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TORO®

Count on it.

Service Manual

Reelmaster® 7000-D

(Models 03780/A and 03781)

Original Instructions (EN)

Revision History

Revision	Date	Description
--	2015	Initial Issue.
A	02/2018	Updated Engine chapter. Added revision history.
B	04/2018	Added VA02 planetary drive information. Revised bedknife installation procedure and painted/aluminum side plate cutting unit information. Added groomer chapters.
C	06/2019	Updated rear axle service drawings.
D	07/2020	Updated Electrical, Cutting Unit, Universal Groomer chapters and Foldout drawing.
E	06/2021	Updated Hydraulic chapter.

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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

(Models 03780/A and 03781)

Reelmaster® 7000–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 7000–D.

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

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

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

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

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



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Chapter 1

Safety

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General Safety Instructions

The Reelmaster 7000 has been tested and certified by TORO for compliance with existing safety standards and specifications. Although hazard control and accident prevention partially are dependent upon the design and configuration of the machine, these factors are also dependent upon the awareness, concern and proper training of the personnel involved in the operation, transport, maintenance and storage of the machine. Improper use or maintenance of the machine can result in injury or death. To reduce the potential for injury or death, comply with the following safety instructions.

WARNING

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

Before Operating

1. Review and understand the contents of the Operator's Manuals and Operator's DVD before starting and operating the vehicle. Become familiar with the controls and know how to stop the vehicle and engine quickly. Additional copies of the Operator's Manual are available on the internet at www.Toro.com.

2. Keep all shields, safety devices and decals in place. If a shield, safety device or decal is defective, illegible or damaged, repair or replace it before operating the machine. Also tighten any loose nuts, bolts or screws to ensure machine is in safe operating condition.

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

4. Since diesel fuel is flammable, handle it carefully:

   A. Use an approved fuel container.

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

   C. Do not smoke while handling fuel.

   D. Fill fuel tank outdoors and only to within an inch of the top of the tank, not the filler neck. Do not overfill.

   E. Wipe up any spilled fuel.

While Operating

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

2. Before starting the engine:

   A. Engage the parking brake.

   B. Make sure traction pedal is in neutral and the PTO switch is OFF (disengaged).

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

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

4. Do not touch engine, exhaust system components or radiator while engine is running or soon after it is stopped. These areas could be hot enough to cause burns.

5. Before getting off the seat:

   A. Ensure that traction pedal is in neutral.

   B. Engage parking brake.

   C. Disengage PTO and wait for cutting unit reel to stop rotating.

   D. Stop engine and remove key from switch.

   E. Toro recommends that anytime the machine is parked (short or long term), the cutting units should be lowered to the ground. This relieves pressure from the lift circuit and eliminates the risk of cutting units accidentally lowering to the ground.

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

Maintenance and Service

1. The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

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

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

4. Never store the machine or fuel container inside where there is an open flame, such as near a water heater or furnace.

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

6. Keep body and hands away from pin hole leaks in hydraulic lines that eject high pressure hydraulic fluid. Use cardboard or paper to find hydraulic leaks. Hydraulic fluid escaping under pressure can penetrate skin and cause injury. Fluid accidentally injected into the skin must be surgically removed within a few hours by a doctor familiar with this form of injury or gangrene may result.

7. 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.

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

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

10. If engine must be running to perform maintenance or an adjustment, keep hands, feet, clothing and other parts of the body away from cutting units and other moving parts. Keep bystanders away.

11. Do not overspeed the engine by changing governor setting. To assure safety and accuracy, check maximum engine speed.

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

13. Disconnect battery before servicing the machine. Disconnect negative battery cable first and positive cable last. If battery voltage is required for troubleshooting or test procedures, temporarily connect the battery. Reconnect positive battery cable first and negative cable last.

IMPORTANT: Before performing welding on the machine, disconnect both positive and negative battery cables from the battery , disconnect the wire harness connector from the TEC and disconnect the terminal connector from the engine alternator . These steps will prevent damage to the machine electrical system when welding.

14. Battery acid is poisonous and can cause burns. Avoid contact with skin, eyes and clothing. Protect your face, eyes and clothing when working with a battery.

15. Battery gases can explode. Keep cigarettes, sparks and flames away from the battery.

16. When welding on machine, disconnect both battery cables to prevent damage to machine electronic equipment. Disconnect negative battery cable first and positive cable last. Also, disconnect the wire harness connector from the Toro Electronic Controller (TEC) and disconnect the terminal connector from the alternator.

17. At the time of manufacture, the machine conformed to the safety standards for riding mowers. To assure optimum performance and continued safety certification of the machine, use genuine Toro replacement parts and accessories. Replacement parts and accessories made by other manufacturers may result in non-conformance with the safety standards and the warranty may be voided.

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

Jacking Instructions

CAUTION

When changing attachments, tires or performing other service, use correct jacks and supports. Make sure machine is parked on a solid, level surface 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. Use jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

Jacking the Front End (Fig. 1)

1. Apply parking brake and chock both rear tires to prevent the machine from moving.

IMPORTANT: Do not place jack, jack stands or blocks under the wheel motors. Wheel motors can be damaged if used for jacking or support points.

2. Position jack securely under the frame, just to the inside of the front tire.

3. Jack front of machine off the ground.

4. Position appropriate jack stands under the frame as close to the wheels as possible to support the machine.

Jacking the Rear End (Fig. 2)

1. Apply parking brake and chock both front tires to prevent the machine from moving.

2. Place jack securely under the center of rear axle.

3. Jack rear of machine off the ground.

4. Position appropriate jack stands under the rear axle to support the machine.

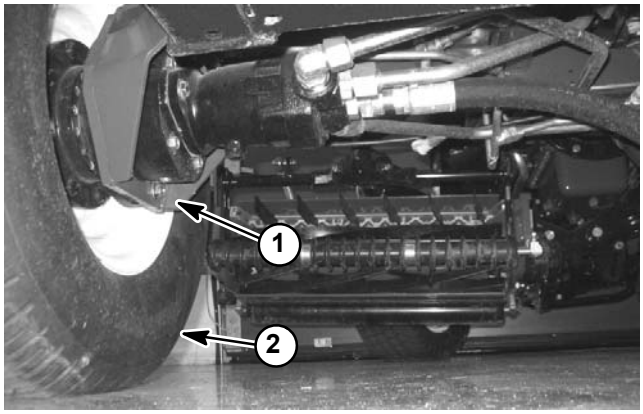


Figure 1

1. **Frame**
2. **Front tire (RH shown)**

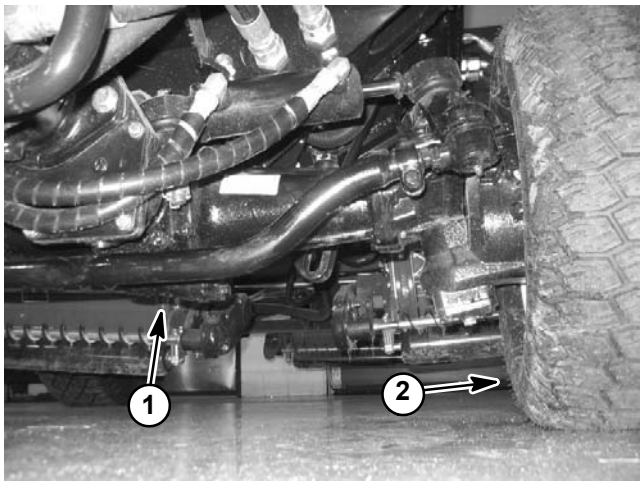


Figure 2

1. **Rear axle**
2. **Rear tire (RH shown)**

Safety and Instruction Decals

Numerous safety and instruction decals are affixed to the Reelmaster 7000. If any decal becomes illegible or damaged, install a new decal. Decal part numbers are listed in your Parts Catalog.

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Product Records and Maintenance

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Product Records

Insert Operator's Manuals and Parts Catalog for your Reelmaster at the end of this chapter. Additionally, insert Installation Instructions, Operator's Manuals and Parts Catalogs for any accessories that have been installed on your Reelmaster at the end of this section.

Maintenance

Maintenance procedures and recommended service intervals for your Reelmaster are covered in the Traction Unit and Cutting Unit Operator's Manuals. Refer to those publications when performing regular equipment maintenance. Several maintenance procedures have break−in intervals identified in the Operator's Manuals. Refer to the Engine Operator's Manual for additional engine specific maintenance procedures.

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 (e.g. Loctite), degree of lubrication on the fastener, presence of a prevailing torque feature (e.g. Nylock nut), hardness of the surface underneath the fastener's head or similar condition which affects the installation.

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

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

Fastener Identification

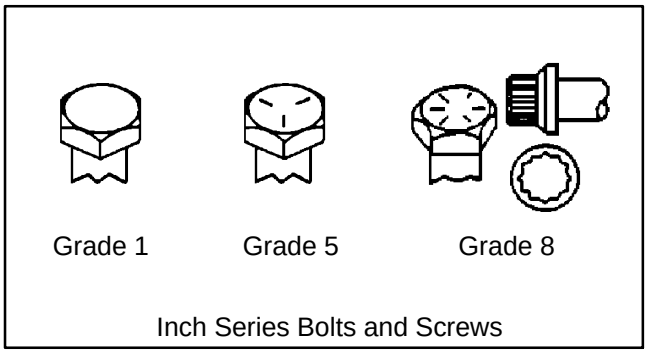


Figure 1

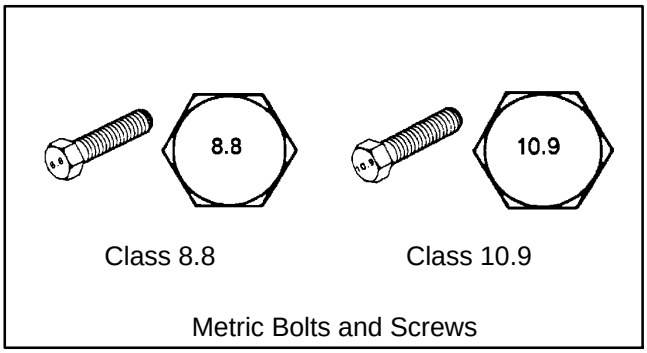


Figure 2

Using a Torque Wrench with an Offset Wrench

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

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

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

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

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

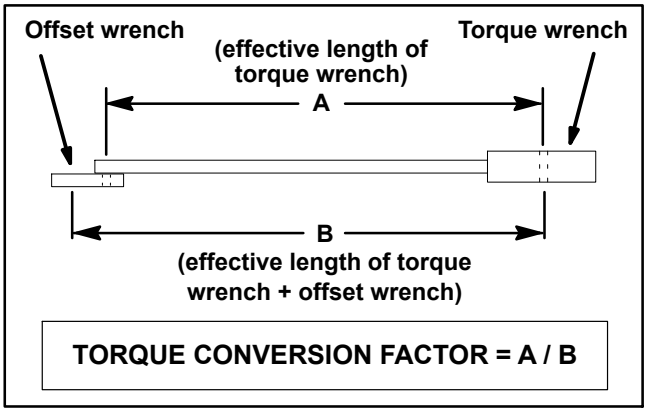


Figure 3

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

Thread Size	Grade 1, 5 & 8 with Thin Height Nuts	SAE Grade 1 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 5 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 2 or Stronger Nuts)		SAE Grade 8 Bolts, Screws, Studs & Sems with Regular Height Nuts (SAE J995 Grade 5 or Stronger Nuts)	
	in−lb	**in−lb**	**N−cm**	**in−lb**	**N−cm**	**in−lb**	**N−cm**
# 6 − 32 UNC	10 ± 2	13 ± 2	147 ± 23	15 ± 2	169 ± 23	23 ± 3	262 ± 34
# 6 − 40 UNF				17 ± 2	192 ± 23	25 ± 3	282 ± 34
# 8 − 32 UNC	13 ± 2	25 ± 5	282 ± 30	29 ± 3	328 ± 34	41 ± 5	463 ± 56
# 8 − 36 UNF				31 ± 4	350 ± 45	43 ± 5	486 ± 56
# 10 − 24 UNC	18 ± 2	30 ± 5	339 ± 56	42 ± 5	475 ± 56	60 ± 6	678 ± 68
# 10 − 32 UNF				48 ± 5	542 ± 56	68 ± 7	768 ± 79
1/4 − 20 UNC	48 ± 7	53 ± 7	599 ± 79	100 ± 10	1130 ± 113	140 ± 15	1582 ± 169
1/4 − 28 UNF	53 ± 7	65 ± 10	734 ± 113	115 ± 12	1299 ± 136	160 ± 17	1808 ± 192
5/16 − 18 UNC	115 ± 15	105 ± 15	1186 ± 169	200 ± 25	2260 ± 282	300 ± 30	3390 ± 339
5/16 − 24 UNF	138 ± 17	128 ± 17	1446 ± 192	225 ± 25	2542 ± 282	325 ± 33	3672 ± 373
	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 ± 5	58 ± 7
3/8 − 24 UNF	17 ± 2	18 ± 2	24 ± 3	35 ± 4	47 ± 5	50 ± 6	68 ± 8
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 ± 6	75 ± 8	77 ± 8	104 ± 11
1/2 − 13 UNC	30 ± 3	48 ± 7	65 ± 9	75 ± 8	102 ± 11	105 ± 11	142 ± 15
1/2 − 20 UNF	32 ± 4	53 ± 7	72 ± 9	85 ± 9	115 ± 12	120 ± 12	163 ± 16
5/8 − 11 UNC	65 ± 10	88 ± 12	119 ± 16	150 ± 15	203 ± 20	210 ± 21	285 ± 28
5/8 − 18 UNF	75 ± 10	95 ± 15	129 ± 20	170 ± 18	230 ± 24	240 ± 24	325 ± 33
3/4 − 10 UNC	93 ± 12	140 ± 20	190 ± 27	265 ± 27	359 ± 37	375 ± 38	508 ± 52
3/4 − 16 UNF	115 ± 15	165 ± 25	224 ± 34	300 ± 30	407 ± 41	420 ± 43	569 ± 58
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 ± 48	644 ± 65	667 ± 66	904 ± 89

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 engine oil or thread sealant such as Loctite.

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.

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

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

Thread Size	Class 8.8 Bolts, Screws and Studs with Regular Height Nuts (Class 8 or Stronger Nuts)		Class 10.9 Bolts, Screws and Studs with Regular Height Nuts (Class 10 or Stronger Nuts)	
M5 X 0.8	57 ± 6 in−lb	644 ± 68 N−cm	78 ± 8 in−lb	881 ± 90 N−cm
M6 X 1.0	96 ± 10 in−lb	1085 ± 113 N−cm	133 ± 14 in−lb	1503 ± 158 N−cm
M8 X 1.25	19 ± 2 ft−lb	26 ± 3 N−m	28 ± 3 ft−lb	38 ± 4 N−m
M10 X 1.5	38 ± 4 ft−lb	52 ± 5 N−m	54 ± 6 ft−lb	73 ± 8 N−m
M12 X 1.75	66 ± 7 ft−lb	90 ± 10 N−m	93 ± 10 ft−lb	126 ± 14 N−m
M16 X 2.0	166 ± 17 ft−lb	225 ± 23 N−m	229 ± 23 ft−lb	310 ± 31 N−m
M20 X 2.5	325 ± 33 ft−lb	440 ± 45 N−m	450 ± 46 ft−lb	610 ± 62 N−m

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 engine oil or thread sealant such as Loctite.

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.

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 and 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

Chapter 3

Yanmar Diesel Engine

MODEL 03780

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YANMAR TNV (Tier 4) SERIES SERVICE MANUAL
YANMAR TNV (Tier 4) SERIES TROUBLESHOOTING MANUAL

Specifications

Item	Description
Make / Designation	Yanmar Model 4TNV86CT–DTR: 4–Cycle, 4 Cylinder, Water Cooled, Turbocharged, Tier 4 Diesel Engine
Bore	3.386 in (86 mm)
Stroke	3.543 in (90 mm)
Total Displacement	127.5 in^3 (2090 cc)
Firing Order	1 (closest to flywheel end) – 3 – 2 – 4 (farthest from flywheel)
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Ultra Low Sulfur Content
Fuel Capacity	22 U.S. gallons (83 liters)
Fuel Pump	Yanmar Supply Pump
Fuel Injection Type	Common Rail with Direct Injection
Governor	Electronic All Speed
Low Idle (no load)	1200 RPM
High Idle (no load)	2850 RPM
Engine Oil	API CJ–4 or higher
Engine Oil Viscosity	See Operator's Manual
Crankcase Oil Capacity	6 U.S. quarts (5.7 liters) with Filter
Oil Pump	Trochoid Type
Coolant Capacity	9 U.S. quarts (8.5 liters)
Alternator/Regulator	12 VDC, 80 amp
Engine Weight (Dry)	496 U.S. pounds (225 kg)

General Information

This Chapter gives information about specifications and repair of the diesel engine used in the Reelmaster 7000−D.

General maintenance procedures are described in your Traction Unit Operator's Manual. Information on engine troubleshooting, testing, disassembly and assembly is identified in the Yanmar Workshop Manual.

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

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

Operator's Manuals

The Traction Unit and Yanmar Engine Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

Yanmar Service and Troubleshooting Manuals

The engine that powers your Reelmaster machine is a Yanmar model 4TNV86CT (Tier 4). Both the Yanmar Service Manual and the Yanmar Troubleshooting Manual is available for this engine. Make sure that the correct engine manuals are used when servicing the engine on your Reelmaster.

Stopping the Engine

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

Engine Electronic Control Unit (ECU)

The Yanmar engine that powers your Reelmaster uses an Electronic Control Unit (ECU) for engine management and also to communicate with the Toro Electronic Controller (TEC) and the operator InfoCenter display on the machine. All wire harness electrical connectors should be plugged into the ECU before the machine ignition switch is moved from the OFF position to either the ON or START position.

The engine electrical components (e.g. ECU, fuel injectors, EGR, exhaust DPF) are identified and matched in the engine ECU program. If engine electrical components are replaced on the engine, the Yanmar electronic tool must be used to update the ECU program which will ensure correct engine operation.

If the engine ECU identifies that an engine problem exists, the engine speed may be reduced or the engine might stop. The Yanmar electronic tool and troubleshooting manual should be used to provide assistance in identifying the cause of the problem and the repairs that are necessary. Contact your Toro distributor for assistance in Yanmar engine troubleshooting.

IMPORTANT: Do not plug or unplug the engine ECU for a period of thirty (30) seconds after the machine key switch is turned OFF. The ECU may remain energized even though the ignition switch is OFF.

If the engine ECU is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the engine ECU. Also, to prevent possible ECU damage when welding on the machine, disconnect the engine ECU from the machine before welding.

The engine ECU is mounted to the machine using four (4) rubber grommets. The grommets isolate the ECU from the machine electrically, and reduce machine vibration to the ECU. Make sure the ECU mounting grommets remain soft and unbroken. Replace grommets as necessary.

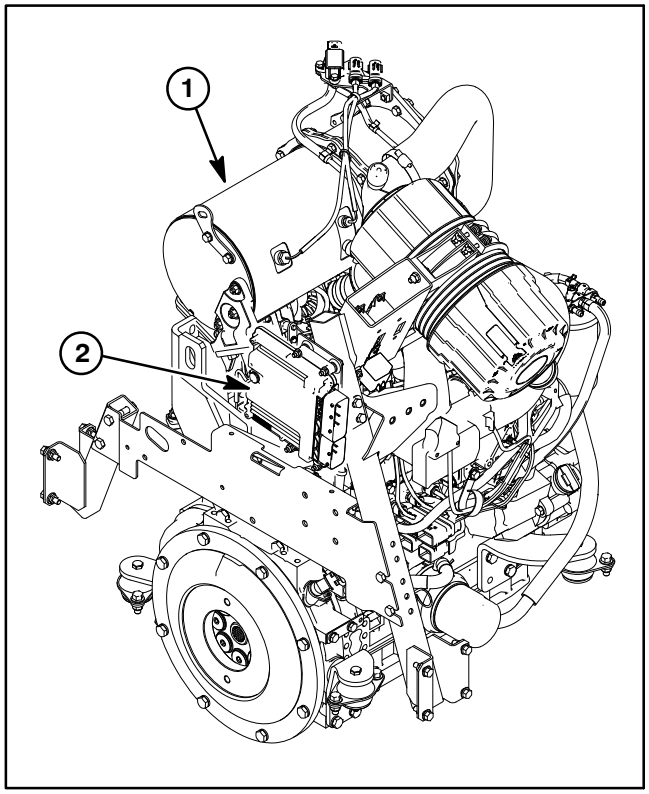


Figure 1

1. **Engine**
2. **Engine ECU**

Yanmar Engine:

The engine used on Reelmaster is a Yanmar TNV Series, turbocharged, diesel engine that complies with EPA Tier 4 emission regulations. Engine features include an electronic control unit (ECU) that controls a common rail fuel injection system with direct injection, water−cooled exhaust gas recirculation (EGR), an electronic governor, an exhaust system diesel oxidation catalyst (DOC) and an exhaust diesel particulate filter (DPF) with active regeneration. Glow plugs are used to assist starting the engine. Numerous engine sensors are used to allow the engine ECU to monitor and control engine operation for optimum engine performance.

During the operation of the engine, if conditions warrant, the engine ECU may generate an engine fault. Use the machine InfoCenter to identify the engine fault; refer to the Yanmar Troubleshooting Manual, or contact an Authorized Toro Distributor for assistance.

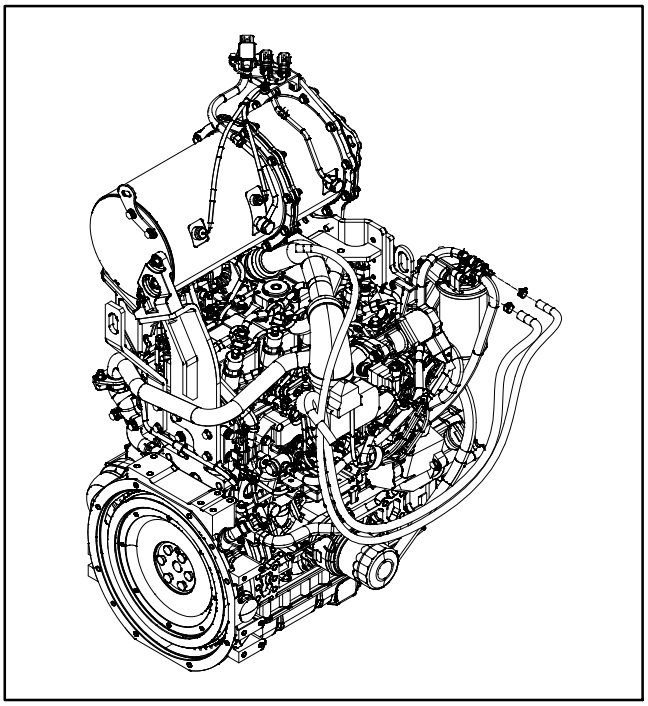


Figure 2

Diesel Particulate Filter (DPF)

The diesel particulate filter (DPF) used on Yanmar Tier 4F compliant engines is designed to breakdown the hazardous elements in the exhaust and prevent the discharge of unburnt fuel or oil known as particulate matter or soot. The DPF includes a Diesel Oxidation Catalyst (DOC), a Soot Filter (SF), 2 temperature sensors, and a pressure differential sensor. Additional information regarding the Diesel Particulate Filter (DPF) can be found in the Yanmar Operation Manual − Industrial Engines TNV supplied with your machine.

Regeneration

The engine ECU monitors the exhaust pressure before and after the soot filter in the DPF to determine if soot is accumulating. If soot is accumulating during normal engine operation, the pressure differential will increase. The increase in pressure will signal the engine to begin a process called Regeneration. Regeneration increases the exhaust temperature and the length of time the engine operates at a higher than normal exhaust temperature, incinerating the built up soot and turning it into ash. The different types of regeneration used are listed in order based on the amount of particulate matter in the soot filter (least to most).

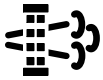
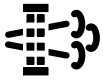
Note: The user interface and InfoCenter displays for DPF regeneration changed with machine software 122-0251E. Use the InfoCenter About screen to verify the software installed on the machine.

– For machines with software 122-0251A thru D: Complete DPF regeneration instructions can be found in the updated traction unit Operator's Manual for the specific machine. Visit www.toro.com to download the updated traction unit Operator's Manual for the machine.

– For machines with software 122-0251E and up: Complete DPF regeneration instructions can be found in the traction unit Operator's Manual. Visit www.toro.com to download the traction unit Operator's Manual with the correct DPF regeneration instructions for the machine.

Types of regeneration that are performed automatically (while the machine is operating)

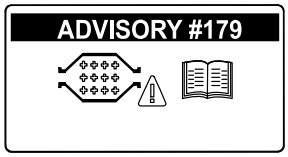
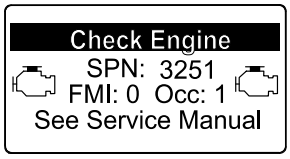
Type	Conditions	Description
Passive	Occurs during normal operation of the machine at high engine speed or high engine load.	The DPF processes high heat exhaust gasses, oxidizing harmful emissions and incinerating soot to ash. The InfoCenter does not display an icon during passive regeneration.
Assist	Occurs because of prolonged operation at low engine speed, low engine load, or when the engine ECU detects the soot filter is becoming obstructed.	The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature.  **For software 122-0251A thru D only:** the InfoCenter displays the assist regeneration icon.
Reset	Occurs every 100 hours of engine operation. Occurs after an assist regeneration if the engine ECU determines the assist regeneration did not sufficiently reduce the soot level. **Note:** Reset regeneration may be temporarily delayed if high exhaust temperatures would create an unsafe condition (the machine is operating indoors or outdoors around trees, brush, tall grass, or other temperature−sensitive plants or materials). Refer to Setting the Inhibit Regen in the traction unit Operators Manual for additional information.	The engine ECU adjusts the exhaust intake throttle and the injector timing to raise the exhaust temperature.  **For all software revisions:** the InfoCenter displays the high exhaust temperature icon.

Type	Conditions	Description
Parked	Occurs when exhaust back pressure in the DPF increases due to continued soot buildup. May be caused by prolonged operation at low engine speed, low engine load, or the use of incorrect fuel or engine oil. May occur if the InfoCenter is set to inhibit regen (preventing a Reset Regeneration) and machine operation is continued. Can be initiated when prompted by the engine ECU or after a minimum of 50 hours of engine operation. **For software 122-0251E and up:** if a parked regeneration is ignored, the machine mow function (PTO) will be disabled approximately 2 hours after the first notification.	Manually initiate a parked regeneration as soon as possible. A parked regeneration will take approximately 30 to 60 minutes and should not be started with less than 1/4 tank of fuel. The machine must remain stationary (cannot be operated) during the entire parked regeneration process. The engine ECU adjusts the exhaust intake throttle to raise the exhaust temperature.  **For all software revisions:** the InfoCenter displays advisory #188 and/or the stationary regeneration icon.
Recovery	Occurs when exhaust back pressure in the DPF increases due to soot buildup reaching a critical level. Can only be initiated when prompted by the engine ECU. **For software 122-0251E and up:** the machine mow function (PTO) will be disabled at first notification.	Manually initiate a recovery regeneration as soon as possible. A recovery regeneration will take approximately 3 hours and should not be started with less than 1/2 tank of fuel. The machine must remain stationary (cannot be operated) during the entire recovery regeneration process. Use the InfoCenter About screen to verify the software installed on the machine. • Machines with software 122-0251A thru D: Recovery regeneration must be initiated by an Authorized Toro Distributor service technician using Yanmar SMARTASSIST−Direct • Machines with software 122-0251E and up: Recovery regeneration can be initiated from the machine InfoCenter  **For software 122-0251E thru D only:** the InfoCenter displays the recovery regeneration icon.  **For software 122-0251E and up:** the InfoCenter displays advisory #190 and/or the stationary regeneration icon. **Note:** Verify the model and serial number of the engine installed in the machine. 4TNV86CT−DTR engines below serial number 03789 cannot run a recovery regeneration without first reprogramming the engine ECU. Contact an Authorized Toro Distributor for assistance.

Soot Accumulation

If the types of regeneration that are performed automatically (while the machine is operating) are bypassed or not allowed to complete before shutting off the engine, soot will continue to accumulate in the soot filter. When enough soot accumulates, the engine ECU will generate an engine fault to prompt a parked or recovery regeneration. In addition to an engine fault appearing on the InfoCenter, the engine output power will be reduced.

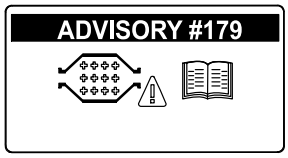
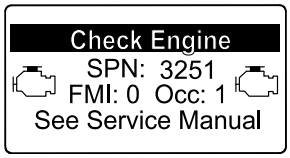
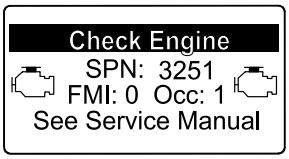
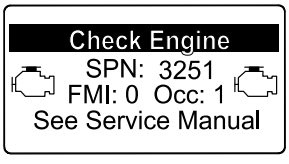
Soot Accumulation Engine Faults

Fault Level	Fault Code	Engine Power Rating	Recommended Action
Level 1: Engine Warning		De−rated to 85%	Perform a parked regeneration as soon as possible.
Level 2: Engine Warning		De−rated to 50%	Perform a recovery regeneration as soon as possible.

Ash Accumulation

Ash is a result of the regeneration processes. The lighter ash is discharged through the exhaust system, while the heavier ash collects in the soot filter. When enough ash accumulates in the soot filter, the engine ECU will generate an engine fault to prompt servicing the DPF. In addition to an engine fault appearing on the InfoCenter, the engine output power and speed will be reduced.

Ash Accumulation Advisories and Engine Faults

Fault Level	Fault Code	Engine Power Rating	Engine Speed Reduction	Recommended Action
System Advisory (machine software 122-0251A thru D only)		100%	None	Plan to service the DPF in the future.
Level 1: Engine Warning		De−rated to 85%	None	Service DPF
Level 2: Engine Warning		De−rated to 50%	None	Service DPF
Level 3: Engine Warning		De−rated to 50%	Maximum torque +200 rpm	Service DPF

Air Cleaner System

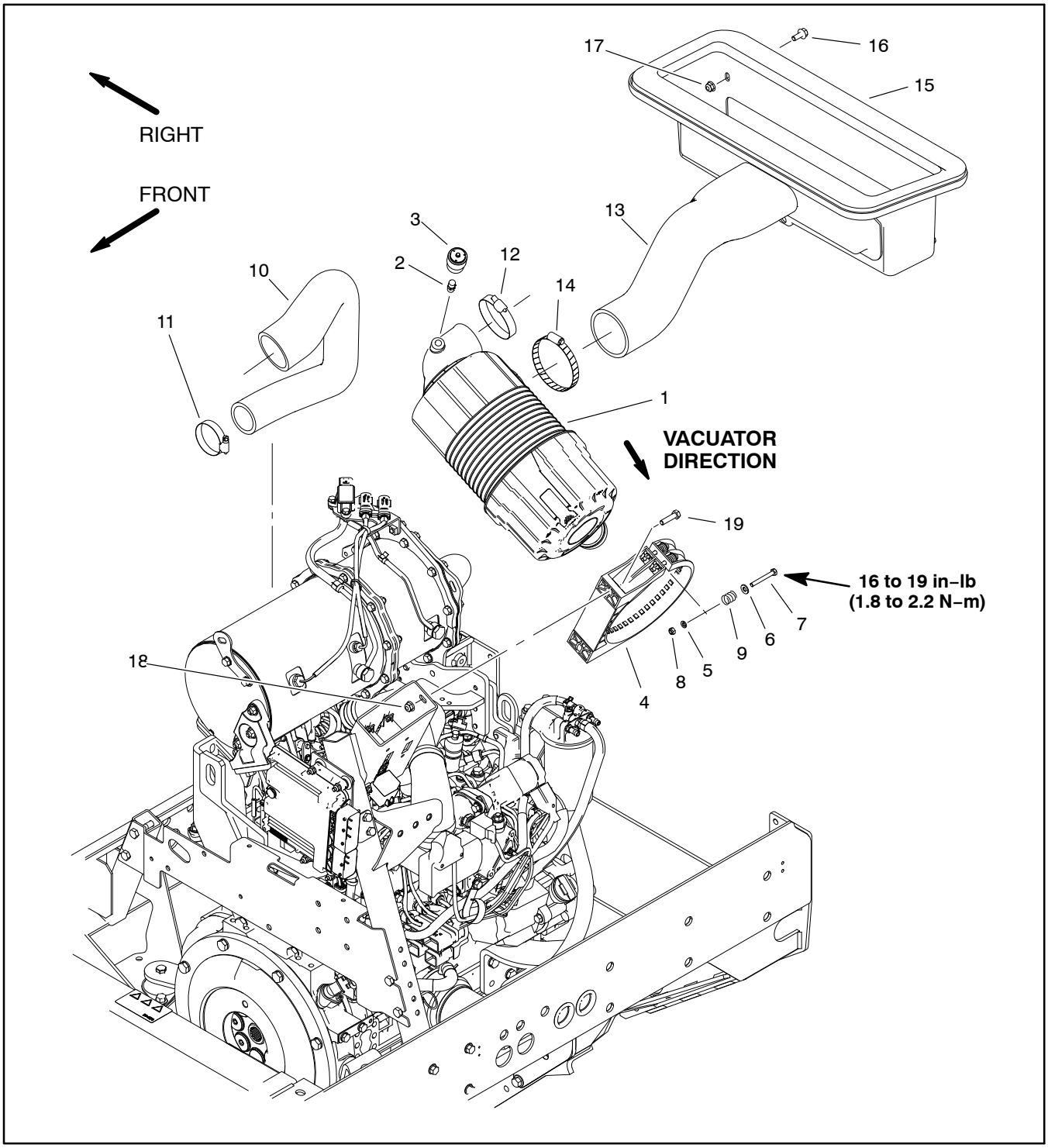


Figure 3

1. Air cleaner assembly
2. Adapter
3. Indicator
4. Air cleaner strap
5. Flat washer (2)
6. Flat washer (2)
7. Socket head screw (2)
8. Lock nut (2)
9. Spring (2)
10. Air cleaner outlet hose
11. Hose clamp
12. Hose clamp
13. Air cleaner inlet hose
14. Hose clamp
15. Plenum
16. Flange head screw (4)
17. Flange nut (4)
18. Flange nut (2)
19. Cap screw (2)

Removal (Fig. 3)

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

2. Raise and support hood.

3. Remove air cleaner components as needed.

Installation (Fig. 3)

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

1. Assemble air cleaner components.

   A. If service indicator was removed from air cleaner housing, apply thread sealant to adapter threads before installing adapter and indicator to housing (Fig. 5). Install adapter so that grooves in adapter hex and adapter filter element are installed toward service indicator. Tighten indicator from **26 to 33 in–lb (3.0 to 3.7 N–m)**.

   B. Orientate vacuator valve on air cleaner cover toward ground.

   C. Make sure that air cleaner hoses do not contact any engine or machine components. To modify clearance, move and/or rotate air cleaner body in air cleaner strap. Verify that tabs in strap mesh fully with slots in air cleaner body. Air cleaner strap should be as close as possible to air cleaner cap. Tighten strap screws from 16 to 19 in–lb (1.8 to 2.2 N–m).

2. Lower and secure hood.

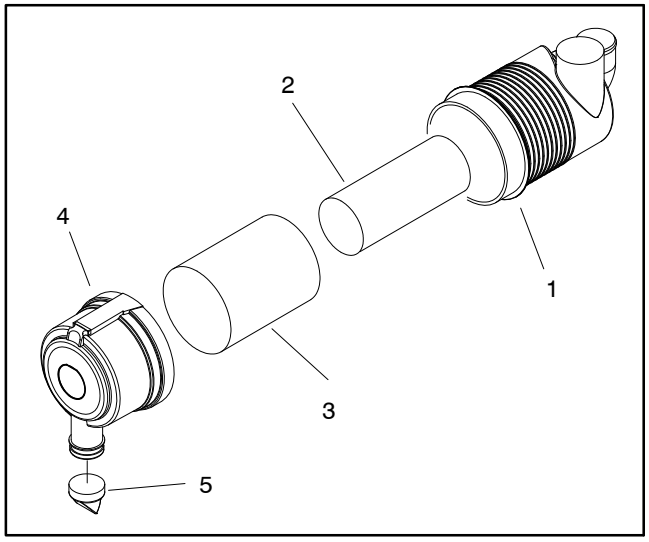


Figure 4

1. **Air cleaner housing**
2. **Safety filter element**
3. **Air filter element**
4. **Air cleaner cap**
5. **Vacuator valve**

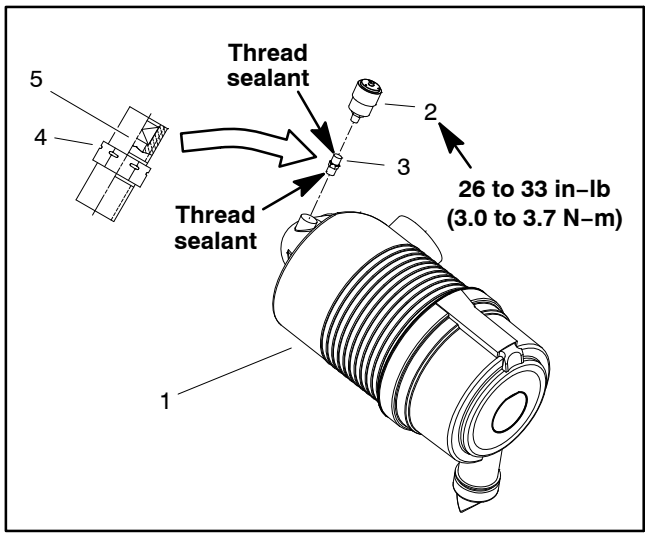


Figure 5

1. **Air cleaner assembly**
2. **Service indicator**
3. **Adapter**
4. **Groove**
5. **Filter element**

Exhaust System

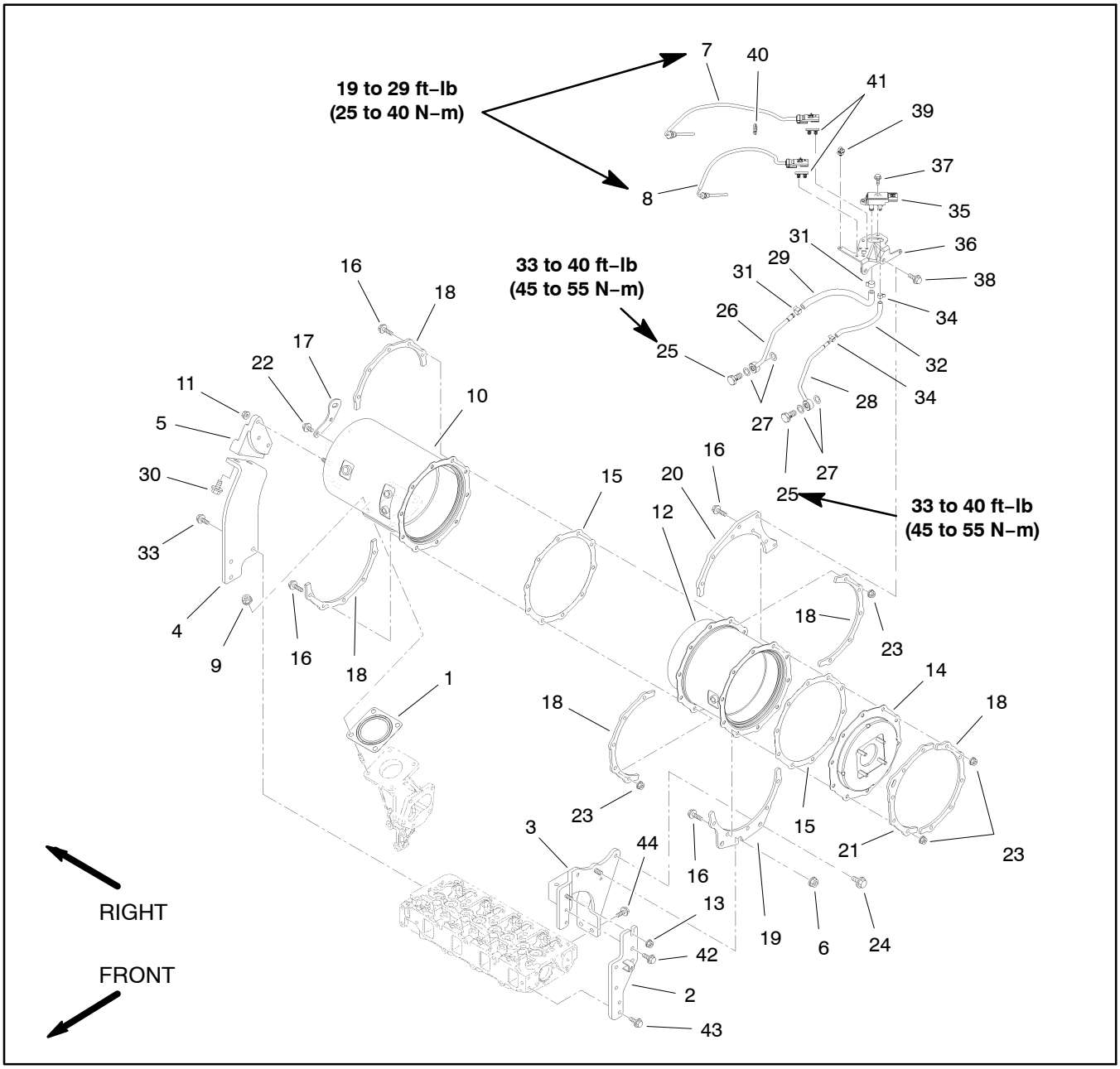


Figure 6

1. Gasket
2. Exhaust assembly stay
3. Exhaust assembly stay
4. Exhaust assembly stay
5. Exhaust assembly stay
6. Nut
7. DOC temp sensor (inlet)
8. DOC temp sensor (outlet)
9. Nut (4)
10. DOC assembly
11. Nut (3)
12. DPF assembly
13. Nut
14. Outlet flange
15. DPF gasket (2)
16. Bolt (20)
17. DPF lifter
18. DPF stiffener (5)
19. DPF stiffener
20. DPF stiffener
21. DPF stiffener
22. Bolt (2)
23. Nut (20)
24. Bolt (2)
25. Pipe joint bolt (2)
26. Exhaust pressure pipe (DPF inlet)
27. Sensor gasket (4)
28. Exhaust pressure pipe (DPF outlet)
29. Exhaust hose
30. Bolt (2)
31. Hose clip (2)
32. Hose
33. Bolt (3)
34. Hose clip (2)
35. Pressure sensor
36. Sensor bracket
37. Bolt (2)
38. Bolt (2)
39. Clip band
40. Band
41. Connector clip (2)
42. Bolt (2)
43. Bolt (2)
44. Bolt (2)

Reelmaster 7000−D models that are powered by a diesel engine that complies with EPA Tier 4 emission regulations are equipped with an exhaust system that includes a diesel oxidation catalyst (DOC) and a diesel particulate filter (DPF). These exhaust components require service or component replacement at intervals identified in your Operator's Manual. Additionally, the exhaust assembly uses two (2) temperature sensors and a pressure differential sensor which are used as inputs for the engine ECU to monitor the operation of the exhaust system.

The diesel particulate filter (DPF) is cleaned periodically through a regenerative process that is controlled by the engine ECU (see the General Information section of this chapter). The InfoCenter display will identify the status of DPF regeneration. At recommended intervals, DPF reconditioning is necessary which will require exhaust system disassembly, DPF removal and DPF reconditioning by a company that has the necessary equipment. Once the DPF has gone through the reconditioning process, it can be re−installed in the exhaust system. Contact your Toro Distributor for information on reconditioning the DPF.

The diesel oxidation catalyst (DOC) has a service life expectancy and requires replacement at recommended intervals. Replacement of the DOC will require exhaust system disassembly, removal of the existing DOC and installation of the new DOC.

Additional information about the diesel particulate filter (DPF) operation and maintenance can be found in the Yanmar Service Manual and the Yanmar Troubleshooting Manual.

Removal (Figs. 6 and 7)

NOTE: The exhaust system DPF and DOC can be removed from the exhaust system without removing the entire exhaust from the engine. Certain engine service procedures (e.g. rocker cover removal for valve clearance adjustment) will require removal of the exhaust system assembly.

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 exhaust system.

1. Raise and support hood to gain access to exhaust system. Allow engine and exhaust to cool before doing any disassembly of exhaust system components.

2. Remove exhaust system components from the engine as necessary. Discard all gaskets removed.

Installation (Figs. 6 and 7)

NOTE: Make sure that all exhaust system flanges and sealing surfaces are free of debris or damage that may prevent a tight seal.

1. Make sure to install **new** gaskets in place of all gaskets that were removed. Do not use any type of gasket sealant on gasket or flange surfaces.

2. Assemble all removed exhaust system components.

   A. If exhaust temperature sensors (Fig. 6 items 7 and 8) were removed, tighten sensors from **19 to 29 ft−lb (25 to 40 N−m)**.

   B. If exhaust pressure pipes (Fig. 6 items 26 and 28) were removed, replace sensor gaskets (item 27) on both sides of the pressure pipe fitting. Tighten pipe fittings from **33 to 40 ft−lb (45 to 55 N−m)**.

   C. If DPF stiffeners (Fig. 6 items 18, 19, 20 and 21) were loosened or removed, tighten fasteners that secure stiffeners before tightening fasteners that secure exhaust system to DPF stays.

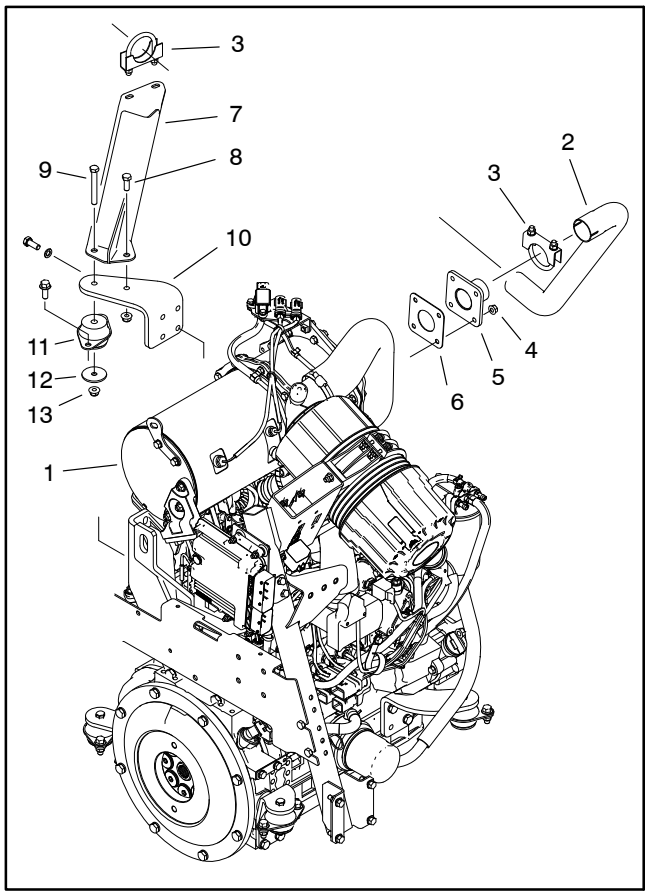


Figure 7

1. **DPF assembly**
2. **Tailpipe**
3. **Clamp assembly**
4. **Flange nut (4)**
5. **Exhaust flange**
6. **Exhaust gasket**
7. **Tailpipe support**
8. **Cap screw**
9. **Cap screw**
10. **Mount bracket − RH rear**
11. **Engine mount**
12. **Rebound washer**
13. **Flange nut**

Fuel System

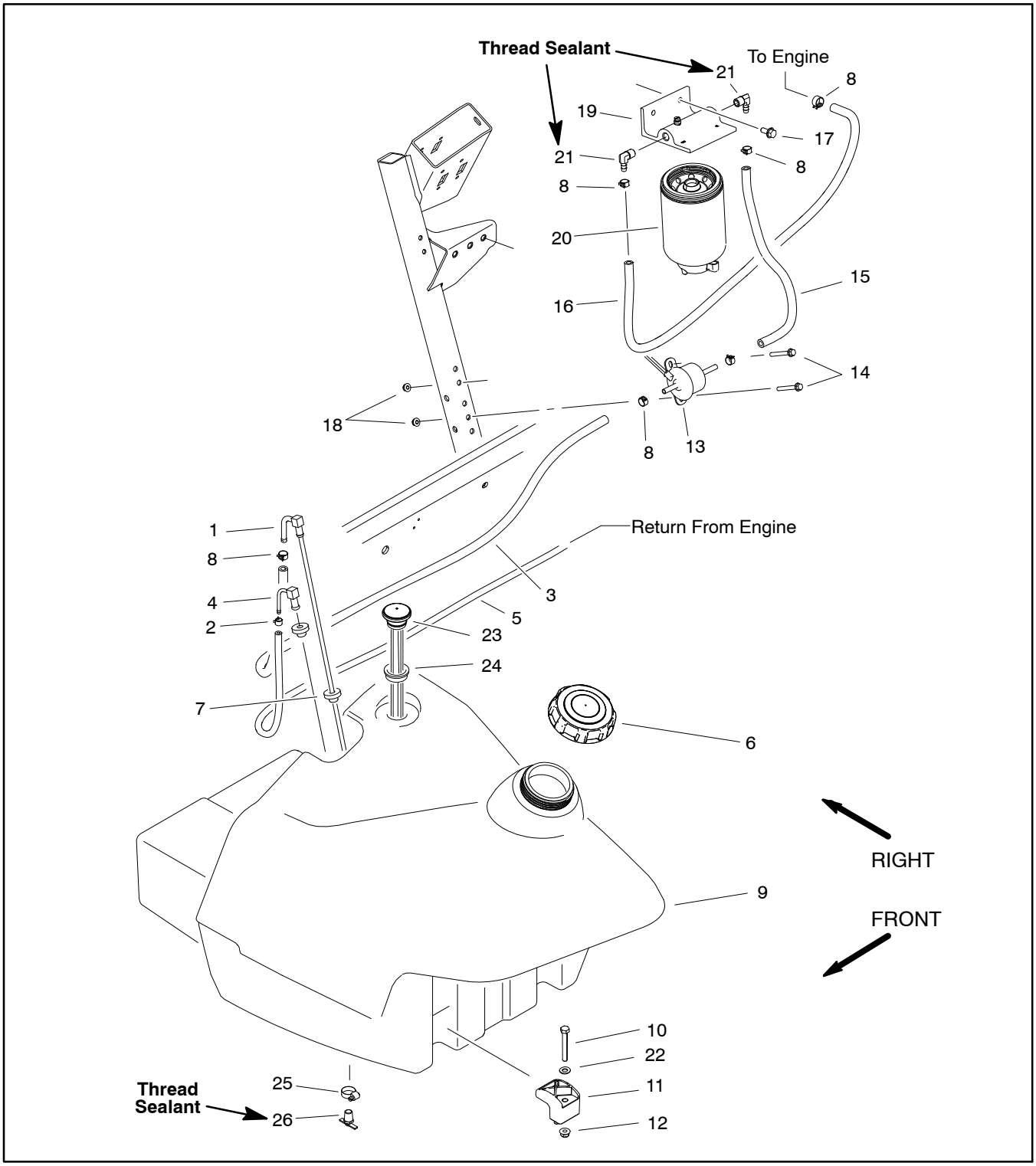


Figure 8

1. Fuel suction tube
2. Fuel line clamp (2)
3. Fuel hose (tank to pump)
4. Return fitting
5. Fuel hose (engine to tank)
6. Fuel tank cap
7. Bushing (2)
8. Hose clamp (6)
9. Fuel tank
10. Cap screw (2)
11. Clamp (2)
12. Flange nut (2)
13. Fuel pump
14. Cap screw
15. Fuel hose (pump to filter)
16. Fuel hose (filter to engine)
17. Cap screw (2)
18. Flange nut (4)
19. Fuel/water separator
20. Filter element
21. Elbow fitting (2)
22. Flat washer (2)
23. Fuel gauge
24. Grommet
25. Hose clamp
26. Draincock

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 as recommended in the Traction Unit Operator's Manual. Check lines for deterioration, damage, leaking or loose connections. Replace hoses, clamps and connections as necessary.

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Traction Unit Operator's Manual. 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. To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of contaminates and debris. Follow all local codes and regulations when recycling or disposing of waste fuel.

Prime the Fuel System

The fuel system needs to be primed before starting the engine for the first time, after running out of fuel or after fuel system maintenance (e.g. draining the filter/water separator, replacing a fuel hose). To prime the fuel system, make sure that the fuel tank has fuel in it. Then, turn the ignition key to the ON position for 10 to 15 seconds which allows the fuel pump to prime the fuel system. **DO NOT** use the engine starter motor to crank the engine in order to prime the fuel system.

Fuel Tank Removal (Fig. 8)

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

2. For assembly purposes, label fuel hoses at suction and return fittings in top of tank. Disconnect fuel hoses from fittings.

3. Use draincock on bottom of tank to empty fuel tank into a suitable container.

4. Remove fuel tank from machine.

Fuel Tank Installation (Fig. 8)

1. Install fuel tank to frame.

2. If draincock (item 26) or fuel pump fittings (item 21) were removed, apply thread sealant to threads of draincock and fittings before installing.

3. Using labels placed during fuel tank removal, correctly connect fuel hoses to the suction and return fittings in top of tank. Secure hoses with hose clamps.

4. Make sure that draincock in bottom of fuel tank is closed.

5. Fill fuel tank with clean fuel.

Radiator/Hydraulic Oil Cooler

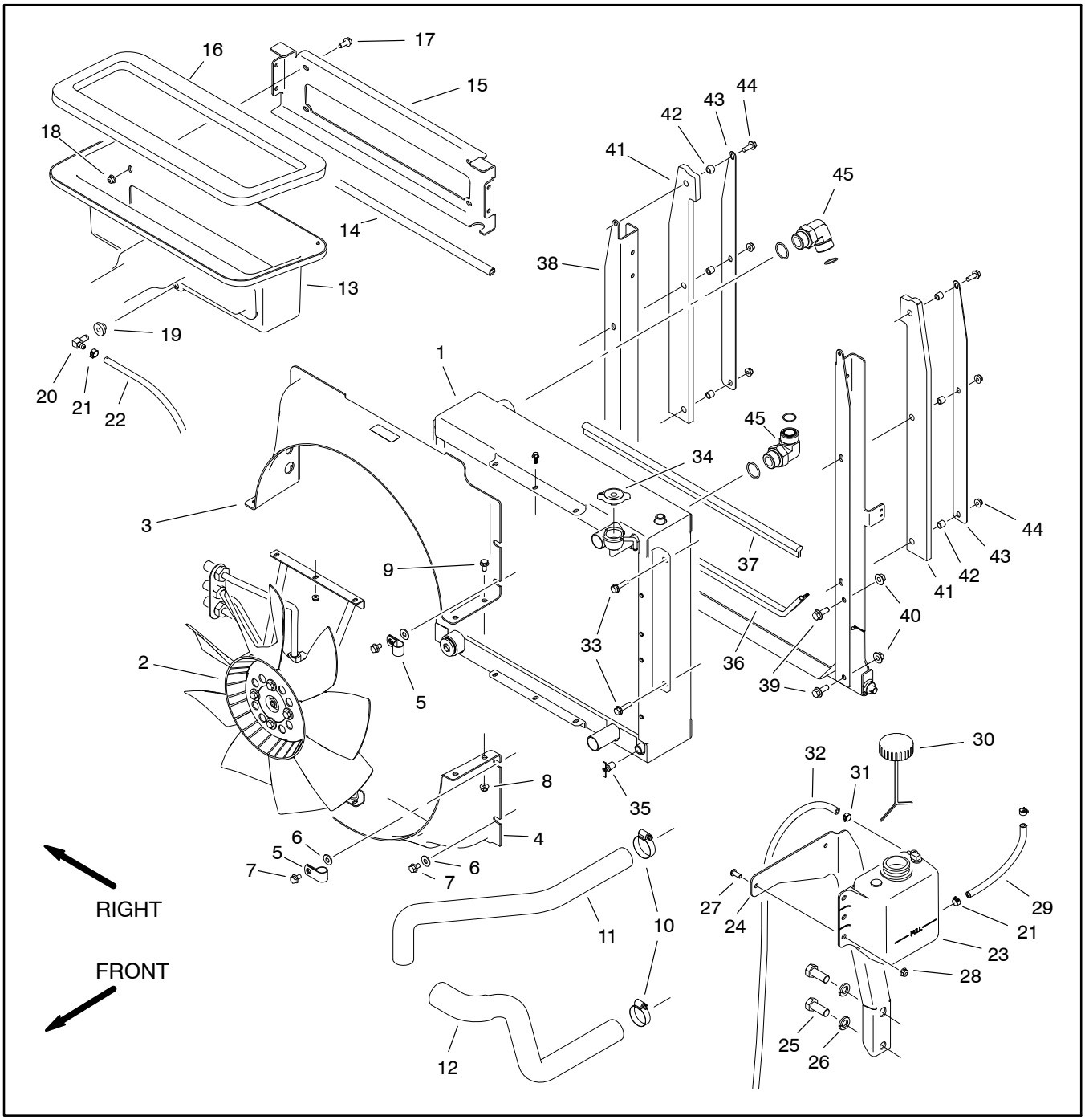


Figure 9

1. Radiator
2. Fan assembly
3. Upper radiator shroud
4. Lower radiator shroud
5. R–clamp (2)
6. Flat washer (8)
7. Flange head screw (8)
8. Flange nut (4)
9. Flange head screw (4)
10. Hose clamp (4)
11. Upper radiator hose
12. Lower radiator hose
13. Plenum
14. Bulb seal
15. Crossover plate
16. Plenum seal
17. Flange head screw (8)
18. Flange nut (8)
19. Bushing
20. Elbow fitting
21. Hose clamp (4)
22. Hose (plenum drain)
23. Coolant reservoir
24. Reservoir bracket
25. Cap screw (2)
26. Lock washer (2)
27. Flange head screw (2)
28. Flange nut (2)
29. Hose (reservoir to radiator)
30. Reservoir cap
31. Hose clamp
32. Hose (reservoir overflow)
33. Flange head screw (4)
34. Radiator cap
35. Radiator draincock
36. Bulb seal
37. Bulb seal
38. Radiator mount
39. Flange head screw (4)
40. Flange nut (4)
41. Foam seal (2)
42. Spacer (6)
43. Seal bracket (2)
44. Flange nut (4)
45. 90º hydraulic fitting (2)

Removal (Fig. 9)

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 in Chapter 8 – Chassis in this manual).

3. Remove air cleaner intake hose from air cleaner.

4. Remove flange head screws and flange nuts that secure plenum (item 13) to crossover plate. Remove plenum with air cleaner hose and drain hose attached.

5. Remove flange head screws and flange nuts that secure crossover plate (item 15) to radiator mount. Remove crossover plate.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

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

6. Remove radiator cap. Drain radiator into a suitable container using the radiator draincock.

7. Disconnect upper and lower hoses from the radiator.

8. Disconnect coolant reservoir hose (item 29) from the radiator.

9. Remove fasteners that secure coolant reservoir bracket (item 24) to frame and remove reservoir and bracket from machine.

10. Remove engine cooling fan assembly including upper radiator shroud from machine (see Engine Cooling Fan Motor in Chapter 5 – Hydraulic System in this manual).

11. To prevent contamination of hydraulic system during radiator/oil cooler removal, thoroughly clean junction of hydraulic hoses and fittings on oil cooler.

12. Disconnect hydraulic hoses from radiator/oil cooler (Fig. 10). Put caps or plugs on open hydraulic hoses and fittings to prevent system contamination. Label the hydraulic hoses to insure correct installation.

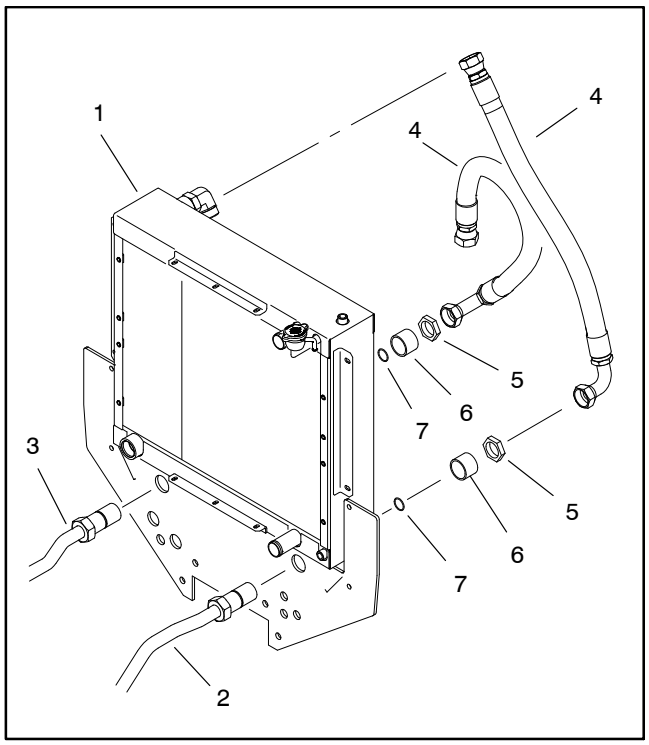


Figure 10

1. **Radiator/oil cooler**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic hose**
5. **Bulkhead nut**
6. **Spacer**
7. **O–ring**

13. Remove flange head screws and flange nuts securing the radiator/oil cooler to the radiator mount (item 38). Carefully remove radiator/oil cooler from the machine. Make sure that spacers (item 42) remain in hood seals.

14. Plug all radiator/oil cooler and hose openings to prevent contamination.

15. If necessary, remove draincock, coolant plug, hydraulic oil plug from radiator/oil cooler (Fig. 11).

16. If hydraulic fittings are to be removed from oil cooler, mark fitting orientation to insure correct assembly. Remove fittings from cooler and discard O–rings.

Installation (Fig. 9)

1. If hydraulic fittings were removed from oil cooler, lubricate and place new O−rings onto fittings. Install fittings into oil cooler openings using marks made during the removal process to properly orientate fittings (Fig. 11). Tighten fittings (see Hydraulic Fitting Installation in Chapter 5 − Hydraulic System in this manual).

2. If hydraulic plug was removed from oil cooler, place new O−ring on plug and install into oil cooler port (Fig. 11).

3. If draincock or plug were removed from radiator, apply thread sealant and install draincock and plug into radiator openings (Fig. 11).

4. Carefully position radiator/oil cooler to the radiator mount. Make sure that spacers (item 42) are positioned in hood seals. Secure radiator/oil cooler in place with four (4) flange head screws and flange nuts.

5. Install engine cooling fan motor assembly and upper radiator shroud to machine (see Engine Cooling Fan Motor in Chapter 5 − Hydraulic System in this manual). Make sure that clearance between shrouds and fan is at least **0.180" (4.6 mm)** at all points. Tighten all upper and lower radiator shroud fasteners.

6. Remove any plugs in radiator coolant openings or coolant hoses.

7. Connect upper and lower radiator hoses to the radiator and secure with hose clamps.

8. Secure coolant reservoir bracket (item 24) to frame with two (2) cap screws and lock washers.

9. Connect reservoir hose (item 29) to the radiator vent tube.

10. Remove caps or plugs from hydraulic hoses and fittings that were installed during disassembly. Connect hydraulic hoses to oil cooler fittings (Fig. 12). Tighten hydraulic hoses (see Hydraulic Hose and Tube Installation in Chapter 5 − Hydraulic System in this manual).

11. Install crossover plate (item 15) to radiator mount and secure with four (4) flange head screws and nuts.

12. Install plenum assembly (item 13) to crossover plate and secure with four (4) flange head screws and nuts. Route plenum drain hose through clamp (item 5).

13. Install air cleaner intake hose to the air cleaner.

14. Make sure that radiator draincock is closed. Fill radiator with coolant.

15. Install hood on the machine (see Hood Installation in Chapter 8 − Chassis in this manual).

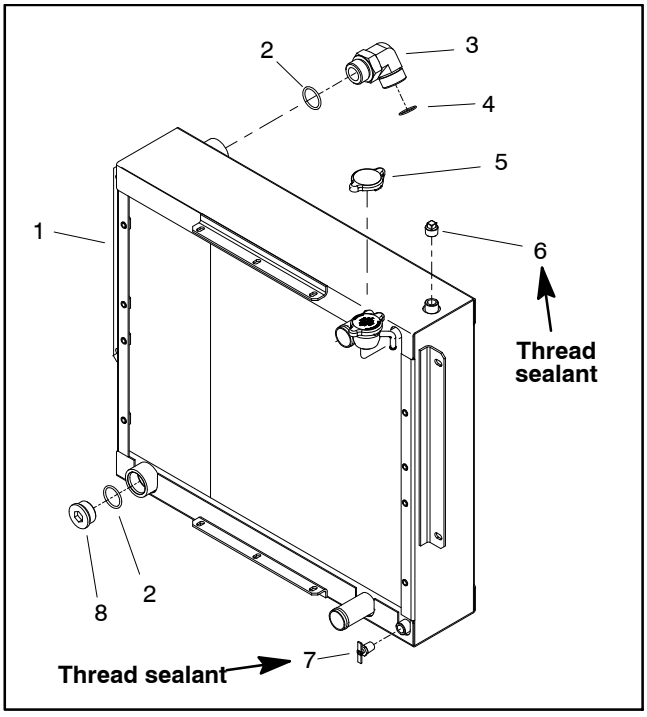


Figure 11

1. **Radiator/oil cooler**
2. **O−ring**
3. **90° Hydraulic fitting (2)**
4. **O−ring**
5. **Radiator cap**
6. **Coolant plug**
7. **Draincock**
8. **Hydraulic plug**

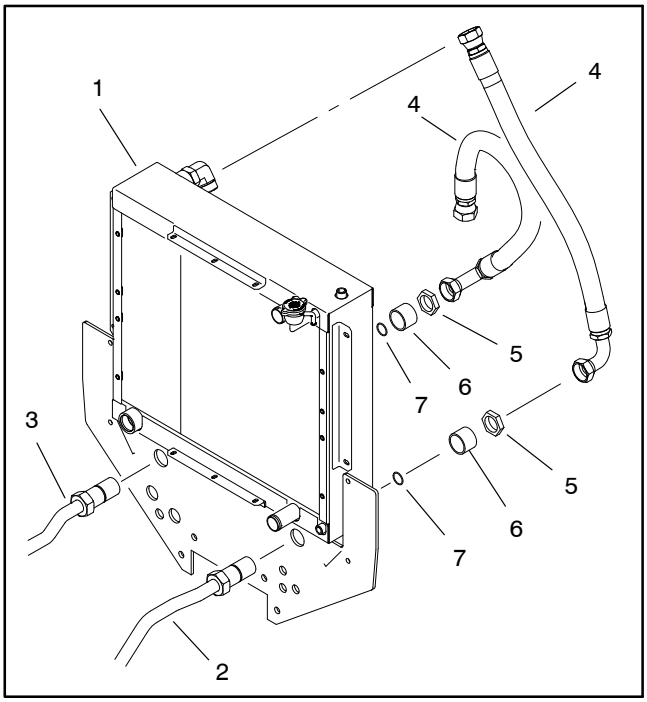


Figure 12

1. **Radiator/oil cooler**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic hose**
5. **Bulkhead nut**
6. **Spacer**
7. **O−ring**

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Engine

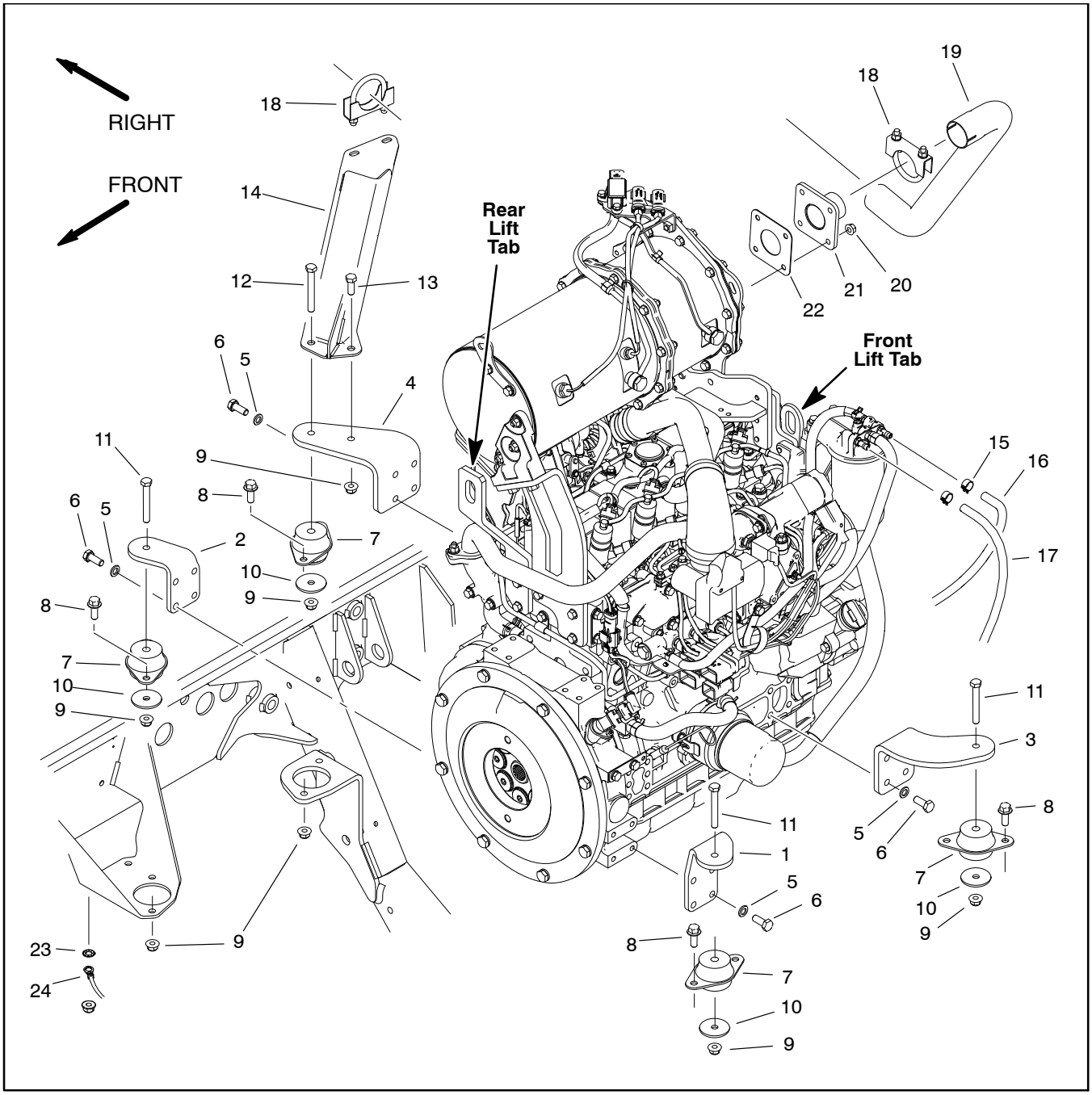


Figure 13

1. Mount bracket – left front
2. Mount bracket – right front
3. Mount bracket – left rear
4. Mount bracket – right rear
5. Lock washer (16)
6. Cap screw (16)
7. Engine mount (4)
8. Flange head screw (7)
9. Flange nut (12)
10. Rebound washer (4)
11. Cap screw (3)
12. Cap screw
13. Cap screw
14. Tailpipe support
15. Hose clamp (2)
16. Fuel hose (filter to engine)
17. Fuel hose (engine to tank)
18. Clamp (2)
19. Exhaust tailpipe
20. Flange nut (4)
21. Exhaust flange
22. Exhaust gasket
23. External tooth lock washer
24. Battery ground cable

Engine Removal (Fig. 13)

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 in Chapter 8 – Chassis in this manual).

3. Open battery box cover and disconnect negative battery cable first and then positive battery cable.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

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

4. Remove radiator cap. Drain radiator into a suitable container using the radiator draincock.

5. Disconnect coolant reservoir hose from the radiator (Fig. 14).

6. Remove fasteners that secure coolant reservoir bracket to frame and remove reservoir and bracket from machine (Fig. 14).

7. Remove air cleaner intake hose from air cleaner.

8. Remove flange head screws and flange nuts that secure plenum to crossover plate (Fig. 14). Remove plenum with air cleaner hose and drain hose attached.

9. Disconnect upper and lower coolant hoses from the radiator.

10. Remove air cleaner system from engine (see Air Cleaner Removal in this chapter).

11. Remove engine cooling fan assembly and fan shrouds from machine (see Engine Cooling Fan Motor in Chapter 5 – Hydraulic System in this manual).

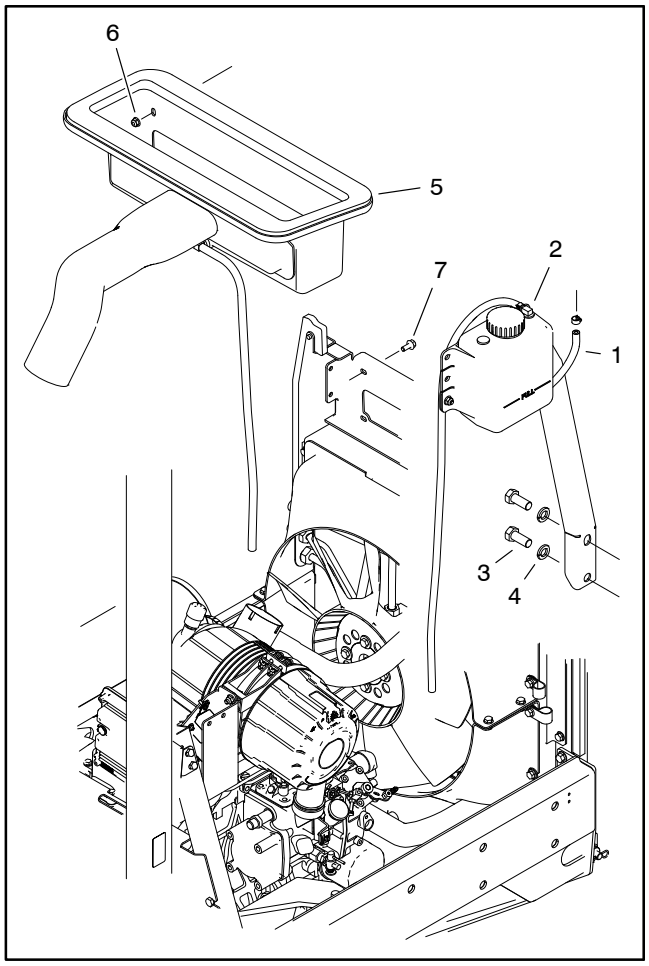


Figure 14

1. **Coolant reservoir hose**
2. **Reservoir and bracket**
3. **Cap screw (2)**
4. **Lock washer (2)**
5. **Plenum**
6. **Flange nut (4)**
7. **Flange head screw (4)**

12. Note location of cable ties used to secure wire harness. Disconnect the following engine electrical connections:

A. The two (2) engine wire harness connectors from the engine ECU.

B. The engine wire harness connector from the machine wire harness located just rearward of the front left engine mount.

C. The engine wire harness connectors at the start relay, EGR relay, and the glow relay. The relays are located on the air cleaner support bracket.

D. The positive battery cable and fusible link harness from the engine starter motor.

E. The negative battery cable, engine wire harness ground, and main wire harness ground wires. These wires are secured with a cap screw and external lock washer to the right side of the engine below the starter motor. Record location of lock washer for assembly purposes.

13. Disconnect fuel supply and return hoses from injection pump (item 16 and 17). Cap fuel hoses and injector pump fittings to prevent contamination.

IMPORTANT: The hydraulic pump assembly can remain in machine during engine removal. To prevent pump assembly from shifting or falling, make sure to support pump assembly before piston (traction) pump mounting fasteners are removed.

14. Support hydraulic pump assembly. Remove fasteners that secure piston (traction) pump assembly to engine (see Piston (Traction) Pump Assembly Removal in Chapter 5 – Hydraulic System in this manual).

15. Make sure all cable ties securing the wire harness, fuel lines and hydraulic hoses to the engine are removed.

16. Connect lift or hoist to the lift brackets on engine.

17. Remove flange nuts, rebound washers and cap screws that secure the engine mount brackets to the rubber engine mounts (item 7).

CAUTION

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

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

18. Carefully move engine away from the hydraulic pump assembly to disengage the pump input shaft from the coupler on the engine flywheel. Once the engine has cleared the hydraulic pump, carefully lift engine from the machine.

19. If necessary, remove exhaust tailpipe (item 19) and engine mount brackets from the engine.

Engine Installation (Fig. 13)

1. Make sure that all parts removed from the engine during maintenance or rebuilding are installed to the engine.

2. If removed, install engine mount brackets to the engine.

3. Connect lift or hoist to the lift tabs on engine.

CAUTION

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

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

4. Carefully lower engine into the machine. Move engine toward the hydraulic pump assembly to engage the pump input shaft with the coupler on the engine flywheel.

5. Align engine mount brackets to the rubber engine mounts (item 7).

Install tailpipe support and secure engine mount brackets to rubber engine mounts with cap screws, rebound washers and flange nuts.

6. Secure hydraulic pump assembly to engine (see Piston (Traction) Pump Assembly Installation in Chapter 5 – Hydraulic System in this manual).

7. Remove caps from fuel hose and injector pump fuel inlet that were installed during engine removal to prevent contamination. Connect fuel supply hose to injection pump. Secure hose with hose clamp.

8. Connect wire harness connectors to the following engine components:

A. The two (2) engine wire harness connectors at the engine ECU.

B. The engine wire harness connector at the machine wire harness located just rearward of the front left engine mount.

C. The engine wire harness connectors at the start relay, EGR relay, and the glow relay. The relays are located on the air cleaner support bracket.

D. The positive battery cable and fusible link harness at the engine starter motor.

E. The electric starter. Torque nut at starter B+ terminal from **70 to 86 in–lb (7.9 to 9.7 N–m)**.

F. The negative battery cable, engine wire harness ground, and main wire harness ground wires. These wires are secured with a cap screw and external lock washer to the right side of the engine below the starter motor.

9. Using notes taken during engine removal, secure wires with cable ties in proper locations.

10. Install engine cooling fan assembly and fan shrouds to machine (see Engine Cooling Fan Motor in Chapter 5 – Hydraulic System in this manual).

11. Install air cleaner assembly to the engine (see Air Cleaner Installation in this chapter).

12. If removed, install exhaust tailpipe.

13. Connect coolant hoses to the radiator.

14. Install plenum with air cleaner hose and drain hose attached. Use flange head screws and flange nuts to secure plenum to crossover plate (Fig.15).

15. Connect air cleaner intake hose to air cleaner.

16. Secure coolant reservoir bracket with reservoir to machine frame (Fig.15).

17. Connect coolant reservoir hose to the radiator (Fig.15).

18. Make sure radiator draincock is closed and fill radiator and reservoir with coolant.

19. Check position of wires, fuel lines, hydraulic hoses and cables for proper clearance with rotating, high temperature and moving components.

20. Connect positive battery cable first and then negative battery cable. Secure battery cover to machine.

21. Check and adjust engine oil level as needed.

22. Check and adjust hydraulic oil level as needed.

23. Prime the fuel system (see Prime the Fuel System in this chapter).

24. Start engine and operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in Chapter 5 – Hydraulic System in this manual).

25. Install hood on the machine (see Hood Installation in Chapter 8 – Chassis in this manual).

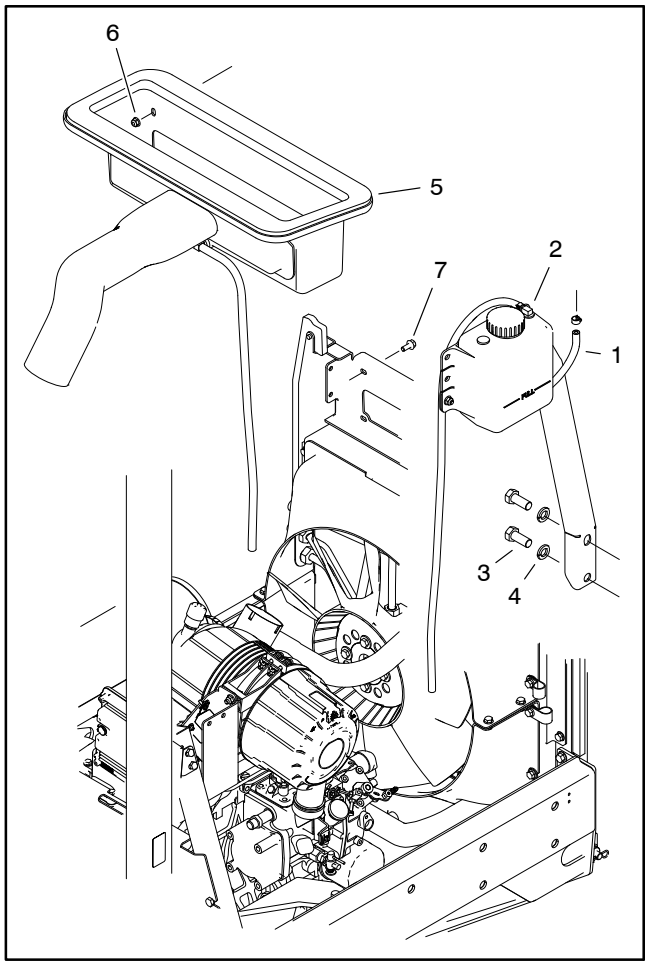


Figure 15

1. **Coolant reservoir hose**
2. **Reservoir and bracket**
3. **Cap screw (2)**
4. **Lock washer (2)**
5. **Plenum**
6. **Flange nut (4)**
7. **Flange head screw (4)**

Pump Adapter Plate

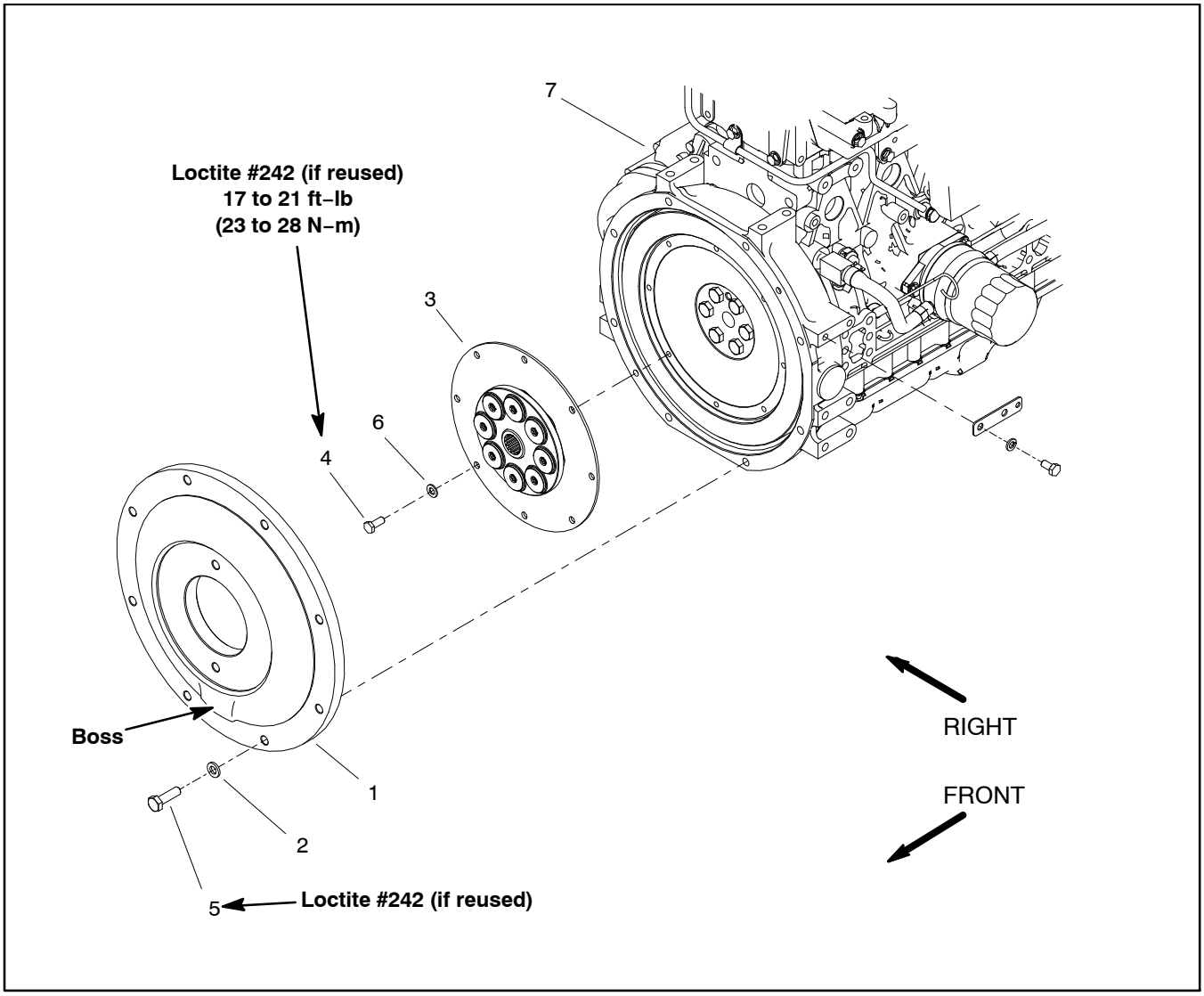


Figure 16

1. Flywheel plate
2. Hardened washer (8)
3. Spring coupler
4. Cap screw with patch lock (8)
5. Cap screw with patch lock (8)
6. Hardened washer (8)
7. Engine assembly

Coupler Removal (Fig. 16)

NOTE: The hydraulic pump assembly needs to be removed from engine before coupler can be removed.

1. If engine is in machine, remove hydraulic pump assembly (see Piston (Traction) Pump in Chapter 5 – Hydraulic System in this manual).

2. Remove flywheel plate and spring coupler from engine.

Coupler Installation (Fig. 16)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupling hub is toward pump (away from engine flywheel) (Fig. 17).

IMPORTANT: The patch lock feature of the cap screws used in this procedure suggest replacing the screws after disassembly. An alternative would be to apply Loctite #242 (or equivalent) to the threads of the original cap screws during assembly.

2. Secure coupler to flywheel with cap screws (item 4) and hardened washers. Tighten cap screws in a crossing pattern from **17 to 21 ft–lb (23 to 28 N–m)**.

3. Position flywheel plate to engine. Make sure that boss on plate is orientated down. Secure flywheel plate with cap screws (item 5) and hardened washers in a crossing pattern.

4. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump in Chapter 5 – Hydraulic System in this manual).

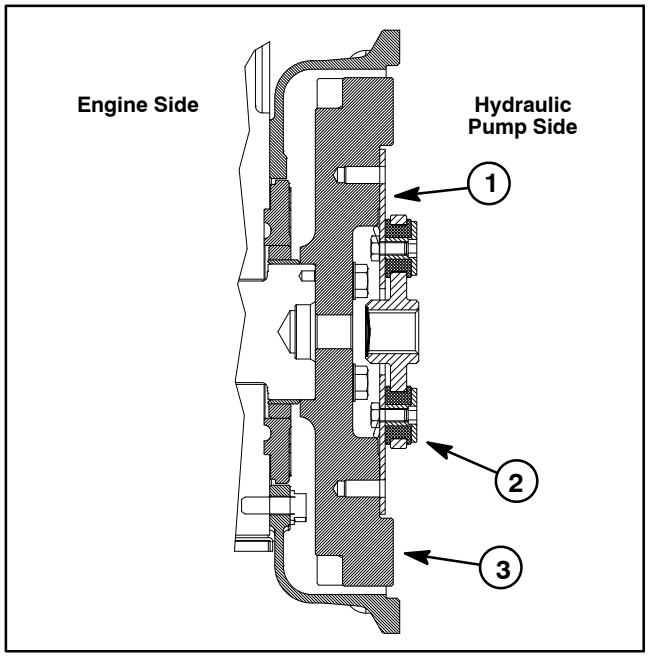


Figure 17

1. **Coupler**
2. **Coupler hub**
3. **Engine flywheel**

Chapter 4

Kubota Diesel Engine

MODEL 03781

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KUBOTA WORKSHOP MANUAL, DIESEL ENGINE,
  03−M−DI−E3B SERIES

Specifications

Item	Description
Make / Designation	Kubota Model V2403−M−DI−E3B 4−Cycle, 4 Cylinder, Liquid Cooled, Diesel Engine
Bore	3.425” (87.0 mm)
Stroke	4.031” (102.4 mm)
Total Displacement	148.5 in^3 (2434 cc)
Firing Order	1 (closest to gear case end) − 3 − 4 (closest to flywheel end) − 2
Combustion Chamber	Spherical Type (E−TVCS)
Compression Ratio	23.2:1
Direction of Rotation	Counterclockwise (viewed from flywheel)
Fuel	Diesel or Biodiesel (up to B20) Fuel with Low or Ultra Low Sulfur Content
Fuel Capacity	22 U.S. gallons (83 liters)
Fuel Injection Pump	Denso PFR 4M Type Mini Pump
Injection Nozzle	Denso OPD Mini Nozzle
Governor	Centrifugal Mechanical
Low Idle (no load)	1550 $\pm$ 50 RPM
High Idle (no load)	2850 +50/−120 RPM
Engine Oil	API CH−4, CI−4 or higher
Engine Oil Viscosity	See Operator’s Manual
Crankcase Oil Capacity	10.0 U.S. Quarts (9.5 Liters) with Filter
Oil Pump	Trochoid Type
Coolant Capacity	9 U.S. quarts (8.5 liters)
Starter	12 VDC, 2.0 kW
Alternator/Regulator Alternator Output	12 VDC 60 amp
Engine Dry Weight	406 U.S. pounds (184 kg)

General Information

This Chapter gives information about specifications and repair of the Kubota diesel engine used in the Reelmaster 7000−D Model 03781.

General maintenance procedures are described in your Traction Unit Operator's Manual. Information on engine troubleshooting, testing, disassembly and assembly is identified in the Kubota Workshop Manual, Diesel Engine, 03−M−DI−E3B.

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, 03−M−DI−E3B. 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 prepared to provide your distributor with the Toro model and serial number.

Operator's Manual

The Traction Unit and Engine Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

Air Filter System

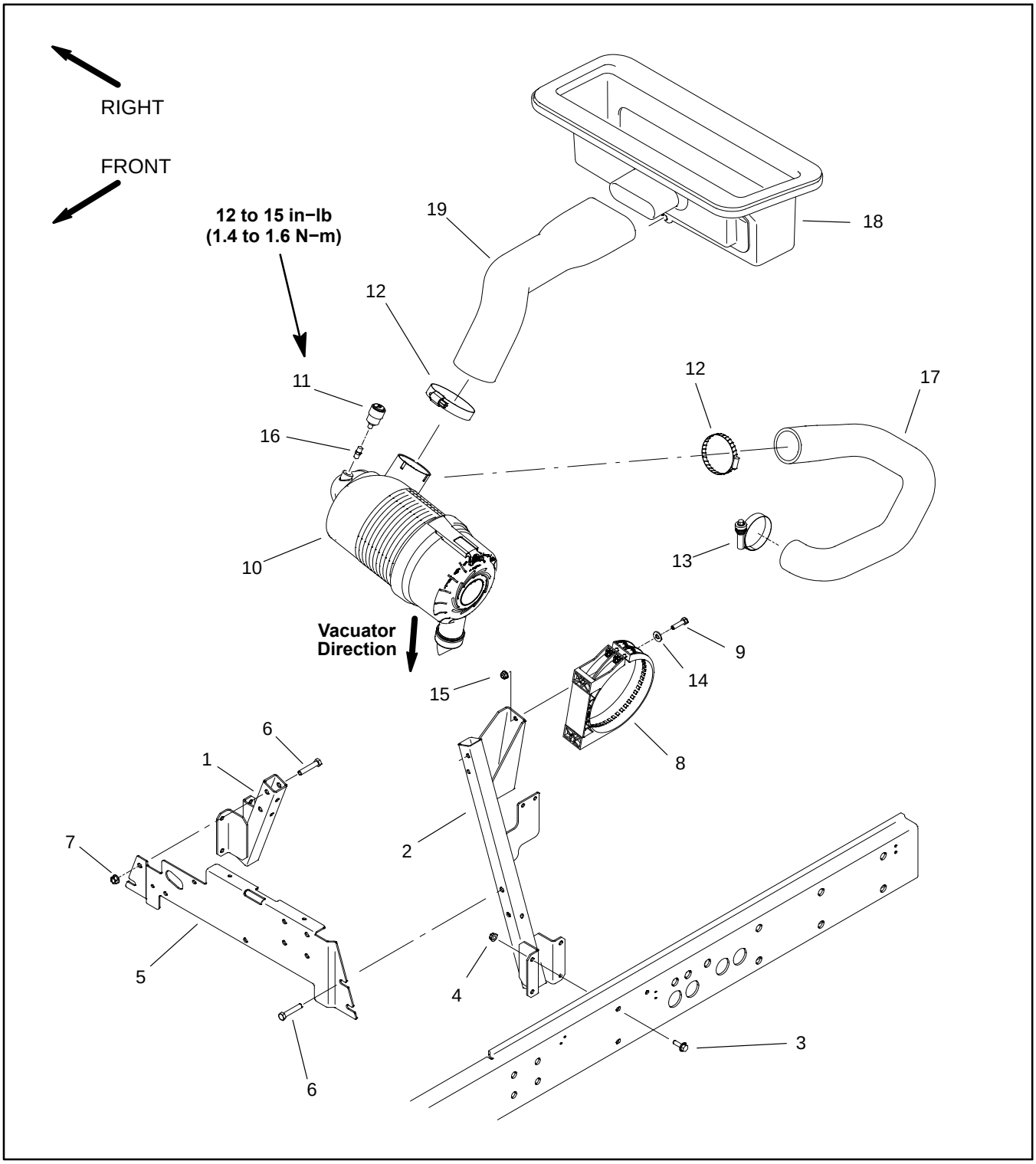


Figure 1

1. Battery support
2. Bracket
3. Flange head screw (8)
4. Flange nut (8)
5. Support bracket
6. Cap screw (4)
7. Flange nut (4)
8. Air cleaner strap
9. Cap screw (2)
10. Air cleaner assembly
11. Service indicator
12. Hose clamp
13. Hose clamp
14. Flat washer (2)
15. Flange nut (2)
16. Adapter
17. Air cleaner hose
18. Plenum
19. Air intake hose

Removal (Fig. 1)

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

2. Raise and support hood.

3. Remove air cleaner components as needed.

Installation (Fig. 1)

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

1. Assemble air filter system.

   A. If service indicator (item 11) or adapter was removed from air cleaner housing, apply thread sealant to adapter threads before installing adapter and indicator. Install adapter so that grooves in adapter hex and adapter filter element are installed toward service indicator (Fig. 3). Torque indicator from **12 to 15 in−lb (1.4 to 1.6 N−m)**.

   B. Orientate vacuator valve on air cleaner cover toward ground.

   C. Install air cleaner so air cleaner strap (item 10) is as close as possible to air cleaner cover.

   D. Make sure that air cleaner hose (item 17) does not contact engine valve cover or other engine components. To modify clearance, move and/or rotate air cleaner body in air cleaner strap. Verify that tabs in strap mesh fully with slots in air cleaner body.

2. Lower and secure hood after air cleaner installation is complete.

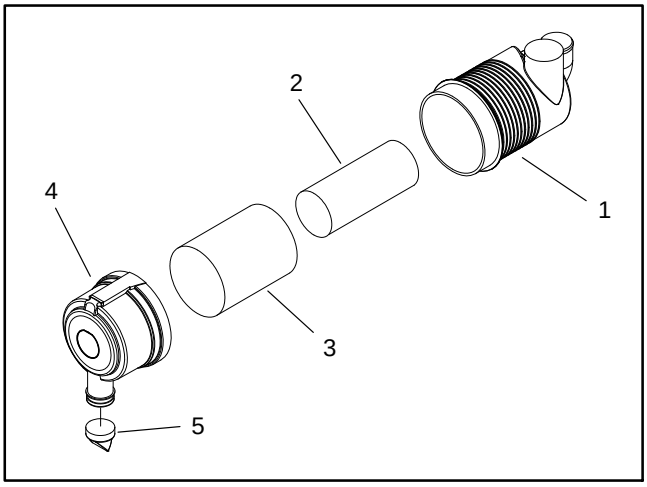


Figure 2

1. **Air cleaner housing**
2. **Safety filter element**
3. **Air filter element**
4. **Air cleaner cover**
5. **Vacuator valve**

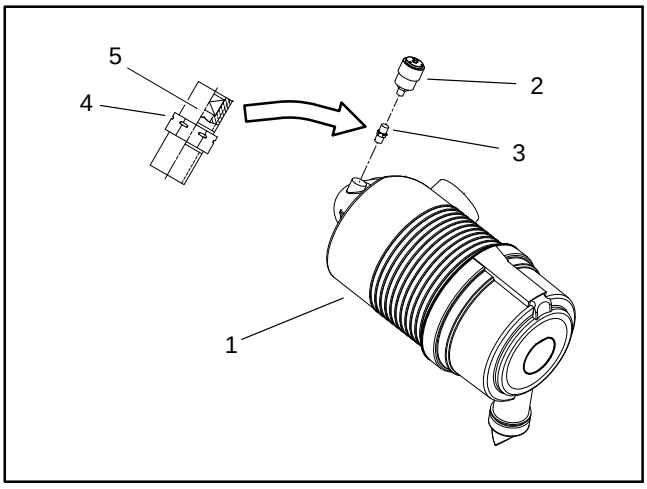


Figure 3

1. **Air cleaner assembly**
2. **Service indicator**
3. **Adapter**
4. **Groove**
5. **Filter element**

Exhaust System

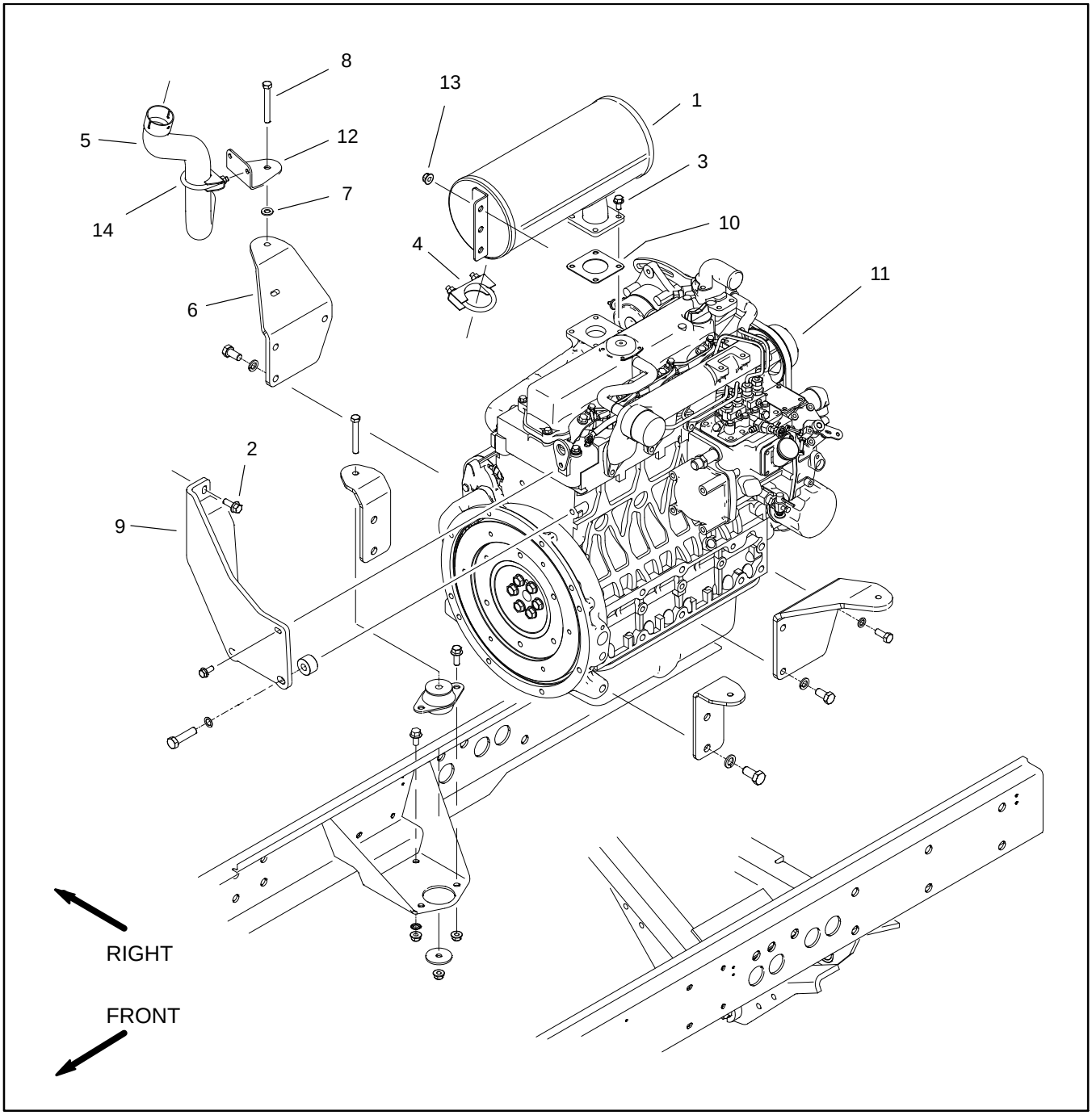


Figure 4

1. **Muffler**
2. **Flange head screw (2)**
3. **Flange head screw (4)**
4. **Muffler clamp**
5. **Tailpipe**
6. **RH engine mount**
7. **Flat washer**
8. **Cap screw**
9. **Muffler bracket**
10. **Muffler gasket**
11. **Engine**
12. **Muffler bracket**
13. **Flange nut (2)**
14. **Muffler clamp**

Removal (Fig. 4)

CAUTION

The muffler and exhaust pipe may be hot. T o 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. Raise and support hood.

3. Remove muffler and/or muffler bracket from the engine as necessary.

Installation (Fig. 4)

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

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

1. Install **new** exhaust gasket if original gasket is damaged or torn.

IMPORTANT: Failure to follow the suggested exhaust system fastener sequence may result in premature muffler failure.

2. Install exhaust system components to the engine. Hand tighten all exhaust system fasteners before fully tightening any fastener.

3. Tailpipe should have equal clearance between frame and engine after installation.

4. Lower and secure hood after exhaust system installation is complete.

Fuel System

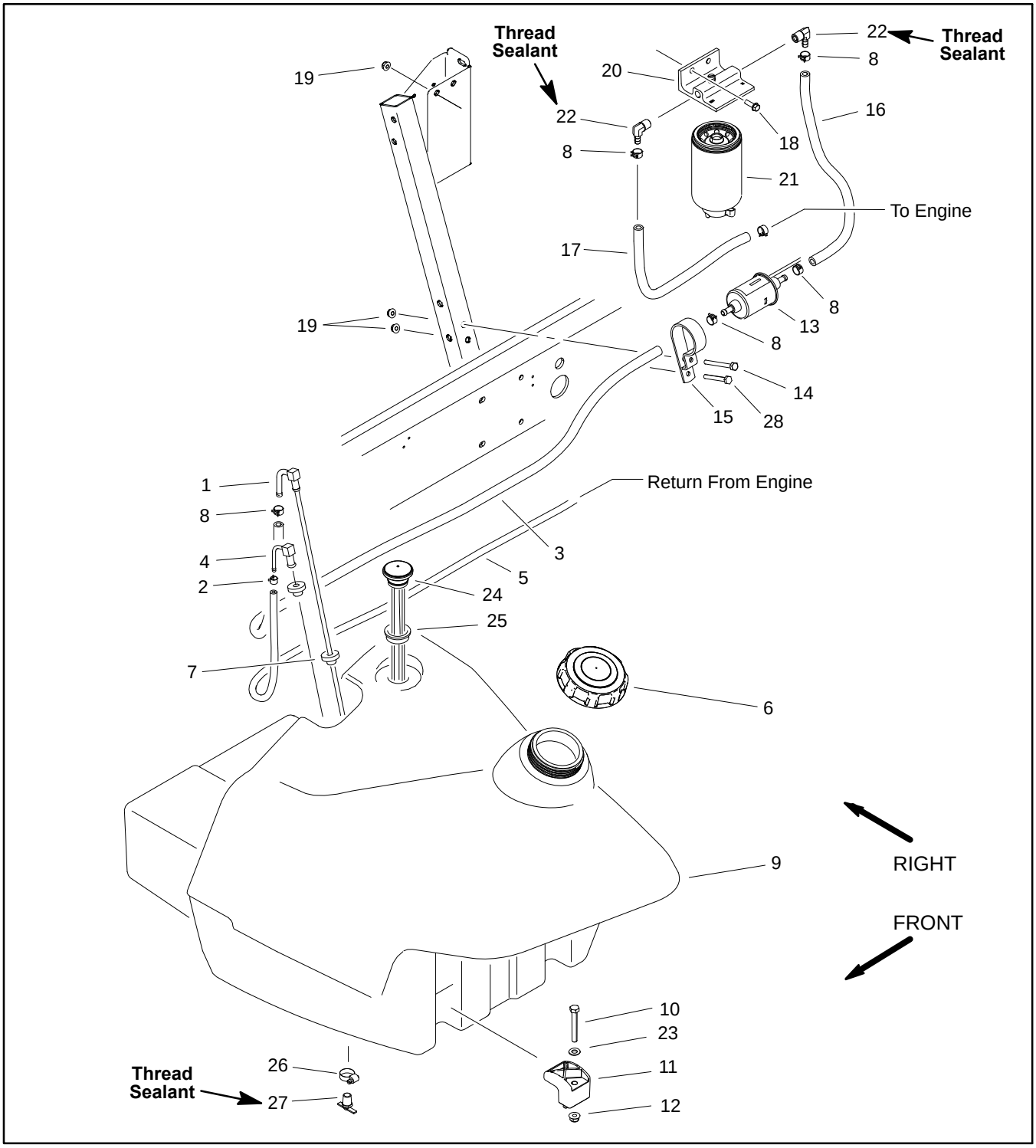


Figure 5

1. Fuel suction tube
2. Fuel line clamp (2)
3. Fuel hose (tank to pump)
4. Return fitting
5. Fuel hose (engine to tank)
6. Fuel tank cap
7. Bushing (2)
8. Hose clamp (6)
9. Fuel tank
10. Cap screw (2)
11. Clamp (2)
12. Flange nut (2)
13. Fuel pump
14. Cap screw
15. Fuel pump bracket
16. Fuel hose (pump to filter)
17. Fuel hose (filter to engine)
18. Cap screw (2)
19. Flange nut (4)
20. Fuel filter/water separator
21. Filter element
22. Elbow fitting (2)
23. Flat washer (2)
24. Fuel gauge
25. Grommet
26. Hose clamp
27. Draincock
28. Cap screw

DANGER

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

Check Fuel Lines and Connections

Check fuel lines and connections as recommended in the Traction Unit Operator's Manual. Check lines for deterioration, damage, leaking or loose connections. Replace hoses, clamps and connections as necessary.

Drain and Clean Fuel Tank

Drain and clean the fuel tank periodically as recommended in the Traction Unit Operator's Manual. 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. To clean fuel tank, flush tank out with clean diesel fuel. Make sure tank is free of contaminates and debris. Follow all local codes and regulations when recycling or disposing of waste fuel.

Fuel Tank Removal (Fig. 5)

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

2. For assembly purposes, label fuel hoses at suction and return fittings in top of tank. Disconnect fuel hoses from fittings.

3. Use draincock on bottom of tank to empty fuel tank into a suitable container.

4. Remove fuel tank from machine.

Fuel Tank Installation (Fig. 5)

1. Install fuel tank to frame.

2. If draincock (item 27) or fuel pump fittings (item 22) were removed, apply thread sealant to threads of draincock and fittings before installing.

3. Using labels placed during fuel tank removal, correctly connect fuel hoses to the suction and return fittings in top of tank. Secure hoses with hose clamps.

4. Make sure that draincock on bottom of tank is closed.

5. Fill fuel tank with clean fuel.

Prime Fuel System

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

2. Release hood latch and open hood.

DANGER

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

- **Fill the fuel tank outdoors, in an open area, when the engine is cold. Wipe up any fuel that spills.**
- **Never fill the fuel tank inside an enclosed trailer.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in an approved container and keep it out of the reach of children. Never buy more than a 180-day supply of fuel.**
- **Do not operate machine without entire exhaust system in place and in proper working condition.**

3. Loosen air bleed screw on the top of the fuel filter/water separator (Fig. 6).

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

5. Loosen air bleed screw on the fuel injection pump (Fig. 7).

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

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

7. Close hood and secure latch.

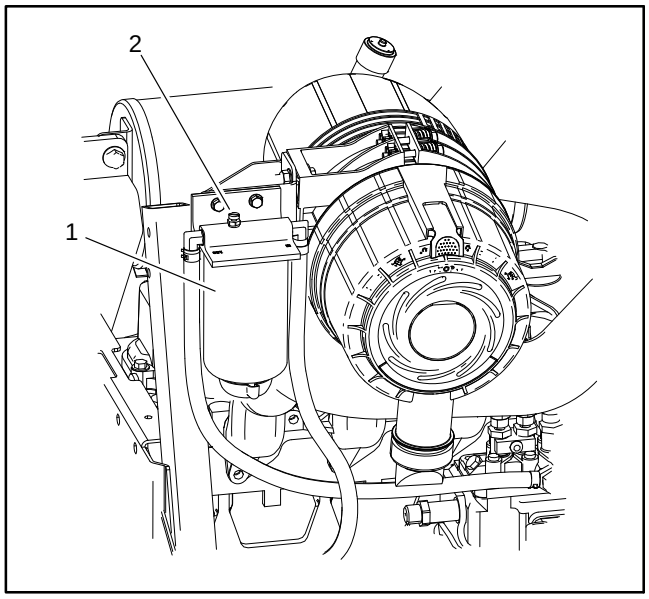


Figure 6

1. Fuel filter/water separator **2. Air bleed screw**

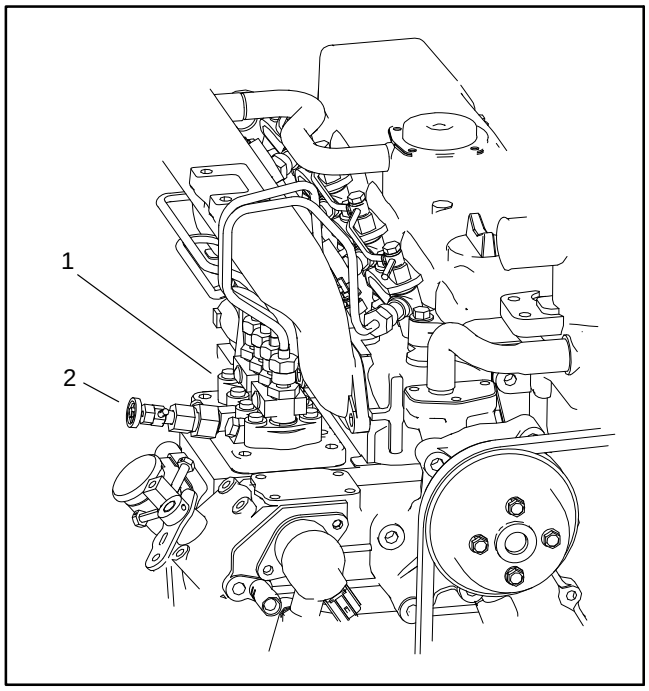


Figure 7

1. Fuel injection pump **2. Bleed screw**

Bleed Air From Injectors

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

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

DANGER

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

- **Fill the fuel tank outdoors, in an open area, when the engine is cold. Wipe up any fuel that spills.**
- **Never fill the fuel tank inside an enclosed trailer.**
- **Never smoke when handling fuel, and stay away from an open flame or where fuel fumes may be ignited by a spark.**
- **Store fuel in an approved container and keep it out of the reach of children. Never buy more than a 180-day supply of fuel.**
- **Do not operate machine without entire exhaust system in place and in proper working condition.**

2. Release hood latch and open hood.

3. Loosen pipe connection to the No. 1 injector nozzle and holder assembly (Fig. 8).

4. Move throttle to FAST position.

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

6. Repeat steps on the remaining injector nozzles.

7. Close hood and secure latch.

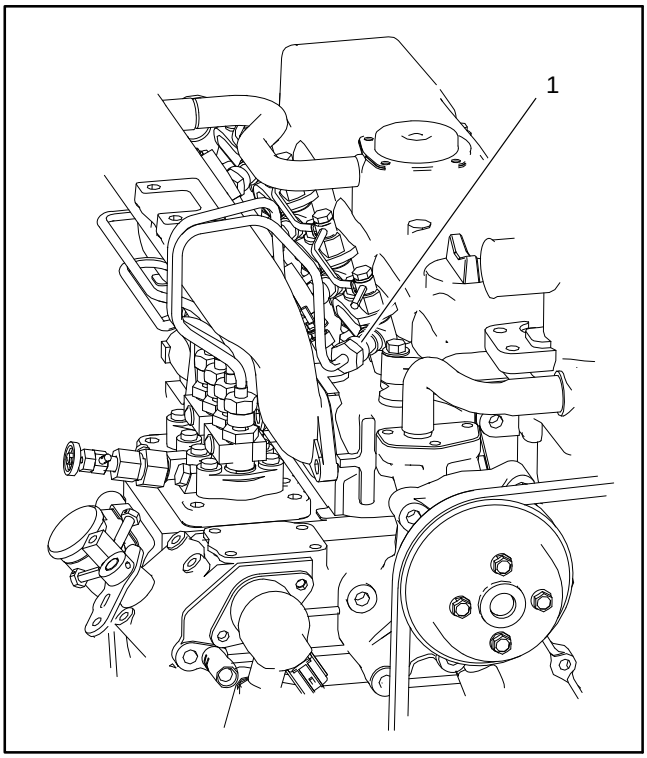


Figure 8

1. **No. 1 Injector/pipe connection**

Radiator/Hydraulic Oil Cooler

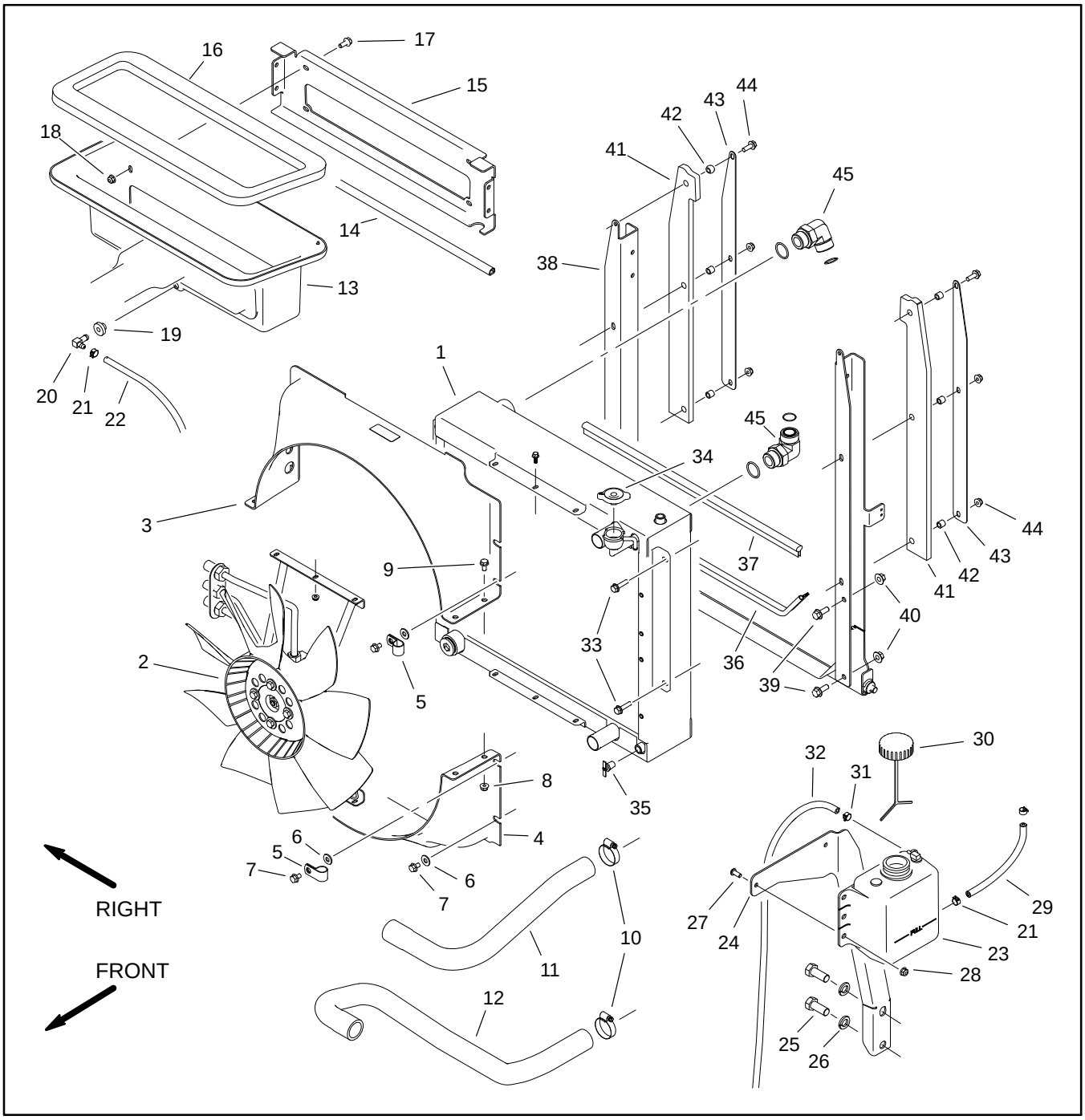


Figure 9

1. Radiator
2. Fan assembly
3. Upper radiator shroud
4. Lower radiator shroud
5. R−clamp (2)
6. Flat washer (8)
7. Flange head screw (8)
8. Flange nut (4)
9. Flange head screw (4)
10. Hose clamp (4)
11. Upper radiator hose
12. Lower radiator hose
13. Plenum
14. Bulb seal
15. Crossover plate
16. Plenum seal
17. Flange head screw (8)
18. Flange nut (8)
19. Bushing
20. Elbow fitting
21. Hose clamp (4)
22. Hose (plenum drain)
23. Coolant reservoir
24. Reservoir bracket
25. Cap screw (2)
26. Lock washer (2)
27. Flange head screw (2)
28. Flange nut (2)
29. Hose (reservoir to radiator)
30. Reservoir cap
31. Hose clamp
32. Hose (reservoir overflow)
33. Flange head screw (4)
34. Radiator cap
35. Radiator draincock
36. Bulb seal
37. Bulb seal
38. Radiator mount
39. Flange head screw (4)
40. Flange nut (4)
41. Foam seal (2)
42. Spacer (6)
43. Seal bracket (2)
44. Flange nut (4)
45. 90º hydraulic fitting (2)

Removal (Fig. 9)

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 in Chapter 8 − Chassis in this manual).

3. Remove air cleaner intake hose from air cleaner.

4. Remove flange head screws and flange nuts that secure plenum (item 13) to crossover plate. Remove plenum with air cleaner hose and drain hose attached.

5. Remove flange head screws and flange nuts that secure crossover plate (item 15) to radiator mount. Remove crossover plate.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

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

6. Remove radiator cap. Drain radiator into a suitable container using the radiator draincock.

7. Disconnect upper and lower hoses from the radiator.

8. Disconnect coolant reservoir hose (item 29) from the radiator.

9. Remove fasteners that secure coolant reservoir bracket (item 24) to frame and remove reservoir and bracket from machine.

10. Remove engine cooling fan assembly including upper radiator shroud from machine (see Engine Cooling Fan Motor in Chapter 5 − Hydraulic System in this manual).

11. To prevent contamination of hydraulic system during radiator/oil cooler removal, thoroughly clean junction of hydraulic hoses and fittings on oil cooler.

12. Disconnect hydraulic hoses from radiator/oil cooler (Fig. 10). Put caps or plugs on open hydraulic hoses and fittings to prevent system contamination. Label the hydraulic hoses to insure correct installation.

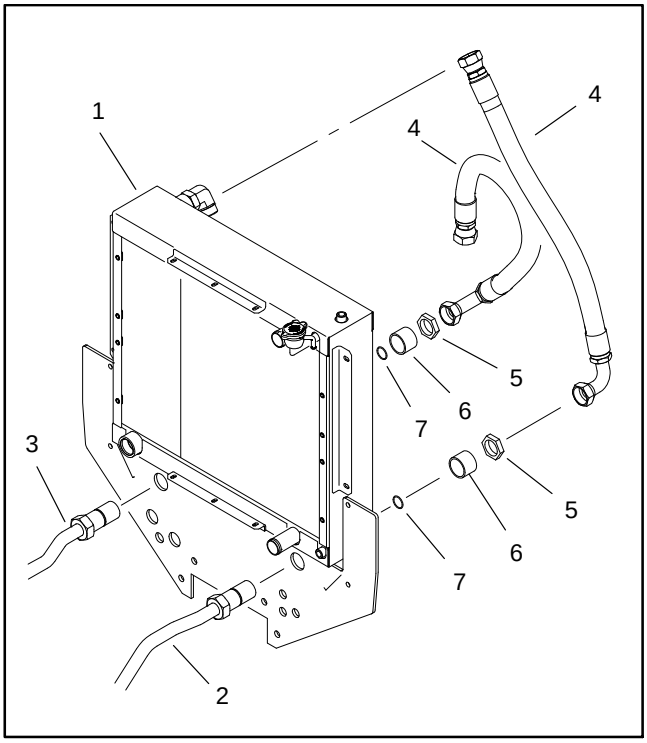


Figure 10

1. **Radiator/oil cooler**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic hose**
5. **Bulkhead nut**
6. **Spacer**
7. **O−ring**

13. Remove flange head screws and flange nuts securing the radiator/oil cooler to the radiator mount (item 38). Carefully remove radiator/oil cooler from the machine. Make sure that spacers (item 42) remain in hood seals.

14. Plug all radiator/oil cooler and hose openings to prevent contamination.

15. If necessary, remove draincock, coolant plug, hydraulic oil plug from radiator/oil cooler (Fig. 11).

16. If hydraulic fittings are to be removed from oil cooler, mark fitting orientation to insure correct assembly. Remove fittings from cooler and discard O−rings.

Installation (Fig. 9)

1. If hydraulic fittings were removed from oil cooler, lubricate and place new O−rings onto fittings. Install fittings into oil cooler openings using marks made during the removal process to properly orientate fittings (Fig. 11). Tighten fittings (see Hydraulic Fitting Installation in Chapter 5 − Hydraulic System in this manual).

2. If hydraulic plug was removed from oil cooler, place new O−ring on plug and install into oil cooler port (Fig. 11).

3. If draincock or plug were removed from radiator, apply thread sealant and install draincock and plug into radiator openings (Fig. 11).

4. Carefully position radiator/oil cooler to the radiator mount. Make sure that spacers (item 42) are positioned in hood seals. Secure radiator/oil cooler in place with four (4) flange head screws and flange nuts.

5. Install engine cooling fan motor assembly and upper radiator shroud to machine (see Engine Cooling Fan Motor in Chapter 5 − Hydraulic System in this manual). Make sure that clearance between shrouds and fan is at least **0.180" (4.6 mm)** at all points. Tighten all upper and lower radiator shroud fasteners.

6. Remove any plugs in radiator coolant openings or coolant hoses.

7. Connect upper and lower radiator hoses to the radiator and secure with hose clamps.

8. Secure coolant reservoir bracket (item 24) to frame with two (2) cap screws and lock washers.

9. Connect reservoir hose (item 29) to the radiator vent tube.

10. Remove caps or plugs from hydraulic hoses and fittings that were installed during disassembly. Connect hydraulic hoses to oil cooler fittings (Fig. 12) Tighten hoses (see Hydraulic Hose and Tube Installation in Chapter 5 − Hydraulic System in this manual).

11. Install crossover plate (item 15) to radiator mount and secure with four (4) flange head screws and nuts.

12. Install plenum assembly (item 13) to crossover plate and secure with four (4) flange head screws and nuts. Route plenum drain hose through clamp (item 5).

13. Install air cleaner intake hose to the air cleaner.

14. Make sure that radiator draincock is closed. Fill radiator with coolant.

15. Install hood on the machine (see Hood Installation in Chapter 8 − Chassis in this manual).

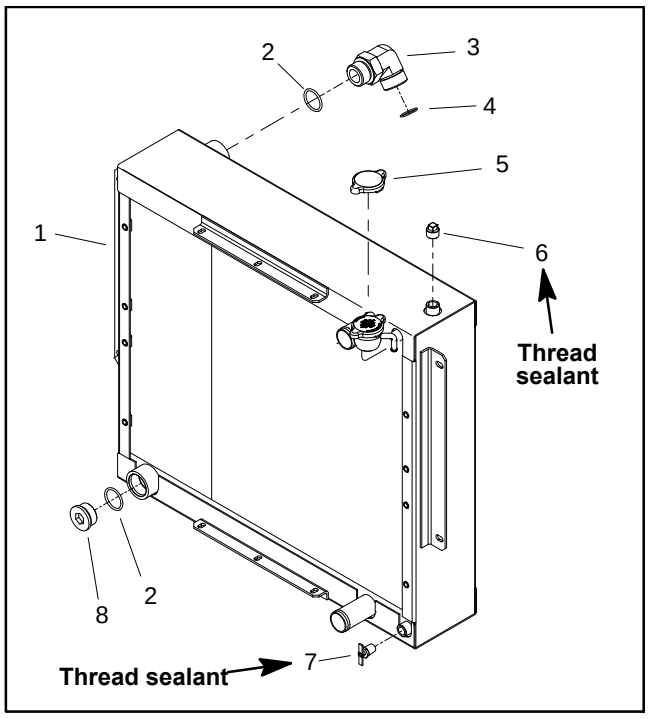


Figure 11

1. **Radiator/oil cooler**
2. **O−ring**
3. **90° Hydraulic fitting (2)**
4. **O−ring**
5. **Radiator cap**
6. **Coolant plug**
7. **Draincock**
8. **Hydraulic plug**

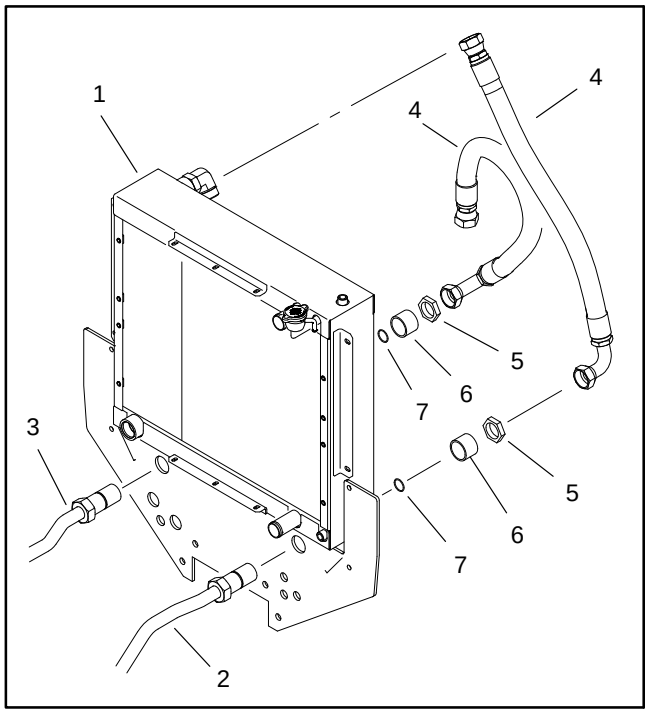


Figure 12

1. **Radiator/oil cooler**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic hose**
5. **Bulkhead nut**
6. **Spacer**
7. **O−ring**

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Engine

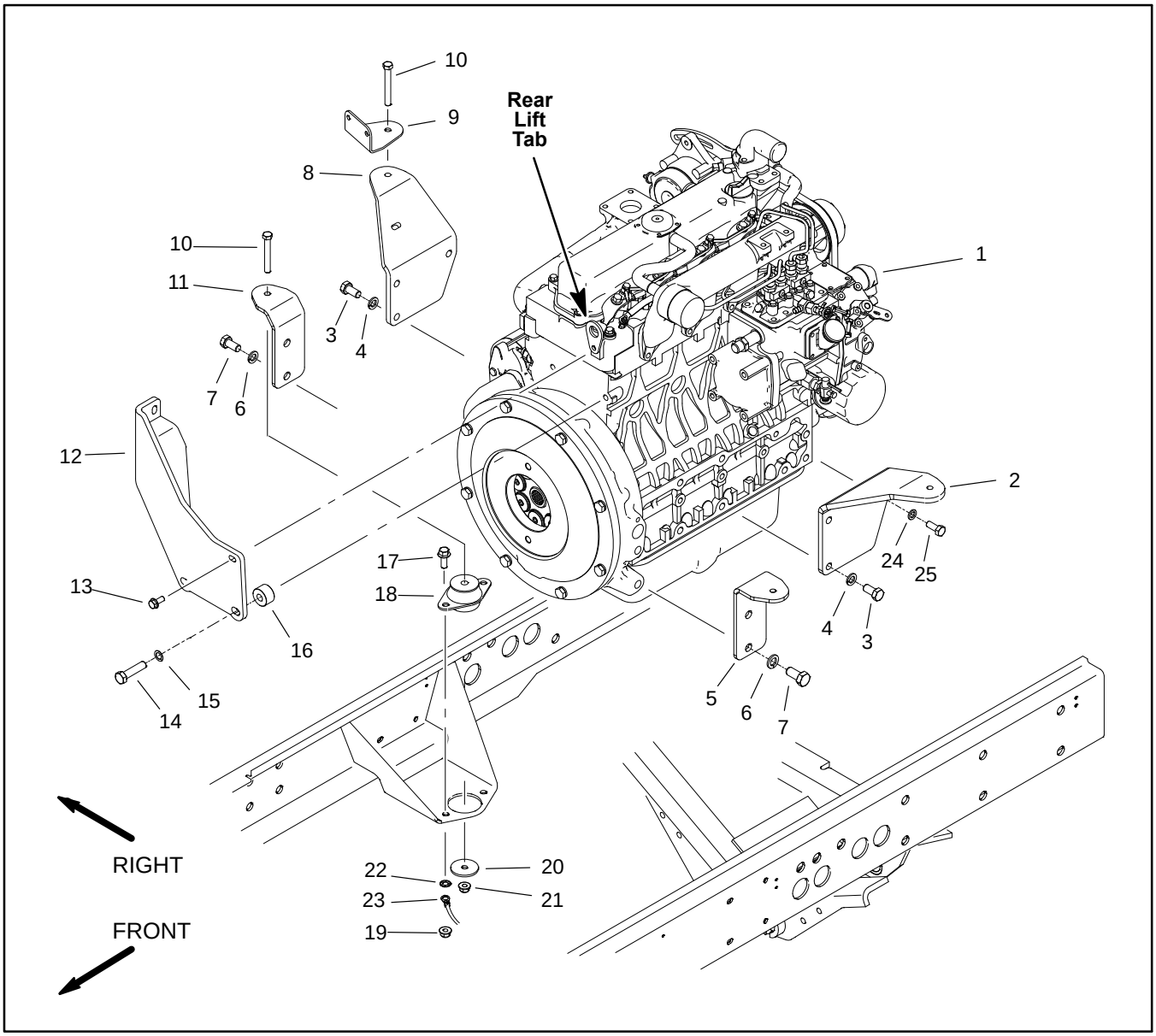


Figure 13

1. Engine
2. Mount bracket − left rear
3. Cap screw (5)
4. Lock washer (5)
5. Mount bracket − left front
6. Lock washer (4)
7. Cap screw (4)
8. Mount bracket − right rear
9. Muffler bracket
10. Cap screw (4)
11. Mount bracket − right front
12. Muffler bracket
13. Flange head screw
14. Cap screw (2)
15. Hardened washer (2)
16. Spacer (2)
17. Flange head screw (8)
18. Rubber engine mount (4)
19. Flange nut (8)
20. Rebound washer (4)
21. Flange nut (4)
22. Lock washer
23. Battery ground cable
24. Lock washer
25. Cap screw

Engine Removal (Fig. 13)

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 in Chapter 8 − Chassis in this manual).

3. Open battery box cover and disconnect negative battery cable first and then positive battery cable.

CAUTION

Do not open radiator cap or drain coolant if the radiator or engine is hot. Pressurized, hot coolant can escape and cause burns.

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

4. Remove radiator cap. Drain radiator into a suitable container using the radiator draincock.

5. Disconnect coolant reservoir hose from the radiator (Fig. 14).

6. Remove fasteners that secure coolant reservoir bracket to frame and remove reservoir and bracket from machine (Fig. 14).

7. Remove air cleaner intake hose from air cleaner.

8. Remove flange head screws and flange nuts that secure plenum to crossover plate (Fig. 14). Remove plenum with air cleaner hose and drain hose attached.

9. Disconnect upper and lower coolant hoses from the radiator.

CAUTION

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

10. Remove exhaust system from engine (see Exhaust System Removal in this chapter).

11. Remove air cleaner system from engine (see Air Cleaner Removal in this chapter).

12. Remove engine cooling fan assembly and fan shrouds from machine (see Engine Cooling Fan Motor in Chapter 5 − Hydraulic System in this manual).

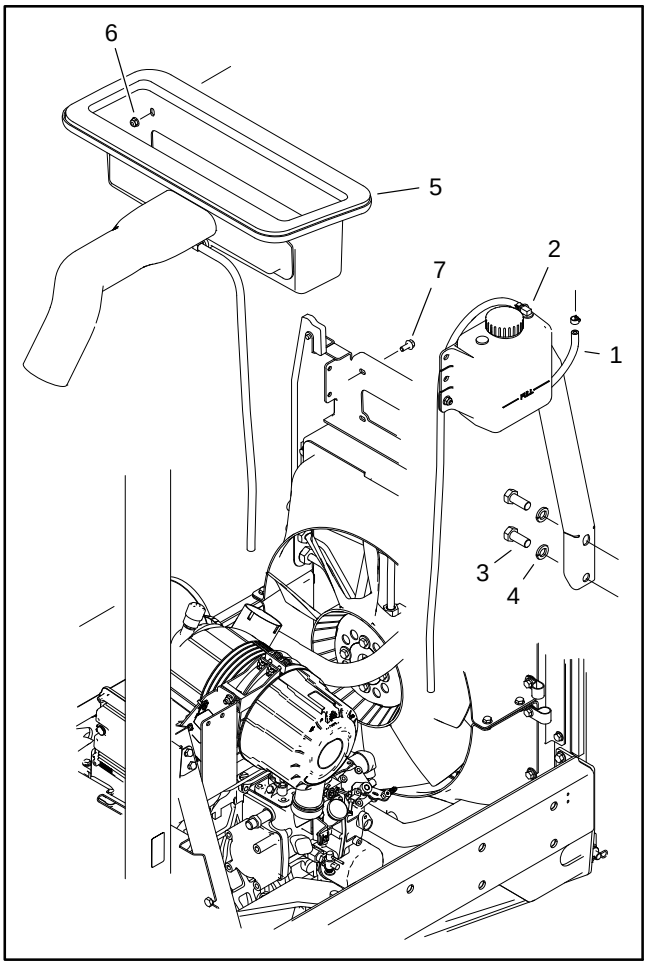


Figure 14

1. **Coolant reservoir hose**
2. **Reservoir and bracket**
3. **Cap screw (2)**
4. **Lock washer (2)**
5. **Plenum**
6. **Flange nut (4)**
7. **Flange head screw (4)**

13. Record the location of cable ties used to secure wire harness. Disconnect the following engine electrical connections:

A. The two (2) engine wire harness connectors from the machine wire harness located just rearward of the front left engine mount.

B. The engine wire harness connectors at the start relay and the glow relay. The relays are located on the air cleaner support bracket.

C. The positive battery cable and fusible link harness from the engine starter motor.

D. The negative battery cable, engine wire harness ground, and main wire harness ground wires. These wires are secured with a cap screw and external lock washer to the right side of the engine below the starter motor. Record location of lock washer for assembly purposes.

14. Disconnect fuel supply and return hose from injection pump (Fig. 15). Cap fuel hoses and injector pump fittings to prevent contamination.

15. Remove throttle cable from engine (Fig. 15):

    A. Remove lock nut that secures throttle cable swivel to speed control lever.

    B. Loosen cable clamp and remove throttle cable from under clamp.

    C. Position throttle cable away from the engine.

IMPORTANT: The hydraulic pump assembly can remain in machine during engine removal. To prevent pump assembly from shifting or falling, make sure to support pump assembly before pump mounting fasteners are removed.

16. Support hydraulic pump assembly. Remove fasteners that secure piston (traction) pump assembly to engine (see Piston (Traction) Pump Assembly Removal in Chapter 5 − Hydraulic System in this manual).

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

18. Connect lift or hoist to the lift tabs on engine.

19. Remove flange nuts, rebound washers and cap screws that secure the engine mount brackets to the rubber engine mounts (item 18).

CAUTION

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

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

20. Carefully move engine away from the hydraulic pump assembly to disengage the pump input shaft from the coupler on the engine flywheel. Once the engine has cleared the hydraulic pump, carefully lift engine from the machine.

21. If necessary, remove engine mounts from the engine.

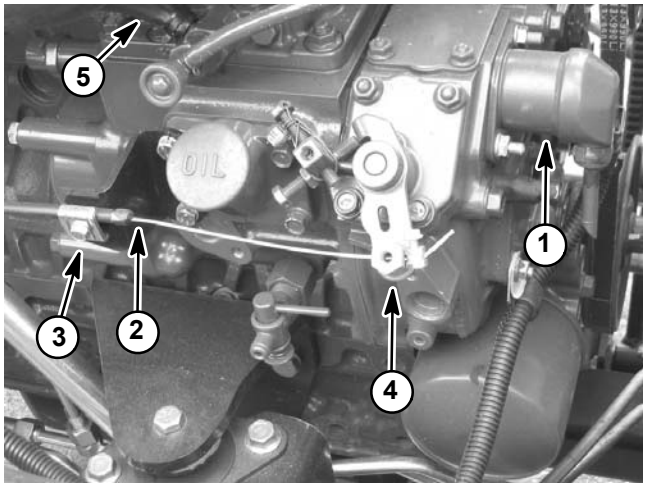


Figure 15

1. **Engine run solenoid**
2. **Throttle cable**
3. **Cable clamp**
4. **Cable swivel**
5. **Fuel supply hose**

Engine Installation (Fig. 13)

1. Make sure that all parts removed from the engine during maintenance or rebuilding are installed to the engine.

2. If removed, install engine mount brackets to the engine.

3. Connect lift or hoist to the lift tabs on engine.

CAUTION

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

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

4. Carefully lower engine into the machine and move engine toward the hydraulic pump assembly to engage the pump input shaft with the coupler on the engine flywheel.

5. Align engine mount brackets to the rubber engine mounts (item 18). Secure engine mount brackets to rubber engine mounts with cap screws, rebound washers and flange nuts.

6. Secure hydraulic pump assembly to engine (see Piston (Traction) Pump Assembly Installation in Chapter 5 − Hydraulic System in this manual).

7. Connect throttle cable to engine (Fig. 16):

   A. Secure throttle cable swivel to speed control lever with lock nut.

   B. Place throttle cable under cable clamp.

   C. Adjust throttle cable position in cable clamp so that engine governor lever contacts the high speed stop bolt at the same time that the throttle lever contacts the end of the slot in the control console.

   D. Tighten cable clamp to secure throttle cable.

8. Remove caps from fuel hose and injector pump fuel inlet that were installed during engine removal to prevent contamination. Connect fuel supply hose to injection pump (Fig. 16). Secure hose with hose clamp.

9. Connect wire harness connectors to the following engine components:

   A. The two (2) engine wire harness connectors at the machine wire harness located just rearward of the front left engine mount.

   B. The engine wire harness connectors at the start relay and the glow relay. The relays are located on the air cleaner support bracket.

   C. The positive battery cable and fusible link harness at the engine starter motor.

   D. The electric starter. Torque nut at starter B+ terminal from **70 to 86 in−lb (7.9 to 9.7 N−m)**.

   E. The negative battery cable, engine wire harness ground, and main wire harness ground wires. These wires are secured with a cap screw and external lock washer to the right side of the engine below the starter motor.

10. Using notes taken during engine removal, secure wires with cable ties in proper locations.

11. Install engine cooling fan assembly and fan shrouds to machine (see Engine Cooling Fan Motor in Chapter 5 − Hydraulic System in this manual).

12. Install air cleaner assembly to the engine (see Air Cleaner Installation in this chapter).

13. Install exhaust system to machine (see Exhaust System Installation in this chapter).

14. Connect coolant hoses to the radiator.

15. Install plenum with air cleaner hose and drain hose attached. Use flange head screws and flange nuts to secure plenum to crossover plate (Fig. 17).

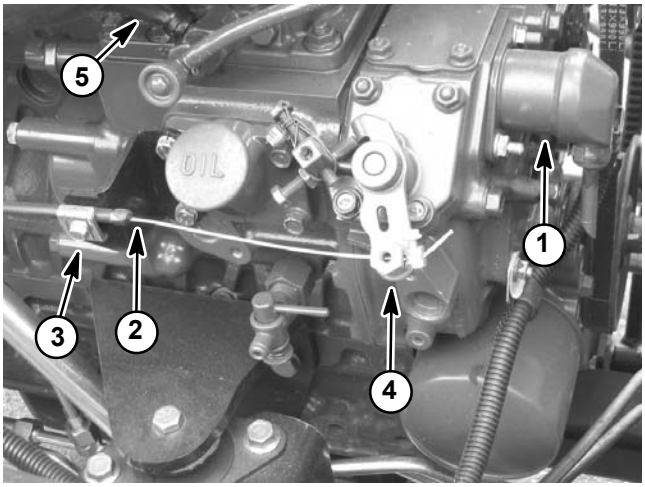


Figure 16

1. **Engine run solenoid**
2. **Throttle cable**
3. **Cable clamp**
4. **Cable swivel**
5. **Fuel supply hose**

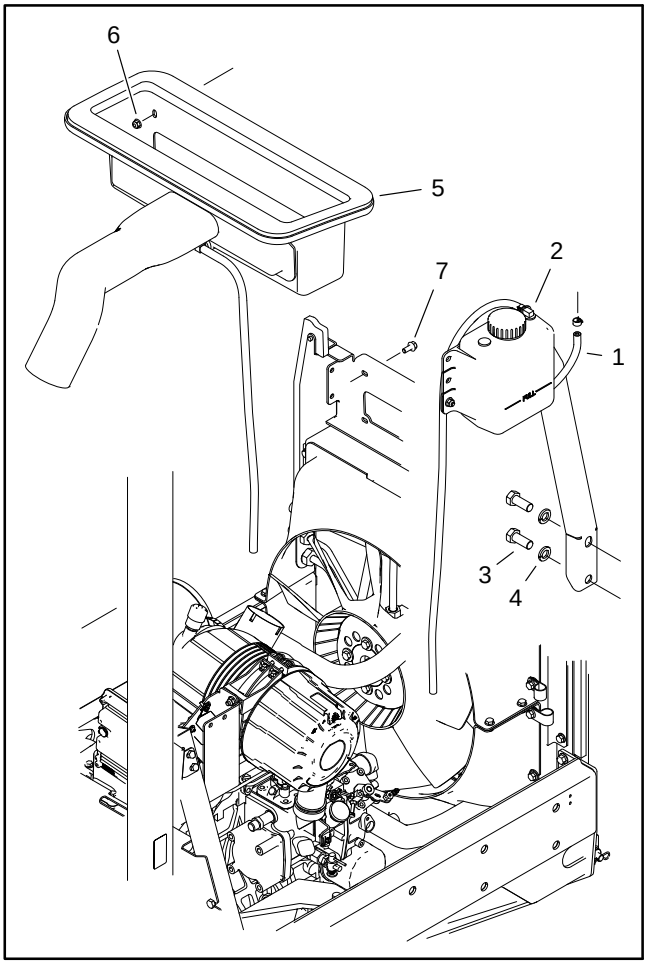


Figure 17

1. **Coolant reservoir hose**
2. **Reservoir and bracket**
3. **Cap screw (2)**
4. **Lock washer (2)**
5. **Plenum**
6. **Flange nut (4)**
7. **Flange head screw (4)**

16. Connect air cleaner intake hose to air cleaner.

17. Secure coolant reservoir bracket with reservoir to machine frame (Fig. 17).

18. Connect coolant reservoir hose to the radiator (Fig. 17).

19. Make sure radiator draincock is closed and fill radiator and reservoir with coolant.

20. Check position of wires, fuel lines, hydraulic hoses and cables for proper clearance with rotating, high temperature and moving components.

21. Connect positive battery cable first and then negative battery cable. Secure battery cover to machine.

22. Check and adjust engine oil level as needed.

23. Check and adjust hydraulic oil level as needed.

24. Prime the fuel system (see Priming The Fuel System in this chapter).

25. Start engine and operate hydraulic controls to properly fill hydraulic system (see Charge Hydraulic System in Chapter 5 − Hydraulic System in this manual).

26. Install hood on the machine (see Hood Installation in Chapter 8 − Chassis in this manual).

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Pump Adapter Plate

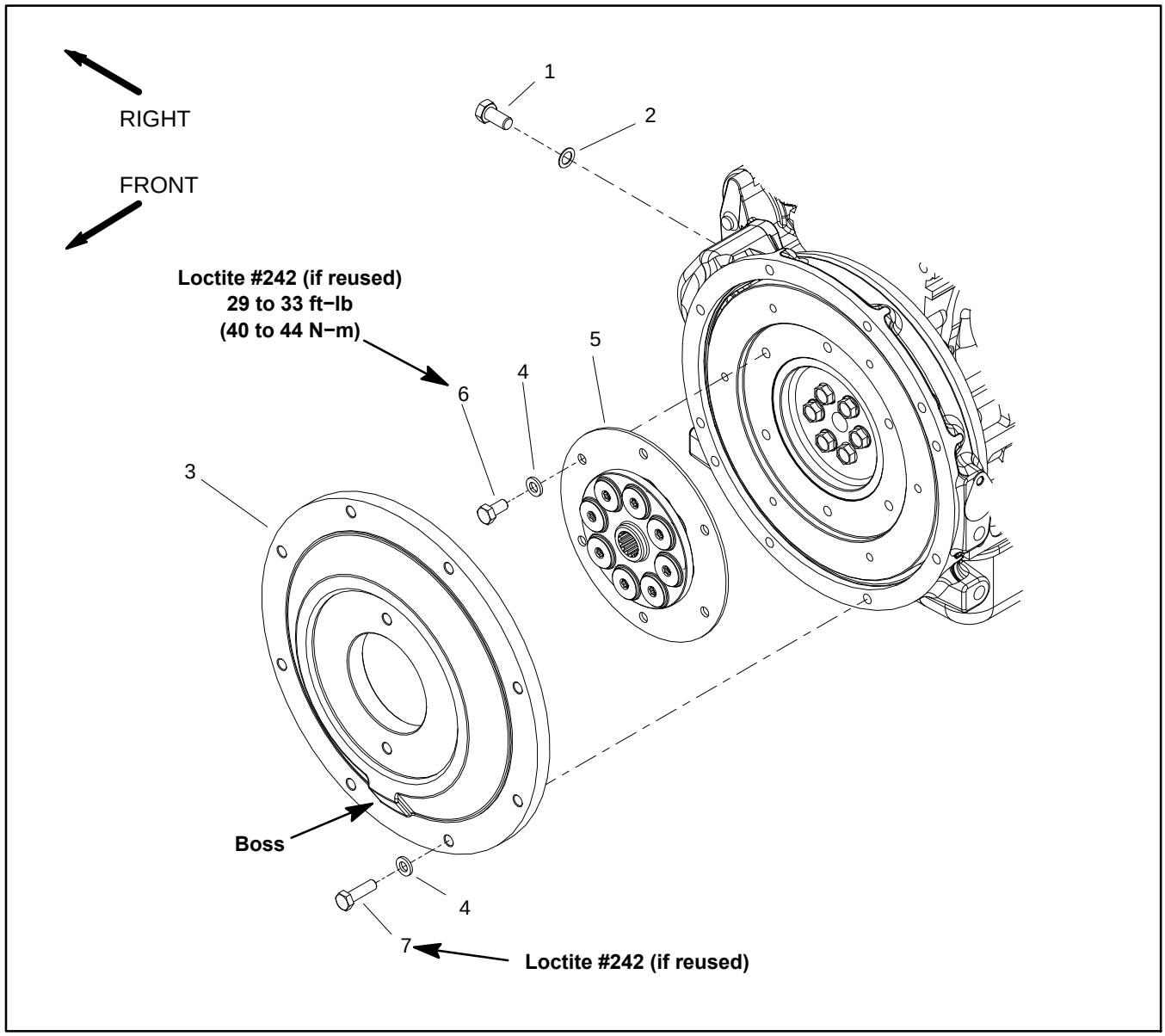


Figure 18

1. Bolt
2. Lock washer
3. Flywheel plate
4. Hardened washer (14)
5. Spring coupler
6. Cap screw with patch lock (6)
7. Cap screw with patch lock (8)

Coupler Removal (Fig. 18)

NOTE: The hydraulic pump assembly needs to be removed from engine before coupler can be removed.

1. If engine is in machine, remove hydraulic pump assembly (see Piston (Traction) Pump Removal in Chapter 5 − Hydraulic System in this manual).

2. Remove flywheel plate and spring coupler from engine.

Coupler Installation (Fig. 18)

1. Position spring coupler to engine flywheel and align mounting holes. Make sure that coupling hub is toward pump (away from engine flywheel) (Fig. 19).

IMPORTANT: The patch lock feature of the cap screws used in this procedure suggest replacing the screws after disassembly. An alternative would be to apply Loctite #242 (or equivalent) to the threads of the original cap screws during assembly.

2. Secure coupler to flywheel with cap screws (item 6) and hardened washers. Tighten bolts in a crossing pattern from **29 to 33 ft−lb (40 to 44 N−m)**.

3. Position flywheel plate to engine. Make sure that boss on plate is orientated down. Secure flywheel plate with cap screws (item 7) and hardened washers in a crossing pattern.

4. If engine is in machine, install hydraulic pump assembly (see Piston (Traction) Pump Installation in Chapter 5 − Hydraulic System in this manual).

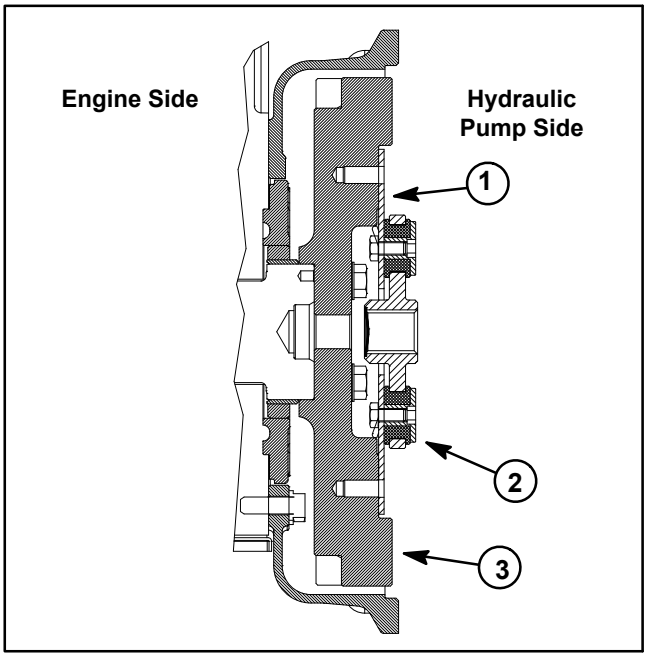


Figure 19

1. Coupler
2. Coupler hub
3. Engine flywheel

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TORO

Chapter 5

Hydraulic System

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EATON MODEL 72400 SERVO CONTROLLED PISTON PUMP REPAIR INFORMATION
DANFOSS K AND L FRAME VARIABLE MOTORS SERVICE MANUAL
DANFOSS STEERING UNIT TYPE OSPM SERVICE MANUAL

Specifications

Item	Description
Piston (Traction) Pump Maximum Displacement (per revolution) System Relief Pressure: Forward System Relief Pressure: Reverse	Eaton servo controlled variable displacement piston pump (Model 72400) 3.00 in^3 (49.2 cc) 5000 PSI (345 bar) 5000 PSI (345 bar)
Charge Pressure	207 PSI (14.3 bar)
Front Wheel Motors Displacement (per revolution)	Danfoss 2−Position Axial Piston Motors 1.83 in^3 (30 cc) Maximum / 0.89 in^3 (14.6 cc) Minimum
Rear Axle Motor Displacement (per revolution)	Danfoss 2−Position Axial Piston Motor with Loop Flushing Valve 2.32 in^3 (38 cc) Maximum / 1.13 in^3 (18.5 cc) Minimum
Gear Pump Section P1/P2 Displacement (per revolution) Section P3/P4 Displacement (per revolution)	Casappa 4 section, positive displacement gear type pump 1.03 in^3 (16.85 cc) 0.56 in^3 (9.16 cc)
Steering Control Valve Displacement (per revolution)	Danfoss Steering Unit, Series OSPM 6.1 in^3 (100 cc)
Steering Circuit Relief Pressure	1050 PSI (72 bar)
Lift/Lower Circuit Relief Pressure	1700 PSI (117 bar)
Cutting Unit Motors Displacement (per revolution)	Casappa Gear Motor 1.63 in^3 (26.7 cc)
Cutting Unit Circuit Relief Pressure	3000 PSI (207 bar)
Engine Cooling Fan Motor Displacement (per revolution)	Casappa Gear Motor 0.51 in^3 (8.4 cc)
Engine Cooling Fan Circuit Relief Pressure	3000 PSI (207 bar)
Hydraulic Filters: Return Filter Charge Filter In−line Suction Strainer	 Spin−on cartridge type Spin−on cartridge type 100 mesh (in reservoir)
Hydraulic Reservoir Capacity	8.25 U.S. Gallons (31.3 Liters)
Hydraulic Oil	See Traction Unit Operator's Manual

NOTE: The pressure specifications listed above are component settings. When using pressure gauges to measure circuit pressures, values may be different than these specifications. See the Testing section of this chapter for hydraulic test procedures and expected test results.

General Information

Operator's Manual

The Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to both the Traction Unit Operator's Manual and the Cutting Unit Operator's Manual for additional information when servicing the machine.

Hydraulic Component Locations

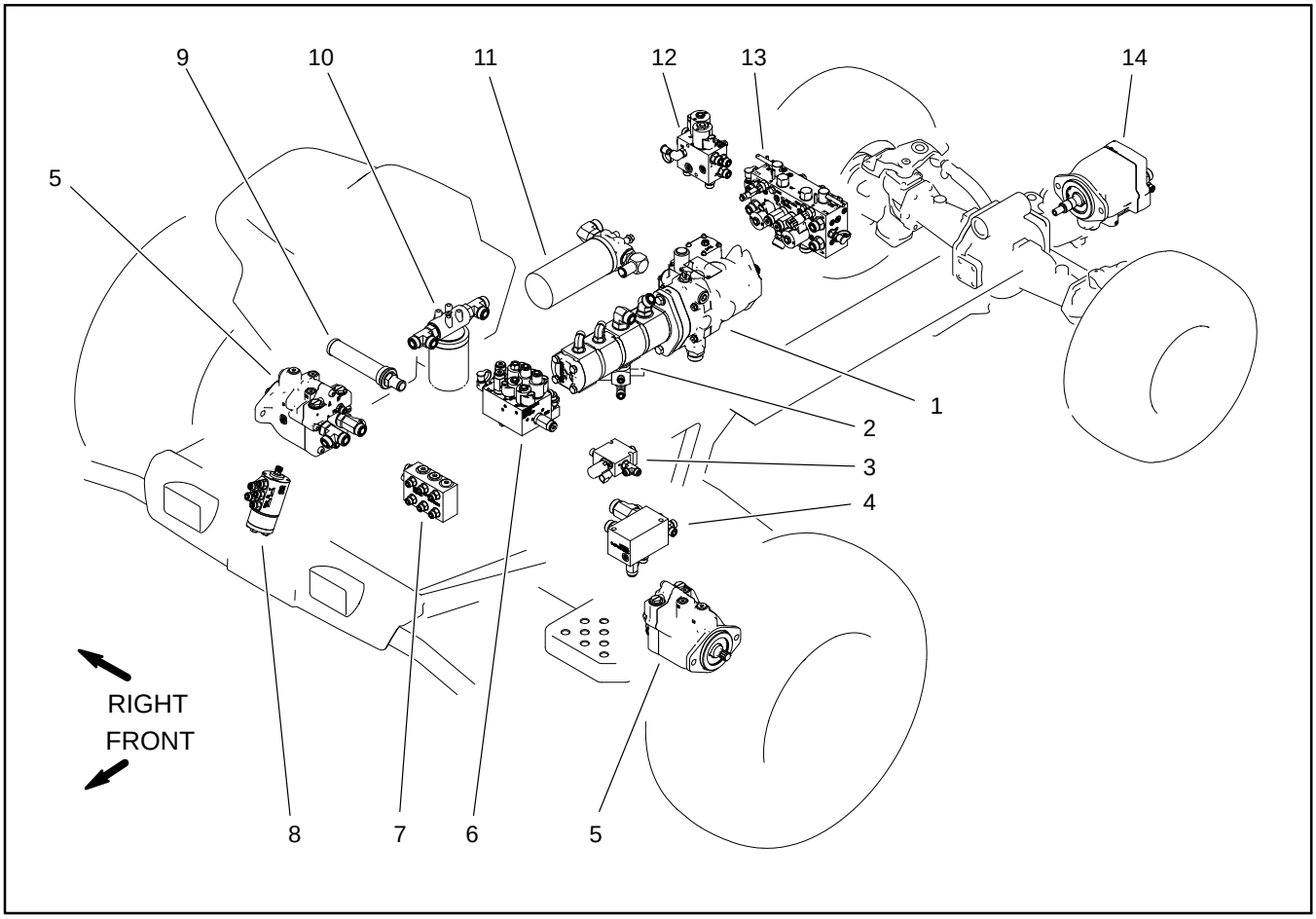


Figure 20

1. **Piston pump P1**
2. **Gear pump P2 − P5**
3. **HI/LOW range manifold**
4. **Rear traction manifold**
5. **Front wheel motor (2)**
6. **Lift control manifold**
7. **Lift junction manifold**
8. **Steering control valve**
9. **Suction strainer**
10. **Charge filter**
11. **Return filter**
12. **Fan control manifold**
13. **Mow control manifold**
14. **Rear axle motor**

Relieving Hydraulic System Pressure

Before disconnecting or performing any work on the hydraulic system, pressure in all of the hydraulic circuits must be relieved.

