An Oshkosh Corporation Company

Service and Maintenance Manual

Model
120HX

P/N - 3120686

April 6, 2009

ANSI

An Oshkosh Corporation Company

SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

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.

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.

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 SERVICEMANUAL.
- 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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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Fuel Tank

26 gallons (98 liters).

Hydraulic Oil Tank

50 gallons (189 liters).

Hydraulic System (Including Tank)

Approximately 60 gallons (227 liters).

Torque Hub

Drive - 2.9 quarts (2.7 liters).

Swing - 1.4 quarts (1.3 liters).

NOTE: *Torque hubs should be one half full of lubricant.*

Engine Crankcase

10.0 quarts (9.5 liters) w/o filter.

1.2 COMPONENT DATA

Diesel Engine

Manufacturer/Model - Deutz F4L912.

Oil Capacity - 10.0 quarts (9.5 liters) w/o filter.

Low RPM - 1800.

High RPM - 2500.

Alternator - 60 Amp, belt drive.

Battery - 85 Amphour, 550 Cold Cranking Amps, 12 VDC.

Horsepower - 76 @ 2500 RPM, no load.

Drive/Steer System

Tires - 445/65R22.5, foam filled.

Drive Hub - 93.7:1 ratio.

Drive Brake - Spring applied, hydraulically released, release pressure 140 psi (9.7 bar).

Drive Motor - 2 speed, 0.4 in.[3]/rev. (6.4 cm[3]/rev.) low speed, 0.2 in.[3]/rev. (2.5 cm[3]/rev.) high speed.

Swing System

Swing Motor Displacement - 2.0 in.[3]/rev. (32.8 cm[3]/rev).

Swing Brake - Automatic spring applied, hydraulically released. Release pressure 150 psi (10.5 kg/cm[2]) initial, 170 psi (12.0 kg/cm[2]) full.

Function Hydraulic Pump

Vendor - John Barnes.

Single section gear pump - 97 in.[3] (1589 cm[3]) displacement.

Output - 7.5 gpm (28.4 lpm) @ 1800 rpm; 10.5 gpm (39.7 lpm) @ 2500 rpm.

Drive Hydraulic Pump

Vendor - Sunstrand.

Overcenter piston pump - 2.8 in.[3] (45.9 cm[3]) displacement.

Output - 30 gpm (113.5 lpm) @ 2500 rpm.

Auxiliary Power Pump

Vendor - John Barnes.

Single section gear pump.

Displacement - 0.2 in.[3] (2.1 cm[3])/rev.

Output - 4.8 gpm (18 lpm).

Hydraulic Filter - Inline

Return - Bypass Type.

25 Microns Nominal.

1.3 PERFORMANCE DATA

Travel Speed

2WD - 3.2 mph (5.1 km/hr).

4WD - 2.7 mph (4.3 km/hr).

Gradeability

2WD - 25%.

4WD - 40%.

Turning Radius (4 Wheel Steer)

Outside.

19 ft. 3 in. (5.86 m) w/axles extended.

18 ft. 0 in. (5.48 m) w/axles retracted.

Inside.

8 ft. 6 in. (2.59 m) w/axles extended.

9 ft. 2 in. (2.79 m) w/axles retracted.

Platform Capacity

Standard - 500 lb. (230 kg).

Boom Elevation

Main boom - -14° to +75°.

Extend-A-Reach - +15° to -80°.

Machine Weight

Approximately 44,000 lb. (19,958 kg).

Maximum Tire Load

26,090 lb. (11,834 kg) @ 149 psi (10 bar).

Machine Height (Stowed)

10 ft. 3-27/32 in. (3.1 m).

Machine Length (Stowed)

Boom erected for use - 52 ft. 4 in. (15.9 m).

Boom stowed for shipping - 35 ft. 10-5/8 in. (10.9 m).

Machine Width

8 ft. 6 in. (2.6 m) w/axles retracted.

10 ft. 10 in. (3.3 m) w/ axles extended.

Wheelbase

11 ft. 4-1/2 in. (3.5 m).

1.4 FUNCTION SPEEDS (MACHINES BUILT PRIOR TO S/N 38697)

Telescope

Extend - 132-170 seconds.

Retract - 140-175 seconds.

Lift

Up - 125-160 seconds.

Down - 108-132 seconds.

Extend-A-Reach

Up - 15-25 seconds.

Down - 15-25 seconds.

Swing Speed 360°

143-243 seconds.

Platform Rotation

Left - 20-30 seconds.

Right - 20-30 seconds.

Ground to 120’

257-330 seconds.

From 120’ to Ground

248 to 307 seconds.

Ground to 120’ to Ground

505 to 637 seconds.

1.5 FUNCTION SPEEDS (MACHINES BUILT AFTER S/N 38697)

Telescope

Extend - 80-100 seconds.

Retract - 85-100 seconds.

Lift

Up - 85-100 seconds.

Down - 75-100 seconds.

Extend-A-Reach

Up - 15-25 seconds.

Down - 15-25 seconds.

Swing Speed 360°

143-243 seconds.

Platform Rotation

Left - 7-20 seconds.

Right - 7-20 seconds.

Ground to 120'

165 to 200 seconds.

From 120' to Ground

150 to 200 Seconds

Ground to 120' to Ground

315 to 400 Seconds

1.6 TORQUE REQUIREMENTS

Table 1-1. Torque Requirements

Description	Torque Value (Dry)	Interval Hours
Bearing To Chassis	220 FT LB (298 NM)	200/500*
Bearing To Turntable	220 FT LB (298 NM)	200/500*
Wheel Lugs	300 FT LB (407 NM)	50
Drive Torque Hub to Spindle	260 FT LB (353 NM)	500
Boom Chains	59 FT LB (80 NM)	200
Swing Motor to Swing Brake	75 FT LB (102 NM)	500
Swing Brake to Torque Hub	110 FT LB (149 NM)	500
Torque Hub to Mounting Plate	260 FT LB (353 NM)	500
Frame Valve Bolts	80 IN LB (9 NM)	See Note Below**
* Retorque swing bearing bolts after first 200 hours of operation and every 500 hours thereafter.		
**Re-torque frame valve bolts after checking or adjusting steer pressure.		

NOTE: *See Section 2 for tightening sequence of turntable bearing bolts.*

NOTE: *When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart Figure 1-1 to determine proper torque value.*

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	
				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

1.7 LUBRICATION

Engine (Crankcase) Oil

NOTE: *Crankcase oil must be a high quality detergent type meeting one of the following API service classifications: CC/SE, CC/SF, CD/SE, CD/SF, CE/SF or CE/SG.I*

Table 1-2. Single Viscosity Oil

When Outside Temperature is Consistently	Use SAE Viscosity Number
-20° F to +25° F (-29° C to -4° C)	*10W
+15° F to +50° F (-10° C to +10° C)	20W-20
+40° F to ++85° F (+4° C to +30° C)	30
Above +75° F (Above +24° C)	40

Table 1-3. Multi Viscosity Oil

When Outside Temperature is Consistently	Use SAE Viscosity Number
-40° F to +75° F (-40° C to +24° C)	*5W-20 (synthetic)
-5° F to +70° F (-21° C to +21° C)	10W-30
-5° F to +85° F (-21° C to +30° C)	10W-40
+15° F to +75° F (-10° C to +24° C)	15W-30
Above +15° F (-10° C and above)	15W-40
* This viscosity can be used at colder temperatures only with engine oil preheating.	

Hydraulic Oil

Table 1-4. 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, 10W30
+50° F to +210° F (+10° C to +99° 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 Kendall Hyken 052 hydraulic oil, which has an SAE viscosity of 10W-20 and a viscosity index of 152, or Mobilfluid 424, which has an SAE viscosity of 10W-30 and a viscosity index of 152. Kendall Hyken 052 and Mobilfluid 424 are fully compatible and can be mixed as necessary.*

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 Kendall Hyken 052 or Mobilfluid 424 is desired, contact JLG Industries for proper recommendations. Kendall Hyken 052 and Mobilfluid 424 are fully compatible and can be mixed as necessary.*

NOTE: *When temperatures remain consistentlybelow 20 degrees F. (-7 degrees C), JLG Industries recommends the use of Mobil DTE11.*

Lubrication Specifications

Table 1-5. Lubrication Specifications

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° 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.
HO	Hydraulic Oil. API service classification GL-3, e.g. Kendall Hyken 052 or Mobilfluid 424.
EO	Engine (crankcase) Oil. Gas - API SG/SH class, MIL-L-2104. Diesel - API CC/CD/CE class, MIL-L-2104B/MIL-L-2104C.

NOTE: *Refer to Figure 1-2 for specific lubrication procedures.*

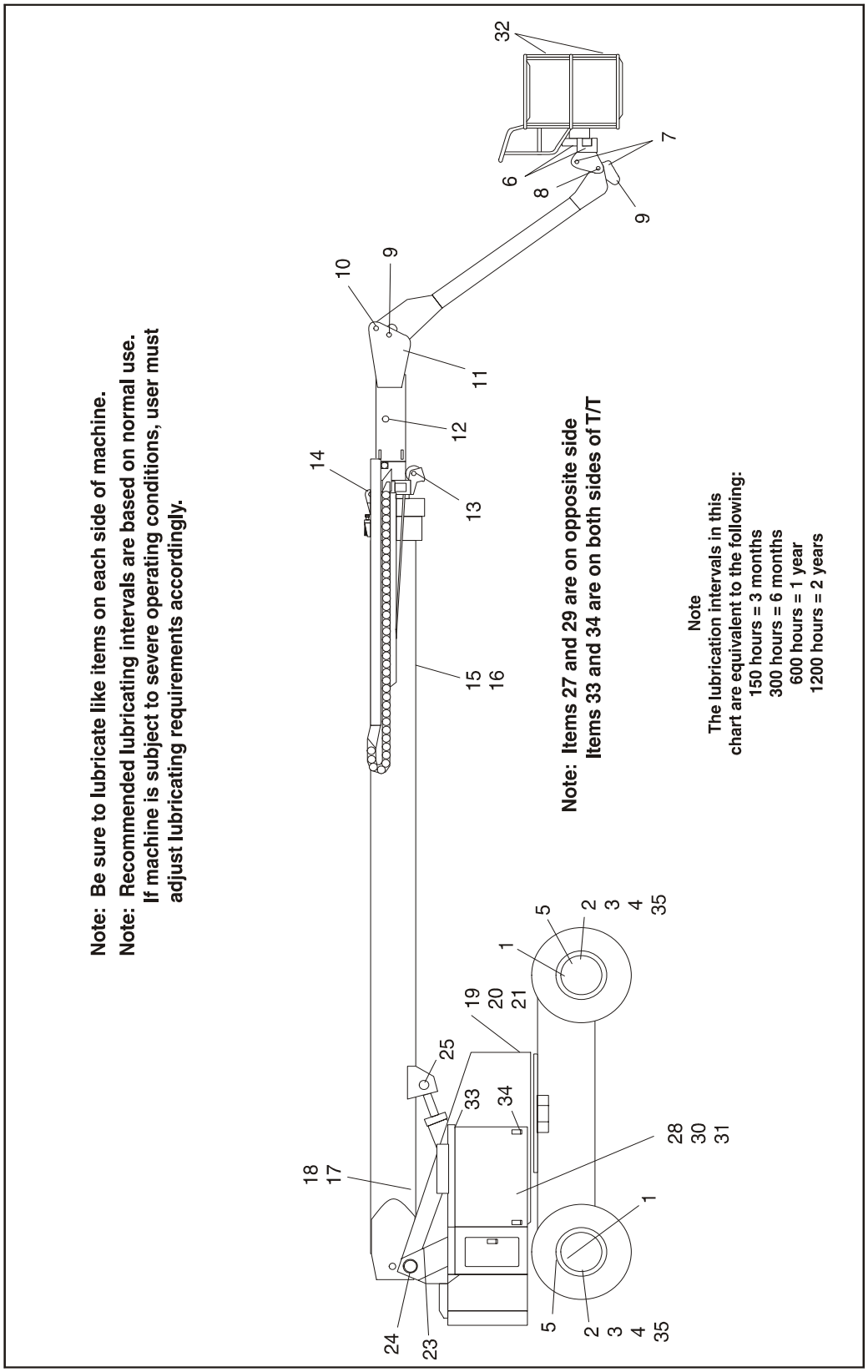


Figure 1-2. Lubrication Diagram

Table 1-6. Lubrication Chart

Index No.	Component	Number/Type Lube Points	Lube & Method	Interval Hours	Comments
1	Wheel Drive Hubs	Fill/Drain Plugs	EPGL (SAE 90)	150/ 1200	Check Every 150 Hours/Change Every 1200 Hours
2	Steer Cylinders - Rod End	2 Grease Fitting	MPG - Pressure Gun	150	
3	Steer Cylinders - Barrel End	2 Grease Fittings	MPG - Pressure Gun	150	
4	King Pins	4 Grease Fittings	MPG - Pressure Gun	150	
5	Tie Rods	4 Grease Fitting	MPG - Pressure Gun	150	
6	Rotary Platform Stand Rotary Worm Gear	2 Grease Fittings N/A	MPG - Pressure Gun MPG - Brush	150 150	Remove Cover to Grease
7	Platform Level cylinder	3 Grease Fittings	MPG - Pressure Gun	150	
8	Platform Pivot Pin	1 Grease Fitting	MPG - Pressure Gun	150	
9	Link Level Pin	2 Grease Fittings	MPG - Pressure Gun	150	
10	E-A-R Pivot Pin	1 Grease Fitting	MPG - Pressure Gun	150	
11	E-A-R Lift Cylinder - Rod End	1 Grease Fitting	MPG - Pressure Gun	150	
12	E-A-R Lift Cylinder - Barrel End	1 Grease Fitting	MPG - Pressure Gun	150	
13	Sheave Pin - Fly Extend	1 Grease Fitting	MPG - Pressure Gun	150	
14	Sheave Pin - Upper Aux.	1 Grease Fitting	MPG - Pressure Gun	150	
15	Tele Cyl. Sheave Pin	1 Grease Fitting	MPG - Pressure Gun	150	Extend boom until grease fitting is accessible thru hole in fly sec.
16	Boom Chains	N/A	Chain Lube/Hot Oil Dip	1200	Extend and Retract Chains
17	Sheave Pin - Fly Retract	2 Grease Fittings	MPG - Pressure Gun	150	Extend boom until fitting is accessible thru hole in fly
18	Sheave Pin - Outer-Mid Retract	2 Grease Fittings	MPG - Pressure Gun	150	Extend boom until fitting is accessible thru hole in fly
19	Lift Cylinder - Barrel End	1 Grease Fitting	MPG - Pressure Gun	150	Remote Access
20	Master Cylinder - Barrel End	1 Grease Fitting	MPG - Pressure Gun	150	Remote Access
21	Swing Bearing	1 Grease Fitting	MPG - Pressure Gun	150	Remote Access. Lube, rotate 180 , lube again.
22	Swing Bearing Gear	N/A	MPG - Brush	150	
23	Master Cylinder - Rod End	1 Grease Fitting	MPG - Pressure Gun	150	
24	Boom Pivot Bearings	2 Grease Fittings	MPG - Pressure Gun	150	
25	Lift Cylinder - Rod End	1 Grease Fitting	MPG - Pressure Gun	150	

Table 1-6. Lubrication Chart

Index No.	Component	Number/Type Lube Points	Lube & Method	Interval Hours	Comments
26	Load Moment Pivot Pins	1 Grease Fitting	MPG - Pressure Gun	150	Position boom over side for access under turntable
27	Hydraulic Filter - Function Pump	N/A	N/A	50/300	Replace after first 50 hrs. of operation, then every 300 hrs. thereafter
28	Hydraulic Filter - Drive Pump	N/A	N/A	50/300	Replace after first 50 hrs. of operation, then every 300 hrs. thereafter
29	Hydraulic Fluid	Fill Cap	HO	10/1200	Check oil daily/Change oil every 1200 hrs
30	Engine Crankcase	Fill Cap/Drain Plug	EO - SAE30	10/300	Check oil daily/Change oil every 300 hrs.
31	Engine Oil Filter	N/A	Replaceable Cartridge	300	
32	Platform Door Hinges	2 Grease Fittings	MPG - Pressure Gun	150	
33	Access Door Hinges	N/A	SAE10 - Oil Can	150	As Needed
34	Access Door Latches	N/A	SAE10 - Oil Can	150	As Needed
35	Axle Beams	N/A	MPG - Brush	600	As Needed
	Key to Lubricants:	MPG - Multipurpose Grease EPGL - Extreme Pressure Gear Lubricant HO - Hydraulic Fluid EO - Engine Oil			

1.8 PRESSURE SETTINGS - PSI (BAR)

NOTE: *All pressures are given in pounds per square inch (psi), with the metric equivalent, bar, given in parentheses.*

Main Control Valve

Main Relief - 3450 (238)

Lift Down Relief - 1200 (83)

Swing Relief - 1200 (83)

Level Up Relief - 2500 (172)

Level Down Relief - 2000 (138)

Rotate Relief - 2500 (172)

Extend-A-Reach Up Relief - 3000 (207)

Extend-A-Reach Down Relief - 1400 (97)

Sequence (Load Sense) - 160 (11)*

* Sequence pressure is pre-set and not normally adjusted.

Frame Mounted Control Valve

Front Steer Relief - 2000 (138)

Rear Steer Relief - 2000 (138)

Front Axle Extend Relief - 2000 (138)

Front Axle Retract Relief - 2200 (152)

Rear Axle Extend Relief - 2000 (138)

Rear Axle Retract Relief - 2200 (152)

1.9 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The plate is located on the left side of the frame, between the bearing area and the left rear wheel. If the serial number plate is damaged or missing, the machine serial number is stamped on the left side of the frame, at the center top, below the turntable bearing; the serial number is also stamped on the left side of the turntable, at center, along the left turntable upright close to the bearing area. In addition, the last five digits of the serial number are stamped on the top left of the fly end of each boom section.

1.10 MAJOR COMPONENT WEIGHTS

Table 1-7. Major Component Weights

COMPONENT	LB (KG)
Platform - 36 x 72 in. (0.9 x 1.8 m) w/Control Box Support and Rotator.	243(110)
Boom (Less Extend-A-Reach Jib and Platform)	9,502 (4310)
Jib, Extend-A-Reach and Pivot Attach	789(358)
Turntable Complete (Less Counterweight)	9,101 (4,128)
Counterweight	9,050 (4,105)
Lift Cylinder	809 (367)
Level Cylinder	60 (27)
Frame Complete (Includes Tires and Wheels)	14,400 (6,532)
Wheel and Tire Assembly (Each)	933 (423)
Complete Machine - 4WD	44,004 (19,960)

1.11 BOOM TAPE

Standard Boom

Red Tape - 56-1/2 in. (143.5 cm).

White Tape - 91-5/8 in. (232.7 cm)

w/Boom Wipers

Red Tape - 54-1/2 in. (138.4 cm).

White Tape - 89-5/8 in. (227.6 cm).

1.12 CYLINDER SPECIFICATIONS

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

Table 1-8. Cylinder Specifications

DESCRIPTION	BORE	STROKE	ROD DIA.
Lift Cylinder	9.0 (22.9)	48.5 (123.2)	4.0 (10.2)
Master Cylinder	2.5 (6.4)	15.1 (38.4)	1.3 (3.2)
Slave Cylinder	3.5 (8.9)	7.3 (18.5)	1.8 (4.4)
Extend-A-Reach Cyl.	3.5 (8.9)	18.3 (46.5)	2.5 (6.4)
Telescope Cylinder	5.0 (12.7)	266.0 (675.6)	3.5 (8.9)
Frame Jack Cyl. (2)	5.0 (12.7)	17.6 (44.8)	3.0 (7.6)
Axle Extend Cyl. (2)	3.0 (7.6)	29.0 (73.7)	2.0 (5.1)
Steer Cylinder (2)	3.0 (7.6)	9.8 (24.9)	1.5 (3.8)

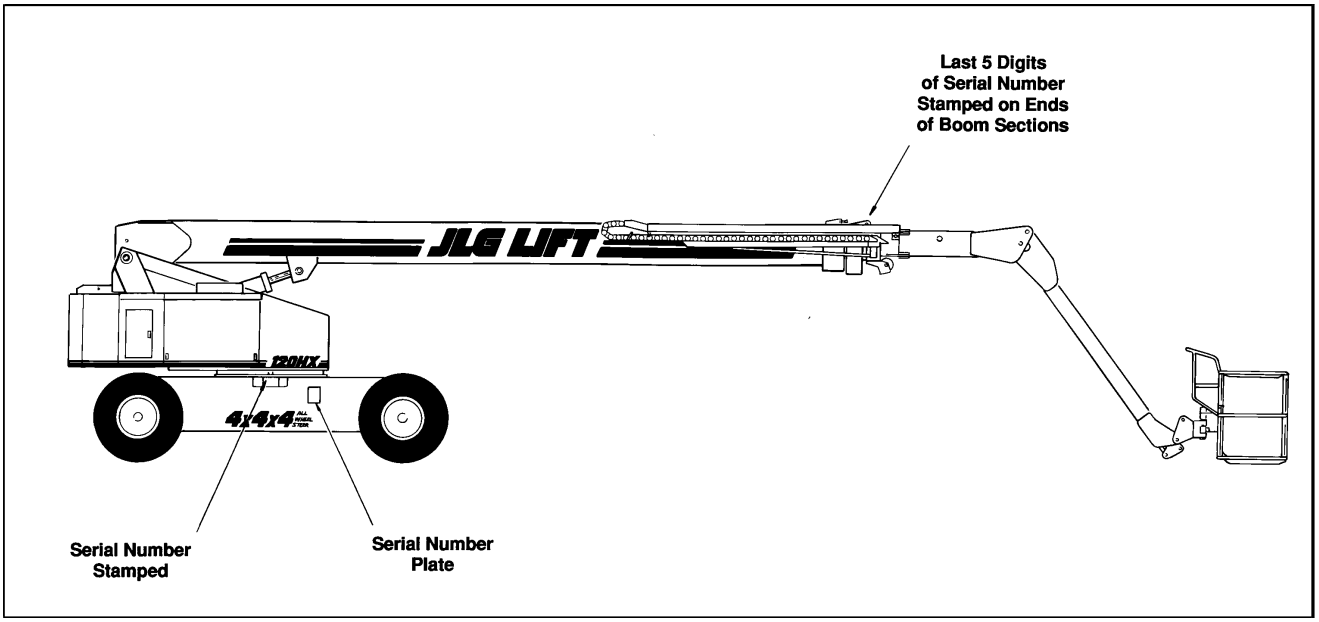


Figure 1-3. Serial Number Locations

1.13 CRITICAL STABILITY WEIGHTS

Table 1-9. Critical Stability Weights

COMPONENT	WEIGHT
Counterweight	9, 050 lb. (4,105 kg)
Foam-Filled Tires (each)	932 lb. (423 kg)
Deutz Engine	837 lb. (380 kg)
Platform	243 lb. (110 kg)

⚠ WARNING

DO NOT REPLACE ITEMS CRITICAL TO STABILITY, SUCH AS THE COUNTERWEIGHT OR FOAM-FILLED TIRES, WITH ITEMS OF DIFFERENT WEIGHT OR SPECIFICATION. DO NOT MODIFY UNIT IN ANY WAY TO AFFECT STABILITY.

SECTION 2. PROCEDURES

2.1 GENERAL

This section provides information necessary to perform maintenance on the aerial platform. 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

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 eyebolt 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.

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 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. (See Figure 1-1.)

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 intervals. When recommended lubricants are not available, consult your local supplier for an equivalent that meets or exceeds the specifications listed.

Battery

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

Lubrication and Servicing

Components and assemblies requiring lubrication and servicing are shown in Figure 1-2.

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 Figure 1-2. 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 Table 1-1 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 or Mobilfluid 424 hydraulic oil, which has an SAE viscosity of 10W-30 and a viscosity index of 152. Kendall Hyken 052 and Mobilfluid 424 are fully compatible, and can be mixed as necessary.

NOTE: *Start-up of hydraulic system with oil temperatures below -15 degrees F (-26 degrees C). 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 degrees F (-26 degrees C).*

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 -20 degrees F (-29 degrees C). However, use of this oil will give poor performance at temperatures above 120 degrees F (49 degrees C). Systems using DTE 11 oil should not be operated at temperatures above 200 degrees F (94 degrees C) 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 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 grease requirements. Should any question arise regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Table 1-2 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: Lift, Telescope, Steer, Master Level, Slave Level, Frame Lift, Axle Extend and Extend-A-Reach. 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.

Holding valves are used in the Lift, Platform Level, Telescope, and Extend-A-Reach circuits 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.

Manual Hydraulic Control Valves

The manual hydraulic control valves consist of four-way, multi-position valve sections, each section incorporating a sliding spool, spring-loaded to neutral or off. Each spool is attached to a control lever which provides for proportional control of the selected system function. This proportional control enables metering of oil flow in accordance with spool position, affording variable and smooth speed control capability. Spool movement causes work ports within the valve to align in a predetermined way, permitting flow to the selected function, with the opposing work ports positioned to allow return flow to the hydraulic reservoir.

Relief Valves

Main relief valves are installed at various points with 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 BOOM CHAINS

Adjusting Procedures

⚠ WARNING

ENSURE MACHINE IS ON A FIRM AND LEVEL SURFACE.

1. Position boom fully retracted at +5 degrees horizontal, no load in platform.
2. Torque outer mid section extend chain adjuster to 59 ft. lb. (80 Nm).
3. Torque outer mid section retract chain adjuster to 59 ft. lb. (80 Nm).
4. Torque fly section extend chain adjuster to 59 ft. lb. (80 Nm).
5. Torque fly section retract chain adjuster to 59 ft. lb. (80 Nm).
6. Cycle boom (extend at least 6 feet (2 meters), then retract fully).
7. Recheck outer mid section extend chain.
8. Recheck outer mid section retract chain.
9. Recheck fly section extend chain.
10. Recheck fly section retract chain.
11. Repeat steps (2) thru (10) if necessary.
12. Check for proper operation of boom.

JLG Industries, Inc. requires a complete boom disassembly, per the instructions outlined in paragraph 2-11, Boom Maintenance, every two years. All boom chains and related components (i.e., sheaves, pins, sprockets, wear pads, etc.) must also be inspected and replaced, as necessary, during this disassembly.

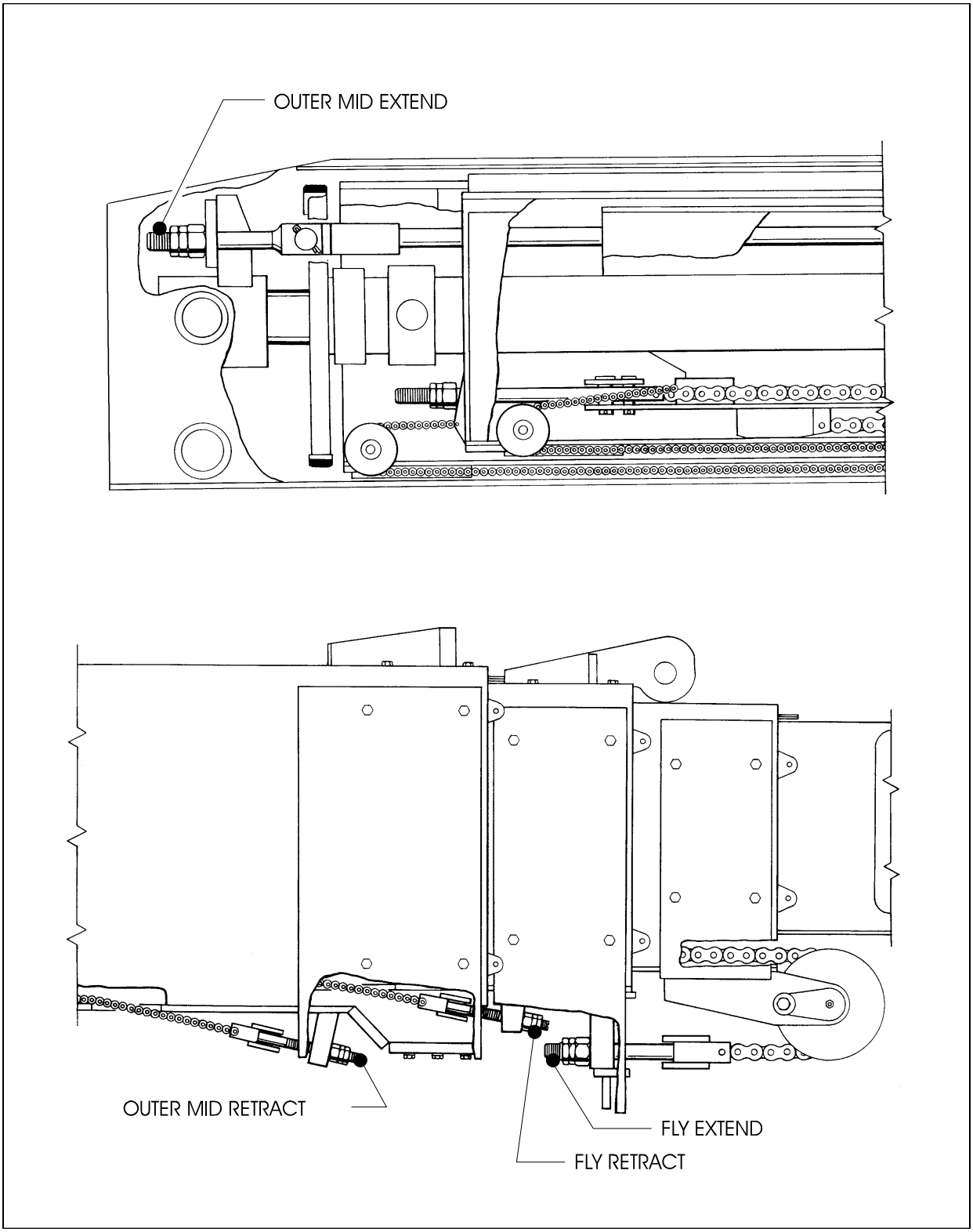


Figure 2-1. Boom Chain Adjustments

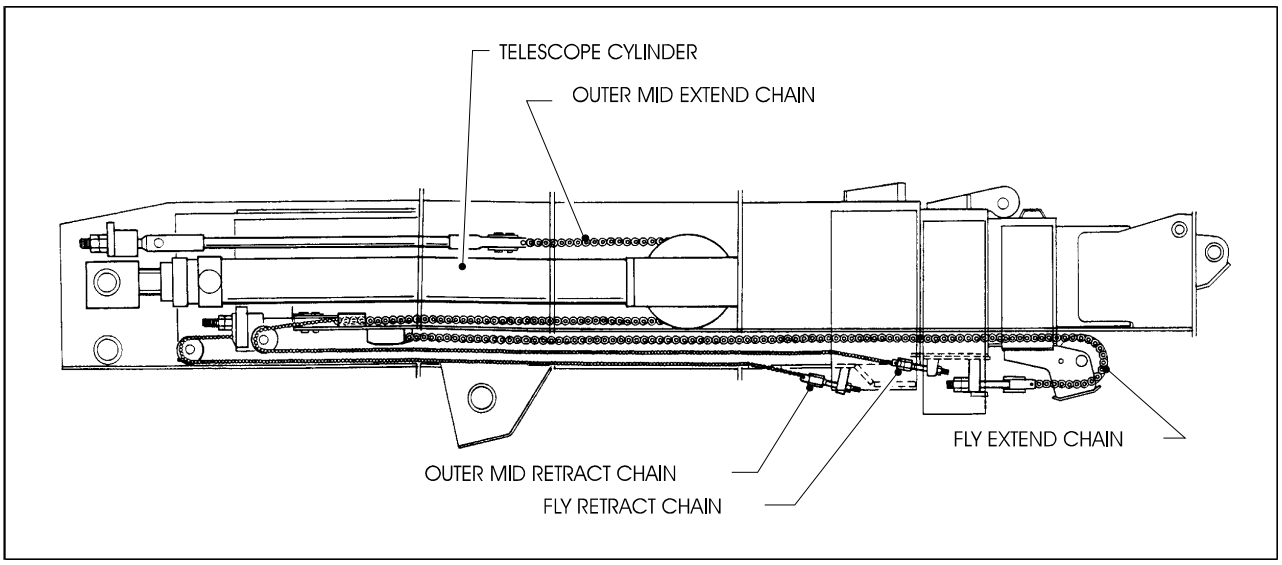


Figure 2-2. Typical Boom Assembly

An immediate disassembly of the boom assembly and inspection of the boom chains and related components is required if any of the following conditions occur:

1. After machine is exposed to hostile environments or conditions (i.e., extreme cold, dust, sand, blasting grit, salt, chemicals, etc.) which could adversely affect boom operation.
2. Erratic boom operation or unusual noise exists. Refer to troubleshooting tables in Section 3.
3. Chain adjustment is required more often than specified in this Section or links need to be removed (chain shortened) to make adjustment.
4. Machine is idle for an extended period (6 months or longer).
5. Boom is overloaded or has sustained a shock load.

