



Service and Maintenance Manual

Models ***3369electric*** ***3969electric***

3120768

March 10, 2004

ANSI



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 SIZZOR UNTIL PLATFORM 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.

REVISION LOG

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Hydraulic Oil Tank

11.0 gallons (41.6 liters)

Hydraulic System

Approximately 13.2 gallons (50.0 liters)

Torque Hubs (2)

17 ounces (0.5 liters)

1.2 COMPONENT DATA

Battery Charger

Input, 110 VAC, 60 HZ

Output, 48 VDC (23 Amp)

Batteries (8)

6 Volt, 245 AmpHour

Drive System

Drive Motor - 36 VDC, 4.1 H.P. @ 1880 rpm. continuous, rotation - reversible

Drive Brake- 24 VDC, spring-applied, electrically released

Steer System

Tires - ST205 75R15, Load Range C, 6 Ply Rating, Poly Filled

Toe-In - Adjust to 1/4 inch (6.4 mm) overall

Hydraulic Filter

Return, 25 Micron

Hydraulic Pump/Electric Motor Assembly

Motor - 48 VDC, 5.5 H.P. @ 2500 rpm

Pump - 0.098 in.³/rev. (1.6 cm³/rev.)

Pump Output - 1.09 gpm (4.13 lpm) @ 2000 psi (137.9 Bar)

1.3 PERFORMANCE DATA

Travel Speed

3369/3969 electric - 3.0 mph (4.8 kmh)

High Drive for/rev (sec/50 ft) - 11-13 sec

Creep Drive for/rev (sec/50 ft) - 50-60 sec

Gradeability

25%

Turning Radius (Inside)

3369 electric - 60 in (1.52 m)

3969 electric - 60 in (1.52 m)

Turning Radius (Outside)

3369 electric - 149 in (3.81 m)

3969 electric - 149 in (3.81 m)

Platform Lift Speed

3369 electric - Lift Up - 75 - 80 seconds

3369 electric - Lift Down - 50 - 60 seconds

3969 electric - Lift Up - 75 - 80 seconds

3969 electric - Lift Down - 50 - 60 seconds

Platform Capacity

3369 electric - 1000 lbs (454 kg)

3969 electric - 750 lbs (340 kg)

Platform Extension Capacity

3369 electric - 500 lbs (227 kg)

3969 electric - 500 lbs (227 kg)

Machine Weight

3369 electric - 8,000 lbs (3629 kg)

3969 electric - 8,800 lbs (3992 kg)

Machine Height (w/rails folded down)

3369 electric - 73 in (1.85 m)

3969 electric - 79 in (2.01 m)

Machine Length (stowed)

3369 electric - 109 in (2.77 m)

3969 electric - 109 in (2.77 m)

SECTION 1 - SPECIFICATIONS

Machine Width

3369 electric - 69 in (1.80 m)

3969 electric - 69 in. (1.80 m)

Wheelbase

3369 electric - 77 in (1.98 m)

3969 electric - 77 in (1.98 m)

Ground Clearance

3369 electric - 7 in (17.8 cm)

3969 electric - 7 in (17.8 cm)

Maximum Tire Load

3369 electric - 3060 lb (1388 kg)

3969 electric - 3145 lb (1427 kg)

Maximum Bearing Pressure

3369 electric - 56 psi (3.9 bar)

3969 electric - 58 psi (3.9 bar)

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 of 152.

When temperatures remain consistently below 2° F (-7 ° C), JLG recommends the use of Mobil DTE 11.

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.

Lubrication Specifications

Table 1-3. Lubrication Specifications

KEY	SPECIFICATIONS
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GI-3, BP Energol SHS46.
LL	Synthetic Lithium Lubricant, Gredag 741 Grease.

*MPG may be substituted for these lubricants, if necessary, but service intervals will be reduced.

NOTE: Refer to Lubrication Chart for specific lubrication procedures.

1.4 TORQUE SPECIFICATIONS

Table 1-1. Torque Specifications

DESCRIPTION	TORQUE VALUE (DRY)	INTERVAL HOURS
Torque Hub	75 ft. lbs. 102 (NM)	500
Wheel Bolts	90 ft. lbs. (122 NM)	50

NOTE: When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.

1.5 LUBRICATION

Table 1-2. Hydraulic Oil

Hydraulic System Operating Temperature Range	SAE Viscosity Grade
0° F to 23° F (-18°C to -5°C)	10W
0° F to 210° F (-18°C to +99°C)	10W-20, 10W-0
50° F to 210° F (+10°C to +99°C)	20W-20

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1.6 PRESSURE SETTINGS

Lift Up Relief - 3369ES - 2500 psi (172 bar)

3969ES - 2700 psi (186 bar)

Lift Down Relief - 1000 psi (69 bar)

Steer Relief - 1200 psi (82.74 bar)

NOTE: Main Relief at Pump - 2700 psi (186.2 bar)

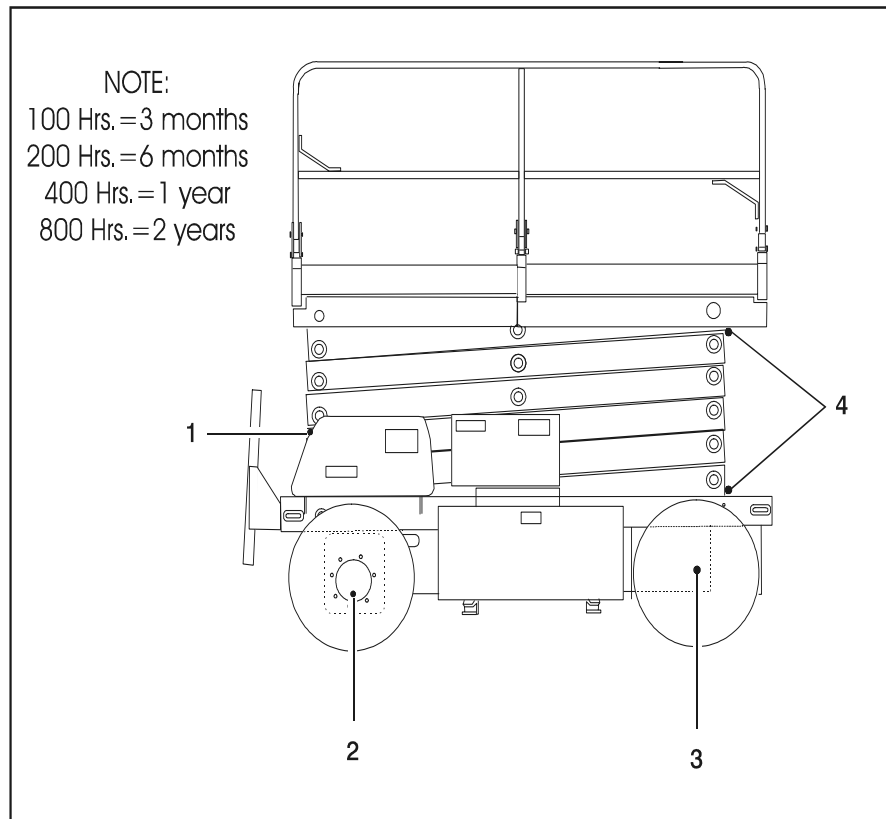


Figure 1-1. Lubrication Chart

Table 1-4. Lubrication Chart

INDEX NUMBER	COMPONENT	NO/TYPE LUBE POINTS	LUBE/METHOD	INTERVAL HOURS	COMMENTS
1	Hydraulic Oil	Fill Cap/Drain Plug	HO-Kendall Hyken 052	8/800	Check oil every 8 hours of operation. Change oil every 800 hours of operation.
2	Torque Hub	Fill Plug/Half Full	EPGL-SAE 90	2000	Check oil level at side plug on hub.
3	Wheel Bearings	N/A	MPG - Repack	800	2 years
4	Sliding Pads	Wear Pads (8)	MPG - Brush	50	N/A
5 (not shown)	Hydraulic Filter Element	N/A	Replaceable Element	40/250	Replace filter element after first 40 hours of operation then every 250 hours thereafter.

KEY TO LUBRICANTS:

HO - Hydraulic Oil -Kendall Hyken 052

EPGL - Extreme Pressure Gear Lube

NOTE: Be sure to lubricate like items on each side of the machine.

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, lubricating frequencies must be increased accordingly

SECTION 1 - SPECIFICATIONS

1.7 CYLINDER SPECIFICATIONS

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

Table 1-5. Cylinder Specifications

DESCRIPTION	BORE	STROKE	ROD DIA.
Lift Cylinder	4.00 (10.16)	14.68 (37.29)	2.50 (6.35)
Steer Cylinder (Double Rod)	2.00 (5.08)	3.00 (7.62) each direction	1.25 (3.18) each rod

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

1.8 MAJOR COMPONENT WEIGHTS

Table 1-6. Major Component Weights

COMPONENT	3369 ELECTRIC		3969 ELECTRIC	
	LBS.	KG.	LBS.	KG.
Platform	761	345	761	345
Platform Extension	320	145	320	145
Arm Assembly (Includes Lift Cylinders)	3393	1539	3903	1770
Chassis (Includes Battery Box and Foam filled Tires)	3662	1661	3662	1661
Machine Complete (GVW)	8000	3629	8800	3992

1.9 CRITICAL STABILITY WEIGHTS

Table 1-7. Critical Stability Weights

COMPONENT	3369/3969 ELECTRIC	
	LBS.	KG.
Platform	761	345
Platform Extension	320	145
Foam Filled Tires	150	68
Battery (Each)	77	35

1.10 RELAYS/CIRCUIT BREAKERS

Console Box

Relay - Potter & Brumfield P/N K10P-11D15-48 48VDC.

Circuit Breaker - Wood Electric Corp. P/N W58 x BIA4 A-5.

1.11 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the front of the frame. If the serial number plate is damaged or missing, the machine serial number is stamped on the right front of the machine frame.

