Service and Maintenance Manual

Model 60HA

3120655
June 1, 1994

ANSI

A. GENERAL.

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

WARNING

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

2. 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.

3. 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.

1. 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.

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

C. MAINTENANCE.

WARNING

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

'NO SMOKING' IS MANDATORY. NEVER REFUEL DURING ELECTRICAL STORMS. ENSURE THAT FUEL CAP IS CLOSED AND SECURE AT ALL OTHER TIMES.

REMOVE ALL RINGS, WATCHES AND JEWELRY WHEN PERFORMING ANY MAINTENANCE.

DO NOT WEAR LONG HAIR UNRESTRAINED, OR LOOSE-FITTING CLOTHING AND NECKTIES WHICH ARE APT TO BECOME CAUGHT ON OR ENTANGLED IN EQUIPMENT.

OBSERVE AND OBEY ALL WARNINGS AND CAUTIONS ON MACHINE AND IN SERVICE MANUAL.

KEEP OIL, GREASE, WATER, ETC. WIPED FROM STANDING SURFACES AND HAND HOLDS.

USE CAUTION WHEN CHECKING A HOT, PRESSURIZED COOLANT SYSTEM.

NEVER WORK UNDER AN ELEVATED BOOM UNTIL BOOM HAS BEEN SAFETY RESTRAINED FROM ANY MOVEMENT BY BLOCKING OR OVERHEAD SLING, OR BOOM SAFETY PROP HAS BEEN ENGAGED.

BEFORE MAKING ADJUSTMENTS, LUBRICATING OR PERFORMING ANY OTHER MAINTENANCE, SHUT OFF ALL POWER CONTROLS.

BATTERY SHOULD ALWAYS BE DISCONNECTED DURING REPLACEMENT OF ELECTRICAL COMPONENTS.

KEEP ALL SUPPORT EQUIPMENT AND ATTACHMENTS STOWED IN THEIR PROPER PLACE. USE ONLY APPROVED, NONFLAMMABLE CLEANING SOLVENTS.

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1-1. CAPACITIES.

- **Fuel Tank.**
  - 25 U.S Gallons (94.6 L).
- **Hydraulic Oil Tank.**
  - Gasoline/Diesel Power - 50 U.S. Gallons (189.3 L) with 10% air space.
- **Hydraulic System. (Including Tank)**
  - Gasoline/Diesel Power - 60 U.S. Gallons (227.12 l).
- **Torque Hub, Drive.**
  - 17 ounces (0.50 l).

Note

Torque hubs should be one half full of lubricant.

- **Engine Crankcase.**
  - Ford LSG-423 Gas w/Filter - 5.00 quarts (4.73 l).
  - Deutz F3L1011 Diesel w/Filter - 6.34 quarts (6.00 l).

1-2. COMPONENT DATA.

- **Engine - Gas. (Water-cooled)**
  - Manufacturer/Model - Ford LSG-423.
  - Oil Capacity.
    - 5.00 Quarts (4.73 l) w/Filter.
    - 4.00 Quarts (3.79 l) w/o Filter.
  - Idle RPM - 1000.
  - Low RPM - 2200.
  - High RPM - 3000.
  - Alternator - 40 Amp, Belt Drive.
  - Battery - 85 Amphour, 550 Cold Cranking Amps, 12 VDC.
  - Fuel Consumption.
    - Low RPM - 3.45 GPH (13.06 lph).
    - High RPM - 4.60 GPH (17.41 lph).
  - Horsepower - 54 @ 2400 RPM, fill load.
  - Cooling System - 16 Quarts (15.14 l.).
- **Engine - Diesel. (Air Cooled)**
  - Manufacturer/Model- Deutz F3L1011.
  - Oil Capacity.
    - 6.34 Quarts (6.00 l) w/Filter.
    - 5.81 Quarts (5.50 l) w/o Filter.
  - Low RPM - 2000.
  - High RPM - 3000.
  - Alternator - 60 Amp, belt drive.
  - Battery - 1000 Cold Cranking Amps, 210 Minutes Reserve Capacity, 12 VDC.
  - Fuel Consumption.
    - Low RPM - 1.90 GPH (7.19 lph).
    - High RPM - 2.50 GPH (9.46 lph).
  - Horsepower - 42 @ 3000 RPM, full load.
- **Engine - Diesel. (Water-cooled)**
  - Manufacturer/Model - Kubota V1902-B.
  - Oil Capacity - 10.50 Quarts (9.00 l) w/Filter.
  - Low RPM - 2000.
  - High RPM - 3000.
  - Generator - 35 Amps, Belt Drive.
  - Battery - 85 Amphor, 550 Cold Cranking Amps, 12 VDC.
  - Fuel Consumption.
    - Low RPM - 1.80 GPH (6.81 lph).
    - High RPM - 2.30 GPH (8.71 lph).
  - Horsepower - 42.4 @ 2800 RPM.
  - Coolant - 1.82 Gallons (6.90 l).

- **Drive System.**
  - Tires - 14 x 17.5, 10 ply rating, traction tread.
  - Drive Motor Displacement.
    - Standard - 2.50 $in.^3$/0.98 $in.^3$/Rev.
    - Four Wheel Drive - 2.43 $in.^3$/Rev.
  - Drive Hub Ratio.
    - Standard - 68.00 to 1.
    - Four Wheel Drive - 49.00 to 1.
  - Drive Brake - Automatic spring applied, hydraulically released disc brakes.
  - Tire Pressure - 14 x 17.5, 85 PSI (5.86 Bar).
- **Steer System.**
  - Tires - 14 x 17.5, 10 ply rating, highway tread, pneumatic.
  - Tires - 15 x 19.5, D 8 ply rating, directional tread, pneumatic.
  - Toe-in, adjust for 1/4" (6.35 mm) overall.
- **Swing System.**
  - Swing Motor Displacement - 3.60 $in.^3$/Rev.
  - Swing Brake - Automatic spring applied hydraulically released disc brakes.
  - Swing Hub Ratio - 69.50 to 1.
- **Hydraulic Pump. (at 3000 RPM)**
  - First Section to Proportional Valve -18.7 GPM (70.78 lpm).
  - Second Section to Solenoid Valve - 11.1 GPM (42.02 lpm).
  - Third Section to Proportional Valve - 11.1 GPM (42.02 lpm).
  - Clockwise Rotation.
- **Auxiliary Power Pump.**
  - 2.0 GPM (7.57 lpm).
  - DC Motor.
  - Clockwise Rotation.
- **Hydraulic Filter - In-line.**
  - Return - Bypass Type.
  - 10 Microns Nominal.

1-3. PERFORMANCE DATA.

- **Travel Speed.**
  - 2WD - 4.0 MPH (6.40 Km/hr.).
  - 4WD - 3.0 MPH (4.80 Km/hr.).
- **Gradeability.**
  - (2WD) 25%.
  - (4WD) 35%.
- **Turning Radius (Outside).**
  - 2WS/2WD - 18 ft. 3 in. (5.56 m).
  - 2WS/4WD - 17ft. 3 in. (5.26 m).
  - 4WS/2WD - 11ft. 7 in. (3.53 m).
  - 4WS/4WD - 11ft. 7 in. (3.53 m).
- **Main Boom Speed - Telescope.**
  - Out 20-30 Seconds.
  - In 28-38 Seconds.
- **Main Boom Speed - Lift.**
  - Up 38-55 Seconds.
  - Down 18-28 Seconds.
- **Tower Boom Speed - Telescope.**
  - Out 80-90 Seconds.
  - In 27-37 Seconds.
- **Tower Boom Speed - Lift.**
  - Up 20-30 Seconds.
  - Down 10-15 Seconds.
- **Swing Speed 360°.**
  - Left 75-90 Seconds.
  - Right 75-90 Seconds.
- **Boom Elevation.**
  - -21.5° to +73.0°.
- **Machine Weight approximately .**
  - 2WD - 20,100 lbs. (9,117 kg).
  - 4WD - 20,600 lbs. (9353 kg).
- **Machine Height (Stowed).**
  - 7 ft. 11 in. (2.41 m).
- **Machine Length (Stowed).**
  - Over Drive Axle - 24 ft. 2 in. (7.40 m).
- **Machine Width.**
  - Standard Frame - 7 ft. 11 in. (2.41 m).
- **Wheel base.**
  - 114 in. (2.90 m).

1-4. TORQUE REQUIREMENTS.

Description	Torque Value (Dry)	Interval Hours
A. Bearing To Chassis	110 FT. LBS. (149 Bar)	200/500*
B. Bearing To Turntable	220 FT. LBS. (298 Bar)	200/500*
C. Wheel Lugs	80 FT. LBS. (109 Bar)	100

*Retorque swing bearing bolts after first 200 hours of operation and every 500 hours thereafter.

Note

See Procedure Section for tightening sequence of turntable bearing bolts.

Note

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

1-5. LUBRICATION.

- **Ford LSG423 Engine.**

  - Single Viscosity Oils (SF, SF-SE, SF-CC, SF-CD).

When Outside Temperature is Consistently	Use SAE Viscosity Number
-10°F. to +60°F.	*10W
+10°F. to +90°F.	20W-20
Above +32°F.	30
Above +50°F.	40

  - Multi-Viscosity Oil. (SF, SF-SE, SF-CC, SF-CD).

When Outside Temperature is Consistently	Use SAE Viscosity Number
Below +10°F.	*5W-20
Below +60°F.	5W-30
-10°F. to +90°F.	10W-30
Above -10°F.	10W-40 or 10W-50
Above +20°F.	20W-40 or 20W-50

***Not recommended for severe service, including high RPM operation.**

Note

Crankcase oil must be high quality detergent type meeting API service classification SF.

- **Deutz F3L1011 Engine**

  - Single Viscosity Oil (CD-SE, CD-SF).

When Outside Temperature is Consistently	Use SAE Viscosity Number
-20°F. to +25°F.	*10W
+5°F to +50°F.	20W-20
+40°F. to +85°F.	30
Above 75°F.	40

  - Multi Viscosity Oil (CD-SE, CD-SF).

When Outside Temperature is Consistently	Use SAE Viscosity Number
-40°F. to +75°F.°	*5W-30 (Synthetic)
-15°F. to +70°F.	10W-30
-15°F. to +85°F.	10W-40
Above -5°F.	15W-40
-5°F. to +75°F.	15W-30

***This viscosity can be used at colder temperatures with engine oil preheating.**

Note

Crankcase oil should be MIL-L2104B/MIL-L2104C or have properties of API classification CC/CD grades.

- **Kubota V1902-B Engine.**

  - Single Viscosity Oils (CC-CD).

When Outside Temperature is Consistently	Use SAE Viscosity Number
+32°F. to +77°F.	20
Above +77°F.	30
Below +32°F.	10W

  - Multi Viscosity Oil (CC-CD).

When Outside Temperature is Consistently	Use SAE Viscosity Number
Below +32°F.	10W-30

- **Hydraulic Oil.**

Table 1-1. Hydraulic Oil.

HYDRAULIC SYSTEM OPERATING TEMPERATURE RANGE	SAE VISCOSITY GRADE
+0° to +180° F (-18° C to +83° C)	10W
+0° F to +210° F (-18° C to +99° C)	10W-20,10W-30
+50° F to +210° F (+10° C to +210° C)	20W-20

Notes

Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Kendall Hyken 052 hydraulic oil, which has an SAE viscosity of 10W-20 and viscosity index of 152.

When temperatures remain consistently below +20° F. (-7° C.), an amount of no. 2 diesel fuel, not to exceed 20% of system capacity, may be added to the hydraulic oil reservoir. This diesel fuel will "thin" the hydraulic oil for easier cold weather operation, and will almost completely dissipate from the hydraulic system over a several month period of time. When cold weather is past, it may be necessary to drain and refill the hydraulic system to rid the system of any remaining diesel fuel.

Aside from JLG recommendations, it is not advisable to mix oils of different brands or types, as they may not contain the same required additives or be of comparable viscosities. If use of hydraulic oil other than Kendall Hyken 052 is desired, contact JLG Industries for proper recommendations.

- **Lubrication Specifications.**

Table 1-2. Lubrication Specifications.

KEY	SPECIFICATIONS
MPG	Multipurpose Grease having a minimum dripping point of 350° F. Excellent water resistance and adhesive qualities, and being of extreme pressure type. (Timken OK 40 pounds minimum.)
EPGL	Extreme Pressure Gear Lube (oil) meeting API service classification GL-5 or MIL-Spec MIL-L-2105.
HO	Hydraulic Oil. API service classification GL-3, e.g. Kendall Hyken 052.
EO	Engine (crankcase) Oil. Gas - API SF class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.

Note

Refer to Lubrication Chart, Figure 1-2 for specific lubrication procedures.

1-6. PRESSURE SETTINGS.

- **Machines with Vickers Proportional Valve.**

  - Vickers Valve
    - Drive - 3200 PSI (220.64 Bar).
    - Tower Boom Lift Up - 3000 PSI (206.85 Bar).
    - Tower Boom Lift Down - 3000 PSI (206.85 Bar).
    - Main Boom Lift Up - 3000 PSI (206.85 Bar).
    - Main Boom Lift Down - 2500 PSI (172.4 Bar).
    - Swing - 1200 PSI (82.7 Bar).
  - Accessory Valve.
    - Main Relief - 3400 PSI (234.43 Bar).
    - Sequence Cartridge - 350 PSI (24.13 Bar).
    - Pressure Reducing Valve - 400 PSI (27.58 Bar).
  - Racine 2-Stack.
    - Main Relief - 2750 PSI (186.1 Bar).
    - Steer Reliefs - 2000 PSI (137.9 Bar).
    - Tower Telescope In - 2750 PSI (189.6 Bar).
    - Tower Telescope Out - 2750 PSI (189.6 Bar).
  - Racine 4-Stack.

Note

This valve governed by Racine 2-Stack Main Relief.

- Main Telescope In - 2000 PSI (137.9 Bar).
- Main Telescope Out - 1500 PSI (103.4 Bar).
- Upright Level - 2750 PSI (189.6 Bar).
- Platform Level - 2750 PSI (189.6 Bar).
- Rotate - 2750 PSI (189.6 Bar).

  - Racine 2-Stack - 4WS **"Only"**.
    - Steer Reliefs - 2WD Front - 1500 PSI (103.4 Bar).
    - Steer Reliefs - 2WD Rear -2000 PSI (137.9 Bar).
    - Steer Reliefs - 4WD Front & Rear -2000 PSI (137.9 Bar).

1-7. CYLINDER SPECIFICATIONS.

TABLE 1-3. CYLINDER SPECIFICATIONS.			
DESCRIPTION	BORE	STROKE	ROD DIA.
TOWER LIFT	5.00 (12.70)	25.56 (64.92)	2.50 (6.35)
TOWER TELESCOPE	3.00/3.50 (7.62/8.89)	54.62 (138.73)	2.00/2.50 (5.08/6.35)
UPRIGHT LEVEL	5.00 (12.70)	20.00 (50.80)	2.50 (6.35)
MAIN LIFT	5.00 (12.70)	23.12 (58.72)	3.50 (8.89)
MAIN TELESCOPE	3.00 (7.62)	153.00 (388.62)	2.00 (5.08)
MASTER LIFT	5.00 (12.70)	20.00 (50.80)	2.50 (6.35)
STEER (2WD)	3.00 (7.62)	8.06 (20.47)	1.25 (3.18)
STEER (4WD)	3.00 (7.62)	9.81 (24.92)	1.50 (3.81)
LOCKOUT (2WD)	3.00 (7.62)	4.57 (11.61)	1.25 (3.18)
LOCKOUT (4WD)	3.00 (7.62)	4.06 (10.31)	1.25 (3.18)
SLAVE LEVEL	4.00 (10.16)	20.00 (50.80)	1.50 (3.81)

1-8. MAJOR COMPONENT WEIGHTS.

WARNING

SELECT LIFTING EQUIPMENT WITH CAPACITY CAPABLE OF SAFELY SUPPORTING WEIGHT.

TABLE 1-4. MAJOR COMPONENT WEIGHTS		
	LB.	KG.
PLATFORM& CONTROL CONSOLE	175	79
PLATFORM LEVEL CYLINDER	70	32
MAIN BOOM (INCLUDES LIFT CYLINDER, ROTATOR AND SUPPORT	1,942	881
UPRIGHT	735	333.4
UPRIGHT LEVEL CYLINDER	135	61
TOWER BOOM COMPLETE	2,425	1099.98
TURNTABLE COMPLETE (INCLUDING ENGINE)	10,965	4973.72
CHASSIS COMPLETE (INCLUDING PNEUMATIC TIRES)	3,770	1710
CHASSIS COMPLETE (INCLUDING FOAM FILLED TIRES)	4,855	2202
MACHINE COMPLETE (GVW) - 2WD W/PNEUMATIC TIRES	20,100	9125
MACHINE COMPLETE (GVW) - 4WD W/PNEUMATIC TIRES	20,366	9238

1-9. CRITICAL STABILITY WEIGHTS.

WARNING

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

TABLE 1-5. CRITICAL STABILITY WEIGHTS				
			LB.	KG.
TIRE & WHEEL (BALLASTED ONLY)		SIZE (14 - 17.5) WEIGHT	415	188.2
		SIZE (15 - 19.5) WEIGHT	500	226.8
ENGINE		FORD	525	238.1
		DEUTZ	600	272.2
		KUBOTA	N/A	N/A
PLATFORM	SIZE	4 FT. (1.22M)	115	52.2
		5 FT. (1.52M)	135	61.2
		6 FT. (1.83M)	155	70.3
		8 FT. (2.44M)	195	88.5

1-10. RELAYS/CIRCUIT BREAKERS

- **Main Terminal Box.**
  - 3740049 - Relay, SPDT, Robert Bosch 0332204174, Potter Brumfield VF4-55F11-S02, with Ford and Deutz engines.
  - 3740058 - Relay, IDEC RY42SUDC12V, with Ford and Deutz engines.
  - 3740059 - Relay, Ford E4JL-11450-AA, with Ford and Deutz engines.
  - 3740061 - Relay, Start Lockout, Precision Governor, with Ford engine.
  - 3740067 - Relay, Solenoid, Prestolite SBC-4201D, with Ford and Deutz engines.
  - 4360212 - Circuit Breaker, 3 amp, Heinemann KDI-3, with Deutz Diesel F3L912 and F3L1011 engines.
  - 4360216 - Circuit Breaker, 30 amp, Littlefuse 813030, with Ford and Deutz engines.
  - 4360232 - Circuit Breaker, 15 amp, self resetting, Great Valley Industries CB2-15.
- **Console Box.**
  - 3740049 - Relay, SPDT, Robert Bosch 0332204174, Potter Brumfield VF4-55F11-S02.
  - 4360209 - Circuit Breaker, 20 amp, Littlefuse 813030 or CB2-20.

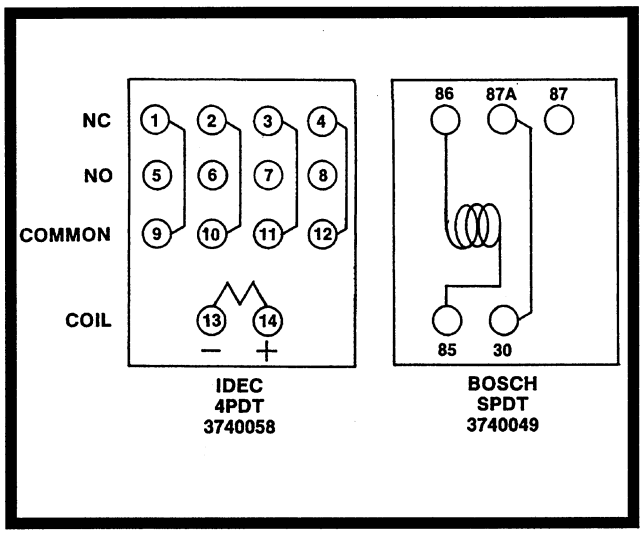


Figure 1-1. Relay Wiring.

1-11. Serial Number Locations.

A serial number plate is affixed to the left rear side of the turntable. If the serial number plate is damaged or missing, the machine serial number is stamped on the left rear of the frame and above that on the left rear of the turntable. In addition, the last five digits of the serial number are stamped on top of the fly end of the upper boom. (See Figure 1-4).

SIZE	THD	BOLT DIA. (IN.)	TENSILE STRESS AREA (SQ. IN.)	SAE GRADE 5 BOLTS				SAE GRADE 8 BOLTS				RECOMMENDED TORQUE WRENCH SIZE		
				CLAMP LOAD (LB.)	TORQUE DRY LB. IN.	TORQUE LUB. LB. IN.	TORQUE LOCTITE LB. IN.	CLAMP LOAD (LB.)	TORQUE DRY LB. IN.	TORQUE LUB. LB. IN.	TORQUE LOCTITE LB. IN.	IN-OZS.	IN-LBS.	IN-LBS.
4	40	0.1120	0.00604	380	8	6		540	12	9		160	10	
	48	0.1120	0.00661	420	9	7		600	13	10		160	10	
6	32	0.1380	0.00909	580	16	12		820	23	17			25	
	40	0.1380	0.01015	610	18	13		920	25	19			25	
8	32	0.1640	0.01400	900	30	22		1260	41	31			25	
	36	0.1640	0.01474	940	31	23		1320	43	32			25	
10	24	0.1900	0.01750	1120	43	32		1580	60	45			50	
	32	0.1900	0.02000	1285	49	36		1800	68	51			50	
1/4	20	0.2500	0.0318	2020	96	75	105	2860	144	108	160		100	
	28	0.2500	0.0364	2320	120	86	135	3280	168	120	185		200	
					LB. FT.	LB. FT.	LB. FT.		LB. FT.	LB. FT.	LB. FT.			
5/16	18	0.3125	0.0524	3340	17	13	19	4720	25	18	30		200	
	24	0.3125	0.0580	3700	19	14	21	5220	25	20	30		200	
3/8	16	0.3750	0.0775	4940	30	23	35	7000	45	35	50		300	25
	24	0.3750	0.0878	5600	35	25	40	7900	50	35	55		300	50
7/16	14	0.4375	0.1063	6800	50	35	55	9550	70	55	80		600	50
	20	0.4375	0.1187	7550	55	40	60	10700	80	60	90		600	50
1/2	13	0.5000	0.1419	9050	75	55	85	12750	110	80	120		1200	100
	20	0.5000	0.1599	10700	90	65	100	14400	120	90	135		1200	100
9/16	12	0.5625	0.1820	11600	110	80	120	16400	150	110	165		1200	100
	18	0.5625	0.2030	12950	120	90	135	18250	170	130	190		1200	100
5/8	11	0.6250	0.2260	14400	150	110	165	20350	220	170	240		1800	150
	18	0.6250	0.2560	16300	170	130	190	23000	240	180	265		1800	150
3/4	10	0.7500	0.3340	21300	260	200	285	30100	380	280	420		2400	200
	16	0.7500	0.3730	23800	300	220	330	33600	420	320	465		2400	200
7/8	9	0.8750	0.4620	29400	430	320	475	41600	600	460	660		3600	300
	14	0.8750	0.5090	32400	470	350	520	45800	660	500	725		3600	300
1	8	1.0000	0.6060	38600	640	480	675	51500	900	680	990		7200	600
	12	1.0000	0.6630	42200	700	530	735	59700	1000	740	1100		7200	600
1 1/8	7	1.1250	0.7630	42300	800	600	840	68700	1280	960	1400		7200	600
	12	1.1250	0.8560	47500	880	660	925	77000	1440	1080	1575		7200	600
1 1/4	7	1.2500	0.9690	53800	1120	840	1175	87200	1820	1360	2000			Mult*
	12	1.2500	1.0703	59600	1240	920	1300	96600	2000	1500	2200			Mult*
1 3/8	6	1.3750	1.1550	64100	1460	1100	1525	104000	2380	1780	2625			
	12	1.3750	1.3150	73000	1680	1260	1750	118100	2720	2040	3000			
1 1/2	6	1.5000	1.4050	78000	1940	1460	2025	126500	3160	2360	3475			Mult*
	12	1.5000	1.5800	87700	2200	1640	2300	142200	3560	2660	3925			Mult*

Figure 1-2. Torque Chart.

NOTE: Tensile strength for bolt size 4 to 1 - 8,274 (min. bar), size 1-1/8 to 1-1/2 - 7,240 (min. bar).
*Torque multiplier.
Torque specifications are usually given in Newton-meters.

SAE Grade 5

SAE Grade 8

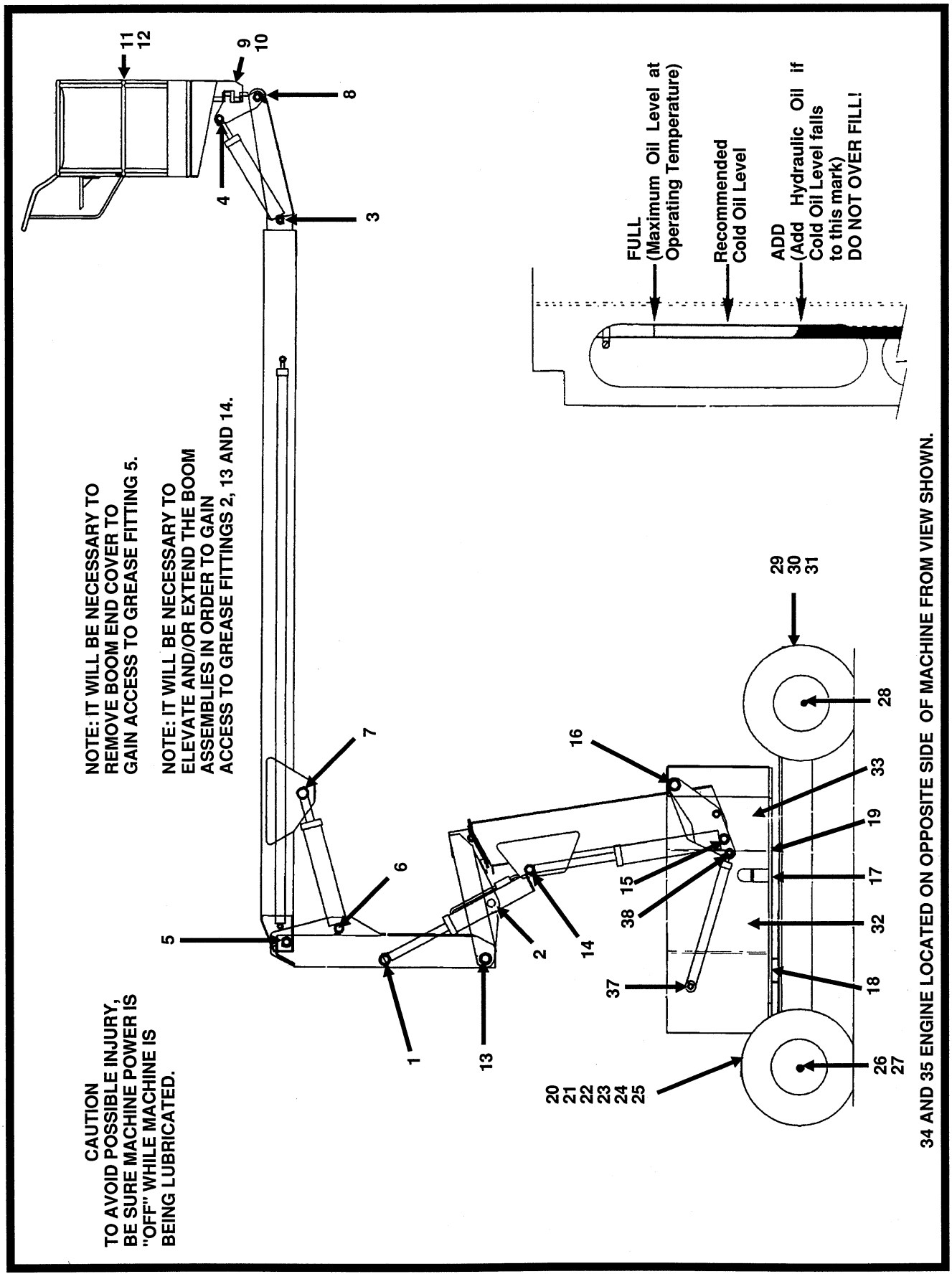


Figure 1-3. Lubrication Chart (Sheet 1 of 2).

INDEX NO.	COMPONENT	NUMBER/TYPE LUBE POINTS	LUBE & METHOD	INTERVAL (HOURS)	
				Machines w/o Excelite	*** Machines w/ Excelite
1.	Upright Level Cylinder (Base Shaft)	1 Grease Fitting	MPG - Pressure Gun	100	250
2.	Upright Level Cylinder (Trunnion End)	2 Grease Fittings	MPG - Pressure Gun	100	250
3.	Slave Level Cylinder (Barrel End)	1 Grease Fitting	MPG - Pressure Gun	100	250
4.	Slave Level Cylinder (Rod End)	1 Grease Fitting	MPG - Pressure Gun	100	250
5.	Main Boom Pivot Pin	2 Grease Fittings	MPG - Pressure Gun	100	250
6.	Main Boom Lift Cylinder (Barrel End)	1 Grease Fitting	MPG - Pressure Gun	100	250
7.	Main Boom Lift Cylinder (Rod End)	1 Grease Fitting	MPG - Pressure Gun	100	250
8.	Platform Pivot Pin	1 Grease Fitting	MPG - Pressure Gun	100	■250
9.	Rotary Platform (If Equipped)	2 Grease Fittings	MPG - Pressure Gun	100	■250
10.	Platform Rotary Gear (If Equipped)	1 Grease Fitting	MPG - Pressure Gun	100	■250
11.	Platform Door Hinges	2 Grease Fittings	MPG - Pressure Gun	100	AS REQ'D
12.	Platform Door Latch	N/A	SAE 10 - Oil Can	100	AS REQ'D
13.	Upright Pivot Pin	1 Grease Fitting	MPG - Pressure Gun	100	250
14.	Tower Boom Lift Cylinder (Rod End)	1 Grease Fitting	MPG - Pressure Gun	100	250
15.	Tower Boom Lift Cylinder (Barrel End)	1 Grease Fitting	MPG - Pressure Gun	100	250
16.	Tower Boom Pivot Pin	1 Grease Fitting	MPG - Pressure Gun	100	250
17.	Swing Bearing Gear	N/A	MPG - Brush	100	■250
18.	Swing Hub (Check oil level every 50 hrs.)	Fill/Plug	EPGL (SAE 90)	2000	2000
19.	Swing Bearing	2 Grease Fittings *	MPG - Pressure Gun	100	■250
20.	Steer Spindles	2 Grease Fittings	MPG - Pressure Gun	100	250
21.	Tie Rods	2 Grease Fittings	MPG - Pressure Gun	100	■250
22.	Steer Cylinder	2 Grease Fittings	MPG - Pressure Gun	100	■250
23.	Oscillating Axle Pivot Pin (If Equipped)	1 Grease Fitting	MPG - Pressure Gun	100	250
24.	Lockout Cylinders (If Equipped)	2 Grease Fittings	MPG - Pressure Gun	100	■250
25.	Steer Spindles (4WD If Equipped)	4 Grease Fittings	MPG - Pressure Gun	100	250
26.	Wheel Bearing	N/A	MPG - Repack	2000	2000
27.	Wheel Drive Hubs (4WD If Equipped)	Fill Plug 1/2 Full	EPGL (SAE 90)	2000	2000
28.	Wheel Drive Hubs (Check oil level every 50 hrs.)	Fill Plug 1/2 Full	EPGL (SAE 90)	2000	2000
29.	Tie Rod (4WS If Equipped)	2 Grease Fittings	MPG - Pressure Gun	100	■250
30.	Steer Spindles (4WS If Equipped)	4 Grease Fittings	MPG - Pressure Gun	100	250
31.	Steer Cylinder (4WS If Equipped)	2 Grease Fittings	MPG - Pressure Gun	100	250
32.	Hydraulic Fluid (Oil)	Fill Cap/Drain Plug	Check Level Every 10 hrs	2000	2000
33.	Hydraulic Filter (Inline)	N/A	Initial Change - 40 hrs. **	250	250
34.	Engine Crankcase	Fill Cap/Drain Plug	EO (See Engine Manual)		
35.	Engine Oil Filter	N/A	Replaceable Element	EO (See Engine Manual)	
36.	Door and Access Panel Hinges	N/A	SAE 10 - Oil Can	A/R	A/R
37.	Master Cylinder (Barrel End)	1 Grease Fitting	MPG - Pressure Gun	100	250
38.	Master Cylinder (Rod End)	1 Grease Fitting	MPG - Pressure Gun	100	250

Key to Lubricants:

EO - Engine Oil
EPGL - Extreme Pressure Gear Lube
HO - Hydraulic Fluid (Kendall Hyken 052 or equal)
MPG - Multi-Purpose Grease

***To reach grease fittings, move boom to the side of frame. Holes in frame will align with bearing grease fittings to allow access from beneath machine.**

**** JLG Industries recommends replacing the hydraulic filter after the first 40 hours of operation and every 250 hours thereafter. Inspect reservoir filter daily for element condition and replace as necessary.**

***** Machines built after April 1994 & subsequent are equipped with Excelite Bushings which extend lubrication intervals.**

■ Hostile Environment, steam washing or weather exposure may necessitate more frequent lubrication.

Figure 1-3. Lubrication Chart (Sheet 2 of 2).

