An Oshkosh Corporation Company

Service and Maintenance Manual

Model 150HAX

P/N - 3120679

February 15, 2012

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 OR ALTERATION OF AN AERIAL WORK PLATFORM SHALL BE MADE ONLY WITH WRITTEN PERMISSION FROM THE MANUFACTURER.

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 COULD RESULT IN MACHINE DAMAGE, PERSONNEL INJURY OR DEATH AND IS A SAFETY VIOLATION.

- ENSURE REPLACEMENT PARTS OR COMPONENTS ARE IDENTICAL OR EQUIVALENT TO ORIGINAL PARTS OR COMPONENTS.
- 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.

REVISON LOG

Original Issue	- May 15, 1992
Revised	- January 2, 2001
Revised	- February 4, 2010
Revised	- February 15, 2012

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SECTION 1. SPECIFICATIONS

1.1 CAPACITIES

Table 1-1. Capacities

Fuel Tank	68 gallons (257 liters)
Hydraulic Oil Tank	Approx. 124 gallons (469 liters)
Hydraulic System	Approx. 150 gallons (568 liters)
Drive - 90 ounces (2.7 liters)	Drive - 90 ounces (2.7 liters)
Swing - 60 ounces (1.8 liters)	Swing - 60 ounces (1.8 liters)
Engine Crankcase	10.0 quarts (9.5 liters) w/o filter
Cooling System System Engine Radiator	 21.4 quarts (20.2 liters) 7.4 quarts (7.0 liters) 14.0 quarts (13.2 liters)
*Torque hubs should be one half full of lubricant.	

1.2 ENGINE DATA

Table 1-2. Engine Datas

Model	Cummins 4B3.9C
Low RPM	1800
High RPM	2500
Alternator	60 Amp, belt driven
Battery	85 Amphour, 550 CCA, 12 volts
Horsepower	76 @ 2500 RPM, no load

1.3 DRIVE/STEER SYSTEM

Table 1-3. Drive Steer System

Drive Hub	Gear Ratio - 93.7:1
Drive Brake	Automatic spring applied, hydraulically released. Release pressure 150 psi (10.3 Bar) initial, 170 psi (11.7 Bar) full.
Tires	Size - 445/65R22.5, foam-filled

1.4 PERFORMANCE DATA

Table 1-4. Performance Data

Maximum Drive Speed	2.7 mph (4.3 kph) @ Max RPM
Maximum Travel Grade (Gradeability)	31%
Turning Radius (Outside)	24 ft. 2 in. (7.4 meters) w/axles retracted 27 ft. 2 in. (8.3 meters) w/axles extended
Gross Machine Weight	57,000 lbs. (25,855 kg)
Length Stowed	39 ft. 5 in. (12.0 meters) w/main boom fully retracted and platform in normal position. 41 ft. 7 in. (12.7 meters) w/main boom telescoped out and platform tilted to stow at minimum height.
Machine Width	11 ft. 6 in. (3.5 meters) w/axles retracted 18 ft. 0 in. (5.5 meters) w/axles extended
Wheelbase	18 ft. 0 in. (5.5 meters)
Platform Capacity	500 lb. (230 kg) unrestricted 1000 lb. (450 kg) restricted

1.5 FUNCTION SPEEDS

Table 1-5. Function Speeds

Function	Speed - In Seconds
Lift Up	115-190
Lift Down	140-160
Tower Lift Up	89-103
Tower Telescope Out	125-160
Tower Telescope In	65-90
Tower Lift Down	61-83
Swing Right & Left	72-84
Telescope Out	46-50
Telescope In	46-50
Platform Rotate Left & Right	24-26
Jib Up	25-27
Jib Down	21-23
High Drive (200 ft.)	42-46 (3.0 mph)
Drive above Horizontal (50 ft.)	65-71 (0.5 mph)

1.6 LUBRICATION

Table 1-6.Hydraulic Oil

Hydraulic System Operating Temperature Range	SAE Viscosity Grade
0° to +23° F(-18° to -5° C)	10W
0° to +210° F(-18° to +100° C)	10W-20, 10W-30
+50° to +210° F(+10° 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 Mobilfluid 424 hydraulic oil, which has an SAE viscosity index of 152 .*

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

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

Table 1-7. Mobilfluid 424 Specs

SAE Grade	10W30
Gravity, API	29.0
Density, Lb/Gal. 60°F	7.35
Pour Point, Max	-46°F (-43°C)
Flash Point, Min.	442°F (228°C)
Viscosity	
Brookfield, cP at -18°C	2700
at 40° C	55 cSt
at 100° C	9.3 cSt
Viscosity Index	152

Table 1-8. Mobil EAL 224 H Specs

Type	Biodegradable Vegetable Oil
ISO Viscosity Grade	32/46
Specific Gravity	.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min.	428°F (220°C)
Weight	7.64 lb. per gal. (0.9 kg per liter)
Viscosity	
at 104° F (40° C)	37 cSt
at 212° F (100° C)	8.4 cSt
Viscosity Index	213
Operating Temp	0-180° F (-17 - -162°C)
Note: Must be stored above 32° F (14° C)	

Table 1-9. Mobil DTE 13M Specs

ISO Viscosity Grade	#32
Specific Gravity	0.877
Pour Point, Max	-40°F (-40°C)
Flash Point, Min.	330°F (166°C)
Viscosity	
at 40° C	33cSt
at 100° C	6.6 cSt
at 100° F	169 SUS
at 210° F	48 SUS
cp at -20° F	6,200
Viscosity Index	140

Table 1-10. Exxon Univis HVI 26 Specs

Specific Gravity	32.1
Pour Point	-76°F (-60°C)
Flash Point	217°F (103°C)
Viscosity	
at 40° C	25.8 cSt
at 100° C	9.3 cSt
Viscosity Index	376
NOTE: *Mobil/Exxon recommends that this oil be checked on a yearly basis for viscosity.*	

1.7 TORQUE REQUIREMENTS

Table 1-11. Torque Requirements

Description	Torque Value (Dry)	Interval Hours
Bearing To Chassis	545 ft. lbs. (740 Nm)	50/600*
Bearing To Turntable	545 ft. lbs. (740 Nm)	50/600*
Wheel Lugs	300 ft. lbs. (407 Nm)	150
Drive Torque Hub to Spindle	260 ft. lbs. (353 Nm)	200
Main Boom Chains	50 ft. lbs. (68 Nm)	200
Swing Motor to Swing Brake	110 ft. lbs. (149 Nm)	500
Torque Hub to Turntable Mounting Plate	340 ft. lbs. (461 Nm)	500
Platform Rotator Brake Bolt	140 ft. lbs. (190 Nm)	500
*Check swing bearing bolts for security after first 50 hours of operation and every 600 hours thereafter. (See Swing Bearing in Section 2)		
NOTE: *When maintenance becomes necessary or a fastener has loosened, refer to the Torque Chart to determine proper torque value.*		

1.8 PRESSURE SETTINGS - PSI (BAR)

Table 1-12. Pressure Settings - 5 Spool Proportional Valve

	PSI	BAR
5 Spool Proportional Valve		
Main Relief	3800	262
Main Tele Out Relief	2000	138
Main Tele In Relief	3300	228
Main Lift Up Relief	3000	207
Main Lift Down Relief	1850	128
Tower Tele Out Relief	3000	207
Tower Tele In Relief	2600	179
Tower Lift Up Relief	3700	255
Tower Lift Down Relief	3000	207
Swing Relief	1700	117
2 Spool Solenoid Valve		
Main Relief	2750	190
Rotate Relief	2500	172
Level Reliefs	2500	172
3 Spool Solenoid Valve		
Steer Reliefs	2000	138
4 Spool Solenoid Valve		
Extension Cylinder Reliefs	2000	138
Low Drive System		
Sequence Valve	450	31
Main Relief on External Relief Valve	3200	221
Proportional Drive Valve Section Relief - Factory set, does not normally need to be adjusted	3200	221

1.9 MAJOR COMPONENT WEIGHTS

Table 1-13. Major Component Weights

	LB.	KG.
36 x 96 Platform	420	191
Platform Level Cylinder	80	36
Main Boom	6350	2880
Main Lift Cylinder	830	377
Master Level Cylinder (each)	60	27
Tower Boom	14700	6668
Tower Lift Cylinder	1100	499
Turntable Complete (includes swing bearing)	14200	6441
Frame Complete	19200	8709
Complete Machine	57000	25855

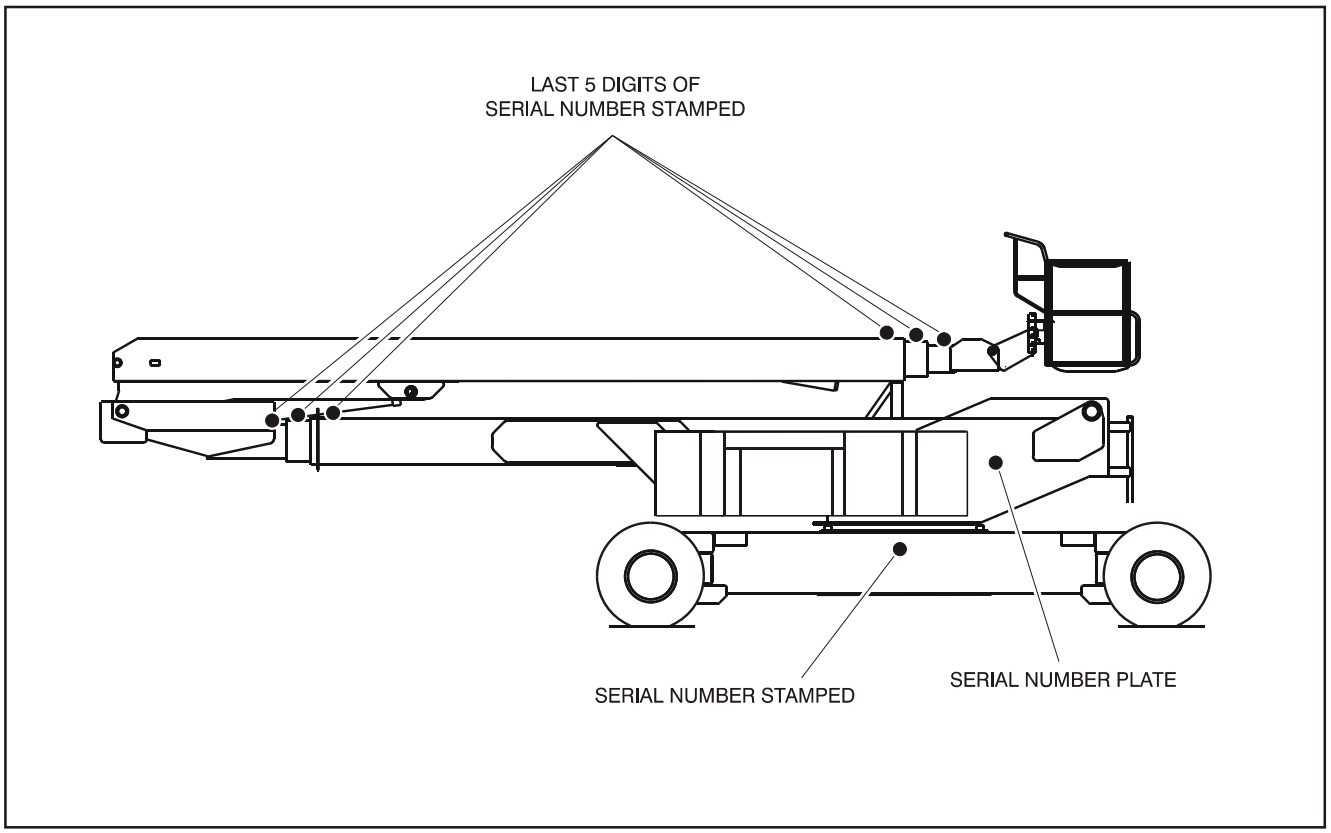
1.10 CRITICAL STABILITY WEIGHTS

Table 1-14. Critical Stability Weights

	LB.	KG.
Counterweight	3285	1490
Tire & Wheel Assembly	1020	494
Engine	680	308
8 ft. Platform	295	134

1.11 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 turntable, just behind the fuel tank. If the serial number plate is missing, the machine serial number is stamped on the left side of the frame, below the turntable bearing. In addition, the last five digits of the serial number are stamped on the top of the fly end of each of the tower boom and main boom sections.



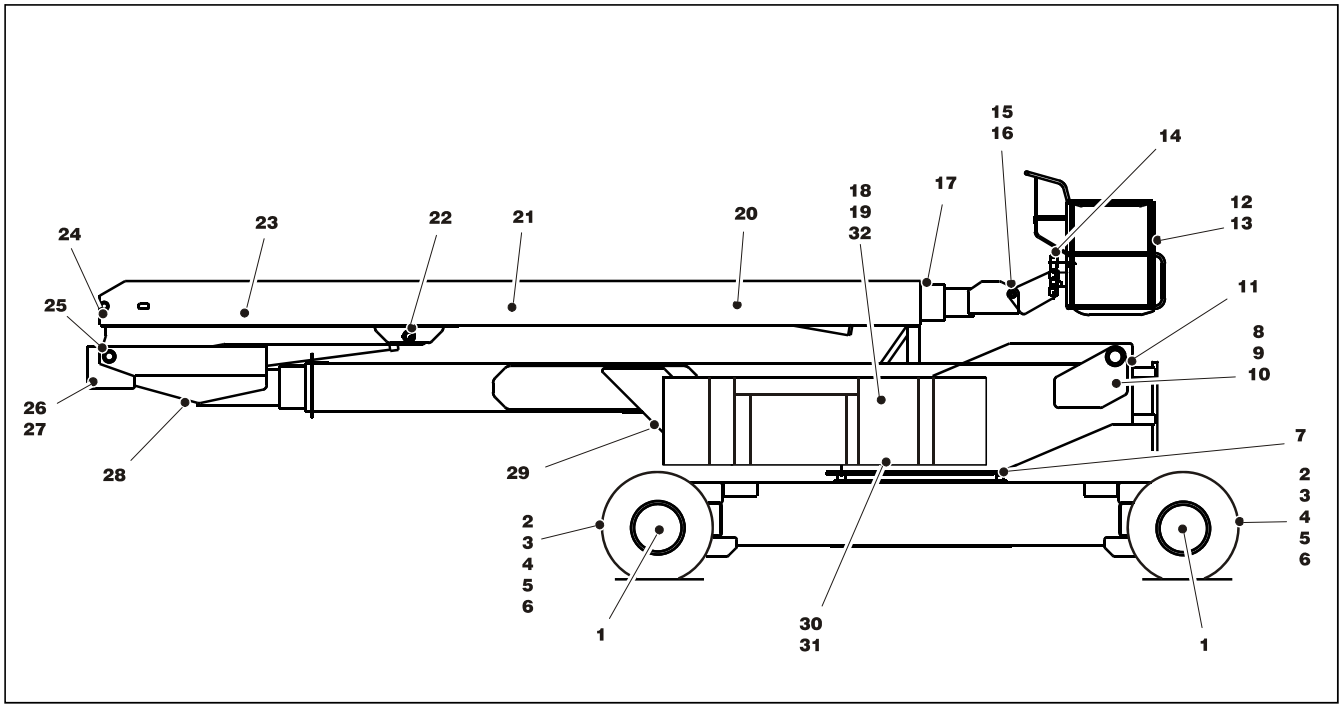


Figure 1-1. Operator Maintenance & Lubrication Diagram

1.12 OPERATOR MAINTENANCE

NOTE: *The following numbers correspond to those in Figure 1-1., Operator Maintenance & Lubrication Diagram.*

NOTE: *The lubrication intervals in Figure 1-1., Operator Maintenance & Lubrication Diagram are equivalent to the following:*

150 hours = 3 months
300 hours = 6 months
600 hours = 1 year
1200 hours = 2 years

Table 1-15. Lubrication Specifications

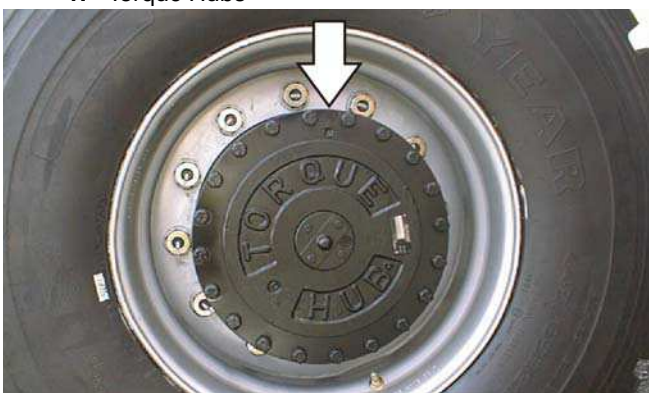
KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F (177° C). Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobilfluid 424.
EO	Engine (crankcase) Oil. Gas - API SF, SH, SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

NOTICE

LUBRICATION INTERVALS ARE BASED ON MACHINE OPERATION UNDER NORMAL CONDITIONS. FOR MACHINES USED IN MULTI-SHIFT OPERATIONS AND/OR EXPOSED TO HOSTILE ENVIRONMENTS OR CONDITIONS, LUBRICATION FREQUENCIES MUST BE INCREASED ACCORDINGLY.

NOTE: *It is recommended as a good practice to replace all filters at the same time.*

1. Torque Hubs

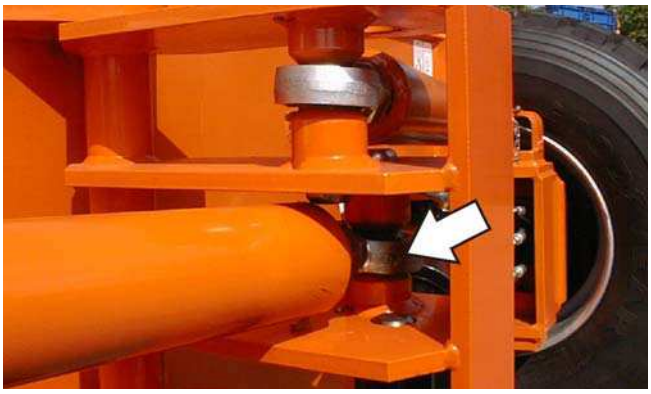


Lube Point(s) - 1 Fill Plug per hub
Capacity -
Lube - EPGL
Interval - Check oil level at side plug on hub weekly. Change after first 3 months or 150 hours then every 2 years or 1200 hours of operation.
Comments - Place Fill port at 12 o'clock position and pour lubricant into fill port until it just starts to flow out of check port when it's at the 3 o'clock position.

2. Steer Spindles

Lube Point(s) - 4 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

3. Tie Rod Center Pivot Links



Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

4. Steer Cylinder Barrel Ends

Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

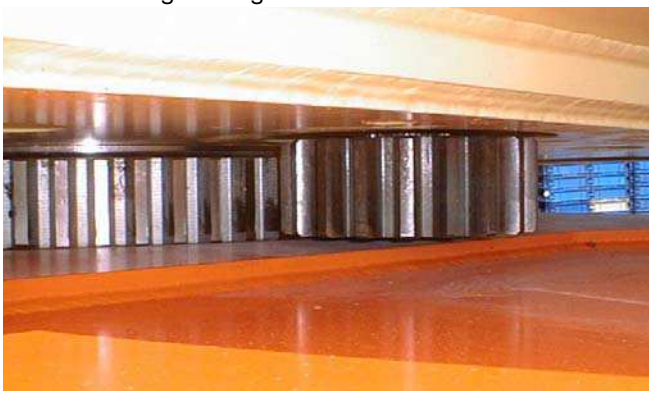
5. Steer Cylinder Rod Ends

Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

6. Extending Axles

Lube Point(s) - N/A
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply by brush

7. Swing Bearing Gear

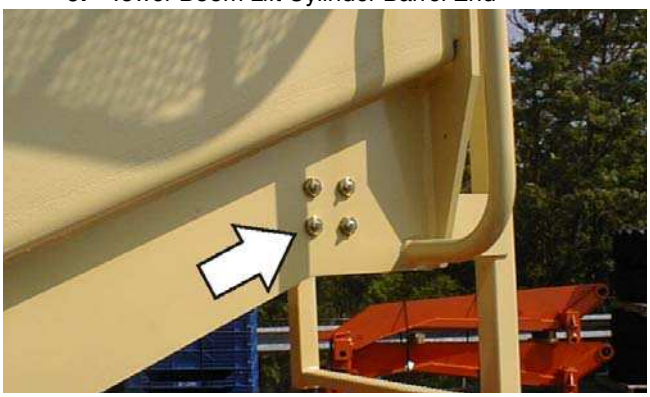


Lube Point(s) - N/A
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Apply by brush

8. Lower Master Cylinder Barrel End

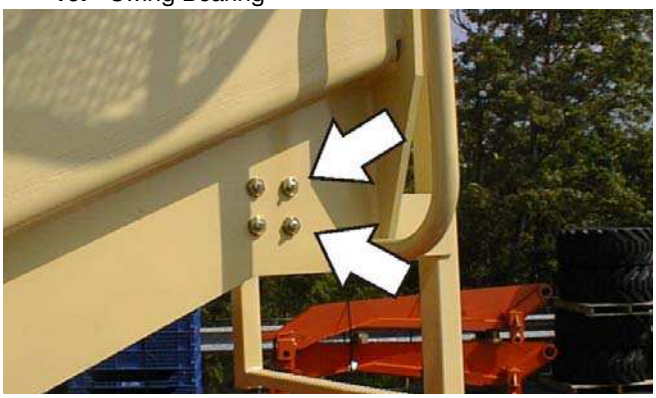
Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Fitting on Left Rear of Turntable

9. Tower Boom Lift Cylinder Barrel End



Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Fitting on Left Rear of Turntable

10. Swing Bearing



Lube Point(s) - 2 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Remote Fitting on Left Rear of Turntable

11. Lower Master Cylinder Rod End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments -

12. Platform Hinges

Lube Point(s) - 2 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

13. Platform Door Latch

Lube Point(s) - N/A
Capacity - A/R
Lube - EO
Interval - Every 3 months or 150 hrs of operation

14. Platform Rotate Pivot/Rotator Worm Gear

Lube Point(s) - 2 Grease Fittings on pivot; 1 Grease Fitting on worm gear
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

15. Platform Level Links

Lube Point(s) - 3 Grease Fittings
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

16. Level Cylinder Rod End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

17. Level Cylinder Barrel End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

18. Engine Crankcase

Lube Point(s) - Fill Cap/Drain Plug
Capacity - 10 quarts (9.5 L) w/o filter
Lube - EO
Comments - Check daily. Refer to Engine Manual for Change interval.

19. Engine Oil Filter

Lube Point(s) - N/A
Lube - EO
Comments - Refer to Engine Manual for Change interval.

20. Main Boom Chains

Lube Point(s) - N/A
Capacity - N/A
Lube - Chain Lube
Interval - Every 2 years or 1200 hours of operation.

21. Main Boom Extend Chain Sheave

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Align access holes in mid and fly boom

22. Main Boom Lift Cylinder

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

23. Main Boom Retract Chain Sheave

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments - Align with access hole in base boom.

24. Main Boom Pivot Pin

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

25. Tower Boom Pivot Pin

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation

26. Level Links

Lube Point(s) - 3 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments -

27. Upper Master Cylinder Rod End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments -

28. Upper Master Cylinder Barrel End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments -

29. Tower Boom Lift Cylinder Rod End

Lube Point(s) - 1 Grease Fitting
Capacity - A/R
Lube - MPG
Interval - Every 3 months or 150 hrs of operation
Comments -

30. Hydraulic Oil

Lube Point(s) - Fill Cap/Drain Plug
Capacity - A/R
Lube - HO
Interval - Check daily. Change every 2 years or 1200 hours
Comments - On new machines, those recently overhauled, or after changing hydraulic oil, operate all systems a minimum of two complete cycles and recheck oil level in reservoir.

31. Hydraulic Filter

Interval - Replace filter after first 50 hours of operation, then every 6 months or 300 hours thereafter.

32. Air Filter

Lube Point(s) - Replaceable Element
Interval - Every 6 months or 300 hours of operation or as indicated by the condition indicator

Values for Zinc Yellow Chromate Fasteners (Ref 4150707)												
SAE GRADE 5 BOLTS & GRADE 2 NUTS												
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry)		Torque Lubricated		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)		Torque (Loctite® 262™ or Vibra-TITE™ 131)	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604	380	8	0.9	6	0.7				
	48	0.1120	0.00661	420	9	1.0	7	0.8				
6	32	0.1380	0.00909	580	16	1.8	12	1.4				
	40	0.1380	0.01015	610	18	2.0	13	1.5				
8	32	0.1640	0.01400	900	30	3.4	22	2.5				
	36	0.1640	0.01474	940	31	3.5	23	2.6				
10	24	0.1900	0.01750	1120	43	4.8	32	3.5				
	32	0.1900	0.02000	1285	49	5.5	36	4				
1/4	20	0.2500	0.0318	2020	96	10.8	75	9	105	12		
	28	0.2500	0.0364	2320	120	13.5	86	10	135	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	3340	17	23	13	18	19	26	16	22
	24	0.3125	0.0580	3700	19	26	14	19	21	29	17	23
3/8	16	0.3750	0.0775	4940	30	41	23	31	35	48	28	38
	24	0.3750	0.0878	5600	35	47	25	34	40	54	32	43
7/16	14	0.4375	0.1063	6800	50	68	35	47	55	75	45	61
	20	0.4375	0.1187	7550	55	75	40	54	60	82	50	68
1/2	13	0.5000	0.1419	9050	75	102	55	75	85	116	68	92
	20	0.5000	0.1599	10700	90	122	65	88	100	136	80	108
9/16	12	0.5625	0.1820	11600	110	149	80	108	120	163	98	133
	18	0.5625	0.2030	12950	120	163	90	122	135	184	109	148
5/8	11	0.6250	0.2260	14400	150	203	110	149	165	224	135	183
	18	0.6250	0.2560	16300	170	230	130	176	190	258	153	207
3/4	10	0.7500	0.3340	21300	260	353	200	271	285	388	240	325
	16	0.7500	0.3730	23800	300	407	220	298	330	449	268	363
7/8	9	0.8750	0.4620	29400	430	583	320	434	475	646	386	523
	14	0.8750	0.5090	32400	470	637	350	475	520	707	425	576
1	8	1.0000	0.6060	38600	640	868	480	651	675	918	579	785
	12	1.0000	0.6630	42200	700	949	530	719	735	1000	633	858
1 1/8	7	1.1250	0.7630	42300	800	1085	600	813	840	1142	714	968
	12	1.1250	0.8560	47500	880	1193	660	895	925	1258	802	1087
1 1/4	7	1.2500	0.9690	53800	1120	1518	840	1139	1175	1598	1009	1368
	12	1.2500	1.0730	59600	1240	1681	920	1247	1300	1768	1118	1516
1 3/8	6	1.3750	1.1550	64100	1460	1979	1100	1491	1525	2074	1322	1792
	12	1.3750	1.3150	73000	1680	2278	1260	1708	1750	2380	1506	2042
1 1/2	6	1.5000	1.4050	78000	1940	2630	1460	1979	2025	2754	1755	2379
	12	1.5000	1.5800	87700	2200	2983	1640	2224	2300	3128	1974	2676

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

	REFERENCE JLG ANEROBIC THREAD LOCKING COMPOUND			
JLG P/N	Loctite® P/N		ND Industries P/N	Description
0100011	242™		Vibra-TITE™ 121	Medium Strength (Blue)
0100019	271™		Vibra-TITE™ 140	High Strength (Red)
0100071	262™		Vibra-TITE™ 131	Medium - High Strength (Red)

Figure 1-2. Torque Chart (SAE Fasteners - Sheet 1 of 7)

				Values for Zinc Yellow Chromate Fasteners (Ref 4150707)						
				SAE GRADE 8 (HEX HD) BOLTS & GRADE 8 NUTS*						
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263) K= 0.20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K=.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474	1320	43	5				
10	24	0.1900	0.01750	1580	60	7				
	32	0.1900	0.02000	1800	68	8				
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	770	1045	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
3. * ASSEMBLY USES HARDENED WASHER

Figure 1-3. Torque Chart (SAE Fasteners - Sheet 2 of 7)

SOCKET HEAD CAP SCREWS										
Magni Coating (Ref 4150701)*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .17		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85® K=0.16		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	122	14	114	13		
	28	0.2500	0.0364	3280	139	16	131	15		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	20	25	20	25	20	25
	24	0.3125	0.0580	5220	25	35	20	25	20	25
3/8	16	0.3750	0.0775	7000	35	50	35	50	35	50
	24	0.3750	0.0878	7900	40	55	40	55	35	50
7/16	14	0.4375	0.1063	9550	60	80	55	75	50	70
	20	0.4375	0.1187	10700	65	90	60	80	60	80
1/2	13	0.5000	0.1419	12750	90	120	85	115	80	110
	20	0.5000	0.1599	14400	100	135	95	130	90	120
9/16	12	0.5625	0.1820	16400	130	175	125	170	115	155
	18	0.5625	0.2030	18250	145	195	135	185	130	175
5/8	11	0.6250	0.2260	20350	180	245	170	230	160	220
	18	0.6250	0.2560	23000	205	280	190	260	180	245
3/4	10	0.7500	0.3340	30100	320	435	300	410	280	380
	16	0.7500	0.3730	33600	355	485	335	455	315	430
7/8	9	0.8750	0.4620	41600	515	700	485	660	455	620
	14	0.8750	0.5090	45800	570	775	535	730	500	680
1	8	1.0000	0.6060	51500	730	995	685	930	645	875
	12	1.0000	0.6630	59700	845	1150	795	1080	745	1015
1 1/8	7	1.1250	0.7630	68700	1095	1490	1030	1400	965	1310
	12	1.1250	0.8560	77000	1225	1665	1155	1570	1085	1475
1 1/4	7	1.2500	0.9690	87200	1545	2100	1455	1980	1365	1855
	12	1.2500	1.0730	96600	1710	2325	1610	2190	1510	2055
1 3/8	6	1.3750	1.1550	104000	2025	2755	1905	2590	1785	2430
	12	1.3750	1.3150	118100	2300	3130	2165	2945	2030	2760
1 1/2	6	1.5000	1.4050	126500	2690	3660	2530	3440	2370	3225
	12	1.5000	1.5800	142200	3020	4105	2845	3870	2665	3625

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-4. Torque Chart (SAE Fasteners - Sheet 3 of 7)

SOCKET HEAD CAP SCREWS										
Zinc Yellow Chromate Fasteners (Ref 4150707)*										
Size	TPI	Bolt Dia	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry) K = .20		Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140 OR Precoat 85® K=0.18		Torque (Loctite® 262™ or Vibra-TITE™ 131) K=0.15	
		In	Sq In	LB	IN-LB	[N.m]	IN-LB	[N.m]	IN-LB	[N.m]
4	40	0.1120	0.00604							
	48	0.1120	0.00661							
6	32	0.1380	0.00909							
	40	0.1380	0.01015							
8	32	0.1640	0.01400							
	36	0.1640	0.01474							
10	24	0.1900	0.01750							
	32	0.1900	0.02000							
1/4	20	0.2500	0.0318	2860	143	16	129	15		
	28	0.2500	0.0364	3280	164	19	148	17		
		In	Sq In	LB	FT-LB	[N.m]	FT-LB	[N.m]	FT-LB	[N.m]
5/16	18	0.3125	0.0524	4720	25	35	20	25	20	25
	24	0.3125	0.0580	5220	25	35	25	35	20	25
3/8	16	0.3750	0.0775	7000	45	60	40	55	35	50
	24	0.3750	0.0878	7900	50	70	45	60	35	50
7/16	14	0.4375	0.1063	9550	70	95	65	90	50	70
	20	0.4375	0.1187	10700	80	110	70	95	60	80
1/2	13	0.5000	0.1419	12750	105	145	95	130	80	110
	20	0.5000	0.1599	14400	120	165	110	150	90	120
9/16	12	0.5625	0.1820	16400	155	210	140	190	115	155
	18	0.5625	0.2030	18250	170	230	155	210	130	175
5/8	11	0.6250	0.2260	20350	210	285	190	260	160	220
	18	0.6250	0.2560	23000	240	325	215	290	180	245
3/4	10	0.7500	0.3340	30100	375	510	340	460	280	380
	16	0.7500	0.3730	33600	420	570	380	515	315	430
7/8	9	0.8750	0.4620	41600	605	825	545	740	455	620
	14	0.8750	0.5090	45800	670	910	600	815	500	680
1	8	1.0000	0.6060	51500	860	1170	775	1055	645	875
	12	1.0000	0.6630	59700	995	1355	895	1215	745	1015
1 1/8	7	1.1250	0.7630	68700	1290	1755	1160	1580	965	1310
	12	1.1250	0.8560	77000	1445	1965	1300	1770	1085	1475
1 1/4	7	1.2500	0.9690	87200	1815	2470	1635	2225	1365	1855
	12	1.2500	1.0730	96600	2015	2740	1810	2460	1510	2055
1 3/8	6	1.3750	1.1550	104000	2385	3245	2145	2915	1785	2430
	12	1.3750	1.3150	118100	2705	3680	2435	3310	2030	2760
1 1/2	6	1.5000	1.4050	126500	3165	4305	2845	3870	2370	3225
	12	1.5000	1.5800	142200	3555	4835	3200	4350	2665	3625

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-5. Torque Chart (SAE Fasteners - Sheet 4 of 7)

			Values for Zinc Yellow Chromate Fasteners (Ref 4150707				
			CLASS 8.8 METRIC BOLTS CLASS 8 METRIC NUTS				
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™)	Torque (Lub)	Torque (Loctite® 262™ OR Vibra-TITE™ 131)	Torque (Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140)
		Sq mm	KN	[N.m]	[N.m]	[N.m]	[N.m]
3	0.5	5.03	2.19	1.3	1.0	1.2	1.4
3.5	0.6	6.78	2.95	2.1	1.6	1.9	2.3
4	0.7	8.78	3.82	3.1	2.3	2.8	3.4
5	0.8	14.20	6.18	6.2	4.6	5.6	6.8
6	1	20.10	8.74	11	7.9	9.4	12
7	1	28.90	12.6	18	13	16	19
8	1.25	36.60	15.9	26	19	23	28
10	1.5	58.00	25.2	50	38	45	55
12	1.75	84.30	36.7	88	66	79	97
14	2	115	50.0	140	105	126	154
16	2	157	68.3	219	164	197	241
18	2.5	192	83.5	301	226	271	331
20	2.5	245	106.5	426	320	383	469
22	2.5	303	132.0	581	436	523	639
24	3	353	153.5	737	553	663	811
27	3	459	199.5	1080	810	970	1130
30	3.5	561	244.0	1460	1100	1320	1530
33	3.5	694	302.0	1990	1490	1790	2090
36	4	817	355.5	2560	1920	2300	2690
42	4.5	1120	487.0	4090	3070	3680	4290

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-6. Torque Chart (METRIC Fasteners - Sheet 5 of 7)

			Values for Zinc Yellow Chromate Fasteners (Ref 4150707) CLASS 10.9 METRIC BOLTS CLASS 10 METRIC NUTS CLASS 12.9 SOCKET HEAD CAP SCREWS M3 - M5*			
Size	PITCH	Tensile Stress Area	Clamp Load	Torque (Dry or Loctite® 263™) K = 0.20	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K= 0.18	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K=0.15
		Sq mm	KN	[N.m]	[N.m]	[N.m]
3	0.5	5.03	3.13			
3.5	0.6	6.78	4.22			
4	0.7	8.78	5.47			
5	0.8	14.20	8.85			
6	1	20.10	12.5			
7	1	28.90	18.0	25.2	22.7	18.9
8	1.25	36.60	22.8	36.5	32.8	27.4
10	1.5	58.00	36.1	70	65	55
12	1.75	84.30	52.5	125	115	95
14	2	115	71.6	200	180	150
16	2	157	97.8	315	280	235
18	2.5	192	119.5	430	385	325
20	2.5	245	152.5	610	550	460
22	2.5	303	189.0	830	750	625
24	3	353	222.0	1065	960	800
27	3	459	286.0	1545	1390	1160
30	3.5	561	349.5	2095	1885	1575
33	3.5	694	432.5	2855	2570	2140
36	4	817	509.0	3665	3300	2750
42	4.5	1120	698.0	5865	5275	4395

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-7. Torque Chart (METRIC Fasteners - Sheet 6 of 7)

			Magni Coating (Ref 4150701)*			
			CLASS 12.9 SOCKET HEAD CAP SCREWS M6 AND ABOVE*			
Size	PITCH	Tensile Stress Area	Clamp Load See Note 4	Torque (Dry or Loctite® 263™) K = .17	Torque (Lub OR Loctite® 242™ or 271™ OR Vibra-TITE™ 111 or 140) K = .16	Torque (Loctite® 262™ OR Vibra-TITE™ 131) K = .15
		Sq mm	kN	[N.m]	[N.m]	[N.m]
3	0.5	5.03				
3.5	0.6	6.78				
4	0.7	8.78				
5	0.8	14.20				
6	1	20.10	12.5	13	12	11
7	1	28.90	18.0	21	20	19
8	1.25	36.60	22.8	31	29	27
10	1.5	58.00	36.1	61	58	54
12	1.75	84.30	52.5	105	100	95
14	2	115	71.6	170	160	150
16	2	157	97.8	265	250	235
18	2.5	192	119.5	365	345	325
20	2.5	245	152.5	520	490	460
22	2.5	303	189.0	705	665	625
24	3	353	220.0	900	845	790
27	3	459	286.0	1315	1235	1160
30	3.5	561	349.5	1780	1680	1575
33	3.5	694	432.5	2425	2285	2140
36	4	817	509.0	3115	2930	2750
42	4.5	1120	698.0	4985	4690	4395

NO. 5000059 REV. J

NOTES: 1. THESE TORQUE VALUES DO NOT APPLY TO CADMIUM PLATED FASTENERS
2. ALL TORQUE VALUES ARE STATIC TORQUE MEASURED PER STANDARD AUDIT METHODS TOLERANCE = ±10%
*3. ASSEMBLY USES HARDENED WASHER OR FASTENER IS PLACED AGAINST PLATED STEEL OR RAW ALUMINUM
4. CLAMP LOAD LISTED FOR SHCS IS SAME AS GRADE 8 OR CLASS 10.9 AND DOES NOT REPRESENT FULL STRENGTH CAPABILITY OF SHCS. IF HIGHER LOAD IS REQUIRED, ADDITIONAL TESTING IS REQUIRED.

Figure 1-8. Torque Chart (METRIC Fasteners - Sheet 7 of 7)

NOTES:

SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

This section provides the necessary information needed by those personnel that are responsible to place the machine in operation readiness and maintain its safe operating condition. For maximum service life and safe operation, ensure that all the necessary inspections and maintenance have been completed before placing the machine into service.

Preparation, Inspection, and Maintenance

It is important to establish and conform to a comprehensive inspection and preventive maintenance program. The following table outlines the periodic machine inspections and maintenance recommended by JLG Industries, Inc. Consult your national, regional, or local regulations for further requirements for aerial work platforms. The frequency of inspections and maintenance must be increased as environment, severity and frequency of usage requires.

Pre-Start Inspection

It is the User's or Operator's primary responsibility to perform a Pre-Start Inspection of the machine prior to use daily or at each change of operator. Reference the Operator's and Safety Manual for completion procedures for the Pre-Start Inspection. The Operator and Safety Manual must be read in its entirety and understood prior to performing the Pre-Start Inspection.

Pre-Delivery Inspection and Frequent Inspection

The Pre-Delivery Inspection and Frequent Inspection shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

The Pre-Delivery Inspection and Frequent Inspection procedures are performed in the same manner, but at different times. The Pre-Delivery Inspection shall be performed prior to each sale, lease, or rental delivery. The Frequent Inspection shall be accomplished for each machine in service for 3 months or 150 hours (whichever comes first); out of service for a period of more than 3 months; or when purchased used. The frequency of this inspection must be increased as environment, severity and frequency of usage requires.

Reference the JLG Pre-Delivery and Frequent Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of these inspections. Reference the appropriate areas of this manual for servicing and maintenance procedures.

Annual Machine Inspection

The Annual Machine Inspection must be performed by a Factory-Trained Service Technician on an annual basis, no later than thirteen (13) months from the date of the prior Annual Machine Inspection. JLG Industries, Inc. recognizes a Factory-Trained Service Technician as a person who has successfully completed the JLG Service Training School for the subject JLG product model. Reference the machine Service and Maintenance Manual and appropriate JLG inspection form for performance of this inspection.

Reference the JLG Annual Machine Inspection Form and the Inspection and Preventative Maintenance Schedule for items requiring inspection during the performance of this inspection. Reference the appropriate areas of this manual for servicing and maintenance procedures.

For the purpose of receiving safety-related bulletins, it is important that JLG Industries, Inc. has updated ownership information for each machine. When performing each Annual Machine Inspection, notify JLG Industries, Inc. of the current machine ownership.

Preventative Maintenance

In conjunction with the specified inspections, maintenance shall be performed by a qualified JLG equipment mechanic. JLG Industries, Inc. recognizes a qualified JLG equipment mechanic as a person who, by possession of a recognized degree, certificate, extensive knowledge, training, or experience, has successfully demonstrated the ability and proficiency to service, repair, and maintain the subject JLG product model.

Reference the Preventative Maintenance Schedule and the appropriate areas of this manual for servicing and maintenance procedures. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.

Table 2-1. Inspection and Maintenance

Type	Frequency	Primary Responsibility	Service Qualification	Reference
Pre-Start Inspection	Prior to use each day; or At each Operator change.	User or Operator	User or Operator	Operator and Safety Manual
Pre-Delivery Inspection	Prior to each sale, lease, or rental delivery.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Frequent Inspection	In service for 3 months or 150 hours, whichever comes first; or Out of service for a period of more than 3 months; or Purchased used.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual and applicable JLG inspection form.
Annual Machine Inspection	Annually, no later than 13 months from the date of the prior inspection.	Owner, Dealer, or User	Factory-Trained Service Technician	Service and Maintenance Manual and applicable JLG inspection form.
Preventative Maintenance	At intervals as specified in the Service and Maintenance Manual.	Owner, Dealer, or User	Qualified JLG Mechanic	Service and Maintenance Manual

2.2 SERVICE AND GUIDELINES

General

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

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 Torque Chart Section 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 the Lubrication Chart in Section 1.

2.3 LUBRICATION AND 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 speci-

fied intervals required in the Lubrication Chart in Section 1. Always examine filters for evidence of metal particles.

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

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

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

Hydraulic Oil

1. Refer to Section 1 for recommendations for viscosity ranges.

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

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 13 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 13 oil should not be operated at temperatures above 200 degrees F (94 degrees C) under any condition.

Changing Hydraulic Oil

1. Filter elements must be changed after the first 50 hours of operation and every 300 hours (unless specified otherwise) 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 Section 1 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2.4 CYLINDER DRIFT TEST

Maximum acceptable cylinder drift is to be measured using the following methods.