1. Park machine on a level surface, lower cutting units fully, set the reel enable/disable switch to the OFF position, stop engine and apply parking brake.

2. Move the traction pedal in both forward and reverse directions (relieves pressure in traction circuit).

3. Rotate steering wheel in both directions (relieves pressure in steering and lift circuit).

NOTE: Pressure in the mow circuit is relieved automatically when the cutting units are disengaged.

Traction Circuit Component Failure

The traction circuit on Reelmaster 7000−D machines is a closed loop system that includes the piston (traction) pump, two (2) front wheel motors and the rear axle motor. 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.

The recommended method of removing traction circuit contamination would be to temporarily install the Toro high flow hydraulic filter (see Special Tools in this chapter) into the circuit. This filter should be used when connecting hydraulic test gauges in order to test traction circuit components or after replacing a failed traction circuit component (e.g. traction (piston) pump or wheel motor). The filter will ensure that contaminates are removed from the closed loop system and do not cause additional component damage.

Once the Toro high flow hydraulic filter kit has been placed in the circuit, raise and support the machine with all drive wheels off the ground. Operate the traction circuit to allow oil flow throughout the circuit. The filter will remove contamination from the traction circuit during operation. Because the Toro high flow filter is bi−directional, the traction circuit can be operated in both the forward and reverse direction. The filter should be removed from the machine after contamination has been removed from the traction circuit. See Filtering Closed−Loop Traction Circuit in this chapter for additional information on using the Toro high flow hydraulic filter.

The alternative to using the Toro high flow hydraulic filter kit after a traction circuit component failure would be to disassemble, drain and thoroughly clean all components, tubes and hoses in the traction circuit. If any debris remains in the traction circuit and the machine is operated, the debris can cause additional circuit component failure.

NOTE: If traction circuit contamination exists, the traction pump case drain could allow contaminates to enter other hydraulic circuits on the machine.

Towing Traction Unit

IMPORTANT: If towing limits are exceeded, severe damage to the piston pump may occur.

If it becomes necessary to tow (or push) the machine, tow (or push) in a **forward direction**, at a speed **below 3 mph (4.8 kph)** and for a distance **less than 1/4 mile (0.4 km)**. The piston (traction) pump is equipped with a bypass valve that needs to be turned 90º for towing (Fig. 1). Do not turn bypass valve when engine is running.

IMPORTANT: If the machine must be pushed or towed in the reverse direction, the bypass valve needs to be turned 90º, and a check valve in the rear traction manifold must be bypassed. Do not exceed 3 mph (4.8 kph) or a distance of ¼ mile (0.4 km) when pushing or towing the machine in reverse.

The following Toro parts are needed to bypass the check valve:

59−7410 diagnostic fitting
354−79 diagnostic fitting cap
95−8843 hydraulic hose
95−0985 coupler fitting (2)
340−77 hydraulic fitting (2)

NOTE: The #6 zero leak plug on the rear traction manifold has a tapered sealing surface on the plug head. 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.

1. To bypass the check valve, install a diagnostic fitting in the unmarked port located between ports M8 and P2 on the rear traction manifold (Fig. 2).

2. Connect a hydraulic hose between the diagnostic fitting installed in the rear traction manifold and the reverse traction pressure test port (Fig. 3).

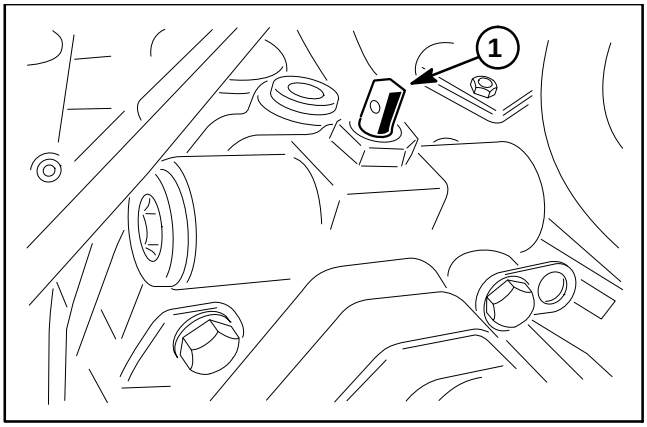


Figure 1

1. Bypass valve location

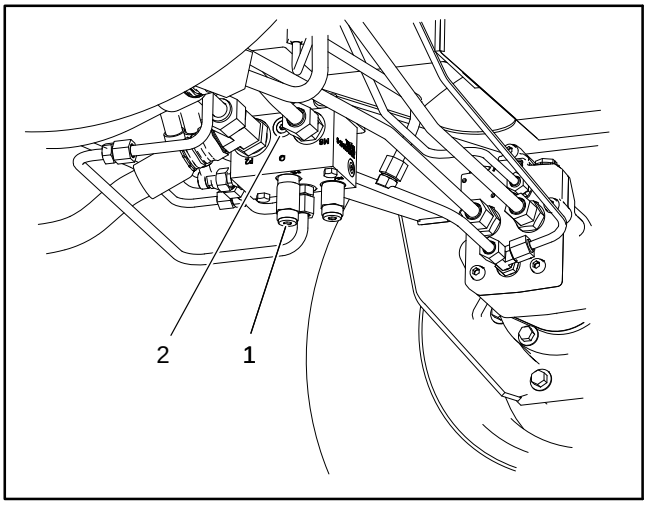


Figure 2

1. Rear traction manifold (behind front left wheel) **2. Unmarked port**

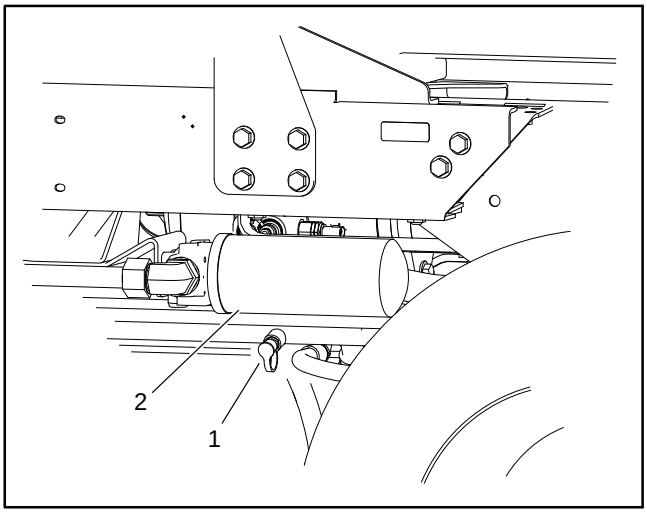


Figure 3

1. Reverse traction pressure test port **2. Hydraulic oil return filter**

Hydraulic Hoses

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

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

Kinked, crushed, flattened or twisted hose.

Blistered, soft, degraded or loose hose cover.

Cracked, damaged or badly corroded hose fittings.

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

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

WARNING

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

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

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

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

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

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

4. Thread the swivel nut onto the fitting by hand. While holding the hose/tube with a wrench, use a torque wrench to tighten the swivel nut to the recommended installation torque shown in Figure 6. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 − Product Records and Maintenance).

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

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

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

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

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

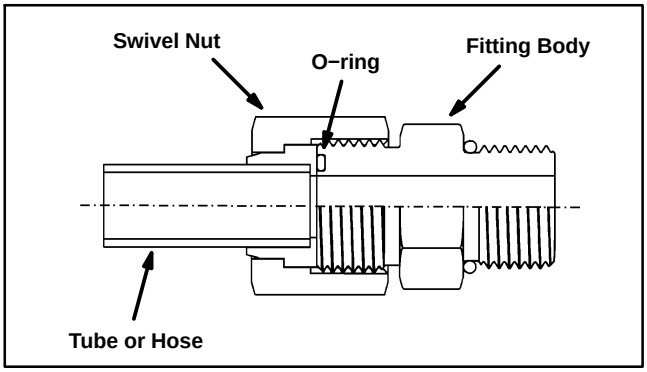


Figure 4

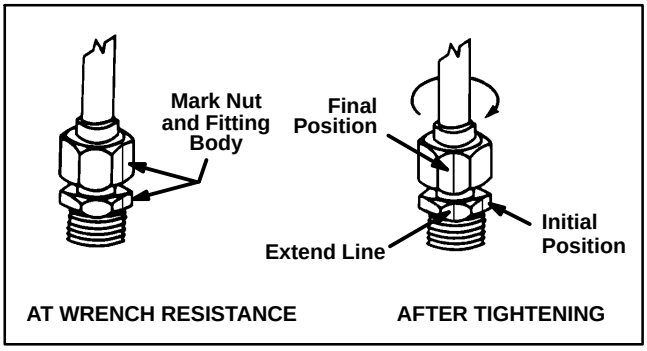


Figure 5

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

Figure 6

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

Non−Adjustable Fitting (Fig. 7)

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

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

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

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

4. Install the fitting into the port. Then, use a torque wrench and socket to tighten the fitting to the recommended installation torque shown in Figure 8.

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

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

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

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

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

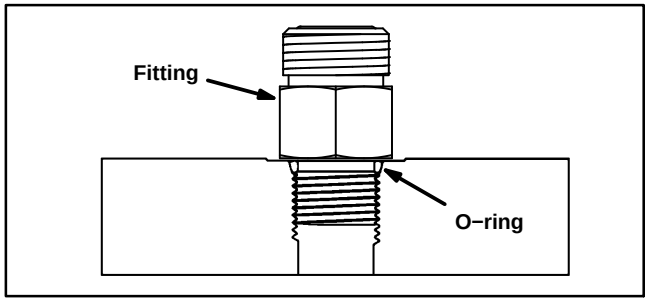


Figure 7

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

Figure 8

Adjustable Fitting (Fig. 9)

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

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

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

4. Turn back the lock nut as far as possible. Make sure the back up washer is not loose and is pushed up as far as possible (Step 1 in Figure 10).

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

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

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

7. Hold the fitting in the desired position with a wrench and use a torque wrench to tighten the fitting to the recommended installation torque shown in Figure 8. This tightening process will require the use of an offset wrench (e.g. crowfoot wrench). Use of an offset wrench will affect torque wrench calibration due to the effective length change of the torque wrench. Tightening torque when using a torque wrench with an offset wrench will be lower than the listed installation torque (see Using a Torque Wrench with an Offset Wrench in the Torque Specifications section of Chapter 2 − Product Records and Maintenance).

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

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

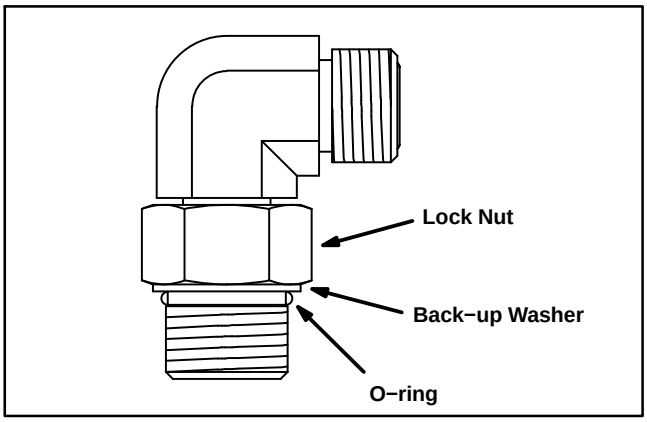


Figure 9

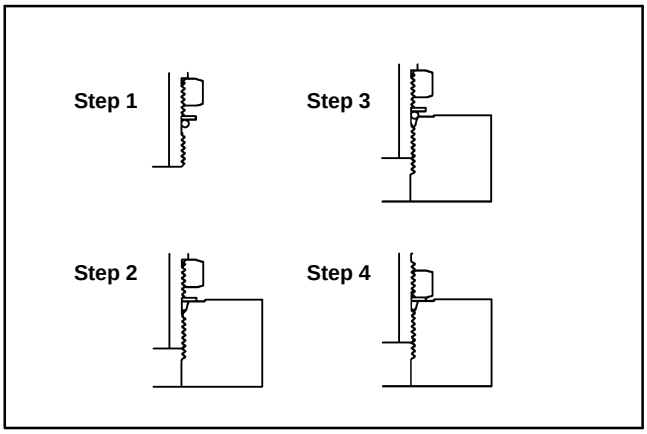
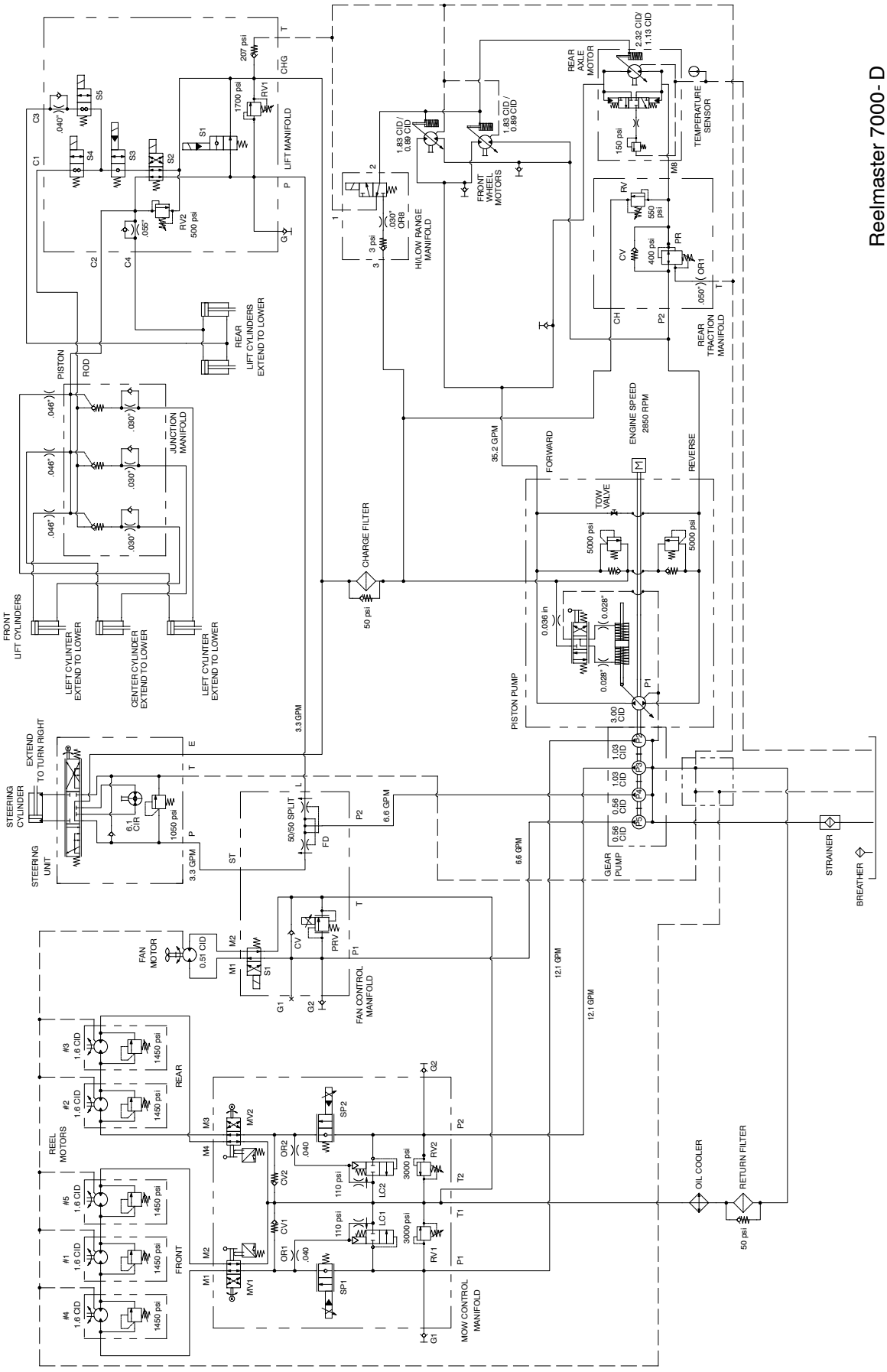


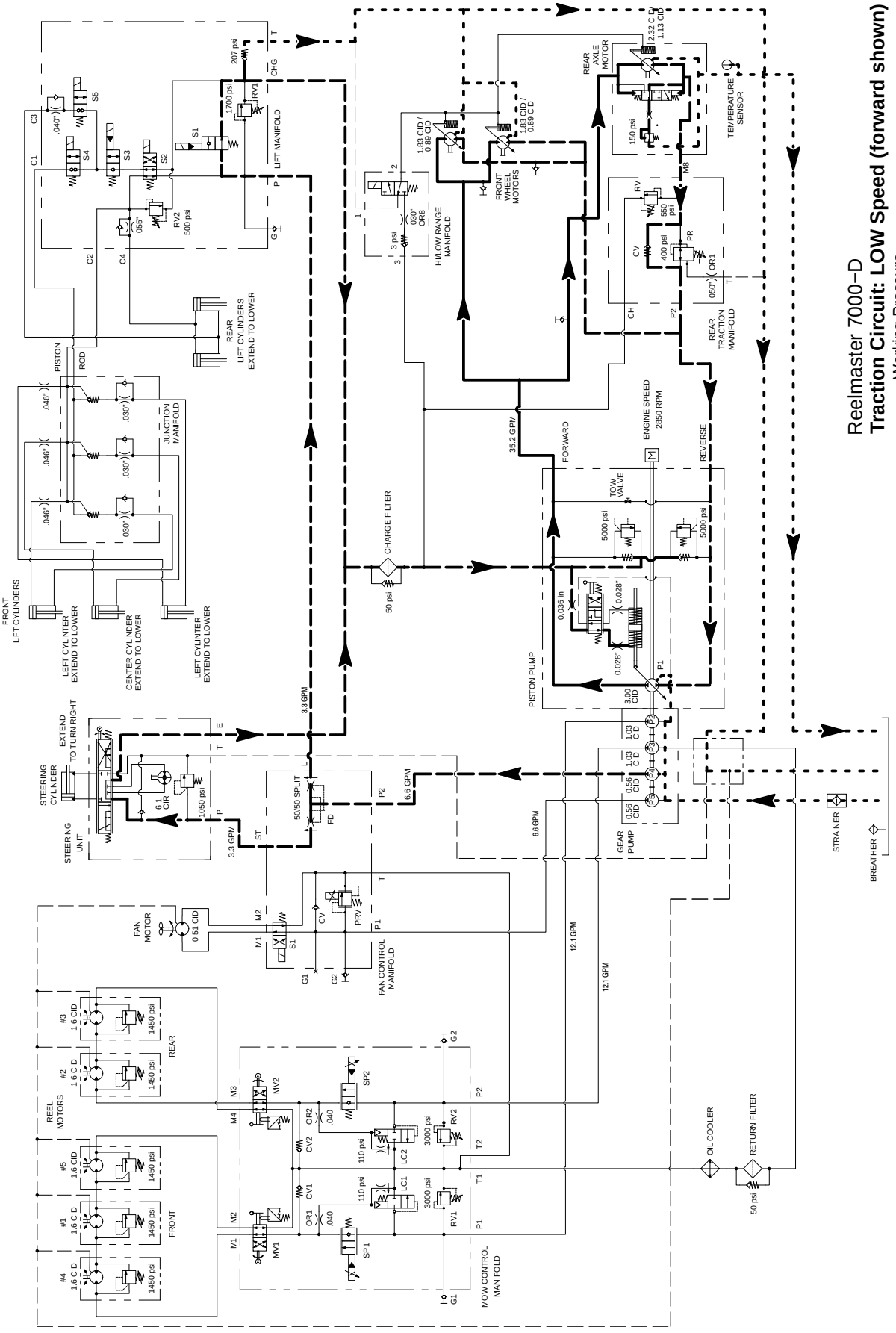
Figure 10

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Hydraulic Schematic



Hydraulic Flow Diagrams



Traction Circuit: LOW Speed (Mow)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. Traction circuit oil is directed to the dual displacement front wheel motors and rear axle motor. Operating pressure on the high pressure side of the closed loop traction circuit is determined by the amount of load developed at the wheel motors and rear axle motor. As the traction load increases, circuit pressure can increase to the relief valves setting of 5000 PSI (345 bar) in forward or reverse. If traction circuit pressure exceeds the relief setting, oil flows through the piston pump relief valve to the low pressure side of the closed loop traction circuit.

Front wheel motors and the rear axle motor are positive, dual displacement motors. The dual displacement feature allows operation in either a LOW (mow) or HI (transport) speed range. The motors are spring biased to maximum displacement for LOW speeds, and are hydraulically shifted to minimum displacement for HI speeds. The rear axle motor includes a flushing valve to help cool the traction circuit oil. The valve bleeds off a small amount of hydraulic oil from the closed loop traction circuit letting the charge circuit replenish the oil that is bled from the traction circuit with cooler oil from the charge circuit.

An optional traction circuit flow divider is available that equally splits traction pump flow between the front wheel motors and rear axle motor to prevent excessive circuit flow going to a spinning wheel. If equipped, the front traction manifold which includes the flow divider is mounted to the right side of the front frame.

The piston pump, front wheel motors and rear axle motor use small amounts of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The charge circuit is designed to replace this traction circuit leakage. The gear pump section (P4) that supplies oil to the steering and lift/lower circuits also provides oil for the charge circuit.

Gear pump flow for the charge circuit is directed through the steering valve, lift manifold, oil filter, and to the low pressure side of the closed loop traction circuit. Charge pressure is limited to 207 PSI (14.3 bar) by a check valve located in the lift manifold.

Forward Direction

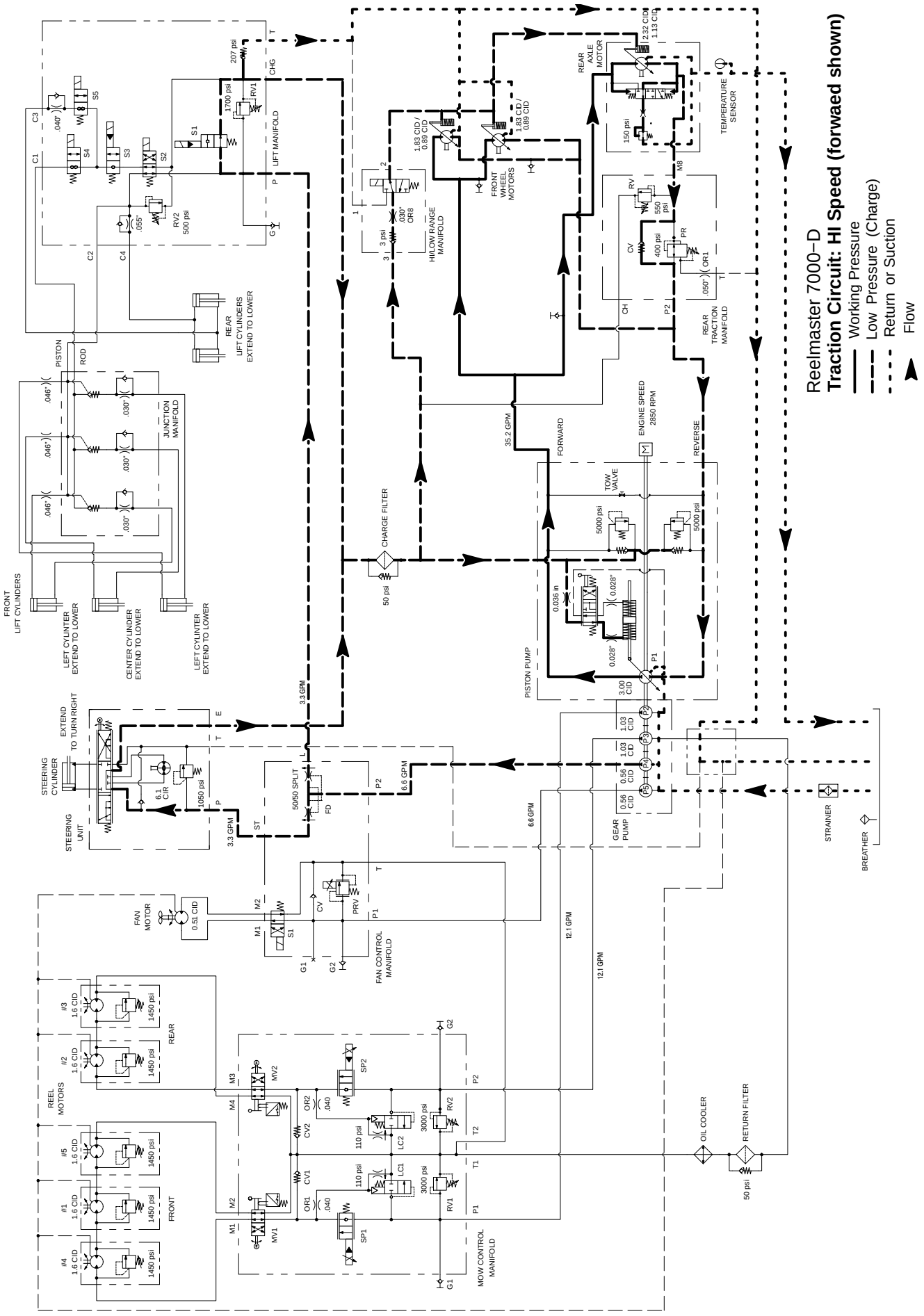
With the mow speed limiter in the LOW speed (mow) position, the solenoid valve in the Hi/Low range manifold is not energized. The front wheel motors and rear axle motor are at their maximum displacement when in LOW speed providing a slower traction speed for mowing conditions.

When in LOW speed (mow) position with the traction pedal pushed in the forward direction, oil from the piston pump is directed to the front wheel motors and rear axle motor through a parallel system. Oil flow to the front wheel motors drives the motors in the forward direction and then returns to the piston pump. Oil flow to the rear axle motor drives the motor in the forward direction. Oil returning from the axle motor enters the rear traction manifold at the M8 port. The majority of the return flow bypasses the pressure reducing (PR) cartridge and passes through a less restrictive check valve (CV), out manifold port P2 and returns to the piston pump.

When going down a hill, the tractor becomes an over−running load that drives the front wheel and rear axle motors. In this condition, the rear axle motor could lock up as the oil pumped from the motor increases pressure as it returns to the piston pump. To prevent rear wheel lock up, an adjustable relief valve (RV) in the rear traction manifold opens to reduce rear axle motor pressure created in down hill, dynamic braking conditions.

Reverse Direction

The traction circuit operates essentially the same in reverse LOW speed (mow) as it does in forward LOW speed (mow). However, the flow through the circuit is reversed. Oil flow from the piston pump is directed to the front wheel motors and also to the rear traction manifold. The oil to the front wheel motors drives them in the reverse direction and then returns to the piston pump. The oil to the rear traction manifold enters the manifold at port P2 and flows through pressure reducing valve (PR) which limits the down stream pressure to the rear axle motor to 400 PSI (27.6 bar) so the rear wheels will not scuff the turf during reverse operation. This reduced pressure flow is directed out rear traction manifold port M8 to drive the rear axle motor in reverse. Return oil from the rear motor returns to the piston pump.


Reelmaster 7000−D
Traction Circuit: HI Speed (forwaed shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
PISTON PUMP
3.00 CID
FORWARD
REVERSE
ENGINE SPEED 2850 RPM
35.2 GPM
CHARGE FILTER
50 psi
TOW VALVE
5000 psi
0.036 in
0.028"
FRONT WHEEL MOTORS
1.83 CID / 0.89 CID
REAR AXLE MOTOR
2.32 CID / 1.13 CID
150 psi
TEMPERATURE SENSOR
REAR TRACTION MANIFOLD
HI/LOW RANGE MANIFOLD
LIFT MANIFOLD
207 psi
1700 psi
RV1
RV2 500 psi
REAR LIFT CYLINDERS EXTEND TO LOWER
JUNCTION MANIFOLD
FRONT LIFT CYLINDERS
LEFT CYLINTER EXTEND TO LOWER
CENTER CYLINDER EXTEND TO LOWER
STEERING CYLINDER
EXTEND TO TURN RIGHT
STEERING UNIT
6.1 CIR
1050 psi
3.3 GPM
50/50 SPLIT
6.6 GPM
GEAR PUMP
1.03 CID
0.56 CID
STRAINER
BREATHER
FAN MOTOR
0.51 CID
FAN CONTROL MANIFOLD
PRV
12.1 GPM
REEL MOTORS
REAR
FRONT
1.6 CID
1450 psi
MOW CONTROL MANIFOLD
MV1
MV2
SP1
SP2
CV1
CV2
LC1
LC2
OR1
OR2
3000 psi
110 psi
OIL COOLER
RETURN FILTER
50 psi

Traction Circuit: HI Speed (Transport)

The traction circuit piston pump is a variable displacement pump that is directly coupled to the engine flywheel. Pushing the traction pedal engages a hydraulic servo valve which controls the variable displacement piston pump swash plate to create a flow of oil. Traction circuit oil is directed to the dual displacement front wheel motors and rear axle motor. Operating pressure on the high pressure side of the closed loop traction circuit is determined by the amount of load developed at the wheel motors and rear axle motor. As the traction load increases, circuit pressure can increase to the relief valves setting of 5000 PSI (345 bar) in forward or reverse. If traction circuit pressure exceeds the relief setting, oil flows through the piston pump relief valve to the low pressure side of the closed loop traction circuit.

Front wheel motors and the rear axle motor are positive, dual displacement motors. The dual displacement feature allows operation in either a LOW (mow) or HI (transport) speed range. The motors are spring biased to maximum displacement for LOW speeds, and are hydraulically shifted to minimum displacement for HI speeds. The rear axle motor includes a flushing valve to help cool the traction circuit oil. The valve bleeds off a small amount of hydraulic oil from the closed loop traction circuit letting the charge circuit replenish the oil that is bled from the traction circuit with cooler oil from the charge circuit.

An optional traction circuit flow divider is available that equally splits traction pump flow between the front wheel motors and rear axle motor to prevent excessive circuit flow going to a spinning wheel. If equipped, the front traction manifold which includes the flow divider is mounted to the right side of the front frame.

The piston pump, front wheel motors and rear axle motor use small amounts of hydraulic fluid for internal lubrication. Fluid is designed to leak across traction pump and motor components into the case drain. This leakage results in the loss of hydraulic fluid from the closed loop traction circuit that must be replaced. The charge circuit is designed to replace this traction circuit leakage. The gear pump section (P4) that supplies oil to the steering and lift/lower circuits also provides oil for the charge circuit.

Gear pump flow for the charge circuit is directed through the steering valve, lift manifold, oil filter, and to the low pressure side of the closed loop traction circuit. Charge pressure is limited to 207 PSI (14.3 bar) by a check valve located in the lift manifold.

Forward Direction

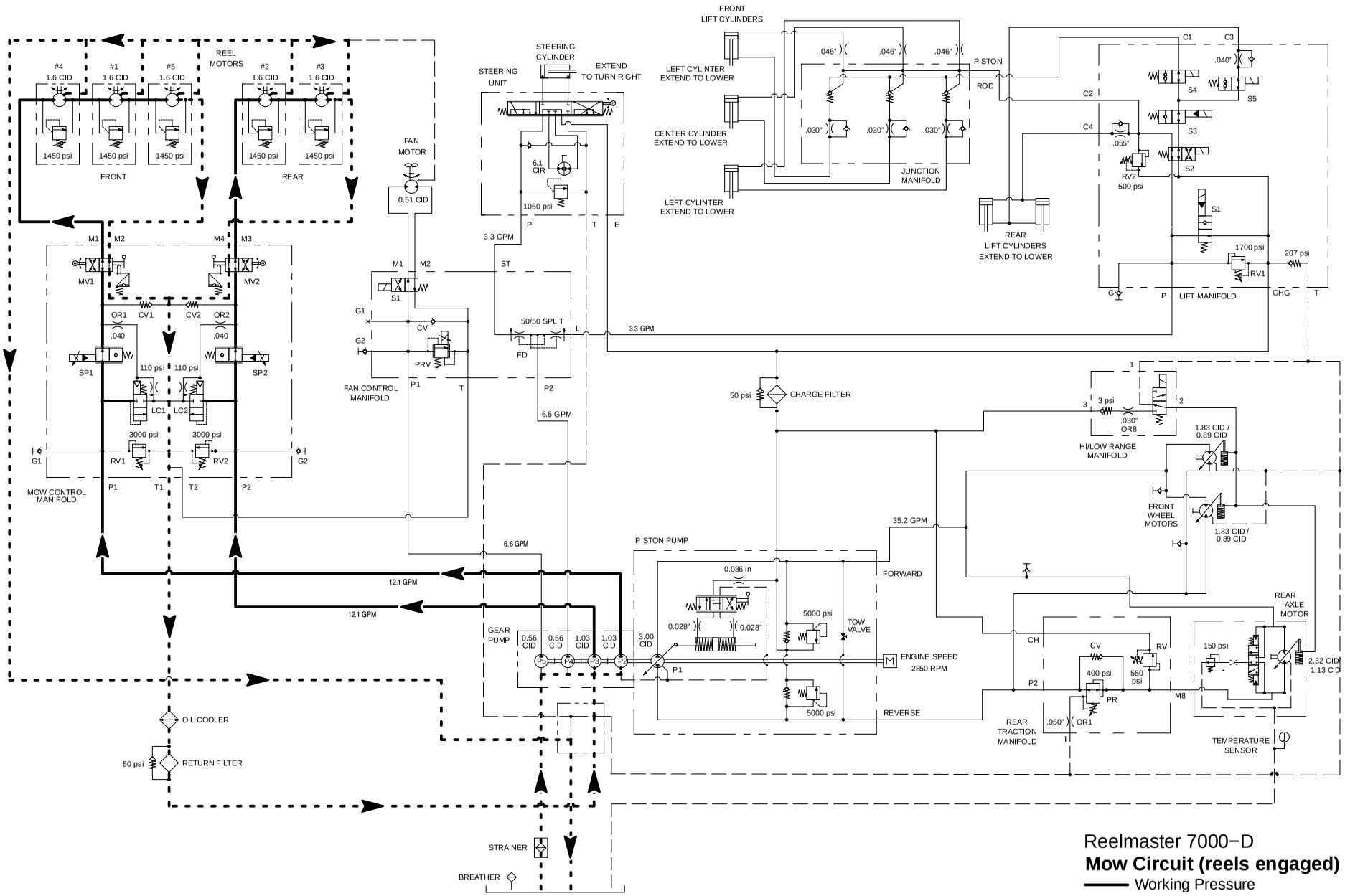
With the mow speed limiter in the HI speed (transport) position, the solenoid valve in the Hi/Low range manifold is energized. This energized solenoid valve directs charge pressure to shift the front wheel motors and rear axle motor to their minimum displacement. With the motors at their minimum displacements, a faster traction speed is available for transport.

When in HI speed (transport) position with the traction pedal pushed in the forward direction, oil from the piston pump oil is directed to the front wheel motors and rear axle motor through a parallel system. Oil flow to the front wheel motors drives the motors in the forward direction and then returns to the piston pump. Oil flow to the rear axle motor drives the motor in the forward direction. Oil returning from the axle motor enters the rear traction manifold at the M8 port. The majority of the return flow bypasses the pressure reducing (PR) cartridge and passes through a less restrictive check valve (CV), out manifold port P2 and returns to the piston pump.

When going down a hill, the tractor becomes an over−running load that drives the front wheel and rear axle motors. In this condition, the rear axle motor could lock up as the oil pumped from the motor increases pressure as it returns to the piston pump. To prevent rear wheel lock up, an adjustable relief valve (RV) in the rear traction manifold opens to reduce rear axle motor pressure created in down hill, dynamic braking conditions.

Reverse Direction

The traction circuit operates essentially the same in reverse HI speed (transport) as it does in forward HI speed (transport). However, the flow through the circuit is reversed. Oil flow from the piston pump is directed to the front wheel motors and also to the rear traction manifold. The oil to the front wheel motors drives them in the reverse direction and then returns to the piston pump. The oil to the rear traction manifold enters the manifold at port P2 and flows through pressure reducing valve (PR) which limits the down stream pressure to the rear axle motor to 450 PSI (31 bar) so the rear wheels will not scuff the turf during reverse operation. This reduced pressure flow is directed out rear traction manifold port M8 to drive the rear axle motor in reverse. Return oil from the rear motor returns to the piston pump.



Reelmaster 7000−D

Mow Circuit (reels engaged)

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Mow Circuit

Hydraulic flow for the mow circuit is supplied by two (2) sections of the gear pump (P2 and P3). Gear pump section P2 supplies hydraulic flow to cutting units 1, 4 and 5 (front cutting units), while gear pump section P3 supplies cutting units 2 and 3 (rear cutting units).

A single mow control manifold is used to control flow from the two (2) pump sections. The manifold includes cartridge valves for control of each of the two (2) pump circuits. Each mow circuit includes a solenoid controlled proportional valve (SP1 and SP2), a logic cartridge (LC1 and LC2) and a circuit relief cartridge (RV1 and RV2).

All cutting reel motors are equipped with cross over relief valves to prevent hydraulic component damage in case a cutting reel should stall.

The Toro Electronic Controller (TEC) uses inputs from various machine switches to determine when solenoid proportional valve (SP1 and SP2) are to be energized. The controller also provides a slight delay in activation of the rear cutting units.

NOTE: The mow speed limiter must be in the LOW speed (mow) position before the mow circuit can be engaged.

Reels Engaged

When the reel enable/disable switch is turned ON with the cutting units lowered, the proportional valves (SP1 and SP2) are energized by the TEC−5002 controller. The energized valves shift to direct pump flow toward the cutting unit motors. Flow from the valves is proportional to current applied to the valve coil by the TEC. The reel speed (defined by InfoCenter settings) provides the input for the TEC to allow the appropriate current to the proportional valve coils.

Flow through the proportional valves (SP1 and SP2) is pressure compensated by the logic cartridge valves (LC1 and LC2). The logic cartridge valve maintains a pressure of 110 PSI (7.6 bar) across the proportional valve. Any excess flow is returned to the oil cooler and return filter.

Maximum mow circuit pressure is limited at each mow manifold circuit by the relief valve (RV1 or RV2). The relief valve pressure is 3000 PSI (207 bar).

When the reels are disengaged, the over−running inertia load of the reels keeps driving the reel motors and can turn them into pumps. The check valves (CV1 and CV2) in the mow control manifold will open to keep the reel motor circuit full of oil so the motors will not cavitate (fill with air).

Reels Disengaged (Fig. 11)

When the reel enable/disable switch is OFF (or if the cutting units are raised), the manifold proportional valves (SP1 and SP2) are not energized, causing a pressure increase that shifts the logic cartridges (LC1 and LC2). The pump flow is routed through the shifted logic cartridge and out manifold port T1. Return oil from the manifold is directed to the oil cooler and return filter.

Backlap

When either of the mow control manifold backlap valves are rotated to the backlap (R) position, pump flow to the cutting unit motors is reversed. This change in flow direction reverses the rotation of the front or rear cutting reel motors allowing the backlap operation.

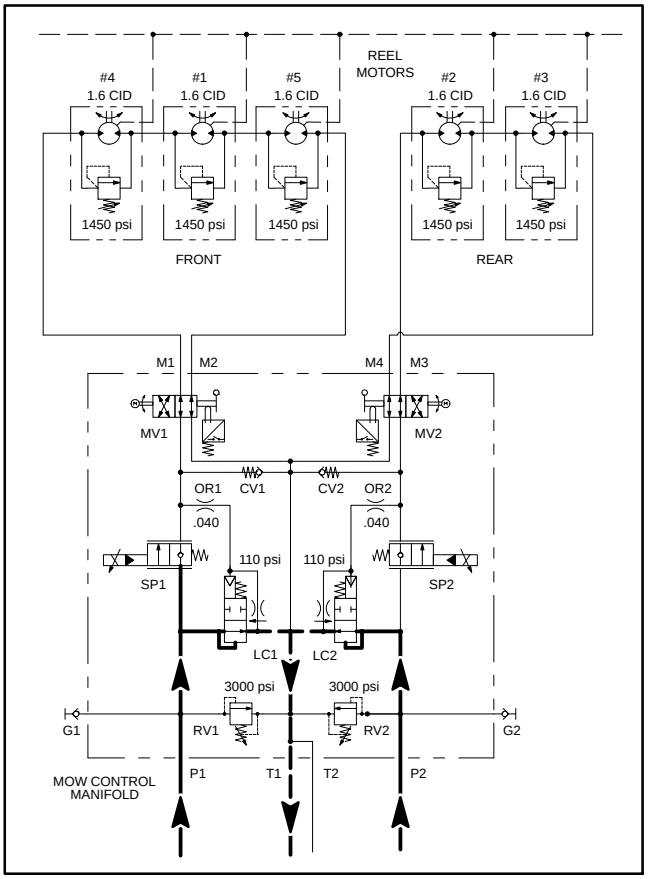
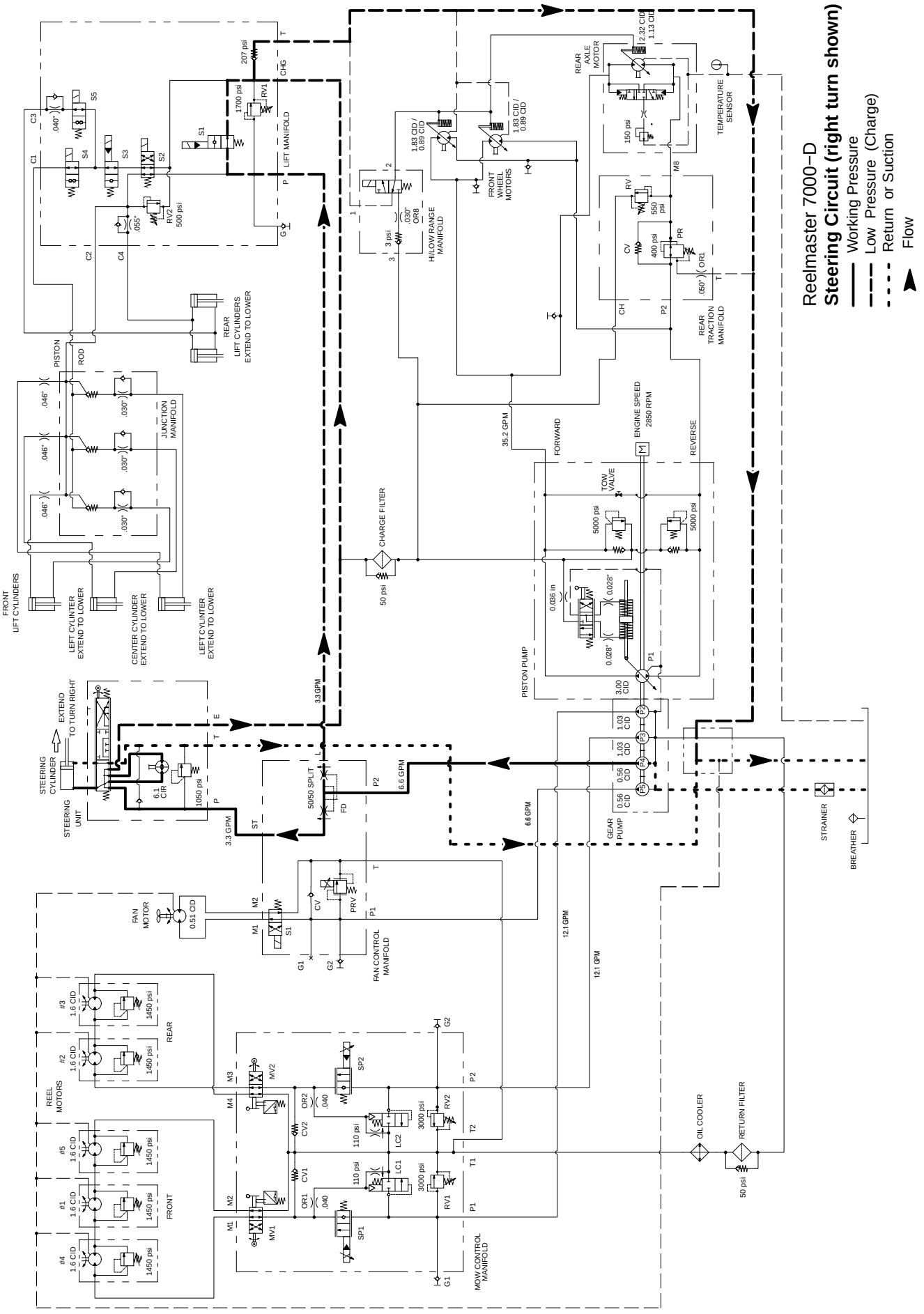


Figure 11


Reelmaster 7000−D
Steering Circuit (right turn shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
REAR AXLE MOTOR
2.32 CID
1.13 CID
TEMPERATURE SENSOR
150 psi
1.83 CID / 0.89 CID
FRONT WHEEL MOTORS
HI/LOW RANGE MANIFOLD
REAR TRACTION MANIFOLD
550 psi
400 psi
207 psi
1700 psi
LIFT MANIFOLD
500 psi
REAR LIFT CYLINDERS EXTEND TO LOWER
PISTON ROD
JUNCTION MANIFOLD
FRONT LIFT CYLINDERS
LEFT CYLINTER EXTEND TO LOWER
CENTER CYLINDER EXTEND TO LOWER
LEFT CYLINTER EXTEND TO LOWER
CHARGE FILTER
50 psi
35.2 GPM
FORWARD
REVERSE
ENGINE SPEED 2850 RPM
TOW VALVE
5000 psi
PISTON PUMP
3.00 CID
1.03 CID
0.56 CID
GEAR PUMP
STEERING CYLINDER
EXTEND TO TURN RIGHT
STEERING UNIT
6.1 CIR
1050 psi
3.3 GPM
50/50 SPLIT
6.6 GPM
FAN MOTOR
0.51 CID
FAN CONTROL MANIFOLD
PRV
CV
12.1 GPM
STRAINER
BREATHER
OIL COOLER
RETURN FILTER
REEL MOTORS
REAR
FRONT
1.6 CID
1450 psi
MOW CONTROL MANIFOLD
MV1
MV2
SP1
SP2
CV1
CV2
LC1
LC2
RV1
RV2
3000 psi
110 psi

Steering Circuit

A four section gear pump is coupled to the piston (traction) pump. The gear pump section P4 supplies hydraulic flow to the steering control valve and the lift control manifold. Gear pump hydraulic flow is delivered to the two circuits through a proportional flow divider located in the fan control manifold. The steering circuit receives priority flow from the flow divider. Steering circuit pressure is limited to 1050 PSI (72 bar) by a relief valve located in the steering control valve.

With the steering wheel in the neutral position and the engine running, pump section P4 flow enters the steering control valve at the P port and goes through the steering control spool valve, bypassing the rotary meter and steering cylinder. Flow leaves the control valve through the E port to the traction charge circuit.

Left Turn

When a left turn is made with the engine running, turning the steering wheel to the left positions the spool valve so that flow goes through the top of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. Most of the flow through the valve is bypassed out the E port back to the traction charge circuit. The remainder of the flow is drawn through the rotary meter and out the L port. Pressure to the rod end of the steering cylinder retracts the cylinder for a left turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount the steering wheel is turned. Fluid leaving the cylinder flows back through the spool valve, out the T port, and returns to the hydraulic reservoir.

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

Right Turn

When a right turn is made with the engine running, turning the steering wheel to the right positions the spool valve so that flow goes through the bottom of the spool. Flow entering the steering control valve at the P port goes through the spool and is routed to two places. Most of the flow through the valve is bypassed out the E port back to the traction charge circuit. The remainder of the flow is drawn through the rotary meter and out the R port. Pressure to the cap end of the steering cylinder extends the cylinder for a right turn. The rotary meter ensures that the oil flow to the cylinder is proportional to the amount the steering wheel is turned. Fluid leaving the cylinder flows back through the spool valve, out the T port, and returns to the hydraulic reservoir.

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

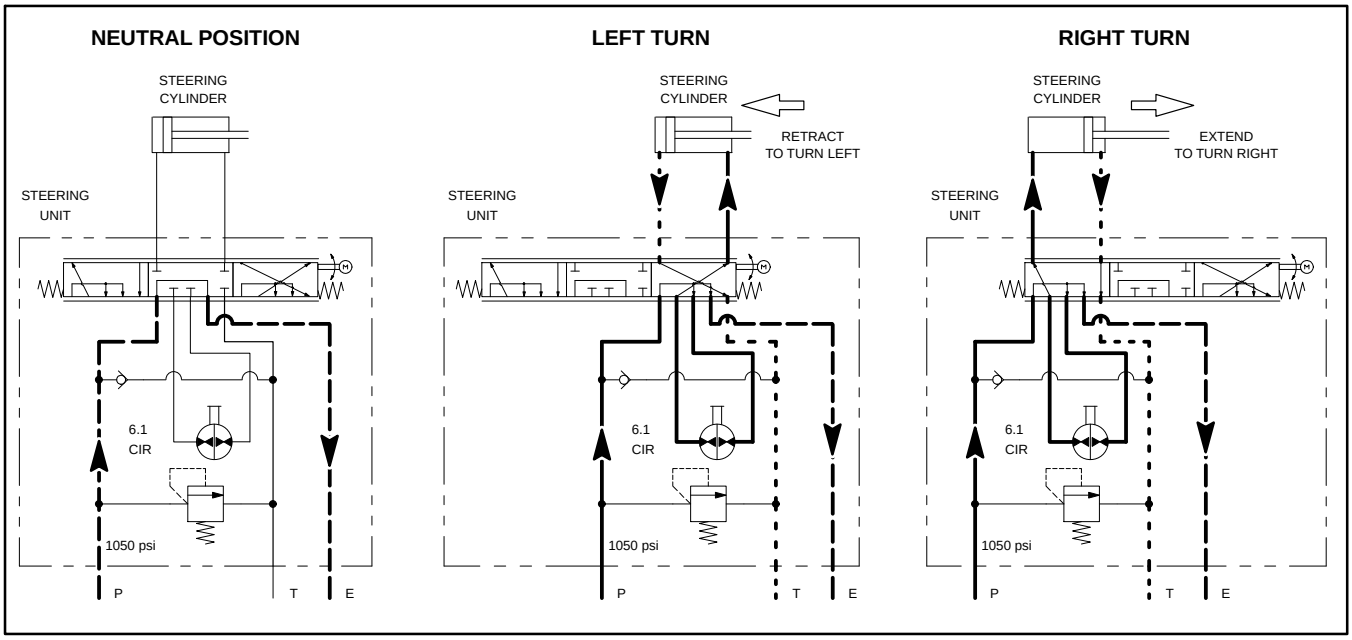
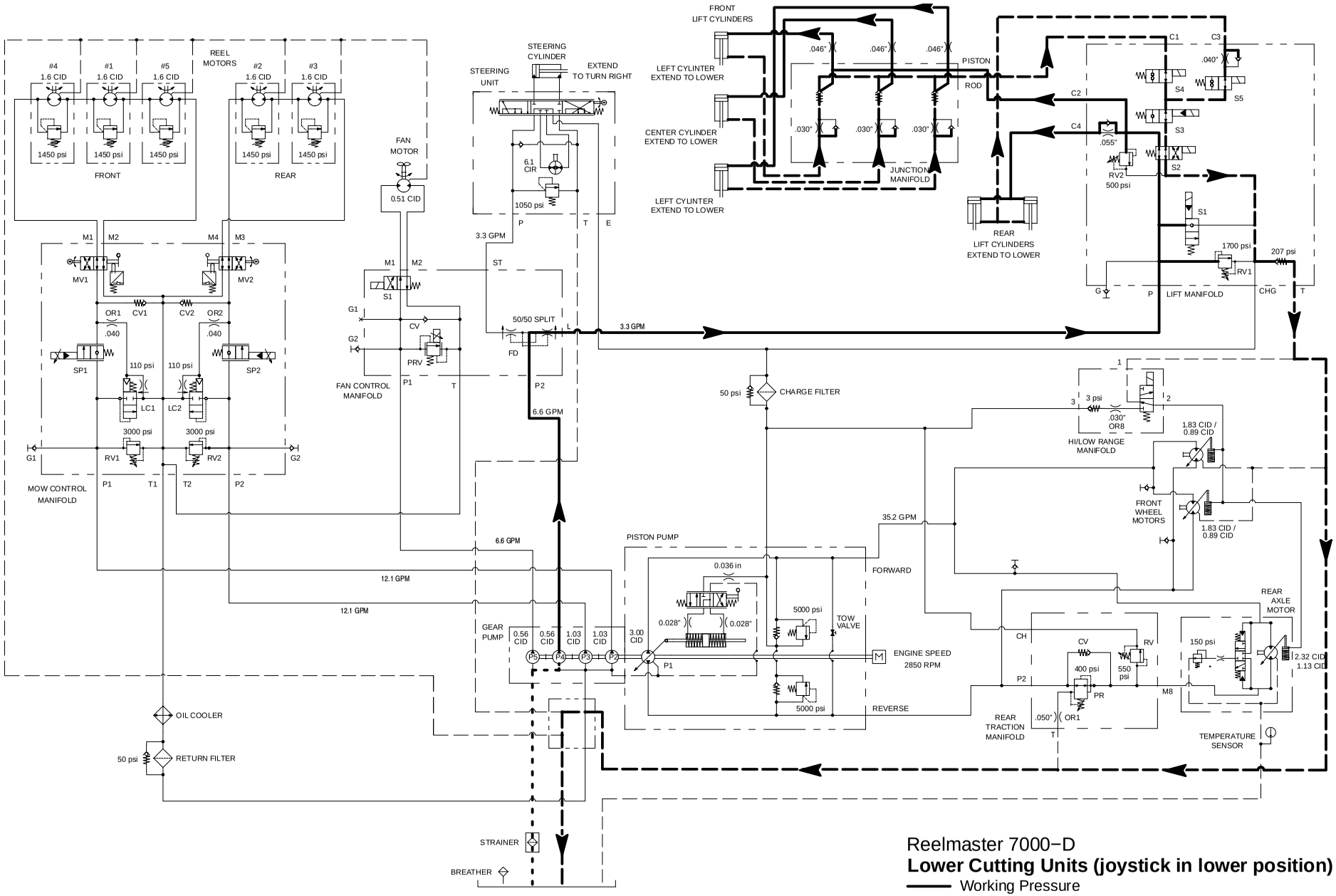


Figure 12



Reelmaster 7000−D

Lower Cutting Units (joystick in lower position)

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Lower Cutting Units

A four section gear pump is coupled to the piston (traction) pump. Gear pump section P4 supplies hydraulic flow to both the lift control manifold and the steering control valve. Hydraulic flow from this pump section is delivered to the circuits through a proportional flow divider located in the fan control manifold. Maximum lift/lower circuit pressure is limited to 1700 PSI (117 bar) by a relief valve (RV1) in the lift control manifold. Lift circuit pressure can be monitored at the test fitting in lift control manifold port G.

A joystick (lower mow/raise control lever) on the console arm is used to raise and lower the five (5) cutting units (Fig. 13). The joystick acts as an input to the Toro Electronic Controller (TEC) which sends electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

When the cutting units are in a stationary position (not raising or lowering), lift circuit flow from gear pump section P4 bypasses the lift cylinders through the lift control manifold solenoid valve S1 (de−energized). Return flow from the manifold is routed to the oil filter and traction charge circuit.

Cutting Unit Lower

NOTE: The operator must be in the operator seat and the mow speed limiter in the LOW speed (mow) position in order to lower the cutting units.

When the joystick is moved to the lower position, solenoid valve S1 along with solenoid valves S3, S4 and S5 are energized by the TEC. To allow the front cutting units to be lowered before the rear cutting units, the controller slightly delays energizing solenoid S5 after the joystick is moved to the lower position. The energized solenoid valves direct gear pump oil flow to the piston end of the lift cylinders. Hydraulic pressure causes the lift cylinder shafts to extend, and lower the cutting units.

The flow to the front lift cylinders is restricted by a series of control orifices in the lift junction manifold. The first set of control orifices restricts the flow to each front lift cylinder in both the lower and raise direction. Three (3) piloted check valves in the junction manifold are shifted by hydraulic pressure to allow return flow from the extending front lift cylinders. The return flow passes through a second set of control orifices in the junction manifold providing additional cylinder speed control while lowering the cutting units.

A flow control orifice in the lift control manifold (port C3) controls the rear cutting unit lowering speed by providing a restriction for the return flow from the lift cylinders.

Because cutting unit weight assists in extending the lift cylinders when lowering the cutting units, less hydraulic pressure is necessary during the cutting unit lowering operation. Lift circuit lower relief valve (RV2) allows lift circuit pressure to be limited to 500 PSI (34 bar) while lowering the cutting units.

NOTE: Adjustment of lift circuit lower relief valve (RV2) is not recommended.

When the joystick is released, solenoid valves S1, S3, S4 and S5 are de−energized and the lift cylinders and cutting units are held in position.

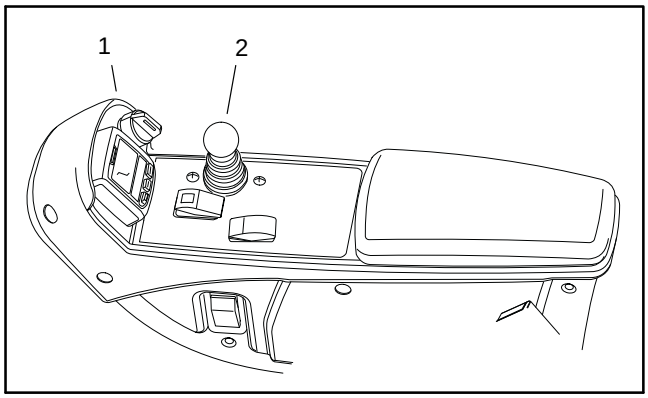


Figure 13

1. **Console**
2. **Joystick (lower mow/raise control lever)**

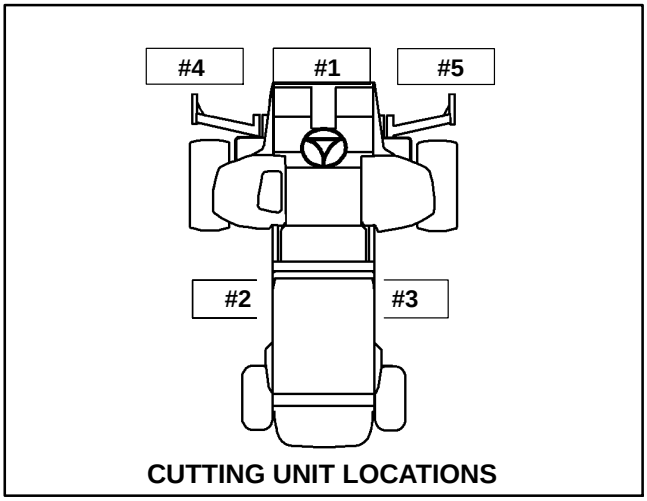
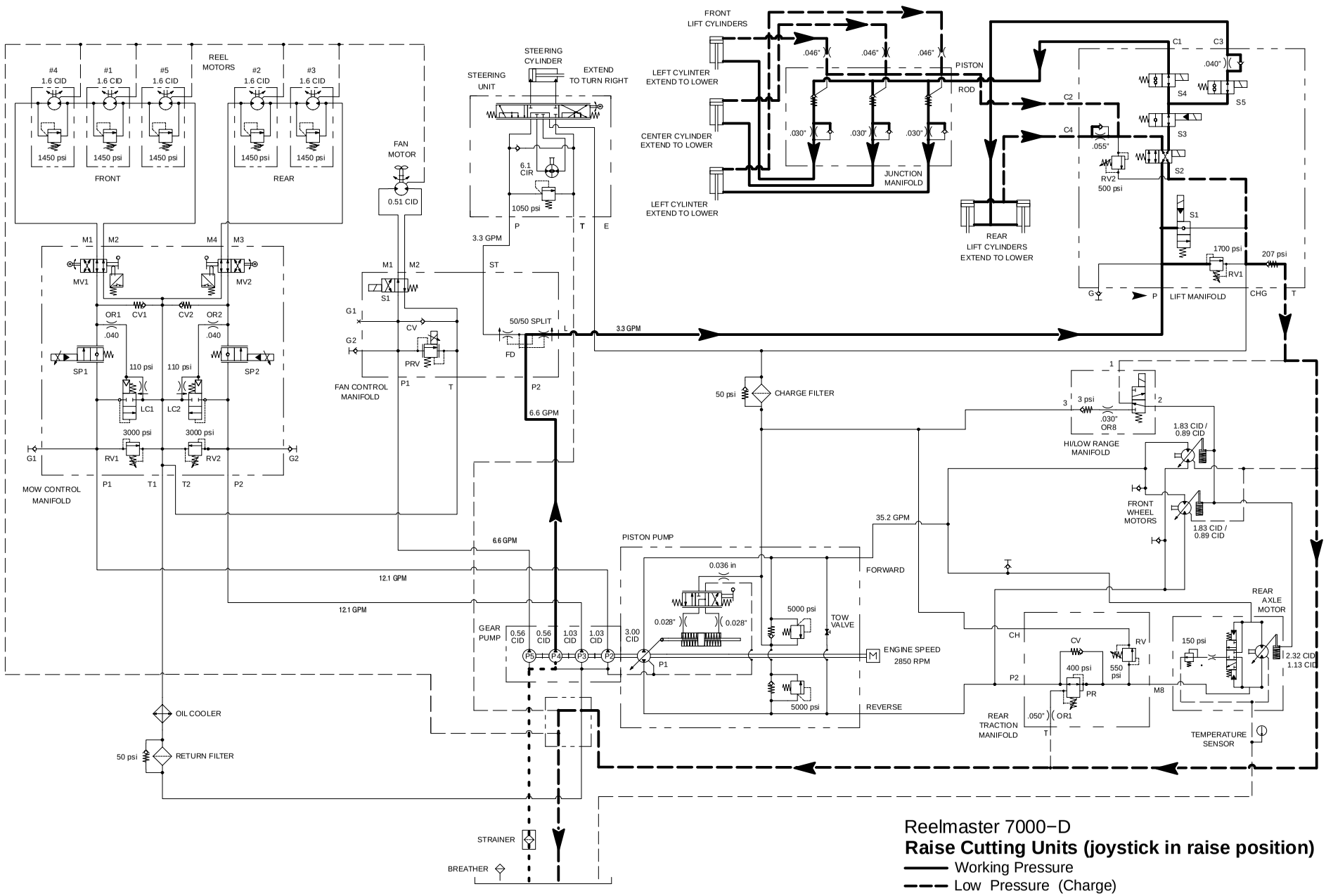


Figure 14



Reelmaster 7000−D

Raise Cutting Units (joystick in raise position)

- Working Pressure
- Low Pressure (Charge)
- Return or Suction
- Flow

Raise Cutting Units

A four section gear pump is coupled to the piston (traction) pump. Gear pump section P4 supplies hydraulic flow to both the lift control manifold and the steering control valve. Hydraulic flow from this pump section is delivered to the circuits through a proportional flow divider located in the fan control manifold. Maximum lift/lower circuit pressure is limited to 1700 PSI (117 bar) by a relief valve (RV1) in the lift control manifold. Lift circuit pressure can be monitored at the test fitting in lift control manifold port G.

A joystick (lower mow/raise control lever) on the console arm is used to raise and lower the five (5) cutting units (Fig. 15). The joystick acts as an input to the Toro Electronic Controller (TEC) which sends electrical outputs to appropriate lift control manifold solenoid coils in order to raise or lower the cutting units.

When the cutting units are in a stationary position (not raising or lowering), lift circuit flow from gear pump section P4 bypasses the lift cylinders through the lift control manifold solenoid valve S1 (de−energized). Return flow from the manifold is routed to the oil filter and traction charge circuit.

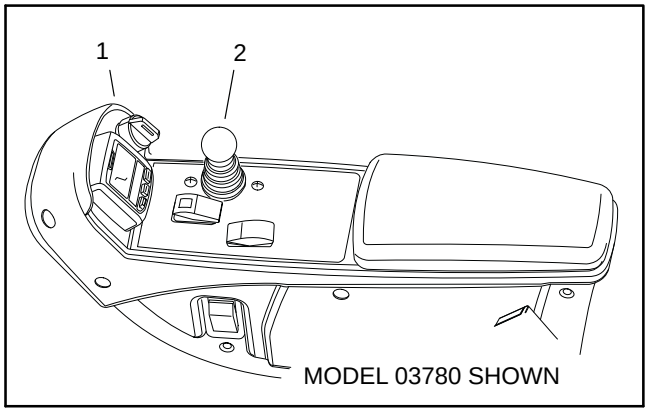


Figure 15

1. **Console**
2. **Joystick (lower mow/raise control lever)**

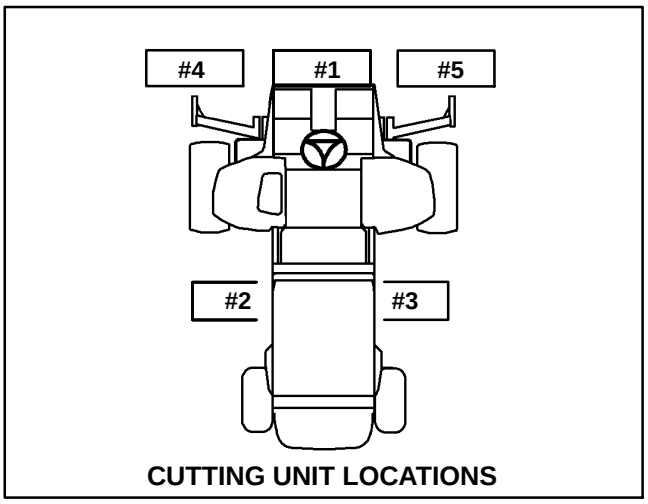


Figure 16

Raise Cutting Units

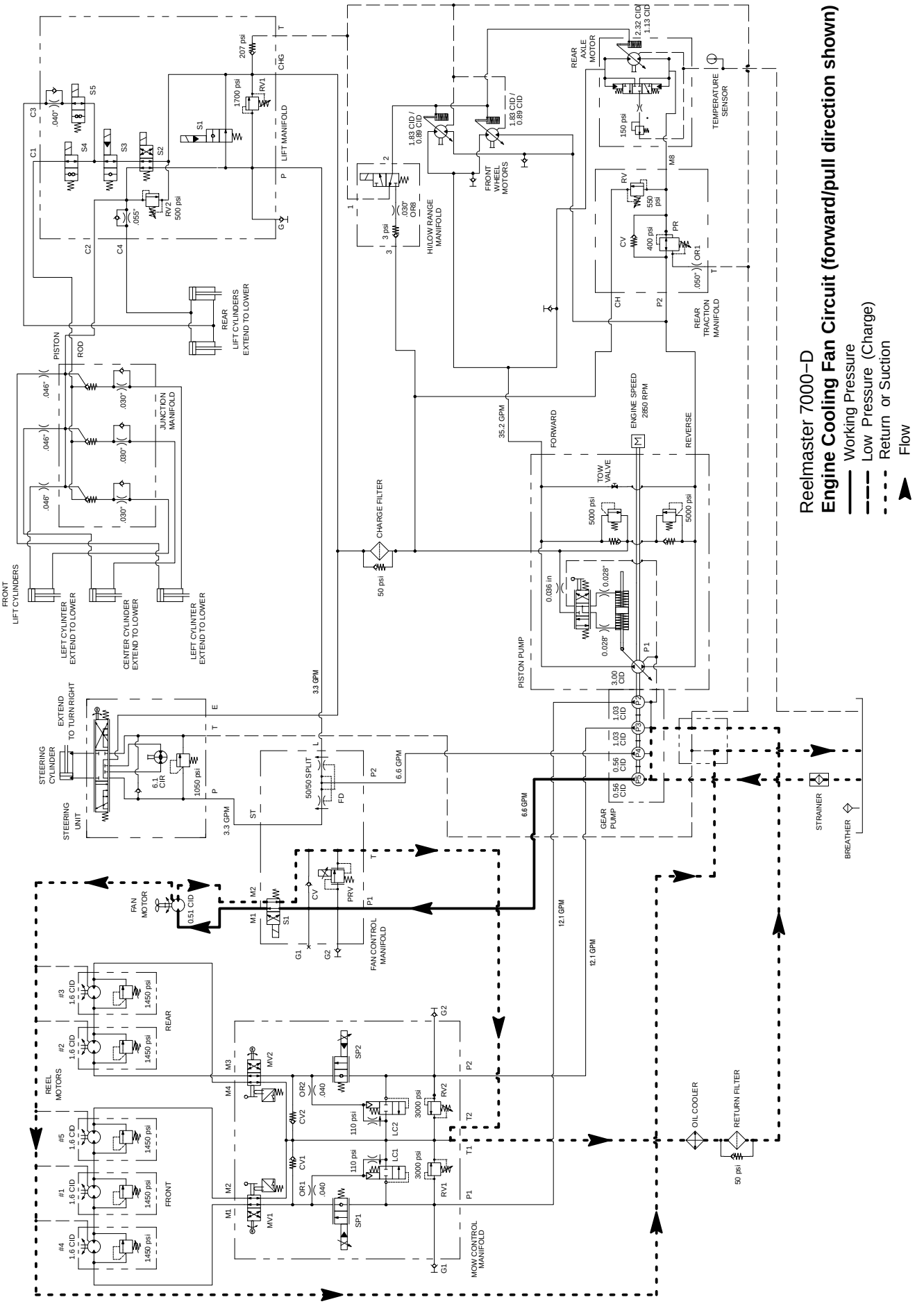
NOTE: The operator must be in the operator seat in order to raise the cutting units.

When the joystick is moved to the raise position, solenoid valve S1 along with solenoid valves S2, S3, S4 and S5 are energized by the TEC. To allow the front cutting units to be raised before the rear cutting units, the controller slightly delays energizing solenoid S5 after the joystick is moved to the raise position. The energized solenoid valves direct gear pump oil flow to the rod end of the lift cylinders. The flow to the front lift cylinders passes through the piloted check valves and bypasses the first set of control orifices. Hydraulic pressure causes the lift cylinder shafts to retract, and raise the cutting units.

The return flow from the retracting front lift cylinders passes through a second set of control orifices in the junction manifold providing cylinder speed control while raising the cutting units.

A flow control orifice in the lift control manifold (port C4) controls the rear cutting unit raising speed by providing a restriction for the return flow from the lift cylinders.

When the joystick is released, solenoid valves S1, S2, S3, S4 and S5 are de−energized and the lift cylinders and cutting units are held in position.


Reelmaster 7000−D
Engine Cooling Fan Circuit (forward/pull direction shown)
Working Pressure
Low Pressure (Charge)
Return or Suction
Flow
PISTON PUMP
GEAR PUMP
CHARGE FILTER
FRONT WHEEL MOTORS
REAR AXLE MOTOR
TEMPERATURE SENSOR
HI/LOW RANGE MANIFOLD
REAR TRACTION MANIFOLD
LIFT MANIFOLD
JUNCTION MANIFOLD
FRONT LIFT CYLINDERS
REAR LIFT CYLINDERS EXTEND TO LOWER
LEFT CYLINTER EXTEND TO LOWER
CENTER CYLINDER EXTEND TO LOWER
LEFT CYLINTER EXTEND TO LOWER
STEERING CYLINDER
STEERING UNIT
EXTEND TO TURN RIGHT
FAN MOTOR
FAN CONTROL MANIFOLD
REEL MOTORS
FRONT
REAR
MOW CONTROL MANIFOLD
TOW VALVE
FORWARD
REVERSE
ENGINE SPEED 2850 RPM
OIL COOLER
RETURN FILTER
STRAINER
BREATHER

Engine Cooling Fan Circuit

A four section gear pump is coupled to the piston (traction) pump. The gear pump section P5 (farthest from the piston pump) supplies hydraulic flow for the hydraulic engine cooling fan motor.

The fan control manifold controls the operation of the hydraulic motor that drives the engine cooling fan in addition to including the flow divider (FD) for the steering and lift circuits. The electronically controlled proportional relief valve (PRV) in the fan control manifold TS port controls the oil flow to the fan motor. The fan control manifold controls the speed and direction of the fan motor based on electrical output from the Toro Electronic Controller (TEC).

Oil flow from the gear pump to the cooling fan motor is controlled by the proportional relief valve (PRV) in the fan control manifold TS port. This valve adjusts fan circuit flow based on a PWM (Pulse Width Modulation) signal from the TEC. The controller uses engine coolant and hydraulic oil temperatures as inputs to determine the proper PWM signal for the proportional relief valve. The fan circuit flow determines the speed of the cooling fan motor.

The fan motor runs at reduced speed until engine coolant temperature reaches approximately 165F (74C), or hydraulic oil temperature reaches 170F (77C). The fan motor increases to full speed (approximately 2800 RPM) as engine coolant temperature reaches 180F (82C), or hydraulic oil temperature reaches 195F (91C).

The fan motor automatically slows down and then reverses direction if engine coolant temperature reaches 203F (95C) or hydraulic oil temperature reaches 212F (100C).

If the fan motor is stalled for any reason, the manifold proportional relief valve (PRV) has a secondary function as a circuit relief to limit fan motor pressure to 3000 PSI (207 bar).

When the engine is shut off, the over−running inertia load of the fan blades keeps driving the fan motor and turns it into a pump. The check valve (CV) in the fan control manifold will open to keep the motor circuit full of oil so the fan motor will not cavitate (fill with air).

NOTE: If PWM current is not available to the fan control manifold proportional relief valve (PRV), the cooling fan motor will run at full speed in the normal (forward) direction.

Fan Operation (forward/pull)

In the forward direction, the fan pulls air from outside the engine compartment through the radiator and oil cooler. Oil flow from the gear pump is sent through the de−energized solenoid valve S1 to rotate the cooling fan motor. Return flow from the motor re−enters manifold port M2, passes through the de−energized solenoid valve S1, out manifold port T, and then is routed through the mow control manifold, oil cooler and return oil filter.

Fan Operation (reverse/push) (Fig. 17)

The TEC can reverse the cooling fan to push air from inside the engine compartment through the radiator and oil cooler to clean debris from the rear intake screen. If hydraulic oil and/or engine coolant temperatures increase to an unsuitable level or if the engine cooling fan switch is pressed to manual reverse, a high PWM signal is sent to the PRV valve to slow the cooling fan and direct pump oil flow away from the fan motor. The controller then energizes solenoid valve S1 in the fan control manifold to reverse cooling fan motor oil flow so that the motor runs in the reverse direction. A lower PWM signal is sent to the PRV valve allowing oil flow to return to the fan motor but in the reverse direction causing the motor and cooling fan to run in reverse for a short time.

NOTE: The fan reversal process is designed to clean the rear intake screen (not the radiator) of debris. Refer to Operator's Manual for radiator cleaning maintenance recommendations.

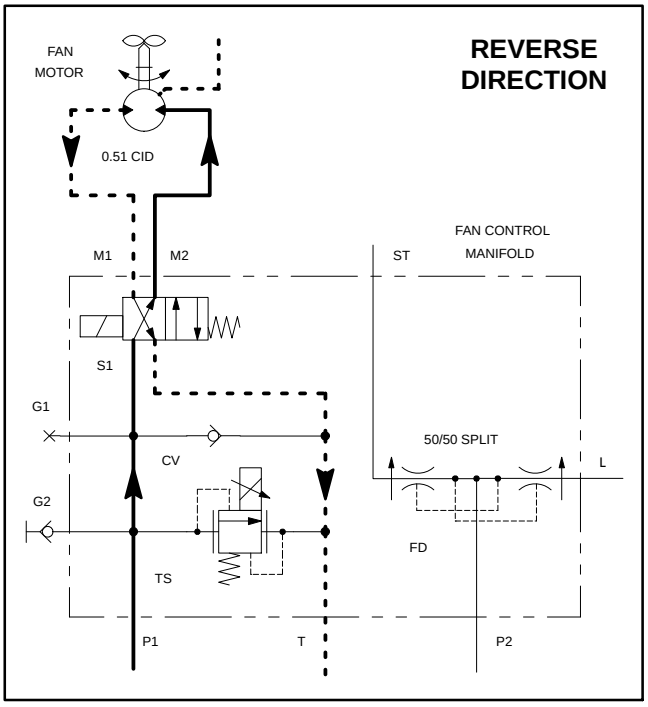


Figure 17

Special Tools

Order the following special tools from your Toro Distributor.

Hydraulic Pressure Test Kit

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

Toro Part Number: **TOR47009**



Figure 18

Hydraulic Tester (Pressure and Flow)

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.

Toro Part Number: **TOR214678**



Figure 19

40 GPM Hydraulic Tester (Pressure and Flow)

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

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

3. FLOW METER: This meter measures actual oil flow in the operating circuit with a gauge rated from 4 to 40 GPM (20 to 150 LPM).

Toro Part Number: **AT40002**

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



Figure 20

Hydraulic Hose Kit

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

Toro Part Number: **TOR6007**

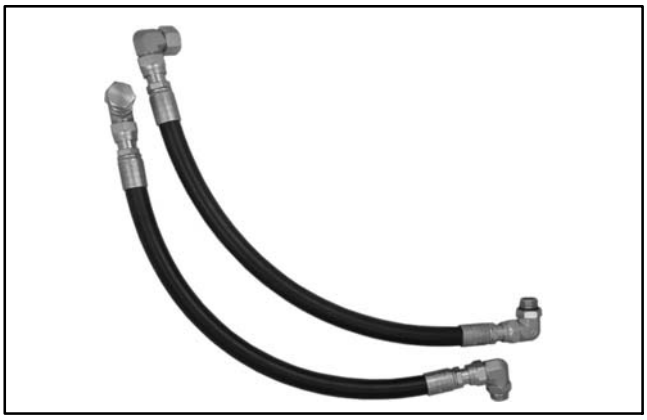


Figure 21

High Flow Hydraulic Filter Kit

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

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

Toro Part Number: **TOR6011**

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

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

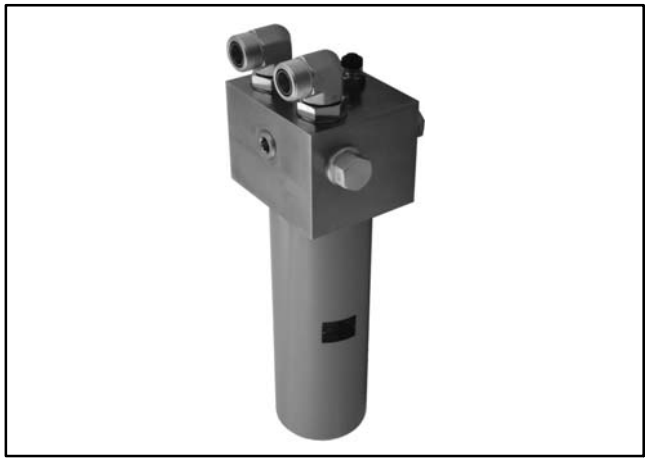


Figure 22

Hydraulic Test Fitting Kit

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

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

Toro Part Number: **TOR4079**

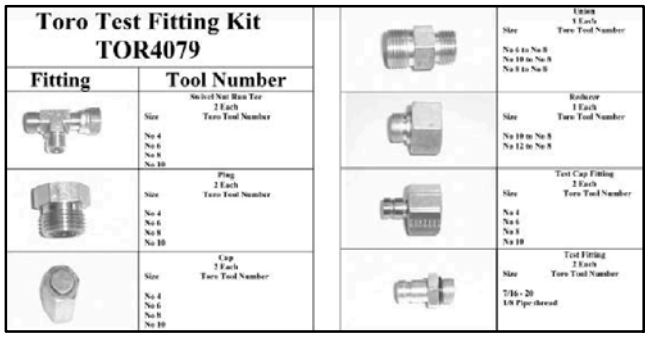


Figure 23

Measuring Container

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

The table in Figure 25 provides gallons per minute (GPM) conversion for measured milliliter or ounce motor case drain leakage.

Toro Part Number: **TOR4077**



Figure 24

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

Figure 25

O-ring Kit

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

Toro Part Number: **117-2727**



Figure 26

Remote Starter Switch

After flushing the hydraulic system or replacing a hydraulic component (e.g. gear pump, piston pump, wheel motor), it is necessary to prime the hydraulic pumps. A remote starter switch (Fig. 27) can be used for this purpose. Obtain a remote starter switch locally.

IMPORTANT: When using a remote starter switch, it is highly recommended to include a 20 amp in−line fuse between the battery and switch connector for circuit protection.

A remote stater switch can also be constructed using Toro switch #106−2027, a length of 14 gauge wire, a 20 amp in−line fuse, two (2) alligator clips and necessary connectors. Connecting the wire to switch terminals 1 and 2 will allow the momentary switch contacts to be used for the remote starter switch (Fig. 28).

NOTE: For information on using the remote starter switch to prime the hydraulic pumps, see Flush Hydraulic System in the Service and Repairs section of this chapter.



Figure 27

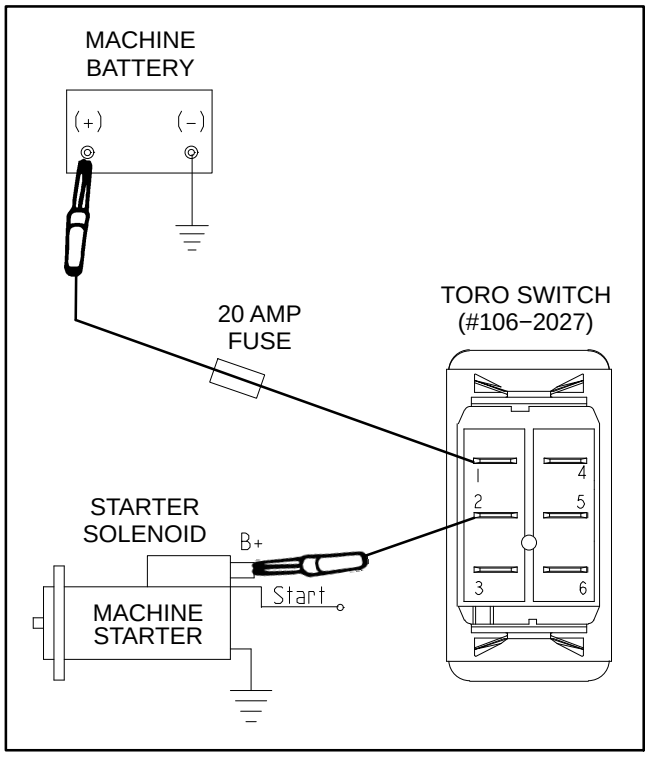


Figure 28

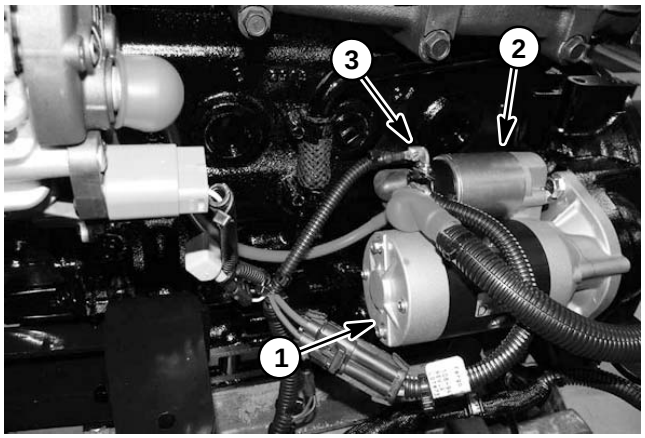


Figure 29

1. **Starter motor**
2. **Starter solenoid**
3. **B+ terminal**

Troubleshooting

The charts that follow contain information to assist in hydraulic system 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 testing procedures.

General Hydraulic System Problems

Problem	Possible Cause
Hydraulic system operates hot. **NOTE:** An indication that the hydraulic system is operating at excessive temperatures would be frequent reversing of the cooling fan and a normal engine coolant temperature.	Engine RPM is too low. Hydraulic reservoir oil level is low. Hydraulic oil is contaminated or the wrong type. Brakes are applied or sticking. Piston pump bypass valve is open or damaged. Cooling system is not operating properly. Charge pressure is low. Engine cooling fan circuit is malfunctioning (see Engine Cooling Fan Circuit Problems in this section). Traction circuit pressure is incorrect. Pump(s) or motor(s) are damaged.
Hydraulic oil in reservoir foams.	Hydraulic reservoir oil level is low. Wrong type of oil is in the hydraulic system. Air is leaking in suction line.
Hydraulic oil leak(s).	Fitting(s), hose or tube loose or damaged. Missing or damaged O-ring in fitting.

Traction Circuit Problems

When troubleshooting traction circuit problems, if a problem exists in both low (mow) and high (transport) speeds, consider a faulty component that affects the entire traction circuit (e.g. charge circuit, traction circuit relief valves, piston pump). If the problem exists in LOW speed (mow) but not in HI speed (transport), consider a problem that only exists in mow (e.g. swashplate components in front wheel or rear axle motor, solenoid valve in HI/LOW range manifold).

Problem	Possible Cause
Machine operates in one direction only.	Piston (traction) pump by−pass valve is open or damaged. Traction relief valve in piston pump is leaking or faulty. Piston (traction) pump servo control valve orifices or screens are plugged or damaged. Problem with TEC output to piston (traction) pump servo control exists (see Chapter 6 − Electrical System).
Traction pedal reaction is sluggish.	Traction pedal components are stuck or binding. Traction charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged.
Machine travels too far before stopping when the traction pedal is released.	Traction pedal components are stuck or binding. Traction charge pressure is low. Piston (traction) pump servo control valve orifices are plugged or damaged.
Traction power is lost or machine will not operate in either direction.	Hydraulic reservoir oil level is low (**NOTE:** Other hydraulic systems are affected as well). Piston (traction) pump by−pass valve is open or damaged. Traction charge pressure is low. Traction circuit pressure is low. Problem with TEC output to servo control (see Chapter 6 − Electrical System).
LOW traction speed (mow) will not engage. **NOTE:** LOW (mow) will not engage when the cutting units are lowered.	Electrical problem exists that prevents solenoid valve in HI/LOW range manifold from being de−energized (see Chapter 6 − Electrical System). Solenoid valve in HI/LOW range manifold is faulty.
LOW traction speed (mow) will not disengage.	Electrical problem exists that prevents solenoid valve in HI/LOW range manifold from being energized (see Chapter 6 − Electrical System). Solenoid valve in HI/LOW range manifold is faulty.

Mow Circuit Problems

Problem	Possible Cause
None of the cutting units will operate. **NOTE:** To engage the mow circuit, the seat must be occupied, the cutting units(s) must be fully lowered, the traction speed must be in the LOW (mow) position and the reel enable/disable switch must be ON.	Cutting units are not fully lowered to ground. Reel enable/disable switch is not in engaged position. Operator seat is unoccupied. Traction system is in HI speed (transport). Engine coolant temperature is above 221F (105C) preventing cutting units from engaging (Fault 01 should be displayed on InfoCenter). Cutting unit position sensor is out of adjustment or faulty. Electrical problem exists that prevents mow control manifold solenoid valve operation (see Chapter 6 − Electrical System). Gear pump sections that supply mow circuits are damaged.
One cutting unit will not operate.	Circuit pressure to the affected reel motor is low. Cutting unit problem exists (see Chapter 9 − DPA Cutting units). Spline on affected reel motor (or adapter) is damaged. Reel motor relief valve is stuck or damaged. Reel motor is damaged. **NOTE:** If appropriate, transfer a suspected damaged motor to another cutting unit. If problem follows the motor, motor needs repair or replacement.
Several cutting units will not operate.	Electrical problem exists that prevents mow control manifold solenoid valve operation (see Chapter 6 − Electrical System). Cutting units are not fully lowered to ground. Solenoid cartridge valve (SP1 or SP2 in mow control manifold) for affected cutting units is faulty. Logic cartridge valve (LC1 or LC2 in mow control manifold) is stuck or damaged. Gear pump section (P2 or P3) is worn or damaged.
All cutting units operate slowly.	Engine RPM is low. Gear pump section (P2 or P3) is worn or damaged.

Mow Circuit Problems (Continued)

Problem	Possible Cause
Cutting unit stops under load.	Relief valve in mow control manifold is bypassing. Traction speed and cutting conditions (e.g. very tall or wet grass) exceed cutting unit capacity. Reel motor relief valve is stuck or damaged. Reel motor has internal leakage (bypassing oil). Gear pump section (P2 or P3) is worn or damaged.

Steering Circuit Problems

Problem	Possible Cause
Steering inoperative or sluggish.	Steering components (e.g. tie rods, steering cylinder ends) are worn or binding. Steering cylinder is binding. Oil level in hydraulic reservoir is low (other hydraulic systems affected as well). Relief valve in steering control valve is stuck or damaged. Flow divider (FD) in fan control manifold is faulty. Steering cylinder leaks internally. Steering control valve is worn or damaged. Gear pump section (P4) is worn or damaged. (**NOTE:** A worn or damaged gear pump section (P4) will also affect the traction (charge) and lift circuits).

Lift/Lower Circuit Problems

Problem	Possible Cause
Cutting units will not raise. **NOTE:** Operator must be in seat in order to raise the cutting units.	Operator seat is unoccupied. Hydraulic oil level in reservoir is low. Electrical problem exists that prevents lift manifold solenoid valve operation (see Chapter 6 − Electrical System). Lift cylinder(s) is (are) damaged. Lift arm pivots are binding. Lift/lower circuit relief valve (RV1) in lift manifold is stuck open. Solenoid valve(s) in lift manifold is damaged or sticking. Flow divider (FD) in fan control manifold is faulty. Gear pump section (P4) is worn or damaged. (**NOTE:** A worn or damaged gear pump section (P4) will also affect the traction (charge) and steering circuits).
Cutting units raise, but will not stay up as the traction units travels between adjacent fairways or fields. **NOTE:** Lift circuit components cannot provide an absolutely perfect seal. The lift arms will eventually lower if left in the raised position during storage.	Lift circuit hydraulic lines or fittings are leaking. Cartridge valve in lift manifold is stuck open. Air exists in lift circuit. Lift cylinder is damaged.
Cutting units will not lower. **NOTE:** Operator must be in seat and traction system must be in LOW speed (mow) in order to lower the cutting units.	Operator seat is unoccupied. Traction system is in HI speed (transport). Lift arm pivots are binding. Lift cylinder is damaged. Electrical problem exists that prevents lift manifold solenoid valve operation (see Chapter 6 − Electrical System). Lift/lower circuit relief valve (RV1) in lift manifold is stuck open.

Engine Cooling Fan Circuit Problems

Problem	Possible Cause
Cooling fan runs only in forward direction (fan does not run in reverse direction).	Fan control manifold solenoid cartridge valve (S1) is faulty. Electrical problem exists that prevents fan control manifold solenoid valve (S1) operation (see Chapter 6 − Electrical System).
Cooling fan does not rotate.	Fan motor is worn or damaged. Gear pump section (P5) is worn or damaged.
Cooling fan always rotates at slow speed.	Fan control manifold cartridge valve seals are leaking. Check valve in fan control manifold is not seating. Fan control manifold proportional relief valve (PRV) is stuck open. Hydraulic fan motor is worn or damaged.
Cooling fan always rotates at fast speed.	Fan control manifold proportional relief valve (PRV) is faulty. Electrical problem exists that prevents fan control manifold proportional relief valve (PRV) operation (see Chapter 6 − Electrical System).

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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).

Remember that pressure specifications that appear on hydraulic schematics are the design specifications for the specific component. Actual system pressure will vary depending on oil temperature, the location of the test port, and the specific components used in the hydraulic circuit.

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.

Before Performing Hydraulic Tests

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

Make sure hydraulic oil is at normal operating temperature by operating the machine under load for approximately ten (10) minutes. Also, make sure the hydraulic reservoir is full.

Precautions for Hydraulic Testing

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.

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 monitor testing equipment and record test results.

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

2. Put metal caps or plugs on any hydraulic lines left open or exposed during testing or while hydraulic components are removed.

3. The engine must be in good operating condition. Use a phototach (non−contact tachometer) when performing a hydraulic test. Engine speed can affect the accuracy of the test readings. Monitor engine RPM during hydraulic testing. Use the information below when performing hydraulic system tests. If engine RPM is above or below the specified speed during a test, you will need to adjust the expected hydraulic performance parameters (aprox. 3% per 100 engine rpm at full throttle)

IMPORTANT: Hydraulic component output volume relates directly to engine RPM. For every 100 engine rpm the following component output volumes will change by the volume listed.

Piston (traction) Pump (P1): 100 engine RPM = 1.3 GPM or 166 oz. (4916 cc) of hydraulic fluid displaced per minute

Gear Pump (P2): 100 engine RPM = 0.45 GPM or 57 oz. (1687 cc) of hydraulic fluid displaced per minute

Gear Pump (P3): 100 engine RPM = 0.45 GPM or 57 oz. (1687 cc) of hydraulic fluid displaced per minute

Gear Pump (P4): 100 engine RPM = 0.24 GPM or 31 oz. (917 cc) of hydraulic fluid displaced per minute

Gear Pump (P4): 100 engine RPM = 0.24 GPM or 31 oz. (917 cc) of hydraulic fluid displaced per minute

NOTE: Engine−to−Pump ratio is 1:1. In other words, 1 engine RPM = 1 pump RPM.

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

5. When using a hydraulic 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 hydraulic tester hoses to prevent moving machine parts from contacting and damaging the hoses or tester.

8. Check fluid 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.

Which Hydraulic Test Are Necessary?

Before beginning any hydraulic test, identify if the problem is related to the traction circuit, mow circuit, lift/lower circuit, steering circuit or engine cooling fan circuit. Once the faulty system has been identified, perform tests that relate to that circuit.

1. If a traction circuit problem exists, consider performing one or more of the following tests: Traction Circuit Charge Pressure, Traction Circuit Relief Pressure, Traction Circuit Reducing Valve (PR) Pressure, Rear Traction Circuit Relief Valve (RV) Pressure, Gear Pump Flow and/or Piston (Traction) Pump Flow Tests.

IMPORTANT: Refer to Traction Circuit Component Failure in the General Information section of this chapter for information regarding the importance of removing contamination from the traction circuit.

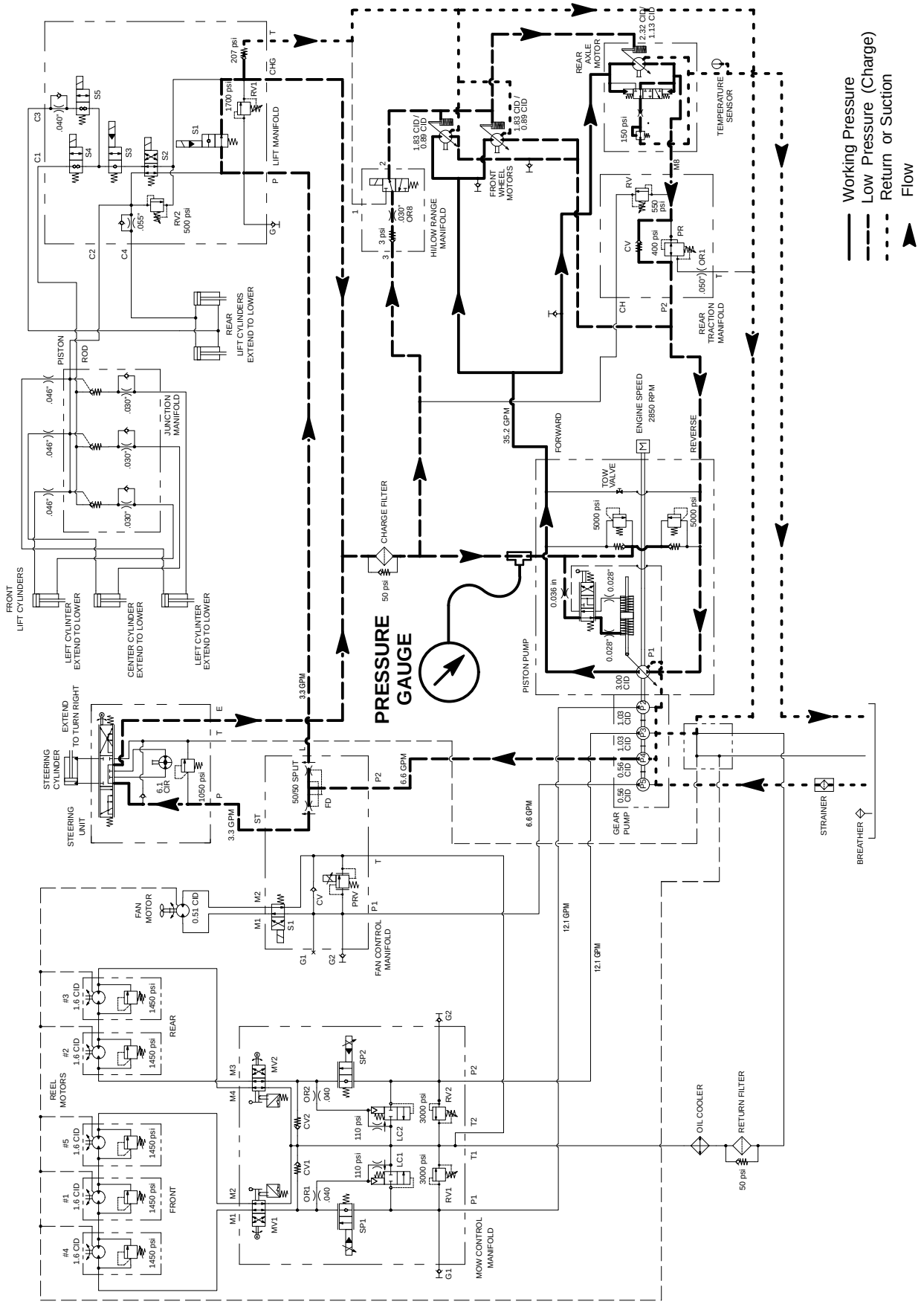
2. If a mow circuit problem exists, consider performing one or more of the following tests: Mow Circuit Pressure, Mow Circuit Relief Pressure, Cutting Unit Motor Case Drain Leakage and/or Gear Pump P2 and P3 Flow Tests.

3. If a lift/lower circuit problem exists, consider performing one or more of the following tests: Lift/Lower Circuit Relief Pressure and/or Gear Pump P4 Flow Tests.

4. If a steering circuit problem exists, consider performing one or more of the following tests: Steering Circuit Relief Pressure, Steering Cylinder Internal Leakage and/or Gear Pump P4 Flow Tests.

5. If an engine cooling fan circuit problem exists, consider performing one or more of the following tests: Cooling Fan Circuit and/or Gear Pump P5 Flow Tests.

Traction Circuit − Charge Pressure Test



Traction Circuit − Charge Pressure Test

The charge pressure test is one of the tests recommended to determine traction circuit performance. A charge pressure drop of more than **20%** indicates an internal leak in the piston (traction) pump. Continued unit operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Special Equipment Required:

- Pressure Gauge − 1000 PSI (70 bar) with hose
- Tee Fitting − 13/16 − 16
- Diagnostic Fitting
- Phototach (non−contact tachometer) for units with Kubota diesel engine

CAUTION

Test machine in an open area, away from people and obstructions.

1. Park machine on a level surface with the cutting units lowered and the reel engage/disengage switch is in the disengage position. Make sure engine is off and the parking brake is engaged.

CAUTION

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

2. Make sure that traction pedal is adjusted to the neutral position (see traction unit Operator's Manual).

3. Disconnect the charge circuit hose at the bottom of the piston (traction) pump. This hose comes from the charge filter (Fig. 30).

4. Install a tee fitting, diagnostic fitting, and a 1000 PSI (70 bar) pressure gauge with hose between the piston (traction) pump fitting and disconnected hose. The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat.

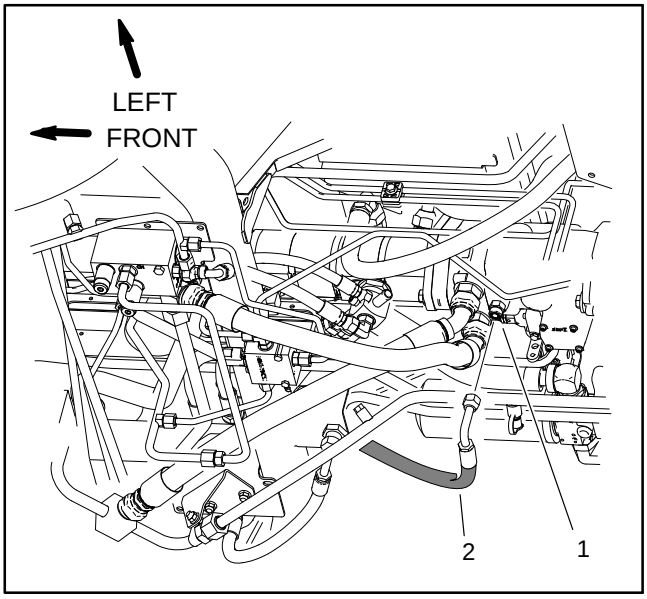


Figure 30

1. Piston (traction) pump **2. Charge circuit hose**

5. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

6. Set throttle to full speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

8. Record reading on pressure gauge. Charge pressure (without load) should read approximately **207 PSI (14.3 Bar).** If charge relief pressure specification is not met, consider the following:

   A. Restriction in gear pump intake line.

   B. Charge relief valve (check valve the lift manifold) is faulty (see Lift Manifold in this chapter).

   C. Gear pump (P3) is faulty (steering/lift circuit performance will also be affected). Test gear pump (P3) flow as outlined in this chapter.

9. Sit in the operator's seat, release the parking brake, apply the brakes and slowly depress the forward traction pedal about half way.

10. Record reading on pressure gauge. Charge pressure (under load) should not drop **more than 20%** when compared to charge pressure (without load) recorded in step 8.

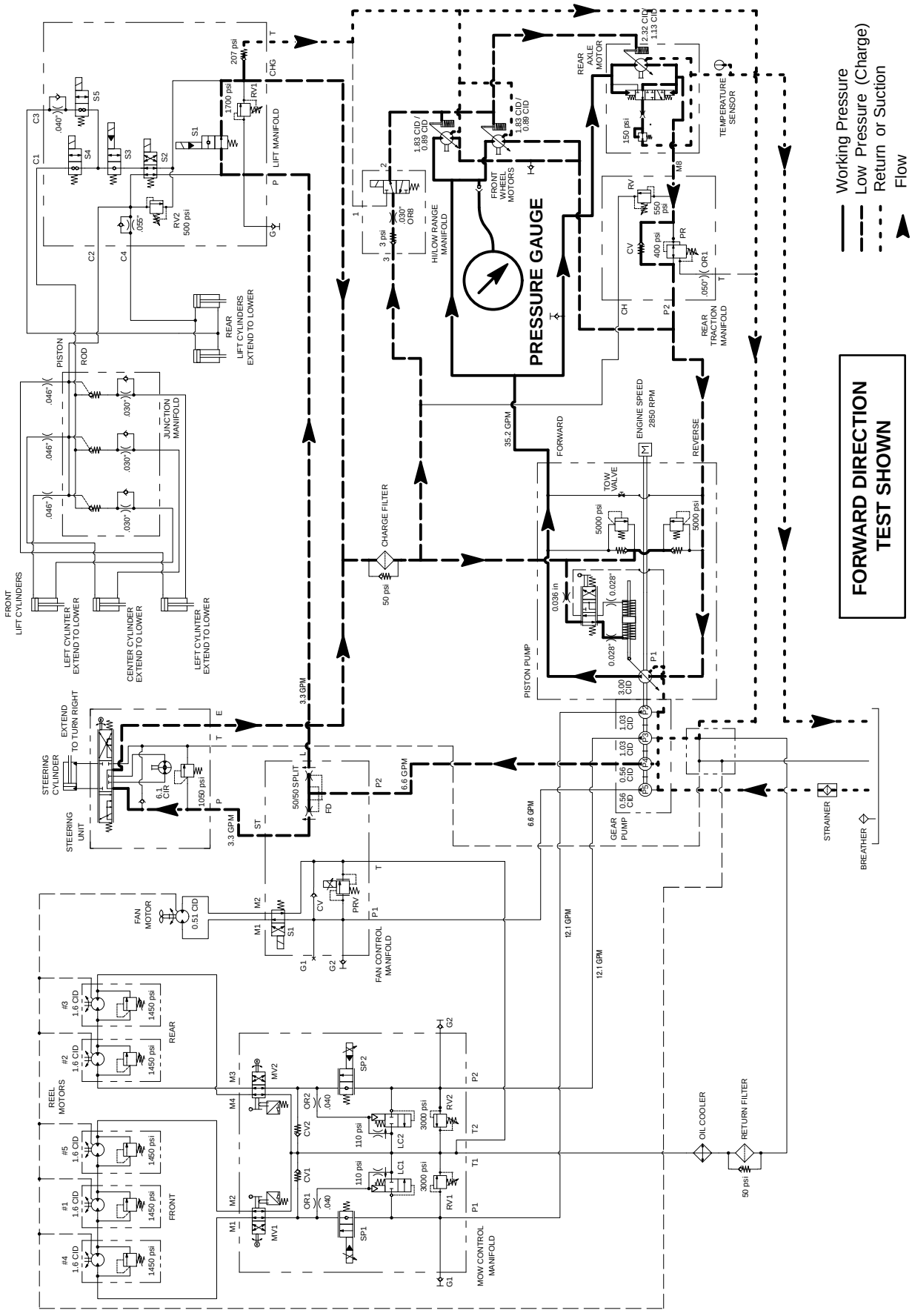
If specifications are not met, perform Piston (traction) Pump Flow Test as outlined in this chapter.

11. Release traction pedal, set parking brake, move throttle to low speed and turn the engine off.

12. Remove pressure gauge and tee fitting when testing is completed. Install charge circuit hose and check for leaks.

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Traction Circuit − Relief Pressure Test



Traction Circuit − Relief Pressure Test

Special Equipment Required:

- Pressure Gauge − 10,000 PSI (700 bar) with hose
- Phototach (non−contact tachometer) for units with Kubota diesel engine

CAUTION

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

1. Drive machine to an open area, lower cutting units, turn the engine off and apply parking brake.

2. Locate traction circuit test port for function to be checked (FORWARD or REVERSE). Test ports are located on hydraulic lines near the right front wheel motor (Fig. 31). **FORWARD traction test port faces the front and REVERSE test port faces rearward.**

3. Connect a 10,000 PSI (700 bar) pressure gauge to traction circuit test port for function to be checked (FORWARD or REVERSE). The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat.

4. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

7. Sit in the operator's seat, set the mow speed limiter to the HI speed (transport) position, release the parking brake and apply the brakes. Slowly depress the traction pedal in the appropriate direction (forward or reverse). Note pressure reading on gauge as relief valve opens.

   GAUGE READING TO BE:
   Forward: **4800 to 5300 PSI (332 to 365 bar)**
   Reverse: **4800 to 5300 PSI (332 to 365 bar)**

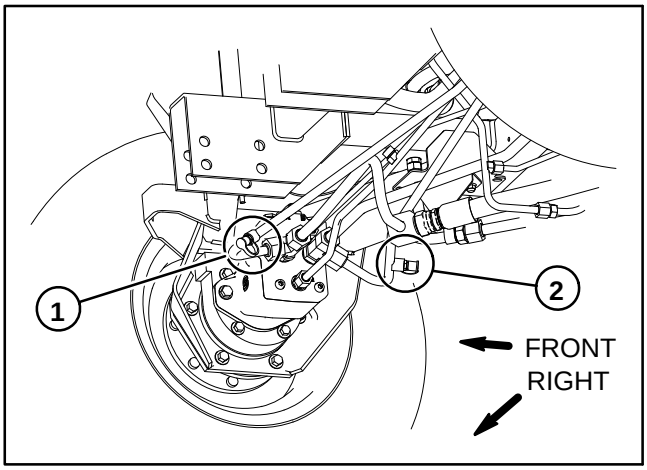


Figure 31

1. **FORWARD test port**
2. **REVERSE test port**

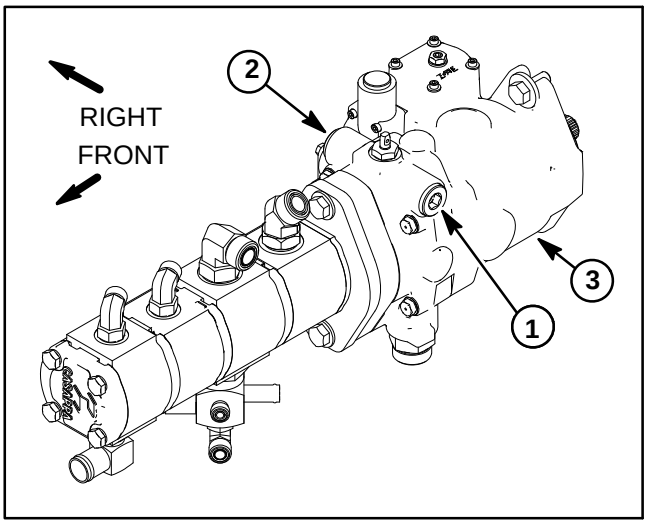


Figure 32

1. **Forward relief valve**
2. **Reverse relief valve**
3. **Traction pump**

8. Release traction pedal, set parking brake, and stop engine. Record test results.

9. If pressure is too low, make sure that bypass (tow) valve in traction pump is fully seated.

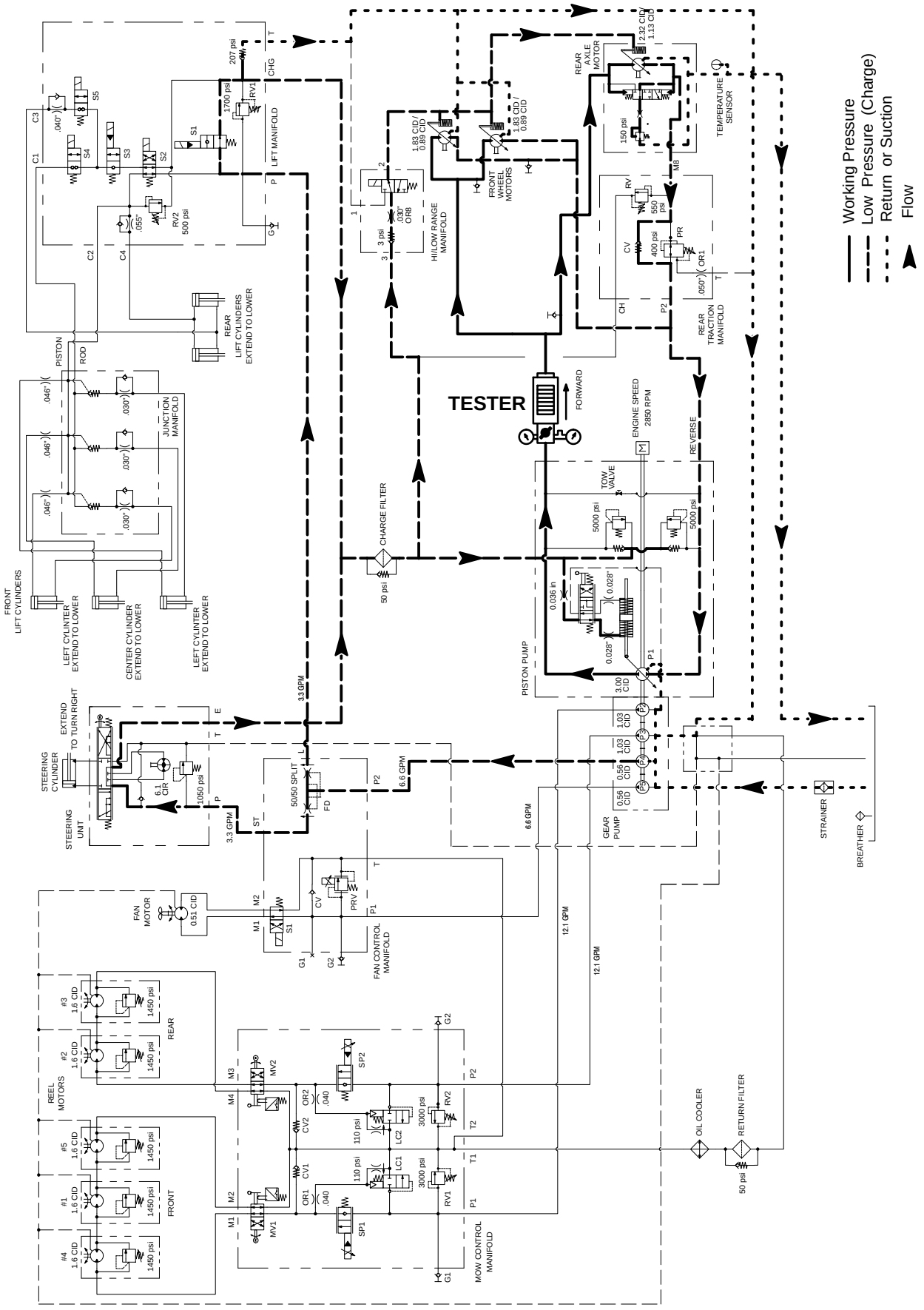
10. If traction pressure is too low, inspect traction pump relief valves (Fig. 32). These cartridge type valves are factory set and are not adjustable. Clean or replace valves as necessary.

NOTE: Forward and reverse relief valves are identical. Relief valves can be switched in piston (traction) pump to help in identifying a faulty relief valve.

If relief valves are in good condition, piston (traction) pump, wheel motors and/or rear axle motor should be tested for wear and efficiency.

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

Traction Circuit − Piston (traction) Pump Flow Test



Traction Circuit − Piston (traction) Pump Flow Test

This test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than **12%** indicates an internal leak or malfunctioning relief valve in the piston (traction) pump. A worn piston pump or malfunctioning relief valve is less efficient. Eventually, enough fluid by−pass will cause the unit to stall under heavy load conditions. Continued operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

Special Equipment Required:

- 40 GPM (151 LPM) Hydraulic Tester (Pressure and Flow) with hoses − 1−7/16 − 12
- Phototach (non−contact tachometer) for units with Kubota diesel engine

CAUTION

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

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

WARNING

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

2. Raise and support machine so all wheels are off the ground (see Jacking Instructions in Chapter 1 − Safety in this manual).

3. Thoroughly clean junction of hydraulic hoses and fittings on bottom of piston (traction) pump.

4. Disconnect hose from **left** side fitting on bottom of piston (traction) pump (forward port) (Fig. 33).

IMPORTANT: Traction circuit flow for the Reelmaster 7000−D is approximately 35 GPM (133 LPM). Use a Hydraulic Tester (pressure and flow) with a 40 GPM or larger capacity for this test (see Special Tools in this chapter).

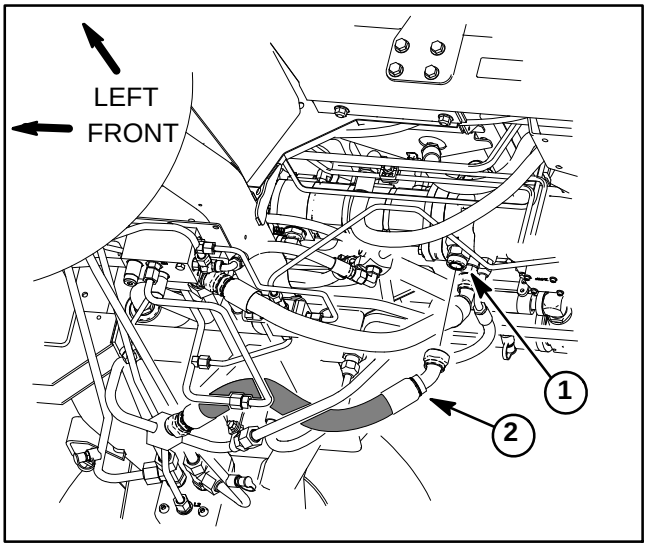


Figure 33

1. Piston (traction) pump
2. Left hose (forward port)

5. Install 40 GPM Hydraulic Tester between piston pump left side fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) so tester can be easily viewed and operated from alongside machine. Make sure that hydraulic connections are properly tightened and the tester flow control valve is fully open.

CAUTION

Use extreme caution when performing piston pump flow tests. The traction unit wheels will be rotating during the test .

6. Make sure the traction pedal and linkage are properly adjusted for neutral (see traction unit Operator's Manual).

7. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

8. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

10. Sit in the operator's seat, set the mow speed limiter to the HIGH speed (transport) position, and release the parking brake.

11. Verify pump flow at No Load as follows:

    A. Slowly depress forward traction pedal to full forward position.

    B. Record tester pressure and flow readings. Unrestricted pump output should be approximately **35 GPM (133 LPM)** at **1000 PSI (69 Bar).**

12. Verify pump flow Under Load as follows:

    A. Slowly depress forward traction pedal to full forward position.

    B. Apply an **additional load of 1500 to 2000 PSI (103 to 138 Bar)** by slowly closing the flow meter. The flow meter pressure gauge should read **2500 to 3000 PSI (172 to 207 Bar)**.

    C. Record tester pressure and flow readings.

13. Release traction pedal to the neutral position, open flow control valve on tester and shut off engine.

14. The Under Load test flow reading (step 12.) should not drop **more than 12%** when compared to the No Load test flow reading (step 11.). A difference of more than 12% may indicate:

    A. The piston (traction) pump swash plate is not being rotated fully (traction pedal & linkage is out of adjustment).

    B. The forward traction relief valve is leaking or faulty (see Traction Circuit − Relief Pressure Test in this chapter).

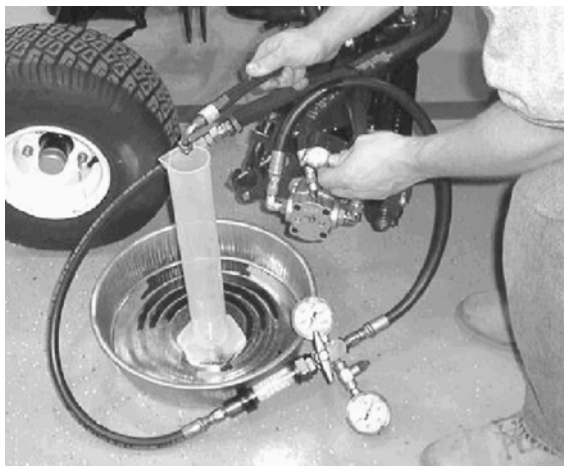
    C. The piston (traction) pump needs to be repaired or replaced as necessary.

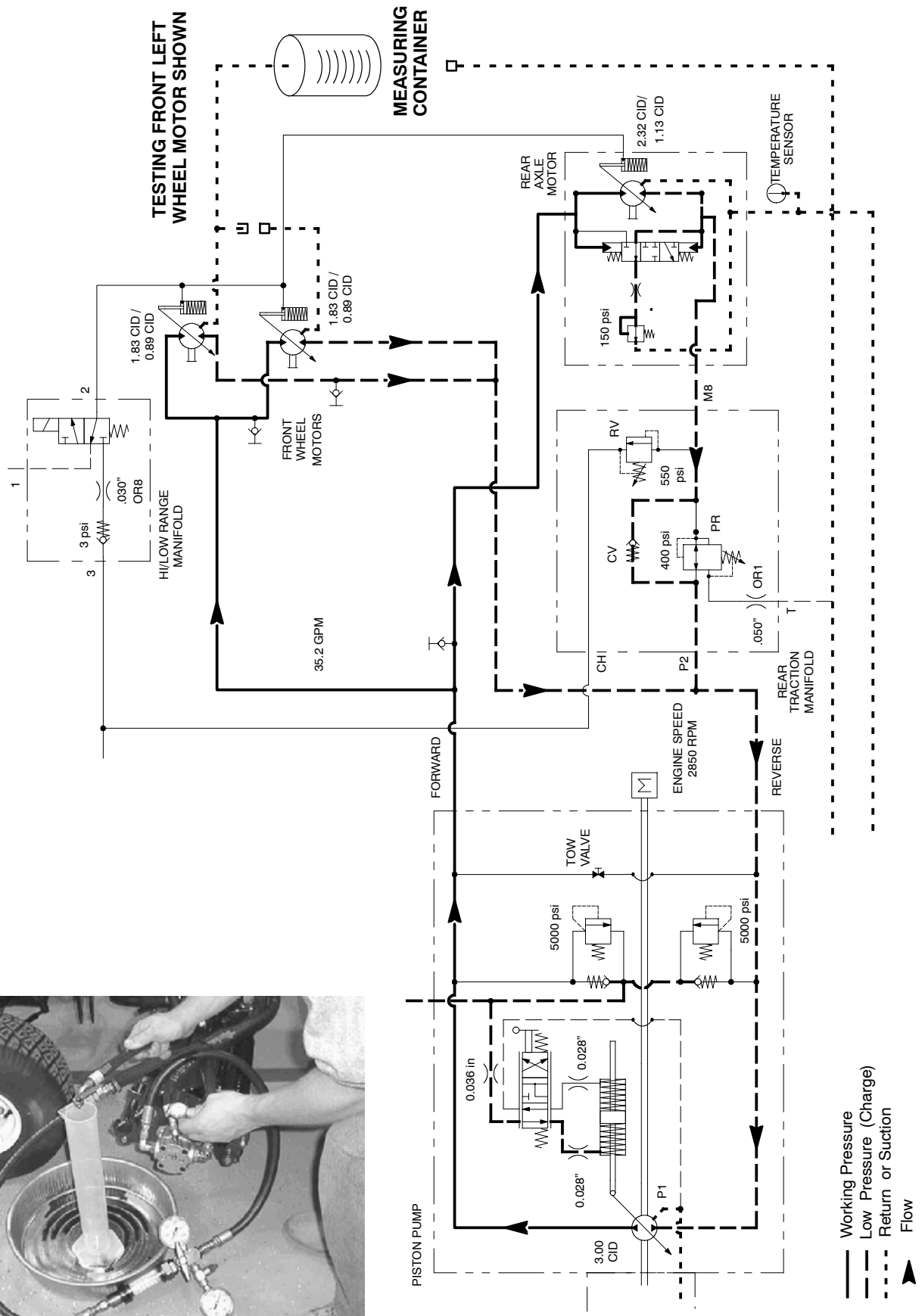
15. Make necessary adjustments or repairs and retest.

16. When testing is complete, disconnect tester from pump fitting and machine hydraulic hose. Reconnect hose to pump fitting and check for leaks. Lower machine to ground.

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Traction Circuit - Front Wheel Motor Case Drain Leakage Test





Traction Circuit − Front Wheel Motor Case Drain Leakage Test

Front wheel motor efficiency is one of tests recommended to determine traction circuit performance. Over a period of time, a wheel motor can wear internally. A worn motor will bypass oil to its case drain causing the motor to be less efficient. Eventually, enough fluid bypass will cause the motor to stall under heavy load conditions. Continued operation can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect overall machine performance.

The front wheel motors used on the Reelmaster 7000−D are 2−position (dual displacement) motors. The motors have a larger displacement/lower operating pressure when set to LOW speed (mow), and a smaller displacement/higher operating pressure when set to HIGH speed (transport) Test each motor individually while set to HI (transport) speed.

Special Equipment Required:

- Pressure Gauge − 10,000 PSI (700 bar) with hose
- Hydraulic Hose − 13/16 − 16 x 6 ft (1.8 m)
- Hydraulic Cap − 13/16 − 16
- Hydraulic Plug − 13/16 − 16
- Phototach (non−contact tachometer) for units with Kubota diesel engine

1. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch is in the DISABLE position. Set the mow speed limiter to HI (transport) speed, turn the engine is off, and set the parking brake.

CAUTION

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

2. Locate traction circuit test port for FORWARD operation. Test ports are located on hydraulic lines near the right front wheel motor (Fig. 34). **Forward traction test port faces the front.**

3. Connect a 10,000 PSI (700 bar) pressure gauge to traction circuit test port for FORWARD operation. The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat.

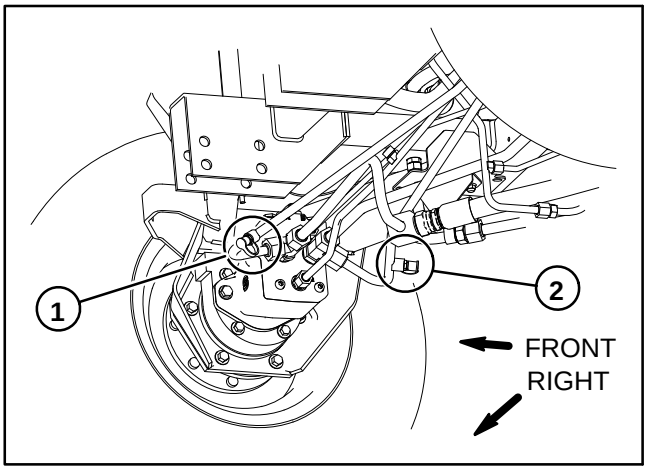


Figure 34

1. FORWARD test port **2. REVERSE test port**

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

5. Chock the wheels to prevent wheel rotation during testing.

6. Start engine and set throttle to full speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

8. Stop the engine and disconnect the motor case drain at the appropriate location (Fig. 35):

   A. Right Front Wheel Motor: disconnect the case drain tube from the straight fitting at motor port L2 and install a 6 ft (1.8 m) hydraulic hose to the fitting. Install a hydraulic plug in the disconnected tube.

   B. Left Front Wheel Motor: disconnect the two (2) case drain tubes from the tee fitting at motor port L2. Install a 6 ft (1.8 m) hydraulic hose to either tee fitting post and install a hydraulic cap on the other. Install hydraulic plugs in the disconnected tubes.

9. Place open end of the case drain test hose into a drain pan.

10. Two people are required to complete the following steps. One person should sit in the operator's seat and operate the machine while another person measures motor case drain volume.

11. Sit in the operator's seat, start the engine and set the throttle to high idle speed.

12. Release the parking brake and apply both left and right brakes. Slowly move the traction pedal in the FORWARD direction until the pressure gauge reaches system relief pressure (approximately 2500- 3000 psi (172- 206 bar)).

NOTE: Use a graduated container (special tool TOR4077) to measure case drain leakage.

13. Have a second person measure flow from the case drain line for **ten (10) seconds**, then release the traction pedal, set the parking brake, and stop the engine. Record test results.

Case drain leakage should be **less than 29 oz (857 ml)** of hydraulic fluid in ten (10) seconds (.225 GPM / 0.85 LPM)**.**

14. If case drain flow is more than specification, the motor is worn or damaged and should be repaired or replaced.

15. Remove case drain test hose. Remove plug from case drain tube and reconnect tube.

16. Repeat test for additional front wheel motor if required.

17. When testing is completed, disconnect pressure gauge from test port and install dust cap.

18. Check hydraulic fluid level and adjust if necessary (see traction unit Operator's Manual). Start engine and run at low idle speed. Check for hydraulic leaks and make corrections if necessary before returning machine to service.

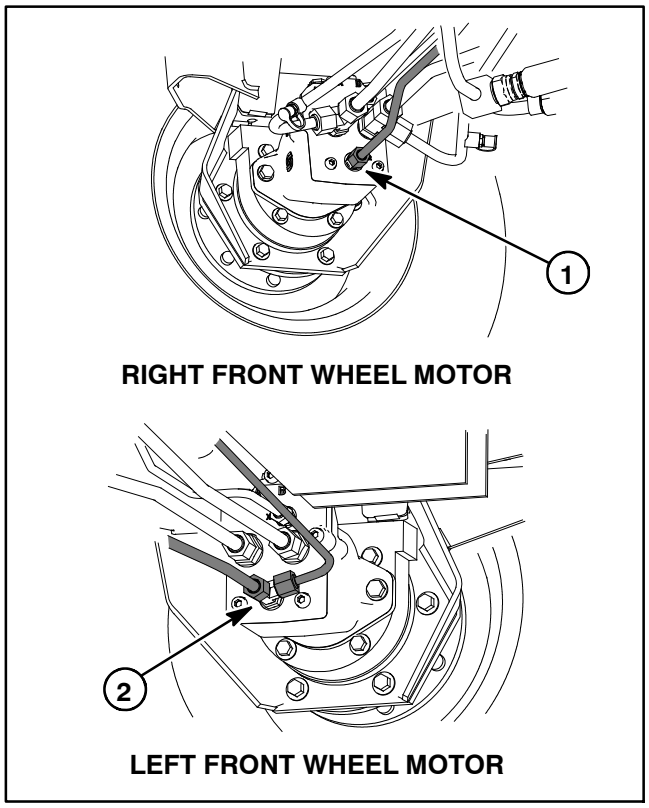
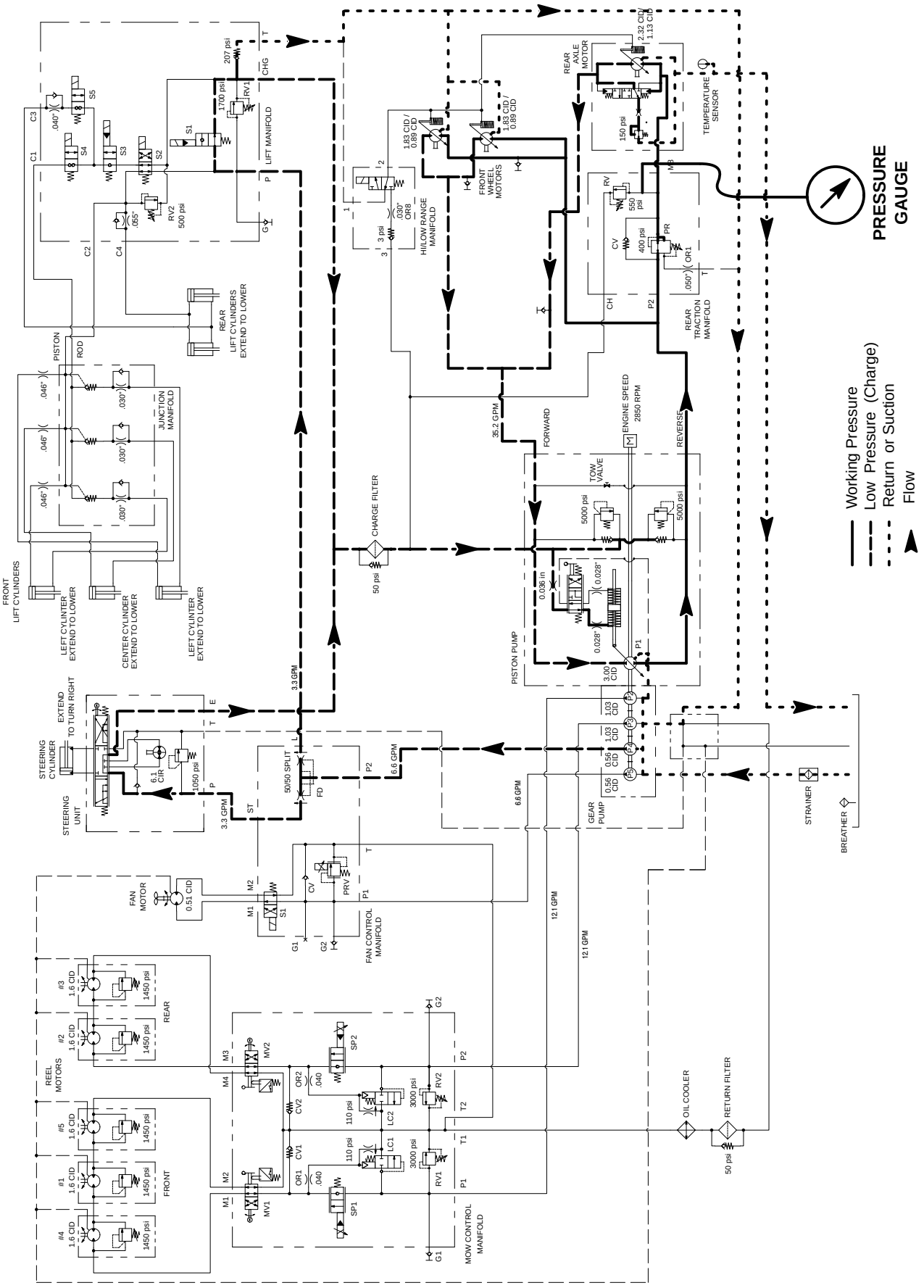


Figure 35

1. **Straight fitting (L2 port)** 2. **Tee fitting (L2 port)**

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Traction Circuit − Reverse Reducing Valve (PR) Pressure Test



Traction Circuit − Reverse Reducing Valve (PR) Pressure Test

When in reverse, pressure reducing valve (PR) located in the rear traction manifold limits the pressure to the rear axle motor to 450 PSI (31 bar) so the rear wheels will not scuff the turf. Check the pressure reducing valve (PR) pressure if the rear wheels are scuffing the turn in reverse (setting too high) of if poor traction performance when in reverse is suspect (setting too low or too close to rear relief valve (RV) setting).

Special Equipment Required:

- Pressure Gauge − 1000 PSI (70 bar) with hose
- Diagnostic Fitting w/Cap − 9/16 − 18
- Phototach (non−contact tachometer) for units with Kubota diesel engine

CAUTION

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

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

NOTE: The #6 zero leak plug on the rear traction manifold has a tapered sealing surface on the plug head. 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.

2. The rear traction manifold is attached to the frame near the left front wheel motor (Fig. 36). Remove the #6 zero leak plug from the unmarked port located between ports M8 and P2 and install a diagnostic fitting.

3. Connect a 1000 PSI (70 bar) pressure gauge with hydraulic hose attached to installed diagnostic fitting. The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat.

4. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

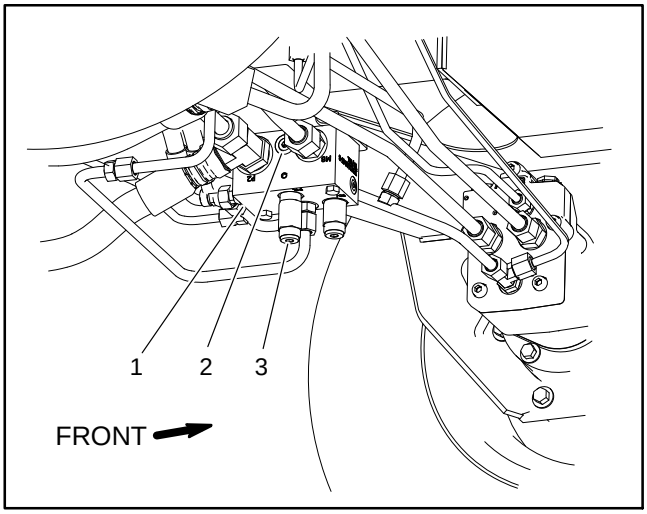


Figure 36

1. **Rear traction manifold**
2. **Unmarked port**
3. **Reducing valve (PR)**

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

7. Sit in the operator's seat, set the mow speed limiter to the LOW speed (mow) position, release the parking brake and apply the brakes. Slowly depress the traction pedal in the reverse direction. Note pressure reading on gauge as relief valve opens.

   GAUGE READING TO BE:
   420 to 470 PSI (29 to 32 bar)

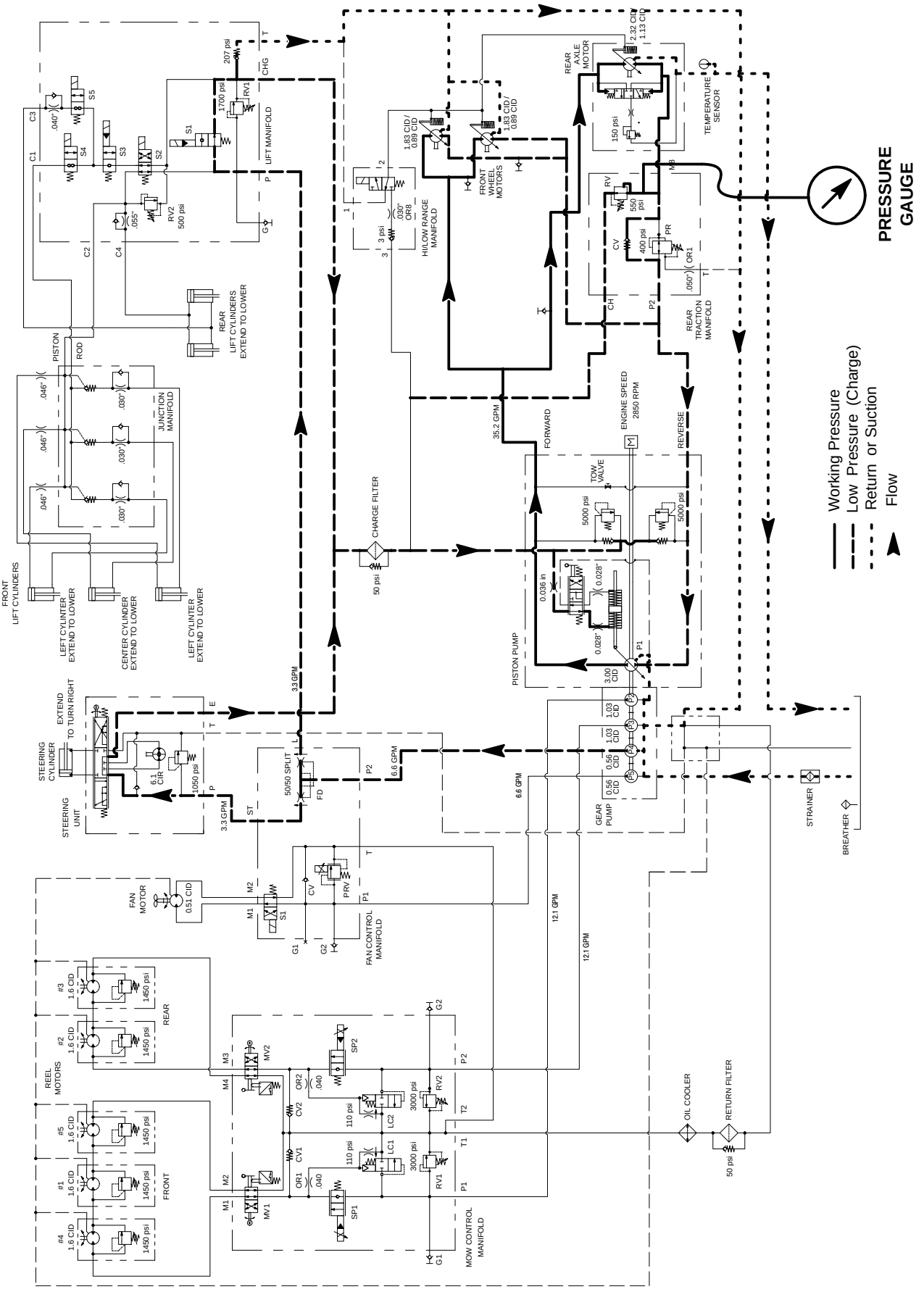
8. Release traction pedal, set parking brake, and stop engine. Record test results.

9. The pressure reducing valve (PR) is located on the bottom of the rear traction manifold (Fig. 36). If test pressure is incorrect, adjust pressure reducing valve (PR) (see Adjust Control Manifold Relief Valves in this chapter). Recheck pressure reducing valve pressure after any adjustment.

NOTE: The rear traction circuit relief valve (RV) pressure test uses the same connection as the traction circuit pressure reducing valve (PR) pressure test. If necessary, conduct the rear traction circuit relief valve (RV) pressure test before removing pressure gauge from rear traction manifold.

10. When testing is completed, disconnect pressure gauge and hose. Leave the diagnostic fitting installed for future testing and reverse towing bypass. install a diagnostic fitting cap to protect the fitting and prevent system contamination.

Traction Circuit − Rear Relief Valve (RV) Pressure Test



Traction Circuit − Rear Relief Valve (RV) Pressure Test

The adjustable rear relief valve (RV) in the rear traction manifold reduces rear axle motor pressure created in down hill, dynamic braking conditions to prevent rear wheel lock up. Check the rear relief valve (RV) pressure if the rear wheels lock up during dynamic braking conditions (setting too high) or if poor traction performance when in reverse is suspect (setting too low or too close to pressure reducing valve (PR) setting).

Special Equipment Required:

- Pressure Gauge − 1000 PSI (70 bar) with hose
- Diagnostic Fitting w/Cap − 9/16 − 18
- Phototach (non−contact tachometer) for units with Kubota diesel engine

CAUTION

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

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

NOTE: The #6 zero leak plug on the rear traction manifold has a tapered sealing surface on the plug head. 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.

2. The rear traction manifold is attached to the frame near the left front wheel motor (Fig. 37). Remove the #6 zero leak plug from the unmarked port located between ports M8 and P2 and install a diagnostic fitting.

3. Connect a 1000 PSI (70 bar) pressure gauge with hydraulic hose attached to installed diagnostic fitting. The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat.

4. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

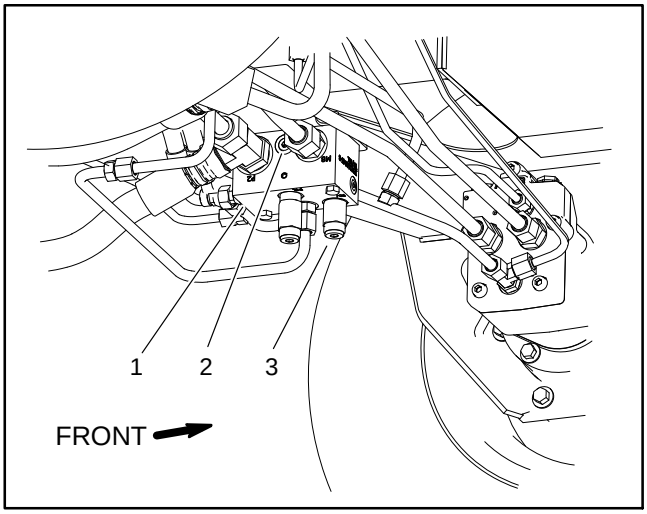


Figure 37

1. **Rear traction manifold**
2. **Unmarked port**
3. **Rear relief valve (RV)**

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

7. Sit in the operator's seat, set the mow speed limiter to the LOW speed (mow) position, and release the parking brake.

8. Operate the machine with the cutting units lowered. Drive down a slope in the forward direction, release the traction pedal and monitor the pressure gauge. Pressure should increase until the rear relief valve (RV) opens.

   GAUGE READING TO BE: **520 to 570 PSI (36 to 39 bar) and at least 100 PSI (7 bar) higher than the reverse reducing valve (PR) pressure** (e.g. if the pressure reducing valve (PR) pressure is 450 PSI (31 bar), relief (RV) pressure should be at least 550 (38 bar) or slightly higher).

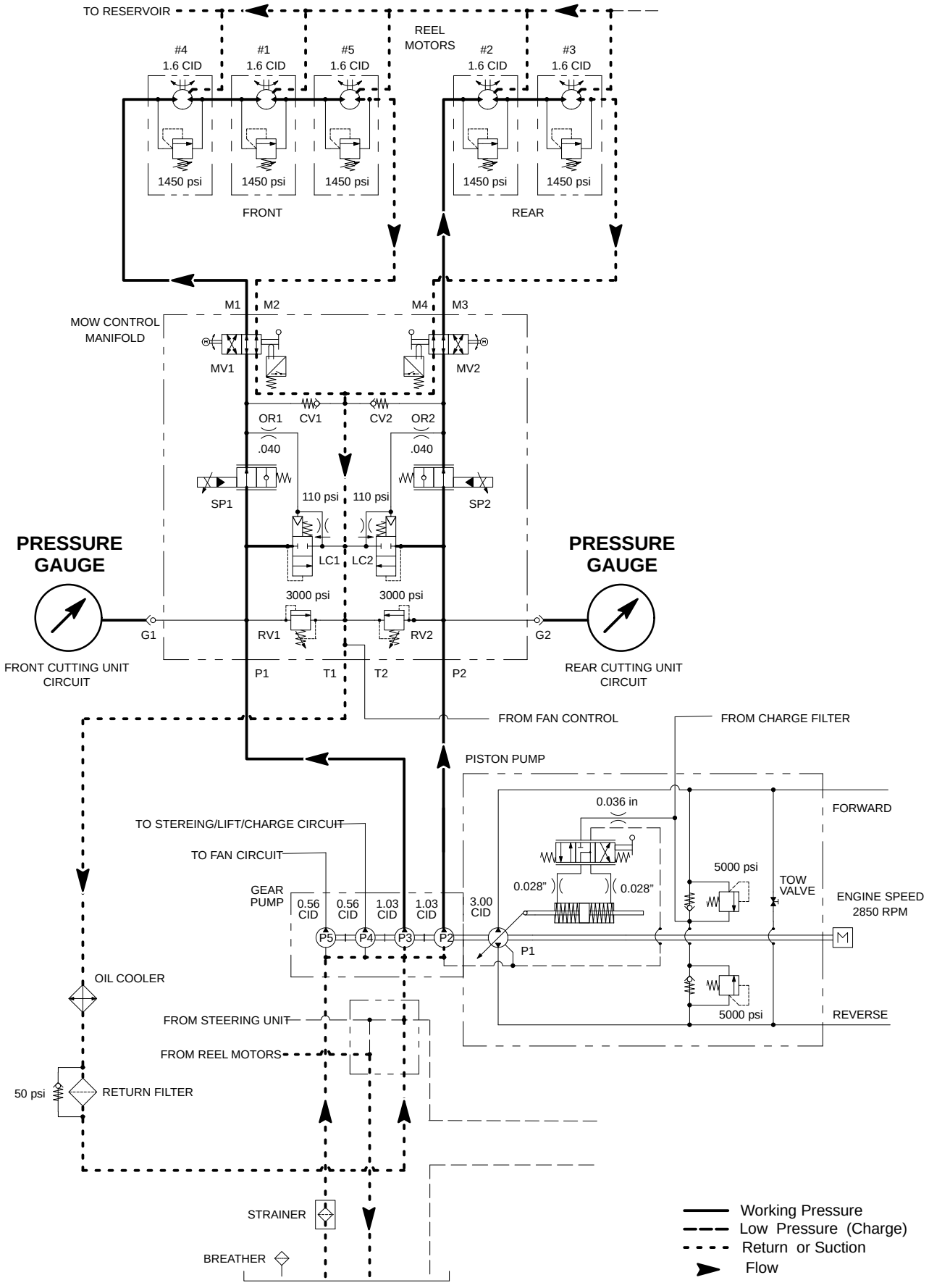
9. Release traction pedal, set parking brake, and stop engine. Record test results.

10. Before adjusting rear relief valve (RV), make sure that pressure reducing valve (PR) pressure is correct (see Traction Circuit − Reverse Reducing Valve (PR) Pressure Test in this manual).

11. The rear relief valve (RV) is located on the bottom of the rear traction manifold (Fig. 37). If test pressure is incorrect, adjust rear relief valve (RV) (see Adjust Control Manifold Relief Valves in this chapter). Recheck rear relief valve pressure after any adjustment.

12. When testing is completed, disconnect pressure gauge and hose. Leave the diagnostic fitting installed for future testing and reverse towing bypass. install a diagnostic fitting cap to protect the fitting and prevent system contamination.

Cutting Unit Circuit − Pressure Test



Cutting Unit Circuit − Pressure Test

Cutting unit circuit pressure is the first in a series of tests recommended to check cutting unit circuit performance. The results from this test will help determine which component(s) are the cause of cutting unit performance issues.

Special Equipment Required:

- Pressure Gauge − 5000 PSI (350 bar) with hose
- Phototach (non−contact tachometer)

1. Park machine on a level surface with the cutting units lowered and disengaged. Make sure engine is off and the parking brake is engaged. The backlap levers on the mow control manifold should be in the mow (F) position.

2. Raise hood to allow access to mow control manifold.

CAUTION

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

3. Connect a 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to the mow control manifold test port for the mow circuit to be tested (Fig. 38). The pressure gauge hydraulic hose must be long enough to safely view the pressure gauge while sitting in the operator's seat. Manifold test port G1 should be used for testing the front cutting units and G2 should be used for testing the rear cutting units.

4. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

7. Sit in the operator's seat, set the mow speed limiter to the LOW speed (mow) position, and release the parking brake.

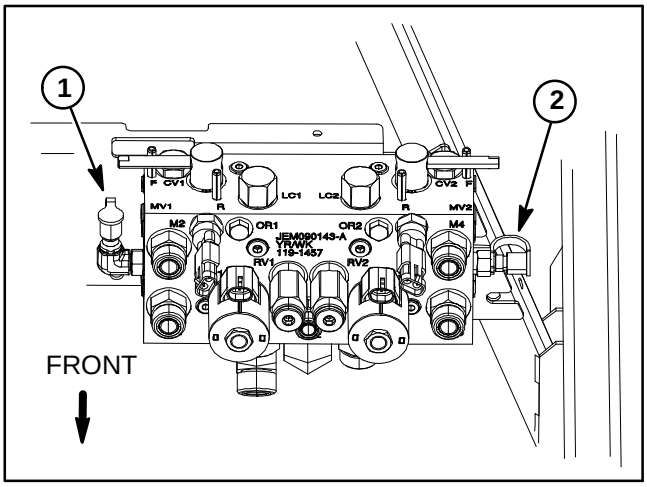


Figure 38

1. **Test port G1 (front cutting unit circuit)**
2. **Test port G3 (rear cutting unit circuit)**

CAUTION

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

8. Use the InfoCenter display to record the current reel speed settings. Set the circuit being tested (front or rear) reel speed to maximum and engage the cutting units.

When engaged, the cutting circuit pressure may exceed manifold relief valve pressure setting of **3000 PSI (207 Bar)** momentarily opening the relief valve. Circuit pressure should then stabilize.

9. Safely secure the test pressure gauge and operate the machine under your specific mowing conditions. Monitor test gauge while mowing. Cutting unit circuit pressure should be approximately **1350 PSI (93 Bar)** for the front cutting unit circuit and **1000 PSI (69 Bar)** for the rear cutting unit circuit at maximum reel speed.

10. Disengage cutting units, move throttle to low speed and shut off engine.

11. If pressure readings are within specifications and cutting unit performance is still in question, test cutting unit motors individually (see Cutting Unit Circuit Testing − Reel Motor Efficiency/Case Drain Test).

12. If pressure specifications are not met, consider the following:

    A. Proportional valve or valve coil SP1 (front cutting units) or SP2 (rear cutting units) is faulty (see Control Manifold Cartridge Valve Service in this chapter, or Hydraulic Solenoid Valve Coils in Chapter 6 − Electrical System in this manual).

    B. Relief valve RV1 (front cutting units) or RV2 (rear cutting units) is faulty (see Cutting Unit Circuit − Relief Valve (RV) Pressure Test in this chapter).

    C. Logic Cartridge LC1 (front cutting units) or LC2 (rear cutting units) Is faulty (see Control Manifold Cartridge Valve Service in this chapter).

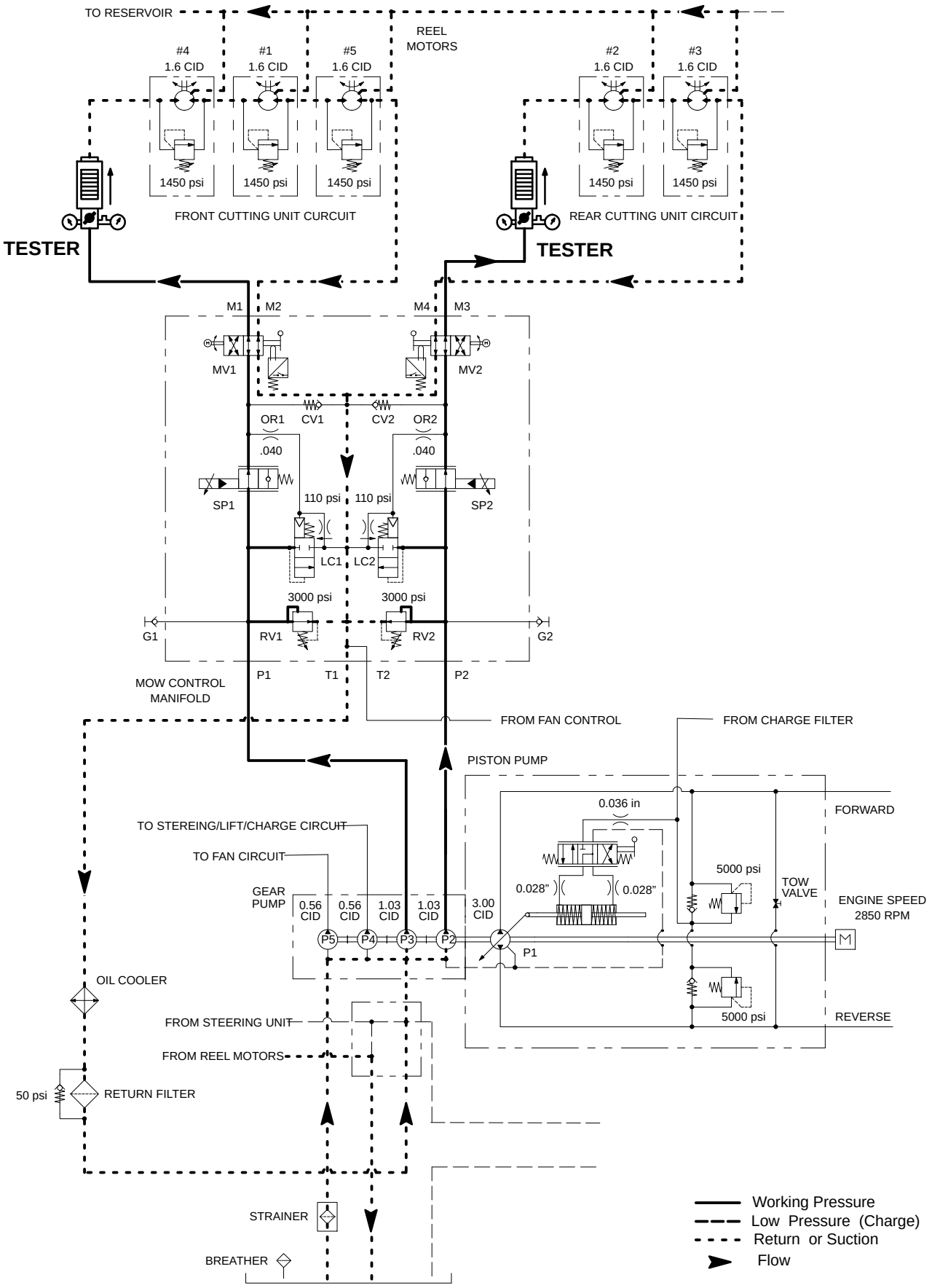
    D. Gear pump P2 (front cutting units) or gear pump P3 (rear cutting units) is faulty (see Gear Pump Flow Test in this chapter).

13. Disconnect test equipment from hydraulic manifold.

14. Use the InfoCenter display to return the cutting unit reel speed to recorded setting.

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Cutting Unit Circuit − Relief Pressure Test



Cutting Unit Circuit − Relief Pressure Test

Two relief valves are used in the Reelmaster 7000−D cutting unit circuit. Relief valve RV1 protects the front cutting unit circuit powered by gear pump section P2, and relief valve RV2 protects the rear cutting unit circuit powered by gear pump P3. Test the performance of the mow control manifold relief valves RV1 or RV2 to make sure that the maximum amount of fluid is available to the cutting unit motors up to the set relief pressure.

Special Equipment Required:

- 15 GPM (56 LPM) Hydraulic Tester (Pressure and Flow) with hoses − 1 − 14
- Phototach (non−contact tachometer)

1. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Engine should be off and the parking brake engaged. Make sure that the backlap levers on the mow control manifold are in the mow (F) position.

CAUTION

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

2. Determine cutting unit circuit relief pressure to be tested:

   A. The tester connection point for relief valve RV1 (front cutting units − gear pump section P2) is at the cutting unit #4 motor supply hose (front hose) (Fig. 39).

   B. The tester connection point for relief valve RV2 (rear cutting units − gear pump section P3) is at the cutting unit #2 motor supply hose (front hose) (Fig. 39).

3. Thoroughly clean junction of appropriate hydraulic supply hose and cutting unit motor fitting. Disconnect the supply hydraulic hose from the motor.

IMPORTANT: Make sure that the oil flow indicator on the tester matches the flow of oil (disconnected hose > tester > hydraulic motor).

4. Install tester with pressure gauge and flow meter in series with the disconnected hose and cutting unit motor fitting. The tester hydraulic hoses must be long enough to safely view the tester while sitting in the operator's seat. Make sure the flow control valve on the tester is fully open.

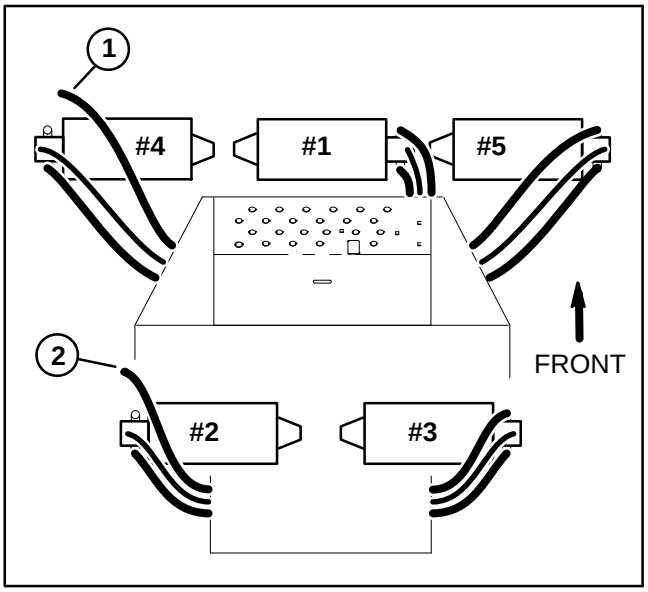


Figure 39

1. **Reel motor #4 supply hose**
2. **Reel motor #2 supply hose**

5. Start engine and run at low idle speed. Check for hydraulic leakage and make corrections if necessary before proceeding with test.

6. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

CAUTION

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

8. Sit in the operator's seat, set the mow speed limiter to the LOW speed (mow) position, release the parking brake and engage the cutting units.

9. Watch tester pressure gauge while slowly closing the tester flow control valve. As the relief valve opens, system pressure should be from **2800 to 3200 PSI (193 to 220 bar)**.