⚠ WARNING

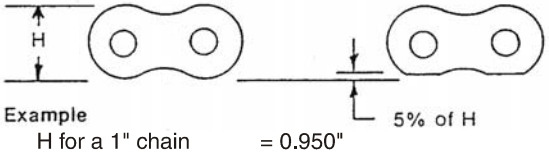
FAILURE TO DISASSEMBLE THE BOOM ASSEMBLY AND PROPERLY INSPECT AND/OR REPLACE THE BOOM CHAINS AND RELATED COMPONENTS (I.E., SHEAVES, PINS, SPROCKETS, WEAR PADS, ETC.) COULD RESULT IN THE DAMAGE AND/OR BREAKAGE OF THE BOOM CHAINS AND/OR RELATED COMPONENTS. DAMAGE AND/OR BREAKAGE OF THESE ITEMS COULD RESULT IN UNCONTROLLED EXTENSION OR RETRACTION OF THE BOOM ASSEMBLY AND COULD CAUSE SERIOUS INJURY OR DEATH TO PERSONNEL OPERATING THE JLG BOOM LIFT.

Inspection Procedure

⚠ WARNING

BOOM CHAINS TO BE INSPECTED AT TIME OF NEXT BOOM OVERHAUL AND WHEN DEEMED NECESSARY BY MACHINE OWNER, BUT NOT TO EXCEED 2 YEARS OF MACHINE OPERATION.

1. Inspect boom chains for the following conditions:
   a. **Wear:** Always inspect that segment of chain that operates over a sheave. As the chain flexes over the extend/retract sheaves, joints and plate edges very gradually wear. Chain “stretch” can be measured using a manufacturers wear scale or steel tape. When chains have elongated 3% they must be removed and replaced. Refer to Table 2-1 for proper chain specifications and allowable stretch tolerances. Peening and wear of chain plate edges are caused by sliding over a chain worn contact face of a sheave, or unusually heavy loads. All of the above require replacement of the chain and correction of the cause. Chain side wear, noticeable when pin heads and outside plates show a definite wear pattern, is caused by misalignment of the sheave/chain anchors and must be corrected promptly. Do not repair chains; if a section of chain is damaged, replace the entire chain set.



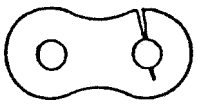
Example
H for a 1" chain = 0.950"
Maximum wear = 5% of 0.950" = 0.047"
Minimum plate depth = 0.950" - 0.047" = 0.903"

b. Lubrication: One of the most important but often overlooked factors is adequate lubrication. In addition to reducing internal friction, maintaining a film of oil on all chain surfaces will inhibit rusting and corrosion. This is important as corrosion of highly stressed, hardened steel chain components can cause a major reduction in the load capacity of leaf chain and result in link plate cracking.

NOTE: *The need for lubrication can be determined by the presence of rust on the exposed portions of chain.*

c. Rust and Corrosion: Rust and corrosion will cause a major reduction in the load carrying capacity of the chain, because these are primary reasons for side plate cracking. The initial lubrication at the factory is applied in a hot dip tank to assure full penetration into the joint. Do not steam clean or degrease this lubricant of chains. At time of chain installation, factory lube must be supplemented by a maintenance program to provide a film of oil on the chains at all times. A grade of SAE 30 or 40 weight, non-detergent motor oil should be used as a supplemental lubricant and a film of this oil should be constantly maintained on the surfaces and internal joints. If chains are corroded, they must be inspected, especially the outside plates, for cracks in-line with the pins. If cracks are found, replace the chain; if no cracks are discovered, lubricate the chains by dipping in heated oil, and reinstall on the machine. Keep chains lubricated.

d. **Fatigue Cracks:** Fatigue is a phenomenon that affects most metals, and is the most common cause of chain plate failures. Fatigue cracks are found through the link holes, perpendicular (90 degrees) from the pin in-line position. Inspect chains carefully after long time use and heavy loading for this type of crack. If any cracks are discovered, replace all chains, as seemingly sound plates are on the verge of cracking. Fatigue and ultimate strength failures on JLG Lifts are incurred as a result of severe abuse as design specs are well within the rated lifting capacity of these chains.

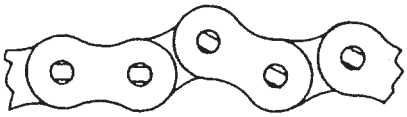


e. **Tight Joints:** All joints in the roller chain should flex freely. On roller chain, tight joints are usually caused by rust/corrosion, or the inside plates “walking” off the bushing. Limber up rusty/corroded chains (after inspecting carefully) with a heavy application of oil (preferably a hot oil dip). Tap inside “walking” plates inward; if “walking” persists, replace the chain. This type of problem is accelerated by poor lubrication maintenance practice, and most tight joint chains have been operated with little or no lubrication. Tight joints on leaf chain are generally caused by:

1. Bent pins or plates.
2. Rusty joints.
3. Peened plate edges.

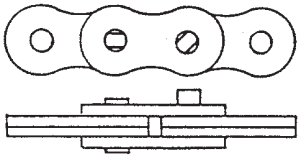
Oil rusty chains, and replace chains with bent or peened chain components. Keep chains lubricated.

TIGHT JOINTS



f. **Protruding or Turned Pins:** Chains operating with inadequate lube generate tremendous friction between the pin and plates (pin and bushing on roller chain). In extreme cases, this frictional torque can actually turn the pins in the outside press-fit plates. Inspect for turned pins, which can be easily spotted as the “V” flats on the pin heads are no longer in line. Replace all chains showing evidence of turned or protruding pins. Keep chains lubricated.

ABNORMAL PROTRUSION OR TURNED PINS

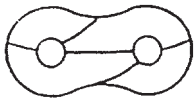


g. **Stress Corrosion Cracking:** The outside link plates, which are heavily press-fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (aperture) but tend to extend in an arc-like path, often parallel to the rolling grain of the material.

Also, more than one crack can often appear on a link plate. In addition to rusting, this condition can be caused by exposure to an acidic or caustic medium or atmosphere. Stress corrosion is an environmentally assisted failure. Two conditions must be present - corrosive agent and static stress. In the chain, static stress is present at the aperture due to the press fit pin. No cycle motion is required and the plates can crack during idle periods. The reactions of many chemical agents (such as battery acid fumes) with hard-

ened metals liberate hydrogen which attacks and weakens the metal grain structure.

ARC-LIKE CRACKED PLATES
(STRESS CORROSION)



h. **Chain Anchors and Sheaves:** An inspection of the chain must include a close examination of chain anchors and sheaves. Check chain anchors for wear breakage and misalignment. Anchors with worn or broken fingers should be replaced. They should also be adjusted to eliminate twisting the chain for an even load distribution.

Sheaves should be inspected for worn flanges, which would indicate misalignment, and wear on the outside diameter of the sheave. A worn sheave can mean several problems, as follows:

1. Chains too tight.
2. Sheave bearings/pin bad.
3. Bent/misaligned chains.

Table 2-1. Chain Stretch Tolerance

CHAIN SIZE	PIN TO PIN MEASUREMENT	ALLOWABLE STRETCH 14 IN. SPAN
0.50 in. (1.27 cm) pitch	14 in. (36 cm) or 28 pitches	0.42 in. (1.07 cm)
1.00 in. (2.54 cm) pitch	14 in. (36 cm) or 14 pitches	0.42 in. (1.07 cm)
1.75 in. (4.45 cm) pitch	14 in. (36 cm) or 8 pitches	0.42 in. (1.07 cm)
2.00 in. (5.08 cm) pitch	14 in. (36 cm) or 7 pitches	0.42 in. (1.07 cm)

2.7 WEAR PADS

Shim up wear pads to within 1/16 in. (1.6 mm) tolerance between wear pad and adjacent surface.

Replace wear pads when worn within 1/8 in. (3.2 mm) of threaded insert.

2.8 DRIFT TEST

NOTE: *It is recommended that the machine be shut down in the test mode for at least one hour prior to beginning the drift test. This will allow the oil temperature in the cylinder to stabilize with the ambient temperature. Thermal expansion or retraction of the hydraulic oil can greatly affect cylinder movement.*

Telescope Cylinder

NOTE: *Switches referenced in this procedure are located on the Ground Control Panel.*

1. Activate hydraulic system, properly set extendable axles and position boom in stowed position; adhere to all safety precautions.

⚠ WARNING

BEFORE RAISING AND EXTENDING BOOM, ENSURE THAT AREAS ABOVE AND BELOW BOOM AND PLATFORM AND AHEAD OF PLATFORM ARE CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

2. Position LIFT control switch to UP and hold until boom reaches horizontal.
3. Position TELESCOPE control switch to OUT and hold until boom extends approximately four (4) feet (1.2 meter); measure from end of base section to end of mid section.
4. Position LIFT control switch to UP and hold until boom reaches maximum elevation. Shut down engine.
5. Tag and carefully disconnect the hydraulic lines to the telescope cylinder at control valve.
6. Observe oil flow from cylinder lines. Oil leaking from extend port hose indicates a leaking counterbalance valve. Oil leaking from retract port hose indicates leakage by cylinder piston.
7. Leave boom elevated in test position for approximately one hour.

⚠ WARNING

BEFORE LOWERING BOOM, ENSURE THAT AREAS BELOW BOOM AND PLATFORM ARE CLEAR OF ALL PERSONNEL AND OBSTRUCTIONS.

8. Position LIFT control switch to DOWN and hold until boom reaches horizontal; check boom length against measurement. If boom has retracted more than 1 inch (2.5 cm) and oil is leaking around rod-end of telescope cylinder (check with light and inspection mirror), seals are defective and require

replacement, or cylinder rod is scored and cylinder requires overhaul or replacement. If boom has retracted and oil is leaking from counterbalance valve, the valve is either improperly adjusted, or defective and requires replacement.

9. Connect hydraulic lines to control valve.

Lift Cylinder

NOTE: *Switches referenced in this procedure are located on the Ground Control Panel.*

1. Activate hydraulic system, properly set extendable axles and position boom in stowed position; adhere to all safety precautions.

NOTE: *Tape measure or cord should be at least 7 feet (2.1 meters) long for use in this test.*

2. Attach tape measure or cord to bottom of platform.

⚠ WARNING

BEFORE RAISING BOOM, ENSURE THAT AREAS ABOVE AND BELOW BOOM AND PLATFORM ARE CLEAR OF ALL OBSTRUCTIONS AND PERSONNEL.

3. With boom fully retracted, place LIFT control switch to UP and hold until platform is approximately 6 feet (2 meters) above ground level. Shut down engine.
4. Tag and carefully disconnect hydraulic lines to lift cylinder at control valve. Use a suitable container to retain any residual hydraulic fluid.
5. Observe oil flow from cylinder lines. Oil leaking from extend port hose indicates a leaking counterbalance valve. Oil leaking from retract port hose indicates leakage by cylinder piston.
6. Leave boom elevated in test position for approximately one (1) hour.
7. With tape measure or cord used for reference, check to see whether boom has lowered (crept) more than 3 inches (7.6 cm).
8. If boom has lowered and oil is leaking around rod-end cap of cylinder, seals in cylinder are defective and require replacement. If boom has lowered and oil is leaking from the counterbalance valve, the valve is either improperly adjusted or defective and requires replacement.

⚠ CAUTION

ENSURE THAT HYDRAULIC LINES ARE CONNECTED AS MARKED PRIOR TO BEING DISCONNECTED.

9. Connect hydraulic lines to control valve.

2.9 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 Cylinders, Master Level Cylinder, Frame Jack Cylinders.

⚠ IMPORTANT

OPERATE FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate engine and fully extend cylinder to be checked. Shut down engine.
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 engine 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 engine and carefully disconnect hydraulic hose from cylinder extend port.
6. Activate engine 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, Telescope Cylinder, Extend-A-Reach 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 BOOM TO HORIZONTAL AND SUPPORT THE BOOM USING A SUITABLE BOOM PROP OR OVERHEAD LIFTING DEVICE.

2. If working on the lift cylinder, raise boom to horizontal and place a suitable boom prop approximately 1 inch (2.5 cm) below the boom. If working on the telescope cylinder, raise the boom above horizontal and extend the fly boom approximately 1 foot (30.5 cm).
3. Shut down hydraulic system and allow machine to sit for 10-15 minutes. Turn ignition switch to ON, move control switch or lever for applicable cylinder in each direction, then turn ignition switch to OFF. This is done to relieve excess 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, cylinder repairs must be made. If the retract port is leaking, the piston seals are defective and must be replaced. If the extend port is leaking, 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. If used, remove boom prop or lifting device from boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

Cylinders w/Dual Counterbalance Valve - Axle Extension Cylinders, Telescope Cylinder, Platform Slave Level Cylinder

⚠ IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.
2. If working on the telescope cylinder, raise the boom above horizontal and extend the fly boom approximately 1 foot (30.5 cm). If working on the platform slave level cylinder, stroke platform level cylinder forward until platform sits at a 45° angle.
3. Shut down hydraulic system and allow machine to sit for 10-15 minutes. Turn ignition switch to ON, move control switch or lever for applicable cylinder in each direction, then turn ignition switch to OFF. 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 counterbalance valve is defective and must be replaced.
5. To check piston seals, carefully remove the counterbalance valve from the retract port. After initial discharge, there should not be any further leakage from the ports. If leakage occurs at a rate of 6-8 drops per minute or more, the piston seals are defective and must be replaced.
6. If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully reconnect hydraulic hoses to cylinder port block.
7. Activate hydraulic system and run cylinder through one complete cycle to check for leaks.

2.10 CYLINDER REMOVAL AND INSTALLATION

Telescope Cylinder Removal

1. Place machine on a flat and level surface, with axles extended and the boom fully retracted and in the horizontal position.
2. Shut down engine. Support boom platform end with a prop or suitable overhead lifting device.
3. Remove boom end cover.
4. Remove boom length/angle indicator from boom assembly.

⚠ CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

5. Tag and disconnect hydraulic lines to telescope cylinder. Use suitable containers to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

⚠ CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

6. Tag and disconnect hydraulic lines to telescope cylinder. Use suitable containers to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
7. Remove the two (2) cotter pins that retain the telescope rod attach pin to the base boom.
8. Using a suitable brass drift, carefully drive the telescope cylinder rod attach pin from the base boom.
9. Remove the telescope cylinder trunnion attach pin cover from each side of the base boom.
10. Remove the setscrews securing the telescope cylinder attach pin from each side of the telescope cylinder trunnion.
11. Using a suitable slide hammer, remove the half pins attaching the telescope cylinder to the inner mid boom section.
12. Attach a suitable sling to the telescope cylinder rod. Support with an overhead crane or other suitable lifting device.
13. Remove the rod support bracket at the aft end of the base boom.
14. Remove the two (2) extension chain adjusting nuts at the aft end of the base boom.
15. Remove the three (3) bolts, washers and lockwashers attaching the chain adjust bracket to the aft end of the base boom and remove bracket.
16. Pull boom sections apart several feet.
17. Using the lifting equipment, raise the cylinder to obtain sufficient clearance for removal of the cylinder.
18. Connect a suitable lifting device to the extension chain adjust rod on top of the telescope cylinder.
19. Using both lifting devices, carefully pull the cylinder from the boom assembly.

NOTE: *The extension rod will come out of the boom twice as far as the telescope cylinder proportionally.*

20. Continue sliding the cylinder and extension rod out of the boom until the rod can be separated from the extension chain by removing the chain clevis attach pin.
21. Using the lifting equipment, remove the extension chain bar.
22. Continue sliding the cylinder from the boom, laying the extension chain on top of the base boom as the cylinder is coming out.
23. Using another lifting device, support the sheave wheel end of the cylinder and remove the cylinder from the boom assembly.
24. Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

Telescope Cylinder Installation

1. Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.
2. Using another lifting device, support the sheave wheel end of the cylinder and install the cylinder into the boom assembly.
3. Slide the extension cylinder into the boom, sliding the extension chain in place as the cylinder is moving in.
4. Using the lifting equipment, install the extension chain bar.
5. Continue sliding the cylinder and extension rod into the boom until the rod can be attached to the extension chain by installing the chain clevis attach pin.
6. Install the chain adjust bracket and install the three (3) bolts, washers and lockwashers which attach the bracket to the aft end of the base boom.

7. Install the two (2) extension chain adjusting nuts at the aft end of the base boom.
8. Install the rod support bracket at the aft end of the base boom.
9. Remove the sling attached to the telescope cylinder rod.
10. Pull boom sections back into the fully retracted position.
11. Using a suitable brass drift, if necessary, install the half pins attaching the telescope cylinder to the inner mid boom section.
12. Install setscrews that attach the telescope cylinder attach pins to each side of the telescope cylinder trunnions.
13. Install the telescope cylinder trunnion attach pin cover to each side of the base boom.
14. Carefully install the telescope cylinder rod attach pin into the base boom.
15. Install the two (2) cotter pins that retain the telescope rod attach pin to the base boom.
16. Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure that all hoses are correctly routed.
17. Cycle telescope function several times to dissipate any air from cylinder and lines. Properly torque boom chains to 59 ft. lb. (80 Nm).
18. Install boom length/angle indicator on boom assembly.

NOTE: *Boom length/angle indicator will need to be adjusted as per the procedure listed in paragraph 2-24 of this manual.*

19. Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
20. Install boom end cover.
21. Retract boom fully and place in stowed position.

Lift Cylinder Removal

1. Place the machine on a flat and level surface. Start the engine and place the boom in a horizontal position. Shut down the engine and attach a suitable support device to the boom.
2. Tag, disconnect and cap the lift cylinder hydraulic lines and ports.
3. Remove the bolt, flatwasher and lockwasher securing the cylinder rod attach pin retaining plate to the boom.
4. Remove the two bolts and two lockwashers securing the pin retaining plate to the pin. Using a suitable brass drift drive out the cylinder rod attach pin.
5. Using auxiliary power, retract the lift cylinder rod completely.
6. Remove the barrel end attach pin retaining plate and hardware. Using a suitable brass drift drive out the barrel end attach pin from the upright.
7. Remove the cylinder from the boom and place in a suitable work area.

Lift Cylinder Installation

1. Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the upright.
2. Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the upright. Secure in place with the pin retaining plate and hardware.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power, extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable drift, drive the cylinder rod attach pin through the aligned holes, taking care to align the grooved pin holes. Secure the pin in place with the bolt, lockwasher and nut.
5. Place boom in the stowed position and shut down engine. Check hydraulic fluid level and adjust accordingly.

Master Level Cylinder Removal

1. With the main boom positioned to horizontal and properly supported, prepare to remove the upright level cylinder.
2. Remove the bolt, lockwasher and nut securing the level cylinder rod attach pin to the tower boom. Using an appropriate brass drift, drive out the level cylinder rod attach pin.
3. Tag, disconnect and cap hydraulic lines to level cylinder.

NOTE: *When disconnecting hydraulic lines, any residual hydraulic fluid should be drained into a suitable container.*

4. Make up two temporary hose assemblies (3/8 In. x 10 ft.) to carry power from the turntable swing motor supply hoses to the lift cylinder. Couple temporary hoses to swing motor supply hoses, using reducer fittings if necessary. Plug ports in swing motor.
5. After installing temporary hoses, activate swing function, using auxiliary power, to fully retract level cylinder rod.
6. Remove temporary hoses from level cylinder and cap them. Plug cylinder ports.
7. Using slings, restrain level cylinder.
8. Remove retaining plate and bolts from upright cylinder attach pin.
9. Using an appropriate brass drift, drive out the upright attach pin. Carefully remove restraining slings and remove level cylinder from boom.

Master Level Cylinder Installation

1. With the boom positioned at horizontal and properly supported, place the master level cylinder in position on the boom and secure in place using slings.
2. Align barrel end bushing with pin attach blocks in turntable upright and install upright attach pin using appropriate brass drift. Secure pin with retaining plate and retaining plate bolts.
3. Remove caps from temporary hydraulic lines and attach to level cylinder ports. Using auxiliary power, activate swing function and extend cylinder rod until rod bushing aligns with boom lift cylinder rod end attach bushing.
4. Using an appropriate brass drift drive the rod attach pin through the aligned bushings of the cylinder rod and boom lift cylinder rod end attach plate, taking care to align holes for bolt attachment. Secure rod end attach pin with bolt, lockwasher and nut.
5. Remove restraining slings from level cylinder.
6. Remove temporary hydraulic lines from cylinder ports and turntable swing motor hydraulic supply. Reattach hydraulic supply to swing motor.
7. Remove caps from cylinder hydraulic lines and correctly install lines to cylinder.
8. Remove boom support. Place boom in stowed position. Check hydraulic fluid level and adjust accordingly.

2.11 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.

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

⚠ WARNING

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 applicable.

⚠ WARNING

FOR CYLINDERS WITH DOUBLE HOLDING VALVES, CRACK BLEEDERS TO RELEASE PRESSURE BEFORE REMOVING HOLDING VALVES.

3. If applicable, remove the cartridge-type holding valve and fittings from the cylinder port block. Discard o-rings.

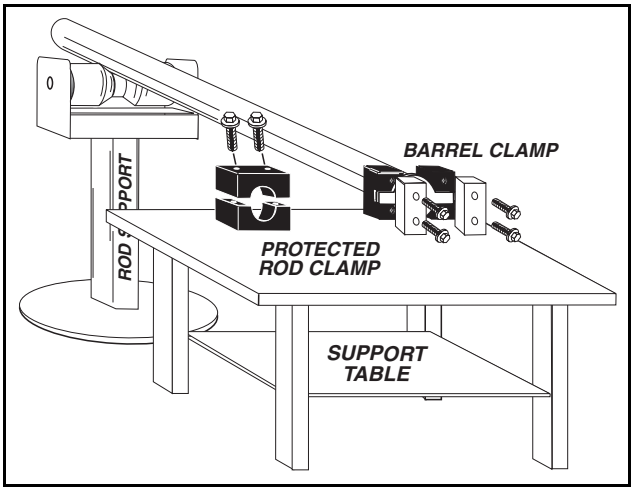


Figure 2-3. Cylinder Barrel Support

4. Place the cylinder barrel into a suitable holding fixture. Tap around outside of cylinder head retainer with a suitable hammer to shatter loctite.
5. Using a suitable spanner wrench, loosen the cylinder head retainer, if applicable, and/or cylinder head gland, and remove from cylinder barrel.
6. 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.

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

⚠ CAUTION

ONCE THE HEAD GLAND HAS CLEARED THE CYLINDER CASE MOUTH, THE ROD MUST BE SUPPORTED CLOSE TO THE CYLINDER CASE PRIOR TO THE PISTON BEING PULLED PAST THE CYLINDER CASE THREADS. THIS IS DONE TO AVOID DAMAGE TO THE CYLINDER CASE THREADS, AND/OR THE PISTON AND PISTON SEALS.

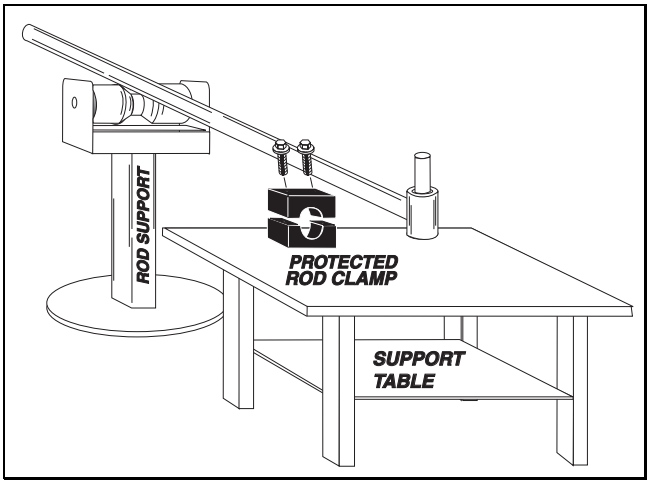


Figure 2-4. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Remove the set screw(s), if applicable, and nut which attach the piston to the rod, and remove the piston. Discard nylon point set screws.
10. Remove the piston rings.
11. Remove and discard the piston o-rings, seal rings, and backup rings.
12. Remove the set screw, if applicable, piston spacer, and wear ring, if applicable, from the rod.
13. Remove the rod from the holding fixture. Remove the cylinder head gland and retainer, 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 seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. If applicable, inspect cylinder head retainer or end cap for surface or thread damage. Repair or replace as necessary.
11. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
12. If applicable, inspect thread ring for scoring or other damage. Dress threads or applicable surfaces as necessary.
13. If applicable, inspect rod and barrel bushings for signs of correct lubrication and excessive wear. Replace as necessary.
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.*

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

⚠ IMPORTANT

WHEN INSTALLING NEW "POLY-PAK" TYPE PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO FIGURE 2-1 FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

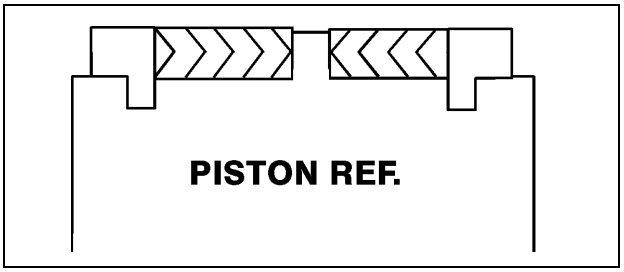


Figure 2-5. Poly-Pak Seal Installation

1. Place a new wiper seal and rod seal into the applicable cylinder head gland grooves.
2. 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.
3. Carefully slide the piston spacer on the rod. If applicable, align the oil holes in the rod and the spacer. Secure the spacer, if applicable.
4. If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.
5. Carefully place the piston on the cylinder rod, ensuring that the o-ring and back-up rings are not damaged or dislodged.
6. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
7. Push the piston onto the rod until it abuts the spacer end and install the attaching nut.

⚠ WARNING

IF CYLINDER IS EQUIPPED WITH A PISTON NUT, APPLY "LOC-QUIC PRIMER T" AND LOCTITE #242 TO PISTON NUT THREADS, THEN TIGHTEN NUT TO TORQUE SHOWN IN TABLE 2-2.

NOTE: *Self-locking setscrews used on piston nuts should be discarded and replaced whenever they are removed.*

Table 2-2. Cylinder Piston Nut Torque Specifications

Description	Nut Torque Value (w/Loctite)	Setscrew Torque Value (w/Loctite)
Axle Extension Cylinder	400 ft. lb. (542 Nm)	100 in. lb. (11 Nm)
Extend-a-Reach Cylinder	400 ft. lb. (542 Nm)	100 in. lb. (11 Nm)
Frame Jack Cylinder	400 ft. lb. (542 Nm)	100 in. lb. (11 Nm)
Level/Slave Cylinder	200 ft. lb. (271 Nm)	100 in. lb. (11 Nm)
Lift Cylinder	600 ft. lb. (813 Nm)	200 in. lb. (22 Nm)
Master Cylinder	80 ft. lb. (108 Nm)	100 in. lb. (11 Nm)
Steer Cylinder	80 ft. lb. (108 Nm)	100 in. lb. (11 Nm)
Telescope Cylinder	600 ft. lb. (813 Nm)	200 in. lb. (22 Nm)

8. If applicable, install the setscrew(s) which secure the piston attaching nut to the diameter groove.
9. Remove the cylinder rod from the holding fixture.
10. Place new o-rings and seals in the applicable outside diameter grooves of both the piston and the cylinder head.
11. 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.

12. 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.
13. 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 threads of the barrel.
14. If applicable, secure the cylinder head retainer using a suitable spanner type wrench in the holes provided.
15. 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.
16. If applicable, install the cartridge-type holding valve and fittings in the rod port block using new o-rings as applicable.

⚠ 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.

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. (204-217 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: *Steps (17) through (20) apply to the telescope cylinder.*

17. Elevate the barrel end of the cylinder to a work bench or other suitable device.
18. Plug the retract port and supply hydraulic power to the extend port.
19. Open the bleeder port plug (TP), venting all trapped air to atmosphere. Retighten the bleeder port plug. Disconnect the hydraulic power source and remove plug from retract port.
20. An alternative to steps (18) through (20) is to position the barrel horizontally in a suitable holding device, attach a hydraulic power source to both extend and retract ports, while supporting the cylinder rod, cycle the cylinder a minimum of 5 times with

the bleeder port unplugged, venting all trapped air to atmosphere. A suitable hose may be attached to the bleeder port with the end in a container suitable to contain the hydraulic fluid. After all air is vented remove all attached hoses, and install the bleeder port plug. Also plug the extend and retract ports until cylinder is installed in boom.

2.12 BOOM MAINTENANCE

Removal

1. Shut down machine systems.

NOTE: *Boom Assembly, less extend-a-reach and jib, weighs approximately 9,500 lb. (4309 kg).*

2. Using suitable lifting equipment, adequately support boom weight along entire length of retracted boom.

⚠ CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

3. Tag and disconnect hydraulic lines that run along the side of the boom.
4. Remove hardware attaching upper lift cylinder attach pin to boom.
5. Using a slide hammer or similar tool, and taking care not to damage pin, remove pin from boom.
6. Using all applicable safety precautions, and only if necessary, operate crane and fully retract lift cylinder.
7. Shut down machine systems.
8. Tag and disconnect all wiring to ground control box.
9. Remove boom length/angle indicator box.
10. Loosen and remove hardware securing boom pivot pin.
11. Ensuring that boom is adequately supported and using a suitable slide hammer, carefully remove pivot pin from boom and turntable structure. Ensure that boom and turntable structure are not damaged.
12. Carefully lift boom assembly clear of turntable and lower to ground or suitably supported work surface.

Disassembly

NOTE: *Left or right is determined facing the machine from the platform.*

1. Loosen the right side powertrack bracket and powertrack and lay on top of boom assembly.

⚠ CAUTION

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

2. Tag and disconnect hydraulic lines to slave level cylinder and rotator motor.
3. Tag and disconnect wiring to platform control box.
4. Remove the left side powertrack.
5. Remove platform from boom assembly.
6. Remove cotter pins retaining telescope cylinder rod attach pin to base section.
7. Using a suitable brass drift, carefully drive telescope cylinder pin from base section.
8. Remove outer mid section extend chain adjust nut and locknut at upper aft end of base section.
9. Remove bolts, washers and lockwashers attaching outer mid section extend chain attach block to upper aft end of base section. Remove block.
10. Remove fly section extend chain adjust nut and locknut at lower front end of inner mid section.
11. Remove outer mid section retract chain adjust nut and locknut at lower front end of base section.
12. Remove fly section retract chain adjust nut and locknut at lower front end of inner mid section.

NOTE: *Note and record the number and thickness of any wear pad shims during wear pad removal.*

13. Remove bolts and lockwashers attaching side wear pads to front of base section. Remove pads and any shims.
14. Remove bolts, washers and lockwashers attaching lower front wear pads and mounting blocks to base section. While supporting assembled fly, outer mid and inner mid sections, remove wear pads, mounting blocks and shims.
15. Remove bolts and lockwashers attaching top front wear pad to base section. Remove pad and shims.
16. Using suitable lifting equipment, partially slide assembled inner mid, outer mid and fly sections out of base section.
17. Using suitable straps, tie off outer mid section retract chains to underside of inner mid section as inner mid, outer mid and fly sections are exiting base section.