Platform Drift

Measure the drift of the platform to the ground. Lower booms (if equipped) slightly elevated, main boom fully extended with the rated load in the platform and power off. Maximum allowable drift is 2 inches (5 cm) in 10 minutes. If the machine does not pass this test, proceed with the following.

Cylinder Drift

Table 2-2. Cylinder Drift

Cylinder Bore Diameter		Max. Acceptable Drift in 10 Minutes	
inches	mm	inches	mm
3	76.2	0.026	0.66
3.5	89	0.019	0.48
4	101.6	0.015	0.38
5	127	0.009	0.22
6	152.4	0.006	0.15
7	177.8	0.005	0.13
8	203.2	0.0038	0.10
9	228.6	0.0030	0.08

Drift is to be measured at the cylinder rod with a calibrated dial indicator. The cylinder oil must be at ambient temperature and temperature stabilized.

The cylinder must have the normal load, which is the normal platform load applied.

If the cylinder passes this test, it is acceptable.

NOTE: *This information is based on 6 drops per minute cylinder leakage.*

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

1. Pinned joints should be disassembled and inspected if the following occurs:
   - **a.** Excessive sloppiness in joints.
   - **b.** Noise originating from the joint during operation.
2. Filament wound bearings should be replaced if any of the following is observed:
   - **a.** Frayed or separated fibers on the liner surface.
   - **b.** Cracked or damaged liner backing.
   - **c.** Bearings that have moved or spun in their housing.
   - **d.** Debris embedded in liner surface.
3. Pins should be replaced if any of the following is observed (pin should be properly cleaned prior to inspection):
   - **a.** Detectable wear in the bearing area.
   - **b.** Flaking, pealing, scoring, or scratches on the pin surface.
   - **c.** Rusting of the pin in the bearing area.
4. Re-assembly of pinned joints using filament wound bearings.
   - **a.** Housing should be blown out to remove all dirt and debris...bearings and bearing housings must be free of all contamination.
   - **b.** Bearing / pins should be cleaned with a solvent to remove all grease and oil...filament wound bearing are a dry joint and should not be lubricated unless otherwise instructed (i.e. sheave pins).
   - **c.** Pins should be inspected to ensure it is free of burrs, nicks, and scratches which would damage the bearing during installation and operation.

2.6 WELDING ON JLG EQUIPMENT

NOTE: *This instruction applies to repairs, or modifications to the machine and to welding performed from the machine on an external structure, or component,*

Do the Following When Welding on JLG Equipment

- Disconnect the battery.
- Disconnect the moment pin connection (where fitted)
- Ground only to structure being welded.

Do NOT Do the Following When Welding on JLG Equipment

- Ground on frame and weld on any other area than the chassis.
- Ground on turntable and weld on any other area than the turntable.
- Ground on the platform/support and weld on any other area than the platform/support.
- Ground on a specific boom section and weld on any other area than that specific boom section.
- Allow pins, wear pads, wire ropes, bearings, gearing, seals, valves, electrical wiring, or hoses to be between the grounding position and the welded area.

NOTICE

FAILURE TO COMPLY WITH THE ABOVE REQUIREMENTS MAY RESULT IN COMPONENT DAMAGE (I.E. ELECTRONIC MODULES, SWING BEARING, COLLECTOR RING, BOOM WIRE ROPES ETC.)

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Boom Assembly	9					
Boom Weldments				1,2,4	1,2,4	
Hose/Cable Carrier Installations				1,2,9,12	1,2,9,12	
Pivot Pins and Pin Retainers				1,2	1,2	
Sheaves, Sheave Pins				1,2	1,2	
Bearings				1,2	1,2	
Wear Pads				1,2	1,2	
Covers or Shields				1,2	1,2	
Extend/Retract Chain or Cable Systems				1,2,3	1,2,3	
Platform Assembly	9					
Platform	1,2				1,2	
Railing	1,2			1	1,2	
Gate			5	1	1,5	
Floor	1,2			1	1,2	
Rotator		9,5		15		
Lanyard Anchorage Point	2			1,2,10	1,2,10	
Turntable Assembly	9					
Swing Bearing or Worm Gear				1,2,14	1,2,3,13,14	
Oil Coupling		9				
Swing Drive System				11	11	
Turntable Lock				1,2,5	1,2,5	
Hood, Hood Props, Hood Latches				5	1,2,5	
Chassis Assembly	9					
Tires	1	16,17		16,17,18	16,17,18	
Wheel Nuts/Bolts	1	15		15	15	
Wheel Bearings						14,24
Oscillating Axle/Lockout Cylinder Systems					5,8	
Outrigger or Extendable Axle Systems				5,8	5,8	
Steer Components						
Drive Motors						
Drive Hubs				11	11	24
Functions/Controls	9					
Platform Controls	5	5		6	6	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Ground Controls	5	5		6	6	
Function Control Locks, Guards, or Detents	1,5	1,5		5	5	
Footswitch	1,5			5	5	
Emergency Stop Switches (Ground & Platform)	5			5	5	
Function Limit or Cutout Switch Systems	5			5	5	
Capacity Indicator					5	
Drive Brakes				5		
Swing Brakes				5		
Boom Synchronization/Sequencing Systems					5	
Manual Descent or Auxiliary Power				5	5	
Power System	9					
Engine Idle, Throttle, and RPM				3	3	
Engine Fluids (Oil, Coolant, Fuel)	11	9,11		11	11	
Air/Fuel Filter		1,7		7	7	
Exhaust System			1,9	9	9	
Batteries	5	1,9			19	
Battery Fluid		11		11	11	
Battery Charger		5			5	
Fuel Reservoir, Cap, and Breather	11,9		2	1,5	1,5	
Hydraulic/Electric System	9					
Hydraulic Pumps		1,9		1,2,9		
Hydraulic Cylinders		1,9,7	2	1,2,9	1,2,9	
Cylinder Attachment Pins and Pin Retainers		1,9		1,2	1,2	
Hydraulic Hoses, Lines, and Fittings		1,9	12	1,2,9,12	1,2,9,12	
Hydraulic Reservoir, Cap, and Breather	11	1,9	2	1,5	1,5	24
Hydraulic Filter		1,9		7	7	
Hydraulic Fluid	11			7,11	7,11	
Electrical Connections		1		20	20	
Instruments, Gauges, Switches, Lights, Horn		1			5,23	
General						
Operators and Safety Manuals in Storage Box	21			21	21	
ANSI and AEM Manuals/Handbooks Installed					21	
Capacity Decals Installed, Secure, Legible	21			21	21	
All Decals/Placards Installed, Secure, Legible	21			21	21	

Table 2-3. Inspection and Preventive Maintenance Schedule

AREA	INTERVAL					
	Pre-Start[1] Inspection	Weekly Preventive Maintenance	Monthly Preventive Maintenance	Pre-Delivery[2] or Frequent[3] Inspection	Annual[4] (Yearly) Inspection	Every 2 Years
Walk-Around Inspection Performed	21					
Annual Machine Inspection Due				21		
No Unauthorized Modifications or Additions				21	21	
All Relevant Safety Publications Incorporated				21	21	
General Structural Condition and Welds				2,4	2,4	
All Fasteners, Pins, Shields, and Covers				1,2	1,2	
Grease and Lubricate to Specifications				22	22	
Function Test of All Systems	21			21	21, 22	
Paint and Appearance				7	7	
Stamp Inspection Date on Frame					22	
Notify JLG of Machine Ownership					22	

Footnotes:

[1] Prior to use each day; or at each Operator change

[2] Prior to each sale, lease, or delivery

[3] In service for 3 months or 150 Hours; or Out of service for 3 months or more; or Purchased used

[4] Annually, no later than 13 months from the date of the prior inspection

Performance Codes:

1 - Check for proper and secure installation
2 - Visual inspection for damage, cracks, distortion or excessive wear
3 - Check for proper adjustment
4 - Check for cracked or broken welds
5 - Operates Properly
6 - Returns to neutral or "off" position when released
7 - Clean and free of debris
8 - Interlocks function properly
9 - Check for signs of leakage
10 - Decals installed and legible
11 - Check for proper fluid level
12 - Check for chafing and proper routing
13 - Check for proper tolerances
14 - Properly lubricated
15 - Torqued to proper specification
16 - No gouges, excessive wear, or cords showing
17 - Properly inflated and seated around rim
18 - Proper and authorized components
19 - Fully charged
20 - No loose connections, corrosion, or abrasions
21 - Verify
22 - Perform
23 - Sealed Properly
24 - Drain, Clean, Refill

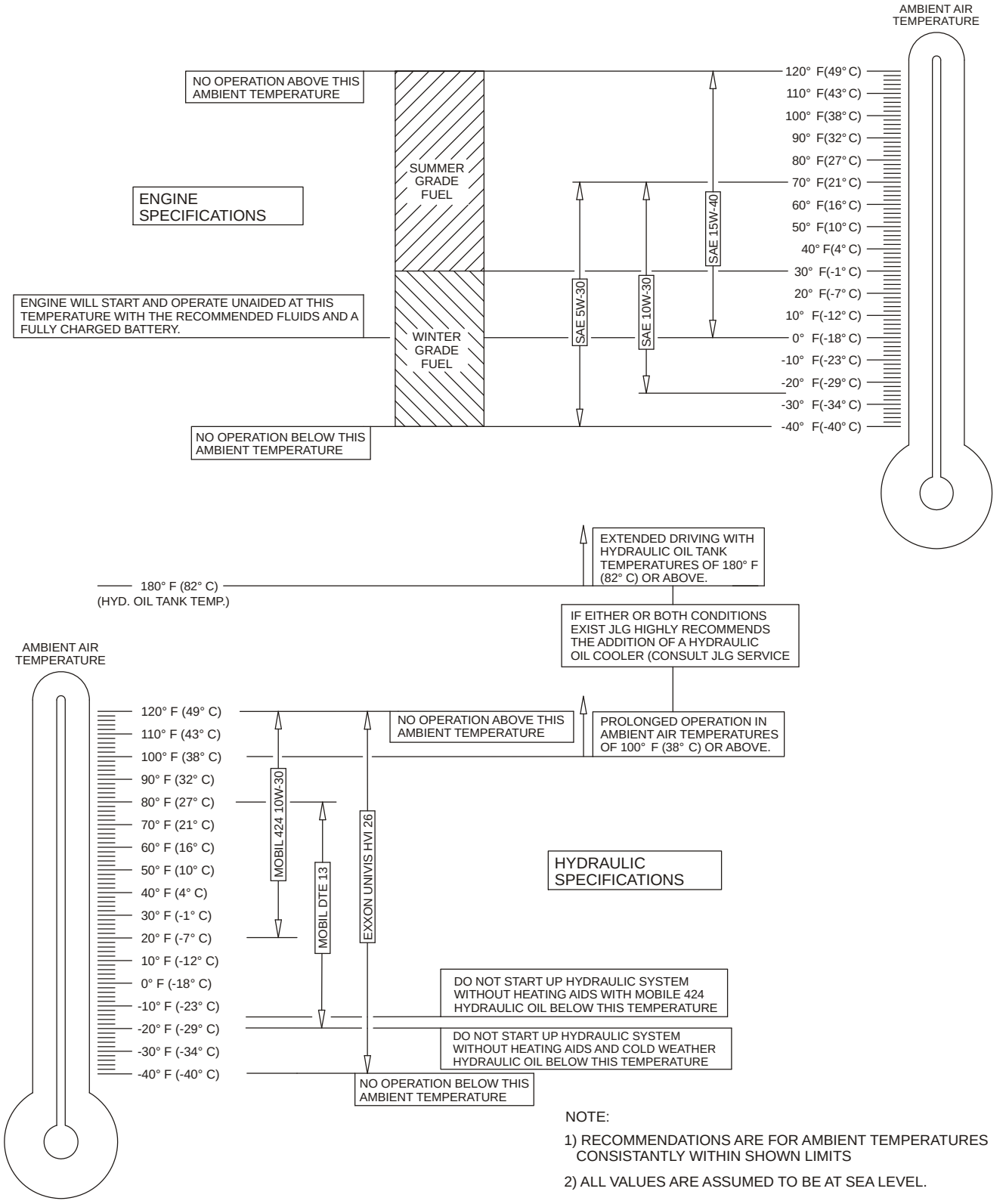


Figure 2-1. Engine Operating Temperature Specifications - Cummins

NOTES:

SECTION 3. CHASSIS & TURNTABLE

3.1 TIRES & WHEELS

Tire Inflation

The air pressure for pneumatic tires must be equal to the air pressure that is stenciled on the side of the JLG product or rim decal for safe and proper operational characteristics.

Tire Damage

For pneumatic tires, JLG Industries, Inc. recommends that when any cut, rip, or tear is discovered that exposes sidewall or tread area cords in the tire, measures must be taken to remove the JLG product from service immediately. Arrangements must be made for replacement of the tire or tire assembly.

For polyurethane foam filled tires, JLG Industries, Inc. recommends that when any of the following are discovered, measures must be taken to remove the JLG product from service immediately and arrangements must be made for replacement of the tire or tire assembly.

- a smooth, even cut through the cord plies which exceeds 3 inches (7.5 cm) in total length
- any tears or rips (ragged edges) in the cord plies which exceeds 1 inch (2.5 cm) in any direction
- any punctures which exceed 1 inch in diameter
- any damage to the bead area cords of the tire

If a tire is damaged but is within the above noted criteria, the tire must be inspected on a daily basis to insure the damage has not propagated beyond the allowable criteria.

Tire Replacement

JLG recommends a replacement tire be the same size, ply and brand as originally installed on the machine. Please refer to the JLG Parts Manual for the part number of the approved tires for a particular machine model. If not using a JLG approved replacement tire, we recommend that replacement tires have the following characteristics:

- Equal or greater ply/load rating and size of original
- Tire tread contact width equal or greater than original
- Wheel diameter, width, and offset dimensions equal to the original
- Approved for the application by the tire manufacturer (including inflation pressure and maximum tire load)

Unless specifically approved by JLG Industries Inc. do not replace a foam filled or ballast filled tire assembly with a pneumatic tire. When selecting and installing a replacement tire, ensure that all tires are inflated to the pressure recommended by JLG. Due to size variations between tire brands, both tires on the same axle should be the same.

Wheel Replacement

The rims installed on each product model have been designed for stability requirements which consist of track width, tire pressure, and load capacity. Size changes such as rim width, center piece location, larger or smaller diameter, etc., without written factory recommendations, may result in an unsafe condition regarding stability.

Wheel Installation

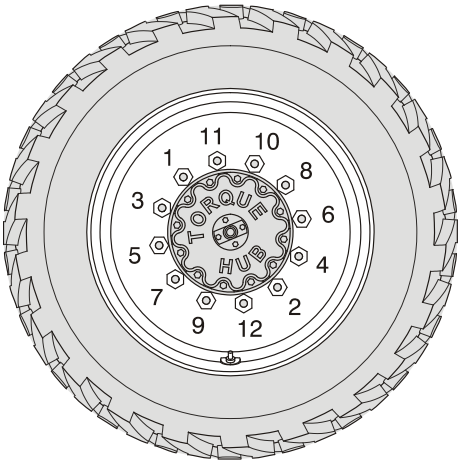
It is extremely important to apply and maintain proper wheel mounting torque.

⚠ WARNING

WHEEL NUTS MUST BE INSTALLED AND MAINTAINED AT THE PROPER TORQUE TO PREVENT LOOSE WHEELS, BROKEN STUDS, AND POSSIBLE DANGEROUS SEPARATION OF WHEEL FROM THE AXLE. BE SURE TO USE ONLY THE NUTS MATCHED TO THE CONE ANGLE OF THE WHEEL.

Tighten the lug nuts to the proper torque to prevent wheels from coming loose. Use a torque wrench to tighten the fasteners. If you do not have a torque wrench, tighten the fasteners with a lug wrench, then immediately have a service garage or dealer tighten the lug nuts to the proper torque. Over-tightening will result in breaking the studs or permanently deforming the mounting stud holes in the wheels. The proper procedure for attaching wheels is as follows:

1. Start all nuts by hand to prevent cross threading. DO NOT use a lubricant on threads or nuts.
2. Tighten nuts in the following sequence:



3. The tightening of the nuts should be done in stages. Following the recommended sequence, tighten nuts per wheel torque chart.

Table 3-1. Wheel Torque Chart

TORQUE SEQUENCE		
1st Stage	2nd Stage	3rd Stage
70 ft. lbs. (95 Nm)	170 ft. lbs. (225 Nm)	300 ft. lbs. (405 Nm)

4. Wheel nuts should be torqued after first 50 hours of operation and after each wheel removal. Check torque every 3 months or 150 hours of operation.

3.2 DRIVE TORQUE HUB

Disassembly

1. Position hub over suitable container and remove drain plug (37) from unit. Allow oil to completely drain.
2. Remove sixteen bolts (1), four shoulder bolts (2), and twenty lockwashers (3) from cover (4) and lift cover from unit. Remove o-ring (14) from counterbore of cover.
3. Disassemble cover (4) as follows:
   a. Remove two bolts (12) securing disconnect cap (11) to cover and remove disconnect cover.
   b. Remove two bolts (12) securing cover cap (7) to cover and remove cap.
   c. Remove disconnect rod (9) from cover cap and remove o-rings (8 and 10) from cover cap. Discard o-rings.
   d. If necessary, remove pipe plugs (5 and 6) 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 (22) from hub and spindle assembly (30).
6. Disassemble carrier as follows:

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

   a. Remove retaining ring (25) from planet shaft (23).
   b. Remove spacer (26) 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 gear (27) from carrier and remove bearing cones (29) from cluster gear.
   d. If necessary, press bearing cups (28) from cluster gear.
7. Lift ring gear (13) from housing (36). Remove o-ring (14) from counterbore of ring gear and discard.
8. Remove input (sun) gear (17), input spacer (18), and input shaft (20) from spindle (30).
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 (21) out of hub.

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

11. Remove keeper ring (40), retaining ring (35), and bearing shim (34) from end of spindle. Remove hub from spindle.
12. Remove bearing cone (32) and seal (31) from spindle (30). Seal will possibly hold bearing cone into hub. If so, remove both from hub. If bearing cups (33) require replacing they can be driven out of hub counterbores. Discard seal and replace with new seal.

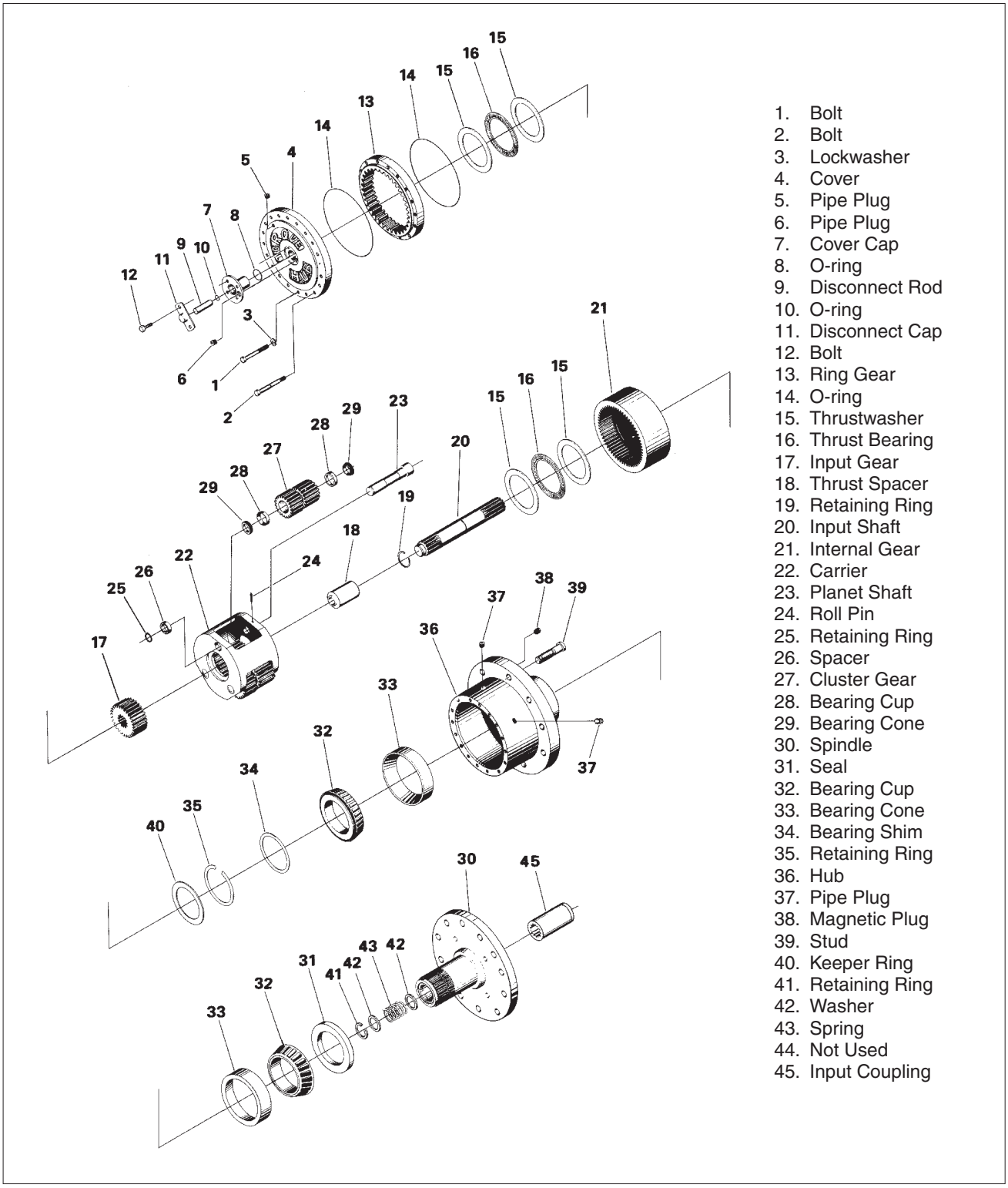
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

13. To remove cluster gear (27) from carrier, remove retaining ring (25) from planet shaft (23) and drive planet shaft out of carrier.
14. Cluster gear and bearings (27, 29) can now be slid out of carrier and spacer (18) removed from carrier bore. If bearing cups (28) require replacing they can be driven out of cluster gear counterbores.
15. Repeat steps (12) and (13) for remaining cluster gears.

NOTICE

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



1. Bolt
2. Bolt
3. Lockwasher
4. Cover
5. Pipe Plug
6. Pipe Plug
7. Cover Cap
8. O-ring
9. Disconnect Rod
10. O-ring
11. Disconnect Cap
12. Bolt
13. Ring Gear
14. O-ring
15. Thrustwasher
16. Thrust Bearing
17. Input Gear
18. Thrust Spacer
19. Retaining Ring
20. Input Shaft
21. Internal Gear
22. Carrier
23. Planet Shaft
24. Roll Pin
25. Retaining Ring
26. Spacer
27. Cluster Gear
28. Bearing Cup
29. Bearing Cone
30. Spindle
31. Seal
32. Bearing Cup
33. Bearing Cone
34. Bearing Shim
35. Retaining Ring
36. Hub
37. Pipe Plug
38. Magnetic Plug
39. Stud
40. Keeper Ring
41. Retaining Ring
42. Washer
43. Spring
44. Not Used
45. Input Coupling

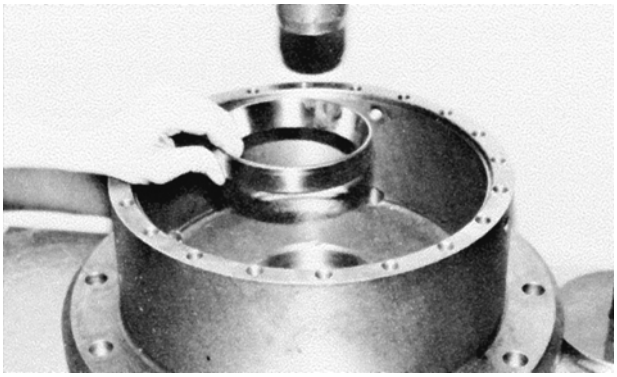
Figure 3-1. Drive Torque Hub

Cleaning and Inspection

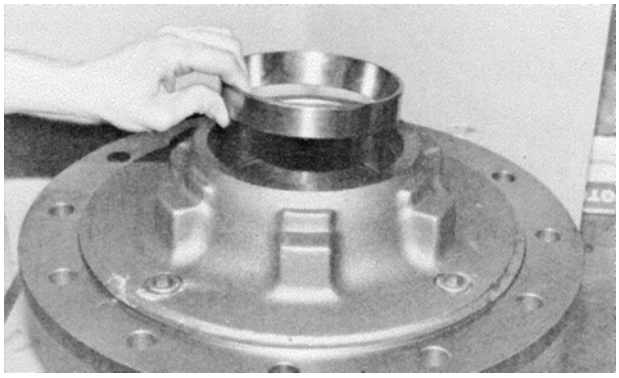
1. Thoroughly clean all parts in an approved cleaning solvent.
2. Inspect geared or splined components in primary and secondary planet carriers, input and output sun gears, ring gear, coupling and input shaft for chipped or broken teeth, and excessive or uneven wear patterns. Replace components as necessary.
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

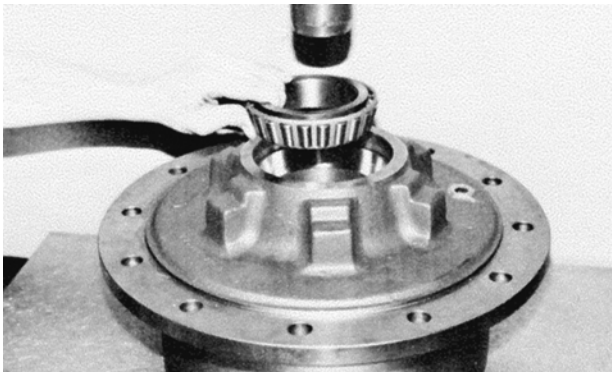
1. If necessary, assemble the hub/spindle assembly (36 and 30) as follows:
   a. With large open end of hub (36) up, press bearing cup (33) into hub. If no press is available, bearing cup may be frozen and tapped into place with a non-metallic faced hammer.



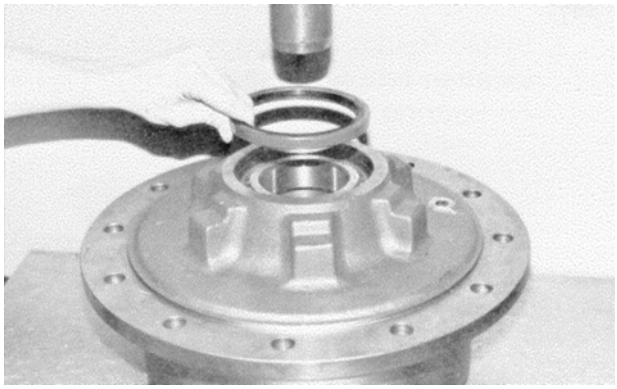
   b. Turn hub over, small diameter up. Install two pipe plugs (37) into hub.
   c. Press bearing cup (33) into small diameter end of hub. If no press is available, bearing cup may be frozen and tapped into place with a non-metallic faced hammer.



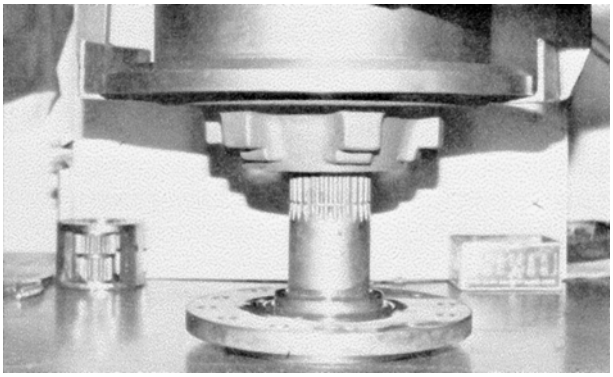
   d. Install bearing cone (32) into bearing cup.



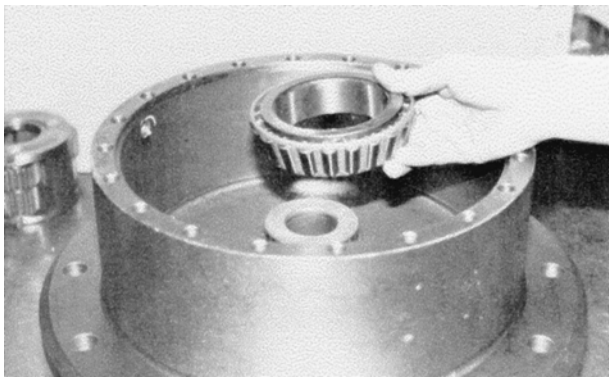
   e. Press seal (31) into hub counterbore with flat metal side facing out. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.



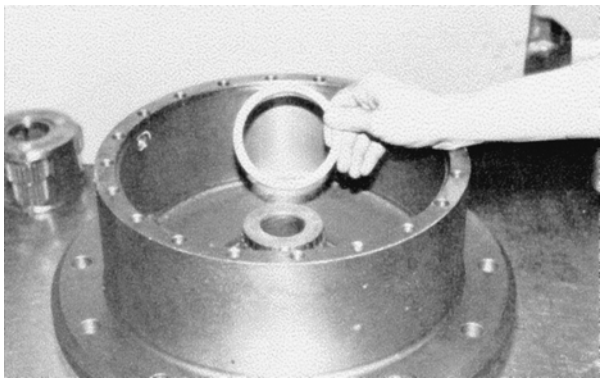
f. Lower hub onto spindle (30) with large open end up.



g. Place bearing cone (32) over end of spindle and into bearing cup.



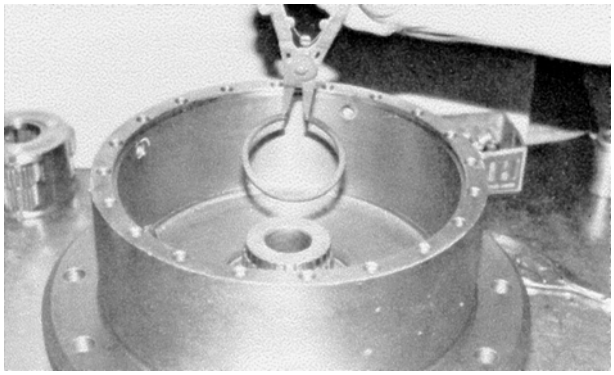
h. Place bearing shim (34) over end of spindle and against bearing cone.



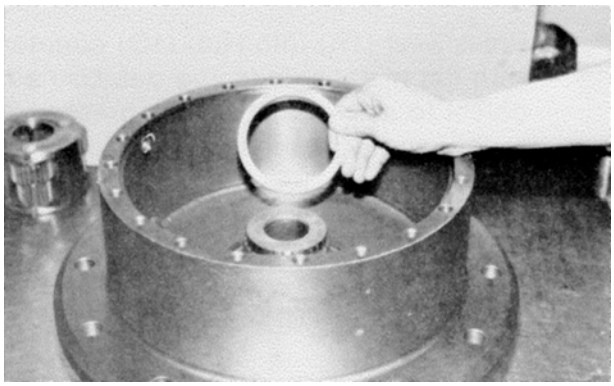
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

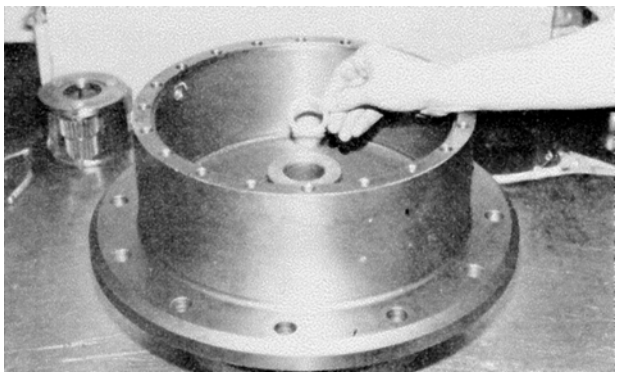
i. Secure retaining ring (35) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.



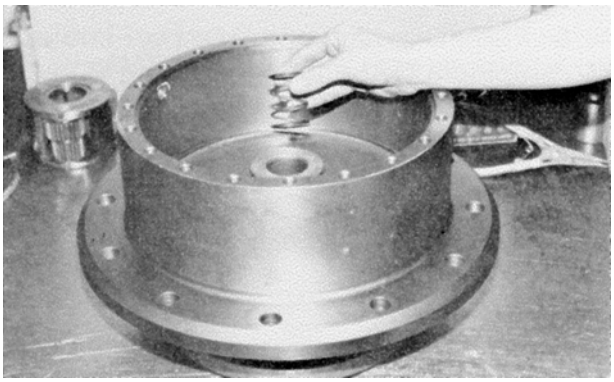
j. Install retaining ring keeper ring (40) in location around retaining ring and on bearing shim.



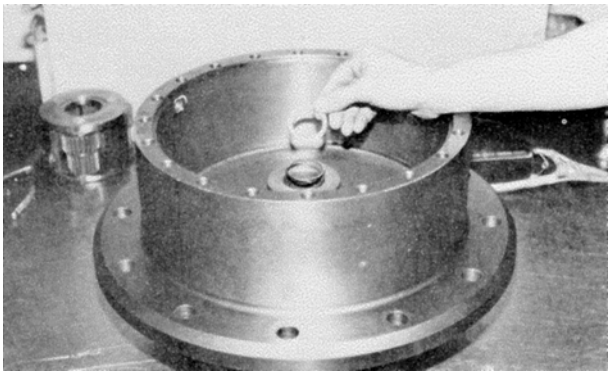
k. With large open end of hub/spindle assembly facing up, place one spacer washer (42) into spindle counterbore.



l. Place spring (43) into spindle counterbore.



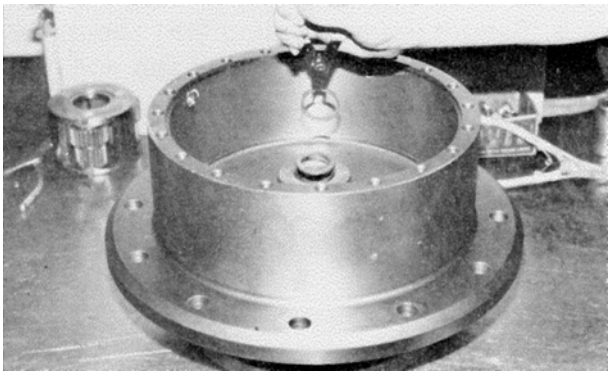
m. Set second spacer washer (42) on top of spring.



⚠ CAUTION

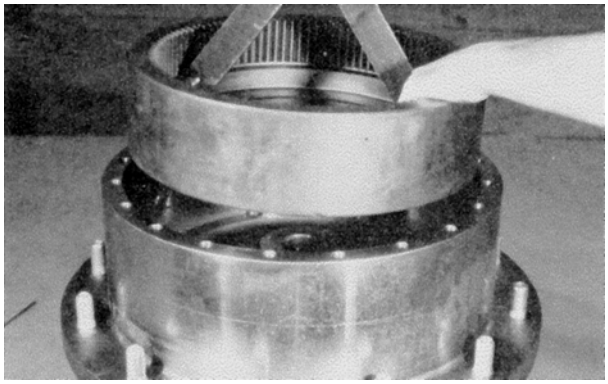
EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

n. Compress spacer washer and spring into spindle counterbore and install retaining ring (41) into spindle groove.

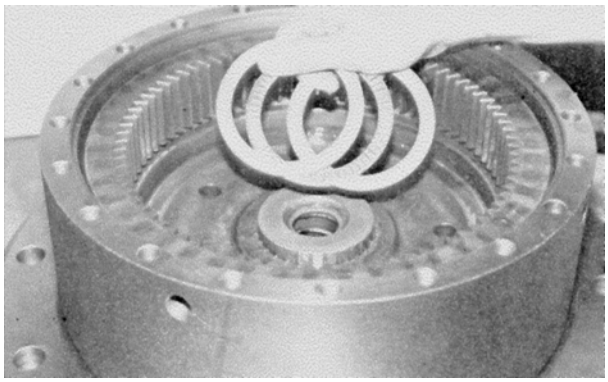


2. Position hub/spindle assembly (36 and 30) with large open end up.

3. Lower internal gear (21) onto spindle.



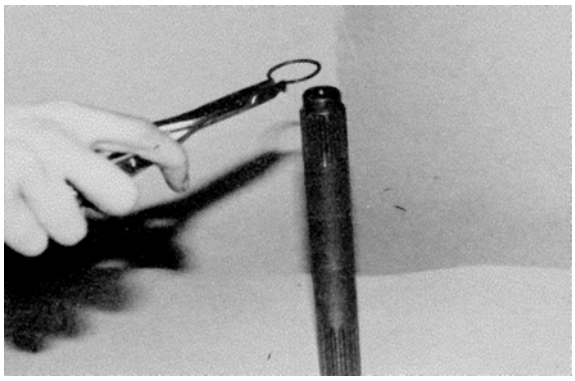
4. Place one thrust bearing (16) between two thrust washers (15) and place them onto spindle pilot.



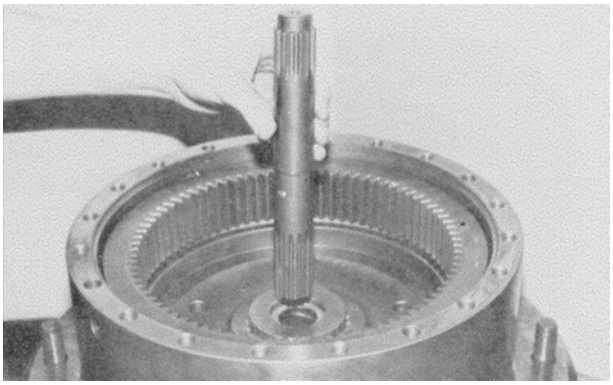
⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

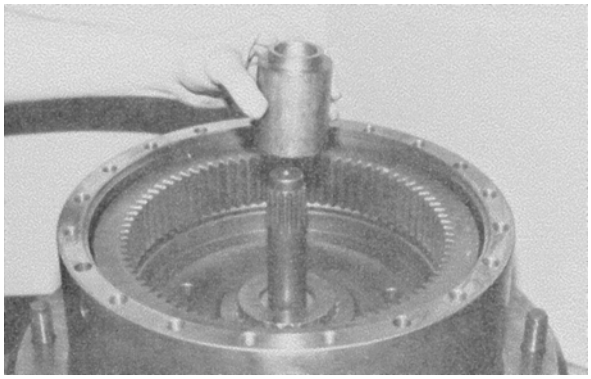
5. Install retaining ring (19) in groove of input shaft (20).



6. Place input shaft into spindle counterbore of hub/spindle assembly. The action of the disengaged spring should be checked at this time.



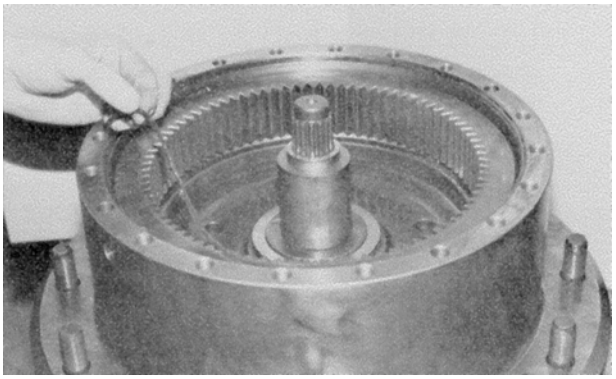
7. Slide thrust spacer (18) onto input shaft.



⚠ CAUTION

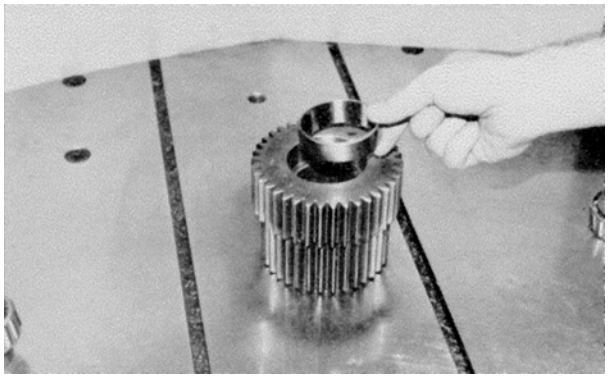
BEWARE OF SHARP EDGES OF COUNTERBORE WHILE SEATING THIS O-RING.

8. Place o-ring (14) into counterbore of hub/spindle assembly. Use grease or petroleum jelly to hold o-ring in place.

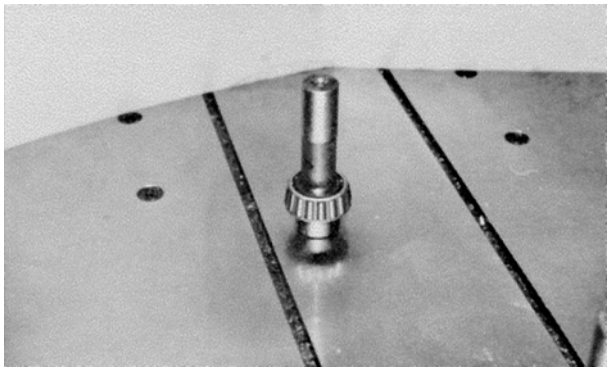


9. Assemble carrier assembly (22) as follows:

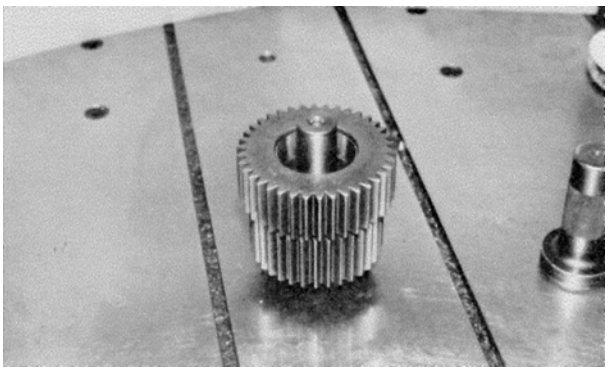
   a. Press bearing cups (28) into both ends of cluster gear (27) with large inside diameter facing out. Use an arbor type press with an adapter tool.



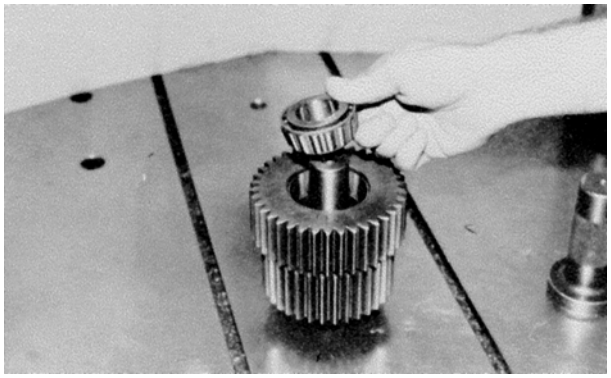
   b. Place planet shaft (23) on a flat surface with large diameter down. Place one bearing cone (29) over shaft and against shoulder. This should be a slip fit.



