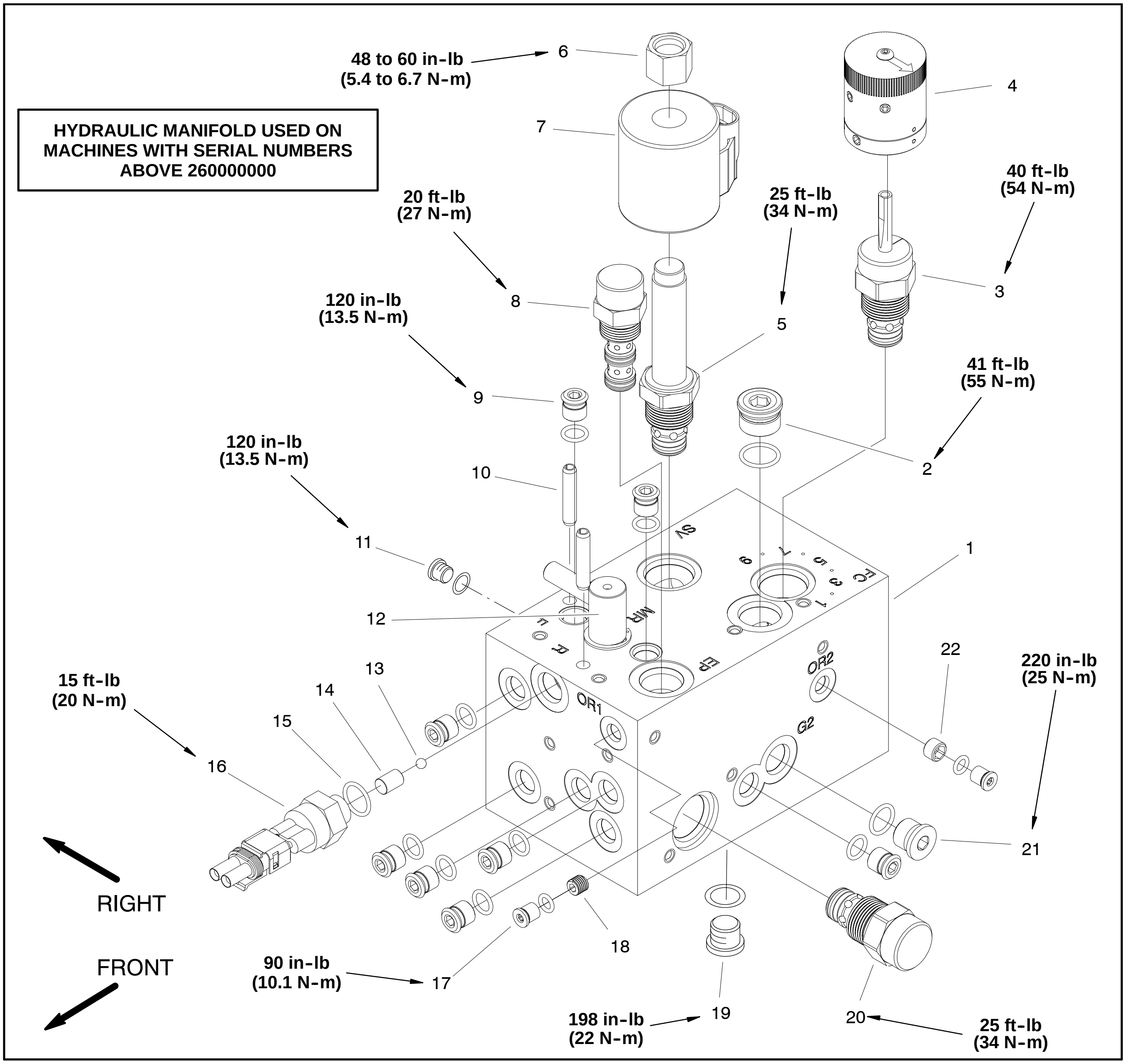

Figure 51

1. **Manifold body**
2. **Plug (Zero Leak #8)**
3. **Rotary cartridge valve (flow control)**
4. **Rotary handle assembly**
5. **Solenoid relief cartridge valve**
6. **Nut**
7. **Solenoid coil**
8. **Logic control cartridge**
9. **Plug (Zero Leak #4) (10 used)**
10. **Spring pin (2 used)**
11. **Plug (SAE #4)**
12. **Mow/backlap spool**
13. **Ball**
14. **Dowel pin**
15. **O-ring**
16. **Ball switch (N.C.)**
17. **Plug (Zero Leak #2) (2 used)**
18. **Orifice (.020)**
19. **Plug (Zero Leak #6)**
20. **Check valve**
21. **Plug (SAE #6) (2 used)**
22. **Orifice (.073)**

NOTE: The ports on the hydraulic manifold are marked for easy identification of components. Example: FC1 is the flow control valve and P1 is the gear pump connection port (See Hydraulic Schematics to identify the function of the hydraulic lines and cartridge valves at each port location).

NOTE: The hydraulic manifold shown in Figure 51 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 51.

Solenoid Operated, Relief and Logic Control Cartridge Valves

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

Note: On manifold shown in Figure 50, solenoid coil has an O-ring on each side of the coil.

2. If solenoid valve is to be removed from manifold, remove nut securing solenoid to the cartridge valve. Carefully slide solenoid and O-rings (if equipped) off the valve.

IMPORTANT: Use care when removing cartridge valves. 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 wrench. Remove seal kit from valve.

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

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

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

CAUTION

Use eye protection such as goggles when using compressed air.

5. Cleaning cartridge valves:

A. For non-solenoid operated valves:
Submerge valve in clean mineral spirits to flush out contamination. If valve design allows, use a probe to push the internal spool in and out 20 to 30 times to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Clean and dry cartridge with compressed air.

B. For solenoid operated valves:
Temporarily install solenoid on cartridge valve and connect a 12 volt power source to the solenoid. While energized, flush out any contamination with a nonflammable 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 cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

C. Torque cartridge valve using a deep well socket to specification shown in manifold illustration.

Note: On manifold shown in Figure 50, solenoid coil has an O-ring on each side of the coil. Also, on this manifold, apply Loctite 242 or equivalent to the threads of the valve before installing the coil nut.

7. For solenoid valve, install solenoid coil and O-rings (if equipped) to the cartridge valve. Torque nut to specification shown in manifold illustration.

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

Rotary Cartridge Valves

1. Remove knob assembly (manifold shown in Fig. 50):

A. Unscrew and remove knob. Remove both jam nuts.

B. Slide off indicator plate being careful not to lose springs. Remove spring.

C. Loosen set screw and slide detent plate off the cartridge valve stem.

D. Remove locating plate with pin from the cartridge valve stem and manifold.

2. Remove rotary handle (manifold shown in Fig. 51) (Fig. 52):

A. Loosen two (2) set screws that secure handle cap. Remove screw and then lift handle cap from valve.

B. Locate and retrieve detent pin, compression spring, bushing and lip seal. The sleeve bearing should stay in the cap.

C. Loosen two (2) set screws that secure handle base to flow control valve and remove base.

3. Make sure manifold is clean before removing the rotary cartridge valve. Remove the valve and seal kit.

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

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

B. If sealing surfaces appear pitted or damaged, the hydraulic system may be overheating or there may be water in the system.

CAUTION

Use eye protection such as goggles when using compressed air.

5. If necessary, clean cartridge valve using clean mineral spirits. Submerge valve in clean mineral spirits to flush out contamination. Particles as fine as talcum powder can affect the operation of high pressure hydraulic valves. Clean and dry with compressed air.

6. Reinstall 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 cartridge valves. Slight bending or distortion of the stem tube can cause binding and malfunction. Make sure that deep well socket fully engages the valve base.

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

7. Install knob assembly (manifold shown in Fig. 50):

A. Install locating plate so that the pin seats into the locating hole.

B. Turn the threaded cartridge valve stem carefully clockwise until it stops.

C. Face detent plate counterbore down. Thread detent plate down onto the valve stem until it is stopped by the locating plate. Turn detent plate back counterclockwise 1/4 turn.

D. Center one detent plate hole over a locating plate indentation. Drop a ball into each hole, then drop a spring into each hole.

E. On the 2-position directional valve cartridge, place indicator plate over the detent plate. Make sure the arrow points directly at the number 1 on the locating plate.

F. On flow control cartridge valve cartridge, place indicator plate over the detent plate. Make sure the arrow points to the right at 45°.

G. While pushing down on the indicator plate and compressing the springs, thread down a jam nut. While tightening the set screw, tighten jam nut at the same time using a 7/16 - inch wrench.

H. Thread second jam nut all the way down the valve stem. Apply ”Loctite 242” or equivalent to the valve stem threads. Screw knob all the way down until it contacts the upper jam nut.

I. On 2-position directional cartridge valve cartridge, turn knob counterclockwise so the arrow is 90° with the back of the manifold. Simultaneously tighten upper jam nut and turn knob so it is tight and the arrow is pointing 45° to the right in line with the indicator plate.

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

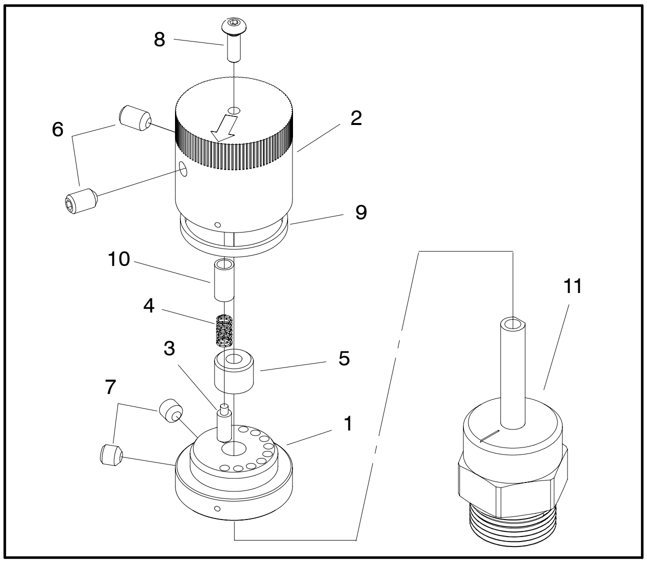

Figure 52

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

8. Install rotary handle (Fig. 52) (manifold shown in Fig. 51) :

A. Place handle base on flow control valve and position alignment mark on base with number 1 on manifold. Secure base with two (2) set screws. Apply a light coating of grease to chamfer on top of base to ease seal installation.

B. Make sure that sleeve bearing is in handle cap. If necessary, press sleeve bearing into cap. Install lip seal on cap with seal lip facing down.

C. Place bushing onto cartridge valve stem. Use a small amount of grease to keep bushing toward the top of the valve stem.

D. Place compression spring and detent pin into handle cap. Use a small amount of grease to hold detent pin in place.

E. Make sure that flow control valve is closed by rotating valve stem fully clockwise. During handle installation, DO NOT rotate valve stem or speed adjustment will be incorrect.

F. Press handle cap onto valve stem with arrow on cap pointing to number 9 on manifold. Make sure that detent pin and spring stay positioned in cap.

G. While pressing on the cap to keep the lip seal in place, rotate cap in a clockwise direction until the arrow on the cap aligns with number 1 on the manifold. By rotating the cap clockwise, the valve will remain closed. Install screw to retain cap.

H. Make sure that alignment marks on cap and base are in line and that arrow on cap is pointing to number 1 on manifold. Tighten two (2) set screws to secure handle cap.

Mow/Backlap Spool (Fig. 53) (Reel Manifold Shown in Fig. 51)

1. Remove spool from mow manifold:

A. Remove backlap switch from mow manifold before removing mow/backlap spool. Remove dowel pin and ball from manifold port after switch is removed. Remove and discard O-ring from switch.

B. Remove lower retaining ring from mow/backlap spool. Raise mow/backlap spool to allow access to retaining ring on upper end of spool. Remove upper retaining ring.

C. Push spool down until O-ring and back-up ring are exposed on bottom of mow manifold. Remove lower O-ring and back-up ring from spool.

D. Pull spool up and out of manifold. Remove O-rings and back-up ring from spool.

E. Discard removed O-rings and back-up rings.

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

3. Install spool into mow 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 mow manifold port until lower O-ring and back-up ring groove is exposed on bottom of manifold. Install lower O-ring and back-up ring to spool. Apply a light coating of grease to O-ring.

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

D. Push mow/backlap spool down and install lower retaining ring to spool.

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

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

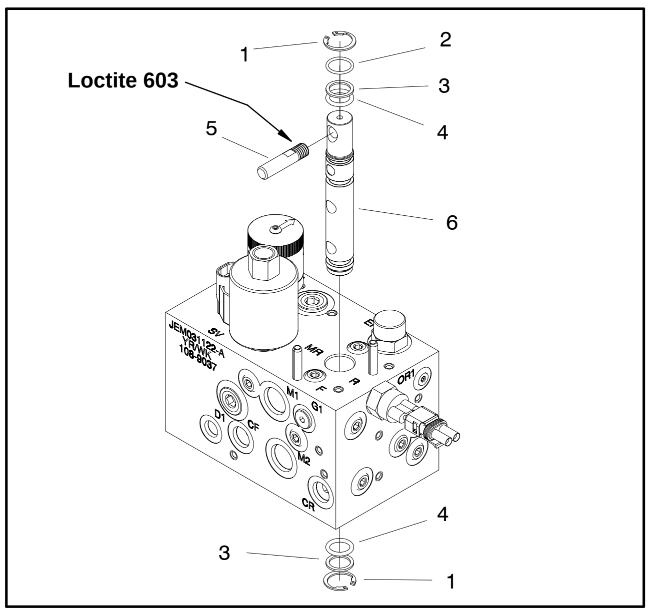

Figure 53

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

Hydraulic System

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Control Valve (Models 03200, 03206 and 03170)

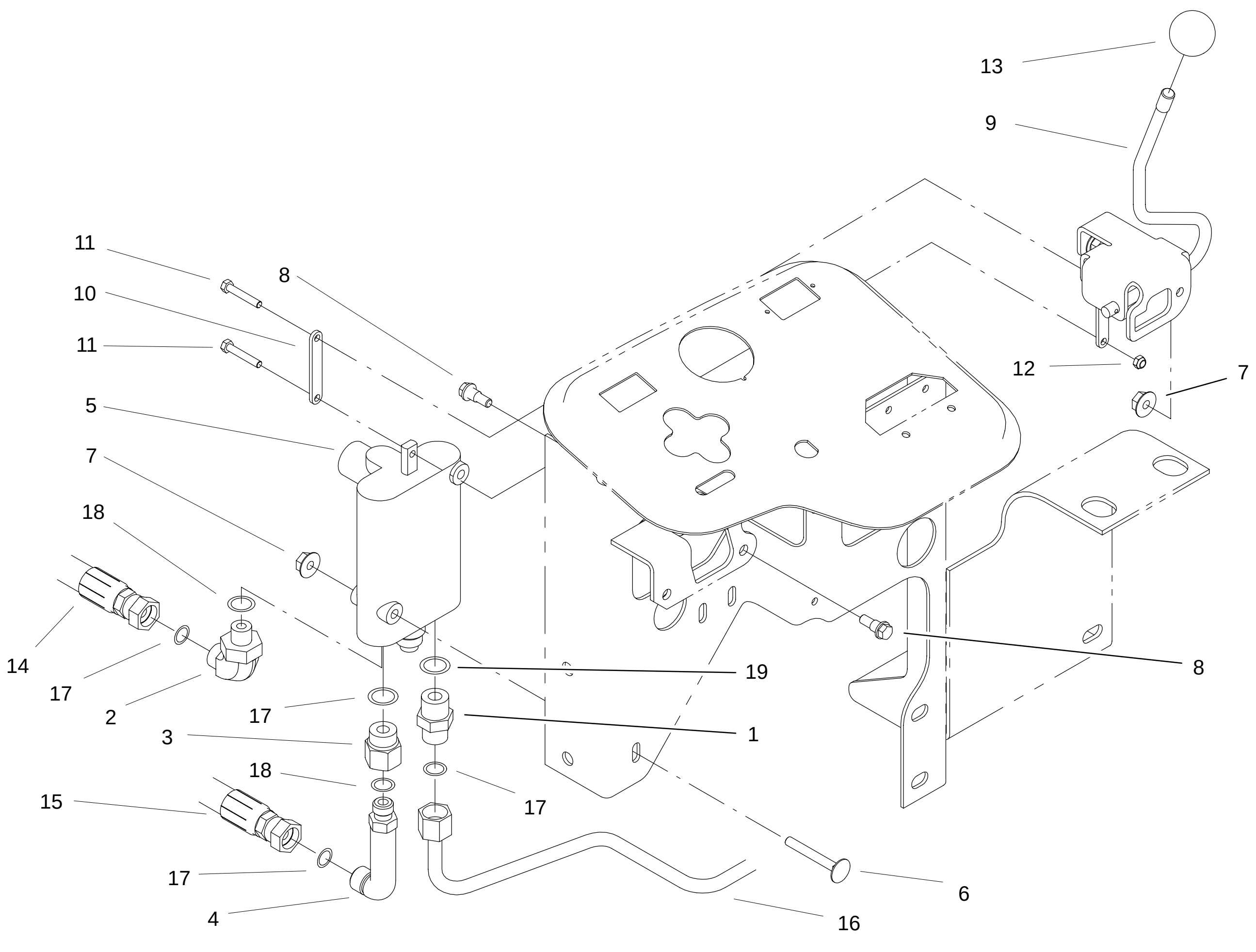

Figure 55

1. **Straight hydraulic fitting**
2. **90º hydraulic fitting**
3. **Hydraulic fitting**
4. **90º hydraulic fitting**
5. **Control valve (single spool)**
6. **Carriage screw (2 used)**
7. **Flange nut**
8. **Shoulder bolt**
9. **Valve lever assembly**
10. **Link (2 used)**
11. **Bolt**
12. **Lock nut (2 used)**
13. **Knob**
14. **Hydraulic hose**
15. **Hydraulic hose**
16. **Hydraulic tube**
17. **O-ring**
18. **O-ring**
19. **O-ring**

Removal

WARNING

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

1. Remove control valve from the frame using Figures 54 and 55 as guides.

2. If hydraulic fittings are to be removed from control valve, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to control valve using marks made during the removal process to properly orientate fittings.

2. Install control valve to the frame using Figures 54 and 55 as guides.

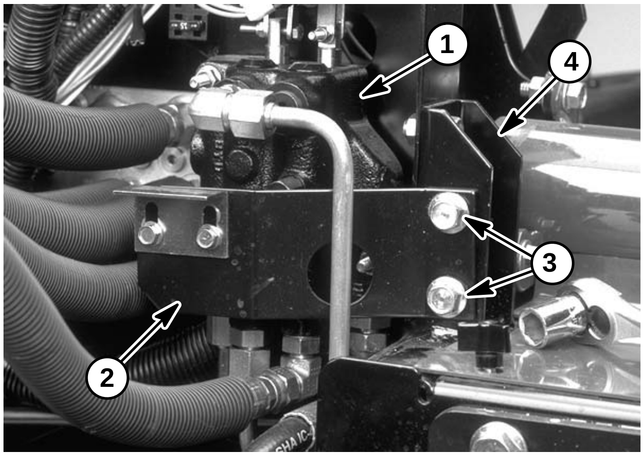

Figure 55

1. **Spool Valve**
2. **Magnet support bracket**
3. **Flange head screws**
4. **Frame**

Hydraulic System

Control Valve Service (Models 03200, 03206 and 03170)

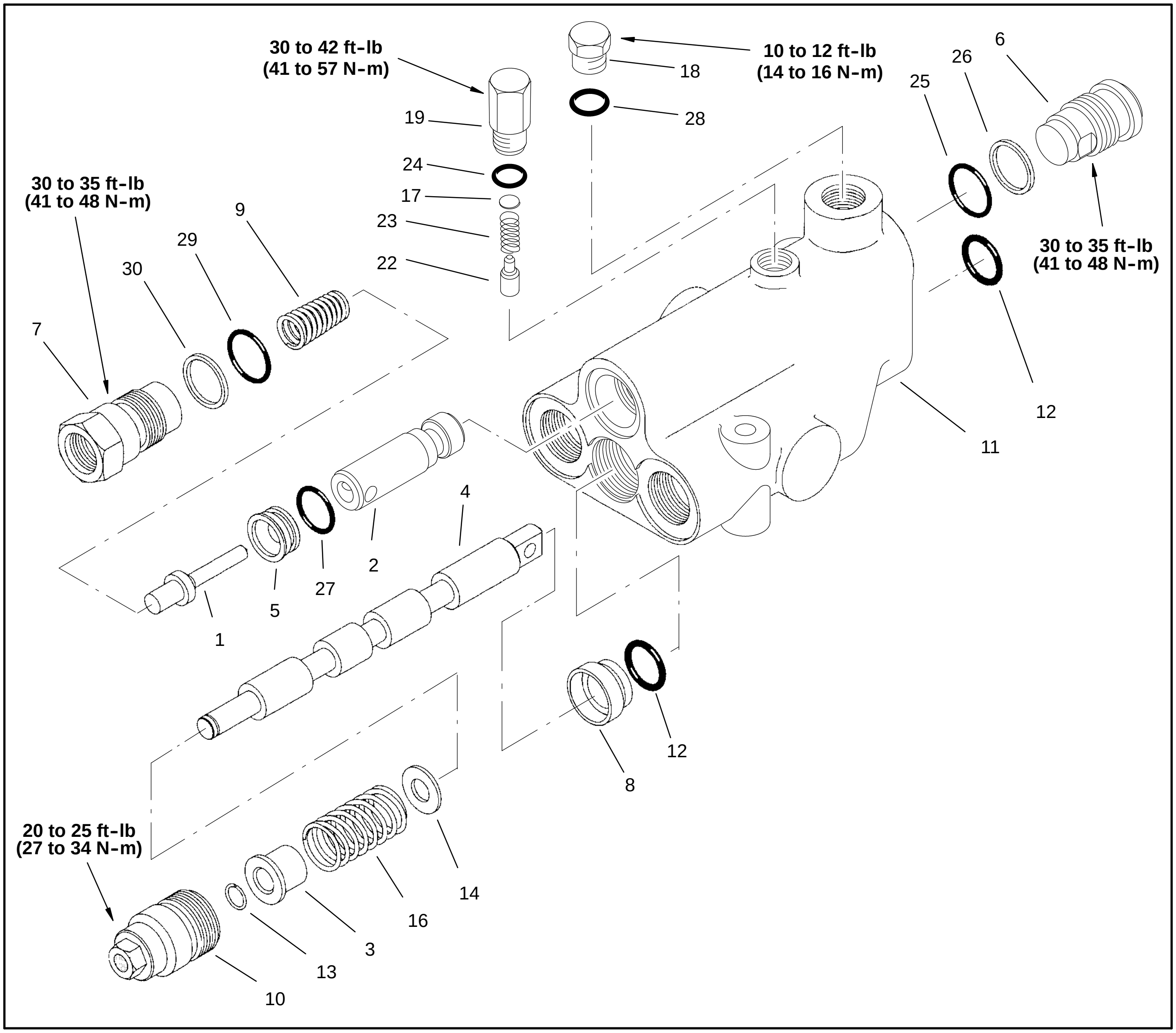

Figure 57

1. **Check poppet**
2. **Plunger**
3. **Spacer**
4. **Spool**
5. **Seat**
6. **Plug (solid)**
7. **Seat retaining plug**
8. **Bushing**
9. **Check spring**
10. **Spool cap**
11. **Valve body**
12. **O-ring**
13. **Retaining ring**
14. **Washer**
15. **Not used**
16. **Spool spring**
17. **Disc**
18. **Plug**
19. **Detent plug**
20. **Not used**
21. **Not used**
22. **Plunger detent**
23. **Spring**
24. **O-ring**
25. **O-ring**
26. **Back-up washer**
27. **O-ring**
28. **O-ring**
29. **O-ring**
30. **Back-up washer**

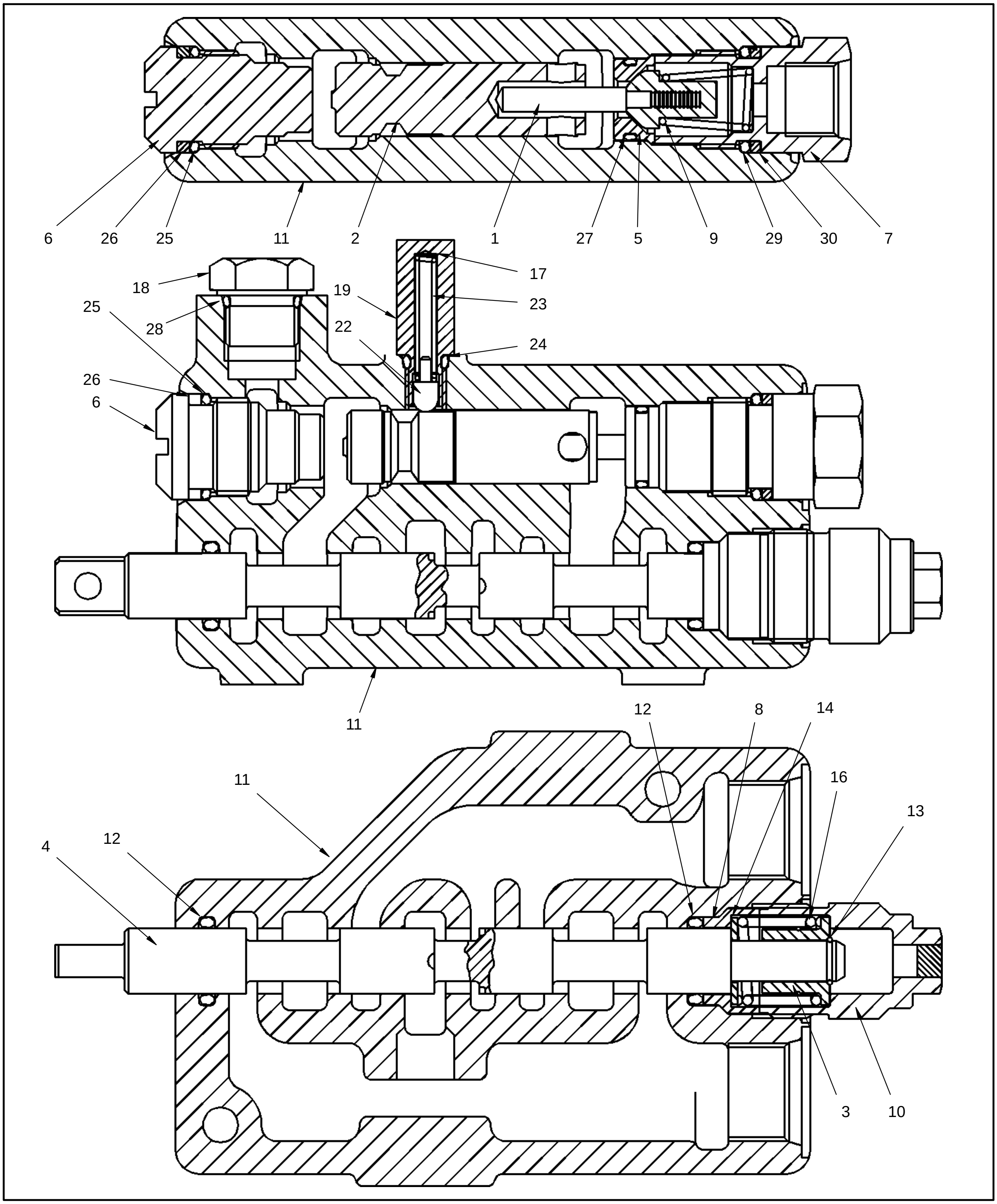

Figure 57

1. Check poppet
2. Plunger
3. Spacer
4. Spool
5. Seat
6. Plug (solid)
7. Seat retaining plug
8. Bushing
9. Check spring
10. Spool cap
11. Valve body
12. O−ring
13. Retaining ring
14. Washer
15. Not used
16. Spool spring
17. Disc
18. Plug
19. Detent plug
20. Not used
21. Not used
22. Plunger detent
23. Spring
24. O−ring
25. O−ring
26. Back−up washer
27. O−ring
28. O−ring
29. O−ring
30. Back−up washer

Disassembly

1. Plug all ports and clean the outside of the valve thoroughly.

2. Remove spool cap and slide the spool assembly from its bore.

3. Remove O−ring and bushing from the spool assembly.

4. Remove O−ring from the spool bore end that is opposite the spool cap.

NOTE: Disassemble spool assembly only if the retaining ring, spacer, spring, or washer need replacing.

5. Remove seat retaining plug, back−up washer, O−ring, and check spring from the valve body.

6. Remove check poppet, seat, O−ring, and plunger from the valve body.

7. Remove solid plug, back−up washer, and O−ring from the opposite end of the plunger.

8. Remove plug and O−ring from the top of the valve body next to the detent plug.

9. Remove detent plug and O−ring from the valve body. Remove disc spring, and detent plunger from the body.

Inspection

1. Inspect spool and spool bore for wear. If wear is excessive, replace valve with new one.

2. Inspect springs and replace as necessary.

3. Inspect plunger, detent plunger, and check poppet for wear. Replace as necessary.

4. Inspect seat, spacer, and bushing for wear. Replace as necessary.

5. Inspect disc and washer. Replace as necessary.

6. Inspect cap and plugs for damaged threads and O−ring sealing surfaces. Replace as necessary.

Assembly

IMPORTANT: Do not wipe parts with paper towels or rags. Lint free cloth must be used to prevent lint from causing damage to the hydraulic system.

CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all metal parts with solvent and blow dry with compressed air.

2. Replace check poppet, O−rings, and back−up washers with new ones.

3. Install new O−rings into the valve body.

4. Slide bushing and new O−ring over the spool.

5. If the spool was disassembled, install washer, spool spring, spacer, and retaining ring to the spool.

6. Lubricate spool liberally with clean hydraulic fluid and install into its proper bore.

7. Install spool cap into valve body. Torque cap from 20 to 25 ft−lb (27 to 34 N−m).

8. Install O−ring, back−up washer, and solid plug into the bore on the opposite end of the plunger. Torque plug from 30 to 35 ft−lb (41 to 48 N−m).

9. Lubricate plunger liberally with clean hydraulic fluid and install into its valve body bore.

10. Install new O−ring, seat, check poppet, and check spring into the plunger bore.

11. Install O−ring, back−up washer, and seat retaining plug into the plunger bore. Torque plug from 30 to 35 ft−lb (41 to 48 N−m).

12. Install O−ring and plug into the top of the valve body next to the detent plug bore. Torque plug from 10 to 12 ft−lb (14 to 16 N−m).

13. Lubricate plunger detent, spring, and disc liberally with clean hydraulic fluid and install into its valve body bore.

14. Install O−ring and detent plug into its proper bore. Torque plug from 30 to 42 ft−lb (41 to 57 N−m).

Hydraulic System

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Control Valve (Models 03201, 03207 and 03171)

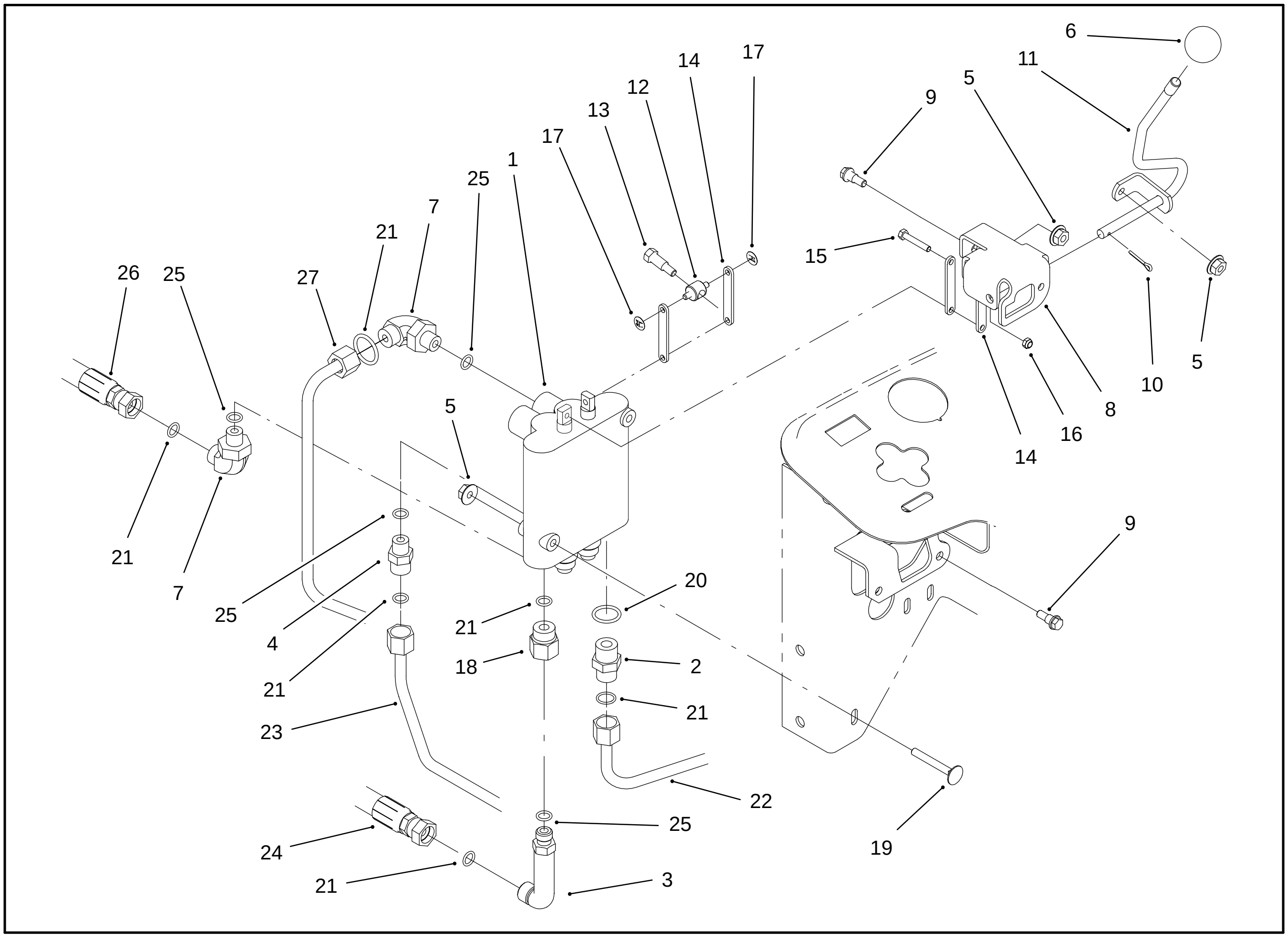

Figure 59

1. **Control valve (2–spool)**
2. **Hydraulic fitting (straight)**
3. **90º hydraulic fitting**
4. **Hydraulic fitting (straight)**
5. **Flange nut**
6. **Knob**
7. **90º hydraulic fitting**
8. **Valve actuator bracket**
9. **Shoulder bolt**
10. **Cotter pin**
11. **Valve lever**
12. **Valve actuator trunnion**
13. **Shoulder bolt**
14. **Link (4 used)**
15. **Bolt**
16. **Lock nut**
17. **Push nut**
18. **Hydraulic fitting**
19. **Carriage screw (2 used)**
20. **O–ring**
21. **O–ring**
22. **Hydraulic tube**
23. **Hydraulic tube**
24. **Hydraulic hose**
25. **O–ring**
26. **Hydraulic hose**
27. **Hydraulic tube**

Removal

WARNING

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

1. Remove control valve from the frame using Figures 58 and 59 as guides.

2. If hydraulic fittings are to be removed from control valve, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to control valve using marks made during the removal process to properly orientate fittings.

2. Install control valve to the frame using Figures 58 and 59 as guides.

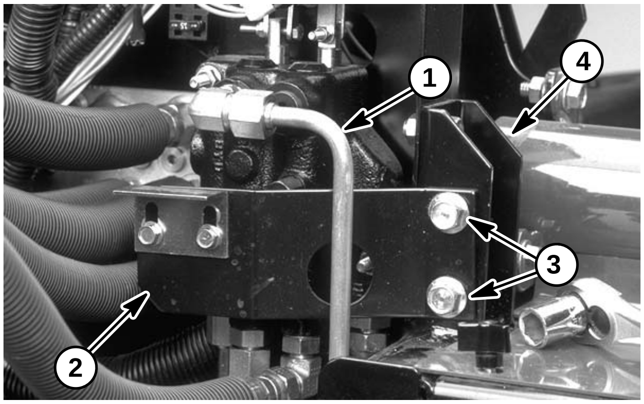

Figure 59

1. **Spool valve**
2. **Magnet support bracket**
3. **Flange head screws**
4. **Frame**

Hydraulic System

Control Valve Service (Models 03201, 03207 and 03171)

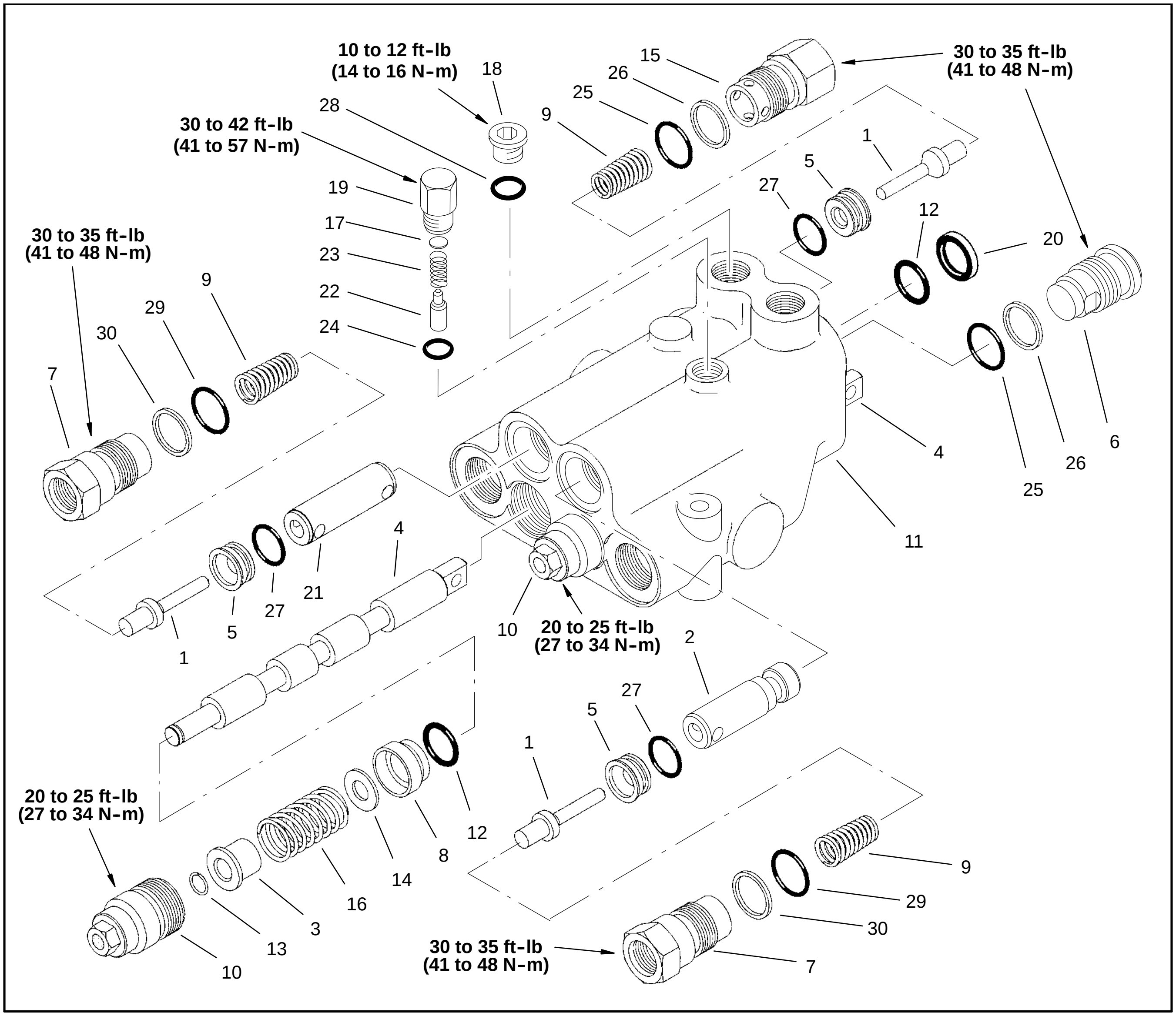

Figure 61

1. **Check poppet**
2. **Grooved plunger**
3. **Spacer**
4. **Spool**
5. **Seat**
6. **Solid plug**
7. **Seat retaining plug with port**
8. **Bushing**
9. **Check spring**
10. **Spool cap**
11. **Valve body**
12. **O-ring**
13. **Retaining ring**
14. **Washer**
15. **Seat retaining plug**
16. **Spool spring**
17. **Disc**
18. **Plug**
19. **Detent plug**
20. **Wiper seal**
21. **Plunger**
22. **Plunger detent**
23. **Detent spring**
24. **O-ring**
25. **O-ring**
26. **Back-up washer**
27. **O-ring**
28. **O-ring**
29. **O-ring**
30. **Back-up washer**

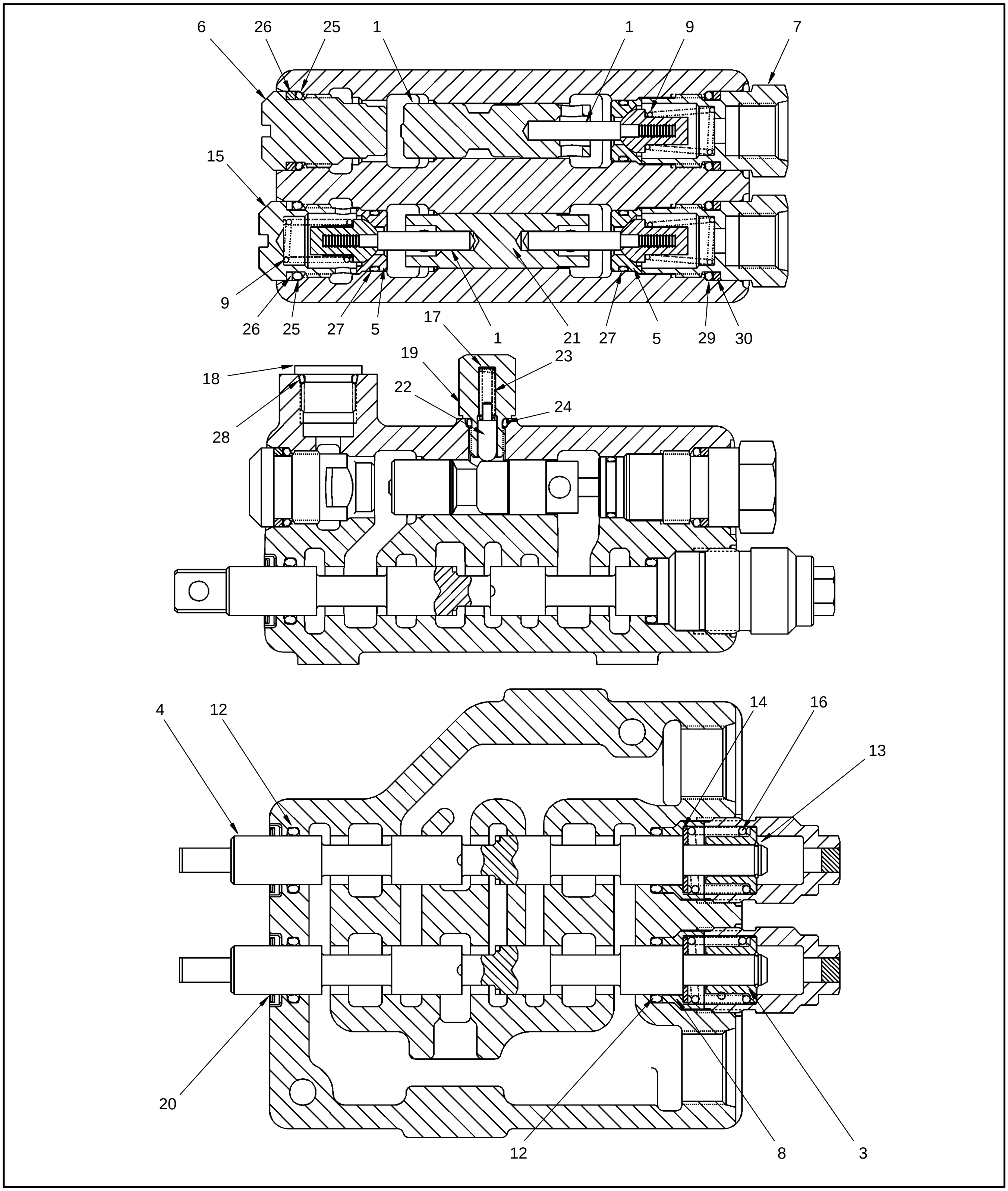

Figure 61

1. **Check poppet**
2. **Grooved plunger**
3. **Spacer**
4. **Spool**
5. **Seat**
6. **Solid plug**
7. **Seat retaining plug with port**
8. **Bushing**
9. **Check spring**
10. **Spool cap**
11. **Valve body**
12. **O−ring**
13. **Retaining ring**
14. **Washer**
15. **Seat retaining plug**
16. **Spool spring**
17. **Disc**
18. **Plug**
19. **Detent plug**
20. **Wiper seal**
21. **Plunger**
22. **Plunger detent**
23. **Detent spring**
24. **O−ring**
25. **O−ring**
26. **Back−up washer**
27. **O−ring**
28. **O−ring**
29. **O−ring**
30. **Back−up washer**

Disassembly

1. Plug all ports and clean the outside of the valve thoroughly.

IMPORTANT: Match mark spools to their associated bores. Spools must be reinstalled to the bore from which they were removed.

2. Remove both spool caps and slide the spool assemblies from their bores.

3. Remove O−ring and bushing from each spool assembly.

4. Remove wiper seals O−rings from the spool bore ends that are opposite the spool caps.

NOTE: Disassemble spool assemblies only if the retaining ring, spacer, spring, or washer need replacing.

5. Remove seat retaining plugs, back−up washers, O−rings, and check springs from the valve body.

6. Remove check poppets, seats, O−rings, and plungers from the valve body.

7. Remove solid plug, back−up washer, and O−ring from the opposite end of the plunger.

8. Remove plug and O−ring from the top of the valve body next to the detent plug.

9. Remove detent plug and O−ring from the valve body. Remove disc spring, and detent plunger from the body.

Inspection

1. Inspect spools and spool bores for wear. If wear is excessive, replace valve with new one.

2. Inspect springs and replace as necessary.

3. Inspect plunger, detent plunger, and check poppet for wear. Replace as necessary.

4. Inspect seat, spacer, and bushing for wear. Replace as necessary.

5. Inspect disc and washer. Replace as necessary.

6. Inspect cap and plugs for damaged threads and O−ring sealing surfaces. Replace as necessary.

Assembly

IMPORTANT: Do not wipe parts with paper towels or rags. Lint may cause damage to the hydraulic system.

CAUTION

Use eye protection such as goggles when using compressed air.

1. Clean all metal parts with solvent and blow dry with compressed air.

2. Replace check poppets, O−rings, and back−up washers with new ones.

3. Install new O−rings into the valve body.

4. Slide bushings and new O−rings over the spools.

5. If a spool was disassembled, install washer, spool spring, spacer, and retaining ring to the spool.

6. Lubricate spools liberally with clean hydraulic fluid and install into their proper bore.

7. Install spool caps into valve body. Torque caps from 20 to 25 ft−lb (27 to 34 N−m).

8. Lubricate both plungers liberally with clean hydraulic fluid and install into their proper bore.

9. Install new O−rings, seats, check poppets, and check springs into the plunger bores.

10. Install O−rings, back−up washers, and seat retaining plugs into their plunger bores. Torque both plugs from 30 to 35 ft−lb (41 to 48 N−m).

11. Install new O−ring, back−up washer, and solid plug into the bore with the grooved plunger. Torque plug from 30 to 35 ft−lb (41 to 48 N−m).

12. Install new O−ring, seat, check poppet, check spring, new O−ring, back−up washer, and seat retaining plug into the bore with the plunger. Torque plug from 30 to 35 ft−lb (41 to 48 N−m).

13. Install O−ring and plug into the top of the valve body next to the detent plug bore. Torque plug from 10 to 12 ft−lb (14 to 16 N−m).

14. Lubricate plunger detent, spring, and disc liberally with clean hydraulic fluid and install into its valve body bore.

15. Install O−ring and detent plug into its proper bore. Torque plug from 30 to 42 ft−lb (41 to 57 N−m).

Hydraulic System

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Piston Pump

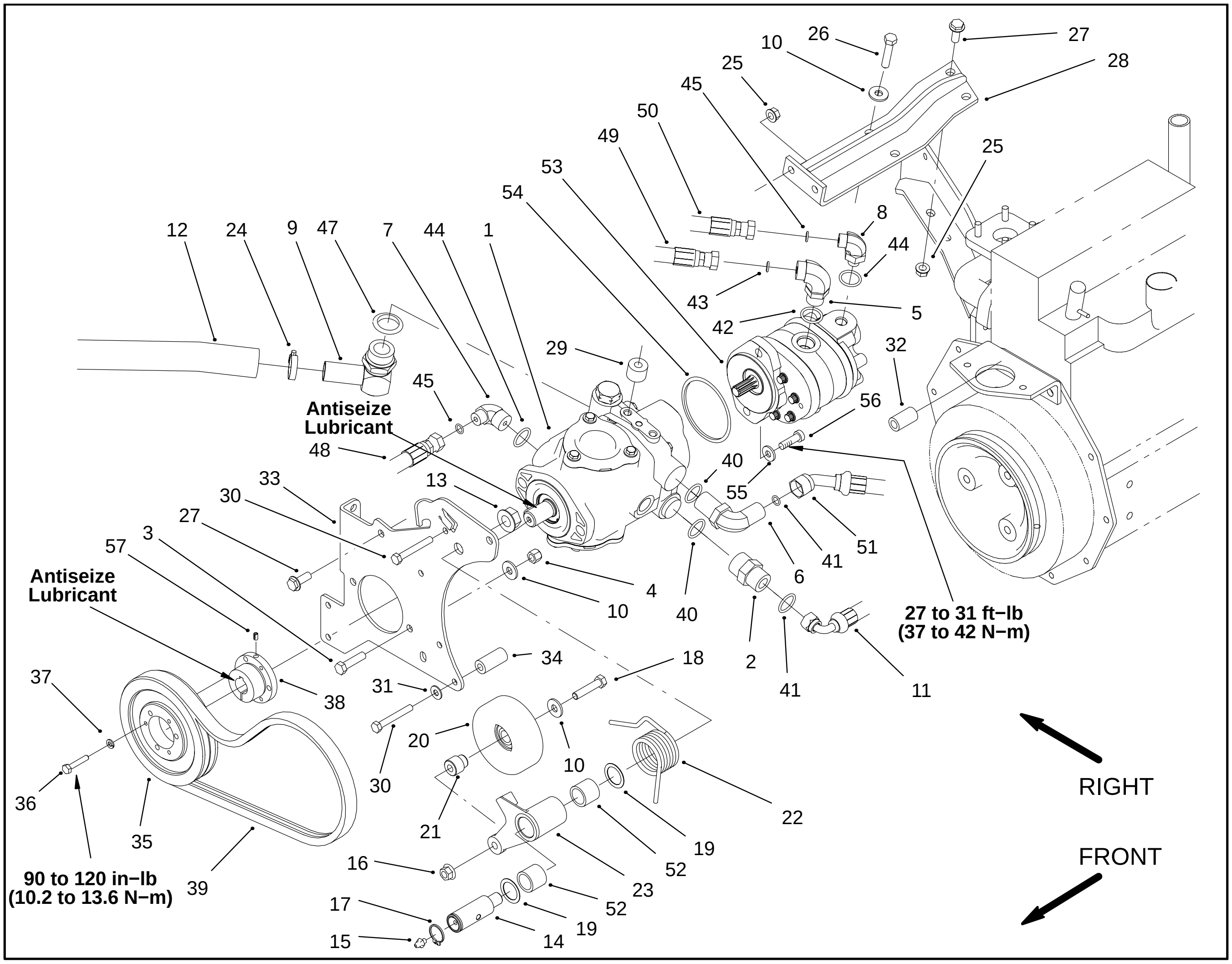

Figure 62

1. **Piston pump**
2. **Straight hydraulic fitting**
3. **Cap screw**
4. **Lock nut**
5. **90º hydraulic fitting**
6. **90º hydraulic fitting**
7. **90º hydraulic fitting**
8. **90º hydraulic fitting**
9. **90º hydraulic fitting**
10. **Washer**
11. **Hydraulic hose**
12. **Suction hose**
13. **Flange nut**
14. **Idler pivot pin**
15. **Grease fitting**
16. **Flange nut**
17. **Retaining ring**
18. **Cap screw**
19. **Thrust washer**
20. **Idler pulley**
21. **Spacer**
22. **Torsion spring**
23. **Idler arm**
24. **Hose clamp**
25. **Flange nut**
26. **Cap screw**
27. **Flange head screw**
28. **Pump support**
29. **Spacer**
30. **Cap screw**
31. **Flat washer**
32. **Spacer**
33. **Pump mount plate**
34. **Pump mount spacer**
35. **Pulley**
36. **Cap screw**
37. **Lock washer**
38. **Taper lock bushing**
39. **V−belt**
40. **O−ring**
41. **O−ring**
42. **O−ring**
43. **O−ring**
44. **O−ring**
45. **O−ring**
46. **O−ring**
47. **O−ring**
48. **Hydraulic hose**
49. **Hydraulic hose**
50. **Hydraulic hose**
51. **Hydraulic hose**
52. **Bushing**
53. **Gear pump**
54. **O−ring**
55. **Flat washer**
56. **Socket head screw**
57. **Set screw**

IMPORTANT: If a piston pump failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

Neutral Arm Assembly

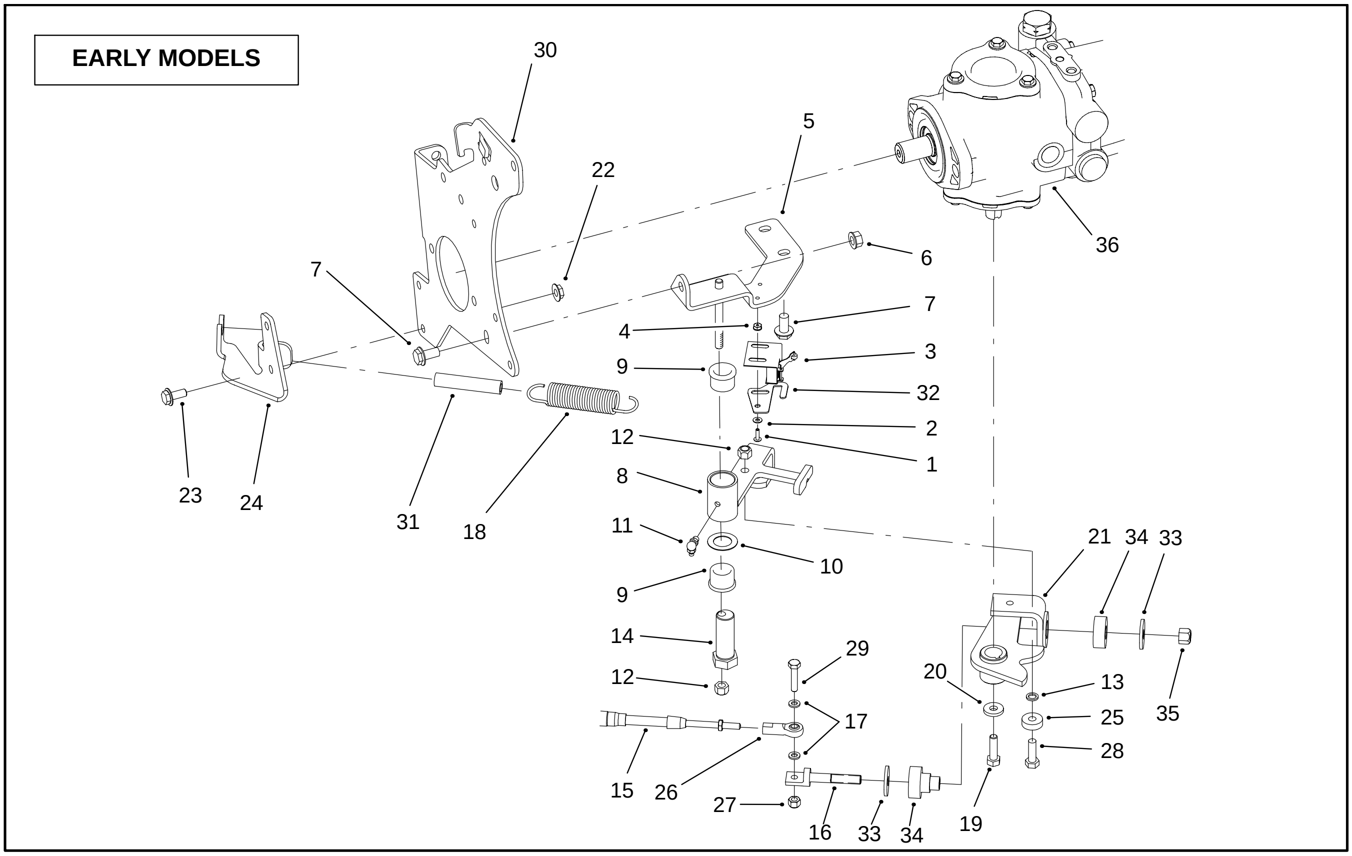

Figure 63

1. **Philips head screw**
2. **Flat washer**
3. **Micro switch**
4. **Keps nut**
5. **Neutral bracket**
6. **Flange nut**
7. **Flange head nut**
8. **Neutral arm**
9. **Flange bushing**
10. **Thrust washer**
11. **90° grease fitting**
12. **Lock nut**
13. **Spacer**
14. **Traction stud**
15. **Traction control cable**
16. **Isolator stud**
17. **Flat washer**
18. **Extension spring**
19. **Cap screw**
20. **Flat washer**
21. **Pump lever**
22. **Flange nut**
23. **Flange head screw**
24. **Cable support bracket**
25. **Ball bearing**
26. **Rod end**
27. **Lock nut**
28. **Screw**
29. **Cap screw**
30. **Pump mount plate**
31. **Spring dampener**
32. **Adjuster bracket**
33. **Flat washer**
34. **Isolation mount**
35. **Lock nut**
36. **Piston pump**

Piston Pump Removal (Fig. 62)

1. Remove traction belt from the pulley (see Replace Traction Belt).

2. Remove pulley from the taper lock bushing:

A. Remove cap screws securing pulley to the taper lock bushing.

IMPORTANT: Excessive or unequal pressure on the cap screws can break the bushing flange.

B. Insert cap screws into threaded removal holes of the pulley. Tighten screws progressively and evenly until the pulley is loose on the bushing. Remove pulley from the bushing.

CAUTION

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

3. Remove neutral arm assembly from the piston pump as follows (Figs. 63 and 64):

A. Disconnect electrical connector from the micro switch (early models).

B. Remove extension spring from the cable support bracket and pump lever.

C. Disconnect traction control cable from the pump lever.

D. Remove both flange head screws securing the neutral bracket to the piston pump. Remove flange nut and flange head screw securing the neutral bracket to the pump mount plate.

E. Remove cap screw and flat washer securing the pump lever to the piston pump trunnion.

F. Separate pump lever from pump trunnion and neutral bracket from mount plate.

4. Drain hydraulic oil from hydraulic tank (see Change Hydraulic Fluid in this section).

WARNING

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

5. Disconnect all hydraulic hoses connected to the hydraulic fittings on the piston and gear pumps. Allow hoses to drain into a suitable container.

CAUTION

Support piston and gear pumps when removing them from the pump support and pump mount plate to prevent them from falling and causing personal injury.

6. Remove both cap screws, washers, and spacers securing the piston pump to the pump support.

7. Remove both lock nuts, cap screws, and washers securing the piston pump to the pump mount plate. Pull pumps from the machine.

8. Remove both socket head screws and flat washers securing gear pump to the piston pump. Separate gear pump and O−ring from the piston pump. Plug openings of gear pump to prevent contamination.

9. Remove hydraulic fittings and O−rings from the piston pump.

10. Remove taper lock bushing from the piston pump shaft.

11. If hydraulic fittings are to be removed from pump, mark fitting orientation to allow correct assembly.

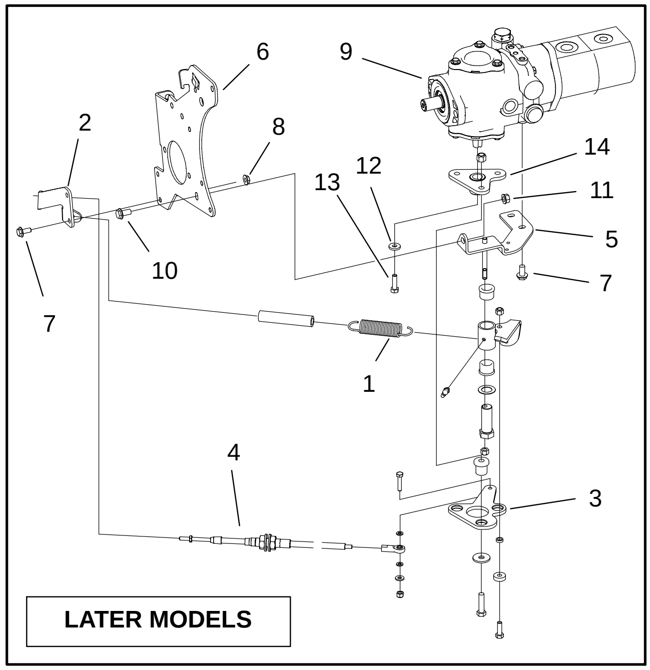

Figure 64

1. **Extension spring**
2. **Cable support bracket**
3. **Pump lever**
4. **Traction control cable**
5. **Neutral bracket**
6. **Pump mount plate**
7. **Flange head screw**
8. **Flange nut**
9. **Piston pump**
10. **Flange head screw**
11. **Flange nut**
12. **Flat washer**
13. **Cap screw**
14. **Pump lever hub**

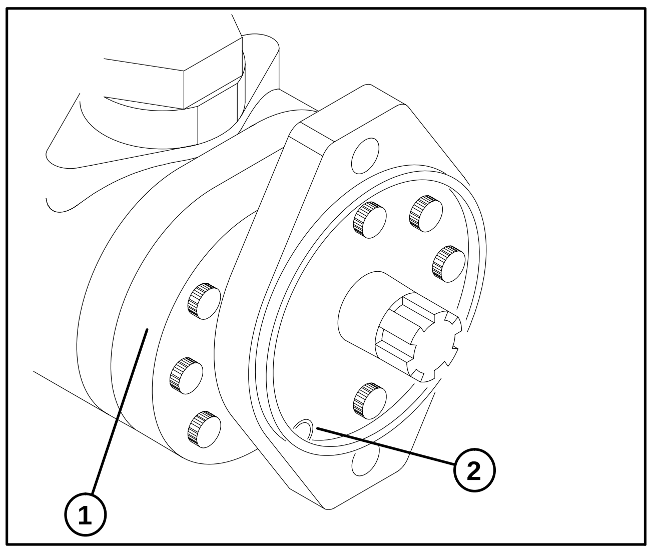

Figure 65

1. **Gear pump**
2. **Suction port**

Piston Pump Installation (Fig. 62)

1. If hydraulic fittings were removed, install fittings to pump using marks made during the removal process to properly orientate fittings.

2. Place key into pump shaft slot. Slide taper lock bushing onto the piston pump shaft with bushing flange toward pump housing.

3. Make sure that tapered surfaces of pulley and taper lock bushing are thoroughly clean (no oil, grease, dirt, rust, etc.).

4. Position pulley to taper lock bushing and align non−threaded holes of pulley with threaded holes of bushing. Loosely install three (3) cap screws with lock washers to bushing and pulley.

5. Install O−rings and hydraulic fittings to their original positions on the piston pump.

NOTE: If installing a new gear pump to the piston pump, make sure to remove the plug from the suction port of the gear pump (Fig. 65). The gear pump suction fitting must be on the same side as the trunnion of the piston pump.

6. Remove plugs from the gear pump. Secure O−ring and gear pump to the piston pump with both flat washers and socket head screws. Torque fasteners from 27 to 31 ft−lb (37 to 42 N−m).

CAUTION

Support piston and gear pumps when installing them to the pump mount plate and pump support to prevent them from falling and causing personal injury.

7. Position piston pump to the pump mount plate. Secure pump to the mount plate with both flat washers, cap screws, and lock nuts. Do not fully tighten fasteners.

8. Secure piston pump to the pump support with both spacers, washers, and cap screws. Tighten fasteners securing the piston pump to the pump mount plat and pump support.

9. Remove plugs from hydraulic hoses. Connect all hydraulic hoses as follows:

A. Secure O−rings and hoses to the gear pump.

B. Connect hydraulic suction hose from the hydraulic tank to the barb fitting with hose clamp.

C. Secure O−rings and hydraulic hoses to the piston pump.

10. Install neutral arm assembly to the piston pump as follows (Figs. 63 and 64):

A. Position neutral bracket to the mount plate, and then pump lever to the pump trunnion.

B. Secure pump lever to the piston pump trunnion with flat washer and cap screw.

C. Secure neutral bracket to the pump mount plate with flange head screw and flange nut. Secure neutral bracket to the piston pump with both flange head screws.

D. Connect traction control cable to the pump lever.

CAUTION

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

E. Install extension spring to the cable support bracket and pump lever.

F. Connect electrical connector to the micro switch (early models).

11. Install traction belt to the pump pulley (see Replace Traction Belt).

12. Using a straight edge across the lower face of the pump pulley, verify traction belt alignment across engine and pump pulleys. Slide pulley and taper lock bushing on pump shaft so that traction belt and straight edge are aligned indicating correct position of pump pulley. Secure taper lock bushing in position with set screw.

IMPORTANT: When tightening bushing cap screws, tighten in three equal steps and in a circular pattern.

13. Secure taper lock bushing by tightening three (3) cap screws to a torque from 90 to 120 in−lb (10.2 to 13.6 N−m) in three equal steps and in a circular pattern to secure pulley and taper lock bushing.

14. Check that belt alignment is still correct. If needed, loosen and re−adjust pulley and taper lock bushing location on pump shaft to allow for correct belt alignment.

15. Fill hydraulic tank with **new** hydraulic fluid (see Traction Unit Operator’s Manual).

16. Adjust traction drive for neutral (see Adjust traction Drive for Neutral).

Piston Pump Service

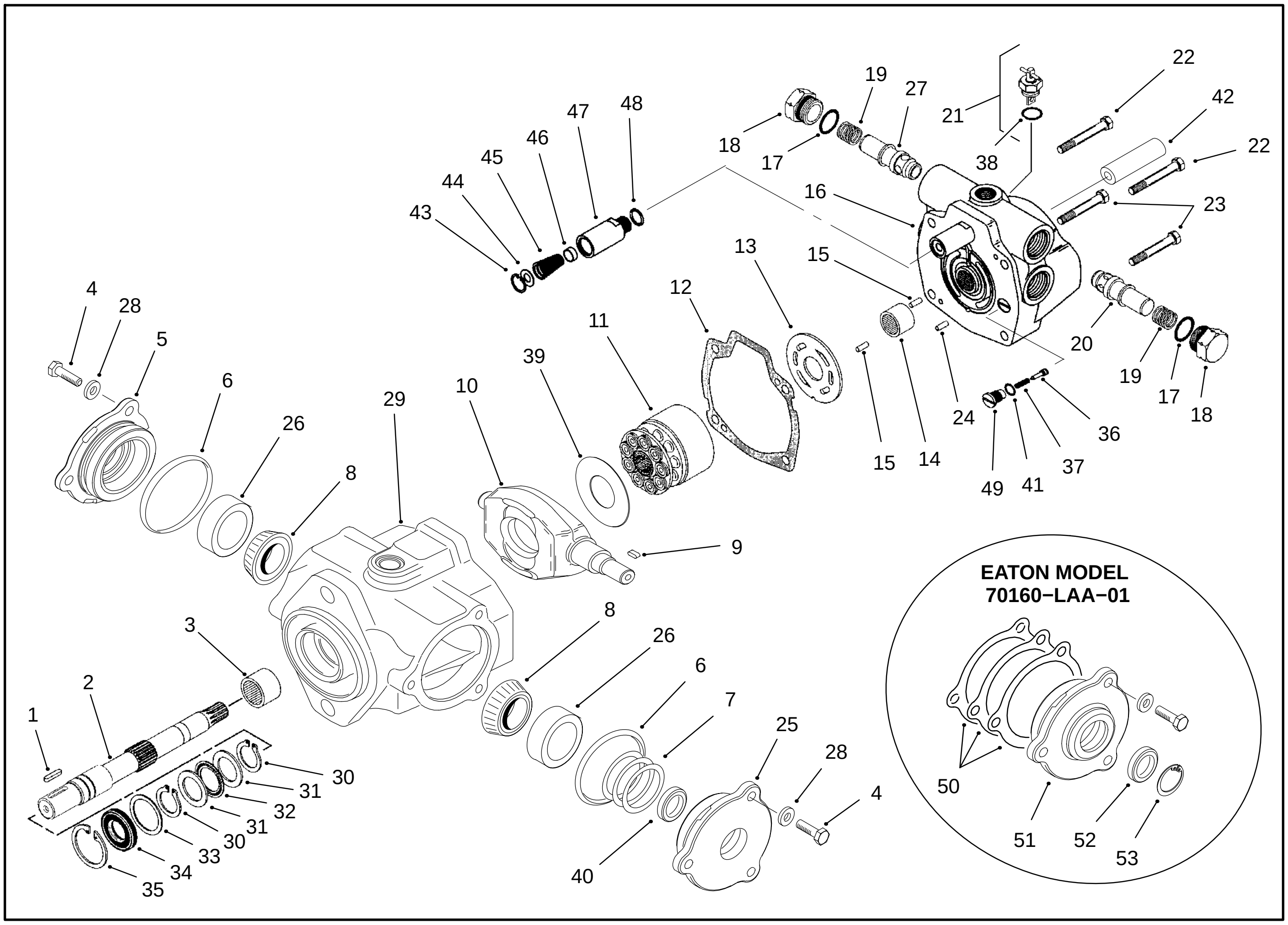

Figure 66

1. **Key**
2. **Drive shaft**
3. **Bearing**
4. **Cap screw (3 used per cover plate)**
5. **Cover plate**
6. **Seal**
7. **Shim kit**
8. **Bearing cone**
9. **Key**
10. **Cam plate**
11. **Rotating kit**
12. **Gasket**
13. **Valve plate**
14. **Bearing**
15. **Dowel pin**
16. **Back plate**
17. **O−ring**
18. **Plug**
19. **Spring**
20. **Seat**
21. **Dump valve**
22. **Cap screw**
23. **Cap screw**
24. **Roll pin**
25. **Cover plate**
26. **Bearing cup**
27. **Relief valve**
28. **Washer (3 used per cover plate)**
29. **Housing**
30. **Retaining ring**
31. **Bearing race**
32. **Thrust bearing**
33. **Washer**
34. **Shaft seal**
35. **Retaining ring**
36. **Bleed−off valve poppet**
37. **Bleed−off spring**
38. **O−ring**
39. **Cam plate insert**
40. **Shaft seal**
41. **O−ring**
42. **Coupler**
43. **Retaining ring**
44. **Washer**
45. **Charge relief spring**
46. **Charge relief poppet**
47. **Charge relief housing**
48. **O−ring**
49. **Cartridge**
50. **Shim (Model 70160−LAA−01)**
51. **Cover plate (70160−LAA−01)**
52. **Shaft seal (70160−LAA−01)**
53. **Retaining ring (70160−LAA−01)**

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

NOTE: Reelmaster 3100−D machines with serial numbers below 90775 were equipped with an Eaton model 70160−LAA−01 piston pump. This pump included some differences in the trunnion shaft design (Items 50 − 53 in Figure 66).

IMPORTANT: If a piston pump failure occurred, refer to Traction Circuit (Closed Loop) Component Failure in the General Information section for information regarding the importance of removing contamination from the traction circuit.

Piston Pump Crush Ring Replacement

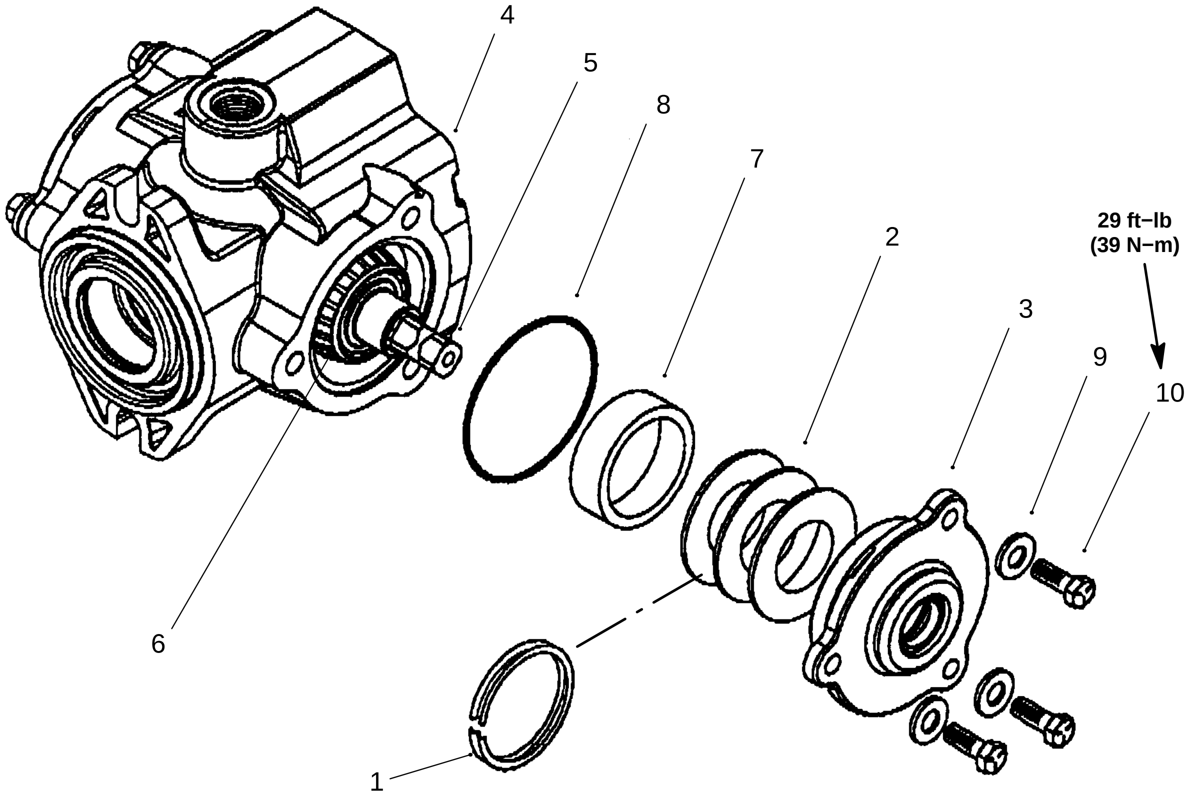

Figure 67

1. Crush ring
2. Shims
3. Cover plate
4. Housing
5. Cam plate (control shaft)
6. Bearing cone
7. Bearing cup
8. Seal
9. Washer (3 used)
10. Cap screw (3 used)

NOTE: The shims replace the crush ring in the piston pump cover plate on Reelmaster 3100−D machines with serial numbers above 90775. If the cam plate, cover plate, or housing is replaced during servicing of the pump, replace the original crush ring with shims 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, cam plate, 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 Repair Information at the end of this chapter).

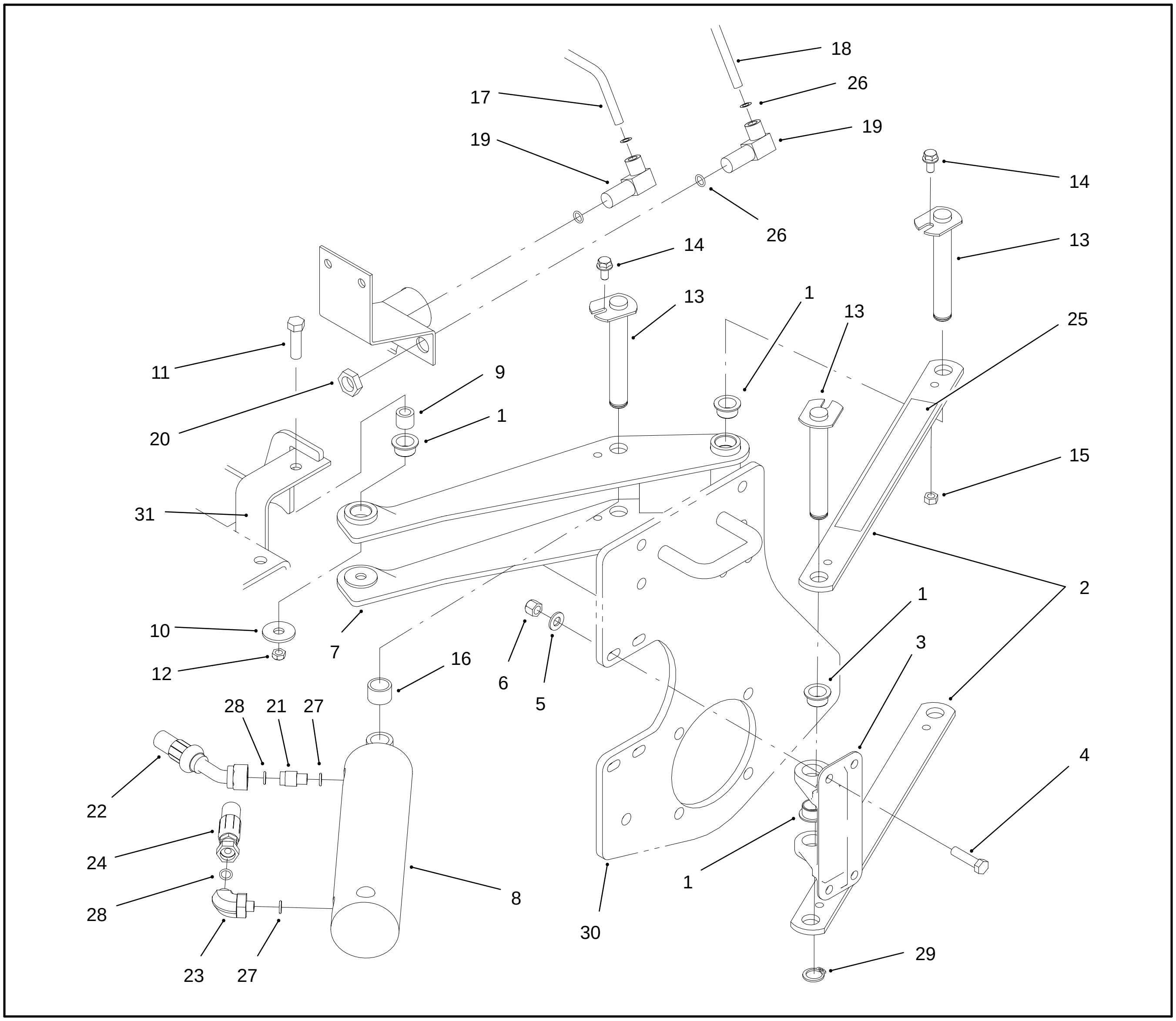

Figure 69

1. Plastic bushing
2. Scissor link
3. Scissor mount
4. Cap screw
5. Flat washer
6. Lock nut
7. Scissor frame
8. Hydraulic cylinder
9. Spacer
10. Flat washer
11. Cap screw
12. Lock nut
13. Welded pin
14. Flange head screw
15. Lock nut
16. Spacer
17. Hydraulic tube
18. Hydraulic tube
19. 90^{o} hydraulic fitting
20. Bulkhead lock nut
21. Straight hydraulic fitting
22. Hydraulic hose
23. 90^{o} hydraulic fitting
24. Hydraulic hose
25. Pinch point decal
26. O–ring
27. O–ring
28. O–ring
29. Retaining ring
30. Lower frame (LH)
31. Frame

Removal

> ⚠ **WARNING**
>
> **Before disconnecting or performing any work on the hydraulic system, all pressure in the system must be relieved. See Relieving Hydraulic System Pressure in the General Information section.**

1. Remove hydraulic cylinder from the frame using Figure 68 as guide.

2. If hydraulic fittings are to be removed from cylinder, mark fitting orientation to allow correct assembly.

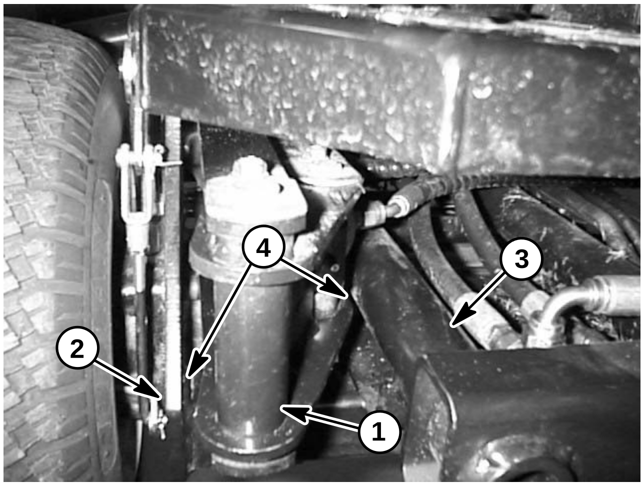

Figure 69

1. **Scissor frame**
2. **Lower frame**
3. **Sidewinder carrier**
4. **Gaps**

Installation

1. If hydraulic fittings were removed, install fittings to cylinder using marks made during the removal process to properly orientate fittings.

2. Install hydraulic cylinder to the frame using Figure 68 as guide.

3. Adjust scissors mount as follows:

   A. Shift sidewinder fully to the left (fully retract cylinder).

   B. Loosen four cap screws securing mount to lower frame.

   C. The gap between the scissor frame and lower frame and the gap between the scissor frame and the sidewinder carrier must be equal distances within 0.060 inch (1.5 mm).