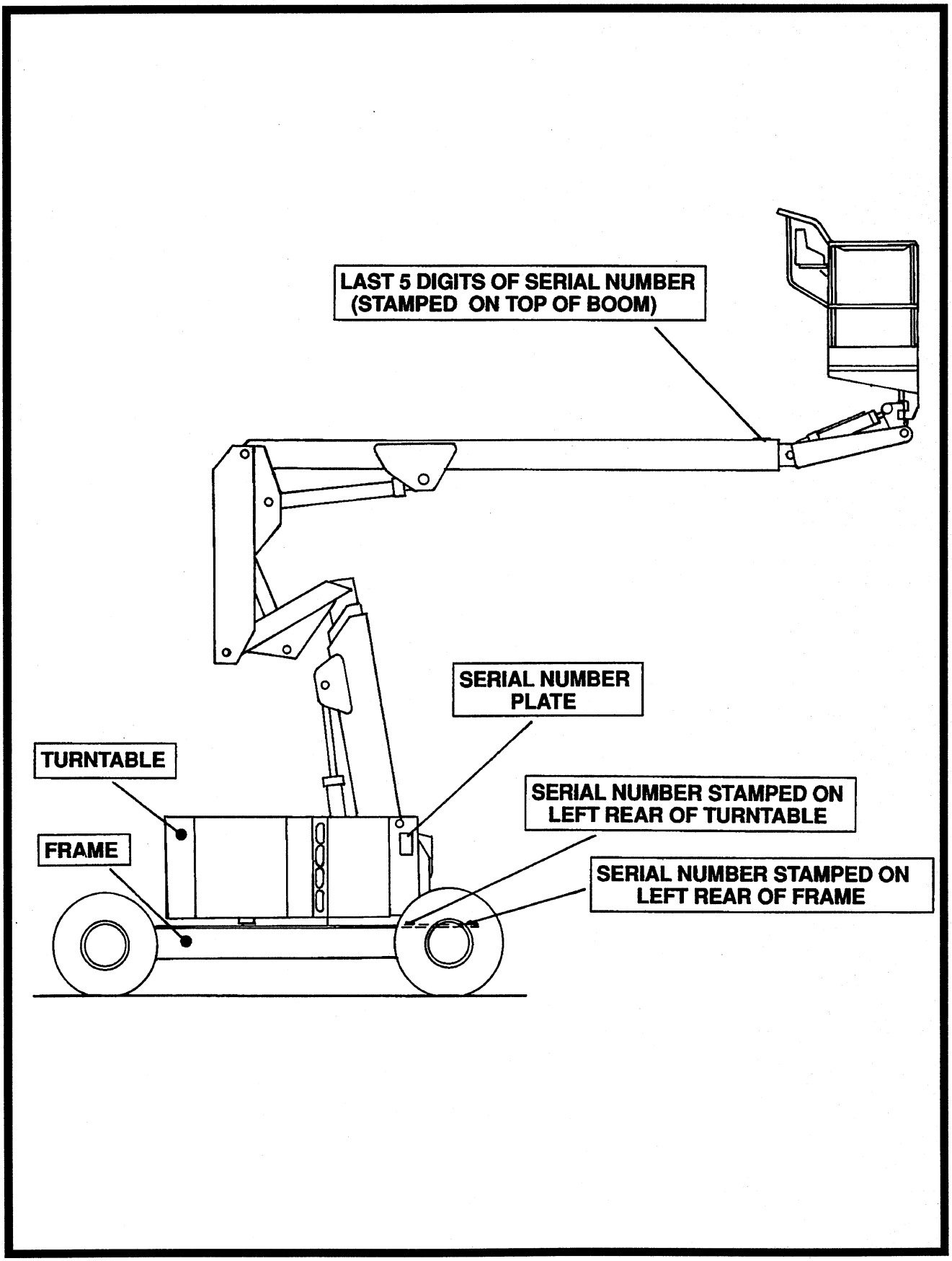


Figure 1-4. Serial Number Location.

2-1. GENERAL.

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

CAUTION

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

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

2-2. SERVICING AND MAINTENANCE GUIDELINES.

a. General.

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

b. 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.

c. 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.

d. 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.

e. 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.

f. Pressure-Fit Parts.

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

g. 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.

h. 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.

i. Bolt Usage and Torque Application.

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

(2). Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Figure 1-1.)

j. 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.

k. 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.

l. 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.

m. 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.

n. Lubrication and Servicing.

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

2-3. LUBRICATION INFORMATION.

a. Hydraulic System.

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

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

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

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

Note

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

b. Hydraulic Oil.

(1). Refer to Table 1-1 for recommendations for viscosity ranges.

(2). JLG recommends Kendall Hyken 052 hydraulic oil, which has an SAE viscosity of 10W-20 and a viscosity index of 152.

Note

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

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

c. Changing Hydraulic Oil.

(1). Use of any of the recommended crankcase or hydraulic oils eliminates the need for changing the oil on a regular basis. However, filter elements must be changed after the first 40 hours of operation and every 250 hours thereafter. If it is necessary to change the oil, use only those oils meeting or exceeding the specifications appearing in this manual. If unable to obtain the same type of oil supplied with the machine, consult local supplier for assistance in selecting the proper equivalent. Avoid mixing petroleum and synthetic base oils. JLG Industries recommends changing the hydraulic oil annually.

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

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

d. Lubrication Specifications.

Specified lubricants, as recommended by the component manufacturers, are always the best choice, however, multi-purpose greases usually have the qualities which meet a variety of single purpose grease requirements. Should any question arise, regarding the use of greases in maintenance stock, consult your local supplier for evaluation. Refer to Table 1-2 for an explanation of the lubricant key designations appearing in the Lubrication Chart.

2-4. CYLINDERS - THEORY OF OPERATION.

a. Systems Incorporating Double Acting Cylinders:

Cylinders are of the double acting type. Systems incorporating double acting cylinders are as follows: Tower Lift, Tower Telescope, Slave Level/Main Level, Main Telescope, Master Level/Upright Level, Steer and Axle lockout 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 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.

b. Systems Incorporating Holding Valves:

Holding valves are used in the Tower Lift, Tower Telescope, Master Level/Upright Level, Main Lift/Slave Level and Main Telescope circuits to prevent retraction of the cylinder rod should a hydraulic line rupture or a leak develop between the cylinder and its related control valve.

2-5. VALVES - THEORY OF OPERATION.

a. Proportional Control Valve - Vickers.

CMX series 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 the pump. The pump senses the difference between the load and pump outlet pressures, and varies the pump displacement to keep the difference constant. This differential pressure is applied across the valves 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 pump. Integral actuator port relief valves, anti cavitation check valves, and load check valves are standard. The load drop check prevents any drop of a suspended load before upward movement.

b. 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 consist 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.

c. 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.

d. Crossover Relief Valves.

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

2-6. WEAR PADS.

(1). Tower Boom.

(a). Shim up wear pads until snug to adjacent surface.

(b). Replace wear pads when gap to adjacent surface reaches 1/32 inch (0.79 mm).

Note

No shims on bottom wear pads of Tower Boom.

(c). Replace wear pads when worn within 1/16 inch (1.59 mm) of threaded insert.

(2). Main Boom.

(a). Shim up wear pads to within 1/32 inch (.79 mm) tolerance between wear pad and adjacent surface.

(b). Replace wear pads when worn within 1/8 inch (3.18 mm) of threaded insert.

2-7. CYLINDER CHECKING PROCEDURE.

Note

Cylinder check must be performed anytime a system component is replaced or when improper system operation is suspected.

a. Cylinders Without Counterbalance Valves - Steer Cylinder.

(1). Using all applicable safety precautions, activate engine and fully extend cylinder to be checked. Shut down engine.

(2). Carefully disconnect hydraulic hoses from retract port of cylinder. There will be some initial weeping of hydraulic fluid which can be caught in a suitable container. After the initial discharge there should not be any further drainage from the retract port.

(3). Activate engine and extend cylinder.

(4). If cylinder retract port leakage is less than 6-8 drops per minute, carefully reconnect hose to port and retract cylinder. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repair must be made.

(5). With cylinder fully retracted, shut down engine and carefully disconnect hydraulic hose from cylinder extend port.

(6). Activate engine and retract cylinder. Check extend port for leakage.

(7). If extend port leakage is less than 6-8 drops per minute, carefully reconnect hose to extend port, than activate cylinder through one complete cycle and check for leaks. If leakage continues at a rate of 6-8 drops per minute or more, cylinder repairs must be made.

b. Cylinders With Single Counterbalance Valve - Main Lift, Main Telescope and Tower Telescope.

IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROLS.

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

WARNING

WHEN WORKING ON THE MAIN LIFT CYLINDER, RAISE THE MAIN BOOM TO HORIZONTAL AND PLACE A BOOM PROP APPROXIMATELY 1 INCH (2.54 CM) BELOW THE MAIN BOOM. DO NOT WORK ON THE CYLINDER WITHOUT A SUITABLE PROP IN PLACE. REFER TO FIGURE 2-1. IF WORKING ON ARTICULATING CYLINDER, RAISE TOWER BOOM HALFWAY, FULLY ELEVATE MAIN BOOM WITH TELESCOPE CYLINDER FULLY RETRACTED AND ATTACH AN OVERHEAD CRANE TO THE UPRIGHT FOR SUPPORT, LEAVING APPROXIMATELY 1 INCH (2.54 CM) OF SLACK IN CHAIN OR SLING FOR TEST PURPOSES. IF WORKING ON THE MAIN OR TOWER TELESCOPE CYLINDER, RAISE THE MAIN OR TOWER BOOM ABOVE HORIZONTAL AND EXTEND THE FLY BOOM APPROXIMATELY 1 INCH (0.3048 M).

(2). After completing the above, 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.

(3). There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should not be any further leakage from the ports. If leakage continues at a rate of 6-8 drops per minute or more, the following cylinder repairs must be made. If the retract port is leaking, the piston seals are defective and must be replaced. If the extend port is leaking, the counterbalance valve is defective and must be replaced.

(4). If no repairs are necessary or when repairs have been made, carefully reconnect hydraulic hoses to the appropriate ports.

(5). If used, remove boom prop from beneath main or tower boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

c. Cylinders With Dual Counterbalance Valves - Tower Lift, Upright Level and Slave Level Cylinders.

IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

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

WARNING

IF WORKING ON THE TOWER BOOM LIFT CYLINDER, RAISE TOWER BOOM HALFWAY, FULLY ELEVATE MAIN BOOM WITH TELESCOPE CYLINDER FULLY RETRACTED AND ATTACH AN OVERHEAD CRANE TO THE UPRIGHT FOR SUPPORT, LEAVING APPROXIMATELY 1 INCH (2.54 CM) OF SLACK IN CHAIN OR SLING FOR TEST PURPOSES. IF WORKING ON THE UPRIGHT LEVEL, RAISE THE TOWER BOOM HALFWAY, THEN RAISE MAIN BOOM TO HORIZONTAL AND POSITION A SUITABLE BOOM PROP APPROXIMATELY 1 INCH (2.54 CM) BELOW MAIN BOOM. IF WORKING ON THE PLATFORM LEVEL CYLINDER, STROKE PLATFORM LEVEL CYLINDER FORWARD UNTIL PLATFORM SITS AT A 45 DEGREES ANGLE.

(2). Shut down hydraulic system and allow machine to sit for 10-15 minutes. If machine is equipped with bang-bang or proportional control valves, turn IGNITION SWITCH to ON, move control switch or lever for applicable cylinder in each direction, then turn IGNITION SWITCH to OFF. If machine is equipped with hydraulic control valves, move control lever for applicable cylinder in each direction. This is done to relieve pressure in the hydraulic lines. Carefully remove hydraulic hoses from appropriate cylinder port block.

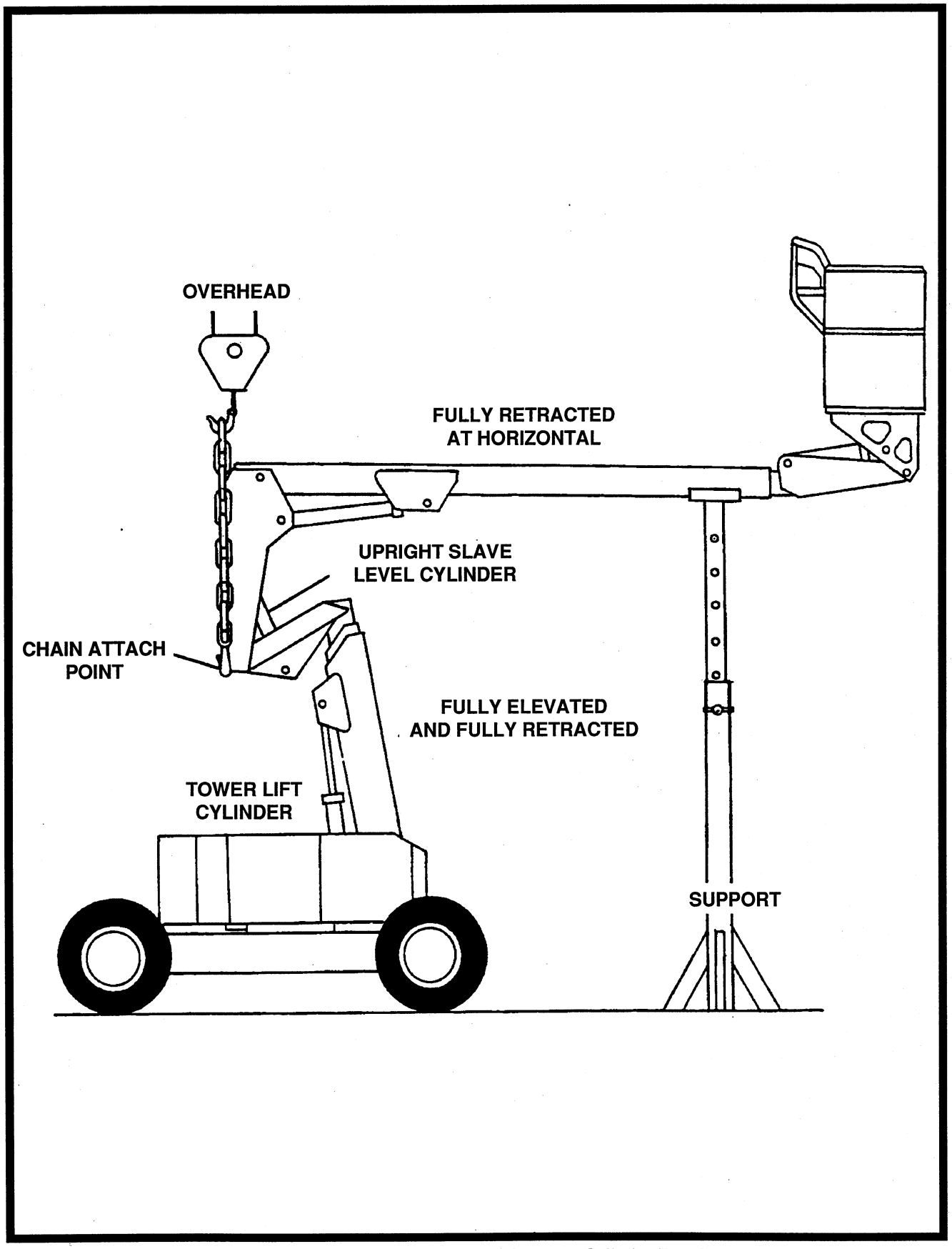


Figure 2-1. Boom Positioning and Support, Cylinder Repair.

(3). 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.

(4). 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.

(5). If no repairs are necessary or when repairs have been made, replace counterbalance valve and carefully connect hydraulic hoses to cylinder port block.

(6). If used, remove lifting device from upright or remove prop from below main boom, activate hydraulic system and run cylinder through one complete cycle to check for leaks.

2-8. 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.

a. Disassembly.

IMPORTANT

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

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

WARNING

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

(2). Operate the hydraulic power source and extend the cylinder. Shut down and disconnect the power source. Adequately support the cylinder rod, if applicable.

(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. Tap around outside of cylinder head retainer with a suitable hammer to shatter loctite.

(5). Using a suitable chain 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.

Note

The cylinder head retainer on the holding valve end of the Tower Telescope Cylinder is held in place by six cap screws.

IMPORTANT

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

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

CAUTION

ONCE THE HEAD GLAND HAS CLEARED THE CYLINDER CASE MOUTH, THE RODS MUST BE SUPPORTED CLOSE TO THE CYLINDER CASE PRIOR TO THE PISTON BEING PULLED PAST THE CYLINDER CASE THREADS, 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.

b. 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 porton 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.

c. Assembly.

Note

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

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

IMPORTANT

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

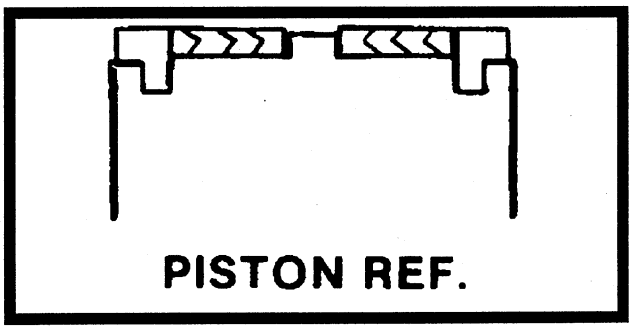


Figure 2-2. Poly-Pak Seal Installation.

(1). Place a new wiper seal and rod seal into the applicable cylinder head gland grooves.

(2). Carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.

(3). Carefully slide the piston spacer on the rod. If applicable, align the oil holes in the rod and the spacer. Secure the spacer, if applicable.

(4). If applicable, correctly place a new o-ring and back-up rings in the inner piston diameter groove.

(5). Carefully place the piston on the cylinder rod, ensuring that the o-ring and back-up rings are not damaged or dislodged.

(6). Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.

(7). Push the piston onto the rod until it abuts the spacer end and install the attaching nut.(See Table 2-1. Torque Specifications). After torquing piston nut spot drill the cylinder rod.

WARNING

WHEN REBUILDING THE MASTER LIFT, STEER, 4WD LOCKOUT, TOWER TELESCOPE, OR MAIN TELESCOPE CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT AND SET SCREWS, THEN TIGHTEN BOTH SECURELY. (SEE TABLE 2-1. TORQUE SPECIFICATIONS).

WHEN REBUILDING THE SLAVE LEVEL OR 2WD LOCKOUT CYLINDERS, APPLY LOCTITE #242 TO SET SCREWS AND TIGHTEN SECURELY. (SEE TABLE 2-1. TORQUE SPECIFICATIONS).

Note

These cylinders use self-locking set screws which should be discarded and replaced whenever they are removed.

(8). If applicable, install the set screw(s) which secure the piston attaching nut to the diameter groove. (See Table 2-1. Torque Specifications).

(9). Remove the cylinder rod from the holding fixture.

(10). Place new o-rings and seals in the applicable outside diameter grooves of both the piston and the cylinder head.

(11). Position the cylinder barrel in a suitable holding fixture.

IMPORTANT

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

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

(13). Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder or, if applicable, until the cylinder head threads engage the threads of the barrel.

(14). If applicable, secure the cylinder head gland using a suitable spanner type wrench in the holes provided.

(15). If applicable, secure the cylinder head retainer using a suitable chain wrench in the holes provided.

(16). 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.

Note

The cylinder head retainer on the holding valve end of the Tower Telescope Cylinder is held in place by six cap screws.

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

Table 2-1. Cylinder Piston Nut Torque Specifications.

Description	Nut Torque Value (Wet)		Setscrew Torque Value (Dry)
Main Telescope	400 ft. lbs. (542 NM)		100 in. lbs. (12 NM)
Main Lift	400 ft. lbs. (542 NM)		100 in. lbs. (12 NM)
Upright Level	400 ft. lbs. (542 NM)		100 in. lbs. (12 NM)
Tower Telescope	Port End	Rod End	100 in. lbs. (12 NM)
	400 ft. lbs. (542 NM)	200 ft. lbs. (271 NM)	
Tower Lift	400 ft. lbs. (542 NM)		100 in. lbs. (12 NM)
Lockout	80 ft. lbs. (109 NM)		100 in. lbs. (12 NM)
Steer	80 ft. lbs. (109 NM)		100 in. lbs. (12 NM)
Master	400 ft. lbs. (542 NM)		100 in. lbs. (12 NM)
Slave	80 ft. lbs. (109 NM)		100 in. lbs. (12 NM)

Note

After torquing cylinder nuts spot drill rod and insert self-locking set screw.

Table 2-2. 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 UNS 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)

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, FORK-LIFT, OR OTHER MEANS TO SUPPORT THE OVERHANGING WEIGHT OF THE EXTENDING ROD.

Note

Steps (18) through (21) apply to the Telescope Cylinders.

(18). Elevate the barrel end of the cylinder to a work bench or other suitable device.

(19). Plug the retract port and supply hydraulic power to the extend port.

(20). Open the bleeder port plug (TP) venting all trapped air to atmosphere. Re tighten the bleeder port plug. Disconnect the hydraulic power source and remove plug from retract port.

(21). An alternative to steps (18) through (20) is to position the barrel horizontally in a suitable holding device, attach a hydraulic power source to both extend and retract ports, while supporting the cylinder rod, cycle the cylinder a minimum of 5 times with the bleeder port unplugged venting all trapped air to atmosphere. A suitable hose may be attached to the bleeder port with the end in a container suitable to contain the hydraulic fluid. After all air is vented remove all attached hoses, and install the bleeder port plug. Also plug the extend and retract ports until cylinder is installed in boom.

2-9. CYLINDER REMOVAL AND INSTALLATION.

a. Main Boom Telescope cylinder.

(1). Place machine on a flat and level surface, with main boom in the horizontal position. Extend main boom until fly attach pin is accessible on fly.

(2). Shut down engine. Support main boom basket end with a prop. Support main boom upright end with an overhead crane (See Figure 2-1.).

CAUTION

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

(3). Tag and disconnect hydraulic lines to telescope cylinder. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

(4). Remove the retaining rings that retain the telescope cylinder rod to the fly boom.

(5). Using a suitable brass drift, carefully drive the telescope cylinder rod pin from the fly boom.

(6). Remove the retaining rings securing the telescope cylinder barrel end to the base boom, or remove the telescope cylinder base pin retaining bolt and nut as applicable.

(7). Using a suitable brass drift, carefully drive the telescope cylinder pin from the base boom section.

(8). Remove the main boom pivot pin retaining hardware.

(9). Using a suitable brass drift, carefully drive the main boom pivot pin from the upright. This allows access to remove the telescope cylinder.

(10). Attach a suitable sling to the telescope cylinder. Using a suitable lifting device attached to the sling carefully pull the cylinder from the boom assembly.

(11). Using another lifting device, support the rod end of the cylinder and remove the cylinder from the boom assembly.

(12). Carefully lift the cylinder clear of the boom assembly and lower to the ground or suitably supported work area.

b. Main Boom Telescope Cylinder Installation.

(1). Attach a hydraulic power supply to the telescope cylinder ports. Using suitable supports or lifting devices at each end of the cylinder, extend the rod so that the cylinder pin attach holes are the same distance apart as the boom pin attach holes.

(2). Using suitable lifting equipment, carefully lower the cylinder to the boom assembly.

(3). Using another lifting device, support the rod end of the cylinder and install the cylinder into the boom assembly.

(4). Remove the lifting devices from the telescope cylinder.

(5). Carefully install the telescope cylinder rod pin through the fly boom and secure it with the retaining rings.

(6). Carefully install the telescope cylinder barrel pin through the base boom and install the pin retaining hardware.

(7). Remove applicable hydraulic line and port caps and correctly connect the hydraulic lines to the telescope cylinder. Ensure all hoses are correctly routed.

(8). Remove boom prop and overhead crane. Activate hydraulic system.

(9). Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.

(10). Check fluid level of hydraulic tank and adjust as necessary.

c. Main Boom Lift Cylinder Removal.

(1). Place the machine on a flat and level surface. Start the engine and place the main boom in a horizontal position. Shut down the engine and prop the boom (See Figure 2-1.).

(2). Remove the hardware retaining the cylinder rod attach pin to the boom. Using a suitable brass drift, drive out the cylinder rod attach pin.

(3). Using auxiliary power, retract the lift cylinder rod completely.

(4). Disconnect, cap and tag the main boom lift cylinder hydraulic lines and ports.

(5). Remove barrel end attach pin retaining hardware. Using a suitable brass drift drive out the barrel end attach pin from the upright.

(6). Remove the cylinder from the boom and place in a suitable work area.

d. Main Boom Lift Cylinder Installation.

(1). Install lift cylinder in place using suitable slings or supports, aligning attach pin mounting holes on the upright.

(2). Using a suitable drift, drive the barrel end attach pin through the mounting holes in the lift cylinder and the upright. Secure in place with the pin retaining hardware.

(3). Remove cylinder port plugs and hydraulic line caps and correctly attach lines to cylinder ports.

(4). Using auxiliary power extend the cylinder rod until the attach pin hole aligns with those in the boom. Using a suitable drift drive the cylinder rod attach pin through the aligned holes, taking care to align the grooved pin holes. Secure the pin in place with attaching hardware.

(5). Remove boom prop and overhead crane. Activate hydraulic system.

(6). Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.

(7). Check fluid level of hydraulic tank and adjust as necessary.

e. Upright Level Cylinder Removal.

(1). With the main boom positioned and supported as in Figure 2-1, prepare to remove the upright level cylinder.

(2). Remove the retaining hardware and pins attaching the Upright Level Cylinder to the Tower Boom.

(3). Tag, disconnect and cap hydraulic lines to level cylinder.

(4). Use two temporary hydraulic hoses (3/8" x 10') to carry power from the turntable swing motor supply hoses to the level cylinder.

(5). After installing temporary hoses and, using auxiliary power, activate swing function to fully retract level cylinder rod.

(6). Remove and cap temporary hoses from level cylinder. Plug cylinder ports.

(7). Using slings, restrain level cylinder.

(8). Remove retaining hardware from upright attach pin.

(9). Using an appropriate brass drift drive out the upright rod attach pin. Carefully remove restraining and remove level cylinder from boom.

f. Upright Level Cylinder Installation.

(1). With the main boom and tower boom positioned and supported as in Figure 2-1, place the upright level cylinder in position on the boom and secure in place using slings.

(2). Align bushing bushing with pin attach blocks in upright and install upright attach pin using appropriate brass drift. Secure pin with retaining hardware.

(3). Remove caps from temporary hydraulic lines and attach to level cylinder ports. Using auxiliary power activate swing function and extend cylinder rod until barrel pin holes align with fly knuckle pin holes.

(4). Using an appropriate brass drift drive the barrel attach pin through the aligned holes of the cylinder and boom knuckle. Secure with retaining hardware.

(5). Remove restraining slings from level cylinder.

(6). Remove temporary hydraulic lines from cylinder ports and turntable swing motor hydraulic supply. Reattach hydraulic supply to swing motor.

(7). Remove caps from cylinder hydraulic lines and correctly install lines to cylinder.

(8). Remove boom prop and overhead crane. Activate hydraulic system

(9). Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.

(10). Check fluid level of hydraulic tank and adjust as necessary.

g. Tower Boom Lift Cylinder Removal.

(1). Place machine on a flat and level surface. Place the main boom in a horizontal position with the telescope cylinder fully retracted. Place the tower boom in a fully elevated and fully retracted position (See Figures 2-1.).

(2). Support the main boom with a prop. Support the upright with an overhead crane (See Figure 2-1.).

(3). Using slings restrain tower lift cylinder.

(4). Using slings restrain the tower lift cylinder.

(5). Remove attaching hardware securing the cylinder rod pin to the boom. Using an appropriate brass drift, drive out the cylinder rod attach pin.

(6). Tag, disconnect and cap the tower lift cylinder hydraulic lines and ports.

(7). Make up two temporary hydraulic hoses 3/8" x 10' (1 cm x 3 cm) to carry power from the turntable swing motor supply hoses to the tower lift cylinder. Couple temporary hoses to swing motor supply hoses, use reducer fittings if necessary, plug port in swing motor.

(8). After installing temporary hoses and, using auxiliary power, activate swing function to fully retract lift cylinder rod.

(9). Remove and cap temporary hoses from lift cylinder. Plug cylinder ports.

(10). Lower Tower Boom approximately 45 degrees to allow access to cylinder barrel pin.

(11). Remove attaching hardware securing the cylinder barrel pin to the turntable. Using an appropriate brass drift drive out the cylinder barrel pin.

(12). Carefully remove restraining slings and remove tower lift cylinder from turntable. Place in a suitable work area.

h. Tower Lift Cylinder Installation.

(1). With the main boom and tower boom positioned and supported as in Figure 2-1, place the tower lift cylinder in position on the turntable and secure in place using slings.

(2). Install the cylinder barrel pin being sure to align the holes of the attaching hardware with the turntable bushing. When holes align install the attaching hardware.

(3). Remove caps from temporary hydraulic lines and attach to lift cylinder ports. Using auxiliary power, activate swing function and extend cylinder rod until the cylinder rod bushing aligns with bushings on boom.

(4). Using an appropriate brass drift, drive the rod attach pin through the aligned bushings. Secure pin with attaching hardware.

(5). Remove temporary hydraulic lines from cylinder ports and cap lines.

(6). Remove caps from cylinder hydraulic lines and correctly install lines to cylinder as previously tagged.

(7). Remove boom prop and overhead crane. Activate hydraulic system.

(8). Using all applicable safety precautions, operate the boom functions. Check for correct operation and hydraulic leaks. Secure as necessary.

(9). Check fluid level of hydraulic tank and adjust as necessary.

i. Tower Telescope Cylinder Removal.

(1). Place machine on a flat and level surface. Using auxiliary power, activate Tower Lift and raise boom approximately 3 degrees. With the aid of an assistant, manually override the Plunger Valve with a pry bar, and from Ground Control, using auxiliary power, extend the Tower Boom out about 3 inches (7.6 mm) to gain access to fly attach pin.

Note

Mid Boom may extend out with Fly Section. If so, use a pry bar to push Mid Boom back against Base Boom.

(2). Install wood block per Figure 2-1 between Mid and Fly Booms. From Ground Control, using Auxiliary Power, retract Tower Telescope until wood block engages between Mid and Fly.

(3). Remove lower cover plate.

(4). Tag, disconnect and cap hydraulic hoses to Tower Telescope Cylinder. Plug cylinder ports.

(5). Remove snap rings securing upper cylinder pin to Fly Boom. Using a suitable brass drift, drive out the cylinder rod pin.

(6). Remove 4 bolts and lock washers attaching retaining plate to Mid Boom and remove plate. Sling or restrain cylinder from moving. Remove set screws and nuts securing cylinder pin to Base Boom. Using a suitable brass drift, drive out the cylinder pin. Remove Telescope Spacer bushings.

(7). Carefully slide the Telescope Cylinder from the boom. Take cylinder to a suitable work area.

j. Tower Telescope Cylinder Installation

(1). With the boom positioned as in Removal (above), slide the Telescope Cylinder into the boom, aligning the cylinder rod hole with holes in Base Boom. Using a suitable brass drift, drive in the pin securing cylinder to Base Boom. Be sure to install the Telescope spacer bushings at this time. Install set screws and nuts securing pin in place. Reinstall retaining plate to Mid Boom.

(2). Remove caps and plugs from hydraulic lines and ports. Properly connect hydraulic lines to cylinder. Reinstall cover plate.

(3). Start engine. With the aid of an assistant, manually override the plunger valve. Activate Tower telescope out to align attaching pin holes in Fly Boom. Shut down engine.

(4) Using a brass drift, drive in the attach pin. Secure in place with snap rings.

(5). Start engine. Activate Tower Telescope Cylinder until wood block can be removed.

(6). Carefully put boom through all functions to assure correct operation. Place boom in stowed position. Shut down engine.

2-10. TILT ALARM SWITCH.

Note

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.

a. Manual Adjustment.

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

Note

Ensure switch mounting bracket is level and securely attached.

(2). Level the base of the indicator by tightening the three flange nuts through approximately one half of its spring 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.

(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 d. 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 c. through e. 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).

b. Voltmeter Adjustment.

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

(2). If engine is not running, turn ignition switch to ON.

(3). Connect black lead of voltmeter to ground and red lead to yellow wire protruding from pot on bottom of sensor.

(4). Adjust leveling nuts to obtain the highest possible voltage reading.

(5). Check Voltage at trip point in all four directions. If voltage reading is not symmetrical, repeat step (4) above.

2-11. TOWER BOOM LIMIT CAM VALVE ADJUSTMENT.

Adjustment procedures are shown in Figure 2-3.

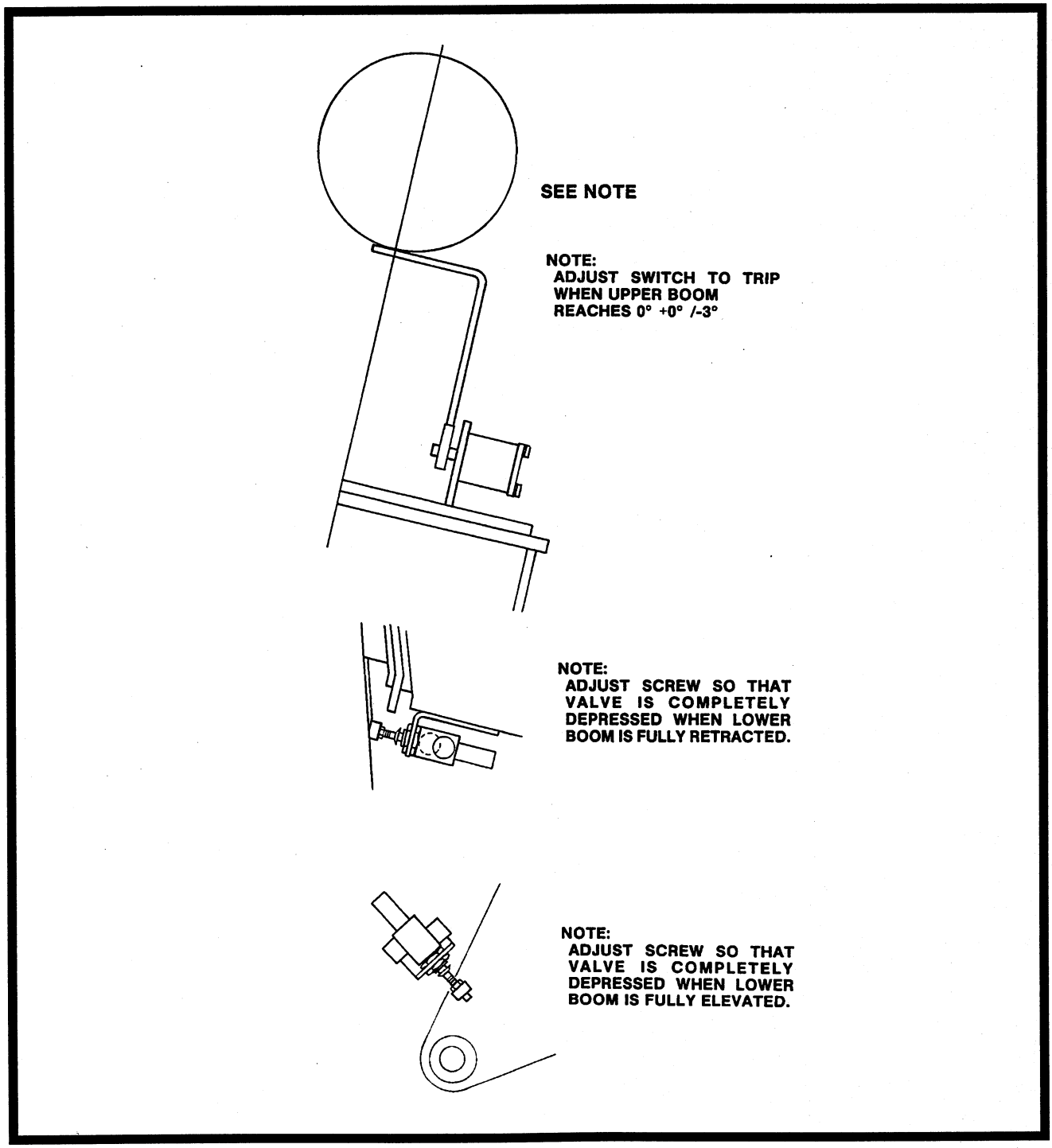


Figure 2-3. Tower Boom Limit Cam Valve Adjustment.