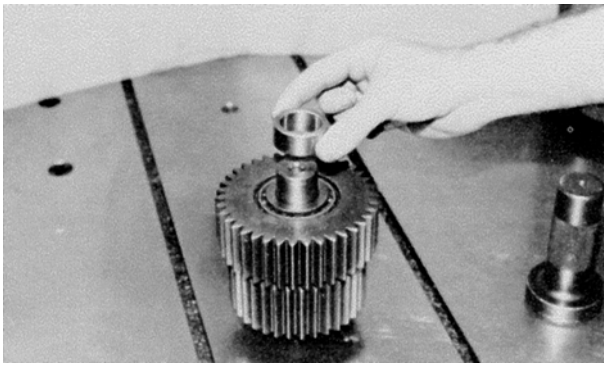
c. Place cluster gear over planet shaft and onto bearing cone, with large gear on top.



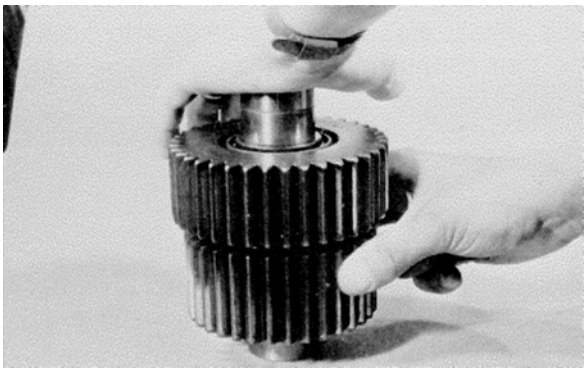
d. Place another bearing cone (29) over planet shaft and into cluster gear. This is a slip fit.



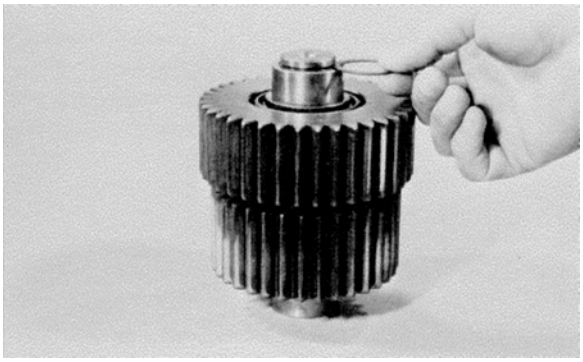
e. Slide largest spacer (26) onto planet shaft.



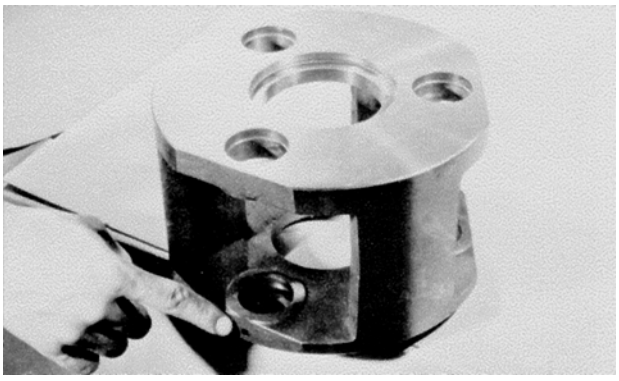
f. Bearings in cluster gear must be seated by applying 25-50 lbs. (11-23 kg) against them and rotating cluster gear at the same time. This can be done by sliding a second spacer (26) over planet shaft and pushing downward while rotating the gear.



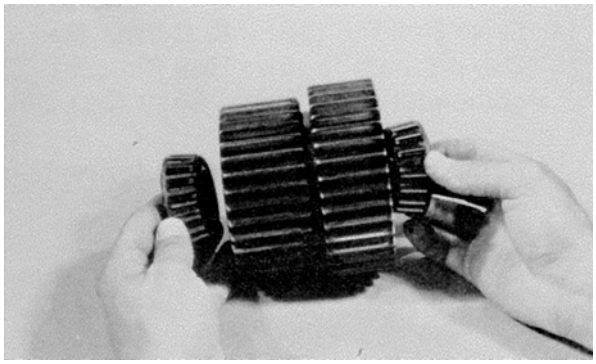
g. See if retaining ring (25) will fit onto planet shaft groove. If not, try smaller spacer (26) until retaining ring fits. This will set bearings at 0.000-0.152 mm.



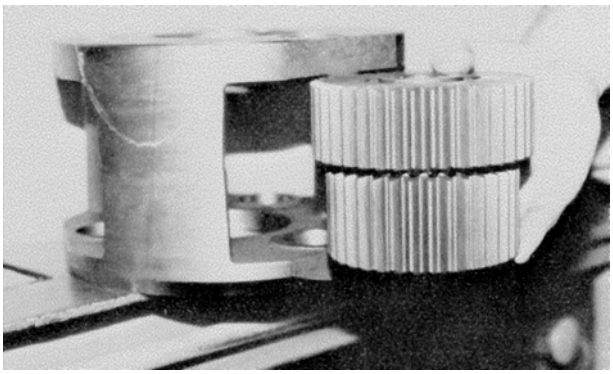
h. Place carrier on edge of a table with one set of holes hanging over the edge. Side with roll pin hole should be down.



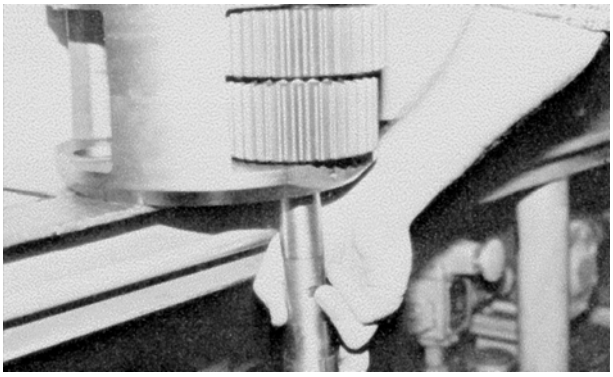
i. Place bearing cones (29) into cluster gear.



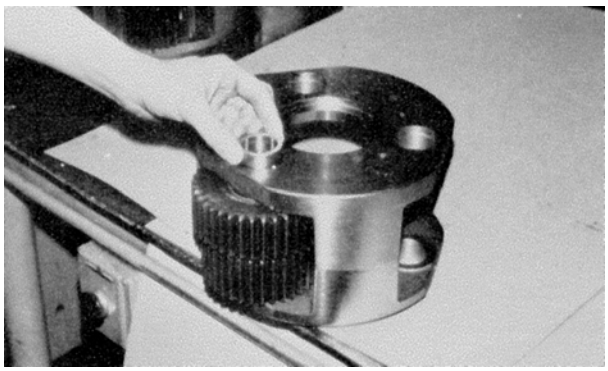
j. Place cluster gear into carrier with large gear up.



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.



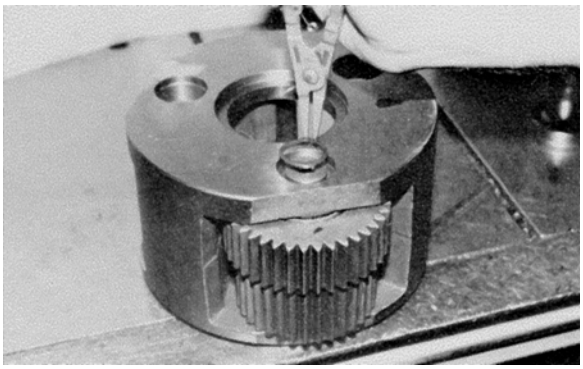
l. While holding planet shaft in position, slide correct spacer onto planet shaft.



⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

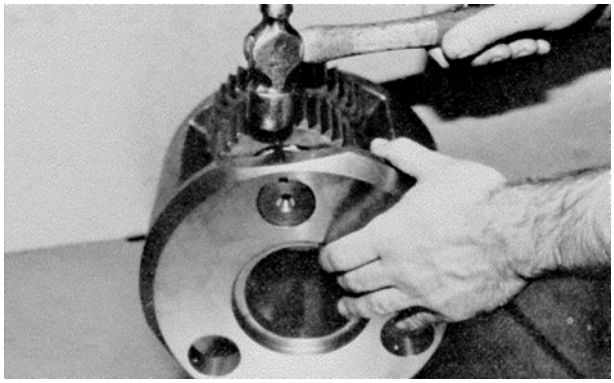
m. Place carrier on table with something under planet shaft to hold it in correct position and install retaining ring (25).



⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING THIS OPERATION.

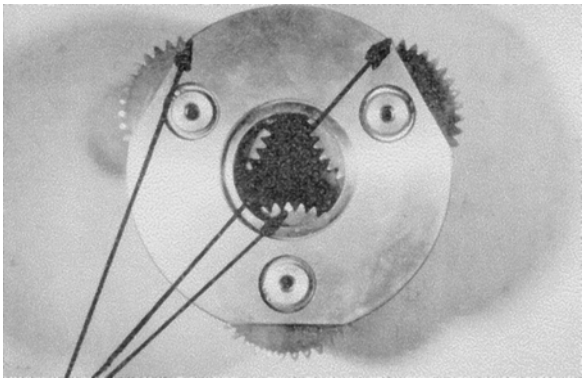
n. Drive roll pin (24) into carrier. Use a punch to drive roll pin completely into planet shaft.



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

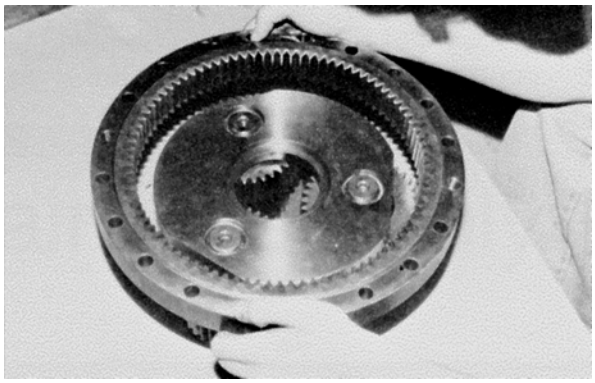
10. Time carrier gears as follows:

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 in Figure 3-2., Torque Hub Carrier Timing.

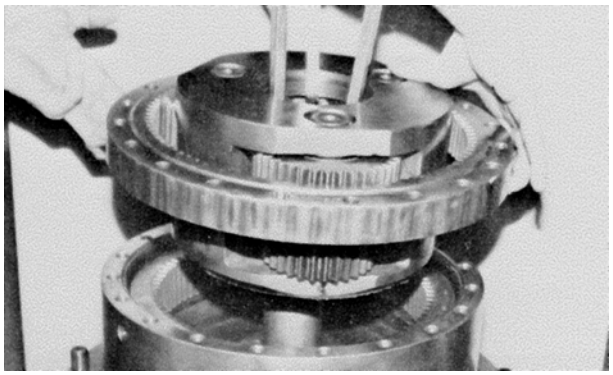


b. Find marked (punch mark) teeth on large gears. Rotate gears until punch mark is located in a straight up, 12 o'clock, position. Punch marks at ten o'clock and two o'clock will be located just under edge of carrier and not readily visible.

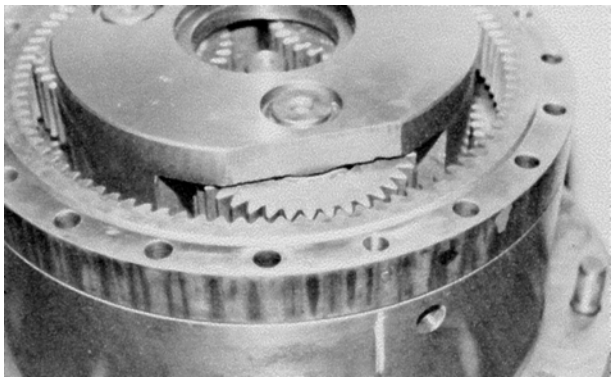
11. Taking care to ensure that timing is maintained, install ring gear (13) in mesh with large diameter cluster gear. Side of ring gear with long shoulder is installed down.



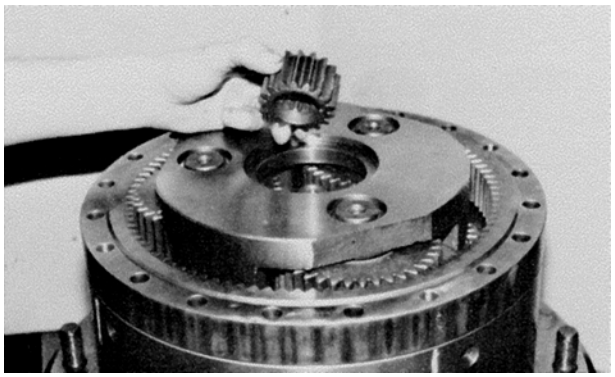
12. While holding ring gear in mesh with carrier assembly, lower into internal gear (21). Small diameter cluster gear will mesh with internal gear. Slight rotation of ring gear may be necessary.



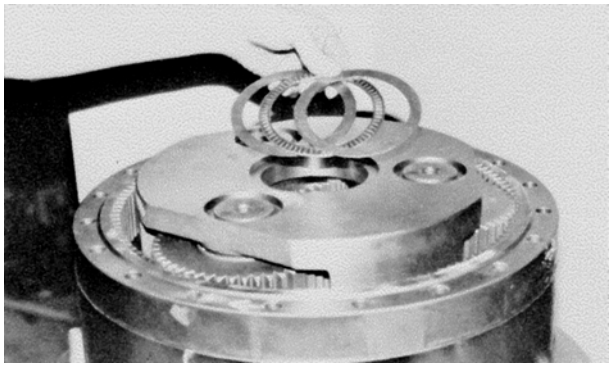
13. Locate the one hole on underside of ring gear that has an "X" stamped beside it. This hole should be positioned in line with one of four counterbored holes in face of hub. These holes have been counterbored to accept four shoulder bolts upon installation of cover.



14. Thrust spacer (18) and input gear (17) are installed onto input shaft (20). 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.



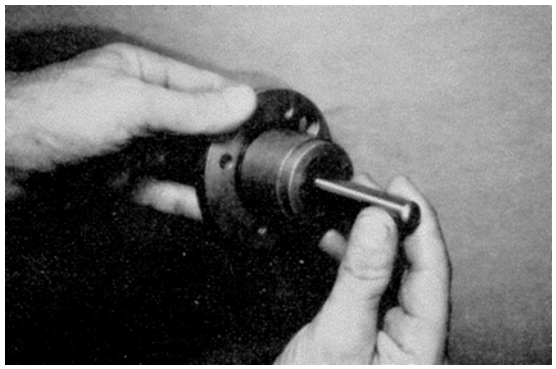
16. Assemble cover assembly as follows:

a. Screw pipe plugs (5 and 6) into cover 4.

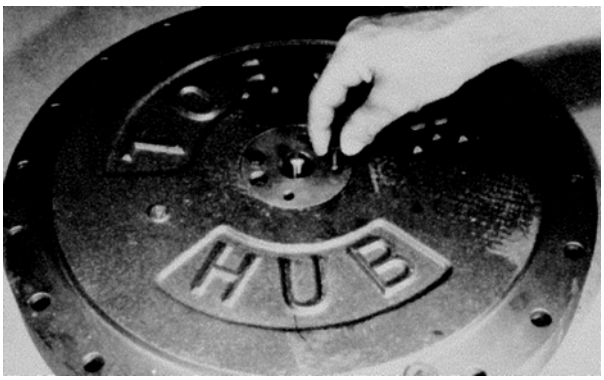
b. Install o-ring (8) over cover cap (7).

c. Install o-ring (10) into bore of cover cap 7. Disconnect rod (9) 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 (12) torqued to 70 to 80 in.lbs. (81-92 kgcm).

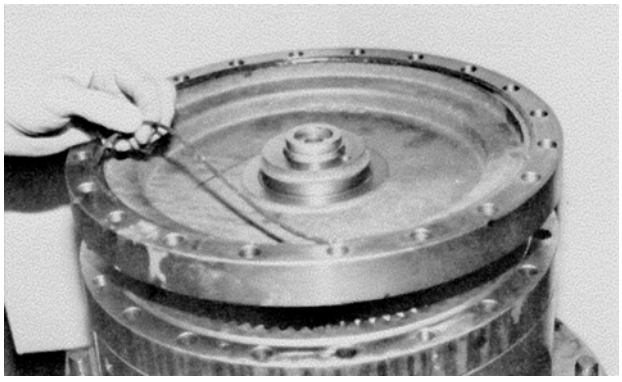


f. Install disconnect cap (11) to cover cap with two remaining bolts (12) torqued to 70 to 80 in.lbs. (81-92 kgcm).

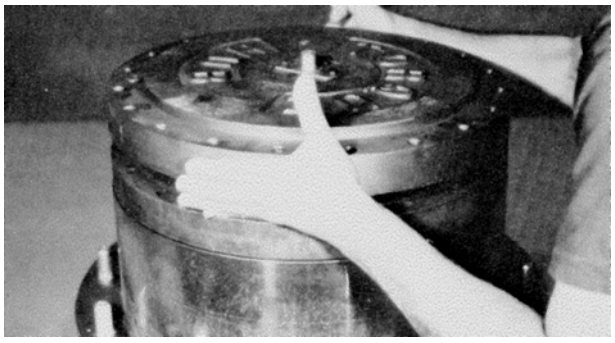
⚠ CAUTION

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

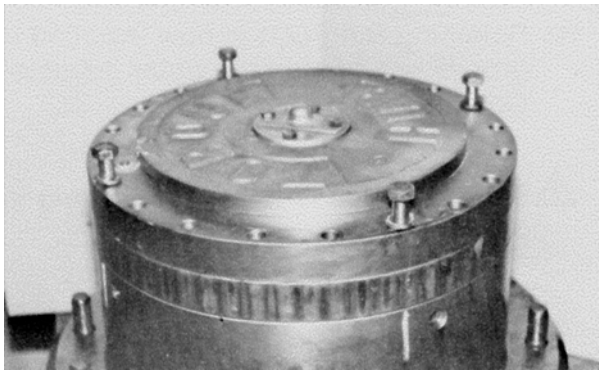
g. Place o-ring (5) into cover counterbore. Use petroleum jelly to hold o-ring into place.



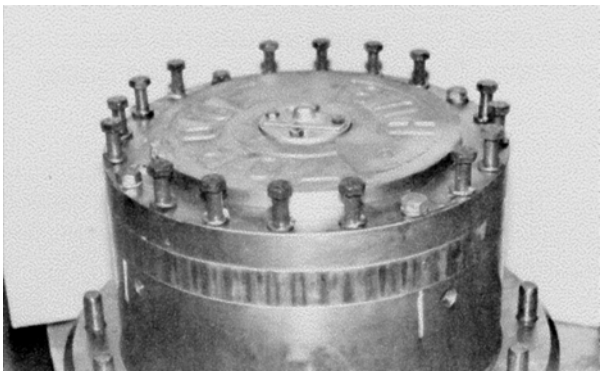
17. Place cover assembly (4) onto ring gear (13). Rotate cover assembly until pipe plug (6) is located 90 degrees and 180 degrees from pipe plugs (38) in opposite end of hub.



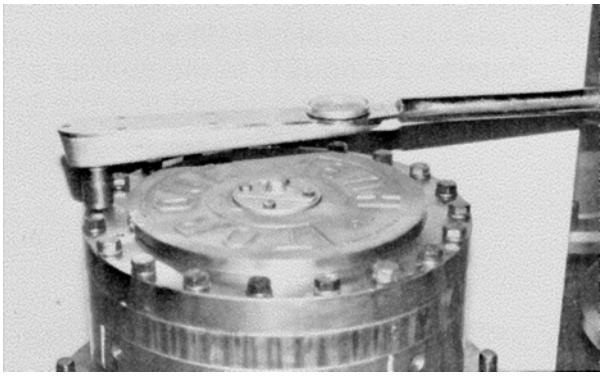
18. Secure cover assembly and ring gear to hub with four shoulder bolts (2) and lockwashers 3. Shoulder bolts fit into four counterbored holes in hub. It may be necessary to start bolts into hub by tapping lightly on bolts with a hammer.



19. Install sixteen Grade 8 bolts (1) and lockwashers (3) in remaining holes.



20. Tighten bolts and shoulder bolts evenly and torque to 100-110 ft.lbs. (14-15 kgm).



21. Install coupling (45) into spindle onto input shaft.

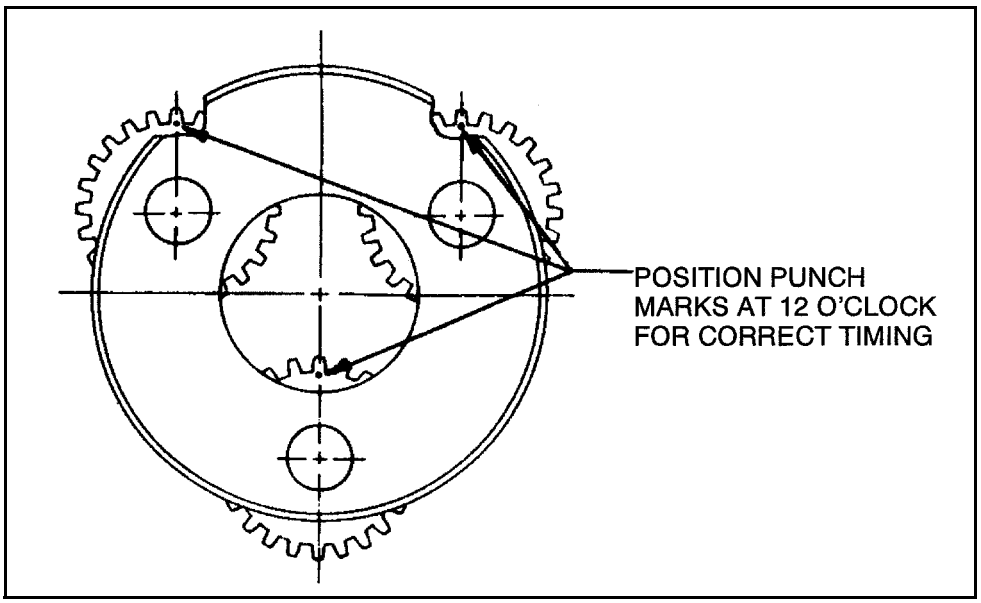


Figure 3-2. Torque Hub Carrier Timing

3.3 DRIVE BRAKE - MICO - MACHINES BUILT MARCH 1992 TO S/N 33476

Disassembly

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

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 907 KG. THE FOUR BOLTS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3,000 LBS. (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).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.*

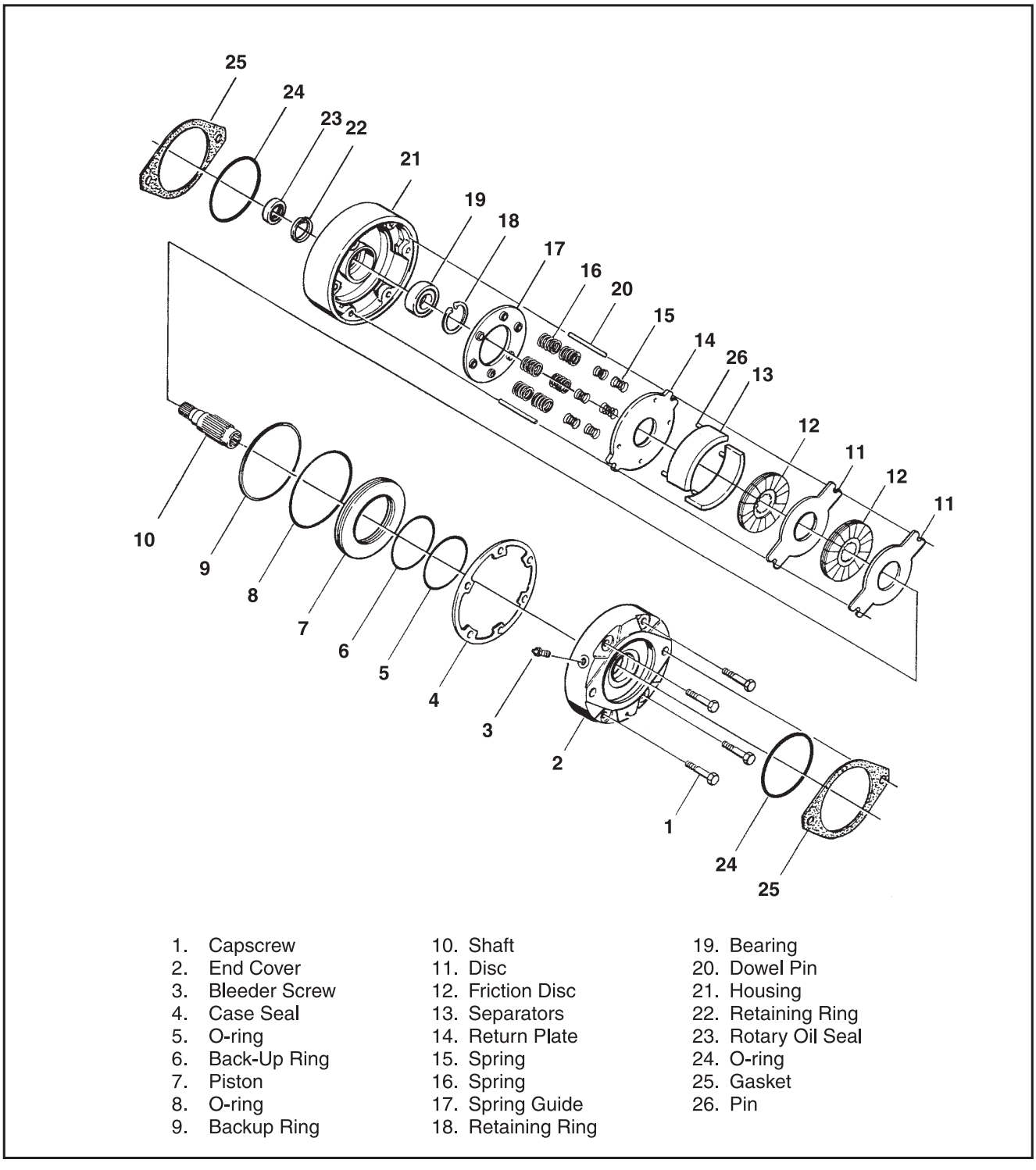
1. Clean all parts thoroughly before assembly.
2. Press new rotary oil seal (23) into housing (21). Note direction of the seal.

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).



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 Guide
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 3-3. Drive Brake - Mico (March 1992 to S/N 33746)

6. Position new large diameter return plate (14) in housing with tabs guided by dowel pins (20) until disc rests on springs (15 & 16).

NOTICE

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

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).

NOTICE

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

3.4 DRIVE BRAKE - MICO - MACHINES BUILT S/N 33476 TO PRESENT

Disassembly

1. With the shaft protrusion downward, remove end cover (13) by removing capscrews (12).

NOTICE

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 681 KG. THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (1362 KG MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Remove case seal (11) from housing (7) then remove bleeder screw (14) from end cover (13).
3. Remove piston (24) from end cover (13).
4. Remove o-ring (19), back-up ring (18), o-ring (21) and back-up ring (20) from piston (24).

5. Remove separators (10) from housing (7).
6. Remove stack assembly, consisting of discs (23), return plate (8) and friction discs (22) from housing (7).
7. Remove dowel pins (17), springs (5 & 6) from housing (7).
8. Remove retaining ring (3) from housing (7).
9. Remove shaft by pressing or using a soft mallet on male end of shaft (4).
10. Remove retaining ring (15) bearing (2) from shaft (4).
11. Press rotary seal (1) from housing (7).

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 inspection, they are found to be in good condition.*

Assembly

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

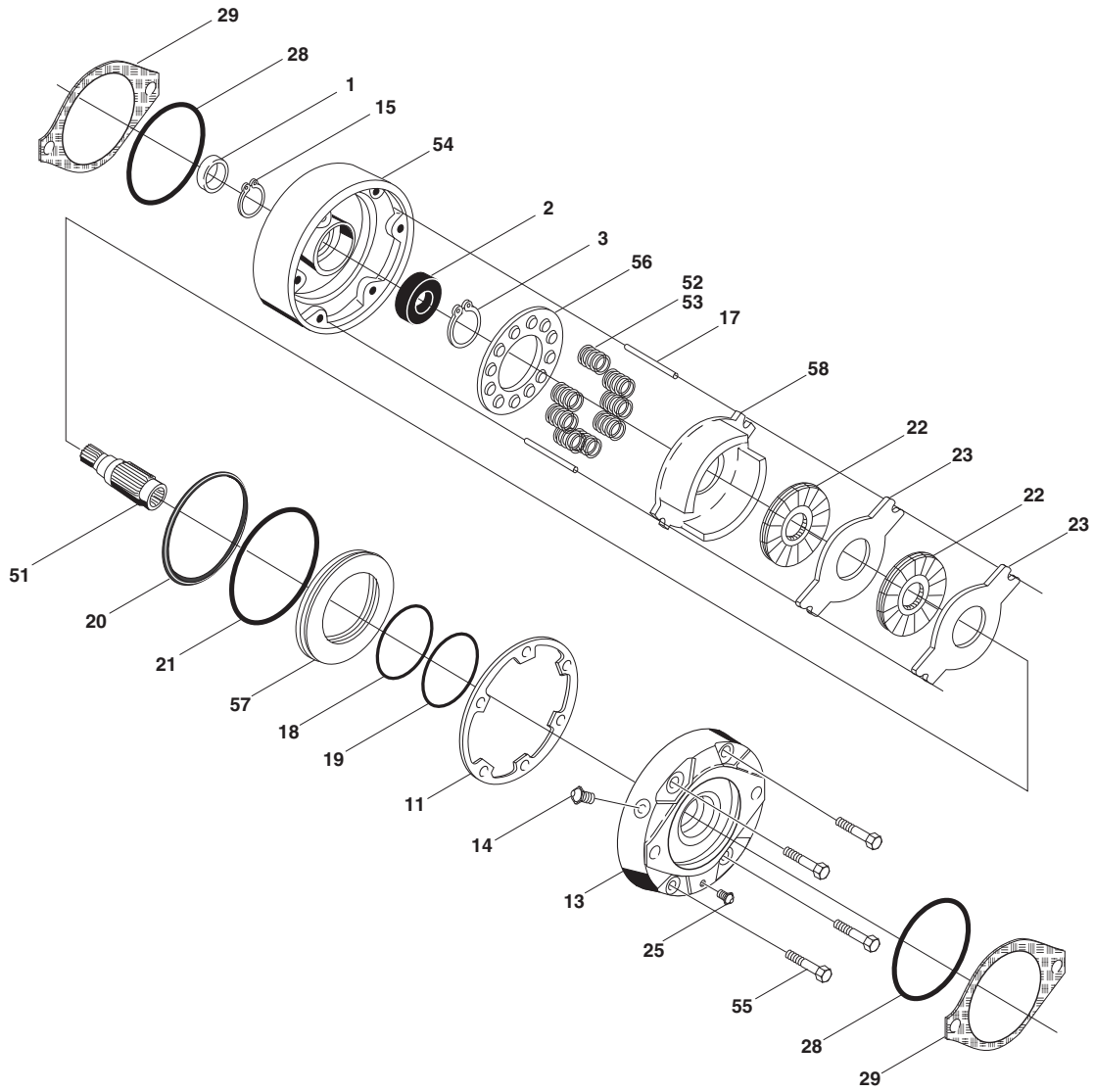
1. Press new rotary seal (1) into housing (7). Note the direction of seal.
2. Install new bearing (2) on shaft (4).
3. Install shaft assembly and retaining ring (3) into housing (7).
4. Install dowel pins (17), spring retainer (16), and springs (5 & 6) into housing (7).

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

5. Position new large diameter return plate (8) in housing with tabs guided by dowel pins (17) until disc rests on springs (5 & 6).

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

6. Place new disc (22) on shaft (4) until it contacts return plate (8).
7. Add additional discs (23) as required to complete assembly.
8. Insert separators (10) in holes of return plate (8).
9. Install new o-ring (19), new back-up ring (18), new o-ring (20) and new back-up ring (21) on piston (24). Insert piston (24) into end cover (13) being careful not to shear o-rings or back-up rings.
10. Install new case seal (11) in housing (7) then install bleeder screw (14) in end cover.
11. Position end cover (13) on housing (7) aligning dowel pins (17) with holes in end cover.
12. Insert capscrews (12) and tighten evenly to draw end cover (13) to housing (7). Torque capscrews to 55 ft. lbs. (75 Nm).



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 Guide
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 3-4. Drive Brake - Mico (S/N 33476 to Present)

3.5 FREE WHEELING OPTION

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

1. Chock wheels securely if not on a flat level surface.
2. Disconnect all drive hubs by inverting disconnect caps in center of hubs.

To Engage Drive Motors and Brakes (Normal Operation)

1. Connect all drive hubs by inverting disconnect cap in center of hub.
2. Remove chocks from wheels as required.

NOTE: *This machine is not equipped with a tow package. Refer to Section 6 of the Operating and Safety Manual for emergency towing procedures.*

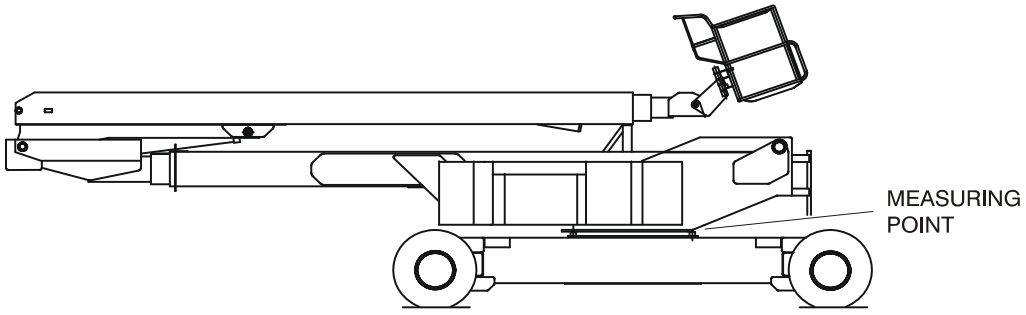
3.6 SWING BEARING

Turntable Bearing Mounting Bolt Condition Check

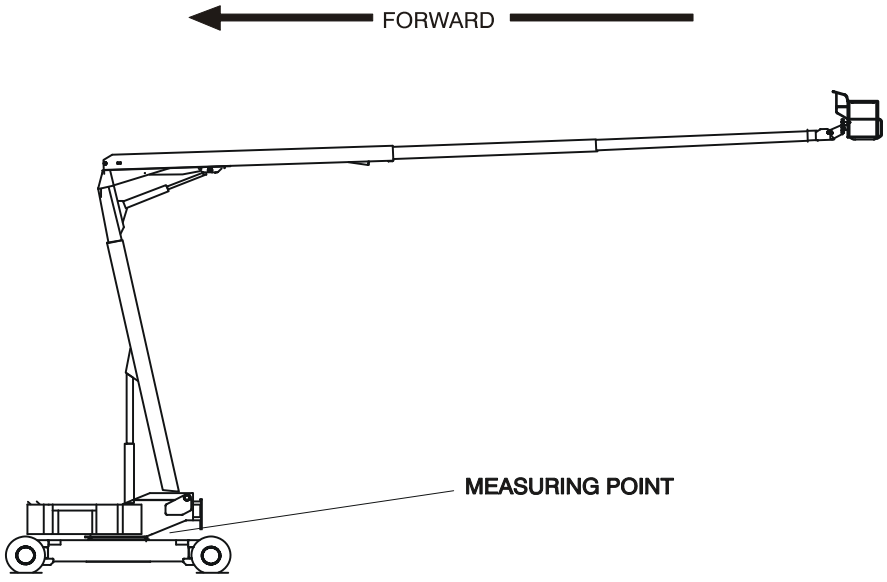
NOTE: *This check is designed to replace the existing bearing bolt torque checks on JLG Lifts in service. This check must be performed after the first 50 hours of machine operation and every 600 hours of machine operation thereafter. If during this check any bolts are found to be missing or loose, replace missing or loose bolts with new bolts and torque to the value specified in the torque chart, after lubricating the bolt threads with JLG Threadlocker P/N 0100019. 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 3-18., 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.



a. Boom at horizontal and fully retracted



b. Tower boom fully elevated and fully retracted. Main boom fully extended at horizontal over the front of the machine.

Figure 3-19. Swing Bearing Tolerance Boom Placement

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 3-18., 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 3-18., 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.

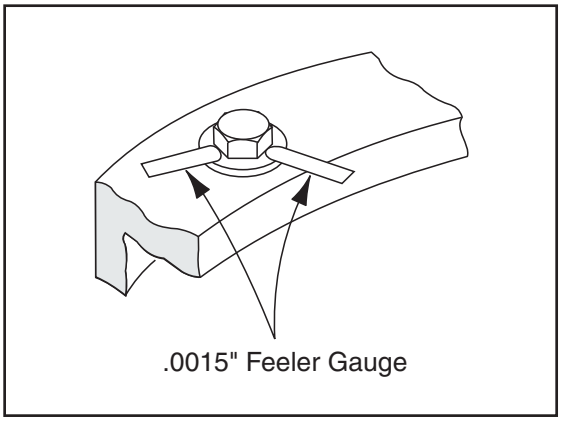


Figure 3-18. Swing Bearing Bolt Feeler Gauge Check

Wear Tolerance

1. From underside of machine, at rear center, with tower boom fully elevated and fully retracted and main fully elevated and fully retracted (See Figure 3-19.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and the frame.
2. At the same point, with tower boom at horizontal and fully retracted and main boom at horizontal and fully extended (See Figure 3-19.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and frame. (See Figure 3-19.)
3. If a difference greater than 0.076 in. (1.93 mm) is determined, the swing bearing should be replaced.
4. If a difference less than 0.076 in. (1.93 mm) is determined, and any of the following conditions exist, the bearing should be removed, disassembled, and inspected for the following:
   a. Metal particles in the grease.
   b. Increased drive power required.
   c. Noise.
   d. Rough rotation.
5. If bearing inspection shows no defects, reassemble bearing and return to service.

NOTICE

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 and Devcon Application Procedures

REMOVAL

1. From ground control station, operate tower boom lift control and raise tower boom adequately to provide access to rotary coupling.

⚠ WARNING

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

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

NOTICE

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

4. Tag and disconnect hydraulic lines from fittings on top and sides of rotary coupling. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.
5. Attach suitable overhead lifting equipment to base of turntable weldment.
6. Using a suitable tool, scribe a line on inner race of swing bearing and on underside of turntable. This line will aid in aligning bearing upon installation. Remove bolts, nuts and washers which attach turntable to bearing inner race. Discard nuts and bolts.
7. Use lifting equipment to carefully lift complete turntable assembly from bearing. Ensure that no damage occurs to turntable, bearing or frame mounted components.
8. Carefully place turntable on a suitably supported trestle.

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

INSTALLATION

NOTE: *Manufacturing tolerances of frames and turntables are inspected prior to the factory installation of swing bearings to determine the need for use of Devcon filler. When servicing machine swing bearing, apply Devcon filler only to those machines having Devcon previously applied at the factory. If new turntable or frame is being installed contact manufacturer for procedures to determine the need for Devcon application.*

1. Use suitable standard tools and equipment to carefully remove any hardened epoxy residue from bearing mounting area of frame and turntable.
2. Apply a layer of Devcon (or equivalent) filler approximately 0.125 in. (3.18 mm) thick on bearing mounting plate on frame.
3. Use suitable lifting equipment to carefully lower swing bearing into position on frame. Ensure that scribed line of outer race of bearing aligns with scribed mark on frame (if a new swing bearing is used, ensure that filler plug fitting is at 90 degrees from fore and aft centerline of frame).
4. Ensure that all frame and bearing attachment holes are aligned, and install four diametrically opposed bolts or clamps to secure bearing to frame. Tighten bolts or clamps evenly in a diametrical pattern to a torque of 20 ft. lb. (27 Nm).
5. Allow Devcon filler to cure at room temperature (approximately 21 degrees C.) for 10 to 16 hours.
6. After the appropriate interval, release clamps or remove bolts. Use a suitable lifting device to carefully remove bearing from frame.
7. Carefully remove any excess filler from frame mounting area, from bearing attachment holes, and from between gear teeth.

⚠ WARNING

ENSURE THAT TURNTABLE IS ADEQUATELY SUPPORTED WHILE APPLYING DEVCON AND WHILE INSTALLING THE BEARING. EXTREME CARE MUST BE TAKEN DURING THE FOLLOWING STEPS TO AVOID SERIOUS OR FATAL INJURY TO PERSONNEL.

a. Apply a layer of Devcon (or equivalent) filler approximately 0.125 in. (3.18 mm) thick to underside of bearing mounting area of turntable base plate.
b. Use suitable hydraulic jacks to carefully raise swing bearing to underside of turntable mounting plate. Ensure that scribed line of inner race of bearing aligns with scribed mark on turntable (if a new swing bearing is used, ensure that filler plug fitting is at 90 degrees from fore and aft centerline of turntable).
c. Ensure that all turntable and bearing attachment holes are aligned, and install four (4) diametrically opposed clamps or bolts and nuts to secure bearing to turntable. Tighten nuts and bolts or clamp evenly in a diametrical pattern to a torque of 20 ft. lb. (27 Nm).
d. Allow Devcon filler to cure at room temperature (approximately 21 degrees C.) for 10 to 16 hours.
e. After the appropriate interval, place a suitable hydraulic jack under bearing and release clamps or remove nuts and bolts; use hydraulic jack to carefully remove bearing from turntable.
f. Carefully remove excess filler from turntable mounting area, from bearing attachment holes and from between gear teeth.
g. Position bearing on machine frame in same position as noted in step (c) above.

⚠ 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.

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

i. Following the Torque Sequence diagram shown in Figure 2-8, tighten bolts to an initial torque of 410 ft. lb. (555 Nm). Then following the same sequence tighten bolts to a final torque of 545 ft. lb. (740 Nm).
j. Remove lifting equipment from bearing.

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

l. Carefully lower turntable onto swing bearing, ensuring that turntable and bearing align as noted in step (i) above.

⚠ 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.

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

n. Following the Torque Sequence diagram shown in Figure 2-9, tighten bolts to an initial torque of 410 ft. lb. (555 Nm). Then, following the same sequence, tighten bolts to a final torque of 545 ft. lb. (740 Nm).

o. Remove lifting equipment.

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

q. Connect hydraulic lines to rotary coupling as tagged prior to removal.