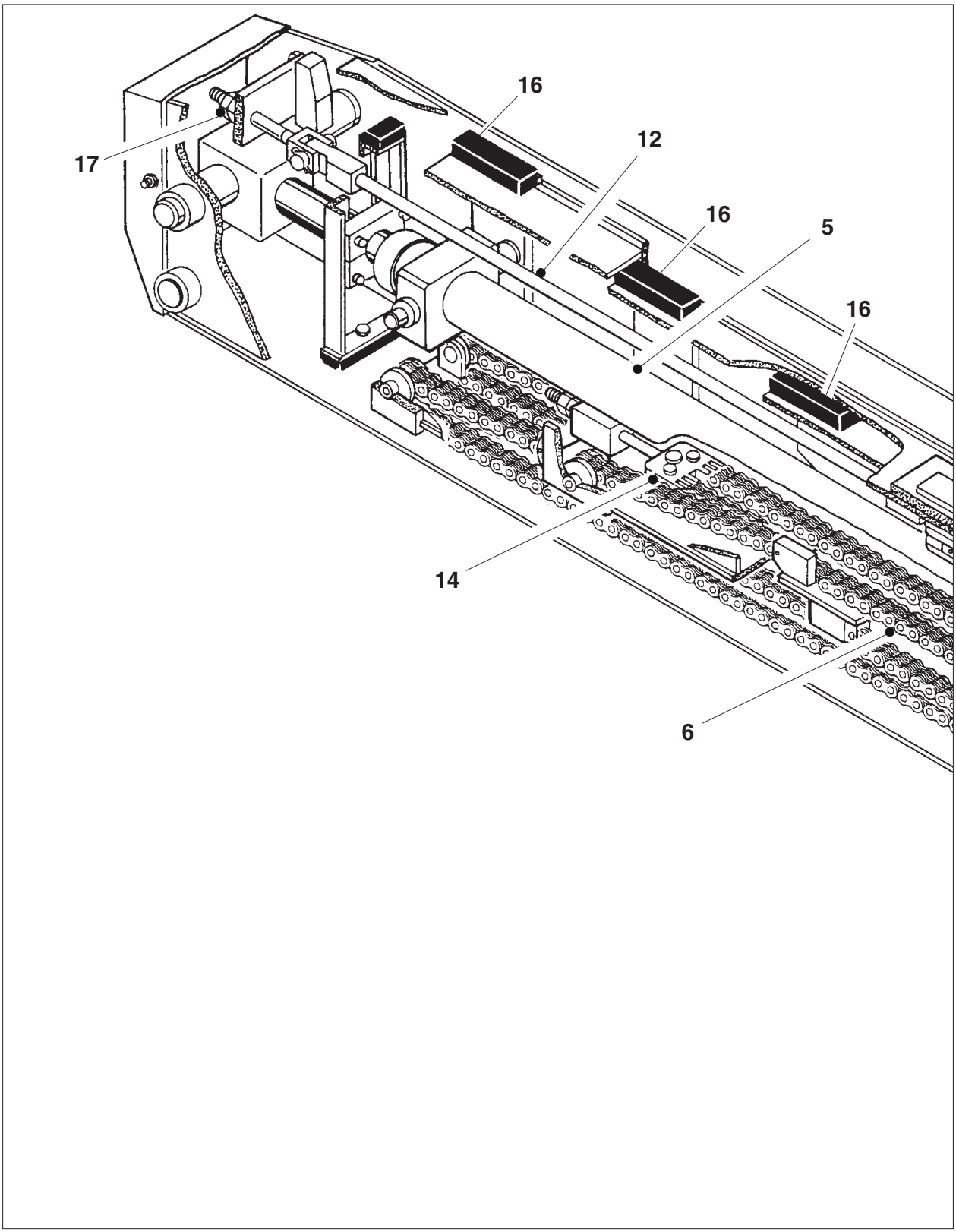


Figure 2-6. Boom Assembly - Sheet 1 of 2

1. Boom Base
2. Inner Mid Boom
3. Outer Mid Boom
4. Fly Boom
5. Telescope Cylinder
6. Outer Mid Extend Chain
7. Fly Extend Chain
8. Fly Retract Chain
9. Outer Mid Retract Chain
10. Tele Cylinder Sheave
11. Sheave
12. Chain Extend Rod
13. Chain Attach Pin
14. Chain Adjustment Assembly
15. Chain Adjustment Assembly
16. Upper Rear Wear Pad
17. Adjustment & Jam Nuts
18. Safety Chain

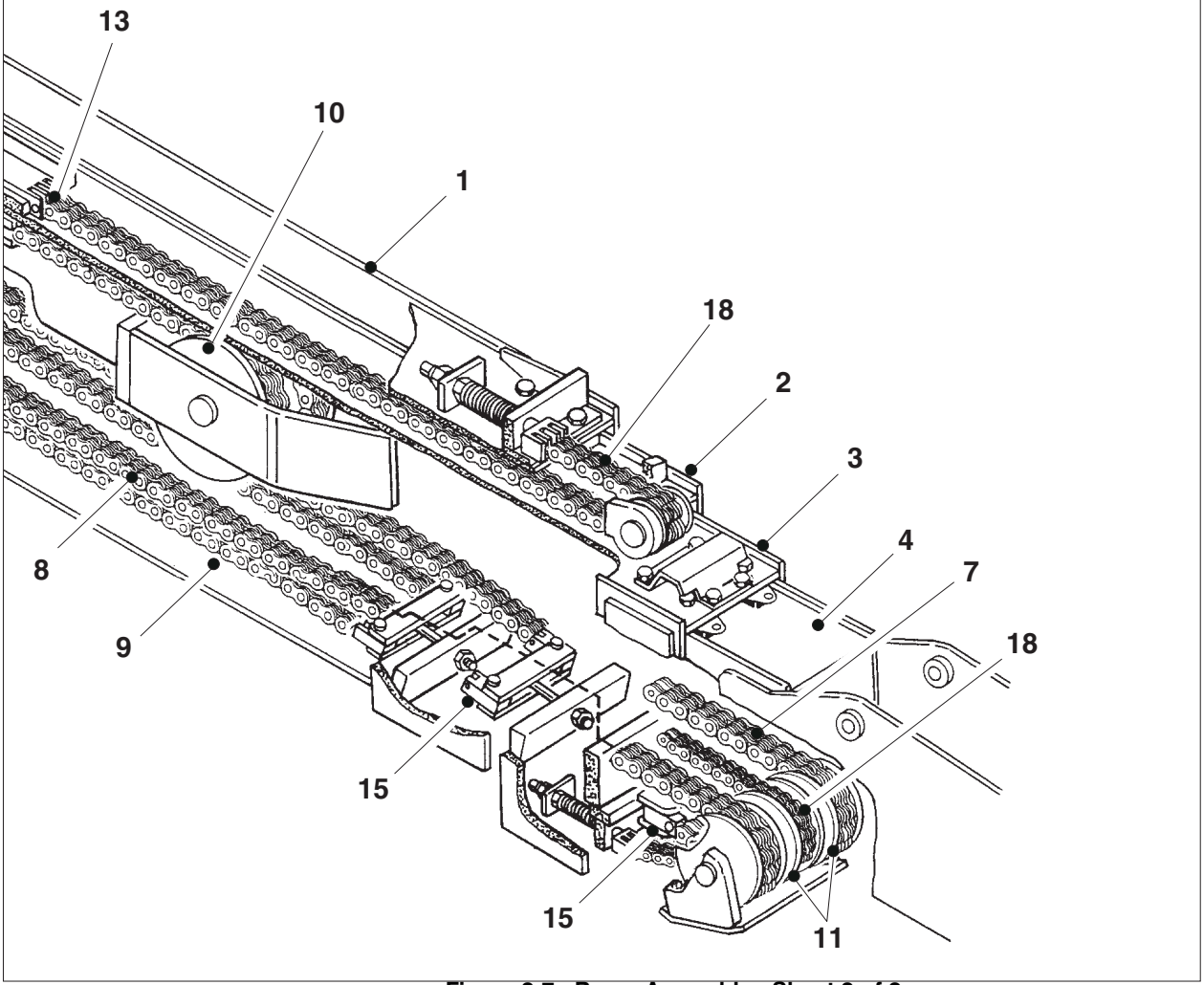


Figure 2-7. Boom Assembly - Sheet 2 of 2

18. Carefully lift inner mid, outer mid and fly sections clear of base section and lower to a suitably supported work area.
19. Using suitable lifting equipment, support telescope cylinder rod.
20. Remove setscrew securing trunnion pins that secure inner mid section to telescope cylinder.
21. Using a suitable tool, scribe a line on the outer end of each trunnion pin and boom structure as an aid to pin alignment during boom assembly.
22. Using a suitable slide hammer, remove trunnion pins attaching telescope cylinder to inner mid section.
23. Remove cotter pins and chain attach pins attaching outer mid section retract chains to lower aft end of outer mid section and remove chains.
24. Remove setscrews which attach chain sheave pins at lower aft end of inner mid section.
25. Using a suitable brass drift, carefully drive sheave pins from inner mid section and remove sheaves and thrust washers. If necessary, remove bushings from sheaves and replace. Ensure that pins, grease fittings and corresponding boom and sheave surfaces are not damaged.
26. Remove cotter pins and chain attach pins attaching fly section retract chains to lower aft end of fly section and remove chains.
27. Remove setscrews which attach chain sheave pins at lower aft end of outer mid section.
28. Using a suitable brass drift, carefully drive sheave pins from outer mid section and remove sheaves, seals, and thrustwashers. If necessary, remove bushings from sheaves and replace. Ensure that pins, grease fittings and corresponding boom and sheave surfaces are not damaged.
29. Pull boom sections out several feet to allow ample clearance for telescope cylinder removal.
30. Remove outer mid section extension chain adjust nut and locknut from clevis at lower aft end of outer mid section.
31. Using suitable lifting equipment, carefully slide telescope cylinder out of fly, outer mid, and inner mid sections, along with extension chain and bar.
32. When approximately one-half of the telescope cylinder is removed from the boom assembly, the extension bar attach to chain will become accessible. Remove cotter pins and clevis pin attaching extension bar to chain and remove bar.
33. Carefully lift telescope cylinder clear of boom assembly and lower to ground or suitably supported work area.
34. Remove bolts attaching outer mid section retract chain adjust block at lower front end of inner mid section and remove block.

NOTE: *Note and record number and thickness of any wear pad shims during wear pad removal.*

35. Remove bolts and lockwashers which attach upper aft inner mid section wear pads and remove pads and any shims.
36. Remove bolts, washers and lockwashers which attach bottom wear pads at front of inner mid section and remove pads and any shims.
37. Remove bolts and lockwashers which attach side wear pads at front of inner mid section and remove pads and any shims.
38. Remove bolts and lockwashers which attach top wear pad at front of inner mid section and remove pad and any shims.
39. Using suitable lifting equipment, carefully slide outer mid and fly sections clear of inner mid section and lower to ground or other suitably supported work area.
40. Remove bolts and lockwashers which attach upper aft outer mid section wear pads and remove pads and any shims.
41. Remove bolts and lockwashers which attach bottom wear pads at front of outer mid section and remove pads and any shims.
42. Remove bolts and lockwashers which attach side wear pads at front of outer mid section and remove pads and any shims.
43. Remove bolts and lockwashers which attach top wear pads to front of outer mid section and remove pads and any shims.
44. Remove bolt, washer and lockwasher attaching fly section right hand extend chain sheave attach pin to front of outer mid section.
45. Using a suitable brass drift, carefully drive each sheave pin from the boom section and remove the sheave assemblies. Inspect pins, lubrication fittings and sheave bearings for damage and dirt or foreign material. Replace components as necessary.
46. Repeat steps (42) and (43) for left hand sheave.
47. Using suitable lifting equipment, carefully slide fly section clear of outer mid section and lower to ground or suitably supported work area.

Inspection

1. Inspect all sheaves (extend chains, retract chains and telescope cylinder) for excessive groove wear, burrs or other damage. Replace sheaves as necessary.
2. Inspect extend chain and retract chain sheave bearings for wear, scoring, or other damage, and for ovality. Replace bearings as necessary, ensuring they are installed flush with sheave surface.
3. Inspect extend chain and retract chain sheave pins for scoring, tapering, ovality and evidence of correct lubrication. Replace pins as necessary.
4. Inspect telescope cylinder sheave pin for tapering, scoring, ovality and evidence of correct lubrication. Replace pin as necessary.
5. Inspect boom pivot pin for wear, scoring or other damage, and for tapering or ovality. Replace pin as necessary.
6. Inspect upper lift cylinder attach pin for tapering, ovality, scoring, wear, or other damage. Ensure pin surfaces are protected prior to installation. Replace pin as necessary.
7. Inspect telescope cylinder trunnion attach pin for tapering, ovality, scoring, wear, or other damage. Replace pin as necessary.
8. Inspect extend chain attach clevis pins for wear, scoring, or other damage. Replace pins as necessary.
9. Inspect telescope cylinder rod attach pin for scoring, wear, or other damage. Replace pin as necessary.
10. Inspect inner diameter of boom pivot bushing for scoring, distortion, wear, or other damage. Replace bushing as necessary.
11. Inspect all wear pads for excessive wear or damage. Replace pads when worn to within 1/8 inch (3.2 mm) of insert.
12. Inspect extend and retract chains and chain attach component for cracks, stretching, distortion, or other damage. Replace components as necessary.
13. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
14. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

NOTE: *When installing fly section wear pads, install same number and thickness of shims as were removed during disassembly.*

1. Install upper aft fly section wear pads and shims, as required, using bolts and lockwashers.
2. Using suitable lifting equipment, carefully slide fly section into outer mid section.
3. Install fly section extend chain sheaves on front of outer mid section and install sheave pins.
4. Install lubrication fittings in ends of pins and lubricate sheaves with MPG.

NOTE: *When installing outer mid section wear pads, install same number and thickness of shims, as required, using bolts and lockwashers.*

5. Install outer mid section top front wear pads and shims, as required, using bolts and lockwashers.
6. Install outer mid section side front wear pads and shims, as required, using bolts and lockwashers.
7. Install outer mid section bottom front wear pads and shims, as required, using bolts and lockwashers.
8. Install outer mid section upper aft wear pads and shims, as required, using bolts and lockwashers.
9. Using suitable lifting equipment, carefully slide assembled outer mid and fly sections into inner mid section.

NOTE: *When installing inner mid section wear pads, install same number and thickness of shims as were removed during disassembly.*

10. Install inner mid section top front wear pads and shims, as required, using bolts and lockwashers.
11. Install inner mid section side front wear pads and shims, as required, using bolts and lockwashers.
12. Install inner mid section bottom front wear pads and shims, as required, using bolts, washers and lockwashers.
13. Install inner mid section upper aft wear pads and shims, as required, using bolts and lockwashers.
14. Install fly section retract chain adjust block on lower front end of inner mid section and secure with bolts.
15. Place outer mid section extend chain assembly along telescope cylinder chain rest with chain adjust assembly hanging just below cylinder sheave.

16. Using lightweight motor oil (SAE 20W), adequately lubricate portion of chain occupying cylinder chain rest.
17. Using suitable lifting equipment, maneuver telescope cylinder and outer mid section extend chain assembly into position at aft end of assembled boom sections.
18. With a slight downward angle on the cylinder, insert sheave and chain adjust into boom sections until it is possible to insert chain adjust into attach block at rear of outer mid section. Temporarily install chain adjust and locknuts.
19. Carefully feed telescope cylinder approximately halfway into boom sections, lubricating chain with lightweight motor oil as it passes along chain rest. Attach extension bar to chain and continue inserting into boom sections.
20. Install fly section retract chain sheaves, seals and thrustwashers at aft end of outer mid section.
21. Install sheave pins and if necessary, tap pins into place using a soft headed mallet. Secure pins with setscrews.
22. Install lubrication fittings on ends of pins and lubricate sheaves with MPG.
23. Install fly section retract chains at lower aft end of fly section. Install chain attach pins and flatwashers and secure with cotter pins.
24. Carefully place fly section retract chains around chain sheaves at aft end of inner mid section and through bottom of inner mid section.
25. Install fly section retract chain clevis into attach block at lower front end of inner mid section. Install adjust nut and locknut on clevis.
26. Install outer mid section retract chain sheaves and thrust washers at aft end of inner mid section.
27. Install sheave pins and, if necessary, tap pins into place using a soft headed mallet. Secure pins with setscrews.
28. Install lubrication fittings on ends of pins and lubricate sheaves with MPG.
29. Install outer mid section retract chains at lower aft end of outer mid section. Install chain attach pins and flatwashers and secure with cotter pins.
30. Carefully place outer mid section retract chains around chain sheaves at aft end of inner mid section. Tie chains to underside of inner mid section using suitable straps.
31. Using suitable lifting equipment, carefully align holes in telescope cylinder trunnion and holes in aft end of inner mid section.
32. Install trunnion pins, ensuring that holes in pins align with holes in trunnion. If necessary, tap pins into place with a soft headed mallet. Secure pins with setscrews.
33. Using suitable lifting equipment, carefully slide assembled inner mid, outer mid, and fly sections into base section.
34. As sections are being installed, remove straps from outer mid section retract chains and feed attach clevis through holes in bottom of forward end of base section.
35. Install outer mid section retract chain clevis into attach block at lower front end of base boom section. Install adjust nut and locknut on clevis.

NOTE: *When installing base section wear pads, install same number and thickness of shims as were removed during disassembly.*

36. Install base section top front wear pads and shims, as required, using bolts and lockwashers.
37. Install base section lower front wear pads, mounting blocks, and shims, as required, using bolts, washers, and lockwashers.
38. Install base section side front wear pads and shims, as required, using bolts and lockwashers.
39. Carefully align telescope cylinder rod end with holes in aft end of base boom section and install attach pin. If necessary, tap pin into place using a soft headed mallet. Secure pin with cotter pins.
40. Install outer mid section extend chain attach block at aft end of base section and secure with bolts and lockwashers.
41. Install outer mid section extend chain clevis through hole in attach block and secure with adjust nut and locknut.
42. Attach platform to boom assembly.
43. Attach the left side powertrack to boom assembly.
44. Connect wiring to consolette box.
45. Connect hydraulic lines to slave level cylinder and rotator motor.
46. Attach the right side powertrack bracket and powertrack to boom assembly.

Installation

1. Using suitable lifting equipment, position assembled boom on turntable so that boom pivot holes in both boom and turntable are aligned.

2. Insert boom pivot pin, ensuring that locating slots in pin are aligned with setscrew locating holes in pin bushings.
3. If necessary, gently tap pin into position with a soft headed mallet. Secure pin with setscrews.
4. Connect all wiring to ground control box.
5. Using all applicable safety precautions, operate lifting equipment in order to position boom lift cylinder so that holes in cylinder rod end and boom structure are aligned. Insert lift cylinder pin.
6. If necessary, gently tap pin into position with a soft headed mallet, ensuring that pin plate holes are aligned with attach holes in boom structure. Install pin attaching bolts, washers and lockwashers.
7. Shut down machine systems.
8. Connect hydraulic lines running along side of boom.
9. Install boom length/angle sensor box. Adjust boom length/angle sensor box in accordance with paragraph 2-26.
10. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle. If chattering is apparent, extend chain system requires adjustment.
11. Retract and lower boom, noting performance of retraction cycle. If chattering is apparent, retract chain system requires adjustment.
12. Shut down machine systems.
13. Adjust extend and retract chain systems as required and secure adjustment locknuts.
14. As necessary, lubricate all points requiring lubrication.

2.13 TILT ALARM SWITCH

⚠ CAUTION

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

NOTE: *Each machine is equipped with a tilt alarm switch (sensor). The switch is factory set to activate at 5 degrees and will illuminate a warning light and sound a warning horn. In addition, if the boom is above horizontal when the switch is activated, LIFT and SWING will go to creep speed. Consult factory for tilt sensor adjustment. The only field adjustment necessary is leveling the switch on the spring loaded studs. There are two methods of adjustment, a manual adjustment and an adjustment using a voltmeter.*

Manual Adjustment

1. Park the machine on a flat, level surface. Ensure machine is level and tires are filled to rated pressure.

NOTE: *Ensure switch mounting bracket is level and securely attached.*

2. Level the base of the indicator by tightening the three flange nuts. Tighten each nut through approximately one half of it's spring's travel. DO NOT ADJUST THE "X" NUT DURING THE REMAINDER OF THE PROCEDURE.
3. With the electrical connections complete, slowly tighten one of the "Y" nuts until the circuit is closed and the light on the Platform Control Console illuminates.

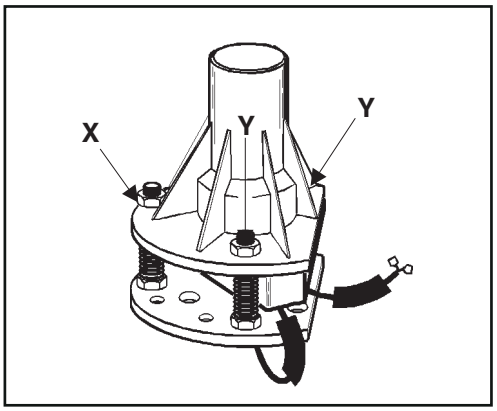


Figure 2-9. Tilt Switch Adjustment - Manual

4. Slowly back off the nut, counting the number of turns, until the circuit is again closed and the light again illuminates.
5. Divide the number of turns determined in step (4) in half. Tighten the nut this many turns. The line determined by this nut and the "X" nut is now parallel to the ground.
6. Repeat steps (3) through (5) for the remaining "Y" nut. The switch is now level.
7. Individually push down on one corner at a time; there should be enough travel to cause the switch to trip. If the switch does not trip in all three tests, the

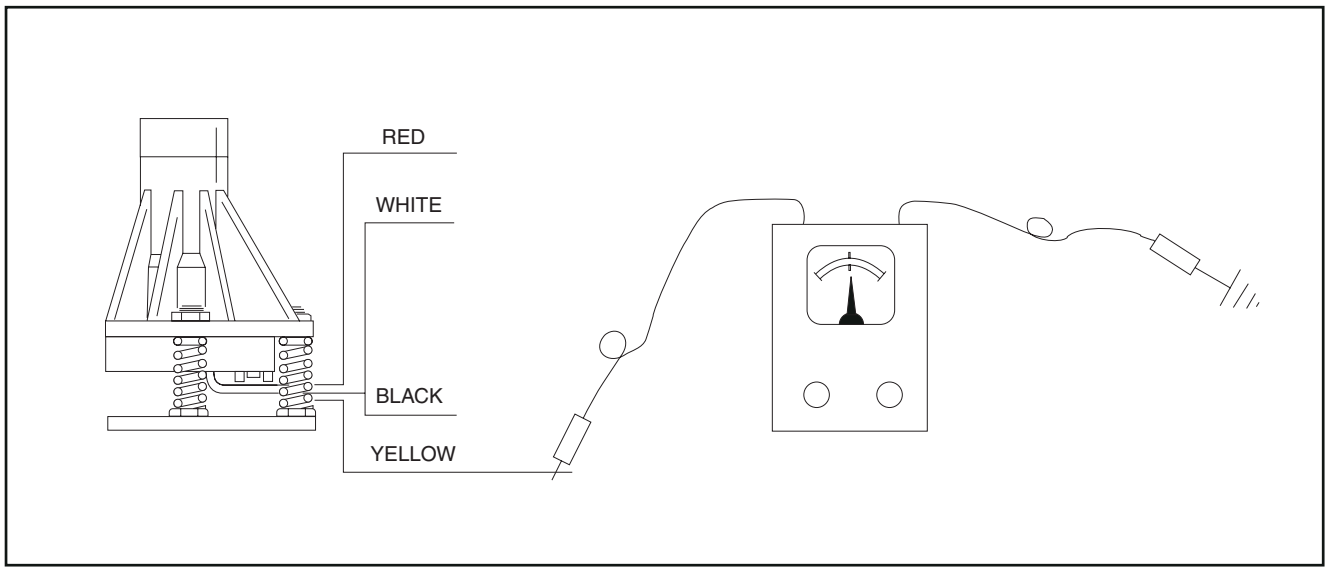


Figure 2-8. Tilt Switch Adjustment - Voltmeter

flange nuts have been tightened too far. Loosen the "X" nut and repeat steps (3) through (7).

Voltmeter Adjustment

1. Park machine on a flat, level surface. Ensure machine is level and tires are filled to rated pressure.
2. If engine is not running, turn ignition switch to ON.
3. Connect black lead of voltmeter to ground and red lead to yellow wire protruding from pot on bottom of sensor.
4. Adjust leveling nuts to obtain the highest possible voltage reading.
5. Check voltage at trip point in all four directions. If voltage reading is not symmetrical, repeat step (4) above.

2.14 LIMIT SWITCH ADJUSTMENTS

Boom Limit Switch

The boom limit switch is located on the left side of the base section of the boom. The switch will activate when the boom is extended past a set point with the axles retracted. When activated, the switch cuts out Telescope Out and Lift Up. Adjust the limit switch to trip at 10 feet (3 meters) of boom extension.

Horizontal Cut-Out Switch

The horizontal cut-out switch is located on the right side of the boom at the boom pivot pin. When activated, the switch cuts out the High Engine, High Drive and 2 Speed functions. Adjust the switch to activate when the boom reaches horizontal.

2.15 THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE

NOTE: *Never run fuel tank dry. Diesel engines cannot be restarted after running out of fuel until fuel system has been air-vented or "bled" of air. See Deutz instruction manual for procedure.*

1. Disconnect actuator cable from throttle lever. With the aid of an assistant, start the engine and allow it to come up to operating temperature. Adjust throttle lever stop until engine runs at 1800 RPM. Shut down engine. Reattach actuator cable to throttle lever, making sure that low (mid) engine setting remains the same. If necessary, adjust slide pin to contact low (mid) engine limit switch at 1800 RPM. Shut down engine.
2. Start the engine from ground controls and allow to come up to operating temperature. Inside the ground control terminal box, attach a "hot" wire from the 12 Volt power (red) wire at the PLATFORM/ GROUND SELECT switch to terminal 1 (brown/black wire) on the relay circuit card at the top of the ground control terminal box. This will cause the engine to run as if HIGH ENGINE and HIGH DRIVE are activated. Adjust slide pin to contact high engine limit switch at 2500 RPM. Remove "hot" wire from terminal 1 and from PLATFORM/GROUND SELECT switch. Shut down engine.

NOTE: *Actuator cable travel must stop slightly before lever makes contact with throttle lever stop. Failure to do so will burn out actuator.*

2.16 PRESSURE SETTING PROCEDURES

Main Valve

1. Main Relief.
   a. Plug pressure gauge into quick-connect on main valve. Monitor gauge.
   b. Bottom out Lift Up function.
   c. Loosen nut at main relief and adjust pressure to 3450 psi (238 bar) using an Allen wrench. Tighten nut.
2. Lift Down Relief.
   a. Monitor pressure gauge at quick-connect on main valve.
   b. Bottom out Lift Down function.
   c. Loosen nut at lift down relief and adjust pressure to 1200 psi (83 bar) using an Allen wrench. Tighten nut.
3. Swing Relief.
   a. Monitor pressure gauge at quick-connect on main valve.
   b. Ensure turntable lock is engaged.
   c. Bottom out Swing Right function.
   d. Loosen nut at swing right relief and adjust pressure to 1200 psi (83 bar) using an Allen wrench. Tighten nut.
   e. Bottom out Swing Left function.
   f. Loosen nut at swing left relief and adjust pressure to 1200 psi (83 bar) using an Allen wrench. Tighten nut.
4. Extend-A-Reach Relief.
   a. Monitor pressure gauge at quick-connect on main valve.

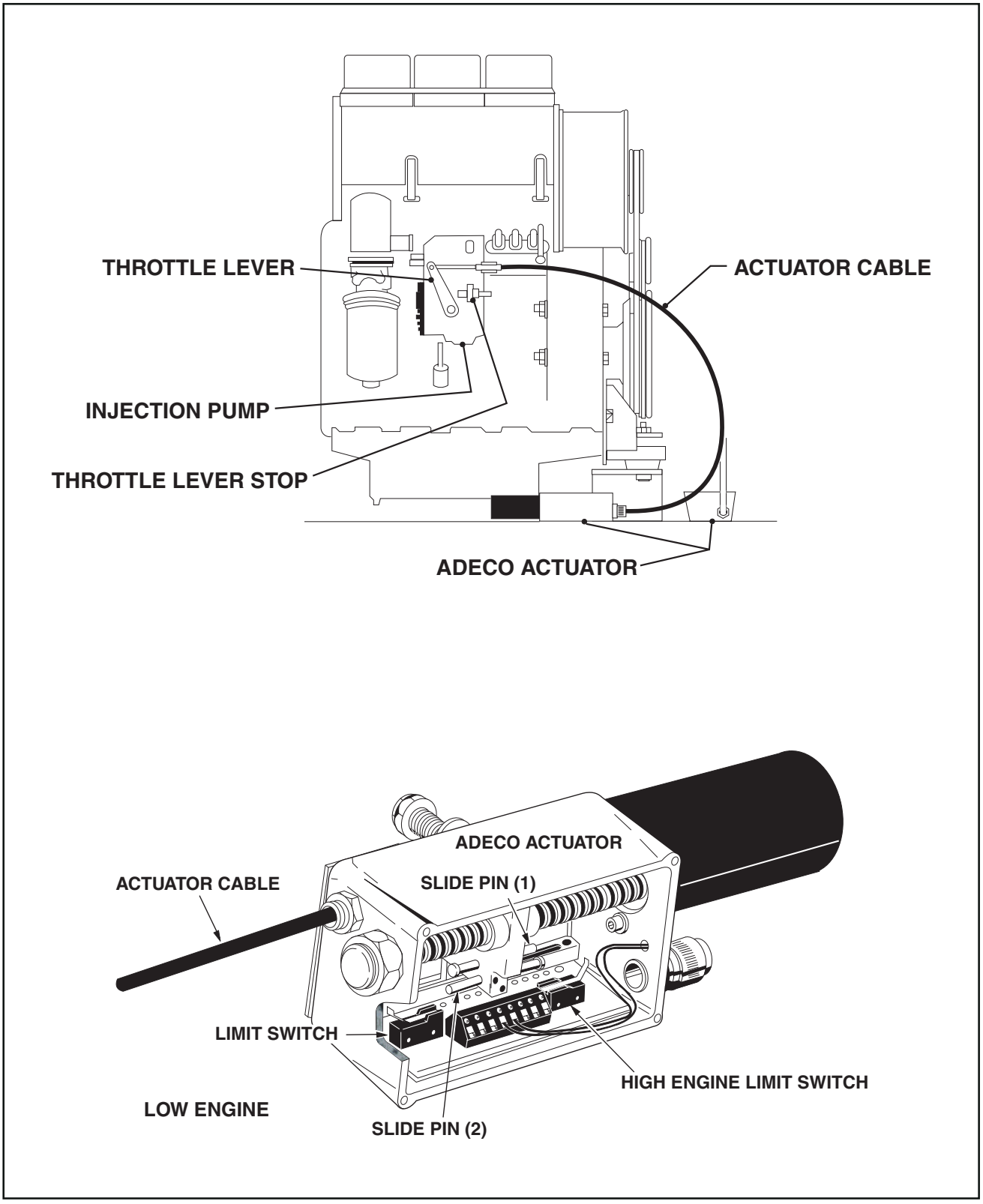


Figure 2-10. Throttle Checks and Adjustments - Deutz Engine

b. Bottom out Extend-A-Reach Up function.

c. Loosen nut at extend-a-reach up relief and adjust pressure to 3000 psi (207 bar) using an Allen wrench. Tighten nut.

d. Bottom out Extend-A-Reach Down function.

e. Loosen nut at extend-a-reach down relief and adjust pressure to 1400 psi (97 bar) using an Allen wrench. Tighten nut.

5. Platform Rotate Relief.

a. Monitor pressure gauge at quick-connect on main valve.

b. Bottom out Rotate Right function.

c. Loosen nut on rotate right relief and adjust pressure to 2500 psi (172 bar). Tighten nut.

d. Bottom out Rotate Left function.

e. Loosen nut on rotate left relief and adjust pressure to 2500 psi (172 bar). Tighten nut.

6. Platform Level Relief.

a. Monitor pressure gauge at quick-connect on main valve.

b. Bottom out Platform Level Up function.

c. Loosen nut on platform level up relief and adjust to Tighten nut.

d. Bottom out Platform Level Down function 2500 psi (172 bar). Tighten nut.

e. Loosen nut on platform level down relief and adjust to 2000 psi (138 bar).

Frame Valve

1. Steer Relief.

NOTE: *Torque frame valve bolts to 80 in. lb. (9 Nm) after checking or adjusting steer pressure.*

a. Plug pressure gauge into quick-connection on frame valve. Monitor gauge.

b. Bottom out Front Steer Right function.

c. Loosen nut on front steer right relief and adjust to 2000 psi (138 bar). Tighten nut.

d. Bottom out Front Steer Left function.

e. Loosen nut on front steer left relief and adjust to 2000 psi (138 bar). Tighten nut.

f. Bottom out Rear Steer Right function.

g. Loosen nut on rear steer right relief and adjust to 2000 psi (138 bar). Tighten nut.

h. Bottom out Rear Steer Left function.

i. Loosen nut on rear steer left relief and adjust to 2000 psi (138 bar). Tighten nut.