2-12. THROTTLE CHECKS AND PRECISION GOVERNOR ADJUSTMENTS - FORD VSG423 ENGINE. (Refer to Figure 2-4.)

a. Checks.

(1). Check that anti-dieseling solenoid is operating. If solenoid is operating, an audible click at the carburetor should be heard when ignition is switched ON and OFF.

(2). Check throttle linkage for smooth operation by rotating throttle lever by hand to full throttle position then slowly back to idle position feeling closely for sticking or binding.

b. Choke Adjustments.

Note

Automatic choke and vacuum pulloff adjustment procedure to be made only on a cold engine.

(1). Make sure choke body and mounting bracket are positioned so that choke rod moves freely with no binding anywhere through its stroke.

(2). The choke spring should hold the choke plate firmly closed but require only slight finger pressure to open at 70 degrees F. (21.28 degrees C.).

(3). Retract pulloff shaft until it bottoms (as if under engine vacuum. Bend pulloff rod until a 3/8 inch (9.53 mm) rod just fits between choke plate and carburetor body.)

(4). The above procedure outlines the correct choke system adjustment for most conditions. Some environments such as high altitude, very warm or very cold temperatures may require that the choke cover be set richer or leaner, or the amount of pulloff may need to be varied somewhat.

c. Carburetor and Governor Adjustments.

(1). With the aid of an assistant, start the engine at the platform console and allow it to come to up to operating temperature with air cleaner installed. Adjust carburetor idle screw until engine idles at 1000 RPM. Shut down engine.

Note

Steps (2), and (3) are preliminary settings.

(2). On controller (in ground control box) turn 'high engine' (P1) adjusting screw 25-30 turns CCW, then 10 turns CW.

(3). On controller (in ground control box) turn 'gain' (P2) adjusting screw CCW to the stop, then CW until screw slot is vertical (approximately 1/4 turn).

(4). On controller (in ground control box) turn 'droop' (P3) adjusting screw CCW to the stop, then CW until screw slot is vertical (approximately 1/4 turn). No further adjustment should be necessary to 'droop' (P3).

(5). With the aid of an assistant at platform console start the engine and allow it to come to up to operating temperature. Then have assistant depress footswitch and place engine speed switch to HIGH ENGINE.

(6). If engine surging occurs at this point, turn 'gain' (P2) adjusting screw CCW until surging ceases. Turn 'high engine' (P1) adjusting screw until engine runs at 3000 RPM. Turning the screw CW increases RPM. Turning the screw CCW decreases RPM.

(7). While your assistant continues to depress the footswitch, have him place engine speed switch to LOW ENGINE. Turn 'low (mid) engine' adjusting screw until engine runs at 1800 RPM. Turning the screw CW increases RPM. Turning the screw CCW decreases RPM. Shut down engine. Seal all trim pots when finished.

Note

If engine surges under no load, high engine and you cannot get enough response from adjusting 'gain' (P2), try adjusting surge screw on actuator. Loosen surge screw locknut. Disconnect throttle linkage. Turn surge screw CW until linkage arm moves. Manually stroke the linkage fully and allow to return slowly until it stops. Try to move linkage towards return position. If linkage moves, turn surge screw CCW 1/2 turn. Again stroke linkage and allow it return slowly until it stops. Try to move linkage towards return position. If linkage moves, turn surge screw CCW 1/2 turn. Repeat the procedure until linkage does not move after stroking. Do not turn any more. This will set buffer spring tension properly. Reconnect throttle linkage.

(8). With engine speed switch set to LOW ENGINE, when footswitch is depressed engine should immediately respond. If response time lags, turn 'gain' (P2) adjusting screw CW to improve response time. Turn adjusting screw in small increments only until response time is correct. Turning adjusting screw too far CW can cause surging. (See step 7 above).

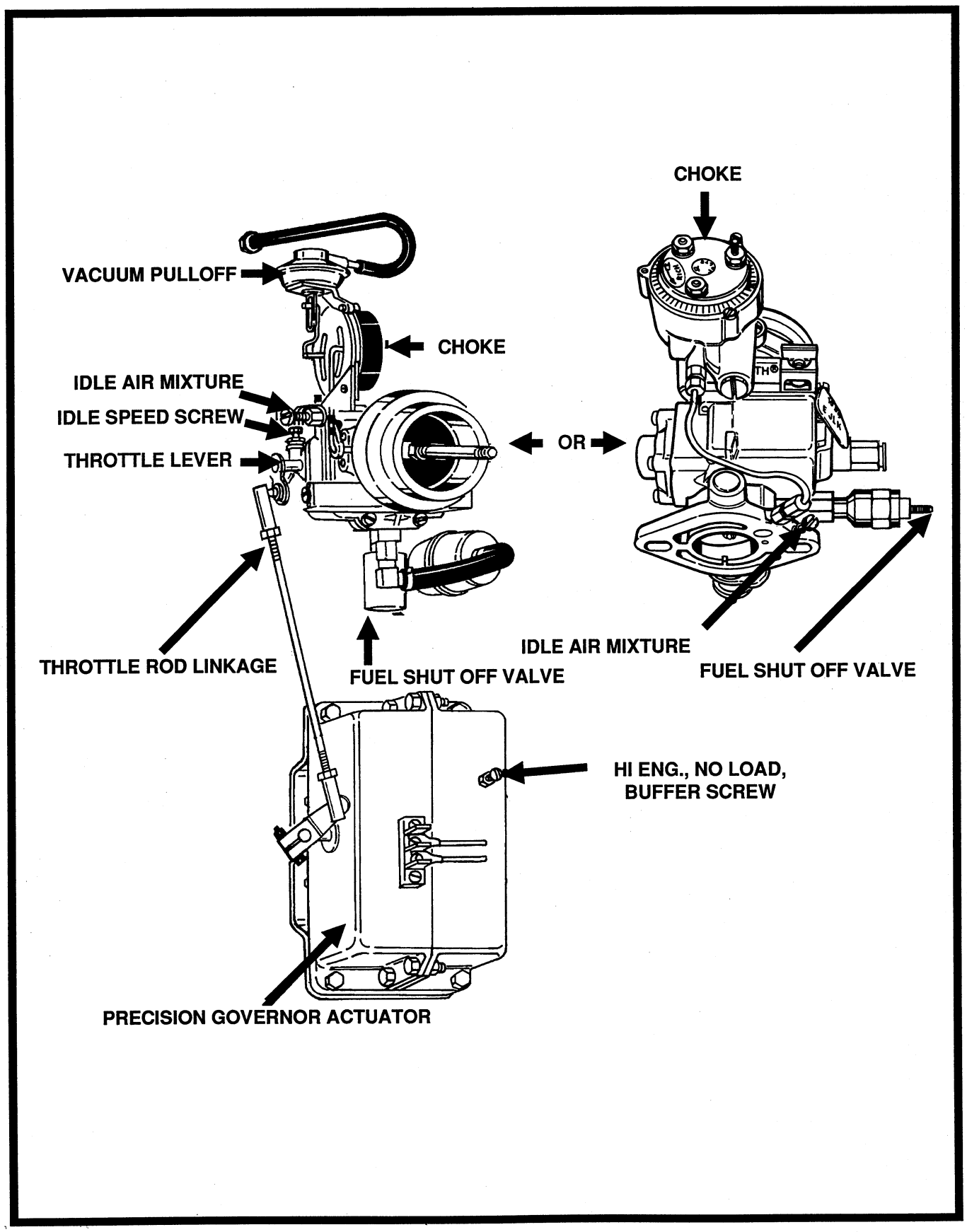
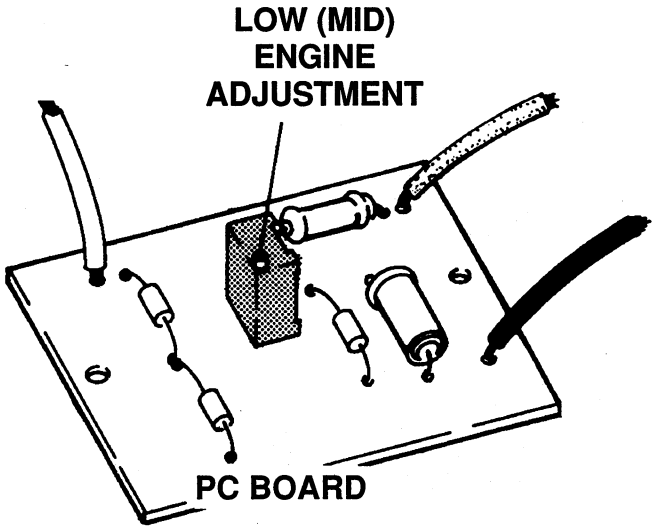
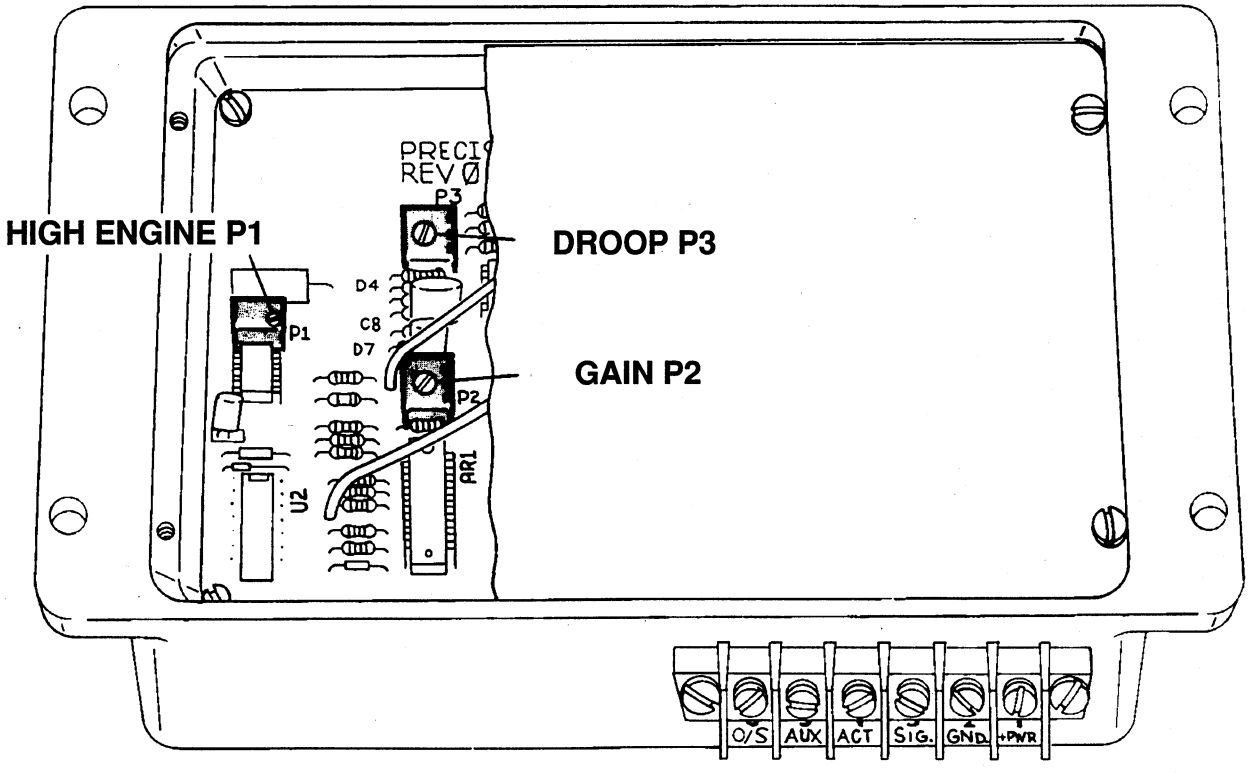


Figure 2-4. Precision Governor Adjustment, LSG-423 (Sheet 1 of 2).



Note

All pots should be sealed with finger nail polish, after adjustments are completed.



PRECISION GOVERNOR CONTROLLER

Figure 2-4. Precision Governor Adjustment, LSG-423 (Sheet 2 of 2).

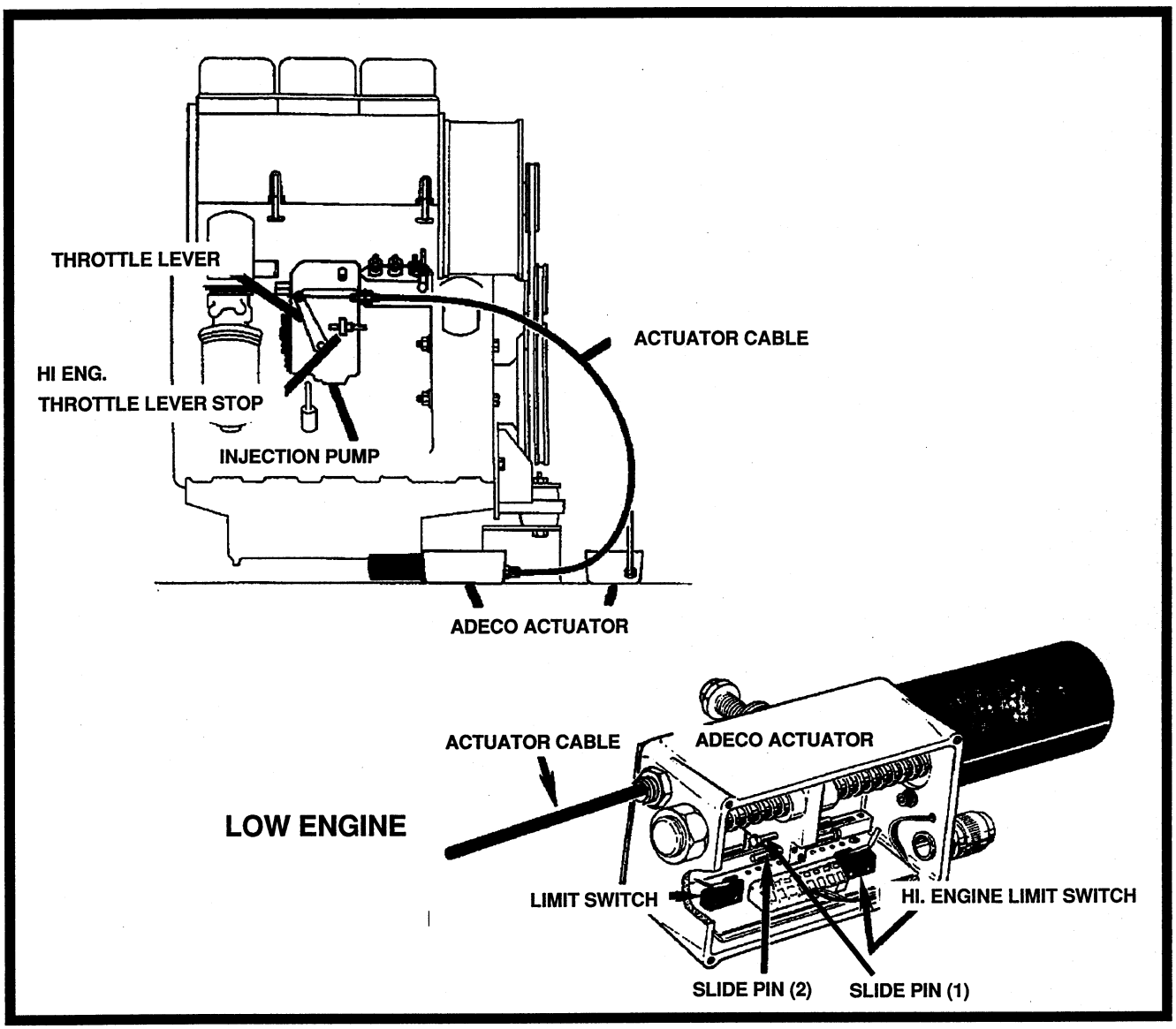


Figure 2-5. Adeco Actuator Adjustments.

2-13. THROTTLE CHECKS AND ADJUSTMENTS - DEUTZ ENGINE. (See Figure 2-5.)

Note

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

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 2000 RPM. Shut down engine. Reattach actuator cable to throttle lever making sure that low engine setting remains the same. If necessary, adjust slide pin to contact low engine limit switch at 2000 RPM. Shut down engine.

b. With the aid of an assistant, start engine from basket and allow to come up to operating temperature. Disconnect proportional dump valve wire. Activate foot switch. Turn on HIGH ENGINE switch. Hold drive controller in full drive position. Adjust slide pin to contact high engine limit switch at 3000 RPM. Shut off all switches and controllers. Reconnect proportional dump valve wire.

Note

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

2-14. PRESSURE SETTING PROCEDURES.

a. Accessory Valve pressure setting procedures for gas or diesel powered machines are shown in Figure 2-6.

b. Proportional Valve pressure setting procedures for gas or diesel powered machines are shown in Figure 2-7.

c. Racine 2-stack valve pressure setting procedures for gas or diesel power machines are shown in Figure 2-8.

d. Racine 2-stack - 4WS valve pressure setting procedures for gas or diesel power machines are shown in Figure 2-9.

e. Racine 4-stack valve pressure setting procedures for gas or diesel powered machines are shown in Figure 2-10.

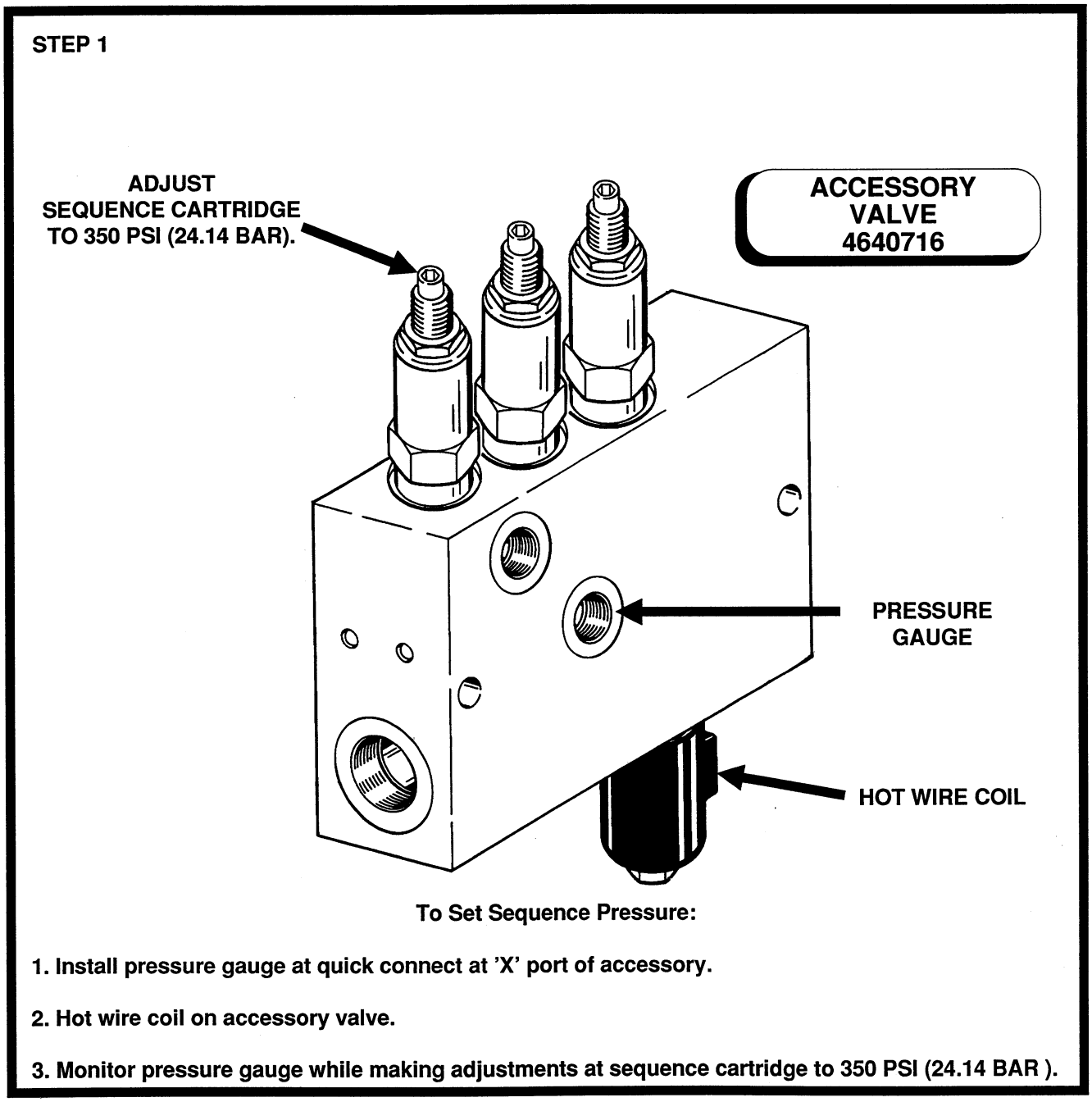
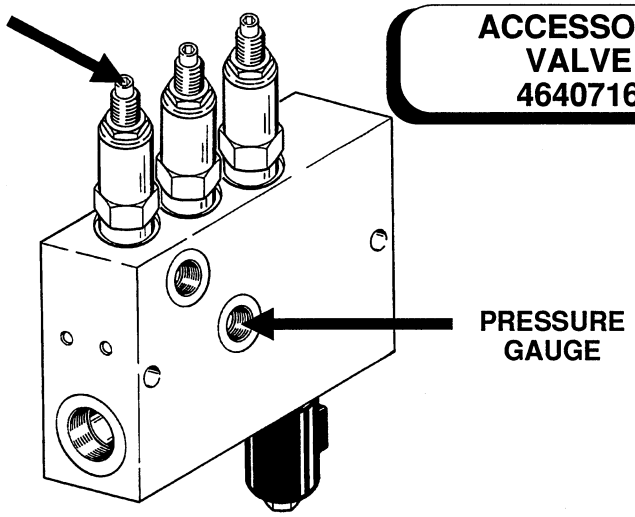


Figure 2-6. Pressure Setting Procedure, Accessory Valve. (Sheet 1 of 2)

ADJUST PRESSURE REDUCING CARTRIDGE TO TO 400 PSI (27.58 BAR).

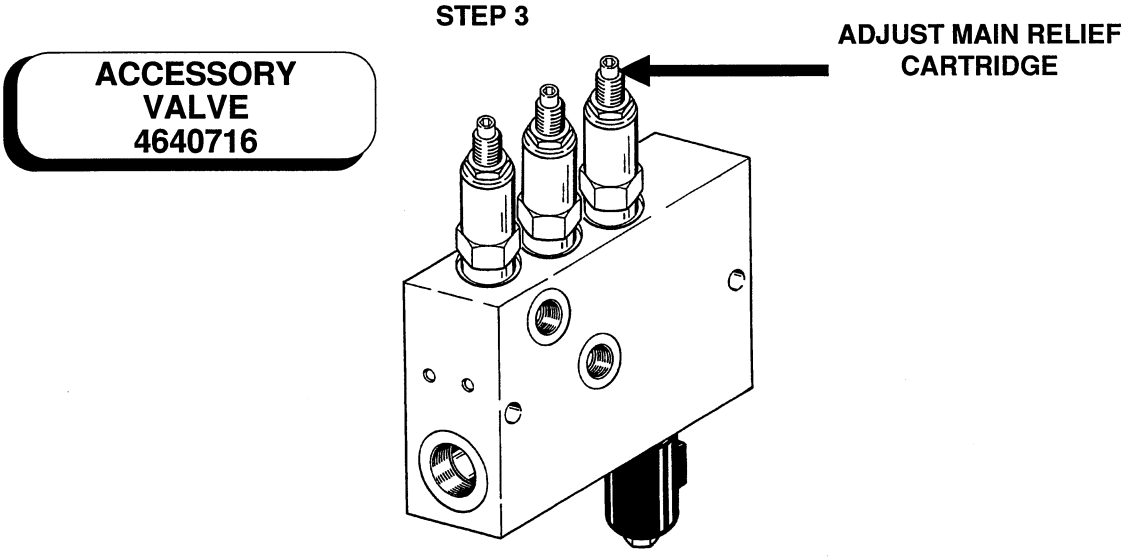
STEP 2



To Set Pilot Pressure:

1. Install pressure gauge at quick connect at 'X' port of accessory.
2. With engine at idle, activate Lift Down.
3. Monitor pressure gauge while making adjustments at sequence cartridge to 400 PSI (27.58 BAR).

STEP 3

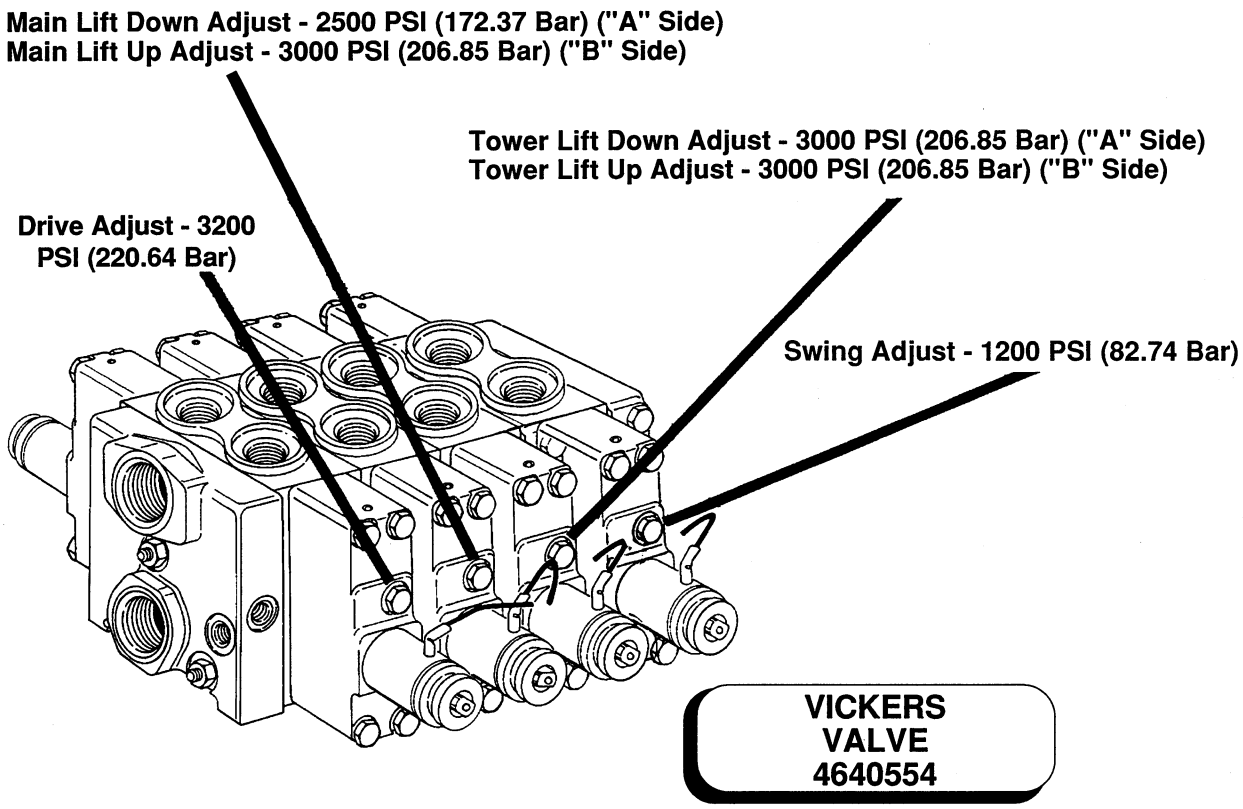


To Set Main Pressure:

1. Install pressure gauge at quick connect on rear port of Main Pump.
2. Disconnect and cap hoses to drive motors. Plug ports on drive section of Vickers Valve.
3. Back out Main Relief adjustment 2 turns. Have assistant activate Drive. Slowly turn adjustment in (clockwise) and watch pressure gauge. Continue turing until gauge stops moving (approximately 3200 PSI) (220.64 BAR). Turn adjustment in an additional 1/2 turn. This will result in approximately 200 PSI (13.79 BAR) higher than Drive Relief setting.

Figure 2-6. Pressure Setting Procedure, Accessory Valve. (Sheet 2 of 2)

STEP 4



To Set Vickers Port Reliefs:

1. Install pressure gauge at quick connect on rear of Main Pump.

2. Swing Adjust - Right and Left - Monitor gauge at quick connect. Lock turntable and activate Swing Right. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Swing Left.

3. Main Lift Adjust - Lift Down - Monitor pressure gauge. Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease pressure.

4. Main Lift Up - Bottom out Lift Up, add shims to increase pressure, remove shims to decrease pressure.

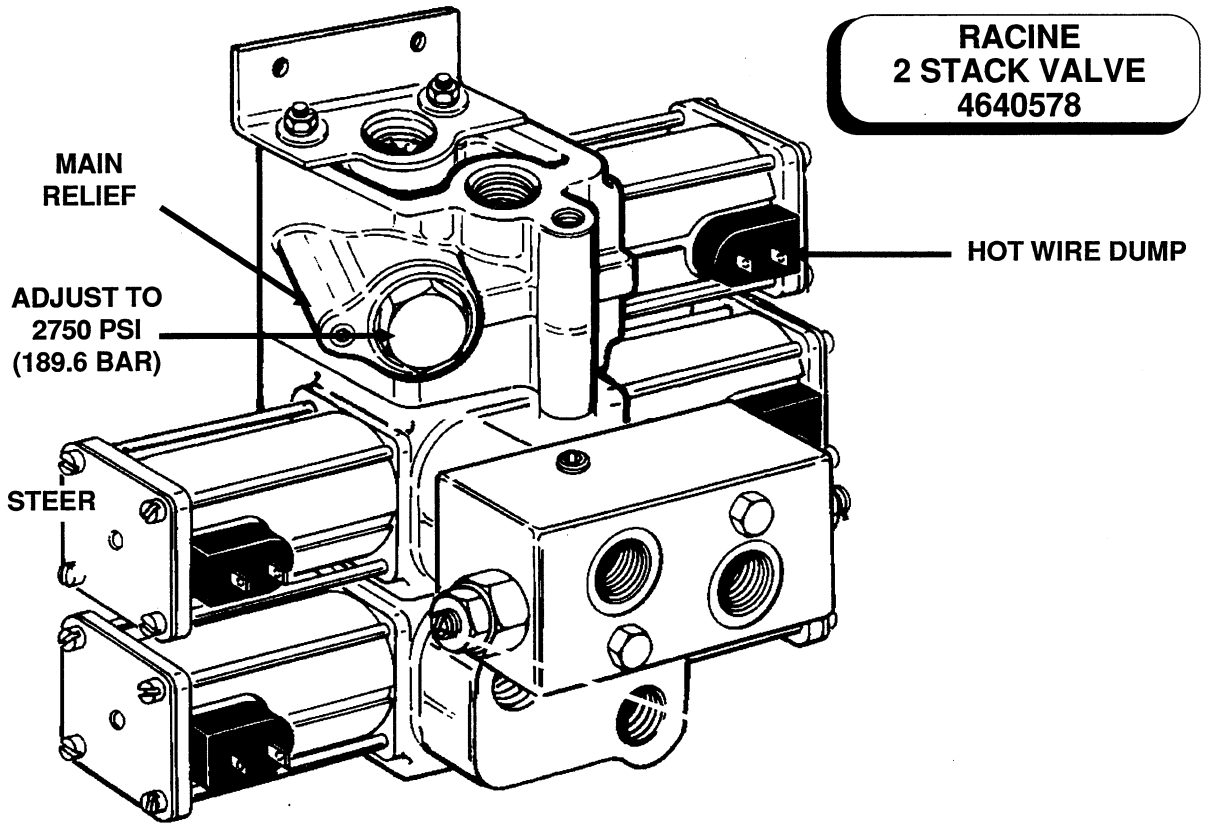
5. Tower Lift Adjust - Lift Down - Monitor pressure gauge. Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease pressure.

6. Tower Lift Up - Bottom out Lift Down. Add shims to increase pressure, remove shims to decrease pressure.

7. Drive Adjust - Disconnect and cap hose to drive motor, also plug port in valve. Have assistant activate Drive Forward. Monitor pressure gauge. Add shims to increase pressure, remove shims to decrease pressure. Same procedure applies to Drive Reverse.

Figure 2-7. Pressure Setting Procedure, Proportional Valve.

STEP 5

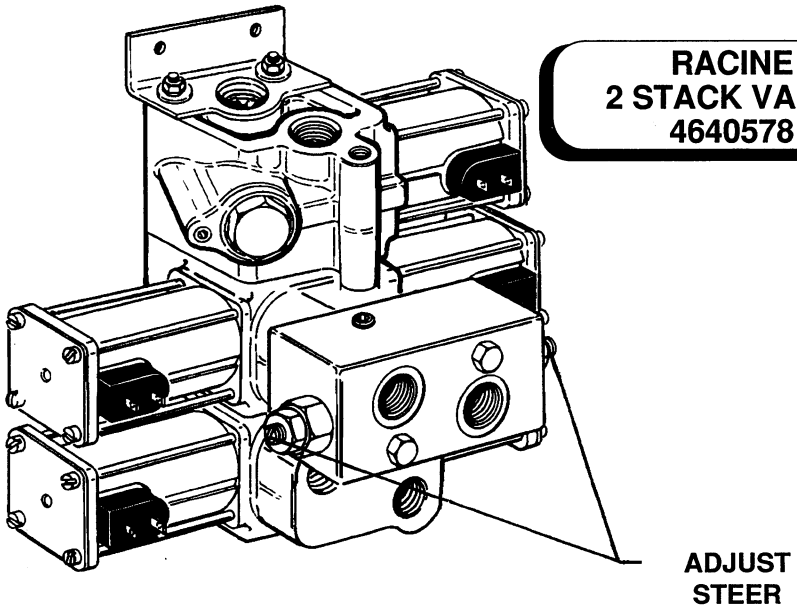


To Set Main Relief:

1. Install pressure gauge at quick connect on bottom port of Main Pump.
2. Hot wire Dump Section Coil.
3. With engine at idle, monitor pressure gauge.
4. Shut down engine before making pressure adjustments, then return to 3 above.

