Table 3-14. LPF Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
1	Were you referred to this procedure by a DTC diagnostic chart?	--	Go to Step 3	Go to Step 2
2	Perform the On Board Diagnostic (OBD) System Check. Are any DTCs present in the ECM?	--	Go to the applicable DTC Table	Go to Step 3
3	Verify that the LPG fuel tank has a minimum of 1/4 tank of fuel, that the manual valve is open and the tank quick connect is fully engaged Does the vehicle have fuel?	--	Go to Step 4	--
4	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Start the engine and allow it to reach operating temperature. Does the engine start and run?	--	Go to Step 5	Go to Step 8
5	With the engine idling, observe the pressure reading for the LPR secondary pressure. Does the fuel pressure fluctuate rhythmically OUTSIDE the specified range?	-1.0" to -2.0" w.c	Go to Step 25	Go to Step 6
6	1. Disconnect the EPR electrical connectors. NOTE: This action will cause a DTC to be set by the ECM 2. With the engine idling observe the pressure reading on the secondary test port. Is the fuel pressure WITHIN the specified range?	-1.0" to -2.0" w.c	Go to Fuel Control System Diagnosis	Go to Step 7
7	1. Inspect the air intake stream between the mixer assembly and the throttle body for leaks. 2. Inspect the fuel hose connection between the LPR and mixer assembly for damage or leakage. 3. Inspect any vacuum hoses for leaks Was a problem found and corrected?	--	Go to Step 26	Go to Step 22
8	1. Connect a water column gauge or a manometer to the secondary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR secondary pressure. Does the fuel pressure indicate a vacuum is present?	--	Go to Step 12	Go to Step 9
9	1. Remove Air induction hose to the mixer 2. Observe the air valve for movement while the engine is cranking. Note: Movement of the air valve will be minimal at cranking speeds. Does the air valve move when the engine is cranked?	--	Go to Step 11	Go to Step 10
10	1. Inspect the air intake stream to the mixer assembly and the throttle body for vacuum leaks. 2. Inspect the vacuum hoses from the mixer for proper connection and condition. Was a problem found and repaired?	--	Go to Step 26	Go to Step 24
11	Inspect the fuel hose connection between the LPR and the mixer assembly for damage or leakage. Was a problem found and repaired?	--	Go to Step 26	Go to Step 12
12	1. Connect a 0-10 psi gauge to the primary test port of the low pressure regulator (LPR). 2. Crank the engine and observe the pressure reading for the LPR primary pressure. Is the fuel pressure ABOVE the specified value?	1-3 PSI	Go to Step 22	Go to Step 13
13	1. Turn OFF the ignition. 2. Disconnect the LPL connector. 3. Install a test light between the pins of the LPL connector. 4. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 14	Go to Step 16
14	Using a DVOM, check the resistance of the low pressure lock-off (LPL). Is the resistance within the specified range?	12W - 16W	Go to Step 15	Go to Step 23

Table 3-14. LPF Fuel System Diagnosis

STEP	ACTION	VALUE(S)	YES	NO
15	1. Turn the ignition OFF. 2. Close the manual shut-off valve on the LPG tank. CAUTION: When disconnecting LPG fuel lines, liquid LPG may be present. Perform this step in a well ventilated area. 3. Loosen the fuel inlet hose fitting at the inlet of the LPL. Was fuel present when the fitting was loosened?	--	Go to Step 23	Go to Step 17
16	1. Turn OFF the ignition. 2. Connect the test light to chassis ground and probe pin A of the LPL connector. 3. Crank the engine. The test light should illuminate. Does the test light illuminate?	--	Go to Step 20	Go to Step 21
17	1. Remove the LPG fuel filter / LPL. 2. Remove the filter from the LPL. 3. Empty the contents of the inlet side of the LPG fuel filter onto a clean surface. 4. Inspect the contents of the LPG fuel filter for an excessive amount of foreign material or water. If necessary, locate and repair the source of contamination. 5. Verify the LPG fuel filter is not restricted or plugged. Was a problem found?	--	Go to Step 19	Go to Step 18
18	The fuel supply system or hoses are plugged or restricted, locate and repair the problem. Is the action complete?	--	Go to Step 26	--
19	Replace the fuel filter. Refer to Fuel Filter Replacement. Is the action complete?	--	Go to Step 26	--
20	Repair the open in the lock-off ground circuit. Is the action complete?	--	Go to Step 26	--
21	Repair the open in the lock-off power circuit. Is the action complete?	--	Go to Step 26	--
22	Replace the low pressure regulator (LPR). Refer to Low Pressure Regulator Replacement. Is the action complete?	--	Go to Step 26	--
23	Replace the lock-off. Refer to Lock-off Replacement. Is the action complete?	--	Go to Step 26	--
24	Replace the mixer assembly. Refer to Fuel Mixer Replacement. Is the action complete?	--	Go to Step 26	--
25	The fuel supply system is operating normally, if a failure of the control solenoids is suspected. Refer to Fuel Control System Diagnosis. 1. Install the test plug in the LPR secondary chamber. 2. If you were sent to this routine by another diagnostic chart, return to the previous diagnostic procedure. Is the action complete?	--	System OK	--
26	1. Disconnect all test equipment 2. Install the primary and secondary test port plugs. 3. Start the engine. 4. Using SNOOP or equivalent, leak check the test port plugs. Is the action complete?	--	System OK	--

Table 3-15. Symptom Diagnosis

Checks	Action
Important Preliminary Checks	
Before Using This Section	Before using this section, you should have performed On Board Diagnostic Check and determined that: 1. The Control Module and MIL (Malfunction Indicator Lamp) are operating correctly. 2. There are no Diagnostic Trouble Codes (DTCs) stored, or a DTC exists but without a MIL. Several of the following symptom procedures call for a careful visual and physical check. The visual and physical checks are very important. The checks can lead to correcting a problem without further checks that may save valuable time.
LPG Fuel System Check	1. Verify the customer complaint. 2. Locate the correct symptom table. 3. Check the items indicated under that symptom. 4. Operate the vehicle under the conditions the symptom occurs. Verify HEGO switching between lean and rich. **IMPORTANT! Normal HEGO switching indicates the LPG fuel system is in closed loop and operating correctly at that time.**
Visual and Physical Checks	Check all ECM system fuses and circuit breakers. Check the ECM ground for being clean, tight and in its proper location. Check the vacuum hoses for splits, kinks and proper connections. Check thoroughly for any type of leak or restriction. Check for air leaks at all the mounting areas of the intake manifold sealing surfaces. Check for proper installation of the mixer module assembly. Check for air leaks at the mixer assembly. Check the ignition wires for the following conditions: - Cracking - Hardness - Proper routing - Carbon tracking Check the wiring for the following items: - Proper connections, pinches or cuts. The following symptom tables contain groups of possible causes for each symptom. The order of these procedures is not important. If the scan tool readings do not indicate the problems, then proceed in a logical order, easiest to check or most likely to cause first.
Intermittent	
DEFINITION: The problem may or may not turn ON the Malfunction Indicator Lamp (MIL) or store a Diagnostic Trouble Code (DTC).	
Preliminary Checks	Refer to Important Preliminary Checks. Do not use the DTC tables. If a fault is an intermittent, the use of the DTC tables may result in the replacement of good parts.
Faulty Electrical Connections or Wiring	Faulty electrical connections or wiring can cause most intermittent problems. Check the suspected circuit for the following conditions: - Faulty fuse or circuit breaker - Connectors poorly mated - Terminals not fully seated in the connector (backed out) - Terminals not properly formed or damaged - Terminal to wires poorly connected - Terminal tension insufficient Carefully remove all the connector terminals in the problem circuit in order to ensure the proper contact tension. If necessary, replace all the connector terminals in the problem circuit in order to ensure the proper contact tension. Checking for poor terminal to wire connections requires removing the terminal from the connector body.
Operational Test	If a visual and physical check does not locate the cause of the problem, drive the vehicle with a scan tool. When the problem occurs, an abnormal voltage or scan reading indicates the problem may be in that circuit.

Table 3-15. Symptom Diagnosis

Checks	Action
Intermittent Malfunction Indicator Lamp (MIL)	The following components can cause intermittent MIL and no DTC(s): A defective relay, Control Module driven solenoid, or a switch that can cause electrical system interference. Normally, the problem will occur when the faulty component is operating. The improper installation of electrical devices, such as lights, 2-way radios, electric motors, etc. The ignition secondary voltage shorted to a ground. The Malfunction Indicator Lamp (MIL) circuit or the Diagnostic Test Terminal intermittently shorted to ground. The Control Module grounds.
Loss of DTC Memory	To check for the loss of the DTC Memory: 1. Disconnect the TMAP sensor. 2. Idle the engine until the Malfunction Indicator Lamp illuminates. The ECM should store a TMAP DTC. The TMAP DTC should remain in the memory when the ignition is turned OFF. If the TMAP DTC does not store and remain, the ECM is faulty.
Additional Checks	
No Start	
DEFINITION: The engine cranks OK[22] but does not start.	
Preliminary Checks	Refer to Important Preliminary Checks.
Control Module Checks	If a scan tool is available: Check for proper communication with both the ECM. Check the fuse in the ECM battery power circuit. Refer to Engine Controls Schematics. Check battery power, ignition power and ground circuits to the ECM. Refer to Engine Control Schematics. Verify voltage and/or continuity for each circuit.
Sensor Checks	Check the TMAP sensor. Check the Magnetic pickup sensor (RPM).
Fuel System Checks	**Important:** A closed LPG manual fuel shut off valve will create a no start condition. Check for air intake system leakage between the mixer and the throttle body. Verify proper operation of the low pressure lock-off solenoids. Check the fuel system pressures. Refer to the LPG Fuel System Diagnosis. Check for proper mixer air valve operation.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. Check for the proper ignition voltage output with J 26792 or the equivalent. Verify that the spark plugs are correct for use with LPG (R42LTS) Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Check for bare or shorted ignition wires. Check for loose ignition coil connections at the coil.
Engine Mechanical Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes.

Table 3-15. Symptom Diagnosis

Checks	Action
Exhaust System Checks	Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes - Inspect the muffler for signs of heat distress or for possible internal failure. Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis.
Hard Start	
DEFINITION: The engine cranks OK, but does not start for a long time. The engine does eventually run, or may start but immediately dies.	
Preliminary Checks	Refer to Important Preliminary Checks. Make sure the vehicle's operator is using the correct starting procedure.
Sensor Checks	Check the Engine Coolant Temperature sensor with the scan tool. Compare the engine coolant temperature with the ambient air temperature on a cold engine. IF the coolant temperature reading is more than 5 degrees greater or less than the ambient air temperature on a cold engine, check for high resistance in the coolant sensor circuit. Refer to DTC 111 Check the Crankshaft Position (CKP) sensor. Check the Throttle position (TPS) sensor.
Fuel System Checks	Important: A closed LPG manual fuel shut off valve will create an extended crank OR no start condition. Verify the excess flow valve in the LPG manual shut-off valve is not tripped. Check mixer module assembly for proper installation and leakage. Verify proper operation of the low pressure lock-off solenoids. Verify proper operation of the EPR. Check for air intake system leakage between the mixer and the throttle body. Check the fuel system pressures. Refer to the Fuel System Diagnosis.
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. Check for the proper ignition voltage output with J 26792 or the equivalent. Verify that the spark plugs are correct for use with LPG (R42LTS). Check the spark plugs for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Check for bare or shorted ignition wires. Check for moisture in the distributor cap if applicable. Check for loose ignition coil connections. **Important:** 1. If the engine starts but then immediately stalls, Check the Crankshaft Position (CKP). 2. Check for improper gap, debris or faulty connections.
Engine Mechanical Checks	Important: The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. Check for the following: - Vacuum leaks - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes Check the intake and exhaust manifolds for casting flash.
Exhaust System Checks	Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes. - Inspect the muffler for signs of heat distress or for possible internal failure. Check for possible plugged catalytic converter. Refer to Restricted Exhaust System Diagnosis or Exhaust System in the GM Base Engine Service Manual.

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Checks	
Cuts Out, Misses	
DEFINITION: A surging or jerking that follows engine speed, usually more pronounced as the engine load increases which is not normally felt above 1500 RPM. The exhaust has a steady spitting sound at idle, low speed, or hard acceleration for the fuel starvation that can cause the engine to cut-out.	
Preliminary Checks	Refer to Important Preliminary Checks.
Ignition System Checks	Start the engine. Wet down the secondary ignition system with water from a spray bottle, and look/listen for arcing or misfiring as you apply water. Check for proper ignition output voltage with spark tester J 26792. Check for a cylinder misfire. Verify that the spark plugs are correct for use with LPG (R42LTS) Remove the spark plugs in these cylinders and check for the following conditions: Insulation cracks Wear Improper gap Burned electrodes Heavy deposits Visually/Physically inspect the secondary ignition for the following: Ignition wires for arcing, cross-firing and proper routing Ignition coils for cracks or carbon tracking
Engine Mechanical Checks	Perform a cylinder compression check. Check the engine for the following: - Improper valve timing - Bent pushrods - Worn rocker arms - Worn camshaft lobes - Broken or weak valve springs Check the intake and exhaust manifold passages for casting flash.
Fuel System Checks	Check the fuel system - plugged fuel filter, low fuel pressure, etc. Refer to LPG Fuel System Diagnosis. Check the condition of the wiring to the low pressure lock-off solenoid.
Additional Check	Check for Electromagnetic Interference (EMI). EMI on the reference circuit can cause a missing condition. Monitoring the engine RPM with a scan tool can detect an EMI. A sudden increase in the RPM with little change in the actual engine RPM, indicates EMI is present. If the problem exists, check the routing of the secondary wires and the ground circuit.
Hesitation, Sag, Stumble	
DEFINITION: The vehicle has a momentary lack of response when depressing the accelerator. The condition can occur at any vehicle speed. The condition may cause the engine to stall if it's severe enough.	
Preliminary Checks	Refer to Important Preliminary Checks.
Fuel System Checks	Check the fuel pressure. Refer to LPG Fuel System Diagnosis. Check for low fuel pressure during a moderate or full throttle acceleration. If the fuel pressure drops below specification, there is possibly a faulty low pressure regulator or a restriction in the fuel system. Check the Manifold Absolute Pressure (MAP) sensor response and accuracy. Check LPL electrical connection. Check the mixer air valve for sticking or binding. Check the mixer module assembly for proper installation and leakage. Check the EPR electrical connections.

Table 3-15. Symptom Diagnosis

Checks	Action
Ignition System Checks	Note: LPG being a gaseous fuel requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. If a problem is reported on LPG and not gasoline, do not discount the possibility of a LPG only ignition system failure and test the system accordingly. Check for the proper ignition voltage output with J 26792 or the equivalent. Verify that the spark plugs are correct for use with LPG (R42LTS). Check for faulty spark plug wires. Check for fouled spark plugs.
Additional Check	Check for manifold vacuum or air induction system leaks. Check the generator output voltage.
Backfire	
DEFINITION: The fuel ignites in the intake manifold, or in the exhaust system, making a loud popping noise.	
Preliminary Check	Refer to Important Preliminary Checks.
Ignition System Checks	**Important! LPG, being a gaseous fuel, requires higher secondary ignition system voltages for the equivalent gasoline operating conditions. The ignition system must be maintained in peak condition to prevent backfire.** Check for the proper ignition coil output voltage using the spark tester J26792 or the equivalent. Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires. Check the connection at each ignition coil. Check for deteriorated spark plug wire insulation. Check the spark plugs. The correct spark plugs for LPG are (R42LTS). Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits
Engine Mechanical Check	Important! The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than a gasoline fuel supply system. Check the engine for the following: - Improper valve timing - Engine compression - Manifold vacuum leaks - Intake manifold gaskets - Sticking or leaking valves - Exhaust system leakage Check the intake and exhaust system for casting flash or other restrictions.
Fuel System Checks	Perform a fuel system diagnosis. Refer to LPG Fuel System Diagnosis.
Lack of Power, Sluggishness, or Sponginess	
DEFINITION: The engine delivers less than expected power. There is little or no increase in speed when partially applying the accelerator pedal.	
Preliminary Checks	Refer to Important Preliminary Checks. Refer to the LPG Fuel system OBD System Check. Compare the customer's vehicle with a similar unit. Make sure the customer has an actual problem. Do not compare the power output of the vehicle operating on LPG to a vehicle operating on gasoline as the fuels do have different drive feel characteristics. Remove the air filter and check for dirt or restriction. Check the vehicle transmission Refer to the OEM transmission diagnostics.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	Check for a restricted fuel filter, contaminated fuel, or improper fuel pressure. Refer to LPG Fuel System Diagnosis. Check for the proper ignition output voltage with the spark tester J 26792 or the equivalent. Check for proper installation of the mixer module assembly. Check all air inlet ducts for condition and proper installation. Check for fuel leaks between the LPR and the mixer. Verify that the LPG tank manual shut-off valve is fully open. Verify that liquid fuel (not vapor) is being delivered to the LPR.
Sensor Checks	Check the Heated Exhaust Gas Oxygen Sensor (HEGO) for contamination and performance. Check for proper operation of the MAP sensor. Check for proper operation of the TPS sensor.
Exhaust System Checks	Check the exhaust system for a possible restriction: - Inspect the exhaust system for damaged or collapsed pipes. - Inspect the muffler for signs of heat distress or for possible internal failure. - Check for possible plugged catalytic converter.
Engine Mechanical Check	Check the engine for the following: Engine compression Valve timing Improper or worn camshaft. Refer to Engine Mechanical in the Service Manual.
Additional Check	Check the ECM grounds for being clean, tight, and in their proper locations. Check the generator output voltage. If all procedures have been completed and no malfunction has been found, review and inspect the following items: Visually and physically, inspect all electrical connections within the suspected circuit and/or systems. Check the scan tool data.
Poor Fuel Economy	
DEFINITION: Fuel economy, as measured by refueling records, is noticeably lower than expected. Also, the economy is noticeably lower than it was on this vehicle at one time, as previously shown by an by refueling records.	
Preliminary Checks	Refer to Important Preliminary Checks. Check the air cleaner element (filter) for dirt or being plugged. Visually (Physically) check the vacuum hoses for splits, kinks, and proper connections. Check the operators driving habits for the following items: - Is there excessive idling or stop and go driving? - Are the tires at the correct air pressure? - Are excessively heavy loads being carried? - Is their often rapid acceleration? Suggest to the owner to fill the fuel tank and to recheck the fuel economy. Suggest that a different operator use the equipment and record the results.
Fuel System Checks	Check the LPR fuel pressure. Refer to LPG Fuel System Diagnosis. Check the fuel system for leakage.
Sensor Checks	Check the Temperature Manifold Absolute Pressure (TMAP) sensor.
Ignition System Checks	Verify that the spark plugs are correct for use with LPG (R42LTS) Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Check the ignition wires for the following items: - Cracking - Hardness - Proper connections
Cooling System Checks	Check the engine thermostat for always being open or for the wrong heat range

Table 3-15. Symptom Diagnosis

Checks	Action
Additional Check	Check the transmission shift pattern. Refer to the OEM Transmission Controls section the Service Manual. Check for dragging brakes.
Rough, Unstable, or Incorrect Idle, Stalling	
DEFINITION: The engine runs unevenly at idle. If severe enough, the engine or vehicle may shake. The engine idle speed may vary in RPM. Either condition may be severe enough to stall the engine.	
Preliminary Check	Refer to Important Preliminary Checks.
Sensor Checks	Check for silicon contamination from fuel or improperly used sealant. The sensor will have a white powdery coating. The sensor will result in a high but false signal voltage (rich exhaust indication). The ECM will reduce the amount of fuel delivered to the engine causing a severe drive-ability problem. Check the Heated Exhaust Gas Oxygen Sensor (HEGO) performance: Check the Temperature Manifold Absolute Pressure (TMAP) sensor response and accuracy.
Fuel System Checks	Check for rich or lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. Check for a sticking mixer air valve. Verify proper operation of the EPR. Perform a cylinder compression test. Refer to Engine Mechanical in the Service Manual. Check the LPR fuel pressure. Refer to the LPG Fuel System Diagnosis. Check mixer module assembly for proper installation and connection.
Ignition System Checks	Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. Verify that the spark plugs are correct for use with LPG (R42LTS) Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Blistered insulators - Heavy deposits Check the spark plug wires by connecting an ohmmeter to the ends of each wire in question. If the meter reads over 30,000 ohms, replace the wires.
Additional Checks	**Important:** The LPG Fuel system works on a fumigation principle of fuel introduction and is more sensitive to intake manifold leakage than the gasoline fuel supply system. Check for vacuum leaks. Vacuum leaks can cause a higher than normal idle and low throttle angle control command. Check the ECM grounds for being clean, tight, and in their proper locations. Check the battery cables and ground straps. They should be clean and secure. Erratic voltage may cause all sensor readings to be skewed resulting in poor idle quality.
Engine Mechanical Check	Check the engine for the following: - Broken motor mounts - Improper valve timing - Low compression - Bent pushrods - Worn rocker arms - Broken or weak valve springs - Worn camshaft lobes
Surges/Chuggles	
DEFINITION: The engine has a power variation under a steady throttle or cruise. The vehicle feels as if it speeds up and slows down with no change in the accelerator pedal.	
Preliminary Checks	Refer to Important Preliminary Checks.
Sensor Checks	Check Heated Exhaust Gas Oxygen Sensor (HEGO) performance.

Table 3-15. Symptom Diagnosis

Checks	Action
Fuel System Checks	Check for Rich or Lean symptom that causes the condition. Drive the vehicle at the speed of the complaint. Monitoring the oxygen sensors will help identify the problem. Check the fuel pressure while the condition exists. Refer to LPG Fuel System Diagnosis. Verify proper fuel control solenoid operation. Verify that the LPG manual shut-off valve is fully open. Check the in-line fuel filter for restrictions.
Ignition System Checks	Check for the proper ignition output voltage using the spark tester J26792 or the equivalent. Verify that the spark plugs are correct for use with LPG (R42LTS). Check the spark plugs. Remove the plugs and inspect them for the following conditions: - Wet plugs - Cracks - Wear - Improper gap - Burned electrodes - Heavy deposits Check the Crankshaft Position (CKP) sensor
Additional Check	Check the ECM grounds for being clean, tight, and in their proper locations. Check the generator output voltage. Check the vacuum hoses for kinks or leaks. Check Transmission.

Table 3-16. DTC to SPN/FMI Cross Reference Chart

DTC	Description	SPN Code	FMI Code
16	Crank Never Synced at Start	636	8
91	Fuel Pump Low Voltage	94	4
92	Fuel Pump High Voltage	94	3
107	MAP Low Voltage	106	4
108	MAP High Pressure	106	16
111	IAT Higher Than Expected 1	105	15
112	IAT Low Voltage	105	4
113	IAT High Voltage	105	3
116	ECT Higher Than Expected 1	110	15
117	ECT Low Voltage	110	4
118	ECT High Voltage	110	3
121	TPS 1 Lower Than TPS 2	51	1
122	TPS 1 Signal Voltage Low	51	4
123	TPS 1 Signal Voltage High	51	3
127	IAT Higher Than Expected 2	105	0
129	BP Low Pressure	108	1
134	EGO 1 Open/Inactive	724	10
154	EGO 2 Open/Inactive	520208	10
171	Adaptive Learn High Gasoline	520200	0
172	Adaptive Learn Low Gasoline	520200	1
182	Fuel Temp Gasoline Low Voltage	174	4
183	Fuel Temp Gasoline High Voltage	174	3
187	Fuel Temp LPG Low Voltage	520240	4
188	Fuel Temp LPG High Voltage	520240	3
217	ECT Higher Than Expected 2	110	0
219	Max Govern Speed Override	515	15
221	TPS 2 Signal Voltage Low	51	0
222	TPS 2 Signal Low Voltage	520251	4
223	TPS 2 Signal High Voltage	520251	3
261	Injector Driver 1 Open	651	5
262	Injector Driver 1 Shorted	651	6
264	Injector Driver 2 Open	652	5
265	Injector Driver 2 Shorted	652	6
267	Injector Driver 3 Open	653	5
268	Injector Driver 3 Shorted	653	6
270	Injector Driver 4 Open	654	5
271	Injector Driver 4 Shorted	654	6
336	Crank Sync Noise	636	2
337	Crank Loss	636	4
341	Cam Sync Noise	723	2
342	Cam Sensor Loss	723	4
420	Gasoline Cat Monitor	520211	10
524	Oil Pressure Low	100	1

Table 3-16. DTC to SPN/FMI Cross Reference Chart

DTC	Description	SPN Code	FMI Code
562	System Voltage Low	168	17
563	System Voltage High	168	15
601	Flash Checksum Invalid	628	13
604	RAM Failure	630	12
606	COP Failure	629	31
642	External 5V Reference Low	1079	4
643	External 5V Reference High	1079	3
685	Power Relay Open	1485	5
686	Power Relay Shorted	1485	4
687	Power Relay Short to Power	1485	3
1111	Fuel Rev Limit	515	16
1112	Spark Rev Limit	515	0
1151	Closed Loop Multiplier High LPG	520206	0
1152	Closed Loop Multiplier Low LPG	520206	1
1155	Closed Loop Multiplier High Gasoline	520204	0
1156	Closed Loop Multiplier Low Gasoline	520204	1
1161	Adaptive Learn High LPG	520202	0
1162	Adaptive Learn Low LPG	520202	1
1165	LPG Cat Monitor	520213	10
1171	LPG Pressure Higher Than Expected	520260	0
1172	LPG Pressure Lower Than Expected	520260	1
1173	EPR Comm Lost	520260	31
1174	EPR Voltage Supply High	520260	3
1175	EPR Voltage Supply Low	520260	4
1176	EPR Internal Actuator Fault	520260	12
1177	EPR Internal Circuitry Fault	520260	12
1178	EPR Internal Comm Fault	520260	12
1612	RTI 1 loss	629	31
1613	RTI 2 Loss	629	31
1614	RTI 3 Loss	629	31
1615	A/D Loss	629	31
1616	Invalid Interrupt	629	31
1625	Shutdown Request	1384	31
1626	CAN Tx Failure	639	12
1627	CAN Rx Failure	639	12
1628	CAN Address Conflict Failure	639	13
1629	Loss of TSC 1	639	31
2111	Unable to Reach Lower TPS	51	7
2112	Unable to Reach Higher TPS	51	
2135	TPS 1/2 Simultaneous Voltages	51	31
2229	BP Pressure High	108	0

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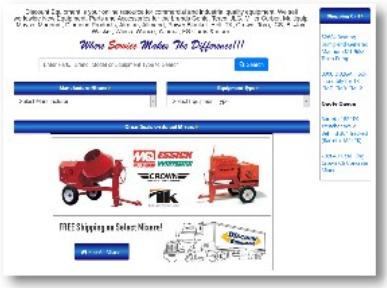

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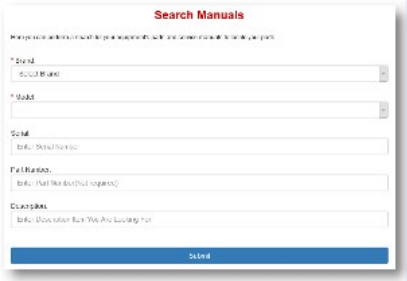

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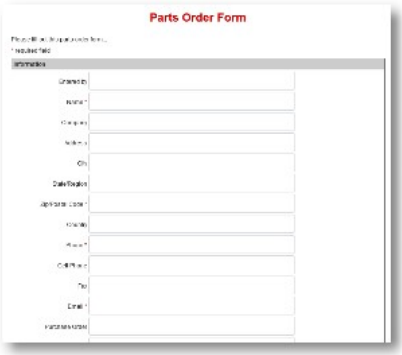

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SECTION 4. BOOM & PLATFORM

4.1 MAIN BOOM ASSEMBLY

Removal

1. Using suitable lifting equipment, adequately support boom assembly weight along entire length.

NOTICE

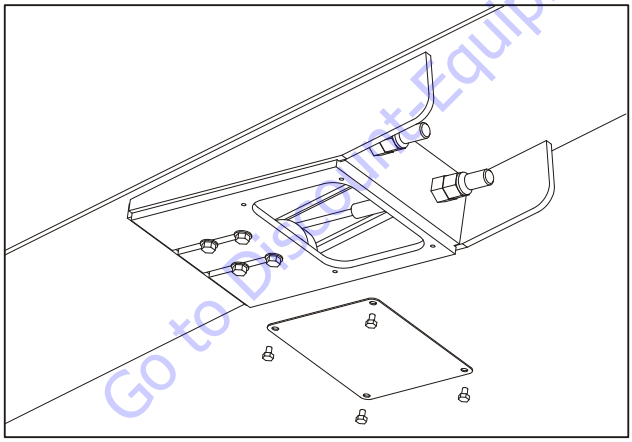
HYDRAULIC LINES AND PORTS SHOULD BE CAPPED IMMEDIATELY AFTER DISCONNECTING LINES TO AVOID ENTRY OF CONTAMINANTS INTO SYSTEM.

2. Tag and disconnect hydraulic lines from telescope cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.

Boom Disassembly

NOTE: *The following procedure assumes the boom is removed from the machine.*

1. Extend the boom approximately 2 ft (0.6 m). This will enable access to the bolts that secure the cable mount block to the boom fly section.
2. Remove hardware securing the telescope cylinder.
3. Remove hardware securing the cover plate on the bottom front of the base boom section.

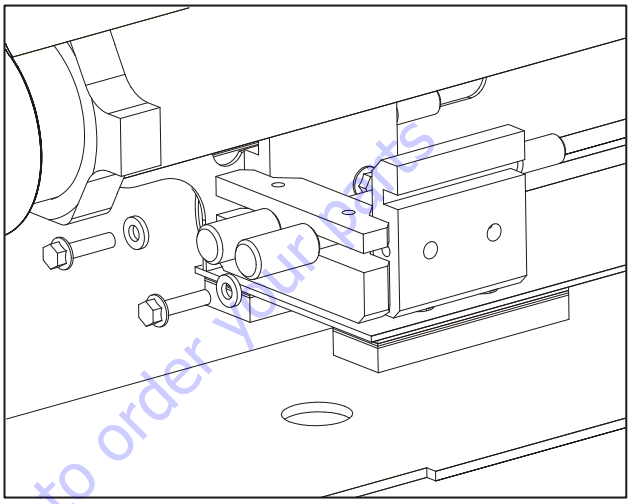


NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

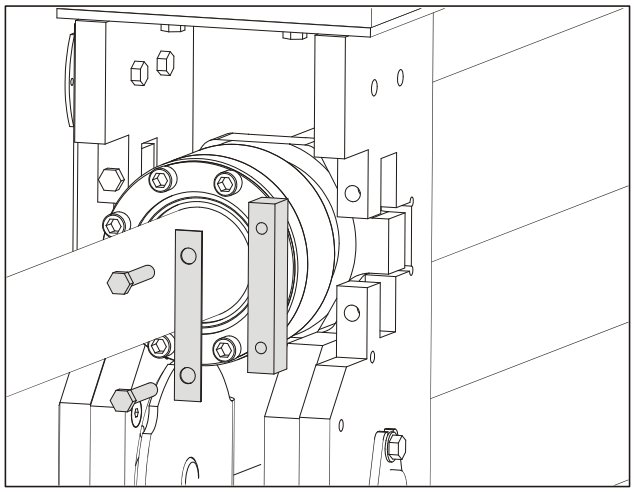
4. Clamp both threaded ends of wire rope to prevent rotation.

NOTE: *Do not clamp on threads. Remove jam nuts and nuts which secure the wire rope adjustments to the bottom front of the base boom section.*

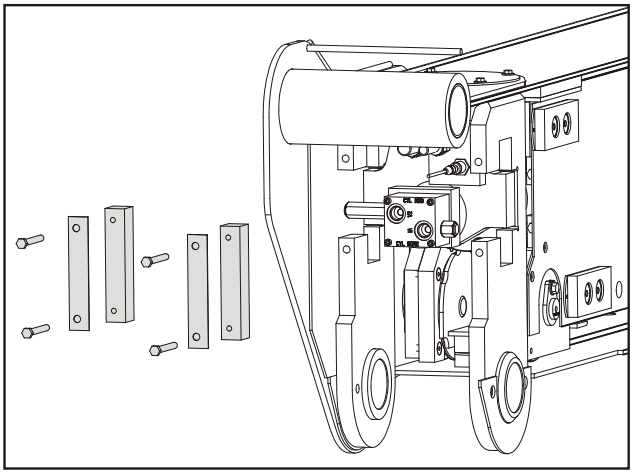
5. Using a 3/8 drive extension approximately 4 ft (1.2 m) long, remove the bolts and washers securing the cable mount block to the boom fly section.



6. Remove the four bolts, shims, and attachment blocks that secure the telescope cylinder barrel to the boom mid section.



7. Remove the four bolts, shims, and mounting blocks that secure the telescope cylinder rod to the boom base section.

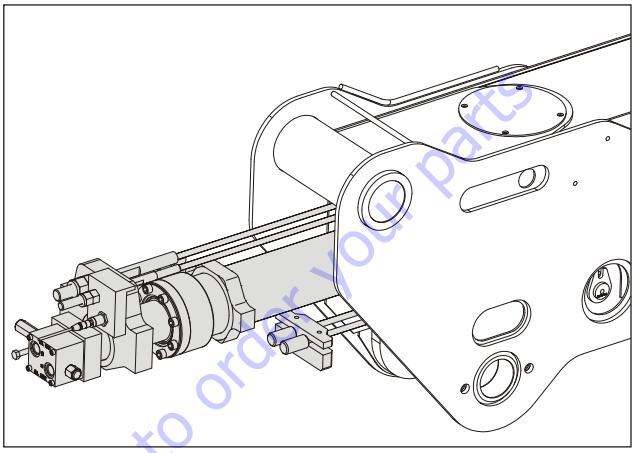


NOTICE

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

NOTE: *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

8. Using overhead cranes or other suitable lifting/supporting devices, carefully pull the telescope cylinder out from the back of the boom. At the same time, also pull the cable mount block out so the extension cables come out with the telescope cylinder and do not bind. The lifting/supporting devices will have to be repositioned to support the weight of the cylinder as it is drawn out of the boom.



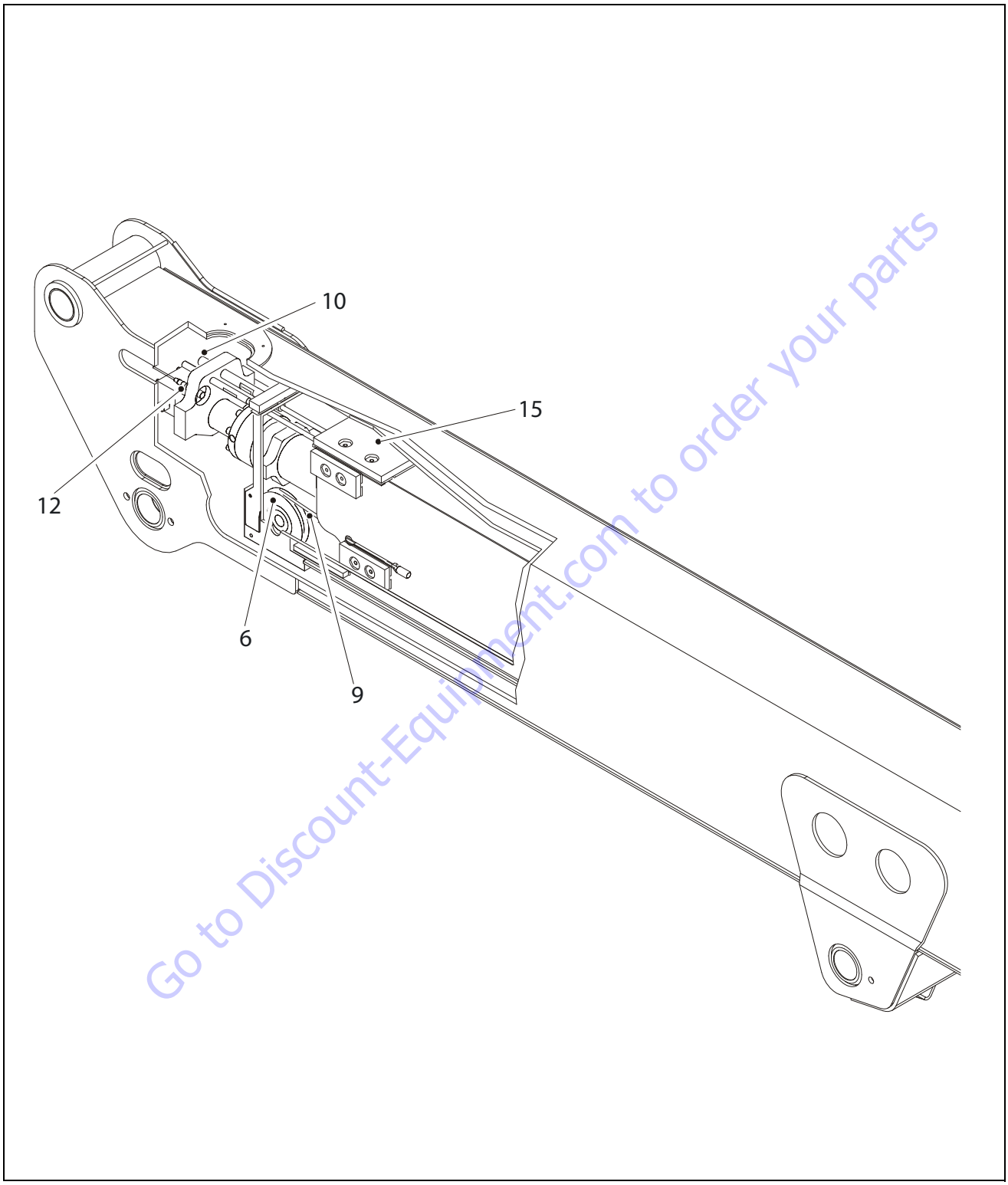
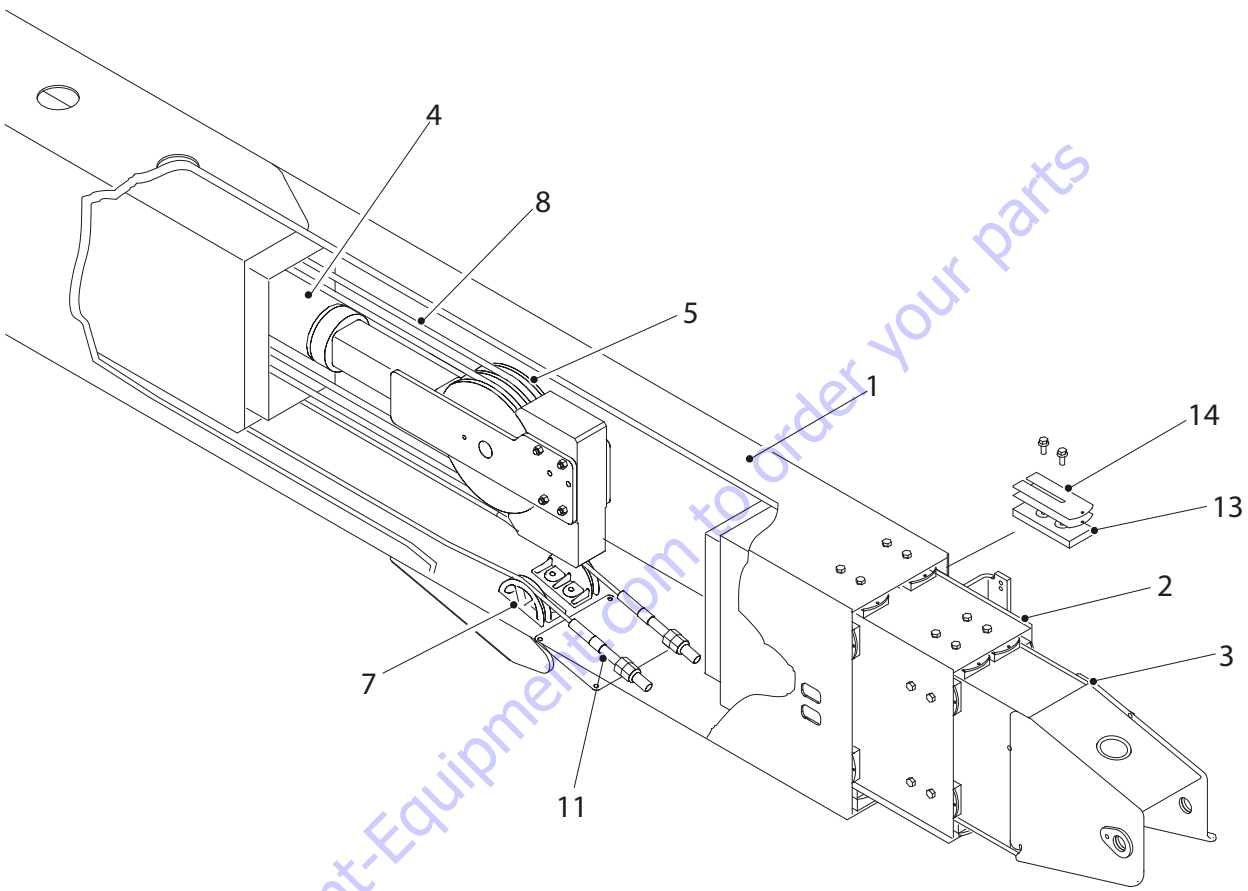
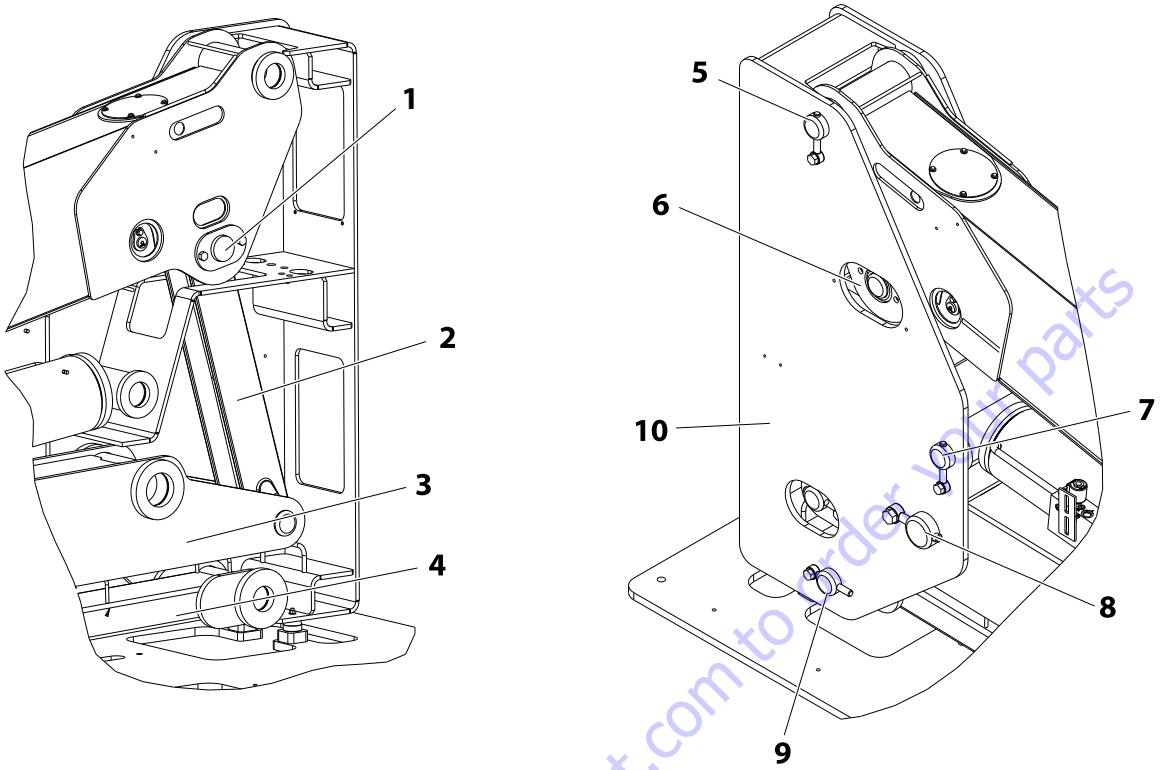