2. Axle Extension/Retraction Relief.

a. Monitor pressure gauge at quick-connect on frame valve.

b. Raise front end of machine using front frame jack.

c. Bottom out Front Axle Extend function.

d. Loosen nut on front axle extend relief and adjust pressure to 2000 psi (138 bar). Tighten nut.

e. Bottom out Front Axle Retract function.

f. Loosen nut on front axle retract relief and adjust pressure to 2200 psi (152 bar). Tighten nut.

g. Lower front end of machine.

h. Raise rear end of machine using rear frame jack.

i. Bottom out Rear Axle Extend function.

j. Loosen nut on rear axle extend relief and adjust pressure to 2000 psi (138 bar). Tighten nut.

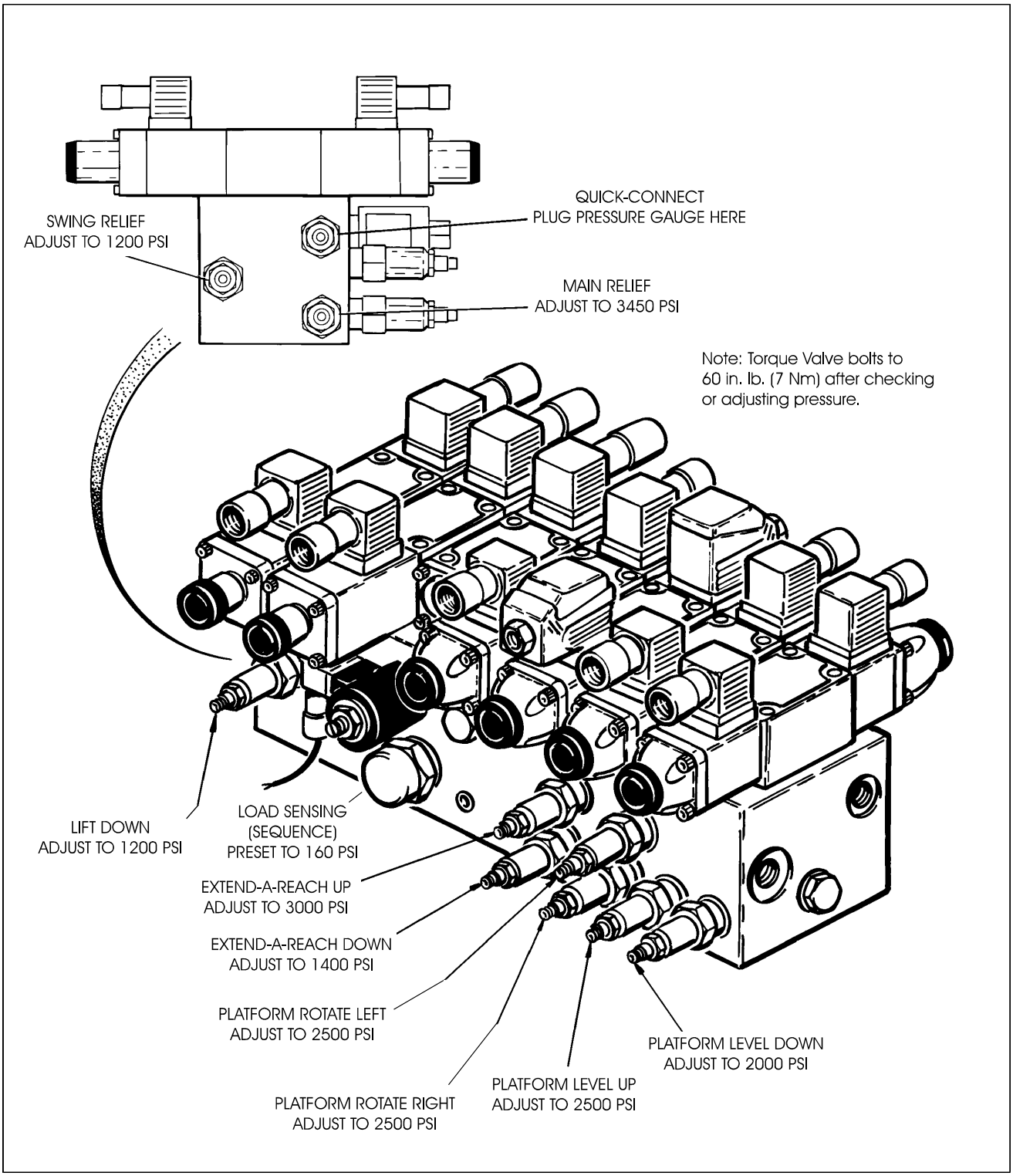


Figure 2-11. Pressure Setting Adjustments - Main Valve - Machines Built Before S/N 38697

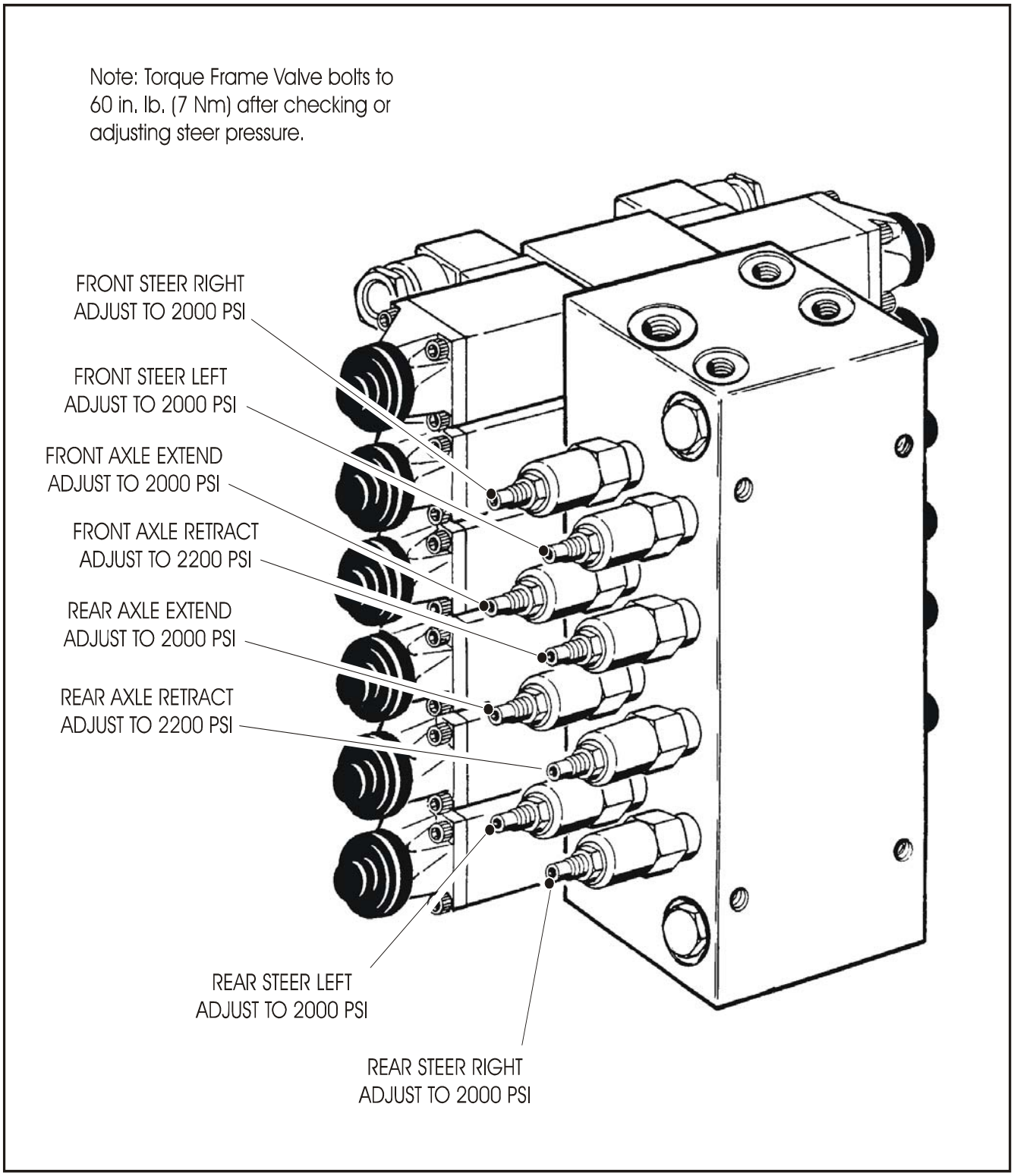
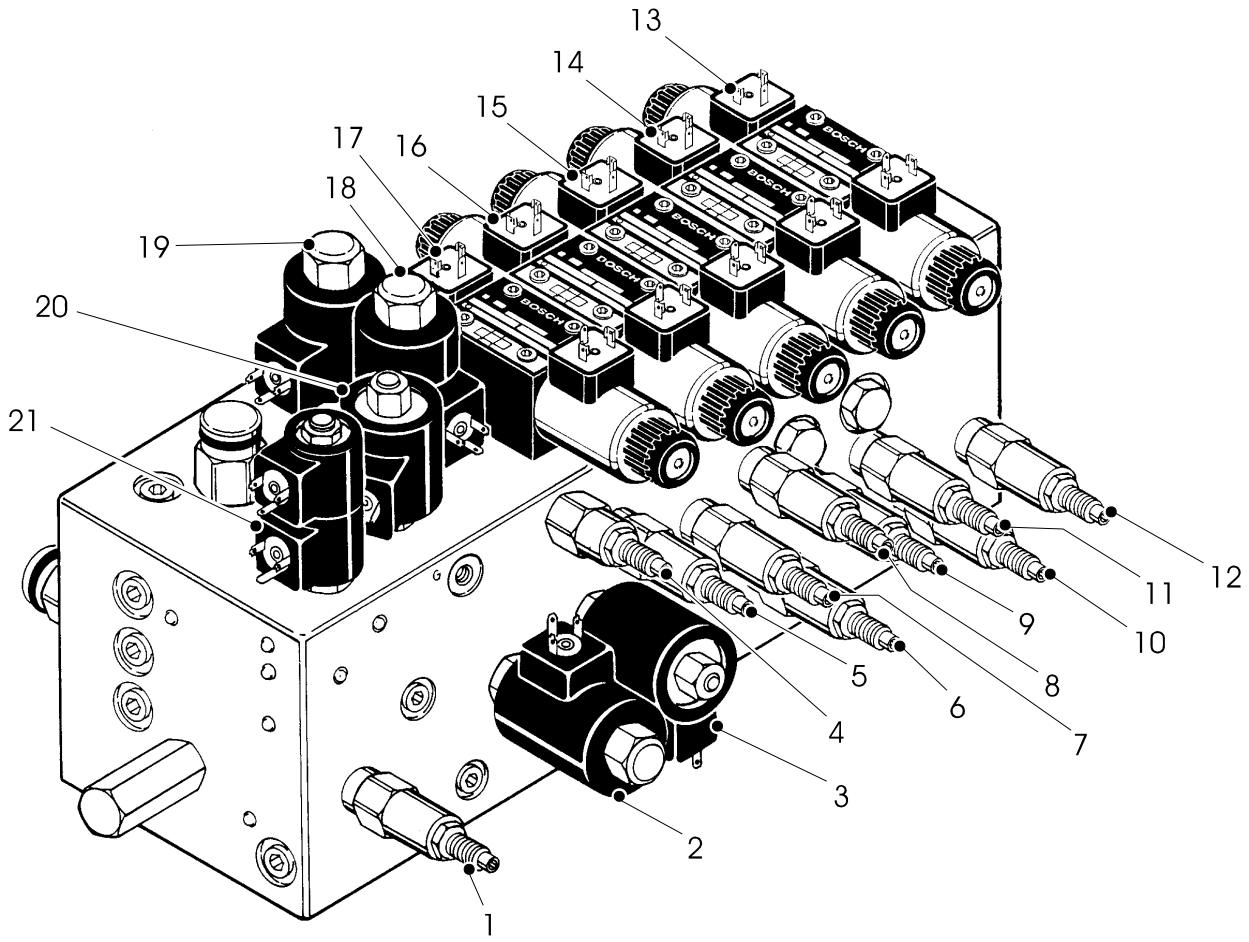


Figure 2-12. Pressure Setting Adjustments - Frame Valve - Machines Built Before S/N 38697



1. Main Pressure Adjustment
2. Swing Flow Control
3. Lift Down/Slow Down
4. Lift Down Pressure
5. Lift Down Speed Control
6. Swing Pressure
7. E.A.R. Up Pressure
8. E.A.R. Down Pressure
9. Rotate Pressure
10. Level Up Pressure
11. Rotate Pressure
12. Level Down Pressure
13. Level
14. Rotate
15. E.A.R.
16. Swing
17. Lift
18. Lift Flow Control
19. Flow Control Telescope/ E.A.R./Rotate/Level
20. Main Dump
21. Telescope

Figure 2-13. Pressure Setting Adjustments - Main Valve - Machines Built After S/N 38697

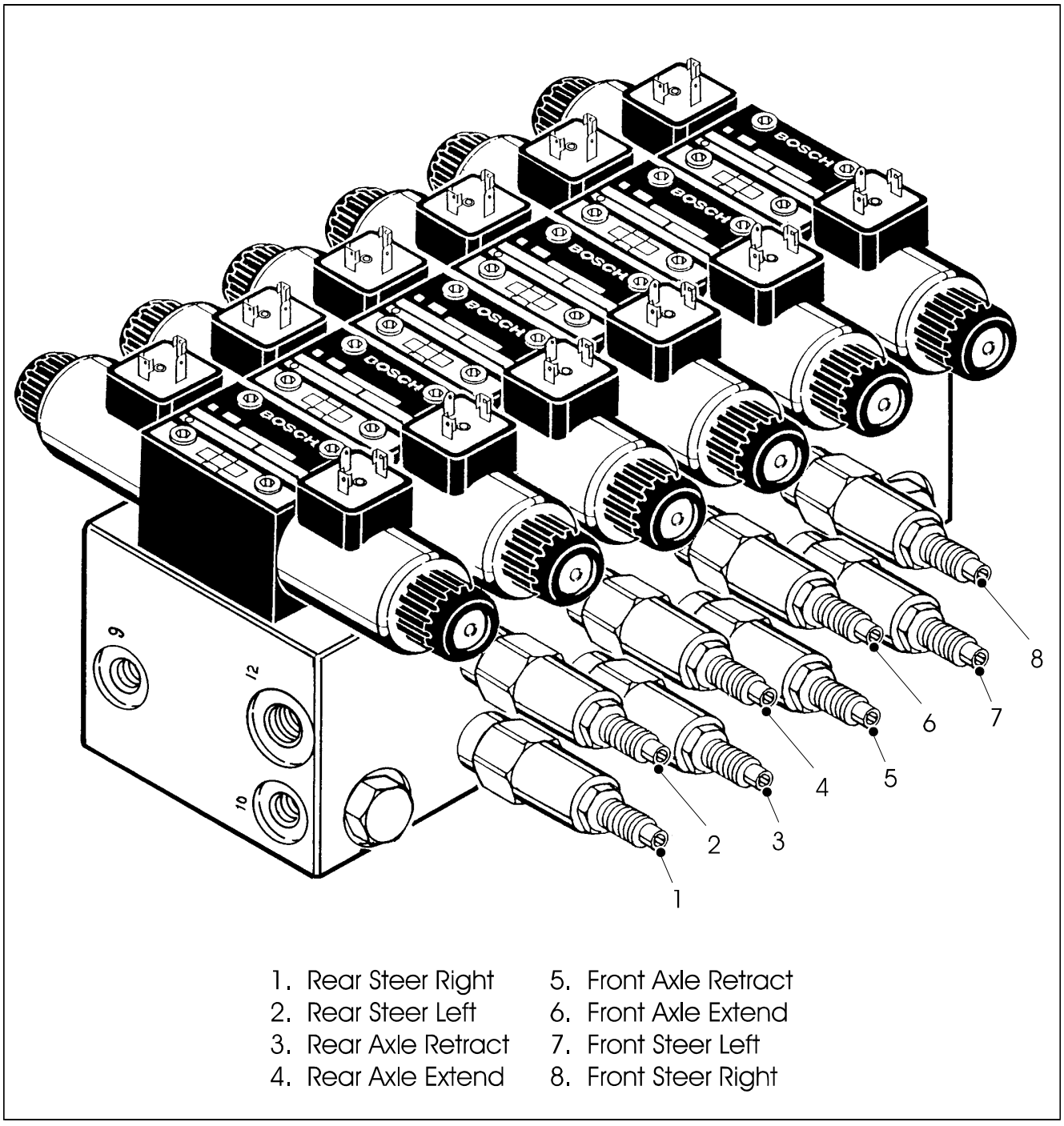


Figure 2-14. Pressure Setting Adjustments - Frame Valve - Machines Built After S/N 38697

k. Bottom out Rear Axle Retract function.

l. Loosen nut on rear axle retract relief and adjust pressure to 2200 psi (152 bar). Tighten nut.

m. Lower rear end of machine.

2.17 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

NOTE: *This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with loctite #271. After replacing and retorquing bolt or bolts recheck all existing bolts for looseness.*

Check the frame to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated on Figure 2-15., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
3. Assure that the 0.0015" feeler gauge will not penetrate under the bolt head to the bolt shank.
4. Swing the turntable 90 degrees, and check some selected bolts at the new position.
5. Continue rotating the turntable at 90 degrees intervals until a sampling of bolts have been checked in all quadrants.

Check the turntable to bearing. Attach bolts as follows:

1. Elevate the fully retracted boom to 70 degrees (full elevation).
2. At the positions indicated on Figure 2-15., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.
3. Lower the boom to horizontal and fully extend the boom.
4. At the position indicated on Figure 2-15., Swing Bearing Bolt Feeler Gauge Check, try and insert the 0.0015" feeler gauge between the bolt head and hardened washer at the arrow indicated position.

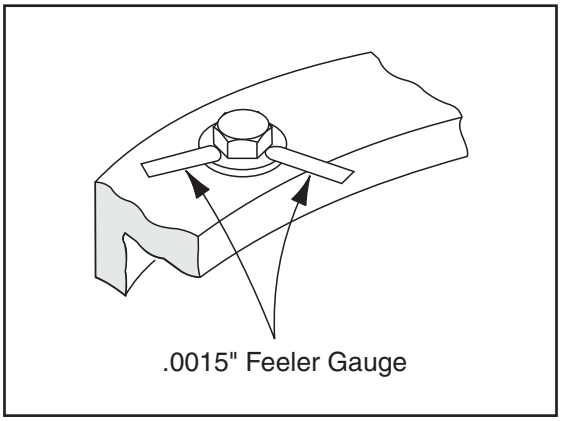


Figure 2-15. Swing Bearing Bolt Feeler Gauge Check

Wear Tolerance

1. From the underside of the machine, at rear center, with the boom fully elevated and fully retracted (See Figure 2-16.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and the frame. (See Figure 2-17.)
2. At the same point, with the boom at horizontal extended until red marking band on mid section is exposed (See Figure 2-16.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 2-17.)
3. If a difference greater than 0.064 in. (1.625 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.064 in. (1.625 mm) is determined, and any of the following conditions exist, the bearing should be removed, disassembled, and inspected for the following:

   Metal particles in the grease.
   Increased drive power required.
   Noise.
   Rough rotation.
5. If bearing inspection shows no defects, reassemble bearing and return to service.

⚠ IMPORTANT

THE SWING BEARING IS ONE OF THE MOST CRITICAL POINTS ON AN AERIAL LIFT. IT IS HERE THAT THE STRESSES OF LIFTING ARE CONCENTRATED, AT THE CENTER OF ROTATION. BECAUSE OF THIS, PROPER MAINTENANCE OF THE SWING BEARING BOLTS IS A MUST FOR SAFE OPERATION.

Replacement

1. Removal.
   a. From ground control station, operate the boom lift control and raise boom adequately to provide access to frame opening or, if equipped, to the rotary coupling.

⚠ WARNING

NEVER WORK BENEATH THE BOOM WITHOUT FIRST PROVIDING ADEQUATE OVERHEAD SLING SUPPORT AND/OR BLOCKING.

   b. Attach an adequate support sling to the boom and draw all slack from sling. Block the boom if feasible.
   c. From under side of machine frame, remove bolts and lockwashers which attach rotary coupling retaining yoke to coupling housing.

⚠ IMPORTANT

HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID THE ENTRY OF CONTAMINANTS INTO THE SYSTEM.

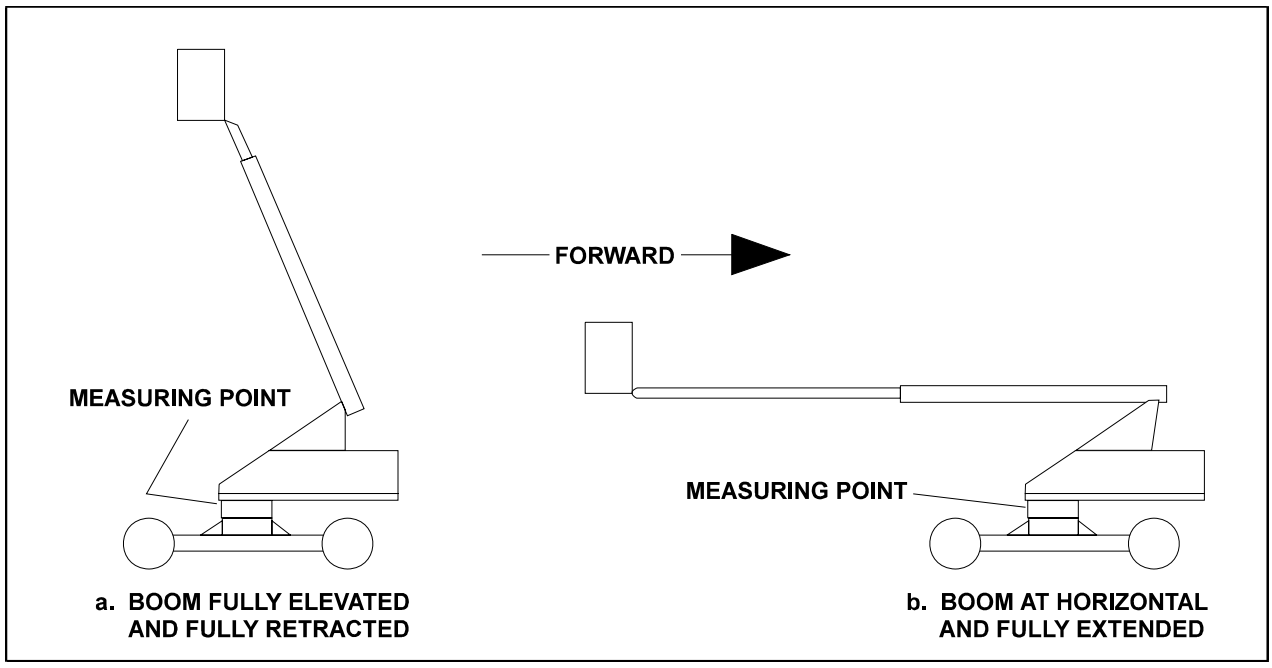


Figure 2-16. Swing Bearing Tolerance Boom Placement

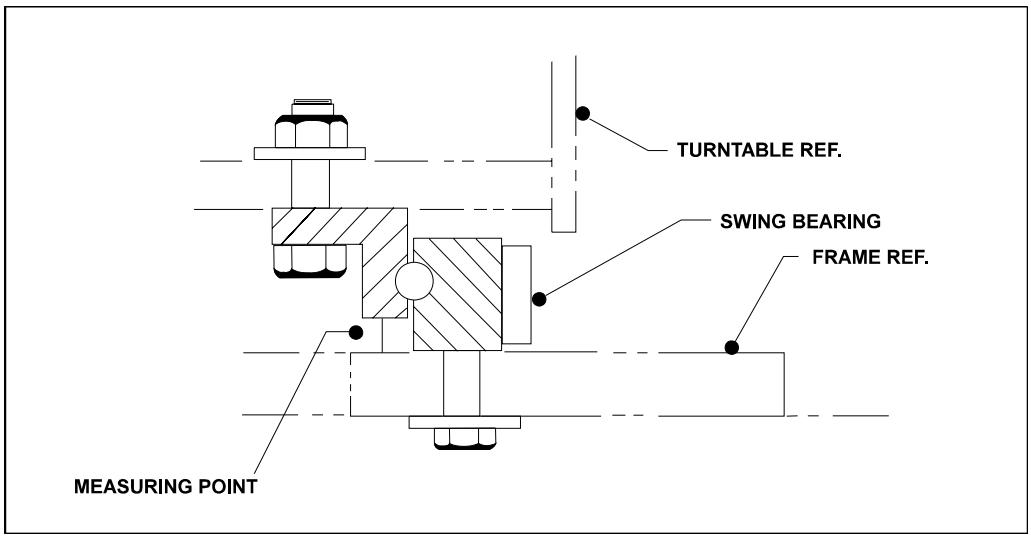


Figure 2-17. Swing Bearing Tolerance Measuring Point

d. Tag and disconnect the hydraulic lines from the fittings on the top and sides of the rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.

e. Attach suitable overhead lifting equipment to the base of the turntable weldment.

f. Use a suitable tool to scribe a line on the inner race of the swing bearing and on the underside of the turntable. This line will aid in aligning the bearing upon installation. Remove the bolts, nuts and washers which attach the turntable to the bearing inner race. Discard the nuts and bolts.

g. Use the lifting equipment to carefully lift the complete turntable assembly from the bearing. Ensure that no damage occurs to the turntable, bearing or frame mounted components.

h. Carefully place the turntable on a suitably supported trestle.

i. Use a suitable tool to scribe a line on the outer race of the swing bearing and the frame. This line will aid in aligning the bearing upon installation. Remove the bolts and washers which attach the outer race of the bearing to the frame. Discard the bolts. Use suitable lifting equipment to remove the bearing from the frame; move the bearing to a clean suitably supported work area.

2. Installation.

a. Use suitable lifting equipment to carefully lower the swing bearing into position on the frame. Ensure that the scribed line of the outer race of the bearing aligns with the scribed mark on the frame (if a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft centerline of the frame).

⚠ CAUTION

JLG INDUSTRIES RECOMMENDS THAT ALL REMOVED BEARING NUTS AND BOLTS BE DISCARDED AND REPLACED WITH NEW NUTS AND BOLTS. SINCE THE SWING BEARING IS THE ONLY STRUCTURAL LINK BETWEEN THE FRAME AND TURNTABLE, IT IS IMPERATIVE THAT SUCH REPLACEMENT HARDWARE MEETS JLG SPECIFICATIONS. USE OF GENUINE JLG HARDWARE IS HIGHLY RECOMMENDED.

b. Apply a light coating of Loctite #277 to the new bearing bolts, and loosely install the bolts and washers through the frame and outer race of bearing.

⚠ CAUTION

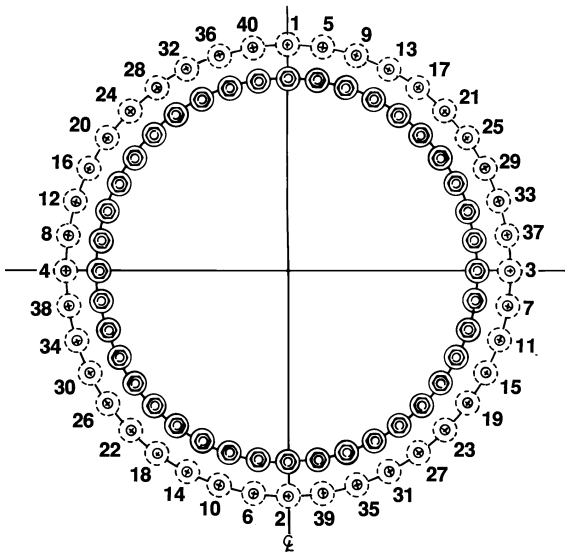
IF COMPRESSED AIR OR ELECTRICALLY-OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

c. Following the Torque Sequence diagram shown in Figure 2-18., tighten the bolts to an initial torque of 130 ft. lb. (177 Nm). Then following the same sequence tighten the bolts to a final torque of 170 ft. lb. (230 Nm) wet.

d. Remove the lifting equipment from the bearing.

e. Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.

f. Carefully lower the turntable onto the swing bearing, ensuring that the turntable and bearing align as noted in step a. above.



1. Use Devcon between bearing and both frame and turntable to ensure contact area.
2. Install bearing with fill plug on side. (as close to centerline of rotation as possible.

Figure 2-18. Swing Bearing Bolt Torquing Sequence

⚠ CAUTION

IF COMPRESSED AIR OR ELECTRICALLY-OPERATED IMPACT WRENCH IS USED FOR TIGHTENING THE BEARING ATTACHMENT BOLTS, THE TORQUE SETTING ACCURACY OF THE TOOL SHOULD BE CHECKED PRIOR TO USE.

g. Apply a light coating of Loctite #277 to the new bearing bolts, and install the bolts, washers and nuts through the turntable and inner race of the bearing.

h. Following the Torque Sequence diagram shown in Figure 2-6, tighten the bolts to an initial torque of 130 ft. lb. (176 Nm). Then following the same sequence tighten the bolts to a final torque of 170 ft. lb. (230 Nm) wet.

i. Remove the lifting equipment.

j. Install the rotary coupling retaining yoke; apply a light coating of Loctite Sealant Number TL277-41 to the attaching bolts and secure the yoke to the rotary coupling with the bolts and lockwashers.

k. Connect the hydraulic lines to the rotary coupling as tagged prior to removal.

l. At ground control station, use boom lift control to lower boom to stowed position.

m. Using all applicable safety precautions, activate hydraulic system and functionally check swing system for proper and safe operation.

Swing Bearing Torque Values

1. Outer Race - 170 ft. lb. (230 Nm) wet, 220 ft. lb. (298 Nm) dry.
2. Inner Race - 170 ft. lb. (230 Nm) wet, 220 ft. lb. (298 Nm) dry.
3. See Figure 2-18. for swing bearing bolt torquing sequence.

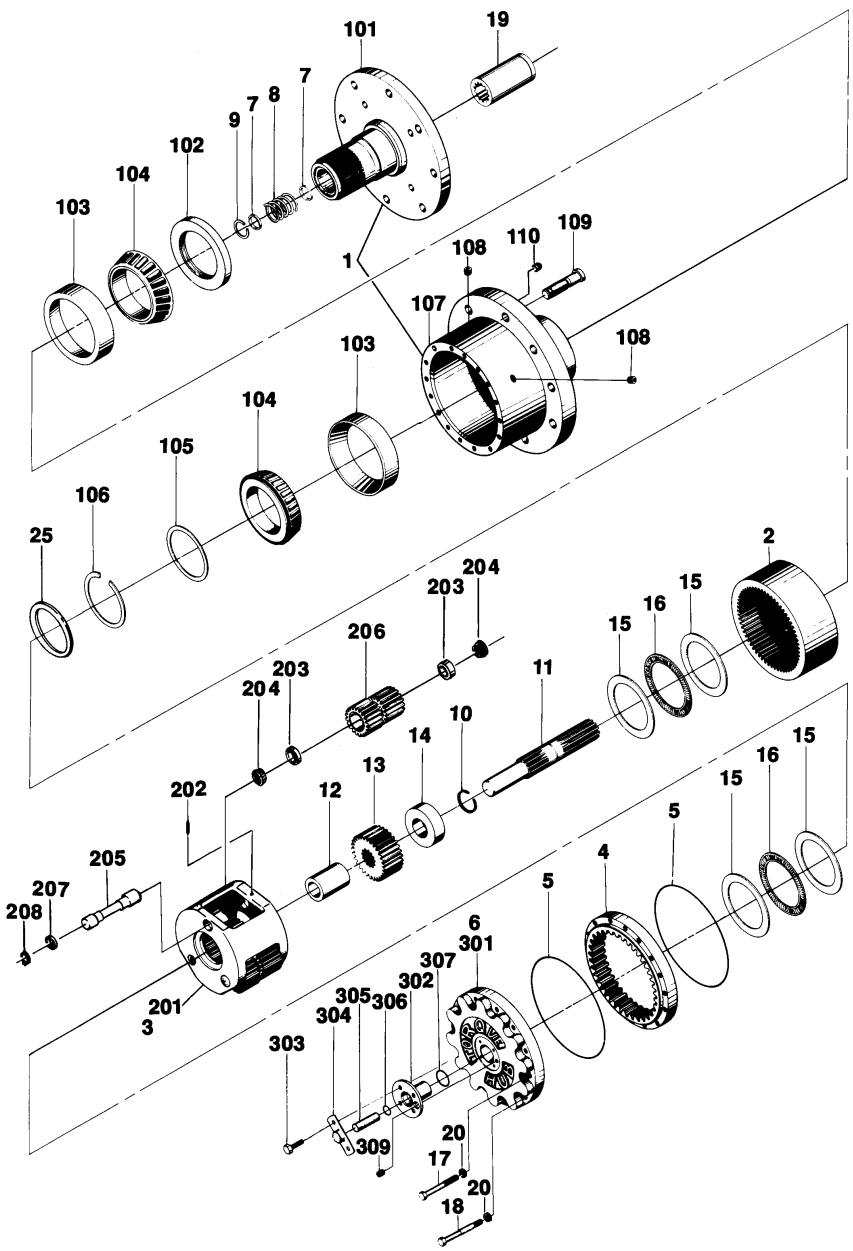
⚠ WARNING

RETORQUE INNER AND OUTER SWING BEARING BOLTS TO 220 FT. LB. (298 NM) AFTER FIRST 200 HOURS OF OPERATION AND EVERY 500 HOURS THEREAFTER.