Figure 2-8. Pressure Setting Procedure, Racine 2-Stack Valve. (Sheet 1 of 2)

STEP 6



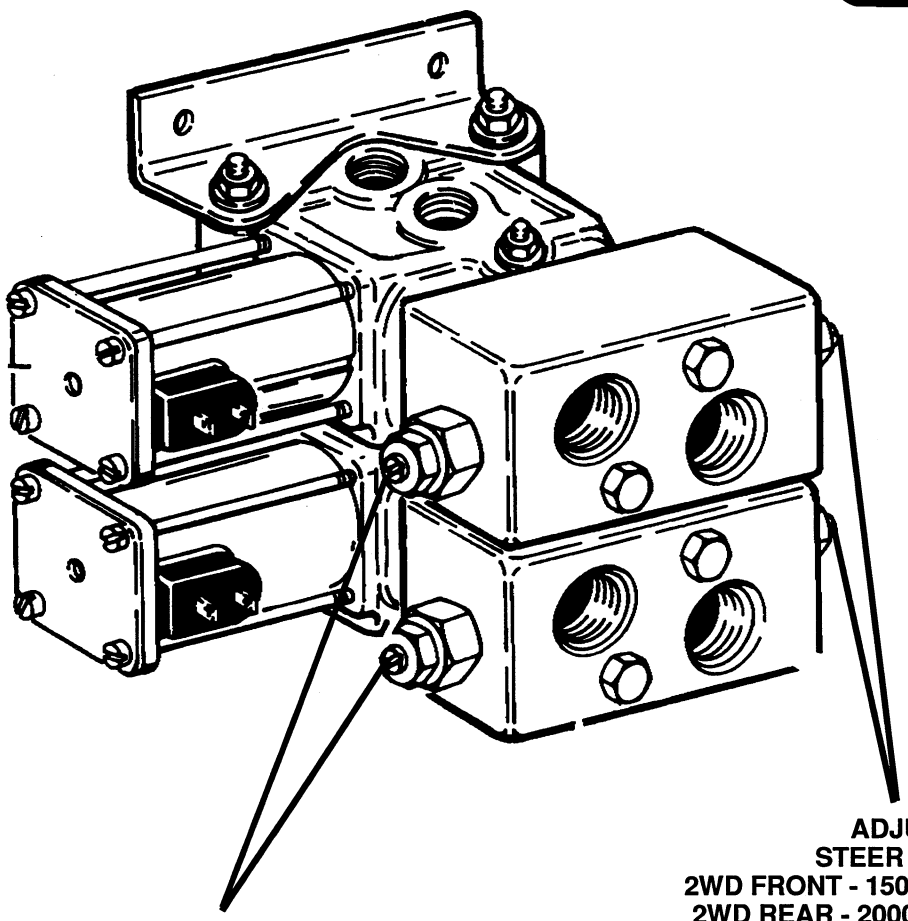
To Set Main Relief:

1. Install pressure gauge at quick connect on bottom port of Main Pump.
2. With the aid of an assistant, activate Steer.
3. While monitoring pressure gauge, make adjustments at crossover relief on Steer Section to 2000 PSI (137.9 Bar).

Figure 2-8. Pressure Setting Procedure, Racine 2-Stack Valve. (Sheet 2 of 2)

STEP 7
(IF EQUIPPED)

RACINE
2 STACK VALVE
4640684



ADJUST
STEER VALVE
2WD FRONT - 1500 PSI (103.4 BAR)
2WD REAR - 2000 PSI (137.9 BAR)
4WD FRONT & REAR - 2000 PSI (137.9 BAR)

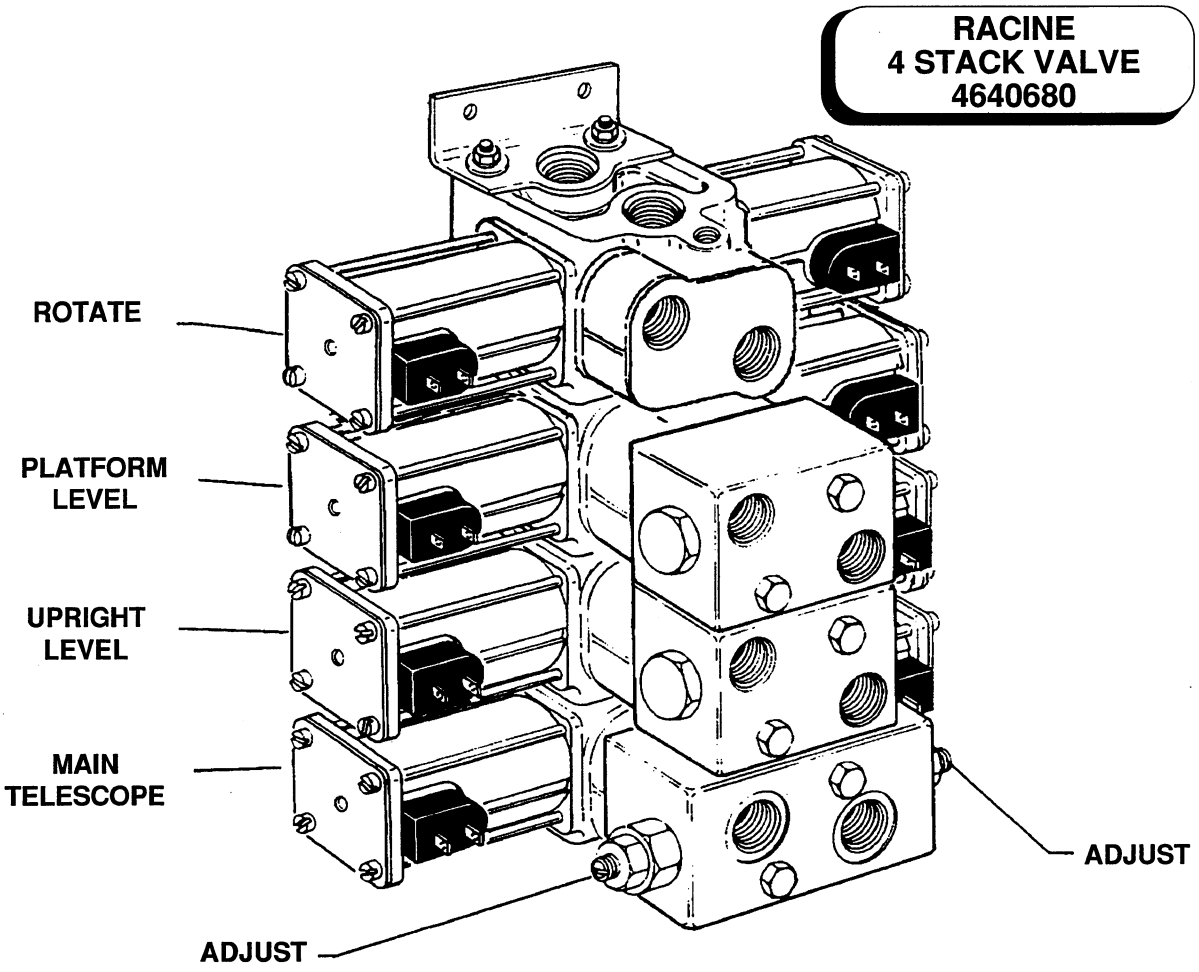
ADJUST
STEER VALVE
2WD FRONT - 1500 PSI (103.4 BAR)
2WD REAR - 2000 PSI (137.9 BAR)
4WD FRONT & REAR - 2000 PSI (137.9 BAR)

To Set 4WS VALVE:

1. Install pressure gauge at quick connect on bottom port of Main Pump.
2. With the aid of an assistant, activate Steer.
3. While monitoring pressure gauge, make adjustments at crossover relief on Steer Valve.

Figure 2-9. Pressure Setting, 4WS Valve.

STEP 8



To Set Main Telescope Reliefs:

1. Install pressure gauge at quick connect on bottom port of Main Pump.
2. With the aid of an assistant, activate Telescope In.
3. While monitoring pressure gauge, make adjustments at crossover relief on Telescope Section to 2000 PSI (137.9 Bar).
4. Activate Telescope Out.
5. While monitoring pressure gauge, make adjustments at crossover relief on Telescope Section to 1500 PSI (103.4 Bar).

Figure 2-10. Pressure Setting Procedure, Racine 4-Stack Valve.

2-15. SWING BEARING.

a. Wear Tolerance.

(1). With the boom positioned over the side of the machine, the main boom fully elevated and fully retracted, and the tower boom 'stowed' (See Figure 2-11.), using a magnetic base dial indicator, measure and record the distance between the swing bearing and turntable. (See figure 2-12.)

(2). At the same point, with the boom positioned over the side of the machine, the main boom horizontal and fully extended, and the tower boom fully elevated (See Figure 2-11.), using a magnetic base dial indicator, measure and record the distance the swing bearing and turntable (See Figure 2-12.).

(3). If a difference greater than .057 in. (1.40 mm) is determined, the swing bearing should be replaced.

(4). If a difference less than .057 in. (1.40 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 and return to service.

IMPORTANT

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

b. Replacement and Devcon Application Procedures on Machines Built Prior to Mid of 1991.

(1). Removal.

(a). From Ground Control station, operate the boom adequately to provide access to frame opening or, if equipped, to rotary coupling.

WARNING

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

(b). Attach an adequate support sling to the boom and draw all slack from sling. Prop or block the boom if feasible.

Note

Steps (c) and (d) apply to those machines equipped with a rotary coupling.

(c). From under side of machine frame, remove bolts and lock washers which attach attach rotary coupling retaining yoke to coupling housing.

IMPORTANT

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

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

(e). If machine is not equipped with a rotary coupling, tag and disconnect hydraulic lines running through center of turntable and frame. Use a suitable container to retain any residual hydraulic fluid. Immediately cap lines and ports.

(f). Attach suitable overhead lifting equipment to the base of the turntable weldment.

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

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

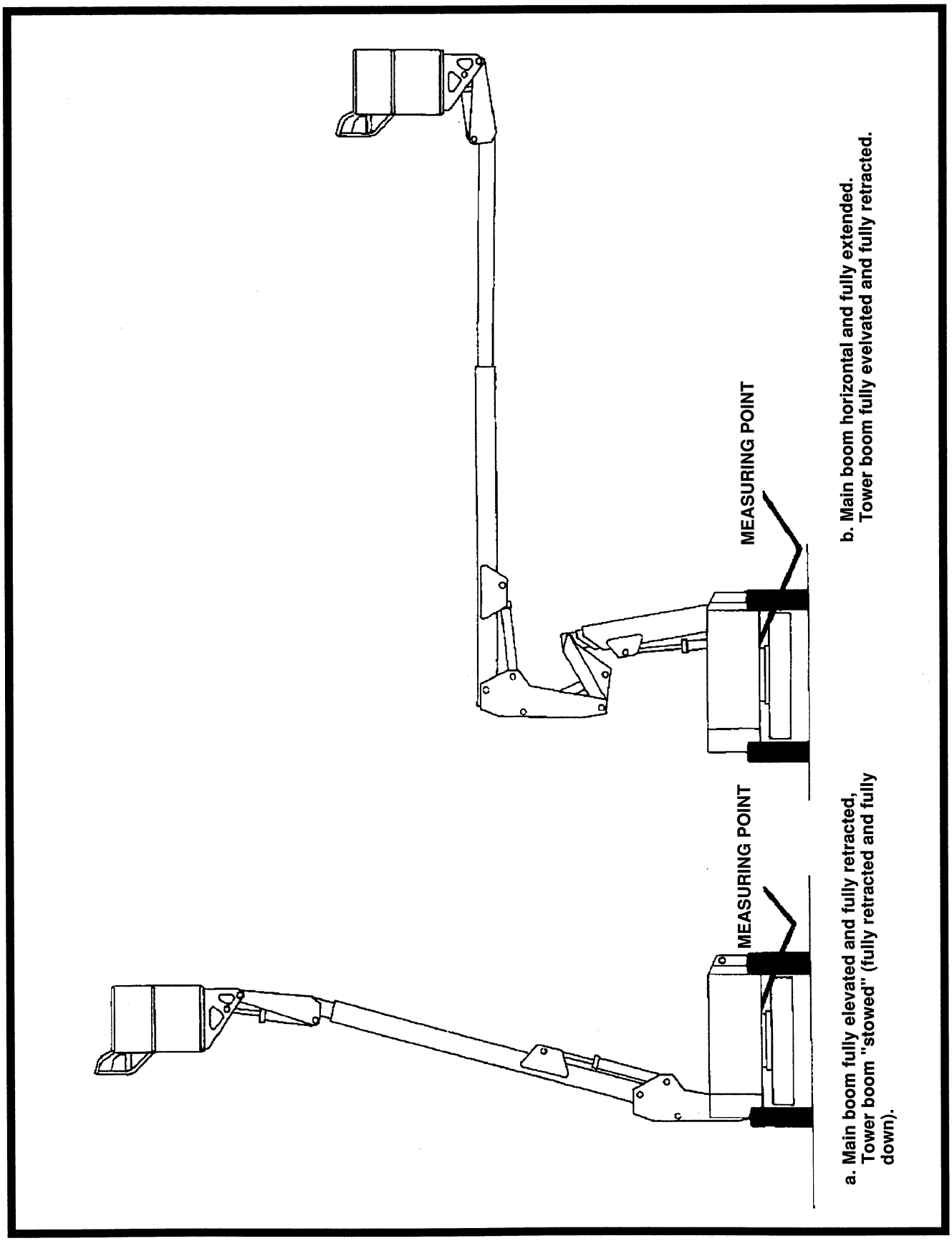


Figure 2-11. Swing Bearing Tolerance Boom Placement.

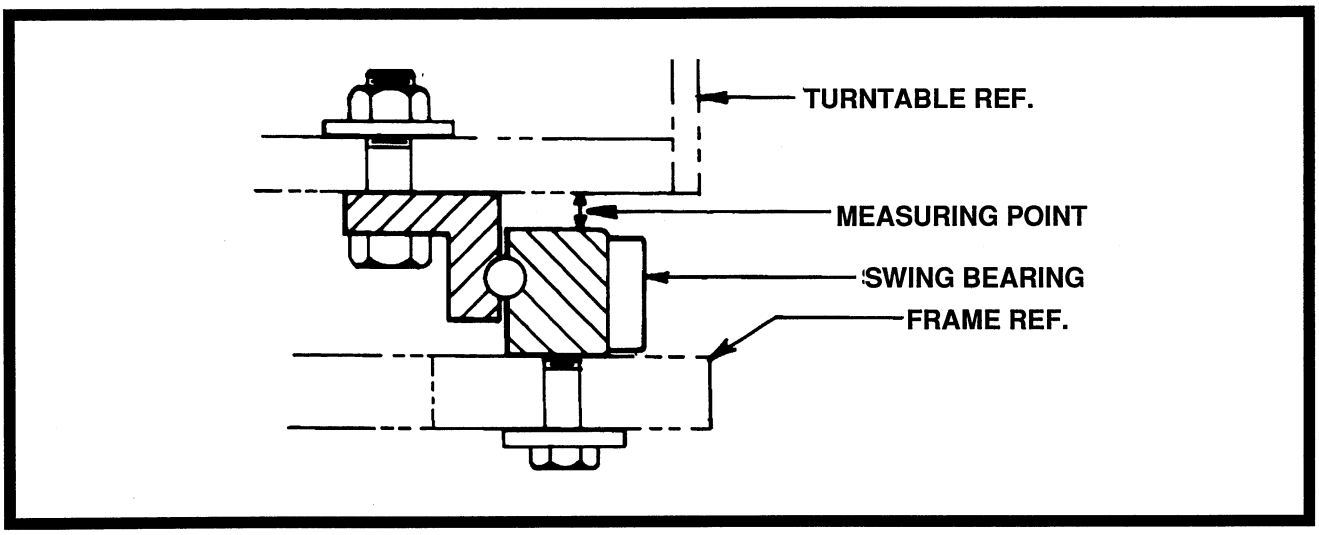


Figure 2-12. Swing Bearing Tolerance Measuring Point.

(i). Carefully place the turntable on a suitably supported trestle.

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

(2). Installation.

Note

A thru M only apply to machines built prior to mid of 1991.

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.

(a). Use suitable standard tools and equipment to carefully remove any hardened epoxy residue from the bearing mounting area of frame and turntable.

(b). Apply a layer of Devcon (or equivalent) filler approximately 0.125 inches (0.318 cm) thick on the bearing mounting plate on the frame.

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

(d). Ensure that all frame and bearing attachment holes are aligned, and install four diametrically opposed bolts or clamps to secure the bearing to the frame. Tighten the bolts or clamps evenly in a diametrically opposed pattern to a torque of 20 ft. lbs (27 NM).

(e). Allow Devcon filler to cure at room temperature (approximately 70 degrees F., 21 degrees C.) for 10 to 16 hours.

(f). After the appropriate interval, release the clamps or remove the bolts. Use a suitable lifting device to carefully remove the bearing from the frame.

(g). Carefully remove any excess filler from the frame mounting area, from the bearing attachment holes, and from between the gear teeth.

WARNING

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

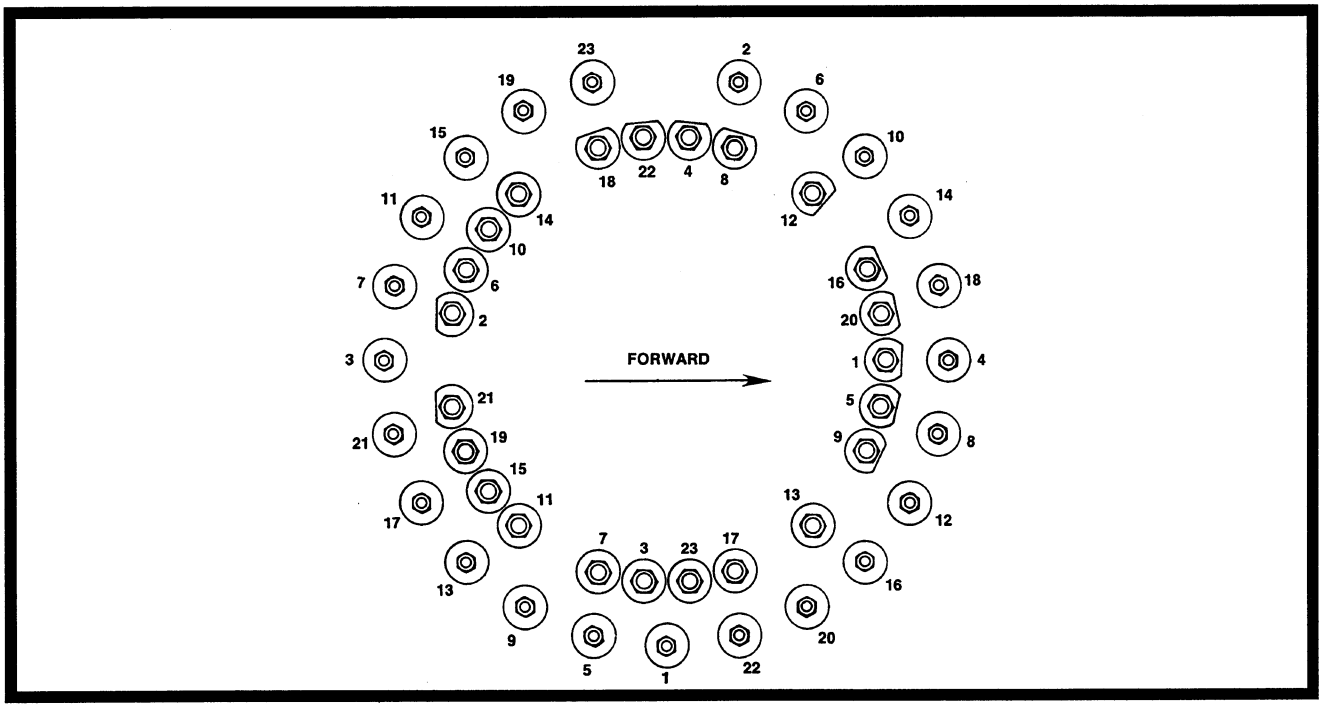


Figure 2-13. Swing Bearing Bolt Torquing Sequence.

(h). Apply a layer of Devcon (or equivalent) filler approximately 0.125 inches (0.318 cm) thick to the underside of the bearing mounting area of the turntable base plate.

(i.) Use suitable hydraulic jacks to carefully raise the swing bearing to the underside of the turntable mounting plate. Ensure that the scribed line of the inner race of the bearing aligns with the scribed mark on the turntable (if a new swing bearing is used, ensure that the filler plug fitting is at 90 degrees from the fore and aft center line of the turntable).

(j). Ensure that all turntable and bearing attachment holes are aligned, and install four diametrically opposed clamps or bolts and nuts to secure the bearing to the turntable. Tighten the nuts and bolts or clamp evenly in a diametrical pattern to a torque of 20 ft. lbs (27 NM).

(k). Allow Devcon filler to cure at room temperature (approximately 70 degrees F., 21 degrees C.) for 10 to 16 hours.

(l). After the appropriate time interval, place a suitable hydraulic jack under the bearing and release the clamps or remove the nuts and bolts, use the hydraulic jack to carefully remove the bearing from the turntable.

(m). Carefully remove excess filler from the turntable mounting area, from the bearing attachment holes and from between gear teeth.

(n). Position the bearing on the machine frame in the 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.

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

CAUTION

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

(p). Following the Torque Sequence diagram shown in Figure 2-13, tighten the bolts to an initial torque of 120 ft. lbs. (163 NM) w/loctite.

(q). Remove the lifting equipment from the bearing.

(r). Use suitable lifting equipment to carefully position the turntable assembly above the machine frame.

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

(t). Spray a light coat of Safety Solvent 13 to the new bearing bolts. Then apply a light coating of Loctite #271 to the new bearing bolts, and install the bolts, washers and nuts through the turntable and inner race of the bearing.

(u). Following the Torque Sequence diagram shown in Figure 2-13, tighten the bolts to an torque to 240 ft. lbs. (326 NM) w/loctite.

(v) Remove the lifting equipment.

Note

Steps (w) and (x) apply to those machines equipped with a rotary coupling.

(w). Install the rotary coupling retaining yoke, apply a light coating of Loctite Sealant #TL277-41 to the attaching bolts and secure the yoke to the rotary coupling with the bolts and lock washer.

(x). Connect the hydraulic lines to the rotary coupling as tagged prior to removal.

(y). If machine is not equipped with a rotary coupling, route hydraulic lines through center of turntable and frame and connect as tagged prior to removal.

(z). At ground control station, use boom lift control to lower boom to stowed position.

(aa).Using all applicable safety precautions, activate the hydraulic system and check the swing system for proper and safe operation

c. Swing Bearing Torque Values

(1). Outer Race - 120 ft. lbs. (163 NM) w/loctite, 110 ft. lbs. (149 NM) dry.

(2). Inner Race - 240 ft. lbs. (326 NM) w/loctite, 220 ft. lbs. (298 NM) dry.

(3). Swing Bearing Torquing Sequence, see Figure 2-13.

WARNING

RE TORQUE THE INNER AND OUTER SWING BEARING BOLTS AFTER FIRST 200 HOURS OF OPERATION, AND EVERY 500 HOURS THEREAFTER.

2-16. TORQUE HUB, DRIVE . (SEE FIGURE 2-14.)

a. Disassembly

(1). Position hub over suitable container and remove drain plugs (7) from unit. Allow oil to completely drain, then replace drain plugs.

(2). Remove twelve bolts (40) and four shoulder bolts (41) securing cover assembly to hub (8). Remove cover assembly and discard o-ring seal (29).

(3). Lift carrier assembly and top thrust washer (31) from hub. Thrust washer may stick inside cover.

(4). Pry ring gear (30) loose from hub and remove it. Remove o-ring seal (29) from hub counter bore and discard it.

(5). Remove input gear (20) and thrust washers (19,21) from input shaft assembly and remove input shaft assembly from hub.

(6). Lift internal gear (13) and thrust washer (18) from hub. Thrust washer may stick to bottom of carrier.

(7). Remove retaining ring (12) from spindle (2) and lift hub from spindle.

CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL.

(8). Remove inside bearing cone (10) and bearing shim (11).

(9). If necessary, pry seal (3) out of hub using screwdriver or pry bar. With seal removed, outside bearing cone (4) can be removed.

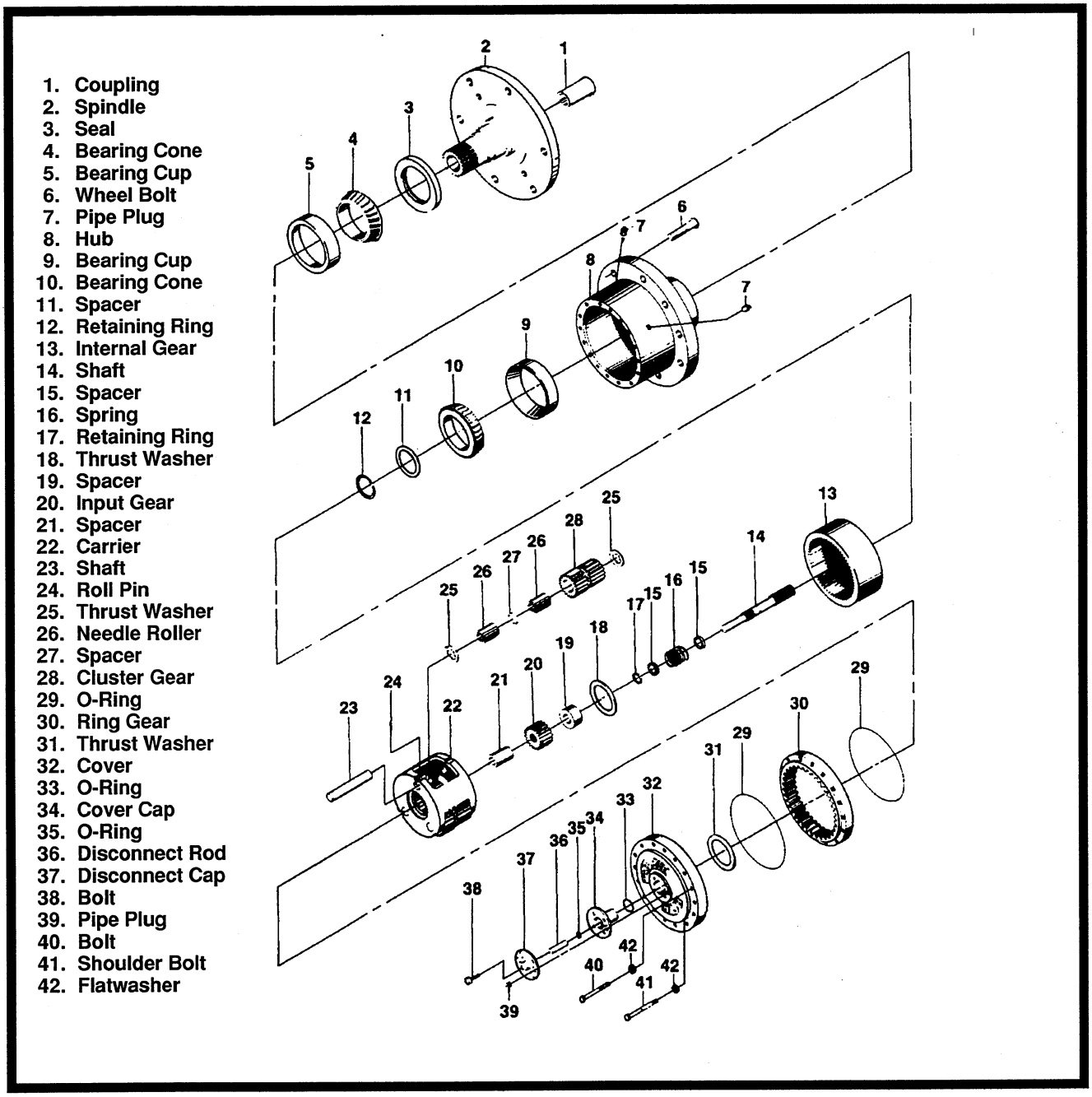


Figure 2-14. Torque Hub Assembly.

(10). If necessary, remove inner and outer bearing cones (5,9) using a suitable slide hammer puller.

IMPORTANT

WHEN REBUILDING TORQUE HUB, REMOVE AND REPLACE ALL O-RINGS AND RETAINING RINGS.

b. Cleaning and Inspection.

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

(2). Inspect bearing cups and cones for damage, pitting, corrosion, or excessive wear. If necessary, replace bearings as a complete ser ensuring that they remain covered until use.

(3). Inspect bearing mounting surfaces on spindle, hub, input shaft and carrier. Replace components as necessary

(4). Inspect all geared components for chipped or broker teeth and for excessive or uneven wear patterns.

(5). Inspect carrier for damage, especially in anti-roll pin and planet shaft hole areas.

(6). Inspect all planet shafts for scoring or other damage.

(7). Inspect all threaded components for damage including stretching, thread deformation, or twisting.

(8) Inspect seal mounting area in hub for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.

(9). Inspect cover for cracks or other damage, and o-ring sealing area for burrs or sharp edges. Dress applicable surfaces or replace cover as necessary.

c. Repair.

(1). Cover Assembly.

(a). Remove two bolts (38) securing disconnect cap (37) to cover (32) and remove cap.

(b). Remove two bolts (38) securing cover cap (34) to cover and remove cap.

(c). remove disconnect rod (36) from cap and remove o-rings (33,35) from cover cap. Discard o-rings.

(d). If necessary, remove pipe plug (39) from cover.

(e). Clean and inspect parts in accordance with paragraph b. Replace parts as necessary.

(f). If removed, screw pipe into cover.

(g). Slip o-ring (33) over cover cap and against face.

(h). Place o-ring (35) into cover cap internal groove. Disconnect rod may be used to push o-ring into groove

(i). Place cover cap into cover with large hole located over pipe plug. Secure cover cap to cover with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 NM).

(j). Place disconnect cap over cover cap with nipple facing out and secure with two bolts. Torque bolts to 70-80 in. lbs. (7.9-9.0 NM).

(k). Turn cover over and push disconnect rod into cover cap. Rod will be held in place by friction from o-ring.

(2). Carrier Assembly.

(a). Drive anti-roll pin (24) into planet (23) using a suitable punch.

(b). Using a suitable press, press planet shaft from carrier (22). After planet shaft is removed, drive anti-roll pin from shaft.

(c). Remove cluster gear (28) and thrust washers (25) from carriers.

(d). Remove sixteen needle rollers (26) from cluster gear bore.

(e). Remove spacer (27) from cluster gear bore and remove second set of sixteen needle rollers (26).

(f). Repeat steps (a) through (e) for remaining two cluster gears.

(g). Clean and inspect all parts in accordance with paragraph b. replace parts as necessary.

(h). Apply a coat of grease or petroleum jelly to cluster gear bore.

(i). Place sixteen needle rollers into cluster gear bore.

(j). Place spacer into opposite side of cluster gear and against needle rollers.

(k). Place second set of sixteen needle rollers into cluster gear.

(l). Apply grease or petroleum jelly to tang side of two thrust washers. Place thrust washers against bosses in carrier with washer tang fitting into slot in carrier outside diameter.

(m). While keeping thrust washers in place, slide cluster gear into carrier with larger gear on side with small pin hole.

(n). Line up cluster gear and thrust washers with hole in carrier and slide planet shaft through. Ensure chamfered side of hole in planet shaft is lined up with pin hole in carrier.

(o). Drive anti-roll pin flush into carrier hole, locking planet shaft into place.

(p). repeat steps (h) through (o) for remaining two cluster gears.

(3). Input Shaft Assembly.

CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING REMOVAL AND INSTALLATION

(a). Carefully remove retaining ring (17) from input shaft (14) and discard retaining ring.

(b). Remove two spacers (17) and spring (16) from input shaft.

(c). Clean and inspect all parts in accordance with paragraph b. Replace parts as necessary.

(d). Place washer (15), spring (16), and washer (15), in that order, onto input shaft.

(e). Install retaining ring into input shaft groove to secure spacers and spring to shaft.

d. Assembly.

(1). Using a suitable press, press new bearing cups (5,9), with large inside diameters facing out, into hub (8) counterbores.

(2). Place bearing cone (4) into bearing cup (5) in small end of hub.

(3). Press new seal (3) into hub counter bore with flat metal side facing in. Use a flat object to ensure that seal is pressed evenly and is flush with hub face.

(4). Lower hub onto spindle (2) with large open end up.

(5). Place bearing cone (10) over end of spindle and into bearing cup.

(6). Place bearing shim (11) over end of spindle and against bearing cone.

CAUTION

EYE PROTECTION SHOULD BE WORN DURING RETAINING RING INSTALLATION.

(7). Install new retaining ring (12) completely into spindle groove and against bearing shim. Ensure retaining ring is entirely in groove.

(8). Place internal gear (13) onto end of spindle

(9). Place input shaft assembly into spindle bore with unsplined end facing out.

(10). Place narrow thrust washer (19) over input shaft (14) with counter bore side facing spindle.

(11). Place o-ring (29) into hub counter bore. Use petroleum or grease to hold o-ring in place. Slight stretching of o-ring may be necessary to insure proper seating.

(12). Place carrier assembly on a flat surface with large gears up and positioned as shown in Figure 2-15. Find punch marked tooth on each large gear and locate at 12 o'clock (straight up) from each planet pin./ Marked tooth will be located just under carrier on upper two gears.

(13). With shoulder side of ring gear (30) facing down, place ring gear over (into mesh with) large gears. Ensure punch marks remain in correct location during ring gear installation.

(14). Install input gear (20) into carrier, meshing with small diameter cluster gears (28). Counter bore in bore of input gear must be to outside of carrier assembly.

(15). Turn over carrier assembly and ring gear while keeping gears in mesh. Place thrust washer (18) into carrier counter bore. Use petroleum jelly or grease to hold washer in place.

(16). While holding ring gear, input gear, and cluster gears in mesh, place small side of cluster gears into mesh with internal gear. On ring gear, locate hole marked 'X' over one of counter bored holes in hub. Mark counter bored holes on outside diameter for later use.

Note

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

(17). Slide thrust spacer (21) over end of input shaft.

(18). Place thrust washer (31) into carrier counter bore.