   D. Tighten four cap screws and lock nuts.

Hydraulic System

Steering Control Valve

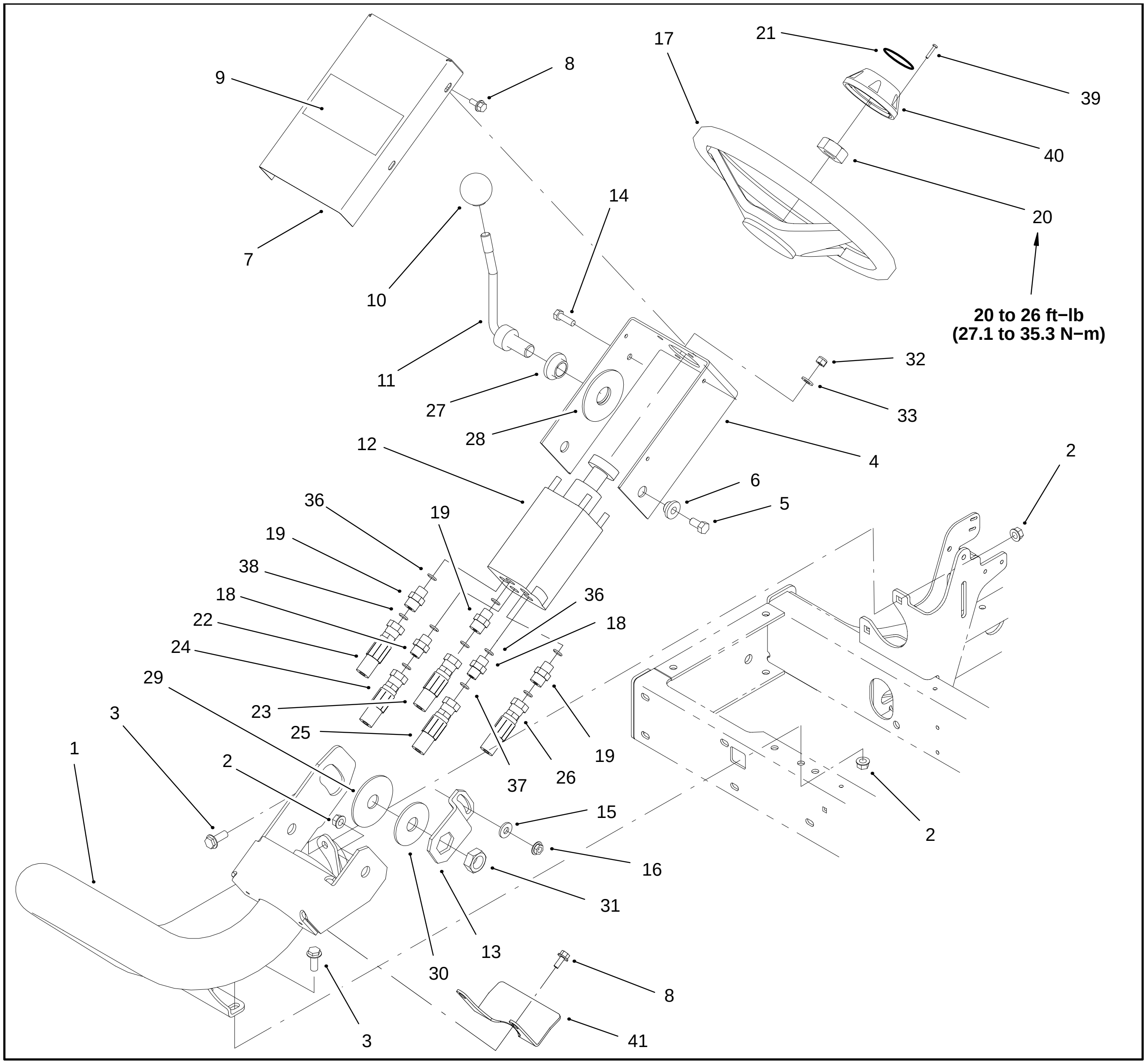

Figure 70

1. Steering arm
2. Flange nut
3. Flange head screw
4. Steering valve bracket
5. Cap screw
6. Pivot hub
7. Steering cover
8. Cap screw
9. Toro decal
10. Ball knob
11. Lever
12. Steering control valve
13. Tilt bracket
14. Cap screw
15. Flat washer
16. Flange nut
17. Steering wheel
18. Hydraulic fitting
19. Hydraulic Fitting
20. Steering wheel nut
21. Toro decal
22. Hydraulic hose
23. Hydraulic hose
24. Hydraulic hose
25. Hydraulic hose
26. Hydraulic hose
27. Tilt steering boss
28. Friction disc
29. Friction disc
30. Flat washer
31. Jam nut
32. Lock nut
33. Flat washer
34. Not used
35. Not used
36. O−ring
37. O−ring
38. O−ring
39. Philips head screw
40. Steering wheel cap
41. Steering shield

Removal

⚠ WARNING

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

1. Remove steering control valve from the steering column using Figures 70, 71, and 72 as guides.

Installation

1. Install steering control valve to the steering column using Figures 70, 71, and 72 as guides.

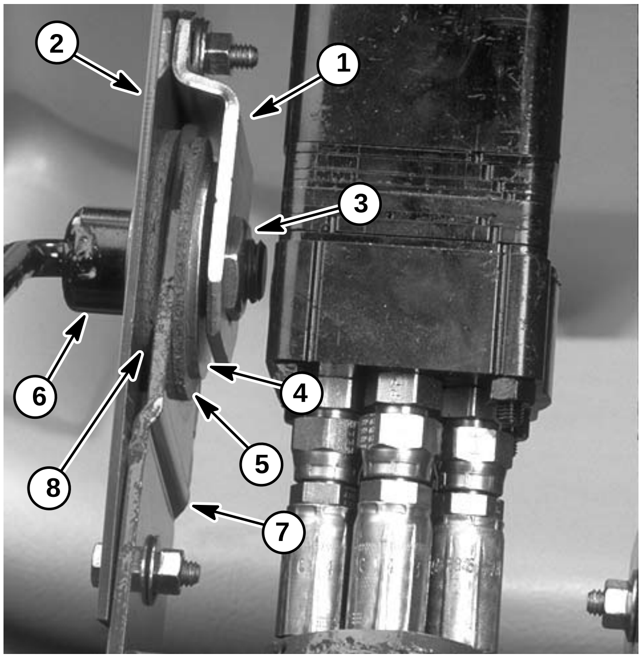

Figure 71

1. **Tilt bracket**
2. **Steering valve bracket**
3. **Jam nut**
4. **Flat washer**
5. **Friction disc**
6. **Lever**
7. **Steering arm**
8. **Friction disc**

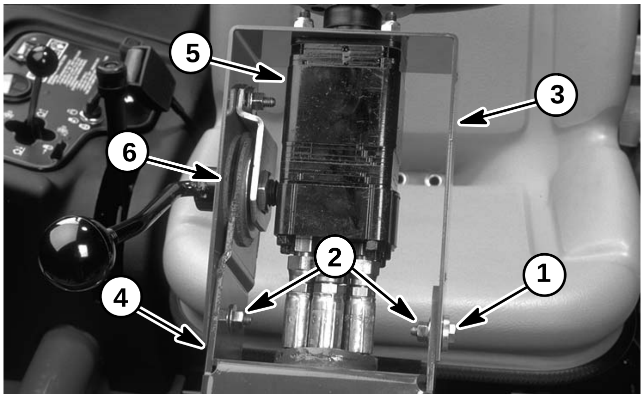

Figure 72

1. **Cap screw**
2. **Flange nuts**
3. **Steering valve bracket**
4. **Steering arm**
5. **Steering control valve**
6. **Friction disc**

Hydraulic System

Steering Control Valve Service (Serial Numbers 90101 to 230999999)

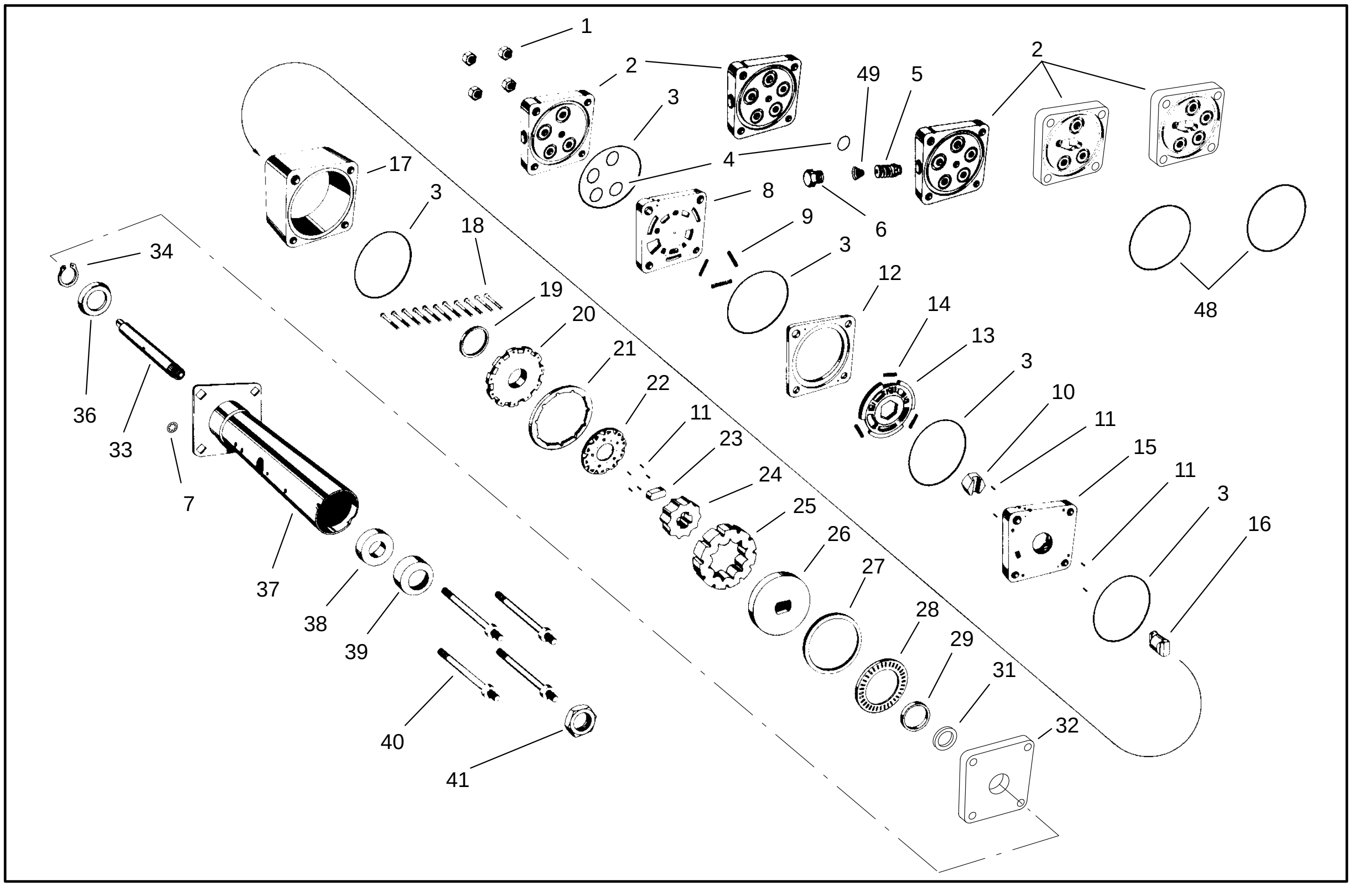

Figure 73

1. **Nut**
2. **Port cover**
3. **Seal ring**
4. **O−ring**
5. **Relief valve cartridge**
6. **Plug**
7. **Push nut**
8. **Port manifold**
9. **Spring**
10. **Drive assembly**
11. **Alignment pin**
12. **Valve ring**
13. **Valve plate**
14. **Spring**
15. **Isolation manifold**
16. **Drive link**
17. **Metering ring**
18. **Socket head screw**
19. **Commutator seal**
20. **Commutator cover**
21. **Commutator ring**
22. **Commutator**
23. **Drive link spacer**
24. **Rotor**
25. **Stator**
26. **Drive plate**
27. **Thrust bearing spacer**
28. **Thrust bearing**
29. **Face seal**
30. **Not used**
31. **Seal spacer**
32. **Upper cover plate**
33. **Input shaft**
34. **Retaining ring**
35. **Not used**
36. **Retaining plate**
37. **Upper cover & jacket assembly**
38. **Bushing**
39. **Seal**
40. **Special bolt**
41. **Nut**
42. **Not used**
43. **Not used**
44. **Not used**
45. **Not used**
46. **Not used**
47. **Not used**
48. **Seal ring (white)**
49. **Coil spring**
50. **Not used**
51. **Spacer**

NOTE: For repair of the steering control valve, see the Ross Hydraguide ™ Hydrostatic Steering System HGF Series Service Procedure at the end of this chapter.

Steering Control Valve Service (Serial Numbers 240000001 and up)

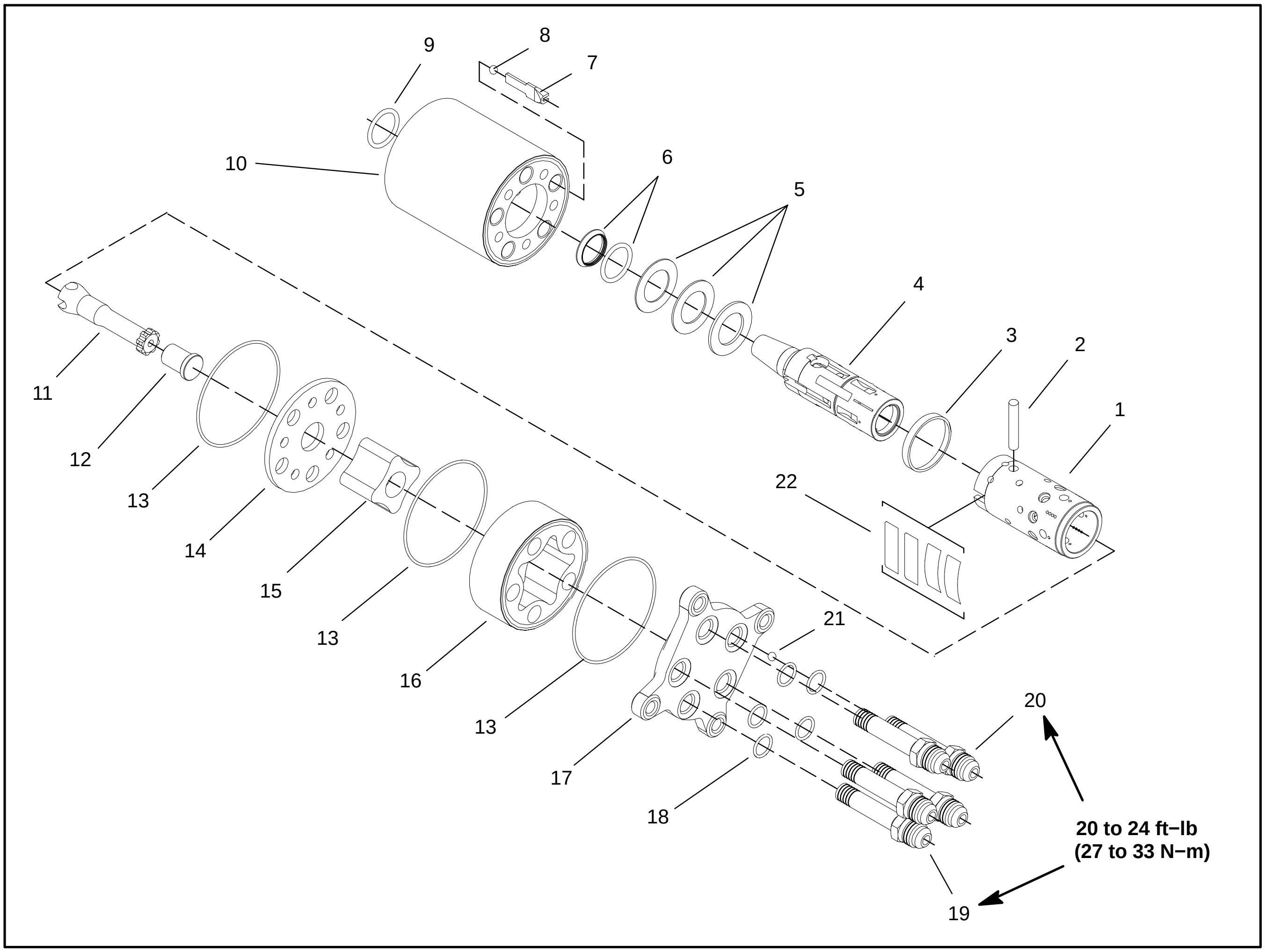

Figure 74

1. **Sleeve**
2. **Cross pin**
3. **Ring**
4. **Spool**
5. **Bearing assembly**
6. **Shaft seal**
7. **Ball stop**
8. **Ball**
9. **Dust seal ring**
10. **Housing**
11. **Cardan shaft**
12. **Spacer**
13. **O−ring**
14. **Distribution plate**
15. **Inner gearwheel**
16. **Outer gearwheel**
17. **End cover**
18. **O−ring (5 used)**
19. **Screw/fitting (ports L, R, T)**
20. **Screw/fitting (ports P and E)**
21. **P port check ball**
22. **Spring set**

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

Gear Pump

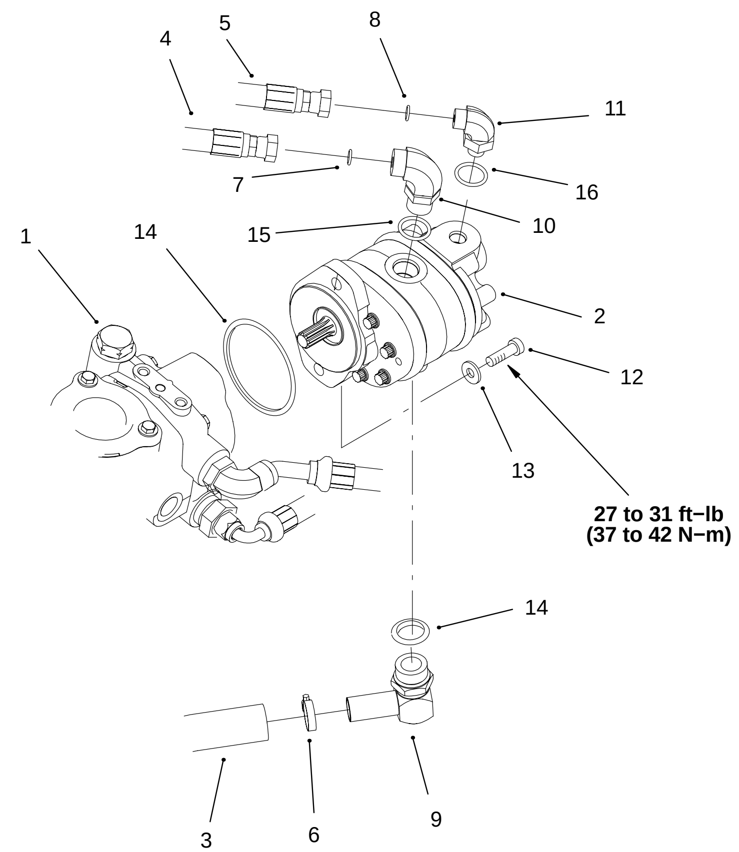

Figure 75

1. **Piston pump**
2. **Gear pump**
3. **Hydraulic hose (tank suction)**
4. **Hydraulic hose (hydraulic manifold)**
5. **Hydraulic hose (steering valve)**
6. **Hose clamp**
7. **O−ring**
8. **O−ring**
9. **Hydraulic barb fitting**
10. **90° hydraulic fitting**
11. **90° hydraulic fitting**
12. **Cap screw**
13. **Flat washer**
14. **O−ring**
15. **O−ring**
16. **O−ring**

Removal

1. Remove muffler from the engine to gain access to the gear pump (see Muffler Removal in Chapter 3 − Kubota Diesel Engine).

2. Drain hydraulic oil from hydraulic tank (see Change Hydraulic Fluid in this section).

WARNING

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

3. Remove gear pump from the piston pump using Figure 75 as guide.

4. If hydraulic fittings are to be removed from gear pump, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to motor using marks made during the removal process to properly orientate fittings.

IMPORTANT: Position gear pump to the piston pump so that the gear pump suction port is facing down.

2. Install gear pump to the piston pump using Figure 75 as guide.

3. Fill hydraulic tank with **new** hydraulic fluid (see Traction Unit Operator's Manual).

4. Install muffler to the engine (see Muffler Installation in Chapter 3 − Kubota Diesel Engine).

Gear Pump Service

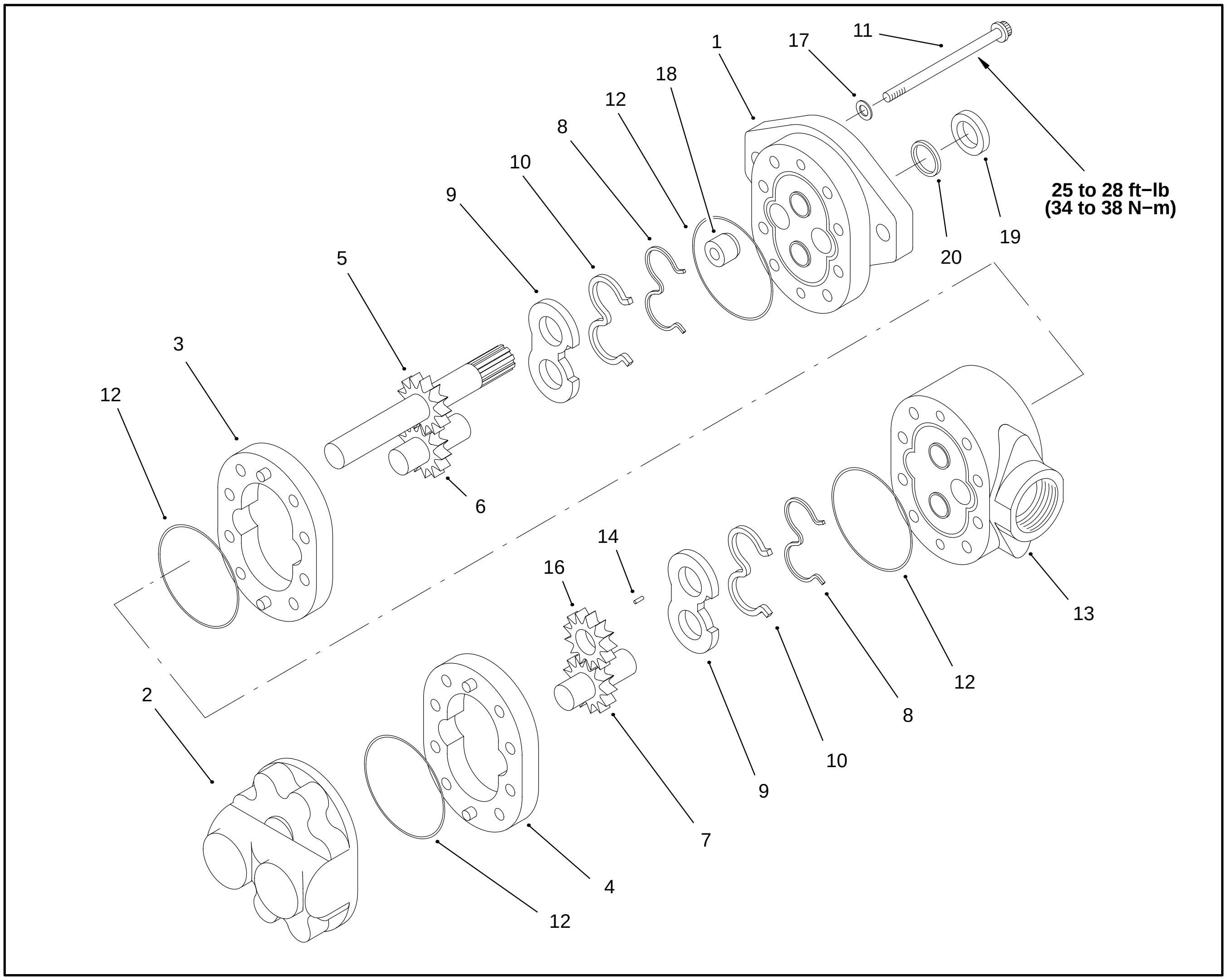

Figure 76

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

Disassembly (Fig. 76)

1. Plug pump ports and clean the outside of the pump thoroughly. After cleaning, remove plugs and drain any oil out of the pump.

2. Make sure key is removed from the shaft of the drive gear.

3. Use a marker to make a **diagonal** line across the front plate, front body, adapter plate, rear body, and back plate for assembly purposes (Fig. 77).

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

4. Clamp pump in a vise with the the shaft end up.

5. Remove cap screws and washers from the front plate.

6. Remove pump from the vise. Turn pump so that the shaft end is facing down.

7. Remove back plate from the rear body by tapping with a soft face hammer. Remove and discard O−ring from the back plate.

8. Loosen rear body from the adapter plate by tapping with a soft face hammer. Lift body straight up to remove.

9. Remove idler gear from the wear and adapter plates. Remove drive gear from the drive gear shaft.

IMPORTANT: Note position of the open and closed side of the wear plate before removing from the adapter plate.

10. Remove wear plate and O−ring from the adapter plate.

11. Remove key from the drive gear shaft using a pencil magnet.

12. Remove O−ring from the adapter plate using an O−ring pick.

13. Loosen adapter plate from the from the front body using a soft face hammer. Remove plate from the body. Turn plate over and remove O−ring using an O−ring pick.

14. Remove front pump body from the front plate.

15. Remove idler gear and drive gear from the front plate.

IMPORTANT: Note position of the open and closed side of the wear plate before removing from the front plate.

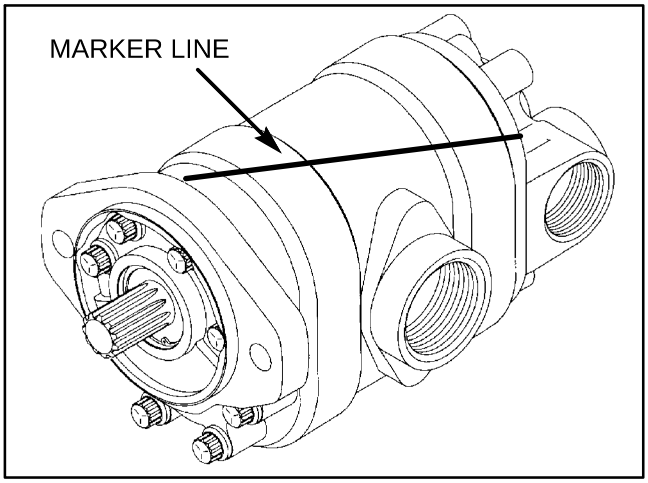

Figure 77

16. Remove wear plate from front plate. Remove O−ring from front plate using O−ring pick.

17. Remove back−up gasket and pressure seal from both wear plates.

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

18. Remove shaft seal from the front plate using a drift punch.

IMPORTANT: Do not remove the plug from the front plate unless rotation of the pump is changed.

Inspection (Fig. 76)

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

CAUTION

Use eye protection such as goggles when using compressed air.

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

3. Inspect gear, drive gear, and idler gears for the following:

A. Drive gear shaft spline should be free of twisted or broken teeth.

B. Gear shafts should be free of rough surfaces and excessive wear at bushing points and sealing areas.

C. Gear shaft diameter in the bushing area should not be less than 0.748 inch (19.0 mm).

D. Gears should be free of excessive scoring and wear.

E. Make sure drive and idler gears have their snap rings in the grooves on each side.

F. Break sharp edges of gear teeth with emery cloth.

G. Gear width on the drive gear and front idler gear should not be less than 0.384 inch (9.75 mm). Gear width on the back gear and back idler gear should not be less than 0.244 inch (6.20 mm).

4. Inspect body for the following:

A. Gear pockets should be free of excessive scoring and wear.

B. Inside diameter of gear pockets should not exceed 1.719 inches (43.7mm).

5. Inspect front plate, back plate, and adapter plate as follows:

A. Inside diameter of all bushings should not exceed 0.755 inch (19.2 mm).

B. Bushings in the front plate should extend 0.126 inch (3.20 mm) from the plate surface.

C. Bushings on the wear plate side of the adapter plate should extend 0.126 inch (3.20 mm) from the plate surface.

D. Scoring on the face of the back plate or the back plate side of the adapter plate should not exceed 0.0015 inch (0.038 mm).

E. The oil groove in the bushings of the front plate should be opposite each other and in line with with the dowel pin holes. The oil groove in the bushings of the back plate should be about 37^{o} to the pressure port (Fig. 78 and 79).

Reassembly (Fig. 76)

NOTE: When reassembling the pump, check the marker line on each part to make sure the parts are properly aligned during reassembly.

1. Lubricate new O−rings, pressure seals, back−up gaskets, and wear plates with a thin coat of petroleum jelly. Lubricate all other internal parts freely with clean hydraulic oil.

2. Install O−ring into the groove of the front plate.

3. Lubricate gear pockets of front body with a thin coat of petroleum jelly. Place front body onto front plate so the half moon port cavities face away from the front plate.

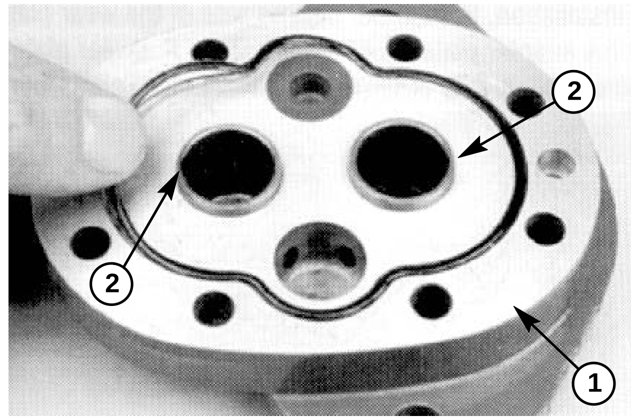

Figure 78

1. **Front plate** 2. **Oil groove**

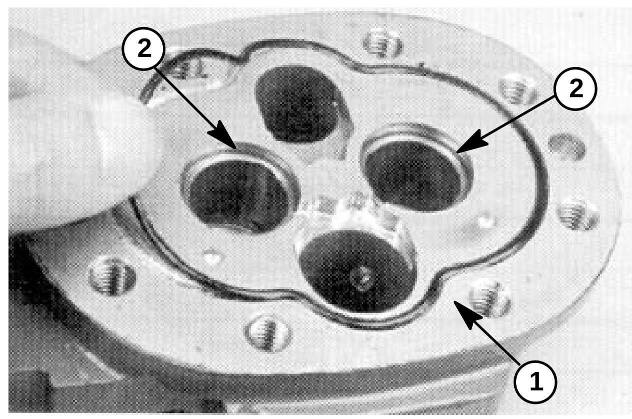

Figure 79

1. **Back plate** 2. **Oil groove**

4. Install new pressure seal and back−up gasket into both new wear plates. The flat section in the middle of the back−up gasket must face away from the wear plate inside the seal.

5. Install wear plate into the gear pocket with the pressure seal and back−up gasket against the front plate. Make sure mid section cut−away of the wear plate is on the suction side of the pump.

6. Dip drive gear and front idler gear into clean hydraulic oil. Install gear shafts into the front plate bushings so that the gears set inside the gear pockets.

7. Install new O−ring into the groove of the adapter plate on the side with the bushings below the surface.

8. Align marker line on the body and adapter plate. Install adapter plate onto the body and gear shafts.

9. Install second new O−ring to the other side of the adapter plate.

10. Coat key lightly with petroleum jelly to hold it in place. Install key into the slot in the drive gear shaft.

11. Align marker line on back body and adapter plate. Install body onto adapter plate and drive gear shaft.

IMPORTANT: Do not dislodge seals during installation.

12. Install wear plate into the gear pocket of back body with the pressure seal and back−up gasket against the adapter plate. Make sure mid section cut−away of the wear plate is on the suction side of the pump.

13. Lubricate back gear with clean hydraulic oil. Install gear onto the drive gear shaft and key.

14. Lubricate back idler gear with clean hydraulic oil. Install idler gear into the gear pocket of back body and the adapter plate.

15. Install new O−ring into the groove of the back plate.

16. Align marker line on the back plate and body. Install back plate onto the body and gear shafts.

17. Secure pump together with cap screws and new washers on cap screws external of the flange cavity. Torque cap screws in a criss−cross pattern from 25 to 28 ft−lb (34 to 38 N−m).

Front Lift Cylinder

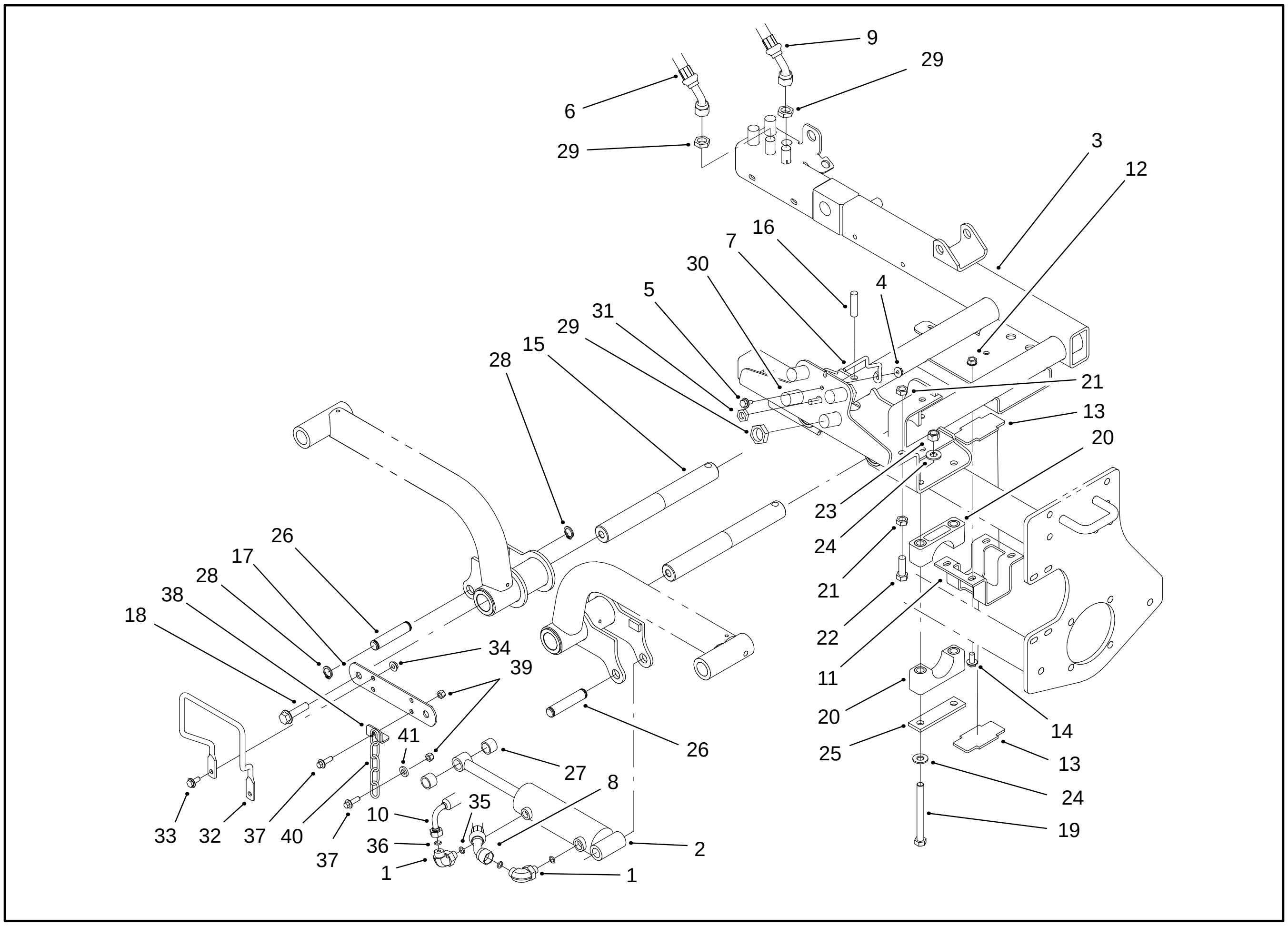

Figure 80

1. 90º hydraulic fitting
2. Hydraulic cylinder
3. Carrier assembly
4. Flange nut
5. Flange head screw
6. Hydraulic hose
7. Centering wire
8. Hydraulic hose
9. Hydraulic hose
10. Hydraulic hose
11. Clamp bracket (model 03200)
11. Slide bracket (model 03201)
12. Flange nut
13. Plastic slide
14. Flange head screw
15. LIft arm pivot shaft
16. Roll pin
17. Pivot shaft link
18. Flange head screw
19. Cap screw
20. Clamp (model 03200)
20. Bearing cap (model 03201)
21. Jam nut
22. Cap screw
23. Lock nut
24. Hardened washer
25. Slide support bar
26. Pin
27. Spacer
28. External retaining ring
29. Bulkhead nut
30. Hydraulic tube
31. Bulkhead nut
32. Hose rod (model 03201)
33. Flange head screw (model 03201)
34. Flange nut (model 03201)
35. O−ring
36. O−ring
37. Flange head screw
38. Link clip
39. Hex nut
40. Straight link chain
41. Flat washer

Removal

1. Remove front lift cylinder from the frame and lift arm using Figure 80 as guide.

2. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to cylinder using marks made during the removal process to properly orientate fittings.

IMPORTANT: With lift arms raised fully, hydraulic hoses should be routed as shown in Figure 81. Make sure clearance between hydraulic hose and lift arm is from 0.040 to 0.120 inches (1.0 to 3.0 mm).

2. Install front lift cylinder to the frame and lift arm using Figure 80 as guide.

3. Adjust front lift arm (see Adjust Front Lift Arm in Chapter 7 − Cutting Units).

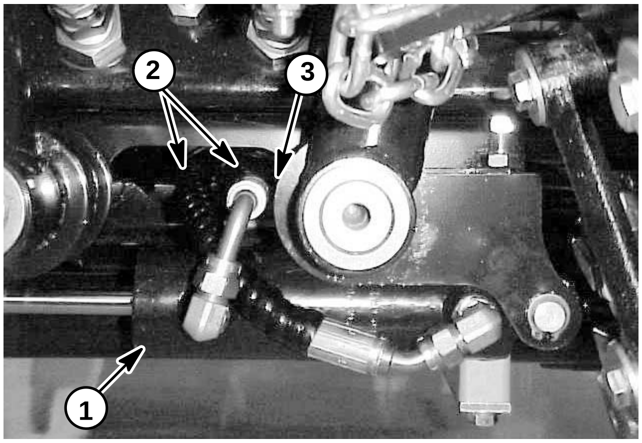

Figure 81

1. Lift cylinder
2. Hydraulic hoses
3. Clearance

Hydraulic System

Rear Lift Cylinder

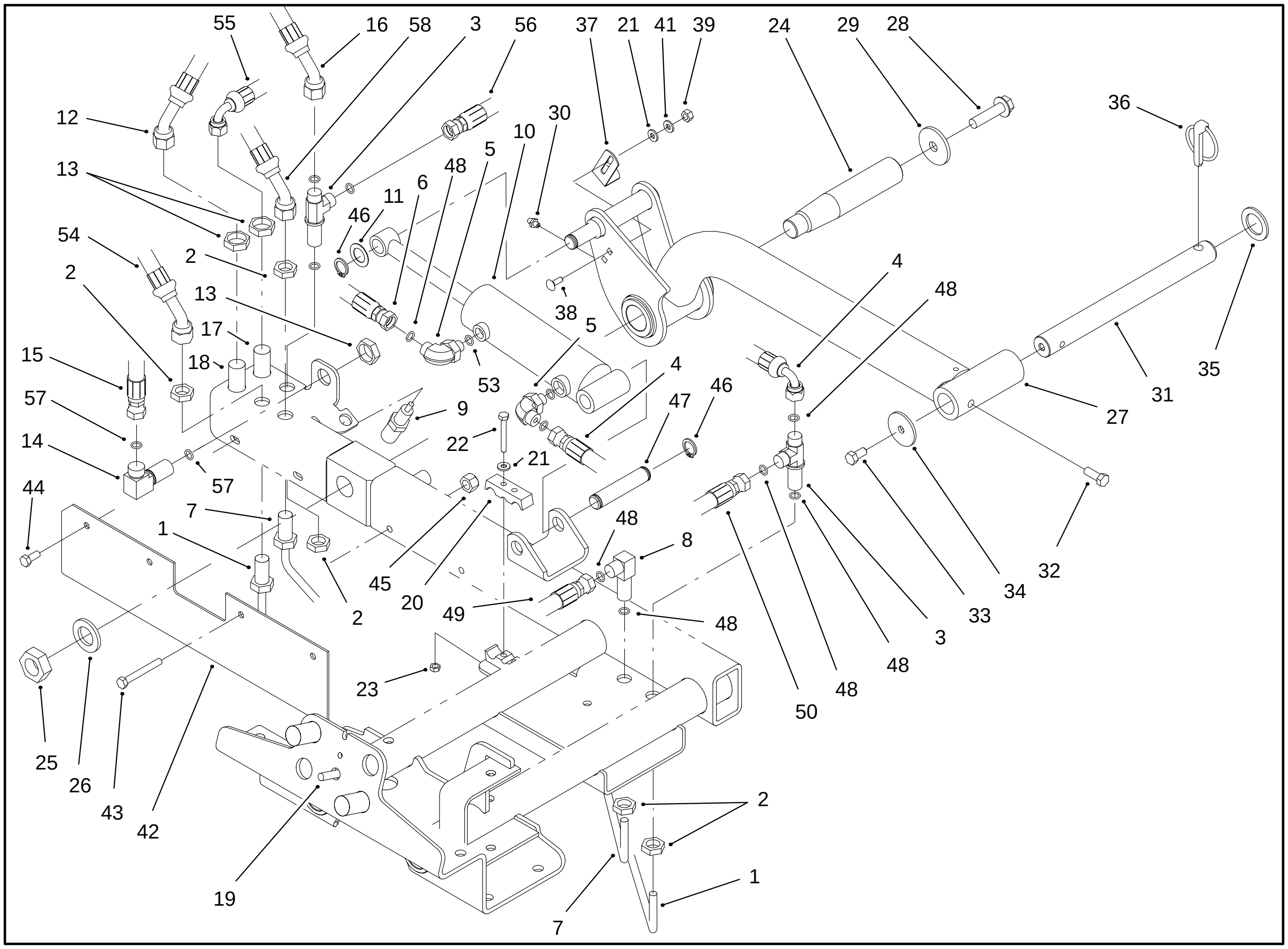

Figure 82

1. Hydraulic tube
2. Lock nut
3. Hydraulic T−fitting
4. Hydraulic hose
5. 90º hydraulic fitting
6. Hydraulic hose
7. Hydraulic tube
8. 90º hydraulic fitting
9. Push button switch
10. Hydraulic cylinder
11. Thrust washer
12. Hydraulic hose
13. Bulkhead nut
14. Hydraulic fitting
15. Hydraulic hose
16. Hydraulic hose
17. Hydraulic tube
18. Hydraulic tube
19. Hydraulic tube
20. Tube clamp
21. Flat washer
22. Cap screw
23. Lock nut
24. Rear pivot shaft
25. Jam nut
26. Washer
27. Lift arm assembly
28. Flange head screw
29. Thrust washer
30. Grease fitting
31. Cutting unit pivot shaft
32. Cap screw
33. Cap screw
34. Rebound washer
35. Washer
36. Lynch pin
37. Switch bracket
38. Carriage screw
39. Nut
40. Not used
41. Lock washer
42. Guard
43. Cap screw
44. Cap screw
45. Lock nut
46. External retaining ring
47. Pin
48. O−ring
49. Hydraulic hose
50. Hydraulic hose
51. Not used
52. Not used
53. O−ring
54. Hydraulic hose
55. Hydraulic hose
56. Hydraulic hose
57. O−ring
58. Hydraulic hose

Removal

1. Remove rear lift cylinder from the frame and lift arm using Figure 82 as guide.

2. If hydraulic fittings are to be removed from lift cylinder, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed, install fittings to lift cylinder using marks made during the removal process to properly orientate fittings.

2. Install rear lift cylinder to the frame and lift arm using Figure 82 as guide.

3. Adjust rear lift arm (see Adjust Rear Lift Arm in Chapter 7 − Cutting Units).

Lift Cylinder Service

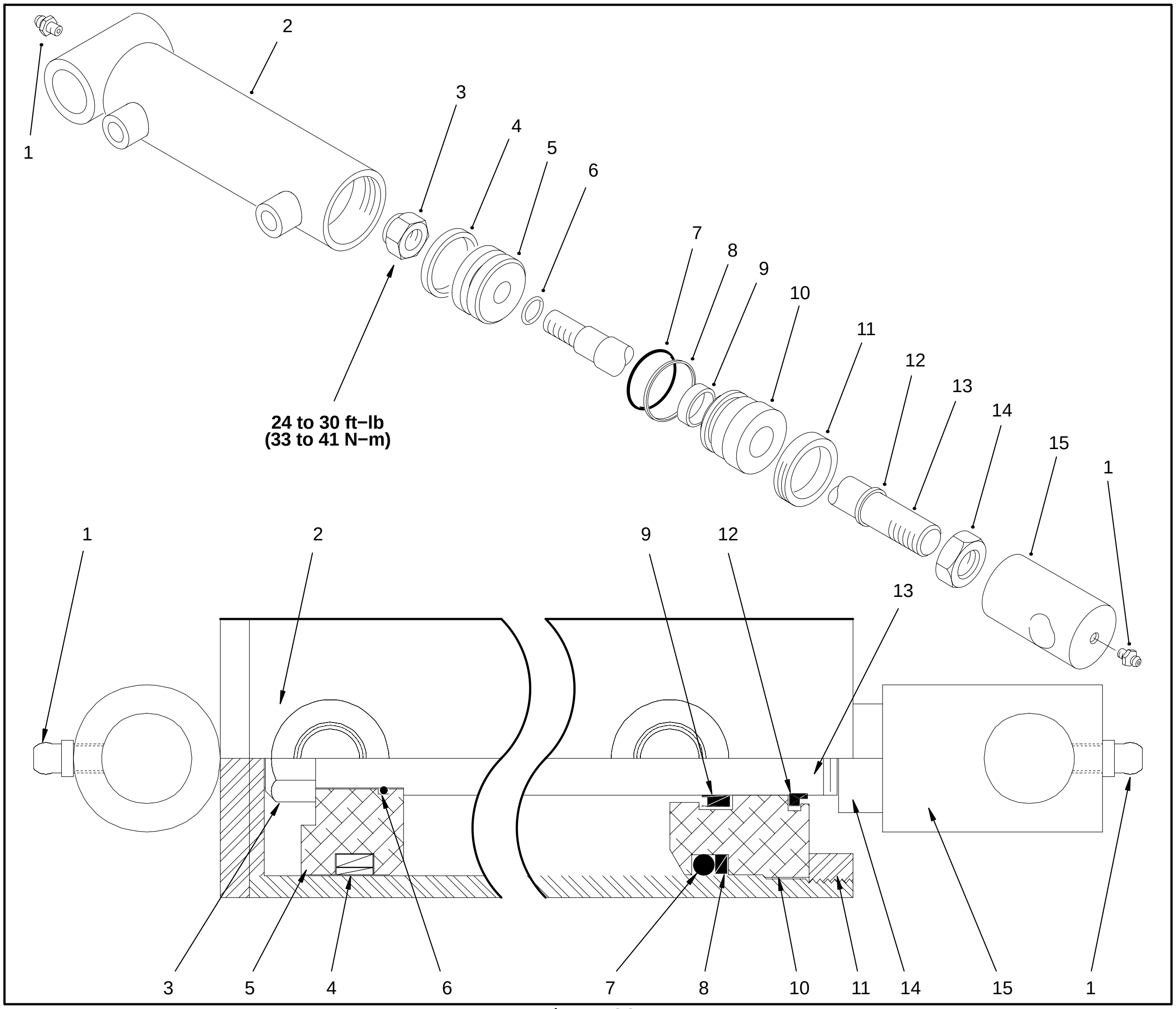

Figure 83

1. **Grease fitting**
2. **Barrel with clevis**
3. **Nut**
4. **Uni−ring**
5. **Piston**
6. **O−ring**
7. **O−ring**
8. **Back−up ring**
9. **Rod seal**
10. **Head**
11. **Internal collar**
12. **Dust seal**
13. **Shaft**
14. **Jam nut**
15. **Clevis**

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.

2. Mount lift cylinder in a vice. Remove internal collar with a spanner wrench.

3. Extract shaft, head, and piston by carefully twisting and pulling on the shaft.

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

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

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

Assembly

1. Make sure all parts are clean before reassembly.

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

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

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

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

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

   A. Coat shaft with with clean hydraulic oil.

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

   C. Install piston and nut onto the shaft. Torque nut from 24 to 30 ft−lb (33 to 41 N−m).

   D. Remove shaft from the vise.

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

4. Mount barrel in a vice.

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

6. Secure head in 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.

Steering Cylinder

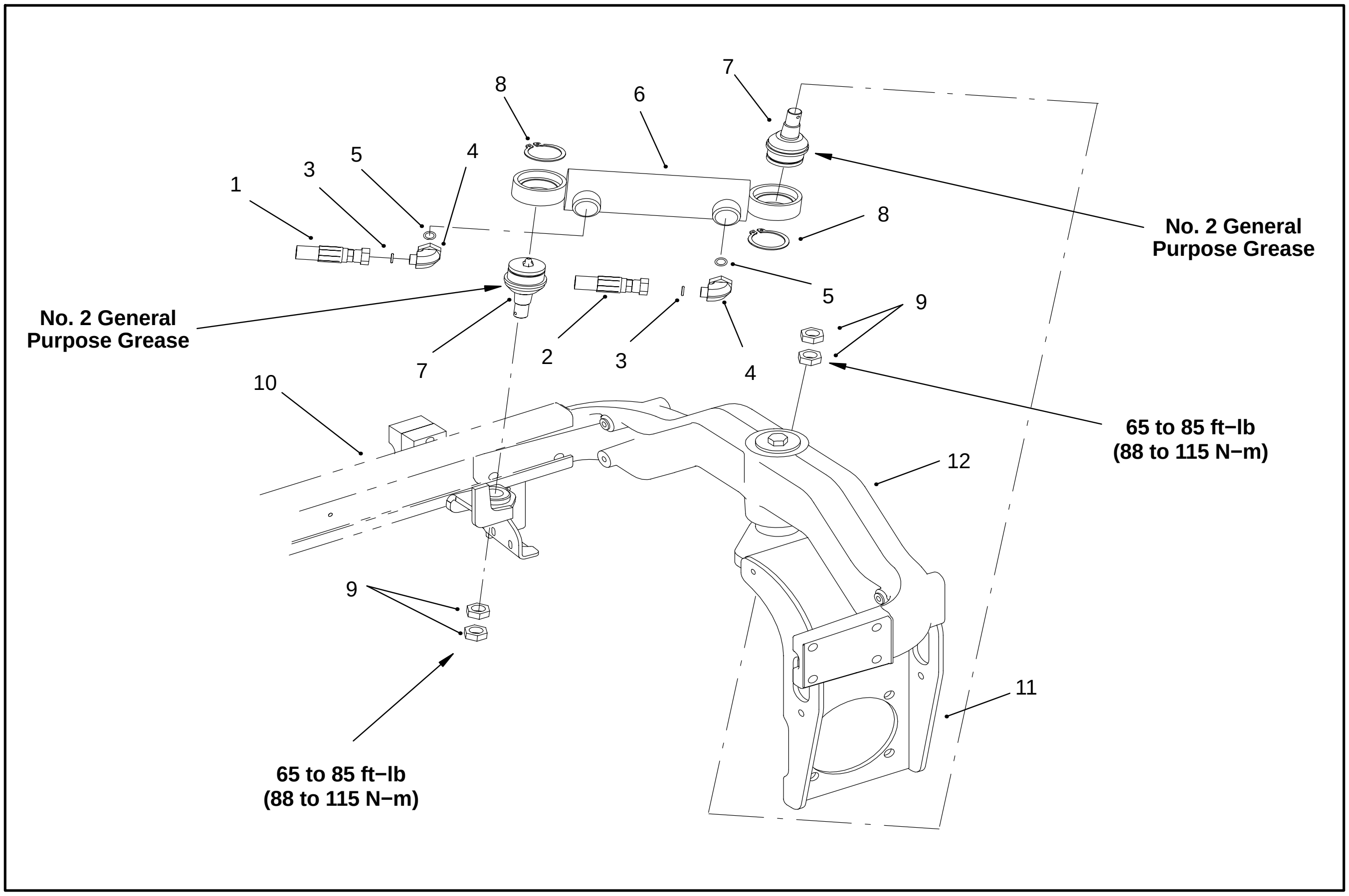

Figure 84

1. **Hydraulic hose**
2. **Hydraulic hose**
3. **O−ring**
4. **Hydraulic fitting**
5. **O−ring**
6. **Steering cylinder**
7. **Ball joint**
8. **Retaining ring**
9. **Jam nut**
10. **Frame**
11. **Rear fork**
12. **Rear casting**

Removal

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

NOTE: The rear tire must be removed to allow sufficient clearance to remove the steering cylinder from the machine.

WARNING

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

2. Jack or lift rear wheel off the ground.

3. Remove rear wheel from the drive studs and wheel hub.

4. Thoroughly clean hydraulic hose ends and fittings on steering cylinder to prevent hydraulic system contamination.

WARNING

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

5. Remove steering cylinder from the frame and rear fork using Figure 84 as guide.

6. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly.

Installation

1. If hydraulic fittings were removed from steering cylinder, install fittings to cylinder using marks made during the removal process to properly orientate fittings.

2. Install steering cylinder to the frame and rear fork using Figure 84 as guide. When securing cylinder ball joints to machine, tighten the first jam nut from 65 to 85 ft−lb (88 to 115 N−m), then tighten the second jam nut to the same specification.

3. Mount rear wheel to the machine with four (4) lug nuts. Lower machine to the ground. Torque lug nuts in a crossing pattern from 45 to 65 ft−lb (61 to 88 N−m).

4. Make sure hydraulic tank is full. Add correct oil if necessary (see Traction Unit Operator's Manual).

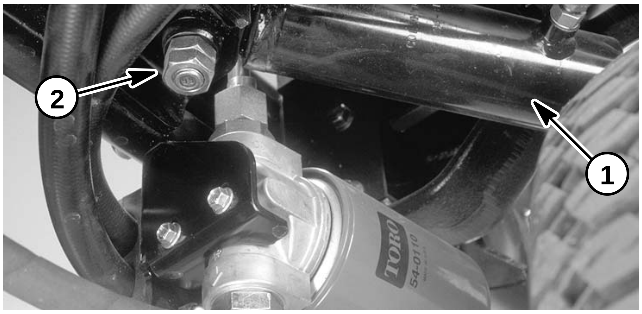

Figure 85

1. **Steering cylinder** 2. **Jam nuts**

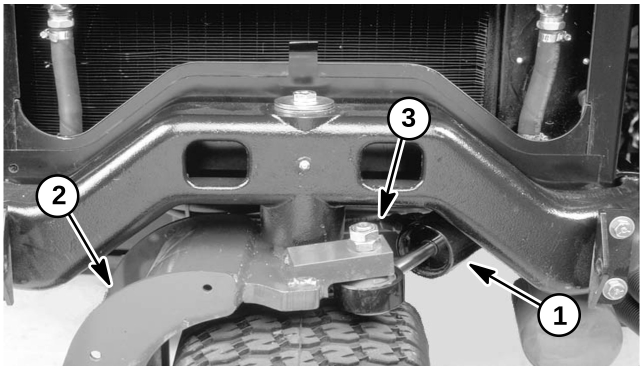

Figure 86

1. **Steering cylinder** 3. **Jam nuts**
2. **Rear fork**

Hydraulic System

Steering Cylinder Service

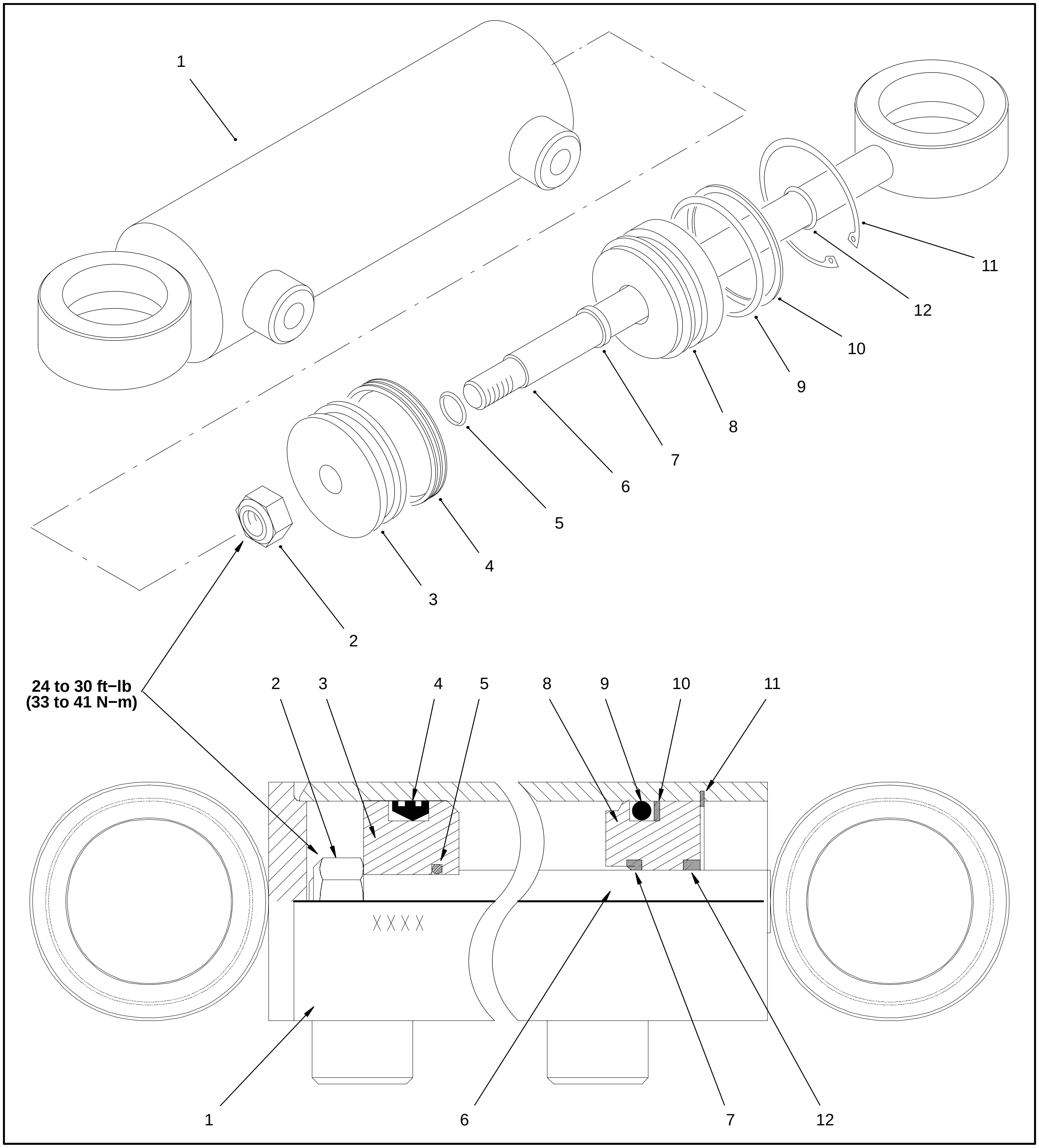

Figure 87

1. **Barrel**
2. **Lock nut**
3. **Piston**
4. **Uni−ring**
5. **O−ring**
6. **Piston rod**
7. **Rod seal**
8. **Cylinder gland**
9. **O−ring**
10. **Back−up ring**
11. **Retaining ring**
12. **O−ring**

Disassembly

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

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

2. Mount clevis end of steering cylinder in a vice. Remove retaining ring.

3. Extract shaft, head, and piston by carefully twisting and pulling on the shaft.

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

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

5. Remove Uni−ring and O−ring from the piston.

6. Remove back−up ring, O−rings, and rod seal from the head.

Reassembly

1. Make sure all parts are clean before reassembly.

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

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

   B. Install O−rings, back−up ring, and rod seal to the head.

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

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

   A. Coat shaft with a light coat of clean hydraulic oil.

   B. Slide head onto the onto the shaft. Install piston and lock nut onto the shaft. Torque nut from 24 to 30 ft−lb (33 to 41 N−m).

   C. Remove shaft from the vise.

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

4. Mount clevis of the barrel in a vice.

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

6. Secure head in the barrel with the retaining ring.

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Chapter 5

Electrical System

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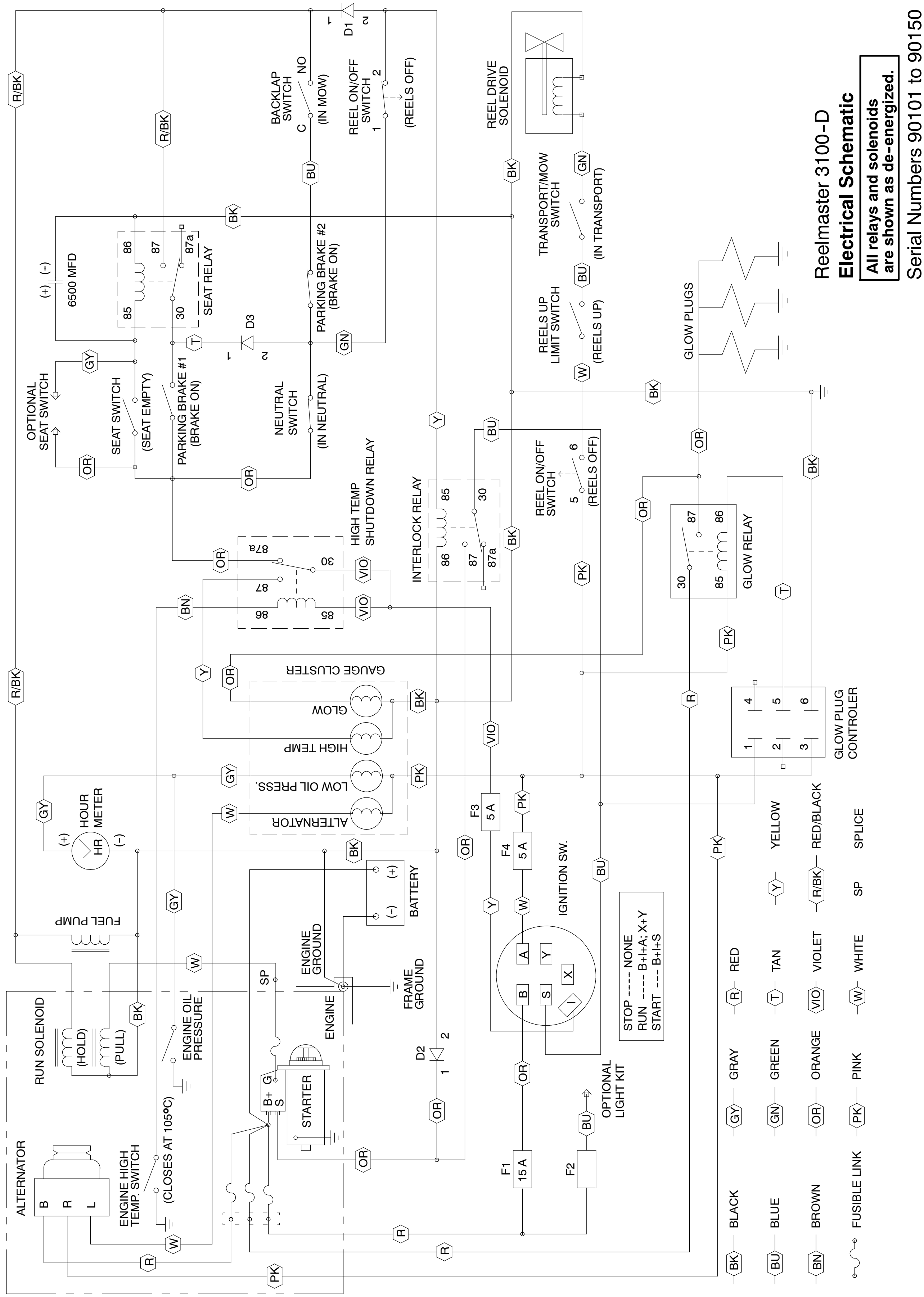
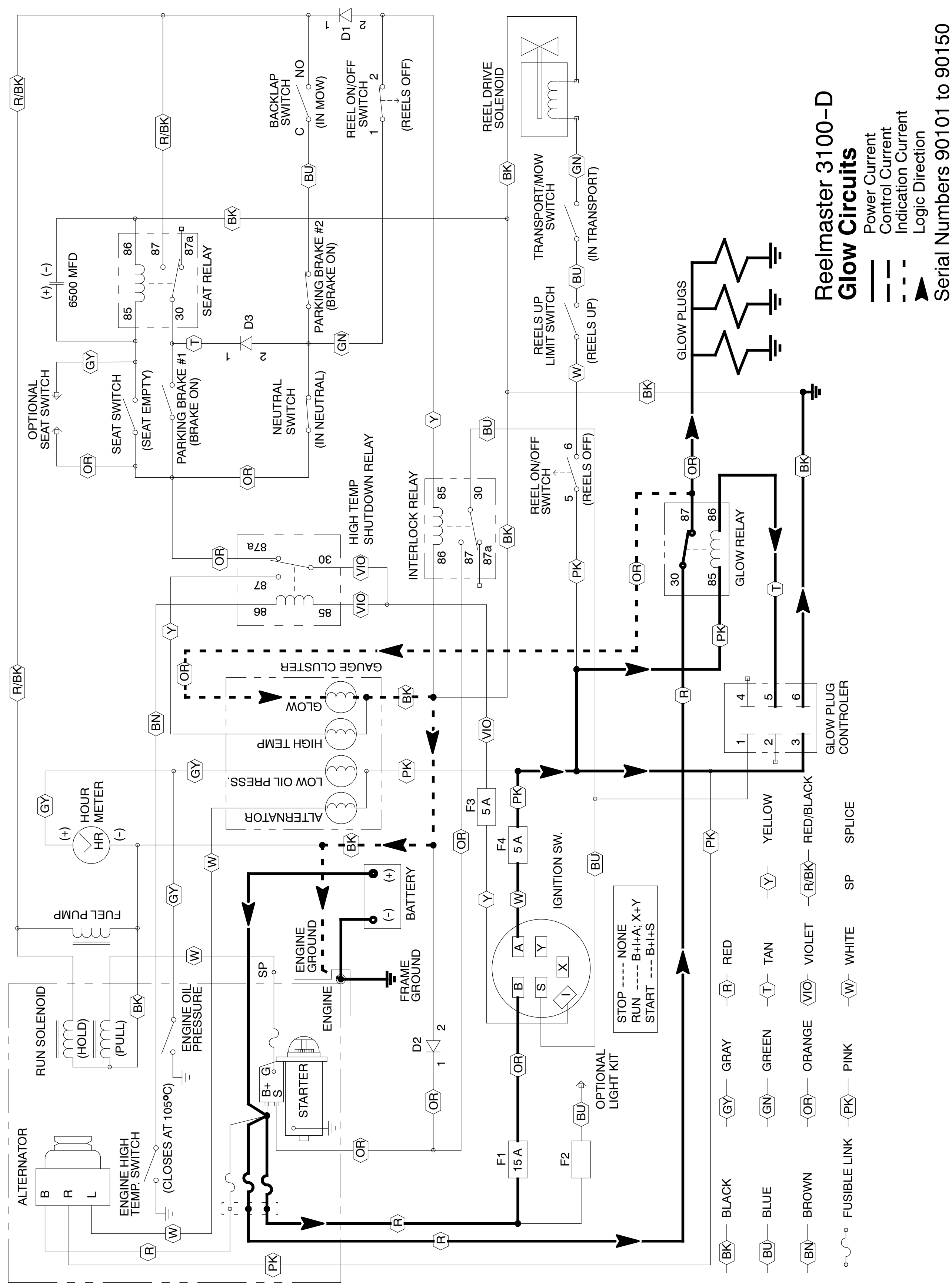
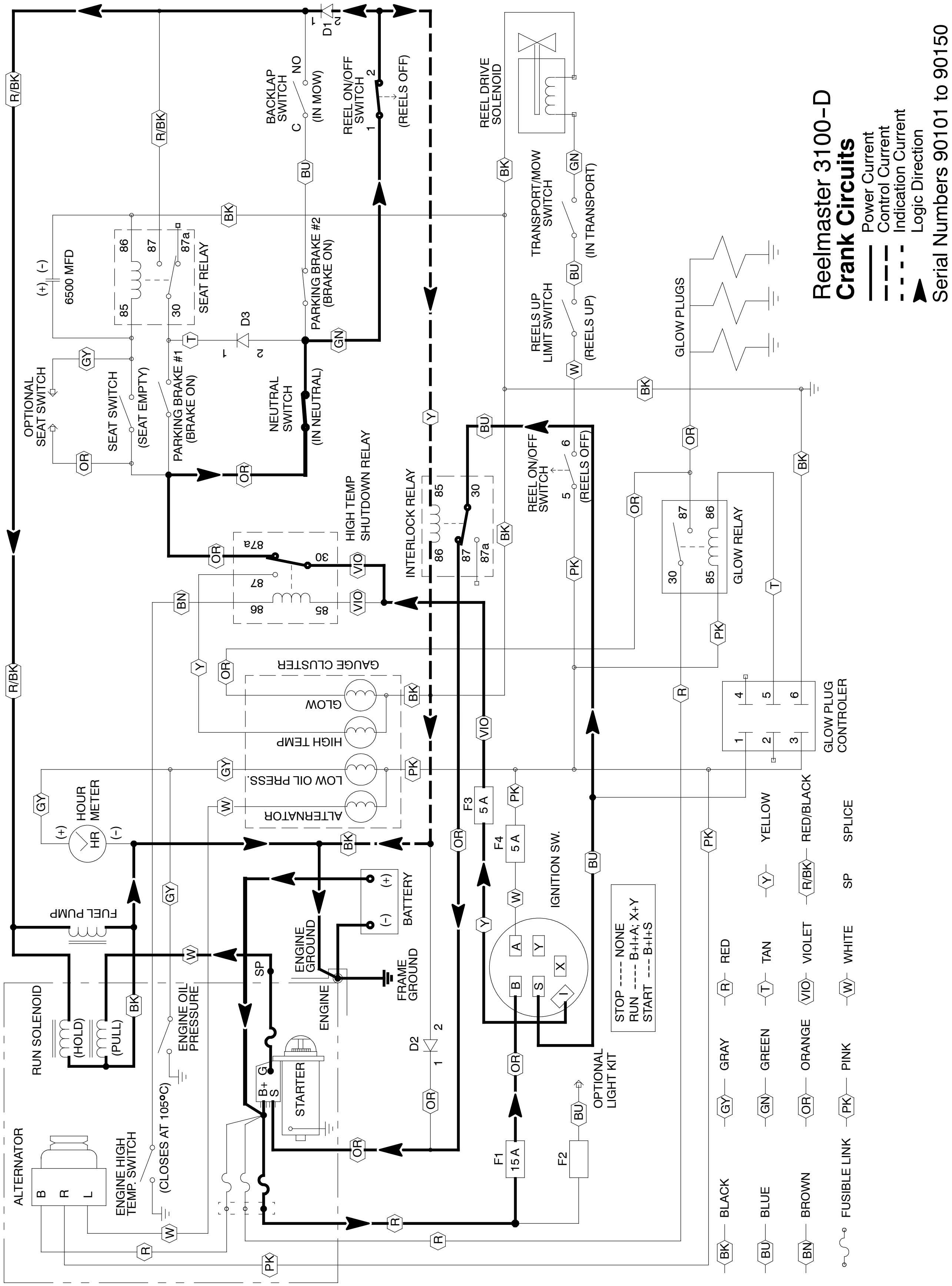


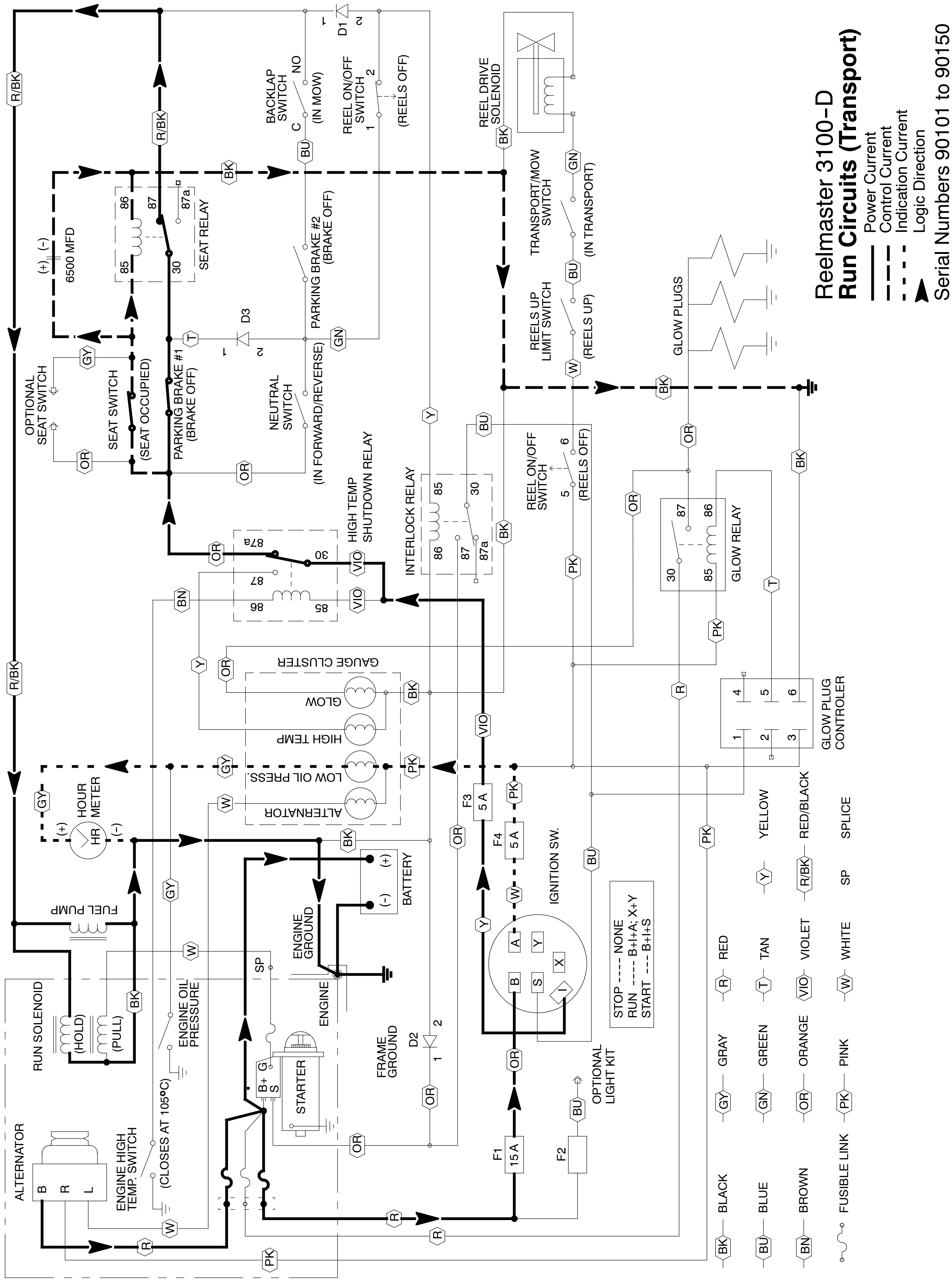
Reelmaster 3100-D
Electrical Schematic
All relays and solenoids are shown as de-energized.
Serial Numbers 90101 to 90150
BACKLAP SWITCH
(IN MOW)
REEL ON/OFF SWITCH
(REELS OFF)
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
(IN TRANSPORT)
REELS UP LIMIT SWITCH
(REELS UP)
6500 MFD
SEAT RELAY
PARKING BRAKE #2
(BRAKE ON)
OPTIONAL SEAT SWITCH
SEAT SWITCH
(SEAT EMPTY)
PARKING BRAKE #1
(BRAKE ON)
NEUTRAL SWITCH
(IN NEUTRAL)
GLOW PLUGS
HIGH TEMP SHUTDOWN RELAY
INTERLOCK RELAY
GLOW RELAY
GAUGE CLUSTER
GLOW
HIGH TEMP
LOW OIL PRESS.
ALTERNATOR
GLOW PLUG CONTROLER
HOUR METER
BATTERY
IGNITION SW.
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
FUEL PUMP
ENGINE GROUND
FRAME GROUND
RUN SOLENOID
(HOLD)
(PULL)
ENGINE OIL PRESSURE
STARTER
ENGINE
OPTIONAL LIGHT KIT
ENGINE HIGH TEMP. SWITCH
(CLOSES AT 105ºC)
BLACK
BLUE
BROWN
FUSIBLE LINK
GRAY
GREEN
ORANGE
PINK
RED
TAN
VIOLET
WHITE
YELLOW
RED/BLACK
SPLICE



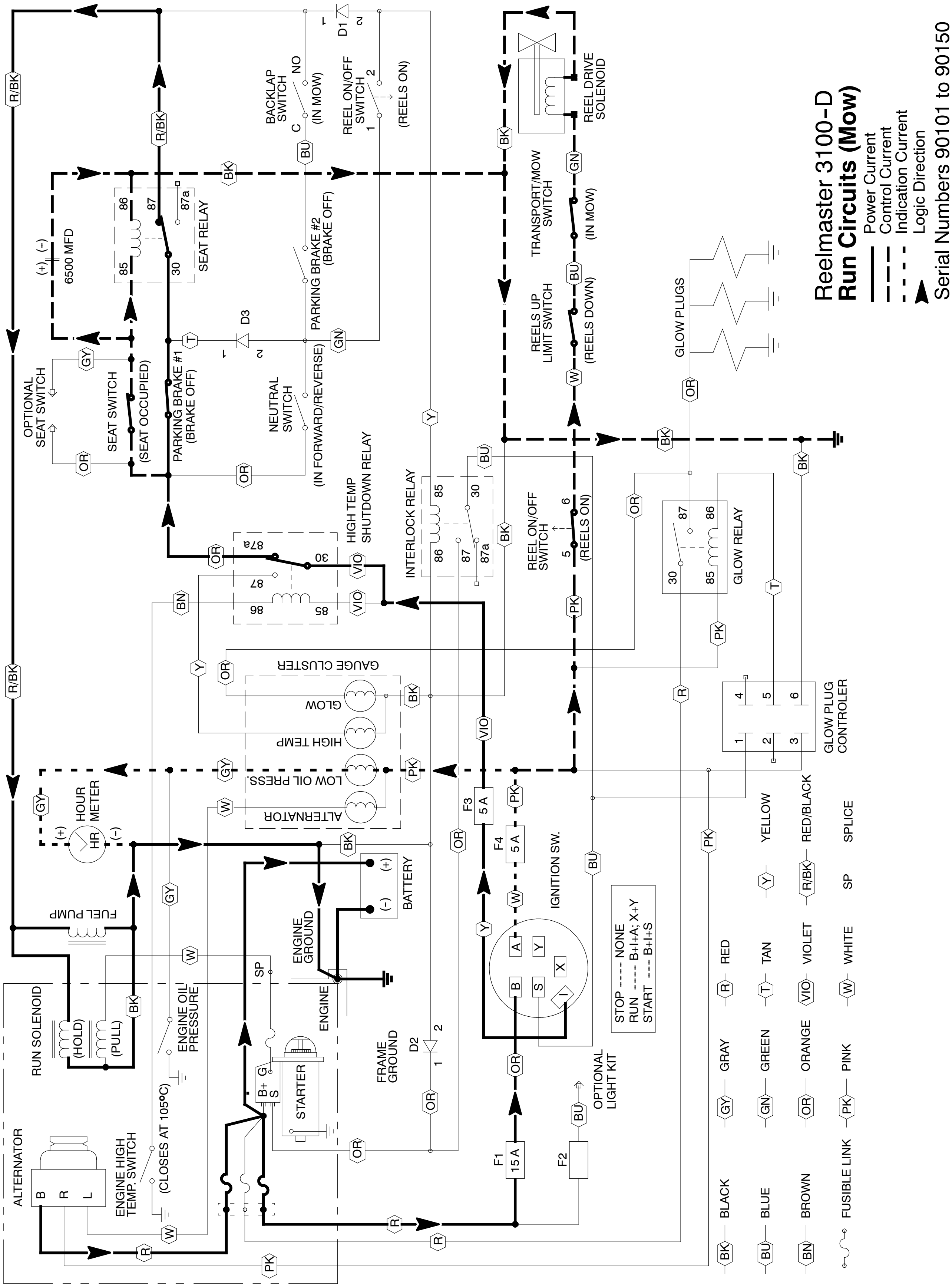
Electrical System

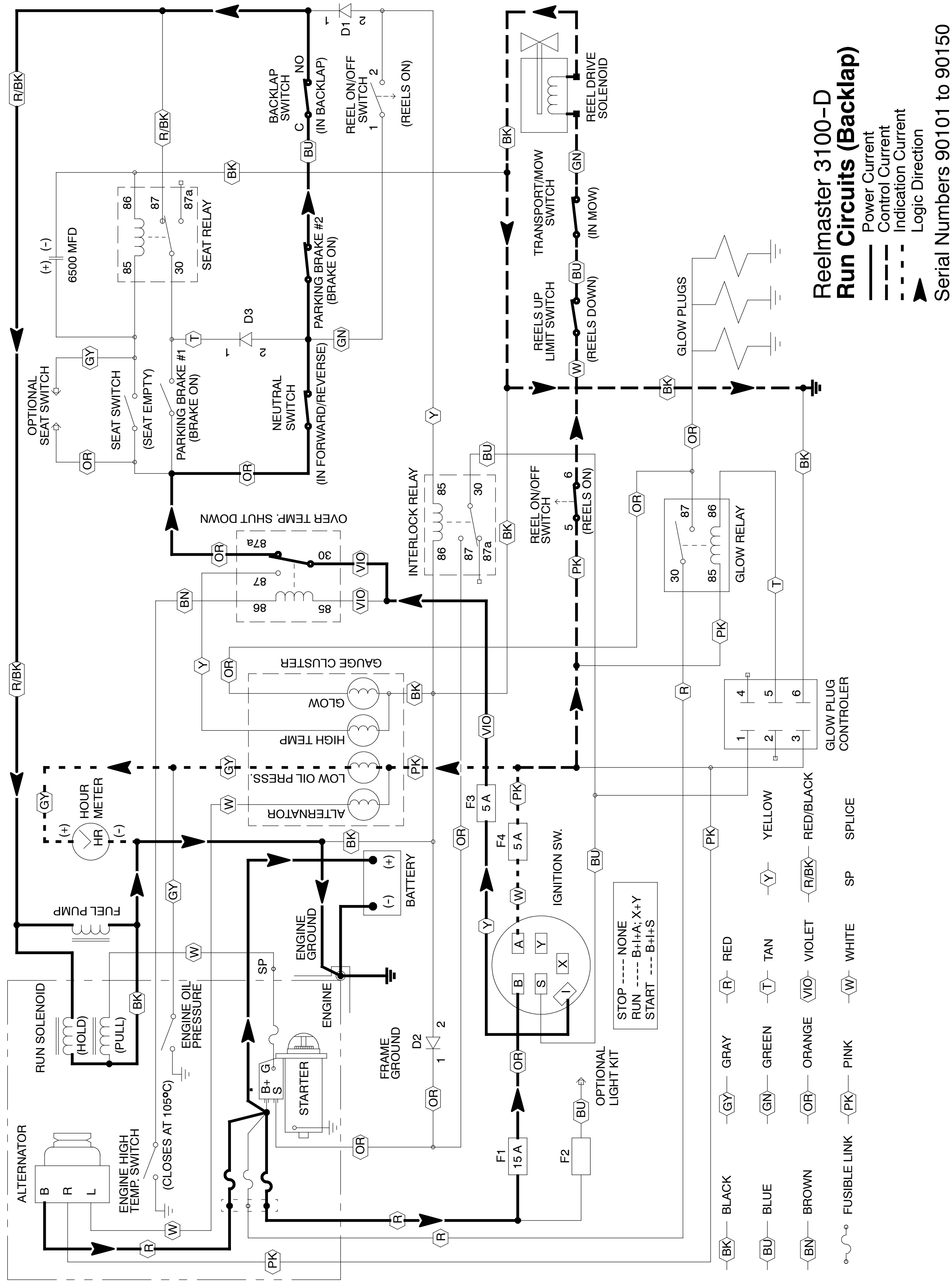


Reelmaster 3100-D
Crank Circuits
Power Current
Control Current
Indication Current
Logic Direction
Serial Numbers 90101 to 90150
ALTERNATOR
ENGINE HIGH TEMP. SWITCH
(CLOSES AT 105ºC)
RUN SOLENOID
(HOLD)
(PULL)
ENGINE OIL PRESSURE
FUEL PUMP
HOUR METER
ENGINE
ENGINE GROUND
FRAME GROUND
STARTER
BATTERY
OPTIONAL SEAT SWITCH
SEAT SWITCH
(SEAT EMPTY)
PARKING BRAKE #1
(BRAKE ON)
NEUTRAL SWITCH
(IN NEUTRAL)
SEAT RELAY
6500 MFD
PARKING BRAKE #2
(BRAKE ON)
BACKLAP SWITCH
(IN MOW)
REEL ON/OFF SWITCH
(REELS OFF)
HIGH TEMP SHUTDOWN RELAY
GAUGE CLUSTER
GLOW
HIGH TEMP
LOW OIL PRESS.
ALTERNATOR
INTERLOCK RELAY
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
(IN TRANSPORT)
REELS UP LIMIT SWITCH
(REELS UP)
GLOW PLUGS
GLOW RELAY
GLOW PLUG CONTROLER
IGNITION SW.
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
OPTIONAL LIGHT KIT
F1 15 A
F2
F3 5 A
F4 5 A
BK BLACK
BU BLUE
BN BROWN
FUSIBLE LINK
GY GRAY
GN GREEN
OR ORANGE
PK PINK
R RED
T TAN
VIO VIOLET
W WHITE
Y YELLOW
R/BK RED/BLACK
SP SPLICE