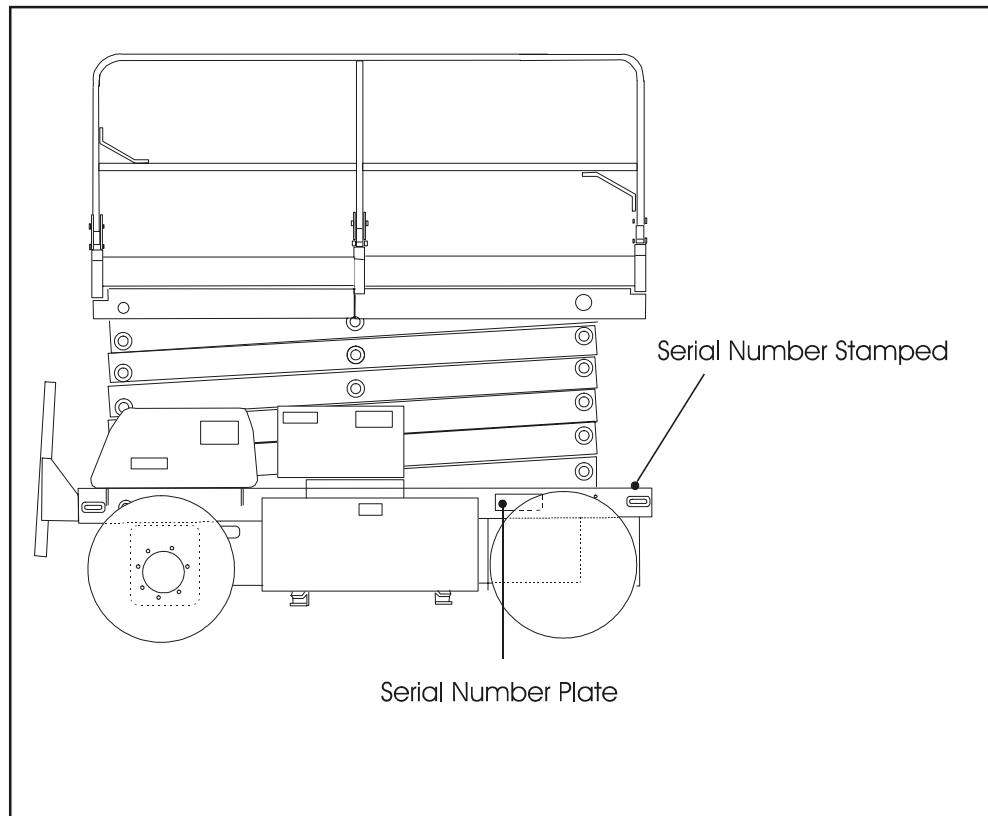


Figure 1-2. Serial Number Location

VALUES FOR ZINC PLATED BOLTS ONLY													UNPLATED CAP SCREWS	
SIZE	THD	BOLT DIA. (IN.)	THREAD STRESS AREA (SQ. IN.)	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	TORQUE (as received) LB. FT.	
				CLAMP LOAD (LB.)		TORQUE (LOCITITE 262) LB. IN.		CLAMP LOAD (LB.)		TORQUE (LOCITITE 262) LB. IN.				
				(DRY OR LOC. 263) LB. IN.	(LUB.) LB. IN.	(LOCITITE 262) LB. IN.	(LOCITITE 242 OR 271) LB. IN.	(DRY OR LOC. 263) LB. IN.	(LUB.) LB. IN.	(LOCITITE 262) LB. IN.	(LOCITITE 242 OR 271) LB. IN.			
4	40	0.1120	0.00604	380	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	—	2860	144	108	—	160	3180 13	
	28		0.0364	2320	120	86	—	3280	168	120	—	185	3640 14	
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 cadmium plated fasteners.



SAE GRADE 5



SAE GRADE 8

Figure 1-3. Torque Chart

SECTION 2. PROCEDURES

2.1 GENERAL

1. This section provides information necessary to perform maintenance on the sizzor 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.

2. 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 oil supplies clean; however, these items must be maintained on a scheduled basis in order to function properly.

2. At any time when hydraulic 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.

Component Removal and Installation

1. 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.
2. Should it be necessary to remove a component on an angle, keep in mind that the capacity of an eye-bolt or similar bracket lessens, as the angle between the supporting structure and the component becomes less than 90 degrees.
3. 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.

SECTION 2 - PROCEDURES

3. If 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 be installed.
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 are 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 interval. 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.; 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.
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 at the specified intervals required in Section 1. 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, 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 Lubrication Specification Table for recommendations for viscosity ranges.
2. JLG recommends Kendall Hyken 052 Hydraulic Oil, which has an SAE viscosity of 10W-20 and a viscosity index of 152.

NOTE: Start-up of hydraulic system with oil temperatures below -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 -15° F.

3. The only exception to the above is to drain and fill the system with Mobil DTE13 oil or its equivalent. This will allow start up at temperatures down to -20° F. However, use of this oil will give poor performance at temperatures above 120° F. Systems using DTE13 oil should not be operated at temperatures above 200° F under any condition.

Changing Hydraulic Oil

1. Use of any of the recommended hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 40 hours of operation and every 250 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 annually.
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 requirements. Should any question arise regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Section 1 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDERS - THEORY OF OPERATION

1. 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.
2. Holding valves are used in the lift circuits to prevent retraction of the cylinder rod should a hydraulic line rupture or leak develop between the cylinder and its related control valve.

2.5 VALVES - THEORY OF OPERATION

Control Valves

It consists of cartridge type valves in an anodized aluminum manifold. The cartridge valves provide for control of flow, volume of flow and pressure in the hydraulic system.

The directional control valves are solenoid operated, three position, 4-way sliding spool type valves. One valve is provided for each of the two functions. Energizing one of the electrical coils on a valve will divert the supply of hydraulic oil to provide motion of that function in one direction. Energizing the other coil will divert the oil for motion in the other direction. When neither coil is energized, the supply of hydraulic oil is blocked.

Flow control valves in the lift circuits provide for control of the rate of flow when the oil is flowing out of the cap ends of the cylinders (the load is being lowered). An adjusting screw on each cartridge flow control valve allows the rate of flow (speed) to be adjusted. When oil is flowing into the cap end of the lift cylinders, an internal check valve feature allows unrestricted flow.

Pressure relief valves limit the pressure in the steer circuit and the rod end of each lift cylinder. When the pressure in one of those circuits reaches the set point of the valve, the valve opens, allowing enough flow to return to the reservoir so that the set pressure is not exceeded. An adjusting screw on each cartridge relief valve allows the set pressure to be adjusted.

The aluminum manifold provides the passages through which the hydraulic oil is diverted to provide the desired movement of the actuators. No moving parts of the valves slide against the manifold and so it is not subject to wear.

2.6 COMPONENT FUNCTIONAL DESCRIPTION

Hydraulic Pump

The single stage gear pump is attached to the electric motor located on the right rear of frame.

Manual Descent Pump

The manual operated hand pump is located on the right rear of frame behind ground control station.

2.7 WEAR PADS

The original thickness of the sliding wear pads is 5 in (12.7 mm). Replace sliding pads when worn to 4.7 in (11.9).

2.8 MOTOR CONTROLLER - MODES OF OPERATION

Traction Motor Drive

Drive in either forward or reverse will start only if the following conditions are satisfied:

1. Function switches off.
2. No procedure or diagnostic faults present.
3. TEB operate

The function is selected in a 3-second window after the TEB has been momentary closed.

The function is selected in a 10-second window after the TEB has been permanently closed.

Another function was operated less than 3-seconds before.

4. FWD or REV selected as appropriate.

Once in "drive" mode, activating a function switch shall not cause drive mode to be exited, the pump/traction contactor drive shall not be energized it will be left at the traction position. If a function switch is selected during traction, a procedure fault will occur when neutral is selected, remaining until a function switch and both directions are no longer selected.

When neutral is selected, the controller will control smooth stopping of the machine, using plug braking, before the electric brake is allowed to operate.

If a function switch is activated in neutral, when the vehicle has stopped and the brake is applied, then pump mode will become operational.

Pump Motor Drive

Pump motor drive will start only if the following conditions are satisfied:

1. FWD and REV switch off.
2. Traction mode off (brake applied).
3. TEB operate

The function is selected in a 3-second window after the TEB has been momentarily CLOSED.

The function is selected in a 10-second window after the TEB has been permanently CLOSED.

Another function was operated less than 3-seconds before.

Pump drive shall only be enabled when the direction selector inputs are in neutral and the machine is stationary. Once pump drive mode has been entered, then the status of the direction selector inputs shall no longer interlock pump operation. If a direction switch is selected during pump drive, a procedure fault will occur when the function switch is no longer selected, remaining until both directions and the function switch are no longer selected.

2.9 FEATURES

Features in Traction Mode

Maximum Speed Control.

The controller incorporates a function to limit the maximum speed of the machine to a percentage of maximum possible speed. The function operates in such a manner as to control vehicle speed by limiting the percentage on of the switching device to keep the machine speed below the maximum permitted value or, if required, to apply variable plug braking to restrict machine speed when traveling down a grade. The speed is controlled based on the percentage of accelerator input.

Features in Pump Mode

1. **Proportional Control of Pump Motor Speed** - The pump motor speed shall be controlled by varying the percentage on of the switching element in relation to a separate pump accelerator input.
2. **Soft Start** - The pump motor speed control incorporates a "soft start" facility by applying acceleration delay to changes in the applied percentage on of the switching element.

General Features

Diagnostics

To obtain flash code, depress enable switch and repeat operation which caused fault. After fault occurs, maintain function position and read flash code.

NOTE: Flash code repeats after pause.

Flash code readings must be taken from platform control box with unit switched to platform

Table 2-1. Flash Codes

Code	Description
LED On	Controller Operational
LED Off	Internal fault or power not turned on
1 Flash	Internal fault
2 Flashes	Procedure fault
3 Flashes	Motor permanently low
4 Flashes	Motor permanently high
5 Flashes	Motor neither low nor high (Open circuit)
6 Flashes	Faulty drive hand controller
7 Flashes	Low battery voltage
8 Flashes	Thermal cutback, controller
10 Flashes	Tachometer fault
11 Flashes	Tachometer out of calibration

NOTE: Refer to Troubleshooting Section 3 for specific flash code troubleshooting information.

2.10 CYLINDER CHECKING PROCEDURES

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

Cylinder Without Counterbalance Valves (Steer)

1. Using all applicable safety precautions, activate hydraulic system and fully extend cylinder to be checked. Shut down hydraulic system.
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 initial discharge, there should be no further leakage from the retract port.

3. Activate hydraulic system, and activate cylinder extend function.
4. If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to retract port and retract cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repairs must be made.
5. With cylinder fully retracted, shut down motor and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate hydraulic system and activate cylinder retract function. Check extend port for leakage.
7. 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. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repairs must be made.

Cylinders With Single Counterbalance Valve (Lift Cylinder)

IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.
2. Raise platform completely and place a suitable overhead lifting device approximately 1 in (2.5 cm) below the platform.
3. After completing the above, shut down hydraulic system and allow machine to sit for 10-15 minutes. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate 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 following cylinder repairs must be made. If the retract port is leaking, the piston is leaking, the piston seals are defective and must be replaced. If the extend port is leaking, the counterbalance 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 complete cycle to check for leaks and operation.

2.11 CYLINDER REMOVAL AND INSTALLATION

Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the motor and raise the platform. Shut down the motor and attach a suitable lifting device to the platform.
2. Remove the bolt, locknut and keeper shaft 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 cylinder rod completely.
4. Tag and disconnect, then cap the lift cylinder hydraulic lines and ports.
5. Remove the bolt, locknut and keeper shaft 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.
6. Carefully remove the cylinder from the sizzor lift and place in a suitable work area.