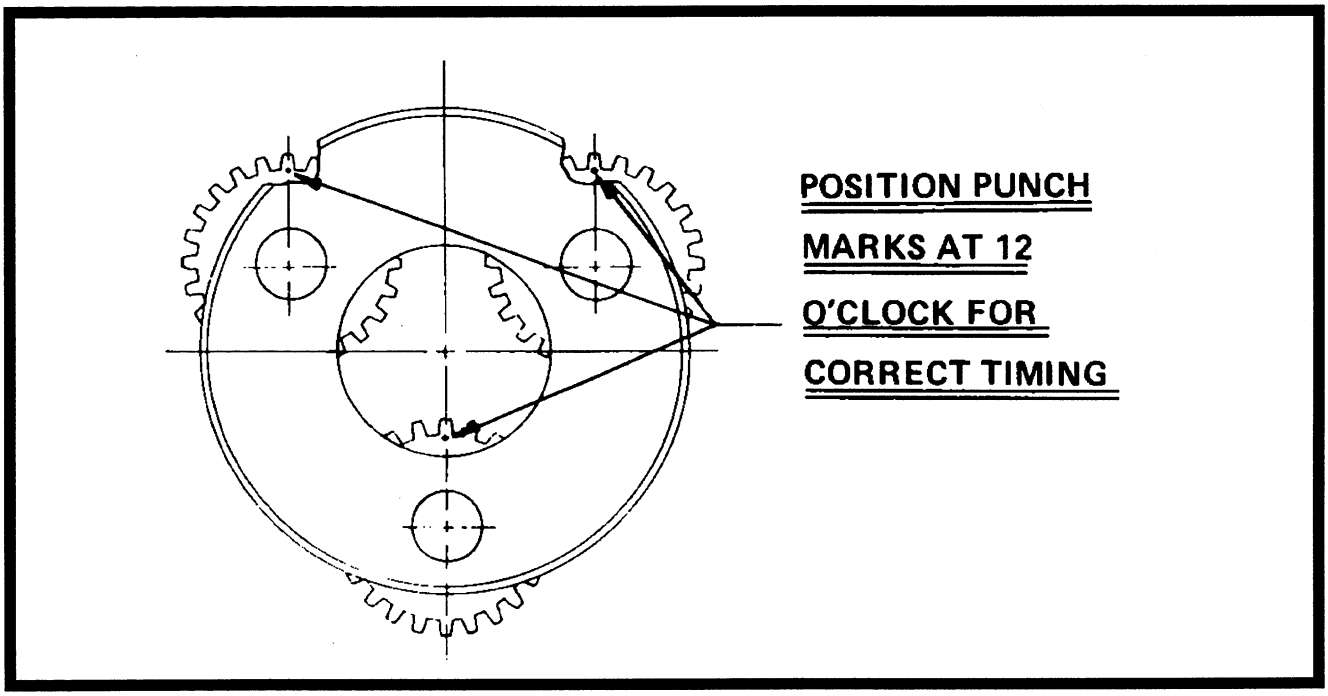


Figure 2-15. Torque Hub Carrier Timing.

(19). Place o-ring (29) into cover assembly counter bore. Use petroleum jelly or grease to hold o-ring in place.

(20). Place cover assembly over ring gear with oil level check plug in cover located approximately 90 degrees from oil fill plug in hub.

(21). Locate four shoulder bolts (41) and flat washers (42), 90 degrees apart into counter bored holes in hub marked in step (16). Torque shoulder bolts to 23-27 ft. lbs. (31-36 NM).

(22). Install bolts (41) and flat washers (42) in remaining holes. Torque bolts to 23-27 ft. lbs. (31-36 NM).

(23). Place coupling (1) into spindle and onto input shaft.

(24). Fill hub one-half full of EPGL 90 lubricant before operation.

2-17. TORQUE HUB / BRAKE - 4WD FRONT. (SEE FIGURE 2-16.)

a. Disassembly.

(1). Remove pipe plug (31) from cover (24) and drain oil from unit.

(2). Inspect the spindle / brake assembly (1) as follows:

(a). Examine the two brake ports on the bottom of the spindle / brake assembly. The bottom of one is tapered and the bottom of the other flat. Install the hydraulic line of a hand pump into the flat brake port.

(b). Insert a bleeder valve into the tapered brake port.

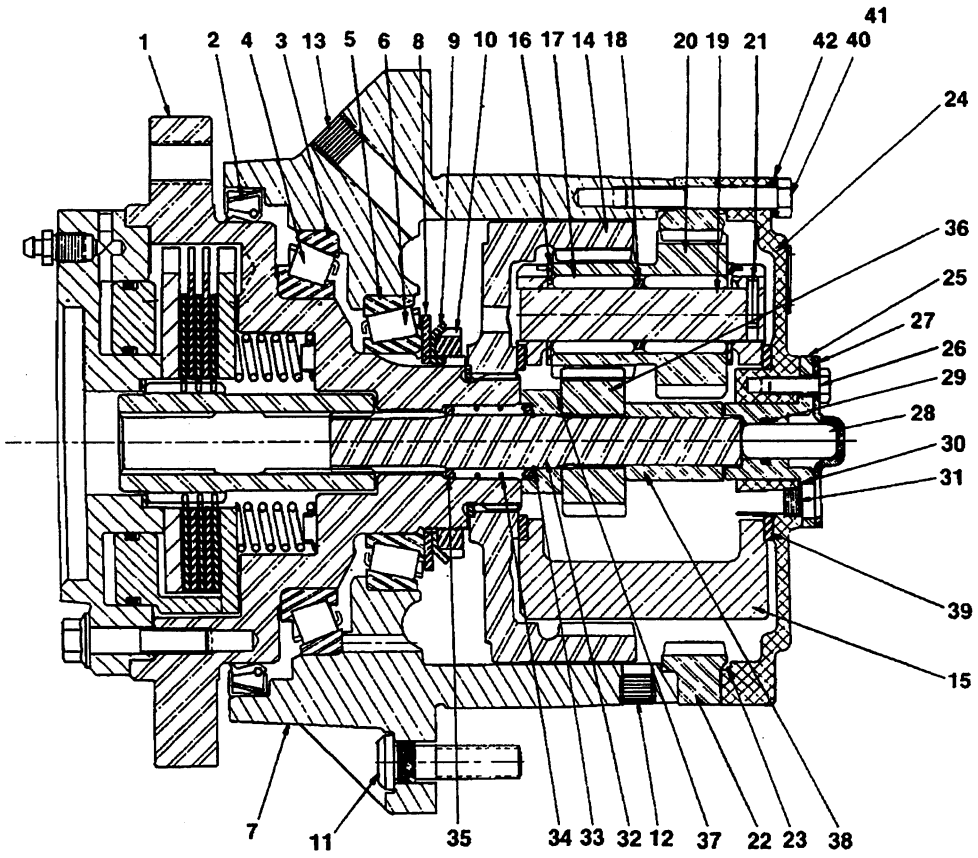
(c). Insert a roll checker into the into the spindle / brake assembly. If the brake is working properly, the roll checker should not turn.

(d). Set the hand pump to 'PUMP'.

(e). Increase the hydraulic pressure in the brake by pumping gradually. At the same time, try to turn the roll checker. If the brake is set correctly, the roll checker should not turn when the pump pressure reaches 140 to 160 psi. (10 - 11 Bar).

(f). Roll test the brake 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.

(g). Set the hand pump to 'RELEASE' and check to see if brake has reset itself. If the brake has reset, the roll checker should not turn.



1. Spindle and Brake Assembly
2. Seal
3. Bearing Cup
4. Bearing Cone
5. Bearing Cup
6. Bearing Cone
7. Hub
8. Tongued Washer
9. Lockwasher
10. Locknut
11. Stud
12. Pipe Plug
13. Magnetic Plug
14. Internal Gear
15. Carrier
16. Thrust Washer
17. Needle Roller
18. Spacer
19. Planet Shaft
20. Cluster Gear
21. Roll Pin
22. Ring Gear
23. O-Ring
24. Cover
25. Cover Cap
26. Bolt
27. Disconnect Cap
28. Disconnect Rod
29. O-Ring
30. O-Ring
31. Pipe Plug
32. Input Shaft
33. Retaining Ring
34. Spring
35. Spacer
36. Input Gear
37. Thrust Spacer
38. Thrust Spacer
39. Thrust Washer
40. Bolt
41. Shoulder Bolt
42. Flatwasher

Figure 2-16. Torque Hub/Brake - 4WD Front.

(h). Remove the roll checker from the spindle / brake assembly.

(i). Remove the hydraulic line from its brake port.

(j). Remove the bleeder valve from its brake port.

(3). Leak test unit at a pressure of 5 PSI (0.34 Bar) for 2-3 minutes.

(4). Remove 12 bolts (40), 4 shoulder bolts (41), and 16 flat washers (42) from cover (24).

(5). Remove cover from hub (7). If necessary, disassemble cover as follows.

(a). Remove pipe plug (31) from cover if it has not already been removed.

(b). Set cover down so that its open end faces up. Remove o-ring (23) from counter bore in cover and discard.

(c). Turn cover over. Remove bolts (26) that hold disconnect cap (27) in place and remove disconnect cap from cover.

(d). Remove the two remaining bolts (26) that hold cover cap (25) in place and remove cover cap from cover.

(e). Remove disconnect rod (28) from cover cap.

(f). Remove o-ring (29) from groove inside cover cap and discard o-ring.

(g). Remove o-ring (30) from outside of cover cap and discard o-ring.

(6). Remove thrust washer (39) from carrier subassembly (15).

(7). Remove thrust spacer (38) from input shaft sub assembly (32).

(8). Remove ring gear (22) from mesh with carrier subassembly.

(9). Remove carrier sub assembly from hub. If necessary, disassemble carrier as follows.

(a). Locate roll pin (21) in carrier housing (15). Drive roll pin down into planet shaft (19) until it bottoms against carrier housing. If roll pin is not completely driven into planet shaft, damage to the carrier could occur when shaft is removed.

(b). Drive roll pin out of planet shaft. Roll pin must come out through side of planet shaft that it originally went into.

(c). Remove planet shaft from carrier housing. The two thrust washers (16) and cluster gear (20) will slide off.

(d). Remove needle rollers (17) and spacer (18) from inside cluster gear.

(e). Repeat steps (a) thru (d) to remove the two remaining cluster gears.

(10). Remove input gear (36) from input shaft sub assembly.

(11). Remove thrust spacer (37) from input shaft sub assembly.

(12). Remove input shaft sub assembly from spindle/brake assembly (1). If necessary, disassemble input shaft as follows:

(a). Remove retaining ring (33) from input shaft (32) and discard retaining ring.

(b). Slide spacer (35), spring (34), and the other spacer (35) off of input shaft.

(13). Remove thrust washer (39) from bottom of internal gear (14).

(14). Remove internal gear from hub.

(15). Remove o-ring (23) from counter bore in hub and discard o-ring.

(16). Using a screwdriver or chisel and hammer, straighten out the tang on lock washer (9) which has been bent into notch in locknut (10).

(17). Using a suitable spanner wrench, loosen locknut. Remove locknut from spindle/brake assembly and discard.

(18). Remove lock washer (9) from spindle/brake assembly and discard.

(19). Remove tongued washer (8) from spindle/brake assembly.

(20). Lift bearing cone (6) out of hub.

(21). Lift hub off of spindle/brake assembly.

(22). Using a slide hammer, remove seal (2) from small end of hub and discard.

(23). Lift bearing cone (4) off spindle/brake assembly.

(24). Using a soft punch and hammer, remove bearing cup (5) from deep end of hub.

Note

When using punch, be very careful not to strike counter bore of hub where cup is located.

(25). Using a soft punch and hammer, remove bearing cup (3) from shallow end of hub.

Note

This cup can be reached by putting punch into small access hole in bottom

(26). Remove pipe plugs (12) from two pipe plug holes in side of hub.

(27). Remove magnetic pipe plugs (13) from two pipe plug holes in flange of hub.

(28). Hammer out nine studs (11) from flange of head.

b. Cleaning and Inspection.

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

(2). Inspect bearing cups and cones for damage, pitting, corrosion, or excessive wear. If necessary, replace bearings as a complete set, ensuring that they remain covered until use.

(3). Inspect bearing mounting surfaces on spindle, hub, input shaft, and carrier. Replace components as necessary.

(4). Inspect all geared components for chipped or broken teeth and for excessive or uneven wear patterns.

(5). Inspect carrier for damage, especially in roll pin and planet shaft hole areas.

(6). Inspect all planet shafts for scoring or other damage.

(7). Inspect all threaded components for damage including stretching, thread deformation, or twisting.

(8). Inspect seal mounting area in hub for burrs or sharp edges. Dress applicable surfaces or replace components as necessary.

(9). Inspect cover for cracks or other damage, and o-ring sealing area for burrs or sharp edges. Dress applicable surfaces or replace cover as necessary.

c. Assembly.

(1). Place hub (7) onto its large end. Using a suitable press, press the nine studs (11) into stud holes in hub.

(2). Apply a light coat of 'never-seize' to magnetic pipe plugs (13) and regular pipe plugs (12).

(3). Tighten magnetic pipe plugs into two pipe plug holes in flange of hub and tighten regular pipe plugs into two pipe plug holes in side of hub.

(4). Using a suitable bearing press, press bearing cup (5) down into counter bore in deep end of hub.

Note

Make sure cup sits square with counter bore before pressing.

(5). Turn hub over. Using a suitable press, press bearing cup (3) into counter bore in shallow end of hub.

Note

Make sure cup sits square with counter bore before pressing.

(6). Using a suitable press, press seal (2) into small end of hub. Part of seal will remain slightly above hub after pressing.

(7). Spray 'Locquic Primer T' on spindle/brake assembly (1) and locknut (10). Allow two minutes drying time.

(8). Place bearing cone (4) onto spindle brake assembly.

(9). Lower hub onto spindle/brake assembly.

(10). Place bearing cone (6) onto spindle/brake assembly.

(11). Place tongued washer (8) on top of bearing cone. Insert tab on tongued washer into slot in spindle/brake assembly.

(12). Place lock washer (9) on top of tongued washer. Insert tab on lock washer into slot in spindle/brake assembly.

(13). Apply Loctite 277 to the second screw-thread from bottom of locknut. Bottom of locknut has a chamfered or sloped edge.

Note

Loctite 277 is an anaerobic adhesive. Once it has been removed from contact with the air, it sets. therefore, once the locknut has been placed on the spindle, it must be tightened and torque immediately or the adhesive will make it difficult to turn.

(14). Place locknut onto spindle/brake assembly. Using a suitable socket wrench and a torque wrench, apply 50 ft. lbs. (68 NM) torque to locknut, then rotate hub in both clockwise and counterclockwise directions. Repeat this step two more times.

IMPORTANT

One tang on lock washer must line up with one notch on locknut. If one tang and one notch are not aligned, apply sufficient INCREASED torque until they are. NEVER LOOSEN THE LOCKNUT.

(15). Bend aligned tang on lock washer up into notch on locknut.

(16). Using a center punch and hammer, stake locknut at four equally spaced points around the locknut and at a distance of 1/8 in. (3.175 mm) from its inside edge.

(17). Grease o-ring (23) and place into counter bore in hub.

CAUTION

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

Note

O-rings may be stretched to fit the counter bore. If an o-ring has been stretched too much, simply squeeze the o-ring together bit by bit as it is placed around the counter bore. It can be made to fit exactly.

(18). Oil all exposed surfaces inside hub.

(19). Mark four shoulder bolt holes on hub so they can be aligned with shoulder bolt holes in ring gear and cover, in a later set-up.

(20). Place internal gear (14) into hub so that its internal splines mesh with external splines of spindle/brake assembly. Oil internal gear.

(21). Place thrust washer (39) onto spindle/brake assembly so that it rests on bottom of internal gear.

(22). If necessary, assemble input shaft assembly as follows:

(a). Place one spacer (35), spring (34) and other spacer (35), in that order, onto smooth end of input shaft.

CAUTION

SAFETY GLASSES SHOULD BE WORN DURING THE FOLLOWING PROCEDURE.

(b). Place retaining ring (33) onto input shaft. Use retaining ring pliers, insert retaining ring into groove on input shaft by compressing spring and spacers together.

(23). With large splined end down, place input shaft assembly into spindle/brake assembly.

(24). Place thrust spacer (37) onto input shaft.

(25). With internal splines facing up, place input gear (36) into mesh with input shaft assembly.

(26). If necessary, assemble carrier subassembly as follows:

(a). Apply grease to inside of one cluster gear (20).

(b). Line one half of cluster gear with 16 needle rollers (17).

(c). Place one spacer (18) inside cluster gear so that it rests on top of needle rollers.

(d). Line remaining half of cluster gear with 16 needle rollers.

(e). Insert a planet shaft (19) into one of the planet shaft holes in carrier housing (15) which has a roll pin hole. End of planet shaft that does NOT have a roll pin hole should be inserted into carrier housing FIRST.

(f). Place one thrust washer (16) onto end of planet shaft which has been inserted through planet shaft hole. Notice that thrust washer has a tang on it. Tang should point straight up so as to fit in slot on inside edge of planet shaft hole.

(g). Following thrust washer, place cluster gear, with needle rollers, onto planet shaft. Large end of cluster gear should go onto shaft first.

(h). Following cluster gear, place one more thrust washer (16) onto planet shaft. Align thrust washer in same manner described in step (f).

(i). Insert planet shaft through opposite planet shaft hole in carrier housing. Use an alignment punch or similar tool to align roll pins in carrier housing and planet shaft.

(j). Drive roll pin (21) down into aligned roll pin holes.

(k). Repeat steps (a) through (j) to install the two remaining cluster gears.

(27). Set carrier sub-assembly on work surface so that large ends of cluster gears face up. Locate punch marks on face of cluster gear and position them at 12 o'clock as shown in Figure 2-15.

(28). With squared shoulder side down, place ring gear (22) into mesh with clusters in carrier. If ring gear is on correctly, the "x" marking a shoulder bolt hole should face up.

Note

Make sure punch marks on cluster gears remain in their correct positions when installing ring gear.

(29). Place carrier sub-assembly and ring gear together into mesh with internal gear (14). Align shoulder bolt hole in ring gear marked with an "x" over one of shoulder bolt holes in hub.

Note

Ring gear may be lifted off hub to align shoulder bolt holes. Ring gear and carrier need to be installed together initially only so that punch marks on carrier remain aligned.

(30). Oil all exposed surfaces inside hub.

(31). Place thrust spacer (38) onto input shaft.

(32). Place thrust washer (39) into counter bore in carrier.

(33). Place cover subassembly (24) onto ring gear. Align pipe holes in cover and hub in accordance with Figure 2-16. Make sure shoulder bolt holes in cover and ring gear are aligned.

(34). Place 16 flat washers (42) on top of bolt holes in cover.

(35). Place four shoulder bolts (41) into four shoulder bolt holes in cover and tighten by hand.

(36) Place twelve grade 8 bolts (40) into twelve bolt holes in cover and torque bolts to 18-25 ft. lbs. (25-34 NM).

(37). Leak test unit at a pressure of 5 PSI (0.34 Bar) for 2-3 minutes.

(38). Inspect spindle/brake assembly in accordance with paragraph a., step (2).

2-18. TORQUE HUB - 4WD REAR. (SEE FIGURE 2-17.)

a. Disassembly.

(1). With hub on its side, remove coupling (35) from wide end of spindle.

(2). Mark location of shoulder bolt holes in outside of ring gear and hub for easy realignment when rebuilding. Remove the four shoulder bolts (11) and twelve bolts (10) from cover.

(3). Remove sixteen flat washers (12) from cover.

(4). Lift cover (9) off of ring gear (14). Set cover on table with interior side facing up.

(5). Remove o-ring (13) from counter bore around edge of cover. Discard o-ring.

(6). Remove thrust washer (15) from counter bore in top of carrier (16).

(7). Remove input gear from (17) from middle of carrier (16).

(8). Lift ring gear (14) off of hub.

(9). Lift carrier (16) out of hub.

(10). Remove thrust spacer (18) from input shaft (19) in middle of spindle (34).

(11). Lift input shaft (19) out of spindle (34) and stand input shaft on its splined end.

CAUTION

WEAR SAFETY GLASSES DURING NEXT STEP. BE AWARE THAT SPRING AND SPACERS MAY POP OFF SHAFT.

(12). Using retaining ring pliers, remove retaining ring (20) from input shaft.

(13). Remove one spacer (21), one spring (22) and other spacer (21) from input shaft.

(14). Remove thrust washer (15) from spindle.

(15). Lift internal gear (23) out of hub.

(16). Remove o-ring (13) from counter bore in hub. Discard o-ring.

CAUTION

WEAR SAFETY GLASSES DURING THE NEXT STEP.

(17). Remove retaining ring (24) from spindle in hub.

(18). Remove spacer (25) from spindle in hub.

(19). Set hub (28), small end down, on something that will support the hub's flange while lifting hub up, so that spindle is not resting on anything. Carefully press or hammer spindle (34) down out of hub. If seal (33) and cone (32) come out of hub and rest on on spindle, remove these parts from spindle and set aside. Discard seal.

(20). If seal and bearing cone did not come out of small end of hub when spindle was pressed out of hub, remove seal (33) and bearing cone (32) from small end of hub. Discard seal.

(21). Bearing cone (26) should be lying loose in wide end of hub. Remove cone (26) from hub.

(22). Remove bearing cup (31) from counter bore in small end of hub.

(23). Turn hub (28) over and lift it out of the flange support. Remove bearing cup (27) from counter bore in the wide end of hub.

(24). Turn hub over onto its small end. Remove two pipe plugs (29) from hub.

(25). Remove two bolts (2) from disconnect cap (1).

(26). Remove disconnect cap from cover cap (4).

(27). Remove two bolts (5) holding cover cap (4) to cover.

(28). Remove cover cap from cover.

(29). Remove disconnect rod (3) from cover cap.

(30). Pry o-ring (7) from out of groove inside cover cap. Discard o-ring.

(31). Remove o-ring (6) from flange of cover cap. Discard o-ring.

(32). Remove pipe plug (8) from cover.

b. Assembly.

(1). Using disconnect rod, push o-ring (7) into groove inside cover cap (4).

(2). Place o-ring (6) onto cover cap so that it rests against cover cap flange.

(3). Insert disconnnect rod (3) into cover cap.

(4). Set cover (9) onto table, exterior side up. Place cover cap onto cover, aligning pipe plug hole in cover cap over pipe plug hole in cover.

(5). Place two cover cap bolts (5) into any two bolt holes 180 degrees apart on cover cap and tighten bolts.

(6). Using a torque wrench, apply 30-43 in. lbs. (4-5 Nm) of torque to both bolts.

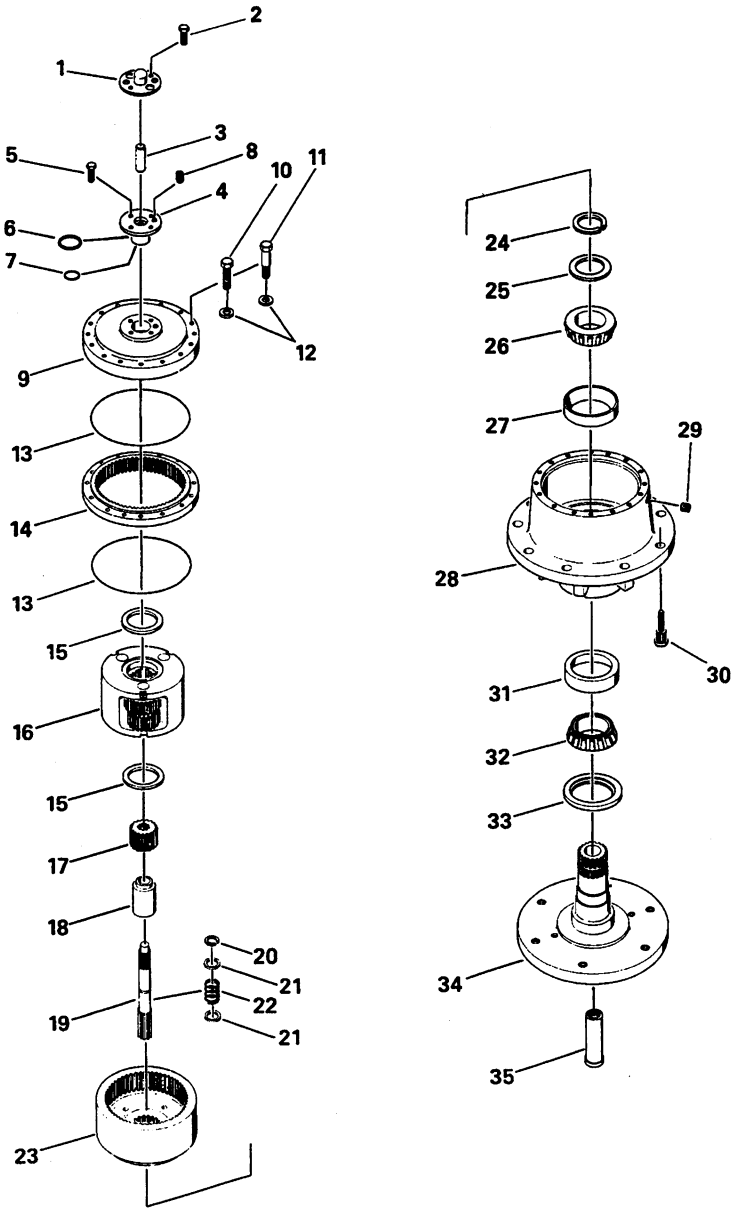
(7). With large end down, place disconnect cap (1) onto cover cap (4), aligning pipe plug hole in disconnect cap over pipe plug hole in cover cap.

(8). Place remaining bolts (2) into bolt holes in disconnect cap and tighten with a torque wrench to 30-43 in lbs. (4-5 Nm).

(9). Apply a light coat of "never seize" to pipe plug and tighten plug into pipe plug hole in cover.

(10). Set hub onto its large end. Press bearing cup (31) into counter bore in small end of hub.

(11). Apply a light coat of "never seize" to two pipe plugs (29) and tighten plugs into two pipe plug holes in side of hub.



1. Disconnect Cap
2. Hex Head Bolt
3. Disconnect Rod
4. Cover Cap
5. Hex Head Bolt
6. O-Ring
7. O-Ring
8. Pipe Plug
9. Cover
10. Hex Head Bolt
11. Hex Head Shoulder Bolt
12. Flatwasher
13. O-Ring
14. Ring Gear
15. Thrust Washer
16. Planet Carrier Assembly
17. Input Gear
18. Sun Gear Spacer
19. Input Shaft
20. Retaining Ring
21. Spacer
22. Spring
23. Stationary Internal Gear
24. Retaining Ring
25. Spacer
26. Tapered Roller Bearing
27. Bearing Cone
28. Hub
29. Pipe Plug
30. Wheel Stud
31. Bearing Cone
32. Tapered Roller Bearing
33. Seal
34. Spindle
35. Input Coupling

Figure 2-17. Torque Hub - 4WD Rear.

(12). Turn hub over onto its small end. Press bearing cup (27) down into counter bore in deep end of hub.

(13). Set hub onto its large end. Place bearing cone (32) into bearing cup.

(14). Press seal (33) into small end of hub.

(15). Oil spindle, then lower hub (28), small end down, onto spindle (34).

(16). Press bearing cone (26) onto spindle in hub.

(17). Place spacer (25) onto spindle in hub.

(18). Place retaining ring (24) over spacer onto spindle in hub.

(19). Grease o-ring (13) and place it into counter bore in hub.

(20). Oil all exposed surfaces inside hub.

(21). Place internal gear (22) into hub so that its internal splines mesh with external splines of spindle. Oil internal gear.

(22). Place thrust washer (15) around spindle so that it rests on bottom of internal gear.

(23). Stand input shaft (19) onto its splined end. Place one spacer (21) onto smooth end of input shaft.

(24). Place one spring (22) onto smooth end of input shaft.

(25). Place other spacer (21) onto smooth end of input shaft.

CAUTION

WEAR SAFETY GLASSES DURING NEXT STEP. BE AWARE THAT SPRING AND SPACERS MAY POP OFF SHAFT IF RING IS RELEASED BEFORE IT IS PROPERLY IN PLACE.

(26). Using retaining ring pliers, insert retaining ring (20) into groove on input shaft by compressing spring and spacers together.

(27). With large splined end down, place input shaft (19) into spindle.

(28). Place thrust spacers (18) onto input shaft.

(29). Set carrier sub assembly (16) on work surface so that large ends of cluster gears face up. Locate punch marks on face of each cluster gear and position punch marks at 12 o'clock as shown in Figure 2-15.

(30). With "x" marked side facing up, place ring gear (14) around planet carrier assembly (16). This will hold punch marks in position while installing carrier onto hub.

(31). Place carrier sub assembly and ring gear together into mesh with internal gear, aligning the "x" marked shoulder bolt hole in ring gear over one of the shoulder bolt holes in the hub. Mark location of shoulder bolt holes on outside of ring gear and hub.

(32). With internal splines facing up, counter bore end facing down, place input gear (17) into mesh with carrier sub assembly.

(33). Oil all exposed surfaces inside hub. Place thrust washer (15) into counter bore in top of carrier.

(34). Set cover (9) on table, interior side up. Grease o-ring (13) and place it into counter bore around edge of cover.

(35). Place cover (9) onto ring gear (14), aligning pipe plug holes in cover and hub. Ensure shoulder bolt holes in cover and ring gear are aligned.

(36). Place four flat washers (12) on top of bolt holes in cover sub assembly.

(37). Place shoulder bolts (11) into shoulder bolt holes in cover (9) and tighten by hand.

(38). Place remaining twelve flat washers (12) onto remaining bolt holes in cover.

(39). Place bolts (10) into remaining bolt holes in cover. Torque bolts (10) and (11) to 18-25 ft. lbs. (25-34 Nm).

(40). Turn hub cover onto its side. Insert coupling (35) into end of spindle.

(41). Fill hub one-half full of EPGL 90 lubricant.

2-19. SWING BRAKE - AUSCO. (Machines Built Prior To August 1991). (SEE FIGURE 2-18.)

a. Disassembly

With the shaft protrusion downward, disassemble in the following order:

(1). Bolts (20) alternately, Power Plate (17), Retaining Ring (4), Shaft (5), Springs (9), Rotating Discs (8), Stationary Disc (10), Primary Disc (7), Pins (6), Springs (2&3).

(2). Remove the Piston (11) from the Power Plate (17) by introducing low pressure air 15 PSI (1.04 Bar) into the hydraulic inlet. Make sure Piston is directed away from the operator. Remove o-rings (13 & 15) from the Piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.

b. Assembly.

Use the reverse of the disassembly procedure with the following notes and additions:

(1). All parts must be thoroughly clean prior to reassembly.

(2). Worn o-rings and damaged or worn back-up rings must be replaced prior to assembly.

(3). Cylinder of the Power Plate, Piston and o-rings must be clean prior to assembly and pre-lubed with hydraulic oil.

(4). Assemble Piston (11) into Power Plate (17) using a shop press, being careful not to damage the o-rings or back-up rings. Visually align the center of the cutouts in the Piston with the Torque Pin (6) holes in the Power Plate.

Note

Depth of Piston installation into the Power Plate is critical. Do not exceed 1/8 in. (3.05 mm) or Piston will cock resulting in a complete loss of braking.

(5). Rotating Discs must be clean and dry. There should be no presence of oil on any lining material or mating surfaces of the Stationary Discs.

(6). Install Bolts (20). Tighten sequentially, one turn at a time, until Power Plate (17) is properly seated. Torque to 50-60 ft. lbs. (68-81Nm).

2-20. SWING BRAKE - AUSCO. (Machines Built From August 1991 To Present). (SEE FIGURE 2-19.)

a. Disassembly

With the shaft protrusion downward, disassemble in the following order:

(1). Bolts (21) alternately, Power Plate (20), Shaft (7), Springs (10), Rotating Discs (11), Stationary Disc (12), Primary Disc (9), Pins (8), Springs (6).

(2). Remove the Piston (13) from the Power Plate (20) by introducing low pressure air 15 PSI (1.04 Bar) into the hydraulic inlet. Make sure Piston is directed away from the operator. Remove o-rings (15 & 17) from the Piston O.D. and I.D. grooves. Back-up rings will be damaged and should not be removed if replacement is not planned.

b. Assembly.

Use the reverse of the disassembly procedure with the following notes and additions:

(1). All parts must be thoroughly clean prior to reassembly.

(2). Worn o-rings and damaged or worn back-up rings must be replaced prior to assembly.

(3). Cylinder of the Power Plate, Piston and o-rings must be clean prior to assembly and pre-lubed with hydraulic oil.

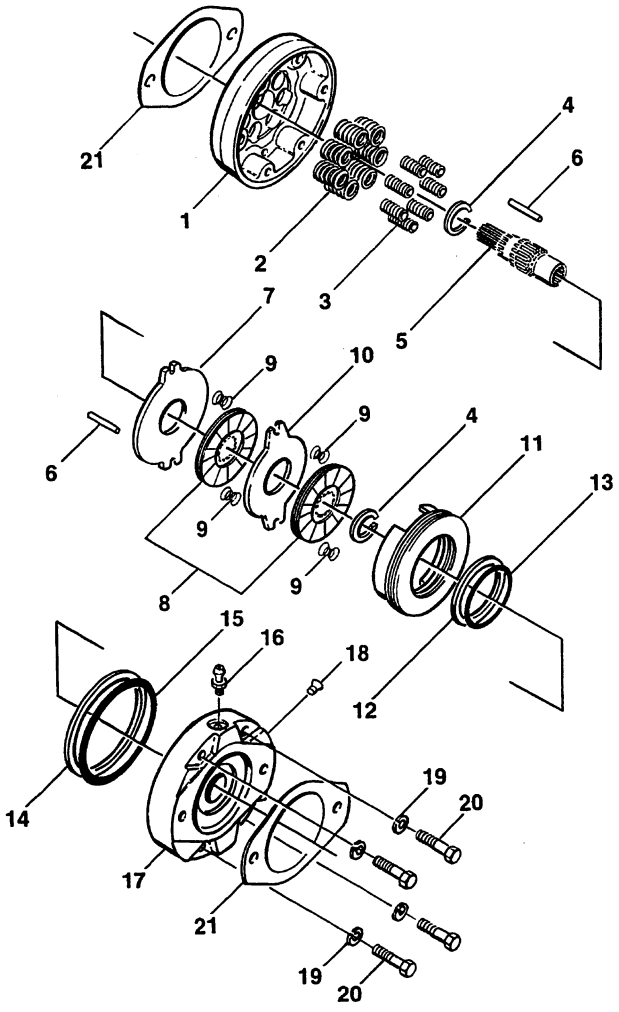
(4). Assemble Piston (13) into Power Plate (20) using a shop press, being careful not to damage the o-rings or back-up rings. Visually align the center of the cutouts in the Piston with the Torque Pin (8) holes in the Power Plate.

Note

Depth of Piston installation into the Power Plate is critical. Do not exceed 1/8 in. (3.05 mm) or Piston will cock resulting in a complete loss of braking.

(5). Rotating Discs must be clean and dry. There should be no presence of oil on any lining material or mating surfaces of the Stationary Discs.

(6). Install Bolts (21). Tighten sequentially, one turn at a time, until Power Plate (20) is properly seated. Torque to 50-60 ft. lbs. (68-81 Nm).