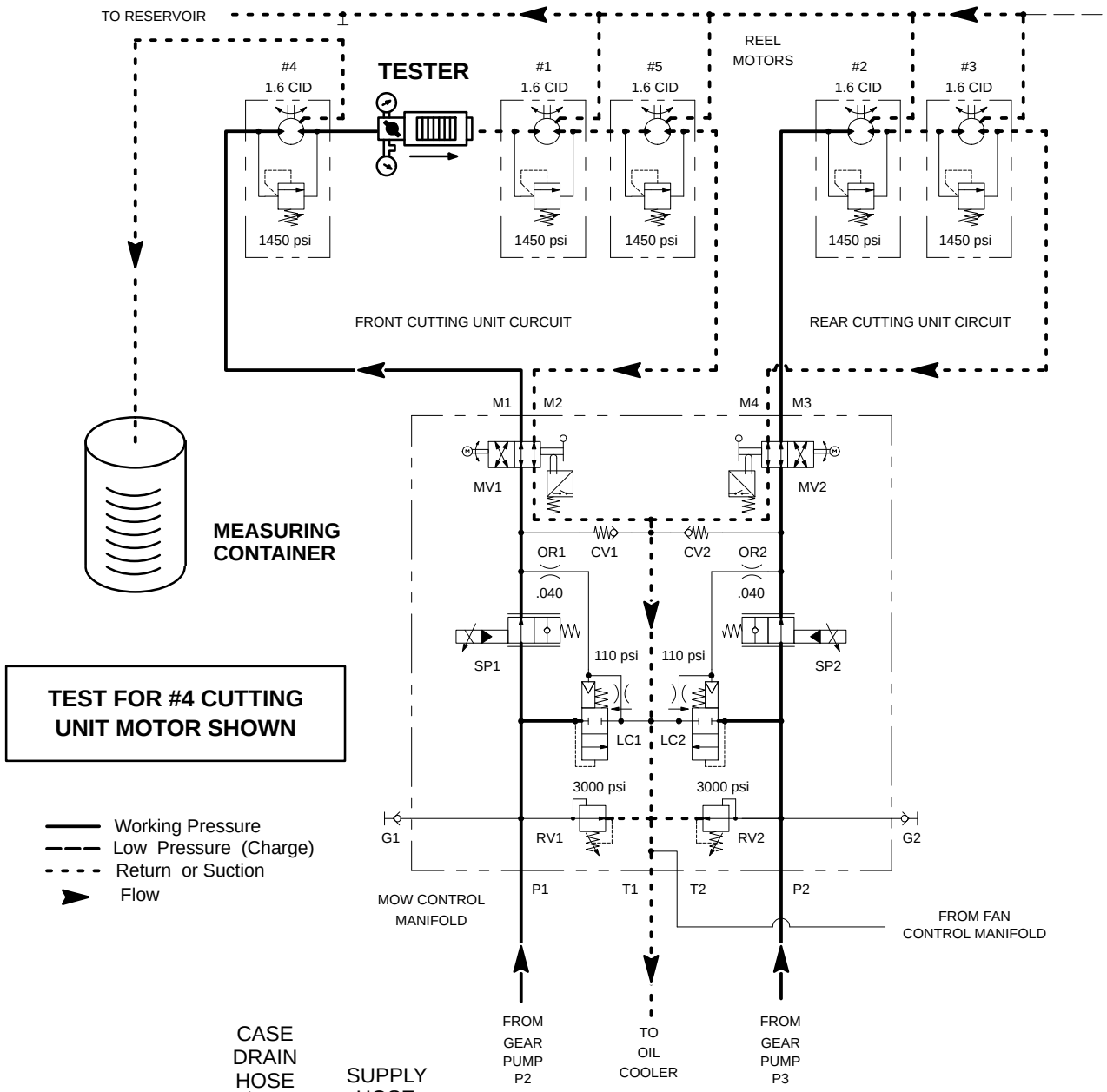
10. Open the tester flow control valve, disengage cutting units and stop the engine. Record test results.

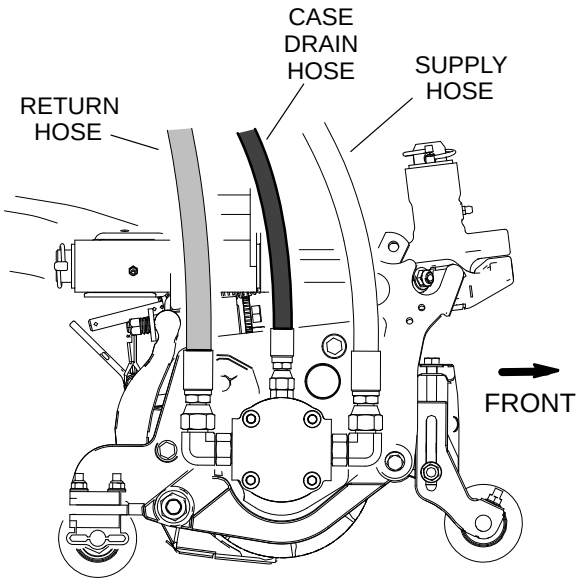
11. If specification is not met, clean or adjust relief valve RV1 (front cutting units) or RV2 (rear cutting units) in the mow control manifold (see Adjust Control Manifold Relief Valves in this chapter). Recheck relief valve pressure setting after adjustment.

12. After testing is complete, disconnect tester from cutting unit motor and hose. Connect hydraulic hose to motor.

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Cutting Unit Circuit − Cutting Unit Motor Case Drain Leakage Test







Cutting Unit Circuit − Cutting Unit Motor Case Drain Leakage Test

The reel motor efficiency/case drain test is the second in a series of tests recommended to check cutting unit circuit performance. Over a period of time, a reel motor can wear internally. This test measures case drain volume while restricting flow across the motor ports. Case drain volume under load of more than **9%** of total motor flow indicates the gears and wear plates in the motor have worn. A worn motor may by−pass hydraulic fluid to its case drain causing the motor to be less efficient. Eventually, enough fluid 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 method to find a failing or malfunctioning cutting unit 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 a different appearance on the turf.

The cutting unit motors are connected in series. Hydraulic oil passes through each reel motor from the front to the rear. The front cutting unit motors are one series powered by gear pump section P2, and the rear cutting unit motors are in another series powered by gear pump P3. If a faulty reel motor is not obvious (based on quality of cut issues) you may have to test all the reel motors in the series. When testing all reel motors in a circuit, start with the first motor in the series (see Hydraulic Schematic).

Special Equipment Required:

- 15 GPM (56 LPM) Hydraulic Tester (Pressure and Flow) with hoses − 1 − 14
- Hydraulic Cap − 11/16 −16
- Phototach (non−contact tachometer)

1. Park the machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Make sure engine is off and the parking brake is disengaged. The backlap levers on the mow control manifold should be in the mow (F) position.

CAUTION

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

IMPORTANT: Make sure that the oil flow indicator on the tester matches the flow of oil (hydraulic motor > tester > disconnected hose).

2. Disconnect the return hose from the motor (hose at the rear of the reel motor) and install a hydraulic tester between the motor and the disconnected return hose. Make sure the tester flow control valve is fully open.

3. Start engine and run at low idle speed. Check for hydraulic leaks at tester connections and make corrections if necessary before proceeding with test.

4. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

6. Use the InfoCenter display to record the current reel speed settings. Set the circuit being tested (front or rear) reel speed to maximum and stop the engine.

7. Disconnect the motor case drain hose (small diameter hose) where it connects to bulkhead fitting at the frame rail (not at the motor). Install a hydraulic cap on the bulkhead fitting to prevent system contamination.

8. Place open end of disconnected case drain hose into a drain pan.

9. Two people are required to complete the following steps. One person should sit in the operator's seat and operate the machine while another person reads the tester and measures reel motor case drain volume.

CAUTION

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

10. Sit in the operator's seat, set the mow speed limiter to the LOW speed (mow) position, and release the parking brake.

11. Start the engine and set the throttle to high idle speed.

12. While watching tester pressure gauge, slowly close flow control valve on tester until a pressure of **2000 PSI (138 bar)** is obtained.

NOTE: Use a graduated container (special tool TOR4077) to measure case drain leakage.

13. Measure oil flow from the disconnected case drain line for **fifteen (15) seconds**, then move the reel enable/disable switch to DISABLE, open the tester flow control valve and stop the engine. Record test results.

    TEST RESULTS: Case drain leakage should be less than **23 ounces (672 ml)** of hydraulic fluid in fifteen (15) seconds (0.7 GPM / 2.7 LPM).

14. If case drain flow is more than **23 ounces (672 ml)** in fifteen (15) seconds, the reel motor is worn or damaged and should be repaired or replaced.

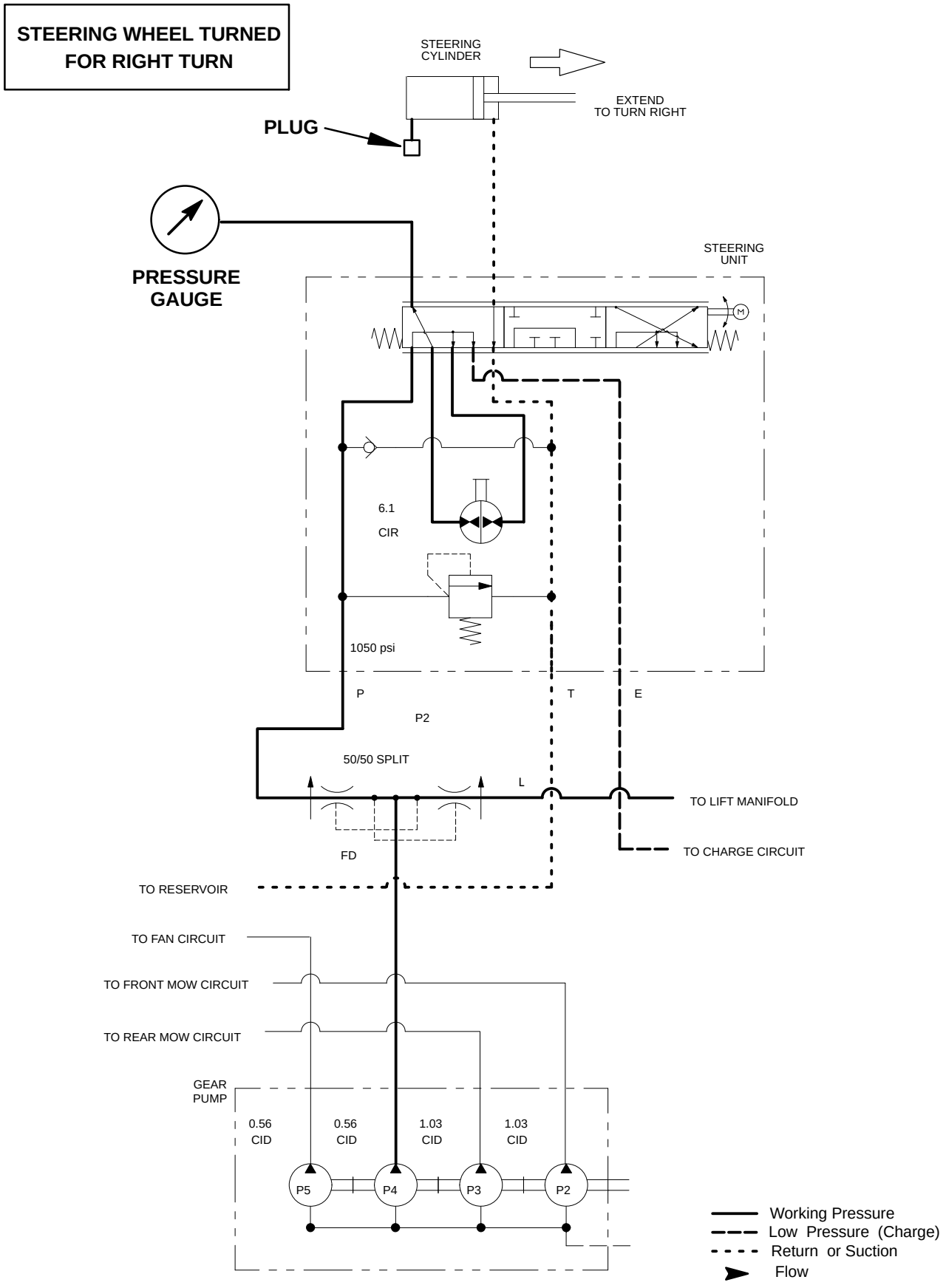
15. Disconnect tester from motor and hose. Reconnect hose to the cutting unit motor. Remove cap from bulkhead fitting and reconnect case drain hose.

16. Repeat test for additional reel motors if required.

17. When finished, use the InfoCenter display to return the cutting unit reel speed to recorded setting.

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Steering/Lift Circuit − Steering Relief Pressure Test



Steering/Lift Circuit − Steering Relief Pressure Test

Unit steering performance 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 conditions are checked and functioning properly before proceeding with any steering system hydraulic testing.

The relief valve for the steering circuit is integrated into the steering control valve. If steering system performs poorly, perform the steering circuit relief pressure test. If both steering and lift operations perform poorly, perform the flow test on gear pump section P4 (see Gear Pump Flow Test in this chapter).

Special Equipment Required:

- Pressure Gauge − 5000 PSI (350 bar) with hose
- Hydraulic Cap − 11/16 − 16
- Phototach (non−contact tachometer)

1. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Make sure engine is off and the parking brake is engaged.

CAUTION

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

2. Thoroughly clean junction of hydraulic hose and steering cylinder fitting at the barrel end of the steering cylinder (Fig. 40). Disconnect hose from fitting in barrel end of steering cylinder.

3. Install 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to disconnected hose. Install a hydraulic cap on steering cylinder fitting to prevent any leakage from cylinder.

4. Start engine and run at low idle speed. Check for hydraulic leaks at tester connections and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

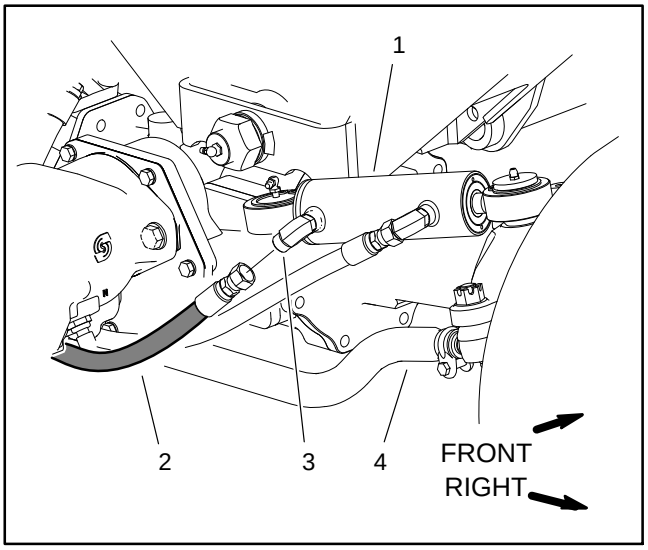


Figure 40

1. **Steering cylinder**
2. **Barrel end hose**
3. **Barrel end fitting**
4. **Rear axle**

IMPORTANT: While testing, rotate steering wheel only long enough to get a system relief pressure reading. Holding the steering circuit at relief pressure for an extended period may damage the steering control valve.

7. Turn steering wheel to the right while monitoring the pressure gauge. When steering circuit pressure reaches the relief pressure setting, pressure should stabilize briefly and then may continue to increase. The steering circuit relief pressure is the gauge reading when pressure stabilizes.

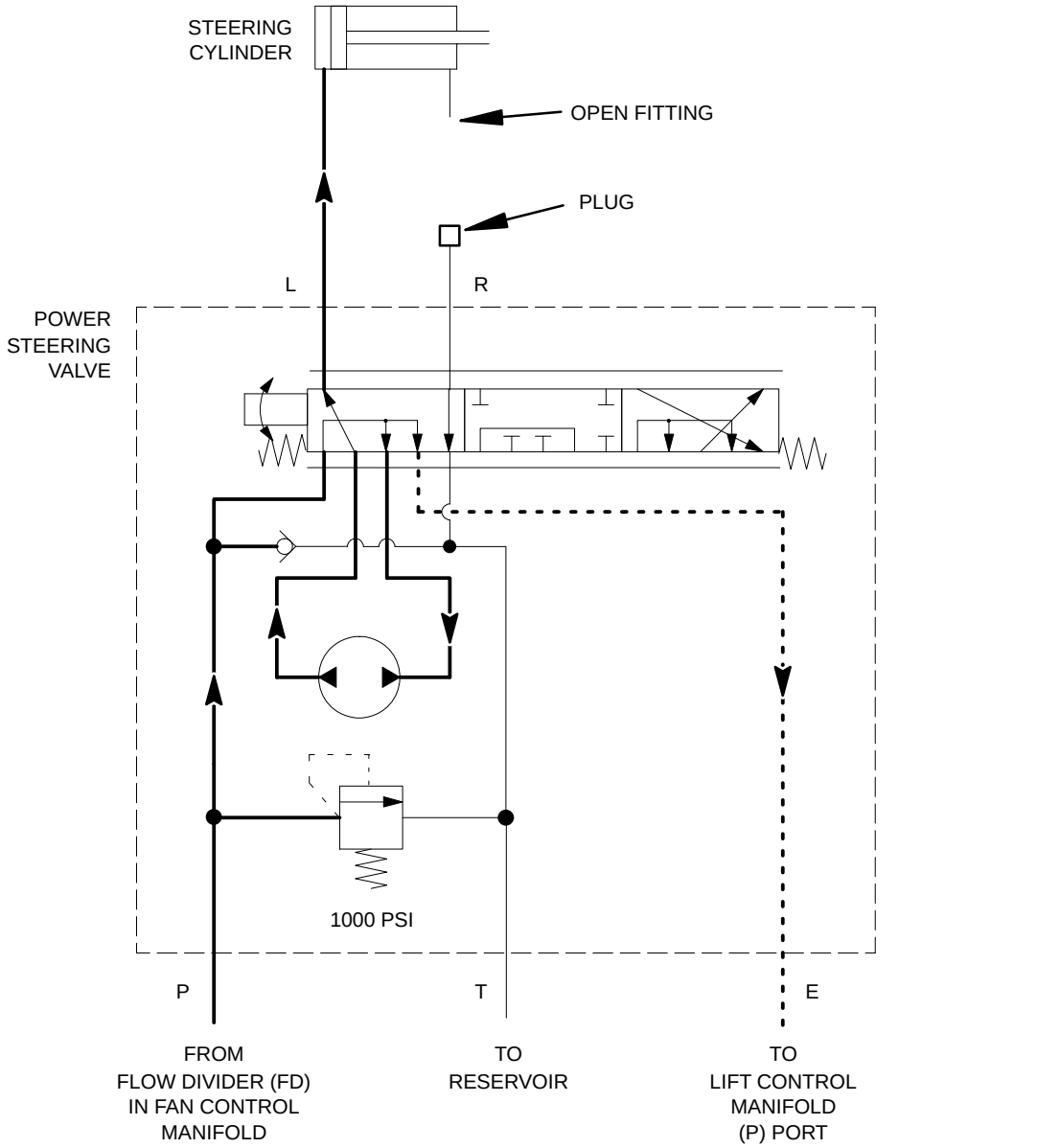
GAUGE READING TO BE:
1015 TO 1088 PSI (70 to 75 bar)

8. Stop the engine. Record test results.

9. If steering relief pressure is incorrect, inspect steering relief valve located in the steering control valve (see Steering Control Valve Service in the Service and Repairs section of this chapter). If relief valve is operating properly and if lift/lower problems also exist, gear pump P4 should be suspected of wear or damage. If steering wheel continues to turn at end of cylinder travel (with lower than normal effort), steering cylinder or steering control valve may be worn or damaged.

10. When testing is complete, relieve steering circuit pressure and remove pressure gauge from hydraulic hose. Remove steel cap from steering cylinder fitting and connect hydraulic hose to steering cylinder.

11. Start engine and run at low idle speed. Check for hydraulic leaks at steering cylinder and make corrections if necessary before returning machine to service.



High Pressure
Low Pressure
Return or Suction
Flow

Steering/Lift Circuit − Steering Cylinder Test

Unit steering performance 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 conditions are checked and functioning properly before proceeding with any steering system hydraulic testing.

Special Equipment Required:

- Hydraulic Plug − 11/16 − 16

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

2. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Turn the steering wheel to the right (clockwise) until the steering cylinder is fully extended. Turn engine off and apply the parking brake.

CAUTION

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

3. Thoroughly clean the area around the hydraulic hose at the rod end of the steering cylinder.

4. Place a drain pan under the steering cylinder. Remove hydraulic hose from the fitting on the rod end of the steering cylinder (Fig. 41). Install a hydraulic plug in the disconnected hose.

5. Remove all hydraulic oil from drain pan. Make sure that empty drain pan remains under the open fitting of the steering cylinder.

6. With the engine off, continue turning the steering wheel to the right (clockwise) with the steering cylinder fully extended. Observe the open fitting on the steering cylinder as the wheel is turned. If hydraulic fluid comes out of the fitting while turning the steering wheel to the right, the steering cylinder has internal leakage and must be repaired or replaced (see Steering Cylinder in this chapter).

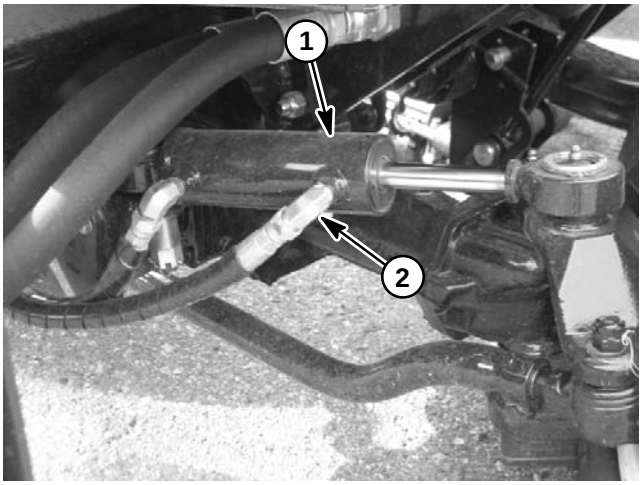


Figure 41

1. **Steering cylinder**
2. **Rod end fitting**

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

8. If a steering problem exists and the steering cylinder tested acceptably, consider the following:

A. Gear pump section P4 (steering, lift, and charge circuits) is worn or damaged (see Gear Pump Flow Test in this chapter).

NOTE: If gear pump P4 is worn or damaged, charge, steering and lift circuits will all be affected.

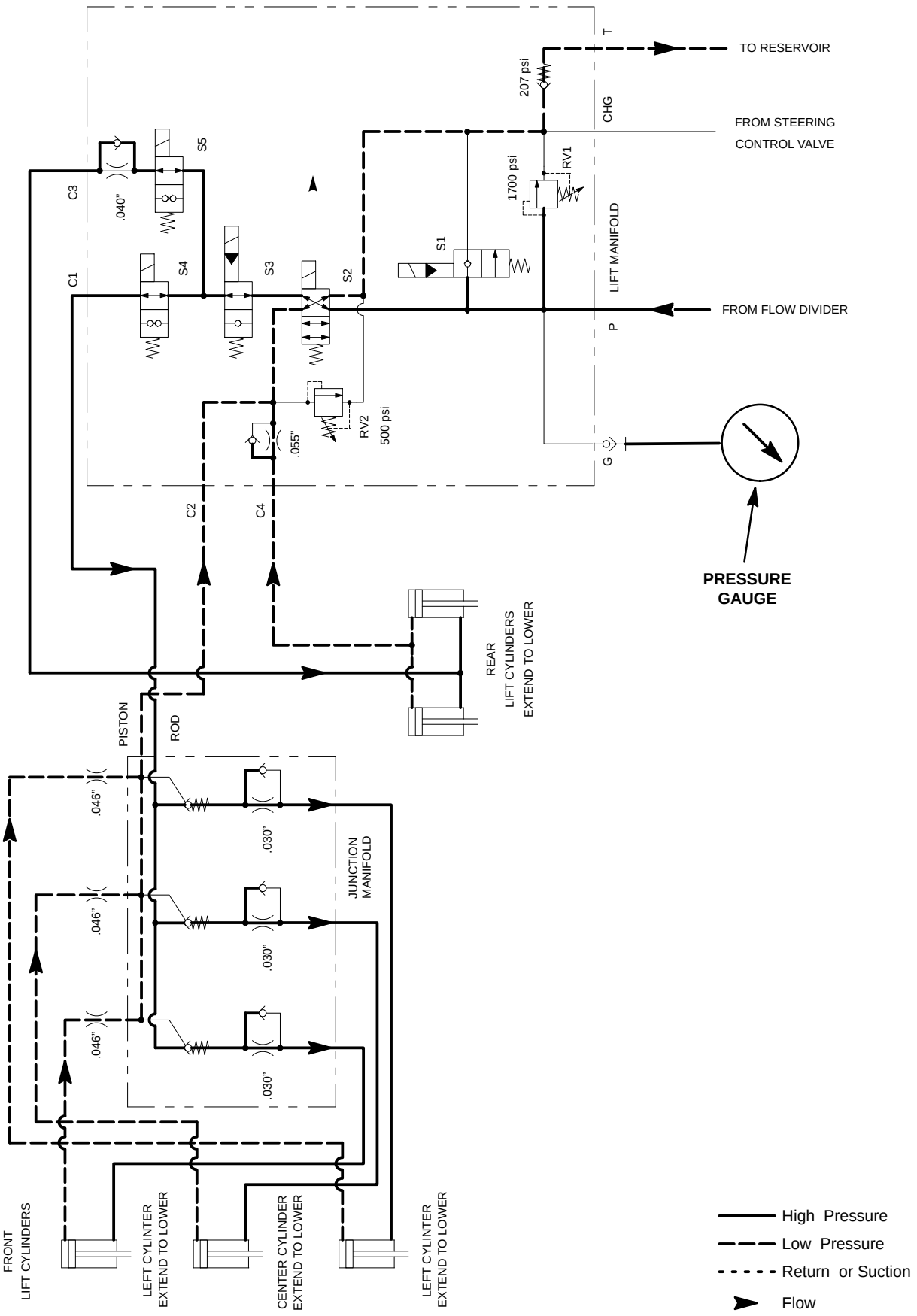
B. The flow divider in the fan control manifold is faulty (see Fan Control Manifold Service in this chapter).

C. The steering control valve requires service (see Steering Control Valve in this chapter).

9. Check oil level in hydraulic reservoir and adjust if needed.

10. Operate machine and check for leaks.

Steering/Lift Circuit − Lift Relief Pressure Test



Steering/Lift Circuit− Lift Relief Pressure Test

If all cutting unit lift arms perform poorly during both raise and lower operations, the lift circuit relief pressure test should be performed. If both steering and lift operations perform poorly, perform the flow test on gear pump section P4 (see Gear Pump Flow Test in this chapter).

Special Equipment Required:

- Pressure Gauge − 5000 PSI (350 bar) with hose
- Phototach (non−contact tachometer)

1. Park machine on a level surface with the cutting units fully lowered and the reel enable/disable switch in the DISABLE position. Apply the parking brake and stop engine.

CAUTION

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

2. Raise and support operator's seat to gain access to lift manifold (Fig. 42). Connect a 5000 PSI (350 bar) pressure gauge with hydraulic hose attached to lift manifold test port G. The pressure gauge hydraulic hose must be routed to safely view the tester while sitting in the operator's seat. Route gauge hose to allow hood to be safely lowered.

3. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

4. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

6. Lower and sit in the operator's seat. Move the joystick to raise and allow the cutting units to fully raise. Momentarily hold the joystick with the lift cylinders fully retracted (cutting units raised) while looking at the pressure gauge.

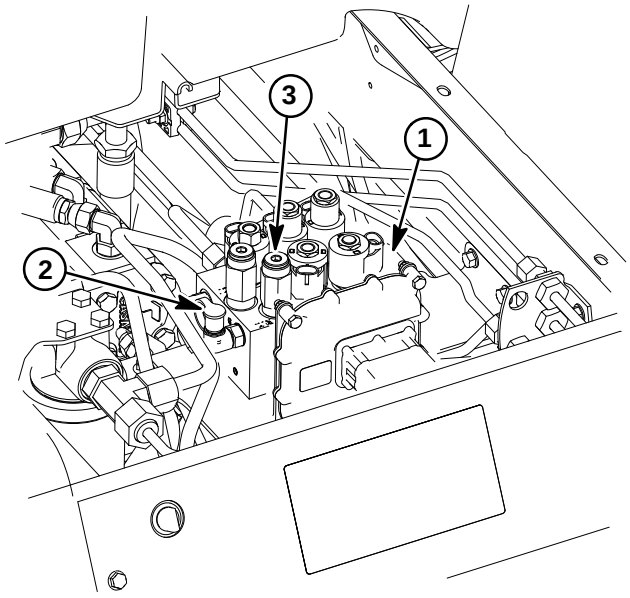


Figure 42

1. **Lift manifold**
2. **Test port G1**
3. **Relief valve RV1**

7. When the lift cylinders are fully retracted (cutting units fully raised) the relief valve opens and the pressure gauge needle will momentarily stop. System pressure as the relief valve RV1 opens should be be approximately **1700 PSI (117 bar)**. Release joystick to the neutral position after observing relief valve pressure.

NOTE: If joystick is held in the raise position after the relief valve has opened, system pressure can increase higher than relief pressure.

8. Stop the engine and record test results.

9. If specification is not met, clean or adjust relief valve RV1 located in the lift manifold.

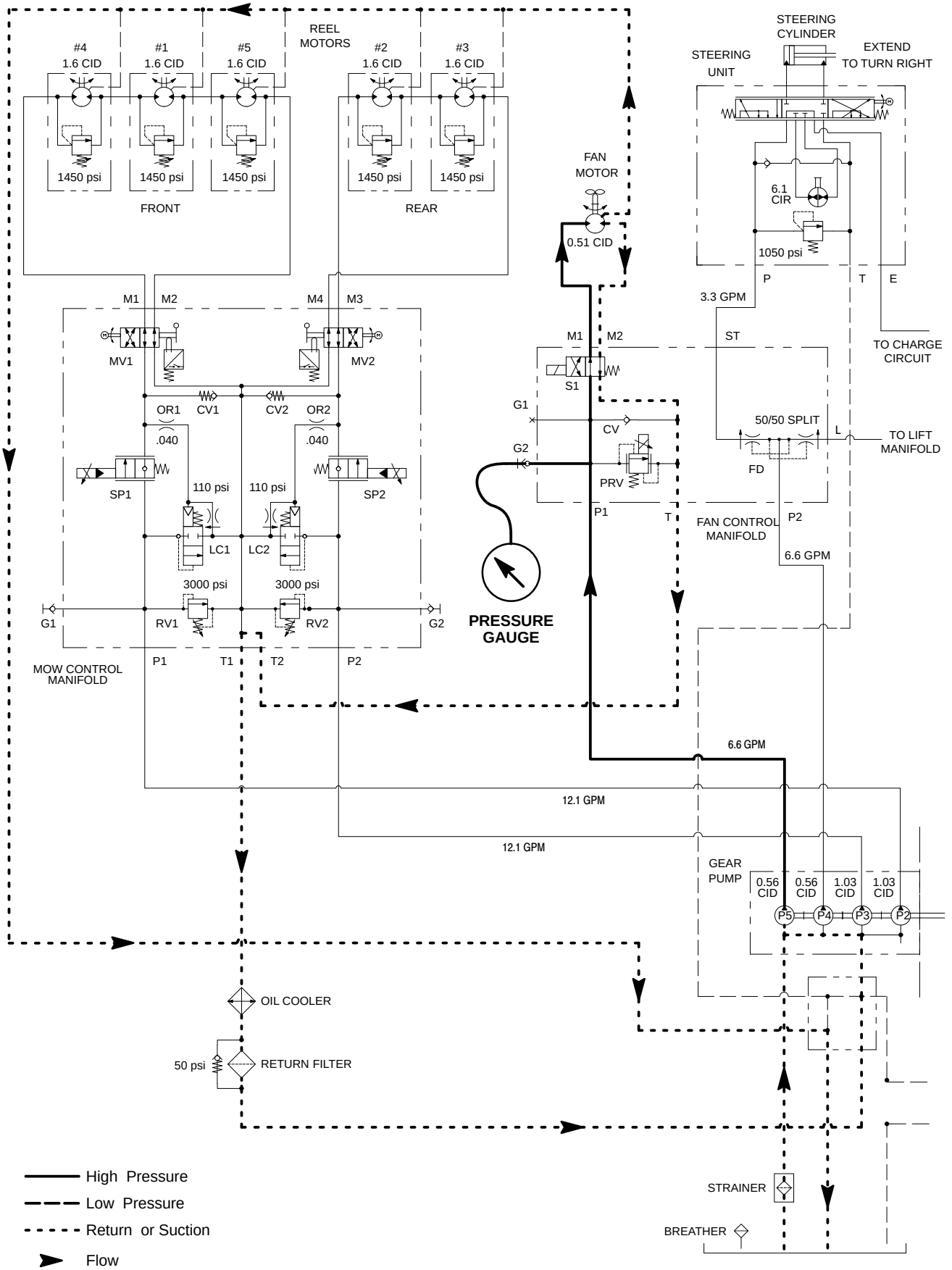
   A. If pressure is too high, adjust relief valve RV1 to reduce lift/lower circuit relief pressure (see Adjust Control Manifold Relief Valves in the Adjustments section of this chapter).

   B. If pressure is too low, clean relief valve RV1 (see Lift Manifold in this chapter). Check for restriction in gear pump intake line. Adjust relief valve RV1 to increase lift circuit relief pressure if necessary (see Adjust Control Manifold Relief Valves in this chapter).

   C. If pressure is still too low after relief valve adjustment/service, lift cylinder(s) or gear pump P4 should be suspect of wear or damage.

10. After testing is completed, remove pressure gauge from manifold test port. Install dust cap to test port fitting. Lower and secure hood.

Cooling Fan Circuit − Pressure Test



Cooling Fan Circuit − Pressure Test

The cooling fan circuit test should be performed to make sure that the engine cooling fan circuit has the correct system pressure, and therefore, fan speed.

Special Equipment Required:

- Pressure Gauge − 5000 PSI (350 bar) with hose
- Phototach (non−contact tachometer)

1. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Make sure engine is off and the parking brake is applied.

CAUTION

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

2. Raise and support hood to gain access to fan control manifold (Fig. 43). Connect a 5,000 PSI (345 bar) gauge with hydraulic hose attached to test fitting in port G2 on rear of manifold.

3. After installing pressure gauge, start engine and run at low idle speed. Check for hydraulic leakage and correct before proceeding with test.

4. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

CAUTION

Cooling fan blades will rotate during the test procedure. Keep away from cooling fan blades during test to prevent personal injury from rotating blades.

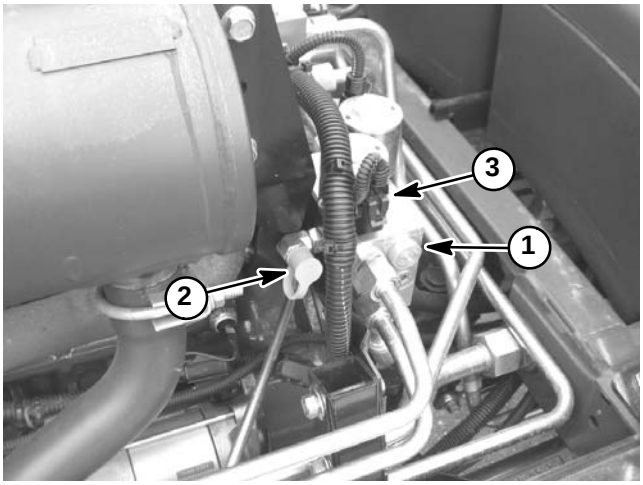


Figure 43

1. **Fan control manifold**
2. **Test fitting (port G2)**
3. **Proportional relief valve solenoid**

6. Use a phototac to identify the cooling fan speed while monitoring the pressure gauge. Disconnect the wire harness connector from the proportional relief valve solenoid at fan control manifold port TS. Both fan speed and pressure should increase and stabilize after the solenoid is disconnected.

   PRESSURE GAUGE READING TO BE approximately **3000 PSI (207 bar)**

   FAN SPEED TO BE approximately **2900 RPM**

7. Stop engine and record test results.

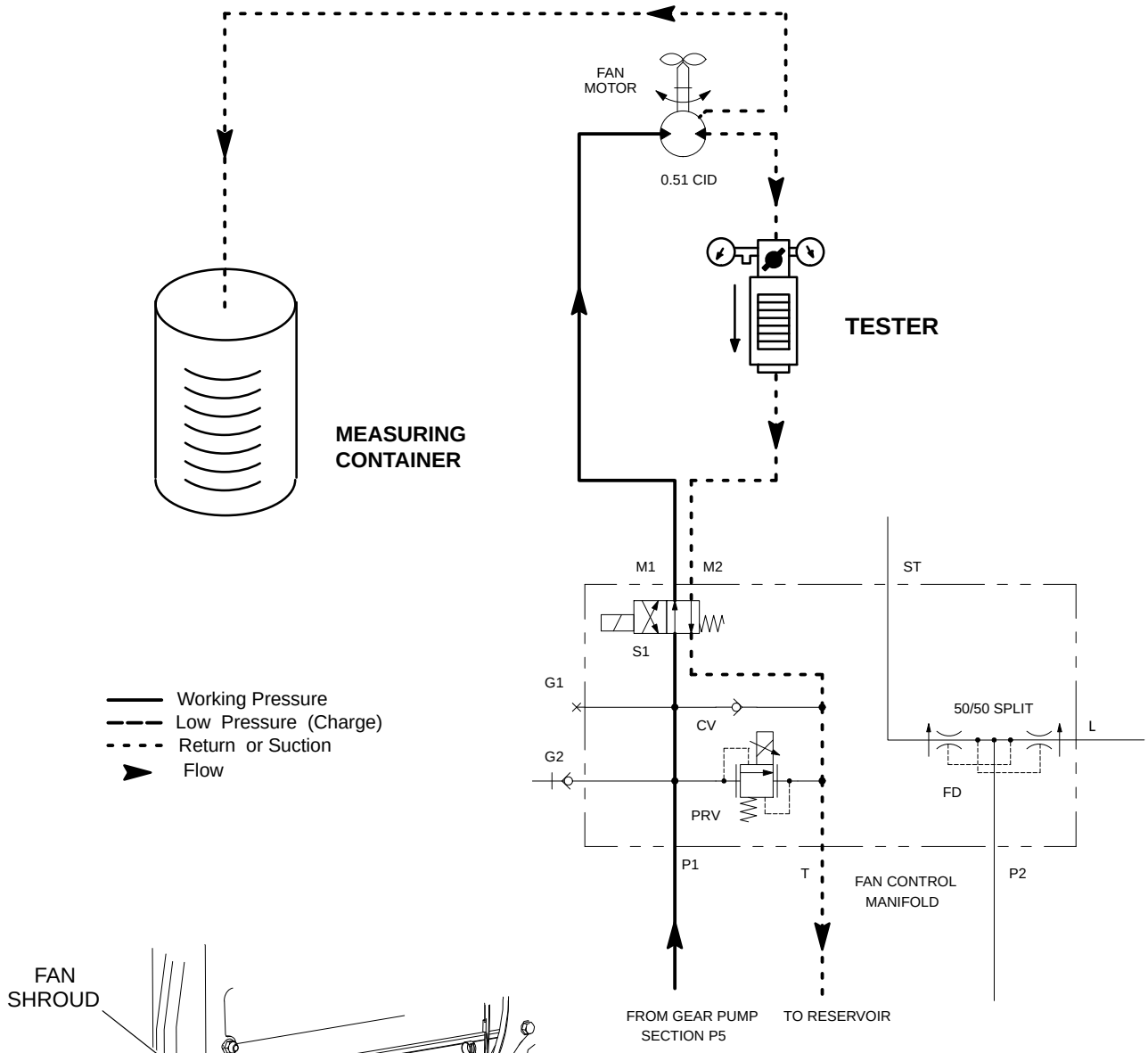
8. If specifications are not met:

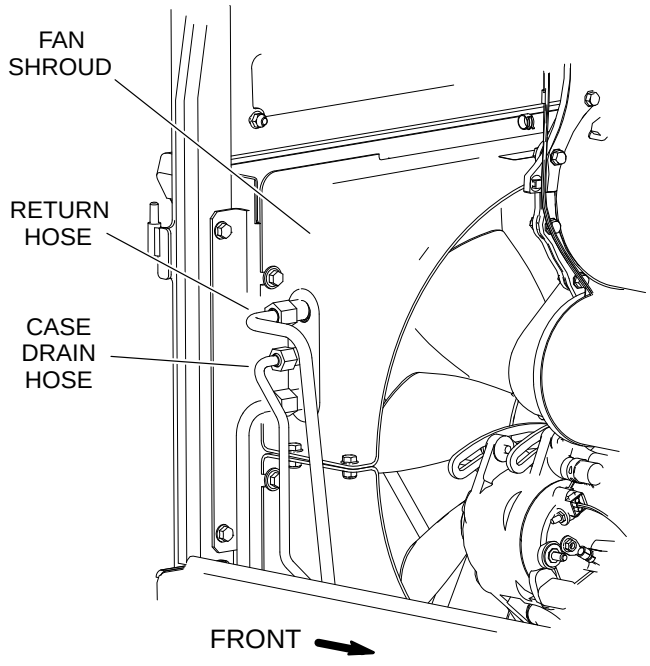
   A. If pressure rises to approximately **3000 PSI (207 bar)** but fan speed is low, consider that the fan motor is worn or damaged. (see Fan Motor Case Drain Leakage Test in this chapter).

   B. If pressure and fan speed are both low, consider that gear pump P5 is worn or damaged (see Gear Pump Flow Test in this section).

9. When testing is complete, remove pressure gauge and hose from manifold fitting and reconnect wire harness to proportional relief valve solenoid. Install dust cap to test port fitting. Lower and secure hood.

Cooling Fan Circuit − Fan Motor Case Drain Leakage Test







Cooling Fan Circuit − Fan Motor Case Drain Leakage Test

Over a period of time, the motor can wear internally. This test measures case drain volume while restricting flow across the motor ports. Case drain volume under load of more than **12%** of total motor flow indicates the gears and wear plates in the motor have worn. A worn motor may by−pass hydraulic fluid to its case drain causing the motor to be less efficient. Eventually, enough fluid loss will cause the fan motor to slow, reducing its ability to cool the engine. Continued operation with a worn, inefficient motor can generate excessive heat, cause damage to seals and other components in the hydraulic system, and affect engine performance.

Special Equipment Required:

- 15 GPM (56 LPM) Hydraulic Tester (Pressure and Flow) with hoses − 13/16 − 16
- Hydraulic Hose − 11/16 − 16 x 6 ft (1.8 m)
- Phototach (non−contact tachometer)

1. Park the machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Make sure engine is off and the parking brake is engaged.

CAUTION

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

2. Raise and support hood to gain access to fan shroud and fan motor plumbing.

IMPORTANT: Make sure that the oil flow indicator on the tester matches the flow of oil (fan shroud upper bulkhead fitting > tester > fan control manifold).

3. Disconnect the return tube from the fan shroud (upper tube) and the fan control manifold M2 port. Remove the hydraulic tube and install a hydraulic tester and hose between the fan shroud bulkhead fitting and the fan control manifold. Make sure the tester flow control valve is fully open.

4. Start engine and run at low idle speed. Check for hydraulic leaks at tester connections and make corrections if necessary before proceeding with test.

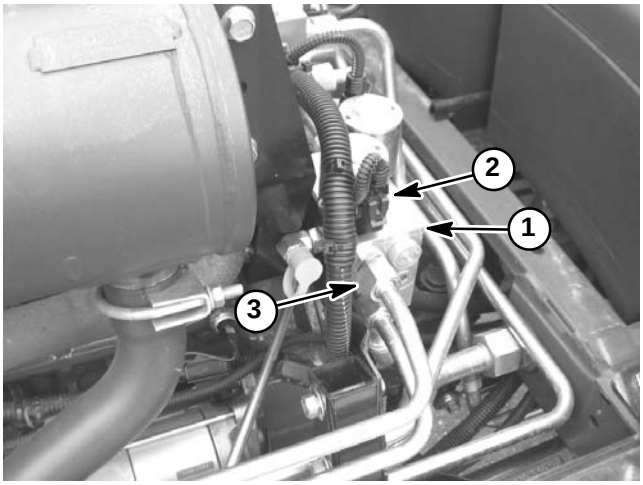


Figure 44

1. **Fan control manifold**
2. **Proportional relief valve solenoid**
3. **M2 port**

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

7. Stop the engine and disconnect the wire harness connector from the proportional relief valve solenoid at fan control manifold port TS (Fig. 44).

8. Disconnect the case drain tube from the motor (small diameter center tube at fan shroud) and install a 6 ft (1.8 m) hydraulic hose to the fan shroud bulkhead fitting. Put a steel plug on the disconnected tube to prevent system contamination.

9. Place open end of the case drain test hose into a drain pan.

10. Two people are required to complete the following steps. One person should sit in the operator's seat and operate the machine while another person reads the tester and measures fan motor case drain volume.

CAUTION

Cooling fan blades will rotate during the test procedure. Keep away from cooling fan blades during test to prevent personal injury from rotating blades.

11. Sit in the operator's seat, start the engine and set the throttle to high idle speed.

12. While watching tester pressure gauge, slowly close flow control valve on tester until a pressure of **2000 PSI (138 bar)** is obtained.

NOTE: Use a graduated container (special tool TOR4077) to measure case drain leakage.

13. Measure oil flow from the case drain test hose for **fifteen (15) seconds**, then open the tester flow control valve and stop the engine. Record test results.

    TEST RESULTS: Case drain leakage should be less than **25 ounces (745 ml)** of hydraulic fluid in fifteen (15) seconds (0.8 GPM / 3 LPM).

14. If case drain flow is more than **25 ounces (745 ml)** in fifteen (15) seconds, the fan motor is worn or damaged and should be repaired or replaced.

15. Remove tester and hose fan control manifold and fan shroud bulkhead fitting. Install removed hydraulic tube.

16. Remove case drain hose. Remove plug from case drain tube and reconnect to fan shroud bulkhead fitting.

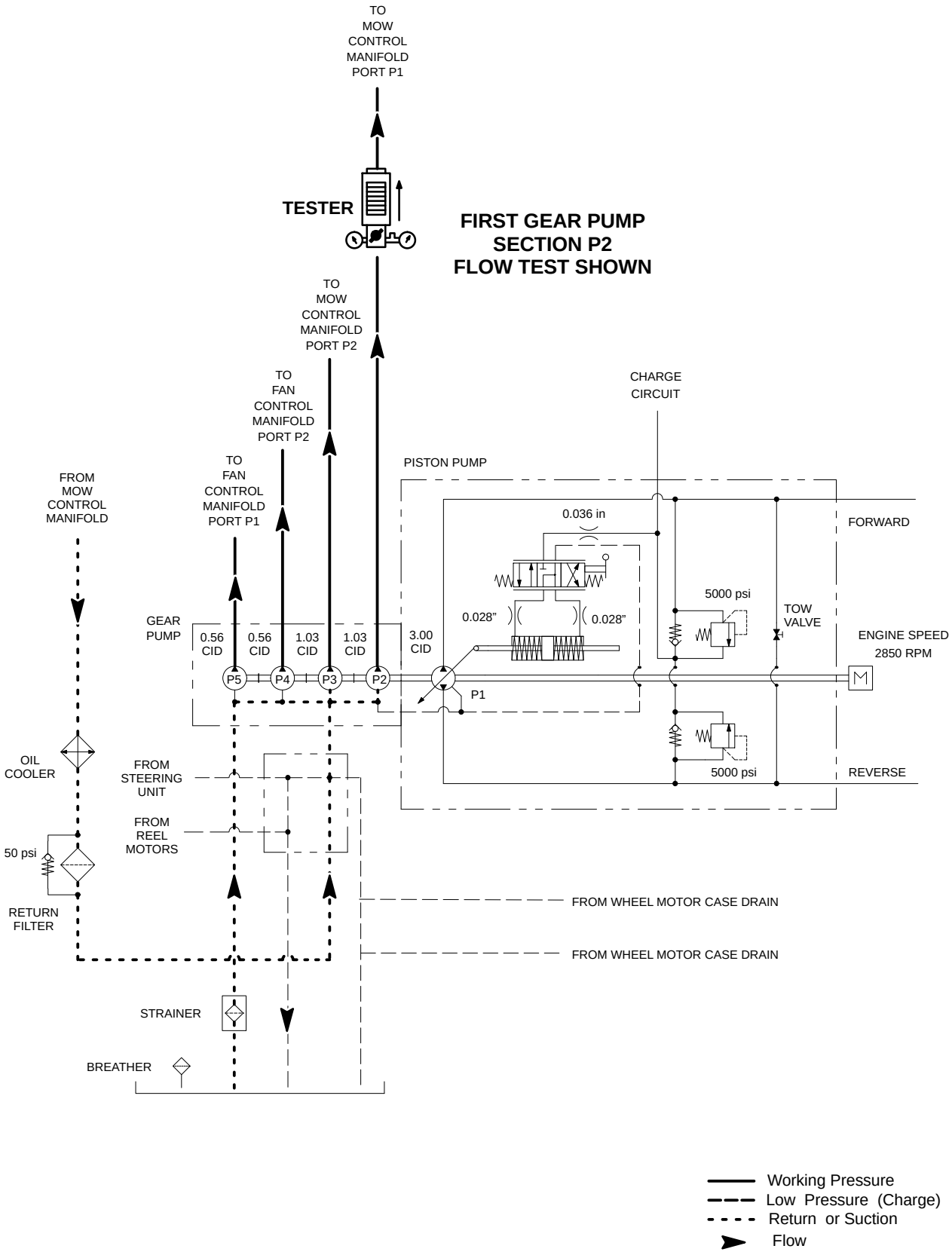
17. Reconnect wire harness to proportional relief valve solenoid.

18. Start engine and run at low idle speed. Check for hydraulic leaks and make corrections if necessary before returning machine to service.

19. Lower and secure hood when finished.

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Gear Pump Flow Test (pump sections P2 thru P5)



Gear Pump Sections P2 thru P5 Flow Test

A gear pump flow test should be performed to make sure a hydraulic circuit has adequate fluid flow. Four (4) gear pumps are used in the Reelmaster 7000−D to power the various hydraulic circuits (Fig. 45). Gear pump section P2 provides hydraulic flow for the front cutting units #1, #4, & #5.Gear pump section P3 provides hydraulic flow for the rear cutting units #2 & #3. Gear pump section P4 provides hydraulic flow for the steering, lift/lower and charge circuits. Gear pump section P5 provides hydraulic flow for the engine cooling fan circuit.

The gear pump flow test compares fluid flow at No Load with fluid flow Under Load. A drop in flow under load of more than **15%** indicates the gears and wear plates in the pump have worn. A worn pump will by−pass hydraulic fluid and make the pump less efficient. Eventually, enough fluid loss will occur to cause the cutting unit 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.

Special Equipment Required:

- 15 GPM (56 LPM) Hydraulic Tester (Pressure and Flow) with hoses − 1−3/16 − 12 (P2 & P3), 13/16 − 16 (P4 & P5)
- Phototach (non−contact tachometer)

CAUTION

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

1. Park machine on a level surface with the cutting units lowered and the reel enable/disable switch in the DISABLE position. Make sure engine is off and the parking brake is applied.

IMPORTANT: Make sure that the oil flow indicator on the tester matches the flow of oil (gear pump > tester > manifold).

2. Determine which gear pump section is to be tested and install the hydraulic tester in series with the disconnected hose and hydraulic fitting at the appropriate location:

   A. Gear Pump P2 − Front Cutting Unit Circuit: disconnect hydraulic hose at top of gear pump section P2 or at mow control manifold port P1.

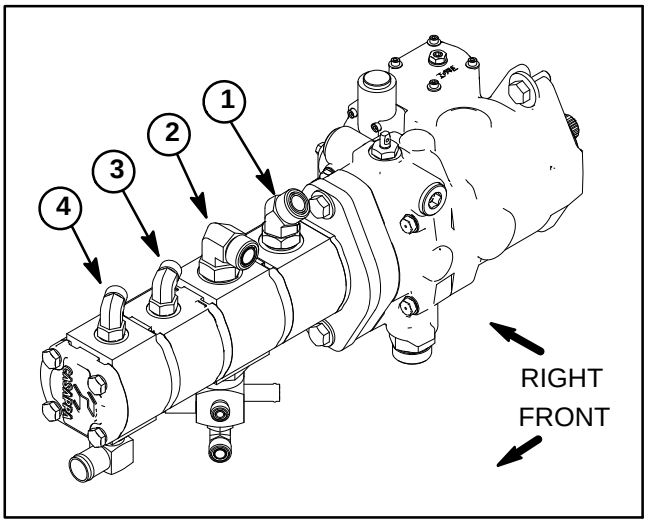


Figure 45

1. **Gear pump section P2 (front cutting units)**
2. **Gear pump section P3 (rear cutting units)**
3. **Gear pump section P4 (steering/lift/charge)**
4. **Gear pump section P5 (engine cooling fan)**

   B. Gear Pump P3 − Rear Cutting Unit Circuit: disconnect hydraulic hose at top of gear pump section P3 or at mow control manifold port P2.

   C. Gear Pump P4 − Steering/Lift/Charge Circuit: disconnect hydraulic hose at top of gear pump section P4 or at fan control manifold port P2.

   D. Gear Pump P5 − Engine Cooling Fan Circuit: disconnect hydraulic hose at top of gear pump section P5 or at fan control manifold port P1.

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

4. Start engine and run at low idle speed. Check for hydraulic leaks at tester connections and make corrections if necessary before proceeding with test.

5. Set throttle to high speed.

   A. Use the InfoCenter display to verify engine RPM on units with Yanmar diesel engines **(2850 RPM)**.

   B. Use a phototach to verify engine RPM on units with Kubota diesel engines **(2850 +50/−120 RPM)**.

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

7. Verify pump flow at No Load as follows:

   Record tester pressure and flow reading at no load (Fig. 46).

CAUTION

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

8. Verify pump flow Under Load as follows:

   A. Watch flow meter pressure gauge carefully while slowly closing the flow control valve until **2000 PSI (137.9 Bar)** is obtained on gauge.

   B. Record tester pressure and flow readings under load.

9. Open tester flow control, set throttle to low speed, and shut off engine.

PUMP SECTION	CIRCUIT	NO LOAD FLOW
P2	Front Cutting Units	12 GPM (45 LPM)
P3	Rear Cutting Units	12 GPM (45 LPM)
P4	Steering/Lift/ Charge	6 GPM (24 LPM)
P5	Engine Cooling Fan	46 GPM (24 LPM)

Figure 46

10. The under load test flow reading (step 8.) should not drop **more than 15%** when compared to no load test flow reading (step 7.). A difference in flow of more than 15%, or the inability to achieve specified pressure may indicate:

    A. A restriction in the pump intake line

    B. The gear pump is worn and should be repaired or replaced

11. Disconnect tester and reconnect hydraulic hose.

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Control Manifold Relief Valve Adjustment

Several of the hydraulic control manifolds on your Reelmaster include adjustable relief valves. The following procedure can be used to adjust these relief valves. Refer to the Testing section of this chapter for information on testing relief pressure.

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

1. Locate relief valve on control manifold.

2. Remove cap on relief valve with an allen wrench.

3. To **increase** pressure setting, turn the adjustment socket on the valve in a clockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

4. To **decrease** pressure setting, turn the adjustment socket on the valve in a counterclockwise direction. A 1/8 turn on the socket will make a measurable change in relief pressure.

5. Install and tighten cap on relief valve.

6. Recheck relief pressure and readjust as needed.

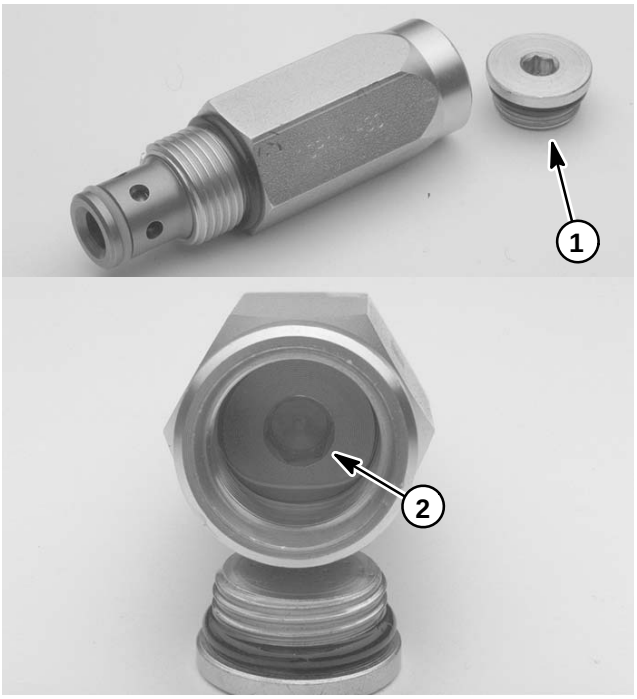


Figure 47

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

General Precautions for Removing and Installing Hydraulic System Components

Before Repair or Replacement of Hydraulic Components

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

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

CAUTION

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

3. Put caps or plugs on any hydraulic lines, hydraulic fittings and components left open or exposed to prevent system 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 installing hydraulic hoses and tubes.

After Repair or Replacement of Hydraulic 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 in this section).

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 in the General Information section of this chapter).

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

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

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

Check Hydraulic Lines and Hoses

WARNING

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

IMPORTANT: Check hydraulic lines and hoses daily for leaks, kinked lines, loose mounting supports, wear, loose fittings or deterioration. Make all necessary repairs before operating the machine.

Priming Hydraulic Pumps

Whenever the hydraulic system is flushed, the hydraulic system is charged or hydraulic components are removed, it is important to properly prime the hydraulic pumps. Hydraulic pump priming ensures that the gear pump and piston (traction) pump have adequate oil during initial start−up and running. The pumps can be primed by using a remote starter switch (see Special Tools in this chapter) to crank engine which allows the pumps to prime.

Use the following procedure to prime the hydraulic pumps:

1. Make sure that ignition switch is in the OFF position and key is removed from switch.

2. Check hydraulic reservoir oil level and adjust if necessary.

NOTE: It may not be necessary to remove the wire from the starter solenoid B+ terminal when connecting a remote starter switch.

3. Connect remote starter switch electrical leads to the starter motor solenoid B+ terminal (Fig. 48) and the positive (+) terminal at the starter or battery.

4. Engage remote starter switch and crank starter for thirty (30) seconds to prime hydraulic pumps. Wait thirty (30) seconds to allow the starter motor and starter solenoid to cool. Repeat cranking procedure a second time.

5. Disconnect remote starter switch leads from starter motor solenoid terminal and positive post of the battery.

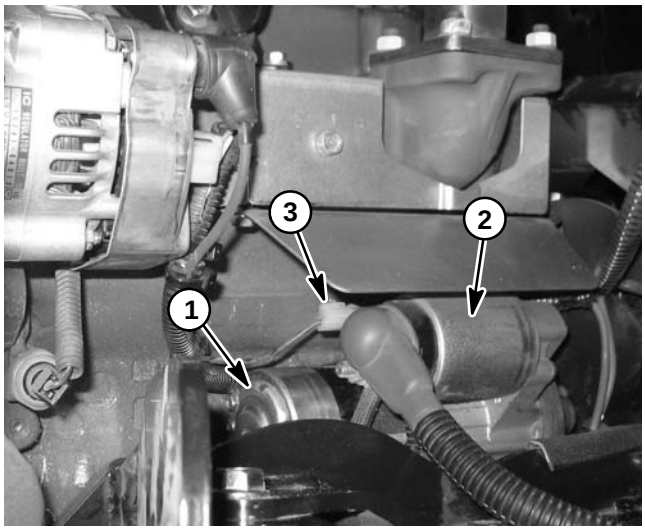


Figure 48

1. **Starter motor**
2. **Starter solenoid**
3. **B+ terminal**

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. 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 this chapter 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 brake. Remove key from the ignition switch.

CAUTION

Operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. Controls must be operated with the ignition switch in OFF. Remove key from the ignition switch.

IMPORTANT: Make sure to clean around any hydraulic connections that will be disassembled.

2. Drain hydraulic reservoir into a suitable container.

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

4. Change and replace both hydraulic oil filters.

5. Inspect and clean hydraulic reservoir (see Hydraulic Reservoir Inspection in the Service and Repair section).

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

NOTE: Use only hydraulic fluids specified in the Traction Unit Operator's Manual. Other fluids may cause system damage.

7. Fill hydraulic reservoir with **new** hydraulic fluid.

8. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

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

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

11. Move reel enable/disable switch to ENABLE to engage cutting units and let them run for several minutes. Move reel enable/disable switch to DISABLE.

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

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

14. Check condition of hydraulic fluid. If the new fluid shows any signs of contamination, repeat steps 1 through 14 again until fluid is clean. If changing to biodegradable fluid, repeat steps 1 through 14 again at least once and until the fluid is clean.

15. Assume normal operation and follow recommended maintenance intervals.

Filtering Closed- Loop Traction Circuit

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

1. Park machine on a level surface with engine stopped and key removed from ignition switch.

WARNING

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

2. Raise and support machine so all wheels are off the ground.

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

3. Thoroughly clean junction of hydraulic hose and **right** side fitting on bottom of traction pump (Fig. 49). Disconnect hose from right side pump fitting.

4. Connect Toro high flow hydraulic filter in series between traction pump fitting and disconnected hose. Use hydraulic hose kit (see Special Tools in this chapter) to connect filter to machine. Make sure that fitting and hose connections are properly tightened.

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

5. After installing high flow filter to machine, check and fill hydraulic reservoir with new hydraulic oil as required.

6. Start engine and run at idle speed. Check for any hydraulic leakage from filter and hose connections. Correct any leaks before proceeding.

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

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

8. With engine running at high idle speed and traction pedal moved to the forward direction, periodically apply brakes to increase pressure in traction circuit. While monitoring filter indicator, continue this process for an additional five (5) minutes.

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

9. With engine running at high idle speed, alternately move traction pedal from forward to reverse. While monitoring filter indicator, continue this process for an additional five (5) minutes.

10. Shut engine off and remove key from ignition switch.

11. Remove high flow hydraulic filter and hydraulic hose kit from machine. Connect hydraulic hose to right side traction pump fitting. Make sure to properly tighten hose (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

12. Lower machine to ground.

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

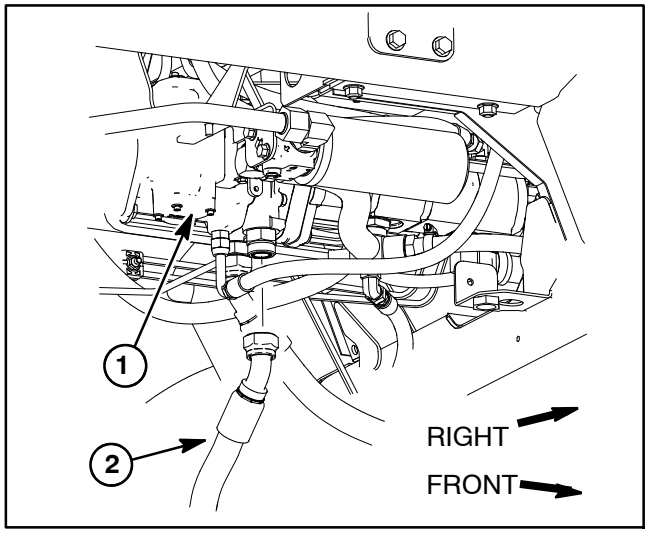


Figure 49

1. Piston (traction) pump
2. Right side fitting/hose

Charge Hydraulic System

NOTE: When initially starting the hydraulic system with new or rebuilt components such as pumps, motors 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. Lower cutting units, stop engine and engage parking brake. Remove key from the ignition switch.

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 in this chapter).

4. Make sure hydraulic reservoir is full. Add correct hydraulic oil if necessary.

5. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

6. Check control rod to the piston (traction) pump for proper adjustment, binding or broken parts.

WARNING

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

IMPORTANT: During initial operation, check hydraulic reservoir oil level frequently and add oil as necessary.

7. Raise one front and one rear wheel off the ground and place support blocks under the frame. Chock remaining wheels to prevent movement of the machine.

8. Make sure traction pedal is in neutral. Sit in the operator's seat and start engine and let it idle at low speed. The hydraulic pumps should pick up hydraulic fluid and fill the hydraulic system. If there is no indication of fill in **30 seconds**, stop the engine and determine the cause.

9. After the hydraulic system starts to show signs of fill, actuate lift control switch until the lift cylinder rods move in and out several times. If the cylinder rods do not move after fifteen (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. Incorrect hydraulic hose routing.

   C. Blocked suction line.

   D. Faulty charge relief valve.

   E. Faulty gear pump.

10. Operate the traction pedal in the forward and reverse directions. The wheels should rotate in the proper direction. If the wheels rotate in the wrong direction, stop engine, remove lines from rear of hydrostat pump, and reverse the connections.

11. Make sure that traction pedal returns to the neutral position when released from the forward or reverse direction and adjust if necessary.

12. Check operation of the traction interlock switches (see Check Operation of Interlock Switches in Chapter - 6, Electrical System in this manual).

13. Stop the engine, remove blocks from wheels and lower machine.

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

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

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

Gear Pump

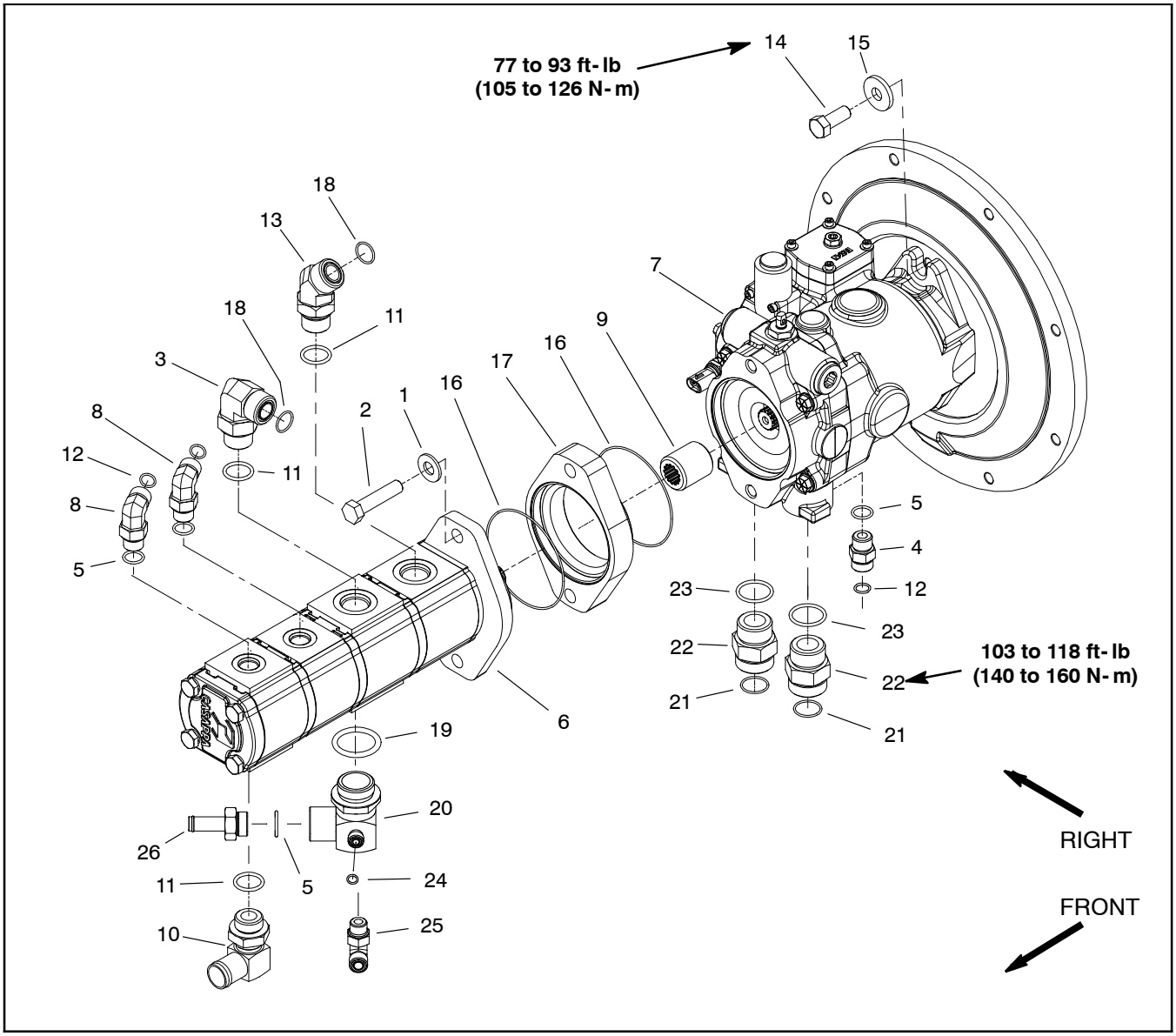


Figure 50

1. Flat washer (2)
2. Cap screw (2)
3. 90º hydraulic fitting
4. Straight hydraulic fitting
5. O- ring (4)
6. Gear pump assembly
7. Piston pump assembly
8. 90º hydraulic fitting (2)
9. Coupler
10. 90º hydraulic fitting
11. O- ring
12. O- ring (4)
13. 45º hydraulic fitting
14. Cap screw (2)
15. Washer (2)
16. O- ring (2)
17. Spacer
18. O- ring (2)
19. O- ring
20. Hydraulic junction fitting
21. O- ring (2)
22. Straight hydraulic fitting (2)
23. O- ring (2)
24. O- ring
25. 90º hydraulic fitting
26. Straight hose fitting

Removal (Fig. 50)

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

2. Raise seat and secure it with prop rod to gain access to gear pump.

3. Drain the hydraulic reservoir into a suitable container.

4. To prevent contamination of hydraulic system during removal, thoroughly clean exterior of pump and fittings.

5. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

6. Disconnect hydraulic lines from gear pump and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly (Fig. 51).

7. Support gear pump assembly to prevent it from falling.

8. Remove two (2) cap screws and washers securing gear pump to piston pump. Remove gear pump, coupler (item 9), spacer (item 17) and O- rings (item 16) from machine.

9. If hydraulic fittings are to be removed from gear pump, mark fitting orientation to allow correct assembly. Remove fittings from pump and discard O- rings.

Installation (Fig. 50)

1. If fittings were removed from gear pump, lubricate and place new O- rings onto fittings. Install fittings into pump ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Lubricate new O- rings (item 16) with clean hydraulic oil. Position O- rings on gear pump and pump spacer flanges.

3. Slide coupler (item 9) onto the piston pump output shaft.

4. Position pump spacer (item 17) to gear pump. Align gear teeth and slide gear pump input shaft into coupler. Secure gear pump to piston pump with two (2) cap screws and flat washers.

5. Remove caps and plugs from hydraulic hoses and fittings. Install hoses to gear pump (see Hydraulic Hose and Tube Installation in this chapter).

6. Replace hydraulic filter and fill hydraulic reservoir with new hydraulic oil (see traction unit Operator's Manual).

7. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

8. Charge hydraulic system (see Charge Hydraulic System in this section).

9. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

10. Lower and secure seat.

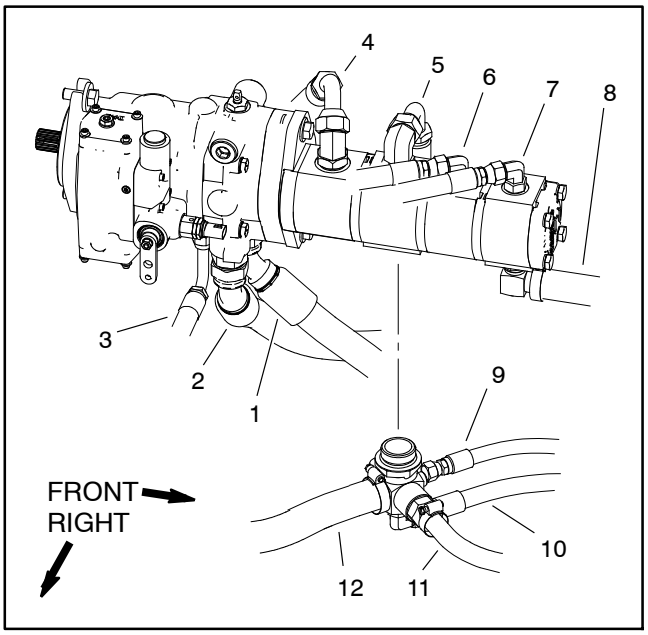


Figure 51

1. **to Traction motors (forward)**
2. **to Traction motors (reverse)**
3. **from Charge filter**
4. **to Mow manifold P1**
5. **to Mow manifold P2**
6. **to Fan manifold P2**
7. **to Fan manifold P1**
8. **from Suction strainer**
9. **from Steering unit**
10. **from Rear traction manifold T**
11. **to Reservoir**
12. **from Return filter**

Gear Pump Service

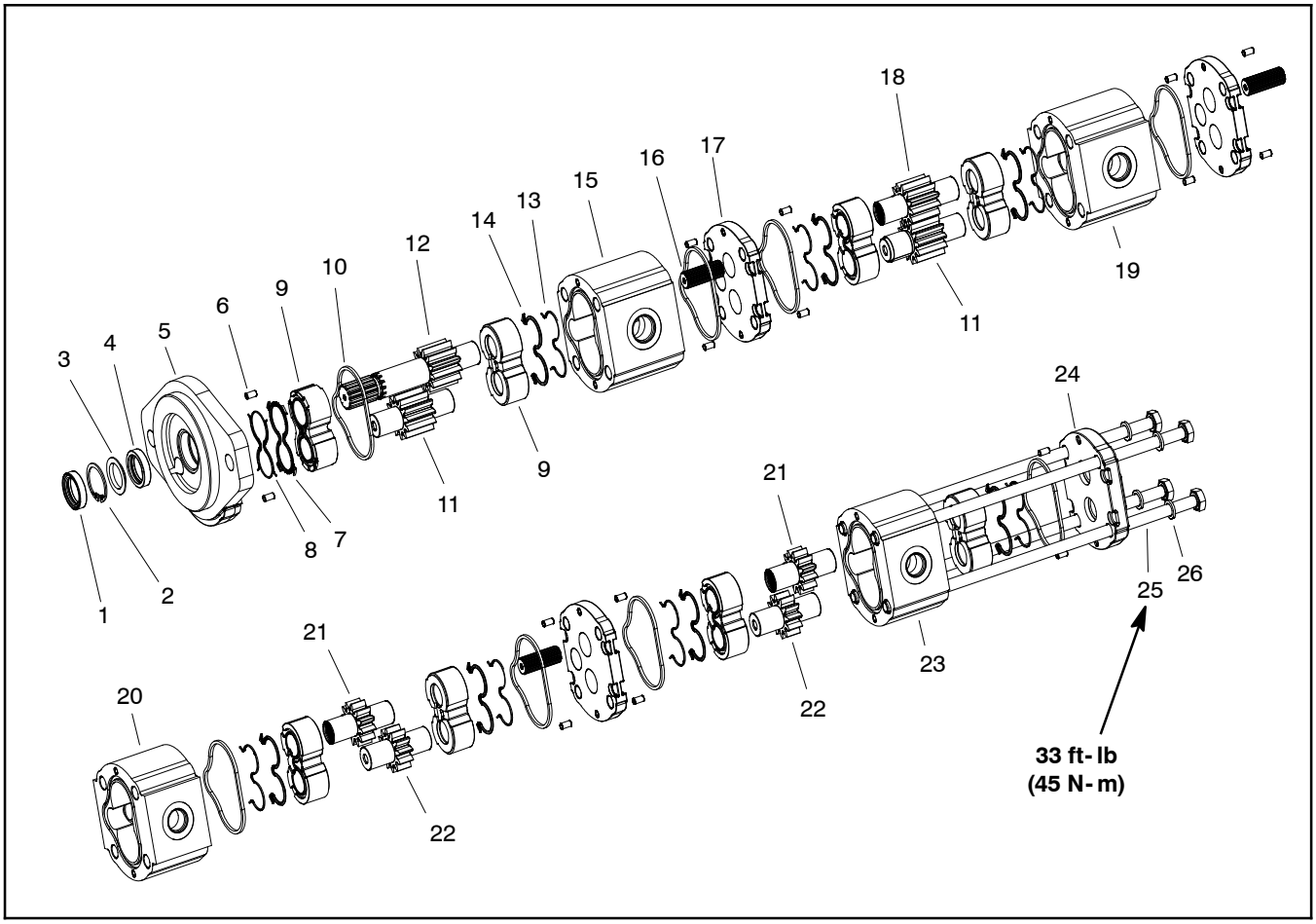


Figure 52

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Front cover**
6. **Dowel pin (16)**
7. **Pressure seal**
8. **Back- up gasket**
9. **Thrust plate (8)**
10. **Seal (8)**
11. **Idler gear**
12. **Drive shaft**
13. **Back- up gasket**
14. **Pressure seal**
15. **Front body (section P2)**
16. **Splined connecting shaft (3)**
17. **Flange**
18. **Drive gear**
19. **Body (section P3)**
20. **Body (section P4)**
21. **Drive gear**
22. **Idler gear**
23. **Rear body (section P5)**
24. **Rear cover**
25. **Cap screw (4)**
26. **Washer (4)**

Disassembly (Fig. 52)

NOTE: The gear pump must be replaced as a complete assembly. Individual gears, housings and thrust plates are not available separately. Disassemble gear pump for cleaning, inspection and seal replacement only.

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

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

2. Use a marker to make a **diagonal** line across the gear pump for assembly purposes (Fig. 53).

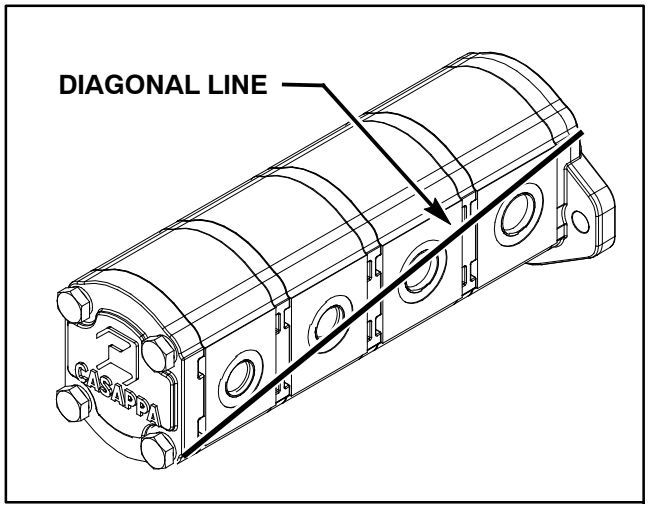


Figure 53

IMPORTANT: Use caution when clamping gear pump in a vise to avoid distorting any pump components.

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

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

5. Remove pump from vise and remove fasteners.

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

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

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

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

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

Assembly (Fig. 52)

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

NOTE: Pressure seals and back-up gaskets fit in grooves machined into thrust plates. Body seals fit in grooves machined in body faces.

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

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

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

Piston (Traction) Pump

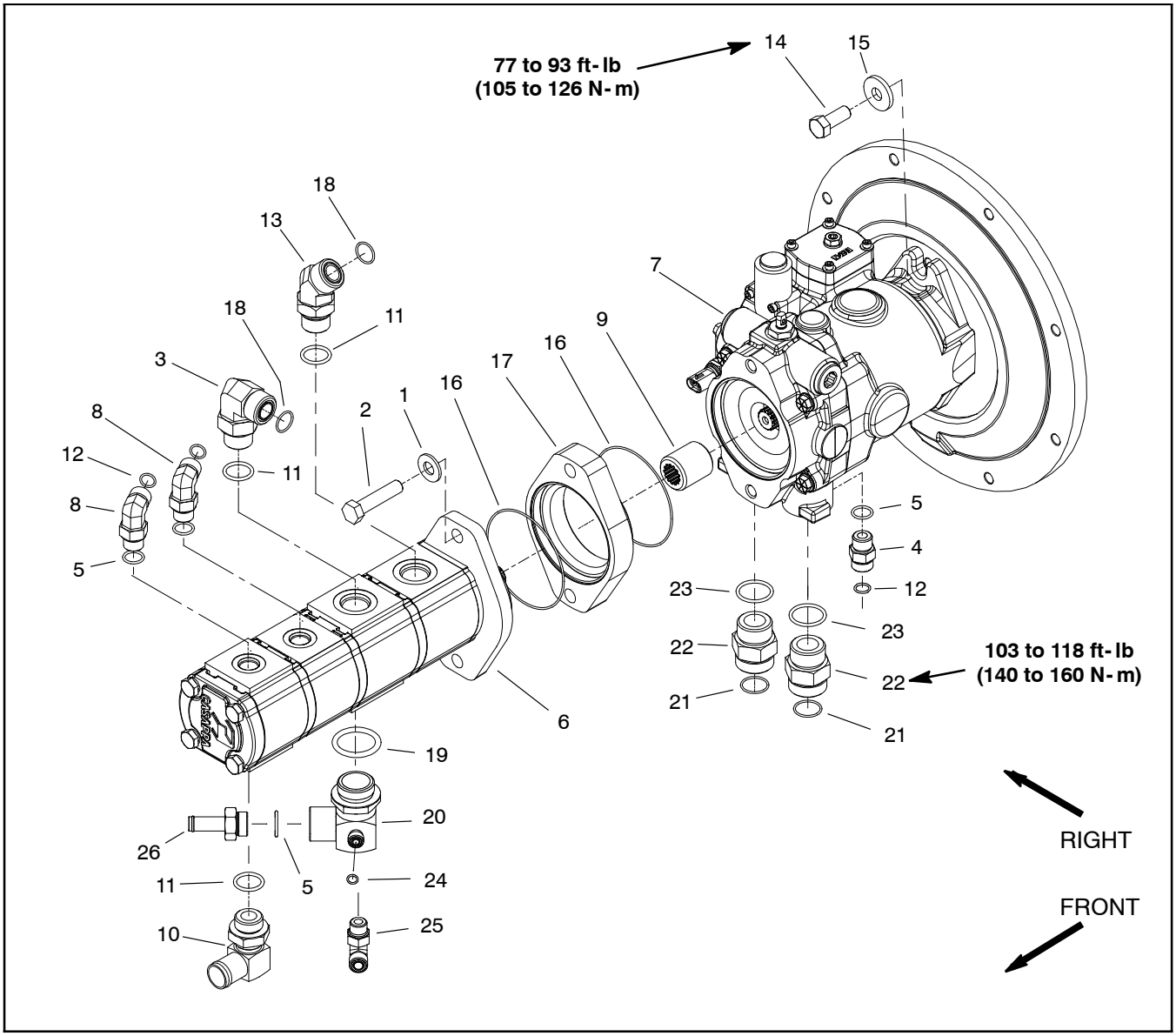


Figure 54

1. Flat washer (2)
2. Cap screw (2)
3. 90º hydraulic fitting
4. Straight hydraulic fitting
5. O-ring (4)
6. Gear pump assembly
7. Piston pump assembly
8. 90º hydraulic fitting (2)
9. Coupler
10. 90º hydraulic fitting
11. O-ring
12. O-ring (4)
13. 45º hydraulic fitting
14. Cap screw (2)
15. Washer (2)
16. O-ring (2)
17. Spacer
18. O-ring (2)
19. O-ring
20. Hydraulic junction fitting
21. O-ring (2)
22. Straight hydraulic fitting (2)
23. O-ring (2)
24. O-ring
25. 90º hydraulic fitting
26. Straight hose fitting

Removal (Fig. 54)

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

2. To prevent contamination of hydraulic system during removal, thoroughly clean exterior of pump assembly.

3. Remove traction rod from control arm on piston pump by removing lock nut and flange head screw (Fig. 55).

4. Disconnect wire harness connector from neutral switch on traction pump (Fig. 55).

5. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

6. Put a drain pan below the pump assembly. Remove hydraulic hoses connected to piston and gear pumps. Put plugs or caps on disconnected hydraulic hoses and fittings to prevent contamination of the system (Fig. 56).

7. Remove gear pump from machine (see Gear Pump Removal in this chapter).

8. Support the piston pump to prevent it from falling while removing two (2) cap screws and washers retaining pump assembly to engine adapter plate. Carefully pull pump assembly from adapter plate and raise it out of the machine.

9. If hydraulic fittings are to be removed from piston pump, mark fitting orientation to allow correct assembly. Remove fittings from pump and discard O- rings.

Installation (Fig. 54)

1. If fittings were removed from piston pump, lubricate and place new O- rings onto fittings. Install fittings into pump ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

IMPORTANT: To prevent spring coupler damage, make sure that piston pump is properly supported and does not put side load into coupler during pump installation.

2. Carefully lower piston pump into the machine and position it to the engine adapter plate. Support pump to prevent it from falling while installing two (2) cap screws and washers securing piston pump to engine adapter plate. Torque screws from **77 to 93 ft- lb (105 to 126 N- m)**.

3. Install gear pump to piston pump (see Gear Pump Installation in this chapter).

4. Install traction rod to control arm on piston pump with flange head screw and lock nut (Fig. 55).

5. Connect wire harness connector to neutral switch.

6. Remove plugs and caps from disconnected hydraulic hoses and fittings. Install fittings and hoses to correct location on gear and piston pumps (see Hydraulic Hose and Tube Installation in this chapter).

7. Install new filter and fill hydraulic reservoir with correct oil (see traction unit Operator's Manual).

8. Prime hydraulic pumps (see Priming Hydraulic Pumps in this chapter).

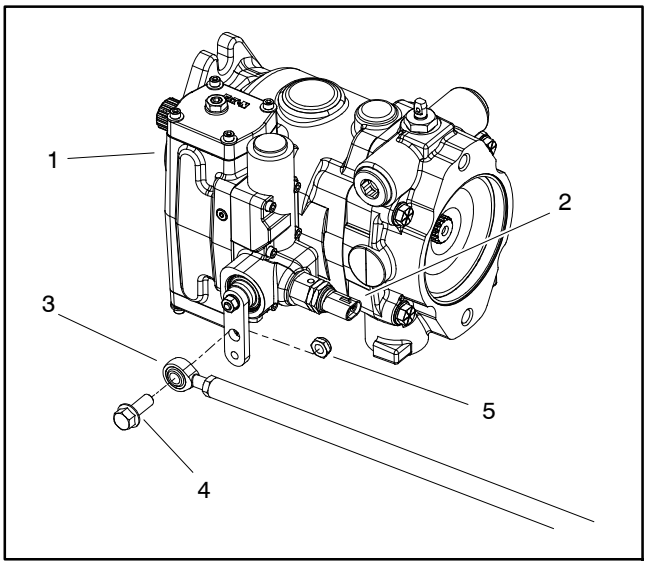


Figure 55

1. **Piston pump**
2. **Neutral switch**
3. **Traction rod**
4. **Flange head screw**
5. **Lock nut**

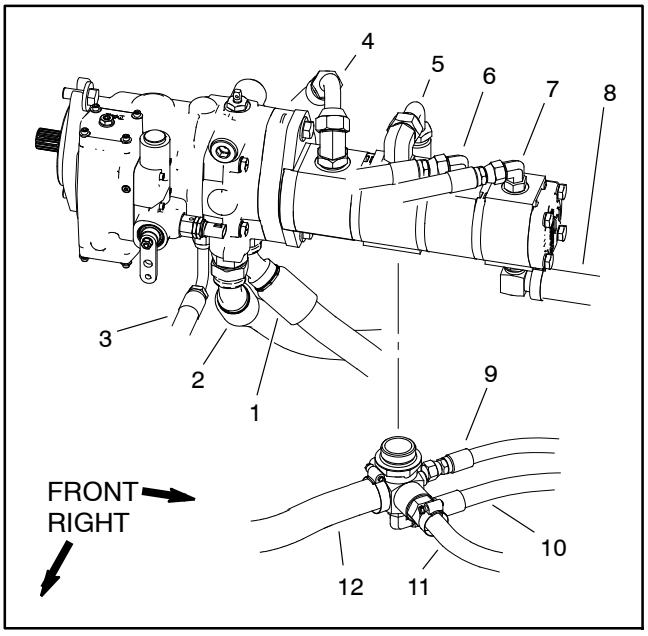


Figure 56

1. **to Traction motors (forward)**
2. **to Traction motors (reverse)**
3. **from Charge filter**
4. **to Mow manifold P1**
5. **to Mow manifold P2**
6. **to Fan manifold P2**
7. **to Fan manifold P1**
8. **from Suction strainer**
9. **from Steering unit**
10. **from Rear traction manifold T**
11. **to Reservoir**
12. **from Return filter**

9. Charge hydraulic system (see Charge Hydraulic System in this section).

10. Stop engine and check for hydraulic oil leaks. Check hydraulic reservoir oil level.

11. Lower and secure seat.

Piston (traction) Pump Service

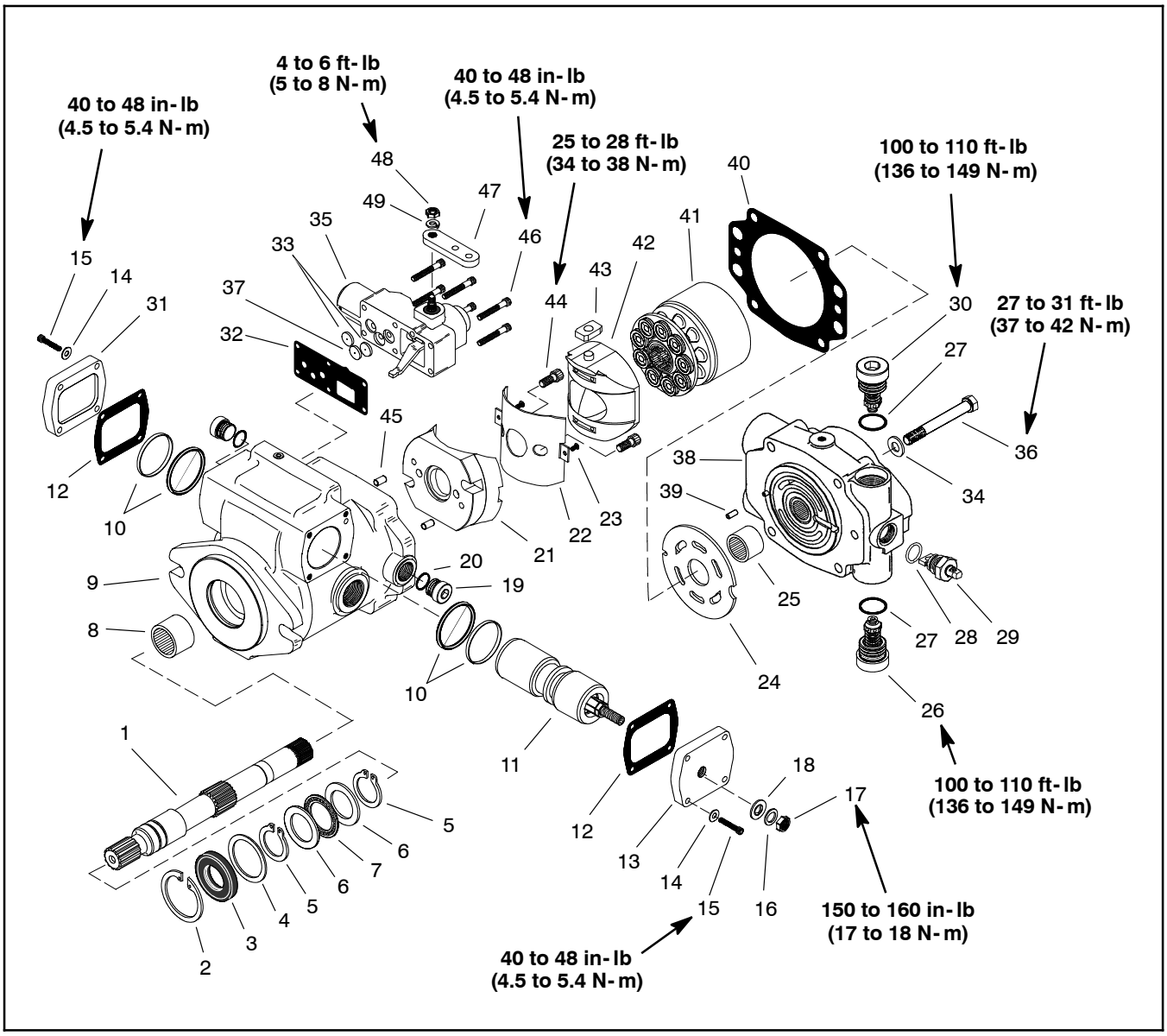


Figure 57

1. Drive shaft
2. Retaining ring
3. Shaft seal
4. Washer
5. Retaining ring
6. Thrust bearing race
7. Thrust bearing
8. Bearing
9. Housing
10. Seal set
11. Servo piston
12. Gasket
13. Cover plate
14. Flat washer (4 per cover)
15. Socket head screw (4 per cover)
16. Washer
17. Jam nut
18. Seal washer
19. Plug
20. O-ring
21. Cradle
22. Bushing
23. Screw
24. Valve plate
25. Bearing
26. Reverse relief valve
27. O-ring
28. O-ring
29. Bypass valve
30. Forward relief valve
31. Cover plate
32. Housing gasket
33. Control orifice - .028" (2)
34. Flat washer (4)
35. Manual servo control assembly
36. Cap screw (4)
37. Control orifice - .036"
38. Backplate
39. Roll pin
40. Housing gasket
41. Rotating kit
42. Camplate
43. Servo piston follower
44. Cap screw (2)
45. Bushing dowel (2)
46. Socket head screw (6)
47. Control arm
48. Hex nut
49. Lock washer

NOTE: For service of the piston (traction) pump, see the Eaton Model 72400 Servo Controlled Piston Pump Repair Information at the end of this chapter.

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Rear Traction Manifold

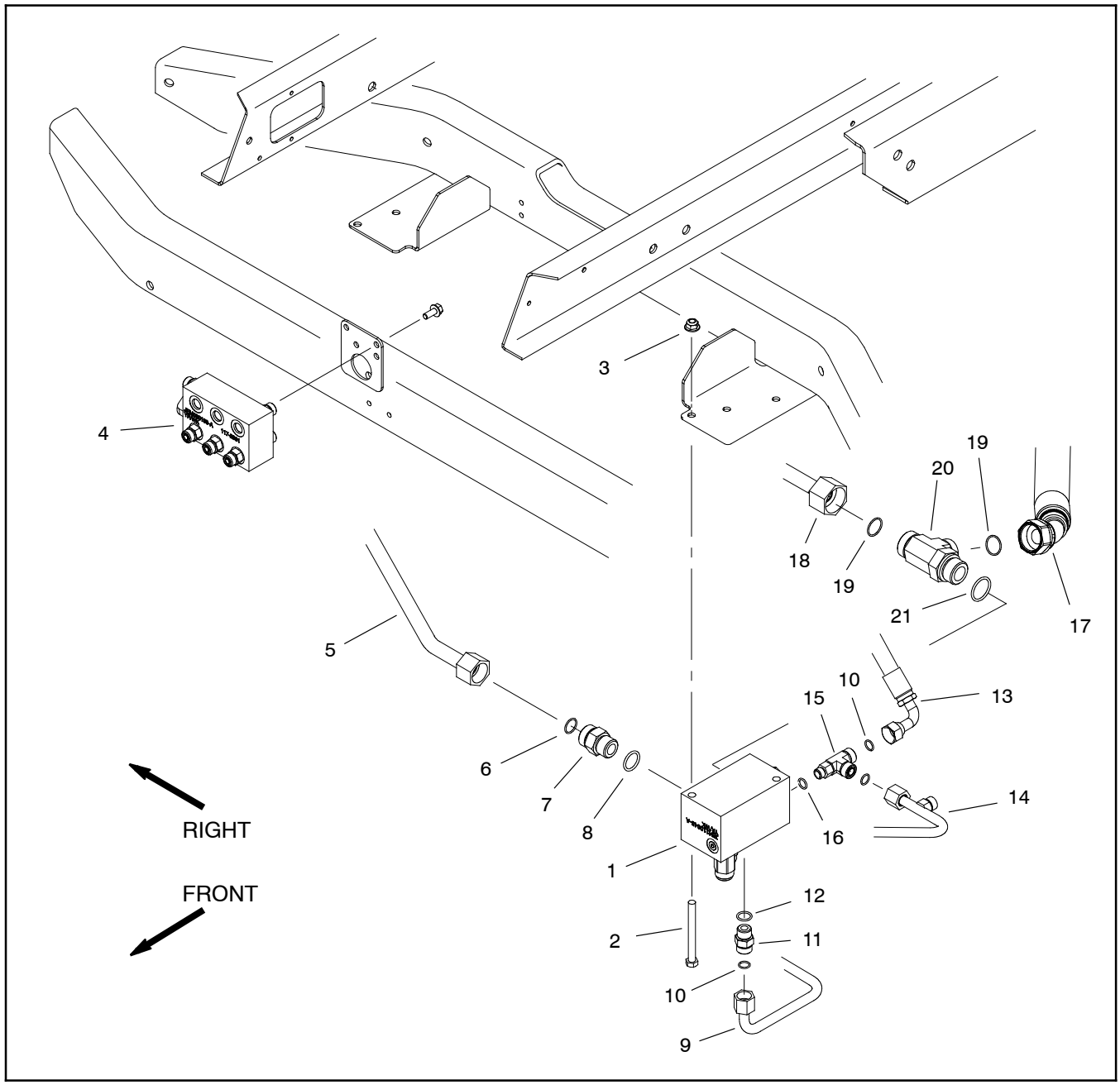


Figure 58

1. Rear traction manifold
2. Cap screw (2)
3. Flange nut (2)
4. Lift circuit junction manifold
5. Hydraulic tube
6. O-ring
7. Hydraulic straight fitting
8. O-ring
9. Hydraulic tube
10. O-ring (3)
11. Hydraulic straight fitting
12. O-ring
13. Hydraulic hose
14. Hydraulic tube
15. Hydraulic tee fitting
16. O-ring
17. Hydraulic hose
18. Hydraulic tube
19. O-ring (2)
20. Hydraulic tee fitting
21. O-ring

Removal (Fig. 58)

NOTE: The ports on the rear traction manifold are marked for easy identification of components. Refer to the Hydraulic Schematics in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port.

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

3. Label all hydraulic lines for assembly purposes.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings.

5. Remove rear traction manifold from the frame.

6. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O- rings.

Installation (Fig. 58)

1. If fittings were removed from manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Install rear traction manifold to the frame.

3. Remove caps and plugs from fittings and hoses. Using labels placed during manifold removal, properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Fill hydraulic reservoir with hydraulic fluid as required (see traction unit Operator's Manual).

Rear Traction Manifold Service

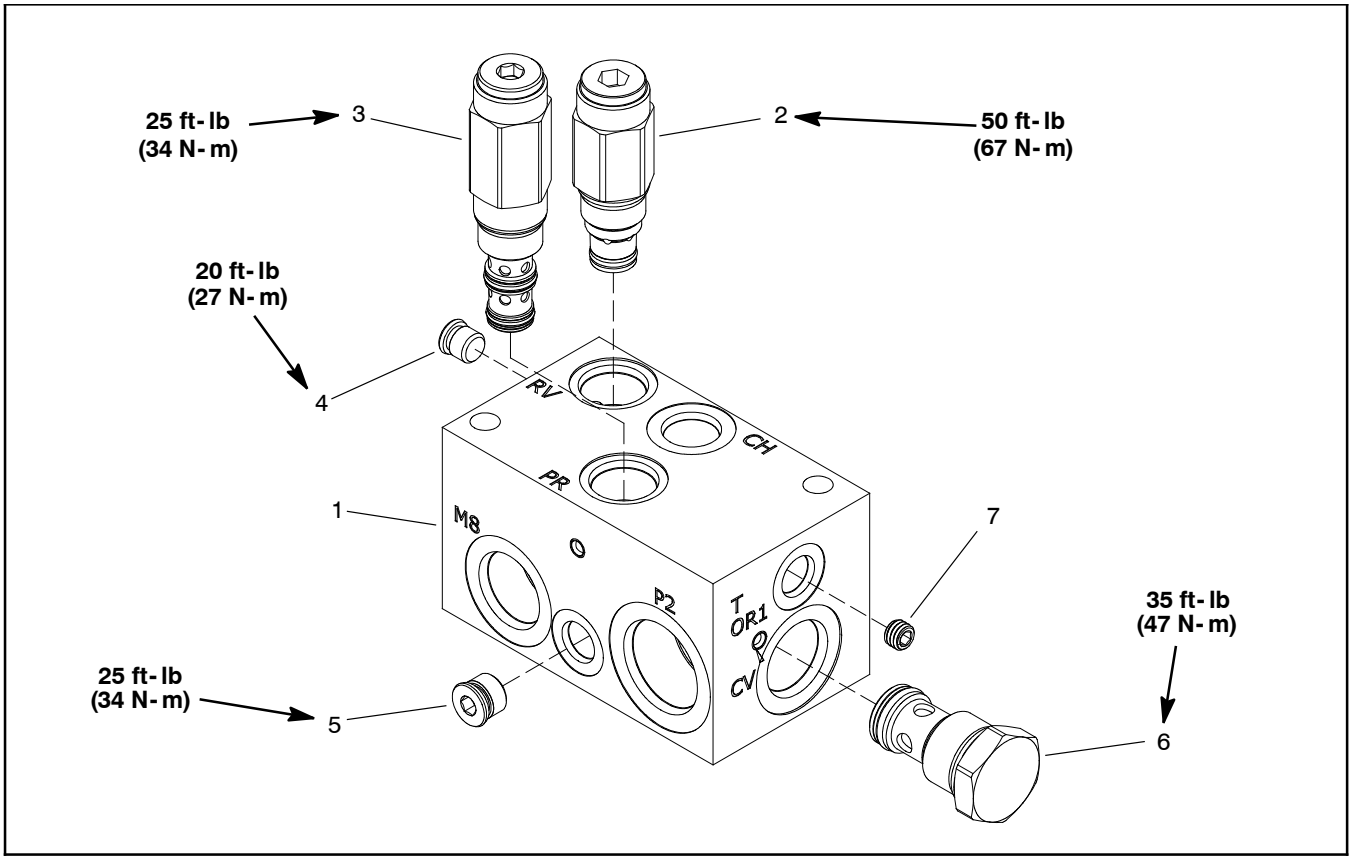


Figure 59

1. Rear traction manifold body
2. Relief valve (RV)
3. Pressure reducing valve (PR)
4. #4 zero leak plug with O- ring
5. #6 zero leak plug with O- ring
6. Check valve (CV)
7. Orifice - 0.050" (OR1)

The ports on the rear traction manifold are marked for easy identification of components. Example: P2 is a piston pump connection port and RV is the location for the relief valve (see Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

The rear traction manifold 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 as 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.

For rear traction manifold cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 59 for rear traction manifold cartridge valve and plug installation torque.

IMPORTANT: A flow control orifice (item 7) is located beneath the hydraulic fitting in rear traction manifold port T/OR1. If the orifice is removed from this manifold port, make sure to label its position for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is properly tightened in the port.

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HI/LOW Range Manifold

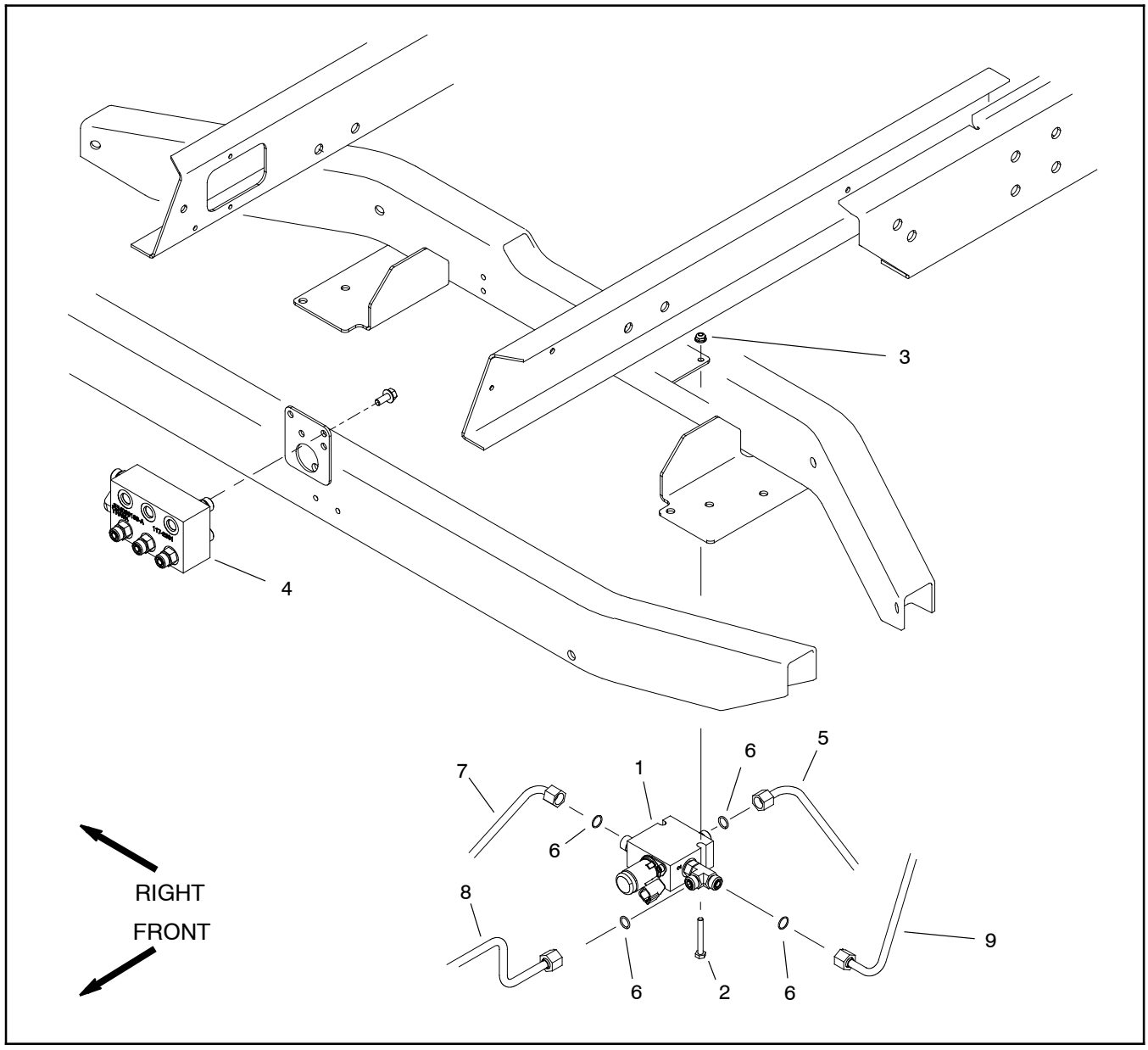


Figure 60

1. **HI/LOW range manifold**
2. **Cap screw (2)**
3. **Flange nut (2)**
4. **Lift circuit junction manifold**
5. **Hydraulic tube**
6. **O- ring (4)**
7. **Hydraulic tube**
8. **Hydraulic tube**
9. **Hydraulic tube**

NOTE: The ports on the HI/LOW range manifold are marked for easy identification of components. Refer to the Hydraulic Schematics in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port.

Removal (Fig. 60)

1. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

2. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of HI/LOW range control manifold.

3. Label all hydraulic lines for assembly purposes.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings.

5. Remove HI/LOW range control manifold from the frame.

6. If hydraulic fittings are to be removed from control manifold, mark fitting orientation to allow correct assembly. Remove fittings from manifold and discard O-rings.

Manifold Service

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this chapter. Refer to Figure 61 for cartridge valve and hydraulic fitting installation torque.

NOTE: The check valve adapter used in the HI/LOW range manifold allows free flow toward the manifold and prevents flow away from the manifold (Fig. 62).

Installation (Fig. 60)

1. If fittings were removed from manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. Install HI/LOW range manifold to the frame.

3. Remove caps and plugs from fittings and hydraulic lines. Using labels placed during manifold removal, properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Fill hydraulic reservoir with hydraulic fluid as required (see traction unit Operator's Manual).

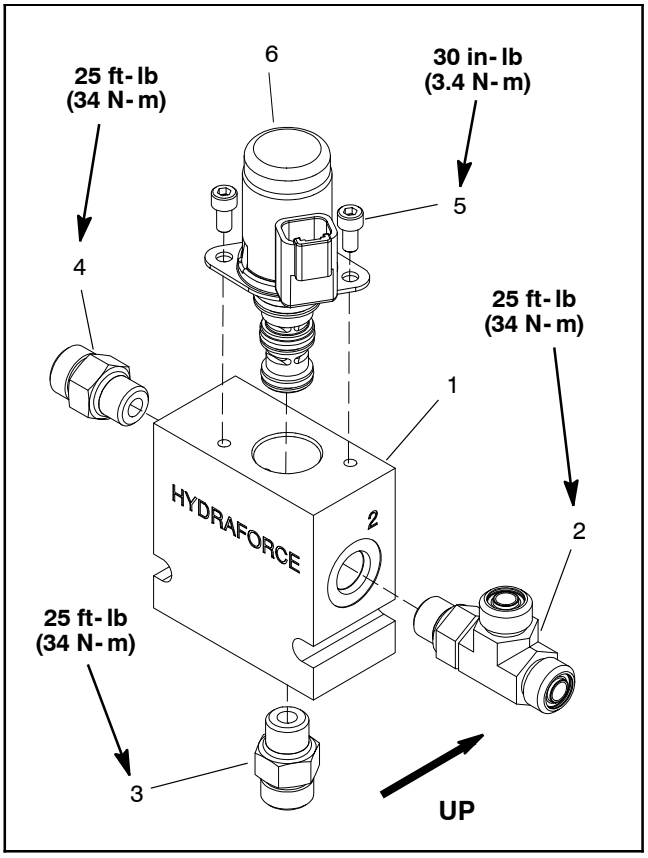


Figure 61

1. **Manifold body**
2. **Tee fitting w/O- ring**
3. **Straight fitting w/O- ring**
4. **Check adapter w/O- ring**
5. **Screw (2)**
6. **Solenoid valve**

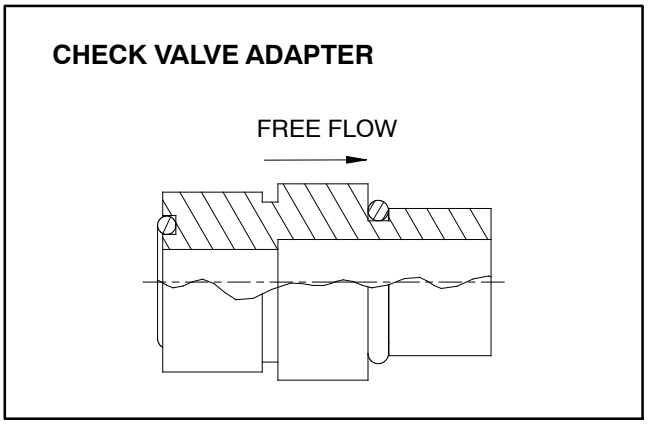


Figure 62

Front Wheel Motors

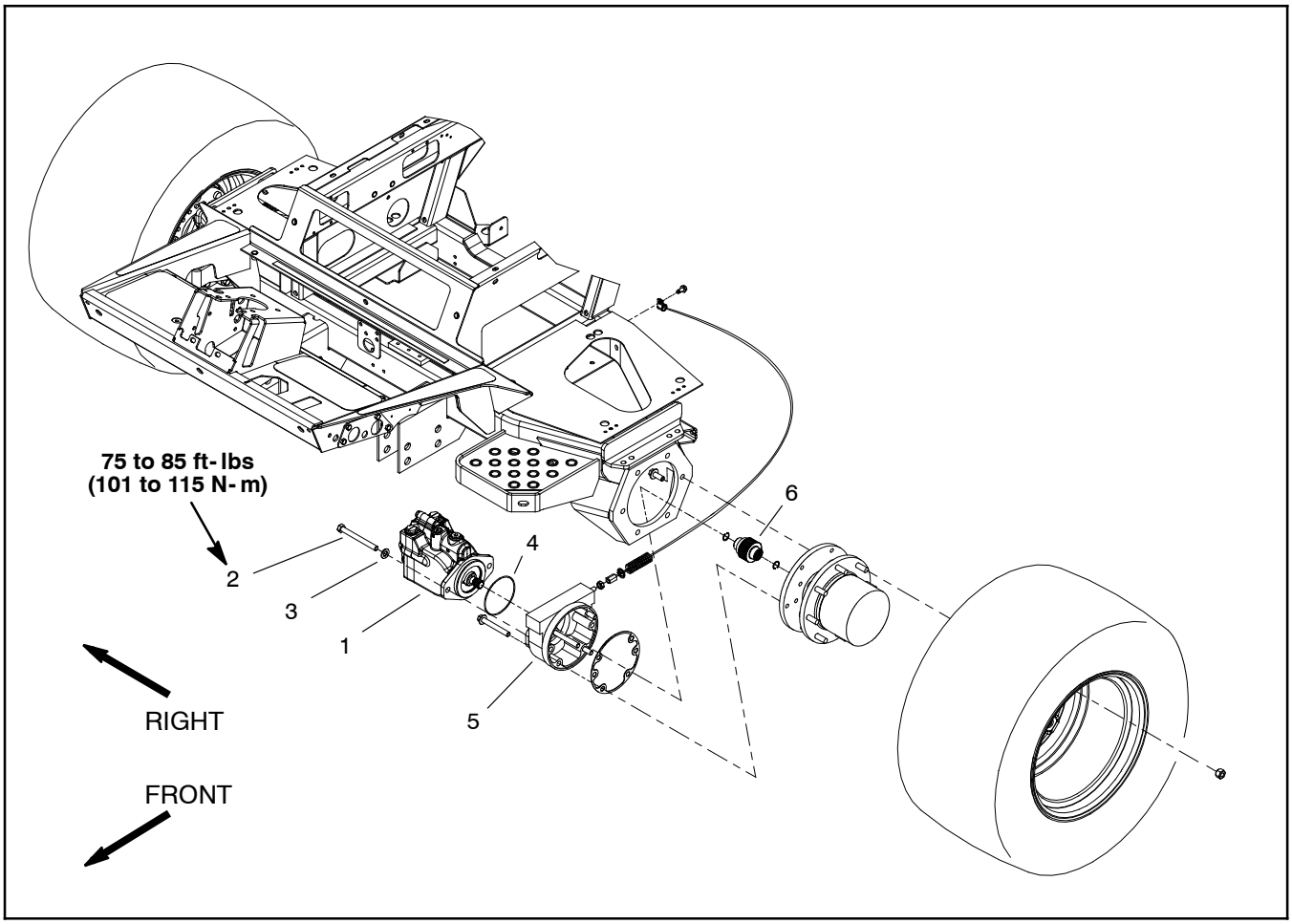


Figure 63

1. **Wheel motor (2)**
2. **Cap screw (2 per motor)**
3. **Flat washer (2 per motor)**
4. **O- ring**
5. **Brake assembly (LH shown)**
6. **Splined brake shaft**

Removal (Fig. 63)

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

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. See Jacking Instructions in Chapter 1 - Safety in this manual for additional information and precautions.

2. Raise front of machine and support with jack stands.

3. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

4. To prevent contamination of hydraulic system during wheel motor removal, thoroughly clean exterior of motor.

5. Disconnect hydraulic lines from wheel motor. Put caps or plugs on lines and fittings to prevent contamination. Label the hydraulic lines to show their correct position on the wheel motor for assembly purposes.

IMPORTANT: Support wheel motor to prevent motor from falling during removal.

6. Remove wheel motor.

7. Remove and discard O- ring (item 16) from flange of wheel motor.

8. If hydraulic fittings are to be removed from wheel motor, mark fitting orientation to allow correct assembly (Figs. 64 and 65). Remove fittings from motor and discard O- rings.

Installation (Fig. 63)

1. If fittings were removed from wheel motor, lubricate and place new O- rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings (Figs. 64 and 65). Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Place new O- ring (item 16) into flange of wheel motor.

3. Position wheel motor to brake assembly.

4. Align splines on motor shaft and splined brake shaft. Slide motor into brake assembly.

5. Secure motor to brake assembly with cap screws and flat washers. Tighten cap screws from **75 to 85 ft- lbs (101 to 115 N- m)**.

6. Remove plugs from lines and fittings. Attach hydraulic lines to wheel motor (see Hydraulic Hose and Tube Installation in this chapter).

7. Lower machine to ground.

8. Fill reservoir with hydraulic fluid as required.

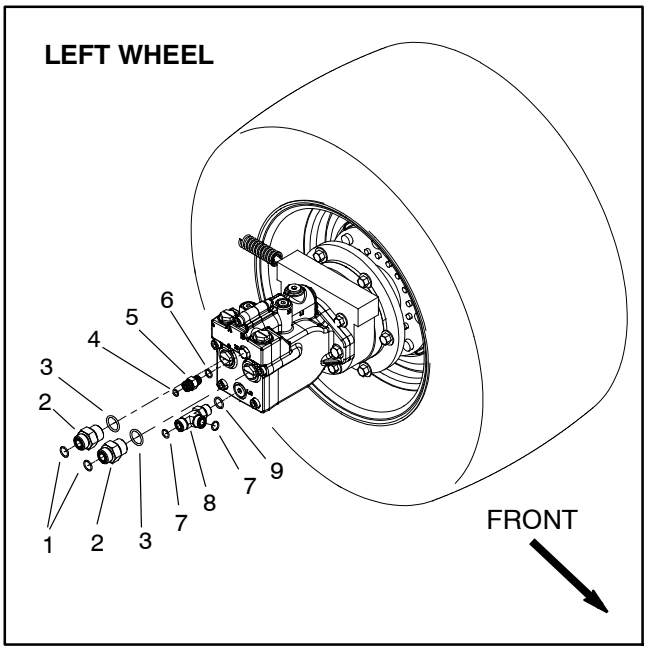


Figure 64

1. **O- ring (2)**
2. **Straight fitting (2)**
3. **O- ring (2)**
4. **O- ring**
5. **Straight fitting**
6. **O- ring**
7. **O- ring (2)**
8. **Tee fitting**
9. **O- ring**

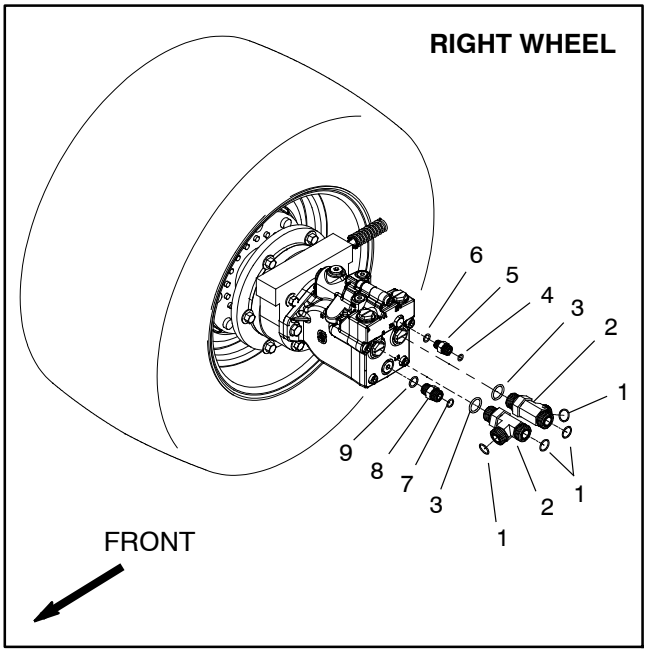


Figure 65

1. **O- ring (4)**
2. **Tee fitting (2)**
3. **O- ring (2)**
4. **O- ring**
5. **Straight fitting**
6. **O- ring**
7. **O- ring**
8. **Straight fitting**
9. **O- ring**

Rear Axle Motor

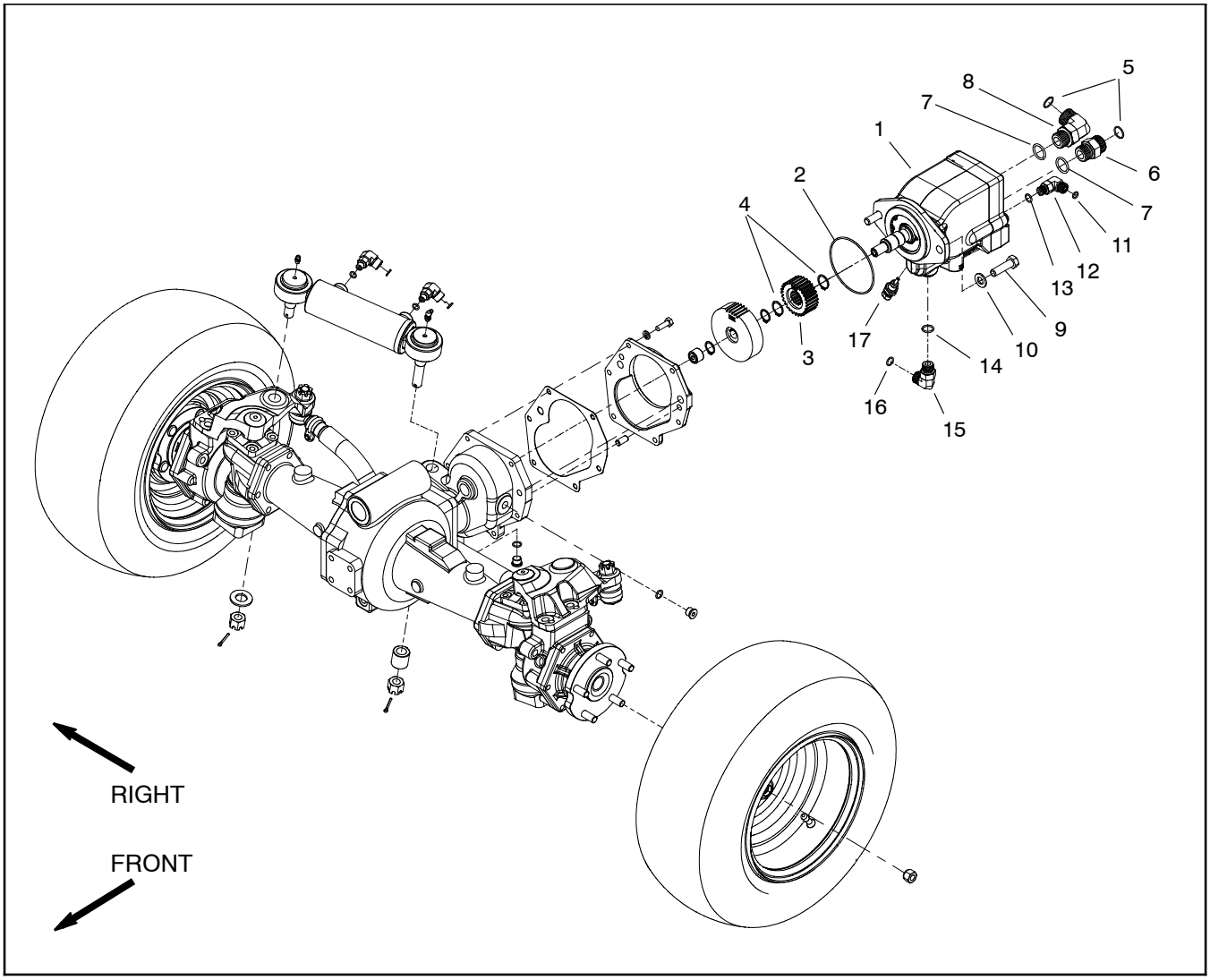


Figure 66

1. **Rear axle motor**
2. **O-ring**
3. **Pinion gear**
4. **External snap ring (2)**
5. **O-ring**
6. **Hydraulic fitting**
7. **O-ring**
8. **90º hydraulic fitting**
9. **Cap screw (2)**
10. **Flat washer (2)**
11. **O-ring**
12. **90º hydraulic fitting**
13. **O-ring**
14. **O-ring**
15. **90º hydraulic fitting**
16. **O-ring**
17. **Temperature sender with O-ring**

Removal (Fig. 66)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. To prevent contamination of hydraulic system during rear axle motor removal, thoroughly clean exterior of motor.

4. Disconnect wire harness connector from the temperature sender (item 17) on the rear axle motor.

5. Disconnect hydraulic lines from motor. Put caps or plugs on lines and fittings to prevent contamination. Label the hydraulic hoses to show their correct position on the axle motor for assembly purposes.

IMPORTANT: Support axle motor to prevent motor from falling during removal.

6. Remove rear axle motor.

7. Remove and discard O- ring (item 2) from flange of wheel motor.

8. If hydraulic fittings are to be removed from axle motor, mark fitting orientation to allow correct assembly. Remove fittings from motor and discard O- rings.

9. If necessary, remove retaining rings and pinion gear (item 3) from motor shaft.

Installation (Fig. 66)

1. If fittings were removed from axle motor, lubricate and place new O- rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. If removed, install pinion gear to axle motor. Make sure that snap rings are fully seated into the motor shaft grooves.

3. Install new O- ring (item 2) onto motor. Position motor to rear axle assembly, align gear teeth and slide motor into place.

4. Secure motor to axle with cap screws and flat washers.

5. Remove plugs from lines and fittings. Attach hydraulic lines to rear axle motor (see Hydraulic Hose and Tube Installation in this chapter).

6. Connect wire harness connector to the temperature sender (item 17) on the rear axle motor.

7. Fill hydraulic reservoir with hydraulic fluid as required.

8. After assembly is completed, verify that hydraulic lines and fittings do not contact any hot or moving parts.

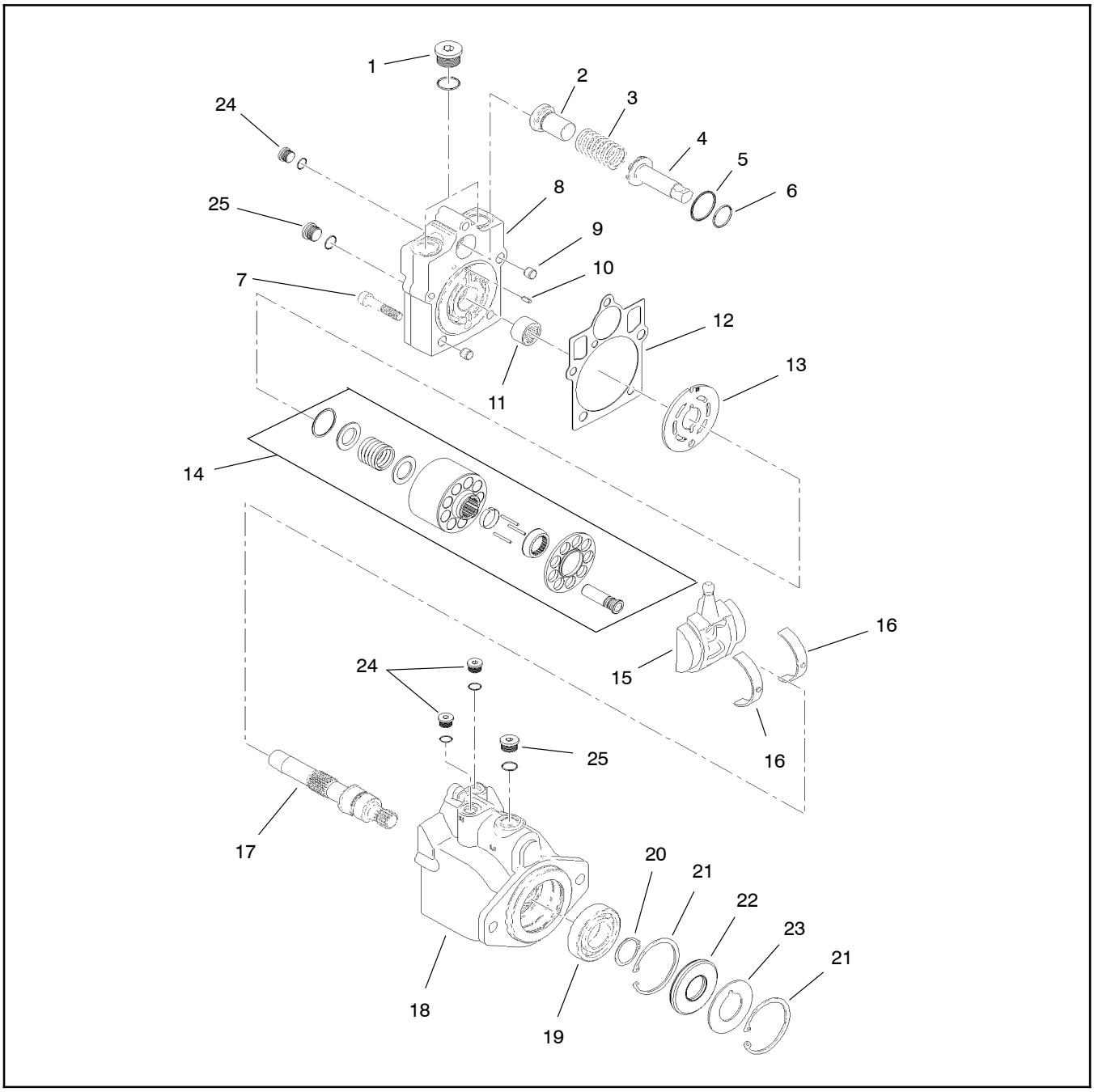


Figure 67

1. Plug with O-ring
2. Minimum angle stop
3. Bias spring
4. Servo piston
5. O-ring
6. O-ring
7. Socket head screw (5)
8. End cap
9. Dowel
10. Dowel pin
11. Bearing
12. Gasket
13. Valve plate
14. Cylinder block kit
15. Swashplate
16. Swashplate bearing assembly
17. Output shaft
18. Housing
19. Bearing
20. Retaining ring
21. Retaining ring (2)
22. Seal
23. Support washer
24. Plug with O-ring (3)
25. Plug with O-ring (2)

NOTE: The front wheel motors are identical (Fig. 67). The rear axle motor includes a flushing valve (Fig. 68) for cooling the closed loop traction circuit and therefore has some differences from the front motors. Use the same procedure to service of the front wheel motors and rear axle motor (see the Sauer- Danfoss K and L Frame Variable Motors Service Manual for additional information).

REAR AXLE MOTOR FLUSHING VALVE

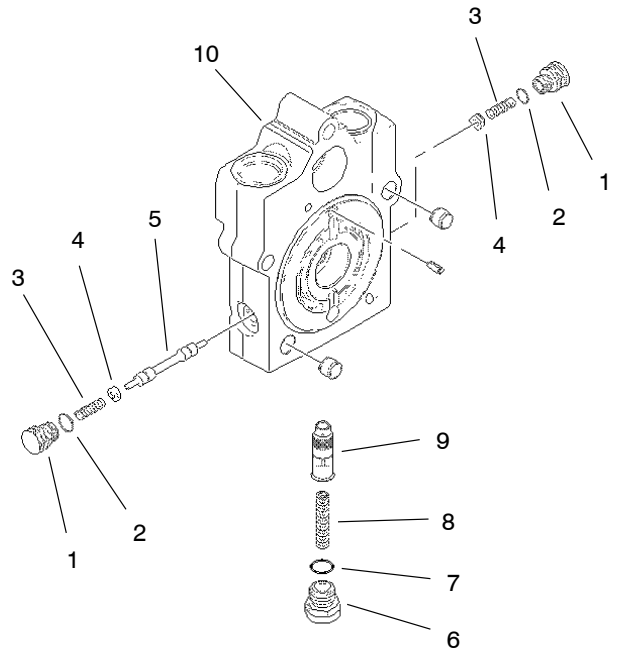


Figure 68

1. **Plug**
2. **O- ring**
3. **Centering spring**
4. **Spring retaining washer**
5. **Shift spool**
6. **Plug**
7. **O- ring**
8. **Centering spring**
9. **Orifice poppet**
10. **End cap**

Cutting Unit Motor

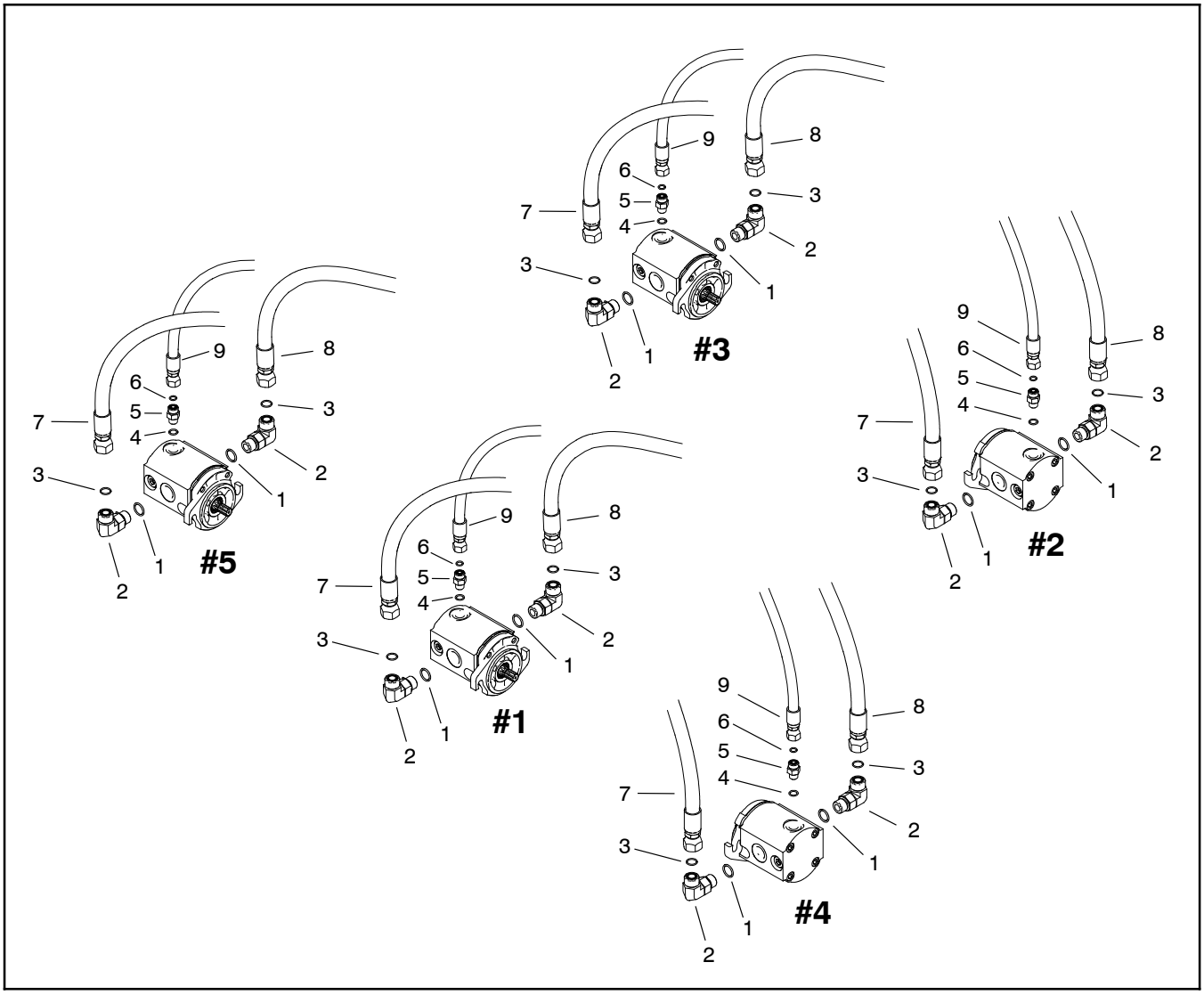


Figure 69

1. O- Ring
2. Elbow fitting
3. O- Ring
4. O- Ring
5. Straight fitting
6. O- Ring
7. Hydraulic hose (inlet)
8. Hydraulic hose (return)
9. Hydraulic hose (case drain)

The hydraulic reel motors used on all cutting units are the same.

Removal (Fig. 69)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. To prevent contamination of hydraulic system during reel motor removal, thoroughly clean exterior of motor.

4. Disconnect hydraulic hoses from reel motor. Put caps or plugs on fittings and hoses to prevent contamination of hydraulic system. Label hydraulic hoses for proper assembly.

5. 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 (Fig. 70).

6. Carefully remove the O- ring from the reel motor flange. Inspect the O- ring for wear or damage. Replace if necessary

7. Inspect reel insert splines for wear. Replace if necessary (see Reel Assembly Removal and Installation in Chapter 9 - DPA Cutting Units in this manual).

8. Place protective plastic cap (see Special Tools in this chapter) into the hole in the cutting unit side plate to prevent debris entry into reel bearing area.

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

Installation (Fig. 69)

1. If fittings were removed from reel motor, lubricate and place new O- rings onto fittings. Install fittings into motor ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Remove cover from cutting unit opening.

3. Coat spline shaft of the reel motor with No. 2 multipurpose lithium base grease.

4. Oil the reel motor O-ring and install it onto the motor flange.

5. 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.

6. 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.

7. 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 (Fig. 70).

8. Remove caps or plugs from hydraulic fittings and hoses. Connect hydraulic hoses to reel motor (see Hydraulic Hose and Tube Installation in this chapter).

9. After assembly is completed, verify that hydraulic hoses and fittings are not contacted by any moving components.

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

11. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

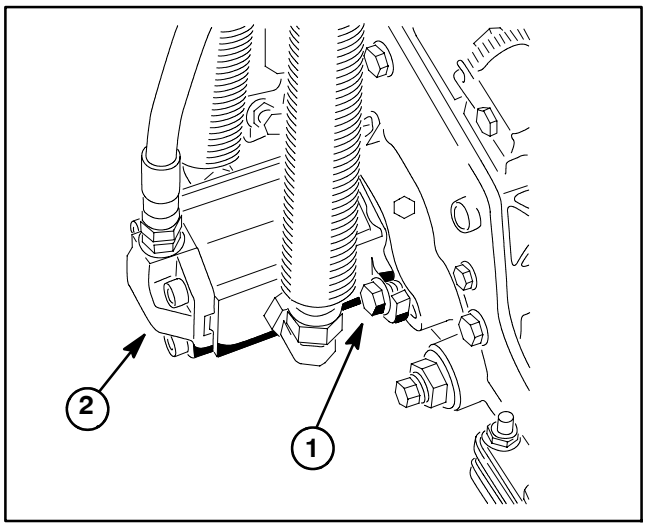


Figure 70

1. **Cap screw**
2. **Hydraulic reel motor**

Cutting Unit Motor Service

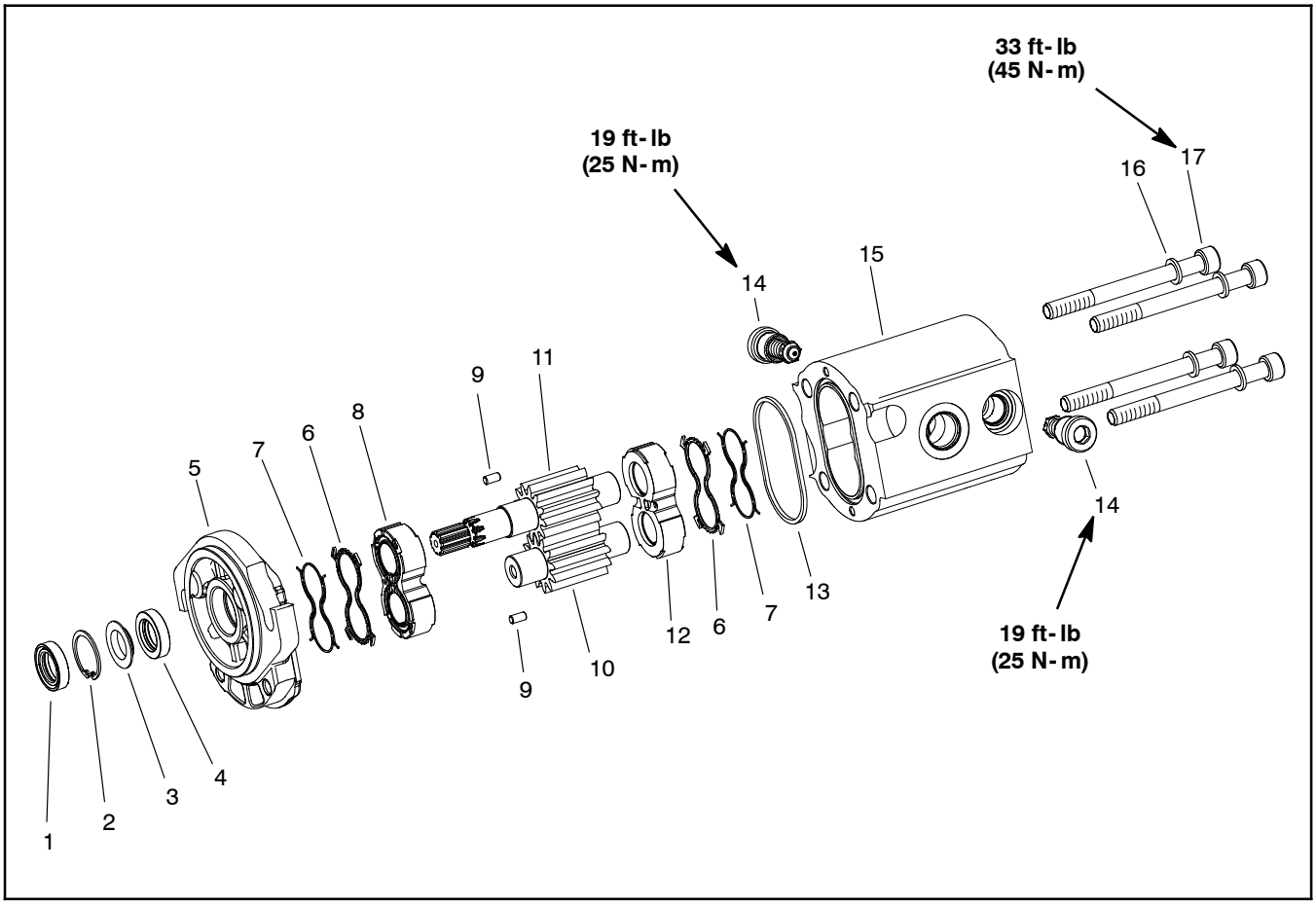


Figure 71

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Front flange**
6. **Pressure seal**
7. **Back- up gasket**
8. **Front wear plate**
9. **Dowel pin**
10. **Idler gear**
11. **Drive shaft**
12. **Rear wear plate**
13. **O- ring**
14. **Relief valve**
15. **Body**
16. **Washer (4)**
17. **Cap screw (4)**

Disassembly (Fig. 71)

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. 72).

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.

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.

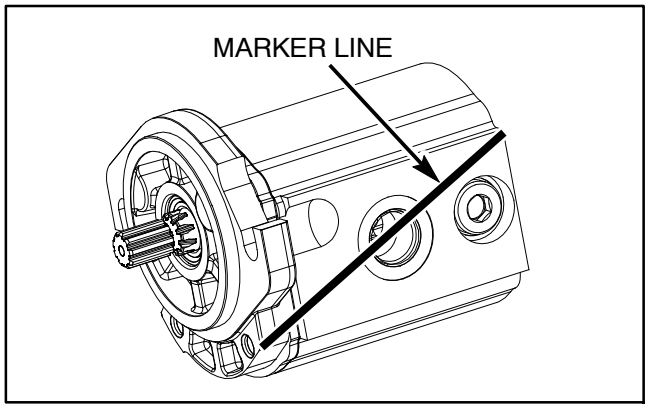


Figure 72

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. 73). 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. 74):

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.

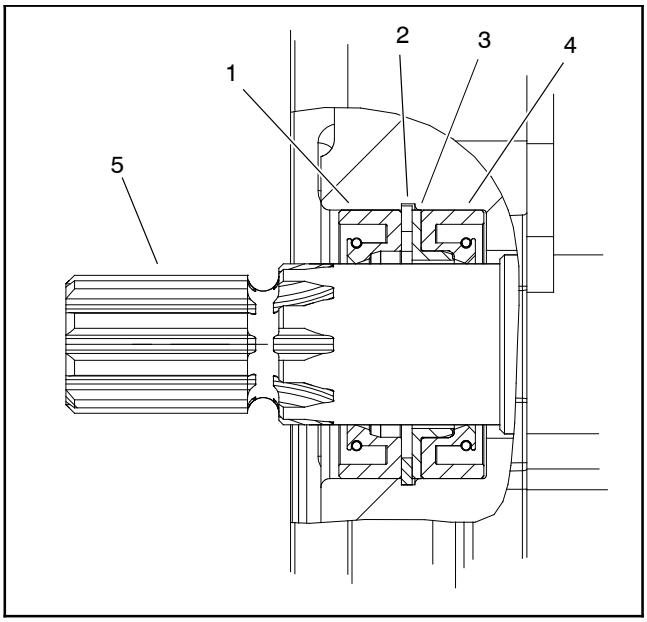


Figure 73

1. **Dust seal**
2. **Retaining ring**
3. **Flange washer**
4. **Shaft seal**
5. **Drive shaft**

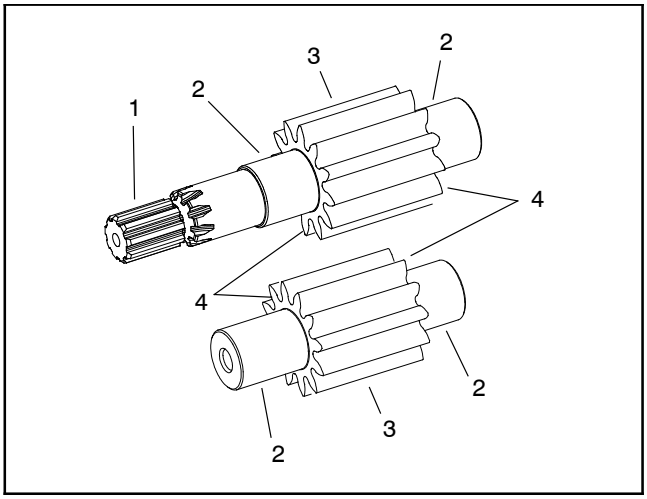


Figure 74

1. **Gear shaft spline**
2. **Gear shaft**
3. **Gear teeth**
4. **Gear face edge**

Assembly (Fig. 71)

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. 73):

   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 tighten the cap screws to **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.

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Mow Control Manifold

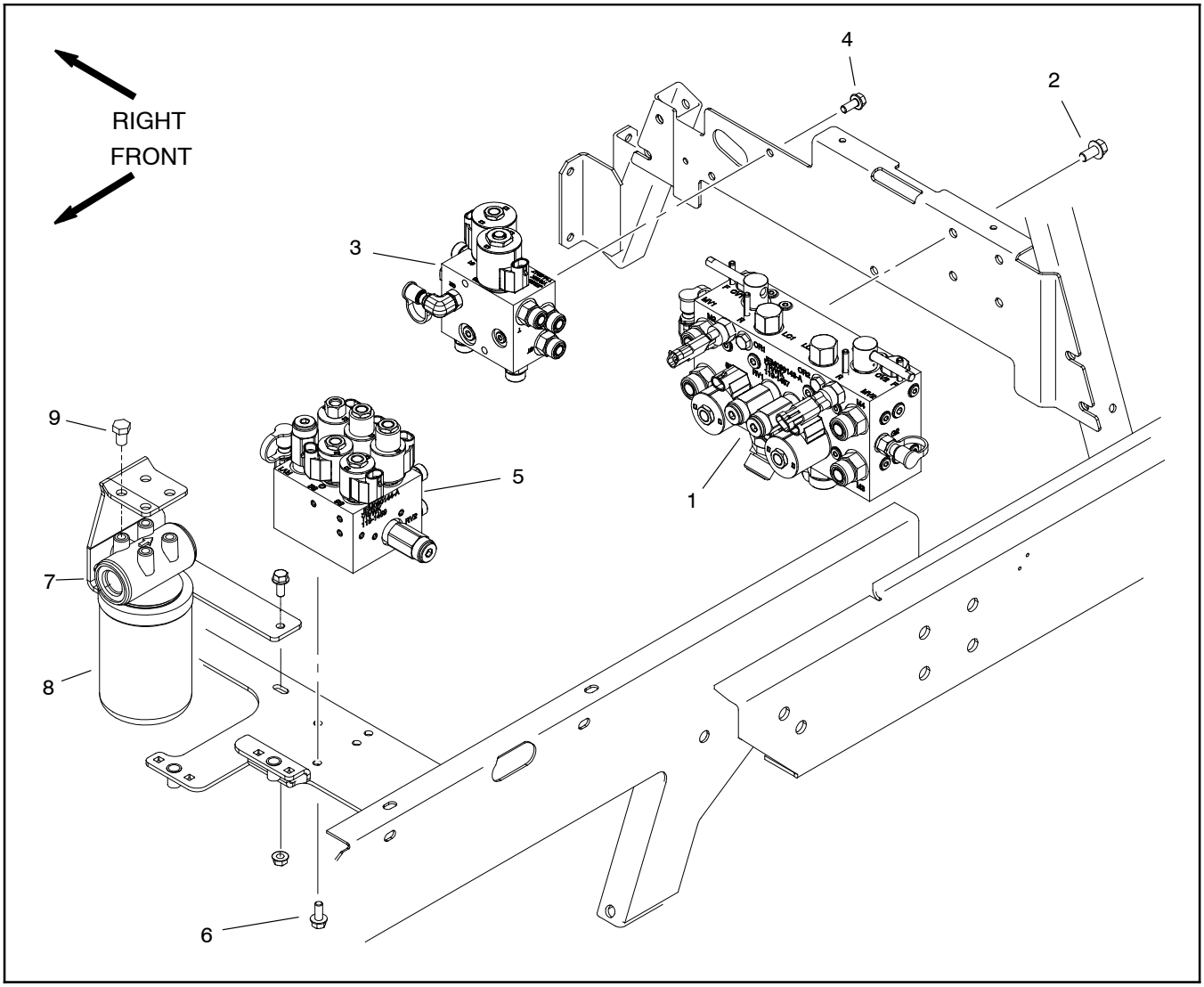


Figure 75

1. **Mow control manifold**
2. **Flange head screw (4)**
3. **Fan control manifold**
4. **Flange head screw (2)**
5. **Lift manifold**
6. **Flange head screw (2)**
7. **Charge filter head**
8. **Charge filter element**
9. **Cap screw (4)**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the supply connection for the front cutting units (see Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 75)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. Unlatch and raise hood.

4. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect connectors from the solenoid coils and backlap switches.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame.

8. If hydraulic fittings are to be removed from manifold, mark fitting orientation to allow correct assembly (Fig. 76). Remove fittings from manifold and discard O- rings.

Installation (Fig. 75)

1. If fittings were removed from manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter). Refer to Figure 76 for fitting installation torque.

2. Install hydraulic manifold to the frame.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Connect wire harness electrical connectors to the solenoid valve coils and backlap switches.

5. Lower and secure hood.

6. Check oil level in hydraulic reservoir and add correct oil if necessary (see traction unit Operator's Manual).

7. Charge hydraulic system (see Charge Hydraulic System in this chapter).

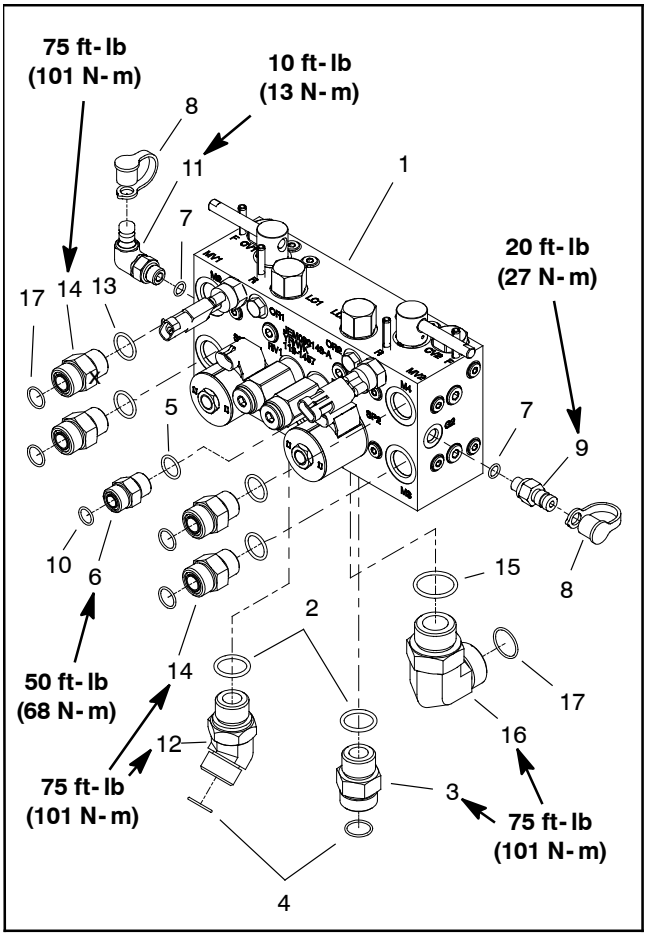


Figure 76

1. Mow control manifold
2. O- ring (2)
3. Straight fitting
4. O- ring (2)
5. O- ring
6. Straight fitting
7. O- ring (2)
8. Dust cover (2)
9. Test fitting
10. O- ring
11. Test fitting
12. 45º fitting
13. O- ring (4)
14. Straight fitting (4)
15. O- ring
16. 90º fitting
17. O- ring (4)

Mow Control Manifold Service

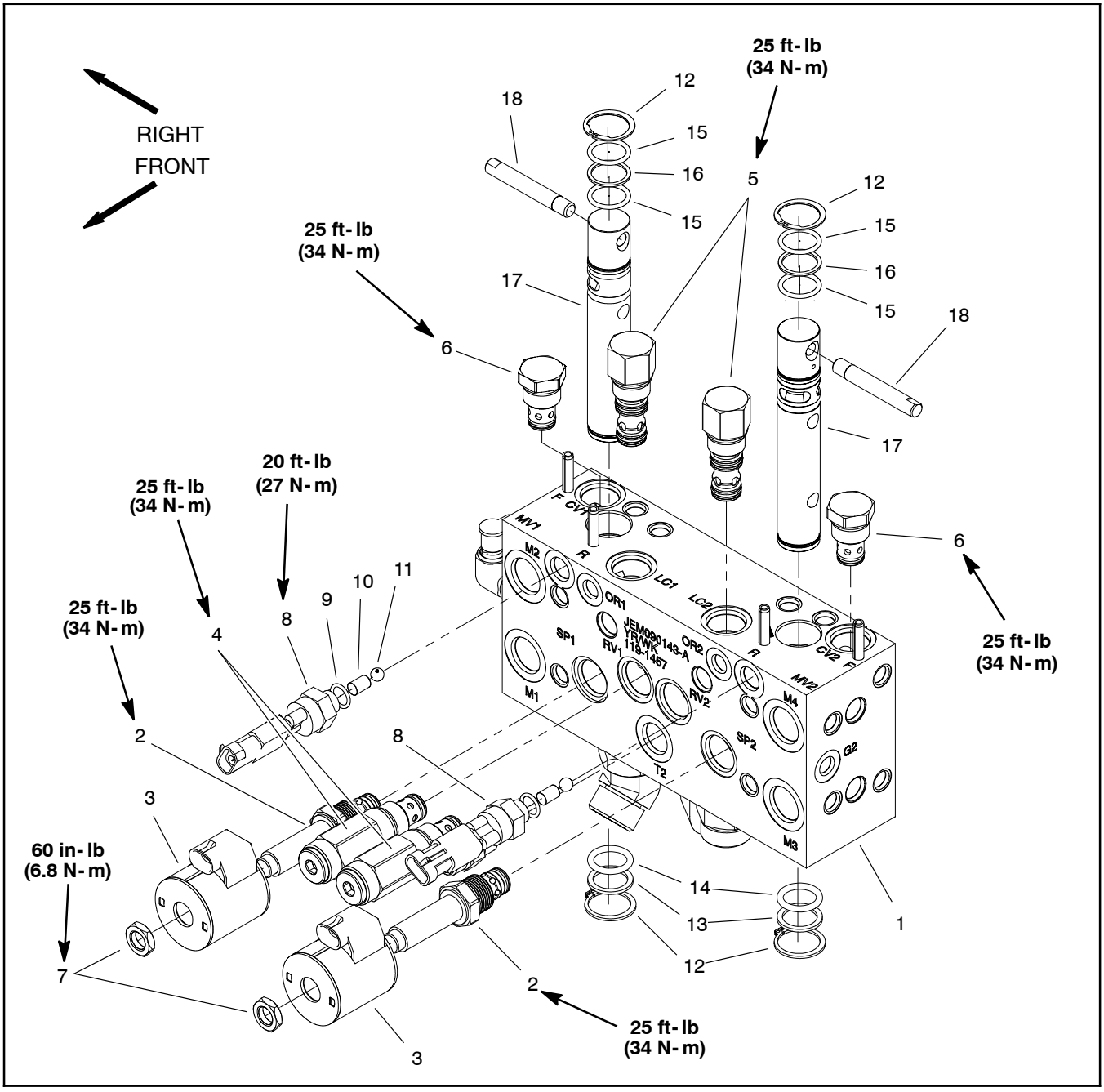


Figure 77

1. Mow control manifold
2. Proportional valve (SP1 & SP2)
3. Solenoid coil (2)
4. Relief valve (RV1 & RV2)
5. Pressure compensator (LC1 & LC2)
6. Check valve (CV1 & CV2)
7. Nut (2)
8. Backlap switch (2)
9. O- ring
10. Dowel
11. Ball
12. Retaining ring (2 per spool)
13. Backup ring
14. O- ring
15. O- ring
16. Backup ring
17. Backlap spool (2)
18. Spool handle

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P1 is a gear pump connection port and PRV1 is the location for a proportional relief valve). See Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

Cartridge Valve Service

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this chapter. Refer to Figure 77 for cartridge valve installation torque.

Mow/Backlap Spool Service (Fig. 77)

1. To remove backlap spool (item 17) from mow control manifold:

   A. Remove backlap switch (item 8) from mow control 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 backlap spool. Raise 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 control manifold. Remove lower O- ring and back- up ring from spool.

   D. Pull spool up and out of mow control manifold. Remove O- rings and back- up ring from spool.

   E. Discard removed O- rings and back- up rings.

2. To install backlap spool (item 17) from mow control manifold:

   A. Install O- rings and back- up ring to upper grooves on backlap spool. Apply a light coating of grease to O- rings.

   B. Carefully push backlap spool down into mow control 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 backlap spool until upper retaining ring groove on spool is exposed on top of manifold. Install upper retaining ring.