Lift Cylinder Installation

1. Install lift cylinder in place using a suitable slings, aligning barrel end attaching 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 bolt, locknut and keeper shaft.
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 holes with the hole on the arm assembly. Secure the pin in place with bolt, locknut and keeper shaft.
5. Lower platform to stowed position and shut down motor. Check hydraulic fluid level and adjust accordingly.

2.12 CYLINDER REPAIR

NOTE: The following are general procedures that apply to all of the cylinders on this machine. Procedures that apply to a specific cylinder will be so noted.

Disassembly

⚠ IMPORTANT

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

6. Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if necessary.
7. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.

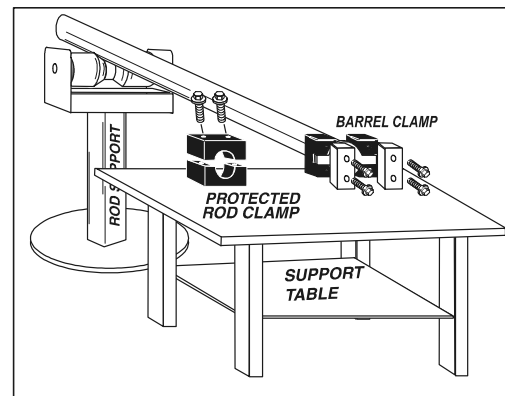


Figure 2-1. Barrel Support

8. Place the cylinder barrel into a suitable holding fixture.

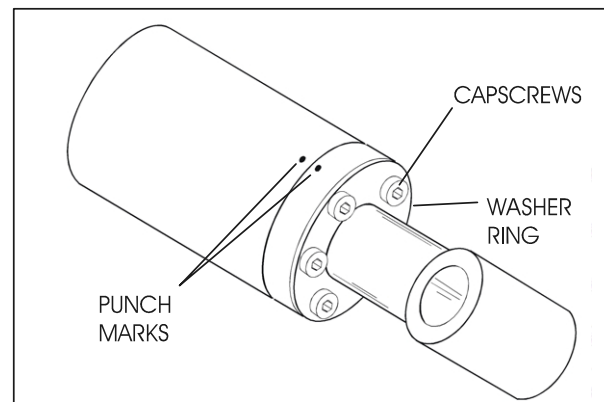


Figure 2-2. Capscrew Removal

9. To aid in realignment, mark cylinder head and barrel with a center punch.
10. Using a suitable spanner wrench, loosen the spanner nut retainer and remove the spanner nut from the cylinder barrel.
11. Attach a suitable pulling device to the cylinder rod port block 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.

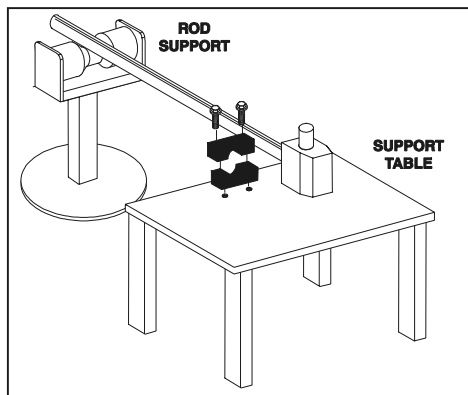


Figure 2-3. Rod Support

8. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
9. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
10. If applicable, loosen and remove the nut which attaches the piston to the rod, then remove the piston from the rod.
11. If applicable, loosen and remove the cap screw(s) securing the tapered bushing to the piston.
12. Insert the capscrew(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, then remove the bushing from the piston.
13. Screw the piston counter-clockwise, by hand, and remove the piston from the cylinder rod.
14. Remove and discard the piston o-rings, back-up rings, guidelock rings and hydrolock seals.
15. If applicable, remove the piston spacer from the rod.

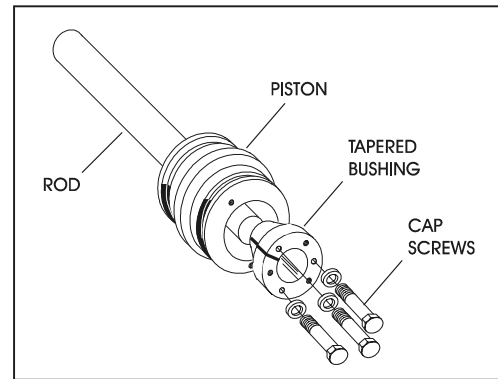


Figure 2-4. Tapered Bushing Removal

16. Remove the rod from the holding fixture. Remove the cylinder head and retainer plate from the rod.

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 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.

SECTION 2 - PROCEDURES

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 lubrication and excessive wear. If necessary, replace bearings as follows:
 - a. Thoroughly clean steel bushing hole 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 or barrel (as applicable) must be replaced.
 - c. Lubricate inside of steel bushing with WD-40 prior to bearing installation.
 - d. Using arbor of the correct size, carefully press the bearing into the steel bushing.

NOTE: Install the cylinder pin into the Oil-lite bearing dry. Lubrication is not required with chrome pins and bearings.

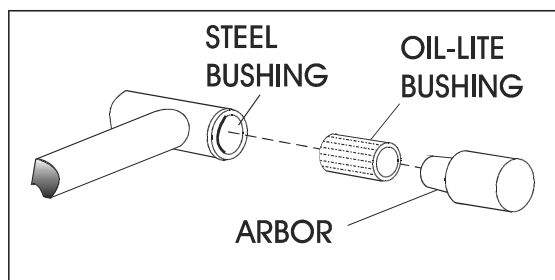


Figure 2-5. Oil-lite Bearing Installation

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.

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

1. Using a special tool, pictured in the following illustration, install a new rod seal into the applicable cylin-

der head gland groove. Refer to the following illustration for the proper tool size.

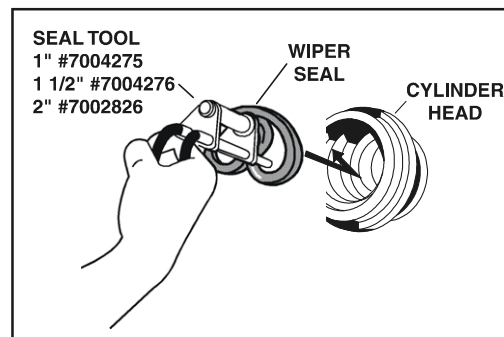


Figure 2-6. Rod Seal Installation

⚠ IMPORTANT

WHEN INSTALLING NEW "POLY-PAK" TYPE PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. (SEE FIGURE 2-11.) FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

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

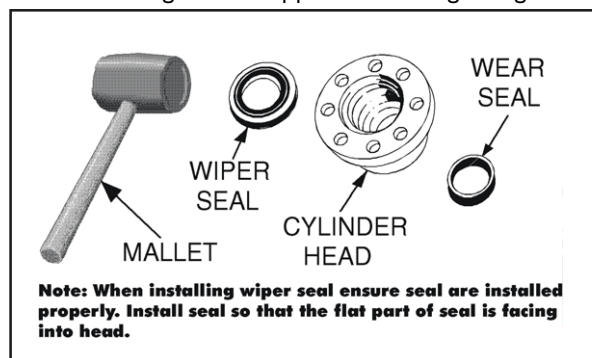


Figure 2-7. Wiper Seal Installation

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

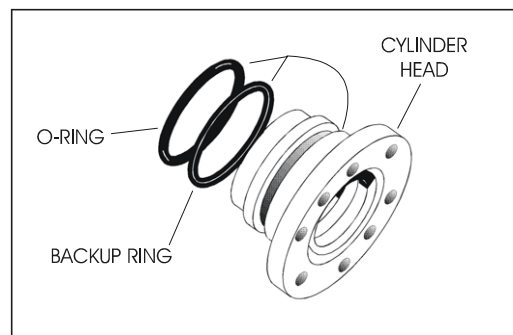


Figure 2-8. Installation of Head Seal Kit

4. Install a washer ring onto the rod, then 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 onto the rod.
6. If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.
7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and back-up rings are not damaged or dislodged.
9. Thread the piston onto the rod until it abuts the spacer end and install the tapered bushing.

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

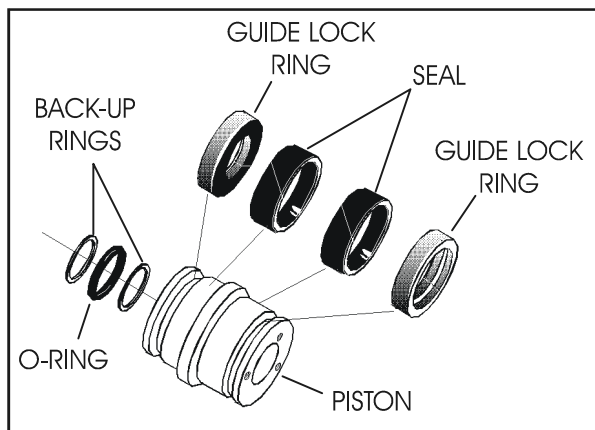


Figure 2-9. Piston Seal Kit Installation

⚠ WARNING

WHEN REBUILDING THE LIFT CYLINDER, APPLY LOCTITE #242 TO TAPERED BUSHING BOLTS, THEN TIGHTEN BOLTS SECURELY. REFER TO TABLE 2-2, CYLINDER PISTON NUT TORQUE SPECIFICATIONS AND TABLE 2-3, HOLDING VALVE TORQUE SPECIFICATIONS FOR PROPER BOLT TORQUE VALUES.

10. Install the bolts into the bushing using Loctite #242. Refer to Cylinder Component Torque Specifications Table for proper bolt torque values.
11. Remove the cylinder rod from the holding fixture.

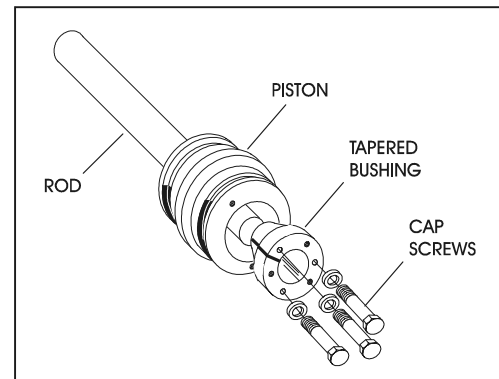


Figure 2-10. Tapered Bushing Installation

12. Place new guidelock and hydrolock seals in the applicable outside diameter grooves of both the piston and the cylinder head.
13. Position the cylinder barrel in a suitable holding fixture.