2.18 DRIVE TORQUE HUB

Disassembly

1. Position hub over suitable container and remove drain plug (108) from unit. Allow oil to completely drain.
2. Remove sixteen bolts (17), four socket head bolts (18), and twenty lockwashers (20) from cover (301) and lift cover from unit. Remove o-ring (5) from counterbore of cover.
3. Disassemble cover (6) as follows:
   a. Remove two bolts (303) securing disconnect cap (304) to cover and remove disconnect cover.



1. Hub and Spindle (includes 101 thru 110)	9. Retaining Ring (int.)	19. Coupling	108. Pipe Plug	208. Retaining Ring (ext.)
2. Internal Gear	10. Retaining Ring (ext.)	20. Lockwasher	109. Stud	301. Cover Plate
3. Carrier Assembly (includes 201 thru 208)	11. Input Shaft	21. Keeper Ring	110. Pipe Plug	302. Cover Cap
4. Ring Gear	12. Input Spacer	101. Spindle	201. Carrier	303. Bolt
5. O-ring	13. Sun Gear	102. Lip Seal	202. Rollpin	304. Disengage Cap
6. Cover Assembly (includes 301 thru 309)	14. Input Spacer	103. Bearing Cup	203. Bearing Cup	305. Disengage Rod
7. Thrust Washer	15. Thrust Washer	104. Bearing Cone	204. Bearing Cone	306. O-ring
8. Spring	16. Thrust Bearing	105. Thrust Washer	205. Planet Shaft	307. O-ring
	17. Bolt	106. Retaining Ring (ext.)	206. Bearing Cone	308. Pipe Plug
	18. Socket Head Bolt	107. Housing	207. Thrust Spacer	309. Pipe Plug

Figure 2-19. Drive Torque Hub

b. Remove two bolts (303) securing cover cap (306) to cover and remove cap.

c. Remove disconnect rod (305) from cover cap and remove o-rings (306 and 307) from cover cap. discard o-rings.

d. If necessary, remove pipe plug (309) from cover.

4. Remove two thrust washers (15) and thrust bearing (16) from carrier counterbore. One thrust washer may stick to cover. Inspect thrust washers and bearing for wear and replace if necessary.

5. Lift carrier assembly (3) from hub and spindle assembly (1).

6. Disassemble carrier as follows:

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

a. Remove retaining (208) from planet shaft (205).

b. Remove spacer (207) from planet shaft, then, using a suitable drift, drive planet shaft from carrier, shearing off roll pin. Tap remaining roll pin from carrier using a suitable punch.

c. Remove cluster (206) gear from carrier and remove bearing cones (204) from cluster gear.

d. If necessary, press bearing cups (203) from cluster gear.

7. Lift ring gear (4) from housing (107). Remove o-ring (5) from counterbore of ring gear and discard.

8. Remove input spacer (12), input (sun) gear (13), input spacer (14), and input shaft (11) from spindle (101).

9. Remove two thrust washers (15) and thrust bearing (16) from end of spindle. One thrust washer may stick in carrier counterbore. Inspect thrust washers and thrust bearing for wear and replace if necessary.

10. Lift internal gear (2) out of hub.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

11. Remove ring keeper (21), retaining ring (106), and thrust washer from end of spindle. Remove hub from spindle.

12. Remove bearing cone (104) and seal (102) from spindle (101). Seal will possibly hold bearing cone into hub. If so, remove both from hub. If bearing cups (103) require replacing they can be driven out of hub counterbores. Discard seal and replace with new seal.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

13. To remove cluster gear (206) from carrier, remove retaining ring (208) from planet shaft (205) and drive planet shaft out of carrier.

14. Cluster gear and bearings (203, 204) can now be slid out of carrier and spacer (207) removed from carrier bore. If bearing cups (203) require replacing they can be driven out of cluster gear counterbores.

15. Repeat steps (12) and (13) for remaining cluster gears.

⚠ IMPORTANT

WHEN REBUILDING THE UNIT, O-RINGS AND RETAINING RINGS SHOULD ALWAYS BE REPLACED.

Cleaning and Inspection

1. Thoroughly clean all parts in an approved cleaning solvent.

2. Inspect geared or splined components in primary and secondary planet carriers, input and output sun gears, ring gear, coupling and input shaft for chipped or broken teeth, and excessive or uneven wear patterns. Replace components as necessary.

3. Inspect all thrust washers for scoring, pitting, erosion, discoloration or excessive wear. Replace thrust washers as necessary.

4. Inspect all bearing cones and cups for scoring, pitting or excessive wear. If necessary, using a suitable press, remove bearing cups from hub and replace bearings as a set.

5. Inspect all needle rollers for scoring, pitting or excessive wear. Replace all rollers as necessary.

6. Inspect planet gear pins for grooves, scoring or excessive wear. Replace pins as necessary.

7. Inspect all threaded components for damage including stretching, thread deformation, or twisting. Replace as necessary.

8. Inspect oil seal surfaces in hub and spindle for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.

9. Inspect mating surfaces of hub, ring gear and cover for burrs and sharp edges. Dress applicable surfaces or replace components as necessary.

Assembly

1. If necessary, assemble the hub/spindle assembly (1) as follows:
   a. With large open end of hub (107) up, press bearing cup (103) into hub. If no press is available, bearing cup may be frozen and tapped into place with a non-metallic faced hammer.
   b. Turn hub over, small diameter up. Install two pipe plugs (110) into hub.
   c. Press bearing cup (103) into small diameter end of hub. If no press is available, bearing cup may be frozen and tapped into place with a non-metallic faced hammer.
   d. Install bearing cone (104) into bearing cup.
   e. Press seal (102) into hub counterbore with flat metal side facing out. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.
   f. Lower hub onto spindle (101) with large open end up.
   g. Place bearing cone (104) over end of spindle and into bearing cup.
   h. Place bearing shim (105) over end of spindle and against bearing cone.

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

   i. Secure retaining ring (106) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.
   j. Install retaining ring keeper ring (21) in location around retaining ring and on bearing spacer.
   k. With large open end of hub/spindle assembly facing up, place one spacer washer (7) into spindle counterbore.
   l. Place spring (8) into spindle counterbore.
   m. Set second spacer washer (7) on top of spring.

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

   n. Compress spacer washer and spring into spindle counterbore and install retaining ring (9) into spindle groove.
2. Position hub/spindle assembly (1) with large open end up.
3. Lower internal gear (2) onto spindle.
4. Place one thrust bearing (16) between two thrust washers (15) and place them onto spindle pilot.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

5. Install retaining ring (10) in groove of input shaft (11).
6. Place input shaft into spindle counterbore of hub/spindle assembly. The action of the disengaged spring should be checked at this time.
7. Slide thrust spacer (12) onto input shaft.

⚠ CAUTION

BEWARE OF SHARP EDGES OF COUNTERBORE WHILE SEATING THIS O-RING.

8. Place o-ring (5) into counterbore of hub/spindle assembly. Use grease or petroleum jelly to hold o-ring in place.
9. Assemble carrier assembly (3) as follows:
   a. Press bearing cups (203) into both ends of cluster gear (206) with large inside diameter facing out. Use an arbor type press with a 5.110 diameter adapter tool.
   b. Place planet shaft (205) on a flat surface with large diameter down. Place one bearing cone (204) over shaft and against shoulder. This should be a slip fit.
   c. Place cluster gear over planet shaft and onto bearing cone, with large gear on top.
   d. Place another bearing cone (204) over planet shaft and into cluster gear. This is a slip fit.
   e. Slide largest spacer (207) onto planet shaft.
   f. Bearings in cluster gear must be seated by applying 25-50 lb. (11-23 kg) against them and rotating cluster gear at the same time. This can be done by sliding a second spacer (207) over planet shaft and pushing downward while rotating the gear.
   g. See if retaining ring (208) will fit onto planet shaft groove. If not, try smaller spacer (207) until retaining ring fits. This will set bearings at 0.000-0.006.
   h. Place carrier on edge of a table with one set of holes hanging over the edge. Side with roll pin hole should be down.
   i. Place bearing cones (203) into cluster gear.
   j. Place cluster gear into carrier with large gear up.

k. Slide planet shaft through carrier and cluster gear from bottom side. Slot in planet shaft must line up with roll pin hole in edge of carrier.

l. While holding planet shaft in position, slide correct spacer onto planet shaft.

⚠ WARNING

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

m. Place carrier on table with something under planet shaft to hold it in correct position and install retaining ring (208).

⚠ WARNING

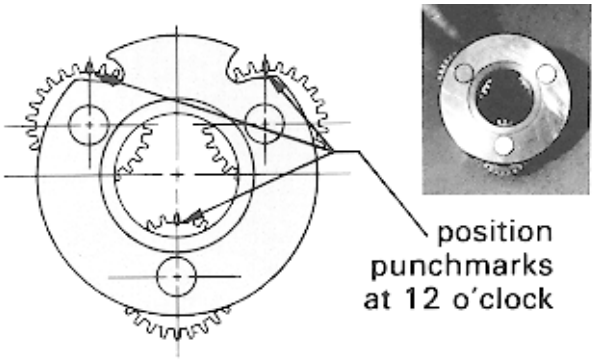
EYE PROTECTION SHOULD BE WORN DURING THIS OPERATION.

n. Drive roll pin (202) into carrier. Use a punch to drive roll pin completely into planet shaft.

o. Repeat steps (a) through (n) for remaining two cluster gears.

10. Time carrier gears as follows:

a. Place carrier assembly on a flat surface, positioning two top gears at ten o'clock and two o'clock, and one bottom gear at six o'clock as shown below.



b. Find marked (punch mark) teeth on large gears. Rotate gears until punch mark is located in a straight up, 12 o'clock, position. Punch marks at ten o'clock and two o'clock will be located just under edge of carrier and not readily visible.

11. Taking care to ensure that timing is maintained, install ring gear (4) in mesh with large diameter cluster gear. Side of ring gear with long shoulder is installed down.

12. While holding ring gear in mesh with carrier assembly, lower into internal gear (2). Small diameter cluster gear will mesh with internal gear. Slight rotation of ring gear may be necessary.

13. Locate the one hole on underside of ring gear that has an "X" stamped beside it. This hole should be positioned in line with one of four counterbored holes in face of hub. These holes have been counterbored to accept four shoulder bolts upon installation of cover.

14. Thrust spacer (14), input gear (13), and input spacer (12) are installed onto input shaft (11). Counterbore in input gear should be facing thrust spacer.

15. Place one thrust bearing (16) between two thrust washers (15) and place into carrier counterbore.

16. Assemble cover assembly as follows:

a. Screw pipe plug (309) into cover (301).

b. Install o-ring (307) over cover cap.

c. Install o-ring (306) into bore of cover cap (302). Disconnect rod (305) may be used to push o-ring down to groove in cover cap bore.

d. Push disconnect rod into bore of cover cap.

e. Locate large clearance hole in cover cap over pipe plug in cover and install cover cap in cover. Use two bolts (303) torqued to 70-80 ft. lb. (95-108 Nm).

f. Install disconnect cap (304) to cover cap with two remaining bolts (303) torqued to 70-80 ft. lb. (95-108 Nm).

⚠ WARNING

BEWARE OF SHARP EDGES OF COUNTERBORE WHILE SEATING THIS O-RING.

g. Place o-ring (5) into cover counterbore. Use petroleum jelly to hold o-ring into place.

17. Place cover assembly (6) onto ring gear (4). Rotate cover assembly until pipe plug (309) is located 90 degrees and 180 degrees from pipe plugs (110) in opposite end of hub.

18. Secure cover assembly and ring gear to hub with four shoulder bolts (18) and lockwashers (20). Shoulder bolts fit into four counterbored holes in hub. It may be necessary to start bolts into hub by tapping lightly on bolts with a hammer.

19. Install sixteen Grade 8 bolts (17) and lockwashers (20) in remaining holes.

20. Tighten bolts evenly and torque to 100-110 ft. lb. (136-149 Nm). Torque the four shoulder bolts to 55 ft. lb. (77 Nm).

21. Install coupling (19) into spindle onto input shaft.

2.19 SWING TORQUE HUB

Disassembly

1. Remove oil plugs (25 and 26) and drain oil from unit into a suitable container. Replace drain plugs.

NOTE: *The screws, hub pinion gear, and retaining plate referenced in steps (2) and (3) are not shown in Figure 2-9, but are attached to the hub output shaft (item 30).*

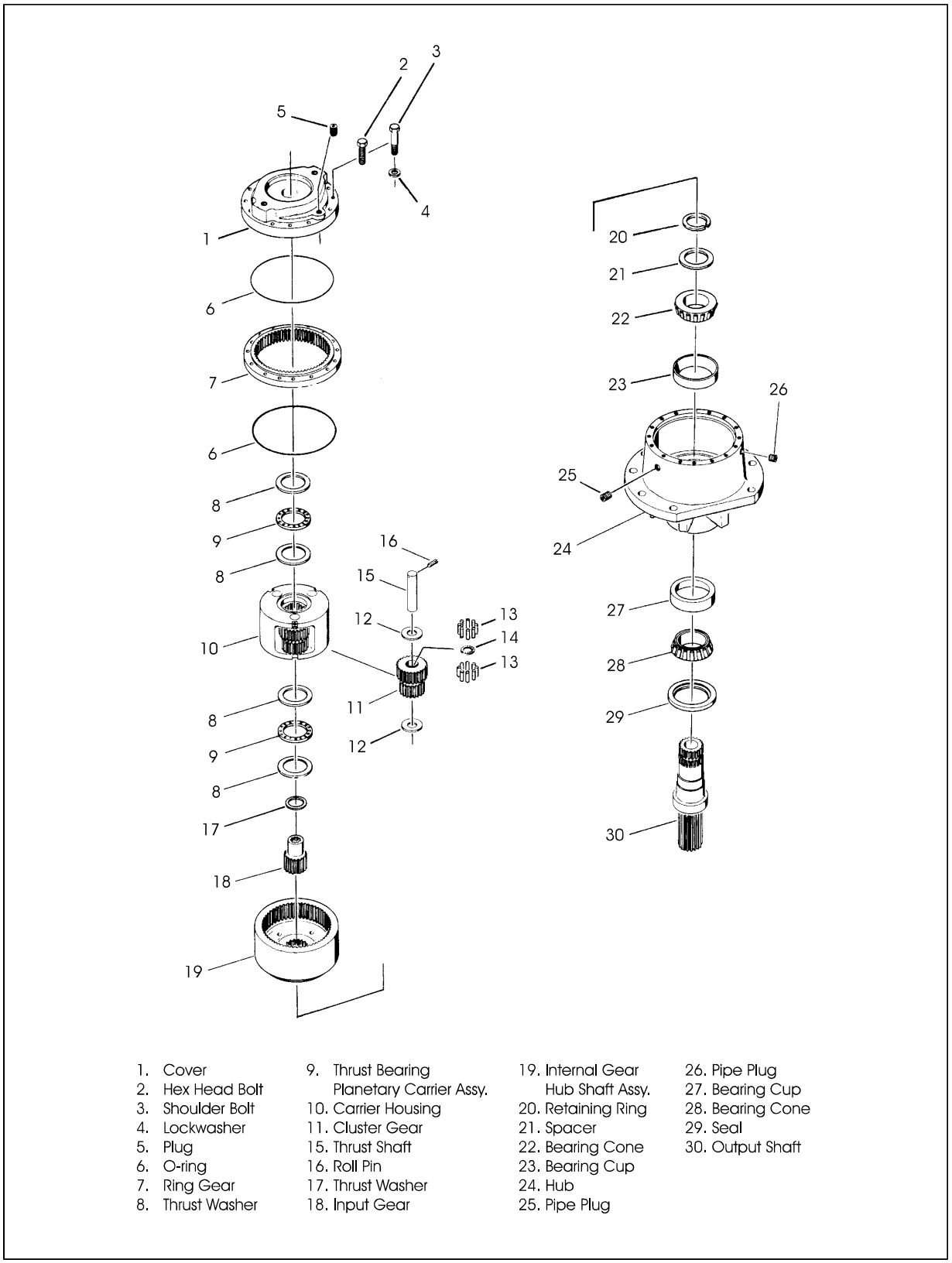
2. Remove the two screws which attach the hub pinion gear retaining plate and remove plate.
3. Carefully remove pinion gear from splined hub output shaft.
4. Using suitable protection, clamp drive hub assembly in a vise or suitable holding fixture.
5. Remove four shoulder bolts (3) and lockwashers (4) from counterbored holes in cover of drive hub assembly.
6. Remove remaining eight bolts (2) which attach cover (1) to ring gear (7).
7. Carefully remove cover assembly (1) from input gear (18) together with outer thrust washers (8) and thrust bearing (9). Remove and discard outer o-ring (6).
8. Remove thrust washer (17) from small diameter of input gear (18).
9. Carefully withdraw input gear (18) from cluster gear (11) and output shaft (30).
10. Rotate ring gear (7) and check that each of the three cluster gears (11) incorporates a punched timing mark.
11. Carefully withdraw ring gear (7) from assembly.
12. Carefully withdraw carrier assembly (10) from internal gear (19).
13. Remove and discard inner o-ring (5).
14. Remove inner thrust washers (8) and thrust bearing (9) from counterbore in carrier assembly (10).
15. Carefully withdraw internal gear (19) from output shaft (30).
16. If necessary, disassemble planet carrier assembly (10) as follows:
    a. Remove three pins (16) by gently tapping a suitable punch against the roll pin until the pin is driven into planet shaft (15).
    b. Using a suitable drift, carefully and gently tap shafts (15) from carrier (10), ensuring that needle rollers (13) on each shaft are not damaged or lost.
    c. Lift cluster gears (11) from carrier (10) and remove thrust washers (12), needle rollers (13) and roller spacer (14).
    d. Drive roll pins (16) from shafts (15) and discard pins.
17. If necessary, disassemble hub and shaft assembly (24) as follows:
    a. Using suitable snap ring pliers, remove retaining ring (20) from groove in output shaft (30).
    b. Remove spacer shim (21) from output shaft.
    c. Place hub in a suitable hand-operated hydraulic press with external portion of shaft (30) down and with suitable block supporting hub (24).
    d. Using suitable protection between inner end of shaft (30) and press cylinder drift, operate press and carefully press shaft from inner bearing assembly (22 and 23).
    e. Remove seal (29) from shaft and discard seal.
    f. Remove bearing cone (22) from cup (23).
    g. Using press, remove bearing cups (23 and 27) from hub (24) and cone (28) from shaft (30).

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect bearing components (22, 23, 27, 28) for damage, pitting, corrosion or excessive wear. Replace bearings as a complete set if necessary.
3. Inspect all thrust washers for scoring or excessive wear.
4. Inspect all geared or splined components for chipped or broken teeth and for excessive or uneven wear patterns.
5. Inspect o-ring grooves in hub (24) and cover (1) for burrs or sharp edges. Dress applicable surfaces as necessary.
6. Inspect all thrust washer and bearing surfaces for damage. Repair or replace as necessary.
7. Inspect all threaded components for damage including stretching, thread deformation or twisting. Replace as necessary.
8. Inspect planet shafts (15) for scoring or other damage. Replace as necessary.

Assembly

1. If necessary, assemble hub and shaft assembly.



1. Cover
2. Hex Head Bolt
3. Shoulder Bolt
4. Lockwasher
5. Plug
6. O-ring
7. Ring Gear
8. Thrust Washer
9. Thrust Bearing Planetary Carrier Assy.
10. Carrier Housing
11. Cluster Gear
15. Thrust Shaft
16. Roll Pin
17. Thrust Washer
18. Input Gear
19. Internal Gear Hub Shaft Assy.
20. Retaining Ring
21. Spacer
22. Bearing Cone
23. Bearing Cup
24. Hub
25. Pipe Plug
26. Pipe Plug
27. Bearing Cup
28. Bearing Cone
29. Seal
30. Output Shaft

Figure 2-20. Swing Torque Hub

a. Using a suitable hydraulic press, install bearing cups (23 and 27) into hub (24).

b. Using the hydraulic press, install bearing cone (28) onto output shaft (30).

c. Correctly position shaft (30) into hub (24) with cone (28) in cup (27).

d. Using a suitable shaft support in the hydraulic press, install bearing cone (22) on shaft (30) until cone abuts bearing cup (23).

e. Position spacer shim (21) on shaft (30) between retainer ring groove and bearing cone (22).

f. Using suitable snap ring pliers, install retaining ring (20) on shaft (30).

g. Using the hydraulic press, install a new seal (29) over shaft and into hub (24). Ensure that seal is installed squarely.

h. Check that output shaft (30) rotates freely in the hub. The oil seal will create a small amount of drag. By tapping the outside of the shaft with a soft headed mallet, any excessive tightness will be reduced.

2. If necessary, assemble planet carrier assembly (10) as follows:

a. Apply a light coating of petroleum jelly or multi-purpose grease to flanged surface of thrust washers (12).

b. Position thrust washers (12) in carrier (10) with tang in appropriate carrier cutaway portion. Ensure that washers are flat against surface on both sides of carrier.

c. Apply a liberal coating of petroleum or multi-purpose grease to inner diameter of cluster gear (11).

d. Position spacer (14) at the approximate midpoint of the gear diameter.

e. On each side of spacer (14), position needle rollers (13) in inner diameter of gear.

f. Position assembled cluster gear (11) into carrier (10) between the two thrust washers (12). Ensure that larger gear is on the roll pin side of carrier.

g. Position planet shaft (15) into carrier hole, with shaft roll pin hole on same side as carrier roll pin hole.

h. Continue inserting shaft through thrust washers (12) and cluster gear (11). Ensure that needle rollers (13) are not displaced.

i. Align roll pin holes in both shaft (15) and carrier (10) with chamfered portion of shaft hole uppermost.

j. Position new roll pin (16) in hole in carrier (10) and drive pin into hole until end of pin is flush with carrier surface.

k. Repeat steps (a) through (j) for remaining two cluster gears.

3. Position internal gear (19) on inner end of output shaft (30).

4. Time carrier cluster gears as follows:

a. Place carrier assembly on a flat surface, positioning two top gears at ten o'clock and two o'clock, and one bottom gear at six o'clock as shown in Figure 2-8.

b. Find marked (punch mark) teeth on large gears. Rotate gears until punch mark is located in a straight up, 12 o'clock, position. Punch marks at ten o'clock and two o'clock will be located just under edge of carrier and not readily visible.

5. Place ring gear (7) over cluster gears (11), with raised shoulder of ring gear facing down.

6. While holding ring gear (7) in position, invert carrier assembly (10) so that ring gear and larger diameter of cluster gears (11) are facing down.

7. Apply a light coating of petroleum jelly or multi-purpose grease to inner thrust washer (8) and thrust bearing (9).

8. Position thrust washer (8), thrust bearing (9), and thrust washer (8) into applicable groove of carrier assembly (10).

9. Apply a light coating of petroleum jelly or multi-purpose grease to new inner o-ring (6).

10. Position o-ring (6) in groove in hub (24).

11. While holding ring gear (7) and carrier assembly (10), insert smaller diameter of cluster gears (11) into internal gear (19).

12. Rotate ring gear (7) until hole marked "X" is located over hub shaft assembly (24).

13. Insert input gear (18) into carrier assembly (10) so that input gear and larger diameter of cluster gears (11) are in mesh. Check that carrier assembly (10) rotates freely.

14. Position thrust washer (17) on shaft of input gear (18).

15. Apply a light coating of petroleum jelly or multi-purpose grease to new outer o-ring (6).

16. Position o-ring (6) into groove of cover (1).

17. Apply a light coating of petroleum jelly or multi-purpose grease to outer thrust washers (8) and thrust bearing (9).

18. Position outer thrust washer (8), thrust bearing (9) and thrust washer (8) in cover (1).
19. Position cover (1) on ring gear (7) with oil check plug (5) in cover located at 90° from oil fill plugs (25 and 26) in hub (24).
20. Install four shoulder bolts (3) and lockwashers (4) into appropriate counterbored holes in hub (24).
21. Install eight bolts (2) which attach cover (1) to ring gear (7) and hub (24) and tighten to a torque of 23-27 ft. lb. (31-37 Nm).
22. Carefully install hub pinion gear on splined output shaft. If necessary, gently tap into position with a soft headed mallet.
23. Apply No. 2 Lift Grade Loctite to pinion gear retaining plate screws.
24. Position gear retaining plate and install attaching screws.
25. Remove oil fill plug (25 or 26) and fill hub assembly with approximately one quart of approved extreme pressure gear lubricant. Install fill plug.

2.20 SWING BRAKE

1. Separate end cover (2) from housing (21) by removing capscrews (1).

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2,000 LB. (907 KG). THE FOUR BOLTS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3,000 LB. [1,360 KG] MINIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Remove case seal (4) from the housing (21), then remove bleeder screw (3) from the end cover (2).
3. Remove piston (7) from end cover (2).
4. Remove o-ring (5), back-up ring (6), o-ring (8) and back-up ring (9) from piston (7).
5. Remove separators (13) from housing (21).
6. Remove stack assembly, consisting of discs (11), return plate (14) and friction discs (12) from housing (21).

NOTE: *Not all models use the same number of springs or spring pattern. Record this information for assembly purposes. Spring retainer (17) was not used in earlier models.*

7. Remove dowel pins (20), springs (15 & 16) and spring retainer (17) from housing (21).
8. Remove retaining ring (18) from housing (21).
9. Remove shaft by pressing or using a soft mallet on male end of shaft (10).

NOTE: *Earlier models did not use retaining ring (22).*

10. Remove retaining ring (22) and bearing (19) from shaft (10).
11. Press Rotary oil seal (23) from housing (21).

Cleaning and Inspection

1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks, and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

NOTE: *Bearings may be reused if, after thorough inspection, they are found to be in good condition.*

Assembly

NOTE: *Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.*

1. Clean all parts thoroughly before assembly.
2. Press new rotary oil seal (23) into housing (21). Note direction of the seal.

NOTE: *Earlier models did not use retaining ring (22).*

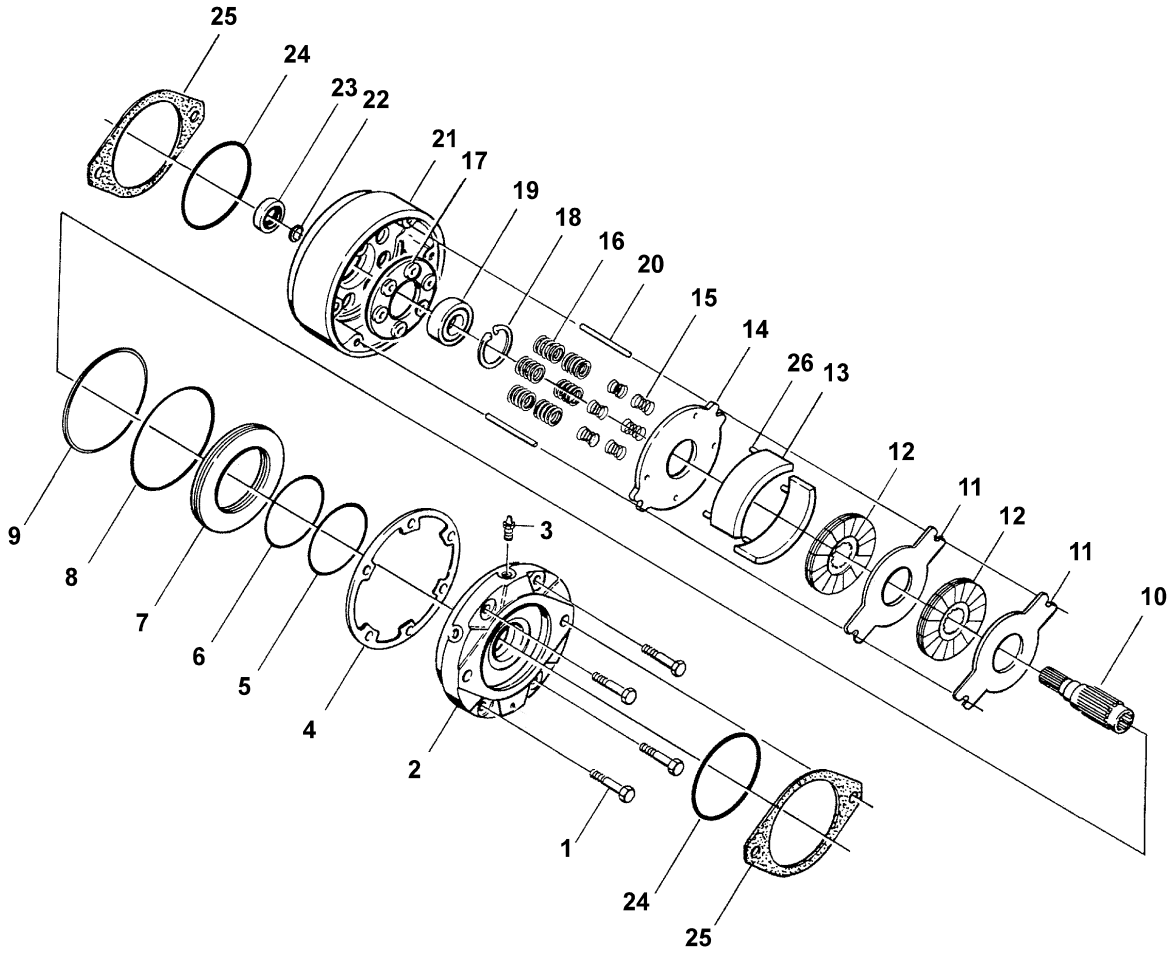
3. Install new bearing (19) and retaining ring (22) on shaft (10).
4. Insert shaft assembly and retaining ring (18) in housing (21).

NOTE: *Be sure to use the same number of springs and spring pattern as recorded during disassembly. Spring retainer (17) was not used in earlier models.*

5. Insert dowel pins (20), spring retainer (17) and springs (15 & 16) in housing (21).
6. Position new large diameter return plate (14) in housing with tabs guided by dowel pins (20) until disc rests on springs (15 & 16).

⚠ IMPORTANT

DISCS (11, 14) AND FRICTION DISCS (12) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.



1. Capscrew
2. End Cover
3. Bleeder Screw
4. Case Seal
5. O-ring
6. Back-Up Ring
7. Piston
8. O-ring
9. Backup Ring
10. Shaft
11. Disc
12. Friction Disc
13. Separators
14. Return Plate
15. Spring
16. Spring
17. Spring Retainer
18. Retaining Ring
19. Bearing
20. Dowel Pin
21. Housing
22. Retaining Ring
23. Rotary Oil Seal
24. O-ring
25. Gasket
26. Pin

Figure 2-21. Swing Brake

7. Place a new friction disc (12) on shaft (10) until it contacts return plate (14).
8. Add additional new discs (11) and new friction discs (12) as required to complete assembly.
9. Insert separators (13) in holes of return plate.
10. Install new o-ring (5), new backup ring (6), new o-ring (8) and new back-up ring (9) on piston (7). Note order of o-rings and back-up rings. Insert piston (7) into end cover (2) being careful not to shear o-rings or back-up rings.
11. Install new case seal (4) in housing (21) then install bleeder screw (3) in end cover (2).
12. Position end cover (2) on housing (21) aligning dowel pins (20) with holes in end cover.

NOTE: *If available, a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening capscrews.*

13. Press on inner ring of bearing (37) until it shoulders on shaft (45) to eliminate binding on bearings. Be certain to restrain opposite end of shaft to avoid excessive thrust loading on bearing (54).

⚠ IMPORTANT

IF HYDROSTATIC BENCH TESTING IS PERFORMED ON THE BRAKE ASSEMBLY, RELEASE PRESSURE SHOULD NOT EXCEED 2000 PSI (138 BAR) UNLESS TWO ADDITIONAL BOLTS ARE USED FOR SUPPLEMENTAL CLAMPING.