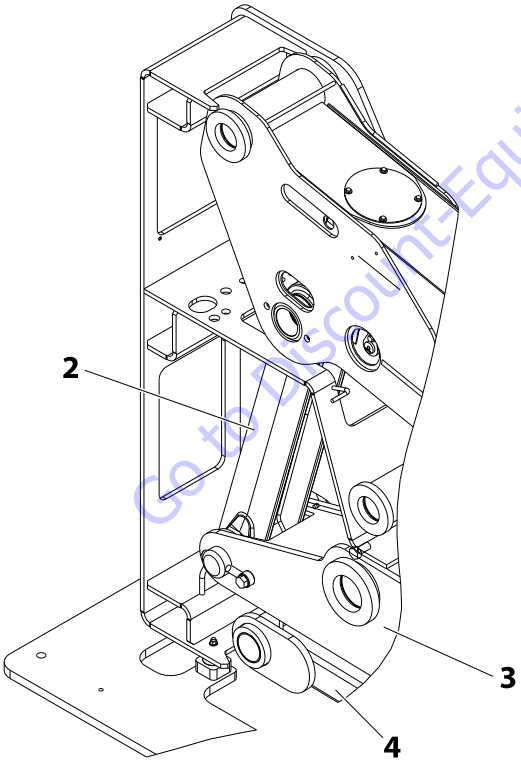
Figure 4-1. Boom Assembly Cutaway - Sheet 1 of 2



1. Base Boom
2. Mid Boom
3. Fly Boom
4. Telescope Cylinder
5. Extend Sheave
6. Retract Sheave
7. Sheave Block
8. Extend Cable
9. Retract Cable
10. Extend Cable Adjustment
11. Retract Cable Adjustment
12. Proximity Switch
13. Wear Pad
14. Shims
15. Wear Pad

Figure 4-2. Boom Assembly Cutaway - Sheet 2 of 2





1. Pivot Pin
2. Power Link
3. Tower
4. Level Link
5. Boom Pivot Pin
6. Pin Cover
7. Lift Cylinder Pivot Pin
8. Tower Pin
9. Level Link Pin
10. Upright

Figure 4-3. Boom Components - Sheet 1 of 2

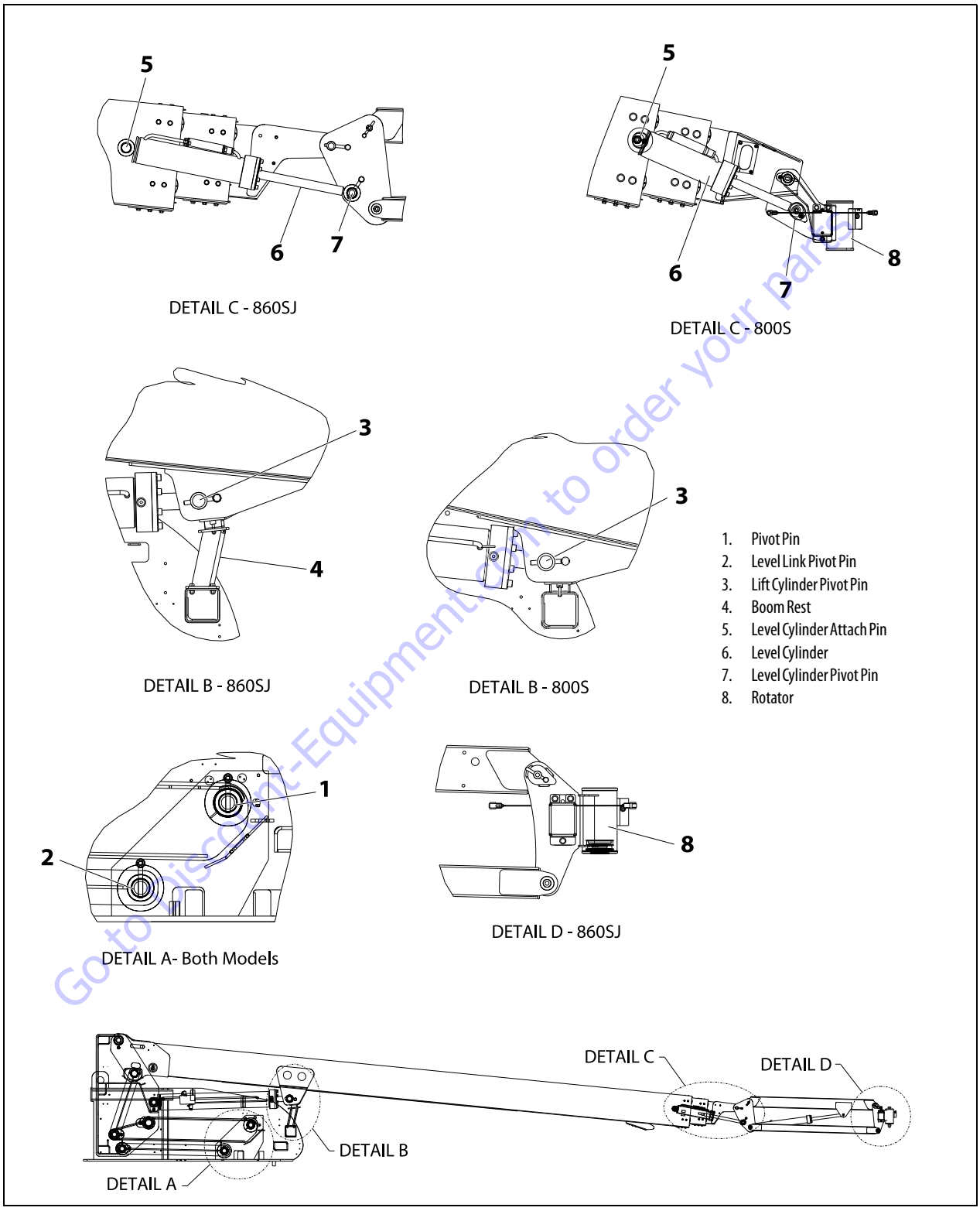


Figure 4-4. Boom Components - Sheet 2 of 2

9. Carefully remove the telescope cylinder and sheave assembly. Place telescope cylinder on a suitable trestle.
   a. Remove hardware from the wear pads; remove wear pads from cylinder.
   b. Remove hardware from the wire rope guard; remove guard from cylinder.
   c. Remove hardware from the sheave pin; remove pin and sheave from cylinder.

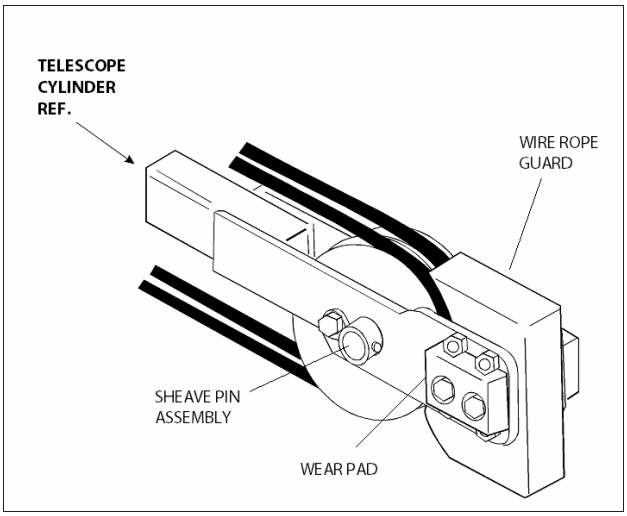


Figure 4-5. Disassembly of Sheave Assembly

10. Remove hardware which secures the wear pads to the front of base boom section; remove wear pads from the top, sides and bottom of the base boom section.
11. Using an overhead crane or suitable lifting device, remove mid and fly boom sections from base section.

NOTE: *When removing mid and fly boom sections from base boom section, retract wire rope must be dragged along with boom sections.*

12. Remove hardware which secures the wear pads to the rear end of mid boom section; remove the wear pads from the top, sides and bottom of the mid boom section.
13. Remove hardware which secures the sheave guards and sheave assemblies to mid boom section, remove sheave assemblies from mid boom section.
14. Remove hardware which secures the wear pads to the front of mid boom section; remove wear pads from the top, sides and bottom of the mid boom section.
15. Using an overhead crane or suitable lifting device, remove fly boom section from mid section.

NOTE: *When removing fly boom section from mid boom section, retract wire rope must be dragged along with fly boom section.*

16. Remove hardware which secures the wear pads to the rear end of fly boom section; remove wear pads from the top, sides and bottom of the fly boom section.
17. When removing wire rope from fly boom section, push the cable into fly boom. Route wire rope back through holes in the side of the fly boom section.

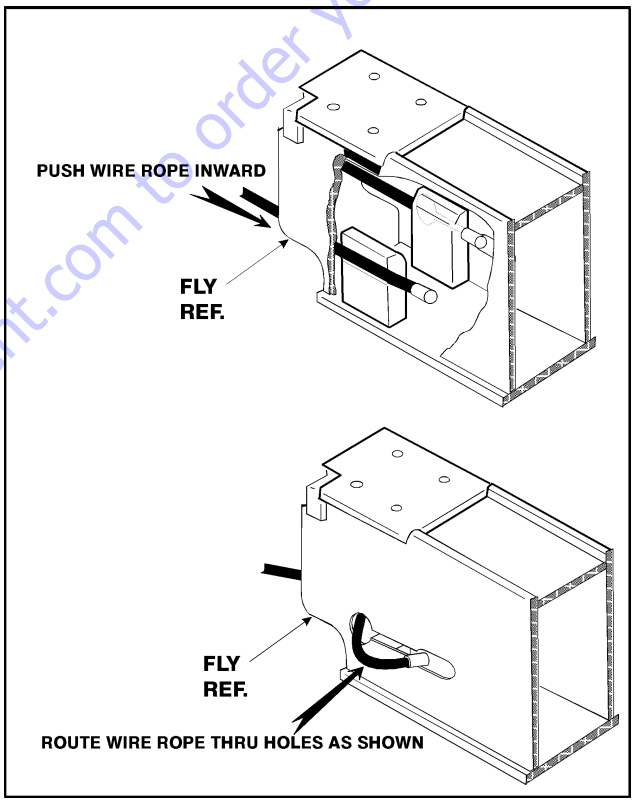


Figure 4-6. Disassembly Wire Rope Routing Procedure

Inspection

NOTE: *When inspecting pins and bearings Refer to the guidelines established in Section 2 - General.*

1. Inspect all sheaves (extend and retract wire ropes and telescope cylinder) for excessive groove wear, burrs or other damage. Replace sheaves as necessary.

NOTE: *To check the size, contour and amount of wear, a groove gauge is used. Replace the sheave if worn as shown in the following drawing.*

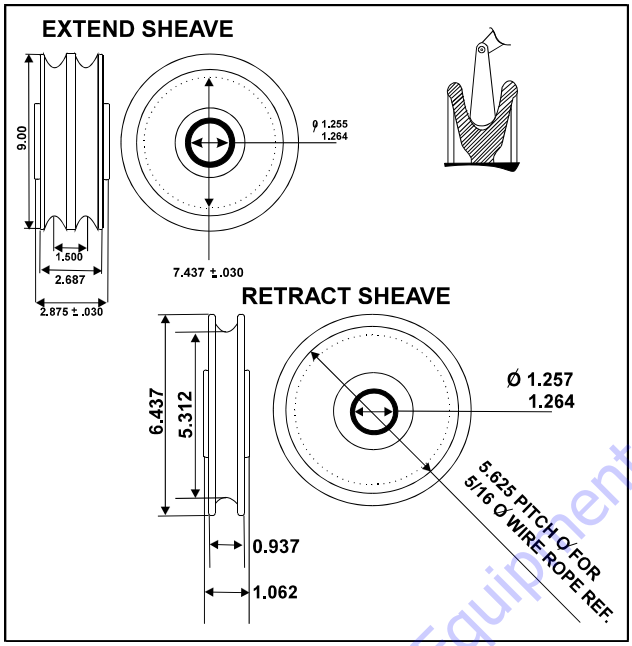


Figure 4-7. Dimension of Sheaves When New

2. Inspect extend and retract wire rope sheave bearings for wear, scoring, or other damage, and for ovality.
3. Inspect extend wire rope and retract wire rope sheave pins for scoring, tapering and ovality. Replace pins as necessary.
4. Inspect telescope cylinder sheave pin for scoring, tapering and ovality. Replace pins as necessary.
5. Inspect boom pivot pin for wear, scoring, tapering and ovality, or other damage. Replace pins as necessary.
6. Inspect telescope cylinder attach point for scoring, tapering and ovality. Replace pins as necessary.
7. Inspect upper lift cylinder attach pin for wear, scoring, tapering and ovality, or other damage. Ensure pin surfaces are protected prior to installation. Replace pins as necessary.
8. Inspect inner diameter of boom pivot bushing for scoring, distortion, wear, or other damage. Replace bearing as necessary.
9. Inspect all wear pads for excessive wear or other damage. Replace pads when worn to within 1/8 in. (3.2 mm) of threaded insert.
10. Inspect extend and retract wire rope attach point components for cracks, stretching, distortion, or other damage. Replace components as necessary.
11. Inspect all threaded components for damage such as stretching, thread deformation, or twisting. Replace as necessary.
12. Inspect structural units of boom assembly for bending, cracking, separation of welds, or other damage. Replace boom sections as necessary.

Assembly

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

1. Measure inside dimensions of the base and mid sections to determine the number of shims required for proper lift.
2. Measure inside dimensions of the mid section to determine the number of shims required for proper lift.
3. Install side, top and bottom wear pads to the rear end of fly section; shim evenly to the measurements of the inside of mid section.

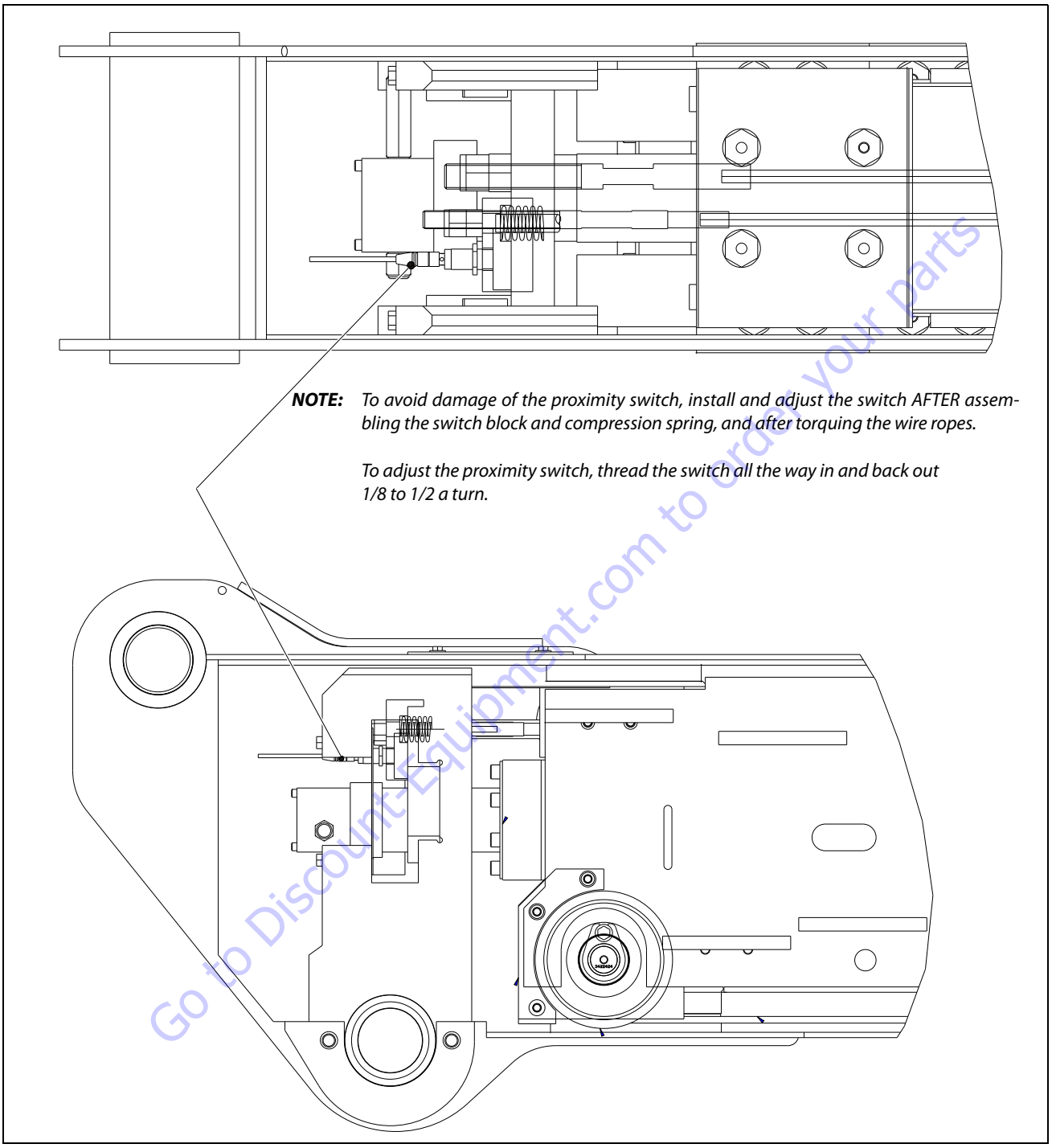


Figure 4-8. Proximity Switch Adjustment

4. Install retract wire ropes into rear end of fly section, route wire ropes through holes in side of fly boom section and pull into slot.

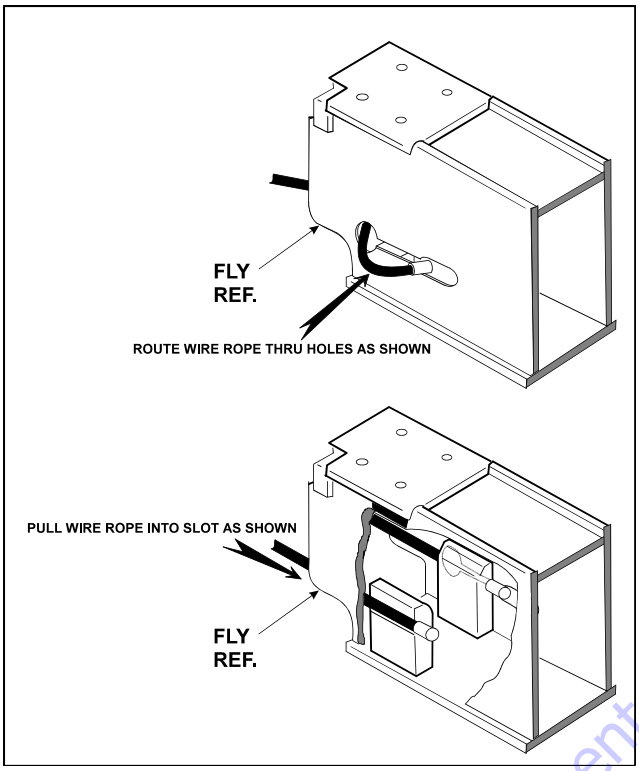


Figure 4-9. Routing Installation of Retract Wire Ropes

5. Install side, top and bottom wear pads to the rear end of mid section; shim evenly to the measurements of the inside of mid section.

NOTICE

WHEN ASSEMBLING BOOM SECTIONS, ENSURE THAT THE BOOM SLIDING TRAJECTORIES HAVE BEEN CLEARED OF CHAINS, TOOLS, AND OTHER OBSTRUCTIONS.

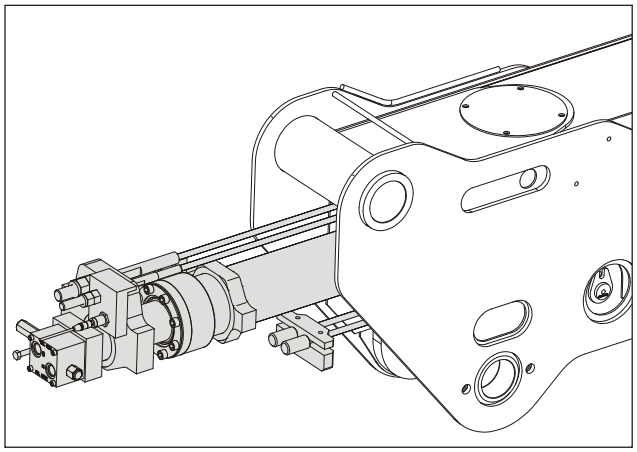
6. Shim the insides of the boom sections for a total of 1/16 in. (1.52 mm) clearance (if the action is centered, there will be 1/32 clearance on each side).
7. Slide fly boom section into the mid boom section. Shim boom, if necessary, for a total of 1/16 in. (1.52 mm) clearance.
8. Install wear pads into the forward position of the mid boom section. Shim boom, if necessary, for a total of 2/10 in. (5.08 mm) clearance.
9. Properly position the retraction wire rope sheaves assemblies at the rear end of the mid boom section; ensure all sheave-to-mounting block attachment holes align. Install the sheave pins and secure them with mounting hardware. Position retract wire ropes onto the sheaves.
10. Install sheave guards to rear end of mid boom section and secure with mounting hardware.
11. Slide mid boom section into the base boom section. Allow the retraction wire ropes to trail between the bottom surfaces of boom sections. Shim boom, if necessary, for a total of 1/16 in. (1.52 mm) clearance.
12. Install wear pads into the forward position of the base boom section. Shim boom, if necessary, for a total of 2/10 in. (5.08 mm) clearance.
13. Install sheave block to bottom of base boom section and adjust block so that retract wire ropes do not come into contact with boom surfaces.
14. Install wire rope threaded ends through attachment holes in the bottom of base boom section. Loosely install nuts and jam nuts onto the threaded ends of wire ropes.
15. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
16. Install a new extend sheave on the end of the telescope cylinder.
17. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the telescope cylinder with the adjusting nuts and lock nuts. Install the opposite end of the cables in the cable mount block.
18. Use tape or tie straps to fasten the cables to the telescope cylinder assembly. It is important that the tape or straps be strong enough to hold the cable in place yet weak enough to break and fall away when the cables are adjusted.

NOTICE

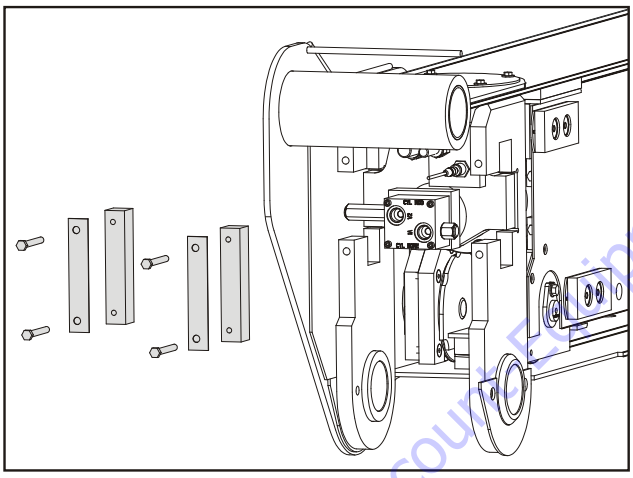
WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

NOTE: *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

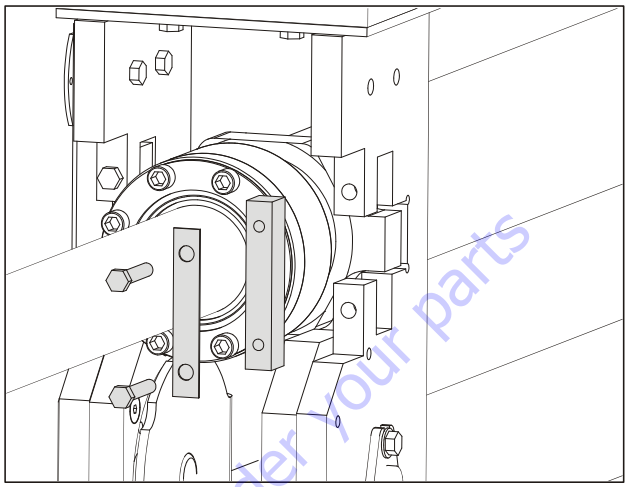
19. Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



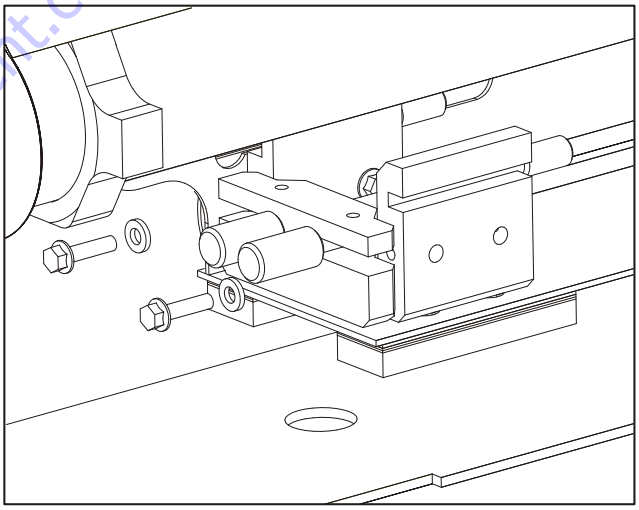
20. Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



21. Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder barrel to the boom mid section with the bolts, shims, mounting blocks.



22. Using a 3/8 drive extension approximately 4 ft (1.2 m) long, install the bolts and washers securing the cable mount block to the boom fly section. Tape the bolts to the socket at the end of the extension to prevent it from coming out of the socket before it engages the mounting threads.



23. Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.

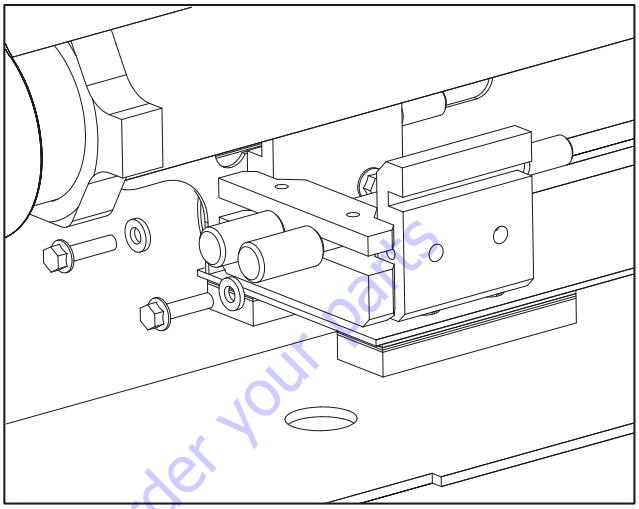
24. Adjust the boom cables as outlined under Section 4.8, Boom Rope Torquing Procedures.

Installation

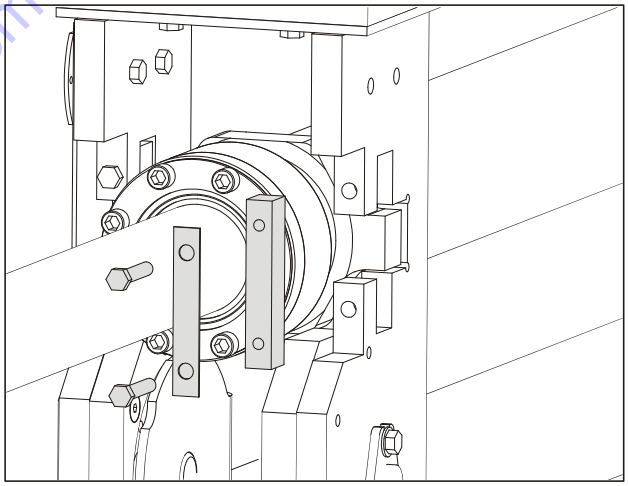
1. Using a suitable lifting device, position boom assembly on upright so that the pivot holes in both boom and upright are aligned.
2. Install boom pivot pin, ensuring that location of hole in pin is aligned with attach point on upright.
3. If necessary, gently tap pin into position with soft headed mallet. Secure pin mounting hardware.
4. Connect all wiring to the ground control box.
5. Connect all hydraulic lines running along side of boom assembly.
6. Using all applicable safety precautions, operate lifting device in order to position boom lift cylinder so that holes in the cylinder rod end and boom structure are aligned. Insert the lift cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
7. Align holes in boom structure with hole in master cylinder. Insert the master cylinder pin, ensuring that location of hole in pin is aligned with attach point on boom.
8. Adjust retract and extend cables to the proper torque. Refer to Section 4.8, Boom Rope Torquing Procedures.
9. Using all applicable safety precautions, operate machine systems and raise and extend boom fully, noting the performance of the extension cycle.
10. Retract and lower boom, noting the performance of the retraction cycle.

Telescope Cylinder/Boom Cable Removal

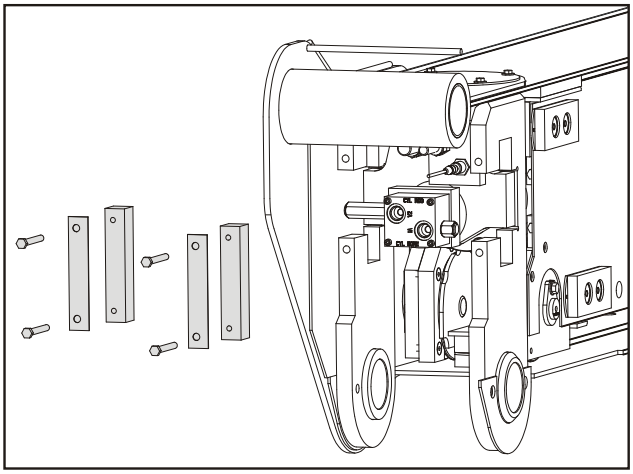
1. Make sure the machine is on a firm, level surface.
2. Raise the boom to a horizontal position.
3. Extend the boom approximately 2 ft (0.6 m). This will enable access to the bolts that secure the cable mount block to the boom fly section.
4. Tag and disconnect all hydraulic hoses running to the telescope cylinder. Cap or plug all openings to prevent any foreign matter from entering the hydraulic system.
5. Using a 3/8 drive extension approximately 4 ft (1.2 m) long, remove the bolts and washers securing the cable mount block to the boom fly section.



6. Remove the four bolts, shims, and attachment blocks that secure the telescope cylinder barrel to the boom mid section.



7. Remove the four bolts, shims, and mounting blocks that secure the telescope cylinder rod to the boom base section.

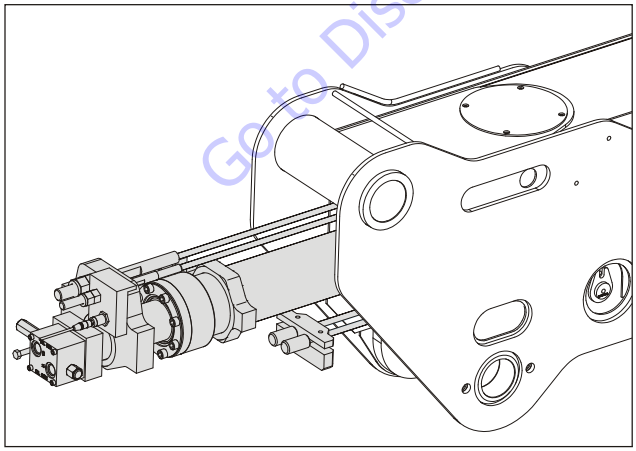


NOTICE

WHEN REMOVING THE TELESCOPE CYLINDER FROM THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY FROM THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

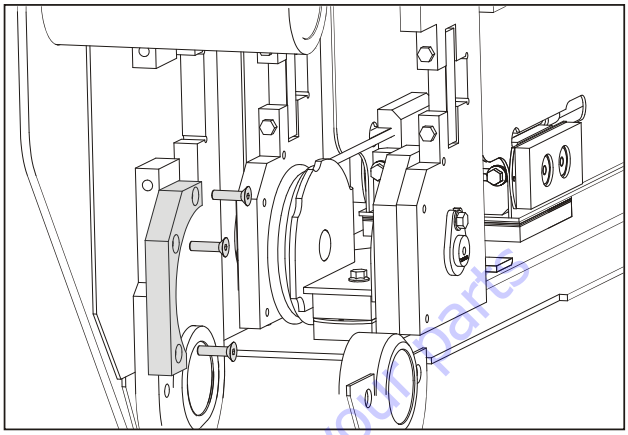
NOTE: *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

8. Using overhead cranes or other suitable lifting/supporting devices, carefully pull the telescope cylinder out from the back of the boom. At the same time, also pull the cable mount block out so the extension cables come out with the telescope cylinder and do not bind. The lifting/supporting devices will have to be repositioned to support the weight of the cylinder as it is drawn out of the boom.

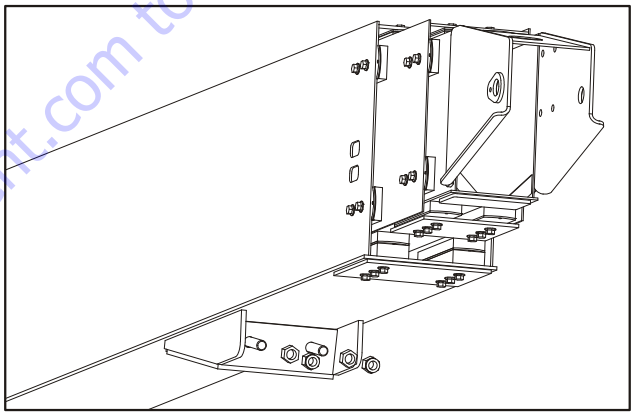


9. Push the boom fly sections back in to gain access to the boom retraction cable.

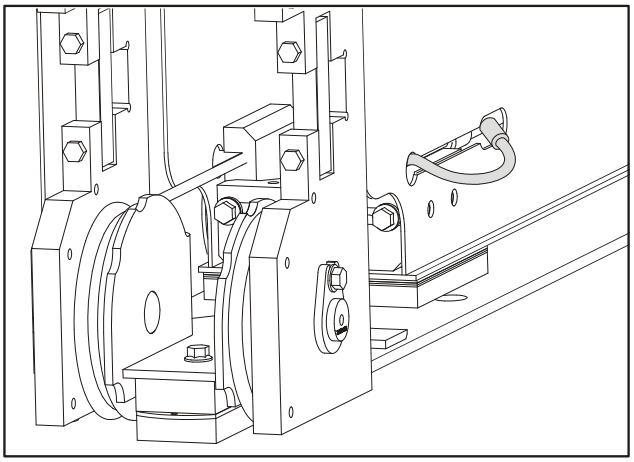
10. Remove the screws securing the sheave guards to the boom mid section and remove the sheave guards.



11. Remove the adjusting nuts and lock nuts from the opposite end of the retraction cables at the front of the boom base section. To aid in installing new retraction cables, fasten a length of tie wire as long as the retraction cables to the ends of the cables.



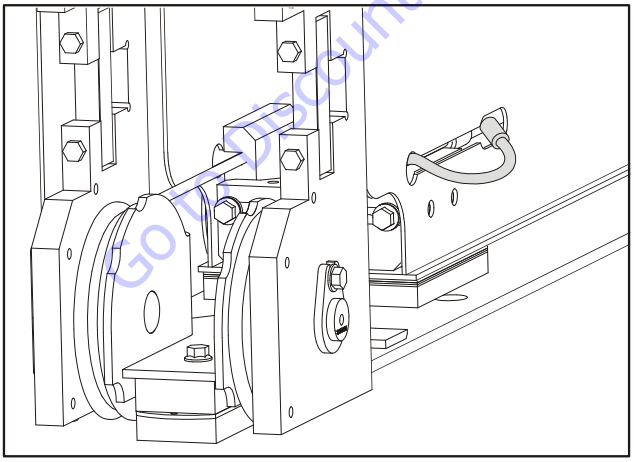
12. Twist the ends of the retraction cables to remove the ends of the cables from the slots in the side of the boom fly section.



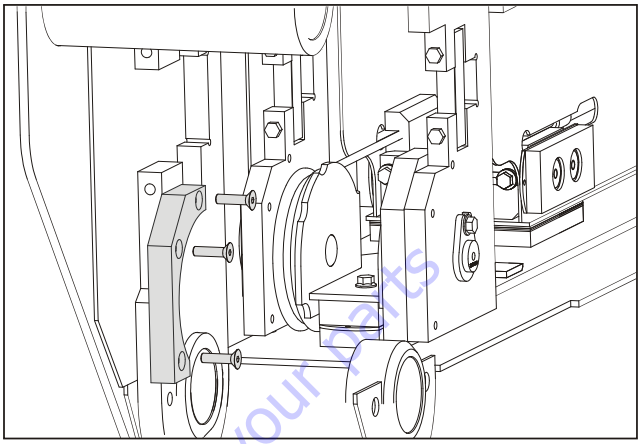
13. From the rear of the boom, pull out the boom retraction cables.

Telescope Cylinder/Boom Cable Installation

1. Attach the threaded end of the new retraction cables to the tie wires used in the removal procedure.
2. From the front of the boom, pull the retraction cables through the boom and through the attachment holes in the bottom of the boom base section. Loosely install the adjustment nuts and jam nuts.
3. Install new retract sheaves, then route the opposite end of the retraction cables around the sheaves. Push the ends of the cables through the slots in the side of the boom fly section.



4. Install the sheave guards and secure them in place with the retaining screws.



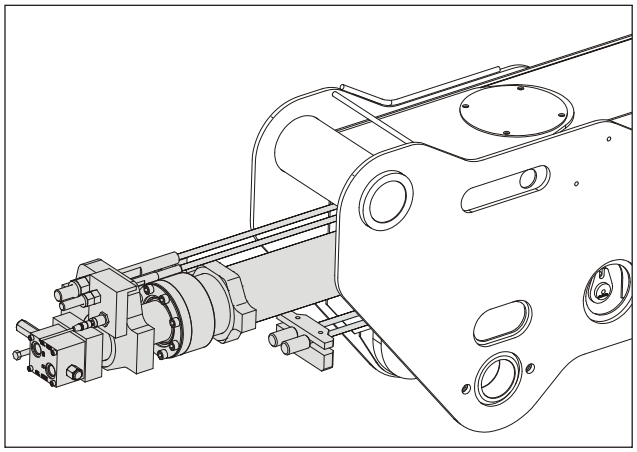
5. Pull the boom sections out to approximately where they were extended to for telescope cylinder removal.
6. Install a new extend sheave on the end of the telescope cylinder.
7. Route new extend cables around the telescope cylinder. Loosely fasten the threaded end of the cables to the rod end of the telescope cylinder with the adjusting nuts and lock nuts. Install the opposite end of the cables in the cable mount block.
8. Use tape or tie straps to fasten the cables to the telescope cylinder assembly. It is important that the tape or straps be strong enough to hold the cable in place yet weak enough to break and fall away when the cables are adjusted.

NOTICE

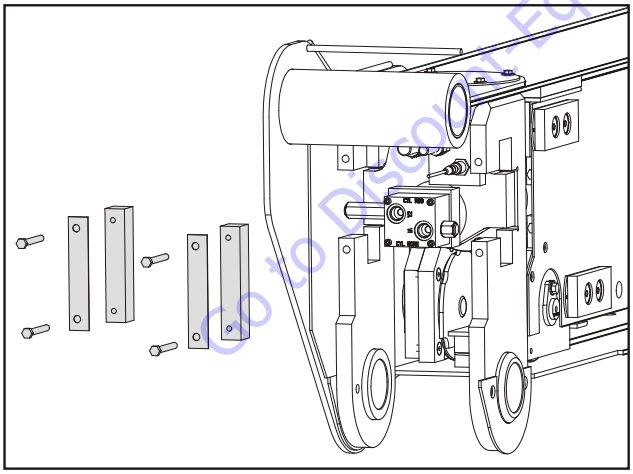
WHEN PUSHING THE TELESCOPE CYLINDER INTO THE BOOM, IT MAY BE NECESSARY AT SOME POINT TO TURN THE CYLINDER SLIGHTLY IN ORDER TO CLEAR ASSEMBLIES MOUNTED WITHIN THE BOOM. CARE MUST BE TAKEN TO MOVE THE CYLINDER SLOWLY INTO THE BOOM. DAMAGE TO COMPONENTS MAY RESULT FROM FORCIBLE IMPACT WITH THESE ASSEMBLIES.