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

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

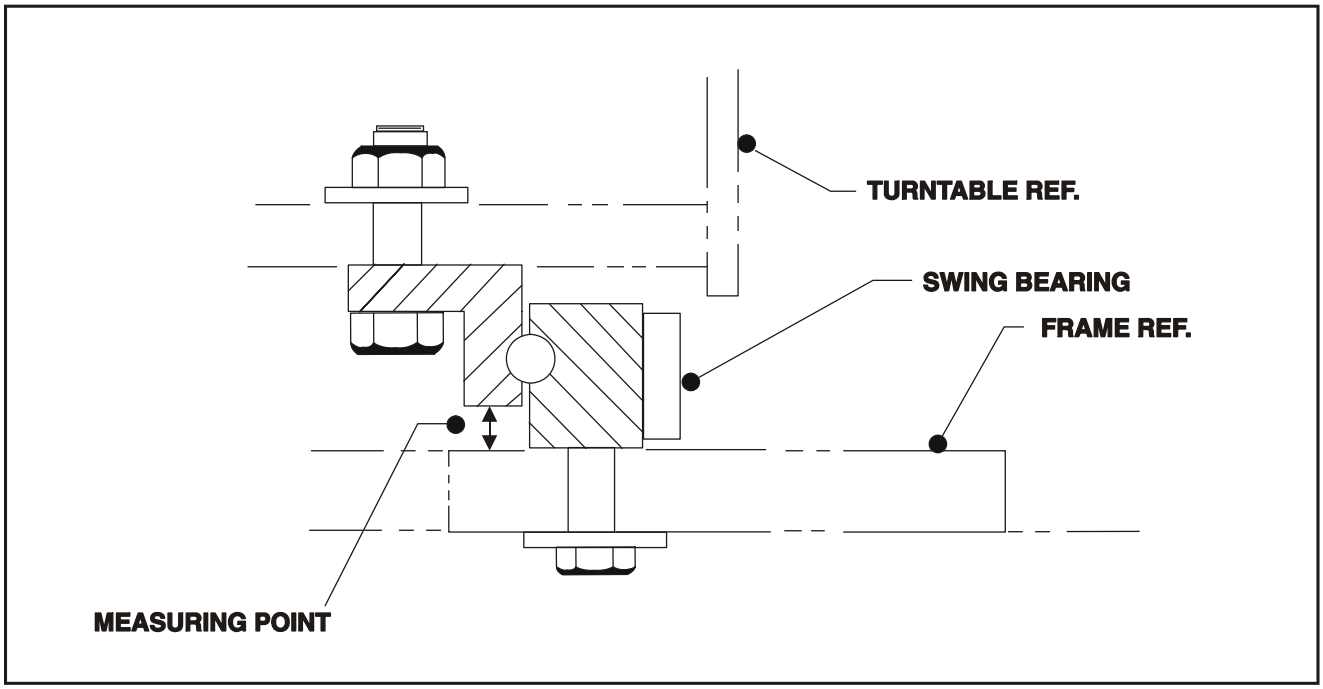


Figure 3-19. Swing Bearing Tolerance Measuring Point

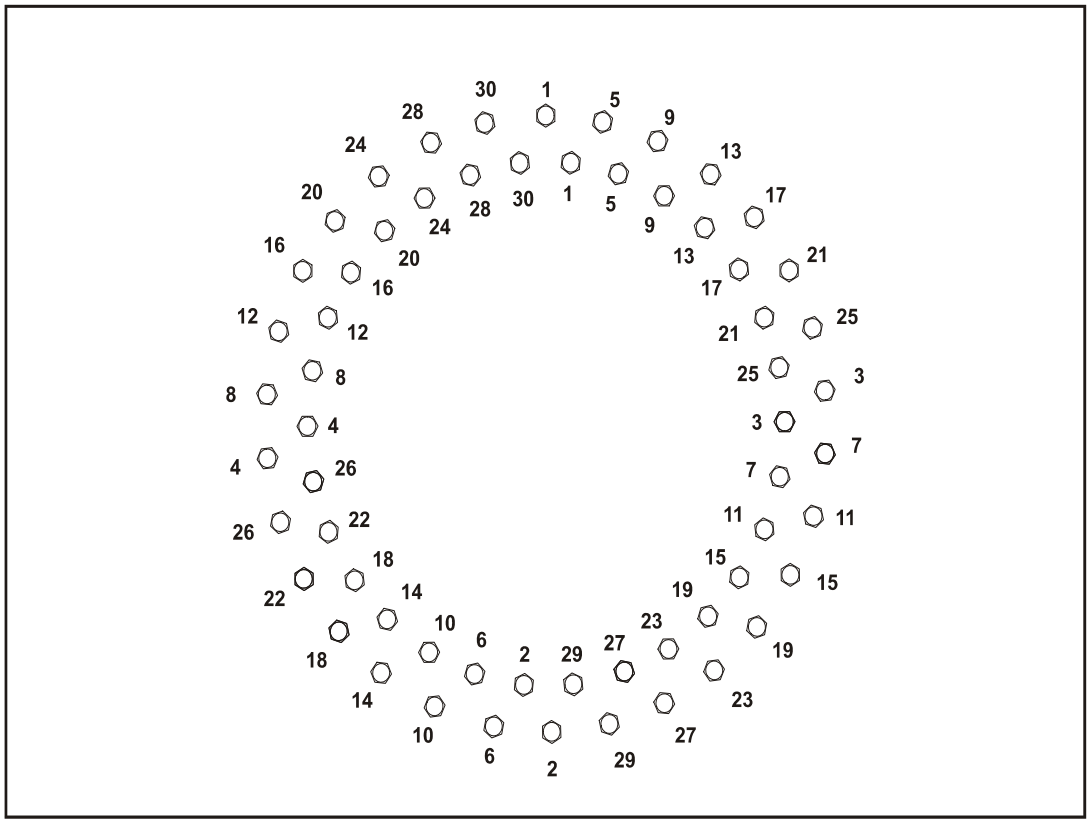


Figure 3-20. Swing Bearing Torquing Sequence

Swing Bearing Torque Values

1. Outer Race - 545 ft. lb. (740 Nm) JLG Threadlocker.
2. Inner Race - 545 ft. lb. (740 Nm) JLG Threadlocker.
3. Swing Bearing Torquing Sequence, see Figure 2-9.

⚠ WARNING

CHECK INNER AND OUTER SWING BEARING BOLTS FOR MISSING BOLTS OR LOOSENESS AFTER FIRST 50 HOURS OF OPERATION AND EVERY 600 HOURS THEREAFTER.

3.7 SWING TORQUE HUB

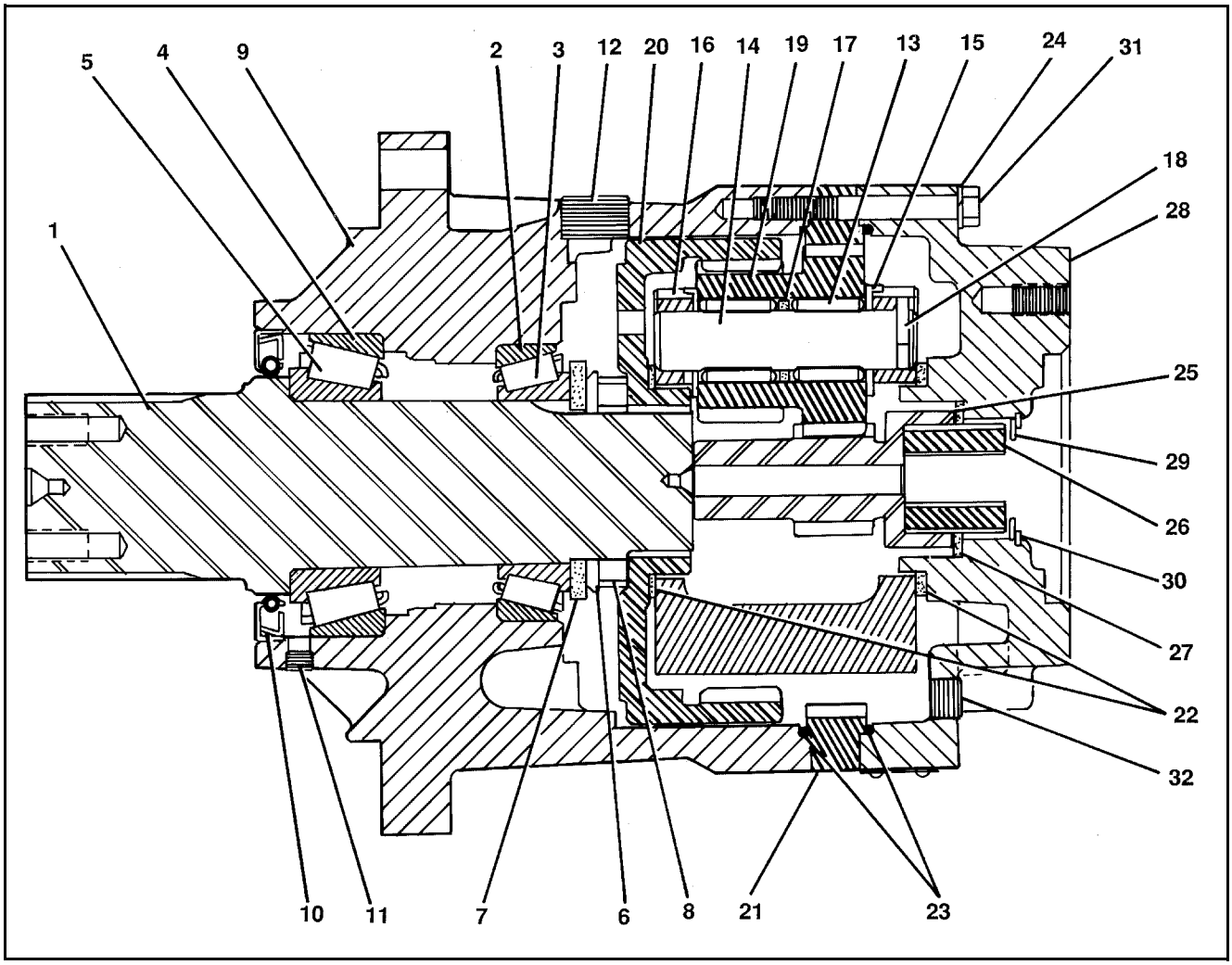
Disassembly

1. Set unit on its shaft (1). Remove pipe plug (11) from bottom of hub near shaft, and drain oil from unit into a suitable container.
2. Remove the three pipe plugs (32) from cover (28).
3. Remove the twenty bolts (31) and lockwashers (24) from cover.
4. Remove thrust washer (29) from inside center counterbore of cover, on top of retaining ring (21).

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

5. Remove retaining ring (30) from groove inside counterbore in center of cover.
6. Lift cover off of ring gear (21) and set it aside, interior side facing up.



1. Output Shield
2. Outer Bearing Cup
3. Outer Bearing Cone
4. Inner Bearing Cup
5. Inner Bearing Cone
6. Lockwasher
7. Flatwasher
8. Bearing Nut
9. Housing
10. Lip Seal
11. Pipe Plug
12. Pipe Plug
13. Needle Bearing
14. Planet Shaft
15. Thrust Washer
16. Carrier
17. Thrust Spacer
18. Roll Pin
19. Cluster Gear
20. Internal Gear
21. Ring Gear
22. Thrust Washer
23. O-ring
24. Lockwasher
25. Sun Gear
26. Adapter Coupling
27. Thrust Washer
28. Input Cover
29. Thrust Washer
30. Retaining Bolt
31. Bolt
32. Pipe Plug

Figure 3-21. Swing Torque Hub

7. Remove o-ring (6) from counterbore around rim of cover. Discard o-ring.
8. Remove thrust washer (27) from “ledge” halfway down in counterbore in center of cover. Thrust washer may be on top of coupling (26). Remove washer and set it aside.
9. Remove thrust washer (22) from around edge of raised circular center of cover. Thrust washer may be around coupling (26). Remove thrust washer and set it aside.
10. Remove coupling from end of input gear (25).
11. Lift ring gear off of hub (9).
12. Lift input gear (25) out of hub.
13. Lift carrier assembly (16) out of hub. Disassemble carrier assembly as follows:
    a. Set cluster (planet) gear (19) on its side. Using a hammer and alignment punch, drive roll pin (18) completely into hole in planet shaft (14). If roll pin is not completely driven into hole in planet shaft, carrier housing could be damaged when planet shaft is removed.
    b. Using a punch and hammer, drive planet shaft down out of carrier housing (16). When planet shaft is removed from carrier housing, two thrust washers (15) and assembled cluster gear will slide off planet shaft into carrier housing. Remove these parts from carrier housing.
    c. Remove nineteen needle rollers (13) from inside large end of cluster gear.
    d. Remove spacer (17) from inside of cluster gear.
    e. Remove nineteen needle rollers (19) from inside of small end of cluster gear.
    f. Repeat steps (a) through (e) for remaining two cluster gears.
14. Remove o-ring (23) from counterbore of hub. Discard o-ring.
15. Remove thrust washer (22) from around shaft (1) in hub.
16. Lift internal gear (20) out of hub.
17. Disassemble hub/shaft assembly (9) as follows:
    a. Remove three pipe plugs (12) from side of hub.
    b. Bend the aligned tang of lockwasher (6) out of slot in locknut (8).
    c. Remove locknut from shaft.

NOTE: *It may be necessary to cut locknut from shaft. If this is necessary, take care not to damage shaft and be sure to discard locknut.*

    d. Remove lockwasher from around shaft.
    e. Remove tanged washer (7) from around shaft.
    f. Set hub on something wide enough to allow shaft to fall out of hub, and hammer or press shaft down out of hub.
    g. Bearing cone (3) should be lying loose in hub. Remove bearing cone and set it aside.
    h. Remove seal (10) and discard it. Seal may be loose around shaft, or it may still be in small end of hub.
    i. Using a punch and hammer, remove bearing cone (5) from around shaft.
    j. Using a punch and hammer, carefully drive bearing cup (4) out of counterbore in small end of hub.
    k. Turn hub over. Using a punch and hammer, carefully drive bearing cup (2) out of counterbore in tall end of hub.

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect bearing components (2, 3, 4, 5) 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 (9) and cover (28) 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 (14) for scoring or other damage. Replace as necessary.

Assembly

1. Assemble hub/shaft assembly as follows:
   a. Set hub (9) on work surface, wide end up. Using a suitable press, press bearing cup (2) into counterbore in tall end of hub.
   b. Set hub on work surface, wide end down. Using the press, install bearing cup (4) into counterbore in small end of hub.
   c. Using the press, press bearing cone (5) onto smaller end of shaft (1).
   d. Slowly lower hub, small end down, onto shaft. Check initial torque. Install one bolt (31) into bolt circle of hub, and, keeping torque wrench tangent to bolt circle, pull torque wrench smoothly toward you. Rolling torque must fall in the range of 30-40 in. lb. (3-5 Nm). If it does, proceed to step (f). If not, perform step (e).
   e. If rolling torque is below 30-40 in. lb. (3-5 Nm), apply more pressure to bearings. If rolling torque is above 30-40 in. lb. (3-5 Nm), tap top of shaft to release bearings and repeat step (d).
   f. Using the bearing press, press bearing cone (3) around shaft in hub.
   g. Clean threads on shaft and apply “Primer T” (a de-greasing agent) to shaft. Apply a light coat of “Primer T” to locknut (8). Allow 2-3 minutes’ drying time.
   h. Place tanged washer (7) over end of shaft.
   i. Place lockwasher (6) over shaft.

NOTE: *Loctite 277 is an anaerobic adhesive; once out of contact with air, it begins to set. Read steps (j) thru (m) before performing them as quickly as possible.*

   j. Apply Loctite 277 to threads of locknut (8). DO NOT put Loctite on shaft threads.
   k. Thread locknut onto shaft, making sure that chamfered side of locknut is facing toward lockwasher, and tighten locknut down by hand.
   l. Using torquing tool and locknut wrench, torque locknut to 175 ft. lb. (237 Nm). One tab of lockwasher should be aligned with slot in locknut when torquing is done. Tighten locknut to align slot if necessary, but NEVER LOOSEN THE LOCKNUT.
   m. Check final rolling torque. Put a torque wrench on bolt in hub, and, keeping torque wrench tangent to bolt circle, pull torque wrench smoothly toward you. Final rolling torque must be 5-10 in. lb. (0.6-1 Nm) greater than initial reading. If final reading is correct, proceed to step (o). If not, perform step (n).
   n. If final rolling torque is less than 5-10 in. lb. (0.6-1 Nm) higher than initial reading, tighten locknut slightly and re-measure. If final rolling torque is greater than 5-10 in. lb. (0.6-1 Nm) higher than initial reading, remove locknut and lockwasher, remove Loctite from all parts, and repeat steps (g) through (m) to reinstall parts.
   o. Remove bolt (31) from bolt circle of hub and bend aligned tang of lockwasher into slot in locknut.
   p. Stake locknut in four equally spaced places 1/8 inch (3.2 mm) from inner edge of locknut.
   q. Apply a light coat of “Never-Seize” to three magnetic pipe plugs (12) and install then into side of hub.
   r. Turn unit over onto its wide end. Using a seal pressing tool, press seal (10), seal lip facing up, into hub around end of shaft.
   s. Apply a light coat of “Never-Seize” to pipe plug (11) and install it into bottom of hub near shaft.
2. Assemble carrier assembly (16) as follows:
   a. Apply a light coating of petroleum jelly or multipurpose grease to inside of one cluster gear (19) and line inside of large end of cluster with nineteen needle rollers (13).
   b. Place spacer (17) on top of needle rollers inside cluster gear.

c. Apply a light coating of petroleum or multi-purpose grease to inside of small end of cluster and line inside of small end of cluster gear with nineteen needle rollers (13).

d. Stand carrier housing (16) on its side. Insert a planet shaft (14), end with roll pin last, into one of the planet shaft holes in carrier housing.

e. Note tab on thrust washer (15). Place thrust washer onto end of planet shaft in carrier housing, placing tab of washer into slot in side of carrier housing.

f. Following the thrust washer, place assembled cluster gear, large end toward roll pin holes, onto planet shaft.

g. Following the cluster gear, place one more thrust washer (15) onto planet shaft, placing tab of thrust washer into slot in side of carrier housing. Now insert planet shaft into opposite planet shaft hole in carrier housing.

h. Using an alignment punch, align roll pin holes in carrier housing and planet shaft, then drive roll pin (18) into the aligned holes.

i. Repeat steps (a) through (h) to assemble and install remaining two cluster gears.

3. Place hub assembly (9) on work surface with open end facing up.

4. Oil all exposed surfaces inside hub, then lower internal gear (20), small end down, into hub.

⚠ CAUTION

BEWARE OF SHARP EDGES AND BURRS IN THE COUNTERBORE WHEN INSTALLING O-RING.

5. Grease and place o-ring (23) into counterbore of hub. O-ring can be made to fit counterbore exactly by stretching it (if it is too small), or by squeezing it together bit by bit as it is placed around the counterbore (if it is too large).

6. Place carrier assembly on work surface so one planet shaft hole faces you and other two planet shaft holes are opposite you. Line up punch marks on gear teeth of carrier assembly to the 12 o'clock position as shown in Figure 3-2. Place ring gear (21) onto carrier to keep punch marks in position.

7. Lower carrier assembly into hub, meshing gears of carrier with internal gear splines.

8. Place input gear (25) down into hub, into middle of carrier.

9. Lift ring off of carrier carefully (so carrier gears do not move) and replace ring gear (21) onto hub, ensuring bolt holes in hub and ring gear are aligned.

⚠ CAUTION

BEWARE OF SHARP EDGES AND BURRS IN THE COUNTERBORE WHEN INSTALLING O-RING.

10. Set cover (28) on work surface, interior side up. Grease and place o-ring (23) into counterbore around rim of cover. Make o-ring fit counterbore exactly by stretching it or by pinching it together bit by bit.

11. Grease and place thrust washer (27) halfway down in counterbore in center of cover, until it rests on a "ledge" in counterbore.

12. Grease and place thrust washer (22) around edge of raised circular center of cover.

13. Lower cover, interior side down, onto ring gear. Align bolt holes in cover and ring gear.

14. Grease and place thrust washer (29) into counterbore inside center of cover, on top of retaining ring (30).

⚠ CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

15. Place retaining ring into groove inside counterbore in center of cover.

16. Place twenty lockwashers (24) over bolt holes in cover.
17. Place twenty bolts (31) into bolt holes in cover and tighten.
18. Torque bolts to 35-45 ft. lb. (47-61 Nm).
19. Apply a light coat of “Never-Seize” to three pipe plugs (32) and tighten pipe plugs into holes in cover.
20. Place roll tester in coupling in end of unit and roll it in both clockwise and counterclockwise directions. Perform the same number of turns in each direction as the ratio of the unit. This number is the same as the last two digits in the model number found on the ID tag of the unit.
21. Leak test unit at 5 psi (2 bar).
22. Remove pipe plugs (12) from hub and fill drive hub half full with EP 90 extreme pressure lubricant, then install pipe plugs in hub. Torque hub is half full when lubricant runs out of side hole on hub.

3.8 SWING BRAKE - AUSCO - MACHINES BUILT TO 1992

Disassembly

1. With shaft protruding downward, remove bolts (22) alternately and evenly to reduce spring tension.
2. Remove power plate (21) and gasket (2).
3. Bearing (18) is pressed onto shaft (7) and must be removed before removal of rotating discs (11) and stationary discs (12).
4. Further disassembly is not recommended unless necessary for the replacement of specific parts.
5. If further disassembly is required, remove shaft (7) and stack sub-assembly from housing (1) by lightly tapping or pressing on the small external spline end of the shaft and removing the shaft, bearings and stack from housing.
6. Remove bearing (18), stationary disc (12), rotating disc (11), springs (10) and primary disc 9.
7. Remove bearing (3) from shaft, taking care not to damage seal 4. Remove seal.
8. Remove springs (6) and spring retainer (5) from housing.
9. Remove piston (13) from power plate by introducing low pressure air (15 psi [10 bar]) into the hydraulic inlet. Direct piston away from operator.
10. Remove o-rings (15 and 17) and back-up rings (14 and 16) from piston OD and ID grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.
11. Pressure relief valve (23) can be removed and inspected to assure spring loaded ball moves freely and is contamination free.

Cleaning and Inspection

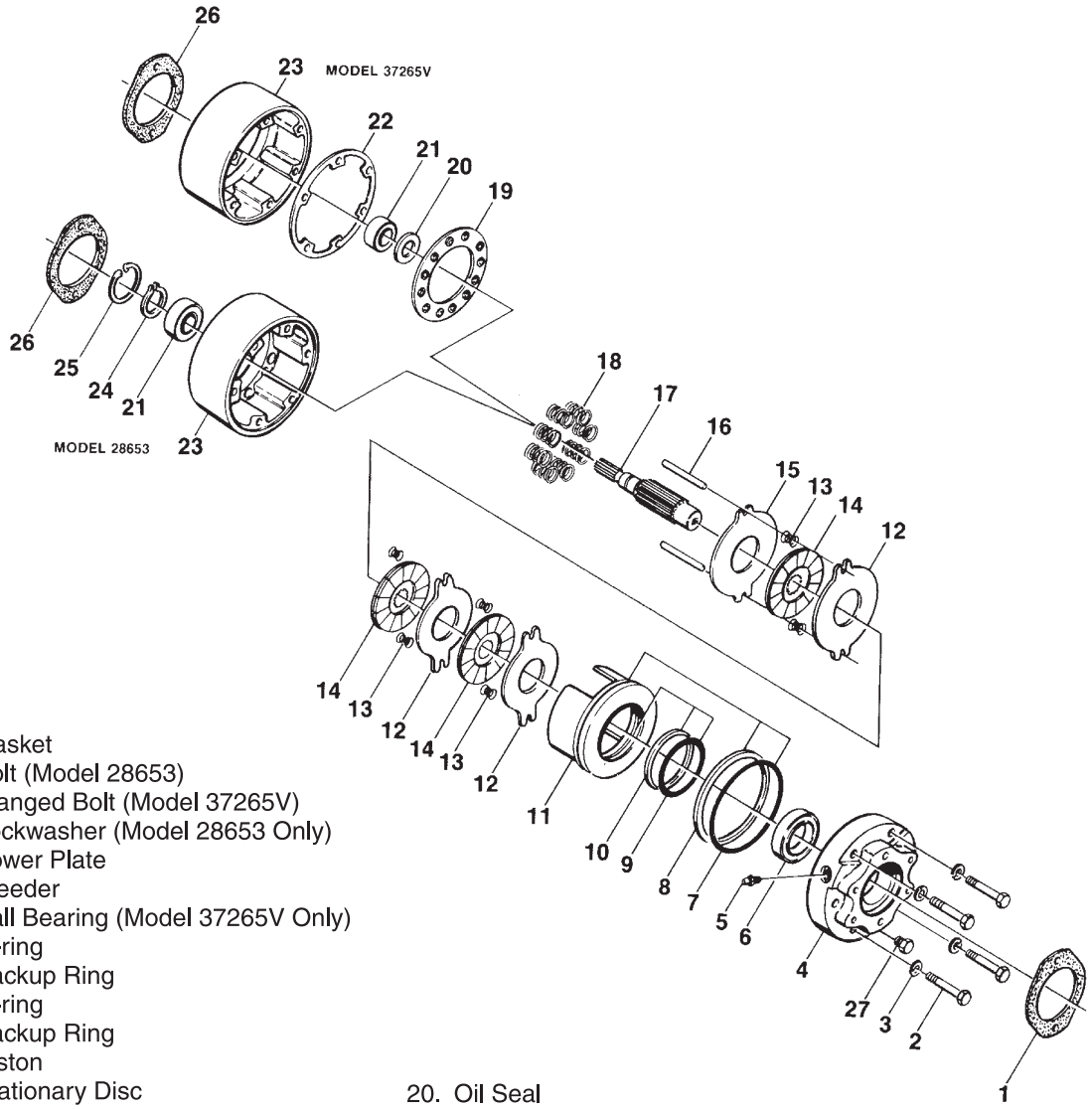
1. Clean all parts thoroughly.
2. Closely inspect all parts for damage, excessive wear, cracks and chips. Replace parts as necessary.
3. Discard seals and o-rings.
4. Closely inspect bearings and bearing contact surfaces.

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

Assembly

NOTE: *Lubricate all seals, o-rings, cylinder of the power plate and piston with clean hydraulic oil prior to assembly.*

1. Assemble piston (13) into power plate (21) using a shop press, being careful not to damage the o-rings or back-up rings. Visually align the center of the cut-outs in piston with torque pin (8) holes in power plate. Avoid pushing the piston all the way to the bottom of the cylinder in the power plate. Try to keep the top surface of the piston flush to 1/8 in. (3.2 mm) below the machined surface of the power plate.
2. When pressing the bearing onto the shaft, press on the inner race of the bearing and support the shaft properly.
3. Rotating discs must be clean and dry. Worn or heavily scored discs must be replaced.
4. Press bearing (3) into housing 1. Bearing must be seated against shoulder in housing.



1. Gasket
2. Bolt (Model 28653)
   Flanged Bolt (Model 37265V)
3. Lockwasher (Model 28653 Only)
4. Power Plate
5. Bleeder
6. Ball Bearing (Model 37265V Only)
7. O-ring
8. Backup Ring
9. O-ring
10. Backup Ring
11. Piston
12. Stationary Disc
13. Compression Spring
14. Rotating Disc
15. Primary Disc
16. Torque Pin
17. Splined Shaft
18. Compression Spring
19. Spring Retainer (Model 37265V)
20. Oil Seal
21. Ball Bearing
22. Gasket
23. Housing
24. Retaining Ring (Model 28653 Only)
25. Retaining Ring (Model 28653 Only)
26. Gasket
27. Pressure Relief Valve

Figure 3-22. Swing Brake - Ausco - Machines Built to 1992

5. Before installing seal (4), lubricate lip of seal with system hydraulic fluid or other suitable lubricant. Face lip of seal toward outside of brake in order to keep gear box oil or other external contaminants out of brake. Using a shop press, install seal (4) by pressing evenly around OD of seal. Use care to avoid cocking seal.
6. Install shaft (7) into housing. Support inner race of bearing (3) when pressing bearing onto shaft.
7. Install gasket 2. Align properly. After installing all remaining brake components, install bearing (18). Properly support shaft when pressing bearing onto shaft.
8. Install power plate sub-assembly. Use a shop press to evenly lower plate into position. There should be no gap at the OD when power plate is properly seated against housing. If a shop press is not available, use assembly bolts (22). Tighten sequentially, one at a time, until power plate is properly seated. Torque bolts to 50 to 60 ft. lb. (68 to 81 Nm).
9. If replacement of pressure relief valve is necessary, install 1/2 to 3/4 turns beyond finger tight.
10. Bleed air from brake via bleeder screw.

3.9 SWING BRAKE - MICO - MACHINES BUILT TO 1992

Disassembly

1. Separate end cover (34) from housing (56) by removing capscrews (31) and lockwashers (32).

⚠ CAUTION

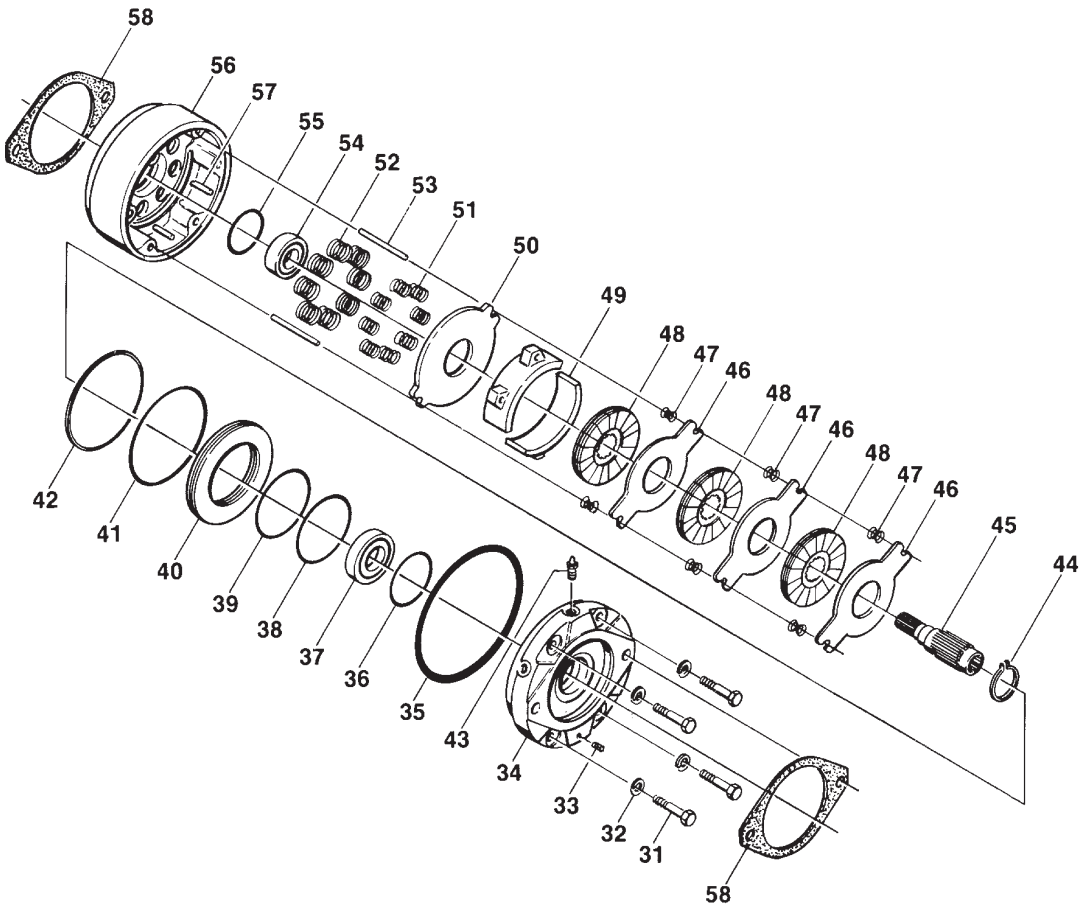
END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 1,500 LB. (680 KG). THE FOUR BOLTS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3,000 LB. [1,360 KG] MINIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

2. Tap cover with a soft mallet in order to dislodge bearing from cover.
3. Remove o-ring (36), square-ring (35), pipe plug (33) and bleeder (43) from end cover.
4. Remove piston (40) from end cover by inserting two 1/4-20 UNC bolts into threaded holes in piston. By turning and pulling, piston can be removed from bore.
5. Remove o-ring (38), back-up ring (39), o-ring (41) and back-up ring (42) from piston.
6. Remove separators (49) from housing (56).
7. Remove shaft assembly, consisting of shaft (45), discs (46, 50), friction plates (48), springs (47), snap ring (44) and bearings (3, 54) from housing by pressing or using a soft mallet on male end of shaft.
8. Remove springs (47) from between tabs of discs (46, 50).
9. Remove bearings (37, 54) from shaft (45) with appropriate bearing puller. The discs and friction discs will then slide off male end of shaft. Remove snap ring and shaft.
10. Remove dowel pins (53), springs (51, 52) and o-ring (55) from housing.

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.*



31. Capscrew
32. Lockwasher
33. Plug
34. Cover
35. Square Ring
36. O-ring
37. Bearing
38. O-ring
39. Back-up Ring
40. Piston
41. O-ring
42. Back-Up Ring
43. Bleeder
44. Retaining Ring
45. Shaft
46. Disc
47. Spring
48. Friction Disc
49. Separator
50. Disc
51. Spring
52. Spring
53. Dowel Pin
54. Bearing
55. O-ring
56. Housing
57. Spiral Pin
58. Gasket

Figure 3-23. Swing Brake - Mico - Machines Built to 1992

Assembly

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

1. Insert new o-ring (55), dowel pins (53) and springs (51, 52) in housing (56).
2. Install new bearing (54) in housing and press until bearing bottoms on shoulder in housing.
3. Position new large diameter disc (50) in housing with tabs guided by dowel pins (53) until disc rests on springs (51, 52).

NOTICE

DISCS (46,50) AND FRICTION DISCS (48) SHOULD REMAIN DRY DURING INSTALLATION. NO OIL RESIDUE SHOULD BE ALLOWED TO CONTAMINATE DISC SURFACES.

4. Place a new friction disc (48) on bottom disc (50), centering it as closely as possible. Insert one spring (47) on each dowel pin.
5. Add additional new discs (46), new friction discs (48) and springs (47) as required for specific model.
6. Install snap ring (44) on shaft (45). Insert shaft (45) thru friction discs (48) until shaft contacts bearing (54). Press shaft (45) until it shoulders on inner race of bearing. A small preload will exist on snap ring (44) at this point.
7. Insert separators (49) over spiral pins in housing (56). Separators will contact top of bottom disc (50) when properly installed.
8. Install new o-ring (38), new back-up ring (39), new o-ring (41) and new back-up ring (42) on piston (40). Insert piston (40) into end cover (34), being careful not to shear o-rings or back-up rings. Inserting 1/4-20 UNC bolts in piston may simplify installation.
9. Install new o-ring (36), new bearing (37), new square ring (35), pipe plug (33) and bleeder screw (43) in end cover.
10. Position end cover (34) on housing, aligning dowel pin (53) with holes in end cover.
11. Install capscrews (31) and lockwashers (32). Tighten evenly to draw end cover (34) to housing and bearing (37) onto shaft (45). Torque capscrews to 68 Nm.

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

12. 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).

NOTICE

PRESS FORCE SHOULD BE LIMITED TO 2,000 LB. (907 KG) MAXIMUM TO AVOID POSSIBLE DAMAGE TO SNAP RING (44).

NOTICE

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

3.10 SWING BRAKE - MACHINES BUILT 1992 TO PRESENT

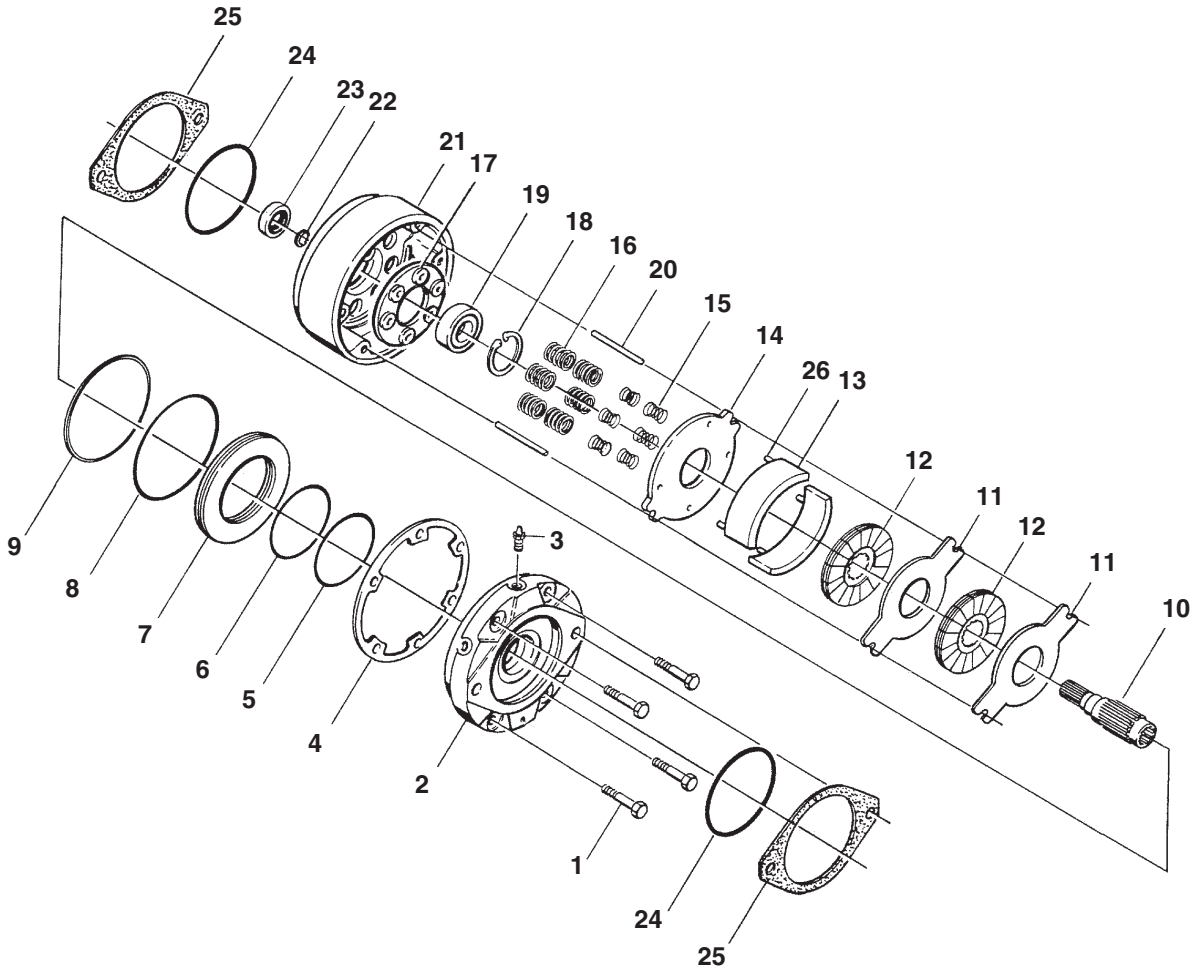
Disassembly

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

⚠ CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 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).



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 3-24. Swing Brake - Machines Built 1992 to Present

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).

NOTICE

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

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).

NOTICE

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

3.11 SWING MOTOR

Disassembly

NOTE: *Prior to any motor disassembly, plug open ports and clean all dirt from outside of motor.*

1. Mount motor in a vise or other holding device with shaft facing down.
2. Remove eight bolts (10) from cover/bearing assembly (13).
3. Remove cover/bearing assembly and o-ring (8). Discard o-ring.
4. Remove IGR assembly (6), starting with outer locating ring and rollers.

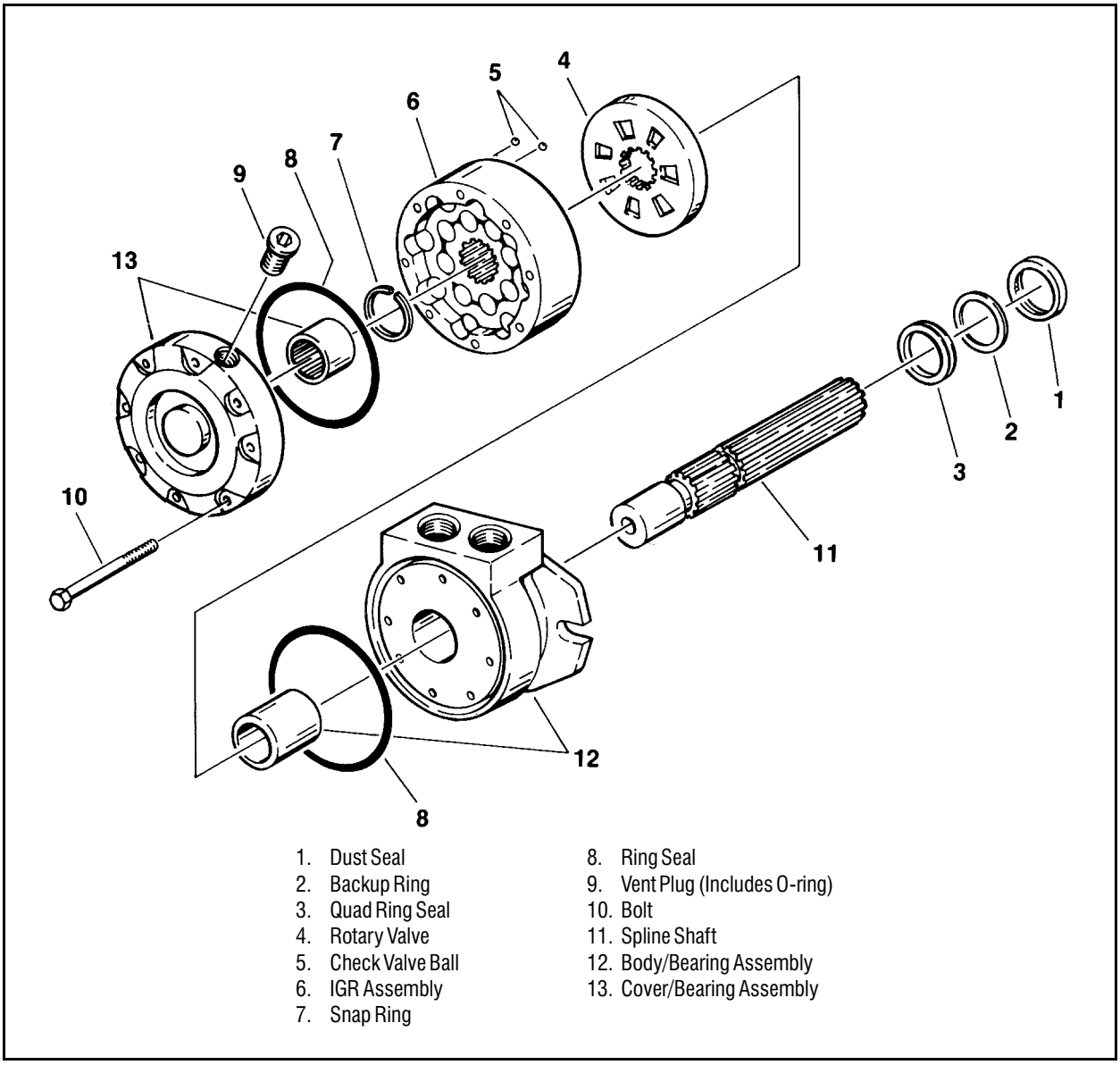
NOTE: *The innermost IGR component and rotary valve (4) are retained on shaft by snap ring (7). Do not remove this snap ring.*

5. Remove two check valve balls (5). Check balls frequently fall into body tapped holes or into body valve ports during disassembly. Ensure check balls are removed and accounted for.
6. Remove shaft (11), IGR element, and rotary valve as one assembly.
7. With shaft assembly removed from body, inspect IGR inner component, rotary valve and shaft for wear or other damage. Shaft should have a smooth polished surface in bearing and seal areas. If any of these components are damaged, snap ring must be removed and appropriate component replaced. If snap ring is removed, discard it and install new snap ring.
8. Quad ring seal (3) and back-up ring (2) can be removed using a dull pointed object such as a pencil point or the end of a paper clip. DO NOT use a sharp object such as a knife because the sealing surface in the body can be damaged.