2.21 DRIVE BRAKE

Disassembly

1. Remove end cover (13) from housing (7) by removing washer head bolts (12).

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2,000 LB. (907 KG). THE FOUR WASHER HEAD BOLTS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3,000 LB. [1,360 KG MIN.]), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE WASHER HEAD CAP SCREWS.

2. Remove case seal (11) from housing, then remove bleeder screw (14), o-ring (28) and gasket (29) from end cover.
3. Remove piston (24) from end cover.
4. Remove o-ring (19), back-up ring (18), o-ring (21) and back-up ring (20) from piston.
5. Remove separator assemblies (9, 10) from housing.
6. Remove stack assembly, consisting of discs (23), return plate (8) and friction discs (22) from housing.
7. Remove dowel pins (17), springs (5 and 6) and spring retainer (16) from housing.

NOTE: *Not all models use the same number of springs or spring pattern. Record this information for assembly purposes.*

8. Remove retaining ring (3) from housing.
9. Remove shaft (4) by pressing or using a soft mallet on male end of shaft.
10. Remove retaining ring (15) and bearing (2) from shaft.
11. Press rotary oil seal (1) from housing, then remove gasket (27) and o-ring (26) from housing.

Inspection

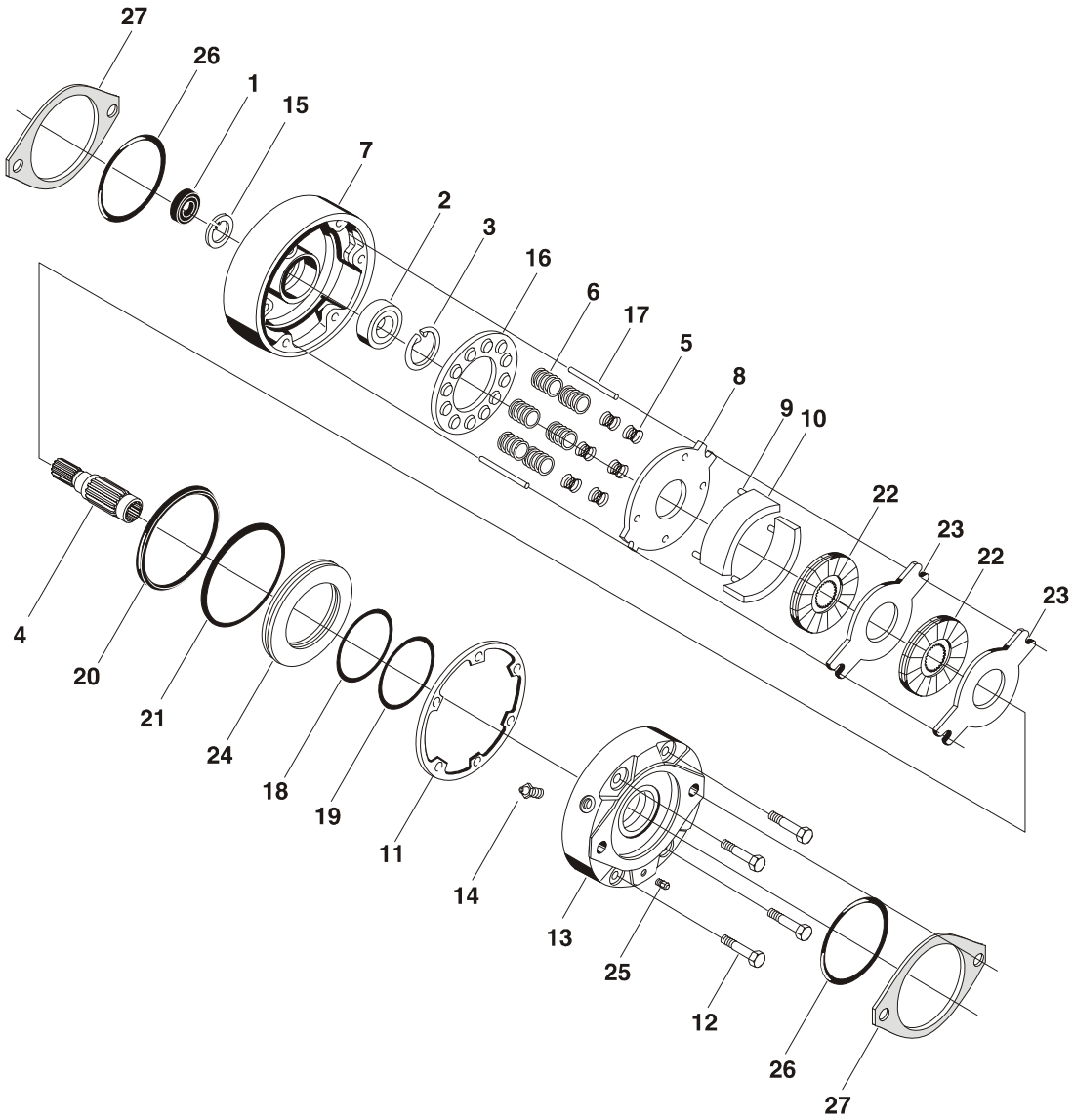
1. Clean all parts thoroughly.
2. Closely inspect all parts for excessive wear, cracks and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces. Replace as necessary.

NOTE: *Bearings may be re-used if, after thorough inspection, they are found to be in good condition.*

Assembly

NOTE: *Lubricate all seals and o-rings with clean hydraulic oil prior to assembly.*

1. Install new gasket (27) and o-ring (26) in housing (7).
2. Press new rotary oil seal (1) into housing. Note direction of seal.
3. Install new bearing (2) and retaining ring (15) on shaft (4).
4. Insert shaft assembly and retaining ring (3) in housing.



1. Oil Seal
2. Bearing
3. Retaining Ring
4. Shaft
5. Inner Spring
6. Outer Spring
7. Housing
8. Return Plate
9. Pin
10. Separator
11. Case Seal
12. Washer Head Cap Screw
13. Cover
14. Bleeder Screw
15. Retainer Ring
16. Guide Spring
17. Dowel Pin
18. Back-Up Ring
19. O-Ring
20. Back-Up Ring
21. O-Ring
22. Disc (Rotor)
23. Friction Disc (Stator)
24. Piston
25. Pipe Plug
26. O-Ring
27. Gasket

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Figure 2-22. Drive Brake, Mico

5. Insert dowel pins (17), spring retainer (16) and springs (5 and 6) in housing. Insert the springs as shown in Figure 2-23., Spring Loading.

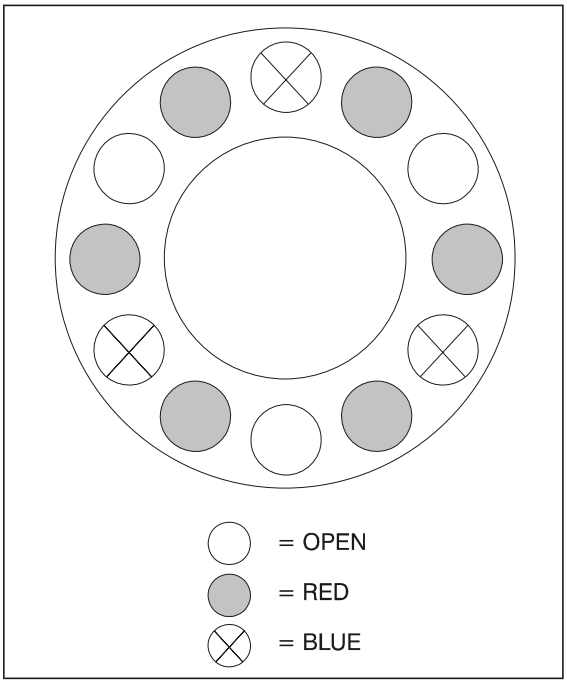


Figure 2-23. Spring Loading

NOTE: *Be sure to use the same number of springs and spring pattern as recorded during disassembly.*

6. Position new large diameter return plate (8) in housing with tabs guided by dowel pins until disc rests on springs.

NOTE: *Discs (8 and 23) and friction discs (22) should remain dry during installation. No oil residue should be allowed to contaminate disc surfaces.*

7. Place a new friction disc (22) on shaft until it contacts return plate.
8. Add additional new discs (23) and new friction discs as required to complete assembly.
9. Insert separator assemblies (9 and 10) in holes of return plate.
10. Install new o-ring (19), new back-up ring (18), new o-ring (21) and new back-up ring (20) on piston (24). Note order of o-rings and back-up rings. Insert piston into end cover (13), being careful not to shear o-rings or back-up rings.
11. Install new case seal (11) in housing, then install bleeder screw (14), gasket (27) and o-ring (26) in end cover.
12. Position end cover on housing, aligning dowel pins with holes in end cover.
13. Install washer head bolts (12) and tighten evenly to draw end cover to housing. Torque washer head bolts to 55 ft. lb. (75 Nm).

NOTE: *If available, a hydraulic press will simplify installation of end cover on housing. Clamp cover in position while tightening the washer head bolts.*

14. If hydrostatic bench testing is performed on the brake assembly, release pressure should not exceed 2,000 psi (138 bar) unless two additional bolts are used for supplemental clamping.

2.22 FREE WHEELING OPTION

To Disengage Drive Motors and Brakes (Free Wheel) for Towing, etc.

1. Chock wheels securely if not on flat level surface.
2. Disconnect both drive hubs by inverting disconnect caps in center of hubs.
3. If equipped, move steer/tow selector valve to float (tow) position by pulling valve knob out.

To Engage Drive Motors and Brakes (Normal Operation)

1. If equipped, move steer/tow selector valve to steer position by pushing valve knob in.
2. Connect both drive hubs by inverting disconnect cap in center of hub.
3. Remove chocks from wheels as required.

2.23 PQ CONTROLLERS

NOTE: *The following procedures are to be used as a beginning basis for controller adjustment. After completing the procedure, final adjustments are to be made based on the machines function speed.*

Table 2-4. Function Speeds

Function	Function Speed	
	In Seconds (Prior to S/N 38697)	In Seconds (S/N 38697 to Present)
Telescope		
Extend	132-170	80-100
Retract	140-175	75-100
Lift		
Up	125-160	85-100
Down	108-132	75-100
Extend-A-Reach		
Up	15-25	15-25
Down	15-25	15-25
Swing Speed		
Full 360	160-200	160-200
Platform Rotation		
Left	20-30	20-30
Right	20-30	20-30
Ground to 120'		
	257-330	165-200
From 120' to Ground		
	248-307	150-200
Ground to 120' to Ground		
	505-637	315-400
Drive Speed		
	46-56 @ 200ft.	46-56 @ 200ft.

Table 2-5. Platform Controller Settings (Prior to S/N 38697)

Function	Settings in mA		
	Lo	Mid	Hi
Lift	410	650	1300
Swing	410	650	1300

Table 2-6. Platform Controller Settings (S/N 38697 to Present)

Function	Settings in mA			Ramp Turns
	Lo	Mid	Hi	
Lift	200	400	1100	6
Swing	200	400	1100	6
Drive	40	70	180	10
Flow Control	170	N/A	1000	N/A

TRIM Adjustment (Prior to S/N 38697)

1. Perform the following checks with ignition power to the platform, with the engine NOT running.

1. Install ammeter capable of measuring from zero to 2 amps in series with either valve coil B or D.

2. Position IGNITION/EMERGENCY STOP switch to ON, but do not start engine.

3. Using a screwdriver, adjust the ramp trimpot counterclockwise 25 turns or until the trimpot clicks.

4. Depress footswitch.

5. Operate controller until trailing edge of slide lock is even with housing lock notch. Hold control handle in that position.

6. Check the mA reading in the opposite direction.

7. Operate the controller until the trailing edge of the slide lock is even with the housing lock notch. Hold the control handle in that position. Check the mA reading.

8. Verify step 7 and step 8 mA readings are within 0.50 mA of each other. If the readings are within tolerance, proceed to step 12.

9. If the readings in step 9 were not within tolerance, Loosen the setscrew located in the gear on the potentiometer shaft of the controller. Using a screwdriver, adjust the potentiometer very slightly in either direction. Tighten the setscrew on the gear and recheck for the proper mA readings. Repeat this step until the proper adjustment is obtained.

10. Place the creep toggle switch in the off position.
11. Using correct size common blade screwdriver, adjust LO trimpot until ammeter indicates the proper value as shown in Table 2-4, Function Speeds. Clockwise rotation of trimpot adjust screw increases ammeter; counterclockwise rotation decreases ammeter reading.
12. Operate controller in the same direction as in step 6 to the full extent of its travel and hold handle in that position.
13. Adjust HI trimpot until ammeter the value shown in Table 2-4, Function Speeds.
14. Repeat step 13.
15. Place the creep toggle switch in the creep on position. Adjust the mid trimpot to the value shown in Table 2-4, Function Speeds.
16. Move controller handle back to the position given in step 6 and check ammeter reading. This reading will have changed due to HI trimpot adjustment, and must be readjusted back to the value shown in Table 2-4, Function Speeds.
17. Move handle to the position given in step 13 and check ammeter reading. This reading too will have changed due to LO trimpot readjustment, and must be adjusted back to the value shown in Table 2-4, Function Speeds.
18. Move controller handle back to the position given in step 6 and check ammeter reading. This reading will have changed due to MID trimpot adjustment, and must be readjusted back to the value shown in Table 2-4, Function Speeds.
19. Repeat steps 17 and 18 until LO and HI readings as shown in Table 2-4, Function Speeds can be achieved without further trimpot adjustments.
20. Adjust the Ramp trimpot 6 turns clockwise.
21. Release footswitch.
22. Connect ORANGE/RED (dump) wire to terminal strip number 3 in platform console.
23. Using all applicable safety precautions, start machine and allow hydraulic oil to reach a temperature of 100° F - 140° F (38° - 60° C).
24. Depress footswitch and operate controller until trailing edge of slide lock is even with housing lock notch. Hold control handle in that position.
25. Adjust LO trimpot until applicable function just starts to work. Immediately stop adjustment.
26. Release footswitch and stop machine.
27. Seal each trimpot with a drop of enamel paint to prevent maladjustment due to vibration.

TRIM Adjustment (S/N 38697 to Present)

NOTE: *For the following procedure, disconnect the controllers at the following locations:*

Flow Control Card: Terminal Strip 23 Red/Orn wire (turn knob to obtain setting)
Lift Controller: Terminal Strip 27 Blk/Yel Wire
Swing Controller: Terminal Strip 24 Blu/Orn wire

1. Perform the following checks with ignition power to the platform, with the engine NOT running and the controllers disconnected as outlined in the note above.
2. Install ammeter capable of measuring from zero to 2 amps in series.
3. Position IGNITION/EMERGENCY STOP switch to ON, but do not start engine.
4. Using a screwdriver, adjust the ramp trimpot counterclockwise 25 turns or until the trimpot clicks.
5. Depress footswitch.
6. Operate controller until 1/2 of slide lock is out of the housing lock notch. Hold control handle in that position.

7. Check the mA reading in the opposite direction.
8. Operate the controller until 1/2 of the slide lock is out of the housing lock notch. Hold the control handle in that position. Check the mA reading.
9. Verify step 7 and step 8 mA readings are within 0.50 mA of each other. If the readings are within tolerance, proceed to step 11.
10. If the readings in step 9 were not within tolerance, Loosen the setscrew located in the gear on the potentiometer shaft of the controller. Using a screwdriver, adjust the potentiometer very slightly in either direction. Tighten the setscrew on the gear and recheck for the proper mA readings. Repeat this step until the proper adjustment is obtained.
11. Place the creep toggle switch in the off position.
12. Position the Controller as outlined in step 6. Using correct size common blade screwdriver, adjust LO trimpot until ammeter indicates the proper value as shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present). Clockwise rotation of trimpot adjust screw increases ammeter; counterclockwise rotation decreases ammeter reading.
13. Operate controller in the same direction as in step 6 to the full extent of its travel and hold handle in that position.
14. Adjust HI trimpot until ammeter indicates the value shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present).
15. Repeat step 13.
16. Place the creep toggle switch in the creep on position. Adjust the mid trimpot to the value shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present) for mid.
17. Move controller handle back to the position given in step 6 and check ammeter reading. This reading will have changed due to HI trimpot adjustment, and must be readjusted back to the value shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present).
18. Move handle to the position given in step 13 and check ammeter reading. This reading too will have changed due to LO trimpot readjustment, and must be adjusted back to the value shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present).
19. Move controller handle back to the position given in step 6 and check ammeter reading. This reading will have changed due to MID trimpot adjustment, and must be readjusted back to the value shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present).
20. Repeat steps 17 and 18 until LO and HI readings as shown in Table 2-6, Platform Controller Settings (S/N 38697 to Present) can be achieved without further trimpot adjustments.
21. Adjust the Ramp trimpot clockwise according to Table 2-6, Platform Controller Settings (S/N 38697 to Present).
22. Release footswitch.
23. Using all applicable safety precautions, start machine and allow hydraulic oil to reach a temperature of 100° F - 140° F (38° - 60° C).
24. Depress footswitch and operate controller until 1/2 of slide lock is out of the housing lock notch. Hold control handle in that position.
25. Adjust LO trimpot until applicable function just starts to work. Immediately stop adjustment.
26. Release footswitch and stop machine.
27. Seal each trimpot with a drop of enamel paint to prevent maladjustment due to vibration.

RAMP Adjustment

Controllers equipped with the RAMP feature actually compensate for abrupt control handle operation by slowing the response time of the output signal regardless of the speed with which the handle is moved.

⚠ WARNING

IT SHOULD BE REMEMBERED THAT THE RAMP FEATURE OPERATES IN BOTH DIRECTIONS OF THE PARTICULAR PROPORTIONAL FUNCTION. THEREFORE ADJUSTING THE RAMP POTENTIOMETER TO PROVIDE A DELAY IN STARTING A FUNCTION WILL PROVIDE A CORRESPONDING DELAY IN STOPPING THAT FUNCTION.

1. Drive Controller.
   a. Using all applicable safety precautions, start machine and ensure that adequate space is available to maneuver machine.
   b. Position ENGINE SPEED switch to HIGH and DRIVE SPEED switch to HIGH.

NOTE: *Clockwise rotation of the ramp potentiometer adjust screw increases ramp (delay) time; counterclockwise rotation decreases ramp (delay) time.*

   c. Operate machine drive function and adjust ramp pot so that machine will stop within 8-12 in. (20-30 cm) when the control handle is released from the full extent of its travel.
   d. Operate machine drive function in the opposite direction and check that stopping distance of 8-12 in. (20-30 cm) is maintained.
   e. Release footswitch and stop machine.
   f. Seal ramp pot adjustment screw with a drop of enamel paint to prevent maladjustment due to vibration.
   g. Install controller and secure machine.

2. Swing Controller.
   a. Using all applicable safety precautions, start machine and ensure that adequate space is available to maneuver machine.
   b. Fully extend boom at horizontal.
   c. Position ENGINE SPEED switch to LOW.
   d. Operate SWING controller at full speed to the left and then quickly move controller to the full speed RIGHT position. The platform should slow, stop and then swing right in one smooth and continuous operation.
   e. If control valve initiates swing right motion before platform momentum is stopped, the ramp potentiometer adjust screw should be rotated clockwise to increase ramp time and the test repeated.
   f. If after operating SWING function as described in step (d), the platform stops moving to the left and the spring action of the boom tends to initiate the swing right motion before the control valve starts to operate, the ramp pot adjust screw should be rotated counterclockwise to decrease ramp time.
   g. Repeat the test in both swing directions.
   h. Release footswitch and stop machine.
   i. Seal ramp pot adjustment screw with a drop of enamel paint to prevent maladjustment due to vibration.
   j. Install controller and secure machine.

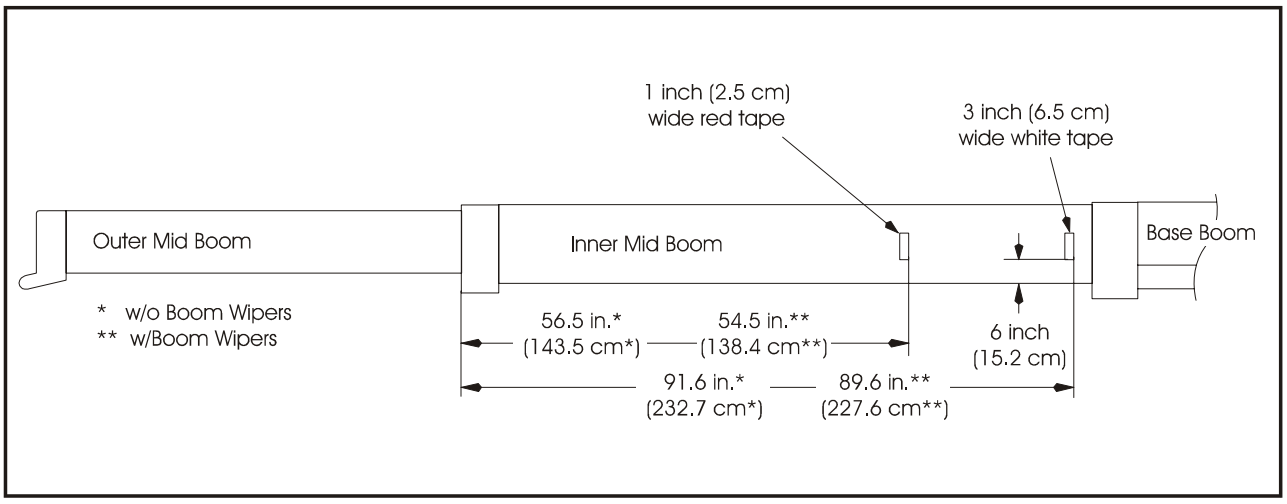


Figure 2-24. Boom Marking Tape Installation

2.24 BOOM MARKING TAPE INSTALLATION

Boom marking tape installation is shown in Figure 2-24.

2.25 BOOM LENGTH/ANGLE SENSOR ADJUSTING PROCEDURE

NOTE: *The boom length/angle sensor is factory set and normally does not require adjusting unless it is removed from the base boom for maintenance purposes, etc.*

Length Indicator Adjustment

1. Fully retract boom and place in horizontal position. Make all adjustments with engine running.
2. On the load radius circuit card measure TP10 to ensure that 10 (+0.1/-0) Volts DC is present.
3. Measure TP1 and adjust P1 until 1.233 Volts DC is present at TP1.
4. Make the following adjustment with the power off.
   a. Disconnect connector J2 (the 6 pin connector) from the load radius circuit card. Measure between Pin (1) of the socket connector and ground (TB1-1) and potentiometer P5 to a value of 1915 (+/- 5) Ohms.
   b. Loosen the three (3) screws holding the 5K potentiometer in the boom cable reel in place. This enables pot/pot shaft to move freely.

NOTE: *When checking the resistance on the 6 pin connector as outlined in step (c), be sure to use connector pins (1) and (4) on plug 2 on the circuit card.*

   c. Rotate the 5K Ohm potentiometer until 100 Ohms is measured between Pin (1) and Pin (4) on the 6 pin plug connector which mates with J2.
   d. Tighten the three (3) screws on the 5K Ohm potentiometer in the boom cable reel.
5. Turn the power on and measure the voltage at TP2. The measurement should be 1.287 Volts.

Boom Angle Sensor Adjustment

1. With the platform level, the boom completely retracted and at 45 (+/- 1) degrees elevation, measure the DC voltage at TP5 on the load radius circuit card.
2. Loosen the three (3) screws securing the sensor to the box and rotate the sensor until 7.1 Volts is measured at TP5. Tighten the screws on the sensor.
3. Return the boom to horizontal.

Radius Adjust and Display Lights Setting Procedure

1. Fully retract the boom and position it to horizontal (zero degrees), with no load in the platform.
2. On the load radius circuit card, measure the voltage at TP11 and adjust potentiometer P6 until 0.525 Volts DC is measured at TP11.
3. Measure the voltage at TP8 and adjust potentiometer P2 until 2.223 Volts DC is measured at TP8.
4. Measure the voltage at TP9 and adjust potentiometer P3 until 5.0 Volts DC is measured at TP9.

5. Telescope the boom until the leading edge of the red marking tape is exposed from the mid boom. Adjust potentiometer P2 until the red light just turns on and the blue lights turns off.
6. Measure the voltage at TP2. Adjust potentiometer P4 until the voltage at TP7 measures 0.05 Volts DC more than the voltage at TP2. This determines the length of the boom (critical length) where the lift down speed limiter is turned on.

Operational Check

1. Raise the boom completely and fully extend the boom.
2. Engage auxiliary power.
3. Engage LIFT DOWN until blue light turns off and red light turns on. When red light turns on, shut down machine and check boom angle. Boom angle should be 64 degrees - 67 degrees. If boom angle is within this range, the boom angle/length indicator system is operating properly and requires no further adjustment. If the boom angle is not within this range, contact the JLG Service Department for further assistance.

Lift Down Speed Limit Adjustment

1. On lift down speed limit circuit card, measure voltage at TP3. Adjust R1 until 8.0 Volts is obtained.
2. Measure voltage at TP1. Adjust R17 until 3.0 Volts is obtained.

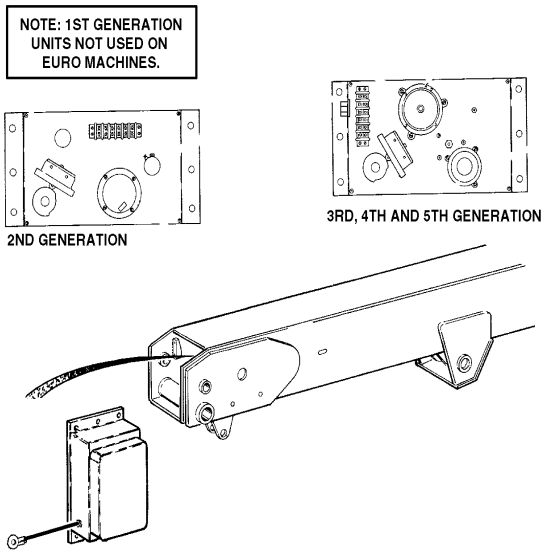
2.26 LOAD MANAGEMENT SYSTEM

The LMS (Load Management System) consists of three independent systems.

Platform Position Indication System

This system illuminates one of the two lamps in the platform position display located on both the platform console and ground control box. A blue light is used to indicate that the platform is within the permitted operating envelope and a red light is used to indicate when the platform is outside the permitted operating envelope. Either the blue or red light should be illuminated at all times.

The elevation angle is sensed by means of a pendulum potentiometer and the extension of the boom sensed by a multi-turn potentiometer driven by means of a cable attached to the telescoping part of the boom. Both of these sensors are situated at the rear of the base boom section and housed in a sealed steel box.



The signals from these sensors (elevation angle and extension distance) are fed into a load radius card which calculates the boom radius.

Boom Radius = Boom Length x Cos Boom Angle

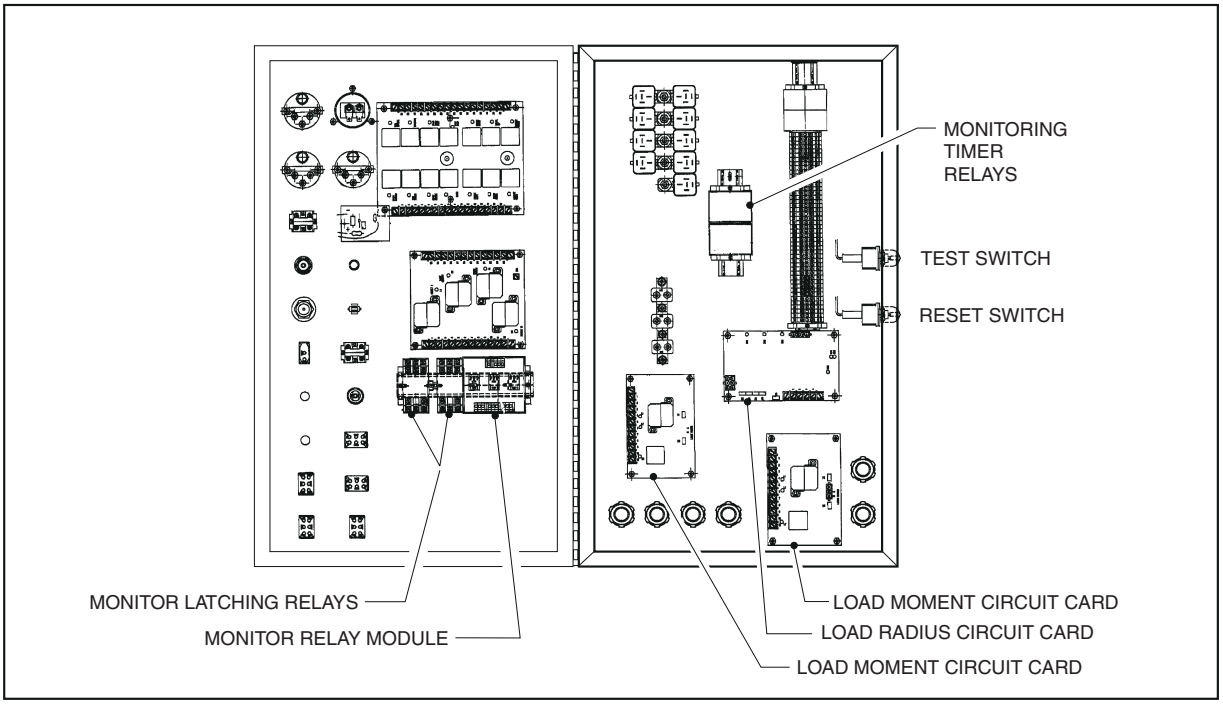


Figure 2-25. Control Box Components

This circuit card operates as follows:

A calibrated dc voltage representing the boom angle is sent from the boom angle sensor to the angle cosine circuit. This voltage is converted to the cosine of the angle and presented to the radius generator circuit.

A calibrated dc voltage representing the boom length is sent from the boom length sensor to the boom length circuit and presented to the radius generator circuit.

The length and cosine dc voltages are multiplied together in the radius generator circuit. The output dc voltage from this circuit is passed to a radius limiting circuit. This circuit is set to detect a specific boom radius dimension. The resultant output signal is sent to a logic network circuit which determines which of the indicator lamps (blue or red) should be energized.

There should be a signal from the sensors at all times, however, if the signal line from the angle, or the boom length sensor is cut a failure circuit detects this and activates an audible warning horn mounted in the console panels.

The boom length circuit also produces output dc voltage when the boom is within a predetermined critical boom length. This signal energizes a 12 volt dc solenoid flow control valve (via a relay in the overmoment control circuit card) to enable the descend function to operate at full speed. When this signal is removed, the descent function defaults to a creep speed.

Also, when an overmoment condition is sensed by the overmoment control circuit, a signal is sent to the logic circuit network. This causes either the red or blue lamp to flash indicating that an overmoment condition exists in that region. This condition also causes the audible warning to sound at the control consoles.

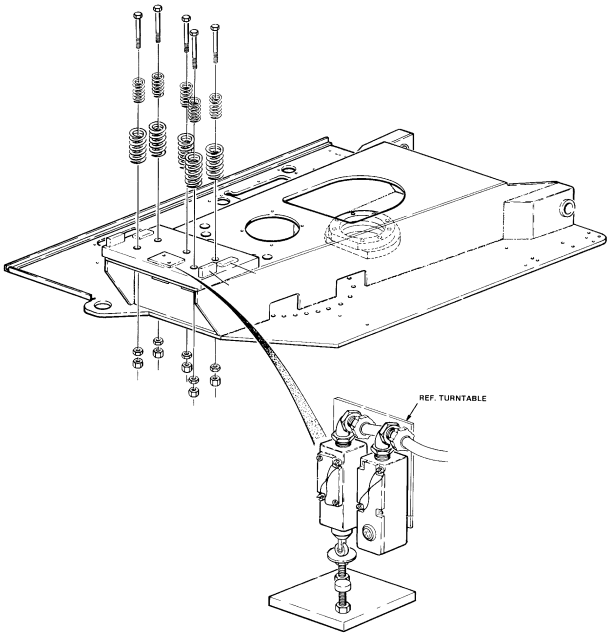
Overmoment Control System

The turntable is pivoted at the lower front area and compression springs, mounted towards the rear, provide a reaction force to the moment produced by boom extension. The force produced by the springs is adjusted to balance the moment produced when the boom is extended to the maximum permitted radius.

Immediately beyond this point of balance the turntable is permitted to pivot a maximum vertical distance of 3 mm. This movement is sensed by two independent switches which power two independent control circuit channels.