NOTE: *The telescope cylinder weighs approximately 600 lbs. (272 kg).*

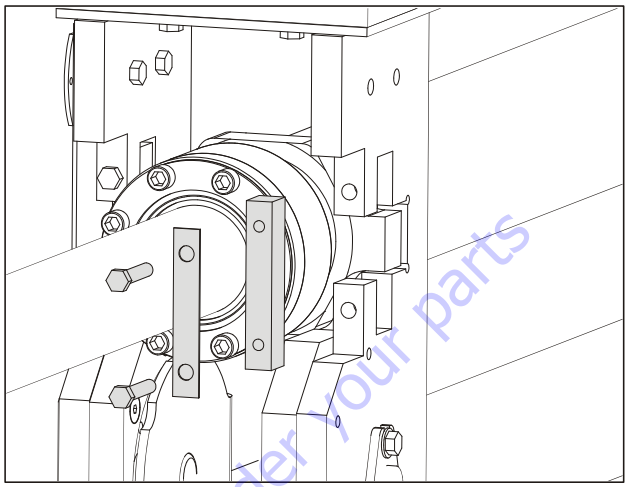
9. Using adequate lifting equipment, carefully push the telescope cylinder assembly and cables back into the boom.



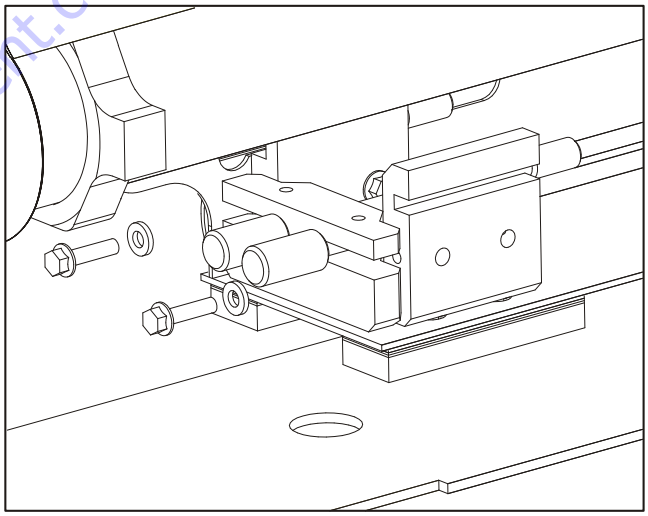
10. Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder rod to the boom base section with the bolts, shims, mounting blocks.



11. Apply JLG Threadlocker P/N 0100011 to the bolts and fasten the telescope cylinder barrel to the boom mid section with the bolts, shims, mounting blocks.



12. Using a 3/8 drive extension approximately 4 ft (1.2 m) long, install the bolts and washers securing the cable mount block to the boom fly section. Tape the bolts to the socket at the end of the extension to prevent it from coming out of the socket before it engages the mounting threads.



13. Connect all the hydraulic lines to the cylinder as tagged during the removal procedure.

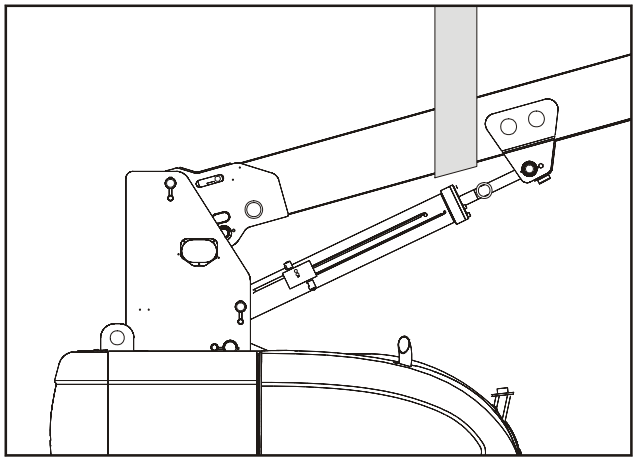
14. Adjust the boom cables as outlined under Section 4.8, Boom Rope Torquing Procedures.

15. Run the boom through all lift and telescope functions and check for proper operation or any leakage.

Lift Cylinder Removal

1. Elevate the boom enough to gain access to the lift cylinder lower pivot pin.
2. Use an adequate supporting device to support the weight of the boom and associated components as shown below.

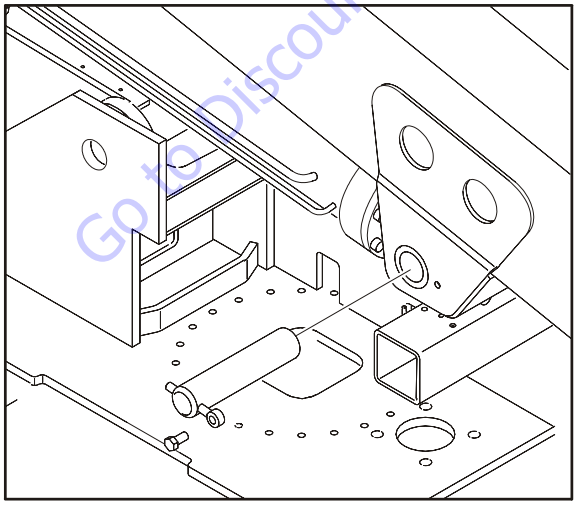
NOTE: *The supporting device must be able to support approximately 5350 lbs (2430 kg).*



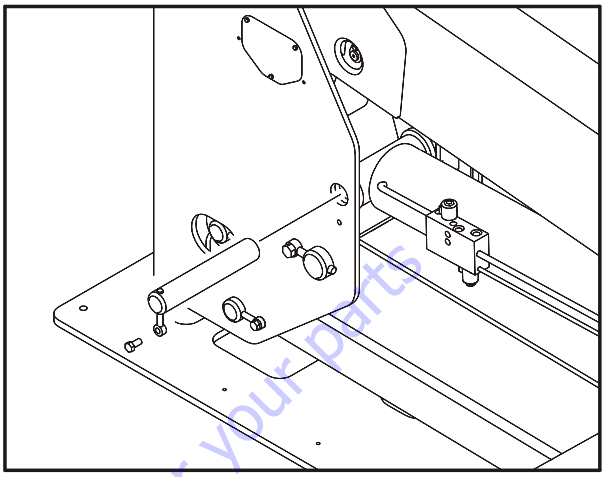
3. Tag and disconnect the hydraulic hoses from the lift cylinder.
4. Use an adequate lifting device to support the lift cylinder.

NOTE: *The lift cylinder weighs approximately 618 lbs (280 kg).*

5. Remove the bolt and keeper pin securing the upper lift cylinder pivot pin and remove the pivot pin.



6. Remove the bolt and keeper pin securing the lower lift cylinder pivot pin and remove the pivot pin.



7. Using the lifting device, slide the lift cylinder back enough to allow the cylinder end to clear the attachment point on the boom.
8. Slide the lift cylinder sideways enough to remove it from the machine.

Lift Cylinder Installation

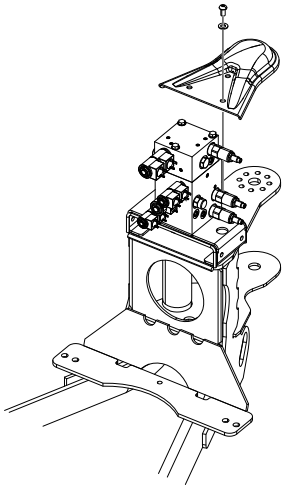
NOTE: *The lift cylinder weighs approximately 618 lbs (280 kg).*

1. Using an adequate lifting device, position the lift cylinder in the machine in the same manner that it was removed.
2. Install the lower pivot pin and secure it in place with the keeper pin and bolt.
3. Connect the hydraulic lines to the cylinder as tagged during removal.
4. Extend the cylinder rod until it aligns with the attachment point on the boom. Take care not to extend the cylinder rod too far.
5. Install the upper lift cylinder pivot pin and secure it in place with the keeper pin and bolt.
6. Remove the supporting device and function check the boom to make sure the lift cylinder operates properly and there are no leaks.

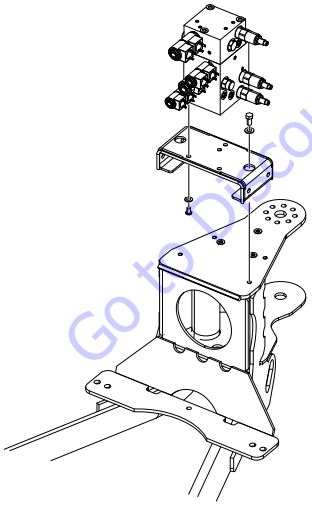
4.2 PLATFORM

Platform Valve Removal

7. Tag and disconnect the hydraulic lines from the platform control valve. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
8. Remove hardware securing cover from the platform support. Remove cover.

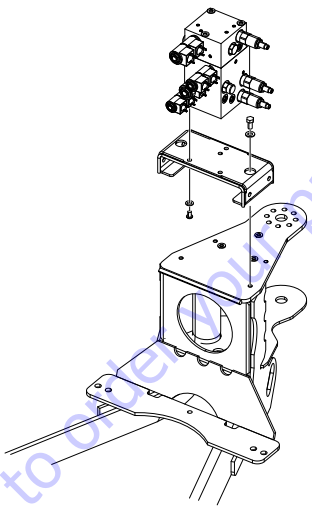


9. Remove hardware securing the mounting bracket to the platform support. Take out the mounting bracket along with platform control valve.
10. Remove hardware securing the platform control valve to the mounting bracket. Remove platform control valve.

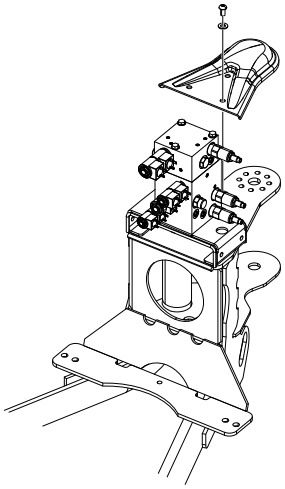


Platform Valve Installation

1. Install platform control valve onto the mounting bracket and secure using hardware.
2. Install the mounting bracket onto the platform support and secure using hardware.



3. Install cover onto the platform support securing the hardware.



4. Remove tag and reconnect the hydraulic lines to the platform control valve.

Support Removal

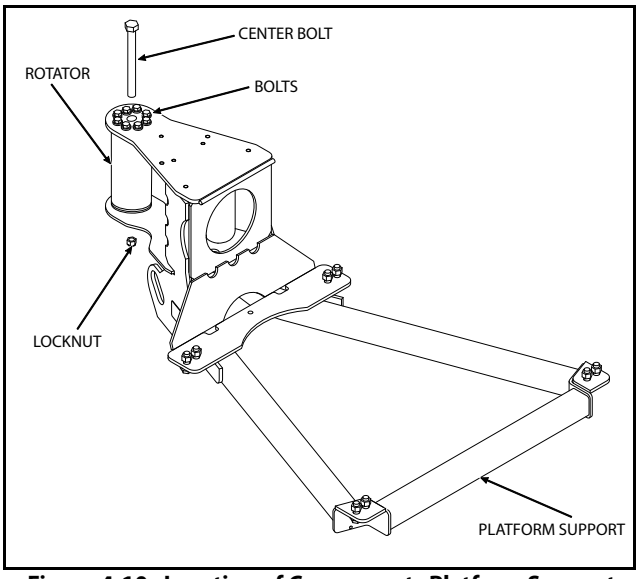
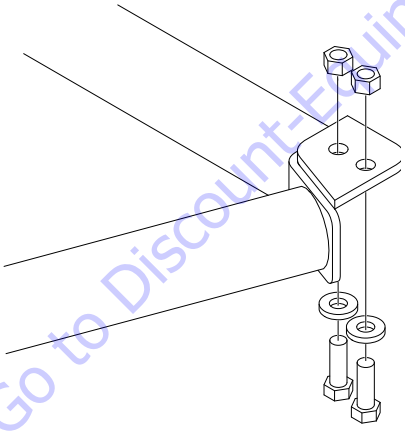


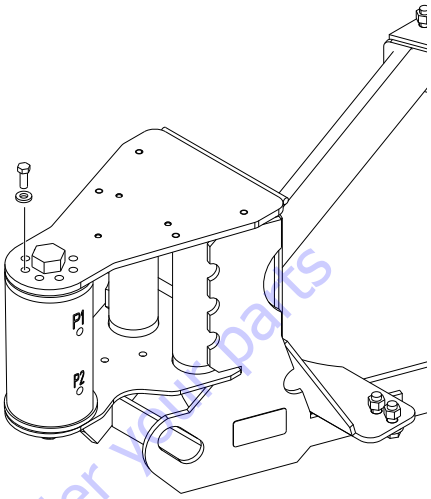
Figure 4-10. Location of Components Platform Support

1. Disconnect electrical cables from control console.
2. Remove the bolts securing the platform to the platform support, then remove the platform.

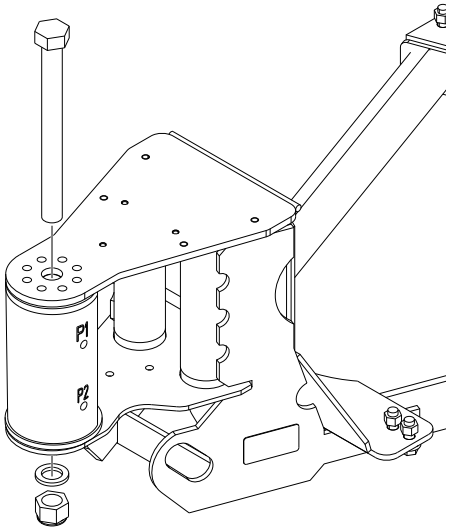
NOTE: *The platform weighs approximately 203 lbs. (104 kg).*



3. Using a suitable device, support the platform support.
4. Remove the bolts and locknuts securing the support to the rotator.



5. Using a suitable brass drift and hammer, remove the rotator center bolt, then remove the support from the rotator.

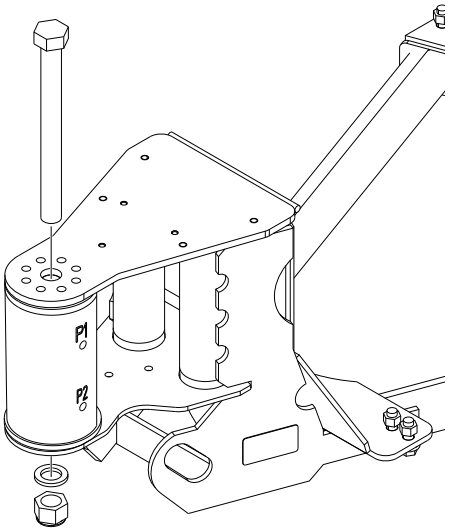


Support Installation

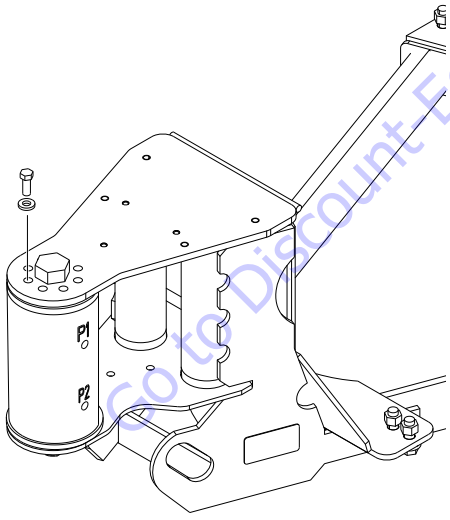
1. Using a suitable device, support the platform support and position it on the rotator.

NOTE: *The platform support weighs approximately 77 lbs. (35 kg).*

2. Install the rotator center bolt.

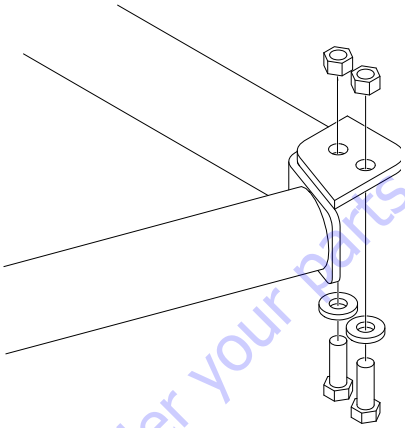


3. Apply JLG Threadlocker P/N 0100011 to the eight bolts and locknuts securing the support to the rotator and install the bolts and locknuts.

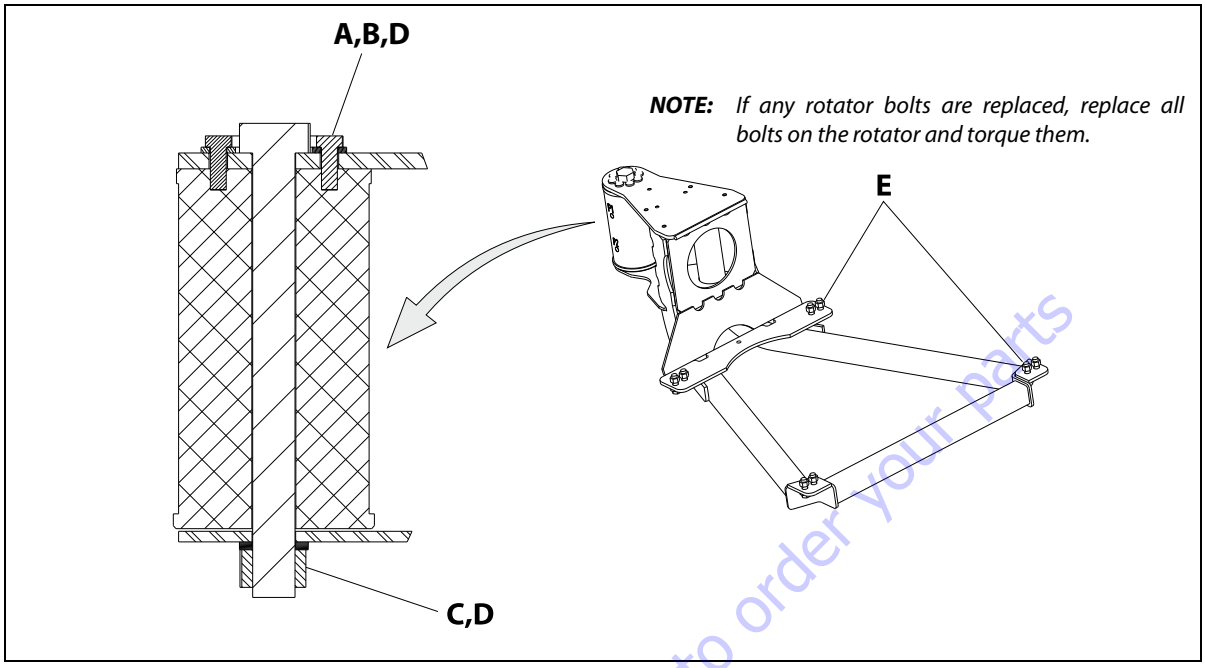


4. Torque the nut on the rotator center bolt to 586 ft. lbs. (795 Nm). Torque the retaining bolts to 40 ft. lbs. (55 Nm).

5. Position the platform on the platform support and install the bolts securing the platform to the platform support. Torque the bolts to 85 ft. lbs. (116 Nm).



6. Connect the electrical cables to the platform control console.



A	Torque to 40 ft.lbs. (55 Nm)
B	JLG Threadlocker P/N 0100011
C	Torque to 586 ft. lbs. (795 Nm)
D	Check torque every 150 hours of operation
E	Torque to 85 ft. lbs. (116 Nm)

Figure 4-11. Platform Support Torque Values

4.3 ROTATOR AND SLAVE CYLINDER

Removal

1. Tag and disconnect hydraulic lines to rotator. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
2. Supporting the rotator, remove hardware from pin #1. Using a suitable brass drift and hammer remove pin #1 from the fly boom.
3. Remove the hardware from pin #2. Using a suitable brass drift and hammer, remove pin #2 from the fly boom and remove the rotator.
4. Telescope the fly section out approximately 20 in. (50 cm) to gain access to the slave leveling cylinder. (860 SJ only).
5. Supporting the slave cylinder remove the hardware from pin #3. Using a suitable brass drift and hammer remove pin #3 from the fly boom.
6. Tag and disconnect hydraulic lines to the slave leveling cylinder. Use a suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports. Remove the slave cylinder.

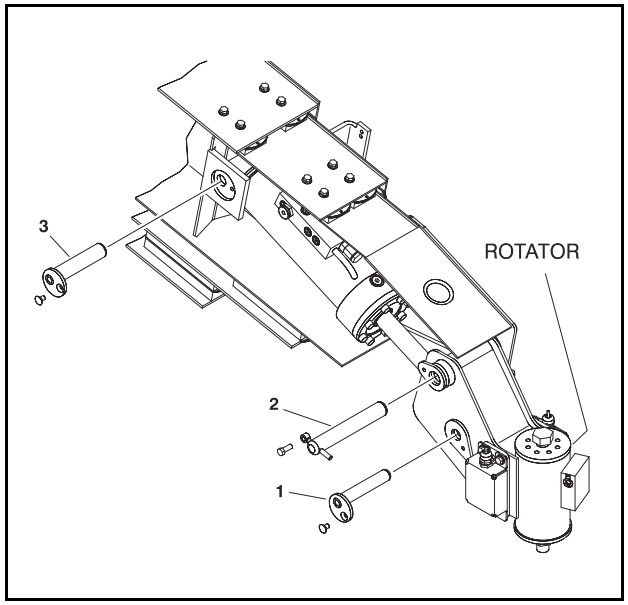


Figure 4-12. Reassembly of Components-Rotator and Leveling Cylinder

4.4 MAIN BOOM POWERTRACK

Removal

1. Disconnect wiring harness connectors located in tower upright.

NOTICE

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

2. Tag and disconnect hydraulic lines from connectors at boom assembly. Use suitable container to retain any residual hydraulic fluid. Cap hydraulic lines and ports.
3. Disconnect dual capacity indicator limit switch from side of boom section.
4. Remove hydraulic lines and electrical cables from Powertrack.
5. Using suitable lifting equipment, adequately support Powertrack weight along entire length.
6. Remove bolt #1 securing the push tube on the fly boom section.

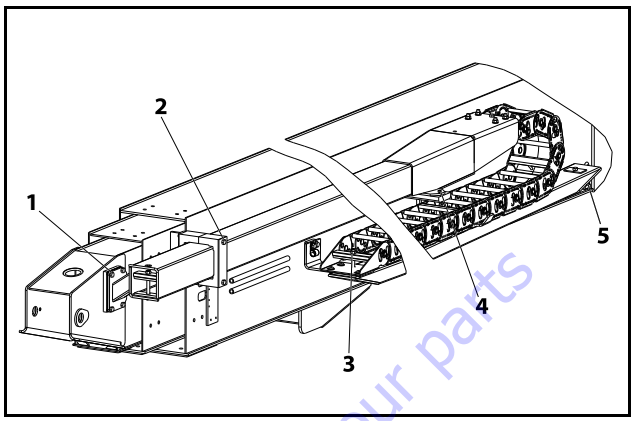


Figure 4-13. Main Boom Powertrack Components

7. Remove bolt #2 securing the push tube on the mid boom section.
8. With Powertrack supported and using all applicable safety precautions, remove bolts #3, #4 and #5 securing rail to the base boom section. Remove Powertrack from boom section.

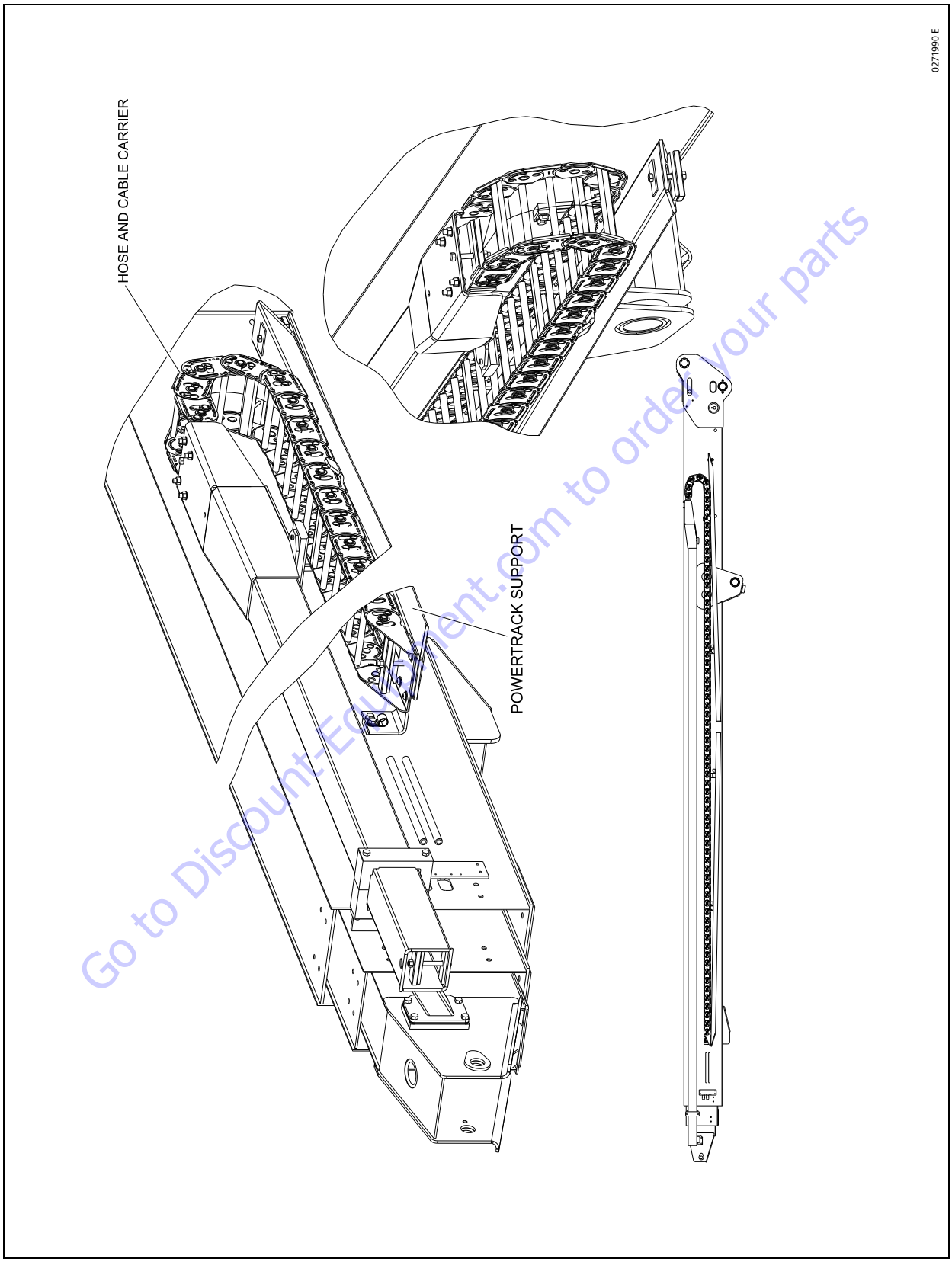


Figure 4-14. Powertrack Installation Main Boom - (Sheet 1 of 2)

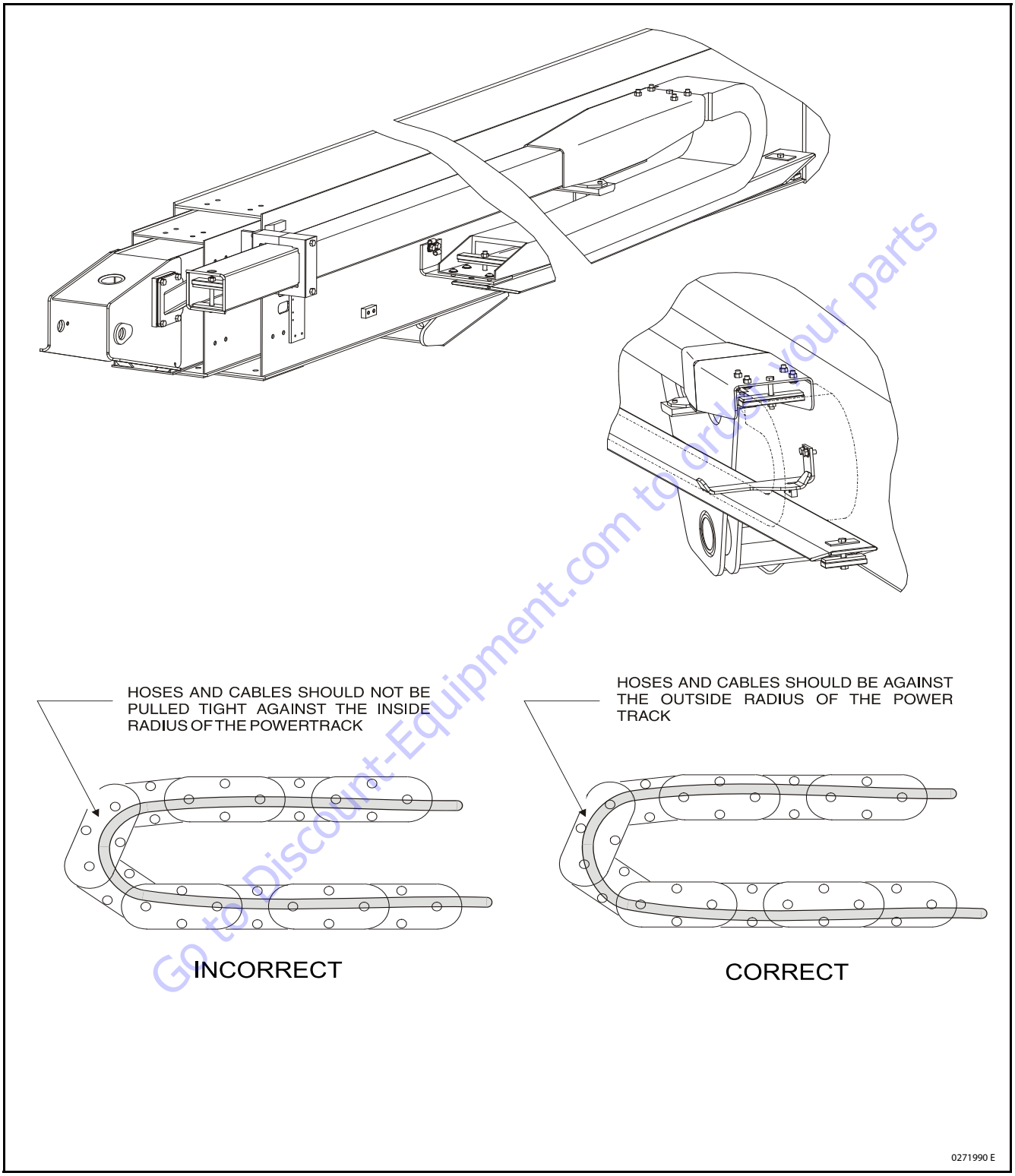
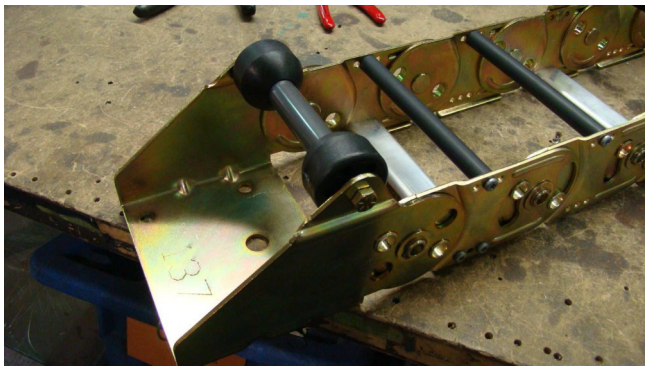


Figure 4-15. Powertrack Installation Main Boom - (Sheet 2 of 2)

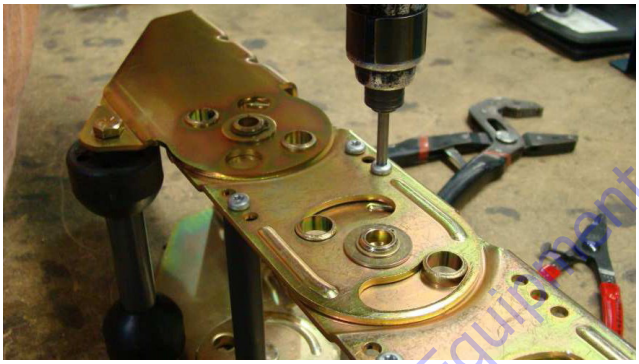
4.5 POWERTRACK MAINTENANCE

One Piece Bracket Maintenance

1. Place the powertrack on a workbench.



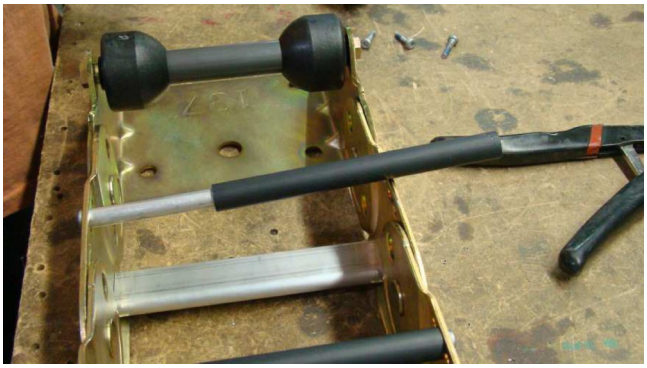
2. Remove the screws from the bars on one side of the powertrack on the first link.

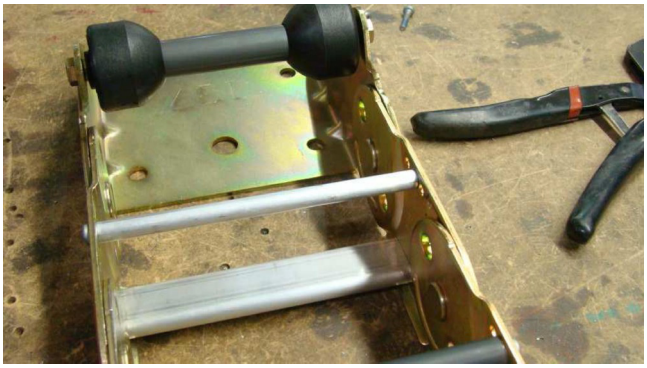


3. Remove the screws from the flat bar on the other side of the powertrack.

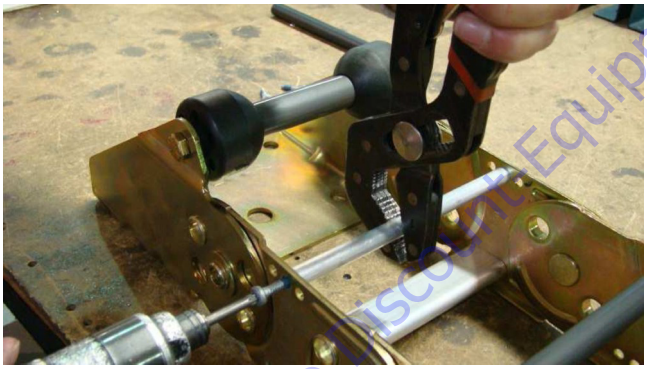
4. Pull up on the loose side of the round bar to allow the poly roller to slide off.

5. Slide the poly roller off of the round bar.

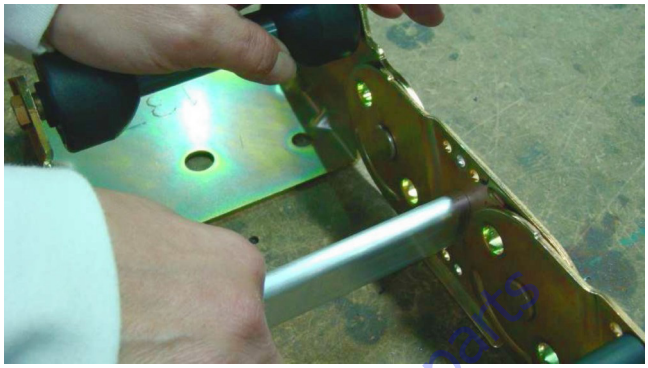


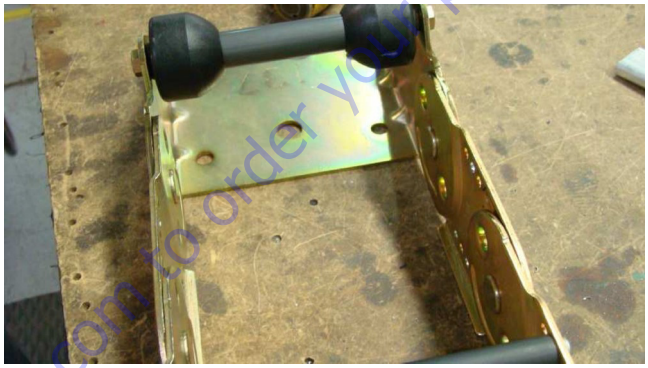


6. Hold the round bar to remove the other screw.

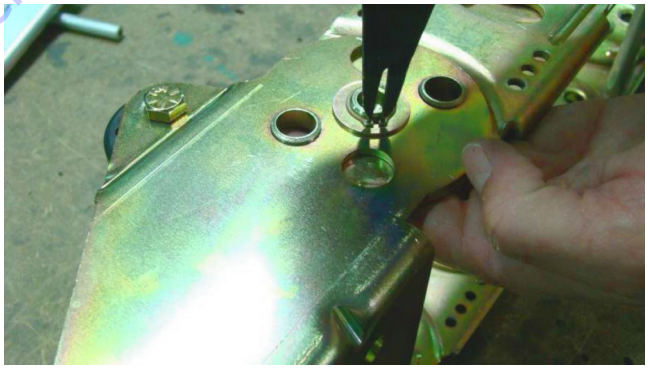


7. Slide the flat bar out.





8. Remove the snap ring from one side of the bracket.



9. Remove the snap ring from the other side of the bracket.

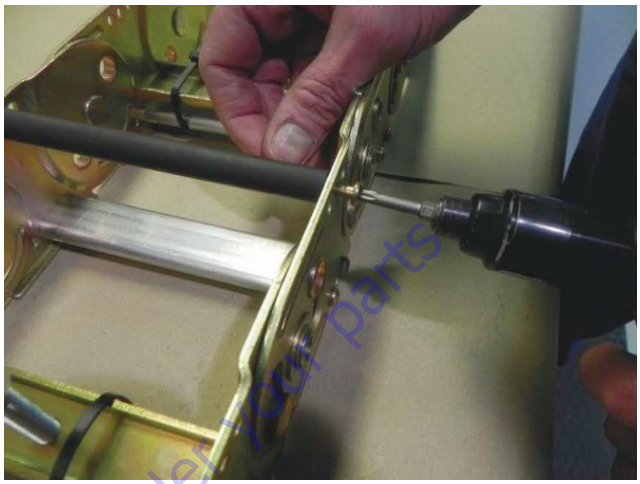
10. Push down with slight pressure on the link and slide the bracket side up and over the extrusion on the link.

11. Repeat the previous step on the other side.

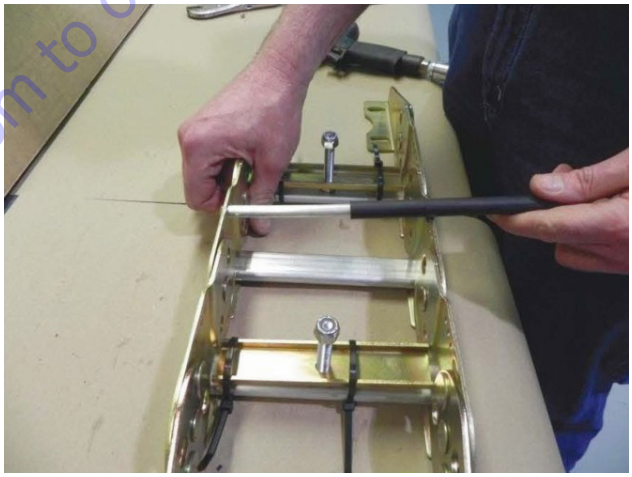
12. Slide the bracket off of the powertrack.

Two Piece Bracket Maintenance

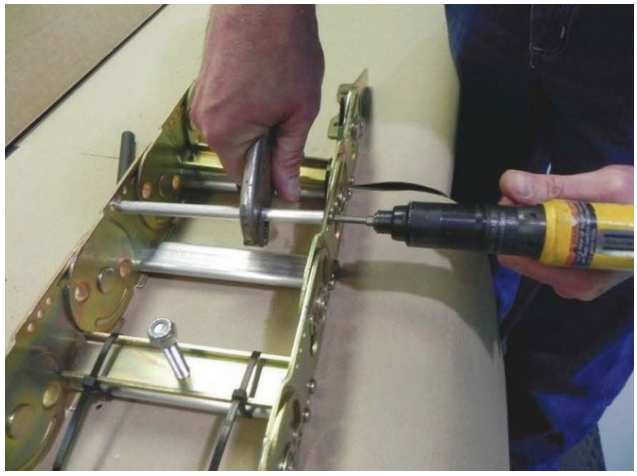
1. Loosen the screw.



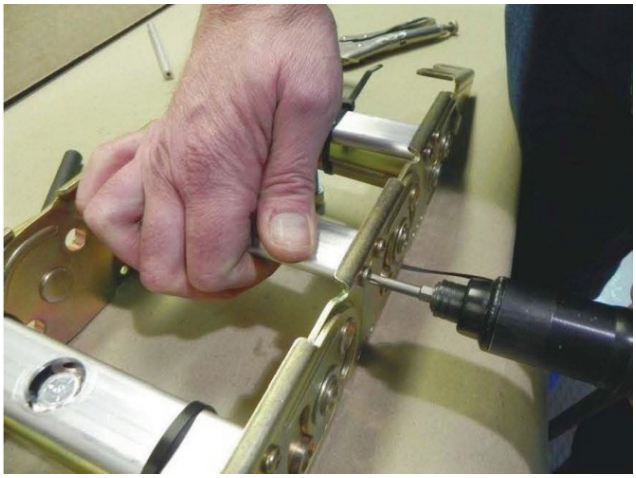
2. Slide the roller off the bar.