1. Housing
2. Compression Spring
3. Compression Spring
4. Retaining Ring
5. Splined Shaft
6. Torque Pin
7. Primary Disc
8. Rotating Disc
9. Compression Spring
10. Stationary Disc
11. Piston
12. Back-Up Ring
13. O-Ring
14. Back-Up Ring
15. O-Ring
16. Bleeder
17. Power Plate
18. Plug
19. Lockwasher
20. Bolt

Figure 2-18. Swing Brake - Ausco. (Machines Built Prior To August 1991)

1. Housing
2. Gasket
3. Bearing
4. Seal
5. Retainer Spring
6. Compression Spring
7. Splined Shaft
8. Torque Pin
9. Primary Disc
10. Compression Spring
11. Rotating Disc
12. Stationary Disc
13. Piston
14. Back-Up Ring
15. O-Ring
16. Back-Up Ring
17. O-Ring
18. Bearing
19. Bleeder Screw
20. Power Plate
21. Bolt
22. Pressure Valve
23. Plug
24. Gasket

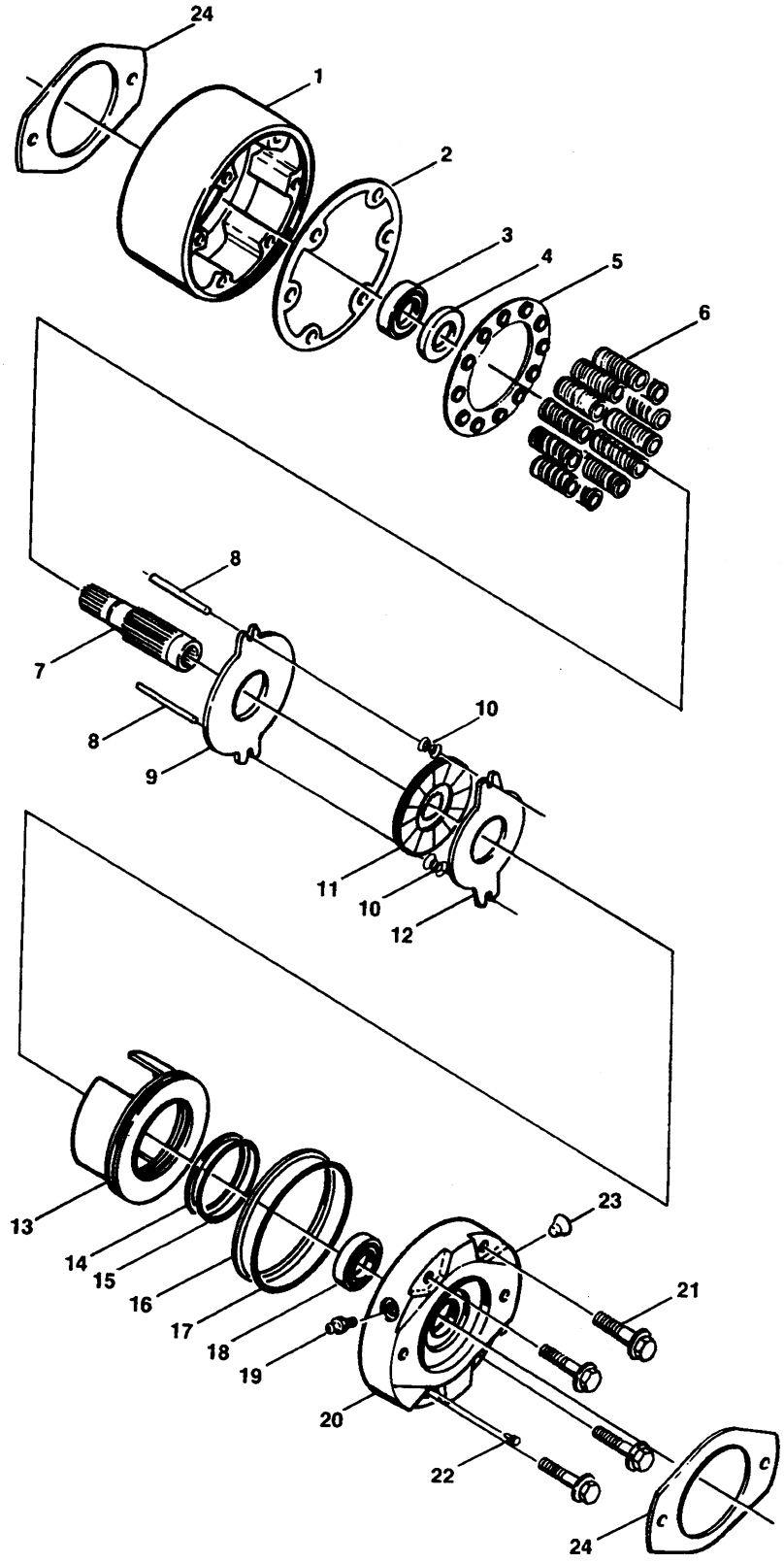


Figure 2-19. Swing Brake - Ausco (Machines Built From August 1991 To Present).

2-21. DRIVE BRAKE - AUSCO (Machines Built Prior To July 1990). (SEE FIGURE 2-20.)

a. Disassembly.

(1). With shaft protrusion downward, remove bolts (21) alternately, power plate (20), and gasket.

(2). Bearing (18) is pressed onto shaft (7) and must be removed before removal of rotating discs (11) and stationary discs (12).

(3). Remove shaft and stack sub assembly from housing by lightly tapping or pressing on the small external spline end of the shaft and removing the shaft, bearings and stack from the housing (1).

(4). Remove bearing (18), stationary disc (12), rotating disc (11), springs (10), and primary disc.

(5). Remove bearing (3) from shaft, using care not to damage seal (4). Remove seal (4) and inspect sealing lip and O.D. for damage. If damaged, replace per reassembly instructions.

(6). Remove springs (6) and spring retainer (5) from housing (1).

(7). Remove the piston (13) from the power plate (20) by introducing low pressure air 15 psi (1.03 Bar) into the hydraulic inlet. Make sure piston is directed away from the operator. Remove o-rings (15 & 17) and backup rings (14 & 16) from the piston O.D. and I.D. grooves.

(8). Pressure relief valve (22) can be removed and inspected to assure spring-loaded ball moves freely and is free of contamination.

b. 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.

c. Assembly.

Note

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

(1). Cylinder of the power plate, piston and o-rings must be clean prior to assembly, and pre-lubed with system hydraulic fluid.

(2). Assemble piston (13) into power plate (20) using a shop press, being careful not to damage the o-rings or the teflon back-up rings. Visually align the center of the cut-outs in piston (13) with torque pin (8) holes in power plate (20).

Note

Avoid pushing the piston all the way to the bottom of the cylinder in power plate. Generally, try to keep the top surface of the piston flush to 1/8 in. (3.18 mm) below the machined surface of the power plate.

(3). When pressing the bearing onto the shaft, press on the inner race of the bearing and support the shaft properly.

(4). Rotating discs must be clean and dry. There should be no presence of oil on any lining material or mating surfaces of the stationary discs. Worn or heavily scored rotating discs must be replaced.

(5). Press bearing (3) into housing (1). Bearing must be sealed against shoulder in housing.

(6). Before installing seal (4), lubricate the lip of the seal with system hydraulic fluid. Use a shop press to install seal (4). Face the lip of the seal toward the outside of the brake in order to keep the gearbox oil or other external contaminants out of the brake.

(7). Install seal (4) into housing by pressing evenly around O.D. of the seal. Use care to avoid cocking. The back of the seal must be installed flush to surface of housing.

(8). Install shaft (7) into housing. Support the inner race of bearing (3) when pressing shaft into bearing.

(9). Install gasket (2). Be sure to properly align. After installing all the remaining internal components of the brake, install bearing (18). Properly support the shaft when pressing the bearing onto shaft.

1. Housing
2. Gasket
3. Bearing
4. Oil Seal
5. Spring Retainer
6. Compression Spring
7. Shaft
8. Torque Pin
9. Primary Disc
10. Separator Spring
11. Rotating Disc
12. Stationary Disc
13. Piston
14. Back-Up Ring
15. O-Ring
16. Back-Up Ring
17. O-Ring
18. Bearing
19. Bleeder Screw
20. Power Plate
21. Screw
22. Pressure Valve
23. Plug
24. Gasket

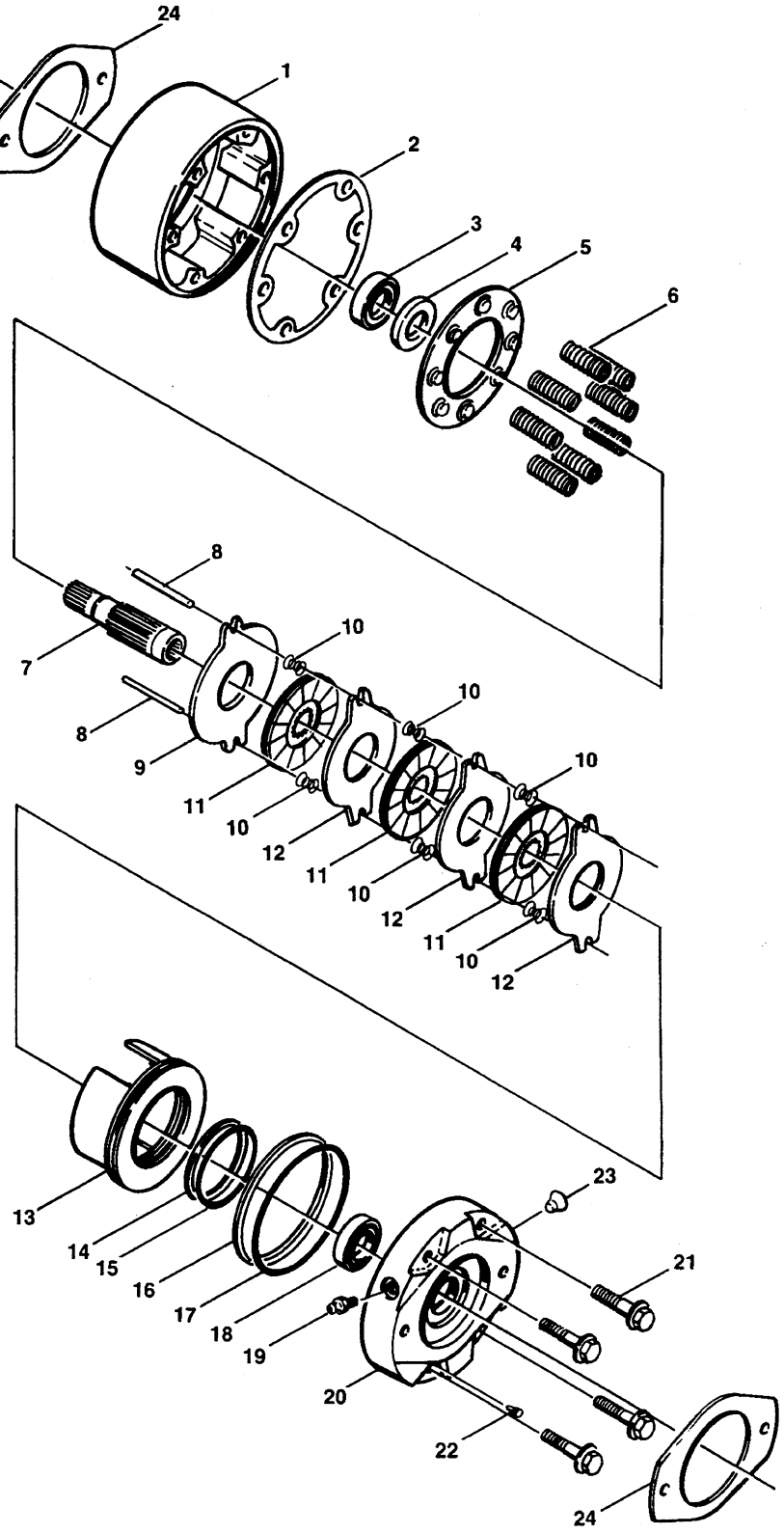


Figure 2-20. Drive Brake - Ausco (Machines Built Prior to July 1990).

(10). Install the power plate sub assembly. Use a shop press to evenly lower plate into position. There should be no gap at the O.D. when the power plate is properly seated against housing. If a shop press is not available, use the assembly bolts (21). Tighten sequentially one turn at a time until power plate is properly seated. Torque to 50-60 ft. lbs. (68-81 Nm).

(11). If replacement of pressure relief valve (22) is necessary, install 1/2 to 3/4 turns beyond finger tight.

(12). Install in place between motor and torque hub. After connecting hydraulic line to brake, bleed air from brake via bleeder screw.

2-22. DRIVE BRAKE - Mico (Machines Built Prior To August 1991). (SEE FIGURE 2-21.)

a. Disassembly.

(1). With shaft protrusion downward, remove end cover (12) by removing capscrews (11).

CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2000 POUNDS (681 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (1362 KG) MAXIMUM), THE COVER CAN BE HELD IN POSITION WHILE REMOVING THE CAPSCREWS AND LOCKWASHERS.

(2). Remove case seal (10) from housing (7) then remove bleeder screw (13) from end cover (12).

(3). Remove piston (21) from end cover (12).

(4). Remove o-ring (16), back-up ring (15), o-ring (18) and back-up ring (17) from piston (21).

(5). Remove separators (9) from housing (7).

(6). Remove stack assembly, consisting of discs (20), return plate (8) and friction discs (19) form housing (7).

(7). Remove dowel pins (14), 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 bearing (2) from shaft (4).

(11). Press rotary seal (1) from housing (7).

b. 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.

c. 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 (14), 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 (14) until disc rests on springs (5 & 6).

Note

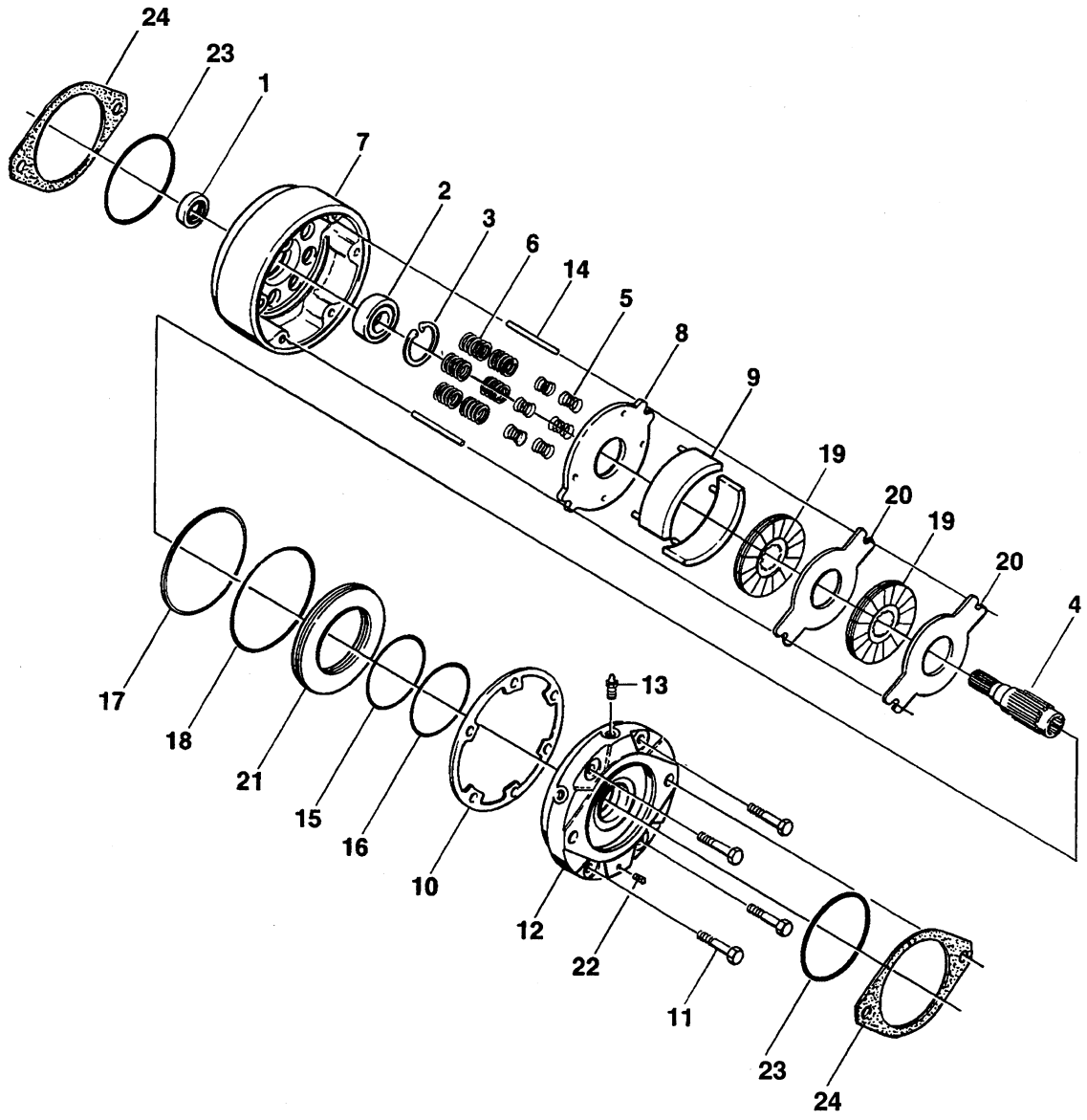
Discs (8 & 20) and friction discs (19) should remain dry during installation. No oil contaminate disc surfaces.

(6). Place new disc (19) on shaft (4) until it contacts return plate (8).

(7). Add additional discs (20) as required to complete assembly.

(8). Insert separators (9) in holes of return plate (8).

(9). Install new o-ring (16), new back-up ring (15), new o-ring (18) and new back-up ring (17) on piston (21). Insert piston (21) into end cover (12) being careful not to shear o-rings or back-up rings.



1. Seal
2. Bearing
3. Retaining Ring
4. Shaft
5. Spring
6. Spring
7. Housing
8. Return Plate
9. Separator
10. Gasket
11. Bolt
12. Power Plate
13. Bleeder Screw
14. Dowel Pin
15. Back-Up Ring
16. O-Ring
17. Back-Up Ring
18. O-Ring
19. Rotor
20. Stator
21. Piston
22. Pipe Plug
23. O-Ring
24. Gasket

Figure 2-21. Drive Brake - Mico (Machines Built Prior To August 1991).

(10). Install new case seal (10) in housing (7) then install bleeder screw (13) in end cover.

(11). Position end cover (12) on housing (7) aligning dowel pins (14) with holes in end cover.

(12). Insert capscrews (11) and tighten evenly to draw end cover (12) to housing (7). Torque capscrews to 55 ft. lbs. (75 Nm).

2-23. DRIVE BRAKE - Mico (Machines Built From August 1991 To Present). (See Figure 2-22)

a. Disassembly.

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

CAUTION

END COVER IS UNDER SPRING TENSION OF APPROXIMATELY 2000 POUNDS (681 KG). THE FOUR CAPSCREWS SHOULD BE LOOSENED EVENLY TO RELIEVE THIS FORCE. IF A HYDRAULIC PRESS IS AVAILABLE (3000 LBS (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 (19) from housing (7).

(6). Remove stack assembly, consisting of discs (23), return plate (8) and friction discs (22) form housing (7).

(7). Remove dowel pins (17), springs (5 & 6) and spring retainer (16) 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) and bearing (2) from shaft (4).

(11). Press rotary seal (1) from housing (7).

b. 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.

c. 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) and retaining ring (15) 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).

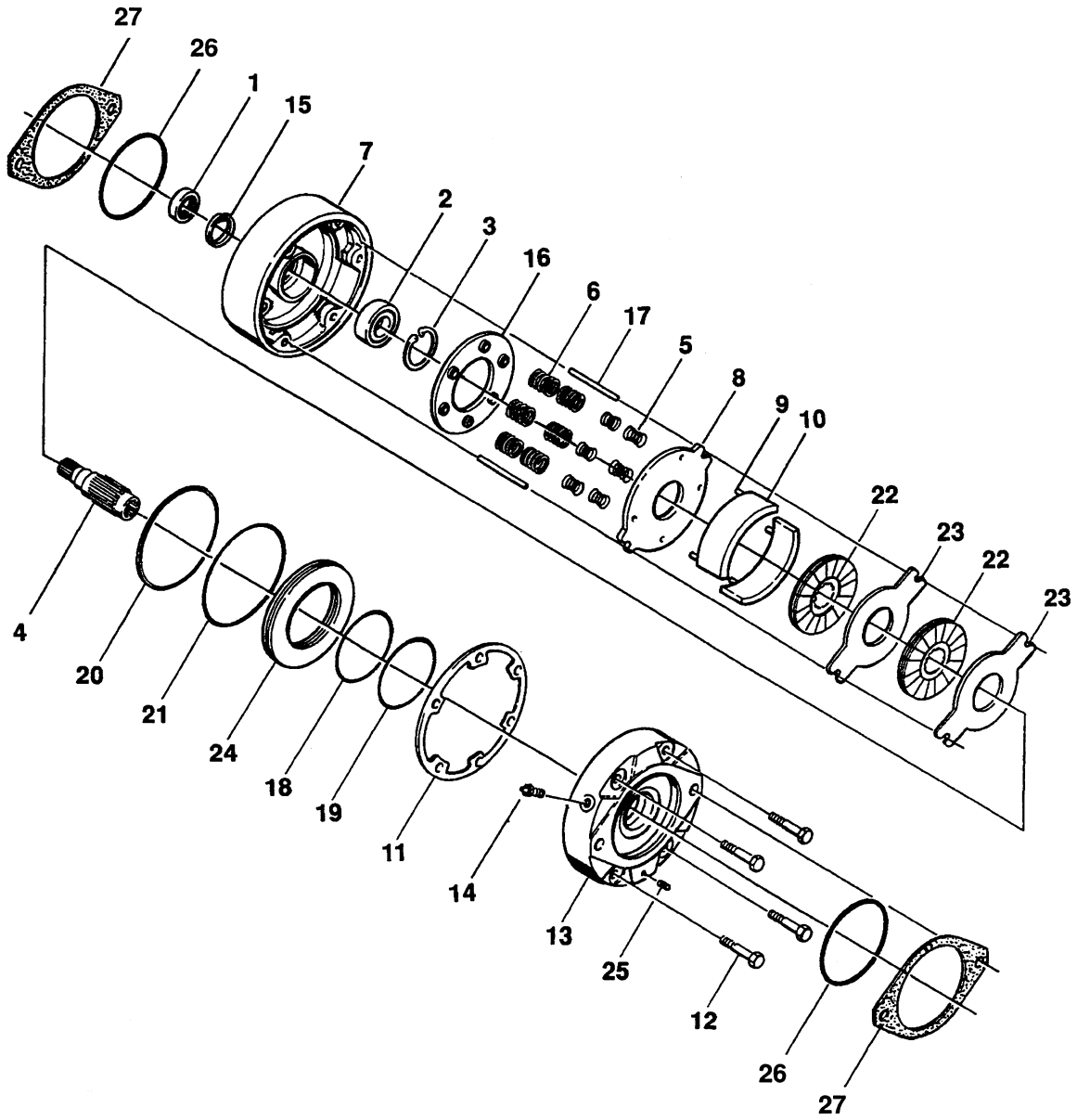
Note

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).



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

Figure 2-22. Drive Brake - Mico (Machines Built From August 1991 To Present).

(9). Install new o-ring (19), new back-up ring (18), new o-ring (21) and new back-up ring (20) 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).

Note

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

(13). If hydrostatic bench testing is performed on the brake assembly, release pressure should not exceed 2000 psi (137.9 Bar) unless two additional bolts are used for supplemental clamping.

2-24. PQ CONTROLLERS

a. Adjustment For Vickers Proportional Valve, - 1600094. (Machines Built Prior To September 1992).

Note

When adjusting any controller you are seeking to match the valves electrical operating range by setting the controller trimpots.

(1). Install ammeter capable of measuring from 0 to 2 amps in series between pin 5 and 6 and the valve coils. Use pin test harness 4920487.

(2). Back off RAMP trimpot CCW completely until a click is heard. Note this is a 22 turn trimpot.

(3). Determine that battery is charged up. Position IGNITION/EMERGENCY STOP switch to ON. Do not start engine.

(4). Depress foot switch.

(5). Operate the controller until the trailing edge of the slide lock is even with the housing lock notch. This is called the Notch-Out position.

(6). Check output on pin 5 and 6, in sequence by stroking controller forward and backward to Notch-Out positions. Settings should be equal in both directions. This is called the Null setting.

(7). To adjust Null, loosen the set screw in gear tooth. Adjust screw in face of gear until equal amp setting is obtained. Then apply loctite and tighten set screw in gear tooth.

(8). Start engine.

(9). With machine in an area clear of obstructions, and on a flat level surface, move controller to Notch-Out position.

(10). Stroke controller (more or less) until function just starts to move. Note ammeter reading.

(11). Stroke controller fully and note ammeter reading. Insure that valve is fully open. This can be accomplished by the following:

(a). With controller stroked completely, back off controller while observing ammeter. When function slows down, note ammeter reading, e.g. 600 mA.

(b). Stroke controller fully until ammeter reads 600 mA.

(c). Quickly move controller to full stroke position.

(d). If there is a surge in function, the valve was not fully open. Note that for some functions the valve need not be fully open.

(e). If there is no surge in function, note ammeter reading.

(f). If there is a surge, move function 25 mA higher, e.g. 625 mA.

(g). Move controller quickly to full stroke and watch for surge.

(h). Repeat steps (f) and (g) until there is no surge noticed. At this point the valve is fully open.

(i). Note ammeter reading.

(12). Valve functioning has been determined. Now the controller can be set to match.

(13). Disconnect dump valve wire.

(14). With engine running, depress foot switch.

(15). Stroke controller to Notch-Out position, and adjust LO trimpot to reading in step (10).

Note

Adjusting LO trimpot affects HI reading, and vice versa.

(16). Fully stroke controller and adjust HI trimpot to ammeter reading from step (e) or (i).

(17). Readjust LO trimpot as in step (15).

(18). Readjust HI trimpot as in step (16).

(19). Repeat steps (17) and (18) until LO and Hi are properly set.

(20). Turn RAMP trimpot CW six turns. Note that clockwise rotation of the RAMP potentiometer adjust screw increases ramp (delay) time, counterclockwise rotation decreases ramp (delay) time.

(21). Release foot switch and stop machine.

(22). Reconnect proportional dump valve wire.

(23). Check function for proper operation.

(24). Seal each trimpot adjustment screw with a drop of enamel paint to prevent maladjustment due to vibration.

b. Adjustment For Vickers Proportional Valve, - 1600140 & 1600141. (Machines Built From September 1992 To Present).

Note

When adjusting any controller you are seeking to match the valves electrical operating range by setting the controller trimpots.

(1). Install ammeter capable of measuring from 0 to 2 amps in series between pin 5 and 6 and the valve coils. Use pin test harness 4921299.

(2). Back off RAMP trimpot CCW completely until a click is heard. Note this is a 25 turn trimpot.

(3). Determine that battery is charged up. Position IGNITION/EMERGENCY STOP switch to ON. Do not start engine.

(4). Depress foot switch.

(5). Operate the controller until the trailing edge of the slide lock is even with the housing lock notch. This is called the Notch-Out position.

(6). Check output on pin 5 and 6, in sequence by stroking controller forward and backward to Notch-Out positions. Settings should be equal in both directions. This is called the Null setting.

(7). To adjust Null, loosen the set screw in gear tooth. Adjust screw in face of gear until equal amp setting is obtained. Then apply loctite and tighten set screw in gear tooth. Also apply locktite to face of gear and shaft.

(8). Start engine.

(9). With machine in an area clear of obstructions, and on a flat level surface, move controller to Notch-Out position.

(10). Stroke controller (more or less) until function just starts to move. Note ammeter reading.

(11). Shut off engine, position IGNITION/EMERGENCY STOP switch to off.

(12). Stroke controller fully and note ammeter reading. Insure that valve is fully open. With DRIVE SPEED switch set on HIGH, note ammeter reading.

(13). With DRIVE SPEED switch set on LOW, fully stroke controller, and note ammeter reading.

(14). Set LO trimpot to ammeter reading in step 10.

(15). With DRIVE SPEED switch set on HIGH, and controller handle at Notch-Out position, set HI trimpot at amp setting recorded in step 12.

(16). With DRIVE SPEED switch set on LOW, fully stroke handle. Adjust MID trimpot to ammeter reading in step 13, or for desired speed.

(17). Turn RAMP trimpot CW 8 turns. Note that clockwise rotation of the RAMP potentiometer adjust screw increases ramp (delay) time, counterclockwise rotation decreases ramp (delay) time.

(18). Check function for proper operation.

(19). Position IGNITION/EMERGENCY STOP switch to OFF.

(20). Seal each trimpot adjustment screw with a drop of enamel paint to prevent maladjustment due to vibration.

2-25. OSCILLATING AXLE BLEEDING PROCEDURE AND LOCKOUT TEST.

a. Lockout Cylinder Bleeding - Machine Built Prior to April 1993.

IMPORTANT

ENSURE PLATFORM IS FULLY LOWERED AND BOOM IS CENTERED OVER REAR AXLE PRIOR TO BEGINNING BLEEDING PROCEDURE.

(1). Place a 6 inch (15.2 cm) high block with ascension ramp in front of left front wheel.

(2). From platform control station, activate machine.

(3). Place ENGINE, PUMP VOLUME, and WHEEL MOTOR SPEED control switches to their respective LOW positions.

(4). Position DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until left front wheel is on top of block. Shut down machine. Ensure cam valve has been tripped.

Note

This procedure utilizes gravity flow from the hydraulic system, therefore the bleeding process may take 10-15 minutes depending upon the amount of air trapped in lockout system.

(5). Open each of the four bleeder screws (two on each lockout cylinder), one at a time, then close bleeder screws when all air is dissipated (bled).

(6). From platform activate machine, place DRIVE control lever to REVERSE, and carefully drive machine off block and ramp.

(7). Place block and ascension ramp in front of right front wheel.

(8). Position DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until right front wheel is on top of block. Shut down machine. Ensure cam valve has been tripped.

(9). Open each of the four bleeder screws (two on each lockout cylinder), one at a time, then close bleeder screws when all air is dissipated (bled).

(10). From platform activate machine, place DRIVE control lever to REVERSE, and carefully drive machine off block and ramp. Shut down machine.

(11). Perform oscillating axle lockout test.

b. Lockout Cylinder Bleeding - Machine Built From April 1993 To Present.

IMPORTANT

ENSURE PLATFORM IS FULLY LOWERED AND BOOM IS CENTERED OVER REAR AXLE PRIOR TO BEGINNING BLEEDING PROCEDURE.

MAKING SURE MACHINE IS ON A LEVEL SURFACE AND REAR WHEELS ARE BLOCKED, DISENGAGE DRIVE HUBS. OPTIONAL 4WD ALL HUBS MUST BE DISENGAGED.

(1). Making sure machine is on a level surface and rear wheels are blocked, disengage drive hubs. **Optional 4WD** all hubs must be disengaged.

(2). Make up an adapter with an air regulator, remove filler cap on hydraulic tank and install regulator.

(3). Attach air supply to the regulator and set regulator to 2 - 5 psi (0.14-0.34 Bar).

CAUTION

DO NOT EXCEED 5 PSI (0.34 BAR) INTO HYDRAULIC TANK. MORE THAN 5 PSI (0.34 BAR) WILL CAUSE DAMAGE TO THE HYDRAULIC TANK.

(4). Activate machine hydraulic system from platform control station.

(5). Place LOW ENGINE, HIGH DRIVE SPEED and HIGH WHEEL MOTOR SPEED control switches to their respective HIGH positions.

(6). Depress footswitch and activate DRIVE CONTROLLER to "FORWARD" position.

(7). Using a suitable lifting equipment lift front of machine and place a 6 in. (15.2 cm) high block under right front wheel.

(8). Lower machine so both of the lockout cylinders are oscillated; one extended, the other retracted.

(9). Use suitable containers to retain any residual hydraulic fluid, place containers under each lockout cylinder.

(10). With DRIVE CONTROLLER activated and engine at idle, open all four bleeder screws (two on each lockout cylinder), one at a time, then close bleeder screws when all air is dissipated (bled).

(11). Using a suitable lifting equipment lift front of machine and remove the 6 in. (15.2 cm) high block.

(12). Transfer the 6 in. (15.2 cm) high block to the left front wheel and repeat steps 2 thru 7, substituting the word "right" for "left" in step 5.

(13). Perform oscillating axle lockout test.

b. Oscillating Axle Lockout Test.

IMPORTANT

LOCKOUT SYSTEM TEST MUST BE PERFORMED QUARTERLY, ANY TIME A SYSTEM COMPONENT IS REPLACED, OR WHEN IMPROPER SYSTEM OPERATION IS SUSPECTED.

Note

Ensure boom is fully retracted, lowered, and centered between drive wheels prior to beginning lockout cylinder test.

(1). Place a 15.2 cm high block with ascension ramp in front of left front wheel.

(2). From platform control station, activate machine hydraulic system.

(3). Place HIGH ENGINE, DRIVE SPEED and WHEEL MOTOR SPEED (if equipped) control switches to their respective LOW positions.

(4). Place DRIVE control lever to FORWARD position and carefully drive machine up ascension ramp until left front wheel is on top of block.

(5). Carefully activate SWING control lever and position boom over right side of machine.

(6). With boom over right side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.

(7). Have an assistant check to see that left front wheel remains locked in position off of ground.

(8). Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). After boom reaches stowed position, activate DRIVE and lockout cylinders should release and allow wheel to rest on ground.

(9). Place the 15.2 cm high block with ascension ramp in front of right front wheel.

(10). Place DRIVE control lever to FORWARD and carefully drive machine up ascension ramp until right front wheel is on top of block.

(11). Carefully activate SWING control lever and position boom over left side of machine.

(12). With boom over left side of machine, place DRIVE control lever to REVERSE and drive machine off of block and ramp.

(13). Have an assistant check to see that right front wheel remains locked in position off of ground.

(14). Carefully activate SWING control lever and return boom to stowed position (centered between drive wheels). After boom reaches stowed position, activate DRIVE and lockout cylinders should release and allow wheel to rest on ground.

(15). If lockout cylinders do not function properly, have qualified personnel correct the malfunction prior to any further operation.

2-26. BASKET ROTATOR BRAKE. (SEE FIGURE 2-23.)

Torque belleville washers (4160026) to 140 ft. lbs. (190 Nm).

2-27. DUAL FUEL SYSTEM.

CAUTION

IT IS POSSIBLE TO SWITCH FROM ONE FUEL SOURCE TO THE OTHER WITHOUT ALLOWING THE ENGINE TO STOP. EXTREME CARE MUST BE TAKEN AND THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

a. Changing from Gasoline to LP Gas.

(1). Start the engine from the ground control station.

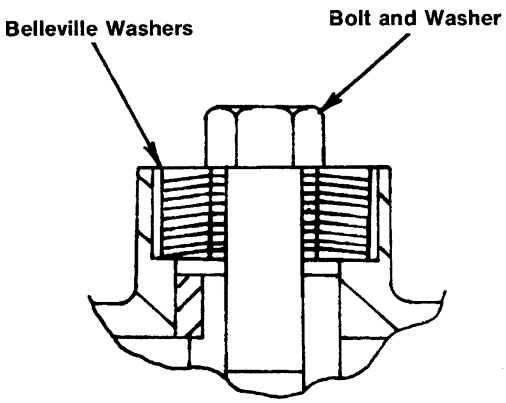
(2). Open the hand valve on the LP gas supply tank by turning counterclockwise.