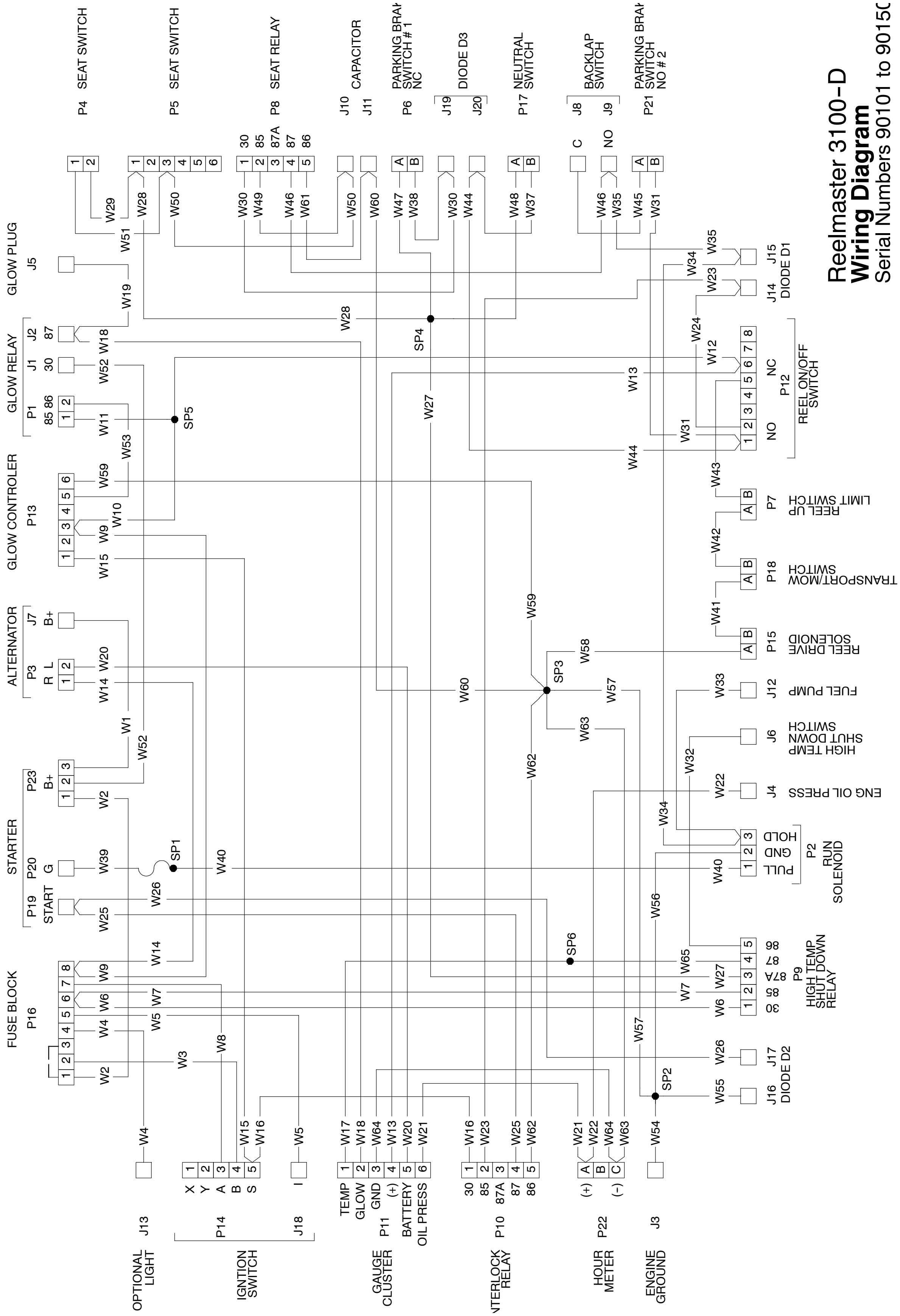


Electrical System


Reelmaster 3100-D
Run Circuits (Mow)
Power Current
Control Current
Indication Current
Logic Direction
Serial Numbers 90101 to 90150
6500 MFD
SEAT RELAY
OPTIONAL SEAT SWITCH
SEAT SWITCH
(SEAT OCCUPIED)
PARKING BRAKE #1 (BRAKE OFF)
PARKING BRAKE #2 (BRAKE OFF)
NEUTRAL SWITCH
(IN FORWARD/REVERSE)
BACKLAP SWITCH
(IN MOW)
REEL ON/OFF SWITCH
(REELS ON)
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
(IN MOW)
REELS UP LIMIT SWITCH
(REELS DOWN)
GLOW PLUGS
HIGH TEMP SHUTDOWN RELAY
INTERLOCK RELAY
GLOW RELAY
GAUGE CLUSTER
GLOW
HIGH TEMP
LOW OIL PRESS.
ALTERNATOR
GLOW PLUG CONTROLER
HOUR METER
FUEL PUMP
BATTERY
ENGINE GROUND
IGNITION SW.
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
RUN SOLENOID
(HOLD)
(PULL)
ENGINE OIL PRESSURE
ENGINE HIGH TEMP. SWITCH
(CLOSES AT 105ºC)
STARTER
ENGINE
FRAME GROUND
OPTIONAL LIGHT KIT
F1 15 A
F2
F3 5 A
F4 5 A
BLACK
BLUE
BROWN
FUSIBLE LINK
GRAY
GREEN
ORANGE
PINK
RED
TAN
VIOLET
WHITE
YELLOW
RED/BLACK
SPLICE



Electrical System

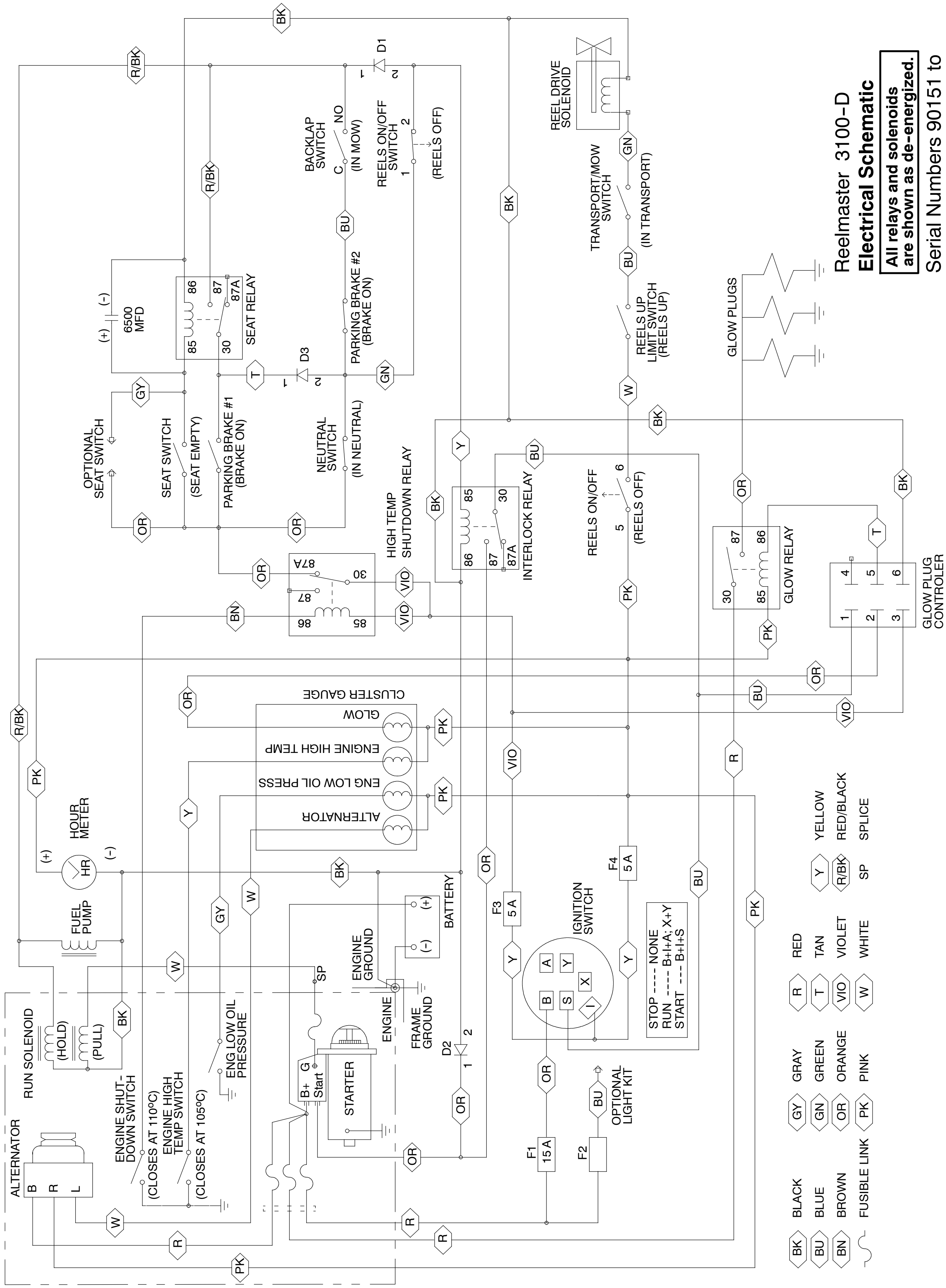

Reelmaster 3100-D
Wiring Diagram
Serial Numbers 90101 to 9015
FUSE BLOCK
STARTER
ALTERNATOR
GLOW CONTROLER
GLOW RELAY
GLOW PLUG
SEAT SWITCH
SEAT RELAY
CAPACITOR
DIODE D3
NEUTRAL SWITCH
BACKLAP SWITCH
REEL ON/OFF SWITCH
REEL UP LIMIT SWITCH
TRANSPORT/MOW SWITCH
REEL DRIVE SOLENOID
FUEL PUMP
HIGH TEMP SHUT DOWN SWITCH
ENG OIL PRESS
RUN SOLENOID
HIGH TEMP SHUT DOWN RELAY
DIODE D1
DIODE D2
OPTIONAL LIGHT
IGNTION SWITCH
GAUGE CLUSTER
HOUR METER
ENGINE GROUND

WIRE IDENTIFICATION

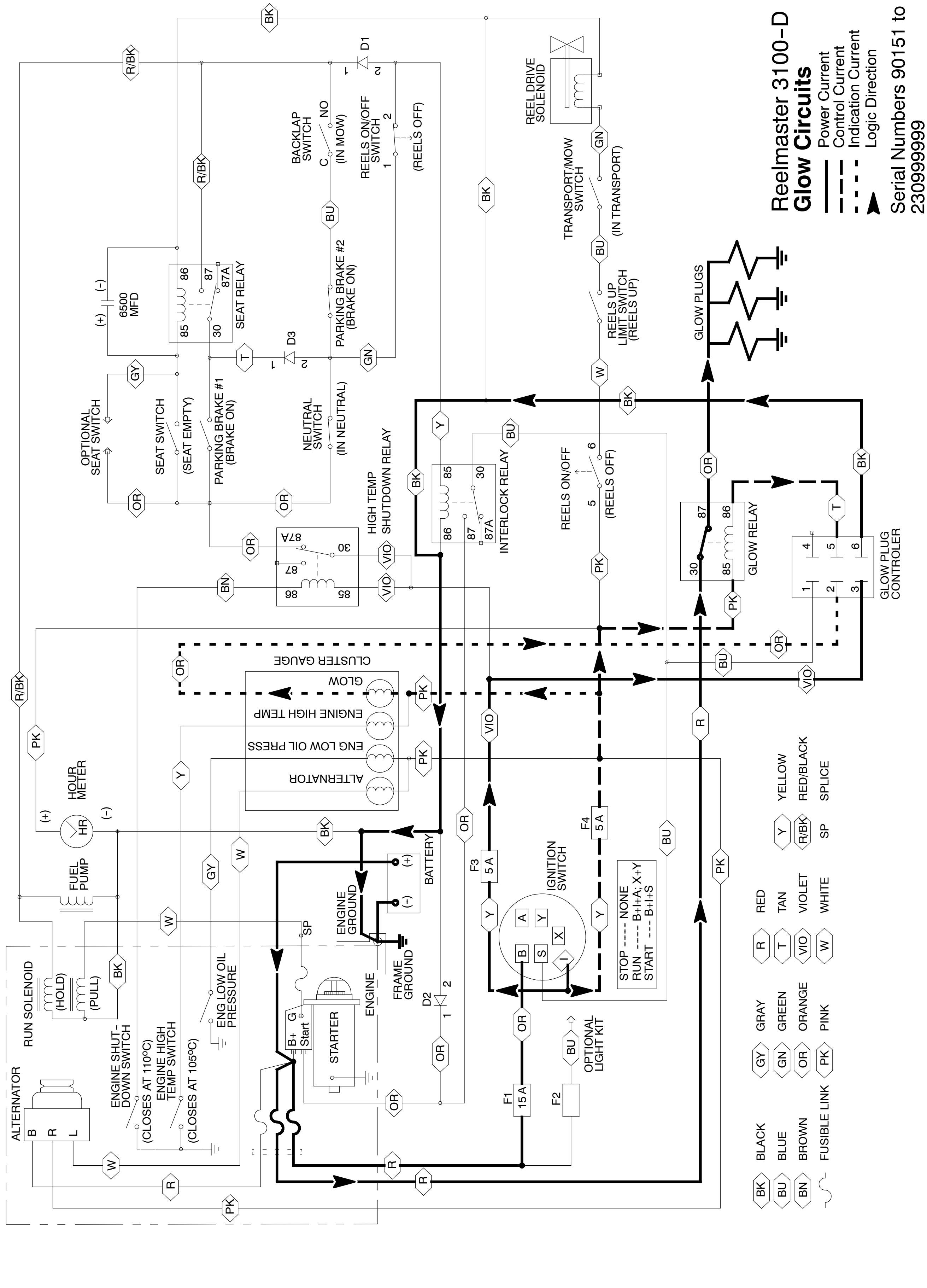
LABEL	COLOR	ROUTE FROM	TO
W1	RED	P23–3	J7
W2	RED	P23–1	P16–1
W3	ORANGE	P16–2	P14–4
W4	BLUE	P16–4	J13
W5	YELLOW	P16–5	J18
W6	VIOLET	P9–1	P16–6 (2)
W7	VIOLET	P16–6 (2)	P9–2
W8	WHITE	P16–7	P14–3
W9	PINK	P16–8 (2)	P13–3 (2)
W10	PINK	P13–3 (2)	SP5
W11	PINK	SP5	P1–1
W12	PINK	SP5	P12–6 (2)
W13	PINK	P12–6 (2)	P11–4
W14	PINK	P16–8 (2)	P3–1
W15	BLUE	P13–1	P14–5 (2)
W16	BLUE	P14–5 (2)	P10–1
W17	YELLOW	P9–4	SP8 (2)
W18	ORANGE	P11–2	J2 (2)
W19	ORANGE	J2 (2)	J5
W20	GRAY	P3–2	P11–5
W21	GRAY	P11–6	P22–A (2)
W22	GRAY	P22–A (2)	J4
W23	YELLOW	P10–2	J14 (2)
W24	YELLOW	J14 (2)	P12–2
W25	ORANGE	P10–4	P19–1 (2)
W26	ORANGE	P19–1 (2)	J17
W27	ORANGE	P9–3	SPA (4)
W28	ORANGE	SP4 (4)	P5–1 (2)
W29	ORANGE	P5–1 (2)	P4–2
W30	TAN	P8–1	J19 (2)
W31	GREEN	P21–B	P12–1 (2)
W32	BROWN	J6	P9–5

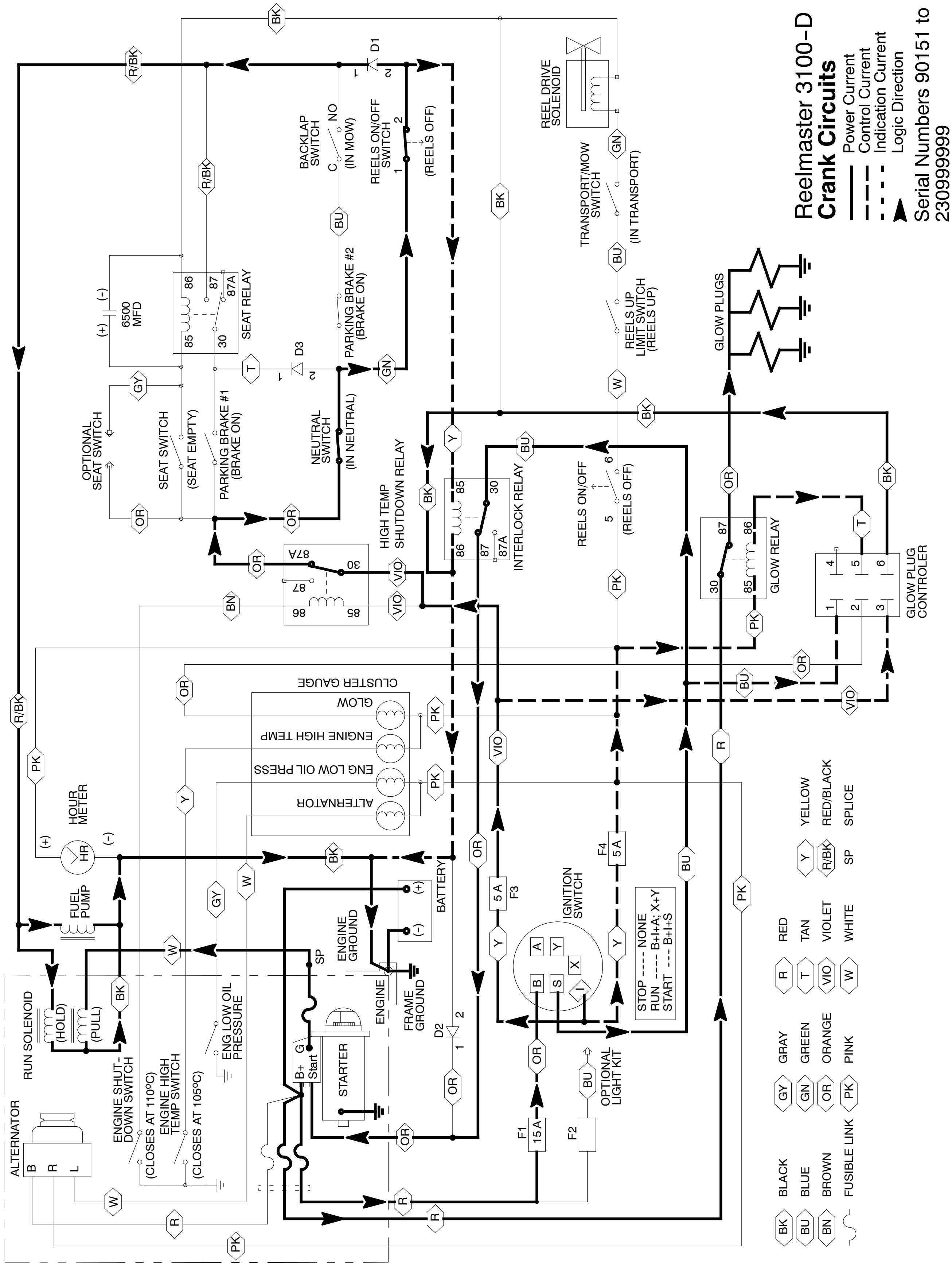
WIRE IDENTIFICATION

LABEL	COLOR	ROUTE FROM	TO
W33	RED/BLACK	J12	P2–3 (2)
W34	RED/BLACK	P2–3 (2)	J15 (2)
W35	RED/BLACK	J15 (2)	J9 (2)
W36	NOT USED		
W37	GREEN	P17–B	J20 (2)
W38	TAN	P6–B	J19 (2)
W39	R 66465	P20	SP1 (2)
W40	WHITE	SP1 (2)	P2–1
W41	GREEN	P15–B	P18–A
W42	BLUE	P18–B	P7–A
W43	WHITE	P7–B	P12–5
W44	GREEN	P12–1 (2)	J20 (2)
W45	BLUE	J8	P21–A
W46	RED/BLACK	P8–4	J9 (2)
W47	ORANGE	SP4 (4)	P6–A
W48	ORANGE	SP4 (4)	P17–A
W49	GRAY	P8–2	J10
W50	GRAY	J10	P5–3 (2)
W51	GRAY	P5–3 (2)	P4–1
W52	RED	J1	P23–2
W53	TAN	P1–2	P13–5
W54	BLACK	J3	SP2 (4)
W55	BLACK	SP2 (4)	J16
W56	BLACK	SP2 (4)	P2–2
W57	BLACK	SP2 (4)	SP3 (6)
W58	BLACK	SP3 (6)	P15–A
W59	BLACK	SP3 (6)	P13–6
W60	BLACK	SP3 (6)	J11 (2)
W61	BLACK	J11 (2)	P8–5
W62	BLACK	SP3 (6)	P10–5
W63	BLACK	SP3 (6)	P22–C (2)
W64	BLACK	P22–C (2)	P11–3
W65	YELLOW	SP8 (2)	P9–4

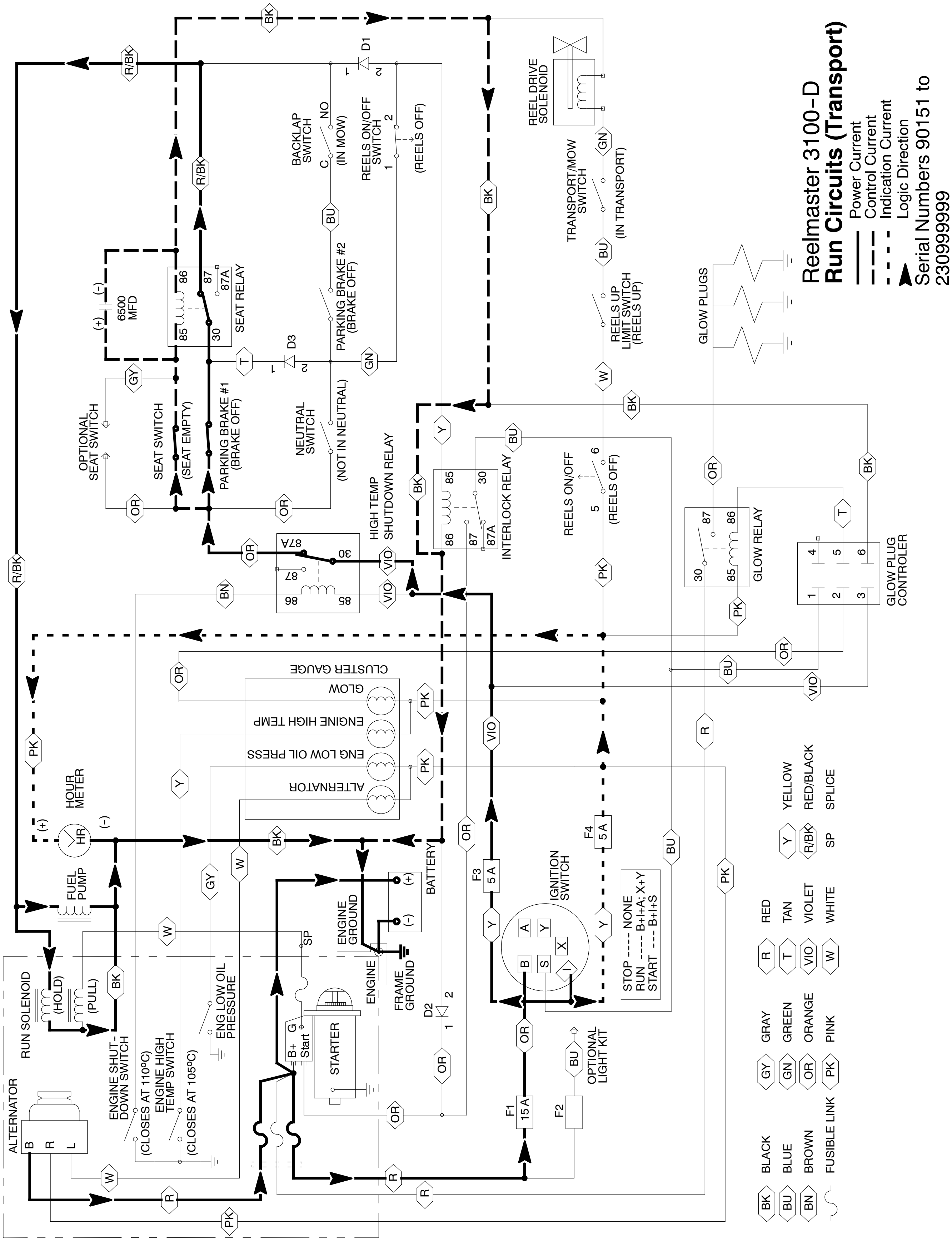


Reelmaster 3100-D
Electrical Schematic
All relays and solenoids are shown as de-energized.
Serial Numbers 90151 to 230999999

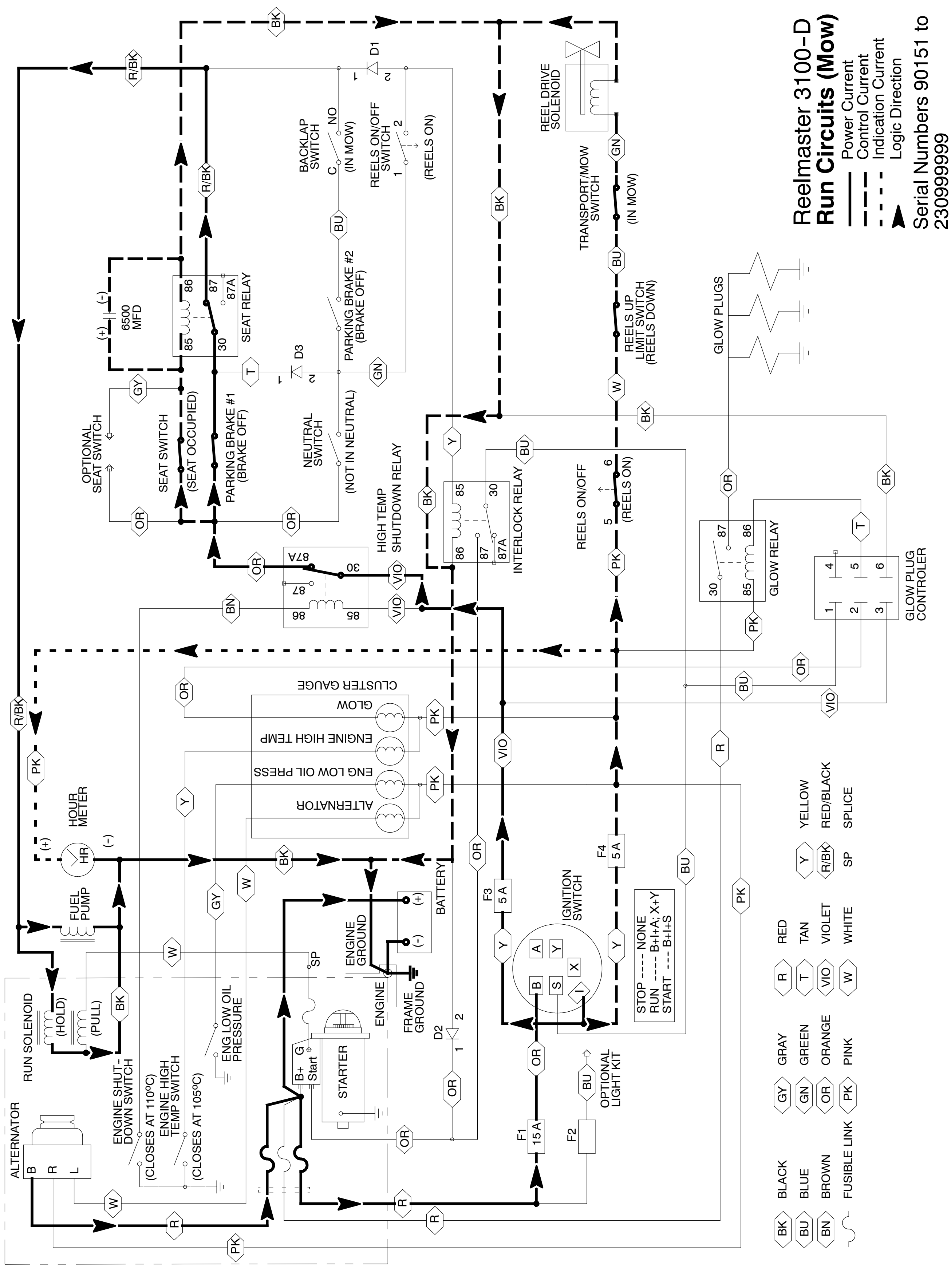

Reelmaster 3100-D
Glow Circuits
Power Current
Control Current
Indication Current
Logic Direction
Serial Numbers 90151 to 230999999
BK BLACK
BU BLUE
BN BROWN
FUSIBLE LINK
GY GRAY
GN GREEN
OR ORANGE
PK PINK
R RED
T TAN
VIO VIOLET
W WHITE
Y YELLOW
R/BK RED/BLACK
SP SPLICE
GLOW PLUGS
GLOW RELAY
GLOW PLUG CONTROLER
IGNITION SWITCH
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
BATTERY
STARTER
ALTERNATOR
RUN SOLENOID
FUEL PUMP
HOUR METER
CLUSTER GAUGE
GLOW
ENGINE HIGH TEMP
ENG LOW OIL PRESS
ALTERNATOR
INTERLOCK RELAY
HIGH TEMP SHUTDOWN RELAY
SEAT RELAY
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
REELS UP LIMIT SWITCH
BACKLAP SWITCH
REELS ON/OFF SWITCH
NEUTRAL SWITCH
SEAT SWITCH
OPTIONAL SEAT SWITCH
PARKING BRAKE #1
PARKING BRAKE #2
ENGINE SHUT-DOWN SWITCH (CLOSES AT 110ºC)
ENGINE HIGH TEMP SWITCH (CLOSES AT 105ºC)
ENG LOW OIL PRESSURE
OPTIONAL LIGHT KIT
ENGINE GROUND
FRAME GROUND

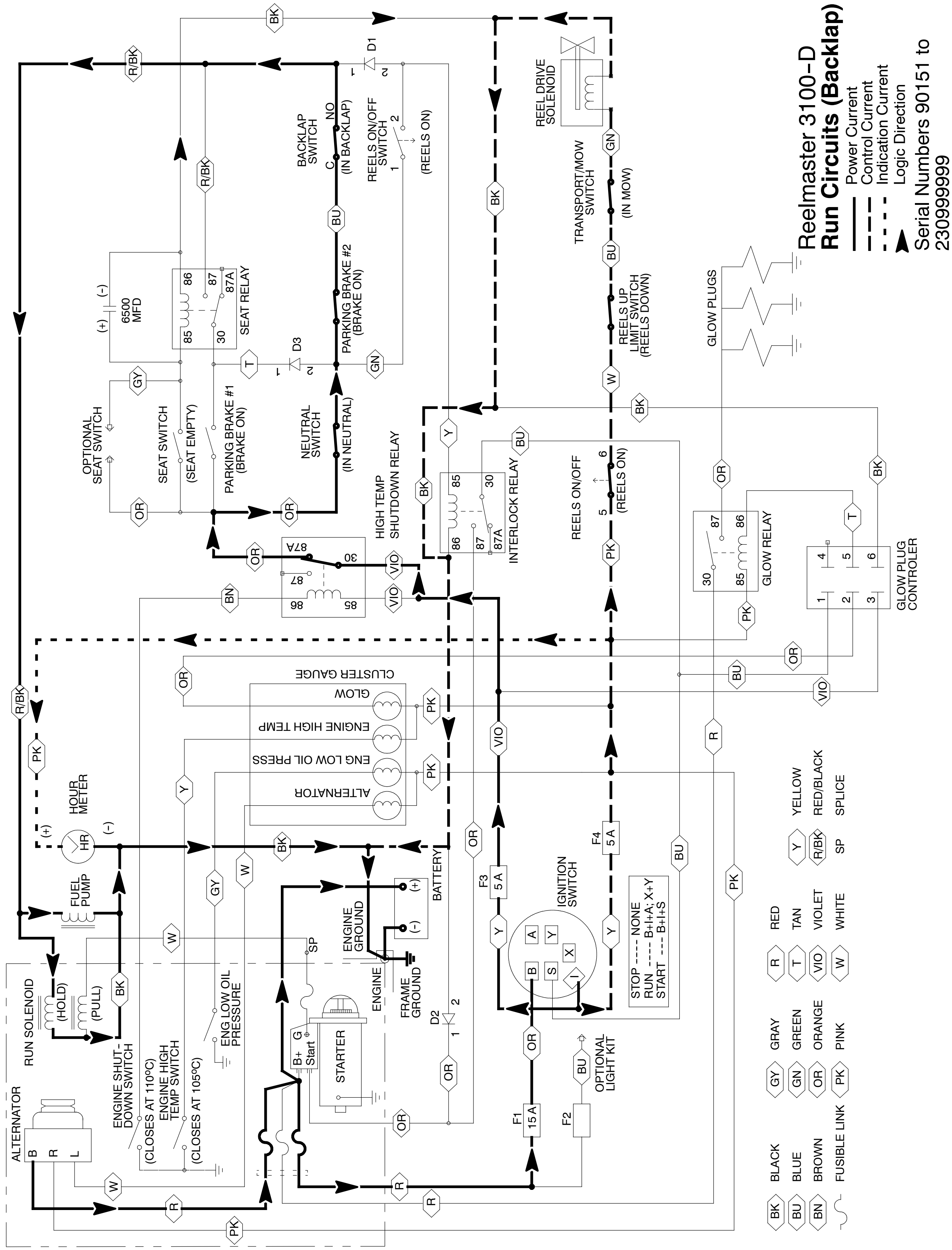


Reelmaster 3100-D
Crank Circuits
Power Current
Control Current
Indication Current
Logic Direction
Serial Numbers 90151 to 230999999
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
(IN TRANSPORT)
REELS UP LIMIT SWITCH (REELS UP)
GLOW PLUGS
BACKLAP SWITCH
(IN MOW)
REELS ON/OFF SWITCH
(REELS OFF)
SEAT RELAY
6500 MFD
PARKING BRAKE #2 (BRAKE ON)
OPTIONAL SEAT SWITCH
SEAT SWITCH
(SEAT EMPTY)
PARKING BRAKE #1 (BRAKE ON)
NEUTRAL SWITCH
(IN NEUTRAL)
HIGH TEMP SHUTDOWN RELAY
INTERLOCK RELAY
REELS ON/OFF
(REELS OFF)
GLOW RELAY
GLOW PLUG CONTROLER
CLUSTER GAUGE
GLOW
ENGINE HIGH TEMP
ENG LOW OIL PRESS
ALTERNATOR
HOUR METER
FUEL PUMP
BATTERY
ENGINE GROUND
IGNITION SWITCH
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
RUN SOLENOID
(HOLD)
(PULL)
ENGINE SHUT-DOWN SWITCH
(CLOSES AT 110ºC)
ENGINE HIGH TEMP SWITCH
(CLOSES AT 105ºC)
ENG LOW OIL PRESSURE
STARTER
ENGINE FRAME GROUND
OPTIONAL LIGHT KIT
BK BLACK
BU BLUE
BN BROWN
FUSIBLE LINK
GY GRAY
GN GREEN
OR ORANGE
PK PINK
R RED
T TAN
VIO VIOLET
W WHITE
Y YELLOW
R/BK RED/BLACK
SP SPLICE

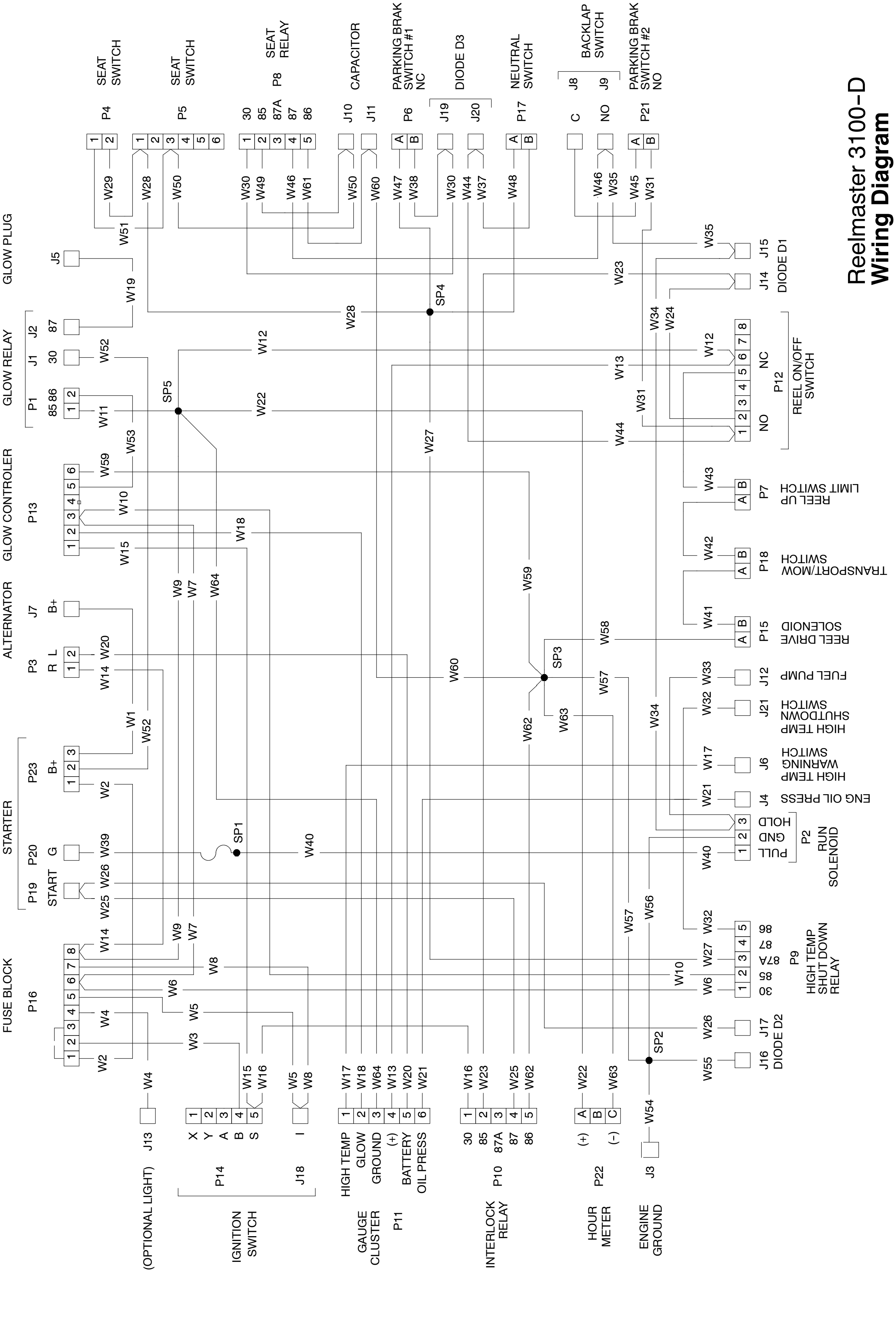


Electrical System


Reelmaster 3100-D
Run Circuits (Mow)
Power Current
Control Current
Indication Current
Logic Direction
Serial Numbers 90151 to 230999999
REEL DRIVE SOLENOID
TRANSPORT/MOW SWITCH
(IN MOW)
REELS UP LIMIT SWITCH (REELS DOWN)
GLOW PLUGS
BACKLAP SWITCH
(IN MOW)
REELS ON/OFF SWITCH
(REELS ON)
PARKING BRAKE #2 (BRAKE OFF)
SEAT RELAY
6500 MFD
OPTIONAL SEAT SWITCH
SEAT SWITCH
(SEAT OCCUPIED)
PARKING BRAKE #1 (BRAKE OFF)
NEUTRAL SWITCH
(NOT IN NEUTRAL)
HIGH TEMP SHUTDOWN RELAY
INTERLOCK RELAY
REELS ON/OFF
(REELS ON)
GLOW RELAY
GLOW PLUG CONTROLER
CLUSTER GAUGE
GLOW
ENGINE HIGH TEMP
ENG LOW OIL PRESS
ALTERNATOR
HOUR METER
FUEL PUMP
BATTERY
ENGINE GROUND
IGNITION SWITCH
STOP ---- NONE
RUN ---- B+I+A; X+Y
START --- B+I+S
RUN SOLENOID
(HOLD)
(PULL)
ENGINE SHUT-DOWN SWITCH
(CLOSES AT 110ºC)
ENGINE HIGH TEMP SWITCH
(CLOSES AT 105ºC)
ENG LOW OIL PRESSURE
STARTER
ENGINE
FRAME GROUND
OPTIONAL LIGHT KIT
F1 15 A
F2
F3 5 A
F4 5 A
D1
D2
D3
BK BLACK
BU BLUE
BN BROWN
FUSIBLE LINK
GY GRAY
GN GREEN
OR ORANGE
PK PINK
R RED
T TAN
VIO VIOLET
W WHITE
Y YELLOW
R/BK RED/BLACK
SP SPLICE



Electrical System



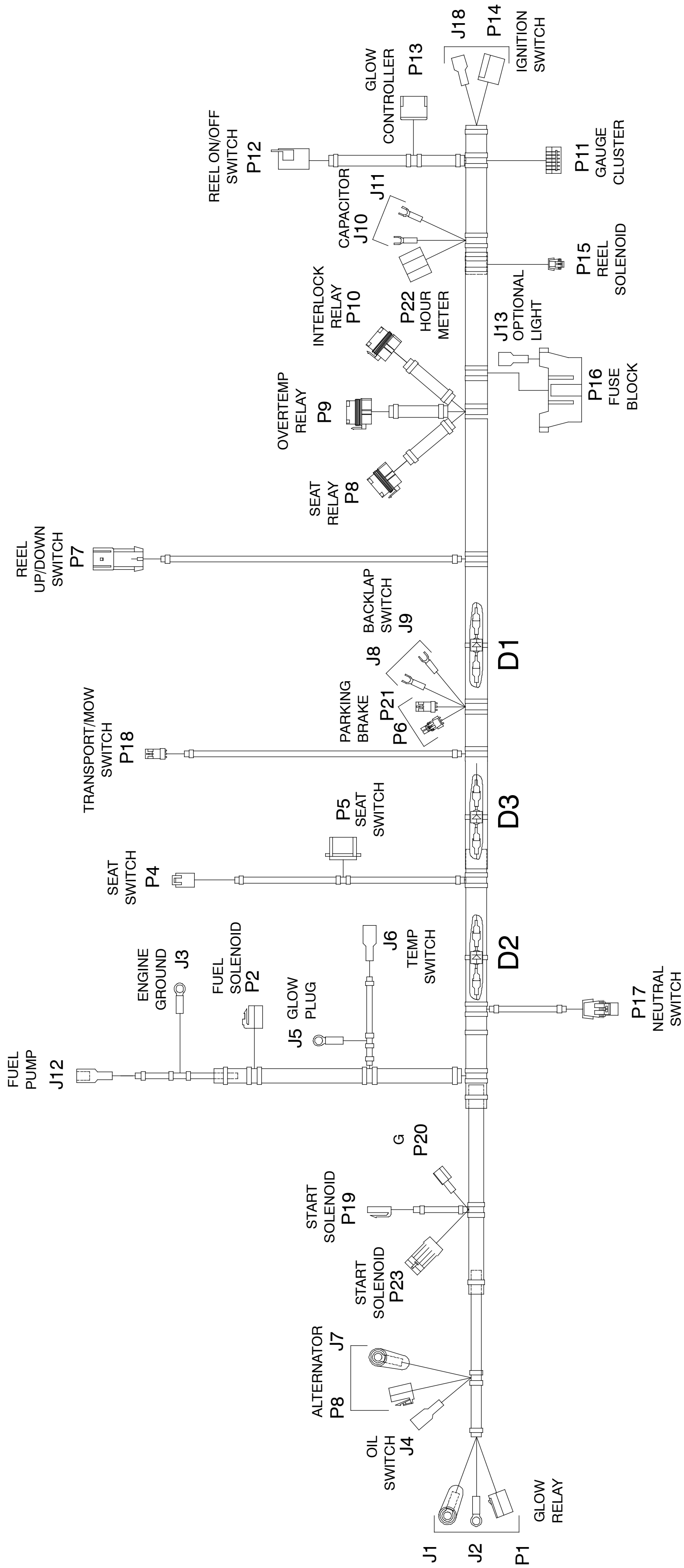
Reelmaster 3100-D
Wiring Diagram
Serial Numbers 90151 to 230999999

WIRE IDENTIFICATION

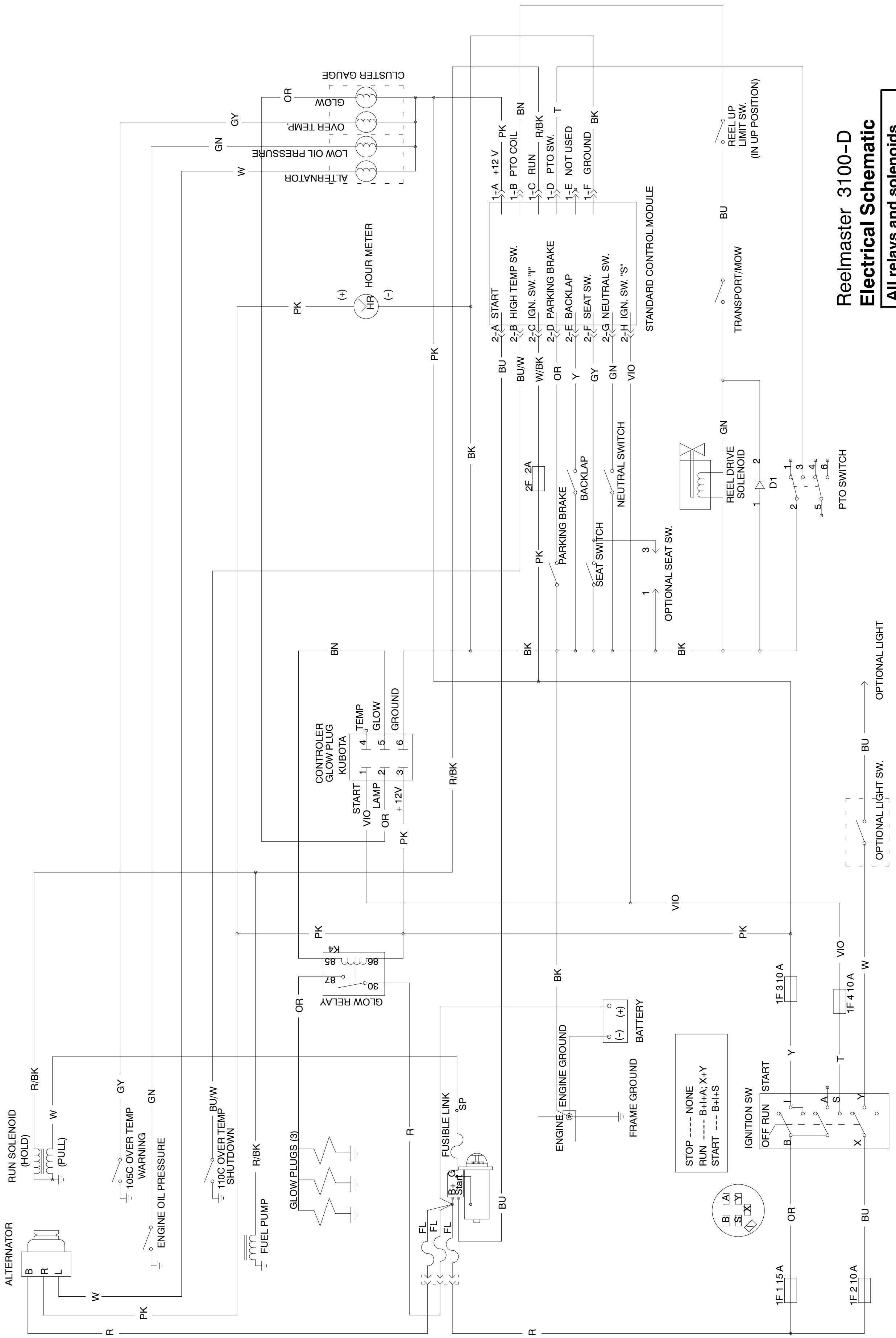
LABEL	COLOR	ROUTE FROM	TO
W1	RED	P23-3	J7
W2	RED	P23-1	P16-1
W3	ORANGE	P16-2	P14-4
W4	BLUE	P16-4	J13
W5	YELLOW	P16-5	J18 (2)
W6	VIOLET	P9-1	P16-6 (2)
W7	VIOLET	P16-6 (2)	P13-3 (2)
W8	YELLOW	P16-7	J18 (2)
W9	PINK	P16-8 (2)	SP5 (4)
W10	VIOLET	P13-3 (2)	P9-2
W11	PINK	SP5 (4)	P1-1
W12	PINK	SP5 (4)	P12-6 (2)
W13	PINK	P12-6 (2)	P11-4
W14	PINK	P16-8 (2)	P3-1
W15	BLUE	P13-1	P14-5 (2)
W16	BLUE	P14-5 (2)	P10-1
W17	YELLOW	P11-1	J6
W18	ORANGE	P11-2	P13-2
W19	ORANGE	J2	J5
W20	WHITE	P3-2	P11-5
W21	GRAY	P11-6	J4
W22	PINK	P22-A	SP5 (4)
W23	YELLOW	P10-2	J14 (2)
W24	YELLOW	J14 (2)	P12-2
W25	ORANGE	P10-4	P19-1 (2)
W26	ORANGE	P19-1 (2)	J17
W27	ORANGE	P9-3	SP4 (4)
W28	ORANGE	SP4 (4)	P5-1 (2)
W29	ORANGE	P5-1 (2)	P4-2
W30	TAN	P8-1	J19 (2)
W31	GREEN	P21-B	P12-1 (2)
W32	BROWN	J6	P9-5

WIRE IDENTIFICATION

LABEL	COLOR	ROUTE FROM	TO
W33	RED/BLACK	J12	P2-3 (2)
W34	RED/BLACK	P2-3 (2)	J15 (2)
W35	RED/BLACK	J15 (2)	J9 (2)
W36	NOT USED		
W37	GREEN	P17-B	J20 (2)
W38	TAN	P6-B	J19 (2)
W39	R 66465	P20	SP1 (2)
W40	WHITE	SP1 (2)	P2-1
W41	GREEN	P15-B	P18-A
W42	BLUE	P18-B	P7-A
W45	WHITE	P7-B	P12-5
W44	GREEN	P12-1 (2)	J20 (2)
W45	BLUE	J8	P21-A
W46	RED/BLACK	P8-4	J9 (2)
W47	ORANGE	SP4 (4)	P6-A
W48	ORANGE	SP4 (4)	P17-A
W49	GRAY	P8-2	J10
W50	GRAY	J10	P5-3 (2)
W51	GRAY	P5-3 (2)	P4-1
W52	RED	J1	P23-2
W53	TAN	P1-2	P13-5
W54	BLACK	J3	SP2 (4)
W55	BLACK	SP2 (4)	J16
W56	BLACK	SP2 (4)	P2-2
W57	BLACK	SP2 (4)	SP3 (6)
W58	BLACK	SP3 (6)	P15-A
W59	BLACK	SP3 (6	)P13-6
W60	BLACK	SP3 (6)	J11 (2)
W61	BLACK	J11 (2)	P8-5
W62	BLACK	SP3 (6)	P10-5
W63	BLACK	SP3 (6)	P22-C (2)
W64	PINK	P11-3	SP5 (5)
W65	NOT USED		



Reelmaster 3100-D
Harness Diagram
Serial Numbers 90151 to 230999999



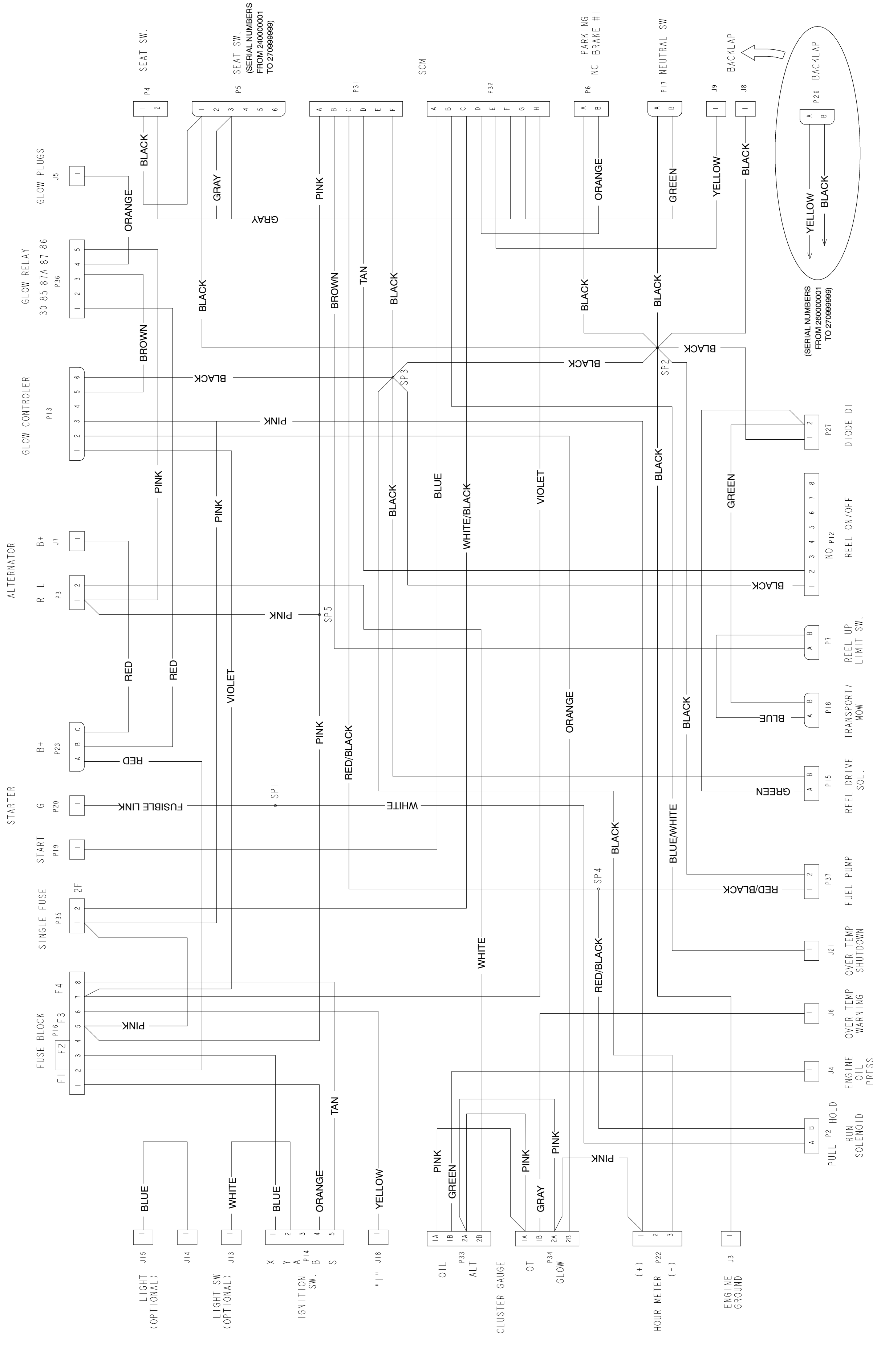
Reelmaster 3100-D

Electrical Schematic

All relays and solenoids are shown as de-energized.

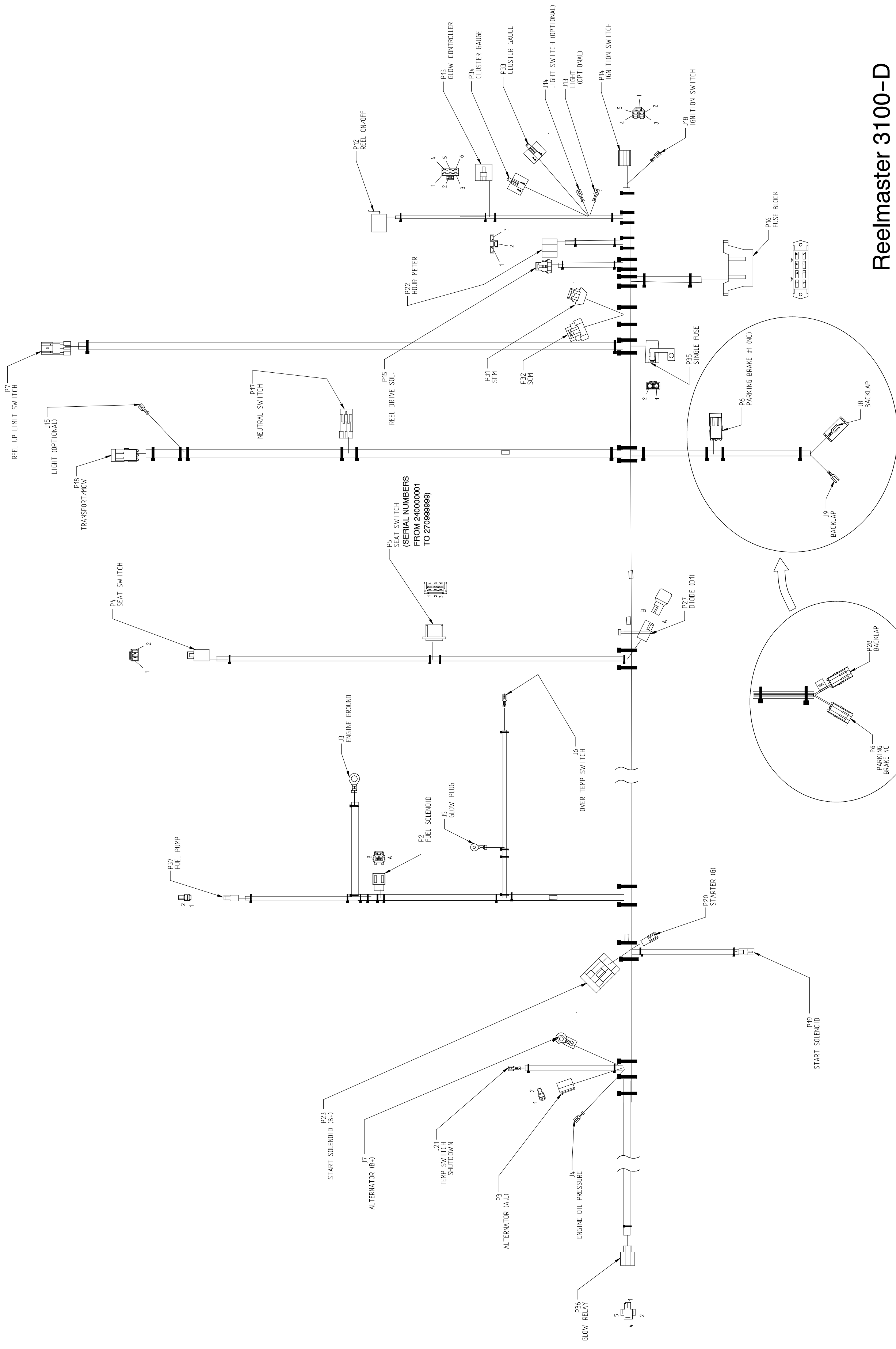
Serial Numbers 240000001 to 314000000

Electrical System

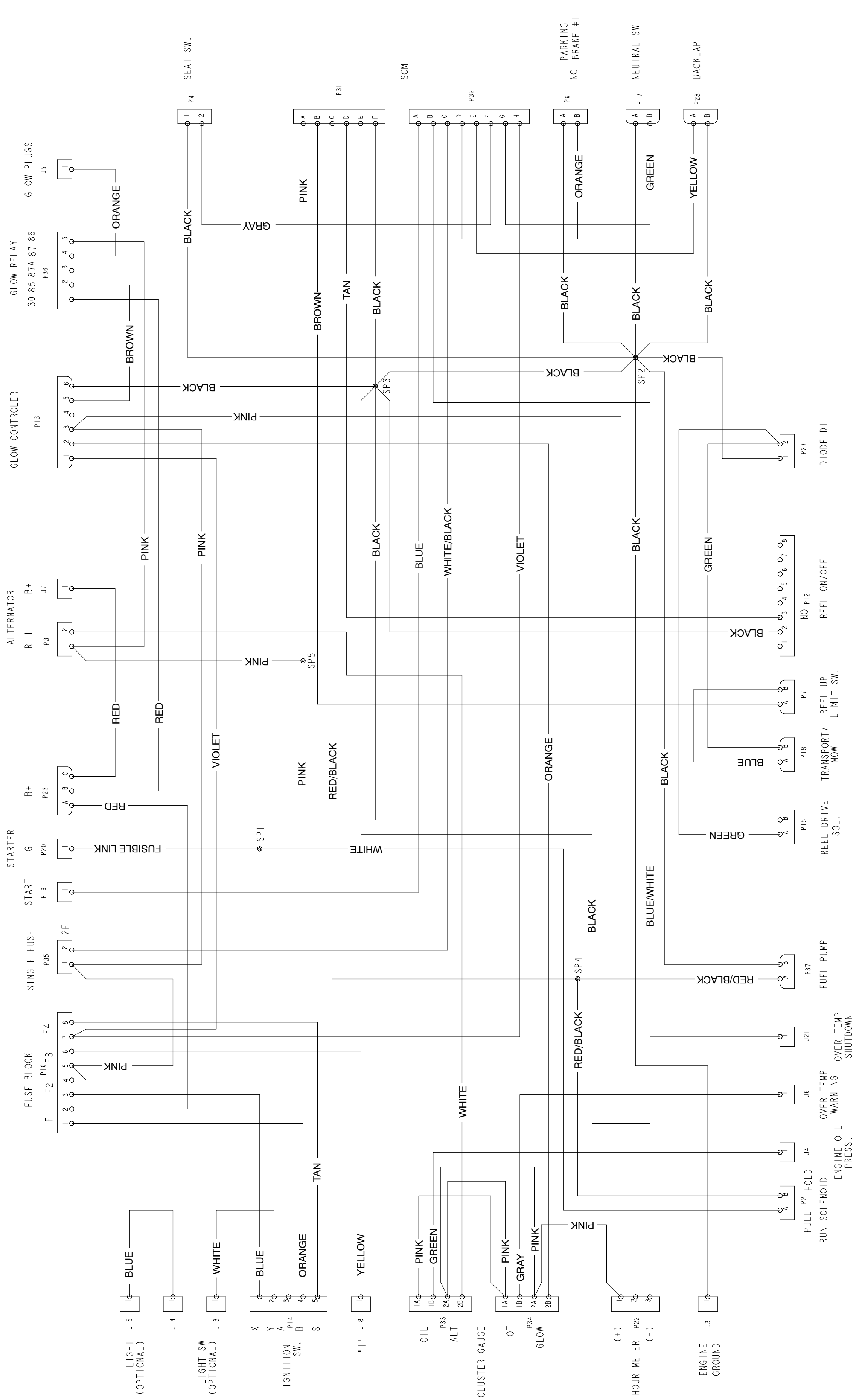


Reelmaster 3100-D
Wiring Diagram
Serial Numbers 240000001 to 270999999

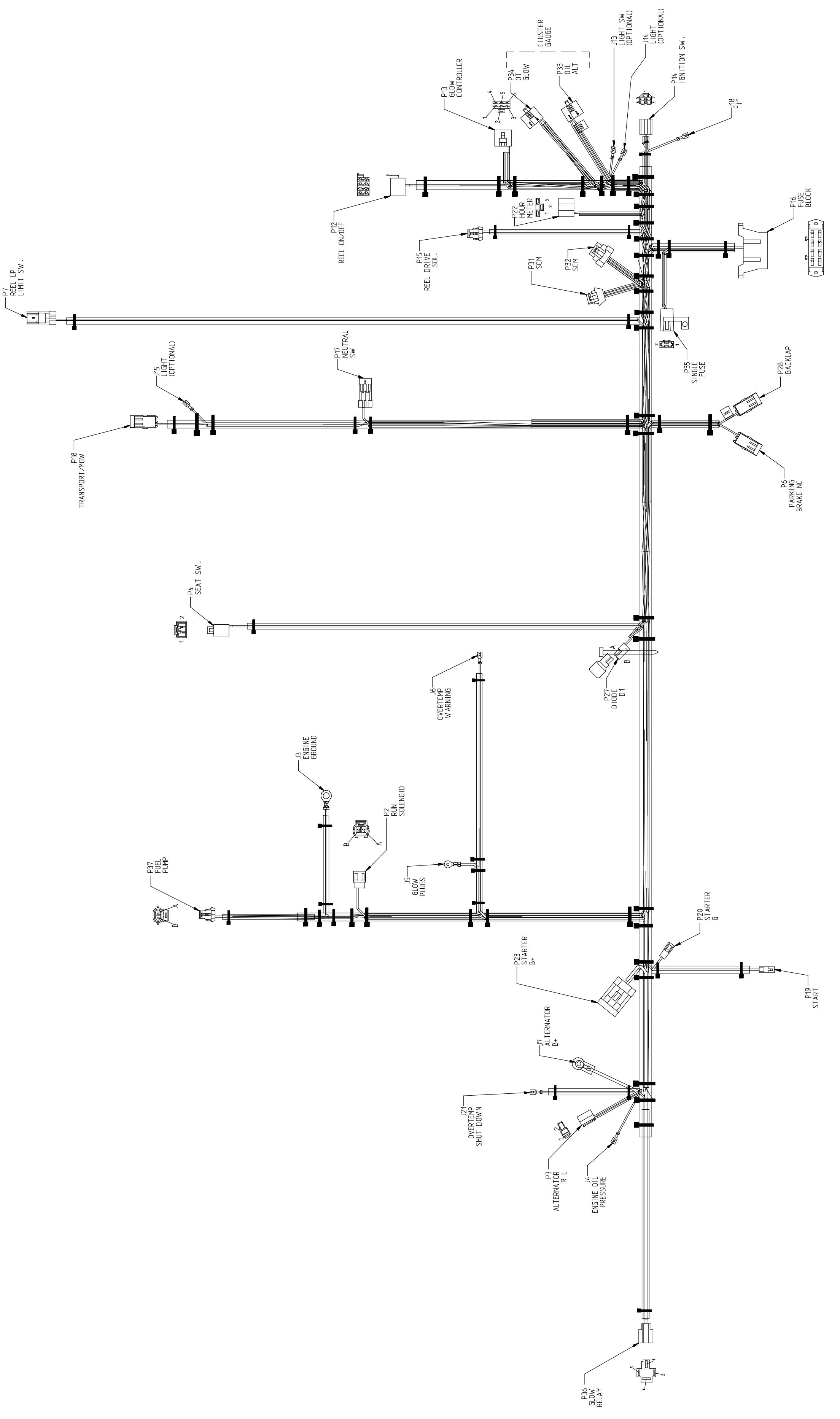
Reelmaster 3100–D
Harness Diagram
Serial Numbers 240000001 to 270999999



Electrical System

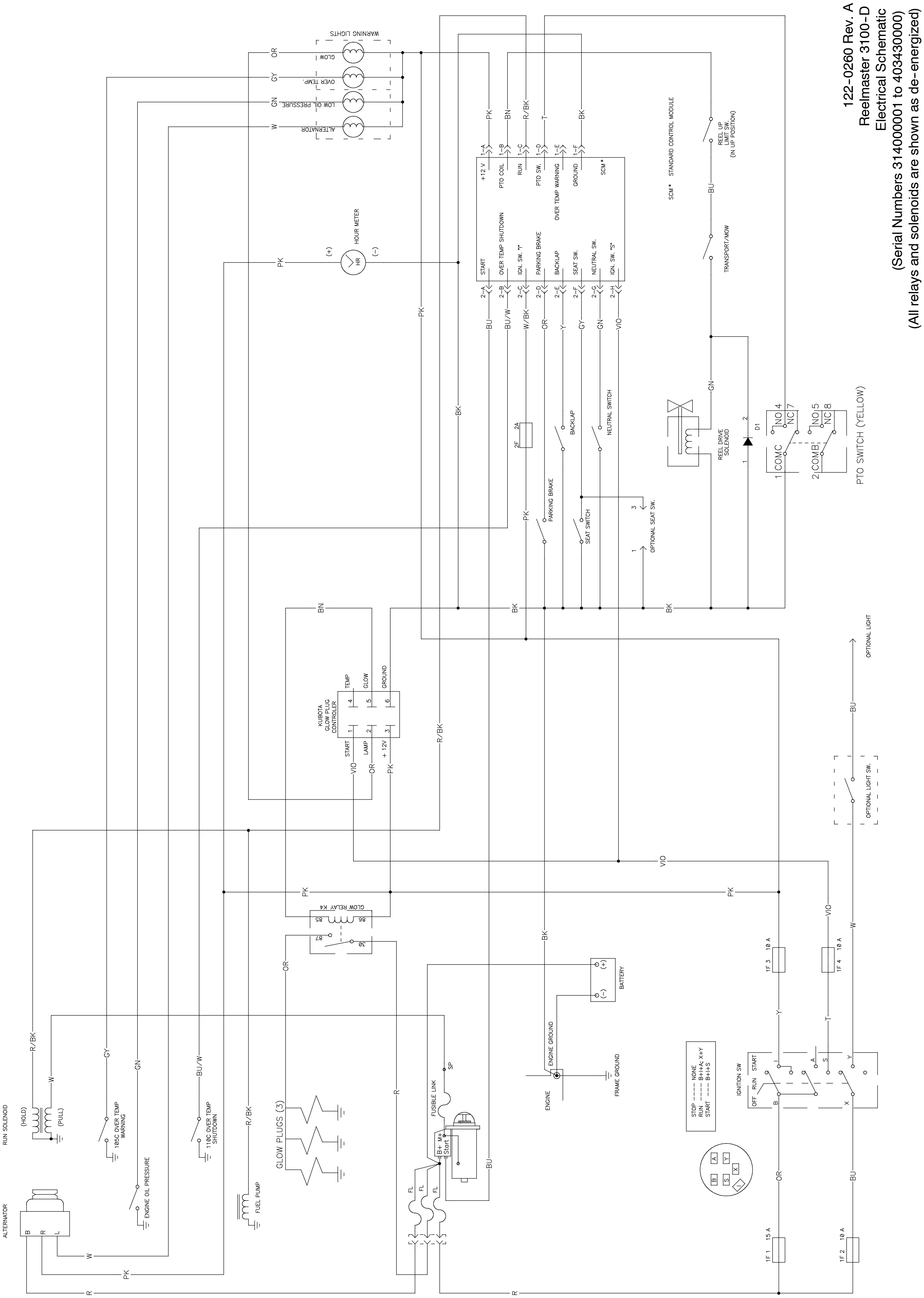


Reelmaster 3100-D
Wiring Diagram
Serial Numbers 280000001 to 314000000

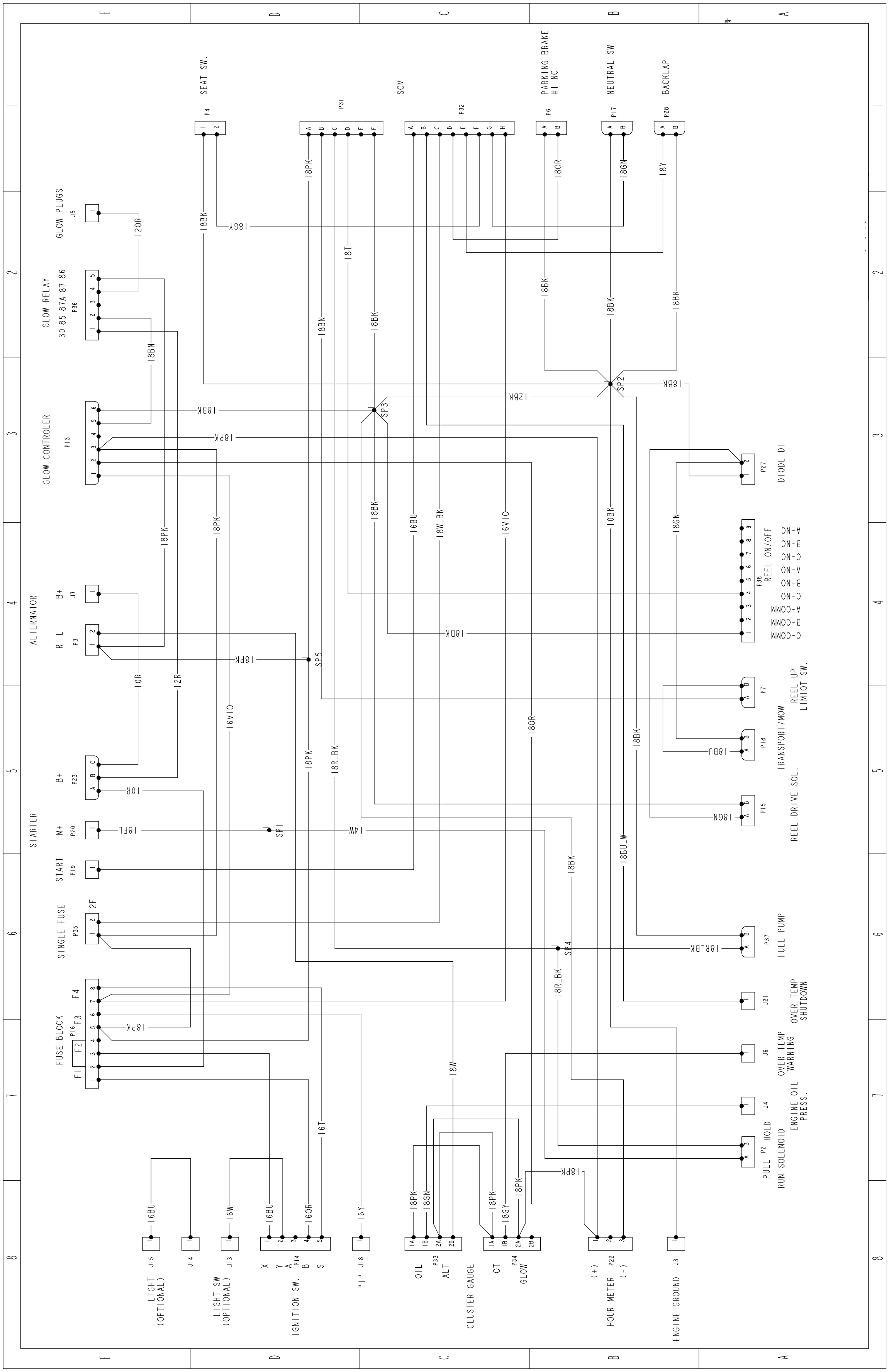


Reelmaster 3100-D
Harness Diagram
Serial Numbers 280000001 to 314000000

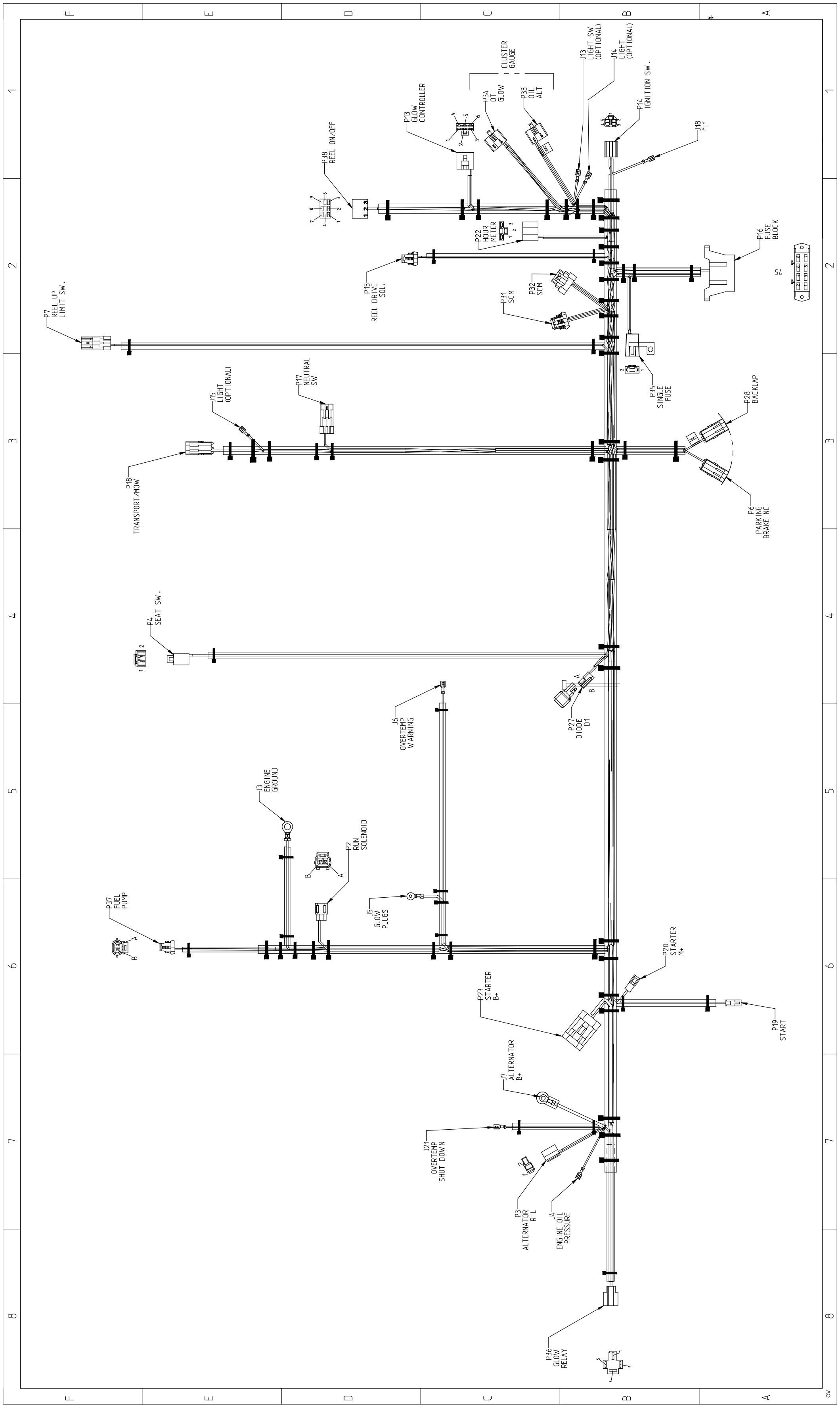
Electrical System


122-0260 Rev. A
Reelmaster 3100-D
Electrical Schematic
(Serial Numbers 314000001 to 403430000)
(All relays and solenoids are shown as de-energized)

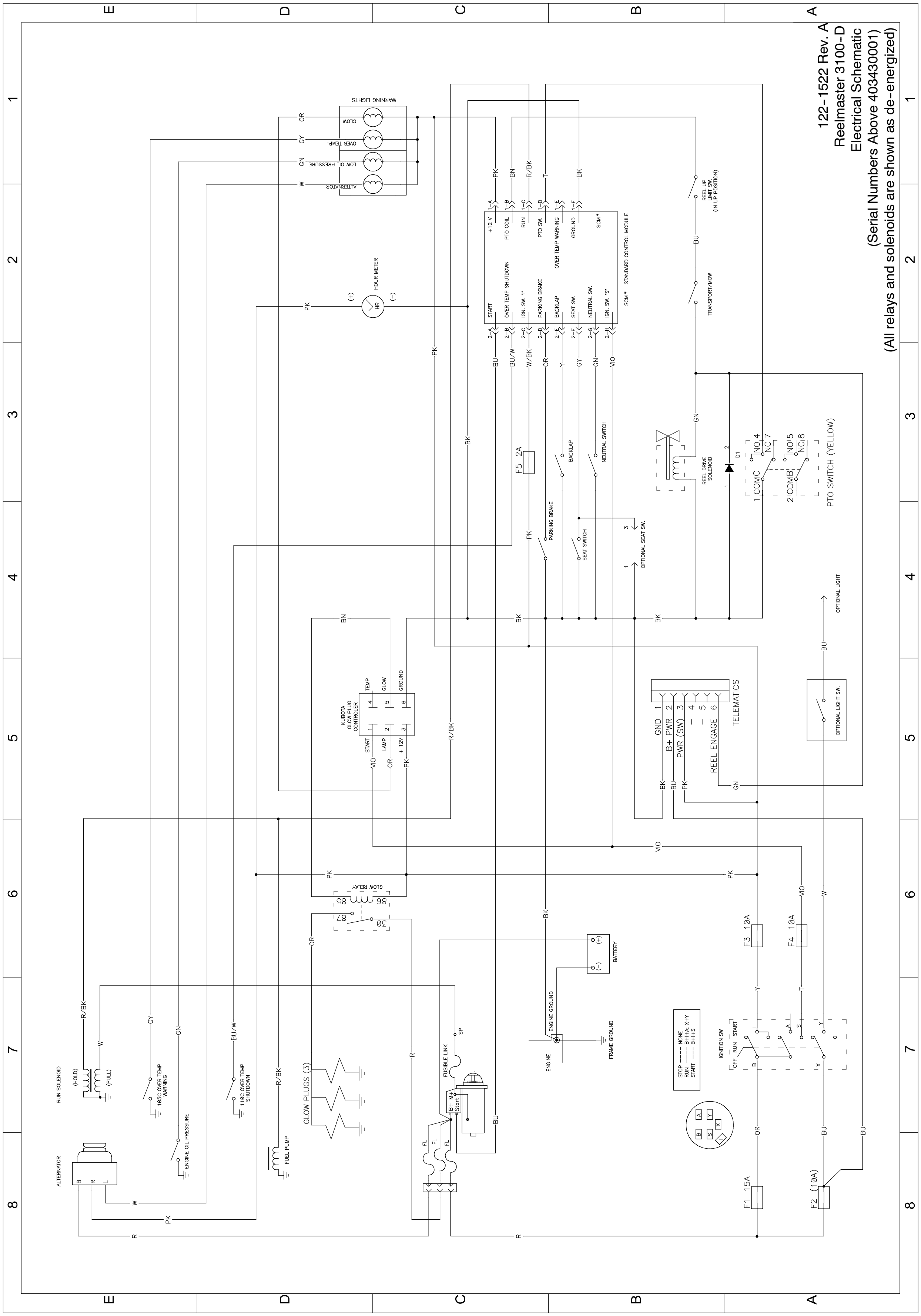
122-0258 Rev. A
Reelmaster 3100-D
Wiring Diagram
(Serial Numbers 314000001 to 404330000)



Electrical System

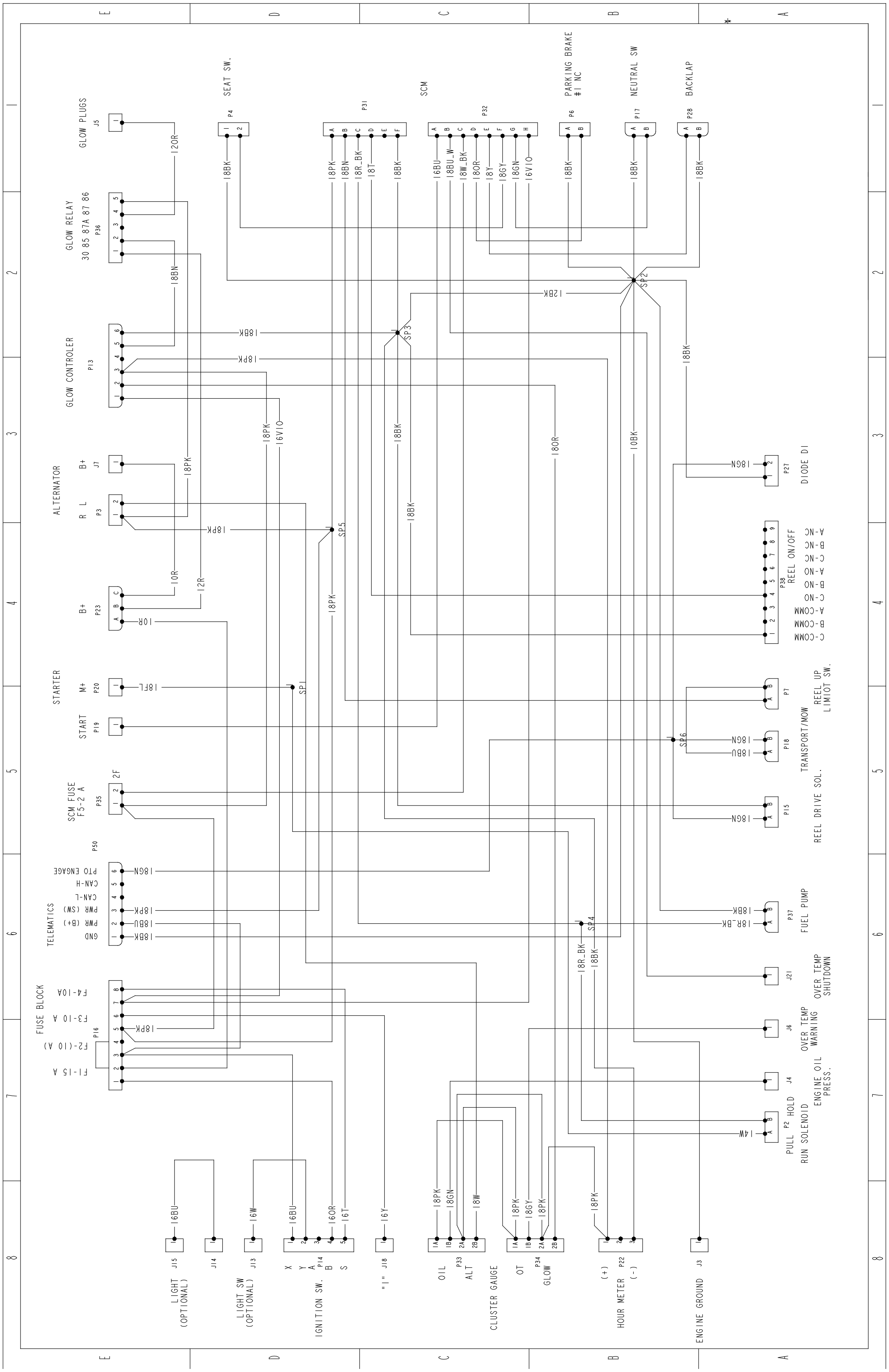


122-0258 Rev. A
Reelmaster 3100-D
Wire Harness Diagram
(Serial Numbers 314000001 to 403430000)

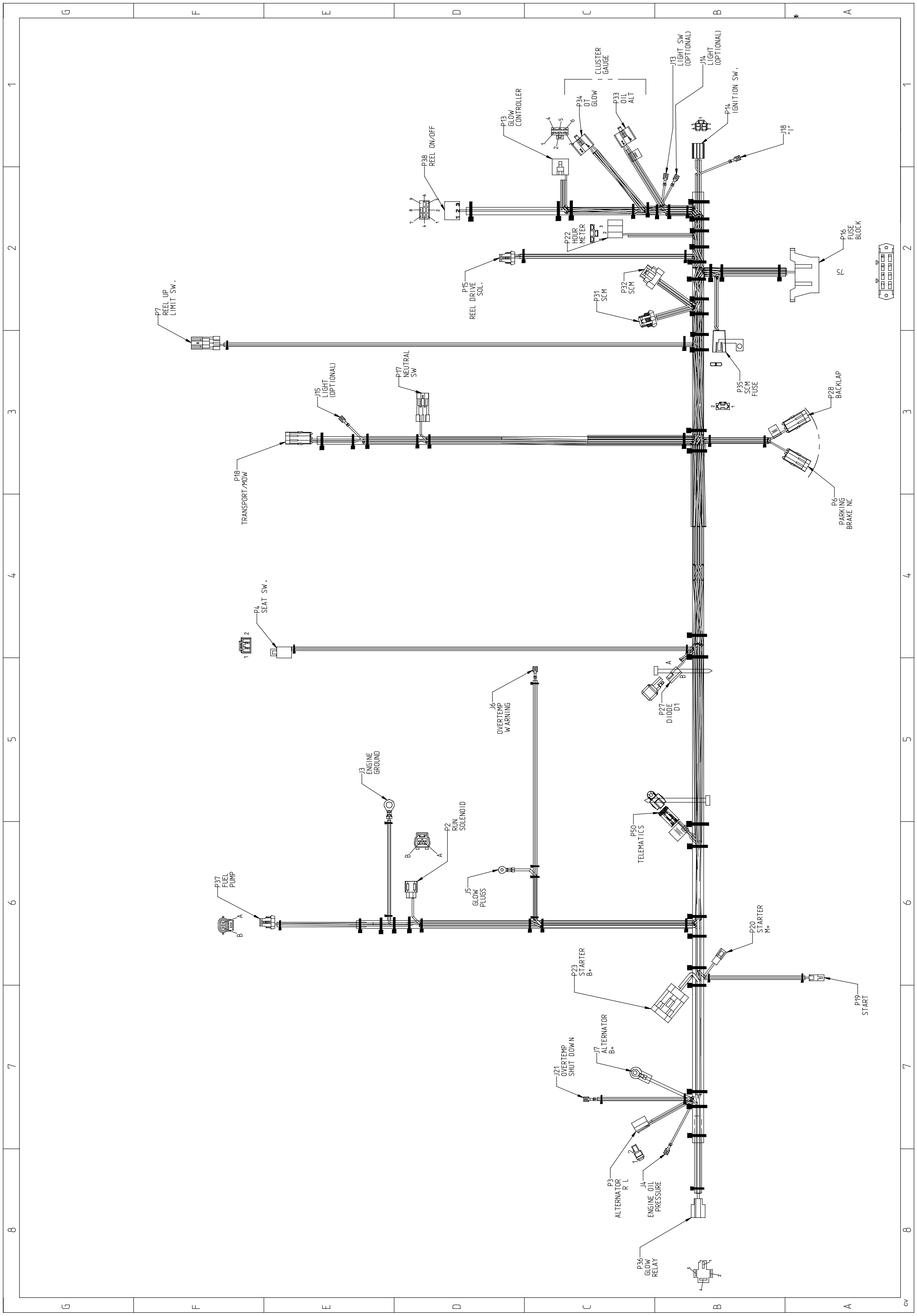


Electrical System

122-1523 Rev. B
Reelmaster 3100-D
Wiring Diagram
(Serial Numbers Above 403430001)



122-1523 Rev. B
Reelmaster 3100-D
Wire Harness Diagram
(Serial Numbers Above 403430001)



Electrical System

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Special Tools

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

Multimeter

The meter can test electrical components and circuits for current, resistance, or voltage.