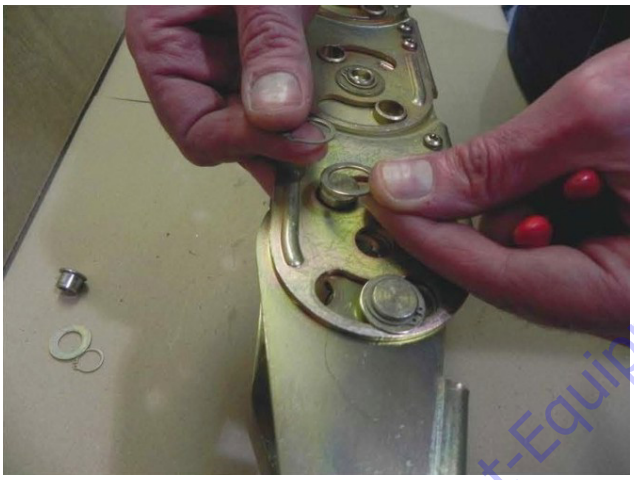
3. Hold the bar tightly and remove the other screw.



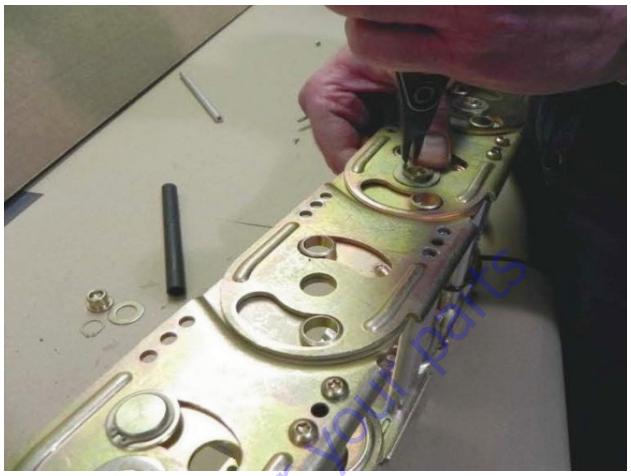
4. Hold the flat bar and remove the screws.



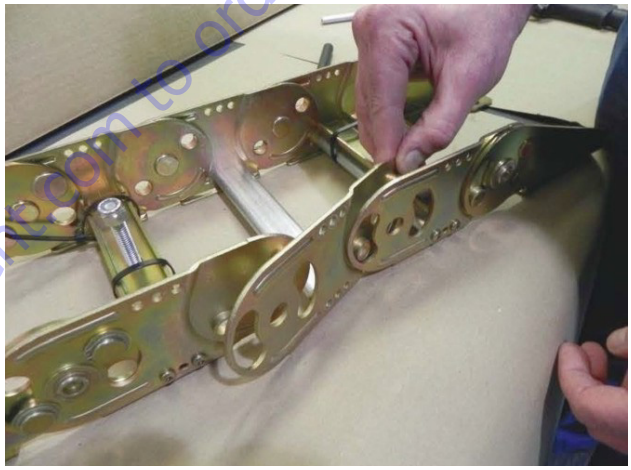
5. Remove the snap rings and pins.



6. Remove the screws from the bar. Remove the snap ring and pin.



7. Slide the link out.

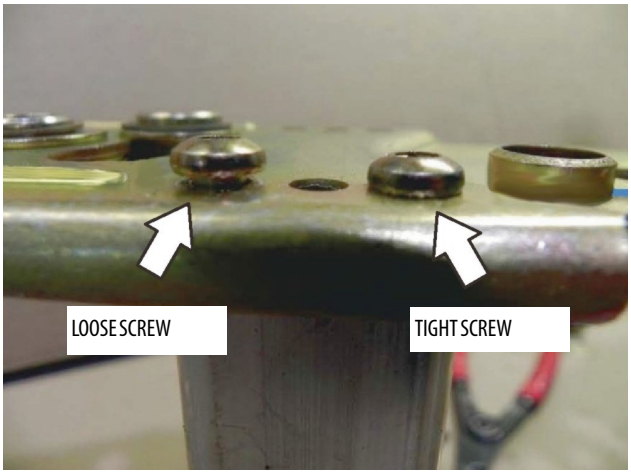


Snap Rings and Screws

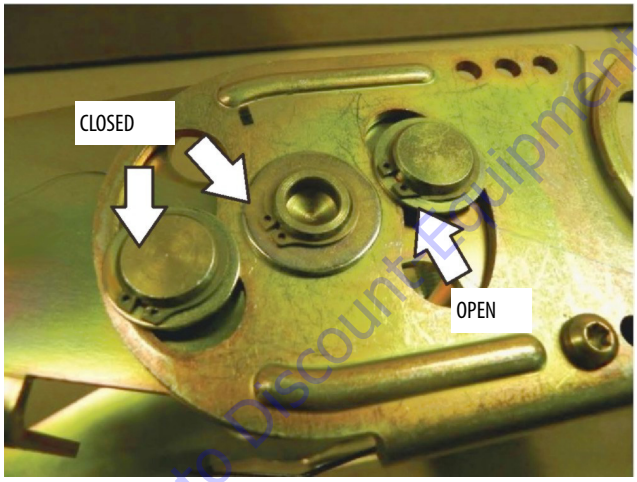
NOTICE

WHEN PERFORMING MAINTENANCE ON THE POWERTRACK, MAKE SURE TO DISCARD AND REPLACE ALL OLD SCREWS.

Make sure screws are tight and installed properly.

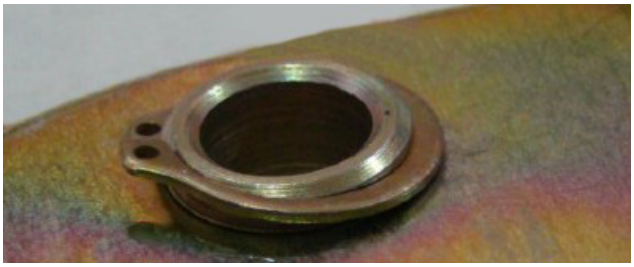


Make sure that all snap rings are closed and seated.

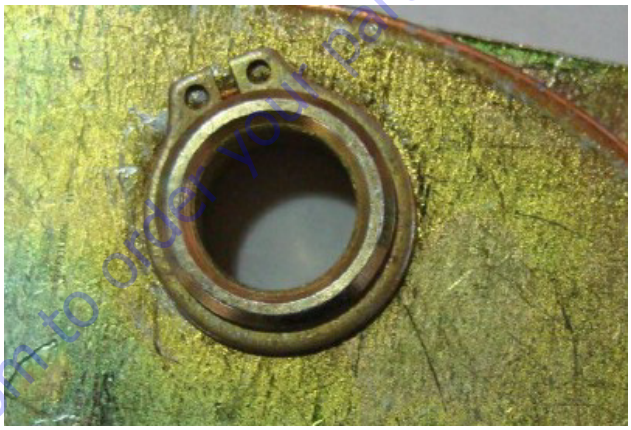


An open snap ring is shown below.

A snap ring that is not seated is shown below.



A seated and closed snap ring is shown below.



10-24 x 0.812 button torx socket head with blue locking patch:

- Tighten to 45-50 in.lbs. (5-5.6 Nm).
- Use T-25 torx bit.
- Do not reuse this screw. After removing replace with a new one.

4.6 BOOM CLEANLINESS GUIDELINES

The following are guidelines for internal boom cleanliness for machines that are used in excessively dirty environments.

1. JLG recommends the use of the JLG Hostile Environment Package if available to keep the internal portions of a boom cleaner and to help prevent dirt and debris from entering the boom. This package reduces the amount of contamination which can enter the boom but does not eliminate the need for more frequent inspections and maintenance when used in these types of environments.
2. JLG recommends that you follow all guidelines for servicing your equipment in accordance with the instructions outlined in the JLG Service & Maintenance Manual for your machine. Periodic maintenance and inspection is vital to the proper operation of the machine. The frequency of service and maintenance must be increased as environment, severity and frequency of usage requires.
3. Debris and foreign matter inside of the boom can cause premature failure of components and should be removed. Methods to remove debris should always be done using all applicable safety precautions outlined in the JLG Service & Maintenance Manuals.
4. The first attempt to remove debris from inside the boom must be to utilize pressurized air to blow the debris toward the nearest exiting point from the boom. Make sure that all debris is removed before operating the machine.
5. If pressurized air cannot dislodge the debris, then water with mild solvents applied via a pressure washer can be used. Again the method is to wash the debris toward the nearest exiting point from the boom. Make sure that all debris is removed, that no “puddling” of water has occurred, and that the boom internal components are dry prior to operating the machine. Make sure you comply with all federal and local laws for disposing of the wash water and debris.
6. If neither pressurized air nor washing of the boom dislodges and removes the debris, then disassemble the boom in accordance to the instructions outlined in the JLG Service & Maintenance Manual to remove the debris.

4.7 WIRE ROPE

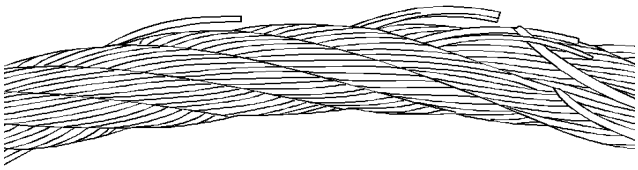
Each day before using the machine:

1. Raise the main boom to approximately horizontal.
2. Extend and retract the boom sections.
3. Check for delayed movement of the fly section, which indicates loose wire ropes.

Inspection

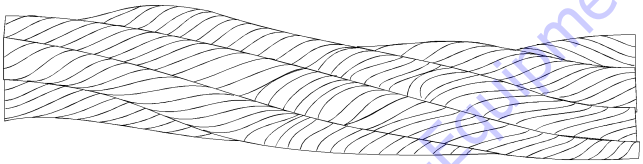
NOTE: *The pictures in this paragraph are just samples to show the replacement criteria of the rope.*

1. Inspect ropes for broken wires, particularly valley wire breaks and breaks at end terminations.



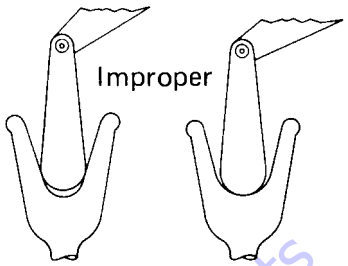
Flexing a wire rope can often expose broken wires hidden in valleys between strands.

2. Inspect ropes for corrosion.
3. Inspect ropes for kinks or abuse.



A kink is caused by pulling down a loop in a slack line during improper handling, installation, or operation.

4. Inspect sheaves for condition of bearings/pins. (See Dimension Of Sheaves for proper dimension.)
5. Inspect sheaves for condition of flanges. (See Dimension Of Sheaves for proper dimension.)
6. Inspect sheaves with a groove wearout gauge for excessive wear.



Observe the groove so that it may be clearly seen whether the contour of the gauge matches the contour of the bottom of the groove.

7. Ropes passing inspection should be lubricated with wire rope lubricant before reassembly.

Three Month Inspection

1. Remove boom covers and visually (with flashlight) inspect the ropes for rust, broken wires, frays, abuse, or any signs of abnormalities.
2. Check rope tension by deflecting the ropes by hand...properly tensioned ropes should have little or no movement.

12 Year or 7000 Hour Replacement

1. Mandatory wire rope and sheave replacement.

   Additional inspection required if:

   a. Machine is exposed to hostile environment or conditions.
   b. Erratic boom operation or unusual noise exists.
   c. Machine is idle for an extended period.
   d. Boom is overloaded or sustained a shock load.
   e. Boom exposed to electrical arc...wires may be fused internally.

Replacement Criteria

1. Sheaves and wire rope must be replaced as sets.
2. Rusted or corroded wire ropes.
3. Kinked, “bird caged”, or crushed ropes.
4. Ropes at end of adjustment range.
5. Sheaves failing wearout gage inspection.
6. Ropes with 6 total broken wires in one rope lay, 3 in one strand in one rope lay, 1 valley break, or 1 break at any end termination.

4.8 BOOM ROPE TORQUING PROCEDURES

Torque Procedures

1. Position boom in fully down and fully retracted position.
2. Clamp both threaded ends of wire rope to prevent rotation.

NOTE: *Do not clamp on threads.*

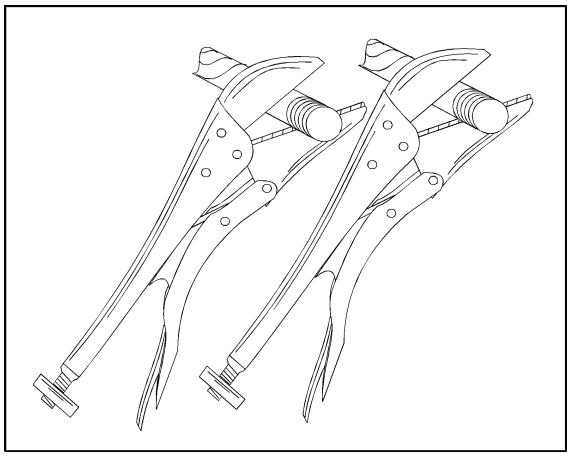


Figure 4-16. Clamping Wire Ropes

3. Install adjusting nuts (or remove nylon collar locknuts if re-adjusting) to both retract and extend wire ropes.
4. Torque retract adjusting nuts (platform end) to 15 ft. lbs. (20 Nm) alternating between the two wire ropes and keeping approximately the same amount of thread beyond the adjusting nut.

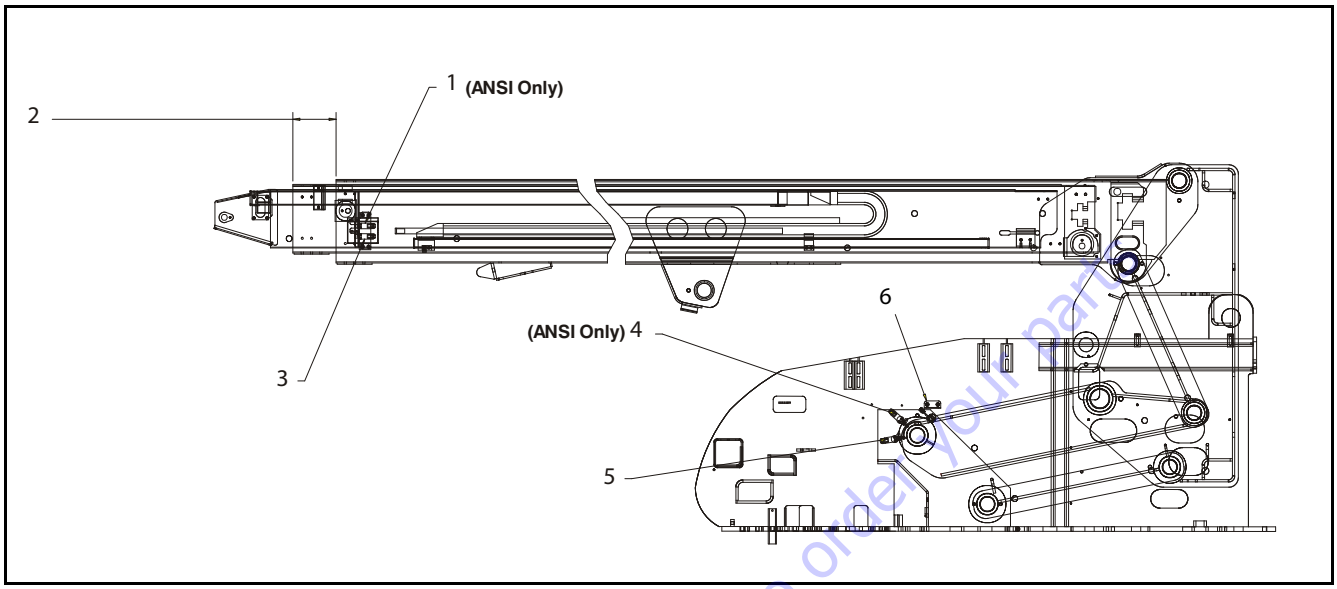
NOTE: *Do not allow wire rope to rotate. This may damage the wire rope.*

5. Repeat the torque procedure in step #4 to the extend wire ropes (turntable end).
6. Extend the boom 2 - 3 ft using the telescope function. Repeat step #4.
7. Retract the boom 1 - 2 ft using the telescope function. Do not bottom out telescope cylinder. Repeat step #5.
8. Extend the boom approximately 2 - 3 ft again and check torque on the retract wire ropes.
9. Retract the boom without bottoming out telescope cylinder and check torque on the extend wire ropes.

NOTE: *Step #8 and #9 may need to be repeated to equalize the torque on all 4 wire ropes.*

10. After all wire ropes have been properly torqued, install nylon collar locknuts. Remove all clamping devices and install all covers and guards. Check the boom for proper function.

4.9 ELEVATION & CAPACITY SWITCHES - 800S



1	Boom Capacity Length Switch to trip boom when it's 216" ± 1" (5486mm ± 25mm) from fully extended
2	150.75" ± 1" (3829mm ± 25mm) position of boom sections to Trip Capacity Length Switch (ANSI Only) 18.25" ± 1" (463.5mm ± 25mm) position of boom sections to trip Transport Length Switch
3	Boom Transport Length Switch to trip when boom is 18" ± 1" from fully retracted
4	Boom Capacity Angle Switch to trip when upper boom is 50° to 55° above horizontal. 52° is the preferred trip angle Boom Capacity Angle Switch to reset when upper boom is 59° to 64° above horizontal. 61° is the preferred reset angle
5	Boom Elevation Switch to trip when upper boom is 7° to 12° above horizontal. 9° is the preferred trip angle Boom Elevation Switch to reset when upper boom is 3° below horizontal to 2° above horizontal. 0° is the preferred reset angle
6	End of Stroke Switch should trip when boom is 5°- 7° from end of extended cylinder stroke

Figure 4-17. Elevation, Dual Capacity and Transport Switch Information - 800S

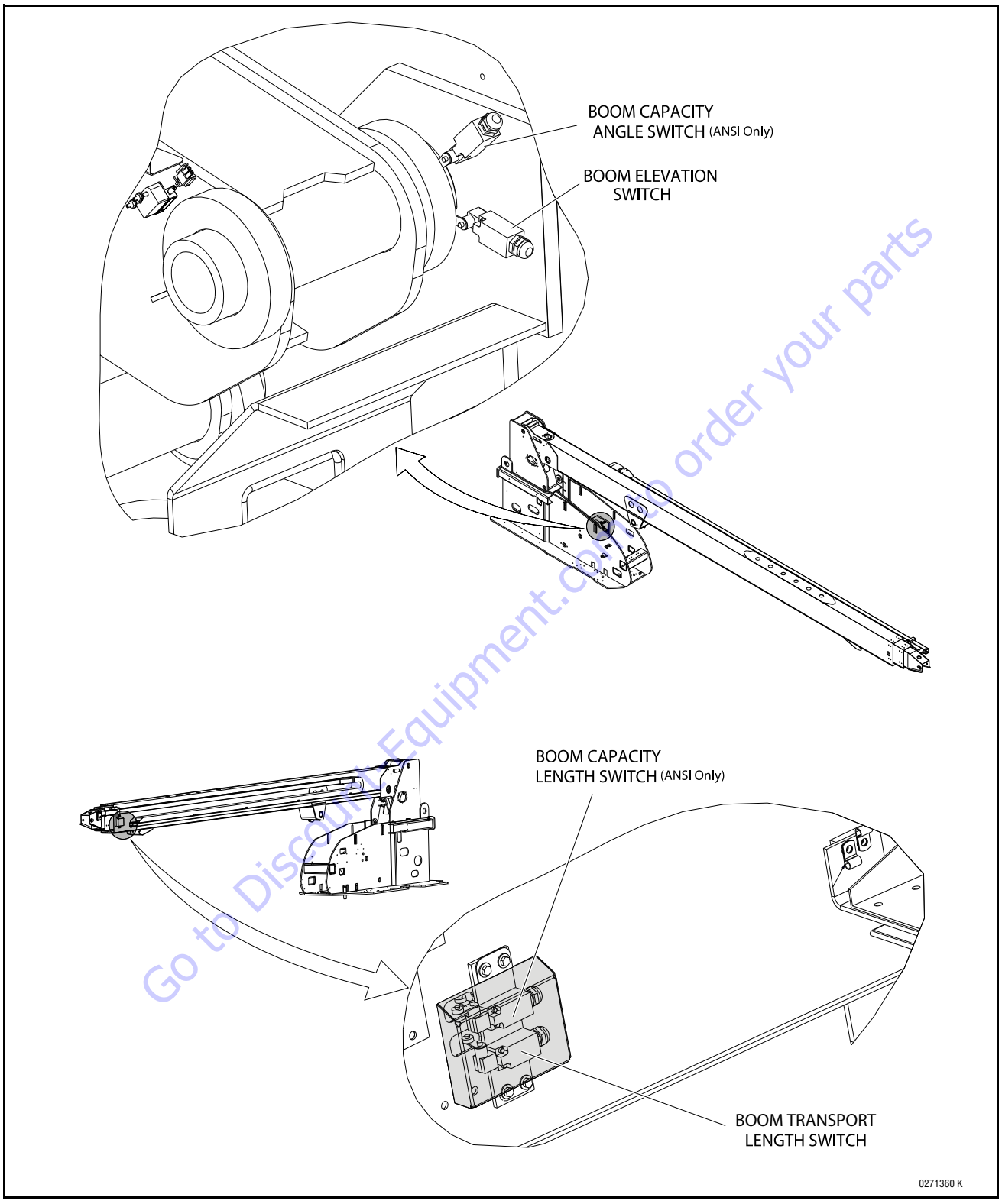
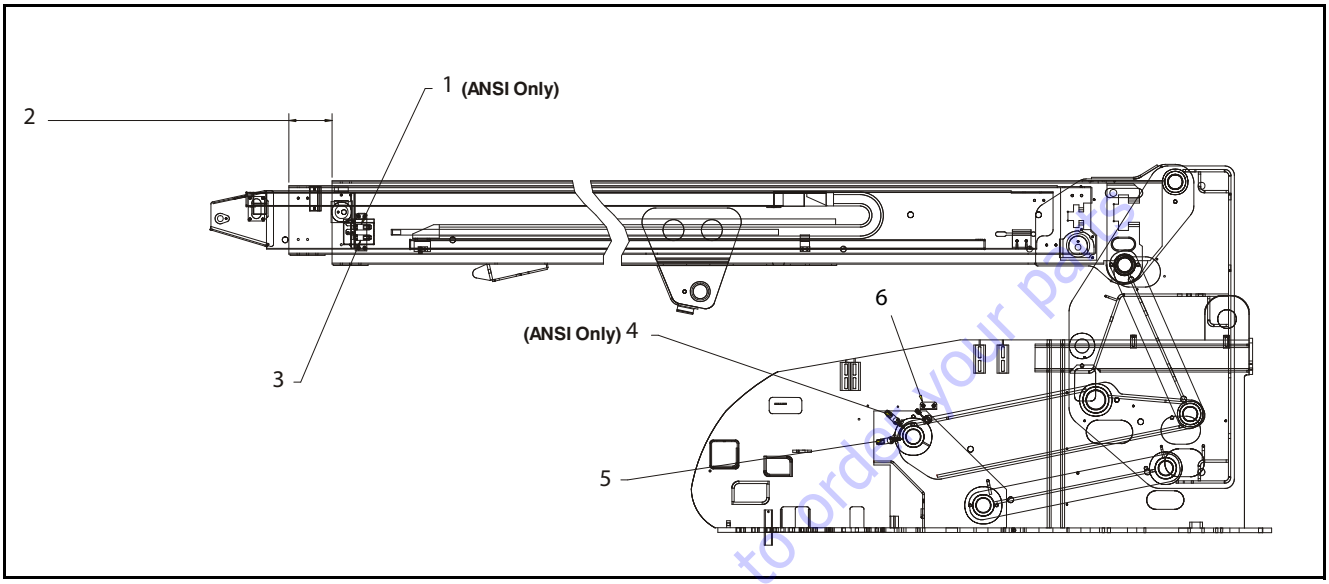


Figure 4-18. Elevation, Dual Capacity and Transport Switch Installation - 800S

4.10 ELEVATION, DUAL CAPACITY, & TRANSPORT SWITCH - 860SJ



1	Boom Capacity Length Switch to trip boom when it's 180" ± 1" (4572mm ± 25mm) from fully extended
2	160.25" ± 1" (4070mm ± 25mm) position of boom sections to Trip Capacity Length Switch (ANSI Only) 18.25" ± 1" (463.5mm ± 25mm) position of boom sections to trip Transport Length Switch
3	Boom Transport Length Switch to trip when boom is 18" ± 1" from fully retracted
4	Boom Capacity Angle Switch to trip when upper boom is 44° to 49° above horizontal. 46° is the preferred trip angle Boom Capacity Angle Switch to reset when upper boom is 52° to 57° above horizontal. 55° is the preferred reset angle
5	Boom Elevation Switch to trip when upper boom is 9° to 14° above horizontal. 12° is the preferred trip angle Boom Elevation Switch to reset when upper boom is 1° below horizontal to 4° above horizontal. 2° is the preferred reset angle
6	End of Stroke Switch should trip when boom is 5° - 7° from end of extended cylinder stroke

Figure 4-19. Elevation, Dual Capacity, and Transport Switch Information - 860SJ

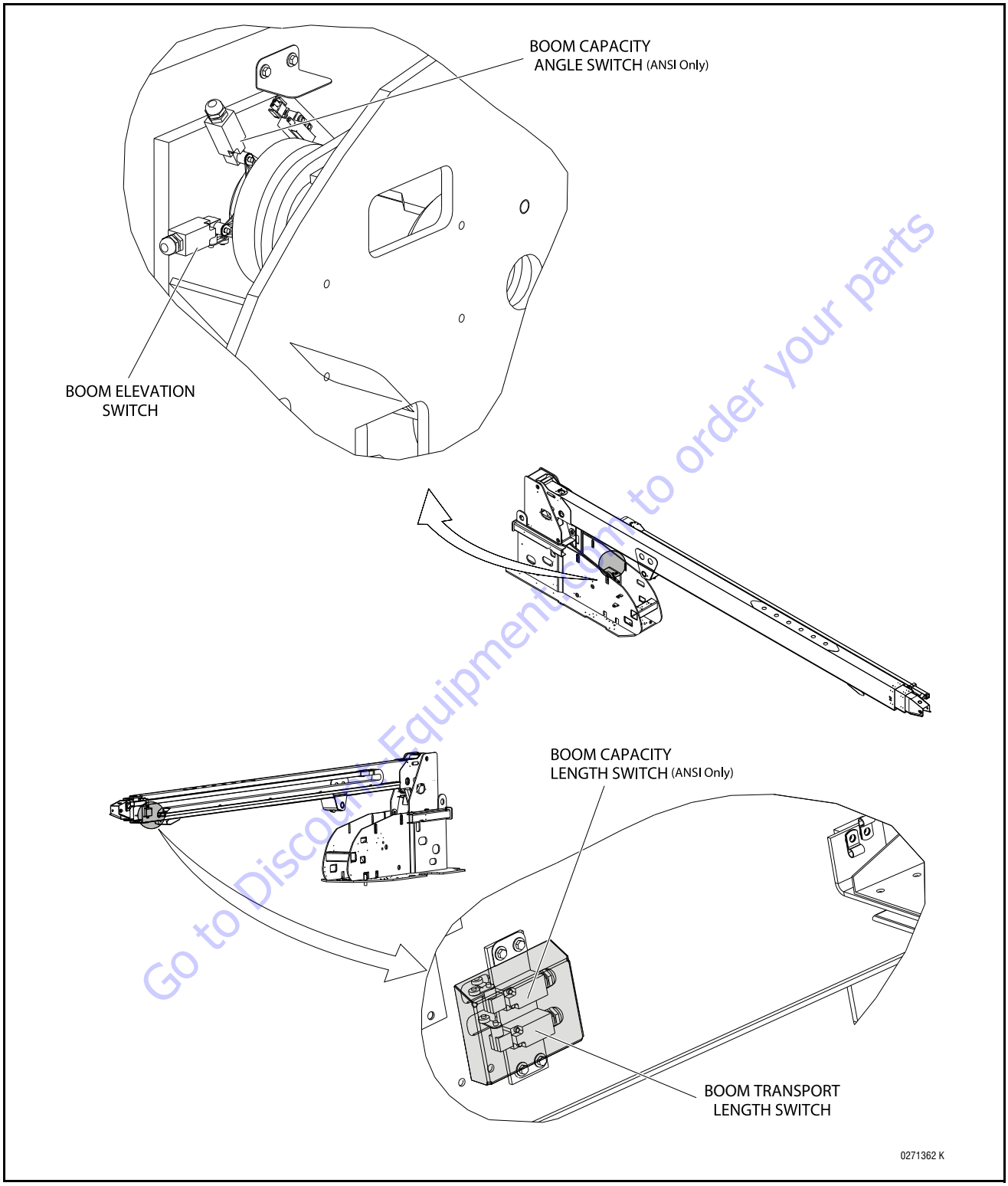


Figure 4-20. Elevation, Dual Capacity, and Transport Switch Installation - 860SJ

4.11 ELECTRONIC PLATFORM LEVELING

Description

Electronic platform leveling replaces the conventional hydraulic method of platform leveling. The term "platform leveling" does not refer to the system maintaining the platform at level (or 0°) with respect to gravity, but instead refers to the controls automatically maintaining the platform within several degrees of a preset angle.

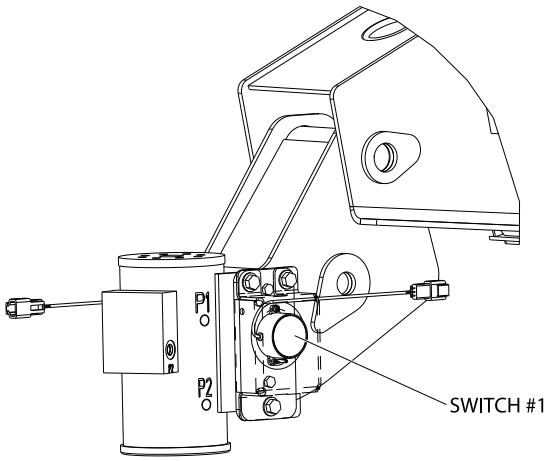
To control electronic platform leveling the platform is equipped with a pair of tilt sensors, one primary and one secondary, mounted to the non-rotating portion of the platform rotator, level up and level down valves that are used to provide proportional hydraulic flow for each directional function, and a control module that interprets the sensor readings and actuates the leveling valves.

PRIMARY AND SECONDARY TILT SENSOR INTERACTION

Two tilt sensors, mounted on each side of the platform support, are used to measure the incline of the platform with respect to gravity and control the automatic platform angle control function. The right one (as viewed from standing in the platform) is used as the primary sensor and the left one as a secondary backup sensor.

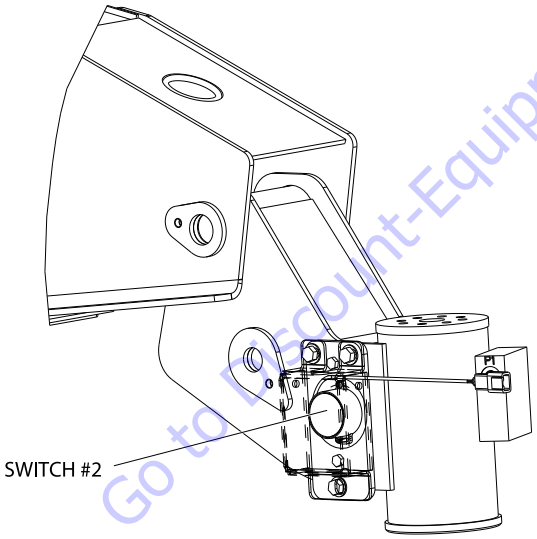
If a fault occurs with the primary sensor, control will revert to the secondary sensor (This is discussed in more detail in the error response section).

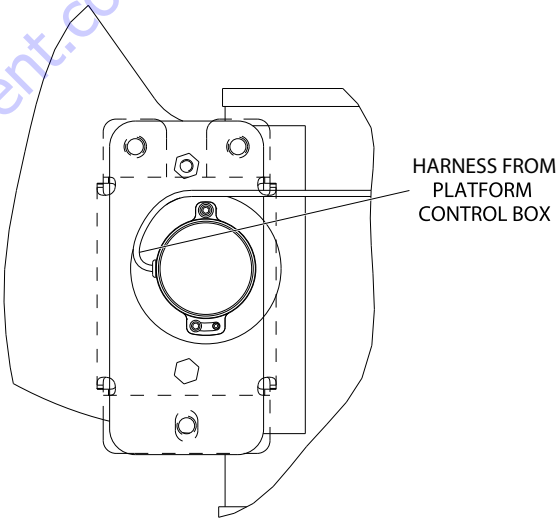
Because of the mounting orientation of the tilt sensors, the primary tilt sensor will output ascending voltage values with increases in positive platform tilt angle. The backup or secondary tilt sensor will output descending voltage values with increases in positive platform angle.



SWITCH #1			
PIN #	DESC	SWITCH	HARNESS
PIN #1	POWER	RED	RED
PIN #2	PWM OUT	GREEN	BLUE
PIN #3	GROUND	BLACK	BLACK

SWITCH #2			
PIN #	DESC	SWITCH	HARNESS
PIN #1	POWER	RED	ORANGE
PIN #2	PWM OUT	GREEN	YELLOW
PIN #3	GROUND	BLACK	BLACK

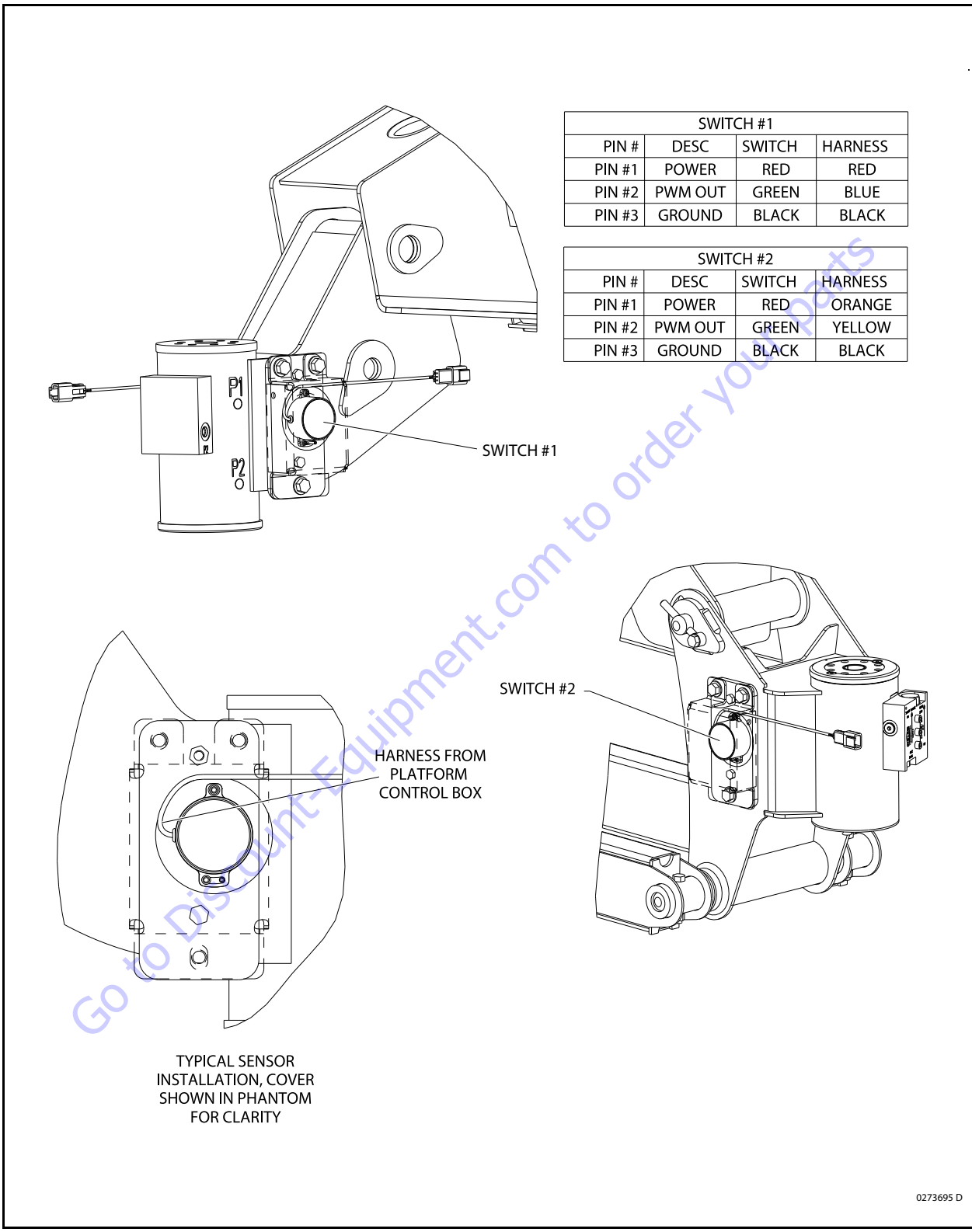




TYPICAL SENSOR
INSTALLATION, COVER
SHOWN IN PHANTOM
FOR CLARITY

0273695 D

Figure 4-21. Level Switches - 800S



SWITCH #1			
PIN #	DESC	SWITCH	HARNESS
PIN #1	POWER	RED	RED
PIN #2	PWM OUT	GREEN	BLUE
PIN #3	GROUND	BLACK	BLACK

SWITCH #2			
PIN #	DESC	SWITCH	HARNESS
PIN #1	POWER	RED	ORANGE
PIN #2	PWM OUT	GREEN	YELLOW
PIN #3	GROUND	BLACK	BLACK

Figure 4-22. Level Switches - 860SJ

PLATFORM VALVES

The platform specific valves are located in a manifold at the platform.

There are six valves that control various platform functions. Two control Platform Level up and down for the leveling function, two are used to rotate the platform, and two to control jib up and down.

All platform valves are Pulse Width Modulated (PWM'd). PWM is a method of setting the voltage across a valve, and therefore the flow through it, by varying the On/Off duty cycle of the control module output. PWMing permits proportional flow control.

There is also a Platform Dump Valve, located in the platform valve manifold, which is used to hydraulically isolate the control valves and to improve hydraulic response.

The Ground Module controls this valve to enable automatic platform leveling and to provide manual platform leveling in the event that the Platform Module is inoperable.

In ground mode, the platform dump valve is turned on whenever any platform or jib valve output is turned on. Whenever all platform and jib valves are turned off, the platform dump valve is turned off.

In platform mode, the platform dump valve is turned on whenever the footswitch is depressed.

Normal Operation

AUTOMATIC PLATFORM ANGLE CONTROL

The level system will assume a new fixed set point (fixed incline of the platform with respect to gravity) each time the control system is powered up (cycling of the EMS) and each time the footswitch is engaged.

Automatic platform angle control only functions while operating drive, telescope, lift or swing. It does not adjust the platform angle while operating any other function (e.g. rotate, jib, or steer). Furthermore, machines equipped with control system software P5.0 and later, automatic platform angle control for drive and swing may be disabled by using the analyzer. For this case, the platform angle setpoint is taken when the joystick moves from a non-leveling function (drive/swing) to a leveling function (lift/tele).

The machine controls attempt to maintain the angle of the platform to setpoint by providing a command proportional to the angular error from setpoint. Since the sensors used to measure the platform angle are fluid-filled, gravity-based sensors, reading the sensors in real time would cause constant correction of the platform position due to machine vibration and inertial changes of the boom. Therefore, the sensor readings are averaged over time, or filtered, in order to achieve a more uniform reading. This filtering has the advantage of providing smoother operation, but has the disadvantage of causing a lag (or sluggishness) in the system response. This lag may cause the platform to be several degrees from setpoint.

In order to provide a better system response, the controls also compute the rate of angular change of the platform position and set the leveling valve positions to achieve a matching velocity. The measured velocity is the average platform speed over the last 0.5 seconds. The desired valve command is computed by comparing the measured velocity to the desired velocity and setting the valve opening to correspond to the required amount of make-up angle. The amount the valve opens when making an automatic correction is proportional to and directly affected by:

- Crackpoint setting
- Velocity error (proportional factor)
- Sum of velocity errors over time (integral factor)

These three factors are summed together with appropriate gain factors to compute the resulting current to the valves. The operator does not have control over the latter two factors, but can affect the resulting current by adjusting the crackpoint. Increasing the crackpoint makes the valve current higher, resulting in quicker more aggressive control and larger amounts of overshoot. Decreasing the crackpoint will result in smoother operation but may not permit enough platform velocity to keep up with the boom (i.e., may get platform timeout alarms) in some multi-function operations. The platform controls are set up to provide smooth leveling operations for the majority of conditions and will perform best for steady operator command, as opposed to command values for function, that change frequently.

In order to obtain acceptable performance while performing all hydraulic functions, five sets of parameters are used. These "zones" allow compensation for differences in how the basket level changes when doing different functions. These zones are as follows:

1. Lift up
2. Lift down
3. Other boom functions
4. Drive
5. Auxiliary

The other boom functions zone includes Swing, Telescope, Jib swing (It is not necessary to level with jib lift, since the mechanical linkage keeps the basket level).

These zones are prioritized when multiple functions are active. The priorities are as follows.

1. Auxiliary power and any other function, zone = auxiliary power
2. Drive and any other function, zone = Drive

3. Lift up and any other function, zone = Lift up
4. Lift down and any other function, zone = Lift down
5. Other boom functions, zone = Other boom functions

During the power-up procedure, function enable, in both Platform and Ground Mode, is delayed during the 1.5 second startup lamp test. During this 1.5 second startup period, the basket level up valve will be energized at 100% duty cycle for 0.5 second, and then the basket level down valve energized at 100% duty cycle for 0.5 second. This will help to keep the valves from sticking.

PLATFORM LEVEL MANUAL OVERRIDE

In addition to automatic platform angle control, the operator is able to manually adjust the platform level position by means of the level override switches located at the platform and ground control positions (similar to a Master/Slave hydraulic system).

If a command from the Platform Level Up and Down toggle switch on either the platform or the ground is received, automatic platform angle control will cease and the appropriate output will be commanded to turn on.

The duty cycle of the output shall be scaled from the pump potentiometer. When the toggle switch is released, after one second, the current filtered value of tilt angle will be taken as **the new set point**.

In other words the operator can chose a platform level incline other than level with gravity and the system will maintain the chosen platform angle within several degrees of setpoint.

