Service & Maintenance Manual

Model

330CRT
400CRT

3121804

April 7, 2004

SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A.A GENERAL

This section contains the general safety precautions which must be observed during maintenance of the aerial platform. It is of utmost importance that maintenance personnel pay strict attention to these warnings and precautions to avoid possible injury to themselves or others, or damage to the equipment. A maintenance program must be followed to ensure that the machine is safe to operate.

⚠ WARNING

MODIFICATION OF THE MACHINE WITHOUT CERTIFICATION BY A RESPONSIBLE AUTHORITY THAT THE MACHINE IS AT LEAST AS SAFE AS ORIGINALLY MANUFACTURED, IS A SAFETY VIOLATION.

The specific precautions to be observed during maintenance are inserted at the appropriate point in the manual. These precautions are, for the most part, those that apply when servicing hydraulic and larger machine component parts.

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

⚠ WARNING

SINCE THE MACHINE MANUFACTURER HAS NO DIRECT CONTROL OVER THE FIELD INSPECTION AND MAINTENANCE, SAFETY IN THIS AREA RESPONSIBILITY OF THE OWNER/OPERATOR.

A.B HYDRAULIC SYSTEM SAFETY

It should be noted that the machines hydraulic systems operate at extremely high potentially dangerous pressures. Every effort should be made to relieve any system pressure prior to disconnecting or removing any portion of the system.

Relieve system pressure by cycling the applicable control several times with the engine stopped and ignition on, to direct any line pressure back into the reservoir. Pressure feed lines to system components can then be disconnected with minimal fluid loss.

A.C MAINTENANCE

⚠ WARNING

FAILURE TO COMPLY WITH SAFETY PRECAUTIONS LISTED IN THIS SECTION MAY RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- NO SMOKING IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.
- REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.
- DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.
- OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.
- KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.
- USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.
- NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFELY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.
- BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.
- BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.
- KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE.
- USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

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TABLE OF CONTENTS

SUBJECT - SECTION, PARAGRAPH **PAGE NO.**

LIST OF FIGURES

LIST OF TABLES

This page left blank intentionally.

SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Hydraulic Oil Tank

Approximately 60.6 liters (16 U.S. gallons) w/15% air space

Hydraulic System (Including Tank)

Approximately 75.7 liters (20 U.S. gallons)

Fuel Tank

Approximately 48.8 liters (13 U.S. gallons)

Engine Crankcase

Gasoline Engine

3.2 liters (3.4 quarts) w/filter

2.7 liters (2.9 quarts) w/o filter

Diesel Engine

5.1 liters (5.4 quarts) w/filter

4.6 liters (4.9 quarts) w/o filter

Coolant Capacity

13.2 liters (3.5 U.S. gallons)

1.2 COMPONENT DATA

Gasoline Engine

Manufacturer - Kubota 750 Dual Fuel

Displacement - 750 cc

Low RPM - 2200

High RPM - 3600

Alternator - 40 Amp external

Battery - 85 Amphour, 700 cold cranking amps @ -17.8°C (0° F)

Fuel Consumption

Low RPM - 4.9 lph (1.3 gph)

High RPM - 9 lph (2.4 gph)

Horsepower - 24.5 @ 3600 RPM

Diesel Engine

Manufacturer - Kubota 1105

Low RPM - 1500

High RPM - 3000

Alternator - 40 Amp

Battery - 85 Amphour, 700 cold cranking amps @ -17.8°C (0° F)

Fuel Consumption

Low RPM - 3.5 lph (.93 gph)

High RPM - 6.6 lph (1.7 gph)

21 kW @ 3000 RPM (28 Horsepower @ 3000 RPM)

Drive/Steer System

Toe-In - Adjust to 12.7 mm (1/2 inch) overall

Drive Motor Displacement- 400 cc

Drive Brake - Spring applied, hydraulic release, release pressure - 20.7 bar (300 psi) max.

Hydraulic Filter - Full flow paper (Cartridge type)

10 Microns Nominal

Tires

Standard 30.4 x 10 loader pneumatic or foam filled

NOTE: *Inflate pnuematic tire to 3.1 bar (45 psi)*

1.3 PERFORMANCE DATA

Travel Speed

High drive - 5.6 kmh (3.5 mph)

Gradeability

35%

Turning Radius (Inside)

7 ft. (2 m)

Lift Speed

Lift up - 330CRT - 36-40 seconds

400CRT - 53-55 seconds

Lift down - 330CRT - 36-40 seconds

400CRT - 49-51 seconds

Platform Capacity

330CRT - 450 kg (1,000 lb.)

400 CRT - 360 kg (800 lb.)

Platform Extension Capacity

All Models - 120 kg (250 lb)

Machine Weight

330CRT - Approx. 4,409 kg (9,720 lb.)

440CRT - Approx. 5,601 kg (12,348 lb.)

Machine Platform Height (Fully Extended)

330 CRT - 10 m (33 ft.)

400 CRT - 12 m (40 ft.)

Machine Platform Height (Platform Lowered)

330 CRT - 1.7 m (66.5 in.)

400 CRT - 1.7 m (68.25 in.)

Machine Length

3 m (10 ft. 2 in.)

Machine Width

1.8 m (69 in.)

1.4 TORQUE REQUIREMENTS

All wheel lugs must be torqued at 142 Nm (105 ft lb) every 50 hours.

1.5 LUBRICATION

Table 1-1. Hydraulic Oil

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
0 to +23 degrees F (-18 to -5 degrees C)	10W
0 to +210 degrees F (-18 to +100 degrees C)	10W-20,10W-30
+50 to +210 degrees F (+10 to +100 degrees C)	20W-20

NOTE: *Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity index of152.*

NOTE: *Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Mobilfluid 424 is desired, contact JLG Industries for proper recommendations.*

Lubrication Specifications

Table 1-2. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350 degrees F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105.
EO	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/ MIL-L-2104C.
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobil 424.

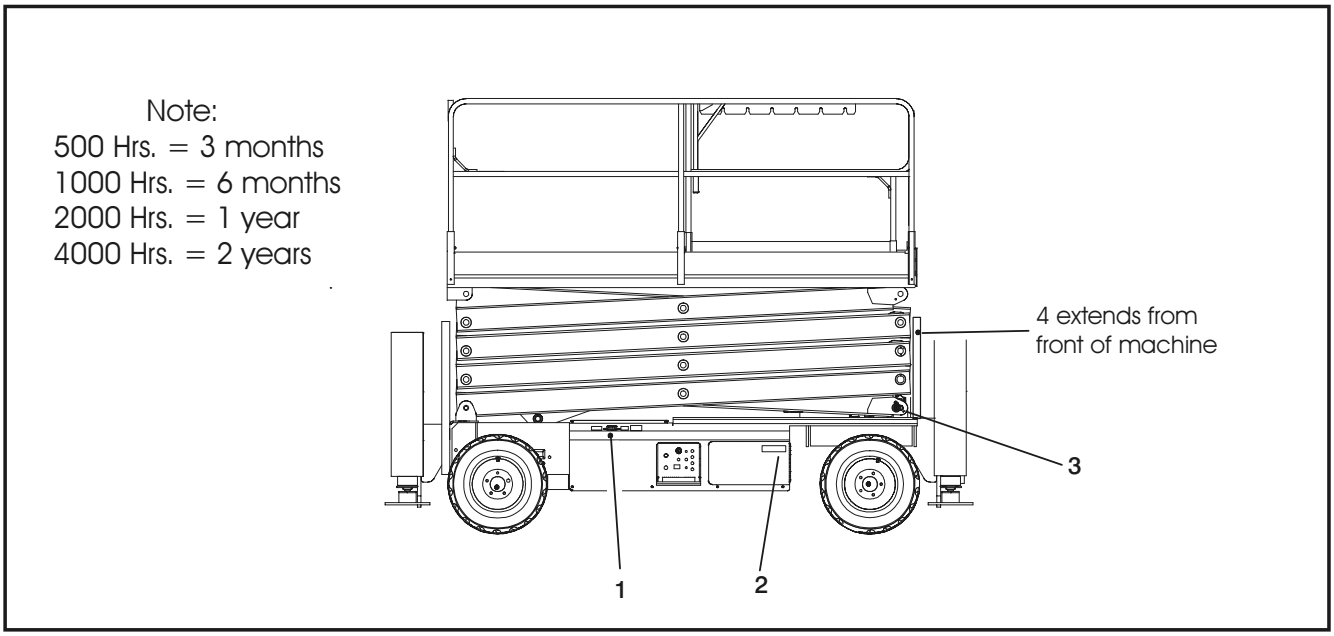

Figure 1-1. Lubrication Diagram

Table 1-3. Lubrication Chart

INDEX NO	COMPONENT	NUMBER/TYPE LUBE POINTS	LUBE METHOD	INTERVAL HOURS
1	Hydraulic Oil Reservoir	Fill Cap/Drain Plug	HO - Check HO Level HO - Change HO	10/500
2	Hydraulic Filter Element	N/A	Initial Change - 50 Hours	250
3	Rail Slides	N/A	MPG - Brush	100
4	Engine Crankcase	Fill Cap/Drain Plug	Check Engine Oil Level	10/100
5	*Slide Blocks	Upper and Lower	MPG	100

***** Item 5 not shown on illustration. Item 5 pertains to items throughout the machine.

KEY TO LUBRICANTS:

MPG - Multi-purpose Grease

EPGL - Extreme Pressure Gear Lube

HO - Hydraulic Oil (Mobil 424)

⚠ WARNING

TO AVOID PERSONAL INJURY, USE SAFETY PROP FOR ALL MAINTENANCE REQUIRING PLATFORM TO BE ELEVATED.

NOTE: *Be sure to lubricate like items on each side*

NOTE: *Recommended lubricating intervals are based on machine operations under normal conditions. For machines used in multi-shift operations and/or exposed to hostile environments or conditions, lubrication frequencies must be increased accordingly.*

Operate hydraulic functions through one complete cycle before checking hydraulic oil level in tank. Oil should be visible in ADD sight window on hydraulic tank. If oil is not visible, add oil until oil is visible in both ADD and FULL sight windows on tank. Do not overfill tank.

Any time the pump coupling is removed, coat splines of coupling with Texaco Code 1912 grease prior to assembly.

SIZE	THD	BOLT DIA. (IN.)	THREAD STRESS AREA (SQ. IN.)	VALUES FOR ZINC PLATED BOLTS ONLY										UNPLATED CAP SCREWS	
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS					UNBRAKO 1960 SERIES SOCKET HEAD CAP SCREW WITH LOC-WEL PATCH	
				CLAMP LOAD (LB.)	TORQUE				CLAMP LOAD (LB.)	TORQUE				CLAMP LOAD (LB.)	TORQUE (as received)
					(DRY OR LOC. 263)	(LUB.)	(LOCTITE 262)	(LOCTITE 242 OR 271)		(DRY OR LOC. 263)	(LUB.)	(LOCTITE 262)	(LOCTITE 242 OR 271)		
					LB. IN.	LB. IN.	LB. IN.	LB. IN.		LB. IN.	LB. IN.	LB. IN.	LB. IN.		LB. FT.
4	40	0.1120	0.00604	380	8	6	—	—	540	12	9	—	—	—	—
	48		0.00661	420	9	7	—	—	600	13	10	—	—	—	—
6	32	0.1380	0.00909	580	16	12	—	—	820	23	17	—	—	—	—
	40		0.01015	610	18	13	—	—	920	25	19	—	—	—	—
8	32	0.1640	0.01400	900	30	22	—	—	1260	41	31	—	—	—	—
	36		0.01474	940	31	23	—	—	1320	43	32	—	—	—	—
10	24	0.1900	0.01750	1120	43	32	—	—	1580	60	45	—	—	—	—
	32		0.02000	1285	49	36	—	—	1800	68	51	—	—	—	—
1/4	20	0.2500	0.0318	2020	96	75	—	105	2860	144	108	—	160	3180	13
	28		0.0364	2320	120	86	—	135	3280	168	120	—	185	3640	14
					LB. FT.	LB. FT.	LB. FT.	LB. FT.		LB. FT.	LB. FT.	LB. FT.	LB. FT.		
5/16	18	0.3125	0.0524	3340	17	13	16	19	4720	25	18	22	30	5240	25
	24		0.0580	3700	19	14	17	21	5220	25	20	25	30	5800	27
3/8	16	0.3750	0.0775	4940	30	23	28	35	7000	45	35	40	50	7750	45
	24		0.0878	5600	35	25	32	40	7900	50	35	45	55	8780	50
7/16	14	0.4375	0.1063	6800	50	35	45	55	9550	70	55	63	80	10630	70
	20		0.1187	7550	55	40	50	60	10700	80	60	70	90	11870	75
1/2	13	0.5000	0.1419	9050	75	55	68	85	12750	110	80	96	120	14190	110
	20		0.1599	10700	90	65	80	100	14400	120	90	108	135	15990	115
9/16	12	0.5625	0.1820	11600	110	80	98	120	16400	150	110	139	165	18200	155
	18		0.2030	12950	120	90	109	135	18250	170	130	154	190	20300	165
5/8	11	0.6250	0.2260	14400	150	110	135	165	20350	220	170	180	240	22600	210
	18		0.2560	16300	170	130	153	190	23000	240	180	204	265	25600	220
3/4	10	0.7500	0.3340	21300	260	200	240	285	30100	380	280	301	420	33400	365
	16		0.3730	23800	300	220	268	330	33600	420	320	336	465	37300	400
7/8	9	0.8750	0.4620	29400	430	320	386	475	41600	600	460	485	660	46200	585
	14		0.5090	32400	470	350	425	520	45800	660	500	534	725	50900	635
1	8	1.000	0.6060	38600	640	480	579	675	51500	900	680	687	990	60600	865
	12		0.6630	42200	700	530	633	735	59700	1000	740	796	1100	66300	915
1-1/8	7	1.1250	0.7630	42300	800	600	714	840	68700	1280	960	1030	1400	76300	1240
	12		0.8560	47500	880	660	802	925	77000	1440	1080	1155	1575	85600	1380
1-1/4	7	1.2500	0.9690	53800	1120	840	1009	1175	87200	1820	1360	1453	2000	96900	1750
	12		1.0730	59600	1240	920	1118	1300	96600	2000	1500	1610	2200	107300	1880
1-1/2	6	1.500	1.1550	64100	1460	1100	1322	1525	104000	2380	1780	1907	2625	115500	2320
	12		1.3150	73000	1680	1260	1506	1750	118100	2720	2040	2165	3000	131500	2440
1-1/2	6	1.500	1.4050	78000	1940	1460	1755	2025	126500	3160	2360	2530	3475	140500	3040
	12		1.5800	87700	2200	1640	1974	2300	142200	3560	2660	2844	3925	158000	3270

Note: These torque values do not apply to cadium plated fasteners.