Assembly

NOTE: *Prior to motor assembly, lightly oil all seals, rollers and threaded bolt ends.*

1. Install new back-up ring (2) first, pushing it sealing surface toward outside of motor. Back-up can be seated with a dull object.
2. Install new quad ring (3) by pushing it against inboard side of back-up ring.
3. Lubricate inside diameter of quad ring and back-up ring with oil or Vaseline.
4. Check output shaft (11) end for burrs and scratches. Deburr if necessary. Shaft must be free of burrs to avoid cutting quad ring and back-up ring during shaft installation.
5. Install shaft assembly into body/bearing assembly (12).
6. Place contour member of IGR (6) over inner member and insert seven rollers into inner pockets. (The seven rollers are larger in diameter than the eight rollers.)
7. Lightly oil square ring seal (8) and place in body groove.
8. Place check balls (5) over two 1/8 inch (3.2 mm) diameter holes in body. Ensure check balls do not fall into tapped holes in body.
9. Place locating ring section (4.5 inch [11.4 cm] diameter) of IGR onto body with check ball holes facing downward over balls. Align eight bolt holes in locating ring with eight holes in body. Holes will align in only one position. Be sure not to dislodge square ring seal while moving locating ring.
10. Install eight locating ring rollers into their pockets and oil lightly.
11. Place lightly oiled square ring seal (8) into groove in cover and place cover shaft and align bolt holes.
12. Install eight bolts (10) with lightly oiled thread ends into bolt holes. Tighten diagonally to 15 ft. lb. (20 Nm). Turn shaft by hand through several rotations. Increase torque of each bolt by 5 ft. lb. (7 Nm) in a diagonal pattern. Turn shaft by hand through several rotations. Repeat this procedure until torque of each bolt has reached 27 ft. lb. (37 Nm).



1. Dust Seal
2. Backup Ring
3. Quad Ring Seal
4. Rotary Valve
5. Check Valve Ball
6. IGR Assembly
7. Snap Ring
8. Ring Seal
9. Vent Plug (Includes O-ring)
10. Bolt
11. Spline Shaft
12. Body/Bearing Assembly
13. Cover/Bearing Assembly

Figure 3-25. Swing Motor

3.12 PQ CONTROLLERS

TRIM Adjustment

1. Disconnect ORANGE/RED (dump) wire from applicable terminal strip in platform console.
2. Install ammeter capable of measuring from zero to 2 amps in series with either valve coil B or D.
3. Position IGNITION/EMERGENCY STOP switch to ON, but do not start engine.
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. Using correct size common blade screwdriver, adjust LO trimpot until am-meter indicates 300 ma. Clockwise rotation of trimpot adjust screw increases ammeter; counterclockwise rotation decreases ammeter reading.
7. Operate controller in the same direction as in step (5) to the full extent of its travel and hold handle in that position.
8. Adjust HI trimpot until ammeter indicates 500 ma.
9. Move controller handle back to the position given in step (5) and check ammeter reading. This reading will have changed due to HI trimpot adjustment, and must be readjusted back to 300 ma.
10. Move handle to the position given in step (7) and check ammeter reading. This reading too will have changed due to LO trimpot readjustment, and must be adjusted back to 500 ma.
11. Repeat steps (9) and (10) until LO and HI readings of 300 ma and 500 ma can be achieved without further trimpot adjustments.
12. Release footswitch.
13. Connect ORANGE/RED (dump) wire to applicable terminal strip in platform console.
14. Using all applicable safety precautions, start machine and allow hydraulic oil to reach a temperature of 100 to 140 degrees (38 to 60 degrees C).
15. Depress footswitch and operate controller until trailing edge of slide lock is even with housing lock notch. Hold control handle in that position.
16. Adjust LO trimpot until applicable function just starts to work. Immediately stop adjustment.
17. Release footswitch and stop machine.
18. Seal each trimpot with a drop of enamel paint to prevent maladjustment due to vibration.
19. Install controller and secure machine.

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.

NOTE: *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 to 12 in. (20 to 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 to 12 in. (20 to 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.

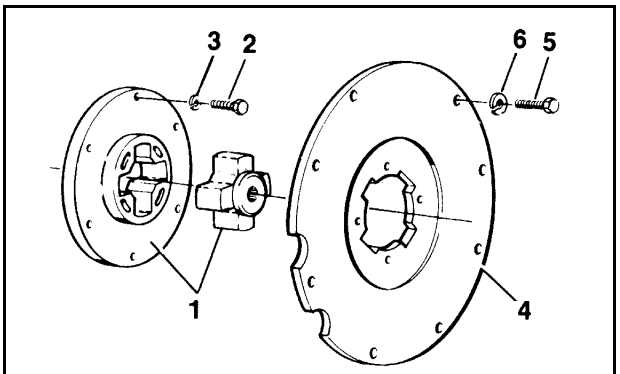
i. Seal ramp pot adjustment screw with a drop of enamel paint to prevent maladjustment due to vibration.

j. Install controller and secure machine.

3.13 PUMP COUPLING CONVERSION PROCEDURES

The following procedures are provided to assist in the conversion from a solid pump coupling to a Lovejoy or Hayes pump coupling.

Lovejoy Coupling



1. Coupling
2. Bolt
3. Lockwasher
4. Pump Adapter
5. Bolt
6. Lockwasher

Figure 3-26. Lovejoy Coupling

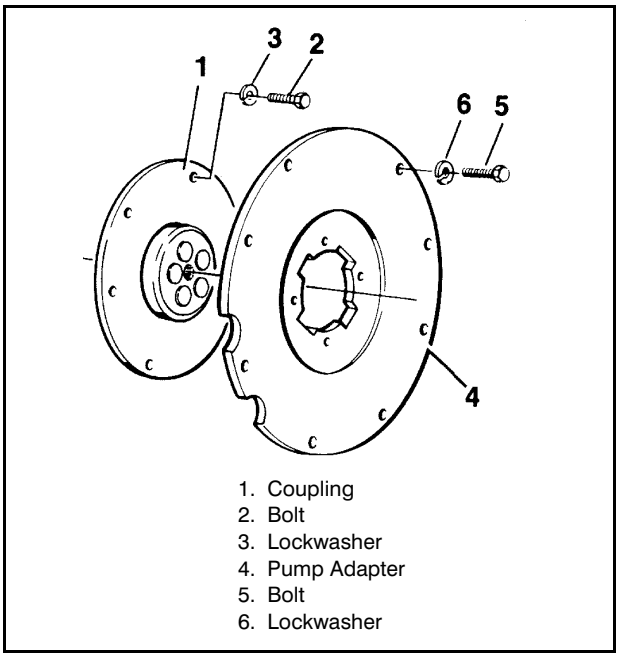
3. Separate coupling disc and hub and align plastic disc on flywheel with webbing facing flywheel. Install attaching bolts and lockwashers and torque bolts to 30 ft. lb. (41 Nm).

4. Attach pump mounting plate adaptor to bell housing of engine and secure with bolts and lockwashers.

5. Slide coupling hub onto pump shaft bottoms out on roll pin (located inside hub). Secure hub onto shaft by torquing torque screws to 22 ft. lb. (30 Nm).

6. Insert coupling hub (now affixed to pump shaft) through pilot bore in pump mounting plate. Align coupling hub and disc, push pump into position and secure with bolts and lockwashers.

Hayes Coupling



1. Coupling
2. Bolt
3. Lockwasher
4. Pump Adapter
5. Bolt
6. Lockwasher

Figure 3-27. Hayes Coupling

1. Install pump coupling on flywheel and secure with bolts and lockwashers. Torque bolts to 30 ft. lb. (41 Nm).

NOTICE

BEFORE ASSEMBLING PUMP COUPLING AND PUMP, BE SURE TO COAT INTERNAL SPLINES OF COUPLING AND EXTERNAL SPLINES OF PUMP SHAFT WITH TEXACO CODE 1912 GREASE.

2. Attach pump mounting plate adaptor to bell housing of engine and secure with bolts and lockwashers.
3. Align pump shaft with coupling, push pump into position and secure with bolts and lockwashers.

3.14 TILT ALARM SWITCH

NOTE: *Each machine is equipped with a tilt alarm switch, factory set to activate at 5 degrees, which will illuminate a warning light, sound a warning horn and cut out 2 speed drive. 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.*

⚠ CAUTION

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

Manual Adjustment

1. Park the machine on a flat, level surface. Ensure machine is level.

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.

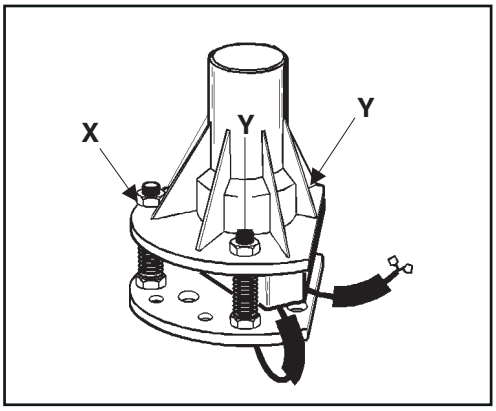


Figure 3-26. Tilt Switch Adjustment - Manual

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

Voltmeter Adjustment

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

3.15 THROTTLE CHECKS AND ADJUSTMENTS

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 Cummins instruction manual for procedure.*

a. 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.

b. Disconnect power (red) wire from high drive dump valve at rear of valve compartment. With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Activate footswitch. Turn on HIGH ENGINE switch. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 2500 RPM. Shut off all switches and controllers. Re-connect power (red) wire to high drive dump valve.

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

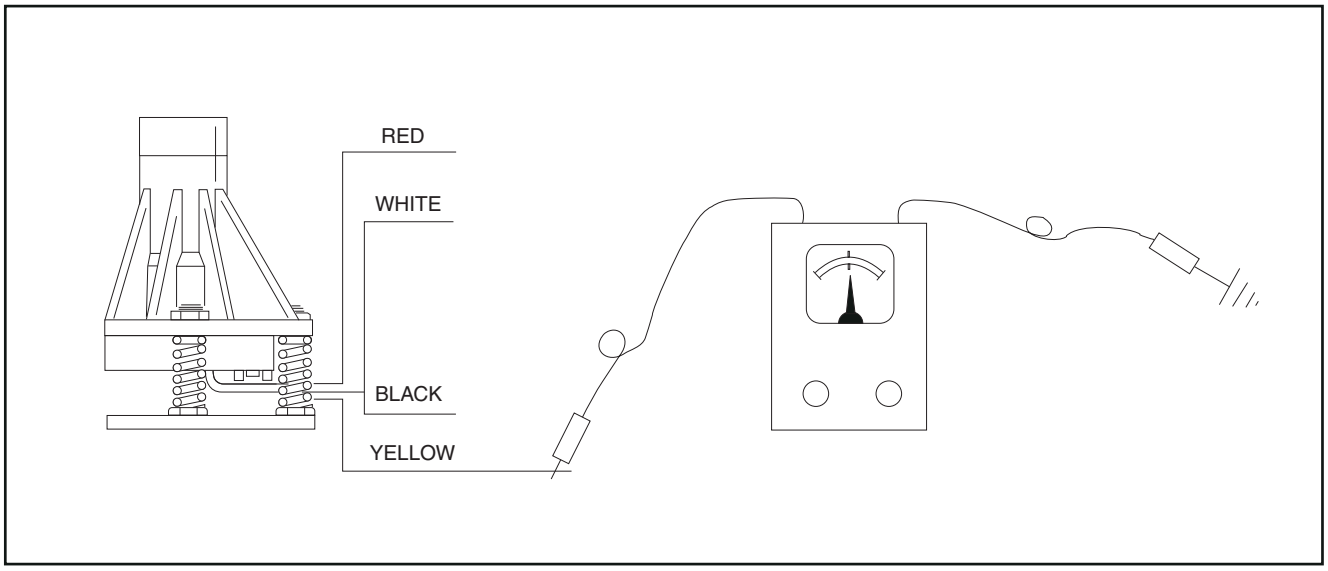


Figure 3-27. Tilt Switch Adjustment - Voltmeter

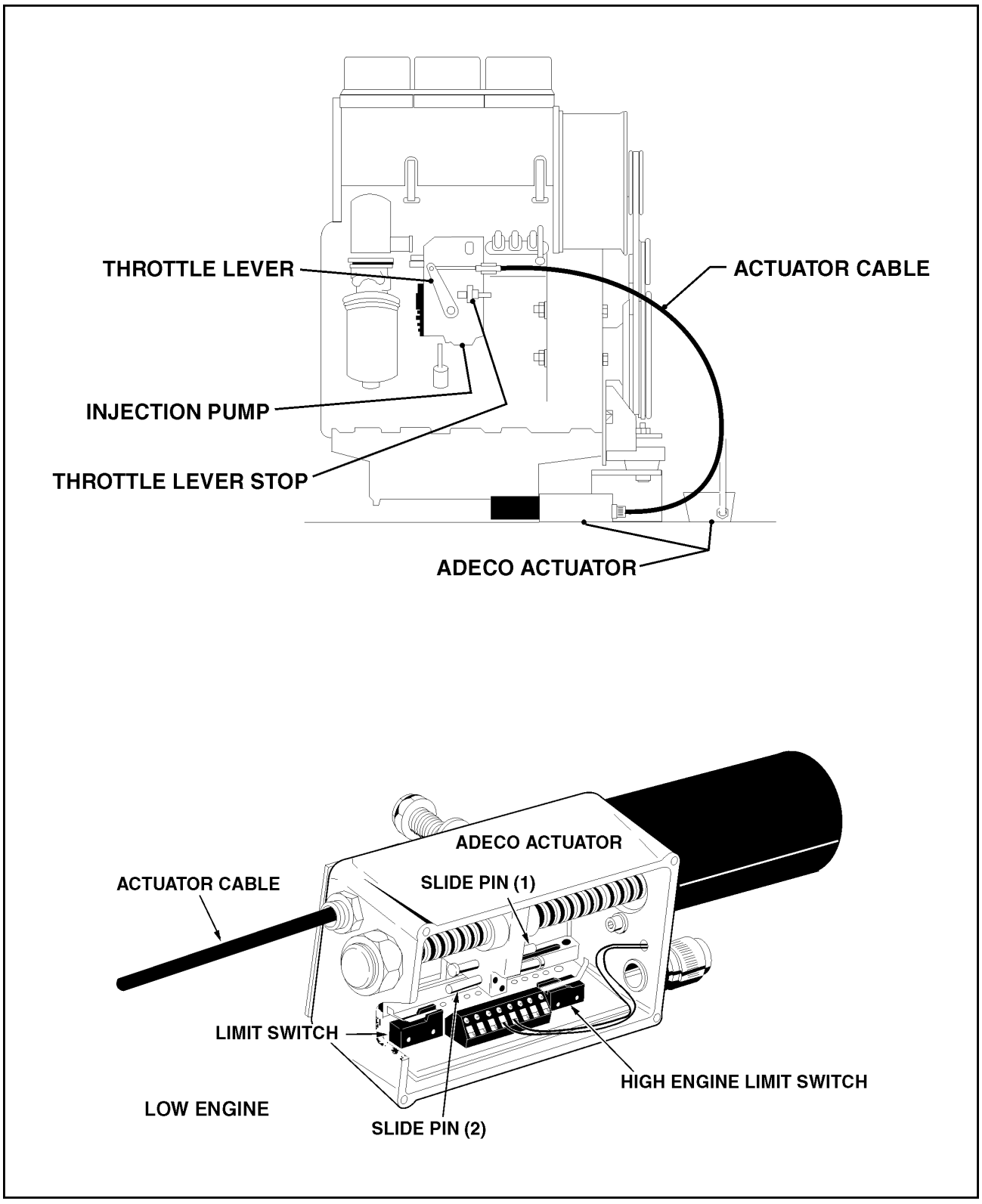


Figure 3-28. Throttle Checks and Adjustments - Deutz Engine

SECTION 4. BOOM & PLATFORM

4.1 BOOM MAINTENANCE

Boom Mounted Limit Switches and Valves

NOTE: *The numbers on the following descriptions correspond with the numbers in Figure 4-1., Boom Mounted Limit Switches and Valves Installation.*

1. Located inside of turntable at the main boom pivot pin on the left side - Controls speed of main boom lift and lower at fully stowed and fully elevated positions.
2. Outside of Fly Boom - Prevents operating tower boom lift or lower until the tower telescope is fully retracted. If tower telescope drifts out when stowed, tower lift will not operate.
3. Base end of Tower Boom on the bottom side - Prevents Hi speeds of the engine, drive, and 2 speed of the drive motors when tower boom is raised. Hi engine will operate when operating tower telescope and tower lift.
4. On top of Fly Boom - Prevents tower lift down unless main boom is fully lowered.
5. Inside of the turn tale on the left side - Cam #1 prevents the tower telescope extend function until tower lift is fully up. Cam #2 prevents main boom lift unless tower boom is fully up.

Main Boom Removal

1. Shut down machine systems.

NOTE: *Main Boom Assembly weighs approximately 6,350 lb. (2,880 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 Bolts and lockwashers attaching upper lift cylinder rod end attach pin to main boom.
5. Using a slide hammer or similar tool, and taking care not to damage pin, remove pin from main boom.
6. Using all applicable safety precautions, and only if necessary, operate main lift down and fully retract main lift cylinder.
7. Shut down machine systems.
8. Remove bolt and lockwasher securing level link attach pin to tower boom and remove pin from tower boom.
9. Remove setscrews securing upper master cylinder attach pin to level links. Remove pin and remove cylinder rod end from level link.
10. Tag and disconnect all wiring to ground control box.
11. Loosen and remove 4 bolts and lockwashers securing main boom pivot pin to tower boom.
12. Ensuring that boom is adequately supported and using a suitable slide hammer, carefully remove pivot pin from main boom and tower boom. Ensure that main boom and tower boom are not damaged.
13. Carefully lift main boom assembly clear of tower boom and lower to ground or suitably supported work surface.

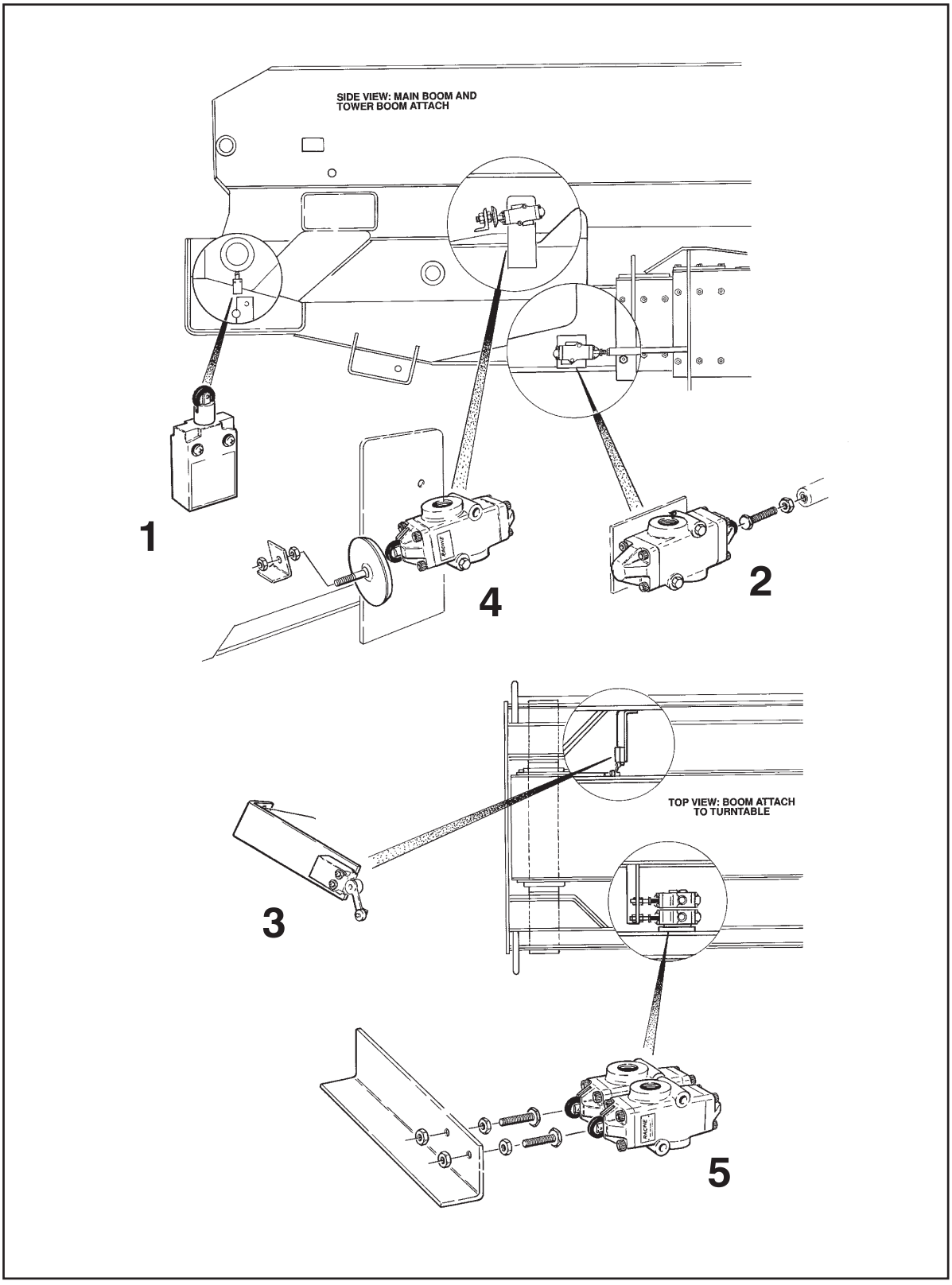


Figure 4-1. Boom Mounted Limit Switches and Valves Installation

Tower Boom Removal

1. Remove main boom as outlined in Main Boom Removal.
2. Shut down machine systems.

NOTE: *Tower Boom Assembly weighs approximately 14,700 lb. (6,668 kg).*

3. 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.

4. Tag and disconnect hydraulic lines that run along the side of the boom, and also lines to main lift cylinder, upper master level cylinder, and tower telescope cylinder.
5. Using suitable lifting equipment, adequately support main lift cylinder.
6. Remove bolts and lockwashers securing main boom lift cylinder barrel end to tower boom.
7. Using a slide hammer or similar tool, and taking care not to damage pin, remove pin from tower boom.
8. Carefully remove main lift cylinder from tower boom and place in a suitable work area.
9. Remove bolts and lockwashers securing tower lift cylinder rod end attach pin to tower boom.
10. Using a slide hammer or similar tool, and taking care not to damage pin, remove pin from tower boom.
11. Using all applicable safety precautions, and only if necessary, operate tower lift down and fully retract tower lift cylinder.
12. Shut down machine systems.
13. Tag and disconnect all wiring to ground control box.
14. Remove the bolts and lockwashers securing the lower master cylinder rod end to the tower boom.
15. Using a slide hammer or similar tool, and taking care not to damage pin, remove pin from tower boom. Remove cylinder rod end from tower boom.
16. Remove bolts and lockwashers securing tower boom pivot pin to turntable.
17. Ensuring that boom is adequately supported and using a suitable slide hammer, carefully remove pivot pin from tower boom and turntable. Ensure that main boom and turntable are not damaged
18. Carefully lift tower boom assembly clear of turntable and lower to ground or suitably supported work surface.

Main Boom 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 platform from end of main boom assembly.
5. Remove setscrews and bushing retaining telescope cylinder rod attach pin to base section.

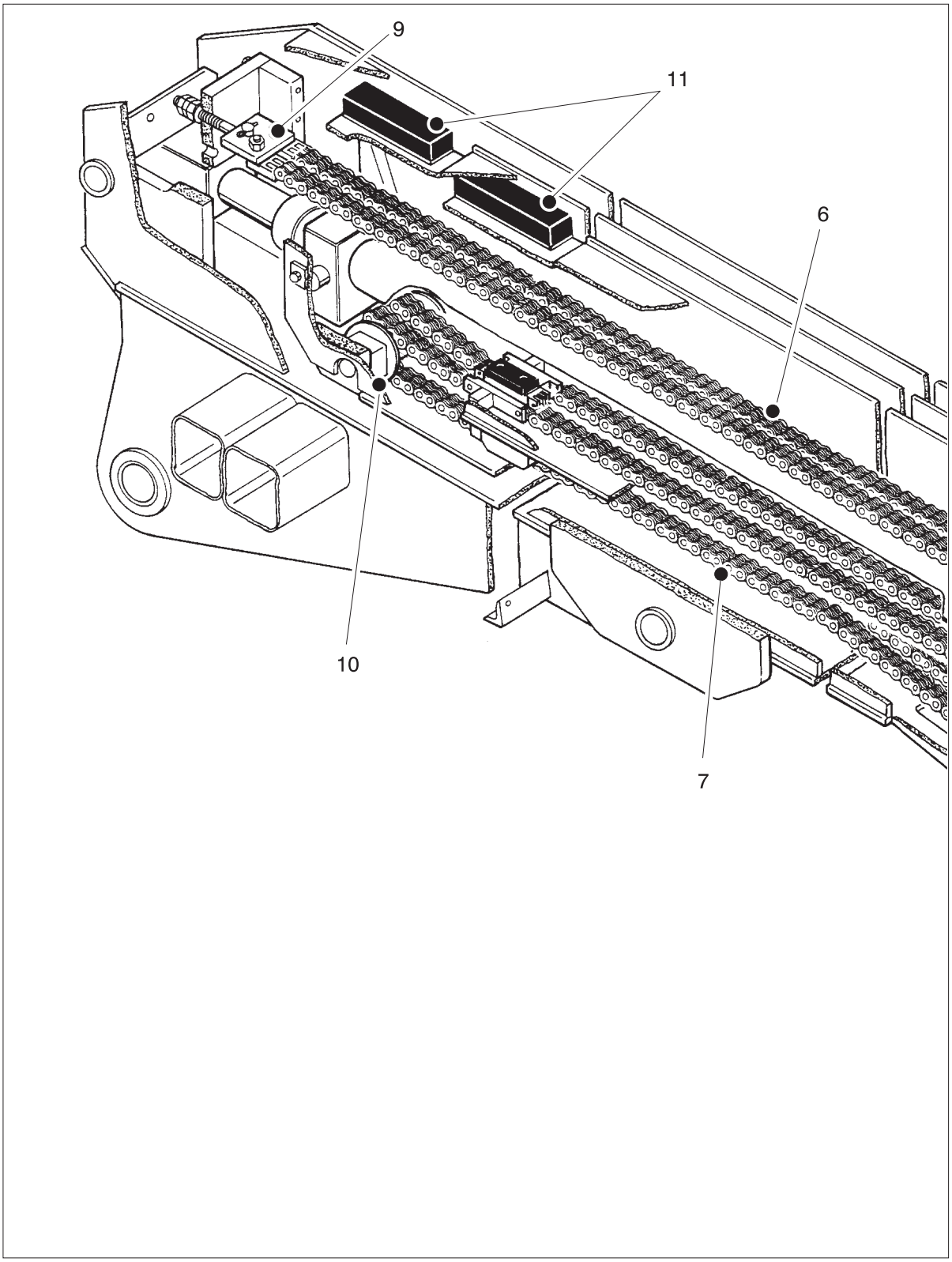


Figure 4-2. Main Boom Assembly - Sheet 1 of 2

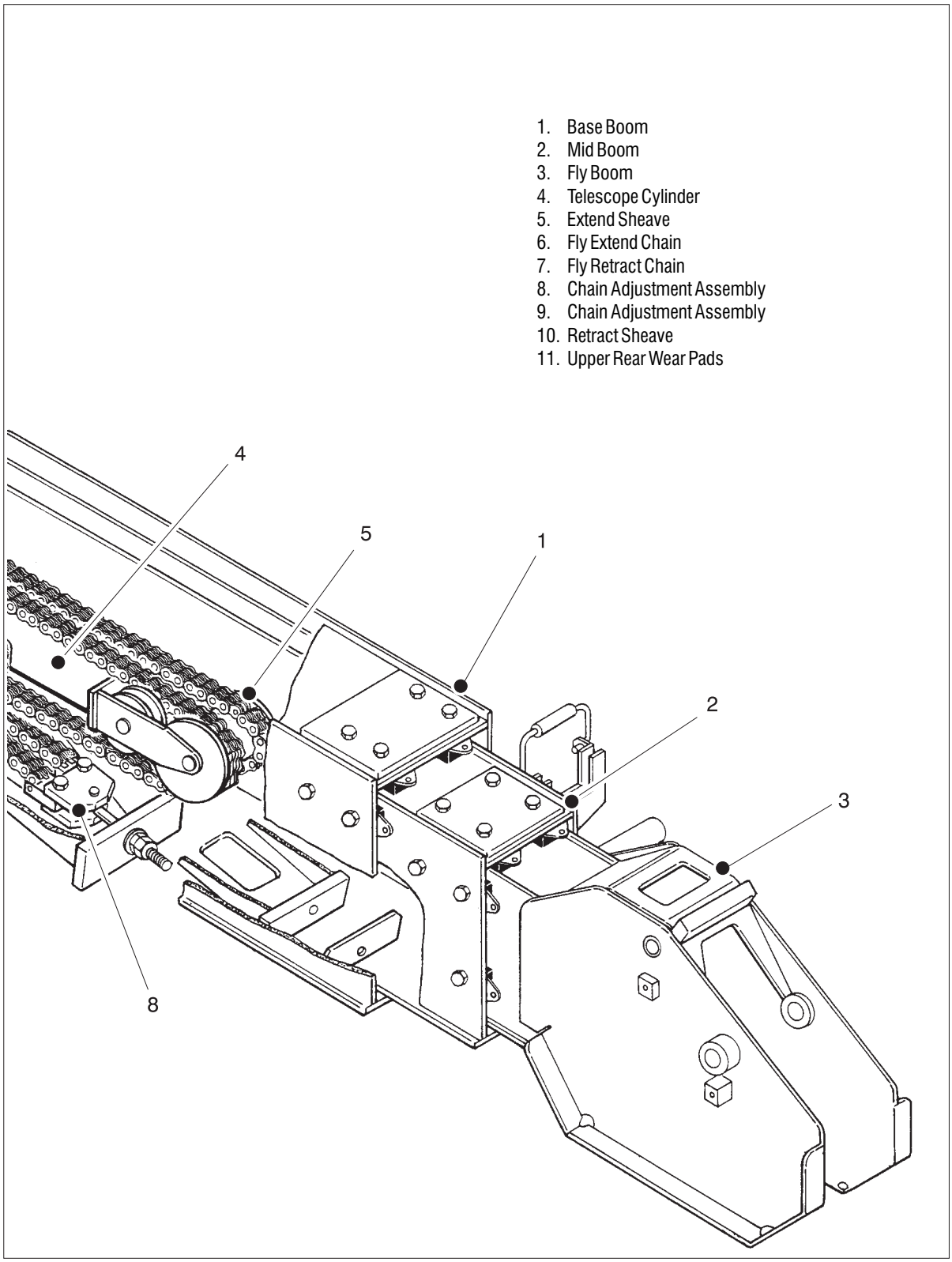


Figure 4-3. Main Boom Assembly - Sheet 2 of 2

6. Using a suitable brass drift, carefully drive telescope cylinder pin from base section.
7. Remove three locknuts and flatwashers from studs on top of aft end of base section.
8. Remove fly section extend chain adjust nut, locknut, and washer from chain attach plate at upper aft end of base section.
9. Remove bolts, washers and lockwashers attaching fly section extend chain attach plate to upper aft end of base section. Remove plate.
10. Remove six bolts and lockwashers securing retract chain clevis cover to lower front bottom of base section.
11. Remove fly section retract chain adjust nut, locknut, and washer at lower front end of base section.

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

12. Remove bolts and lockwashers attaching side wear pads to front of base section. Remove pads and any shims.
13. Remove bolts, washers and lockwashers attaching lower front wear pads and mounting blocks to base section. While supporting assembled fly and mid sections, remove wear pads, mounting blocks and shims.
14. Remove bolts and lockwashers attaching top front wear pads to base section. Remove pads and shims.
15. Using suitable lifting equipment, partially slide assembled mid and fly sections out of base section.
16. Using suitable straps, tie off fly section retract chains to underside of mid section as mid and fly sections are exiting base section.
17. Carefully lift mid and fly sections clear of base section and lower to a suitably supported work area.
18. Using suitable lifting equipment, support telescope cylinder rod.
19. Remove two bolts, washers, and lockwashers securing each trunnion pin cover to mid section.
20. 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.
21. Using a suitable slide hammer, remove trunnion pins attaching telescope cylinder to mid section.
22. Remove cotter pins and chain attach pins attaching fly retract chains to chain clevis at lower aft end of fly section and remove chains.
23. Remove setscrews which attach retract chain sheave pin at lower aft end of mid section.
24. Using a suitable brass drift, carefully drive sheave pin from mid section and remove sheave. If necessary, remove bushings from sheave and replace. Ensure that pins, grease fittings and corresponding boom and sheave surfaces are not damaged.
25. Pull fly section out several feet to allow ample clearance for telescope cylinder removal.
26. Using suitable lifting equipment, carefully slide telescope cylinder out of fly and mid sections, along with extension chain.
27. Carefully lift telescope cylinder clear of boom assembly and lower to ground or suitably supported work area.

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

28. Remove bolts and lockwashers which attach upper aft mid section wear pads and remove pads and any shims.

29. Remove bolts and lockwashers which attach bottom wear pads at front of outer mid section and remove pads and any shims.
30. Remove bolts and lockwashers which attach side wear pads at front of mid section and remove pads and any shims.
31. Remove bolts and lockwashers which attach top wear pads to front of mid section and remove pads and any shims.
32. Using suitable lifting equipment, carefully slide fly section clear of outer mid section and lower to ground or suitably supported work area.
33. Remove bolts and lockwashers which secure top and side aft wear pads to fly section.

Tower Boom Disassembly

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

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

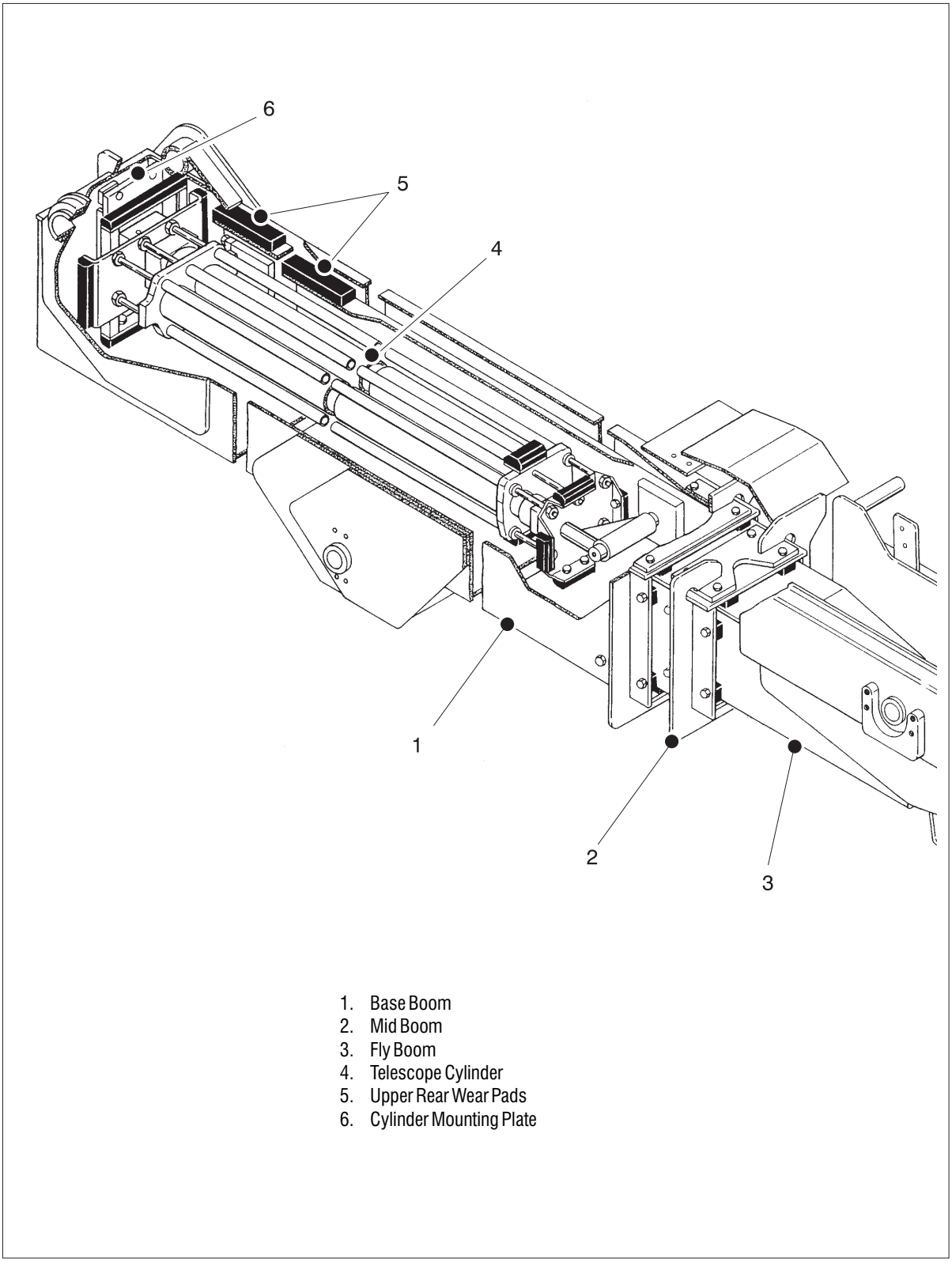
⚠ CAUTION

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

2. Remove bolts and lockwashers securing telescope cylinder attach plate to aft end of base boom.
3. Remove bolts and lockwashers securing telescope cylinder mounting plate to telescope cylinder.

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

4. Remove bolts and lockwashers attaching side wear pads to front of base section. Remove pads and any shims.
5. Remove bolts, washers and lockwashers attaching lower front wear pads and mounting blocks to base section. While supporting assembled fly and mid sections, remove wear pads, mounting blocks and shims.
6. Remove bolts and lockwashers attaching top front wear pads to base section. Remove pads and shims.
7. Using suitable lifting equipment, slide assembled mid and fly sections out of base section.
8. Carefully lift mid and fly sections clear of base section and lower to a suitably supported work area.
9. Remove bolts and lockwashers securing trunnion blocks to sides of mid section.
10. Carefully pull fly section from mid section far enough to expose telescope cylinder fly attach pin cover caps.
11. Remove bolts and lockwashers securing cover caps to each end of telescope cylinder fly attach pin. Remove cover caps.
12. Using a slide hammer or brass drift, remove attach pin from fly section.



1. Base Boom
2. Mid Boom
3. Fly Boom
4. Telescope Cylinder
5. Upper Rear Wear Pads
6. Cylinder Mounting Plate

Figure 4-4. Tower Boom

13. Using suitable lifting equipment, carefully slide telescope cylinder out of fly and mid sections and lower to ground or suitably supported work area.

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

14. Remove bolts and lockwashers which attach mid section top aft wear pads and remove pads and any shims.
15. Remove bolts and lockwashers which attach mid section side aft wear pads and remove pads and any shims.
16. Remove bolts and lockwashers which attach mid section bottom front wear pads and remove pads and any shims.
17. Remove bolts and lockwashers which attach side wear pads to front of mid section and remove pads and any shims.
18. Remove bolts and lockwashers which attach top wear pads to front of mid section and remove pads and any shims.
19. Using suitable lifting equipment, carefully slide fly section clear of mid section and lower to ground or suitably supported work area.
20. Remove bolts and lockwashers which attach top aft wear pads to fly section and remove pads and any shims.
21. Remove bolts and lockwashers which attach side aft wear pads to fly section and remove pads and any shims.
22. If necessary, remove bolt and lockwasher securing horizontal level link attach pin to fly section. Using a slide hammer or other suitable tool, remove pin from fly section and remove level link and bushings.
23. If necessary, remove bolt and lockwasher securing barrel end of upper master cylinder to fly section. Using a slide hammer or other suitable tool, remove pin from fly section and remove cylinder.

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 bushings for wear, scoring, or other damage, and for ovality. Replace bushings 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 pins for tapering, ovality, scoring, wear, or other damage. Replace pins 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 in. (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.

Main Boom Assembly

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

1. Install top and side aft fly section wear pads and shims, as required, using bolts and lockwashers.
2. Using suitable lifting equipment, carefully slide fly section into mid section.