Platform Leveling Fault

The JLG Control System takes a snapshot of the two sensor values and records the difference once on each power up. The Control system allows a ±5 degree difference from those values. For example, if Sensor 1 is at 5 degrees and Sensor 2 is at 11 degrees, the difference is 6 degrees and the DTC is triggered when the sensors are 1 degree (or less) apart or 11 degrees (or more) apart.

If a fault occurs in the platform leveling system the following will occur:

1. Automatic platform angle control will stop and the platform dump valve will be disabled (level, rotate, and jib functions disabled). The exception is when there is a fault in only one sensor automatic platform angle control will remain active as the control system will use the other sensor to control leveling.
2. The level system fault lamp will flash (to indicate that the leveling function has been lost).
3. The platform alarm will sound.
4. A system fault will be logged.
5. All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position see below).

To reset the fault the emergency stop switch should be recycled.

NOTICE

IF THE LEVEL SYSTEM FAULT INDICATOR REMAINS ILLUMINATED, RETURN THE PLATFORM TO THE STOWED POSITION, SHUT DOWN THE MACHINE, AND REPAIR THE LEVELING SYSTEM.

ERROR RESPONSE

If basket level varies from the current **setpoint** by ± 5.5° for more than 2 seconds for large variations from setpoint when the platform is not in the transport position, the controls assume the system is not properly set up or has degraded and initiate a fault.

When the unit is in the transport position and driving and the current setpoint varies by ± 5.5° for more than 10 seconds the events 1,2,3 & 4 above will occur. (note function speeds will operate normally). Since the control system can not anticipate all conditions under which a machine is to be operated, these parameters have been chosen to provide reasonable performance and safe operation. If an error occurs, cycling the EMS will clear the fault. The operator should evaluate the operating situation and assess his machine to determine the source of the fault.

VALVE DRIVER ERRORS

There are three possible level valve driver errors, short to battery, short to ground, and open circuit.

1. In the case of a **short to ground or an open circuit**, the platform valve cannot be turned on and the following will occur:
   - **a.** All interactions with platform leveling shall cease
   - **b.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **c.** The platform alarm will sound.
   - **d.** A system fault will be logged.
   - **e.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).
2. In the case of a **short to battery** on one of the platform leveling valves, the valve cannot be turned off and the following will occur:
   - **a.** The platform dump valve will be turned off to prevent unintended tilting of the platform.
   - **b.** All interactions with platform leveling shall cease.
   - **c.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **d.** The platform alarm will sound.
   - **e.** A system fault will be logged.
   - **f.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).
3. In the case of a **short to battery on the platform dump valve**, the valve cannot be turned off. The controllability of the platform leveling function will be impaired and the following will occur:
   - **a.** All interactions with platform leveling shall cease.
   - **b.** The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
   - **c.** The platform alarm will sound.
   - **d.** A system fault will be logged.
   - **e.** All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).

Lift, swing, drive and telescope will continue to operate

In each of the cases above it shall be necessary to re-cycle the EMS to clear the fault. Operable functions shall be in the creep mode except while below elevation.

TILT SENSOR ERRORS

If the secondary tilt sensor is faulty, the control system will continue to utilize information from the primary sensor.

If the primary sensor is faulty, the control system will switch to the backup sensor for control.

In both cases above the following will occur:

1. The Electronic Leveling System Fault Lamp will flash (to indicate that there is a leveling fault).
2. The platform alarm will sound.
3. A system fault will be logged.
4. All function speeds (lift, swing, telescope, jib and drive) will be placed in creep mode (except when the platform is in the transport position).
5. Automatic platform angle control remains active.

Lift, swing, drive and telescope will continue to operate.

In each of the cases above it will be necessary to re-cycle the EMS to clear the fault. Operable functions shall be in the creep mode except while below elevation.

When both sensors appear to be working but have measurements that disagree by ±5.5º The following will occur:

1. All interactions with platform leveling shall cease.
2. The Electronic Leveling System Fault Lamp shall flash (to indicate that the leveling function has been lost).
3. The platform alarm will sound.
4. A system fault will be logged.
5. All function speeds (lift, swing, telescope and drive) will be placed in creep mode (except when the platform is in the transport position).

At this point, the operator must use the level up and down toggle switch to manually level during descent. It shall be necessary to re-cycle the EMS to clear the fault.

CAN Errors

The Ground Module has two direct outputs dedicated to overriding the Platform Module's control of the leveling valves. The EPBC Ground Module "Platform Level Up/Down" outputs are used to control the platform level up and down valves.

When in ground mode, if the Ground Module reads a platform leveling switch command, the switch command is communicated over CAN to the Platform Module where it is handled normally.

If Ground Module determines that CAN communication is inoperable, it turns on the platform control valve and the appropriate platform leveling override outputs while the switch is engaged.

If the Platform Module is still running when CAN is down nothing will operate when in platform mode. When the operator switches to ground mode, the platform will not control any of its valve outputs and a CAN error message is signaled.

Replacing the Level Sensors

Earlier generations of this machine had three different generations of level sensors that were used on this machine. JLG P/N 4360503, P/N 4360528, and P/N 4360544. P/N 4360528 and 4360544 supersede P/N 4360503. If one of the 4360503 sensors fail, BOTH sensors must be replaced with two P/N 4360544 sensors. 4360503 Sensors can be identified by the code SSY0185-13 which is printed on the sensor. Otherwise, single 4360528 or 4360544 9999sensors may be replaced.

Additional Platform and Jib Valves

The high side drivers for the platform left and right and the jib up and down valves are be located in the Platform Module and are PWM'd. The control for these functions are the same as currently implemented for the EPBC except that the flow through the valves is individually controllable instead of controlled by single the flow control valve. The individually controlled duty cycle will be the same as would otherwise have been commanded to the flow control valve.

Only one platform or jib function is allowed at one time to limit the amount of current draw, minimizing the voltage drop on the supply to the PM.

The function is enabled first shall remain active until it is released. Any other function commanded while another function is active is ignored.

If only one other function is commanded when the active function is released, the other function will be activated.

If more than one function is commanded when the active function is released, only one function shall be activated.

Platform Leveling Calibration Procedure

STEP 1: SETTING THE PLATFORM VALVE MINIMUMS

1. Put machine into "Ground Mode".
2. Start machine and plug in Analyzer.
3. Go to the "Access Level 2" screen.
4. Enter "33271" to get into Access Level 1 mode.
5. Go to the "Personalities" menu and adjust the following personalities. Refer to the Personality Ranges/Defaults table in Section 6 - JLG Control System for proper setting values.

   Basket Level Up Min
   Basket Level Up Max
   Basket Level Down Max
   Jib Up Min
   Jib Down Min
6. Recycle EMS.

STEP 2: CALIBRATING THE PLATFORM LEVEL SENSORS (FOR PLATFORM SOFTWARE PRIOR TO VERSION P3.4)

1. Put machine into "Ground Mode".
2. Start machine and plug in Analyzer.
3. Manually level the platform with the switch on the MTB.
4. Go to the "Access Level 2" screen.
5. Enter "33271" to get into Access Level 1 mode.
6. Go to the "Calibrations" menu and hit ENTER.
7. Use RIGHT ARROW go to "Plat. Leveling" screen.
8. Hit ENTER. "Calibrate?" prompt should appear.
9. Hit ENTER again to calibrate level sensors.
10. When calibration has been successful "Cal. Complete" should appear.
11. Cycle power to the machine.

STEP 3: BLEEDING THE PLATFORM VALVES

Start up the machine and exercise the following platform functions (from the ground) eight (8) to ten (10) times for 5 seconds in each direction.

Basket Rotate
Basket Level
Jib U/D (if configured)

STEP 4: CALIBRATING THE PLATFORM LEVEL UP AND DOWN VALVE CRACKPOINTS

NOTE: *Since the valve position which allows minimum oil flow (crackpoint) is dependent on the oil pressure, verify the proper stand-by pressure as outlined in Section 5.3 prior to setting the crackpoints.*

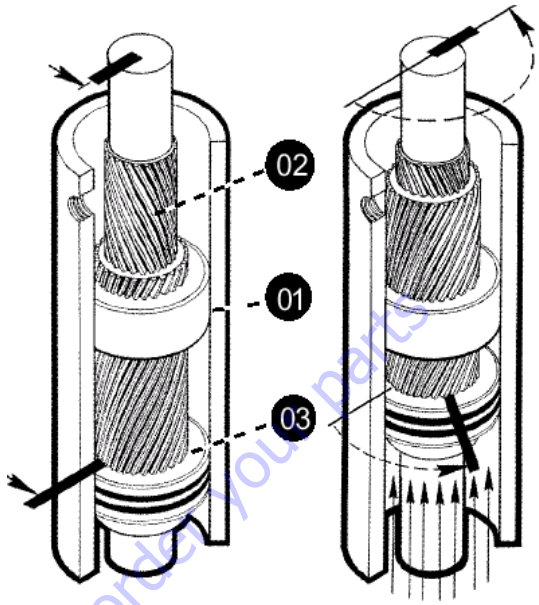
1. Put machine into "Ground Mode".
2. Start machine and plug in Analyzer.
3. Go to the "Access Level 2" screen.
4. Enter "33271" to get into Access Level 1 mode.
5. Go to the "Calibrations" menu and hit ENTER.
6. Go to the "Basket U Crkpt" Screen. Hit ENTER.
7. "Calibrate?" prompt should appear. Hit ENTER again.
8. You will hear engine go to 1800 rpm.
9. Using UP ARROW, increase the value until you see the basket up movement. (Typically from 275 – 425).
10. Hit ENTER again. "Cal. Complete" message should appear
11. Engine should again return to idle.
12. Hit ESC should return to "Basket U Crkpt" screen.
13. Hit RIGHT ARROW to get to the "Basket D Crkpt" screen. Hit ENTER.
14. "Calibrate?" prompt should appear. Hit ENTER again.
15. You will hear engine go to 1800 rpm.
16. Using UP ARROW, increase the value until you see the basket down movement. (Typically from 275 – 425).
17. Hit ENTER again. "Cal. Complete" message should appear.
18. Engine should again return to idle.
19. Hit ESC to exit.
20. Cycle power to the machine.
21. The preceding steps will provide acceptable crackpoint settings for the majority of machines. However, if the operator can feel small jolts in the platform from the valve opening during a leveling operation, the crackpoint is likely too high for this machine. A high crackpoint may also lead to "over-leveling", causing the platform to drift beyond the set point. An example of this would be the platform tilting too far backwards during a Lift Up operation. Therefore, use the following guidelines to evaluate whether further crackpoint adjustment is required.
    a. Telescope the machine halfway.
    b. Perform Lift Up. If the basket leans backward (over compensates), the Level Down crackpoint is too high. If the basket leans forward or a BASKET LEVELING SYSTEM TIMEOUT fault occurs, the Level Down crackpoint is too low.
    c. Perform Lift Down. If the basket leans forward (over compensates), the Level Up crackpoint is too high. If the basket leans backwards or the Tilt Cutout Alarm comes on, the Level Up crackpoint is too low.

4.12 HELAC ROTARY ACTUATOR

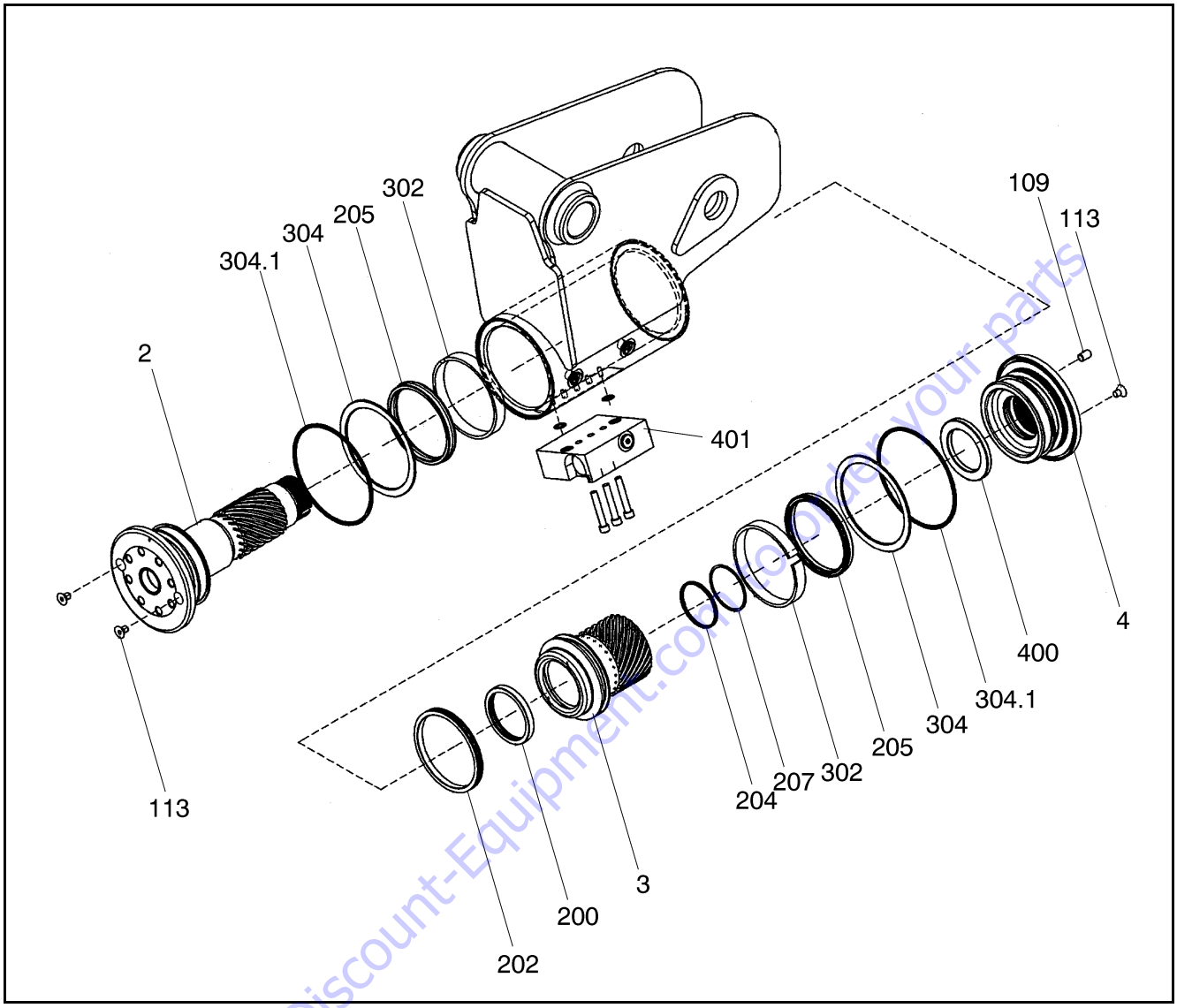
Theory of Operation

The rotary actuator is a simple mechanism that uses the sliding spline operating concept to convert linear piston motion into powerful shaft rotation. Each actuator is composed of a housing with integrated gear teeth (01) and only two moving parts: the central shaft with integrated bearing tube and mounting flange (02), and the annular piston sleeve (03). Helical spline teeth machined on the shaft engage matching splines on the in-side diameter of the piston. The outside diameter of the piston carries a second set of splines, of opposite hand, which engage with matching splines in the housing. As hydraulic pressure is applied, the piston is displaced axially within the housing -similar to the operation of a hydraulic cylinder while the splines cause the shaft to rotate. When the control valve is closed, oil is trapped inside the actuator, preventing piston movement and locking the shaft in position.

The shaft is supported radially by the large upper radial bearing and the lower radial bearing. Axially, the shaft is separated from the housing by the upper and lower thrust washers. The end cap is adjusted for axial clearance and locked in position by set screws or pins.

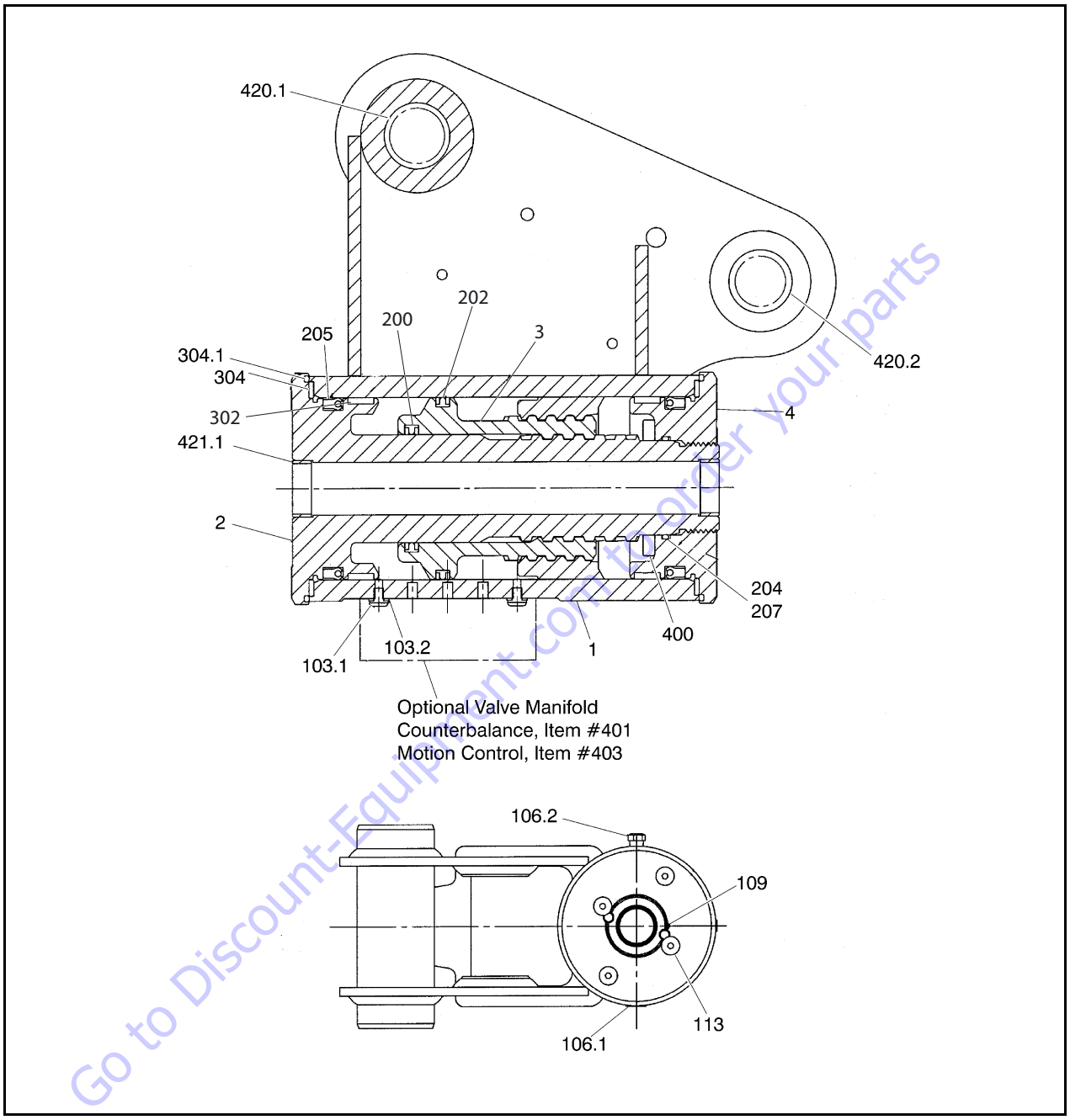


NOTE: *Bars indicate starting positions of piston and shaft. Arrows indicate direction they will rotate. The housing with integral ring gear remains stationary.*
As fluid pressure is applied, the piston is displaced axially while the helical gearing causes the piston and shaft to rotate simultaneously. The double helix design compounds rotation: shaft rotation is about twice that of the piston.



1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
109. Lock Pin
113. Cap Screw
200. T-Seal
202. T-Seal
204. O-ring
205. Cup Seal
207. Backup Ring
302. Wear Guide
304. Thrust Washer
304.1. Wiper Seal
401. Counterbalance Valve
400. Stop Tube

Figure 4-23. Rotary Actuator (Exploded View)



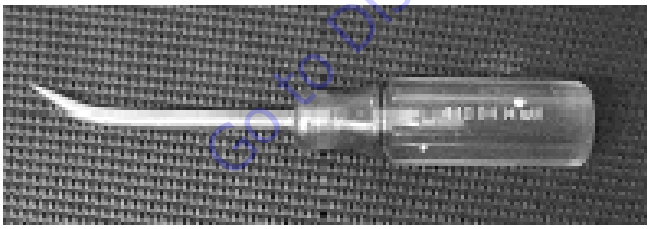
1. Housing
2. Shaft
3. Piston Sleeve
4. End Cap
103.1. Screw (Optional)
103.2. Washer (Optional)
106.1. Port Plug
106.2. Port Plug
109. Lock Pin
113. Cap Screw
200. T-Seal
202. T-Seal
204. O-ring
205. Cup Seal
207. Backup Ring
302. Wear Guide
304. Thrust Washer
304.1. Wiper Seal
400. Stop Tube (Optional)
420.1. Bushing
420.2. Bushing (Optional)
421.1. Bushing (Optional)

Figure 4-24. Rotary Actuator (Cutaway View)

Tools Required for Assembly/Disassembly

Upon assembly and disassembly of the actuator there are basic tools required. The tools and their intended functions are as follows:

1. Flashlight- helps examine timing marks, component failure and overall condition.
2. Felt Marker- match mark the timing marks and outline troubled areas.
3. Allen wrench- removal of port plugs and setscrews.
4. Box knife- removal of seals.
5. Seal tool- assembly and disassembly of seals and wear guides.
6. Pry bar- removal of end cap and manual rotation of shaft.
7. Rubber mallet- removal and installation of shaft and piston sleeve assembly.
8. Nylon drift- installation of piston sleeve.
9. End cap dowel pins- removal and installation of end cap (sold with seal kit).



The seal tool is merely a customized standard flat head screwdriver. To make this tool you will need to heat the flat end with a torch. Secure the heated end of the screwdriver in a vise and physically bend the heated end to a slight radius. Once the radius is achieved round off all sharp edges of the heated end by using a grinder. There may be some slight modifications for your own personal preference.

Disassembly

1. Remove the capscrews (113) over end caplock pins (109).

2. Using a 1/8" (3.18mm) drill bit, drill a hole in the center of each lock pin to a depth of approximately 3/ 16" (4.76mm).

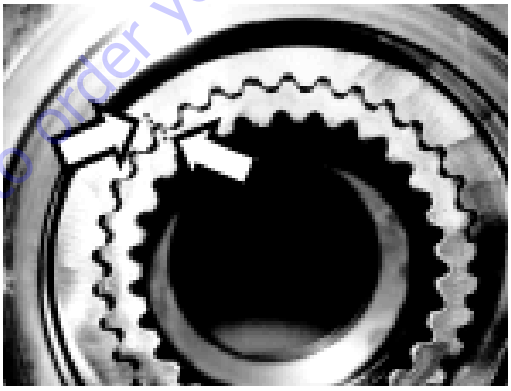
3. Remove the lock pins using an "Easy Out" (a size #2 is shown). If the pin will not come out with the "Easy Out", use 5/16" drill bit to a depth of 1/2" (12.7mm) to drill out the entire pin.

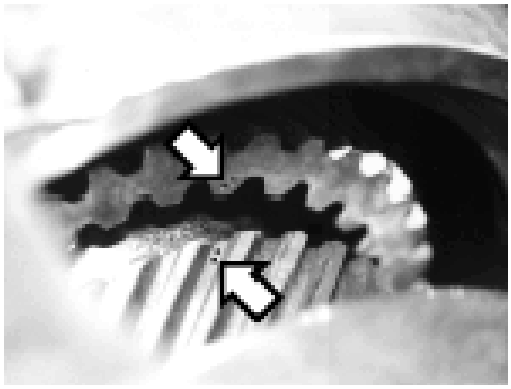
4. Install the end cap (4) removal tools provided with the Helac seal kit.

5. Using a metal bar, or something similar, unscrew the end cap (4) by turning it counter clockwise.

6. Remove the end cap (4) and set aside for later inspection.

7. Remove the stop tube if included. The stop tube is an available option to limit the rotation of the actuator.





8. Every actuator has timing marks for proper engagement.

9. Prior to removing the shaft, (2), use a felt marker to clearly indicate the timing marks between shaft and piston. This will greatly simplify timing during assembly.

10. Remove the shaft (2). It may be necessary to strike the threaded end of the shaft with a rubber mallet.

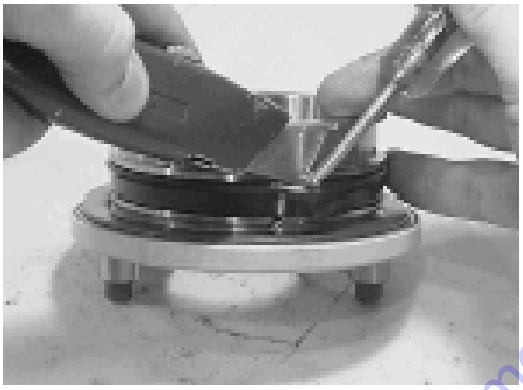
11. Before removing the piston (3), mark the housing (1) ring gear in relation to the piston O.D. gear. There should now be timing marks on the housing (1) ring gear, the piston (3) and the shaft (2).

12. To remove the piston (3) use a rubber mallet and a plastic mandrel so the piston is no damaged.

13. At the point when the piston gear teeth come out of engagement with the housing gear teeth, mark the piston and housing with a marker as shown.

14. Remove the o-ring (204) and backup ring (207) from end cap (4) and set aside for inspection.

15. Remove the wear guides (302) from the end cap (4) and shaft (2).



16. To remove the main pressure seals (205), it is easiest to cut them using a sharp razor blade being careful not to damage the seal groove.

17. Remove the thrust washers (304), from the end cap (4) and shaft (2).

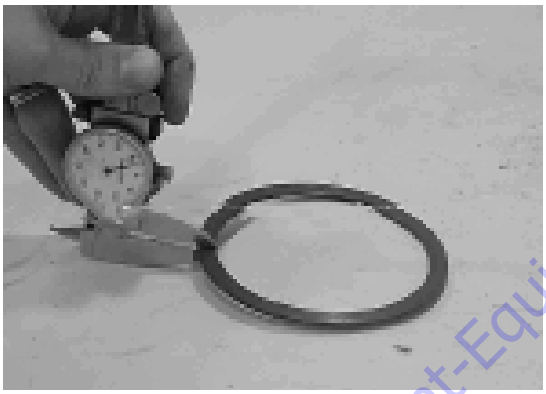
18. Remove the wiper seal (304.1) from its groove in the end cap (4) and shaft (2).

19. Remove the piston O.D. seal (202).

20. Remove the piston I.D. seal (200). You may now proceed to the inspection process.

Inspection

1. Clean all parts in a solvent tank and dry with compressed air prior to inspecting. Carefully inspect all critical areas for any surface finish abnormalities: Seal grooves, bearing grooves, thrust surfaces, rod surface, housing bore and gear teeth.



2. Inspect the thrust washers (304) for rough or worn edges and surfaces. Measure it's thickness to make sure it is within specifications (Not less than 0.092" or 2.34 mm).

3. Inspect the wear guide condition and measure thickness (not less than 0.123" or 3.12 mm).

Assembly

1. Gather all the components and tools into one location prior to re-assembly. Use the cut away drawing to reference the seal orientations.

2. Install the thrust washer (304) onto shaft (2) and end cap (4).

3. Install the wiper seal (304.1/green o-ring) into it's groove on the shaft (2) and end cap (4) around the outside edge of the thrust washer (304).

4. Using a seal tool install the main pressure seal (205) onto shaft (2) and end cap (4). Use the seal tool in a circular motion.

5. Install the o-ring (204) and backup ring (207) into the inner seal groove on the end cap (4).

6. Install the wear guide (302) on the end cap (4) and shaft (2).

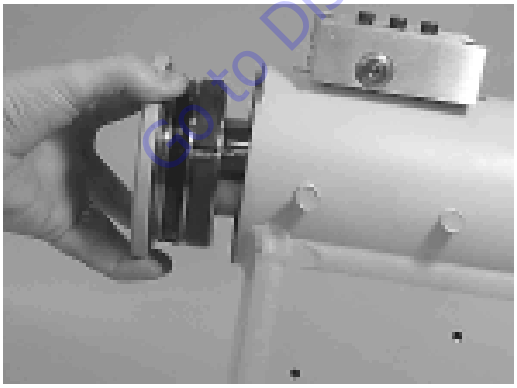
7. Install the inner T-seal (200) into the piston (3) using a circular motion. Install the outer T-seal (202) by stretching it around the groove in a circular motion. Each T-seal has 2 backup rings (see drawing for orientation).

Beginning with the inner seal (200) insert one end of b/u ring in the lower groove and feed the rest in using a circular motion. Make sure the wedged ends overlap correctly. Repeat this step for the outer seal (202).

8. Insert the piston (3) into the housing (1) as shown, until the outer piston seal (202) is touching inside the housing bore.

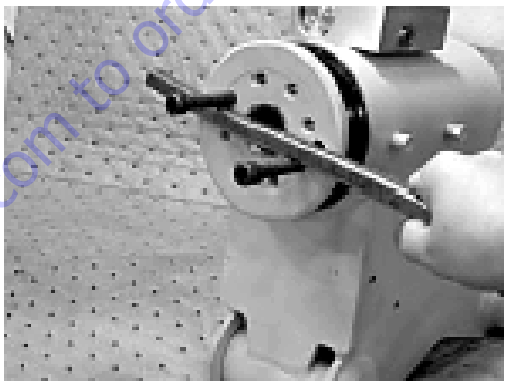
9. Looking from the angle shown, rotate the piston (3) until the marks you put on the piston and the housing (1) during disassembly line up as shown. Using a rubber mallet, tap the piston into the housing up to the point where the gear teeth meet.

10. Looking from the opposite end of the housing (1) you can see if your timing marks are lining up. When they do, tap the piston (3) in until the gear teeth mesh together. Tap the piston into the housing the rest of the way until it bottoms out.



11. Install the shaft (2) into the piston (3). Be careful not to damage the seals. Do not engage the piston gear teeth yet.

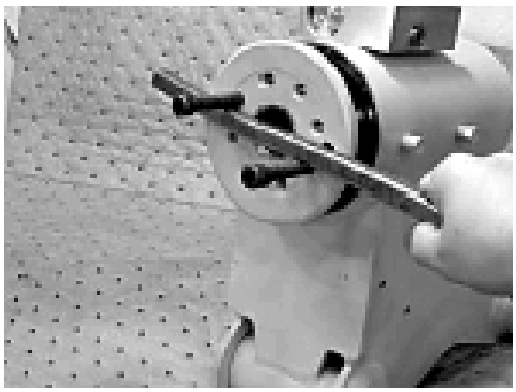
12. Looking from the view shown, use the existing timing marks to line up the gear teeth on the shaft (2) with the gear teeth on the inside of the piston (3). Now tap the flange end of the shaft with a rubber mallet until the gear teeth engage.



13. Install two bolts in the threaded holes in the flange. Using a bar, rotate the shaft in a clockwise direction until the wear guides are seated inside the housing bore.

NOTICE

AS THE SHAFT IS ROTATED, BE CAREFUL NOT TO DISENGAGE THE PISTON AND HOUSING GEARING.



14. Install the stop tube onto the shaft end. Stop tube is an available option to limit the rotation of an actuator.

15. Coat the threads on the end of the shaft with antiseize grease to prevent galling.

16. Thread the end cap (4) onto the shaft (2) end. Make sure the wear guide stays in place on the end cap as it is threaded into the housing (1).

17. Tighten the end cap (4). In most cases the original holes for the lock pins will line up.

18. Place the lock pins (109) provided in the Helac seal kit in the holes with the dimple side up. Then, using a punch, tap the lock pins to the bottom of the hole.

19. Insert the set screws (113) over the lock pins. Tighten them to 25 in. lbs. (2.825 Nm).

Installing Counterbalance Valve

Refer to Figure 4-25., Rotator Counterbalance Valve.

1. Make sure the surface of the actuator is clean, free of any contamination and foreign debris including old Loctite.
2. Make sure the new valve has the o-rings in the counterbores of the valve to seal it to the actuator housing.
3. The bolts that come with the valve are grade 8 bolts. New bolts should be installed with a new valve. JLG Threadlocker P/N 0100011 should be applied to the shank of the three bolts at the time of installation.
4. Torque the 1/4-in. bolts 110 to 120 in. lbs. (12.4 to 13.5 Nm). Do not torque over 125 in. lbs (14.1 Nm). Torque the 5/16-in. bolts 140 in. lbs. (15.8 Nm). Do not torque over 145 in. lbs. (16.3 Nm).

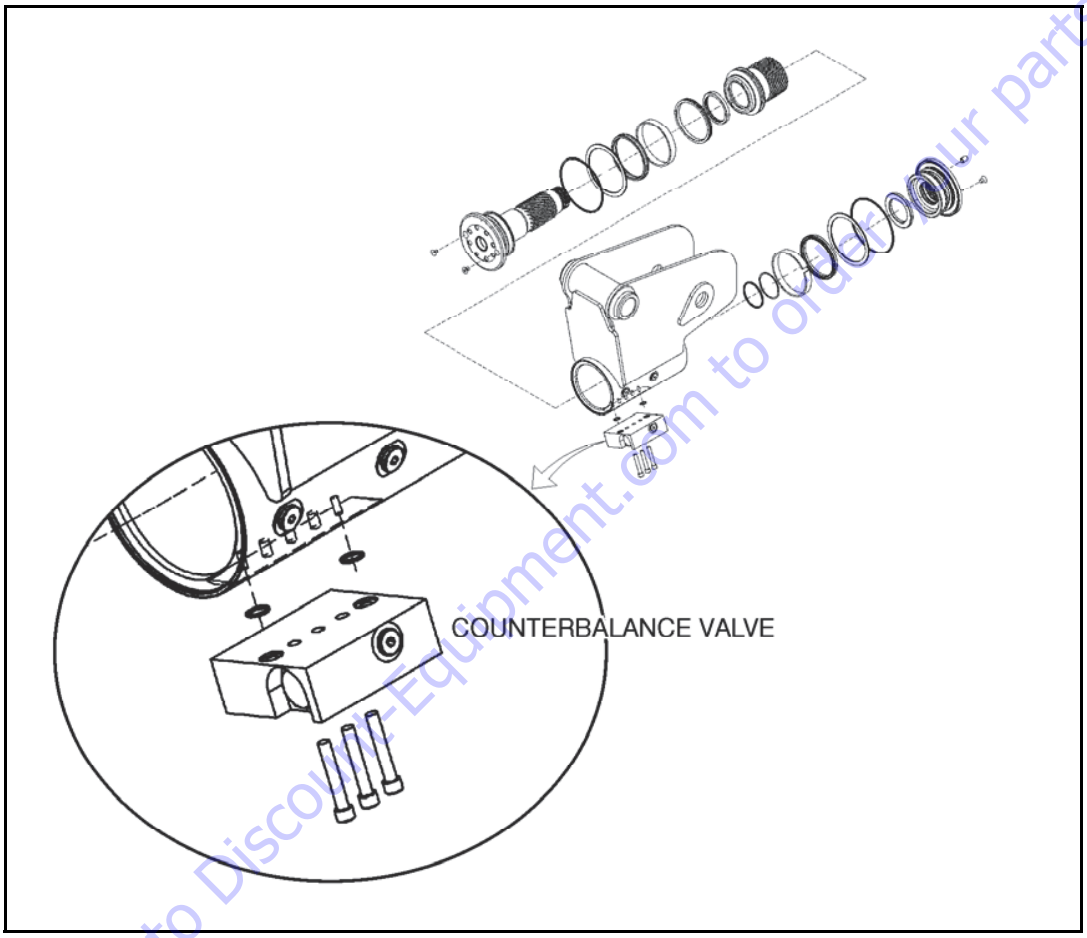


Figure 4-25. Rotator Counterbalance Valve

Testing the Actuator

If the equipment is available, the actuator should be tested on a hydraulic test bench. The breakaway pressure — the pressure at which the shaft begins to rotate — should be approximately 400 psi (28 bar). Cycle the actuator at least 25 times at 3000 psi (210 bar) pressure. After the 25 rotations, increase the pressure to 4500 psi (315 bar) to check for leaks and cracks. Perform the test again at the end of the rotation in the opposite direction.

TESTING THE ACTUATOR FOR INTERNAL LEAKAGE

If the actuator is equipped with a counterbalance valve, plug the valve ports. Connect the hydraulic lines to the housing ports. Bleed all air from the actuator (see Installation and Bleeding) Rotate the shaft to the end of rotation at 3000 psi (210 bar) and maintain pressure. Remove the hydraulic line from the non-pressurized side.

Continuous oil flow from the open housing port indicates internal leakage across the piston. Replace the line and rotate the shaft to the end of rotation in the opposite direction. Repeat the test procedure outlined above for the other port. If there is an internal leak, disassemble, inspect and repair.

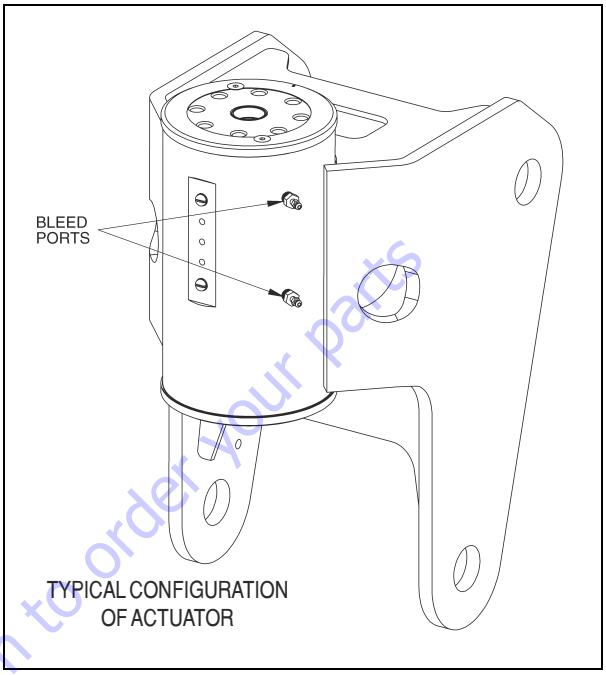
Installation and Bleeding

After installation of the actuator on the equipment, it is important that all safety devices such as tie rods or safety cables are properly reattached.

To purge air from the hydraulic lines, connect them together to create a closed loop and pump hydraulic fluid through them. Review the hydraulic schematic to determine which hydraulic lines to connect. The linear feet and inside diameter of the hydraulic supply lines together with pump capacity will determine the amount of pumping time required to fully purge the hydraulic system.

Bleeding may be necessary if excessive backlash is exhibited after the actuator is connected to the hydraulic system. The following steps are recommended when a minimum of two gallons (8 liters) is purged.

1. Connect a 3/16" inside diameter x 5/16" outside diameter x 5 foot clear, vinyl drain tube to each of the two bleed nipples. Secure them with hose clamps. Place the vinyl tubes in a clean 5-gallon container to collect the purged oil. The oil can be returned to the reservoir after this procedure is completed.



TYPICAL CONFIGURATION
OF ACTUATOR

2. With an operator in the platform, open both bleed nipples 1/4 turn. Hydraulically rotate the platform to the end of rotation (either clockwise or counterclockwise), and maintain hydraulic pressure. Oil with small air bubbles will be seen flowing through the tubes. Allow a 1/2 gallon of fluid to be purged from the actuator.
3. Keep the fittings open and rotate the platform in the opposite direction to the end position. Maintain hydraulic pressure until an additional 1/4 gallon of fluid is pumped into the container.
4. Repeat steps 2 & 3. After the last 1/2 gallon is purged, close both bleed nipples before rotating away from the end position.

Troubleshooting

Table 4-1. Troubleshooting

Problem	Cause	Solution
1. Shaft rotates slowly or not at all	a. Insufficient torque output	a. Verify correct operating pressure. Do not exceed OEM's pressure specifications. Load may be above maximum capacity of the actuator.
	b. Low rate of fluid flow	b. Inspect ports for obstructions and hydraulic lines for restrictions and leaks.
	c. Control or counterbalance valve has internal leak	c. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	d. Piston and/or shaft seal leak	d. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	e. Corrosion build-up on the thrust surfaces	e. Re-build the actuator. Remove all rust then polish. Replacement parts may be needed.
	f. Swollen seals and composite bearings caused by incompatible hydraulic fluid	f. Re-build the actuator. Use fluid that is compatible with seals and bearings.
2. Operation is erratic or not responsive	a. Air in actuator	a. Purge air from actuator. See bleeding procedures.
3. Shaft will not fully rotate	a. Twisted or chipped gear teeth	a. Check for gear binding. Actuator may not be able to be re-built and may need to be replaced. Damage could be a result of overload or shock.
	b. Port fittings are obstructing the piston	b. Check thread length of port fittings. Fittings should during stroke not reach inside the housing bore.
4. Selected position cannot be maintained	a. Control or counterbalance valve has internal leak	a. Disconnect hydraulic lines and bypass valve. Leave valve ports open and operate the actuator through housing ports (do not exceed OEM's operating pressure). The valve must be replaced if a steady flow of fluid is seen coming from the valve ports.
	b. Piston and/or shaft seal leak	b. Remove the plug and the housing's valve ports. Operate the actuator through the housing ports. Conduct the internal leakage test as described in the Testing section on page 24 of this manual.
	c. Air in actuator	c. Purge air from actuator. See bleeding procedures

4.13 LOAD SENSING DEVICE

Calibrating the Load Sensor

NOTE: *Refer to Section 6 - JLG Control System.*

1. Place the boom in the following position.
   - **a.** Boom - Stowed
   - **b.** Telescope - In
   - **c.** Jib - 0 Degrees
   - **d.** Swing - 0 Degrees
   - **e.** Basket Level - 0 Degrees
   - **f.** Basket Rotate - 0 Degrees
   - **g.** Weight in Basket - 0
   - **h.** Machine parked on firm, level surface
2. Activate both emergency stop switches and turn the key switch to the platform position.
3. Remove all loads from the platform, including the operator.
4. Turn P1 clockwise (in) until the potentiometer begins to click.
5. Plug the analyzer into the port in the platform.
6. Select Access Level from Main Menu.
7. Enter 33271.
8. Select Machine Set-Up>Load Cell>1 Warn Only.
9. Select Machine Diagnostics>System Load Cell on the Analyzer.
10. Adjust P2 until the Load = 0%.
11. Place 525 lbs. (238 kg) in the center of the basket.
12. Adjust P1 until the Load = 100%
13. Verify that the overload indicator lights continuously and the alarm sounds continuously during an overload condition.
14. Remove the weight from the platform.
15. Adjust P2 until the Load = 0%.
16. Place 525 lbs. (238 kg) in the center of the basket.
17. Adjust P1 until the Load = 100%
18. Remove the weight from the basket.
19. Seal the potentiometers with fingernail polish.