SAE GRADE 5

SAE GRADE 8

Figure 1-1. Torque Chart

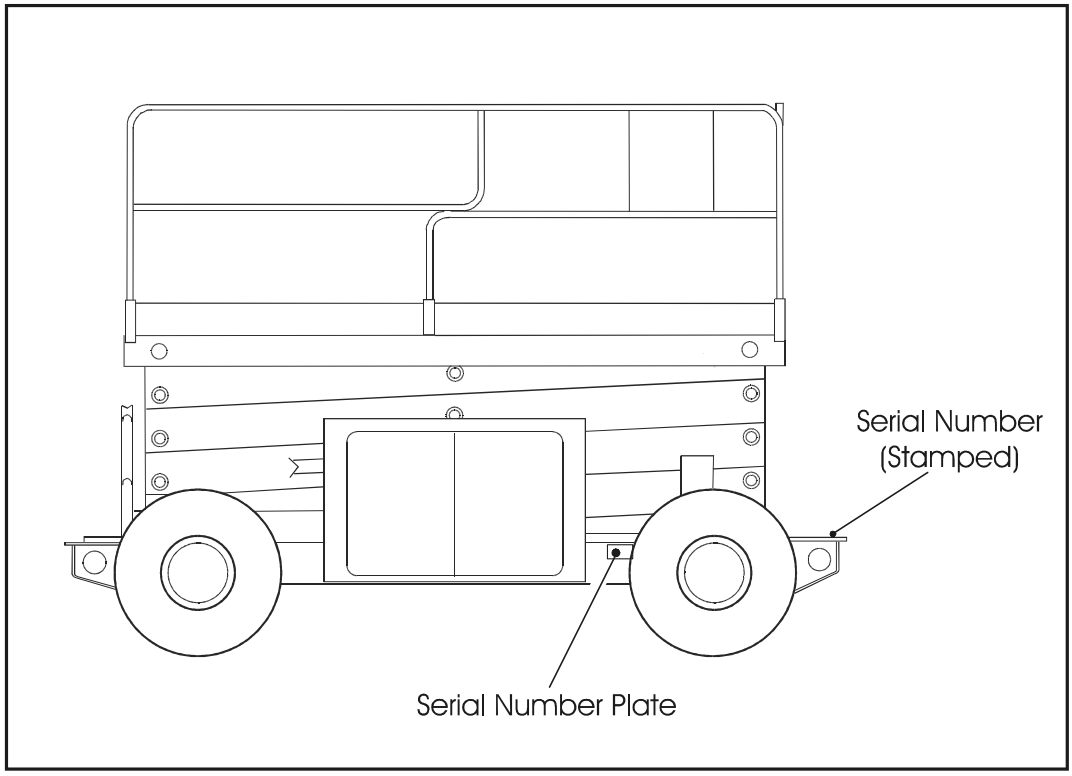

Figure 1-2. Serial Number Location

1.6 PRESSURE SETTINGS

Main Relief - 228 bar ± 3.4 bar (3300 psi ± 50 psi)

Steer Relief (Left) - max 179 bar (2600 psi)

Steer Relief (Right) - max 110 bar (1600 psi)

Lift Pressure - 330CRT - 159 bar (2300 psi)

400CRT - 172 bar (2500 psi)

Leveling Jacks Valve (If Equipped) - 83 bar (1200 psi)

1.7 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The plate is located on the leftt side of the machine between the fuel tank and the rear wheel. In addition, should the serial number plate be damaged or missing, the machine serial number is stamped on the top of frame between the front wheels.

1.8 LIMIT SWITCHES

The machine is equipped with the following limit switches:

High Drive Speed Cut-Out - High drive speed is cut out when platform is raised above stowed (fully lowered) position.

Tilt Alarm - 3° - A horn is sounded and a warning light is illuminated when the machine is operated on a slope that exceeds 3° with the platform raised. If the machine is operated on a 3° slope with the platform completely lowered, only the warning light is illuminated.

Drive Cut-Out (400CRT only) - Drive function is cut-out when the machine reaches a preset height of 9.1 m. (30 ft).

1.9 CYLINDER SPECIFICATIONS

NOTE: All dimensions are given in inches (in), with the metric equivalent, centimeters (cm), in parentheses.

Table 1-4. Cylinder Specifications

Description	Bore	Stroke	Rod Dia
Lift Cylinder (330CRT)	4.0 (10.2)	63.7 (161.8)	2.75 (7.0)
Upper Lift Cylinder (400CRT)	3.0 (7.62)	58.1 (147.6)	2.75 (7.0)
Lower Lift Cylinder (400CRT)	4.0 (10.2)	58.1 (147.6)	2.75 (7.0)
Lockout Cylinder (Oscillating Axle)	3.0 (7.6)	3.75 (9.5)	1.25 (3.2)
Leveling Jack Cylinder	2.0 (5.1)	14.0 (35.6)	1.25 (3.2)
Steer Cylinder	2.5 (6.4)	7.1 (18.1)	1.25 (3.2)

1.10 MAJOR COMPONENT WEIGHTS

Table 1-5. Major Component Weights

Component	Lb	Kg
Fixed Platform	569	258
Platform Extension	230	104
Arm Assembly- 330CRT (Includes Lift Cylinder)	3200	1452
Arm Assembly- 400CRT (Includes Lift Cylinder)	3900	1769
Chassis with Foam Filled Tires	4980	2259

1.11 CRITICAL STABILITY WEIGHTS

⚠ WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION (FOR EXAMPLE: FILLED TIRES, ENGINE) DO NOT MODIFY UNIT IN ANY WAY TO AFFECT STABILITY.

Table 1-6. Critical Stability Weights

Component	Lb	Kg
Tires (Balasted Only)	246	111
Engine (Gas)	136	62
Engine (Diesel)	93	42

SECTION 2. PROCEDURES

2.1 GENERAL

This section provides information necessary to perform maintenance on the scissor lift. Descriptions, techniques and specific procedures are designed to provide the safest and most efficient maintenance for use by personnel responsible for ensuring the correct installation and operation of machine components and systems.

⚠ CAUTION

WHEN AN ABNORMAL CONDITION IS NOTED AND PROCEDURES CONTAINED HEREIN DO NOT SPECIFICALLY RELATE TO THE NOTED IRREGULARITY, WORK SHOULD BE STOPPED AND TECHNICALLY QUALIFIED GUIDANCE OBTAINED BEFORE WORK IS RESUMED.

The maintenance procedures included consist of servicing and component removal and installation, disassembly and assembly, inspection, lubrication and cleaning. Information on any special tools or test equipment is also provided where applicable.

2.2 SERVICING AND MAINTENANCE GUIDELINES

General

The following information is provided to assist you in the use and application of servicing and maintenance procedures contained in this chapter.

Safety and Workmanship

Your safety, and that of others, is the first consideration when engaging in the maintenance of equipment. Always be conscious of weight. Never attempt to move heavy parts without the aid of a mechanical device. Do not allow heavy objects to rest in an unstable position. When raising a portion of the equipment, ensure that adequate support is provided.

Cleanliness

1. The most important single item in preserving the long service life of a machine is to keep dirt and foreign materials out of the vital components. Precautions have been taken to safeguard against this. Shields, covers, seals, and filters are provided to keep air, fuel, and oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.
2. At any time when air, fuel, or oil lines are disconnected, clear adjacent areas as well as the openings and fittings themselves. As soon as a line or component is disconnected, cap or cover all openings to prevent entry of foreign matter.
3. Clean and inspect all parts during servicing or maintenance, and assure that all passages and openings are unobstructed. Cover all parts to keep them clean. Be sure all parts are clean before they are installed. New parts should remain in their containers until they are ready to be used.

Components Removal and Installation

4. Use adjustable lifting devices, whenever possible, if mechanical assistance is required. All slings (chains, cables, etc.) should be parallel to each other and as near perpendicular as possible to top of part being lifted.
5. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eyebolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90°.
6. If a part resists removal, check to see whether all nuts, bolts, cables, brackets, wiring, etc., have been removed and that no adjacent parts are interfering.

Component Disassembly and Reassembly

When disassembling or reassembling a component, complete the procedural steps in sequence. Do not partially disassemble or assemble one part, then start on another. Always recheck your work to assure that nothing has been overlooked. Do not make any adjustments, other than those recommended, without obtaining proper approval.

Pressure-Fit Parts

When assembling pressure-fit parts, use an “anti-seize” or molybdenum disulfide base compound to lubricate the mating surface.

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.

3. If a bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.

4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

Gaskets

Check that holes in gaskets align with openings in the mating parts. If it becomes necessary to hand-fabricate a gasket, use gasket material or stock of equivalent material and thickness. Be sure to cut holes in the right location, as blank gaskets can cause serious system damage.

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.

2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices.

Hydraulic Lines and Electrical Wiring

Clearly mark or tag hydraulic lines and electrical wiring, as well as their receptacles, when disconnecting or removing them from the unit. This will assure that they are correctly reinstalled.

Hydraulic System

1. Keep the system clean. If evidence of metal or rubber particles is found in the hydraulic system, drain and flush the entire system.

2. Disassemble and reassemble parts on clean work surface. Clean all metal parts with non-flammable cleaning solvent. Lubricate components, as required, to aid assembly.

Lubrication

Service applicable components with the amount, type, and grade of lubricant recommended in this manual, at the specified intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

Batteries

Clean batteries, using a non-metallic brush and a solution of baking soda and water. Rinse with clean water. After cleaning, thoroughly dry batteries and coat terminals with an anti-corrosion compound.

Lubrication and Servicing

Components and assemblies requiring lubrication and servicing are shown in Section 1.

2.3 LUBRICATION INFORMATION

Hydraulic System

1. The primary enemy of a hydraulic system is contamination. Contaminants enter the system by various means, e.g., using inadequate hydraulic oil, allowing moisture, grease, filings, sealing components, sand, etc., to enter when performing maintenance, or by permitting the pump to cavitate due to insufficient system warm-up or leaks in the pump supply (suction) lines.

2. The design and manufacturing tolerances of the component working parts are very close, therefore, even the smallest amount of dirt or foreign matter entering a system can cause wear or damage to the components and generally results in faulty operation. Every precaution must be taken to keep hydraulic oil clean, including reserve oil in storage. Hydraulic system filters should be checked, cleaned, and/or replaced as necessary, at the specified intervals required in the Lubrication Chart in Section 1 and the Preventive Maintenance and Inspection Chart in this section. Always examine filters for evidence of metal particles.

3. Cloudy oils indicate a high moisture content which permits organic growth, resulting in oxidation or corrosion. If this condition occurs, the system must be drained, flushed, and refilled with clean oil.

4. It is not advisable to mix oils of different brands or types, except as recommended, as they may not contain the same required additives or be of comparable viscosities. Good grade mineral oils, with viscosities suited to the ambient temperatures in which the machine is operating, are recommended for use.

NOTE: *Metal particles may appear in the oil or filters of new machines due to the wear-in of meshing components.*

Hydraulic Oil

1. Refer to Section1 for recommendations for viscosity ranges.

2. JLG recommends Mobilfluid 424, which has an SAE viscosity of 10W-30 and a viscosity index of 152.

NOTE: *Start-up of hydraulic system with oil temperatures below -26°C (-15°F). is not recommended. If it is necessary to start the system in a sub-zero environment, it will be necessary to heat the oil with a low density, 100VAC heater to a minimum temperature of -26°C (-15°F).*

3. The only exception to the above is to drain and fill the system with Mobil DTE 11 oil or its equivalent. This will allow start up at temperatures down to -29° C (-20°F). However, use of this oil will give poor performance at temperatures above 49°C (120°F). Systems using DTE 11 oil should not be operated at temperatures above 94°C (200°F). under any condition.

Changing Hydraulic Oil

1. Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 50 hours of operation and every 300 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils. JLG Industries recommends changing the hydraulic oil every two years.

2. Use every precaution to keep the hydraulic oil clean. If the oil must be poured from the original container into another, be sure to clean all possible contaminants from the service container. Always clean the mesh element of the filter and replace the cartridge any time the system oil is changed.

3. While the unit is shut down, a good preventive maintenance measure is to make a thorough inspection of all hydraulic components, lines, fittings, etc., as well as a functional check of each system, before placing the machine back in service.

Lubrication Specifications

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise regarding the use of greases in maintenance stock, consult your local supplier for evaluation.

2.4 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. The Lift and Steer systems incorporate double acting cylinders. A double acting cylinder is one that requires oil flow to operate the cylinder rod in both directions. Directing oil (by actuating the corresponding control valve to the piston side of the cylinder) forces the piston to travel toward the rod end of the barrel, extending the cylinder rod (piston attached to rod). When the oil flow is stopped, movement of the rod will stop. By directing oil to the rod side of the cylinder, the piston will be forced in the opposite direction and the cylinder rod will retract.

A holding valve is used in the Lift circuit to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

2.5 VALVES - THEORY OF OPERATION

Solenoid Control Valves (Bang-Bang)

Control valves used are four-way three-position solenoid valves of the sliding spool design. When a circuit is activated and the control valve solenoid energizes, the spool is shifted and the corresponding work port opens to permit oil flow to the component in the selected circuit, with the opposite work port opening to reservoir. Once the circuit is deactivated (control returned to neutral), the valve spool returns to neutral (center) and oil flow is then directed through the valve body and returns to reservoir. A typical control valve consists of the valve body, sliding spool, and two solenoid assemblies. The spool is machine fitted in the bore of the valve body. Lands on the spool divide the bore into various chambers, which, when the spool is shifted, align with corresponding ports in the valve body open to common flow. At the same time other ports would be blocked to flow. The spool is spring-loaded to center position, therefore when the control is released, the spool automatically returns to neutral, prohibiting any flow through the circuit.

Proportional Control Valves

The proportional control valves provide a power output matching that required by the load. A small line connected to a load sensing port feeds load pressure back to a sequence valve. The sequence valve senses the difference between the load and pump outlet pressure, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valve's meter-in spool, with the effect that pump flow is determined by the degree of spool opening, independent of load pressure. Return lines are connected together, simplifying routing of return flow and to help reduce cavitation. Load sensing lines connect through shuttle valves to feed the highest load signal back to the sequence valve. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard.

Relief Valves

Main relief valves are installed at various points within the hydraulic system to protect associated systems and components against excessive pressure. Excessive pressure can be developed when a cylinder reaches its limit of travel and the flow of pressurized fluid continues from the system control. The relief valve provides an alternate path for the continuing flow from the pump, thus preventing rupture of the cylinder, hydraulic line or fitting. Complete failure of the system pump is also avoided by relieving circuit pressure. The relief valve is installed in the circuit between the pump outlet (pressure line) and the cylinder of the circuit, generally as an integral part of the system valve bank. Relief pressures are set slightly higher than the load requirement, with the valve diverting excess pump delivery back to the reservoir when operating pressure of the component is reached.

Crossover Relief Valves

Crossover relief valves are used in circuits where the actuator requires an operating pressure lower than that supplied to the system. When the circuit is activated and the required pressure at the actuator is developed, the crossover relief diverts excess pump flow to the reservoir. Individual, integral reliefs are provided for each side of the circuit.

2.6 COMPONENT FUNCTIONAL DESCRIPTION

Hydraulic Pump

The machine is equipped with two hydraulic pumps, a function pump and a drive pump. The function pump is a single-section gear pump that controls the lift and steer functions and provides a maximum output of 18 lpm (4.75 gpm). The drive pump is a single-section piston pump that controls the drive function and provides an output of 83.3 lpm (22 gpm).

Lift Cylinder Counterbalance/Manual Descent Valve

The lift cylinder counterbalance/manual descent valve is located on top of the lift cylinder. The counterbalance valve is used to hold the platform in place when raised. A cable is connected to the valve which, when pulled, manually opens the lift down port and allows the platform to be lowered in the event hydraulic power is lost.

2.7 WEAR PADS

Sliding Pads

The original thickness of the sliding pads is 51 mm (2 in). Replace sliding pads when worn to 48 mm (1.875 in).

2.8 CYLINDER CHECKING PROCEDURES

NOTE: *Cylinder checks must be performed any time a cylinder component is replaced or when improper system operation is suspected.*

Cylinder w/o Counterbalance Valves - Steer Cylinder

IMPORTANT

OPERATE FUNCTIONS FROM GROUND CONTROL STATION ONLY.

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

1. Using all applicable safety precautions, activate motor and fully extend cylinder to be checked. Shut down motor.
2. Carefully disconnect hydraulic hose from retract port of cylinder. There will be initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the retract port.

3. Activate motor and activate cylinder extend function. Check retract port for leakage.
4. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to retract port and retract cylinder.
5. With cylinder fully retracted, shut down motor and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate motor and activate cylinder retract function. Check extend port for leakage.
7. If cylinder leakage is 6-8 drops per minute or more, piston seals are defective and must be replaced. If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, then activate cylinder through one complete cycle and check for leaks.

Cylinders w/Single Counterbalance Valves - Lift Cylinder

IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.

⚠ WARNING

WHEN WORKING ON THE LIFT CYLINDER, RAISE THE PLATFORM COMPLETELY AND SUPPORT THE PLATFORM USING A SUITABLE OVERHEAD LIFTING DEVICE. (EXAMPLE: SEE FIGURE 2-1., ARMS AND PLATFORM POSITIONING AND SUPPORT, CYLINDER REPAIR)

DO NOT FULLY EXTEND LIFT CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Raise platform completely then retract cylinder slightly to avoid trapping pressure. Place a suitable overhead lifting device approximately 2.5 cm (1 in) below the platform.
3. Shut down hydraulic system and allow machine to sit for 10-15 minutes. Carefully remove hydraulic hoses from cylinder port block.
4. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should not be any further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the counterbalance valve is defective and must be replaced.
5. If no repairs are necessary or when repairs have been made, carefully reconnect hydraulic hoses to the appropriate ports.
6. Remove lifting device from platform, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

2.9 LIFT CYLINDER REMOVAL AND INSTALLATION

Removal

1. Place the machine on a flat and level surface. Start the motor and raise the platform. Shut down the engine and attach a suitable lifting device to the platform.
2. Remove the bolt and locknut securing the cylinder rod attach pin to the upper inner arm assembly. Using a suitable brass drift, drive out the rod end attach pin from the arm assembly.
3. Retract the lift cylinder rod completely.
4. Tag and disconnect the hydraulic lines, then cap the lift cylinder hydraulic lines and ports.
5. Remove the bolt and locknut securing the barrel end attach pin to the lower arm assembly. Using a suitable brass drift, drive out the barrel end attach pin from the arm assembly.
6. Carefully remove the cylinder from the scissor lift and place in a suitable work area.