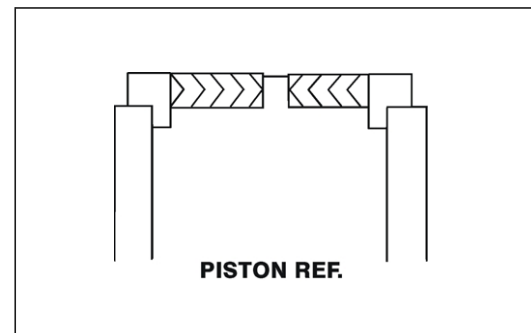


Figure 2-11. Poly-Pak Piston Seal Installation

⚠ 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.

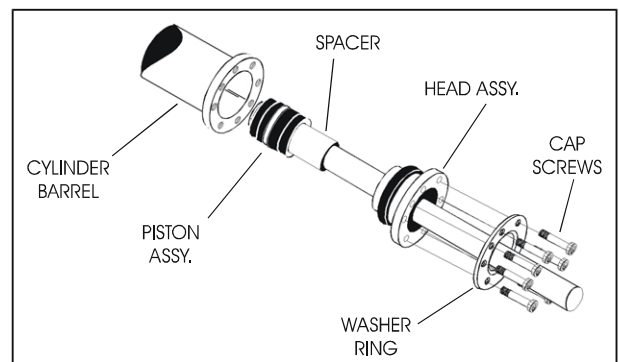


Figure 2-12. Rod Assembly Installation

SECTION 2 - PROCEDURES

14. With the barrel clamped securely, and while adequately supporting the rod, insert the piston end into the cylinder barrel. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
15. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the cylinder barrel.
16. Secure the cylinder head gland using the washer ring and socket head bolts.
17. 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.
18. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable.

WARNING

WHEN REBUILDING THE LIFT CYLINDERS, APPLY LOCTITE 242 TO PISTON NUT AND SETSCREWS.

Table 2-2. Cylinder Piston Nut Torque Specifications

Description	Nut Torque Value (Wet)	Setcrew Torque Value (Dry)
Lift Cylinder	400 ft. lbs. (542 NM)	100 in. lbs. (12 NM)
Steer Cylinder	N/A	N/A

Table 2-3. 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	150-160 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)

NOTE: These cylinders use setscrews which should be discarded and replaced whenever they are removed.

19. Remove cylinder rod from the holding fixture.
20. Place new o-rings and seals in the applicable outside diameter grooves of both the piston and the cylinder head.
21. 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.

22. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the cylinder barrel. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
23. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder or if applicable until the cylinder head threads engage the barrel threads.
24. If applicable, apply loctite #222 and secure the cylinder head retainer using a suitable chain wrench.

NOTE: Step (16) applies to the Steer Cylinder.

25. Insert the other cylinder head gland into the barrel cylinder. Secure the cylinder head retainer using a suitable chain wrench.
26. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valves.
27. If applicable, install the cartridge type holding valve and fittings in the rod port block using new o-rings as applicable. Refer to Table 2-3, Holding Valve Torque Specifications for proper torque.

CAUTION

IF THE CYLINDER IS TO BE TESTED PRIOR TO INSTALLATION ON THE MACHINE, EXTREME CARE SHOULD BE USED TO INSURE THAT THE OUTER END OF THE ROD IS SUPPORTED. USE EITHER A TRAVELING OVERHEAD HOIST, FORKLIFT, OR OTHER MEANS TO SUPPORT THE OVERHANGING WEIGHT OF THE EXTENDING ROD.

2.13 TILT SWITCH INDICATOR LEVELING PROCEDURE

⚠ CAUTION

PERFORM TILT SWITCH LEVELING PROCEDURE A MINIMUM OF EVERY SIX MONTHS TO ENSURE PROPER OPERATION AND ADJUSTMENT OF SWITCH.

Manual Adjustment

1. Park the machine on a flat level surface. Be sure it is as level as possible, with tires filled to rated pressure.

NOTE: Ensure switch mounting is level and securely attached.

2. Tighten the three flange nuts with a socket wrench. Each nut should be tightened approximately one-quarter of its spring's travel.
3. Using bubble level on top of indicator, Tighten or loosen the three flange nuts until indicator is level.
4. Individually push down on one corner at a time. There should be enough travel to cause the indicator to trip. If the indicator does not trip in all three tests, the flange nuts have been tightened too far.

2.14 LIMIT SWITCHES

Drive Cut-Out Limit Switch (3969electric)

This switch is located on the front of the machine frame. Adjust cam to trip limit switch when platform is elevated to 32 ft (9.75 m).

High Speed Drive Cut-Out

High drive speed is cut out when platform is raised above stowed (fully lowered) position.

NOTE: There is no adjustment to be made to the Platform Ext. limit switch which bolts on the bottom of the platform (If Equipped).

2.15 PRESSURE SETTING PROCEDURES

Main Relief at Pump

1. Install pressure gauge at port "G" on 4640915 valve.
2. Activate and bottom out Lift Up. Adjust Main Relief to 2500 psi (172.37 bar).

Lift UP Relief

1. With pressure gauge at "G" port on 4640915 valve, activate and bottom out Lift Up.
2. Adjust Lift Relief to 2500 psi (172 bar).on the 3369ES and 2700 psi (186 bar) on the 3969ES

Lift Down Relief

1. With pressure gauge at "G" port on 4640915 valve, activate and bottom out Lift Down.
2. Adjust Lift Relief to 900 psi (62.06 bar).

Steer Relief

1. With pressure gauge at "G" port on 4640915 valve, activate and bottom out Steer Left or Right.
2. Adjust Steer Relief to 1200 (82.7 bar).
3. Shut down hydraulic system and remove pressure gauge.

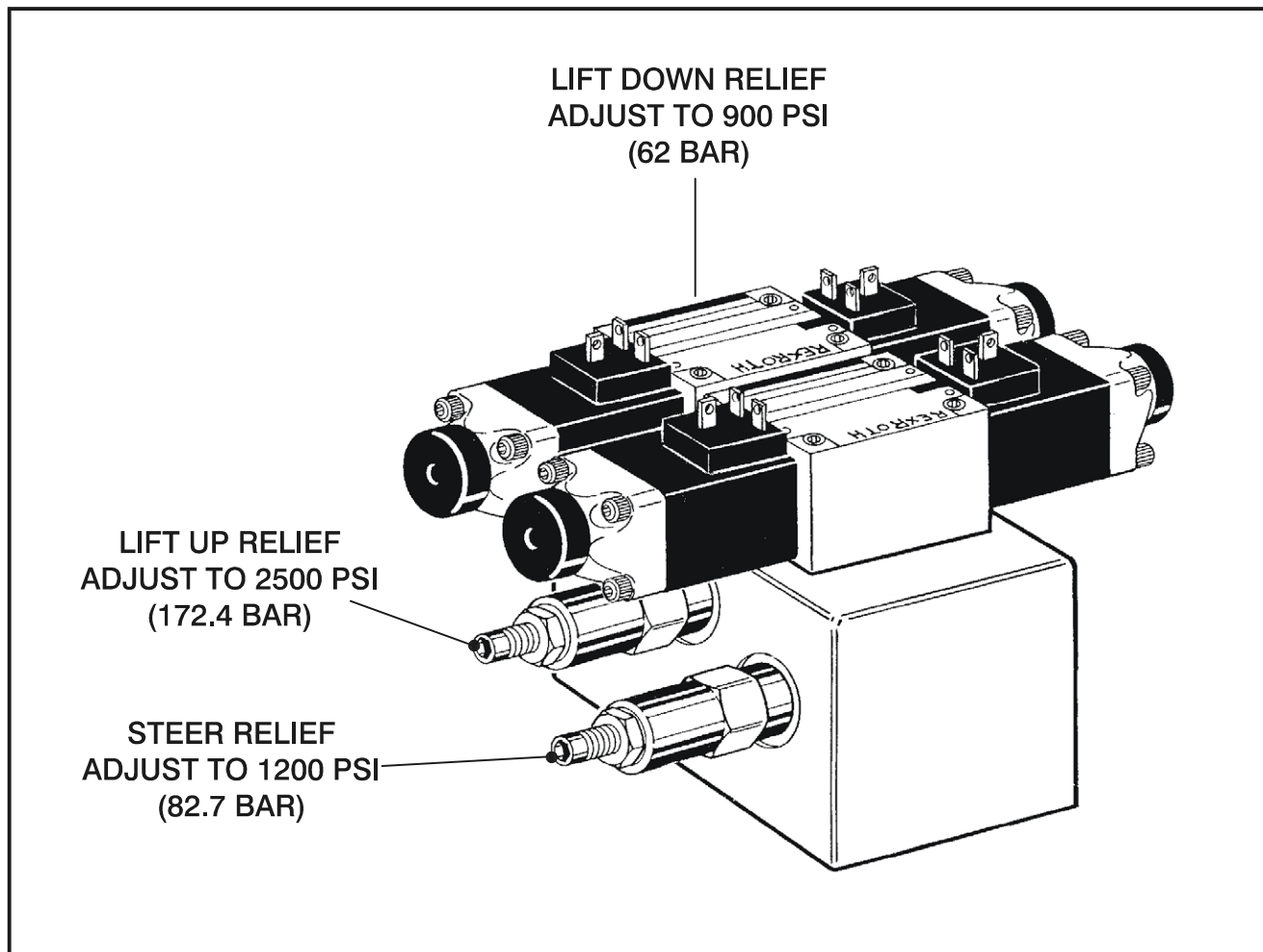


Figure 2-13. Pressure Setting Procedures

2.16 DRIVE TORQUE HUB

Disassembly

1. Loosen all cover bolts (28 & 29) and drain oil from unit.
2. Remove the cover bolts (28 & 29) and lift off input cover. Remove and discard o-ring from counterbore of input cover.
3. Remove sun gear and thrust washer.
4. Lift out the carrier and thrust washer.
5. Remove input spacer.
6. Lift out internal gear and thrust washer.
7. While wearing eye protection, remove the retaining ring from the output shaft and discard.
8. Remove thrust washer from the output shaft.
9. The output shaft may now be pressed out of the housing.
10. The bearing cups will remain in hub as will the inner bearing cone. The outer bearing cone will remain on the output shaft. The lip seal will be automatically removed during this procedure.

NOTE: If bearing replacement is necessary, the bearing cups can be removed with a slide hammer puller or driven out with a punch.

11. To remove the cluster gears from the carrier, drive the roll pin into the planet shaft. The planet shaft may now be tapped out of the carrier. After planet shaft has been removed, the roll pin can be driven out.