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

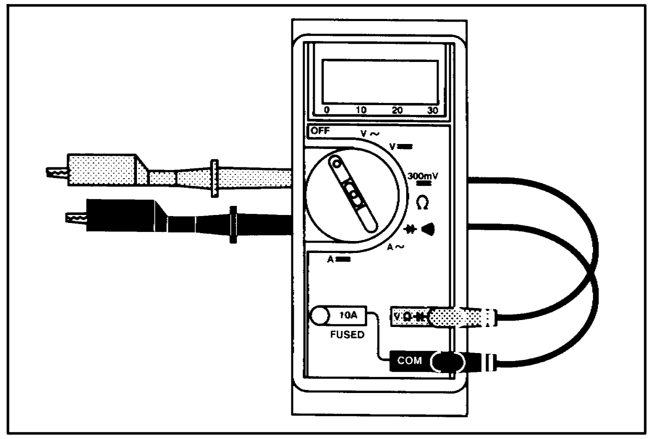

Figure 1

Skin-Over Grease

Special non-conductive grease (Toro Part No. 505-165) which forms a light protective skin which helps waterproof electrical switches and contacts.

Figure 2

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, you must have a good understanding of the electrical circuits and components used on this machine (see Electrical Schematics and Diagrams section of this chapter).

If the machine has any interlock switches by-passed, they must be reconnected for proper troubleshooting and safety.

Starting Problems

Problem	**Possible Causes**
Starter solenoid clicks, but starter will not crank (if solenoid clicks, problem is not in safety interlock system).	Low battery charge. Loose or corroded battery cables. Loose or corroded ground. Faulty wiring at the starter. Faulty starter solenoid.
Nothing happens when start attempt is made.	The traction pedal is not in neutral position or the neutral switch is faulty. Reel on/off switch is in the ON position or faulty. The engine is too hot or the over temperature shut down relay is faulty. The battery is dead. Fuse F1 or F3 is faulty or blown. Loose or corroded battery or ground cables. Loose or corroded ground. Wiring in the crank circuit (see Electrical Schematics) is loose, corroded, or damaged. The ignition switch faulty. Starter solenoid wiring loose, corroded or damaged. Starter solenoid faulty. The interlock relay is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine cranks, but does not start.	Wiring in the crank circuit (see Electrical Schematics) is loose, corroded, or damaged. Engine run solenoid or fuel pump faulty. The fuel tank is empty. An engine or fuel system problem exists. The glow circuit does not operate properly.
The glow circuit does not operate properly.	Wiring in the glow circuit (see Electrical Schematics) is loose, corroded, or damaged. The glow relay or glow plug controller is faulty. Fuse F4 is blown or faulty.
Engine cranks (but should not) with the reel on/off switch in the ON position.	The reel on/off switch is faulty or short circuited. Short circuit in reel drive neutral switch circuit.

General Run and Transport Problems

Engine kills during operation (operator sitting on seat).	Operator moved too far forward on seat (seat switch is not depressed). The engine overheated. The parking brake was engaged or the parking brake switch No. 1 failed. The seat relay or seat switch failed. The high temperature shutdown relay failed. Fuse F1 or F3 failed. The run solenoid or fuel pump failed. Wiring in the run circuit (see Electrical Schematics) broke or disconnected.
Engine kills when the backlap switch is in the BACKLAP position and the parking brake is ON.	The parking brake was released or the backlap switch was moved to MOW. The engine overheated. The traction pedal was moved from the neutral. The high temperature shutdown relay failed. Fuse F1 or F3 failed. The run solenoid or fuel pump failed. Wiring in the run circuit (see Electrical Schematics) broke or disconnected.
Battery does not charge.	Loose or broken wire(s). Faulty alternator. Dead battery. Alternator warning lamp is faulty or burned out. Alternator warning lamp wiring loose, corroded or damaged.

Cutting Unit Operating Problems

The cutting units will not run with the transport mow switch in MOW and the reel on/off switch in ON with the cutting units lowered.	Wiring to the reel drive circuit is (see Electrical Schematics) is loose, corroded, or damaged. Fuse F4 is faulty or blown. The coil to solenoid valve S1 on the hydraulic manifold is faulty or the valve is stuck. The reels on/off is faulty. The reels up limit or transport/mow switch is faulty or misadjusted. There is insufficient hydraulic oil pressure to turn the reels (see Troubleshooting in Chapter – 4, Hydraulic System).
The cutting units run, but should not run when raised.	The coil to solenoid valve S1 on the hydraulic manifold is faulty or the valve is stuck. The reels up limit switch is stuck, faulty, or misadjusted.

Electrical System

Electrical System Quick Check

Battery Test (Open Circuit Test)

Use a multimeter to measure the voltage between the battery terminals.

Set multimeter to the DC volts setting. The battery should be at a temperature of 60 to 100°F (16 to 38°C). The ignition key should be off and all accessories turned off. Connect the positive (+) meter lead to the positive battery post and the negative (–) meter lead the the negative battery post.

NOTE: This test provides a relative condition of the battery. Load testing of the battery will provide additional and more accurate information.

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

Charging System Test

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

Tool required: Digital multimeter set to DC volts.

Test instructions: 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 charging system voltage will increase at different rates as the battery charges.

Start the engine and run at high idle (2650 RPM). Allow the battery to charge for at least 3 minutes. Record the battery voltage.

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

Example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 v
Difference	= +0.55 v

Glow Plug System Test

This is a fast, simple test that can help to determine the integrity and operation of the Reelmaster 3100–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.

Tool(s) required: Digital multimeter and/or inductive Ammeter (AC/DC Current Transducer).

Test instructions: Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions). 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 (see Traction Unit Operator's Manual) and record the multimeter results.

The Reelmaster 3100–D glow plug system should have a reading of approximately 27 Amps.

Check Operation of Interlock Switches

CAUTION

Do not disconnect safety switches. They are for the operator's protection. Check the operation of the interlock switches daily for proper operation. Replace any malfunctioning switches before operating the machine.

Note: The machine is equipped with an interlock switch on the parking brake. The engine will stop if the traction pedal is depressed with the parking brake engaged.

1. Make sure all bystanders are away from the area of operation. Keep hands and feet away from cutting units.

2. With operator on the seat, the engine must not start with either the reel switch engaged or the traction pedal engaged. Correct problem if not operating properly.

3. With operator on the seat, the traction pedal in neutral, the parking brake off, and the reel switch in the OFF position, the engine should start. Lift off seat and slowly depress traction pedal, the engine should stop in one to three seconds. Correct problem if not operating properly.

4. With operator on the seat, the engine running, the reel transport slide in mow, and the reel switch in the ON position, lower cutting units. Reels should come on. Pull back on the lift lever, the reels should stop when fully raised. Correct problem if not operating properly.

Component Testing

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

NOTE: For more component testing information, see the Kubota Workshop Manual, Diesel Engine, 05 Series.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Ignition Switch

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

SWITCH POSITION	NORMAL CIRCUITS	OTHER CIRCUITS
OFF	NONE	NONE
RUN	B + A + I	X + Y
START	B + S + I	NONE

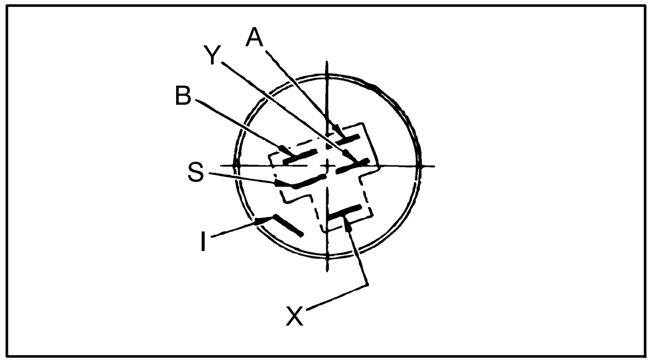

Figure 3

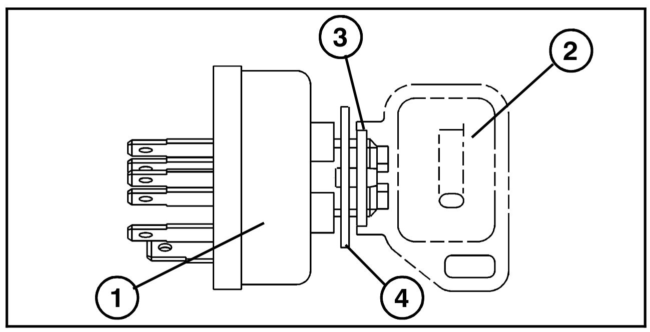

Figure 4

1. **Switch**
2. **Key**
3. **Hex nut**
4. **Lock washer**

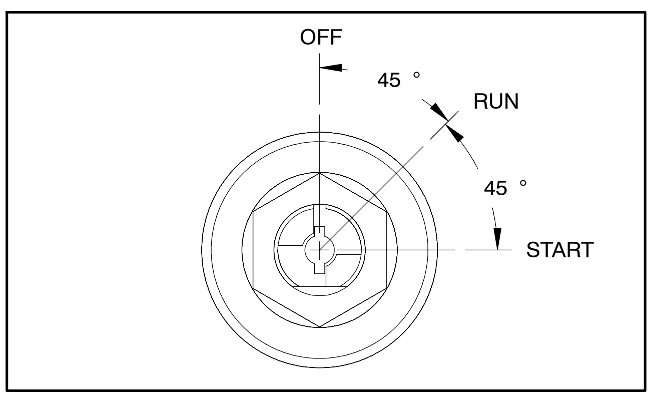

Figure 5

Glow Relay

The glow relay is attached to the radiator assembly. When energized, the glow relay allows electrical current to the engine glow plugs.

Two styles of glow relays have been used on the Reelmaster 3100-D. On machines with serial numbers below 240000000, two of the four relay connections are secured with screws (Fig. 6). Machines with serial numbers above 240000000 are connected to the wire harness with a four wire connector (Fig. 7).

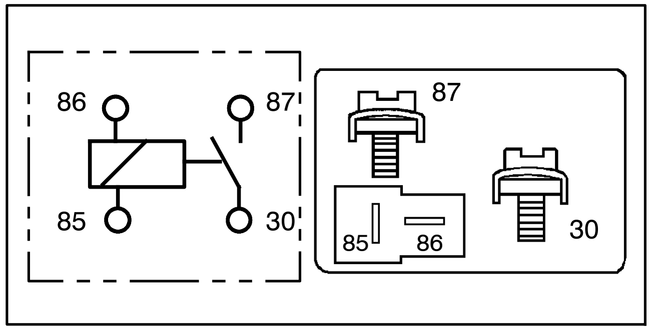

Figure 6

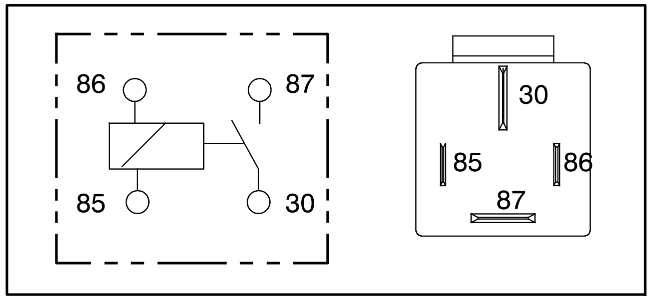

Figure 7

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting):

   A. On machines with serial numbers below 240000000, resistance should be from 41 to 51 ohms.

   B. On machines with serial numbers above 240000000, resistance should be approximately 72 ohms.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85.

3. Disconnect voltage and leads from the terminals.

Start, Seat, and High Temperature Shutdown Relays

These relays are located under the control panel on machines with Serial Numbers below 240000000.

1. Verify coil resistance between terminals 86 and 85 with a multimeter (ohms setting). Resistance should be from 80 to 90 ohms. There should be continuity between terminals 87A and 30.

2. Connect multimeter (ohms setting) leads to relay terminals 30 and 87. Ground terminal 86 and apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87 as 12 VDC is applied and removed from terminal 85.

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

4. Connect multimeter (ohms setting) lead to relay terminal 30 and 87A. Apply +12 VDC to terminal 85. The relay should make and break continuity between terminals 30 and 87A as 12 VDC is applied and removed from terminal 85.

5. Disconnect voltage and multimeter leads from the relay terminals.

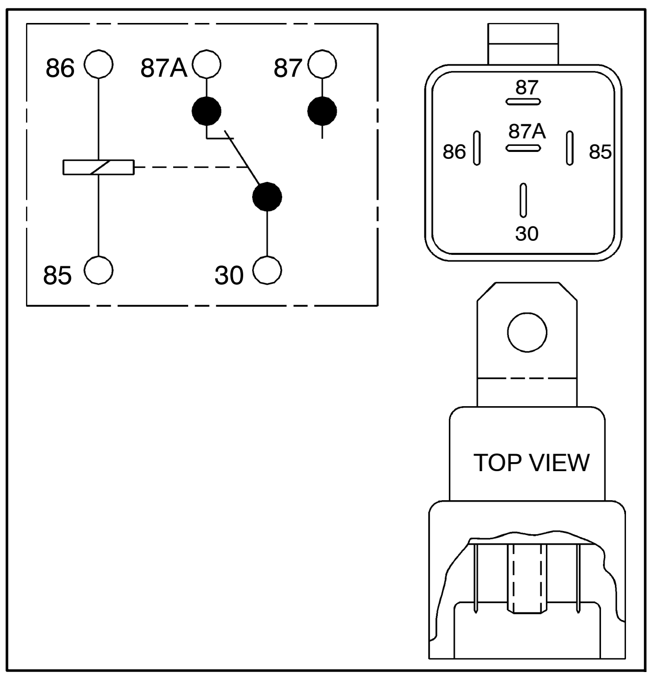

Figure 8

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 minutes.

4. Disconnect the voltage source from the hour meter.

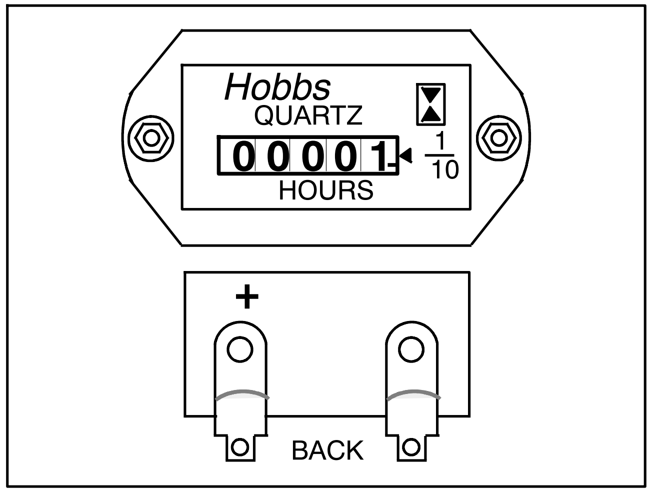

Figure 9

Reel Drive Solenoid

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

1. Make sure engine is off. Disconnect solenoid valve electrical connector.

2. Apply 12VDC source directly to the solenoid. Listen for solenoid to switch on.

3. Remove 12VDC source from the solenoid. Listen for solenoid to switch off.

4. Measure resistance between the two connector terminals. The resistance should be about 7.2 ohms.

5. Install **new** solenoid if necessary.

   A. Make sure o-ring is installed at each end of coil. Apply "Loctite 242" or equivalent to threads on end of valve stem before installing nut.

   B. Tighten nut to a torque of 15 in-lb (17.3 kg-cm). Over-tightening may damage the solenoid or cause the valve to malfunction.

6. Reconnect electrical connector to the solenoid.

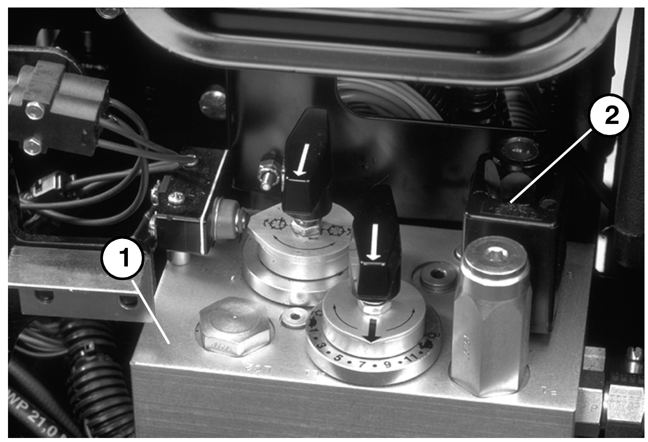

Figure 10

1. Hydraulic manifold **2. Solenoid**

High Temperature Warning and Shutdown Switches

The high temperature warning and shut down switches are located on the water pump, which is located on the rear end of the engine block. The high temperature shutdown switch is on the alternator side of the engine (Fig. 11).

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. 12).

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

Note: On units with serial numbers from 90101 to 90150, the high temperature shutdown switch settings are the same as the high temperature warning switch below.

3. Check continuity of the switch with a multimeter (ohms setting).

   A. The high temperature warning switch is normally open and should close between 216 to 226°F (102 to 108°C).

   B. The high temperature shutdown switch is normally open and should close between 225 to 235°F (107 to 113°C).

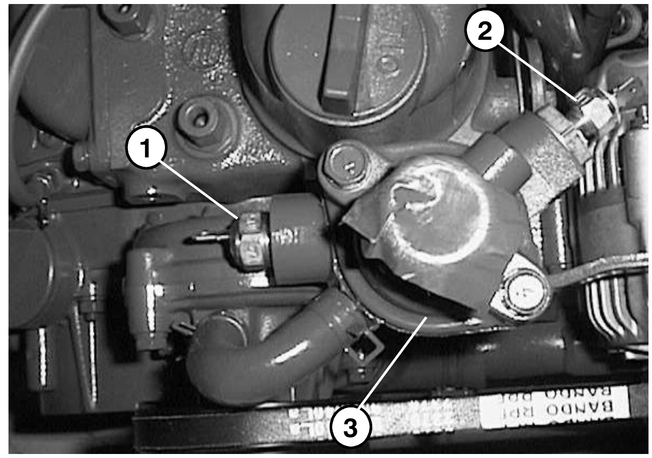

Figure 11

1. **Temp. warning switch**
2. **Temp. shutdown switch**
3. **Water pump**

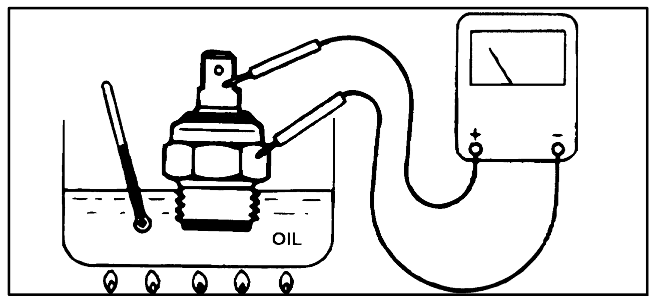

Figure 12

4. Allow oil to cool while observing temperature.

   A. The high temperature warning switch should open at about 208°F (98°C).

   B. The high temperature shutdown switch should open at about 219°F (104°C).

5. Replace switch if necessary.

Electrical System

Diode Assemblies

The diode D1 and D2 provide logic for the interlock switches. Diode D3 is used for circuit protection from inductive voltage spikes when the interlock relay is deenergized. Machines equipped with the standard control module (serial numbers above 240000000) use only one diode.

Two types of diodes have been used on the Reelmaster 3100-D:

1. On early production machines, the diodes are located within the main wiring harness that lies under the hydraulic tank and control console (Fig. 13).

2. Later production machines use diodes that plug into the wiring harness (Fig. 14). Location of the diodes is under the control console.

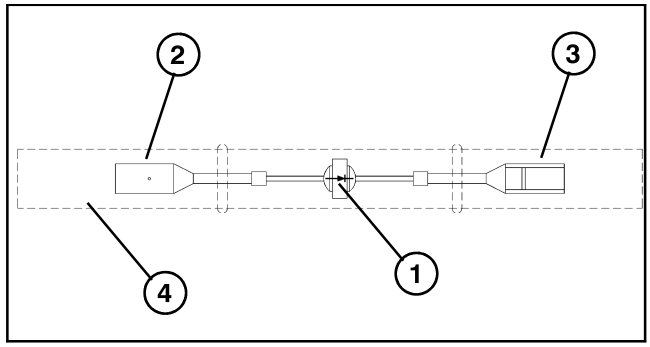

Figure 13

1. **Diode**
2. **Male terminal blade**
3. **Female terminal blade**
4. **Clear PVC tubing**

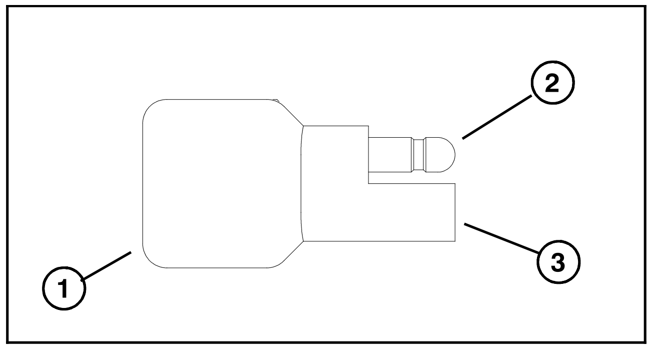

Figure 14

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Testing

The diodes can be individually tested using a digital multimeter (ohms setting) and the tables **below**.

1. Diodes located within the main harness (Fig. 13):

Multimeter Red Lead (+) on Terminal Blade	Multimeter Black Lead (-) on Terminal Blade	Continuity
Male	Female	YES
Female	Male	NO

2. Plug-in style diodes (Fig. 14):

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (-) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Warning Light Cluster (Serial Numbers Below 240000000)

Note: Individual light bulbs can be tested by removing them from the lighting cluster and applying 12 VDC to their wiring terminals.

Oil Pressure Light

The oil pressure light should come on when the ignition switch is in the ON position with the engine not running. Also, it should light with the engine running when the oil pressure drops below 4 PSI (0.3 kg/cm^2).

1. Disconnect green/blue wire from the oil pressure switch.

2. Ground green/blue wire to the engine block.

3. Turn the ignition switch to ON; the light should come on.

4. Turn the ignition switch to OFF. Connect green/blue wire to the oil pressure switch.

High Temperature (Water) Shutdown Light

Units with Serial Numbers from 90101 to 90150

When the coolant temperature is above 221°F (105°C), the temperature light comes on as the high temperature shutdown switch and relay stop the engine.

Units with Serial Numbers from 90150 to 230999999

When the coolant temperature is above 221°F (105°C), the temperature light comes on. However, the high temperature shutdown switch and relay do not stop the engine until the high temperature shutdown switch is above 230°F (110°C).

Glow Light

The glow light comes on when the ignition switch is placed in RUN prior to placing the ignition switch in START, and stays lit for 10 seconds while left in RUN.

Battery Light

The battery light should come on when the ignition switch is in ON with the engine not running, or with an improperly operating charging circuit while the engine is running.

1. Turn ignition switch to ON; the light should come on.

2. Turn ignition switch to OFF.

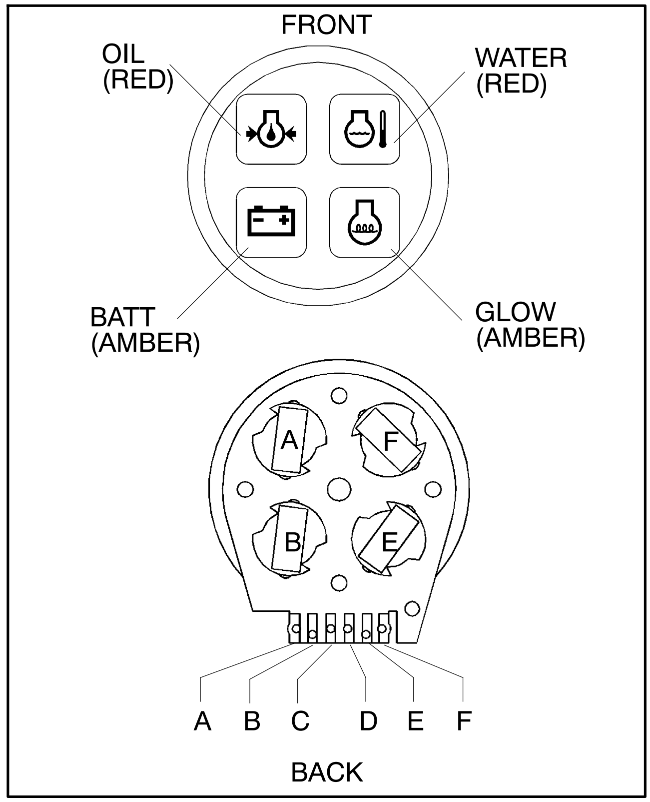

Figure 15

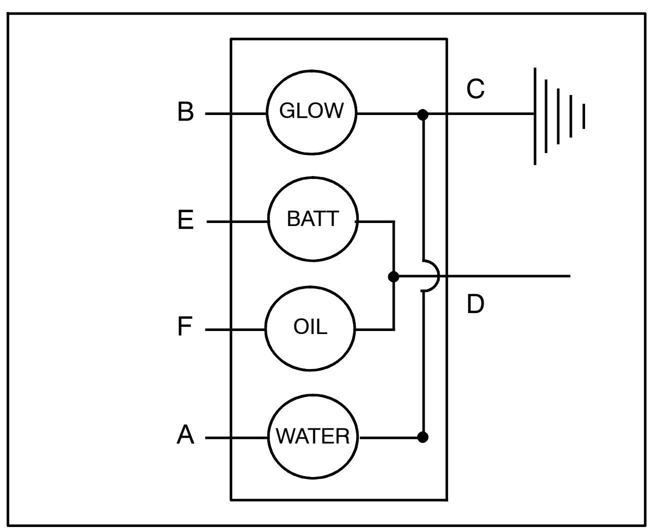

Figure 16

Indicator Lights (Serial Numbers Above 240000000)

Charge Indicator Light

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

Engine Oil Pressure Light

The engine oil pressure light should come on when the ignition switch is in the ON 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 ON position; the engine oil pressure light should come on indicating correct operation of the indicator light and circuit wiring.

High Temperature Warning Light

If the engine coolant temperature reaches 221ºF (105ºC) (approximate), the high temperature warning light should come on.

To test the high temperature warning light and circuit wiring, turn ignition switch to the ON position and ground the wire attached to high temperature sender located on the engine water pump housing (see Temperature Sender in this Chapter). The high temperature warning light should illuminate.

Glow Plug Indicator Light

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

Testing Indicator Lights

1. Apply 12 VDC to terminals 1A and 2A (Fig. 18).

2. Ground terminals 1B and 2B (Fig. 18).

3. Both indicator lights should illuminate.

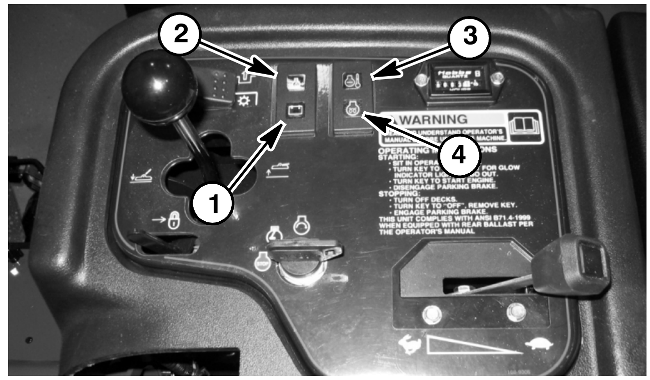

Figure 17

1. **Charge indicator**
2. **Engine oil pressure**
3. **High temp shutdown**
4. **Glow plug indicator**

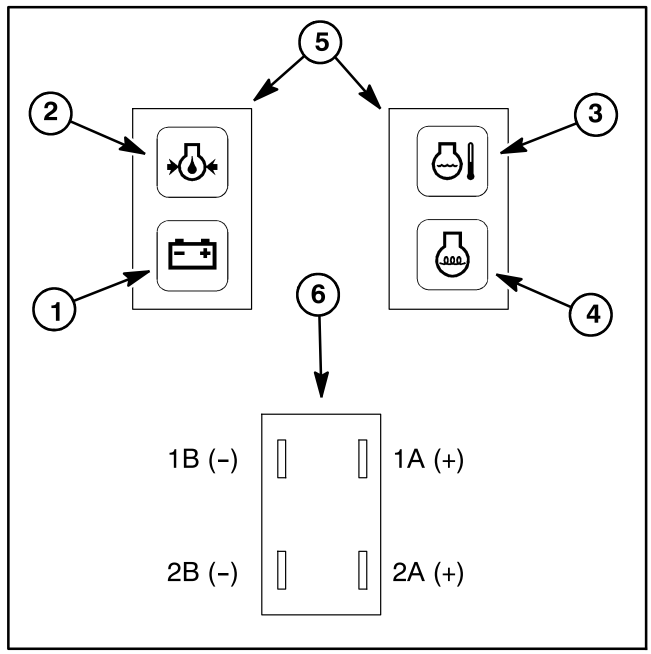

Figure 18

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

Fuel Pump

The fuel pump is attached to the frame just outboard of the fuel injection pump.

Operational Test

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

2. Disconnect electrical connector from the fuel stop solenoid to prevent the engine from firing.

3. Disconnect fuel hose (pump discharge) from the fuel filter.

4. Make sure fuel hoses attached to the fuel pump are free of obstructions.

5. Place fuel hose (pump discharge) into a large, graduated cylinder sufficient enough to collect 1 liter (33.8 fluid ounces).

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

Note: Machines that are equipped with a Biodiesel Conversion Kit will have the same fuel pump as machines with serial numbers above 280000000.

6. Collect fuel in the graduated cylinder by turning ignition switch to the RUN position. Allow pump to run for time listed below, then return switch to OFF.

A. For machines with serial numbers below 230999999, the amount of fuel collected in the graduated cylinder should be approximately **6.8 fl oz (200 ml) after thirty (30) seconds**.

B. For machines with serial numbers from 240000000 to 270999999, the amount of fuel collected in the graduated cylinder should be approximately **11.8 fl oz (350 ml) after thirty (30) seconds**.

C. For machines with serial numbers above 280000000, the amount of fuel collected in the graduated cylinder should be approximately **16 fl oz (475 ml) after fifteen (15) seconds**.

7. Replace fuel pump as necessary. Install fuel hose (pump discharge) to the fuel filter.

8. Reconnect electrical connector to the fuel stop solenoid.

9. Prime fuel system.

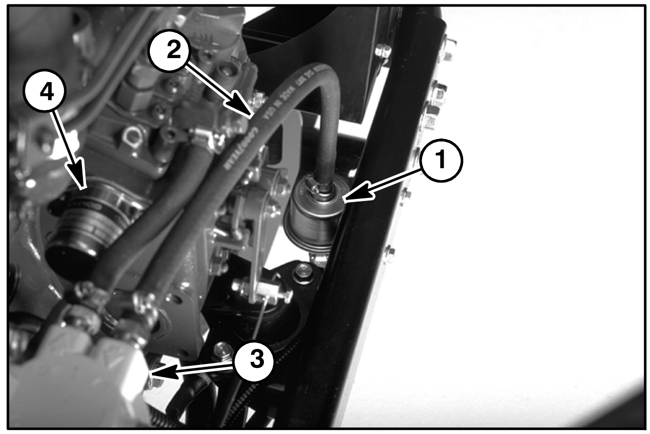

Figure 19

1. Fuel pump
2. Fuel hose (discharge)
3. Fuel filter
4. Fuel stop solenoid

Fuel Pump Specifications

Fuel pump specifications for machines with serial numbers below 240000000 are as follows:

Pump Capacity	13.5 fl oz/min (400 ml/min)
Pressure	5.4 psi (37.3 kPa)
Current Draw	1.5 amp

Fuel pump specifications for machines with serial numbers from 240000000 to 270999999 are as follows:

Pump Capacity	23.5 fl oz/min (700 ml/min)
Pressure	3.3 PSI (22.8 kPa)
Current Draw	0.9 amp

Fuel pump specifications for machines with serial numbers above 280000000 are as follows:

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

Fuel Stop Solenoid (Solenoid With 3 Wire Connector)

The fuel stop solenoid must be energized for the engine to run. It is mounted on the engine block near the injection pump (Fig. 20).

The fuel stop solenoid includes two coils for operation: the pull coil and the hold coil. When the ignition switch is turned to START, the fuel stop solenoid is initially energized and the pull coil retracts the solenoid plunger. 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. The fuel stop solenoid is grounded through the common (black) wire of the solenoid wire connector.

NOTE: Refer to Electrical Diagrams in this chapter when troubleshooting the fuel stop solenoid.

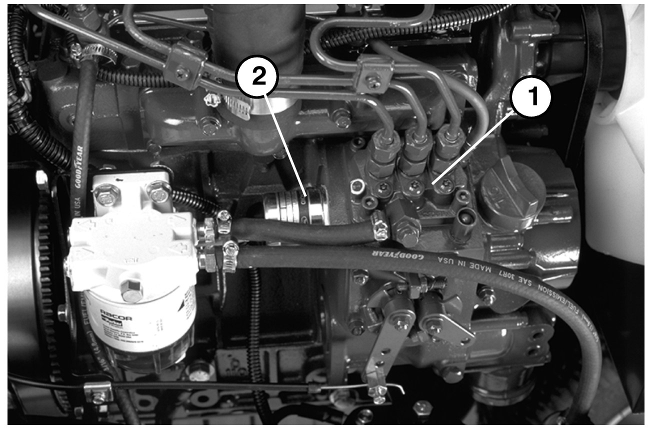

Figure 20

1. **Injection pump**
2. **Fuel stop solenoid**

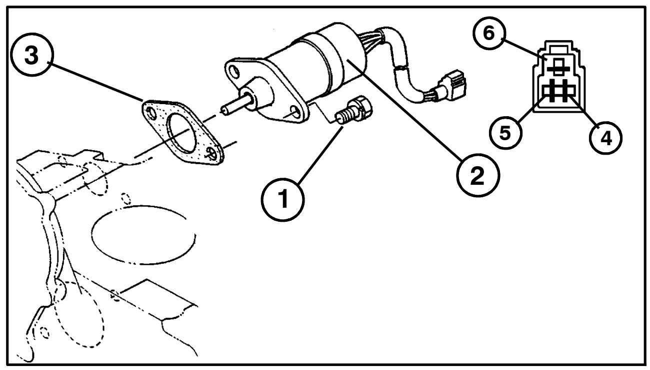

Figure 21

1. **Cap screw**
2. **Fuel stop solenoid**
3. **Gasket**
4. **Common (Black wire)**
5. **Hold coil (Red wire)**
6. **Pull coil (White wire)**

Testing

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

1. Make sure ignition switch is in the OFF position. Disconnect the connector from the solenoid.

2. Using a digital multimeter, touch one test lead to the pin of the **black** wire and the other test lead to the pin of the **white** wire (Fig. 21). The resistance of the **pull coil** should be about 0.33 ohms.

3. Using a digital multimeter, touch one test lead to the pin of the **black** wire and the other test lead to the pin of the **red** wire (Fig. 21). The resistance of the **hold coil** should be about 12.2 ohms.

4. Connect solenoid to the wiring harness.

Fuel Stop Solenoid (Solenoid With 2 Wire Connector)

The fuel stop solenoid used on the Reelmaster 3100-D must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Fig. 22).

The fuel stop solenoid includes two coils for operation: the pull coil and the hold coil. When the ignition switch is turned to START, the fuel stop solenoid is initially energized and the pull coil retracts the solenoid plunger. 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. The fuel stop solenoid is grounded through the solenoid housing.

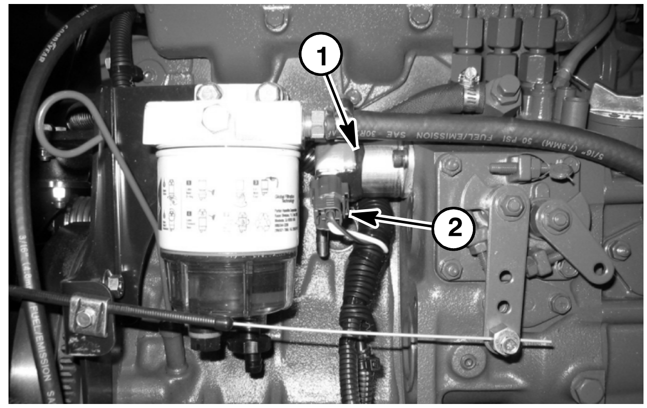

Figure 22

1. **Fuel stop solenoid**
2. **Harness connector**

NOTE: Refer to Chapter 8 - Electrical Diagrams when troubleshooting the fuel stop solenoid.

In Place Testing

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

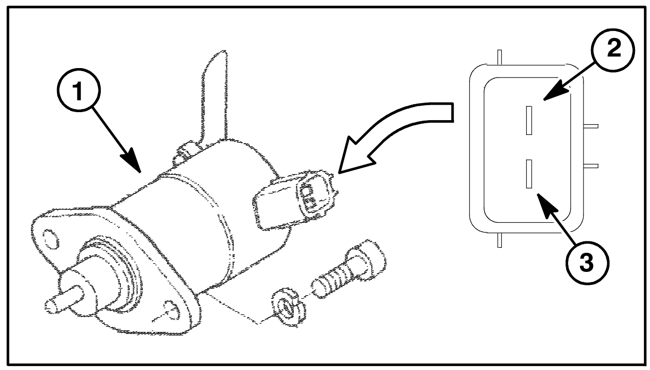

Figure 23

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

1. Make sure ignition switch is in the OFF position. Disconnect wire harness connector from fuel stop solenoid.

2. Using a digital multimeter, touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 23). The resistance of the pull coil should be less than 1 ohm (but not zero).

3. Using a digital multimeter, touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 23). The resistance of the hold coil should be approximately 15 ohms.

4. Connect solenoid to the wiring harness.

Electrical System

Glow Controller

The controller is located under the right lower corner of the instrument panel.

Note: Refer to Electrical Schematics and Diagrams at the beginning of the chapter when troubleshooting the controller.

Controller Operation

1. When the ignition switch is placed in the RUN position, the controller energizes the glow plugs and lights up the glow lamp for 10 seconds.

Note: On units with serial numbers from 90101 to 90150, the glow controller is not in use when the ignition switch is turned to start.

2. When the ignition switch is held in the START position, the glow plugs will energize while the switch is held in START and the glow lamp will **not** light.

3. When the ignition switch is released from START to RUN, the glow plugs will deenergize and the glow lamp will remain off.

Controller Checks

1. Make sure there is power from the battery.

2. Disconnect electrical connector to the run 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 indicator lamp is on.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Glow indicator lamp goes out and glow plugs deenergize after 10 seconds.

Note: On units with serial numbers from 90101 to 90150, the glow controller is not in use when the ignition switch is turned to start.

Note: If there is no power to terminal 1 of the glow controller, verify continuity of the circuitry from the ignition switch to the controller and perform step 4 again (see Electrical Schematics and Diagrams in this chapter).

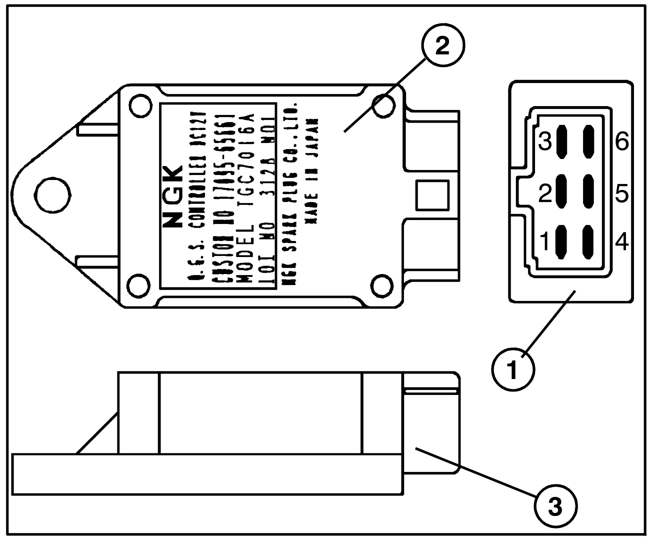

Figure 24

1. **Glow controller end view**
2. **Top view**
3. **Side view**

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

   A. Glow indicator lamp is out.

   B. Glow relay is energized.

   C. Glow plugs are energized.

   D. Power to terminal 1 of the glow controller.

5. If any of the conditions in step 3 are not met or 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 Electrical Schematics and Diagrams in this chapter).

   B. Verify continuity of the circuitry from the battery to ignition switch, glow controller, glow lamp, glow relay, and ground (see Electrical Schematics and Diagrams in this chapter).

   C. Replace parts as necessary.

6. Connect electrical connector to the run solenoid.

Standard Control Module

Reelmaster 3100–D machines with Serial Numbers above 240000000 are equipped with a Standard Control Module to monitor and control electrical components required for safe operation. This Module is attached to the back of the instrument panel.

Inputs from the neutral, parking brake, PTO, start (ignition), backlap, and high temperature switches are monitored by the Module. Output to the PTO (reel drive solenoid), fuel pump, and engine run solenoid are controlled based on the inputs received by the Module.

The Standard Control Module does not connect to an external computer or hand held device, can not be re–programmed, and does not record intermittent fault data.

The Standard Control Module can be used to check operation of machine switches by monitoring the LED of the module. If a Module LED does not illuminate (e.g. the in seat input LED does not illuminate with the seat occupied and the ignition switch in the run position), testing of the switch and circuit wiring would be required.

Refer to the Traction Unit Operator's Manual for operation and troubleshooting of the Standard Control Module.

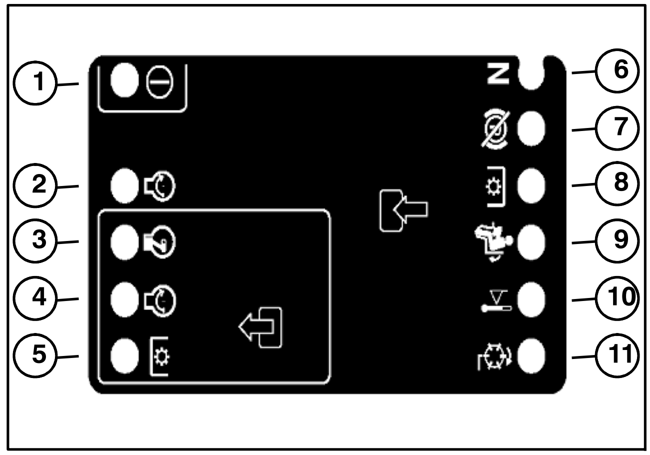

Figure 25

1. **Power input LED**
2. **Start input LED**
3. **Engine run output LED**
4. **Start output LED**
5. **PTO output LED**
6. **Neutral input LED**
7. **Park brake off input LED**
8. **PTO switch input LED**
9. **In seat input LED**
10. **High temp input LED**
11. **Backlap input LED**

Electrical System

Service and Repairs

NOTE: For more component repair information, see the Kubota Workshop Manual, Diesel Engine, 05 Series.

Battery Storage

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

1. Remove the battery and charge it fully (see Battery Service).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service).

Battery Care

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

WARNING

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

2. Keep top of battery clean by washing periodically with a brush dipped in ammonia or bicarbonate of soda solution. Flush top surface with water after cleaning. Do not remove the fill cap while cleaning.

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

WARNING

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

4. If corrosion occurs at terminals, disconnect cables. Always disconnect negative (−) cable first. Scrape clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat terminals with petroleum jelly.

5. Check electrolyte level every 25 operating hours, and every 30 days if machine is in storage.

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

Battery Service

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

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

Electrolyte Specific Gravity
Fully charged: 1.265 corrected to 80°F (26.7°C)
Discharged: less than 1.240

Battery Specifications
BCI Group Size 55:
450 CCA at 0° F (-17.8° C)
Reserve Capacity of 60 minutes at 80°F (26.7°C)

Dimensions (including terminal posts and caps)

Length	8.90 inches (22.61 cm)
Width	6.03 inches (15.31 cm)
Height	8.49 inches (21.56 cm)

Removal (Fig. 26 and 27)

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

1. Remove battery cover from the frame. Loosen battery retainer securing the back of the battery to the battery support.

2. Loosen nut on ground cable (-) post first and remove cable from battery. This should prevent short circuiting the battery, other components, or the operators hands.

3. Loosen nut on positive (+) cable post and remove cable from battery.

4. Make sure battery vent caps are on tightly.

5. Remove battery from the battery compartment to a service area to allow better access for service.

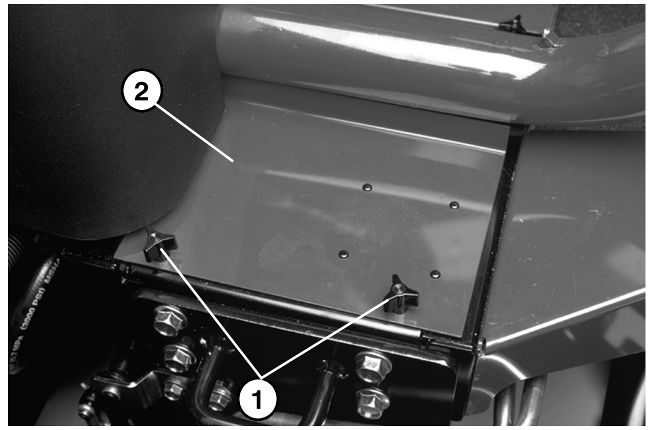

Figure 26

1. **Knobs** 2. **Battery cover**

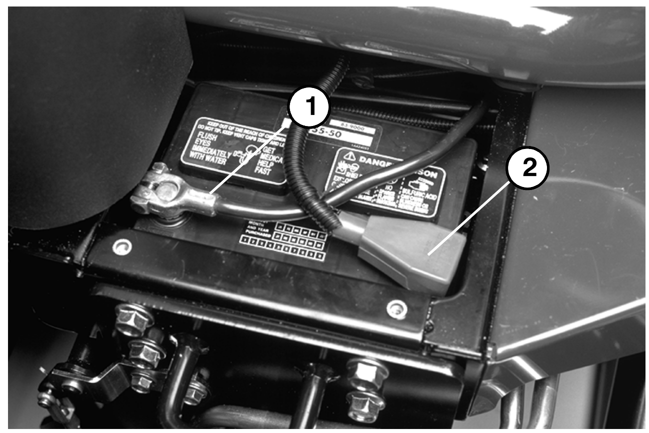

Figure 27

1. **Ground cable** 2. **Positive cable**

Inspection, Maintenance, and Testing

1. Perform following inspections and maintenance:

A. Check for cracks. Replace battery if cracked or leaking.

B. Check battery terminal posts for corrosion. Use wire brush to clean corrosion from posts.

IMPORTANT: Before cleaning the battery, tape or block vent holes to the filler caps and make sure the caps are on tightly.

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

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

E. Check the electrolyte level in each cell. If the level is below the tops of the plates in any cell, fill all cells with **distilled** water between the minimum and maximum fill lines. Charge at 15 to 25 amps for 15 minutes to allow sufficient mixing of the electrolyte.

2. Conduct a hydrometer test of the battery electrolyte.

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

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

B. Temperature correct each cell reading. For each 10°F (5.5°C) above 80°F (26.7°C) add 0.004 to the specific gravity reading. For each 10°F (5.5°C) below 80°F (26.7°C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100°F
Cell Gravity	1.245
100°F minus 80°F equals 20°F	
(37.7°C minus 26.7°C equals 11.0°C)	
20°F multiply by 0.004/10°F equals 0.008	
(11°C multiply by 0.004/5.5°C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80°F (26.7°C)	1.253

C. If the difference between the highest and lowest cell specific gravity is 0.050 or greater or the lowest cell specific gravity is less than 1.225, charge the battery. Charge at the recommended rate and time given in **Charging** or until all cells specific gravity is 1.225 or greater with the difference in specific gravity between the highest and lowest cell less than 0.050. If these charging conditions can not be met, replace the battery.

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

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

CAUTION

Follow the manufacturer's instructions when using a battery tester.

A. Check the voltage across the battery terminals prior to testing the battery. If the voltage is less than 12.4 VDC, recharge the battery.

B. If the battery has been charged, apply a 150 amp load for 15 seconds to remove the surface charge. Use a battery load tester following the manufacturer's instructions.

C. Make sure battery terminals are free of corrosion.

D. Measure the temperature of the center cell.

E. Connect a battery load tester to the battery terminals **following the manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of one half the Cranking Performance (see Battery Specifications) rating of the battery for 15 seconds.

G. Take a voltage reading at 15 seconds, then remove the load.

H. Using the table below, determine the minimum voltage for the cell temperature reading.

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70°F (and up)	21.1°C (and up)
9.5	60°F	15.6°C
9.4	50°F	10.0°C
9.3	40°F	4.4°C
9.1	30°F	-1.1°C
8.9	20°F	-6.7°C
8.7	10°F	-12.2°C
8.5	0°F	-17.8°C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Installation

IMPORTANT: To prevent possible electrical problems, install only a fully charged battery.

1. Make sure ignition and all accessories are **off**.

2. Make sure battery compartment is clean and repainted if necessary.

3. Make sure all battery cables and connections are in good condition and battery retainer has been repaired or replaced.

4. Place battery in its compartment. Make sure battery is level and flat. Connect positive cable connector onto positive battery post. Tighten cap screw and lock nut with two wrenches.

IMPORTANT: The nut must be on top of the battery retainer during installation to prevent the cap screw from hitting hydraulic hard lines when the sidewinder is shifted.

5. Secure battery retainer. Do not overtighten to prevent cracking or distorting the battery case.

6. Apply a light coat of grease on all battery posts and cable connectors to reduce corrosion after connections are made.

7. Connect a digital multimeter (set to amps) between the negative battery post and the negative (ground) cable connector. The reading should be less than 0.1 amp. If the reading is 0.1 amp or more, the unit's electrical system should be tested and repaired.

8. Connect negative (ground) cable connector to the negative battery post. Tighten cap screw and lock nut with two wrenches.

Charging

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

CAUTION

Follow the manufacturer's instructions when using a battery charger.

NOTE: Using specific gravity of the battery cells is the most accurate method of determining battery condition.

1. Determine the battery charge level from either its open specific gravity or circuit voltage.

Battery Charge Level	Specific Gravity	Open Circuit Voltage
100%	1.265	12.68
75%	1.225	12.45
50%	1.190	12.24
25%	1.155	12.06
0%	1.120	11.89

2. Determine the charging time and rate **using the manufacturer's battery charger instructions** or the following table.

Battery Reserve Capacity (Minutes)	Battery Charge Level (Percent of Fully Charged)			
	75%	50%	25%	0%
80 or less	3.8 hrs @ 3 amps	7.5 hrs @ 3 amps	11.3 hrs @ 3 amps	15 hrs @ 3 amps
81 to 125	5.3 hrs @ 4 amps	10.5 hrs @ 4 amps	15.8 hrs @ 4 amps	21 hrs @ 4 amps
126 to 170	5.5 hrs @ 5 amps	11 hrs @ 5 amps	16.5 hrs @ 5 amps	22 hrs @ 5 amps
171 to 250	5.8 hrs @ 6 amps	11.5 hrs @ 6 amps	17.3 hrs @ 6 amps	23 hrs @ 6 amps
above 250	6 hrs @ 10 amps	12 hrs @ 10 amps	18 hrs @ 10 amps	24 hrs @ 10 amps

CAUTION

Do not charge a frozen battery because it can explode and cause injury. Let the battery warm to 60°F (15.5° C) before connecting to a charger.

Charge the battery in a well-ventilated place to dissipate gases produced from charging. These gases are explosive; keep open flame and electrical spark away from the battery. Do not smoke. Nausea may result if the gases are inhaled. Unplug the charger from the electrical outlet before connecting or disconnecting the charger leads from the battery posts.

3. **Following the manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125°F (51.6°C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

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

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Chapter 6

Wheels, Brakes, and Miscellaneous

Table of Contents

Wheels, Brakes, and Miscellaneous

Specifications

Item	Description
Tire pressure	14 to 18 PSI (0.97 to 1.24 bar)
Wheel lug nut torque	45 to 65 ft−lb (61 to 88 N−m)

Special Tools

Wheel Hub Puller

Part Number: **TOR4097**

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

Figure 1

Adjustments

Adjust Brake

CAUTION

Before and after adjusting the brakes, always check the brakes in a wide open area that is flat and free of other persons and obstructions.

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

2. Adjust parking brake lever until a force of 30 to 40 lbs (133 to 178 N) is required to actuate lever. To adjust:

   A. Loosen set screw on adjustment knob (Fig. 2).

   B. Turn adjustment knob clockwise to increase force and counterclockwise to decrease force.

   C. Tighten set screw after adjustment.

3. Check brake adjustment as follows:

   A. Rotate by−pass valve on the piston pump 90 degrees to allow front wheels to turn freely (Fig. 3).

CAUTION

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

   B. Chock rear wheel. Jack up both front wheels and support the machine with hardwood blocks.

   C. With the parking brake applied, use a torque wrench on the wheel hub lock nut to identify the break away torque at each front wheel. The minimum break away torque with the parking applied should be 270 ft−lb (366 N−m).

4. If adjustment is necessary, adjust brakes as follows:

   A. Remove both front wheel assemblies from the machine (see Front Brake and Wheel Removal in the Service and Repairs section).

   B. Adjust brakes by turning clevis to increase or decrease shoe pressure on the brake drum (Fig. 4). Make sure that brake shoes do not drag against drums with the parking brake lever released.

   C. If brakes can not be adjusted properly, repair or replace brake components as necessary.

   D. After adjustment is complete, install front wheel assemblies to the machine (see Front Brake and Wheel Installation in the Service and Repairs section).

   E. Lower front wheels to the ground.

   F. Before starting engine, close by−pass valve on pump by rotating it 90 degrees (Fig. 3).

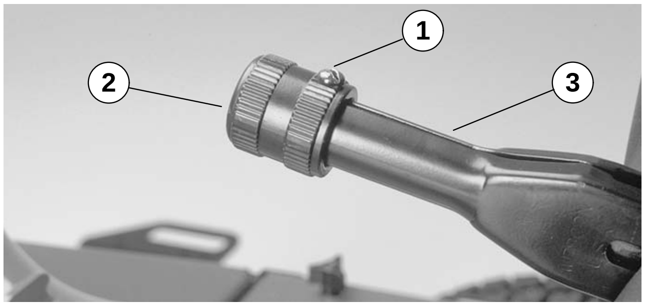

Figure 2

1. **Set screw**
2. **Adjustment knob**
3. **Brake lever**

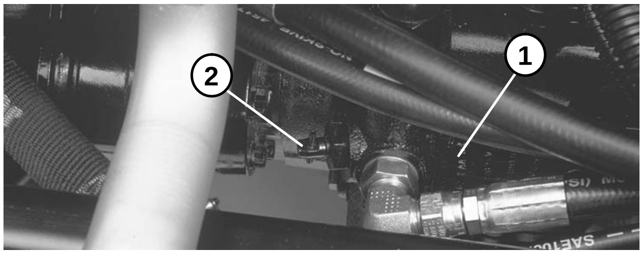

Figure 3

1. **Piston pump**
2. **By−pass valve**

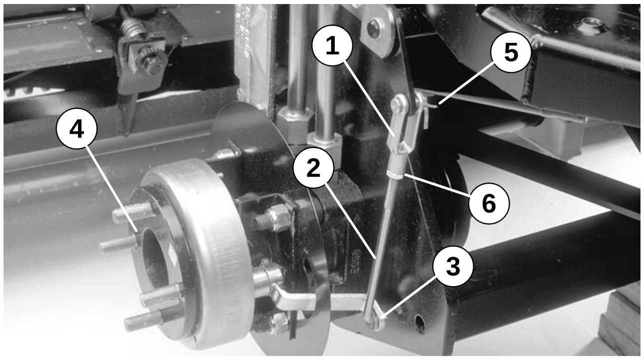

Figure 4

1. **Clevis**
2. **Adjustment rod**
3. **Brake lever**
4. **Wheel hub**
5. **Cotter pin**
6. **Jam nut**

Wheels, Brakes, and Miscellaneous

Service and Repairs

Standard Seat

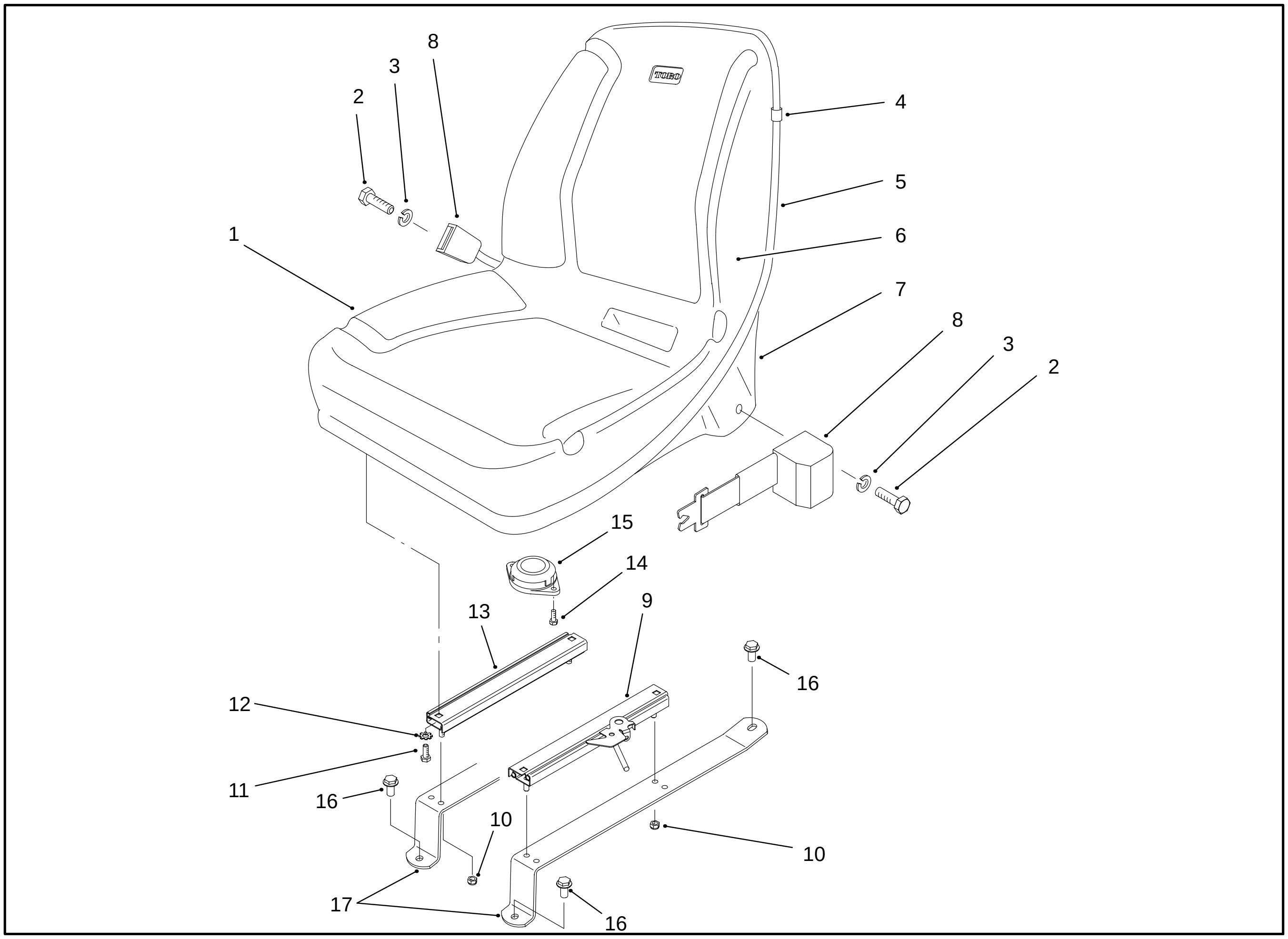

Figure 5

1. **Seat (incl. 4 thru 7, 14, &15)**
2. **Cap screw**
3. **Spring lock washer**
4. **Edging clip**
5. **Edging**
6. **Seat cushion (repair kit)**
7. **Seat shell**
8. **Seat belt**
9. **Seat adjuster with latch**
10. **Flange hex nut**
11. **Cap screw**
12. **Lock washer**
13. **Seat adjuster**
14. **Cap screw**
15. **Seat switch**
16. **Hex flange head screw**
17. **Seat support strap**

Removal

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

2. Remove four hex flange head screws securing the seat support straps to the frame.

3. Disconnect electrical connector from the seat switch. Separate seat from the frame.

4. Remove seat parts as necessary to make repairs using Figure 5 as a guide.

Installation

1. Install any new seat parts using Figure 5 as a guide.

2. Position seat and support straps to the fuel tank and frame.

3. Connect electrical connector to the seat switch.

4. Secure seat support straps to the frame with four hex flange head screws.

Deluxe Seat

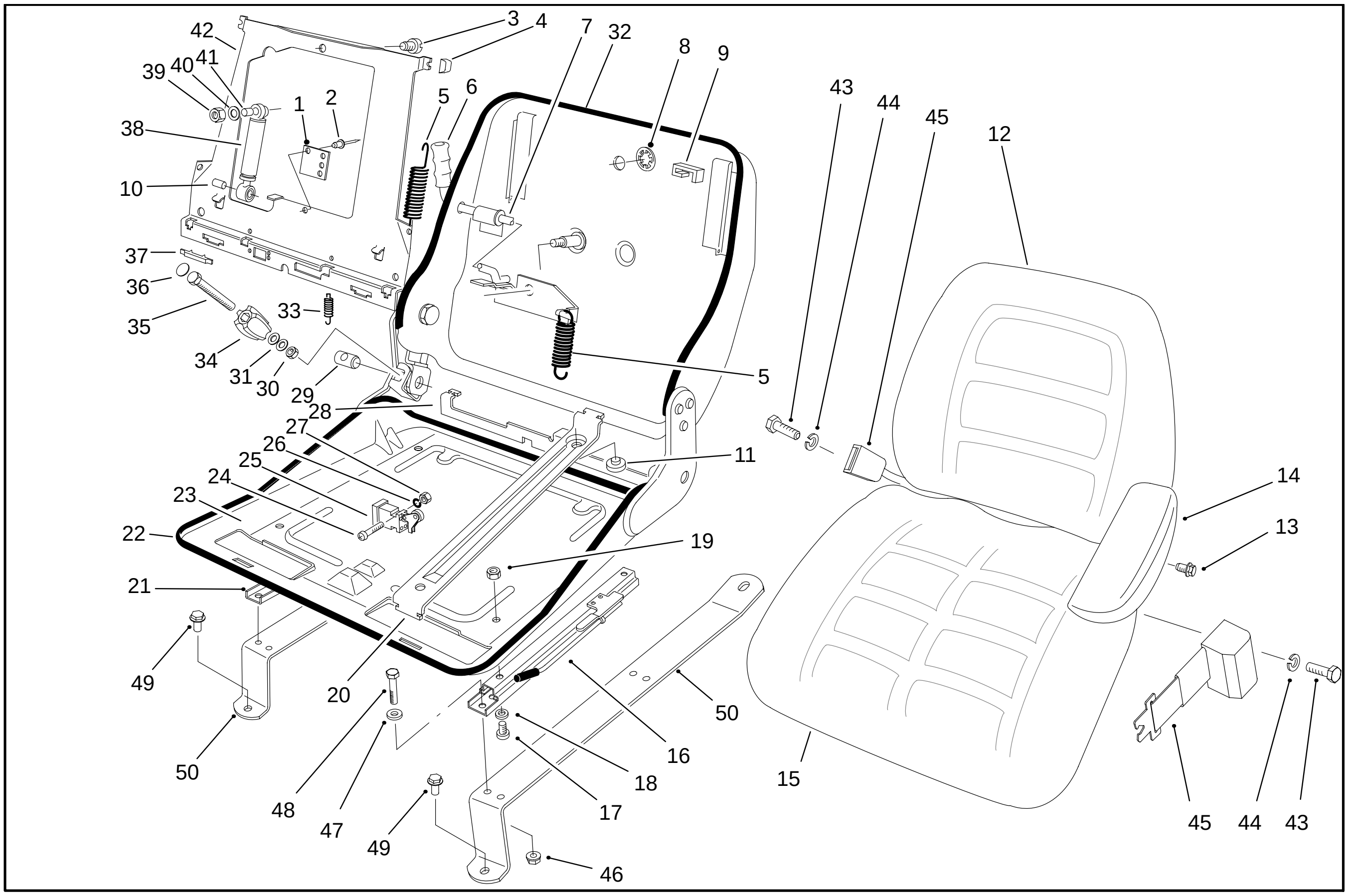

Figure 6

1. **Plate**
2. **Rivet**
3. **Screw**
4. **Wear parts kit (incl. 8 thru 11)**
5. **Tension spring set**
6. **Handle grip**
7. **Adjusting lever**
8. **Cover**
9. **Bumper**
10. **Bushing**
11. **Pad**
12. **Backrest cushion**
13. **Hex head machine screw**
14. **Arm rests**
15. **Bottom cushion**
16. **Adjusting rail (LH)**
17. **Screw**
18. **Washer**
19. **Nut**
20. **Swing arm assembly (incl. 28 & 42)**
21. **Adjusting rail (RH)**
22. **Bottom trim**
23. **Seat frame**
24. **Screw**
25. **Seat switch (incl. 24, 26, & 27)**
26. **Spring washer**
27. **Nut**
28. **Back plate pivot**
29. **Threaded clevis**
30. **Nut**
31. **Washer**
32. **Backrest trim**
33. **Tension spring set**
34. **Spindle adjuster (incl. 29 thru 31, 35 & 36)**
35. **Screw**
36. **Cover**
37. **Clamp**
38. **Shock absorber**
39. **Nut**
40. **Washer**
41. **Bushing kit (incl. 39 & 40)**
42. **Backrest plate**
43. **Cap screw**
44. **Lock washer**
45. **Seat belt**
46. **Hex flange nut**
47. **Flat washer**
48. **Cap screw**
49. **Hex flange head screw**
50. **Seat support strap**

Removal

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

2. Remove four hex flange head screws securing the seat support straps to the frame.

3. Disconnect electrical connector from the seat switch. Separate seat from the frame.

4. Remove seat parts as necessary to make repairs using Figure 6 as a guide.

Installation

1. Install any new seat parts using Figure 6 as a guide.

2. Position seat and support straps to the fuel tank and frame.

3. Connect electrical connector to the seat switch.

4. Secure seat support straps to the frame with four hex flange head screws.

Front Wheel and Brake

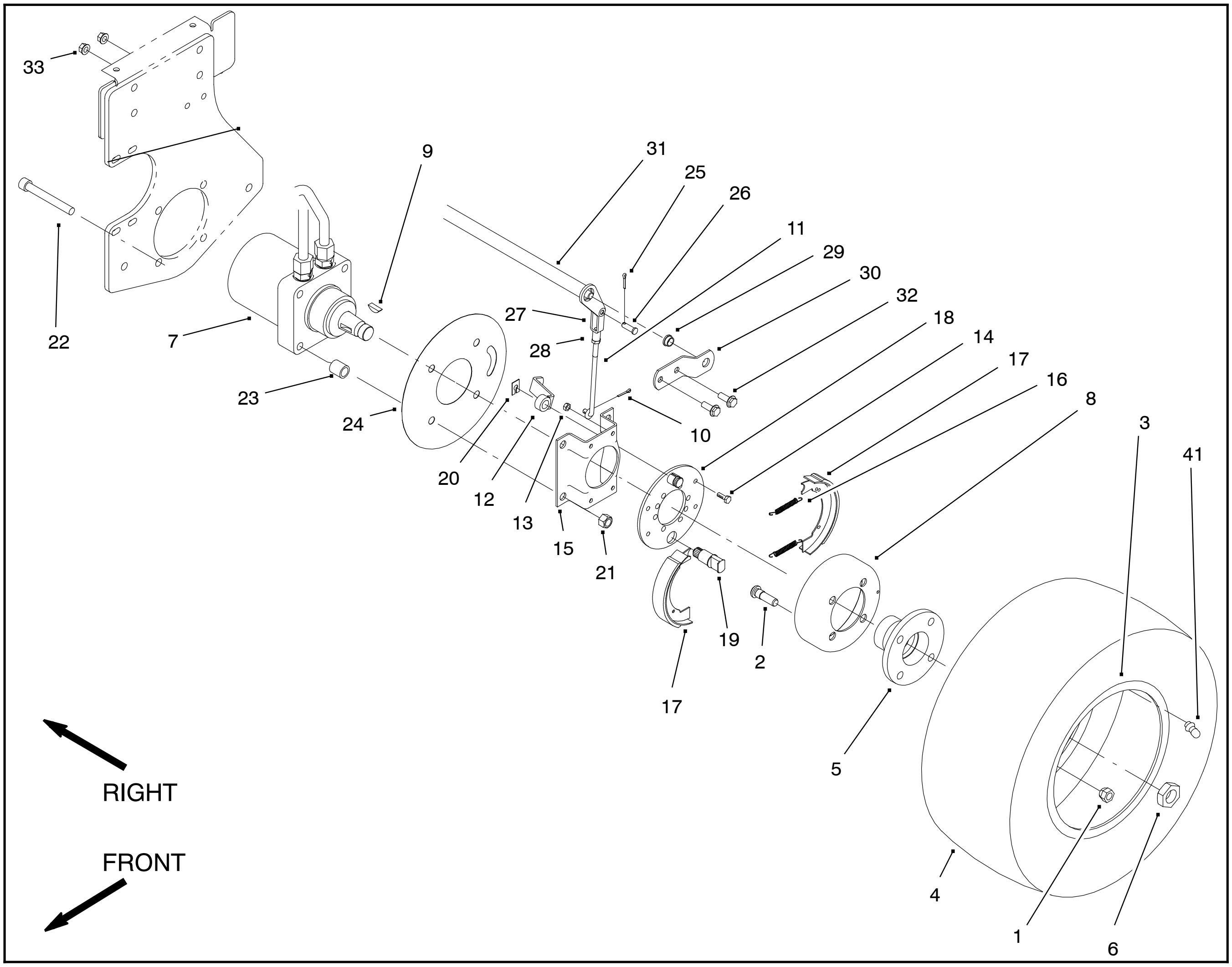

Figure 7

1. Lug nut	**12. Brake lever**	**23. Spacer**
2. Drive stud	**13. Lock nut**	**24. Wheel shield**
3. Wheel rim	**14. Cap screw**	**25. Cotter pin**
4. Tire	**15. Brake bracket**	**26. Clevis pin**
5. Wheel hub	**16. Return spring**	**27. Clevis**
6. Lock nut	**17. Brake shoe**	**28. Jam nut**
7. Hydraulic motor	**18. Backing plate**	**29. Flange bushing**
8. Brake drum	**19. Cam shaft**	**30. Brake pivot bracket**
9. Woodruff key	**20. Retainer Clip**	**31. Brake pivot shaft**
10. Cotter pin	**21. Lock nut**	**32. Hex flange head screw**
11. Adjustment rod	**22. Cap screw**	**33. Hex flange nut**

Removal (Fig. 7)

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

WARNING

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

2. Jack up front wheel and use wood blocks to keep the rear tire off the floor.

3. Remove lug nuts from drive studs. Pull wheel from drive studs and wheel hub.

NOTE: The installation torque of the locknut is from **250 to 275 ft- lb (339 to 372 N- m)**. Use impact wrench to remove lock nut from the hydraulic motor shaft.

4. Loosen, but do not remove, lock nut from the hydraulic motor shaft. Release parking brake.

IMPORTANT: Do not hit wheel hub, wheel hub puller or wheel motor with a hammer during removal or installation. Hammering may cause damage to the hydraulic wheel motor.

5. Using hub puller (see Special Tools), loosen wheel hub from wheel motor.

6. Remove lock nut, hub, and brake drum from motor shaft. Locate and retrieve woodruff key.

7. Remove cotter pin from the adjustment rod. Separate adjustment rod from the brake lever.

NOTE: The brake lever, backing plate, retaining clip, return springs, brake shoes, and cam shaft can be removed as a complete **brake assembly**.

8. If it is desired to remove the **brake assembly** from the brake bracket, remove four cap screws and lock nuts securing the assembly to the bracket.

9. Disassemble brake assembly as follows (Fig. 8):

A. Remove return springs from the brake shoes. Remove brake shoes from the backing plate.

B. Matchmark brake cam and brake lever to assure proper alignment during reassembly. Remove retaining clip from the brake cam. Pull brake lever from the cam. Remove cam from backing plate.

10. The brake bracket and wheel shield can be removed as follows:

A. Remove lock nuts, spacers, and cap screws securing the brake bracket, wheel shield, and hydraulic motor to the frame.

B. Separate bracket and shield from the frame.

Installation (Fig. 7)

1. Insert four cap screws through the frame, hydraulic motor, spacers, wheel shield, and brake bracket. Secure with lock nuts, but do not fully tighten.

2. Assemble brake assembly as follows (Fig. 8):

A. Secure backing plate to the brake bracket with four cap screws and lock washers.

B. Apply antiseize lubricant to cam shaft splines. Insert cam shaft through the backing plate.

C. Attach brake lever to the cam shaft. Make sure matchmarks are aligned properly. Secure lever to shaft with retaining clip.

D. Lubricate brake shoe pivot points with a light coating of grease.

E. Position both brake shoes on the backing plate so that the concave heels attach to the anchor pin.

F. Insert both return springs into the holes of both brake shoes. Make sure shoes fit snuggly against the anchor pin and cam.

3. If the brake lever, backing plate, retaining clip, return springs, brake shoes, and cam shaft were removed as a complete brake assembly, secure backing plate to the brake bracket with four cap screws and lock washers. Tighten fasteners.

4. Attach adjustment rod to the brake lever. Secure adjustment rod with cotter pin.

5. Thoroughly clean wheel motor shaft and wheel hub taper.

6. Install woodruff key to the slot on the hydraulic motor shaft. Slide wheel hub and brake drum assembly onto the shaft.

7. Secure wheel hub and brake drum to the hydraulic motor shaft with lock nut.

NOTE: For proper brake operation, the brake shoes and backing plate must be concentrically aligned with the brake drum.

8. To align brake shoes and drum, apply parking brake. Then tighten four socket head screws and lock nuts that secure the brake bracket and wheel motor to the frame.

9. Place wheel onto drive studs and wheel hub. Secure wheel with lug nuts on drive studs.

10. Lower wheel to ground. Torque lug nuts from 45 to 65 ft-lb (61 to 88 N-m) in a criss-cross pattern. Torque lock nut from **250 to 275 ft-lb (339 to 372 N-m)**.

11. Check and adjust brakes (see Adjust Brake).

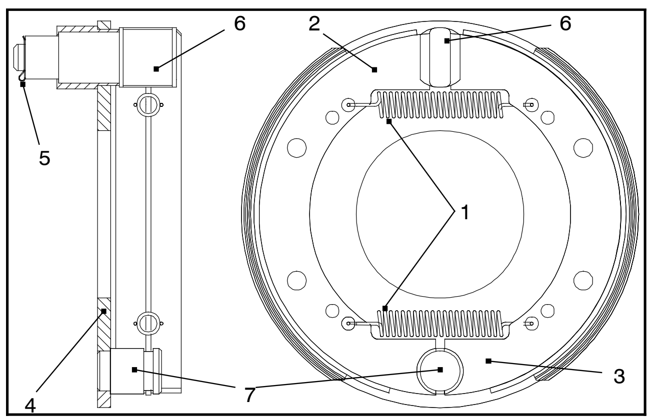

Figure 8

1. **Return spring**
2. **Brake shoe (toe end)**
3. **Brake shoe (heel end)**
4. **Backing plate**
5. **Retaining clip**
6. **Cam shaft**
7. **Anchor pin**

Burnish Brake Pads

After brake pad replacement, burnish (break-in) the brakes before use.

1. Bring the machine to full speed and apply the brakes to rapidly stop the machine without skidding or locking up the wheels.

2. Repeat this procedure 10 times. To avoid overheating the brakes, wait 1 minute between each stop.

Rear Fork and Wheel

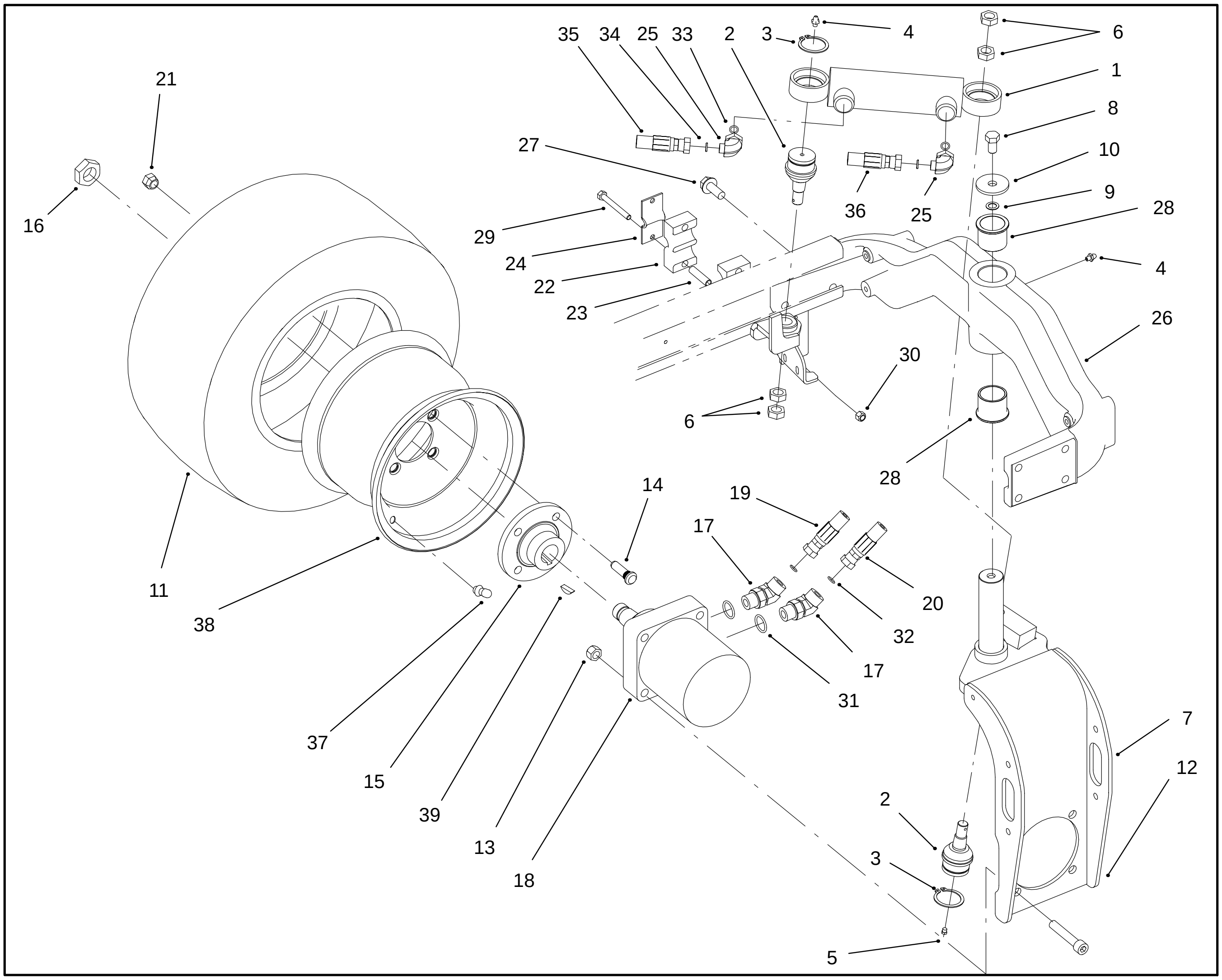

Figure 9

1. Hydraulic cylinder	**14. Drive stud**	**27. Hex flange head screw**
2. Ball joint	**15. Wheel hub**	**28. Bushing**
3. External retaining ring	**16. Lock nut**	**29. Cap screw**
4. Grease fitting	**17. 45º hydraulic fitting**	**30. Lock nut**
5. Grease fitting plug	**18. Hydraulic motor**	**31. O−ring**
6. Jam nut	**19. Hydraulic hose**	**32. O−ring**
7. Rear fork	**20. Hydraulic hose**	**33. O−ring**
8. Cap screw	**21. Lug nut**	**34. O−ring**
9. Lock washer	**22. Clamp**	**35. Hose assembly**
10. Thrust washer	**23. Spacer**	**36. Hose assembly**
11. Tire	**24. Case drain clamp**	**37. Valve stem**
12. Hex socket head screw	**25. Hydraulic fitting**	**38. Wheel rim**
13. Lock nut	**26. Rear casting**	**39. Woodruff key**

Removal

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

2. Remove hood from the machine (see Hood Removal).

3. Separate hydraulic cylinder from the rear fork as follows:

A. Remove both jam nuts securing the ball joint to the rear fork.

B. Separate ball joint from the rear fork.

C. Swing cylinder clear of the rear fork.

WARNING

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

4. Jack up rear wheel enough to allow the removal of the rear fork.

5. Remove lug nuts from drive studs. Remove tire with wheel rim from wheel hub.

6. Remove four lock nuts and hex socket head screws securing the hydraulic motor to the rear fork. Remove motor from the fork and position it away from the fork.

