Service & Maintenance Manual

Model
3394RT
4394RT

3121133

October 4, 2005

ANSI

CE

ISO9001 REGISTERED COMPANY

UKAS QUALITY MANAGEMENT 015

SECTION A. INTRODUCTION - MAINTENANCE SAFETY PRECAUTIONS

A.A GENERAL

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

⚠ WARNING

MODIFICATION OF THE MACHINE WITHOUT APPROVAL BY JLG IND INC, IS A SAFETY VIOLATION.

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

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

⚠ WARNING

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

A.B HYDRAULIC SYSTEM SAFETY

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

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

A.C MAINTENANCE

⚠ WARNING

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

- No smoking is mandatory. never refuel during electrical storms. ensure that fuel cap is closed and secure at all other times.
- Remove all rings, watches and jewelry when performing any maintenance.
- Do not wear long hair unrestrained, or loose-fitting clothing and neckties which are apt to become caught on or entangled in equipment.
- Observe and obey all warnings and cautions on machine and in service manual.
- Keep oil, grease, water, etc. wiped from standing surfaces and hand holds.
- Use caution when checking a hot, pressurized coolant system.
- Never work under an elevated sizzor until platform has been safely restrained from any movement by blocking or overhead sling, or boom safety prop has been engaged.
- Before making adjustments, lubricating or performing any other maintenance, shut off all power controls.
- Battery should always be disconnected during replacement of electrical components.
- Keep all support equipment and attachments stowed in their proper place.
- Use only approved, nonflammable cleaning solvents.

REVISON LOG

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1.1 SPECIFICATIONS

Table 1-1. Operating Specifications

Model	3394RT	4394RT
Maximum Occupants	6	
Maximum Workload (Capacity): Single Extension: Dual Extension: Extension Only:	2250 lbs (1020 kg) 2000 lbs (905 kg) 500 lbs (230 kg)	1500 lbs (680 kg) 1250 lbs (565 kg) 500 lbs (230 kg)
Maximum Travel Grade (Gradeability See Figure 4-1): 2 WD 4WD	35% 45%	
Maximum Travel Grade (Sideslope - See Figure 4-1) :	3°	
Maximum Platform Height	33 ft	43 ft
Maximum Drive Speed 2 WD Maximum Drive Speed 4WD	3.0 mph (4.8 kph) 3.5 mph (5.6 kph)	3.0 mph (4.8 kph) 3.5 mph (5.6 kph)
LIft Up Speed (Stowed to Full Height)	29 - 31 sec	40 - 45 sec
Lift Down Speed (Full Height to Stowed)		
Maximum Wind Speed	28 mph (12.5 m/s)	
Maximum Manual Force	Reference Decal on Machine	
Maximum Tire Load	Reference Decal on Machine	
Ground Bearing Pressure 12 x 16.5 (pneumatic) 31 x 15.5 (pneumatic)	 116 psi(8.2 kg/cm^2) 169 psi (11.9 kg/cm^2)	
Leveling Jack Bearing Pressure	69 psi (4.9 kg/cm^2)	
Wheelbase	9.67 ft (2.95 m)	
Ground Clearance	12 in (30 cm)	
Maximum Hydraulic System Pressure	3000 psi (207 bar)	
Electrical System Voltage	12 Volt	
Inside Turning Radius	14 ft 5 in (4.39 m)	
Outside Turning Radius	20 ft 1 in (6.12 m)	

Capacities

Table 1-2. Capacities

Fuel Tank	31.5 gal (119 l)
Hydraulic Tank	40 gal (151 l)

1.2 COMPONENT DATA

Engines

Table 1-3. Ford LRG-425 Specifications

Fuel	Gasoline
Oil Capacity	4.5 Quarts (4.25 L) w/Filter
Idle RPM	1000
Low RPM	1800
High RPM	2800
Alternator	40 Amp, Belt Drive
Battery	112 Amphour, 950 Cold Cranking Amps, 12 VDC
Fuel Consumption Low RPM High RPM	 3.45 GPH (13.06 lph) 4.60 GPH (17.41 lph)
Horsepower	54 @ 2400 RPM, full load
Cooling System	16 Quarts (15.14 L)
Spark Plug	AWSF-52-C
Spark Plug Gap	0.044 in. (1.117 mm)

Table 1-4. Deutz F3M2011 Specifications

Fuel	DIesel
Oil Capacity	8.5 Quarts (8 L) w/Filter
Low RPM	900
High RPM	2800
Alternator	95 Amp, Belt Drive
Battery	112 Amphour, 950 Cold Cranking Amps, 12 VDC
Fuel Consumption Low RPM High RPM	 1.3 GPH (4.9 lph) 1.6 GPH (6.0 lph)
Horsepower	48 @ 2800 RPM, full load

Tires

Size	12 x 16.5 Pneumatic	12 x 16.5 Foam Filled	33/1550-16.5 Pneumatic	33/1550 x 16.5 Foam Filled	33/16LLx16.1 Foam Filled - Sand	12 x 16.5 Pneumatic (Non-Marking)
Ply Rating	10	10	12	12	10	10
Inflation Pressure	90 psi (6.3 kg/cm^2)	--	90 psi (6.3 kg/cm^2)	--	--	90 psi (6.3 kg/cm^2)
Wheel Nut Torque	170 ft lbs (238 Nm)					

Gross Machine Weight

Model	3394RT	4394RT
Single Extension, No Leveling Jacks, Pneumatic Tires (DOM)	11,910 lbs (5,402 kg)	15,240 lbs (6,913 kg)
Single Extension, Leveling Jacks, Pneumatic Tires (DOM)	12,810 lbs (5,810 kg)	15,140 lbs (6,867 kg)
Single Extension, No Leveling Jacks, Foam Filled Tires (DOM)	12,910 lbs (5,856 kg)	15,240 lbs (6,913 kg)
Single Extension, Leveling Jacks, Foam Filled Tires (DOM)	13,810 lbs (6,264 kg)	15,140 lbs (6,867 kg)
Dual Extension, No Leveling Jacks, Pneumatic Tires (DOM)	12,350 lbs (5,602 kg)	15,680 lbs (7,112 kg)
Dual Extension, Leveling Jacks, Pneumatic Tires (DOM)	13,250 lbs (6,010 kg)	15,580 lbs (7,067 kg)
Dual Extension, No Leveling Jacks, Foam Filled Tires (DOM)	13,350 lbs (6,055 kg)	15,680 lbs (7,112 kg)
Dual Extension, Leveling Jacks, Foam Filled Tires (DOM)	14,250 lbs (6,464 kg)	15,580 lbs (7,067 kg)
Single Extension,No Leveling Jacks, Foam Filled Tires (CE/ AUS)	12,900 lbs (5,851 kg)	15,140 lbs (6,913 kg)
Single Extension, Leveling Jacks, Foam Filled Tires (CE/ AUS)	13,800 lbs (6,260 kg)	15,140 lbs (6,867 kg)
Dual Extension, No Leveling Jacks, Foam Filled Tires (CE/ AUS)	13,440 lbs (6,096 kg)	15,680 lbs (7,112 kg)
Dual Extension, Leveling Jacks, Foam Filled Tires (CE/ AUS)	14,240 lbs (6,460 kg)	16,580 lbs (7,521 kg)

Machine Dimensions

	3394RT	4394RT
Machine Height (rails down)	61.75 in (1.6 m)	70.4 in (1.8 m)
Machine Width	7ft 10in (2.4 m)	
Machine Length	13 ft (4 m)	

1.3 TORQUE REQUIREMENTS

All wheel lugs must be torqued at 170 ft lbs (238 Nm) every 50 hours.

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

1.4 PRESSURE SETTINGS

Table 1-5. Pressure Settings

	PSI	Bar
Main Relief	3000	207
Steer Relief	2800	193
Lift	2700	186
Leveling Jack Relief	2500	172

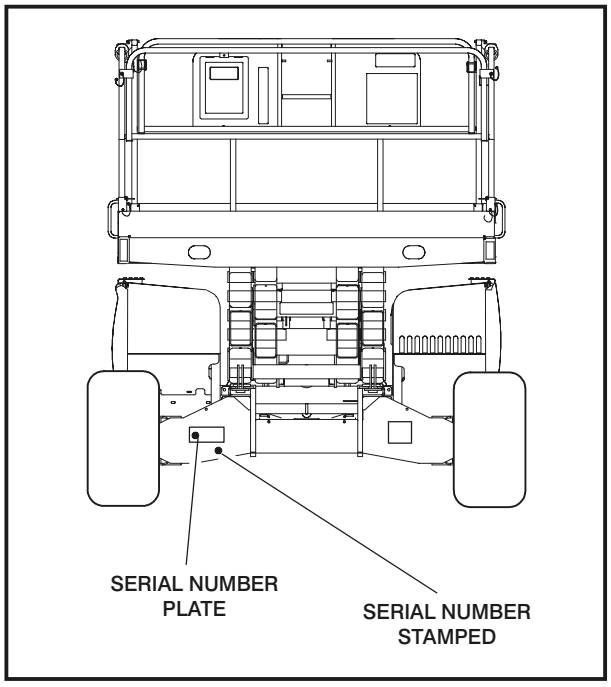


Figure 1-1. Serial Number Location

1.5 SERIAL NUMBER LOCATIONS

For machine identification, a serial number plate is affixed to the machine. The plate is located at the rear of the machine on the left side of the axle. In addition, should the serial number plate be damaged or missing, the machine serial number is stamped directly under the seriel number plate.

1.6 SENSORS

The machine is equipped with the following limit switches:

Elevation Switch/Roatary Position Sensor - High drive speed is cut out when platform is raised above the preset heights listed in Table 1-6, High Drive Cut-Out Height.

Table 1-6. High Drive Cut-Out Height

Model	Feet	Meters
3394RT	6-9	1.8 - 2.7
4394RT	7-10	2.1 - 3

Tilt Alarm - An alarm is sounds and a warning light is illuminated when the machine is operated on a slope that exceeds the values in Table 1-7, Tilt Cut-Out. The lift and drive functions will cut out at these set heights.

NOTE: *Alarm only sounds when above elevation.*

NOTE: *If the machine is operated beyond the specified slope, with the platform completely lowered, only the warning light is illuminated.*

Table 1-7. Tilt Cut-Out

Model	Front To Back	Side To Side
3394RT (Australia)	5°	5° up to 26 feet 4° 26-30 feet 3 ° 30-33 feet
4394RT (Australia)	5°	5° up to 30 feet 4° 30-36 feet 3° 36-43 feet
3394RT/4394RT(CSA)	3°	3°

1.7 CYLINDER SPECIFICATIONS

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

Table 1-8. Cylinder Specifications

Description	Bore	Stroke	Rod Dia
Lift Cylinder	4.5 (11.4)	83 (211)	3.5 (8.9
Leveling Jack Cylinder	3.0 (7.6)	21.5 (54.6)	2.0 (5.0)
Lockout Cylinder (Oscillating Axle)	2.5 (6.4)	6.0 (15.2)	1.75 (4.4)
Power Deck Extension Cylinders	1.5 (3.8)	48 (122.0)	1.0 (2.5)
Steer Cylinder	2.5 (6.4)	4.6 (11.17	1.75 (4.4)

1.8 MAJOR COMPONENT WEIGHTS

Table 1-9. Major Component Weights

Component	Lb	Kg
Fixed Platform	1070	485
Platform Extension	440	200
Arm Assembly- (Includes Lift Cylinder) 3394RT 4394RT	 3600 4550	 1633 2064
Chassis with Pneumatic Tires 3394RT 4394RT	 6790 9080	 3080 4119
Chassis with Foam Filled Tires 3394RT 4394RT	 7788 9086	 3533 4121

1.9 CRITICAL STABILITY WEIGHTS

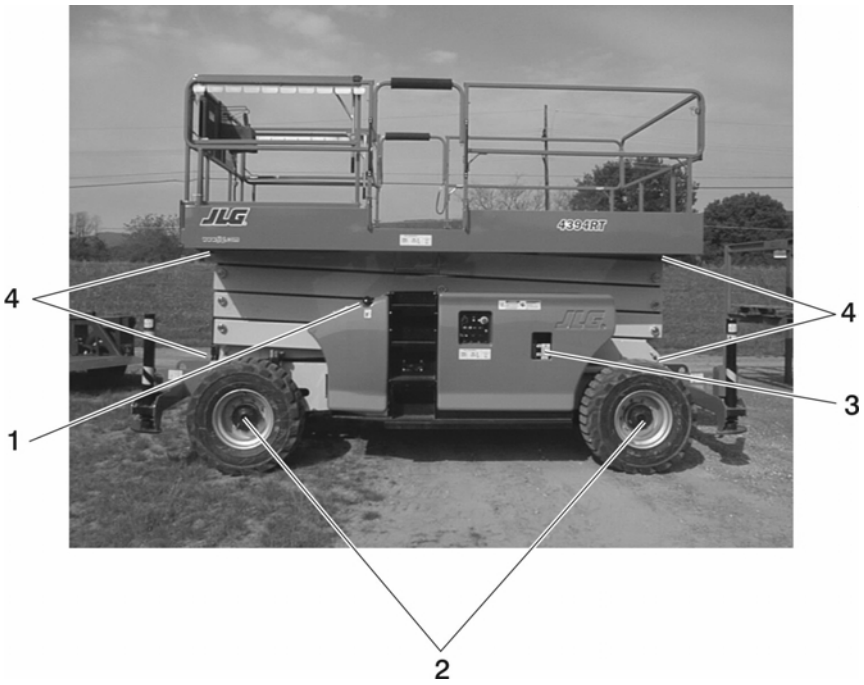
⚠ WARNING

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

Table 1-10. Critcal Stability Weights

Component	Lb	Kg
Tires 12 x 16.5 Pneumatic 12 x16.5 Foam Filled 33/1550-16.5 Pneumatic 33/1550-16.5 Foam Filled 33/16LL x 16.1 Foam Filled - Sand	 132 352 162 410 426	 60 160 73 186 193
Engine (Ford)	525	238
Engine (Deutz)	675	306

1.10 LUBRICATION



1. Fuel Tank
2. Drive Hubs
3. Hydraulic Oil Tank
4. Sliding Wear Pads

Figure 1-2. Lubrication Diagram

⚠ WARNING

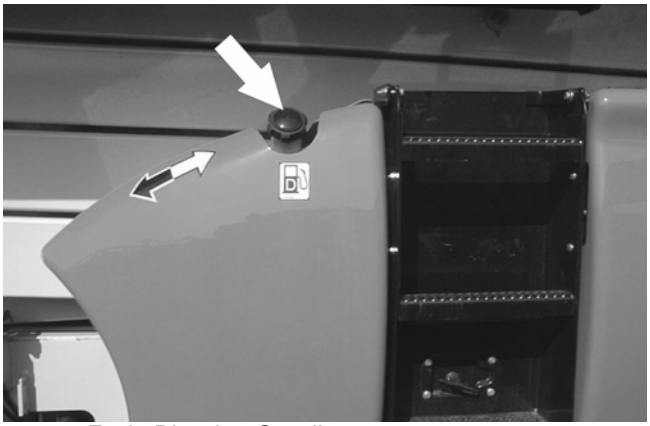
AVOID PERSONAL INJURY, USE SAFETY PROP FOR ALL MAINTENANCE REQUIRING THE PLATFORM TO BE ELEVATEDE.

Table 1-11. 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.
EO	Engine (crankcase) Oil. Gas - API SF/SG class, MIL-L-2104. Diesel - API CC/CD class, MIL-L-2104B/MIL-L-2104C.
HO	Hydraulic Oil. API service classification GL-3, e.g. Mobil 424.

NOTE: ***1.*** *Be sure to lubricate like items on each side*
2. *Recommended lubricating intervals are based on machine operations under normal conditions. For machines used in multi-shift operations and/or exposed to hostile environments or conditions, lubrication frequencies must be increased accordingly.*

1. Fuel Tank

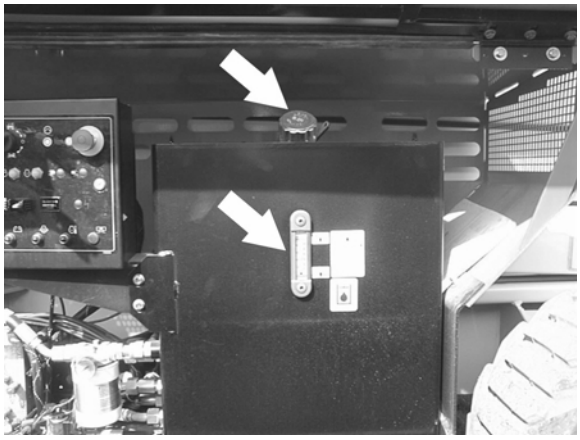


Fuel - Diesel or Gasoline
Capacity - 31.5 gal (119 l)

2. Drive Hub

Lube Points - Fill Plugs (4)
Lube - EPGL
Interval - Every 2 years or 1200 hours

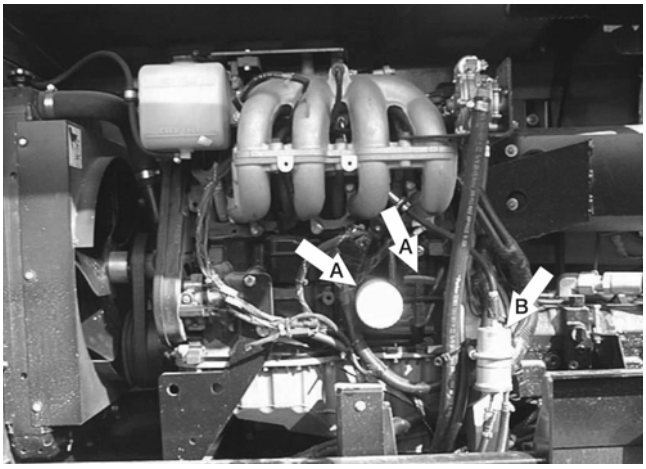
3. Hydraulic Oil



Lube Point - Fill Cap/Fill Level
Lube - HO
Interval - Check oil every 10 hours of operation; change oil every 2 years or 1200 hours of operation.

4. Sliding Wear Pads
Lube Points - 8 Sliding Wear Pads
Lube - MPG
Interval - Every month or 50 hours.

5. Engine Compartment - (Opposite Side - Not Shown)



a. Engine Oil Check/Fill
Capacity - See Engine Manual
Lube - See Engine Manual
Interval - Check level daily; change per manufacturer's engine manual.

b. Fuel Filter
Lube Point - Filter Element
Interval - Clean every 3 months or 150 hours; change every 6 months or 300 hours.

Ford LRG425 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
(-24°C. to +16°C.)	*10W
+10°F. to +90°F	*10W
(+12°C. to +32°C.)	20W-20
Above +32°F. (+0°C.)	30
Above +50°F. (+10°C.)	40

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

*Not recommended for severe service, including high RPM operation

When Outside Temperature is Consistently	Use SAE Viscosity Number
Below +10°F. (+12°C.)	*5W-20
Below +60°F. (+16°C.)	5W-30
-10°F. to +90°F. (-23°C. to +32°C.)	10W-30
Above -10°F. (-23°C.)	10W-40 or 10W-50
Above +20°F. (+7°C.)	20W-40 or 20W-50

*Not recommended for severe service, including high RPM operation

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

Deutz F3M1011F Engine

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

When Outside Temperature is Consistently	Use SAE Viscosity Number
-20°F. to +25°F. (-29°C. to +4°C.)	*10W-30
+5°F. to +50°F. (+15°C. to +10°C.)	20W-50
+40°F. to +85°F. (+4°C. to +30°C.)	30
Above 75°F. (24°C.)	40

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

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

When Outside Temperature is Consistently	Use SAE Viscosity Number
-40°F. to +75°F. (-40°C. to +24°C.)	*5W-30
-15°F. to +70°F. (-26°C. to +21°C.)	5W-30
-15°F. to +85°F. (-26°C. to +30°C.)	5W-40
Above -5°F. (-21°C.)	5W-40
-5°F. to +75°F. (-21°C. to +24°C.)	5W-30

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

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

Lubrication Specifications

Table 1-12. Hydraulic Oil

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

NOTE: *Hydraulic oils must have anti-wear qualities at least to API Service Classification GL-3, and sufficient chemical stability for mobile hydraulic system service. JLG Industries recommends Mobilfluid 424 hydraulic oil, which has an SAE viscosity index of 152 .*

Table 1-13. Mobil DTE 13M Specs

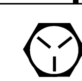
ISO Viscosity Grade	#32
Specific Gravity	0.877
Pour Point, Max	-40˚F (-40˚C)
Flash Point, Min.	330˚F (166˚C)
Viscosity	
at 40° C	33cSt
at 100° C	6.6 cSt
at 100° F	169 SUS
at 210° F	48 SUS
cp at -20° F	6,200
Viscosity Index	140

Table 1-14. Mobil EAL 224H Specs

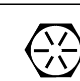
Type	Synthetic Biodegradable
ISO Viscosity Grade	32/46
Specific Gravity	.922
Pour Point, Max	-25°F (-32°C)
Flash Point, Min.	428°F (220°C)
Operating Temp.	0 to 180°F (-17 to 162°C)
Viscosity	
at 40° C	37 cSt
at 100° C	8.4 cSt
Viscosity Index	213
NOTE: *Must be stored above 32°F (14°C)*	

SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY										UNPLATED CAP SCREWS		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS					UNBRAKO 1960 SERIES SOCKET HEAD		
				CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE	
					DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH
		IN	SQ. IN.	LB.	IN-LB	IN-LB	IN-LB	IN-LB	LB.	IN-LB.	IN-LB	IN-LB	IN-LB	LB.	IN-LB	IN-LB
4	40	0.1120	0.00604	380	8	6	—	—	540	12	9	—	—	—	—	—
	48		0.00661	420	9	7	—	—	600	13	10	—	—	—	—	—
6	32	0.1380	0.00909	580	16	12	—	—	820	23	17	—	—	—	—	—
	40		0.01015	610	18	13	—	—	920	25	19	—	—	—	—	—
8	32	0.1640	0.01400	900	30	22	—	—	1260	41	31	—	—	—	—	—
	36		0.01474	940	31	23	—	—	1320	43	32	—	—	—	—	—
10	24	0.1900	0.01750	1120	43	32	—	—	1580	60	45	—	—	—	—	—
	32		0.02000	1285	49	36	—	—	1800	68	51	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	96	75	—	105	2860	144	108	—	160	3180	160	168
	28		0.0364	2320	120	86	—	135	3280	168	120	—	185	3640	168	178
		IN	SQ. IN.	LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB	FT-LB	FT-LB	LB.	FT-LB	FT-LB
5/16	18	0.3125	0.0524	3340	17	13	16	19	4720	25	18	22	30	5240	25	28
	24		0.0580	3700	19	14	17	21	5220	25	20	25	30	5800	27	30
3/8	16	0.3750	0.0775	4940	30	23	28	35	7000	45	35	40	50	7750	45	50
	24		0.0878	5600	35	25	32	40	7900	50	35	45	55	8780	50	55
7/16	14	0.4375	0.1063	6800	50	35	45	55	9550	70	55	63	80	10630	70	77
	20		0.1187	7550	55	40	50	60	10700	80	60	70	90	11870	75	82
1/2	13	0.5000	0.1419	9050	75	55	68	85	12750	110	80	96	120	14190	110	120
	20		0.1599	10700	90	65	80	100	14400	120	90	108	130	15990	115	127
9/16	12	0.5625	0.1820	11600	110	80	98	120	16400	150	110	139	165	18200	155	170
	18		0.2030	12950	120	90	109	135	18250	170	130	154	190	20300	165	182
5/8	11	0.6250	0.2260	14400	150	110	135	165	20350	220	170	180	240	22600	210	231
	18		0.2560	16300	170	130	153	190	23000	240	180	204	265	25600	220	242
3/4	10	0.7500	0.3340	21300	260	200	240	285	30100	380	280	301	420	33400	365	400
	16		0.3730	23800	300	220	268	330	33600	420	320	336	465	37300	400	440
7/8	9	0.8750	0.4620	29400	430	320	386	475	41600	600	460	485	660	46200	585	645
	14		0.5090	32400	470	350	425	520	45800	660	500	534	725	50900	635	700
1	8	1.0000	0.6060	38600	640	480	579	675	51500	900	680	687	990	60600	865	950
	12		0.6630	42200	700	530	633	735	59700	1000	740	796	1100	66300	915	1000
1-1/8	7	1.1250	0.7630	42300	800	600	714	840	68700	1280	960	1030	1400	76300	1240	1365
	12		0.8560	47500	880	660	802	925	77000	1440	1080	1155	1575	85600	1380	1520
1-1/4	7	1.2500	0.9690	53800	1120	840	1009	1175	87200	1820	1360	1453	2000	96900	1750	1925
	12		1.0730	59600	1240	920	1118	1300	96600	2000	1500	1610	2200	107300	1880	2070
1-3/8	6	1.3750	1.1550	64100	1460	1100	1322	1525	104000	2380	1780	1907	2625	115500	2320	2550
	12		1.3150	73000	1680	1260	1506	1750	118100	2720	2040	2165	3000	131500	2440	2685
1-1/2	6	1.5000	1.4050	78000	1940	1460	1755	2025	126500	3160	2360	2530	3475	140500	3040	3345
	12		1.5800	87700	2200	1640	1974	2300	142200	3560	2660	2844	3925	158000	3270	3600

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



SAE GRADE 5



SAE GRADE 8

Figure 1-3. Torque Chart - (In/Lb - Ft/Lb). (For ASTM Fasteners)

				VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY										UNPLATED CAP SCREWS		
				SAE GRADE 5 BOLTS & GRADE 2 NUTS					SAE GRADE 8 BOLTS & GRADE 8 NUTS & SOCKET HEAD CAP SCREWS					UNBRAKO 1960 SERIES SOCKET HEAD		
					TORQUE					TORQUE					TORQUE	
SIZE	THDS. PER INCH	BOLT DIA.	TENSILE STRESS AREA	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271	CLAMP LOAD	WITHOUT LOC-WEL PATCH	WITH LOC-WEL PATCH
		IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m
4	40	0.1120	0.00604	380	.8	.8	—	—	540	1.4	1.0	—	—	—	—	—
	48		0.00661	420	1.0	.8	—	—	600	1.5	1.0	—	—	—	—	—
6	32	0.1380	0.00909	580	1.8	1.4	—	—	820	2.6	2.0	—	—	—	—	—
	40		0.01015	610	2.0	1.6	—	—	920	2.8	2.2	—	—	—	—	—
8	32	0.1640	0.01400	900	3.4	2.4	—	—	1260	4.6	3.4	—	—	—	—	—
	36		0.01474	940	3.4	2.6	—	—	1320	5	3.6	—	—	—	—	—
10	24	0.1900	0.01750	1120	5	3.6	—	—	1580	7	5	—	—	—	—	—
	32		0.02000	1285	6	4	—	—	1800	8	6	—	—	—	—	—
1/4	20	0.2500	0.0318	2020	11	8	—	12	2860	16	12	—	18	3180	18	19
	28		0.0364	2320	14	10	—	15	3280	19	14	—	21	3640	19	20
		IN	SQ. IN.	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m	N, m	N, m	LB.	N, m	N, m
5/16	18	0.3125	0.0524	3340	23	18	22	26	4720	34	24	30	41	5240	34	38
	24		0.0580	3700	26	19	23	28	5220	34	27	34	41	5800	37	41
3/8	16	0.3750	0.0775	4940	41	31	38	47	7000	61	47	54	68	7750	61	68
	24		0.0878	5600	47	34	43	54	7900	68	47	61	75	8780	68	75
7/16	14	0.4375	0.1063	6800	68	47	61	75	9550	95	75	85	108	10630	95	104
	20		0.1187	7550	75	54	68	81	10700	108	81	95	122	11870	102	111
1/2	13	0.5000	0.1419	9050	102	75	92	115	12750	149	108	130	163	14190	149	163
	20		0.1599	10700	122	88	108	136	14400	163	122	146	183	15990	156	172
9/16	12	0.5625	0.1820	11600	149	108	133	163	16400	203	149	188	224	18200	210	230
	18		0.2030	12950	163	122	148	183	18250	230	176	209	258	20300	224	247
5/8	11	0.6250	0.2260	14400	203	149	183	224	20350	298	230	244	325	22600	285	313
	18		0.2560	16300	230	176	207	258	23000	325	244	277	359	25600	298	328
3/4	10	0.7500	0.3340	21300	353	271	325	386	30100	515	380	408	569	33400	495	542
	16		0.3730	23800	407	298	363	447	33600	569	434	456	630	37300	542	597
7/8	9	0.8750	0.4620	29400	583	434	523	644	41600	813	624	658	895	46200	793	874
	14		0.5090	32400	637	475	576	705	45800	895	678	724	983	50900	861	949
1	8	1.0000	0.6060	38600	868	651	785	915	51500	1220	922	931	1342	60600	1173	1288
	12		0.6630	42200	949	719	858	997	59700	1356	1003	1079	1491	66300	1241	1356
1-1/8	7	1.1250	0.7630	42300	1085	813	968	1139	68700	1735	1302	1396	1898	76300	1681	1851
	12		0.8560	47500	1193	895	1087	1254	77000	1952	1464	1566	2135	85600	1871	2061
1-1/4	7	1.2500	0.9690	53800	1518	1139	1368	1593	87200	2468	1844	1970	2712	96900	2373	2610
	12		1.0730	59600	1681	1247	1516	1763	96600	2712	2034	2183	2983	107300	2549	2807
1-3/8	6	1.3750	1.1550	64100	1979	1491	1792	2068	104000	3227	2413	2586	3559	115500	3145	3457
	12		1.3150	73000	2278	1708	2042	2373	118100	3688	2766	2935	4067	131500	3308	3640
1-1/2	6	1.5000	1.4050	78000	2630	1979	2379	2745	126500	4284	3200	3430	4711	140500	4122	4535
	12		1.5800	87700	2983	2224	2676	3118	142200	4827	3606	3856	5322	158000	4433	4881

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

Figure 1-4. Torque Chart (Metric Conversion) - (For ASTM Fasteners)

			VALUES FOR ZINC PLATED / YELLOW CHROMATE FASTENERS ONLY									
			CLASS 8.8 METRIC BOLTS & CLASS 8 METRIC NUTS					CLASS 10.9 METRIC BOLTS & CLASS 10 METRIC NUTS				
SIZE	PITCH	TENSILE STRESS AREA	CLAMP LOAD	TORQUE				CLAMP LOAD	TORQUE			
				DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271		DRY OR LOCTITE 263	LUB	LOCTITE 262	LOCTITE 242 OR 271
		sq. mm	KN	N, m	N, m	N, m	N, m	KN	N, m	N, m	N, m	N, m
3	.5	5.03	2.19	1.3	1.0	1.2	1.4	3.13	1.9	1.4	1.5	2.1
3.5	.6	6.78	2.95	2.1	1.6	1.9	2.3	4.22	3.0	2.2	2.4	3.3
4	.7	8.78	3.82	3.1	2.3	2.8	3.4	5.47	4.4	3.3	3.5	4.8
5	.8	14.2	6.18	6.2	4.6	5.6	6.8	8.85	8.9	6.6	7.1	9.7
6	1	20.1	8.74	11	7.9	9.4	12	12.5	15	11	12	17
7	1	28.9	12.6	18	13	16	19	18	25	19	20	28
8	1.25	36.6	15.9	25	19	23	28	22.8	37	27	29	40
10	1.5	58.0	25.2	50	38	45	55	36.1	72	54	58	79
12	1.75	84.3	36.7	88	66	79	97	52.5	126	95	101	139
14	2	115	50.0	140	105	126	154	71.6	200	150	160	220
16	2	157	68.3	219	164	197	241	97.8	313	235	250	344
18	2.5	192	83.5	301	226	271	331	119.5	430	323	344	473
20	2.5	245	106.5	426	320	383	469	152.5	610	458	488	671
22	2.5	303	132.0	581	436	523	639	189.0	832	624	665	915
24	3	353	153.5	737	553	663	811	220.0	1060	792	845	1170
27	3	459	199.5	1080	810	970	1130	286.0	1540	1160	1240	1690
30	3.5	561	244.0	1460	1100	1320	1530	349.5	2100	1570	1680	2310
33	3.5	694	302.0	1990	1490	1790	2090	432.5	2600	2140	2280	2860
36	4	817	355.0	2560	1920	2300	2690	509.0	3660	2750	2930	4020
42	4.5	1120	487.0	4090	3070	3680	4290	698.0	5860	4400	4690	6440

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

METRIC CLASS 8.8

METRIC CLASS 10.9

Figure 1-5. Torque Chart - (N, m) - (For Metric Class Fasteners).

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SECTION 2. GENERAL

2.1 MACHINE PREPARATION, INSPECTION, AND MAINTENANCE

General

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

Preparation, Inspection, and Maintenance

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

Pre-Start Inspection

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

Pre-Delivery Inspection and Frequent Inspection

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

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

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

Annual Machine Inspection

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

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

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

Preventative Maintenance

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

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

Table 2-1. Inspection and Maintenance

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

2.2 SERVICE AND GUIDELINES

General

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

Safety and Workmanship

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

Cleanliness

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

Components Removal and Installation

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

Component Disassembly and Reassembly

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

Pressure-Fit Parts

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

Bearings

1. When a bearing is removed, cover it to keep out dirt and abrasives. Clean bearings in nonflammable cleaning solvent and allow to drip dry. Compressed air can be used but do not spin the bearing.
2. Discard bearings if the races and balls (or rollers) are pitted, scored, or burned.
3. If bearing is found to be serviceable, apply a light coat of oil and wrap it in clean (waxed) paper. Do not unwrap reusable or new bearings until they are ready to install.
4. Lubricate new or used serviceable bearings before installation. When pressing a bearing into a retainer or bore, apply pressure to the outer race. If the bearing is to be installed on a shaft, apply pressure to the inner race.