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

3. Install mid section top front wear pads and shims, as required, using bolts and lockwashers.
4. Install mid section side front wear pads and shims, as required, using bolts and lockwashers.
5. Install mid section bottom front wear pads and shims, as required, using bolts and lockwashers.
6. Install mid section top aft wear pads and shims, as required, using bolts and lockwashers.
7. Install mid section side aft wear pads and shims, as required, using bolts and lockwashers.
8. Using suitable lifting equipment, carefully slide assembled mid and fly sections into base section.
9. Place fly section extend chain assembly along telescope cylinder chain rest with front end of chain hanging just below cylinder sheave.
10. Using lightweight motor oil (SAE 20W), adequately lubricate portion of chain occupying cylinder chain rest.
11. Using suitable lifting equipment, maneuver telescope cylinder and fly section extend chain assembly into position at aft end of assembled boom sections.
12. Attach loose end of extend chain to chain clevis at lower aft end of fly section. Install chain attach pins and flatwashers and secure with cotter pins.
13. Secure chain clevis to bottom aft of fly section with clevis pins and cotter pins.
14. If removed, install chain attach plate to aft end of base section. Secure with bolts, washers, and lockwashers.
15. With a slight downward angle on the cylinder, insert sheave and chain into boom sections until it is possible to insert chain adjust clevis into chain attach plate at aft end of base section. Install chain adjust clevis and locknuts.
16. Carefully feed telescope cylinder approximately halfway into boom sections, lubricating chain with lightweight motor oil as it passes along chain rest. Continue inserting into boom sections.
17. Install fly section retract chain sheave at aft end of mid section.
18. Install sheave pin and if necessary, tap pin into place using a soft headed mallet. Secure pin with setscrews.
19. Install lubrication fitting on end of pin and lubricate sheave with MPG.
20. Attach fly section retract chain to chain clevis at lower aft end of fly section. Install chain attach pins and flatwashers and secure with cotter pins.
21. Carefully place fly section retract chain around chain sheave at aft end of mid section and through bottom of base section.
22. Install fly section retract chain clevis into attach block at lower front end of base section. Install adjust nut and locknut on clevis. Install clevis cover on bottom of base section and secure in place with bolts and lockwashers.
23. Using suitable lifting equipment, carefully align holes in telescope cylinder trunnion and holes in aft end of mid section.

24. Install trunnion pins, tapping pins into place with a soft headed mallet if necessary. Install cover plate over trunnion pins and secure to mid section with bolts, washers, and lockwashers.

25. 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.*

26. Install base section top front wear pads and shims, as required, using bolts and lockwashers.

27. Install base section lower front wear pads, mounting blocks, and shims, as required, using bolts, washers, and lockwashers.

28. Install base section side front wear pads and shims, as required, using bolts and lockwashers.

29. Carefully align telescope cylinder rod end with holes in aft end of base boom section and install attach pin and bushing. If necessary, tap pin and bushing into place using a soft headed mallet. Secure pin and bushing with set screws.

30. Torque extend and retract chains to 50 ft. lb. (68 Nm) and tighten locknuts.

31. Install base boom end cover and secure in place with locknuts and washers.

32. Attach platform to boom assembly.

33. Connect wiring to platform control box.

34. Connect hydraulic lines to slave level cylinder and rotator motor.

35. Attach the right side bracket and powertrack to boom assembly.

Tower Boom Assembly

1. If removed, align barrel end of upper master cylinder with mounting holes on end of tower boom fly section and install attach pin. Secure pin in place with a bolt and lockwasher.

2. If removed, align horizontal level link with mounting holes in end of fly section and install attach pin. Secure pin in place with a bolt and lockwasher.

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

3. Install top aft fly section wear pads and shims, as required, using bolts and lockwashers.

4. Install side aft fly section wear pads and shims, as required, using bolts and lockwashers.

5. Using suitable lifting equipment, carefully slide fly section into mid section, just far enough that telescope cylinder fly end attach pin mounting hole is still exposed.

6. Using suitable lifting equipment, maneuver telescope cylinder into position at aft end of assembled boom sections.

7. Align fly attach end of telescope cylinder with mounting holes in fly section and install attach pin. Secure pin in place with cover caps, bolts, and lockwashers.

8. Carefully slide fly section the rest of the way into the mid section.

9. Carefully align ears on base end of cylinder barrel with notches in base end of mid section. Secure cylinder barrel in place with trunnion blocks, bolts, and lockwashers.

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

10. Install mid section top front wear pads and shims, as required, using bolts and lockwashers.
11. Install mid section side front wear pads and shims, as required, using bolts and lockwashers.
12. Install mid section bottom front wear pads and shims, as required, using bolts and lockwashers.
13. Install mid section top aft wear pads and shims, as required, using bolts and lockwashers.
14. Install mid section side aft wear pads and shims, as required, using bolts and lockwashers.
15. Using suitable lifting equipment, carefully slide assembled mid and fly sections into base section.
16. Install telescope cylinder mounting plate on base attach end of telescope cylinder. Secure mounting plate with bolts and lockwashers
17. Install telescope cylinder mounting plate on aft end end of base boom and secure with bolts and lockwashers.

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

18. Install base section top front wear pads and shims, as required, using bolts and lockwashers.
19. Install base section lower front wear pads, mounting blocks, and shims, as required, using bolts, washers, and lockwashers.
20. Install base section side front wear pads and shims, as required, using bolts and lockwashers.
21. Attach the right side bracket and powertrack to boom assembly.

Tower Boom Installation

1. Using suitable lifting equipment, position assembled tower boom on turntable so that boom pivot holes in tower boom and turntable are aligned.
2. Insert boom pivot pin, gently tapping pin into position with a soft headed mallet if necessary. Secure pin with bolts and lockwashers.
3. Align rod end attach hole of lower master cylinder with mounting hole in tower boom. Install attach pin.
4. If necessary, gently tap pin into position with a soft headed mallet and secure with a bolt and lockwasher.
5. Connect all wiring to ground control box.
6. Activate hydraulic system and operate tower lift up to extend tower lift cylinder until rod end attach hole is aligned with mounting hole in tower boom. Install attach pin.
7. If necessary, gently tap pin into position with a soft headed mallet and secure with bolts and lockwashers.
8. Connect hydraulic lines that run along the side of the boom.
9. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, then lower and retract boom fully. If problems are present, re-check procedures and make adjustments as necessary.
10. Shut down machine systems.
11. As necessary, lubricate all points requiring lubrication.

Main Boom Installation

1. Using suitable lifting equipment, position assembled main boom on tower boom so that boom pivot holes in main boom and tower boom are aligned.
2. Insert boom pivot pin, gently tapping pin into position with a soft headed mallet if necessary. Secure pin with bolts and lockwashers.
3. Align rod end of upper master cylinder with attaching holes in level links. Install attach pin and secure with setscrews.
4. Align horizontal level link with mounting hole in tower boom and insert attach pin. Secure pin with bolt and lockwasher.
5. Connect all wiring to ground control box.
6. Using all applicable safety precautions, operate lifting equipment in order to position main boom lift cylinder so that holes in cylinder rod end and boom structure are aligned. Insert lift cylinder pin.
7. 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 and lockwashers.
8. Shut down machine systems.
9. Connect hydraulic lines running along side of boom.
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. If necessary, adjust extend and retract chain systems and secure adjustment locknuts.
14. As necessary, lubricate all points requiring lubrication.

4.2 BOOM CHAINS

Adjusting Procedures - Main Boom

⚠ WARNING

ENSURE MACHINE IS ON A FIRM AND LEVEL SURFACE.

1. Position main boom fully retracted at +5 degrees horizontal, no load in platform.
2. Extend main boom 3 feet (1 meter).
3. Torque retract chain adjuster to 50 ft. lb. (68 Nm), then torque extend chain adjuster to 50 ft. lb. (68 Nm).
4. Retract main boom 1 foot (30.5 cm).
5. Check torque on extend chain adjuster.
6. Again retract main boom 1 foot (30.5 cm).
7. Recheck torque on extend chain adjuster.
8. Extend main boom 1 foot (30.5 cm).
9. Recheck retract chain adjuster torque.
10. Check for proper operation of main boom.

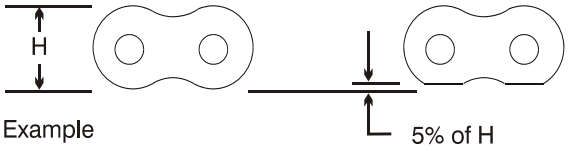
Inspection Procedure

⚠ WARNING

BOOM CHAINS ARE TO BE INSPECTED AT TIME OF NEXT BOOM OVERHAUL AND WHEN DEEMED NECESSARY BY MACHINE OWNER. INSPECTION INTERVAL SHOULD NOT EXCEED 500 HOURS OF MACHINE OPERATION.

Inspect boom chains for the following conditions:

1. **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 4-1, Chain Stretch Tolerance 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.



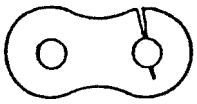
H for a 1" chain = 0.950"
Maximum wear = 5% of 0.950" = 0.047"
Minimum plate depth = 0.950" - 0.047" = 0.903"

2. **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.*

3. **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 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. 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.

4. **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.

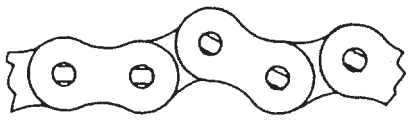


5. **Tight Joints:** All joints in the roller chain should flex freely. On roller chain, tight joints are usually caused by rust/corrosion, or the inside plates “walking” off the bushing. Limber up rusty/corroded chains (after inspecting care fully) with a heavy application of oil (preferably a hot oil 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.

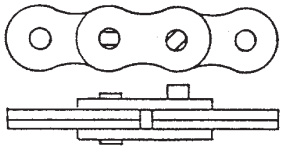
   TIGHT JOINTS

6. **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.

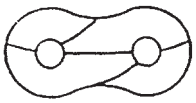
7. **Stress Corrosion Cracking:** The outside link plates, which are heavily press-fitted to the pins, are particularly susceptible to stress corrosion cracking. Like fatigue cracks, these initiate at the point of highest stress (aperture) but tend to extend in an arc-like path, often parallel to the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

   ABNORMAL PROTRUSION OR TURNED PINS

   Also, more then 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.

   ARC-LIKE CRACKED PLATES (STRESS CORROSION)

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

8. **Chain Anchors, Sheaves, and Pins:** 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 4-1. Chain Stretch Tolerance

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

4.3 WEAR PADS

Shim up wear pads to within 5/16 in. (0.8 mm) tolerance between wear pad and adjacent surface.

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

4.4 PLATFORM ROTATOR BRAKE

The platform rotator is equipped with a brake, which uses a stack of belleville washers to apply friction to the platform pivot point. To ensure proper friction, torque bolt securing belleville washers to 140 ft. lb. (190 Nm).

SECTION 5. HYDRAULICS

5.1 VALVES - THEORY OF OPERATION

Solenoid Control Valves (Bang-Bang)

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

Proportional Control Valves - Vickers

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

Load sensing lines connect through shuttle valves to feed the highest load signal back to the sequence valve. Integral actuator port relief valves, anti-cavitation check valves, and load check valves are standard.

Relief Valves

Main relief valves are installed at various points 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.

5.2 CYLINDERS - THEORY OF OPERATION

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: Tower Lift, Tower Telescope, Main Lift, Main Telescope, Front and Rear Steer, Lower Master, Upper Master, Platform Slave Level, Front and Rear Frame Lift and Front and Rear Axle Extend. 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 Tower Lift, Tower Telescope, Main Lift, Main Telescope and Platform Slave Level 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.

5.3 CYLINDER CHECKING PROCEDURES

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

Cylinders w/o Counterbalance Valves - Front and Rear Steer Cylinders, Front and Rear Frame Lift Cylinders, Upper Master Cylinder, Lower Master Cylinder, Front and Rear Axle Extension Cylinders

NOTICE

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 - Main Lift Cylinder, Tower Telescope Cylinder

NOTICE

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

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

⚠ WARNING

WHEN WORKING ON THE MAIN LIFT CYLINDER, RAISE THE TOWER BOOM AND THEN RAISE THE MAIN BOOM TO HORIZONTAL. SUPPORT THE MAIN BOOM USING A SUITABLE BOOM PROP OR OVERHEAD LIFTING DEVICE.

2. If working on the main lift cylinder, raise the tower boom and then raise the main boom to horizontal. Place a suitable boom prop approximately 1 in. (2.5 cm) below the boom. If working on the tower telescope cylinder, raise the tower boom above horizontal and extend the fly section 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 - Main Telescope Cylinder, Tower Lift Cylinder, Platform Slave Level Cylinder

NOTICE

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.
2. If working on the main telescope cylinder, raise the tower boom and then raise the main boom above horizontal. Extend the main 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 degree 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.

5.4 CYLINDER REMOVAL AND INSTALLATION

Tower Telescope Cylinder Removal

NOTE: *The tower boom can be telescoped without elevating the tower by overriding the plunger valves. Refer to Figure 4-1., Boom Mounted Limit Switches and Valves Installation.*

⚠ CAUTION

MAKE SURE THE TOWER BOOM IS NOT EXTENDED BEYOND WHAT IS NEEDED TO GAIN ACCESS TO THE ATTACH PINS.

NOTICE

MAKE SURE THE TOOLS USED TO OVERRIDE THE PLUNGER VALVE IS REMOVED BEFORE RETURNING THE MACHINE TO SERVICE.

1. Place machine on a flat and level surface, with boom in the horizontal position and extended just enough so that the fly section cylinder attach pins are exposed.
2. Shut down engine. Support main boom and tower boom with props or overhead lifting devices.
3. Remove four bolts and lockwashers securing telescope cylinder attach plate to base end of tower boom.
4. Remove four bolts and lockwashers securing telescope cylinder attach plate to port block of telescope cylinder. Remove attach plate.

⚠ 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.

6. Remove two bolts and lockwashers securing each of two trunnion blocks to base end of mid boom section. Remove trunnion blocks.
7. Remove bolt, lockwasher and end cap from each end of fly attach pin. Using a suitable brass drift, carefully drive fly attach pin from fly section.
8. Attach a suitable sling to the telescope cylinder rod. Support with an overhead crane or other suitable lifting device.
9. Using the lifting equipment, carefully pull cylinder from boom assembly.
10. Using another lifting device, support telescope cylinder fly end rod and remove cylinder from boom assembly. Lower cylinder to the ground or suitably supported work area.

Tower Telescope Cylinder Installation

1. Using suitable lifting equipment, carefully insert fly end cylinder rod into boom assembly.
2. Slide cylinder trunnion into appropriate slots inside mid boom section and secure with two trunnion blocks, four bolts and lockwashers.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Install cylinder mounting plate on cylinder base end port block and secure with four bolts and lockwashers.
5. Secure cylinder mounting plate to base boom with four bolts and lockwashers.
6. Using auxiliary power, extend telescope cylinder until fly end rod attach bushing is aligned with fly attach holes in fly boom.
7. Using a suitable brass drift, drive fly attach pin into fly boom and fly end rod attach bushing. Secure attach pin with end cap, bolt and lockwasher on each end of pin.
8. Fully retract boom and shut down engine. Check hydraulic fluid level and adjust accordingly.

Tower Lift Cylinder Removal

1. Place machine on a flat and level surface. Start engine and raise tower boom. Shut down engine and attach a suitable support device to boom.
2. Remove four bolts and lockwashers securing lift cylinder rod attach pin to tower boom. Using a suitable brass drift, drive out lift cylinder rod attach pin.
3. Using auxiliary power, retract tower lift cylinder rod completely.
4. Tag, disconnect and cap tower lift cylinder hydraulic lines and ports.
5. Remove the four bolts and lockwashers securing barrel end attach pin to turntable. Using a suitable brass drift, drive out barrel end attach pin from turntable.
6. Remove cylinder from boom and place in a suitable work area.

Tower Lift Cylinder Installation

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

Main Telescope Cylinder Removal

1. Place machine on a flat and level surface, with main boom fully retracted and in the horizontal position.
2. Shut down engine. Support boom platform end with a prop or overhead lifting device.
3. Remove boom end cover.

⚠ CAUTION

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

4. Tag and disconnect hydraulic lines to telescope cylinder. Use suitable containers to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
5. Remove two snap rings securing telescope cylinder pin to base boom.
6. Using a suitable brass drift, carefully drive telescope cylinder pin from base boom.
7. Remove telescope cylinder trunnion pin covers from each side of boom.
8. Remove capscrews securing trunnion pins from each side of boom.
9. Using a suitable slide hammer, remove trunnion pins attaching telescope cylinder to mid boom.
10. Attach a suitable sling to telescope cylinder rod. Support with an overhead crane or other suitable lifting device.
11. Remove two extension chain adjusting nuts from eye bolt through chain adjust block.
12. Remove four bolts and lockwashers attaching chain attach block to base boom section and remove block.
13. Using the lifting equipment, raise cylinder to obtain sufficient clearance for removal of rod support bracket.
14. Remove cylinder rod support bracket.
15. Attach a suitable lifting device to extension chain adjusting eye bolt above cylinder rod.

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

16. Using both lifting devices, carefully pull cylinder from boom assembly.
17. As cylinder is removed from boom, lay extension chain on top of base boom.
18. Using another lifting device, support sheave wheel end of cylinder and remove cylinder from boom assembly.
19. Carefully lift cylinder clear of boom assembly and lower to ground or suitably supported work area.

Main Telescope Cylinder Installation

1. Using suitable lifting equipment, carefully lower cylinder to boom assembly.
2. Using another lifting device, support sheave wheel end of cylinder and install cylinder into boom assembly.
3. Slide cylinder into boom, sliding extension chain in place as cylinder is moving in.
4. Attach a suitable lifting device to extension chain adjusting eye bolt.
5. Attach cylinder rod support bracket to rod support block on telescope cylinder.
6. Install chain adjust block to base boom section with four lockwashers and bolts.
7. Install two extension chain adjusting nuts that attach eye bolt to chain adjust block.
8. Remove sling attached to telescope cylinder rod.
9. Using a suitable brass drift, install trunnion pins attaching telescope cylinder to mid boom section.
10. Install capscrews securing trunnion pins to each side of boom. Note that JLG Threadlocker P/N 0100011 is required on capscrew threads.
11. Install trunnion pin covers on each side of boom.
12. Carefully install telescope cylinder rod attach pin into base boom.
13. Install snap rings that retain telescope rod attach pin to base boom.
14. Remove applicable hydraulic line and port caps and correctly connect hydraulic lines to telescope cylinder. Ensure all hoses are correctly routed.
15. Install boom end cover.
16. Activate hydraulic system.
17. Using all applicable safety precautions operate boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.
18. Cycle boom several times and torque boom chains to 50 ft. lb. (68 Nm).
19. Check fluid level of hydraulic tank and adjust as necessary.

Main Lift Cylinder Removal

1. With tower boom at horizontal, depress plunger on limit switch in main lift circuit, located inside turntable. Keep plunger depressed with a c-clamp. Raise main boom above horizontal, just enough to be able to access main lift cylinder. Attach a suitable support device or devices to main boom.

NOTE: *When raising main boom with tower boom at horizontal, do not completely raise main boom, as tipping may occur.*

2. Remove four bolts and lockwashers securing main lift cylinder rod end attach pin to boom. Using a suitable brass drift, drive attach pin from main boom.
3. Using auxiliary power, retract main lift cylinder completely.
4. Remove four bolts and lockwashers securing main lift cylinder barrel end attach pin to tower boom. Using a suitable brass drift, drive out attach pin from tower boom.
5. Remove cylinder from boom and place in a suitable work area.

Main Lift Cylinder Installation

1. Install main lift cylinder in place using suitable lifting slings or supports, aligning barrel end attach pins with holes in base boom.
2. Using a suitable brass drift, drive barrel end attach pin through mounting holes in base boom and cylinder barrel end. Secure in place with four bolts and lockwashers.
3. Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.
4. Using auxiliary power, extend cylinder rod until rod end aligns with attach pin holes in main boom. Using a suitable brass drift, drive rod end attach pin through aligned holes, taking care to align pin retaining plate holes with holes in main boom. Secure pin in place with four bolts and lockwashers.
5. Remove supports and lower boom to stowed position. Remove c-clamp from limit switch to release plunger. Shut down engine, check hydraulic fluid level and adjust accordingly.

Lower Master Level Cylinder Removal

1. With tower boom partly raised and properly supported, prepare to remove lower master level cylinder.
2. Remove bolt and lockwasher securing level cylinder rod attach pin to base end of tower boom. Using an appropriate brass drift, drive out level cylinder rod attach pin.
3. Tag, disconnect and cap hydraulic lines to level cylinder and disconnect supply lines from turntable swing motor.

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

4. Make up two temporary hydraulic hoses to carry power from swing motor supply lines to lower master level cylinder. Couple temporary hoses to swing motor supply hoses and to lower master level cylinder. Plug ports in swing motor.
5. After installing temporary hoses, use auxiliary power and activate swing function to fully retract lower master level cylinder.
6. Remove temporary hoses from lower master level cylinder and cap them. Plug cylinder ports.
7. Remove bolt and lockwasher securing barrel end attach pin to turntable. Using a suitable brass drift, drive out barrel end attach pin from cylinder. Remove cylinder from turntable.

Lower Master Level Cylinder Installation

1. With tower boom partly raised and properly supported, align level cylinder barrel end bushing with pin attach blocks in turntable and install barrel attach pin using appropriate brass drift. Secure pin with bolt and lockwasher.
2. 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 cylinder rod end attach points on base boom.
3. Using an appropriate brass drift, drive rod attach pin through aligned bushing of cylinder rod end and boom attach points, taking care to align pin attach hole with hole on boom. Secure rod end attach pin with bolt and lockwasher.
4. Remove temporary hydraulic lines from cylinder ports and turntable swing motor hydraulic supply. Reattach hydraulic supply to swing motor.
5. Remove caps from cylinder hydraulic lines and correctly install lines to cylinder.
6. Remove supports from boom. Lower tower boom to stowed position. Check hydraulic fluid level and adjust accordingly.

Upper Master Level Cylinder Removal

1. With main boom positioned to horizontal and properly supported, prepare to remove upper master level cylinder.
2. Loosen and remove setscrews securing upper master level cylinder rod attach pin to level links. Using an appropriate brass drift, drive out level cylinder rod attach pin.
3. Tag, disconnect and cap hydraulic lines to level cylinder and disconnect supply lines from turntable swing motor.

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

4. Make up two temporary hydraulic hoses to carry power from swing motor supply lines to upper master level cylinder. Couple temporary hoses to swing motor supply hoses and to upper master level cylinder. Plug ports in swing motor.
5. After installing temporary hoses, use auxiliary power and activate swing function to fully retract upper master level cylinder.
6. Remove temporary hoses from lower master level cylinder and cap them. Plug cylinder ports.
7. Remove bolt and lockwasher securing level cylinder barrel attach pin to lower boom. Using an appropriate brass drift, drive out level cylinder barrel attach pin and remove cylinder from lower boom.

Upper Master Level Cylinder Installation

1. With tower boom at horizontal, align level cylinder barrel end bushing with pin attach holes in turntable and install barrel attach pin using appropriate brass drift. Secure pin with bolt and lockwasher.
2. 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 cylinder rod end attach points on level links.
3. Using an appropriate brass drift, drive rod attach pin through aligned bushing of cylinder rod end and level link attach points. Secure rod end attach pin with setscrews.
4. Remove temporary hydraulic lines from cylinder ports and turntable swing motor hydraulic supply. Reattach hydraulic supply to swing motor.
5. Remove caps from cylinder hydraulic lines and correctly install lines to cylinder. Check hydraulic fluid level and adjust accordingly.

5.5 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

NOTICE

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

NOTICE

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.

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.*

NOTICE

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.

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.

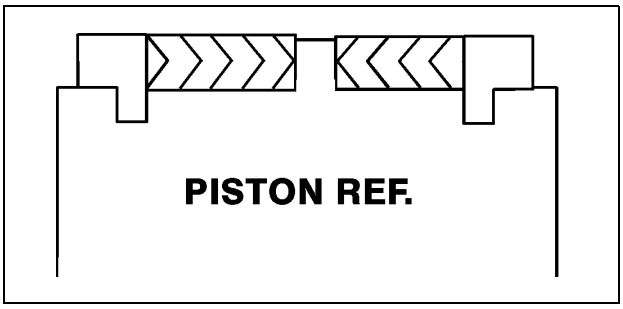


Figure 5-1. Poly-Pak Seal Installation

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 "LOCQUIC PRIMER T" AND JLG THREADLOCKER P/N 0100011 TO PISTON NUT THREADS, THEN TIGHTEN NUT TO TORQUE SHOWN IN Table 5-1.

Table 5-1. Cylinder Piston Nut Torque Specifications

Description	Piston Nut Torque Value (w/JLG Threadlocker)	Setscrew Torque Value (w/o JLG Threadlocker)
Main Lift Cylinder	600 ft. lb. (Nm)	200 in. lb. (23 Nm)
Tower Lift Cylinder	600 ft. lb. (813 Nm)	200 in. lb. (23 Nm)
Main Telescope Cylinder	600 ft. lb. (813 Nm)	100 in. lb. (11 Nm)
Tower Telescope Cyl. - 1st Section - 2nd Section	600 ft. lb. (813 Nm) 400 ft. lb. (542 Nm)	200 in. lb. (23 Nm) 100 in. lb. (11 Nm)
Master Cylinder	80 ft. lb. (108 Nm)	100 in. lb. (11 Nm)
Platform Level Cylinder	80 ft. lb. (108 Nm)	100 in. lb. (11 Nm)
Steer Cylinder	80 ft. lb. (108 Nm)	100 in. lb. (11 Nm)
Axle Extend Cylinder	100 ft. lb. (136 Nm)	100 in. lb. (11 Nm)
Axle Lift Cylinder	400 ft. lb. (542 Nm)	N/A

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

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.

NOTICE

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 5-2.Holding Valve Torque Specifications

Description	Torque Value
Sun - 7/8 Hex M20 x 1.5 Thds.	30-35 ft. lbs. (41-48 Nm)
Sun - 1 1/8 Hex 1/14 UND Thds.	45-50 ft. lbs. (61-68 Nm)
Sun - 1 1/4 Hex M36 x 2 Thds.	150-160 ft. lbs. (204-217 Nm)
Racine - 1 1/8 Hex 1 1/16 - 12 Thds.	50-55 ft. lbs. (68-75 Nm)
Racine - 1 3/8 Hex 1 3/16 - 12 Thds.	75-80 ft. lbs. (102-109 Nm)
Racine - 1 7/8 Hex 1 5/8 - 12 Thds.	100-110 ft. lbs. (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.

5.6 PRESSURE SETTING PROCEDURES

Cold temperatures have a significant impact on pressure readings. JLG Industries, Inc. recommends operating the machine until hydraulic system has warmed to normal operating temperatures prior to checking pressures. It is also recommended that a calibrated gauge is used. Pressure readings are acceptable if within ±5% of specified pressures.

Low Drive System

NOTE: *Make all drive pressure adjustments with pressure gauge plugged into quick-connect on the proportional relief and dump valve.*

1. Sequence Pressure.
   - **a.** Using a suitable “hot wire”, activate dump valve.
   - **b.** Loosen locknut on sequence valve and adjust to 450 psi (31 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut and remove “hot wire” from dump valve.
2. Single Stack Proportional Valve.

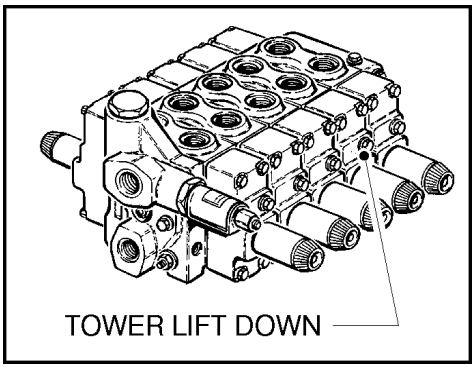
NOTE: *Prior to adjusting drive pressure, plug brake port (S) on drive counterbalance valve, located inside frame beneath swing bearing.*

- **a.** Bottom out Drive function.
- **b.** Loosen locknut on adjusting screw on proportional relief and dump valve and adjust to 3200 psi (221 bar). Turn screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

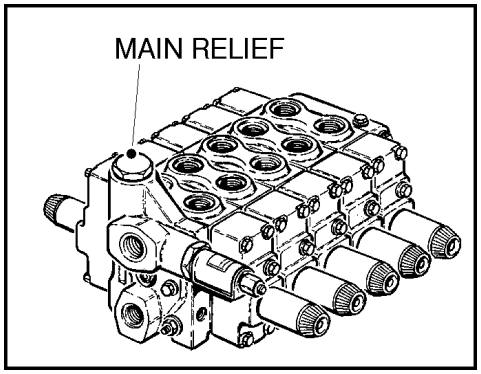
5 Stack Directional Control Valve (Internal Relief Adjustment)

NOTE: *Make all pressure adjustments with pressure gauge plugged into quick-connect adjacent to high drive dump valve at rear of valve compartment.*

1. Test the hydraulic pressures:
   - **a.** Start the engine and stall each function. Record the pressures.
   - **b.** Shut off the engine and apply a vacuum to the hydraulic tank.
   - **c.** Remove the plug cap from the Tower Lift Down valve section and add 6 shims. Reinstall the cap and remove the vacuum from the hydraulic tank.



   - **d.** Start the engine and stall the Tower Lift Down function. Record the main relief pressure.
   - **e.** Shut off the engine and apply a vacuum to the hydraulic tank.
   - **f.** Remove the plug cap from the Tower Lift Down valve section and remove the 6 shims. Reinstall the cap and remove the vacuum.
2. Adjust the hydraulic pressures:
   - **a.** Shut off the engine and apply a vacuum to the hydraulic tank.
   - **b.** If the main relief pressure is incorrect, replace the main relief cartridge in the inlet section.



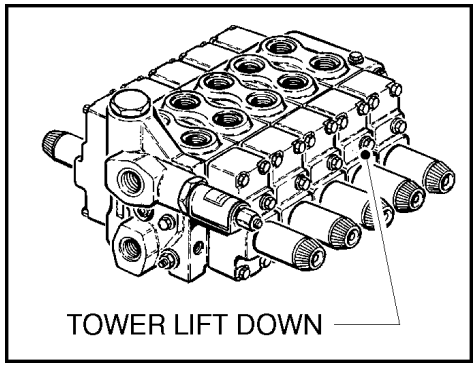
   - **c.** To adjust the functions, identify the correct plug.
   - **d.** Remove the plug and add shims to increase pressure or remove shims to decrease pressure. Each shim added or removed will change the pressure setting approximately 150 psi (10 Bar)

5 Stack Directional Control Valve (External Relief Adjustment Screws)

NOTE: *Make all pressure adjustments with pressure gauge plugged into quick-connect adjacent to high drive dump valve at rear of valve compartment.*

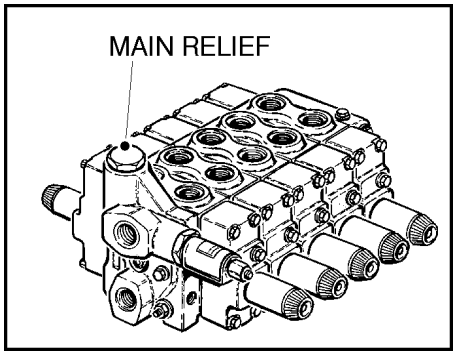
1. Main Relief.

a. Locate the Tower Lift Down Relief Valve. Screw the adjustment screw in all the way.



b. Activate Tower Lift Down function. The gauge should read 3800 psi (262 bar). If the pressure gauge reads 3800 psi (262 bar), reset the tower lift down relief to 3000 psi (207 bar).

c. If the pressure gauge does not read 3800 psi (262 bar), the main relief cartridge will have to be replaced as follows.



d. Turn off the engine and apply a vacuum to the hydraulic tank.

e. Remove the main relief cap.

f. Remove the springs and relief cartridge.

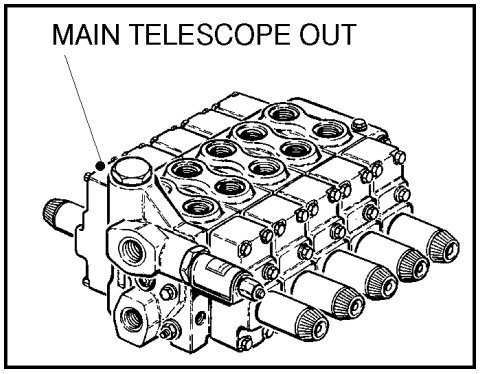
g. Install a new relief cartridge and springs and install the main relief cap.

h. Remove the vacuum from the hydraulic tank and retest the main pressure reading.

2. Main Telescope Relief.

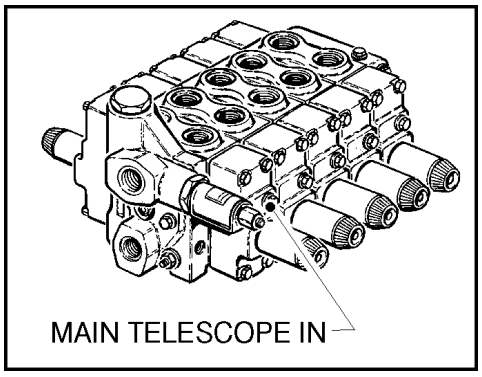
a. Bottom out Main Telescope Out function.

b. Adjust pressure to 3000 psi (207 bar).



c. Bottom out Main Telescope In function.

d. Adjust pressure to 3300 psi (228 bar).

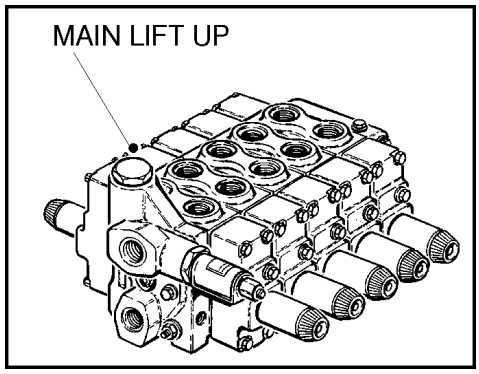


3. Main Lift Relief.

a. Tower boom section must be fully raised to operate Main Lift Up and Main Lift Down functions.

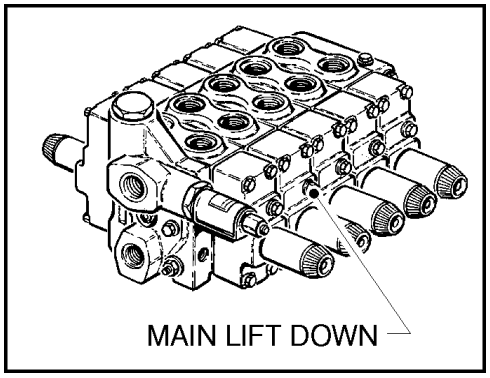
b. Bottom out Main Lift Up function.

c. Adjust pressure to 3000 psi (207 bar).



d. Bottom out Main Lift Down function.

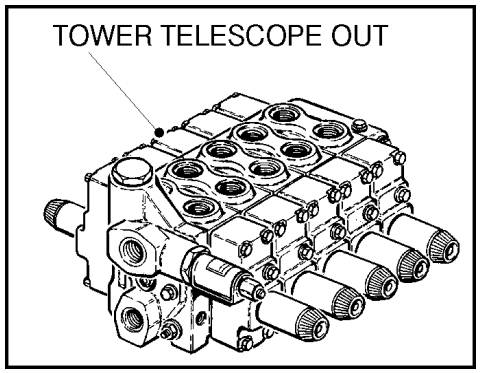
e. Adjust pressure to 1850 psi (128 bar).



4. Tower Telescope Relief.

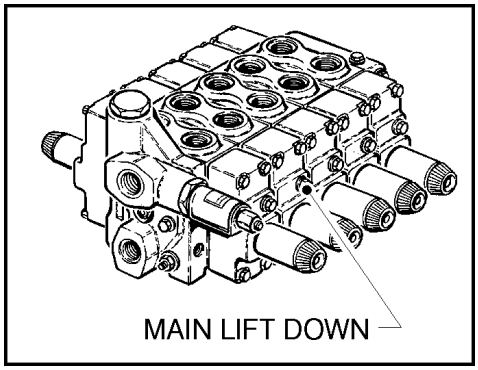
a. Bottom out Tower Telescope Out function.

b. Adjust pressure to 3000 psi (207 bar).



c. Bottom out Tower Telescope In function.

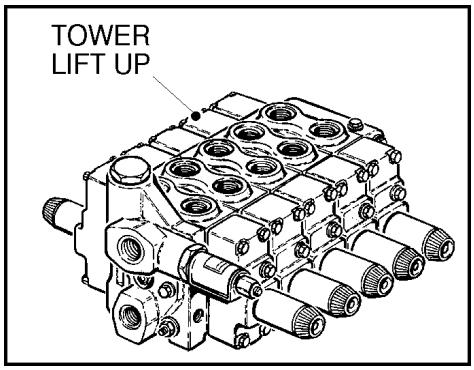
d. Adjust pressure to 2600 psi (179 bar).



5. Tower Lift Relief.

a. Bottom out Tower Lift Up function.

b. Adjust pressure to 3700 psi (255 bar).



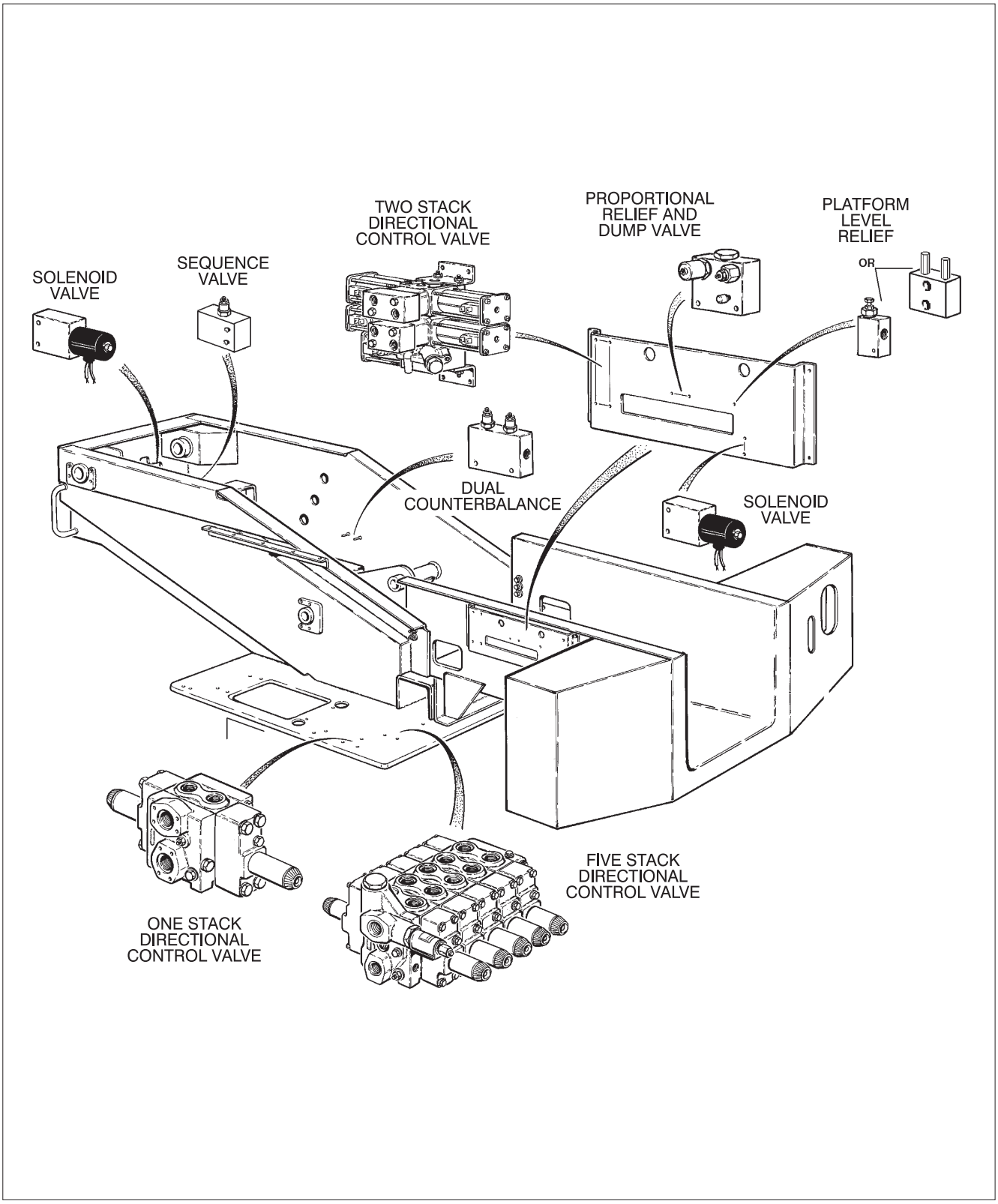


Figure 5-2. Valve Locations - Turntable Mounted Valves

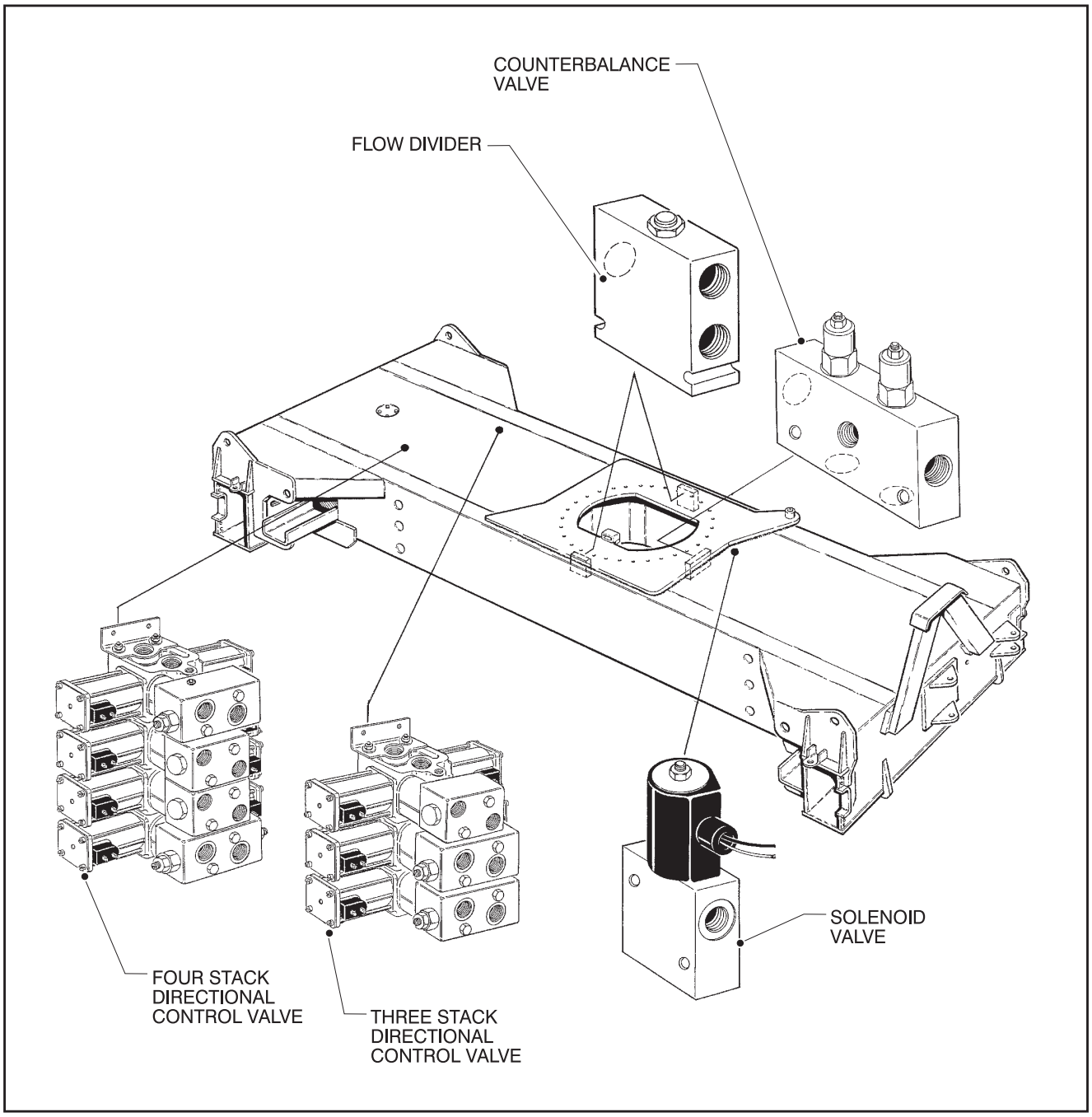
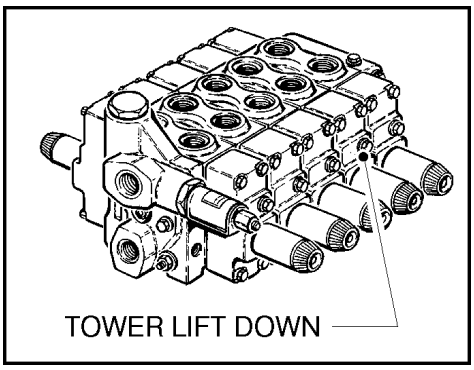


Figure 5-3. Valve Locations - Frame Mounted Valves

c. Bottom out Tower Lift Down function.

d. Adjust pressure to 3000 psi (207 bar).