   D. Push 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 in manifold. Apply Loctite 603 Retaining Compound (or equivalent) to threads on handle and install handle into spool.

   F. Place ball and dowel pin in backlap switch manifold port. Install new O- ring onto backlap switch. Thread backlap switch into port and torque **20 ft- lb (27 N- m)**.

Manifold Plugs (Fig. 78)

NOTE: The mow control manifold 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 as a secondary seal. If zero leak plug removal is necessary, lightly rap the plug head using a pin 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 head of the plug.

IMPORTANT: An orifice is located beneath the plug in mow control manifold ports OR1 and OR2. If an orifice is removed from these manifold ports, make sure to label its position for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is properly tightened in the port.

1. Remove plugs as needed. Discard O- ring after plug removal.

2. Lubricate and place new O- ring onto removed plugs. If plug was removed from port OR1 or OR2, make sure that orifice is correctly installed before threading plug into manifold. Install plugs into manifold openings. Torque #4 plugs to **20 ft- lb (27 N- m)** and #6 plugs to **25 ft- lb (34 N- m)**.

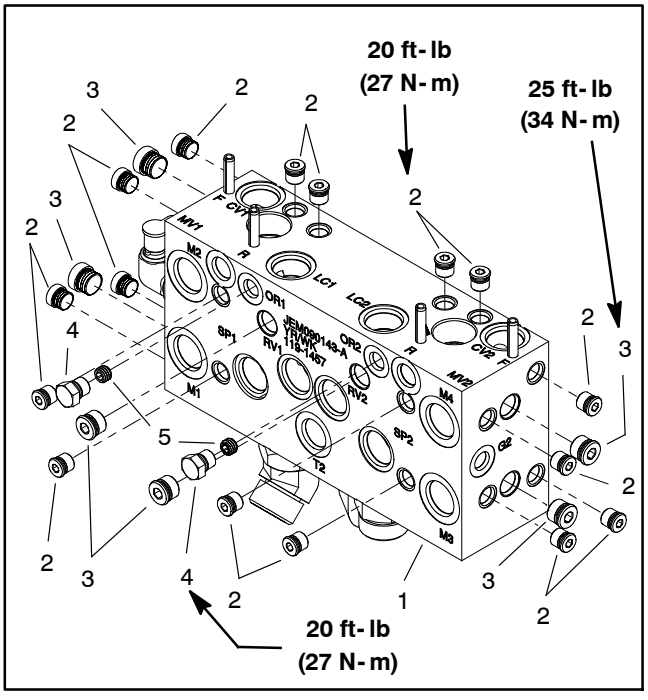


Figure 78

1. Mow control manifold
2. #4 zero leak plug (16)
3. #6 zero leak plug (6)
4. #4 zero leak plug (2)
5. Orifice - .040”

Steering Control Valve

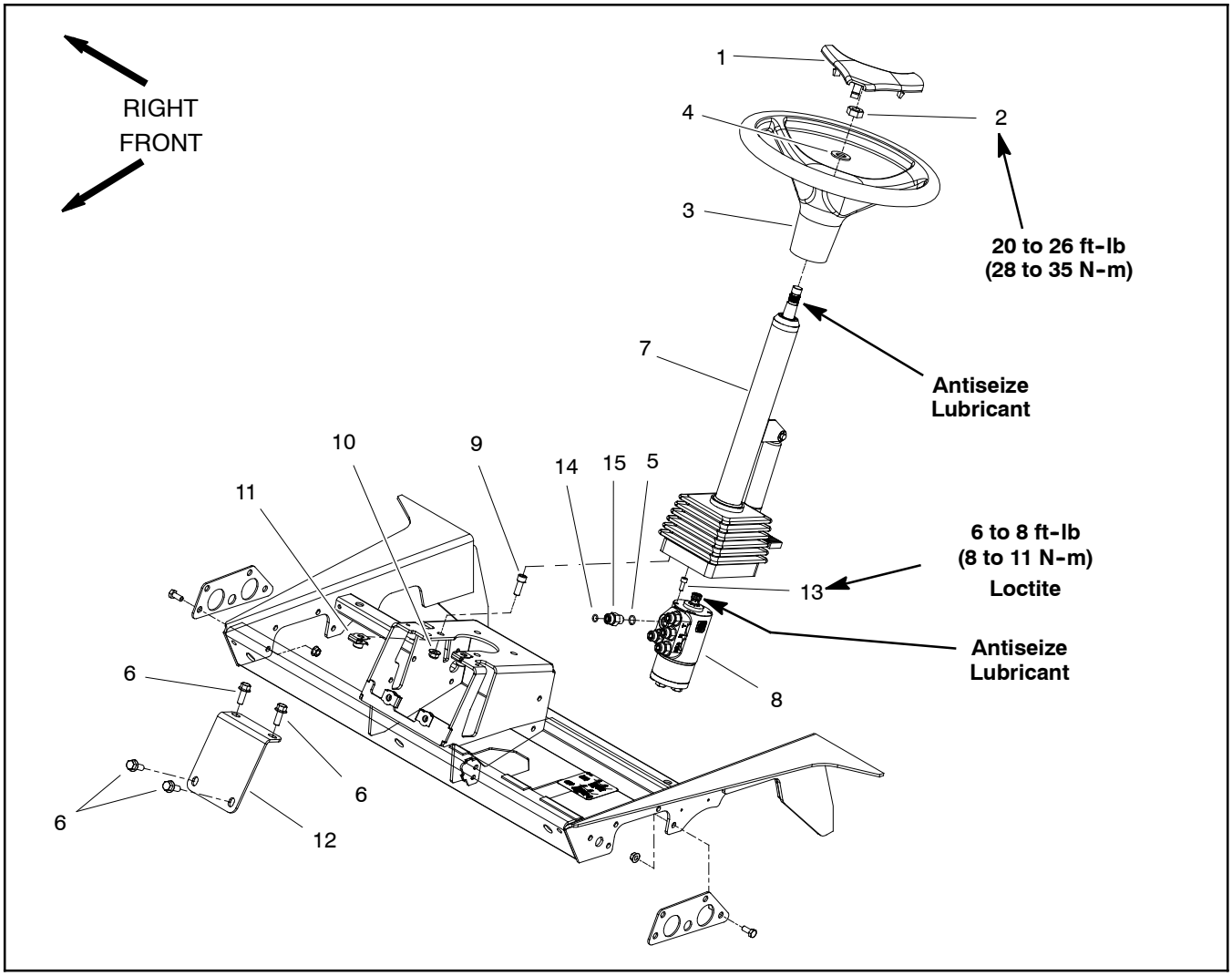


Figure 79

1. **Steering wheel cover**
2. **Lock nut**
3. **Steering wheel**
4. **Flat washer**
5. **O-ring**
6. **Flange head screw (4)**
7. **Steering column**
8. **Steering control valve**
9. **Socket head screw (4)**
10. **Flange nut (4)**
11. **Tinnerman nut (4)**
12. **Column brace**
13. **Socket head screw (4)**
14. **O-ring**
15. **Straight fitting (5)**

Removal (Fig. 79)

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

2. Remove fasteners that secure shroud to front of machine (Fig. 80). Remove shroud from machine to allow access to steering control valve.

3. Remove four (4) flange head screws that secure column brace (item 12) to frame platform. Remove brace from machine to allow access to steering column fasteners.

4. Slide rubber bellows up from bottom of steering column. Support steering column to prevent it from falling.

5. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

6. Thoroughly clean hydraulic connections prior to loosening hydraulic lines.

7. Label all hydraulic connections for assembly purposes. Note port designations on steering control valve (Fig. 81).

CAUTION

Before opening hydraulic system, operate all hydraulic controls to relieve system pressure and avoid injury from pressurized hydraulic oil. See Relieving Hydraulic System Pressure in the General Information section of this chapter.

8. Disconnect hydraulic lines from steering control valve. Allow lines to drain into a suitable container.

9. Put caps or plugs on disconnected lines and fittings to prevent contamination.

10. Loosen and remove four (4) socket head screws and flange nuts that secure steering column to machine.

11. Remove steering column assembly with steering control valve attached from machine.

12. Loosen and remove four (4) socket head screws that secure steering control valve to steering column.

13. Remove steering control valve from steering column.

14. If necessary, remove fittings and O−rings from steering control valve. Discard all removed O−rings.

Installation (Fig. 79)

1. If fittings were removed, lubricate new O−rings with clean hydraulic oil and install fittings to steering control valve (see Hydraulic Fitting Installation in this chapter).

2. Apply antiseize lubricant to splines of steering control valve shaft.

3. Slide steering control valve shaft into steering column universal joint. Position control valve with ports toward front of machine.

4. Apply loctite to four (4) socket head screws and secure steering control valve to steering column with four (4) screws. Torque screws in a criss−cross pattern from **6 to 8 ft−lb (8 to 11 N−m)**.

5. Position steering column assembly to machine. Secure steering column in place with four (4) socket head screws and flange nuts.

6. Remove caps and plugs from disconnected lines and fittings.

7. Lubricate new O−rings and connect hydraulic lines to fittings on steering control valve (see Hydraulic Hose and Tube Installation in this chapter).

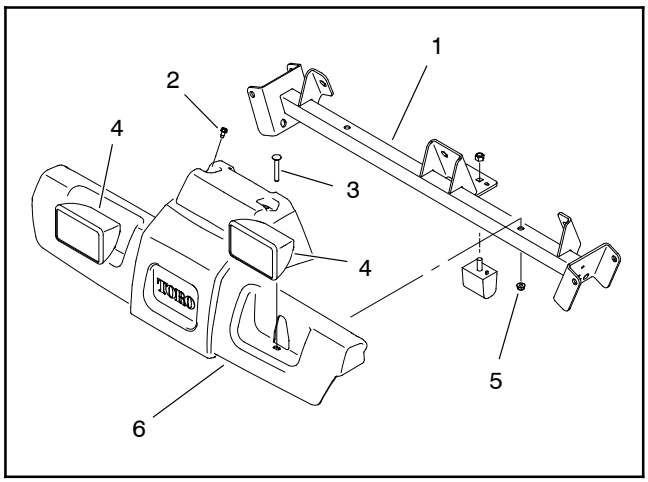


Figure 80

1. **Roller support**
2. **Screw (2)**
3. **Carriage screw (2)**
4. **Headlight assembly**
5. **Flange nut (2)**
6. **Platform shroud**

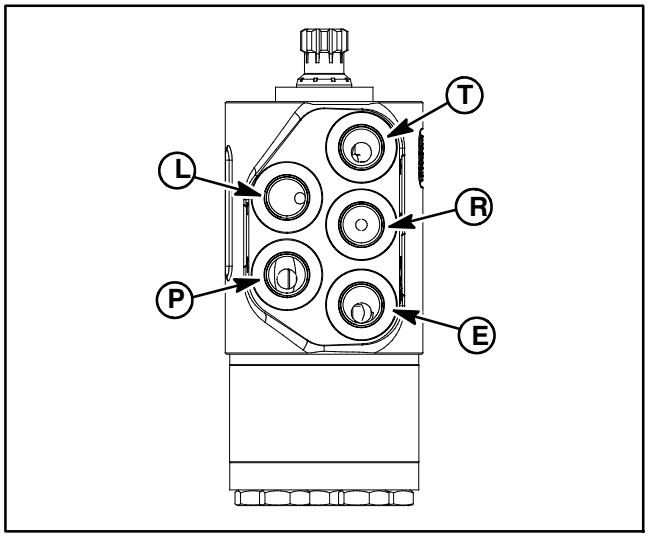


Figure 81

8. Position steering column brace (item 12) to machine and secure with four (4) flange head screws.

9. Slide rubber bellows to bottom of steering column.

10. Position shroud in place and secure with removed fasteners (Fig. 80).

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

12. Charge hydraulic system (see Charge Hydraulic System in this section).

Steering Control Valve Service

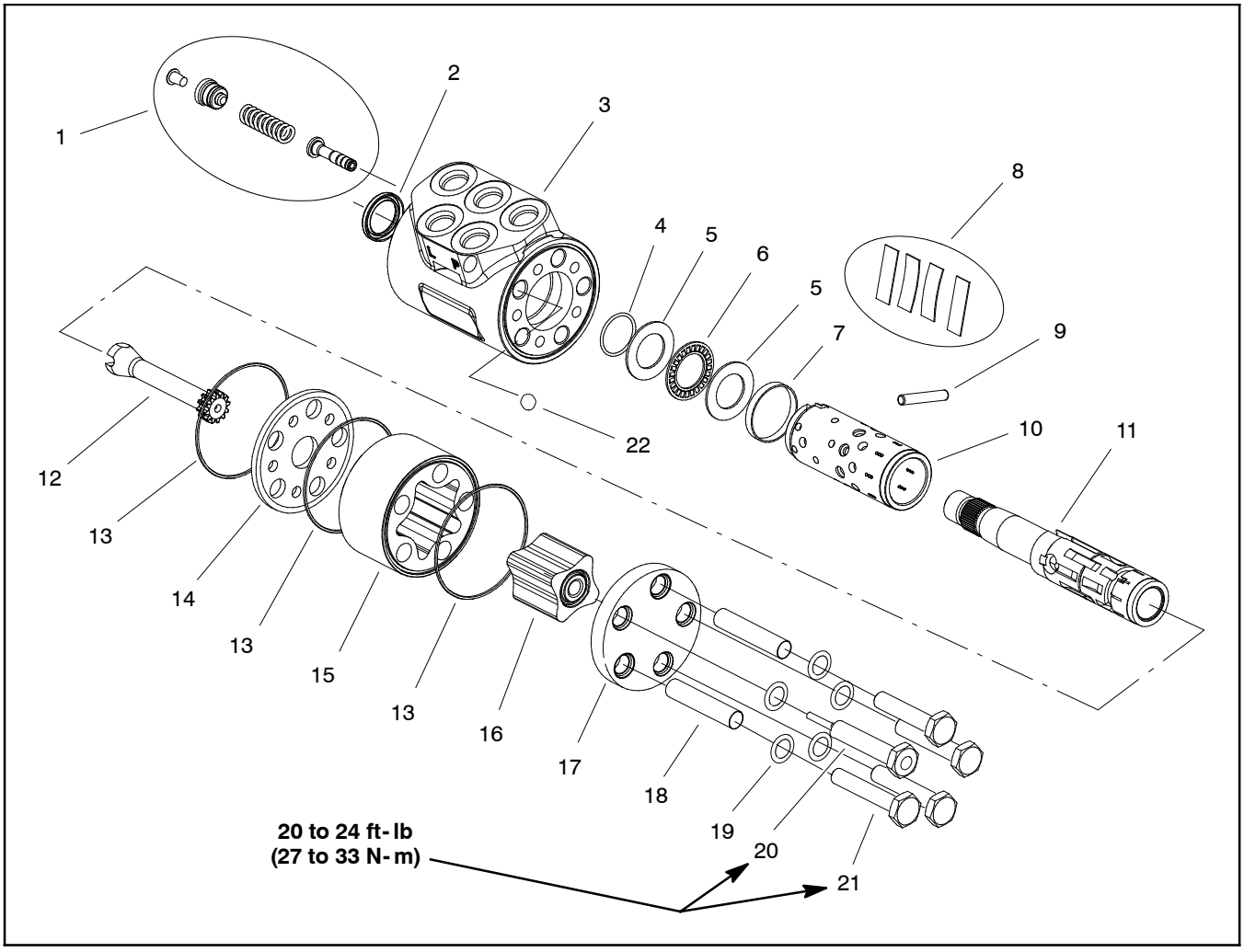


Figure 82

1. **Relief valve assembly**
2. **Dust seal ring**
3. **Steering valve housing**
4. **Shaft seal**
5. **Thrust washer**
6. **Bearing race**
7. **Ring**
8. **Spring set**
9. **Cross pin**
10. **Sleeve**
11. **Spool**
12. **Cardan shaft**
13. **O-ring**
14. **Distributor plate**
15. **Outer gearwheel**
16. **Inner gearwheel**
17. **End cover**
18. **Tube (2)**
19. **Washer (5)**
20. **Pin bolt**
21. **Cap screw (4)**
22. **Ball**

NOTE: For repair of the steering control valve, see the Sauer-Danfoss Steering Unit Type OSPM Service Manual at the end of this chapter.

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Steering Cylinder

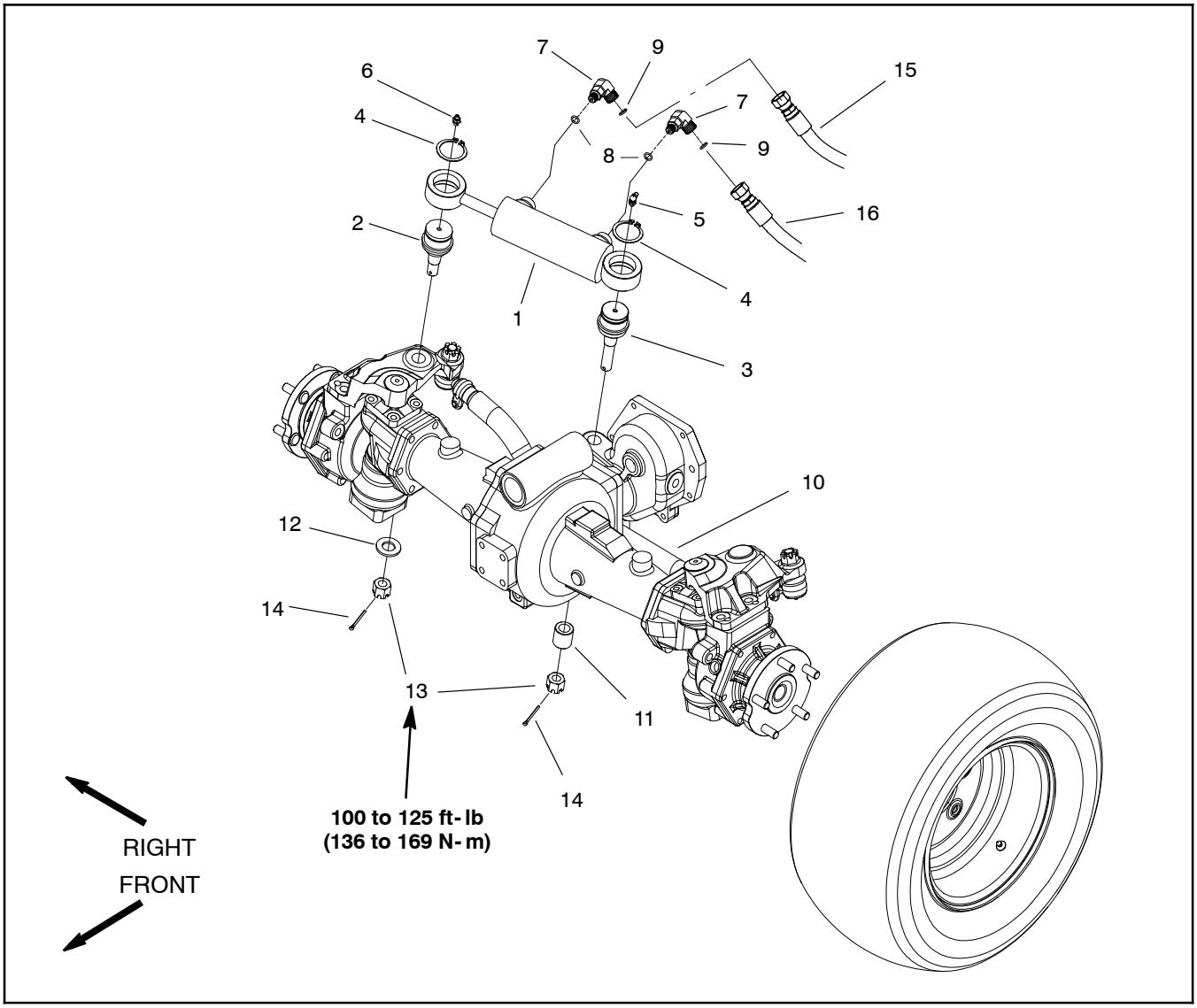


Figure 83

1. Steering cylinder
2. Ball joint
3. Ball joint
4. Retaining ring
5. Grease fitting
6. Grease fitting
7. 90º hydraulic fitting
8. O- ring
9. O- ring
10. Drive axle assembly
11. Ball joint spacer
12. Axle washer
13. Slotted hex nut
14. Cotter pin
15. Hydraulic hose
16. Hydraulic hose

Removal (Fig. 83)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during steering cylinder removal, thoroughly clean exterior of steering cylinder.

4. Remove hydraulic hoses from steering cylinder. Label the hydraulic hoses to show their correct position on the steering cylinder for assembly purposes.

5. Remove cotter pins, slotted hex nuts, axle washer and ball joint spacer from the threaded ends of ball joints. Remove steering cylinder with ball joints from machine.

6. If necessary, remove ball joints from steering cylinder.

7. If hydraulic fittings are to be removed from steering cylinder, mark fitting orientation to allow correct assembly. Remove fittings from cylinder and discard O- rings.

Installation (Fig. 83)

1. If fittings were removed from steering cylinder, lubricate and place new O- rings onto fittings. Install fittings into cylinder ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in the General Information section of this chapter).

2. If removed, press ball joints into lift cylinder and secure with retaining ring.

3. Slide ram end ball joint through hole on steering arm. Secure with axle washer and slotted hex nut. Slide fixed end of cylinder through hole on axle. Install spacer onto ball joint and secure with slotted hex nut. Torque slotted hex nuts from **100 to 125 ft- lbs (136 to 169 N- m)** prior to inserting cotter pins.

4. Install hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in the General Information section of this chapter).

5. Fill reservoir with hydraulic fluid as required.

6. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

7. After assembly is completed, operate steering cylinder to verify that hydraulic hoses and fittings are not contacted by anything.

Steering Cylinder Service

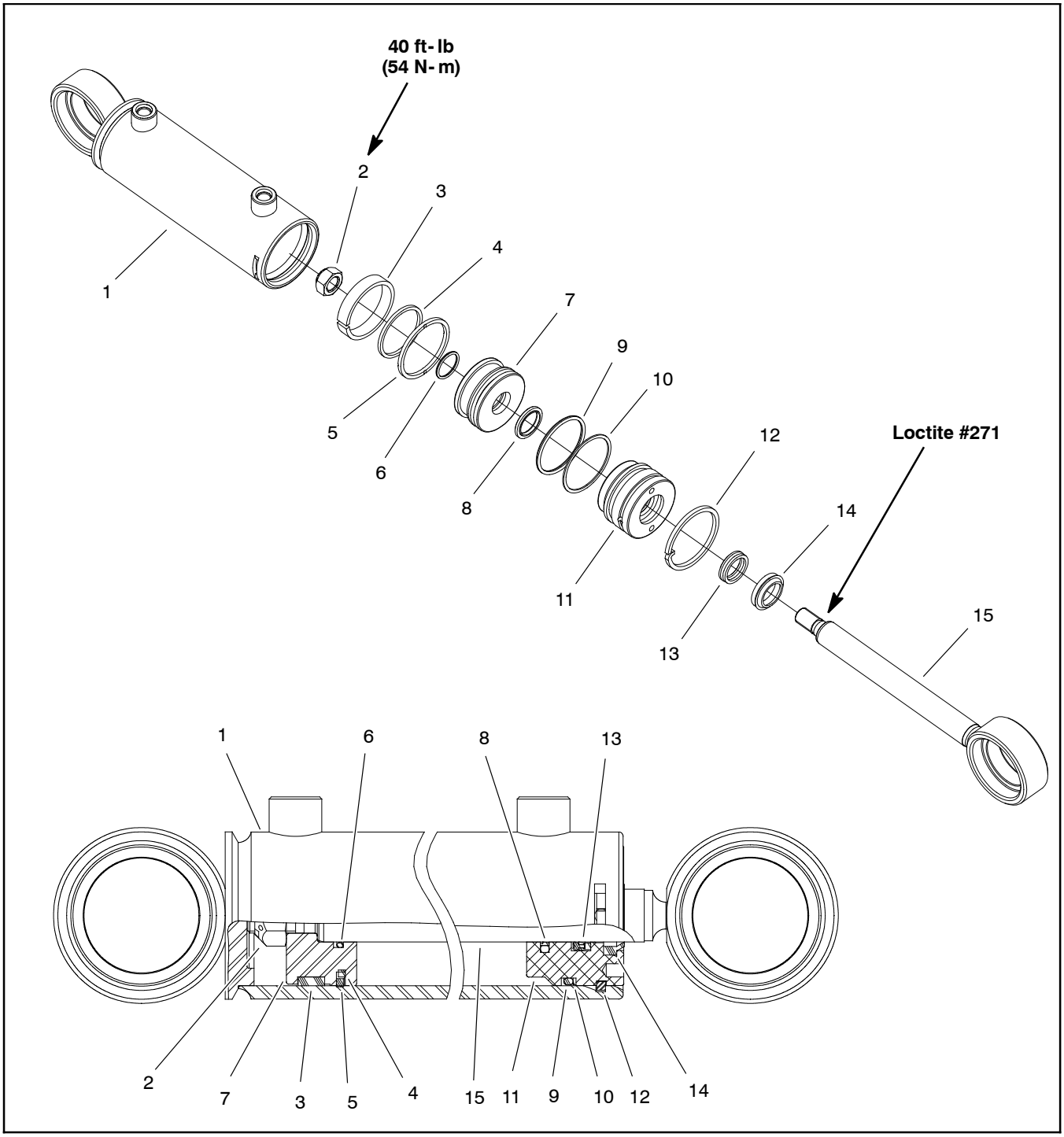


Figure 84

1. Barrel
2. Lock nut
3. Wear band
4. Square ring
5. Piston seal
6. O- ring
7. Piston
8. Buffer seal
9. O- ring
10. Back- up ring
11. Head
12. Retaining ring
13. Head seal
14. Wiper
15. Rod assembly

Disassembly (Fig. 84)

1. Remove oil from 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 cylinder in a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

2. Mount steering cylinder securely in a vise by clamping on the clevis end of the barrel. Use of a vise with soft jaws is recommended.

3. Loosen head from barrel:

   A. Use a spanner wrench to rotate head clockwise until the edge of the retaining ring appears in the barrel opening.

   B. Insert a screwdriver under the beveled edge of the retaining ring to start the retaining ring through the opening.

   C. Rotate the head counter- clockwise to remove retaining ring from barrel and head.

4. Extract rod with head and piston by carefully twisting and pulling on the rod.

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

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

6. For assembly purposes, note location and orientation of all seals and O- rings on piston and head. Remove and discard all seals and O- rings from the piston and the head.

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

8. Carefully inspect internal surface of barrel for damage (deep scratches, out- of- round, etc.). Replace entire cylinder if barrel is damaged. Inspect piston rod and piston for evidence of excessive scoring, pitting or wear. Replace any damaged parts.

Assembly (Fig. 84)

1. Make sure all cylinder components are clean before assembly.

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

   A. Install new seals, O- ring and wear band to the piston.

   B. Install new seals, O- ring and back- up ring to the head.

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

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

   A. Coat rod with clean hydraulic oil.

   B. Carefully slide head and piston onto the rod.

   C. Clean threads on end of rod. Apply **Loctite #271** (or equivalent) to rod threads.

   D. Secure piston to rod with lock nut. Torque lock nut to **40 ft- lb (54 N- m)**.

IMPORTANT: When installing the rod assembly into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.

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

IMPORTANT: Prevent damage when clamping the cylinder's barrel into a vise; clamp on the clevis only. Do not close vise enough to distort the barrel.

5. Mount steering cylinder in a vise with soft jaws. Secure head in barrel:

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

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

   C. Apply silicone sealer to barrel access slot.

Engine Cooling Fan Motor

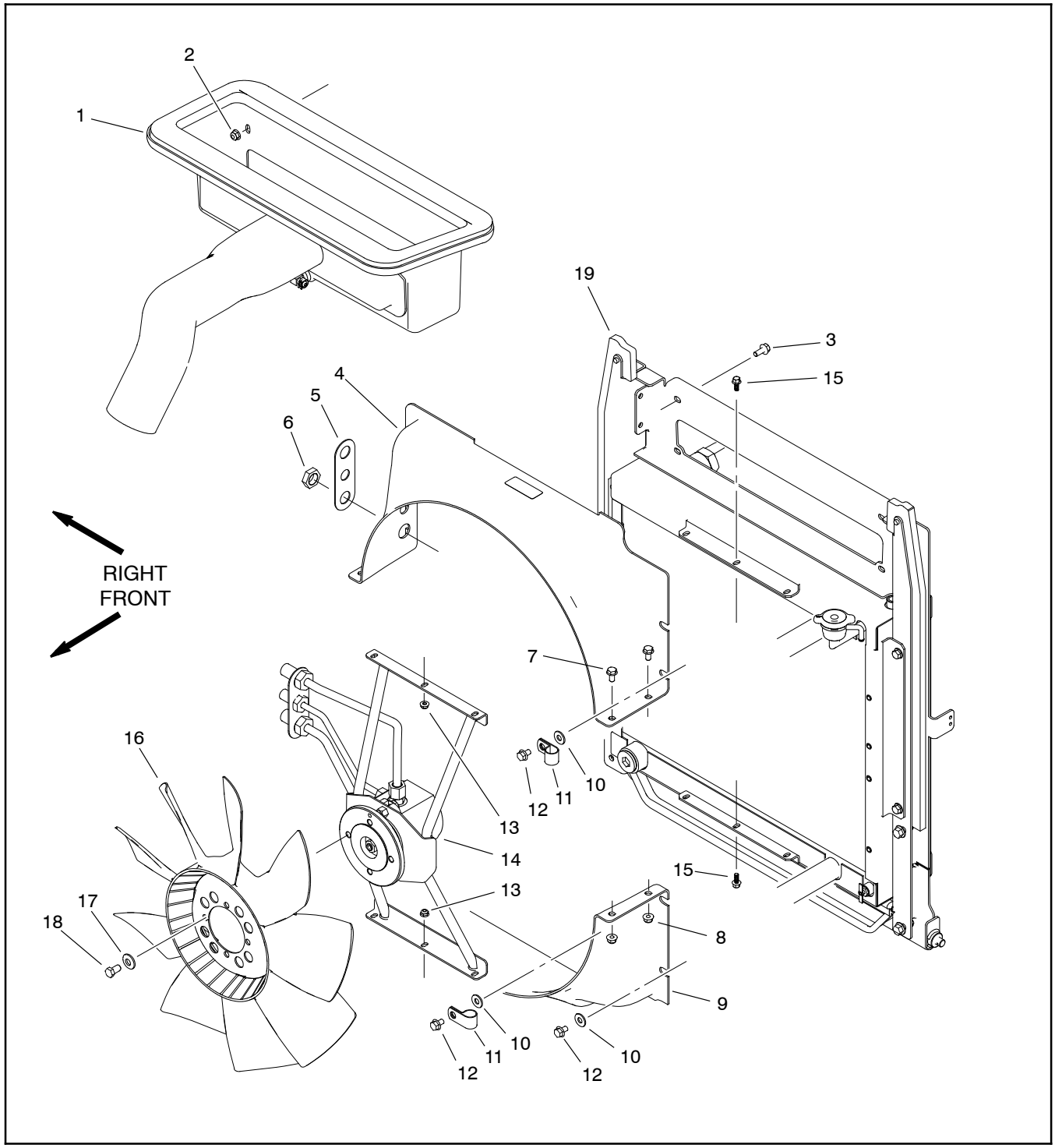


Figure 85

1. Plenum assembly
2. Flange nut (4)
3. Flange head screw (4)
4. Upper fan shroud
5. Support shim (2)
6. Bulkhead nut (3)
7. Flange head screw (4)
8. Flange nut (4)
9. Lower fan shroud
10. Flat washer (8)
11. R-clamp (2)
12. Flange head screw (8)
13. Flange nut (6)
14. Fan motor and bracket assembly
15. Flange head screw (6)
16. Fan
17. Flat washer (4)
18. Cap screw (4)
19. Radiator/oil cooler assembly

Removal (Fig. 85)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components in this chapter.

3. Unlatch and raise hood.

4. Remove air cleaner intake hose from air cleaner.

5. Remove flange head screws and flange nuts that secure plenum assembly (item 1) to crossover plate. Remove plenum with air cleaner hose and drain hose attached.

6. Remove four (4) cap screws (item 18) and washers used to secure fan to fan hub. Remove fan.

CAUTION

The radiator and engine may be hot. To avoid possible burns, allow the engine and cooling systems to cool before removing fan motor.

7. Remove upper fan shroud:

   A. Clean junction of hydraulic tubes on right side of upper radiator shroud. Loosen and separate hydraulic tubes that lead to hydraulic fan motor.

   B. Remove bulkhead nuts (item 6) that secure hydraulic tubes to upper fan shroud. Slide outer support shim (item 5) from tubes.

   C. Remove fasteners that secure upper fan shroud to lower fan shroud and radiator. Carefully lift upper shroud from machine.

   D. Put caps or plugs on disconnected hydraulic tubes to prevent contamination.

8. Remove fasteners that secure lower fan shroud to radiator and remove lower fan shroud from machine.

IMPORTANT: Make sure to not damage the radiator or other machine components while loosening and removing the fan motor and bracket assembly.

9. Remove six (6) cap screws (item 15) and flange nuts that secure fan motor bracket to radiator. Carefully remove fan motor, hydraulic tubes and bracket assembly from machine and place on suitable work surface.

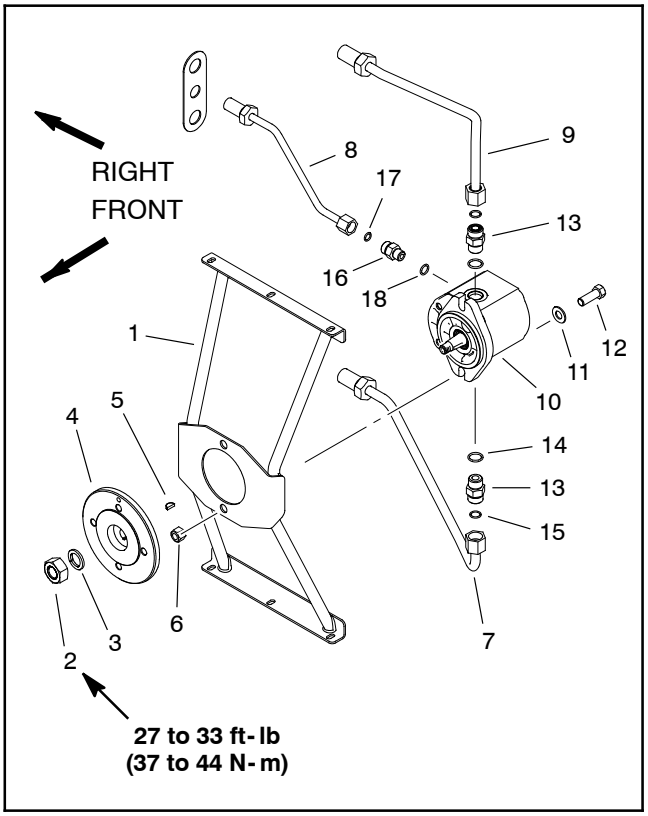


Figure 86

1. **Fan motor bracket**
2. **Hex nut**
3. **Lock washer**
4. **Fan Hub**
5. **Woodruff key**
6. **Lock nut (2)**
7. **Hydraulic tube**
8. **Hydraulic tube**
9. **Hydraulic tube**
10. **Fan motor**
11. **Flat washer (2)**
12. **Cap screw (2)**
13. **Hydraulic fitting (2)**
14. **O- ring (2)**
15. **O- Ring (2)**
16. **Hydraulic fitting**
17. **O- ring**
18. **O- ring**

10. Remove fan motor from bracket (Fig. 86):

    A. Disconnect hydraulic tubes (items 7, 8 and 9) from fan motor fittings. Label hydraulic tubes for proper assembly.

    B. Remove hex nut (item 2) and washer that secure fan hub to fan motor. Use suitable puller to carefully remove fan hub from fan motor shaft. Locate and retrieve woodruff key (item 5).

    C. Remove two (2) cap screws (item 12), flat washers and lock nuts that secure fan motor to fan motor bracket. Remove fan motor from bracket.

    D. If necessary, remove hydraulic fittings from fan motor and discard O- rings.

Installation (Fig. 85)

1. If fittings were removed from fan motor, lubricate and place new O-rings onto fittings. Install fittings into port openings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Secure fan motor to bracket (Fig. 86):

   A. Position fan motor to fan motor bracket and secure with two (2) cap screws (item 8), flat washers and lock nuts.

   B. Thoroughly clean tapered surfaces of fan motor shaft and fan hub. Place woodruff key (item 5) in slot in motor shaft.

   C. Position fan hub onto motor shaft and secure with washer and hex nut (item 2). Torque nut from **27 to 33 ft-lb (37 to 44 N-m)**.

   D. Connect hydraulic tubes (items 7, 8 and 9) to fan motor fittings. Use support shim (item 19) to help orientate tubes during assembly.

IMPORTANT: Make sure to not damage the radiator or other machine components while installing the fan motor and bracket assembly.

3. Carefully position fan motor and bracket assembly to radiator and secure with six (6) cap screws and flange nuts.

4. Secure lower fan shroud to radiator with removed fasteners. Make sure that clearance between shroud and cooling fan is at least 0.180" (4.6 mm) at all points.

5. Install upper fan shroud (Fig. 85):

   A. Place support shim (item 5) on hydraulic tubes connected to fan motor.

   B. Carefully install upper shroud to machine. Make sure that upper shroud mounting holes properly align with hydraulic tubes and fastener locations in radiator and lower shroud.

   C. Secure upper fan shroud to lower shroud and radiator with removed fasteners. Make sure that clearance between shroud and cooling fan is at least 0.180" (4.6 mm) at all points.

   D. Slide remaining support shim onto hydraulic tubes and secure tubes to upper shroud with bulkhead nuts (item 6).

   E. Remove caps and plugs placed in hydraulic tubes during removal to prevent contamination.

   F. Lubricate O-rings and connect and secure hydraulic tubes (see Hydraulic Hose and Tube Installation in this chapter).

6. Position fan to fan hub and secure with four (4) cap screws (item 18) and washers.

7. Use flange head screws and flange nuts to secure plenum assembly (item 1) with air cleaner hose and drain hose attached to crossover plate.

8. Connect air cleaner intake hose to air cleaner.

9. Lower and secure hood.

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Engine Cooling Fan Motor Service

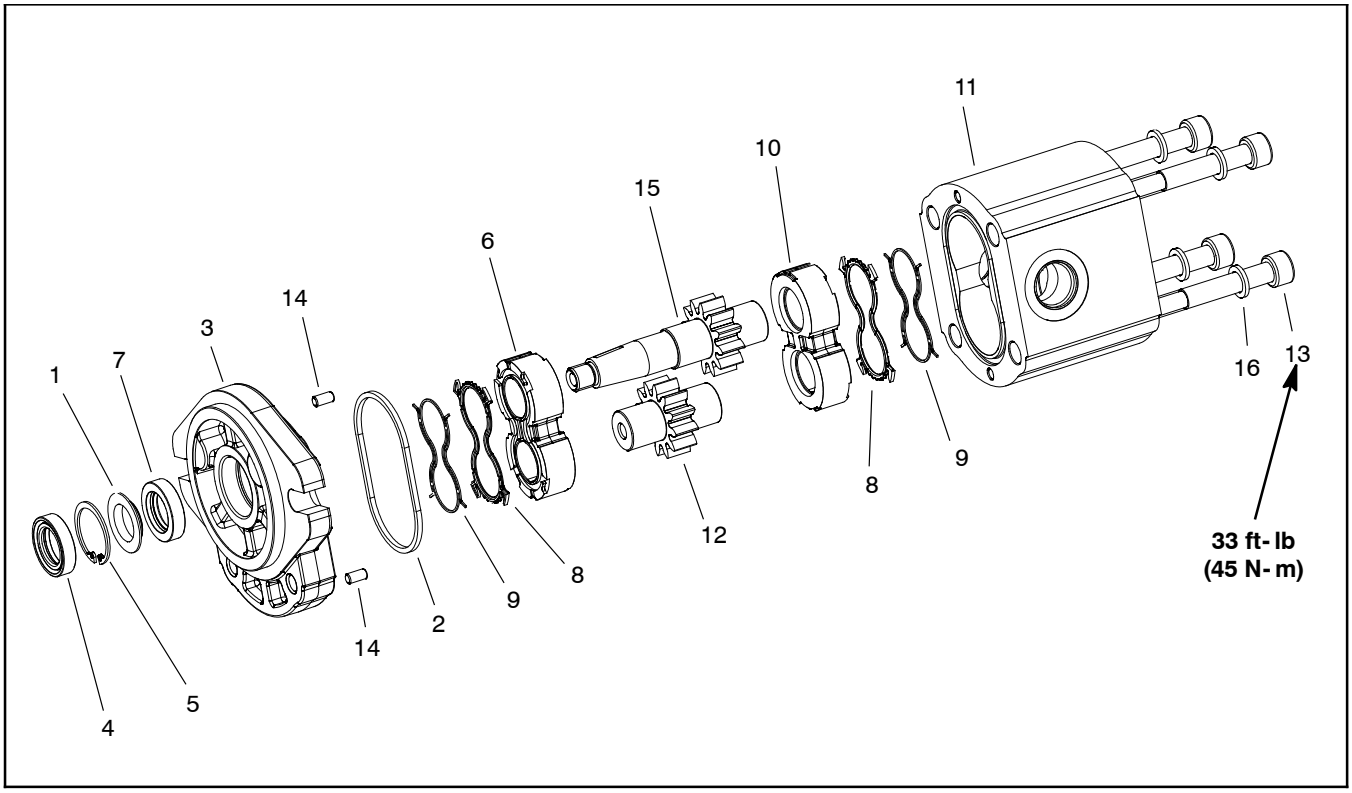


Figure 87

1. Flange washer
2. O- ring
3. Front flange
4. Dust seal
5. Retaining ring
6. Front wear plate
7. Shaft seal
8. Backup gasket
9. Pressure seal
10. Rear wear plate
11. Body
12. Idler gear
13. Cap screw (4)
14. Dowel (2)
15. Drive gear
16. Washer (4)

The engine cooling fan motor is similar to the cutting unit motors. For disassembly, inspection and assembly procedures of the cooling fan motor, refer to Cutting Unit Motor Service in this chapter.

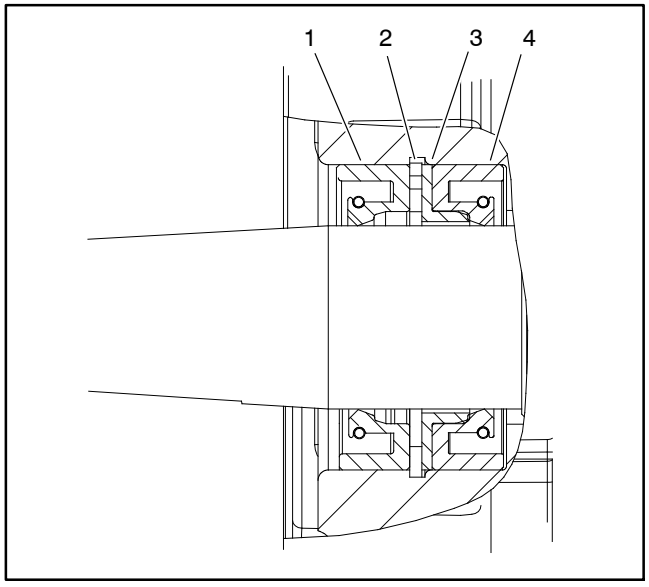


Figure 88

1. Dust seal
2. Retaining ring
3. Flange washer
4. Shaft seal

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Fan Control Manifold

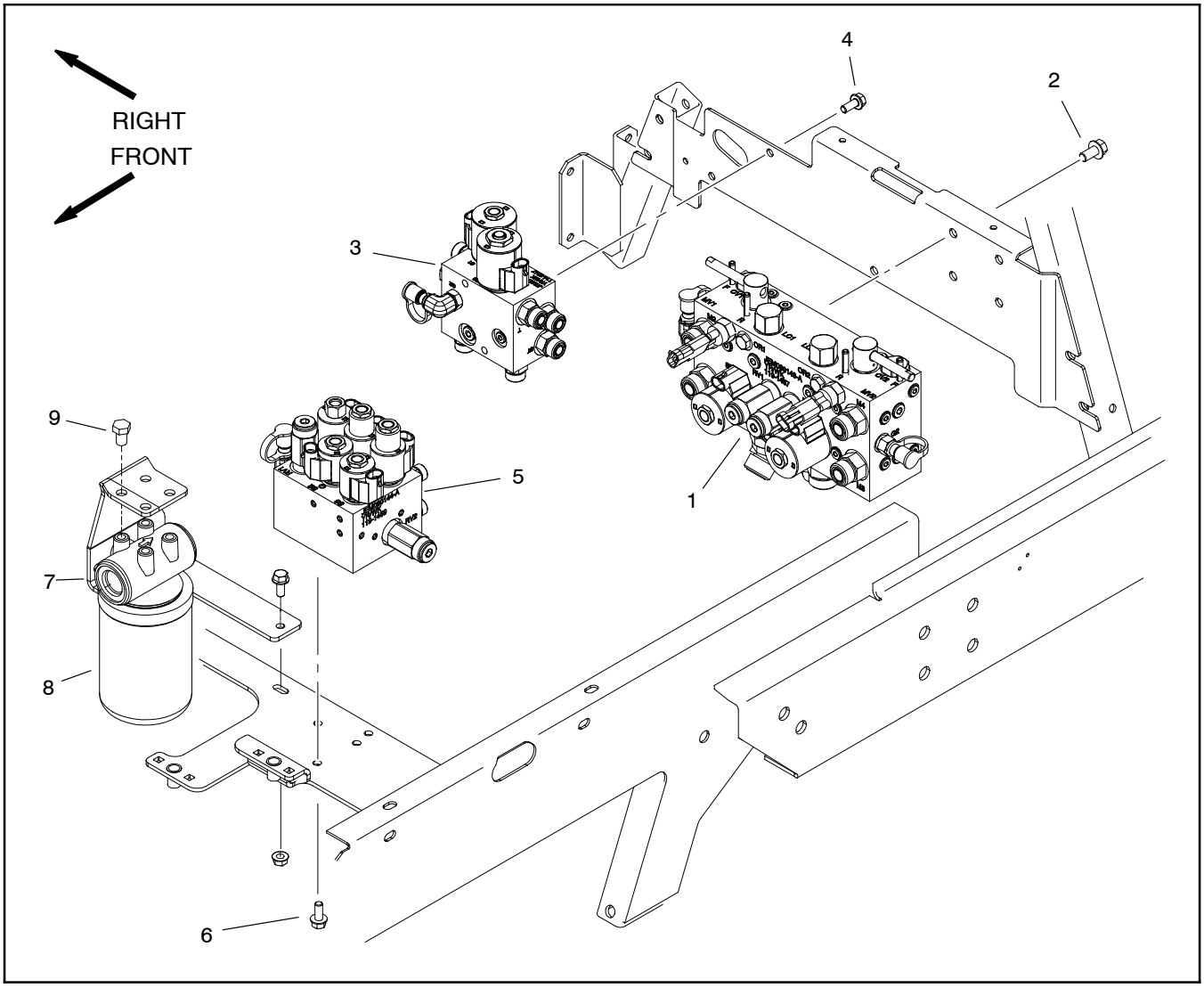


Figure 89

1. **Mow control manifold**
2. **Flange head screw (4)**
3. **Fan control manifold**
4. **Flange head screw (2)**
5. **Lift manifold**
6. **Flange head screw (2)**
7. **Charge filter head**
8. **Charge filter element**
9. **Cap screw (4)**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P1 is the gear pump connection port (see Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 89)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. Unlatch and raise hood.

4. To prevent contamination of hydraulic system during fan control manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect connectors from the solenoid coils.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame.

8. If hydraulic fittings are to be removed from fan control manifold, mark fitting orientation to allow correct assembly (Fig. 90). Remove fittings from manifold and discard O-rings.

Installation (Fig. 89)

1. If fittings were removed from fan control manifold, lubricate and place new O-rings onto fittings. Install fittings into manifold ports using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter). Refer to Figure 90 for fitting installation torque.

2. Install hydraulic manifold to the frame.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Connect wire harness electrical connectors to the solenoid valves.

5. Lower and secure hood.

6. Check oil level in hydraulic reservoir and add correct oil if necessary (see traction unit Operator's Manual).

7. Follow hydraulic system start-up procedures (see Charge Hydraulic System in this section).

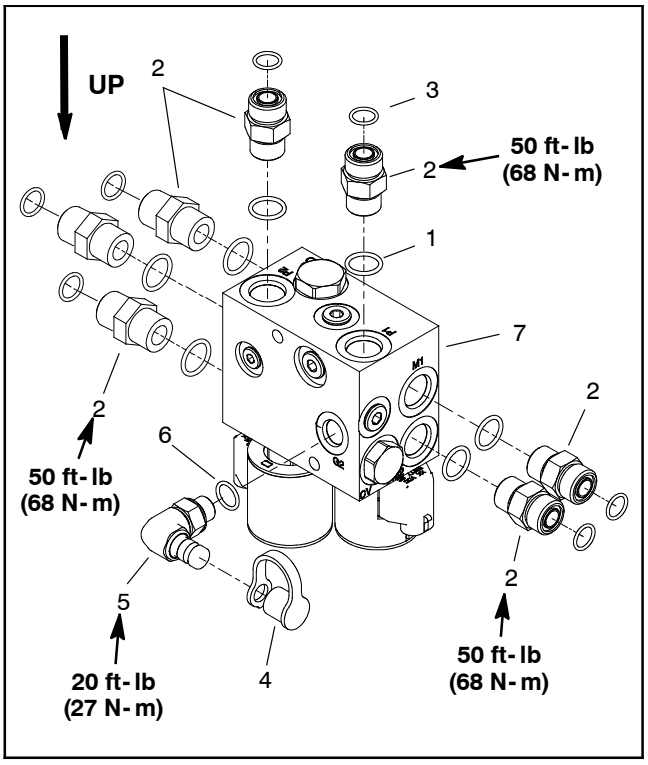


Figure 90

1. O-ring (7)
2. Straight fitting (7)
3. O-ring (7)
4. Dust cap
5. Test fitting
6. O-ring
7. Fan control manifold

Fan Control Manifold Service

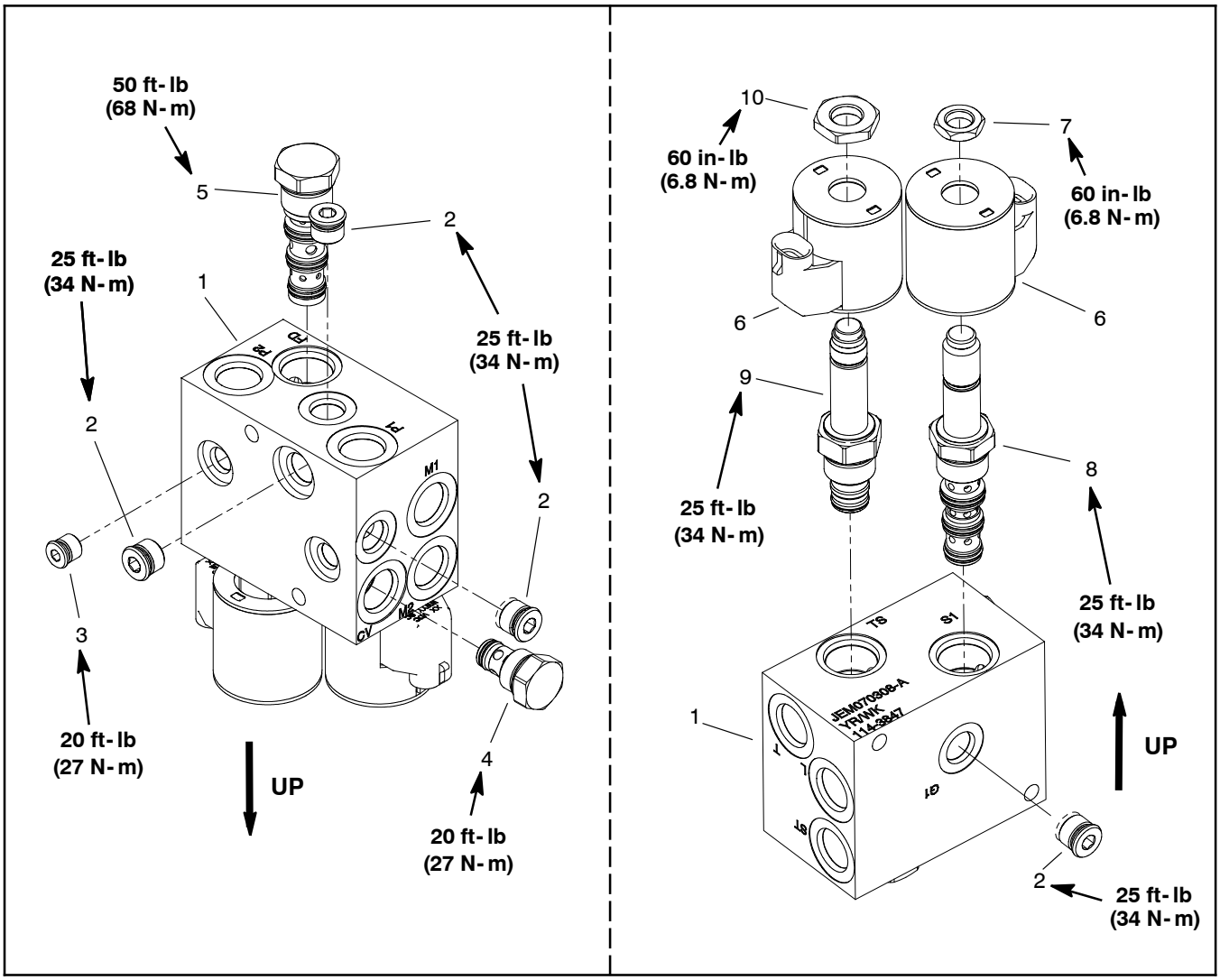


Figure 91

1. Manifold body
2. Zero leak plug - #6 (4)
3. Zero leak plug - #4
4. Check valve (CV)
5. Flow divider cartridge (FD)
6. Solenoid coil (2)
7. Nut
8. Solenoid valve (S1)
9. Proportional relief cartridge (TS)
10. Nut

The ports on the fan control manifold are marked for easy identification of components (e.g. ST is the supply to the steering control valve and FD is the location of the flow divider cartridge valve). See Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this chapter. Refer to Figure 91 for cartridge valve and plug installation torque.

The fan control manifold includes 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 as 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.

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Lift Manifold

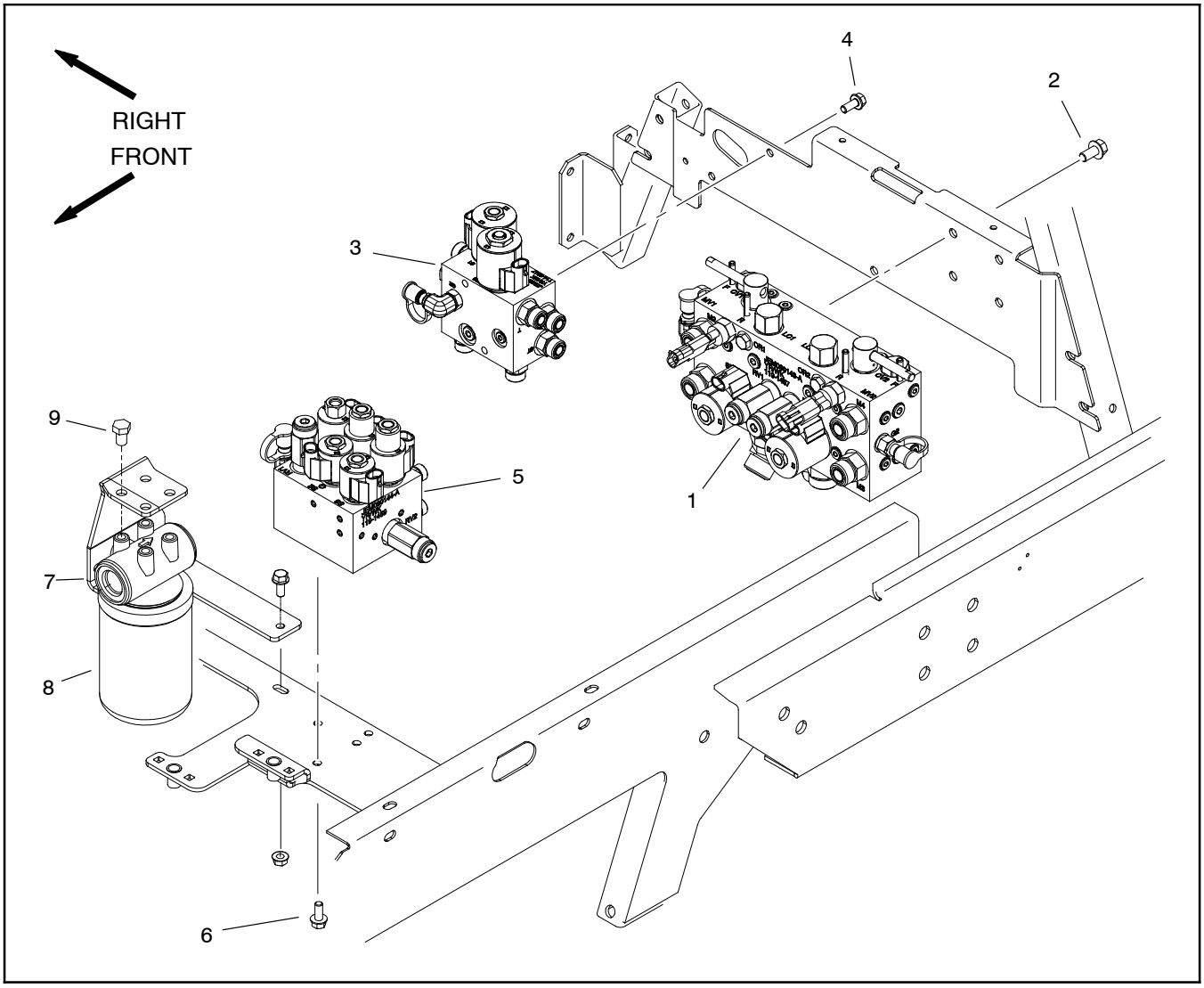


Figure 92

1. **Mow control manifold**
2. **Flange head screw (4)**
3. **Fan control manifold**
4. **Flange head screw (2)**
5. **Lift manifold**
6. **Flange head screw (2)**
7. **Charge filter head**
8. **Charge filter element**
9. **Cap screw (4)**

NOTE: The ports on the manifold are marked for easy identification of components. Example: P is the supply connection port (see Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port).

Removal (Fig. 92)

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

IMPORTANT: To prevent unexpected cutting unit lowering, make sure that cutting units are fully lowered before loosening hydraulic lines from lift manifold.

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. Unlatch and raise hood.

4. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

5. Label wire harness electrical connectors that attach to manifold solenoid coils. Disconnect wire harness electrical connectors from the solenoid valve coils.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift manifold. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

6. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

7. Remove hydraulic manifold from the frame.

IMPORTANT: A flow control orifice is placed beneath hydraulic fittings in lift manifold ports C2, C3 and C4 (Fig. 93). If a fitting is removed from the lift junction manifold and an orifice is in the manifold port, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes.

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

Installation (Fig. 92)

IMPORTANT: When installing orifice in manifold port, make sure that orifice is flat in the base of the manifold port. Manifold damage is possible if the orifice is cocked in the cavity.

1. If fittings were removed from lift junction manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold openings making sure that orifice is correctly placed before threading fitting into manifold. Tighten fittings (see Hydraulic Fitting Installation in this chapter). Refer to Figure 93 for fitting installation torque.

2. Install hydraulic manifold to the frame.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Connect wire harness electrical connectors to the solenoid valve coils.

5. Lower and secure hood.

6. Check oil level in hydraulic reservoir and add correct oil if necessary (see traction unit Operator's Manual).

7. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

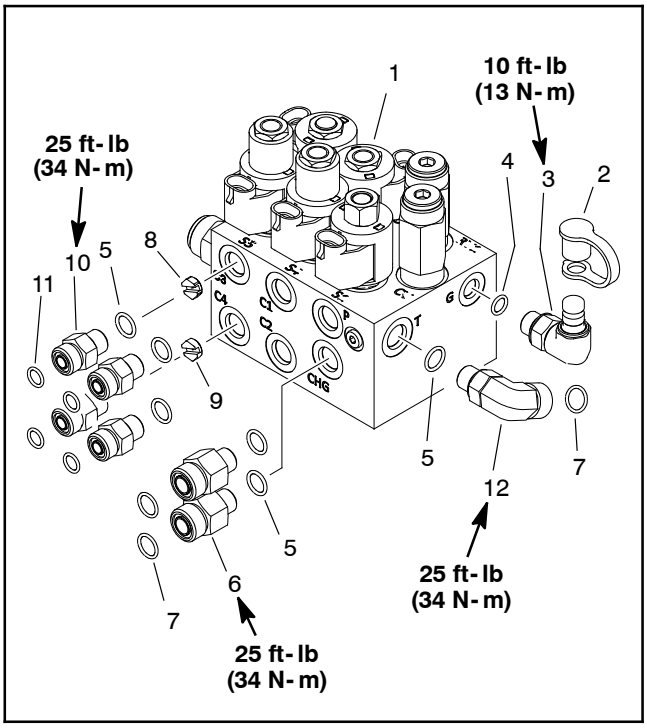


Figure 93

1. Lift manifold
2. Dust cap
3. Test fitting
4. O- ring
5. O- ring (7)
6. Straight fitting (2)
7. O- ring (3)
8. Orifice - 0.040" (C3)
9. Orifice - 0.055" (C4)
10. Straight fitting (4)
11. O- ring (4)
12. Elbow fitting

Lift Manifold Service

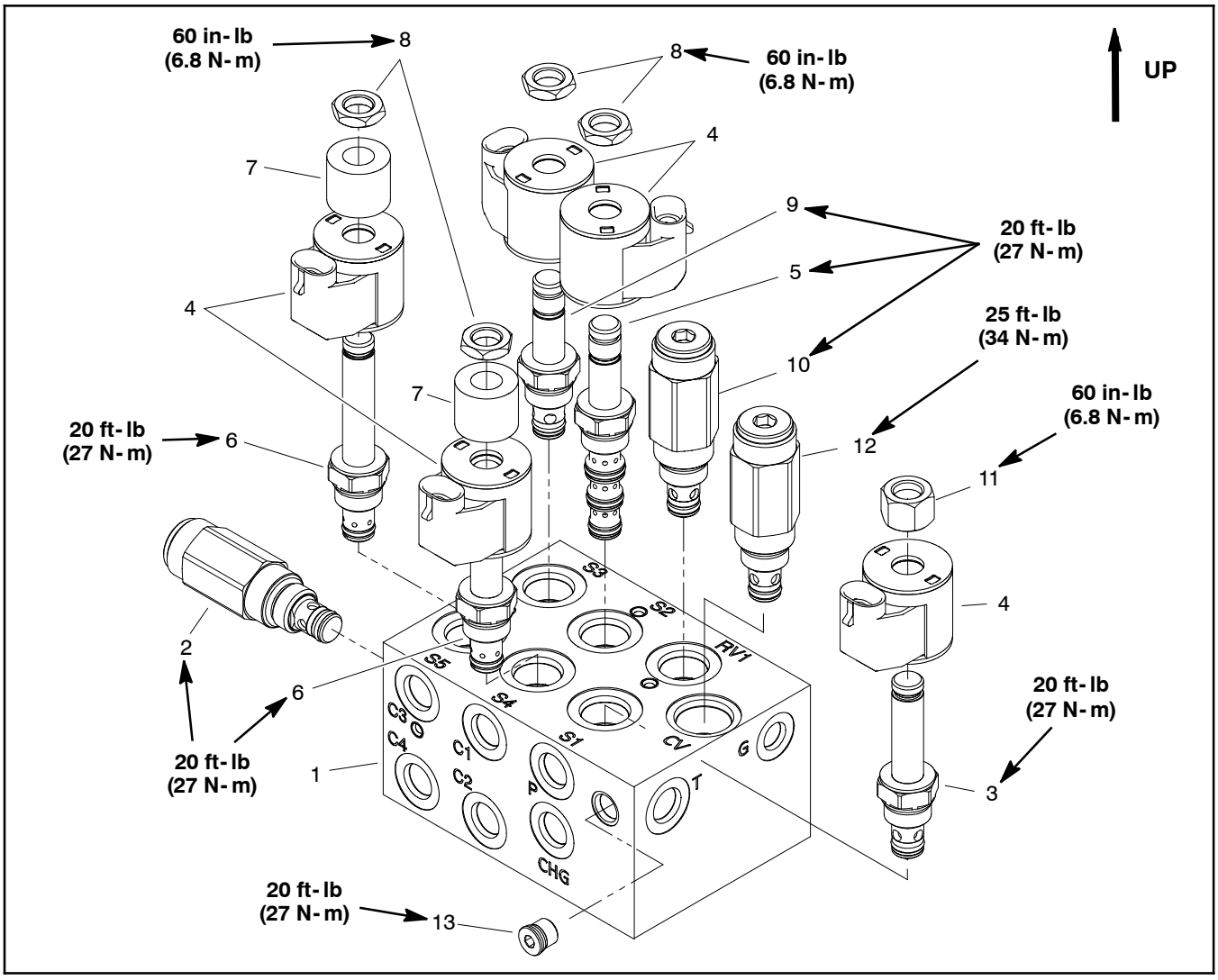


Figure 94

1. Manifold body
2. Relief valve (RV2)
3. Solenoid valve (S1)
4. Solenoid coil (5)
5. Solenoid valve (S2)
6. Solenoid valve (S4 and S5)
7. Coil spacer (2)
8. Nut
9. Solenoid valve (S3)
10. Relief valve (RV1)
11. Nut
12. Check valve (CV)
13. Zero leak plug - #4

NOTE: The ports on the manifold are marked for easy identification of components (e.g. P is the supply connection port and RV1 is the location for the lift relief valve). See Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines and cartridge valves at each port location.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines or cartridge valves from lift manifold. If cutting units are raised as components are loosened, cutting units may drop unexpectedly.

For cartridge valve service procedures, see Control Manifold Cartridge Valve Service in this section. Refer to Figure 94 for cartridge valve and plug installation torque.

IMPORTANT: A flow control orifice is placed beneath the hydraulic fittings in lift manifold ports C2, C3 and C4. If any of these fittings are removed from the manifold, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes. When installing the orifice in the manifold, make sure that the orifice is flat in the base of the port. Manifold damage is possible if the orifice is cocked in the port.

Control Manifold Cartridge Valve Service

1. Make sure the control manifold is clean before removing the cartridge valve from the control manifold.

2. If cartridge valve is solenoid operated, remove nut securing solenoid coil to the cartridge valve. Carefully slide coil off the valve. Test cartridge valve oil if necessary (see Hydraulic Solenoid Valve Coils in Chapter 6 - Electrical System in this manual).

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

3. Remove cartridge valve from manifold using a deep socket wrench. Note correct location for O- rings, sealing rings and backup rings. Remove seal kit from cartridge valve and discard removed seals.

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

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

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

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

CAUTION

Use goggles or other appropriate eye protection when using compressed air for drying parts.

6. 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. If cartridge design allows, use a wood or plastic probe to push the internal spool in and out 20 to 30 times to flush out contamination. Be extremely careful not to damage cartridge. Use compressed air for cleaning.

7. Install the cartridge valve into the manifold:

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

   B. Dip assembled cartridge into clean hydraulic oil.

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

   C. Thread cartridge valve carefully into manifold port by hand until the top O- ring is met. The valve should go into manifold port easily without binding.

   D. Torque cartridge valve using a deep socket wrench to value identified in control manifold illustration.

8. If cartridge valve is solenoid operated, carefully install solenoid coil to the cartridge valve. Secure coil to valve with nut and torque nut to **60 in- lb (6.8 N- m)**.

9. If problems still exist after assembly, remove valve and clean again or replace valve.

Lift Junction Manifold

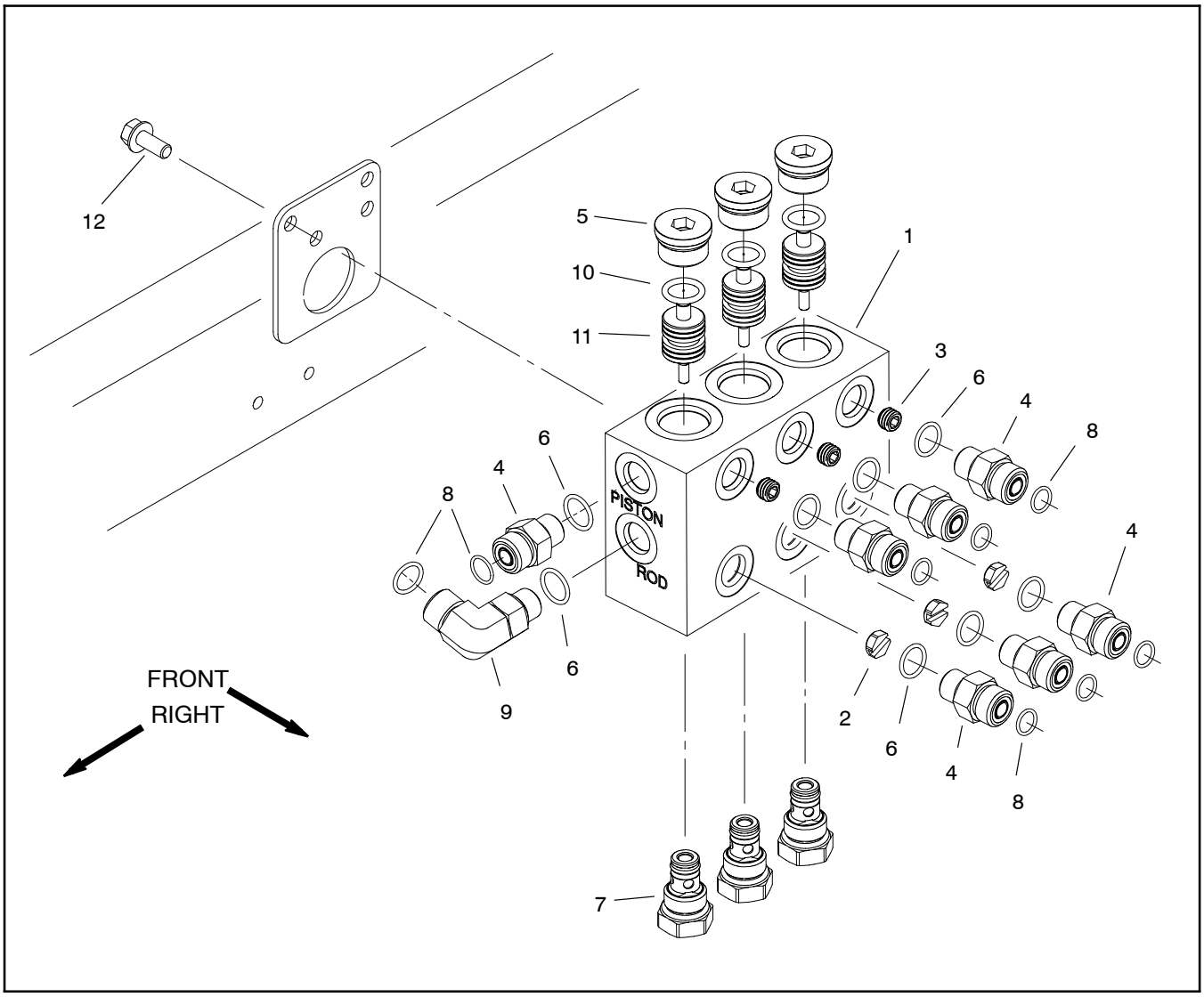


Figure 95

1. **Lift junction manifold**
2. **Orifice - .030" (3)**
3. **Orifice - .046" (3)**
4. **Straight fitting (7)**
5. **Socket plug (3)**
6. **O-ring (8)**
7. **Check valve (3)**
8. **O-ring (8)**
9. **90º hydraulic fitting**
10. **O-ring (3)**
11. **Pilot piston (3)**
12. **Cap screw (2)**

NOTE: The ports on the lift junction manifold are marked for easy identification of components (e.g. P1 is the gear pump connection port). See Hydraulic Schematic in Chapter 10 - Foldout Drawings to identify the function of the hydraulic lines at each port.

Removal (Fig. 95)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

IMPORTANT: To prevent unexpected cutting unit lowering, make sure that cutting units are fully lowered before loosening hydraulic lines from lift junction manifold.

3. To prevent contamination of hydraulic system during manifold removal, thoroughly clean exterior of manifold.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift junction manifold. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic lines from manifold and put caps or plugs on open hydraulic lines and fittings. Label disconnected hydraulic lines for proper assembly.

5. Remove hydraulic manifold from the frame.

IMPORTANT: A flow control orifice is placed beneath several of the hydraulic fittings on the lift junction manifold. If a fitting is removed from the lift junction manifold and an orifice is in the manifold port, make sure to remove orifice and label its position for assembly purposes. Also note location of groove in orifice for assembly purposes.

6. If necessary, remove fittings from manifold and discard O- rings.

Installation (Fig. 95)

IMPORTANT: When installing orifice in manifold, make sure that orifice is flat in the base of the manifold port. Manifold damage is possible if the orifice is cocked in the cavity.

1. If fittings were removed from lift junction manifold, lubricate and place new O- rings onto fittings. Install fittings into manifold openings making sure that orifice is correctly placed before threading fitting into manifold. Tighten fittings (see Hydraulic Fitting Installation in this chapter). Refer to Figure 95 for fitting installation torque.

2. Install hydraulic manifold to the frame.

3. Remove caps and plugs from fittings and hoses. Properly connect hydraulic lines to manifold (see Hydraulic Hose and Tube Installation in this chapter).

4. Check oil level in hydraulic reservoir and add correct oil if necessary (see traction unit Operator's Manual).

5. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

Front Lift Cylinders

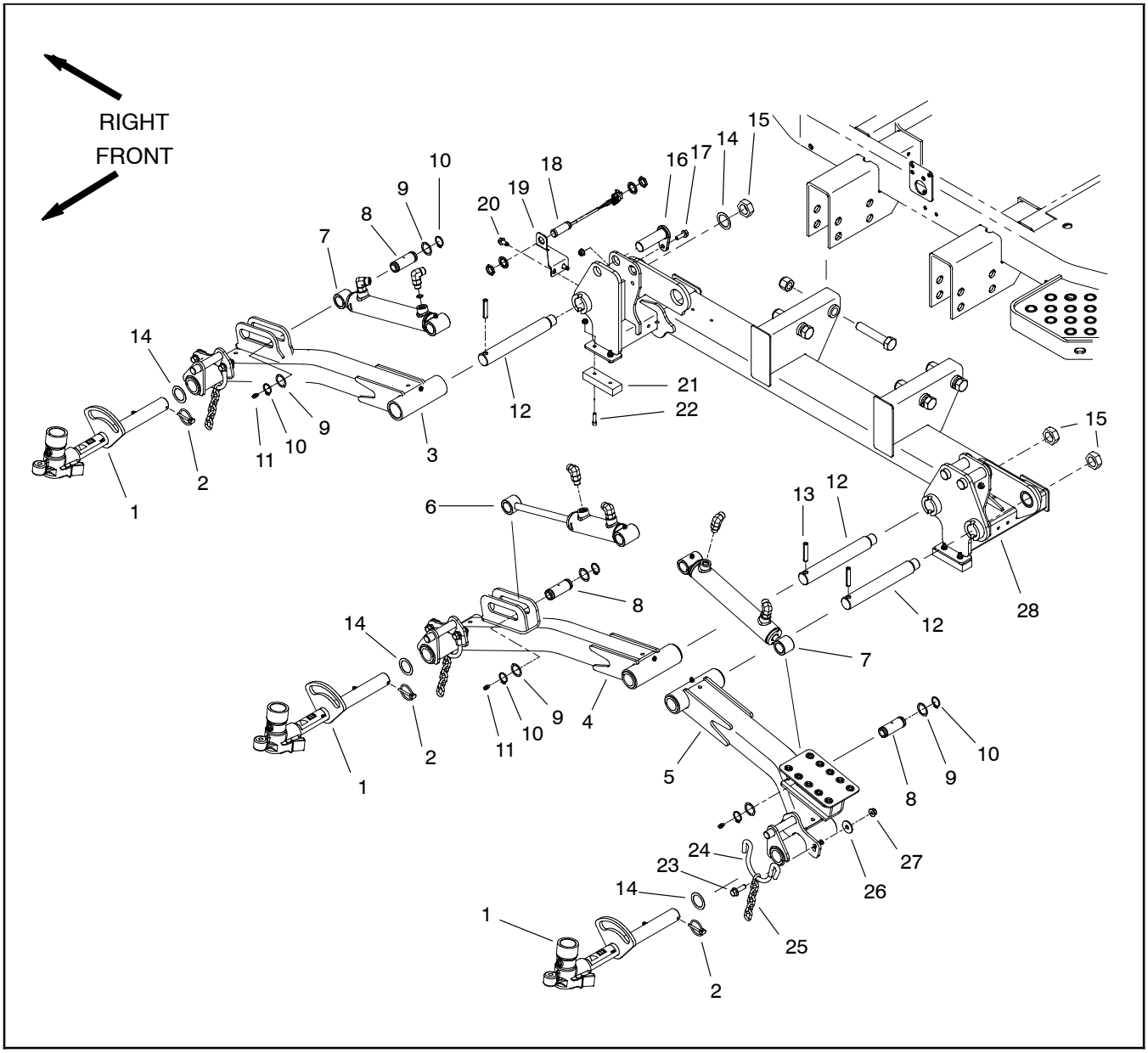


Figure 96

1. **Pivot yoke**
2. **Lynch pin**
3. **Lift arm (cutting unit #5)**
4. **Lift arm (cutting unit #1)**
5. **Lift arm (cutting unit #4)**
6. **Lift cylinder (cutting unit #1)**
7. **Lift cylinder (cutting units #4 and #5)**
8. **Cylinder pin (3)**
9. **Thrust washer (2 per pin)**
10. **Retaining ring (2 per pin)**
11. **Grease fitting (3)**
12. **Pivot pin (3)**
13. **Slotted roll pin (1 per pin)**
14. **Thrust Washer (6)**
15. **Lock nut (3)**
16. **Cylinder pin (3)**
17. **Flange head screw (3)**
18. **Cutting unit position sensor**
19. **Sensor bracket**
20. **Flange head screw (2)**
21.
22.
23. **Flange head screw (2 per hoop)**
24. **Chain hoop**
25. **Lift chain**
26. **Washer (2 per hoop)**
27. **Flange nut (2 per hoop)**
28. **Front carrier frame**

Removal (Fig. 96)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of lift cylinder that is to be removed from machine.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift cylinder. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic hoses from lift cylinder. Put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label disconnected hydraulic lines for proper assembly.

5. Remove one (1) retaining ring and washer from the cylinder pin (item 8). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

6. Remove flange nut and flange head screw that secure the cylinder pin (item 16) to the frame. Pull pin from frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

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

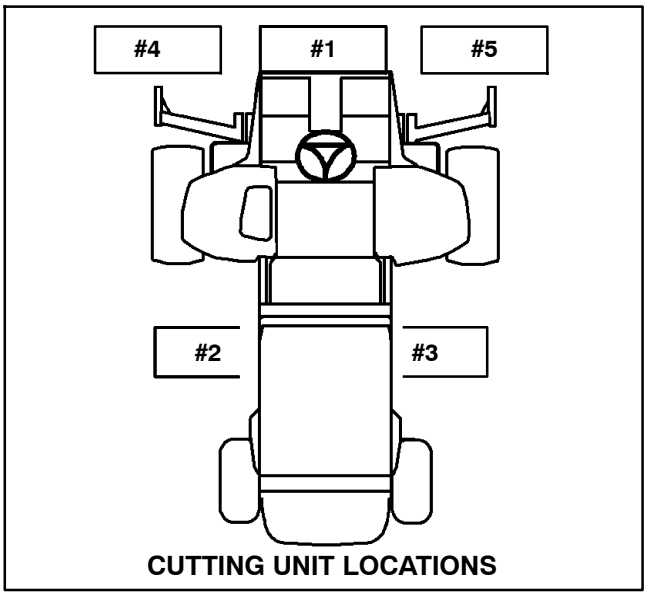


Figure 97

Installation (Fig. 96)

1. If fittings were removed from lift cylinder, lubricate and place new O- rings onto fittings. Install fittings into cylinder openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

2. Position lift cylinder barrel end to frame and insert cylinder pin (item 14) into frame and cylinder. Secure pin with flange nut and flange head screw.

3. Position cylinder rod clevis to lift arm and insert cylinder pin (item 8) with one (1) retaining ring and washer installed through the lift arm and cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

4. Remove caps and plugs from hoses and fittings. Attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in this chapter).

5. Fill reservoir with hydraulic fluid as required (see traction unit Operator's Manual).

6. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

7. After assembly is completed, operate lift cylinder to verify that nothing contacts the hydraulic hoses and fittings during operation.

Rear Lift Cylinders

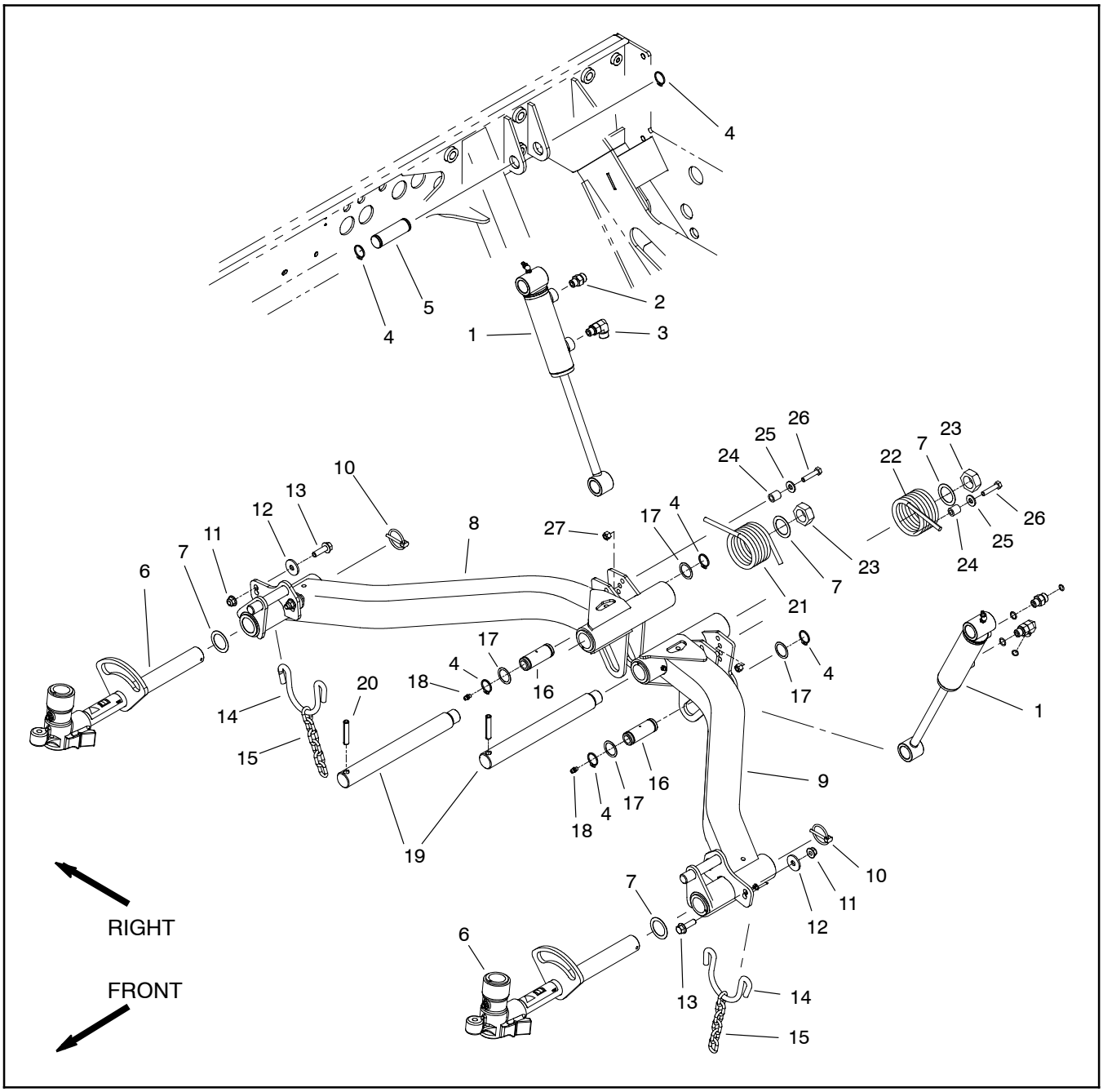


Figure 98

1. Lift cylinder (cutting units #2 and #3)
2. Straight hydraulic fitting (2)
3. 90º hydraulic fitting (2)
4. Retaining ring (2 per pin)
5. Cylinder pin (2)
6. Pivot yoke assembly (2)
7. Thrust washer (4)
8. Lift arm (cutting unit #2)
9. Lift arm (cutting unit #3)
10. Lynch pin (2)
11. Flange nut (2)
12. Flat washer (2)
13. Flange head screw (2)
14. Chain hoop (2)
15. Lift chain (2)
16. Cylinder pin (2)
17. Thrust washer (4)
18. Grease fitting (2)
19. Pivot pin (2)
20. Slotted roll pin (2)
21. RH torsion spring
22. LH torsion spring
23. Lock nut (2)
24. Spacer (2)
25. Flat washer (2)
26. Cap screw (2)
27. Lock nut (2)

Removal (Fig. 98)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of this chapter.

3. To prevent contamination of hydraulic system during lift cylinder removal, thoroughly clean exterior of lift cylinder.

WARNING

Make sure that cutting units are fully lowered before loosening hydraulic lines from lift cylinder. If cutting units are raised as hydraulic lines are loosened, cutting units may drop unexpectedly.

4. Disconnect hydraulic hoses from lift cylinder. Put caps or plugs on open hydraulic lines and fittings to prevent system contamination. Label the hydraulic hoses to show their correct position on the lift cylinder for assembly purposes.

5. Remove one (1) retaining ring and washer from the cylinder pin (item 16) that secures the lift cylinder rod clevis to the lift arm. Remove pin from lift arm and cylinder shaft clevis.

6. Remove one (1) retaining ring from the cylinder pin (item 5) that secures the lift cylinder barrel clevis to the frame. Remove cylinder pin from the frame and cylinder barrel clevis.

7. Remove lift cylinder from machine.

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

Installation (Fig. 98)

1. If fittings were removed from lift cylinder, lubricate and place new O- rings onto fittings. Install fittings into cylinder openings using marks made during the removal process to properly orientate fittings. Tighten fittings (see Hydraulic Fitting Installation in this chapter).

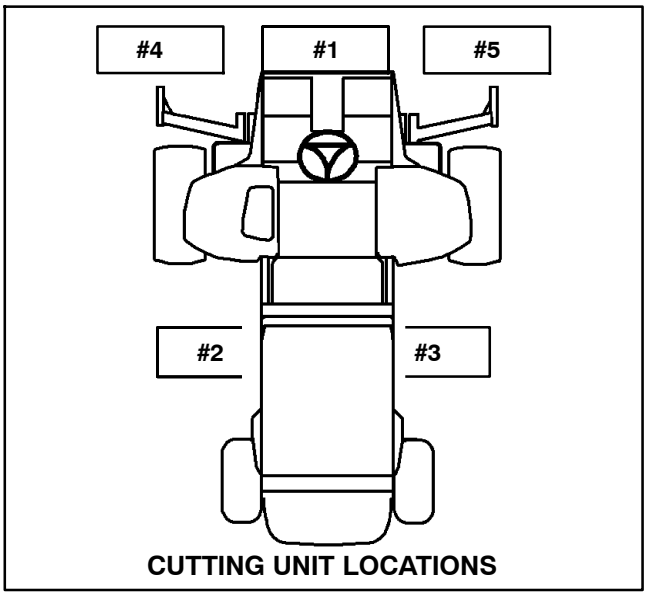


Figure 99

2. Position cylinder barrel end to frame and insert cylinder pin (item 5) with one (1) retaining ring installed through the frame and cylinder clevis. Secure pin with second retaining ring. Make sure that retaining ring is fully seated in pin.

3. Position cylinder rod end to lift arm and insert cylinder pin (item 16) with one (1) retaining ring and washer installed through the lift arm and cylinder rod clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

4. Remove caps and plugs from hoses and fittings. Attach hydraulic hoses to lift cylinder (see Hydraulic Hose and Tube Installation in this chapter).

5. Fill reservoir with hydraulic fluid as required (see traction unit Operator's Manual).

6. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

7. After assembly is completed, operate lift cylinder to verify that nothing contacts the hydraulic hoses and fittings during operation.

Lift Cylinder Service

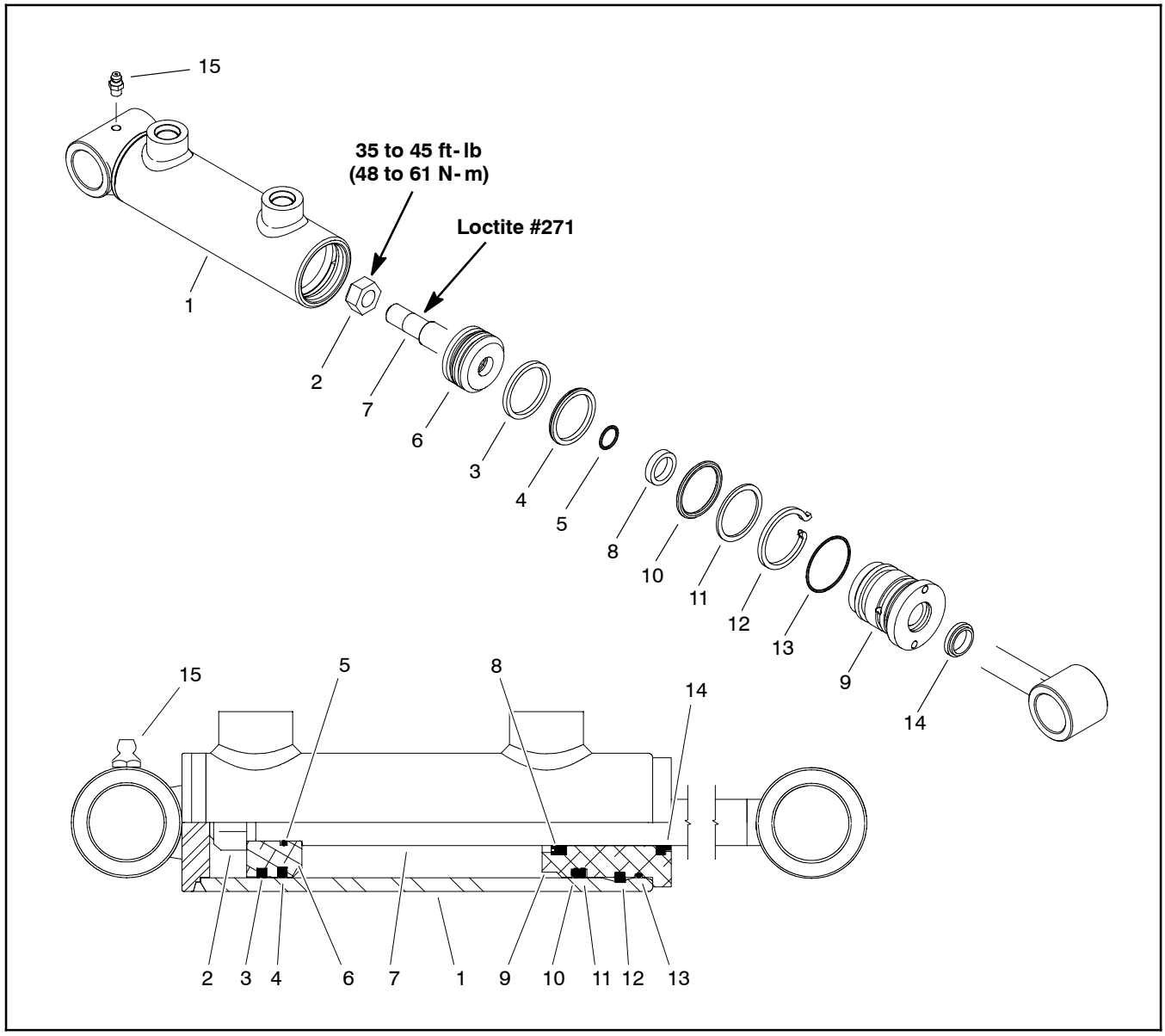


Figure 100

1. **Barrel**
2. **Lock nut**
3. **Wear ring**
4. **Piston seal**
5. **O-ring**
6. **Piston**
7. **Rod**
8. **Head seal**
9. **Head**
10. **O-ring**
11. **Back-up**
12. **Retaining ring**
13. **O-Ring**
14. **Dust seal**
15. **Grease fitting**

NOTE: The lift cylinders used on the Reelmaster 7000-D are all very similar regardless of the location on the machine. The disassembly and assembly procedure is the same for all lift cylinders.

Disassembly (Fig. 100)

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

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

2. Mount lift cylinder securely in a vise by clamping on the barrel end clevis. Use of a vise with soft jaws is recommended.

3. Insert a screwdriver under the edge of the retaining ring outside hook and using a spanner wrench, rotate head clockwise to start the retaining ring through the opening. Continue rotating the head clockwise to remove retaining ring from barrel and head.

4. Remove plugs from ports. Extract shaft, head and piston by carefully twisting and pulling on the shaft.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the clevis ONLY.

5. Mount shaft securely in a vise by clamping on the shaft clevis. Remove lock nut and piston from the shaft. Carefully slide head off the shaft.

6. Taking care to not scratch or damage the piston, remove piston seal, wear ring, and O- ring from the piston.

7. Taking care to not scratch or damage the head, remove O- rings, back- up ring, and head seal from the head.

Inspection

CAUTION

Use eye protection such as goggles when using compressed air.

1. Wash all lift cylinder components in solvent. Dry parts with compressed air.

2. Inspect internal surface of barrel and external surface of rod for deep scratches, out- of- roundness and bending.

3. Inspect head and piston for excessive pitting, scoring and wear.

4. Replace lift cylinder if internal components are found to be worn or damaged.

Assembly (Fig. 100)

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

2. Coat new O- rings, back- up washer and other seals with clean hydraulic oil.

   A. Carefully install piston seal, wear ring, and O- ring to the piston.

   B. Carefully install back- up washer, O- rings, and head seal.

IMPORTANT: Do not clamp vise jaws against the shaft surface. Clamp on the shaft clevis ONLY.

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

   A. Coat shaft with clean hydraulic oil.

   B. Slide head onto the shaft.

   C. Install piston onto the shaft and secure with lock nut. Torque lock nut from **30 to 35 ft- lb (41 to 47 N- m)**.

   D. Remove shaft assembly from the vise.

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

4. Mount barrel securely in a vise by clamping on the barrel clevis.

IMPORTANT: When installing the head into the barrel, pay careful attention to the retaining ring slot in the barrel to insure that the piston and head seals do not lodge in the slot.

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

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

Hydraulic Reservoir

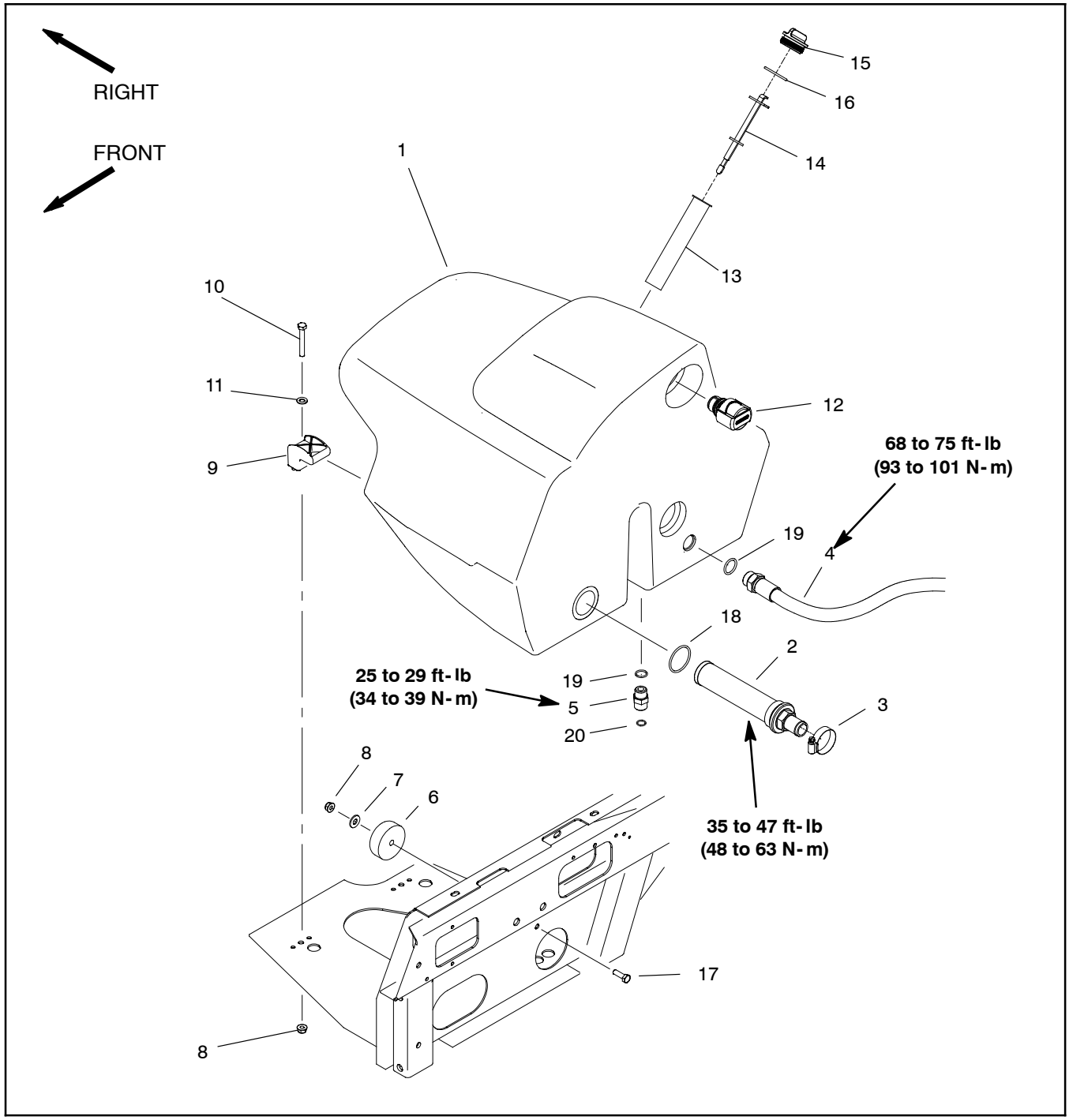


Figure 101

1. Hydraulic reservoir
2. Tank strainer
3. Hose clamp
4. Hydraulic hose assembly
5. Hydraulic straight fitting
6. Bumper
7. Flat washer
8. Flange nut (3)
9. Clamp (2)
10. Cap screw (2)
11. Flat washer (2)
12. Breather
13. Screen filter
14. Dipstick
15. Plug
16. O- ring
17. Cap screw
18. O- ring
19. O- ring (19)
20. O- ring

Removal (Fig. 101)

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

2. Read the General Precautions for Removing and Installing Hydraulic System Components at the beginning of the Service and Repairs section of this chapter.

3. To prevent contamination of hydraulic system during hydraulic reservoir removal, thoroughly clean exterior of reservoir.

4. Disconnect the hydraulic tube from the bottom of the reservoir to allow draining of reservoir. Drain reservoir into a suitable container.

5. Disconnect remaining hydraulic hoses from reservoir. Label the hydraulic hoses to show their correct position on the reservoir for assembly purposes.

6. Remove hydraulic reservoir from frame.

7. If hydraulic fittings are to be removed from reservoir, mark fitting orientation to allow correct assembly. Remove fittings from reservoir and discard O- rings.

Inspection

1. Clean hydraulic reservoir and suction strainer with solvent.

2. Inspect reservoir for leaks, cracks or other damage.

Installation (Fig. 101)

1. If fittings were removed from reservoir, lubricate and place new O- rings onto fittings. Install fittings into reservoir openings using marks made during the removal process to properly orientate fittings. Torque fittings to values provided (see Fig. 101).

2. Install reservoir to frame.

IMPORTANT: When tightening hoses to reservoir fittings, hold fitting with wrench to prevent overtightening of fitting and potential reservoir damage.

3. Connect hydraulic hoses to reservoir fittings (see Hydraulic Hose and Tube Installation in this chapter).

4. Fill reservoir with hydraulic fluid to proper level (see traction unit Operator's Manual).

5. Follow hydraulic system start- up procedures (see Charge Hydraulic System in this chapter).

Hydraulic Oil Cooler

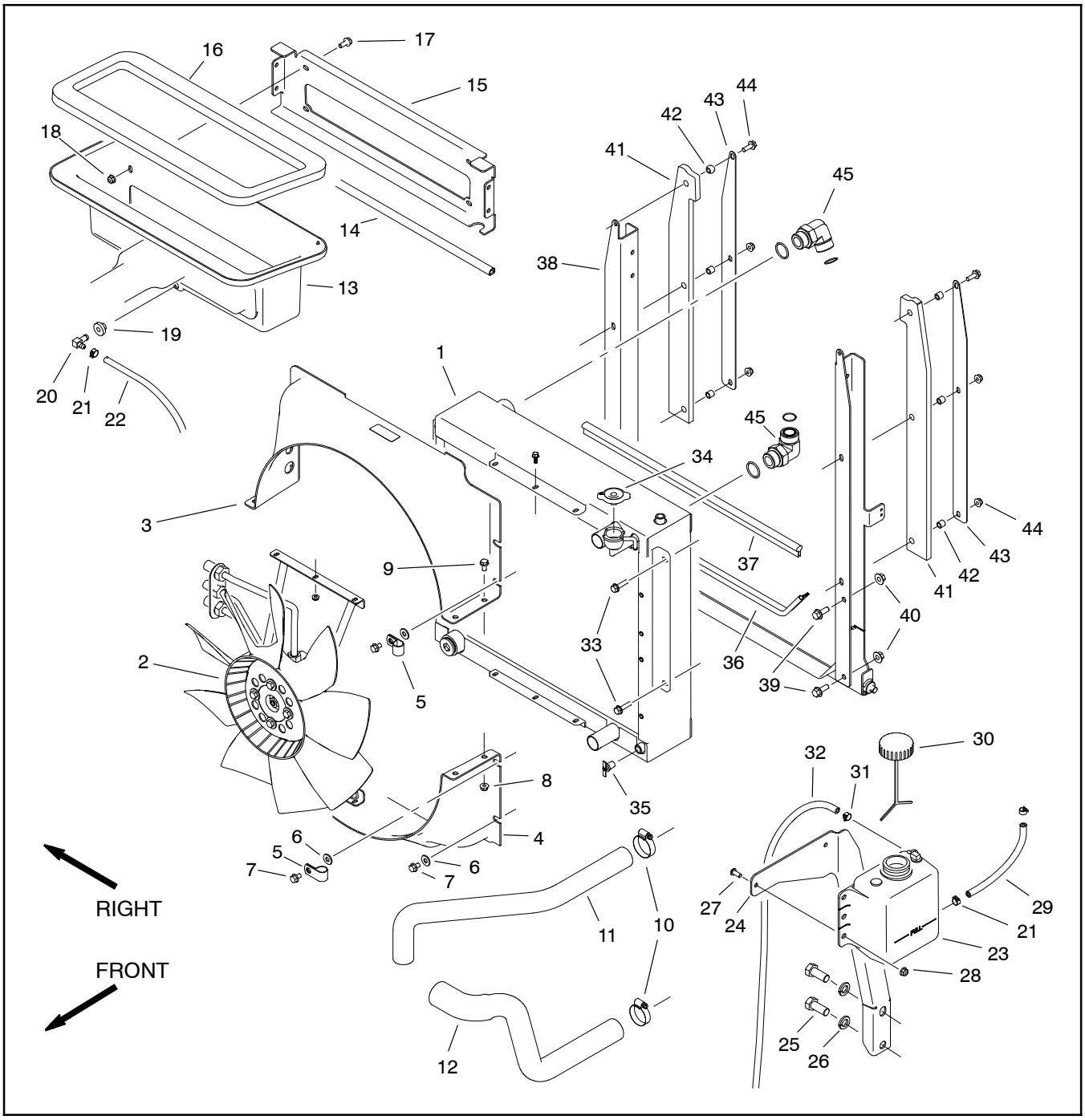


Figure 102

1. Radiator
2. Fan assembly
3. Upper radiator shroud
4. Lower radiator shroud
5. R- clamp (2)
6. Flat washer (8)
7. Flange head screw (8)
8. Flange nut (4)
9. Flange head screw (4)
10. Hose clamp (4)
11. Upper radiator hose
12. Lower radiator hose
13. Plenum
14. Bulb seal
15. Crossover plate
16. Plenum seal
17. Flange head screw (8)
18. Flange nut (8)
19. Bushing
20. Elbow fitting
21. Hose clamp (4)
22. Hose (plenum drain)
23. Coolant reservoir
24. Reservoir bracket
25. Cap screw (2)
26. Lock washer (2)
27. Flange head screw (2)
28. Flange nut (2)
29. Hose (reservoir to radiator)
30. Reservoir cap
31. Hose clamp
32. Hose (reservoir overflow)
33. Flange head screw (4)
34. Radiator cap
35. Radiator draincock
36. Bulb seal
37. Bulb seal
38. Radiator mount
39. Flange head screw (4)
40. Flange nut (4)
41. Foam seal (2)
42. Spacer (6)
43. Seal bracket (2)
44. Flange nut (4)
45. 90º hydraulic fitting (2)

NOTE: The hydraulic oil cooler on your Reelmaster 7000- D is combined with the radiator. See Radiator and Oil Cooler Assembly in Chapter 3 - Yanmar Diesel Engine (Model 03780) or Chapter 4 - Kubota Diesel Engine (Model 03781) in this manual for information on removal and installation of the radiator/oil cooler assembly.

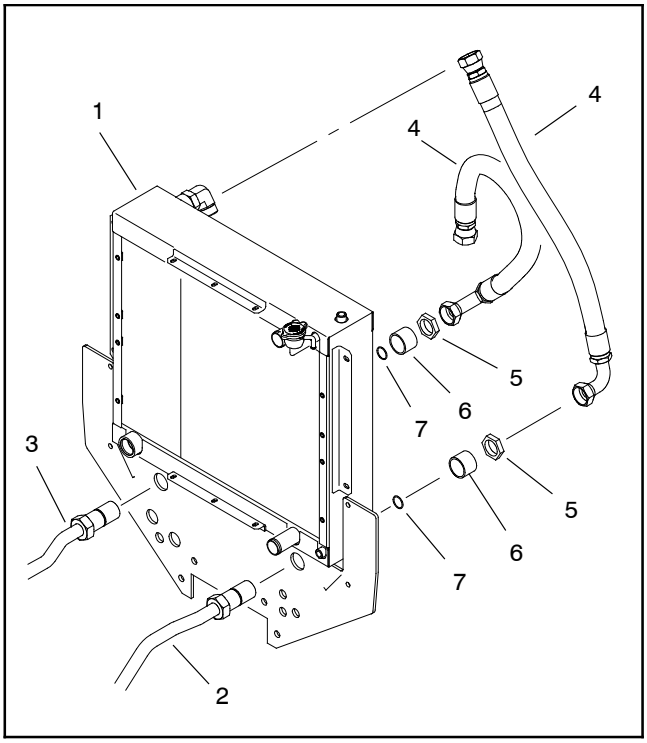


Figure 103

1. **Radiator/oil cooler**
2. **Hydraulic tube**
3. **Hydraulic tube**
4. **Hydraulic hose**
5. **Bulkhead nut**
6. **Spacer**
7. **O- ring**

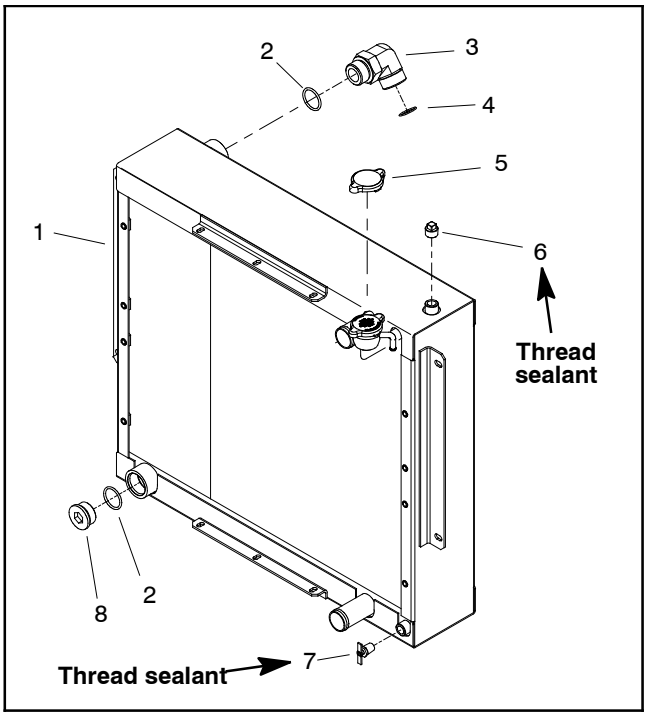


Figure 104

1. **Radiator/oil cooler**
2. **O- ring**
3. **90° Hydraulic fitting (2)**
4. **O- ring**
5. **Radiator cap**
6. **Coolant plug**
7. **Draincock**
8. **Hydraulic plug**

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Chapter 6

Electrical System

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General Information

Operator's Manual

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

Toro Electronic Controller (TEC)

Reelmaster 7000−D machines use a single Toro Electronic Controller (TEC−5002) to manage machine electrical functions. The TEC is attached to a bracket under the Operator's seat (Fig. 1).

The TEC contains a microcontroller that senses the condition of various machine switches (inputs) and directs electrical power to control appropriate machine functions (outputs) based on the state of the inputs. The status of inputs to the controllers as well as outputs from the controllers can be checked with the Diagnostic Display (see Special Tools).

Because of the solid state circuitry built into the Toro Electronic Controller (TEC), there is no method to test it directly. The TEC may be damaged if an attempt is made to test it with an electrical test device, such as a digital multimeter.

IMPORTANT: Before performing any welding on the machine, disconnect the battery cables from the battery, disconnect the wire harness connectors from the Toro Electronic Controller(s) and disconnect the terminal connector from the alternator to prevent damage to the machine electrical system.

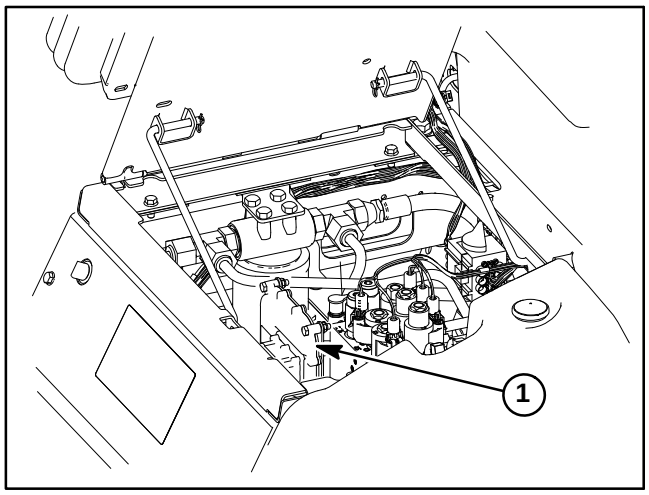


Figure 1

1. Toro Electronic Controller

Engine Electrical Components

When servicing or troubleshooting the engine electrical components, use the correct engine service manual and troubleshooting manual. For machines with Yanmar diesel engines, the Yanmar SMARTASSIST−Direct electronic control diagnostics service system is available to support the error diagnosis and maintenance services of engine electrical control devices.

Engine Electronic Control Unit (ECU) (Yanmar Diesel Engines Only)

The Yanmar engine that powers the Reelmaster 7000−D (Model 03780/03780A) uses an electronic control unit (ECU) for engine management and also to communicate with the Toro Electronic Controller (TEC) and the InfoCenter Display on the machine. All engine ECU electrical connectors should be plugged into the controller before the machine ignition switch is moved to either the ON or START position. If the engine ECU is to be disconnected for any reason, make sure that the ignition switch is in the OFF position with the key removed before disconnecting the engine ECU. See Chapter 3 − Yanmar Diesel Engine for additional engine ECU information.

IMPORTANT: Do not plug or unplug the engine ECU for a period of thirty (30) seconds after the machine ignition switch is turned OFF. The ECU may remain energized even though the ignition switch is OFF.

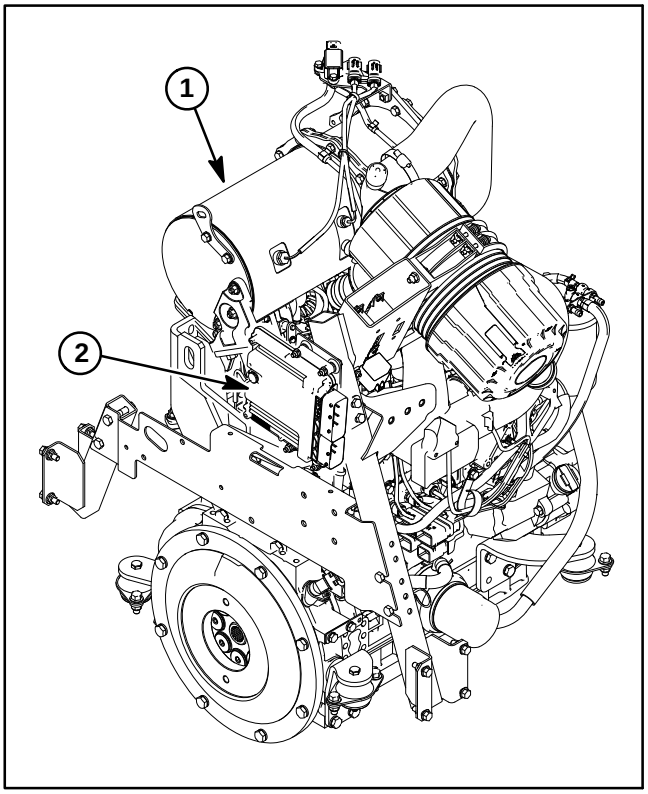


Figure 1

1. Yanmar engine
2. Engine ECU

CAN−bus Communications

The Toro Electronic Controller (TEC) used on the Reelmaster 7000−D can communicate with other electrical components (engine ECU and InfoCenter display) on a CAN−bus communication system. The CAN−bus system reduces the number of electrical components and connections used on the machine and allows the number of wires in the wire harness to be reduced.

CAN identifies the Controller Area Network that is used on the Reelmaster. Two (2) specially designed, twisted cables form the bus. These wires provide the data pathways between machine components. The engineering term for these two (2) cables are CAN−high and CAN−low. At the ends of the twisted pair of bus cables are 120 ohm termination resistors.

Each of the components that is controlled by the CAN−bus link only needs four (4) wires to operate and communicate to the system: CAN−high, CAN−low, B+ (power) and ground.

IMPORTANT: The termination resistors at the ends of the bus cables are required for proper electrical system operation.

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Electrical Drawings

The electrical schematics and other electrical drawings for the Reelmaster 7000−D are located in Chapter 10 − Foldout Drawings.

Special Tools

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

Multimeter

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

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

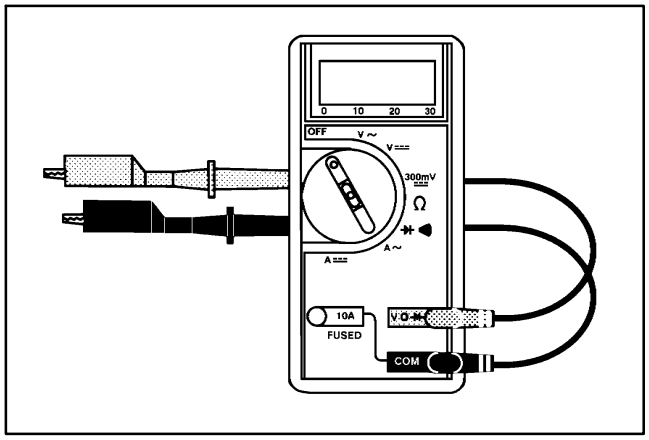


Figure 2

Dielectric Gel

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

Do not use dielectric gel on sealed connection terminals as the gel can unseat connector seals during assembly.

Toro Part Number: **107−0342**



Figure 3

Battery Hydrometer

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



Figure 4

Terminal Protector

Aerosol spray that should be used on battery terminals, ring terminals, and fork terminals to reduce corrosion problems. Apply battery terminal protector to the connection after the battery cable, ring terminal, or fork terminal has been secured.

Toro Part Number: **107−0392**



Figure 5

InfoCenter Display

The InfoCenter Display used on your Reelmaster is a LCD device that is located on the console arm (Fig. 6). The InfoCenter provides information for machine Operators, it provides electrical system diagnostic assistance for technicians, and provides access to adjustable machine settings (Fig. 7).

A CAN−bus system provides communication necessary for machine operation between the Toro Electronic Controller (TEC), the engine ECU (on machines with Yanmar diesel engines), and the InfoCenter.

Use the InfoCenter Display to test TEC inputs and outputs when troubleshooting an electrical problem on your Reelmaster 7000−D (see Using the InfoCenter Display to Test TEC Inputs and Outputs in this chapter).

NOTE: Icons used by the InfoCenter display are identified in the traction unit Operator's Manual.

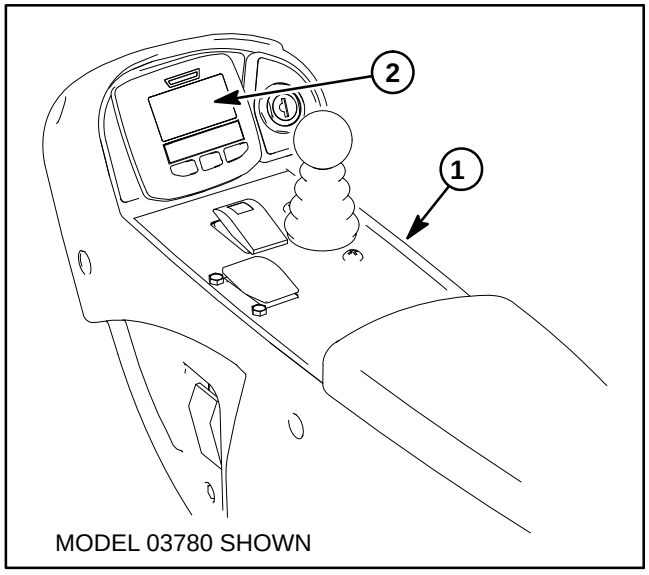


Figure 6

1. Console arm **2. InfoCenter Display**

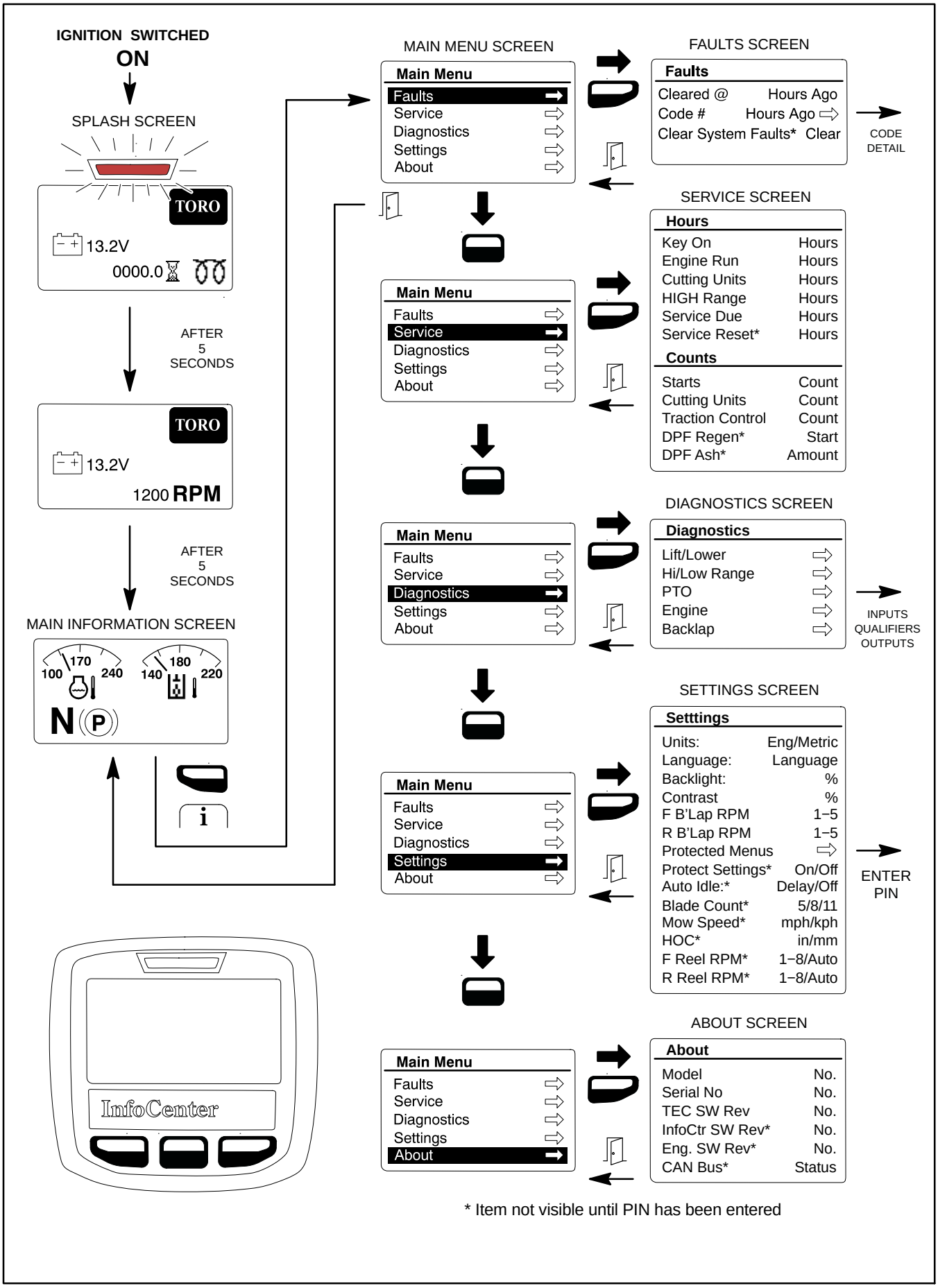


Figure 7 InfoCenter Display Screens

Splash Screen

When the ignition switch is turned from the OFF position to the ON/PREHEAT or START position, the fault indicator illuminates for a few seconds to verify indicator operation and the InfoCenter splash screen appears (Fig. 8). The splash screen provides the following information to the operator:

- Voltmeter
- Hourmeter (displayed for first five seconds)
- Glow plug indicator (displayed only while glow plugs are energized)
- Tachometer (displayed after five seconds)

After the splash screen has been displayed for ten seconds, the main information screen will be appear on the InfoCenter.

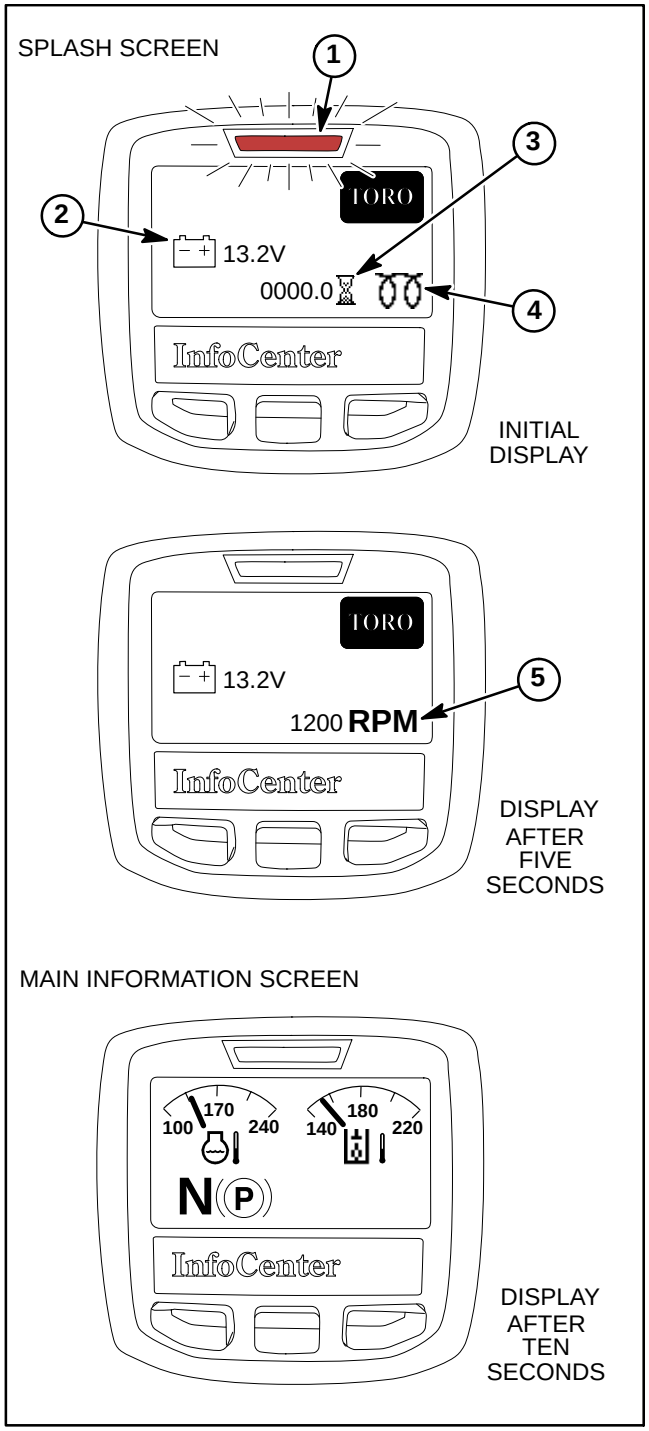


Figure 8

1. **Fault indicator**
2. **Voltmeter**
3. **Hourmeter**
4. **Glow plug indicator**
5. **Tachometer**

Main Information Screen

The InfoCenter main information screen is displayed about 10 seconds after the ignition switch has been turned from the OFF position to the ON/PREHEAT or START position (Fig. 9). The main information screen is the “default” screen as it will be displayed during normal machine operation. The main information screen provides the following information to the operator:

- Engine coolant temperature
- Hydraulic oil temperature
- Traction system
  Either the neutral, high (transport) speed range, or low (mow) speed range icon will appear at all times
- Parking brake
  Icon appears when parking brake is engaged
- Reels
  Icon appears when reels are engaged
- Lift arms
  Up icon appears while lift arms are raising
  Down icon appears while lift arms are lowering
- Operator’s seat
  Icon appears when the operator is out of the seat and the seat must be occupied before machine operation can continue

Press the Menu/Back button once to expose the navigation pane, then press the Right/Left button (as indicated by the ➡ in the navigation pane) to toggle between the main information screen and the splash screen (Fig. 10). The navigation pane will close automatically if another button is not pressed within six seconds.

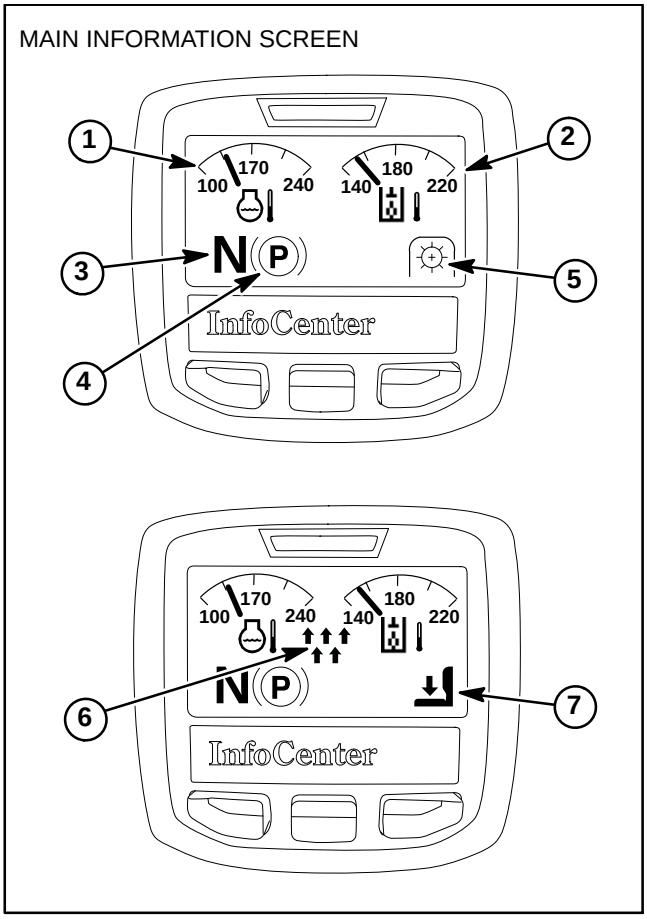


Figure 9

1. **Engine coolant temperature**
2. **Hydraulic oil temperature**
3. **Traction system (neutral)**
4. **Parking brake (engaged)**
5. **Reels (engaged)**
6. **Lift arms (raising)**
7. **Operator’s seat (unoccupied)**

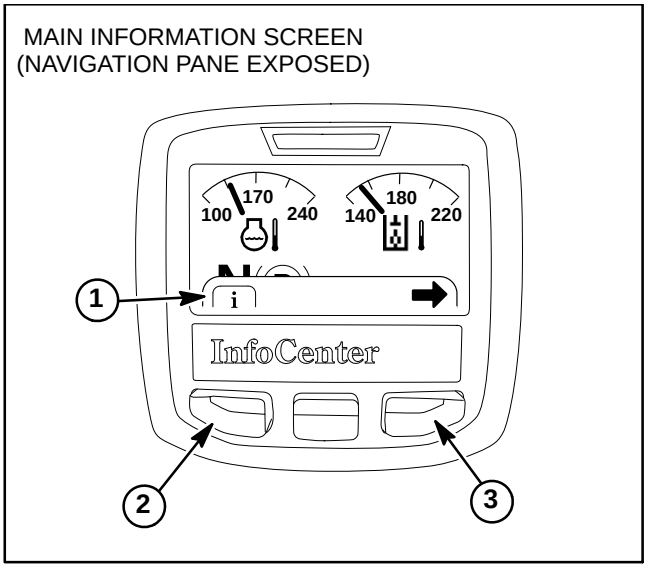


Figure 10

1. **Navigation pane**
2. **Menu/Back button**
3. **Left/Right button**

Operator Advisory Screen

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (Fig. 11). Each advisory screen has three elements: the advisory number/code, the advisory description, and the advisory qualifier.

An advisory qualifier denotes the condition(s) that triggered the advisory and provides instruction on eliminating the advisory. An operator advisory may involve one or more advisory qualifier. Typically, an advisory can be eliminated by changing the position of the operator control(s) referenced by the advisory qualifier. Once the first qualifier displayed is satisfied, any additional qualifiers that remain to be satisfied will appear in the operator advisory screen individually.

NOTE: If a machine fault occurs during machine operation, the InfoCenter fault indicator will blink to notify the operator (see Faults Screen in this chapter).

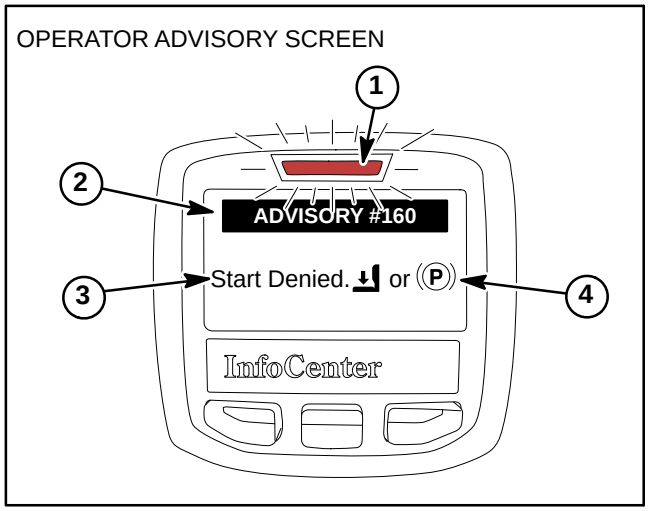


Figure 11

1. **Fault indicator**
2. **Advisory number/code**
3. **Advisory description**
4. **Advisory qualifier**

Main Menu Screen

The main menu screen (Fig. 12) is accessed from the InfoCenter main information screen. Press the Menu/Back button once to expose the navigation pane, then press the Menu/Back button again (as indicated by the i in the navigation pane). The main menu screen provides access to the following menu screens:

- Faults
- Service
- Diagnostics
- Settings
- About

Press the Down button (as indicated by the ⬇ at the bottom of the screen) to highlight the desired menu screen, then press the Left/Right button (as indicated by the ➡ at the bottom of the screen) to enter the highlighted menu screen.

To return to the main information screen, press the Menu/Back button (as indicated by the ⍐ at the bottom of the screen).

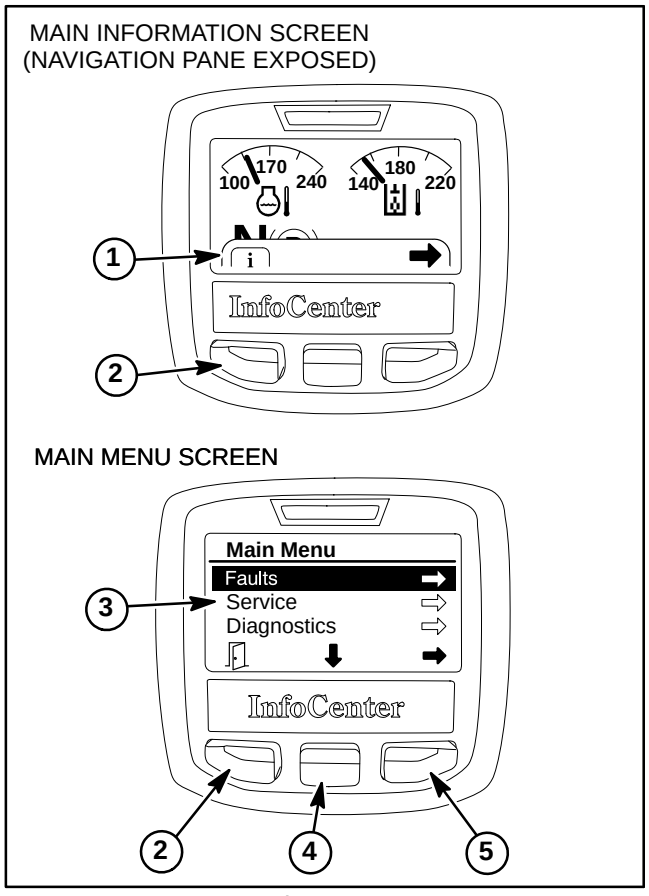


Figure 12

1. **Navigation pane**
2. **Menu/Back button**
3. **Menu screens**
4. **Down button**
5. **Left/Right button**

Faults Screen

The faults screen (Fig. 13) will list all machine electrical faults that have occurred since the faults were last cleared from the InfoCenter. The faults will be identified by a number code and when the fault occurred. See Table 3: Fault Codes in the Troubleshooting section of this chapter for a listing of the possible fault codes for the Reelmaster 7000−D.

If a machine fault occurs during operation, the InfoCenter fault indicator will blink to notify the operator, and machine functionality may be affected due to the fault. To regain full machine functionality:

A. Disengage the cutting units

B. Turn the ignition switch OFF and allow all machine functions to stop

C. Allow the machine to remain OFF for at least one (1) minute

D. Restart the engine and check machine operation

E. If a fault continues, further system evaluation and possible component repair or replacement will be necessary

To view a description of a fault that has occurred since the faults were last cleared from the InfoCenter, press the Down button (as indicated by the ⬇ at the bottom of the screen) to highlight the desired fault, then press the Left/Right button (as indicated by the ➡).

To return to the previous screen, press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen).

NOTE: Yanmar Diesel Engines − If an engine fault occurs during machine operation, the fault indicator will illuminate and the fault will be displayed on the InfoCenter to notify the operator (Fig. 14). The engine fault will continue to appear until the offending condition is corrected. Once the offending condition has been corrected, the engine fault will be retained in the engine electronic control unit (ECU) and can only be viewed using the engine diagnostic tool. Engine faults are not stored in the Toro Electronic Controller (TEC) so engine fault history cannot be viewed using the InfoCenter faults screen.

Clear System Faults (PIN required) If the correct passcode (PIN) has been entered (see Settings Screen − Protected Menus in this chapter) the InfoCenter fault log can be cleared by selecting Clear System Faults. The cleared faults will be removed from the InfoCenter list but will be retained in the TEC memory. Contact your Toro Distributor to view faults stored in the TEC memory.

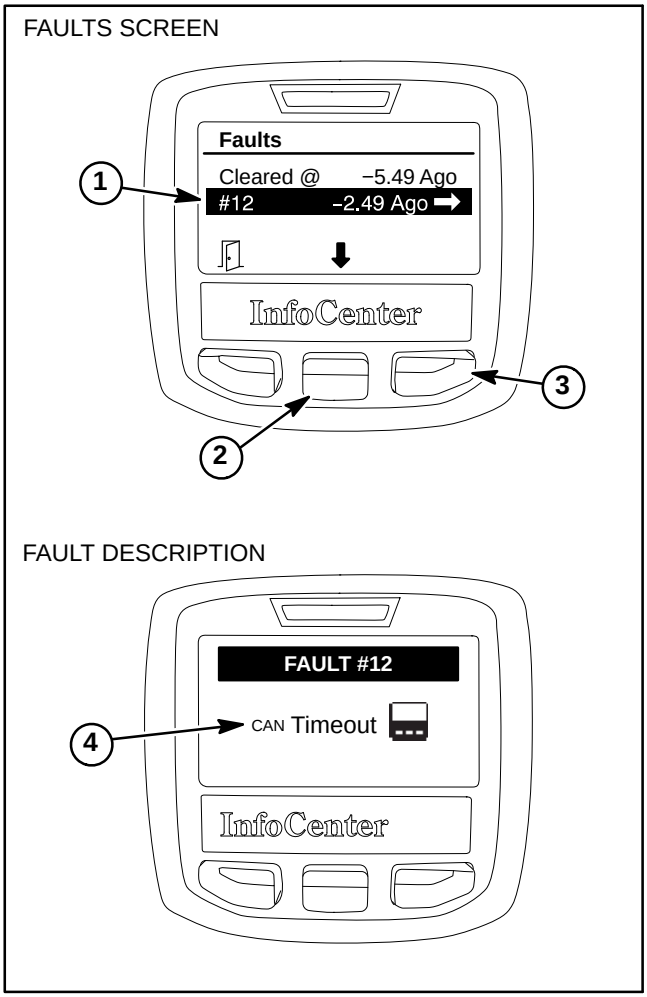


Figure 13

1. **Fault code (highlighted)**
2. **Down button**
3. **Left/Right button**
4. **Fault description**

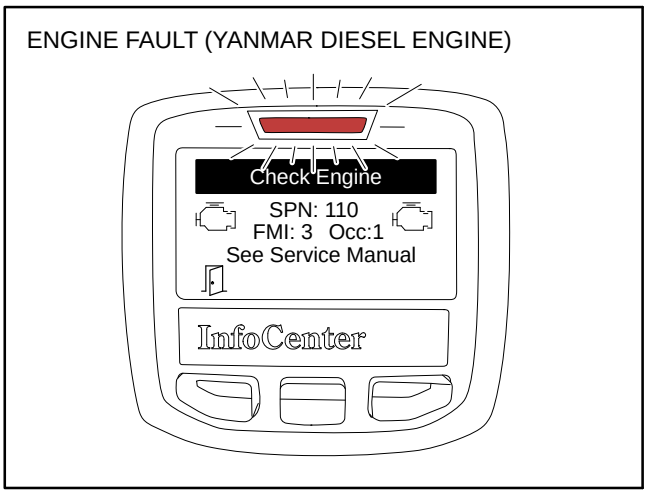


Figure 14

1. **Engine fault (Yanmar Diesel engine)**

Service Screen

The service screen (Fig. 15) contains machine operational information including hours and counts. If the correct passcode (PIN) has been entered (see Settings Screen − Protected Menus in this chapter) the service screen allows access to initiate a manual DPF regeneration, provides information on DPF ash accumulation, and allows resetting the Service Due timer. To scroll through the list of service records and view the current values, press the Down button (as indicated by the ⬇ at the bottom of the screen).

To return to the previous screen, press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen).

Hours provides access to the following information:

Key On identifies the number of hours that the ignition switch has been in the ON position.

Engine Run identifies the number of hours that the engine has been running.

Cutting Units identifies the number of hours that the machine has been operated with the cutting units engaged.

H **High Range** identifies the number of hours that the machine has been operated in HIGH (transport) speed range.

Service Due identifies the number of hours until the next scheduled maintenance is due. This is a count down timer and the numbers of hours displayed will decrease as the machine is used.

→ 250 **Service Timer Reset** (PIN required) identifies the total number of hours between scheduled maintenance intervals. Reset the Service Due timer to the service interval (250 hours) by pressing the Left/Right button (as indicated by the ➡ at the bottom of the screen) and then pressing the Down button (as indicated by the **Yes** or ➡ at the bottom of the screen).

Counts provides access to the following information:

Starts identifies the number of times that the engine has been started.

Cutting Units identifies the number of times the cutting units have been engaged.

L→H **Traction Control** identifies the number of times the traction control system has been shifted from LOW (mow) to HIGH (transport) speed range.

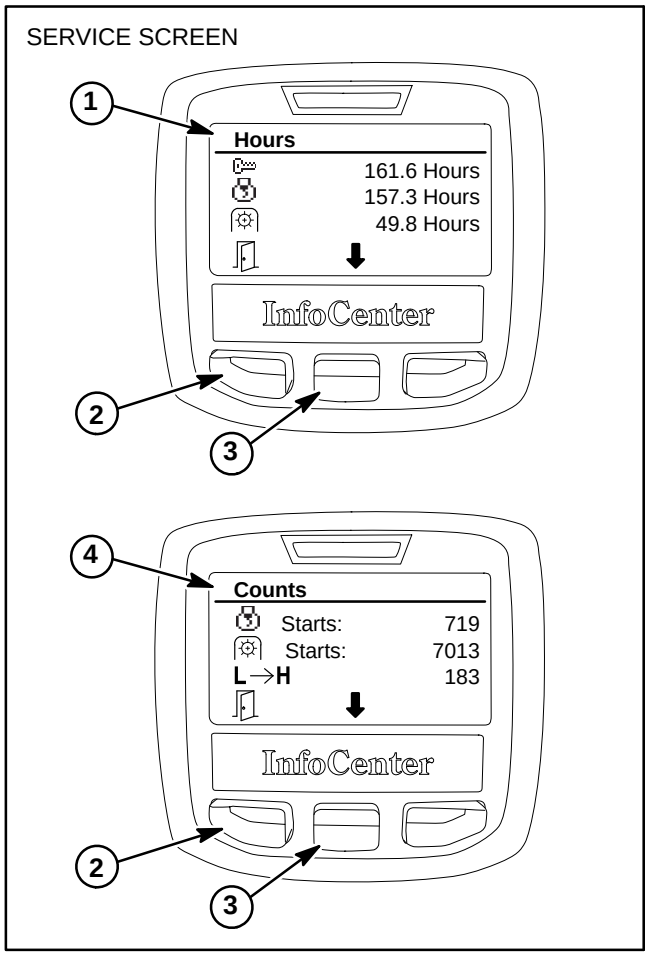


Figure 15

1. **Service screen (hours)**
2. **Menu/Back button**
3. **Down button**
4. **Service screen (counts)**

DPF Regeneration (PIN required) allows an operator or technician to initiate a stationary regeneration for the exhaust system DPF (diesel particulate filter) on machines with Yanmar diesel engines. If the engine ECU identifies that a stationary DPF regeneration is necessary, an advisory will occur on the InfoCenter Display.

Move the machine to a well ventilated area and initiate a stationary DPF regeneration by pressing the Left/Right button (as indicated by the ➡ at the bottom of the screen) and then pressing the Down button (as indicated by the Yes or ➡ at the bottom of the screen). Additional information can be found in the Yanmar Service Manual.

DPF Ash (PIN required) DPF ash is the level of ash accumulated in the DPF (diesel particulate filter) on machines with Yanmar diesel engines. Ash is the byproduct of performing numerous regeneration operations. When there is too much ash build up in the filter, it has to either be serviced or replaced.

Diagnostics Screen

The diagnostics screen (Fig. 16) lists a variety of machine operations and the current state of the Toro Electronic Controller (TEC) inputs, the qualifiers and the outputs required to allow the operation to proceed. The diagnostics screen should be used to troubleshoot machine operation issues, and check that necessary components and circuit wiring are functioning correctly (see Troubleshooting in this chapter). To scroll through the list of operations and select (highlight) the operation to be viewed, press the Down button (as indicated by the ⬇ at the bottom of the screen).

To return to the previous screen, press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen).

Lift/Lower Identifies the requirements necessary to allow the TEC to raise and lower the cutting units.

Inputs	Qualifiers	Outputs
Joystick Lower	Engine Running	Solenoid SV1 (solenoid S1 − lower and raise)
Joystick Raise	Low Range	Solenoid SV2 (solenoid S2 − raise only)
Key Run	OK to Lower (Front) or	Solenoid SV3 (solenoid S3 − lower only)
	OK to Lower (Rear)	Raise Front (solenoid S4 − raise only)
	OK to Raise (Front) or	Raise Rear (solenoid S5 − raise only)
	OK to Raise (Rear)	Lower Front (solenoid S4 − lower only)
		Lower Rear (solenoid S5 − lower only)

Hi/Low Range identifies the requirements necessary to allow the TEC to shift the two speed shift manifold valve from LOW to High speed range.

Inputs	Qualifiers	Outputs
High Range Reqd:	Cutting units must be above turn−around position	Two speed shift manifold solenoid valve

PTO Identifies the requirements necessary to allow the TEC to engage the cutting units.

Inputs	Qualifiers	Outputs
Reel Enable/Disable Switch	Low Range	Front Reel Engage (solenoid SP1)
	Engine Running	Rear Reel Engage (solenoid SP2)
	In Seat	
	Engine Temp OK	
	Cutting Unit Down	

DIAGNOSTICS SCREEN

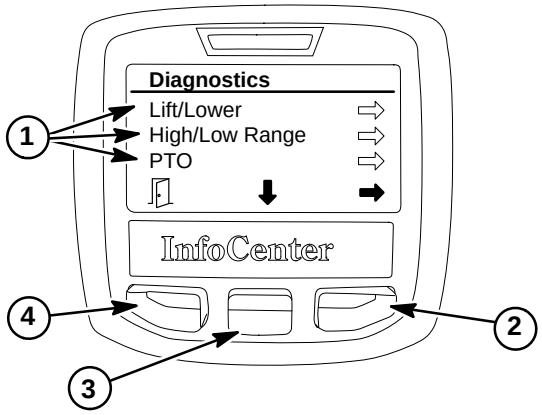


Figure 16

1. **Machine operations**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

Engine Identifies the requirements necessary to allow the TEC to start and run the engine.

Inputs	Qualifiers	Outputs
Key Start	Joystick Lower OFF	ENG START (see NOTES)
Key Run	Joystick Raise OFF	ENG RUN (see NOTES)
	Reel Enable/Disable Switch OFF	
	Neutral	
	Seat or P Brake	

NOTE: For machines with Yanmar diesel engines, the ENG START and ENGINE RUN output component is the engine ECU. The engine ECU controls the individual components (e.g. start relay, glow relay) necessary to start and run the engine.

NOTE: For machines with Kubota diesel engines, the ENG START output components are the start relay and the the glow relay. The ENGINE RUN output components are the fuel pump and the fuel stop solenoid hold coil.

Backlap Identifies the requirements necessary to allow the TEC to engage the cutting units in the reverse direction for backlapping cutting units.

Inputs	Qualifiers	Outputs
Front Backlap	In Seat or	Front Reel Engage (solenoid SP1)
Rear Backlap	Parking Brake	Rear Reel Engage (solenoid SP2)
Reel Enable/Disable Switch	Cutting Unit Down	
	Engine Running	

Settings Screen

The settings screen (Fig 17) allows the operator or technician to customize the InfoCenter display, modify a variety of machine functions, and provides access to unlock various protected menus and settings. To scroll through the list of functions, view its current setting, and select (highlight) the setting to be modified, press the Down button (as indicated by the ⬇ at the bottom of the screen).

To return to the previous screen, press the Menu/Back button (as indicated by the ⍐ at the bottom of the screen).

Units: Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select between metric or English units of measure. Allow the desired selection to remain in view for five (5) seconds. The fault indicator will illuminate and an operator advisory #180 (New Value Saved in Permanent Memory) will appear on the InfoCenter display to confirm that the change has been recorded.

Language: Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select from numerous language options. Allow the desired selection to remain in view for five (5) seconds. The fault indicator will illuminate and an operator advisory #180 (New Value Saved in Permanent Memory) will appear on the InfoCenter display to confirm that the change has been recorded.

Backlight: Press the Left/Right button (as indicated by the ➡ at the bottom of the screen) then use the Down button to decrease or the Left/Right button to increase the InfoCenter Display brightness (as indicated by the **−** and the **+** at the bottom of the screen).

Contrast: Press the Left/Right button (as indicated by the ➡ at the bottom of the screen) then use the Down button to decrease or the Left/Right button to increase the InfoCenter Display contrast (as indicated by the **−** and the **+** at the bottom of the screen).

F B'Lap RPM: Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select the reel speed used when backlapping the front reels. Choose from five (5) preset reel speeds.

R B'Lap RPM: Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select the reel speed used when backlapping the rear reels. Choose from five (5) preset reel speeds.

SETTINGS SCREEN

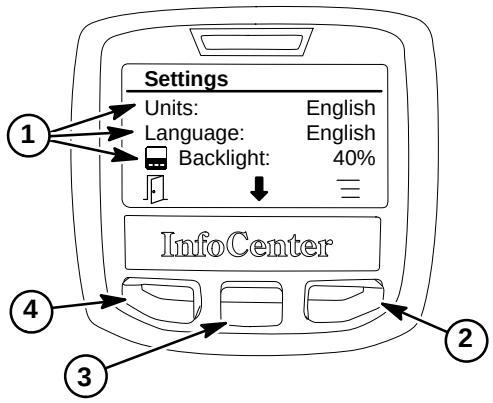


Figure 17

1. **Settings items**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

Protected Menus: Authorized individuals can enter the four (4) digit passcode (PIN) to reveal the following service functions (see Faults Screen and Service Screen in this chapter):

- Clear System Faults
- Service Timer Reset
- DPF Regeneration
- DPF Ash

Entering the correct PIN will also reveal and allow adjustment of various machine functions on the settings screen if Protect Settings is set to ON (see Settings Screen − Protect Settings).

Use the Down button and Left/Right button (as indicated by the ⬇ and the ➡ at the bottom of the screen) to enter the four (4) digit passcode (PIN). Once the correct PIN has been entered, press the down button (as indicated by the ✓ at the bottom of the screen). **PIN** will appear in the upper right hand corner of the InfoCenter display. The protected items will be visible as long as the ignition switch remains ON.

To edit the passcode (PIN), enter the current PIN as previously described (**PIN** will appear in the upper right hand corner). Select Protected Menus again and use the Down button and Left/Right button (as indicated by the ⬇ and the ➡ at the bottom of the screen) to enter a new four (4) digit PIN. Press the Down button to save the change (as indicated by the 🖫 at the bottom of the screen).

NOTE: The initial PIN will be either 1234 or 0000. If the PIN has been changed and is forgotten, a temporary PIN can be obtained from your Toro distributor.

The following settings will only be visible if Protect Settings is set to ON and the correct passcode (PIN) has been entered, or Protect Settings is set to OFF:

Protect Settings: Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select OFF or ON. When Protect Settings is set to OFF, the remaining settings will be visible and adjustable at all times. When Protect Settings is set to ON, the remaining settings will be visible and adjustable only after the correct passcode (PIN) has been entered (see Settings Screen − Protected Menus).

Auto Idle: (Yanmar diesel engines only) When the engine is running and the machine is in neutral , the engine will automatically return to the low idle setting after the set time delay. When the engine is running and the machine is not in neutral , the engine will automatically return to the high idle setting after the set time delay. Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select 8, 10, 15, 20 or 30 seconds or the auto idle feature can be set to OFF.

Blade Count: The blade count setting should match the number of blades on the cutting unit reels installed on the machine. The blade count setting is used by the TEC to manage cutting unit reel speed. Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to select 5, 8 or 11. The fault indicator will illuminate and an operator advisory #176 (Reel Speed Changed) will appear on the InfoCenter display to confirm that the change has been recorded.

Mow Speed: The mow speed setting should match the current mow speed limiter setting on the machine (see traction unit. The mow speed setting is used by the TEC to manage cutting unit reel speed. Press the Left/Right button (as indicated by the ➡ at the bottom of the screen) then use the Down button to decrease or the Left/Right button to increase the mow speed in 0.5 mph (0.8 kph) increments. The fault indicator will illuminate and an operator advisory #176 (Reel Speed Changed) will appear on the InfoCenter display to confirm that the change has been recorded.

HOC: The HOC (height of cut) setting should match the current cutting unit HOC. The HOC setting is used by the TEC to manage cutting unit reel speed. Press the Left/Right button (as indicated by the ➡ at the bottom of the screen) then use the Down button to decrease or the Left/Right button to increase the HOC in 0.063 in. (1.59 mm) increments. The fault indicator will illuminate and an operator advisory #176 (Reel Speed Changed) will appear on the InfoCenter display to confirm that the change has been recorded.

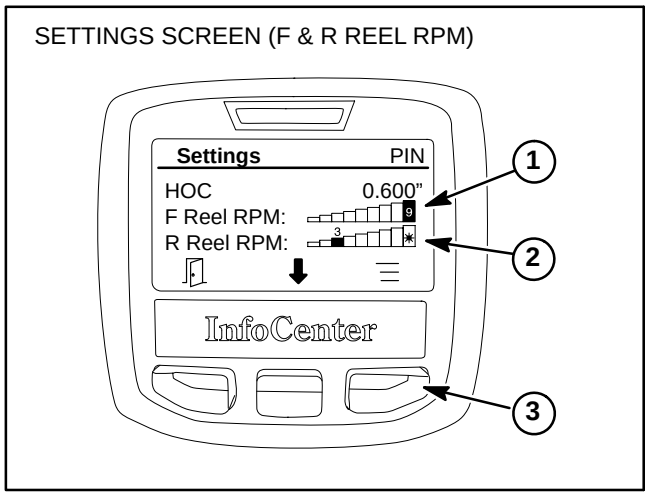


Figure 18

1. **Front reel RPM** (at TEC set RPM 9)
2. **Rear reel RPM** (manually set to 3, TEC RPM is 9)
3. **Left/Right button**

F Reel RPM: Initially, the front reel speed is set by the TEC based on the values entered for blade count, mow speed and HOC. Front reel RPM can also be manually adjusted. Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to manually adjust the reel RPM. The fault indicator will illuminate and an operator advisory #176 (Reel Speed Changed) will appear on the InfoCenter display to confirm that the change has been recorded. The TEC calculated RPM is referenced by ✳ when reel RPM is manually set.

A manual RPM adjustment will remain active until the blade count, mow speed, or HOC setting is changed. When one of the cutting unit settings is changed, the reel RPM will return to the TEC calculated speed.

R Reel RPM: Initially, the rear reel speed is set by the TEC based on the values entered for blade count, mow speed and HOC. Rear reel RPM can also be manually adjusted. Use the Left/Right button (as indicated by the ☰ at the bottom of the screen) to manually adjust the reel RPM. The fault indicator will illuminate and an operator advisory #176 (Reel Speed Changed) will appear on the InfoCenter display to confirm that the change has been recorded. The TEC calculated RPM is referenced by ✳ when reel RPM is manually set.

A manual RPM adjustment will remain active until the blade count, mow speed, or HOC setting is changed. When one of the cutting unit settings is changed, the reel RPM will return to the TEC calculated speed.

About Screen

The about screen (Fig. 19) identifies the machine model number, serial number and software revision for the machine. If the correct passcode (PIN) has been entered (see Settings Screen − Protected Menus in this chapter), the Toro Electronic Controller (TEC), InfoCenter, and engine ECU software is displayed, and the CAN−bus status will be visible. Press the Down button to scroll through the screen items (as indicated by the ⬇ at the bottom of the screen). The information found in the about screen can only be edited by your Toro Distributor.

To return to the previous screen, press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen).

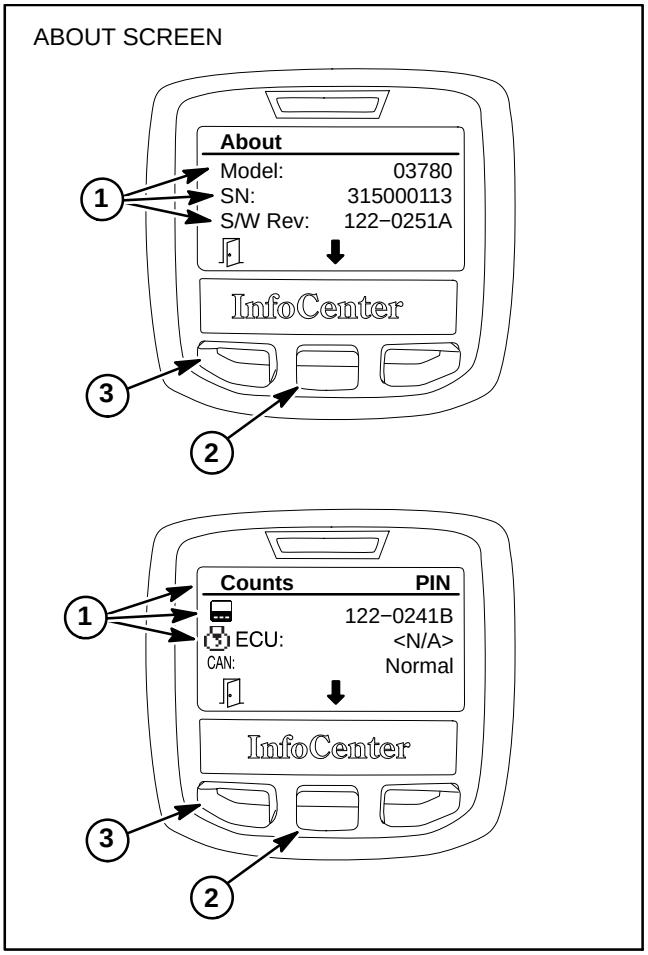


Figure 19

1. **Screen items**
2. **Down button**
3. **Menu/Back button**

Troubleshooting

CAUTION

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

For effective troubleshooting and repairs, there must be a good understanding of the electrical circuits and components used on this machine.