Gaskets

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

Bolt Usage and Torque Application

1. Use bolts of proper length. A bolt which is too long will bottom before the head is tight against its related part. If a bolt is too short, there will not be enough thread area to engage and hold the part properly. When replacing bolts, use only those having the same specifications of the original, or one which is equivalent.
2. Unless specific torque requirements are given within the text, standard torque values should be used on heat-treated bolts, studs, and steel nuts, in accordance with recommended shop practices. (See Torque Chart Section 1.)

Hydraulic Lines and Electrical Wiring

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

Hydraulic System

1. Keep the system clean. If evidence of metal or rubber particles are found in the hydraulic system, drain and flush the entire system.
2. Disassemble and reassemble parts on clean work surface. Clean all metal parts with non-flammable cleaning solvent. Lubricate components, as required, to aid assembly.

Lubrication

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

Battery

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

Lubrication and Servicing

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

2.3 LUBRICATION AND INFORMATION

Hydraulic System

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

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

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

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

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

Hydraulic Oil

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

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

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

3. The only exception to the above is to drain and fill the system with Mobil DTE 13 oil or its equivalent. This will allow start up at temperatures down to -20° F (-29° C). However, use of this oil will give poor performance at temperatures above 120° F (49° C). Systems using DTE 13 oil should not be operated at temperatures above 200° F (94° C) under any condition.

Changing Hydraulic Oil

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

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

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

Lubrication Specifications

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

2.4 CYLINDER DRIFT TEST

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

Platform Drift

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

Cylinder Drift

Table 2-2. Cylinder Drift

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

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

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

If the cylinder passes this test, it is acceptable.

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

2.5 PINS AND COMPOSITE BEARING REPAIR GUIDELINES

Filament wound bearings.

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

2.6 PREVENTIVE MAINTENANCE AND INSPECTION SCHEDULE

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

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

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

⚠ IMPORTANT

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

NOTE: *This machine requires periodic safety and maintenance inspections by a JLG Dealer. A decal located on the frame affords a place to record (stamp) inspection dates. Notify dealer if inspection is overdue.*

The inspection and maintenance code numbers are as follows:

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

Table 2-3. Preventive Maintenance and Safety Inspection

AREA	INTERVAL				
	Daily	Weekly	300 Hours (6 months)	600 Hours (1 year)	1200 Hours (2 years)
PLATFORM					
1. Controller	1,11				
2. Switches	1,11				
3. Placards and Decals	1,2				
4. Control Tags	1,2				
5. Hoses and Cables		4,8			
6. Wear Pads			8		
7. Handrails and Chains	1,4				
CHASSIS					
1. Engine Oil	3	5			
2. Battery	3	5			
3. Air Cleaner	1	14			
4. Exhaust System	1		1,5		
5. Engine Mounts			1		
6. Hydraulic Pump	1	5			
7. Valves	1	5			
8. Hydraulic Filter (See Lubrication Chart)		5,14	14		
9. Hydraulic Hoses and Tubing	1	5			
10. Hydraulic Oil Tank*	3	5	4		
11. Hydraulic Tank Breather		6,14			
12. Fuel Tank	3,5		4		
13. Lift Cylinder	1,12	5,6,13	4		
14. Limit Switch	1,7				
15. Tilt Alarm Switch				1,7	
16. Placards and Decals	1,2				
17. Wheel and Tire Assemblies	1	8,9			
18. Drive Motors		1,5,6			
19. Drive Brakes		1,6	8		
20. Drive Torque Hubs		1,3,5,6			
21. Steer Cylinder	1	5,6,13	4		
22. Steer Components	1	4,6	8		
23. Wheel Bearings (2 Wheel Drive)			8	12	
24. Sizzor Arms	1,4				
25. Safety Props	1,4				
26. Sliding Wear Pads			8		
27. Pivot Pins/Bolts	1,4		7,8		
28. Switches, Ground Control	1,11				
29. Control Tags	1,2				

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SECTION 3. CHASSIS & SIZZOR ARMS

3.1 FORD EFI ENGINE

Performing Diagnostics

1. Verify the complaint and determine if it is a deviation from normal operation.
2. Once the complaint has been verified, preliminary checks can be done. Conduct a thorough visual inspection, be alert for unusual sounds or odors, and gather diagnostic trouble code information.
3. Perform a system check that will verify the proper operation of the system in question and check for recent information updates.
4. If a diagnostic trouble code (DTC) is stored, contact a JLG distributor to make an effective repair.
5. If no DTC is stored, select the symptom from the symptom tables and follow the diagnostic path or suggestions to complete the repair.
6. After the repair has been made and validated for proper operation, the old part should be momentarily re-installed to verify that it was indeed the source of the problem.

If no matching symptom is available, analyze the complaint and develop a plan for diagnostics utilizing the wiring diagrams, technical assistance, and repair history.

Intermittent conditions may be resolved by using a check sheet to pinpoint the circuit or electrical system component. Some diagnostic charts contain Diagnostic Aids which give additional information about a system. Be sure to use all of the information that is available to you.

VISUAL/PHYSICAL ENGINE INSPECTION CHECK

Perform a careful visual and physical engine inspection before performing any diagnostic procedure. Perform all necessary repairs before proceeding with additional diagnosis, this can often lead to repairing a problem without performing unnecessary steps. Use the following guidelines when performing a visual/physical inspection check:

- Inspect engine for modifications or aftermarket equipment that can contribute to the symptom; verify that all electrical and mechanical loads or accessory equipment is "OFF" or disconnected before performing diagnosis.
- Inspect engine fluids for correct levels and evidence of leaks.
- Inspect vacuum hoses for damage, leaks, cracks, kinks and improper routing, inspect intake manifold sealing surface for a possible vacuum leak.
- Inspect PCV valve for proper installation and operation.
- Inspect all wires and harnesses for proper connections and routing; bent or broken connector pins; burned, chafed, or pinched wires; and corrosion. Verify that harness grounds are clean and tight.
- Inspect engine control module (ECM), sensors, and actuators for physical damage.
- Inspect ECM grounds for cleanliness, tightness, and proper location.
- Inspect fuel system for adequate fuel level, and fuel quality (concerns such as proper octane, contamination, winter/summer blend).
- Inspect intake air system and air filter for restrictions.
- Inspect battery condition and starter current draw.

If no evidence of a problem is found after visual/physical engine check has been performed, proceed to MIL DTC retrieval procedure.

EFI Diagnostics

The EFI diagnostics are designed to assist in locating a faulty circuit or component. When a malfunction is detected by the Engine Control Module (ECM), a diagnostic trouble code (DTC) is set and will be displayed on the JLG Control System Analyzer. Refer to Section 6 - JLG Control System.

CLEARING TROUBLE CODES

To clear the trouble codes from the ECM, the electrical current running to the ECM must be shut off. To do this, disconnect the negative terminal from the battery for a period of approximately 15 minutes.

ECM and Sensors

CRANKSHAFT POSITION (CKP) SENSOR

The crankshaft position (CKP) sensor provides a signal used by the engine control module (ECM) to calculate the ignition sequence. The CKP sensor initiates the reference pulses which the ECM uses to calculate RPM and crankshaft position.

CAMSHAFT POSITION (CMP) SENSOR AND SIGNAL

The camshaft position (CMP) sensor sends a CMP signal to the ECM. The ECM uses this signal as a "sync pulse" to trigger the injectors in the proper sequence. The ECM uses the CMP signal to indicate the position of the #1 piston during its power stroke. The CMP uses a Hall Effect sensor to measure piston position. This allows the ECM to calculate true sequential fuel injection (SFI) mode of operation. If the ECM detects an incorrect CMP signal while the engine is running, DTC 53 will set. If the CMP signal is lost while the engine is running, the fuel injection system will shift to a calculated sequential fuel injection mode based on the last fuel injection pulse, and the engine will continue to nun. As long as the fault is present, the engine can be restarted. It will run in the previously established injection sequence

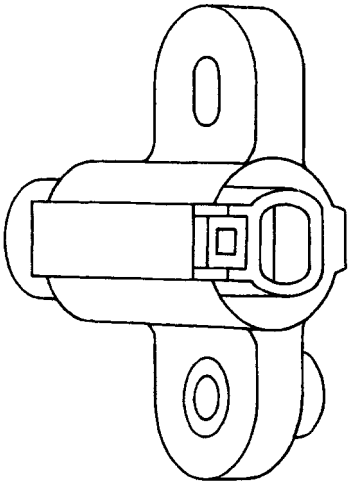


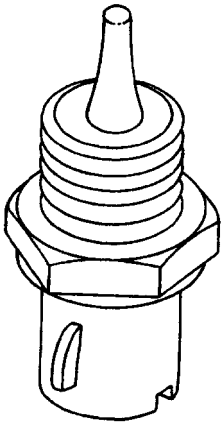
Table 3-1. ECM Diagnostic Trouble Codes

Diagnostic Trouble Code	Description
11	All Systems OK
12	Throttle Position (TP) Sensor Low Voltage
14	Manifold Absolute Pressure (MAP) Low Voltage
15	Under Minimum Map Sensor Temperature
21	Overspeed
22	Throttle Position (TP) Sensor High Voltage
23	Over maximum throttle
24	Manifold Absolute Pressure (MAP) High Voltage
25	Over Maximum Map Sensor Temperature
26	Over maximum initial Throttle Position Sensor Voltage
31	Fuel Pump Low Voltage
32	Heated Oxygen Sensor (HO2S) Low Voltage
33	Engine Coolant Temperature (ECT) Sensor High Voltage
35	Intake Air Temperature (IAT) Sensor High Voltage
41	Fuel Pump High Voltage
42	Heated Oxygen Sensor (HO2S) High Voltage
43	Engine Coolant Temperature (ECT) Sensor Low Voltage
45	Intake Air Temperature (IAT) Sensor Low Voltage
51	Low Oil Pressure
52	Crankshaft Position (CKP) Sensor Extra/Missing Pulses
53	Camshaft Position Sensor (CMP) Sensor Illegal Pattern
54	Engine Control Module (ECM) Fault Illegal Operation
55	Engine Control Module (ECM) Fault Illegal Interruption
56	Engine Control Module (ECM) Fault COP (Computer Operating Properly) Failure
61	System Voltage Low
62	System Voltage High

ENGINE COOLANT TEMPERATURE (ECT) SENSOR

The engine coolant temperature (ECT) sensor is a g thermistor (a resistor which changes value based on temperature) mounted in the engine coolant stream. Low coolant temperature produces a high resistance of 100,000 ohms at -40°C (-40°F). High temperature causes a low resistance of 70 ohms at 130°C (266°F). The ECM supplies a 5-volt signal to the ECT sensor through resistors in the ECM and measures the voltage. The signal voltage will be high when the engine is cold and low when the engine is hot. By measuring the voltage, the ECM calculates the engine coolant temperature. Engine coolant temperature affects most of the systems that the ECM controls.

After engine start-up, the temperature should rise steadily to about 85°C (185°F). it then stabilizes when the thermostat opens. If the engine has not been run for several hours (overnight), the engine coolant temperature and intake air temperature displays should be close to each other. A fault in the engine coolant sensor circuit will set DTC 33 or DTC 43.



ELECTRICALLY ERASABLE PROGRAMMABLE READ ONLY MEMORY (EEPROM)

The electrically erasable programmable read only memory (EEPROM) is a permanent memory chip that is located within the ECM. The EEPROM contains the program and the calibration information that the ECM needs to control engine operations.
If the ECM is replaced, the new ECM will need to be programmed. An IBM-compatible computer and software containing the correct program and calibration for the application are required to program the ECM.

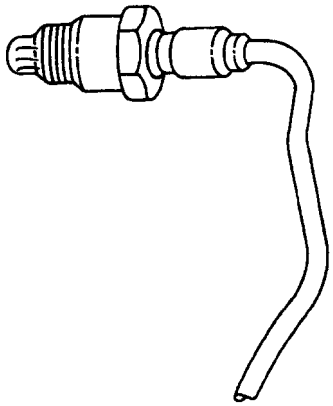
HEATED OXYGEN SENSOR

The heated oxygen sensor is mounted in the exhaust stream where it can monitor the oxygen content of the exhaust gas. The oxygen present in the exhaust gas reacts with the sensor to produce a voltage output. This voltage should constantly fluctuate from approximately 100 mV to 900 mV. The heated oxygen sensor voltage can be monitored on an IBM PC-compatible computer with diagnostic software. By monitoring the voltage out-put of the oxygen sensor, the ECM calculates the pulse width command for the injectors to produce the proper combustion chamber mixture.

Low HO2S voltage indicates a lean mixture which will result in a rich command to compensate.

High HO2S voltage indicates a rich mixture which will result in a lean command to compensate.

A constant voltage below 200 mV for 10 consecutive seconds will set OTC 32. A constant voltage above 650 mV for 10 consecutive seconds will set OTC 42.



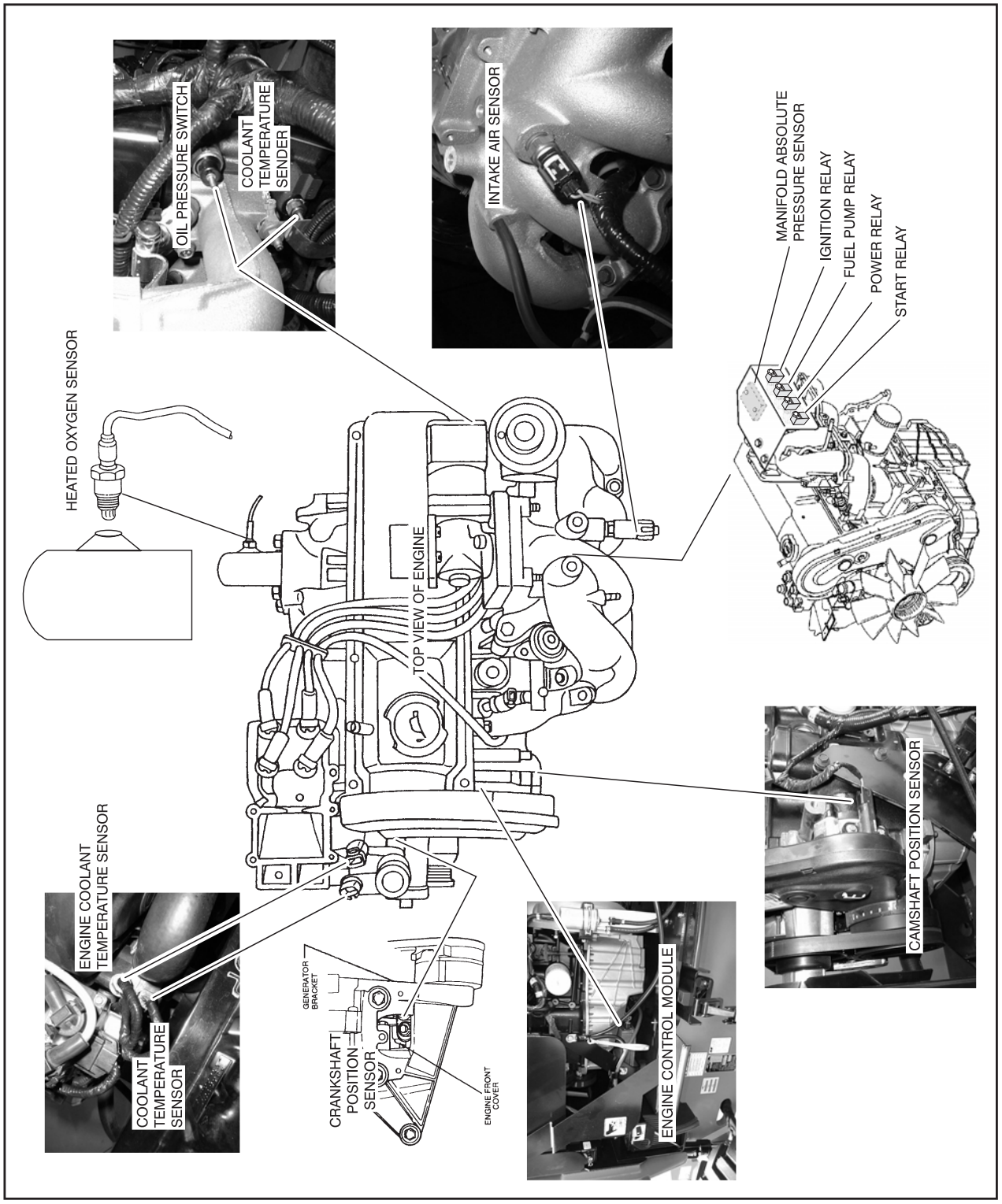
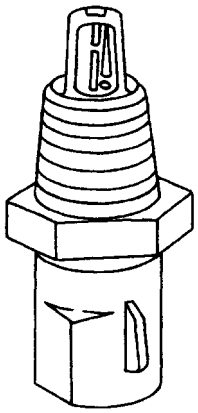


Figure 3-1. EFI Component Location

INTAKE AIR TEMPERATURE (IAT) SENSOR

The intake air temperature (IAT) sensor is a thermistor which changes its resistance based on the temperature of air entering the engine. Low temperature produces a high resistance of 100,000 ohms at -40°C (-40°F). High temperature causes a low resistance of 70 ohms at 130°C (266°F). The ECM supplies a 5-volt signal to the sensor through a resistor in the ECM and monitors the signal voltage. The signal voltage will be high when the incoming air is cold and low when the incoming air is hot. By measuring the voltage, the ECM calculates the incoming air temperature. The IAT sensor signal is used to adjust spark timing according to the incoming air density. An IBM PC-compatible computer with diagnostic soft-ware can be used to display the temperature of the air entering the engine. The temperature should read close to the ambient air temperature when the engine is cold, and rise as engine compartment temperature increases. If the engine has not been run for several hours (overnight), the IAT sensor temperature and engine coolant temperature should read close to each other. A failure in the IAT sensor circuit will set DTC 35 or DTC 45.



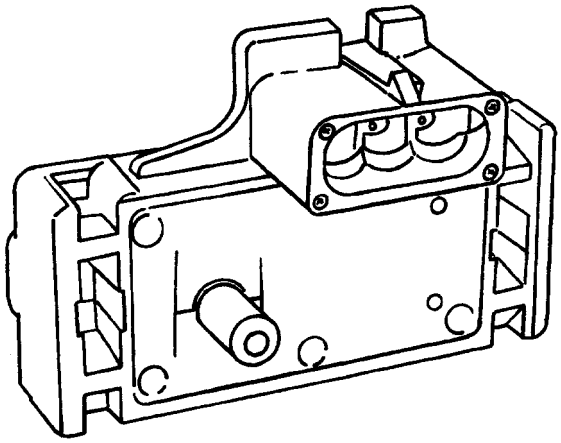
MANIFOLD ABSOLUTE PRESSURE (MAP) SENSOR

The manifold absolute pressure (MAP) sensor responds to changes in intake manifold pressure (vacuum). The MAP sensor signal voltage to the ECM varies from below 2 volts at idle (high vacuum) to above 4 volts with the ignition ON, engine not running or at wide-open throttle (low vacuum).

The MAP sensor is used to determine the following:

- Engine vacuum level for engine control purposes.
- Barometric pressure (BARO)

If the ECM detects a voltage that is significantly lower than the estimated MAP value for 2 or more consecutive seconds, DTC 14 will be set. A signal voltage significantly higher than the estimated MAP value for 2 or more consecutive seconds will set DTC 24.



ENGINE CONTROL MODULE (ECM)

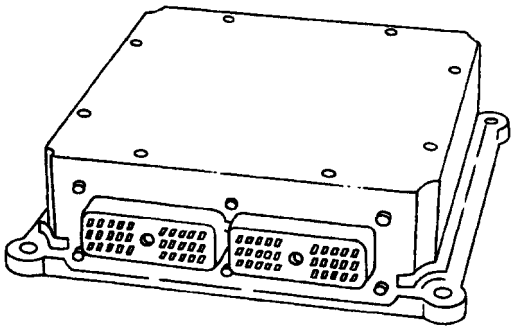
The ECM controls the following:

- Fuel metering system
- Ignition timing
- On-board diagnostics for engine functions

The ECM constantly observes the information from various sensors. The ECM controls the systems that affect engine performance. The ECM performs the diagnostic function of the system. It can recognize operational problems, alert the operator through the Malfunction Indicator Lamp (MIL), and store diagnostic trouble codes (DTCs). DTCs identify the problem areas to aid the technician in making repairs.

The ECM supplies either 5 or 12 volts to power various sensors or switches. The power is supplied through resistances in the ECM which are so huh in value that a test light will not light when connected to the circuit. In some cases, even an ordinary shop voltmeter will not give an accurate reading because its resistance is too low. Therefore, a digital voltmeter with at least 10 meg ohms input impedance is required to ensure accurate voltage readings. The ECM controls output circuits such as the fuel injectors, electronic governor, etc., by control ling the ground or the power feed circuit through transistors or other solid state devices.

The ECM is designed to maintain exhaust emission levels to government mandated standards while providing excellent operation and fuel efficiency. The ECM monitors numerous engine functions via electronic sensors such as the throttle position (TP) sensor and the heated oxygen sensor (HO2S).



ECM INPUTS/OUTPUTS

Inputs—Operating Conditions

- Engine Coolant Temperature
- Crankshaft Position
- Exhaust Oxygen Content
- Manifold Absolute Pressure
- Battery Voltage
- Throttle Position
- Fuel Pump Voltage
- Intake Air Temperature
- Camshaft Position

Outputs - System Controlled

- Fuel Control
- Idle Air Control
- Electric Fuel Pump
- Diagnostics:
  - Malfunction Indicator Lamp
  - Data Link Connector (DLC)

ECM SERVICE PRECAUTIONS

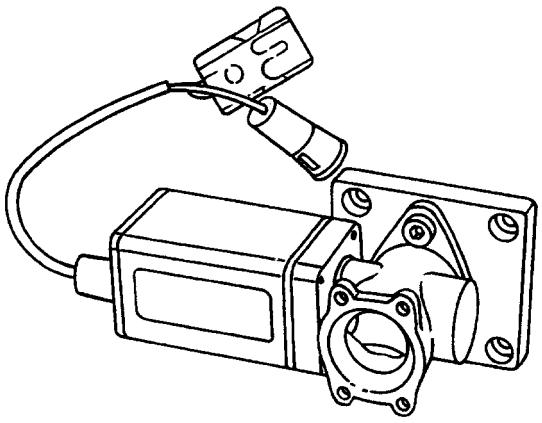
The ECM is designed to withstand normal current draws associated with engine operation. When servicing the ECM, observe the following guidelines:

- Do not overload any circuit.
- Do not probe wires for testing. This can cause a voltage drop that would be critical to the operation of the ECM.
- When testing for opens and shorts, do not ground or apply voltage to any of the ECM's circuits unless instructed to do so.
- When measuring voltages, use only a digital voltmeter with an input impedance of at least 10 megohms.
- Do not jump start with more than 12 volts. This could cause damage to the electronic components.
- Do not employ any non-standard practices such as charging the battery with an arc welder.
- Take proper precautions to avoid static damage to the ECM. Refer to "Electrostatic Discharge Damage" for more information.

THROTTLE POSITION (TP) SENSOR

The throttle position (TP) sensor is a potentiometer connected to the throttle shaft on the throttle body which is built into the electronic governor. The ECM monitors the voltage on the signal line and calculates throttle position. As the throttle valve angle is changed, the TP sensor signal also changes. At a closed throttle position, the output of the TP sensor is low. As the throttle valve opens, the output increases so that at wide open throttle (WOT), the output voltage should be above 4 volts.

The ECM calculates fuel delivery based on throttle valve angle (operator demand). A broken or loose TP sensor may cause intermittent bursts of fuel from an injector and unstable idle because the ECM thinks the throttle is moving. A hard failure in the TP sensor 5-Volt reference or signal circuits for greater than 2 consecutive seconds will set either a DTC 12 or DTC 22. A hard failure with the TP sensor ground circuit for more than two consecutive seconds may set DTC 22. If either DTC 12 or DTC 22 are set, the throttle will be forced to a 6% (idle) position.



USE OF CIRCUIT TESTING TOOLS

Do not use a test light to diagnose the engine electrical systems unless specifically instructed by the diagnostic procedures. A test light can put an excessive load on an ECM circuit and result in component damage. For voltage measurements, use only a digital voltmeter with an input impedance of at least 10 megohms.

ELECTROSTATIC DISCHARGE DAMAGE

Electronic components used in the ECM are often designed to carry very low voltage. Electronic components are susceptible to damage caused by electrostatic discharge. Less than 100 volts of static electricity can cause damage to some electronic components. By comparison, It takes as much as 4000 volts for a person to feel the spark of a static discharge.

There are several ways for a person to become statically charged. The most common methods of charging are by friction and induction.

An example of charging by friction is a person sliding across a seat.

Charge by induction occurs when a person with well-insulated shoes stands near a highly charged object and momentarily touches ground. Charges of the same polarity are drained off, leaving the person highly charged with the opposite polarity. Static charges can cause damage, therefore it is important to-use care when handling and testing electronic components.

To prevent possible electrostatic discharge damage, follow these guidelines:

- Do not touch the ECM connector pins or soldered components on the ECM board.
- Do not open the replacement part package until the part is ready to be installed.
- Before removing the part from the package, ground the package to a known good ground on the equipment.
- If the part has been handled while sliding across a seat, while sitting down from a standing position, or while walking a distance, touch a known good ground before installing the part.

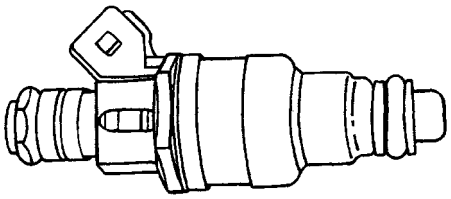
Fuel System

FUEL INJECTOR

The Electronic Fuel Injection (EFI) fuel injector is a solenoid-operated device controlled by the ECM. The ECM energizes the solenoid, which opens a valve to allow fuel delivery.

The fuel is injected under pressure in a conical spray pattern at the opening of the intake valve. Excess fuel not used by the injectors passes through the fuel pressure regulator before being returned to the fuel tank.

A fuel injector which is stuck partly open will cause a loss of fuel pressure after the engine is shut down, causing long crank times.



FUEL METERING SYSTEM COMPONENTS

The fuel metering system is made up of the following parts:

- The fuel injectors
- The fuel rail
- The fuel pressure regulator/filter assembly
- The electronic governor
- The ECM
- The crankshaft position (CKP) sensor
- The camshaft position (CMP) sensor
- The fuel pump
- The fuel pump relay

BASIC SYSTEM OPERATION

The fuel metering system starts with the fuel in the fuel tank. The fuel is drawn up to the fuel pump through a prefilter. The electric fuel pump then delivers the fuel to the fuel rail through an inane fuel filter. The pump is designed to provide fuel at a pressure above the pressure needed by the injectors. A fuel pressure regulator in the fuel filter assembly keeps fuel available to the fuel injectors at a constant pressure. A return line delivers unused fuel back to the tank.

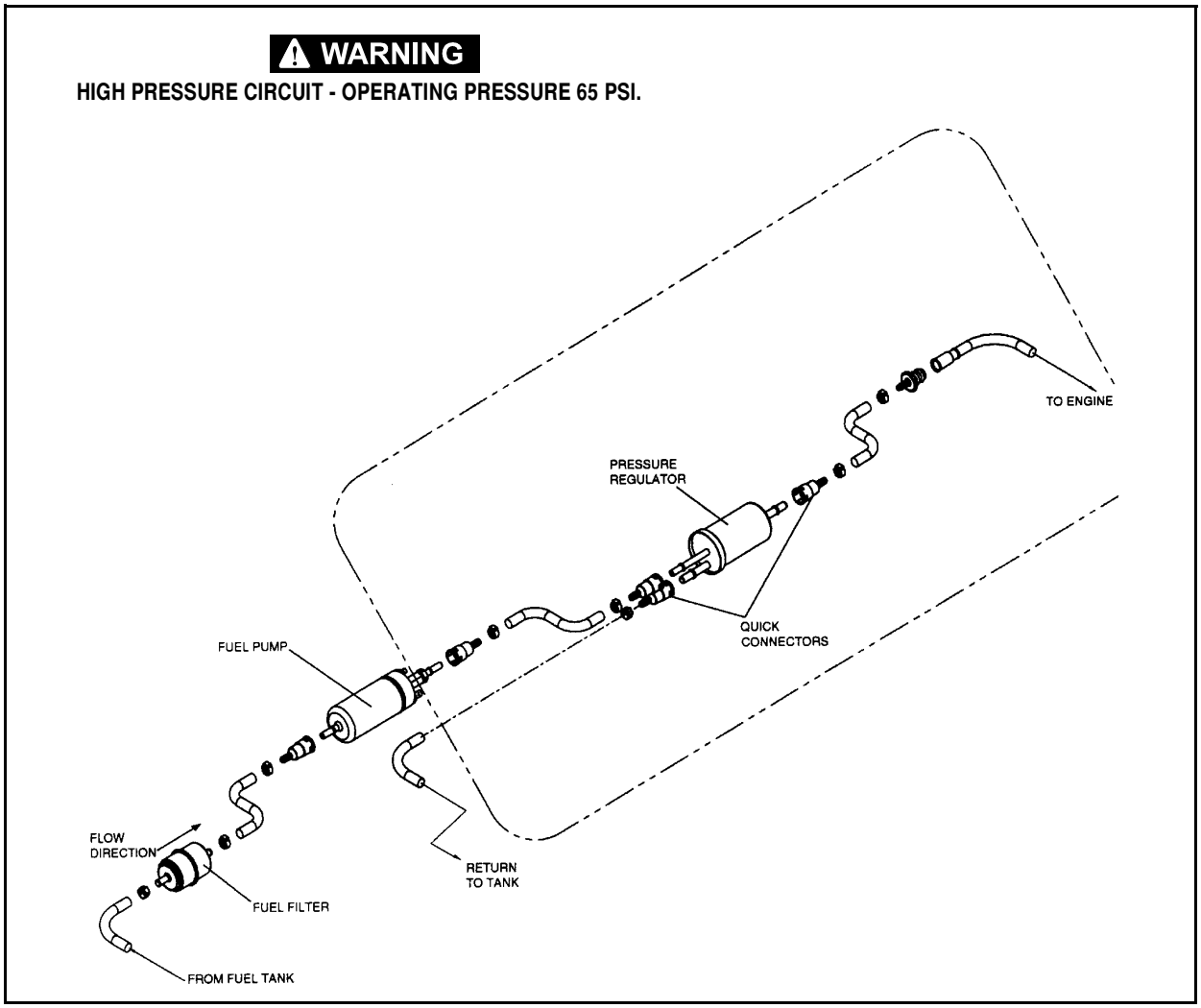


Figure 3-2. Typical Fuel System

FUEL METERING SYSTEM PURPOSE

The basic function of the air/fuel metering system is to control the air/fuel delivery to the engine. Fuel is delivered to the engine by individual fuel injectors mounted in the intake manifold near each intake valve.

The main control sensor is the heated oxygen sensor (H02S) located in the exhaust system. The H02S tells the ECM how much oxygen is in the exhaust gas. The ECM changes the air/fuel ratio to the engine by controlling the amount of time that the fuel injector is "ON." The best mixture to minimize exhaust emissions is 14.7 parts of air to 1 part of gasoline by weight, which provides the most efficient combustion. Because of the constant measuring and adjusting of the air/fuel ratio, the fuel injection system is called a "closed loop" system.

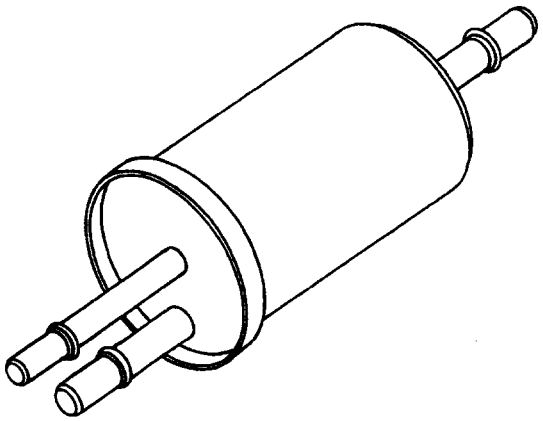
The ECM monitors signals from several sensors in order to determine the fuel needs of the engine. Fuel is delivered under one of several conditions called "modes." All modes are controlled by the ECM. Refer to "Open Loop and Closed Loop Operation" for more information.

FUEL PRESSURE REGULATOR

The fuel pressure regulator is a relief valve mounted in the fuel filter. It provides a constant fuel pressure of 441 kPa (64 psi).

If the pressure is too low, poor performance and a DTC 32 will set. If the pressure is too high, excessive odor and/or a DTC 42 will result.

When replacing the fuel filter, be sure to use an identical filter/regulator assembly. A standard fuel filter does not regulate pressure and could cause engine problems or component damage.



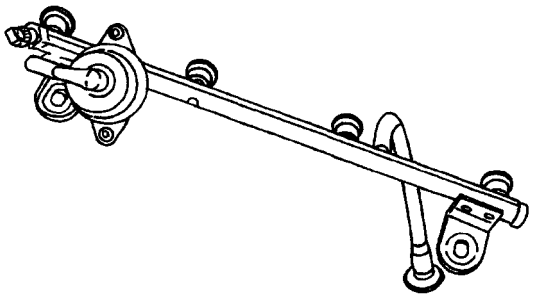
FUEL PUMP ELECTRICAL CIRCUIT

When the key is first turned "ON," the ECM energizes the fuel pump relay for two seconds to build up the fuel pressure quickly. If the engine is not started within two seconds, the ECM shuts the fuel pump off and waits until the engine is cranked. When the engine is cranked and crankshaft position signal has been detected by the SECM, the ECM supplies 12 volts to the fuel pump relay to energize the electric fuel pump.