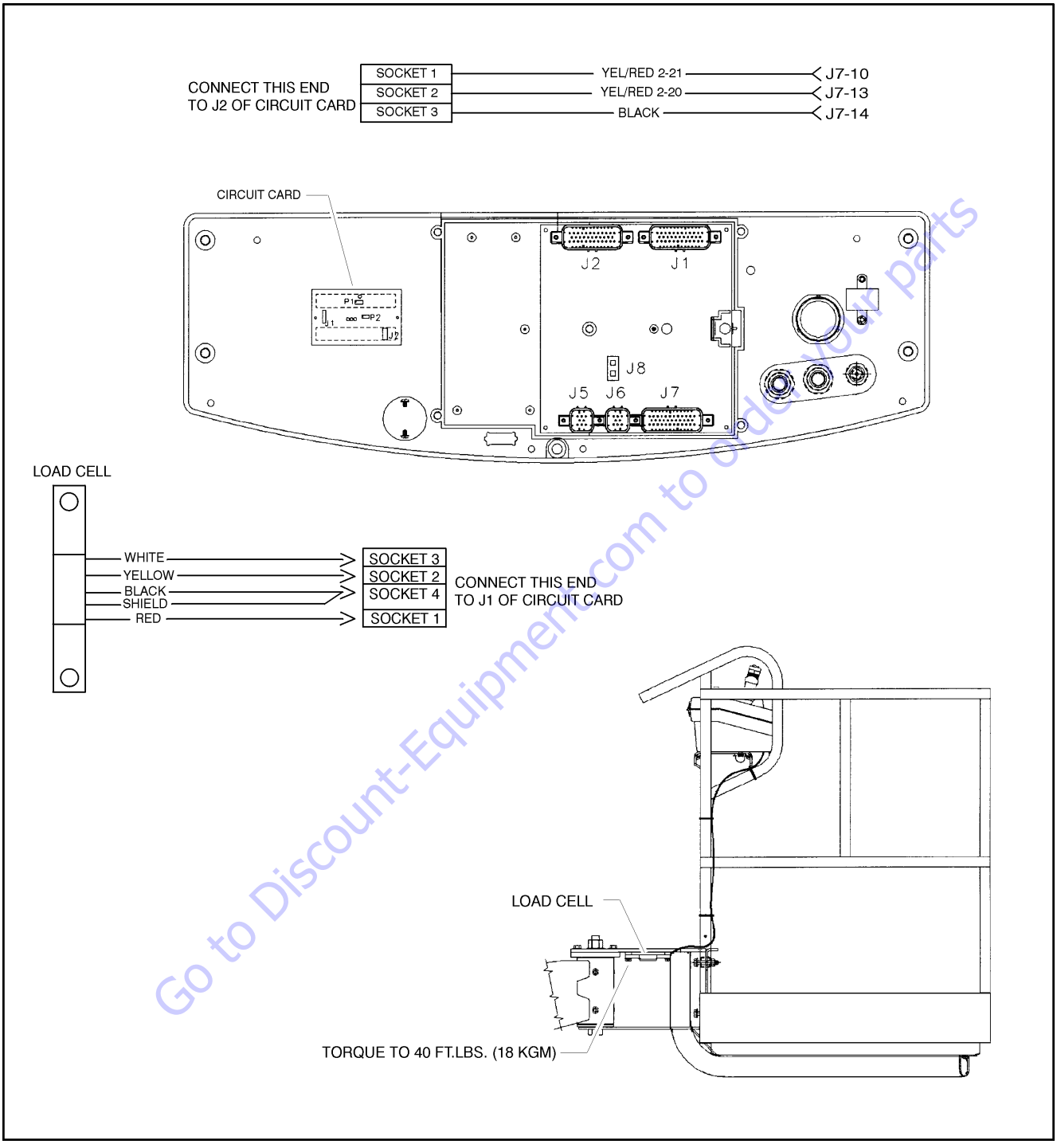


Figure 4-26. Load Sensing Device

PARTS FINDER

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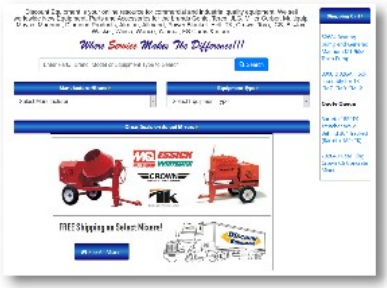

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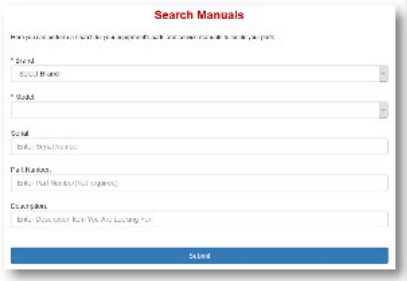

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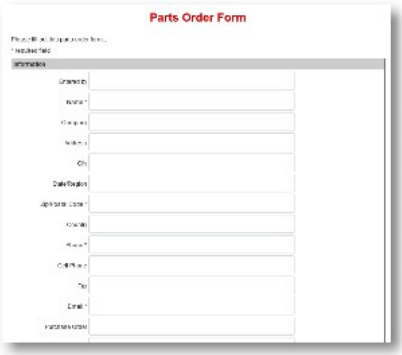

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SECTION 5. BASIC HYDRAULIC INFORMATION & HYDRAULIC SCHEMATICS

5.1 LUBRICATING O-RINGS IN THE HYDRAULIC SYSTEM

When assembling connectors in the hydraulic that use o-ring fittings, it is necessary to lubricate all fittings with hydraulic oil prior to assembly. To lubricate the fittings, use one of the following procedures.

NOTE: *All o-ring fittings must be pre-lubricated with hydraulic oil prior to assembly.*

Cup and Brush

The following is needed to correctly oil the o-ring in this manner:

- A small container for hydraulic oil
- Small paint brush

1. Hold the fitting in one hand while using the brush with the other hand to dip into the container. Remove excess hydraulic oil from the brush so an even film of oil is applied on the o-ring.

2. Holding the fitting over the hydraulic oil container, brush an even film of oil around the entire o-ring in the fitting, making sure the entire o-ring is completely saturated.

3. Turn the o-ring on the other side of the fitting and repeat the previous step, ensuring the entire o-ring is coated with hydraulic oil.

Dip Method

NOTE: *This method works best with Face Seal o-rings, but will work for all o-ring fitting types.*

The following is needed to correctly oil the o-ring in this manner:

- A small leak proof container
- Sponge cut to fit inside the container
- A small amount of hydraulic oil to saturate the sponge.

1. Place the sponge inside the container and add hydraulic oil to the sponge until it is fully saturated.
2. Dip the fitting into the sponge using firm pressure. Upon lifting the fitting, a small droplet will form and drip from the bottom of the fitting. This should signify an even coating of oil on the fitting.

3. O-ring Boss type fittings will require more pressure in able to immerse more of the fitting into the saturated sponge. This will also cause more oil to be dispersed from the sponge.

Spray Method

This method requires a pump or trigger spray bottle.

1. Fill the spray bottle with hydraulic oil.
2. Hold the fitting over a suitable catch can.
3. Spray the entire o-ring surface with a medium coat of oil.

Brush-on Method

This method requires a sealed bottle brush.

1. Fill the bottle with hydraulic oil.
2. Using slight pressure to the body of the spray bottle, invert the bottle so the brush end is in the downward position.
3. Brush hydraulic oil on the entire o-ring, applying an even coat of oil.

5.2 CYLINDER REPAIR

Axle Lockout Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ 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. Remove the counterbalance valves, plugs and bleeder valves from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

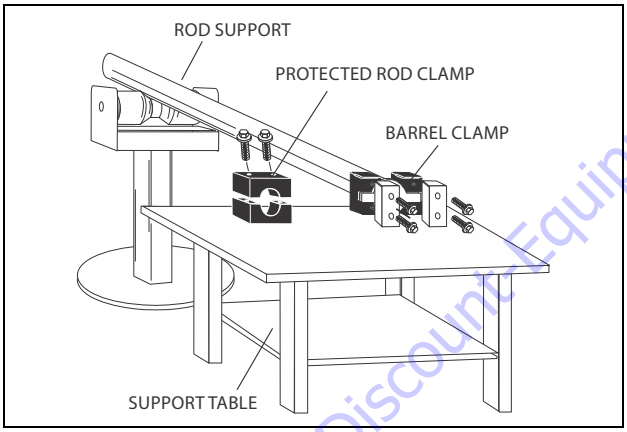


Figure 5-1. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the eight cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

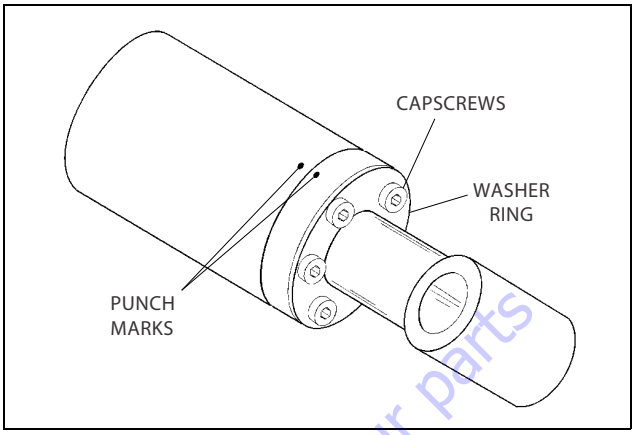


Figure 5-2. Capscrew Removal

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

NOTICE

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

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

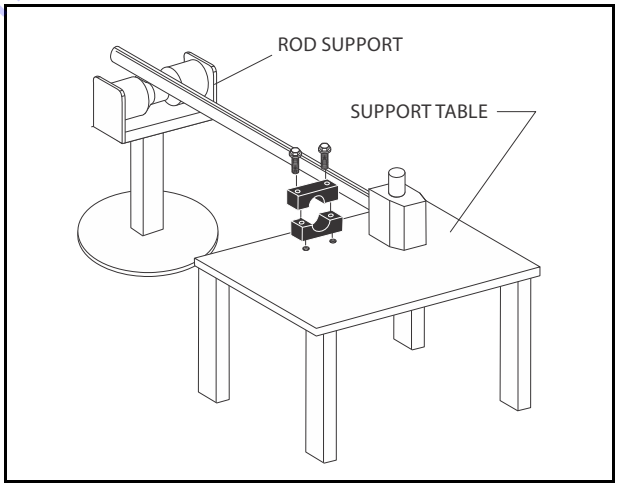
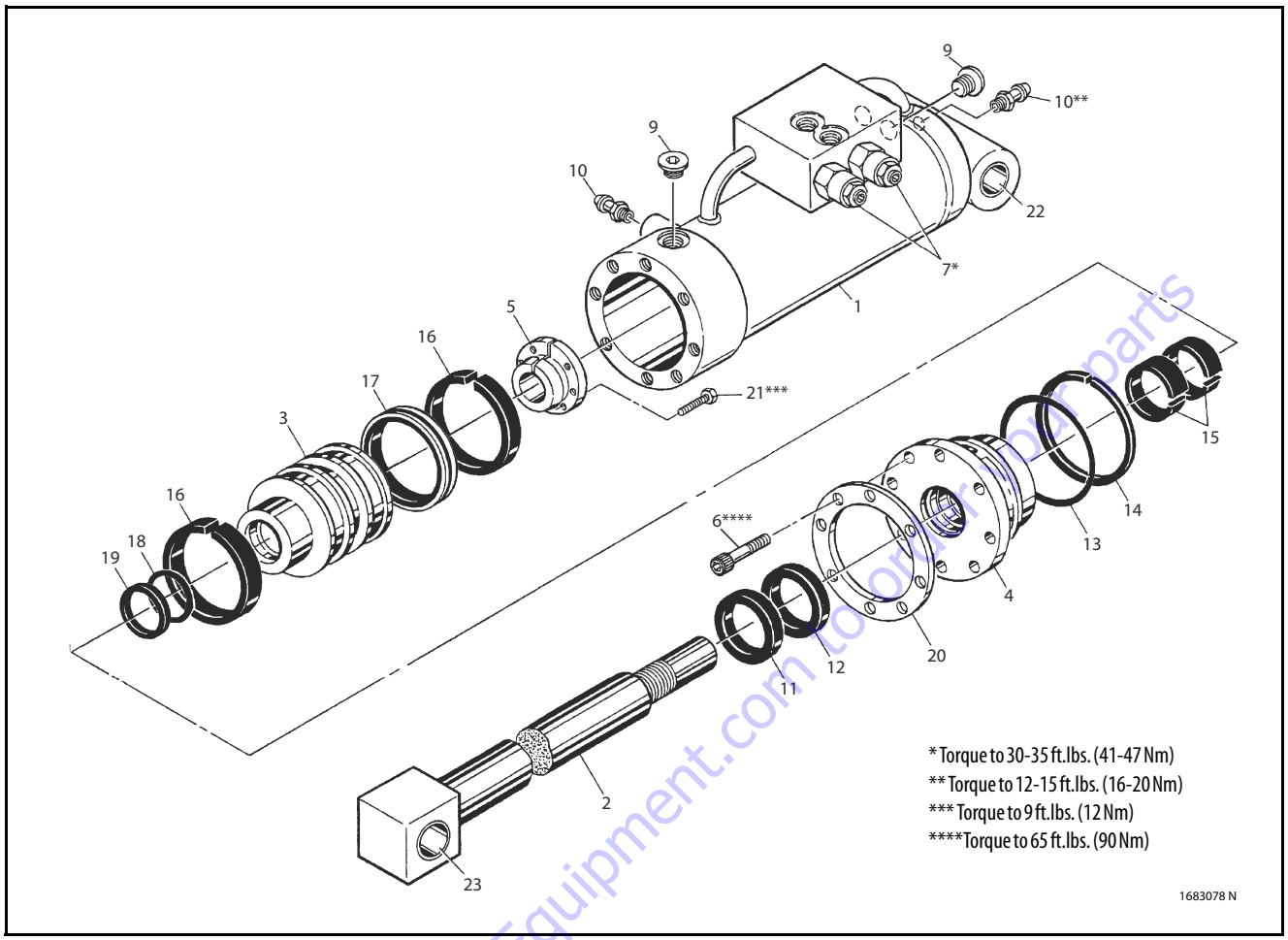


Figure 5-3. Cylinder Rod Support

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Loosen and remove nut which attaches the piston to the rod, and remove the piston.



1. Barrel
2. Rod
3. Piston
4. Head
5. Bushing
6. Bolt
7. Counterbalance Valve
8. Bushing
9. Plug
10. Bleeder Valve
11. Wiper Seal
12. Rod Seal
13. O-ring
14. Backup Ring
15. Wear Ring
16. Wear Ring
17. T-Seal
18. O-ring
19. Backup Ring
20. Washer Ring
21. Bolt
22. Bushing

Figure 5-4. Axle Lockout Cylinder

10. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loose on the piston.
11. Remove the bushing from the piston.

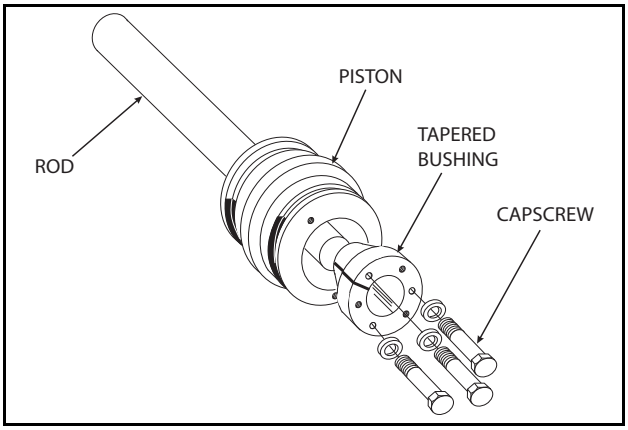


Figure 5-5. Tapered Bushing Removal

12. With the barrel clamped securely, apply pressure to the rod pulling device and carefully withdraw the complete rod assembly from the cylinder barrel.
13. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
14. Loosen and remove nut which attaches the piston to the rod, and remove the piston.
15. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loose on the piston.
16. Remove the bushing from the piston.
17. Screw the piston by hand, and remove the piston from cylinder rod.
18. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
19. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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, 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 the 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 composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

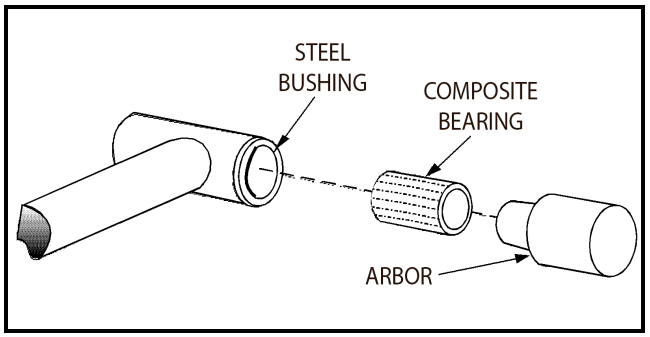


Figure 5-6. Composite Bearing Installation

14. If applicable, inspect port block fittings and holding valve. Replace as necessary.

15. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

16. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

Assembly

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

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

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

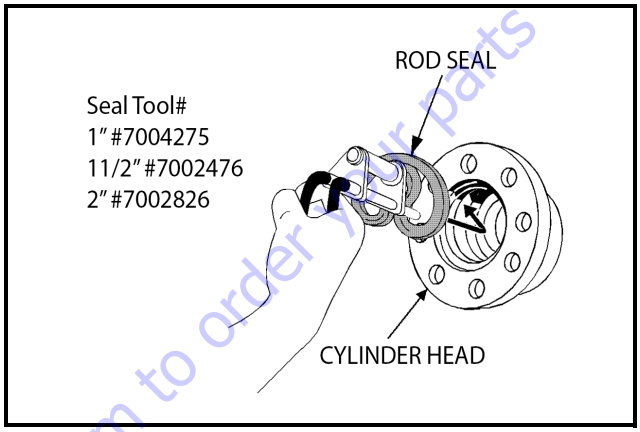


Figure 5-7. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

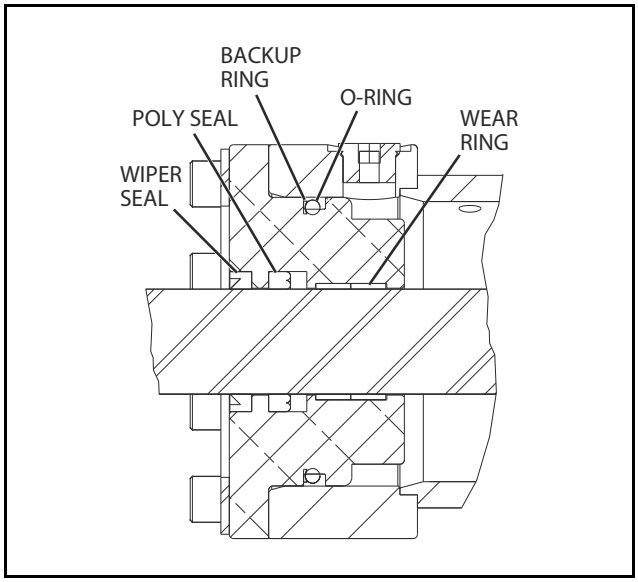


Figure 5-8. Cylinder Head Seal Installation

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.

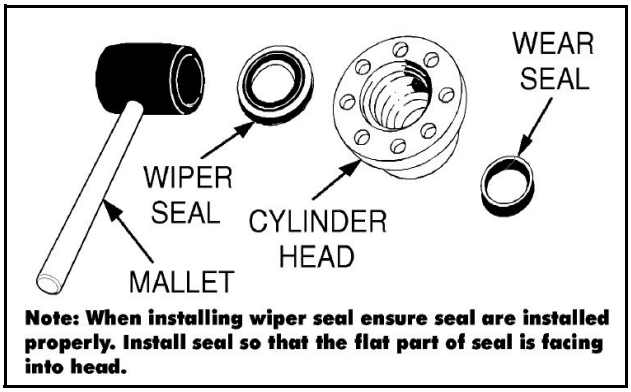


Figure 5-9. Wiper Seal Installation

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

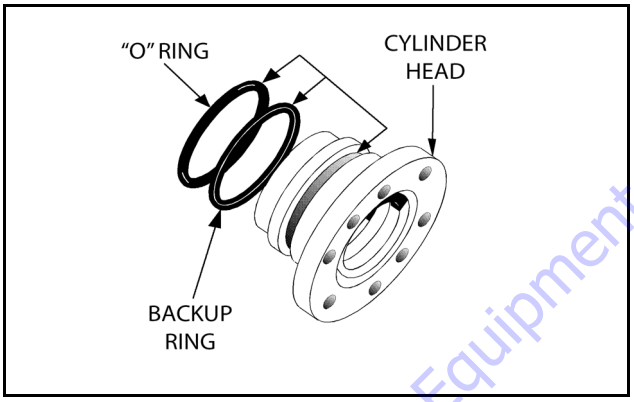


Figure 5-10. Installation of Head Seal Kit

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

6. Place a new o-ring and backup rings in the inner piston diameter groove.

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

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

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

9. Install the bolts in tapered bushing.

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

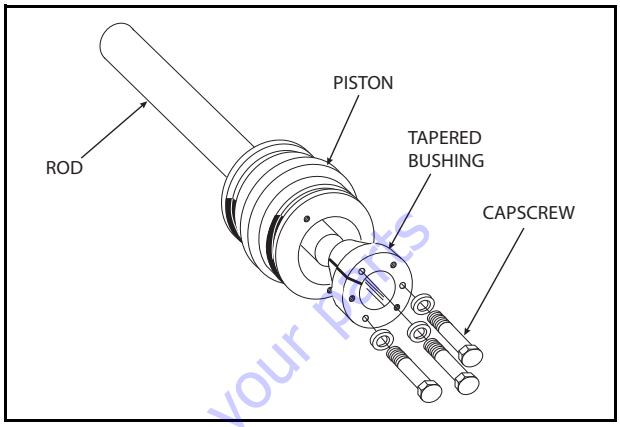


Figure 5-11. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. 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.

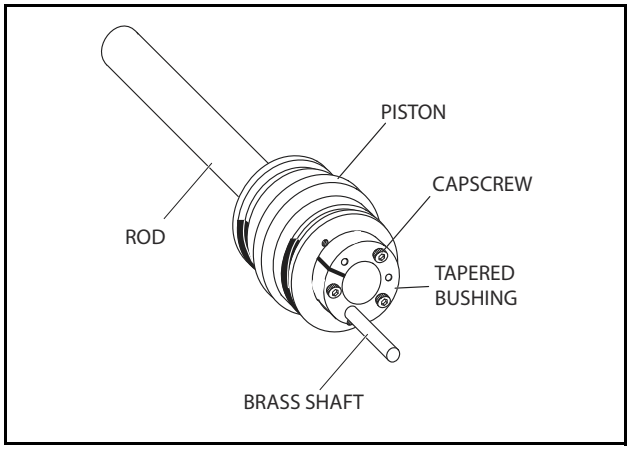


Figure 5-12. Seating the Tapered Bushing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place seals in the applicable outside diameter grooves of the cylinder piston. (See Figure 5-13., Piston Seal Kit Installation).

16. Place new seals 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).

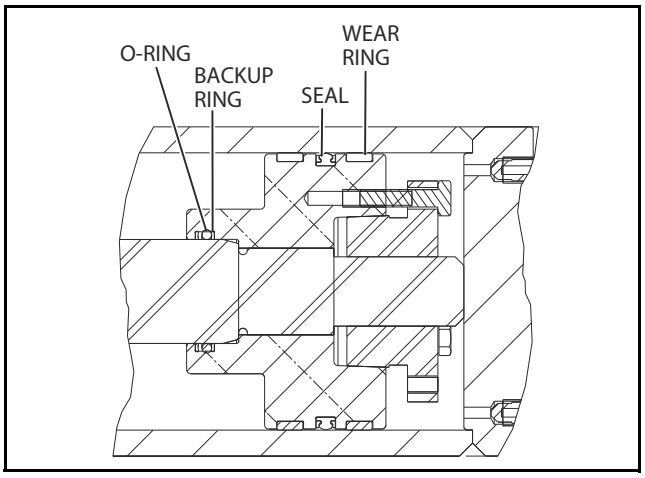


Figure 5-13. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

18. 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.

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

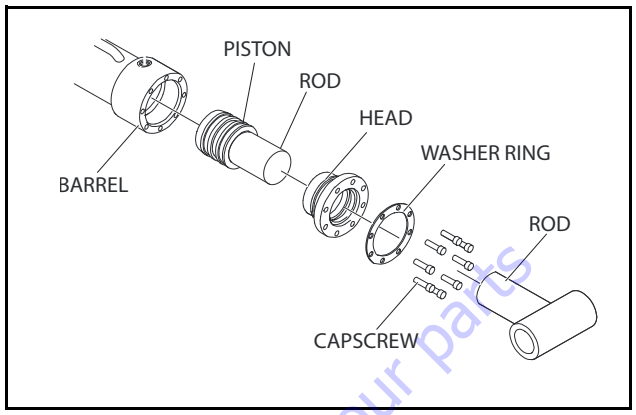


Figure 5-14. Rod Assembly Installation

20. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 65 ft.lbs. (90 Nm).

21. 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.

22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable.

Jib Lift Cylinder (860SJ Only)

DISASSEMBLY

NOTICE

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

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

⚠ 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. Remove the counterbalance holding valve and plugs from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

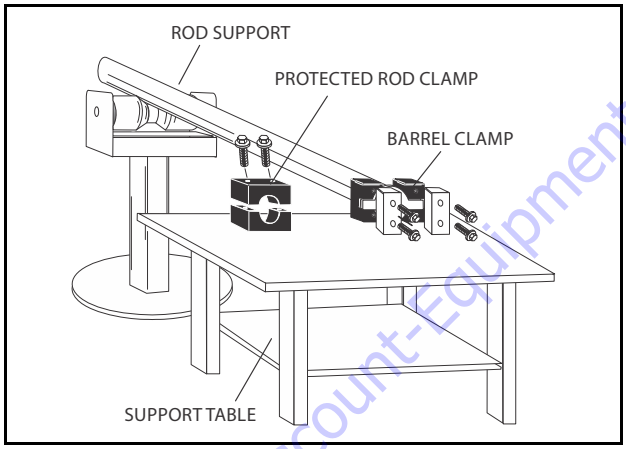


Figure 5-15. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

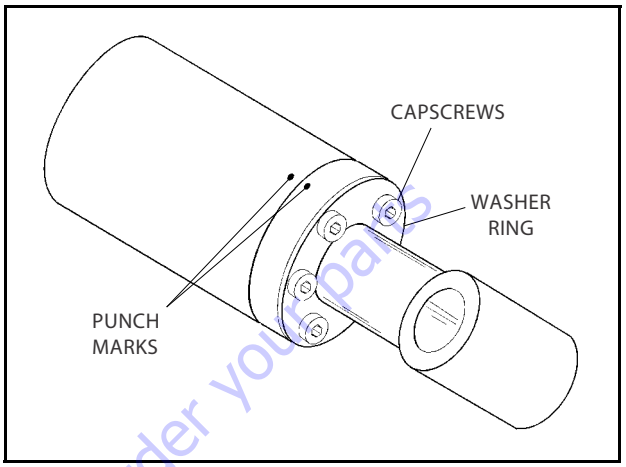


Figure 5-16. Capscrew Removal

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

NOTICE

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

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

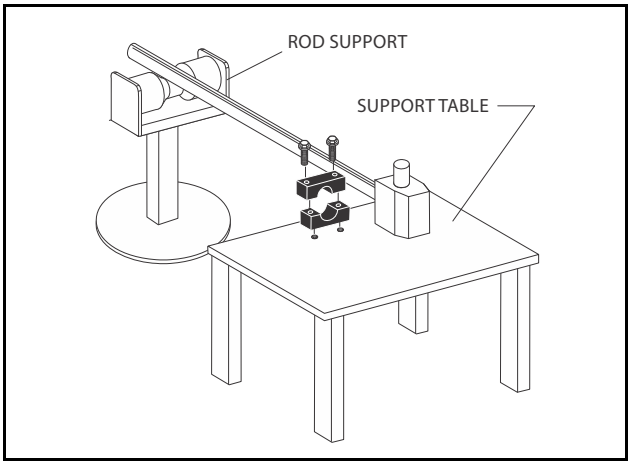
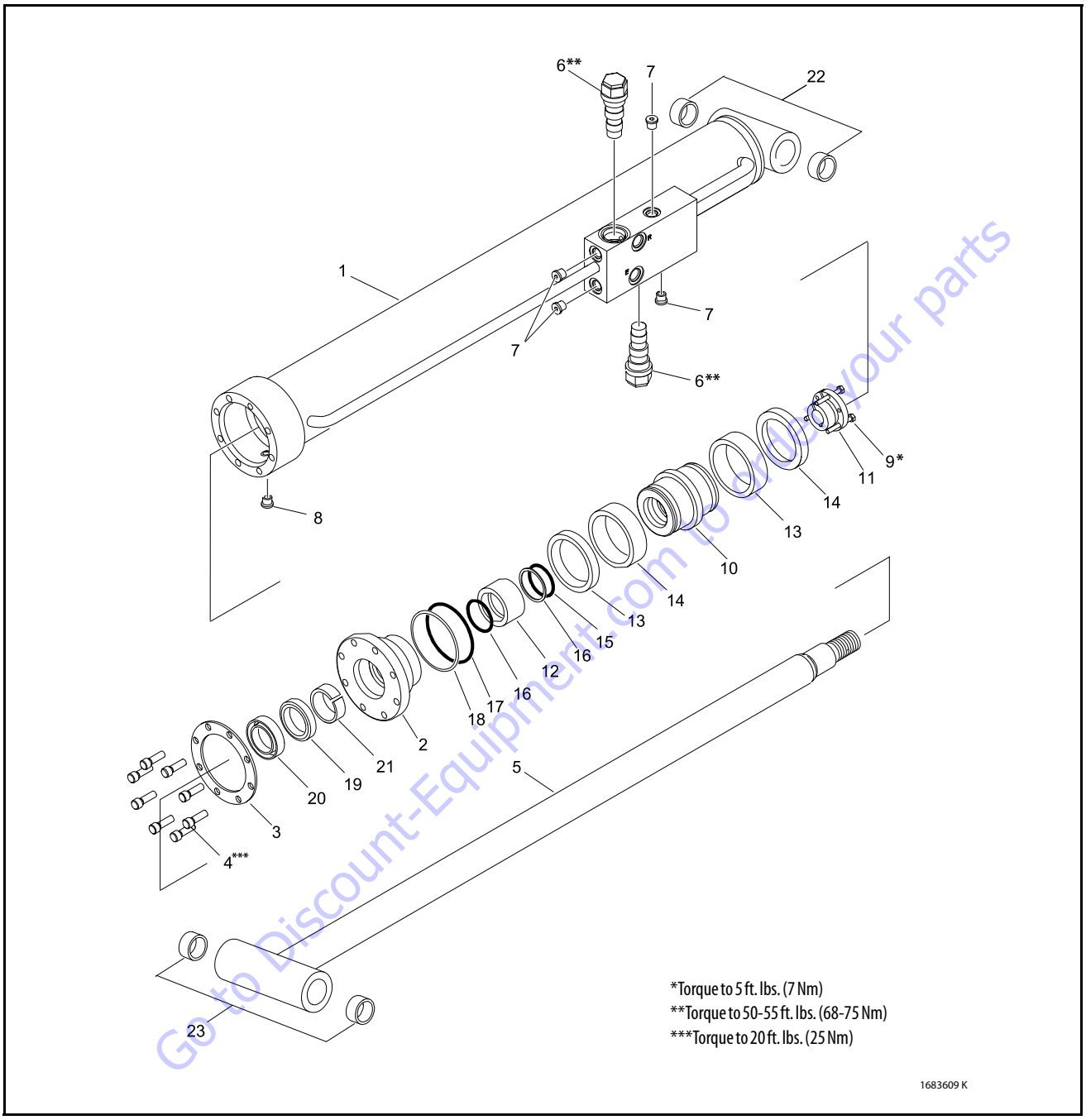


Figure 5-17. Cylinder Rod Support



1. Barrel
2. Head
3. Washer Ring
4. Bolt
5. Rod
6. Counterbalance Valve
7. Plug
8. Plug
9. Capscrew
10. Piston
11. Tapered Bushing
12. Spacer Tube
13. Lock Ring
14. Piston Seal
15. O-ring
16. Backup ring
17. O-ring
18. Backup Ring
19. Rod Seal
20. Wiper Seal
21. Wear Ring
22. Bushing
23. Bushing

Figure 5-18. Jib Lift Cylinder (860SJ Only)

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loose on the piston.
10. Remove the bushing from the piston.

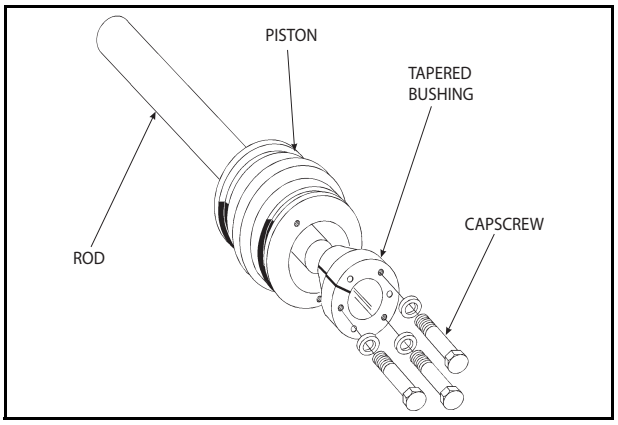


Figure 5-19. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, and backup rings.
13. Remove piston spacer, if applicable, from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

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

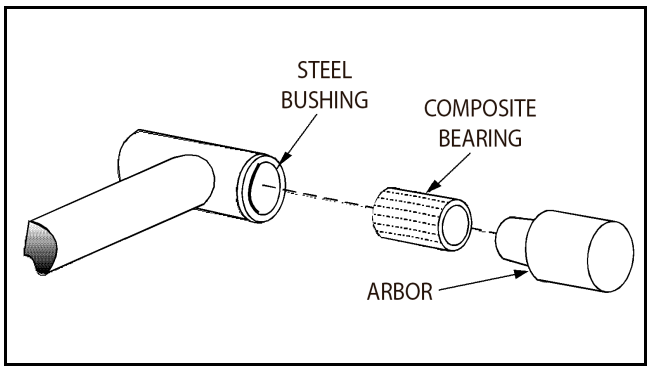


Figure 5-20. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.

13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

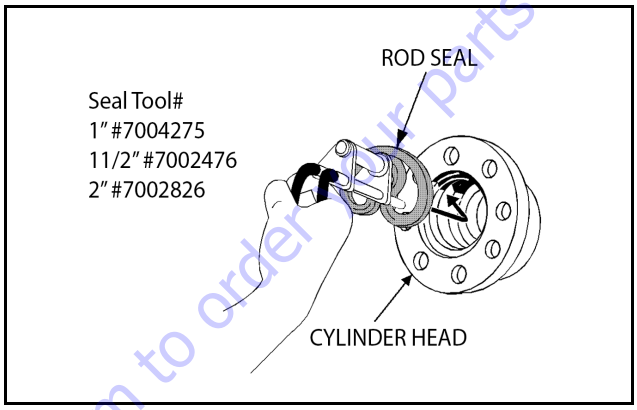


Figure 5-21. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

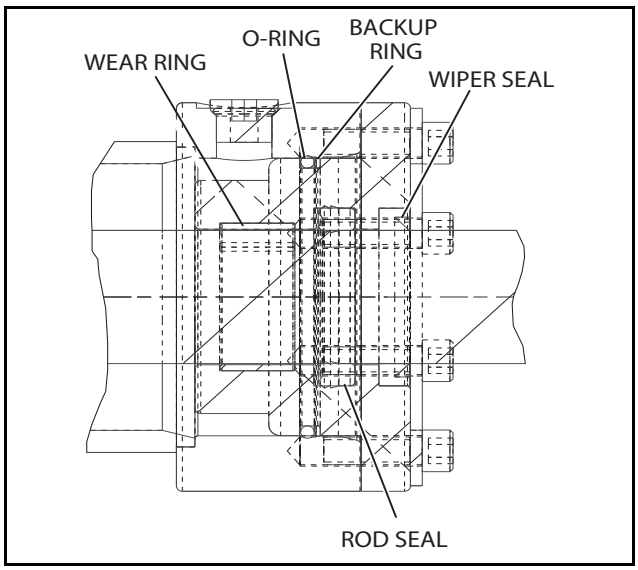


Figure 5-22. Cylinder Head Seal Installation

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.

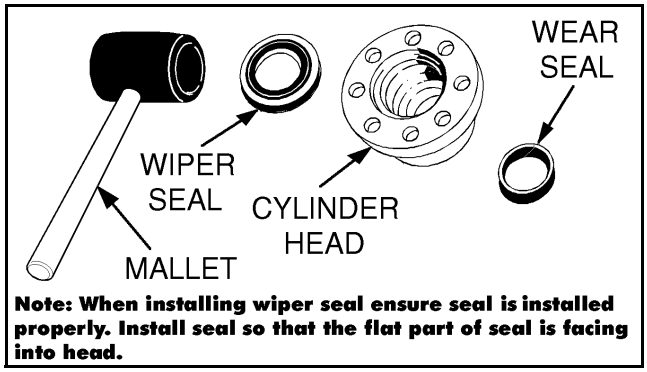


Figure 5-23. Wiper Seal Installation

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

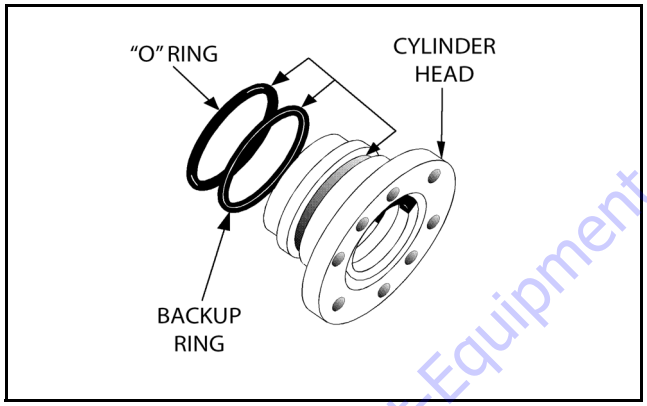


Figure 5-24. Installation of Head Seal Kit

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

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod end and install the tapered bushing.

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

10. Install the bolts in tapered bushing.

11. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

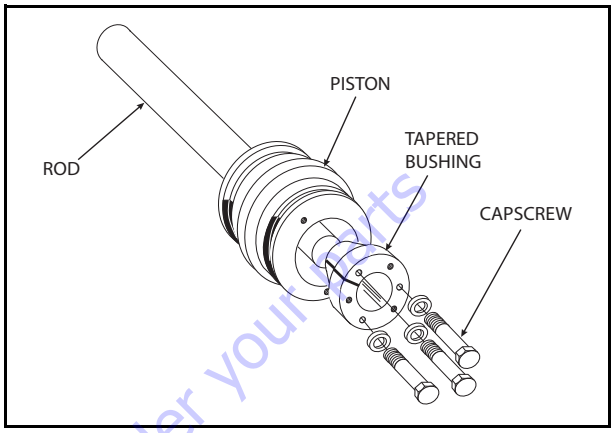


Figure 5-25. Tapered Bushing Installation

12. Tighten the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

13. 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.

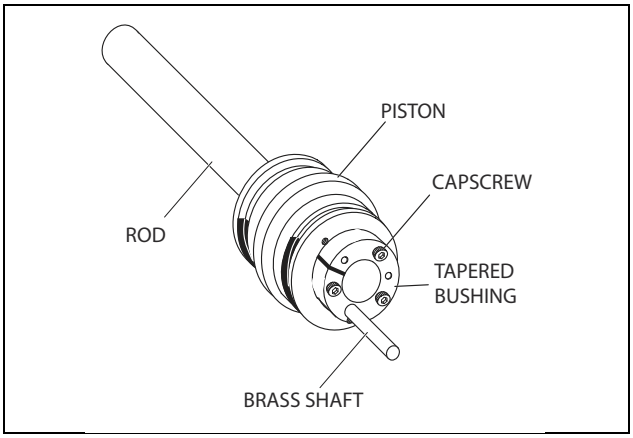


Figure 5-26. Seating the Tapered Bearing

14. Rotate the capscrews evenly and progressively in rotation to 5 ft.lbs. (7 Nm).

15. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

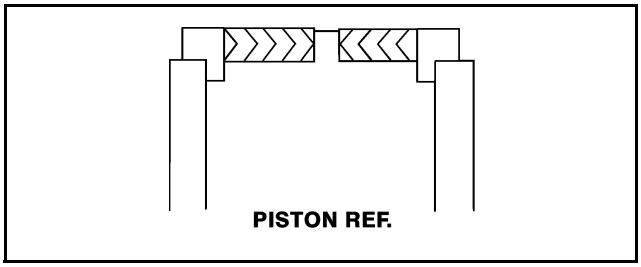


Figure 5-27. Hydrolock Piston Seal Installation

16. Place new hydrolock seal and guidelock 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).

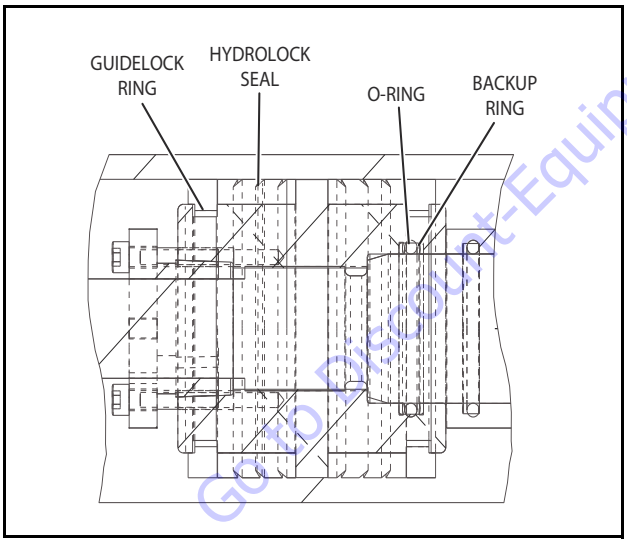


Figure 5-28. Piston Seal Kit Installation

17. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

18. 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.