Installation

1. Install lift cylinder in place using suitable slings, aligning barrel end attach pin mounting holes on lower arm assembly.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the lower arm assembly. Secure in place with the bolt and locknut.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Extend the cylinder rod until the attach pin hole aligns with those in the upper arm assembly. Using a suitable drift, drive the cylinder rod attach pin through the aligned holes, taking care to align the pin retaining hole with the hole in arm assembly. Secure the pin in place with the bolt and locknut.
5. Lower platform to stowed position and shut down motor. Check hydraulic fluid level and adjust accordingly.

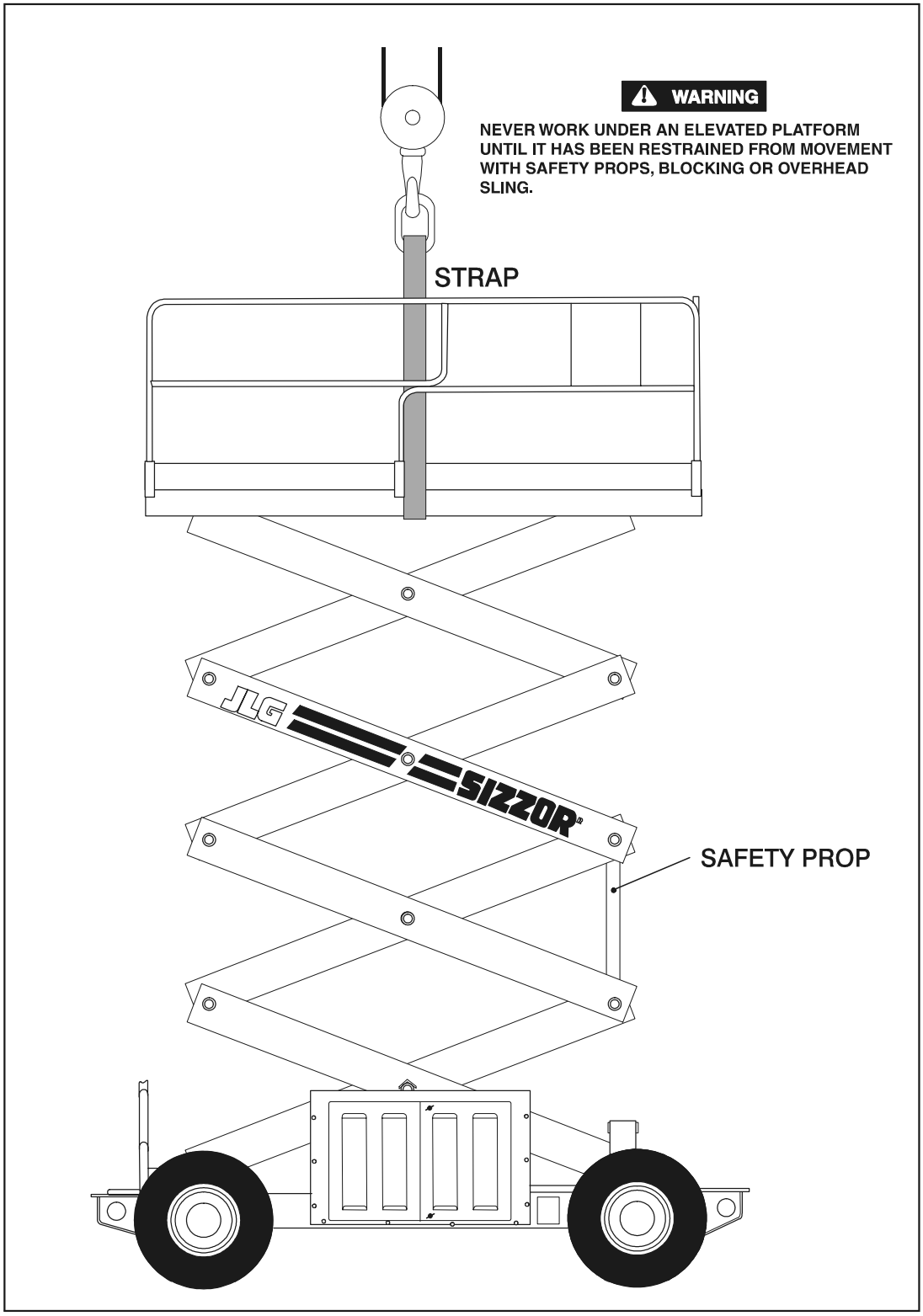

Figure 2-1. Arms and Platform Positioning and Support, Cylinder Repair

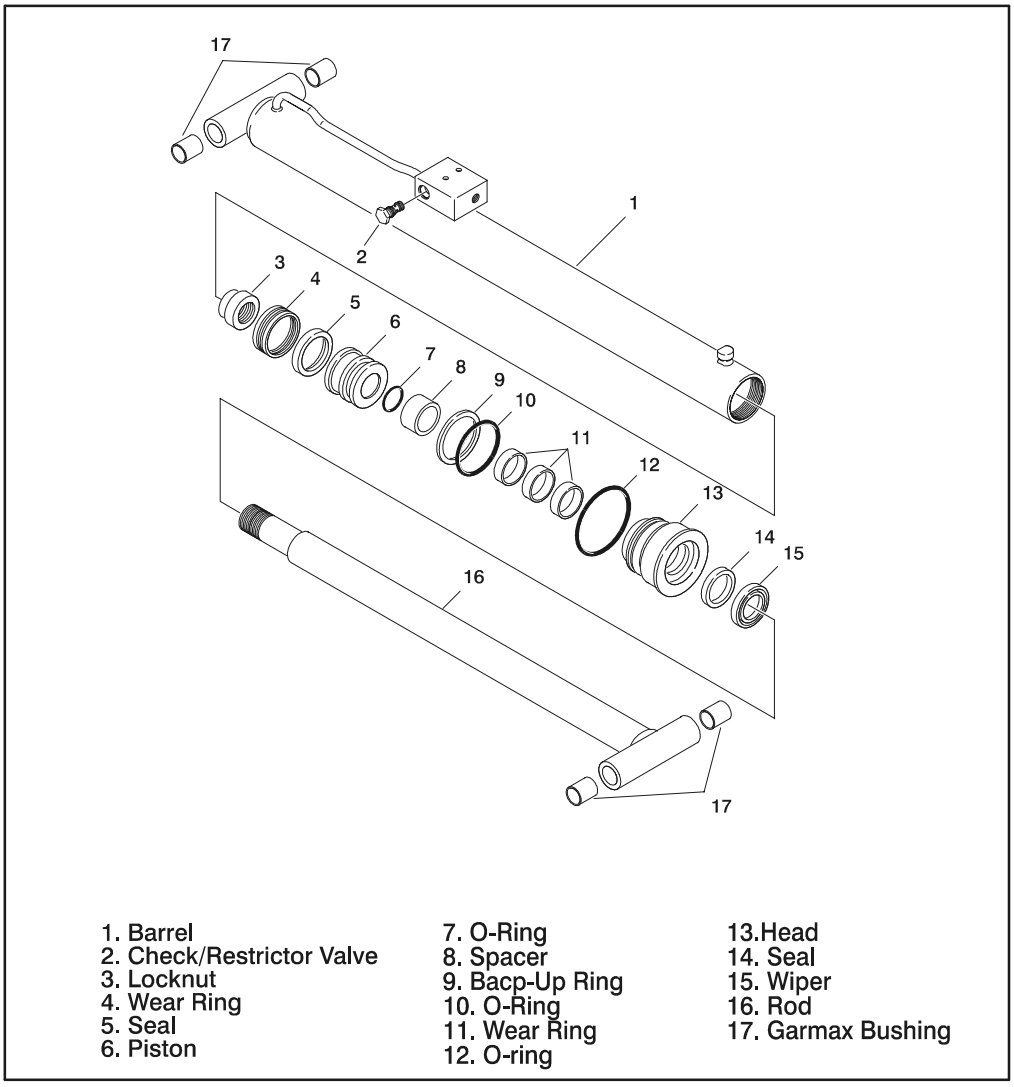

Figure 2-2. 330CRT Lift Cylinder

6. Remove the cylinder rod from the holding fixture.
7. Position the cylinder barrel in a suitable holding fixture.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
9. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
10. If applicable, secure the cylinder head retainer using a suitable chain wrench.
11. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
12. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable.

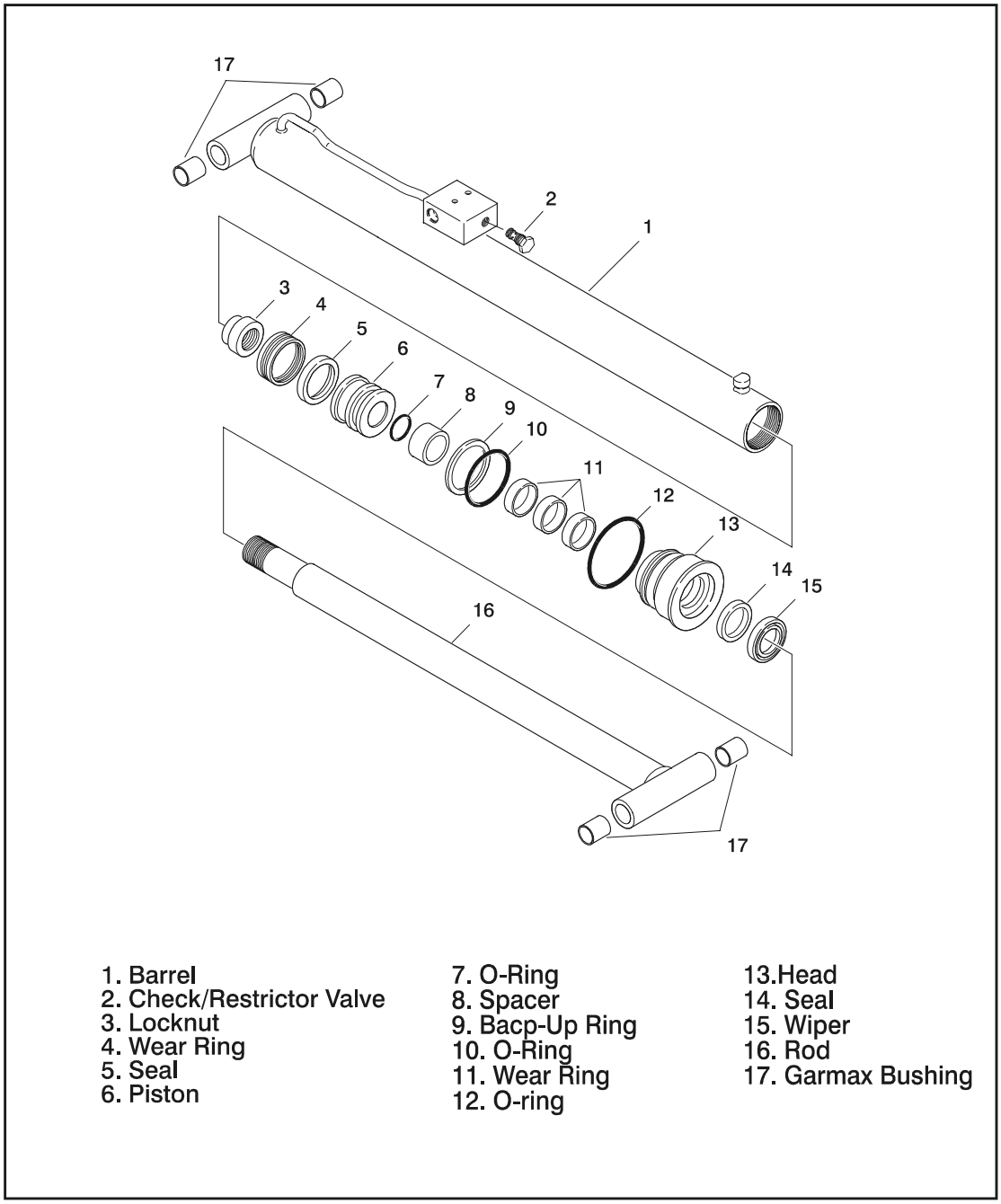

Figure 2-3. 400CRT LIft Cylinder

2.10 LIFT CYLINDER REPAIR

Disassembly

IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Connect a suitable auxiliary hydraulic power source to the cylinder port block fitting.

IMPORTANT

DO NOT FULLY EXTEND CYLINDER TO END OF STROKE. RETRACT CYLINDER SLIGHTLY TO AVOID TRAPPING PRESSURE.

2. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if necessary.
3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture..

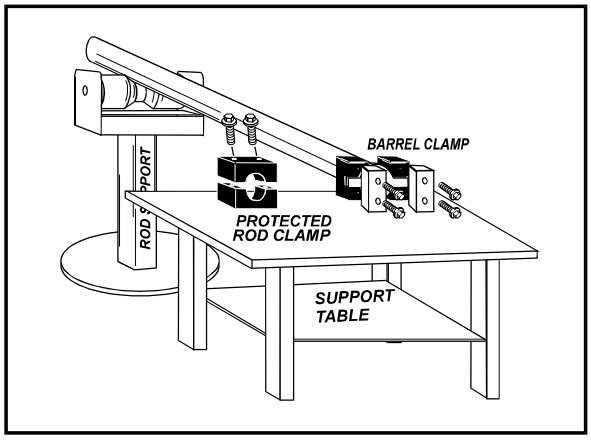

Figure 2-4. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer cap screws, and remove cap screws from cylinder barrel.

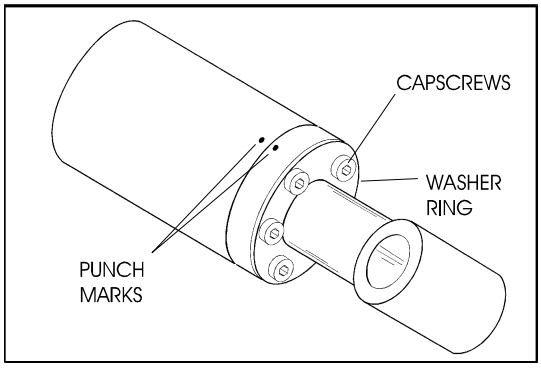

Figure 2-5. Capscrew Removal

6. Using a spanner wrench, loosen the end cap or head retainer, and remove from cylinder barrel.
7. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.

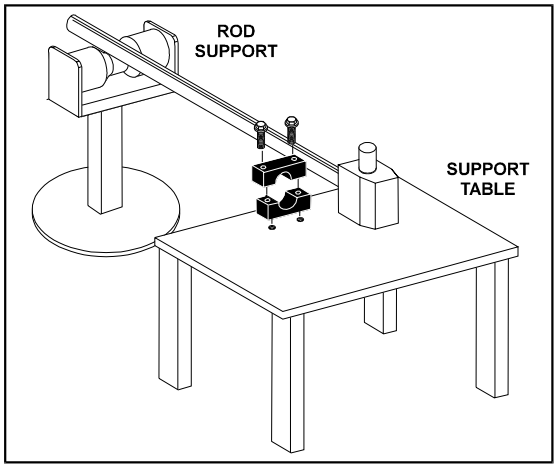

Figure 2-6. Cylinder Rod Support

9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. Loosen and remove the cap screw(s), if applicable, which attach the tapered bushing to the piston.

11. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston.
12. Remove the bushing from the piston.