An inoperative fuel pump will cause a "no-start" condition. A fuel pump which does not provide enough pressure will result in poor performance.

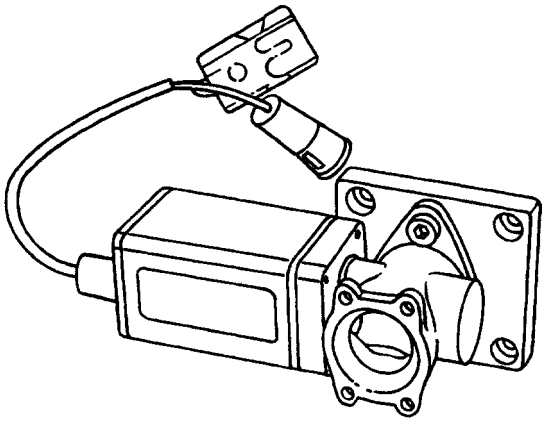
FUEL RAIL

The fuel rail is mounted to the top of the engine and distributes fuel to the individual injectors. Fuel is delivered to the fuel inlet tube of the fuel rail by the fuel lines.



ELECTRONIC GOVERNOR AND THROTTLE BODY

In the 2.5L EFI industrial engine, throttle control is achieved by using an electronic governor which is controlled by the engine control module (ECM).



The electronic governor consists of a throttle body, an electronically-actuated throttle plate, and a built-in throttle position (TP) sensor. There are two pigtails that exit the governor body. The 3-wire pigtail connects the TP sensor to the ECM. Refer to "Throttle Position (TP) Sensor" for more information.

The 2-wire pigtail carries the throttle signal from the ECM to the governor. Desired engine speeds are stored in the configuration program for each specific application, and can be changed with the ECM calibration software. When an engine speed is selected with the toggle switch, the ECM sends the appropriate signal to the governor. This is a pulse-width modulated (PWM) signal which cannot be read with conventional diagnostic tools such as a voltmeter. A 12-volt signal is pulsed on and off at a high rate of speed. The width of the "on" pulse determines the amount of throttle opening. The ECM sends a signal with the appropriate pulse width to the governor based on the operator's choice of switch settings.

The electronic governor also acts as an idle air control (IAC) valve. Changes in engine load are detected by the ECM by comparing manifold absolute pressure (MAP) with throttle position. When the ECM detects a change in engine load, it can adjust idle speed by changing the PWM signal to the governor.

OPEN LOOP AND CLOSED LOOP OPERATION

The ECM will operate in the following two modes:

- Open loop
- Closed loop

When the engine is first started, the system is in "open loop" operation. In open loop, the ECM ignores the signal from the heated oxygen sensor (HO2S). it uses a pre-programmed routine to calculate the air/fuel ratio based on inputs from the TP, ECT, and MAP sensors.

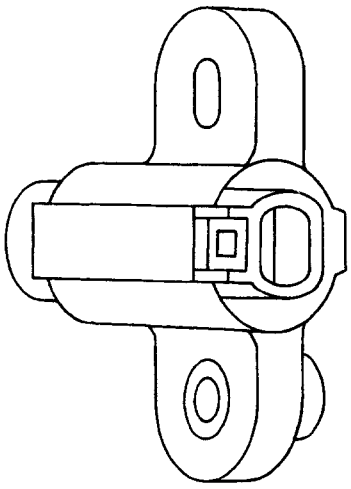
The system remains in open loop until the following conditions are met:

- The HO2S has a varying voltage output showing that it is hot enough to operate properly (this depends on temperature).
- The ECT has reached 160°F (71°C).
- Seven minutes has elapsed since starting the engine.

After these conditions are met, the engine is said to be operating in "closed loop." In closed loop, The ECM continuously adjusts the air/fuel ratio by responding to signals from the HO2S (except at wide-open throttle). When the HO2S reports a lean condition (low sensor signal voltage), the ECM responds by increasing the "on" time of the fuel injectors, thus enriching the mixture. When the HO2S reports a rich condition (high sensor signal Voltages the ECM responds by reducing the "on" time of the fuel injectors, thus leaning out the mixture.

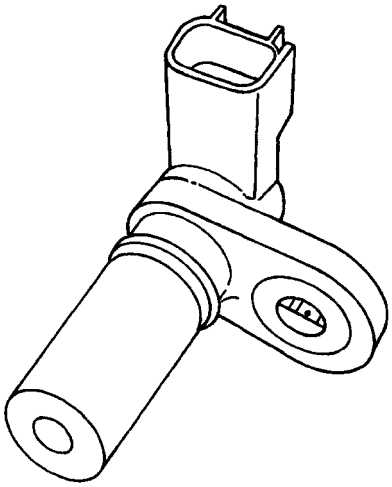
CAMSHAFT POSITION (CMP) SENSOR

The CMP sensor uses a variable reactor sensor to detect camshaft position. The CMP signal is created as piston #1 is a predetermined number of degrees after top dead center on the power stroke.



CRANKSHAFT POSITION (CKP) SENSOR

The crankshaft position (CKP) sensor provides a signal used by the engine control module (ECM) to calculate the ignition sequence. The sensor initiates the reference pulses which the ECM uses to calculate RPM and crankshaft position.



ELECTRONIC IGNITION

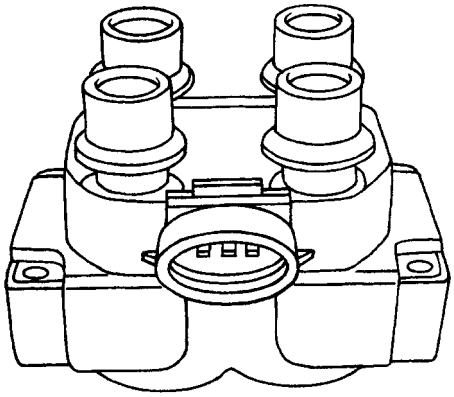
The electronic ignition system controls fuel combustion by providing a spark to ignite the compressed air/fuel w mixture at the correct time. To provide optimum engine performance, fuel economy, and control of exhaust emissions, the ECM controls the spark advance of the ignition system. Electronic ignition has the following advantages over a mechanical distributor system:

- No moving parts
- Less maintenance
- Remote mounting capability
- No mechanical load on the engine
- More coil cooldown time between firing events
- Elimination of mechanical timing adjustments
- Increased available ignition coil saturation time

IGNITION COIL

The electronic ignition system uses a coil pack with one ignition coil for each two cylinders in the engine. Each cylinder is paired with its opposing cylinder in the firing order, so that one cylinder on compression fires simultaneously with the opposing cylinder on exhaust. The spark that occurs in the cylinder on the exhaust stroke is referred to as a "waste spark."

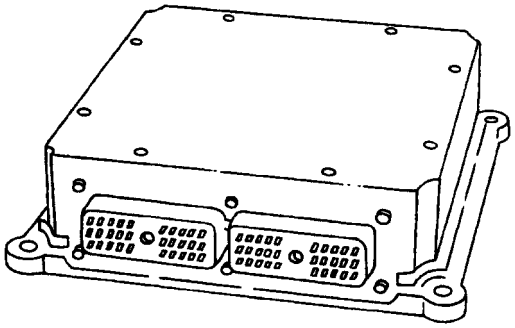
The primary coils in the coil pack are triggered by the "Ignition Coil Feed #1" and "Ignition Coil Feed #2" Signals from the ECM.



ENGINE CONTROL MODULE (ECM)

The ECM is responsible for maintaining proper spark and fuel injection timing for all operating conditions. To provide optimum operation and emissions, the ECM monitors the input signals from the following components in order to calculate spark timing:

- Engine coolant temperature (ECT) sensor
- Intake air temperature (IAT) sensor
- Throttle position sensor
- Crankshaft position sensor



3.2 OPERATING CHARACTERISTICS

Leveling Jacks

The machine may be equipped with auto leveling jacks. These leveling jacks are operated through one switch unlike the traditional four switch system. The leveling jacks are operated by a bang bang valve.

NOTE: *The engine speed will drop when the leveling jacks are in contact with the ground.*

1. Activate the leveling jack button located on the platform control box.
2. Extend the jacks by moving the joystick forward.

NOTE: *Once all four jacks make contact with the ground the system will go from set mode into level mode. At this point the engine will return to idle.*

3. The tilt indicator will go out once the machine is level.

NOTE: *If the machine is not level it will not lift. If you hit the end of stroke on any of the cylinders you cannot lift the machine.*

NOTE: *There is a limit switch on each cylinder that senses when the cylinder is fully retracted when all four are fully retracted, the stowed light in the platform control box will light.*

If you receive a 2/5 flash code through the system fault light at the platform control station the machine is unable to level. You must reposition and try again.

The jacks are operational (extend or retract) if the machine is in the stowed position. The proximity sensor and rotary sensor together must sense that the machine is stowed. A failure of either sensor will prevent the jacks from being activated.

Power Deck

The power deck is operated through a non proportional valve. This will not effect any other function when activated.

⚠ WARNING

BE SURE AND RETRACT ANY POWER DECK BEFORE LOWERING MACHINE.

Generator

When the generator switch is activated the engine RPM will speed up to 2000 RPM for a 60 Hz generator or 1700 RPM for a 50 Hz generator.

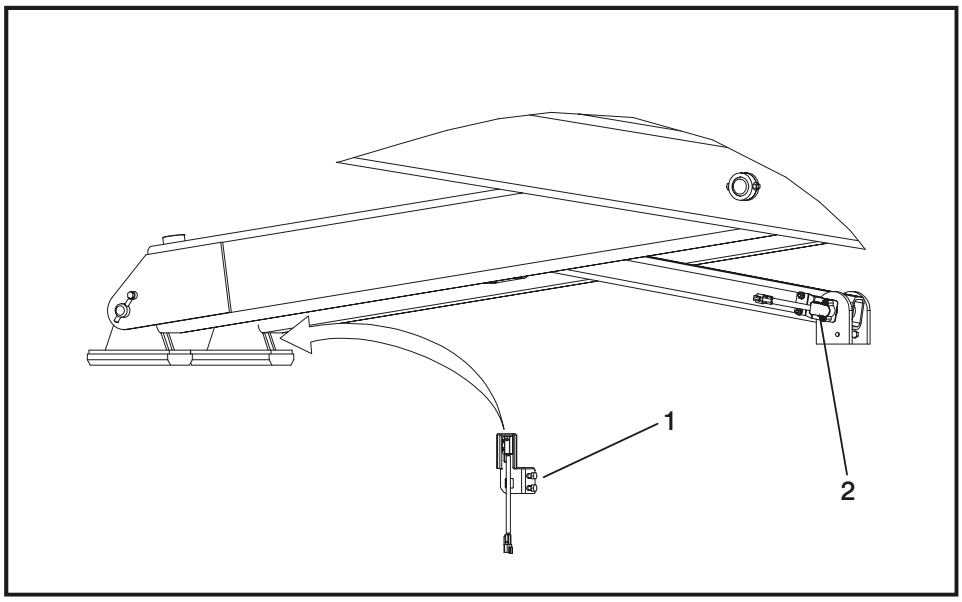
When a function is selcted for operation, which requires a higher engine speed than the generator, the generator will automatically shut off during the operation of the function. Once the function has stopped, the genrator will be active again.

Lift

There is a flow control valve which controls both the lift up and lift down speeds.
Anytime you abruptly change lift directions, there is a three second delay between lift up and lift down.

Drive

If driving at high drive up a grade and you hit an 8° incline,the drive function will cut back to mid drive speed. The drive pump will shitft back into high drive once the incline decreases to 5°. There will be a 2 second delay before the machine goes back into high drive.



1. Proximity Sensor
2. Rotary Angle Sensor

Figure 3-3. Limit Switch Location

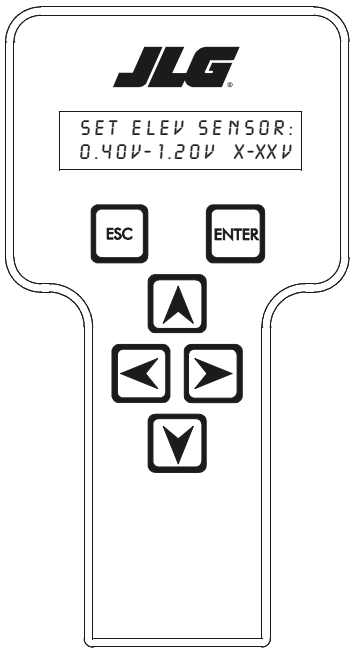
3.3 PROXIMITY AND ROTARY ANGLE SWITCH INSTALLATION

NOTE: *Make sure your analyzer is in ACCES LEVEL 1.*

When using the analyzer, under the DIAGNOSTIC menu the term referring to ROTARY & PROXIMITY sensors is ELEV SENSOR .

Use CALIBRATIONS menu for rotary switch adjustments

1. When mounting, make sure the rotary switch is aligned with the bladed pin mounted on the center link as shown in Figure 3-3., Limit Switch Location. There must be a preload when installing the rotary switch on the bladed pin bracket.
2. There are (3) mounting screws that hold the switch onto the center link mounting lug, make sure they are snug, not loose, so you are able to rotate the rotary switch.
3. Make sure the deck is fully lowered. Plug in the analyzer and enter the service password (33271).
4. Go to CALIBRATIONS, then SET ELEV SENSOR and hit enter then right arrow.
5. The bottom line on the analyzer display will show the range of voltage the sensor must be within for proper calibration. the actual voltage is displayed on the bottom line to the right as shown.



6. Press the left arrow button and then enter.

NOTE: *Anytime the ground control board or if the rotary sensor is replaced the rotary sensor must be reset (zeroed out).*

When stowed, if angle sensor is 0.05 < or > CALIB, the machine should be recalibrated.

NOTE: *If the gap ever increases beyond 5/16 in., the switch may cause intermittent operation*

7. Completely lower the platform. Using the analyzer press escape and scroll through DIAGNOSTICS and then go to ELEV SENSOR, press ENTER. Check to see that the following items are reading correctly.

   ANGLE SNSR 0.40 - X.XXV

   ZEROED 0.00V

   ELEV CUT

   CALIB 0.40v - 1.20v

8. Press ESCAPE until you arrive at DIAGNOSTICS, then scroll over to top level menu SET ELEV SENSOR, press ENTER. At this point press ENTER key. If everything tested properly the analyzer will read COMPLETE.

9. Now lift the machine up. Drive speed should be reduced to elevated speed at the following heights;

   3394RT - 6-9 ft (1.8 - 2.7m)

   4394RT - 7-10 ft (2.1 - 3m)

10. Press ESCAPE, remove analyzer and assure all hardware is tight.

NOTE: *If voltage is too low the analyzer will display SENSOR FAILURE. If the voltage is set too hig the analyzer will read NOT STOWED. When calibration is attempted, once it is set within the proper limits, the analyzer will read COMPLETE.*

Level Sensor and Analyzer Connections

The level sensor is located at the ground control station. Using a screwdriver, open the ground control station and locate the level sensor as shown in Figure 3-4., Level Sensor and Analyzer Connections.

There are two analyzer connection ports. One in the ground control station and the other at the platform control station on the under side of the platform control box as shown in Figure 3-4., Level Sensor and Analyzer Connections.

NOTE: *Ensure that the level sensor is installed with the bubble towards the top side of the lower control box..*

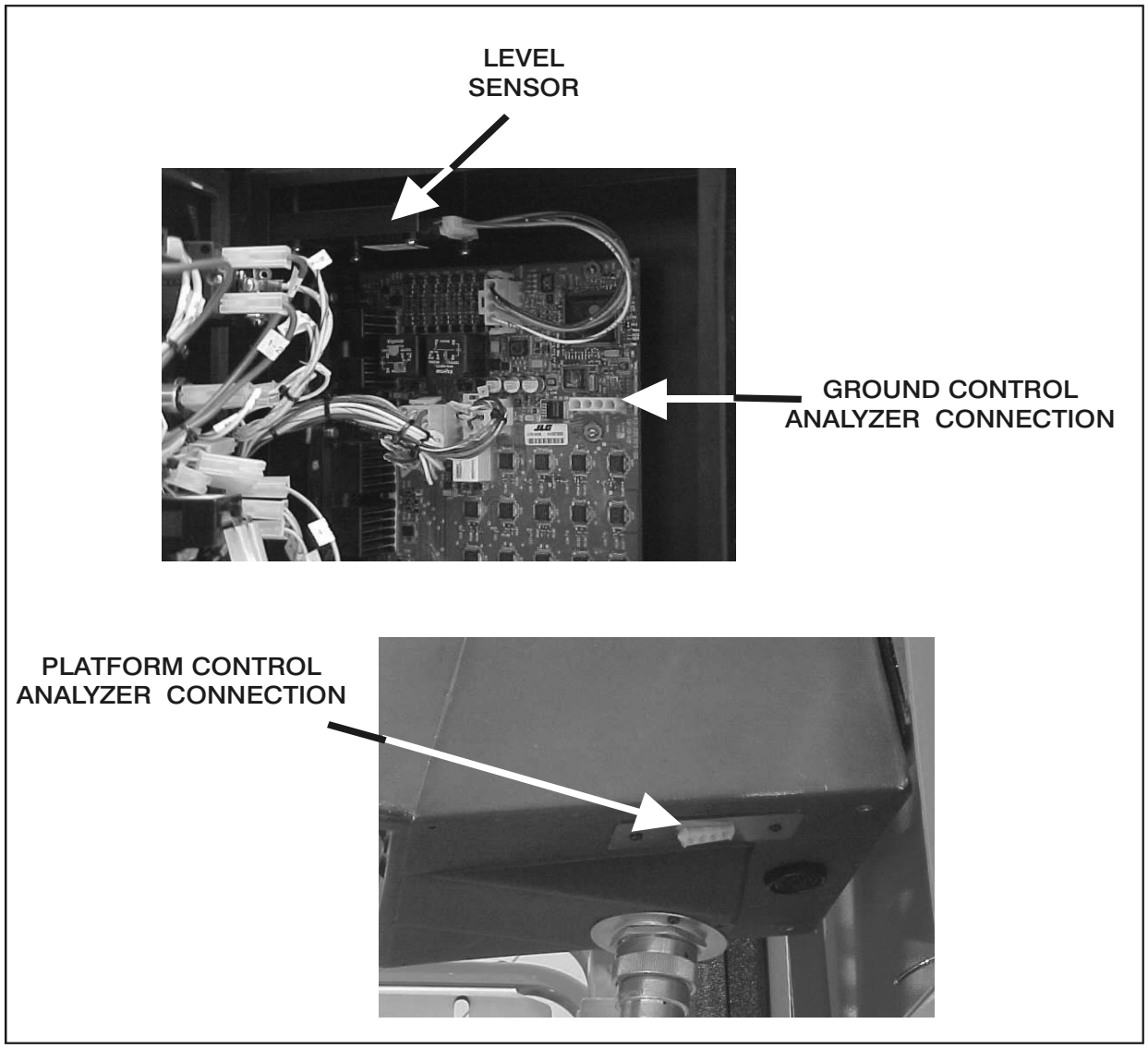


Figure 3-4. Level Sensor and Analyzer Connections

3.4 INTEGRATED TORQUE/DRIVE HUB

The Integrated Torque/Drive Hub is an axial piston-hydraulic motor with integrated, hydraulic released multi plate parking brake and a 2-stage planetary gearbox and a disconnect mechanism.

To insure an optimum balancing of loads, each planetary stage comprises of planet gears in sets. The externally toothed wheels are case-hardened.

The hydraulically released, wet running, multi plate brake, integrated in the hydraulic motor, is a parking brake. It is normally closed by spring force and released when pressurized by hydraulic oil.

⚠ IMPORTANT

TORQUE HUB UNITS SHOULD ALWAYS BE ROLL AND LEAK TESTED BEFORE DISASSEMBLY AND AFTER ASSEMBLY TO MAKE SURE THAT THE UNIT'S GEARS AND SEALANTS ARE WORKING PROPERLY.

Roll Test

The purpose of a roll test is to determine if the unit's gears are rotating freely and properly. Gears should be able to be rotated by applying a constant force to the roll checker. If more drag is felt in the gears only at certain points, then the gears are not rolling freely and should be be examined for proper installation or defects. Some gear packages roll with more difficulty than others. Do not be concerned if gears seem to roll hard as long as they roll with consistency.

Leak Test

The purpose of the leak test is to make sure the unit is air tight. The unit has a leak if the pressure gauge reading on the air checker starts to fall once the unit has been pressurized. Leaks will most likely occur at main seal or wherever o-rings or gaskets are located. The exact location of a leak can usually be detected by brushing a soap and water solution around the main seal and where o-rings or gaskets meet the exterior of the unit, then checking for air bubbles. If a leak is detected in a seal, o-ring, or gasket, the part must be replaced.

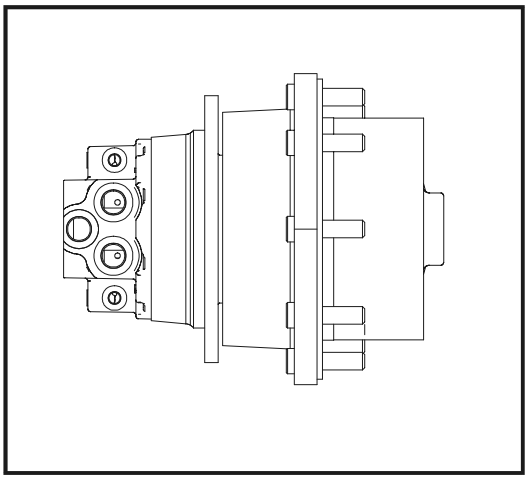


Figure 3-5. Integrated Torque/Drive Hub

3.5 DUAL FUEL/LPG SYSTEM

⚠ CAUTION

IT IS POSSIBLE TO SWITCH FROM ONE FUEL SOURCE TO THE OTHER WITHOUT ALLOWING THE ENGINE TO STOP. THE FOLLOWING INSTRUCTIONS MUST BE FOLLOWED.

Changing From Gasoline to LP Gas

NOTE: Before climbing onto the platform, open hand valve on LP gas supply tank by turning valve counterclockwise.

1. Start engine from platform control station.
2. While engine is operating, place the dual fuel switch at platform control station to the LPG position. Allow engine to operate, without load, until engine begins to “stumble” from lack of gasoline. At this time the machine is allowing the LP fuel to be sent to the fuel regulator.

Changing From LP Gas to Gasoline

1. With engine operating on LP under a no-load condition, throw LPG/GASOLINE switch at platform control station to GASOLINE position.
2. If engine “stumbles” because of lack of gasoline, place switch to LPG position until engine regains smoothness, then return switch to GASOLINE position.
3. Close hand valve on LP gas supply by turning clockwise.

Using Liquid Petroleum (LP) Gas

⚠ WARNING

CLOSE FUEL VALVE ON TANK WHEN PARKING SIZZOR LIFT MORE THAN MOMENTARILY.

WHEN REFUELING LPG POWERED SIZZOR LIFTS, ALWAYS FOLLOW MANUFACTURERS SPECIFICATIONS AND/OR APPLICABLE REGULATIONS.

1. If machine is to be left overnight or longer, it must be parked outside or the LPG tank removed and stored outside.
2. LPG is extremely flammable. No smoking.
3. Only trained and authorized personnel are permitted to operate filling equipment.
4. Fill LPG tanks outdoors. Stay at least 50 ft (15 m) from buildings, motor vehicles, electrical equipment or other ignition sources. Stay at least 15 ft (5 m) from LPG storage tanks.
5. During transfer of LPG, metal components can become very cold. Always wear gloves when refilling or changing tanks to prevent “freeze burns” to skin.
6. Do not store LPG tanks near heat or open flame. For complete instructions on the storage of LPG fuels, refer to ANSI/NFPA 58 & 505 or applicable standards.

⚠ WARNING

DO NOT USE AN LPG TANK THAT IS DAMAGED. A DAMAGED TANK MUST BE REMOVED FROM SERVICE. FROST ON THE SURFACE OF A TANK, VALVES, OR FITTINGS INDICATES LEAKAGE. A STRONG ODOR OF LPG FUEL CAN INDICATE A LEAK.

SECTION 4. HYDRAULICS

4.1 CYLINDERS - THEORY OF OPERATION

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

NOTE: *The lift cylinder is a single acting cylinder which takes hydraulic pressure to extend and gravity to retract.*

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

4.2 VALVES - THEORY OF OPERATION

Solenoid Control Valves (Bang-Bang)

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

Relief Valves

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

Crossover Relief Valves

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

4.3 COMPONENT FUNCTIONAL DESCRIPTION

Piston Hydraulic Pump

The Rexroth tandum piston pump is attached to and driven by the engine. The pump is a 28 cc piston pump that powers the drive motors.

Gear Hydraulic Pump

The Bosch rexroth gear pump is "piggy-backed" to the piston pump, and operates all machine functions except drive. The gear pump is a 14 cc pump which pumps 14.5 GPM.

Manual Descent Valve

The manual descent valve is located on top of the holding valve on the lift cylinder. The holding valve is a normally closed solenoid valve, and holds the platform in place when raised. When activated, the valve opens to permit lift down. The holding valve is connected to the manual descent valve, which is connected to a cable which, when pulled, manually opens the lift down port of the valve and allows the platform to be lowered in the event hydraulic power is lost.

4.4 CYLINDER CHECKING PROCEDURE

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

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 be no 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.

Cylinders With Single Counterbalance Valve

⚠ IMPORTANT

OPERATE ALL FUNCTIONS FROM GROUND CONTROL STATION ONLY.

1. Using all applicable safety precautions, activate hydraulic system.
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.
3. There will be initial weeping of hydraulic fluid, which can be caught in a suitable container. After the initial discharge, there should be no further leakage from the 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 be no 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.

4.5 CYLINDER REPAIR

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

Disassembly

⚠ 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.

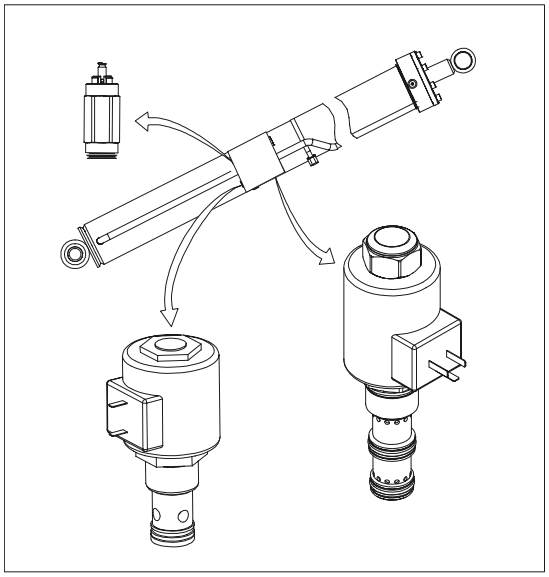


Figure 4-1. Lift Cylinder Holding Valve and Fitting Removal

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

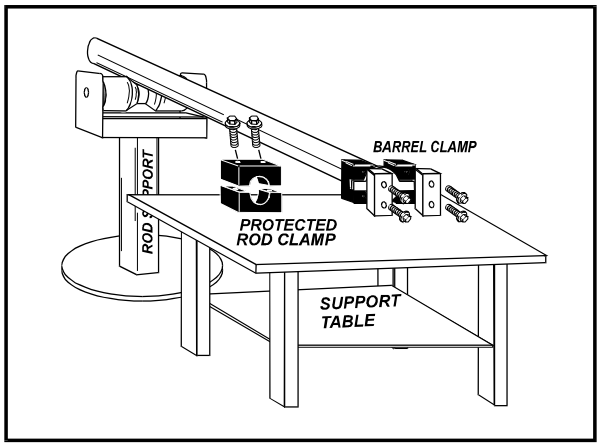


Figure 4-2. Cylinder Barrel Support

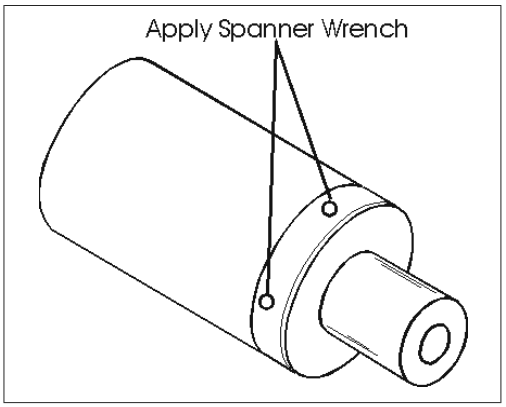
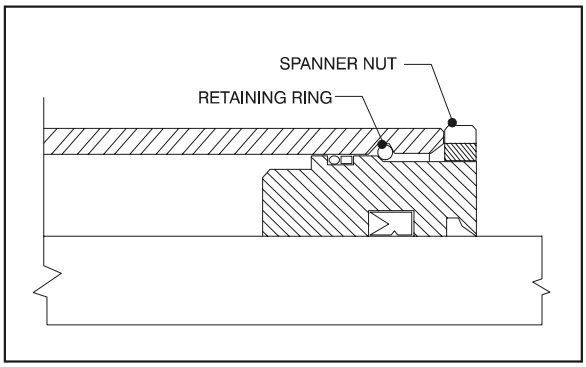


Figure 4-3. Lift Cylinder Cap Screw Removal

NOTE: *Steps 6 and 7 apply only to the steer cylinder.*

5. Using a spanner wrench, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.

6. Being careful not to mar the surface of the rod, use a punch or wooden dowel and hammer to drive the rod guide about one inch down into the cylinder bore. Using a screw driver, carefully push one end of the round retaining ring back towards the inside of the cylinder and then slip the screwdriver tip under that end. Pull the ring out of the groove toward the wall mouth. Once one end of the retaining ring is free from the groove, the remainder can be easily pried free using ones fingers or pliers.



7. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

⚠ IMPORTANT

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

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

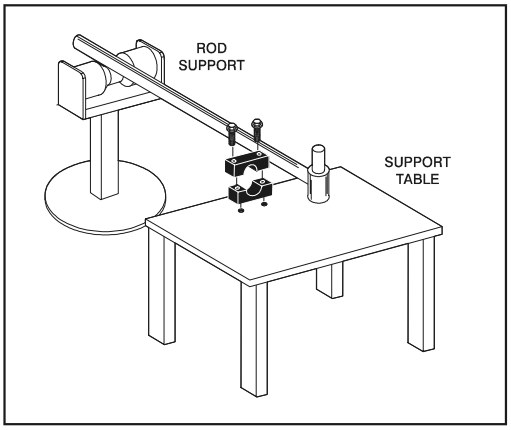


Figure 4-4. Cylinder Rod Support

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

NOTE: *Step 11 applies only to the steer cylinder.*

10. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
11. Loosen and remove the cap screw(s), if applicable, which attach the tapered bushing to the piston.
12. Insert the cap screw(s) in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the cap screw(s) until the bushing is loose on the piston.
13. Remove the bushing from the piston.

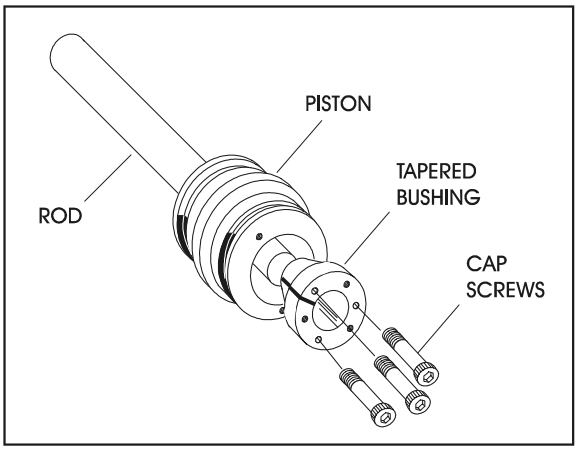


Figure 4-5. Tapered Bushing Removal

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

Cleaning and Inspection

1. Clean all parts thoroughly in an approved cleaning solvent.
2. Inspect the cylinder rod for scoring, tapering, ovality, or other damage. If necessary, dress rod with Scotch Brite or equivalent. Replace rod if necessary.
3. Inspect threaded portion of rod for excessive damage. Dress threads as necessary.
4. Inspect inner surface of cylinder barrel tube for scoring or other damage. Check inside diameter for tapering or ovality. Replace if necessary.
5. Inspect threaded portion of barrel for damage. Dress threads as necessary.
6. Inspect piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
7. Inspect threaded portion of piston for damage. Dress threads as necessary.
8. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.

9. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
10. Inspect threaded portion of head for damage. Dress threads as necessary.
11. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
12. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
13. If applicable, inspect rod and barrel bearings for signs of correct excessive wear or damage. Replace as necessary.
    a. Thoroughly clean hole, (steel bushing) of burrs, dirt etc. to facilitate bearing installation.
    b. Inspect steel bushing for wear or other damage. If steel bushing is worn or damaged, rod/barrel must be replaced.
    c. Lubricate inside of steel bushing with WD40 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

NOTE: *Install pin into the Gar-Max bearing dry. Lubrication is not required with nickel plated pins and bearings.*

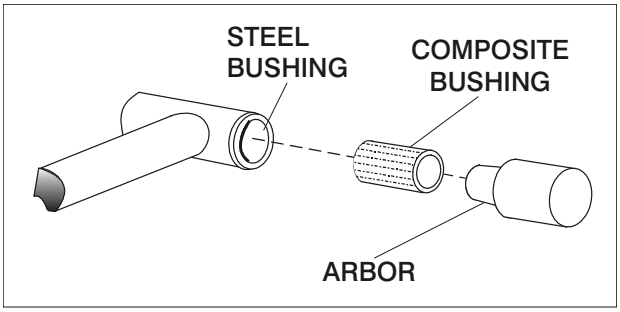


Figure 4-6. Bushing Installation

14. Inspect travel limiting collar or spacer for burrs and sharp edges. If necessary, dress inside diameter surface with Scotch Brite or equivalent.
15. If applicable, inspect port block fittings and holding valve. Replace as necessary.
16. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
17. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

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

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

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

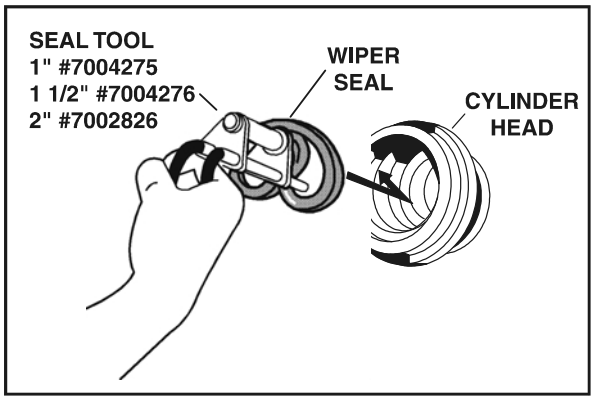


Figure 4-7. Rod Seal Installation

⚠ IMPORTANT

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

⚠ IMPORTANT

WHEN INSTALLING THE WIPER SEAL ON THE LOWER (TOWER) LIFT CYLINDER, APPLY LOCTITE #609 ON THE WIPER SEAL IN THREE EVENLY SPACED PLACES TO AID IN RETENTION OF THE SEAL.

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

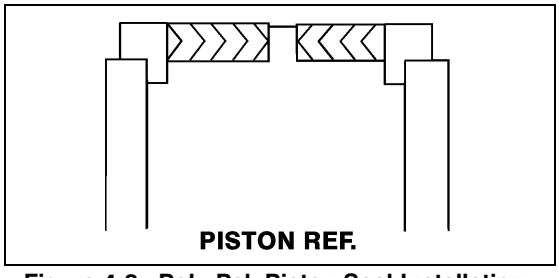


Figure 4-8. Poly-Pak Piston Seal Installation

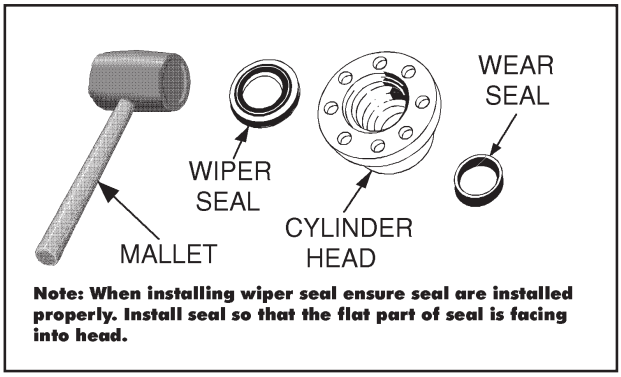


Figure 4-9. Wiper Seal Installation

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

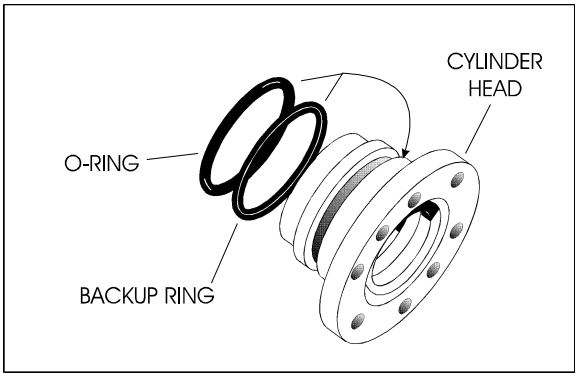


Figure 4-10. Installation of Head Seal Kit

4. Install washer ring onto rod, carefully install the head gland on the rod, ensuring that the wiper and rod seals are not damaged or dislodged. Push the head along the rod to the rod end, as applicable.
5. Carefully slide the piston spacer on the rod.
6. If applicable, correctly place new o-ring in the inner piston diameter groove. (The backup ring side facing the O-ring is grooved.)
7. If applicable, correctly place new seals and guide lock rings in the outer piston diameter groove. (A tube, with I.D. slightly larger than the O.D.of the piston is recommended to install the solid seal.)

NOTE: *The backup rings for the solid seal have a radius on one side. This side faces the solid seal.(See magnified insert in (See Figure 4-11.))The split of seals and backup rings are to be positioned so as not to be in alignment with each other.*

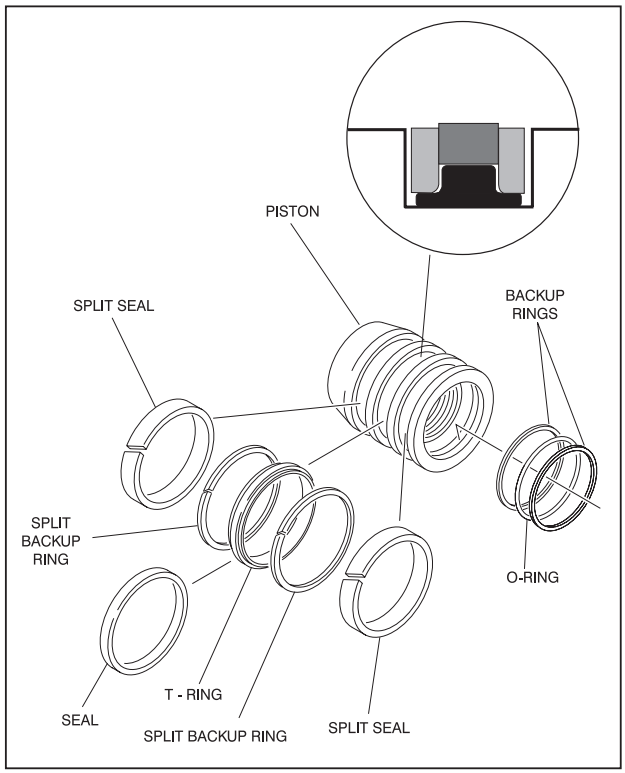


Figure 4-11. Piston Seal Kit Installation

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

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

4. Assemble the tapered bushing loosely into the piston and insert JLG capscrews (not vendor cap-

screws) through the drilled holes in the bushing and into the tapped holes in the piston.

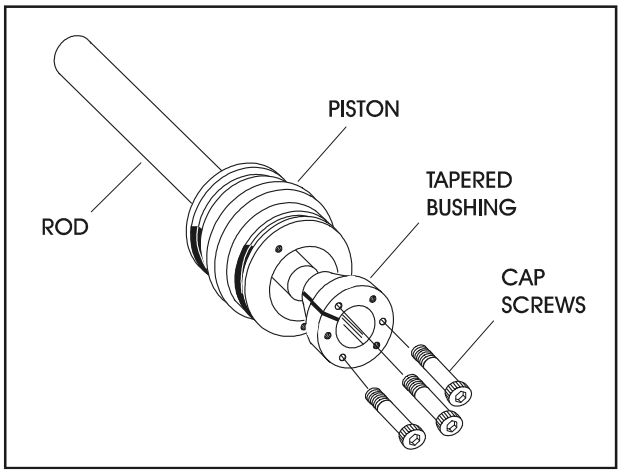


Figure 4-12. Tapered Bushing Installation

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

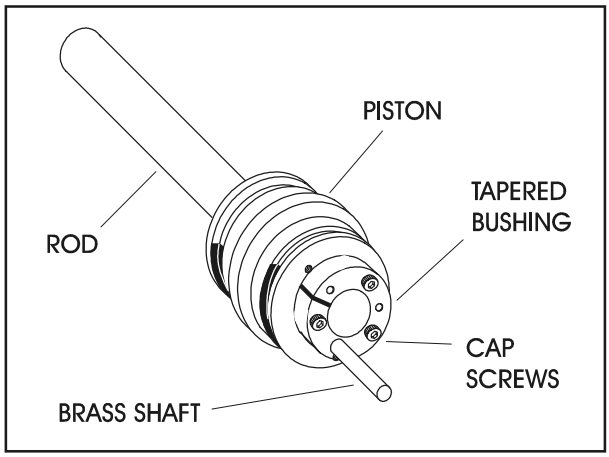


Figure 4-13. Seating the Tapered Bearing

7. Retorque the capscrews evenly and progressively in rotation to the specified torque value.
8. Remove the cylinder rod from the holding fixture.
9. Place new guide locks and seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 4-11.)
10. Position the cylinder barrel in a suitable holding fixture.

⚠ IMPORTANT

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

11. With barrel clamped securely, and while adequately supporting the rod, insert the piston end into the barrel cylinder. Ensure that the piston loading o-ring and seal ring are not damaged or dislodged.
12. Continue pushing the rod into the barrel until the cylinder head gland can be inserted into the barrel cylinder.
13. Secure the cylinder head gland using the washer ring and socket head bolts.

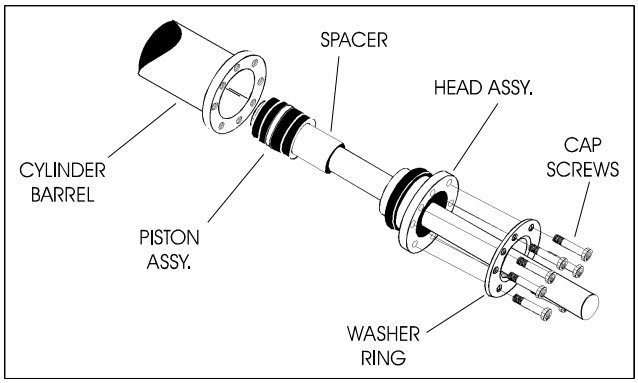


Figure 4-14. Rod Assembly Installation

14. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.
15. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. (See Table 4-2, Holding Valve Torque Specifications).

Table 4-1. Cylinder Piston Nut Torque Specifications

Description	Nut Torque Value	Setscrew torque Value
Lift Cylinder	400 ft lb (542 Nm)	100 in lb (12 Nm)
Lockout Cylinder	N/A	N/A
Steer Cylinder	N/A	N/A

Table 4-2. Holding Valve Torque Specifications

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

9. Push the piston onto the rod until it abuts the spacer end and install the attaching nut.

⚠ WARNING

WHEN REBUILDING THE CYLINDERS, APPLY LOCTITE #242 TO PISTON NUT AND SETSCREW, THEN TORQUE PISTON NUT. REFER TO TABLE 4-1, CYLINDER PISTON NUT TORQUE SPECIFICATIONS

NOTE: *The Steer Cylinder uses snap rings to secure piston.*

10. Prior to setscrew installation spot drill rod before installing the setscrew(s) which secure the piston attaching nut to the diameter groove.

11. Remove the cylinder rod from the holding fixture.

12. 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.

13. 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.

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

15. If applicable, secure the cylinder head retainer using a suitable chain wrench.

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.

17. If applicable, install the cartridge-type holding valve and fittings in the port block using new o-rings as applicable. Refer to Table 4-2, Holding Valve Torque Specifications.

4.6 DRIVE PUMP START-UP PROCEDURE

⚠ IMPORTANT

THE FOLLOWING PROCEDURE SHOULD ALWAYS BE PERFORMED WHEN STARTING A NEW PUMP OR WHEN RESTARTING AN INSTALLATION IN WHICH EITHER THE PUMP OR MOTOR HAVE BEEN REMOVED FROM THE SYSTEM.

⚠ IMPORTANT

THE FOLLOWING PROCEDURE SHOULD ALWAYS BE PERFORMED WHEN STARTING A NEW PUMP OR WHEN RESTARTING AN INSTALLATION IN WHICH EITHER THE PUMP OR MOTOR HAVE BEEN REMOVED FROM THE SYSTEM.
THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, DRIVE FUNCTION DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY TO TECHNICIAN AND OTHER PERSONNEL. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE MACHINE.

Prior to installing pump and/or motor, inspect unit(s) for damage incurred during shipping and handling. Make certain all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with hydraulic fluid.

Fill reservoir with recommended hydraulic fluid, which should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to components, which may result in unexpected machine movement.

The inlet line leading from the reservoir to the pump should be filled prior to start-up. Check inlet line for properly tightened fittings and make sure it is free of restrictions and air leaks.

Be certain to fill pump and/or motor housing with clean hydraulic fluid prior to start-up. Fill housing by pouring filtered oil into upper case drain port.

Install a 0 to 500 psi (0 to 35 bar) pressure gauge in the charge pressure gauge port to monitor charge pressure during start-up.

It is recommended that the external control input signal electrical connections be disconnected at the pump control until after initial start-up. This will allow the pump to remain in its neutral position.

"Jog" or slowly rotate prime mover until charge pressure starts to rise. Start prime mover and run at the lowest possible RPM until charge pressure has been established. Excess air may be bled from high pressure lines through high pressure gauge ports.

⚠ WARNING

DO NOT START PRIME MOVER UNLESS PUMP IS IN NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be approximately 220 psi (15.5 bar) minimum. If charge pressure is incorrect, shut down and determine cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR'S ABILITY TO CONTROL THE MACHINE.

Shut down prime mover and connect external control input signal. start prime mover, checking to be certain pump remains in neutral. with prime mover at normal operating speed, slowly check for forward and reverse machine operation.

Charge pressure should remain at 220 psi to 240 psi (15.5 bar to 16.9 bar) minimum during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down prime mover, remove gauges, and plug ports. Check reservoir level and add fluid if necessary.

4.7 HYDRAULIC COMPONENT START-UP PROCEDURES AND RECOMMENDATIONS

From a hydrostatic component standpoint, the goal at system start up is to put into functional operation, the hydrostatic system in such a way as to preserve the designed life span of the system. The following start-up procedure should be adhered to whenever a new pump or motor is initially installed into a machine, or a system is restarted after either a pump or motor has been removed and/or replaced.

⚠ WARNING

THE FOLLOWING PROCEDURE MAY REQUIRE THE MACHINE TO BE DISABLED (WHEELS RAISED OFF THE GROUND, WORK FUNCTIONS DISCONNECTED, ETC.) WHILE PERFORMING THE PROCEDURE IN ORDER TO PREVENT INJURY. TAKE NECESSARY SAFETY PRECAUTIONS BEFORE MOVING THE VEHICLE/MACHINE.

Prior to installing the pump and/or motor, inspect the unit(s) for damage that may have been incurred during shipping and handling. Make certain that all system components (reservoir, hoses, valves, fittings, heat exchanger, etc.) are clean prior to filling with fluid.

Fill the reservoir with recommended hydraulic fluid. This fluid should be passed through a 10 micron (nominal, no bypass) filter prior to entering the reservoir. The use of contaminated fluid will cause damage to the components, which may result in unexpected vehicle/machine movement.

NOTE: *If a pump or motor is being replaced due to internal damage, the remaining units (pump or motors) need to be inspected for damage and contamination, and the entire hydraulic system will need to be flushed and the fluid replaced. Failure to do so may cause considerable damage to the entire system.*

The inlet line leading from the reservoir to the pump must be filled prior to start-up. Check the inlet line for property tightened fittings and make sure it is free of restrictions and air leaks.

NOTE: *In most cases, the reservoir is above the pump inlet so that the pressure head created by the higher oil level helps to keep the inlet pressures within an acceptable range and prevent high vacuum levels. However, due to hose routing or low reservoir locations, there may be air trapped within this line. It is important to assure that the air is bled from this line. This can be accomplished by loosening the hose at the fitting closest the pump. When oil begins to flow, the line is full, the air has been purged, and the fitting can be retightened to its specified torque. If the tank needs to be pressurized in order to start the flow of oil, a vacuum reading should be taken at the inlet of the pump during operation in order to verify that the pump is not being asked to draw an inlet vacuum higher than it is capable of.*

Be certain to fill the pump and/or motor housing with clean hydraulic fluid prior to start up. Fill the housing by pouring filtered oil into the upper case drain port.

NOTE: *It is highly recommended to use the highest possible case drain port, this ensures that the housing contains as much oil as possible and offers the greatest amount of lubrication to the internal components.*

NOTE: *In initial start-up conditions, it may be convenient to fill the housing, just prior to installing the case drain line. Component, (especially motor), location may be such that access to the case drain port after installation is not realistic.*

NOTE: *Make certain that the oil being used to fill the component housing is as clean as possible, and store the fill container in such a way as to prevent it from becoming contaminated.*

Install a 60 bar (or 1000 psi) pressure gauge in the charge pressure gauge port in order to monitor the charge pressure during start-up.

It is recommended that the external control input signal, (electrical connections for EDC), be disconnected at the pump control until after initial start-up. This will ensure that the pump remains in its neutral position.

⚠ WARNING

DO NOT START THE ENGINE UNLESS PUMP IS IN THE NEUTRAL POSITION (0 DEGREES SWASHPLATE ANGLE). TAKE PRECAUTIONS TO PREVENT MACHINE MOVEMENT IN CASE PUMP IS ACTUATED DURING INITIAL START-UP.

"Jog" or slowly rotate the engine until charge pressure starts to rise. Start the engine and run at the lowest possible RPM until charge pressure has been established. Excess air should be bled from the system lines as close to the motors as possible.

NOTE: *With the engine on low idle, "crack", (loosen-don't remove), the system lines at the motor(s). Continue to run the engine at low idle and tighten the system lines as soon as oil is observed to leak from them. When oil is observed to "leak" at the motor the line is full, the air has been purged, and the system hoses should be retightened to their specified torque.*

Once charge pressure has been established, increase speed to normal operating RPM. Charge pressure should be as indicated in the pump model code. If charge pressure is inadequate, shut down and determine the cause for improper pressure.

⚠ WARNING

INADEQUATE CHARGE PRESSURE WILL AFFECT THE OPERATOR' S ABILITY TO CONTROL THE MACHINE.

Shut down the engine and connect the external control input signal. Also reconnect the machine function(s), if disconnected earlier. Start the engine, checking to be certain the pump remains in neutral. With the engine at normal operating RPM, slowly check for forward and reverse machine operation.

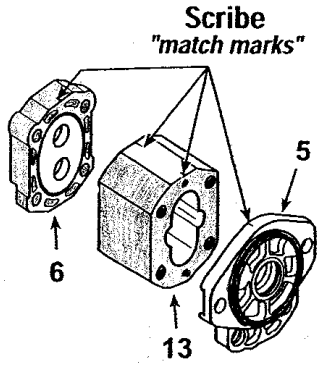
Charge pressure may slightly decrease during forward or reverse operation. Continue to cycle slowly between forward and reverse for at least five minutes.

Shut down engine, remove gauges, and plug ports. Check reservoir level and add filtered fluid if needed.

The machine is now ready for operation.

4.8 HYDRAULIC GEAR PUMP

Overhaul pump only in a clean, dust free location, using clean tools and equipment. dirt and grit will damage the highly machined surfaces and will result in leakage or premature failure of the pump.

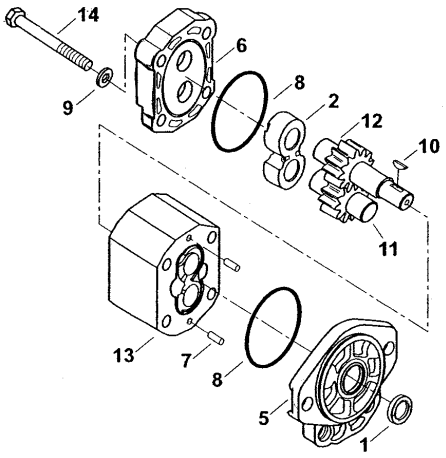


Before beginning disassembly, scribe "match marks" on the body (13) and covers (5 and 6) to insure that the pump will be reassembled inthe same manner as it was shipped fromt he factory. If the body or rear cover is replaced during overhaul, scribe a match mark on the new part in the same location as on the part it replaced.

Pump Disassembly

1. Clean outside of pump with a good grade solvent and dry thoroughly.
2. On models with a splined drive shaft, proceed to step 3. On models with a keyed drive shaft, remove drive key (10) from drive shaft. Using a file or stone, remove burrs from shaft end of keyway.
3. Using light clamping pressure on the ears of the front cover, secure unit in vise with shaft side down; remove cap screws (14) and washers (9).
4. Seperate rear cover (6) from the body (13). The static seal (8) may remain either with the body or the cover. In either case, remove the static seal and discard.

5. Lift out the rear bearing block (2), drive gear (12), and driven gear (11).



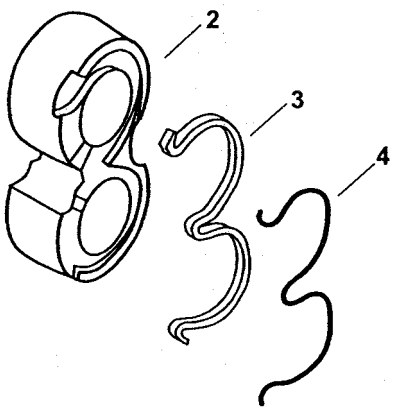
6. Seperate body (13) from front cover (5). Dowel pins (7) and the front static seal (8) may remain with either the body (13) or the front cover (5). In either case, remove the static seal and discard.
7. usually the front bearing block (2) will remain in the body (13), so invert the body and lift out the bearing block.
8. Invert front cover (5) with shaft seal up. Remove the shaft seal (1) by prying it out with a large screwdriver.

NOTE: *During disassembly, take special note of the wear patterns onthe bearing blocks (2) and body (13). Relate these patterns to the inlet and outlet sides of the pump. The large port whether in the body (13) or the rear cover (6) corresponds to the inlet side of the pump. The inlet side of the body can be identified by the gear contact pattern in the gear bore. The bearing block will have somewhat heavier wear patterns on the inlet side.*

Parts Inspection

1. Wash all part and dry thoroughly.
2. Inspect front and rear bearing block. replace if scoring or uneven wear is observed.

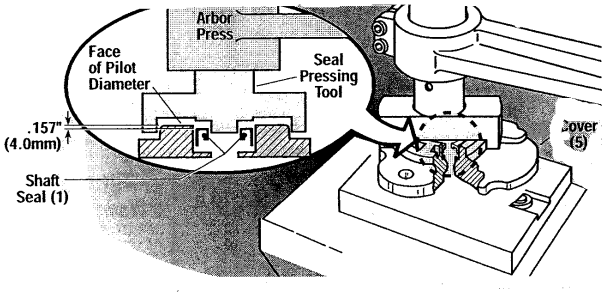
NOTE: *A somewhat heavier wear patteren is normal on the low pressure (inlet) side of the bearing blocks (2). However, there should be no heavy scoring in this area.*

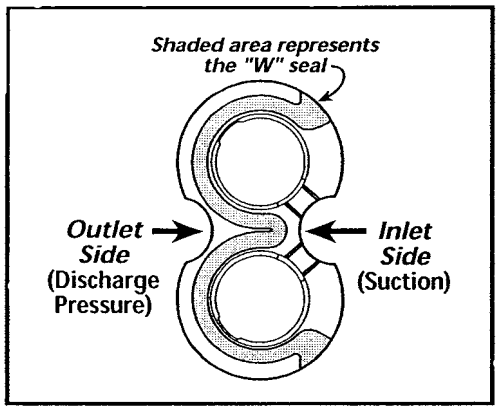


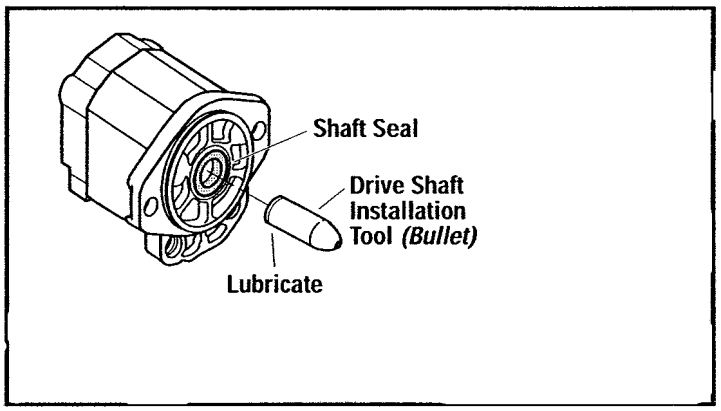
3. Remove anti extrsion seal (4) and pressure loading seal (3) from each bearing block and discard.
4. Inspect bushings in each bearing block (2). replace bearing block if bushings are heavily scored or burned.
5. Inspect gear journals and faces. Replace if faces or journals are scored or worn.
6. Inspect body for wear and scoring. If gear contact wear on low pressure side (inlet) exceeds 0.005 in. (.127mm) depth, replace body. If the body is usable, lightly wipe and remove burr's with suitable de-burring tool.

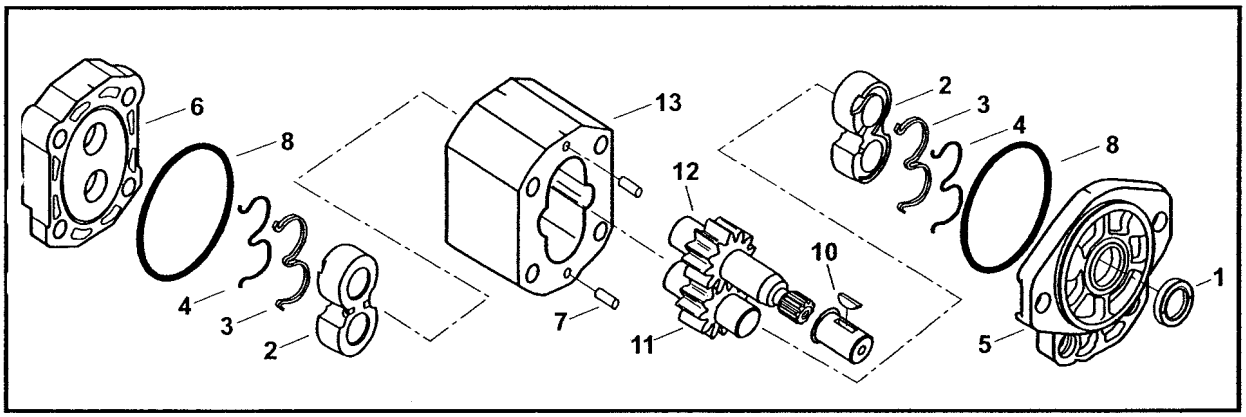
Pump Reassembly

1. Place the front cover (5) on a flat plate with the steal shaft seal bore up. Install new shaft seal (1). Press seal until it is 0.157 in (4.0mm) below front surface. Pack the area between the double lip of the seal with Lubriplate or and equivalent grease.









2. Clamp front cover into vise so that the ring groove is up. Apply a small amount of grease tot he seal groove and install a new seal rring (8) into the groove.

3. Apply lubriplate or equivalent to outer surface of drive shaft installation tool. Insert tool (bullet) into shaft seal from seal ring groove side of front cover.

4. Place a small amount of grease onthe seal groove on the front bearing block (2). Install a new load seal and anti extrusion seal inthe groove. Insert the bearing block into the body, maing sure that the load seal (3) and anti extrusion seal (4) are positioned properly. ensure the outside of the "W" seal is exposed tothe discharge pressure.

5. Apply a small amount of grease tot he dowel pins (7) and install them into the body (13).

6. Set the body (13) onto the front cover (5), matching the scribes marks on the body and front cover. The dowel pins (7) should go into the matingholes on the front cover (5).

7. Install drive gear (12), and driven gear (11).

8. Place a small amount of grease in seal groove onthe rear bearing block (2). Install a new load seal and anti extrsion seal in groove. Insert the bearing block into the body, making sure that the load seal and anti extrusion seal are postioned properly. Ensure outside of the "W" seal is exposed to the discharge pressure.

9. Apply a small amount of grease tot he seal groove int he rear cover (6) and install a new seal ring (8) into the groove. Set the rear cover (6) onto the body (13), matching the scribes marks ont he body and rear cover.

10. Insert he cap screw (14) and washers (9); torque to 42-46 ft lb. (57-62 Nm).

11. On models equipped with keyed drive shaft, install drive key (10).

12. With an adjustable wrench, Check that the drive shaft turns without evidence of a mechanical bind.

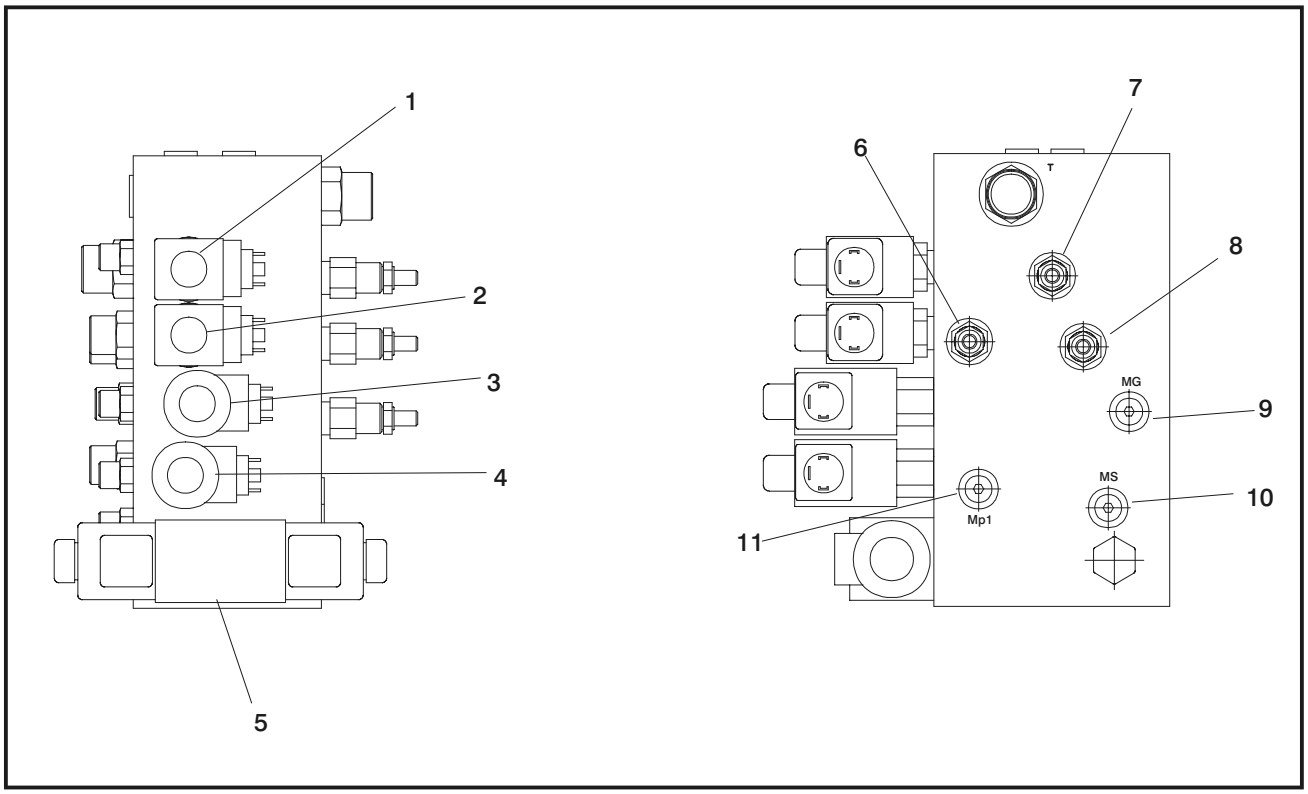


Table 4-3. Main Valve Torque Values

Valve	Ft-lb	Mn
1. Dump Valve	30 - 35	42 - 49
2. Lift Valve	25 - 30	35 - 42
3. Two Speed Valve	30 - 35	42 - 49
4. Brake Valve	30 - 35	42 - 49
5. Steer Valve	25 - 30	35 - 42
6. Lift Rrelief	30 - 35	42 - 49
7. Main Relief	25 - 30	35 - 42
8. Steer Relief	30 - 35	42 - 49
9. MG Port	N/A	N/A
10. MS Port	N/A	N/A
11. MP1 Port	N/A	N/A

Figure 4-15. Main ValveTorque Values

4.9 PRESSURE SETTING PROCEDURES

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

Main Valve

1. Install pressure gauge at the MP1 port.
2. Adjust both Steer Section Crossover Relief's all the way in.
3. Adjust Main Relief Cartridge out several turns.
4. Activate engine and allow hydraulic system to come up to operating temperature.
5. Bottom out Steer function. Adjust Main Relief to 3000 psi (207 bar).
6. Bottom out Steer Right and Steer Left functions and adjust each Steer Crossover Relief to 2800 psi (193 bar).
7. Bottom out Lift Up functions and adjust Lift Pressure to 2700 psi (186 bar)
8. De-energize Lift function, shut down motor, and disconnect pressure gauge.Leveling Jacks Valve (If Equipped)

1. Activate engine and allow hydraulic system to come up to operating temperature.
2. Install pressure gauge at quick connect on main valve (M1).
3. Energize and bottom ut the leveling jack function. Adjust relief to 2800 psi (193 bar).
4. De-energize jack function and shut down engine. Remove pressure gauge.