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

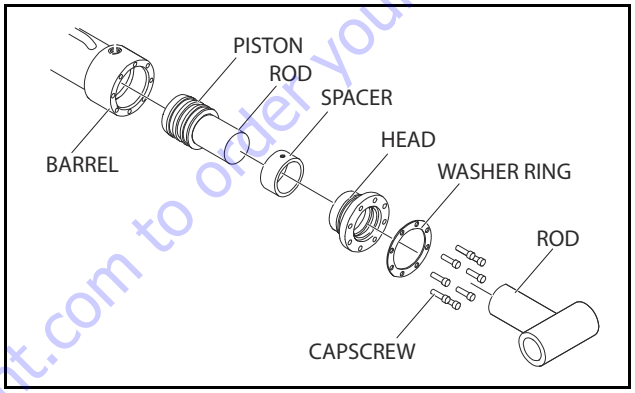


Figure 5-29. Rod Assembly Installation

20. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 20 ft.lbs. (27 Nm).

21. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

22. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft.lbs. (68-75 Nm).

Main Boom Lift Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ 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. Remove the proportional valve, lift holding valve, relief valve, check valve, and plugs. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

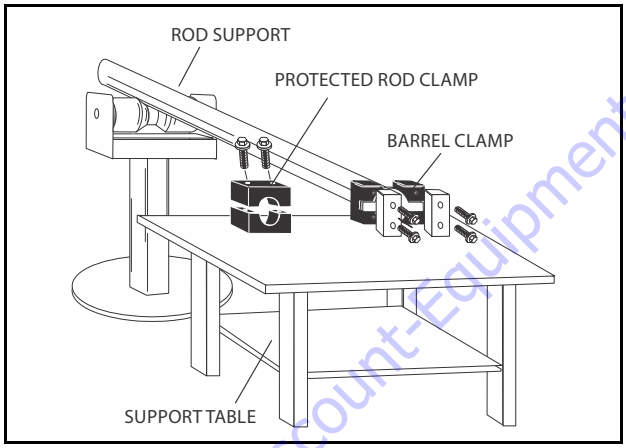


Figure 5-30. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

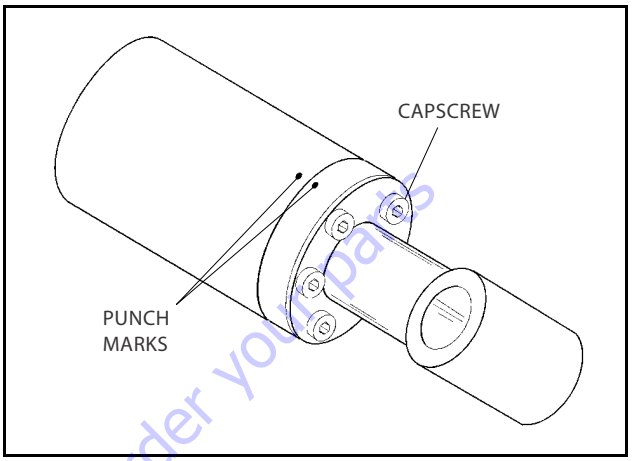


Figure 5-31. Capscrew Removal

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

NOTICE

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

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

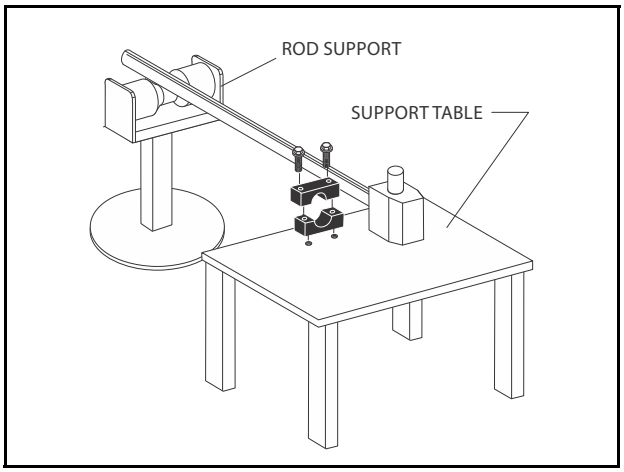
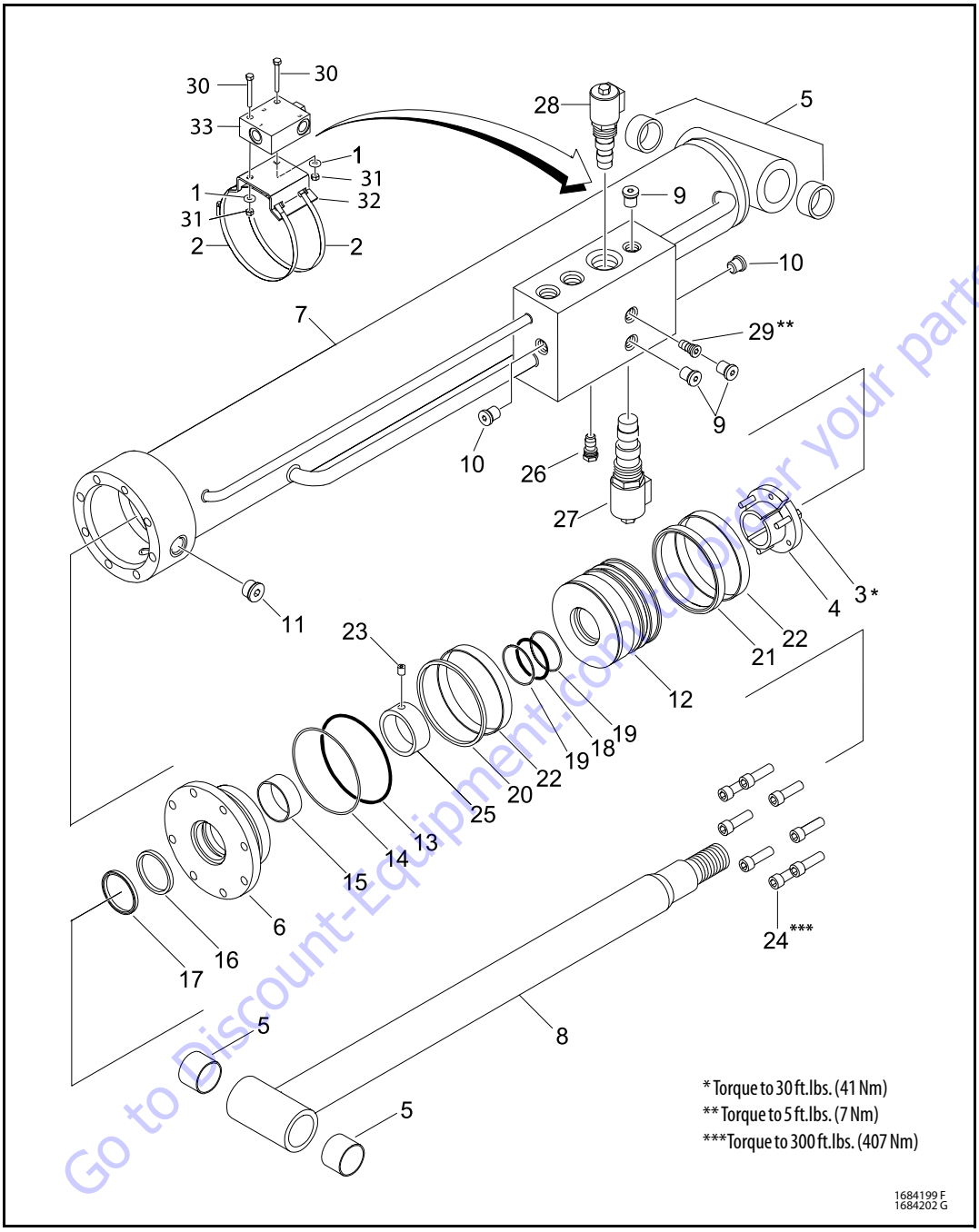


Figure 5-32. Cylinder Rod Support



1.	Flatwasher	8.	Rod	15.	Wear Ring	22.	Guidelock Ring	29.	Relief Valve
2.	Clamp	9.	Plug	16.	Rod Seal	23.	Setscrew	30.	Bolt
3.	Bolt	10.	Plug	17.	Wiper Seal	24.	Capscrew	31.	Locknut
4.	Tapered Bushing	11.	Plug	18.	O-ring	25.	Spacer	32.	Plate
5.	Bushing	12.	Piston	19.	Backup ring	26.	Check Valve	33.	Check Valve
6.	Head	13.	O-ring	20.	Guidelock Ring	27.	Lift Dump Proportional Solenoid		
7.	Barrel	14.	Backup Ring	21.	Seal	28.	Lift Holding Solenoid		

Figure 5-33. Main Boom Lift Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

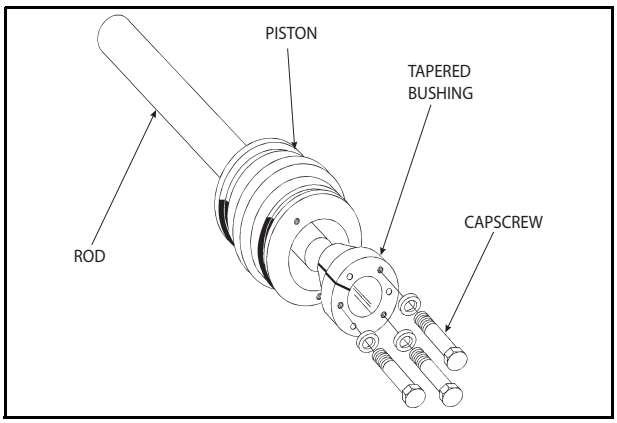


Figure 5-34. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
13. Remove setscrew and piston spacer from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

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

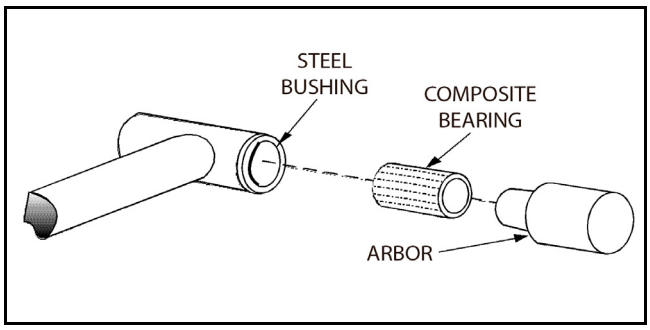


Figure 5-35. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.

13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

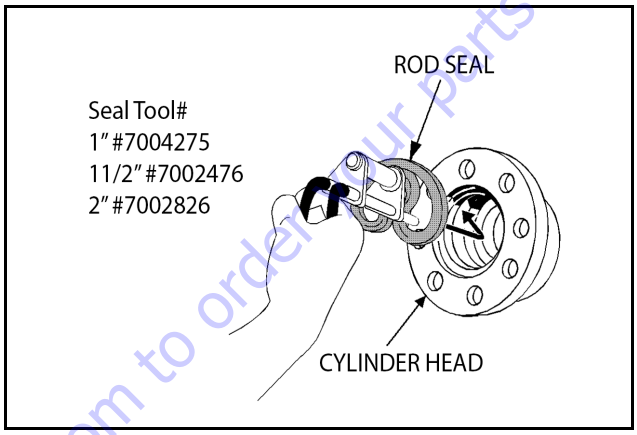


Figure 5-36. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

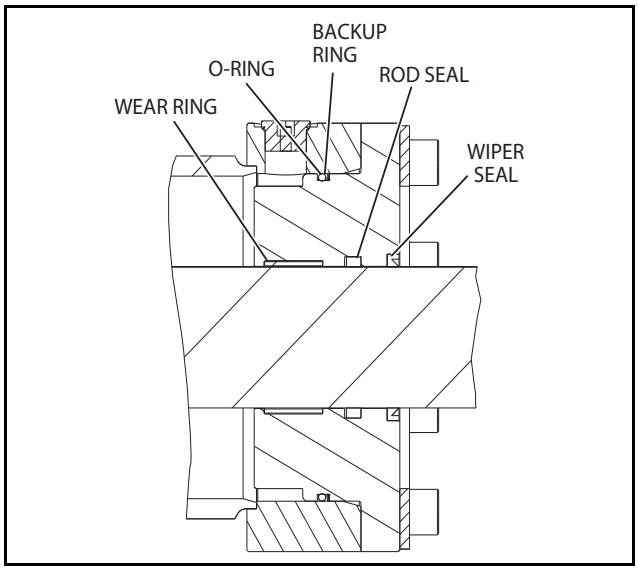


Figure 5-37. Cylinder Head Seal Installation

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.

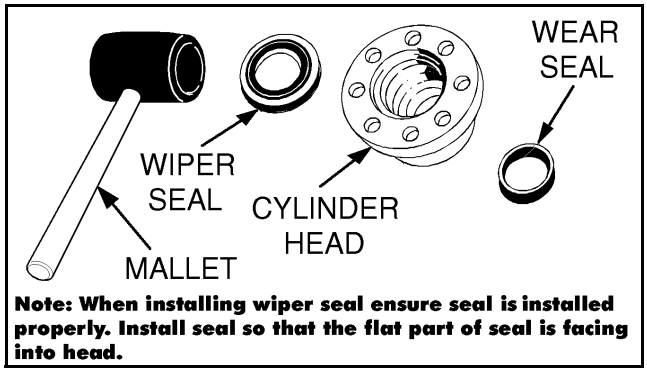


Figure 5-38. Wiper Seal Installation

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

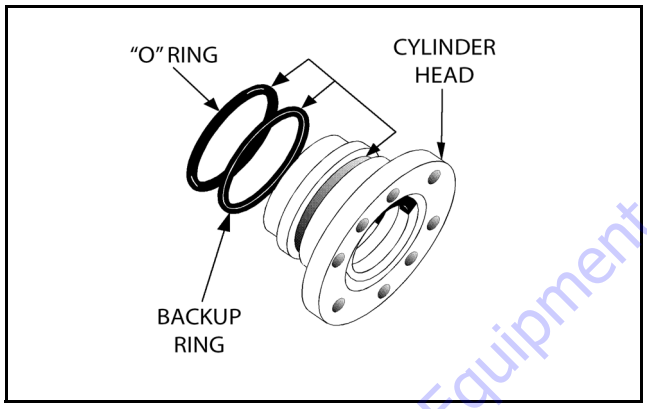


Figure 5-39. Installation of Head Seal Kit

4. 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 and tighten the setscrew.

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

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod hand tight and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

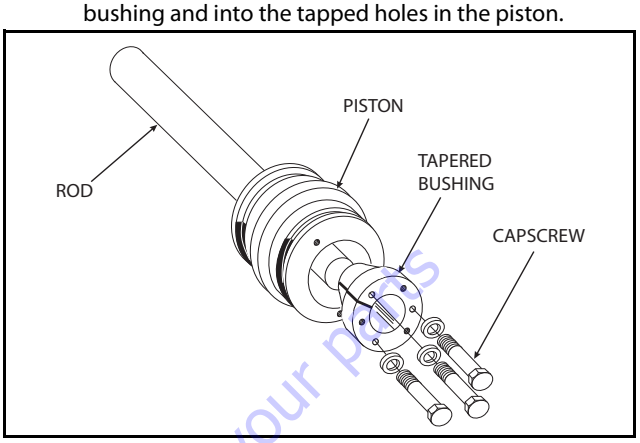


Figure 5-40. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

12. 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.

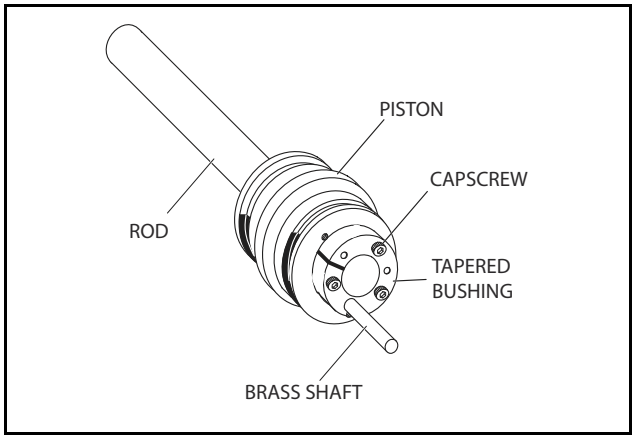


Figure 5-41. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 30 ft.lbs. (41 Nm).

14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

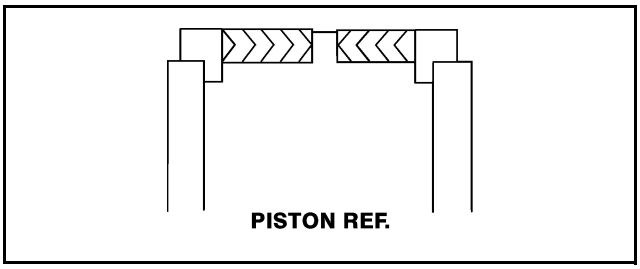


Figure 5-42. Hydrolock Piston Seal Installation

15. Place new seal and wear 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).

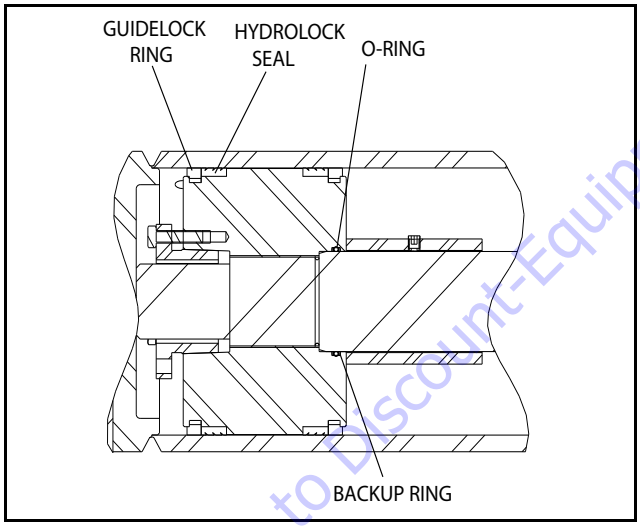


Figure 5-43. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

17. 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.

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

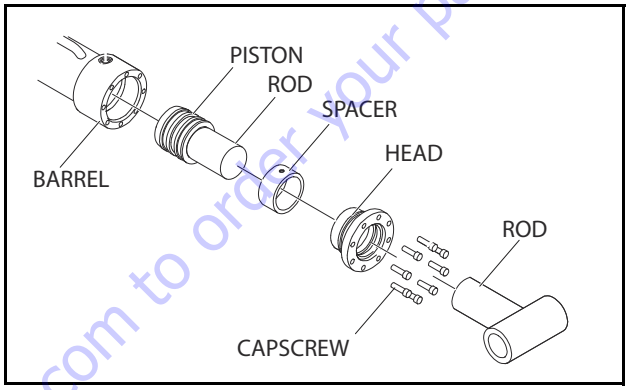


Figure 5-44. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the bolts. Torque bolts to 300 ft.lbs. (407 Nm).

20. 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.

21. Install the proportional valve, lift holding valve, relief valve, check valve and plugs, using new o-rings as applicable.Torque valves to 30-37 ft. lbs. (41-50 Nm).

Platform Level Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ 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. Remove the cartridge valve and fittings from the cylinder port block. Discard o-rings.
4. Place the cylinder barrel into a suitable holding fixture.

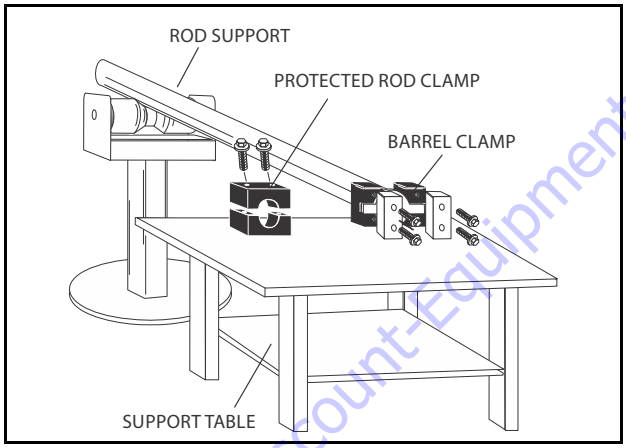


Figure 5-45. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

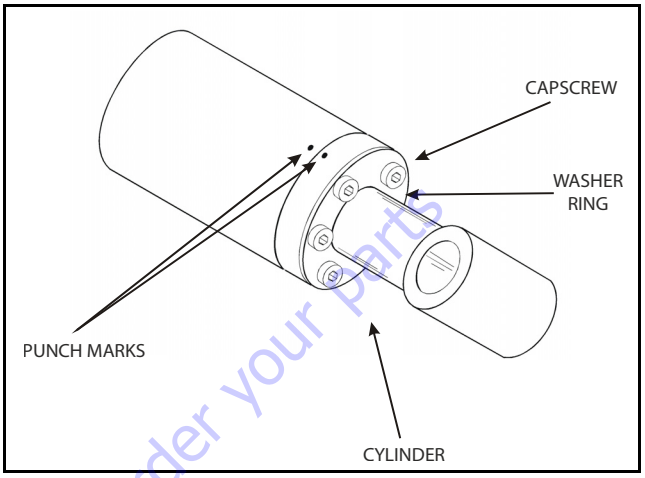


Figure 5-46. Capscrew Removal

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

NOTICE

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

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

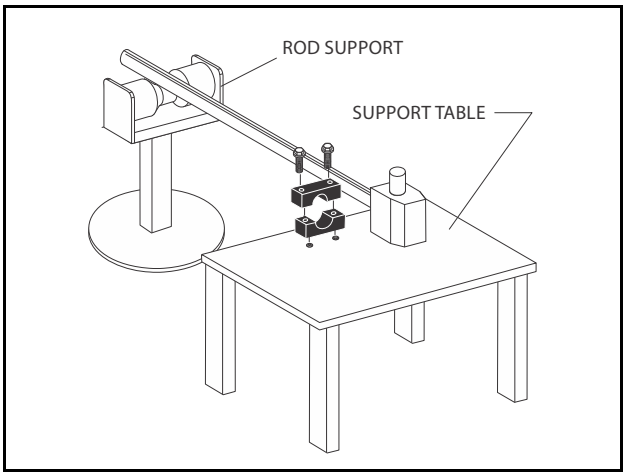
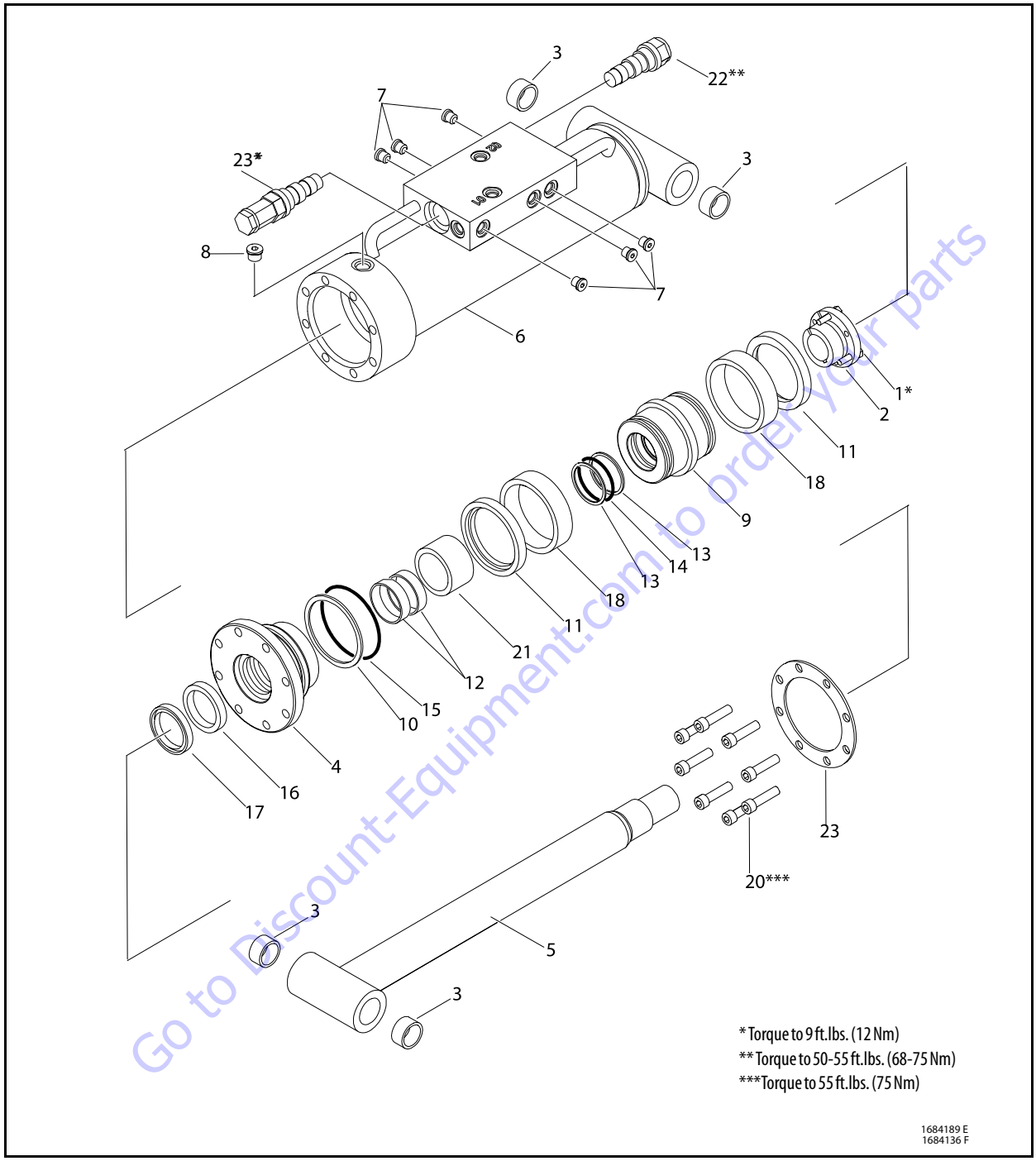


Figure 5-47. Cylinder Rod Support



1.	Capscrew	6.	Barrel	11.	Lock Ring	16.	Rod Seal	21.	Spacer
2.	Tapered Bushing	7.	Plug	12.	Wear Ring	17.	Wiper Seal	22.	Cartridge Valve
3.	Bushing	8.	Plug	13.	Backup Ring	18.	Seal	23.	Cartridge Valve
4.	Head	9.	Piston	14.	O-ring	19.	Washer Ring		
5.	Rod	10.	Backup Ring	15.	O-ring	20.	Capscrew		

Figure 5-48. Platform Level Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

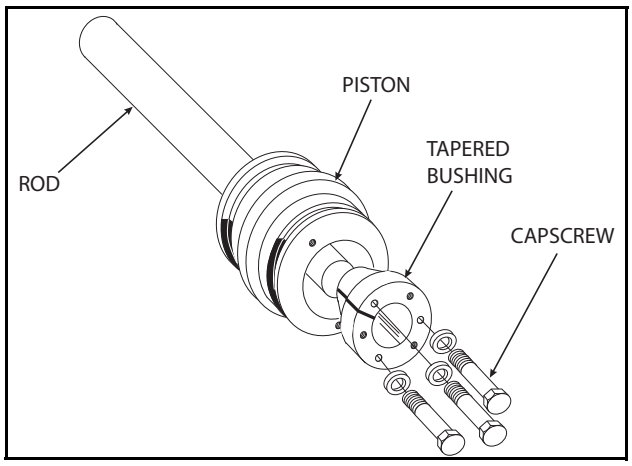


Figure 5-49. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, lock rings and backup rings.
13. Remove piston spacer from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

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

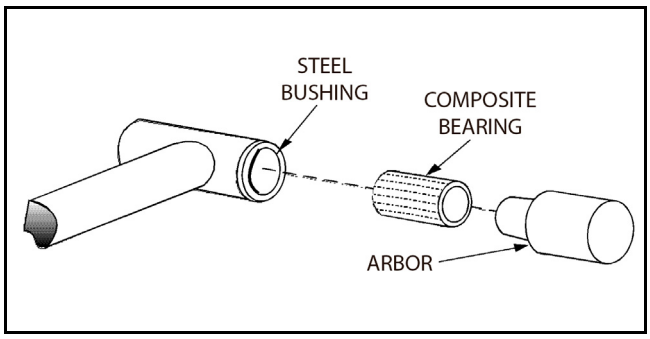


Figure 5-50. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.

13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

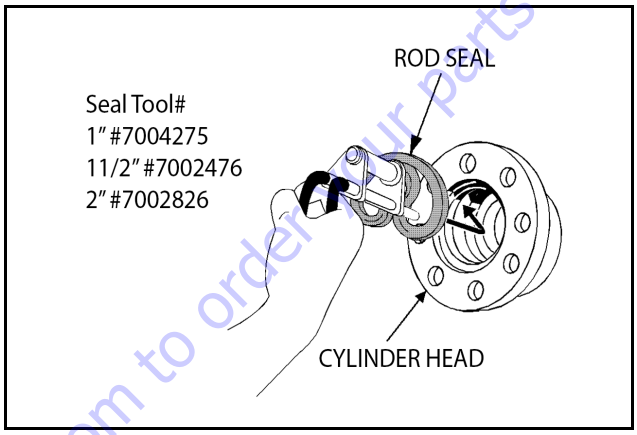


Figure 5-51. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

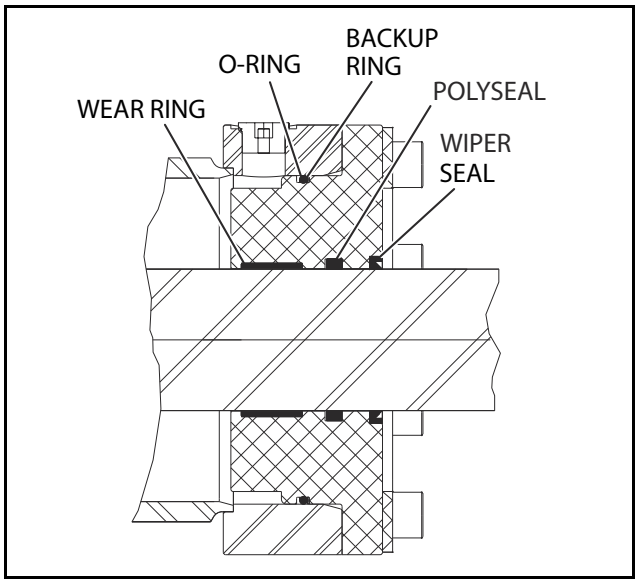


Figure 5-52. Cylinder Head Seal Installation

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.

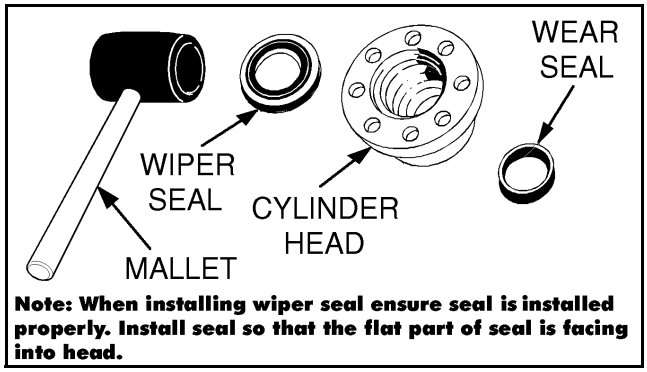


Figure 5-53. Wiper Seal Installation

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

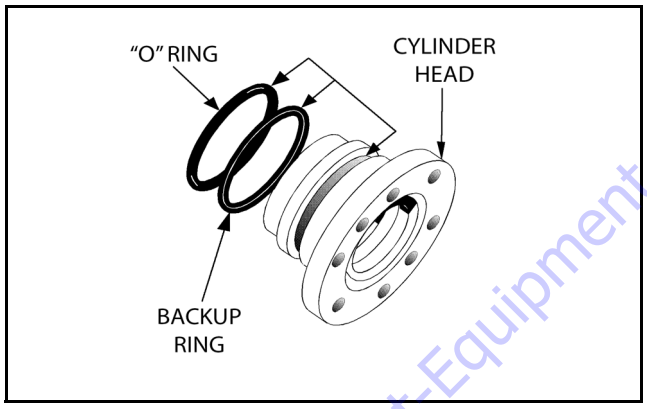


Figure 5-54. Installation of Head Seal Kit

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

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. Thread piston onto rod and install the tapered bushing.

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

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

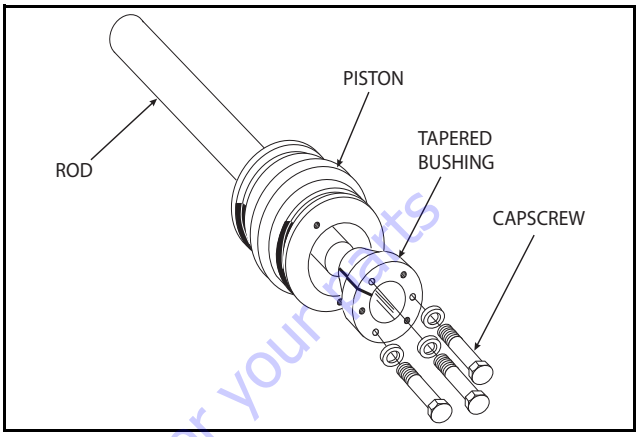


Figure 5-55. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs (12 Nm).

12. 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.

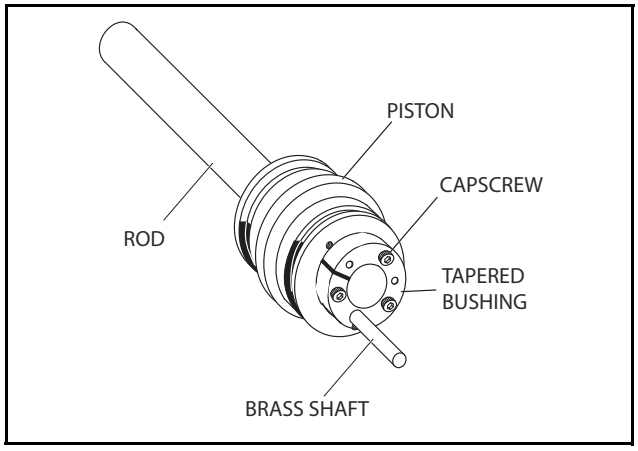


Figure 5-56. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs (81 Nm).

14. Remove the cylinder rod from the holding fixture.

NOTICE

WHEN INSTALLING HYDROLOCK PISTON SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. REFER TO HYDROLOCKK PISTON SEAL INSTALLATION FOR CORRECT SEAL ORIENTATION. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

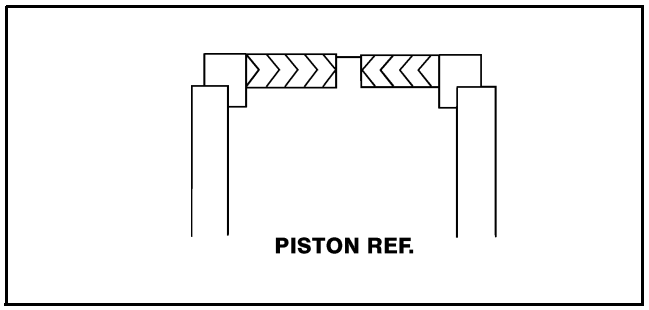


Figure 5-57. Hydrolock Piston Seal Installation

15. Place new hydrolock seal and guidelock 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).

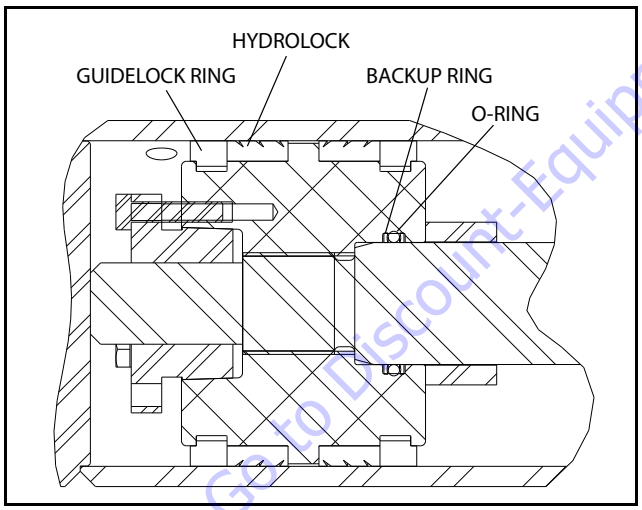


Figure 5-58. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

17. 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.

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

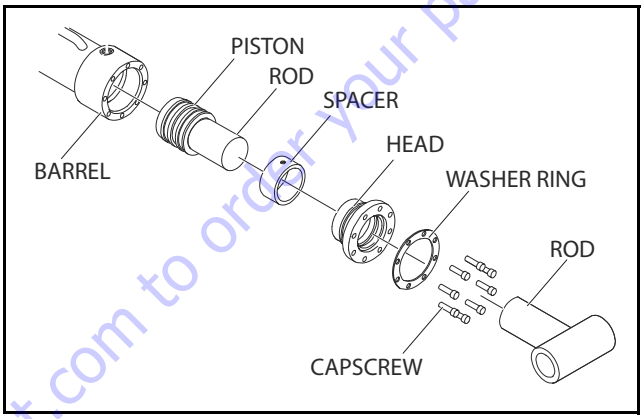


Figure 5-59. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 35 ft.lbs. (50 Nm).

20. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

21. If applicable, install the cartridge-type holding valve and fittings in the rod port block, using new o-rings as applicable. Torque valves to 50-55 ft.lbs. (68-75 Nm).