CAUTION

Support front fork to prevent its falling during removal and installation. Personal injury or damage to the fork may result from improper handling.

7. Remove cap screw, thrust washer, and lock washer from the rear fork shaft.

8. Lower rear fork from machine.

9. Check bushings for wear and damage. Replace if necessary.

Installation

1. Position rear fork through the frame.

2. Install lock washer, thrust washer, and cap screw to the rear fork shaft. Torque cap screw from 60 to 80 ft−lb (81.4 to 108.5 N−m). Make sure fork turns freely.

3. Install hydraulic motor to the rear fork. Secure motor to the fork with four hex socket head screws and lock nuts.

4. Secure wheel rim to the wheel hub with four lug nuts. Torque nuts from 45 to 65 ft−lb (61 to 88 N−m).

5. Lower rear wheel to the ground.

6. Secure hydraulic cylinder to the rear fork as follows:

   A. Swing cylinder to the rear fork.

   B. Separate ball joint to rear fork.

   C. Secure ball joint to the rear fork with both jam nuts.

Brake Linkages

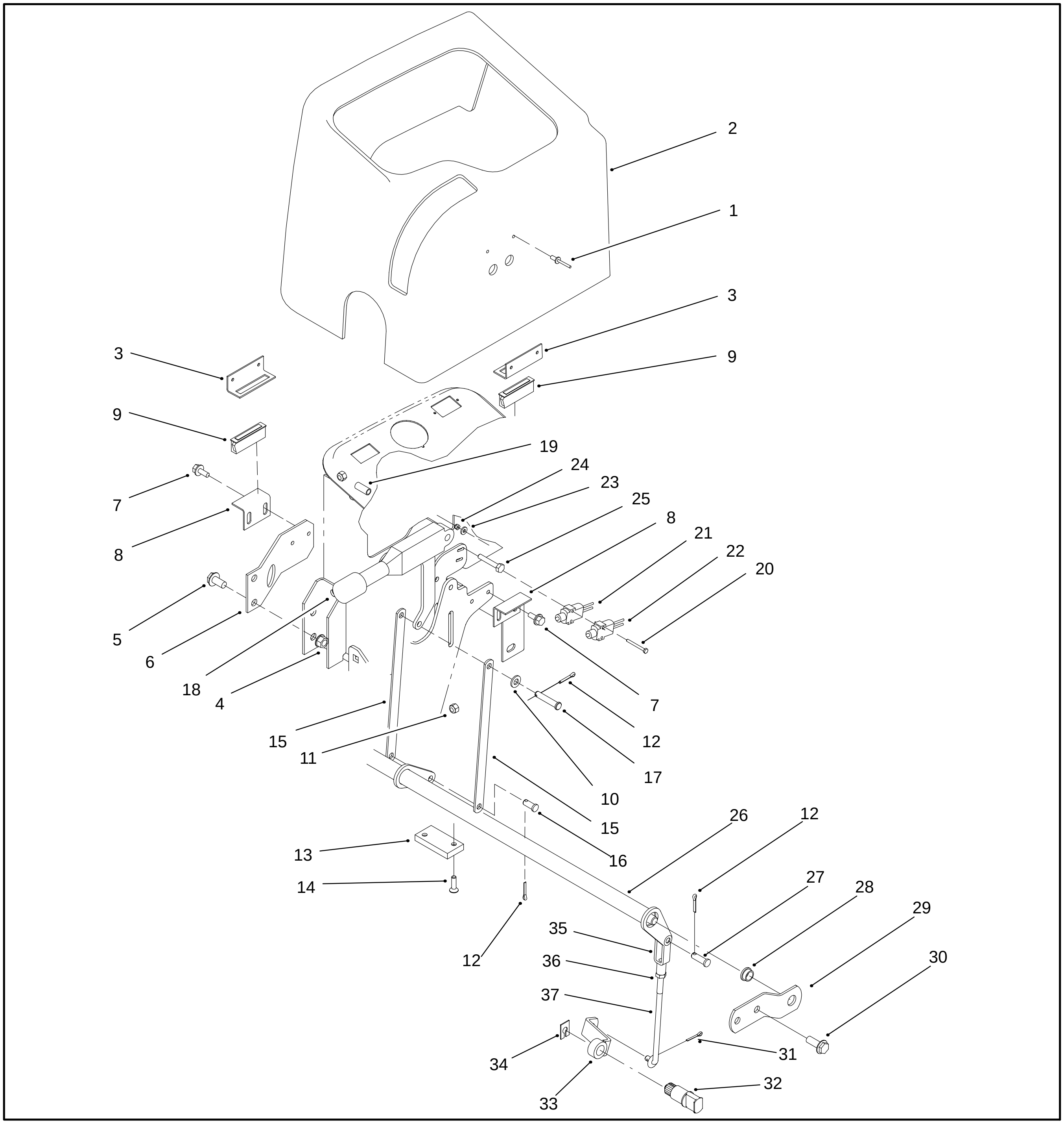

Figure 10

1. Pop rivet
2. Control panel cover
3. Cover bracket
4. Flange nut
5. Hex flange head screw
6. Magnet support
7. Hex washer head screw
8. Strike bracket
9. Magnetic catch
10. Flat washer
11. Lock nut
12. Cotter pin
13. Bumper pad
14. Hex socket flat head screw
15. Parking brake link
16. Clevis pin
17. Clevis pin
18. Lever Assembly
19. Parking brake spacer
20. Slotted hex head screw
21. Switch
22. Switch
23. Flat washer
24. Lock nut
25. Cap screw
26. Brake pivot shaft
27. Clevis pin
28. Flange bushing
29. Brake pivot bracket
30. Hex flange head screw
31. Cotter pin
32. Brake cam shaft
33. Brake lever
34. Retainer clip
35. Adjustable clevis
36. Jam nut
37. Adjustment rod

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

2. Remove control panel cover from the machine.

IMPORTANT: When removing the adjustable clevis from either the brake pivot shaft or adjustment rod or the brake lever from the cam shaft on the brake assembly, make sure to matchmark both parts. Marking both parts will make reassembly and brake adjustment easier.

3. Remove and replace parts as necessary to repair brake linkages.

4. Install control panel cover to the machine.

IMPORTANT: Always check and adjust the brakes anytime brake linkages are disassembled or repaired.

5. Adjust brake linkages (see Brake Adjustment).

Steering Column

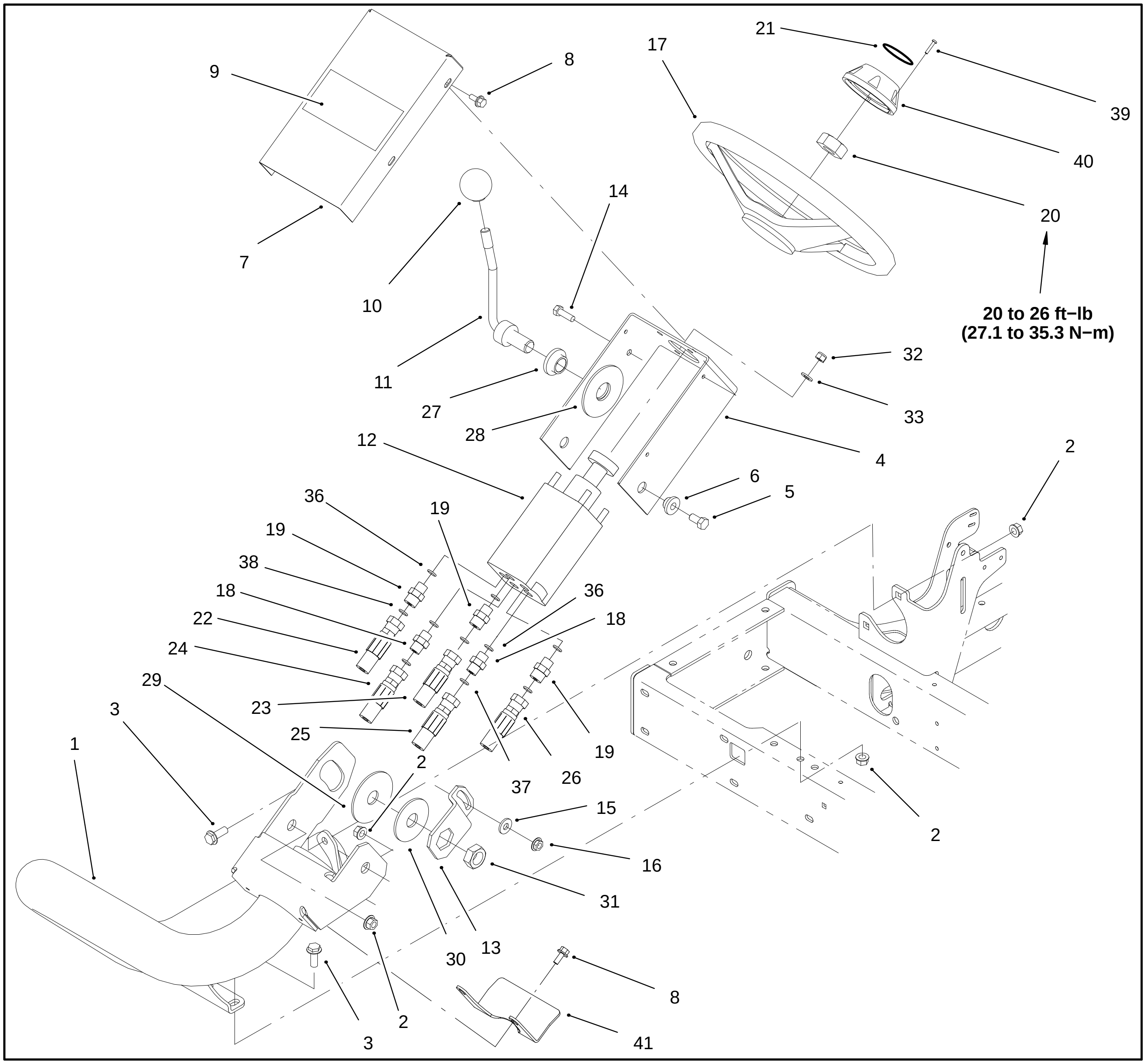

Figure 11

1. **Steering arm**
2. **Flange hex nut**
3. **Hex flange head screw**
4. **Steering control valve bracket**
5. **Cap screw**
6. **Pivot hub**
7. **Steering cover**
8. **Cap screw**
9. **Toro decal**
10. **Ball knob**
11. **Lever**
12. **Steering control valve**
13. **Tilt bracket**
14. **Cap screw**
15. **Flat washer**
16. **Flange hex nut**
17. **Steering wheel**
18. **Hydraulic fitting**
19. **Hydraulic fitting**
20. **Steering wheel nut**
21. **Toro decal**
22. **Hose assembly**
23. **Hose assembly**
24. **Hose assembly**
25. **Hose assembly**
26. **Hose assembly**
27. **Tilt steering boss**
28. **Friction disc**
29. **Friction disc**
30. **Flat washer**
31. **Jam nut**
32. **Lock nut**
33. **Flat washer**
34. **Not used**
35. **Not used**
36. **O−ring**
37. **O−ring**
38. **O−ring**
39. **Philips pan head screw**
40. **Steering wheel cap**
41. **Steering shield**

Disassembly

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

2. Remove philips pan head screws and steering wheel cap from the steering wheel.

3. Remove steering wheel nut from the steering control valve. Pull steering wheel from the control valve.

4. Remove steering cover from the steering control valve bracket.

5. Remove four lock nuts and flat washers securing the steering control valve to the steering control valve bracket.

6. Remove both hex flange nuts, cap screws, and pivot hubs securing the steering control valve bracket to the steering arm. Slide bracket from the steering control valve and steering arm.

7. Remove and replace parts as necessary to repair steering column using Figure 11 as a guide.

Assembly

1. Make sure lever and friction discs are properly assembled to the steering control valve bracket using Figure 11 as a guide.

2. Position steering control bracket to the steering control valve and steering arm. Secure bracket to the steering arm with pivot hubs, cap screws, and hex flange nuts.

3. Secure steering control valve bracket to the steering control valve studs with four flat washers and lock nuts.

4. Secure steering cover to the steering control valve bracket with cap screws.

5. Install steering wheel to the steering control valve. Secure steering wheel nut to the steering control valve. Torque steering wheel nut from 20 to 26 ft−lb (27.1 to 35.3 N−m).

6. Secure steering wheel cap to the steering wheel with six philips pan head screws.

Chapter 7

SPA Cutting Units

Table of Contents

Specifications

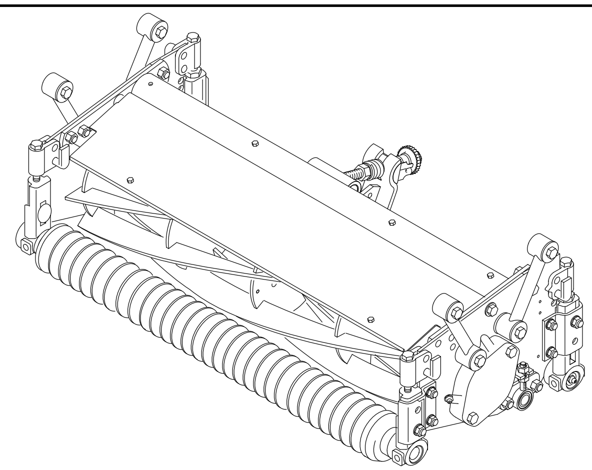

Figure 1

MOUNTING: All cutting units are supported by equal length independent lift arms and are interchangeable to all three cutting unit positions.

CONSTRUCTION: 5 or 8 blades of 7 inches (18 cm) diameter welded to stamped steel spiders. Reels are mounted on greaseable self−aligning ball bearings. A cutting unit has a reel of either 27 inches (69 cm) in length or 32 inches (81 cm) in length.

HEIGHT OF CUT RANGE:
Floating Cutting Unit − 1/4 to 1−3/4 inches (6.4mm to 44.4mm).
Fixed Cutting Unit − 1/2 to 2−5/8 inches (12.7 mm to 65.6 mm).

POWER: Reel motors allow easy removal from or installation onto the cutting unit. Cutting units can be driven from either end.

HEIGHT−OF−CUT & ROLLER ADJUSTMENT: Height−of−cut adjustment is made with the rollers by a quick locating pin and/or threaded micro−adjustment.

BEDKNIFE AND BEDBAR ADJUSTMENT: A single knob (SPA) screw adjustment for bedknife to reel is located at the center of the bedbar.

CUTTING UNIT LIFT: Hydraulic lift has an automatic reel shut off. All units are controlled from one lever.

SUSPENSION SYSTEM: A fully floating suspension with hydraulic counterbalance. L−I−N−K−S™ cutting unit suspension system provides fore and aft oscillation. Main center pivot allows side−to−side oscillation. With optional Fixed Kit (Part No. 93−6915), cutting units can be locked into fixed (fore/aft) position for use with skids or anti−scalp rollers.

CLIP FREQUENCY: With variable speed set to maximum rpm:

5 blade at 1040 reel rpm moving at 5 mph (8.1 km/h) 1 inch (25.4 mm) clip.
5 blade at 1040 reel rpm moving at 6 mph (9.7 km/h) 1.20 inch (30.5 mm) clip.
8 blade at 1040 reel rpm moving at 5 mph (8.1 km/h) 0.63 inch (16.0 mm) clip.
8 blade at 1040 reel rpm moving at 6 mph (9.7 km/h) 0.76 inch (19.3 mm) clip.

OPTIONAL EQUIPMENT:

27−inch Cutting Units	
Full Roller Kit	Model No. 03440
Sectional Roller Kit	Model No. 03445
Wiehle Roller Kit	Model No. 03450
Anti−Scalp Roller Kit	Model No. 03447
Roller Scraper Kit	Part No. 60−9560
Wiehle Roller Scraper Kit	Part No. 94−5082
Comb Kit	Part No. 67−9400
32−inch Cutting Units	
Sectional Roller Kit	Model No. 03476
Wiehle Roller Kit	Model No. 03475
Full Roller Kit	Model No. 03479
Anti−Scalp Roller Kit	Model No. 03477
Roller Scraper Kit	Model No. 03478
Wiehle Roller Scraper Kit	Part No. 94−5081
Both Models of Cutting Units	
Fixed Kit	Part No. 93−6915
Skid Kit	Part No. 94−3664
Backlapping Brush Assembly	Part No. 29−9100
Gauge Bar Assembly	Part No. 13−8199
Bedknife Screw Tool	Part No. 51−0880

Special Tools

Order special tools from your Toro Distributor. Some tools may have been supplied with your machine or available as TORO parts. Some tools may also be available from a local supplier.

Gauge Bar Assembly

Use gauge bar to verify height of cut (Toro Part No. 13−8199).

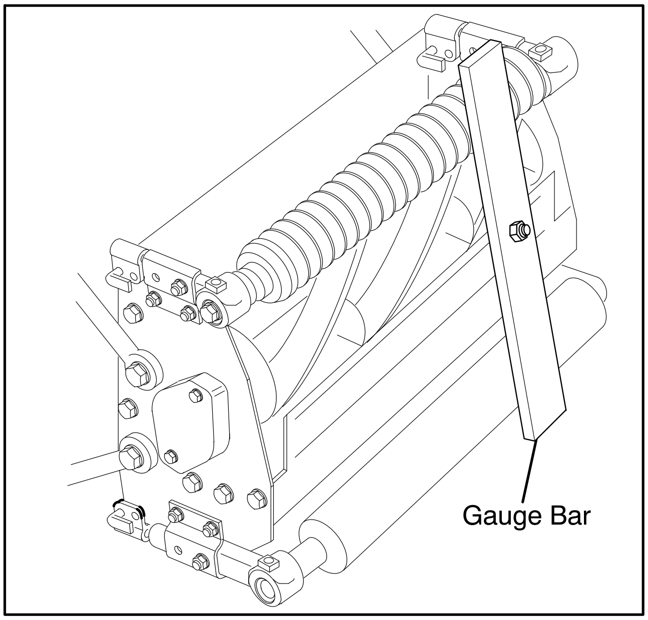

Figure 2

Handle Assembly – TOR299100

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

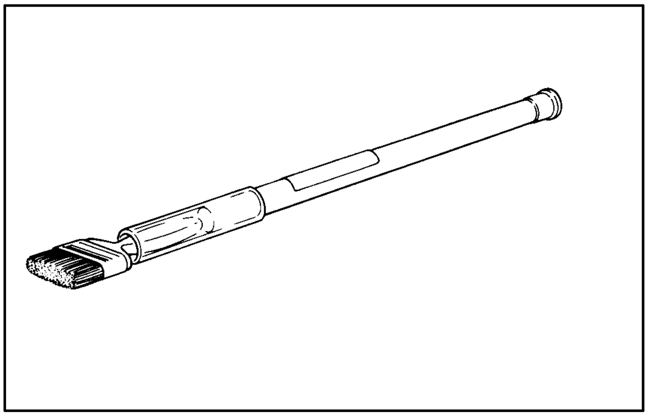

Figure 3

SPA Cutting Units

Bedknife Screw Tool – TOR510880

This screwdriver type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT: Do not use and air or manual impact wrench with this tool.

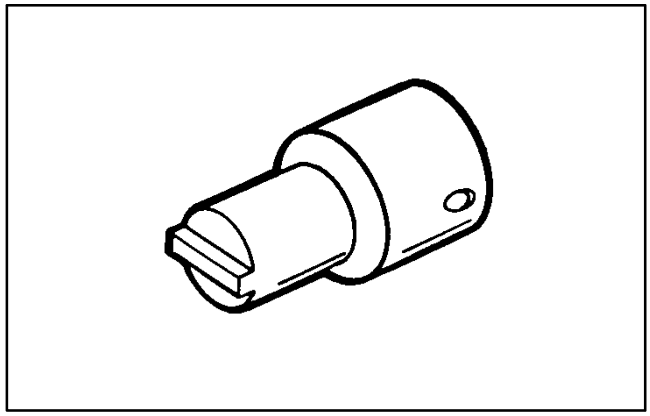

Figure 4

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. 5).

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. 6).

4. Place the angle indicator on the mount with the digital display facing you as shown (Fig. 6). The angle displayed on the indicator is the current bedknife top angle. The angle measured should be between 8° and 12°.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

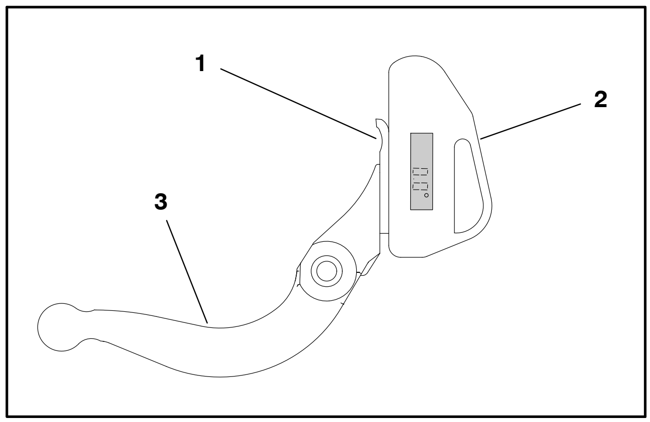

Figure 5

1. **Bedknife**
2. **Angle indicator**
3. **Bedbar**

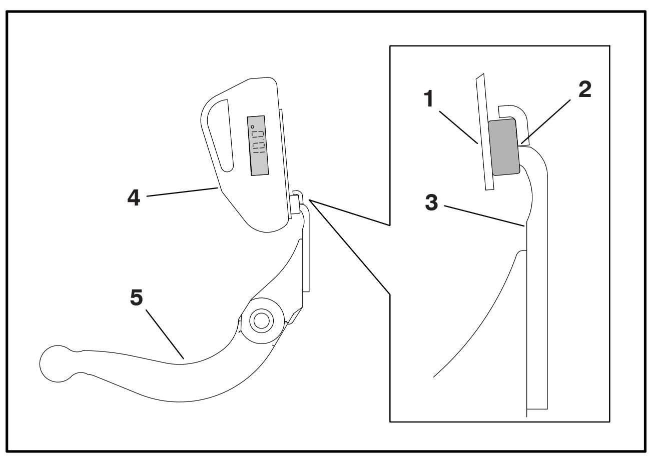

Figure 6

1. **Angle indicator mount**
2. **Magnet**
3. **Bedknife**
4. **Angle indicator**
5. **Bedbar**

Troubleshooting

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the machine. It is important to remember that the lower the height of cut, the more critical these factors are.

Remember that the “effective” or actual height of cut depends on cutting unit weight and turf conditions. Effective height of cut will be different than the bench set height of cut.

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)**

Factors That Can Affect Quality of Cut

Factor	Possible Problem/Correction
1. Engine maximum governed speed.	Check maximum governed engine speed. Adjust speed to specifications if necessary. If engine is not running at specified maximum governed RPM, reel speed settings may not match ground speed.
2. Reel speed and ground speed.	Adjust reel speed to setting shown on REEL SPEED SETTINGS graph for the number of reel blades (5 or 8) and the desired ground speed (see Operator’s Manual). All reels should rotate at the same speed. All cutting units should have equal bedknife to reel contact. If checking RPM, do not run reel too long without cutting grass, or bedknife and/or reel may overheat and “rifle”. See other items in Troubleshooting section of Chapter 4 – Hydraulic System.
3. Tire pressure.	Check each tire’s pressure. Adjust to pressures specified in Specifications section of Chapter 6 – Wheels and Brakes.
4. Reel bearing condition.	All reels should rotate freely. Make sure bearings are properly lubricated. Replace bearings if worn or damaged. See Reel Assembly in the Service and Repairs section of this chapter.
5. Reel and bedknife sharpness.	Reel and/or bedknife that has rounded cutting edges or “rifling” **cannot** be corrected by tightening bedknife to reel contact. Grind reel to remove taper and/or rifling (grooved or wavy appearance). Grind bedknife to sharpen and/or remove rifling. (Most common cause of rifling is bedknife to reel contact that is **too tight**.) **NOTE:** New bedknife must be ground or backlapped after installing on bedbar.

Factor	Possible Problem/Correction
6. Bedknife to reel adjustment.	Check bedknife to reel contact daily. Bedknife must have light contact all across the reel. No contact will cause cutting edges to become dull. Excessive contact accelerates wear; quality of cut may be adversely affected. Slightly dull cutting edges may be corrected by backlapping, Excessively dull cutting edges must be corrected by grinding the reel and bedknife.
7. Front roller position.	Make sure front rollers on all cutting units are in the same position.
8. Rear roller parallel to reel.	Rear roller must be set so that it is parallel with the reel before setting height of cut.
9. Height−of−cut.	Make sure all cutting units are set at the same height of cut. Set units as specified in the Operator's Manual.
10. Bedbar stability.	Check bedbar end bushings, adjuster pivot bushings and nylon flanged bushings for wear or damage. Check adjustment knob to make sure detent holds adjustment.
11. Number of reel blades.	Use cutting unit model with the correct number of blades for clip frequency and optimum quality of cut range (see Specifications).
12. Cutting unit alignment and ground following.	Check lift arms and cutting unit pivot linkages for wear, damage, binding, or bent pivot pins.
13. Roller condition.	All rollers should rotate freely. Make sure bearings are properly lubricated. Replace bearings if worn or damaged.

Adjustments

CAUTION

Never install or work on the cutting units or lift arms with the engine running. Always stop engine and remove key first.

Characteristics

The single knob (SPA) 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 the single knob/bedbar 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 permits optimum bedknife attitude and location for varying height–of–cuts and turf conditions.

If a cutting unit is expected to be out of adjustment, use the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.

2. Adjust the front roller.

3. Level the rear roller.

4. Set height–of–cut.

Daily Adjustments

Prior to each day's mowing, or as required, each cutting unit must be checked to verify proper bedknife–to–reel contact. **This must be performed even though quality of cut is acceptable.**

1. Lower cutting units onto a hard, level surface. Shut off engine and remove key from ignition.

2. Slowly rotate reel in the reverse direction while listening for reel–to–bedknife contact. If no contact is evident, turn bedknife adjusting knob clockwise, one click at a time, until light contact is felt and heard.

3. If excessive contact is felt, turn bedknife adjusting knob counterclockwise, one click at a time until no contact is evident. Then turn bedknife adjusting knob one click at a time clockwise, until light contact is felt and heard.

IMPORTANT: Light contact is preferred at all times. If light contact is not maintained, bedknife and reel edges will not sufficiently self–sharpen and dull cutting edges will result after a period of operation. If excessive contact is maintained, bedknife and reel wear will be accelerated, uneven wear can result, and quality of cut may be adversely affected.

NOTE: As the reel blades continue to run against the bedknife, a slight burr will appear on the front cutting edge surface for the full length of the bedknife. Running a file occasionally across the front edge to remove this burr will improved cutting quality.

After extended running, a ridge will eventually develop at both ends of the bedknife. These ridges must be rounded off or filed flush with cutting edge of bedknife to assure smooth operation.

Adjust Bedknife Parallel to Reel

NOTE: A 3/4−inch (19 mm) wrench will be needed to rotate the bedknife adjustment knob (Fig. 7).

IMPORTANT: Do not allow cutting unit to rest on the bedknife adjusting screw. The setting of the bedknife will be changed.

1. Remove any reel contact by turning the bedknife adjustment knob counterclockwise (Fig. 7). Tip cutting unit to gain access to the reel and bedknife (Fig. 8).

2. On either end of the reel, insert a long strip of dry newspaper between the reel and bedknife. While slowly rotating reel into the bedknife, turn bedknife adjusting knob clockwise, one click at a time until the paper is pinched lightly. The pinching should result in a slight drag when the paper is pulled.

3. Check for light contact at the other end of reel using newspaper as in step 2. If light contact is not evident, proceed to the next step.

4. Remove counter weights and gasket from the end of the cutting unit.

5. Loosen both carriage bolts on the bedbar adjuster (Fig.9).

6. Adjust nuts to move bedbar adjuster up or down until paper is pinched along entire bedknife surface, when bedknife adjustment knob is adjusted to no more than two clicks beyond first contact of reel bedknife (Fig.9).

7. Tighten nuts and carriage bolts and verify adjustment.

8. Reinstall counter weights to the same ends of the cutting units that they were removed from.

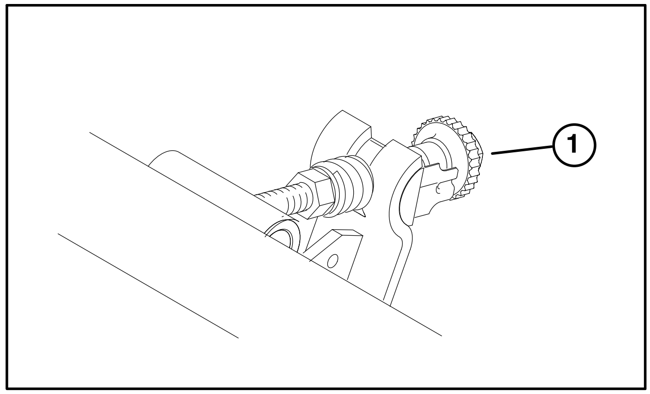

Figure 7
1. Bedknife adjusting screw

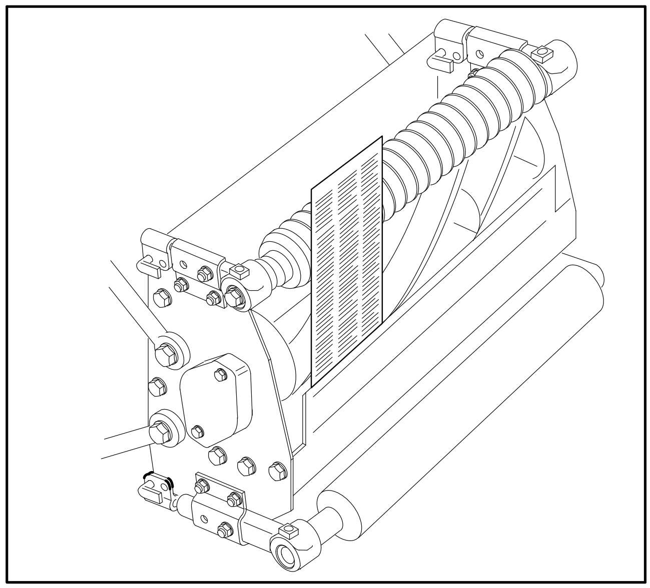

Figure 8

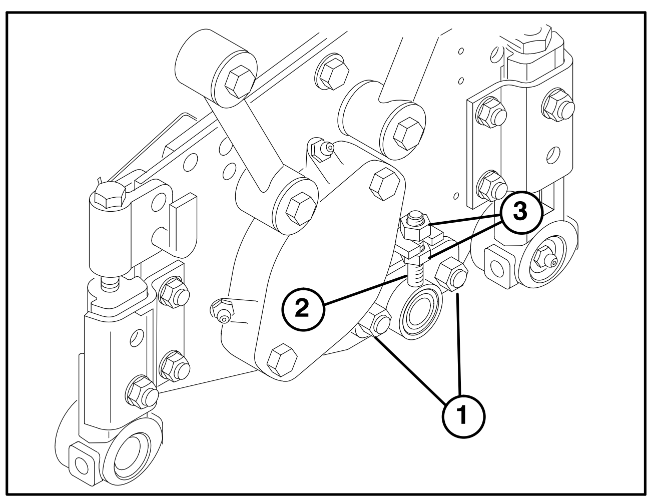

Figure 9
1. **Carriage bolts**
2. **Bedbar adjuster**
3. **Adjustment nuts**

Set Height–of–Cut and Level Both Rollers

Note: Both floating and fixed cutting units can use this method for making height–of–cut adjustments and leveling both front and back rollers.

1. Position cutting unit on a flat level table or board.

2. Loosen nut slightly that secures each roller bracket to the angle bracket.

3. For the front roller, adjust support cap screw to achieve a 1 inch ± 1/16 (25.4 mm ± 1.6) dimension between both height–of–cut supports and each front roller bracket at each end of the cutting unit.

4. For the rear roller, adjust support cap screw to achieve 5/8 inch ±1/16 (15.9 mm ± 1.6) dimension between both height–of–cut supports and each rear roller bracket at each end of the cutting unit.

5. For the rear roller, remove hairpin cotters securing rear height–of–cut pins. Reinstall height–of–cut pins in the 1/2–inch setting as indicated on the rear height–of–cut plate.

6. For the front roller, remove hairpin cotters securing front height–of–cut pins. Reinstall height–of–cut pins in the 1/4–inch setting as indicated on the front height–of–cut plate to allow for clearance between the front roller and table.

7. Position a 1/2–inch or thicker bar under the reel blades and against the front face of the bedknife. Make sure the bar covers the full length of reel blades.

8. Verify that the rear roller is level by attempting to insert a piece of paper under each end of the roller. The paper should not fit between the roller and table.

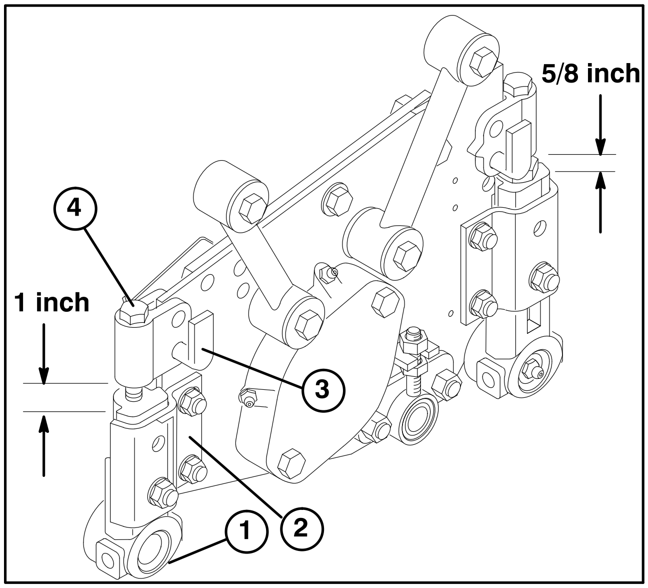

Figure 10

1. **Nut**
2. **Rear roller bracket**
3. **Front roller bracket**
4. **Angle bracket**
5. **Support capscrew**
6. **Height–of–cut support**
7. **Height–of–cut pins**
8. **Height–of cut plate**

9. Level rear roller by adjusting the appropriate support cap screw on the rear roller supports until the roller is parallel and the entire length of roller contacts the table. A piece of paper inserted between the roller and the table should not fit.

10. When roller is level, adjust both rollers to desired height–of–cut with height–of–cut pins. **Tighten nuts securing roller brackets and replace hairpin cotters to the height–of–cut pins.**

SPA Cutting Units

Verify Height−of−Cut and Front Roller Level

NOTE: Gauge bar (Toro Part No. 13−8199) may be obtained from your local Toro Distributor.

IMPORTANT: Height−of−cut must be set and both rollers leveled before performing this adjustment (see Set Height−of−Cut and Level Both Rollers).

1. On the gauge bar, set head of the screw to the desired Height−of−Cut. This measurement is from the bar face to the underside of the screw head.

2. Loosen nuts slightly that secure each front roller bracket to the angle bracket.

3. Place gauge bar across the front and rear rollers. Adjust both front roller support capscrews until the underside of the head of screw on the gauge bar engages the bedknife cutting edge. Do this on both ends of reel.

4. Tighten all nuts securing the roller brackets.

5. Place cutting unit on a flat surface. Verify that front and rear rollers contact the flat surface. Readjust Height−of−Cut as required (see Set Height−of−Cut and Level Rear Roller).

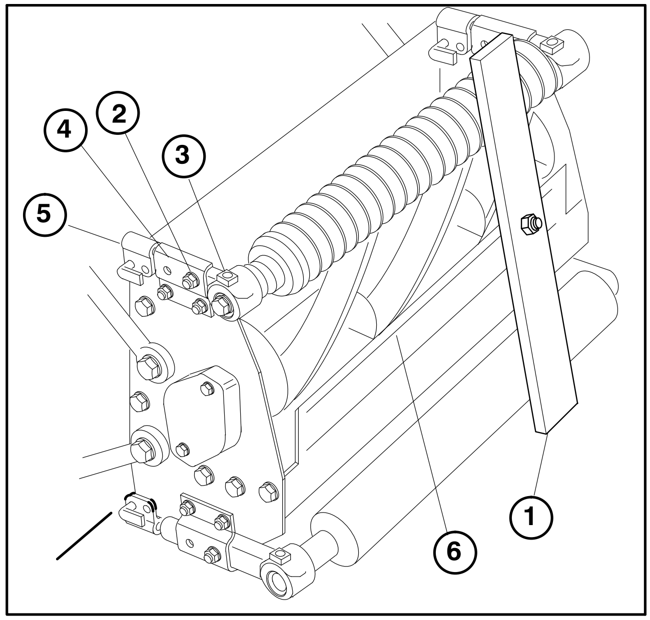

Figure 11

1. **Gauge bar**
2. **Front roller bracket nut**
3. **Front roller bracket**
4. **Angle bracket**
5. **Front roller support cap screw**
6. **Bedknife**

Adjust Front Lift Arms

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

IMPORTANT: Keep front cutting units on the lift arms when performing this adjustment.

2. Raise front lift arms. Make sure clearance between each lift arm and floor plate bracket is 0.18 to 0.32 inch (4.6 to 8.1 mm) (Fig. 12).

3. If the clearance is not in this range, attain proper clearance as follows:

   A. Back off stop bolts if reducing the clearance between the stop bolt and lift arm (Fig. 13).

   B. Adjust front hydraulic cylinder by backing off jam nut on the cylinder, removing the pin from the clevis, and rotating the clevis (Fig. 14).

   C. Install pin to clevis and check clearance. Repeat steps A and B if necessary.

4. Make sure clearance between each lift arm and stop bolt is 0.005 to 0.040 inch (0.127 to 1.02 mm). If the clearance is not in this range, adjust stop bolts as necessary (Fig 13).

IMPORTANT: The lack of clearance at the front stops can damage the lift arms.

5. Install both front cutting units to the lift arms (see Cutting Unit Removal and Installation).

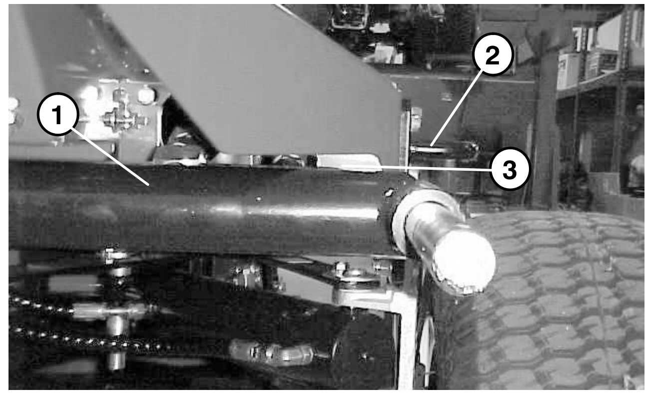

Figure 12

1. **Lift arm**
2. **Floor plate bracket**
3. **Clearance**

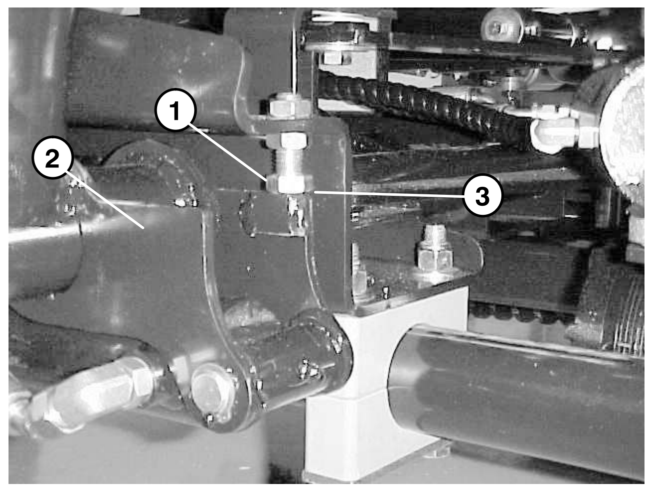

Figure 13

1. **Stop bolt**
2. **Lift arm**
3. **Clearance**

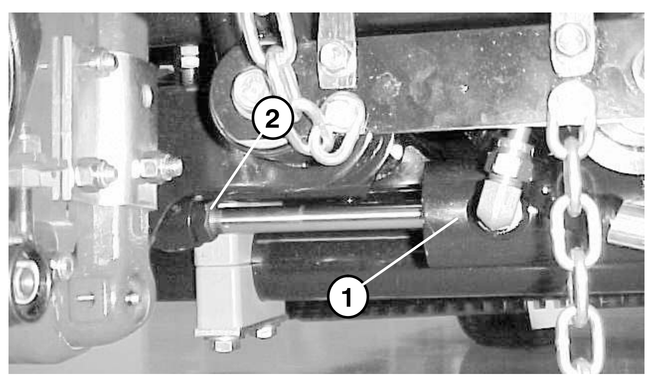

Figure 14

1. **Hydraulic cylinder**
2. **Jam nut**

SPA Cutting Units

Adjust Rear Lift Arm

1. Park machine on a level surface and engage parking brake.

IMPORTANT: This adjustment must be performed with the rear cutting unit attached to the rear lift arm.

2. Raise lift arms. Make sure clearance between wear strap on the top of the rear cutting unit wear bar and bumper strap is 0.020 to 0.100 inch (0.508 to 2.54 mm) (Fig. 15).

3. If the clearance is not in this range, attain proper clearance by adjusting the rear hydraulic cylinder as follows (Fig. 16):

A. Lower cutting units, turn engine off, and remove key from the ignition switch.

B. Back off jam nut from the rear hydraulic cylinder clevis.

IMPORTANT: Use a protective covering around the hydraulic cylinder rod when rotating the rod to prevent damage to the rod.

C. Grasp cylinder rod near the jam nut and rotate the rod.

D. Raise cutting units and check clearance. Repeat steps A through C as necessary. Tighten jam nut on hydraulic cylinder rod.

NOTE: If rear lift arm makes clunking noises during transport, the clearance can be reduced.

IMPORTANT: The lack of clearance at the rear wear bar can damage the rear lift arm.

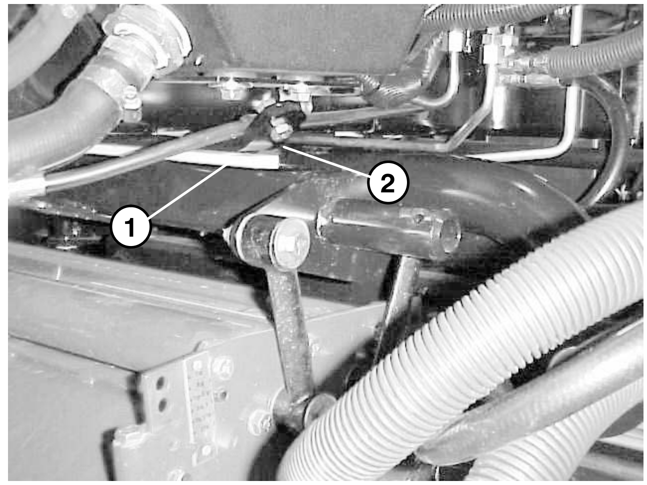

Figure 15

1. **Wear bar** 2. **Bumper strap**

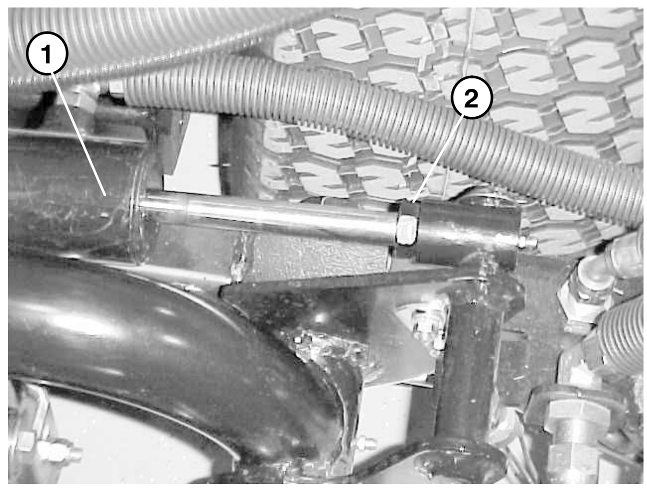

Figure 16

1. **Rear hydraulic cylinder** 2. **Jam nut**

Service and Repairs

Greasing Bearings, Bushings, and Pivot Points

Each cutting unit has 9 grease fittings (with an optional front roller installed) that must be lubricated regularly with No. 2 general purpose lithium base grease.

Grease Fitting Locations and Quantities

Each bedknife adjuster has 1 fitting (Fig. 17). Each reel bearing housing has 2 fittings. Each front and rear roller has 2 fittings, one on each end of the roller (Fig. 18).

NOTE: Lubricate only one reel bearing grease fitting on each end of cutting unit.

IMPORTANT: Lubricate cutting units immediately after washing. This helps purge water out of bearings and increases bearing life.

1. Wipe each grease fitting with a clean rag.

IMPORTANT: Do not apply too much pressure or grease seals will be permanently damaged.

2. Apply grease until pressure is felt against the handle.

3. Wipe excess grease away.

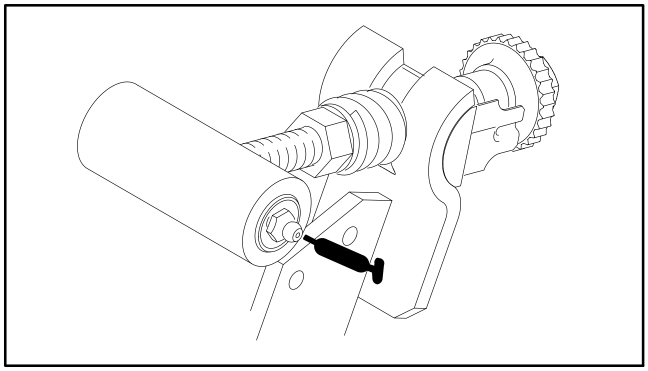

Figure 17
Grease every 50 hours

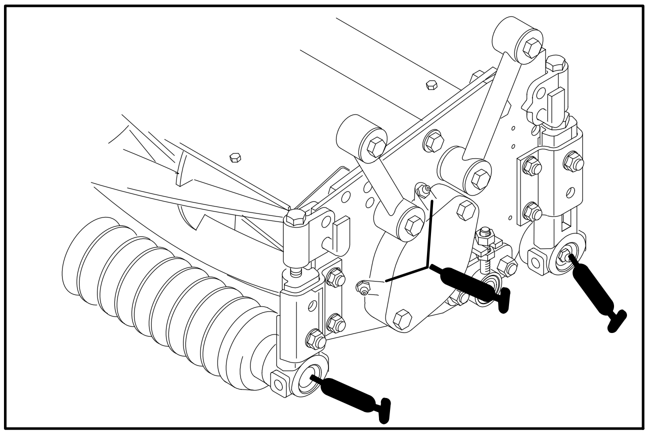

Figure 18

Grease every 8 hours

Backlapping

DANGER

TO AVOID PERSONAL INJURY OR DEATH:
– Never place hands or feet in reel area while the engine is running.
– While backlapping, reels may stall and restart.
– Do not attempt to restart reels by hand or foot.
– Do not adjust reels while the engine is running. If the reel stalls, stop engine before attempting to clear the reel.
– Reel motors are connected in series, moving one motor moves the other two.

Note: Additional instructions and procedures on backlapping are available in the Toro General Service Training Book, Reel Mower Basics (part no. 09168SL).

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

2. Remove console cover to expose the controls.

3. Rotate backlap knob on the manifold block clockwise to the BACKLAP position. Rotate reel speed knob to position 1 (Fig. 20).

4. Make initial reel to bedknife adjustments appropriate for backlapping on all cutting units. Start engine and set engine speed to low idle.

5. Engage reels by moving mow/transport lever to MOW and depressing the reel ON/OFF switch.

CAUTION

Be careful when lapping the reel because contact with the reel or other moving parts can result in personal injury.

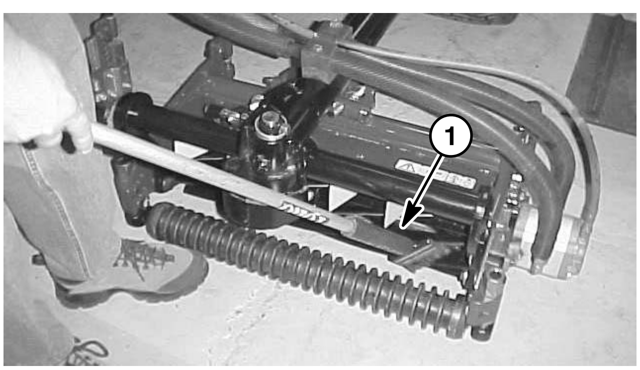

Figure 19

1. **Long Handle Brush**

6. Apply lapping compound with a long handled brush.

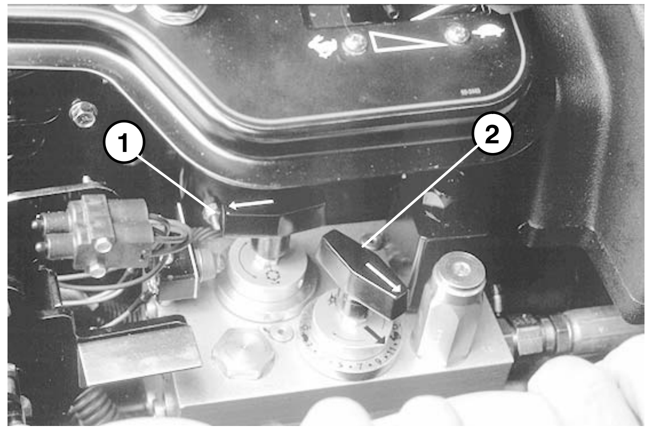

Figure 20

1. **Backlap knob**
2. **Reel speed knob**

7. To make an adjustment to the cutting units while backlapping, turn off the reels by pushing in the reels ON/OFF switch on instrument panel to OFF position and stopping the engine. After adjustments have been completed, repeat steps 4 through 6.

8. When backlap operation is completed, rotate backlap knob counter-clockwise to the MOW position, set reel speed controls to the desired mowing setting, and wash all lapping compound off the cutting units.

Note: For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed. This will remove any burrs or rough edges that may have built up on the cutting edge.

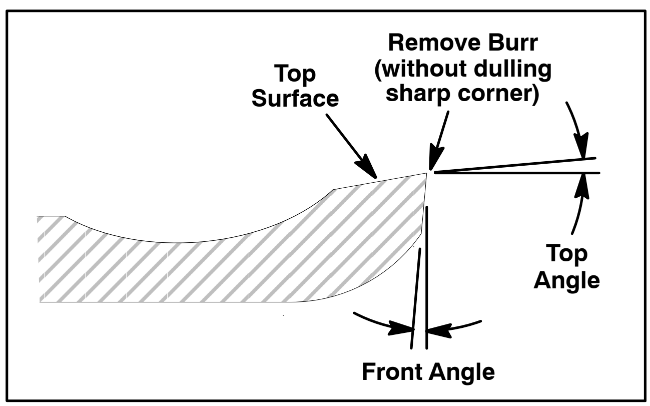

Figure 21

Cutting Unit Removal and Installation

Removal

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

2. On the front cutting units, detach chain from the cutting unit carrier frame by removing the lock nut and cap screw (Fig. 23).

3. Remove hydraulic motor from the cutting unit (see Reel Motor Removal).

4. Remove lynch pin from pivot shaft (Fig. 24 and 25).

5. Slide cutting unit carrier frame and thrust washer from the pivot shaft.

Installation

1. On the front cutting units, slide thrust washer and then cutting unit carrier frame onto pivot shaft (Fig. 24).

2. On the rear cutting unit, slide cutting unit carrier frame and then thrust washer onto pivot shaft (Fig. 25).

3. Install lynch pin onto the pivot shaft (Fig. 24 and 25).

4. Install hydraulic motor to the cutting unit (see Reel Motor Installation).

5. On front cutting units, attach chain to the cutting unit carrier frame with cap screw and lock nut (Fig. 23).

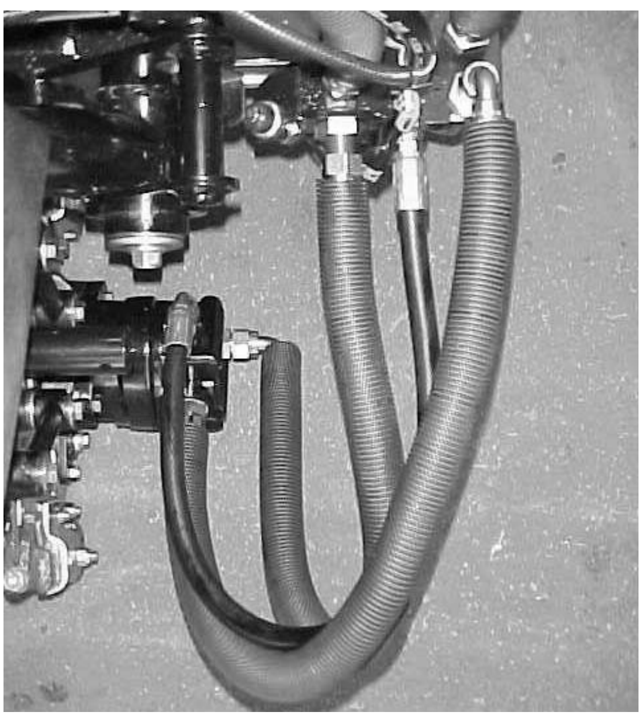

Figure 22

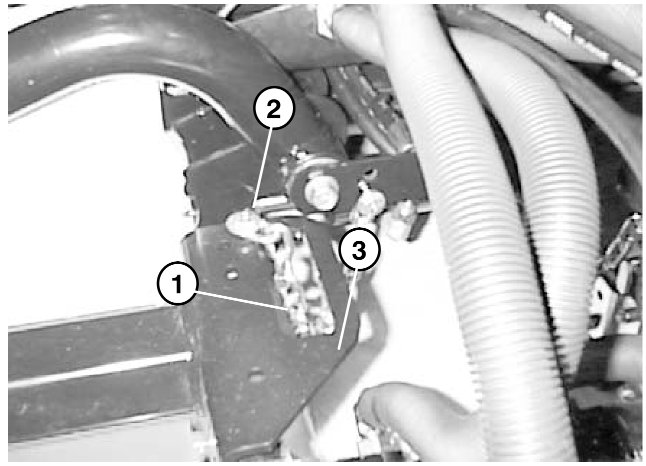

Figure 23

1. **Chain**
2. **Cap screw & lock nut**
3. **Front carrier frame (RH)**

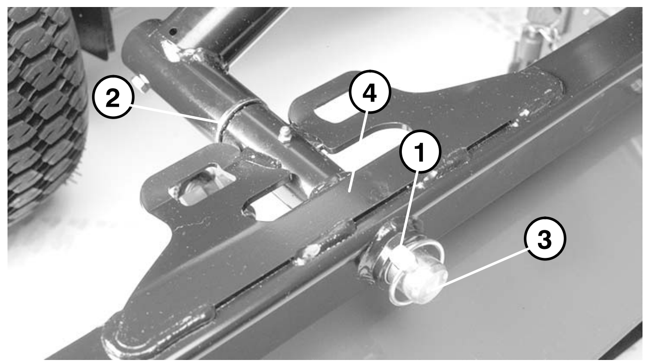

Figure 24

1. **Lynch pin**
2. **Thrust washer**
3. **Pivot shaft**
4. **Front unit carrier frame**

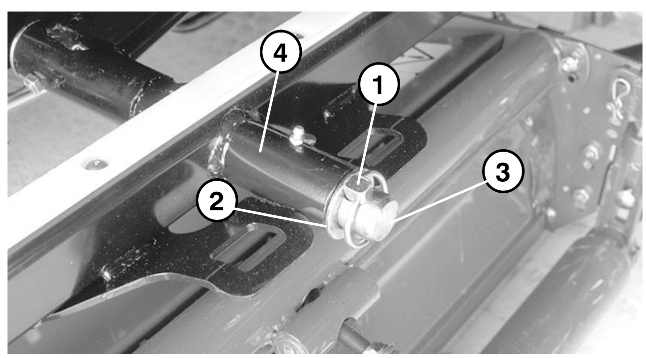

Figure 25

1. **Lynch pin**
2. **Thrust washer**
3. **Pivot shaft**
4. **Rear unit carrier frame**

IMPORTANT: Make sure hoses are free of twists and sharp bends. Route rear cutting unit hoses as shown (Fig. 22). Raise cutting units and shift them to the left (Model 03201 only). Rear cutting unit hoses must not contact the traction cable bracket. If required, reposition fittings and hoses.

SPA Cutting Units

Reel Motor Removal and Installation

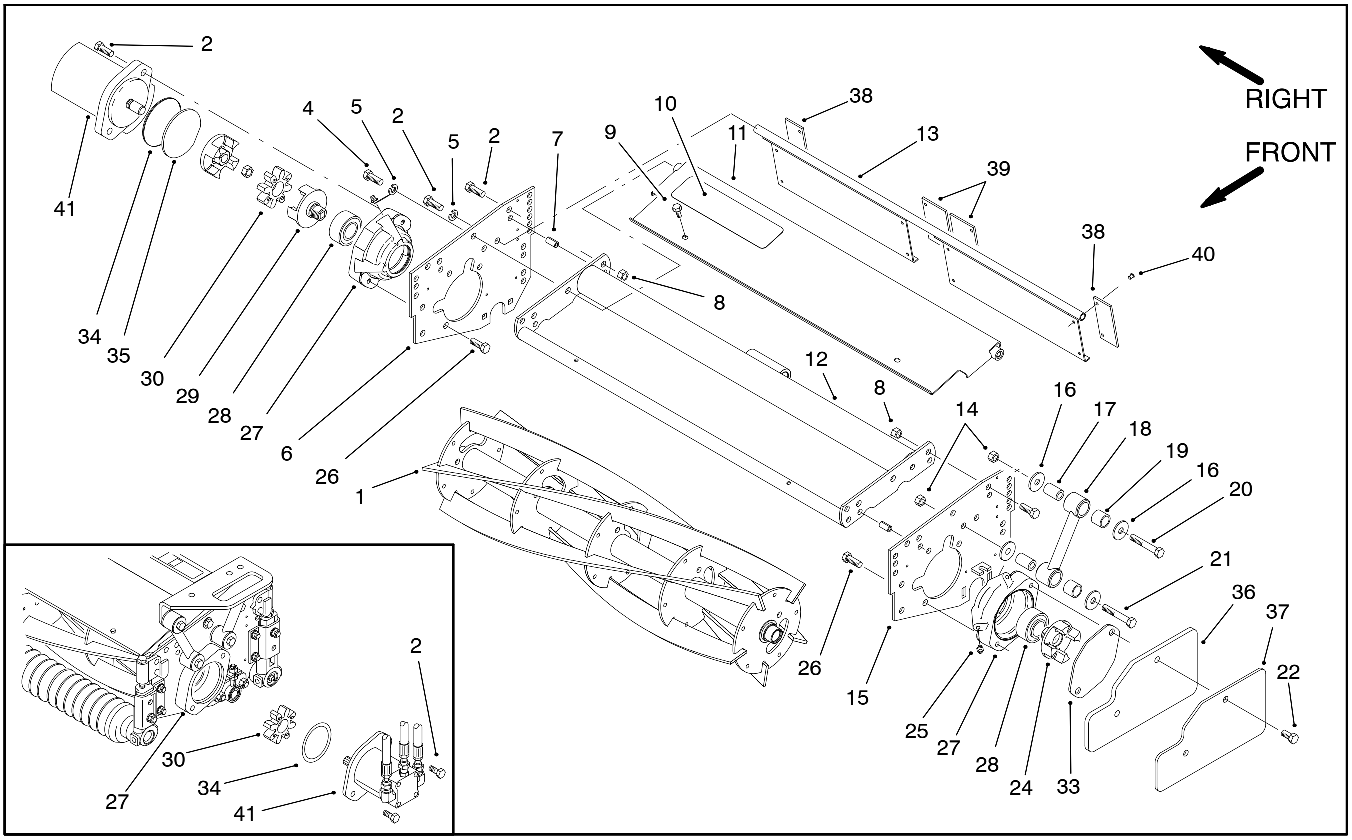

Figure 26

1. **Reel**
2. **Cap screw**
3. **Not used**
4. **Cap screw**
5. **Lock washer**
6. **Side plate (RH)**
7. **Roll pin**
8. **Lock nut**
9. **Hex nut**
10. **Waring decal**
11. **Front grass guard**
12. **Frame assembly**
13. **Rear grass guard**
14. **Flange nut**
15. **Side plate (LH)**
16. **Washer**
17. **Spacer**
18. **Link**
19. **Bushing**
20. **Cap screw**
21. **Cap screw**
22. **Cap screw**
23. **Not used**
24. **Reel coupler (LH)**
25. **Grease fitting**
26. **Hex flange head screw**
27. **Bearing housing**
28. **Bearing**
29. **Reel coupler (RH)**
30. **Spider coupler**
31. **Not used**
32. **Not used**
33. **Cover gasket**
34. **O−ring**
35. **Shipping plug**
36. **Weight (3.5 lbs)**
37. **Weight (2.0 lbs)**
38. **Rubber side cover**
39. **Rubber center cover**
40. **Rivet**
41. **Hydraulic motor**

Removal

1. Remove two capscrews holding the hydraulic motor to the bearing housing.

2. Remove hydraulic motor and spider coupling from the bearing housing. Position hydraulic motor away from the cutting unit prior to removing or working on the cutting unit.

Inspection

1. Inspect spider coupling for wear. Replace worn coupling with new one.

2. Check coupling inside bearing housing. If coupling is loose remove and check for worn threads. Replace coupling if threads are worn. Reinstall coupling (see Reel Removal and Bearing Replacement).

Installation

Note: The cutting unit can be installed with the hydraulic motor on either side. If installing on the opposite side, remove cap screws, weights, and cover gasket; reinstall them on the other bearing housing.

1. Dip spider coupling in No. 2 general purpose lithium base grease. Reinstall spider coupling into the bearing housing.

2. Install O−ring on the front plate of the motor. Mount hydraulic motor to the bearing housing. Secure motor with the two capscrews.

3. Grease bearing housing sufficiently to fill housing with grease (see Greasing Bearings, Bushings, and Pivot Points).

Reel Removal and Bearing Replacement

Remove Reel (Fig. 26)

1. Remove hydraulic motor from the cutting unit (see Hydraulic Motor Removal and Installation). Remove cutting unit from the machine (see Cutting Unit Removal and Installation).

2. Remove bedbar assembly from the cutting unit (see Bedbar Removal and Installation).

3. Remove front roller from the cutting unit (see Roller Removal and Installation).

Note: A 3/8−inch drive ratchet with an extension will fit into the square hole of the coupling.

4. Unscrew reel coupler (LH) from the reel. **This coupler is left hand threaded.** Unscrew reel coupling (RH) from the reel. **This coupler is right hand threaded.**

IMPORTANT: Support reel to prevent it from dropping when the bearing housings are removed.

5. Remove cap screws from both bearing housings. Pull bearing housings and bearings from reel. Remove reel from the cutting unit.

6. Rotate bearings within the bearing housings, and remove bearings from both bearing housings through the loading grooves.

Inspect Reel (Fig. 26)

1. Replace reel if the diameter has decreased to the service limit (see Reel Grinding Specification in Preparing Reel For Grinding).

2. Replace reel if blades are bent or cracked.

3. Check for a bent reel shaft by placing the reel shaft ends in V−blocks. Replace reel if the reel shaft is bent.

Install Reel (Fig. 26)

1. Inspect bearings and replace if worn or damaged. Replace both bearings as a set.

2. Make sure bearing seating surfaces and threads on reel shaft ends are clean. Apply anti−seize lubricant to both bearing seating surfaces.

3. Align reel inside the cutting unit with the bearing housing holes. The reel must be positioned so that the grooved end of the shaft (left−hand threads) is on the left side of the cutting unit.

4. Clean inside of the bearing housing before installing. Install bearing into bearing housing as follows:

   A. Load bearing through loading grooves.

   B. Position bearing so its outer grease holes will be 90° to the loading grooves.

   C. Rotate bearing inside of the housing so the extended part of the inner race is facing the inside of the housing.

5. Slide bearings and bearing housings onto the reel shaft.

6. Make sure bearing housings are installed with the grease fittings pointing up and to the front of the cutting unit.

7. Secure bearing housings and bearings on the reel shaft ends and cutting unit with the cap screws.

8. Remove grease from the threaded end of reel couplers and the reel shaft. Make sure grease is completely removed.

9. Apply removable Loctite 242 or equivalent to reel coupler threads. **Do not get Loctite on the bearing seal**.

10. Screw reel coupler (RH) to the reel. **This coupling is right hand threaded.** Screw reel coupler (LH) to the reel. **This coupling is left hand threaded.** Torque both couplers from 55 to 65 Ft−lb (74.6 to 88.1 N−m).

11. Install front roller to cutting unit (see Roller Removal and Installation).

12. Install bedbar assembly to cutting unit (see Bedbar Removal and Installation).

13. Install cover gasket, weights, and cap screws to the bearing housing.

14. Complete cutting unit set−up and adjustment sequence (see Adjustments section).

15. Grease both bearings (see Greasing Bearings, Bushings, and Pivot Points).

Bedbar Removal and Installation

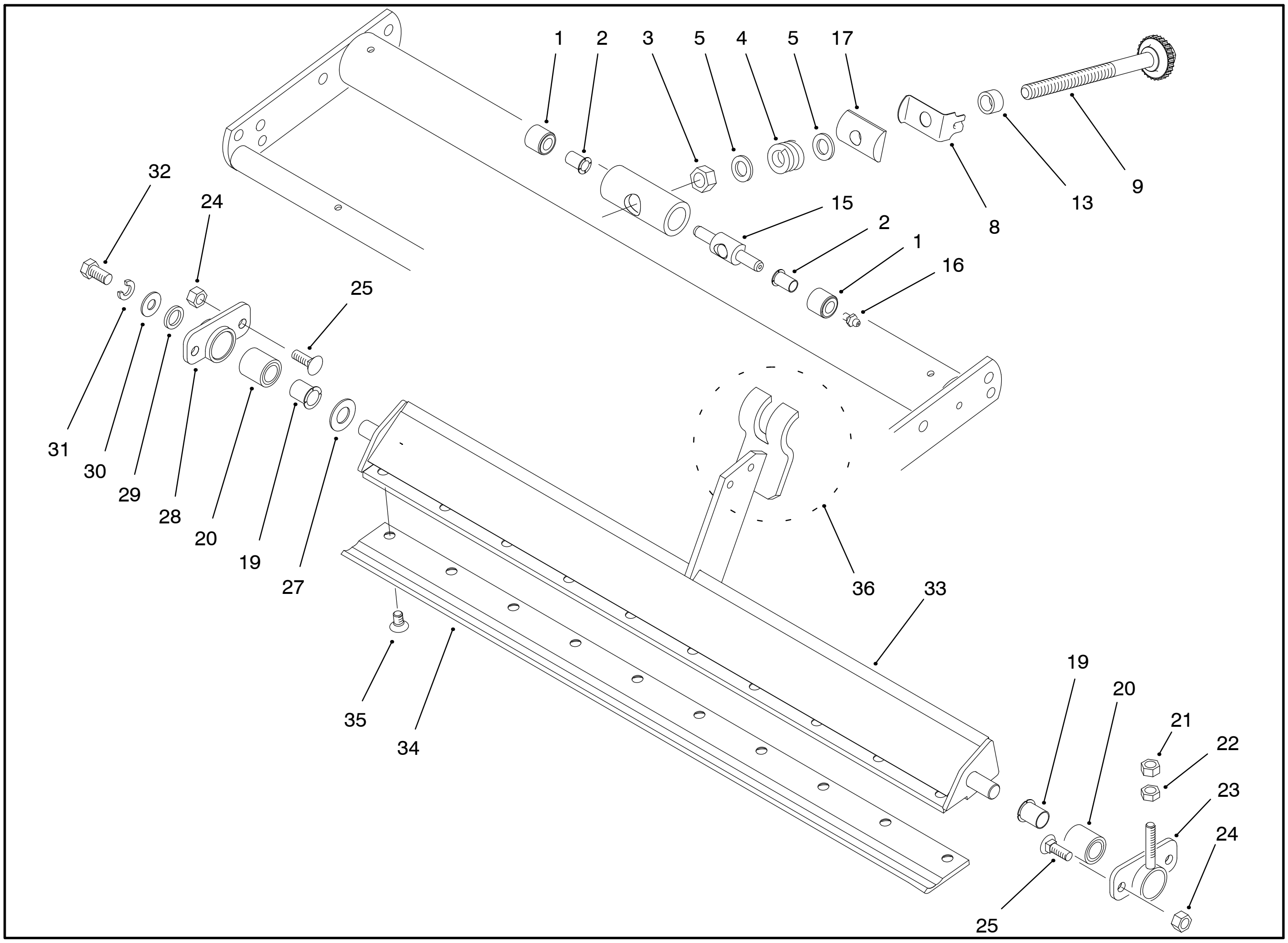

Figure 27

1. Rubber bushing
2. Flanged bushing
3. Jam nut
4. Compression spring
5. Washer
6. Not used
7. Not used
8. Spring arm
9. Bedbar adjuster
10. Not used
11. Not used
12. Not used
13. Adjuster spacer
14. Not used
15. Bedbar pivot
16. Grease fitting
17. Bedbar fitting
18. Not used
19. Flange bushing
20. Bushing
21. Lock nut
22. Hex nut
23. Adjusting housing
24. Lock nut
25. Carriage bolt
26. Not used
27. Bedbar washer
28. Bedbar housing
29. Spacer
30. Flat washer
31. Lock washer
32. Cap screw
33. Bedbar
34. Bedknife
35. Screw
36. Bedbar yoke

Bedbar Removal

1. Turn bedbar adjuster to loosen bedknife to reel contact. Unscrew bedbar adjuster (left–hand threaded) while loosening jam nut from the compression spring until the bedbar fitting is clear of the bedbar yoke.

2. Remove cap screws, weights, and cover gasket from the bearing housing (Fig. 26).

3. Remove capscrew, lock washer, flat washer, and spacer from the end of the bedbar.

4. Loosen both adjusting lock nuts on the adjusting housing (Fig. 28).

5. Remove both carriage bolts and nuts from the adjusting housing (Fig. 28).

6. Remove both carriage bolts and nuts from the bedbar housing. Remove bedbar from the cutting unit.

7. Remove adjusting housing and bedbar housing from the bed bar. Remove bedbar washer.

8. Sharpen or replace bedknife as necessary (see **Bedknife Replacement and Grinding**).

Bedbar Installation (Fig. 27)

1. Inspect flanged bushings and bushing for wear; replace if necessary.

2. Clean and apply anti−seize lubricant to both bedbar pivots. Install bedbar washer on the bedbar.

3. Install bedbar adjusting housing and bedbar housing on the bed bar. Reinstall spacer, flat washer, lock washer, and cap screw on the bedbar.

4. Install bedbar assembly on the cutting unit.

5. Secure bedbar housing to the cutting unit with both carriage bolts and nuts.

6. Secure adjusting housing to the cutting unit with both carriage bolts and nuts (Fig. 28).

7. Tighten both adjusting lock nuts on the adjusting housing (Fig. 28).

8. Position bedbar fitting to the bedbar yoke. Screw adjusting handle (left−hand threaded) until the bedbar fitting is snug against the bedbar yoke.

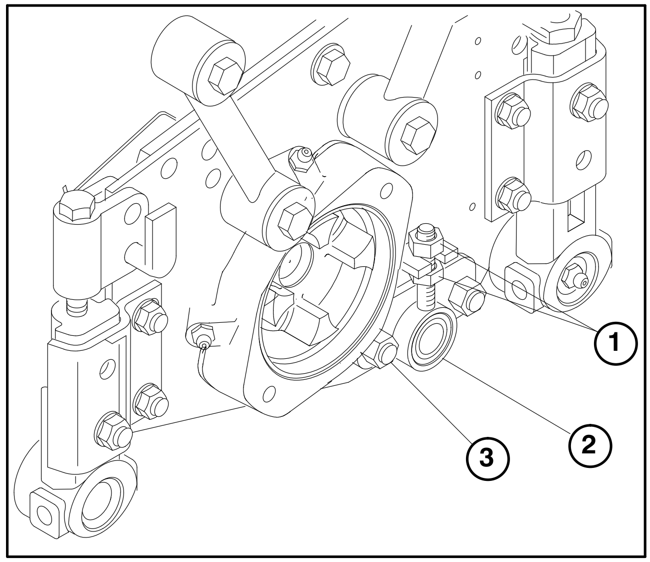

Figure 28

1. **Adjusting lock nut**
2. **Adjusting housing**
3. **Carriage bolt and nut**

9. Adjust bedknife to reel (see Bedknife to Parallel to Reel Adjustment).

SPA Cutting Units

Bedknife Replacement and Grinding

Bedknife Removal

1. Remove bedbar from cutting unit (see Bedbar Removal in this chapter).

NOTE: 27" cutting units use 10 screws to secure bedknife to bedbar. 32" cutting units use 12 screws to secure bedknife to bedbar.

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. 29).

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. 30), tighten screws from **200 to 250 in−lb (23 to 28 N−m)**.

7. After installing bedknife to bedbar, grind bedknife.

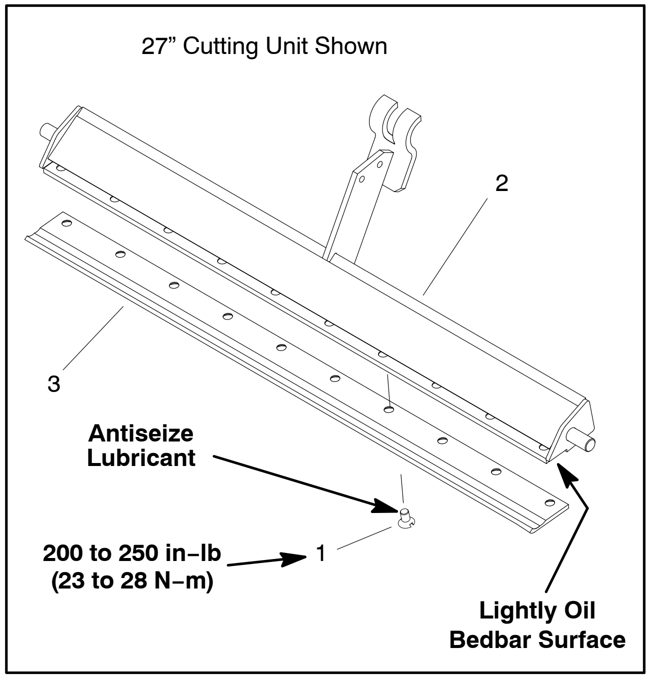

Figure 29

1. Screw (10 or 12 used)
2. Bedbar
3. Bedknife

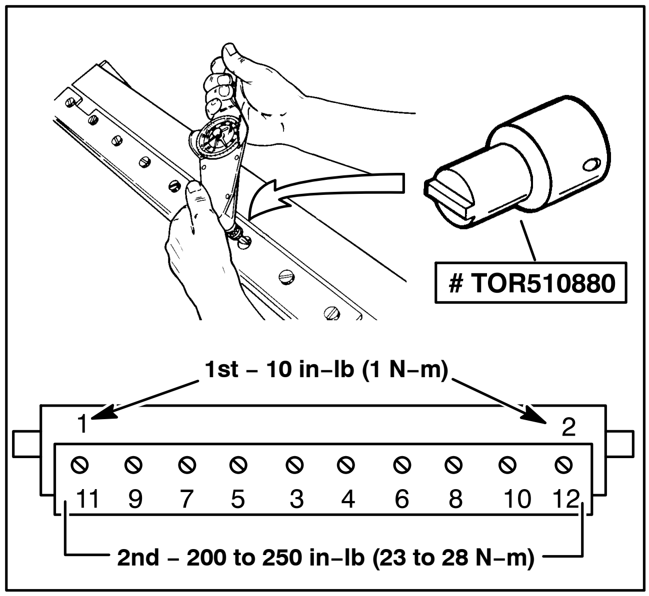

Figure 30

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided and grind only enough to make sure the top surface of the bedknife is true (Fig. 31 and 32).

IMPORTANT: Do Not grind the bedknife below it's service limit (Fig. 33). Operating the cutting unit with the bedknife below the service limit may result in poor after−cut appearance and reduce the structural integrity of the bedknife for impacts.

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

NOTE: EdgeMax® bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after−cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to the Angle Indicator and Magnetic Mount in the Special Tools section of this Chapter.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

Bedknife Grinding Specifications			
Bedknife	Lip Height Service Limit	Top Angle	Front Angle
Lowcut	0.19” (4.8 mm)	10°	10°
Highcut	0.19” (4.8 mm)	10°	10°

Figure 31

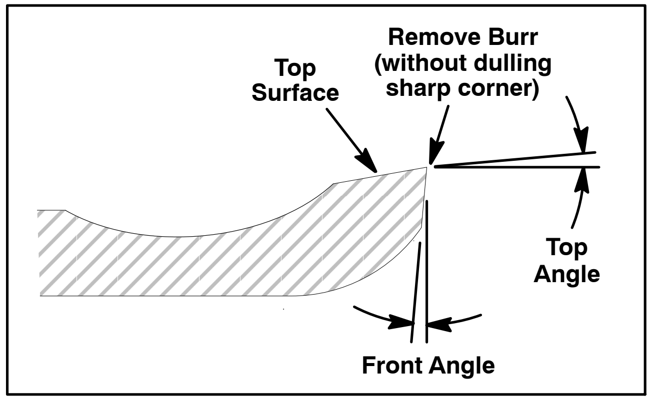

Figure 32

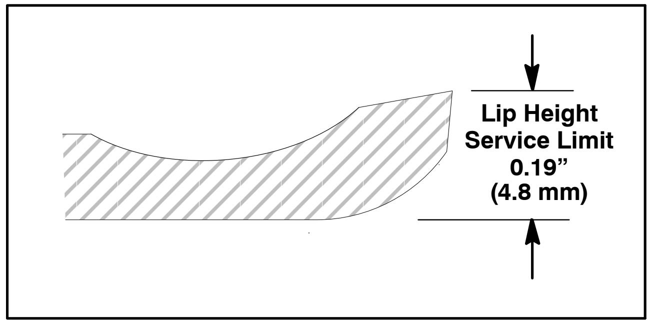

Figure 33

1. Bedknife

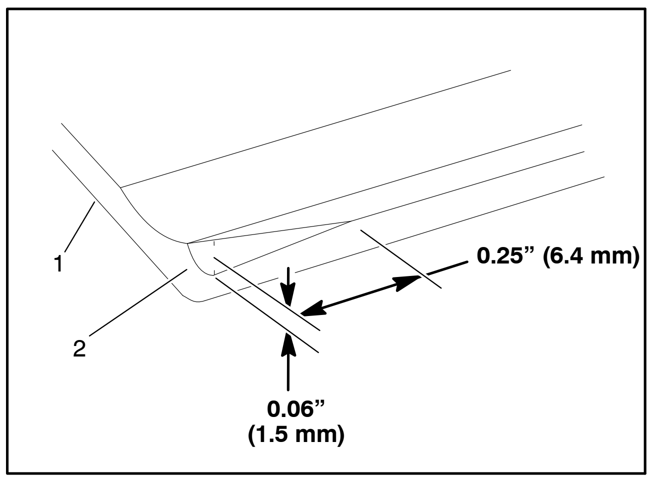

Figure 34

1. Bedknife
2. Lead −in Chamfer

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.

2. A lead−in chamfer is ground into all new bedknives (Fig. 34). The original chamfer should last for the first 40% of the bedknife service life. Check and re−grind the lead−in chamfer as necessary.

3. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Installation in this section).

Roller Removal and Installation

Note: This section can be used for both the front and rear rollers.

Roller Removal

1. Remove both height−of−cut pins and hairpin cotters from each roller bracket.

2. Remove both locknuts from the capscrews securing each angle bracket to the cutting unit.

3. Remove capscrews from both angle brackets and the cutting unit.

4. Separate roller assembly, roller brackets, and angle brackets from the cutting unit.

5. Remove roller brackets from the roller assembly.

Roller Installation

1. Inspect flanged bushing and bushings for wear; replace if necessary.

Note: The flanged end of the flanged bushing must face inside toward the roller when the roller bracket is installed onto the cutting unit.

Note: A soft hammer may be needed to tap the roller bracket into position on the hex adjustment nut of the roller.

2. Insert smaller diameter roller shaft into the flanged bushing, bushing, and roller bracket. **Make sure hex of the roller bracket mates with the hex adjustment nut on the roller.**

3. Insert the other end of the roller shaft into the other bushing and roller bracket. **Make sure hex of the roller bracket mates with the hex adjustment nut on the roller.**

4. Hold one roller bracket stationary and use the other bracket as a wrench to loosen or tighten bearing clearance. The roller must not exceed 5 in−lb (0.57 N−m) rolling torque and have no bearing end play.

5. Make sure roller brackets are aligned prior to installing them onto the cutting unit. If necessary after bearing adjustment, align roller brackets as follows:

A. Remove roller bracket on the side with the flanged bushing.

B. Replace roller bracket so it is aligned to within ± one hex flat of the roller adjustment nut.

C. Align both roller brackets.

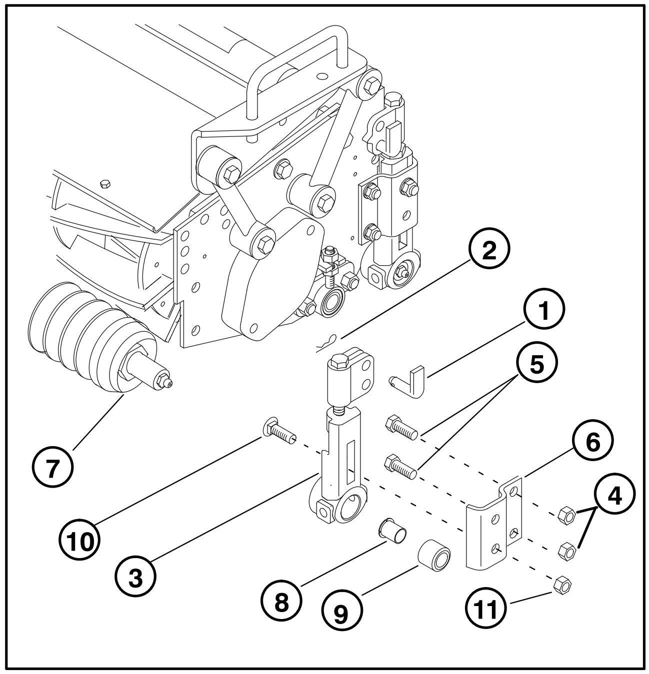

Figure 35

1. **Height−of−cut pin**
2. **Hairpin cotter**
3. **Roller bracket**
4. **Lock nut**
5. **Capscrew**
6. **Angle bracket**
7. **Front roller assembly**
8. **Flanged bushing**
9. **Bushing**
10. **Carriage bolt**
11. **Lock nut**

6. Mount roller, roller brackets, and angle brackets to the cutting unit. Secure roller brackets and angle brackets to the cutting unit with capscrews.