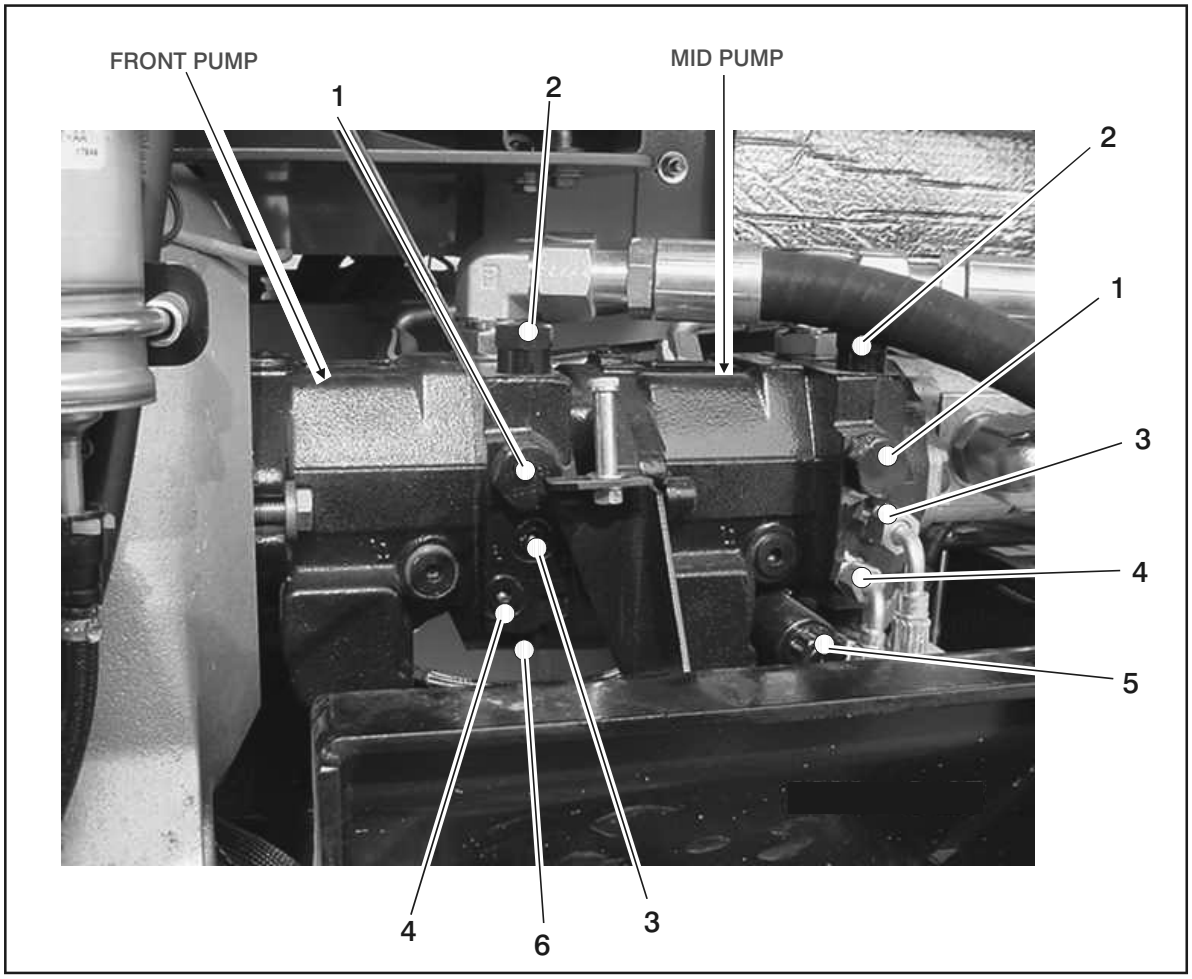


Figure 4-16. Pump Pressure Locations

Table 4-3. Pump Pressure

Valve	Pressure
1. Charge Pump Relief	320 psi
2. Cross Relief Pressure	3000 psi
3.G Port	4800 psi
4. PS Port	4800 psi
5. Coil	N/A
6. Cross Relief Pressure	N/A

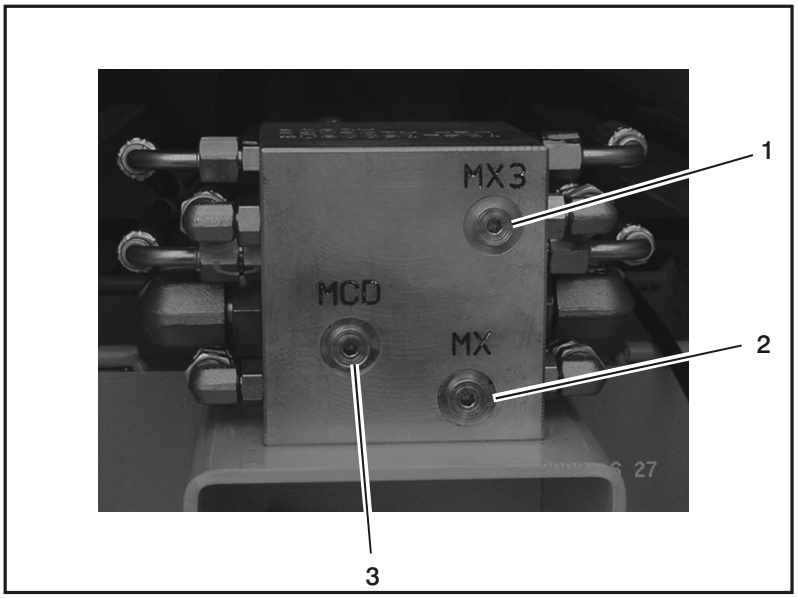


Figure 4-17. Brake, Two Speed and Case Drain Pressures

1. MX3
2. MX
3. MCD

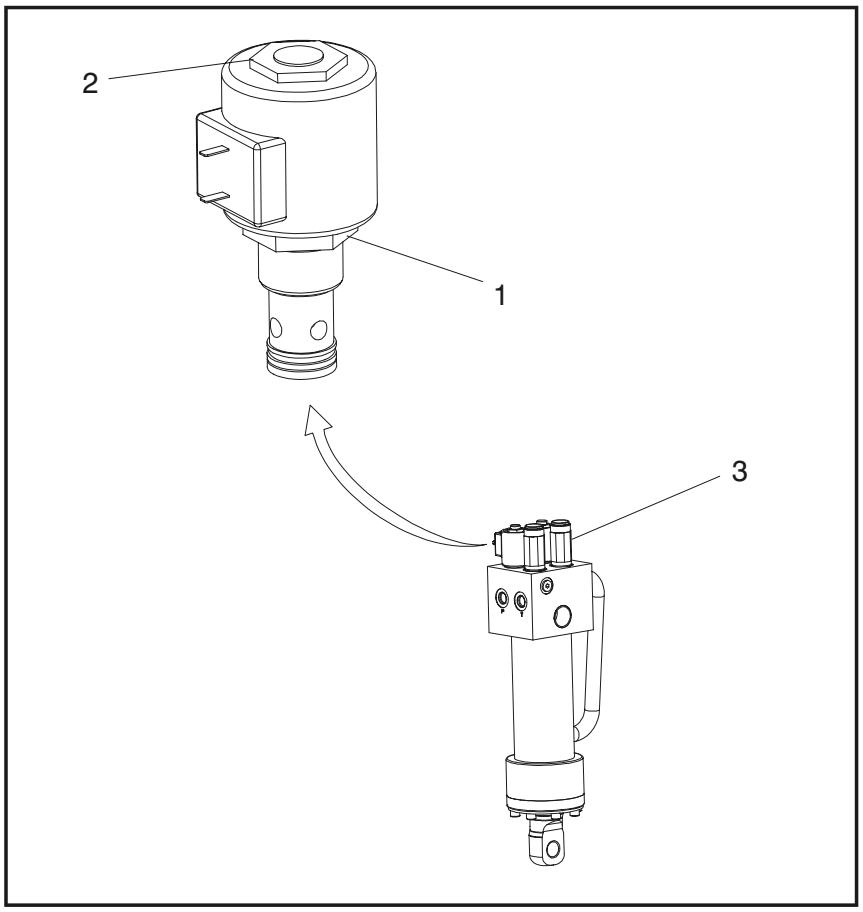
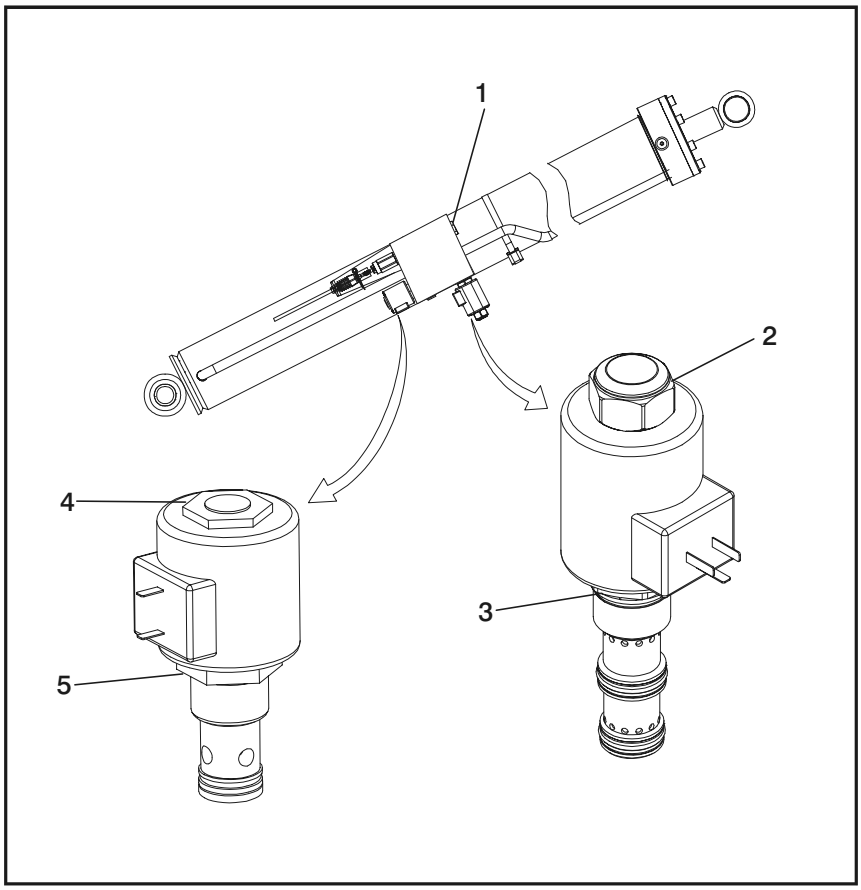


Table 4-3. Cartridge Torque Values

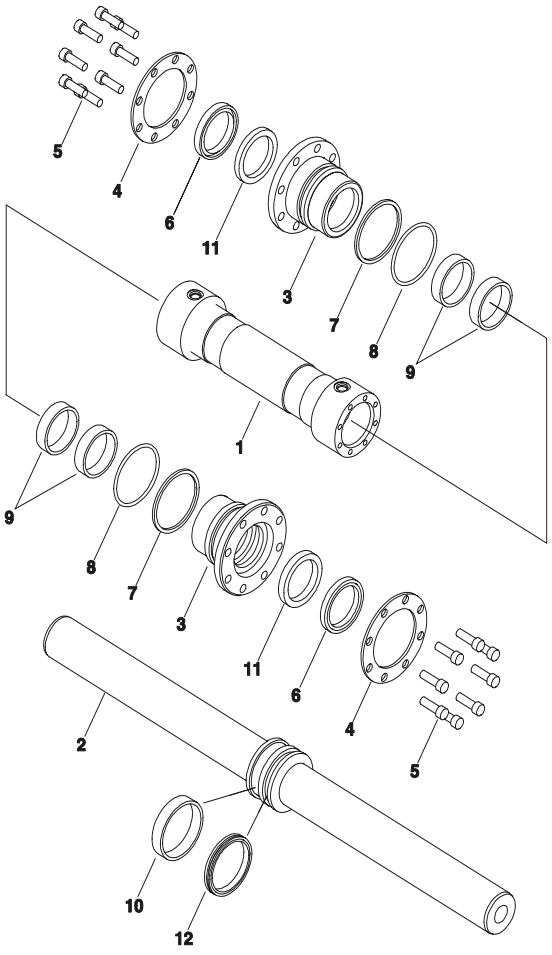
	Ft-Lbs	Nm
1	18.5 - 22	25 - 30
2	3 - 4.5	4.2 - 6.3
3	20 - 25	28 - 35

Figure 4-18. Oscillating Axle Valve Cartridge Torque Values



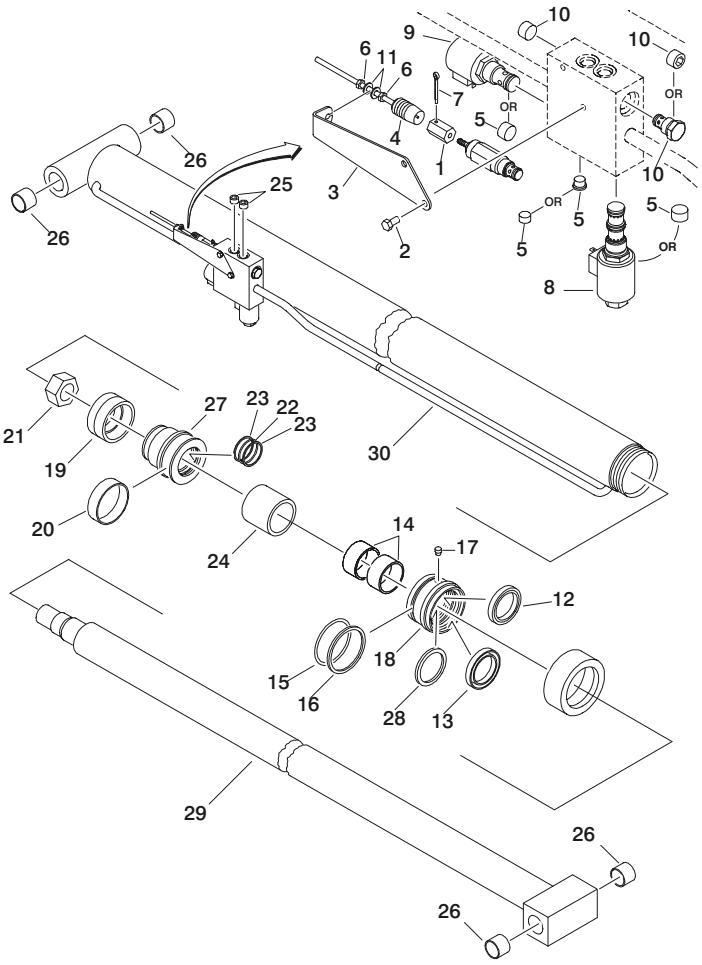
1. 25 ft. lbs. (35 Nm)
2. 10 - 12 ft. lbs. (14 - 17 Nm)
3. 35 ft. lbs. (49 Nm)
4. 5 ft. lbs. (7 Nm)
5. 30 ft. lbs. (42 Nm)

Figure 4-18. Lift Cylinder Valve Cartridge Torque Values



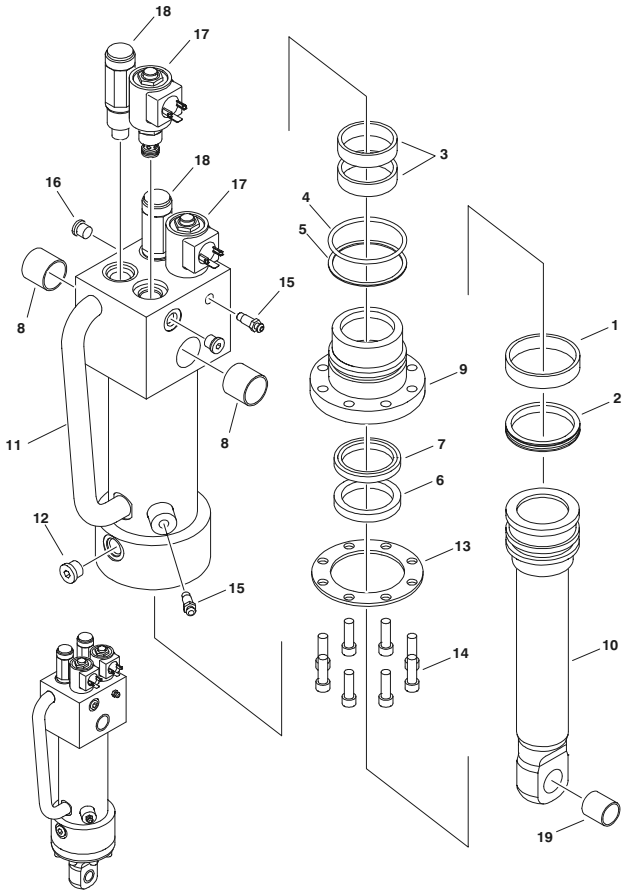
1. BARREL
2. ROD
3. CAP
4. RING, WASHER
5. SOCKET HEAD BOLT
6. WIPER
7. RING, BACK-UP
8. O-RING
9. RING, WEAR
10. RING, WEAR
11. SEAL
12. T-SEAL

Figure 4-19. Steer Cylinder



1. CABLE ADAPTER
2. BOLT
3. BRACKET
4. MANUAL DESCENT CABLE
5. PLUG, O-RING
6. JAM NUT
7. COTTER PIN
8. CARTRIDGE, LIFT HOLDING SOLENOID
9. CARTRIDGE, LIFT HOLDING SOLENOID
10. CARTRIDGE, CHECK
11. FLAT WASHER
12. WIPER
13. SEAL
14. RING, WEAR
15. SEAL
16. RING, BACK-UP
17. SETSCREW
18. HEAD
19. SEAL
20. RING, WEAR
21. NUT
22. SEAL
23. RING, BACK-UP
24. SPACER
25. PLUG, O-RING
26. BUSHING
27. PISTON
28. SEAL
29. ROD
30. BARREL

Figure 4-20. Lift Cylinder



1. RING, WEAR
2. T-SEAL
3. RING, WEAR
4. O-RING
5. RING, BACK-UP
6. SEAL, WIPER
7. POLYSEAL
8. BUSHING
9. HEAD
10. ROD
11. BARREL
12. PLUG, O-RING
13. RING, WASHER
14. CAPSCREW
15. BLEEDER
16. PLUG, O-RING
17. SOLENOID
18. RELIEF VALVE
19. BEARING

Figure 4-21. Oscillating Axle Cylinder

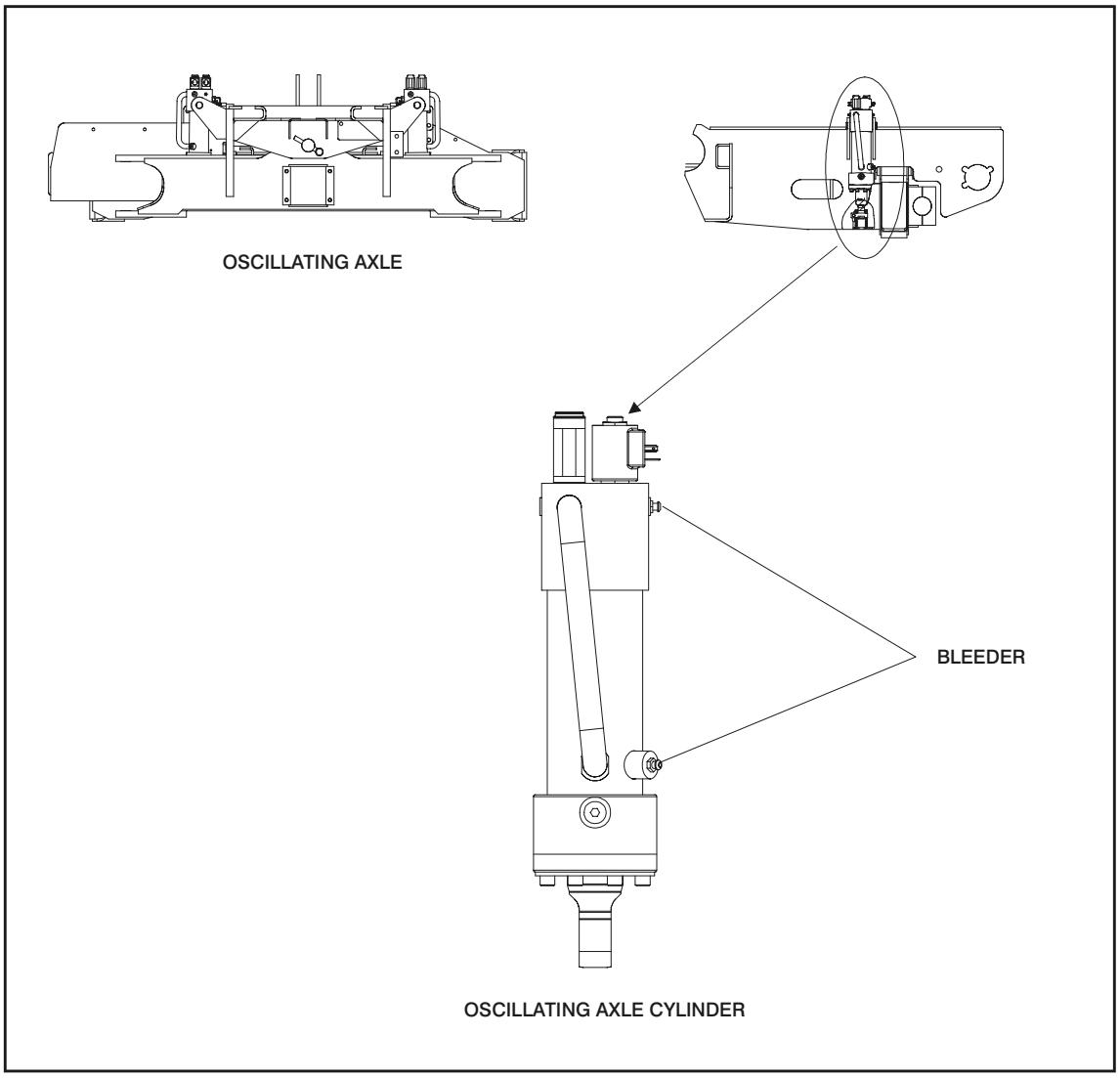


Figure 4-22. Oscillating Axle Bleeding

4.10 OSCILLATING AXLE BLEEDING PROCEDURE

1. Attach 1/4" hose to bleeder valve to capture oil
2. Oscillate axle fully in one direction.
3. Open the bleeder valve at the top of the retracted cylinder approx. 1/2 turn and open bleeder valve at the bottom of extended cylinder approx. 1/2 turn.
4. Run pump for 10 seconds, close bleeder valves.
5. Oscillate axle fully in the opposite direction and repeat steps 3 and 4.

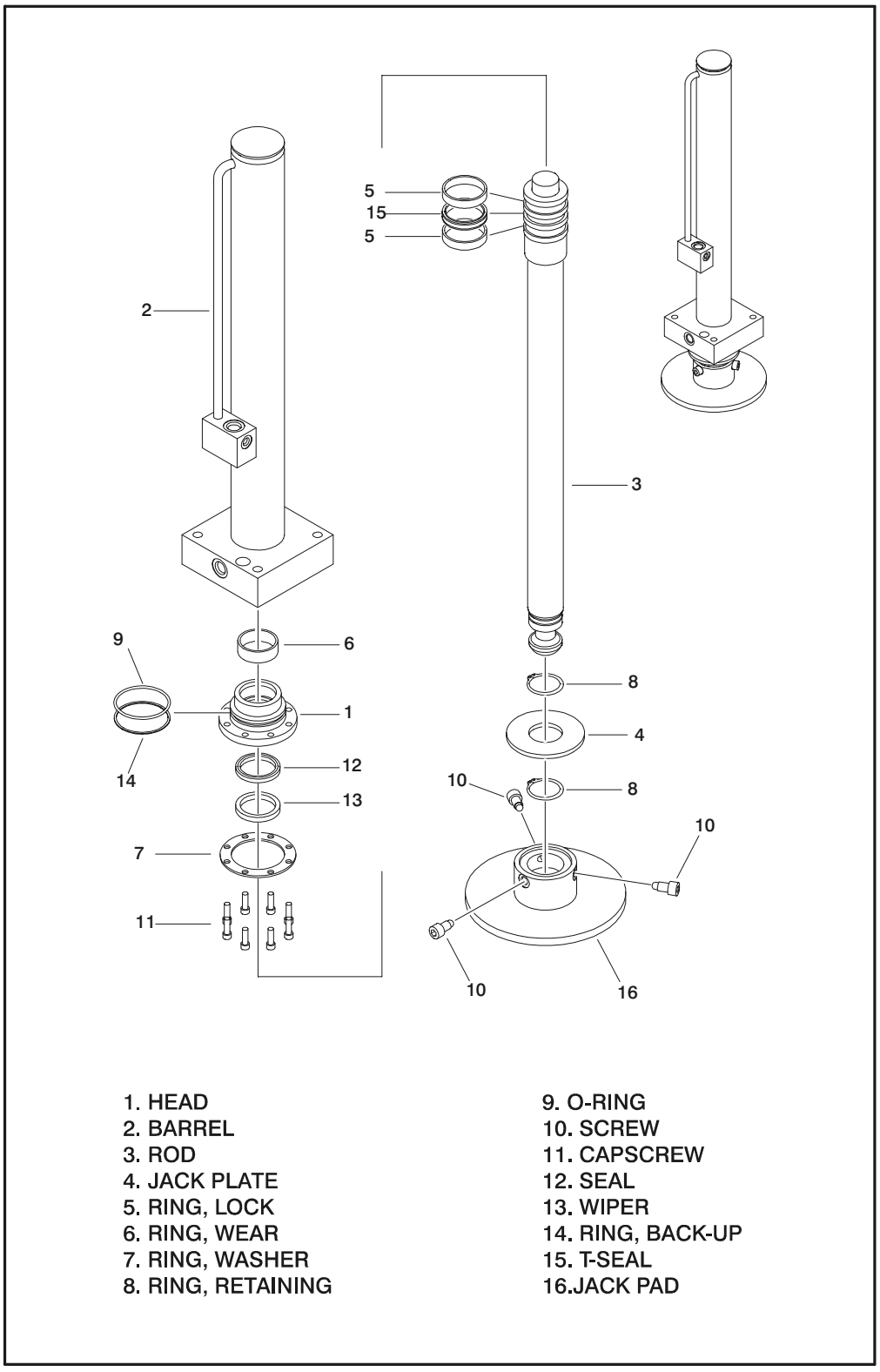


Figure 4-23. Leveling Jack Cylinder

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SECTION 5. JLG CONTROL SYSTEM

5.1 ELECTRONIC CONTROL SYSTEM

To Connect the Hand Held Analyzer:

1. Connect the four pin end of the cable supplied with the analyzer, to the four position connector on the PCB in the ground control station or at the platform control station as shown in. Connect the remaining end of the cable to the analyzer.

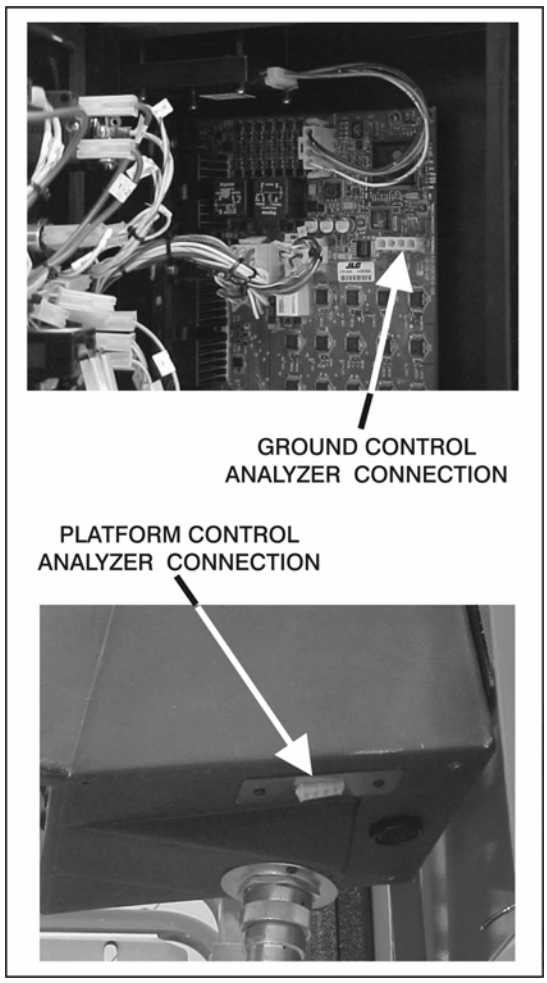


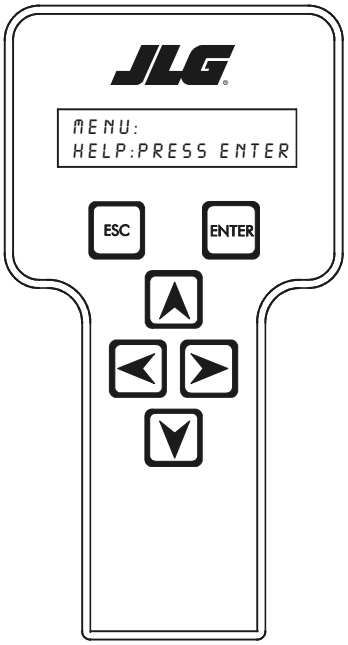
Figure 5-1. Analyzer Connection

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

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

Using the Analyzer:

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



HELP:

PRESS ENTER

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

The top level menus are as follows:

HELP

DIAGNOSTICS

ACCESS LEVEL

PERSONALITIES

MACHINE SETUP

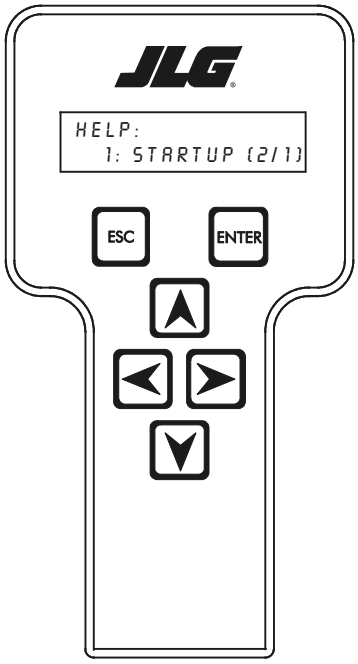
ACTIVATE TESTS

CALIBRATION

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

In platform mode**, HELP: EVERYTHING OK,**
In ground mode**, GROUND MODE OK**

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



LOGGED HELP

1: STARTUP (2/1): (Or last recorded fault**)**

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

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

DRIVE

LIFT

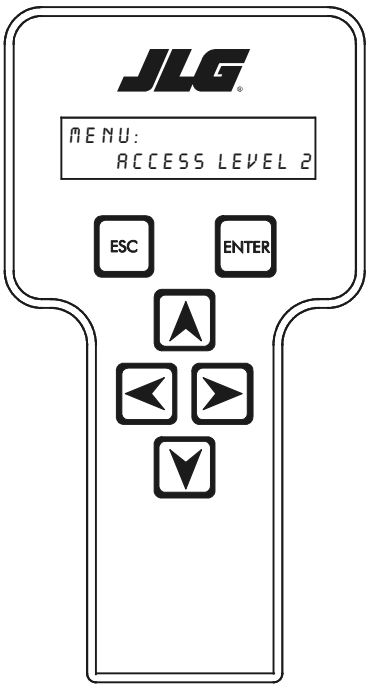
STEER

GROUND

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

Changing the Access Level of the Hand Held Analyzer:

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



MENU:

ACCESS LEVEL 2

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

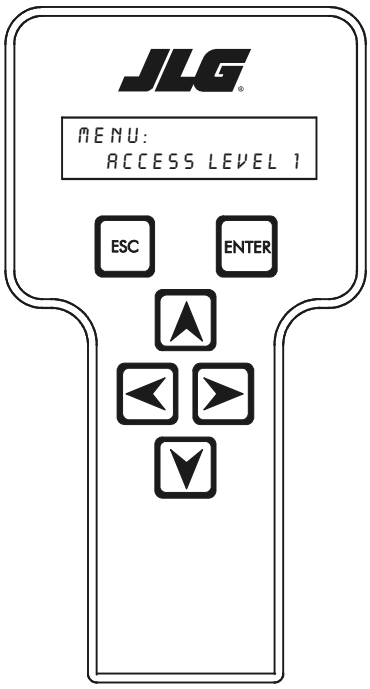
Using the **UP** or **DOWN** arrow keys, enter the first digit of the password, 3.

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

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

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

Once the correct password is displayed, press **ENTER**. The access level should display the following, if the password was entered correctly:



MENU:

ACCESS LEVEL 1

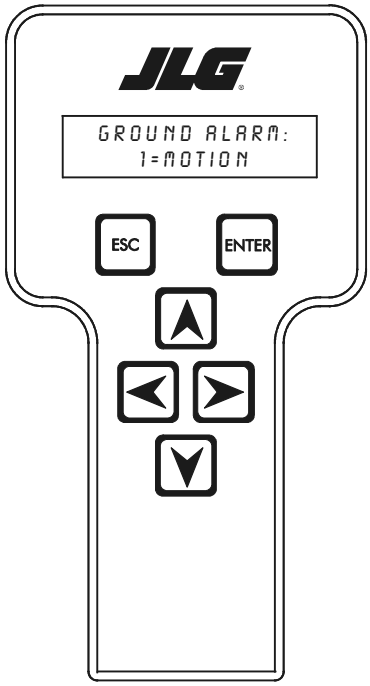
Repeat the above steps if the correct access level is not displayed or you can not adjust the personality settings:

Machine Setup

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

⚠ WARNING

FAILURE TO MAKE THE PROPER SETTINGS FOR THE PARTICULAR MACHINE CAN RESULT IN IMPROPER OPERATION.



GROUND ALARM:

1=MOTION

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

When selecting the machine model to match the size of the machine, the personality settings will return to default settings.