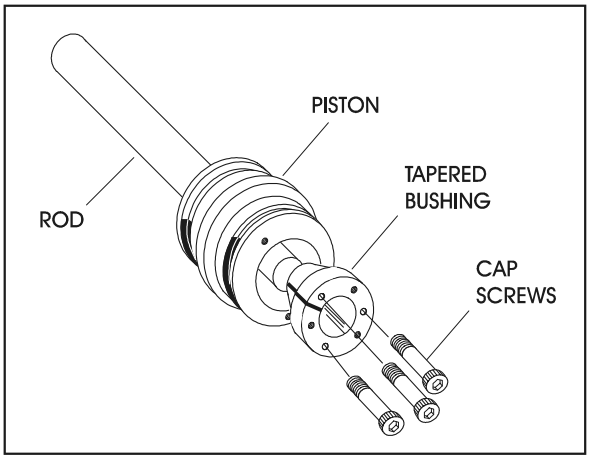

Figure 2-7. Tapered Bushing Removal

13. Screw the piston CCW, by hand, and remove the piston from cylinder rod.
14. Remove and discard the piston o-rings, seal rings, and backup rings.
15. Remove piston spacer, if applicable, from the rod.
16. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer plate, if applicable. Discard the o-rings, back-up rings, rod seals, and wiper seals.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of the steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.
14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used. See your JLG Parts Manual.*

Apply a light film of hydraulic oil to all components prior to assembly.

1. A special tool is used to install a new rod seal into the applicable cylinder head gland groove.

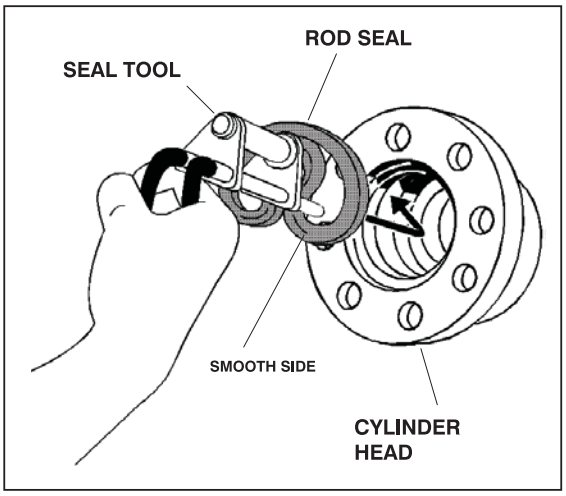

Figure 2-8. Rod Seal Installation

IMPORTANT

WHEN INSTALLING "POLY-PAK" PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO WIPER SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

2. Use a soft mallet to tap a new wiper seal into the applicable cylinder head gland groove. Install a new wear ring into the applicable cylinder head gland groove.

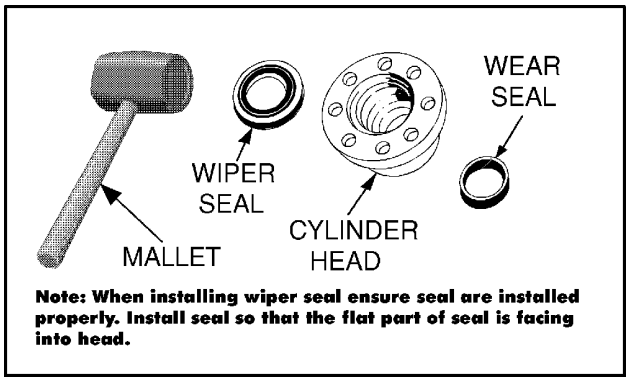

Figure 2-9. Wiper Seal Installation

3. Place a new o-ring and back-up seal in the applicable outside diameter groove of the cylinder head.

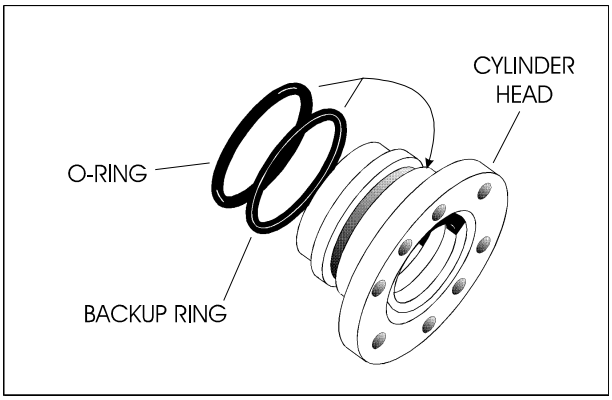

Figure 2-10. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

5. Carefully slide the piston spacer on the rod.

6. If applicable, correctly place new o-ring in the inner piston diameter groove. (The backup ring side facing the O-ring is grooved.)

7. If applicable, correctly place new seals and guide lock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D.of the piston is recommended to install the solid seal.)

NOTE: *The backup rings for the solid seal have a radius on one side. This side faces the solid seal.(See magnified insert in (See Figure 2-11.))The split of seals and backup rings are to be positioned so as not to be in alignment with each other.*

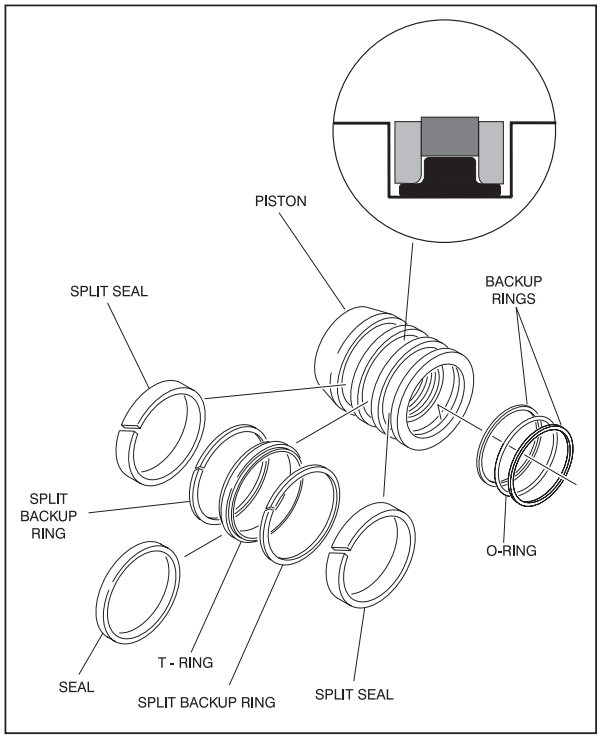

Figure 2-11. Piston Seal Kit Installation

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to piston as possible.
2. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
3. Thread piston onto rod until it abuts the spacer end and install the tapered bushing.

NOTE: *When installing the tapered bushing, piston and mating end of rod must be free of oil.*

4. Assemble the tapered bushing loosely into the piston and insert JLG capscrews (not vendor capscrews) through the drilled holes in the bushing and into the tapped holes in the piston.

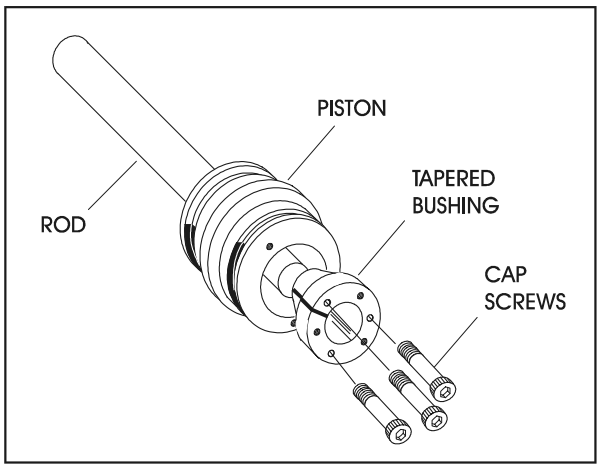

Figure 2-12. Tapered Bushing Installation

5. Tighten the capscrews evenly and progressively in rotation to the specified torque value.
6. After the screws have been torqued, tap the tapered bushing with a hammer (16 to 24 oz.) and brass shaft (approximately 3/4" in diameter) as follows;
   a. Place the shaft against the cylinder rod and in contact with the bushing in the spaces between the capscrews.
   b. Tap each space once; this means the tapered bushing is tapped 3 times as there are 3 spaces between the capscrews.

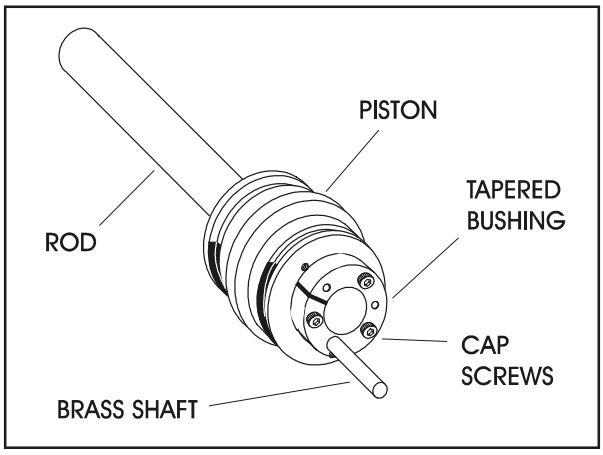

Figure 2-13. Seating the Tapered Bearing

7. Retorque the capscrews evenly and progressively in rotation to the specified torque value.
8. Remove the cylinder rod from the holding fixture.
9. Place new guide locks and seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 2-11.)

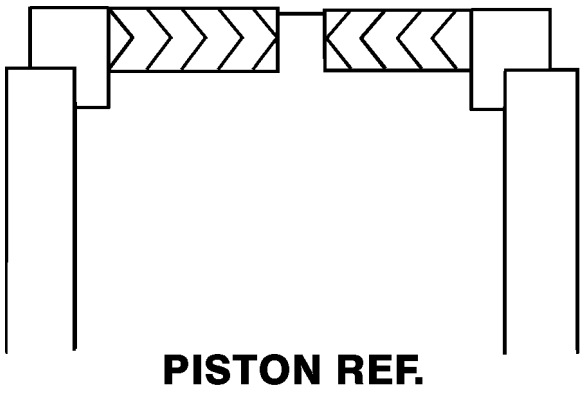

Figure 2-14. Poly-Pak Piston Seal Installlation

10. Position the cylinder barrel in a suitable holding fixture.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, HEAD, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

11. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.

12. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.

13. Secure the cylinder head gland using the washer ring and socket head bolts.

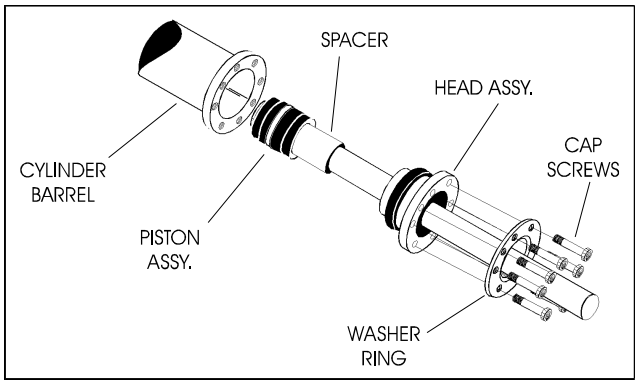

Figure 2-15. Rod Assembly Installation

14. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

15. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. (See Table 2-1, Cylinder Component Torque).

Table 2-1. Cylinder Component Torque

Component	Torque Value (w/Loctite)
Tapered Bushing Retaining Screws - Lift Cylinder	80 ft lb (108 Nm)
Head Retaining Screws - Lift Cylinder	9 ft lb (12 Nm)

Table 2-2. Holding Valve Torque Specifications

Description	Torque Value	
Sun - 7/8 hex M20 x 1.5 thds	30 - 35 ft lb	41 - 48 Nm
Sun - 1-1/8 hex 1 - 14 UNS thds	45 - 50 ft lb	61 - 68 Nm
Sun - 1-1/4 hex M36 x 2 thds	150 - 153 ft lb	204 - 207 Nm
Racine - 1-1/8 hex 1-1/16 - 12 thds	50 - 55 ft lb	68 - 75 Nm
Racine - 1-3/8 hex 1-3/16 - 12 thds	75 - 80 ft lb	102 - 109 Nm
Racine - 1-7/8 hex 1-5/8 - 12 thds	100 - 110 ft lb	136 - 149 Nm

2.11 STEER CYLINDER REPAIR

Removal

Before beginning this procedure, ensure that the parking brake is engaged and the rear wheels are chocked.

1. Tag and disconnect the hydraulic lines to the steer cylinder, then cap the steer cylinder hydraulic lines and ports.
2. At each steer spindle, remove the bolt and lock nut securing the steer cylinder to the spindle.
3. When the steer cylinder is disconnected from the steer spindles, turn each wheel by hand to give clearance to remove the steer cylinder from the front axle.
4. Carefully lift the steer cylinder until the cylinder mounting block clears the mounting slot in the bottom of the axle, then slowly remove the cylinder from the axle and place it in a suitable work area.

Disassembly

IMPORTANT

DISASSEMBLY OF THE CYLINDER SHOULD BE PERFORMED ON A CLEAN WORK SURFACE IN A DIRT FREE WORK AREA.

1. Place the cylinder barrel into a suitable holding fixture.
2. Using a suitable chain wrench, carefully remove the cylinder head retainer from one end of the cylinder barrel.
3. Attach a suitable pulling device to one end of the cylinder rod.

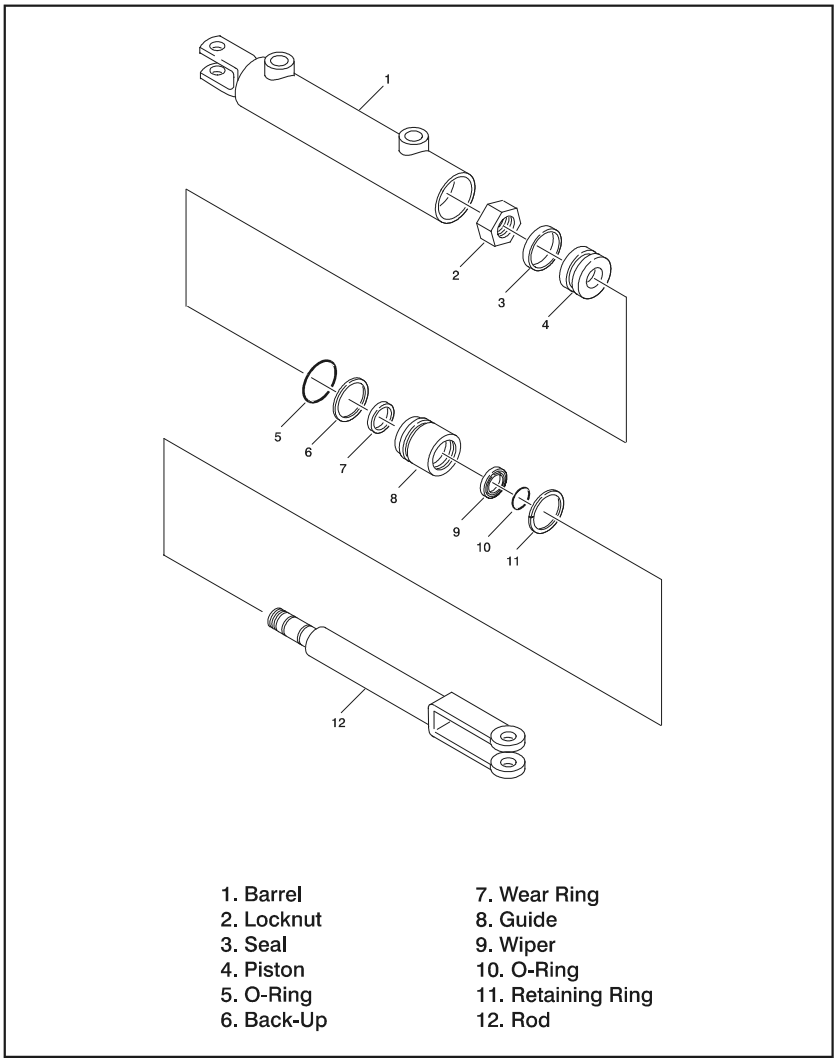

Figure 2-16. Steer Cylinder Assembly

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN REMOVING THE CYLINDER ROD, SPACER, AND PISTON. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

4. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
5. Using a suitable chain wrench, carefully remove the remaining cylinder head retainer from the opposite end of the cylinder barrel. Remove the head and remove and discard the wiper, rod seal, 0-ring and wear ring.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
7. Carefully remove the head from the cylinder rod and remove and discard the wiper, rod seal, o-ring and wear ring.
8. Carefully remove the spacers from the cylinder rod, then remove the retaining rings securing the piston in place on the cylinder rod. Discard the retaining rings.
9. Carefully remove the piston from the cylinder rod. Remove and discard the T-seal and o-ring.
10. Remove the cylinder rod from the holding fixture.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress the rod with Scotch Brite or equivalent. Replace the rod if necessary.
3. Inspect the threaded portion of the rod for excessive damage. Dress the threads as necessary.
4. Inspect the inner surface of the cylinder barrel tube for scoring or other damage. Check the inside diameter for tapering or ovality. Replace the barrel if necessary.
5. Inspect the piston surface for damage, scoring and distortion. Dress the piston surface or replace the piston as necessary.
6. Inspect the seal and o-ring grooves in the piston for burrs and sharp edges. Dress applicable surfaces as necessary.
7. Inspect the inside diameter of the spacers and heads for scoring or other damage and for ovality and tapering. Replace as necessary.
8. Inspect the seal and o-ring grooves in the heads for burrs and sharp edges. Dress applicable surfaces as necessary.
9. Inspect the outside diameter of the spacers and heads for scoring or other damage and ovality and tapering. Replace as necessary.
10. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
11. Inspect the cam follower for wear or damage. Replace as necessary.