If the machine has any interlock switches by−passed, reconnect the switches for proper safety and troubleshooting.

Use the InfoCenter Display to test Toro Electronic Controller (TEC) inputs and outputs when troubleshooting an electrical problem on your Reelmaster 7000−D (see Using the InfoCenter Display to Test TEC Inputs and Outputs in this chapter).

Operator Advisories

If one or more Toro Electronic Controller (TEC) inputs are not in the correct position to allow certain machine operations, or are malfunctioning, the fault indicator will illuminate and an advisory screen will appear on the InfoCenter Display (Figs. 20 and 21). Each advisory screen has three elements: the advisory number/code, the advisory description, and the advisory qualifier.

An advisory qualifier denotes the condition(s) that triggered the advisory and provides instruction on eliminating the advisory. An operator advisory may involve one or more advisory qualifier. Typically, an advisory can be eliminated by changing the position of the operator control(s) referenced by the advisory qualifier. Once the first qualifier displayed is satisfied, any additional qualifiers that remain to be satisfied will appear in the operator advisory screen individually.

Operator advisory numbers/codes, descriptions, and conditions/actions are listed in Table 1

Possible advisory qualifiers are listed in Table 2

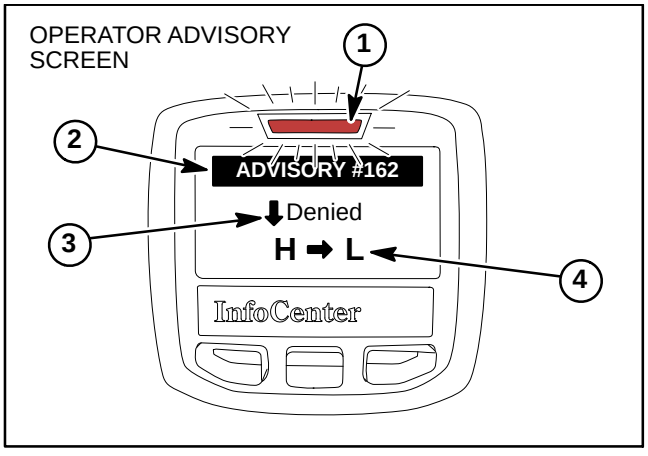


Figure 20

1. **Fault indicator**
2. **Advisory number/code**
3. **Advisory description**
4. **Advisory qualifier**

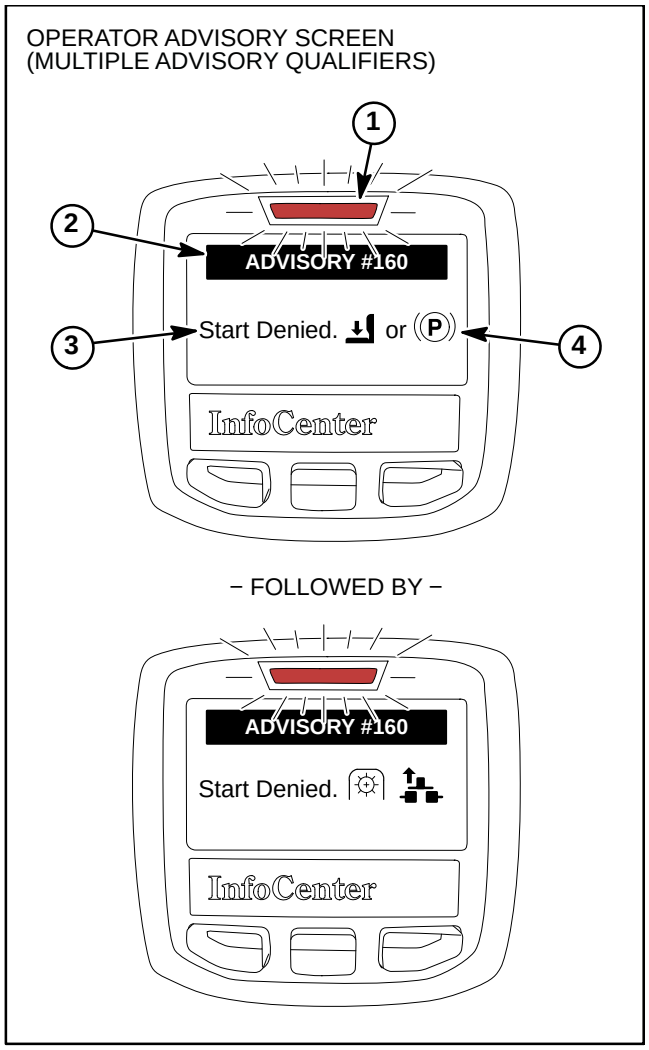


Figure 21

1. **Fault indicator**
2. **Advisory number/code**
3. **Advisory description**
4. **First fault qualifier**
5. **Second fault qualifier**

Number/ Code	Description	Condition/Action
160	Start Denied	Wait to start until system functions have been initialized No operator in seat and parking brake is not engaged. Traction pedal is in FORWARD or REVERSE position Joystick is in RAISE position Joystick is in LOWER position Reel Enable/Disable switch is in ENGAGE position
161	Engage Cutting Unit Denied	No operator in seat Engine coolant temperature is excessive
162	Lower Cutting Unit Denied	Speed limiter is in HIGH (transport) position
163	HIGH (transport speed range) Denied	Cutting unit position switch is closed (cutting units below turnaround position).
169	Engine Shutdown	No operator in seat and parking brake is not engaged. Parking brake IS engaged while traction pedal is in FORWARD or REVERSE position Engine coolant temperature is excessive Engine oil pressure is low
170	Recycle Keyswitch (ignition switch)	Engine starter motor has been engaged for more than 30 seconds or engine start attempt already happened
171	Auto Idle Engaged (Yanmar diesel engines only)	Engine RPM has been reduced to low idle speed as machine has been inactive for the set period of time. Inactive means the traction pedal is in NEUTRAL, reel enable/disable switch is in DISENGAGED position, joystick is in NEUTRAL position, and engine speed switch (Yanmar diesel engines) is not pressed. Auto idle feature timing can be reduced, increased, or turned OFF as needed.
173	Master Address Claim (TEC)	
176	Reel Speed Changed	An item on the Setting Screen used to calculate reel speed has been changed
177	Reel Speed Changed Out of Range	
179	Ash Cleaning Warning	See Yanmar diesel engine Service Manual
180	New Value Saved in Permanent Memory	An item on the Setting Screen has been changed

Table 1: Operator Advisories

Engine running
Version check restriction
or Sit down or set parking brake
N Not in neutral
Raise switch closed
Lower switch closed
Not in seat
Range high engaged
Coolant too hot
Hydraulic oil too hot
Reel Enable/Disable switch enabled
Parking brake is set
Loss of CAN
Key start held too long
Safety kill
Recycle keyswitch
Engine Oil Pressure Low

Table 2: Operator Advisory Qualifiers

Using the InfoCenter Display for Troubleshooting

The diagnostics screen of the InfoCenter display can be very helpful when troubleshooting machine operation issues (see Diagnostics Screen in this chapter). The diagnostics screen (Fig. 22) lists a variety of machine operations and the current state of the inputs, the qualifiers and the outputs required to allow the operation to proceed. The electrical components involved in the following machine operations can be evaluated using the diagnostics screen prior to testing each component individually:

Lift/Lower The components necessary to raise or lower the cutting units.

High/Low Range The components necessary to shift the dual displacement wheel/axle motors from LOW to HIGH speed range.

PTO The components necessary to engage the cutting units.

Engine The components necessary to start and run the engine.

Backlap The components necessary to engage the cutting units in the reverse direction for backlapping.

If a machine operation is malfunctioning, the following procedure can help identify the cause of the component or circuit wiring causing the malfunction.

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

2. Set the ignition switch to the ON position and navigate to the InfoCenter Diagnostic Screen.

3. Select (highlight) the malfunctioning machine operation and press the Left/Right button (as indicated by the ➡ at the bottom of the screen). For this example, the PTO operation has been selected (Fig. 23).

4. Select (highlight) Inputs and press the Left/Right button (as indicated by the ➡ at the bottom of the screen).

5. Manually operate each input item listed (Fig. 24). The input condition on the InfoCenter display should alternate ON and OFF as the input is switched open and closed. If ON and OFF do not alternate during input operation, the input component or its circuit wiring is faulty and should be tested (see Component Testing in this chapter).

In the PTO operation example, the only input is the Reel Enable/Disable switch. If ON and OFF do not alternate when the switch is moved back and forth from ENABLE to DISABLE, the switch or the circuit wiring for the switch is faulty and should be tested as described.

DIAGNOSTICS SCREEN

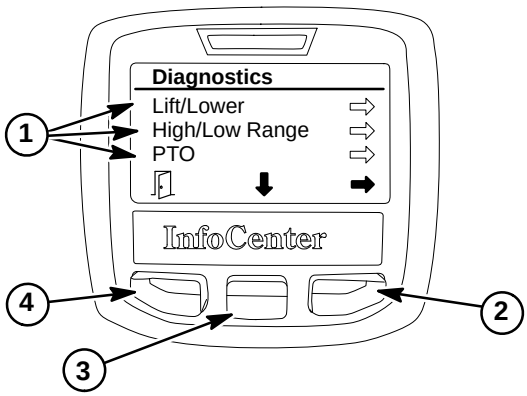


Figure 22

1. **Machine operations**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

DIAGNOSTICS SCREEN (PTO SELECTED)

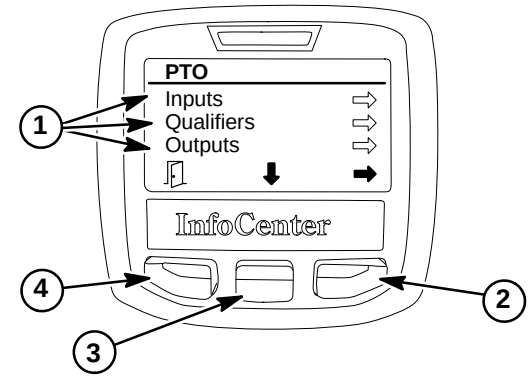


Figure 23

1. **Diagnostics items**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

DIAGNOSTICS SCREEN (PTO INPUTS SELECTED)

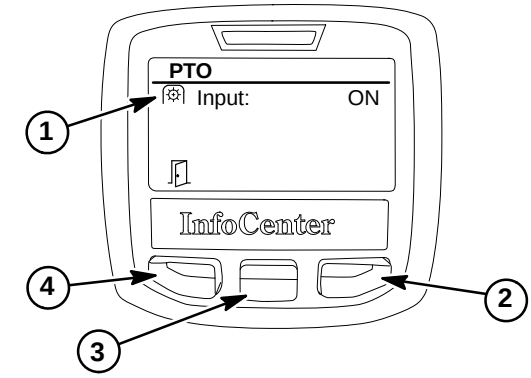


Figure 24

1. **Input items**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

6. Press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen. Select (highlight) Qualifiers and press the Left/Right button (as indicated by the ➡ at the bottom of the screen).

NOTE: All of the qualifiers for the machine operation must be in the desired condition (☑) before the operation Outputs can be energized.

7. Manually operate each qualifier listed (Fig. 25). The qualifier condition on the InfoCenter display should alternate ☑ and ☐ as the qualifiers condition is changed. If ☑ and ☐ do not alternate during qualifier operation, the qualifier component or its circuit wiring is faulty and should be tested (see Component Testing in this chapter).

CAUTION

It may be necessary to start and run the engine, raise and lower the cutting units, or otherwise operate the machine during the troubleshooting process. Make sure the machine is in a well ventilated area and keep away from cutting units and moving parts while troubleshooting to prevent personal injury.

In the PTO operation example, the following qualifiers must be in the desired condition (☑) before any operation Outputs can be energized:

- HI/LOW (transport/mow) switch in LOW (mow) range
- Engine must be running
  − engine RPM above 800 as reported by engine ECU on Yanmar diesel engines
  − engine oil pressure switch above minimum pressure (open) on Kubota diesel engines
- Operator must be in seat (seat switch)
- Engine coolant temperature must be below 220F (104.4C) (engine temperature sender)
- Cutting units must be lowered below turn−around position (cutting unit position switch)

If ☑ and ☐ do not alternate when the qualifier condition is changed, the qualifier or the circuit wiring for the qualifier is faulty and should be tested as described.

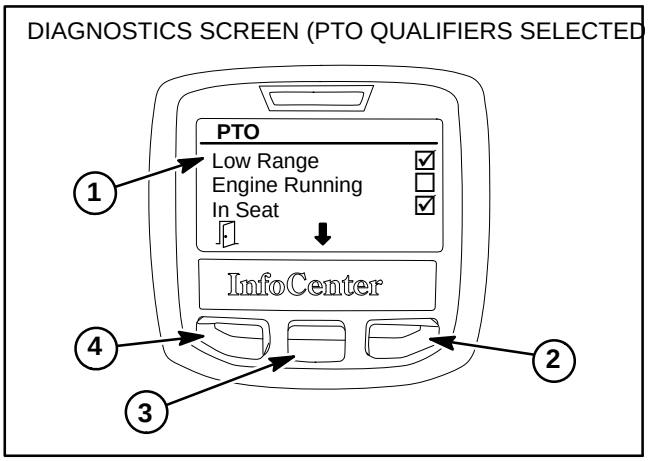


Figure 25

1. **Qualifier items**
2. **Left/Right button**
3. **Down button**
4. **Menu/Back button**

8. Press the Menu/Back button (as indicated by the ⮌ at the bottom of the screen. Select (highlight) Outputs and press the Left/Right button (as indicated by the ➡ at the bottom of the screen).

9. If all the Inputs are ON and all the Qualifiers are in their desired condition (☑), the Outputs for the machine operation should be ON. If the outputs remain OFF, the Toro Electronic Controller (TEC) or TEC software may be damaged and require reloading or replacement. Contact your Toro Distributor for assistance.

10. If the outputs listed on the InfoCenter Display are ON, and the operation is still malfunctioning:

- Test the specific output and output wiring (see Component Testing in this chapter).
- Hydraulic components related to the operation should be tested (see Chapter 5 − Hydraulic System in this manual).

In the PTO operation example, the outputs are the proportional solenoid valve SP1 for the front cutting units and proportional solenoid valve SP2 for the rear cutting units. If ON appears next to these outputs on the InfoCenter Display:

- Test the hydraulic solenoid valve coils (see Hydraulic Solenoid Valve Coils in the Testing section of this chapter).
- Perform cutting unit hydraulic circuit tests (see Chapter 5 − Hydraulic System in this manual).

Fault Codes

The list below identifies the fault codes that are generated by the Toro Electronic Controller (TEC) to identify an electrical system fault (malfunction) that occurred during machine operation. Use the InfoCenter Display to view faults that have occurred since the faults were last cleared from the InfoCenter (see Faults Screen in this chapter).

Fault codes 13 through 24 identify problems with TEC inputs (e.g. switches and senders). For input problems, use the InfoCenter Display to check the different switch or sensor positions before testing the component (see Using the InfoCenter Display for Troubleshooting in this chapter).

Fault codes 26 through 56 identify problems with TEC or the outputs energized by the TEC (e.g. relays and solenoids). Output problems may involve issues with the output device or the portion of the wire harness used to support the device. Test the component (see Component Testing in this chapter), then test the wire harness (see Electrical Schematics and Wire Harness Drawings and Diagrams in Chapter 10 − Foldout Drawings in this manual).

Fault Code	Fault Description	Service Suggestions
1	Excessive engine coolant temperature − above 221F (105C) caused reels to disengage	Check radiator and screen for debris buildup Check engine cooling fan and drive belt operation Check engine coolant level
2	Excessive engine coolant temperature − above 239F (115C) for more than 20 seconds caused engine to stop	Check radiator and screen for debris buildup Check engine cooling fan and drive belt operation Check engine coolant level
3	One of the TEC output fuse is faulty	Check fuse F−A1, F−B1, or F−C1 (7.5 Amp)
4	Integrated Programming Environment (IPE) voltage is low indicating that TEC fuse or TEC is faulty	Check fuse F−D1 (2 Amp) Consider that TEC is faulty
5	Main power relay is faulty	Test main power relay and circuit wiring
6	Ignition switch was held in the START position for more than 30 seconds or the ignition switch is faulty	Cycle ignition switch Check fuel level in fuel tank Test ignition switch and circuit wiring Test fuel pump and circuit wiring Test fuel stop solenoid and circuit wiring
7	TEC software is incompatible	Contact Toro Distributor for reprogramming assistance
8	Charging system voltage is too high	Test engine alternator
9	Charging system voltage is too low	Check alternator drive belt Test engine alternator and circuit wiring
10	Engine has not been seen on CAN−bus for 10 seconds (Yanmar diesel engines)	
12	InfoCenter has not been seen on CAN−bus for 1 second	
13	Ignition switch is faulty	Test ignition switch and circuit wiring
14	Engine oil pressure low	Check engine oil level Test oil pressure switch and circuit wiring

Table 3: Fault Codes

Fault Code	Fault Description	Service Suggestions
15	Engine speed switch (Yanmar diesel engines) is faulty	Test engine speed switch and circuit wiring
16	Alternator voltage is too low	Check alternator drive belt Test engine alternator and circuit wiring
18	Hydraulic temperature sender is faulty	Test temperature sender and circuit wiring
19	Engine coolant temperature sender is faulty	Test temperature sender and circuit wiring
24	Joystick raise or lower switch is faulty	Test joystick raise or lower switches and circuit wiring
26	Engine START output has open or short to ground	Test engine ECU circuit wiring (Yanmar diesel engines) Test start relay (Kubota diesel engines)
27	Engine RUN output has open or short to ground	Test fuel pump and circuit wiring Test engine ECU circuit wiring (Yanmar diesel engines) Test fuel stop solenoid run coil (Kubota diesel engines)
28	HIGH/LOW (transport mow) solenoid valve has open or short to ground	Test HIGH/LOW (transport/mow) solenoid valve coil and circuit
35	Fan control manifold solenoid valve S1 (fan direction) has open or short to ground	Test control manifold solenoid valve S1 coil and circuit wiring
37	Glow relay (Kubota diesel engines) has open or short to ground	Test glow relay and circuit wiring
50	Mow control manifold proportional valve SP1 has open or short to ground	Test mow control manifold proportional valve SP1 coil and circuit wiring
51	Mow control manifold proportional valve SP2 has open or short to ground	Test mow control manifold proportional valve SP2 coil and circuit wiring
52	Fan control manifold proportional relief valve PRV (fan speed) has open or short to ground	Test fan control manifold proportional relief valve PRV coil (TS port) and circuit wiring
52	Lift control manifold solenoid valve S1 or S3 has open or short to ground	Test lift control manifold solenoid valve S1 or S3 coil and circuit wiring
54	Lift control manifold solenoid valve S2 has open or short to ground	Test lift control manifold solenoid valve S2 coil and circuit wiring
55	Lift control manifold solenoid valve S4 has open or short to ground	Test lift control manifold solenoid valve S4 coil and circuit wiring
56	Lift control manifold solenoid valve S5 has open or short to ground	Test lift control manifold solenoid valve S5 coil and circuit wiring

Table 3: Fault Codes (continued)

Starting Problems

NOTE: Check InfoCenter Display for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	Possible Causes
No electrical power to machine (including gauges).	Battery is discharged. Battery cables are loose or corroded. Ground connection on machine is loose or corroded. Fuse F−D1 (2 amp) is faulty (open). The ignition switch or circuit wiring is faulty.
Starter solenoid clicks, but starter will not crank. **NOTE:** If the solenoid clicks, the problem is **not** in the interlock circuit.	Battery is discharged. Battery cables are loose or corroded. Ground connection on machine is loose or corroded. Wiring at the starter is faulty. Starter solenoid is faulty. Starter is faulty.
Nothing happens when start attempt is made but Operator Advisory is displayed on InfoCenter (see Operator Advisory list in this section).	The traction pedal is not in neutral position. Operator seat is unoccupied OR the parking brake is not applied. The reel enable/disable switch is ENABLED. The joystick is in the raise or lower position The traction neutral switch or circuit wiring is faulty. Seat switch or circuit wiring is faulty. Parking brake switch or circuit wiring is faulty. Reel enable/disable switch or circuit wiring is faulty. Joystick switches or circuit wiring is faulty. Engine or fuel system is malfunctioning (see Engine Service Manual).
Nothing happens when start attempt is made. InfoCenter display operates with the ignition switch in the ON position. No Operator Advisory displayed on InfoCenter.	TEC fuses F−A1 (7.5 amp) protecting the fuel pump and start relay circuits is faulty. Ignition switch or circuit wiring is faulty. The fusible link harness at the engine starter motor is faulty. Start relay or circuit wiring is faulty. Starter solenoid or starter motor is faulty.

Starting Problems (continued)

Problem	Possible Causes
Engine starts, but stops when the ignition switch is released from the START position.	Kubota Diesel Engine Only − The engine fuel stop solenoid or circuit wiring is faulty (solenoid pull coil operates but hold coil is faulty).
Engine cranks, but does not start.	Fuel tank is empty. Engine is not cranking fast enough. Engine and/or fuel may be too cold. Glow relay, glow plugs or fusible link harness at the engine starter motor is faulty. Fuel pump is faulty. Kubota Diesel Engine Only − Fuse F5−1 (40 amp) is faulty (open). Kubota Diesel Engine Only − Engine fuel stop solenoid or circuit wiring is faulty. Engine or fuel system is malfunctioning (see Engine Service Manual).
Starter cranks, but should not when the traction pedal is depressed.	The traction neutral switch is out of adjustment. The traction neutral switch or circuit wiring is faulty.

General Run and Transport Problems

NOTE: Check InfoCenter Display for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	Possible Causes
Engine continues to run, but should not, when the ignition switch is turned to OFF.	Ignition switch or circuit wiring is faulty. Kubota Diesel engines Only − The engine fuel stop solenoid is stuck open. The engine or fuel system is malfunctioning (see Engine Service Manual).
Machine continues to run without an InfoCenter Advisory, but should not, when the traction pedal is depressed with no operator in the seat.	The seat switch or circuit wiring is faulty. Traction neutral switch or circuit wiring is faulty.
The engine stops during operation, but is able to restart. **NOTE:** Excessive engine coolant temperature will cause the cutting units to be disengaged and can lead to engine shutdown. If excessive coolant temperature causes engine shutdown, the operator can restart the engine to allow the machine to be moved a short distance. After a restart in this condition, the engine will run for approximately ten (10) seconds before the engine shuts down again.	The operator is lifting off the seat switch while mowing. The seat switch or circuit wiring is faulty. The ignition switch or circuit wiring is faulty. The engine coolant temperature is excessive − 240F (115.5C). Machine is being operated on a slope with a low fuel level. The engine or fuel system is malfunctioning (see Engine Service Manual).
The engine kills when the traction pedal is depressed without an InfoCenter Advisory.	The seat switch or circuit wiring is faulty. The parking brake switch or circuit wiring is faulty.
Battery does not charge.	Loose, corroded or broken wire(s) in charging circuit. The engine alternator belt is out of adjustment. The alternator is faulty. Battery is damaged.

Cutting Unit Operating Problems

NOTE: Check InfoCenter Display for possible operator advisories or faults whenever diagnosing machine electrical problems.

Problem	Possible Causes
Cutting units run, but should not, when raised. Cutting units shut off with the reel enable/disable switch.	The cutting unit position switch or circuit wiring is faulty. Wire harness connections are incorrectly connected to hydraulic solenoid valve coils on hydraulic mow control manifold. A hydraulic problem in the mow circuit exists (see Chapter 5 − Hydraulic System in this manual). TEC is faulty.
Cutting units run, but should not, when raised. Cutting units do not shut off with the reel enable/disable switch.	The cutting unit position switch or circuit wiring AND reel enable/disable switch or circuit wiring are faulty. A hydraulic problem in the mow circuit exists (see Chapter 5 − Hydraulic System in this manual).
Cutting units run, but should not, when lowered with reel enable/disable switch in the DISABLE position.	The reel enable/disable switch or circuit wiring is faulty.
Cutting unit(s) do not operate and an Operator Advisory is displayed on InfoCenter (see Operator Advisory list in this section).	The cutting units are not fully lowered. The operator seat is lifting off the seat. Mow speed limiter is not in LOW speed (mow) position.
Cutting unit(s) do not operate and no Operator Advisory is displayed on InfoCenter.	High temperature of engine coolant 220F (104.4C) has disabled the cutting units. TEC fuse F−B1 (7.5 amp) protecting the circuits for hydraulic valves SP1 and SP2 is faulty. The seat switch or circuit wiring is faulty. The reel enable/disable switch or circuit wiring is faulty. The cutting unit position switch or circuit wiring is faulty. The mow speed limiter switch or circuit wiring is faulty. Hydraulic valve solenoid(s) or circuit wiring to the mow control manifold SP1 or SP2 is faulty. A hydraulic problem in the mow circuit exists (see Chapter 5 − Hydraulic System in this manual). TEC is faulty.

Cutting Unit Lift/Lower Problems

NOTE: Check InfoCenter Display for possible operator advisories or faults whenever diagnosing machine electrical problems.

NOTE: To lower the cutting units, the operator must be in the operator seat and the speed limiter must be in the LOW speed (mow) position. To raise the cutting units, the operator must be in the operator seat.

Problem	Possible Causes
None of the cutting units will lower and Operator Advisory is displayed on InfoCenter (see Operator Advisory list in this section).	The speed limiter is in the HI speed (transport) position. Operator is not fully depressing the seat switch.
None of the cutting units will lower and no Operator Advisory is displayed on InfoCenter	TEC fuse F−C1 (7.5 amp) protecting the circuits for hydraulic valves S1 and S3 are faulty. The seat switch or circuit wiring is faulty. The speed limiter switch or circuit wiring is faulty. Hydraulic valve solenoid(s) or circuit wiring to the lift control manifold S1 or S3 is faulty. A problem in the lift/lower hydraulic circuit exists (see Chapter 5 - Hydraulic System in this manual). The TEC is faulty.
None of the cutting units will raise.	TEC fuse F−B1 and/or F−C1 (7.5 amp) protecting the circuits for hydraulic valves S1, S2 and S3 are faulty. The seat switch or circuit wiring is faulty. A problem in the lift/lower hydraulic circuit exists (see Chapter 5 - Hydraulic System in this manual). The TEC is faulty.
Front cutting units **will not** raise or lower, but rear cutting units **will** raise and lower.	Lift control manifold solenoid coils S4 or circuit wiring is faulty. A problem in the lift/lower hydraulic circuit exists (see Chapter 5 - Hydraulic System in this manual). TEC is faulty.
Rear cutting units **will not** raise or lower, but front cutting units **will** raise and lower.	Lift control manifold solenoid coils S5 or circuit wiring is faulty. A problem in the lift/lower hydraulic circuit exists (see Chapter 5 - Hydraulic System in this manual). TEC is faulty.

Electrical System Quick Checks

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 60º to 100ºF (16º to 38ºC). 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 to the negative battery post.

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

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

Charging System Test

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

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

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

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

Start the engine and run at high idle **(2850 RPM)**. Allow the battery to charge for at least three (3) minutes. Record the battery voltage.

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

An example of a charging system that is functioning:

At least 0.50 volt over initial battery voltage.	
Initial Battery Voltage	= 12.30 v
Battery Voltage after 3 Minute Charge	= 12.85 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 your Reelmaster glow plug system. The test should be run anytime hard starting (cold engine) is encountered on a diesel engine equipped with a glow plug system.

Use a digital multimeter and/or inductive Ammeter (AC/DC Current Transducer). Properly connect the ammeter to the digital multimeter (refer to manufacturers' instructions) and set the multimeter to the correct scale. With the ignition switch in the OFF position, place the ammeter pickup around the main glow plug power supply wire and read the meter prior to activating the glow plug system. Adjust the meter to read zero (if applicable). Activate the glow plug system by turning the ignition switch to ON and record the multimeter results.

The Reelmaster glow plug system should have a reading of approximately nine (9) amps per glow plug (36 amps total). If low current reading is observed, one (or more) of the glow plugs is faulty.

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.

Interlock switch operation is described in the Traction Unit Operator's Manual. Your Reelmaster is equipped with an Toro Electronic Controller (TEC) which monitors interlock switch operation. Testing of individual interlock switches is included in the Component Testing section of this Chapter.

NOTE: Use the InfoCenter Display (see InfoCenter Display in this chapter) to test Toro Electronic Controller inputs and outputs before further troubleshooting of an electrical problem on your Groundsmaster.

HI/LOW (transport/mow) Switch

The HI/LOW switch is a normally open proximity switch mounted to a bracket under the footrest platform (Fig. 26). When the speed limiter is moved to the HIGH (transport) position, a tab on the speed limiter swings in front of the switch, closing the switch. The HILOW switch provides an input for the Toro Electronic Controller (TEC) during various machine operation modes.

Adjustment

1. The gap between the HI/LOW switch and the mow speed limiter should be from **0.040” to 0.100” (1.1 to 2.5 mm)**.

2. If gap is incorrect, loosen jam nuts that secure switch to footrest platform. Position switch with jam nuts to allow correct gap between switch and mow speed limiter. Tighten jam nuts to secure adjustment. Jam nuts should be torqued from **13 to 17 ft−lb (17.6 to 23.0 N−m)**. After jam nuts are tightened, make sure that clearance between end of HI/LOW switch and the mow speed limiter has not changed.

3. Check for proper HI/LOW switch operation after adjustment (see HI/LOW switch testing in this chapter).

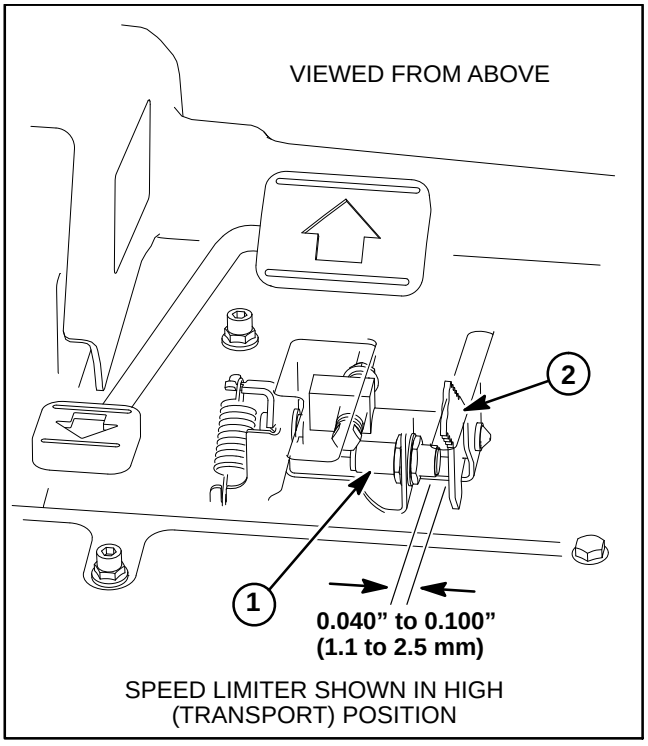


Figure 26

1. **HI/LOW switch**
2. **Speed limiter**

Cutting Unit Position Switch

The cutting unit position switch is a normally open proximity switch that is located on the front carrier frame (Fig. 27). When a gusset on the front right cutting unit (#5) lift arm passes in front of the switch, the switch closes. The cutting unit position switch provides an input for the Toro Electronic Controller (TEC) during various machine operation modes.

Adjustment

The gap between the cutting unit position switch and the lift arm gusset should be **0.063” (1.6 mm)**. If distance is incorrect, loosen jam nuts that secure position switch to bracket. Adjust switch location with jam nuts to allow correct gap between switch and lift arm gusset. Jam nuts should be torqued from **13 to 17 ft−lb (17.6 to 23.0 N−m)**. After jam nuts are tightened, make sure that gap has not changed.

The vertical location of the cutting unit position switch on the switch bracket will determine the height of the cutting unit turn−around position. Raising the switch on the bracket will allow a higher cutting unit turn−around position. Lowering the switch on the bracket will allow a lower cutting unit turn−around position. Loosen the cap screws (item 3) and adjust the switch bracket as necessary.

4. Check for proper cutting unit position switch operation after adjustment (see cutting unit position switch testing in this chapter).

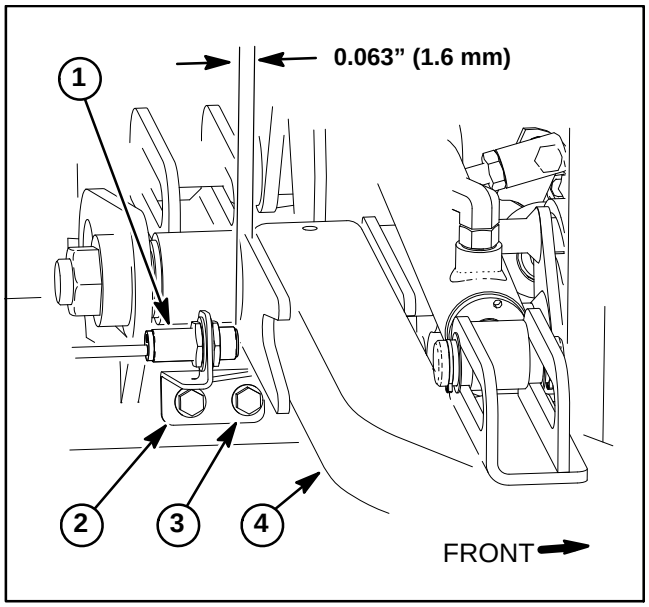


Figure 27

1. **Position switch**
2. **Switch bracket**
3. **Cap screw (2)**
4. **#5 Lift arm**

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 checking continuity on the switch terminals).

NOTE: For engine component testing information, see the Yanmar Model 4TNV86CT−DTR Service Manual or Troubleshooting Manual, or the Kubota Model 03−M−DI−E3B Workshop Manual.

CAUTION

When testing electrical components for continuity with a multimeter (ohms setting), make sure that power to the circuit has been disconnected.

Fusible Link Harness

Your Groundsmaster uses two (2) fusible links for circuit protection. These fusible links are located in a harness that connects the starter B+ terminal to the wire harness (Fig. 28). If either of these links should fail, current to the protected circuits will cease. Refer to wire harness drawings in Chapter 9 − Foldout Drawings for additional fusible link information.

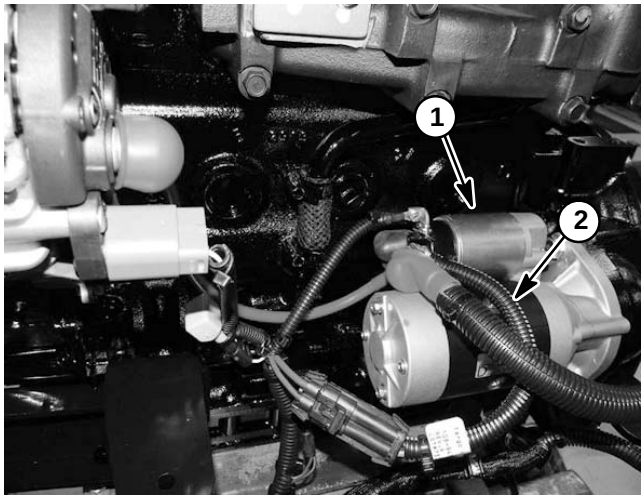


Figure 28

1. **Starter motor**
2. **Fusible link harness**

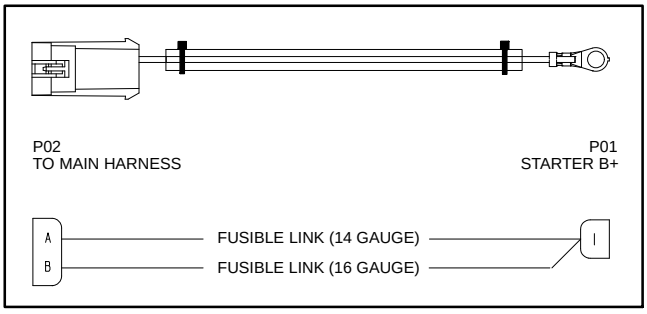


Figure 29

Testing

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

2. Disconnect negative battery cable from battery terminal and then disconnect positive cable from battery (see Battery Service in the Service and Repairs section of this chapter).

3. Locate and unplug fusible link connector from machine wire harness.

4. Use a multimeter to make sure that continuity exists between the fusible link terminals.

5. If either fusible link is open, replace the fusible link harness.

NOTE: It is not recommended to replace individual fusible link conductors of the fusible link harness. If any of the harness links are open (failed), replace the entire fusible link harness.

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

Fuses

Your Reelmaster 7000−D uses numerous fuses for circuit protection. Most of the fuses reside in the power center behind the operator's seat. An additional in−line fuse holder located in the wire harness near the battery holds fuse M1. On machines with Kubota diesel engines, an additional in−line fuse holder located in the wire harness near the engine starter motor holds fuse F5−1.

Fuse Identification and Function (Fig. 30)

Fuse F−A1 (7.5 amp) protects TEC output power supply for engine start/start relay, engine run/fuel stop solenoid hold coil, fuel pump, cooling fan directional solenoid (S1), and front cutting unit solenoid (S4).

Fuse F−A2 (7.5 amp) is not used on Reelmaster 7000−D machines.

Fuse F−A3 (10 amp) protects the power supply to the hourmeter connector (not used), cutting unit position switch, and HI/LOW (transport/mow) switch.

Fuse F−A4 (10 amp) protects the power supply to the worklight circuit.

Fuse F−B1 (7.5 amp) protects TEC output power supply for the two (2) cutting unit solenoids (SP1 and SP2), the cooling fan speed solenoid (TS), rear cutting unit solenoid (S5), and the cutting unit raise or lower solenoid (S2).

Fuse F−B2 (7.5 amp) is not used on Reelmaster 7000−D machines.

Fuse F−B3 (2 amp) protects the power supply to the InfoCenter display.

Fuse F−B4 (10 amp) protects the power supply to the operator air ride seat circuit.

Fuse F−C1 (7.5 amp) protects TEC output power supply for the glow plugs/glow relay, cutting unit raise and lower solenoids (S1 and S3), and the HI/LOW range solenoid.

Fuse F−C2 (7.5 amp) is not used on Reelmaster 7000−D machines.

Fuse F−C3 (10 amp) protects the power supply to the power point.

Fuse F−C4 position available for optional kit.

Fuse F−D1 (2 amp) protects the logic power circuit for the TEC and the ignition switch.

Fuse F−D2 (2 amp) is not used on Reelmaster 7000−D machines.

Fuse F−D3 (10 amp) protects the power supply to the engine control unit (ECU) on machines with Yanmar engines. The fuse is not used on machines with Kubota engines.

Fuse F−D4 position available for optional kit.

Maxi−fuse M1 (60A) supplies power to the optional operator cab.

Fuse F5−1 (in−line 40 amp) protects power supply for the fuel stop solenoid pull coil on machines with Kubota diesel engines.

Fuse Testing

1. Make sure that ignition switch is OFF and key is removed from switch.

2. Open power center cover from operator platform to access fuses.

3. Remove fuse from fuse block for testing. Fuse should have continuity across the terminals. Replace fuse if necessary.

4. Install fuse into fuse block.

5. Close and secure power center cover.

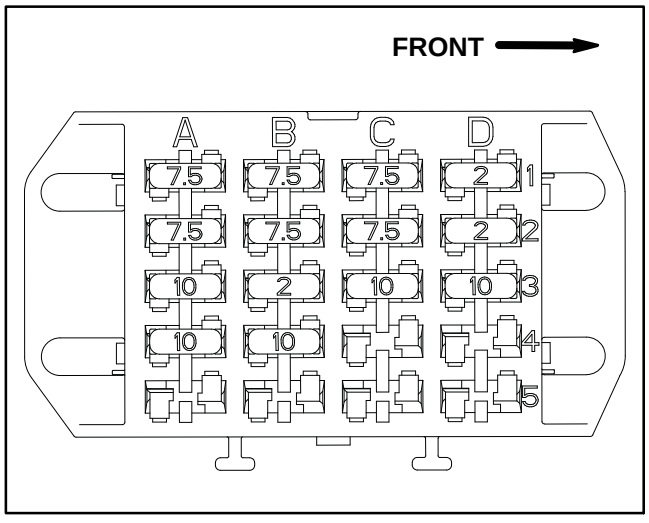


Figure 30

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Toro Electronic Controllers (TEC)

Reelmaster 7000−D machines use a Toro Electronic Controller (TEC) to control electrical system operation. The controller contains a microcontroller that monitors the condition of various switches and senders (inputs). The controller then directs electrical power to control appropriate machine functions (outputs) based on the input conditions. The controller is attached to a bracket under the operator seat (Fig. 31).

Logic power is provided to the controllers as long as the battery cables are connected to the battery. A 2 amp fuse (F−D1) provides circuit protection for the logic power to the controller.

The electrical power for controller outputs is provided through three (3) connector terminals (PWR 2, PWR 3 and PWR 4). Three (3) 7.5 amp fuses (F−A1, F−B1, and F−C1) provide circuit protection for the controller outputs.

The TEC monitors the states of the following components as inputs:

Input Number	Description
IN 1	Parking Brake Switch OFF
IN 2	Cutting Unit Position Switch
IN 3	Neutral Switch
IN 4	Seat Switch
IN 5	HIGH/LOW (transport/mow) Switch
IN 6	Joystick Raise Switch
IN 7	Joystick Lower Switch
IN 8	Reel Enable/Disable Switch
IN 9	Engine Speed Switch − Increase (Yanmar diesel engines) − OR − Engine Oil Pressure (Kubota diesel engines)
IN 10	Front Backlap
IN 11	Rear Backlap
IN 12	Engine Speed Switch − Decrease (Yanmar diesel engines) − OR − Alternator (Kubota diesel engines)
ANALOG IN 5	Hydraulic Oil Temperature Sender
ANALOG IN 6	Engine Temperature Sender (Kubota diesel engines)

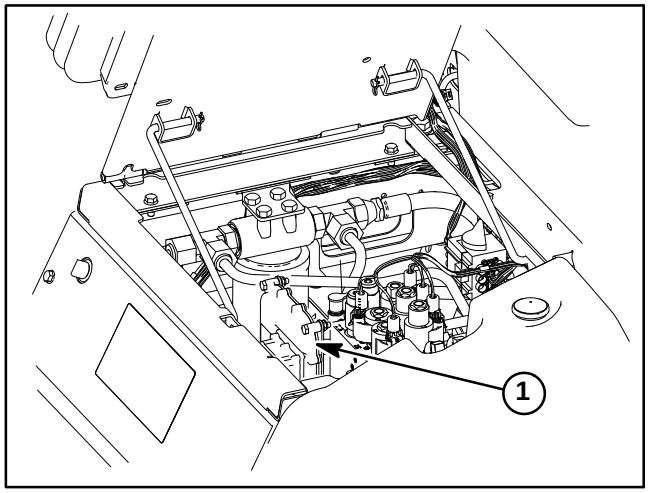


Figure 31

1. **Toro Electronic Controller**

The TEC controls electrical output to the following outputs:

Output Number	Description
OUT 1	Engine ECU (Yanmar engine) − OR − Start Relay (Kubota engine)
OUT 2	Fuel Pump and Engine ECU (Yanmar engine) − OR − Fuel Stop Solenoid Hold Coil (Kubota engine)
OUT 3	Fan Direction Solenoid Valve (S1)
OUT 4	Front Cutting Units Lift and Lower Solenoid Valve (S4)
OUT 5	Front Cutting Units Engage Proportional Valve (SP1)
OUT 6	Rear Cutting Units Engage Proportional Valve (SP2)
OUT 7	Fan Speed Proportional Valve (PRV)
OUT 8	Not Used
OUT 9	Rear Cutting Units Lift and Lower Solenoid Valve (S5)
OUT 10	Cutting Units Lift or Lower (direction) Solenoid Valve (S2)
OUT 11	Glow Relay (Kubota diesel engines)
OUT 12	Not Used
OUT 13	Cutting Units Lift and Lower (enable) Solenoid Valves (S1 and S3)
OUT 14	HIGH/LOW (transport/mow) Range Solenoid Valve

The InfoCenter display should be used to check inputs and outputs of the TEC (see Using the InfoCenter Display to Test TEC Inputs and Outputs in this chapter).

A fifty (50) pin wire harness connector attaches to the controller. The connection terminal functions for the TEC and the wire harness connector pins are identified in in Figure 33.The layout of the wire harness connectors that plug into the TEC is shown in Figure 34.

IMPORTANT: When testing for wire harness continuity at the connector for the TEC, take care to not damage the connector pins with multimeter test leads. If connector pins are enlarged or damaged during testing, connector repair may be necessary for proper machine operation.

The machine electrical schematic and wire harness drawings in Chapter 10 – Foldout Drawings can be used to identify possible circuit problems between the controller and the input or output devices (e.g. switches and solenoid coils).

Because of the solid state circuitry built into the TEC, there is no method to test the controller directly. A controller may be damaged if an attempt is made to test it with an electrical test device (e.g. digital multimeter or test light).

NOTE: The TEC used on the Reelmaster 7000-D is programed for correct machine operation. If the TEC is replaced for any reason, system software needs to be reprogrammed by your Toro Distributor.

IMPORTANT: Before performing welding on the machine, disconnect both positive and negative battery cables from the battery, disconnect the wire harness connector from the TEC and disconnect the terminal connector from the alternator. Also, disconnect and remove the engine ECU (Yanmar diesel engines) before welding. These steps will prevent damage to the machine electrical system when welding.

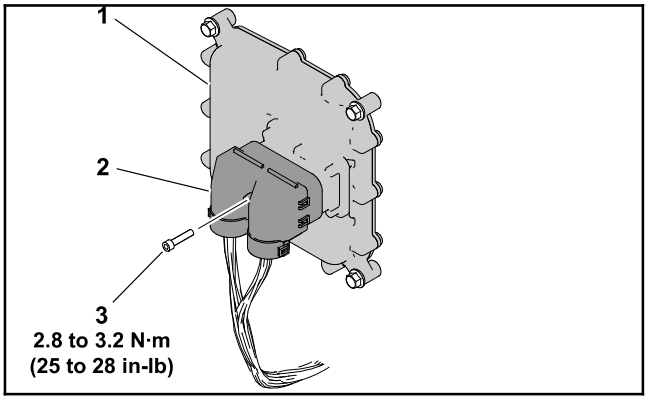


Figure 32

1. **TEC controller**
2. **Machine harness connector**
3. **Socket head screw**

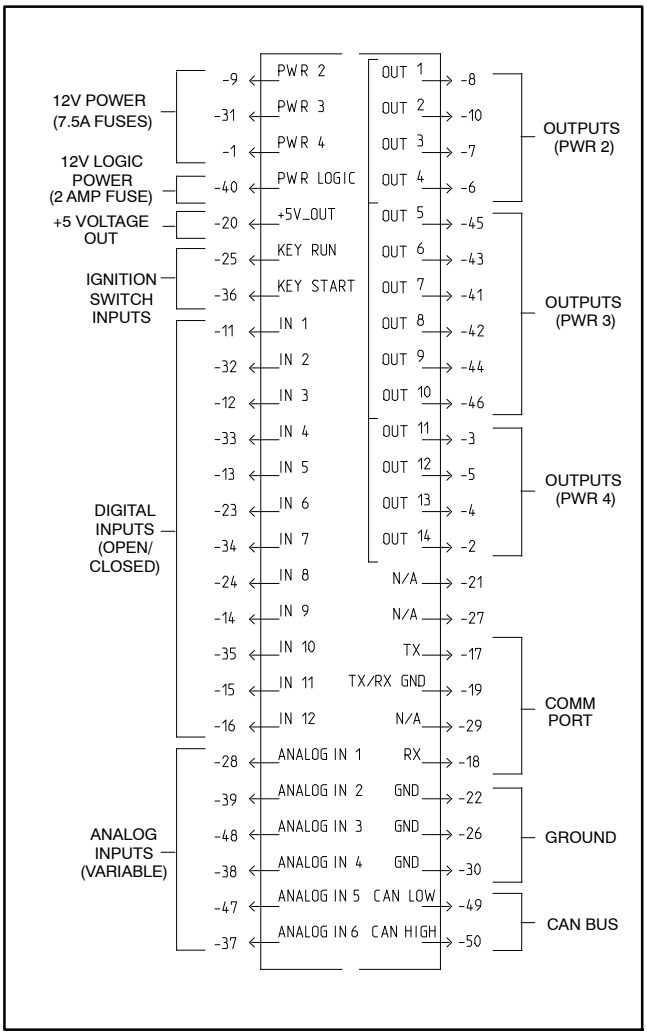


Figure 33

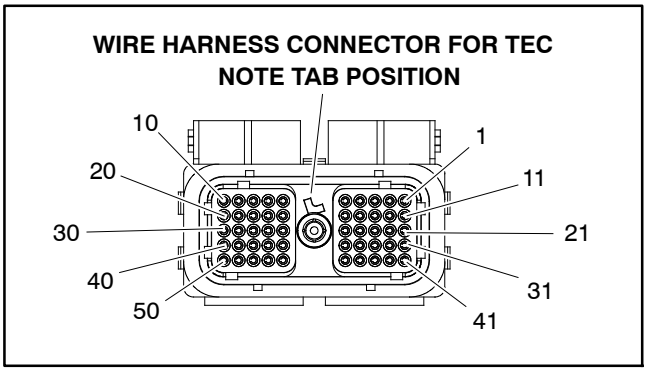


Figure 34

If the wire harness connector is removed from the TEC controller for any reason, tighten the harness connector screw from **25 to 28 in-lb (2.8 to 3.2 N·m)**.

Ignition Switch

The ignition switch on the console arm has three (3) positions − OFF, ON and START (Fig. 34).The ignition switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The ignition switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Disassemble console arm to gain access to ignition switch (see Console Arm Disassembly in Chapter 8 − Chassis in this manual).

3. Disconnect wire harness electrical connector from the ignition switch.

4. The ignition switch terminals are identified as shown in Figure 35. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

5. Replace switch if testing identifies that switch is faulty.

6. If ignition switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

7. After testing is completed, connect the wire harness connector to the ignition switch.

8. Assemble console arm (see Console Arm in Chapter 8 − Chassis in this manual).

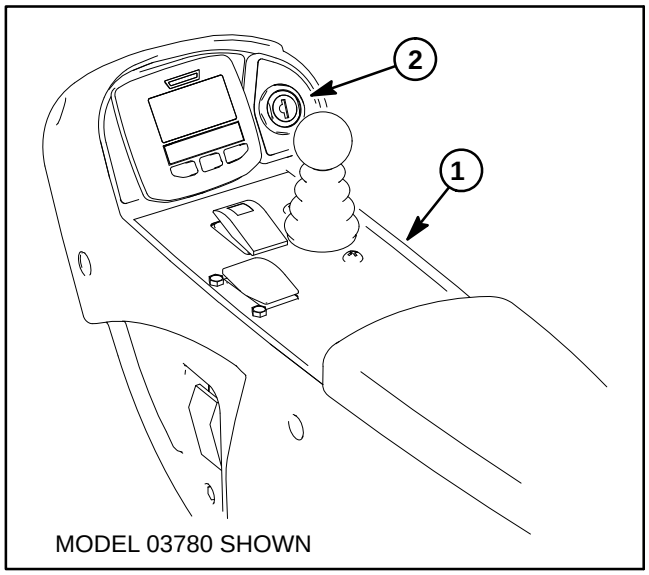


Figure 34

1. Console arm **2. Ignition switch**

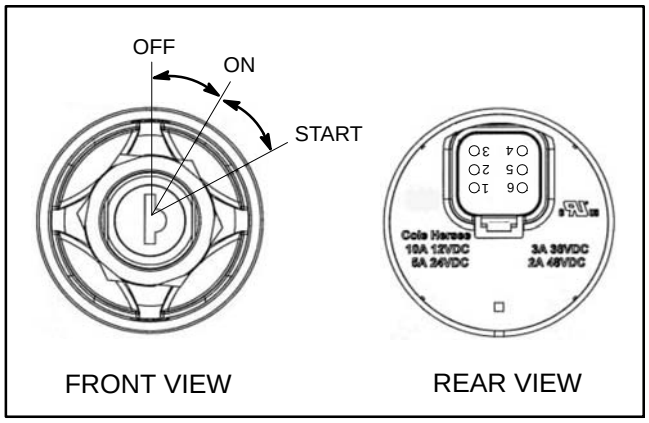


Figure 35

SWITCH POSITION	CIRCUITS
OFF	1 + 6, 4 + 5
ON	1 + 3 + 4 + 5 + 6
START	1 + 2 + 4 + 5 + 6

Reel Enable/Disable Switch

The reel enable/disable switch is located on the console arm (Fig. 36). The reel enable/disable switch is an illuminated three (3) position rocker style switch. Push down on the front of the switch to engage the cutting units (switch light illuminated) and push down on the rear of the switch to disengage the cutting units. The reel enable/disable switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

NOTE: To engage the cutting units, the seat has to be occupied, the speed limiter has to be in LOW (mow) speed, and the cutting units have to be fully lowered.

Testing

The reel enable/disable switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Disassemble console arm to gain access to the reel enable/disable switch (see Console Arm in Chapter 8 − Chassis in this manual).

3. Disconnect harness electrical connector from the reel enable/disable switch.

4. The switch terminals are marked as shown in Figure 37. With the use of a multimeter (ohms setting), the switch functions can be tested to determine whether continuity exists between the various terminals for each switch position. Verify continuity between switch terminals.

5. Replace switch if testing identifies that switch is faulty.

6. If reel enable/disable switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

7. After testing is completed, connect the wire harness connector to the reel enable/disable switch.

8. Assemble console arm (see Console Arm in Chapter 8 − Chassis of this manual).

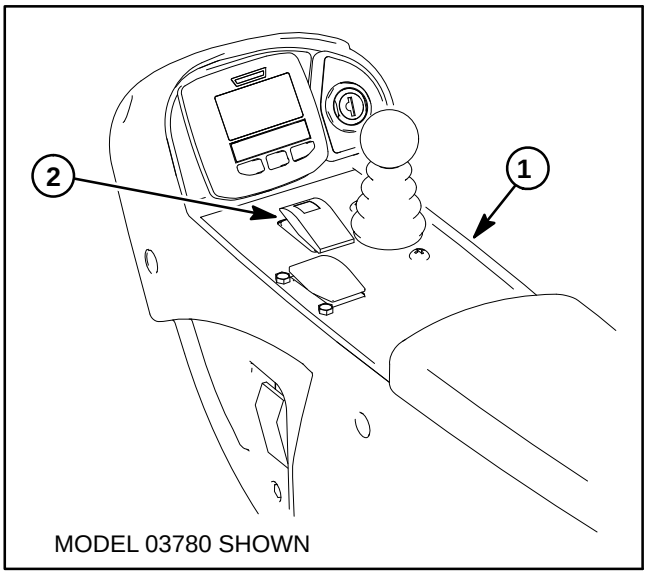


Figure 36

1. **Console arm**
2. **Reel enable/disable switch**

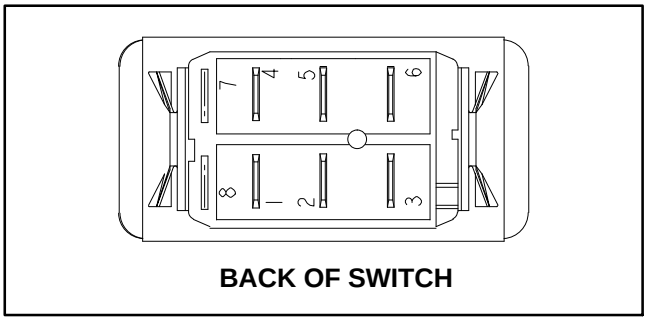


Figure 37

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
FRONT OF SWITCH PRESSED	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
REAR OF SWITCH PRESSED	2 + 1 5 + 4	2 + 3 5 + 6

Engine Speed Switch (Yanmar Diesel Engine Only)

The engine speed switch is located on the console arm (Fig. 38). The engine speed switch is used as an input for the engine control unit (ECU) to raise or lower the engine speed. By momentarily tapping the switch, the engine speed can be increased or decreased in 100 rpm increments. By holding the switch down the engine RPM will automatically increase or decrease to the set High or Low idle speed, depending on which end of the switch is depressed. The current engine RPM will be displayed on the InfoCenter screen for five seconds when the engine speed switch is depressed.

The engine speed switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The engine speed switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Remove console arm covers to gain access to engine speed switch (see Console Arm in Chapter 8 − Chassis).

3. Disconnect wire harness electrical connector from the engine speed switch.

4. The switch terminals are marked as shown in Figure 39. 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.

5. Replace switch if testing identifies a faulty switch.

6. If switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

7. After testing is completed, connect wire harness connector to the switch.

8. Assemble console arm (see Console Arm in Chapter 8 − Chassis in this manual).

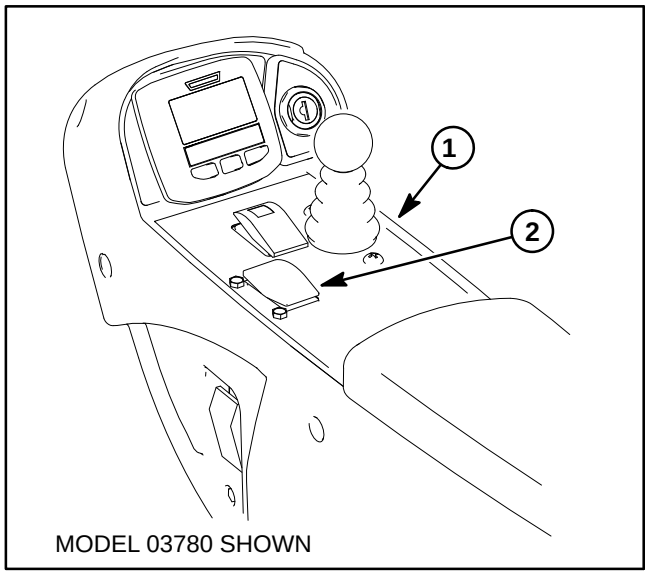


Figure 38

1. **Console arm**
2. **Reel enable/disable switch**

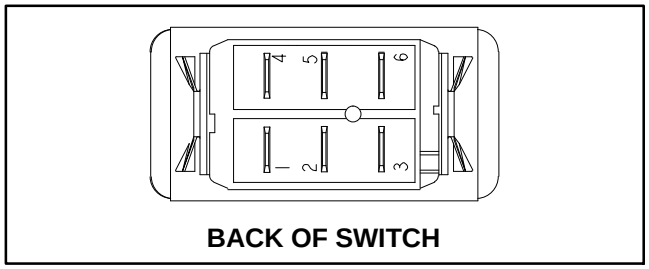


Figure 39

SWITCH POSITION	CLOSED CIRCUITS	OPEN CIRCUITS
FRONT OF SWITCH PRESSED	2 + 3 5 + 6	2 + 1 5 + 4
NEUTRAL	NONE	ALL
REAR OF SWITCH PRESSED	2 + 1 5 + 4	2 + 3 5 + 6

NOTE: Switch terminals 4, 5 and 6 are not used on Reelmaster 7000−D machines.

Lower/Raise Joystick Switches

The cutting unit lower and raise switches are located on the joystick assembly that is located on the console arm Fig. 40). When the joystick is pushed forward, the rear switch is used to lower the cutting units. When the joystick is pulled backward, and the front switch is used to raise the cutting units (Fig. 41). The switches are identical.

The Toro Electronic Controller (TEC) monitors the position of the normally open lower/raise switches. The lower/raise joystick switches are inputs used by the TEC to manage various machine functions.

Testing

The joystick switches and their circuit wiring can be tested as a TEC inputs using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Remove control arm covers to gain access to joystick switches (see Console Arm in Chapter 8 − Chassis in this manual).

3. Disconnect wire harness connectors from raise and lower switches on joystick assembly.

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

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

   B. With the joystick in the raise position (raise switch) or lower position (lower switch) continuity should only exist between the common and Normally Open (NO) terminals.

5. If either joystick switch is faulty, replace switch.

6. If the joystick switch tests correctly and a circuit problem still exists, check wire harness (see Wiring Schematic and Circuit Drawings in Chapter 10 − Foldout Drawings in this manual).

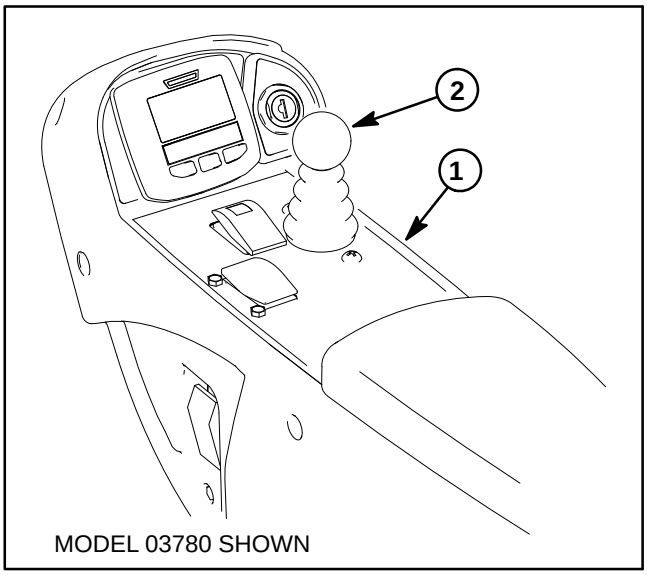


Figure 40

1. **Console arm**
2. **Joystick**

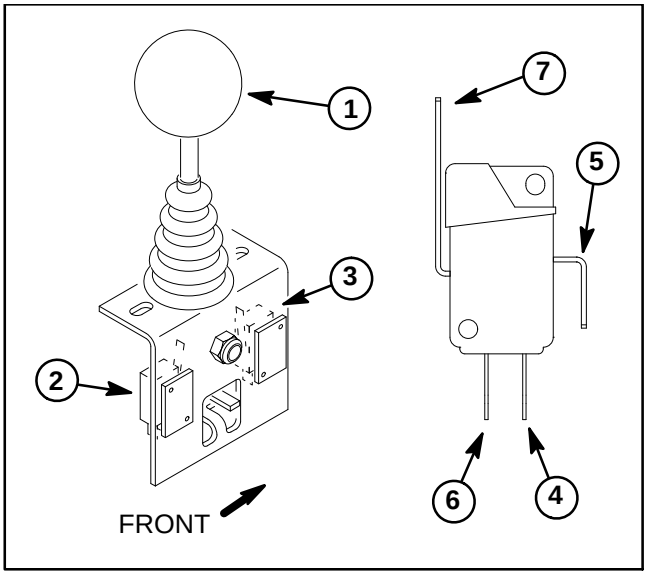


Figure 41

1. **Joystick**
2. **Lower switch**
3. **Raise switch**
4. **Normally Open (NO) terminal**
5. **Common terminal**
6. **Normally Closed terminal (not used)**
7. **Switch lever**

7. After testing is completed, connect wire harness connectors to the joystick switches.

8. Assemble console arm (see Console Arm in Chapter 8 − Chassis in this manual).

Seat Switch

The seat switch is normally open and closes when the operator is on the seat. The seat switch and its electrical connector are located in the seat assembly. Testing of the switch can be done without seat removal by disconnecting the switch wire from the machine wire harness (Fig. 42). The seat switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

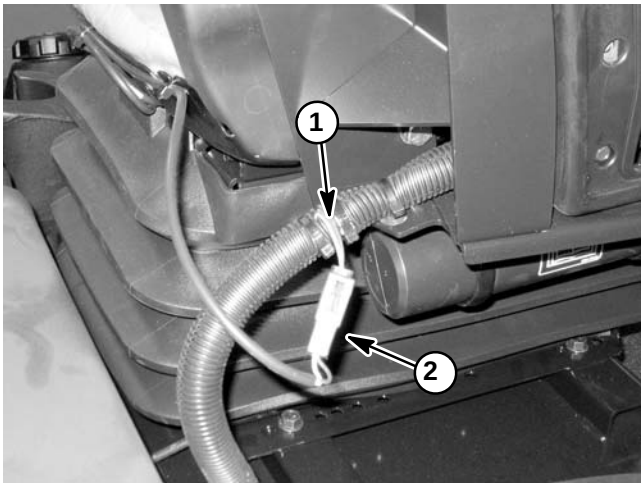


Figure 42

1. **Wire harness connector** 2. **Seat switch connector**

Testing

The seat switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Disconnect seat switch connector from the machine wire harness connector.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the seat switch connector terminals.

4. With no pressure on the seat, there should be no continuity between the seat switch terminals.

5. Press directly onto the seat switch through the seat cushion. There should be continuity as the seat cushion approaches the bottom of its travel.

6. If seat switch is faulty, replace switch.

7. If testing determines that seat switch is faulty, replace seat switch (see Operator Seat Service in Chapter 8 − Chassis in this manual).

8. Connect seat switch connector to wire harness connector after testing is complete.

Traction Neutral Switch

The traction neutral switch is closed when the traction pedal is in the neutral position and opens when the pedal is depressed in either direction. The switch is located on the right side of the piston (traction) pump (Fig. 43). The neutral switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

NOTE: Make sure that traction pedal is adjusted to the neutral position (see traction unit Operator's Manual) before testing the traction neutral switch.

The traction neutral switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Unlatch and raise hood to allow access to the piston (traction) pump. Locate the neutral switch and disconnect the harness electrical connector from the neutral switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

4. Move the traction pedal to the FORWARD or REVERSE position while watching the multimeter. Continuity should be broken as the switch opens.

5. Allow the traction pedal to return to the NEURTAL position while watching the multimeter. Continuity should be made as the switch closes.

6. If neutral switch is faulty, replace switch.

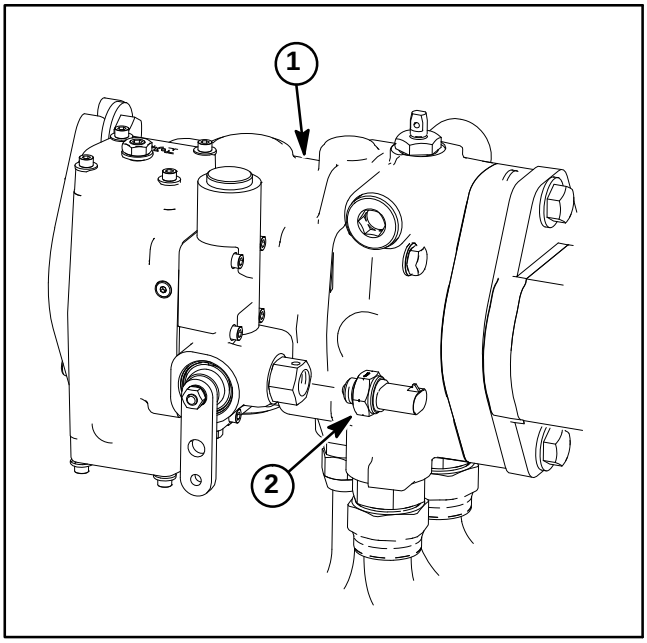


Figure 43

1. Piston (traction) pump **2. Neutral switch**

7. If the neutral switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

8. After testing is completed, connect harness electrical connector to the neutral switches. Lower and secure hood.

Parking Brake Switch

The parking brake switch is a normally open proximity switch. The parking brake switch is attached to the bottom of the RH brake pedal (Fig. 44).

When the parking brake is not applied, the parking brake detent is positioned near the target end of the parking brake switch so the switch is closed. The parking brake detent is moved away from the switch when the parking brake is applied causing the switch to open. The parking brake switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The parking brake switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Disconnect wire harness electrical connector from the parking brake switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the connector terminals.

4. When the parking brake is released (brake not applied), there should be continuity (closed) between the switch terminals.

5. When the parking brake pedal is depressed (brake applied), there should not be continuity (open) between the switch terminals.

6. Replace parking brake switch if testing determines that it is faulty.

NOTE: When installing the parking brake switch to the brake pedal, place switch plate tab into switch mounting hole that is closest to target end of switch (Fig. 44 and 45).

7. If the parking brake switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

8. After testing is completed, connect harness electrical connector to the parking brake switch.

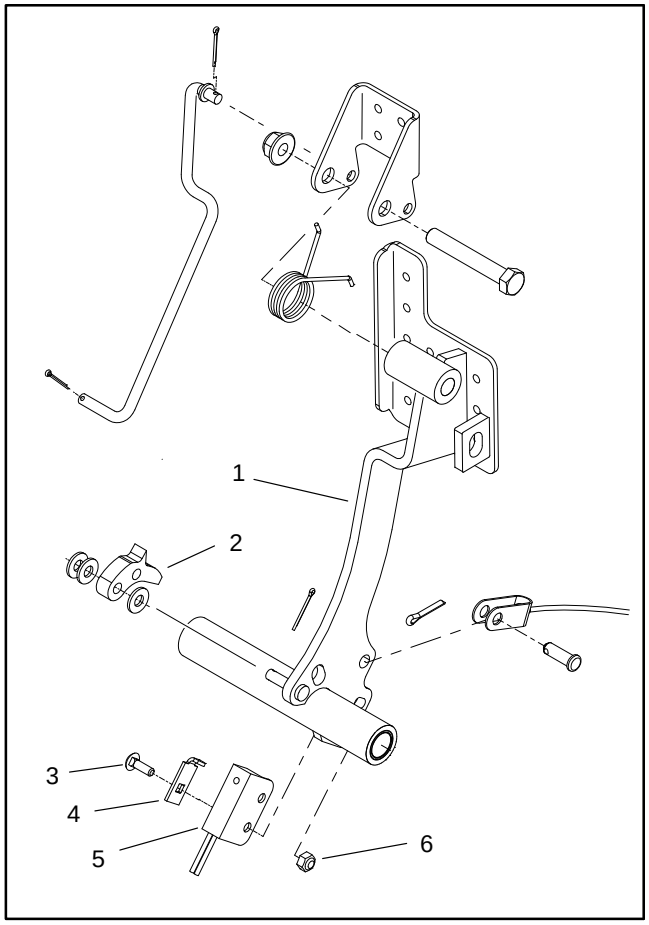


Figure 44

1. **RH brake pedal**
2. **Brake detent**
3. **Carriage screw**
4. **Switch plate**
5. **Parking brake switch**
6. **Lock nut**

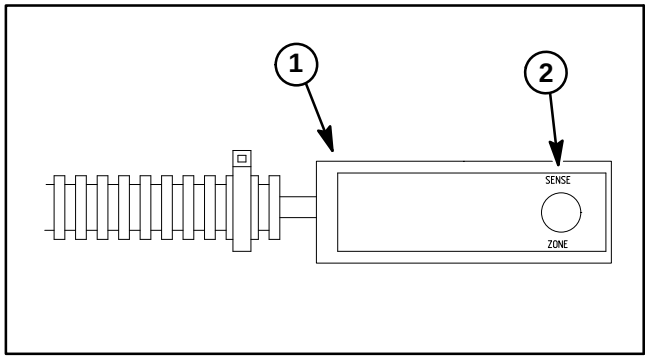


Figure 45

1. **Brake switch**
2. **Switch target area**

HI/LOW (Transport/Mow) Switch

The HI/LOW (transport/mow) switch is a normally open proximity switch that closes when the speed limiter is placed in the HI (transport) position. The switch mounts to a bracket on the footrest platform. The sensing plate for the HI/LOW (transport/mow) switch is the mow speed limiter. The HI/LOW (transport/mow) switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The HI/LOW (transport/mow) switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Turn ignition switch to the ON position (do not start engine) and check LED on the cable end of (transport/mow) switch (Fig. 46). The LED should be illuminated when the speed limiter is in the HIGH (transport) speed position. The LED should not be illuminated when the limiter is in the LOW (mow) position.

3. If the HI/LOW (transport/mow) switch LED did not function correctly:

   A. Make sure that the HIGH/LOW switch is properly adjusted (see HIGH/LOW (transport/mow) Switch in this chapter). If necessary, adjust switch and retest.

   B. Make sure ignition switch is OFF and disconnect the HI/LOW switch from machine wire harness.

   C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

4. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function as desired, replace HI/LOW switch. Adjust switch after installation (see HIGH/LOW (transport/mow) Switch in this chapter).

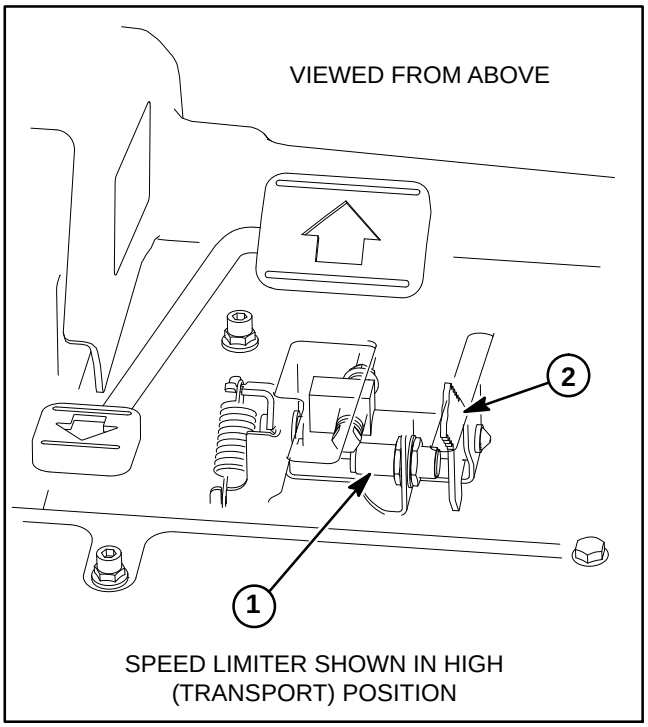


Figure 46

1. **HI/LOW switch**
2. **Speed limiter**

5. If the HI/LOW switch tests correctly and a circuit problem still exists, check yellow output wire continuity between HIGH/LOW switch connector and TEC connector (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

6. Make sure that HI/LOW switch is connected to wire harness when testing is complete.

Cutting Unit Position Switch

The cutting unit position switch is a normally open proximity switch that is located on the traction unit frame (Fig. 47). The sensing plate that closes the switch is a gusset on the front right cutting unit (#5) lift arm. When the cutting units are lowered, the gusset on the lift arm comes to rest in front of the position switch and the switch closes. The cutting unit position switch is an input used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The cutting unit position switch and its circuit wiring can be tested as a TEC input using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switch and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Turn ignition switch to ON position and check LED on cable end of cutting unit position switch (Fig. 47). The LED should be illuminated when the cutting units are fully lowered. The LED should not be illuminated when the cutting units are raised above the turn−around position.

3. If the cutting unit position switch LED did not function correctly:

   A. Make sure that the cutting unit position switch is properly adjusted (see Cutting Unit Position Switch in this chapter). If necessary, adjust switch and retest.

   B. Make sure ignition switch is OFF and disconnect the cutting unit position switch from machine wire harness.

   C. Verify that the machine wire harness connector terminal for black wire is closed (continuity) to ground.

   D. Turn ignition switch to the ON position (do not start engine) and verify with a multimeter that machine wire harness connector terminal for pink wire has system voltage (12 VDC) present.

4. If black wire is closed to ground, pink wire has system voltage present and switch LED did not function as desired, replace cutting unit position switch. Adjust switch after installation (see Cutting Unit Position Switch in this chapter).

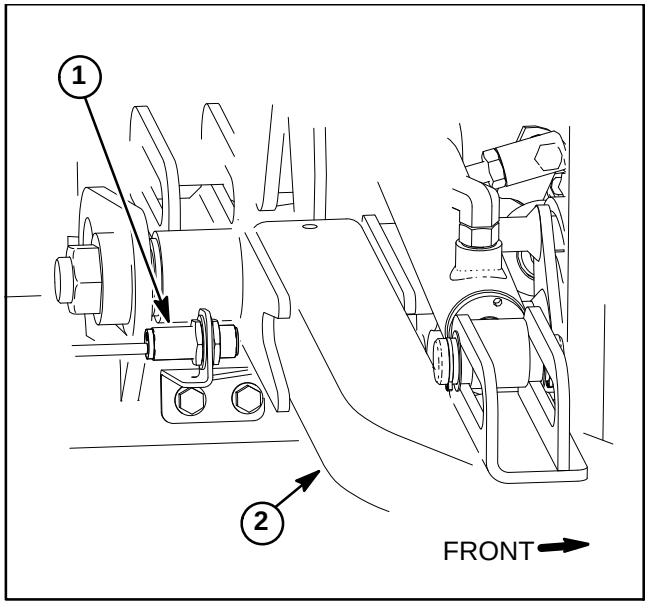


Figure 47

1. Position switch **2. Front right (#5) lift arm**

5. If the cutting unit position switch tests correctly and a circuit problem still exists, check green output wire continuity between cutting unit position switch connector and TEC connector (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

6. Make sure that cutting unit position switch is connected to wire harness when testing is complete.

Backlap Switches

The backlap switches are normally open ball switches that are in the normal, open state when the backlap levers are in the mow position. When a backlap lever is in the backlap position, the switch closes. The backlap switches are attached to the hydraulic mow control manifold located under the hood (Fig. 48). The backlap switches are inputs used by the Toro Electronic Controller (TEC) to manage various machine functions.

Testing

The backlap switches and their circuit wiring can be tested as TEC inputs using the InfoCenter Display (see InfoCenter Display in this chapter). If testing determines that the switches and circuit wiring are not functioning correctly, proceed with the following test procedure:

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

2. Unlatch and raise hood to allow access to hydraulic mow control manifold. Locate the backlap switches on the front of the manifold. Disconnect the harness electrical connector from the backlap switch.

3. Check the continuity of the switch by connecting a multimeter (ohms setting) across the switch connector terminals.

4. Turn the backlap lever to the backlap position while watching the multimeter. Continuity should be made as the switch closes.

5. Turn the backlap lever to the mow position while watching the multimeter. Continuity should be broken as the switch opens.

6. If backlap switch is faulty, replace switch (Fig. 49).

7. If the backlap switch tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

8. After testing is completed, connect harness electrical connector to the backlap switches. Lower and secure hood.

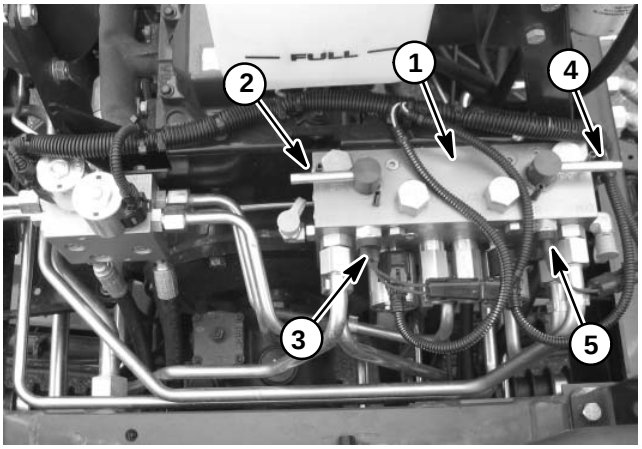


Figure 48

1. **Mow control manifold**
2. **Front backlap lever**
3. **Front backlap switch**
4. **Rear backlap lever**
5. **Rear backlap switch**

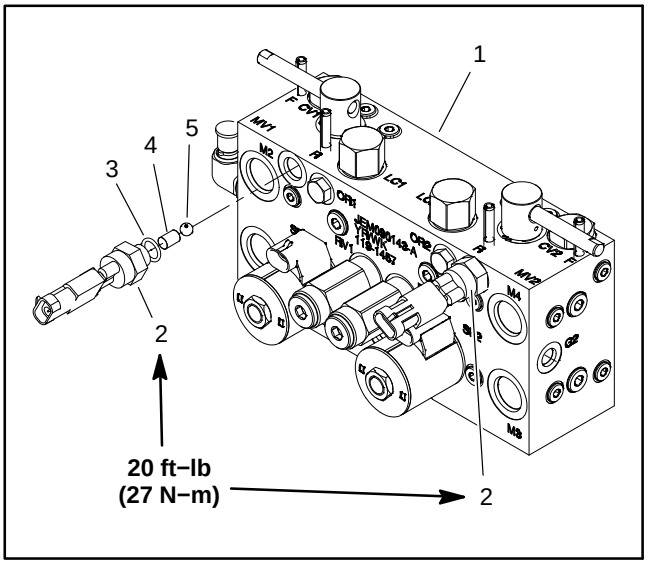


Figure 49

1. **Mow control manifold**
2. **Backlap switch (2 used)**
3. **O−ring**
4. **Dowel**
5. **Ball**

Hydraulic Oil Temperature Sender

A temperature sender is used as an input for the Toro Electronic Controller (TEC) to identify if the hydraulic oil temperature has reached an excessive level. The hydraulic oil temperature sender is attached to the rear axle motor (Fig. 50).

Testing

If the hydraulic oil temperature is not displayed on the InfoCenter during machine operation (see InfoCenter Display in this chapter), or if the temperature indicator remains stationary after starting the machine, proceed with the following test procedure:

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

2. Locate hydraulic oil temperature sender on bottom of rear axle motor. Disconnect wire harness connector from sender.

3. Thoroughly clean area around temperature sender and remove sender from rear axle motor.

4. Plug the port in the rear axle motor to prevent system contamination.

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

5. Put sensing end of sender in a container of oil with a thermometer and slowly heat the oil (Fig. 51).

NOTE: Prior to taking resistance readings with a digital multimeter, short the meter 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 tested component.

6. Check resistance of the sender with a multimeter (ohms setting) as the oil temperature increases.

A. The meter should indicate from 11.6 to 13.5 kilo ohms at 68F (20C).

B. The meter should indicate from 2.3 to 2.5 kilo ohms at 140F (60C).

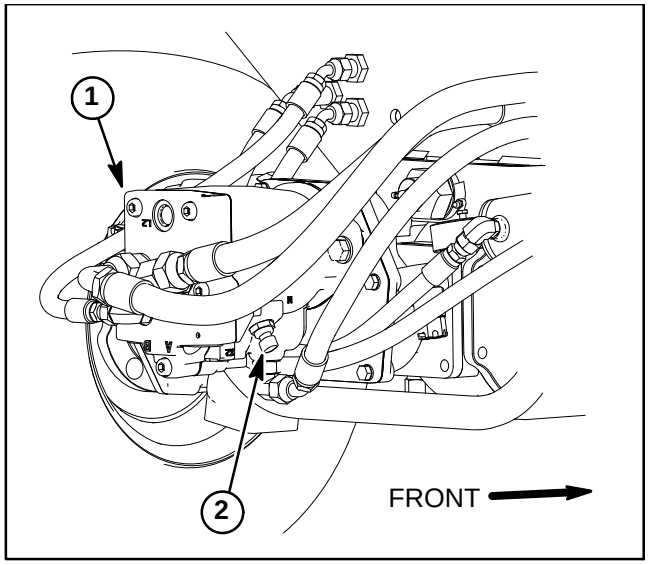


Figure 50

1. Rear axle motor
2. Oil temp sender

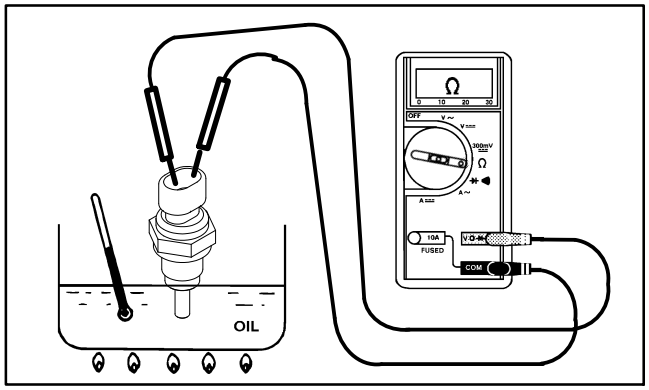


Figure 51

C. The meter should indicate from 605 to 669 ohms at 212F (100C).

D. Replace sender if specifications are not met.

7. After allowing the sender to cool, install new O−ring on sender, remove the plug from the rear axle motor, and thread sender into motor port. Torque sender from **9 to 11 ft−lb (12.3 to 14.9 N−m)**.

8. If the hydraulic oil temperature sender tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

9. After testing is completed, connect harness electrical connector to the hydraulic oil temperature sender.

10. Check and fill hydraulic system to proper level.

Engine Temperature Sender (Kubota Diesel Engine Only)

All Reelmaster 7000−D machines have an engine temperature sender. The sender is used as an input for the Toro Electronic Controller (TEC) to identify if the engine coolant temperature has reached an excessive level. For machines with Yanmar diesel engines, refer to the Yanmar Service Manual and the Yanmar Troubleshooting Manual for sender testing information.

For machines with Kubota diesel engines, the engine temperature sender is located near the alternator on the coolant flange attached to the engine cylinder head (Fig. 52).

Testing

If the engine coolant temperature is not displayed on the InfoCenter during machine operation (see InfoCenter Display in this chapter), or if the temperature indicator remains stationary after starting the machine, proceed with the following test procedure:

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

CAUTION

Make sure engine is cool before removing the temperature sender from engine.

2. Remove radiator cap. Lower coolant level below temperature sender by draining coolant into a suitable container using the radiator draincock.

CAUTION

Handle the hot oil with extreme care to prevent personal injury or fire.

3. Put sender in a container of oil or coolant with a thermometer and slowly heat the oil (Fig. 53).

NOTE: Prior to taking resistance readings with a digital multi meter, short the meter 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.

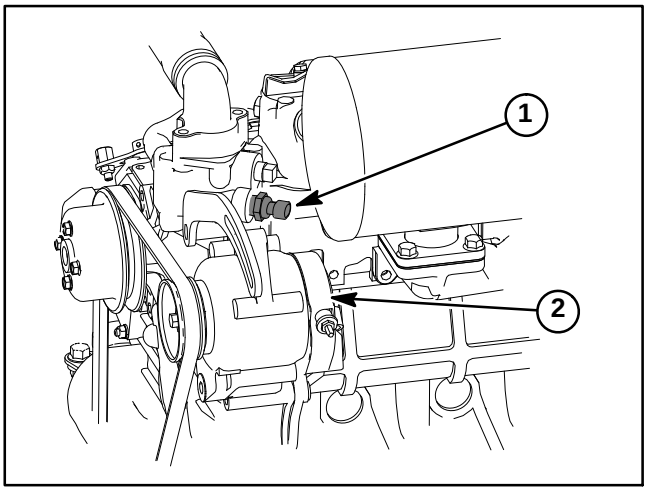


Figure 52

1. **Temperature sender** 2. **Alternator**

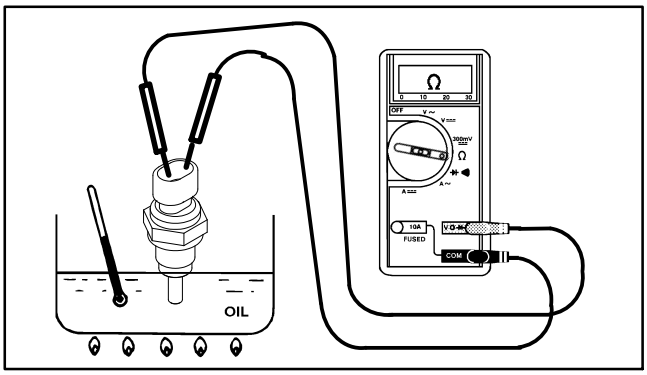


Figure 53

4. Check resistance of the sender with a multimeter (ohms setting) as the temperature increases. Replace sender if specifications are not met.

OIL TEMP	TEMP SENDER RESISTANCE
68F (20C)	11.4 to 13.6K ohms
140F (60C)	2.3 to 2.7K ohms
212F (100C)	640 to 720 ohms

5. Clean threads of coolant flange thoroughly. Allow sender to cool and clean threads of sender thoroughly. Apply thread sealant to the threads of the sender.

6. Screw sender into the coolant flange and tighten from **16 to 20 ft−lb (22 to 27 N−m)**.

7. If the engine temperature sender tests correctly and a circuit problem still exists, check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

8. After testing is completed, connect harness electrical connector to the engine temperature sender.

9. Fill engine cooling system.

Relays with Four (4) Terminals

Your Reelmaster 7000−D uses a number of electrical relays that have four (4) terminals. A tag near the wire harness relay connector can be used to identify each relay.

The main power relay is used to provide current to most of the fuse protected circuits (operator seat, InfoCenter display, engine electronic control unit (ECU), power point and optional electric equipment). The main power relay is energized when the ignition switch is in the ON or START position. The main power relay is located in the power center compartment of the battery box (Fig. 54).

If the machine is equipped with an operator cab, the cab power relay provides current to the operator cab electrical components. The cab power relay is energized when the ignition switch is in the ON or START position. The cab power relay is located in the power center compartment of the battery box (Fig. 54).

The glow relay is used to provide current to the engine glow plugs. The glow relay is energized and monitored by either the engine ECU (Yanmar diesel engines) or the TEC (Kubota diesel engines). The glow relay is located on the air cleaner mounting bracket (Fig. 55 and 56).

On machines with Yanmar diesel engines, the start relay is a four (4) terminal relay. The start relay is used to provide current to the engine starter motor solenoid. The start relay is energized and monitored by the engine ECU. The start relay is located on the air cleaner mounting bracket (Fig. 55).

Testing

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

2. To make sure that machine operation does not occur unexpectedly, disconnect negative (−) cable from battery and then disconnect positive (+) cable from battery (see Battery Service in this chapter).

3. Locate relay that is to be tested.

4. Disconnect wire harness connector from relay. Remove relay from mounting bracket for testing.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter 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.

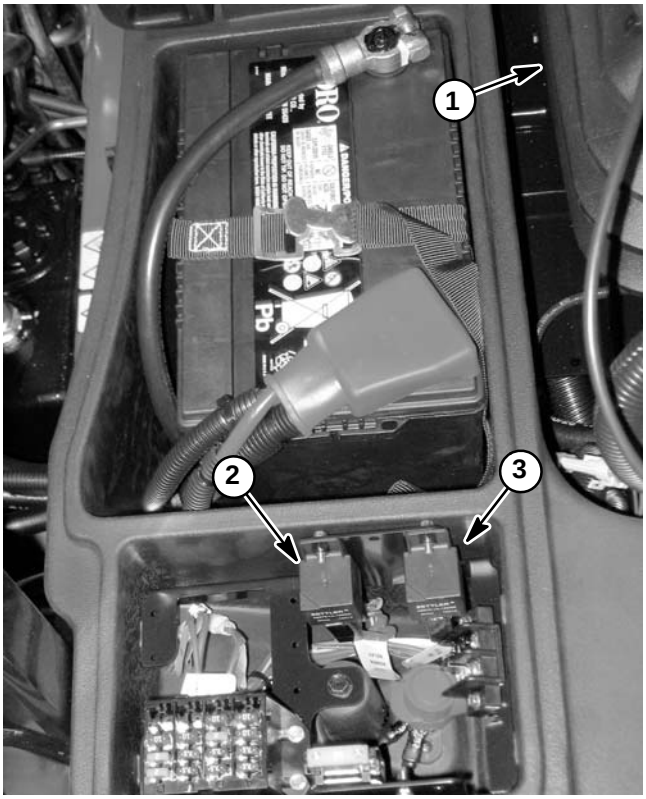


Figure 54

1. **Operator seat**
2. **Main power relay**
3. **Cab power relay**

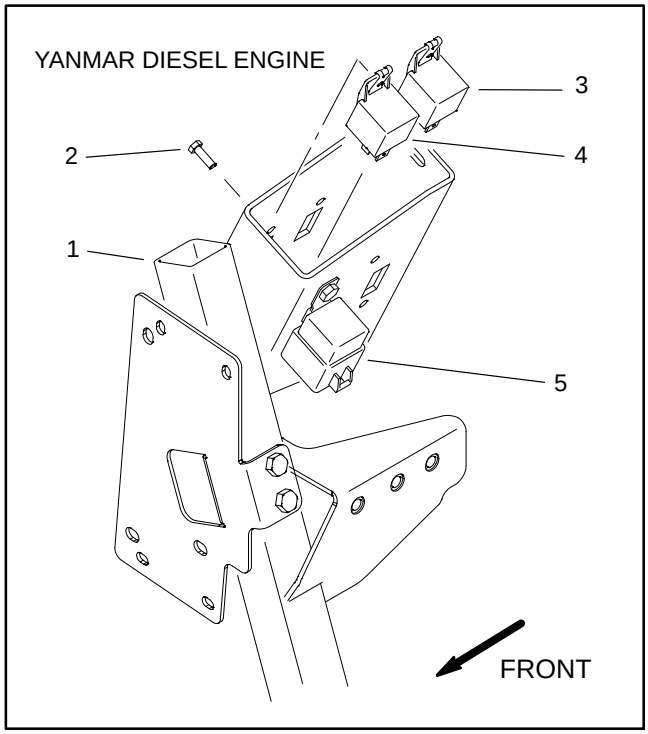


Figure 55

1. **Air cleaner mount**
2. **Screw (3)**
3. **Start relay (4 terminal)**
4. **Glow relay (4 terminal)**
5. **EGR relay (5 terminal)**

5. Using a multimeter, verify that coil resistance between terminals 86 and 85 is approximately 72 ohms (Fig. 57).

6. 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 (Fig. 57).

7. Disconnect voltage and test leads from the relay terminals.

8. If testing determines that the relay is not functioning correctly, replace the relay.

9. If the relay tests correctly and a circuit problem still exists:

   A. Check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

   B. Use the InfoCenter Display to check specific TEC output operation (see InfoCenter Display in this chapter).

10. Secure relay to mounting bracket and connect wire harness connector to relay.

11. Secure all removed components to machine.

12. Connect positive (+) cable to battery and then connect negative (−) cable to battery (see Battery Service in this chapter).

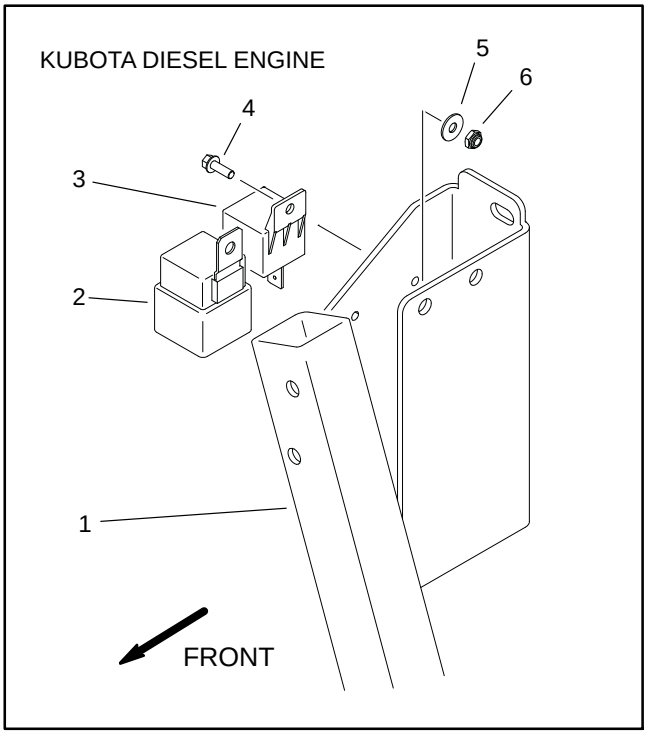


Figure 56

1. Air cleaner mount
2. Start relay (5 terminal)
3. Glow relay (4 terminal)
4. Screw (2)
5. Washer (2)
6. Lock nut (2)

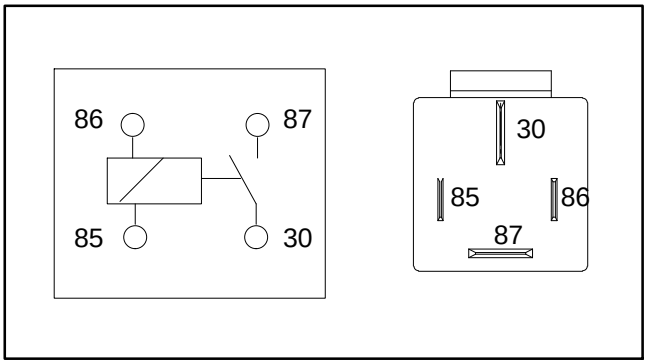


Figure 57

Relays with Five (5) Terminals

Your Reelmaster 7000−D uses an electrical relay that has five (5) terminals. A tag near the wire harness relay connector can be used to identify each relay.

On machines with Yanmar diesel engines, an EGR relay is used to provide current to the engine EGR valve when energized by the engine ECU. The EGR relay is located on the air cleaner mounting bracket (Fig. 58)

On machines with Kubota diesel engines,the start relay is a five (5) terminal relay. The start relay is used to provide current to the engine starter motor solenoid. The start relay is energized and monitored by the Toro Electronic Controller (TEC). The start relay is located on the air cleaner mounting bracket (Fig. 59).

Testing

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

2. To make sure that machine operation does not occur unexpectedly, disconnect negative (−) cable from battery and then disconnect positive (+) cable from battery (see Battery Service in this chapter).

3. Locate relay that is to be tested.

4. Disconnect wire harness connector from relay. Remove relay from mounting bracket for testing.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter 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.

5. Using a multimeter, verify that coil resistance between terminals 85 and 86 is from 71 to 88 ohms (Fig. 60).

6. 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.

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

8. Connect multimeter (ohms setting) leads to relay terminals 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.

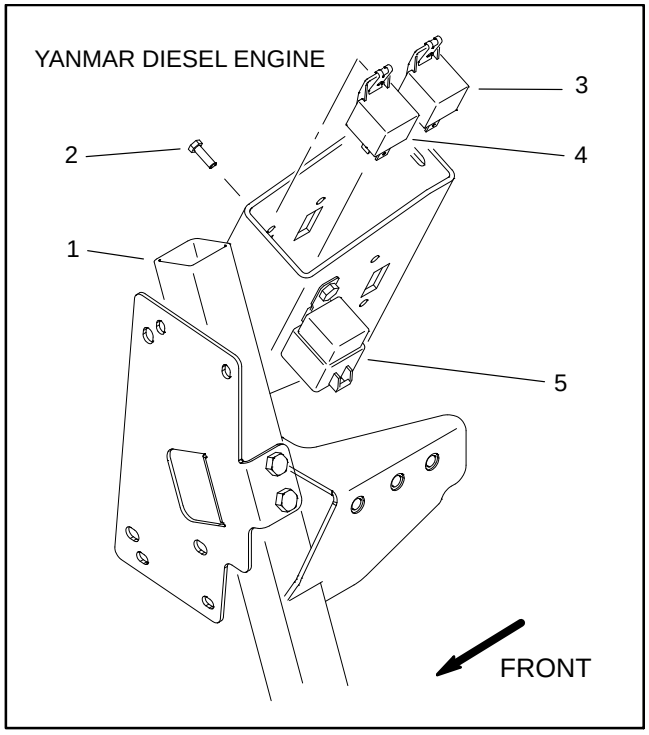


Figure 58

1. **Air cleaner mount**
2. **Screw (3)**
3. **Start relay (4 terminal)**
4. **Glow relay (4 terminal)**
5. **EGR relay (5 terminal)**

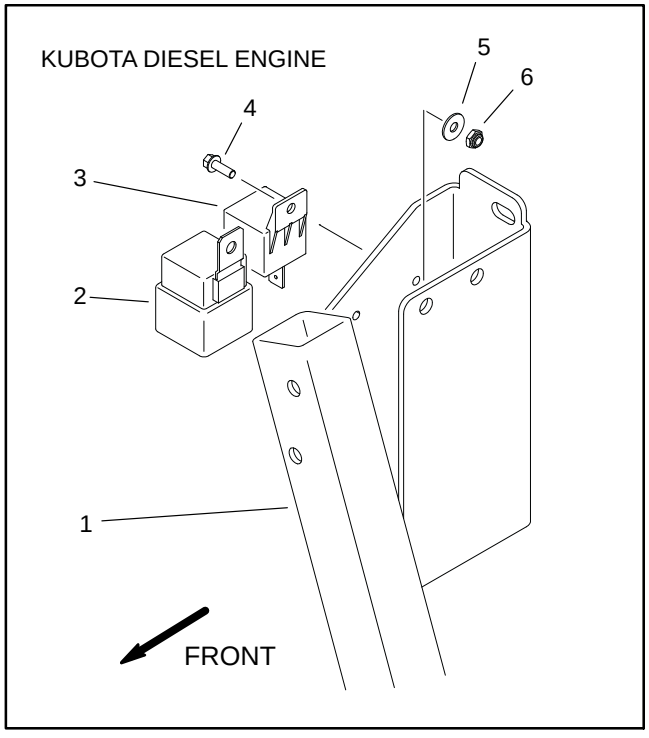


Figure 59

1. **Air cleaner mount**
2. **Start relay (5 terminal)**
3. **Glow relay (4 terminal)**
4. **Screw (2)**
5. **Washer (2)**
6. **Lock nut (2)**

9. Disconnect voltage and test leads from the relay terminals.

10. If testing determines that the relay is not functioning correctly, replace the relay.

11. If the relay tests correctly and a circuit problem still exists:

    A. Check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

    B. Use the InfoCenter Display to check specific TEC output operation (see InfoCenter Display in this chapter).

12. Secure relay to mounting bracket and connect wire harness connector to relay.

13. Secure all removed components to machine.

14. Connect positive (+) cable to battery and then connect negative (−) cable to battery (see Battery Service in this chapter).

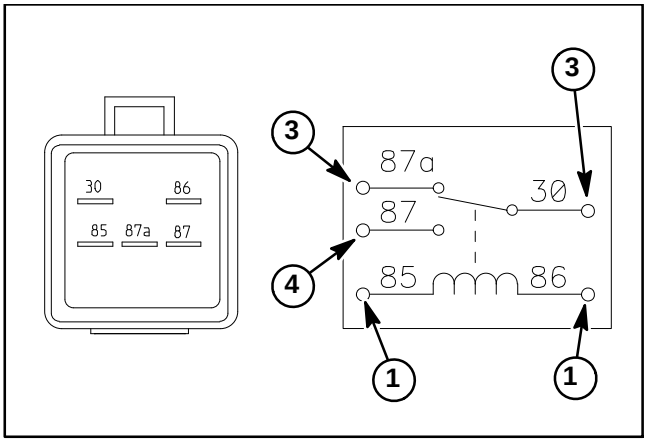


Figure 60

1. **Coil terminal**
2. **Common terminal**
3. **Normally closed term.**
4. **Normally open term.**

Hydraulic Solenoid Valve Coils

Numerous hydraulic solenoid valve coils are used on the hydraulic control manifolds of Reelmaster 7000−D machines. The solenoid valve coils are energized by the Toro Electronic Controller (TEC) to provide hydraulic circuit control.

Two (2) different solenoid valve coils are used on the Reelmaster 7000−D. A coil can be identified by measuring it's height and diameter (Fig. 61). Testing of the coils can be done with the coil remaining on the hydraulic valve.

NOTE: To assist in troubleshooting, identical solenoid coils can be exchanged. If the problem follows the exchanged coil, a problem with the coil likely exists. If the problem remains unchanged, something other than the solenoid coil is the problem source (e.g. switch, circuit wiring, hydraulic problem).

Testing

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

2. Locate hydraulic valve solenoid coil to be tested (see Chapter 5 − Hydraulic System in this manual). Identify coil by measuring the coil diameter and coil height (Fig. 61).

3. Disconnect wire harness connector from coil.

NOTE: Prior to taking small resistance readings with a digital multimeter, short the meter 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.

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

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

5. If solenoid coil resistance is incorrect, replace solenoid (see Hydraulic Solenoid Valve Coil in this chapter).

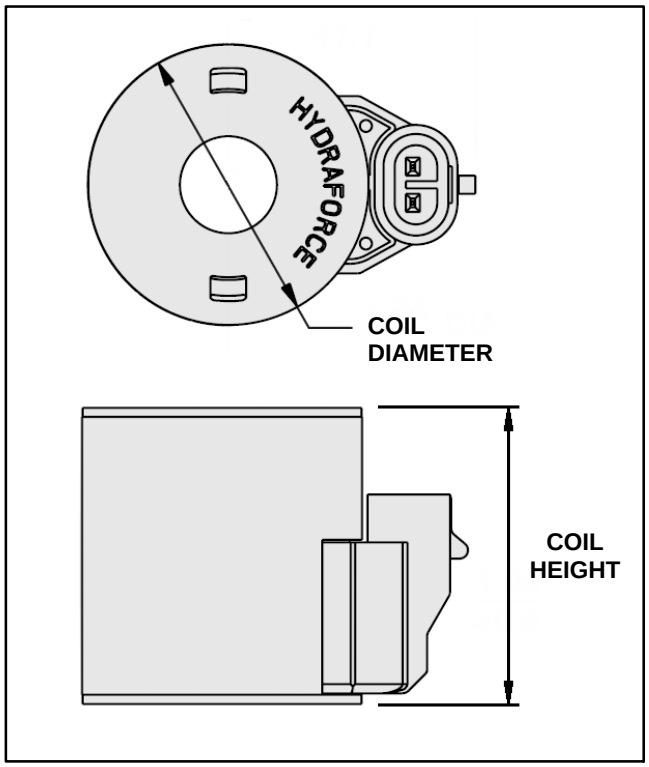


Figure 61

COIL DIAMETER	COIL HEIGHT	COIL RESISTANCE
1.840 inch (46.7 mm)	1.960 inch (49.9 mm)	7.1 ohm
1.410 inch (35.8 mm)	1.430 inch (36.3 mm)	8.8 ohm

6. If the solenoid coil tests correctly and a circuit problem still exists:

   A. Check wire harness (see Electrical Schematic and Wire Harness Drawings in Chapter 10 − Foldout Drawings in this manual).

   B. Use the InfoCenter Display to check specific TEC output operation (see InfoCenter Display in this chapter).

7. After testing is completed, connect wire harness connector to the solenoid coil.

Fuel Pump (Yanmar Diesel Engine Only)

The fuel pump is attached to the air cleaner mounting bracket below the fuel water separator (Fig. 62).

Test

1. Park machine on a level surface, lower cutting units, stop engine and apply parking brake. Raise hood to access fuel pump.

2. Make sure fuel hoses attached to the fuel pump are free of obstructions.

3. Disconnect fuel pump discharge hose from the fuel/water separator.

4. Place disconnected end of pump discharge hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

IMPORTANT: When testing fuel pump output, do not turn ignition switch to the START position.

5. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for thirty (30) seconds, then turn switch to OFF.

6. The amount of fuel collected in the graduated cylinder should be approximately **11.8 fl oz (350 ml) after thirty (30) seconds**.

7. Replace fuel pump if output specification is not met.

IMPORTANT: If fuel pump is replaced, make sure that replacement pump is correct for your Reelmaster by using your Toro Parts Catalog. If incorrect pump is used, fuel system damage can occur

8. Connect fuel pump discharge hose to fuel water separator and secure with hose clamp.

9. Prime fuel system (see Prime Fuel System in Chapter 3 - Yanmar Diesel Engine in this manual).

10. Lower and secure hood.

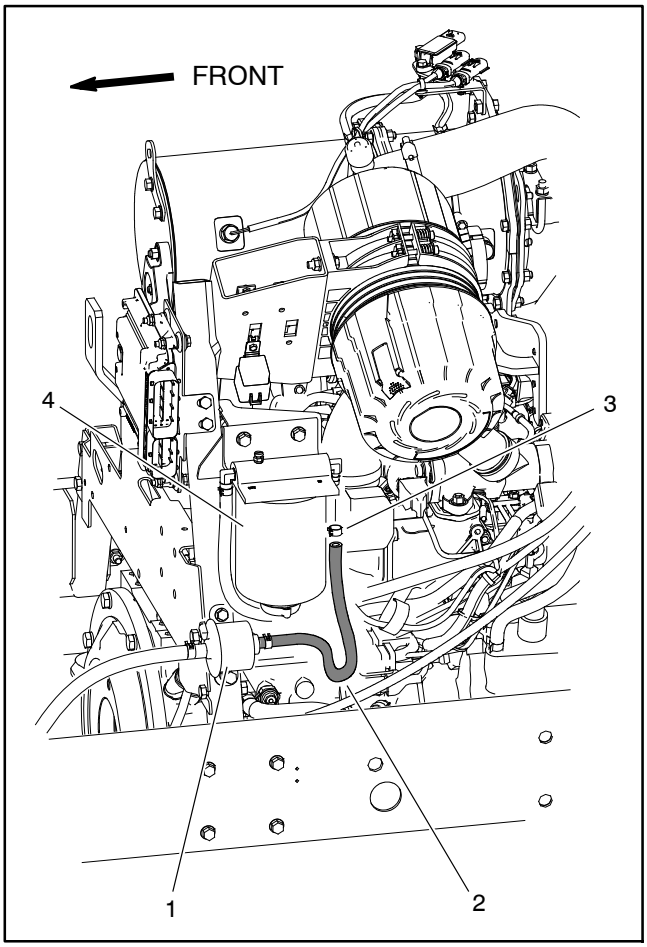


Figure 62

1. **Fuel pump**
2. **Pump discharge hose**
3. **Hose clamp**
4. **Fuel/water separator**

Fuel Pump Specifications

Pump Capacity	23.5 fl oz/min (700 ml/min)
Pressure	3.3 PSI (22.8 kPa)
Current Draw	0.9 amp

Fuel Pump (Kubota Diesel Engine Only)

The fuel pump is attached to the air cleaner mounting bracket below the fuel water separator (Fig. 63).

Test

1. Park machine on a level surface, lower cutting units, stop engine and apply parking brake. Raise hood to access fuel pump.

2. Make sure fuel hoses attached to the fuel pump are free of obstructions.

3. Disconnect fuel pump discharge hose from the fuel water separator.

4. Place disconnected end of supply hose into a large, graduated cylinder sufficient enough to collect 1 quart (0.95 liter).

IMPORTANT: When testing fuel pump output, do not turn ignition switch to the START position.

5. Collect fuel in the graduated cylinder by turning ignition switch to the ON position. Allow pump to run for fifteen (15) seconds, then turn switch to OFF.

6. 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 if output specification is not met.

IMPORTANT: If fuel pump is replaced, make sure that replacement pump is the correct for your Reelmaster by using your Toro Parts Catalog. If incorrect pump is used, fuel system damage may occur.

8. Connect fuel pump discharge hose to fuel/water separator and secure with hose clamp.

9. Prime fuel system (see Prime Fuel System in Chapter 3 - Kubota Diesel Engine in this manual).

10. Lower and secure hood.

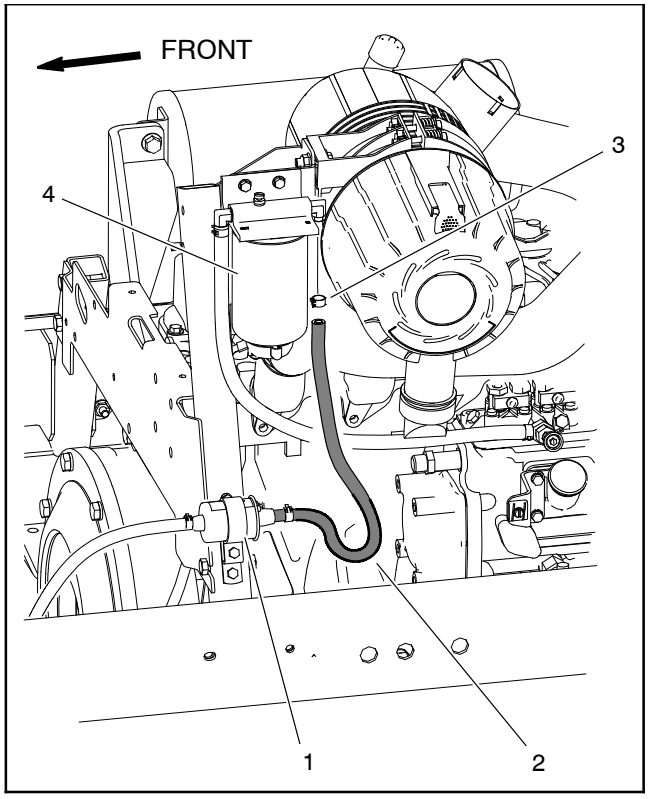


Figure 63

1. **Fuel pump**
2. **Fuel supply hose**
3. **Hose clamp**
4. **Fuel/water separator**

Fuel Pump Specifications

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

Fuel Stop Solenoid (Kubota Diesel Engines Only)

The fuel stop solenoid used on your Reelmaster 7000−D must be energized for the diesel engine to run. The solenoid is mounted to the injection pump on the engine (Fig. 64).

The Toro Electronic Controller (TEC) monitors the operation of the fuel stop solenoid. The solenoid and its circuit wiring should be tested as a controller output with the Diagnostic Display before following the testing procedure listed below (see Special Tools and Troubleshooting in this chapter).

Testing

1. Park machine on a level surface, lower cutting units, stop engine, apply parking brake and remove key from ignition switch. Open hood to gain access to engine.

2. Disconnect wire harness connector from fuel stop solenoid.

NOTE: The fuel stop solenoid may be removed from the engine or tested in place.

3. If the solenoid is removed from the engine, make sure that the solenoid plunger moves freely and is free of dirt, debris and corrosion.

NOTE: 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.

4. Using a digital multimeter (ohms setting), touch one test lead to the pull coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 65). The resistance of the pull coil should be less than 1 ohm (but not zero).

5. Using a digital multimeter (ohms setting), touch one test lead to the hold coil terminal and the other test lead to the fuel stop solenoid frame (ground) (Fig. 65). The resistance of the hold coil should be approximately 15 ohms.

6. If either coil resistance is incorrect, replace fuel stop solenoid.

7. Connect wire harness connector to the fuel stop solenoid.

8. Lower and secure hood.

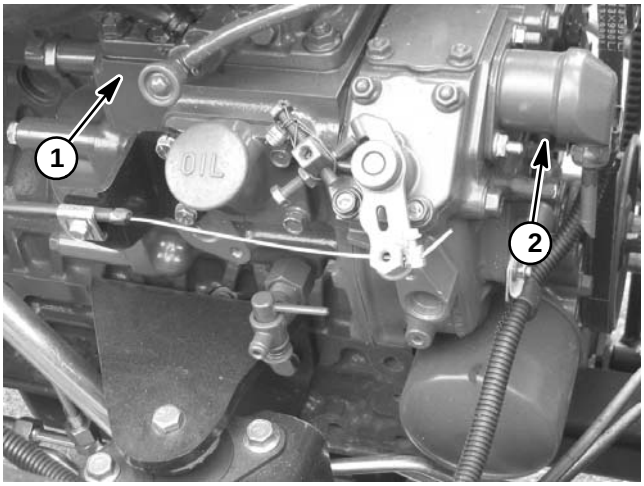


Figure 64

1. **Injection pump**
2. **Fuel stop solenoid**

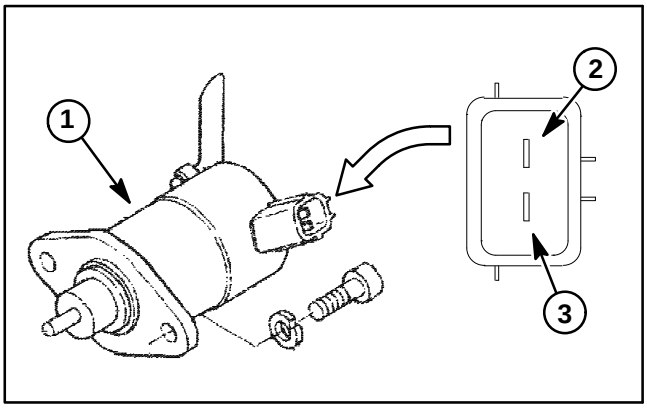


Figure 65

1. **Fuel stop solenoid**
2. **Pull coil terminal**
3. **Hold coil terminal**

CAN−bus Termination Resistor

System communication between electrical components on Reelmaster 7000−D machines is accomplished on a CAN−bus communication system. Two (2) specially designed, twisted cables form the bus for the network used on the machine. These wires provide the data pathways between machine components.

All Reelmaster 7000−D machines have a 120 ohm termination resistor at the end of the twisted pair of bus cables near the InfoCenter display (see seat and console wire harness drawing in Chapter 10 − Foldout Drawings in this manual). The resistor can be accessed by removing the cover plate on the right side of the control arm. The wire harness connector has a blue insert to identify the proper location for the termination resistor.

Machines with Kubota diesel engines have an additional 120 ohm termination resistor at the end of the twisted pair of bus cables near the fuel pump (see Kubota engine wire harness drawing in Chapter 10 − Foldout Drawings in this manual). The resistor can be accessed by raising the hood. The wire harness connector has a blue insert to identify the proper location for the termination resistor.

NOTE: Refer to the Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings for additional information on termination resistor locations and wire connections.

IMPORTANT: The termination resistor is required for proper electrical system operation.

Testing

1. The termination resistors (Fig. 66) can be individually tested using a digital multimeter (ohms setting). Locate resistor and remove cable tie that secures resistor to wire harness. Unplug the resistor from the wire harness for testing.

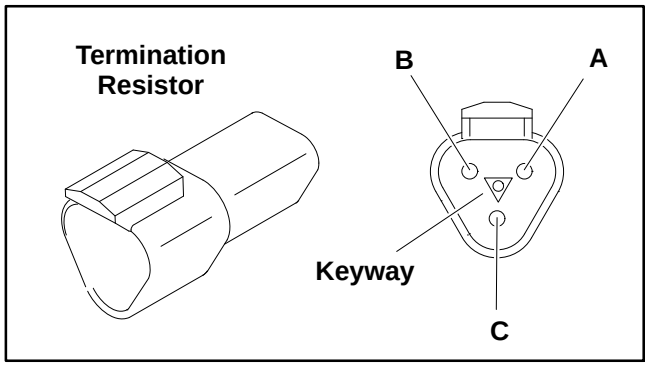


Figure 66

NOTE: The insulator wedge in the termination resistor is blue for identification purposes. There also is a center keyway to prevent the termination resistor from plugging into the wrong wire harness connector.

2. Use a digital multimeter (ohms setting) to measure the resistance value for the termination resistor. There should be **120 ohms** resistance between terminals A and B. Terminal C is not used.

3. If testing determines that termination resistor is faulty, replace resistor.

4. After testing is complete, make sure that termination resistor is fully installed into wire harness connector and secured to wire harness with cable tie.

Diode Assembly

All Reelmaster 7000−D machines have a diode that is used to protect the circuit from voltage spikes when the engine starter solenoid is de−energized. The diode plugs into the engine wiring harness near the starter motor (see engine wire harness drawings in Chapter 10 − Foldout Drawings in this manual).

Machines with Yanmar diesel engines have an additional diode that is used to protect the engine ECU from voltage spikes when the EGR relay is de−energized. The diode plugs into the engine wiring harness near the engine ECU (see Yanmar engine wire harness drawing in Chapter 10 − Foldout Drawings in this manual).

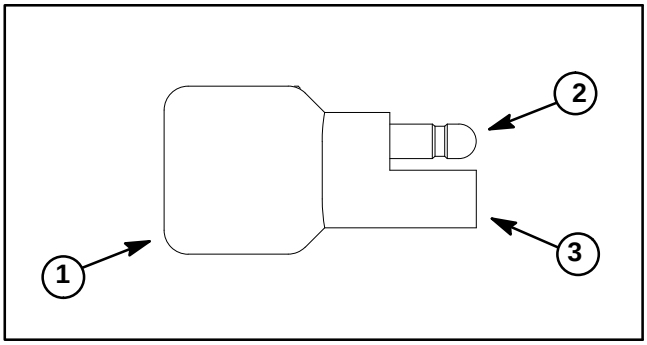


Figure 67

1. **Diode**
2. **Male terminal**
3. **Female terminal**

Diode Test

The diode (Fig. 67) can be individually tested using a digital multimeter (diode test or ohms setting) and the table to the right.

Multimeter Red Lead (+) on Terminal	Multimeter Black Lead (−) on Terminal	Continuity
Female	Male	YES
Male	Female	NO

Resistor Assembly

A 75 ohm resistor is necessary for proper ignition switch operation on all Reelmaster 7000−D machines. The resistor plugs into the console wire harness near the ignition switch (see seat and console wire harness drawing in Chapter 10 − Foldout Drawings in this manual).

On machines with Yanmar diesel engines (80 Amp alternator) an additional 1.6K resister is necessary for proper ignition switch operation. The resistor plugs into the engine wire harness near the alternator (see Yanmar engine wire harness drawing in Chapter 10 − Foldout Drawings in this manual).

The resistor assemblies can be identified by their gray color, resistor symbol and Toro part number on the end of the resistor assembly body.

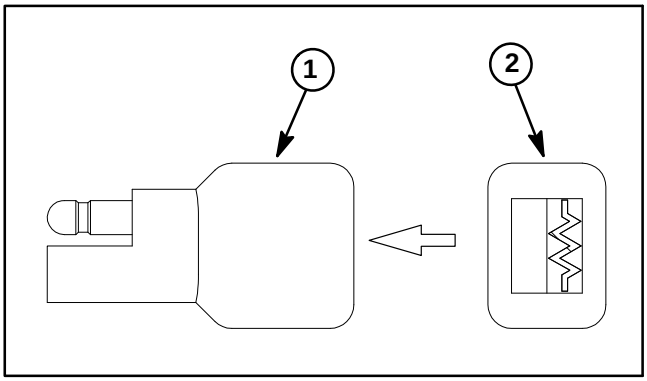


Figure 68

1. **Resistor assembly**
2. **End of resistor body**

Testing

The resistor can be tested using a digital multimeter (ohms setting). The resistance across the resistor terminals should be either 75 ohms or 1.6K ohms depending on which resistor is tested.

Worklight Switch

The worklight switch is located on the operator side of the console arm (Fig. 69). This two (2) position rocker switch allows the worklights to be turned ON and OFF.

Testing

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

2. Disassemble console arm to gain access to the worklight switch (see Console Arm in Chapter 8 − Chassis in this manual).

3. Disconnect harness electrical connector from the switch.

4. 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 switch position. The switch terminals are marked as shown in Figure 70. Verify continuity between switch terminals. Replace worklight switch if testing identifies a faulty switch.

5. If headlight switch tests correctly and circuit problem still exists, check wire harness (see Electrical Schematics and Wire Harness Drawings in Chapter 10 − Foldout Drawings).

6. After testing is completed, connect wire harness connector to the worklight switch.

7. Assemble console arm (see Console Arm in Chapter 8 − Chassis in this manual).

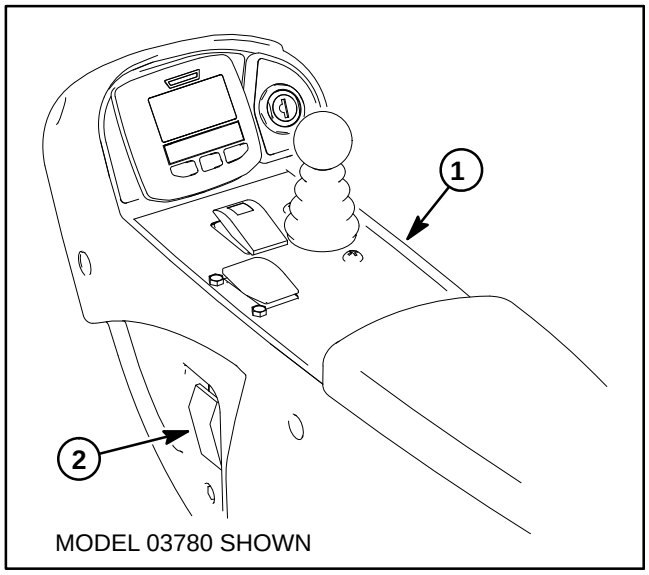


Figure 69

1. Console arm **2. Worklight switch**

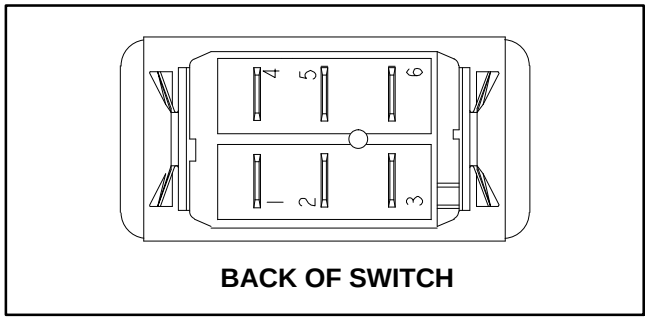


Figure 70

SWITCH POSITION	CIRCUIT 1	CIRCUIT 2
ON	2 + 3	5 + 6
OFF	2 + 1	5 + 4

NOTE: Headlight switch terminals 1, 4, 5 and 6 are not used on Reelmaster 7000−D machines.

Service and Repairs

NOTE: For engine component repair information, see the Yanmar Model 4TNV86CT−DTR Service Manual or Troubleshooting Manual, or the Kubota Model 03−M−DI−E3B Workshop Manual.

Battery Storage

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

1. Remove the battery and charge it fully (see Battery Service in this section).

2. Either store battery on a shelf or on the machine.

3. Leave cables disconnected if the battery is stored on the machine.

4. Store battery in a cool atmosphere to avoid quick deterioration of the battery charge.

5. To help prevent the battery from freezing, make sure it is fully charged (see Battery Service in this section).

Battery Care

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

WARNING

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

IMPORTANT: Do not remove fill caps while cleaning.

2. Check battery condition weekly or after every 50 hours of operation. Keep terminals and entire battery case clean because a dirty battery will discharge slowly.

   A. Clean battery by washing entire case with a solution of baking soda and water. Rinse with clear water.

   B. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

3. Battery cables must be tight on battery 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 battery terminals, disconnect cables. Always disconnect negative (−) cable first. Clean clamps and terminals separately. Reconnect cables with positive (+) cable first. Coat battery posts and cable connectors with battery terminal protector (see Special Tools in this chapter) or petroleum jelly to prevent corrosion.

5. Check electrolyte level every 25 operating hours and every 30 days if machine is in storage.

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

Battery Service

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

CAUTION

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

Battery Specifications

BCI Group 24 Battery
660 Amp Cranking Performance at 0F (−18C)
110 minute Reserve Capacity at 80F (27C)
Electrolyte Specific Gravity (fully charged): from 1.250 to 1.280
Electrolyte Specific Gravity (discharged): 1.240

Battery Removal and Installation (Fig. 71)

1. Unlatch and raise battery storage box cover behind the operator seat to access battery.

2. Loosen and remove negative cable from battery. After negative cable is removed, loosen and remove positive cable from battery.

3. Loosen strap that secures battery in storage box.

4. Carefully remove battery from machine.

5. Install battery in reverse order making sure to connect and tighten positive cable to battery before connecting the negative cable.

NOTE: Before connecting the negative (ground) cable, 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 machine's electrical system should be tested for short circuits or faulty components and repaired.

6. Make sure that rubber boot is properly placed over positive cable end and positive battery post.

7. Lower and secure battery storage box cover.

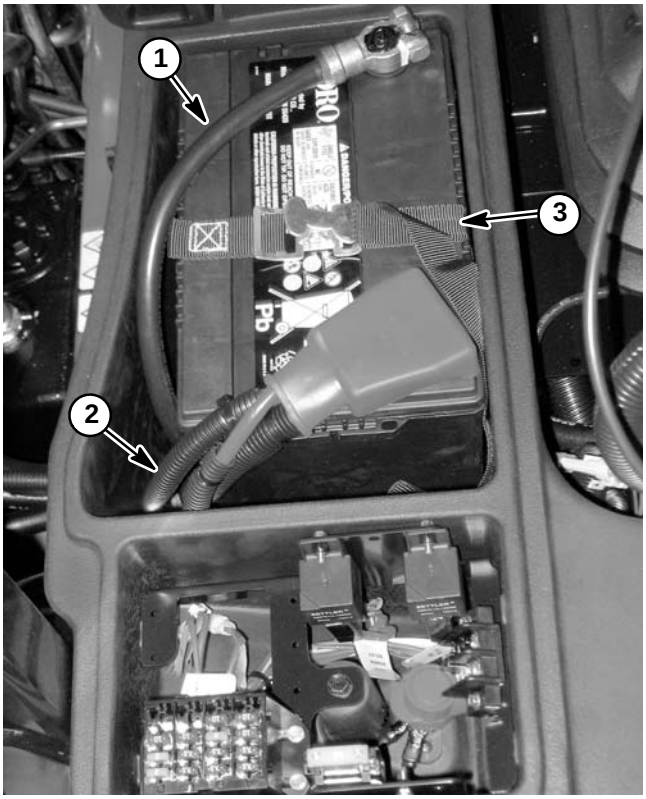


Figure 71

1. **Negative cable**
2. **Positive cable**
3. **Battery strap**

Battery Inspection and Maintenance

1. Replace battery if case is cracked or leaking.

2. 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.

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

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

5. Check the electrolyte level in each cell. If 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 fifteen (15) minutes to allow sufficient mixing of the electrolyte.

Battery Testing

1. Conduct a hydrometer test of the battery electrolyte.

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

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

B. Temperature correct each cell reading. For each 10ºF (6C) above 80F (27C) add 0.004 to the specific gravity reading. For each 10F (6C) below 80F (27C) subtract 0.004 from the specific gravity reading.

Example: Cell Temperature	100F
Cell Gravity	1.245
100F minus 80F equals 20F	
(38C minus 27C equals 11C)	
20F multiply by 0.004/10F equals 0.008	
(11C multiply by 0.004/6C equals 0.008)	
ADD (conversion above)	0.008
Correction to 80F (27C)	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 **Battery 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.

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

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

CAUTION

Follow the battery load tester manufacturer's instructions when using a load 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 fifteen (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 battery cell.

E. Connect a battery load tester to the battery terminals **following the load tester manufacturer's instructions**. Connect a digital multimeter to the battery terminals.

F. Apply a test load of 330 amps (one half the Cranking Performance rating of the battery) for fifteen (15) seconds.

G. Take a battery voltage reading after the load has been applied to the battery for fifteen (15) seconds, then remove the load. Record the voltage reading.

H. Using the table below, determine the minimum voltage for the cell temperature reading:

Minimum Voltage	Battery Electrolyte Temperature	
9.6	70F (and up)	21C (and up)
9.5	60F	16C
9.4	50F	10C
9.3	40F	4C
9.1	30F	−1C
8.9	20F	−7C
8.7	10F	−12C
8.5	0F	−18C

I. If the test voltage is below the minimum, replace the battery. If the test voltage is at or above the minimum, return the battery to service.

Battery 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 locations.

CAUTION

Follow the battery charger 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 specific gravity or open 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 battery charger manufacturer's 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 60F (16C) 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 battery charger manufacturer's instructions**, connect the charger cables to the battery. Make sure a good connection is made.

4. Charge the battery **following the battery charger manufacturer's instructions**.

5. Occasionally check the temperature of the battery electrolyte. If the temperature exceeds 125F (52C) or the electrolyte is violently gassing or spewing, the charging rate must be lowered or temporarily stopped.

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

Hydraulic Solenoid Valve Coils

A solenoid valve coil on a hydraulic control manifold can be replaced without opening the hydraulic system.

Removal (Fig. 72)

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

2. Locate solenoid valve coil that is to be removed (see Chapter 5 − Hydraulic System in this manual for assistance in locating specific solenoid valves).

3. Disconnect wire harness electrical connector from the coil that is to be removed. Note orientation of electrical connector on coil for assembly purposes.

4. Remove nut that secures coil to hydraulic valve.

5. Slide solenoid coil from valve.

6. Clean any corrosion or dirt from valve stem.

Installation (Fig. 72)

1. Slide solenoid coil onto the hydraulic valve. Position coil so that connector is properly orientated.

2. Install nut onto valve and torque nut **60 in−lb (6.8 N−m)** (do not over tighten).

3. Connect machine wire harness connector to the solenoid coil.

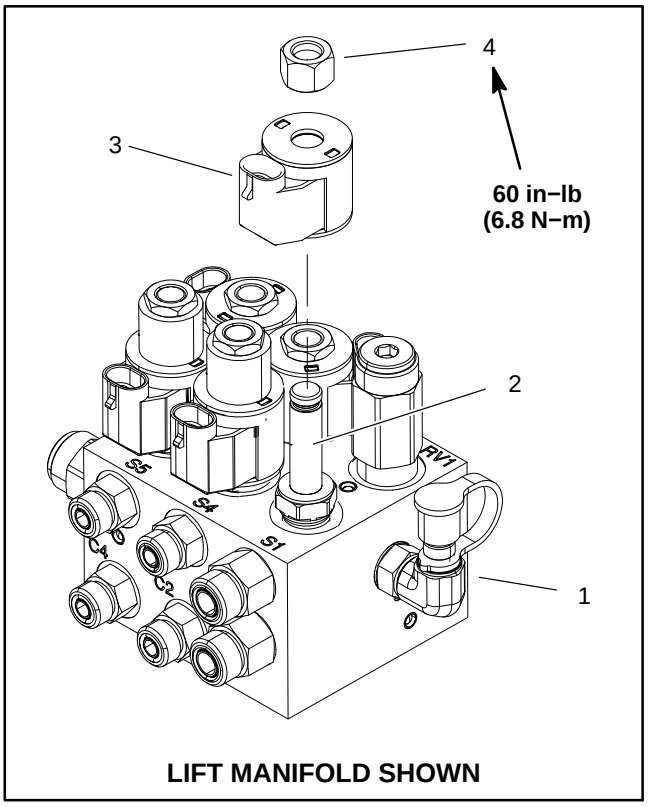


Figure 72

1. **Control manifold**
2. **Solenoid valve**
3. **Solenoid coil**
4. **Nut**

Worklight Bulb Replacement

The worklights are adjustable left and right, and up and down as necessary. The worklights use a replaceable halogen bulb.

CAUTION

The worklights use a halogen bulb that becomes extremely hot when in operation. Handling a hot bulb can cause severe burns and personal injury. Allow enough time for bulb to cool before handling.

Bulb Replacement (Fig. 73)

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

2. Remove screw securing bezel to worklight body and remove bezel.

3. Disconnect worklight from wire harness at bulb and remove worklight.

4. Loosen the bulb from the worklight by rotating it 1/4 turn counter−clockwise. Then, grasp bulb base and remove bulb from the worklight.

CAUTION

Any surface contamination can damage the halogen bulb and lead to its failure or explosion creating a serious safety hazard.

Halogen bulbs should be handled without touching the clear bulb surface. Handle the bulb by holding onto the base.

5. Align tabs on bulb with notches in headlight opening. Insert bulb into back of headlight without touching the glass bulb surface. Secure bulb to worklight by rotating it 1/4 turn clockwise.

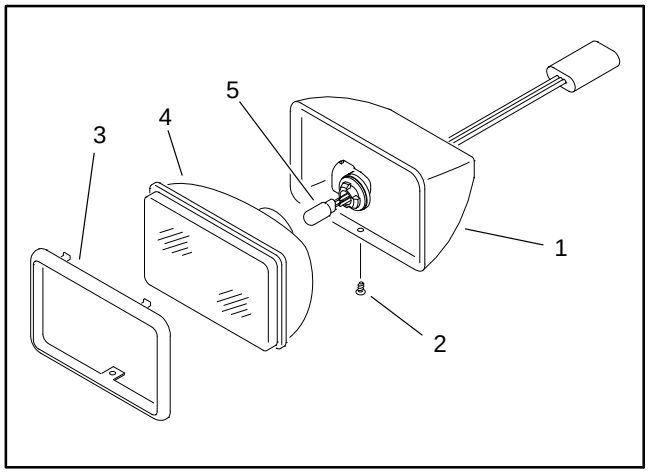


Figure 73

1. **Body**
2. **Screw**
3. **Bezel**
4. **Worklight**
5. **Bulb**

6. Connect worklight to wire harness at bulb.

7. Install worklight, bezel, and screw.

8. Adjust/aim worklight as needed.

Chapter 7

Axles, Planetaries and Brakes

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Specifications

Item	Specification
Wheel lug nut torque (front and rear)	85 to 100 ft–lb (116 to 135 N–m)
Steering cylinder bolt torque	100 to 125 ft–lb (136 to 169 N–m)
Planetary, Brake Assembly and Wheel Motor Mounting Screw Torque OPH–2 series planetary VA02 series planetary Planetary wheel drive mounting screw torque	 60 ft–lb (81 N–m) 75 to 85 ft–lb (101 to 115 N–m) 75 to 85 ft–lb (102 to 116 N–m)
Rear wheel toe–in	0.125 in (3 mm)
Tire pressure (front and rear)	12 to 15 psi (83 to 103 kPa)
Planetary Drive Lubricant Capacity (each wheel)	SAE 85W–140 wt. Gear Lube 16 to 20 fl oz (0.47 to 0.59 L)
Rear axle lubricant Rear axle gear lube capacity	SAE 85W–140 wt. gear lube 128 fl oz (3.31 L) total Center Housing = 80 fl oz (2.37 L) Outer Housings (ea.) = 16 fl oz (0.47 L) Gearbox = 16 fl oz (0.47 L)

General Information

Operator's Manual

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

Adjustments

Planetary Drive End Play (OPH−2 series planetary drives)

A front planetary wheel drive assembly that is properly operating should have no endplay. Any endplay in a planetary assembly indicates that there are potential problems with the planetary. Check planetary endplay at intervals specified in your Operator's Manual.

Endplay Checking Procedure

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

CAUTION

When changing attachments, tires or performing other service, use correct jacks, hoists and jack stands to raise and support machine. See Jacking Instructions in Chapter 1 − Safety for additional information and precautions.

2. Chock rear wheels, raise front of machine, and support machine with appropriate jack stands (see Jacking Instructions in Chapter 1 − Safety).

3. Grasp front wheel and check for endplay in the planetary assembly as indicated by axial wheel movement. Make sure that there is no endplay in assembly.

4. If any endplay is detected, the planetary should be disassembled, inspected and serviced as necessary (see Planetary Wheel Drive Assembly in the Service and Repairs section of this chapter).

5. After planetary endplay checking is completed, lower machine to ground.

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Brake Assembly

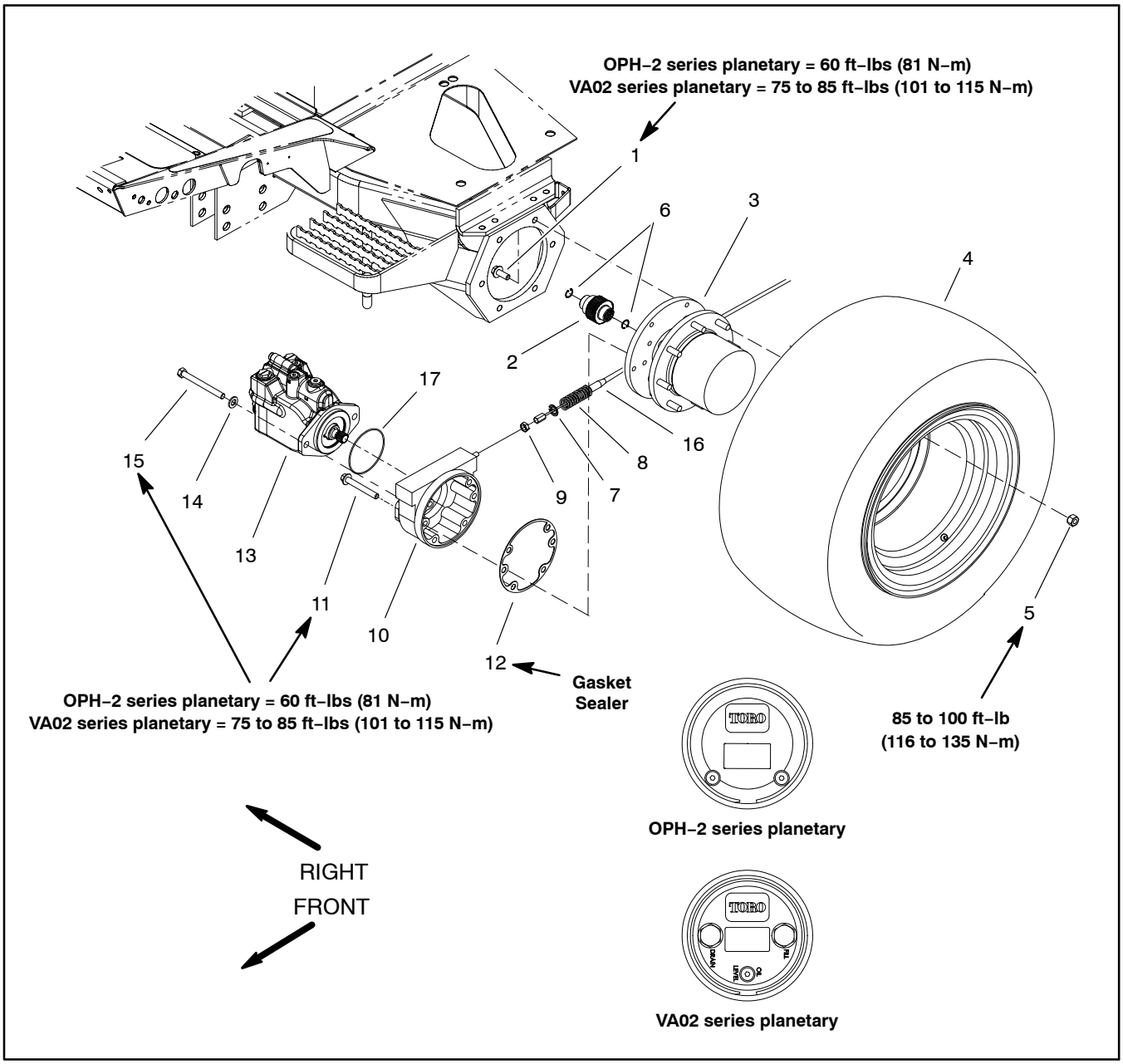


Figure 1

1. Flange head screw (6 per planetary)
2. Splined brake shaft
3. Planetary assembly (2)
4. Front wheel assembly (2)
5. Lug nut (8 per wheel)
6. Retaining ring
7. Spring plate
8. Compression spring
9. Jam nut
10. Brake assembly (LH shown)
11. Flange head screw (4 per brake)
12. Gasket
13. Piston motor (2)
14. Flat washer (2 per motor)
15. Cap screw (2 per motor)
16. Brake cable (LH shown)

Brake Assembly Removal (Fig. 1)

1. Park machine on a level surface and raise cutting units to allow easier access to front brake assembly. Stop engine, engage parking brake and remove key from the ignition switch.

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

CAUTION

When changing attachments, tires or performing other service, use correct blocks, hoists and jacks to raise and support machine. Make sure machine is parked on a solid level surface 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. Use appropriate jack stands to support the raised machine. If the machine is not properly supported by jack stands, the machine may move or fall, which may result in personal injury.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with appropriate jack stands.

4. Remove wheel assembly.

5. Remove hydraulic wheel motor (see Front Wheel Motors in Service and Repairs section of Chapter 4 – Hydraulic System).

6. Disconnect brake cable from pull rod on brake.

NOTE: Be careful to not drop splined brake shaft as brake assembly is removed.

7. Support brake assembly and remove flange head cap screws (item 11) securing brake assembly to frame. Remove brake assembly.

8. Remove splined brake shaft.

9. Complete brake inspection and repair (see Brake Inspection and Repair in this section).

Brake Assembly Installation (Fig. 1)

NOTE: The stepped end of the splined brake shaft must be aligned toward the hydraulic wheel motor (Fig. 2).

1. Install splined brake shaft into brake assembly. Make sure that splines engage rotating discs in brake assembly.

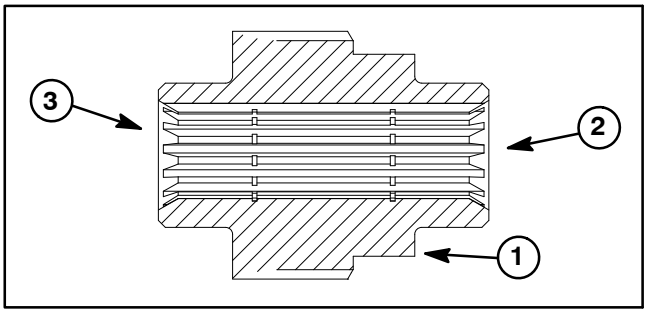


Figure 2

1. **Splined brake shaft step**
2. **Hydraulic motor end**
3. **Planetary assembly end**

2. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with eight (8) flange head screws.

   For OPH–2 series planetary drives: tighten screws to **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

3. Make sure that gasket surfaces of planetary and brake assembly are clean. Position new gasket (item 3) to brake assembly.

4. Position brake assembly to machine, aligning splined brake shaft with input shaft on planetary wheel drive.

5. Make sure gasket (item 3) is properly aligned and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

   For OPH–2 series planetary drives: tighten screws from **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

6. Install brake cable to pull rod on brake assembly. Brake cable end should be completely threaded onto pull rod before tightening jam nut.

7. Make sure wheel motor O–ring (item 4) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

   For OPH–2 series planetary drives: tighten screws from **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

8. Install wheel assembly.

9. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

10. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

11. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

12. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Brake Inspection and Repair

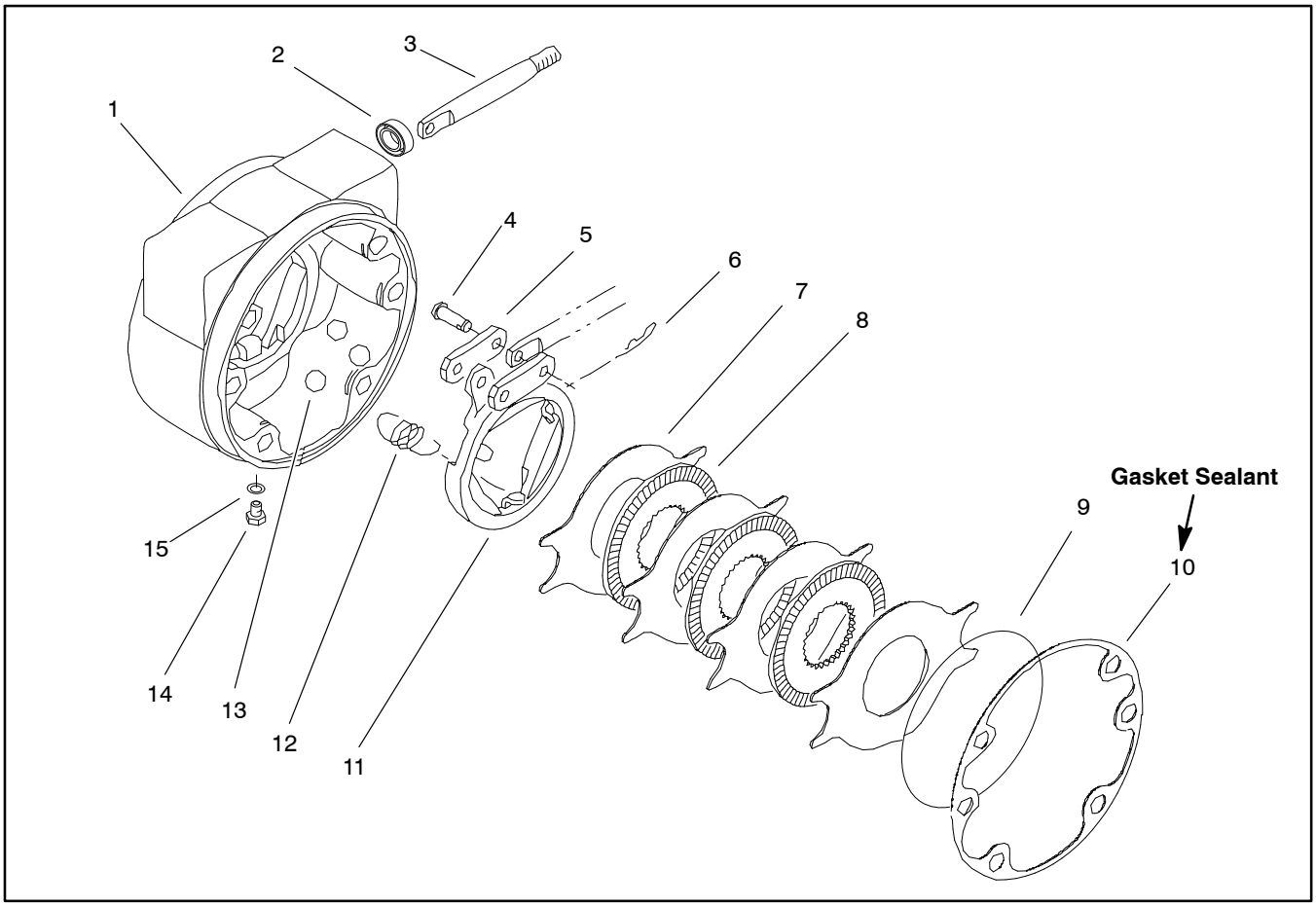


Figure 3

1. **Brake housing (LH shown)**
2. **Seal**
3. **Pull rod**
4. **Clevis pin (2)**
5. **Link (2)**
6. **Hitch pin (2)**
7. **Stationary disc (4)**
8. **Rotating disc (3)**
9. **Retaining ring**
10. **Gasket**
11. **Rotating actuator**
12. **Extension spring (3)**
13. **Ball (3)**
14. **Plug**
15. **O−ring**

Brake Inspection and Repair (Fig. 3)

1. Carefully scrape gasket material (item 10) from brake housing and planetary wheel drive mounting surfaces.

2. Remove retaining ring (item 9).

3. Remove stationary discs (item 7) and rotating discs (item 8).

4. Remove extension springs (item 12).

5. Remove pull rod assembly (items 3, 4, 5 and 6).

6. Remove actuator and balls (items 11 and 13).

7. Remove seal (item 2) from brake housing.

8. Wash parts in cleaning solvent. Inspect components for wear or damage.

9. Reverse steps 2. – 7. to assemble brakes, installing new parts as necessary. Install a new seal (item 2).

10. Use a new gasket (item 10) and gasket sealant when installing brake assembly to machine.

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Planetary Drive Assembly

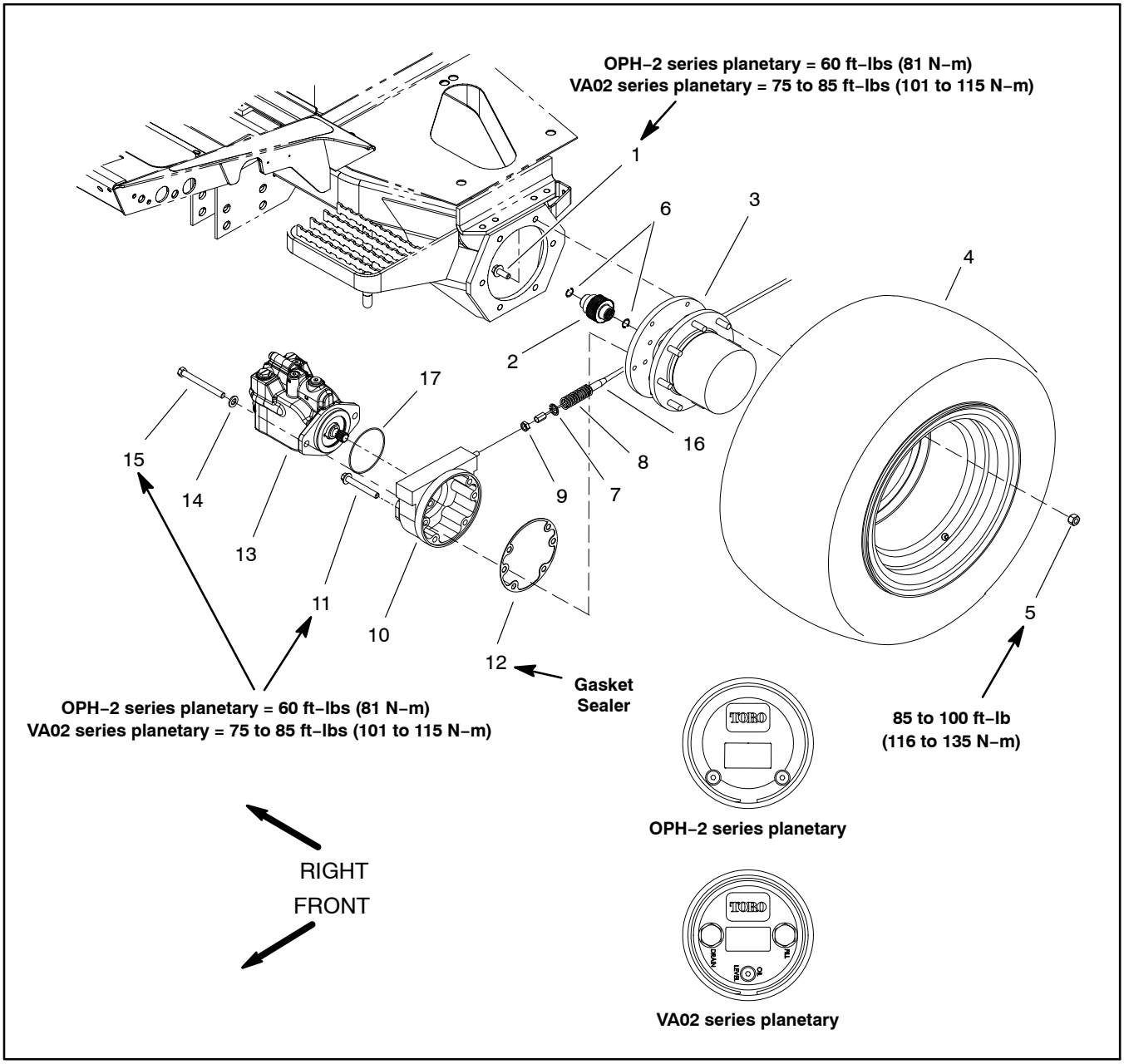


Figure 4

1. Flange head screw (6 per planetary)
2. Splined brake shaft
3. Planetary assembly (2)
4. Front wheel assembly (2)
5. Lug nut (8 per wheel)
6. Retaining ring
7. Spring plate
8. Compression spring
9. Jam nut
10. Brake assembly (LH shown)
11. Flange head screw (4 per brake)
12. Gasket
13. Piston motor (2)
14. Flat washer (2 per motor)
15. Cap screw (2 per motor)
16. Brake cable (LH shown)

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine (see Planetary Wheel Drive Service in this section). Use the following procedure to remove and install the planetary wheel drive assembly from machine.

Planetary Drive Removal (Fig. 4)

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

2. Drain the oil from the brake assembly and the Planetary drive; refer to the traction unit Operator's Manual.

CAUTION

Before removing wheels or performing other service, make sure machine is parked on a solid, level surface such as a concrete floor. Always chock or block wheels. Use jack stands or other appropriate load holding devices to support the raised machine. If the machine is not properly supported, the machine may move or fall, which may result in personal injury.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety in this manual). Support machine with jack stands.

4. Remove front wheel assembly.

5. Support wheel motor and brake assembly to prevent them from shifting during planetary removal.

NOTE: The wheel motor and brake assembly fasteners thread into the planetary housing, and must be removed prior to removing the planetary drive from the machine.

6. Remove two (2) cap screws and flat washers that secure wheel motor to planetary assembly. Check condition of O–ring (item 17) and replace if necessary (see wheel motors in Chapter 5 – Hydraulic System in this manual).

7. Remove four (4) flange head screws that secure brake assembly to planetary assembly (see Brake Assembly in this chapter). Remove and discard gasket (item 12).

8. Support planetary assembly to prevent it from falling. Loosen and remove six (6) flange head screws that secure planetary assembly to frame. Remove planetary assembly from machine.

Planetary Drive Installation (Fig. 4)

1. Position planetary assembly to machine making sure to engage splined brake shaft with planetary drive shaft. Secure planetary assembly to frame with six (6) flange head screws.

   For OPH–2 series planetary drives: tighten screws to **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

2. Make sure that gasket surfaces of planetary and brake assembly are clean.

3. Make sure gasket (item 12) is properly aligned and secure brake assembly to planetary (see Brake Assembly in this section of this chapter).

   For OPH–2 series planetary drives: tighten screws to **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

4. Make sure wheel motor O–ring (item 17) is in position and secure wheel motor to planetary with two (2) cap screws and flat washers.

   For OPH–2 series planetary drives: tighten screws from **60 ft–lb (81 N–m)**.

   For VA02 series planetary drives: tighten screws from **75 to 85 ft–lb (101 to 115 N–m)**.

5. Install wheel assembly.

6. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

7. Test planetary drive operation.

8. Check and adjust brake cables for proper brake operation (see machine Operator's Manual).

WARNING

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

9. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft–lb (116 to 135 N–m)**.