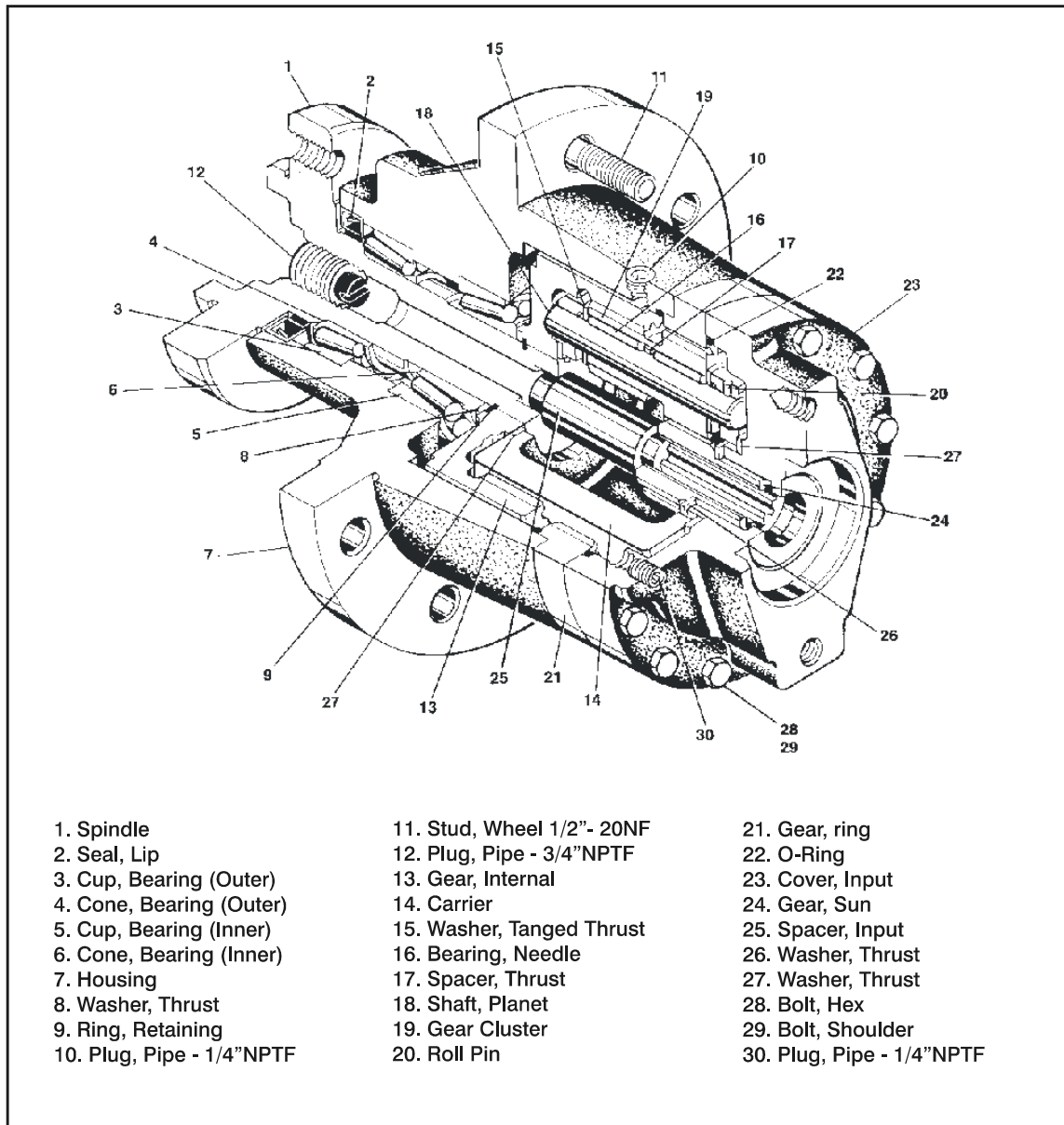


Figure 2-14. Drive Torque Hub Assembly

12. The cluster gear can now be removed from the carrier). The tanged thrust washer will be removed from the cluster gear.
13. The needle bearings and thrust spacer are now removed from cluster gear.

NOTE: When rebuilding or repairing the unit, the retaining ring (9), o-rings (22), and seal (2) should always be replaced.

Assembly

1. With the hub shaft sub-assembly resting on the shaft install internal gear. The spline of the internal gear. bore will mesh with the spline of the output shaft.
2. Thrust washer (27) is installed on the face of the output shaft. Sufficient grease or petroleum jelly should be used to hold thrust washer in place.

3. Place o-ring into hub counterbore. Use petroleum jelly to hold in place. Locate and mark the four counter beamed holes in the face of the housing. This is for identification later in the assembly.
4. Thrust spacer (25) is installed into the bore of the output shaft. This should be a slip fit and the thrust spacer should rotate in this location.
5. Place carrier assembly on a flat surface with the gear cluster up. Find the punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin.
6. With shoulder side of ring gear facing down, place ring gear over (into mesh with) cluster gear. Be sure that punch marks remain in correct location during installation. The side of the ring gear with an "X" stamped on it should be up.
7. While holding ring gear and cluster gear in mesh, place small side of cluster gear into mesh with the internal gear and sun gear. On the ring gear, locate the hole marked "X" over one of the marked counterbored holes in hub.

NOTE: *If gears do not mesh easily or carrier assembly does not rotate freely, then remove the carrier and ring gear and check the cluster gear timing.*

8. Sun gear is installed, meshing with the teeth of the large diameter cluster gear. The counterbore on the sun gear locates on the shoulder of the input spacer. This is to be a slip fit and should operate freely.
9. Thrust washer is installed onto the sun gear and should locate on the gear teeth shoulder.
10. Thrust washer is installed into the counterbore of the carrier.
11. Place o-ring into input cover counterbore. Use petroleum jelly to hold o-ring in place.
12. The input cover is now installed on this assembly. Taking care to correctly align pipe plug hole with those in the hub, usually 90 degrees to one another, locate the four counterbore holes in housing, marked in step (3) and install four shoulder bolts. A tap with a hammer may be necessary to align shoulder bolt with hub counterbore.
13. Install bolts into remaining holes.
14. Pipe plugs are to be installed into input cover using a lubricant seal.
15. Torque bolts (28 & 29) to 23 - 27 ft. lbs. (31- 36 NM).
16. Fill unit one-half full with EP90 lubricant.

2.17 DRIVE BRAKE ASSEMBLY

Disassembly

1. After removing brake from its installation, place brake on a clean dry work bench with mounting plate uppermost.
2. Unscrew the socket head bolts in equal increments to ensure the spring pressure within the brake is reduced gradually and evenly.
3. Remove and lay aside the shaft and mounting plate sub-assembly. Should it be necessary to replace ball bearings, retainer rings and press bearing off.
4. Remove friction plate and spacers and set aside. Spacers are factory set for each brake to obtain required air-gap and are not interchangeable between brakes.
5. Armature and compression springs can be removed and set aside.

Inspection

1. Inspect the friction plate and the mating surfaces on the armature and mounting plate for wear and/or damage.
2. Examine the compression spring.
3. Examine the friction plate and the shaft for wear and/or damage to the spline.
4. Examine the pole faces of the magnet and the armature for bruises, swellings or damage. Any bruises, swellings or damage should be stoned flat.
5. Examine input and output splines of shaft for wear and/or damage.
6. Check ball bearing for axial float and/or wear.

NOTE: *It is essential when replacing the friction plate that spacers are also replaced.*

Assembly

1. Clean all parts thoroughly.
2. Reverse disassembly procedure above, taking particular care with the assembly sequence of the friction plate.

NOTE: *Assemble friction plate with two center-punches facing towards mounting plate.*

3. If a new plate has been fitted, then new spacers will have to be adjusted for air gap of 0.014 - 0.024 inches (0.35 - 0.60 mm).
4. After checking air gap, connect power supply.

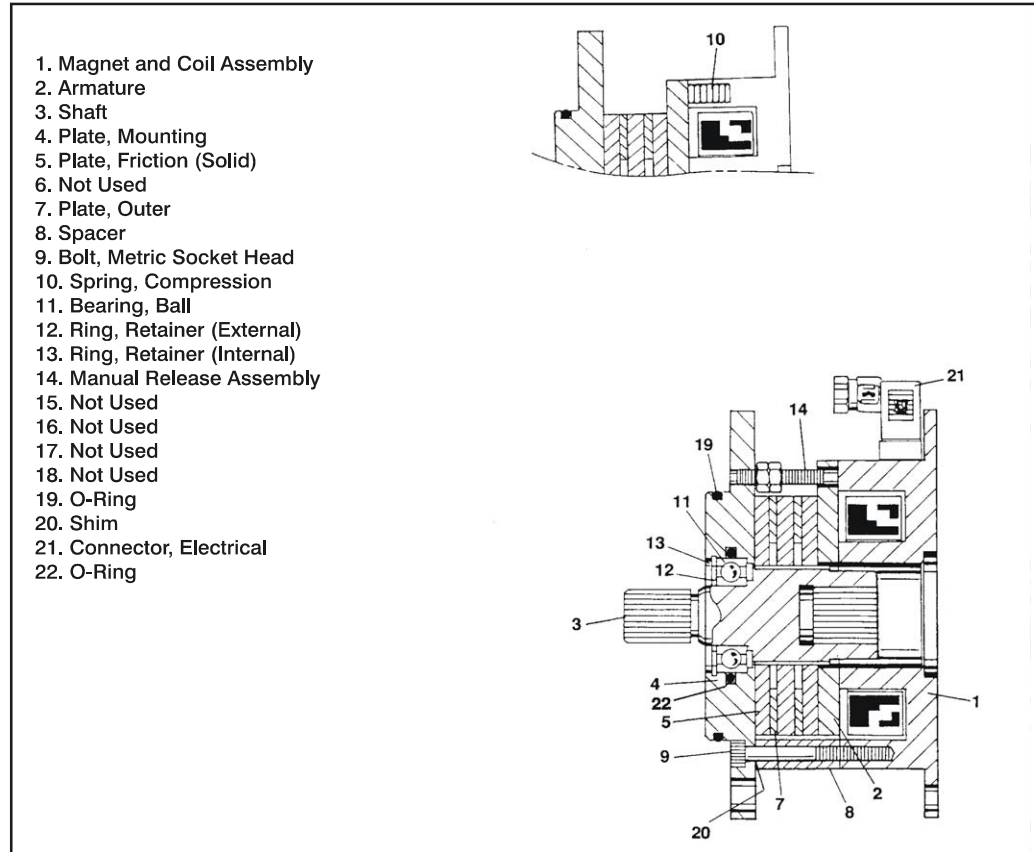


Figure 2-15. Drive Brake Assembly

5. Switch on power supply and ensure brake fully releases.
6. The brake can be adjusted for friction plate wear by removing spacers and machining them to maintain the correct air gap. Length of all three spacers should be within 0.001 in. (0.025 mm)
6. Disengage the mechanical release on both drive brakes by loosening, completely reversing (towards torque hub) and tightening the three nuts on each brake.
7. Remove chocks from wheels as desired.

2.18 FREE WHEELING PROCEDURE

Use the following procedures **ONLY** for emergency movement to a suitable maintenance area.