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

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

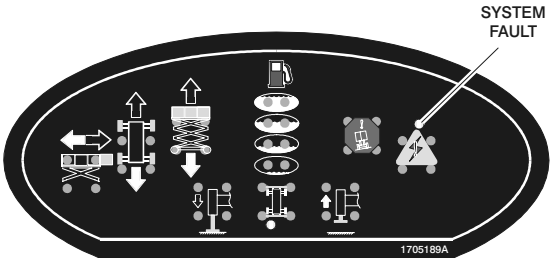
⚠ WARNING

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

⚠ IMPORTANT

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

The flash code is indicated on the face of the platform control box as shown:



NOTE: *Flash codes are also displayed on the handheld analyzer. For descriptions see,Table 5-1, Fault Code LIsting*

5.2 FLASH CODES AND DESCRIPTIONS

Table 5-1. Fault Code LIsting

HELP MESSAGE	FAULT		FAULT REMOVAL
OK	0	0	REPORTS FAULT ONLY
FUNCTION SELECTED BUT TRIGGER SWITCH OPEN	0	0	REPORTS FAULT ONLY
RUNNING AT CUTBACK - ABOVE ELEVATION	0	0	REPORTS FAULT ONLY
STARTUP	2	1	CLEARS WHEN FAULT IS REMOVED
JOYSTICK MOVED BUT NO FUNCTION SELECTED	2	2	CLEARS WHEN FAULT IS REMOVED
TRIGGER SWITCH WIRING SHORTED HIGH IN PLATFORM	2	2	CLEARS WHEN FAULT IS REMOVED
TRIGGER SWITCH WIRING SHORTED LOW IN PLATFORM	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - DRIVE SELECT PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - LIFT SELECT PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - FRONT DECK PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - REAR DECK PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - START PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - STEER LEFT PERMANENLTY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - STEER RIGHT PERMANENLTY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GLOW PLUG SWITCH PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - AUX POWER SWITCH PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GENERATOR SWITCH PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - AUTOLEVEL SWITCH PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
TRIGGER CLOSED TOO LONG WHILE IN NEUTRAL	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - JOYSTICK NOT CENTERED	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - TRIGGER SWITCH PERMANENTLY CLOSED	2	2	CLEARS WHEN FAULT IS REMOVED
JOYSTICK FAULTY - STEER SWITCHES ACTIVE TOGETHER	2	2	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND LIFT UP PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND LIFT DN PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND F. DECK EXT PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND F. DECK RET PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND REAR DECK EXT PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
FUNCTION LOCKED OUT - GROUND REAR DECK RET PERMANENTLY CLOSED	2	3	CLEARS WHEN FAULT IS REMOVED
GROUND LIFT UP/DOWN ACTIVE TOGETHER	2	3	CLEARS WHEN FAULT IS REMOVED
GROUND FRONT DECK EXTEND/RETRACT ACTIVE TOGETHER	2	3	CLEARS WHEN FAULT IS REMOVED
GROUND REAR DECK EXTEND/RETRACT ACTIVE TOGETHER	2	3	CLEARS WHEN FAULT IS REMOVED
NO SIGNAL FROM TILT SENSOR X AXIS - CHECK WIRING	2	3	REPORTS FAULT ONLY
NO SIGNAL FROM TILT SENSOR Y AXIS - CHECK WIRING	2	3	REPORTS FAULT ONLY
LEVEL SENSOR FAILURE	2	3	REPORTS FAULT ONLY
ELEV ANGLE SENSOR FAULTY - NOT MOUNTED OR VOLTAGE OUT OF RANGE	2	5	CLEARS WHEN FAULT IS REMOVED
ELEV ANGLE SENSOR HAS NOT BEEN CALIBRATED	2	5	CLEARS WHEN FAULT IS REMOVED
ELEVATION PROX SWITCH PERMANENTLY CLOSED	2	5	REPORTS FAULT ONLY
ELEVATION PROX SWITCH PERMANENTLY OPEN	2	5	REPORTS FAULT ONLY
FRONT LEFT LEVELING JACK AT END OF STROKE	2	5	CLEARS WHEN FAULT IS REMOVED

Table 5-1. Fault Code LIsting

FRONT RIGHT LEVELING JACK AT END OF STROKE	2	5	CLEARS WHEN FAULT IS REMOVED
REAR LEFT LEVELING JACK AT END OF STROKE	2	5	CLEARS WHEN FAULT IS REMOVED
FRONT RIGHT LEVELING JACK AT END OF STROKE	2	5	CLEARS WHEN FAULT IS REMOVED
FRONT LEFT LEVELING JACK PRESSURE TRANSDUCER FAILURE	2	5	CLEARS WHEN FAULT IS REMOVED
FRONT RIGHT LEVELING JACK PRESSURE TRANSDUCER FAILURE	2	5	CLEARS WHEN FAULT IS REMOVED
REAR LEFT LEVELING JACK PRESSURE TRANSDUCER FAILURE	2	5	CLEARS WHEN FAULT IS REMOVED
REAR RIGHT LEVELING JACK PRESSURE TRANSDUCER FAILURE	2	5	CLEARS WHEN FAULT IS REMOVED
CAN NOT LEVEL	2	5	CLEARS WHEN FAULT IS REMOVED
FUEL SENSOR SHORT TO BATTERY	4	3	REPORTS FAULT ONLY
FUEL SENSOR SHORT TO GROUND	4	3	REPORTS FAULT ONLY
FUEL SENSOR DISCONNECTED	4	3	REPORTS FAULT ONLY
OIL PRESSURE SHORT TO BATTERY	4	3	CLEARS WHEN FAULT IS REMOVED
OIL PRESSURE SHORT OT GROUND	4	3	CLEARS WHEN FAULT IS REMOVED
COOLANT TEMPERATURE SHORT TO GROUND	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 12	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 13	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 14	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 15	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 21	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 22	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 23	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 24	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 25	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 26	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 31	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 32	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 33	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 34	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 35	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 36	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 41	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 42	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 43	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 44	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 45	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 46	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 51	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 52	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 53	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 54	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 55	4	3	CLEARS WHEN FAULT IS REMOVED

Table 5-1. Fault Code LIsting

FORD FAULT CODE 56	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 57	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 61	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 62	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 63	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE 64	4	3	CLEARS WHEN FAULT IS REMOVED
FORD FAULT CODE UNKNOWN	4	3	CLEARS WHEN FAULT IS REMOVED
BATTERY LOW	4	4	CLEARS WHEN FAULT IS REMOVED
BATTERY TOO HIGH - SYSTEM SHUT DOWN	4	4	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT
BATTERY TOO LOW - SYSTEM SHUT DOWN	4	4	CLEARS WHEN FAULT IS REMOVED
SPEED SENSOR READING INVALID SPEED	5	5	CLEARS WHEN FAULT IS REMOVED
SPEED INPUT LOSS	5	5	CLEARS WHEN FAULT IS REMOVED
ENGINE TEMPERATURE HIGH	4	3	CLEARS WHEN FAULT IS REMOVED
NO ALTERNATOR OUTPUT	4	3	CLEARS WHEN FAULT IS REMOVED
OIL PRESSURE LOW	4	3	CLEARS WHEN FAULT IS REMOVED
485 COMMUNICATIONS LOST	4	3	CLEARS WHEN FAULT IS REMOVED
CAN BUS FAILURE	6	6	CLEARS WHEN FAULT IS REMOVED
EEPROM FAILURE - CHECK ALL SETTINGS	9	9	REQUIRES EMS TO BE RECYCLED TO CLEAR FAULT

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
None		**No flash code is indicated for the following help messages. They are intended to hint at a possible problem if the vehicle is not behaving as expected.**	
None	FUNCTION SELECTED BUT TRIGGER SWITCH OPEN	Reported when the trigger is not closed with function selected and joystick out of center.	
None	RUNNING AT CUTBACK – ABOVE ELEVATION	Reported any time the machine is considered to be above elevation.	
None	ACCESSORY FAULT	Reports when CAN faults are reported by an accessory module.	1
None	FRONT LEFT LEVELING JACK AT END OF STROKE	Reported when the front left leveling jack is reported to be at the end of stroke pressure.	
None	FRONT RIGHT LEVELING JACK AT END OF STROKE	Reported when the front right leveling jack is reported to be at the end of stroke pressure.	
None	REAR LEFT LEVELING JACK AT END OF STROKE	Reported when the rear left leveling jack is reported to be at the end of stroke pressure.	
None	REAR RIGHT LEVELING JACK AT END OF STROKE	Reported when the rear right leveling jack is reported to be at the end of stroke pressure.	
2/1		**Flash code 2/1 indicates issues at power up.**	
2/1	KEYSWITCH FAULTY – PLATFORM & GROUND ACTIVE TOGETHER	Reported when the ground module is reading both ground and platform modes are selected by the keyswitch. The control system defaults control to ground mode.	2

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/2		Flash code 2/2 indicates difficultly with the platform controls.	
2/2	TRIGGER SWITCH WIRING SHORTED HIGH IN PLATFORM CABLE	Reports when the CAN message coming from the platform board and the DI on ground board conflict.	
2/2	TRIGGER SWITCH WIRING SHORTED LOW IN PLATFORM CABLE	Reports when the CAN message coming from the platform board and the DI on ground board conflict.	
2/2	FUNCTION LOCKED OUT – DRIVE SELECT PERMANENTLY CLOSED	Reported when drive select is closed during power up.	
2/2	FUNCTION LOCKED OUT – LIFT SELECT PERMANENTLY CLOSED	Reported when lift select is closed during power up.	
2/2	FUNCTION LOCKED OUT – FRONT DECK SELECT PERMANENTLY CLOSED	Reported when front deck select is closed during power up.	
2/2	FUNCTION LOCKED OUT – REAR DECK SELECT PERMANENTLY CLOSED	Reported when rear deck select is closed during power up.	
2/2	FUNCTION LOCKED OUT – START PERMANENTLY CLOSED	Reported when the start switch is closed during power up.	
2/2	FUNCTION LOCKED OUT – STEER LEFT PERMANENTLY CLOSED	Reported when the left steer switch is closed during power up.	**3**
2/2	FUNCTION LOCKED OUT – STEER RIGHT PERMANENTLY CLOSED	Reported when the right steer switch is closed during power up.	
2/2	FUNCTION LOCKED OUT – AUX POWER SWITCH PERMANENTLY CLOSED	Reported when the auxiliary switch is closed during power up.	
2/2	FUNCTION LOCKED OUT – GENERATOR SWITCH PERMANENTLY CLOSED	Reported when the generator switch is closed during power up.	
2/2	FUNCTION LOCKED OUT – AUTOLEVEL SWITCH PERMANENTLY CLOSED	Reported when the leveling jack select switch is closed during power up.	
2/2	TRIGGER CLOSED TOO LONG WHILE IN NEUTRAL	Reported when trigger is closed for ten seconds and no function selected.	
2/2	FUNCTION LOCKED OUT – JOYSTICK NOT CENTERED	Reported when joystick is not centered while selecting a function.	
2/2	FUNCTION LOCKED OUT – TRIGGER SWITCH PERMANENTLY CLOSED	Reported when the trigger switch is closed during power up.	
2/2	JOYSTICK FAULTY – STEER SWITCHES ACTIVE TOGETHER	Reported when both the left and right steer switches are closed at the same time.	
2/2	FUNCTION LOCKED OUT – HORN SWITCH PERMANENTLY CLOSED	Reported when the horn switch is closed during power up.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/3		**Flash code 2/3 indicates difficultly with ground controls.**	
2/3	FUNCTION LOCKED OUT – GROUND LIFT UP PERMANENTLY CLOSED	Reported when the ground lift up switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND LIFT DOWN PERMANENTLY CLOSED	Reported when the ground lift down switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND FRONT DECK EXT PERMANENTLY CLOSED	Reported when the ground front deck extend switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND FRONT DECK RET PREMANENTLY CLOSED	Reported when the ground front deck retract switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND REAR DECK EXT PERMANENTLY CLOSED	Reported when the ground rear deck extend switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND REAR DECK RET PERMANENTLY CLOSED	Reported when the ground rear deck retract switch is closed during power up.	
2/3	GROUND LIFT UP/DOWN ACTIVE TOGETHER	Reported when the ground lift up and lift down switches are closed at the same time.	**4**
2/3	GROUND FRONT DECK EXTEND/RETRACT ACTIVE TOGETHER	Reported when the ground front deck extend and retract switches are closed at the same time.	
2/3	GROUND REAR DECK EXTEND/RETRACT ACTIVE TOGETHER	Reported when the ground rear deck extend and retract switches are closed at the same time.	
2/3	NO SIGNAL FROM TILT SENSOR X AXIS – CHECK WIRING	Reported when sensor X-axis value is not valid.	
2/3	NO SIGNAL FROM TILT SENSOR Y AXIS – CHECK WIRING	Reported when sensor Y-axis value is not valid.	
2/3	LEVEL SENSOR FAILURE	Reported when the tilt sensor frequency is outside the range of acceptable value.	
2/3	FUNCTION LOCKED OUT – GROUND AUX SWITCH PERMANENTLY CLOSED	Reported when the ground auxiliary power switch is closed during power up.	
2/3	FUNCTION LOCKED OUT – GROUND START SWITCH PERMANENTLY CLOSED	Reported when the ground start switch is closed during power up.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/5		**Flash code 2/5 indicates issues that may cutout functions.**	**5**
2/5	ELEV ANGLE SENSOR FAULTY – NOT MOUNTED OR VOLTAGE OUT OF RANGE	Reported when the elevation rotary sensor voltage is outside the range of acceptable values.	
2/5	ELEV ANGLE SENSOR HAS NOT BEEN CALIBRATED	Reported when the rotary calibration value does not exist.	
2/5	ELEVATION PROX SWITCH PERMANENTLY CLOSED	Reported when the elevation rotary sensor is reporting above elevation and the elevation proximity switch is still closed.	
2/5	ELEVATION PROX SWITCH PERMANENTLY OPEN	Reported when the elevation rotary sensor is reporting stowed and the elevation proximity switch is open.	
2/5	FRONT LEFT LEVELING JACK PRESSURE TRANSDUCER FAILURE	Reported when the front left leveling jack pressure reading is well below 0PSI.	
2/5	FRONT RIGHT LEVELING JACK PRESSURE TRANSDUCER FAILURE	Reported when the front right leveling jack pressure reading is well below 0PSI.	
2/5	REAR LEFT LEVELING JACK PRESSURE TRANSDUCER FAILURE	Reported when the rear left leveling jack pressure reading is well below 0PSI.	
2/5	REAR RIGHT LEVELING JACK PRESSURE TRANSDUCER FAILURE	Reported when the rear right leveling jack pressure reading is well below 0PSI.	
2/5	PLATFORM OVERLOAD	Reported when the overload is setup and the LSS is reading the platform is overloaded.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/6		**Flash code 2/6 indicates leveling jack or power deck issues.**	**6**
2/6	FRONT LEFT LEVELING JACK OPEN CIRCUIT	Reported by the I/O module and during system test when the front left leveling jack is open circuit.	
2/6	FRONT LEFT LEVELING JACK SHORT TO GROUND	Reported by the I/O module and during system test when the front left leveling jack is short to ground.	
2/6	FRONT LEFT LEVELING JACK SHORT TO BATTERY	Reported by the I/O module and during system test when the front left leveling jack is short to battery.	
2/6	FRONT RIGHT LEVELING JACK OPEN CIRCUIT	Reported by the I/O module and during system test when the front right leveling jack is open circuit.	
2/6	FRONT RIGHT LEVELING JACK SHORT TO GROUND	Reported by the I/O module and during system test when the front right leveling jack is short to ground.	
2/6	FRONT RIGHT LEVELING JACK SHORT TO BATTERY	Reported by the I/O module and during system test when the front right leveling jack is short to battery.	
2/6	REAR LEFT LEVELING JACK OPEN CIRCUIT	Reported by the I/O module and during system test when the rear left leveling jack is open circuit.	
2/6	REAR LEFT LEVELING JACK SHORT TO GROUND	Reported by the I/O module and during system test when the rear left leveling jack is short to ground.	
2/6	REAR LEFT LEVELING JACK SHORT TO BATTERY	Reported by the I/O module and during system test when the rear left leveling jack is short to battery.	
2/6	REAR RIGHT LEVELING JACK OPEN CIRCUIT	Reported by the I/O module and during system test when the rear right leveling jack is open circuit.	
2/6	REAR RIGHT LEVELING JACK SHORT TO GROUND	Reported by the I/O module and during system test when the rear right leveling jack is short to ground.	
2/6	REAR RIGHT LEVELING JACK SHORT TO BATTERY	Reported by the I/O module and during system test when the rear right leveling jack is short to battery.	
2/6	LEVELING JACK EXTEND VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the leveling jack extend valve is open circuit.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
2/6	LEVELING JACK EXTEND VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the leveling jack extend valve is short to ground.	6
2/6	LEVELING JACK EXTEND VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the leveling jack extend valve is short to battery.	
2/6	LEVELING JACK RETRACT VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the leveling jack retract valve is open circuit.	
2/6	LEVELING JACK RETRACT VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the leveling jack retract valve is short to ground.	
2/6	LEVELING JACK RETRACT VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the leveling jack retract valve is short to battery.	
2/6	FRONT DECK EXTEND VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the front deck extend valve is open circuit.	
2/6	FRONT DECK EXTEND VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the front deck extend valve is short to ground.	
2/6	FRONT DECK EXTEND VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the front deck extend valve is short to battery.	
2/6	FRONT DECK RETRACT VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the front deck retract valve is open circuit.	
2/6	FRONT DECK RETRACT VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the front deck retract valve is short to ground.	
2/6	FRONT DECK RETRACT VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the front deck retract valve is short to battery.	
2/6	REAR DECK EXTEND VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the rear deck extend valve is open circuit.	
2/6	REAR DECK EXTEND VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the rear deck extend valve is short to ground.	
2/6	REAR DECK EXTEND VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the rear deck extend valve is short to battery.	
2/6	REAR DECK RETRACT VALVE OPEN CIRCUIT	Reported by the I/O module and during system test when the rear deck retract valve is open circuit.	
2/6	REAR DECK RETRACT VALVE SHORT TO GROUND	Reported by the I/O module and during system test when the rear deck retract valve is short to ground.	
2/6	REAR DECK RETRACT VALVE SHORT TO BATTERY	Reported by the I/O module and during system test when the rear deck retract valve is short to battery.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
4/3		**Flash code 4/3 indicates engine issues.**	
4/3	FUEL SENSOR SHORT TO BATTERY	Reported when the fuel sensor is reading a value that is much too high.	
4/3	FUEL SENSOR SHORT TO GROUND	Reported when the fuel sensor is reading ground.	
4/3	FUEL SENSOR DISCONNECTED	Reported when the fuel sensor is reading a value that is too high.	
4/3	OIL PRESSURE SHORT TO BATTERY	Reported when the oil pressure sensor is reading a value that is too high.	
4/3	OIL PRESSURE SHORT TO GROUND	Reported when the oil pressure sensor is reading a value that is too low.	
4/3	COOLANT TEMPERATURE SHORT TO GROUND	Reported when the coolant temperature sensor is reading a value that is too low.	
4/3	FORD FAULT CODE	Reported by the Ford engine.	**7**
4/3	ENGINE TEMPERATURE HIGH	This fault is not reported at this time.	
4/3	AIR FILTER BYPASSED	This fault is not reported at this time.	
4/3	NO ALTERNATOR OUTPUT	Reported when the engine is running for at least a few seconds and the alternator input is on the ground board is high.	
4/3	OIL PRESSURE LOW	Reported when the oil pressure is below eight PSI and the engine is running for at least a few seconds.	
4/3	485 COMMUNICATIONS LOST	Reported when a Ford engine is selected and communications with the Ford engine controller are lost.	
4/3	ENGINE SHUTDOWN COMMANDED – CHECK ENGINE SENSORS	Reported when the engine is commanded to shutdown by the control system.	
4/4		**Flash code 4/4 indicates a battery supply issue.**	
4/4	BATTERY LOW	Reported when the voltage on the system is below 11 volts.	
4/4	BATTERY TOO HIGH – SYSTEM SHUTDOWN	Reported when the voltage on the system is above 16 volts.	
4/4	BATTERY TOO LOW – SYSTEM SHUTDOWN	Reported when the voltage on the system is below 9 volts.	**8**
4/4	LSS BATTERY VOLTAGE HIGH	Reported when the voltage on the LSS is above 34 volts.	
4/4	LSS BATTERY VOLTAGE LOW	Reported when the voltage on the LSS is below 9 volts.	
5/5		**Flash code 5/5 indicates a speed sensor issue.**	
5/5	SPEED SENSOR READING INVALID SPEED	Reported when the speed sensor is reading a value over 4000 RPM.	**9**
5/5	SPEED INPUT LOST	Reported when the speed sensor is reading zero RPM and the oil pressure is over eight PSI.	

Table 5-2. Fault Code Listing - Software Version 1.14

Fault Flash Code	Communicated (Displayed on Analyzer) Fault	Description	Priority
6/6		Flash code 6/6 indicates CANbus issues.	
6/6	CAN BUS FAILURE	Reported when there is a problem with the CANbus.	**10**
6/6	LSS NOT SENDING CAN MESSAGES	Reported when the LSS is configured and not seen on the CANbus.	
8/*		**Flash codes 8/* indicate load cells issues.**	
8/1	LSS CELL #1 ERROR	Reported when there is a problem with cell #1 on the LSS.	
8/2	LSS CELL #2 ERROR	Reported when there is a problem with cell #2 on the LSS.	**11**
8/3	LSS CELL #3 ERROR	Reported when there is a problem with cell #3 on the LSS.	
8/4	LSS CELL #4 ERROR	Reported when there is a problem with cell #4 on the LSS.	
9/*		**Flash codes 9/* indicate LSS or memory issues.**	
9/1	LSS WATCHDOG RESET	Reported when the LSS's microprocessor watchdog has been triggered.	
9/2	LSS EEPROM ERROR	Reported when there is a problem with the stored memory in the LSS.	
9/3	LSS HAS NOT BEEN CALIBRATED	Reported when the LSS is configured but not calibrated.	
9/9	LSS NEEDS TO BE RE-CALIBRATED	Reported when the LSS is configured and reporting a value that is less than half of the off-set value; this will be reported as a negative value.	**12**
9/9	LSS INTERNAL ERROR – PIN EXCITATION	Reported when a pin in the LSS is reporting a voltage below 4.25 volts.	
9/9	LSS INTERNAL ERROR – DRIVER FAULT	Reported when the LSS detects this internal error.	
9/9	LSS INTERNAL ERROR – DRDY MISSING FROM A/D	Reported when the LSS detects this internal error.	
9/9	EEPROM FAILURE – CHECK ALL SETTINGS	Reported when the memory in the ground or platform module has become corrupt.	

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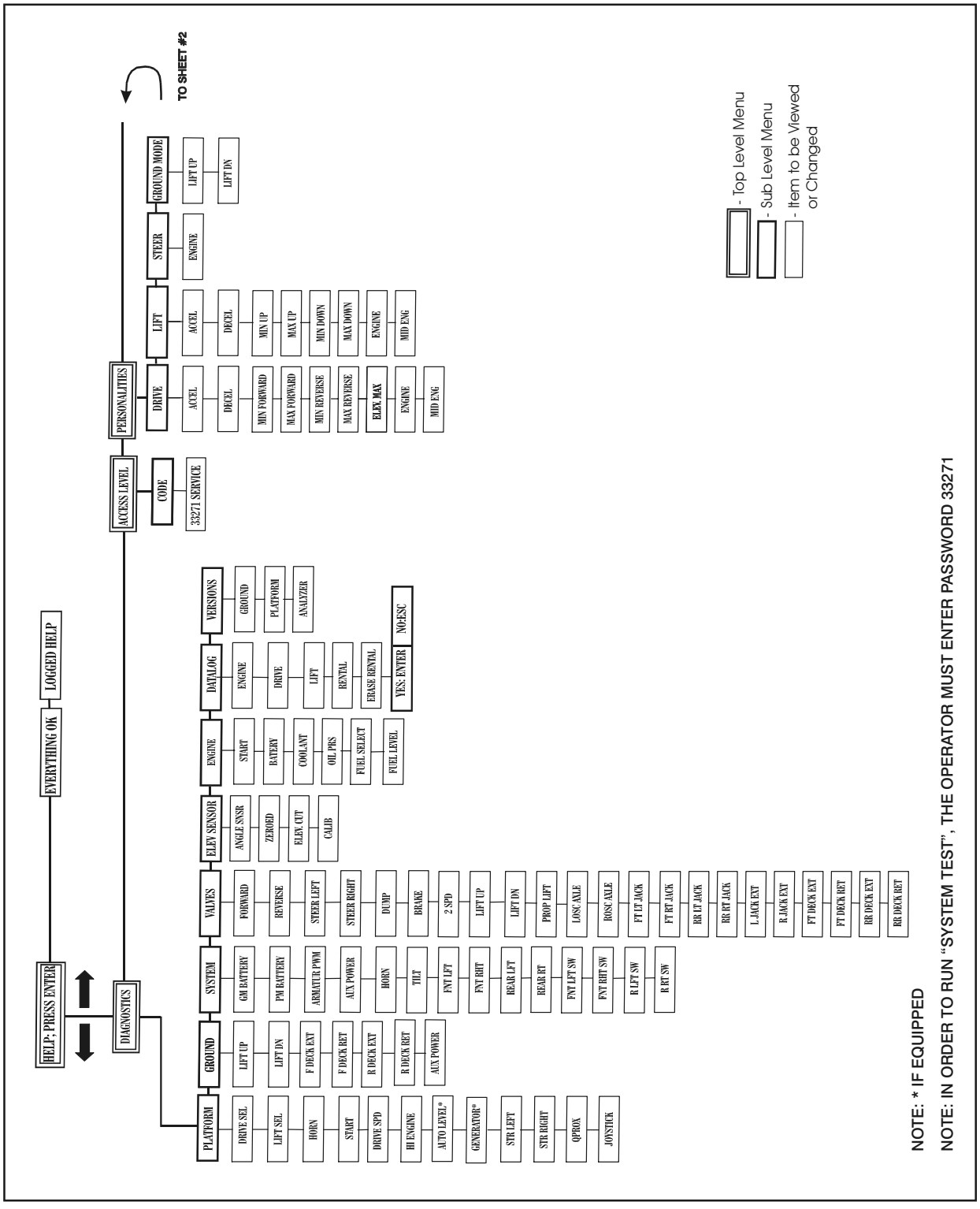

Figure 5-2. Analyzer Flow Chart - Sheet 1

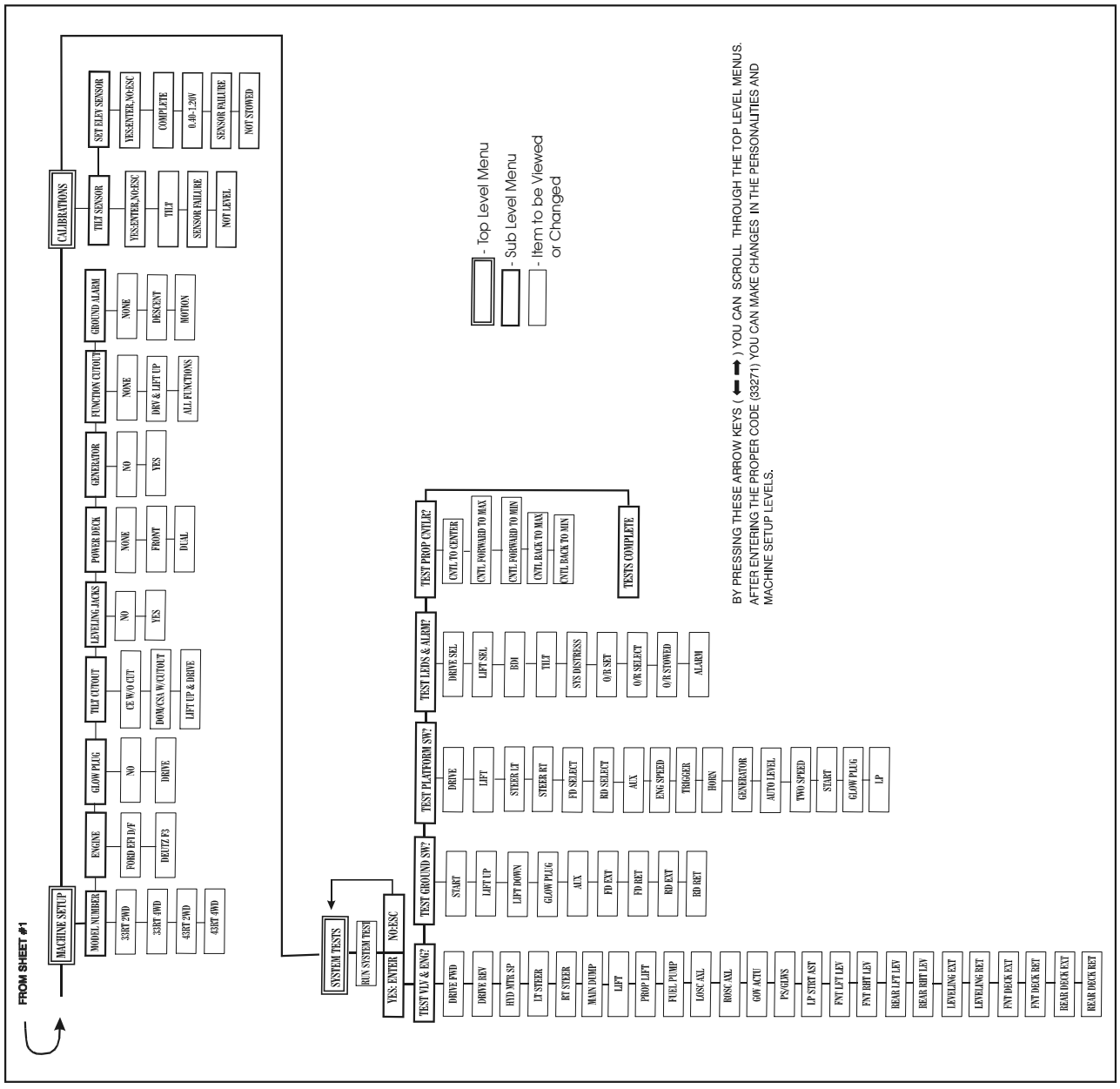

Figure 5-3. Analyzer Flow Chart - Sheet 2

Table 5-3. Machine Model Adjustment

Adjustment	Adjustment Range	Default - 3394RT 2WD	Default - 3394RT 4WD	Default - 4394RT 2WD	Default - 4394RT 4WD
DRIVE					
ACCEL	0.1 - 5.0 (Sec)	3	3	3	3
DECEL	0.1 - 3.0 (Sec)	1.2	1.2	1.2	1.2
DRIVE FORWARD MIN	0 - 35%	24	24	24	24
DRIVE FORWARD MAX	0 -100%	70	70	70	70
DRIVE REVERSE MIN	0 - 35%	24	24	24	24
DRIVE REVERSE MAX	0 -100%	70	70	70	70
MAX ENGINE SPD	800 - 2900RPM	2800	2800	2800	2800
MID ENGINE SPD	800 - 2700RPM	2000	2000	2000	2000
DRIVE ELEVATED	20 - 50%	41	41	41	41
LIFT					
LIFT UP ACCEL	0.1 - 5.0 (Sec)	2	2	2	2
LIFT UP DECEL	0.8 - 1.5 (Sec)	1	1	1	1
LIFT UP MIN	0 - 35%	12	12	12	12
LIFT UP MAX	0 - 65%	55	55	45	45
LIFT DOWN MIN	0 - 35%	12	12	12	12
LIFT DOWN MAX	0 - 65%	55	55	40	40
LIFT UP ENGINE SPD MAX	800 - 2900RPM	2800	2800	2800	2800
LIFT UP ENGINE SPD MID	800 - 2700RPM	2000	2000	2000	2000
STEER					
ENGINE SPD	800 - 2900RPM	2800	2800	2800	2800
GROUND					
LIFT UP MAX	0 - 65%	55	55	45	45
LIFT DOWN MAX	0 - 65%	55	55	40	40
LOAD					
OVERLOAD	1000 - 2700 lbs (454 - 1225 kg)	2475 (1123 kg)	2475 (1123 kg)	1650 (748 kg)	1650 (748 kg)
OVERLOAD 2	1000 - 2700 lbs (454 - 1225 kg)	1000 lbs (454 kg)	1000 lbs (454 kg)	1000 lbs (454 kg)	1000 lbs (454 kg)
ACC'Y	0 - 500 lbs (0 - 227 kg)	0	0	0	0
OVERLOAD DEBOUNCE	0 - 10 sec	3	3	3	3
OVERLOAD HOLD	1 - 10 sec	5	5	5	5

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NOTE: *These settings may change in order to achieve optimal performance on a machine by machine basis.*