CAUTION

BE SURE ALL GASOLINE IS EXHAUSTED BEFORE SWITCHING TO LP GAS.

(3). While the engine is operating, place the three position LPG/Gasoline switch at the ground control station to the center "off" position. Allow the engine to operate without load, until the engine begins to "stumble" from lack of gasoline.

(4). As the engine begins to "stumble", place the switch to the LPG position, allowing the LP fuel to be sent to the fuel regulator.



Install Belleville Washers as shown.
Torque Bolt to 140 FT.LB. (19.36 KGM).

Figure 2-23. Platform Rotator Brake.

b. Changing from LP Gas to Gasoline.

(1). With engine operating on LP under a no load condition, throw the LPG/Gasoline switch at the ground control station to the "Gasoline" position.

(2). If engine "stumbles" because of lack of gasoline, place the switch to the LPG position until engine regains smoothness, then return the switch to the Gasoline position. Repeat as necessary until engine runs smoothly on gasoline.

(3). Close the hand valve on the LP gas supply tank by turning clockwise.

2-28. FREE WHEELING OPTION.

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

(1). Chock wheels securely if not on flat level surface.

(2). Disconnect both drive hubs by inverting disconnect caps in center of hubs.

(3). If equipped, move steer/tow selector valve to float (tow) position by pulling valve knob out.

b. To Engage Drive Motors and Brakes (Normal Operation).

(1). If equipped, move steer/tow valve to steer position by pushing valve knob in.

(2). Connect both drive hubs by inverting disconnect cap in center of hub.

(3). Remove chocks from wheels as required.

2-29. SPARK ARRESTOR MUFFLERS.

The multiple discs on these mufflers will require frequent cleaning if used with oily or sooty exhaust (diesel), or on malfunctioning engines (as evidenced by visible exhaust.

2-30. FOOT SWITCH ADJUSTMENT.

Adjust so that functions will operate when pedal is at center of travel. If switch operates within last 1/4 in. (6.35 mm) of travel, top or bottom, it should be adjusted.

2-31. HYDRAULIC PUMP W/HAYES PUMP DRIVE COUPLING LUBRICATION.

Any time pump or pump drive coupling is removed coat pump and drive coupling splines with Lithium Soap Base Grease (TEXACO CODE 1912 OR EQUIVALENT) coupling is greased prior to assembly.

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2-38. PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE.

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

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

Note

This machine requires periodic safety and maintenance inspections by a JLG Dealer. A decal on the frame affords a place to record (stamp) inspection dates.

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

IMPORTANT

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

Note

This machine requires periodic safety and maintenance inspections by a JLG dealer. A decal located on the frame/turntable affords a place to record (stamp) inspection dates. Notify dealer if inspection is overdue.

d. The inspection and maintenance code numbers are as follows:

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

Table 2-3. Preventive Maintenance and Inspection Schedule.

AREA	INTERVAL				
BOOM	**(10 HRS) DAILY**	**(50 HRS) WEEKLY**	**(200 HRS) MONTHLY**	**(500 HRS) QUTRLY**	**(1000 HRS) 6 MONTH**
1. Platform Gate	1,4		12		
2. Platform Door	1,4		12		
3. Platform	1,4				
4. Platform Rotator (If Equipped)		5,11	8,12		
5. Footswitch	1,11				
6. Controllers	1,11				
7. Switches	1,11				
8. Placards and Decals	1,2				
9. Control Tags	1,2				
10 Valves		5,6			
11. Carrier (Hose and Cable)	1	4,8			
12. Hydraulic Hoses and Tubing	1	5			
13. Pins			8,12		
14. Bushings			8,12		
15. Wear Pads			8		
16. Cylinders		1,5,6,13	12		
17. Drift Test				*	
TURNTABLE					
1. Engine Oil (See MFG. Manual)	3	5			
2. Battery	3	5			
3. Radiator (If Equipped)		3,5			
4. Air Cleaner	1	14			
5. Exhaust System	1		1,5		
6. Engine Mount			1		
7. Gauges/Ground Controls	1,2,11				
8. Main Hydraulic Pump	1	5			
9. Auxiliary Power Pump	1	5			
10. Valves	1	5			
11. Hydraulic Filters	14	5			
12. Hydraulic Hoses and Tubing	1	5			
13. Hydraulic Oil Tank**	3	5	4		16
14. Breather Hydraulic Tank		6,14			
15. Fuel Tank	3,5		4		
16. Cylinders		1,5,6,13	4,12		
17. Shields	1				
18. Turntable Locking Pin	1,7		4		
19. Horizontal Limit Switch	1,7				
20. Oil Coupling		5			
21. Placards and Decals	1,2				
22. Swing Bearing		1	12	9	
23. Swing Brake		1,5,6	8		
24. Tower Boom Cam Valves	1,7				
CHASSIS					
1. Wheel and Tire Assembly	1	8,9,15			
2. Drive Motors		1,5,6			
3. Drive Torque Hubs		1,5,6	3	10	
4. Drive Brakes		1,5,6	8		
5. Steer Cylinder	1	1,5,6,13	12		
6. Steer Components	1	4,6	8,12		
7. Lockout Cylinders (If Equipped)	1	5,13	12	***	
8. Front Axle Pin (If Equipped)	1		8,12		
9. Hydraulic Hoses and Tubing	1	5			
10. Placards and Decals	1,2				
11. Shields	1				
12. Wheel Bearings			8		
13. Swing Bearing/Pinion Gear			12	9	

*To be performed quarterly.
**Inspection and Maintenance Code 10 to be performed annually.
***Axle Lockout Test to be performed quarterly.

3-1. GENERAL.

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

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

3-2. TROUBLESHOOTING INFORMATION.

a. 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 six major groups, each covered seperately within this section. These groups are as follows: platform assembly, boom assembly, turntable assembly, chassis assembly, hydraulic system and electrical system.

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

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

d. 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 of which have more than one probable cause and remedy ore included. This means that problems for which the probable cause and remedy may be immediately obvious are not listed in this section.

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

3-3. HYDRAULIC CIRCUIT CHECKS.

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

Table 3-1. Platform Assembly Troubleshooting.

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

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Control Valves.		
Valve spool sticking.	Dirt in oil causing excessive temperature build-up.	Flush system and change oil using recommended viscosity
	Moisture in oil.	Flush system and change oil using recommended viscosity.
	Incorrect valve mounting causing warping of the unit.	Loosen valve and check mounting. Repair as necessary.
	Hoses rubbing manual overrides on upper 4-stack valve.	Reroute hoses correctly.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Tie-bolts in valve over torqued.	Correctly torque bolts.
	Return spring weak or broken.	Remove valve and repair or replace as necessary.
	Relief valve malfunctioning causing excessive pressure within valve.	Check pressure delivery to and from valve and repair or replace as necessary.
Valve leaking.	Dirt or other foreign material under seal.	Remove and repair valve as necessary.
	Valve spool scored.	Remove valve and repair or replace as necessary.
	Excessive back pressure caused by restricted return line to reservoir.	Remove line and clear obstruction or replace line as necessary.
	Damaged valve seals.	Remove valve and repair or replace as necessary.
Boom Elevation System.		
No response to control.	Lift control inoperative.	Repair or replace control lever.
	Lift cylinder holding valve inoperative.	Repair or replace holding valve.
	Dump valve (bypass) not operating.	Determine cause and repair or replace valve.
	Electrical malfunction.	See wiring diagram.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	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.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Boom Elevation System (Continued).		
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.
	Electrical failure to valves.	See proper wiring diagram.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Bypass valve (dump) not functioning.	Repair or replace valve.
	Lift cylinder not functioning properly.	Repair or replace cylinder.
	Binding lift cylinder or boom pivot pin.	Repair or replace cylinder or pin.
Boom will not lower.	See: Boom will not raise.	
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Holding valve not functioning properly.	Re-adjust or replace valve.
Boom raises and lowers erratically.	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	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.	Worn seals in lift cylinder.	Replace seals.
Pump Volume, Wheel Motor Speed, High Engine does not operate below horizontal.	Damaged wiring on level limit switch.	Repair or replace wiring.
	Solenoid failure.	Replace solenoid.
	Tripped circuit breaker.	Reset circuit breaker.
	Damaged level limit switch.	Replace switch, repair or replace holder.
	Defective relay, main terminal box.	Replace relay.
	Defective platform switch.	Replace switch.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Main Telescope System.		
No response to control.	Telescope control inoperative.	Repair or replace control lever.
	Hydraulic system oil low.	Replenish oil as necessary.
	Damaged wiring on control switch or solenoid valve.	Repair or replace wiring.
	Control valve not functioning properly.	Repair or replace valve.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Boom will not extend.	Control valve not functioning properly.	Repair or replace control valve.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Pressure setting incorrect.	Check pressure/re-adjust as necessary.
	Telescope cylinder not functioning properly.	Repair or replace cylinder.
Boom extends and retracts erratically.	Hydraulic system oil low.	Replenish oil as necessary.
	Wear pads worn.	Replace pads as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in telescope cylinder.	Replace seals.
	Cylinder not functioning properly.	Repair or replace cylinder.
	Distorted boom section(s).	Replace distorted section(s).
	Counterbalance valve not functioning properly.	Replace counterbalance valve.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Tower Telescope System.		
Tower telescope cylinder will not extend.	Tower lift cylinder not fully elevated.	Fully elevate tower lift cylinder.
	Cam valves out of adjustment.	Correctly adjust cam valves.
	Tower level cylinder not synchronized.	Correctly adjust cam valves.
	Defective cylinder or binding boom.	Repair or replace cylinder or defective boom parts.
Tower lift cylinder will not lower.	Tower telescope cylinder not fully retracted.	Fully retract tower telescope cylinder.
	Cam valves out of adjustment.	Correctly adjust limit cam valves.
	Defective cylinder or binding boom.	Repair or replace cylinder or defective boom parts.
No response to control.	Valve spool sticking.	Repair or replace valve.
	Poor ground on valves.	See proper wiring diagram.
	No electric power to valves.	See proper wiring diagram.
	No electric power to dump valve on cylinder.	See proper wiring diagram.
	Internal damage to cylinder.	Repair or replace cylinder.
Boom leaks down.	Holding valve sticking.	Replace holding valve.
	Damaged cylinder.	Repair or replace cylinder.
Boom Swing System.		
No response to control.	Hydraulic system oil low.	Replenish oil as necessary.
	Swing control lever not functioning.	Repair or replace swing control 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.
	Restrictor valve(s) plugged.	Clean or replace restrictor valve.
	Foreign objects(s) wedged between swing motor pinion and swing gear.	Remove objects, check for damage, and repair or replace component(s) as required.
	Sheared shaft on swing motor/brake.	Repair or replace motor/brake.
	Pressure reducing valve in swing circuit malfunctioning.	Repair or replace pressure reducing valve.
	No electric power to valve.	See proper wiring diagram.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Boom Swing System (Continued).		
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 swing motor 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 speed reducer 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 swing motor pinion.	Replace gear(s) as required.
	Swing brake not functioning properly.	Repair or replace swing brake.
	Restrictor valves(s) plugged.	Clean or replace restrictor valve.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Tower Lift and Upright Circuit.		
No response to control.	Tower lift control inoperative.	Repair or replace control lever.
	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken supply line on valve bank or hydraulic pump.	Clean or replace line.
	No electric to control.	See proper wiring diagram.
	Control valve not functioning properly.	Repair or replace valve.
	Overcenter valve malfunction.	Repair or replace valve.
	Hydraulic pump not functioning properly.	Repair or replace pump.
Tower lift and upright 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, replace line or fitting.
	Holding valve(s) on cylinder(s) not working.	Replace holding valve(s).
	Control valves not functioning properly.	Repair or replace valve.
	Pressure relief valve not functioning properly.	Re-adjust or replace valve.
	Bypass valve (dump) not functioning.	Repair or replace valve.
	Tower lift cylinder not functioning properly.	Repair or replace cylinder.
	Counterbalance valve not adjusted.	Replace counterbalance valve.
	Failed master cylinder.	Repair or replace master cylinder.
	Tower level cylinder not synchronized.	Correctly adjust cam valves.
Tower lift and upright will not lower.	See: Tower lift and upright will not raise.	
	No electric power to dump valve.	Repair or replace valve.

Table 3-2. Boom Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Tower Lift and Upright Circuit (Continued).		
Tower lift and upright raises and lowers erratically.	Hydraulic system oil low.	Replenish oil as required.
	Restricted or broken hydraulic line or fitting.	Clean, repair, replace line.
	Lack of lubricant on cylinder shafts.	Lubricate as required. (Refer to Lubrication Chart.)
	Counterbalance valve on tower lift cylinder improperly adjusted or not functioning properly.	Replace counterbalance valve.
	Control valve not functioning properly.	Repair or replace valve.
	Worn seals in tower lift cylinder.	Replace seals.
	Upright level cylinder not functioning properly.	Repair or replace cylinder.
	Air in upright cylinder.	Fully cycle upright level cylinder 2-3 times.
	Holding valves on tower lift or upright level cylinder contaminated.	Determine and remedy source of contamination. Replace holding valve.
	Relief valve set too low on level circuit.	Correctly adjust valve.
	Tower level master cylinder defective or leaking.	Repair or replace master cylinder.
	Air in tower master cylinder.	Fully cycle tower master cylinder 2-3 times.
	Seals worn and leaking in tower master cylinder.	Repair master cylinder.
Tower level override circuit not working.	Electrical failure at switch or relay.	See wiring diagram. Replace switch/relay.
	No power to select valve.	See wiring diagram.
	No power to directional valve in tower.	See wiring diagram.
	Stuck valve spool in directional valve.	Repair or replace valve.
	PQ switch defective or not set properly.	Repair or replace controller.
	Horizontal switch not working or not tripped.	Repair or replace switch.
	Machine not on level surface.	Make sure machine is level.
	Power select switch not set to ground function.	Place select switch to ground function.

Table 3-3. Turntable Assembly Troubleshooting.

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

Table 3-3. Turntable Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Power Plant. (continued)		
Engine will not accelerate above low speed.	Damaged wiring on speed control switch or high engine solenoid.	Repair or replace wiring.
	Speed control switch not functioning properly.	Replace switch.
	High engine solenoid not functioning properly.	Repair or replace solenoid.
	High engine circuit breaker not functioning properly.	Replace circuit breaker.
	Switch not functioning properly or improperly adjusted.	Adjust, repair, or replace horizontal limit switch.
	Excessive load on engine.	Reduce load.
	Engine worn badly.	Rebuild engine.
	Engine improperly timed.	Time engine.
	Engine overheating.	Determine cause of overheating and remedy.
	Dirty fuel filter (diesel).	Replace filter.
	Fuel line pinched (diesel).	Replace fuel line.
	Throttle governor not working properly.	Repair or replace governor.
Engine surges.	Governor not adjusted properly.	Correctly adjust governor.
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.

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Control Valves. (continued)		
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	Fuel tank overfilled.	Check fuel tank and immediately wipe up spilled fuel.
	Fuel tank damaged.	Drain all fuel from tank and remove tank for replacement or repair.
	Fuel line from tank damaged.	Replace fuel line.
	Carburetor flooding.	Repair,replace or adjust carburetor.
Front Frame Axle Area.		
One or both 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 and cotter pin as necessary.
Rear Frame Axle Area.		
Difficulty encountered when moving machine.	Load capacity exceeded.	Reduce load. Apply loads only in accordance with load capacity indicator.
	Flow divider sticking.	Repair or replace flow divider.
	Machine being moved up too steep a grade.	Remove machine from grade and check that drive system operates correctly.
	Grade too steep.	See Caution Placard on platform for specified grades and sideslopes.
	Drive wheel tire treads worn smooth.	Replace tires as necessary and inflate to specified pressure.
	Drive brakes "dragging".	Re-adjust pressure.
	System pressure too low.	Re-adjust pressure.
	Drive hub(s) defective.	Repair or replace hub.
	Engine RPM's not set.	Correctly set engine RPM.
	Drive motors worn.	Repair or replace drive motors.

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Rear Frame Axle Area (Continued).		
Difficulty encountered when moving machine.(Continued)	Counterbalance valve defective.	Replace counterbalance valve.
	Accessory valve not adjusted properly.	Correctly adjust accessory valve.
	Low amperage on controller.	Correctly adjust controller.
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. (If equipped.)	Clean, repair or replace line.
	Drive hub(s) disconnected.	Reconnect disconnect cap on hub.
	If equipped, 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 switch not functioning properly.	Replace switch.
	Brake(s) not releasing.	Determine cause and repair or replace.
Machine will not travel in forward.	Hydraulic system oil low.	Replenish oil as necessary.
	Restricted or broken hydraulic line or fitting.	Clean, repair or replace line or fitting.
	Control valve not functioning properly.	Repair or replace valve.
	Drive motor(s) not functioning properly.	Repair or replace motor(s).
	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	No power to wheel motor speed switch.	See proper wiring diagram.
	Two speed valve sticking.	Repair or replace valve.
	Counterbalance valve sticking on return side.	Adjust return counterbalance out 3 turns - cycle drive - return to original position.
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.	Valve not returning to neutral.	Check neutral springs.
	Function speed switch malfunction.	Replace function switch.
	Sticking spool due to contamination.	Remove end cap and check spool freedom. Repair as necessary.

Table 3-4. Chassis Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Drive System (Continued).		
Motor turns slowly at maximum command.	Valve spool is not traveling far enough due to:	
	Worn, leaking drive motor(s).	Repair or replace drive motor(s).
	Engine speed too low.	Properly adjust engine speed.
	Low control pressure supply.	Replace pressure regulator if necessary.
	Function speed switch malfunction.	Replace switch.
	Amperage too low on controller.	Correctly adjust controller.
	Defective pump, low oil volume.	Repair or replace pump.
Poor response, function shuts off slowly when command is removed.	Low spool spring preload.	Check for correct spring and shims in end caps.
	Sticking spool due to contamination.	Remove end cap and check spool freedom.
	Ramp set too high in controller.	Adjust controller.
	Sticking control handle.	Repair or replace controller.
Steering System.		
No response to control.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	If equipped, steer/tow selector in "tow" position.	Actuate control to "steer" position. (Valve knob "in".)
	Hydraulic system oil low.	Replenish oil as necessary.
	Hydraulic system pressure too low.	Adjust pressure.
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Control switch not functioning properly.	Replace switch.
	Restricted or broken hydraulic line on valve bank, hydraulic pump or rotary coupling. (If equipped.)	Clean, repair or replace line.
	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 3-4. Chassis Assembly Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Steering System (Continued).		
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.
	Spindle pins tight or need lubrication.	Repair or lubricate spindles.
Steering inoperative.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring on control switch or solenoid valve.	See proper wiring diagram.
	Solenoid valve not functioning properly.	Repair or replace valve.
	Control switch not functioning properly.	Replace switch.
	Relief valve improperly set or not functioning properly.	Reset, repair or replace valves as required.
	Steer cylinder not functioning properly.	Repair or replace cylinder.
Machine will not steer left or to the right.	Wiring on control switch is damaged.	See proper wiring diagram.
	Wiring on solenoid valve damaged.	Repair or replace wiring.
	Coil in solenoid damaged.	Replace coil.
	No oil flow or pressure to steer circuit.	Take pressure reading at steer valve and adjust as necessary.
	Bent cylinder rod.	Repair or replace cylinder.
	Damaged tie rod.	Replace tie rod.
	Crossover relief valve sticking.	Repair crossover relief valve.
	Cylinder packing defective.	Repair or replace cylinder.
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.
	Swivel seals leaking.	Repair swivel leak.

Table 3-5. Hydraulic System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic Systems - General.		
Hydraulic pump noisy.	Air entering system through broken line or fitting. (Suction Side.)	Repair or replace line or fitting.
	Suction screen dirty.	Clean suction screen.
	Air bubbles in oil. (Reservoir oil too low.)	Replenish oil as required.
	Suction hose squeezed shut.	Determine cause and repair.
	Oil filter dirty.	Replace hydraulic filter.
	Wrong type of hydraulic oil.	Replace hydraulic oil.
Pump cavitating. (Vacuum in pump due to oil starvation.)	Restricted suction line.	Clean, repair, or replace line.
	Restricted reservoir air vent.	Clean or replace vent.
	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Air leak in suction side of tank.	Repair leak.
	Restricted suction strainer.	Clean strainer.
System overheating.	Oil viscosity too high.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Bypass valve not operating properly.	Repair or replace valve.
	Main relief valve set too low.	Reset valve as required.
	Hydraulic system oil low.	Replenish oil as necessary.
	Port relief set too high.	Reset valve as required.
	Restricted or blocked return line.	Repair or replace line.
Pump not delivering oil.	Restricted suction line.	Clean, repair, or replace line.
	Air entering system through broken line or fitting.	Repair or replace line or fitting.
	Broken pump drive shaft/pump coupling.	Repair or replace pump/pump coupling. **Note: Any time pump or pump drive coupling is removed coat pump and drive coupling splines with Lithium Soap Base Grease (TEXACO CODE 1912 OR EQUIVALENT).**

Table 3-5. Hydraulic System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Hydraulic Systems - General. (continued)		
Function sluggish during operation. (System pressure too low.)	Main relief valve set too low.	Reset valve as required.
	Pump section not delivering sufficient oil.	Repair or replace pump section or pump.
	Main relief valve stuck in open position.	Clean, repair, or replace valve. (Check system oil for contamination.)
	Oil viscosity too low.	Drain system and replace with recommended oil. (Refer to Hydraulic Oils.)
	Leak in component, line or fitting.	Repair or replace component, line or fitting.
	Scored valve spool; scored cylinder.	Replace valve; replace cylinder.
	Amperage too low on controller.	Correctly adjust controller.
	Low sequence pressure.	Reset valve as required.
	Low pilot pressure.	Reset valve as required.
	Wrong/defective spool in drive section.	Repair or replace drive section.
	Shuttle balls leaking in proportional valve.	Repair or replace valve.
	Low voltage in electrical system.	Correct low voltage problem.
System(s) operate erratically.	Sticking or binding valve spools, pistons.	Clean, repair, or replace components as required.
Auxiliary Hydraulic System.		
Auxiliary hydraulic pump inoperable.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Check valve in system leaking.	Repair or replace check valve.
	Battery requires charging or will not hold a charge.	Charge or replace battery as required.
	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.

Table 3-6. Electrical System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Platform Controls.		
No power to platform controls.	15 Amp self-reset circuit breaker open.	Check footswitch to ensure that both switches are making contact when pedal is depressed. Repair or replace footswitch as necessary.
	Contact block in footswitch malfunctioning.	Repair, replace or adjust contact block as required.
	Faulty power circuit wiring.	Check wiring continuity. Refer to proper wiring diagram.
	Select switch in wrong position.	Place select switch to correct position.
Engine Starter System.		
Starter will not crank.	Discharged battery or loose battery terminals.	Check and charge battery or replace battery as necessary. Clean and secure battery terminals.
	Starter relay faulty or faulty relay connections.	Using a test meter, check relay coil terminals for presence of electrical power and for energization of relay coil. Also check relay terminals for correct switching of contacts. Replace relay as necessary.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Malfunctioning ignition switch.	Using a test meter, check ignition switch for correct switching of contacts. Replace switch as necessary.
	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. See proper wiring diagram.
	Faulty start lockout system.	See correct wiring diagram.
	Faulty start switch.	Replace switch.
Engine continues to crank.	Faulty ignition and/or starter circuit wiring.	Check wiring continuity. See proper wiring diagram.
	Malfunctioning starter solenoid or motor.	Replace solenoid or motor in accordance with applicable manufacturer's manual.
	Faulty start switch.	Replace switch.

Table 3-6. Electrical System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Instruments and Indicators.		
Travel warning horn inoperative.	Circuit breaker open.	Determine and correct cause; reset circuit breaker.
	Damaged wiring in horn circuit.	Repair or replace wiring.
	Damaged horn.	Replace horn.
Hourmeter inoperative.	Damaged wiring in hourmeter circuit.	Repair or replace wiring.
	Defective 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.
	Defective bulb in tilt light.	Replace bulb.
Wheel motor speed circuit.	Switch damaged or inoperative.	Replace switch.
	Damaged or disconnected wiring in circuit.	See proper wiring diagram.
	Plugged orifice in shifter valve.	Clean orifice.
	Faulty shifter valve.	Repair or replace valve.
High engine speed will not function.	Boom above horizontal.	Lower boom.
	Horizontal limit switch out of adjustment.	Adjust switch to activate (close) with boom at horizontal and below.
	High engine solenoid malfunctioning.	Repair or replace solenoid valve.
	Drive pressure switch malfunctioning.	Replace pressure switch.
	Electrical malfunction.	See wiring diagram.
	Defective engine governor.	Repair or replace governor.
High pump volume will not function.	Boom above horizontal.	Lower boom.
	Horizontal limit switch out of adjustment.	Adjust switch to activate (close) with boom at horizontal and below.
	Defective pump section.	Repair or replace pump section.
	Oil by-passing in step valve.	Repair or replace step valve.
	Electrical malfunction.	See correct wiring diagram.

Table 3-6. Electrical System Troubleshooting.

TROUBLE	PROBABLE CAUSE	REMEDY
Instruments and Indicators. (continued)		
High wheel motor speed will not function.	Boom above horizontal.	Lower boom.
	Horizontal limit switch out of adjustment.	Adjust switch to activate (close) with boom at horizontal and below.
	Two speed drive solenoid valve malfunctioning.	Repair or replace solenoid valve.
	Drive pressure switch malfunctioning.	Replace pressure switch.
	Valve orifice plugged.	Unplug valve orifice.
	Defective drive motor.	Repair or replace motor.
	Grade too steep.	Check gradeability of machine.

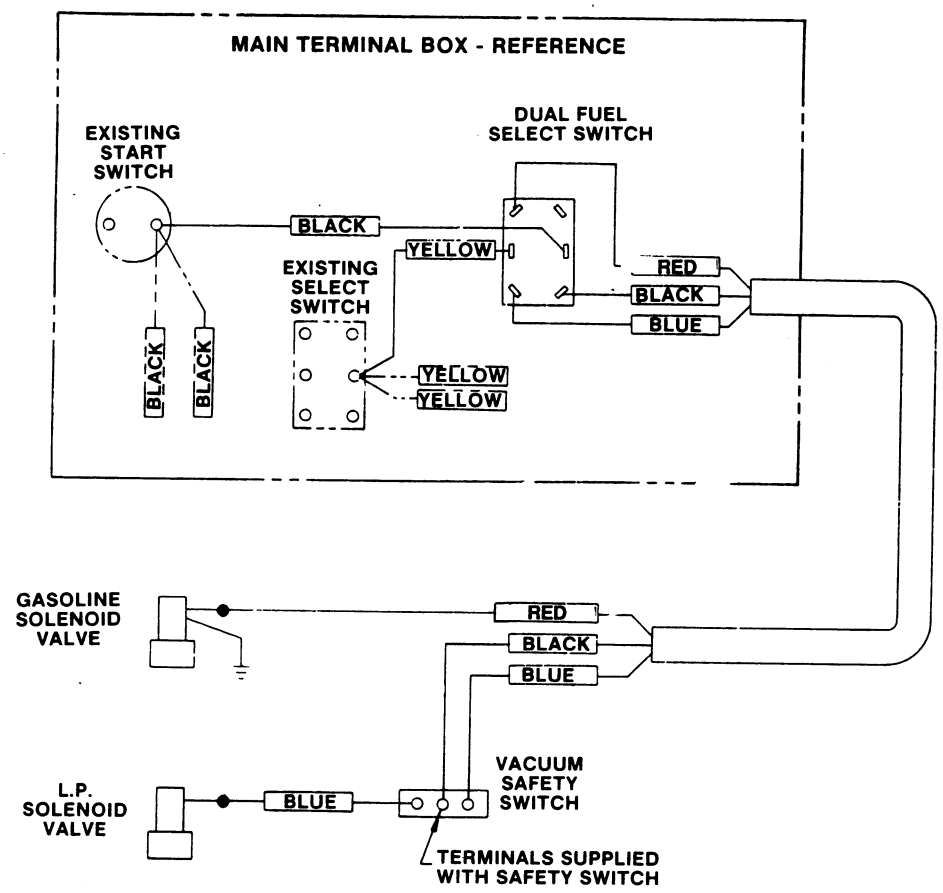


Figure 3-1. Electrical Diagram - Dual Fuel.

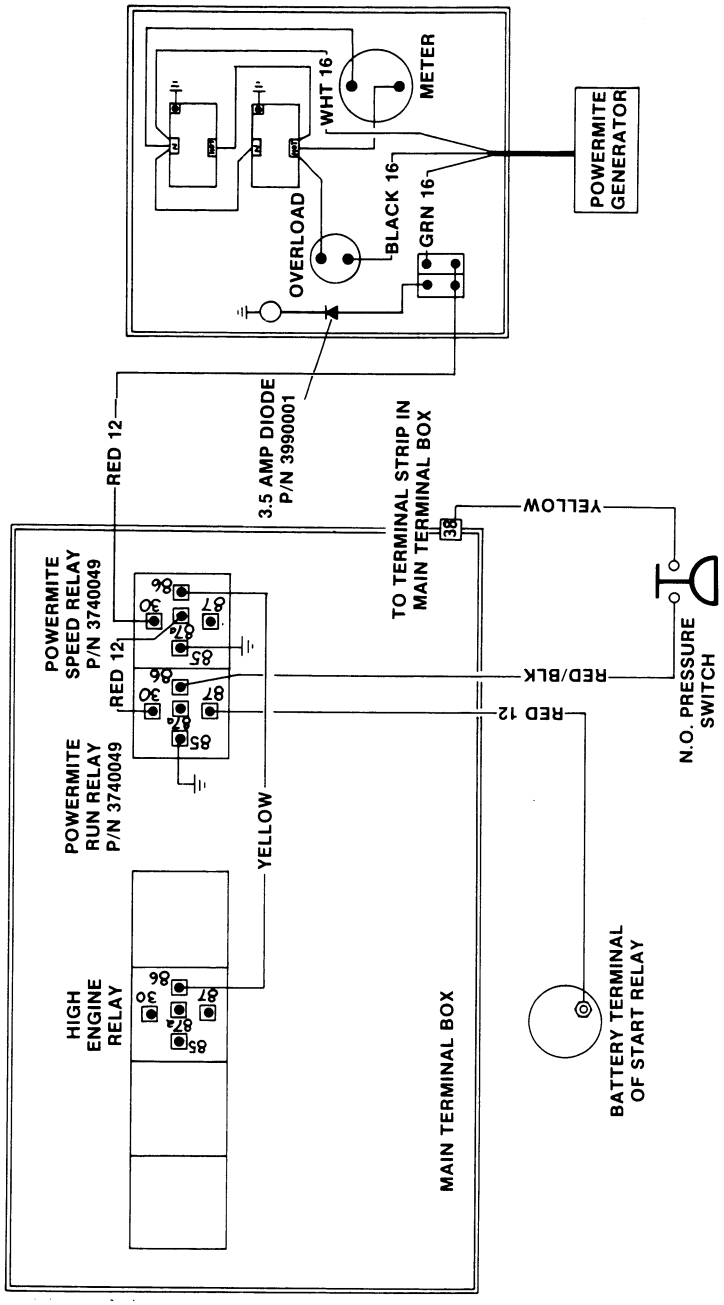


Figure 3-2. Electrical Diagram - Generator (Deutz).

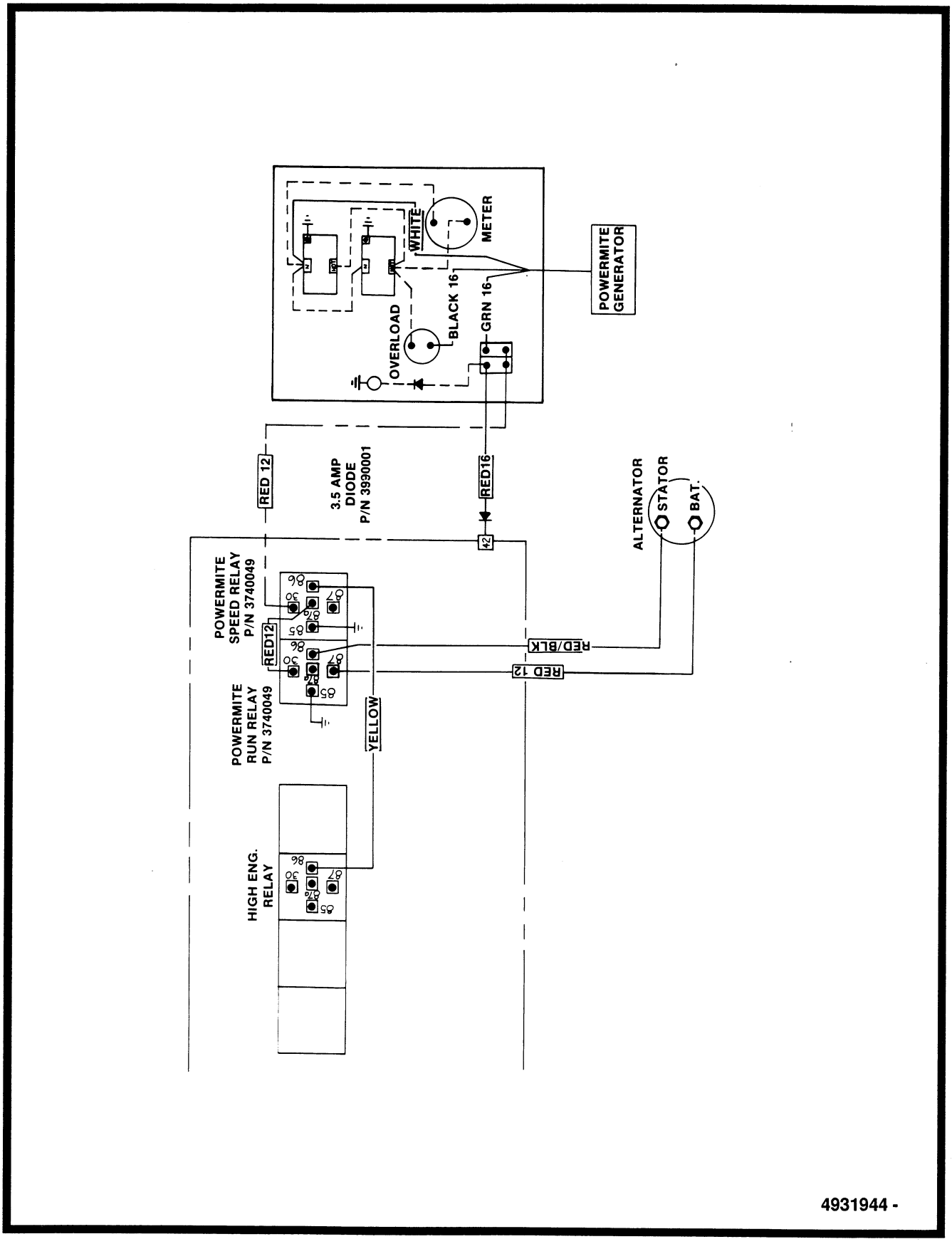


Figure 3-3. Electrical Diagram - Generator (Ford).