7. Install both height−of−cut pins and hairpin cotters.

8. Install both locknuts to the capscrews, and secure each angle bracket to the cutting unit.

9. Adjust roller level (see Height−of−Cut and Leveling Both Rollers).

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SPA Cutting Units

Roller Bearing and Seal Replacement

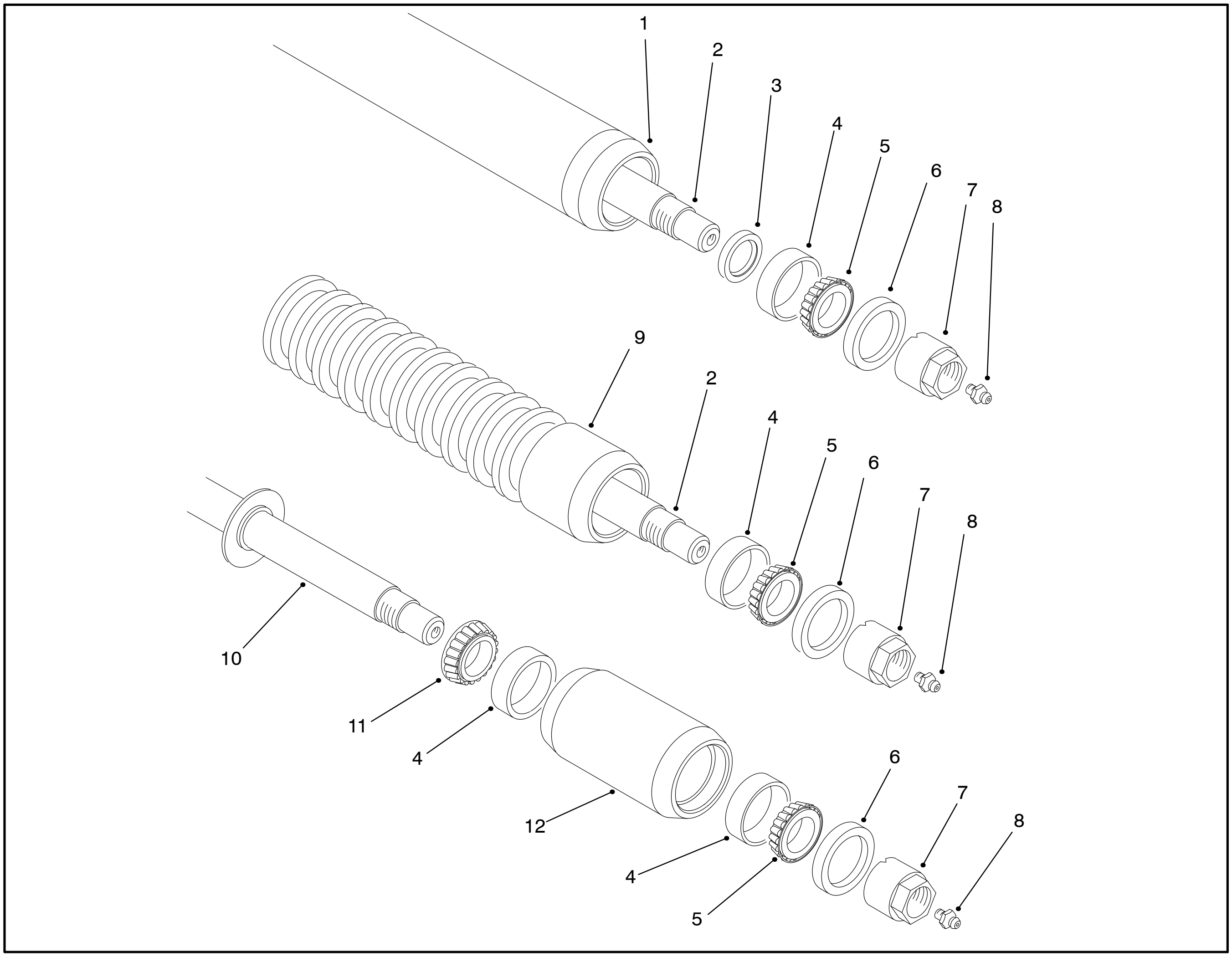

Figure 36

1. Full roller	**5. Bearing cone (outer)**	**9. Wiehle roller**
2. Roller shaft	**6. Outer seal**	**10. Sectional roller shaft**
3. Grease seal	**7. Adjustment nut**	**11. Bearing cone (inner)**
4. Bearing cup	**8. Grease fitting**	**12. Sectional roller**

Remove Seals and Bearings

1. Clean inside of roller around both adjusting nuts and roller shaft ends. Both areas should be free of dirt and debris.

2. Remove adjusting nut from one end of the roller shaft. On the sectional roller, remove both adjusting nuts from each end of the roller.

NOTE: When disassembling a full roller, pour the oil from inside the roller into a suitable container.

3. Keep roller level and slide the shaft with the remaining adjusting nut out of the roller. On the sectional roller, slide both sectional rollers of the shaft.

4. Secure roller in a vise.

5. Remove outer seals.

6. Remove both bearing cones. On the sectional roller, remove all four bearing cones.

Note: An electric arc welder can be used to shrink the bearing cup to simplify its removal. Only a small arc in one location on the cup is required.

7. Remove both bearing cups from the roller. Remove both inner seals installed on the full roller. On the sectional roller, remove all four bearing cups.

8. Discard seals and bearings.

Install New Seals and Bearings on Full or Wiehle Roller

1. Make sure all parts are clean prior to installing bearings and seals.

2. On the full roller, make sure cupped side of the inner seal faces the inside of the roller. Press an inner seal into each end of the roller.

3. Make sure narrow end of the taper on the bearing cup faces the inside of the roller. Press a cup into each end of the roller.

4. Keep roller level and secured roller in a vise.

5. If assembling a full roller, fill the inside of roller tube with 6 oz. (170 gm) of SAE 90 oil.

6. Pack both bearing cones with No. 2 general purpose lithium base grease.

7. Install a bearing cone into the bearing cup at each end of the roller.

8. Position outer seal to the roller with the hard surface of seal facing out. Press a seal onto each end of the roller.

9. Slide roller shaft through the bearing cones and roller.

10. Install remaining adjustment nut and tighten it to seat both bearings. Roller should be rotated to seat both bearings.

11. Back off both adjustment nuts to allow the roller to spin freely. Tighten both adjustment nuts again so there is no bearing end play and rolling torque does not exceed 5 in−lb (0.57 N−m).

12. Grease both bearings (see Greasing Bearings, Bushings, and Pivot Points).

Install New Seals and Bearings on Sectional Roller

1. Make sure all parts are clean prior to installing bearings and seals.

2. Press two bearing cups into each sectional roller. Make sure narrow end of taper faces the inside of the roller.

3. Secured sectional roller shaft in a vise. Make sure shaft is level.

4. Pack all bearing cones with No. 2 general purpose lithium base grease.

NOTE: Install bearing cone with the seal into the end of the roller that faces the inner part of the shaft.

5. On both rollers, install a bearing cone into the bearing cup at each end of the roller.

6. Install outer seal onto the end of each roller. Make sure the hard surface of seal faces out.

7. Slide each roller onto the shaft.

8. Install adjustment nut onto each end of the shaft. Tighten each nut to seat both bearings of each roller. Roller should be rotated to seat both bearings.

9. Back off both adjustment nuts to allow the rollers to spin freely. Tighten both adjustment nuts again so there is no bearing end play and rolling torque does not exceed 5 in−lb (0.57 N−m).

10. Grease both bearings (see Greasing Bearings, Bushings, and Pivot Points).

Prepare Reel for Grinding

Note: Check to make sure reel bearings are in good condition and properly adjusted before grinding reel.

1. Remove bedbar assembly (see Bedbar Removal and Installation).

2. Remove front roller and brackets (see Roller Removal and Installation).

Note: Most reel grinders require that the rear roller assembly be mounted to the cutting unit for proper support in the reel grinder. The rear roller must be parallel to the reel shaft to remove taper when grinding, or the cutting unit must be aligned so the grinding wheel will travel parallel to the reel shaft. This will result in the the reel being ground to the desired cylinder shape.

Note: When grinding, be careful to not overheat the reel blades. Remove small amounts of material with each pass of the grinder.

3. Refer to Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) for reel grinding information.

4. After completing grinding process:

   A. Install front roller and brackets (see Roller Removal and Installation).

   B. Install bedbar assembly (see Bedbar Removal and Installation).

   C. Complete cutting unit set−up and adjustment sequence (see Adjustments section).

Reel Grinding Specifications	
Nominal Reel Diameter	7 inches (178 mm)
Service Limit Reel Diameter	6.2 inches (158 mm)
Blade Relief Angle	30°
Relief Angle Range	20° to 40°
Blade Land Width	0.060 inch (1.5 mm)
Land Width Range	0.050 to 0.090 inch (1.3 to 2.3 mm)
Maximum Reel Taper	0.060 inch (1.5 mm)

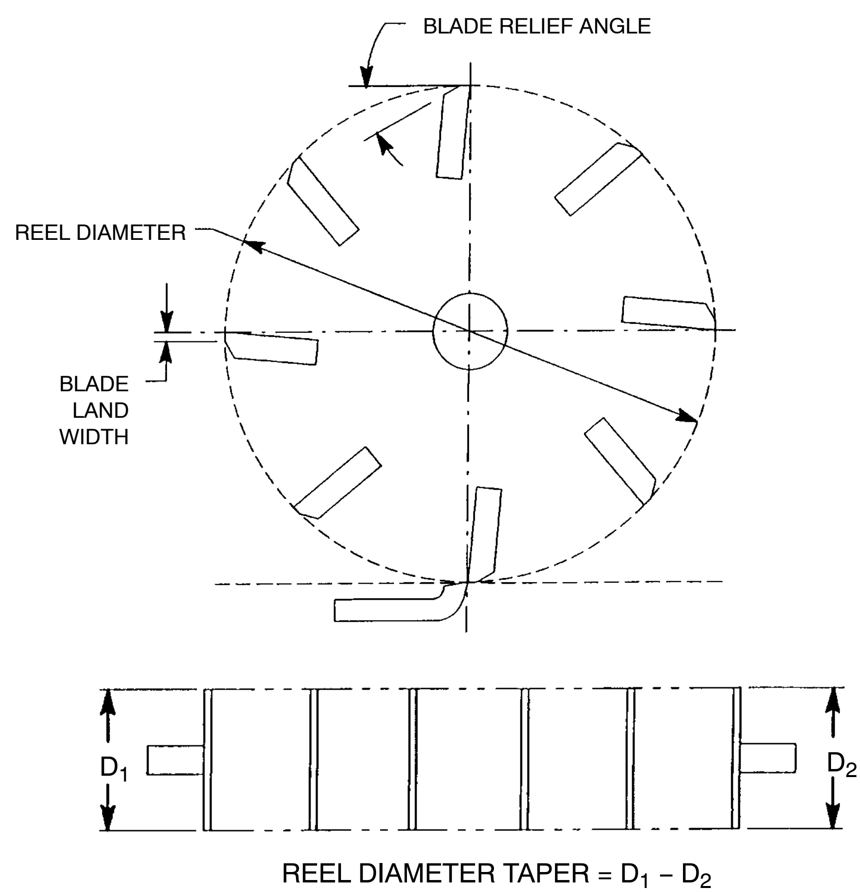

Figure 37

Fixed Side Plate Installation

1. Remove pop rivets and rear height−of−cut plates from both sides of the cutting unit (Fig. 38).

2. Remove lock nuts, capscrews, washers, and both links from the cutting unit (Fig. 38).

3. Align fixed side plate with holes on the cutting unit (Fig. 39).

4. Attach new capscrews, washers, and flanged lock nuts to the fixed side plate and the cutting unit (Fig. 39).

5. Tighten lock nuts and capscrews.

6. Fasten new height−of−cut plate to the cutting unit with new pop rivets (Fig. 39).

7. Repeat steps 1 through 6 on the other side of the cutting unit.

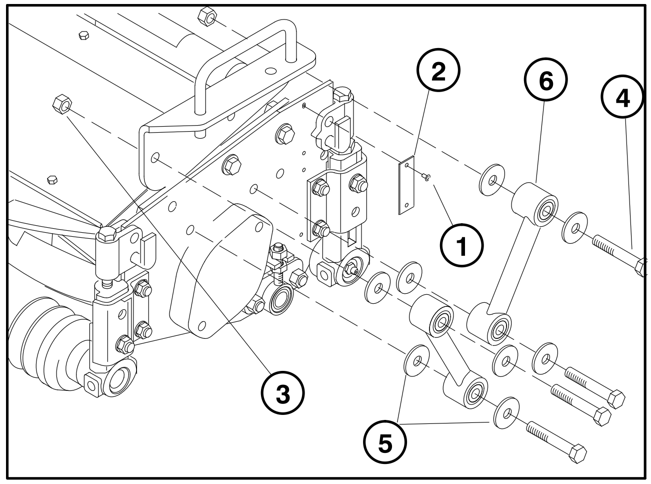

Figure 38

1. **Pop rivet**
2. **Height−of−cut plate**
3. **Lock nut**
4. **Capscrew**
5. **Washer**
6. **Link**

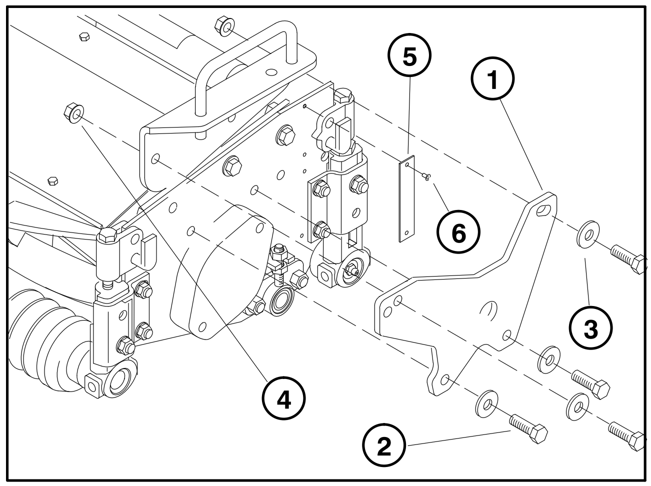

Figure 39

1. **Fixed side plate**
2. **Capscrews**
3. **Washers**
4. **Flanged lock nut**
5. **Height−of−cut plate**
6. **Pop rivet**

SPA Cutting Units

Front Lift Arms

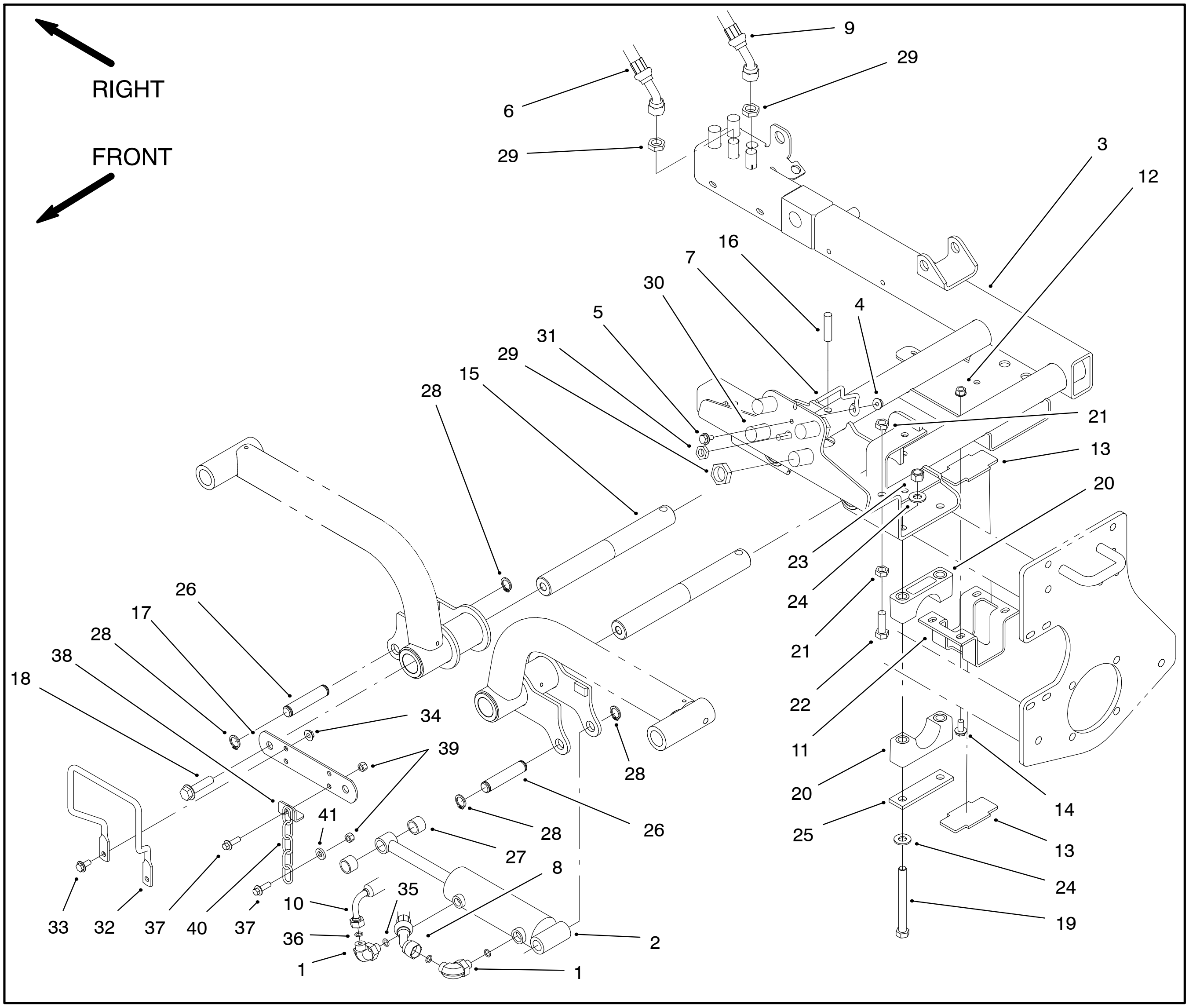

Figure 40

1. 90° hydraulic fitting
2. Hydraulic cylinder
3. Carrier assembly
4. Flange nut
5. Flange head screw
6. Hydraulic hose
7. Centering wire
8. Hydraulic hose
9. Hydraulic hose
10. Hydraulic hose
11. Clamp bracket (Model 03200)
11. Slide bracket (Model 03201)
12. Flange nut (Model 03201)
13. Plastic slide
14. Flange head screw
15. Lift arm pivot shaft
16. Roll pin
17. Pivot shaft link
18. Flange head screw
19. Cap screw
20. Clamp (Model 03200)
20. Bearing cap (Model 03201)
21. Jam nut
22. Cap screw
23. Lock nut
24. Hardened washer
25. Slide bar support
26. Pin
27. Spacer
28. External retaining ring
29. Bulkhead nut
30. Hydraulic tube
31. Bulkhead nut
32. Hose rod (Model 03201)
33. Flange head screw (Model 03201)
34. Flange nut (Model 03201)
35. O−ring
36. O−ring
37. Flange head screw
38. Link clip
39. Hex nut
40. Tipper chain
41. Flat washer

Removal

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

2. Remove cutting unit from the pivot shaft of the front lift arm (see Cutting Unit Removal).

NOTE: Remove both spacers from the hydraulic cylinder shaft clevis when removing the right, front lift arm.

3. Disconnect hydraulic cylinder from the front lift arm by removing external retaining rings and pin.

4. Remove both flange head screws and pivot shaft link from the lift arm pivot shafts (Fig. 41).

5. Slide lift arm off the lift arm pivot shaft.

6. Disassemble lift arm as necessary using Figure 42 as a guide.

Installation

1. Assemble lift arm using Figure 42 as a guide.

2. Slide lift arm onto the lift arm pivot shaft.

3. Secure pivot shaft link with both flange head screws to the lift arm pivot shafts. Torque flange head screws to 70 Ft−lb (95 N−m) (Fig. 41).

NOTE: Install both spacers to the hydraulic cylinder shaft clevis when installing the right, front lift arm.

4. Secure hydraulic cylinder to the lift arm with pin and external retaining rings.

5. Route hydraulic hoses so they clear the lift arm by 0.04 to 0.12 inch (1.0 to 3.0 mm) when the lift arm is fully raised (Fig. 43).

6. Adjust lift arms to proper clearance (see Adjust Front Lift Arms).

7. Install cutting unit to the pivot shaft of the front lift arm (see Cutting Unit Installation).

8. Grease front lift arm.

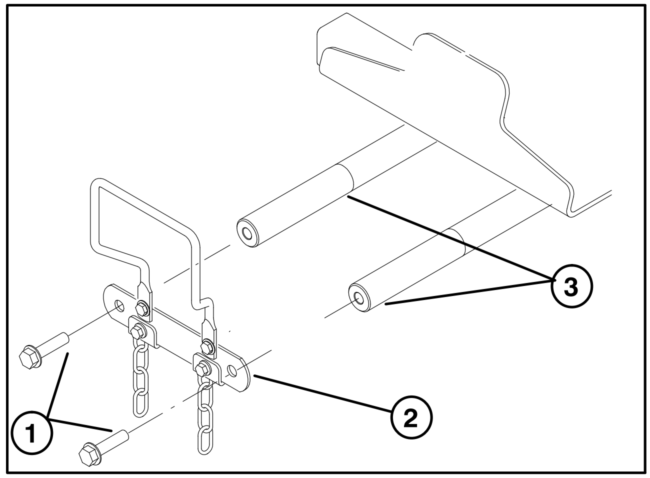

Figure 41

1. **Flange head screw**
2. **Pivot shaft link**
3. **Lift arm pivot shaft**

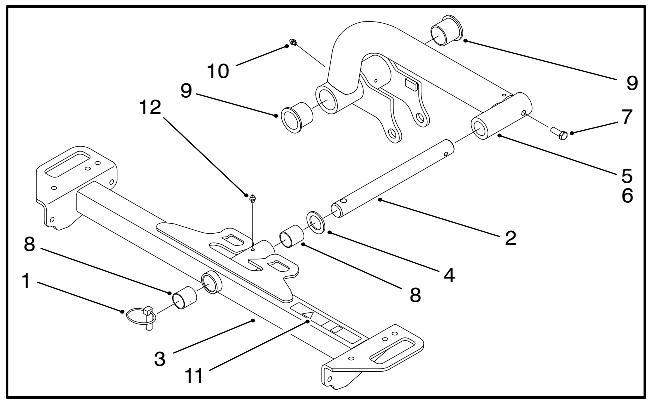

Figure 42

1. **Lynch pin**
2. **Cutting unit pivot shaft**
3. **Carrier frame**
4. **Thrust washer**
5. **Lift arm (LH)**
6. **Lift arm (RH) (not shown)**
7. **Cap screw**
8. **Bushing**
9. **Bushing**
10. **Grease fitting**
11. **Pinch point decal**

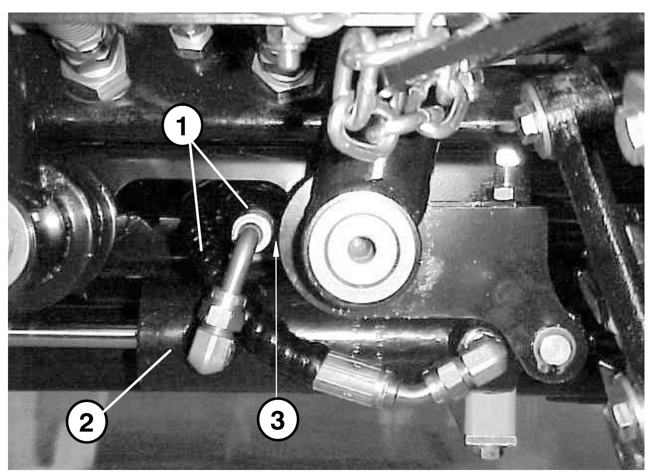

Figure 43

1. **Hydraulic hoses**
2. **Hydraulic cylinder**
3. **Hydraulic cylinder**

SPA Cutting Units

Rear Lift Arm

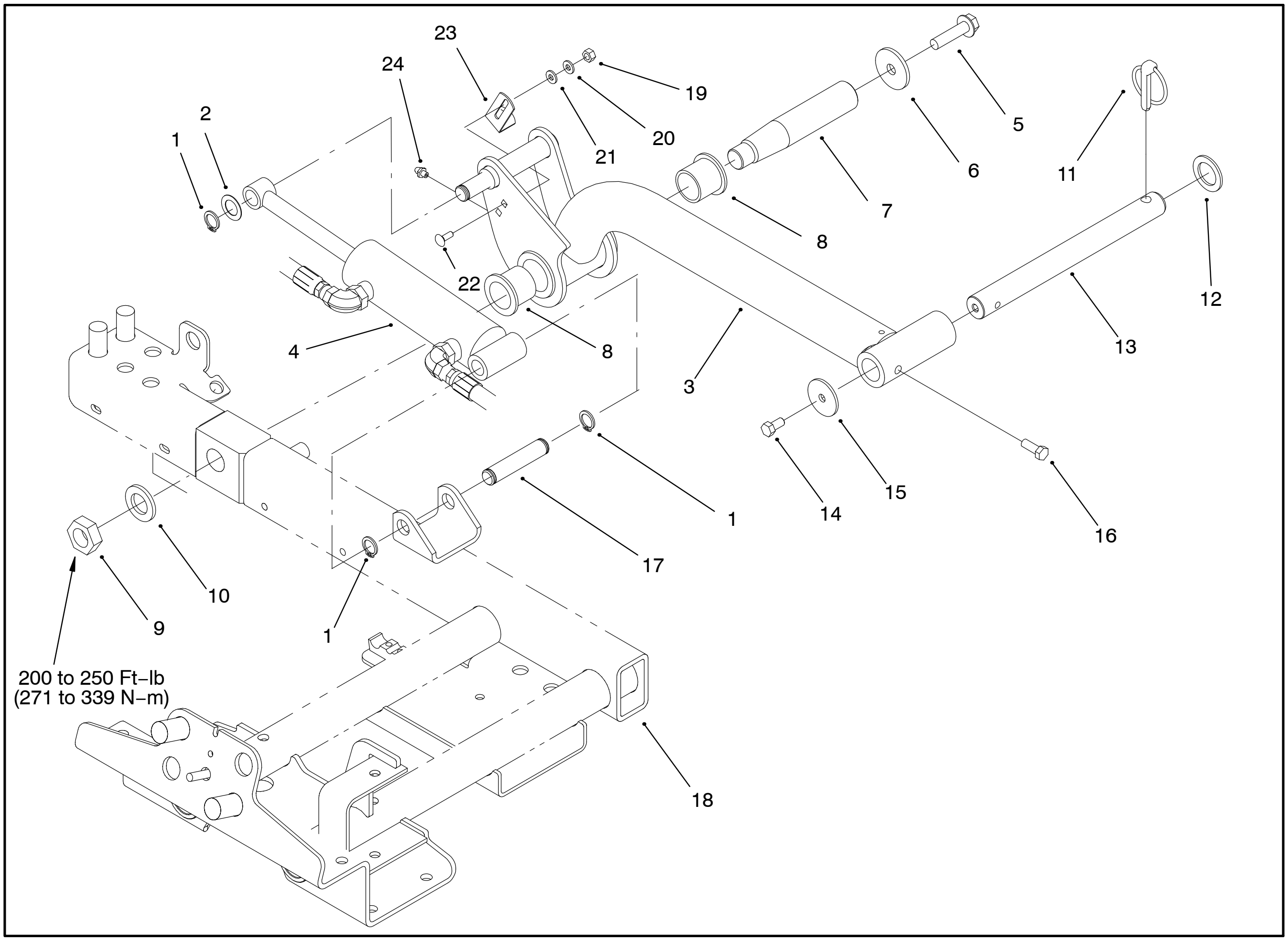

Figure 44

1. External retaining ring	**9. Jam nut**	**17. Pin**
2. Thrust washer	**10. Washer**	**18. Carrier assembly**
3. Rear lift arm	**11. Lynch pin**	**19. Hex nut**
4. Rear hydraulic cylinder	**12. Washer**	**20. Lock washer**
5. Flange head screw	**13. Cutting unit pivot shaft**	**21. Flat washer**
6. Thrust washer	**14. Cap screw**	**22. Carriage screw**
7. Rear pivot shaft	**15. Rebound washer**	**23. Switch bracket**
8. Bushing	**16. Cap screw**	**24. Grease fitting**

Removal

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

2. Remove cutting unit from the pivot shaft of the rear lift arm (see Cutting Unit Removal).

3. Remove external retaining ring and thrust washer from the lift cylinder shaft of the rear lift arm.

4. Remove flange head screw and thrust washer from the rear pivot shaft.

5. Slide rear lift arm from rear pivot shaft and hydraulic cylinder.

6. Disassemble lift arm as necessary using Figure 44 as a guide.

Installation

1. Assemble lift arm using Figure 42 as a guide.

A. If the rear pivot shaft was removed, torque jam nut from 200 to 250 Ft−lb (271 to 339 N−m).

B. If the switch bracket was removed, make sure the lip of the switch bracket faces away from the rear lift arm when installed.

2. Slide rear lift arm onto rear pivot shaft making sure that the lift shaft of the rear lift arm slides into the clevis of the hydraulic cylinder.

3. Secure hydraulic cylinder clevis to the lift cylinder shaft of the rear lift arm with the thrust washer and external retaining ring.

4. Install rear cutting unit to the pivot shaft of the rear lift arm (see Cutting Unit Removal).

5. Adjust lift arms to proper clearance (see Adjust Rear Lift Arm).

6. Grease front lift arm.

Skid Kit Installation

1. Remove front roller from the cutting unit (see Roller Removal and Installation).

2. Align skid slots with the angle bracket holes on the cutting unit.

3. Secure skid to the cutting unit with both flange head screws, flat washers, and lock nuts.

4. Repeat steps 1 through 3 on the other side of the cutting unit.

5. Adjust skid height as necessary by loosening lock nuts and flange head screws, then retighten fasteners.

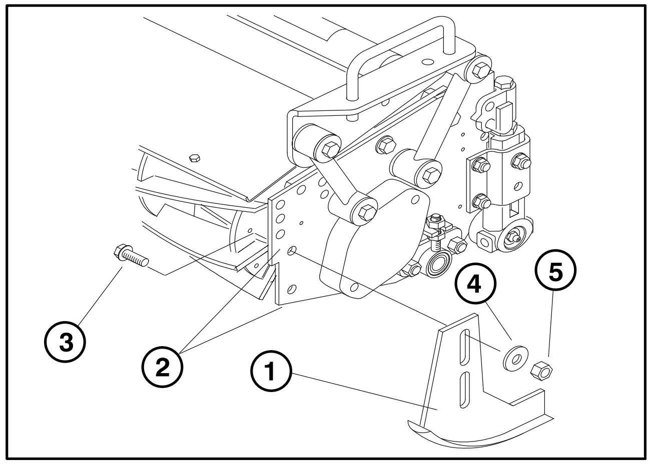

Figure 45

1. Skid
2. Angle bracket holes
3. Flange head screw
4. Flat washer
5. Lock nut

Carrier Frame

Removal

1. Make sure cutting unit and carrier frame are placed firmly on a flat working surface.

2. Remove tipper chain from the top of the carrier frame (Fig. 46).

3. Remove lock nut, both flat washers, and large cap screw securing mounting links to the carrier frame. Remove carrier frame from the cutting unit (Fig. 47).

Installation

1. Make sure cutting unit is placed firmly on a flat working surface.

2. Position carrier frame (flat edge forward) onto the cutting while aligning mounting holes with all mounting links (Fig. 47).

NOTE: A flat washer must be on each side of all mounting links during installation.

3. Secure all four mounting links to the carrier frame with both flat washers, large cap screw, and lock nut. Torque lock nut and cap screw to 31 Ft−lb (42 N−m).

4. Route tipper chain up through the slot in each end of the carrier frame. Secure chain to the top of the carrier frame with washer, cap screw, and lock nut (Fig. 46).

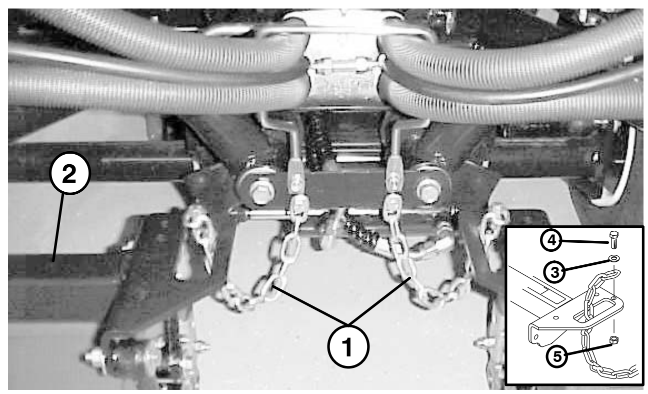

Figure 46

1. Tipper chain
2. Carrier frame
3. Washer
4. Cap screw
5. Lock nut

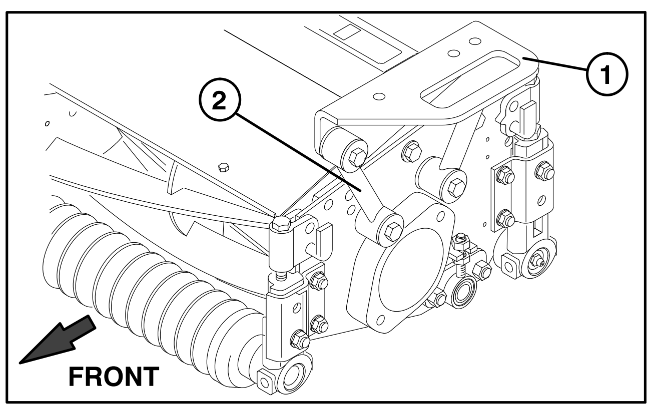

Figure 47

1. Carrier frame
2. Mounting link

Chapter 8

DPA Cutting Units

Table of Contents

DPA Cutting Units

Specifications

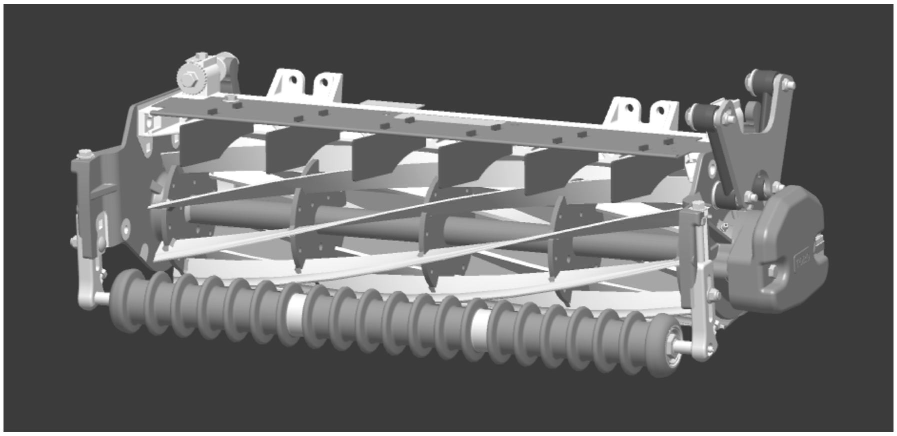

Figure 1

Frame Construction: Precision machined die cast aluminum cross member with bolt-on cast ductile iron or aluminum side plates.

Reel Construction: Reels are 27 inches (69 cm) or 32 inches (81 cm) in length and 7 inch (18 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. 27 inch reels are available in 5, 8 and 11 blade configurations. 32 inch reels have 8 blades.

Reel Bearings:

Cutting units with painted side plates have two double row, self-aligning ball bearings press fit onto reel shaft with inboard seal for protection. Reel bearing adjustment is maintained by an adjuster nut in the left side plate of the cutting unit.

Cutting units with aluminum side plates have two stainless steel sealed radial ball bearings pressed onto the reel shaft. Reel end play is maintained by an internal wave spring (no adjustment required).

Reel Drive: The reel weldment shaft is a 1 5/16 inch (33.3 mm) diameter tube with drive inserts threaded into both ends. The reel drive inserts have an internal nine (9) tooth spline.

Height-of-Cut (HOC): Cutting height is adjusted on the front roller by two (2) vertical screws. Effective HOC may vary depending on turf conditions, type of bedknife, roller type and installed attachments.

Bedknife: Replaceable, single edged, high carbon steel bedknife is fastened to a machined cast iron bedbar with screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw adjustment to the reel; detents corresponding to 0.0009 inch (0.023 mm) bedknife movement for each indexed position.

Front and Rear Rollers: Greaseable through-shaft front and rear rollers are used with these cutting units. All rollers use the same heavy duty, stainless steel ball bearings and seal package.

Counterbalance Weight: A cast iron weight or a groomer and/or a powered rear roller brush accessory is mounted opposite to the hydraulic drive motor to balance the cutting unit.

Cutting Unit Weight:

27” Reel, 5 Blade	**148 lb. (67 kg)**
27” Reel, 8 Blade	**153 lb. (69 kg)**
27” Reel, 11 Blade	**167 lb. (76 kg)**
32” Reel, 8 Blade	**158 lb. (72 kg)**

Options:
Refer to Cutting Unit Parts Catalog for available options for your Reelmaster DPA cutting unit.

General Information

Cutting Unit Operator's Manual

The Cutting Unit Operator's Manual provides information regarding the operation, general maintenance and maintenance intervals for the DPA cutting units on your Reelmaster machine. Additionally, if optional kits have been installed on the cutting units (e.g. rear roller brush), the installation instructions for the kit includes set-up and operation information. Refer to those publications for additional information when servicing the cutting units.

Special Tools

Special tools for servicing Toro Commercial Products are available from your Toro Distributor. Some tools may have been supplied with your machine or are available as TORO parts.

Gauge Bar Assembly

Toro Part Number: **108-6715**

Use gauge bar to verify height-of-cut adjustment.

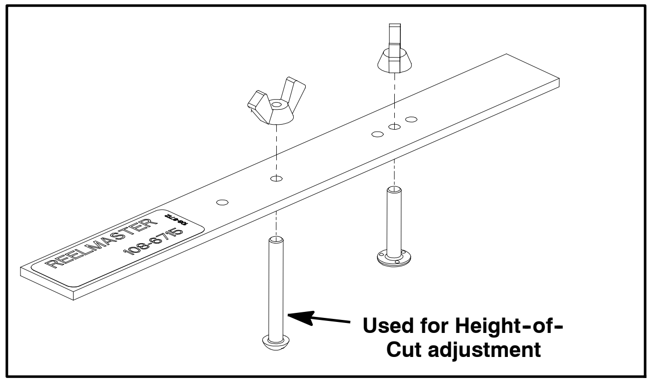

Figure 2

Bedknife Screw Tool

Toro Part Number: **TOR510880**

This screwdriver-type bit is made to fit Toro bedknife attaching screws. Use this bit with a torque wrench to secure the bedknife to the bedbar.

IMPORTANT: To prevent damage to the bedbar, DO NOT use an air or manual impact wrench with this tool.

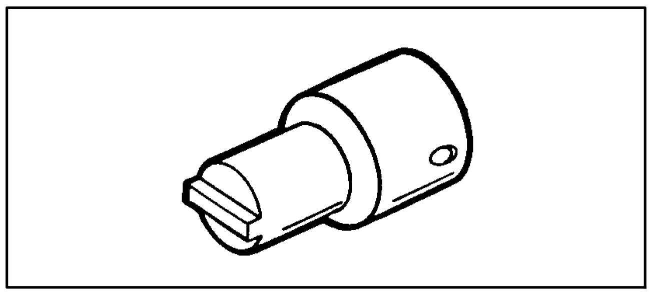

Figure 3

Handle Assembly

Toro Part Number: **29-9100**

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

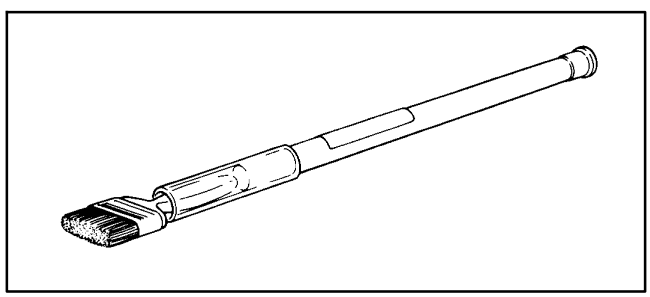

Figure 4

Plastic Plug

Toro Part Number: **94-2703**

This plug is used for placement into the side plate bearing housing when the hydraulic reel motor is removed. It prevents dirt and debris from entering the cutting reel bearing area.

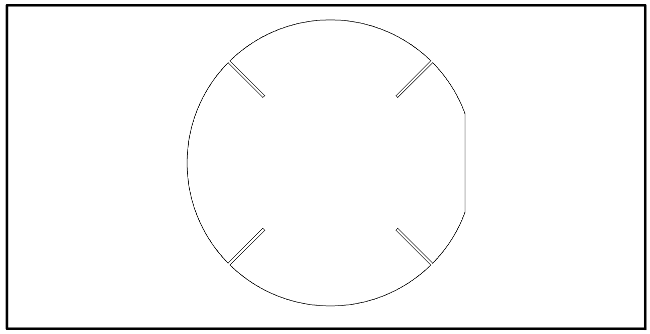

Figure 5

Cutting Unit Kickstand

Toro Part Number: **119-8010-03**

The cutting unit kickstand is used to prop up the rear of the cutting unit during service. Use of this tool prevents the bedbar adjusting screws from resting on the work surface.

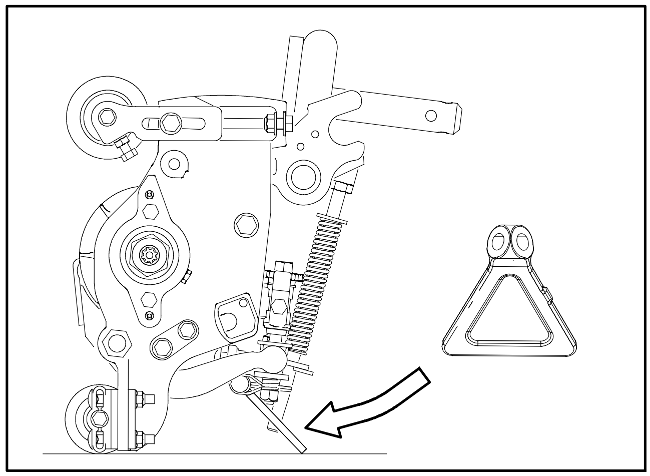

Figure 6

Spline Insert Tool

Toro Part Number: **TOR4074** (9 tooth)

Use the spline insert tool for rotating the cutting reel when hydraulic motor is removed. Also, use this tool for installation of threaded inserts into the cutting reel shaft.

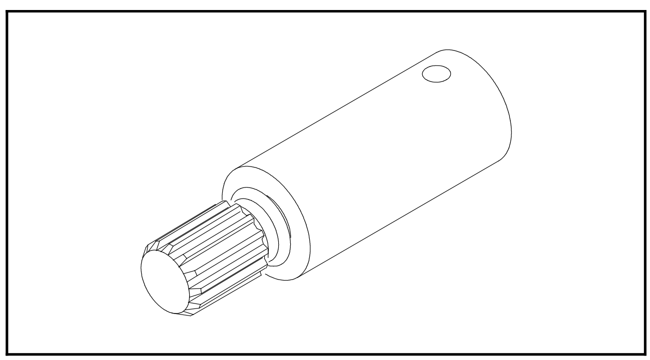

Figure 7

Diameter/Circumference Measuring Tape

Toro Part Number: **TOR6023**

Spring steel measuring tape for accurately measuring the circumference and outside diameter of cutting reel and other spherical components. Tape calibration is in fixed inch readings (no adjustments).

Figure 8

Roller Rebuild Kit

Toro Part Number: **115-0803**

This tool kit is used to assemble the cutting unit rollers. Tools in this kit are also available individually as follows:

115-0852	Inner Seal Tool
115-0853	Bearing/Outer Seal Tool
107-8133	Bearing Installation Washer

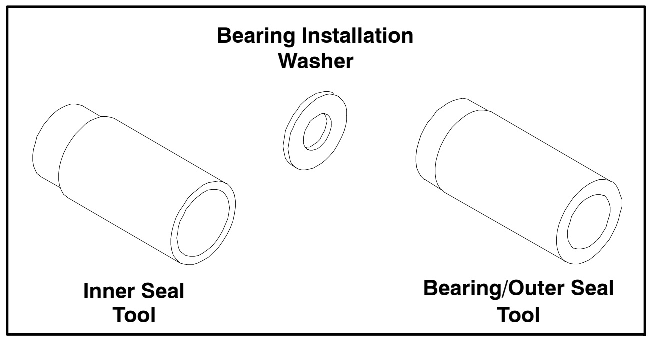

Figure 9

Turf Evaluator Tool

Toro Model Number: **04399**

Many turf discrepancies are subtle and require closer examination. In these instances, the Turf Evaluator grass viewing tool is helpful. It can assist turf managers and service technicians in determining causes for poor reel mower performance and in comparing the effective height-of-cut of one mowed surface to another. This tool should be used with the Toro Guide to Evaluation Reel Mower Performance and Using the TurfEvaluator (Toro part no. 97931SL).

Figure 10

Reel Bearing Installation Tool (cutting units with painted side plates)

Toro Part Number: **117-0975**

Use the reel bearing installation tool to keep the reel bearing aligned as the cutting unit side plate is installed on the bearing.

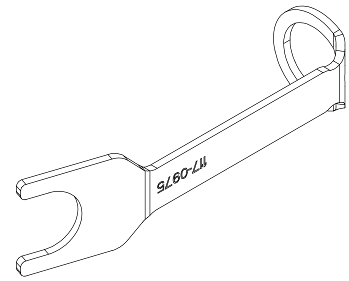

Figure 11

Cutting Reel Shim

Toro Part Number: **125-5611**

The cutting reel shim (0.002”) is used to help parallel the bedknife and cutting reel.

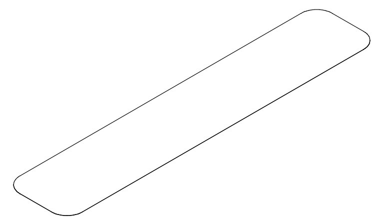

Figure 12

Cutting Performance Paper

Toro Part Number: **125-5610**

Cutting performance paper is used to test the cutting reel performance after adjusting the reel to bedknife clearance. 10 packs (30 strips per pack) of cutting performance paper are included in this part number.

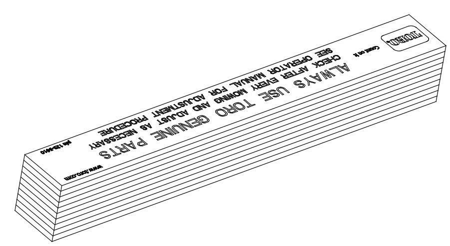

Figure 13

Pulley Alignment Tool

Toro Part Number: **114-5446**

Use pulley alignment tool to verify alignment of groomer and/or rear roller brush drive and driven pulleys.

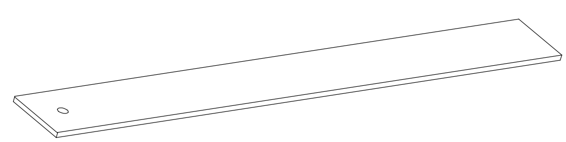

Figure 14

Bedknife Top Angle Indicator and Mount

Toro Part Numbers: **131-6828** and **131-6829**

Because the top grind angle on bedknives is critical for edge retention, and therefore after- cut appearance, Toro has developed these service tools for accurately measuring the top grind angle on all bedknives.

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar.

1. Place the angle indicator on the bottom side of the bedknife with the digital display facing you as shown (Fig. 15).

2. Press the Alt Zero button on the angle indicator.

3. Remove the angle indicator and place the angle-indicator mount on the edge of the bedknife so the face of the magnet is flat against the top of the bedknife (Fig. 16).

4. Place the angle indicator on the mount with the digital display facing you as shown (Fig. 16). The angle displayed on the indicator is the current bedknife top angle. The angle measured should be between 8° and 12°.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

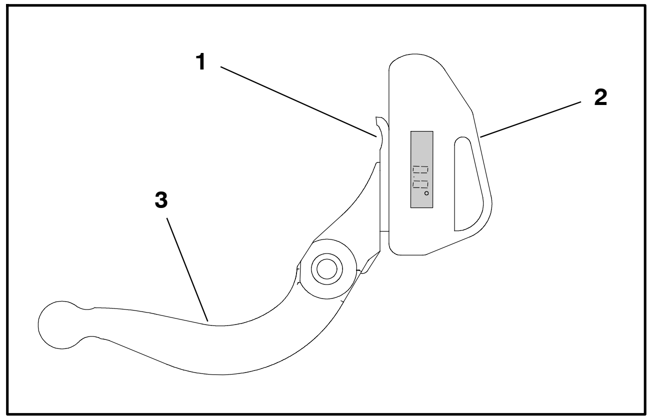

Figure 15

1. **Bedknife**
2. **Angle indicator**
3. **Bedbar**

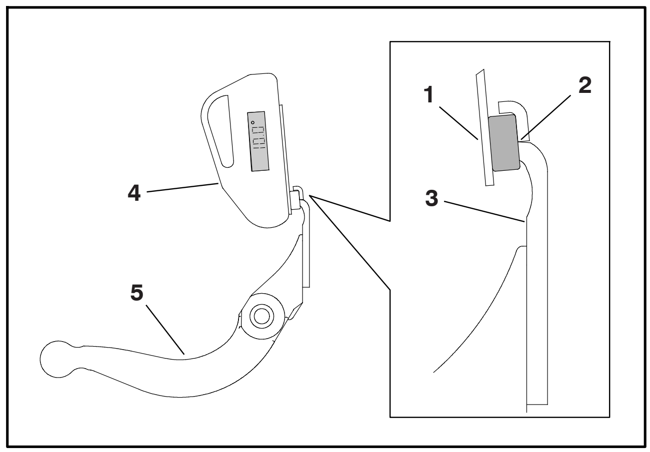

Figure 16

1. **Angle indicator mount**
2. **Magnet**
3. **Bedknife**
4. **Angle indicator**
5. **Bedbar**

Factors That Can Affect Cutting Performance

There are a number of factors that can contribute to unsatisfactory quality of cut, some of which may be turf conditions. Turf conditions such as excessive thatch, “sponginess” or attempting to cut off too much grass height may not always be overcome by adjusting the cutting unit. It is important to remember that the lower the height-of-cut, the more critical these factors are.

Refer to the Cutting Unit’s Operator’s Manual for detailed cutting unit adjustment procedures. For cutting unit repair information, refer to the Service and Repairs section of this chapter.

Note: For additional information regarding cutting unit troubleshooting, see **Aftercut Appearance Troubleshooting Aid (Toro part no. 00076SL)**.

Factor	**Possible Problem/Correction**
Tire pressure	Check tire pressure of all traction unit tires. Adjust tire pressure as necessary (see the Traction Unit Operator’s manual).
Governed engine speed	For best cutting performance and appearance, engine should be run at maximum governed speed during machine operation. Check maximum governed engine speed. Adjust engine to specifications if necessary. See the Traction Unit Operator’s Manual and Chapter 3 - Kubota Diesel Engine in this manual.
Reel speed	All cutting reels must rotate at the same speed (within 100 rpm) (see Troubleshooting in Chapter 4 - Hydraulic System in this manual). All cutting units must have equal bedknife to reel and height-of-cut adjustments. Make sure that reel speed selection is correct (see Clip Chart in Traction Unit Operator’s Manual).
Reel bearing condition	Check reel bearings for wear and replace if necessary. See Reel Assembly Service in the Service and Repairs section of this chapter.
Bedknife to reel adjustment	Check bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions (see Bedknife to Reel Adjustment in the Cutting Unit Operator’s Manual).

Factor	Possible Problem/Correction
Reel and bedknife sharpness **NOTE:** After grinding the reel and/or bedknife, check the reel to bedknife contact again after cutting two (2) fairways. During this initial use, any burrs will be removed from reel and bedknife which may create improper reel to bedknife clearance and thus accelerate wear. This practice of re-checking the reel to bedknife contact after grinding will extend the longevity of the sharpness of the edge of the reel and the bedknife.	A reel and/or bedknife that has rounded cutting edges or “rifling” (grooved or wavy appearance) **cannot** be corrected by tightening the bedknife to reel contact. Grind cutting reel to remove taper and/or rifling. Grind bedknife to sharpen and/or remove rifling. The most common cause of rifling is bedknife to reel contact that is too tight. Dull cutting edges must be corrected by grinding the bedknife and cutting reel (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). **A new bedknife must be ground flat (within 0.002”) after installation to the bedbar. Backlapping may be required to properly mate the reel and bedknife after installation into the cutting unit.** **Note:** On cutting units equipped with optional bedknives, slightly dull cutting edges may be corrected by backlapping (see Backlapping in the Service and Repairs section of this chapter).
Rear roller adjustment	Adjust the rear roller brackets to correct position depending on the height-of-cut range and aggressiveness of cut that is desired. See Rear Roller Adjustment in the Cutting Unit Operator’s Manual.
Height-of-cut	“Effective” or actual height-of-cut depends on the cutting unit weight and turf conditions. Effective height-of-cut will be different from the bench set height-of-cut. See Height-of-Cut Adjustment in the Cutting Unit Operator’s Manual.
Proper bedknife selection for height-of-cut desired	If the bedknife is incorrect for effective height-of-cut, poor quality of cut will result. See Cutting Unit Operator’s Manual for bedknife options.
Stability of bedbar	Make sure bedbar pivot bolts are seated securely. Check condition of the bushings in the side plates. See Bedbar Removal and Installation in the Service and Repairs section of this chapter.
Number of reel blades	Use correct number of reel blades for clip frequency and optimum height-of-cut range. Refer to Clip Chart in Traction Unit Operator’s Manual.
Cutting unit alignment and carrier frame ground following	Check carrier frames and lift arms for damage, binding conditions or bushing wear. Repair if necessary.

Factor	Possible Problem/Correction
Roller condition and roller type	Make sure rollers rotate freely. Repair roller bearings as necessary. See Roller Service in the Service and Repairs section of this chapter. Refer to Cutting Unit Operator's Manual for roller options.
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to Operator's Manual for a listing of available accessories.

Adjustments

Characteristics

CAUTION

Never install or work on the cutting units or lift arms with the engine running. Always stop engine and remove key first.

The dual knob bedknife-to-reel adjustment system incorporated in this cutting unit simplifies the adjustment procedure needed to deliver optimum mowing performance. The precise adjustment possible with this design gives the necessary control to provide a continual self-sharpening action. This feature maintains sharp cutting edges, assures good quality of cut and greatly reduces the need for routine backlapping.

In addition, the rear roller positioning system allows for various height-of-cut ranges and aggressiveness of cut selections.

If a cutting unit is determined to be out of adjustment, complete the following procedures in the specified order to adjust the cutting unit properly.

1. Adjust the bedknife parallel to the reel.

2. Determine desired height-of-cut range and install rear roller mounting shim(s) accordingly.

3. Adjust the height-of-cut.

See Cutting Unit Operator's Manual for cutting unit adjustment procedures for your Reelmaster.

Reel Bearing Adjustment (cutting units with painted side plates)

NOTE: Cutting units that have aluminum side plates do not require reel bearing adjustment.

To insure cut quality and long life of the cutting reel bearings, periodically check reel bearing adjustment.

Check Reel Bearing Adjustment

1. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of this chapter).

2. Loosen bedknife to reel adjustment until no contact exists (see Cutting Unit Operator's Manual).

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. Hold on to the reel shaft and try to move the reel assembly side to side. If reel end play exists, side to side movement will be detected.

4. Using a suitable torque wrench and spline insert tool (see Special Tools), measure the rolling resistance of the cutting reel. Cutting reel rolling torque should not exceed **10 in-lb (1.1 N-m)**.

5. If reel has end play or if rolling torque is incorrect, perform reel bearing adjustment (see below).

6. After checking or adjusting reel bearings, adjust cutting unit (see Cutting Unit Operator's Manual).

7. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of this chapter).

Reel Bearing Adjustment (Fig. 17)

1. Make sure that no contact exists between bedknife and reel.

2. Remove cutting unit components on LH side plate to allow access to bearing adjuster nut. If cutting unit is equipped with an optional groomer or rear roller brush, remove components for those options from left hand side plate of cutting unit. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

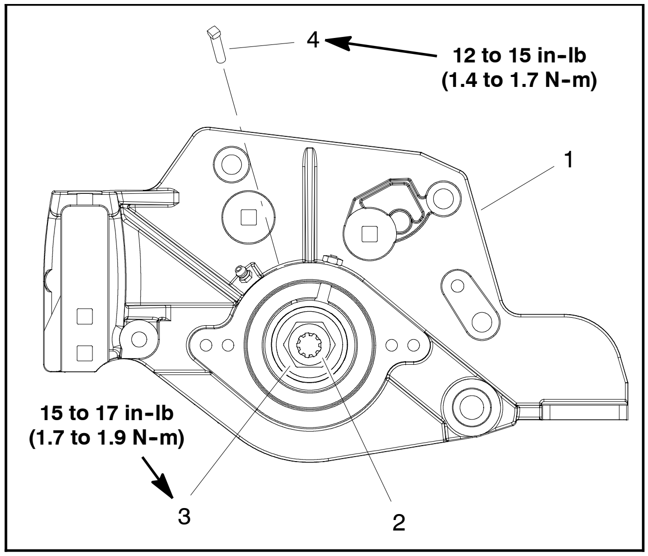

Figure 17

1. LH side plate
2. Threaded insert
3. Bearing adjuster nut
4. Set screw

3. Loosen set screw that secures bearing adjuster nut in LH side plate of cutting unit.

IMPORTANT: Over tightening reel bearing adjuster nut may damage reel bearings.

4. With the cutting unit and reel in a horizontal position, use a 1 3/8" socket and torque wrench to overtighten the bearing adjuster nut to **40 to 45 in-lb (4.5 to 5.1 N-m)**.

5. Loosen the bearing adjuster nut and then torque bearing adjuster nut from **15 to 17 in-lb (1.7 to 1.9 N-m)**.

6. Using a suitable torque wrench and spline insert tool (see Special Tools), check that reel rolling torque does not exceed 10 in-lb (1.1 N-m). Also, check if reel bearing endplay exists. If endplay exists after bearing adjuster nut is properly torqued, replace the cutting reel bearings and seals (see Reel Assembly and Reel Assembly Service in the Service and Repairs section of this chapter).

7. Apply Loctite #243 (or equivalent) to threads of set screw and secure bearing adjuster nut in place with set screw. Torque set screw from **12 to 15 in-lb (1.4 to 1.7 N-m)**.

8. After reel bearing adjustment, install all removed cutting unit components or accessories.

Leveling Rear Roller

The precision machined components of the cutting unit frame keep the rear roller and cutting reel in alignment (parallel). If the side plates are disassembled or as the cutting reel wears, a limited amount of side plate adjustment is possible to make sure that the cutting unit is properly aligned.

1. Place the assembled cutting unit on a surface plate.

2. Make sure that bedknife is properly adjusted to cutting reel.

3. Check if the rear roller is level to the cutting reel by using a 0.005” (0.13 mm) feeler gauge to determine the clearance between the surface plate and the rear roller at each end of the roller. As the rear roller is rotated one full turn, check if the feeler gauge will consistently pass under the roller at one end but will not pass under the opposite end. Check rear roller with the feeler gauge just inside the machined ends of the roller. A frame adjustment should be made if there is consistently more than 0.005” (0.13 mm) clearance under the roller on one end but not on the other.

4. Loosen, but do not remove, the three (3) shoulder bolts that secure the side plate to the frame opposite the side that is not level (Fig. 18).

5. Adjust the position of the side plate to parallel the rear roller and cutting reel. Then, tighten the shoulder bolts to a torque from **27 to 33 ft-lb (37 to 44 N-m)**.

6. After tightening the side plate, recheck the rear roller. If necessary, loosen and adjust second side plate.

7. If rear roller is still not level after adjusting both side plates, check to see if cutting reel is tapered (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). If cutting reel is not tapered and rear roller is not level, a 0.010” shim (part number 107-4001) is available to allow additional rear roller adjustment. The shim would be used on one side of the rear roller and should be installed between the rear roller bracket and roller shim (Fig. 19).

8. After leveling rear roller, complete cutting unit set-up and adjustment sequence.

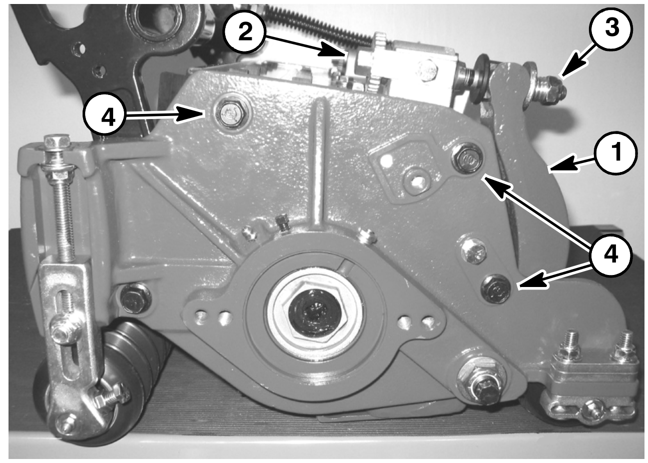

Figure 18

1. **Bedbar**
2. **Bedbar adjuster screw**
3. **Spring tension lock nut**
4. **Shoulder bolt**

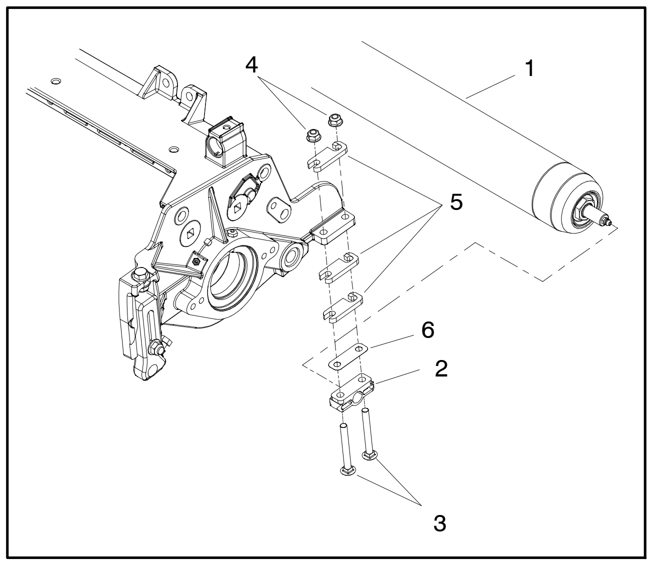

Figure 19

1. **Rear roller assembly**
2. **Rear roller bracket**
3. **Carriage screw**
4. **Flange nut**
5. **Roller shim**
6. **0.010” shim (if needed)**

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DPA Cutting Units

Service and Repairs

Hydraulic Reel Motor

IMPORTANT: When performing maintenance procedures on the cutting units, carefully position the cutting unit reel motors to prevent damage to the motors or hydraulic hoses.

Removal

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

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

3. Inspect reel insert splines for wear. Replace if necessary (see Reel Removal and Installation in the Service and Repairs section of this chapter).

4. Place protective plastic cap (see Special Tools) into the hole in the cutting unit side plate to prevent debris entry into reel bearing area.

Installation

Note: Refer to Figure 20 for correct placement of cutting unit reel motors and weights.

1. Coat spline shaft of the reel motor with No. 2 multipurpose lithium base grease.

2. Install the cap screws for the reel drive motor into the cutting unit side plate and leave approximately 1/2 inch (12.7 mm) of threads exposed on each screw.

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

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

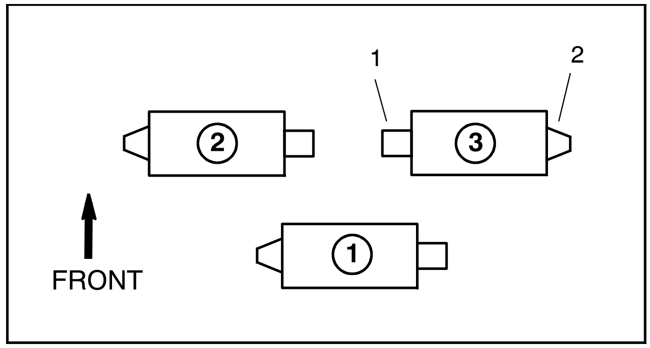

Figure 20

1. **Reel motor location**
2. **Weight location**

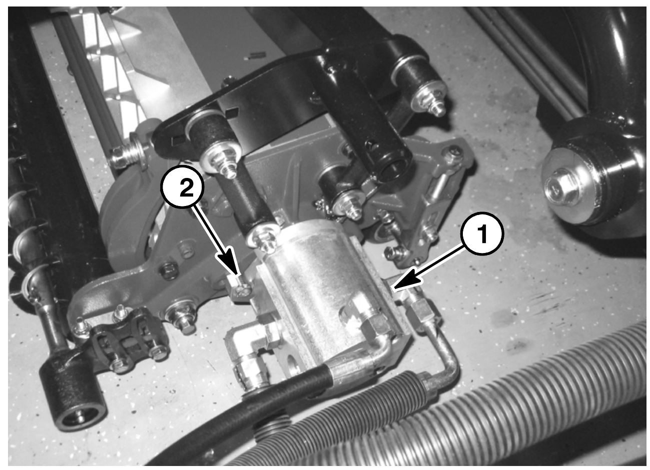

Figure 21

1. **Hydraulic reel motor**
2. **Cap screw**

Backlapping

DANGER

TO AVOID PERSONAL INJURY OR DEATH:

- **Never place hands or feet in the reel area while the engine is running.**
- **When backlapping, run engine at idle speed only.**
- **While backlapping, the reels may stall and then restart.**
- **Do not attempt to restart reels by hand or foot.**
- **Do not adjust reels while the engine is running.**
- **If a reel stalls, stop engine before attempting to clear the reel.**
- **Reel motors are connected in series: rotating one motor causes rotation in other motors.**

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

2. On all cutting units, make initial reel to bedknife adjustments appropriate for backlapping.

IMPORTANT: Do not attempt to rotate the directional valve lever on the hydraulic manifold when the engine or reels are running.

3. Remove the console cover and locate the reel speed selector knob and backlap lever on the hydraulic manifold (Fig. 22). Rotate the reel speed selector knob to position "1" and the backlap lever to the R (backlap) position.

4. Start engine and run at **low idle speed**.

5. With the mow speed limiter in the mow position, move the PTO switch to the ON position. Press the lift switch to start the backlapping operation on the designated reels.

6. Apply lapping compound to cutting reels with a long handle brush (see Special Tools). Never use a short handled brush to apply lapping compound.

CAUTION

Be careful when backlapping the reel because contact with the reel or other moving parts can result in personal injury.

7. To make a cutting unit adjustment while backlapping, turn reels OFF, shut off engine and wait for all machine and cutting unit motion to completely stop. Then, after cutting unit adjustments have been completed, repeat steps 4 through 6.

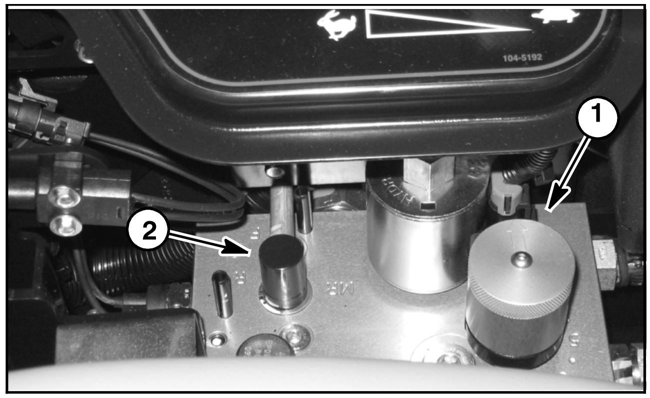

Figure 22

1. **Reel Speed Selector Knob**
2. **Backlap Lever**

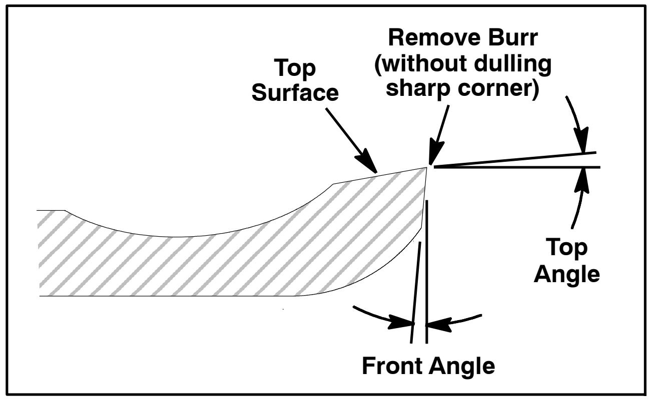

Figure 23

8. When the backlap operation is completed, shut off engine and rotate directional valve lever fully (90º from the backlap position) to the F (forward) position. Also, rotate flow control valve knob to correct mowing position.

9. Wash all lapping compound from the cutting units.

10. For a better cutting edge, run a file across the front face of the bedknife when the lapping operation is completed (Fig. 23). This will remove any burrs or rough edges that may have built up on the cutting edge.

NOTE: Additional instructions and procedures on backlapping are available in the **Toro General Service Training Book, Reel Mower Basics (part no. 09168SL)**.

Bedbar Assembly

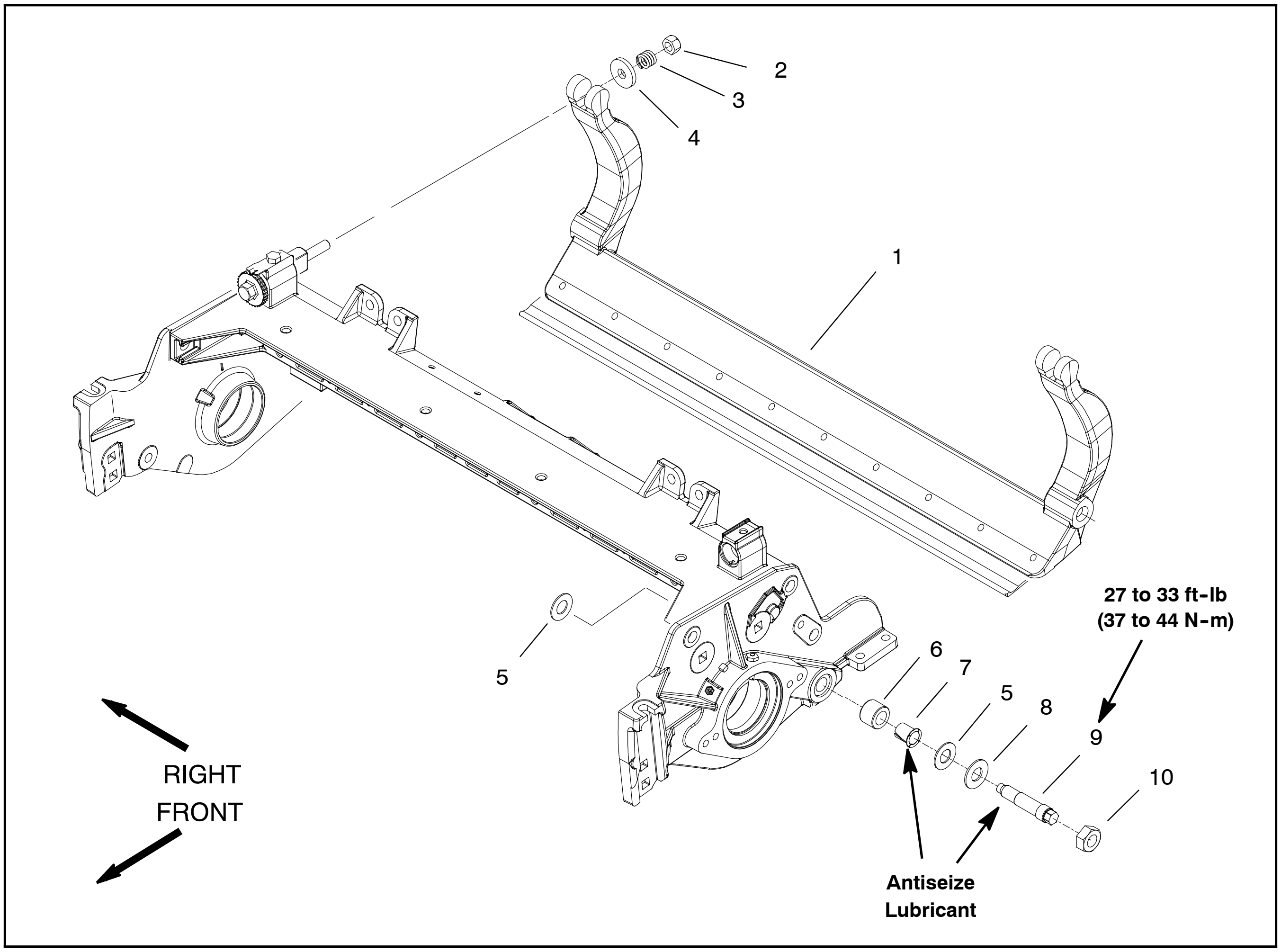

Figure 24

1. **Bedbar assembly**
2. **Lock nut (2 used)**
3. **Compression spring (2 used)**
4. **Washer (2 used)**
5. **Plastic washer (4 used)**
6. **Rubber bushing (2 used)**
7. **Flange bushing (2 used)**
8. **Metal washer (2 used)**
9. **Bedbar pivot bolt (2 used)**
10. **Lock nut (2 used)**

Bedbar Removal (Fig. 24)

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

2. Remove the cutting unit from the machine. Use the cutting unit kickstand to support the cutting unit (see Special Tools).

3. Loosen the lock nuts (item 2) on the end of each bedbar adjuster assembly until washer (item 2) is loose.

4. Loosen the lock nuts (item 10) on each bedbar pivot bolt.

5. Remove two (2) bedbar pivot bolts (item 9), two (2) metal washers and four (4) plastic washers from the cutting unit side plates.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

6. Remove bedbar assembly from cutting unit.

7. Inspect flange bushings (item 7) and rubber bushings (item 6) in side plates for wear or damage. Remove bushings and replace if necessary.

Bedbar Installation (Fig. 24)

1. If rubber bushing was removed from either cutting unit side plate, install a new bushing. The bushing should be installed flush with the inside of the side plate (Fig. 25).

2. If removed, install the flange bushings with flange facing outward. Apply antiseize lubricant to inside of flange bushing.

3. Apply antiseize lubricant to the bedbar threads and the shoulder area of each bedbar pivot bolt.

4. Slide one metal washer and one plastic washer onto each bedbar pivot bolt.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when handling the bedbar.

5. Position bedbar into cutting unit. Make sure that the top of each bedbar arm is between washer (item 4) and adjuster screw flange.

6. Position a plastic washer between bedbar and each cutting unit side plate (Fig. 25).

7. Install the bedbar pivot bolt assemblies:

A. Push each bedbar pivot bolt through the side plate and into the bedbar enough to hold the bedbar in position.

IMPORTANT: Do Not use a powered wrench or an impact wrench to install the bedbar pivot bolts.

B. Start threading of one of the pivot bolts into the bedbar and continue until the pivot bolt bottoms out. Repeat for remaining pivot bolt.

C. Make sure that plastic washers are not caught on the threads of the pivot bolts.

D. Tighten each bedbar pivot bolt from **27 to 33 ft-lbs (37 to 44 N-m)**.

8. Tighten both lock nuts (item 10) until outside metal washer just rotates. Do not over tighten the lock nuts as this can distort the side plates and affect reel to bedknife contact, or in the case of cutting units with painted side plates, reel bearing adjustment. The plastic washer between the bedbar and side plate should be loose.

9. Tighten the lock nut (item 2) on each bedbar adjuster assembly until the adjuster spring is fully compressed, then loosen lock nut 1/2 turn.

10. Adjust cutting unit (see Cutting Unit Operator's Manual).

11. Install cutting unit to machine.

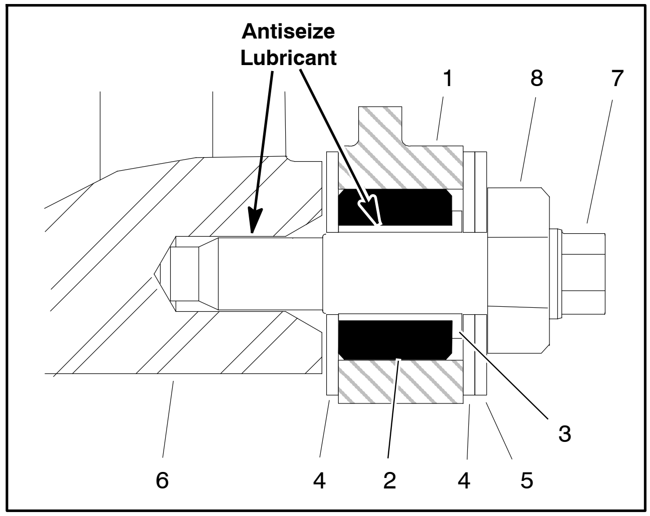

Figure 25

1. **Cutting unit sideplate**
2. **Rubber bushing**
3. **Flange bushing**
4. **Washer (plastic)**
5. **Washer (metal)**
6. **Bedbar**
7. **Bedbar pivot bolt**
8. **Lock nut**

Bedknife Replacement and Grinding

Bedknife Removal

1. Remove bedbar from cutting unit (see Bedbar Removal in this chapter).

NOTE: 18” cutting units use 6 screws to secure bedknife to bedbar. 22” cutting units use 8 screws to secure bedknife to bedbar.

2. Remove screws from bedbar using a socket wrench and bedknife screw tool (see Special Tools in this chapter). Discard screws. Remove bedknife from the bedbar (Fig. 26).

3. See bedknife grinding information on the following pages.

Bedknife Installation

1. Use scraper to remove all rust, scale and corrosion from bedbar surface. Lightly oil bedbar surface before installing bedknife.

2. Make sure that screw threads in bedbar (5/16-18UNC-2A) are clean.

IMPORTANT: Do not use an impact wrench to tighten screws into the bedbar.

3. Use new screws to secure bedknife to bedbar. Apply antiseize lubricant to the threads of new screws. Do not apply antiseize lubricant to the taper of the screw heads.

4. Install all screws but do not tighten.

5. Using a torque wrench and bedknife screw tool, tighten the 2 outer screws to **10 in-lb (1 N-m)**.

6. Working from the center of the bedknife toward each end (Fig. 27), tighten screws from **200 to 250 in-lb (23 to 28 N-m)**.

7. After installing bedknife to bedbar, grind bedknife.

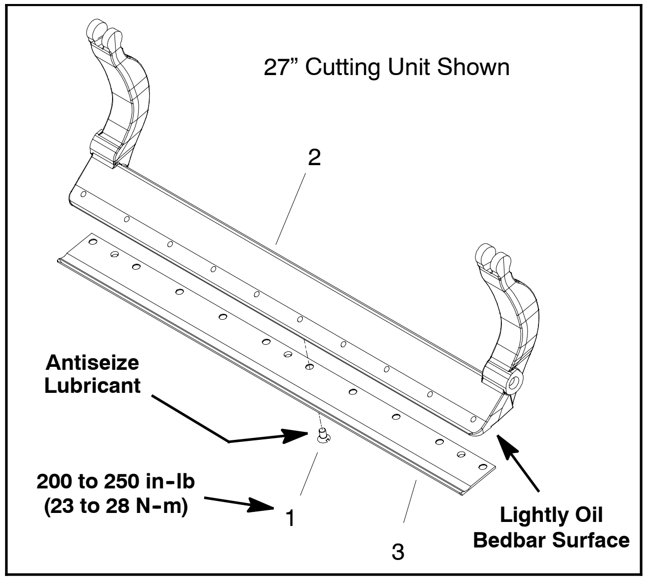

Figure 26

1. **Screw**
2. **Bedbar**
3. **Bedknife**

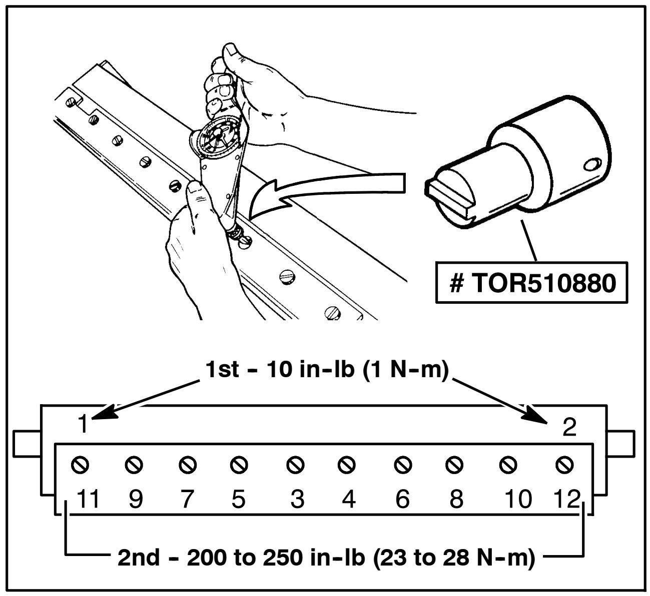

Figure 27

Bedknife Grinding

Since there can be variations in the mounting surface of the bedbar, it is necessary to grind the bedknife after installing it to the bedbar. Follow the bedknife grinding specifications provided and grind only enough to make sure the top surface of the bedknife is true (Fig. 28 and 29).

IMPORTANT: Do Not grind the bedknife below it's service limit (Fig. 30). Operating the cutting unit with the bedknife below the service limit may result in poor after-cut appearance and reduce the structural integrity of the bedknife for impacts.

When grinding the bedknife, be careful to not overheat the bedknife. Remove small amounts of material with each pass of the grinder. **Also, clean and dress grinding stone often during the grinding process.**

NOTE: EdgeMax® bedknives are extremely hard. Using a diamond grinding wheel is recommended to prevent overheating or damaging the bedknife edge while grinding.

Because the top grind angle on bedknives is critical for edge retention, and therefore after-cut appearance, Toro has developed special service tools for accurately measuring the top grind angle on all bedknives; refer to the Angle Indicator and Magnetic Mount in the Special Tools section of this Chapter.

NOTE: Some bedknives were produced with a 5° top angle. Use a 10° top angle when regrinding all bedknives.

Bedknife Grinding Specifications			
Bedknife	Lip Height Service Limit	Top Angle	Front Angle
EdgeMax Low HOC	0.19" (4.8 mm)	10°	5°
Premium Low HOC			
Standard Low HOC			
Extended EdgeMax Low HOC			10°
Extended Low HOC			
EdgeMax Standard HOC			5°
Standard Standard HOC			
Heavy Duty Standard HOC			

Figure 28

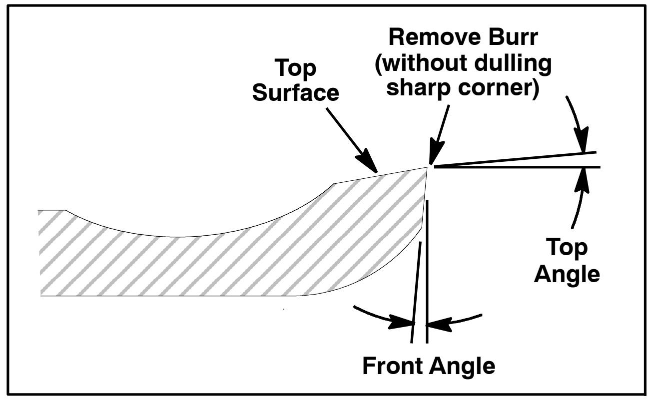

Figure 29

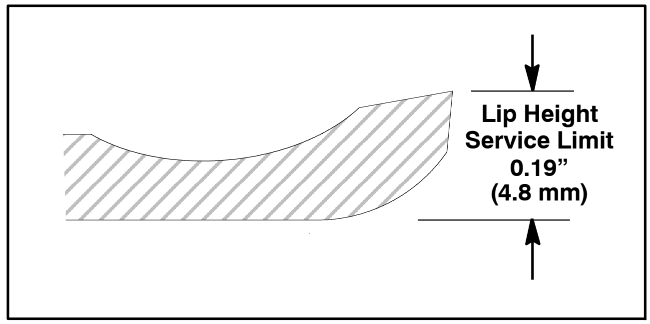

Figure 30

1. Bedknife

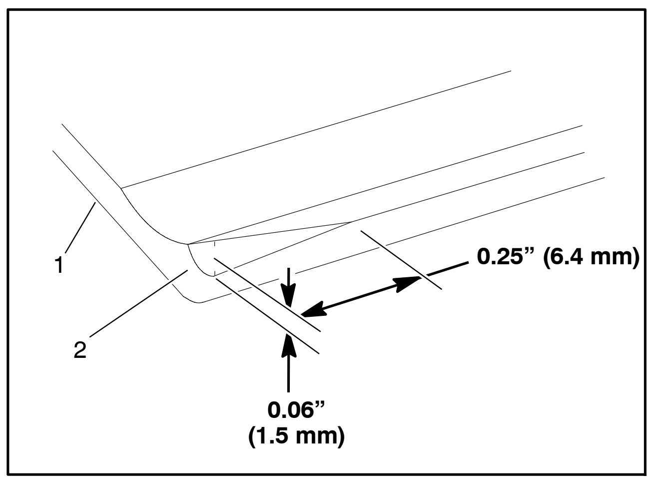

Figure 31

1. Bedknife 2. Lead-in Chamfer

1. Use Toro General Service Training Book, Reel Mower Basics (part no. 09168SL) and grinder manufacturer's instructions for bedknife grinding information.