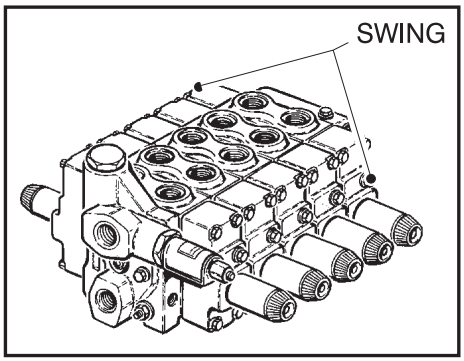


6. Swing Relief.

a. Lock turntable.

b. Bottom out Swing Right function.

c. Adjust pressure to 1700 psi (117 bar).



d. Bottom out Swing Left function.

e. Adjust pressure to 1700 psi (117 bar).

f. Unlock turntable.

Two Stack Directional Control Valve

1. Attach pressure gauge to quick disconnect at two stack directional control valve, located inside control valve compartment on right side of machine, adjacent to engine compartment

2. Loosen locknut on adjusting screw on rotate right valve section and turn adjusting screw clockwise to increase pressure.

3. Bottom out Rotate Right function.

4. Remove cap plug on main relief and adjust main relief to 2750 psi (190 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Replace cap plug.

5. After main relief has been set, bottom out Rotate Right again and turn adjusting screw on rotate right valve section to 2500 psi (172 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

6. Bottom out Rotate Left function.

7. Loosen locknut and turn adjusting screw on opposite side of valve section to 2500 psi (172 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

8. Bottom out Level Up function.

9. Loosen locknut and adjust level up relief valve, located adjacent to single spool proportional relief valve, to 2500 psi (172 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

10. Bottom out Level Down function.

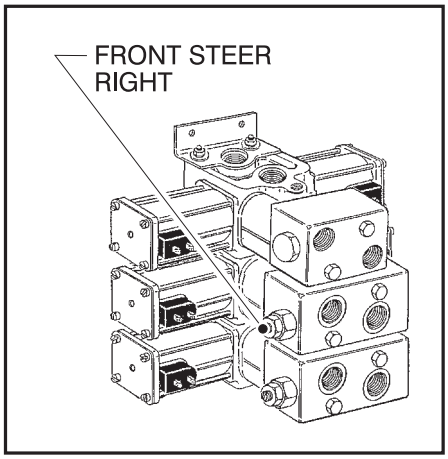
11. Loosen locknut and adjust level down relief valve, located adjacent to single spool proportional relief valve, to 2500 psi (172 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

Three Stack Directional Control Valve

1. Plug pressure gauge into quick-connect at three stack directional control valve, located inside left rear of machine frame.

2. Bottom out Front Steer Right function.

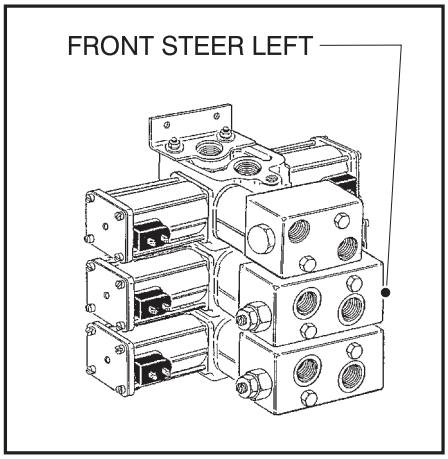
3. Loosen locknut on front steer valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



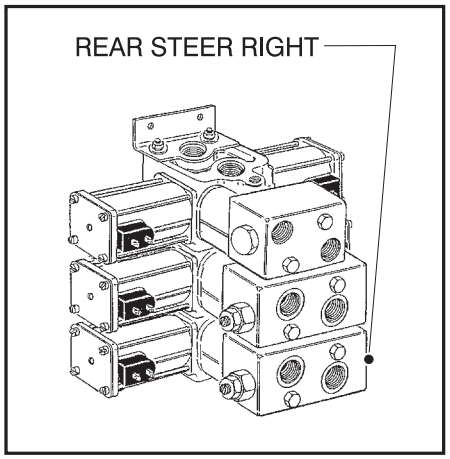
4. Bottom out Front Steer Left function.

5. Loosen lock nut on opposite side of valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise

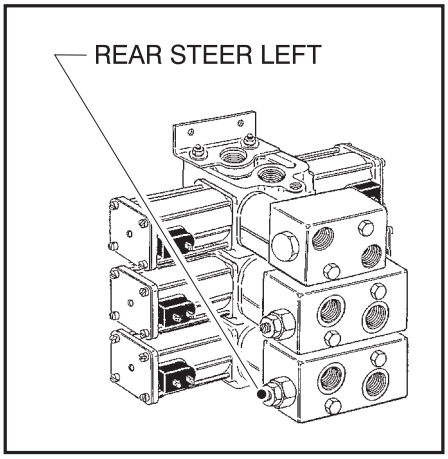
to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



6. Bottom out Rear Steer Right function.
7. Loosen locknut on rear steer valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

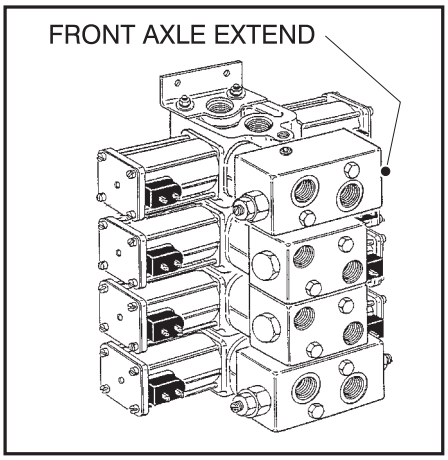


8. Bottom out Rear Steer Left function.
9. Loosen lock nut on opposite side of valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



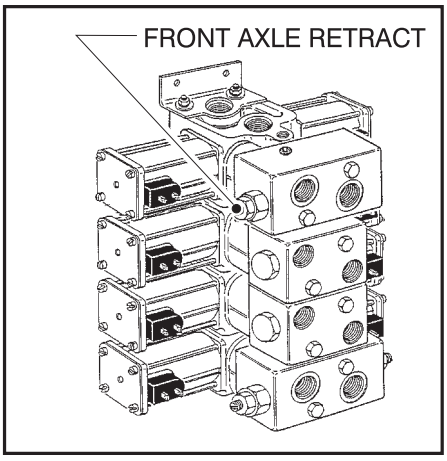
Four Stack Directional Control Valve

1. Plug pressure gauge into quick-connect at three stack directional control valve, located inside left rear of machine frame.
2. Bottom out Front Axle Extend function.
3. Loosen locknut on applicable valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.

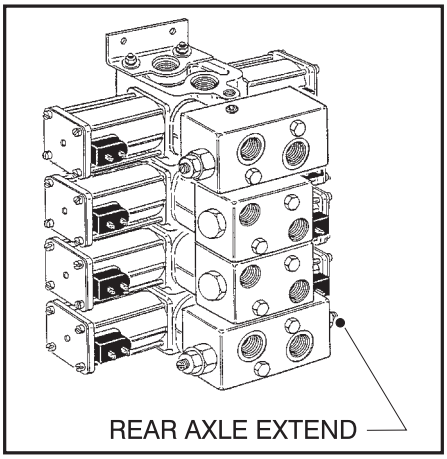


4. Bottom out Front Axle Retract function.
5. Loosen lock nut on opposite side of valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise

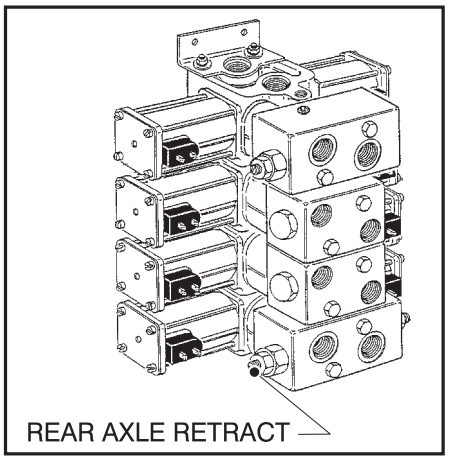
to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



6. Bottom out Rear Axle Extend function.
7. Loosen locknut on applicable valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



8. Bottom out Rear Axle Retract function.
9. Loosen lock nut on opposite side of valve section and turn adjusting screw to adjust valve section to 2000 psi (138 bar). Turn adjusting screw clockwise to increase pressure, counterclockwise to decrease pressure. Tighten locknut.



10. The two valve sections controlling the front and rear jack cylinders are controlled by system pressure and are non-adjustable.

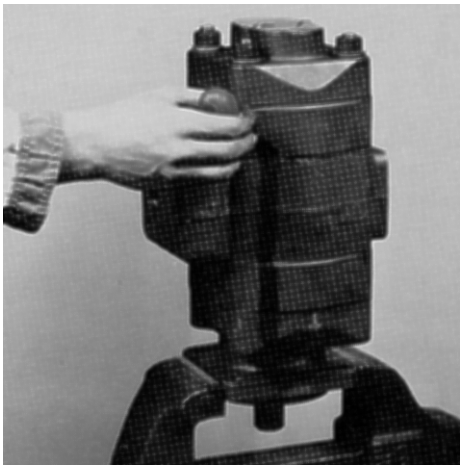
5.7 HYDRAULIC GEAR PUMP

Disassembly

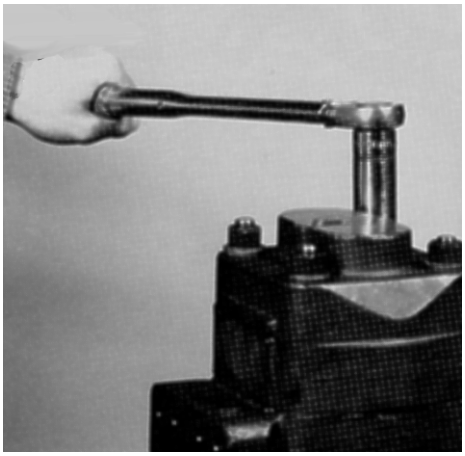
⚠ CAUTION

DO NOT GRIP ON OR NEAR ANY MACHINED SURFACES DURING ASSEMBLY OR DISASSEMBLY.

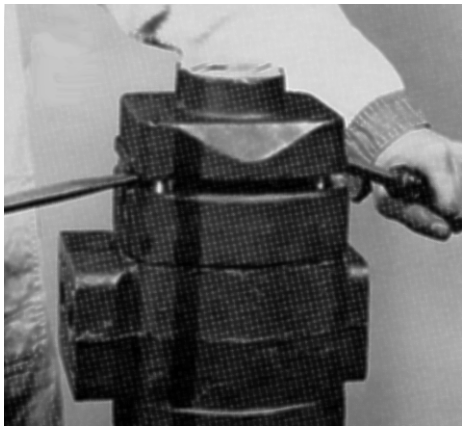
1. Place the pump in a vise with the drive shaft pointing down. Match mark all sections. Be sure to align these marks when reassembling.



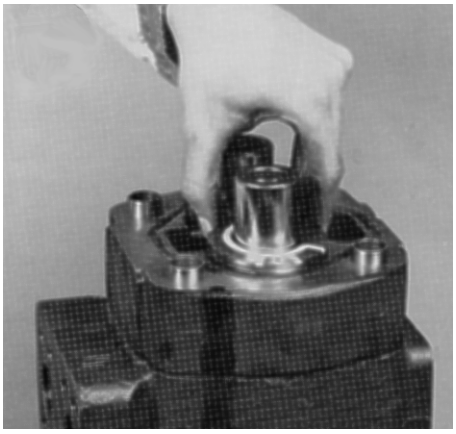
2. Use a socket wrench to remove the four hex nuts, studs, and washers.



3. Lift off the port end cover. If prying is necessary, be careful not to damage the machined surfaces. Dowel pins will remain in either port end cover or gear housing. Do not remove the dowel pins.

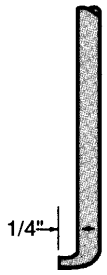


4. Remove the thrust plate. Examine and replace if necessary.



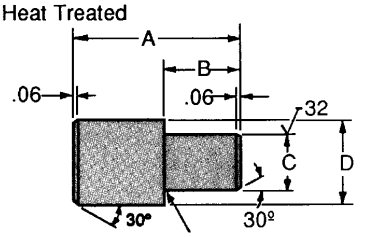
Tool List

- Arbor press
- Awl
- 1 1/2" Dia. steel ball
- Bearing puller (Owatonna Tool Co. MD - 956 or equivalent)
- Bushing remover tool (See sketch)
- Clean lintless cloths
- Deburring tool (an old file with cutting teeth ground off)
- Machinist's hammer
- Soft hammer
- Permatex Aviation Form-A-Gasket No. 3 non-hardening sealant or equivalent
- Medium grit carborundum stone
- Seal removal tool (see sketch)
- Oil and grease
- Snap ring pliers
- Prick punch
- Bushing installation tool (see sketch)
- Scale (1/32" or 1/64" graduations)
- Small screw driver
- Torque wrench
- Vise with 6" minimum opening.
- Bar for lip seal installation
  Note: For 315 use 1 5/8" dia. x 2" bar.
  For 330 use 1 3/4" dia. x 2" bar.
  For 350 use 2 1/2" dia. x 2" bar
  For 365 use 2 1/2" dia. x 2" bar.
- Special steel sleeve (see sketch)



Seal Removal Tool
Easily made from old screw driver. Heat tip and bend as shown. Grind tip to fit notch behind the shaft seal.

Bushing Installation Tool
A.I.S.I. 8620 Bearing Quality Steel
Heat Treated

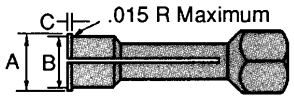


Grind Relief Allowable

	A	B	C Dia.	D. Dia.
P315	2.312	1.15	.937 +.000 -.002	1.250
P330	3.00	1.47	1.054 +.000 -.002	1.250
P350	3.00	1.47	1.282 +.000 -.002	1.625
P365	3.00	1.73	1.492 +.000 -.002	1.750

Bushing Puller: The bushings in P315, P330, P350 and P365 pumps may be removed from their bores using blind hole collet-type bushing pullers similar to those manufactured by Owatonna Tool Co. The table below illustrates the modifications necessary to adapt the OTC collets to this task. Equivalent pullers from other suppliers may be modified in similar fashion.

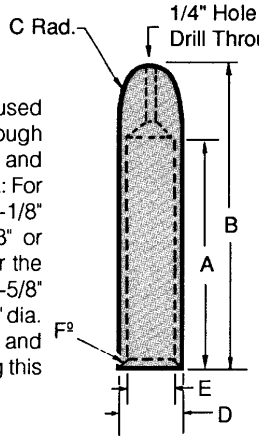
Typical Collet



Pump/Motor	A	B	C	Make From OTC Collet No.
315	.900 / .890	.800 / .790	.100 / .090	33863
330	.980 / .970	.875 / Ref.	.100 / .090	33863
350	1.122 / 1.122	1.000 / 0.990	.072 / .052	33864
365	1.382 / 1.372	1.260 / 1.250	.100 / .120	33865

Special Steel Sleeve

The special steel sleeve is used to insert the drive shaft through the lip seal without damage and can be made from bar stock: For the P315 use a 1" dia. x 3-1/8" bar; for the P330 use a 1-1/8" or 1-1/4" dia. x 4- 5/8" bar; for the P350 use a 1-3/8" dia. x 4-5/8" bar; for the P365 use a 1-1/2" dia. x 4-5/8" bar. The drawing and chart give details for making this special tool.



	A	B	C Rad	D Dia.	E. Dia.	Fº chamfer
P315	1-7/8"	3"	9/16"	.944 +.000 -.002	.885 +.002 -.000	.050" x 60º
P330	3-3/8"	4-1/2"	9/16"	1.065 +.000 -.002	1.002 +.002 -.000	.015" x 45º
P350	3-3/8"	4-1/2"	9/16"	1.290 +.000 -.002	1.250 +.002 -.000	.015" x 60º
P365	3-3/8"	4-1/2"	9/16"	1.377 +.000 -.002	1.250 +.002 -.000	.015" x 60º

All external surfaces must be free of scratches and burrs.

Figure 5-4. Recommended Tool List

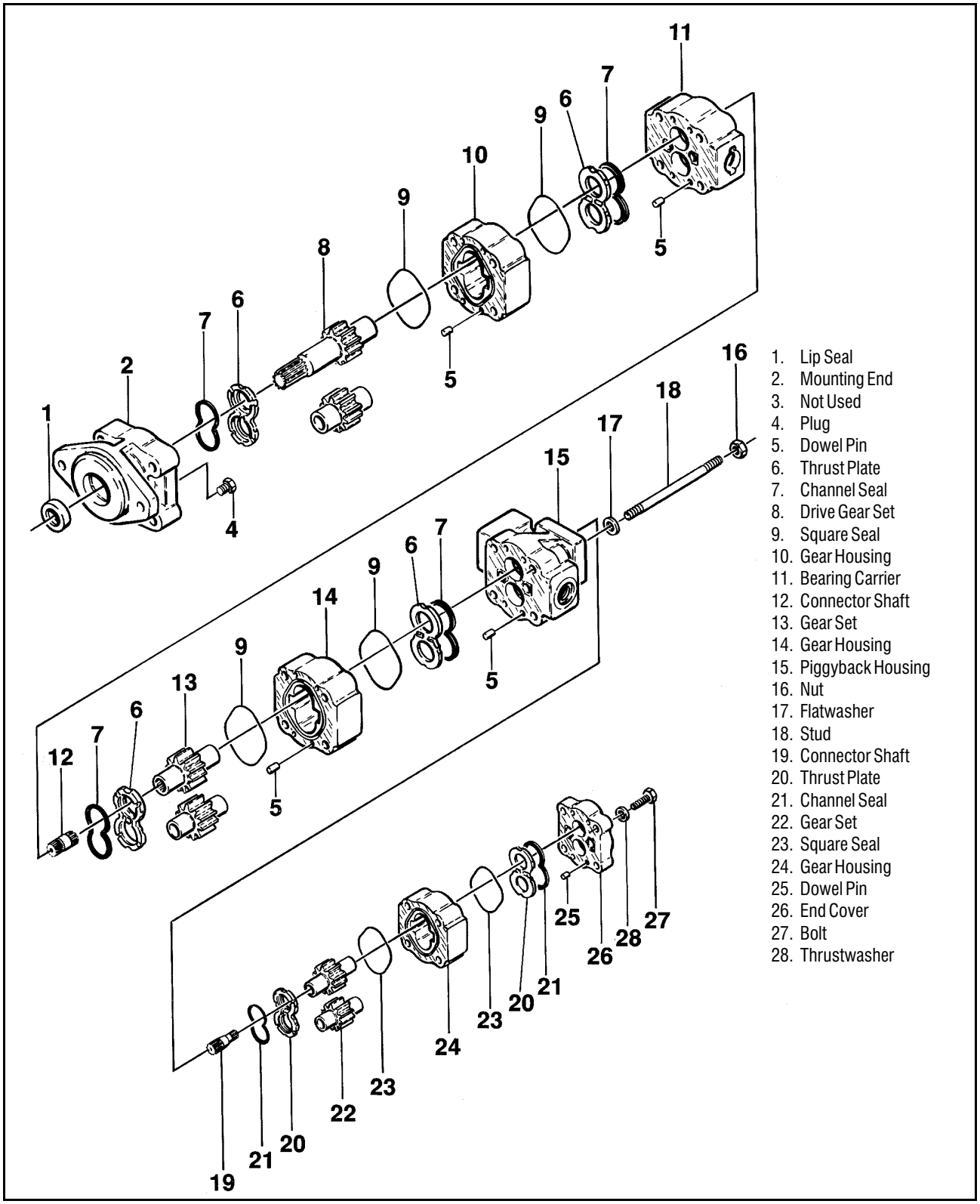
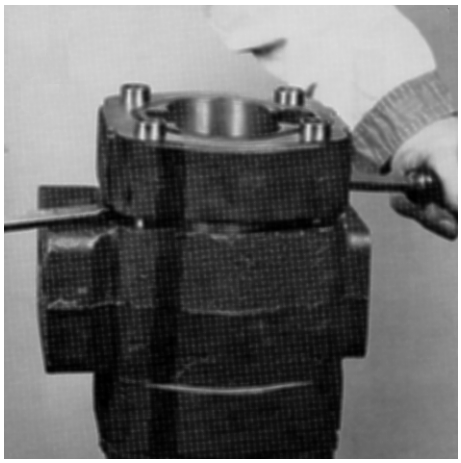


Figure 5-5. Main Gear Pump Assembly

5. Carefully remove the drive and driven gears. Avoid tapping the gear teeth together or against other hardened surfaces. Keep these gears together because they are a matched set. Examine and replace if necessary. Remove the thrust plate from the bearing carrier. Examine and replace if necessary.

6. Lift the gear housing from the bearing carrier. If prying is necessary, take care not to damage machined surfaces. Examine and replace if necessary.

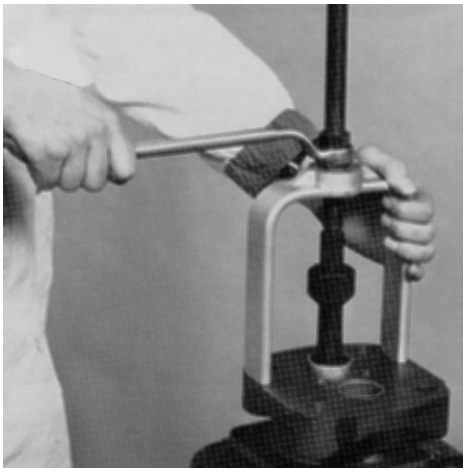


7. Carefully lift of pry off the bearing carrier to prevent damage to contact face and edges. Dowel pins will remain in either the bearing carrier or the gear housing. Do not remove them.

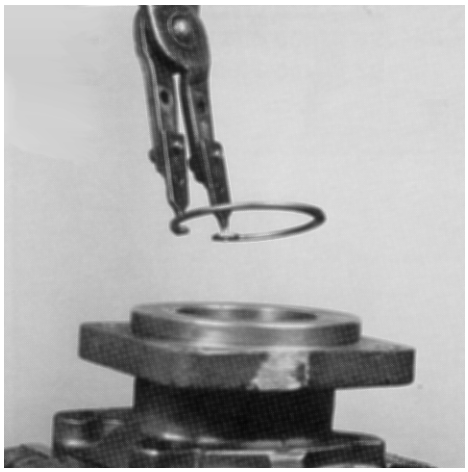
8. Remove the connecting shaft. Remove the thrust plate. Examine and replace if necessary. Remove the driven gear and the integral gear and drive shaft. Keep these together as they are a matched set. Examine and replace if necessary. Be careful not to damage the machined surfaces of the gears.

9. Lift or pry off the first section gear housing. Be careful not to damage machined surfaces. Examine and replace if necessary.

10. Inspect all bushings for scoring or discoloration and replace if necessary. Use a bushing puller as shown in the tool list to remove bushings.

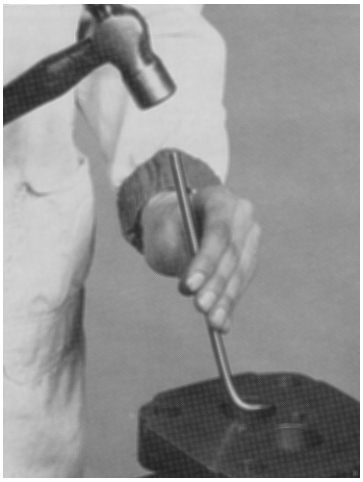


11. If the pump is equipped with an outboard bearing, place the shaft end cover in the vise with the mounting face up. Remove the snap ring with snap ring pliers. If the unit is equipped with a spiral lock retaining ring, remove with a small screwdriver or awl.



12. Use a bearing puller to remove the outboard bearing.

13. Grip the shaft end cover in a vise with the mounting face down. Remove the double lip seal by inserting the special seal removal tool into the notch between the double lip seal and the shaft end cover. Tap the seal out and discard. Remove and discard all rubber and polymer seals.



Assembly

1. Stone all machined surfaces with a medium grit carborundum stone.

2. If bushings have been removed, deburr the bushing bores with emery cloth. Rinse parts in solvent. Air blast all parts and wipe with a clean lint less cloth before starting assembly.

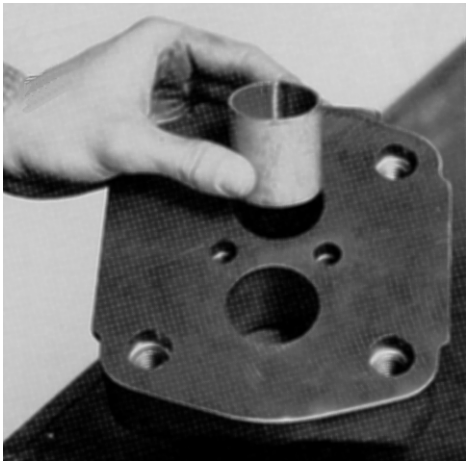
3. Grip shaft end cover in a vise with the mounting face down. Examine the plug or plugs to be sure they're tightly in place. Replacement is necessary only if parts are damaged. Remove with a screwdriver.

4. New plugs should be screwed in tightly. Stake plug with a prick punch at both ends of screwdriver slot and around edges. Peen edge of hole 0.031 to 0.062 inches with a 1.5 inch diameter steel ball.

NOTE: *If new plugs are being installed coat threads with JLG Threadlocker.*

5. Steps 5 thru 8 apply to shaft end cover, bearing carriers, and port end cover

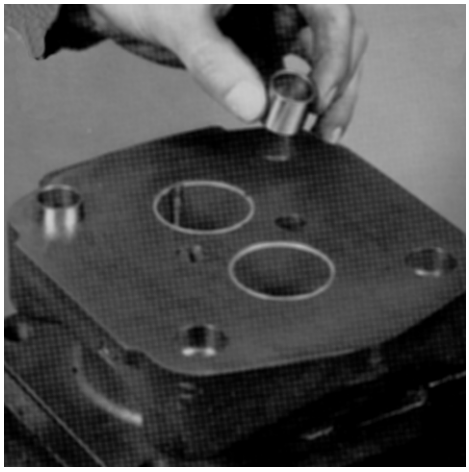
   Any bushings removed from the shaft end cover, port end cover, or bearing carrier should be assembled in drive bores with groove to the top of unit (12 o'clock). Assemble bushings in driven bores with the groove to the bottom of the unit (6 o'clock). Model P315 pumps do not have grooved bushings, so the bushing seams should be placed at the 12 and 6 o'clock positions.



6. Bushings should be pressed into the bores, one at a time using the special installation tool and an arbor press. Be sure the grooves (or seams) are positioned as stated in step 5. Bushings must be pressed into the bores flush with the casting face. Be sure to support the castings so they are square and level.

7. Repeat steps 1 and 2, stone and rinse parts.

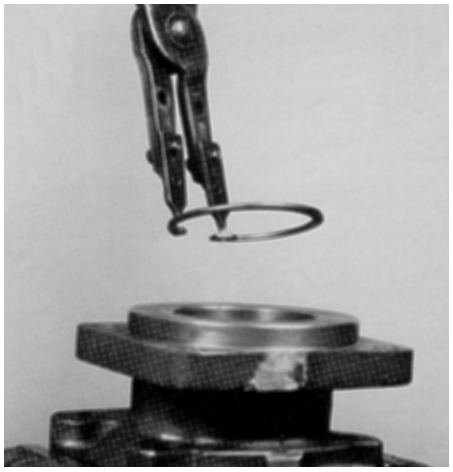
8. See that dowel pins are in place in any new castings. Examine all dowels. Before inserting make sure the hole is clean and free from burrs. Gently start pin straight into hole and tap lightly with a soft hammer.



9. Before inserting a new lip seal in the shaft end cover, coat the outer edge of the lip seal and its recess with Permatex Aviation Form-A-Gasket No. 3 non hardening sealant or equivalent. With the metal side of the lip seal up, press it into the mounting flange side of the shaft end cover with an arbor press and bar. Be careful not do damage the lip of the seal. Press in until flush with the recess. Wipe off excess sealant.

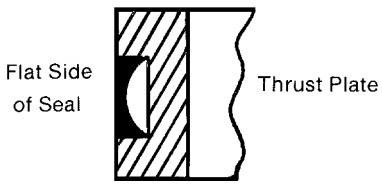
10. If the unit is equipped with an outboard bearing, guide the bearing into it's recess in the shaft end cover. This is a light press fit. It may be necessary to lightly tap the bearing into the bore.

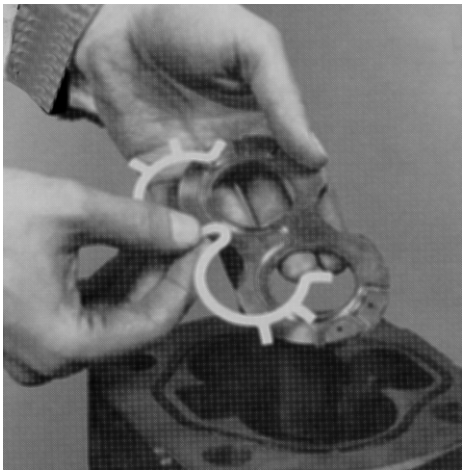
11. If the pump is equipped with an outboard bearing, place the shaft end cover in the vise with the mounting face up. Install the snap ring in the groove to retain the outboard bearing.



12. Grease the new gasket seals and insert them into the grooves in both sides of all gear housings. Position the first gear housing over the shaft end cover and dowels. Tap it with a soft hammer until it rests tightly against the shaft end cover. Be careful not to pinch the gasket seal. Also be sure the large rounded core is on the inlet side.

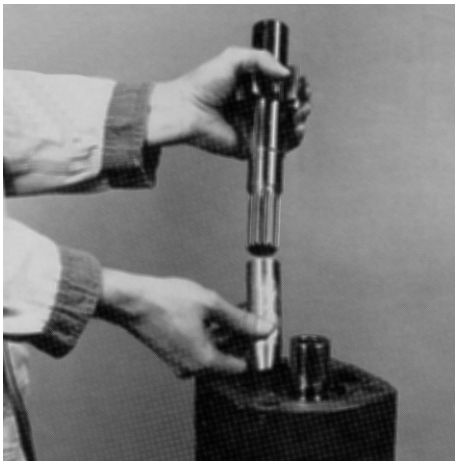
13. Assemble the channel seals into the grooves in the thrust plates with the flat side of the seal facing away from the thrust plate as shown below.





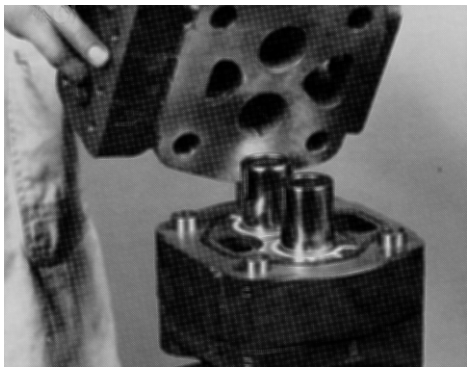
14. Gently slip the thrust plate through the gear housing and into place on the shaft end cover. The channel seal from step 13 should face the shaft end cover. The relief groove in the plate should face the outlet side of the pump.

15. Slide the driven gear through the housing and into the bushing in the shaft end cover. Coat the steel sleeve tool with grease. Place the lightly greased drive shaft inside the sleeve and slide both through the shaft end cover with a twisting motion until the integral gear rests against the thrust plate. Avoid damaging the double lip seal. Remove the steel sleeve. Squirt clean oil over the gears.

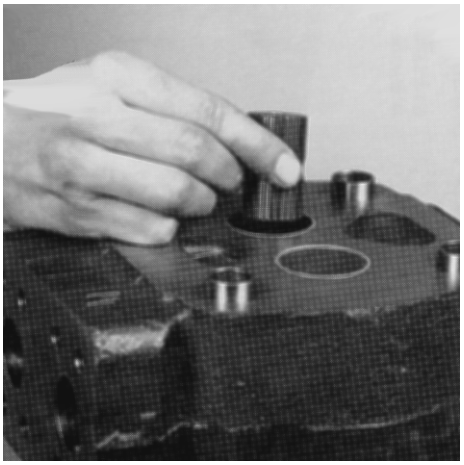


16. Slip the thrust plate with seal over gear journals and into the housing bore. The flat side of the seal should face up with the relief groove facing the outlet side.

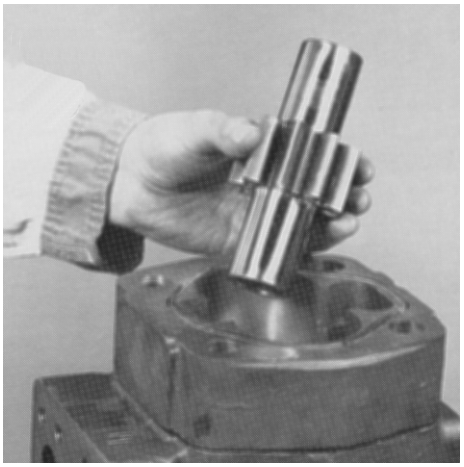
17. Position the bearing carrier over the gear housing so the bushings receive the journals of the drive and driven gears. Be sure to line up the dowel holes over the dowel pins. When the parts are parallel, squeeze them together or alternately tap over each dowel until the parts are together.



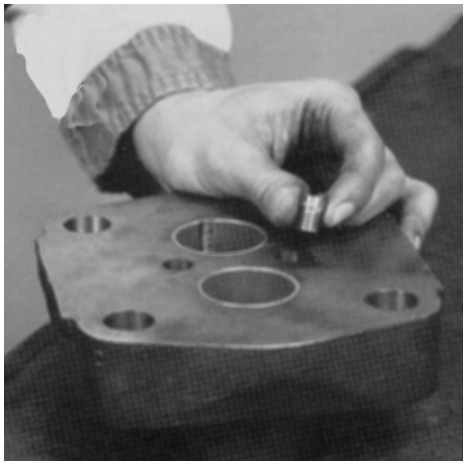
18. Insert the connecting shaft in the spline of the drive gear. Position and place the second gear housing on the bearing carrier as outlined in step 12.



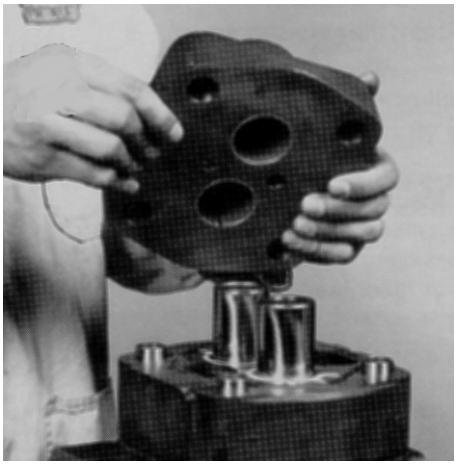
19. Place the thrust plate in the gear housing per step 14. Insert the drive and driven gears of the second section in their respective bearings. Make sure the gears are in contact with the thrust plate face. Place the port end cover plate in the housing per step 16.



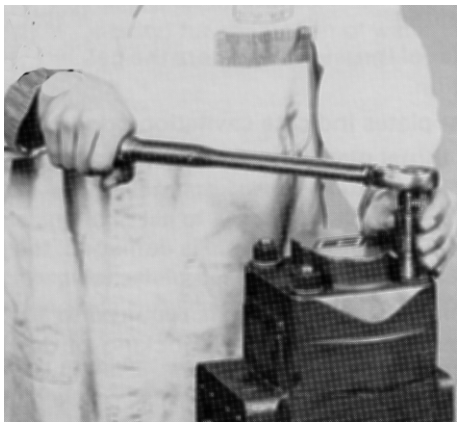
20. Check the plug or plugs in the port end cover to be sure they are tight. Follow the procedure outlined in step 4 for new plugs.



21. Place the port end cover over the gear journals. Align the dowels with the holes in the mating casting. Being careful not to pinch the gasket seal, tap the port end cover lightly in the center between bearing bores to engage the dowels and to move parts together in the final seating.



22. Thread the studs, washers, and nuts into the shaft end cover and tighten alternately or cross-corner. Rotate the drive shaft with a wrench to make sure there is no binding in the pump. After the fasteners are tight and there is no internal binding, torque the fasteners in a diagonally opposed pattern to 200 ft.lbs. (280 Nm) or for P315 models to 140 ft. lbs. (196 Nm).



Wear Guide for Replacement

GEAR HOUSINGS

Wear in excess of 0.007 in. (0.18 mm) cut out necessitates replacement of the gear housing Place a straight-edge across the bore. If a 0.007 feeler gauge can be slipped under the straight-edge in the cut out area, replace the gear housing.

Pressure pushes the gears against the housing on the low pressure side. As the hubs and bushings wear, the cut-out becomes pronounced. Excessive cut out in a short period of time indicates excessive pressure or oil contamination. If the relief valve settings are within prescribed limits, check for shock pressures or tampering. Withdraw oil sample and check it, and tank, for dirt.

GEARS

Any scoring on gear hubs necessitates replacement. Scoring, grooving, or burring of outside diameter of teeth requires replacement. Nicking, grooving, or fretting of teeth surfaces also necessitates replacement.

DRIVE SHAFTS

Replace if there is any wear detectable by touch in the seal area or at the drive coupling. 0.002 inches (0.05 mm) wear is the maximum allowable.

Wear in the shaft seal area indicates oil contamination. Wear or damage to splines, keys, or keyways necessitates replacement.

THRUST PLATES

The thrust plates seal the gear section at the sides of the gears. Wear here will allow internal slippage, meaning oil will bypass the pump.

A maximum of 0.002 inches (0.05 mm) wear is allowable. Replace thrust plates if they are scored, eroded, or pitted.

Check center of thrust plates where the gears mesh. Erosion here indicates oil contamination.

Pitted thrust plates indicate cavitation or oil aeration.

Discolored thrust plates indicate overheating, probably insufficient oil.

DOWEL PINS

If either the dowel or dowel pin hole is damaged, the dowel or machined casting, or both must be replaced.

If more than reasonable force is required to seat dowels, the cause may be poorly deburred or dirty parts; cocking of dowel in the hole; or improper pin-to-hole fit.

BUSHINGS

If gears are replaced, bushings must be replaced. Bushings should fit into bore with a heavy press fit.

SEALS AND GASKETS

Replace all rubber and polymer seals, including all o-rings, thrust plate channel seals, shaft seal, and gasket seal.

PLUGS

Examine the plugs in the shaft end and port end cover to make sure they are in the proper position and tight.

Recommended Start-up Procedure for New or Rebuilt Pump

Before installing a new or rebuilt pump, back off the main relief valve until the spring tension on the adjusting screw is relieved. This will avoid the possibility of immediate damage to the replacement unit in the event that the relief valve setting had been increased beyond the recommended operating pressure prior to removing the old unit.

Before connecting any lines to the pump, fill all ports with clean oil to provide initial lubrication. This is particularly important if the unit is located above the oil reservoir.

After connecting the lines and mounting the replacement unit, operate the pump at least two minutes at no load and at low rpm (400 min.) During this break-in period, the unit should run free and not develop an excessive amount of heat. If the unit operates properly, speed and pressure can then be increased to normal operating settings.

Reset the main relief valve to its proper setting while the pump is running at maximum operating engine (motor) speed for the vehicle.

Recommended Test Procedure

Be sure there is an adequate supply of oil for the pump, at least one gallon of oil for each gpm of pump capacity.

If one section of a tandem pump is being tested, make sure that all other sections not being tested are adequately supplied with oil. If any of the other sections run dry, or if plugs are left in ports, serious and permanent damage will result.

The oil should be a good quality hydraulic oil rated at 150SSU at 100°F., with the oil temperature held at 120° F. plus or minus 5° F. (Test procedures are described in detail in SAE handbooks; see Hydraulic Power Pump Test Procedure, SAE J745c.)

The feed line must be of adequate size with no more than 5" mercury vacuum adjacent to the pump inlet. As a rule, the feed line must provide a feed flow velocity not in excess of 8 feet per second.

Feeding hot oil into a cold pump may cause the pump to seize. Jog the pump by momentarily starting the driving engine or motor to gradually equalize pump and oil temperatures.

Run the pump at least two minutes at no load and moderate speed (not over 1500 rpm). if the pump becomes excessively hot, shut down immediately and locate the problem source.

Gradually increase pressure on pump, in 500 psi increments until the desired test pressure has been reached. This should take about five minutes.

Delivery should run close to rated performance figures which are averaged from testing several pumps. Something like a 5% lower reading may be used as a rated minimum if new or relatively new parts have been used. When rebuilding the pump with parts from the original pump, which, while worn, appear satisfactory for reuse, a 10% or 15% lower reading may be permitted, depending on the performance expected from the equipment. One's own experience will prove the best guide here.

Many repairmen measure the output at normal operating speed and at zero pressure, then again at 1000 psi (or the operating pressure of the equipment) and allow a volume decrease approximating the listing below. It is a suggested reference only which makes allowance for reused parts.