OPH−2 Planetary Drive Service

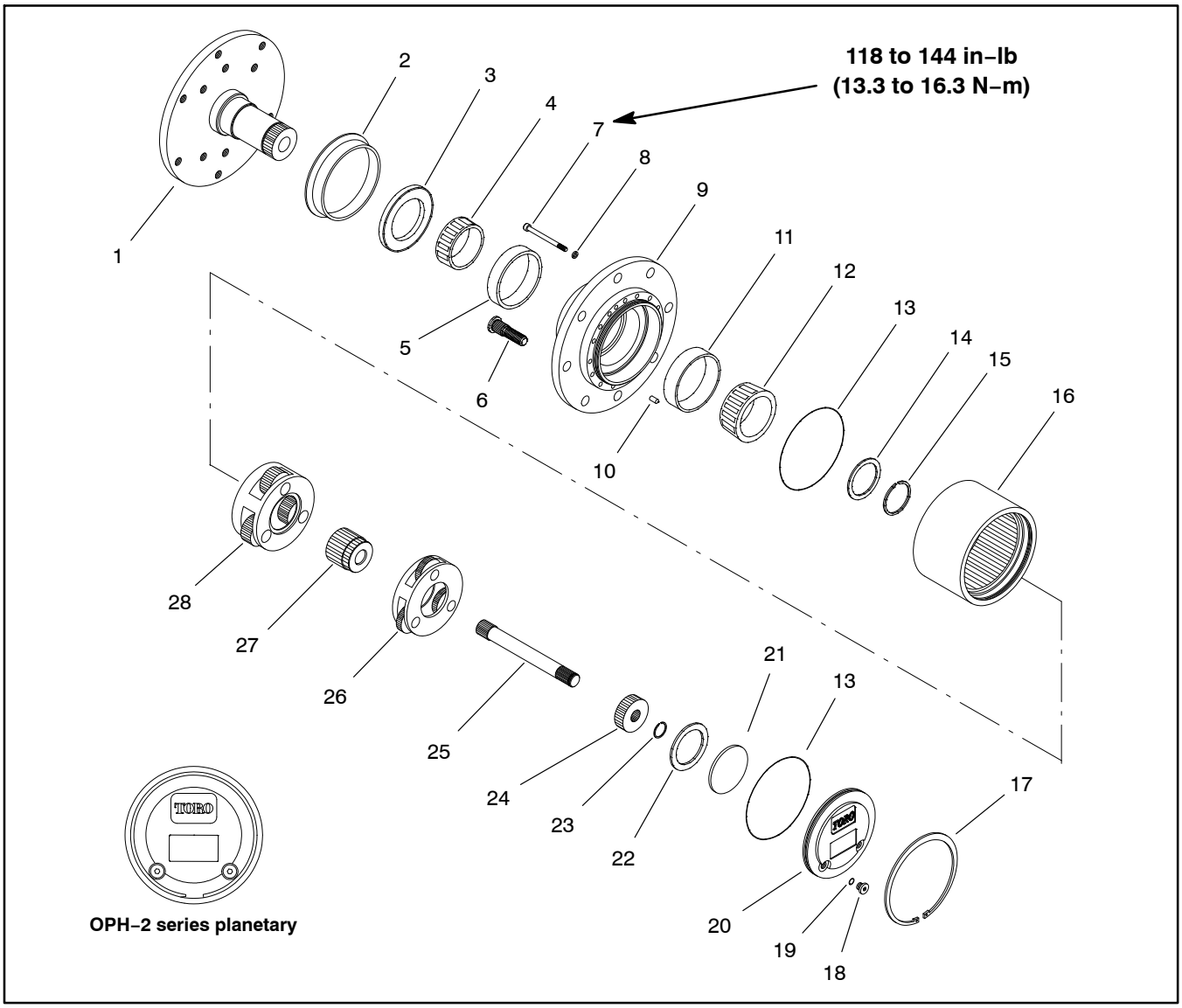


Figure 5

1. Spindle
2. Boot seal
3. Oil seal
4. Inner bearing cone
5. Inner bearing cup
6. Wheel stud (8)
7. Socket head screw (16)
8. Lock washer (16)
9. Housing
10. Dowel pin (2)
11. Outer bearing cup
12. Outer bearing cone
13. O−ring
14. Thrust washer
15. Retaining ring (external)
16. Ring gear
17. Retaining ring (internal)
18. Plug (2)
19. O−ring (2)
20. End cap
21. Thrust plug
22. Thrust washer
23. Retaining ring
24. Primary gear
25. Drive shaft
26. Primary carrier assembly
27. Secondary gear
28. Secondary carrier assembly

NOTE: The planetary wheel drive assembly can be serviced with the planetary installed to machine. If the spindle (item 1) needs to be removed from machine, see Planetary Wheel Drive Assembly in this section.

Disassembly (Figs. 5 and 6)

1. Park machine on a level surface, stop engine and remove key from the ignition switch.

2. Drain oil from planetary wheel drive/brake assembly; refer to traction unit Operator's Manual.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove wheel assembly.

4. Remove retaining ring (item 17).

5. Remove end cap (item 20). Thrust plug (item 21) and thrust washer (item 22) usually remain in end cap bore and should be removed for cleaning and inspection.

6. Remove drive shaft assembly (items 23, 24 and 25) If necessary, remove retaining ring and primary gear from shaft.

7. Remove primary carrier (item 26), secondary gear (item 27) and secondary carrier (item 28).

NOTE: Steps 8. through 11. are necessary only if inspecting or replacing bearings and/or seals.

IMPORTANT: Do not reuse retaining ring (item 10) after it has been removed.

8. Remove retaining ring (item 15) and thrust washer (item 14). Discard retaining ring.

9. Carefully remove housing (item 9) from spindle (item 1). Remove outer bearing cone (item 12).

10. Remove and discard seals (items 2 and 3) and O–rings (item 13) from housing.

11. Remove inner bearing cone (item 4) from housing. If necessary, remove bearing cups (items 5 and 11) from housing.

12. If wheel stud (item 6) removal is necessary, use press to extract stud(s) from housing.

13. If necessary, remove socket head screws (item 7) with lock washers (item 8) that secure ring gear (item 16) to housing. Remove ring gear and two (2) dowel pins (item 10) from housing.

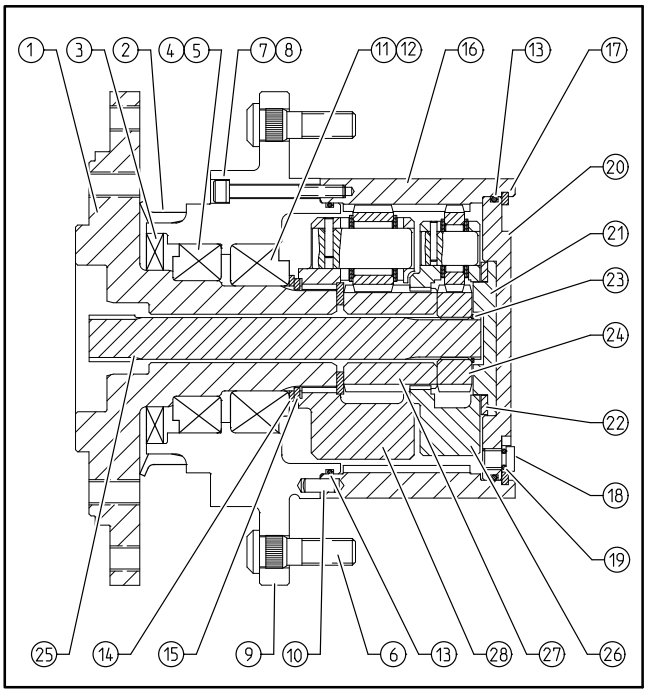


Figure 6

1. **Spindle**
2. **Boot seal**
3. **Oil seal**
4. **Inner bearing cone**
5. **Inner bearing cup**
6. **Wheel stud (8)**
7. **Socket head screw (16)**
8. **Lock washer (16)**
9. **Housing**
10. **Dowel pin (2)**
11. **Outer bearing cup**
12. **Outer bearing cone**
13. **O–ring**
14. **Thrust washer**
15. **Retaining ring (external)**
16. **Ring gear**
17. **Retaining ring (internal)**
18. **Plug (2)**
19. **O–ring (2)**
20. **End cap**
21. **Thrust plug**
22. **Thrust washer**
23. **Retaining ring**
24. **Primary gear**
25. **Drive shaft**
26. **Primary carrier assy.**
27. **Secondary gear**
28. **Secondary carrier assy.**

Assembly (Figs. 5 and 6)

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

NOTE: Use new seal and shim kits when assembling planetary wheel drive.

3. If spindle and housing were separated:

   A. Press bearing cups (items 5 and 11) into housing (item 9). Cups should be pressed fully to shoulder of the housing bore.

   B. Set inner bearing cone (item 4) into inner bearing cup.

C. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal (item 3) is not rubber or does not have a sealant coating, apply light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face. Lightly grease seal lips.

D. Pack boot seal (item 2) with grease and install.

E. If ring gear was removed from housing, place dowel pins (item 10) in housing. Secure ring gear to housing with lock washers (item 8) and socket head screws (item 7). Torque socket head screws from **118 to 144 in−lb (13.3 to 16.3 N−m)**.

F. Lightly oil bearing journals on spindle shaft. Slide housing assembly onto spindle (item 1) taking care to not damage seal or spindle. Make sure that inner bearing fully seats against spindle shaft shoulder.

G. Install outer bearing cone (item 12) onto spindle.

NOTE: The planetary shim kit includes the retaining ring and several thrust washers with thickness in incremental steps of 0.004 inch (0.10 mm).

H. Measure thickness of thrust washer (item 14) that was removed during disassembly. Choose new thrust washer of equal thickness or the next available thickness from thrust washers in the shim kit.

I. Apply a light coating of oil to spindle shaft, thrust washer (item 14) and new retaining ring (item 15). Install thrust washer onto spindle shaft.

WARNING

If retaining ring (item 15) is not fully installed in spindle groove, loss of wheel and personal injury may result.

J. Carefully install new retaining ring (item 15) into the spindle shaft groove taking care to not distort ring. If the proper thrust washer has been installed, the retaining ring should fit tightly between the thrust washer and spindle groove. Tap the OD of the retaining ring starting in the center and working out toward each end to ensure that the retaining ring is properly seated. Make sure that retaining ring ID is fully seated to spindle shaft groove.

K. After retaining ring is installed, make sure that there is no endplay in assembly. If required, remove retaining ring and install a thrust washer of different thickness to adjust endplay.

L. Install new O−ring (item 13) into groove in housing.

4. Install secondary carrier (item 28), secondary gear (item 27) and primary carrier (item 26) making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

5. If primary gear (item 24) was removed from drive shaft, slide gear onto shaft and secure with retaining ring (item 23).

6. Install drive shaft assembly (items 25, 24 and 23) making sure that drive shaft spline aligns with carrier gears.

7. Install thrust plug (item 21) and thrust washer (item 22) into end cap (item 20). Make sure that thrust plug and thrust washer are captive on inside of end cap (item 20).

8. Install new O−ring (item 13) to end cap and then install end cap. Secure cap with retaining ring (item 17).

NOTE: If the planetary drive is not installed on the machine, check operation of planetary drive by hand. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

9. Install wheel assembly.

10. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

11. Test planetary drive operation.

WARNING

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

12. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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VA02 Series Planetary Drive Service

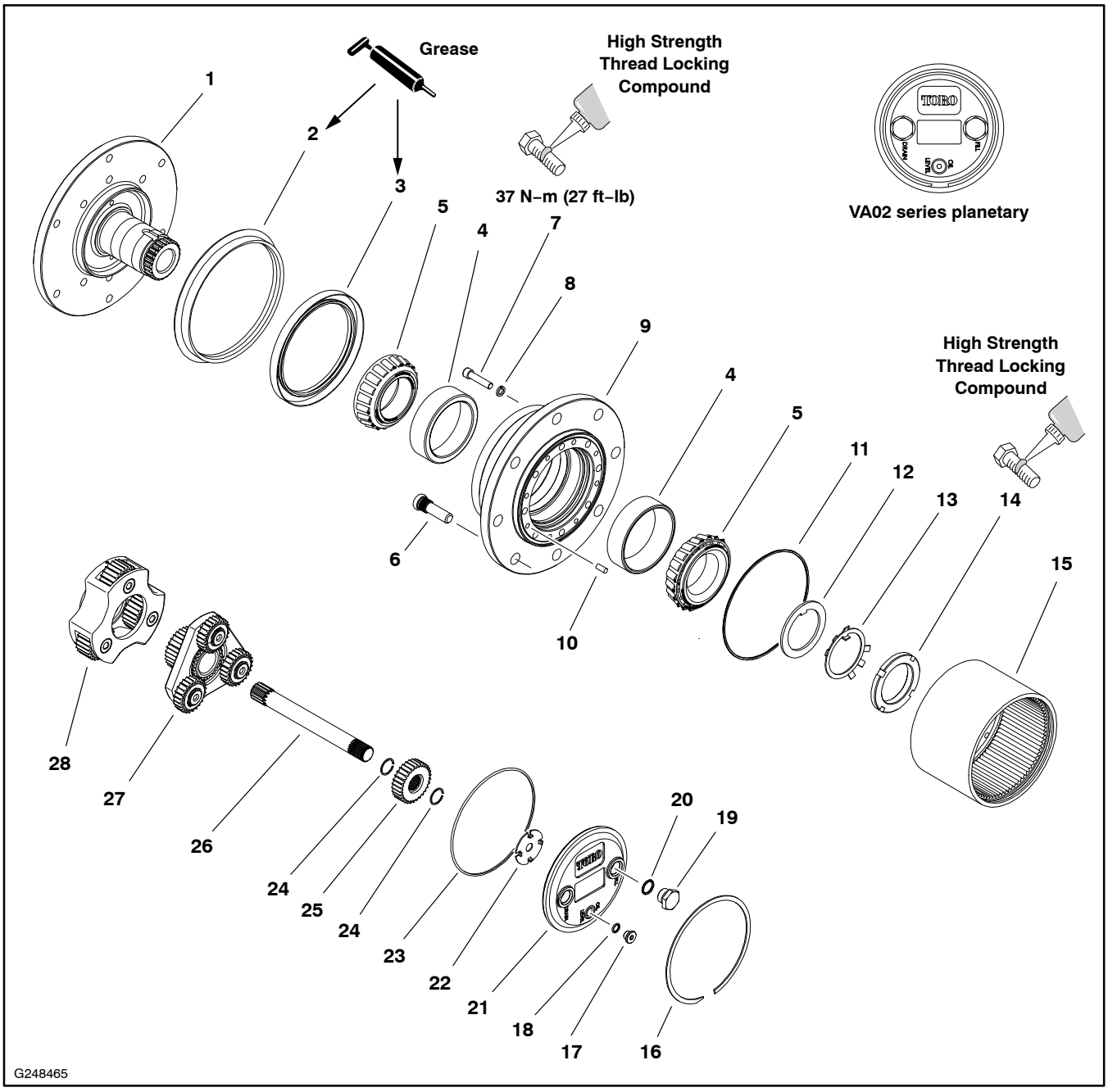


Figure 7

1. Spindle
2. Boot seal
3. Lip seal
4. Inner bearing cup (2)
5. Inner bearing cone (2)
6. Wheel stud (8)
7. Socket head screw (8)
8. Lock washer (8)
9. Housing
10. Dowel pin (4)
11. O–ring
12. Spacer
13. Locking washer
14. Lock nut
15. Ring gear
16. Retaining ring
17. Plug
18. O–ring
19. Plug (2)
20. O–Ring (2)
21. End cap
22. Thrust plate
23. O–Ring
24. Retaining ring (2)
25. Primary gear
26. Drive shaft
27. Primary carrier assembly
28. Secondary carrier assembly

NOTE: The planetary drive assembly is best serviced with the planetary installed to machine or the spindle firmly secured to a fixture or workbench. If the spindle (item 1) needs to be removed from machine, see Planetary Drive Assembly in this chapter.

Disassembly

1. Park machine on a level surface, stop engine and remove key from the ignition switch.

2. Drain oil from planetary drive and brake assembly; refer to traction unit Operator's Manual.

3. Chock rear wheels and jack up front of machine (see Jacking Instructions in Chapter 1 – Safety). Support machine with jack stands and remove wheel assembly.

4. Remove retaining ring (item 16).

5. Remove end cap and thrust plate. Retrieve and discard O–ring from ring gear bore.

6. Remove primary gear and drive shaft assembly (items 24–26).

7. Remove primary carrier and secondary carrier from ring gear.

8. Bend the locking washer tab away from the lock nut. Use a TMFS12 spanner socket to remove the 55 x 1.5 mm lock nut. Remove the locking washer and spacer. Discard the locking washer.

9. Carefully remove housing and bearing cones from spindle.

10. Remove and discard seals from housing.

11. If necessary, remove bearing cups from housing.

12. If wheel stud removal is necessary, use a press to remove the stud(s) from the housing.

13. If necessary, remove the ring gear from the housing:

NOTE: High strength thread locking compound was used during assembly. It may be necessary to heat the ring gear near the mounting screws to release the screws.

A. Remove socket head screws (item 7) and lock washers that secure the ring gear to the housing.

B. Remove the ring gear and retrieve the four (4) dowel pins (item X) from housing.

C. Remove the O–ring from the housing bore and discard.

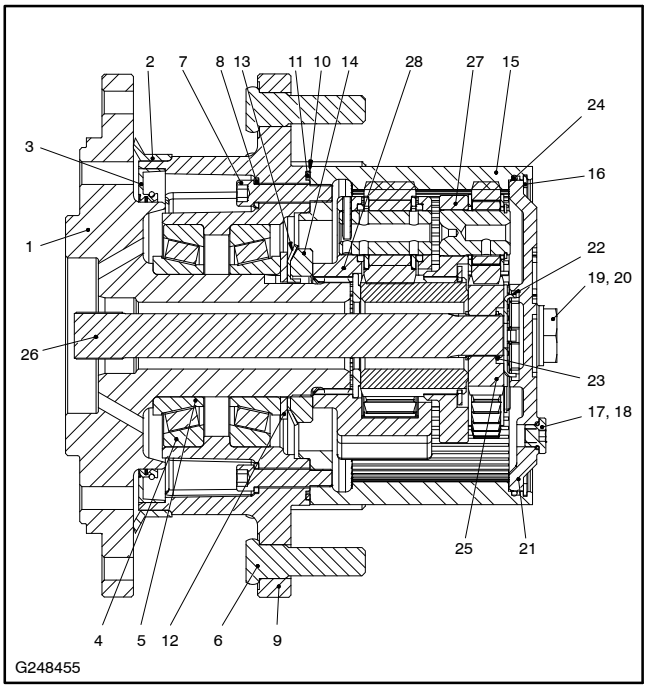


Figure 8

1. **Spindle**
2. **Boot seal**
3. **Lip seal**
4. **Inner bearing cup (2)**
5. **Inner bearing cone (2)**
6. **Wheel stud (8)**
7. **Socket head screw (8)**
8. **Lock washer (8)**
9. **Housing**
10. **Dowel pin (4)**
11. **O–ring**
12. **Spacer**
13. **Locking washer**
14. **Lock nut**
15. **Ring gear**
16. **Retaining ring**
17. **Plug**
18. **O–ring**
19. **Plug (2)**
20. **O–Ring (2)**
21. **End cap**
22. **Thrust plate**
23. **O–Ring**
24. **Retaining ring (2)**
25. **Primary gear**
26. **Drive shaft**
27. **Primary carrier asm**
28. **Secondary carrier asm**

Assembly

NOTE: Use new seals, O–rings and locking washer when assembling the planetary drive.

1. Thoroughly clean parts in solvent and dry completely after cleaning. Inspect parts for damage or excessive wear and replace as necessary.

2. If any wheel studs were removed, use a press to install new studs into housing. Make sure that stud shoulder is fully pressed against housing surface.

3. If ring gear was removed from housing:

A. Fit four (4) dowel pins in housing.

B. Apply a light coat of grease to a new O–ring and install it in the housing bore.

C. Apply high strength thread locking compound and secure ring gear to housing with lock washers and socket head screws. Tighten screws to **27 ft–lb (37 N–m)**.

4. If previously removed, press bearing cups into housing. Cups should be pressed fully to shoulder of the housing bore.

5. Fit inner bearing cone onto spindle. Make sure inner bearing cone seats fully against spindle shoulder. If inner bearing is not seated fully, lightly tap bearing cone on inner hub until it seats properly.

6. Make sure that seal bore in housing is thoroughly cleaned. If OD of seal is not rubber or does not have a sealant coating, apply a light coating of silicone sealant to seal bore in housing. Install seal into housing so it is flush with housing face.

7. Install boot seal. Cover surface of lip seal and boot seal with grease.

8. Lightly oil bearing cups then place housing assembly over spindle and inner bearing cone. Take care to not damage seals or spindle during installation.

9. Fit outer bearing cone onto spindle.

10. Align key on spacer and install spacer onto spindle shaft.

11. Align key on locking washer and install locking washer onto spindle shaft.

IMPORTANT: .Perform the following steps without interruption. Once the thread locking compound is applied, you have only a few minutes before the curing process will influence the bearing lock nut torque.

12. Install the bearing lock nut:

A. Apply high strength thread locking compound (Loctite 263 or equivalent) and install the lock nut.

B. Tighten the lock nut to **110 ft−lb (150 N−m)**.

C. Rotate the housing on the spindle a few revolutions to align the bearings.

D. Tighten the lock nut to **150 ft−lb (200 N−m)**.

E. Rotate the housing on the spindle a few revolutions to seat the bearings.

IMPORTANT If installing the bearing nut with the spindle installed on machine, have an assistant hold the housing firmly in position during the following step.

F. Loosen the lock nut completely, then tighten to **90 ft−lb (122 N−m).**

IMPORTANT: Continue to tighten the lock nut until it aligns with one of the locking washer tabs. Do Not loosen the lock nut to align it with the locking washer tabs.

G. Secure the lock nut by bending one of the locking washer tabs into a slot in the lock nut.

13. Install secondary carrier and primary carrier making sure that carrier gear teeth align with ring gear and spline on spindle shaft.

14. If primary gear (item 25) was removed from drive shaft, slide gear onto shaft and secure with retaining rings.

15. Install drive shaft assembly (items 24−26) making sure that drive shaft spline aligns with carrier gears.

16. Cover the outer face of the thrust plate with grease and fit thrust plate onto end cap. Make sure that thrust plate tabs are captive in end cap.

17. Apply a light coat of grease to a new O−ring and install it in the ring gear bore. Avoid pinching or cutting the O−ring and install the end cap. Use a soft mallet to fully seat the end cap.

18. Secure the end cap with the retaining ring. Make sure the retaining ring is fully seated in the ring groove.

NOTE: If the planetary drive is not installed on the machine, check operation of planetary drive by hand. With a constant turning force applied, rotation of the planetary should be consistent. If there is more drag at certain points, gears are not rolling freely and the planetary should be examined for improper assembly or damaged components.

19. Install wheel assembly.

20. Fill planetary drive with gear lube; refer to traction unit Operator's Manual. A portion of the gear lube will pass into the brake assembly automatically.

21. Test planetary drive operation.

WARNING

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

22. Remove jack stands and lower machine to ground. Tighten wheel lug nuts in a crossing pattern from **85 to 100 ft−lb (116 to 135 N−m)**.

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Rear Axle Assembly

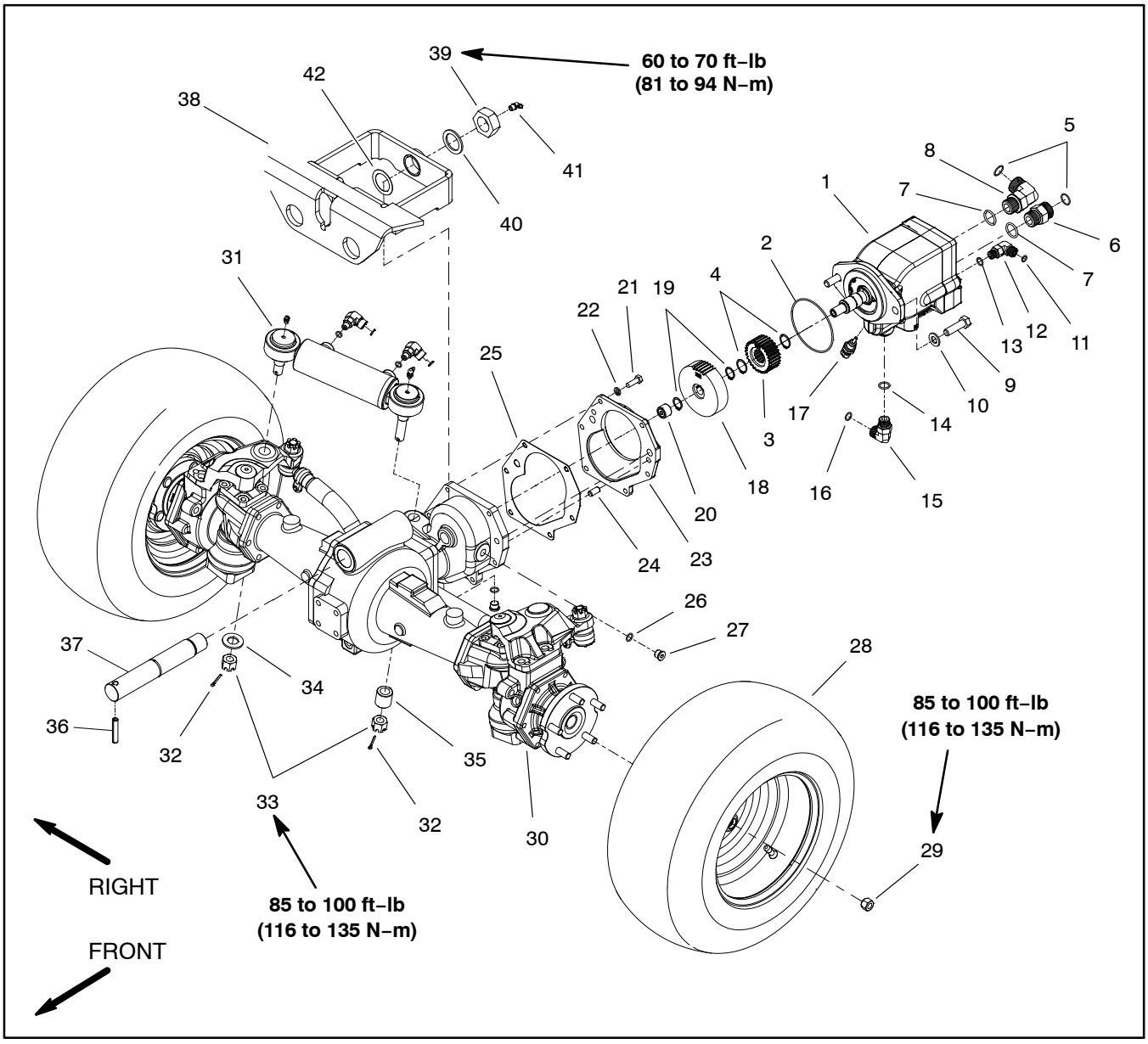


Figure 9

1. Rear axle motor
2. O−ring
3. Pinion gear
4. External snap ring (2)
5. O−ring
6. Hydraulic fitting
7. O−ring
8. 90º hydraulic fitting
9. Cap screw (2)
10. Flat washer (2)
11. O−ring
12. 90º hydraulic fitting
13. O−ring
14. O−ring
15. 90º hydraulic fitting
16. O−ring
17. Temperature sender with O−ring
18. Gear
19. External snap ring (2)
20. Needle bearing
21. Cap screw (6)
22. Lock washer (6)
23. Cover plate
24. Dowel pin (2)
25. Gasket
26. O−ring
27. Plug
28. Rear wheel assembly
29. Lug nut (5 per wheel)
30. Rear axle assembly
31. Steering cylinder assembly
32. Cotter pin (2)
33. Slotted hex nut (2)
34. Flat washer
35. Spacer
36. Slotted roll pin
37. Rear axle pivot pin
38. Machine frame
39. Lock nut
40. Thrust washer
41. Grease fitting
42. Thrust washer (2)

Remove Rear Axle (Fig. 9)

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

2. Clean the area around the drain plugs and drain oil from rear axle assembly:

   A. Both outer housings (Fig. 10)

   B. Center section (Fig. 10)

   C. Gearbox (Fig. 11)

CAUTION

When changing attachments, tires or performing other service, use correct jacks, hoists and jack stands to raise and support machine. See Jacking Instructions in Chapter 1 – Safety for additional information and precautions.

3. Chock front wheels, raise rear of machine and support machine with appropriate jack stands (see Jacking Instructions in Chapter 1 – Safety).

4. Remove both wheel assemblies from rear axle.

5. Remove hydraulic motor from axle assembly (see Rear Axle Motor in Chapter 5 – Hydraulic System).

6. Remove hydraulic hoses from steering cylinder. Put caps or plugs on hoses and cylinder fittings to prevent contamination.

7. Remove lock nut (item 39) and thrust washer (item 40) from rear axle pivot pin.

8. Support rear axle to prevent it from falling. Remove pivot pin from frame and rear axle. Lower rear axle from machine. Note location of thrust washer (item 42) on both ends of axle mounting boss.

9. If needed for further axle disassembly, remove steering cylinder from axle (see Steering Cylinder in Chapter 5 – Hydraulic System).

10. If required, remove tie rod ends from steering arms on rear axle (Fig. 12). Remove the cotter pins and castle nuts from the tie rod ball joints. Use a ball joint fork and remove the tie rod ends from the axle steering arms.

11. Clean the rear axle pivot pin and pivot bushings. Inspect the pin and bushings for wear or damage. Replace components as necessary.

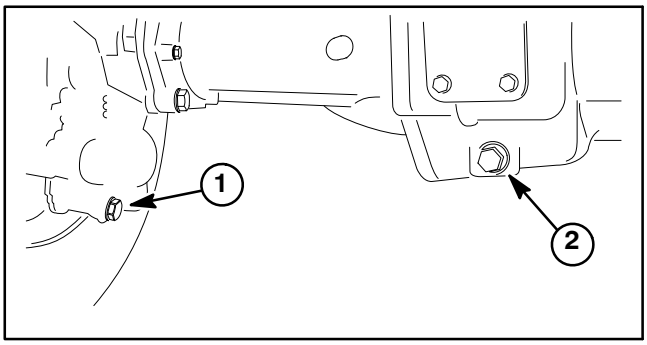


Figure 10

1. Outer housing plug (2)
2. Center axle drain plug

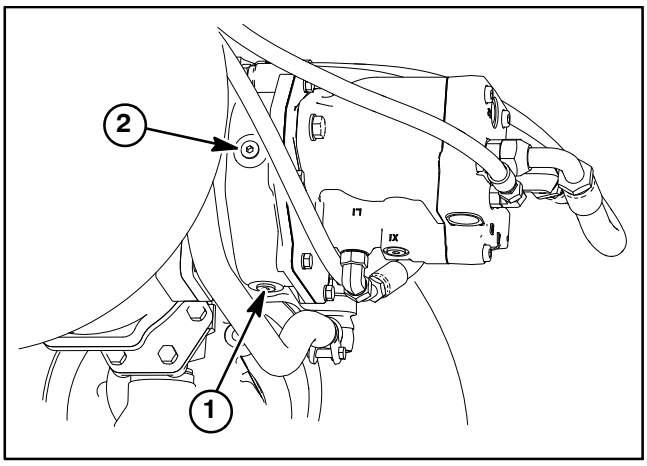


Figure 11

1. Gearbox drain plug
2. Gearbox fill plug

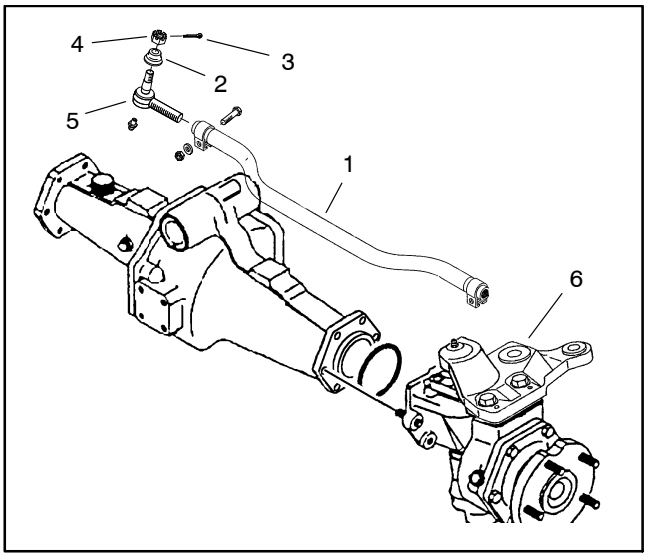


Figure 12

1. Tie rod
2. Dust cover
3. Cotter pin
4. Castle nut
5. Tie rod end
6. Steering arm (LH)

Install Rear Axle (Fig. 9)

1. If removed, install steering cylinder to axle assembly (see Steering Cylinder in Chapter 5 – Hydraulic System).

2. If removed, install the tie rod to rear axle (Fig. 12). Tighten ball joint castle nuts and install new cotter pins.

3. Support axle under machine with a jack. Position axle assembly to rear frame mount.

4. Install rear axle pivot pin to secure axle to frame. Make sure to install thrust washer (item 42) between axle pivot and frame on both ends of the pivot. With thrust washers installed, there should be from **0.002 to 0.020 inch (0.05 to 0.51 mm)** clearance between rear frame mount and axle mounting boss. Add additional thrust washers if needed to adjust clearance.

5. Install thrust washer (item 40) and lock nut (item 39) onto axle pivot pin. Lock nut should be tightened enough to allow pivot pin to rotate **(70 ft–lb (94 N–m) maximum)**.

6. Install hydraulic motor to axle assembly (see Rear Axle Motor in Chapter 5 – Hydraulic System).

7. Remove caps and plugs from hydraulic hoses and steering cylinder fittings. Secure hydraulic hoses to steering cylinder (see Hydraulic Hose and Tube Installation in Chapter 5 – Hydraulic System).

WARNING

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

8. Install wheel assemblies to rear axle. Lower machine to ground. Torque wheel lug nuts from **85 to 100 ft–lb (116 to 135 N–m)**.

9. Replace drain plugs and fill rear axle with SAE 85W–140 weight gear lube – 128 fl. oz. (3.31 L) total:

   A. Gearbox (Fig. 11) – 16 fl. oz. (0.47 L)

   B. Both outer housings (Fig. 13) – 16 fl. oz. (0.47 L)

   C. Center section (Fig. 14) – 80 fl. oz. (2.37 L)

10. Check rear wheel toe–in and adjust if necessary (see traction unit Operator's Manual).

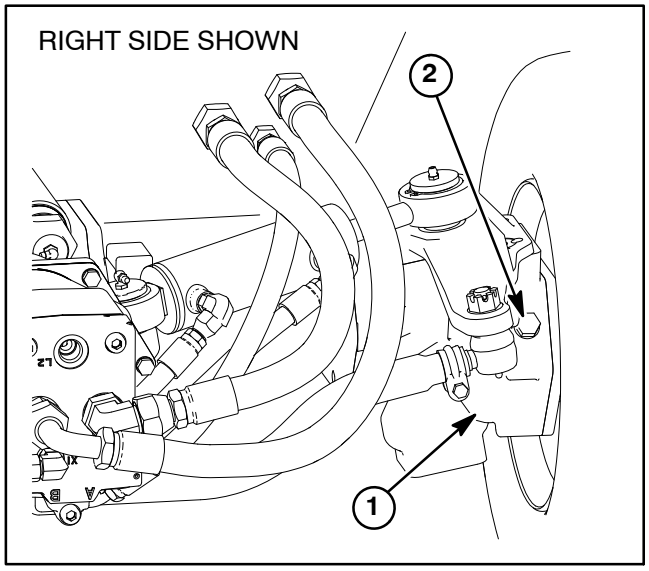


Figure 13

1. **Outer housing (2)** 2. **Housing check/fill plug**

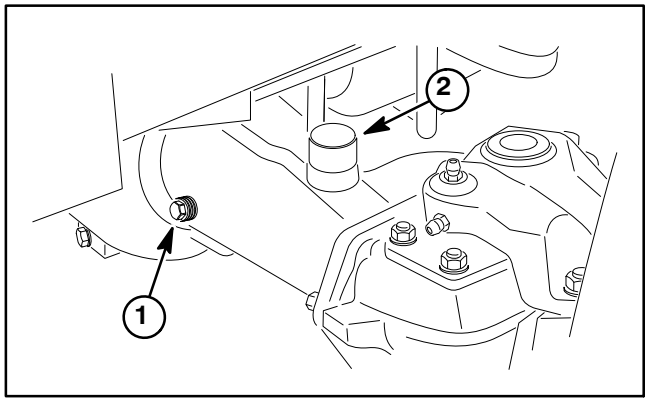


Figure 14

1. **Axle check plug** 2. **Axle fill plug**

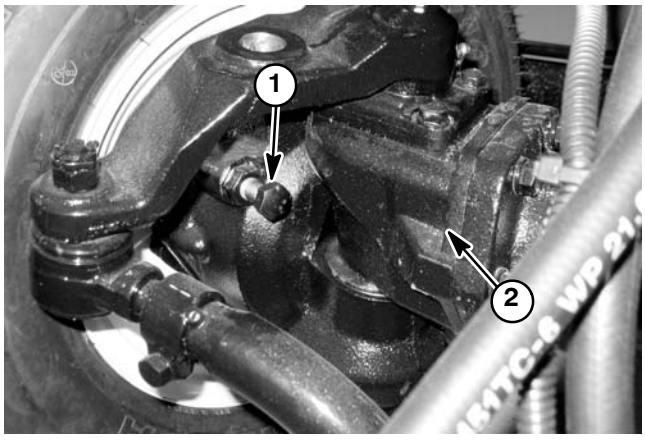


Figure 15

1. **Steering stop bolt** 2. **Bevel gear case (LH)**

11. Check steering stop bolt adjustment. When the steering cylinder is fully retracted (left turn), a gap of **1/16" (1.6 mm)** should exist between bevel gear case casting and stop bolt on left axle case. Figure 15 shows stop bolt location.

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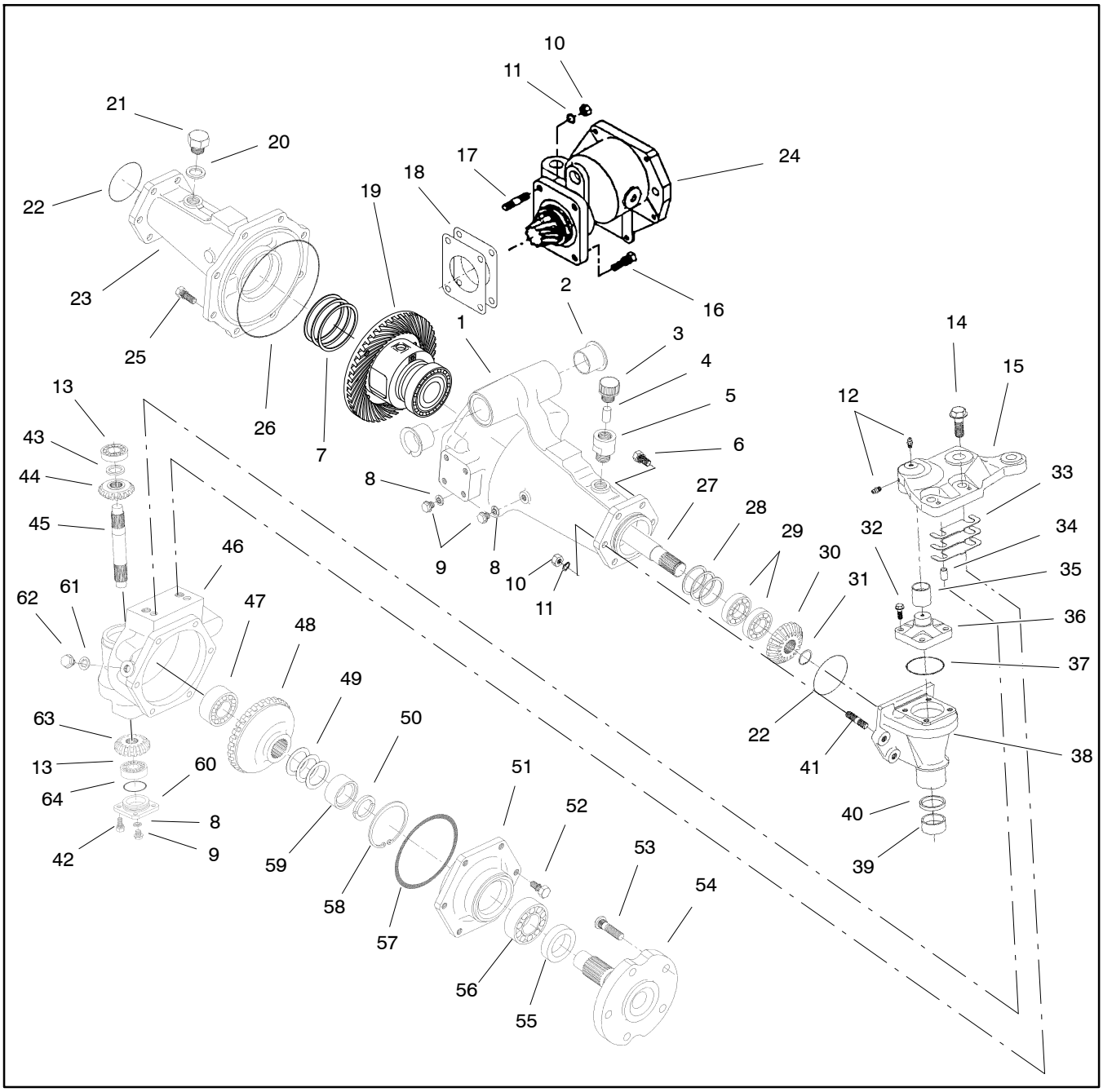

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Figure 16

Figure 12 (Continued)

1. LH axle support
2. Flange bushing (2)
3. Axle vent
4. Filter
5. Vent extension
6. Cap screw (4 per gear case)
7. Shim set
8. Seal washer
9. Plug
10. Lock nut
11. Lock washer
12. Grease fitting
13. Ball bearing
14. Screw (2 per steering arm)
15. Axle case support (LH shown)
16. Bolt (2)
17. Stud (2)
18. Shim set
19. Differential assembly
20. O−ring
21. Plug
22. O−ring
23. RH axle support
24. Input shaft assembly
25. Bolt (8)
26. O−ring
27. Differential shaft (LH shown)
28. Shim set
29. Ball bearing
30. Bevel gear (15 tooth)
31. Retaining ring
32. Bolt (4 per knuckle)
33. Shim set
34. Dowel pin (2 per axle case)
35. Bushing
36. Knuckle pin
37. O−ring
38. Bevel gear case (LH shown)
39. Bushing
40. Shaft seal
41. Stud (2 per gear case)
42. Bolt (4 per cover)
43. Collar
44. Bevel gear (17 tooth)
45. Bevel gear shaft
46. Axle case (LH shown)
47. Ball bearing
48. Bevel gear (29 tooth)
49. Shim set
50. Clip (2 per axle case)
51. Axle cover
52. Screw (6 per cover)
53. Wheel stud (5 per axle)
54. Axle
55. Oil seal
56. Ball bearing
57. O−ring
58. Retaining ring
59. Spacer
60. Axle case cover
61. Seal washer
62. Plug
63. Bevel gear (17 tooth)
64. O−ring

NOTE: Figure 16 illustrates the rear axle used on the Reelmaster 7000−D. Service procedures for the rear axle is on the following pages of this section.

Bevel Gear Case and Axle Case

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 17).

2. Mark both right and left bevel gear case/axle case assemblies.

IMPORTANT: Do not interchange right and left bevel gear case/axle case assemblies.

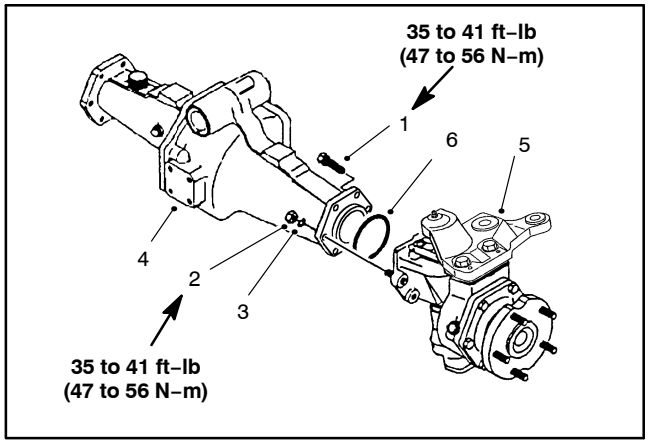


Figure 17

1. Cap screw (4)
2. Lock nut (2)
3. Lock washer (2)
4. Axle support
5. Bevel gear case/axle case assembly
6. O-ring

3. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 18).

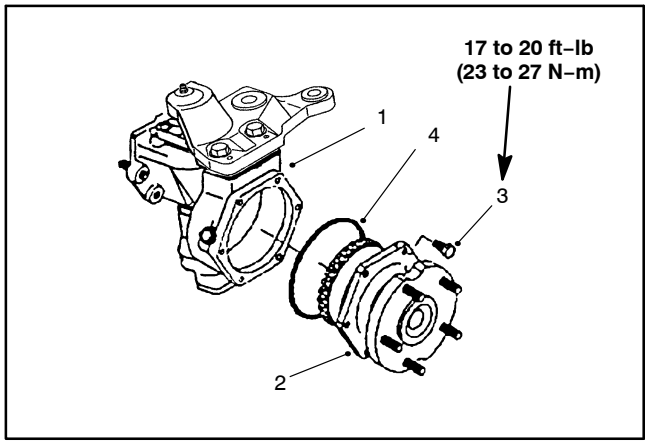


Figure 18

1. Axle case
2. Axle cover assembly
3. Screw (6)
4. O-ring

4. Remove the axle case support mounting screws, the axle case support and the support shims (Fig. 19).

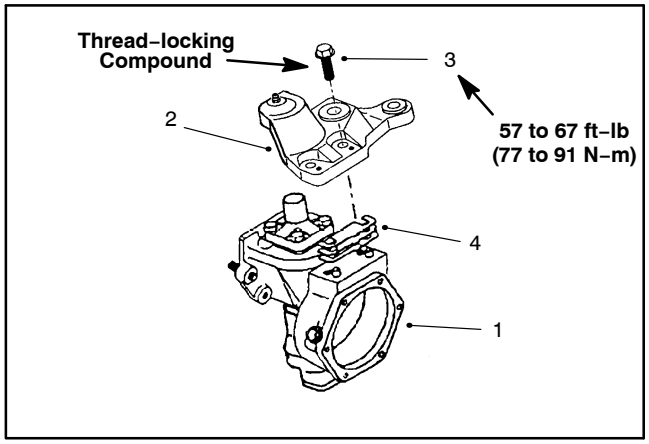


Figure 19

1. Axle case
2. Axle case support
3. Screw (2)
4. Support shim

5. Remove the knuckle pin mounting screws and the knuckle pin. Remove the gasket and any remaining gasket material from either mating surface (Fig. 20).

6. While holding the bevel gear case, tap the upper end of the bevel gear shaft out of the upper bearing and upper bevel gear.

7. Pull the bevel gear case from the axle case and remove the upper bevel gear and collar from the gear case.

8. Remove the axle case cover screws, cover and the O-ring from the axle case.

9. Remove the plug and sealing washer from the center of the axle case cover. While holding the axle case cover, lightly tap the lower end of the bevel gear shaft out of the lower bearing and lower bevel gear.

10. Remove and discard bevel gear shaft seal from axle case (Fig. 20).

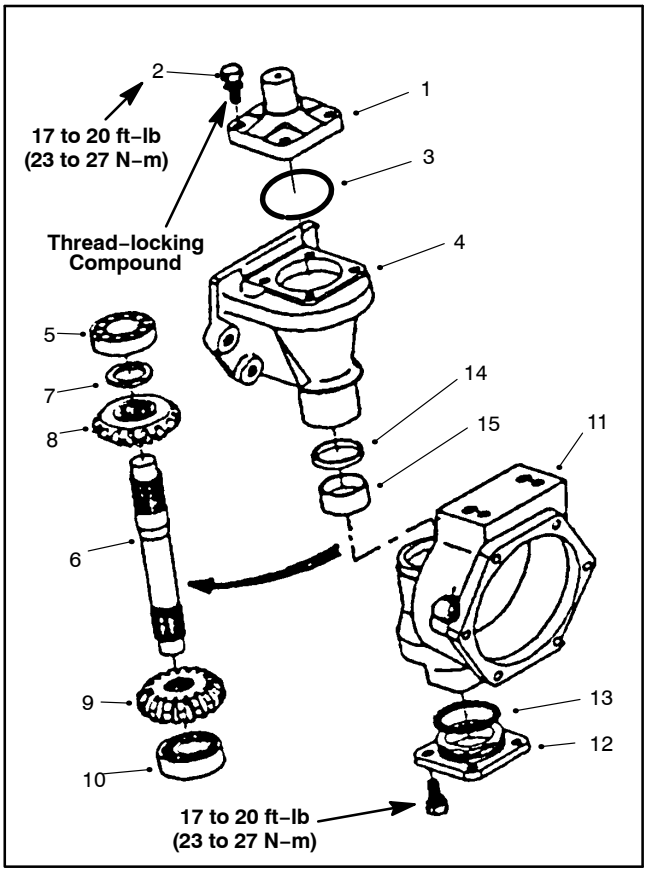


Figure 20

1. Knuckle pin
2. Mounting screw (4)
3. O–ring
4. Bevel gear case
5. Upper bearing
6. Bevel gear shaft
7. Collar
8. Upper bevel gear
9. Lower bevel gear
10. Lower bearing
11. Axle case
12. Axle case cover
13. O-ring
14. Shaft seal
15. Bushing

Inspection

1. Measure the knuckle pin O.D. and the axle case support bushing I.D. to determine the bushing to pin clearance (Fig. 21). Replace components as necessary.

BUSHING TO PIN CLEARANCE:
0.002 to 0.016 inch (0.05 to 0.40 mm)

KNUCKLE PIN O.D. (Factory Spec.):
0.982 to 0.983 inch (24.95 to 24.98 mm)

AXLE CASE SUPPORT BUSHING I.D.
(Factory Spec.):
0.984 to 0.987 inch (25.00 to 25.08 mm)

2. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

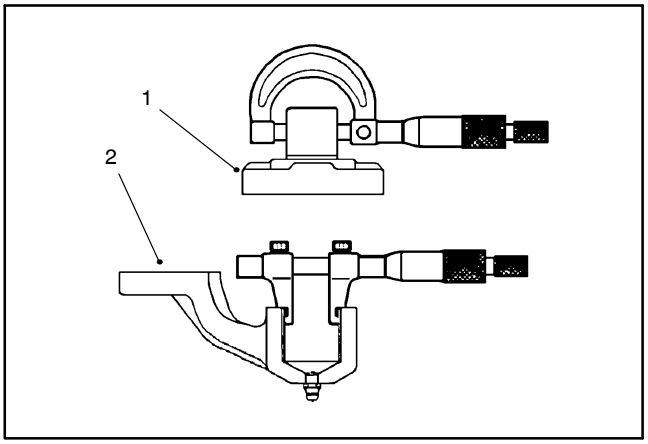


Figure 21

1. Knuckle pin
2. Axle case support

Installation

1. Coat new shaft seal with grease and install in axle case as shown (Fig. 22).

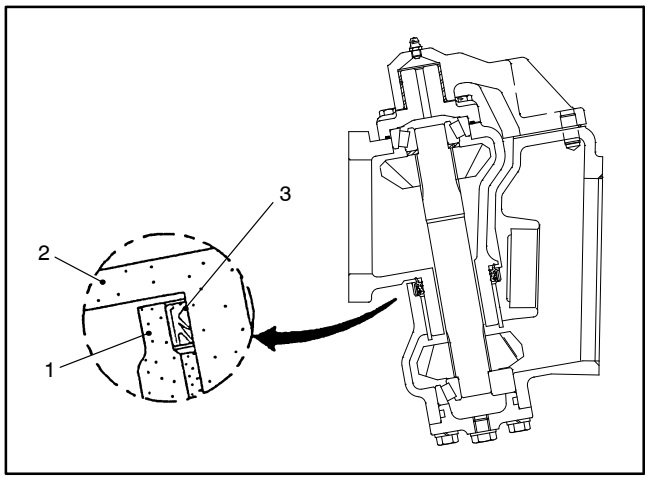


Figure 22

1. **Axle case**
2. **Bevel gear case**
3. **Shaft seal**

2. Install the lower bevel gear and bevel gear shaft in the axle case cover. Coat a new O-ring with grease and install the axle case cover (Fig. 23). Tighten cover screws from **17 to 20 ft-lb (23 to 27 N–m)**.

3. Slide the bevel gear case over the bevel gear shaft and install the bevel gear and collar. Make sure the bevel gear shaft is completely seated in the upper and lower bearings (Fig. 23).

4. Install the knuckle pin. Use medium strength thread–locking compound and tighten the knuckle pin mounting screws from **17 to 20 ft-lb (23 to 27 N–m)**.

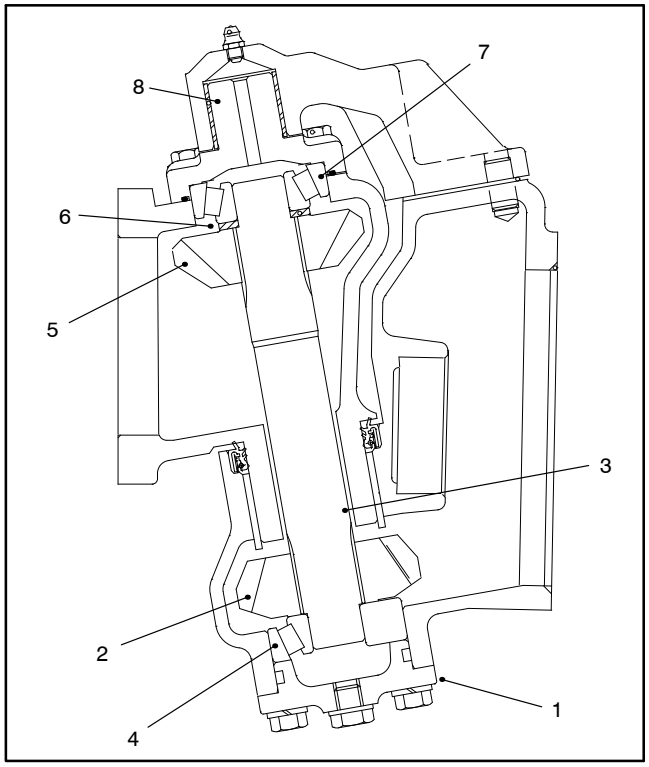


Figure 23

1. **Axle case cover**
2. **Lower bevel gear**
3. **Bevel gear shaft**
4. **Lower bearing**
5. **Upper bevel gear**
6. **Collar**
7. **Upper bearing**
8. **Knuckle pin**

5. Determine necessary quantity of support shims.

A. Lubricate the axle case support bushing with a thin coat of grease and slide axle case support onto knuckle pin.

B. Position support shims that were removed during disassembly between axle case support and axle case. Install mounting screws into axle case. Slowly tighten screws while frequently checking for clearance (vertical endplay) between axle case support and knuckle pin. If binding of components is noted before screws are fully tightened, add additional support shims. Torque screws from **57 to 67 ft−lb (77 to 91 N−m)**.

C. Use dial indicator to measure vertical endplay of axle case (Fig. 24).

AXLE CASE ASSEMBLY ENDPLAY:
0.001 to 0.008 inch (0.02 to 0.20 mm)

D. Adjust endplay by increasing or reducing number of axle case support shims.

NOTE: Axle case support shims are available in 0.004 inch (0.1 mm), 0.008 inch (0.2 mm) and 0.016 inch (0.4 mm) thickness.

6. After correct support shims have been determined, remove mounting screws, apply heavy strength thread−locking compound to screw threads, reinstall screws and torque from **57 to 67 ft−lb (77 to 91 N−m)**.

IMPORTANT: Correct engagement between bevel gears is critical to axle performance and durability.

7. Temporarily install the bevel gear case/axle case assembly on the axle support. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the upper bevel gear to differential shaft gear backlash (Fig. 25).

UPPER BEVEL GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

8. Adjust backlash by increasing or reducing axle bearing shim thickness (see Differential Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.004 inch (0.1 mm), 0.008 inch (0.2 mm) and 0.020 inch (0.5 mm) thickness.

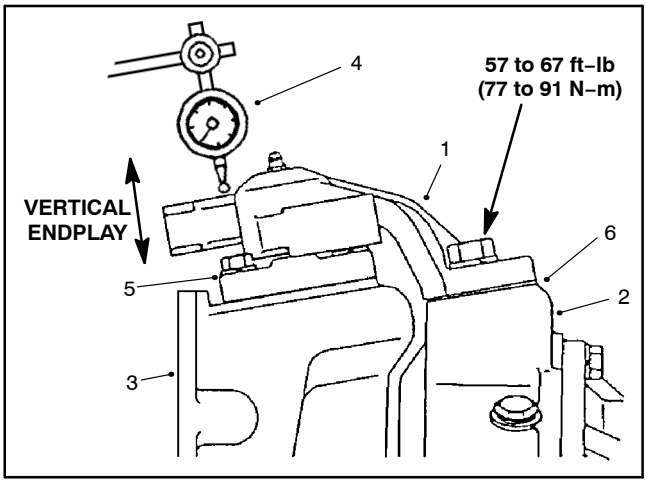


Figure 24

1. **Axle case support**
2. **Axle case**
3. **Bevel gear case**
4. **Dial indicator**
5. **Knuckle pin**
6. **Support shim location**

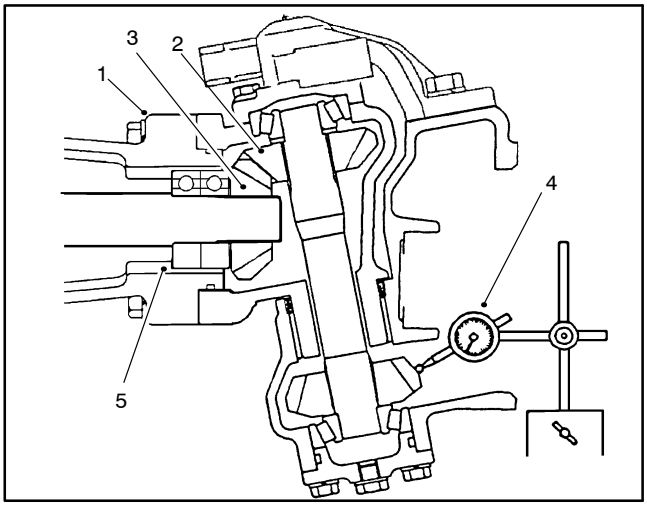


Figure 25

1. **Axle support**
2. **Upper bevel gear**
3. **Differential shaft gear**
4. **Dial indicator**
5. **Axle bearing shims**

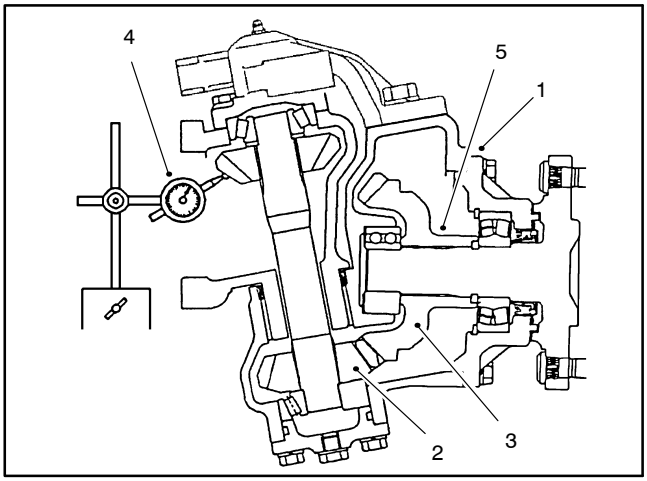


Figure 26

1. **Axle cover assembly**
2. **Lower bevel gear**
3. **Axle gear**
4. **Dial indicator**
5. **Axle bearing shims**

9. Remove the bevel gear case/axle case assembly from the axle support. Coat a new O-ring with grease and temporarily install the axle cover assembly. Position a dial indicator at the tooths center. Prevent the axle from turning and measure the lower bevel gear to axle gear backlash (Fig. 26).

LOWER BEVEL GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

10. Adjust backlash by increasing or reducing axle bearing shim thickness (see Axle Shafts in this section of this manual).

NOTE: Axle bearing shims are available in 0.008 inch (0.2 mm), 0.012 inch (0.3 mm) and 0.020 inch (0.5 mm) thickness.

11. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N−m)**.

12. Coat a new O-ring with grease and install the bevel gear case/axle case assembly on the axle support. Tighten mounting screws and nuts from **35 to 41 ft-lb (47 to 56 N−m)** (Fig. 17).

Differential Shafts

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

IMPORTANT: Do not interchange right and left differential shaft assemblies.

1. Remove the mounting screws, nuts and lock washers. Remove the bevel gear case/axle case assembly and O-ring from the axle support (Fig. 27).

2. Mark and pull the differential shaft assembly from the axle support.

3. Remove the retaining ring and bevel gear (Fig 28).

4. Drive the differential shaft out of the bearings. Remove the bearings and bearing shims.

5. Inspect all gears, shafts, bearings and cases for damage and wear. Replace components as necessary.

Installation

1. Press bearings onto differential shaft. Place correct combination of bearing shims in axle support and drive differential shaft and bearing assembly into axle support.

2. Install bevel gear and retaining ring.

3. Coat new O-ring with grease. Align differential shaft splines with differential gear assembly and slide differential shaft assembly onto axle support.

4. Install bevel gear case/axle case assembly (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

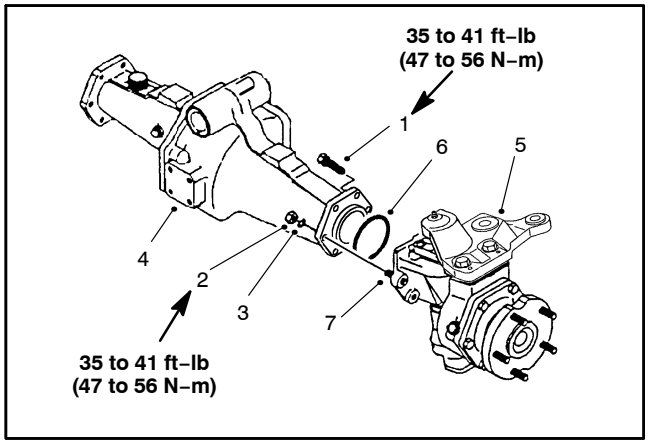


Figure 27

1. Cap screw (4)
2. Lock nut (2)
3. Lock washer (2)
4. Axle support
5. Bevel gear/axle case assembly
6. O-ring
7. Stud (2)

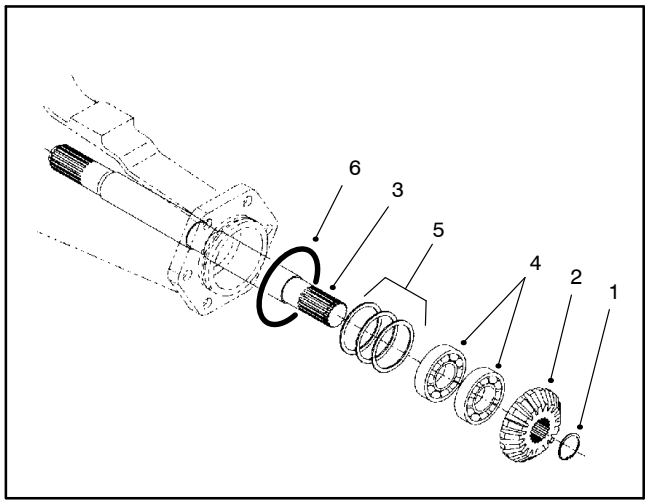


Figure 28

1. Retaining ring
2. Bevel gear
3. Differential shaft
4. Bearing
5. Bearing shims
6. O-ring

Axle Shafts

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove the axle cover mounting screws. Remove the axle cover from the axle case as an assembly (Fig. 29).

2. Use a bearing puller to remove the bearing and bevel gear as shown (Fig. 30).

3. Remove the shims, spacer and retaining ring. Drive the axle out of the bearing and cover. Remove and discard the axle shaft seal.

4. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

Installation

1. Coat new axle shaft seal with grease and install in axle cover as shown (Fig. 31).

2. Press the axle cover and bearing assembly onto the axle shaft. Press only on the inner race of the cover bearing (Fig. 31).

3. Install retaining ring, spacer and correct combination of bearing shims. Install bevel gear and bearing.

4. Coat a new O-ring with grease and install the axle cover assembly. Tighten axle cover screws from **17 to 20 ft-lb (23 to 27 N–m)**.

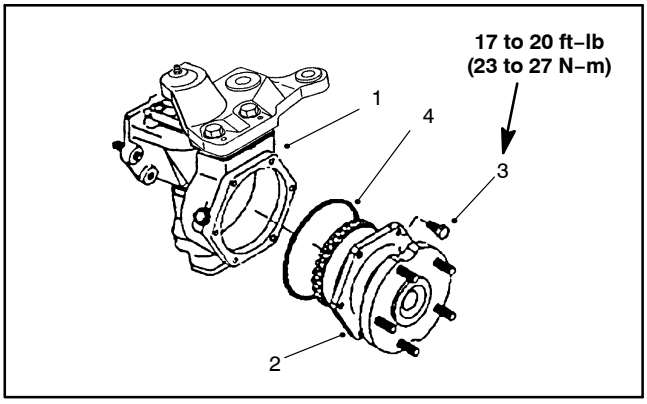


Figure 29

1. **Axle case**
2. **Axle cover assembly**
3. **Screw (6)**
4. **O-ring**

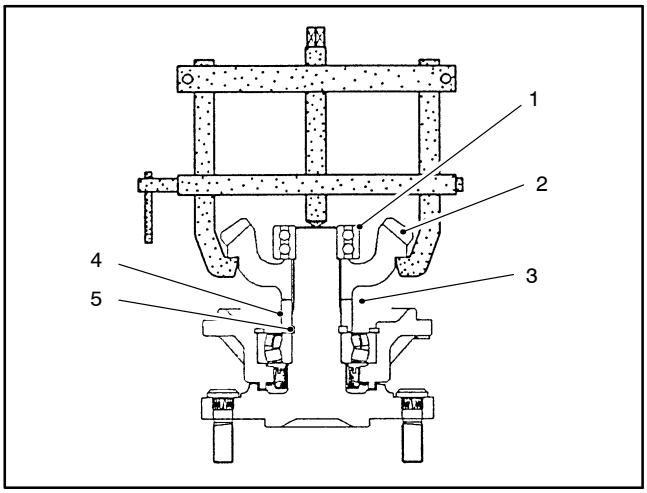


Figure 30

1. **Bearing**
2. **Bevel gear**
3. **Shims**
4. **Spacer**
5. **Retaining ring**

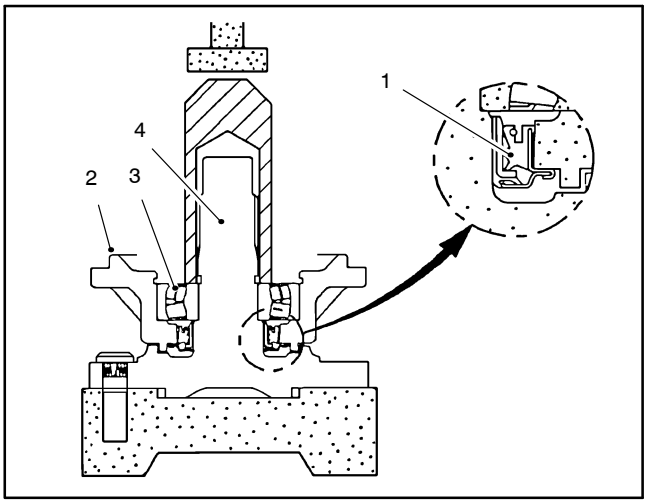


Figure 31

1. **Axle shaft seal**
2. **Axle cover**
3. **Bearing**
4. **Axle shaft**

Input Shaft/Pinion Gear

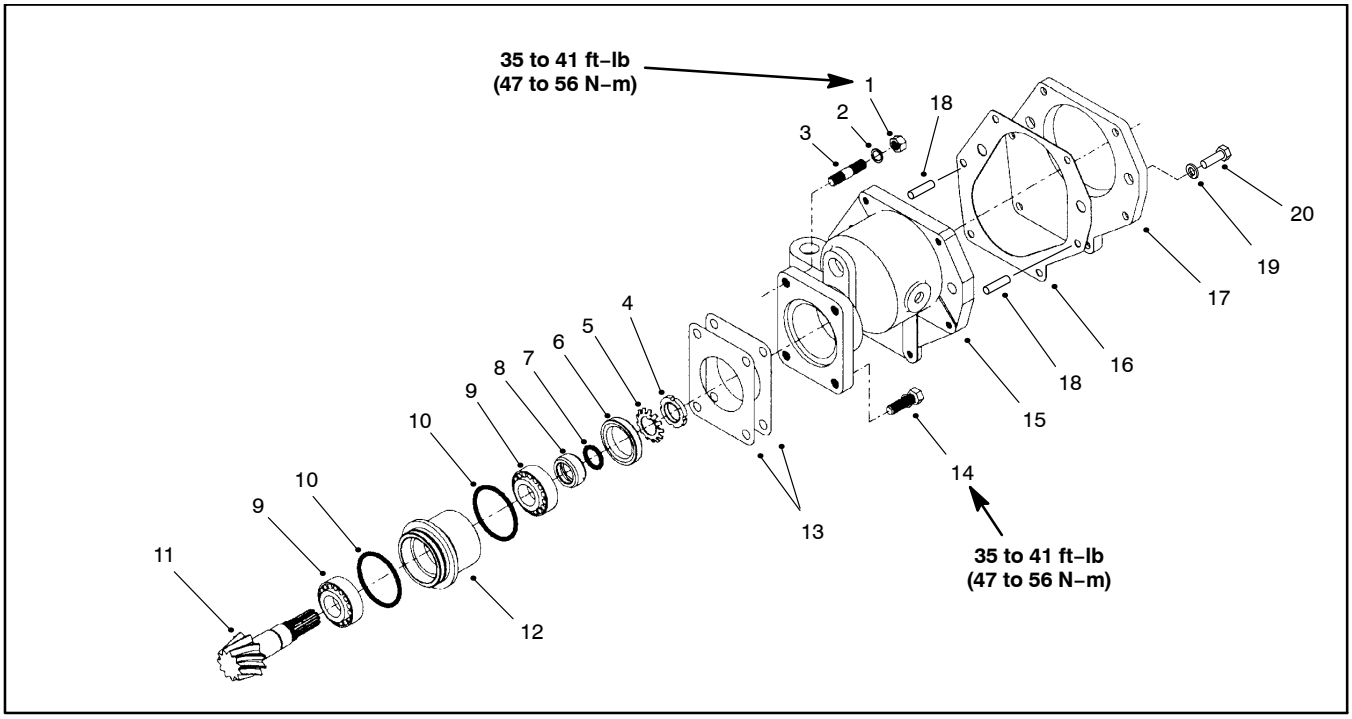


Figure 32

1. Nut (2)
2. Lock washer (2)
3. Stud (2)
4. Lock nut
5. Stake washer
6. Oil seal
7. O-ring
8. Seal collar
9. Bearing
10. O-ring
11. Input shaft/pinion gear
12. Bearing case
13. Shim
14. Screw (2)
15. Gear case
16. Gasket
17. Cover plate
18. Dowel pin
19. Lock washer (6)
20. Cap screw (6)

The following procedures assume the rear axle assembly has been removed from the machine.

Removal (Fig. 32)

1. Remove the cover plate, gasket and gear case assembly from the axle assembly. Remove the gasket and any remaining gasket material.

2. Remove the retaining rings and the driven gear from the input shaft/pinion gear.

3. Remove input shaft/pinion gear assembly from the gear case. Remove the shims and bearing case O-rings.

4. Release the stake washer and remove the lock nut. Remove and discard the stake washer.

5. Drive the input shaft/pinion gear out from the outer bearing cone and bearing case. Remove and discard the oil seal and O-ring.

6. Inspect all gears, shafts, bearings, spacers and cases for damage and wear. Replace components as necessary.

NOTE: Replacement input shaft/pinion gear (item 11) is only available in matched set with differential ring gear.

Installation (Fig. 32)

NOTE: When installing bearing cones onto the input shaft/pinion gear, press only on the inner race of the bearing cone.

1. If the inner bearing cone was removed, press a new bearing cone all the way onto the input shaft/pinion gear.

2. Place the shaft and bearing assembly in the bearing case and install the outer bearing cone.

NOTE: The bearings must be completely seated. There should be no input shaft/pinion gear end play.

3. Coat a new oil seal with grease and install as shown (Fig. 33). The seal should be installed with the garter spring towards the hydraulic motor location.

4. Coat new O-ring with grease. Install O-ring in the oil seal collar and install the collar.

5. Install a new stake washer. Install the lock nut finger tight.

6. Set the bearing preload by securing the bearing case in a vise. Thread a M12 x 1.5 hex head cap screw into the splined end of the input shaft/pinion gear and slowly tighten the lock nut until 4 to 6 in-lb (0.4 to 0.7 N–m) of force is required to rotate the input shaft/pinion gear in the bearing case.

7. Secure the lock nut with the stake washer.

8. Use a depth gauge to measure the distance from the end face of the input shaft/pinion gear to the mating surface of the bearing case. Subtract the “Design Cone Center Distance” from this distance to determine initial shim thickness (Fig. 34).

DESIGN CONE CENTER DISTANCE
(distance from mating surface of axle support to end face of pinion gear):
1.870 ± 0.002 inch (47.5 ± 0.05 mm)

NOTE: Bearing case shims are available in 0.004 inch (0.1 mm) and 0.008 inch (0.2 mm) thickness.

9. Coat new O-rings with grease and install the bearing case in the gear case. Place shims on the gear case and temporarily install gear case assembly into axle case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N–m)**.

10. Insert a screwdriver through the drain plug hole to hold ring gear and measure the pinion gear to ring gear backlash (Fig. 35).

PINION GEAR TO RING GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

11. Adjust backlash by increasing or reducing gear case shim thickness.

12. Check pinion gear to ring gear engagement (see Pinion Gear to Ring Gear Engagement in this section of this manual).

13. Place the correct combination of shims on the gear case. Tighten mounting nuts and screws from **35 to 41 ft-lb (47 to 56 N–m)**.

14. Install retaining rings and driven gear on input shaft/pinion gear.

15. If the drive gear (on drive motor shaft) was removed, install the retaining rings and drive gear on the motor shaft.

16. Use a new gasket and install the cover plate. Use a new O-ring and install the drive motor.

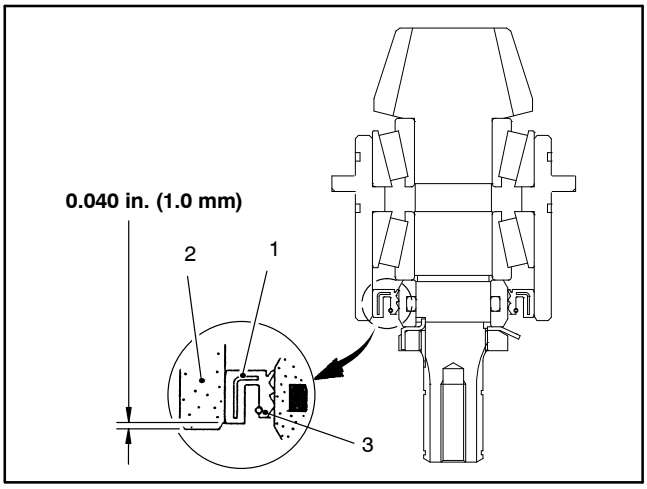


Figure 33

1. **Oil seal**
2. **Bearing case**
3. **Seal garter spring**

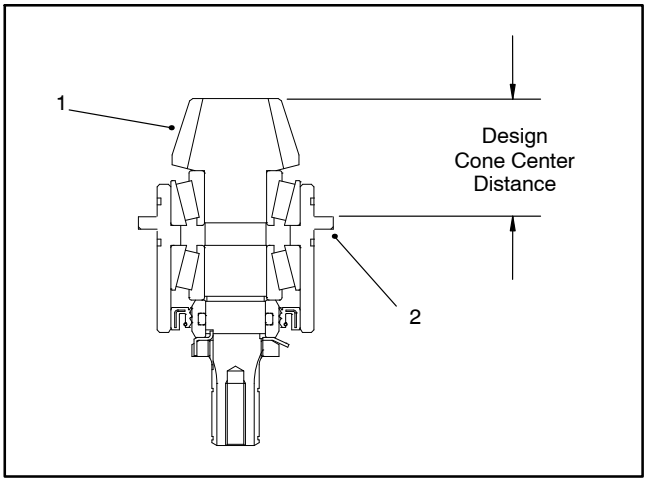


Figure 34

1. **Input shaft/pinion gear**
2. **Bearing case**

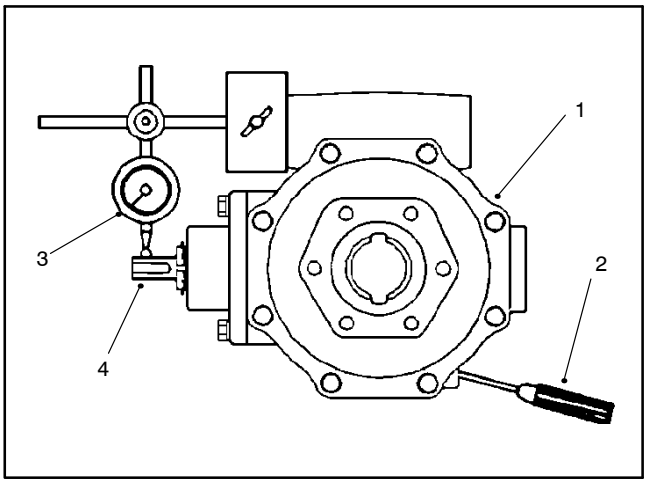


Figure 35

1. **Axle case**
2. **Screwdriver**
3. **Dial indicator**
4. **Input shaft/pinion gear**

Differential Gear

The following procedures assume the rear axle assembly has been removed from the machine.

Removal

1. Remove bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

IMPORTANT: Do not interchange right and left differential shafts assemblies.

2. Mark and pull the differential shaft assemblies from the axle support.

3. Remove input shaft/pinion gear assembly, shims and O-ring from the axle support (Fig. 36).

4. Remove the axle support case screws. Separate the axle support halves and remove the O-ring.

5. Remove the differential gear assembly, bearings and adjusting shims from the axle case.

6. Drive the spring pin from the differential case with a punch and hammer. Discard the spring pin (Fig. 37).

NOTE: Mark and arrange all components so they can be reassembled in their original position.

7. Remove the differential pinion shaft, pinion gears and pinion washers. Remove the differential side gears and side gear shims. Remove the ring gear only if it will be replaced (Fig. 38).

NOTE: Replacement ring gears are only available in matched ring and pinion sets.

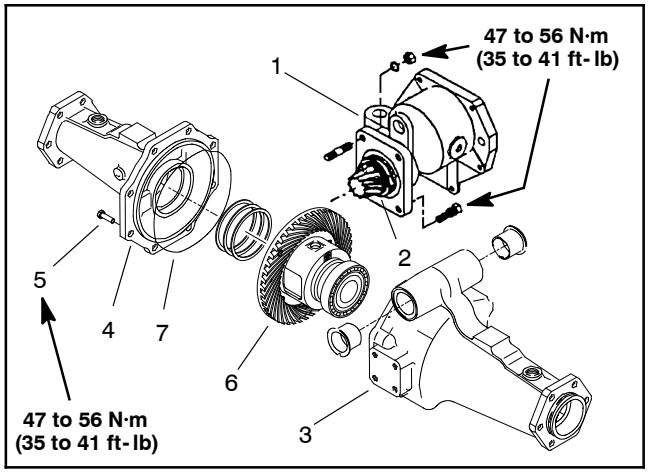


Figure 36

1. Gear Case
2. Pinion Gear
3. Axle support (left)
4. Axle support (right)
5. Case screw (8)
6. Differential gear
7. O-ring

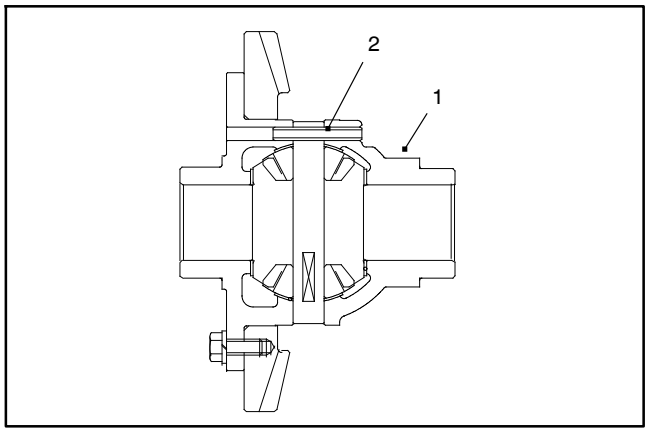


Figure 37

1. Differential case
2. Spring pin

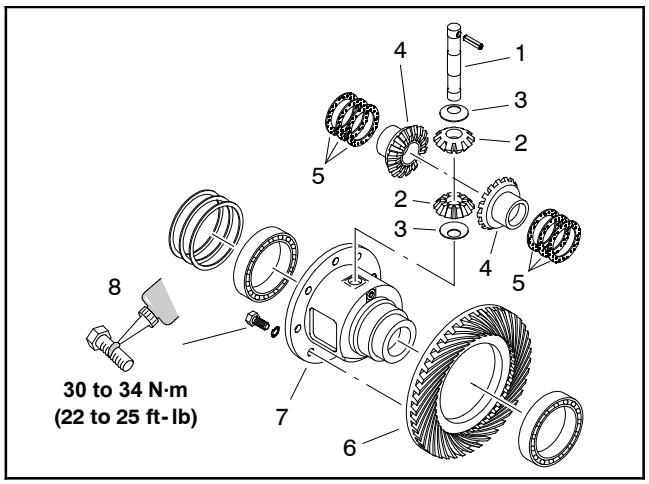


Figure 38

1. Differential pinion shaft
2. Pinion gear
3. Pinion washer
4. Side gear
5. Side gear shims
6. Ring gear
7. Differential case
8. Bolt/washer (8)

Inspection

1. Measure the differential side gear O.D. and the differential case I.D. to determine the side gear to case clearance (Fig. 39). Replace components as necessary.

SIDE GEAR TO CASE CLEARANCE:
0.002 to 0.012 inch (0.05 to 0.30 mm)

SIDE GEAR O.D. (Factory Spec.):
1.335 to 1.337 inch (33.91 to 33.95 mm)

DIFFERENTIAL CASE I.D. (Factory Spec.):
1.339 to 1.341 inch (34.00 to 34.06 mm)

2. Measure the differential pinion shaft O.D. and the pinion gear I.D. to determine the pinion shaft to pinion gear clearance (Fig. 40). Replace components as necessary.

PINION SHAFT TO PINION GEAR CLEARANCE:
0.001 to 0.010 inch (0.03 to 0.25 mm)

PINION SHAFT O.D. (Factory Spec.):
0.550 to 0.551 inch (13.97 to 13.10 mm)

PINION GEAR I.D. (Factory Spec.):
0.551 to 0.552 inch (13.10 to 14.02 mm)

3. Inspect all gears, shafts, bearings, cases and covers for damage and wear. Replace components as necessary.

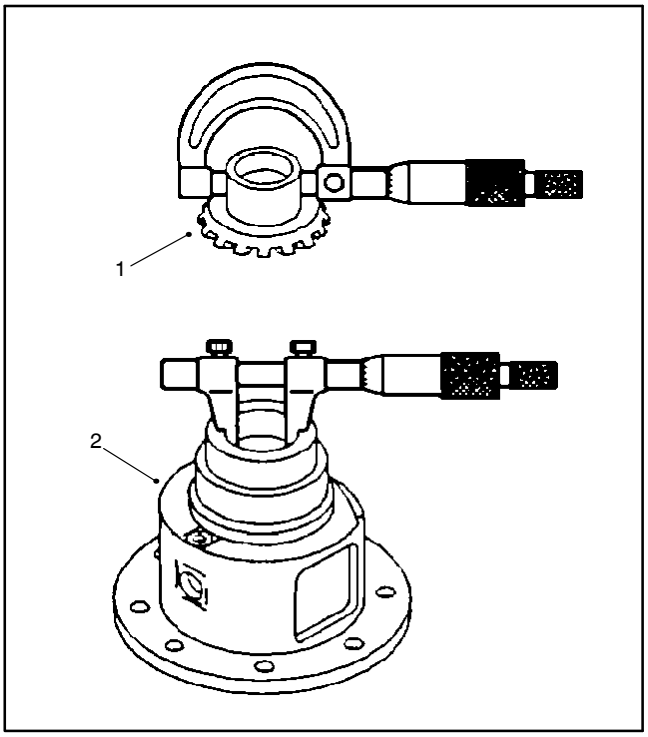


Figure 39

1. Side gear **2. Differential case**

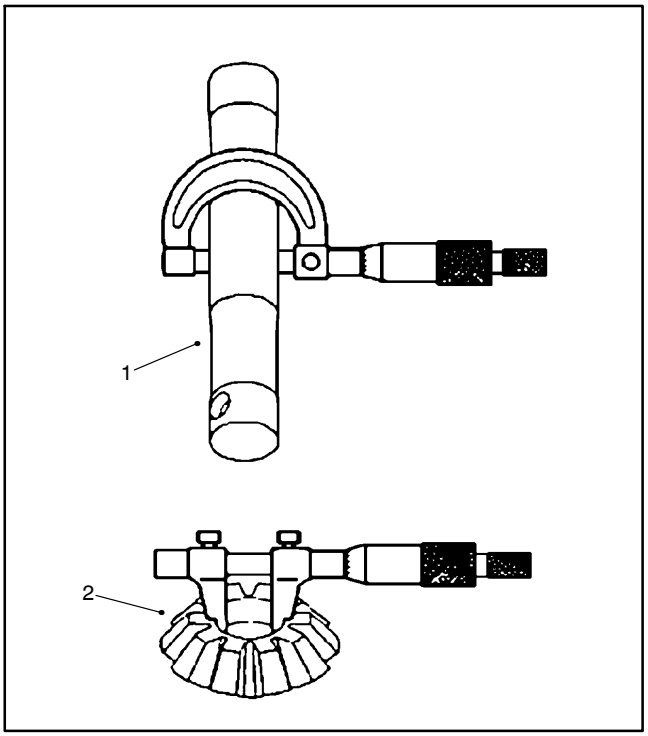


Figure 40

1. Pinion shaft **2. Pinion gear**

Installation

1. If the ring gear was removed from the differential case, use medium strength Loctite thread locker and tighten the mounting screws from **22 to 25 ft-lb (30 to 34 N–m)**.

2. Apply molybdenum disulfide lubricant (Three Bond 1901 or equivalent) to the splines and bearing surfaces of the differential pinion gears, pinion washers and side gears.

3. Install the side gear shims and side gears in their original location in the differential case.

4. Place the differential pinion gears and pinion washers in their original location in the differential case. Temporarily install the differential pinion shaft.

5. Secure the differential case in a soft jawed vise. Position a dial indicator on a tooth of the differential pinion gear. Press the pinion and side gear against the differential case and measure the pinion gear to side gear backlash (Fig. 41).

PINION GEAR TO SIDE GEAR BACKLASH:
0.004 to 0.016 inch (0.10 to 0.40 mm)

6. Adjust backlash by increasing or reducing side gear shim thickness.

NOTE: Side gear shims are available in 0.043 inch (1.10 mm), 0.047 inch (1.20 mm) and 0.051 inch (1.30 mm) thickness.

7. Apply gear marking compound, such as DyKem® Steel Blue lightly over several gear teeth.

8. While applying a light load to either side gear, rotate either pinion gear until the side gears have made one complete revolution.

9. Ideal tooth contact should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe (small) end (Fig. 42).

10. Adjust side gear shims if necessary to correct tooth contact. Recheck differential pinion gear to side gear backlash if any changes are made.

11. After backlash and tooth contact have been adjusted, align the hole in the differential pinion shaft with the hole in the differential case and install a new spring pin.

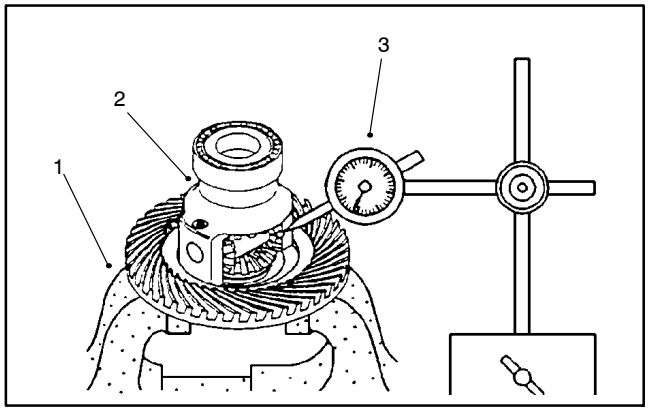


Figure 41

1. **Vise**
2. **Differential gear case**
3. **Dial indicator**

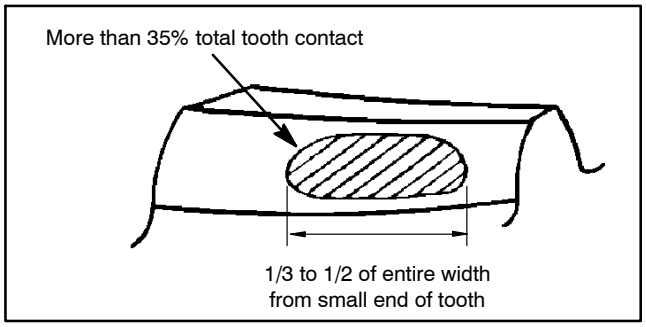


Figure 42

12. Install differential gear assembly in right side axle support half.

13. Coat a new o-ring with grease and install left side axle support half. Tighten axle support case screws from **35 to 41 ft-lb (47 to 56 N–m)**.

14. Install input shaft/pinion gear assembly (see Input Shaft/Pinion Gear in this section of this manual).

15. Coat new o-rings with grease, align differential shaft splines with differential gear assembly and slide differential shaft assemblies onto axle support.

16. Install bevel gear case/axle case assemblies (see Bevel Gear Case/Axle Case Assembly in this section of this manual).

Pinion Gear to Ring Gear Engagement

The final position of the pinion gear is verified by using the gear contact pattern method as described in the following procedure.

GEAR TOOTH DEFINITIONS (Fig. 43):

Toe - the portion of the tooth surface at the end towards the center.

Heel - the portion of the gear tooth at the outer end.

Top Land - top surface of tooth.

1. Paint the teeth of the ring gear, both drive and coast side, with a gear marking compound, such as DyKem® Steel Blue.

2. Install the input shaft/pinion gear assembly into axle case.

3. While applying a light load to the ring gear, rotate the pinion gear in the direction of forward travel until the ring gear has made one complete revolution.

Ideal tooth contact observed on the ring gear should cover more than 35% of each tooth surface. The contact area should be in the center of each tooth and extend 1/3 to 1/2 way across each tooth from the toe end (Fig. 44).

Adjustments to the gear contact position are made by moving the input shaft/pinion gear (bearing case shims) or by moving the differential gear case (differential bearing shims) (Fig. 45).

NOTE: Bearing case shims are available in 0.004 inch (0.10 mm) and 0.008 inch (0.20 mm) thickness.

NOTE: Differential bearing shims are available in 0.004 inch (0.10 mm), 0.008 inch (0.20 mm) and 0.016 inch (0.40 mm) thickness.

Study the different contact patterns (Figs. 46 and 47) and correct gear engagement as necessary.

NOTE: When making changes, note that two variables are involved (see Gear Pattern Movement Summary in this section of this manual).

Example: If the pinion gear to ring gear backlash is set correctly to specifications and the bearing case shim is changed to adjust tooth contact, it may be necessary to readjust backlash to the correct specification before checking the contact pattern.

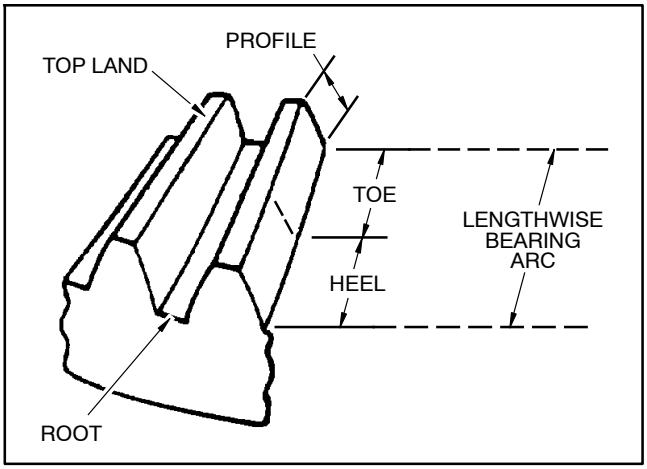


Figure 43

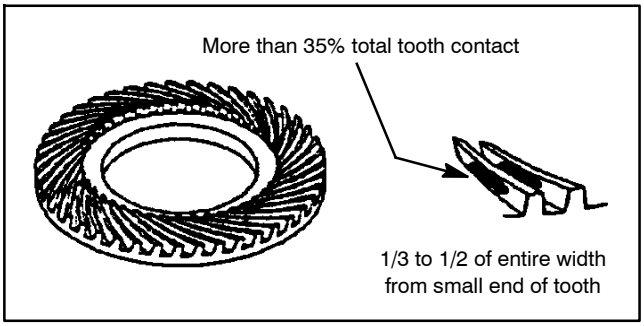


Figure 44

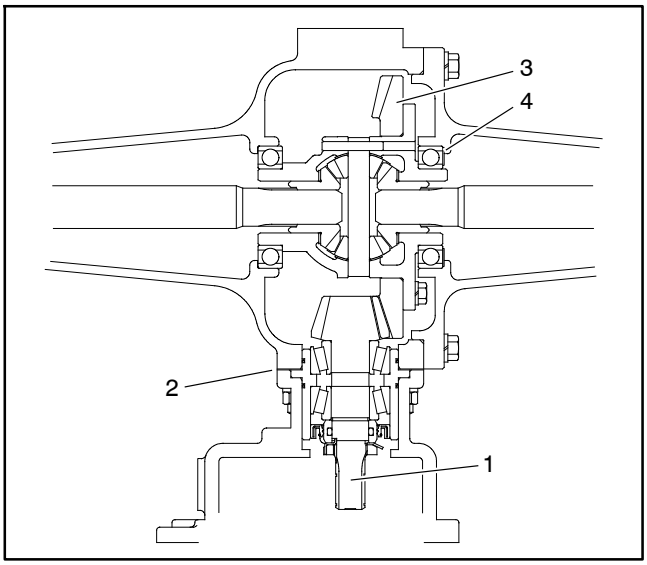


Figure 45

1. **Input shaft/pinion gear**
2. **Bearing case shims**
3. **Differential gear case**
4. **Differential bearing shims**

Gear Pattern Movement Summary

Every gear has a characteristic pattern. The illustrations show typical patterns only and explain how patterns shift as gear location is changed.

1. If contact is toward the heel or base of the gear (Fig. 46):

   A. Install thicker or additional bearing case shim(s) to move pinion shaft toward ring gear.

   B. Install thinner or remove differential bearing shim(s) to move ring gear backward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

2. If contact is toward the toe or tip of the gear (Fig. 47):

   A. Install thinner or remove bearing case shim(s) to move pinion shaft away from ring gear.

   B. Install thicker or additional differential bearing shim(s) to move ring gear forward.

   C. Repeat until proper tooth contact and pinion gear to ring gear backlash are correct.

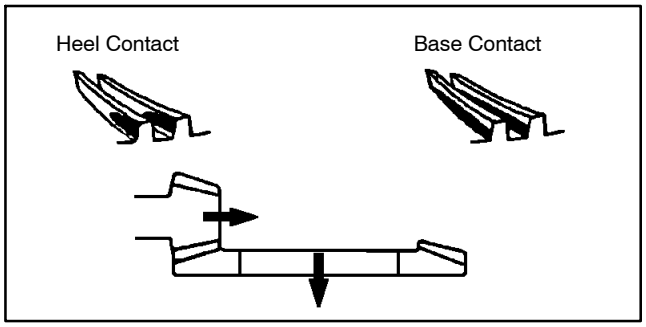


Figure 46

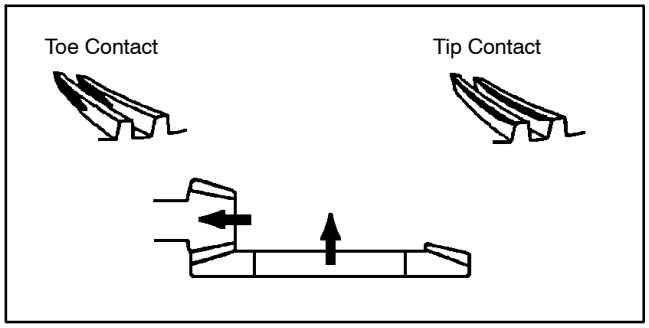


Figure 47

Chapter 8

Chassis

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General Information

Operator's Manual

The Traction Unit and Cutting Unit Operator's Manuals provide information regarding the operation, general maintenance and maintenance intervals for your Reelmaster machine. Refer to these publications for additional information when servicing the machine.

Cutting Unit Identification

Cutting units on the Reelmaster 7000−D are identified as shown in Figure 1.

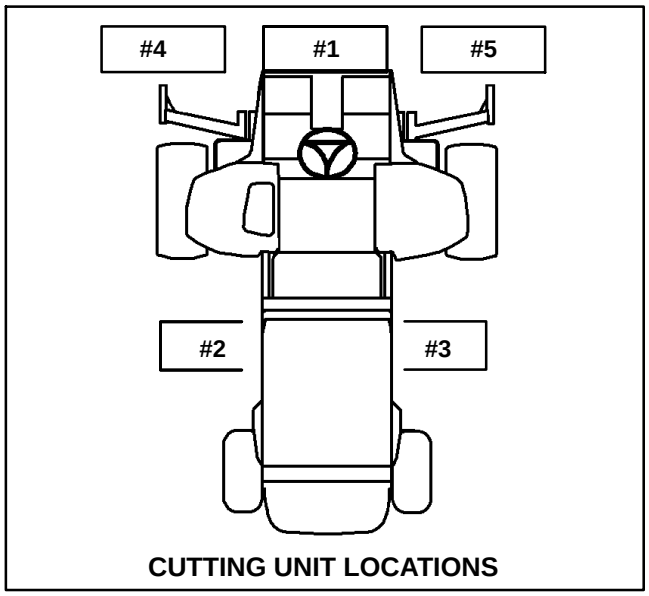


Figure 1

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Steering Column

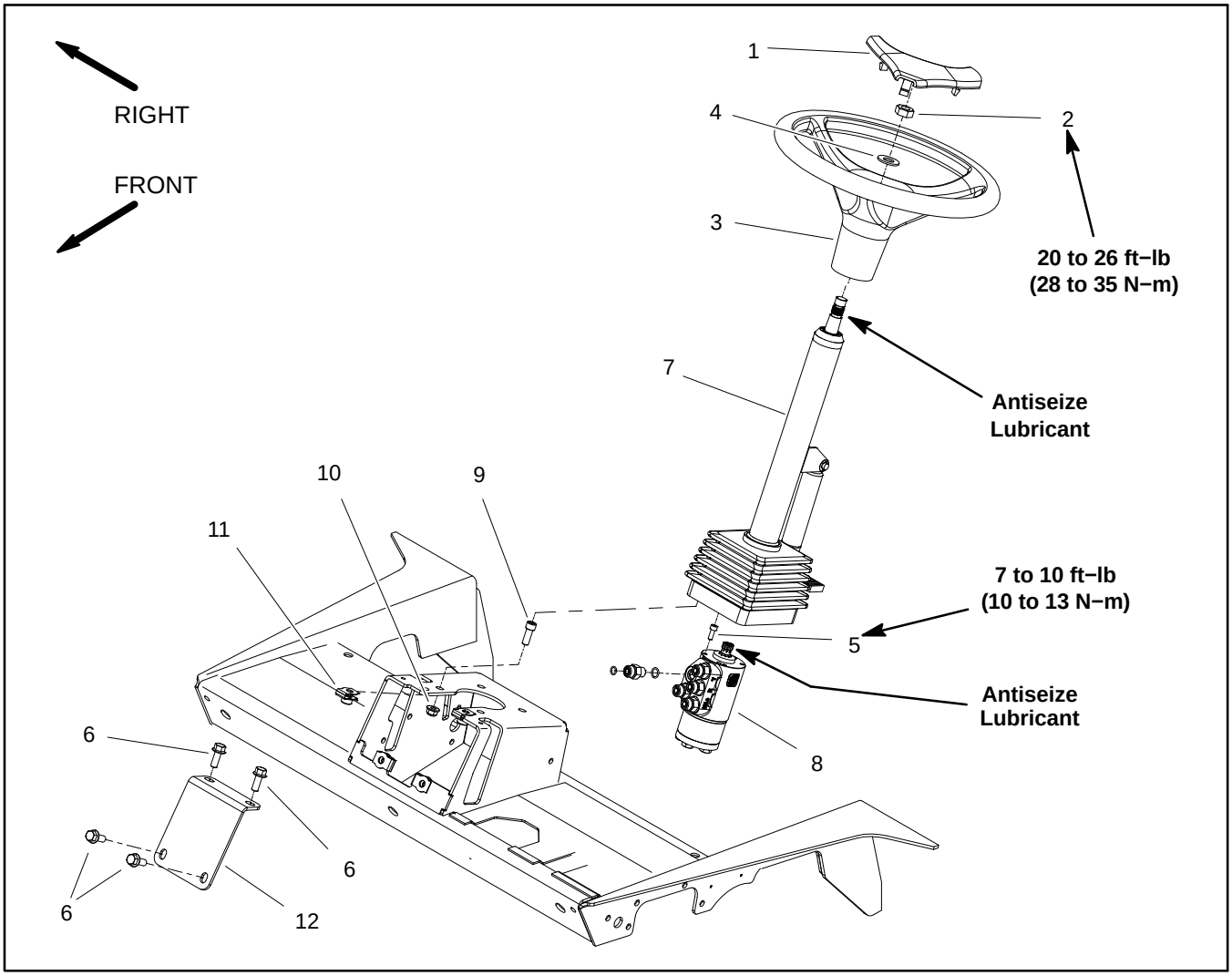


Figure 2

1. **Steering wheel cover**
2. **Lock nut**
3. **Steering wheel**
4. **Flat washer**
5. **Socket head screw (4)**
6. **Flange head screw (4)**
7. **Steering column**
8. **Steering control valve**
9. **Socket head screw (4)**
10. **Flange nut (4)**
11. **Tinnerman nut (4)**
12. **Column brace**

Removal (Fig. 2)

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

2. Remove platform shroud from machine to allow access to steering column fasteners (Fig. 3).

3. Remove cover from steering wheel by carefully prying up on one of the cover spokes.

4. Remove lock nut and flat washer that secure steering wheel to steering column.

5. Use a suitable puller to remove steering wheel from steering column.

6. Remove four (4) flange head screws that secure column brace (item 12) to frame platform. Remove brace from machine to allow access to steering column fasteners.

7. Slide rubber bellows up steering column to allow access to fasteners that secure steering control valve and steering column to machine.

8. Support steering control valve to prevent it from shifting during steering column removal.

9. Loosen and remove four (4) socket head screws (item 5) that secure steering control valve to steering column.

10. Loosen and remove four (4) socket head screws (item 9) and flange nuts (item 10) that secure steering column to machine.

11. Raise steering column assembly from steering control valve and machine.

12. Disassemble steering column assembly as needed using Figure 4 as a guide.

Installation (Fig. 2)

1. Assemble steering column using Figure 4 as a guide. After assembly, make sure that release pin on end of cylinder shaft is positioned against the pedal. Jam nut on cylinder shaft can be used to adjust location of release pin.

2. Apply antiseize lubricant to input shaft of steering control valve.

3. Slide steering column onto steering control valve. Secure steering column in place with four (4) socket head screws (item 9) and flange nuts (item 10).

4. Secure steering control valve to steering column with four (4) socket head screws (item 5). Torque screws from **7 to 10 ft−lb (10 to 13 N−m)**.

5. Slide rubber bellows to bottom of steering column.

6. Position column brace (item 12) in place and secure with four (4) flange head screws.

7. Thoroughly clean tapered surfaces of steering wheel and steering column.

8. Apply antiseize lubricant to splines of steering column taking care to keep antiseize lubricant from column taper. Slide steering wheel onto steering column.

9. Secure steering wheel to steering column with flat washer and lock nut. Torque hex nut from **20 to 26 ft−lb (28 to 35 N−m)**.

10. Install steering wheel cover to steering wheel.

11. Install and secure platform shroud to machine (Fig. 3).

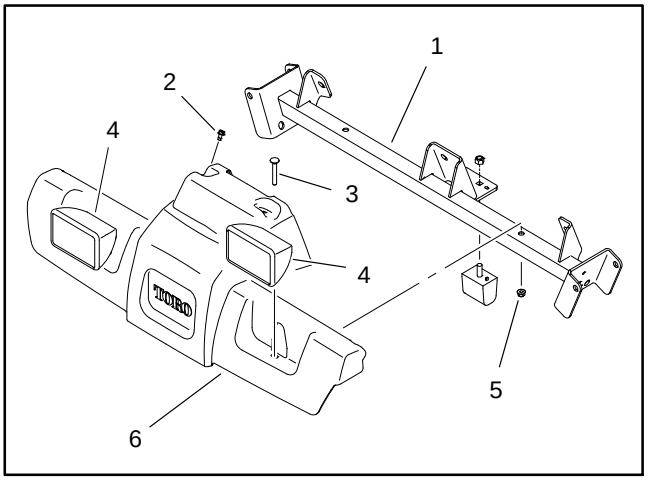


Figure 3

1. **Roller support**
2. **Screw (2)**
3. **Carriage screw (2)**
4. **Headlight assembly**
5. **Flange nut (2)**
6. **Platform shroud**

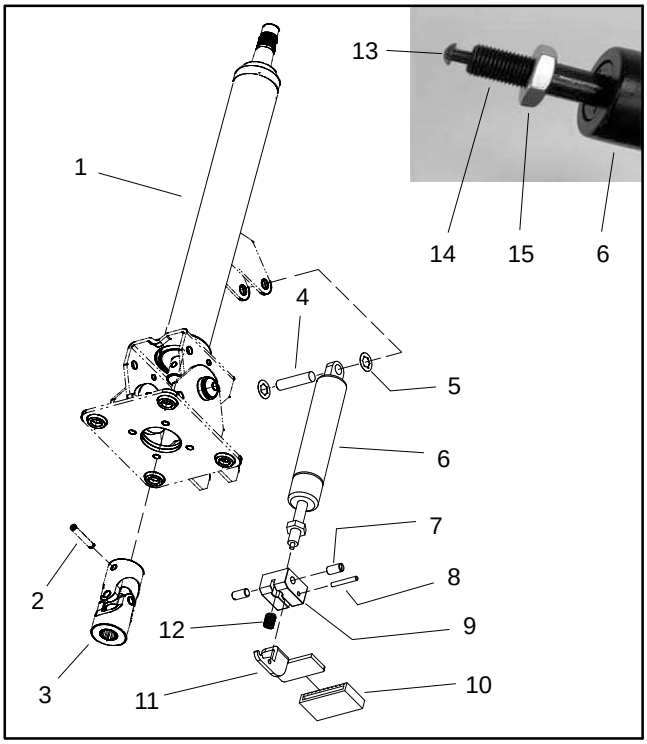


Figure 4

1. **Steering column**
2. **Pin**
3. **Universal joint**
4. **Pin**
5. **Lock washer (2)**
6. **Cylinder**
7. **Bolt (2)**
8. **Pin**
9. **Pedal block**
10. **Pedal cover**
11. **Pedal**
12. **Spring**
13. **Release pin**
14. **Cylinder shaft**
15. **Jam nut**

Console Arm

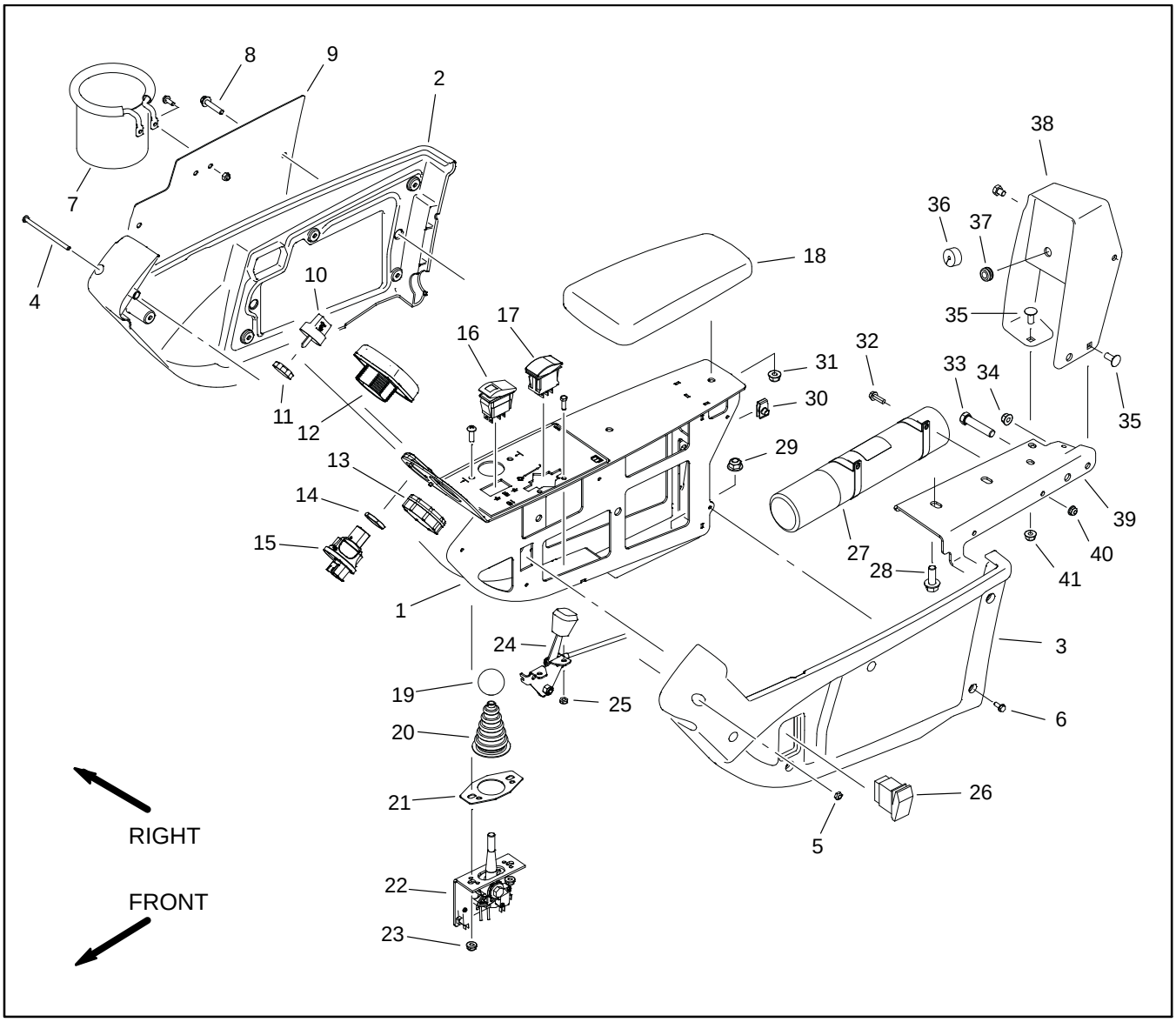


Figure 5

1. Console arm frame
2. RH cover
3. LH cover
4. Phillips head screw
5. Lock nut
6. Washer head screw (10)
7. Bag holder
8. Flange head screw (2)
9. Cover plate
10. Ignition key
11. Nut
12. InfoCenter display
13. Nut
14. Nut
15. Ignition switch
16. Reel enable/disable switch
17. Engine speed switch (Yanmar diesel engine)
18. Arm rest
19. Knob
20. Boot
21. Plate
22. Joystick
23. Flange nut (2)
24. Throttle (Kubota diesel engine)
25. Lock nut (2)
26. Headlight switch
27. Manual tube
28. Flange head screw (2)
29. Flange nut (2)
30. Panel clip (2)
31. Flange nut (2)
32. Washer head screw (2)
33. Hex head screw
34. Flange nut (2)
35. Carriage screw (4)
36. Foam seal
37. Grommet
38. Console arm support
39. Support channel
40. Flange nut (2)
41. Flange nut (4)

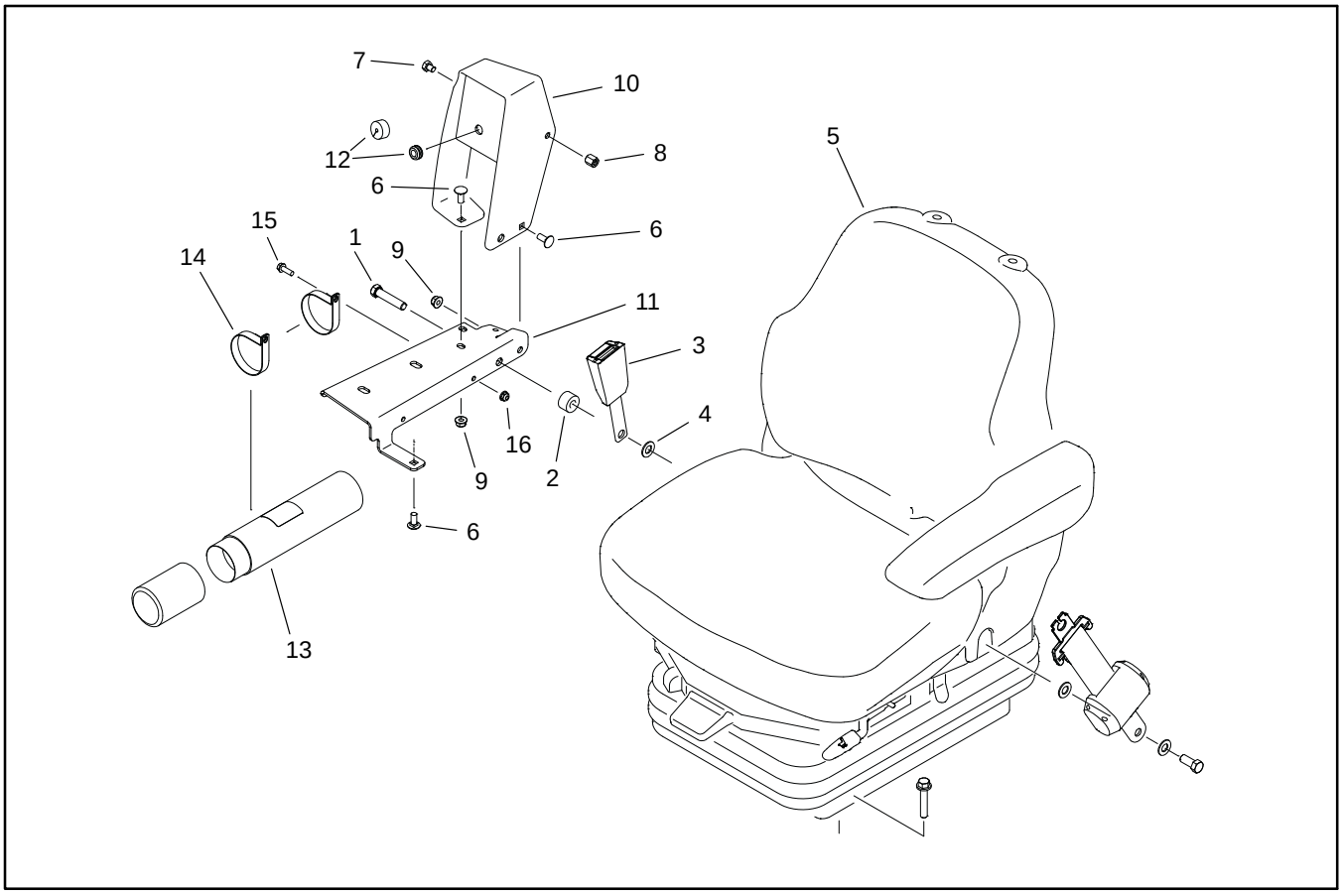


Figure 6

1. **Hex head screw**
2. **Spacer**
3. **Seat belt buckle**
4. **Flat washer**
5. **Operator seat**
6. **Carriage screw (4)**
7. **Hex head screw**
8. **Coupling nut**
9. **Flange nut (4)**
10. **Console arm support**
11. **Support channel**
12. **Grommet or foam seal**
13. **Manual tube**
14. **Clamp (2)**
15. **Cap screw (2)**
16. **Flange nut (2)**

Disassembly (Fig. 5)

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

2. Remove two (2) flange head screws (item 8) and cover plate (item 9) from outside of console arm.

3. At front of console arm, remove screw (item 4) and lock nut (item 5) that secure console arm covers to each other.

4. Remove five (5) washer head screws (item 6) that secure each cover to console arm panel.

5. Remove console arm covers from machine. As LH cover (item 3) is removed from console arm, unplug wire harness connector from headlight switch.

6. Remove components from console arm as needed.

7. If necessary, remove console panel and supports from machine (Fig. 6).

Assembly (Fig. 5)

1. Install all removed console arm components.

2. Position covers to console arm. Install headlight switch wire harness connector to switch before installing LH cover (item 3).

3. Secure each cover to console arm with five (5) washer head screws (item 6). Install screw (item 4) and lock nut (item 5) to secure covers at front of console arm.

4. Position cover plate (item 9) to outside of console arm. Secure with two (2) flange head screws.

Lift Arms for Front Cutting Units (#1, #4 and #5)

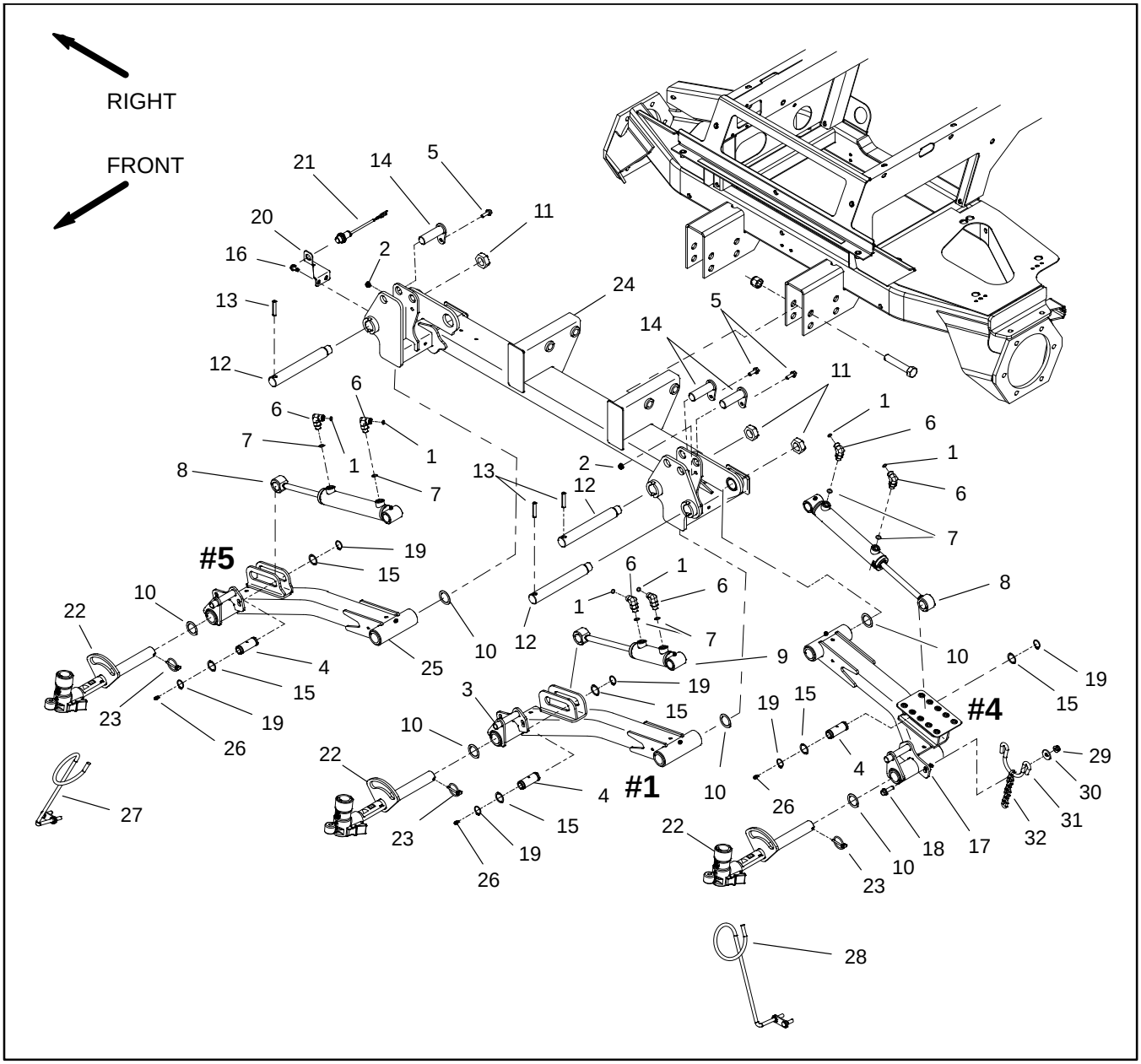


Figure 7

1. O−ring
2. Flange nut
3. Lift arm (cutting unit #1)
4. Cylinder pin
5. Flange head screw
6. 90º hydraulic fitting (2 per cylinder)
7. O−ring
8. Lift cylinder (cutting units #4 and #5)
9. Lift cylinder (cutting unit #1)
10. Thrust washer
11. Lock nut
12. Pivot pin
13. Slotted roll pin
14. Cylinder pin
15. Washer (2 per pin)
16. Washer head screw
17. Lift arm (cutting unit #4)
18. Flange head screw (2 per hoop)
19. Retaining ring (2 per pin)
20. Switch bracket
21. Cutting unit position sensor
22. Pivot yoke
23. Lynch pin
24. Front carrier frame
25. Lift arm (cutting unit #5)
26. Grease fitting
27. RH hose guide
28. LH hose guide
29. Flange nut (2 per hoop)
30. Washer (2 per hoop)
31. Chain hoop
32. Lift chain

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.

2. Remove cutting unit assembly from lift arm (see Cutting Unit Removal in Chapter 9 − DPA Cutting Units in this manual).

3. If lift arm for either cutting unit #4 or #5 is to be removed, remove hose guide (item 27 or 28) from the cutting unit.

4. Remove one (1) retaining ring and washer from the cylinder pin (item 4). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

5. Loosen and remove lock nut (item 11) from lift arm pivot pin.

6. Support lift arm and pull lift arm pivot pin from lift arm and frame. Locate and remove thrust washer (item 10) from rear of lift arm during pivot pin removal.

7. Disassemble lift arm as needed.

8. Clean lift arm and pivot pin. Inspect lift arm bushings and pivot pin for damage or wear. Replace worn or damaged components.

Installation (Fig 7)

1. Assemble lift arm.

2. Position lift arm to frame. Fit thrust washer (item 10) between rear of lift arm and frame. Slide pivot pin into frame and lift arm. Align roll pin in pivot pin with slot in frame flange.

3. Install and tighten lock nut (item 11) to secure lift arm pivot pin.

4. Position lift cylinder rod clevis to lift arm

5. Make sure that one (1) retaining ring and washer are installed on cylinder pin (item 4). Insert cylinder pin through the lift arm and lift cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

NOTE: Install thrust washer (item 10) on carrier pivot shaft before installing cutting unit on pivot shaft.

6. Position and install cutting unit to lift arm (see Cutting Unit Installation in Chapter 9 − DPA Cutting Units in this manual).

7. If lift arm for either cutting unit #4 or #5 was removed, install hose guide (item 27 or 28) to the cutting unit.

8. Lubricate lift arm and lift cylinder grease fittings after assembly is complete.

9. After assembly, raise and lower the cutting unit to verify that hydraulic hoses and fittings do not contact anything.

Lift Arms for Rear Cutting Units (#2 and #3)

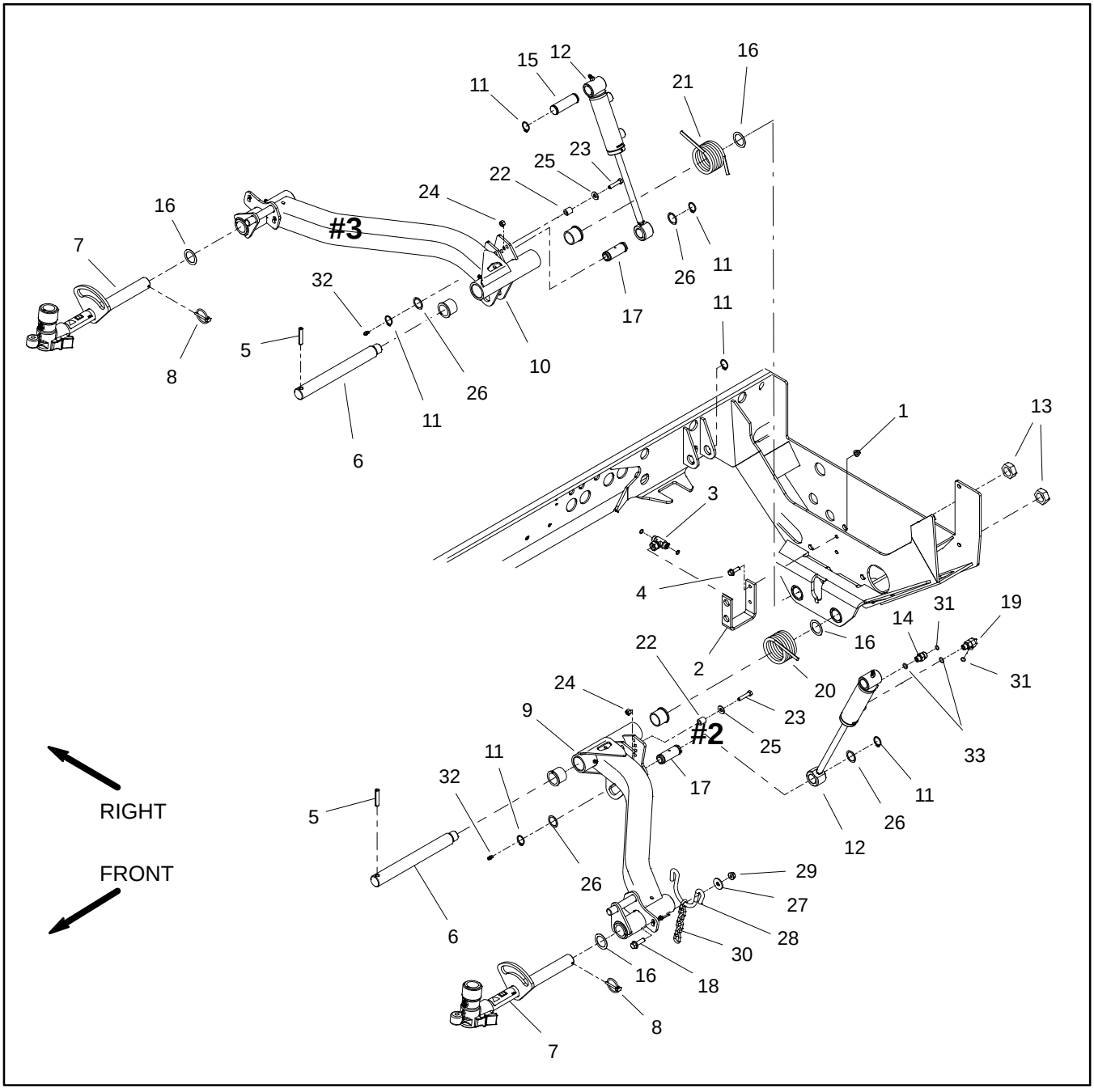


Figure 8

1. Flange nut (2 used)
2. Bulkhead bracket
3. Hydraulic tee fitting
4. Flange head screw (2 used)
5. Slotted roll pin
6. Pivot pin
7. Pivot yoke
8. Lynch pin
9. Lift arm (cutting unit #2)
10. Lift arm (cutting unit #3)
11. Retaining ring (2 per pin)
12. Lift cylinder (cutting units #2 and #3)
13. Lock nut
14. Straight hydraulic fitting
15. Cylinder pin
16. Thrust washer
17. Cylinder pin
18. Flange head screw (2 per hoop)
19. 90° hydraulic fitting
20. LH torsion spring
21. RH torsion spring
22. Spacer
23. Cap screw
24. Lock nut
25. Flat washer
26. Washer (2 per pin)
27. Washer (2 per hoop)
28. Chain hoop
29. Flange nut (2 per hoop)
30. Lift chain
31. O−ring
32. Grease fitting
33. O−ring

Removal (Fig. 8)

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 lift arm (see Cutting Unit Removal in Chapter 9 − DPA Cutting Units in this manual).

3. Remove one (1) retaining ring and washer from the cylinder pin (item 17). Remove cylinder pin from the lift arm and cylinder rod clevis which will free lift cylinder from lift arm.

CAUTION

Be careful when removing tension from the torsion spring on the rear lift arms. The spring is under heavy load and may cause personal injury.

4. Remove tension from torsion spring on rear of lift arm tube (Fig. 9):

   A. Insert nut driver or small piece of pipe onto the end of the torsion spring that is on the rear of the lift arm.

   B. Push down and rearward on the spring end to unhook the spring from the stop on the lift arm.

5. Loosen and remove lock nut (item 13) from lift arm pivot pin.

6. Support lift arm and pull lift arm pivot pin from lift arm and frame. Locate and remove thrust washer (item 16) from rear of lift arm during pivot pin removal.

7. Remove lift arm and torsion spring from machine.

8. Disassemble lift arm as needed.

9. Clean lift arm and pivot pin. Inspect lift arm bushings and pivot pin for damage or wear. Replace worn or damaged components.

Installation (Fig. 8)

1. Assemble lift arm.

2. Place torsion spring over rear of lift arm tube. Position long leg of spring forward and pointing out from top of spring.

3. Position lift arm to frame (Fig. 8). Fit thrust washer (item 16) between rear of lift arm and frame. Slide pivot pin into frame and lift arm. Align roll pin in pivot pin with slot in frame flange.

4. Install and tighten lock nut (item 13) to secure lift arm pivot pin.

5. Position lift cylinder rod clevis to lift arm

6. Make sure that one (1) retaining ring and washer are installed on cylinder pin (item 17). Insert cylinder pin through the lift arm and lift cylinder clevis. Secure pin with second washer and retaining ring. Make sure that retaining ring is fully seated in pin.

CAUTION

Be careful when applying tension to the torsion spring on the rear lift arms. The spring is under heavy load and may cause personal injury.

7. Apply tension to torsion spring (Fig. 9):

   A. Insert nut driver or small piece of pipe onto the long leg of the torsion spring on the rear of the lift arm.

   B. Push down and forward on the spring end to hook the spring to the stop on the lift arm.

8. Position and install cutting unit to lift arm (see Cutting Unit Installation in Chapter 9 − DPA Cutting Units in this manual).

9. Lubricate lift arm and lift cylinder grease fittings after assembly is complete.

10. After assembly, raise and lower the cutting unit to verify that hydraulic hoses and fittings do not contact anything.

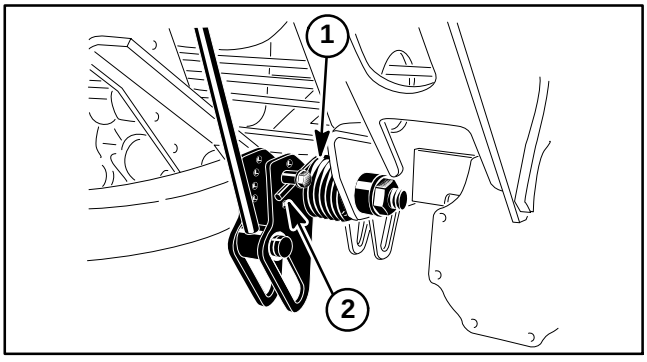


Figure 9

1. Torsion spring
2. Spring end

Operator Seat

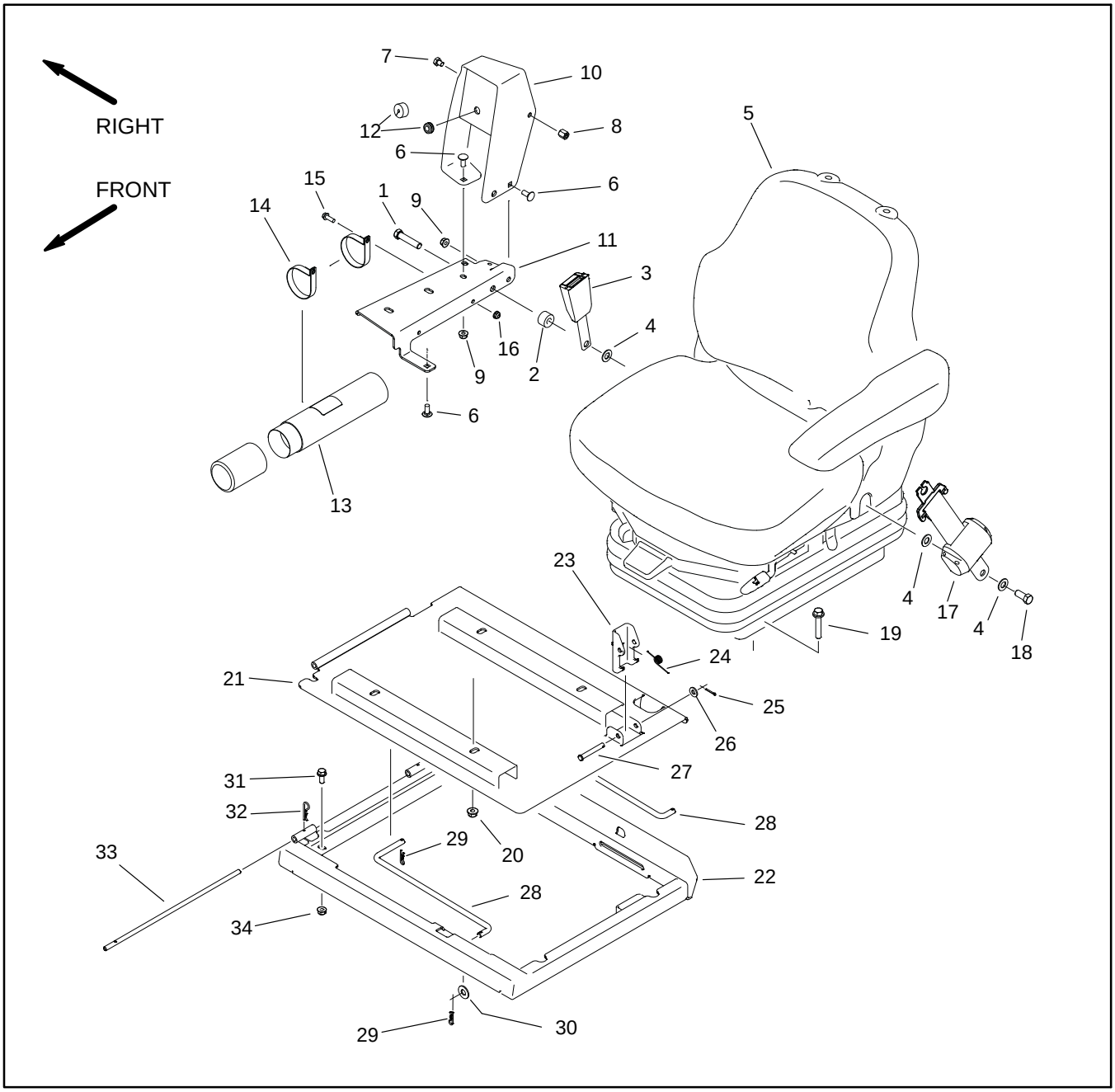


Figure 10

1. Hex head screw
2. Spacer
3. Seat belt buckle
4. Flat washer (3)
5. Operator seat
6. Carriage screw (4)
7. Hex head screw
8. Coupling nut
9. Flange nut (4)
10. Console arm support
11. Support channel
12. Grommet or foam seal
13. Manual tube
14. Clamp (2)
15. Cap screw (2)
16. Flange nut (2)
17. Seat belt
18. Hex head screw
19. Flange head screw (4)
20. Flange nut (4)
21. Seat plate
22. Seat frame
23. Latch
24. Spring
25. Cotter pin
26. Flat washer
27. Clevis pin
28. Support rod (2)
29. Hair pin (4)
30. Flat washer (2)
31. Flange head screw (4)
32. Hair pin
33. Pivot shaft
34. Flange nut (4)

Removal (Fig. 10)

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

2. Disconnect seat electrical connector from machine wire harness.

3. Support console arm assembly to prevent it from shifting.

4. Remove flange nut and carriage screw (item 6) that secure support channel (item 11) to front left corner of seat.

5. Remove cap screw (item 7) that secures console arm support (item 10) to coupling nut (item 8).

6. Remove cap screw (item 1), flat washer (item 4), spacer (item 2) and seat belt buckle (item 3) from seat and console arm support (item 10).

IMPORTANT: Make sure to not damage the electrical harness, control cable or other parts while moving the console arm assembly.

7. Carefully move console arm assembly away from seat. Support console arm to prevent it from falling.

8. Remove four (4) torx head screws that secure seat to seat suspension (Fig. 11).

9. Lift seat from seat suspension and remove from machine.

Installation (Fig. 10)

1. Carefully position seat to seat suspension.

2. Secure seat to seat suspension with four (4) torx head screws (Fig. 11). Make sure that longer screw is positioned near the seat adjustment handle. Torque screws **18 ft−lb (25 N−m)**.

IMPORTANT: Make sure to not damage the electrical harness, control cable or other parts while moving the console arm assembly.

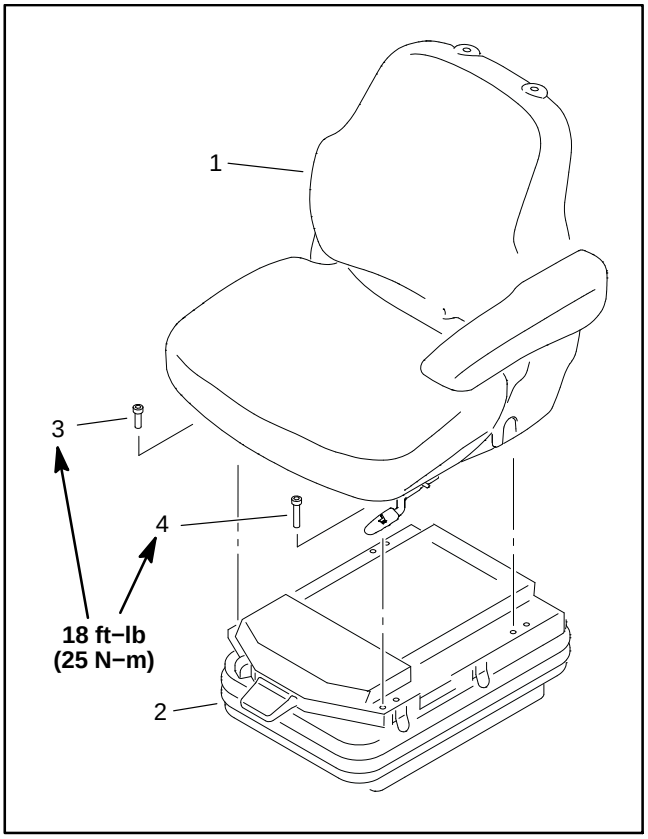


Figure 11

1. **Seat**
2. **Suspension assembly**
3. **Screw − M8x12 (3)**
4. **Screw − M8x16**

3. Position and secure console arm assembly to seat. Install all fasteners before fully tightening them.

   A. Place flat washer (item 4), seat belt buckle (item 3) and spacer (item 2) between seat and console arm support (item 10). Secure with cap screw (item 1).

   B. Secure console arm support (item 10) to coupling nut (item 8) with cap screw (item 7).

   C. Secure support channel (item 11) to front left corner of seat with flange nut and carriage screw (item 6).

   D. Fully tighten all fasteners to secure console arm assembly to seat.

4. Connect seat electrical connector to machine wire harness.

Operator Seat Service

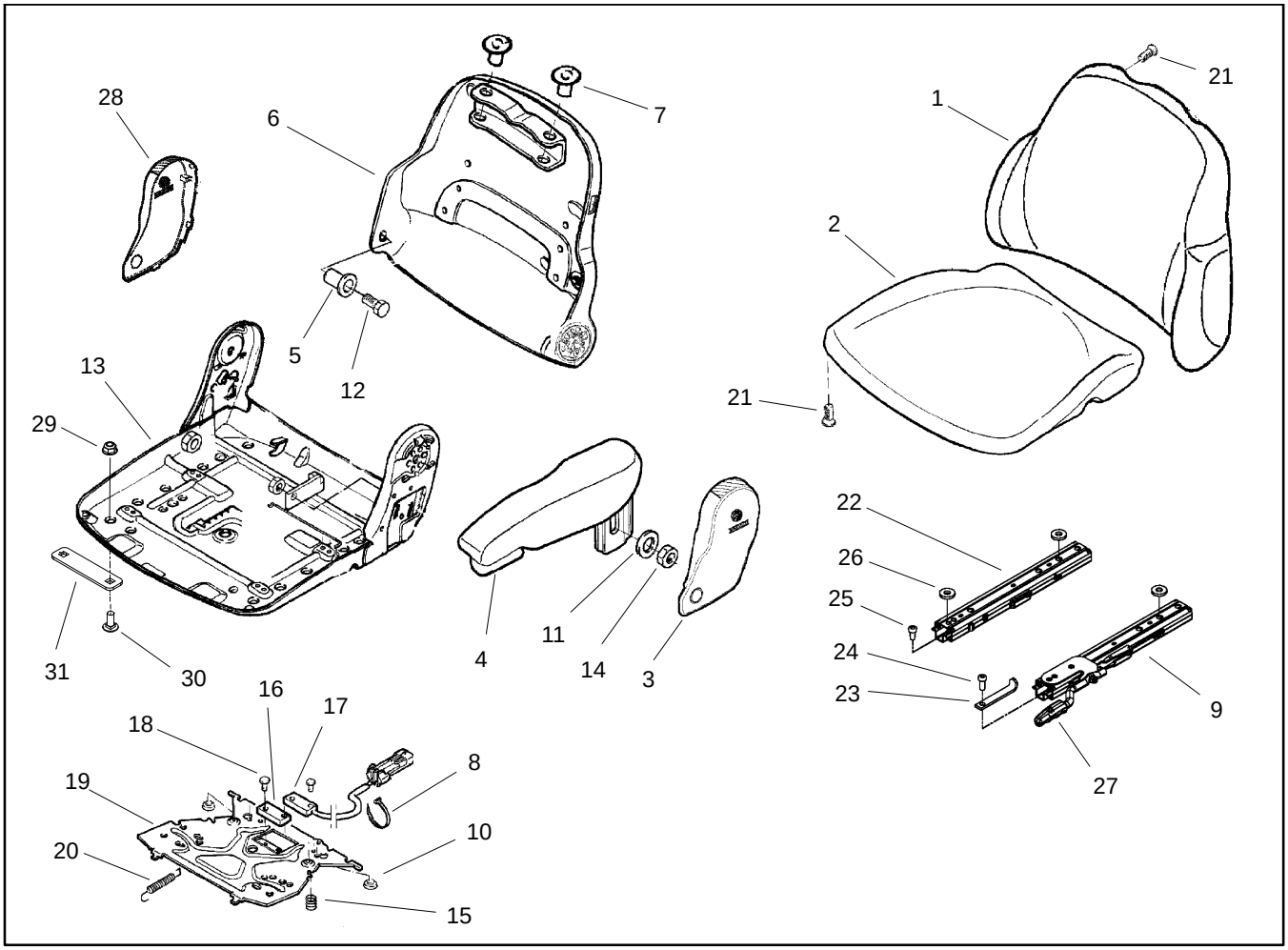


Figure 12

1. **Backrest cushion**
2. **Seat cushion**
3. **LH armrest cover**
4. **LH armrest**
5. **Bushing (2)**
6. **Backrest**
7. **Plug (2)**
8. **Cable tie (3)**
9. **LH adjustment rail**
10. **Bumper (2)**
11. **Washer**
12. **Cap screw (2)**
13. **Seat**
14. **Nut**
15. **Spring (2)**
16. **Magnet**
17. **Seat switch**
18. **Rivet (4)**
19. **Mounting plate**
20. **Return spring**
21. **Torx screw (5)**
22. **RH adjustment rail**
23. **Rail stop**
24. **Torx screw**
25. **Torx screw (3)**
26. **Washer (3)**
27. **Handle**
28. **RH armrest cover**
29. **Flange nut**
30. **Carriage screw**
31. **Support bracket**

Disassembly (Fig. 12)

1. Remove seat from machine for service (see Operator Seat Removal in this chapter).

2. Disassemble operator seat as necessary.

Assembly (Fig. 12)

1. Assemble operator seat.

2. Install seat to machine (see Operator Seat Installation in this chapter).

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Operator Seat Suspension

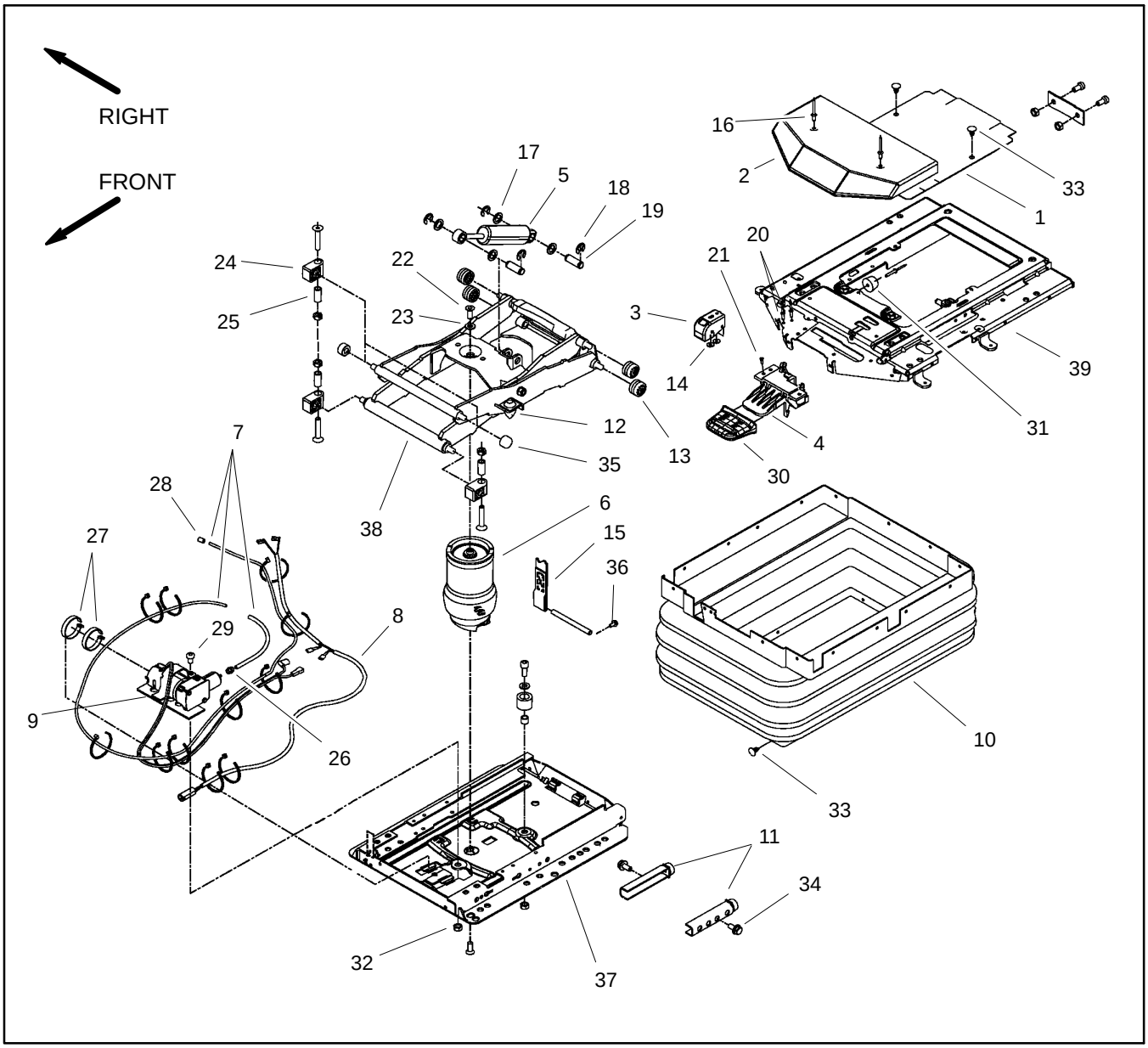


Figure 13

1. Cover
2. Cover
3. Level control
4. Air control valve
5. Shock absorber
6. Air spring
7. Air tube assembly
8. Wire harness
9. Compressor
10. Bellows
11. Stop
12. Bumper set (2)
13. Roller (4)
14. Washer (2)
15. Tether
16. Rivet (2)
17. Washer (4)
18. C−clip (4)
19. Pin (2)
20. Rivet (2)
21. Washer (3)
22. Screw (2)
23. Washer
24. Housing support (4)
25. Spacer (4)
26. Hose nipple
27. Clamp (2)
28. Hose nipple
29. Screw
30. Handle
31. Bumper
32. Nut
33. Plastic plug (23)
34. Screw (2)
35. Roller (2)
36. Screw (4)
37. Base plate
38. Suspension frame
39. Upper plate

NOTE: Most of the seat suspension components can be serviced with the seat suspension base mounted to the seat plate. If the air spring assembly (item 6) requires removal, the seat suspension base will have to be removed from the seat plate.

Disassembly (Fig. 13)

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

2. Remove operator seat from seat suspension (see Operator Seat Removal in this chapter).

3. Disconnect seat suspension electrical connector from machine wire harness.

4. If the air spring assembly (item 6) or base plate (item 37) requires removal, remove seat suspension from seat plate (Fig. 14):

   A. Raise and support seat plate assembly. Support seat suspension to prevent it from falling.

   B. Remove four (4) flange head screws and flange nuts that secure seat suspension to seat plate.

   C. Remove seat suspension from machine.

5. Remove seat suspension components as needed.

Assembly (Fig. 13)

1. Install all removed seat suspension components.

2. If seat suspension was removed from seat platform (Fig. 14):

   A. Position seat suspension onto seat plate.

   B. Secure seat suspension to seat plate with four (4) flange head screws and flange nuts.

3. Install operator seat to seat suspension (see Operator Seat Installation in this chapter).

4. Make sure that seat electrical connectors are secured to machine wire harness.

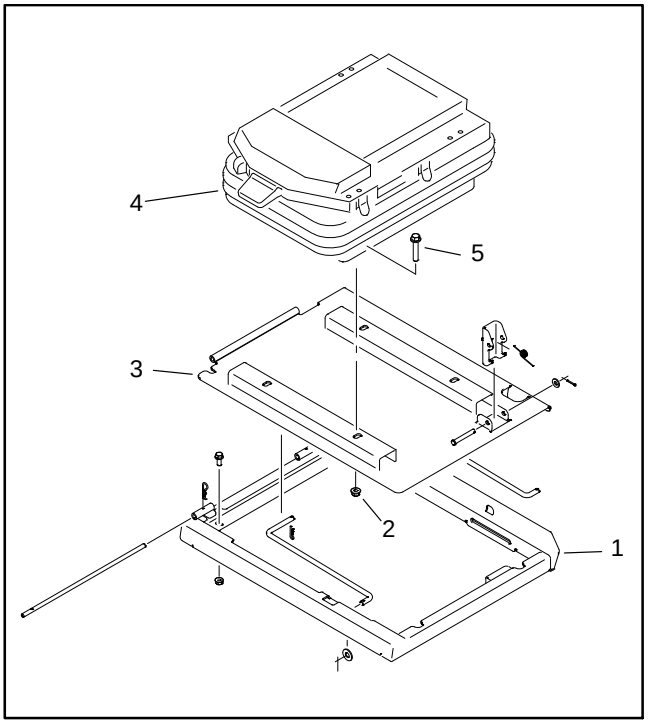


Figure 14

1. **Seat frame**
2. **Flange nut (4)**
3. **Seat plate**
4. **Seat suspension**
5. **Flange screw (4)**

Hood

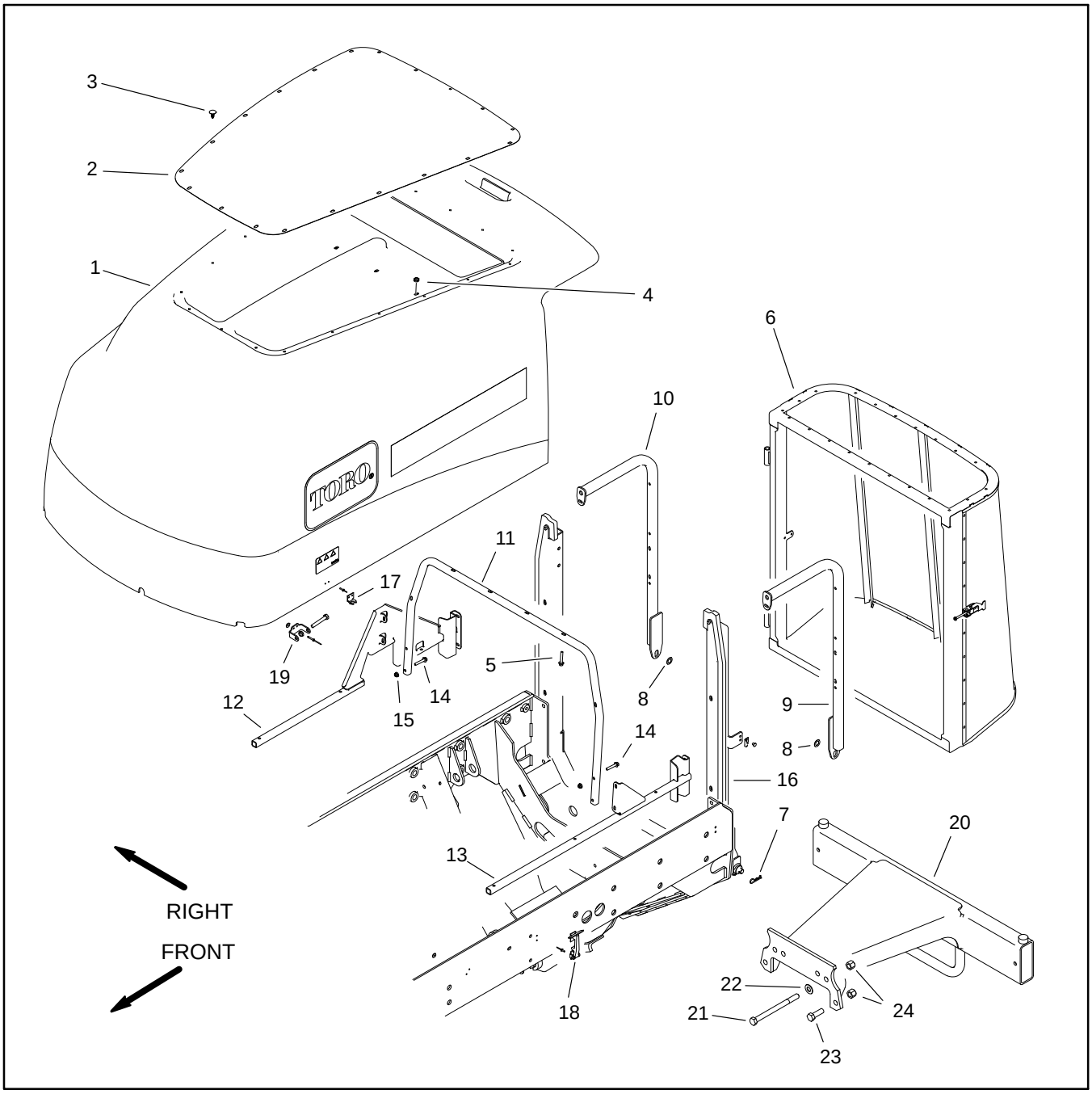


Figure 15

1. **Hood**
2. **Hood screen**
3. **Plastic plug (20)**
4. **Flange nut (4)**
5. **Flange head screw (4)**
6. **Screen assembly**
7. **Hair pin (2)**
8. **Washer (2)**
9. **Hood frame tube − LH**
10. **Hood frame tube − RH**
11. **Hood frame tube − center**
12. **Hood frame tube − RH**
13. **Hood frame tube − LH**
14. **Flange head screw (4)**
15. **Flange nut (4)**
16. **Radiator frame**
17. **Latch − hood**
18. **Latch − frame**
19. **Latch lock − CE**
20. **Rear bumper**
21. **Cap screw (2)**
22. **Washer (2)**
23. **Cap screw (2)**
24. **Lock nut (4)**

Removal (Fig. 15)

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

2. Release hood latches and raise hood.

3. Remove hair pins and washers from pivot pins on radiator frame.

4. Remove hood from pivot pins and machine.

5. If necessary, disassemble hood.

Installation (Fig. 15)

1. If components were removed from hood, assemble hood.

2. Slide hood frame onto radiator frame pivot pins.

3. Secure hood to frame with hair pins and washers.

4. Check hood alignment for correct operation of hood latches and dust seals.

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TORO

Chapter 9

DPA Cutting Units

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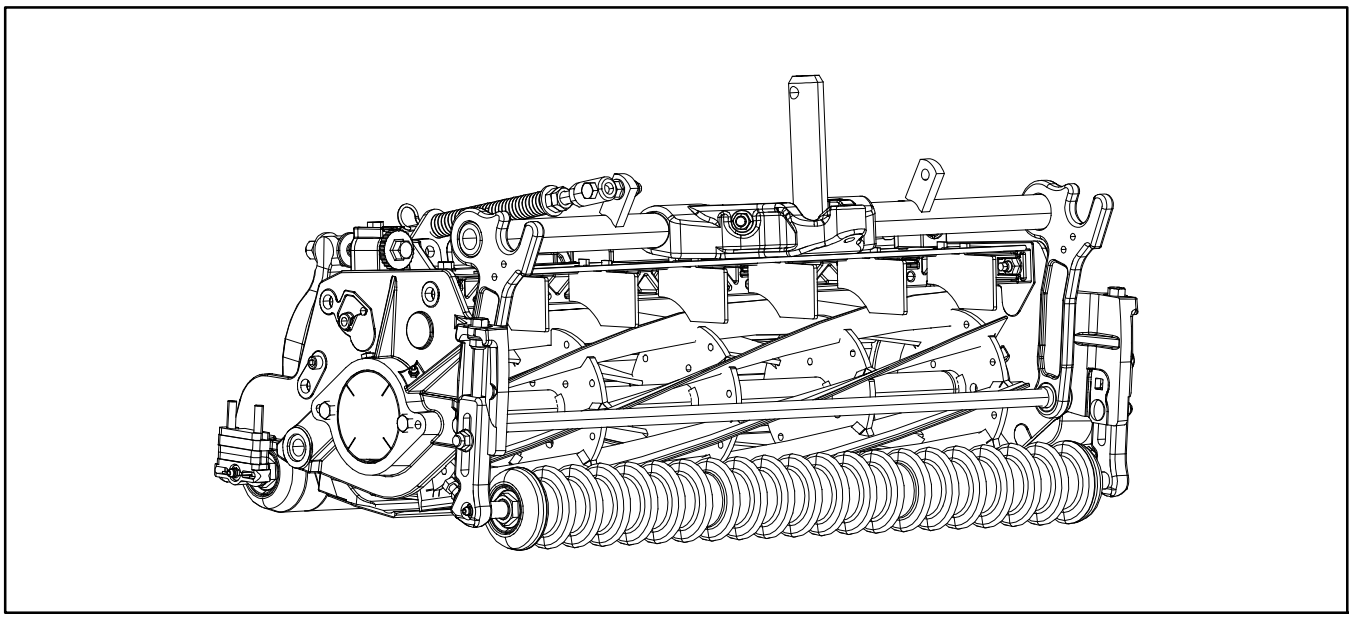


Figure 1

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) in length and 7 inch (18 cm) in diameter. High strength, low alloy steel blades are thru hardened and impact resistant. Reels are available in 8 and 11 blade configurations. Optional 32 inch (81 cm), 8 blade reels are available for the rear cutting unit positions.