2. A lead-in chamfer is ground into all new bedknives (Fig. 31). The original chamfer should last for the first 40% of the bedknife service life. Check and re-grind the lead-in chamfer as necessary.

3. After bedknife grinding is complete, install bedbar to cutting unit (see Bedbar Installation in this section).

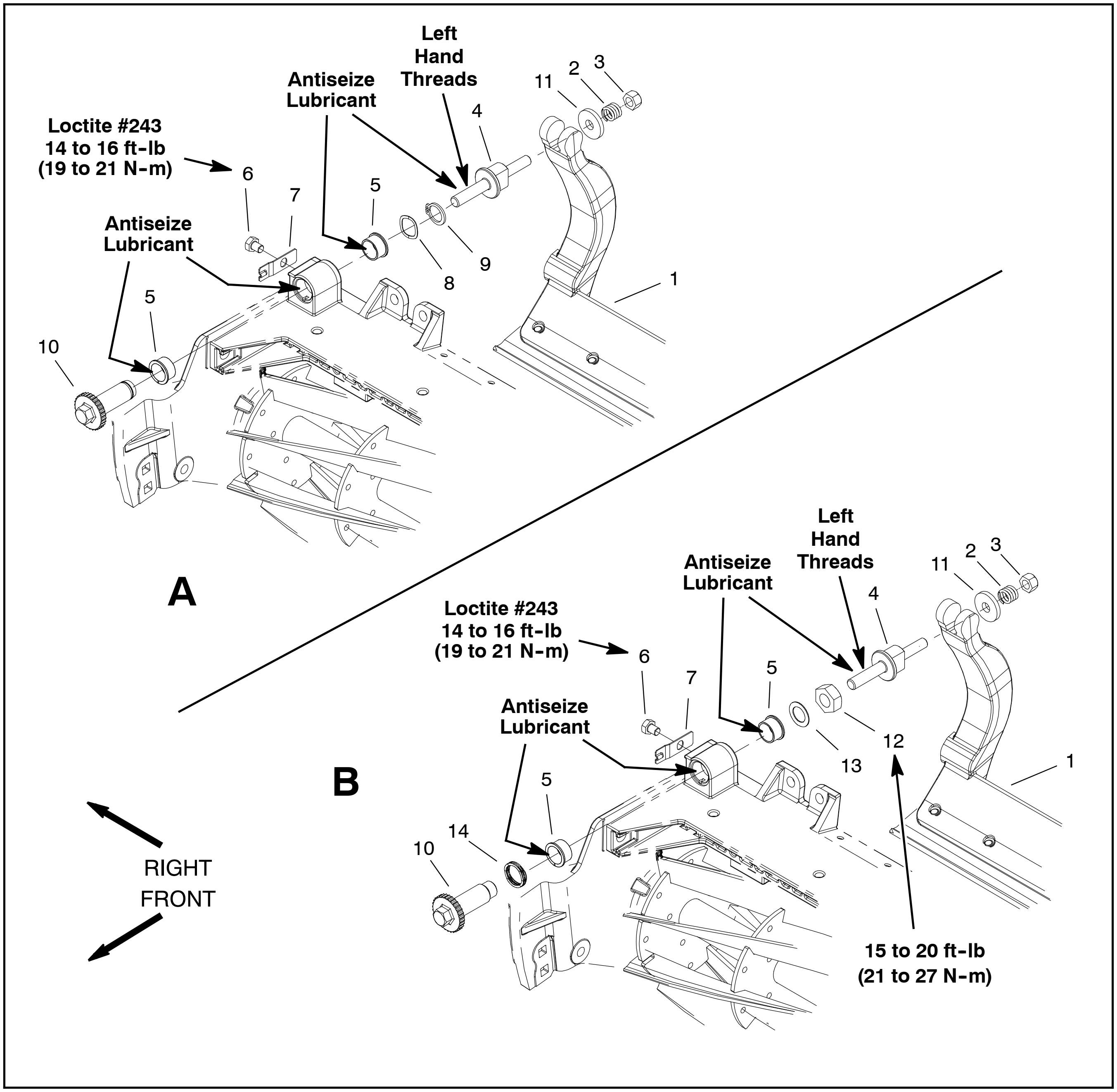

Figure 32

1. **Bedbar assembly**
2. **Compression spring**
3. **Lock nut**
4. **Bedbar adjuster screw**
5. **Flange bushing**
6. **Cap screw**
7. **Detent**
8. **Wave washer**
9. **Retaining ring**
10. **Bedbar adjuster shaft**
11. **Washer**
12. **Lock nut**
13. **Flat washer**
14. **Wave washer**

NOTE: The bedbar adjuster system for early production DPA cutting units (Fig. 32 A) used a retaining ring on the end of the bedbar adjuster shaft. Current production DPA cutting units (Fig. 32 B) include a lock nut on the end of the bedbar adjuster shaft. Upgrading to the current production style adjusters is recommended using Heavy Duty DPA Kit p/n 120-7230. The bedbar adjuster service procedures for either style of adjuster shaft is very similar.

Removal (Fig. 32)

1. Remove lock nut (item 3), compression spring and washer from bedbar adjuster screw (item 4).

2. Remove bedbar assembly (see Bedbar Assembly Removal in this section).

3. Remove bedbar adjuster screw (left hand threads) from the bedbar adjuster shaft (item 10).

4. Remove adjuster shaft from cutting unit frame:

A. On early production cutting units (Fig. 32 A), remove retaining ring and wave washer from adjuster shaft. Slide adjuster shaft from cutting unit frame.

B. On current production cutting units (Fig. 32 B), remove lock nut and flat washer from adjuster shaft. Slide adjuster shaft and wave washer from cutting unit frame.

5. Inspect flange bushings (item 5) in cutting unit frame and remove if necessary.

6. If detent (item 7) is damaged, remove it from cutting unit side plate.

Installation (Fig. 32)

1. If detent (item 7) was removed, apply Loctite #243 (or equivalent) to threads of cap screw and secure detent to cutting unit side plate with cap screw. Tighten cap screw from **14 to 16 ft-lb (19 to 21 N-m)**.

2. If flange bushings (item 5) were removed, apply antiseize lubricant to bore of cutting unit frame. Align key on bushing to slot in frame and install bushings into frame. Apply antiseize lubricant to bore of each flange bushing.

3. Install adjuster shaft to cutting unit frame:

A. On early production cutting units (Fig. 32 A), slide bedbar adjuster shaft into flange bushings in cutting unit frame. Secure adjuster shaft with wave washer and retaining ring.

B. On current production cutting units (Fig. 32 B), slide wave washer onto adjuster shaft and then slide adjuster shaft into flange bushings in cutting unit frame. Secure adjuster shaft with flat washer and lock nut. Tighten lock nut to shoulder of adjuster shaft and then torque lock nut from **15 to 20 ft-lb (21 to 27 N-m)**.

NOTE: Inside threads in bedbar adjuster shaft (item 4) are left-hand threads.

4. Apply antiseize lubricant to left hand threads threads of bedbar adjuster screw (item 4). Thread bedbar adjuster screw into adjuster shaft (item 10).

5. Install washer (item 11), compression spring and lock nut onto adjuster screw.

6. Install bedbar assembly (see Bedbar Assembly Installation in this section).

7. Adjust cutting unit (see Cutting Unit Operator's Manual).

Reel Assembly (cutting units with painted side plates)

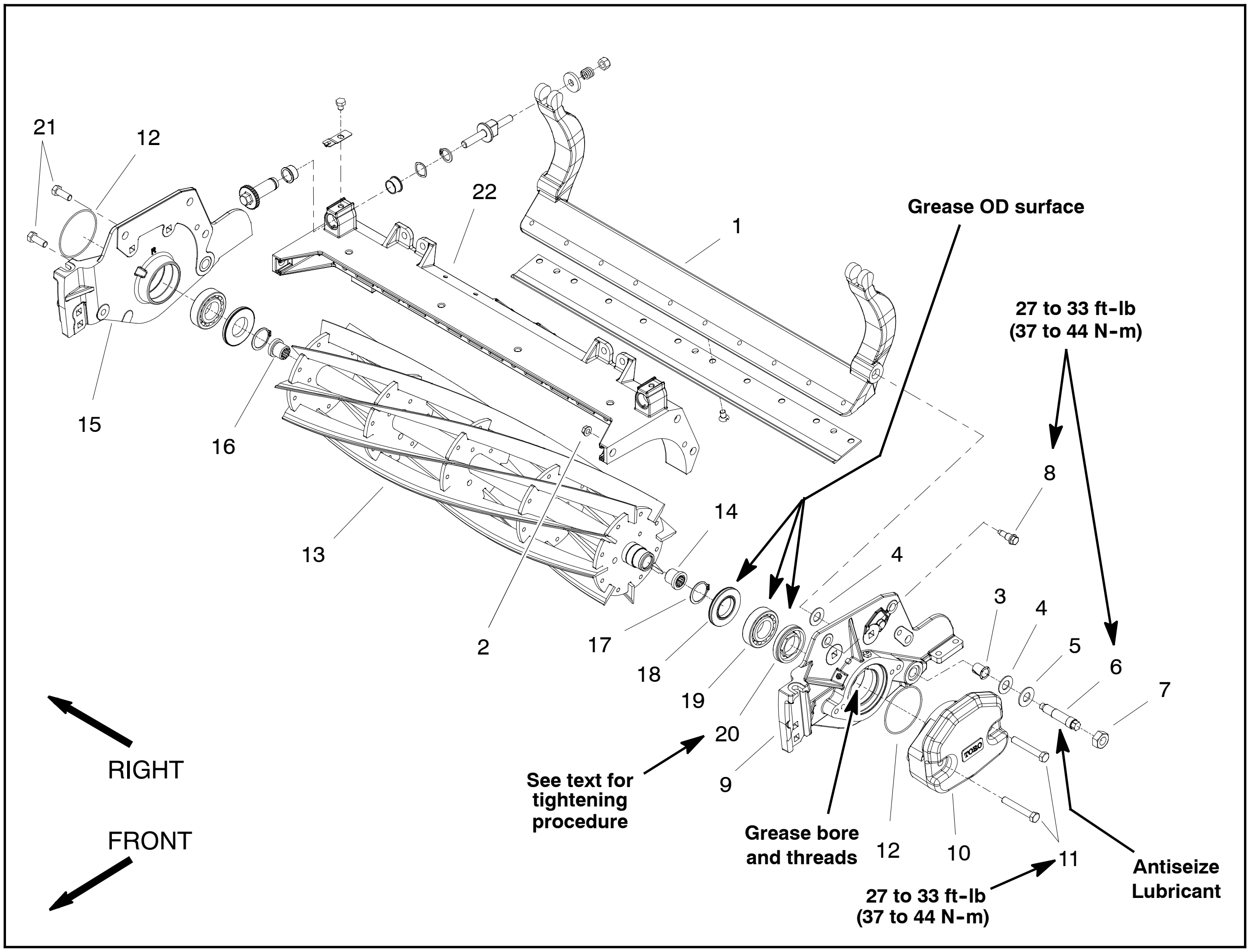

Figure 33

1. **Bedbar assembly**
2. **Flange nut (3 used per side plate)**
3. **Flange bushing (2 used)**
4. **Plastic washer (4 used)**
5. **Metal washer (2 used)**
6. **Bedbar pivot bolt (2 used)**
7. **Lock nut (2 used)**
8. **Shoulder bolt (3 used per side plate)**
9. **LH side plate**
10. **Weight**
11. **Cap screw (2 used)**
12. **O-ring**
13. **Cutting reel**
14. **Spline insert (LH thread)**
15. **RH side plate**
16. **Spline insert (RH thread)**
17. **Retaining ring (2 used)**
18. **Grease seal (2 used)**
19. **Bearing (2 used)**
20. **Bearing adjuster nut**
21. **Cap screw (2 used)**
22. **Cutting unit frame**

Note: This section provides the procedure for removing and installing the cutting reel assembly (cutting reel, spline inserts, grease seals and bearings) from the cutting unit.

Note: Refer to Reel Assembly Service later in this section for information on replacing cutting reel grease seals, bearings and spline inserts.

Note: Removal of the cutting reel requires removal of the left side plate from the cutting unit frame. The right side plate does not have to be removed from the frame.

Reel Assembly Removal (Fig. 33)

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

2. Remove the cutting unit from the machine and place on a flat work area.

3. If cutting unit is equipped with a weight on LH side plate (as shown in Figure 33), remove the two (2) cap screws securing the weight to the side plate. Remove weight from the cutting unit. Remove and discard O-ring from weight.

4. If cutting unit is equipped with an optional rear roller brush, remove components for those options from left hand side plate of cutting unit. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

IMPORTANT: If the reel bearings or seals are being replaced, the reel spline inserts must be removed. Use the following procedure to restrain the reel and loosen the spline insert before removing the rollers.

5. Loosen the spline inserts:

A. Tip 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.

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 spline insert being loosened. Use correct spline insert tool (see Special Tools).

IMPORTANT: The spline insert on the left end of the cutting reel has left hand threads and the spline insert on the right end of the cutting reel has right hand threads.

D. Rest the handle of the pry bar against the front roller and loosen the spline insert closest to the pry bar.

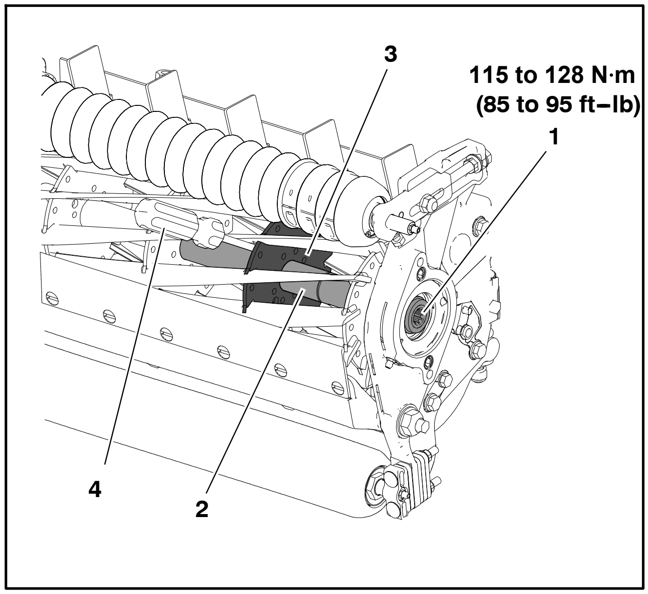

Figure 34

1. Spline insert (LH)
2. Reel shaft
3. Reel support plate
4. Pry bar

E. Position the pry bar in the same manner on the opposite end of the reel and loosen the remaining spline insert.

F. Tip the cutting unit back onto its rollers.

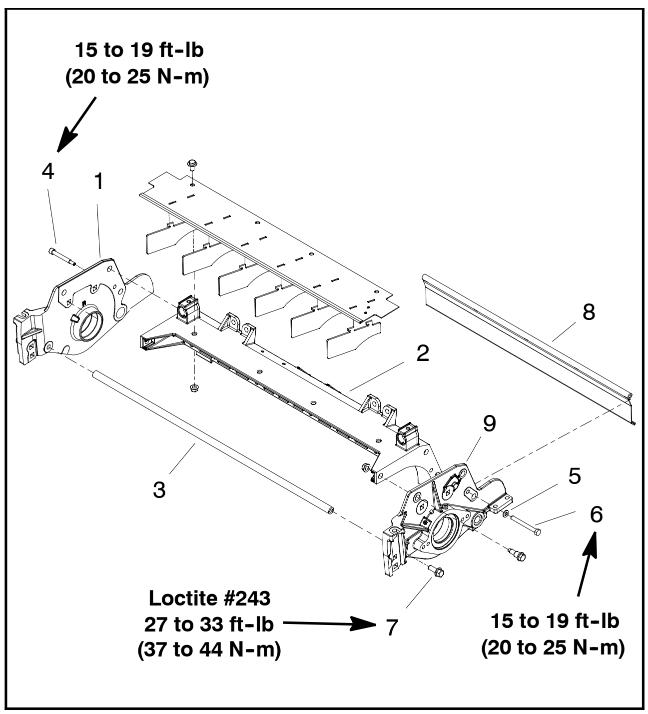

Figure 35

1. RH side plate
2. Center frame
3. Support tube
4. Socket head screw
5. Flat washer
6. Cap screw
7. Flange head screw
8. Rear grass shield
9. LH side plate

6. Remove the bedbar pivot bolt and washers from the LH side plate.

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. Remove cap screw and flat washer that secure rear grass shield to LH side plate (Fig. 35).

9. Remove flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 35).

Note: The reel bearings and grease seals are press fit on the cutting reel shaft and should remain on the reel when removing the LH side plate.

10. Remove shoulder bolts (item 8) and flange nuts (item 24) that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft, rollers, bedbar and cutting unit frame.

11. Carefully slide the cutting reel with bearings, grease seals and splined inserts from the RH side plate.

12. Inspect and service cutting reel assembly as required (see Reel Assembly Service in this section).

Reel Assembly Installation (Fig. 33)

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates for wear or damage and replace if needed.

Note: Check that grease seals on cutting reel shaft are flush to 0.060" (1.5 mm) away from retaining ring on reel shaft. If necessary, adjust position of grease seals to allow proper clearance.

2. Make sure that grease seals and bearings are properly greased and positioned on cutting reel (see Reel Assembly Service in this section). Apply thin coat of grease to outside of grease seals and bearings on cutting reel to ease reel installation. Also, apply grease to bearing bores and threads in side plates.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

IMPORTANT: During cutting reel installation, keep inner and outer bearing races aligned. If bearing races are not aligned, binding will occur and reel installation may cause bearing damage. Use reel bearing installation tool (#117-0975) to help with bearing alignment during reel installation.

3. Using reel bearing installation tool (see Special Tools in this chapter) to keep reel bearing aligned, carefully slide the cutting reel with bearings and grease seals into the RH side plate. Make sure that bearing is fully seated into side plate.

4. On LH side plate, loosen set screw (item 21) and back-off (loosen) bearing adjuster nut (item 20) one complete turn.

5. Using reel bearing installation tool (see Special Tools in this chapter) to keep reel bearing aligned, carefully slide the LH side plate onto the cutting reel assembly, front roller and rear roller. Make sure that reel end in RH side plate does not shift in position.

6. Install shoulder bolts (item 8) and flange nuts (item 24) that secure the LH side plate to the cutting unit frame. Torque the shoulder bolts from **27 to 33 ft-lb (37 to 44 N-m)**.

7. Apply Loctite #243 (or equivalent) to threads of flange head screw that secures support tube, frame spacer and carrier frame to LH side plate (Fig. 35). Install screw and torque from **27 to 33 ft-lb (37 to 44 N-m)**. After tightening screw, check the clearance between the carrier frame and side plate. If clearance is more than 0.090" (2.3 mm), remove flange head screw and position shim(s) (part number 67-9410) between carrier frame and side plate so that clearance is less than 0.090" (2.3 mm). Make sure that the carrier frame pivots freely after assembly.

8. Install cap screw and flat washer that secure rear grass shield to LH side plate (Fig. 35). Torque screw from **15 to 19 ft-lb (20 to 25 N-m)**.

9. Secure the bedbar assembly to LH side plate (see Bedbar Installation in this section).

10. Secure front and rear rollers to LH side plate (see Front Roller Installation and Rear Roller Installation in this section).

IMPORTANT: Over tightening reel bearing adjuster nut may damage reel bearings.

11. Make sure that set screw (item 21) is loose in LH side plate to allow bearing adjuster nut movement. With the cutting unit and reel in a horizontal position, torque the bearing adjuster nut (item 20) **25 in-lb (2.8 N-m)** to remove cutting reel end play.

12. Loosen the bearing adjuster nut. Then torque bearing adjuster nut from **15 to 17 in-lb (1.7 to 1.9 N-m)**. After torquing nut, check that reel rolling torque does not exceed 10 in-lb (1.1 N-m).

13.Apply Loctite #243 (or equivalent) to threads of set screw and secure bearing adjuster nut in place with set screw. Torque set screw from **12 to 15 in-lb (1.4 to 1.7 N-m)**.

14.Adjust cutting unit (see Cutting Unit Operator's Manual).

Note: The parallel position of the rear roller to the cutting reel is controlled by the precision machined frame and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in the Set-Up and Adjustments section of this Chapter).

15.If cutting unit is equipped with optional rear roller brush, install components for those options to left hand side plate of cutting unit. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

16.Tighten the spline inserts:

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.

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 spline insert being tightened.

IMPORTANT: The spline insert on the left end of the cutting reel has left hand threads and the spline insert on the right end of the cutting reel has right hand threads.

C. Rest the handle of the pry bar against the front roller and tighten the spline insert closest to the pry bar. The spline inserts are installed with thread locking compound (Loctite #243 or equivalent). Tighten the spline insert from **85 to 95 ft-lb (115 to128 N-m)**. Use correct spline insert tool (see Special Tools).

D. Position the pry bar in the same manner on the opposite end of the reel and tighten the remaining spline insert.

17.If weight was removed from cutting unit, install new O-ring (item 12) on weight. Secure weight to cutting unit side plate with two (2) cap screws. Torque screws from **27 to 33 ft-lb (37 to 44 N-m)**.

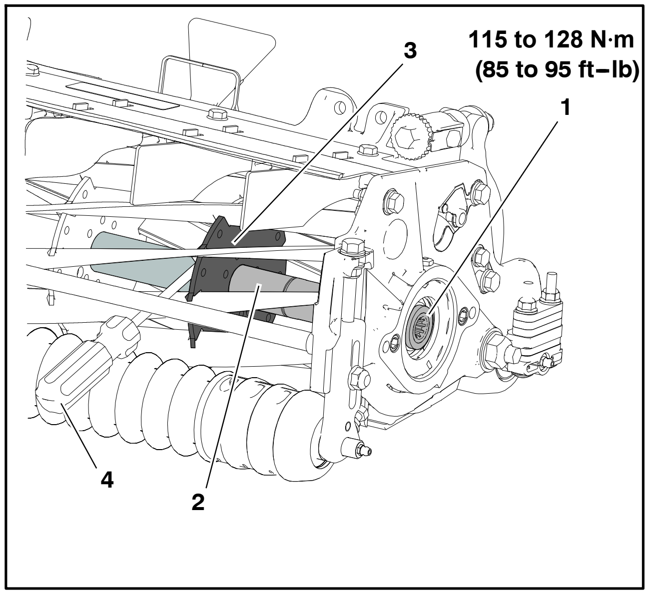

Figure 36

1. **Spline insert (LH)**
2. **Reel shaft**
3. **Reel support plate**
4. **Pry bar**

18.Lubricate cutting unit grease fittings until grease purges from relief valves in side plates. Initial greasing may require several pumps of a hand grease gun.

19.Install cutting unit to the machine.

Reel Assembly Service (cutting units with painted side plates)

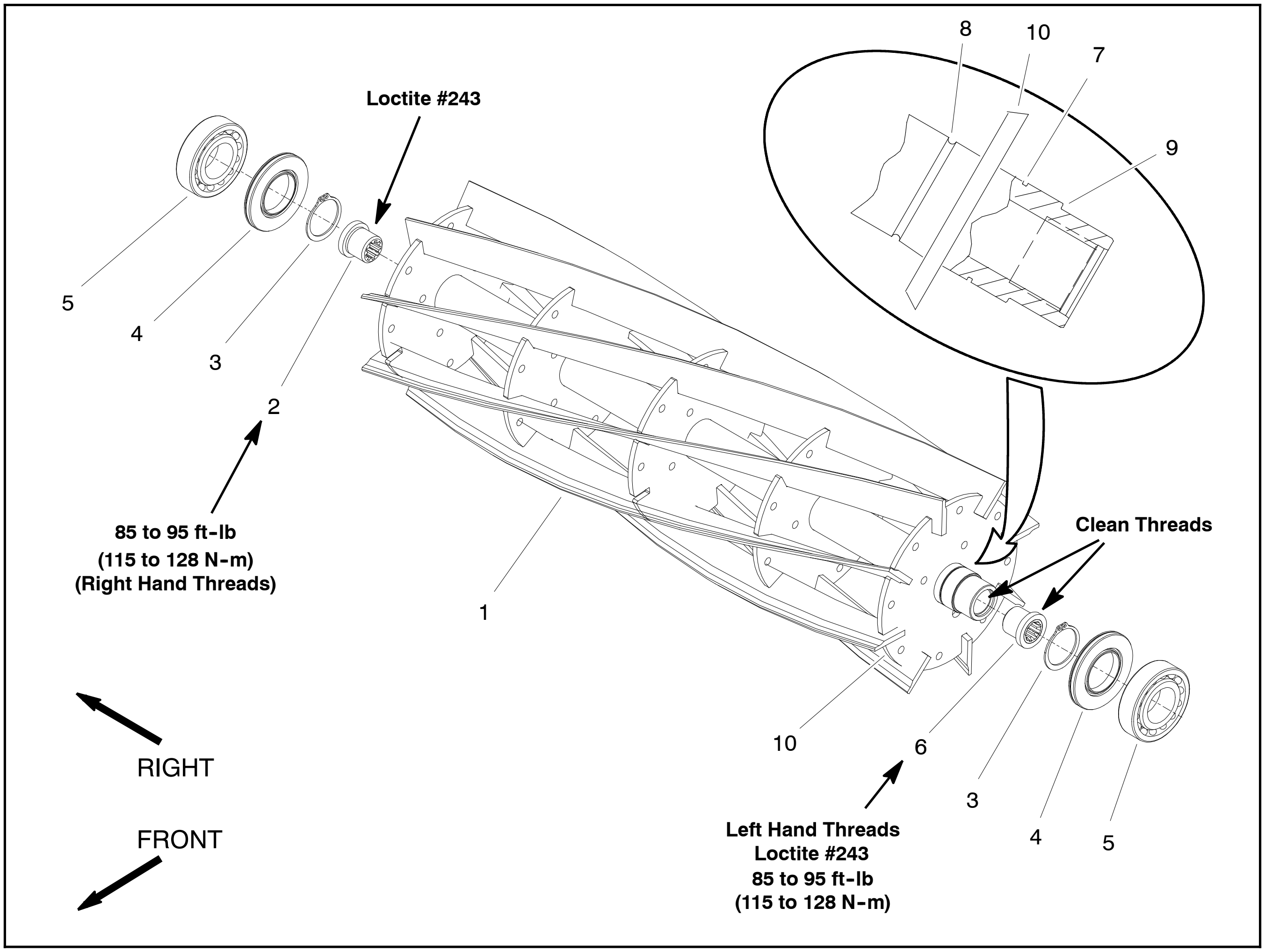

Figure 37

1. **Cutting reel**
2. **Threaded insert (RH thread)**
3. **Retaining ring**
4. **Grease seal**
5. **Bearing**
6. **Threaded insert (LH thread)**
7. **Retaining ring groove**
8. **Groove indicating LH threads**
9. **Bearing shoulder**
10. **Reel spider**

Inspection of Cutting Reel (Fig. 37)

1. Inspect reel bearings to insure that they spin freely and have minimal axial play. The bearing balls must be free of deformation and scoring.

2. Inspect the reel shaft as follows. If reel damage is detected, replace reel.

A. Check the reel shaft for bending and distortion by placing the shaft ends in V-blocks.

B. Check the reel blades for bending or cracking.

C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).

3. Check the threaded inserts in the reel shaft for excessive wear or distortion. Replace inserts if damage is evident.

A. The threaded inserts are installed with thread locking compound (Loctite #243 or equivalent). One insert has LH threads and the other RH threads. The insert with LH threads has an identification groove on the flange face. A groove on the reel shaft approximately 2” from the end identifies the reel end that has LH threads (see illustration in Fig. 37).

B. To remove or install threaded spline inserts, use correct spline insert tool (see Special Tools).

C. To install spline insert into cutting reel, clean threads of insert and cutting reel shaft. Apply Loctite #243 (or equivalent) to threads of insert, thread insert into reel shaft and torque from **85 to 95 ft-lb (115 to 128 N-m)**.

Assembly of Cutting Reel (Fig. 37)

1. If seals and/or bearings were removed from reel shaft, discard removed components and replace.

2. Make sure that the two (2) retaining rings are fully seated into the grooves on the cutting reel shaft.

3. If bearings and seals were removed from reel shaft:

A. Make sure that bore of seals are clean with **no** grease or lubricant applied to ID of seal.

IMPORTANT: The grease seal should be installed so the metal side of the seal is toward the bearing location.

B. Press grease seals onto reel shaft with metal side orientated toward bearing location. Final position of seal should be flush to 0.060" (1.5 mm) away from retaining ring on reel shaft. Do not force seal against retaining ring. Seal must be perpendicular to reel shaft after installation.

C. Pack replacement reel bearings with Mobil High Temperature HP grease (or equivalent).

D. Press grease packed bearings fully onto reel shaft. Bearings should bottom on reel shaft shoulder. Press equally on inner and outer bearing race when installing bearings onto reel shaft.

4. Pack bore of reel shaft with Mobil High Temperature HP (or equivalent) grease.

Reel Assembly (cutting units with aluminum side plates)

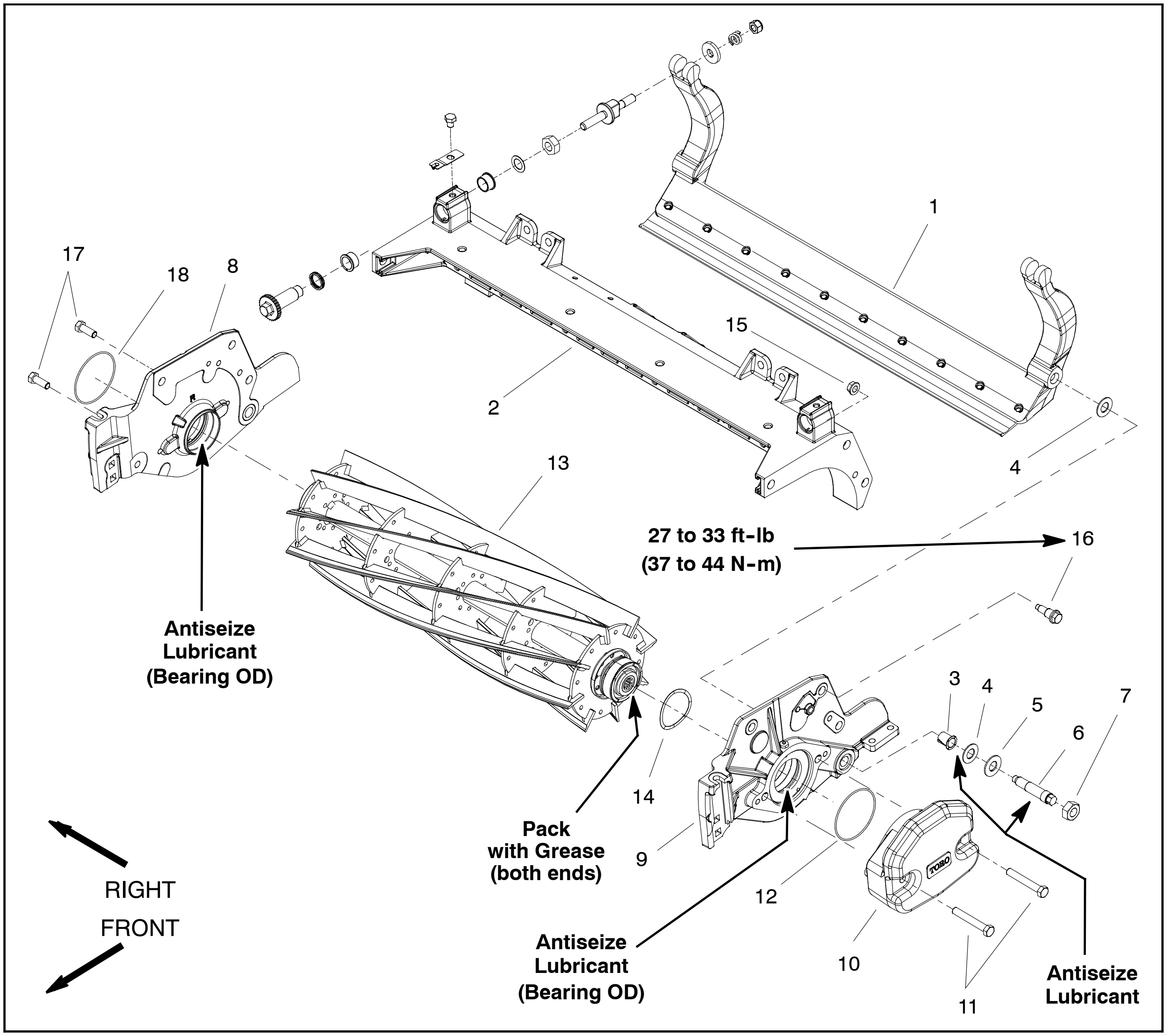

Figure 38

1. **Bedbar assembly**
2. **Cutting unit frame**
3. **Flange bushing (2 used)**
4. **Plastic washer (4 used)**
5. **Metal washer (2 used)**
6. **Bedbar pivot bolt (2 used)**
7. **Lock nut (2 used)**
8. **RH side plate**
9. **LH side plate**
10. **Weight**
11. **Cap screw (2 used)**
12. **O-ring**
13. **Cutting reel assembly**
14. **Wire spring**
15. **Flange nut (3 used per side plate)**
16. **Shoulder bolt (3 used per side plate)**
17. **Cap screw (2 used)**
18. **O-ring**

NOTE: Refer to Reel Assembly Service later in this section for information on replacing cutting reel seals and bearings.

NOTE: Removal of the cutting reel requires removal of the left side plate from the cutting unit frame. The right side plate does not have to be removed from the frame.

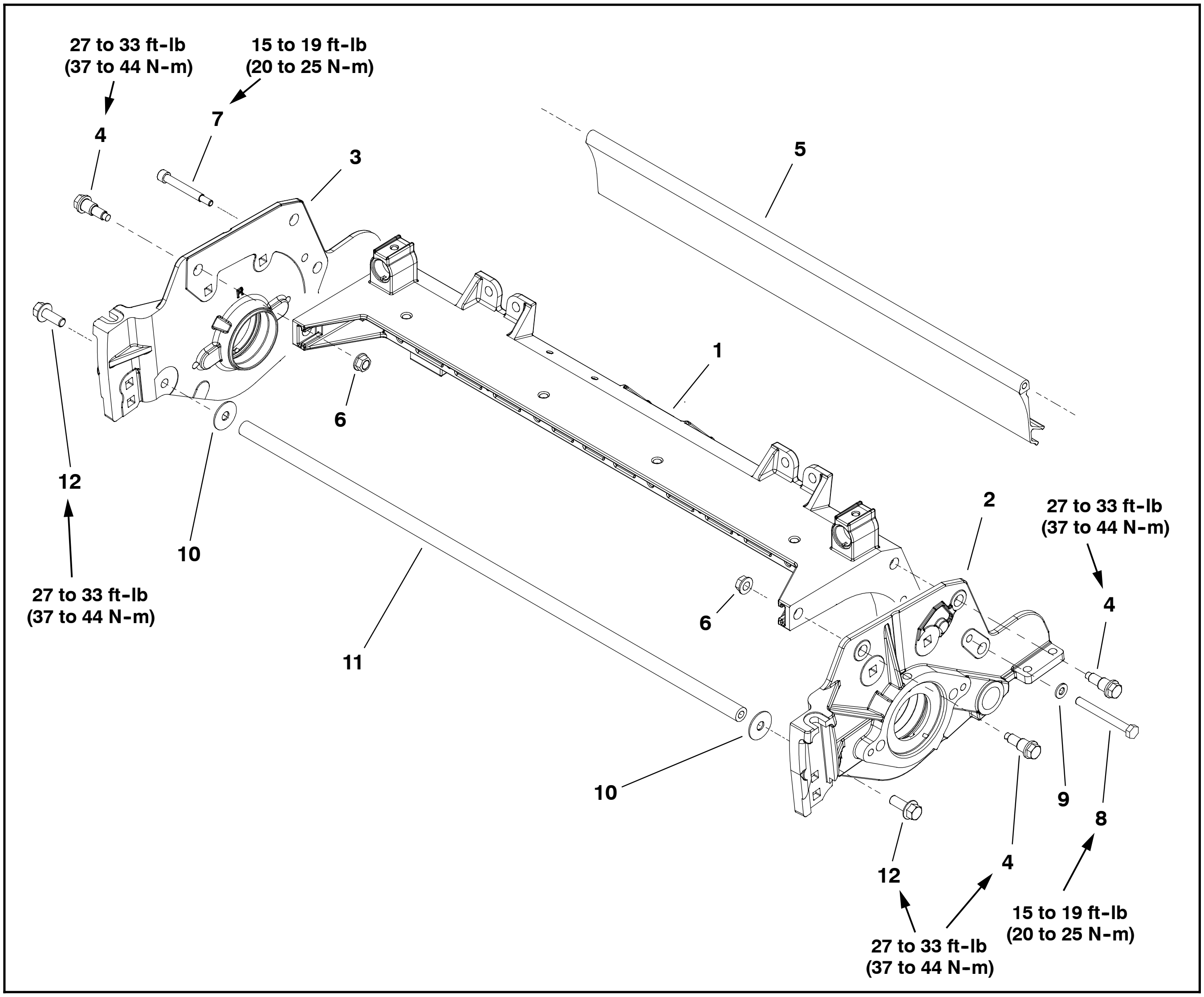

Figure 39

1. Frame
2. LH side plate
3. RH side plate
4. Shoulder bolt (6)
5. Rear grass shield
6. Flange nut (6)
7. Special screw
8. Flat washer
9. Cap screw
10. Washer (2)
11. Support rod
12. Flange head screw (2)

Reel Assembly Removal

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

2. Remove the cutting unit from the machine and place on a flat work area.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

3. If cutting unit is equipped with a counterweight or accessory on LH side plate, remove the counter weight or accessory from the cutting unit. Remove and discard O-ring from counter weight. See Chapter 9 - Universal Groomer in this manual for additional Groomer information. See Rear Roller Brush in this chapter for information on rear roller brush.

IMPORTANT: If the reel bearings or seals are being replaced, the reel spline inserts must be removed. Use the following procedure to restrain the reel and loosen the spline insert before removing the rollers.

4. Loosen the spline inserts:

A. Tip 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.

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 spline insert being loosened. Use correct spline insert tool (see Special Tools).

IMPORTANT: The spline insert on the left end of the cutting reel has left hand threads and the spline insert on the right end of the cutting reel has right hand threads.

D. Rest the handle of the pry bar against the front roller and loosen the spline insert 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 spline insert.

F. Tip the cutting unit back onto its rollers.

5. Remove bedbar assembly (see Bedbar Assembly Removal in this chapter).

6. Remove front and rear rollers (see Front Roller Removal and Rear Roller Removal in this chapter).

7. Remove cap screw and flat washer that secure rear grass shield to LH side plate.

8. Remove flange head screw and flange nut that secures frame spacer and carrier frame to LH side plate.

NOTE: The reel bearings and grease seals are press fit on the cutting reel shaft and should remain on the reel when removing the LH side plate.

9. Remove three (3) shoulder bolts and flange nuts that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft and cutting unit frame.

10. Carefully pull the cutting reel assembly from the RH side plate.

11. Inspect and service cutting reel assembly as required (see Reel Assembly Service in this chapter).

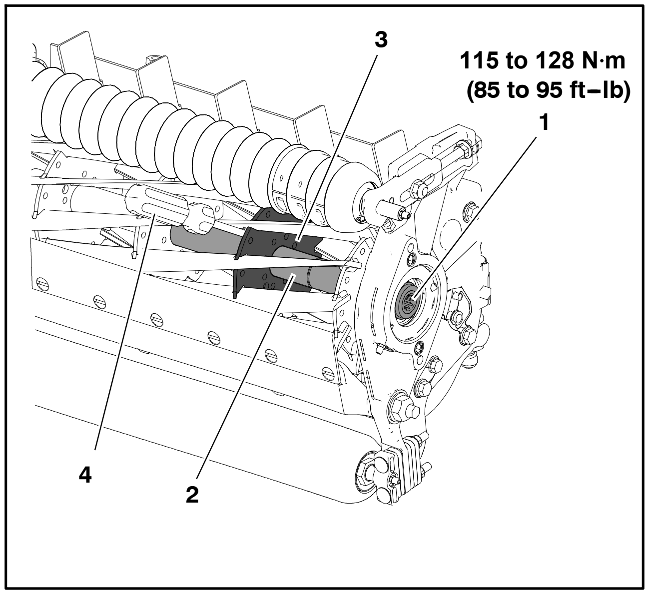

Figure 40

1. **Spline insert (LH)**
2. **Reel shaft**
3. **Reel support plate**
4. **Pry bar**

Reel Assembly Installation

1. Thoroughly clean side plates and other cutting unit components. Inspect side plates for wear or damage and replace if needed.

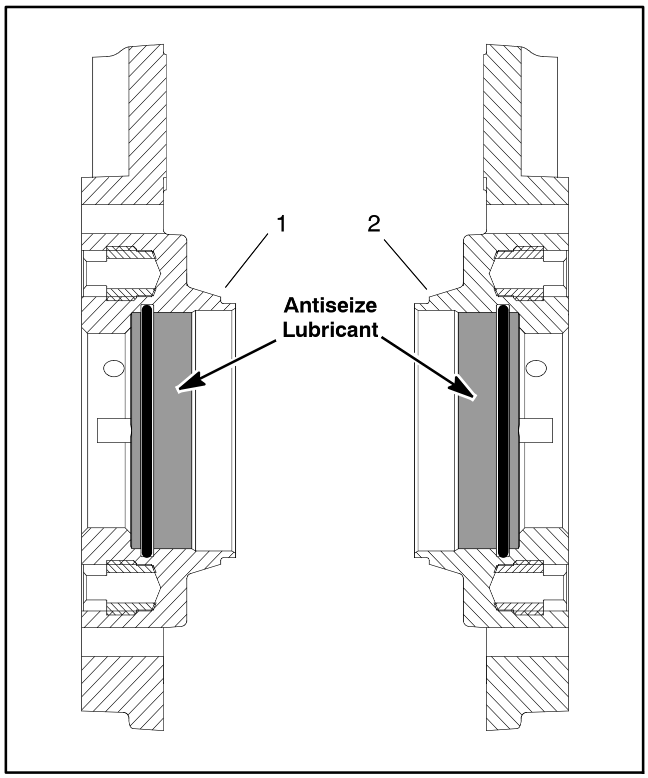

Figure 41

1. **Side plate - RH**
2. **Side plate - LH**

2. Make sure that grease seals and bearings are properly installed on cutting reel (see Reel Assembly Service in this Chapter).

3. The cutting unit has O-rings in the reel bearing bore of each side plate. Make sure the O-rings are in good condition and properly installed in the side plates.

4. Apply a thin coat of antiseize lubricant to the reel bearing bore of each side plate (Fig. 41).

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when installing the cutting reel.

5. Make sure that flat wire spring (item 14 in Fig. 38) is installed into LH side plate.

6. Carefully slide the RH end of the cutting reel assembly (no groove in reel shaft or on face of threaded insert) into the RH side plate. Make sure that bearing is fully seated into side plate.

7. Slide the LH side plate onto the cutting reel assembly.

8. Install shoulder bolts and flange nuts that secure the LH side plate to the cutting unit frame. Torque the shoulder bolts from **27 to 33 ft-lbs (37 to 44 N-m)**.

9. Apply Loctite #243 (or equivalent) to threads of flange head screw that secures support rod to LH side plate. Install screw and torque from **27 to 33 ft-lbs (37 to 44 N-m)**.

10. Install cap screw and flat washer that secure rear grass shield to LH side plate. Torque screw from **15 to 19 ft-lbs (20 to 25 N-m)**.

11. Install the bedbar assembly (see Bedbar Installation in this section).

12. Install front and rear rollers (see Front Roller Installation and Rear Roller Installation in this section).

13. Adjust cutting unit (see Cutting Unit Operator's Manual).

NOTE: The parallel position of the rear roller to the cutting reel is controlled by the precision machined frame and side plates of the cutting unit. If necessary, the cutting unit side plates can be loosened and a slight adjustment can be made to parallel the rear roller with the cutting reel (see Leveling Rear Roller in this Chapter).

14. Install accessories if equipped. See Chapter 9 - Universal Groomer in this manual for additional Groomer information. See Rear Roller Brush in this chapter for information on rear roller brush.

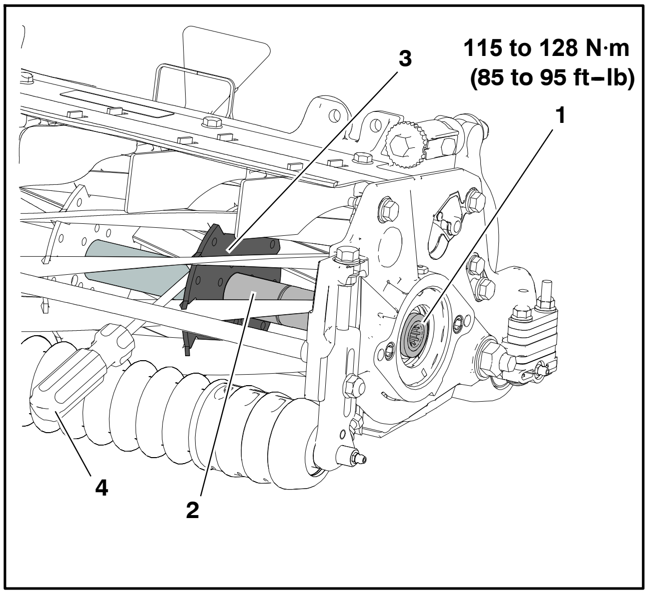

Figure 42

1. Spline insert (LH)
2. Reel shaft
3. Reel support plate
4. Pry bar

15. Tighten the spline inserts:

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.

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 spline insert being tightened.

IMPORTANT: The spline insert on the left end of the cutting reel has left hand threads and the spline insert on the right end of the cutting reel has right hand threads.

C. Rest the handle of the pry bar against the front roller and tighten the spline insert closest to the pry bar. The spline inserts are installed with thread locking compound (Loctite #243 or equivalent). Tighten the spline insert from **85 to 95 ft-lb (115 to128 N-m)**. Use correct spline insert tool (see Special Tools).

D. Position the pry bar in the same manner on the opposite end of the reel and tighten the remaining spline insert.

16. If counterweight was removed from cutting unit, install new O-ring on counter weight. Secure counter weight to cutting unit side plate with two (2) flange nuts. Torque screws from **27 to 33 ft-lbs (37 to 44 N-m)**.

17. Install cutting unit to the machine.

Reel Assembly Service (cutting units with aluminum side plates)

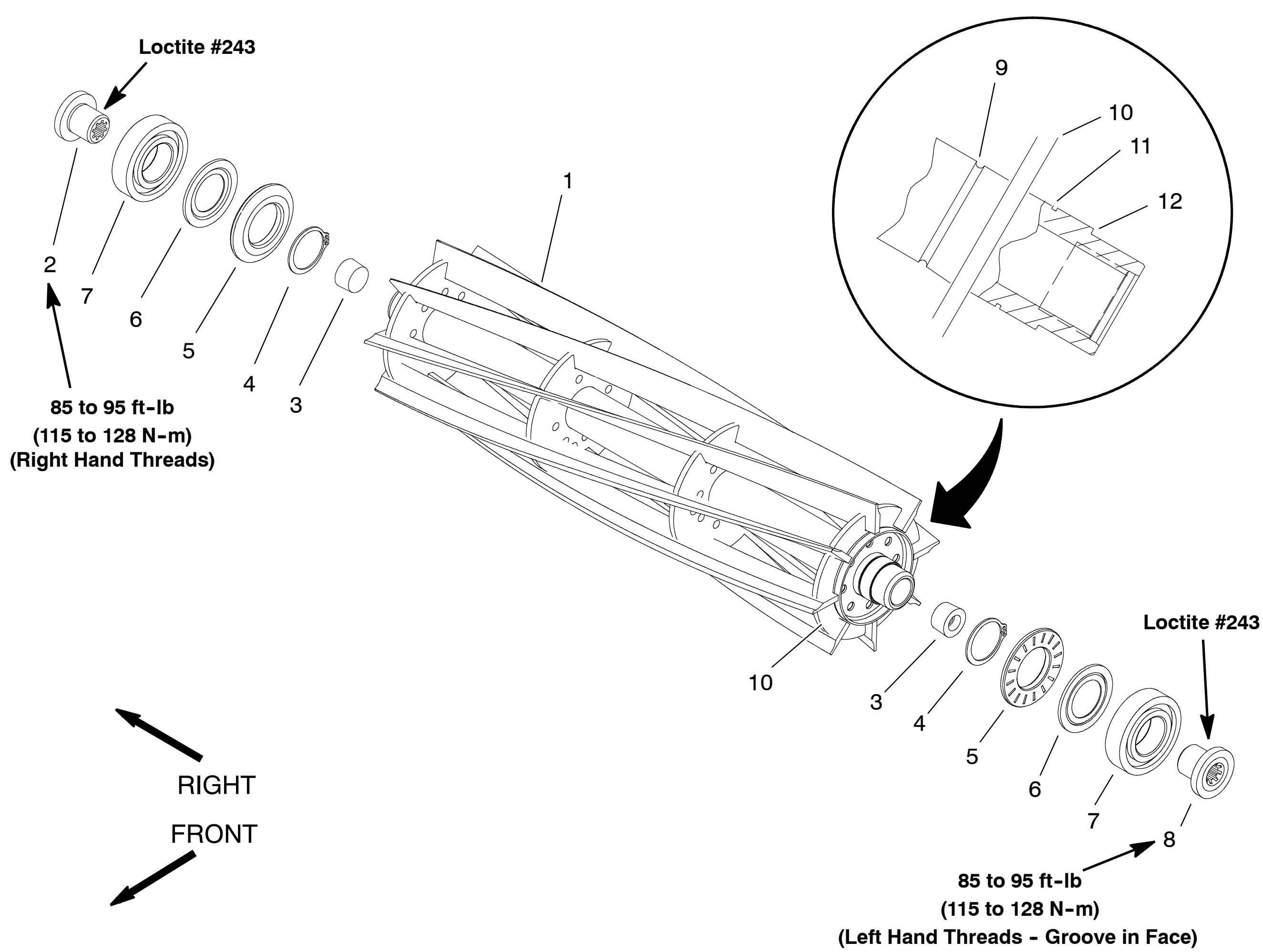

Figure 43

1. **Cutting reel**
2. **Threaded insert (RH thread)**
3. **Plastic plug (2)**
4. **Retaining ring**
5. **Special washer**
6. **Flocked seal**
7. **Sealed bearing**
8. **Threaded insert (LH thread)**
9. **Groove indicating LH threads**
10. **Reel spider**
11. **Retaining ring groove**
12. **Bearing shoulder**

Reel Assembly Inspection

1. Inspect reel bearings to insure that they spin freely and have minimal axial play.

2. Inspect the reel shaft as follows. If reel damage is detected, replace reel.

A. Check the reel shaft for bending and distortion by placing the shaft ends in V-blocks.

B. Check the reel blades for bending or cracking.

C. Check the service limit of the reel diameter (see Preparing a Reel for Grinding in this section).

3. Check the threaded inserts in the reel shaft for excessive wear or distortion. Replace inserts if damage is evident.

A. One insert has LH threads and the other insert has RH threads. The insert with LH threads has a groove on the insert face. A groove is cut in the end of the reel shaft that has LH threads.

B. Use correct spline insert tool to remove threaded inserts (see Special Tools in this chapter).

Reel Assembly

1. If removed, install new reel shaft plugs into cutting reel shaft. For cutting unit serial no. prior to 315000001, make sure plastic plug is pressed flush into end of threaded insert. For cutting unit serial no. 315000001 & Up, make sure plastic plug is pressed unto reel shaft **1.63 to 1.37 in. (41 to 35 mm)** below the end of the shaft (Fig. 44)

NOTE: One insert has LH threads and the other insert has RH threads. The insert with LH threads has a groove on the insert face. A groove is cut in the end of the reel shaft that has LH threads.

2. If previously removed, use correct spline insert tool to install threaded inserts (see Special Tools in this chapter). Apply thread locking compound (Loctite #243 or equivalent) to threaded portion of insert. Tighten threaded insert from **85 to 95 ft-lb (115 to 128 N-m)**.

3. Make sure that the two (2) retaining rings are fully seated into the grooves on the cutting reel shaft.

4. Carefully drive special washers onto reel shaft with tapered side of washers toward reel (flat side toward bearing location). Installed washers should be tight against retaining ring and should not wobble as the reel is rotated.

IMPORTANT: The flocked seal should be installed so the flocked (red) side of the seal is toward the bearing location.

5. Slide flocked seals (flocked (red) side orientated toward bearing location) and bearings fully onto reel shaft. Flocked seals and bearings should bottom on reel shaft shoulder.

6. Fill threaded insert splines with high temp Mobil XHP-222 grease or equivalent.

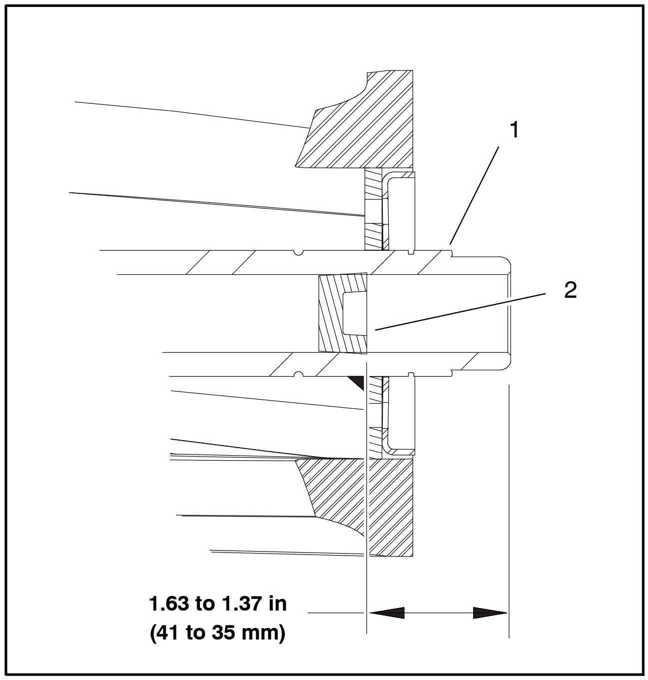

Figure 44

1. **Reel shaft**
2. **Plastic plug (2)**

DPA Cutting Units

Preparing Reel for Grinding

Three (3) types of reel designs are used in Reelmaster cutting units: scalloped radial reel, tapered radial reel and tapered forward swept reel (Fig. 45). The radial reel designs have blades that are placed in line with the center of the reel shaft. The rear of the blades either have a scalloped relief or a tapered relief. The forward swept reel have blades that have a slight forward slant. The rear of the forward swept reel blades have a tapered relief. Before grinding a reel, identify the type of reel design to make sure that grinding is correctly done.

Before grinding a cutting reel, make sure that all cutting unit components are in good condition. Depending on type of grinder used, faulty cutting unit components can affect grinding results. When grinding, be careful to not overheat the cutting reel blades. Remove small amounts of material with each pass of the grinder.

Follow reel grinder manufacturer's instructions to grind cutting reel to Toro specifications (see Reel Grinding Specifications chart below). Additional reel grinding information can be found in your Cutting Unit Operator's Manual. An additional resource is the Toro Basics Series Training Book, Reel Mower Basics (part no. 09168SL) found on the Service Reference Set available from your Authorized Toro Distributor.

Reel Grinding Specifications	
Reel Diameter (New)	7.060 in (179.3 mm)
Service Limit - Reel Diameter	6.600 in (168 mm)
Reel Shaft Diameter (OD)	1.313 in (33.3 mm)
Reel Diameter Taper (Fig. 46)	0.001 in (0.025 mm) Service Limit: 0.010 in (0.25 mm)
Blade Land Width	0.050 to 0.060 in (1.3 to 1.8 mm) Service Limit: .120 in (3.0 mm)
Blade Relief Angle	30° +/- 5°

Relief grind the reel blades to the minimum blade land width if the reel blade land width exceeds the service limit. Spin grind the reel to restore its cylindrical shape.

NOTE: Spin grind the reel and establish the specified blade land width after relief grinding.

After grinding the reel and/or bedknife, adjust the cutting unit (see Cutting Unit Operator's Manual). Check the reel to bedknife contact again after cutting two (2) fairways. During this initial use, any burrs will be removed from reel and bedknife which may create improper reel to bedknife clearance and thus accelerate wear. This practice of re-checking the reel to bedknife contact after grinding will extend the longevity of the sharpness of the edge of the reel and the bedknife.

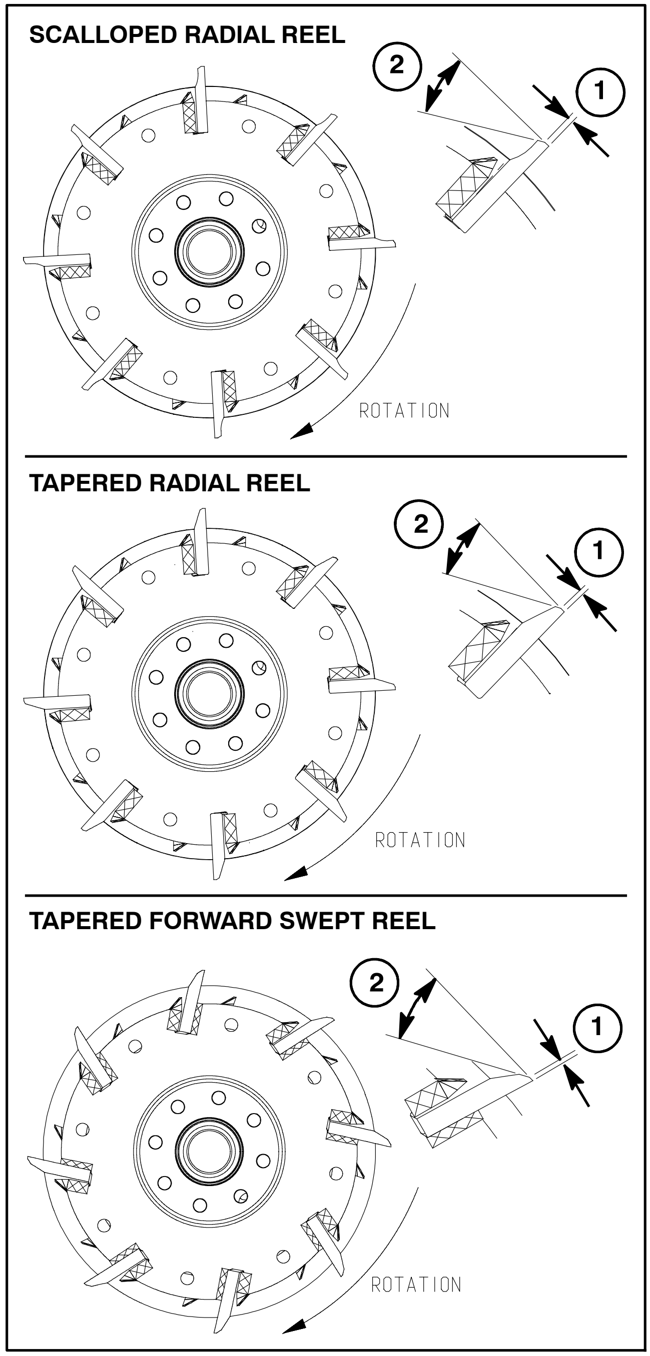

Figure 45

1. **Blade land width**
2. **Blade relief angle**

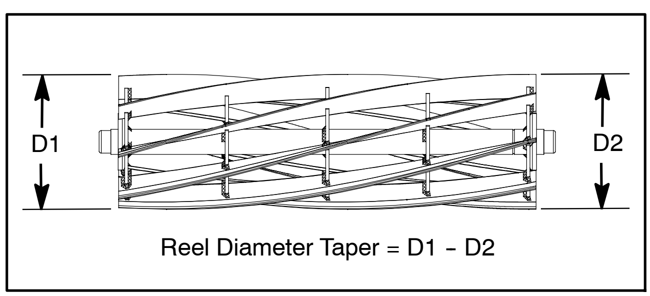

Figure 46

Front Roller

Removal (Fig. 47)

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

2. Remove the cutting unit from the machine and place on a level working surface. Use cutting unit kickstand (see Special Tools) to raise front roller from work surface.

3. Loosen flange nut and cap screw securing the front roller shaft to each front height-of-cut (roller) bracket.

4. On one of the height-of-cut (roller) brackets:

   A. Remove flange lock nut and carriage screw that secure bracket to the cutting unit side plate.

   B. Remove the height-of-cut (roller) bracket from the cutting unit.

5. Slide the front roller assembly from the remaining height-of-cut (roller) bracket on the cutting unit.

6. If necessary, remove the second height-of-cut (roller) bracket from the cutting unit.

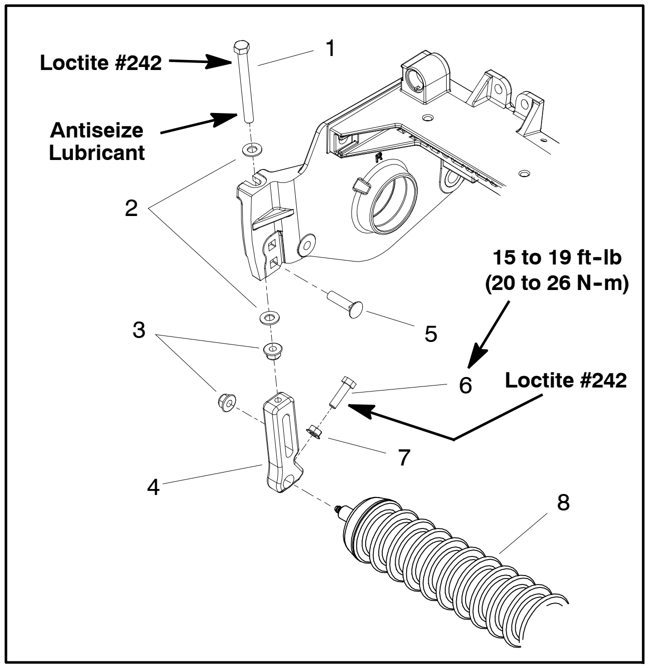

Figure 47

1. **Cap screw**
2. **Flat washer**
3. **Flange lock nut**
4. **HOC (roller) bracket**
5. **Carriage screw**
6. **Cap screw**
7. **Flange nut**
8. **Front roller assembly**

Installation (Fig. 47)

1. Place cutting unit on a level working surface and use cutting unit kickstand (see Special Tools) to support cutting unit.

2. Inspect condition of cap screws (item 1) in both height-of-cut (roller) brackets. Replace cap screw(s) if necessary:

   A. Place two (2) flat washers on cap screw and thread flange lock nut onto cap screw to a position 0.750” (19 mm) from screw head.

   B. Apply antiseize lubricant to cap screw threads that will extend into height-of-cut (roller) bracket.

   C. Thread cap screw into bracket.

Note: When assembling height-of-cut (roller) brackets to side plate, make sure that cap screw head and one washer are above adjustment flange on side plate and second washer and flange lock nut are below flange.

3. If both front height-of-cut (roller) brackets were removed from cutting unit side plate, position one of the brackets to side plate. Secure bracket to side plate with carriage screw and flange lock nut.

4. Slide front roller shaft into bracket attached to the cutting unit. Slide second height-of-cut (roller) bracket onto the other end of roller shaft. Secure second bracket to cutting unit side plate with carriage screw and flange nut.

5. Apply Loctite #243 (or equivalent) to exposed threads of cap screw (item 1) between flange of side plate and position of flange lock nut (item 3) on cap screw. Tighten flange lock nut on cap screw and then loosen nut 1/4 to 1/2 turn. Cap screw should rotate freely with little (if any) endplay after lock nut installation.

6. Apply Loctite #243 (or equivalent) to threads of two (2) cap screws (item 6). Center front roller to the cutting reel and secure in place with two (2) cap screws. Torque cap screws from **15 to 19 ft-lb (20 to 26 N-m)**. Secure cap screws with flange nuts.

7. Lubricate front roller.

8. Adjust cutting unit (see Cutting Unit Operator’s Manual).

Rear Roller

Removal (Fig. 48)

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

2. Remove the cutting unit from the machine and place on a level working surface. Place support blocks under bedbar to raise rear roller from work surface.

3. Loosen two (2) flange nuts that secure the rear roller shaft to each rear roller bracket.

4. On one of the rear roller brackets:

   Note: On cutting units equipped with optional High Height of Cut Kit, there will be additional roller shims installed between rear roller bracket and cutting unit side plate.

   A. Remove flange nuts and carriage screws that secure rear roller bracket and roller shims to the cutting unit side plate.

   B. Remove the roller bracket and roller shims from the rear roller and cutting unit.

5. Slide the rear roller assembly from the remaining rear roller bracket on the cutting unit.

6. If necessary, remove the second rear roller bracket and roller shims from the cutting unit.

Installation (Fig. 48)

1. Place cutting unit on a level working surface.

Note: Refer to Cutting Unit Operator's Manual for number of roller shims required for various height of cut settings.

Note: A 0.010" shim (part number 107-4001) is available to allow for leveling of the rear roller (see Leveling Rear Roller in the Set-up and Adjustments section of this chapter). If necessary, this shim would be used on one side of the rear roller and should be installed between the rear roller bracket and roller shim.

2. If both rear roller brackets were removed from cutting unit side plate, position brackets and roller shims to one of the side plates. Install two (2) carriage screws and flange nuts to retain bracket in position. Do not fully tighten flange nuts.

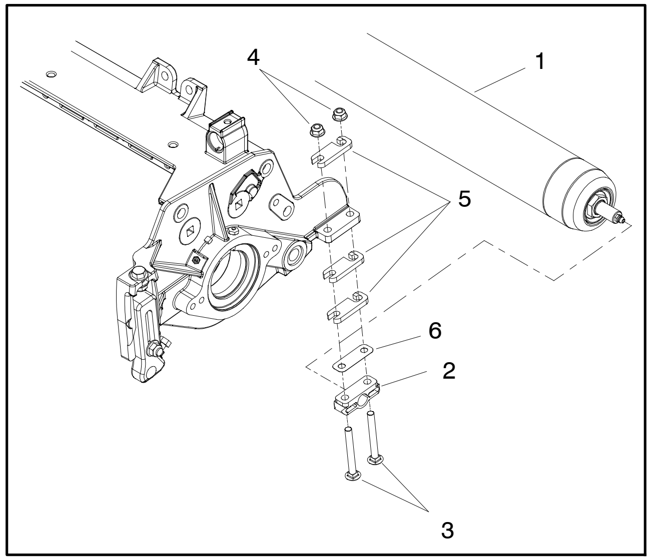

Figure 48

1. **Rear roller assembly**
2. **Rear roller bracket**
3. **Carriage screw**
4. **Flange nut**
5. **Roller shim**
6. **0.010" shim (if needed)**

3. Slide rear roller shaft into the rear roller bracket attached to the cutting unit. Slide second rear roller bracket onto the other end of roller shaft. Secure second roller bracket and shims to cutting unit side plate with two (2) carriage screws and flange nuts. Do not fully tighten flange nuts.

4. Center rear roller to the cutting reel and secure in place by tightening four (4) flange nuts.

5. Lubricate rear roller.

6. Adjust cutting unit (see Cutting Unit Operator's Manual).

Roller Service

Disassembly (Fig. 49)

1. Remove bearing lock nut from each end of roller shaft.

2. Loosely secure roller assembly in bench vise and lightly tap one end of roller shaft until outer seals and bearing are removed from opposite end of roller tube. Remove second set of outer seals and bearing from roller tube by tapping on opposite end of shaft. Remove shaft from roller tube.

3. Carefully remove inner seal from both ends of roller tube taking care to not damage tube surfaces.

4. Discard removed seals and bearings.

5. Clean roller shaft and all surfaces on the inside of the roller tube. Inspect components for wear or damage. Also, carefully inspect seating surface and threads of bearing lock nuts. Replace all damaged components.

Assembly (Fig. 49)

1. Install inner seals into roller tube making sure that seal lip (and garter spring) faces end of tube. Use inner seal tool (see Special Tools) and soft face hammer to fully seat seals against roller shoulder (Fig. 50). Apply a small amount of grease around the lip of both inner seals after installation.

IMPORTANT: During assembly process, frequently check that bearings rotate freely and do not bind. If any binding is detected, consider component removal and reinstallation.

2. Install new bearing and outer seals into one end of roller tube:

    A. Position a new bearing into one end of roller tube. Use bearing/outer seal tool (see Special Tools) with a soft face hammer to fully seat bearing against roller shoulder (Fig. 51). After bearing installation, make sure that it rotates freely with no binding.

    B. Apply a small amount of grease around the lip of both outer seals.

    C. Install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools) and soft face hammer to lightly seat seal against roller shoulder (Fig. 52). Make sure that bearing still freely rotates after seal installation.

    D. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that bearing still freely rotates.

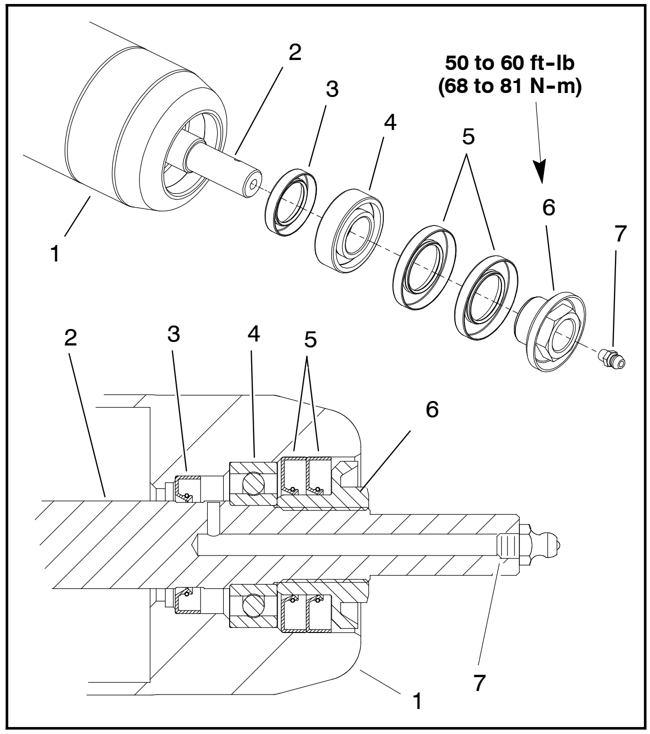

Figure 49

1. Roller tube
2. Roller shaft
3. Inner seal
4. Bearing
5. Outer seal
6. Bearing lock nut
7. Grease fitting

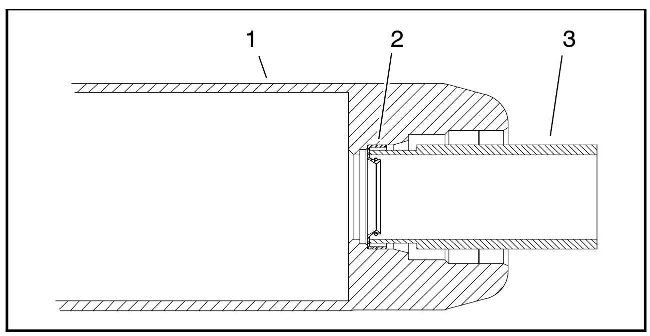

Figure 50

1. Roller tube
2. Inner seal
3. Inner seal tool

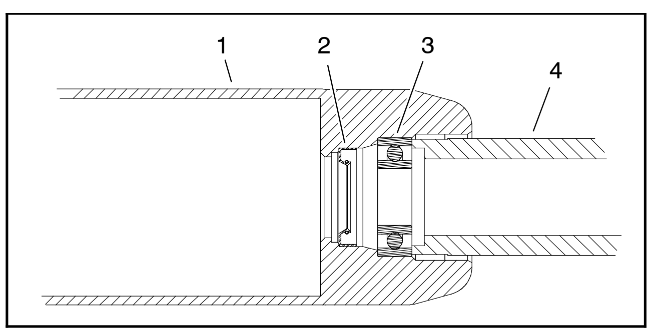

Figure 51

1. Roller tube
2. Inner seal
3. Bearing
4. Washer
5. Bearing/outer seal tool

DPA Cutting Units

3. From the roller tube end with only the inner seal installed, carefully install the roller shaft into the roller tube. Make sure that seals are not damaged as shaft is installed.

4. Install new bearing and outer seals into second end of roller tube:

A. Position a second new bearing to roller shaft and tube. Position washer (see Special Tools) on bearing to allow pressing on both inner and outer bearing races simultaneously.

B. Use washer and bearing/outer seal tool (see Special Tools) with a soft face hammer to fully seat bearing (Fig. 53). After bearing installation, make sure that shaft freely rotates and that no binding is detected. If necessary, lightly tap bearing and/or shaft ends to align shaft and bearings. Remove washer from roller.

C. Apply a small amount of grease around the lip of both outer seals.

D. Carefully install first outer seal into roller tube making sure that seal lip (and garter spring) faces end of tube. Use bearing/outer seal tool (see Special Tools) and soft face hammer to lightly seat seal (Fig. 54). Make sure that shaft and bearings still freely rotate after seal installation.

E. Using the same process, install second outer seal making sure to not crush the installed outer seal. Again, make sure that shaft and bearings still freely rotate.

IMPORTANT: Make sure that all grease is removed from shaft threads to prevent bearing lock nut loosening.

5. Thoroughly clean threads on both ends of roller shaft.

NOTE: If original bearing lock nut(s) are being used, apply Loctite #243 (or equivalent) to threads of lock nut(s).

6. Install bearing lock nut onto each end of the roller shaft. Make sure that outer seals are not damaged during nut installation. Torque lock nuts from **50 to 60 ft-lb (68 to 81 N-m)**.

7. If grease fittings were removed from end of roller shaft, install fittings in shaft.

NOTE: After roller is installed to cutting unit, lubricate roller grease fittings, rotate roller to properly distribute grease in bearings and clean excess grease from roller ends. A properly assembled roller should rotate with less than 5 in-lb (0.68 N-m) resistance.

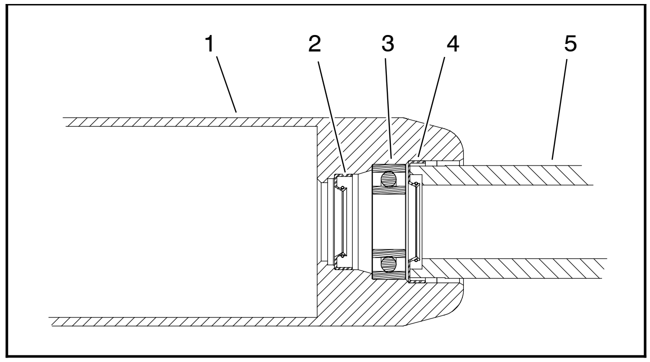

Figure 52

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Outer seal**
5. **Bearing/outer seal tool**

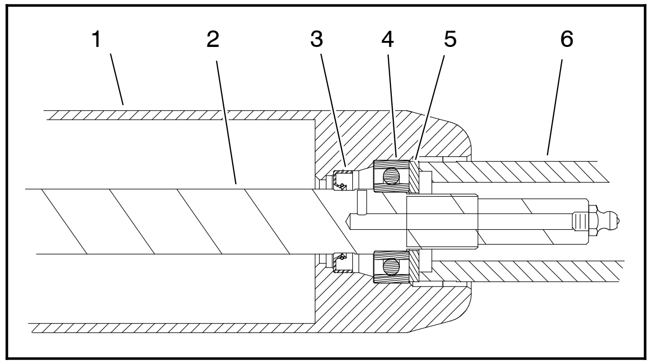

Figure 53

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Washer**
6. **Bearing/outer seal tool**

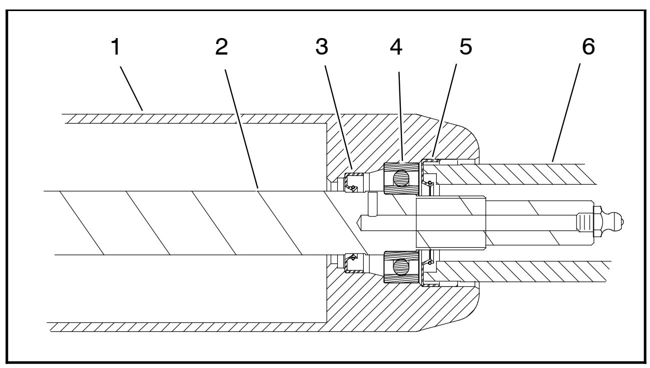

Figure 54

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing/outer seal tool**

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Rear Roller Brush – Optional (cutting units with painted side plates)

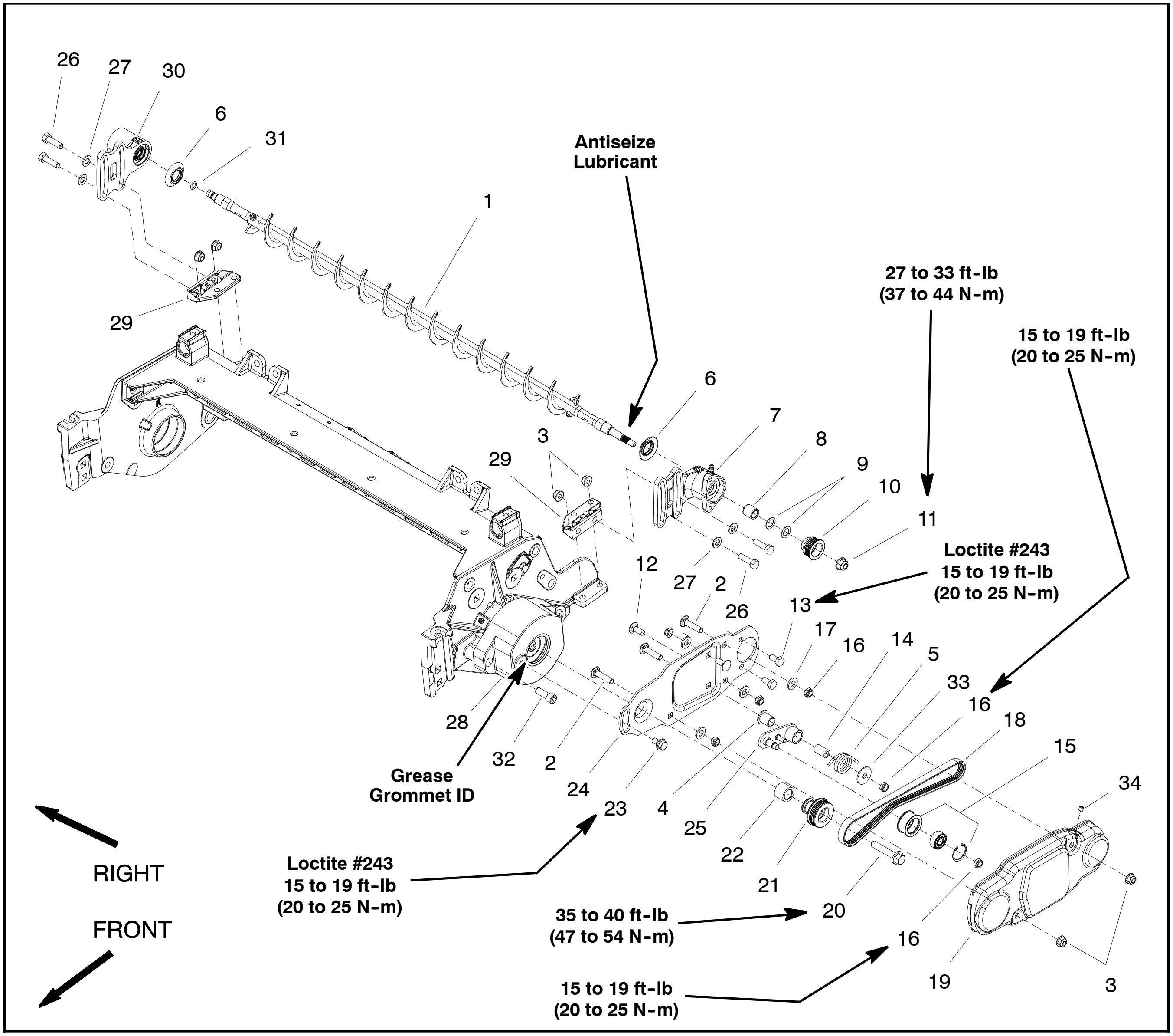

Figure 55

1. **Roller brush assembly**
2. **Carriage screw (3 used)**
3. **Flange nut**
4. **Flange bushing**
5. **Idler spring**
6. **Excluder seal (2 used)**
7. **Bearing assembly (driven)**
8. **Spacer**
9. **Hardened washer (as required)**
10. **Driven pulley**
11. **Flange nut**
12. **Carriage screw (2 used)**
13. **Cap screw (2 used)**
14. **Idler spacer**
15. **Idler pulley assembly**
16. **Lock nut**
17. **Flat washer (4 used)**
18. **Drive belt**
19. **Brush cover**
20. **Flange head screw**
21. **Drive pulley**
22. **Spacer**
23. **Shoulder bolt**
24. **Brush plate**
25. **Idler plate**
26. **Cap screw (4 used)**
27. **Hardened washer (4 used)**
28. **Drive bearing housing**
29. **Mounting bracket (2 used)**
30. **Bearing assembly (non-driven)**
31. **O-ring**
32. **Socket head screw (2 used)**
33. **Pivot washer**
34. **Set screw (top hole in cover)**

Note: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 55 shows components used when the brush drive is on the left side of the cutting unit.

Note: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

Disassembly (Fig. 55)

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

2. To remove roller brush from brush shaft:

A. Remove the non-driven brush bearing assembly (item 30) from cutting unit.

B. Slide excluder seal (item 6) from roller brush shaft.

C. Remove lock nut and J-bolt from both ends of the brush (Fig. 56).

D. While rotating brush, slide brush from the shaft.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. To remove roller brush drive belt, rotate the cutting reel and carefully pry the belt off the drive pulley.

4. Disassemble roller brush components as necessary using Figures 55 as a guide.

Assembly (Fig. 55)

1. If brush was removed from shaft, slide brush onto shaft while rotating brush. Secure brush to shaft with two (2) J-bolts and lock nuts. Make sure that the J-bolts are installed with the threaded portion on the outside of the brush (Fig. 56). Torque lock nuts from **20 to 25 in-lb (2.3 to 2.8 N-m)**.

2. If seals or bearings were removed from brush bearing housings, install new components noting proper orientation as shown in Figure 57.

A. Pack bearings with grease before installation.

B. Press bearing into bearing housing so that bearing contacts shoulder in housing bore.

C. Install grease seals so that seal lips are positioned toward the brush location. Press inner seals into housing so that seal contacts bore shoulder. Press outer seals into housing until inner seal is contacted.

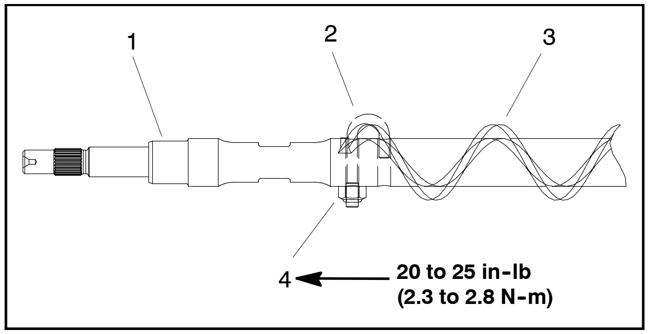

Figure 56

1. Roller brush shaft
2. J-bolt
3. Roller brush
4. Lock nut

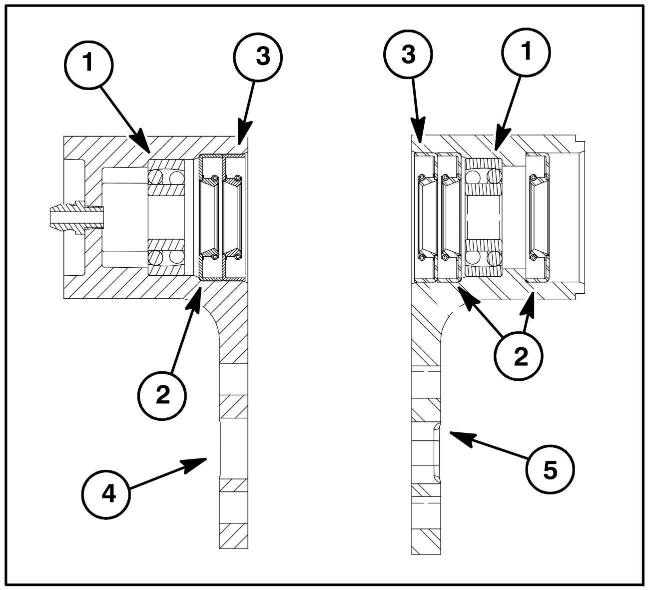

Figure 57

1. Bearing
2. Inner grease seal
3. Outer grease seal
4. Housing (non-driven)
5. Housing (driven)

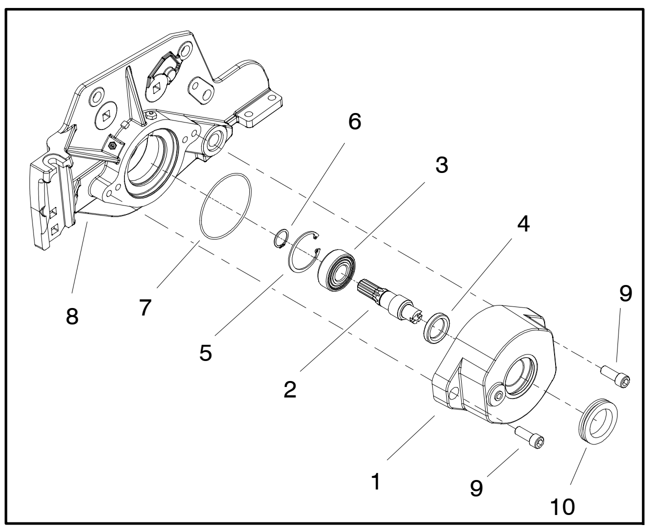

Figure 58

1. Bearing housing
2. Drive shaft
3. Ball bearing
4. Grease seal
5. Retaining ring
6. Snap ring
7. O-ring
8. Side plate
9. Socket head screw
10. Grommet

DPA Cutting Units

3. If drive bearing housing was disassembled, install new components noting proper orientation as shown in Figures 58 and 59.