1. Chock all wheels securely.
2. Engage the mechanical release on both brakes by loosening, completely reversing (towards drive motor) and tightening the three nuts on each brake.
3. Connect suitable equipment, remove chocks, and move machine.
4. After moving machine, position on a firm, level surface.
5. Chock wheels securely.

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" of the table, the various systems along with 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. Forms 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 by a JLG Dealer. A decal located on the frame affords a place to record (stamp) inspection dates. Notify dealer if inspection is overdue.*

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 engine 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.
16. Clean or replace suction screen.

Table 2-4. Preventive Maintenance and Inspection Schedule

AREA	INTERVAL				
PLATFORM	10 HOURS DAILY	50 HOURS WEEKLY	200 HOURS MONTHLY	500 HOURS 3 MONTHS	1000 HOURS 6 MONTHS
1. Controller	1, 11				
2. Switches	1, 11				
3. Placards and Decals	1, 2				
4. Control Tags	1, 2				
5. Hoses and Cables	1	4, 8			
6. Wear Pads			8		
7. Handrail and Chains	1, 4				
CHASSIS					
1. Batteries	3	5			
2. Battery Charger	1				
3. Hydraulic Pump/Motor	1	5			
4. Valves	1	5			
5. Hydraulic Filter		5, 14	14		
6. Hydraulic Hoses and Tubing	1	5			
7. Hydraulic Oil Tank*	3	5	4		
8. Breather - Hydraulic Tank		6, 14			
9. Lift Cylinder	1	5, 6, 13	4		
10. Limit Switch	1, 7				
11. Placards and Decals	1, 2				
12. Wheel and Tire Assemblies	1	8, 9			
13. Drive Motors		1, 5, 6			
14. Drive Torque Hubs		1, 3, 5, 6			
15. Drive Brakes		1, 6	8		
16. Steer Cylinder	1	5, 6, 13	4		
17. Steer Components	1	4, 6	8		
18. Wheel Bearings			8		
19. Sizzor Arms	1, 4				
20. Safety Prop	1, 4				
21. Wear Pads			8		
22. Pivot Pins/Bolts	1, 4		7, 8		
23. Switches, Ground Control	1, 11				
24. Control Tags	1, 2				
25. Hose and Cable	1	4, 8			
* Inspection and Maintenance Code 10 to be performed annually.					

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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. 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.

3.2 TROUBLESHOOTING INFORMATION

1. The troubleshooting procedures applicable to the aerial platform are listed and defined in Tables 9-1 through 9-4. As an aid to table use, the aerial platform is divided into four major groups, each covered separately within this section. These groups are as follows: elevation system, chassis assembly, hydraulic system and electrical system.
2. 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 the remedial action should, where possible, be checked in the order listed in the tables.
3. It should be noted that there is no substitute for a thorough knowledge of the equipment and related systems.
4. 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 are symptomatic of greater 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.
5. 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 control 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 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 diagrams of the various circuits.

SECTION 3 - TROUBLESHOOTING

Table 3-1. Platform Assembly Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM ELEVATION SYSTEM		
No response to control switch	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Lift control switch inoperative	Replace control switch
	Hydraulic oil system low	Replenish oil system necessary
	Restricted or broken supply line on valve or pump	Clean, repair or replace as necessary
	Control valve not functioning properly	Repair or replace valve
	Lift cylinder not functioning properly	Repair or replace lift cylinder
	Hydraulic pump not functioning properly	Check Sevcon control contactors for proper functioning
	Low battery voltage	Check voltage and charge batteries or replace batteries as necessary
Platform will not raise	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Load capacity exceeded. (Personnel and/or equipment on platform)	Reduce load to recommended capacity
	Hydraulic oil system low	Replenish oil as necessary
	Restricted or broken oil line or fitting	Clean, repair or replace as necessary
	Control valve not functioning properly	Repair or replace valve
	Lift cylinder not functioning properly	Repair or replace lift cylinder
	Motor/Pump does not respond when lift control switch is moved to the up position	Refer to the electrical schematic and/or electrical system troubleshooting chart
	No electrical signal being sent to lift up control valve cartridge	Refer to the electrical schematic and/or electrical system troubleshooting chart
	Pressure set to low on pump	Check pressure and reset as necessary
Platform will not lower	No electrical signal being sent to lift down control valve cartridge	Refer to the electrical schematic and/or electrical system troubleshooting chart
	Lift down control cartridge not functioning properly	Repair or replace lift down control cartridge
	Lift cylinder not functioning properly	Repair or replace lift cylinder

Table 3-1. Platform Assembly Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Platform raises or lowers erratically	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	replace enable switch circuit card
	Hydraulic system low	replenish oil as necessary
	Restricted or broken hydraulic line or fitting	Clean, repair or replace as necessary
	Control valve not functioning properly	Repair or replace valve
	Worn seals in lift cylinder	Replace seals
	Cylinder not functioning properly	Repair or replace cylinder
Platform drifts down	Worn seals in lift cylinder	Replace seals
	Manual descent valve open	Close manual descent valve
High drive does not operate below horizontal	Damaged wiring on limit switch	Repair or replace wiring
	Damaged limit switch	Replace limit switch

SECTION 3 - TROUBLESHOOTING

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
DRIVE SYSTEM		
No response to control	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Drive motor(s) not functioning properly	Repair or replace drive motors
	Damaged wiring on hand controller	See wiring schematic. repair or replace wiring as necessary
	Sevcon overheated	Check flashcode
	Defective hand controller	Repair or replace hand controller
	Damaged wiring on motor controller	See wiring schematic. repair or replace wiring as necessary
	Defective enable switch	Repair or replace enable switch
	Defective motor controller	Check flashcode. Replace motor controller
	Defective motor controller contactors	Repair or replace contactors
	Low battery	Check flashcode on sevcon
Machine will not travel forward	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Drive motor(s) not functioning properly	Repair or replace drive motors
	Brake(s) not releasing	Repair or replace electric brake
	Motor/Pump will not respond when drive control moved to forward	Refer to electrical system troubleshooting
	Motor controller forward contactor defective	Repair or replace contactor
Machine will not travel in reverse	Motor controller reverse contactor defective	Repair or replace contactor
		See machine will not travel forward
Machine travels very slow below horizontal	Defective hand controller	Check flashcode on Sevcon (6 flashes)
	Sevcon controller not programmed properly	Reprogram Sevcon
Drive system very jerky	Sevcon controller defective	Check flashcode
Machine will speed up in forward or reverse	Wires loose or broken from Tach Drive system to Sevcon controller	Check flashcode on Sevcon. Repair or replace wire as necessary
	Tach Drive shaft broke off	Replace Tach Drive shaft
	Tach Drive defective	Check flashcode

Table 3-2. Chassis Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
STEER SYSTEM		
No response to control	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after Enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Hydraulic system low	Replenish oil as necessary
	Damaged wiring on control switch or solenoid valve	Repair or replace wiring as necessary
	Control switch not functioning properly	Replace switch
	Restricted or broken hydraulic line on steer valve or hydraulic pump	Clean repair or replace hydraulic line
	Control valve not functioning properly	Repair or replace control valve
	Steer cylinder not functioning properly	Repair or replace steer cylinder
Machine hard to steer or steering erratic	Hydraulic system oil low	Replenish oil as necessary
	Restricted hydraulic line or fitting	Clean repair or replace hydraulic line or fitting
	Bent steering linkage	Repair or replace steering linkage as required
	Hydraulic pump not functioning properly	Repair or replace hydraulic pump
	Steer cylinder not functioning properly	Repair or replace steer cylinder
Steering inoperative	Wiring damaged on control switch or solenoid valve	Repair or replace wiring
	Solenoid valve not functioning properly	Repair or replace solenoid valve
	Steer control switch not functioning properly	Replace steer control switch
	Steer cylinder not functioning properly	Repair or replace steer cylinder
Machine will not steer left or right	Enable switch not activated	Activate enable switch
	Function not activated within 3 seconds after enable switch was depressed	Reactivate enable switch
	Enable switch not functioning properly	Replace enable switch circuit card
	Wiring on steer control switch damaged	Repair or replace wiring as necessary
	Wiring on steer solenoid valve damaged	Repair or replace wiring as necessary
	Steer solenoid coil damaged	Replace coil
	Bent steer cylinder rod	Repair or replace cylinder
	Damaged steer linkage	Repair or replace steer linkage

SECTION 3 - TROUBLESHOOTING

Table 3-3. Hydraulic System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
HYDRAULIC SYSTEM - GENERAL		
Hydraulic pump noisy	Air bubbles in oil	Reservoir oil level low. Replenish oil as necessary
	Oil filter dirty	Replace oil filter
Pump cavitating. (Vacuum in pump due to oil starvation)	Oil in reservoir low	Replenish oil as necessary
	Restricted reservoir air vent	Clean air vent
	Oil viscosity too high	Drain hydraulic system and replace with recommended oil
	Leak in suction line	Repair or replace suction line
System overheating	Oil viscosity too high	Drain hydraulic system and replace with recommended oil
	Hydraulic oil low in reservoir	Replenish oil to proper level
	Extended driving periods	Do not drive machine for extended periods
Pump not delivering oil	Defective motor on pump	Repair or replace motor
System pressure too low	Leak in component, line or fitting	Repair or replace component, line or fitting
	Hydraulic pump not functioning properly	Repair or replace pump
	Defective valve cartridge	Replace cartridge
Systems operate erratically	Sticking or binding valve cartridge, piston rod, etc.	Clean, repair or replace components as required
	Hydraulic oil not at operating temperature	Allow oil sufficient time to warm up

Table 3-4. Electrical System Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
ELECTRICAL SYSTEM		
Hand controller	No electric power to hand controller	Check electrical input to hand controller
Control valve will not function when thumb-switch is moved in either direction	No electric power to valve	Check electric output and electrical signal at the valve
	Improper ground	Check for proper grounding
No response to a function control switch	Emergency stop switch not positioned properly	Place emergency stop switch to on position
	Platform/Ground select switch not positioned properly	Place Platform/Ground select switch to proper position
	Batteries defective or require charging	Check batteries for serviceability. Replace or charge batteries as necessary
	No voltage supplied to drive motors	Check motor controller and contactors for proper functioning. Repair or replace as necessary
	Defective function switch	Replace switch
	Defective circuit breaker	Replace circuit breaker
	No voltage present at applicable control valve	Check applicable wire for proper connection. Using suitable test meter, perform continuity test on wire. Repair or replace wire as necessary
	Defective motor/pump assembly	Replace motor/pump assembly
Drive motors will not function when hand controller is activated	Motor controller 200 Amp fuse blown	Check flashcode on Sevcon and determine cause and repair. Replace fuse
Hydraulic pump/motor will not run	Batteries require charging or will not charge	Charge or replace batteries as required
	Motor controller contactors not functioning properly	Repair or replace contactors
	Pump/motor not functioning properly	Repair or replace pump/motor
Motor controller malfunctioning	See remedy column	Refer to flash code troubleshooting chart