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, tool steel EdgeMax™ bedknife is fastened to a machined cast iron bedbar with 10 screws. Optional bedknives are available.

Bedknife Adjustment: Dual screw assemblies allow for precise bedknife adjustment. Adjustment detents correspond to bedknife movement of 0.0009 inch (0.022 mm) 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, 8 Blade	**170 lb. (77 kg)**
27” Reel, 11 Blade	**175 lb. (79 kg)**
32” Reel, 8 Blade (optional)	**191 lb. (87 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 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.

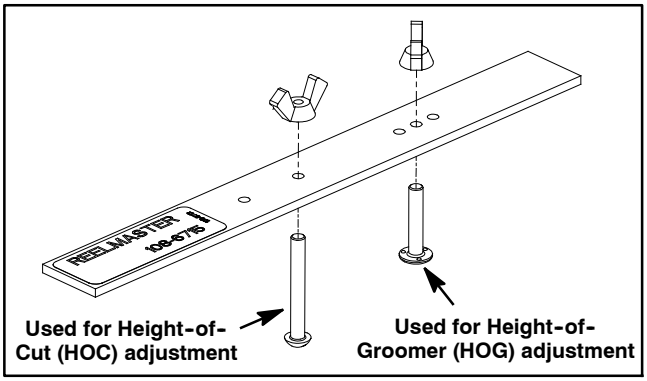


Figure 2

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.

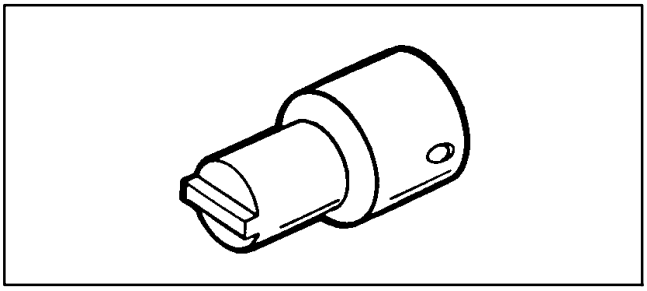


Figure 3

Handle Assembly

Toro Part Number: **29-9100**

For applying lapping compound to cutting units while keeping hands a safe distance from the rotating reel.

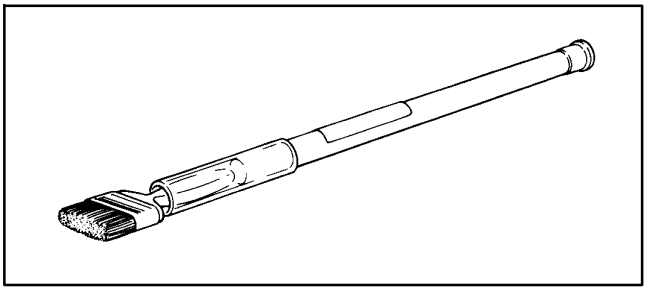


Figure 4

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.

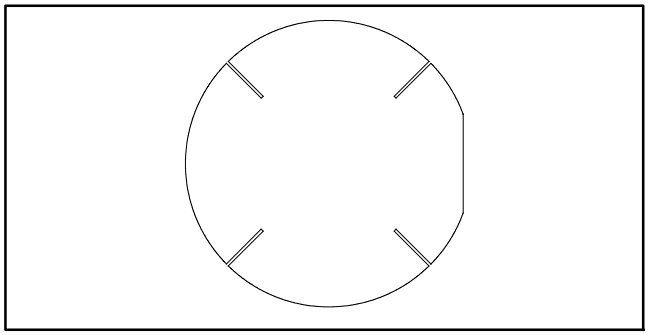


Figure 5

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.

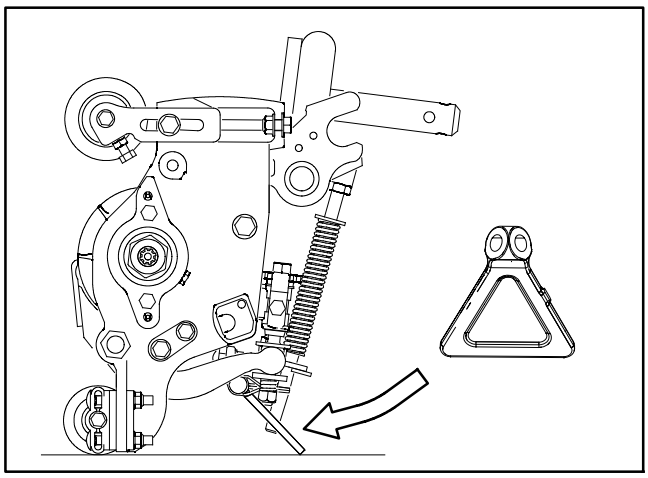


Figure 6

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.

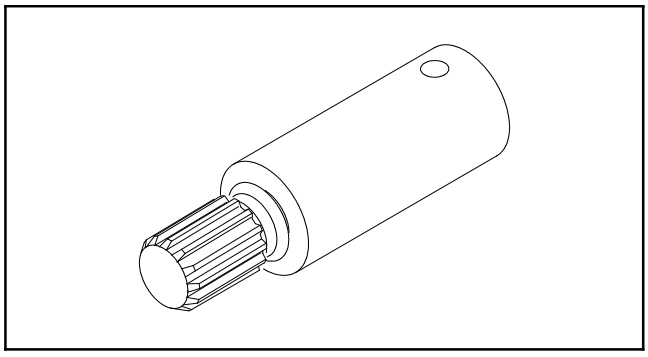


Figure 7

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

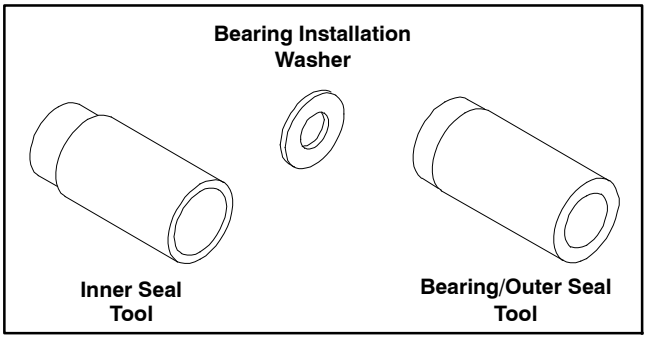


Figure 9

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 bearings aligned during reel installation.

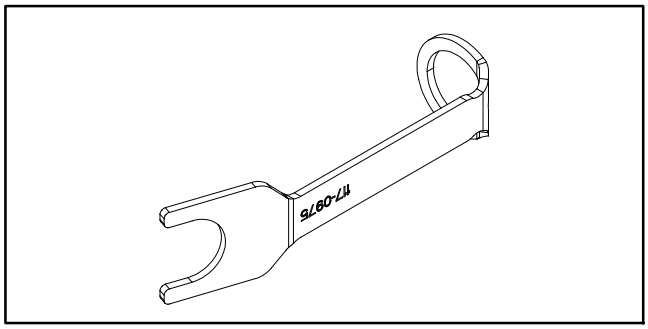


Figure 11

Cutting Reel Shim

Toro Part Number: **125-5611**

The cutting reel shim (0.002”) is used to help parallel the bedknife and cutting reel.

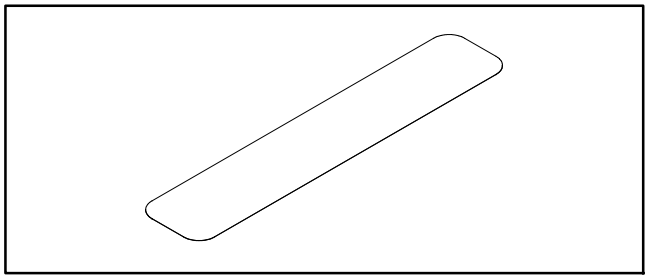


Figure 12

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.

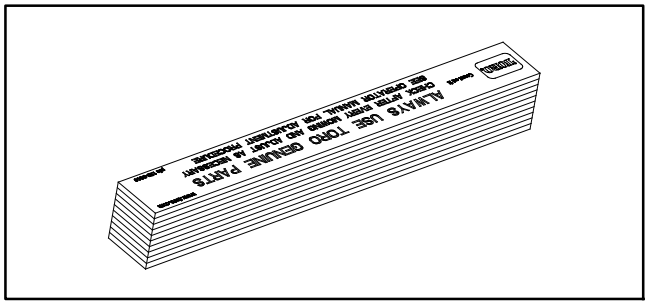


Figure 13

Pulley Alignment Tool

Toro Part Number: **114-5446**

Use the alignment tool for aligning optional rear roller brush drive pulleys.

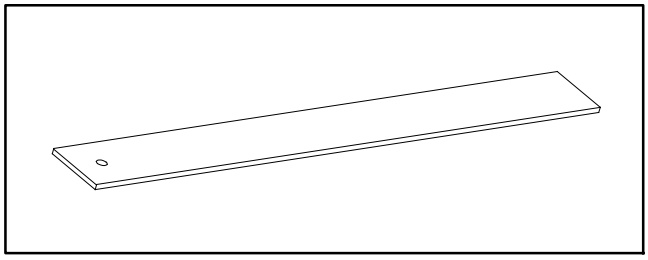


Figure 14

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.

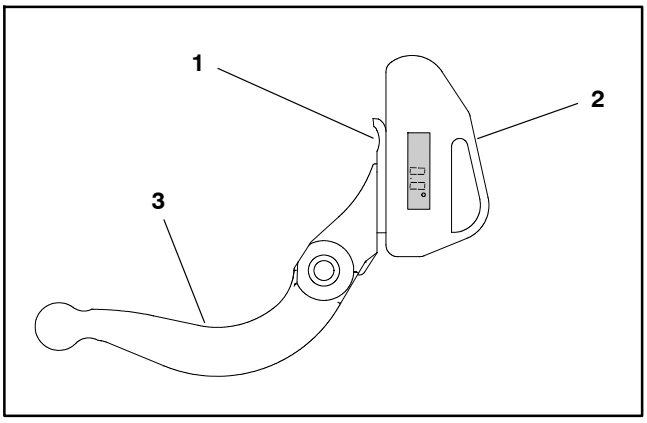


Figure 15

1. **Bedknife**
2. **Angle indicator**
3. **Bedbar**

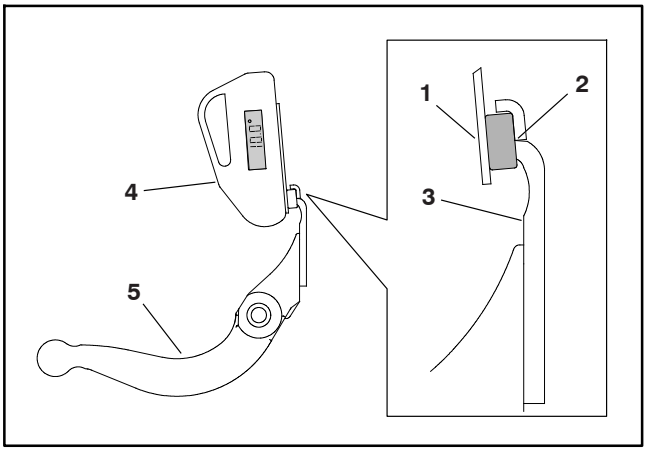


Figure 16

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 – Yanmar Diesel Engine or Chapter 4 – Kubota Diesel Engine in this manual.
Reel speed	All cutting reels must rotate at the same speed (within 100 rpm) (see Troubleshooting in Chapter 5 – Hydraulic System in this manual). All cutting units must have equal bedknife to reel and height–of–cut adjustments. Make sure that reel speed selection is correct (see Clip Chart in traction unit Operator’s Manual).
Reel bearing condition	Check reel bearings for wear and replace if necessary. See Reel Assembly Service in the Service and Repairs section of this chapter.
Bedknife to reel adjustment	Check bedknife to reel contact daily. The bedknife must have light contact across the entire reel. No contact will dull the cutting edges. Excessive contact accelerates wear of both edges. Quality of cut is adversely affected by both conditions (see Bedknife to Reel Adjustment in the cutting unit Operator’s Manual).

Factor	Possible Problem/Correction
Reel and bedknife sharpness	A reel and/or bedknife that has rounded cutting edges or “rifling” (grooved or wavy appearance) **cannot** be corrected by tightening the bedknife to reel contact. Grind cutting reel to remove taper and/or rifling. Grind bedknife to sharpen and/or remove rifling. The most common cause of rifling is bedknife to reel contact that is too tight. Dull cutting edges must be corrected by grinding the bedknife and cutting reel (see Preparing Reel for Grinding in the Service and Repairs section of this chapter). **A new bedknife must be ground flat (within 0.002”) after installation to the bedbar. Backlapping may be required to properly mate the reel and bedknife after installation into the cutting unit.** **NOTE:** On cutting units equipped with optional bedknives, slightly dull cutting edges may be corrected by backlapping (see Backlapping in the Service and Repairs section of this chapter).
Rear roller adjustment	Adjust the rear roller brackets to correct position depending on the height−of−cut range desired. See Rear Roller Adjustment in the cutting unit Operator’s Manual.
Height−of−cut	“Effective” or actual height−of−cut depends on the cutting unit weight and turf conditions. Effective height−of−cut will be different from the bench set height−of−cut. See Height−of−Cut Adjustment in the cutting unit Operator’s Manual.
Proper bedknife selection for height−of−cut desired	If the bedknife is incorrect for effective height−of−cut, poor quality of cut will result. See cutting unit Operator’s Manual for bedknife options.
Stability of bedbar	Make sure bedbar pivot bolts are seated securely. Check condition of the bushings in the side plates. See Bedbar Removal and Installation in the Service and Repairs section of this chapter.
Number of reel blades	Use correct number of reel blades for clip frequency and optimum height−of−cut range.
Cutting unit alignment and carrier frame ground following	Check carrier frames and lift arms for damage, binding conditions or bushing wear. Repair if necessary.

Factor	Possible Problem/Correction
Roller condition and roller type	Make sure rollers rotate freely. Repair roller bearings as necessary. See Roller Service in the Service and Repairs section of this chapter. Refer to cutting unit Operator's Manual for roller options.
Cutting unit accessories	A variety of cutting unit accessories are available that can be used to enhance aftercut appearance. Refer to cutting unit 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 in this chapter), 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 Service and Repairs section of Chapter 10 – Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

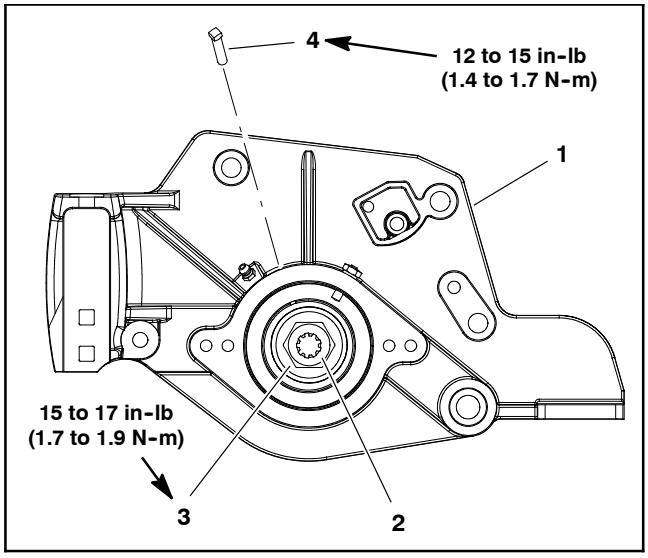


Figure 17

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 over tighten 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. Using the surface plate, check if rear roller is level to cutting reel by using a 0.005" (0.13 mm) shim at each end of rear roller. If the shim will pass under the roller at one end but not the other, a frame adjustment should be made.

4. Loosen, but do not remove, the three (3) shoulder bolts that secure the side plate to the frame opposite the side that is not level (Fig. 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. Use the shim on one side of the rear roller and install it between the rear roller bracket and roller shim (Fig. 19).

8. After leveling rear roller, complete cutting unit set-up and adjustment sequence.

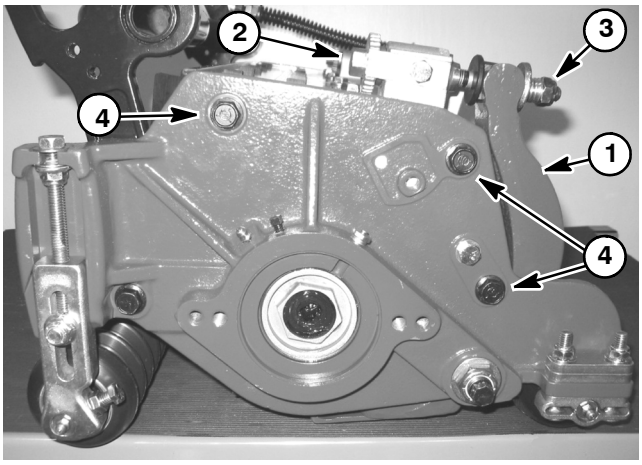


Figure 18

1. **Bedbar**
2. **Bedbar adjuster screw**
3. **Spring tension lock nut**
4. **Shoulder bolt**

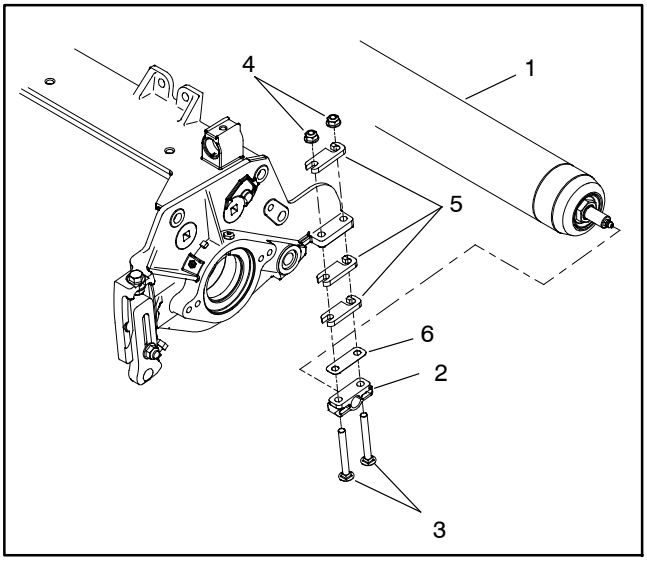


Figure 19

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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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

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.

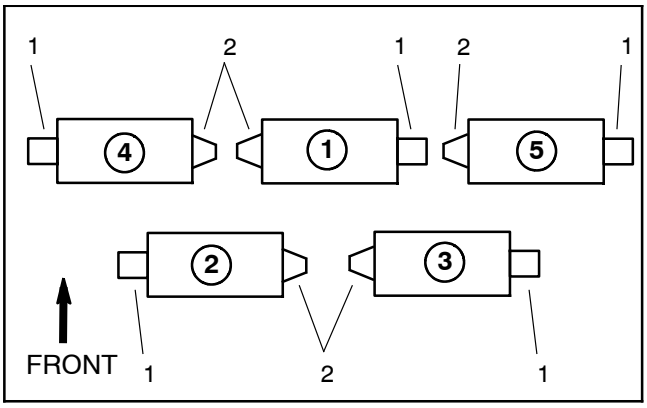


Figure 20

1. Reel motor location **2. Weight location**

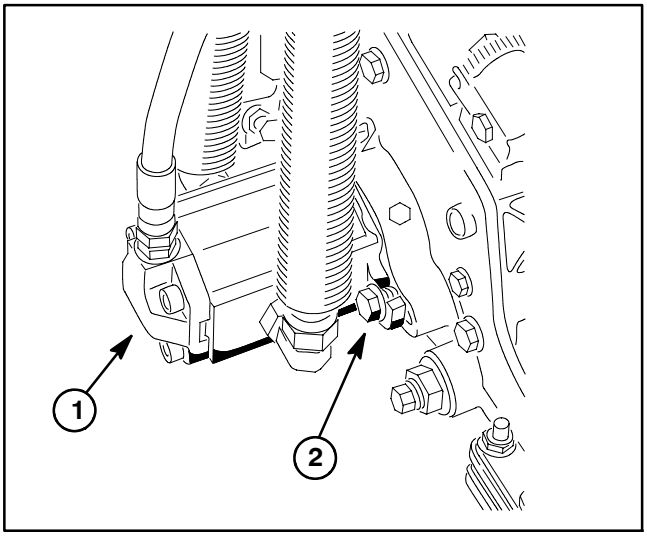


Figure 21

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. Stay away from the cutting reels when backlapping.**
- **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 mow control manifold when the engine or reels are running.

3. Raise seat, locate hydraulic mow control manifold and rotate directional valve lever fully to the R (backlap) position (Fig. 22). Rotate flow control valve knob to position 1.

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.

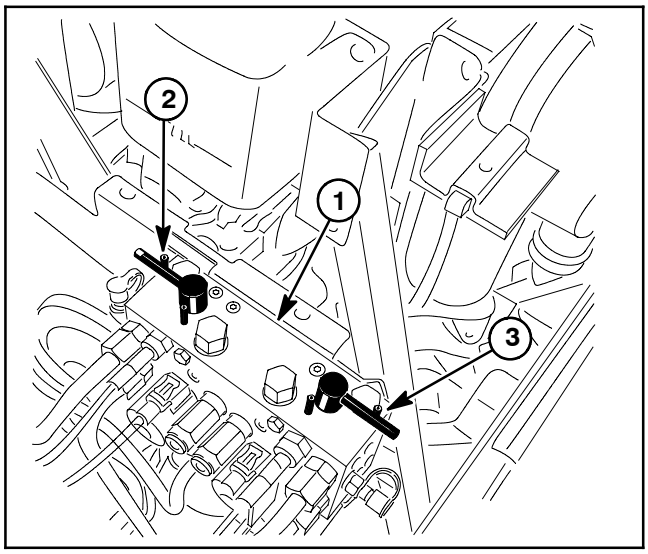


Figure 22

1. **Mow manifold**
2. **Front backlap lever**
3. **Rear backlap lever**

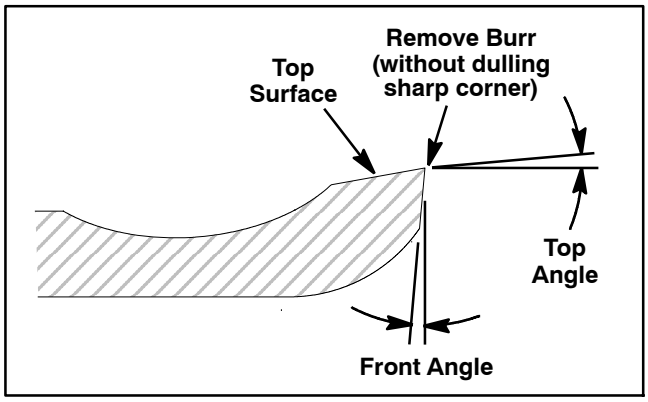


Figure 23

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

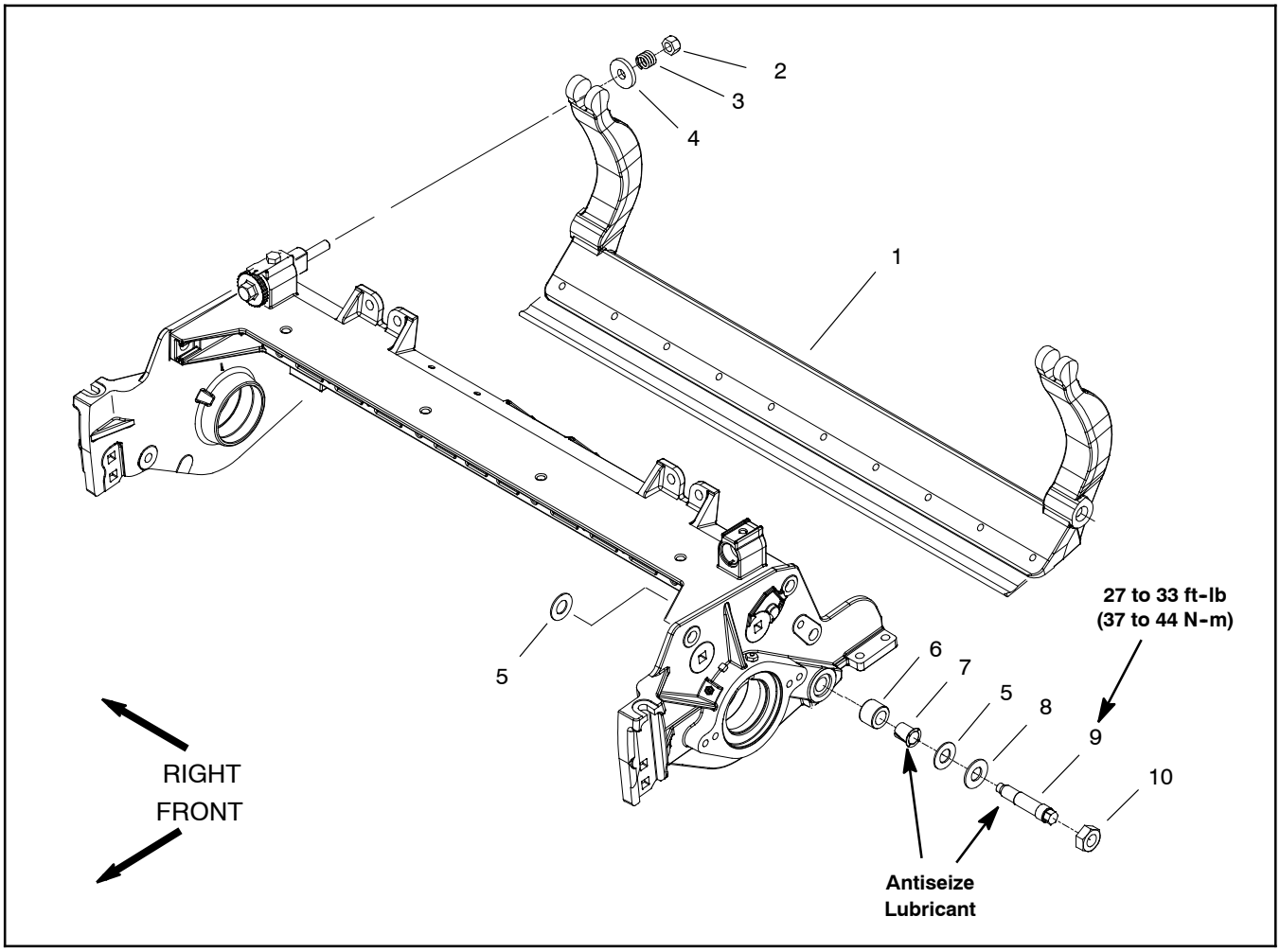


Figure 24

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.

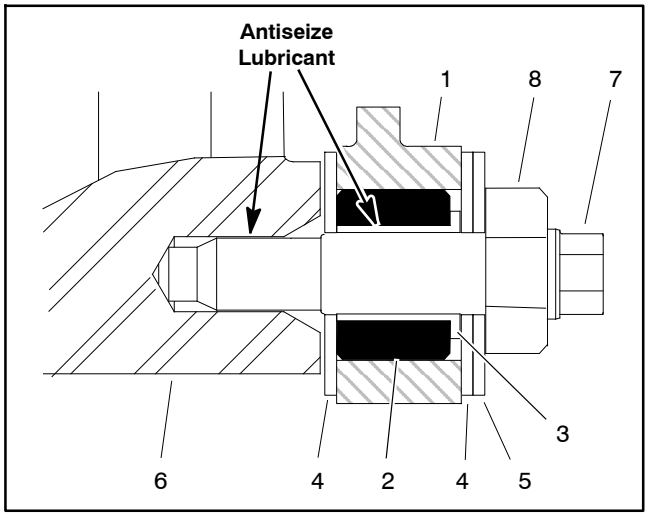


Figure 25

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 assembly from cutting unit (see Bedbar Assembly in this chapter).

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.

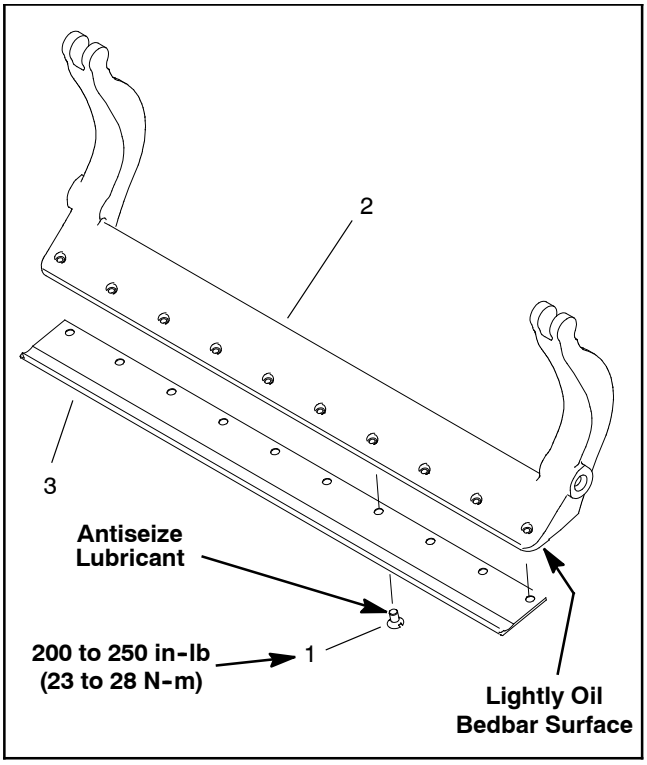


Figure 26

1. Screw (8 used)
2. Bedbar
3. Bedknife

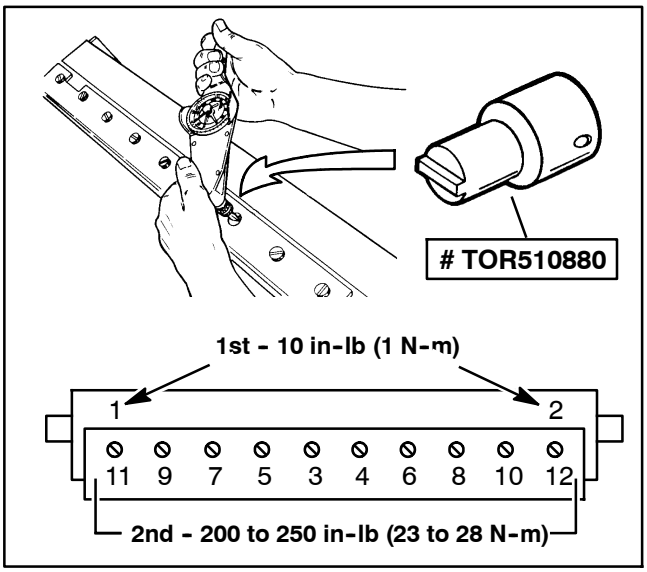


Figure 27

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

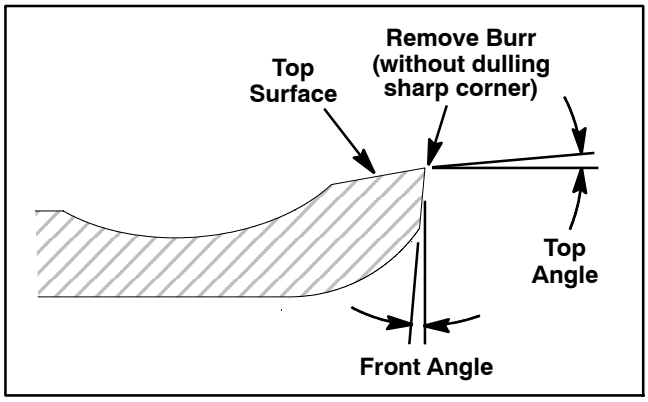


Figure 29

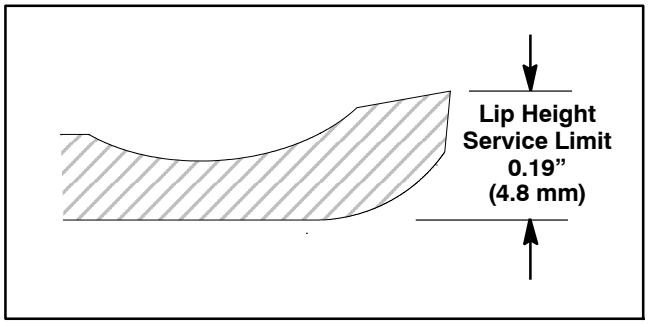


Figure 30

1. Bedknife

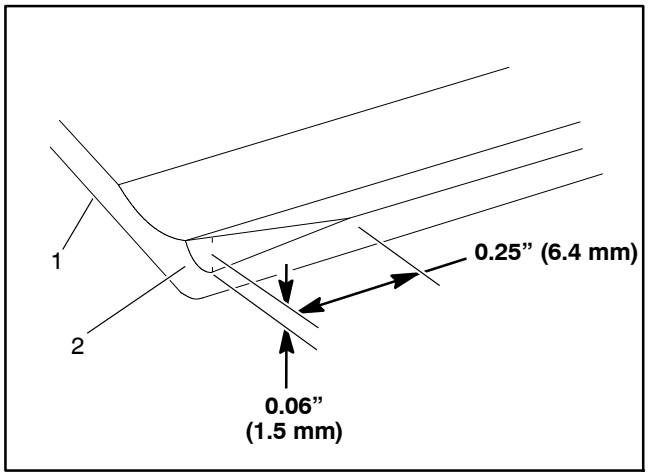


Figure 31

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).

Bedbar Adjuster Service

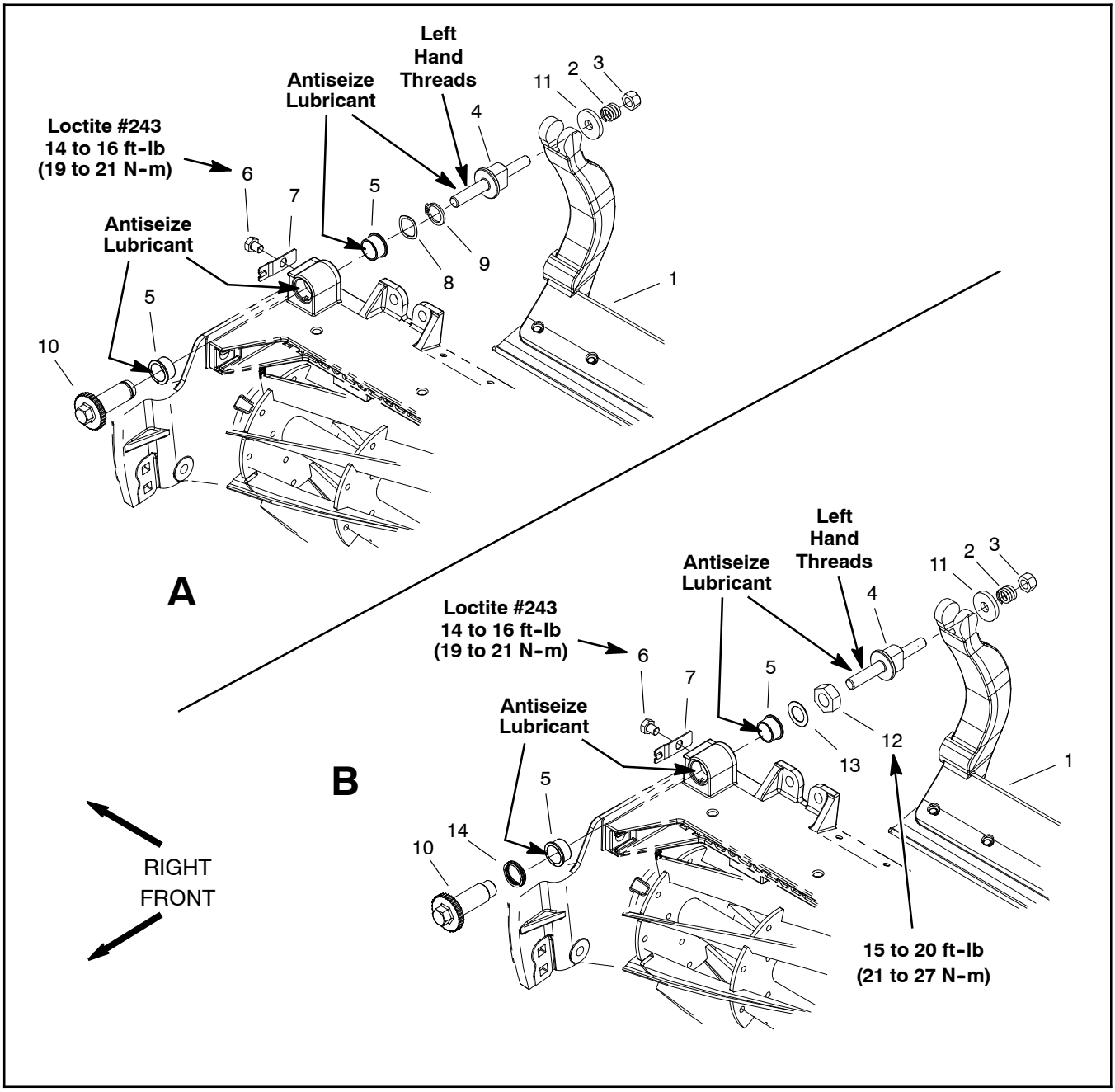


Figure 32

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)

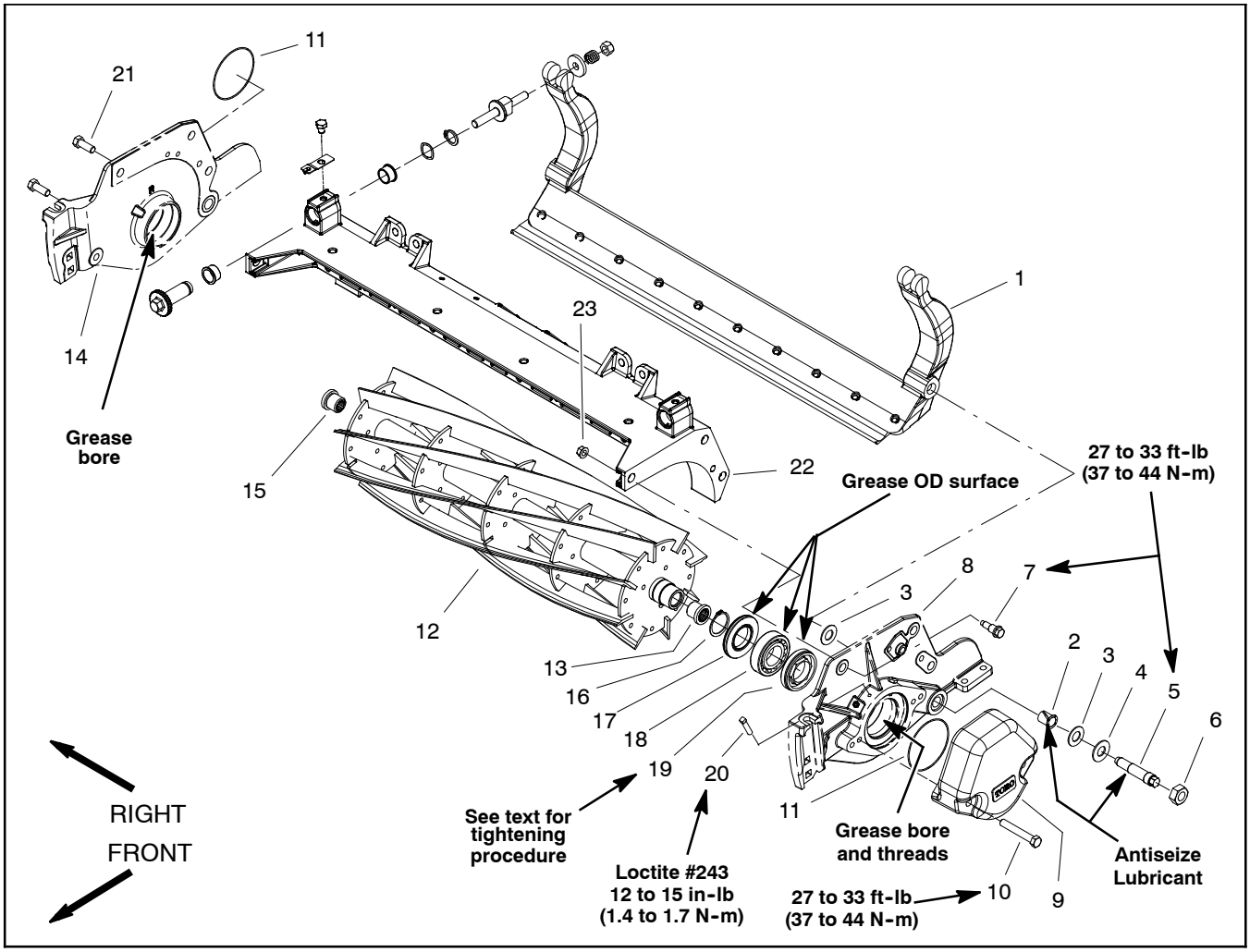


Figure 33

1. Bedbar assembly
2. Flange bushing (2 used)
3. Plastic washer (4 used)
4. Metal washer (2 used)
5. Bedbar pivot bolt (2 used)
6. Lock nut (2 used)
7. Shoulder bolt (3 used per side plate)
8. LH side plate
9. Weight
10. Cap screw (2 used)
11. O-ring
12. Cutting reel
13. Spline insert (LH thread)
14. RH side plate
15. Spline insert (RH thread)
16. Retaining ring (2 used)
17. Grease seal (2 used)
18. Bearing (2 used)
19. Bearing adjuster nut
20. Set screw
21. Cap screw (2 used)
22. Cutting unit frame
23. Flange nut (3 used per side plate)

NOTE: This section provides the procedure for removing and installing the cutting reel assembly (cutting reel, spline inserts, grease seals and bearings) from the cutting unit.

NOTE: Refer to Reel Assembly Service later in this section for information on replacing cutting reel grease seals, bearings and spline inserts.

NOTE: Removal of the cutting reel requires removal of the left side plate from the cutting unit frame. The right side plate does not have to be removed from the frame.

Reel Assembly Removal (Fig. 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 the cutting unit is equipped with a counterweight or accessory on LH side plate, remove the counter weight or accessory. Remove and discard the O−ring from counter weight.

4. If cutting unit is equipped with an optional groomer or rear roller brush, remove components for those options from left hand side plate of cutting unit. See Service and Repairs section of Chapter 10 − Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of 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.

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.

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.

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).

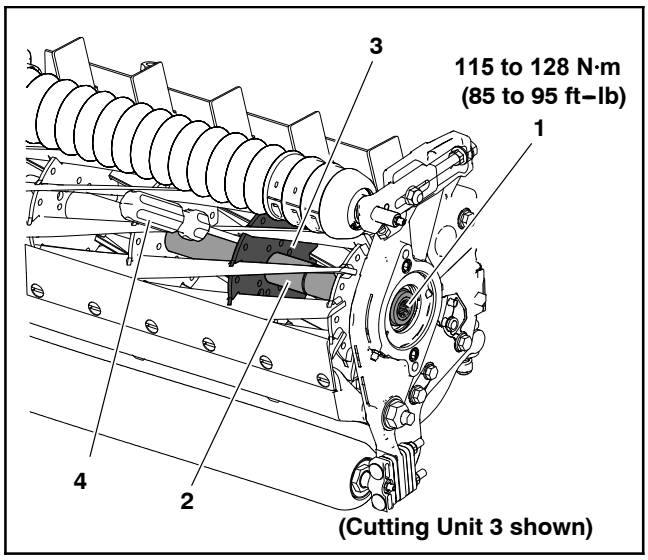


Figure 34

1. Spline insert (LH)
2. Reel shaft
3. Reel support plate
4. Pry bar

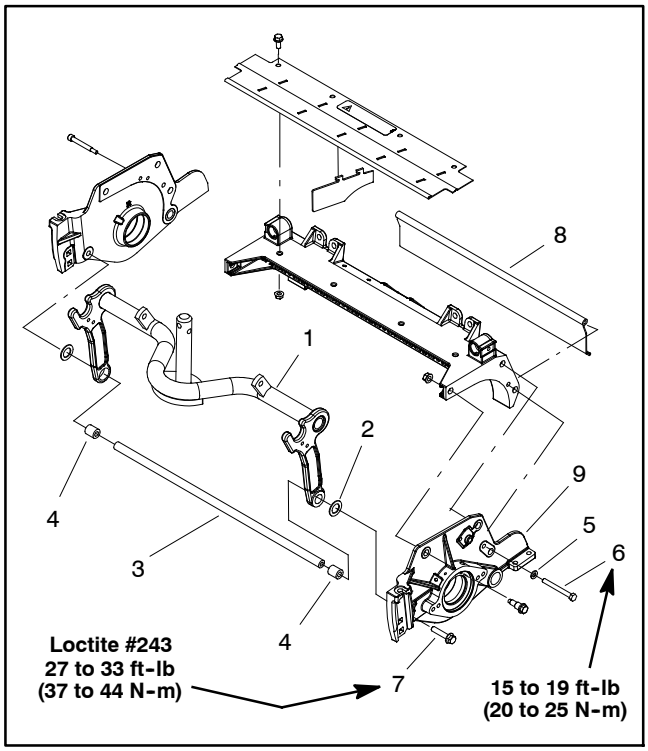


Figure 35

1. Carrier frame
2. Shim (if equipped)
3. Support tube
4. Frame spacer
5. Flat washer
6. Cap screw
7. Flange head screw
8. Rear grass shield
9. LH side plate

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 7) and flange nuts that secure the LH side plate to the cutting unit frame. Remove the LH side plate from the reel shaft, rollers, bedbar assembly and cutting unit frame.

CAUTION

Contact with the reel, bedknife or other cutting unit parts can result in personal injury. Use heavy gloves when removing the cutting reel.

11. Carefully pull 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 (Toro part number 117-0975) to help with bearing alignment during reel installation.

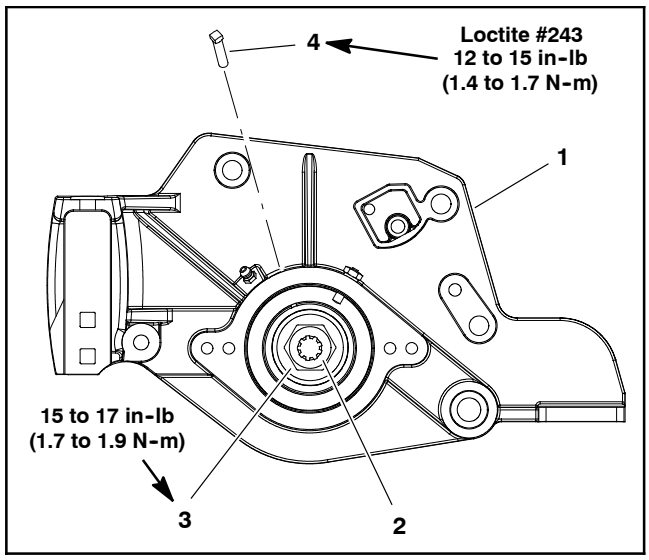


Figure 36

1. LH side plate
2. Threaded insert
3. Bearing adjuster nut
4. Set screw

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. Loosen set screw (item 20) and back-off (loosen) bearing adjuster nut one complete turn.

5. Slide the LH side plate onto the cutting reel assembly, front roller and rear roller. Make sure that reel end in RH side plate does not shift in position.

6. Install shoulder bolts (item 7) 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)**.

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-lbs (37 to 44 N-m)**. After tightening screw, check the clearance between the carrier frame and side plate. If clearance is more than 0.090" (2.3 mm), remove flange head screw and position shim(s) (part number 67-9410) between carrier frame and side plate so that clearance is less than 0.090" (2.3 mm). Make sure that the carrier frame pivots freely after assembly.

8. Install cap screw and flat washer that secure rear grass shield to LH side plate (Fig. 35). Torque screw from **15 to 19 ft-lbs (20 to 25 N-m)**.

9. Secure the bedbar assembly to LH side plate (see Bedbar Installation in this section).

10. Secure front and rear rollers to LH side plate (see Front Roller Installation and Rear Roller Installation in this section).

IMPORTANT: Over tightening reel bearing adjuster nut may damage reel bearings.

11. Make sure that set screw is loose in LH side plate to allow bearing adjuster nut movement. With the cutting unit and reel in a horizontal position, tighten the bearing adjuster nut to **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. 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).

14. 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)**.

15. 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 Adjustments section of this Chapter).

16. If cutting unit is equipped with optional groomer or rear roller brush, install components for those options to left hand side plate of cutting unit. See Service and Repairs section of Chapter 10 - Belt Driven Groomer for information on groomer. See Rear Roller Brush in the Service and Repairs section of this chapter for information on rear roller brush.

17. 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.

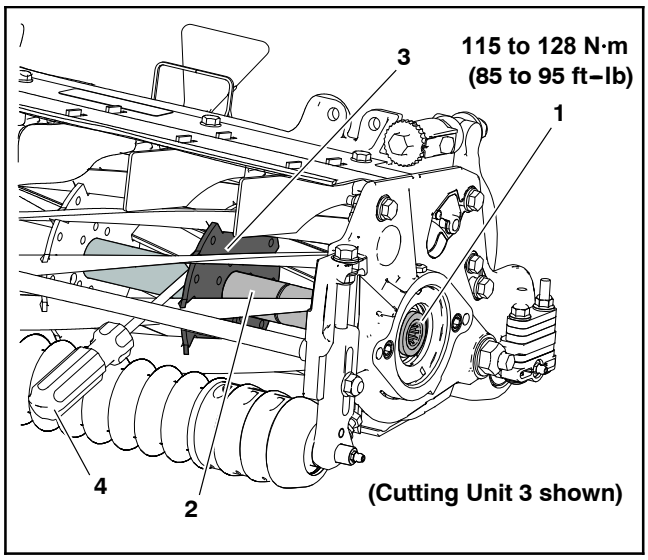


Figure 37

1. Spline insert (LH)
2. Reel shaft
3. Reel support plate
4. Pry bar

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 to 128N·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.

18. If counterweight or accessory was removed from cutting unit, install new O-ring (item 11). Secure counter weight or accessory to cutting unit. Tighten counterweight screws from **27 to 33 ft-lbs (37 to 44 N-m)**.

19. 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.

20. Install cutting unit to the machine.

Reel Assembly Service (cutting units with painted side plates)

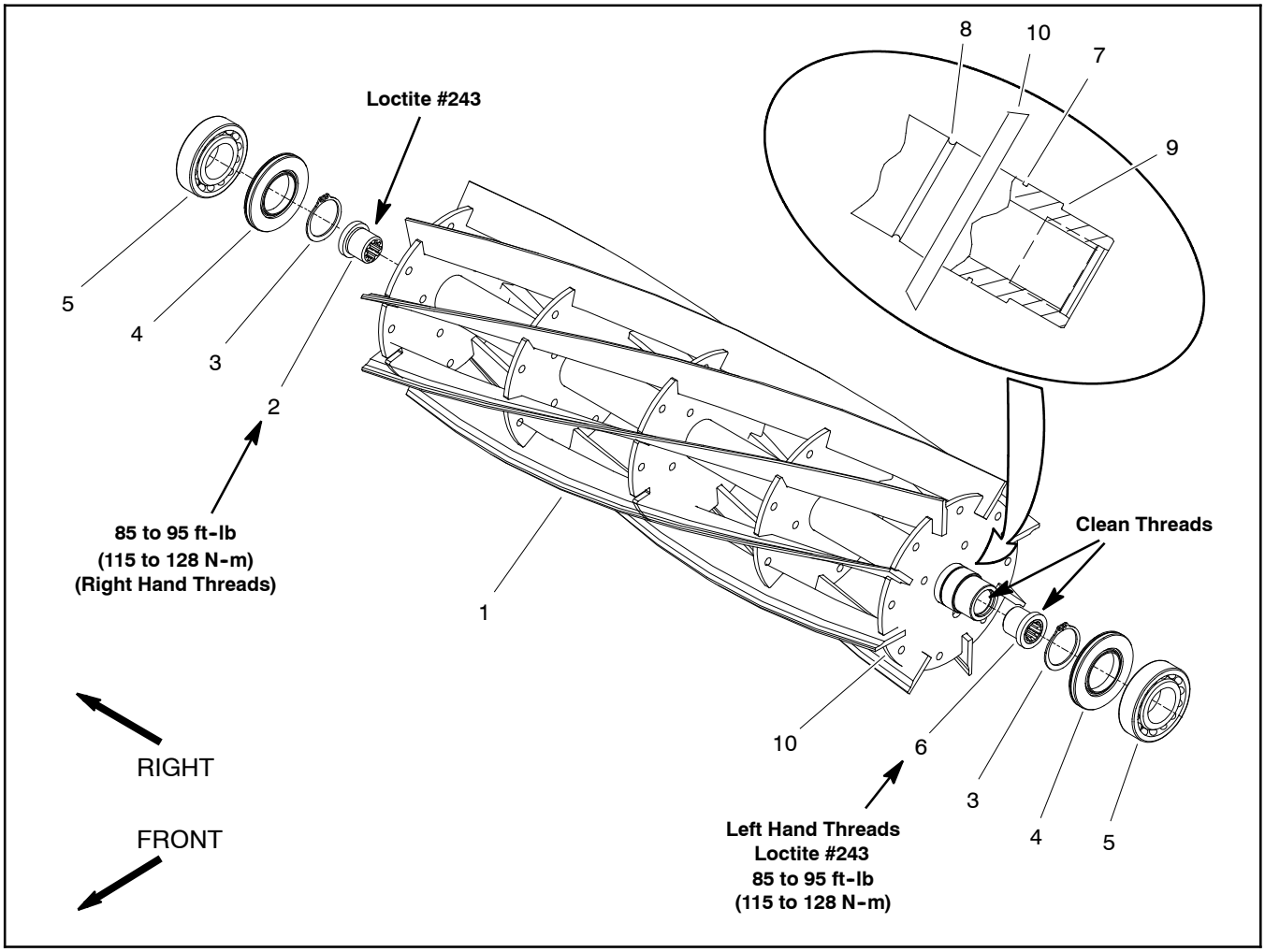


Figure 38

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. 38)

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 identifies the reel end that has LH threads (see illustration in Fig. 38).

   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. 38)

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. Fill threaded insert splines with high temp Mobil XHP-222 grease or equivalent.

Reel Assembly (cutting units with aluminum side plates)

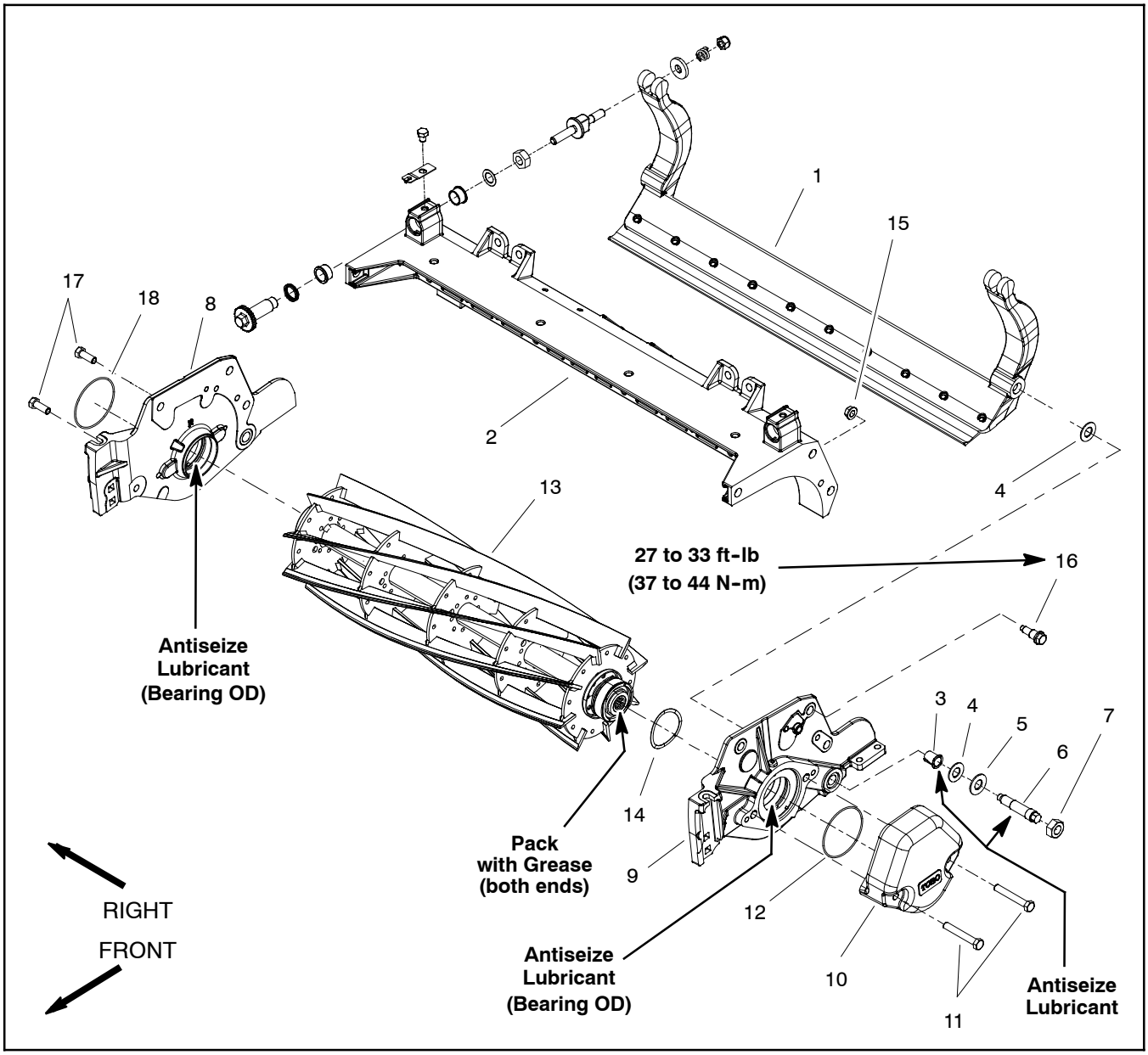


Figure 39

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.

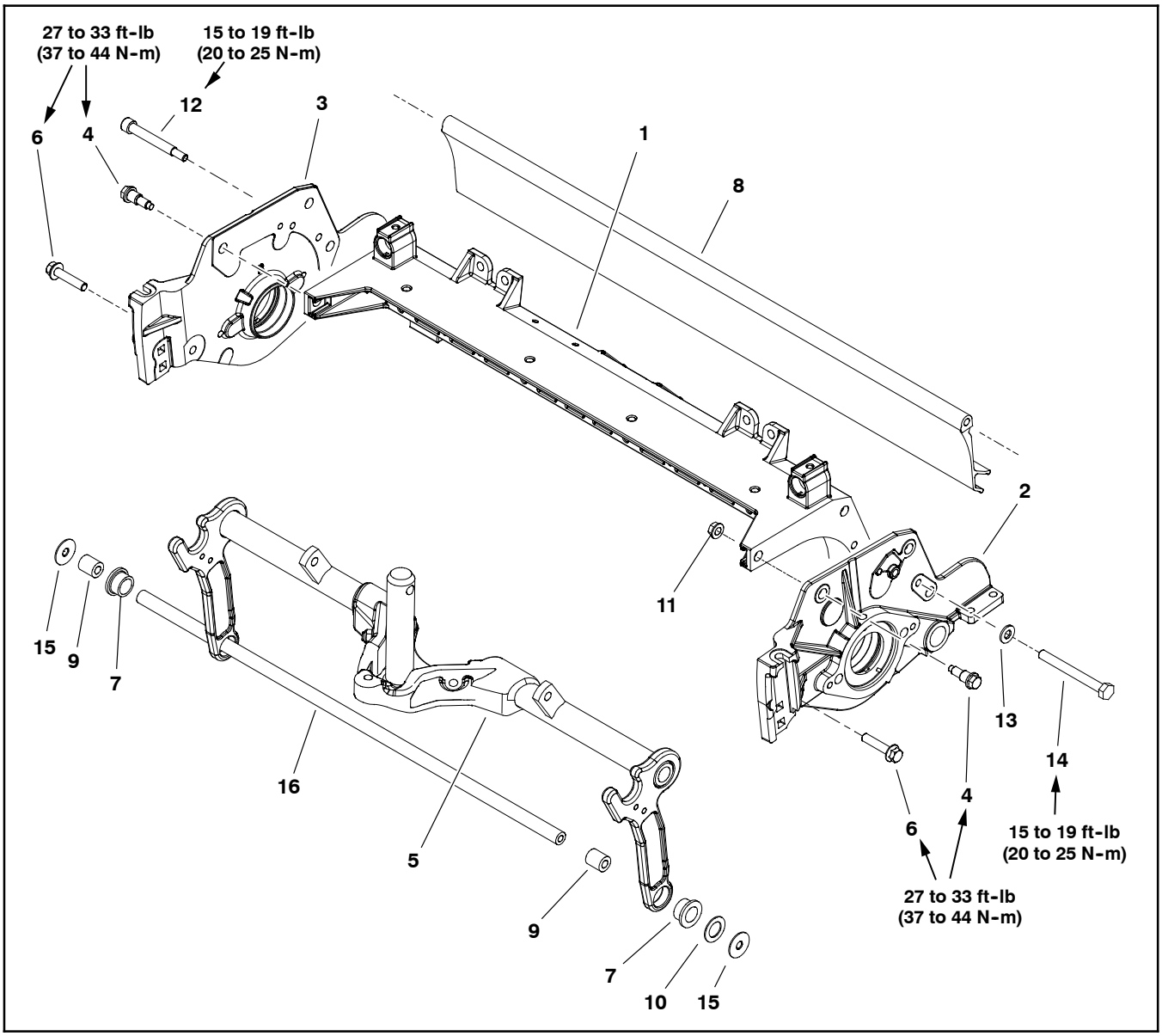


Figure 40

1. Frame
2. LH side plate
3. RH side plate
4. Shoulder bolt (6)
5. Carrier frame
6. Flange head screw (2)
7. Flange bushing (2)
8. Rear grass shield
9. Spacer (2)
10. Shim (0.060" - as required)
11. Flange nut (6)
12. Special screw
13. Flat washer
14. Cap screw
15. Washer (2)
16. Support rod

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.

3. If cutting unit is equipped with a counterweight or accessory on LH side plate, remove the counter weight or accessory. Remove and discard O-ring from counter weight. See Chapter 10 - Belt Driven Groomer or Chapter 10 - Universal Groomer for more information. See Rear Roller Brush in this chapter for more information.

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.

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).

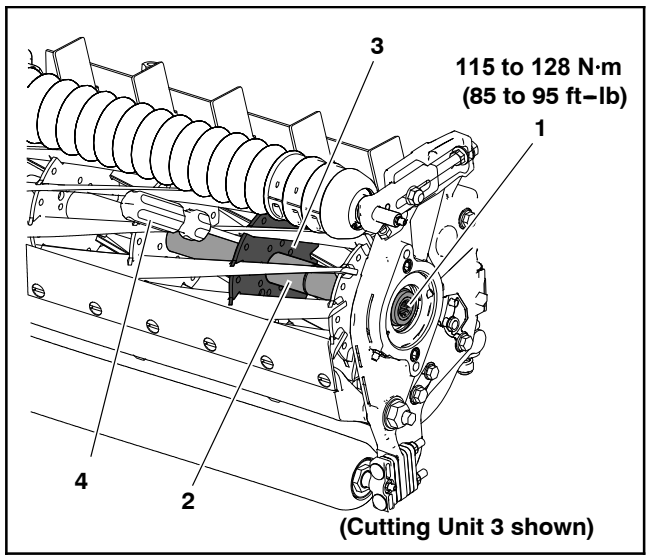


Figure 41

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.

2. Make sure that grease seals and bearings are properly installed on cutting reel (see Reel Assembly Service in this Chapter).

3. Cutting unit serial nos. 315000001 & Up have 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. 42).

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. 39) 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 frame spacer and carrier frame to LH side plate. Install screw and torque from **27 to 33 ft-lbs (37 to 44 N-m)**. After tightening screw, check the clearance between the carrier frame and side plate. If clearance is more than **0.065" (1.6 mm)**, remove flange head screw and position shim(s) between carrier frame and side plate so that clearance is less than **0.065" (1.6 mm)**. Make sure that the carrier frame pivots freely after assembly.

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 10 – Belt Driven Groomer or Chapter 10 – Universal Groomer in this manual for additional Groomer information. See Rear Roller Brush in this chapter for information on rear roller brush.

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 to 128N·m)**. Use correct spline insert tool (see Special Tools).

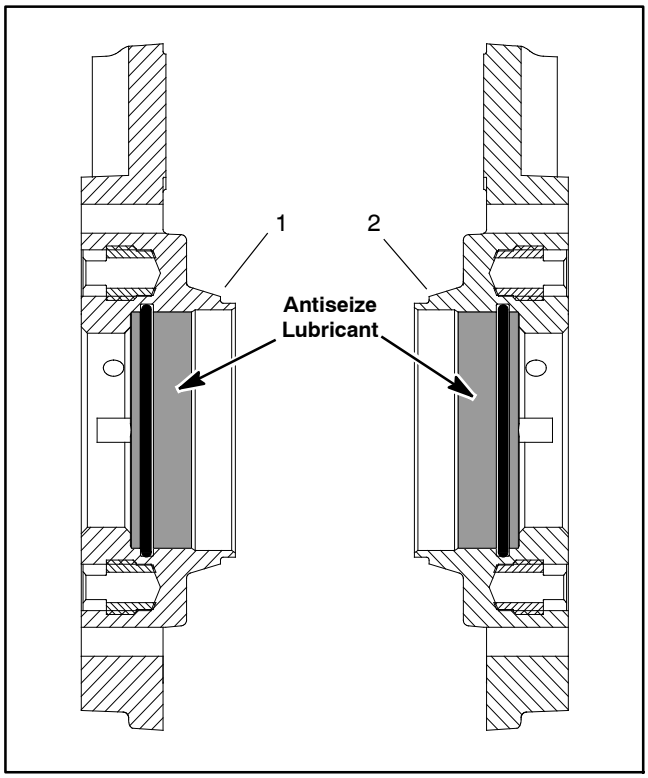


Figure 42

1. **Side plate - RH**
2. **Side plate - LH**

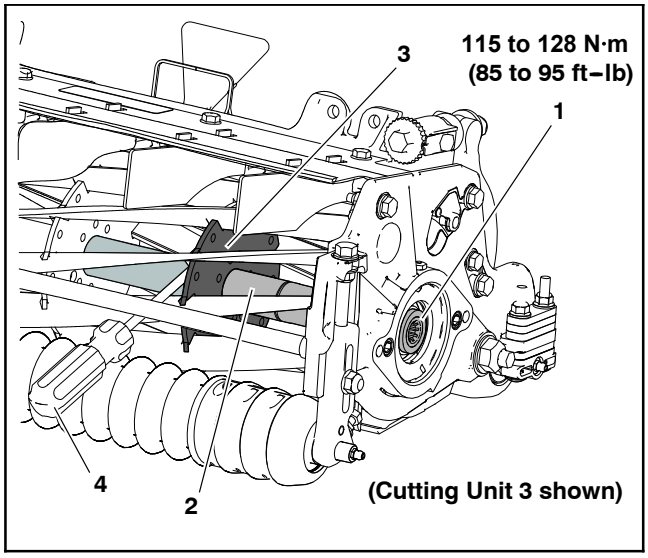


Figure 43

1. **Spline insert (LH)**
2. **Reel shaft**
3. **Reel support plate**
4. **Pry bar**

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)

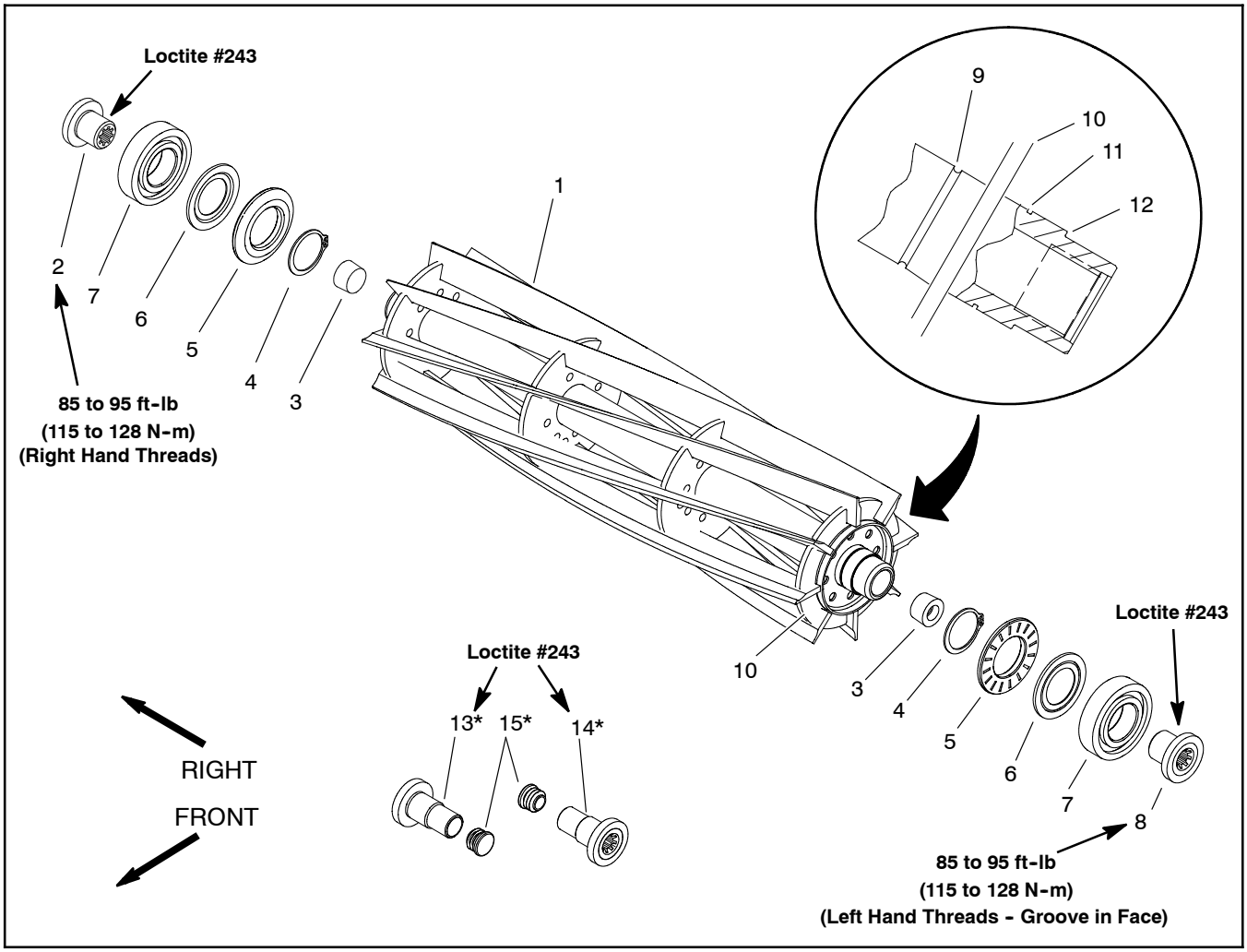


Figure 44

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**
13. **Threaded insert (RH thread)***
14. **Threaded insert (LH thread)***
15. **Plastic plug (2)***

*Used on cutting units prior to serial no. 315000001.

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. 45)

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.

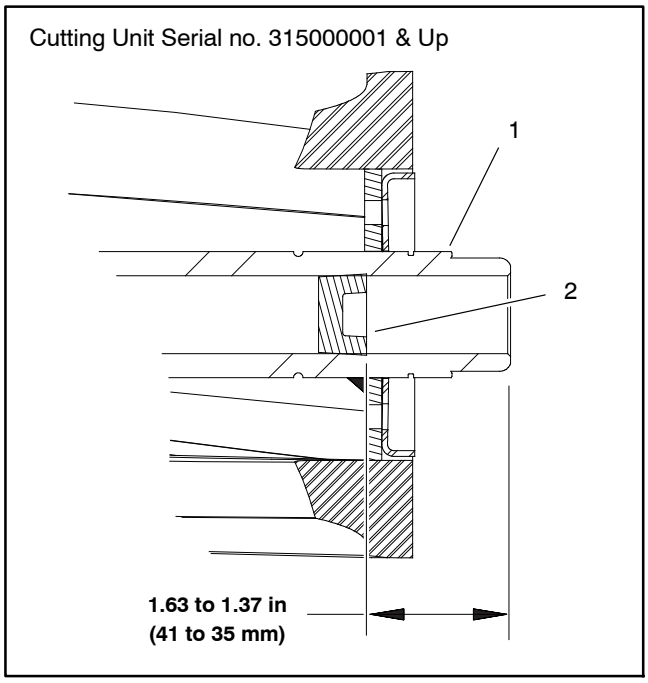


Figure 45

1. **Reel shaft**
2. **Plastic plug (2)**

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. 46). 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 (168.0 mm)
Reel Shaft Diameter (OD)	1.313 in (34.4 mm)
Reel Diameter Taper (Fig. 47)	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	30º +/- 5º

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.

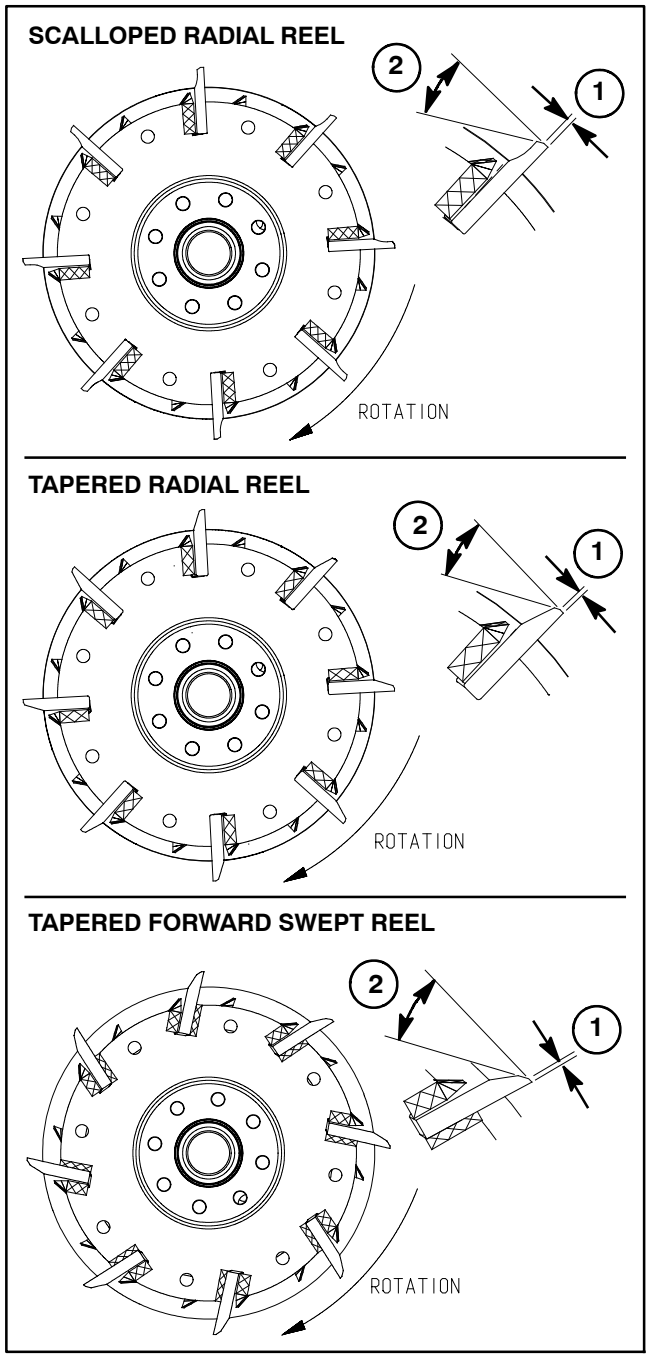


Figure 46

1. **Blade land width**
2. **Blade relief angle**

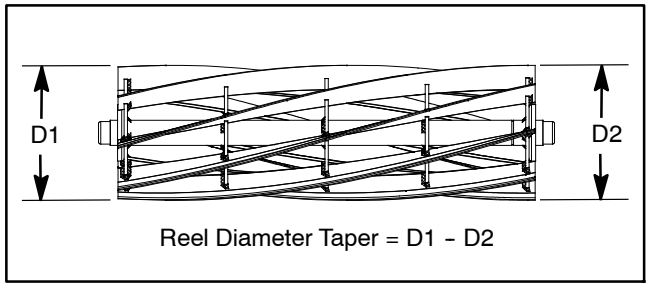


Figure 47

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Front 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. Use cutting unit kickstand (see Special Tools) to raise front roller from work surface.

3. Loosen flange nut and cap screw securing the front roller shaft to each front height−of−cut (roller) bracket.

4. On one of the height−of−cut (roller) brackets:

   A. Remove flange lock nut and carriage screw that secure bracket to the cutting unit side plate.

   B. Remove the height−of−cut (roller) bracket from the cutting unit.

5. Slide the front roller assembly from the remaining height−of−cut (roller) bracket on the cutting unit.

6. If necessary, remove the second height−of−cut (roller) bracket from the cutting unit.

Installation (Fig. 48)

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 only to the cap screw threads that will extend into height−of−cut (roller) bracket.

   C. Thread cap screw into height−of−cut (roller) bracket.

NOTE: When assembling height−of−cut (roller) brackets to side plate, make sure that cap screw head and one washer are above adjustment flange on side plate and second washer and flange lock nut are below flange.

3. If both front height−of−cut (roller) brackets were removed from cutting unit side plate, position one of the brackets to side plate. Secure bracket to side plate with carriage screw and flange lock nut.

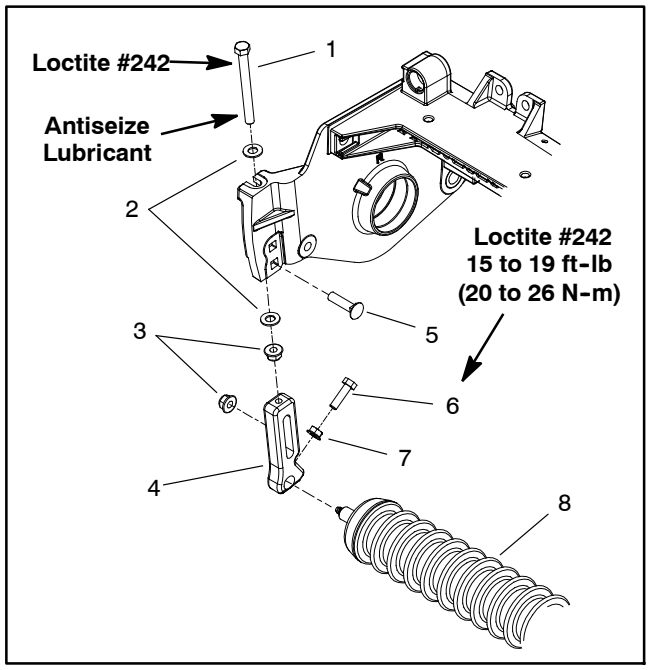


Figure 48

1. **Cap screw**
2. **Flat washer**
3. **Flange lock nut**
4. **HOC (roller) bracket**
5. **Carriage screw**
6. **Cap screw**
7. **Flange nut**
8. **Front roller assembly**

4. Slide front roller shaft into bracket attached to the cutting unit. Slide second height−of−cut (roller) bracket onto the other end of roller shaft. Secure second bracket to cutting unit side plate with carriage screw and flange nut.

5. Apply Loctite #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 roller 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. 49)

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. 49)

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 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.

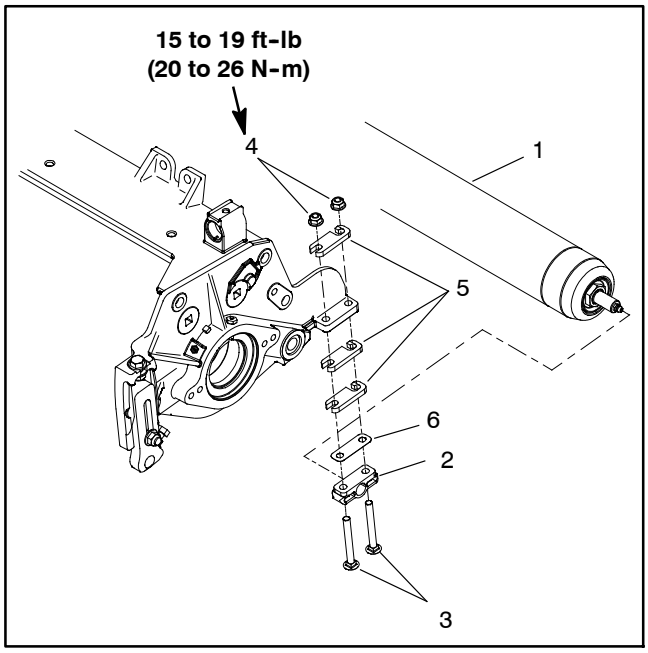


Figure 49

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 from **15 to 19 ft-lb (20 to 26 N-m)**.

5. Lubricate rear roller.

6. Adjust cutting unit (see cutting unit Operator's Manual).

Roller Service

Disassembly (Fig. 50)

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. 50)

1. Install both 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. 51). 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. 52). 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. 53). 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.

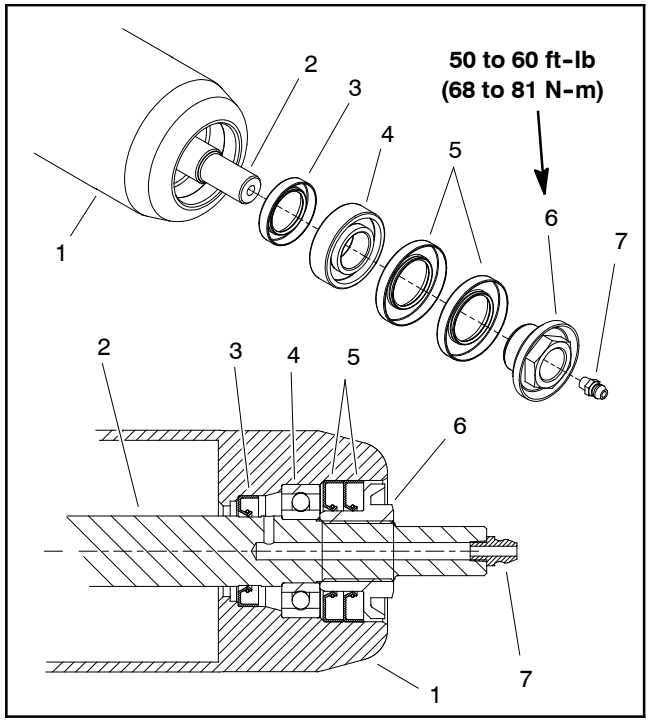


Figure 50

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing lock nut**
7. **Grease fitting**

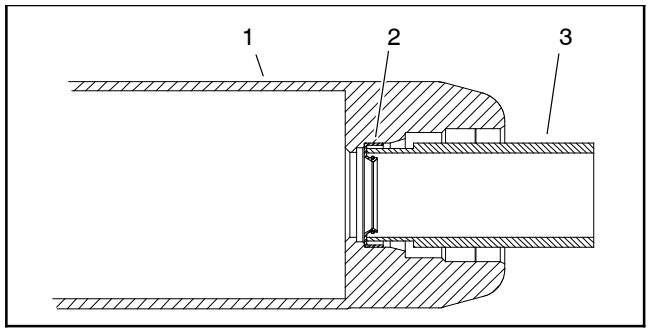


Figure 51

1. **Roller tube**
2. **Inner seal**
3. **Inner seal tool**

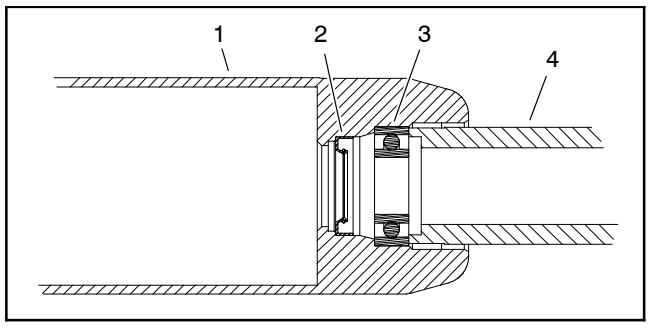


Figure 52

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Bearing/outer seal tool**

3. From the roller tube end with only the inner seal installed, carefully install the roller shaft into the roller tube. Make sure that seals are not damaged as shaft is installed.

4. Install new bearing and outer seals into second end of roller tube:

A. Position a second new bearing to roller shaft and tube. Position washer (see Special Tools) on bearing to allow pressing on both inner and outer bearing races simultaneously.

B. Use washer and bearing/outer seal tool (see Special Tools) with a soft face hammer to fully seat bearing (Fig. 54). 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. 55). 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 bearing 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.

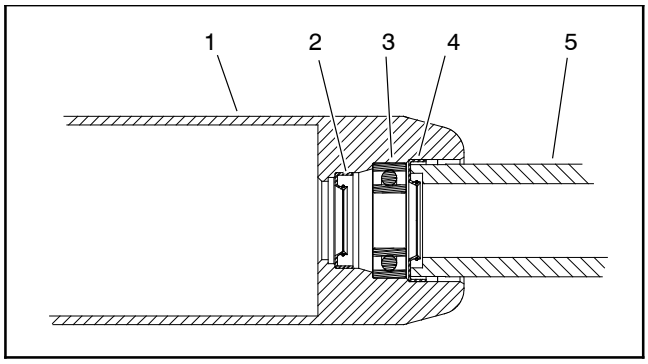


Figure 53

1. **Roller tube**
2. **Inner seal**
3. **Bearing**
4. **Outer seal**
5. **Bearing/outer seal tool**

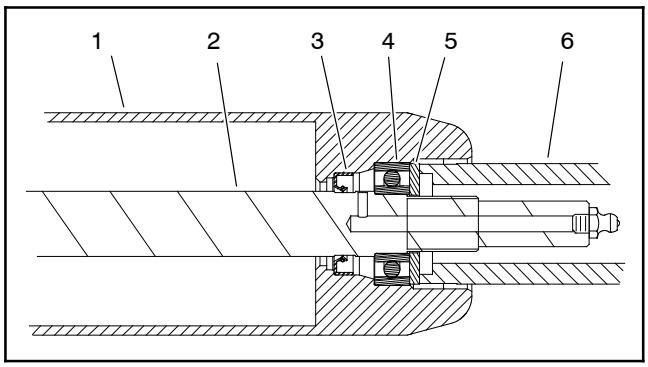


Figure 54

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Washer**
6. **Bearing/outer seal tool**

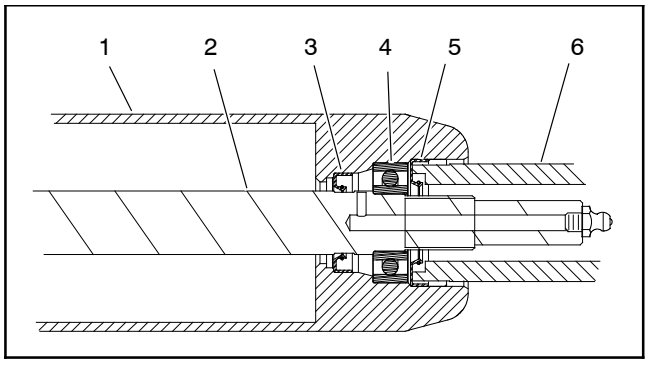


Figure 55

1. **Roller tube**
2. **Roller shaft**
3. **Inner seal**
4. **Bearing**
5. **Outer seal**
6. **Bearing/outer seal tool**

Rear Roller Brush - Optional (cutting units with painted side plates)

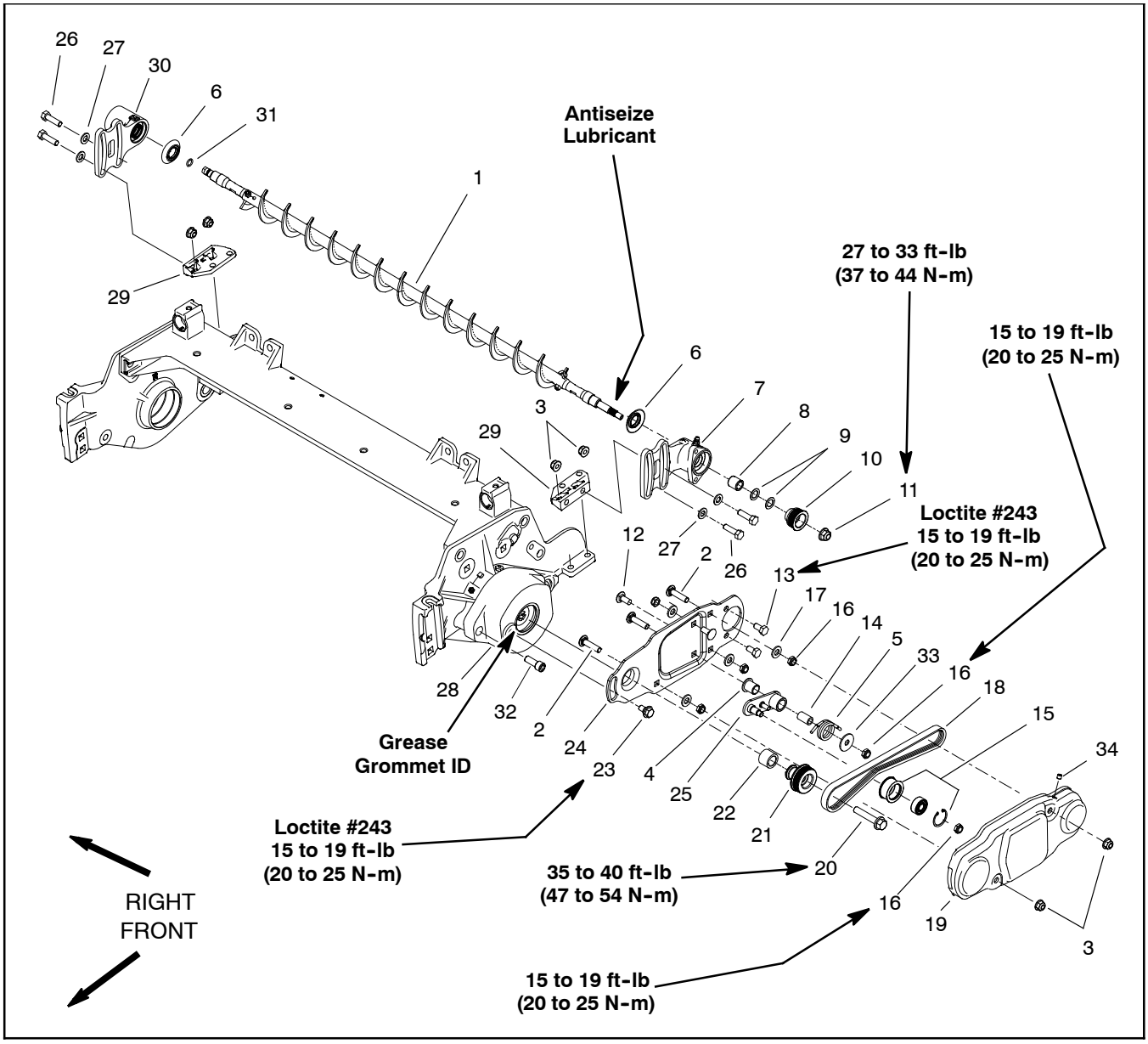


Figure 56

1. Roller brush assembly
2. Carriage screw (3)
3. Flange nut
4. Flange bushing
5. Idler spring
6. Excluder seal (2)
7. Bearing assembly (driven)
8. Spacer
9. Hardened washer (as required)
10. Driven pulley
11. Flange nut
12. Carriage screw (2)
13. Cap screw (2)
14. Idler spacer
15. Idler pulley assembly
16. Lock nut
17. Flat washer (4)
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)
27. Hardened washer (4)
28. Drive bearing housing
29. Mounting bracket (2)
30. Bearing assembly (non-driven)
31. O-ring
32. Socket head screw (2)
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 56 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. 56)

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. 57).

   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.

Assembly (Fig. 56)

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. 57). 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 (Fig. 58).

   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.

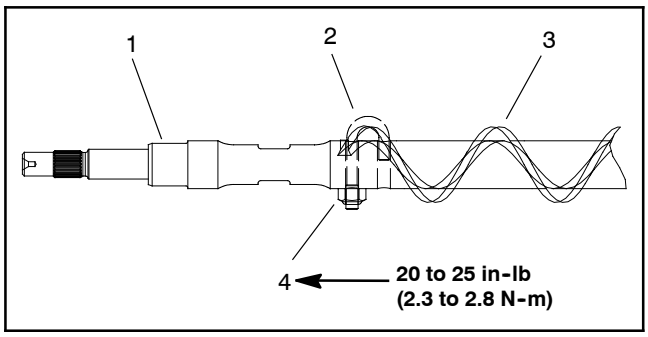


Figure 57

1. Roller brush shaft
2. J-bolt
3. Roller brush
4. Lock nut

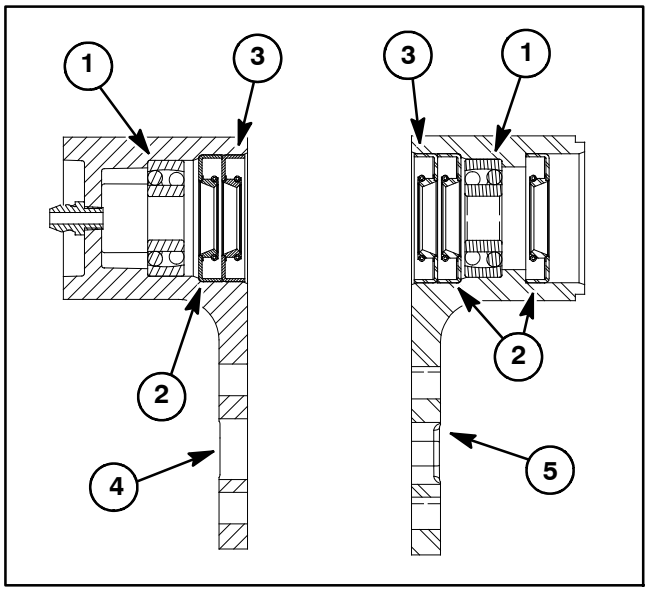


Figure 58

1. Bearing
2. Inner grease seal
3. Outer grease seal
4. Housing (non-driven)
5. Housing (driven)

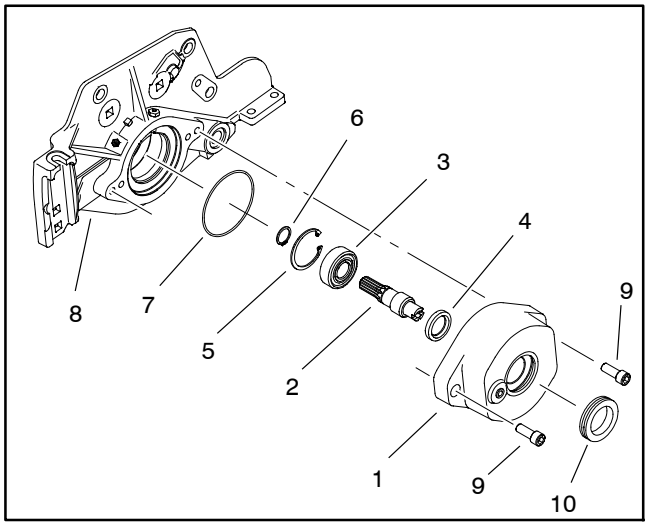


Figure 59

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

3. If drive bearing housing was disassembled, install new components noting proper orientation as shown (Fig. 59 and 60).

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. 59, 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. 59, item 5) to secure bearing in housing.

4. Assemble roller brush components.

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.

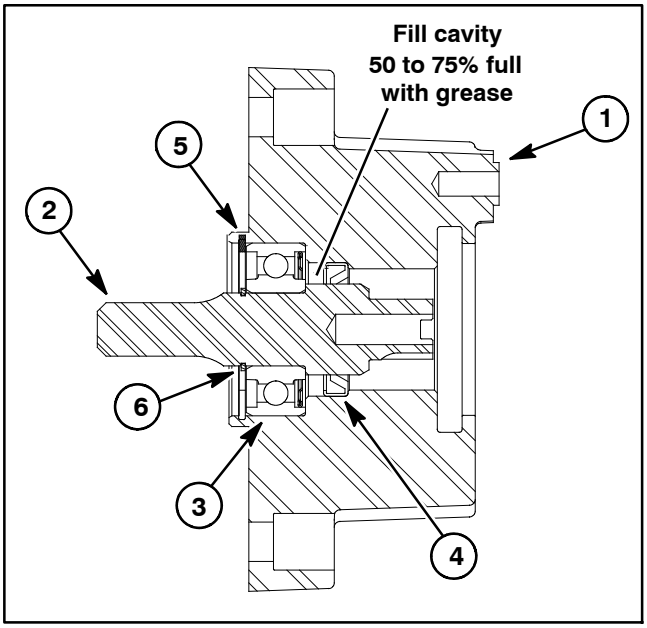


Figure 60

1. **Bearing housing**
2. **Drive shaft**
3. **Ball bearing**
4. **Grease seal**
5. **Retaining ring**
6. **Snap ring**

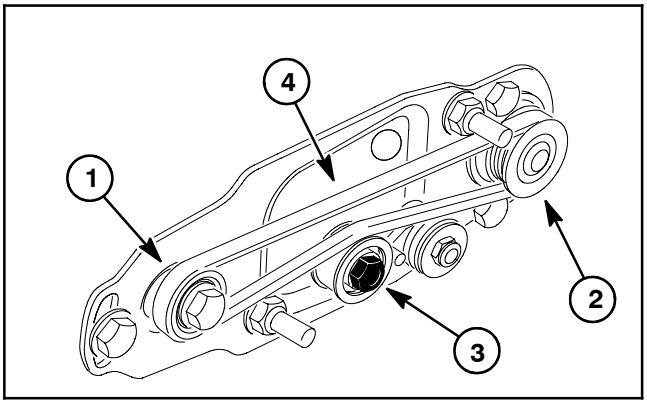


Figure 61

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. 62). 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. 63). 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.

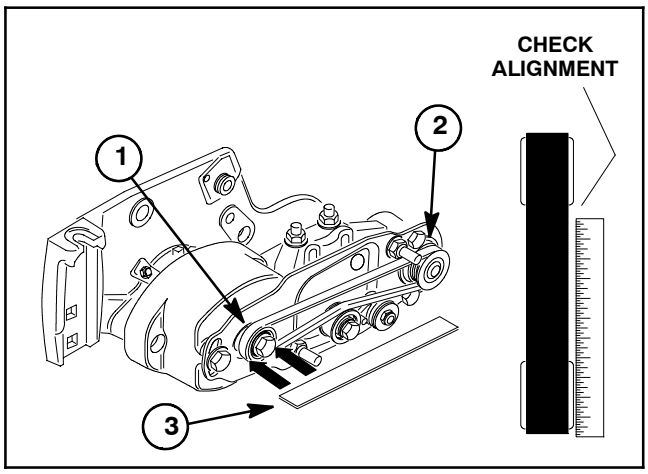


Figure 62

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

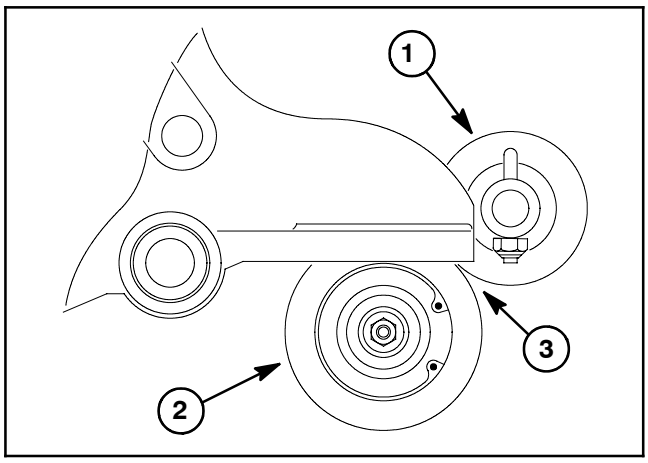


Figure 63

1. **Rear roller brush**
2. **Rear roller**
3. **Light contact**

Rear Roller Brush - Optional (cutting units with aluminum side plates)

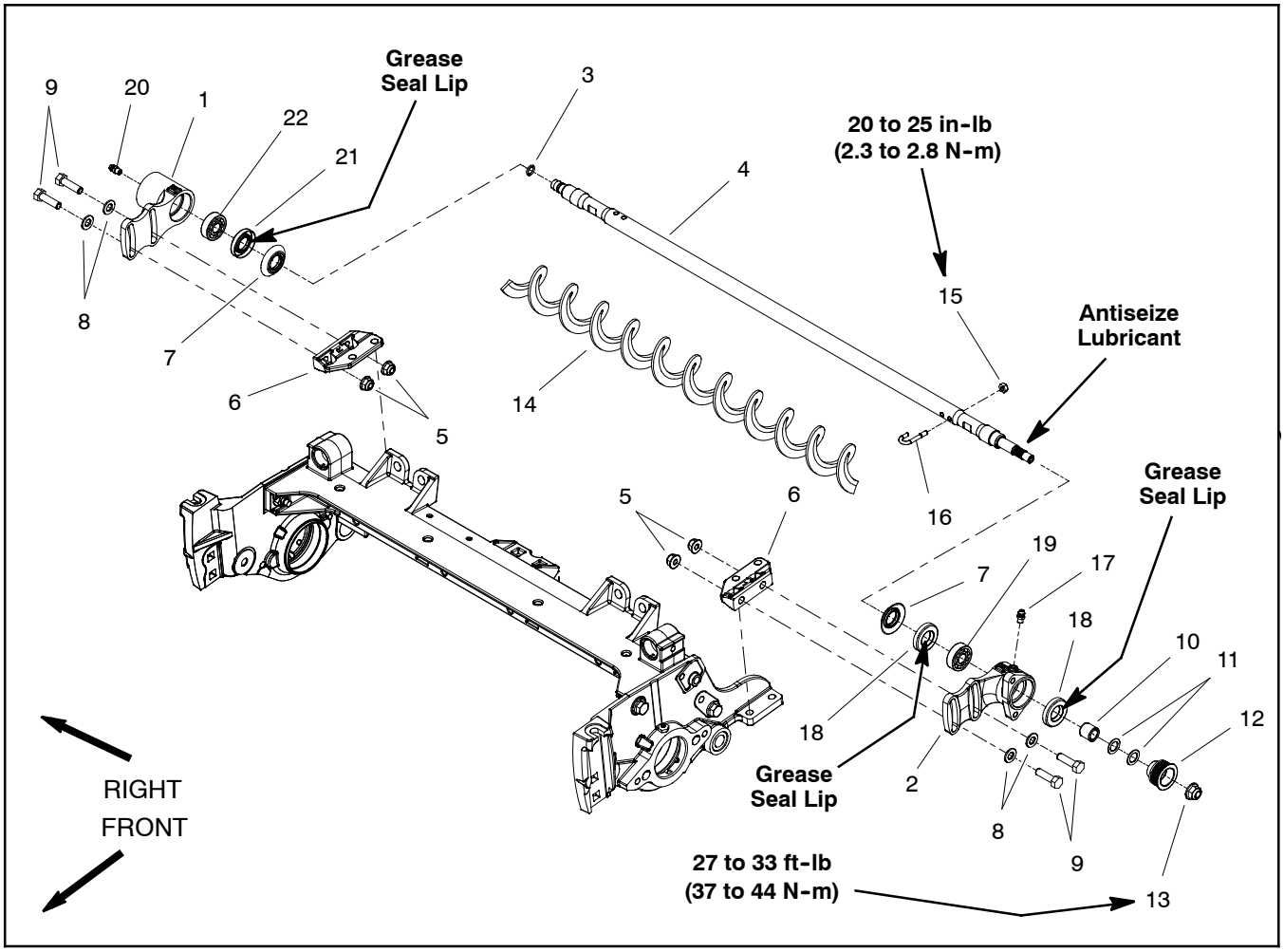


Figure 64

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 56 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. 56)

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 56 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. 56)

1. If seals or bearings were removed from brush bearing housings, install new components noting proper orientation as shown in Figure 58.

   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. 58. 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. 57). Torque lock nuts from **20 to 25 in-lb (2.3 to 2.8 N-m)**.

3. Assemble roller brush components using Figure 56 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. 63). 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.

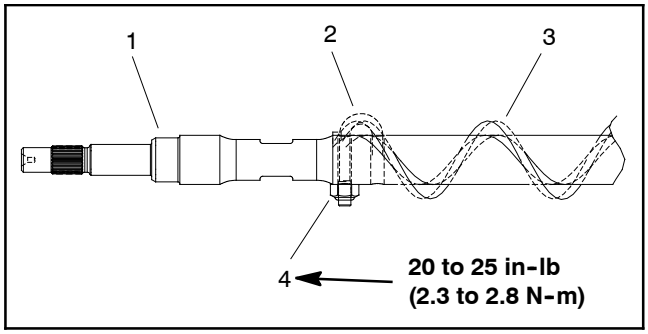


Figure 65

1. **Roller brush shaft**
2. **J-bolt**
3. **Roller brush**
4. **Lock nut**

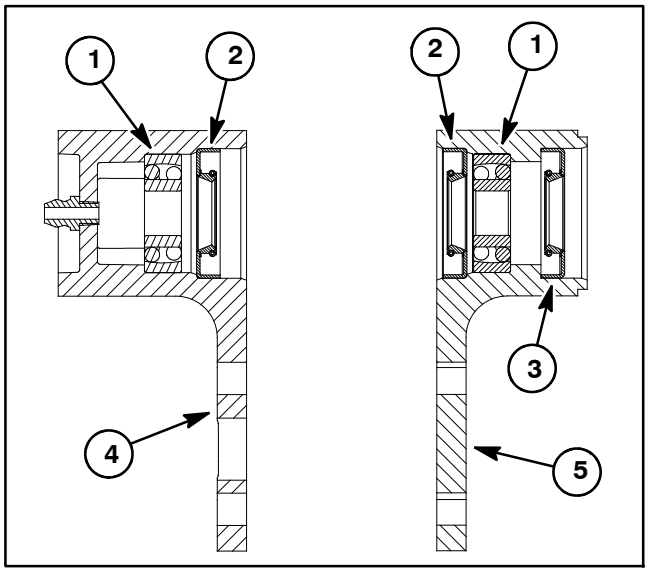


Figure 66

1. **Bearing**
2. **Inner grease seal**
3. **Outer grease seal**
4. **Housing (non-driven)**
5. **Housing (driven)**

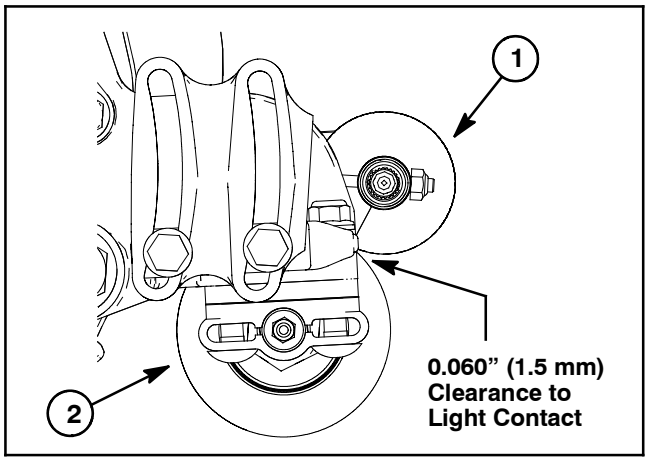


Figure 67

1. **Rear roller brush**
2. **Rear roller**

Drive System Disassembly (Fig. 68)

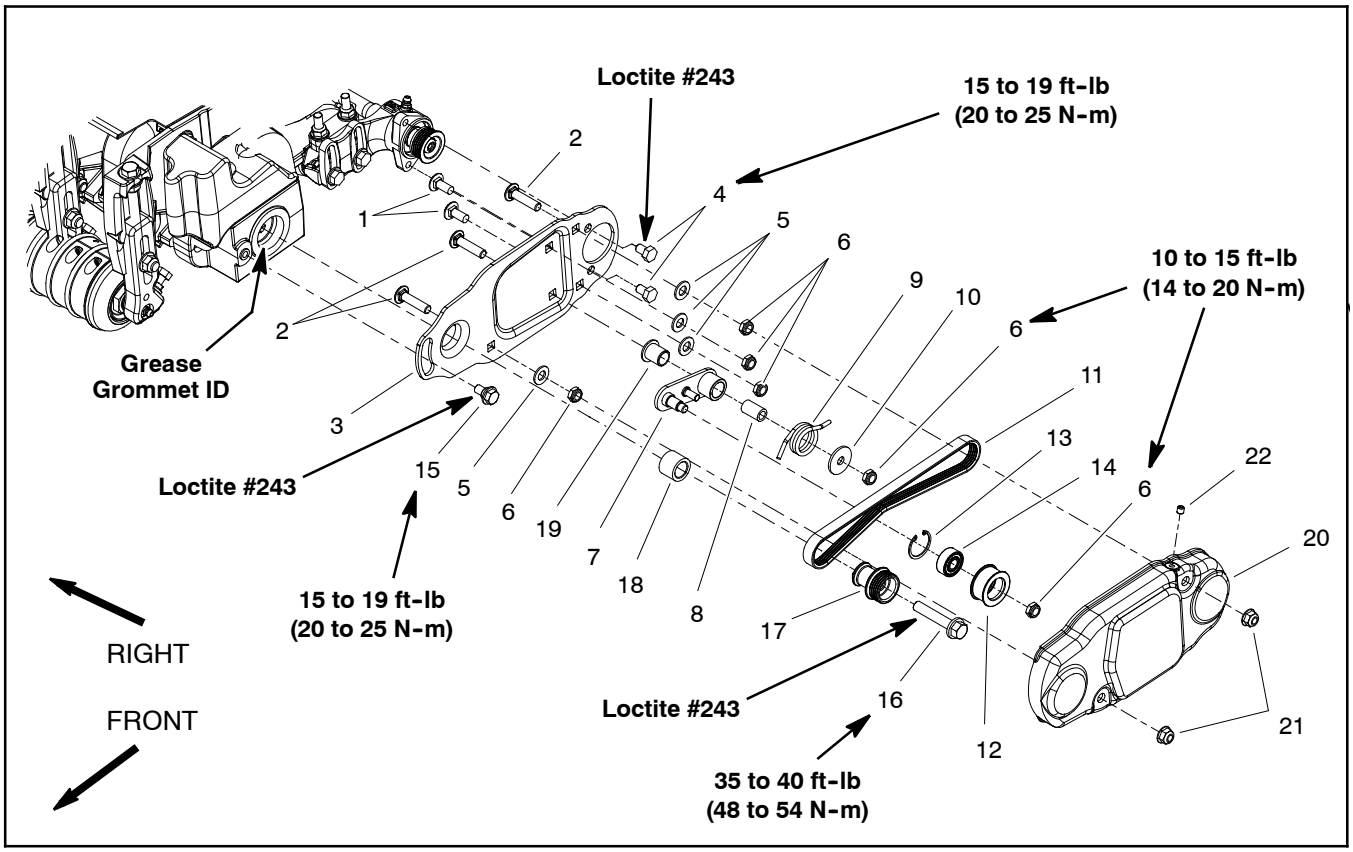


Figure 68

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 56 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 68 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. 70).

   B. Loosen and remove drive shaft from cutting reel.

Drive System Assembly (Fig. 68)

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. 70).

   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 68 as a guide.

   A. During assembly, apply Loctite #243 (or equivalent) to threads of fasteners and torque fasteners as shown in Figure 68.

   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.

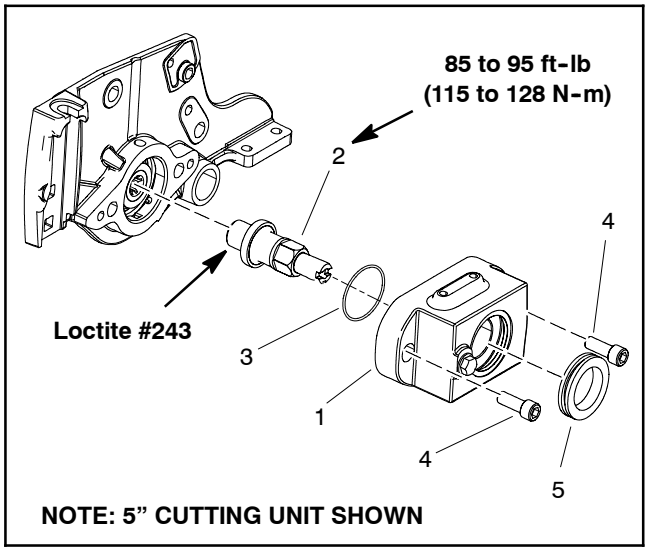


Figure 69

1. **Drive housing**
2. **Drive shaft**
3. **O-ring**
4. **Socket head screw**
5. **Grommet**

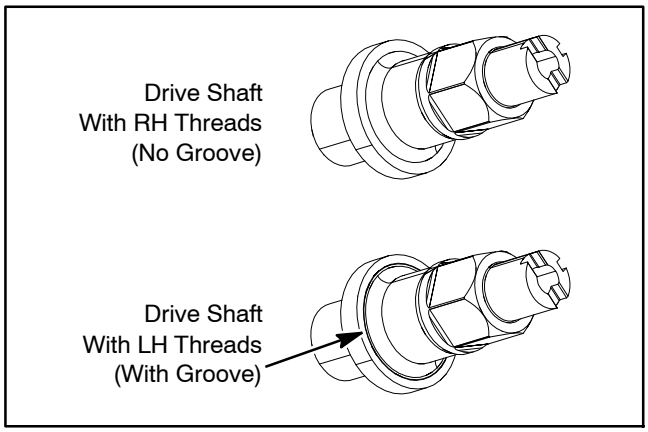


Figure 70

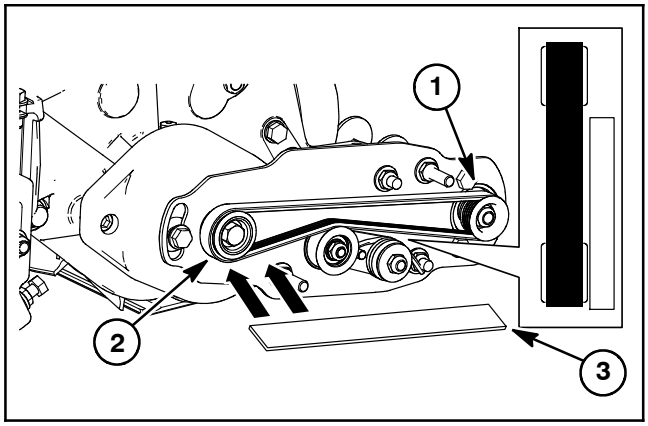


Figure 71

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. 62).

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. 72).

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.

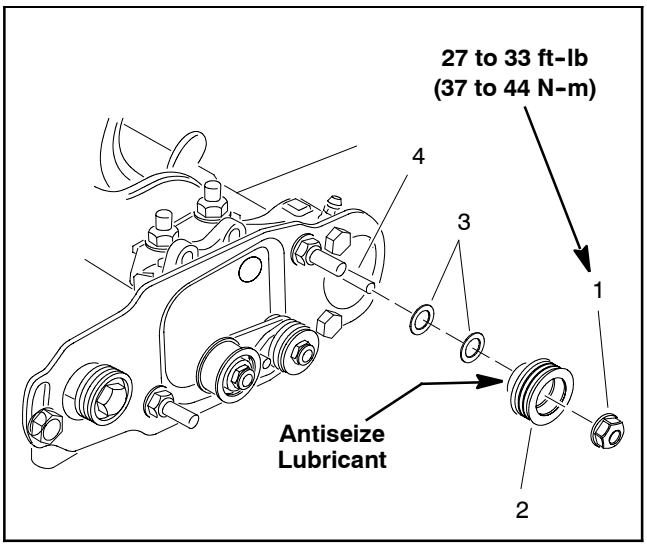


Figure 72

1. **Flange nut**
2. **Driven pulley**
3. **Flat washer**
4. **Roller brush shaft**

Chapter 10

Belt Driven Groomer (Optional)

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Grooming Performance

There are a number of factors that can affect the performance of grooming. These factors vary for different golf courses and from fairway to fairway. It is important to inspect the turf frequently and vary the grooming practice with turf needs.

IMPORTANT: Improper or overaggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer carefully. READ AND UNDERSTAND THE GROOMER OPERATION INSTRUCTIONS BEFORE OPERATING OR TESTING GROOMER PERFORMANCE.

It is important to remember that factors affecting quality of cut also affect grooming performance.

Variables That Affect the Use and Performance of Groomers:

1. The growing season and weather conditions.

2. General turf conditions.

3. The frequency of grooming/cutting – number of cuttings per week and how many passes per cutting.

4. The height–of–cut.

5. The grooming depth.

6. The type of grass.

7. The amount of time that a groomer reel has been in use on a particular turf area.

8. The amount of traffic on the turf.

9. The overall turf management program – irrigation, fertilizing, weed control, coring, overseeding, sand dressing, disease control and pest control.

10. Stress periods for turf – high temperatures, high humidity, unusually high traffic.

Troubleshooting

Groomer Reel Mechanical Problems

Problem	Possible Causes	Correction
No rotation of the groomer reel.	The groomer drive belt needs to be adjusted.	Adjust groomer drive belt.
	Seized groomer reel or idler bearing(s) in groomer side plate(s).	Identify and replace faulty bearing(s).
	Broken or damaged idler spring.	Replace spring.
	The groomer drive belt is worn, broken or damaged.	If the drive belt slips, it probably is out of adjustment or worn. Repair or replace drive belt if necessary. A broken or worn belt could be the result of improper belt routing or seized bearings in groomer assembly.
	Grooming depth is too deep.	Change grooming depth.
The turf is damaged or has uneven grooming.	The groomer reel blades are bent, damaged or missing.	Repair or replace blades if necessary.
	The groomer reel shaft is bent or damaged.	Replace groomer reel shaft.
	Grooming depth is not equal on both ends of groomer reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height−of−cut, etc.).

Adjustments

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Installation Instructions provide information regarding the installation, set−up and operation of the optional groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

Groomer Height/Depth Adjustment

NOTE: Grooming is performed above the soil level. When adjusting groomer height/depth, groomer blades should never penetrate the soil.

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

2. Make sure rollers are clean and cutting unit is set to the desired height−of−cut (see Cutting Unit Operator's Manual).

3. Place the groomer reel in the grooming (lowered) position by rotating the raise/lower lever toward the front of the cutting unit (Fig. 1).

NOTE: Improper or over−aggressive use of the groomer (e.g. too deep or too frequent grooming) may cause unnecessary stress on the turf leading to severe turf damage. Use the groomer cautiously.

4. On one end of the groomer reel, measure the distance from the lowest tip of the groomer blade to the working surface. Turn groomer height adjuster to raise or lower the groomer blade tip to the desired height (Fig. 1).

5. Repeat step 4 on the opposite end of the groomer. Then, recheck setting on the first side of groomer. Height setting on both ends of groomer should be identical.

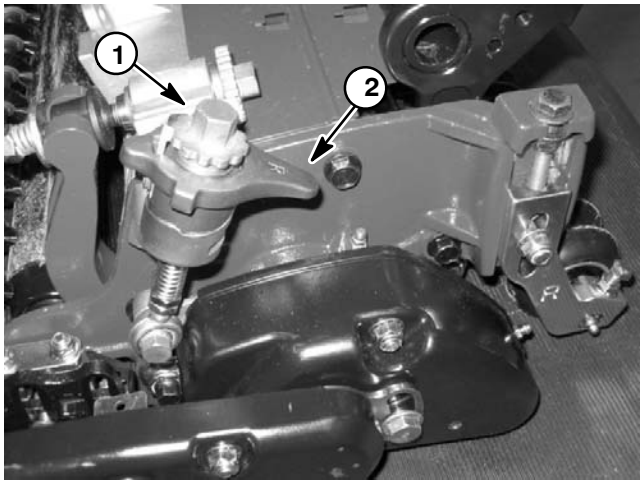


Figure 1

1. **Groomer height adjuster** 2. **Raise/lower lever**

Service and Repairs

CAUTION

Never work on the groomer with the engine running. Always stop the engine, remove the key from the ignition switch and wait for all machine movement to stop before working on the groomer.

NOTE: The Groomer Installation Instructions provide information regarding the installation, set−up and operation of the optional groomer on your Reelmaster machine. Refer to these instructions for additional information when servicing the groomer.

Groomer Drive Belt Replacement

The groomer drive belt should be inspected/replaced **annually or after 750 hours of operation**.

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

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to replace groomer drive belt (see Roller Brush (Optional) in the Service and Repairs section of Chapter 9 − Cutting Units).

NOTE: When removing groomer cover, groomer weight does not have to be removed from cover.

2. Remove two (2) flange nuts that secure groomer cover, then remove cover (Fig. 2).

3. Remove groomer belt tension by pivoting idler plate and pulley using a wrench on pulley nut. Slip groomer drive belt off pulleys (Fig. 3). Carefully release idler plate and pulley.

4. Install new drive belt to drive pulley, idler pulley and driven pulley observing correct belt routing (Fig. 3). Make sure that groomer drive belt is above idler pulley after belt installation.

5. Install groomer cover and secure with two (2) flange nuts.

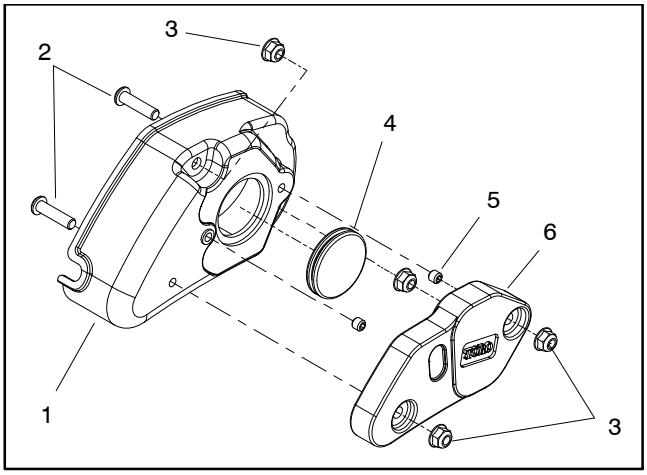


Figure 2

1. **Groomer cover**
2. **Socket head screw**
3. **Flange nut**
4. **Rubber grommet**
5. **Set screw**
6. **Groomer weight**

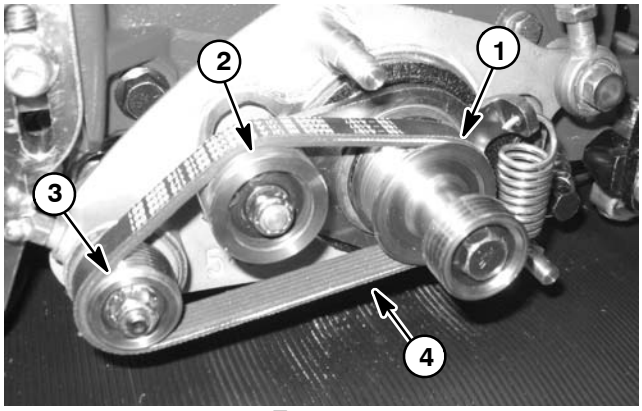


Figure 3

1. **Drive pulley**
2. **Idler pulley**
3. **Driven pulley**
4. **Groomer drive belt**

Groomer Plate Assembly

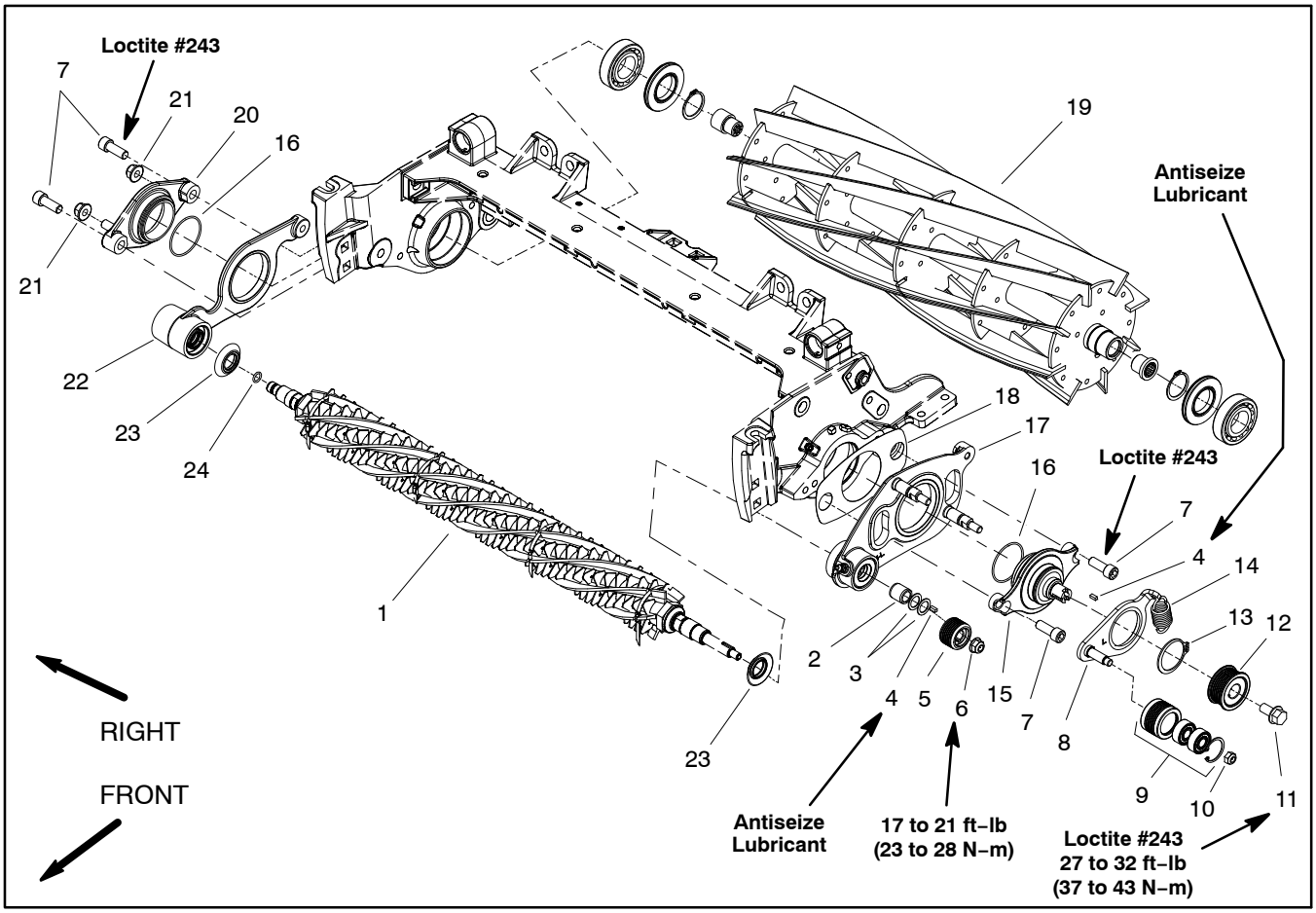


Figure 4

1. Groomer reel
2. Pulley spacer
3. Washer (as required)
4. Square key
5. Driven pulley
6. Flange nut
7. Socket head screw
8. Idler plate
9. Idler pulley assembly
10. Lock nut
11. Flange head screw
12. Drive pulley
13. Retaining ring
14. Extension spring
15. Pivot hub assembly (drive)
16. O–ring
17. Groomer plate (drive)
18. Groomer shim
19. Cutting reel
20. Pivot hub assembly (non–drive)
21. Flange nut
22. Groomer plate (non–drive)
23. Excluder seal
24. O–ring

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 4 shows components used when the groomer reel drive is on the left side of the cutting unit.

Removal (Fig. 4)

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

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to service groomer plate assemblies (see Roller Brush (Optional) in the Service and Repairs section of Chapter 9 – Cutting Units).

2. To remove groomer plate assembly from groomer drive side of cutting unit:

A. Remove groomer belt cover and groomer drive belt from groomer drive (see Groomer Belt Replacement in this section).

NOTE: To prevent cutting reel from turning when removing drive pulley, block reel with piece of wood.

B. Remove flange head screw (item 11) that retains drive pulley. Pull drive pulley from drive shaft. Locate and retrieve square key (item 4) from drive shaft.

NOTE: To prevent groomer shaft from turning when removing driven pulley, use wrench on shaft flats to hold groomer shaft.

C. Remove the flange nut (item 6) that secures driven pulley (item 5) to groomer shaft. Remove driven pulley from shaft. Locate and retrieve square key (item 4) that locates driven pulley on shaft.

D. Slide washer (item 3) and pulley spacer (item 2) from groomer shaft.

E. Remove shoulder bolt that secures quick−up ball joint rod to groomer plate (Fig. 10).

F. Disconnect extension spring (item 14) from stud on groomer plate.

G. Remove two (2) socket head screws (item 7) that secure groomer components to cutting unit side plate.

H. Remove pivot hub and idler plate assembly from cutting unit.

I. Support groomer shaft to prevent it from falling. Carefully slide drive side groomer plate from groomer shaft and cutting unit. Remove groomer shim.

3. To remove groomer plate assembly from groomer non−drive side of cutting unit:

A. Remove hydraulic reel motor from cutting unit (see Hydraulic Reel Motor Removal in the Service and Repairs section of Chapter 9 − Cutting Units).

B. Remove two (2) socket head screws (item 7) that secure groomer components to cutting unit side plate.

C. Remove pivot hub from cutting unit.

D. Support groomer shaft to prevent it from falling. Carefully slide non−drive side groomer plate from groomer shaft and cutting unit.

4. Inspect seals, bearings and bushing in groomer plates. Remove and discard damaged or worn components.

Installation (Fig. 4)

1. If seals, bearings or bushing was removed from groomer plates, install new components noting proper orientation as shown in Figure 5.

A. Pack bearings with grease before installation.

B. Press bearings into groomer plate so that bearings contact shoulder in groomer plate bore.

C. Install grease seals so that seal lips are positioned toward the groomer blade location. Seals should be flush with surface of groomer plate.

D. Press bushings into groomer plate until the bushing contacts the shoulder in the groomer plate bore.

E. If groomer studs (not shown) were removed from groomer plate (item 17), install new studs into groomer plate and torque from **14 to 18 ft−lb (19 to 24 N−m)**.

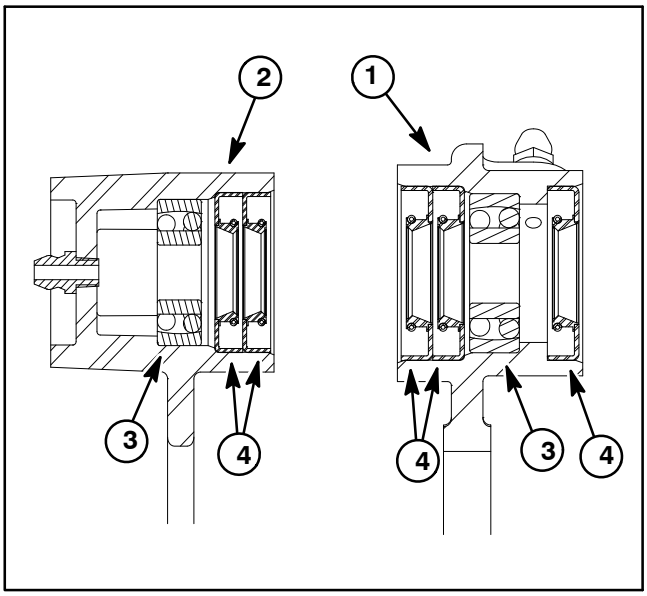


Figure 5

1. **Drive side groomer plate**
2. **Non−drive groomer plate**
3. **Bearing**
4. **Grease seal**

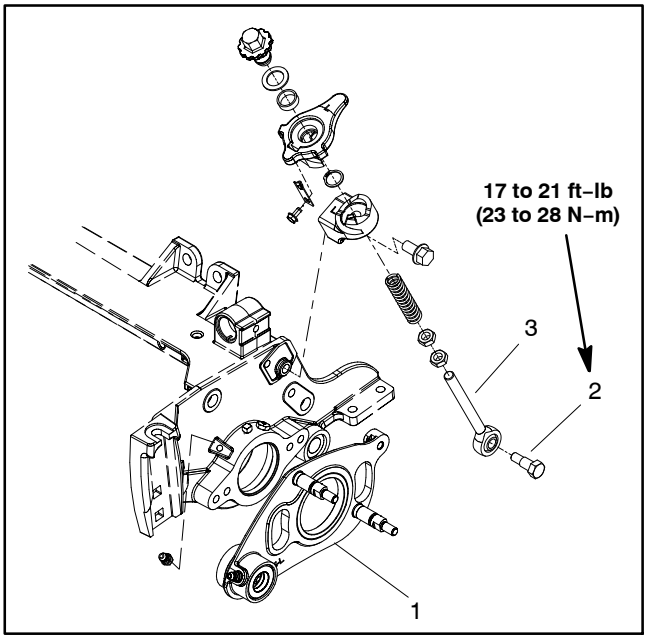


Figure 6

1. **Groomer plate**
2. **Shoulder bolt**
3. **Quick−up ball joint rod**

2. Install groomer plate assembly to groomer non−drive side of cutting unit:

A. Carefully position non−drive side groomer plate onto groomer shaft and slide to cutting unit.

B. Position pivot hub to cutting unit.

C. Secure groomer components to cutting unit side plate with two (2) socket head screws (item 7).

D. Install hydraulic reel motor to cutting unit (see Hydraulic Reel Motor Installation in the Service and Repairs section of Chapter 9 − Cutting Units).

3. Install groomer plate assembly to groomer drive side of cutting unit:

A. Position groomer shim to cutting unit side plate. Carefully position drive side groomer plate onto groomer shaft and slide to cutting unit.

B. Position pivot hub and idler plate assembly to cutting unit side plate and secure with two (2) socket head screws (item 7).

C. Connect extension spring (item 14) to stud on groomer plate. Make sure that spring is in the stud groove and that spring hook is positioned toward the drive pulley.

D. Secure quick−up ball joint rod to drive side groomer plate with shoulder bolt (Fig. 6). Torque shoulder bolt from **17 to 21 ft−lb (23 to 28 N−m)**.

E. Slide pulley spacer (item 2) and washer (item 3) onto groomer shaft.

F. Apply antiseize lubricant to square keys (item 4) that locate drive and driven pulleys. Position keys into shaft slots.

NOTE: To prevent cutting reel from turning when installing drive pulley, block cutting reel with piece of wood.

G. Apply Loctite #243 to threads of flange head screw that secures drive pulley to pivot hub shaft. Slide drive pulley onto shaft and secure with flange head screw. Torque screw from **27 to 32 ft−lb (37 to 43 N−m)**.

NOTE: To prevent groomer shaft from turning when installing driven pulley, use wrench on groomer shaft flats.

H. Slide driven pulley onto groomer shaft and secure with flange nut. Torque flange nut from **17 to 21 ft−lb (23 to 28 N−m)**.

I. Check pulley alignment by laying a straight edge along the outer face of the drive pulley (Fig. 7). Drive and driven pulleys should be in line within 0.030" (0.76 mm). If necessary, align pulleys by removing driven pulley and installing or removing washer(s) (item 3) between pulley and pulley spacer.

J. After pulleys are aligned, install groomer drive belt and groomer belt cover (see Groomer Belt Replacement in this section).

4. Check that excluder seals just touch groomer plate assembly. Reposition excluder seals on groomer shaft if necessary.

5. Check groomer reel height and mower height−of−cut settings. Adjust as needed.

6. Lubricate groomer bearings.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

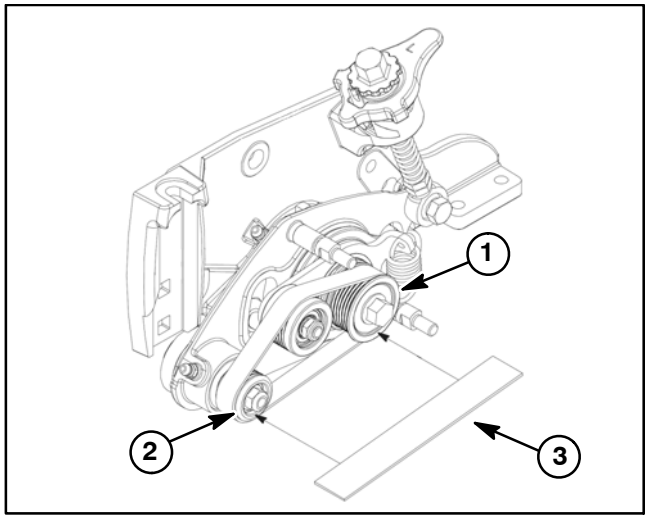


Figure 7

1. **Drive pulley**
2. **Driven pulley**
3. **Straight edge**

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Groomer Reel

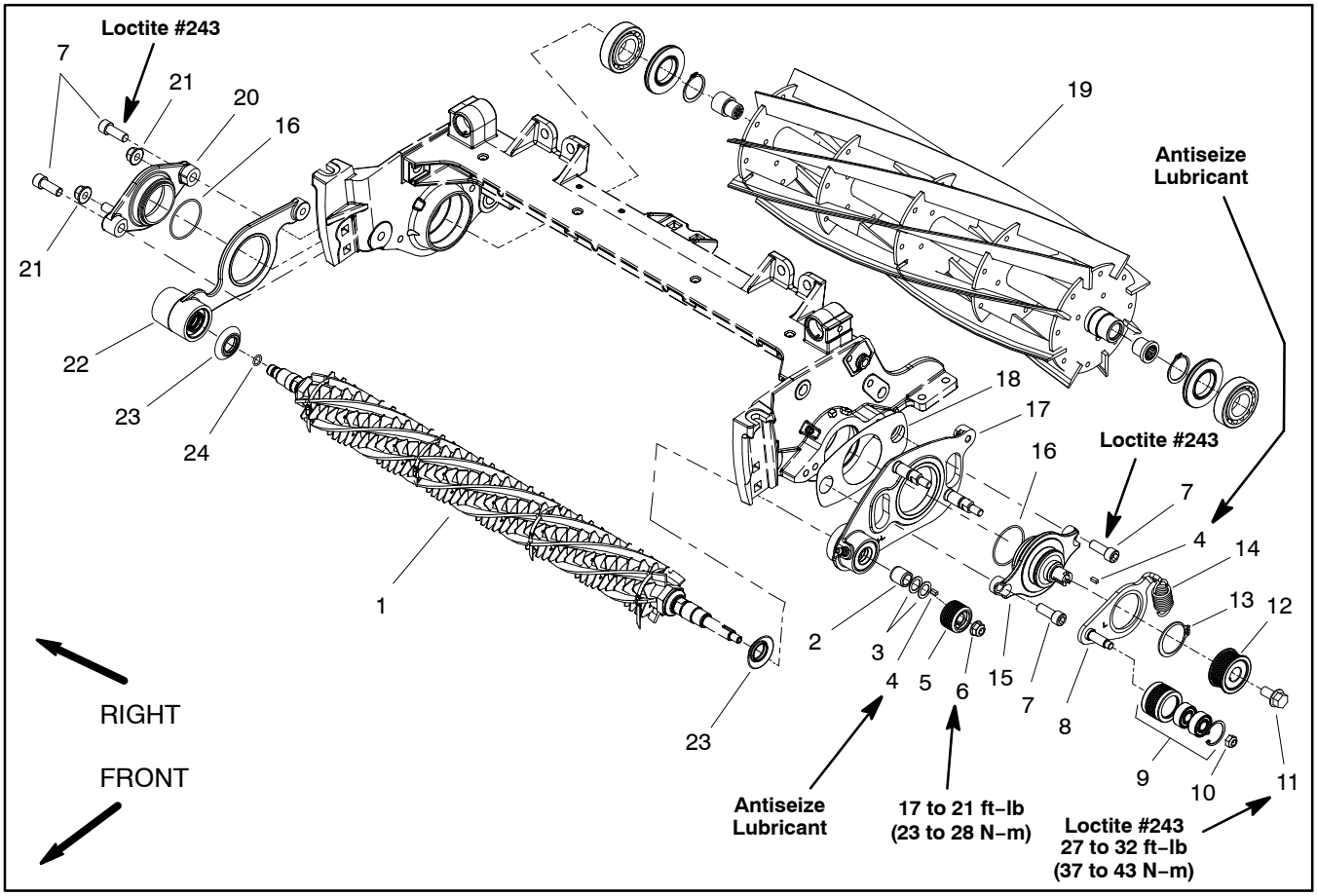


Figure 8

1. Groomer reel
2. Pulley spacer
3. Washer
4. Square key
5. Driven pulley
6. Flange nut
7. Socket head screw
8. Idler plate
9. Idler pulley assembly
10. Lock nut
11. Flange head screw
12. Drive pulley
13. Retaining ring
14. Extension spring
15. Pivot hub assembly (drive)
16. O–ring
17. Groomer plate (drive)
18. Groomer shim
19. Cutting reel
20. Pivot hub assembly (non–drive)
21. Flange nut
22. Groomer plate (non–drive)
23. Excluder seal
24. O–ring

Remove the groomer reel to replace individual groomer blades or replace the shaft. The groomer blades can be reversed on the shaft to provide additional blade life.

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the reel hydraulic motor. Figure 8 shows the groomer reel drive on the left side of the cutting unit.

Removal (Fig. 8)

1. Park machine on a clean and level surface, lower cutting units completely to the ground, stop engine, engage parking brake and remove key from the ignition switch. If desired, remove cutting unit from machine (see Traction Unit Operator's Manual).

NOTE: If cutting unit is equipped with powered rear roller brush, removal of roller brush components will be necessary to remove groomer reel (see Roller Brush (Optional) in the Service and Repairs section of Chapter 9 – Cutting Units).

2. Remove groomer plate assembly from groomer drive side of cutting unit (see Groomer Plate Assembly Removal in this section).

3. Carefully pull the groomer reel from the non–drive side groomer plate assembly.

4. Inspect all seals, bushings and bearings in groomer plate assemblies for wear or damage. Replace components as needed (see Groomer Plate Assembly in this section).

Installation (Fig. 8)

1. Position cutting unit on a level surface. If cutting unit is attached to traction unit, make sure to stop engine, engage parking brake and remove key from the ignition switch.

2. Apply a light coating of grease to seal lips in groomer plate assemblies.

3. Make sure that excluder seals (item 23) and O−ring (item 24) are positioned on groomer shaft. The excluder seal lips should be toward the end of the groomer shaft. Apply a film of grease onto seal lip.

4. Carefully slide the groomer reel into the non−drive side groomer plate assembly taking care not to damage seals in groomer plate assembly.

5. Carefully install groomer plate assembly to groomer reel and groomer drive side of cutting unit (see Groomer Plate Assembly Installation in this section).

6. Check that excluder seals just touch groomer plate assembly (Fig. 10). Reposition excluder seals on groomer shaft if necessary.

7. Check groomer reel height and mower height−of−cut settings. Adjust as needed.

8. Lubricate groomer bearings.

NOTE: After greasing groomer bearings, operate groomer for 30 seconds, stop machine and wipe excess grease from groomer shaft and seals.

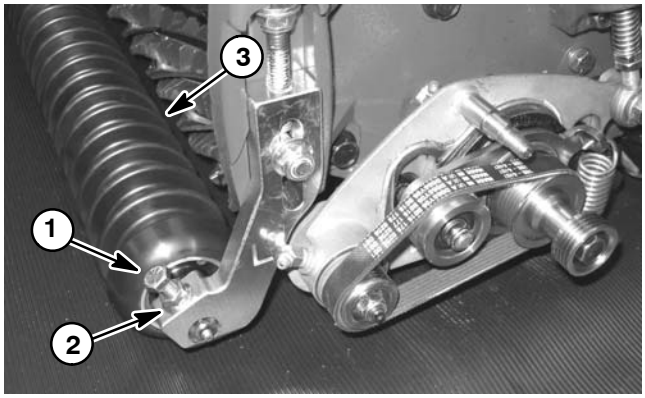


Figure 9

1. **Cap screw**
2. **Flange nut**
3. **Front roller**

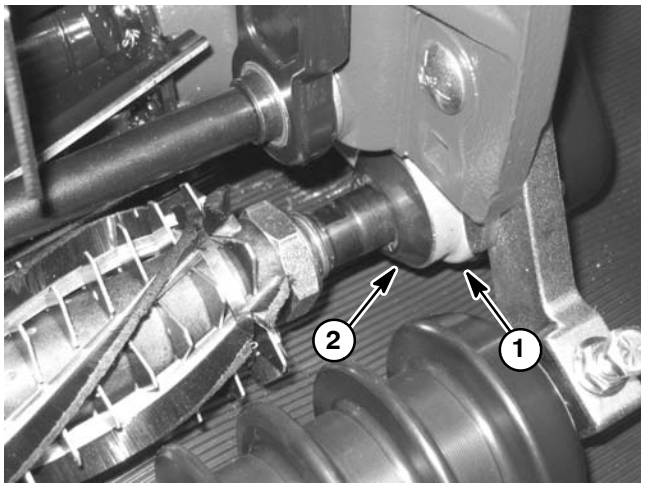


Figure 10

1. **Groomer plate**
2. **Excluder seal**

Groomer Reel Service

Inspect groomer reel blades frequently for damage and wear. Straighten bent blades with a pliers. Either replace worn blades or reverse the blades to put the sharpest blade edge forward (Fig. 11). Blades that are rounded to the midpoint of the blade tip must be reversed or replaced for best groomer performance.

Groomer shafts are either hex shaped or splined so two styles of groomer blades are available. The blade shown in Figure 11 is for the hex shaft and the blade shown in Figure 12 is for the splined shaft.

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. Remove excluder seals from groomer reel.

4. If groomer reel is equipped with broomer kit (Fig. 14), remove straps and broomer brushes from reel.

5. Remove lock nut from either end of the shaft (Fig. 13).

6. Remove spacers and blades from groomer shaft. If needed, remove second lock nut from shaft.

7. If necessary, remove groomer shaft ends from groomer shaft.

Assembly (Fig. 13)

1. Install lock nut on drive end of groomer shaft. Place first spacer and then first blade on shaft.

2. Alternately install remaining spacers and blades making sure that all blades are separated by a spacer. Additionally, if groomer shaft has a hex shape, rotate location hole on each installed blade one flat of the shaft, in a counterclockwise direction.

3. When all blades have been installed, place final spacer on shaft and then thread second lock nut onto the shaft. Center blades on shaft with lock nuts.

4. Using wrench on shaft flats to prevent shaft from turning, torque second lock nut from **200 to 250 in−lb (23 to 28 N−m)**. After torquing lock nut, spacers should **not** be free to rotate and groomer blades should be centered on shaft.

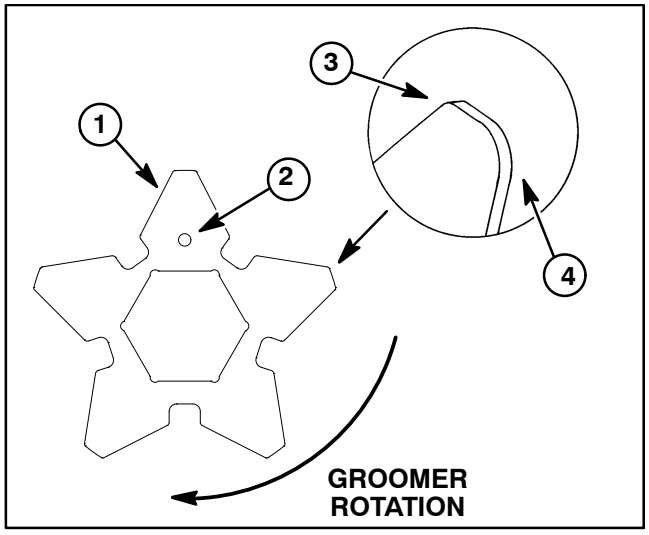


Figure 11

1. Groomer blade
2. Location hole
3. Sharp edge
4. Dull (rounded) edge

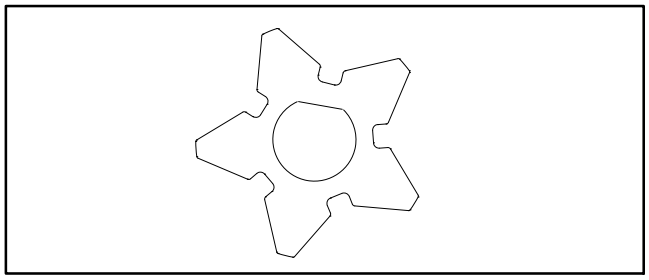


Figure 12

1. Groomer blade for splined shaft

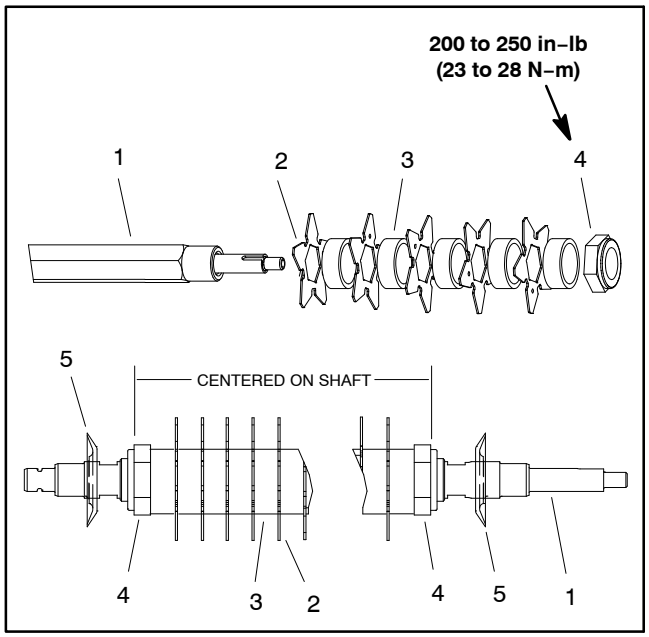


Figure 13

1. Groomer reel shaft
2. Groomer blade (42 used)
3. Spacer (43 used)
4. Lock nut (2 used)
5. Excluder seal

5. If groomer reel is equipped with broomer kit (Fig. 14), position broomer brushes to reel blades and secure with straps. Straps should be positioned between blades 1−2, 14−15, 28−29 and 41−42. Pull straps tight and cut off strap extension approximately 1/4” (6 mm) beyond retainer.

6. Place excluder seals on groomer shaft.

7. Install O−ring on non−drive end of groomer shaft.

8. Install groomer reel back on cutting unit (see Groomer Reel Installation in this section).

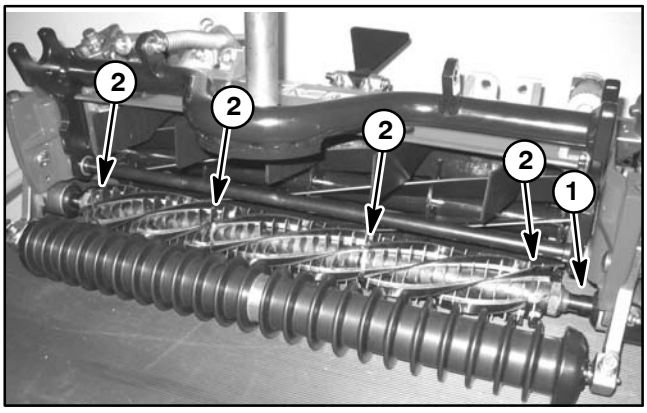


Figure 14

1. **Groomer shaft**
2. **Broomer strap**

Groomer Pivot Hub

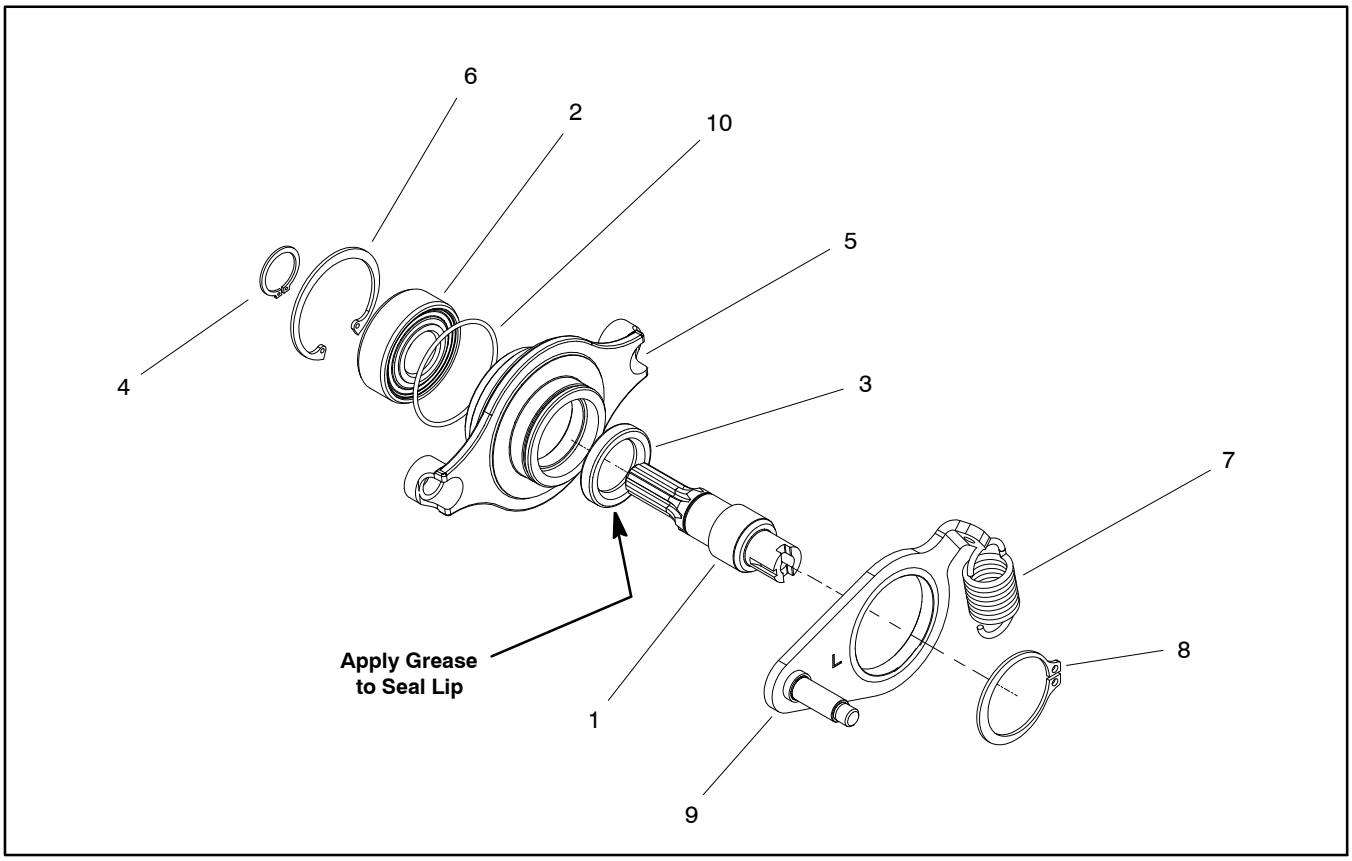


Figure 15

1. **Groomer drive shaft**
2. **Ball bearing**
3. **Grease seal**
4. **Retaining ring**
5. **Pivot hub**
6. **Retaining ring**
7. **Extension spring**
8. **Retaining ring**
9. **Idler plate**
10. **O−ring (7” cutting unit only)**

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 15 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 15)

1. Remove pivot hub assembly (with idler plate) from cutting unit (see Groomer Plate Assembly Removal in this section).

2. Remove retaining ring (item 4) that secures idler plate to pivot hub. Slide idler plate from pivot hub.

3. Remove retaining ring (item 8) that retains ball bearing into pivot hub. Slide drive shaft and bearing out of hub.

4. Remove retaining ring (item 7) that retains bearing on drive shaft. Press ball bearing from shaft. Discard bearing.

5. Remove grease seal from pivot hub. Discard seal.

6. On 7" cutting units, remove and discard O−ring (item 10) from flange of pivot hub.

7. Clean all pivot hub components and inspect for wear or damage.

Assembly (Fig. 15)

1. Install bearing on drive shaft by pressing equally on the inner and outer bearing races. Install the bearing so that the bearing seal is closest to the shoulder on the shaft. Install retaining ring (item 7) onto shaft to retain bearing.

2. Install new grease seal into housing with the lip of the seal toward the outside of the housing. Apply grease to lip of seal.

3. Fill cavity between bearing location and grease seal 50% to 75% full with high temperature Mobil XHP−222 grease (or equivalent) (Fig. 16).

4. Carefully slide shaft and bearing fully into pivot hub bore taking care to not damage the grease seal. Install retaining ring (item 8) to secure bearing in pivot hub.