Assembly

NOTE: *Prior to cylinder assembly, ensure that the proper cylinder seal kit is used.*

Apply a light film of hydraulic oil to all components prior to assembly.

1. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture.
2. Place a new o-ring into the cylinder rod piston groove.
3. Place a new T-seal on the piston, then carefully install the piston the cylinder rod, ensuring that the o-ring in the rod groove is not damaged or dislodged. Secure the piston in place with two new retaining rings.
4. Carefully slide the spacers onto the cylinder rod.
5. Place a new wiper, rod seal, o-ring and wear ring on each of the two cylinder heads. Set the heads aside for later installation on the cylinder rod.
6. Remove the cylinder rod assembly from the holding fixture.
7. Position the cylinder barrel in a suitable holding fixture.

IMPORTANT

EXTREME CARE SHOULD BE TAKEN WHEN INSTALLING THE CYLINDER ROD, PISTON AND HEADS. AVOID PULLING THE ROD OFF-CENTER, WHICH COULD CAUSE DAMAGE TO THE PISTON AND CYLINDER BARREL SURFACES.

8. With the barrel clamped securely, and while adequately supporting the cylinder rod assembly, insert the cylinder rod assembly into the cylinder barrel. Ensure that the piston T-seal and o-ring are not damaged or dislodged.
9. Continue pushing the rod assembly into the cylinder barrel until the cylinder rod is approximately centered in the barrel.

10. Carefully install one of the cylinder heads on one end of the cylinder rod and push the head onto the rod until it is snug against the end of the cylinder barrel.

11. Install one of the cylinder head retainers on the end of the cylinder barrel and tighten with a suitable chain wrench.

12. Carefully install the remaining cylinder head on the opposite end of the cylinder rod and push the head onto the rod until it is snug against the end of the cylinder barrel.

13. Install the remaining cylinder head retainer on the end of the cylinder barrel and tighten with a suitable chain wrench.

Installation

1. Carefully install the steer cylinder assembly into the front axle. Align the cylinder mounting block on the barrel with the mounting slot in the bottom of the axle and lower the steer cylinder until the mounting block rests in the slot.

2. Turn the steer wheels to line up the mounting holes in the steer spindles and the steer cylinder ends. Secure each end of the steer cylinder with a bolt and lock nut.

3. Reconnect the hydraulic hoses to the applicable cylinder ports.

2.12 OSCILLATION CYLINDER BLEEDING

NOTE: *Park the machine on a firm and level surface with the rear wheels blocked before starting the bleeding procedure.*

1. Jack up the front of the machine so that both wheels are raised enough to allow the axle to fully oscillate.

2. Have a second person start the engine, press and hold the start button until Hi engine is activated.

3. On the side of the axle that is fully raised, loosen the bleeder screw to release any air that may be in the hydraulic line. Continue to bleed until no air bubbles are visible.

4. Tighten the bleeder screw then push the raised wheel down and repeat the process for the opposite level cylinder.

2.13 MAGNETIC SPEED PICKUP CLEANING PROCEDURE

1. Locate the magnetic speed pickup on the bell housing on the right side of the motor.

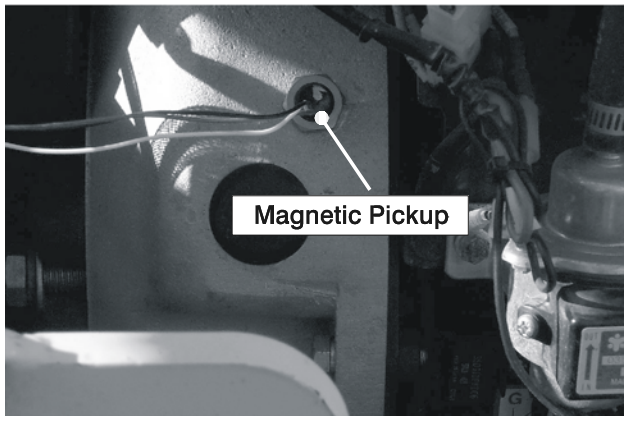

Figure 2-17. Magnetic Speed Pickup

2. Using an 11/16 wrench, loosen the jam nut and, using your fingers, thread the pickup out of the bell housing.

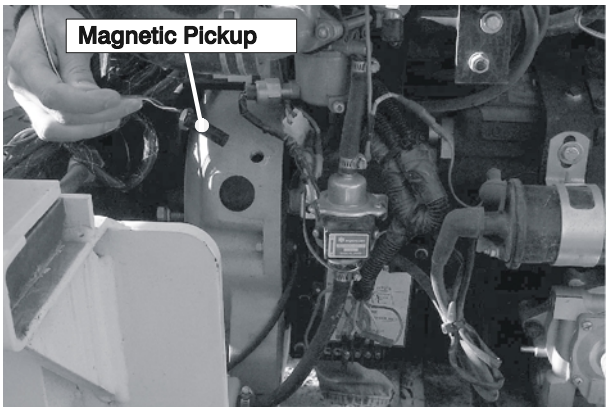

Figure 2-18. Magnetic Speed Pickup Removal

3. After cleaning and inspecting the magnetic speed pickup reinstall back into the bell housing.

4. The magnetic speed pickup should be tightened finger tight and then backed out 1/4 turn to properly set.

NOTE: *Flats on the magnetic pickup must be oriented vertically.*

5. Replace the jam nut and tighten.

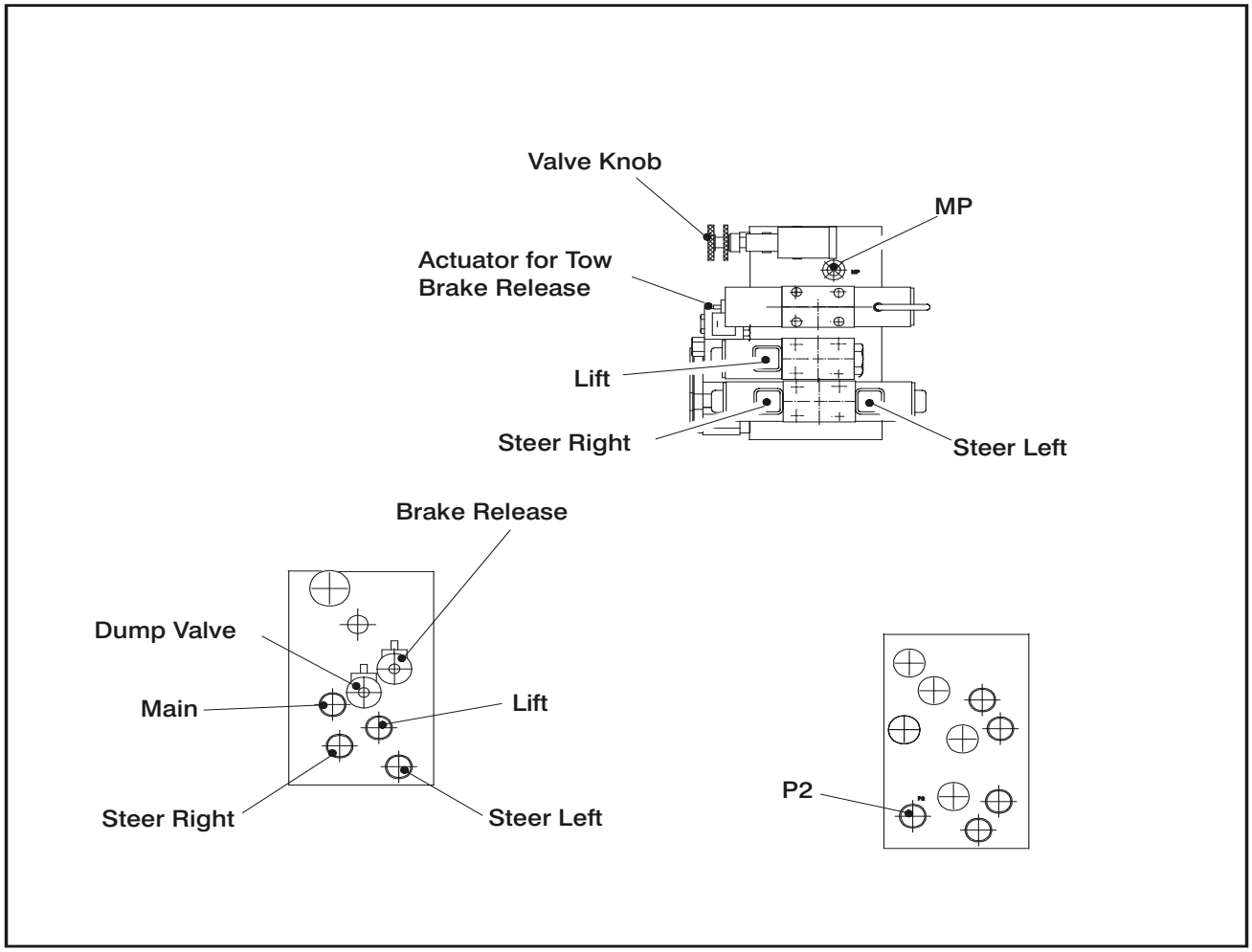

Figure 2-19. Valve Components

2.14 PRESSURE SETTING PROCEDURES

NOTE: *Make all pressure adjustments with the engine operating and the hydraulic oil at normal operating temperature. In addition, all functions must be operated from the platform control station in order to achieve full pump speed. It may be necessary to use an assistant to adjust the pressure settings while operating the functions from the platform control station.*

Lift Relief Adjustments

1. Install a pressure gauge at gauge port MP, located on the front upper right side of the valve body. The port is identified by a stamping on the valve body.
2. From the platform control station, activate the Lift Up function by selecting the lift control switch and positioning the joystick to the up position.
3. Bottom out the Lift Up function and adjust the Lift Up relief to 159 bar (2300 psi) on the 330CRT and 172 bar (2500 psi) on the 400CRT.
4. Remove the pressure gauge from gauge port MP.

Steer Relief Adjustment

1. Install a pressure gauge at gauge port MP2, located on the lower right side of the valve body. The port is identified by a stamping on the valve body.
2. Activate the Steer Right function and check Steer pressure. If necessary, adjust Steer pressure to 110 bar (1600 psi).
3. Activate the Steer Left function and check Steer pressure. If necessary, adjust Steer pressure to 179 bar (2600 psi).
4. Remove the pressure gauge from gauge port MP2.

2.15 LIMIT SWITCH ADJUSTMENT

Speed Cutout Switch

The speed cutout switch is located on the right side of the frame of the machine. When activated, the switch cuts out the high drive function. Adjust the switch to activate when the platform is raised above the stowed position.

Drive Cutout Switch (400 CRT)

The drive cutout switch is located on the left side of the frame of the machine. When activated, the switch cuts out the drive function. Adjust the switch to activate when the platform is raised to 9.1m (30 ft.).

2.16 AUTOMATIC CHOKE - FIELD ADJUSTMENT (DF-750)

Inspection

NOTE: *All automatic choke assemblies have been pre-set to operate between -7°C and 38°C (20°F and 100°F) with little or no adjustment. If the machine will be operated for prolong use outside these temperature ranges, adjustments could be made to improve performance of the engine.*

The machine will take time to warm up and you may experience low power or rough running for the first few minutes of operation or until the engine warms up. LET THE ENGINE WARM UP.

Make sure that the choke shaft operates freely and does not bind. This can be done without removing the air horn by rotating the bronze coupling with an eraser on a pencil or by removing the vacuum pull off line at the manifold and supply a small amount of vacuum to the hose. the choke rod should move freely using either method.

Adjustments

NOTE: *If the choke rod is binding make sure the support bracket is straight*

1. There are two adjustments Vertical (loosening the air horn nuts) and Horizontal (loosening the bracket to adaptor screws). These two adjustments should resolve any binding problem.
2. To adjust the choke at 21°C (70°F) ambient, remove the air horn and reinstall the nut that holds the choke and support bracket securely making sure the choke moves freely.
3. Loosen the 3 top cover screws and rotate the top cover till the choke butterfly is closed with 1/32 in space between the plate and the wall of the carburetor.
4. If the ambient temperature is less then 21°C (70°F) the top cover counter should be rotated CCW 1 mark for every -15°C (5°F) less then 21°C (70°F).
5. If the ambient temperature is more then 21°C (70°F) the top cover counter should be rotated CW 1 mark for every -15°C (5°F) less then 21°C (70°F).

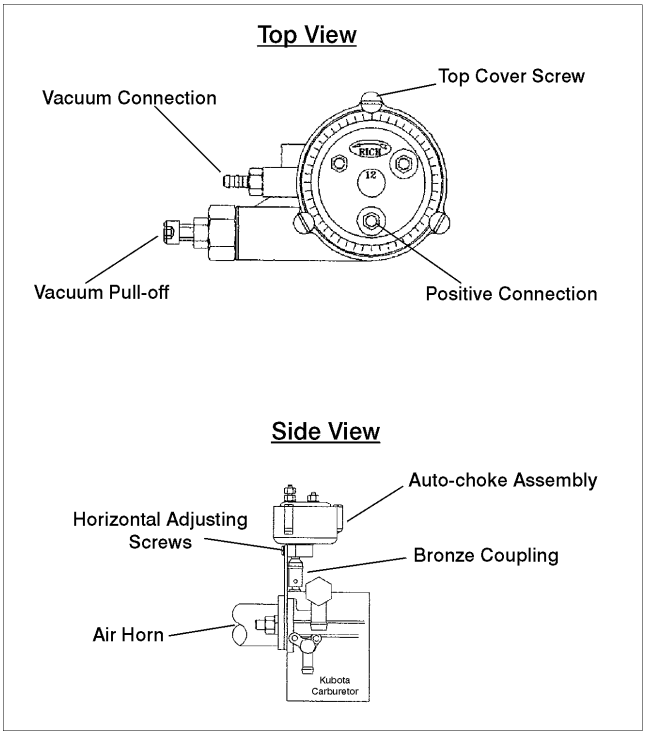

Figure 2-20. Automatic Choke Adjustment (DF-750)

Reassembly

Reassemble the air horn making sure the choke is not binding, test to insure that none of the settings have moved and the choke is not binding.

The vacuum pull off should be set such that when vacuum is applied to the choke system the choke butterfly is full open.

NOTE: *If the machine starts and stalls immediately or if it is extremely cold, limiting the choke pull off to 75% to 90% may improve the performance of the machine. No adjustment is normally required.*

Diesel Engine

NOTE: *Never run the fuel tank dry. Diesel engines cannot be restarted after running out of fuel until the fuel system has been air-vented or 'bled' of air. See the Kubota Instruction Manual for the proper procedure.*

2.17 ELECTRONIC CONTROL SYSTEM

To Connect the Hand Held Analyzer:

1. Connect the four pin end of the cable supplied with the analyzer, to the top connection of the motor controller and connect the remaining end of the cable to the analyzer.

NOTE: *The cable has a four pin connector at each end of the cable; the cable cannot be connected backwards.*

2. Power up the Control System by turning the lower key to the platform position and pulling both emergency stop buttons on.

Using the Analyzer:

With the machine power on and the analyzer connected properly, the analyzer will display the following:

HELP:

PRESS ENTER

At this point, using the **RIGHT** and **LEFT** arrow keys, you can move between the top level menu items. To select a displayed menu item, press **ENTER.** To cancel a selected menu item, press **ESC**; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP

DIAGNOSTICS

ACTIVATE TESTS

ACCESS LEVEL

PERSONALITIES

MACHINE SETUP

LEVEL VEHICLE

If you press **ENTER**, at the HELP:PRESS ENTER display, and a fault is present during power up, the analyzer display will scroll the fault across the screen. If there was no fault detected during power up, the display will read: **HELP: EVERYTHING OK**

If **ENTER** is pressed again, the display moves to the following display:

LOGGED HELP

1: STARTUP (2/1)

At this point, the analyzer will display the current fault, if any are present. You may scroll through the fault logs to view what the last fifteen faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESC** two times.