SECTION 3 - TROUBLESHOOTING

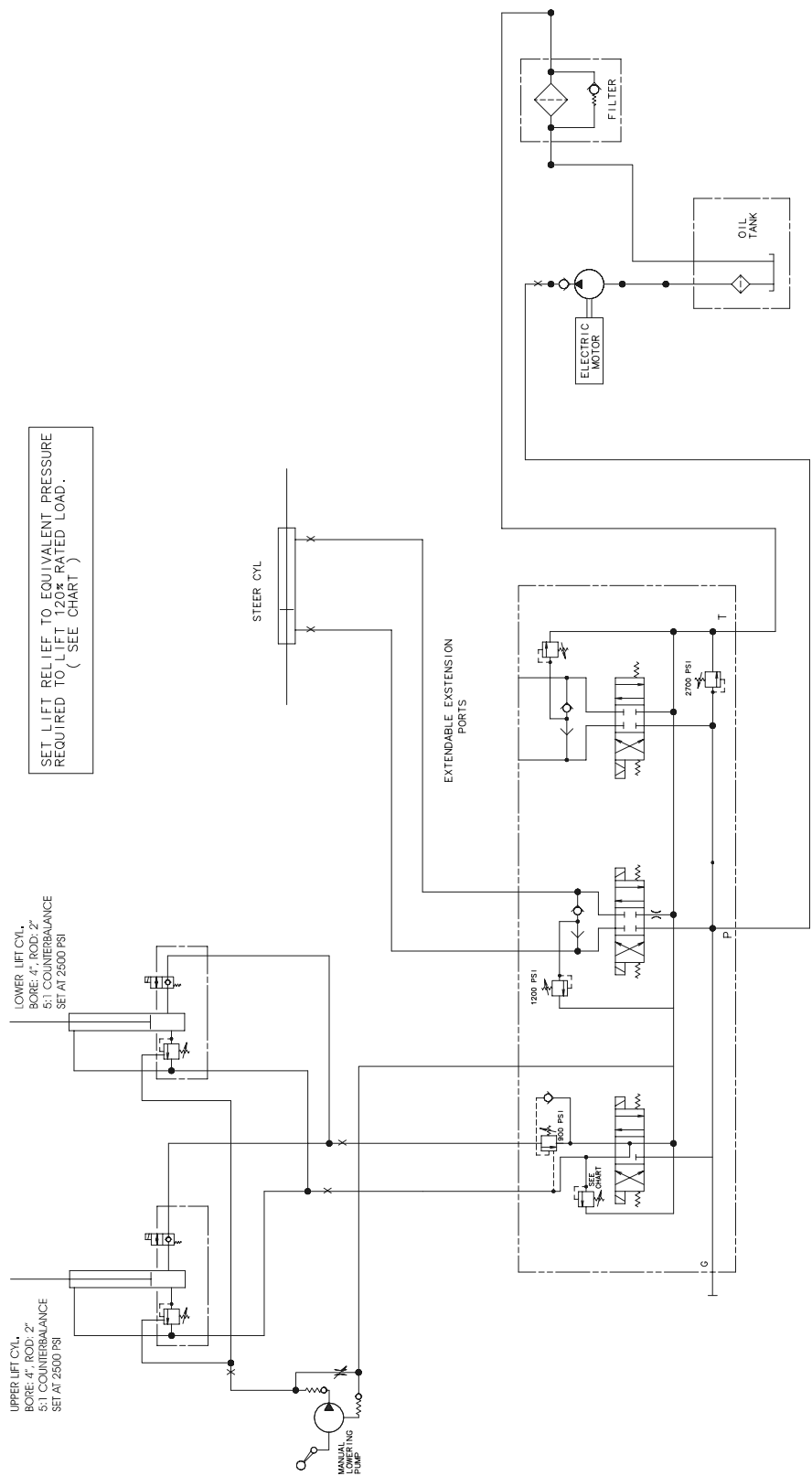
Table 3-5. Flash Code Troubleshooting Messages

CODE	MESSAGE	REMEDY
1 Flash	Internal fault	Replace MOS90
2 Flashes*	Check enable wiring Check for correct start up sequence Check that both directions are not selected	Retry Retry Select only one direction
3 Flashes	Check power and control wiring for shorts Replace controller	Rectify
4 Flashes	Check direction contactor tips Check power wiring for shorts Check motor for armature to field shorts Check for shorts to frame and battery leakage Replace controller	Free/change tips Rectify Rectify Rectify
5 Flashes	Check contactor tips Check contactor for mechanical operation and coil check power and control wiring Check motor Replace controller	Repair/replace Repair/replace Rectify Rectify
6 Flashes	Check operation of hand controller with Test Sequence Check pot operation with voltmeter for voltage at minimum setting Replace controller	Rectify/replace Adjust as necessary or replace
7 Flashes	Check battery voltage with voltmeter Check power connections, fuses, etc. Check for battery leakage to frame Replace controller	Change/charge battery Repair or replace Rectify
8 Flashes	Check current draw Check mounting and heat sinking of controller	Rectify Rectify
10 Flashes	Check tachometer wiring Check speed tachometer Replace tachometer	Repair Rectify
11 Flashes	Recycle emergency stop switch Check pin voltage	Replace tachometer PC board

NOTE: If the machine is operated at a very slow speed or stalled when climbing a grade of 20% or greater, a 10 flash fault will occur. recycle the emergency stop switch to recover.

NOTE: All flash codes must be checked with unit switched to platform control

* If speed switch is turned 25% - 50% toward full speed, Sevcon controller will give a 2 flash fault indicating a procedure fault. If, while 2 flash fault is being indicated, the speed control knob is turned to less than 25% the 2 flash fault will stop and LED will come on steady, indicating controller operational.



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Figure 3-1. Hydraulic Schematic

SECTION 3 - TROUBLESHOOTING

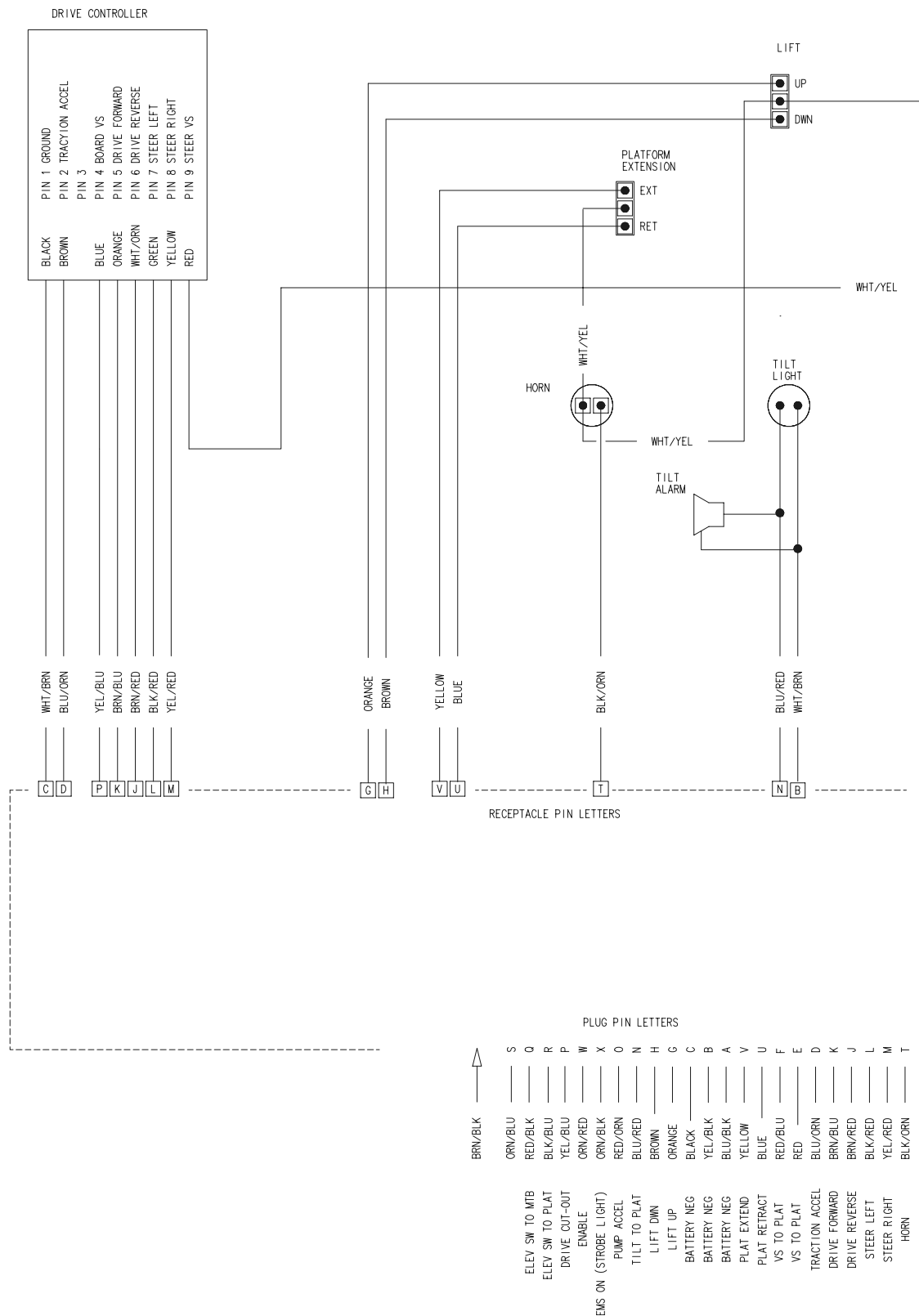
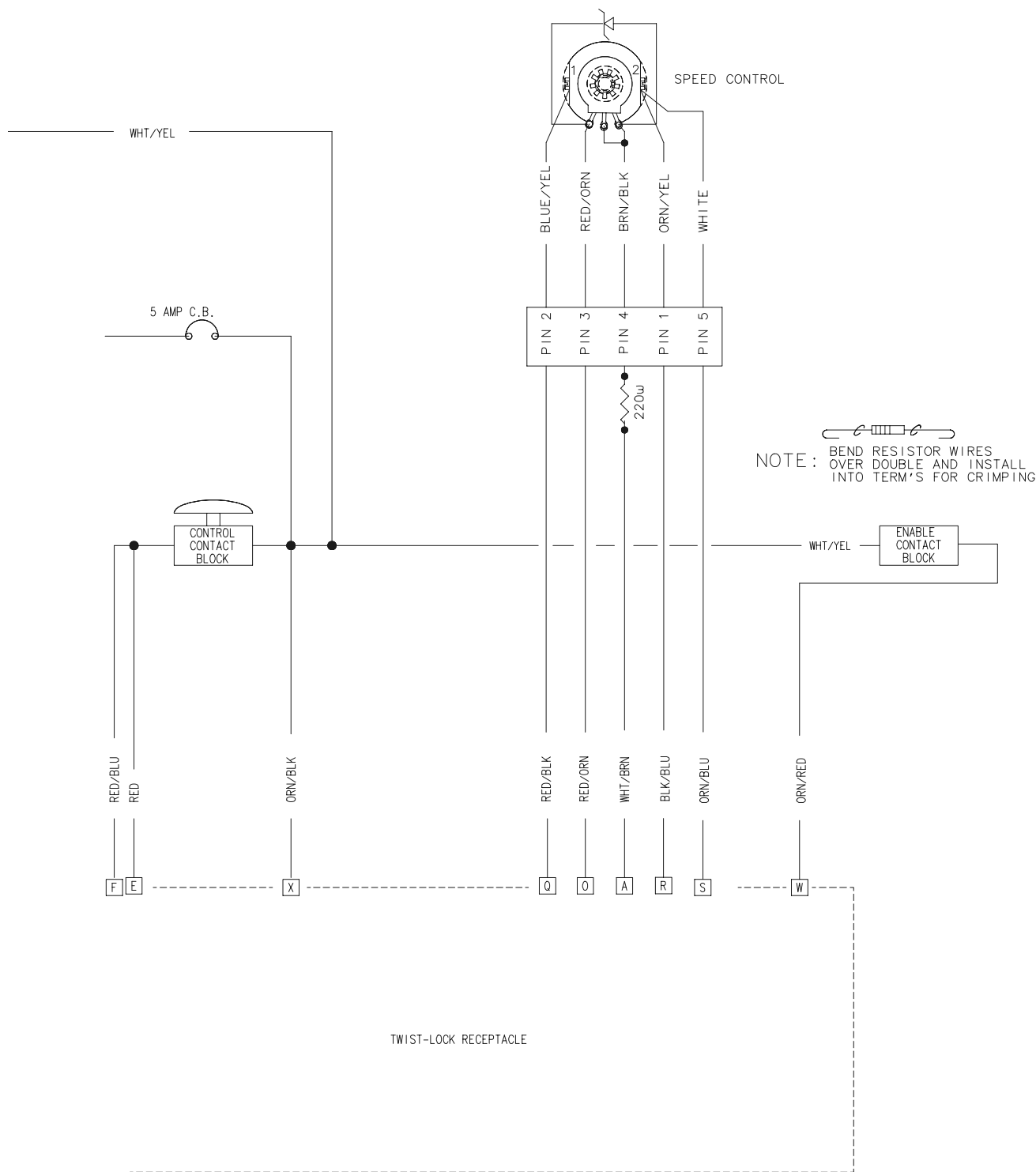