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

Table 5-4. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
1 (Model #)	0 1 2 3	3394RT 2WD 3394RT 4WD 4394RT 2WD 4394RT 4WD	1
2 (Engine)	0 1	FORD EFI D/F DEUTZ F3	0
3 (Glow Plug)	0-60	Time in seconds the glow plugs are on. Only available if DEUTZ is the engine configured	5
4 (Tilt)	0 1 2	CE W/O CUT - Tilt angle is 3° side to side, 5° front to back. ANSI/AUSTRALIAN w/CUT - Cutout lift up and drive if tilted and elevated to the following angles and heights: 3394RT - side to side 5° up to 26 feet 4° 26-30 feet 3° 30 - 33 feet 4394RT - side to side 5° up to 30 feet 4° 30-36 feet 3° 36 - 43 feet 3394RT & 4394RT - front to back 5° to full height (Degree values are nominal) Light activates at the respective angles, the alarm only activates when elevated. CSA W/CUTOUT - Cutout lift up and drive if tilted and elevated. required for CSA market Tilt angle 3°	1
5 (Leveling Jacks)	0 1	No Yes	0
6 (Power Deck)	0 1 2	None Front Dual	0
7 (Generator)	0 1	No Yes	0
8 (Function Cutout)	0 1 2	None Drive & Lift Up (Allows Lift Down) All functions Note: The function cutout input functionality is disabled whenever LSS is enabled.	0
9 (Load)	0 1 2	Not Installed Cutout PLT - Prevents all lift and drive if overloaded in platform mode. Ground control operates normally. Cutout ALL - Prevents all Lift and drive if overloaded no matter which control station is active. Note: Also known as LSS (Load Sense System)	0

Table 5-4. Machine Configuration Programming Information

10 (Ground Alarm)	0 1 2	None Descent Motion	1

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NOTE: *When configuring an RT, the Machine Configuration must be completed before any Personality settings can be changed. Changing the Personality settings first and then changing the Model of the Machine Configuration will cause the Personality settings to return to default values*

NOTE: *Shaded entries are not available for the selected Market*

Table 5-5. Machine Configuration Programming Information

Configuration Digit	Setting	Description	Market Default				
			0	1	2	3	4
1 (MODEL)	0 1 2 3	33RT 2WD 33RT 4WD 43RT 2WD 43RT 4WD	1				
2 (ENGINE)	0 1 2 3	FORD EFI D/F DEUTZ F3 FORD D/F (T2) DEUTZ F3 (T2)	0				
3 (MARKET)	0 1 2 3 4	ANSI USA ANSI EXPORT CSA CE AUSTRALIA	0				
4 (GLOW PLUGS)	0 1 2 3 4 5 6 7	NO GLOW PLUGS 5 SEC GLOW 10 SEC GLOW 20 SEC GLOW 30 SEC GLOW 40 SEC GLOW 50 SEC GLOW 60 SEC GLOW	0				
5 (LEVELING JACKS)	0 1	No - Leveling Jacks not installed on vehicle. YES – Leveling Jacks are installed on vehicle.	0				
6 (POWER DECK)	0 1 2	NONE – Power Deck Extensions not installed on vehicle. FRONT – Power Deck Extension is installed on the Front of the vehicle. DUAL – Power Deck Extensions are installed on the Front and Rear of the vehicle.	0				

Table 5-5. Machine Configuration Programming Information

Configuration Digit	Setting	Description	Market Default				
			0	1	2	3	4
7 (GEN-ERA-TOR)	0	NOT INSTALLED – Generator is not installed on the vehicle.	0				
	1	60HZ – Generator is installed and engine speed set for 2000RPM when enabled.					
	2	50HZ – Generator is installed and engine speed set for 1700RPM when enabled.					
8 (FUNCTION CUTOUT)	0	NOT INSTALLED – Vehicle is not equipped with a Function Cutout device.	0				
	1	DRV & LIFT UP – Vehicle is equipped with a Function Cutout device. Drive and Lift Up will be prevented when active.					
	2	ALL FUNCTIONS – Vehicle is equipped with a Function Cutout device. All Functions will be prevented when active.					
9 (LOAD)	0	NOT INSTALLED – Load Sensing System (LSS) is not fitted to the vehicle.	0	1	0	1	0
	1	CUTOUT PLT – Load Sensing System (LSS) is fitted, and Platform Controls are prevented in the event of an Overload. Ground Controls remain functional. This is the default setting for CE machines.					
	2	CUTOUT ALL – Load Sensing System (LSS) is fitted. Platform and Ground Controls are prevented in the event of an Overload.					
10 (GROUND ALARM)	0	NOT INSTALLED – Vehicle alarm will function for Overload (if LOAD enabled).	2	2	2	0	2
	1	DESCENT – Vehicle alarm will function for Overload (if LOAD enabled) and during Lift Down motion.					
	2	MOTION – Vehicle alarm will function for Overload (if LOAD enabled), during Drive motion, and during Lift motion.					
	ANSI USA						
	ANSI EXPORT						
	CSA						
	CE						
	AUSTRALIA						
43RT 2WD 43RT 4WD	ANSI USA						
	ANSI EXPORT						
	CSA						
	CE						
	AUSTRALIA						

Table 5-6. Machine Tilt Configuration

Model	Market	LImits
33RT 2WD 33RT 4WD	ANSI USA	Lift Up and Drive prevented when Elevated and Tilted beyond the following limits: Front to Back: ±5º to Full Height Side to Side: ±5º to 26 Feet; ±4º to 30 Feet; ±3º to Full Heightv
	ANSI EXPORT	Same as ANSI USA
	CSA	Lift Up and Drive prevented when Elevated and Tilted beyond the following limits: Front to Back: ±3º to Full Height Side to Side: ±3º to Full Height
	CE	Tilt Lamp energized when Tilted beyond the following limits: Front to Back: ±5º to Full Height Side to Side: ±3º to Full Height
	AUSTRALIA	Same as ANSI USA
33RT 2WD 33RT 4WD	ANSI USA	Lift Up and Drive prevented when Elevated and Tilted beyond the following limits: Front to Back: ±5º to Full Height Side to Side: ±5º to 30 Feet; ±4º to 36 Feet; ±3º to Full Height
	ANSI EXPORT	Same as ANSI USA
	CSA	Lift Up and Drive prevented when Elevated and Tilted beyond the following limits: Front to Back: ±3º to Full Height Side to Side: ±3º to Full Height
	CE	Tilt Lamp energized when Tilted beyond the following limits: Front to Back: ±5º to Full Height Side to Side: ±3º to Full Height
	AUSTRALIA	Same as ANSI USA

SECTION 6. SCHEMATICS

6.1 GENERAL

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

6.2 TROUBLESHOOTING

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

It should be recognized that the majority of the problems arising in the machine will be centered in the hydraulic and electrical systems.

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

6.3 HYDRAULIC CIRCUIT CHECKS

The 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.

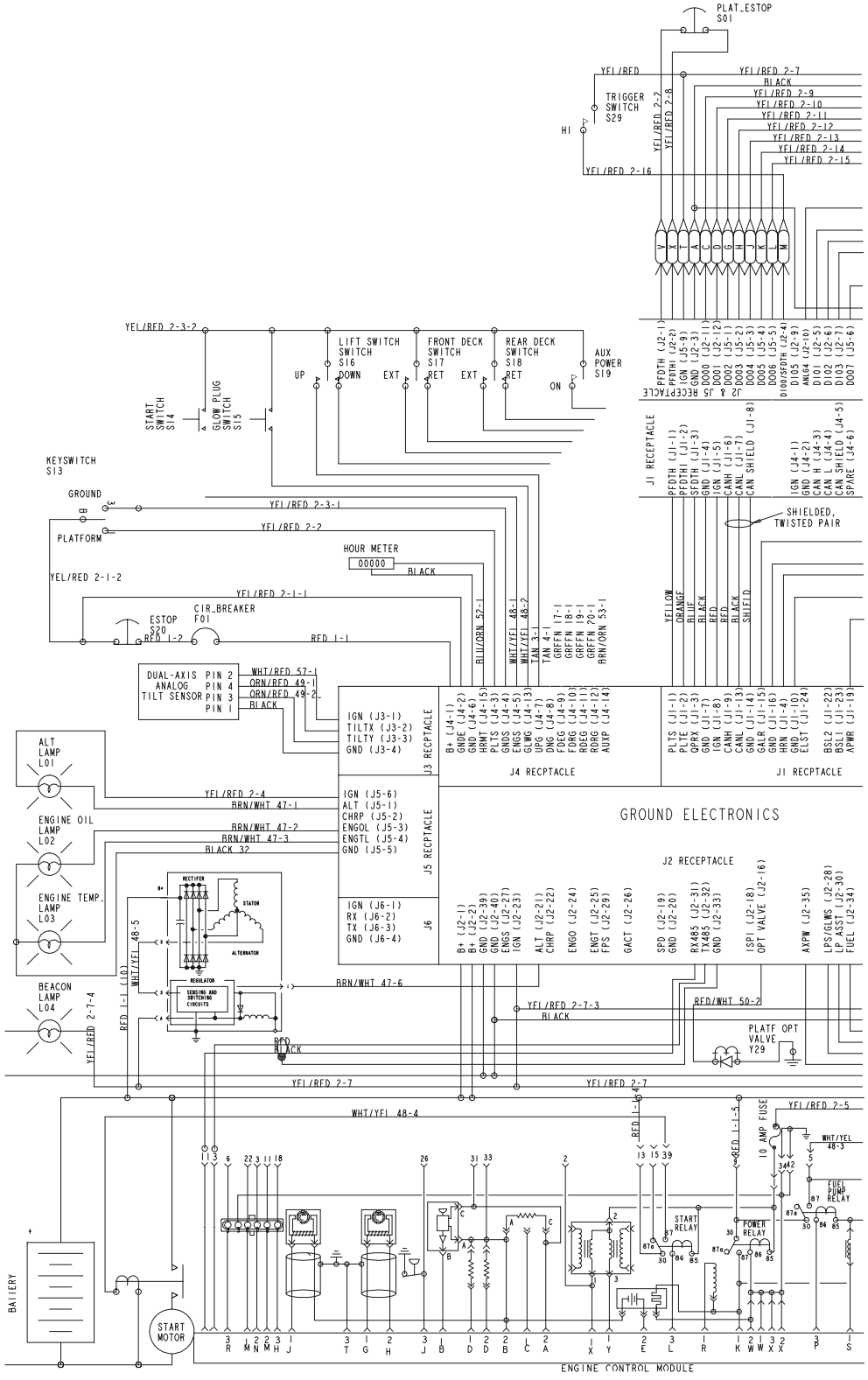

Figure 6-1. Electrical Schematic - Dual Fuel - Sheet 1

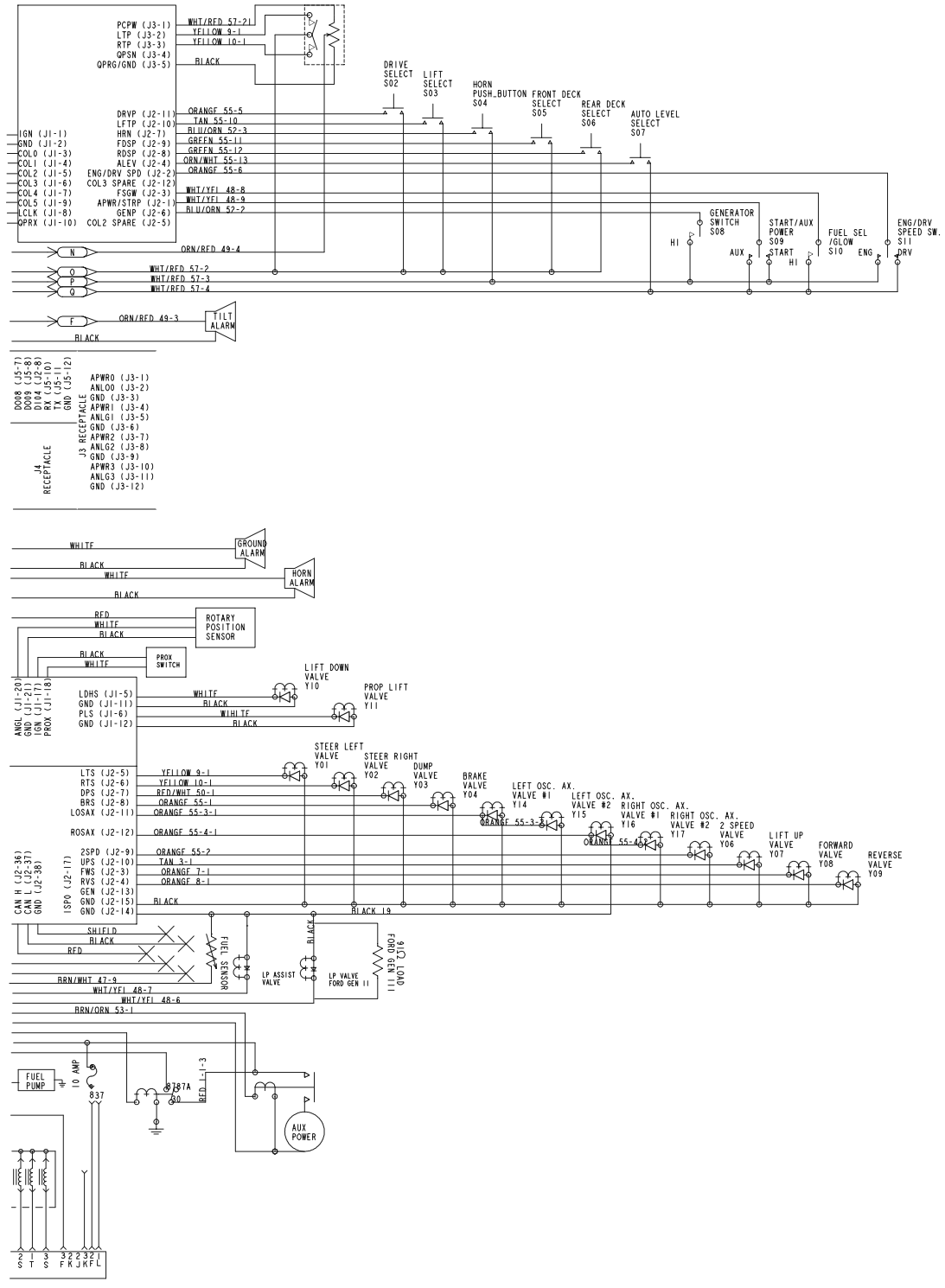

Figure 6-2. Electrical Schematic - Dual Fuel - Sheet 2

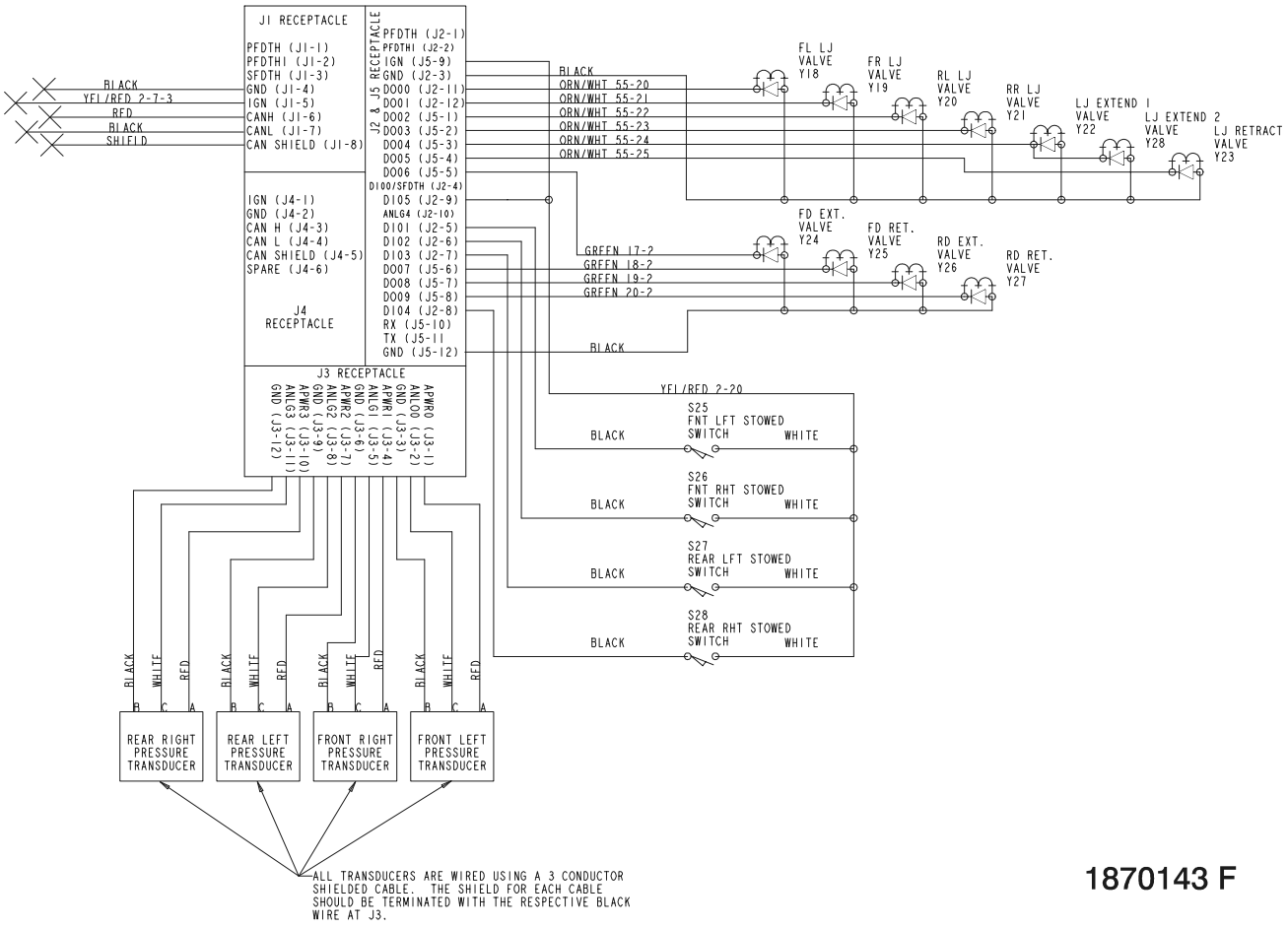

Figure 6-3. Electrical Schematic - Dual Fuel - Sheet 3

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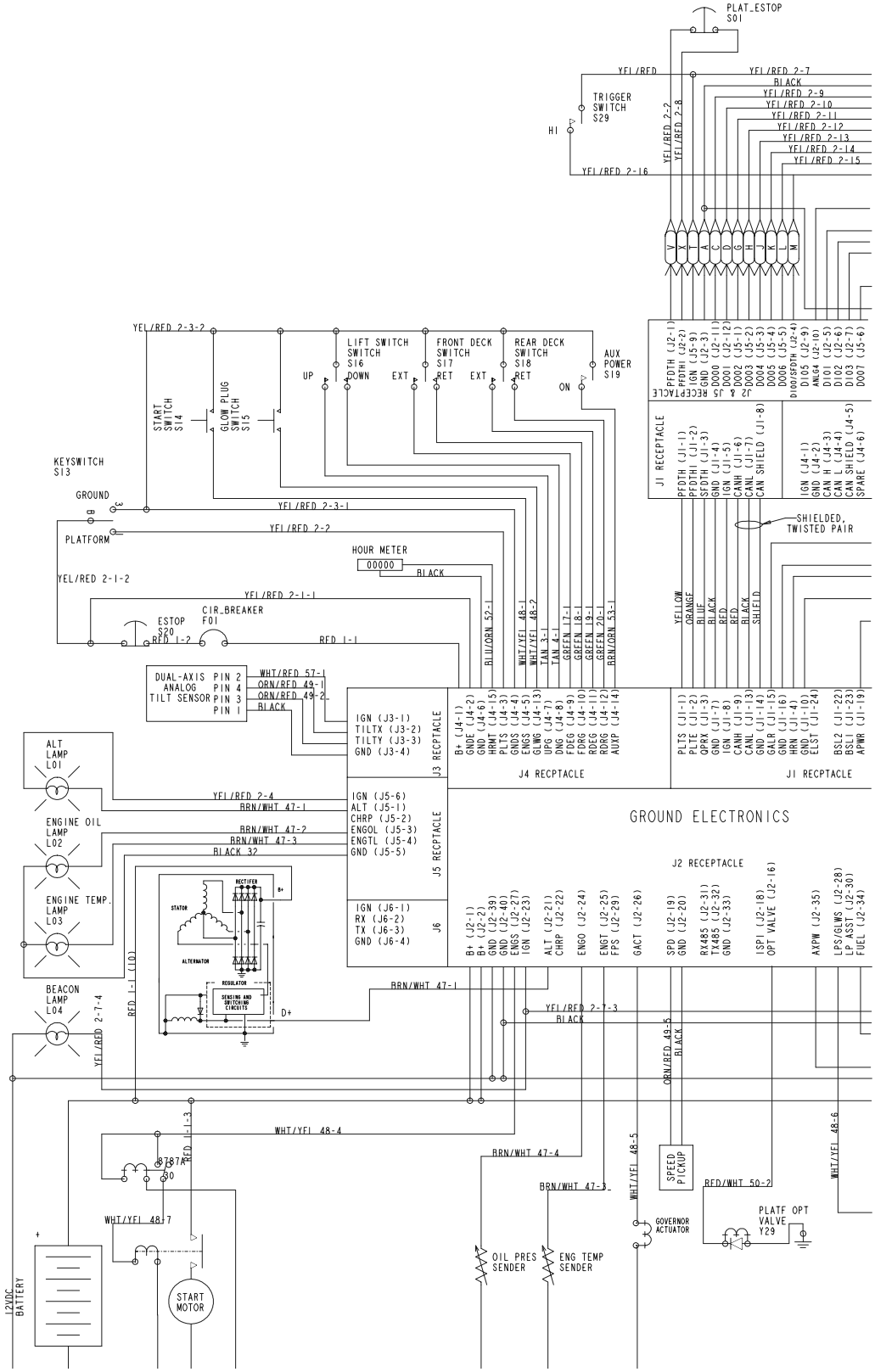

Figure 6-4. Electrical Schematic - Diesel - Sheet 1

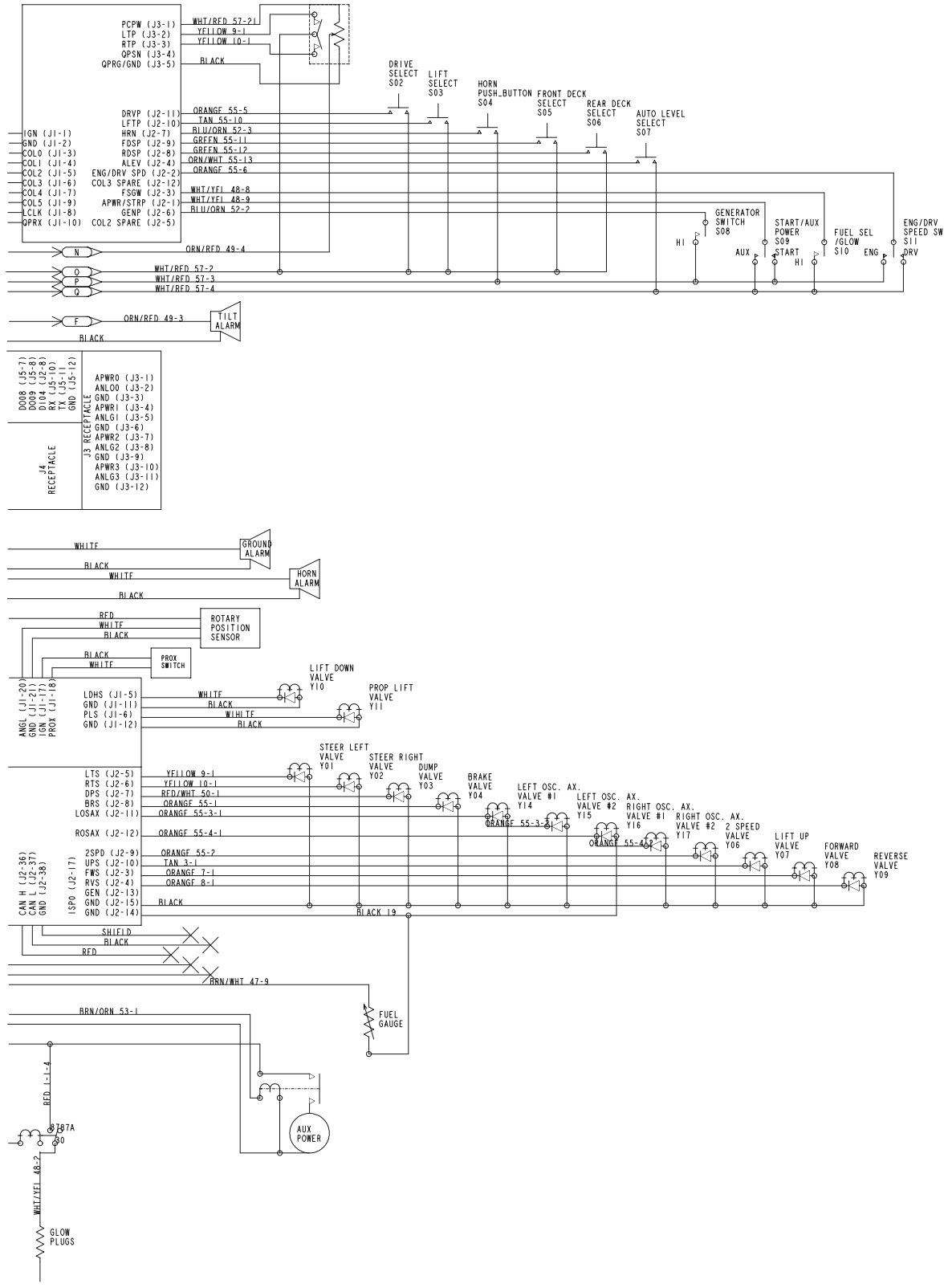

Figure 6-5. Electrical Schematic - Diesel - Sheet 2

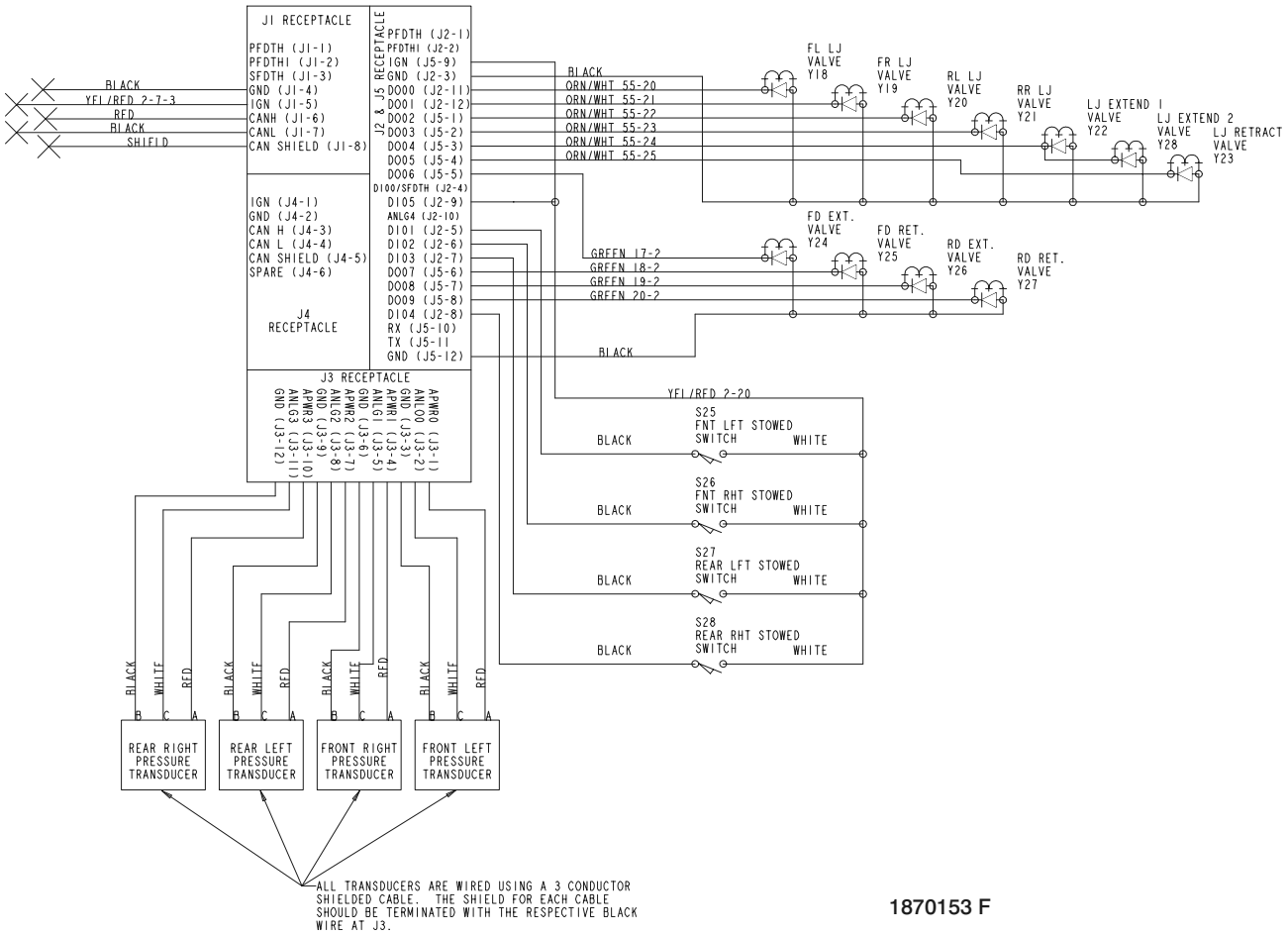

Figure 6-6. Electrical Schematic - Diesel - Sheet 3

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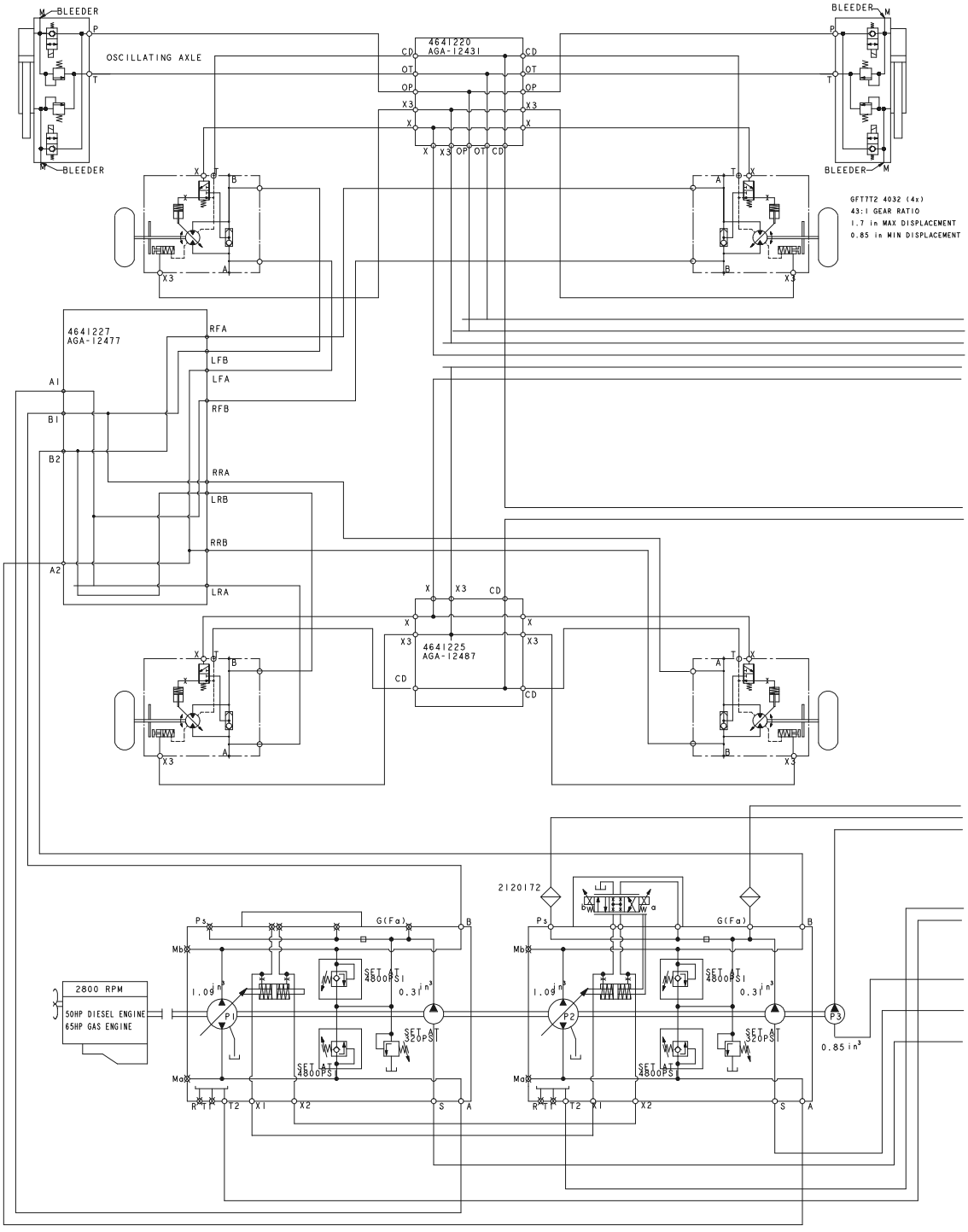