When a top level menu is selected, a new set of menu items may be offered; for example:

PLATFORM

DRIVE

LIFT SEL

SPEED SEL

HORN

ENGINE START

FUEL/GLOW

STEER LEFT

STEER RIGHT

JOYSTICK

Pressing **ENTER** with any of the above displayed menus, will display additional sub-menus within the selected menu. In some cases the next level is the parameter or information to be changed. Refer to the flow chart for what menus are available within the top level menus. You may only view the personality settings for selected menus while in access level 2. Remember, you may always cancel a selected menu item by pressing the **ESC** key.

Changing the Access Level of the Hand Held Analyzer:

When the analyzer is first connected, you will be in access level 2 which enables you to only view most configuration settings which cannot be changed until you enter a password to advance to a lower level. This ensures that a setting cannot be accidentally altered. To change the access level, the correct password must be entered. To enter the password, scroll to the **ACCESS LEVEL** menu. For example:

MENU:

ACCESS LEVEL 2

Press **ENTER** to select the **ACCESS LEVEL** menu.

Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

Then using the **RIGHT** arrow key, position the cursor to the right one space to enter the second digit of the password.

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 3.

Repeat this process until you have entered all five digits of the password which is **33271**.

Once the correct password is displayed, press **ENTER**.

The access level should display the following, if the password was entered correctly:

MENU:

ACCESS LEVEL 1

Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings.

When a machine digit item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

GROUND ALARM:

2=DRIVE

The effect of the machine digit value is displayed along with its value. The above display would be selected if the machine was equipped with a ground alarm and you wanted it to sound when driving. There are certain settings allowed to install optional features or select the machine model.

When selecting the machine model to match the size of the machine, the personality settings will all default to the factory recommended settings.

NOTE: *Refer to the appropriate Machine Personality Settings Table, and the Machine Setup Table in the JLG Service Manual for the recommended factory settings.*

Password 33271 will give you access to level 1, which will permit you to change all machine personality settings.

⚠ WARNING

CHANGING THESE SETTINGS MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

IMPORTANT

IT IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES, INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

2.18 FLASH CODES AND DESCRIPTIONS

Table 2-3. Help Messages and Flash Codes

FLASH CODE	HELP MESSAGE AND DESCRIPTION
No Flash Code	ALARM SOUNDING - TILTED & ABOVE ELEVATION Platform is elevated and the chassis is not level.
	DIFFERENT FUNCTION SELECTED & IGNORED A function (i.e. Drive, Lift, etc.) is active and the operator has selected another function. The system has ignored the new selection.
	DRIVING AT CUTBACK - ABOVE ELEVATION Platform is elevated and the machine is in the drive mode of operation.
	FUNCTION SELECTED BUT TRIGGER SWITCH OPEN A function (i.e. Drive, Lift, etc.) has been selected by the operator, but the trigger switch is not active (closed).
	JOYSTICK MOVED BUT NO FUNCTION SELECTED The joystick was moved out of the center position before a function was selected.
2-1	STARTUP A new system power up has occurred since the last help message.
2-2	FUNCTIONS LOCKED OUT - SHORT TO PLATFORM ROW INPUT DETECTED Battery power has been detected on a row input (pins J1-8, J1-9, or J1-13).
	FUNCTION PROBLEM - DRIVE PERMANENTLY SELECTED Drive select switch in the platform control box closed at start up or for more than ten seconds. Release switch to clear fault.
	FUNCTION PROBLEM - LIFT PERMANENTLY SELECTED Lift select switch in the platform control box closed at start up or for more than ten seconds. Release switch to clear fault
	FUNCTION PROBLEM - O/R PERMANENTLY SELECTED An outrigger select switch in the platform control box closed at start up or for more than ten seconds. Release switch to clear fault
	FUNCTION PROBLEM - START PERMANENTLY SELECTED Start switch in the platform control box closed at start up. Release switch to clear fault
	FUNCTION PROBLEM - GLOW PLUG PERMANENTLY SELECTED Glow plug switch in the platform control box closed at start up. Release switch to clear fault
	FUNCTION PROBLEM - STEER LEFT PERMANENTLY SELECTED Steer left switch in the platform control box closed at start up. Release switch to clear fault
	FUNCTION PROBLEM - STEER RIGHT PERMANENTLY SELECTED Steer right switch in the platform control box closed at start up. Release switch to clear fault
	JOYSTICK FAULTY - WIPER OUT OF RANGE The joystick wiper signal input is outside the acceptable voltage range. The wiper wire being off, the wiper wire shorted to battery power, or the wiper wire shorted to battery negative could cause this.
	JOYSTICK FAULTY - STEER SWITCHES ACTIVE TOGETHER Both the steer left and steer right inputs are closed at the same time. A short in the steer switch wiring or a failed steer switch can cause this.
	FUNCTION LOCKED OUT - JOYSTICK NOT CENTERED Selected function is not allowed because the joystick is not centered. Return joystick to center and reselect function.
	FUNCTION PROBLEM - TRIGGER PERMANENTLY CLOSED Trigger switch in the platform control box closed at start up. Release switch to clear fault.
	TRIGGER CLOSED TOO LONG WHILE IN NEUTRAL Trigger switch in the platform control box closed for more than ten seconds while the joystick is in the neutral position. Release switch to clear fault.
2-3	FUNCTION PROBLEM - LIFT PERMANENTLY SELECTED Lift switch (up or down) in the ground control box closed at start up. Release switch to clear fault

Table 2-3. Help Messages and Flash Codes

	FUNCTION PROBLEM - START PERMANENTLY SELECTED Start switch in the ground control box closed at start up. Release switch to clear fault
	FUNCTION PROBLEM - GLOW PLUG PERMANENTLY SELECTED Glow plug switch in the ground control box closed at start up. Release switch to clear fault
	NO DATA FROM TILT SENSOR - NOT CONNECTED OR FAULTY No signal from the tilt switch. Check wiring and plug connections at the level sensor and at the ground control board.
4-4	BATTERY VOLTAGE TOO LOW Battery voltage below 8.0V. Check battery and alternator.
	BATTERY VOLTAGE TOO HIGH Battery voltage above 16V. Check battery and alternator.
5-5	ENGINE SHUTDOWN – OVERSPEED The engine speed exceeded 4500 RPM for more than 2 seconds. Check throttle actuator for debris or interference, which prevents free movement of actuator. Recycle power to clear the fault and restart.
	ENGINE SHUTDOWN - OIL PRES / COOLANT TEMP The engine oil pressure was too low or the engine coolant temperature was too high for more than 10 seconds. Check engine fluid levels. Recycle power to clear fault and restart.

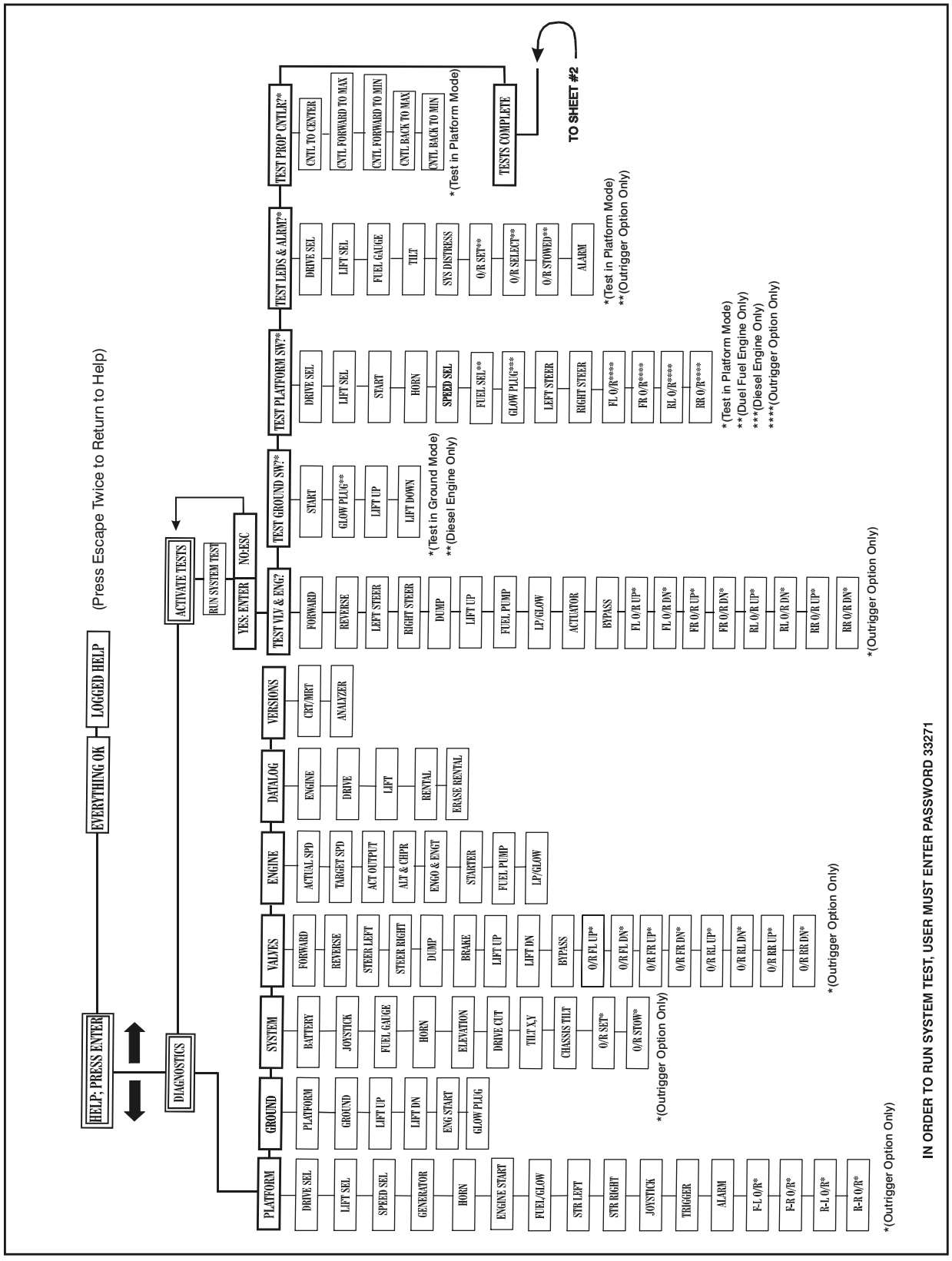

Figure 2-21. Analyzer Flow Chart - Sheet 1 of 2

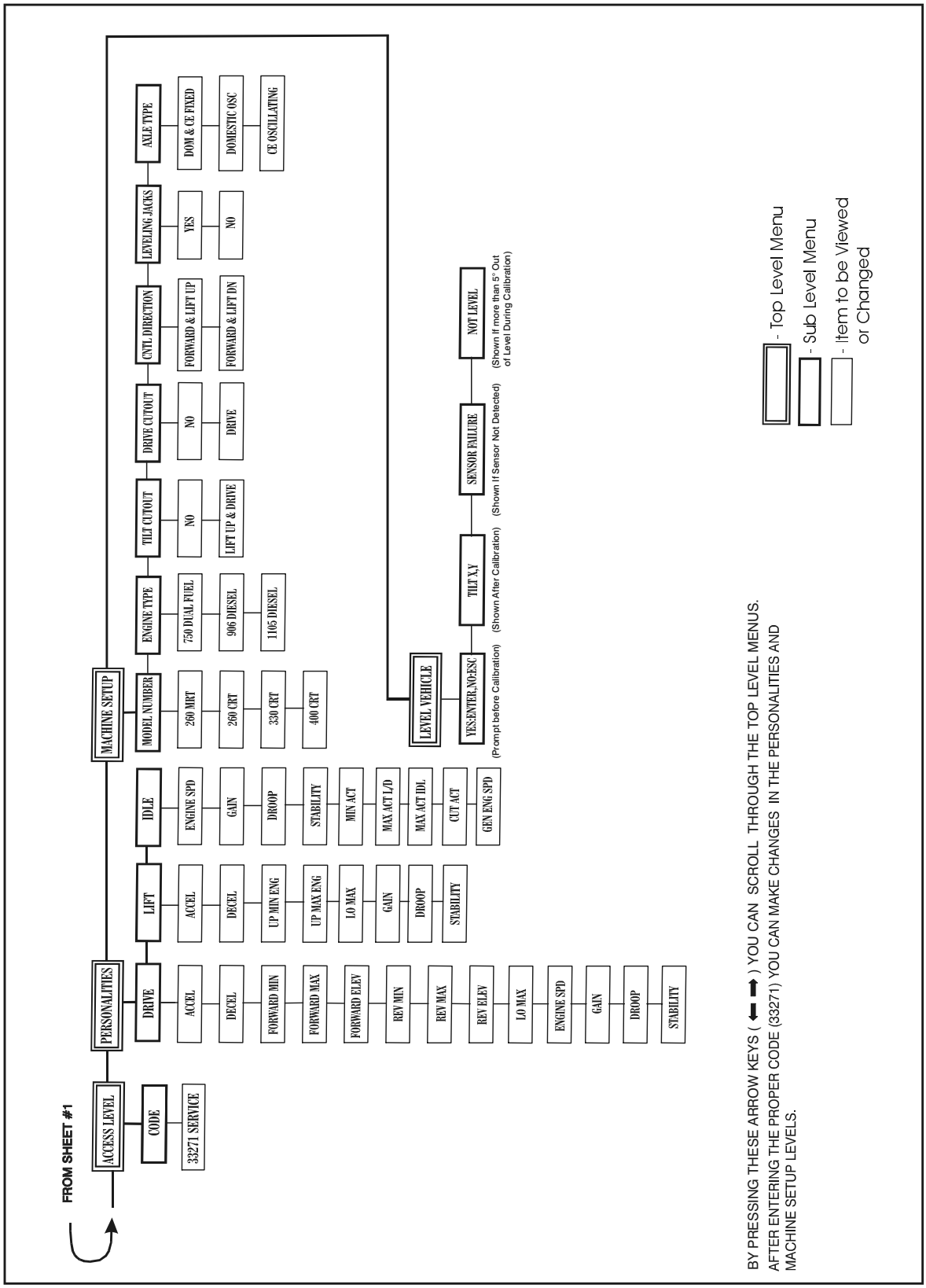

Figure 2-22. Analyzer Flow Chart - Sheet 2 of 2

Table 2-4. Machine Model Adjustment

Adjustment	Adjustment range	Default Values - Gas	Default Values - Diesel
DRIVE			
Accel	1.0 to 5.0 sec	4	4
Decel	1.0 to 5.0 sec	2	2
FWD MIN	0 to 100%	21	21
FWD MAX	0 to 100%	48	48
FWD ELEV	0 to 35%	30	30
REV MIN	0 to 100%	21	21
REV MAX	0 to 100%	52	52
REV ELEV	0 to 35%	30	30
LO MAX	35 to 65%	50	50
ENGINE SPD	2800 to 3800 RPM	3600	3000
GAIN	0 to 999	180	50
DROOP	0 to 999	200	250
STABILITY	0 to 999	170	125
LIFT			
Accel	0.2 TO 5.0	4	4
Decel	0.2 TO 5.0	0.5	0.5
UP MIN ENG	1400 TO 2200 RPM	2000	2000
UP MAX ENG	2600 to 3600 RPM	3000	3000
LO MAX	35 to 55%	50	50
GAIN	0 to 999	150	10
DROOP	0 to 999	220	240
STABILITY	0 to 999	125	70
IDLE			
ENGINE SPEED	1200 TO 1500 rpm	1500	1500
GAIN	0 to 999	150	10
DROOP	0 to 999	250	85
STABILITY	0 to 999	100	90
MIN ACT	0 T0 100%	19	25
MAX ACT L/D	0 T0 100%	60	100
MAX ACT IDLE	0 T0 100%	55	40
CUT ACT	200 TO 2800 RPM	500	500

NOTE: *When configuring a CRT scissors machine, the machine configuration must be completed before any personality settings can be changed. Changing the personality settings first and then changing the model number of the machine configuration will cause the personality settings to return to default values.*

Table 2-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
1 (Model #)	1 2 3	260 CRT 330 CRT 400 CRT	0
2 (Engine Selection)	0 1 2	750 Dual Fuel 905 Diesel 1105 Diesel	0
3 (Tilt)	0 1	No Cutout Cutout lift up and drive if tilted and elevated. Required for AUS and BRZ markets	0
4 (Drive Cutout)	0 1	No drive cutout switch installed. Cuts out **drive** when deck is elevated above a predetermined elevation (Default for 400 CRT)	0
5 (Control Direction)	0 1	FWD & LIFT up FWD & LIFT dn (for future use)	0
6 (Leveling Jacks)	0 1	No Yes	0

2.19 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

The preventive maintenance and inspection checks are listed and defined in the following table. This table is divided into two basic parts, the “AREA” to be inspected and the “INTERVAL” at which the inspection is to take place. Under the “AREA” portion of the table, the various systems along with the components that make up that system are listed. The “INTERVAL” portion of the table is divided into five columns representing the various inspection time periods. The numbers listed within the interval column represent the applicable inspection code for which that component is to be checked.