A. Install bearing on shaft by pressing equally on the inner and outer bearing races. Install the bearing so that the bearing seal is closest to the shoulder on the shaft. Install snap ring (Fig. 58, item 6) onto shaft to retain bearing.

B. Install new grease seal into housing with the lip of the seal toward the drive shaft splines. Apply grease to lip of seal.

C. Fill cavity between bearing location and grease seal 50% to 75% full with high temperature Mobil XHP-222 grease (or equivalent).

D. Carefully slide shaft and bearing fully into housing bore taking care to not damage the grease seal. Install retaining ring (Fig. 58, item 5) to secure bearing in housing.

4. Assemble roller brush components using Figure 55 as a guide.

A. Apply a light coating of grease to inner diameter of the grommet in drive bearing housing.

B. Apply Loctite #243 (or equivalent) to threads of cap screws (item 13) that secure brush plate to driven bearing housing assembly. Torque cap screws from **15 to 19 ft-lb (20 to 25 N-m)**.

C. Check that brush plate is parallel to cutting unit side plate. If necessary, change position of mounting bracket (item 29) to allow brush plate to be parallel to side plate.

D. Apply Loctite #243 (or equivalent) to threads of flange head screw (item 20) that secures drive pulley to drive shaft. Torque flange head screw from **35 to 40 ft-lb (47 to 54 N-m)**.

E. Apply antiseize lubricant to splines of roller brush shaft before sliding hardened washer(s) (item 9) and driven pulley (item 10) onto shaft. Torque flange nut (item 11) that secures driven pulley to roller brush shaft from **15 to 19 ft-lb (20 to 25 N-m)**.

F. Position excluder seals on brush shaft so that seals just touch bearing housings.

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

G. To install drive belt, loop belt around driven pulley and over the top of the idler pulley. While rotating the cutting reel, carefully guide belt onto drive pulley. After belt installation, make sure that belt and pulley grooves are aligned and that belt is centered in idler pulley.

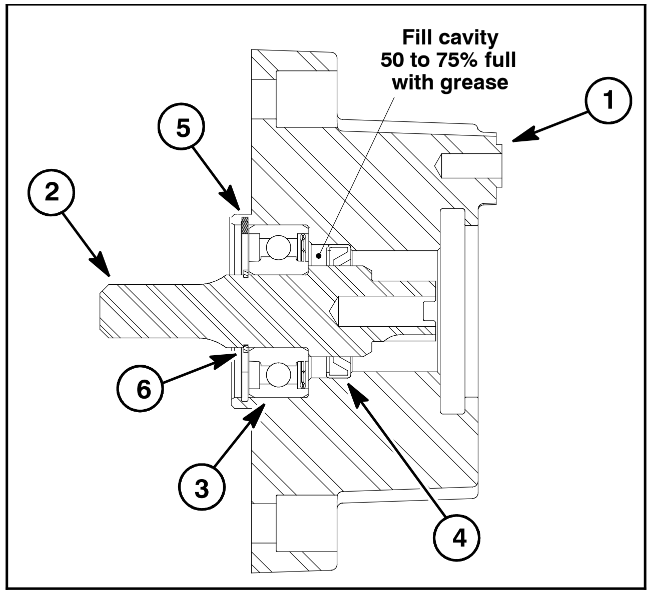

Figure 59

1. **Bearing housing**
2. **Drive shaft**
3. **Ball bearing**
4. **Grease seal**
5. **Retaining ring**
6. **Snap ring**

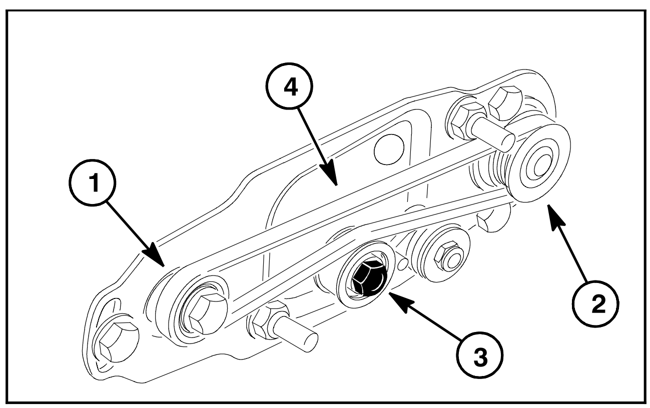

Figure 60

1. **Drive pulley**
2. **Driven pulley**
3. **Idler pulley**
4. **Drive belt**

5. Check alignment of pulleys with a straight edge placed along the outer face of the driven pulley (Fig. 61). The outer faces of the driven and drive pulleys (not the idler pulley) should be in line within 0.030” (0.76 mm). If necessary to align pulleys, remove driven pulley from brush shaft and add or remove hardened washer(s) (item 9) until drive and driven pulleys are aligned within 0.030” (0.76 mm).

6. Check that roller brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with roller (Fig. 62). If contact is incorrect, brush operation will be adversely affected.

7. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

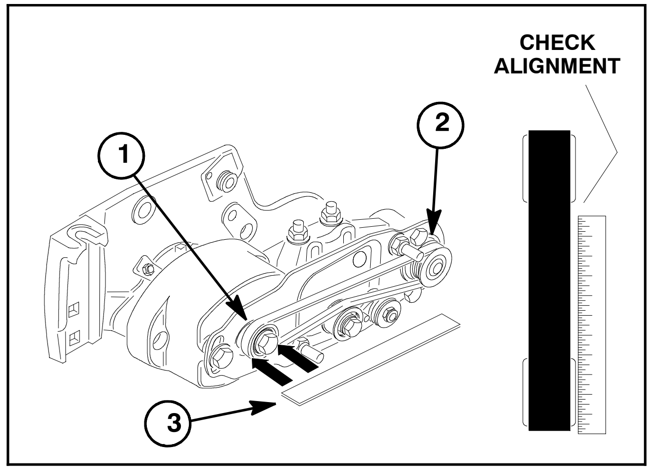

Figure 61

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

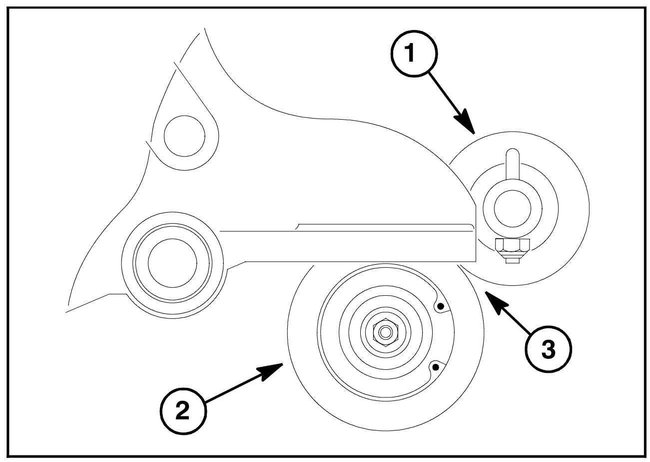

Figure 62

1. **Rear roller brush**
2. **Rear roller**
3. **Light contact**

Rear Roller Brush – Optional (cutting units with aluminum side plates)

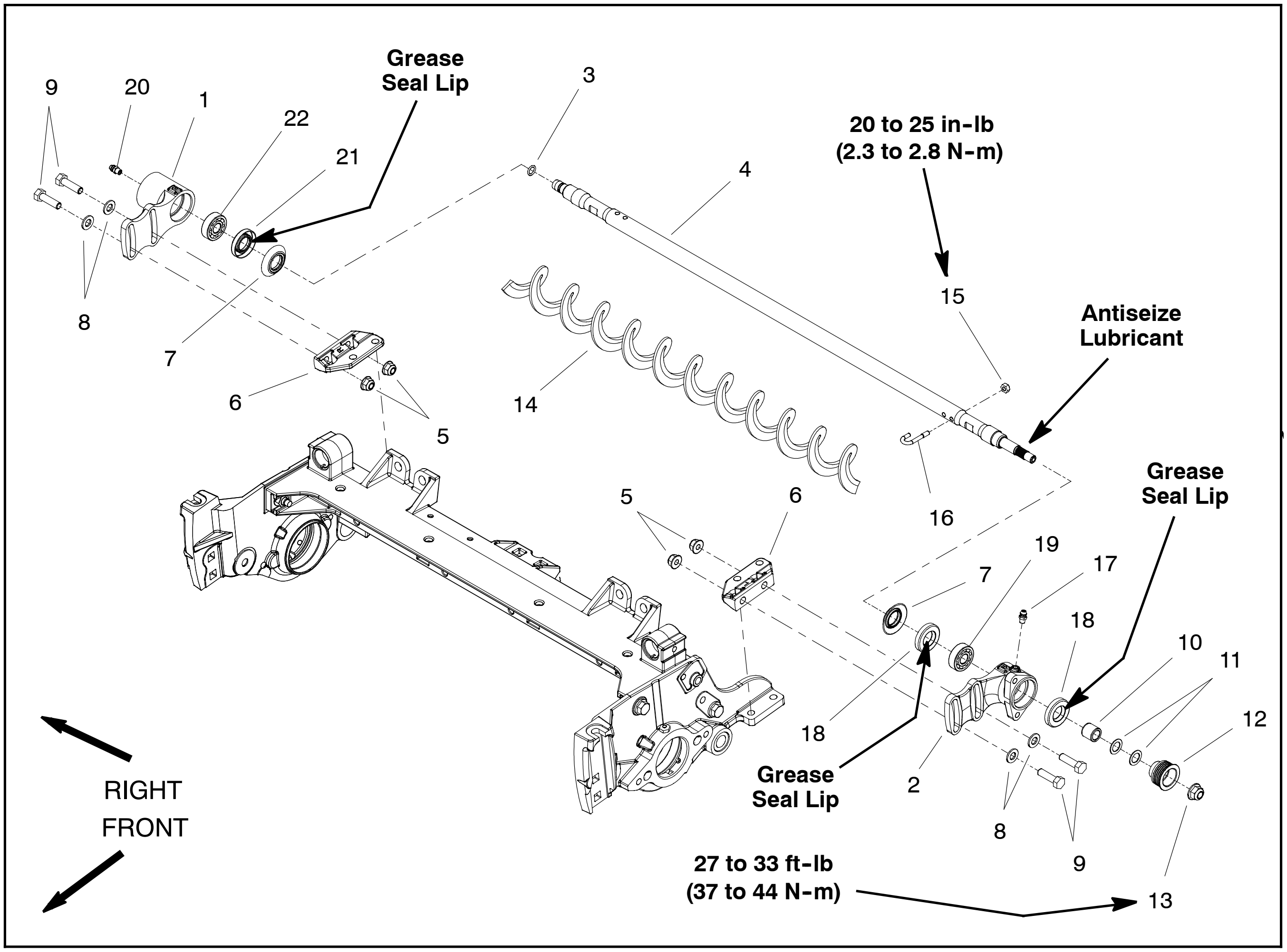

Figure 63

1. **Brush bearing housing (non-drive)**
2. **Brush bearing housing (drive)**
3. **O-ring**
4. **Roller brush shaft**
5. **Flange nut (4 used)**
6. **Mounting bracket (2 used)**
7. **Excluder seal (2 used)**
8. **Flat washer (4 used)**
9. **Cap screw (4 used)**
10. **Spacer**
11. **Flat washer (for pulley alignment)**
12. **Driven pulley**
13. **Flange nut**
14. **Roller brush**
15. **Lock nut**
16. **J-bolt (2 used)**
17. **Grease fitting**
18. **Grease seal**
19. **Ball bearing**
20. **Grease fitting**
21. **Grease seal**
22. **Ball bearing**

NOTE: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel motor. Figure 55 shows components used when the brush drive is on the left side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

Rear Roller Brush Disassembly (Fig. 55)

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

2. To remove roller brush from brush shaft:

A. Remove the non-drive brush bearing housing (item 1) from cutting unit.

B. Slide excluder seal from roller brush shaft.

C. Remove lock nut and J-bolt from both ends of the brush.

D. While rotating brush, slide brush from the shaft.

3. Disassemble roller brush components as necessary using Figures 55 as a guide. If drive brush bearing housing (item 2) or driven pulley (item 12) need to be removed, brush cover and drive belt removal will be necessary (see Rear Roller Brush Drive System in this section).

Rear Roller Brush Assembly (Fig. 55)

1. If seals or bearings were removed from brush bearing housings, install new components noting proper orientation as shown in Figure 57.

   A. Pack bearings with high temp Mobil XHP-222 grease (or equivalent) before installation.

   B. Press bearing into bearing housing so that bearing contacts shoulder in housing bore.

   C. Install grease seals so that seal lips are positioned toward the brush location as shown in Fig. 57. Press seals into housing so that seal contacts bore shoulder.

2. If roller brush was removed from roller shaft, slide brush onto shaft while rotating brush. Secure brush to shaft with two (2) J-bolts and lock nuts. Make sure that the J-bolts are installed with the threaded portion on the outside of the brush (Fig. 56). Torque lock nuts from **20 to 25 in-lb (2.3 to 2.8 N-m)**.

3. Assemble roller brush components using Figure 55 as a guide noting the following items:

   A. Apply coating of grease to lips of grease seals in brush bearing housing before inserting brush shaft into housing.

   B. If driven pulley (item 12) was removed from roller brush shaft, apply antiseize lubricant to splines of pulley bore and slide pulley onto shaft. Install and tighten flange nut until pulley is seated onto shaft and then torque flange nut from **27 to 33 ft-lb (37 to 44 N-m)**. Use a ½ wrench on roller brush shaft flats to prevent shaft from rotating when tightening nut.

   C. Position excluder seals on brush shaft so that seals just touch bearing housings.

   D. If driven pulley (item 12) was removed, check and adjust alignment of drive and driven pulleys (see Rear Roller Brush Drive System in this section).

4. Check that brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with rear roller (Fig. 62). If contact is incorrect, brush operation will be adversely affected.

5. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

6. Once all rear roller brush service is completed, plug the 48 VDC battery disconnect back in before operating the machine.

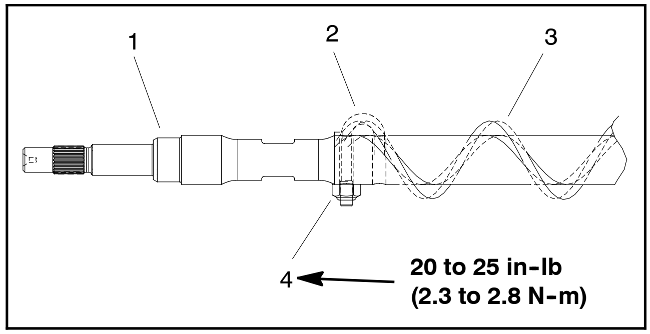

Figure 64

1. **Roller brush shaft**
2. **J-bolt**
3. **Roller brush**
4. **Lock nut**

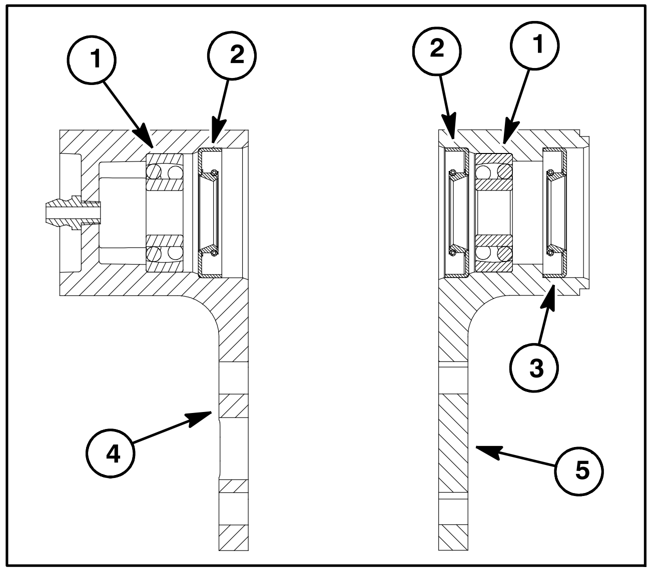

Figure 65

1. **Bearing**
2. **Inner grease seal**
3. **Outer grease seal**
4. **Housing (non-driven)**
5. **Housing (driven)**

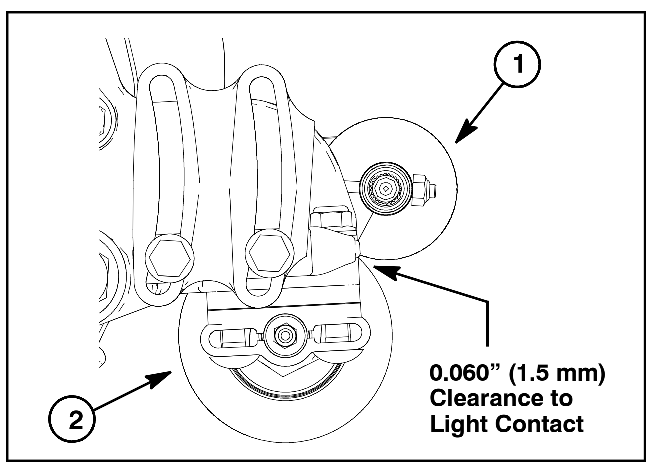

Figure 66

1. **Rear roller brush**
2. **Rear roller**

DPA Cutting Units

Drive System Disassembly (Fig. 67)

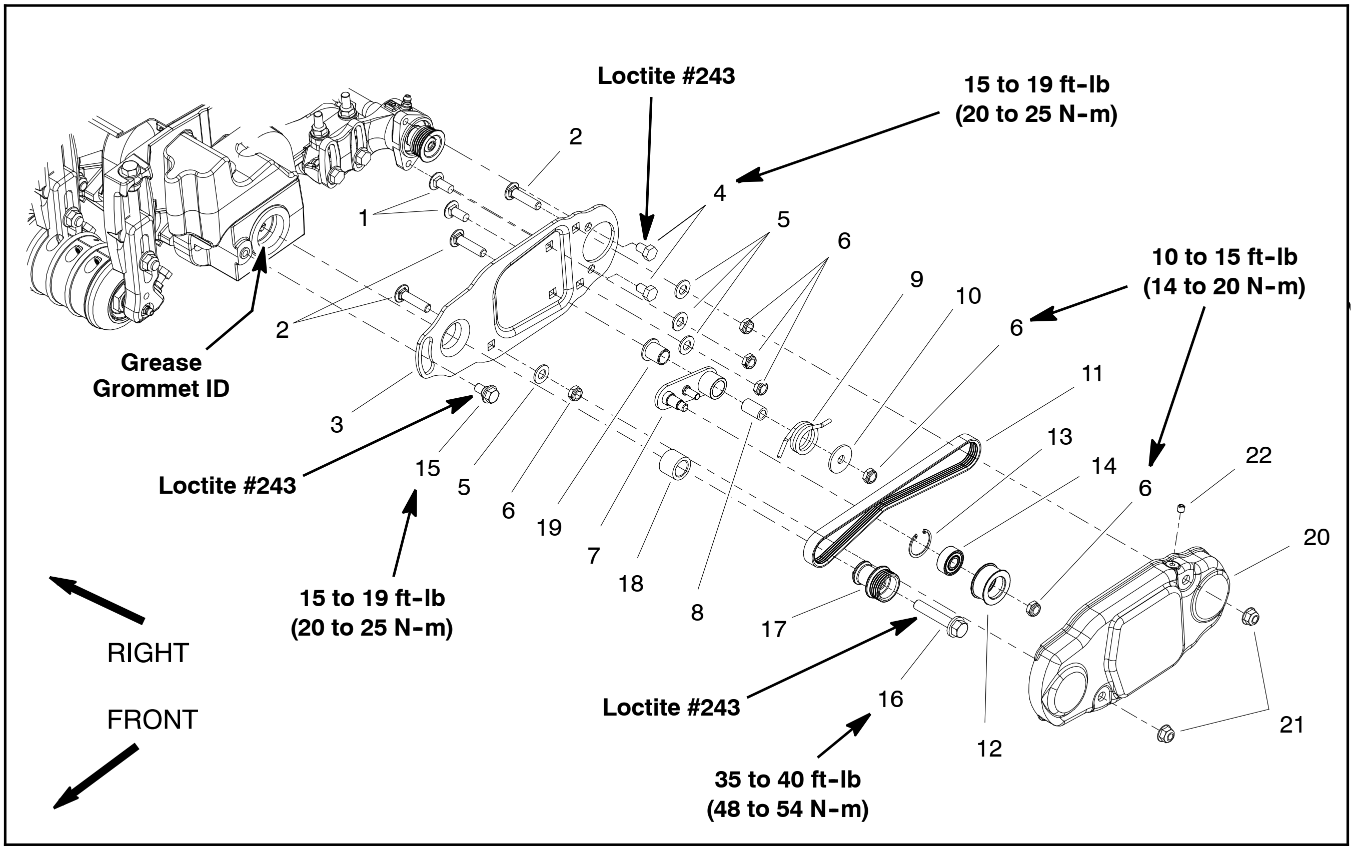

Figure 67

1. Carriage screw (2 used)
2. Carriage screw (3 used)
3. Brush plate
4. Cap screw (2 used)
5. Flat washer (4 used)
6. Lock nut (6 used)
7. Idler arm
8. Idler spacer
9. Idler spring
10. Pivot washer
11. Drive belt
12. Idler pulley
13. Retaining ring
14. Bearing
15. Shoulder screw
16. Flange head screw
17. Drive pulley
18. Spacer
19. Flange bushing
20. Cover
21. Flange nut (2 used)
22. Set screw (top of cover only)

NOTE: Drive components for the rear roller brush are located on the opposite side of the cutting unit from the cutting reel motor. Figure 55 shows components used when the brush drive is on the left side of the cutting unit.

NOTE: The Installation Instructions for the rear roller brush kit has detailed information regarding assembly and adjustment. Use those Instructions along with this Service Manual when servicing the rear roller brush.

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

2. Remove cover (item 20) to access rear roller brush drive components.

3. Remove roller brush drive components as necessary using Figure 67 as a guide.

4. Remove roller brush drive shaft if needed:

A. Remove socket head screws that secure drive housing to cutting unit side plate and remove housing from cutting unit.

IMPORTANT: If rear roller brush drive is on left side of cutting unit, drive shaft has left hand threads and can be identified by a groove on the flange. If the rear roller brush drive is on right side of cutting unit, drive shaft has right hand threads and does not have a groove on the flange (Fig. 69).

B. Loosen and remove drive shaft from cutting reel.

Drive System Assembly (Fig. 67)

1. Install drive shaft if it was removed:

   IMPORTANT: If rear roller brush drive is on left side of cutting unit, drive shaft has left hand threads and can be identified by a groove on the flange. If the rear roller brush drive is on right side of cutting unit, drive shaft has right hand threads and does not have a groove on the flange (Fig. 69).

   A. Apply Loctite #243 (or equivalent) to threads of drive shaft. Thread drive shaft into cutting reel and torque from **85 to 95 ft-lb (115 to 128 N-m)**.

   B. Make sure that O-ring is placed on inner flange of drive housing.

   C. Position housing to cutting unit side plate and secure to cutting unit with two (2) socket head screws.

   D. Make sure that grommet groove is correctly seated on flange in drive housing bore.

2. Assemble roller brush components using Figure 67 as a guide.

   A. During assembly, apply Loctite #243 (or equivalent) to threads of fasteners and torque fasteners as shown in Figure 67.

   B. Apply a light coating of grease to inner diameter of the grommet in drive bearing housing before installing brush plate.

   C. Brush plate should be installed so that idler pulley assembly is toward the bottom of the plate. Also, the shoulder bolt (item 15) should not clamp the brush plate to the drive housing during assembly.

   D. When installing drive pulley (item 17), make sure that tabs on pulley engage slot in drive shaft.

   E. Idler arm (item 7) should be free to rotate after assembly to brush plate. Make sure that idler spring is installed so that it can rotate the idler arm and pulley and apply tension to the drive belt.

   F. After drive belt installation, make sure that the ribs on the belt are properly seated in the grooves of both the drive and driven pulleys and that the belt is in the center of the idler pulley.

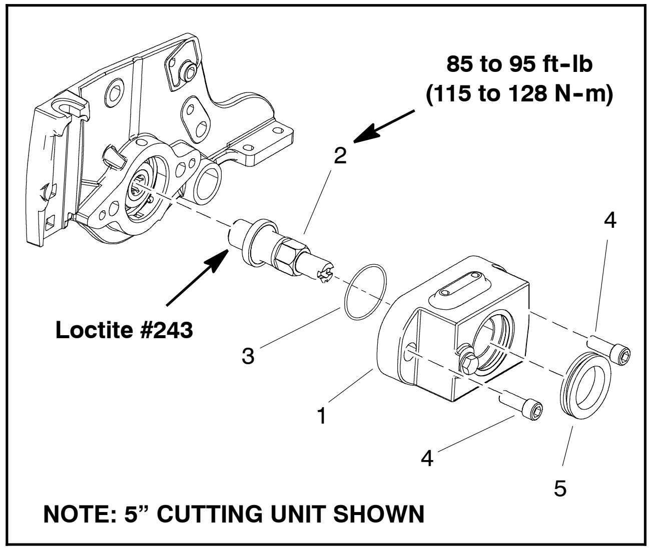

Figure 68

1. **Drive housing**
2. **Drive shaft**
3. **O-ring**
4. **Socket head screw**
5. **Grommet**

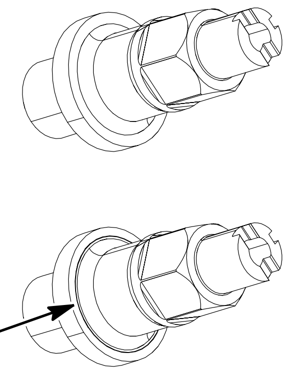

Figure 69

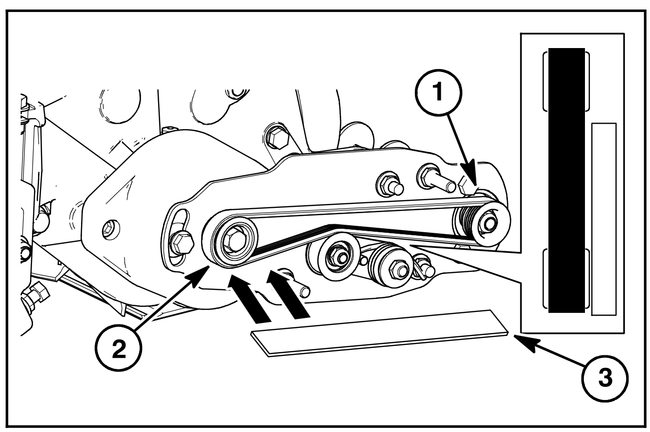

Figure 70

1. **Driven pulley**
2. **Drive pulley**
3. **Straight edge**

3. After assembly (including drive belt installation), check alignment of pulleys with a straight edge placed along the outer face of the drive pulley (Fig. 61).

A. The outer faces of the drive and driven pulleys (not the idler pulley) should be in-line within 0.030” (0.76 mm).

B. If necessary to align pulleys, remove driven pulley from brush shaft and add or remove flat washer(s) until drive and driven pulleys are correctly aligned (Fig. 71).

C. If driven pulley was removed from roller brush shaft, apply antiseize lubricant to splines of pulley bore and slide pulley onto shaft. Install and tighten flange nut until pulley is seated onto shaft and then torque flange nut from **27 to 33 ft-lb (37 to 44 N-m)**. Use a ½ wrench on roller brush shaft flats to prevent shaft from rotating when tightening nut.

IMPORTANT: The roller brush shaft must nor contact the cutting unit side plate. Also, heavy brush contact on the rear roller will cause premature brush wear.

4. Check that brush is parallel to rear roller with 0.060” (1.5 mm) clearance to light contact with rear roller. If contact is incorrect, brush operation will be adversely affected.

5. Install cover (item 20).There **should not** be a set screw installed in the bottom of the cover.

6. Lubricate grease fittings on brush housings until grease purges past inboard seals. Wipe excess grease from seals and fittings.

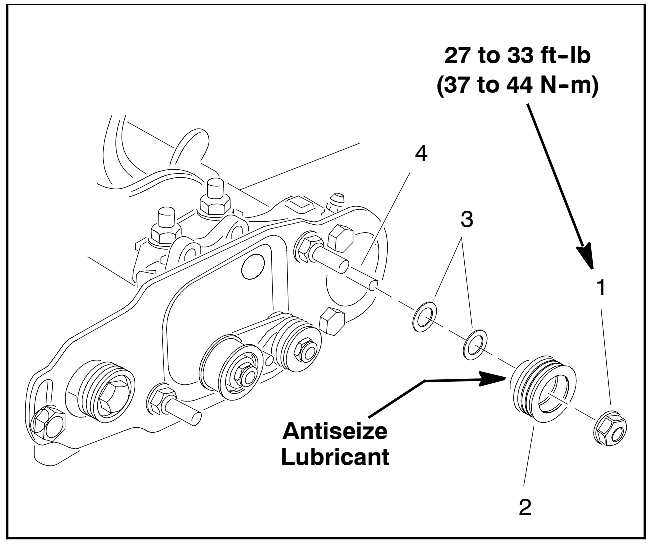

Figure 71

1. **Flange nut**
2. **Driven pulley**
3. **Flat washer**
4. **Roller brush shaft**

Chapter 9

Universal Groomer - DPA Cutting Units (Optional)

Table of Contents

Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT: Improper or overaggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. READ AND UNDERSTAND THE GROOMER OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

It is important to remember that factors affecting quality of cut also affect grooming performance.

Variables That Affect the Use and Performance of Groomers:

1. The growing season and weather conditions.

2. General turf conditions.

3. The frequency of grooming/cutting – number of cuttings per week and how many passes per cutting.

4. The height–of–cut.

5. The grooming depth.

6. The type of grass.

7. The amount of time that a groomer reel has been in use on a particular turf area.

8. The amount of traffic on the turf.

9. The overall turf management program – irrigation, fertilizing, weed control, coring, over–seeding, sand dressing, disease control and pest control.

10. Stress periods for turf – high temperatures, high humidity, unusually high traffic.

Troubleshooting

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
No rotation of the groomer reel.	The groomer drive is in Neutral.	Engage groomer drive to Forward or Reverse.
	Damaged or seized groomer drive gears.	Repair groomer drive.
The turf is damaged or has uneven grooming.	The groomer reel blades are bent, damaged or missing.	Repair or replace blades if neces- sary.
	The groomer reel shaft is bent or damaged.	Replace groomer reel shaft.
	Grooming depth is not equal on both ends of groomer reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height-of-cut, etc.).

Service and Repairs

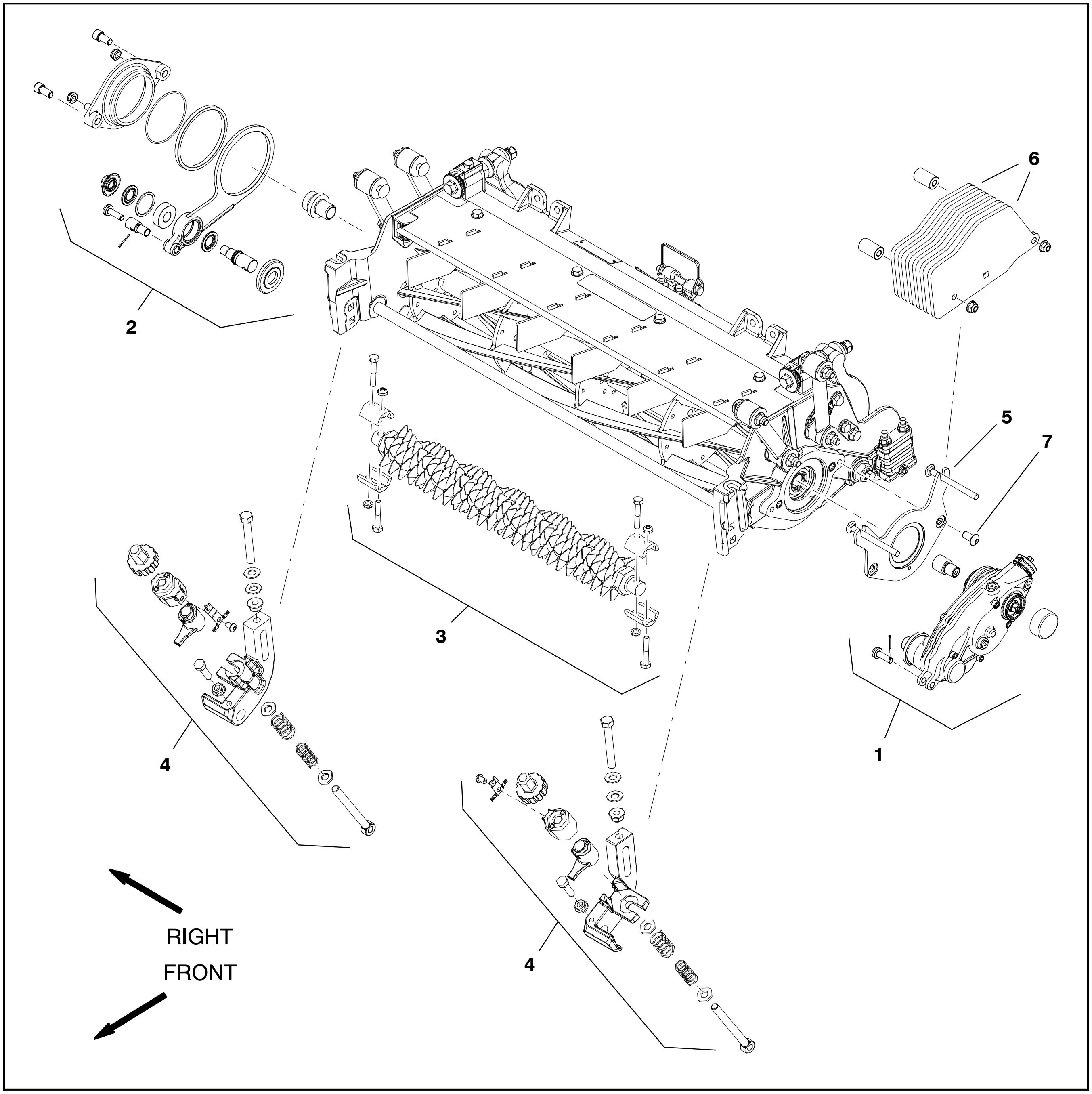

Figure 1

1. **Gear box assembly**
2. **Idler assembly**
3. **Groomer reel**
4. **Height adjuster assembly (2)**
5. **Plate**
6. **Weights**
7. **Button head screw (2)**

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Operator's Manual provides information regarding the installation, set–up, operation and maintenance of the universal groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

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Gear Box Assembly

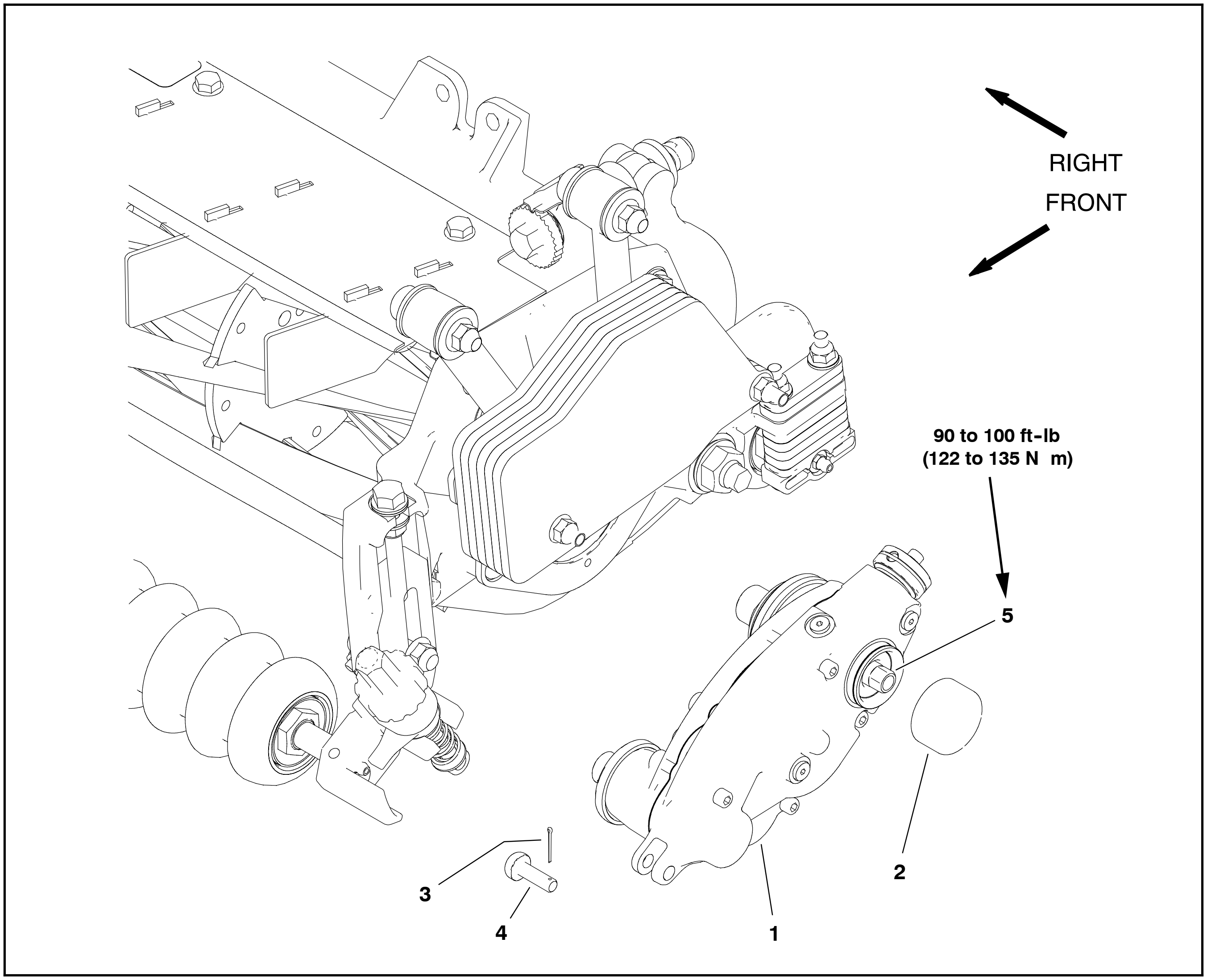

Figure 2

1. **Gear box assembly**
2. **Rear roller brush drive shield**
3. **Cotter pin**
4. **Clevis pin**
5. **Input shaft**

NOTE: The groomer gear box assembly is located on the opposite side of the cutting unit from the cutting unit hydraulic motor.

Removal (Fig. 2)

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

2. Remove the groomer reel assembly (see Groomer reel in this chapter).

NOTE: If cutting unit is equipped with an optional powered rear roller brush, remove the rear roller brush cover, drive belt and drive housing assembly to service the groomer drive (see Roller Brush (Optional) in Chapter 8 – Cutting Units in this manual for additional information).

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

3. Safely prevent reel from rotating by blocking the cutting reel with piece of wood near one of the reel spiders.

4. If installed, remove the rear roller brush drive shield from the gear box.

IMPORTANT: Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft (rear roller brush drive shaft) clockwise to remove the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread. Turn the input shaft counterclockwise to remove the gear box.

5. 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 **120 in-lb (13 N·m)**; refer to (Fig. 3)

6. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the groomer gear box. Discard cotter pin.

7. Tip up the cutting unit to access the bottom of the reel to remove the drive shaft assembly.

8. 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.

9. 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 in correct direction to remove the gear box.

10. Rest the handle of the pry bar against the front roller and turn the drive shaft in correct direction to loosen it from the reel. Continue to unscrew the drive shaft and remove the gear box from the cutting unit.

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.

B. Remove the 4 socket-head screws and remove the gear box cover assembly and driven gear. Remove and discard the cover gasket.

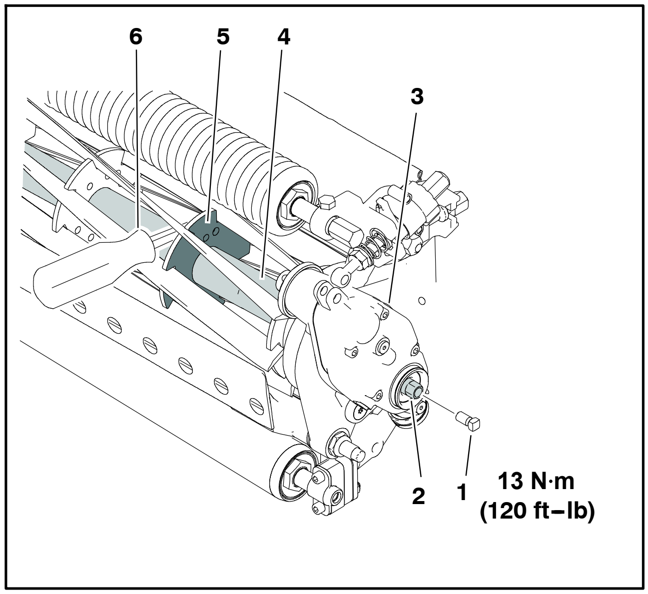

Figure 3

1. **Square head set screw**
2. **Input shaft assembly**
3. **Gear box assembly**
4. **Reel shaft**
5. **Reel support plate**
6. **Pry bar**

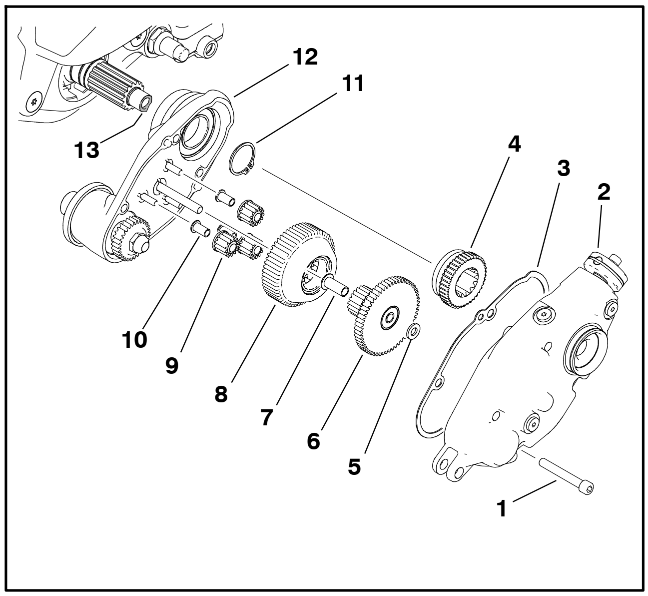

Figure 4

1. **Socket head screw (4)**
2. **Gear box cover assembly**
3. **Cover gasket**
4. **Driven gear**
5. **Thrust washer**
6. **Ring gear**
7. **Flange bushing**
8. **Sun gear**
9. **Planet gear (3)**
10. **Flange bushing**
11. **Retaining ring**
12. **Gear box housing assembly**
13. **Damaged drive shaft**

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.

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.

J. Use the drive shaft removal tool (Toro p/n **137-0920**) on the large flats of the drive shaft assembly; refer to Fig. 5.

K. Rest the handle of the pry bar against the front roller and turn the drive shaft in correct direction to loosen it from the reel.

12. Tip the cutting unit back onto its rollers.

13. 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:

A. 15/16–16 Right-Hand Thread – Toro p/n. **137–0926**

B. 15/16–16 Left-Hand Thread – Toro p/n. **137–0927**

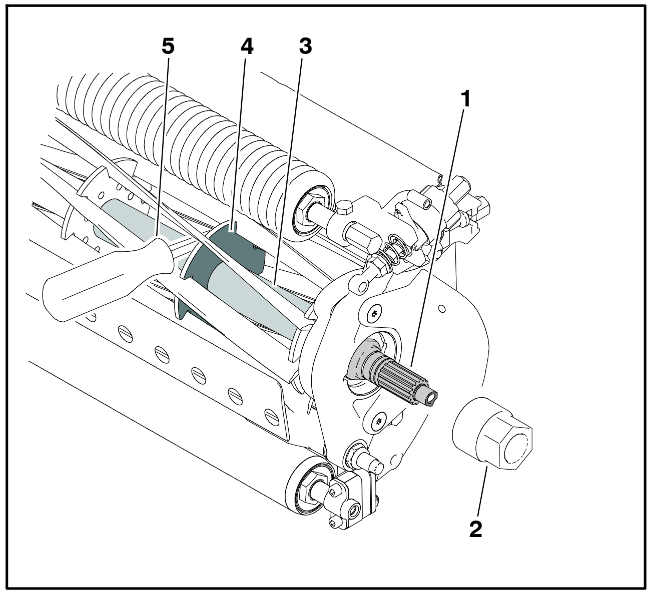

Figure 5

1. Damaged input shaft assembly
2. Drive shaft removal tool
3. Reel shaft
4. Reel support plate
5. Pry bar

Disassembly (Fig. 6)

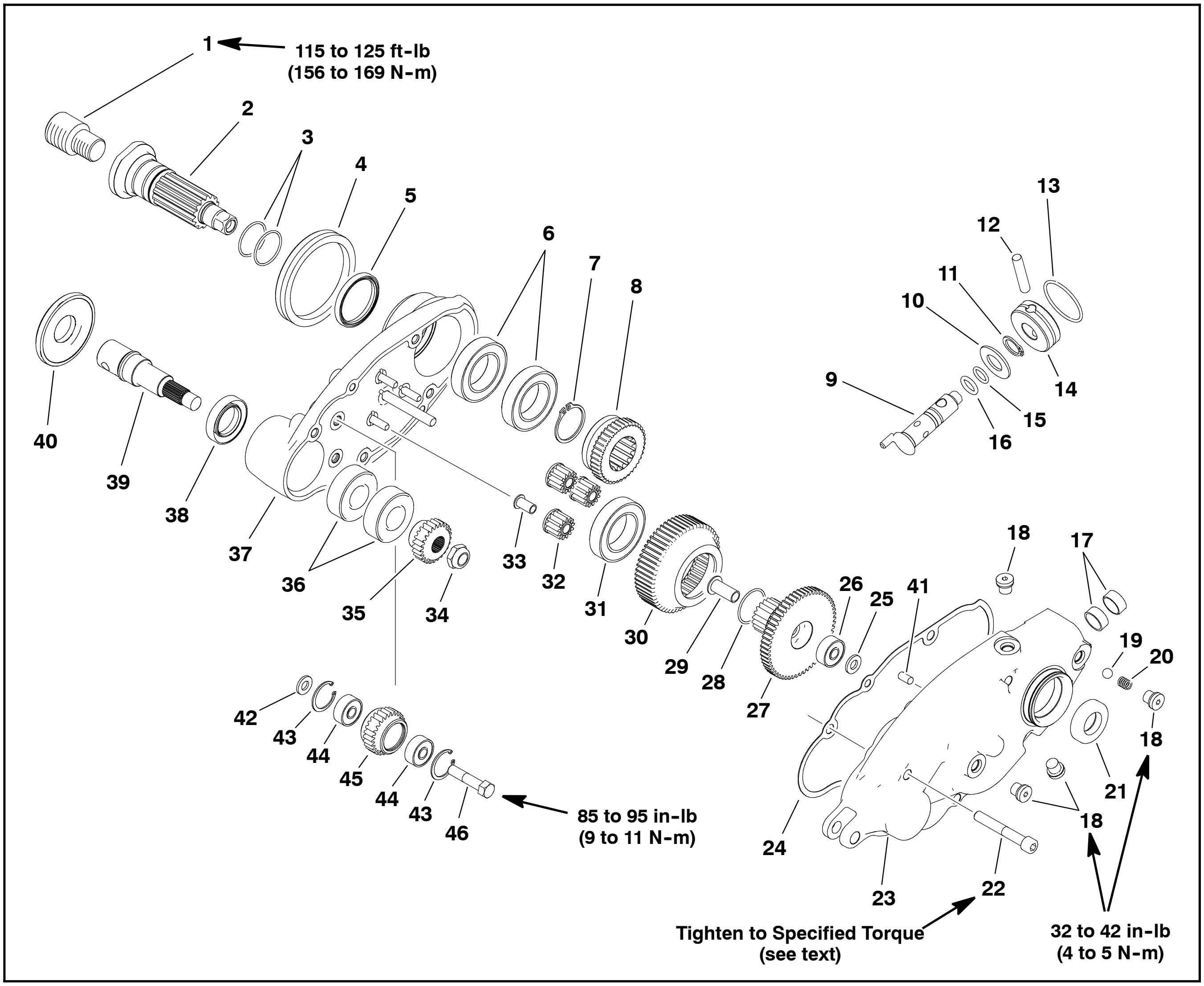

Figure 6

1. **Threaded adapter**
2. **Input shaft**
3. **O-Ring (2)**
4. **V-Ring**
5. **Seal**
6. **Bearing (2)**
7. **Retaining ring**
8. **Slider gear**
9. **Shifter shaft**
10. **Thrust washer**
11. **Retaining ring**
12. **Dowel pin**
13. **O-ring**
14. **Knob**
15. **O-ring**
16. **O-ring**
17. **Bushing (2)**
18. **Drain/fill plug (4)**
19. **Ball**
20. **Detent spring**
21. **Seal**
22. **Socket head screw (4)**
23. **Cover**
24. **Gasket**
25. **Thrust washer**
26. **Bearing**
27. **Sun gear**
28. **O-ring**
29. **Bushing**
30. **Ring gear**
31. **Bearing**
32. **Planet gear (3)**
33. **Bushing (3)**
34. **Lock nut**
35. **Output gear**
36. **Bearing (2)**
37. **Housing**
38. **Seal**
39. **Output shaft**
40. **Shield**
41. **Dowel pin (2)**
42. **Thrust washer (2)**
43. **Retaining ring (2)**
44. **Bearing (4)**
45. **Idler gear (2)**
46. **Cap screw (2)**

CAUTION

Use the 1-3/8” flats on the input shaft to prevent the input shaft from rotating during adapter removal. DO NOT use the 1/2” hex on the input shaft to secure the shaft during adapter removal or input shaft damage may occur.

1. Remove input shaft adapter (item 1) if necessary.

2. Remove the drain/fill plug and drain the oil from the gear box.

3. Remove four (4) socket head cap screws (item 22) and separate the gear box cover and housing.

4. Remove and discard the cover gasket.

5. Slide the sun gear, ring gear and planet gears from the pins on the gear box housing.

6. Continue to disassemble the gear box as necessary.

7. Carefully clean any gasket material from gear box housing and cover.

8. Inspect V-ring, seals, bearings, gears and bushings in gear box assembly. Replace damaged or worn components as necessary.

Assembly (Fig. 6)

1. If sun gear, ring gear or gear box housing bearings are replaced, press bearings all the way to shoulder in part.

2. If flange bushings are replaced, ensure bushing flange is fully seated against part.

3. Ensure all retaining rings and O-rings are fully seated in ring groove.

4. Lubricate seal lips and O-rings before installing shafts.

5. If idler gear assemblies were removed (Gear box for 7 in. reel cutting units only) tighten idler gear cap screw from **85 to 95 in-lb (9 to 11 N-m)**.

6. Lubricate planet gear and sun gear pins in gear box housing with gear oil and install planet, ring and sun gears.

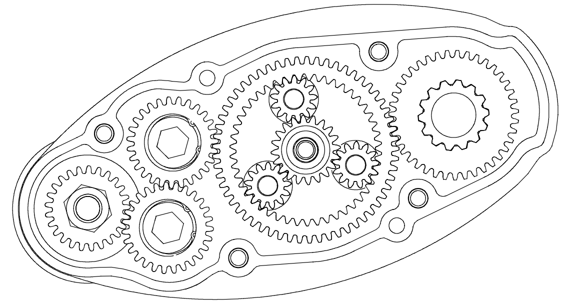

Figure 7

7. Clean gasket surface on gear box housing and cover with solvent and install new gasket.

8. Fit gear box cover over dowel pins and install four (4) socket head screws. Tighten screws from **15 to 40 in-lb (2 to 4 N-m)**. In an alternating cross pattern, tighten four (4) socket head screws from **75 to 85 in-lb (8 to 9 N-m)**.

9. Fill the gear box with 80W-90 gear oil and tighten drain/fill plug from **32 to 52 in-lb (4 to 5 N-m)**.

Gear box oil capacity for 7 in. reel cutting units = 3 oz. (90 cc)

CAUTION

Use the 1-3/8” flats on the input shaft to prevent the input shaft from rotating during adapter installation. DO NOT use the 1/2” hex on the input shaft to secure the shaft during adapter installation or input shaft damage may occur.

10. If removed, install the threaded adapter in the input shaft. If reusing a previously installed threaded adapter, apply medium strength thread locker to the smaller (5/8-11) threads only. Tighten threaded adapter from **115-125 ft-lb (156-196 N-m)**.

11. Operate groomer gear box by hand to check for proper operation prior ro installation.

Installation (Fig. 2)

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

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the cutting reel.

2. Safely prevent reel from rotating by blocking the cutting reel with piece of wood near one of the reel spiders.

IMPORTANT: Groomer gear boxes installed on the left side of the cutting unit use a left hand thread. Turn the input shaft (rear roller brush drive shaft) counterclockwise to install the gear box. Groomer gear boxes installed on the right side of the cutting unit use a right hand thread. Turn the input shaft clockwise to install the gear box.

3. 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.

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.

5. Position the gear box assembly against the cutting unit and turn the drive shaft assembly in correct direction 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. Groomer gear boxes installed on the left side of the cutting unit use a left hand thread; turn the drive shaft in correct direction to install the gear box.

6. Tighten the input shaft from **90 to 100 ft-lb (122 to 153 N-m)**.

7. Remove the square head set screw from the end of the drive shaft.

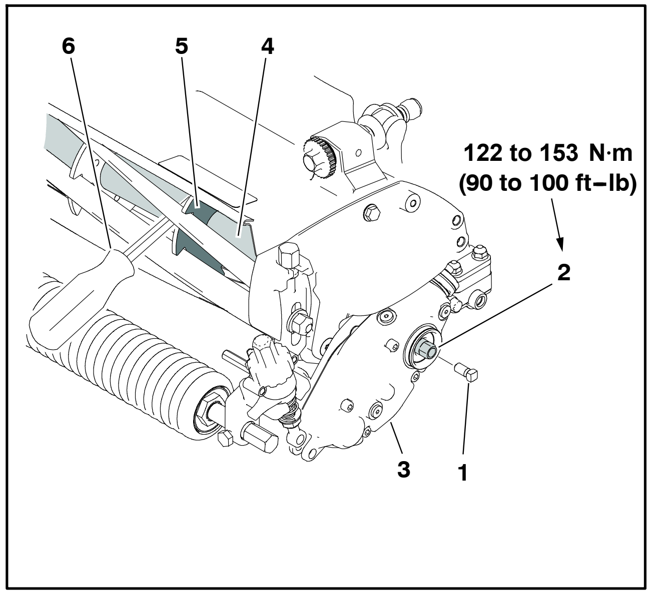

Figure 8

1. Square head set screw
2. Input shaft assembly
3. Gear box assembly
4. Reel shaft
5. Reel support plate
6. Pry bar

8. Use a new cotter pin and install the cotter pin and clevis pin securing the height adjustment rod to the front of the groomer gear box.

9. Install the rear roller brush drive shield if previously removed.

NOTE: If cutting unit is equipped with an optional powered rear roller brush, install the rear roller brush drive housing assembly, drive belt and cover (see Roller Brush (Optional) in Chapter 8 - Cutting Units in this manual for additional information).

10. Install the groomer reel assembly (see Groomer reel in this chapter).

Idler Assembly

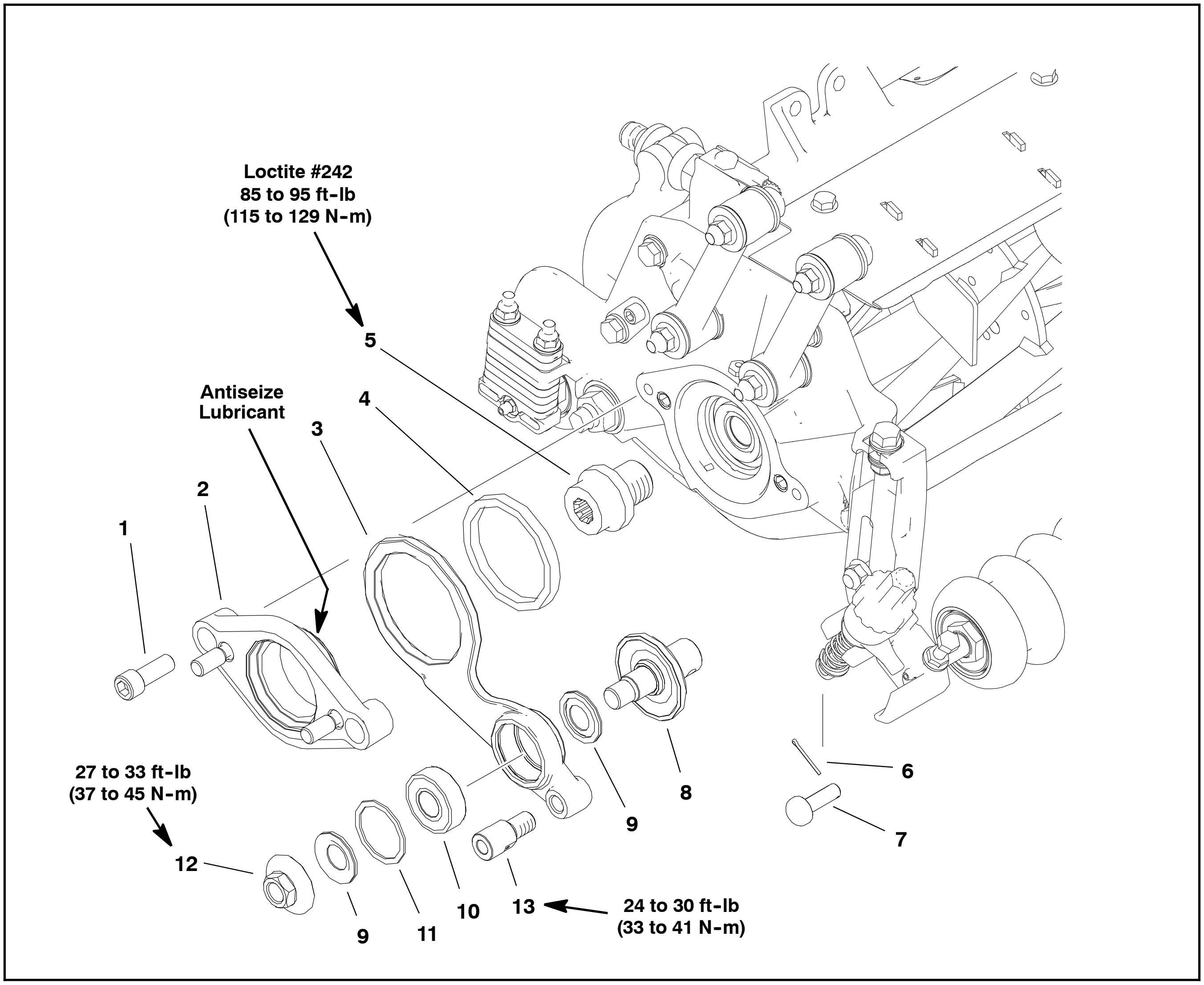

Figure 9

1. **Socket head screw (2)**
2. **Pivot hub**
3. **Idler arm**
4. **Bushing**
5. **Threaded insert**
6. **Cotter pin**
7. **Clevis pin**
8. **Stub shaft and shield**
9. **Bearing shield (2)**
10. **Bearing**
11. **Retaining ring**
12. **Flange nut**
13. **Collar**

NOTE: The groomer idler assembly is located on the same side of the cutting unit as the cutting unit hydraulic motor.

Removal (Fig. 9)

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

2. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in Chapter 8 - Cutting Units in this manual).

3. Remove the groomer reel assembly (see Groomer reel in this chapter).

4. Remove the cotter pin and clevis pin from the height adjustment rod at the front of the idler arm. Discard cotter pin.

5. Remove the socket head cap screws securing the pivot hub to the cutting unit and remove the pivot hub and idler assembly from the cutting unit.

6. Inspect shields, bearing and bushing in idler assembly. Remove and discard damaged or worn components.

Installation (Fig. 9)

1. If shields, bearing or bushing was removed from idler arm, install new components.

   A. Press bushing into groomer plate until the bushing is centered in the idler arm bore.

   B. Press bearing into idler arm so that bearing contact shoulder in idler arm bore and install bearing retaining ring.

   C. Install bearing shields with flocked side of shield toward bearing.

   D. Verify idler arm orientation (LH or RH cutting unit) and insert stub shaft through shields and bearing. Using through hole in shaft to prevent shaft from rotating, tighten flange nut from **27 to 33 ft-lb (37 to 45 N-m)**.

   E. If collar was removed from idler arm, install collar and tighten from **24 to 30 ft-lb (33 to 41 N-m)**.

2. Apply antisieze lubricant to the outside diameter of the pivot hub (Fig. 10). Position idler arm over pivot hub.

3. Apply Loctite to two (2) socket head screws and secure pivot hub and idler arm to cutting unit side plate.

4. Use a new cotter pin and install the cotter pin and clevis pin securing the height adjustment rod to the front of the idler arm.

5. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in Chapter 8 - Cutting Units in this manual).

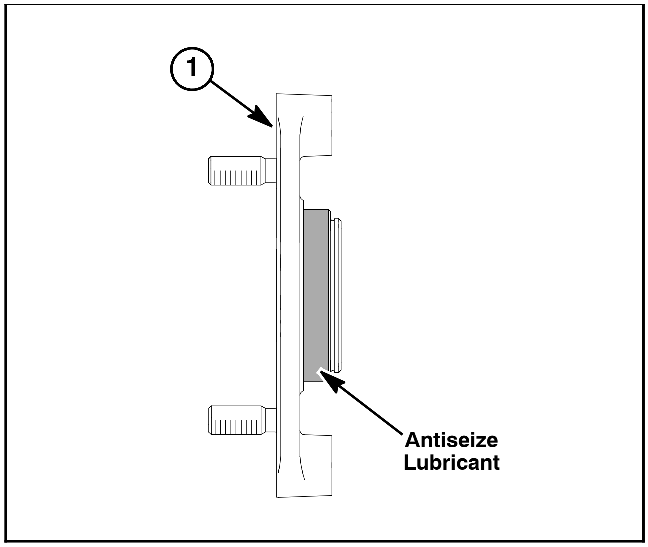

Figure 10

1. **Pivot hub**

Groomer Reel

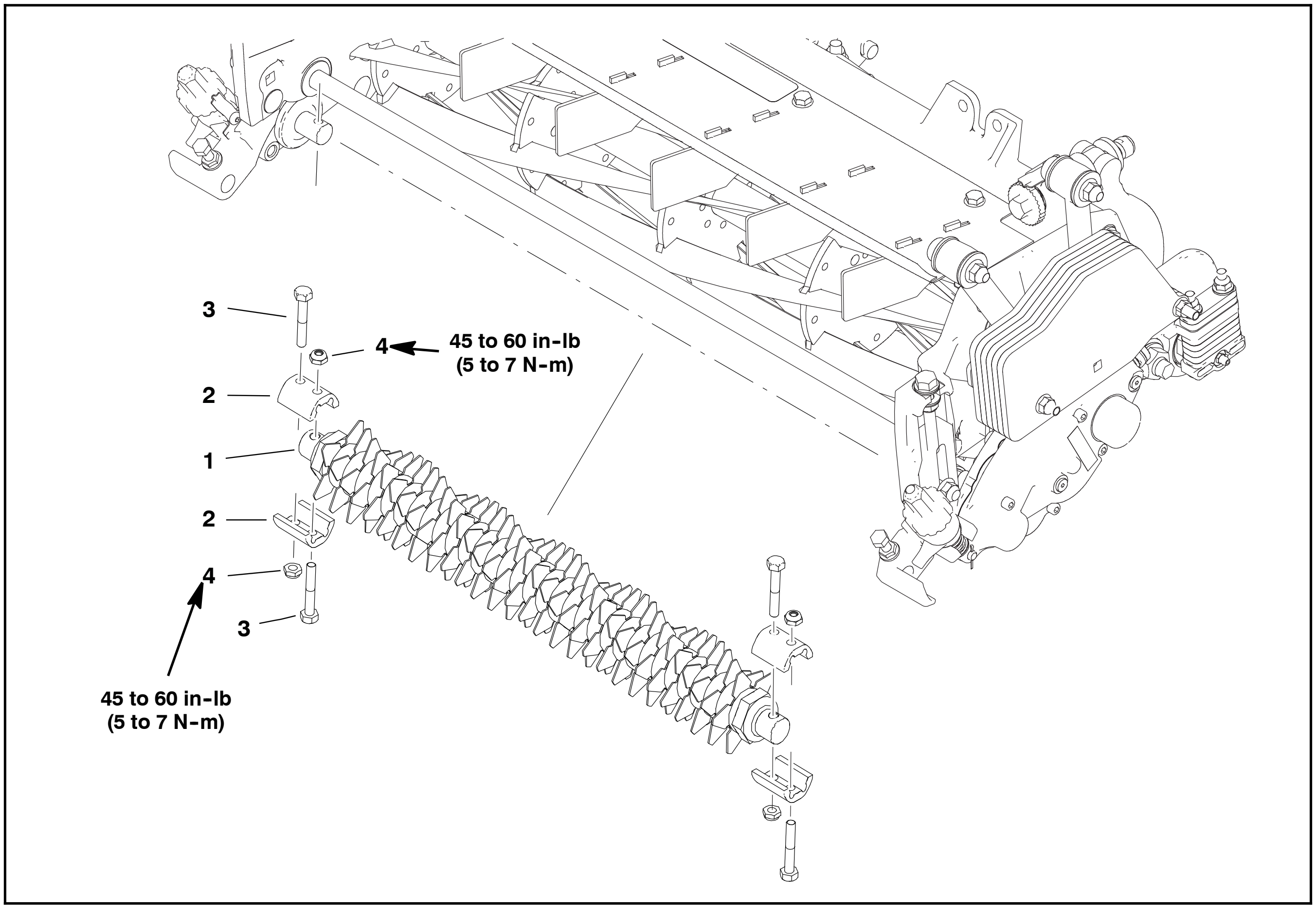

Figure 11

1. **Groomer reel**
2. **Shaft clamp (4)**
3. **Cap screw (4)**
4. **Jam nut (4)**

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer reel can be reversed to provide additional blade life.

Removal (Fig. 11)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch. If desired, remove cutting unit from machine (see Traction Unit Operator's Manual).

CAUTION

Contact with the reel or other cutting unit parts can result in personal injury. Use heavy gloves when handling the groomer reel.

2. Carefully remove the four (4) jam nuts, cap screws and shaft clamps securing the groomer reel to the output and stub shafts.

3. Lift the groomer reel from the cutting unit.

4. Inspect seal, shields, bushing and bearings for wear or damage. Replace components as needed (see Gear Box Assembly and Idler Assembly in this section).

Installation (Fig. 11)

1. Position cutting unit on a level surface. If cutting unit is attached to traction unit, make sure to stop engine, engage parking brake and remove key from the ignition switch.

2. Position the groomer reel between the groomer output and stub shafts.

3. Secure the groomer reel to the cutting unit with four (4) jam nuts, cap screws and shaft clamps. Tighten the cap screws to **46 to 60 in-lb (5 to 7 N-m)**.

4. Check groomer reel height and mower height-of-cut settings. Adjust as needed.

Groomer Reel Service

Inspect groomer reel blades frequently for damage and wear. Straighten bent blades. Either replace worn blades or reverse the individual blades to put the sharpest blade edge forward (Fig. 12). Blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

Disassembly (Fig. 13)

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

2. Remove groomer reel from cutting unit (see Groomer Reel Removal in this section).

3. If groomer reel is equipped with broomer kit, remove straps and broomer brushes from reel (Fig. 16).

4. Remove lock nut from either end of the shaft (Fig. 13).

5. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

Assembly (Fig. 13)

1. Install lock nut on drive end of groomer shaft. Place a 1/4” (6.3 mm) spacer on the groomer shaft followed by the first groomer blade.

2. Alternately install 1-1/4” (31.7 mm) spacers and blades making sure that all blades are separated by a spacer.

3. When all blades have been installed, place remaining 1/4” (6.3 mm) on shaft. Thread second lock nut onto the shaft. Center blades on shaft by adjusting lock nuts.

4. Using through holes in shaft to prevent shaft from rotating, tighten second lock nut from **31 to 35 in-lb (42 to 48 N-m)**. After tightening lock nut, spacers should not be free to rotate and groomer blades should be centered on shaft.

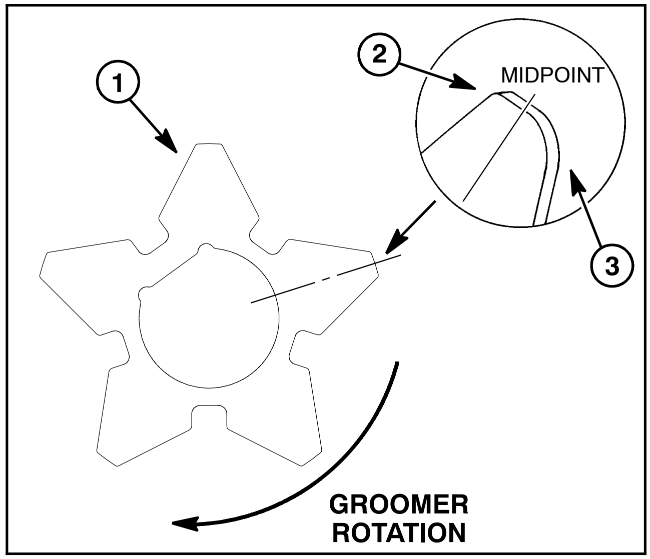

Figure 12

1. **Groomer blade**
2. **Sharp edge**
3. **Dull (rounded) edge**

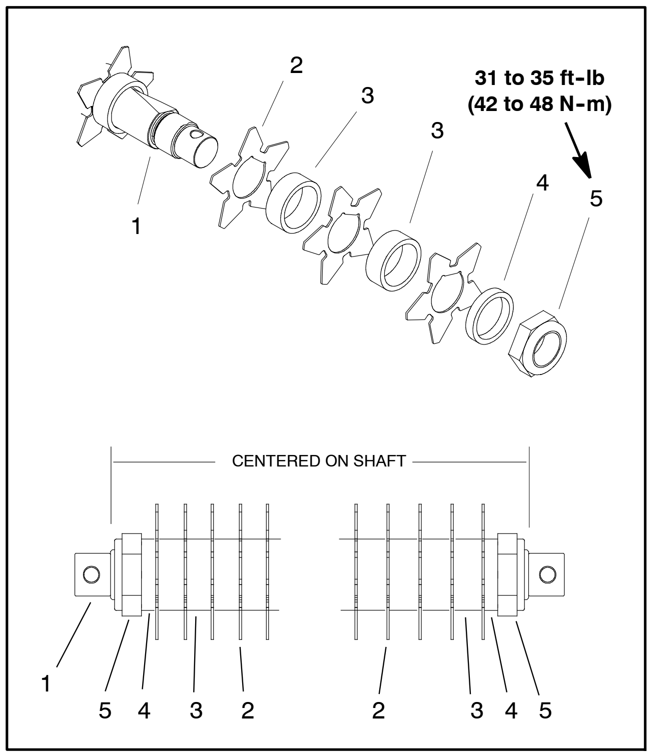

Figure 13

1. **Groomer reel shaft**
2. **Groomer blade (18 in. Reel = 32) (11 in. Reel = 40)**
3. **1-1/4” (31.7 mm) Spacer (18 in. reel = 31) (22 in. Reel = 39)**
4. **1/4” (6.3 mm) Spacer (2)**
5. **Lock nut (2)**

5. If groomer reel is equipped with broomer kit:

A. Loosen the groomer blade retaining nuts on each end of the groomer shaft.

B. Slide a brush into each groove around the full length of the groomer reel (Fig. 14). Make sure brushes are seated in groomer blade slots (Fig. 15)

IMPORTANT: The straps must be wrapped around the groomer blade and brush assembly in the correct direction.

C. Loosely wrap the straps around the groomer reel shaft and brushes as shown (Fig. 14). Straps should be positioned in the pre-cut notches of each brush and at the following locations on the broomer shaft:

18” reels - between blades 2-3, 11-12, 21-22 and 30-31.

22” reels - between blades 2-3, 14-15, 26-27 and 38-39.

Position the broomer brushes properly in the blade slots, and tighten the groomer blade-retaining nuts from **31 to 35 ft-lb (42 to 48 N-m).**

D. While holding strap buckle in place, pull straps tight into the pre-cut notches of each brush.

E. Cut off strap extension approximately 1/4” (6 mm) beyond retainer and fold the excess strap over the buckle (Fig. 16).

6. Install O-ring on non-drive end of groomer shaft.

7. Install groomer reel back on cutting unit (see Groomer Reel Installation in this section).

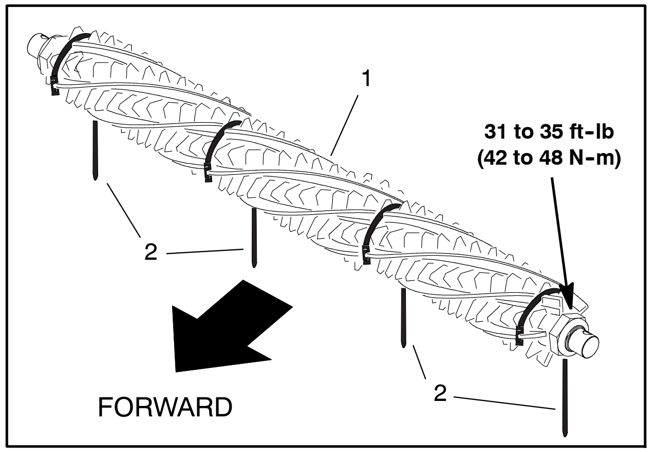

Figure 14

1. **Groomer reel** 2. **Broomer strap (4)**

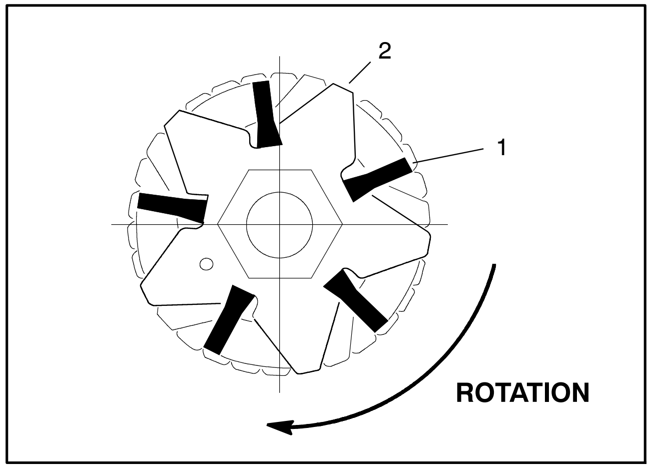

Figure 15

1. **Brush** 2. **Blade**

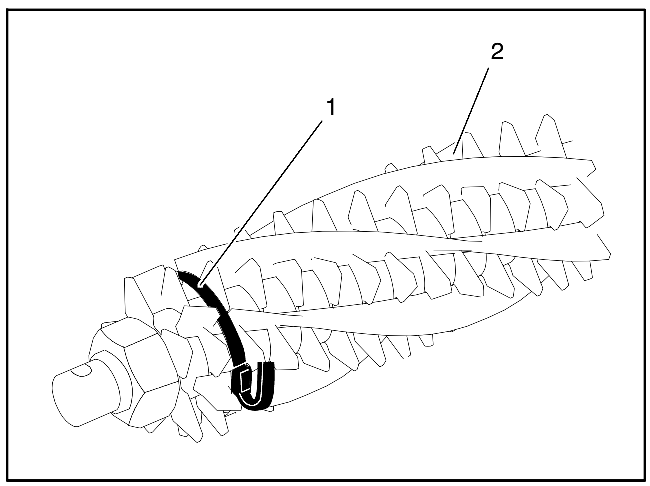

Figure 16

1. **Strap** 2. **Brush**

Grooming Brush (Optional) Service

The optional grooming brush is removed and installed from the groomer in the same manner as the groomer reel (see Groomer Reel in this chapter).

The grooming brush element or shaft can be serviced separately (Fig. 17).

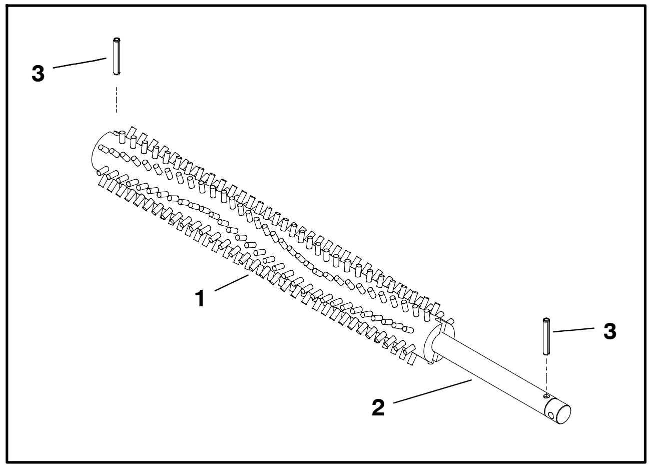

Figure 17

1. **Brush element**
2. **Shaft**
3. **Roll pin (2)**

Height Adjuster Assembly

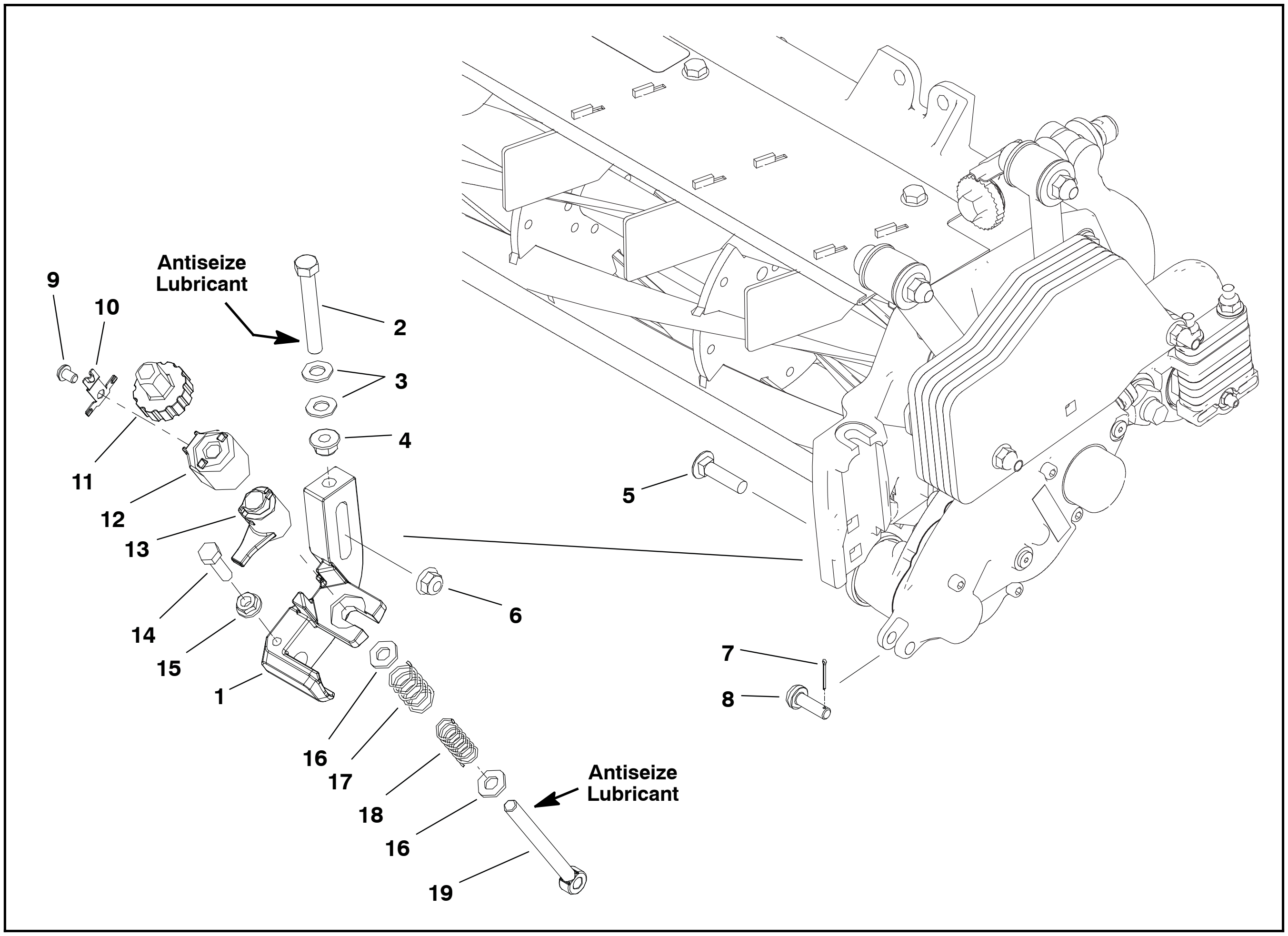

Figure 18

1. Height of cut bracket
2. Height adjustment bolt
3. Washer (2)
4. Lock nut
5. Carriage bolt
6. Flange nut
7. Cotter pin
8. Clevis pin
9. Button head screw
10. Detent spring
11. Groomer height adjuster knob
12. Quick up cover
13. Quick up lever
14. Pinch bolt (front roller)
15. Lock nut
16. Washer (2)
17. Outer spring
18. Inner spring
19. Height adjustment rod

Disassembly (Fig. 18)

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

2. Remove the cotter pins and clevis pins securing the height adjustment rods to the groomer gear box and idler arm. Discard cotter pins.

3. Loosen the two (2) height adjustment bolt lock nuts.

4. Loosen the two (2) front roller pinch bolt lock nuts and cap screws.

5. Remove the flange nut and carriage bolt securing the height adjuster assembly to the cutting unit side plate and remove the front roller and height adjuster from the cutting unit.

6. Disassemble height adjuster assembly.

7. Clean all components and inspect for wear or damage. Replace all worn or damaged components.

Assembly (Fig. 18)

1. Apply antiseize lubricant to upper threads of adjustment rod and lower threads of height adjusters. Assemble height adjuster assembly as shown.

2. If both height adjusters were removed, fit one height adjuster assembly to the cutting unit side plate and secure with carriage bolt and flange nut. Do Not tighten the flange nut at this time. Ensure the height adjustment bolt and one (1) washer is above slot in side plate and one (1) washer and lock nut is below slot in side plate.

3. Position front roller between height adjuster assemblies and secure height adjuster assembly to cutting unit side plate with carriage bolt and flange nut. Do Not tighten the flange nut at this time. Ensure the height adjustment bolt and one (1) washer is above slot in side plate and one (1) washer and lock nut is below slot in side plate.

4. Use new cotter pins and install the cotter pins and clevis pins securing the height adjustment rods to the groomer gear box and idler arm.

5. Adjust the cutting unit height of cut (see Cutting Unit Operators Manual).

6. Check groomer reel height and adjust as needed.

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