Figure 6-7. Hydraulic Schematic 4WD - Sheet 1

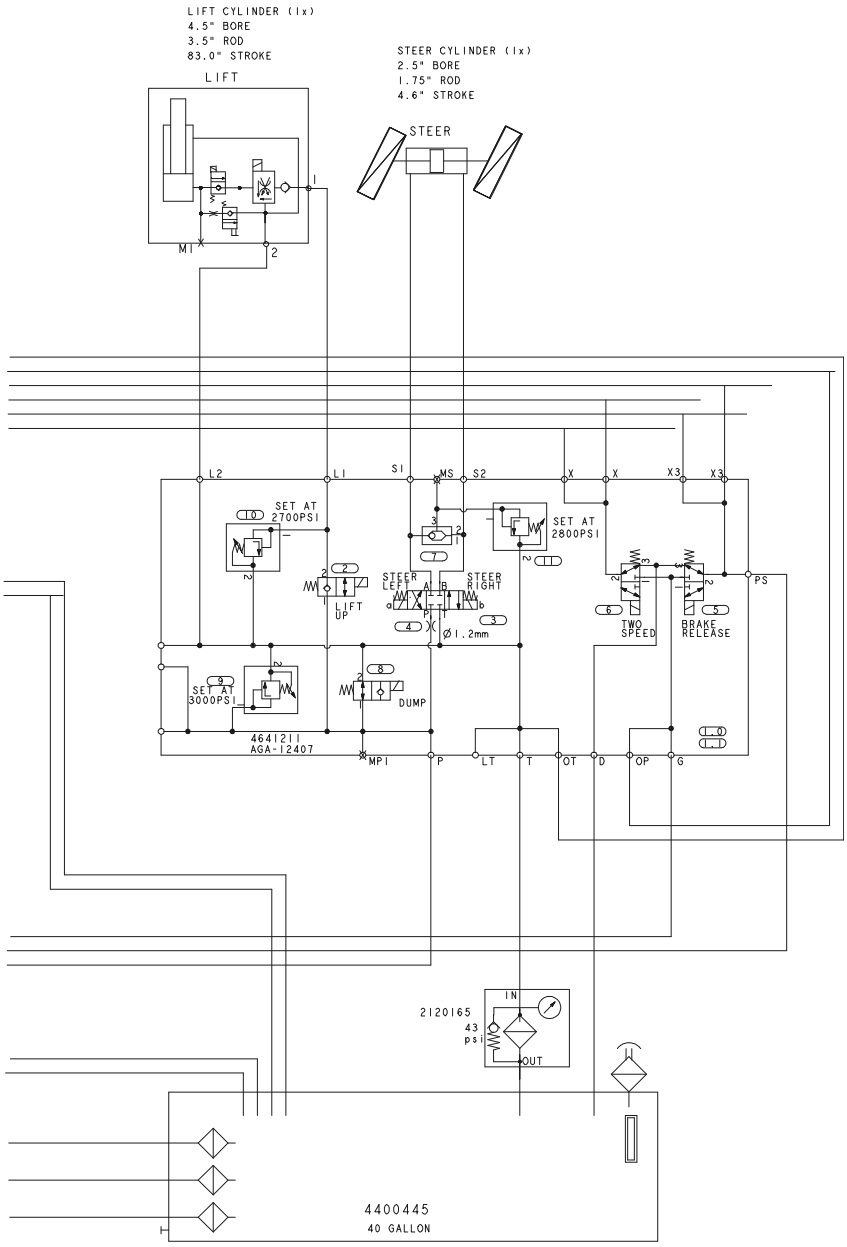

Figure 6-8. Hydraulic Schematic 4WD - Sheet 2

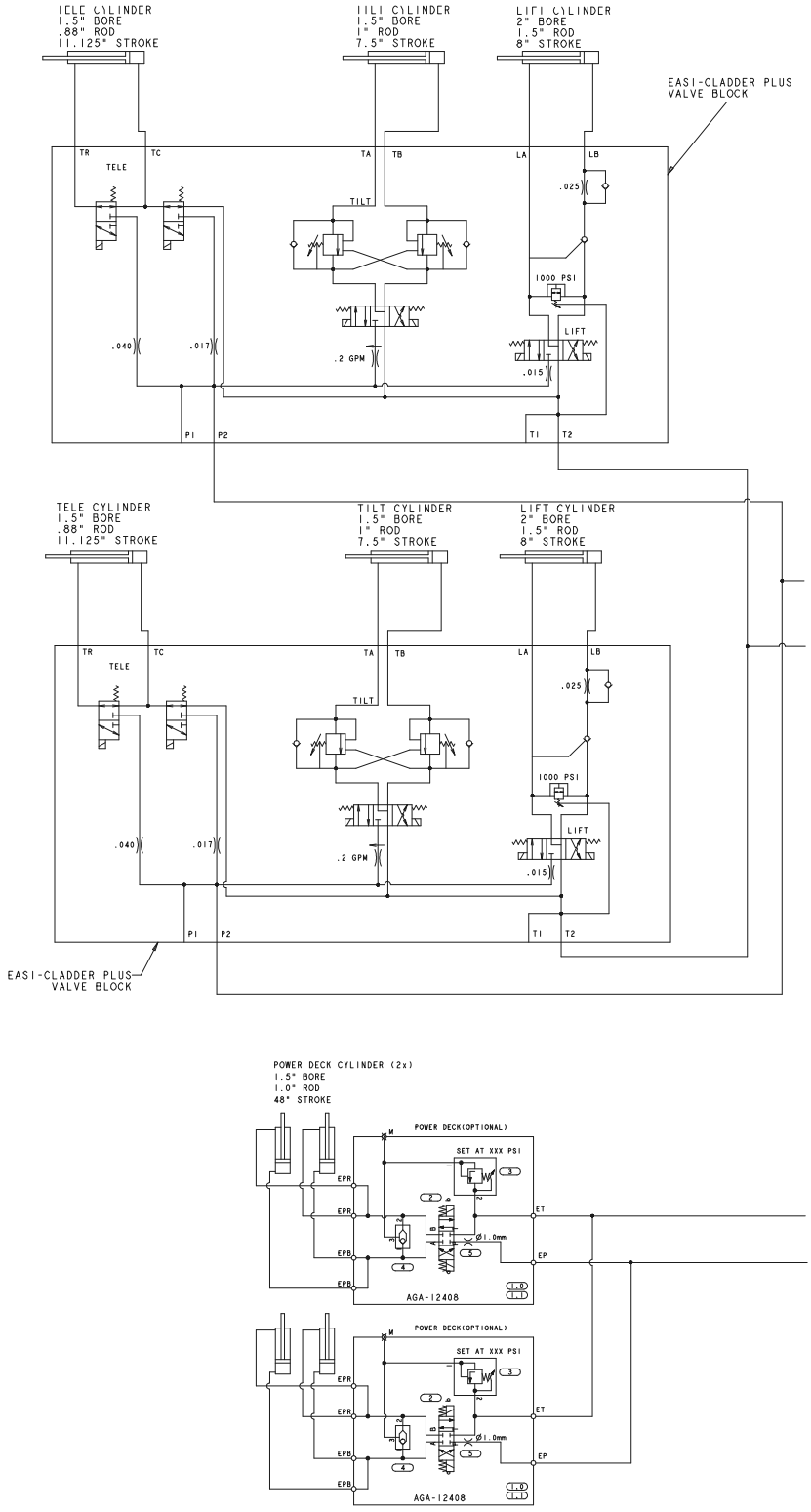

Figure 6-9. Hydraulic Schematic 4WD - Sheet 3

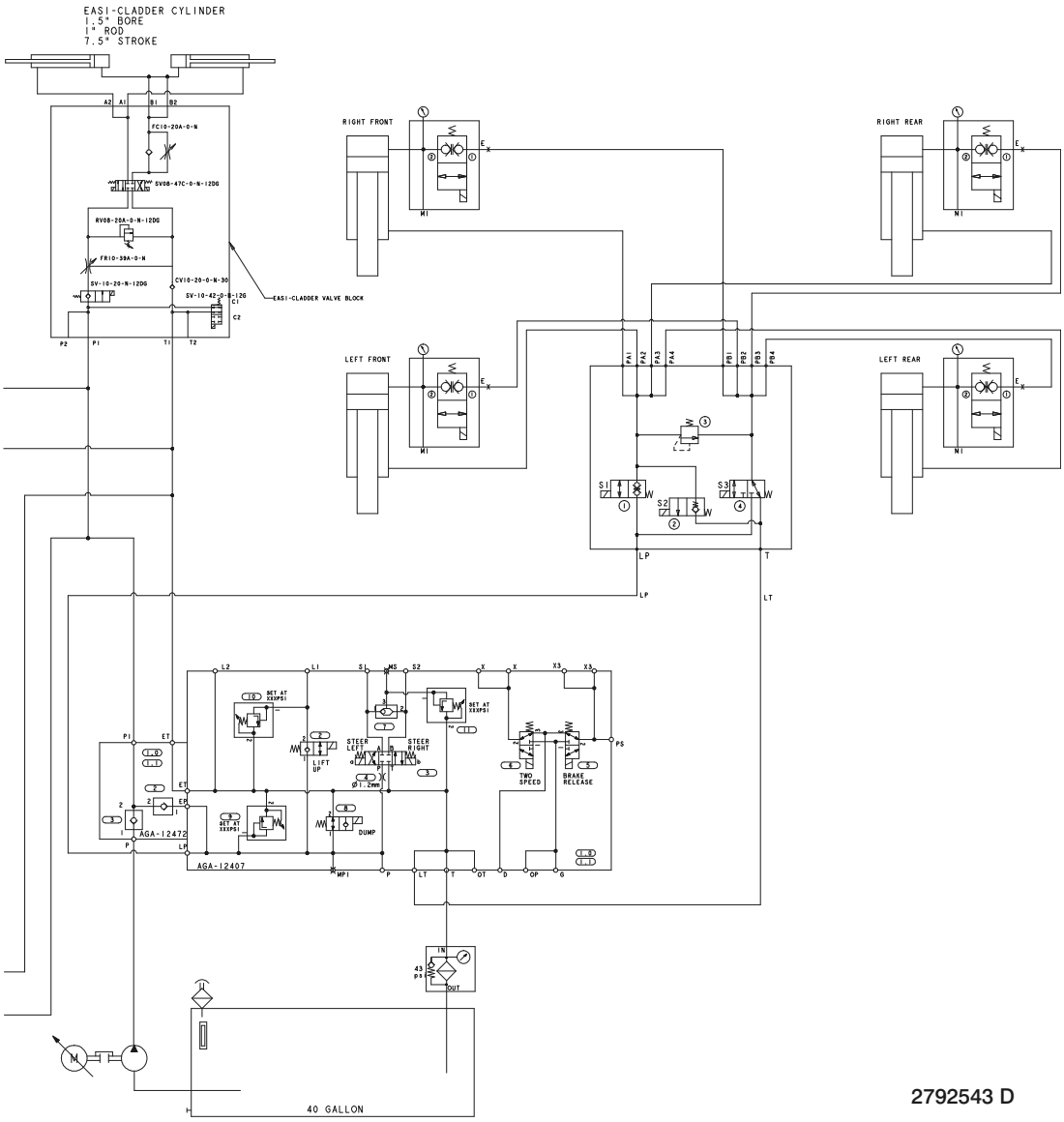

Figure 6-10. Hydraulic Schematic 4WD - Sheet 4

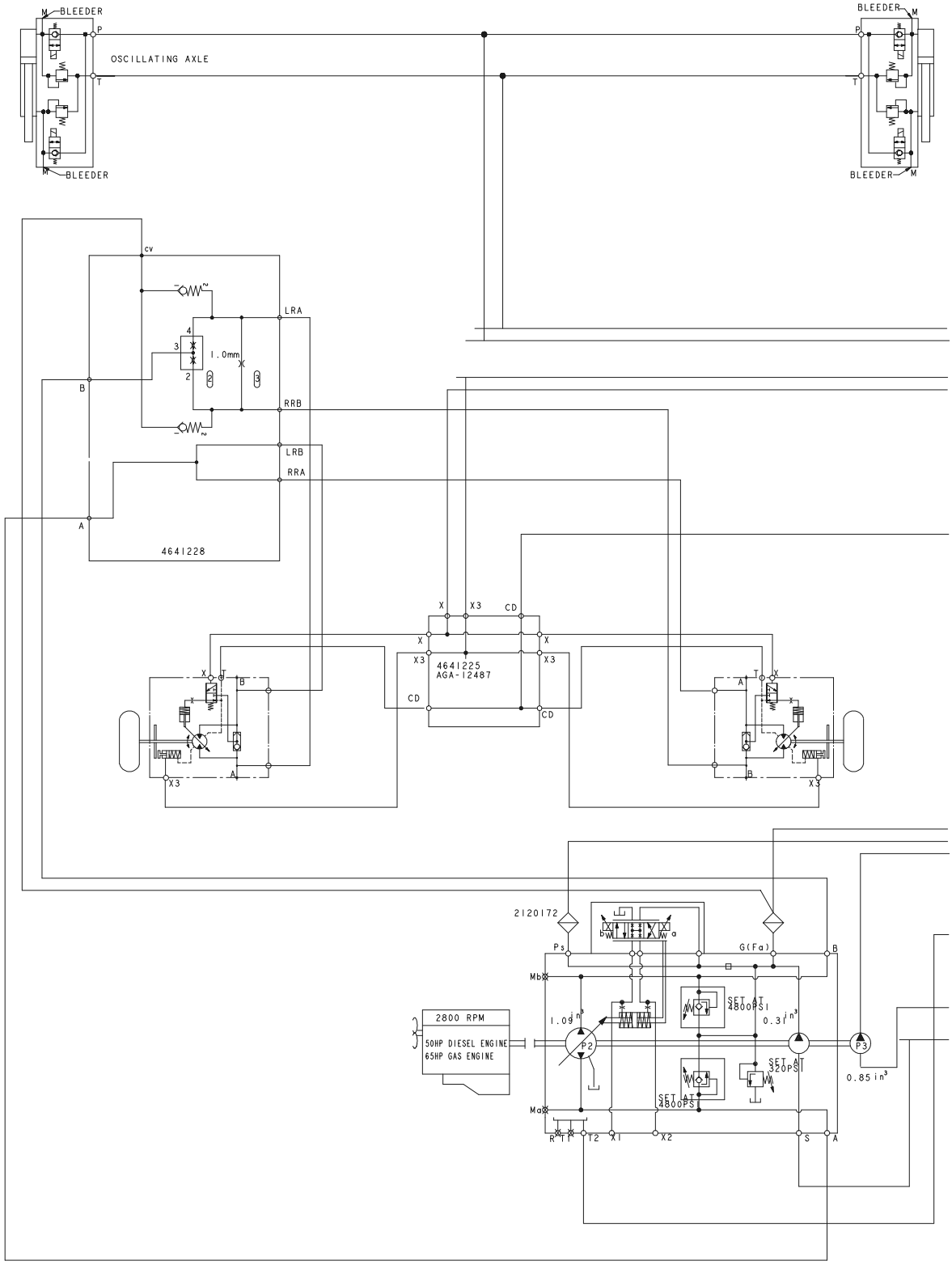

Figure 6-11. Hydraulic Schematic 2WD - Sheet 1

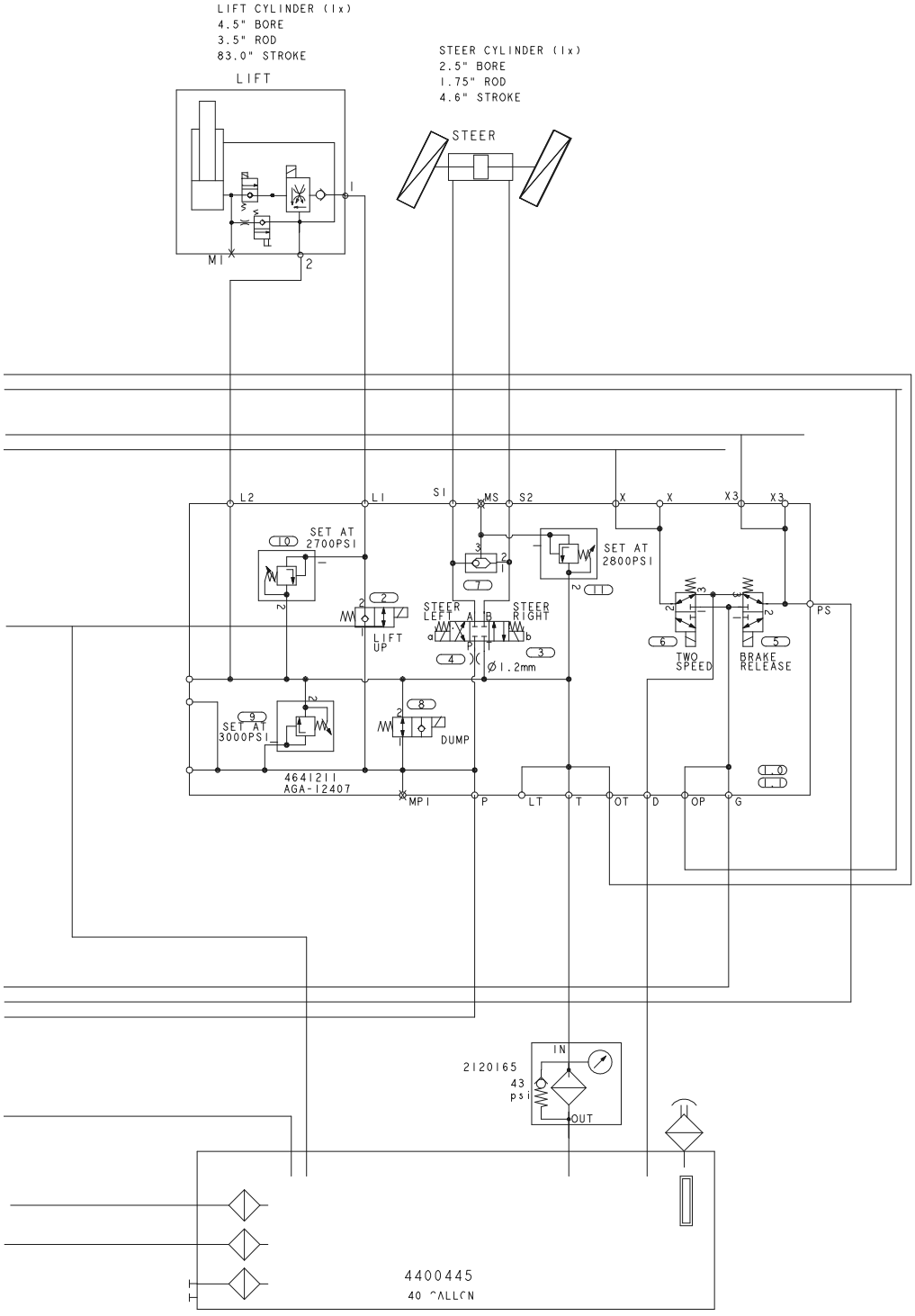

Figure 6-12. Hydraulic Schematic 2WD - Sheet 2

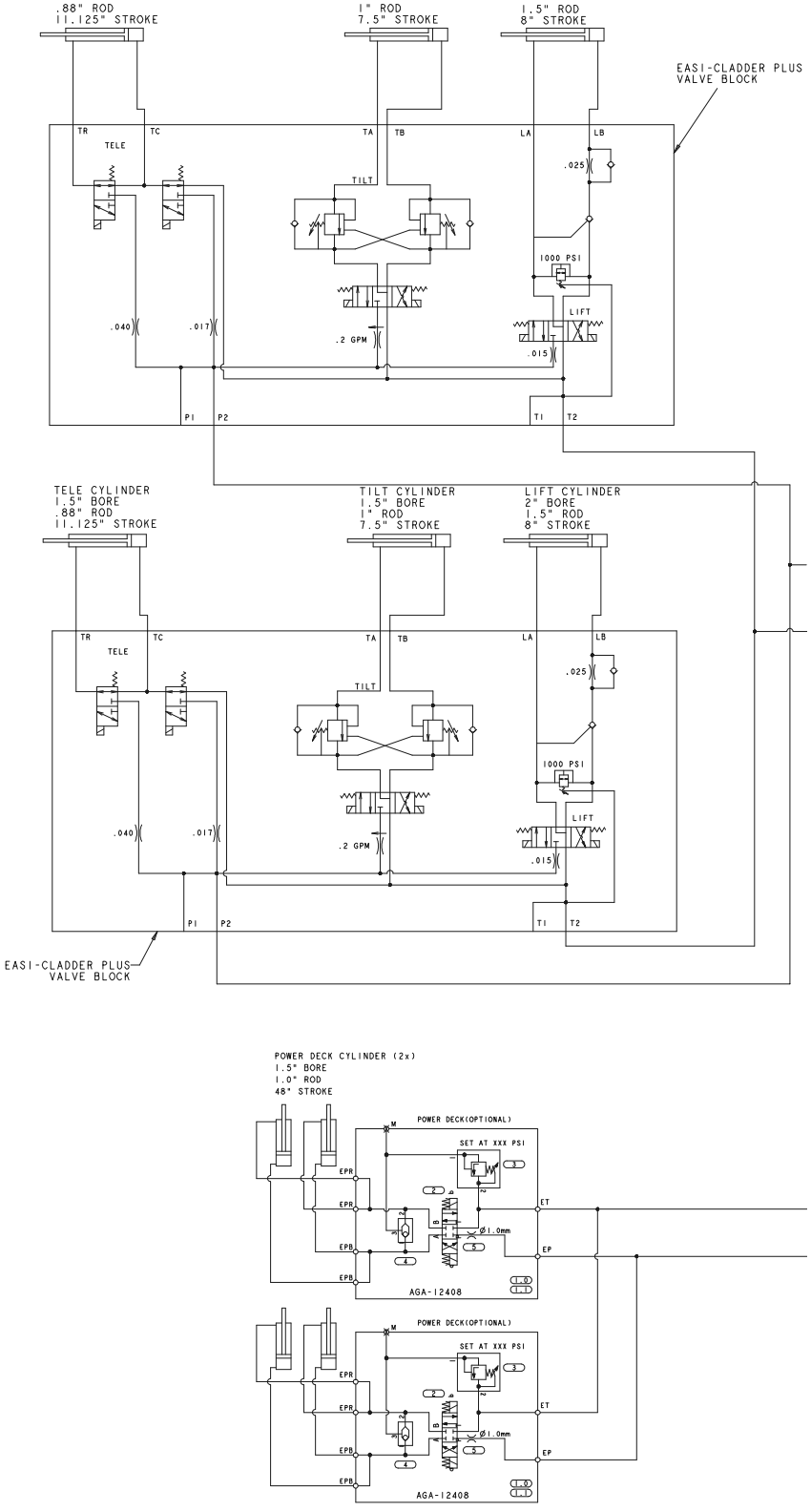

Figure 6-13. Hydraulic Schematic 2WD - Sheet 3

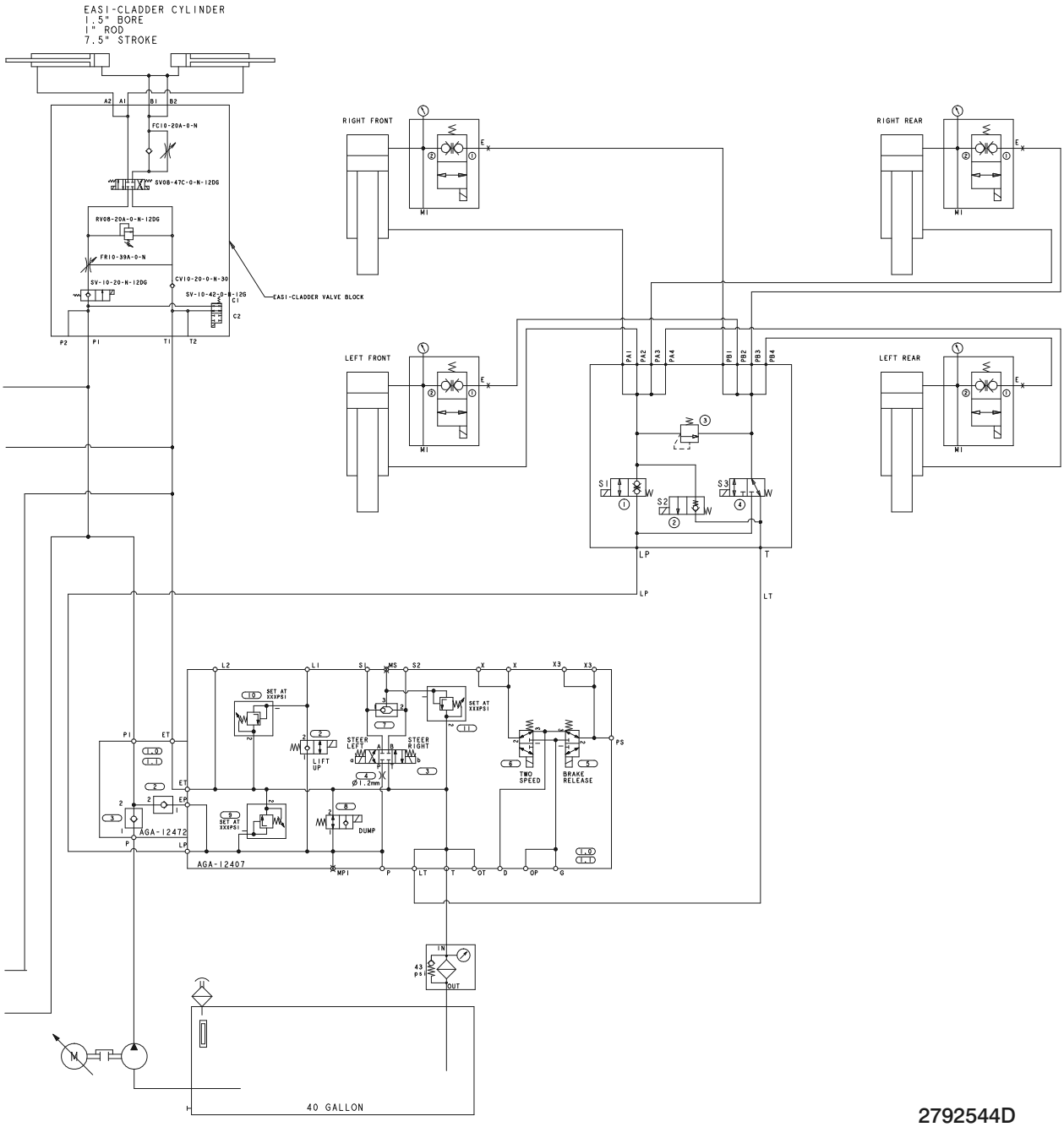

Figure 6-14. Hydraulic Schematic 2WD - Sheet 4

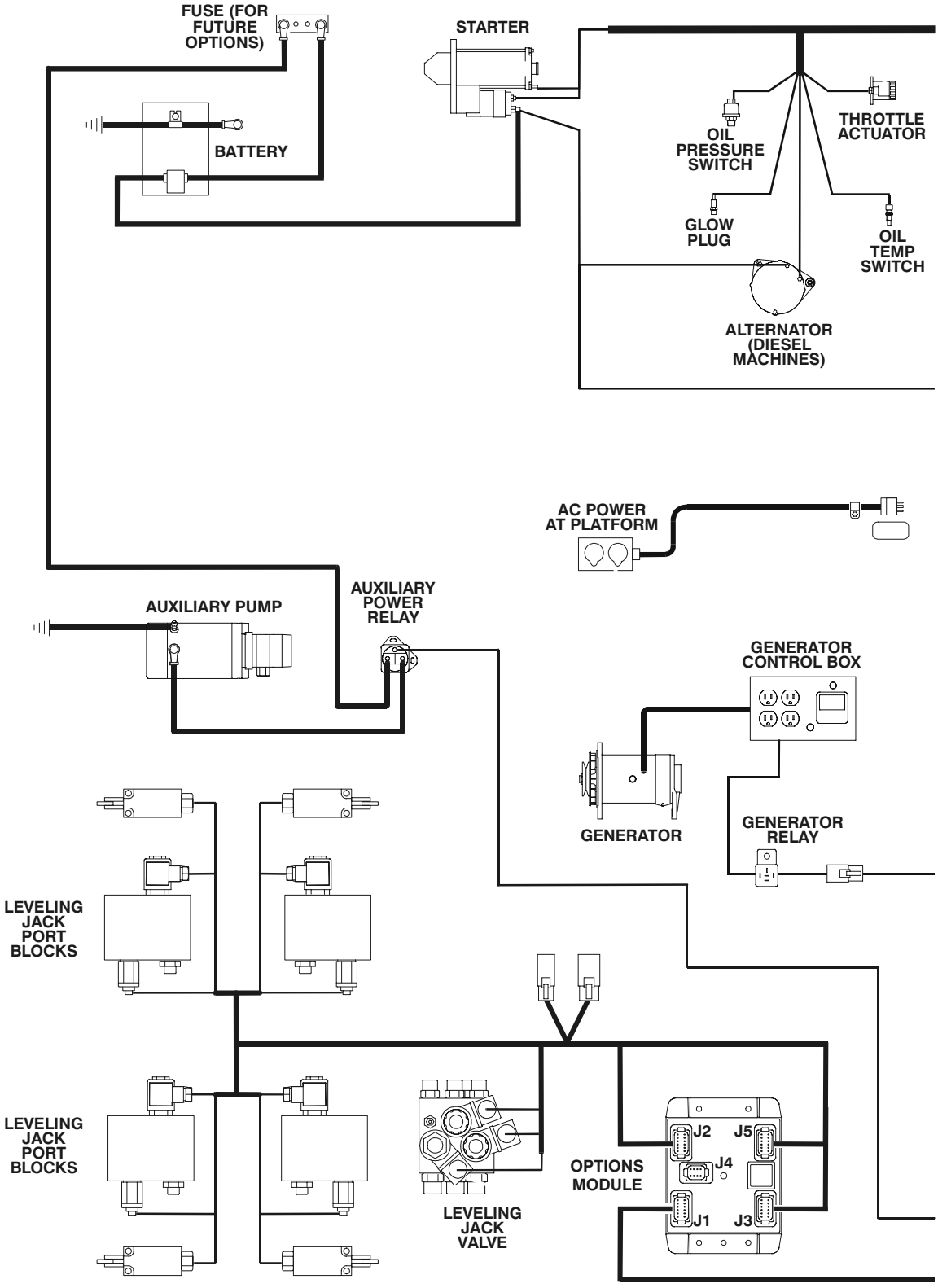

Figure 6-15. Electrical Componants Installation - Sheet 1

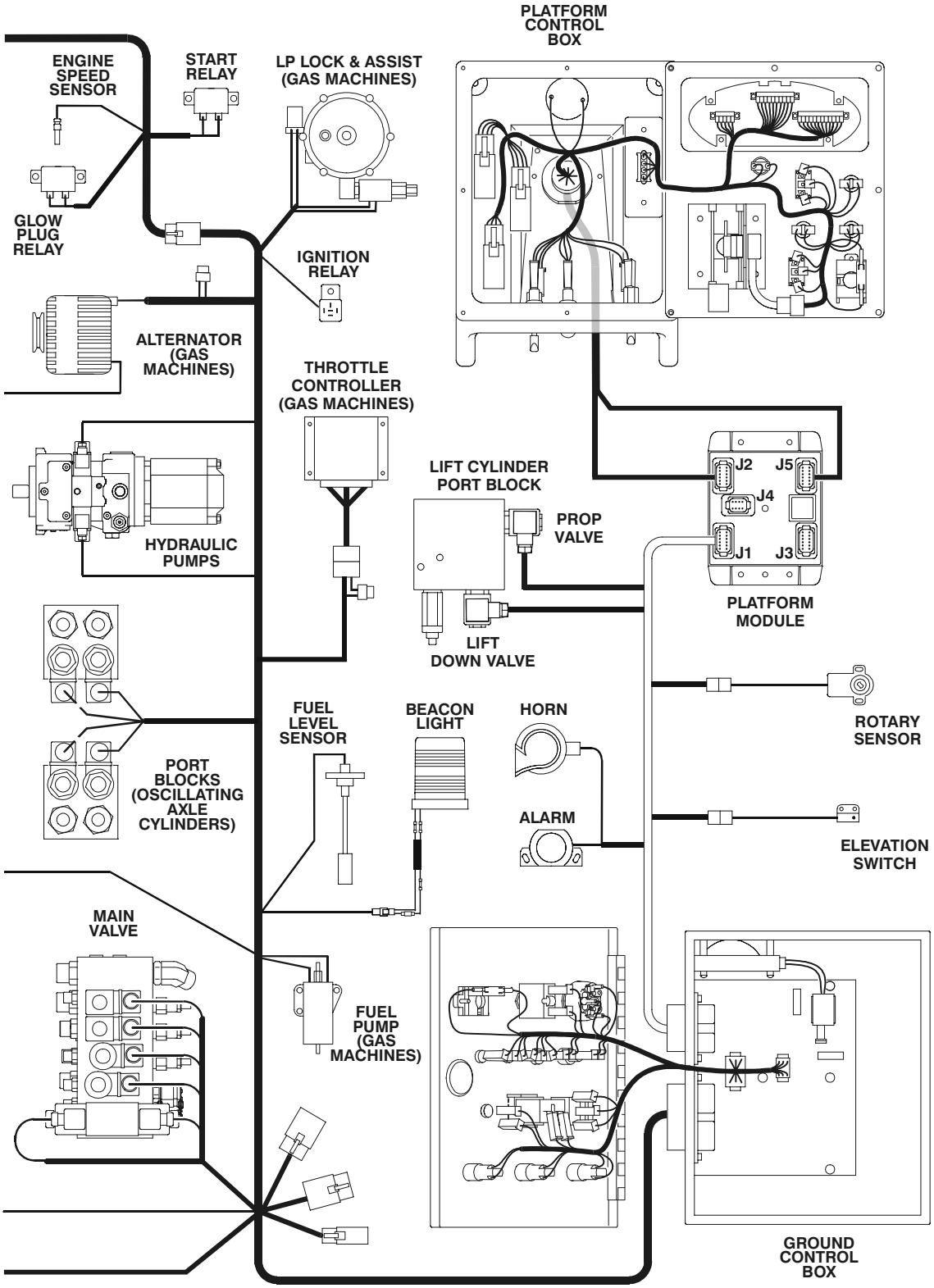

Figure 6-16. Electrical Componants Installation - Sheet 2

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