5. Install new O−ring (item 10) into groove in pivot hub flange.

6. Slide idler plate onto pivot hub and secure with retaining ring (item 4).

7. Install pivot hub and idler plate assembly to cutting unit (see Groomer Plate Assembly Installation in this section).

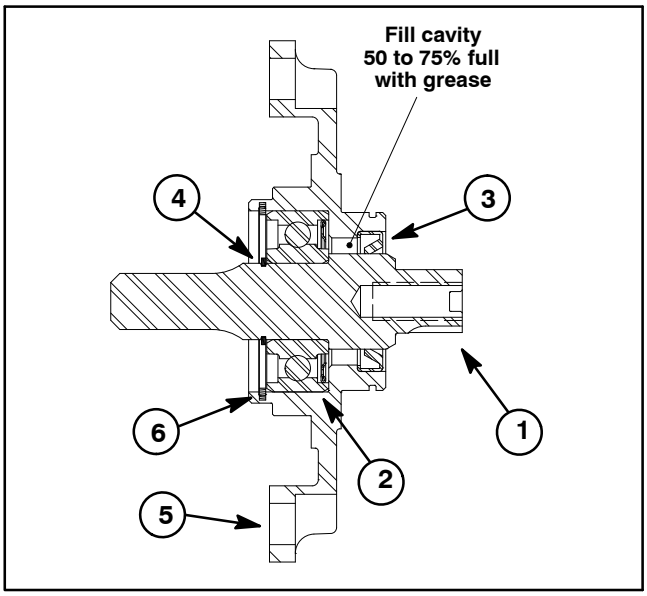


Figure 16

1. **Drive shaft**
2. **Bearing**
3. **Oil seal**
4. **Retaining ring**
5. **Pivot hub**
6. **Retaining ring**

Height Adjuster Assembly

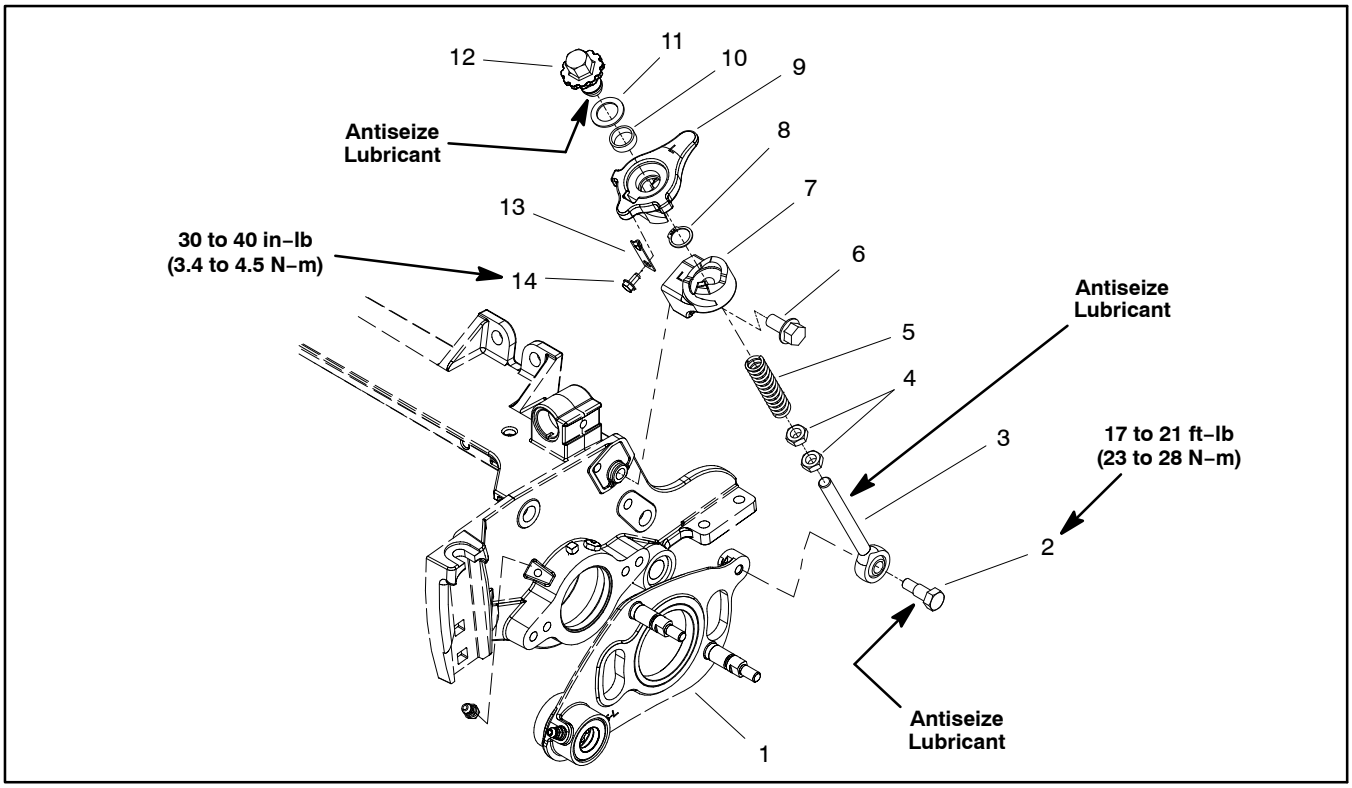


Figure 17

1. Groomer plate (LH drive shown)
2. Shoulder bolt
3. Ball joint rod
4. Jam nut
5. Compression spring
6. Flange head screw
7. Lower ramp
8. External snap ring
9. Upper ramp
10. Bushing
11. Flat washer
12. Groomer adjuster
13. Detent spring
14. Washer head screw

NOTE: The groomer reel drive is located on the opposite side of the cutting unit from the cutting reel hydraulic motor. Figure 17 shows components used when the groomer reel drive is on the left side of the cutting unit.

Disassembly (Fig. 17)

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

2. Disassemble height adjuster using Figure 17 as a guide.

3. Clean all components and inspect for wear or damage. Replace all worn or damaged components.

Assembly (Fig. 17)

1. Assemble height adjuster using Figure 17 as a guide noting the following items:

A. If bushing (item 10) was removed from upper ramp, press new bushing into housing fully to the shoulder in the bore.

B. If jam nuts (item 4) were removed from ball joint rod, apply antiseize lubricant to threads of rod where jam nuts will be positioned. Install jam nuts so that distance from end of ball joint rod to top of upper nut is from 3.060” to 3.180” (7.8 to 8.0 cm).

C. Apply antiseize lubricant to threads of groomer adjuster (item 12) before installing it on threads of ball joint rod.

D. If detent spring (item 13) was removed, secure detent spring to upper ramp with washer head screw. Torque screw from **30 to 40 in−lb (3.4 to 4.5 N−m)**.

2. Secure ball joint rod to groomer plate with shoulder bolt (item 2). Torque shoulder bolt from **17 to 21 ft−lb (23 to 28 N−m)**.

3. Check groomer reel height and adjust as needed.

4. After groomer height has been adjusted, adjust location of jam nuts so compression spring length is 1.375” (3.5 cm) when the groomer handle is in the disengaged position (handle toward rear of cutting unit).

TORO

Chapter 11

Universal Groomer (Optional)

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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 necessary.
	The groomer reel shaft is bent or damaged.	Replace groomer reel shaft.
	Grooming depth is not equal on both ends of groomer reel.	Adjust depth if necessary. Check and adjust cutting unit set up (level bedknife to reel, level rear roller to reel, set height–of–cut, etc.).

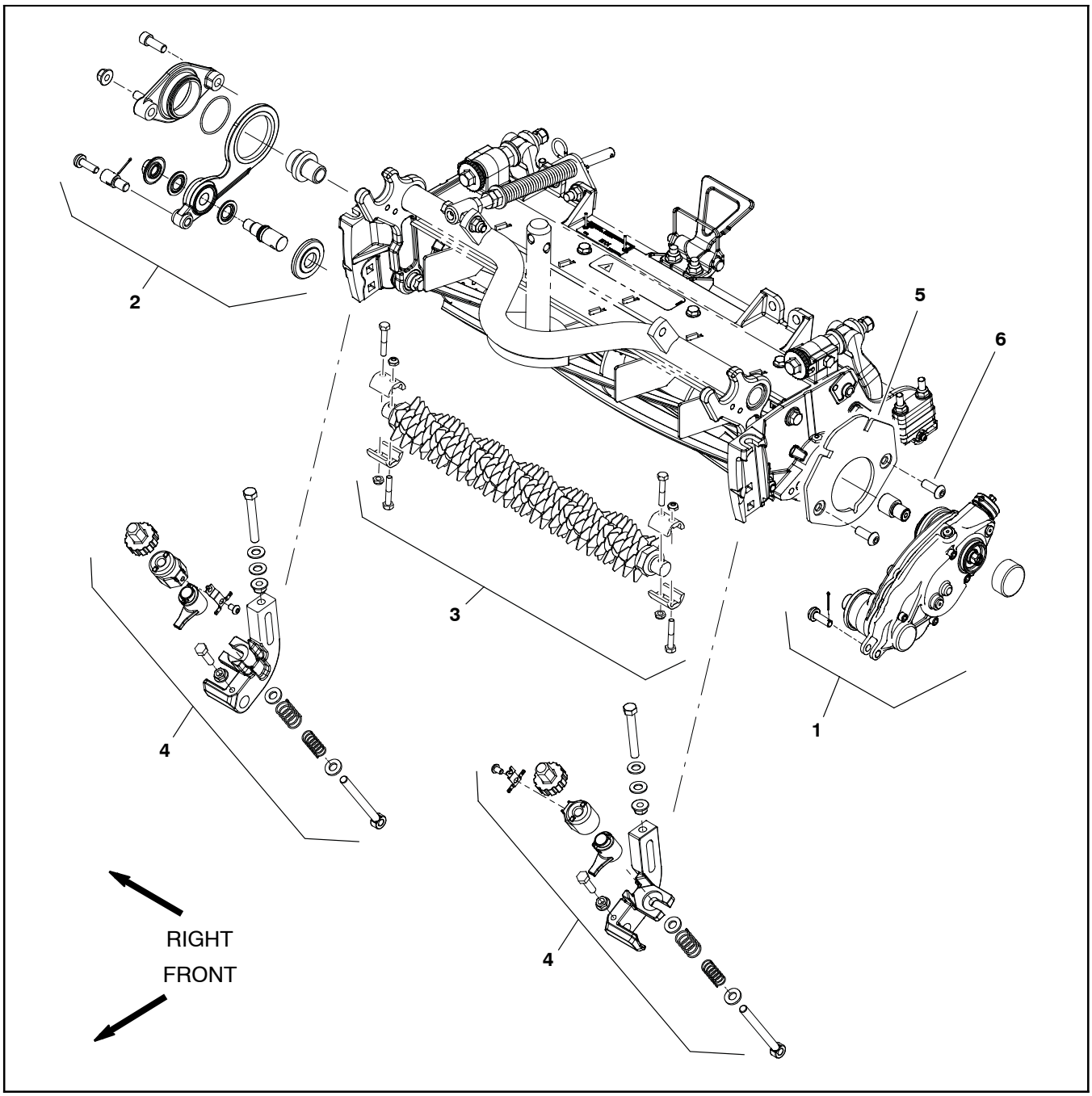


Figure 1

1. **Gear box assembly**
2. **Idler assembly**
3. **Groomer reel**
4. **Height adjuster assembly (2)**
5. **Weight**
6. **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

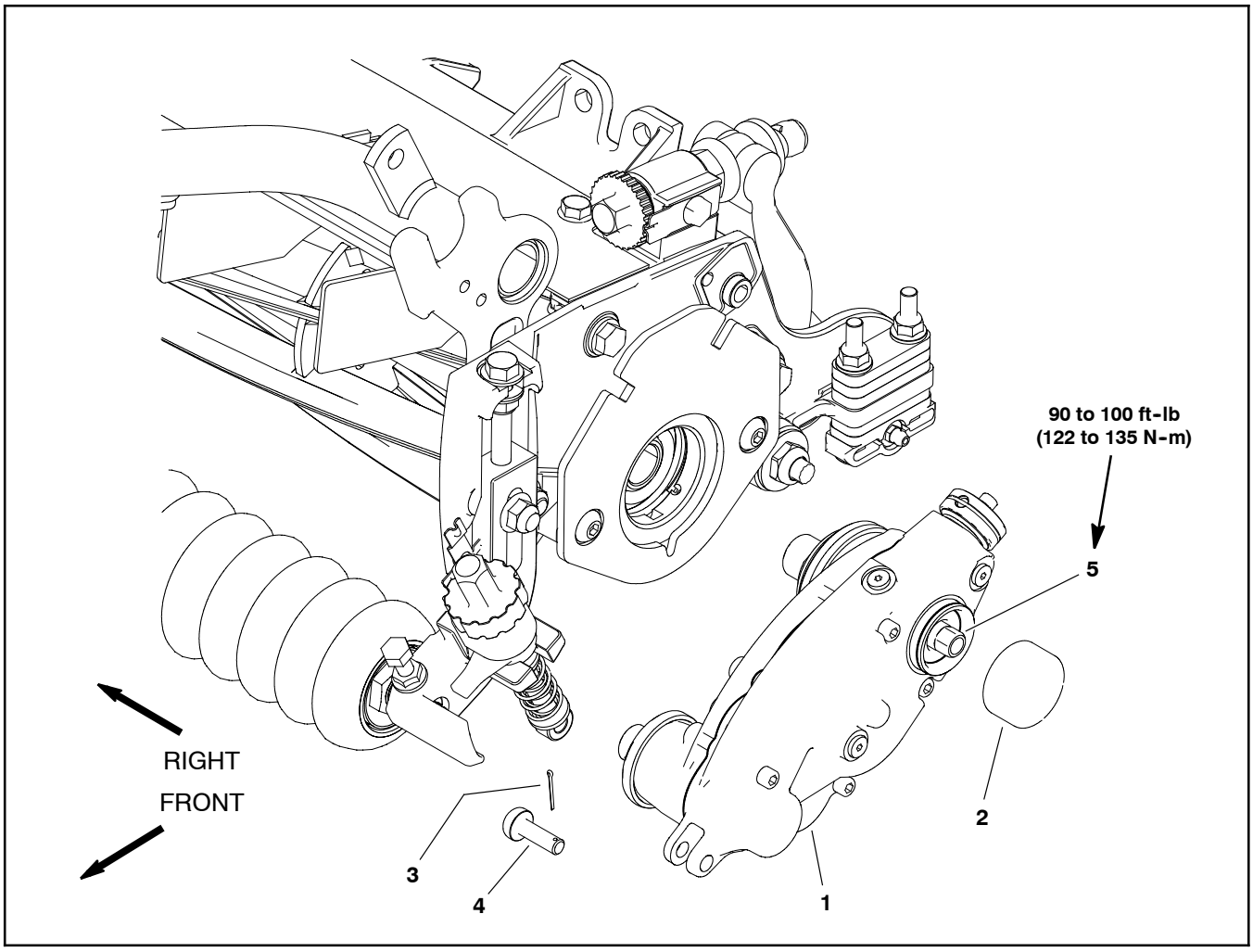


Figure 2

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 9 – 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 13 N·m (120 in–lb); 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.

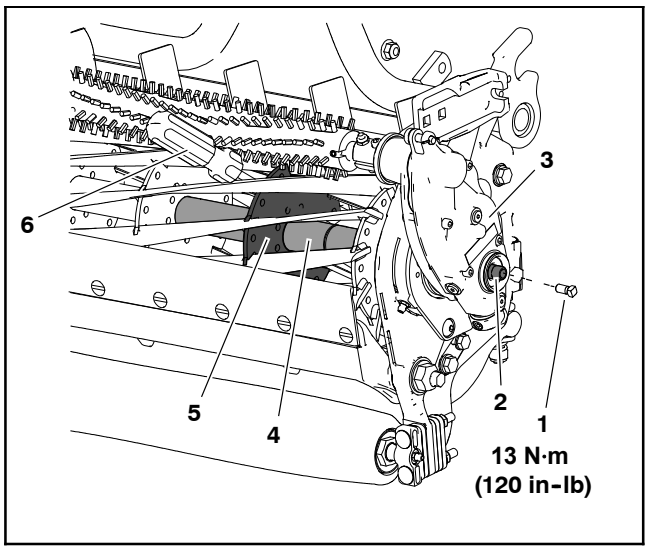


Figure 3

1. Square head set screw
2. Input shaft assembly
3. Gear box assembly
4. Reel shaft
5. Reel support plate
6. Pry bar

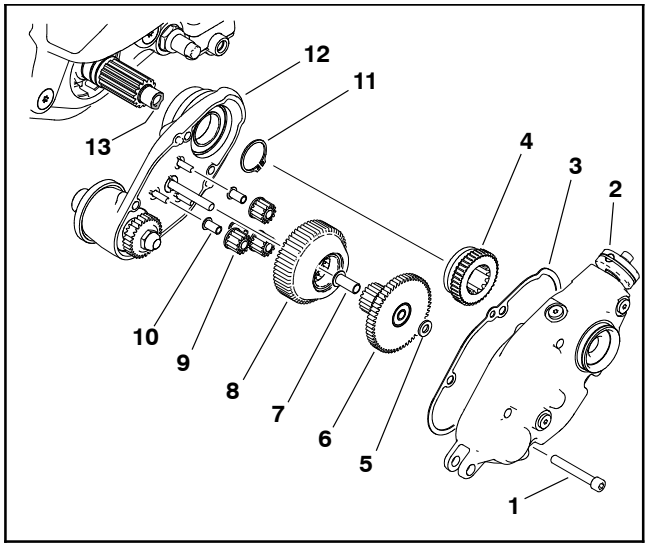


Figure 4

1. Socket head screw (4)
2. Gear box cover assy
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 assy
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

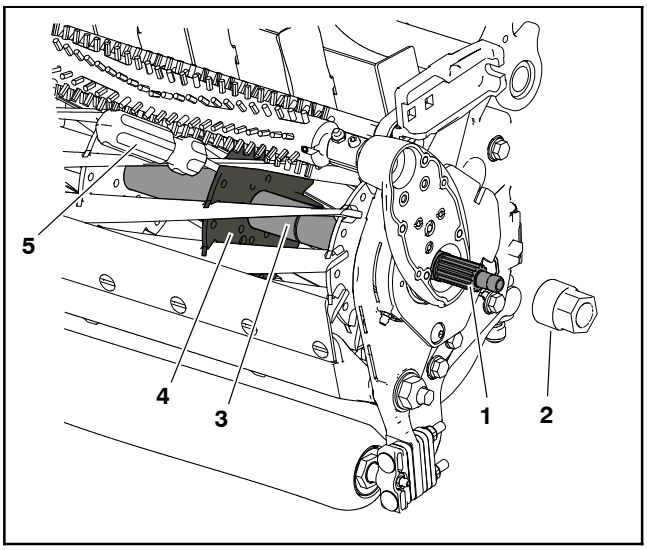


Figure 5

1. Damaged input shaft assy
2. Drive shaft removal tool
3. Reel shaft
4. Reel support plate
5. Pry bar

Disassembly (Fig. 6)

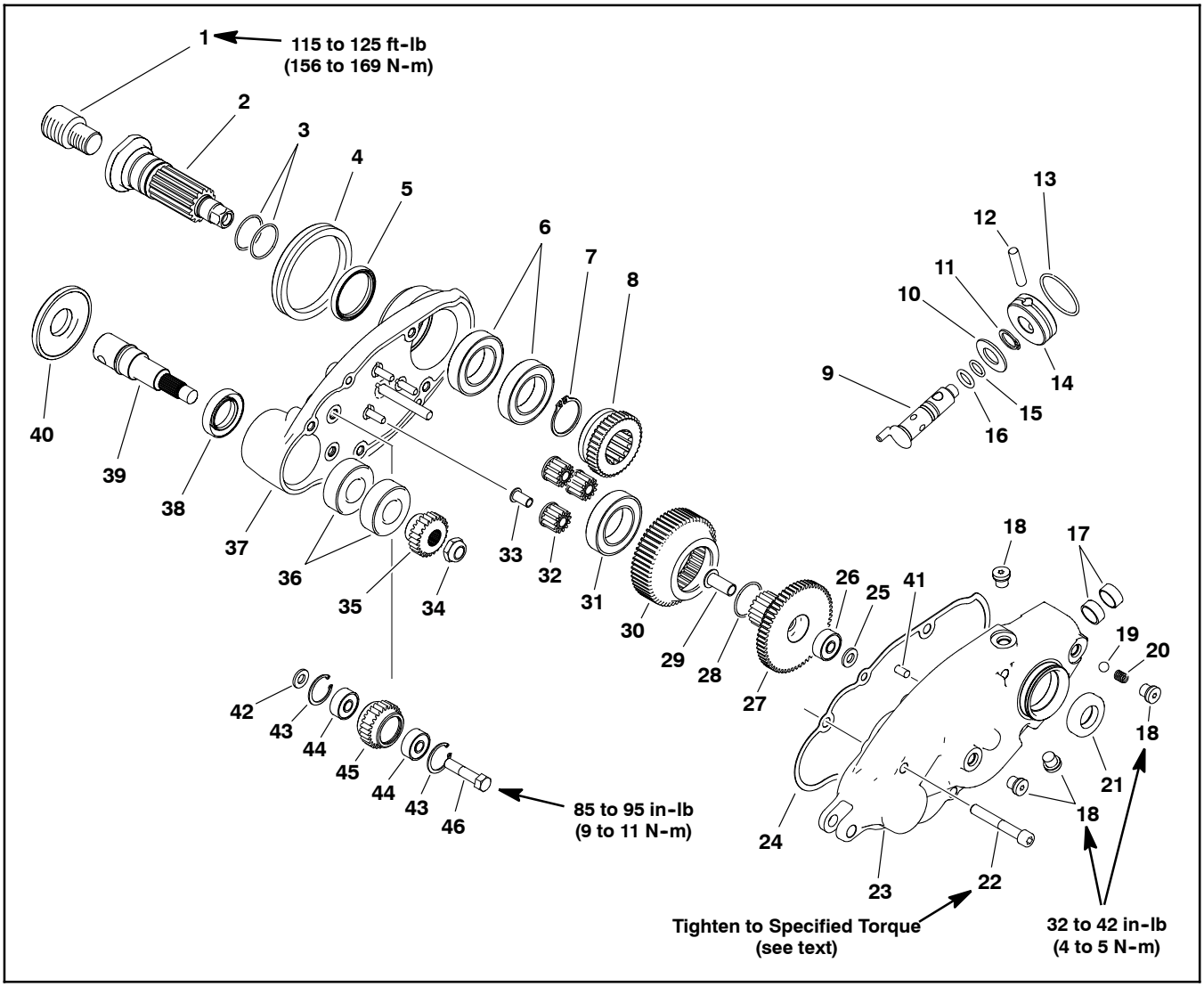


Figure 6

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.

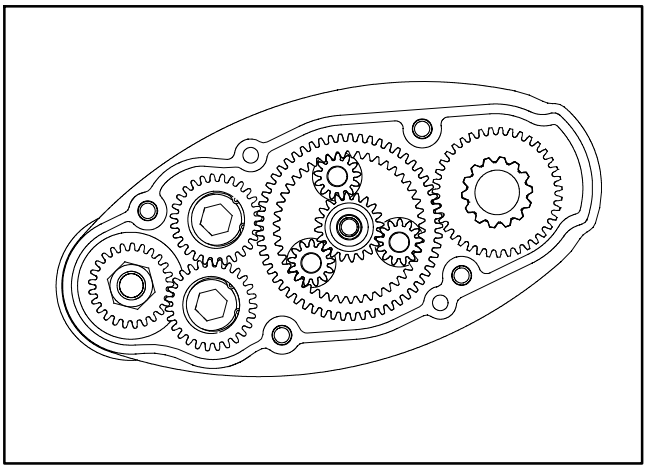


Figure 7

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 135 N-m)**.

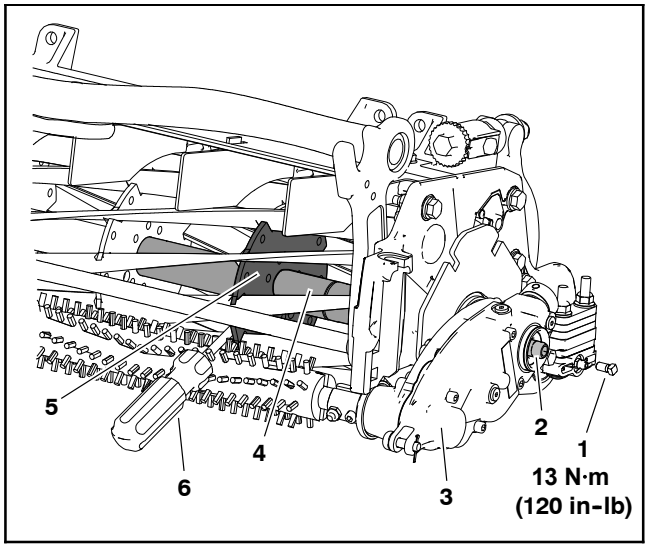


Figure 8

1. **Square head set screw**
2. **Input shaft assembly**
3. **Gear box assembly**
4. **Reel shaft**
5. **Reel support plate**
6. **Pry bar**

7. Remove the square head set screw from the end of the drive shaft.

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 9 - Cutting Units in this manual for additional information).

10. Install the groomer reel assembly (see Groomer reel in this chapter).

Idler Assembly

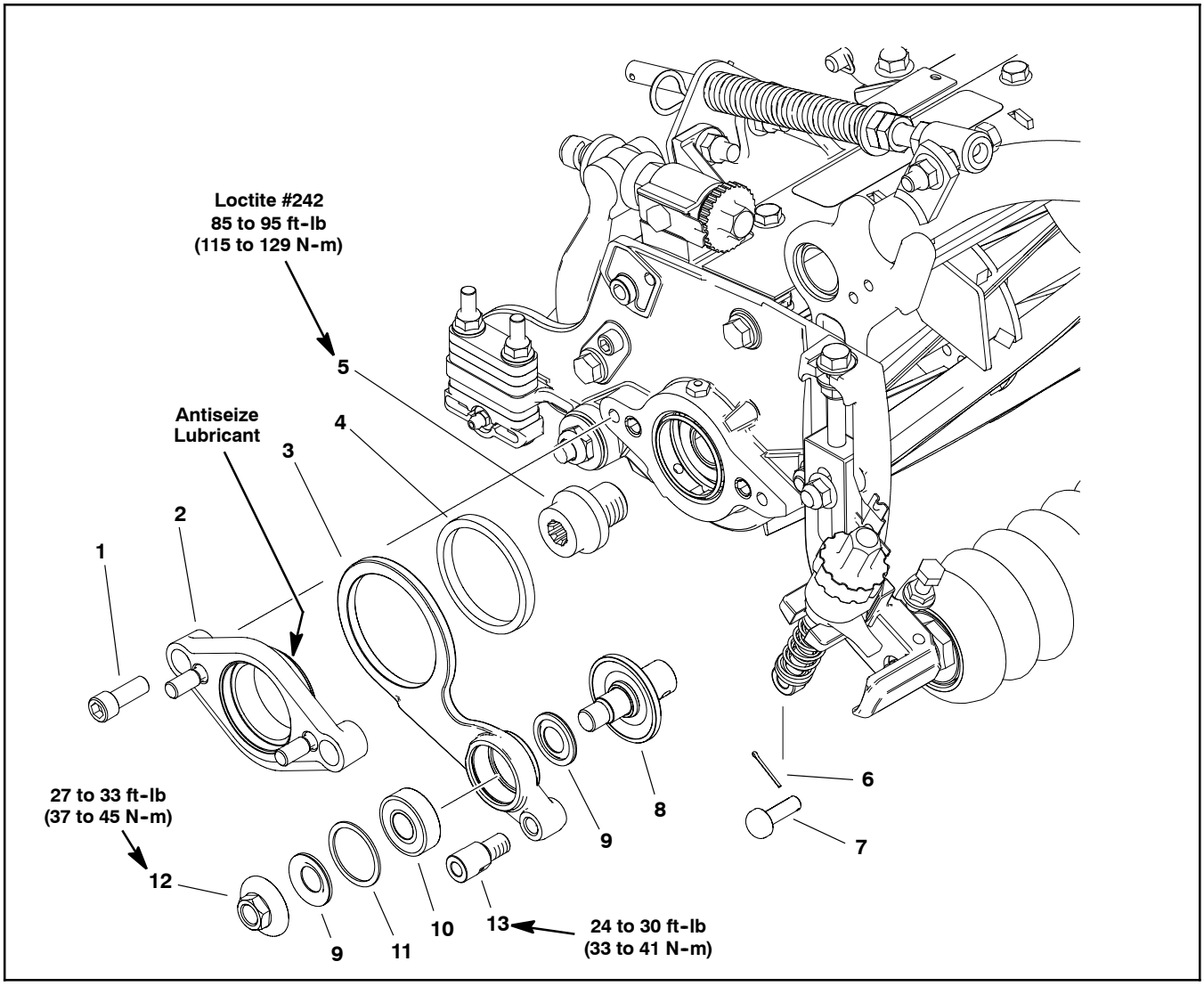


Figure 9

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 9 – 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 9 – Cutting Units in this manual).

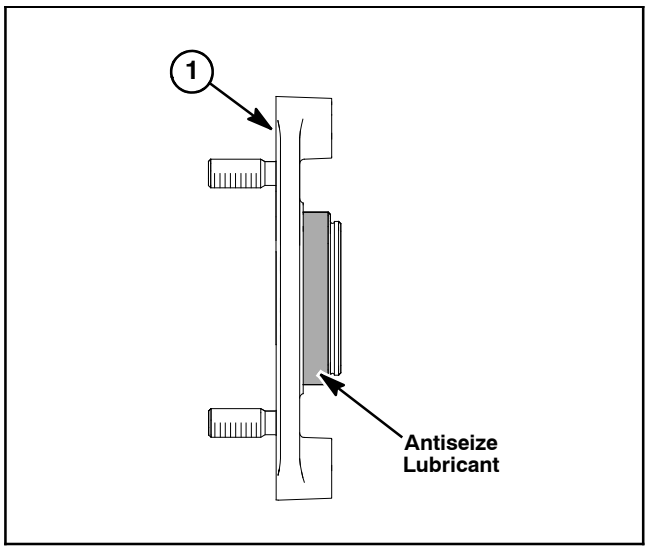


Figure 10

1. **Pivot hub**

Groomer Reel

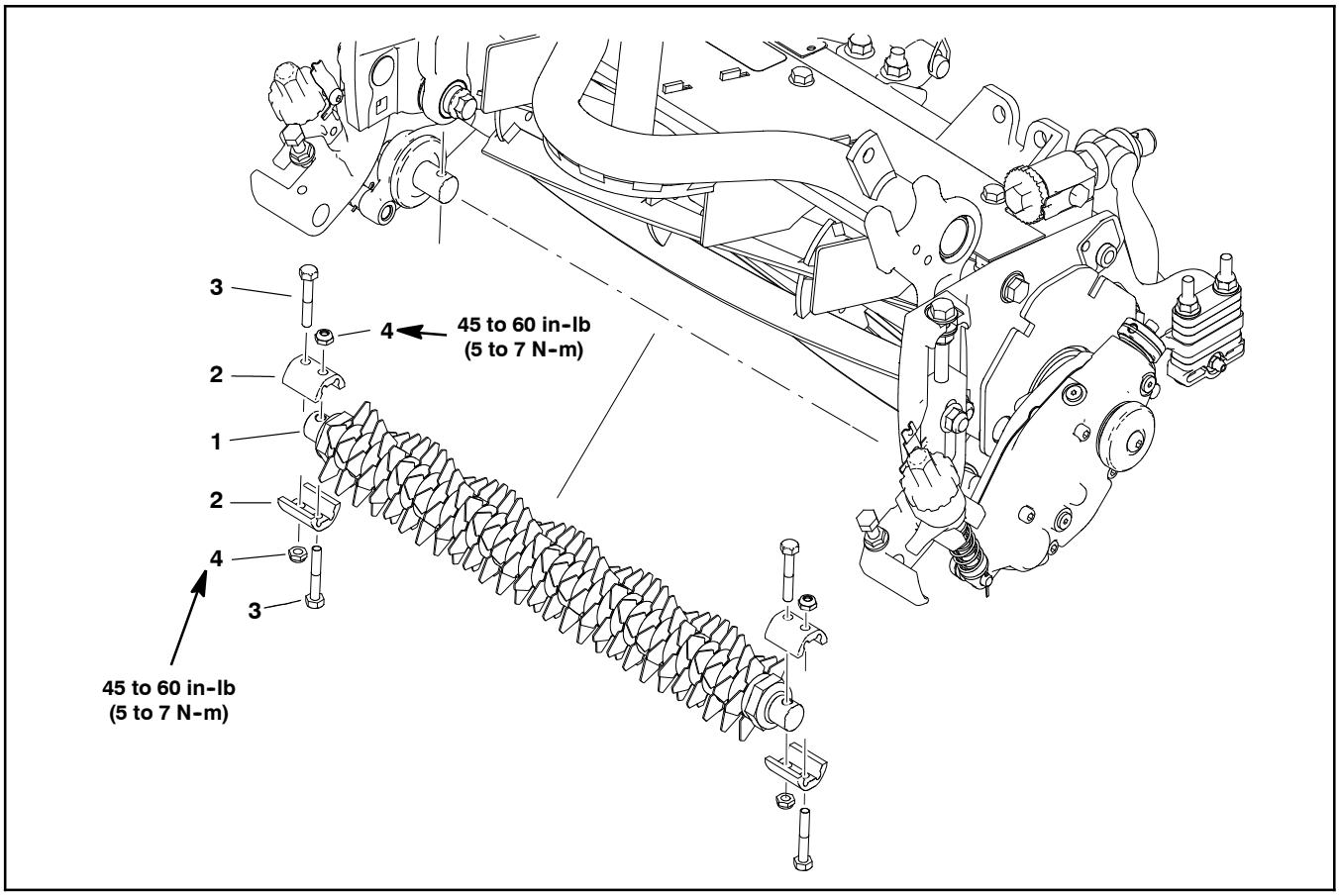


Figure 11

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.

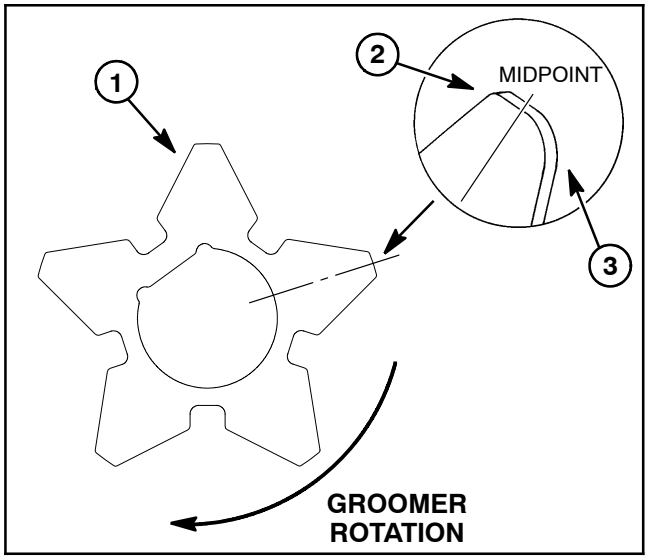


Figure 12

1. **Groomer blade**
2. **Sharp edge**
3. **Dull (rounded) edge**

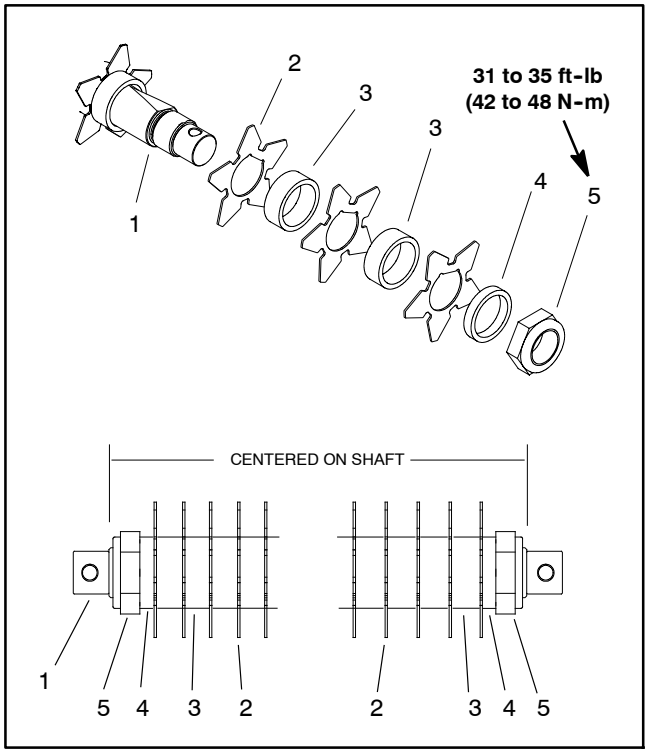


Figure 13

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).

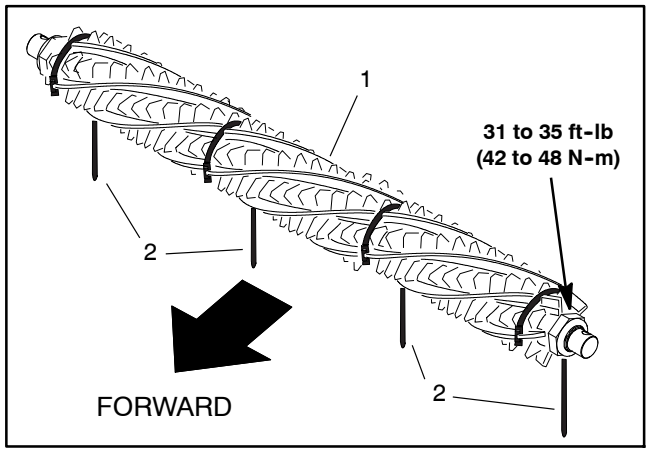


Figure 14

1. Groomer reel **2. Broomer strap (4)**

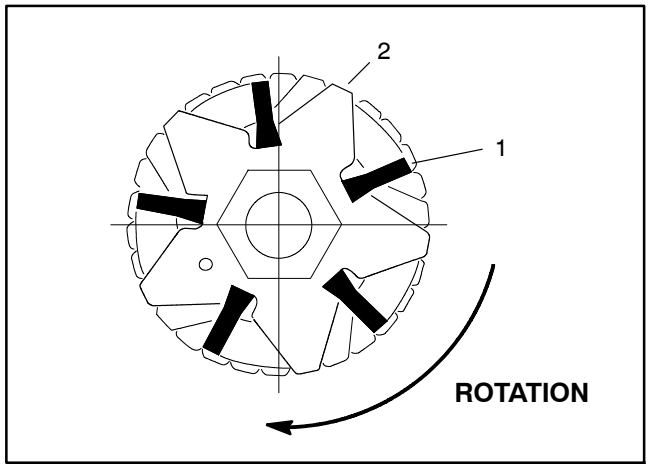


Figure 15

1. Brush **2. Blade**

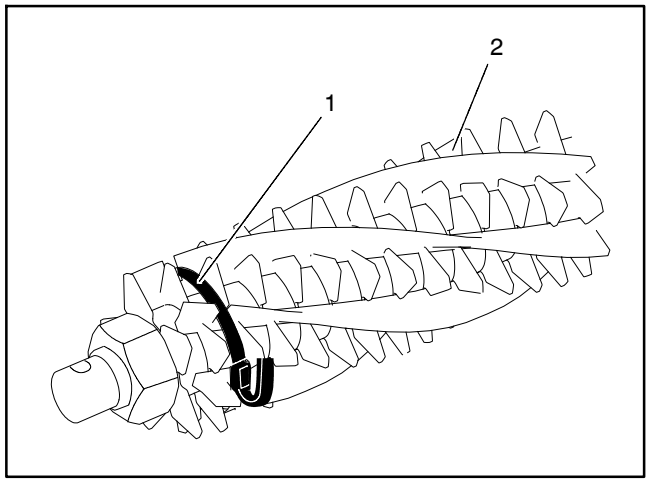


Figure 16

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).

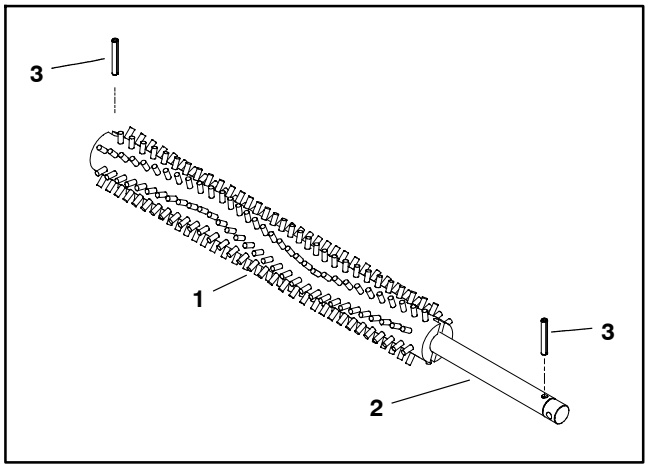


Figure 17

1. **Brush element**
2. **Shaft**
3. **Roll pin (2)**

Height Adjuster Assembly

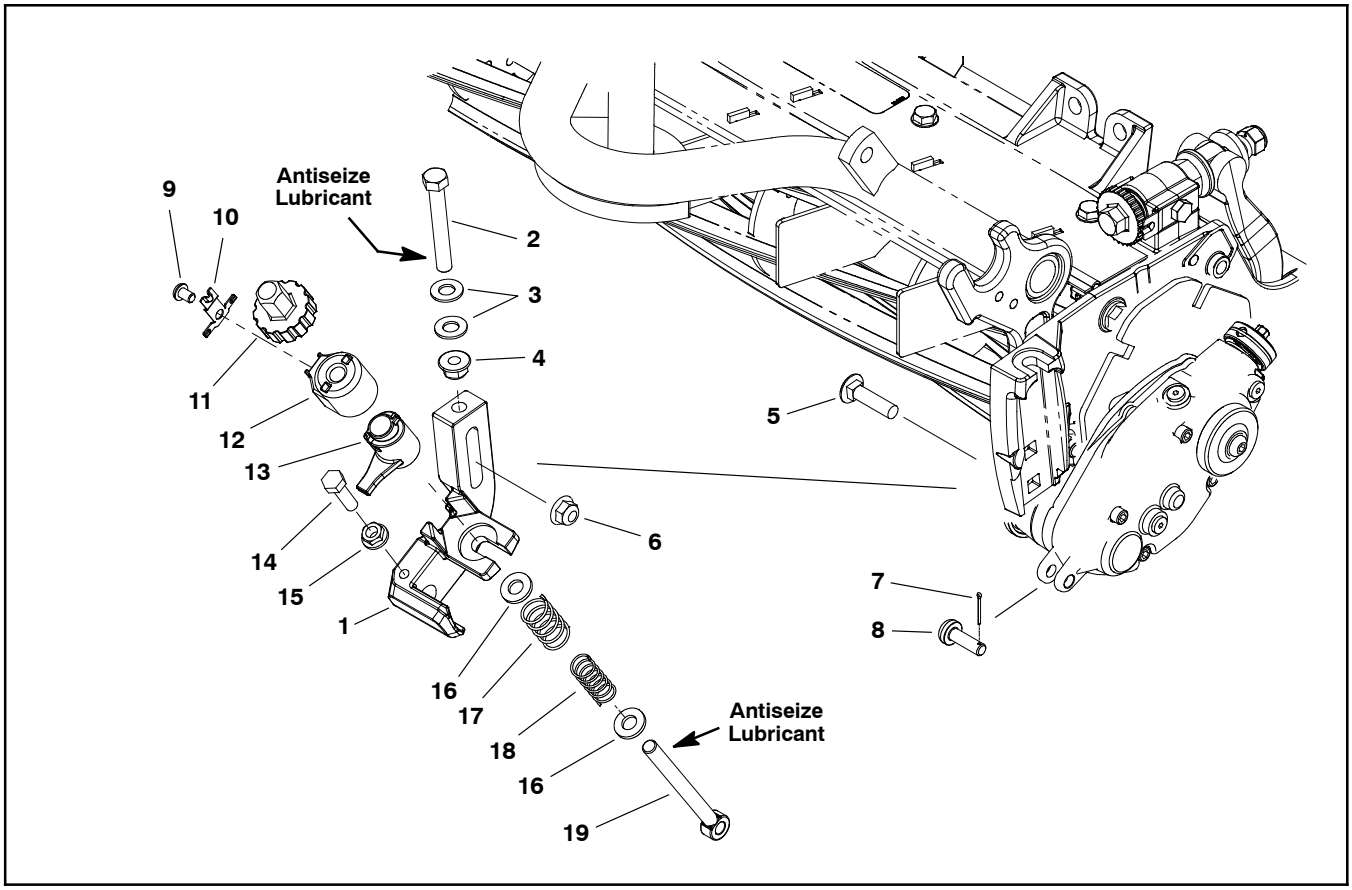


Figure 18

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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Foldout Drawings

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Electrical Drawing Designations

NOTE: A splice used in a wire harness will be identified on the wire harness diagram by SP. The manufacturing number of the splice is also identified on the wire harness diagram (e.g. SP01 is splice number 1).

Wire Color

The following abbreviations are used for wire harness colors on the electrical schematics and wire harness drawings in this chapter.

ABBREVIATION	COLOR
BK	BLACK
BR or BN	BROWN
BU	BLUE
GN	GREEN
GY	GRAY
OR	ORANGE
PK	PINK
R or RD	RED
T	TAN
VIO	VIOLET
W or WH	WHITE
Y or YE	YELLOW

Numerous harness wires used on Toro machines include a line with an alternate color. These wires are identified with the wire color and line color with either a / or _ separating the color abbreviations listed above (e.g. R/BK is a red wire with a black line, OR_BK is an orange wire with a black line).

Wire Size

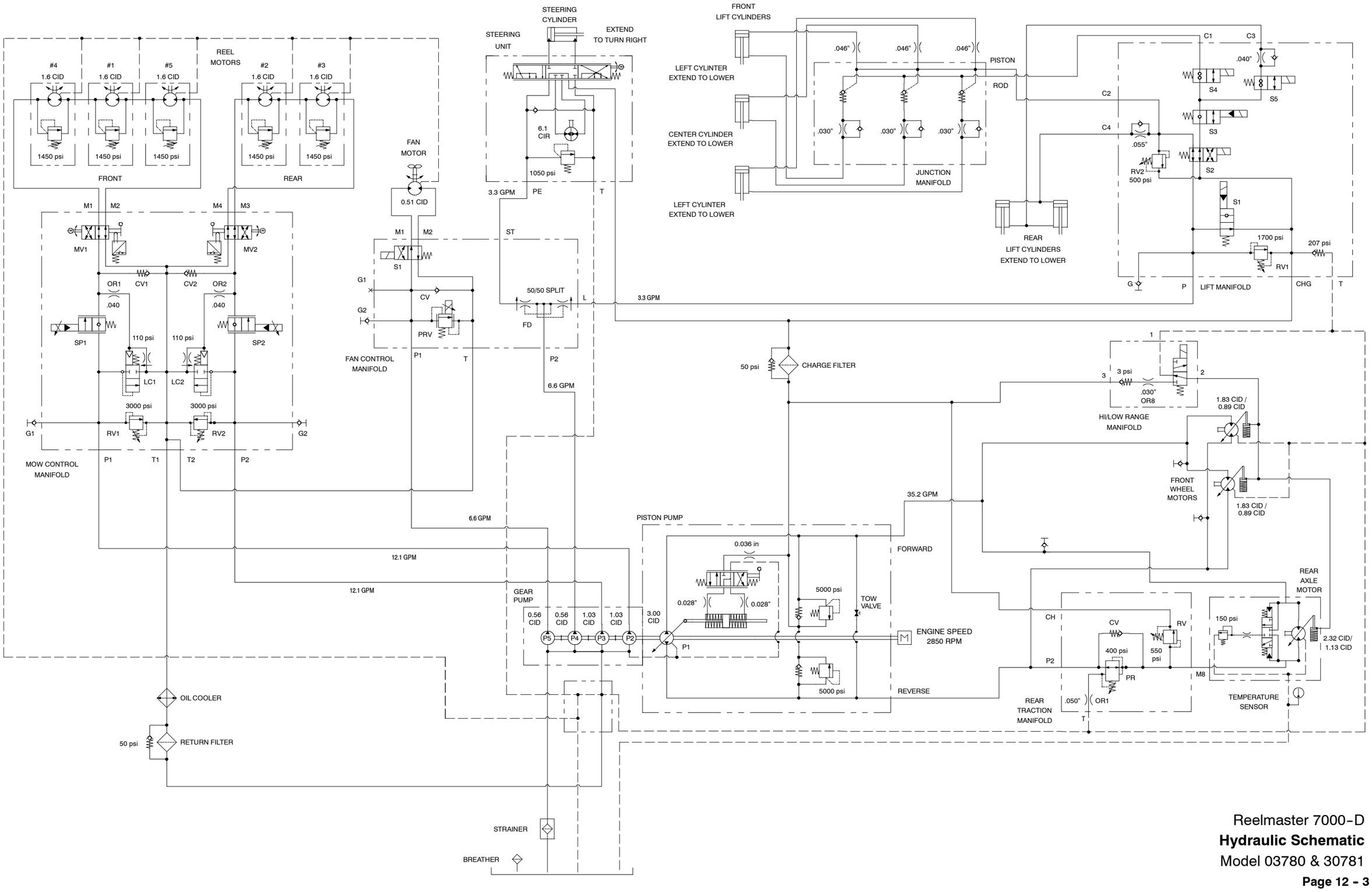
The individual wires of the electrical harness diagrams in this chapter identify both the wire color and the wire size.

Examples:

16 BK = 16 AWG (American Wire Gauge) wire that has a black insulator

050 R = 0.5 mm metric wire that has a red insulator (AWG equivalents for metric wire appear in the following table)

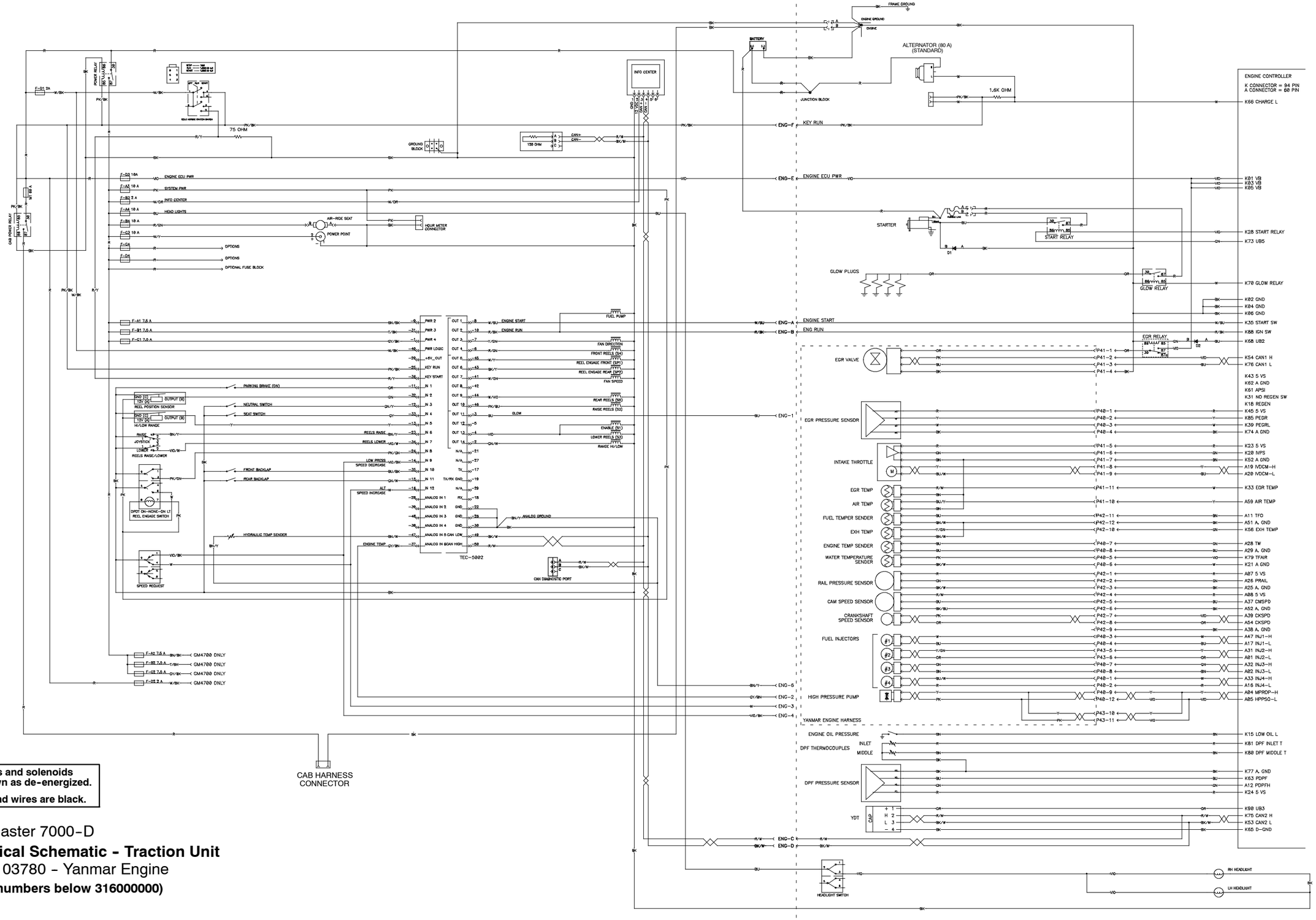
AWG EQUIVALENTS FOR METRIC WIRE		
DIAGRAM LABEL	METRIC SIZE	AWG EQUIVALENT
050	0.5 mm	20 GA
175	0.75 mm	18 GA
100	1.0 mm	16 GA
150	1.5 mm	14 GA



Reelmaster 7000-D

Hydraulic Schematic

Model 03780 & 30781



All relays and solenoids are shown as de-energized.

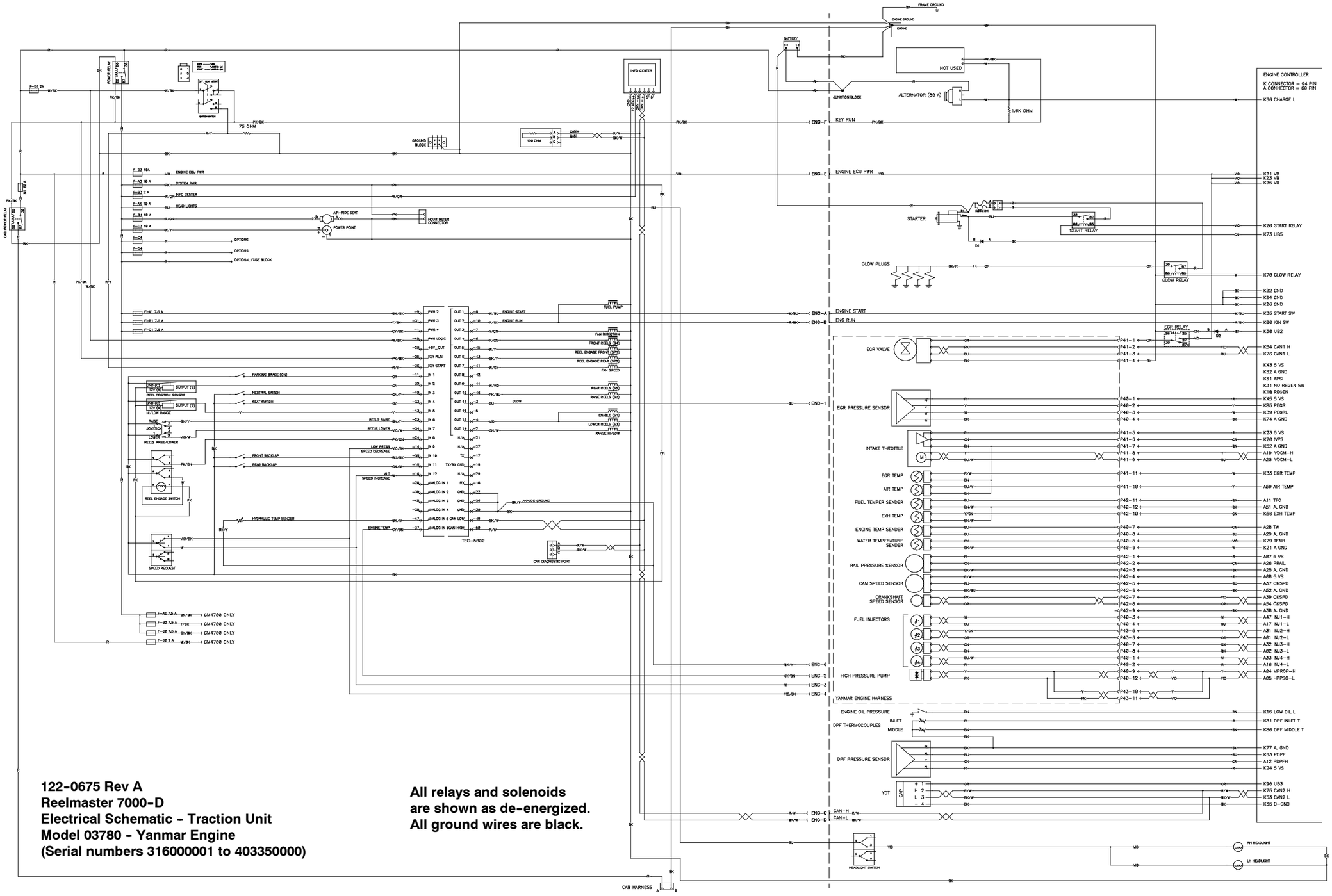
All ground wires are black.

Reelmaster 7000-D

Electrical Schematic - Traction Unit

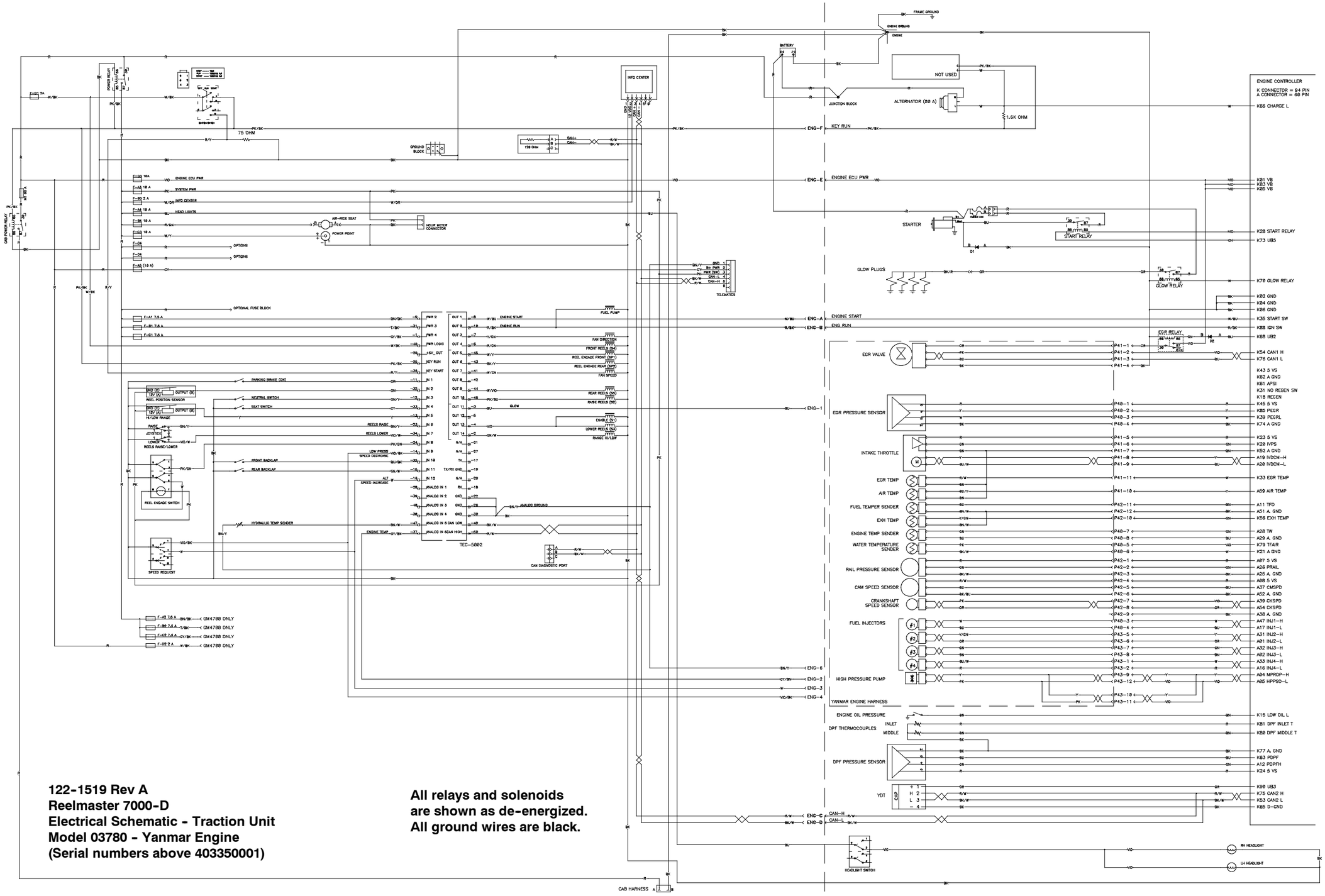
Model 03780 - Yanmar Engine

(Serial numbers below 316000000)



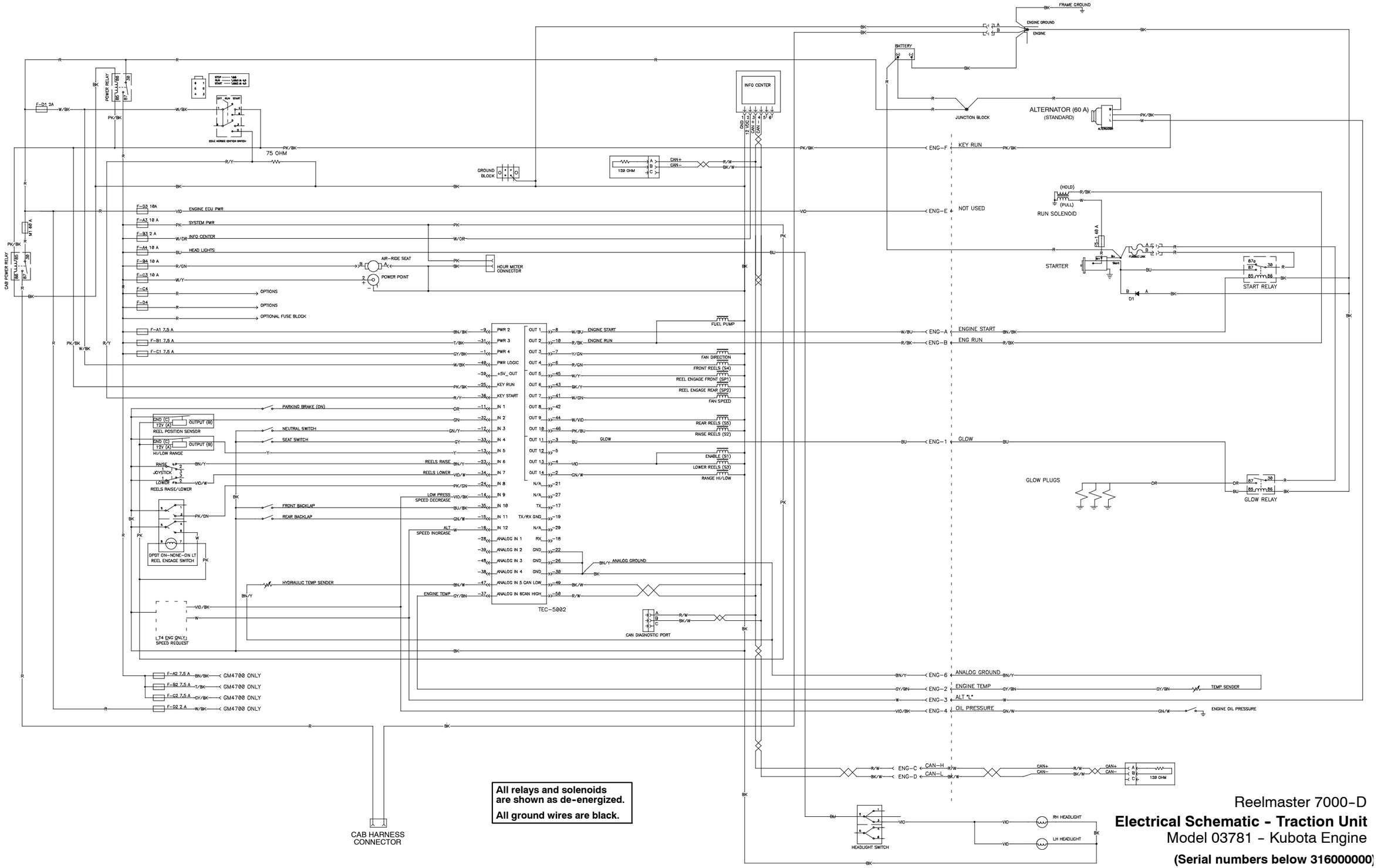
122-0675 Rev A
Reelmaster 7000-D
Electrical Schematic - Traction Unit
Model 03780 - Yanmar Engine
(Serial numbers 316000001 to 403350000)

All relays and solenoids are shown as de-energized. All ground wires are black.



122-1519 Rev A
Reelmaster 7000-D
Electrical Schematic - Traction Unit
Model 03780 - Yanmar Engine
(Serial numbers above 403350001)

All relays and solenoids are shown as de-energized. All ground wires are black.

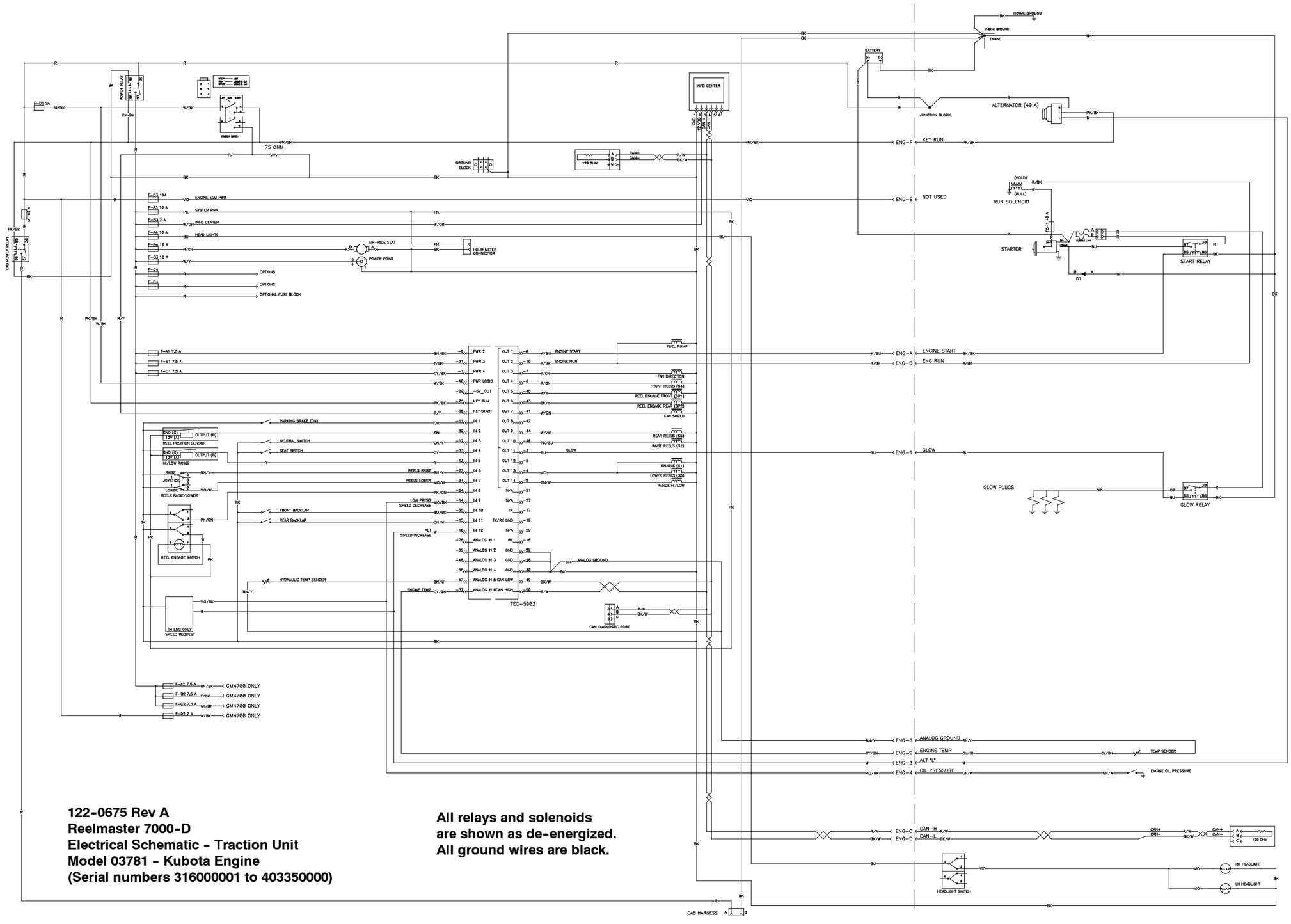


Reelmaster 7000-D

Electrical Schematic - Traction Unit

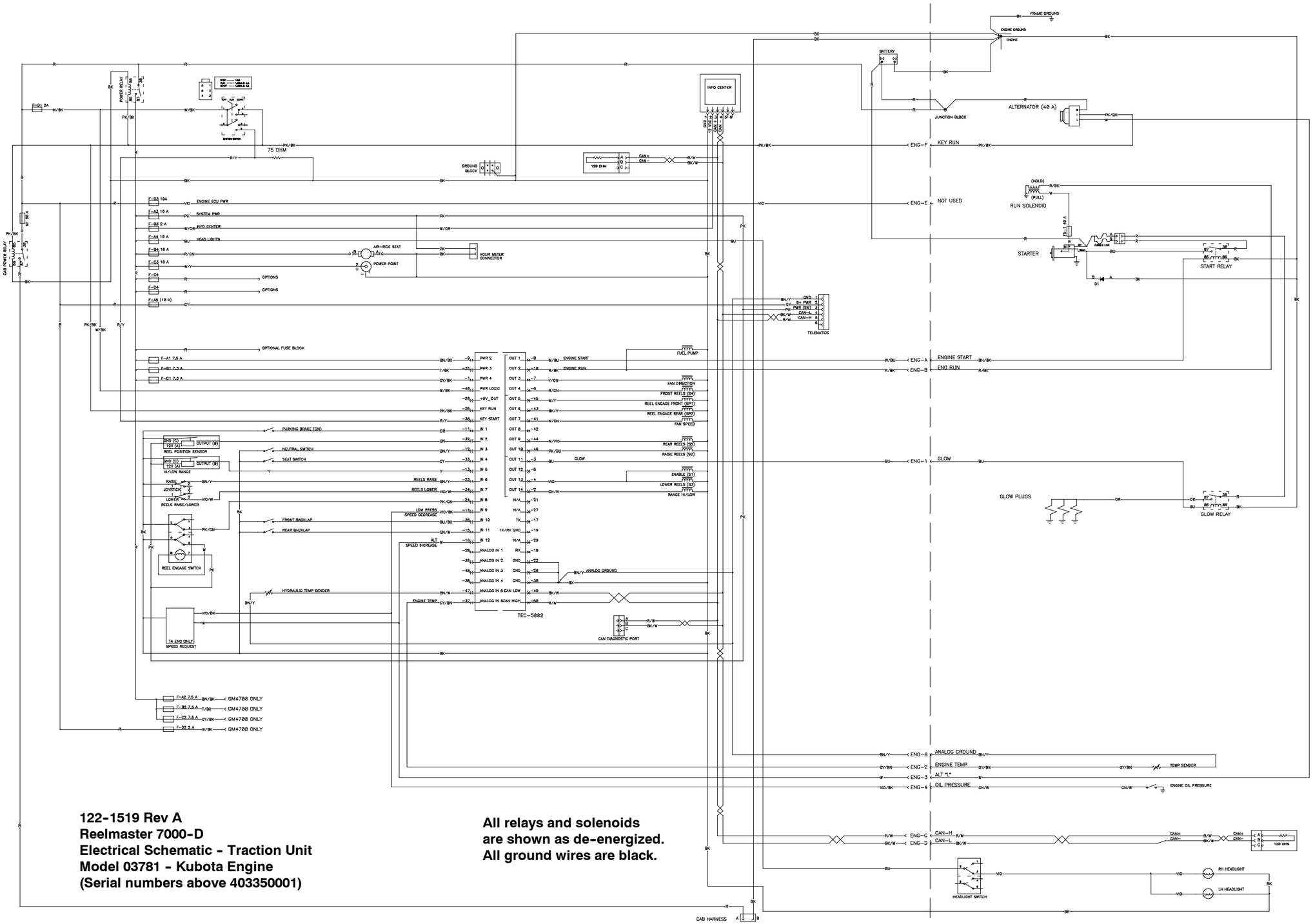
Model 03781 - Kubota Engine

(Serial numbers below 316000000)



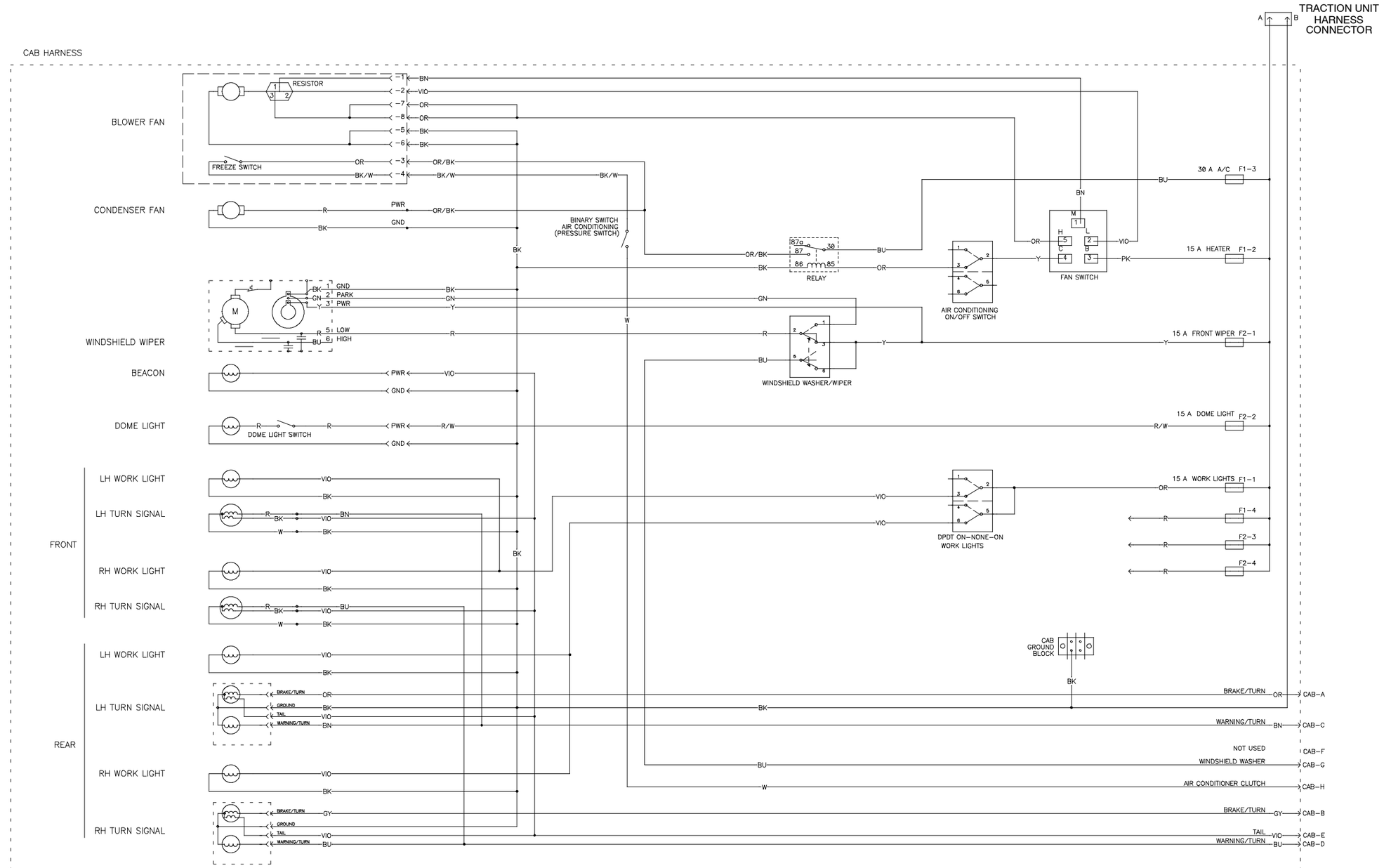
122-0675 Rev A
Reelmaster 7000-D
Electrical Schematic - Traction Unit
Model 03781 - Kubota Engine
(Serial numbers 316000001 to 403350000)

All relays and solenoids are shown as de-energized. All ground wires are black.



122-1519 Rev A
Reelmaster 7000-D
Electrical Schematic - Traction Unit
Model 03781 - Kubota Engine
(Serial numbers above 403350001)

All relays and solenoids are shown as de-energized. All ground wires are black.



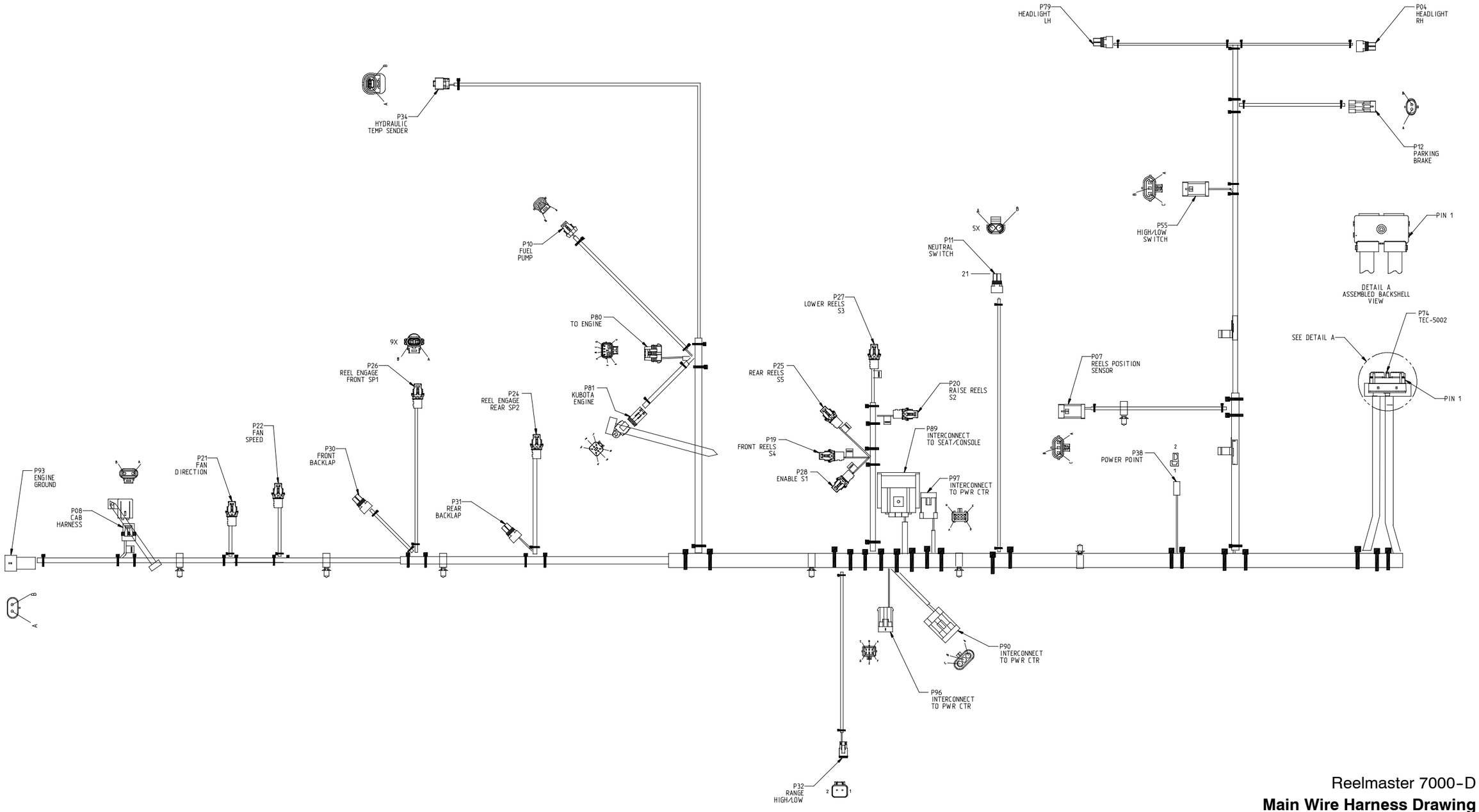
All relays and solenoids are shown as de-energized.

All ground wires are black.

Reelmaster 7000-D

Electrical Schematic - Cab

Model 03780 & 30781

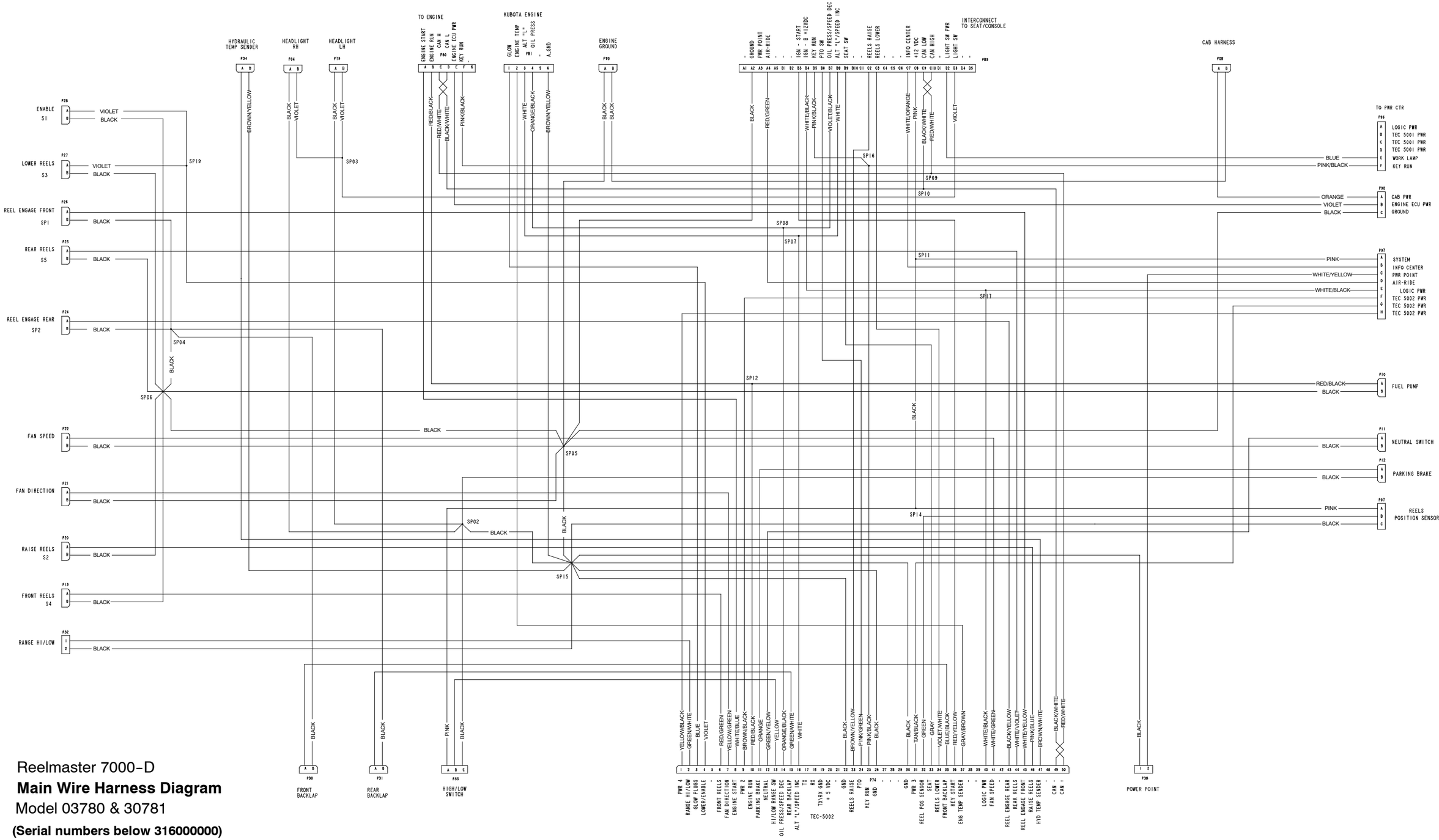


Reelmaster 7000-D

Main Wire Harness Drawing

Model 03780 & 30781

(Serial numbers below 316000000)

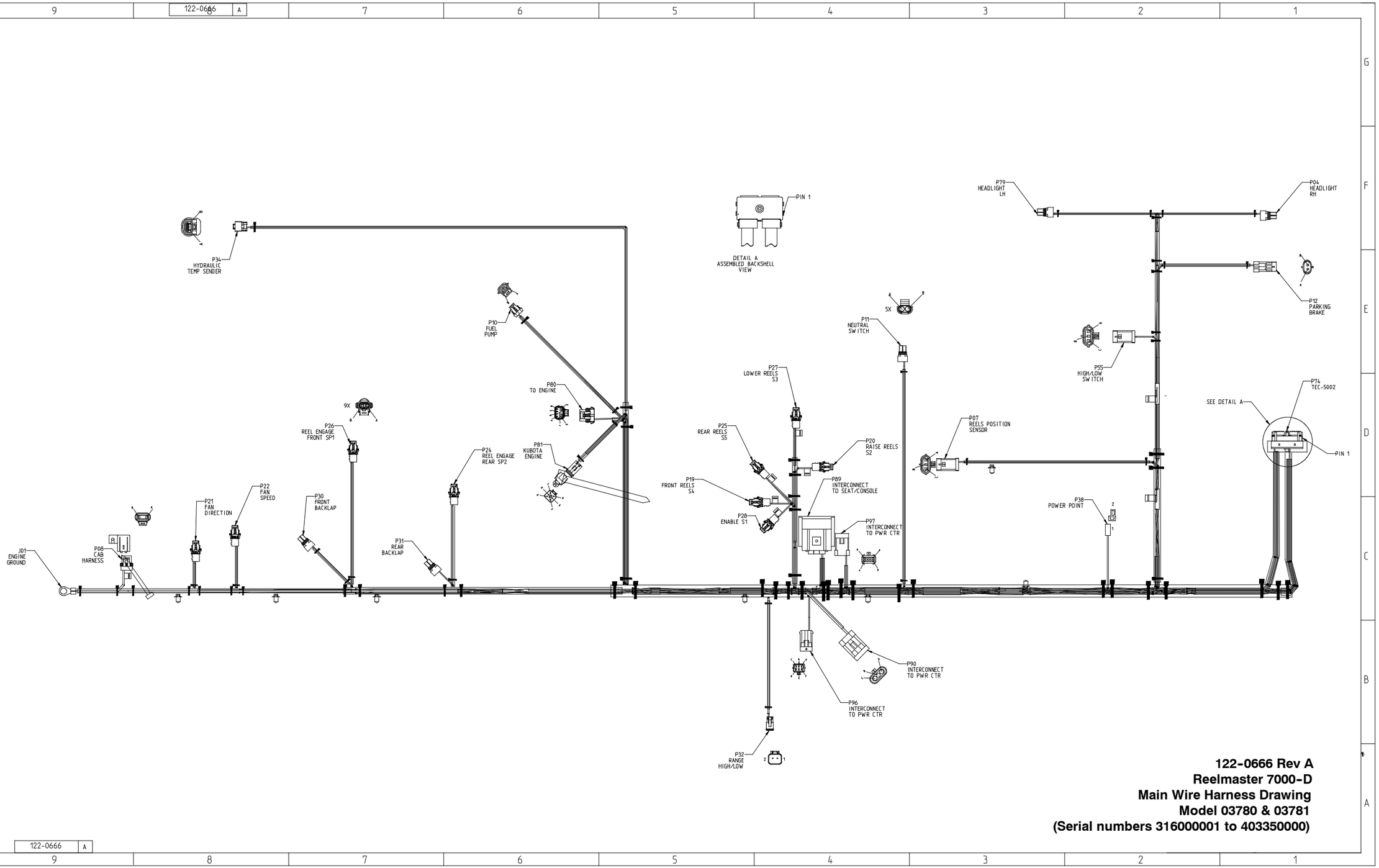


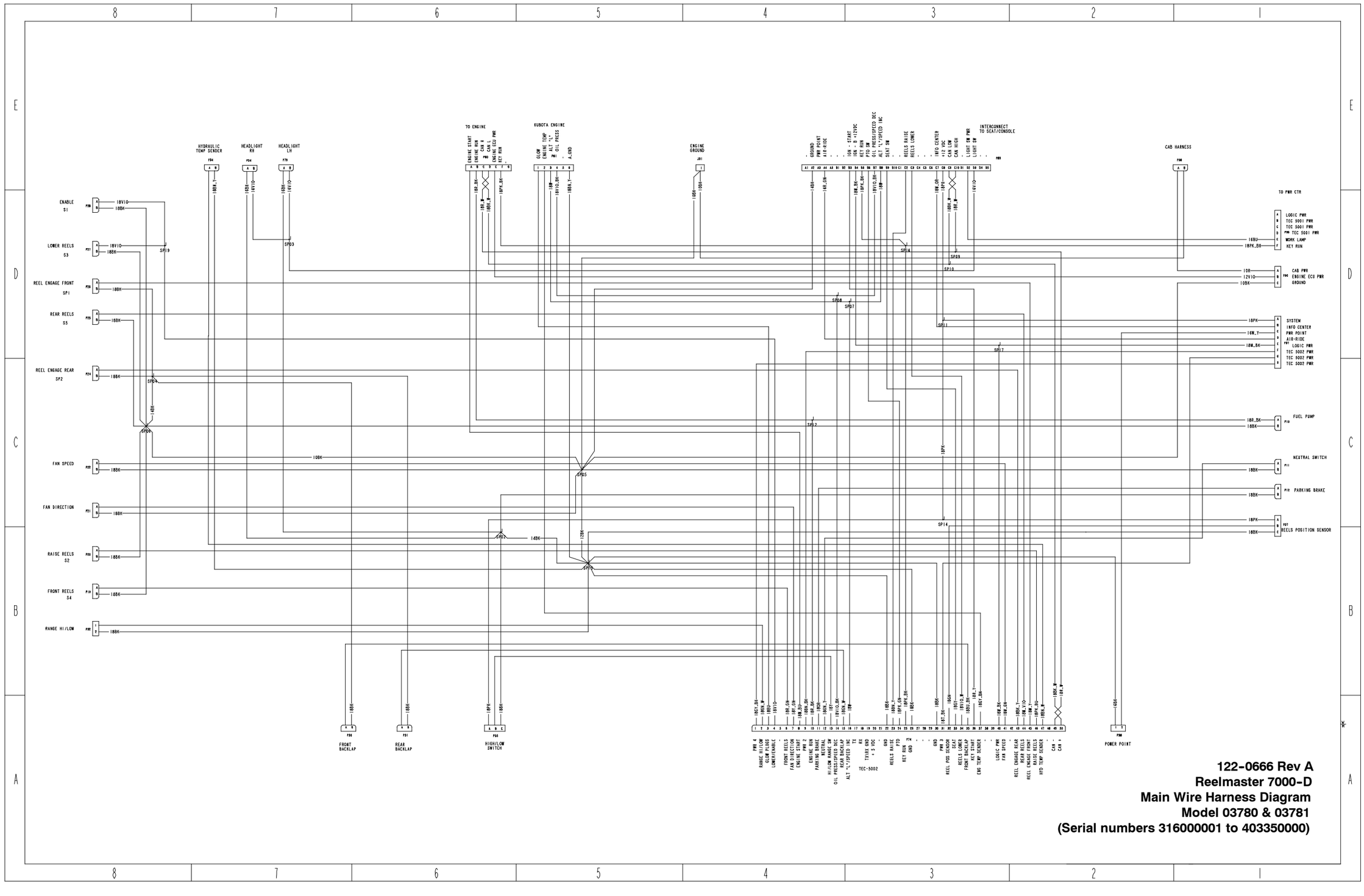
Reelmaster 7000-D

Main Wire Harness Diagram

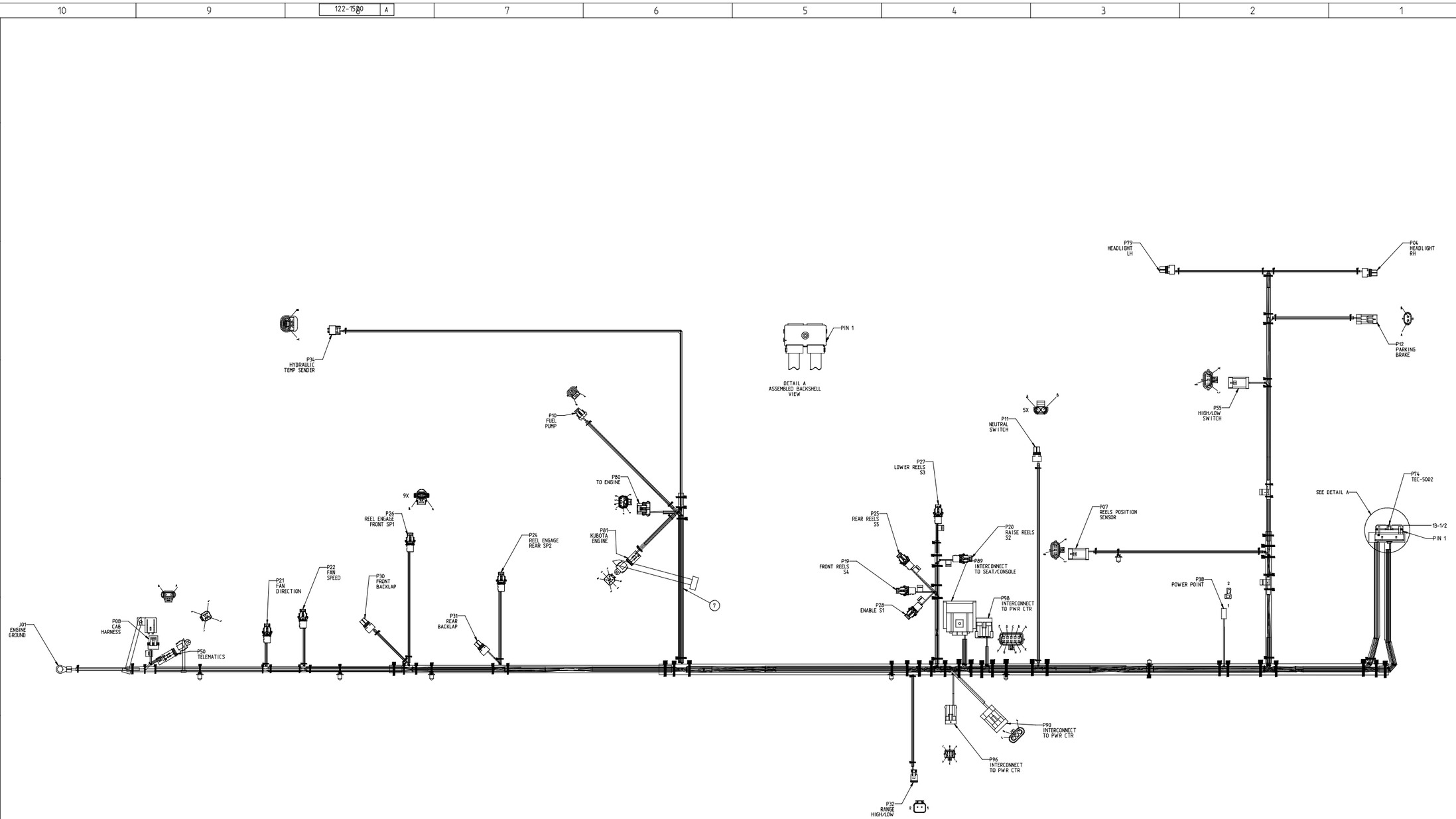
Model 03780 & 30781

(Serial numbers below 316000000)

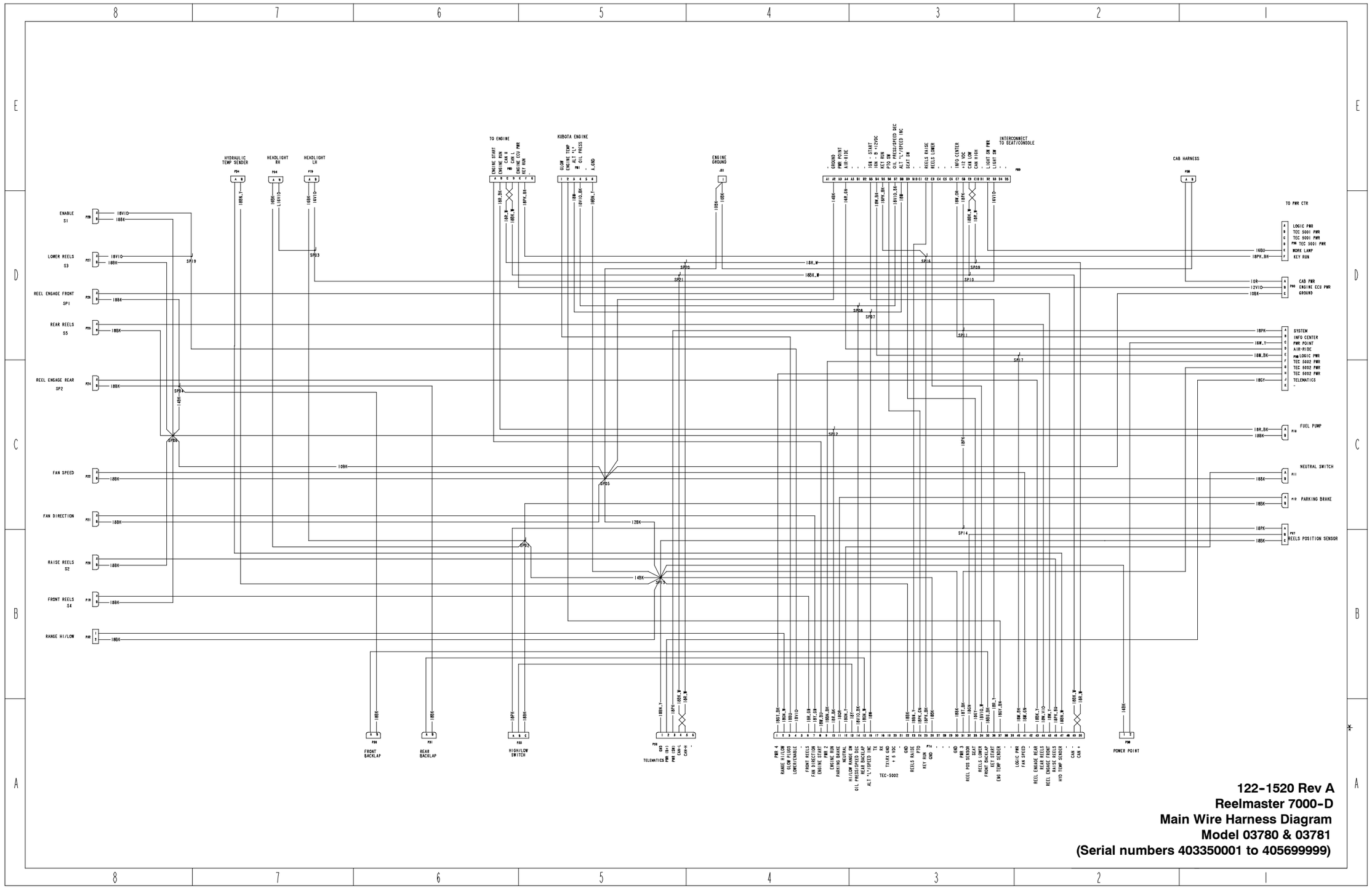

122-0666 A
P34
HYDRAULIC
TEMP SENDER
P10
FUEL
PUMP
P80
TO ENGINE
9X
P26
REEL ENGAGE
FRONT SP1
P24
REEL ENGAGE
REAR SP2
P81
KUBOTA
ENGINE
P22
FAN
SPEED
P21
FAN
DIRECTION
P30
FRONT
BACKLAP
P31
REAR
BACKLAP
J01
ENGINE
GROUND
P08
CAB
HARNESS
DETAIL A
ASSEMBLED BACKSHELL
VIEW
PIN 1
5X
P11
NEUTRAL
SWITCH
P27
LOWER REELS
S3
P25
REAR REELS
S5
P20
RAISE REELS
S2
P19
FRONT REELS
S4
P28
ENABLE S1
P89
INTERCONNECT
TO SEAT/CONSOLE
P97
INTERCONNECT
TO PWR CTR
P90
INTERCONNECT
TO PWR CTR
P96
INTERCONNECT
TO PWR CTR
P32
RANGE
HIGH/LOW
P79
HEADLIGHT
LH
P04
HEADLIGHT
RH
P12
PARKING
BRAKE
P55
HIGH/LOW
SWITCH
P07
REELS POSITION
SENSOR
P38
POWER POINT
SEE DETAIL A
P74
TEC-5002
PIN 1
122-0666 Rev A
Reelmaster 7000-D
Main Wire Harness Drawing
Model 03780 & 03781
(Serial numbers 316000001 to 403350000)
122-0666 A

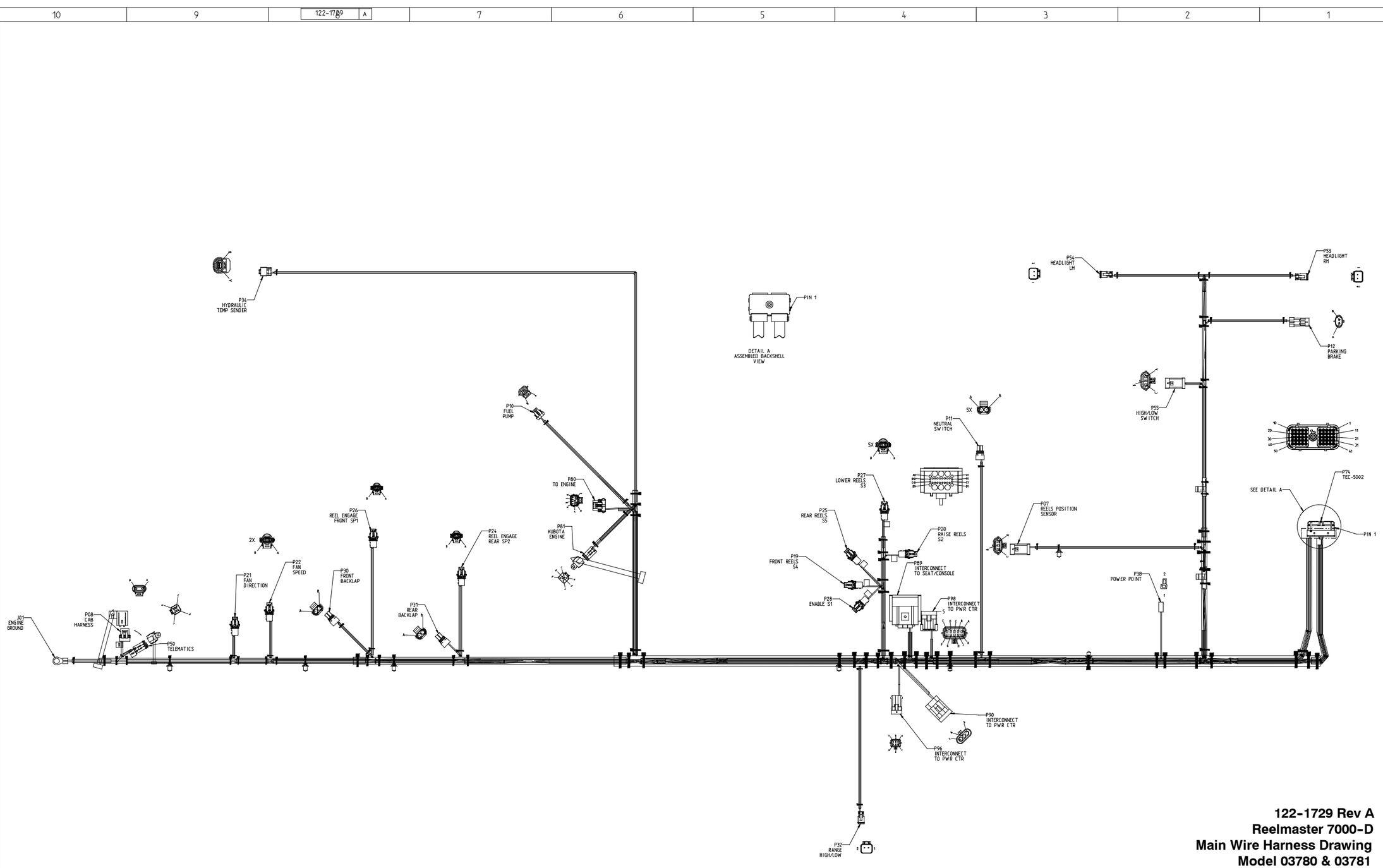


122-0666 Rev A
Reelmaster 7000-D
Main Wire Harness Diagram
Model 03780 & 03781
(Serial numbers 316000001 to 403350000)

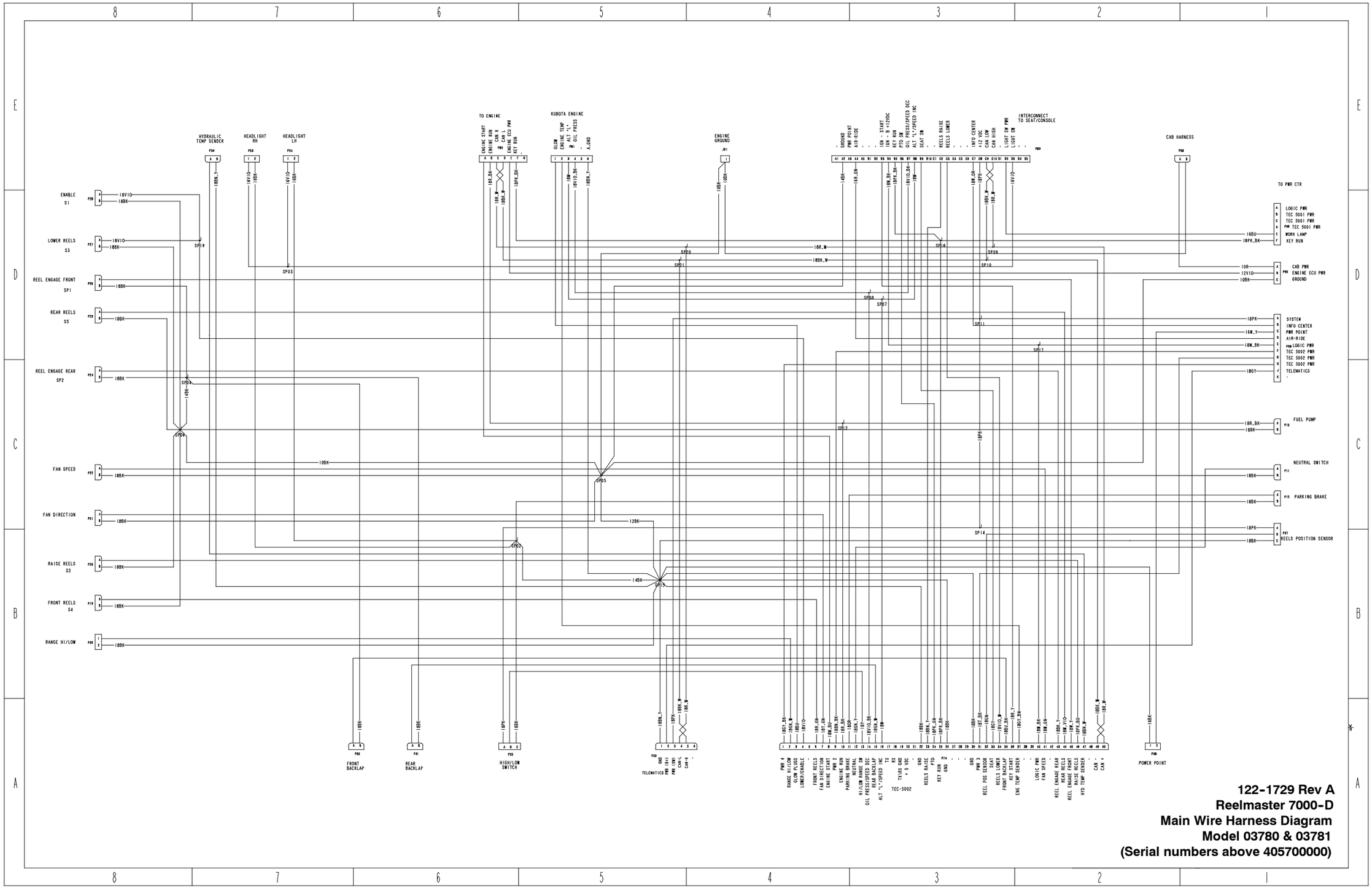


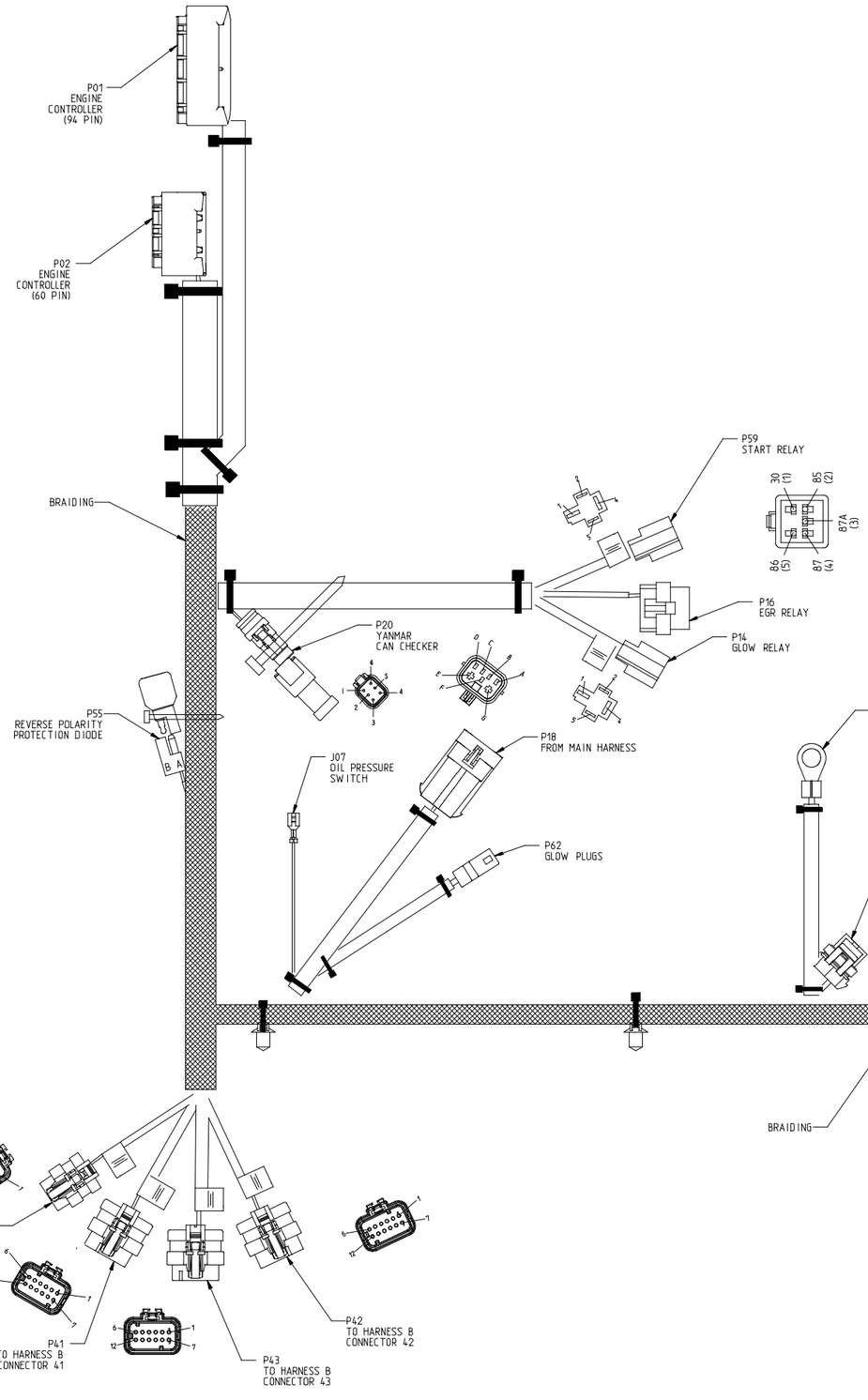
122-1520 Rev A
Reelmaster 7000-D
Main Wire Harness Drawing
Model 03780 & 03781
(Serial numbers 403350001 to 405699999)

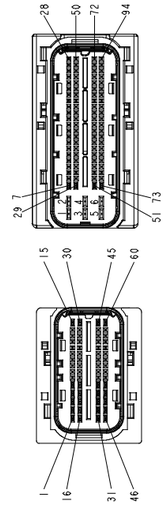

TO ENGINE
KUBOTA ENGINE
INTERCONNECT TO SEAT/CONSOLE
CAB HARNESS
TO PWR CTR
ENABLE S1
LOWER REELS S3
REEL ENGAGE FRONT SP1
REAR REELS S5
REEL ENGAGE REAR SP2
FAN SPEED
FAN DIRECTION
RAISE REELS S2
FRONT REELS S4
RANGE HI/LOW
HYDRAULIC TEMP SENDER
HEADLIGHT RH
HEADLIGHT LH
ENGINE GROUND
FUEL PUMP
NEUTRAL SWITCH
PARKING BRAKE
REELS POSITION SENSOR
FRONT BACKLAP
REAR BACKLAP
HIGH/LOW SWITCH
TELEMATICS
TEC-5002
POWER POINT
122-1520 Rev A
Reelmaster 7000-D
Main Wire Harness Diagram
Model 03780 & 03781
(Serial numbers 403350001 to 405699999)

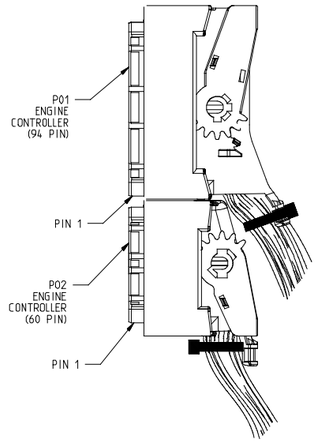


122-1729 Rev A
Reelmaster 7000-D
Main Wire Harness Drawing
Model 03780 & 03781
(Serial numbers above 405700000)

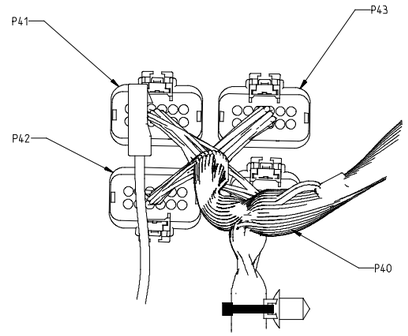

HYDRAULIC TEMP SENDER
HEADLIGHT RH
HEADLIGHT LH
TO ENGINE
KUBOTA ENGINE
ENGINE GROUND
INTERCONNECT TO SEAT/CONSOLE
CAB HARNESS
TO PWR CTR
ENABLE S1
LOWER REELS S3
REEL ENGAGE FRONT SP1
REAR REELS S5
REEL ENGAGE REAR SP2
FAN SPEED
FAN DIRECTION
RAISE REELS S2
FRONT REELS S4
RANGE HI/LOW
FRONT BACKLAP
REAR BACKLAP
HIGH/LOW SWITCH
TELEMATICS
TEC-5002
POWER POINT
FUEL PUMP
NEUTRAL SWITCH
PARKING BRAKE
REELS POSITION SENSOR
122-1729 Rev A
Reelmaster 7000-D
Main Wire Harness Diagram
Model 03780 & 03781
(Serial numbers above 405700000)



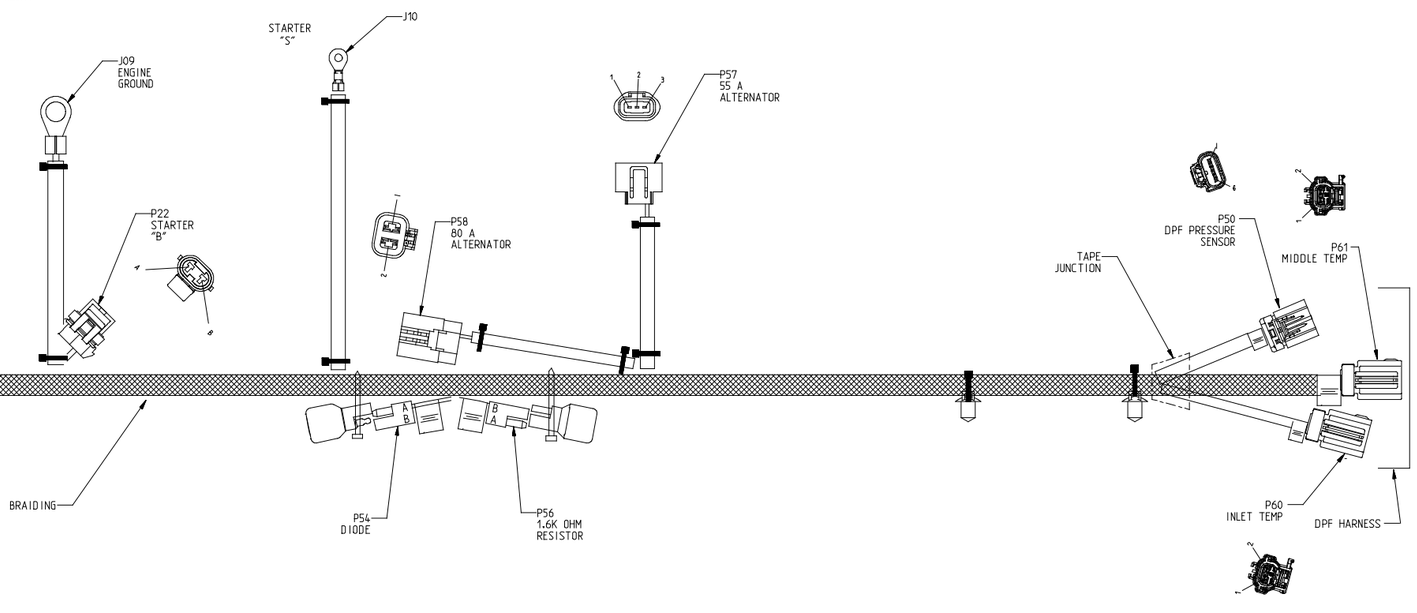




BACKSHELL ORIENTATION
FOR P01 & P02



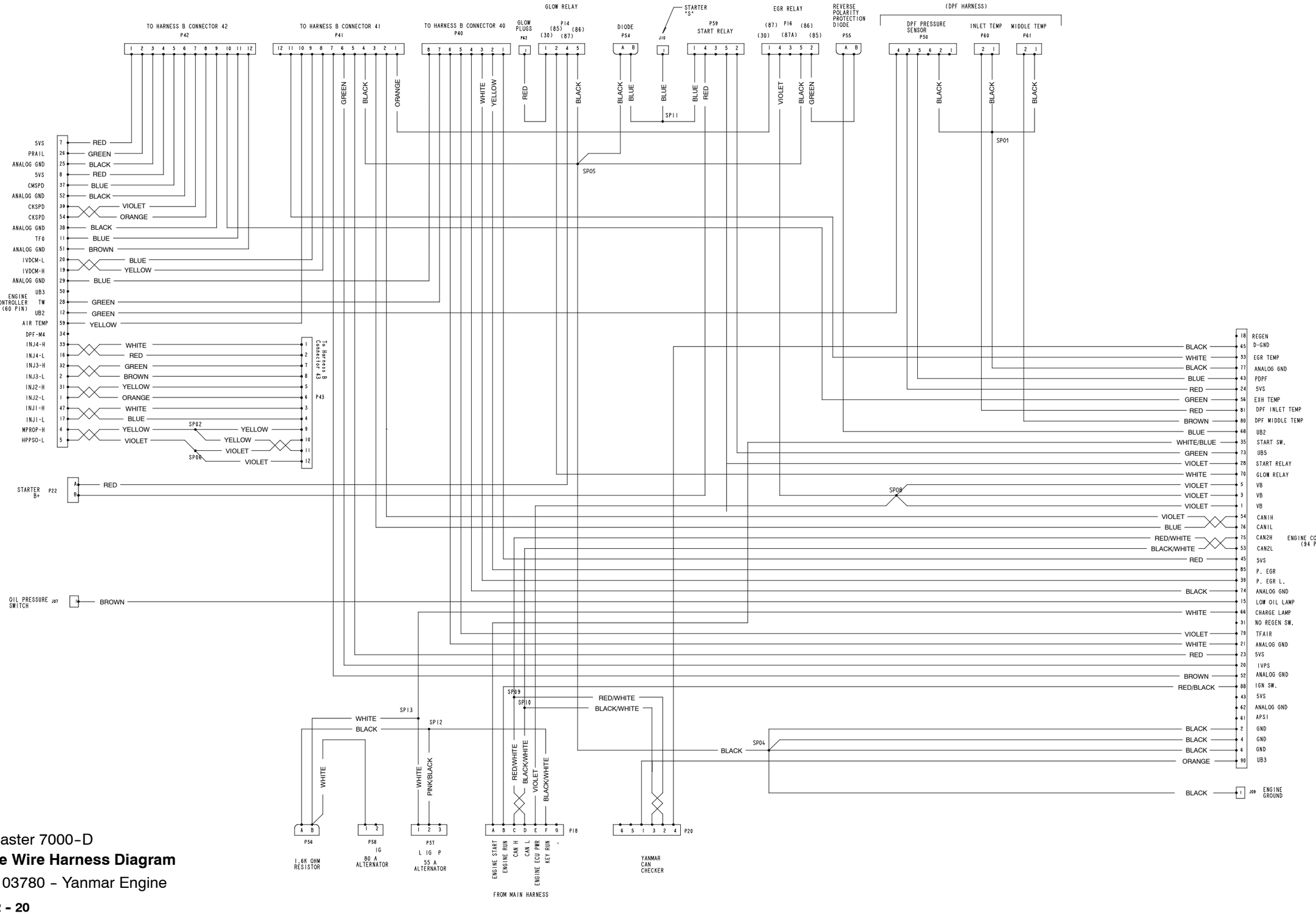
FRONT VIEW TO
SHOW ORIENTATION



Reelmaster 7000-D

Engine Wire Harness Drawing

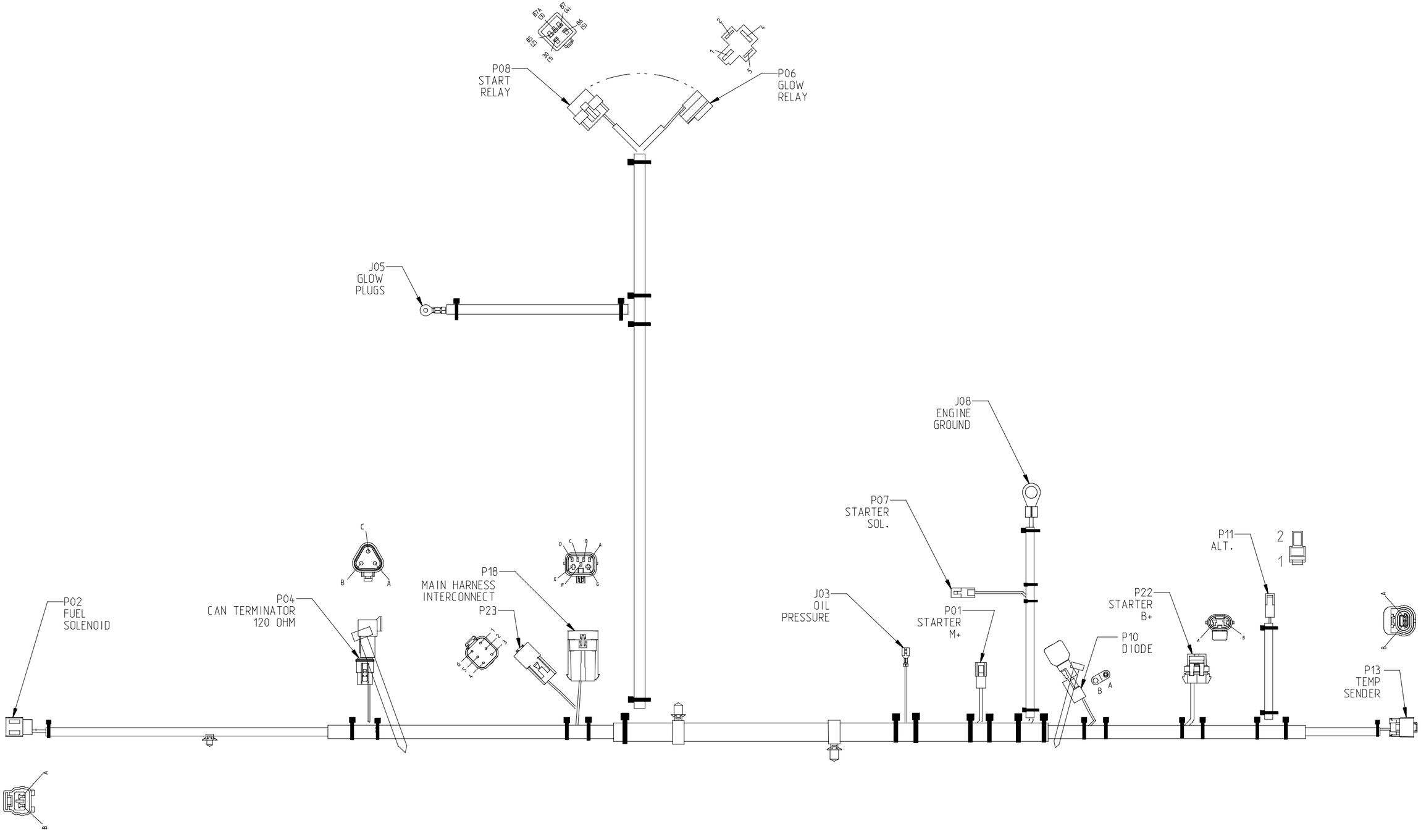
Model 03780 – Yanmar Engine

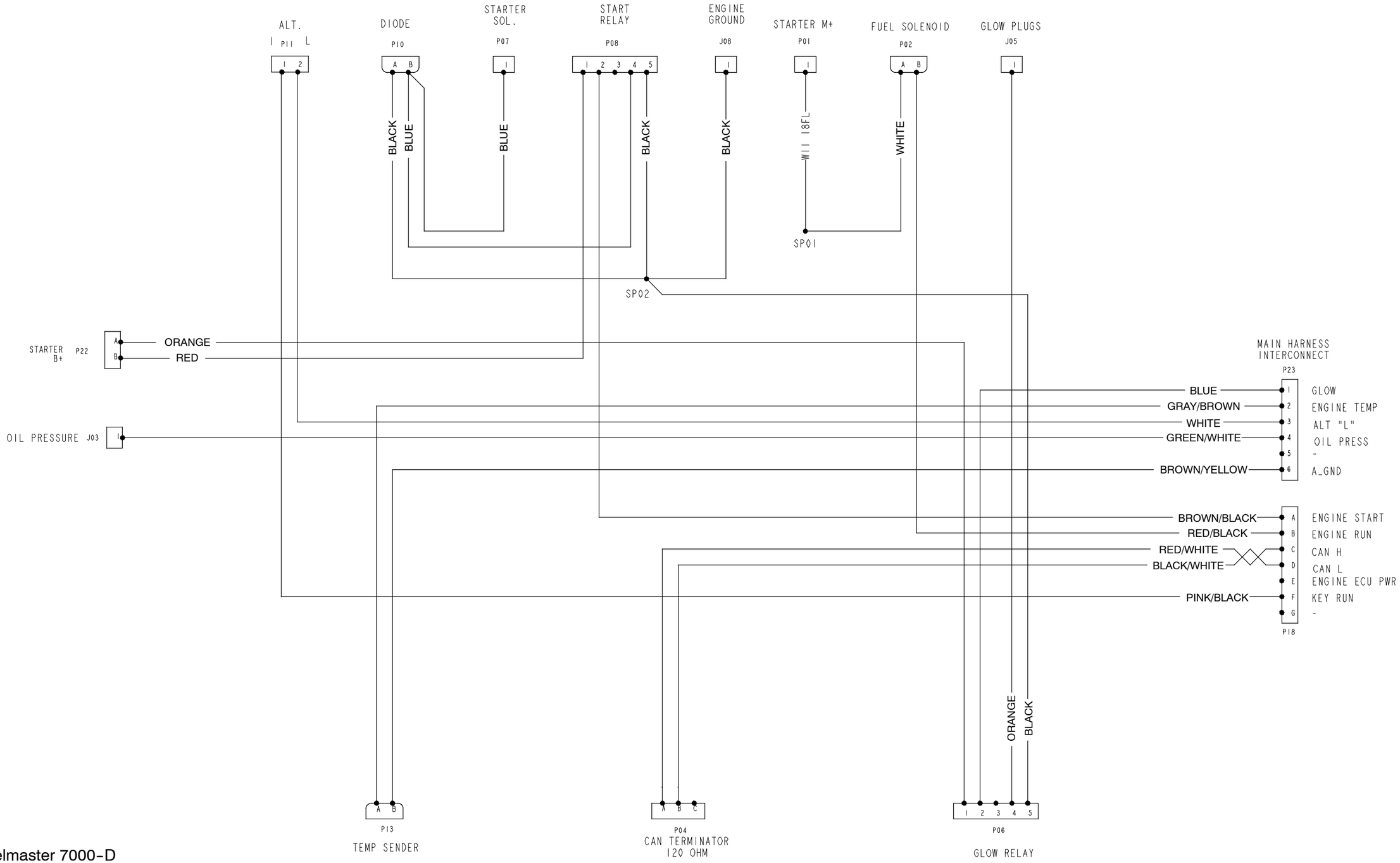


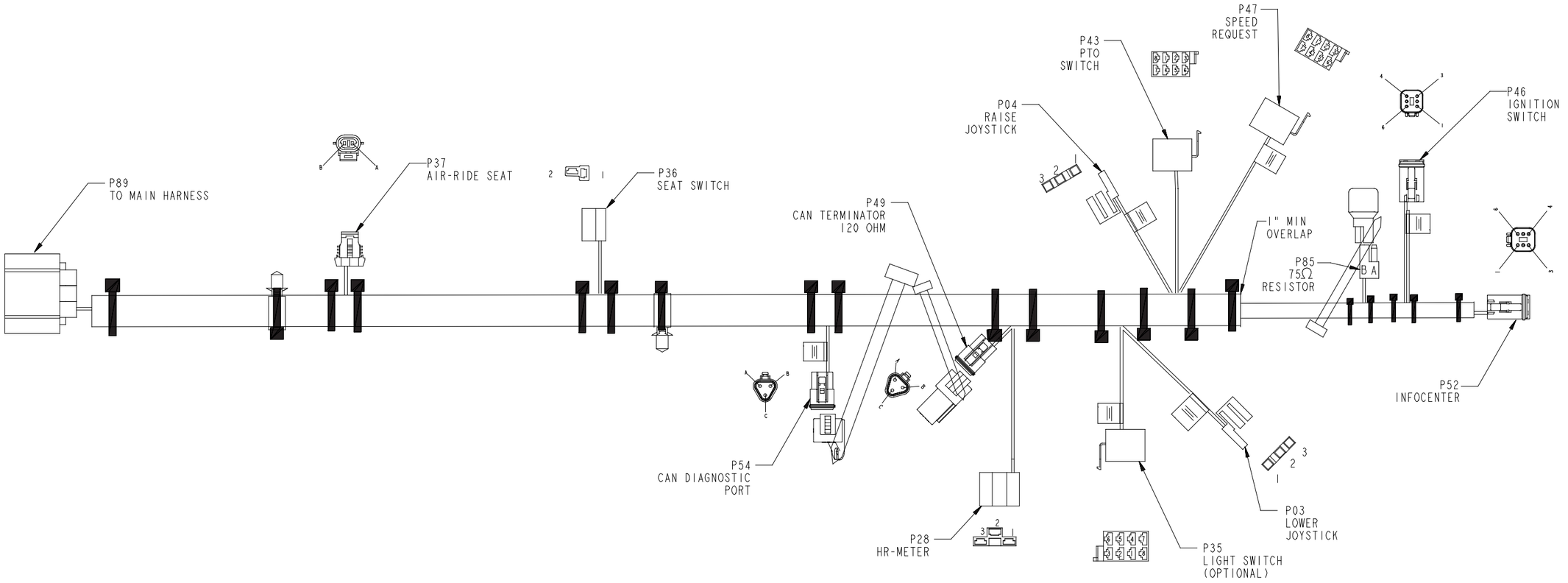
Reelmaster 7000-D

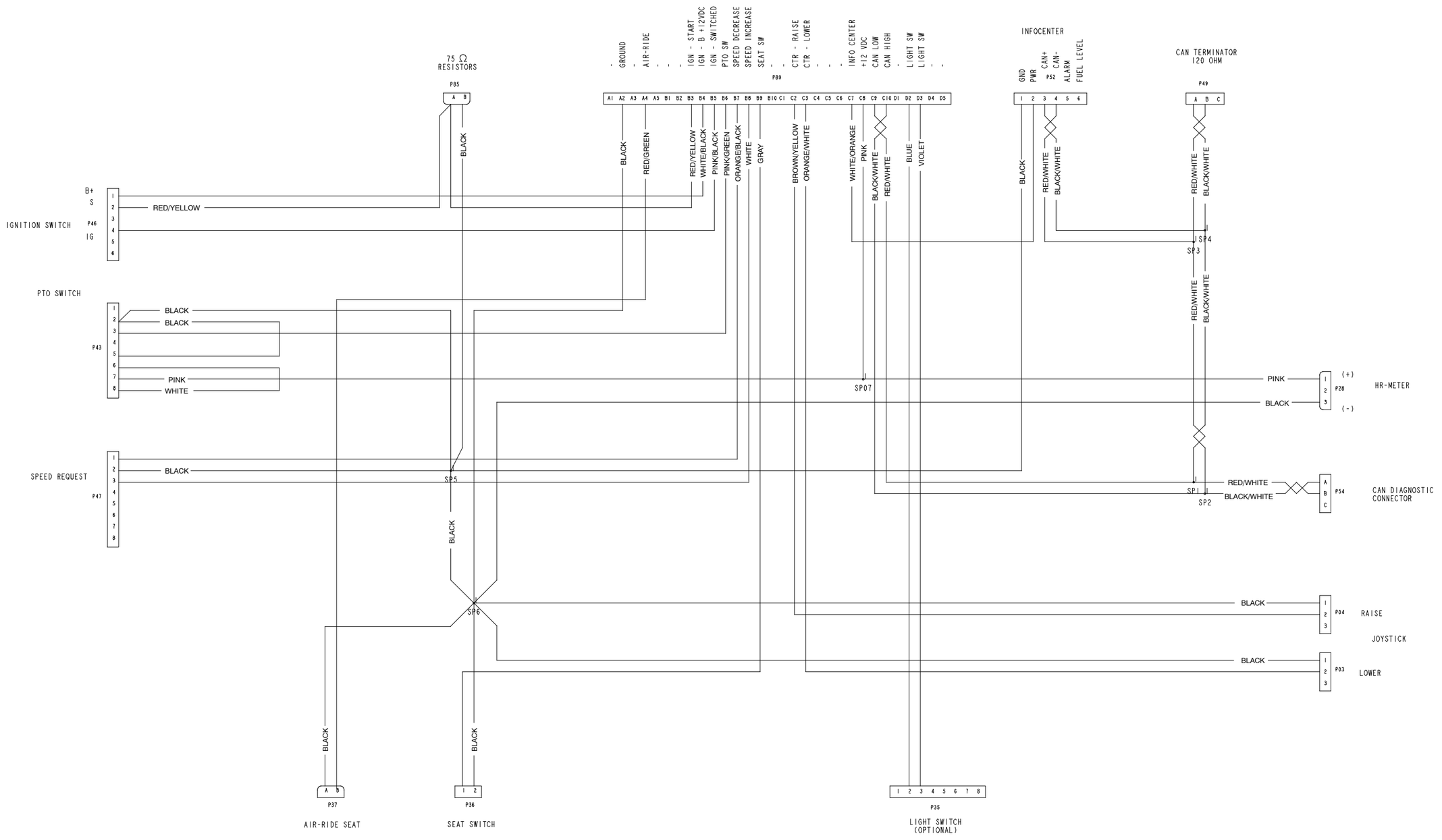
Engine Wire Harness Diagram

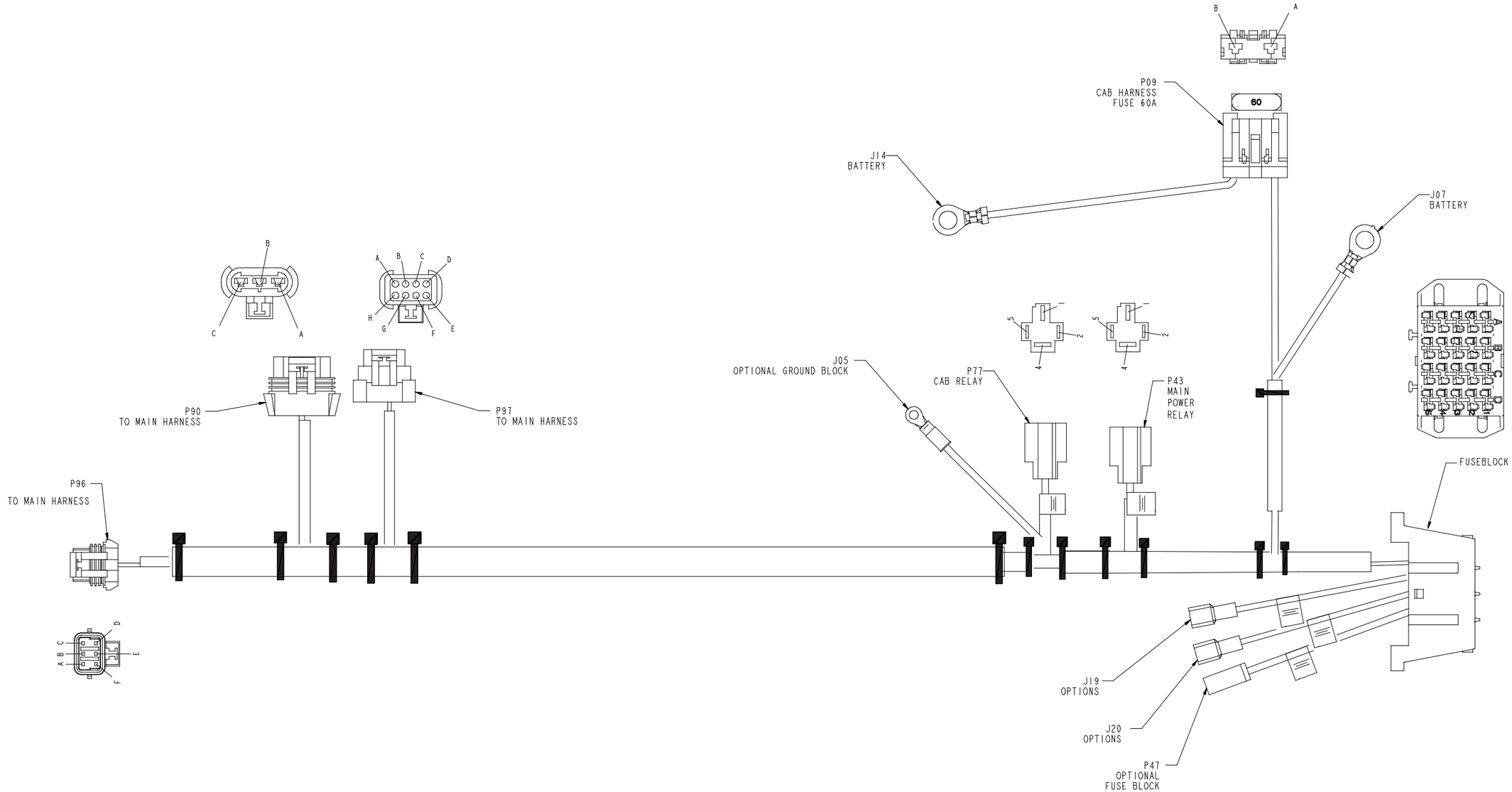
Model 03780 - Yanmar Engine


P08
START
RELAY
P06
GLOW
RELAY
J05
GLOW
PLUGS
J08
ENGINE
GROUND
P07
STARTER
SOL.
P11
ALT.
2
1
P02
FUEL
SOLENOID
P04
CAN TERMINATOR
120 OHM
P18
MAIN HARNESS
INTERCONNECT
P23
J03
OIL
PRESSURE
P01
STARTER
M+
P10
DIODE
P22
STARTER
B+
P13
TEMP
SENDER


ALT.
P11
L
DIODE
P10
STARTER SOL.
P07
START RELAY
P08
ENGINE GROUND
J08
STARTER M+
P01
FUEL SOLENOID
P02
GLOW PLUGS
J05
BLACK
BLUE
BLUE
BLACK
BLACK
WHITE
W11 18FL
SP01
SP02
STARTER B+ P22
ORANGE
RED
OIL PRESSURE J03
MAIN HARNESS INTERCONNECT
P23
BLUE
GRAY/BROWN
WHITE
GREEN/WHITE
BROWN/YELLOW
GLOW
ENGINE TEMP
ALT "L"
OIL PRESS
-
A_GND
BROWN/BLACK
RED/BLACK
RED/WHITE
BLACK/WHITE
PINK/BLACK
ENGINE START
ENGINE RUN
CAN H
CAN L
ENGINE ECU PWR
KEY RUN
-
P18
ORANGE
BLACK
P13
TEMP SENDER
P04
CAN TERMINATOR
120 OHM
P06
GLOW RELAY


P89
TO MAIN HARNESS
P37
AIR-RIDE SEAT
P36
SEAT SWITCH
P49
CAN TERMINATOR
120 OHM
P04
RAISE
JOYSTICK
P43
PTO
SWITCH
P47
SPEED
REQUEST
P46
IGNITION
SWITCH
1" MIN
OVERLAP
P85
75Ω
RESISTOR
P52
INFOCENTER
P54
CAN DIAGNOSTIC
PORT
P28
HR-METER
P03
LOWER
JOYSTICK
P35
LIGHT SWITCH
(OPTIONAL)


75 Ω RESISTORS
P85
A B
BLACK
P89
A1 A2 A3 A4 A5 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 C1 C2 C3 C4 C5 C6 C7 C8 C9 C10 D1 D2 D3 D4 D5
- GROUND - AIR-RIDE - - - IGN - START IGN - B +12VDC IGN - SWITCHED PTO SW SPEED DECREASE SPEED INCREASE SEAT SW - - CTR - RAISE CTR - LOWER - - - INFO CENTER +12 VDC CAN LOW CAN HIGH - LIGHT SW LIGHT SW - -
BLACK
RED/GREEN
RED/YELLOW
WHITE/BLACK
PINK/BLACK
PINK/GREEN
ORANGE/BLACK
WHITE
GRAY
BROWN/YELLOW
ORANGE/WHITE
WHITE/ORANGE
PINK
BLACK/WHITE
RED/WHITE
BLUE
VIOLET
INFOCENTER
GND
PWR
CAN+
CAN-
ALARM
FUEL LEVEL
P52
1 2 3 4 5 6
BLACK
RED/WHITE
BLACK/WHITE
CAN TERMINATOR
120 OHM
P49
A B C
RED/WHITE
BLACK/WHITE
SP4
SP3
B+
S
IGNITION SWITCH
P46
IG
1 2 3 4 5 6
RED/YELLOW
PTO SWITCH
P43
1 2 3 4 5 6 7 8
BLACK
BLACK
PINK
WHITE
SP07
PINK
BLACK
P28
1 2 3
(+)
(-)
HR-METER
SPEED REQUEST
P47
1 2 3 4 5 6 7 8
BLACK
SP5
BLACK
SP6
SP1
SP2
RED/WHITE
BLACK/WHITE
P54
A B C
CAN DIAGNOSTIC CONNECTOR
BLACK
P04
1 2 3
RAISE
JOYSTICK
BLACK
P03
1 2 3
LOWER
BLACK
BLACK
A B
P37
AIR-RIDE SEAT
1 2
P36
SEAT SWITCH
1 2 3 4 5 6 7 8
P35
LIGHT SWITCH
(OPTIONAL)

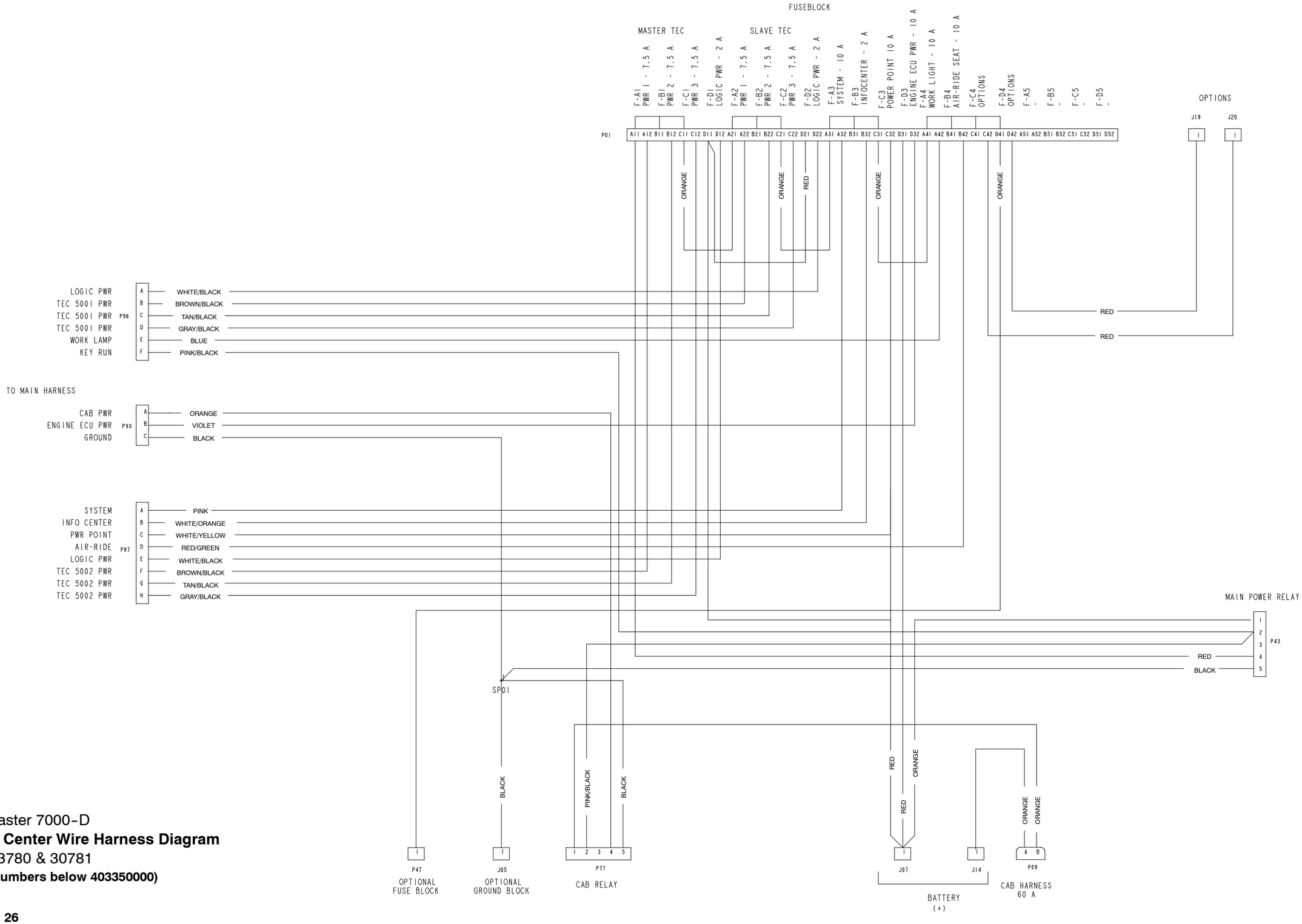


Reelmaster 7000-D

Power Center Wire Harness Drawing

Model 03780 & 30781

(Serial numbers below 403350000

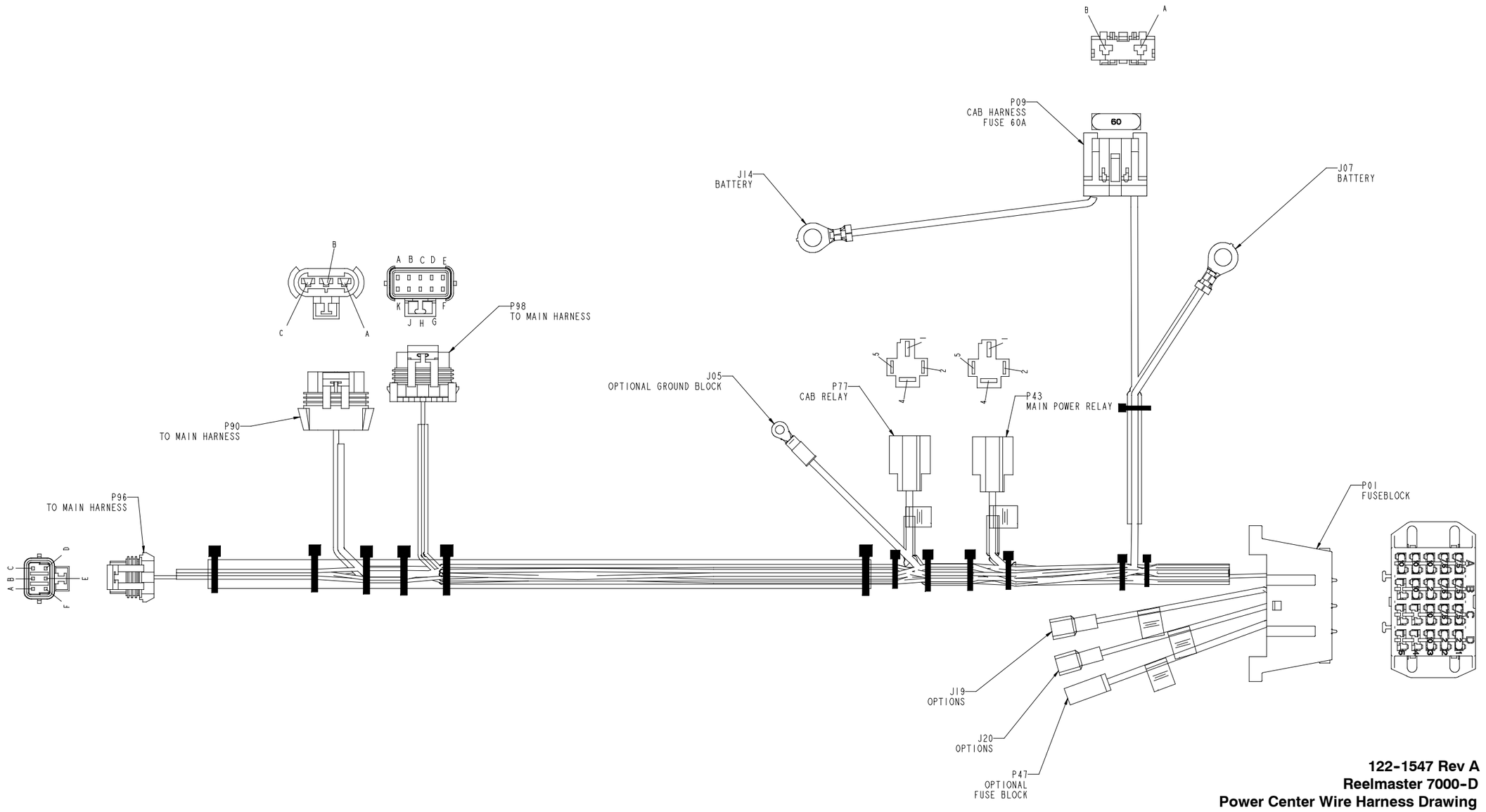


Reelmaster 7000-D

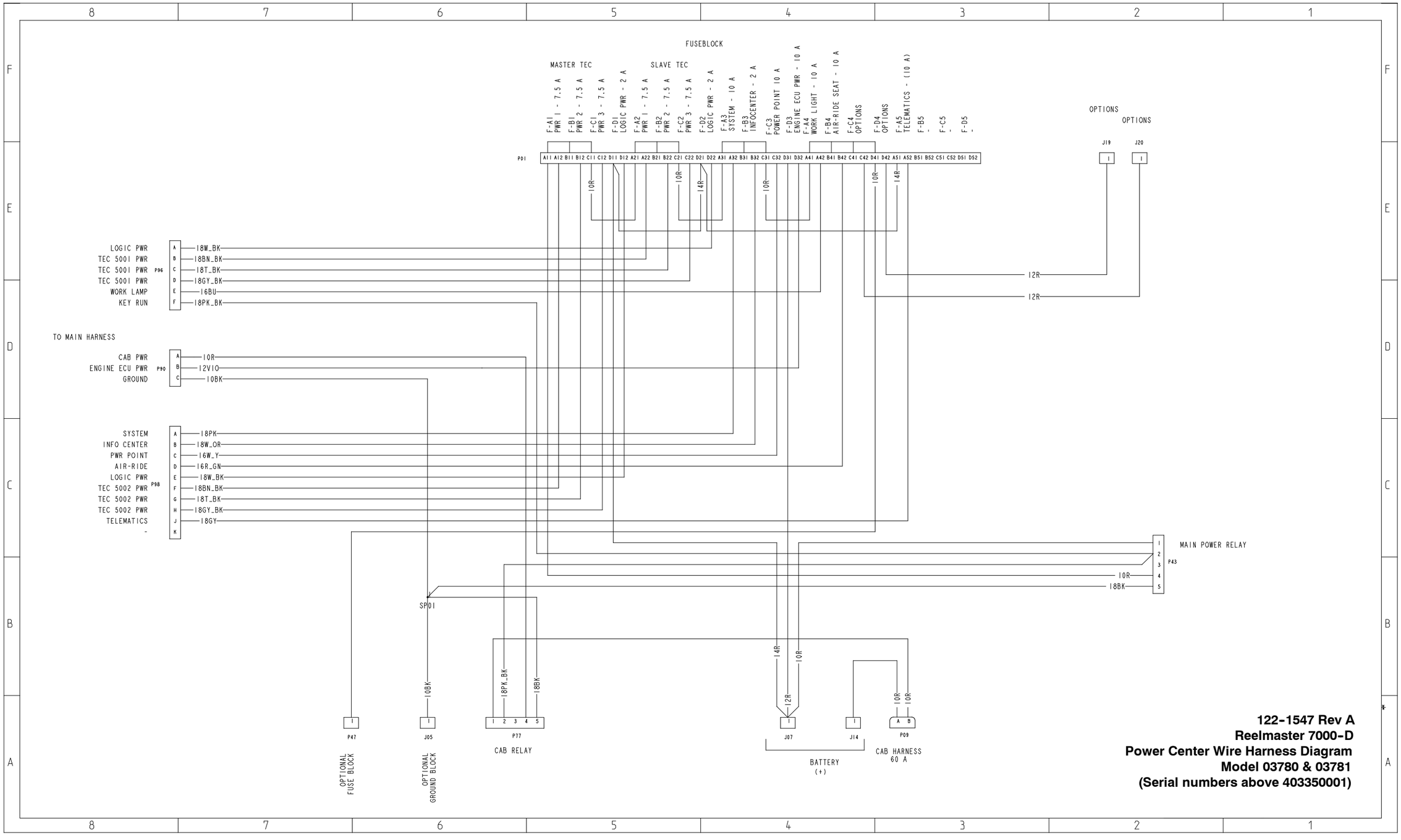
Power Center Wire Harness Diagram

Model 03780 & 30781

(Serial numbers below 403350000)



122-1547 Rev A
Reelmaster 7000-D
Power Center Wire Harness Drawing
Model 03780 & 03781
(Serial numbers above 403350001)


FUSEBLOCK
MASTER TEC
SLAVE TEC
F-A1 PWR 1 - 7.5 A
F-B1 PWR 2 - 7.5 A
F-C1 PWR 3 - 7.5 A
F-D1 LOGIC PWR - 2 A
F-A2 PWR 1 - 7.5 A
F-B2 PWR 2 - 7.5 A
F-C2 PWR 3 - 7.5 A
F-D2 LOGIC PWR - 2 A
F-A3 SYSTEM - 10 A
F-B3 INFOCENTER - 2 A
F-C3 POWER POINT 10 A
F-D3 ENGINE ECU PWR - 10 A
F-A4 WORK LIGHT - 10 A
F-B4 AIR-RIDE SEAT - 10 A
F-C4 OPTIONS
F-D4 OPTIONS
F-A5 TELEMATICS - (10 A)
F-B5 -
F-C5 -
F-D5 -
P01
OPTIONS
OPTIONS
J19
J20
10R
14R
12R
LOGIC PWR
TEC 5001 PWR
TEC 5001 PWR
TEC 5001 PWR
WORK LAMP
KEY RUN
P96
18W_BK
18BN_BK
18T_BK
18GY_BK
16BU
18PK_BK
TO MAIN HARNESS
CAB PWR
ENGINE ECU PWR
GROUND
P90
10R
12V10
10BK
SYSTEM
INFO CENTER
PWR POINT
AIR-RIDE
LOGIC PWR
TEC 5002 PWR
TEC 5002 PWR
TEC 5002 PWR
TELEMATICS
P98
18PK
18W_OR
16W_Y
16R_GN
18W_BK
18BN_BK
18T_BK
18GY_BK
18GY
MAIN POWER RELAY
P43
10R
18BK
SP01
10BK
18PK_BK
18BK
P47
J05
P77
CAB RELAY
OPTIONAL FUSE BLOCK
OPTIONAL GROUND BLOCK
14R
10R
12R
J07
J14
P09
BATTERY (+)
CAB HARNESS 60 A
122-1547 Rev A
Reelmaster 7000-D
Power Center Wire Harness Diagram
Model 03780 & 03781
(Serial numbers above 403350001)