The checks and services listed in this schedule are not intended to replace any local or regional regulations that may pertain to this type of equipment nor should the lists be considered as all inclusive. Variances in interval times may occur due to climate and/or conditions and depending on the location and use of the machine.

JLG Industries requires that a complete annual inspection be performed in accordance with the “Annual Machine Inspection Report” form. Forms are supplied with each new machine and are also available from JLG Customer Service. Form must be completed and returned to JLG Industries.

IMPORTANT

JLG INDUSTRIES REQUIRES THAT A COMPLETE ANNUAL INSPECTION BE PERFORMED IN ACCORDANCE WITH THE “ANNUAL MACHINE INSPECTION REPORT” FORM.

NOTE: *This machine requires periodic safety and maintenance inspections be a JLG Dealer.*

The inspection and maintenance code numbers are as follows:

1. Check for proper and secure installation.
2. Check for visible damage and legibility.
3. Check for proper fluid level.
4. Check for any structural damage; cracked or broken welds; bent or warped surfaces.
5. Check for leakage.
6. Check for presence of excessive dirt or foreign material.
7. Check for proper operation and freedom of movement.
8. Check for excessive wear or damage.
9. Check for proper tightness and adjustment.
10. Drain, clean and refill.
11. Check for proper operation while pump/motor is running.
12. Check for proper lubrication.
13. Check for evidence of scratches, nicks or rust and for straightness of rod.
14. Check for condition of element; replace as necessary.
15. Check for proper inflation.

Table 2-6. Preventive Maintenance and Safety Inspection

AREA	INTERVAL				
	10Hours (Daily)	50 Hours (Weekly)	200 Hours (Monthly)	500 Hours (3 Month)	1000 Hours (6 Month)
PLATFORM					
1. Controller	1,11				
2. Switches	1,11				
3. Placards and Decals	1,2				
4. Control Tags	1,2				
5. Hoses and Cables		4,8			
6. Wear Pads			8		
7. Handrails and Chains	1,4				
CHASSIS					
1. Engine Oil	3	5			
2. Battery	3	5			
3. Air Cleaner	1	14			
4. Exhaust System	1		1,5		
5. Engine Mounts			1		
6. Hydraulic Pump	1	5			
7. Valves	1	5			
8. Hydraulic Filter (See Lubrication Chart)		5,14			
9. Hydraulic Hoses and Tubing	1	5			
10. Hydraulic Oil Tank*	3	5	4		
11. Hydraulic Tank Breather		6,14			
12. Fuel Tank	3,5		4		
13. Lift Cylinder	1,12	5,6,13	4		
14. Limit Switch	1,7				
15. Tilt Alarm Switch					1,7
16. Placards and Decals	1,2				
17. Wheel and Tire Assemblies	1	8,9			
18. Drive Motors		1,5,6			
19. Drive Brakes		1,6	8		
20. Drive Torque Hubs		1,3,5,6			
21. Steer Cylinder	1	5,6,13	4		
22. Steer Components	1	4,6	8		
23. Wheel Bearings (2 Wheel Drive)			8	12	
24. Sizzor Arms	1,4				
25. Safety Props	1,4				
26. Sliding Wear Pads			8		
27. Pivot Pins/Bolts	1,4		7,8		
28. Switches, Ground Control	1,11				
29. Control Tags	1,2				

*** Inspection and Maintenance code 10 to be performed annually**

SECTION 3. TROUBLESHOOTING

3.1 GENERAL

This section contains troubleshooting information to be used for locating and correcting most of the operating problems which may develop in the aerial platform. If a problem should develop which is not presented in this section or which is not corrected by listed corrective actions, technically qualified guidance should be obtained before proceeding with any maintenance.

Troubleshooting and maintenance information pertaining to the prime mover (engine/motor) that are not contained in this manual are contained in the applicable engine maintenance manual.

3.2 TROUBLESHOOTING INFORMATION

The troubleshooting procedures applicable to the aerial platform are listed and defined in Tables 3-1 through 3-4. As an aid to table use, the platform sizzor is divided into 4 major groups, each covered separately within this section. These groups are as follows: Platform, chassis, hydraulic system and electrical system.

Each malfunction within an individual group or system is followed by a listing of probable causes which will enable determination of the applicable remedial action. The probable causes and remedial action should, where possible, be checked in the order listed in the tables.

It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.

It should be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems. For this reason, every effort has been made to ensure that all likely problems in these areas are given the fullest possible treatment. In the remaining machine groups, only those problems which have more than one probable cause and remedy are included. This means that problems for which the probable cause and remedy may be immediately obvious are not listed in this section.

The first rule for troubleshooting any circuit that is hydraulically operated and electrically controlled is to determine if the circuit is lacking hydraulic oil and electrical power. This can be ascertained by overriding the bypass valve (mechanically or electrically) so that oil is available to the function valve, then overriding the function valve mechanically. If the function performs satisfactorily, the problem exists with the control circuit.

3.3 HYDRAULIC CIRCUIT CHECKS

The first reference for improper function of a hydraulic system, where the cause is not immediately apparent, should be the troubleshooting chart. The best place to begin the problem analysis is at the power source (pump) Once it is determined that the pump is serviceable, then a systematic check of the circuit components, beginning with the control, would follow. For aid in troubleshooting, refer to the Illustrated Parts Manual for hydraulic diagram of the various circuits.

Table 3-1. Elevation System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Platform Elevation System		
No Response to LIft Control		
	Lift not performed within three seconds after lift function switch is selected.	Reselect lift function switch, then activate joystick within three seconds.
	Lift control switch inoperative.	Repair or replace control switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or pump.	Clean, repair or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Platform will not raise.		
	Joystick not activated within three seconds after lift switch is activated.	Activate lift switch, then activate joystick within three seconds.
	Load capacity exceeded. (Personnel and/or equipment on platform).	Reduce load. (Refer to capacity placard).
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
	Engine does not respond when lift control switch is moved to up position.	Refer to Electrical System Troubleshooting - No response to control switch.
	No electrical signal being sent to lift up control valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
Platform will not lower		
	Joystick not activated within three sec. after lift switch is activated.	Depress lift switch, then activate controller within three seconds.
	No electrical signal sent to lift down control valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
	Lift down control valve cartridge not functioning properly.	Repair or replace lift down control valve cartridge.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
	Engine does not respond when lift switch is moved to down position.	Refer to Electrical System Troubleshoot ing - No response to control switch.
	No electrical signal being sent to lift down control valve.	Refer to Electrical System Troubleshoot ing - No response to control switch.
Platform raises and lowers erratically		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line.

Table 3-1. Elevation System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Counterbalance valve on lift cyl. improperly adjusted or not functioning properly.	Replace valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Lift cylinder not functioning properly.	Repair or replace lift cylinder.
Platform drifts down		
	Manual lowering valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Holding valve on lift cylinder not functioning properly.	Repair or replace valve.
High Drive does not operate below horizontal		
	Damaged wiring on limit switch.	Repair or replace wiring.
	Damaged limit switch.	Replace limit switch

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Drive System	
No response to drive controller		
	Joystick not activated within three seconds after drive select switch is activated.	Activate drive select switch, then activate joystick within three seconds.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken pump supply line.	Clean, repair or replace line.
	Drive motor not functioning properly.	Repair or replace motor.
	Damaged wiring on drive controller.	Repair or replace wiring.
	Drive controller not functioning properly.	Repair or replace controller.
	Drive brake not releasing.	Determine cause and repair or replace brake.
Machine drives erratically		
	Microcircuit on controller improperly adjusted.	Adjust microswitch on controller for proper operation.
Machine will not travel forward		
	Joystick not activated within three seconds after drive switch is activated.	Activate drive switch, then activate joystick within three seconds.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Drive motor not functioning properly.	Repair or replace motor.
	Brake not functioning properly.	Repair or replace brake.
	Engine will not respond when enable switch is activated and drive controller is activated.	Refer to Electrical System Troubleshooting - No response to control switch.
	No electrical signal being sent to the drive valve cartridge.	Refer to Electrical System Troubleshooting - No response to control switch.
Machine will not travel in reverse		
	See: Machine will not travel forward.	
High-Speed Drive function does not operate		

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Loose or damaged wiring between drive controller and High Speed switch.	Ensure proper connection of wires. Using suitable test meter, perform continuity test on wiring between switches. Repair or replace wires as necessary.
	Defective high speed control switch.	Replace high speed control switch.
	Loose or damaged wiring in control box wire harness.	Ensure proper connection of wires at the control switch. Using suitable test meter, perform continuity test on wires. Repair or replace harness as necessary.
	Loose or damaged wiring between platform and high speed solenoid.	Ensure proper connection of wires at the platform and at the high speed solenoid. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	High speed solenoid not functioning properly.	Replace solenoid.
	Loose or damaged wiring between high speed relay and high speed limit switch.	Ensure proper connection of wires between high speed relay and high speed limit switch. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	High speed limit switch not functioning properly.	Repair or replace limit switch.
	Loose or damaged wiring in valve wiring harness.	Ensure proper connection of wires at terminal strip. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
Steering System		
No response to steer control switch on controller		
	Steer switch on controller not functioning properly.	Repair or replace switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic system pressure too low.	Adjust pressure.
	Loose or damaged wiring on control switch or solenoid valve.	Ensure proper connection of wires at control switch or solenoid valve. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	Restricted or broken hydraulic line on valve bank or hydraulic pump.	Clean, repair or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine hard to steer or steering is erratic		
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Machine hard to steer or steering is erratic (cont.)		
	Lack of lubrication on steer components.	Lubricate steer components in accordance with Lubrication Chart.
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressure.
	Bent steering linkage.	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Steering inoperative		
	Steer switch on controller not functioning properly.	Repair or replace switch.
	Hydraulic system pressure too low.	Adjust pressure.
	Loose or damaged wiring on control switch or solenoid valve.	Ensure proper connection of wires at control switch or solenoid valve. Using suitable test meter, perform continuity test on wires. Repair or replace wires as necessary.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Restricted or broken hydraulic line on valve bank or hydraulic pump.	Clean, repair or replace line.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valve as necessary.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine will not steer left or right		
	Steer switch on controller not functioning properly.	Replace controller.
	Wiring on steer control switch is damaged.	Repair or replace wiring.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	Bent cylinder rod.	Repair or replace cylinder.
	Damaged steer linkage.	Repair or replace steer linkage.
Machine wanders; steering not firm		
	Crossover relief valve set too low or not functioning properly.	Reset, repair or replace valve as necessary.
	Steer linkage loose.	Tighten linkage.
	Spindle bushings badly worn.	Replace bushings.

Table 3-3. Hydraulic System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic pump noisy		
	Air entering system through broken line or fitting	Repair or replace line or fitting
	Air bubbles in oil	Replenish oil as required
	Faulty pump coupler	Replace coupler
	Defective pump bearing	Repair or replace pump
	Oil filter(s) dirty	Clean and/or replace filter(s) as necessary
Pump cavitating (Vacuum in pump due to oil starvation		
	Restricted suction line	Clean, repair, or replace line
	Oll in reserve low	Replenish oil to proper level
	Restricted reservoir air vent	Clean vent
	Oil viscosity to high	Drain system and replace with recommended oil (Refer to hydraulic oils)
	Leak in suction line or manifold	Repair or replace line or manifold as necessary
System overheating		
	Oil viscosity too high	Drain system and replace with recommended oil (Refer to hydraulic oils)
	Restricted or blocked hydraulic line	Repair or replace line
	Machine overloaded	Check weight in platform
	Main relief valve set too high	Reset valve as required
	Hydraulic system oil low	Replenish oil as necessary
Pump not delivering oil		
	Restricted suction line	Clean repair or replace line
	Air entering system through broken line or fitting (suction side)	Replace or repair line or fitting
	Oil level too low	Replenish oil to proper level
	Plugged strainer in tank	Clean strainer
	Pump coupling defective	Replace pump coupling
	Broken pump drive shaft	Repair or replace pump
System pressure too low		
	Main relief valve set too low	Reset valve as required
	Main relief valve stuck in open position	Clean, repair or replace valve (Check system oil for contamination)
	Hydraulic pump not functioning properly	Repair or replace pump
	Leak in component, line or fitting	Repair or replace component, line or fitting
	Scored valve spool; Scored cylinder	Replace valve; Replace cylinder
System(s) operate erratically		
	Sticking or binding valve spools, piston rod, etc	Clean, repair or replace components as required
	Hydraulic oil not a t optimum operating temperature	Allow oil sufficient time to warm up
	Pump drive slipping	Repair or replace drive

Table 3-4. Electrical System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
HAND CONTROLLER		
Regardless of which way handle is moved, only one function occurs		
	Improper or loose wiring to the solenoid(s)	Check all wiring for proper connections
	Directional valve stuck in one direction	Repair or replace valve
Valve will not function when handle is moved in either direction		
	Joystick not activated within the 3 seconds after function switch was depressed	Reactivate function switch
	No electrical power to handle	Check electrical input to hand controller (12V)
	No electrical power to valve	Check electrical output of printed circuit board and electrical signal at the valve
	Improper ground	Check for proper grounding of handle
	Defective controller	Repair or replace controller
	Microswitches on controller bad or need adjustment	Adjust or replace switches
CONTROL SWITCHES		
No response to a function control switch		
	Emergency stop switch not positioned properly	Place emergency stop switch to on
	Platform/Ground select switch not positioned properly	Place switch to platform or ground, as necessary
	Circuit breaker open	Determine and correct cause. Reset circuit breaker
	No voltage present at emergency stop switch	Check battery cable from battery to emergency stop switch for proper connection or damage. Repair or replace cable as necessary
	Emergency stop switch not functioning properly	Replace switch
	No voltage supplied to start relay from emergency stop switch	Check battery cable from switch to relay for proper connection or damage. Repair or replace cable as necessary
	No voltage input at terminal strip	Check wire from battery to terminal strip for proper connection or damage. Repair or replace cable as necessary
	No voltage present at circuit breaker	Check wire from terminal strip to battery for proper connection or damage. Repair or replace cable as necessary
	Defective circuit breaker	Replace circuit breaker
	No voltage present at Platform/Ground select switch	Unplug ground control box harness from platform receptacle. check wire from applicable pin in plug to control box power switch for proper connection. Using suitable test meter, perform continuity test on wire. Repair or replace harness as necessary
	Defective Platform/Ground select switch	Replace Platform/Ground select switch

Table 3-4. Electrical System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	No voltage present at function control switch	Check wiring from power switch to function control switch for proper connection or damage. Repair or replace wiring as necessary
	Defective function control switch	Replace function control switch
	No voltage present at applicable control valve coil	Check applicable wire for proper connection at terminal strip, valve harness plug pin, valve harness receptacle pin and valve coil. Using suitable test meter, perform continuity test on wire. Repair or replace harness as necessary
	No voltage supplied to motor from start relay	Check battery cable from relay to motor for proper connection or damage. Repair or replace cable as necessary
	Defective motor/pump assembly	Replace motor/pump assembly
ENGINE STARTER SYSTEM		
Engine will not crank		
	Discharged battery or loose battery terminals	Check and charge battery or replace battery as necessary. Clean and secure battery terminals
	Starter relay faulty or faulty relay connections	Using a test meter, check relay coil terminals for presence of electrical power and for energization of relay coil. Also check relay terminals for correct switching of contacts. Replace relay as necessary
	Malfunctioning starter solenoid or motor	Replace solenoid or motor in accordance with applicable manufacturer's manual
	Defective start lockout solenoid	Replace start lockout solenoid
	Malfunctioning ignition switch	Using a test meter, check ignition switch for correct switching of contacts. replace switch as necessary
	Faulty ignition and/or starter circuit wiring	Check wiring continuity. refer to wiring diagram
	Defective ring gear or flywheel	Replace ring gear
INSTRUMENTS AND INDICATORS		
Ammeter inoperative		
	Damaged wiring in circuits	Repair or replace wiring
	Ammeter not functioning properly	Replace ammeter
	Alternator not charging	Repair or replace alternator
Travel warning horn inoperative		
	Circuit breaker open	Determine and correct cause
	Damaged wiring in horn circuit	Replace horn
Hourmeter inoperative		
	Damaged wiring in hourmeter circuit	Repair or replace wiring
	Inoperative hourmeter	Replace hourmeter