Figure 3-2. Platform Wiring Diagram (Sheet 1 of 2)



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Figure 3-2. Platform wiring Diagram (Sheet 2 of 2)

SECTION 3 - TROUBLESHOOTING

16/24 CABLE FROM THE PLATFORM

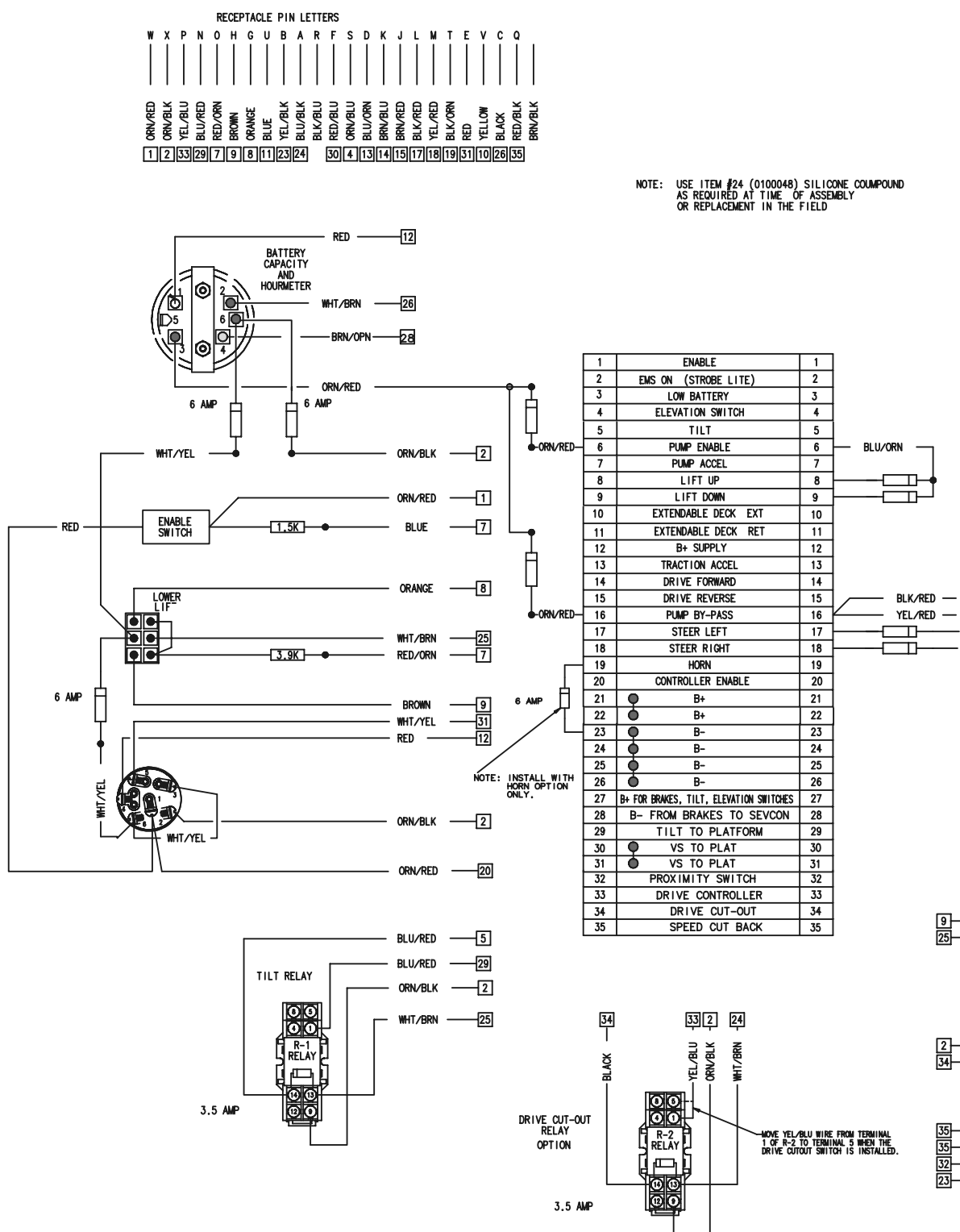
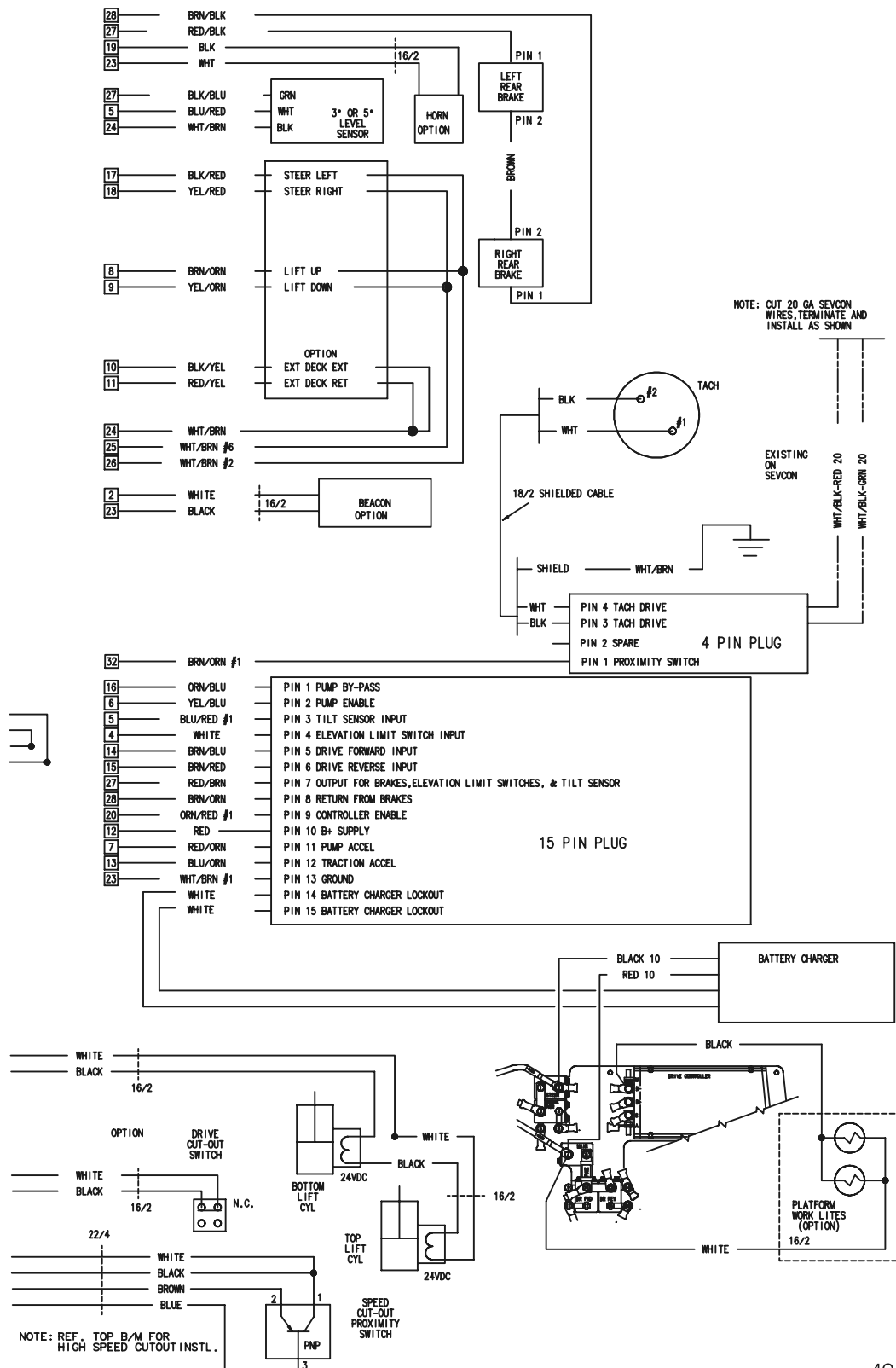


Figure 3-3. Ground Control Wiring Diagram (Sheet 1 of 2)



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Figure 3-3. Ground Control Wiring Diagram (Sheet 2 of 2)

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