GPM DELIVERY at 1800 rpm 100psi	GPM DROP OFF AT....		
	1000 psi/70 bar	2000 psi/140 bar	3000 psi/210 bar
10 - 30	1.5 - 3	2 - 3.5	2.5 - 4
30 - 50	2 - 3	2.5 - 4	3 - 4.5
50 - 70	2.5 - 3.5	3 - 5	3.5 - 5.5

At test speeds other than 1800 rpm, gpm delivery wilt vary almost proportionately, but the same (drop-oft) figures should be used.

Be sure to run the pump in the direction for which it was designed and built. Driving pump in the wrong direction will build up pressure behind shaft seal, damaging it and necessitating replacement.

After completing testing procedures, pump is ready for installation and immediate duty operationonequipment.Againf itmustberememberedthattopreventseizure,hotoilmustnot be fed into a cold pump.

NOTES:

SECTION 6. SCHEMATICS

6.1 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.

6.2 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.

6.3 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 6-1.Platform Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM LEVELING SYSTEMS		
Platform will not maintain level attitude.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Dual pilot check valves dirty/ inoperative.	Clean or replace as necessary.
	Restricted or broken hydraulic line or fitting on slave cylinder or master leveling cylinder.	Clean, repair, or replace line or fitting.
	Spit valve(s) leaking.	Clean, repair, or replace spit valve(s).
	Worn seal(s) in slave level or master leveling cylinder.	Replace seal(s).
	Slave level or master leveling cylinder not functioning properly.	Repair or replace cylinder.
	Counterbalance valve on slave leveling cylinder improperly adjusted or not functioning properly.	Adjust or replace valve.
No response to platform leveling controls.		
	Circuit breaker open.	Determine and correct cause. Reset circuit breaker.
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Slave cylinder not functioning properly.	Repair or replace cylinder.
Platform will not adjust “up” to level.		
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Slave cylinder not functioning properly.	Repair or replace cylinder.
Platform will not adjust “down” to level.		
	See: Platform will not adjust “up” to level.	

Table 6-1.Platform 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.

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Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	BOOM ELEVATION SYSTEM.	
No response to lift control switch.		
	Lift control inoperative.	Repair or replace control lever.
	Dump valve (bypass) not operating.	Determine cause and repair or replace valve.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Control valve not functioning properly.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Boom will not raise.		
	Load capacity exceeded (personnel or equipment on platform).	Reduce load. (Refer to capacity placard.)
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	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.
	Contaminated port relief.	Repair or replace valve.
Boom will not lower.		
	See: Boom will not raise	

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom raises and lowers erratically.		
	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean or replace line.
	Lack of lubricant on cylinder shafts and/or boom pivot.	Lubricate as required. (Refer to Lubrication Chart)
	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.		
	Manual lowering valve not functioning properly.	Repair or replace valve.
	Worn seals in lift cylinder.	Replace seals.
	Holding valve on cylinder not functioning properly.	Repair or replace valve.
High engine does not operate below horizontal.		
	Damaged wiring on boom limit switch.	Repair or replace wiring.
	Damaged boom limit switch.	Replace switch.
	MAIN TELESCOPE SYSTEM.	
No response to telescope control.		
	Circuit breaker open.	Determine and correct cause. Reset circuit breaker.
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch, solenoid valve or proportional valve.	Repair or replace wiring.
	Control switch or valve not functioning properly.	Replace switch or 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.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Boom will not extend.		
	Damaged wiring on control switch, solenoid valve or proportional valve.	Repair or replace wiring.
	Solenoid valve or proportional valve not functioning properly.	Repair or replace valve.
	Control lever not functioning properly.	Repair or replace lever.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.
	Pressure setting not correct.	Check pressure/re-adjust as necessary.
	Broken telescope chain. (Main boom only.)	Replace chain. (Main boom only.)
Boom extends and retracts erratically.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Wear pads not adjusted or worn.	Adjust or replace pads as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control lever not functioning properly.	Replace lever.
	Worn seals in telescope cylinder.	Replace seals.
	Cylinder not functioning properly.	Replace cylinder.
	Distorted boom section(s).	Replace distorted section(s).
	Chain sheaves worn/damaged. (Main boom only.)	Replace worn/damaged components. (Main boom only.)
	Boom chains loose. (Main boom only.)	Tighten chains. (Torque to 50 ft. lb. [68 Nm] dry.). (Main boom only.)
	Counterbalance valve not functioning properly.	Replace counterbalance valve.
Mid or fly section inoperative.		
	Broken drive chain. (Main boom only.)	Repair or replace chain.
Mid and fly sections extend and retract erratically.		
	Drive chain out of adjustment.	Adjust chain as required. (Main boom only.)
	Wear pads out of adjustment or worn.	Adjust or replace pads as required.
	Damaged/worn sheave or chain links. (Main boom only.)	Repair or replace chain or sheave as required. (Main boom only.)
	Mid or fly section distorted.	Replace mid or fly section, as necessary.

Table 6-2.Boom Assembly - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	BOOM SWING SYSTEM	
No response to swing control.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Swing control lever not functioning.	Repair or replace swing lever.
	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.
	Swing brake not releasing.	Repair or replace brake.
	Torque hub not functioning properly.	Repair or replace torque hub.
	Foreign objects(s) wedged between torque hub pinion and swing gear.	Remove objects, check for damage, and repair or replace component(s) as required.
	Sheared shaft on swing motor/brake.	Repair or replace motor/brake.
.Boom will not swing outside of drive/steer wheels.		
	Axles not extended and locked.	Extend and lock axles.
Boom will swing in only one direction.		
	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 torque hub pinion and swing gear.	Remove object(s), check for damage and repair or replace component(s) as required.
	Swing control lever not functioning properly.	Repair or replace swing control lever.
	Brake shuttle valve defective.	Replace shuttle valve.
Boom swings erratically in either direction.		
	Hydraulic system oil low.	Replenish oil as necessary.
	Lack of lubricant on swing gear or torque hub pinion.	Lubricate as required. (See Lubrication Chart.)
	Swing motor not functioning properly.	Repair or replace swing control lever.
	Worn or broken teeth on swing gear or torque hub pinion.	Replace gear(s) as required.
	Swing brake not functioning properly.	Repair or replace swing brake.
	Swing brake shuttle valve defective.	Repair or replace valve.

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Table 6-3.Turntable - 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.
	Fuel shutoff solenoid defective.	Replace solenoid.
	Damaged wiring in ignition circuit (broken wire on starter).	Repair or replace wiring.
	Ignition switch not functioning properly.	Replace switch.
	Defective start solenoid.	Replace start solenoid.
	Starter relay defective.	Replace starter relay.
	Ignition circuit shorted to ground.	Repair circuit as required.
	Battery cable(s) not making contact.	Clean and tighten cable(s).
.Engine will not start. (Ignition O.K.)		
	No fuel.	Replenish fuel as necessary.
	Restricted or broken fuel line.	Clean or replace fuel line.
	Battery defective or discharged.	Replace or charge battery, as required.
	Fuel pump not working.	Replace fuel pump.
.Engine will not accelerate above low speed.		
	Damaged wiring on speed control switch or governor solenoid.	Repair or replace wiring.
	Speed control switch not functioning properly.	Replace switch.
	Governor not functioning properly.	Repair or replace governor.
	Boom horizontal limit switch not functioning properly or improperly adjusted.	Adjust, repair or replace switch.
	Control handle micro switch not functioning properly.	Repair or replace control handle.

Table 6-3.Turntable - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
	CONTROL VALVES	
Valve Spool Sticking.		
	Dirt in oil causing excessive temperature build-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 repair 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.
	FUEL SYSTEM	
Strong fuel odor during machine operation.		
	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.

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Table 6-4.Chassis - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
FRONT AXLE AREA		
One or both front 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.
	Hub attachment nut loose or missing.	Secure or replace hub attachment nut cotter pin as necessary.
Difficulty encountered when moving machine.		
	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Grade too steep.	See Caution Placard on platform for specified grades and sideslopes.
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	System pressure too low.	Re-adjust pressure.
REAR FRAME AXLE AREA.		
One or both front 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.
	Hub attachment nut loose or missing.	Secure or replace hub attachment nut cotter pin as necessary.

Table 6-4.Chassis - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Difficulty encountered when moving machine.		
	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Grade too steep.	See Caution Placard on platform for specified grades and sideslopes.
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	System pressure too low.	Re-adjust pressure.
DRIVE SYSTEM.		
No response to control.		
	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 or rotary coupling.	Clean, repair or replace line.
	Rotary coupling leaking internally. (Seals worn.)	Repair or replace coupling.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Air in wheel brake circuit.	Bleed circuit, determine and correct cause.
	Damaged wiring on control switch.	Repair or replace wiring.
	Control lever not functioning properly.	Replace lever.
	Brake(s) not releasing.	Determine cause and repair or replace.
Machine drives erratically.		
	Microswitch on controller improperly adjusted.	Adjust microswitch on controller for proper operation.

Table 6-4.Chassis - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
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.
Machine will not travel in reverse.		
	See: Machine will not travel in forward.	
Machine overspeeds when descending a grade.		
	Counterbalance valve improperly adjusted or defective.	Adjust or replace valve.
Motor turns slowly in the direction of the last command.		
	Failed controller resulting in a command at neutral position.	Replace controller.
	Failed pilot valve.	Replace pilot valve.
	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:	
	Low pressure gain of pilot valve.	Check filter in the inlet section for restriction.
	Low control pressure supply.	Replace pressure regulator if necessary.
	Plugged pilot valve.	Change pilot valve.

Table 6-4.Chassis - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Poor response, function shuts off slowly when command is removed.		
	Low spool spring preload.	Check for correct spring and shims in end caps.
	Restricted tank return line.	Check for restrictions in tank return line.
	Sticking spool due to contamination.	Remove end cap and check spool freedom.
	Ramp potentiometer adjustment improper.	Re-adjust ramping time on controller.
STEERING SYSTEM.		
No response to 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/controller not functioning properly.	Replace switch/controller.
	Restricted or broken hydraulic line on valve bank, hydraulic pump or rotary coupling.	Clean, repair or replace line.
	If equipped, swivel coupling leaking internally. (Seals defective.)	Repair or replace coupling.
	Control valve not functioning properly.	Repair or replace valve.
	Steer cylinder not functioning properly.	Repair or replace cylinder.

Table 6-4.Chassis - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
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.
	Lack of lubrication.	Lubricate as required. (Refer to Lubrication Chart.)
	Restricted crossover relief valve.	Clean or replace valve.
	Steer system pressure low.	Adjust pressure.
	Bent linkage (tie rod(s) or steering hitch).	Repair or replace linkage as required.
	Hydraulic pump not functioning properly.	Repair or replace pump.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
	King pins and bushings worn.	Replace king pins and bushings.
Steering inoperative.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring on control switch/ controller or solenoid valve.	See proper wiring diagram.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Control switch/controller not functioning properly.	Replace switch/controller.
	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/controller is damaged.	Repair or replace wiring.
	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.

Table 6-4.Chassis - 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.
	Leaking rotary oil coupling.	Repair or replace oil coupling.

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Table 6-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
HYDRAULIC SYSTEM - GENERAL		
Hydraulic pump noisy.		
	Air entering system through broken line or fitting. (Suction Side.)	Repair or replace line or fitting.
	Air bubbles in oil. (Reservoir oil too low.)	Replenish oil as required.
	Oil filter(s) dirty.	Clean and/or replace filter(s) as necessary.
Pump cavitating. (Vacuum in pump due to oil starvation.)		
	Restricted suction line.	Clean, repair, or replace line.
	Restricted reservoir air vent.	Clean vent.
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
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 high.	Reset valve as required.
	Hydraulic system oil low.	Replenish oil as necessary.
Pump not delivering oil.		
	Restricted suction line.	Clean, repair, or replace line.
	Air entering system through broken line or fitting.	Repair or replace line or fitting.
	Broken pump drive shaft/pump coupling.	Repair or replace pump/pump coupling.
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.

Table 6-5.Hydraulic System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
System(s) operate erratically.		
	Sticking or binding valve spools, pistons, rods, etc.	Clean, repair, or replace components as required.
AUXILIARY HYDRAULIC SYSTEM.		
Auxiliary hydraulic pump inoperable.		
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Battery requires charging or will not hold a charge.	Charge or replace battery as required.
	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.
	Low pilot pressure.	Adjust pilot pressure to 250-400 psi (17-28 bar).

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Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
PLATFORM CONTROLS		
No power to platform controls.		
	20 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.
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.
INSTRUMENTS AND INDICATORS		
Ammeter inoperative.		
	Damaged wiring in circuit.	Repair or replace wiring.
	Ammeter not functioning properly.	Replace ammeter.
	Defective charging circuit components	Check charging system for correct output. Repair or replace as necessary.
Voltmeter inoperative.		
	Broken wire/faulty voltmeter.	Repair or replace as necessary.

Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Travel warning horn inoperative.		
	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 vacuum switch.	Replace vacuum 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 as described in Section 2.
Wheel motor speed circuit.		
	Switch damaged or inoperative.	Replace switch.
	Damaged or disconnected wiring in circuit.	Repair or replace wiring.
P.Q. CONTROLLER		
Actuation of a function of the valve continues when the handle is in the center position.		
	Improper null of the handle with the control handle safety deadman switch failed.	Check the safety deadman switch and replace. Re-adjust the null of the handle.
	Improper null of the handle with the handle safety deadman switch failed.	Check the safety deadman switch and replace. Readjust the null of the potentiometer.
	Too much ramp in controller.	Adjust ramp as required.
	Microswitch in controller bad.	Replace microswitch.
	Controller improperly adjusted.	Adjust controller.
Regardless of which way the handle is moved, only one function occurs.		
	Improper wiring or loose wiring to the solenoids or potentiometer.	Check all wiring for proper connections.
	Printed circuit board failure.	Replace printed circuit board or use a handle assembly from the circuit that is presently working to check valve.
	Potentiometer needs adjusted.	Adjust potentiometer as required.
	Spool stuck in valve bank.	Clean/replace spool.

Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Function occurs very rapidly when handle is moved in one direction and very slowly when moved in the opposite direction.		
	Improper null of the handle.	Check and re-adjust null.
	Potentiometer off center.	Center potentiometer.
	Defective printed circuit board.	Replace printed circuit board.
Valve will not function when handle is moved in either direction.		
	No electrical power to handle.	Check electrical input to handle (12V).
	No electrical signal to valve.	Check electrical valve output of printed circuit board and electrical signal at the valve.
	Failed printed circuit handle.	Replace square wave generator or use a handle assembly that is presently working in the system.
	Failed open control handle safety deadman switch.	Check and replace safety deadman switch.
	Improper ground.	Check for proper grounding of handle.
	Failed microswitch.	Replace microswitch.
	No pilot oil at valve.	Check pressure reducing valve and adjust if needed.
	No sequence pressure at valve.	Check pressure reducing valve and adjust as needed.
	No oil volume at valve bank.	Check pump for failure. Check hydraulic oil level.
	Failed or stuck port relief.	Clean or replace port relief.
Functions occur in the opposite direction than required in regard to handle movement.		
	Valve coils are reversed.	Reverse control valve coils.
	Coil wires are reversed.	Reverse coil wires.
	Hydraulic hoses reversed.	Refer to hydraulic diagram for proper hosing.
Abrupt start-up of any functions: both directions.		
	Card “Low” potentiometer setting too high.	Adjust “Low” potentiometer to “Just Start” function.
	“High” and “Low” pots set too close together.	Adjust per PQ Publication 3120304.
Slow function speed/engine lugs down at full throw handle position.		
	Card “High” potentiometer set too low.	Adjust “High” potentiometer until function speed does not lug down.

Table 6-6.Electrical System - Troubleshooting

TROUBLE	PROBABLE CAUSE	REMEDY
Speed not proportional.		
	"High" and "Low" pots not adjusted properly.	Adjust pots to factory specifications or refer to PQ Publication 3120304 for proper adjustment.
Cylinder drifts or drive motor slowly rotates when controller is returned to neutral. (high null bias)		
	Controller failed resulting in a command at neutral position.	Adjust or replace microswitch.
	Microswitch remained open in controller.	Replace microswitch.
	Ramp too high in controller.	Set ramp as needed.
	Brakes not applying in swing or drive.	Check brakes. Repair or replace if needed.

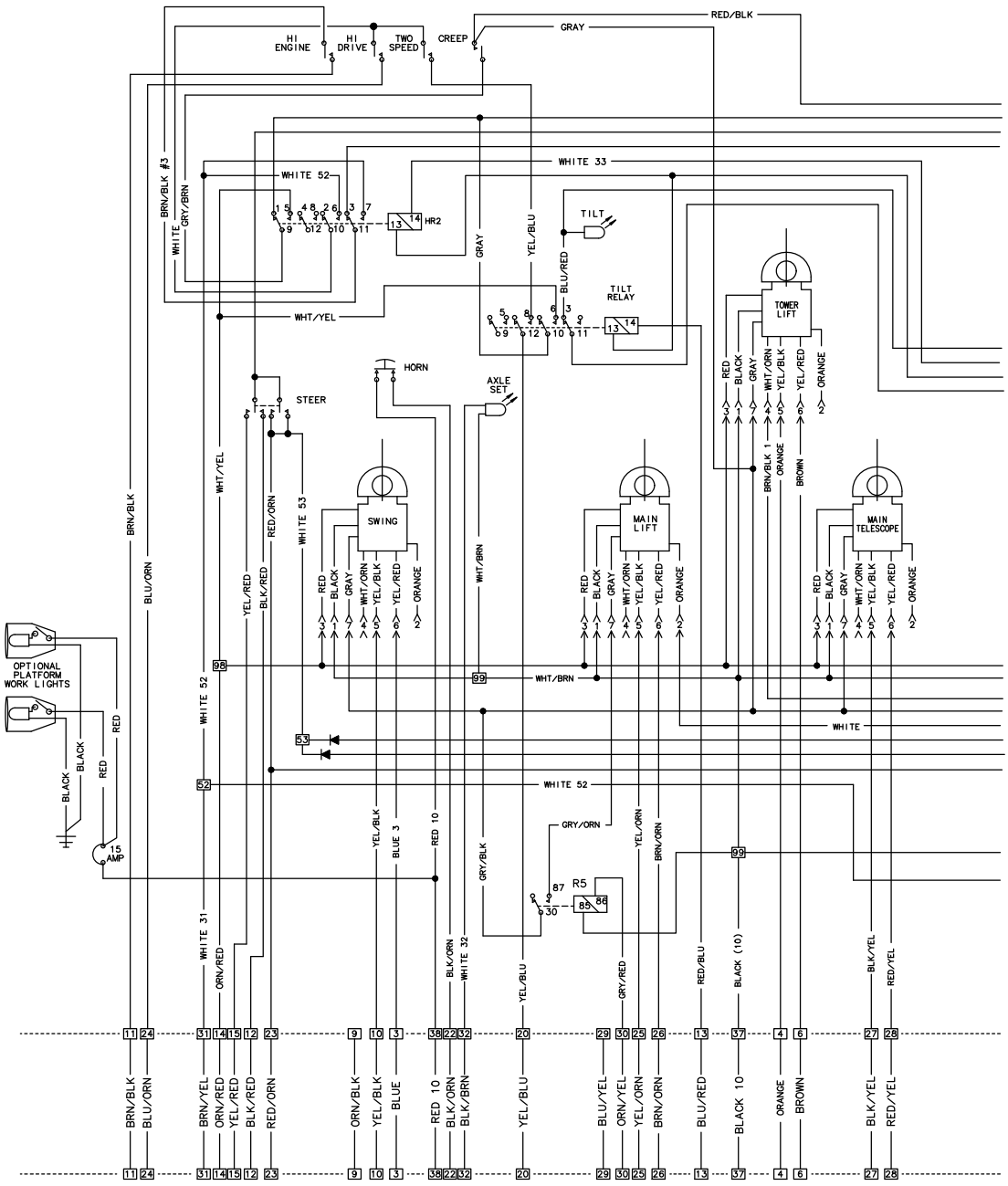

Figure 6-1. Electrical Schematic - Sheet 1 of 5

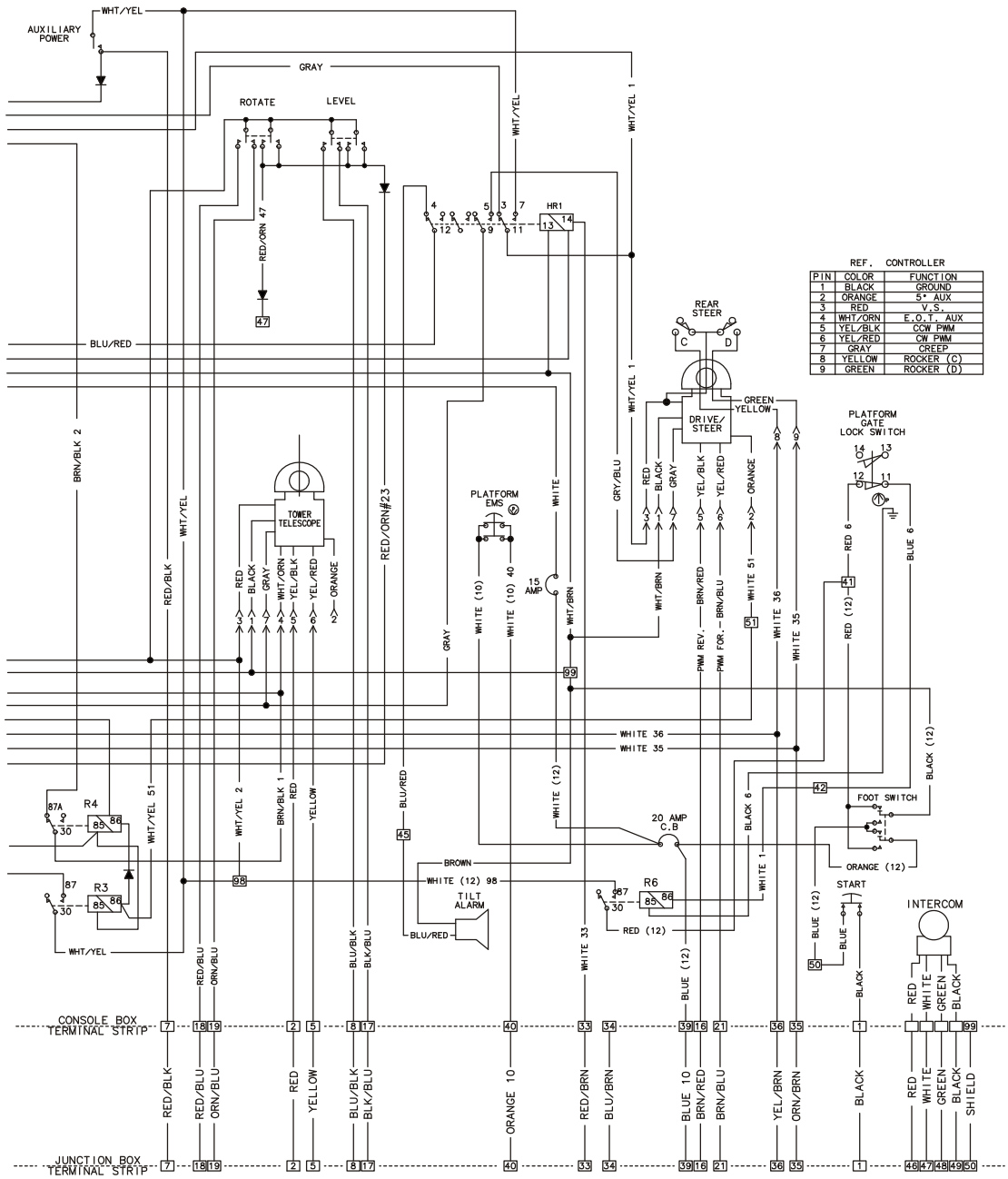

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Figure 6-2. Electrical Schematic - Sheet 2 of 5

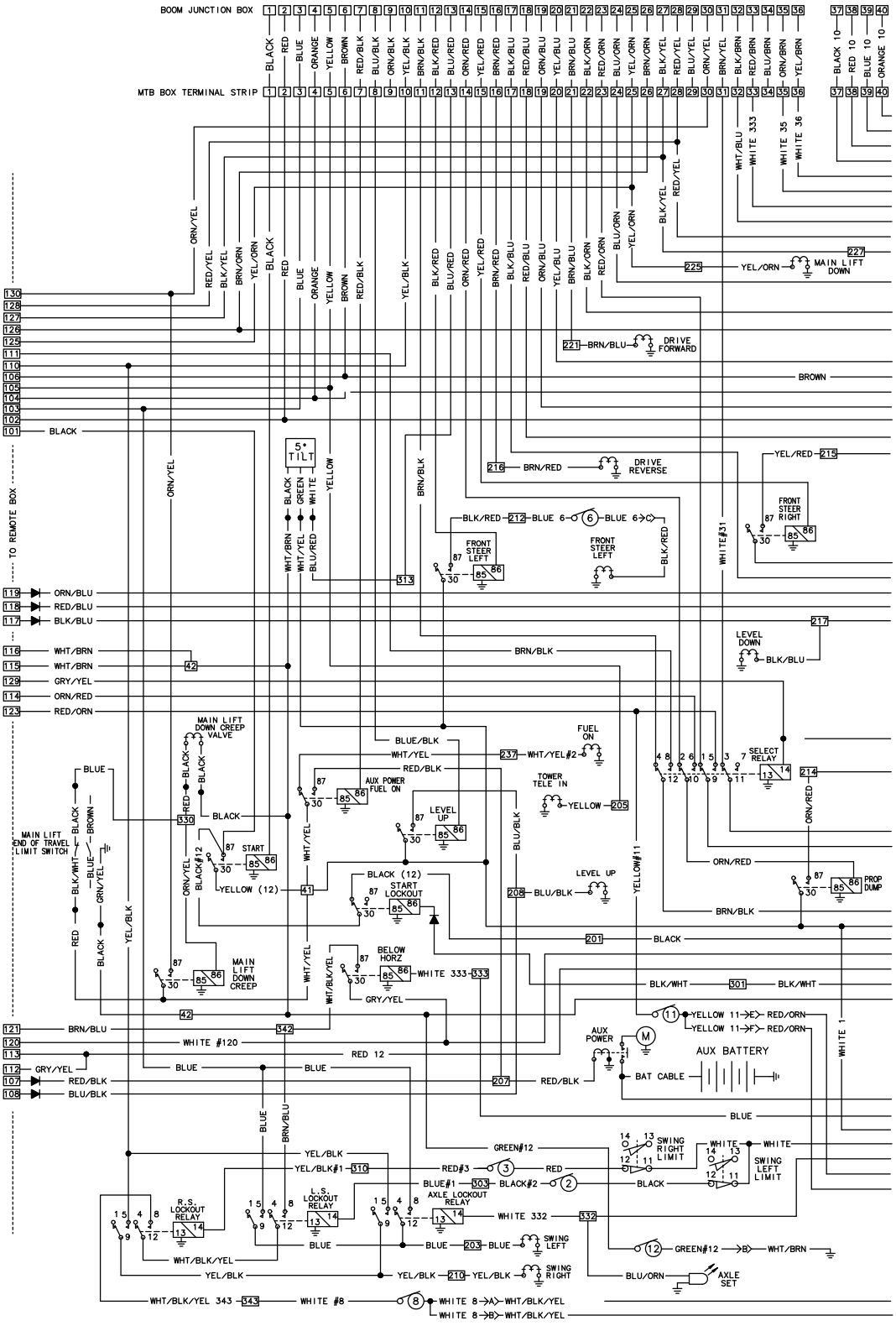

Figure 6-3. Electrical Schematic - Sheet 3 of 5

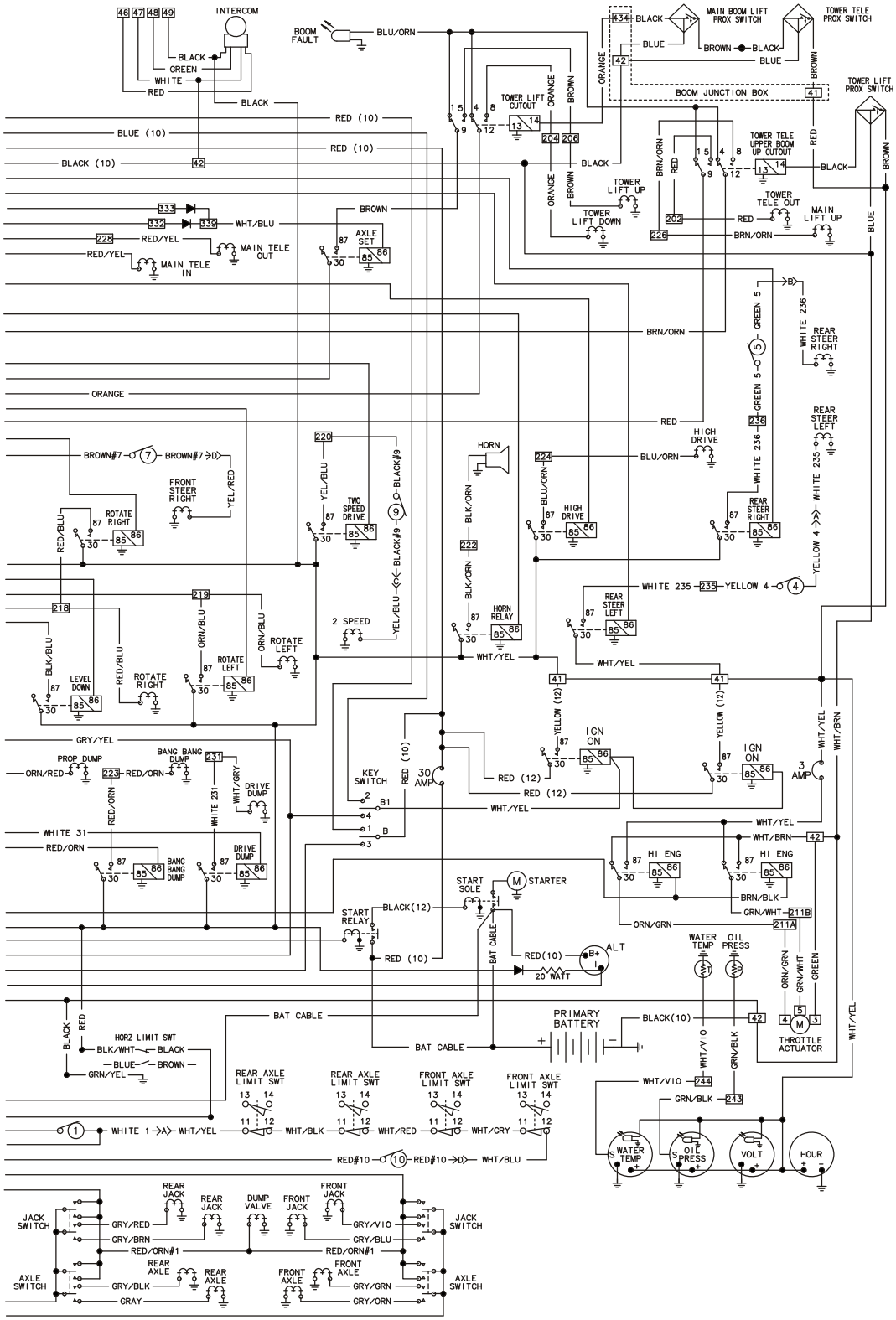

Figure 6-4. Electrical Schematic - Sheet 4 of 5

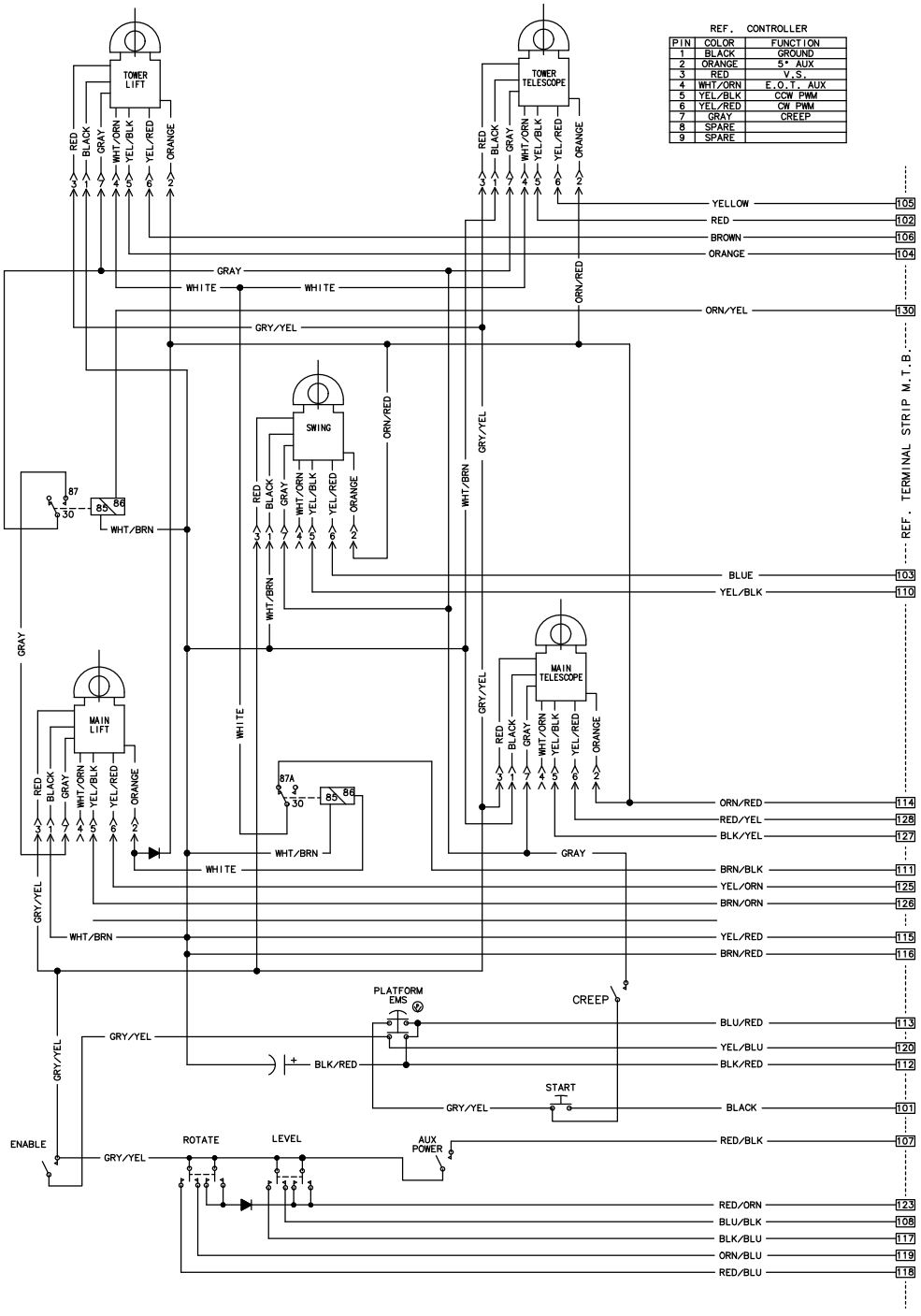

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Figure 6-5. Electrical Schematic - Sheet 5 of 5

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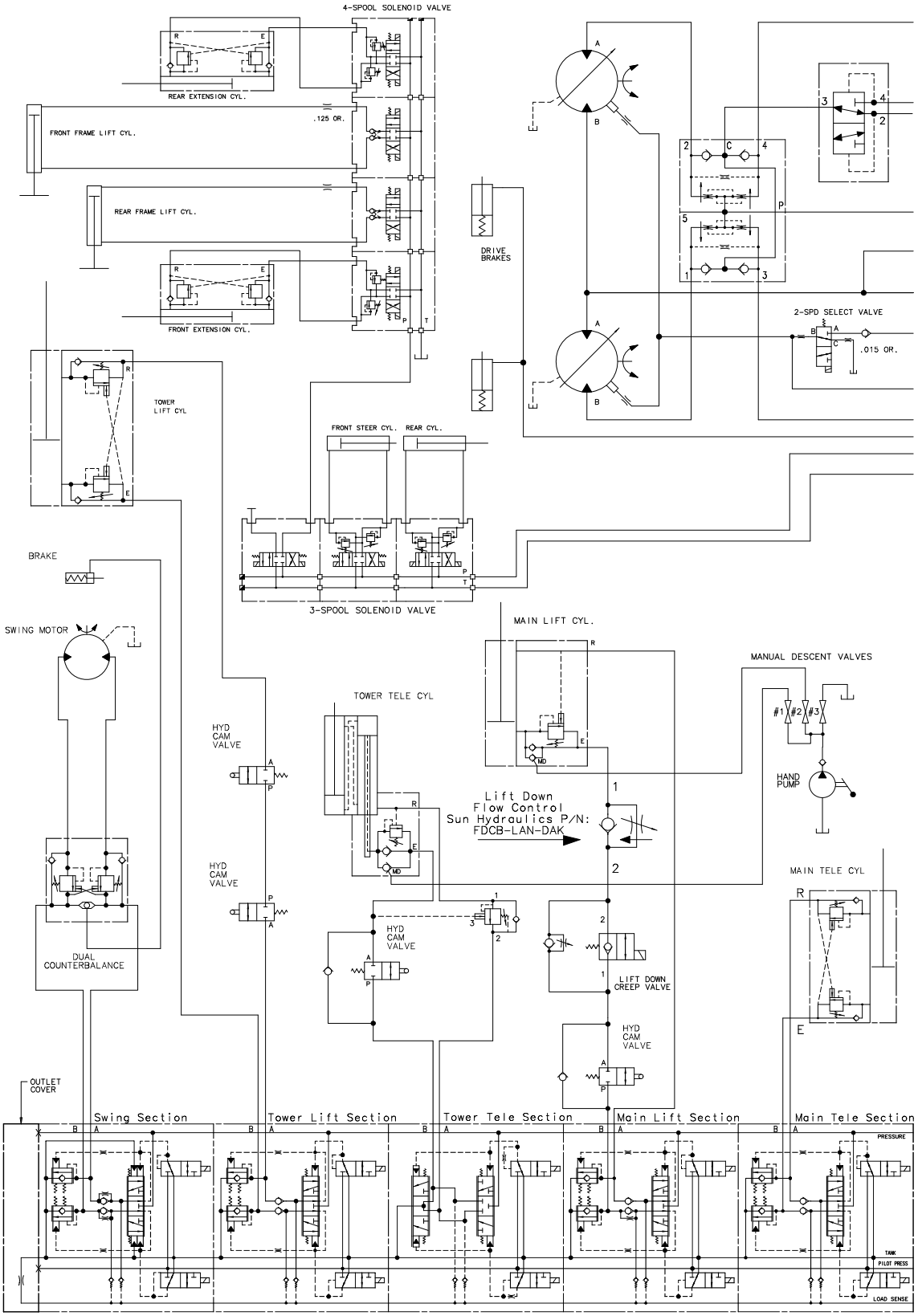

Figure 6-6. Hydraulic Schematic - Sheet 1 of 2

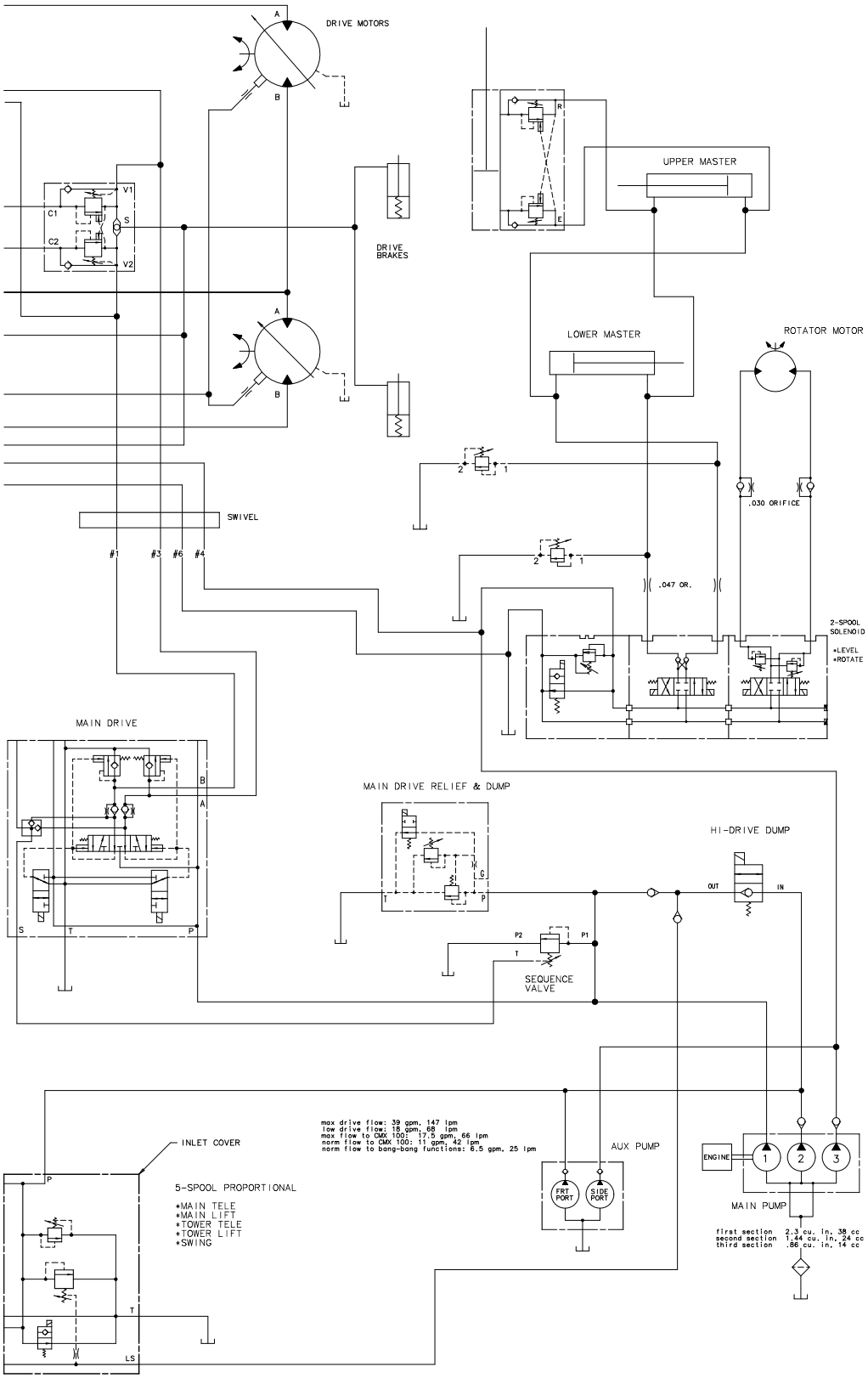

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Figure 6-7. Hydraulic Schematic - Sheet 2 of 2

NOTES:

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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