1. A positive break mechanical limit switch.

2. An inductive proximity switch.



Each circuit channel is arranged as follows:

The switch provides a 12 volt dc signal to a circuit card. The output from this card energizes a relay which permits the functional signals for boom extend and descend. When an input signal to a channel or an output signal from a circuit card is not present, the lift down and telescope out functions are interlocked.

There is also a warning horn signal present, at both the platform console and ground box, when either channel is not energized.

Overmoment Control Monitoring System

The 12 volt dc input signals from the overmoment control sensing switches are constantly monitored and compared with the output from the circuit cards by the monitoring system circuit.

If any fault is detected (input to output on the same channel or input to output on different channels) all movements of the platform that could increase instability (lift up, lift down, telescope out) are shut down and the boom permitted to retract and descend in a controlled sequence. The machine will remain in this state until reset by a competent person.

The monitoring system operates as follows:

There is an output of 12 volts dc at terminal 7 on the overmoment circuit card only after the input at pin No 2 has received a 12 volt dc signal (from a sensing switch) for a time duration greater than 3 seconds and this output signal will continue 0.5 seconds after the input signal is removed.

These input signals also energize two independent 12 volt timer relays (1 second delay off relay B) which control the output signals from both circuit cards. If the input is removed the timer relay B will de-energize after 1 second. If an output signal from either card remains it will energize two lockout latching relays (relay C). These relays control the function signals to lift, lower, and extend the boom.

Therefore, when the latching coils receive a signal the operator is permitted to retract the platform, to within 3 meters of the fully retracted position. This will enable operation of the boom lower function to bring the platform to the ground level position. The machine will remain in this condition (i.e. in the lowered position) until reset by a competent person.

NOTE: *The monitoring system only activates when there is a malfunction of the overmoment control system.*

Load Management System Daily Check

At the beginning of each days' use, perform check with no load (persons or material) in platform from ground control station.

1. Extend all axles fully and insert lock pins (if applicable).
2. With boom fully retracted, raise boom to horizontal.
3. Position toggle switch located on the right side of the ground control station in the "P" position and hold.
4. Extend boom until it stops. Boom must stop on white tape on mid boom. Release toggle switch.
5. Retract boom 3 meters and attempt to extend boom. boom must not extend. Reset system by activating toggle switch marked "R" located on right side of ground control station.
6. Position toggle switch located on the right side of the ground control station in the "M" position and hold.
7. Extend boom until it stops. Boom must stop on white tape on mid boom. Release toggle switch.
8. Retract boom 10 feet (3 meters) and attempt to extend boom. Boom must not extend. Reset system by activating toggle switch marked "R" located on right side of ground control station.

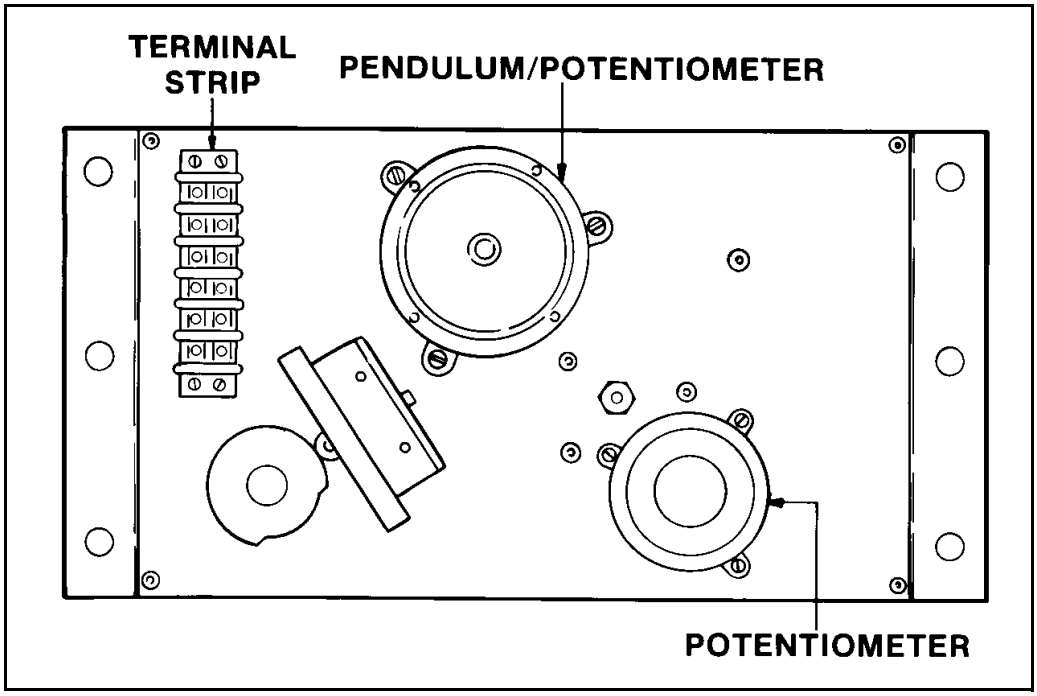


Figure 2-27. Boom Length/Angle Sensor Configuration

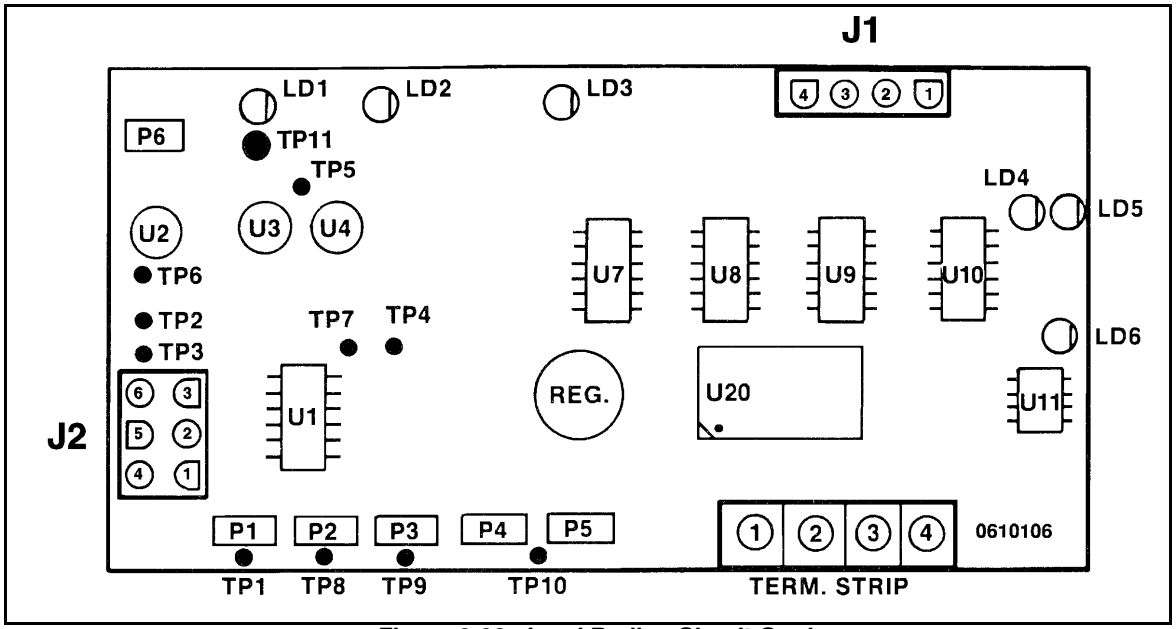


Figure 2-28. Load Radius Circuit Card

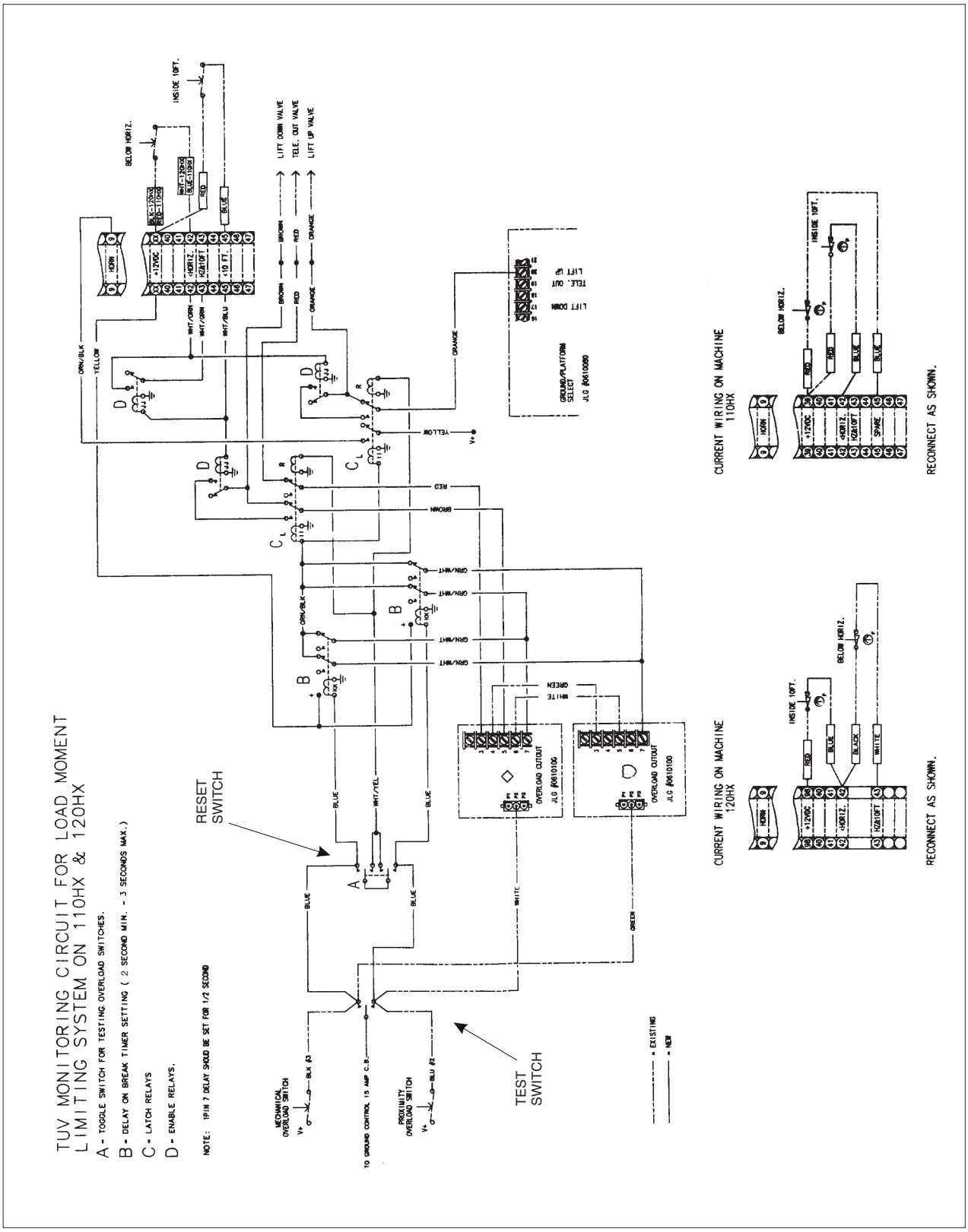


Figure 2-26. Load Moment Limiting System Monitoring Circuit

9. If boom does not stop at white tape or boom can be extended after being retracted 10 feet (3 meters) without resetting, system must be repaired by JLG authorized service personnel before machine can be used.

2.27 LOAD MANAGEMENT SYSTEM ADJUSTMENT

1. With boom retracted, limit switch and proximity switch are in neutral position.
2. Extend boom in horizontal position until white tape on inner mid boom is fully exposed, no load in platform.
3. Adjust proximity switch actuator to trip switch, then secure locking nut.
4. Adjust proximity switch target until LED just turns on, then secure locking nut.
5. To test cutoff switches, retract boom to reset position, then extend boom to test cutoff. Do not extend boom past white tape.
6. To test limit switch, retract boom to reset, then extend boom to cutoff while holding test bypass switch in “M” position. To test proximity switch, retract boom to reset, then extend boom to cutoff while holding test bypass switch in “P” position. When testing switches, do not extend boom past white tape on inner mid boom.

2.28 TURNTABLE SPRINGS

Removal

1. Fully retract boom.
2. Remove rear turntable cover.
3. Remove the five (5) nuts and jam nuts from beneath the turntable which attach to the turntable spring bolts.
4. If necessary, remove the bolts which secure the load management switches to the mounting bracket and allow the switches to hang freely.

⚠ IMPORTANT

WRAP MASKING TAPE AROUND THE LOAD MANAGEMENT SWITCHES TO INSURE THAT THE SWITCHES WILL STILL BE OPERABLE.

5. Position boom to horizontal.
6. Remove the five (5) bolts and turntable springs from the turntable.

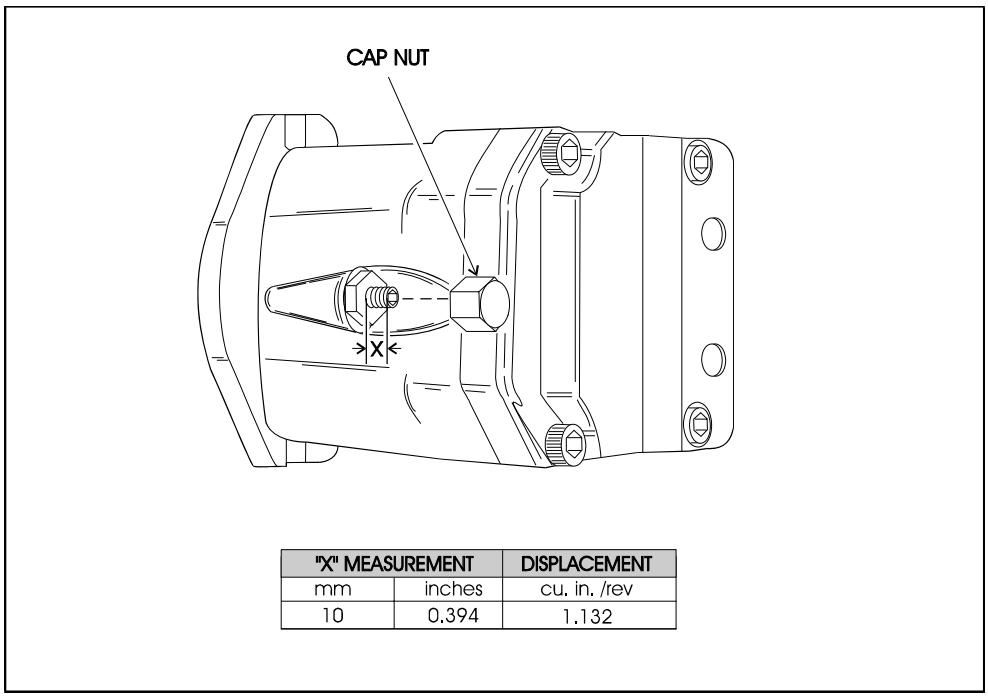
Installation

1. Position boom to horizontal.
2. Install the five (5) bolts and turntable springs onto the turntable.
3. Install the five (5) nuts and jam nuts on the turntable bolts.
4. Extend boom to cutoff position then retract boom until turntable raises 0.25 in. (6.4 mm) from cutoff position, measured at spring area.
5. Snug jam nuts, then fully retract boom.
6. Torque jam nuts to 75 ft. lb. (102 Nm), then tighten nuts.
7. If removed, install load management switches on mounting brackets.
8. Position boom to horizontal. Refer to paragraph 2-25 and adjust load management switches as required.

2.29 DRIVE MOTOR ADJUSTMENT PROCEDURE

1. Remove the cap nut from adjustment screw.
2. Loosen jam nut on the adjustment screw and make adjustment.
3. Measure from top of jam nut to the end of adjustment screw. (Figure 2-29., Drive Motor Adjustment)
4. Tighten jam nut, install cap nut.

NOTE: *The “o” ring must be seated in groove in cap nut.*



"X" MEASUREMENT		DISPLACEMENT
mm	inches	cu. in. /rev
10	0.394	1.132

Figure 2-29. Drive Motor Adjustment

2.30 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.

This machine requires periodic safety and maintenance inspections by a JLG Dealer. A decal located on the turntable 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.
17. Drain and clean.

* To be performed quarterly.

** Inspection and Maintenance Code 10, 12, 16 to performed every two years.

Table 2-7.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	YEARLY
	BOOM						
1.	Platform	1,4					
2.	Platform Gate	1,4		12			
3.	Platform Rotator		5,11	8, 12			
4.	Footswitch	1,11					
5.	Controllers	1,11					
6.	Switches	1,11					
7.	Placards and Decals	1,2					
8.	Control Tags	1,2					
9.	Valves	1,11	5,6				
10.	Carrier (Hoses and Cables)	1	4,8				
12.	Pins			8, 12			
13.	Bushings			8, 12			
14.	Wear Pads			8, 12			
15.	Cylinders		1,5,6,13	12			
	Boom Chain Adjusters		9				
	Sheaves			8, 12			
	Radius Limit Tape		1, 2				
17.	Drift Test*						

Table 2-7.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	YEARLY
	TURNTABLE						
1.	Engine Oil (see mfg. manual)	3	5				
2.	Battery	3	5				
3.	Radiator		3, 5				
4.	Air Cleaner	1	14				
5.	Exhaust System	1		1,5			
7.	Engine Mount			1			
8.	Ground Controls	1,2,11					
9.	Main Hydraulic Pump	1	5				
10.	Auxiliary Power Pump	1	5				
11.	Valves	1,11	5				
12.	Hydraulic Filters		5, 14	14			
13.	Hydraulic Hoses	1	5				
14.	Hydraulic Oil Tank**	3	5	4			
15.	Breather Hydraulic Tank		6,14				
16.	Fuel Tank	3,5		4			
17.	Cylinders		1,5,6,13	4, 12			
19.	Turntable Locking Pin	1,7					
20.	Horizontal Limit Switch	1,7					
21.	Oil Coupling		5				
22.	Placards and Decals	1,2					
	Tilt Alarm Switch		1, 7				
23.	Swing Bearing		1		9, 12		
24.	Swing Brake		1,5,6	8			
25.	Swing Hub		1, 3, 5,6		10		

Table 2-7.Preventive Maintenance and Inspection Schedule

AREA		INTERVAL					
		DAILY	WEEKLY	MONTHLY	3 MONTH	6 MONTH	YEARLY
	CHASSIS						
1.	Wheel and Tire Assembly	1	8,9,15				
2.	Drive Motors		1,5,6				
3.	Drive Torque Hubs		1,5,6	3	10		
4.	Drive Brakes		1,5,6	8			
5.	Steer Cylinders		1,5,6,13	12			
6.	Steer Components	1	4,6	8, 12			
7.	Tie Rod Lock Pin	1	8				
8.	Hydraulic Hoses	1	5				
9.	Placards and Decals	1,2					
10.	Wheel Bearings			8	12		
11.	Swing Bearing/Worm Gear			12	9		

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

The troubleshooting procedures applicable to the aerial platform are listed and defined in Tables 3-1 through 3-6. 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.

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.

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 are symptomatic of greater problems which have more that 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 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

Table 3-1.Platform Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Automatic leveling inoperative.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Dual check valves dirty/inoperative.	Clean or replace as necessary.
	Restricted or broken hydraulic line or fitting on slave cylinder or main lift cylinder.	Clean, repair, or replace line or fitting.
	Worn seal(s) in slave level or main lift cylinder.	Replace seal(s).
	Counterbalance valve in slave cylinder defective.	Replace counterbalance valve.
	Slave level or main lift cylinder not functioning properly.	Slave level or main lift cylinder not functioning properly.
Platform will not maintain level attitude.		
	Counterbalance valve on slave leveling cylinder improperly adjusted or not functioning properly.	Replace valve.
	Worn seal(s) in slave level or main lift cylinder.	Replace seal(s).
	Damaged slave level or main lift cylinder.	Repair or replace cylinder.
No response to platform leveling controls.		
	Level function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Level control switch inoperative.	Repair or replace control switch lever.
	Hydraulic system oil low.	Replenish oil as necessary.
	System orifice plugged/dirty.	Clean orifice.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	No electric to dump or control valve.	See proper wiring diagram.
	Slave cylinder not functioning properly.	Repair or replace pump.
Platform will not adjust "up" or "down" to level.		
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Slave cylinder not functioning properly.	Repair or replace cylinder.
	Electrical failure.	See proper wiring diagram.
	Orifice plugged.	Clean orifice.

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Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	CONTROL VALVES	
Valve spool sticking.		
	Dirt in oil causing excessive temperature build-up.	Flush system and change oil using recommended viscosity
	Moisture in oil.	Flush system and change oil using recommended viscosity
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting. Repair as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Tie-bolts in valve over torqued.	Correctly torque bolts.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.		
	Dirt or other foreign material under seal.	Remove and repair valve as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Remove valve and repair or replace as necessary.
	BOOM ELEVATION SYSTEM.	
No response to lift control switch.		
	Lift function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Lift control switch inoperative.	Repair or replace control switch.
	Lift cylinder holding valve inoperative.	Repair or replace holding valve.
	Dump valve (bypass) not operating.	Determine cause and repair or replace valve.
	Electrical malfunction.	See wiring diagram.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Fuse is blown out on control card.	Replace fuse.
	Control valve not functioning properly.	Repair or replace valve.
	Hydraulic Pump not functioning properly.	Repair or replace pump.
	Lift cylinder not functioning properly.	Repair or replace cylinder
Boom will not raise.		
	Lift function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Load capacity exceeded (personnel or equipment on platform).	Reduce load.(Refer to capacity placard.)
	Hydraulic system oil low.	Replenish oil as necessary.
	Electrical failure to valves.	See proper wiring diagram.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Bypass valve (dump) not functioning.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Binding lift cylinder or boom pivot pin.	Repair or replace cylinder or pin.
Boom will not lower.		
	See: Boom will not raise.	
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Holding valve not functioning properly.	Re-adjust or replace valve.
Boom raises and lowers erratically.		
	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Counterbalance valve on lift cylinder improperly adjusted or not functioning properly.	Replace valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
Boom drifts down.		
	Worn seals in lift cylinder.	Replace seals.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Function Speed, Drive Speed and High Engine does not operate below horizontal.		
	Damaged wiring on level limit switch.	Repair or replace wiring.
	Solenoid failure.	Replace solenoid.
	Tripped circuit breaker.	Reset circuit breaker.
	Damaged level limit switch.	Replace switch, repair or replace holder.
	Defective relay, main terminal box.	Replace relay.
	Defective platform switch.	Replace switch.
LOWER LIFT FUNCTION.		
If the boom assembly does not fully lower.		
	The Mid and Lower Booms are out of synchronization.	Refer to synchronize procedure.
MAIN TELESCOPE SYSTEM.		
No response to telescope control.		
	Telescope function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Telescope control switch inoperative.	Repair or replace control switch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Control valve not functioning properly.	Repair or replace valve.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Boom will not extend.		
	Telescope function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Control valve not functioning properly.	Repair or replace control valve.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Pressure setting incorrect.	Check pressure/re-adjust as necessary.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom extends and retracts erratically.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Wear pads worn.	Replace pads as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in telescope cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
	Counterbalance valve not functioning properly.	Replace counterbalance valve.
TOWER TELESCOPE SYSTEM (A MODELS		
Tower telescope cylinder will not extend.		
	Function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Tower lift cylinder not fully elevated.	Fully elevate tower lift cylinder.
	Cam valves out of adjustment.	Correctly adjust cam valves.
	Tower level cylinder not synchronized.	Correctly adjust cam valves.
	Defective cylinder or binding boom.	Repair or replace cylinder or defective boom parts.
Tower lift cylinder will not lower.		
	Function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Tower telescope cylinder not fully retracted.	Fully retract tower telescope cylinder.
	Cam valves out of adjustment.	Correctly adjust limit cam valves.
	Defective cylinder or binding boom.	Repair or replace cylinder or defective boom parts.
No response to control.		
	Function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Valve spool sticking.	Repair or replace valve.
	Poor ground on valves.	See proper wiring diagram.
	No electric power to dump valve on cylinder.	See proper wiring diagram.
	No electric power to valves.	See proper wiring diagram.
	Internal damage to cylinder.	Repair or replace cylinder.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom leaks down.		
	Holding valve sticking.	Replace holding valve.
	Damaged cylinder.	Repair or replace cylinder.
BOOM SWING SYSTEM		
No response to swing control.		
	Swing function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	Hydraulic system oil low.	Replenish oil as necessary.
	Swing control switch not functioning.	Repair or replace swing control switch.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Swing motor not functioning properly.	Repair or replace motor.
	Restrictor valve(s) plugged.	Clean or replace restrictor valve.
	Foreign objects(s) wedged between swing motor pinion and swing gear.	Remove objects, check for damage, and repair or replace component(s) as required.
	Pressure reducing valve in swing circuit malfunctioning.	Repair or replace pressure reducing valve.
	No electric power to valve.	See proper wiring diagram.
Boom will swing in one direction only.		
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Foreign object(s) wedged between swing motor pinion and swing gear.	Remove object(s), check for damage and repair or replace component(s) as required.
	Swing control switch not functioning properly.	Repair or replace swing control switch.
Boom swings erratically in either direction.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Lack of lubricant on swing gear or speed reducer pinion.	Lubricate as required. (See Lubrication Chart.)
	Swing motor not functioning properly.	Repair or replace swing control switch.
	Worn or broken teeth on swing gear or swing motor pinion.	Replace gear(s) as required.
	Restrictor valves(s) plugged.	Clean or replace restrictor valve.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
TOWER LIFT AND UPRIGHT CIRCUIT (A MODELS		
No response to control.		
	Function not activated within 7 seconds after footswitch depressed.	Recycle footswitch.
	Tower lift control inoperative.	Repair or replace control lever.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	No electric to control.	See proper wiring diagram.
	Control valve not functioning properly.	Repair or replace valve.
	Over center valve malfunction.	Repair or replace valve.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Tower lift and upright will not raise.		
	Function not activated within 7 seconds after footswitch depressed.	Recycle footswitch.
	Load capacity exceeded (personnel or equipment on platform.	Reduce load. (Refer to capacity placard)
	Hydraulic oil system low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair, replace line or fitting.
	Holding valve(s) on cylinder(s) not working.	Replace holding valve(s).
	Control valves not functioning properly.	Repair or replace valve.
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Bypass valve (dump) not functioning.	Repair or replace valve.
	Tower lift cylinder not functioning properly.	Repair or replace cylinder.
	Counterbalance valve not adjusted.	Replace counterbalance valve.
	Failed master cylinder.	Repair or replace master cylinder.
	Tower level cylinder not synchronized.	Correctly adjust cam valves.
Tower lift and upright will not lower.		
	See: Tower lift and upright will not raise	
	No electric power to dump valve.	Repair or replace valve.
Tower lift and upright raises and lowers erratically.		
	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, replace line.

Table 3-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Counterbalance valve on tower lift cylinder improperly adjusted or not functioning properly.	Replace counterbalance valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in tower lift cylinder.	Replace seals.
	Upright level cylinder not functioning properly.	Repair or replace cylinder.
	Air in upright cylinder.	Fully cycle upright level cylinder 2-3 times.
	Holding valves on tower lift or upright level cylinder contaminated.	Determine and remedy source of contamination. Replace holding valve.
	Relief valve set too low on level circuit.	Correctly adjust valve.
	Tower level master cylinder defective or leaking.	Repair or replace master cylinder.
	Air in tower master cylinder.	Fully cycle tower master cylinder 2-3 times.
	Seals worn or leaking in tower master cylinder.	Repair master cylinder.

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Table 3-3.Turntable Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
CONTROL VALVE.		
Valve Spool Sticking.		
	Dirt in oil causing excessive temperature built-up.	Change oil using recommended viscosity and flush system.
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting.Repair as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.		
	Dirt or other foreign material under seal.	Remove and replace valve as necessary.
	Valve spool scored.	Repair or replace valve.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Repair or replace valve as necessary.

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Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
POWER PLANT.		
Engine will not start.		
	Station power selector switch not in required position.	Actuate switch as required.
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Defective starter motor.	Replace starter motor.
	Damaged wiring in ignition circuit (broken wire on starter).	Repair, replace wiring.
	Ignition switch not functioning properly.	Replace switch.
	Ignition relay not functioning properly.	Replace relay.
	Ignition circuit shorted to ground.	See proper wiring diagram.
	Battery cable(s) not making contact.	Clean and tighten cable(s).
	Start lockout not working.	See wiring diagram. Check relay.
Engine will not start (ignition OK).		
	No fuel.	Replenish fuel as necessary.
	Clogged fuel filter.	Replace fuel filter.
	Choke solenoid malfunction.	Replace choke solenoid.
	Restricted or broken fuel line.	Clean or replace fuel line.
	Fuel shut-off valve in carburetor stuck or frozen.	Repair or replace fuel shut-off. Check for electrical power.
	Battery discharged.	Charge battery, replace if defective.
	Fuel pump not working.	Replace fuel pump.
	Cam timing belt jumped time or broken.	Repair or replace timing belt.
	Ignition timing slipped.	Repair timing.
Engine will not accelerate above low.		
	Damaged wiring on speed control switch or high engine solenoid.	Repair or replace wiring.
	Drive controller not functioning properly.	Replace controller.
	Actuator not functioning properly.	Repair or replace solenoid.
	Excessive load on engine.	Reduce load.

Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Engine worn badly.	Rebuild engine.
	Engine improperly timed.	Time engine.
	Engine overheating.	Determine cause of overheating and remedy.
	Dirty fuel filter.	Replace filter.
	Fuel line pinched.	Replace fuel line.
	Throttle governor not working properly.	Repair or replace governor.
Engine surges.		
	Governor not adjusted properly.	Correctly adjust governor.
Strong fuel odor.		
	Fuel tank overfilled.	Check fuel tank and immediately wipe up spilled fuel.
	Fuel tank damaged.	Drain all fuel from tank and remove tank for replacement or repair.
	Fuel line from tank damaged.	Replace fuel line.
	Carburetor flooding.	Repair, replace or adjust carburetor.
FRONT FRAME AXLE AREA.		
One or both wheels will not steer.		
	Steering link or tie rod broken or attaching hardware missing.	Replace steering link, tie rod or hardware as necessary.
One or both front wheels will not rotate or rotate erratically.		
	Wheel hub or bearings damaged or not lubricated.	Replace hub or bearings as necessary and repack bearings with approved grease.
REAR FRAME AXLE AREA.		
Difficulty encountered when moving machine.		
	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Flow divider sticking.	Repair or replace flow divider.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Grade too steep.	See WARNING Placard on platform for specified grades and sideslopes.
	Towing valve not closed.	Close towing valve.

Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	Drive brakes "dragging".	Re-adjust pressure.
	System pressure too low.	Re-adjust pressure.
	Drive hub(s) defective.	Repair or replace hub.
	Engine RPM's not set.	Correctly set engine RPM.
	Drive motors worn.	Repair or replace drive motors.
	Counterbalance valve defective.	Replace counterbalance valve.
	Low amperage on controller.	Correctly adjust controller.
DRIVE SYSTEM.		
No response to control.		
	Drive function not activated within 7 seconds after footswitch was depressed.	Recycle footswitch.
	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.
	Restricted or broken line on valve bank.	Clean, repair or replace line.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Air in wheel brake circuit.	Bleed circuit, determine and correct cause.
	Fuse is blow-out on control card.	Replace fuse.
	Damaged wiring on control switch.	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Brake(s) not releasing.	Determine cause and repair or replace.
Machine will not travel in forward.		
	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(s) not functioning properly.	Repair or replace motor(s).
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Counterbalance valve sticking on return side.	Adjust return counterbalance out 3 turns - cycle drive - return to original position.

Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Motor turns slowly in the direction of the last command.		
	Valve not returning to neutral.	Check neutral springs.
	Function speed switch malfunction.	Replace function switch.
	Sticking spool due to contamination.	Remove end cap and check spool freedom. Repair as necessary.
Motor turns slowly at maximum command.		
	Valve spool is not traveling far enough due to:	Repair or replace drive motor(s).
	Worn, leaking drive motor(s).	Repair or replace drive motor(s).
	Engine RPM's set too low.	Properly adjust engine RPM's.
	Low control pressure supply.	Replace pressure regulator if necessary.
	Function speed switch malfunction.	Replace switch.
	Amperage too low on controller.	Correctly adjust controller.
	Defective pump, low oil volume.	Repair or replace pump.
Poor response, function shuts off slowly when command is removed.		
	Low spool spring preload.	Check for correct spring and shims in end caps.
	Sticking spool due to contamination.	Remove end cap and check spool freedom.
	Ramp set too high in controller.	Adjust controller.
	Sticking control handle.	Repair or replace controller.
STEERING SYSTEM.		
No response to steer control.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic system pressure too low.	Adjust pressure.
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line on valve bank, hydraulic pump or rotary coupling. (If equipped.)	Clean, repair or replace line.

Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	If equipped, swivel coupling leaking internally. (Seals defective.)	Repair or replace coupling.
	Steer 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 hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressure.
	Bent linkage (tie rods).	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Steering inoperative.		
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Control switch not functioning properly.	Replace switch.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valves as required.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine will not steer left or to the right.		
	Wiring on control switch is damaged.	See proper wiring diagram.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	No oil flow or pressure to steer circuit.	Take pressure reading at steer valve and adjust as necessary.
	Bent cylinder rod.	Repair or replace cylinder.
	Damaged tie rod.	Replace tie rod.
	Crossover relief valve sticking.	Repair crossover relief valve.
	Cylinder packing defective.	Repair or replace cylinder.

Table 3-4.Chassis Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Machine wanders; steering not firm.		
	Crossover relief valve set too low or not functioning properly.	Reset, repair or replace valve as required.
	Steer linkages loose.	Tighten linkage.
	Steer wheel toe-in not set properly.	Adjust toe-in for 1/4 inch overall.
	Spindle bushings badly worn.	Replace bushings.

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Table 3-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
HYDRAULIC SYSTEMS - GENERAL.		
Hydraulic pump noisy.		
	Air entering system through broken line or fitting. (Suction Side.)	Repair or replace line or fitting.
	Suction screen dirty.	Clean suction screen.
	Air bubbles in oil. (Reservoir oil too low.	Replenish oil as required.
	Suction hose squeezed shut.	Determine cause and repair.
	Oil filter dirty.	Replace hydraulic filter.
	Wrong type of hydraulic oil.	Replace hydraulic oil.
Pump cavitating. (Vacuum in pump due to oil starvation.)		
	Restricted suction line.	Clean, repair, or replace line.
	Restricted reservoir air vent.	Clean or replace vent.
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Air leak in suction side of tank.	Repair leak.
	Restricted suction strainer.	Clean strainer.
System overheating.		
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Bypass valve not operating properly.	Repair or replace valve.
	Main relief valve set too low.	Reset valve as required.
	Hydraulic system oil low.	Replenish oil as necessary.
	Port relief set too high.	Reset valve as required.
	Restricted or blocked return line.	Repair or replace line.

Table 3-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Pump not delivering oil.		
	Restricted suction line.	Clean, repair, or replace line.
	Air entering system through broken line or fitting.	Repair or replace line or fitting.
	Broken pump drive shaft/pump coupling.	Repair or replace pump/pump coupling. **Note: Any time pump or pump drive coupling is removed coat pump and drive coupling splines with Lithium Soap Base Grease (TEXACO CODE 1912 OR EQUIVALENT).**
Function sluggish during operation. (System pressure too low.)		
	Main relief valve set too low.	Reset valve as required.
	Pump section not delivering sufficient oil.	Repair or replace pump section or pump.
	Main relief valve stuck in open position.	Clean, repair, or replace valve. (Check system oil for contamination.)
	Oil viscosity too low.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Leak in component, line or fitting.	Repair or replace component, line or fitting.
	Scored valve spool; scored cylinder.	Replace valve; replace cylinder.
	Amperage too low on controller.	Correctly adjust controller.
	Low sequence pressure.	Reset valve as required.
	Low pilot pressure.	Reset valve as required.
	Wrong/defective spool in drive section.	Repair or replace drive section.
	Shuttle balls leaking in proportional valve.	Repair or replace valve.
	Low voltage in electrical system.	Correct low voltage problem.
System(s) operate erratically.		
	Sticking or binding valve spools, pistons.	Clean, repair, or replace components as required.
AUXILIARY HYDRAULIC SYSTEM.		
Auxiliary hydraulic pump inoperable.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Engine is running.	Shut down engine.
	Check valve in system leaking.	Repair or replace check valve.
	Battery requires charging or will not hold a charge.	Charge or replace battery as required.

Table 3-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	Damaged wiring on control switch or auxiliary pump.	See proper wiring diagram.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Pump motor solenoid not functioning properly.	Replace solenoid.
	Pump motor not functioning properly.	Repair or replace motor.

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Table 3-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM CONTROLS.		
No power to platform controls.		
	15 Amp self-reset circuit breaker open.	Check footswitch to ensure that both switches are making contact when pedal is depressed. Repair or replace footswitch as necessary.
	Contact block in footswitch malfunctioning.	Repair, replace or adjust contact block as required.
	Faulty power circuit wiring.	Check wiring continuity. Refer to proper wiring diagram.
	Select switch in wrong position.	Place select switch to correct position.
ENGINE STARTER SYSTEM.		
Starter 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.
	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. See proper wiring diagram.
	Faulty start lockout system.	See correct wiring diagram.
	Faulty start switch.	Replace switch.
Engine continues to crank.		
	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. See proper wiring diagram.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Faulty start switch.	Replace switch.

Table 3-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
INSTRUMENTS AND INDICATORS.		
Travel warning horn inoperative.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring in horn circuit.	Repair or replace wiring.
	Damaged horn.	Replace horn.
Hourmeter inoperative.		
	Damaged wiring in hourmeter circuit.	Repair or replace wiring.
	Defective pressure switch.	Replace pressure switch.
	Inoperative hourmeter.	Replace hourmeter.
Tilt alarm circuit.		
	Damaged wiring in tilt alarm circuit.	Repair or replace wiring. See proper wiring diagram.
	Tilt alarm inoperative.	Replace tilt alarm.
	Tilt alarm not adjusted properly.	Adjust tilt alarm.
	Defective bulb in tilt light.	Replace bulb.
High engine speed will not function.		
	Boom above horizontal.	Lower boom.
	Horizontal limit switch malfunctioning.	Repair or replace limit switch.
	Drive controller defective.	Replace controller.
	High engine solenoid malfunctioning.	Repair or replace solenoid valve.
	Drive pressure switch malfunctioning.	Replace pressure switch.
	Electrical malfunction.	See wiring diagram.
	Defective engine governor.	Repair or replace governor.
Function speed control will not function.		
	Boom above horizontal.	Lower boom.
	Horizontal limit switch malfunctioning.	Repair or replace limit switch.
	Defective pump section.	Repair or replace pump section.
	Electrical malfunction.	See correct wiring diagram.

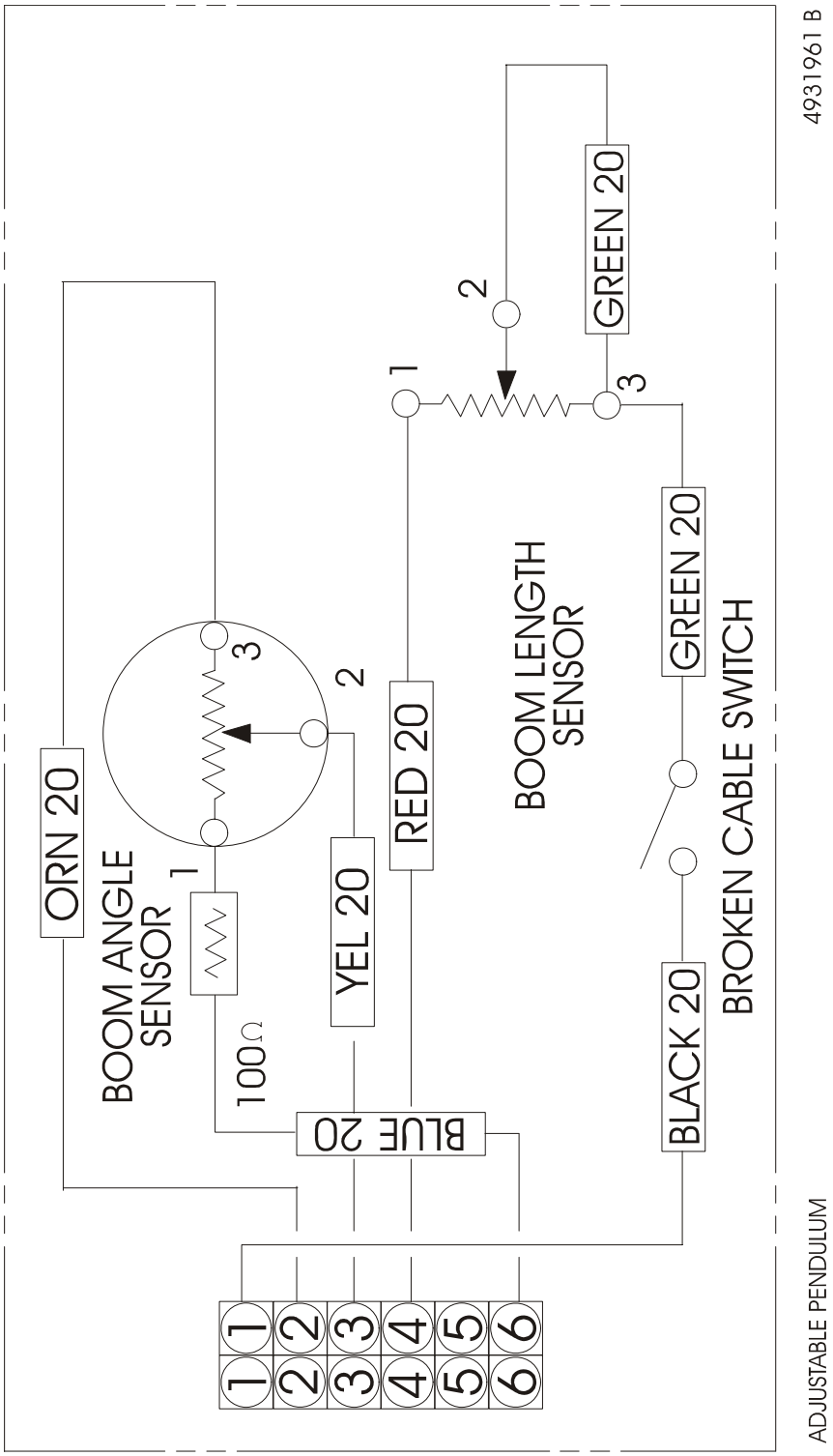

Figure 3-1. Electrical Diagram - Boom Length Indicator

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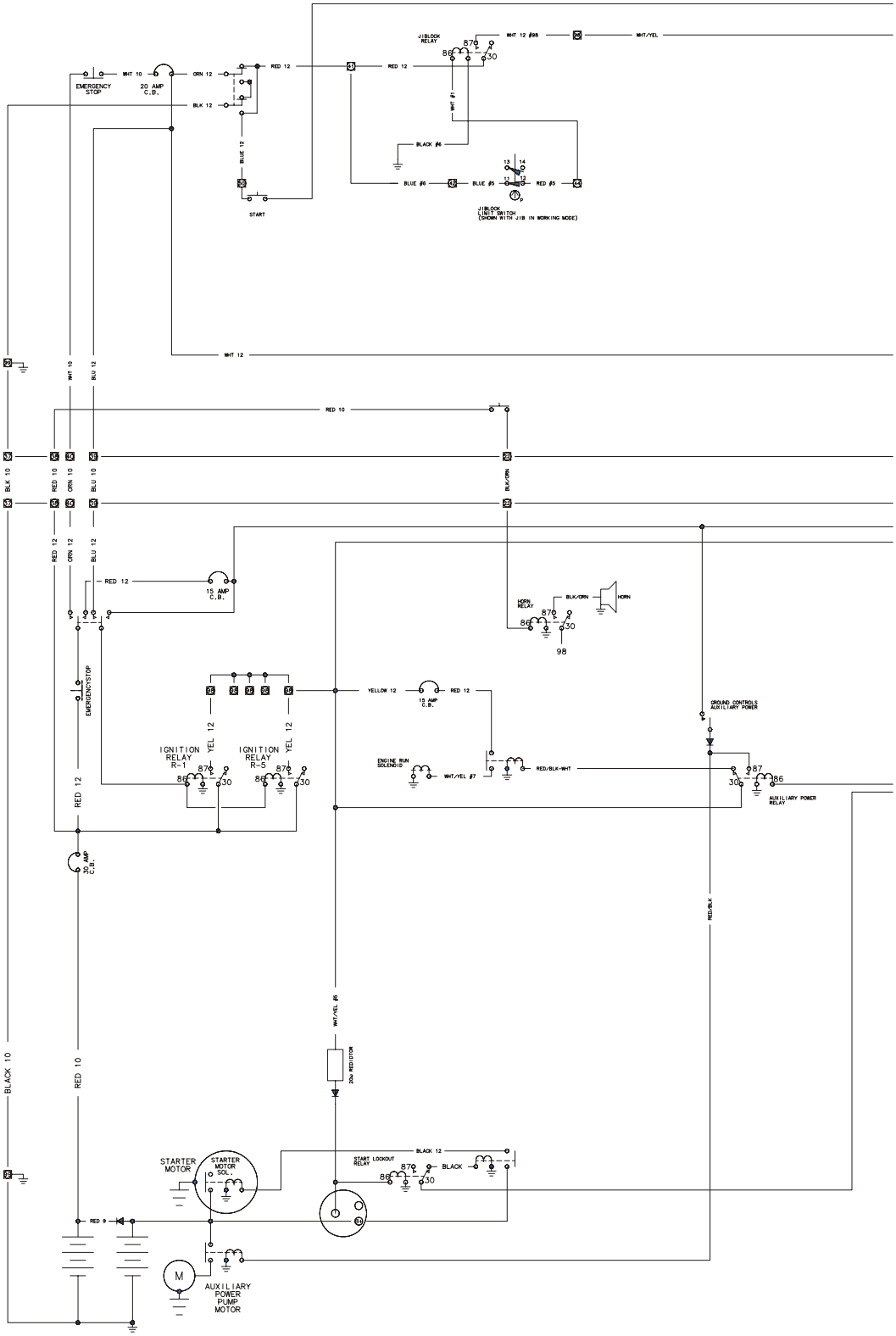

Figure 3-2. Electrical Schematic - Sheet 1 of 4

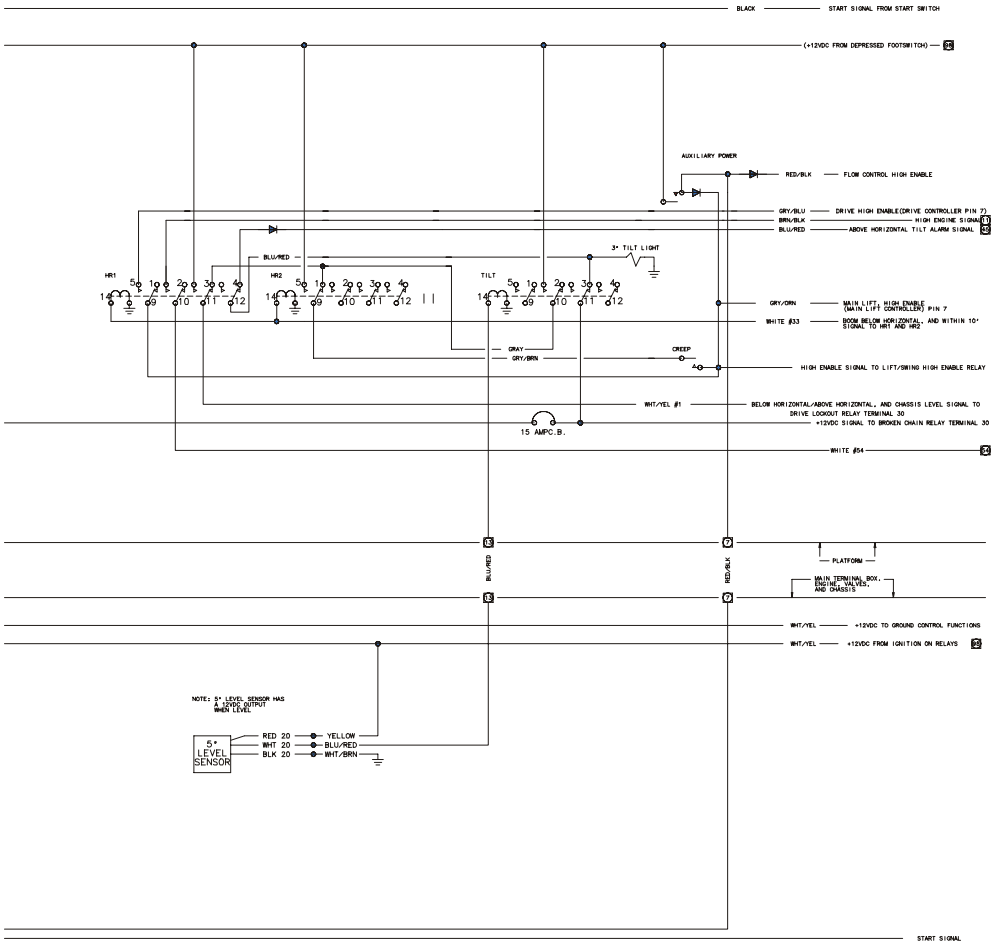

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Figure 3-3. Electrical Schematic - Sheet 2 of 4

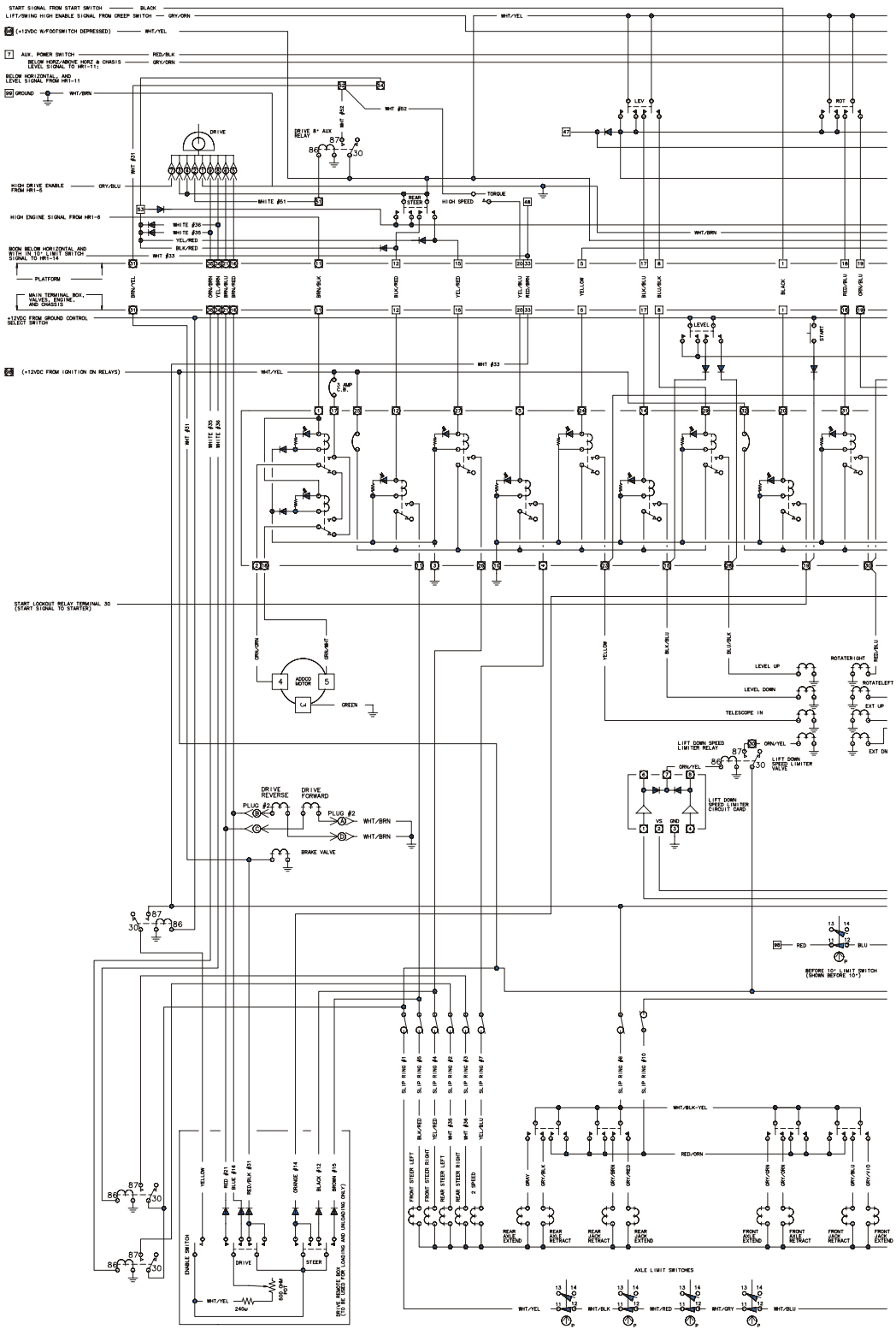

Figure 3-4. Electrical Schematic - Sheet 3 of 4

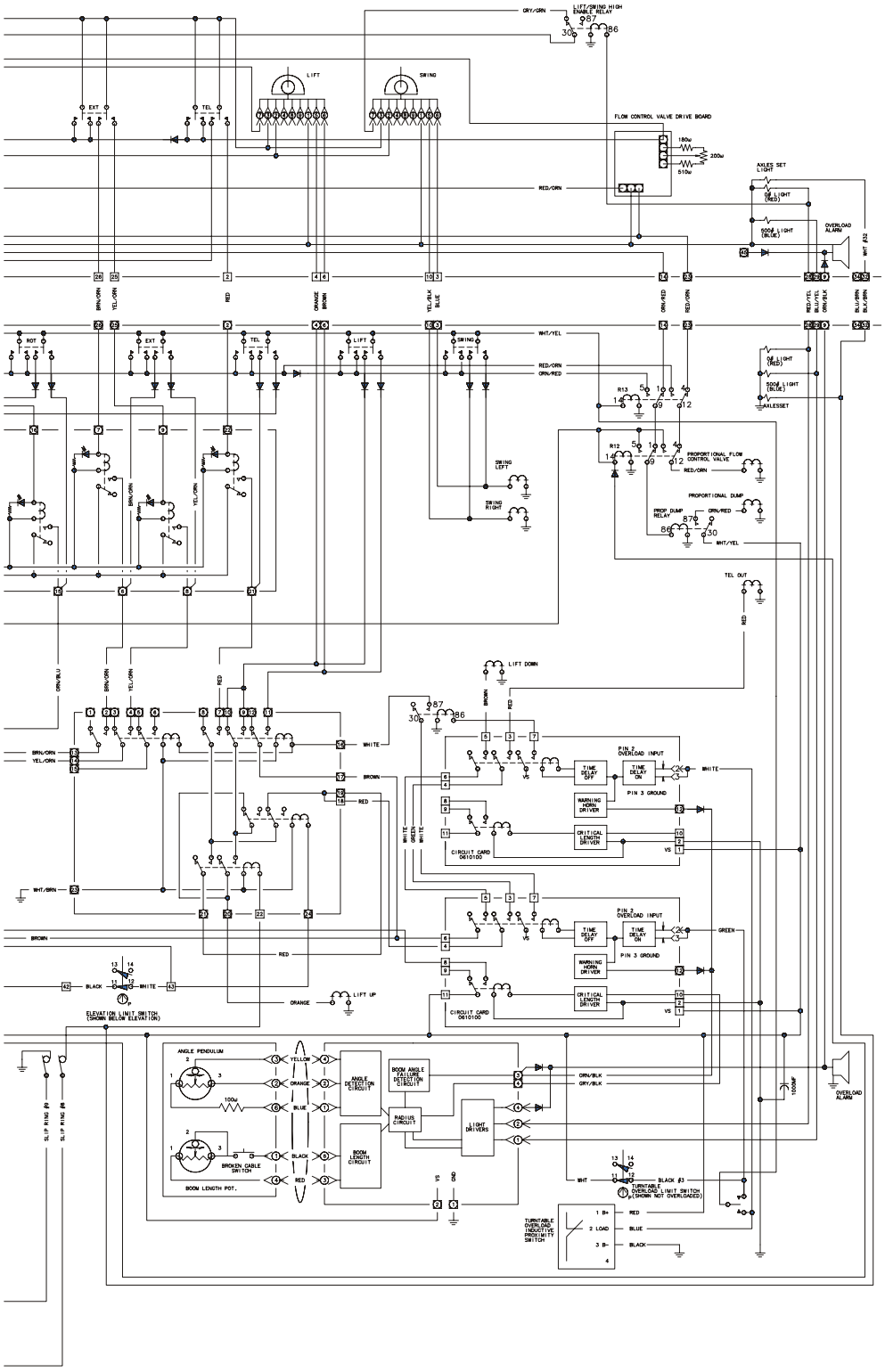

Figure 3-5. Electrical Schematic - Sheet 4 of 4

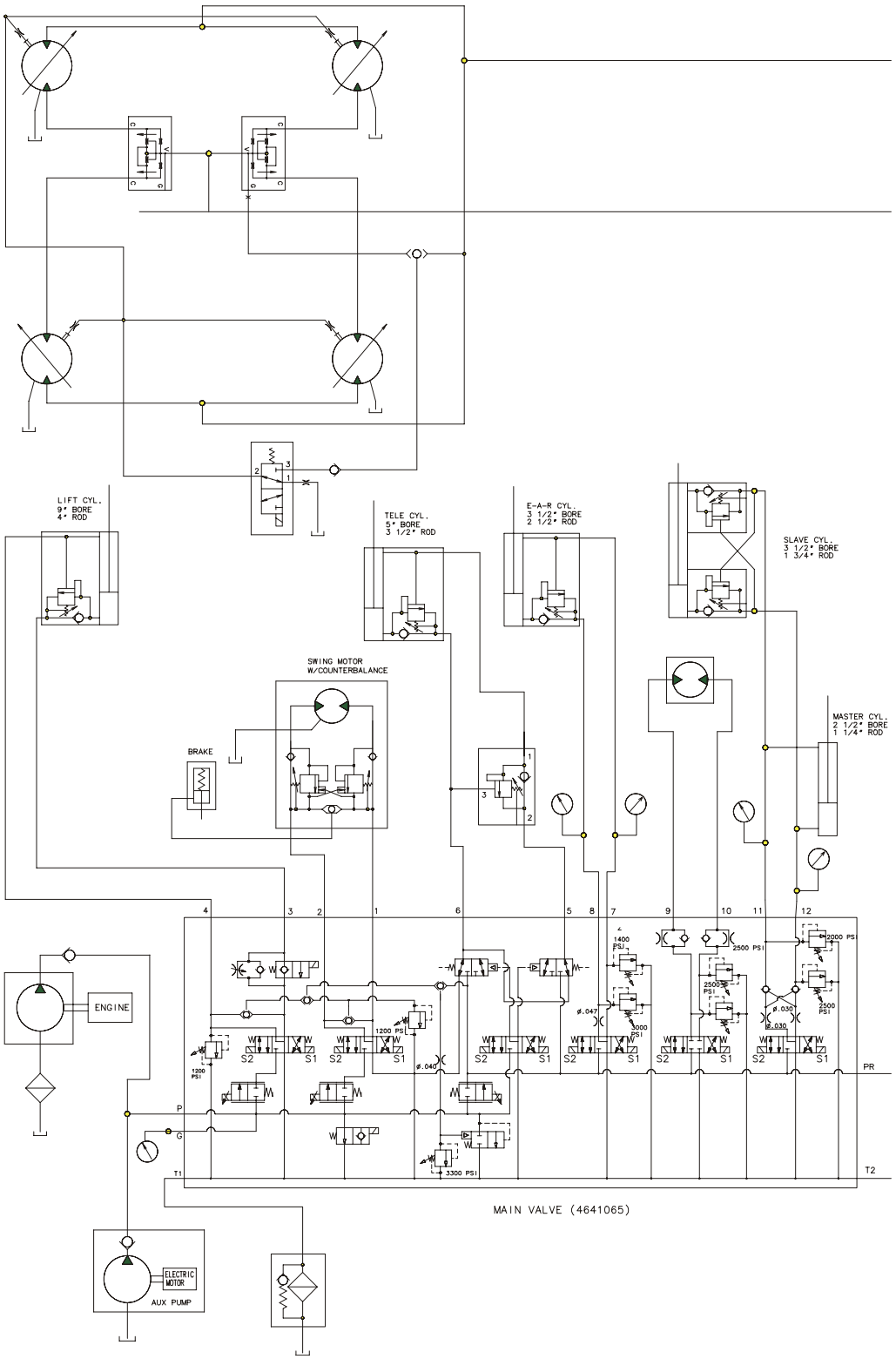

Figure 3-6. Hydraulic Schematic - (Sheet 1 of 2)

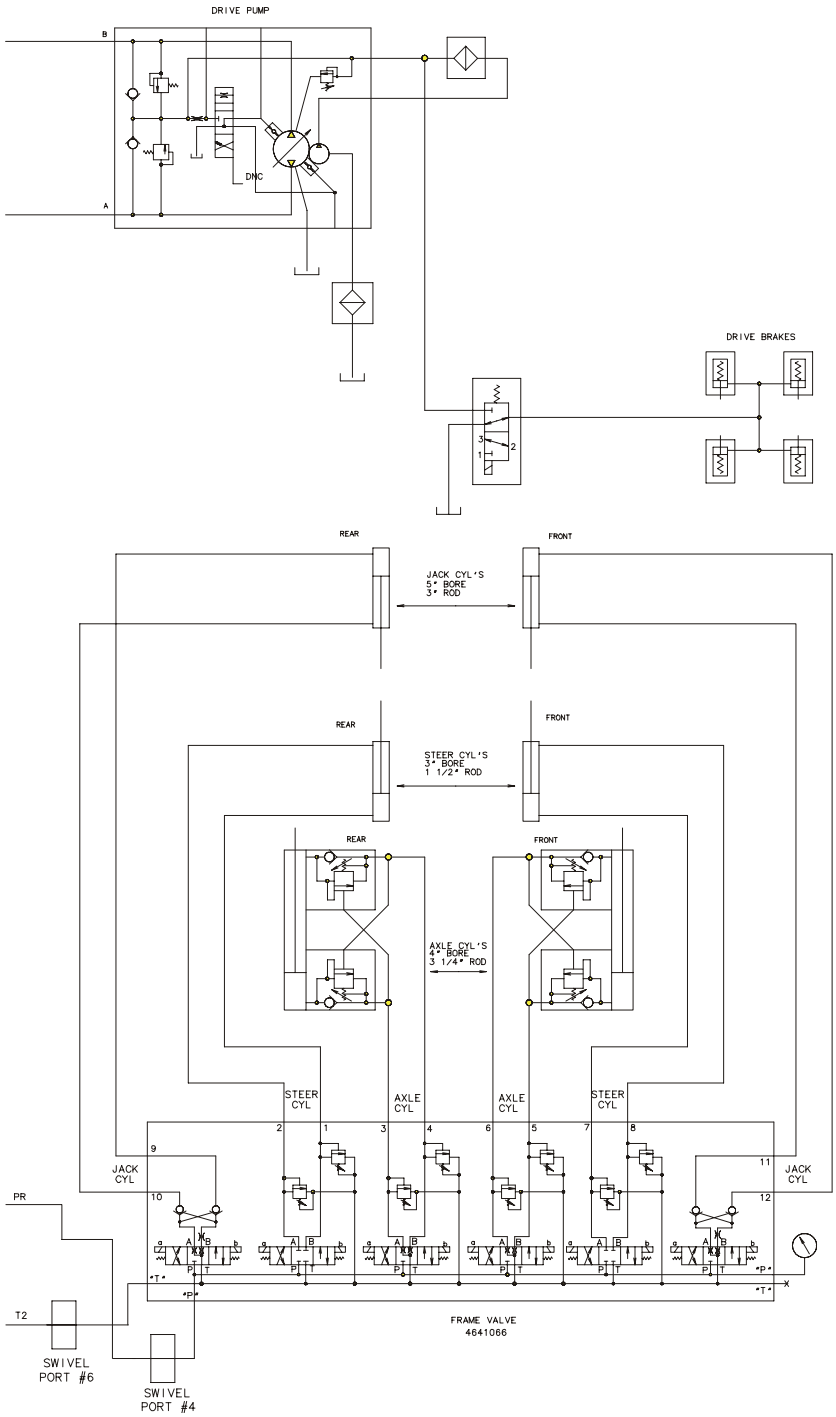

Figure 3-7. Hydraulic Schematic - (Sheet 2 of 2)

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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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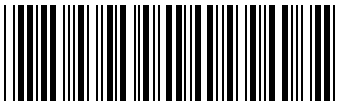

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