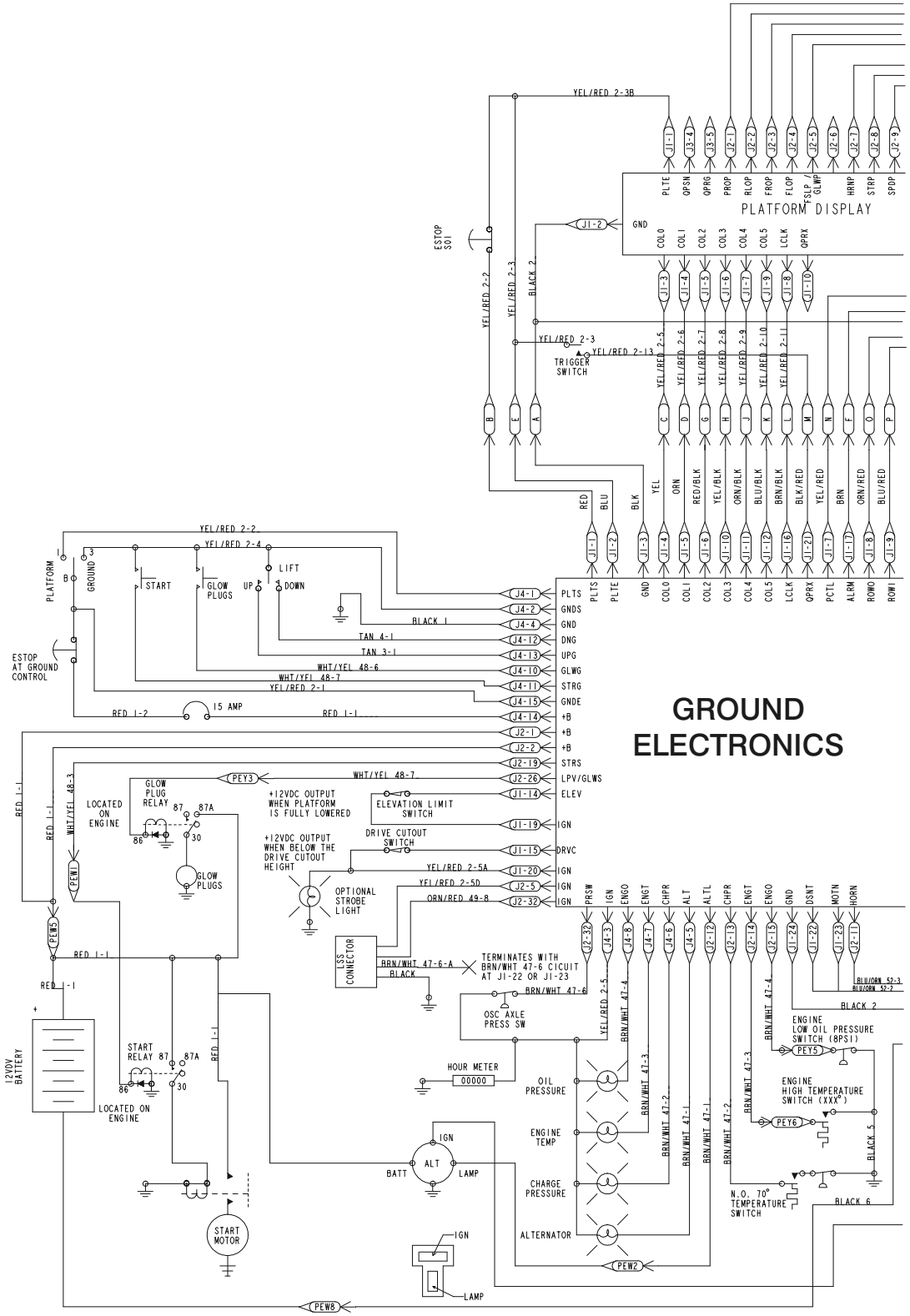

Figure 3-1. Electrical Schematic - Sheet 1 of 2

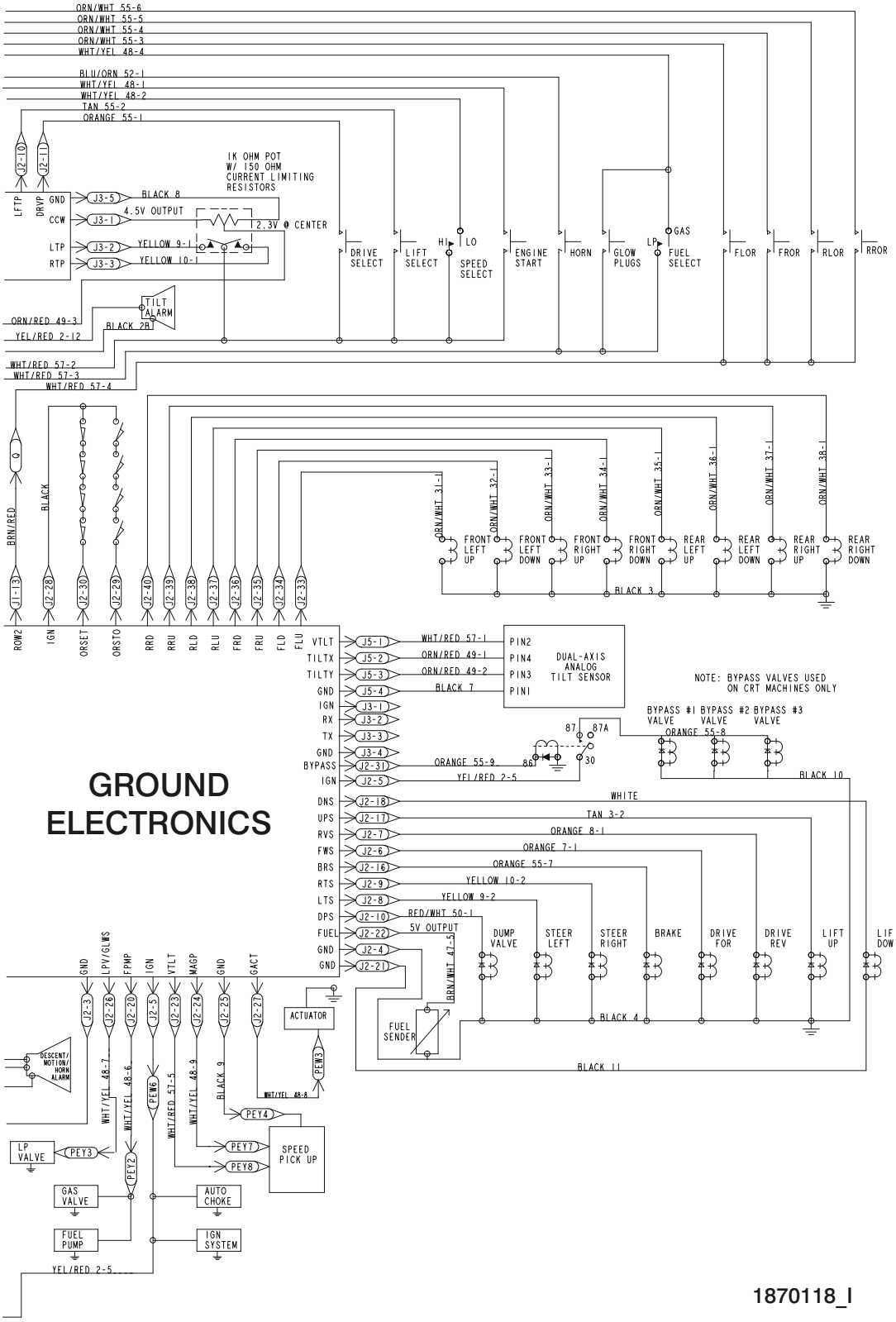

Figure 3-2. Electrical Schematic - Sheet 2 of 2

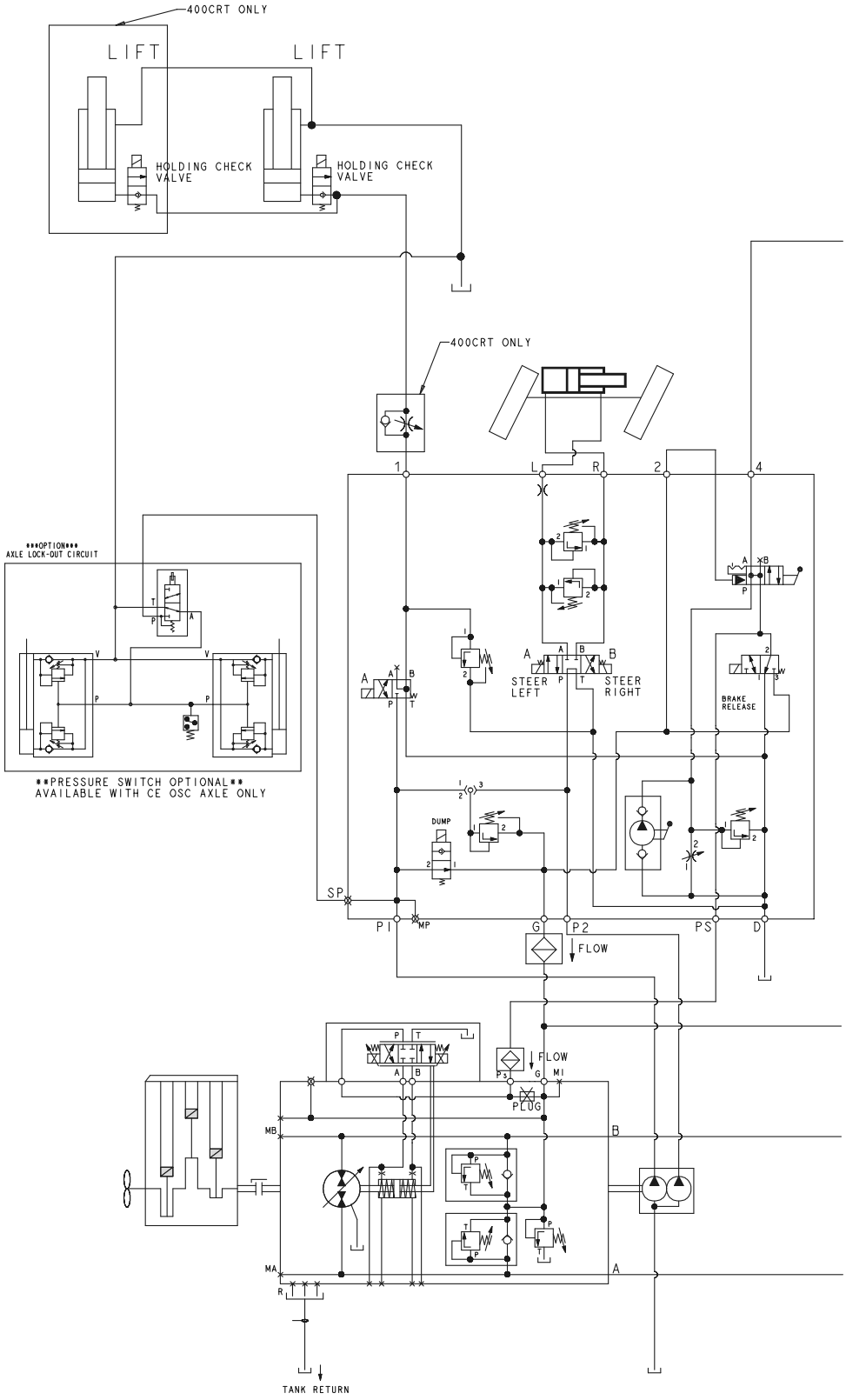

Figure 3-3. Hydraulic Schematic - Sheet 1 of 2

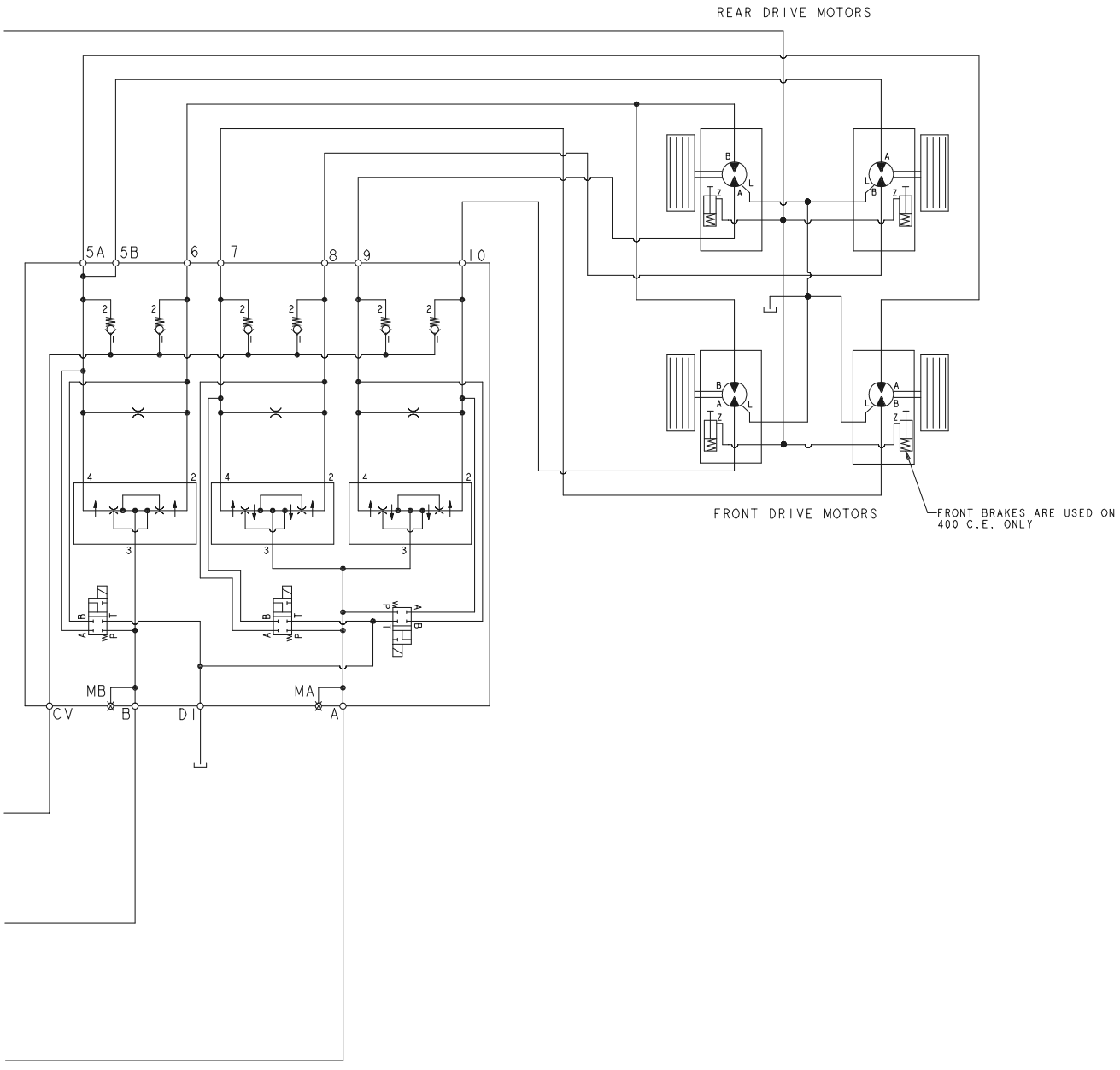

Figure 3-4. Hydraulic Schematic - Sheet 2 of 2

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PROPOSITION 65 WARNING

- **Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.**
- **Batteries also contain other chemicals known to the State of California to cause cancer.**
- **Wash hands after handling.**

⚠ WARNING: ⚠

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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