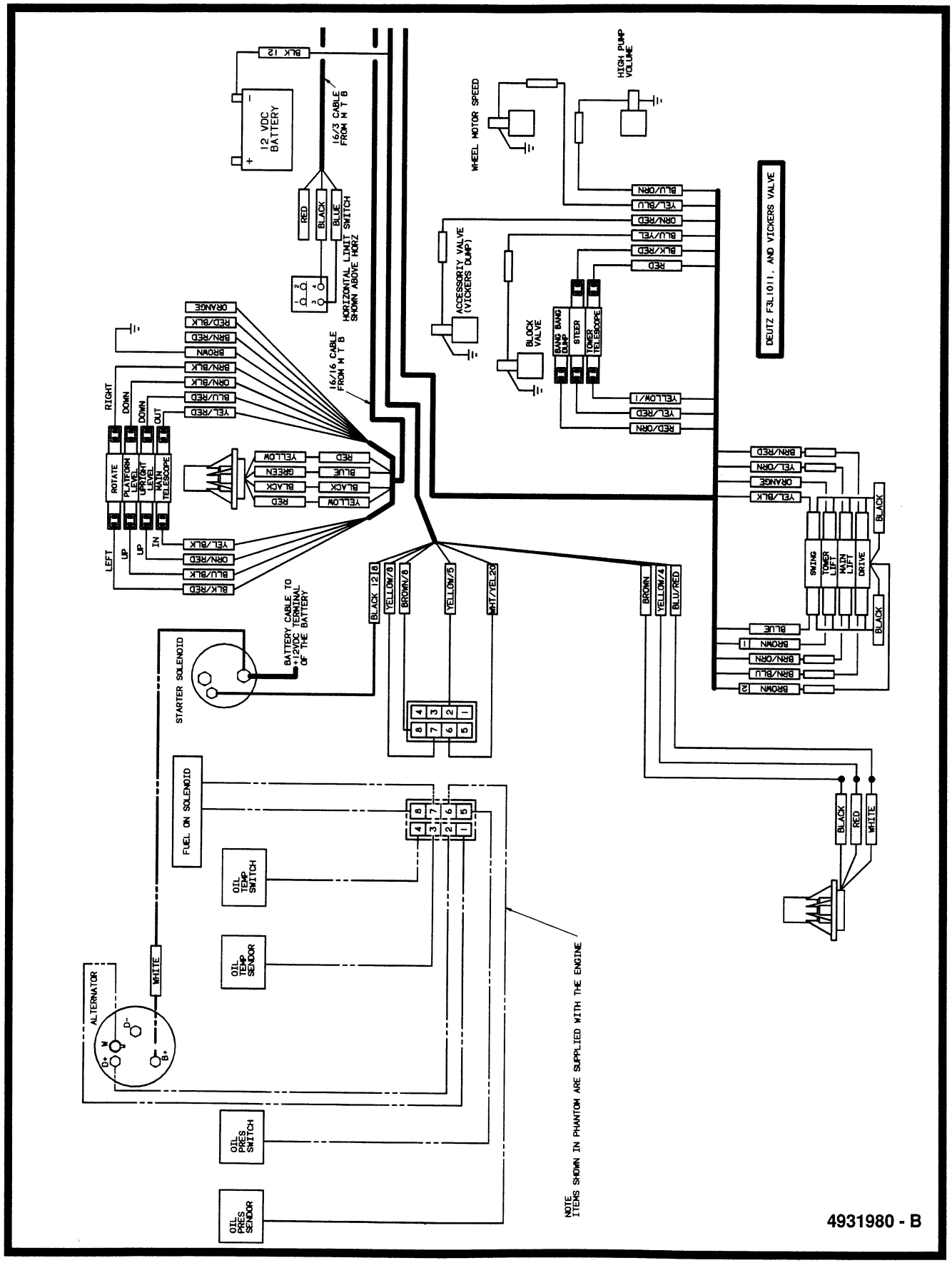


Figure 3-4. Electrical Diagram - Engine & Valve (Deutz).

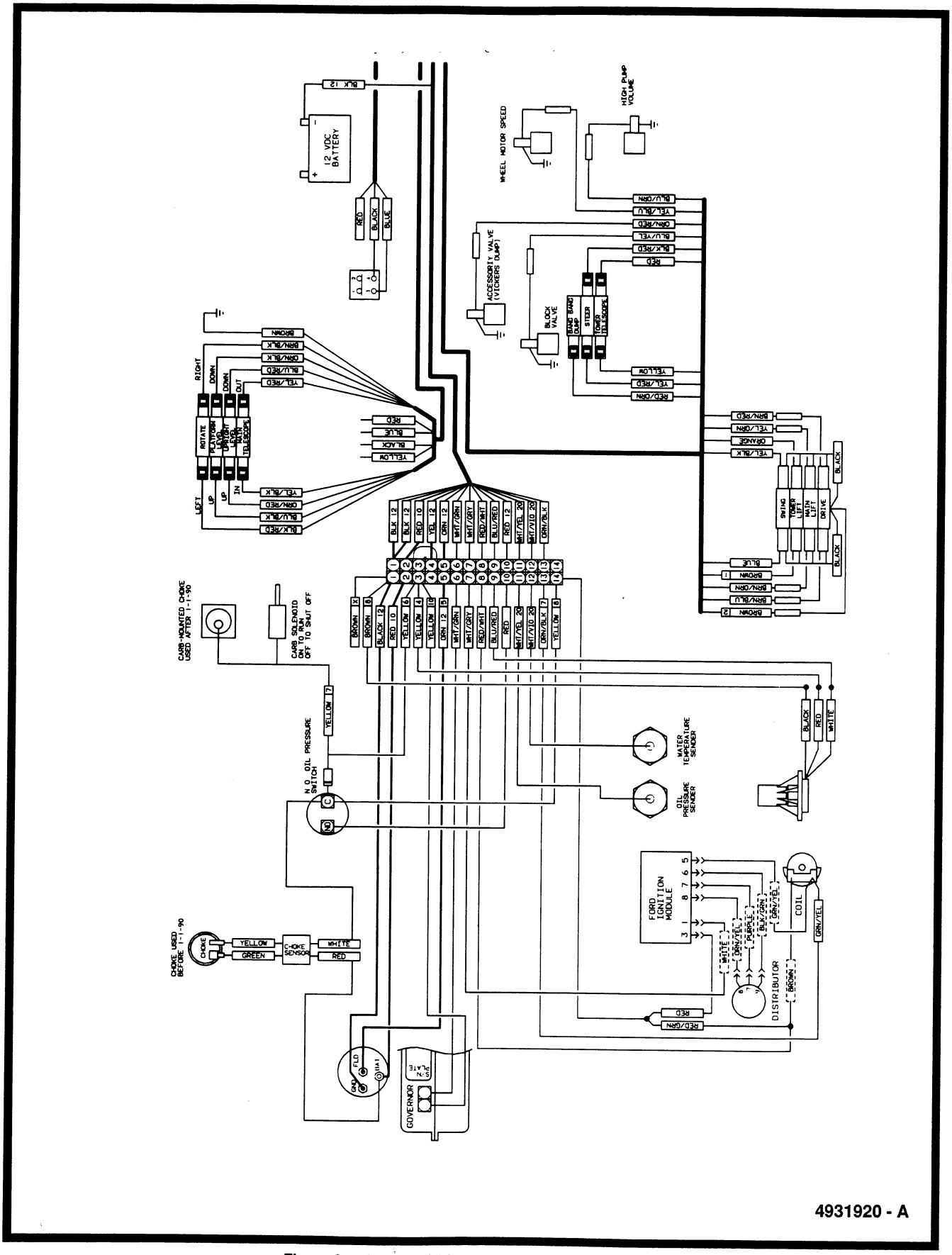


Figure 3-5. Electrical Diagram - Engine & Valve (Ford).

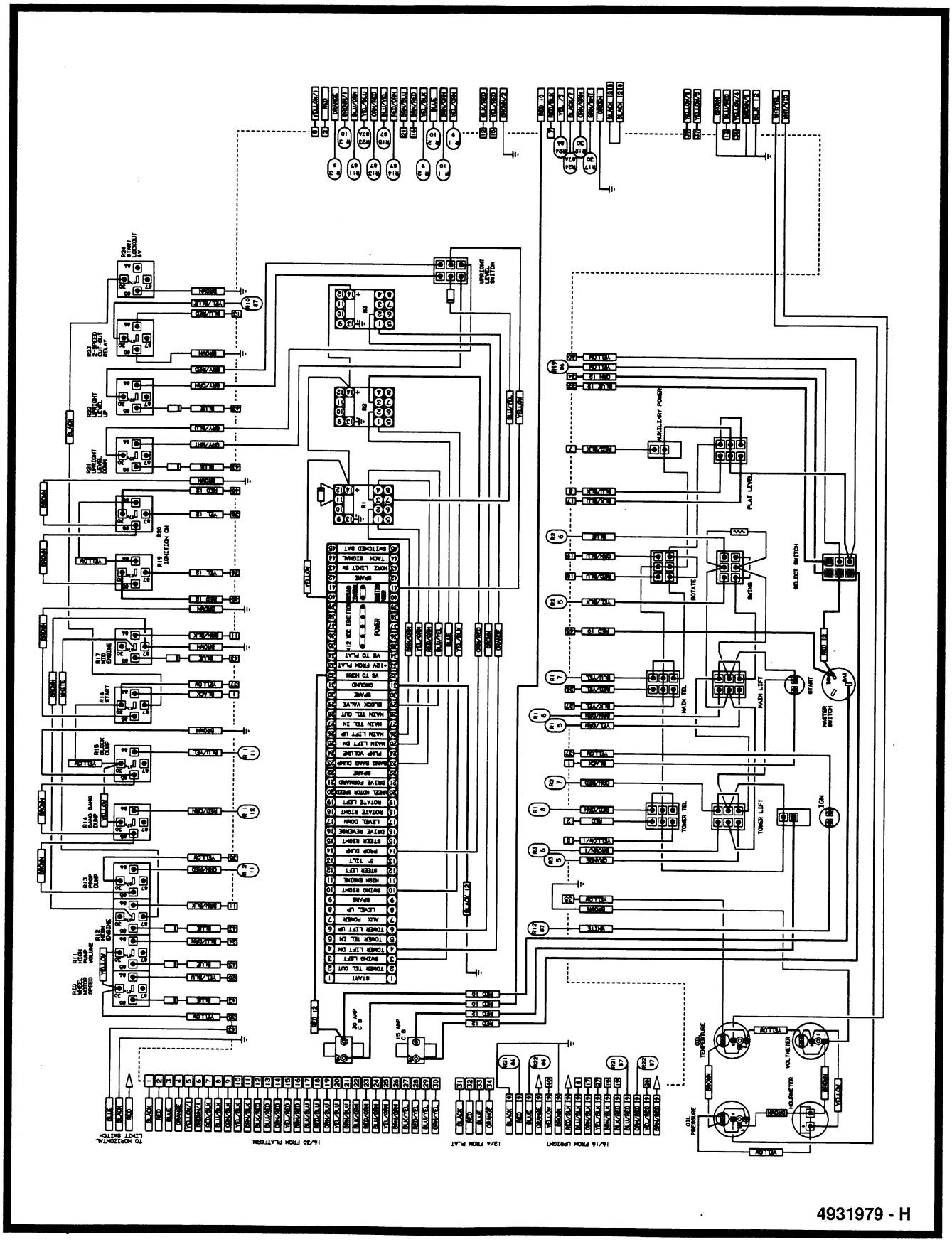


Figure 3-6. Electrical Diagram - Ground Control Box (Deutz) - (Sheet 1 of 2).

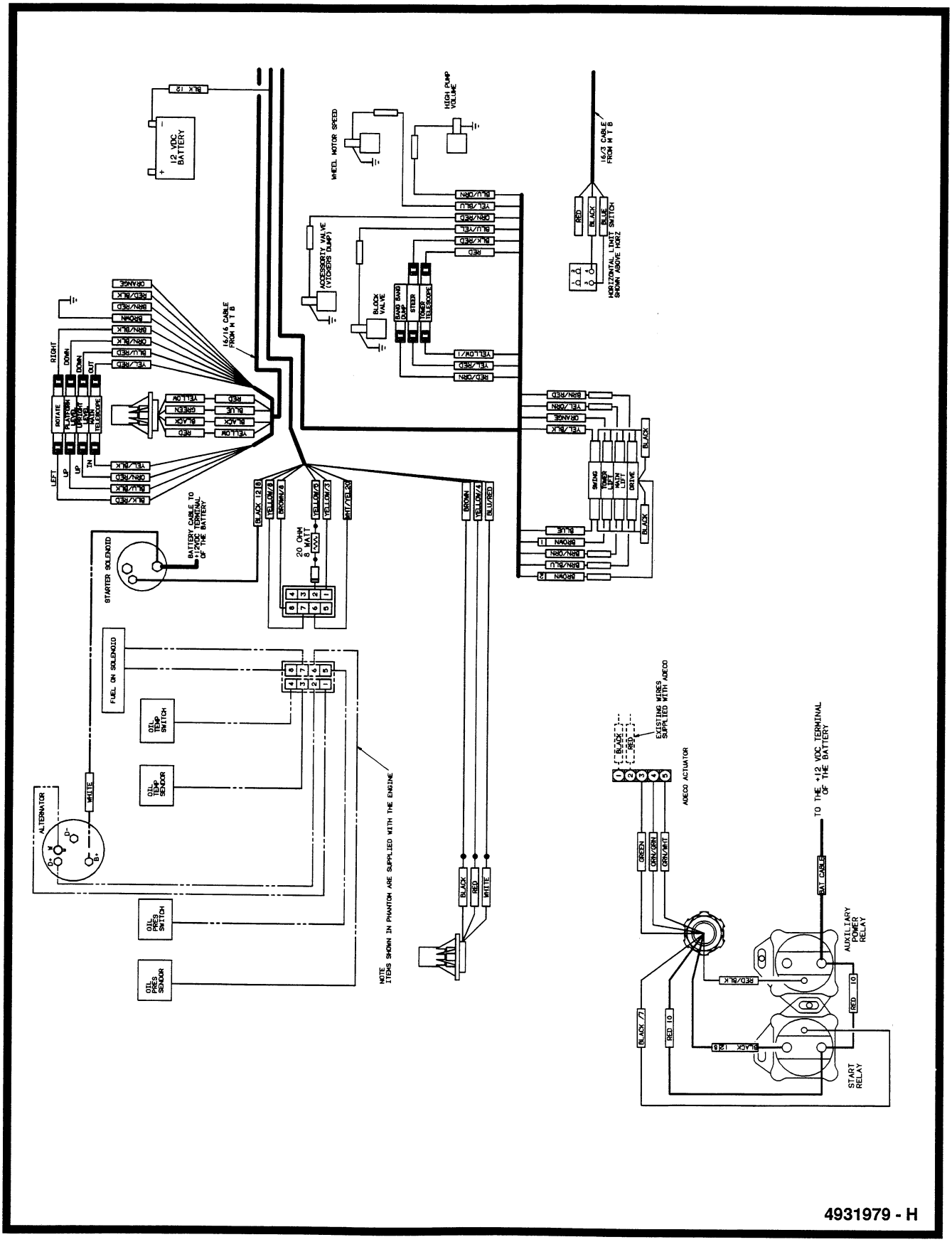


Figure 3-6. Electrical Diagram - Ground Control Box (Deutz) - (Sheet 2 of 2).

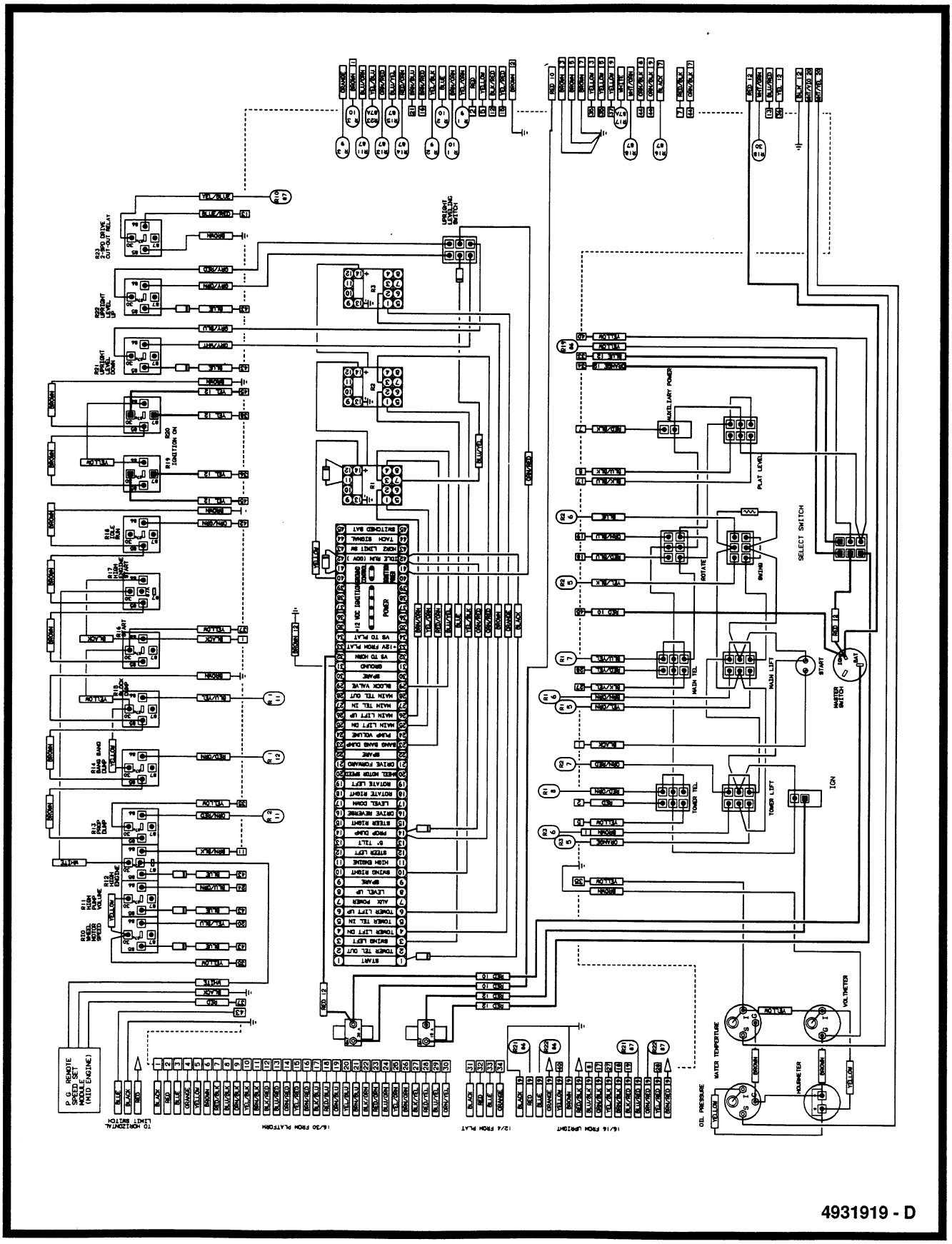


Figure 3-7. Electrical Diagram - Ground Control Box (Ford) - (Sheet 1 of 2).

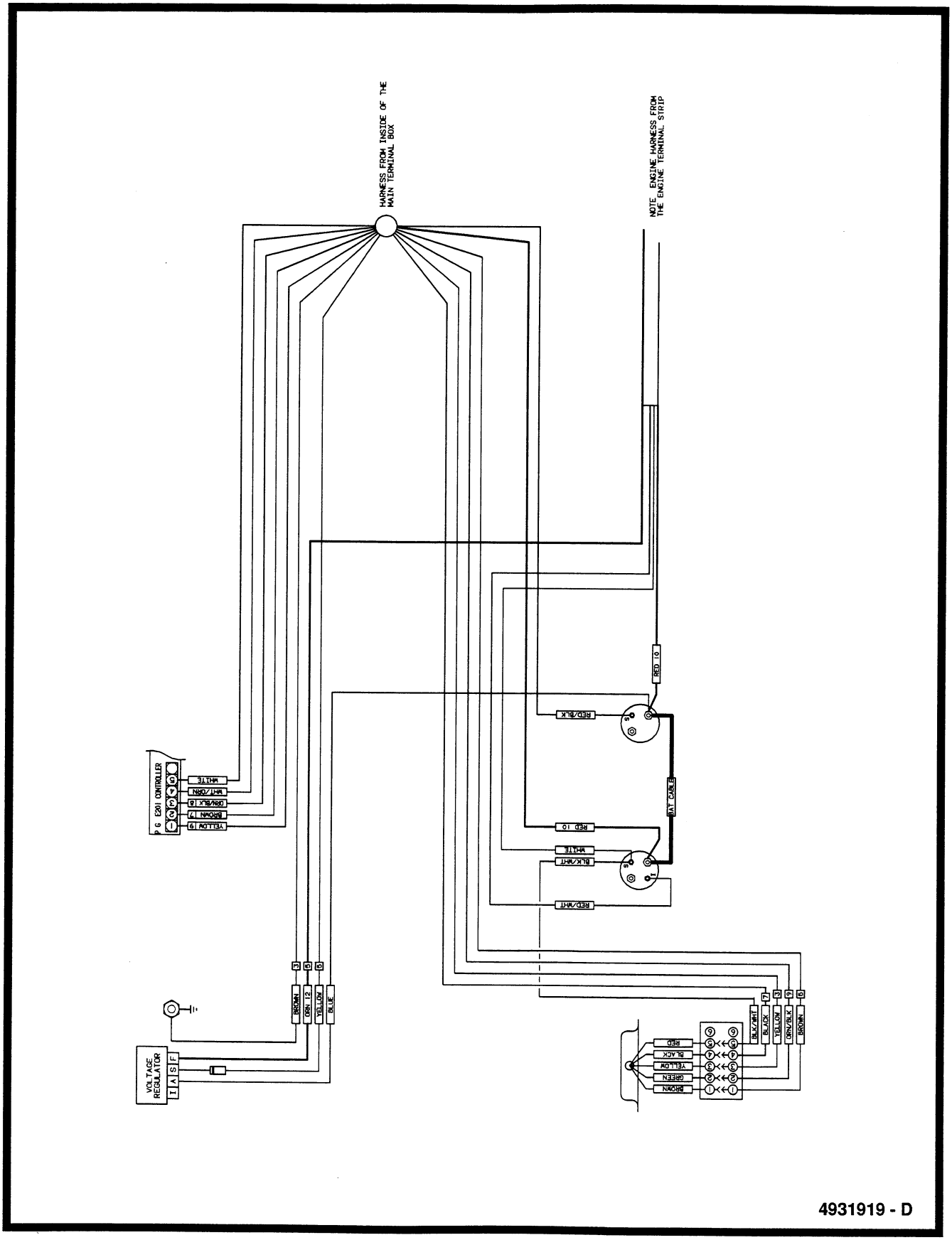
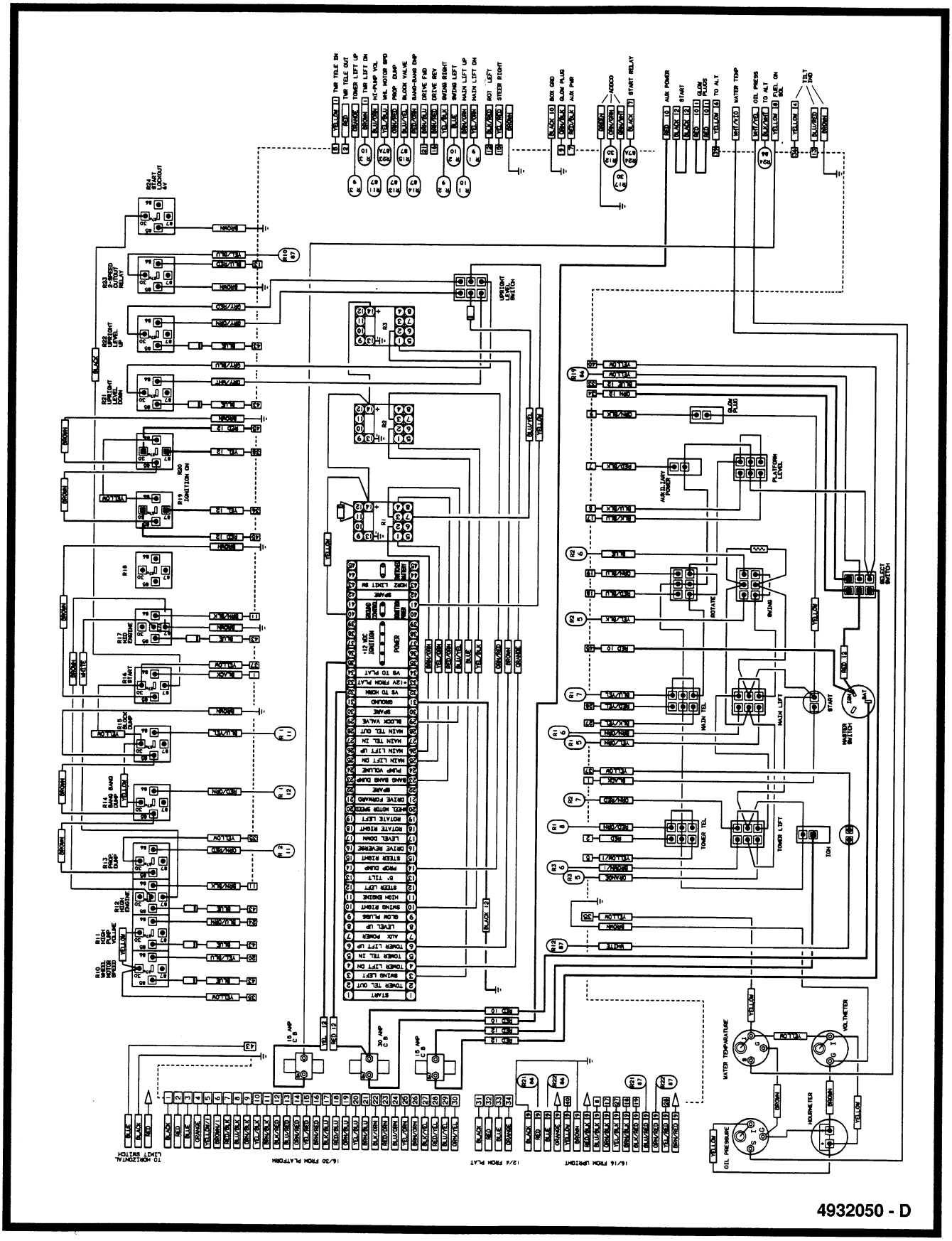


Figure 3-7. Electrical Diagram - Ground Control Box (Ford) - (Sheet 2 of 2).



Figuren 3-8. Electrical Diagram - Ground Control Box (Kubota) - (Sheet 1 of 2).

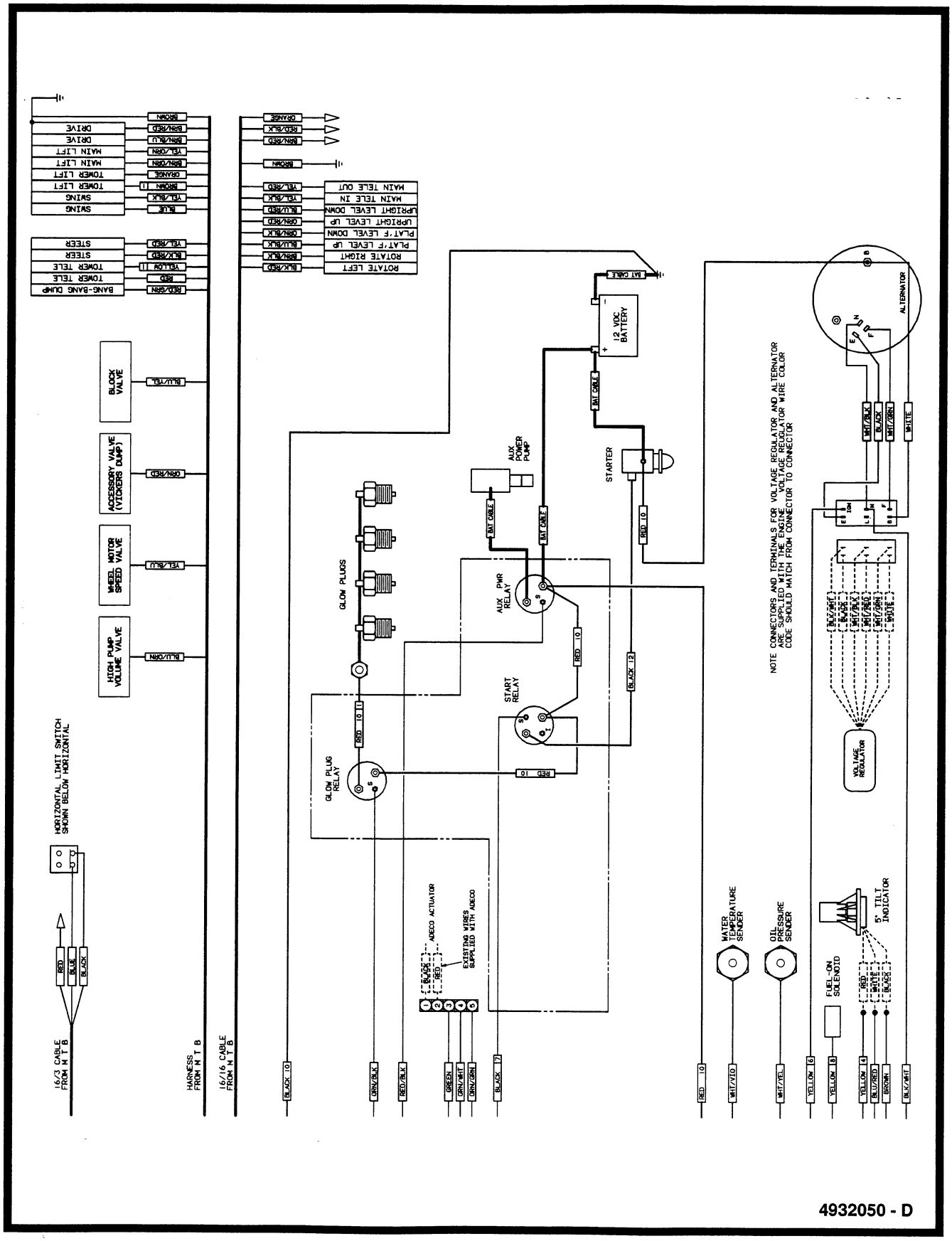


Figure 3-8. Electrical Diagram - Ground Control Box (Kubota) - (Sheet 2 of 2).

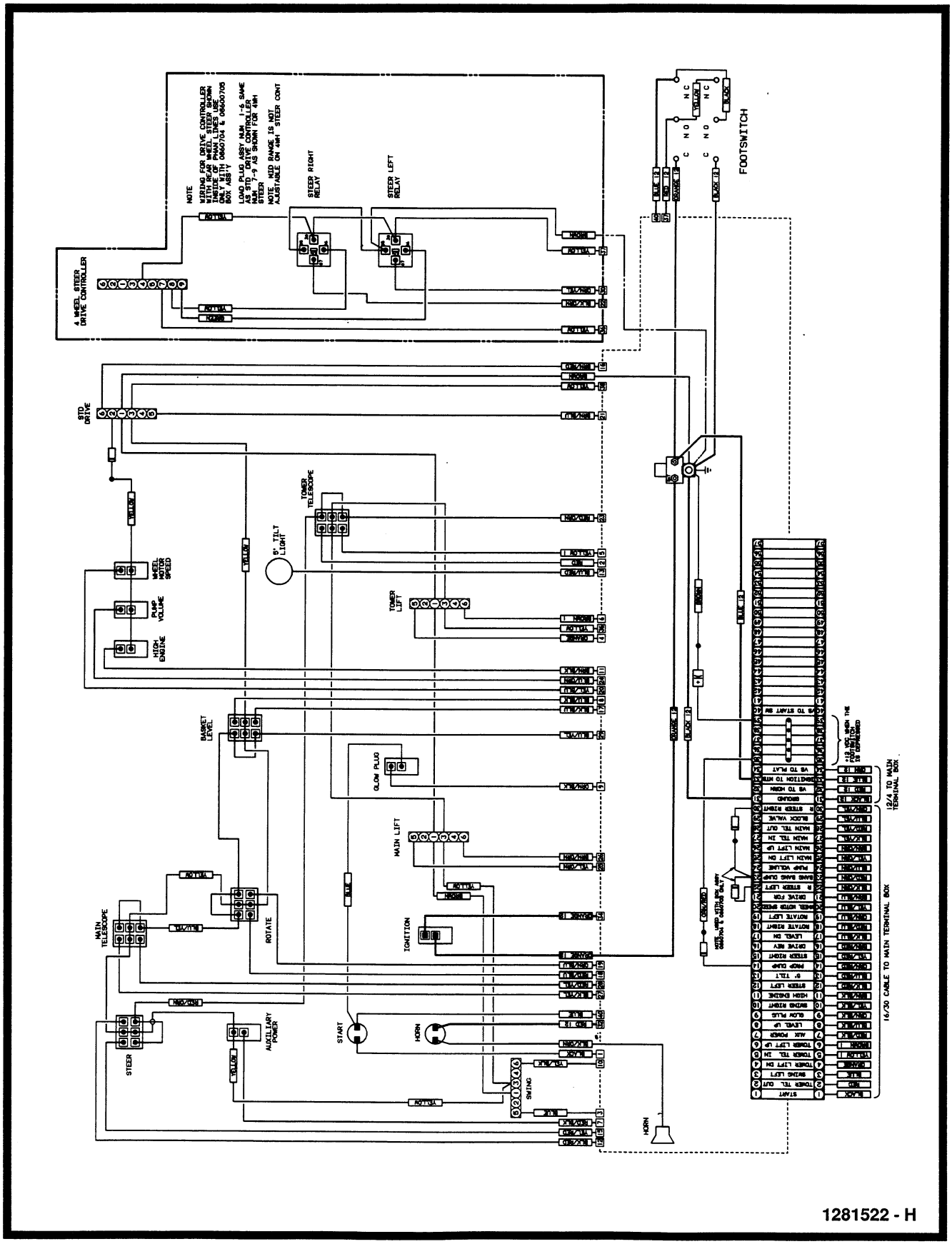


Figure 3-9. Electrical Diagram - Platform Console (PQ Controllers).

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