Steer Cylinder (Prior to SN 0300142665)

DISASSEMBLY

NOTICE

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

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

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

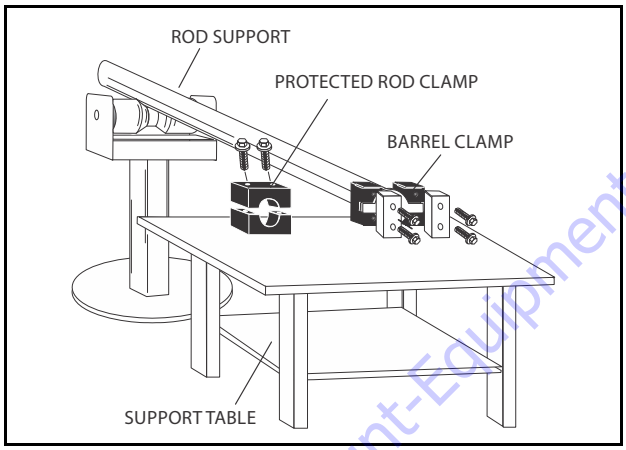


Figure 5-60. Cylinder Barrel Support

4. Using a hook spanner, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.

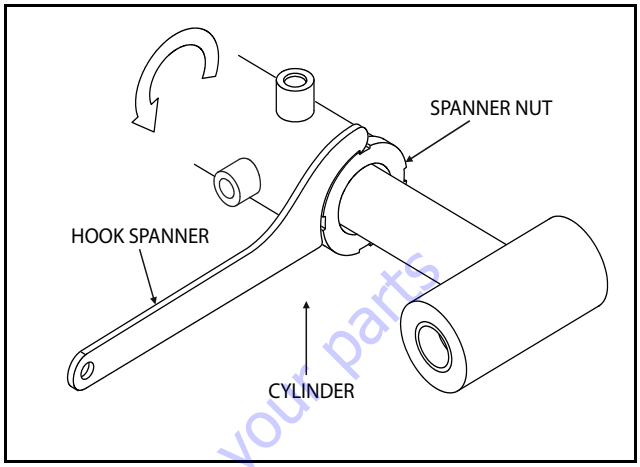


Figure 5-61. Spanner Nut Support

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

NOTICE

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

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

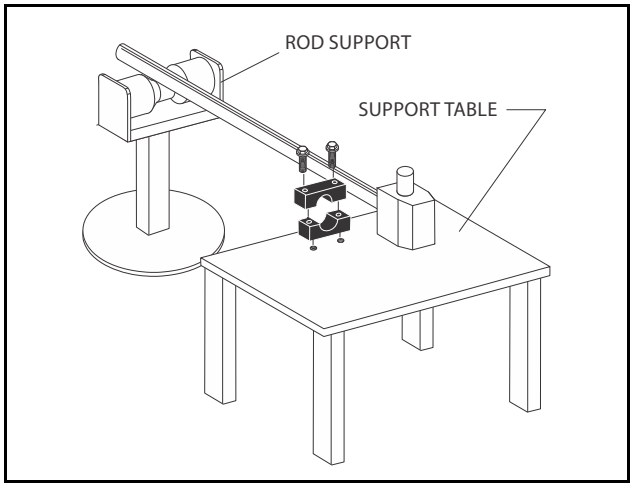
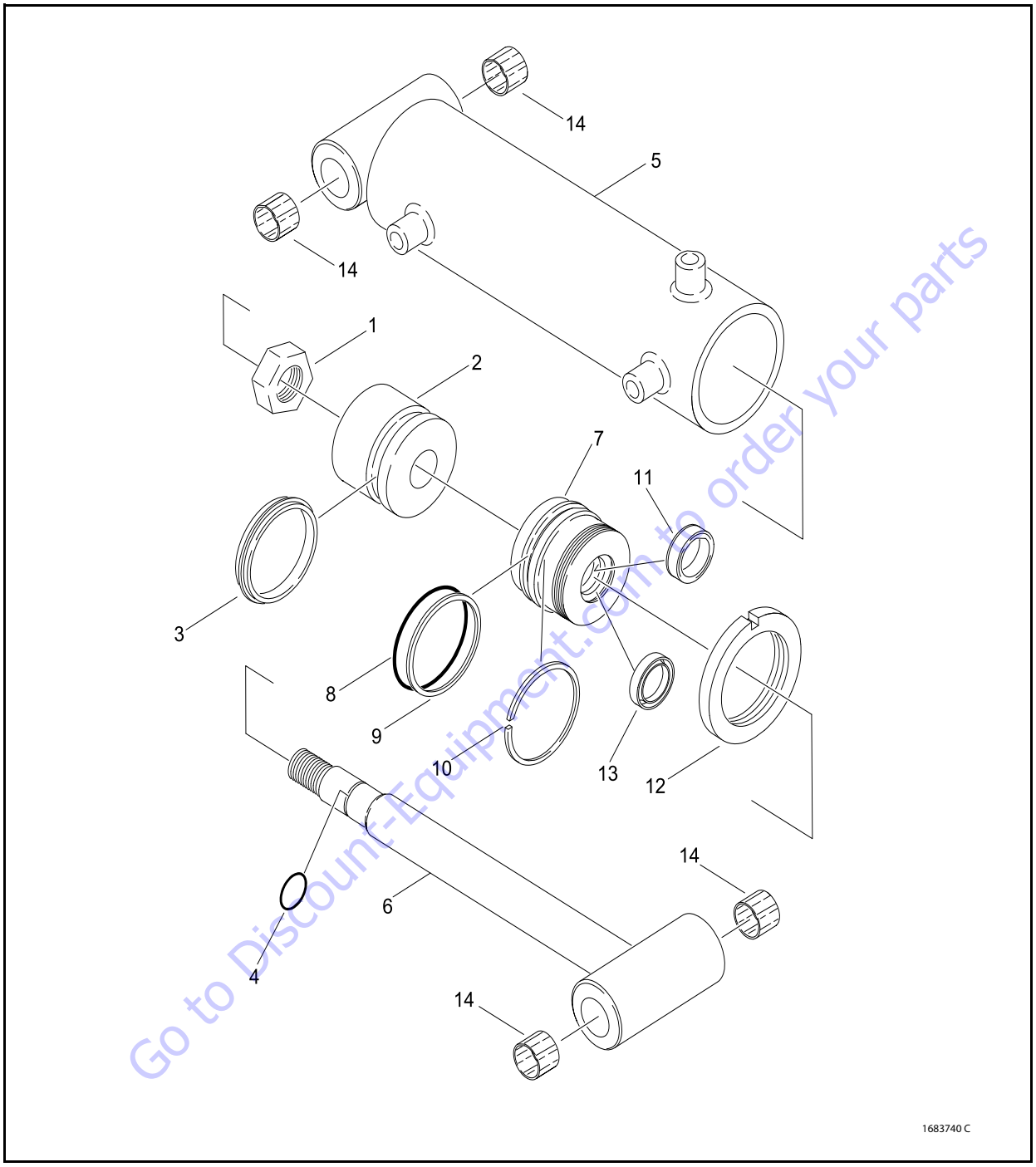


Figure 5-62. Cylinder Rod Support



1. Locknut
2. Piston
3. Seal
4. O-ring
5. Barrel
6. Rod
7. Head
8. O-ring
9. Backup Ring
10. Retainer Ring
11. Rod Seal
12. Spanner Nut
13. Wiper Seal
14. Bushing

Figure 5-63. Steer Cylinder (Prior to SN 0300142665)

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Loosen and remove nut which attaches the piston to the rod.
9. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seal rings, and backup rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, retainer ring 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

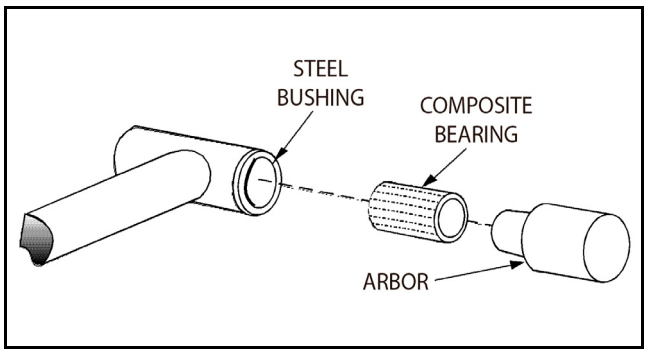


Figure 5-64. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.

13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.

14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

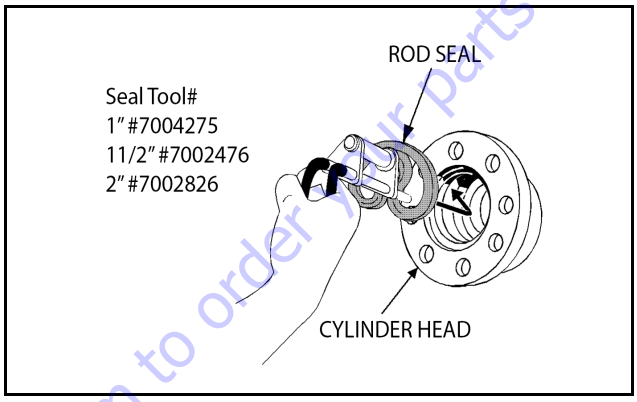


Figure 5-65. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

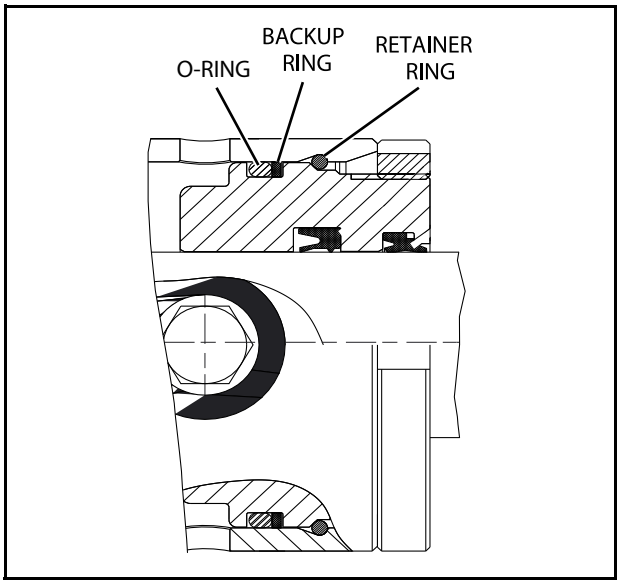
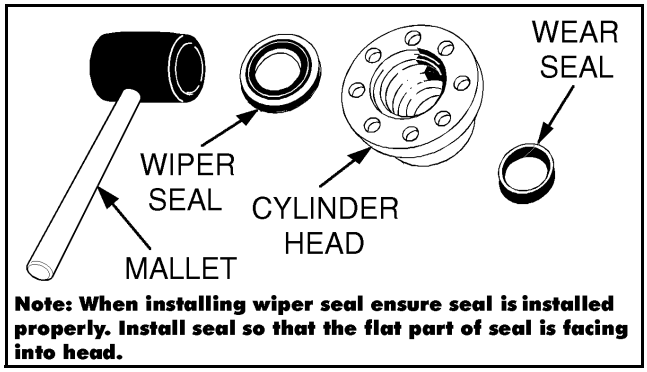


Figure 5-66. Cylinder Head Seal Installation

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.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-67. Wiper Seal Installation

3. Place a new o-ring, backup seal and retainer ring in the applicable outside diameter groove of the cylinder head.

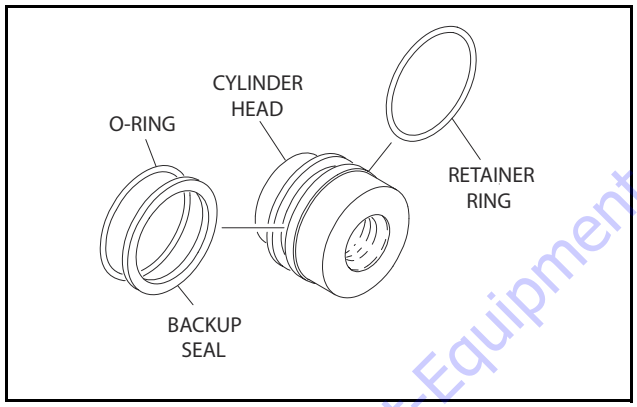


Figure 5-68. Installation of Head Seal Kit

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

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

7. Remove the cylinder rod from the holding fixture.

8. Place a new o-ring in the inner piston diameter groove. (See Figure 5-69.)

9. Place new seals 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). (See Figure 5-69.).

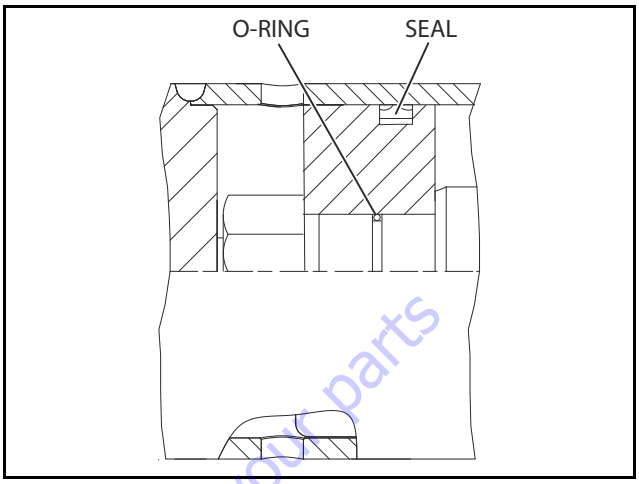


Figure 5-69. Piston Seal Kit Installation

10. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

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. Secure Piston to the rod using nut.

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

14. Secure the cylinder head gland using the spanner nut.

15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the reinstallation of any holding valve or valves.

NOTE: **Steer cylinder spanner nut is tightened as per Spec. "CYR" Cylinder spanner nut tightening procedure. Pressurize cylinder on retract to 80/100 psi to push rod guide firmly against the round retaining ring. (Apply 1 drop of JLG Threadlocker P/N 0100011, 2 places, at 180° apart. Hand tighten nut, then tighten 1/4 turn with spanner wrench).*

Steer Cylinder (SN 0300014266 through 0300182743, SN B300000100 through B300001091)

DISASSEMBLY

NOTICE

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

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

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

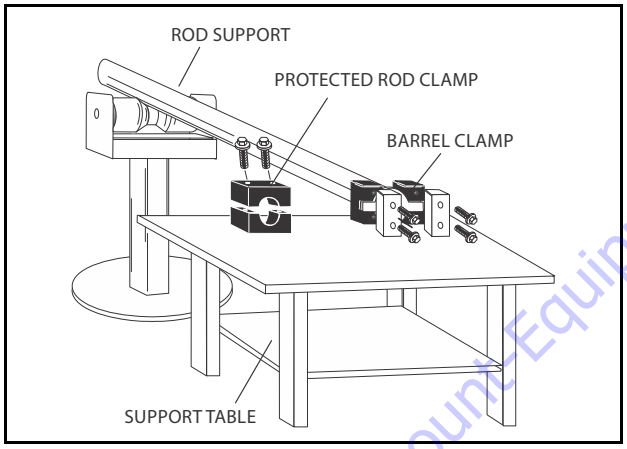


Figure 5-70. Cylinder Barrel Support

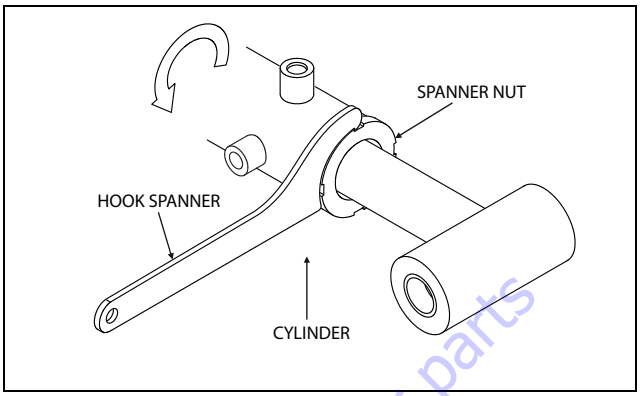


Figure 5-71. Spanner Nut Removal

4. Using a hook Spanner, loosen the spanner nut retainer, and remove spanner nut from cylinder barrel.
5. Attach a suitable pulling device to the cylinder rod port block end or cylinder rod end, as applicable.

NOTICE

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

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

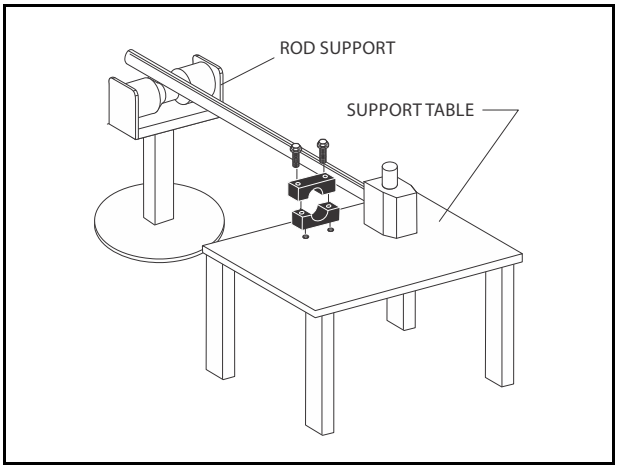
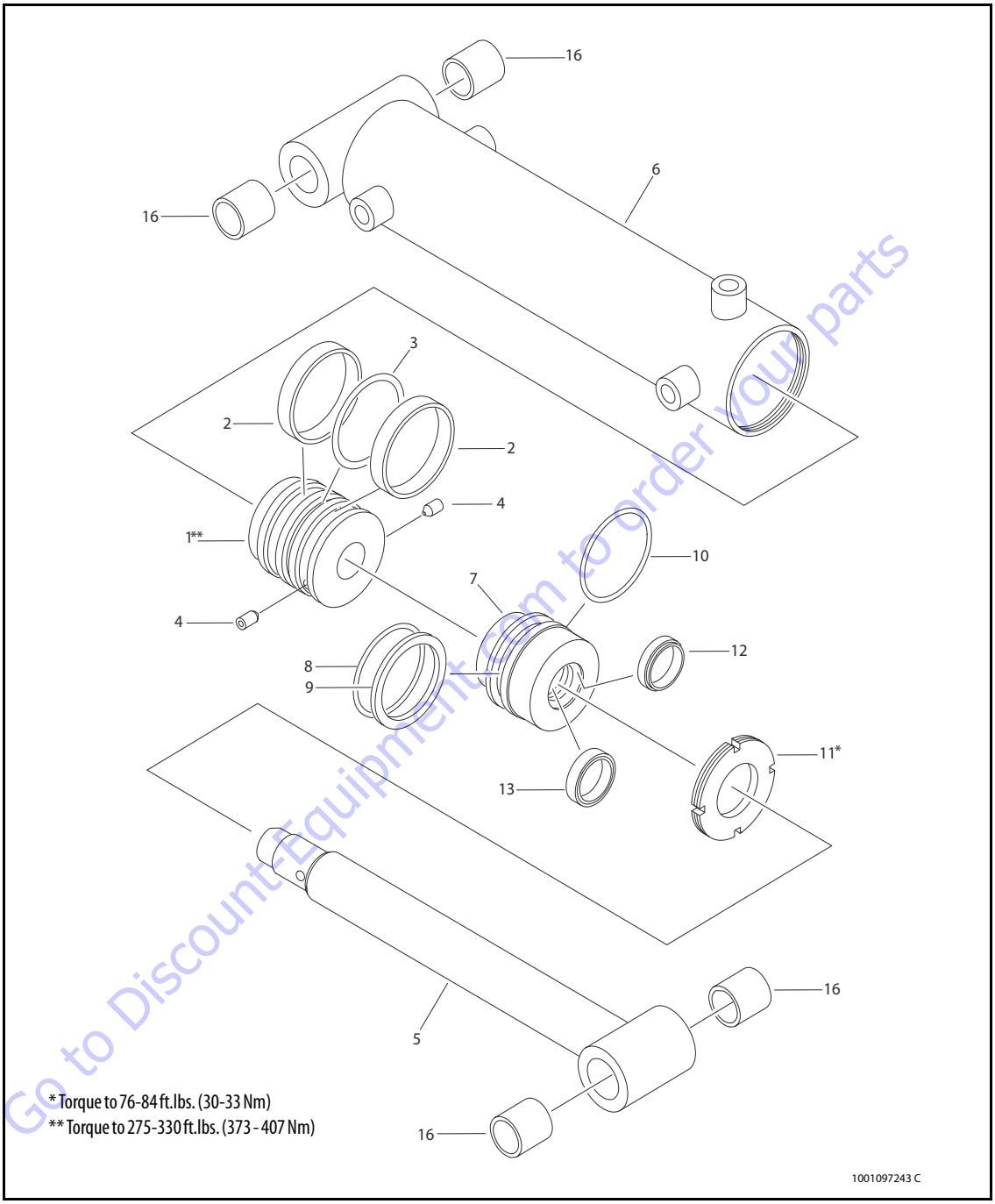


Figure 5-72. Cylinder Rod Support



1. Piston
2. Seal
3. Seal
4. Setscrew
5. Rod
6. Barrel
7. Head
8. O-ring
9. Backup Ring
10. Retainer Ring
11. Spanner Nut
12. Seal
13. Wiper
14. Bushing

Figure 5-73. Steer Cylinder (SN 0300014266 through 0300182743, SN B300000100 through B300001091)

7. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
8. Loosen and remove setscrew which attaches the piston to the rod.
9. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
10. Remove and discard the piston o-rings, seal rings.
11. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, retainer ring 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 composite bearing dry. Lubrication is not required with nickel plated pins and bearings.*

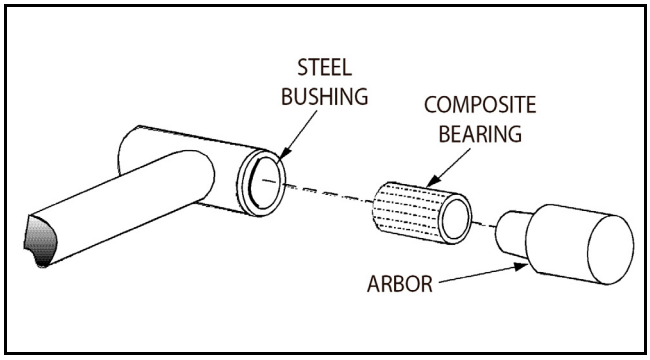


Figure 5-74. Composite Bearing Installation

12. If applicable, inspect port block fittings and holding valve. Replace as necessary.
13. Inspect the oil ports for blockage or the presence of dirt or other foreign material. Repair as necessary.
14. If applicable, inspect piston rings for cracks or other damage. Replace as necessary.

ASSEMBLY

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

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

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

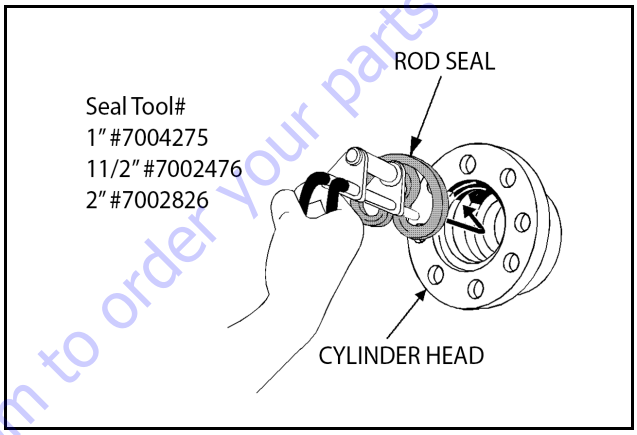


Figure 5-75. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

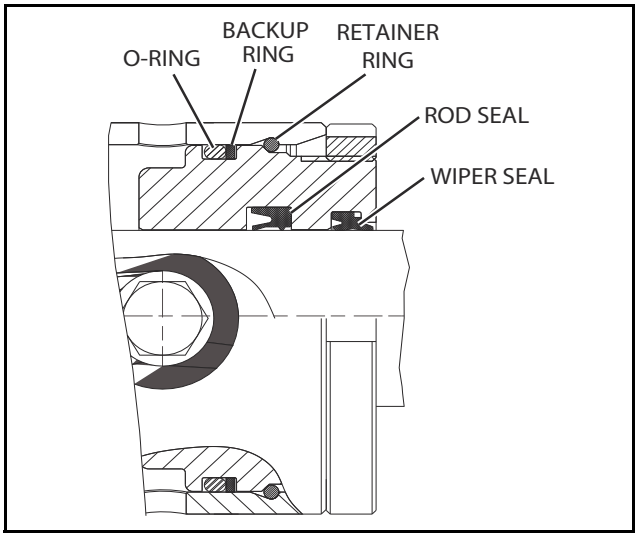
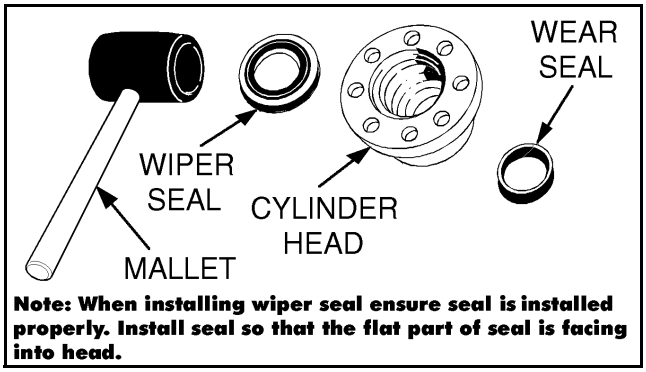


Figure 5-76. Cylinder Head Seal Installation

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.



Note: When installing wiper seal ensure seal is installed properly. Install seal so that the flat part of seal is facing into head.

Figure 5-77. Wiper Seal Installation

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

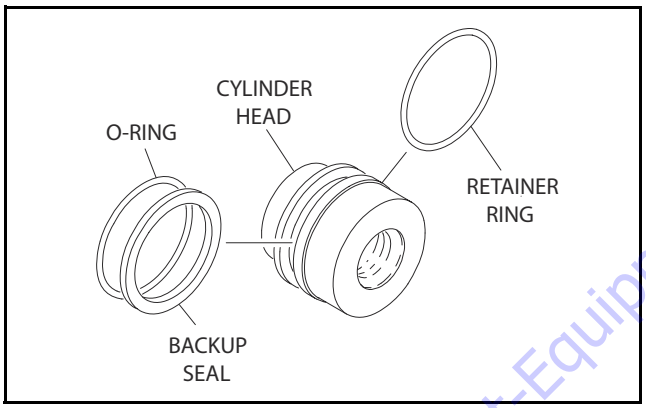


Figure 5-78. Installation of Head Seal Kit

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

6. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

7. Remove the cylinder rod from the holding fixture.

8. Place a new o-ring in the inner piston diameter groove. (See Figure 5-79.)

9. Place new seals 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). (See Figure 5-79.).

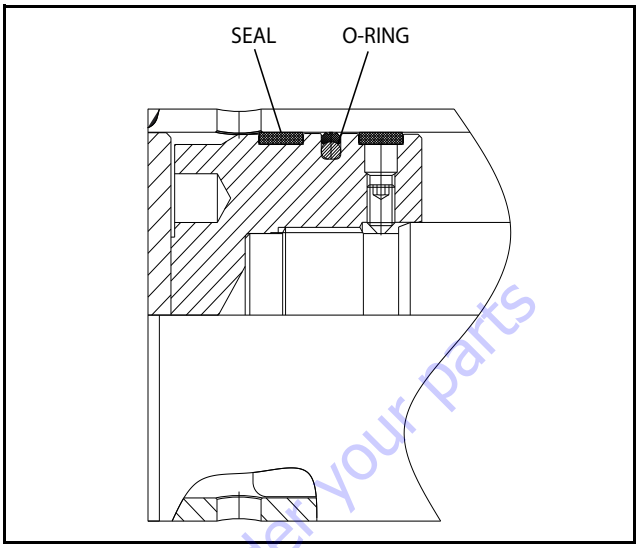


Figure 5-79. Piston Seal Kit Installation (Prior to SN 0300142664)

10. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

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. Secure Piston to the rod using nut.

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

14. Secure the cylinder head gland using the spanner nut. Torque bolts to 275-300 ft.lbs (373- 407 Nm).

15. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

NOTE: **Steer cylinder spanner nut is tightened as per Spec. "CYR" Cylinder spanner nut tightening procedure. Pressurize cylinder on retract to 80/100 psi to push rod guide firmly against the round retaining ring. (Apply 1 drop of JLG Threadlocker P/N 0100011, 2 places, at 180° apart. Hand tighten nut, then tighten 1/4 turn with spanner wrench).*

Telescope Cylinder

DISASSEMBLY

NOTICE

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

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

⚠ WARNING

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

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

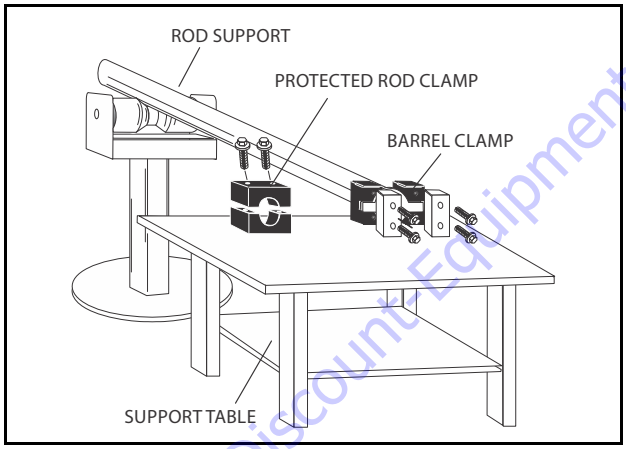


Figure 5-80. Cylinder Barrel Support

5. Mark cylinder head and barrel with a center punch for easy realignment. Using an allen wrench, loosen the cylinder head retainer capscrews, and remove capscrews from cylinder barrel.

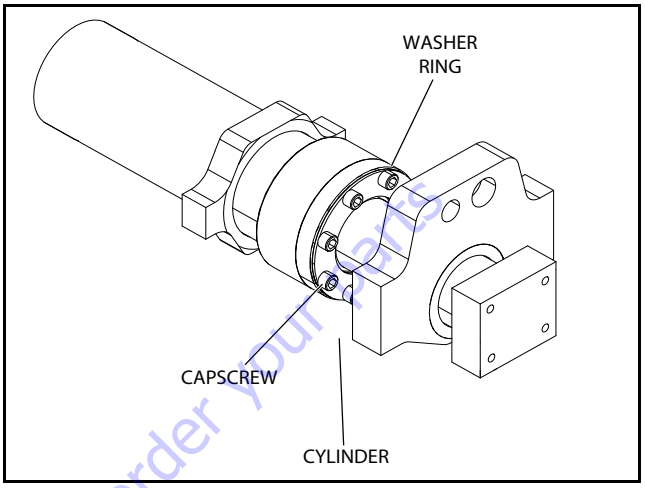


Figure 5-81. Capscrew Removal

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

NOTICE

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

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

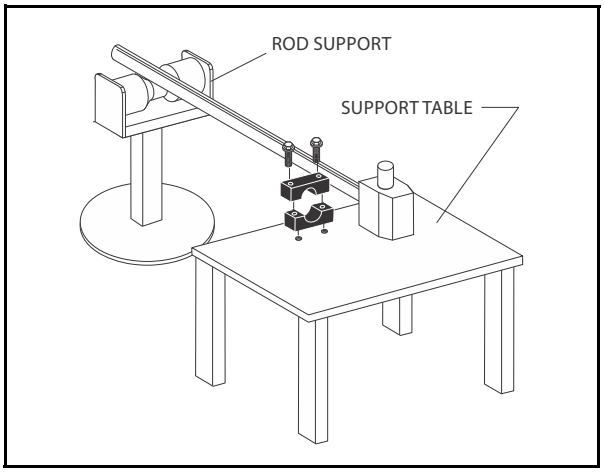
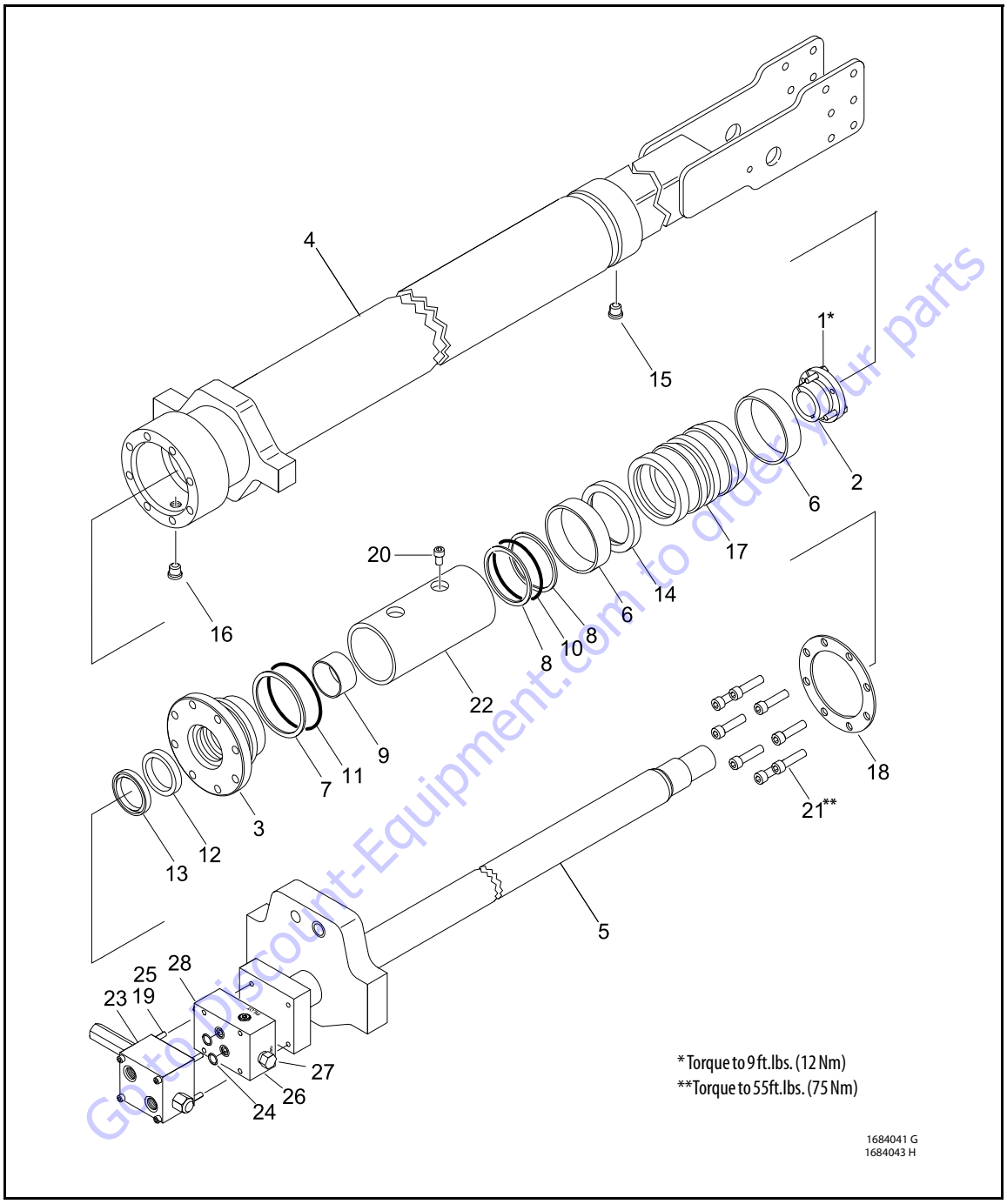


Figure 5-82. Cylinder Rod Support



1. Bolt
2. Tapered Bushing
3. Head
4. Barrel
5. Rod
6. Wear Ring
7. Backup Ring
8. Backup Ring
9. Wear Ring
10. O-ring
11. O-ring
12. Rod Seal
13. Wiper
14. T-Seal
15. O-ring Plug
16. O-ring Plug
17. Piston
18. Washer Ring
19. Capscrew
20. Capscrew
21. Capscrew
22. Spacer
23. Valve assembly
24. O-ring
25. Capscrew
26. Assembly Valve
27. Cartridge Seal Kit
28. Cartridge Seal Kit

Figure 5-83. Telescopic Cylinder

8. Using suitable protection, clamp the cylinder rod in a vise or similar holding fixture as close to the piston as possible.
9. Insert the capscrews in the threaded holes in the outer piece of the tapered bushing. Progressively tighten the capscrews until the bushing is loosen on the piston.
10. Remove the bushing from the piston.

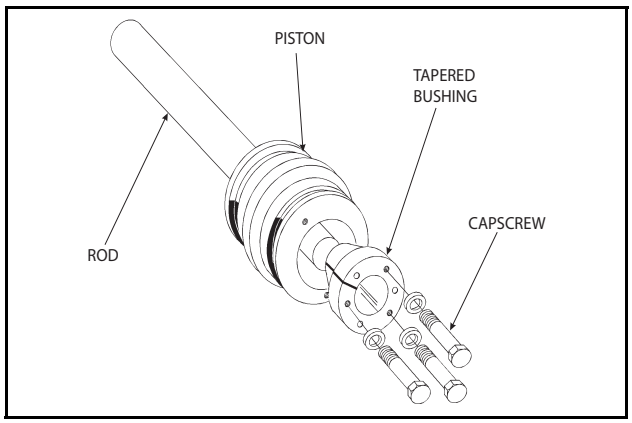


Figure 5-84. Tapered Bushing Removal

11. Screw the piston counterclockwise, by hand, and remove the piston from cylinder rod.
12. Remove and discard the piston o-rings, seal rings, wear rings and backup rings.
13. Remove setscrew from the piston spacer. Remove spacer from the rod.
14. Remove the rod from the holding fixture. Remove the cylinder head gland. Discard the o-rings, backup rings, rod seals, wear rings 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 piston surface for damage and scoring and for distortion. Dress piston surface or replace piston as necessary.
6. Inspect threaded portion of piston for damage. Dress threads as necessary.
7. Inspect seal and o-ring grooves in piston for burrs and sharp edges. Dress applicable surfaces as necessary.
8. Inspect cylinder head inside diameter for scoring or other damage and for ovality and tapering. Replace as necessary.
9. Inspect seal and o-ring grooves in head for burrs and sharp edges. Dress applicable surfaces as necessary.
10. Inspect cylinder head outside diameter for scoring or other damage and ovality and tapering. Replace as necessary.
11. 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 prior to bearing installation.
    d. Using an arbor of the correct size, carefully press the bearing into steel bushing.

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

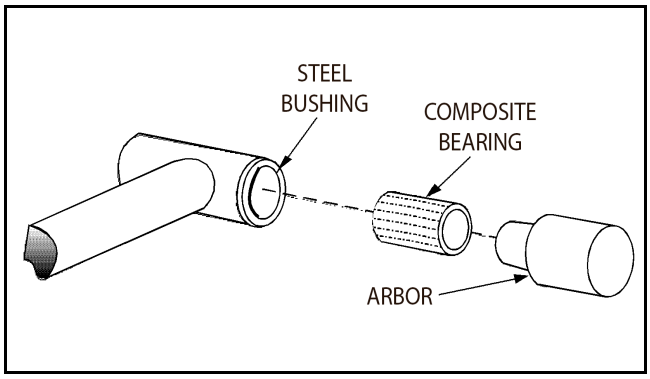


Figure 5-85. Composite Bearing Installation

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

ASSEMBLY

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

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

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

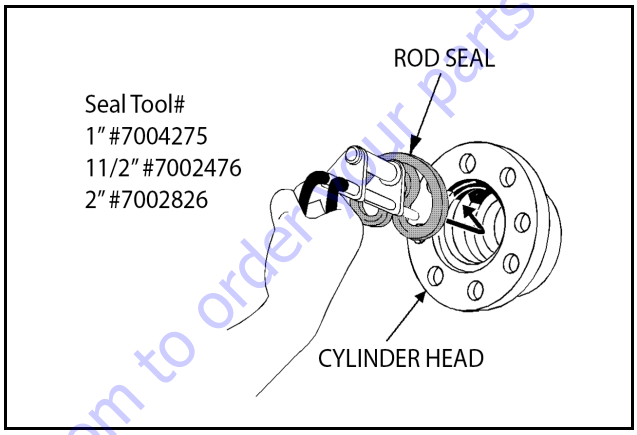


Figure 5-86. Rod Seal Installation

NOTICE

WHEN INSTALLING NEW SEALS, ENSURE SEALS ARE INSTALLED PROPERLY. IMPROPER SEAL INSTALLATION COULD RESULT IN CYLINDER LEAKAGE AND IMPROPER CYLINDER OPERATION.

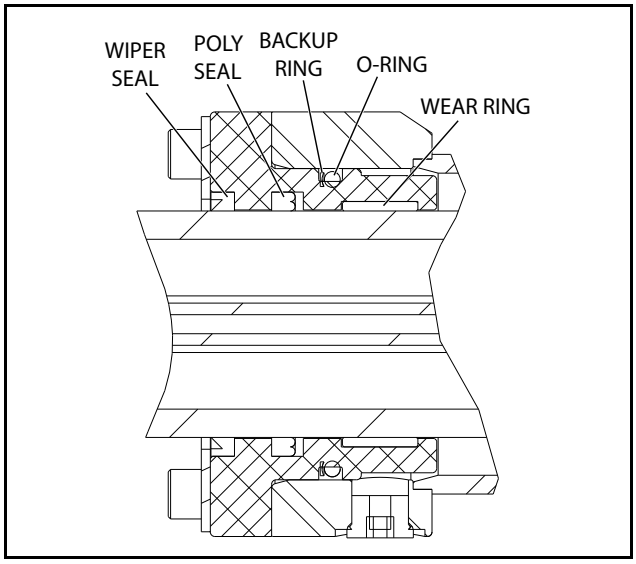


Figure 5-87. Cylinder Head Seal Installation

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.

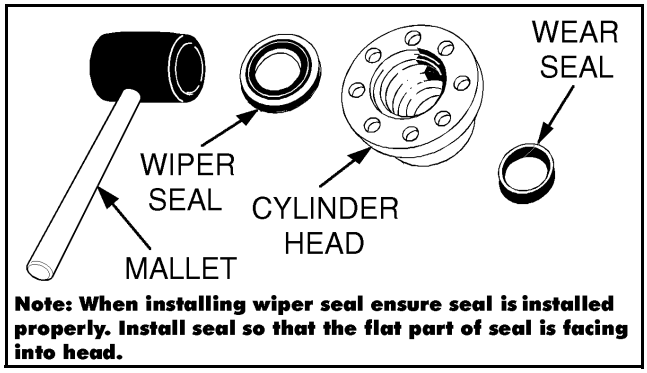


Figure 5-88. Wiper Seal Installation

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

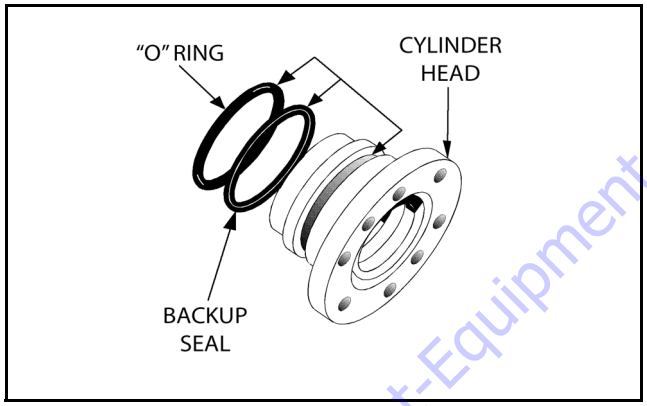


Figure 5-89. Installation of Head Seal Kit

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. Install capscrew on the spacer.

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

7. Place a new o-ring and backup rings in the inner piston diameter groove.

8. Carefully thread the piston on the cylinder rod hand tight, ensuring that the o-ring and backup rings are not damaged or dislodged.

9. 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.*

10. Assemble the tapered bushing loosely into the piston and insert capscrews through the drilled holes in the bushing and into the tapped holes in the piston.

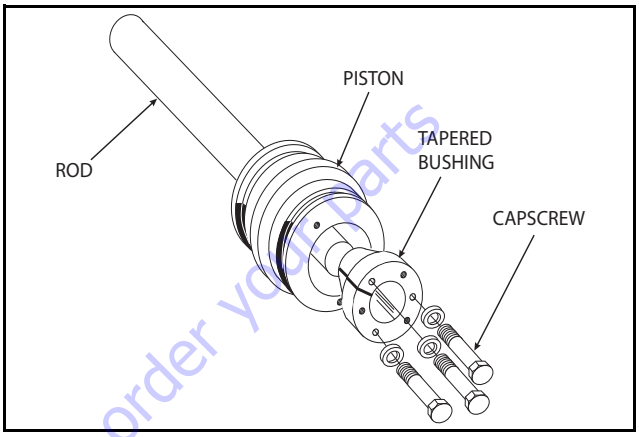


Figure 5-90. Tapered Bushing Installation

11. Tighten the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

12. 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.

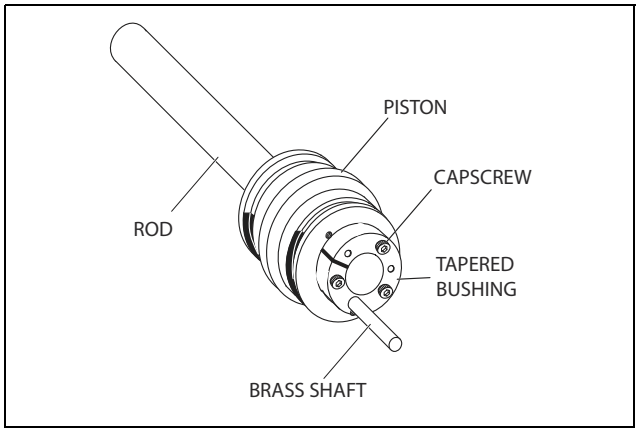


Figure 5-91. Seating the Tapered Bearing

13. Rotate the capscrews evenly and progressively in rotation to 9 ft.lbs. (12 Nm).

14. Remove the cylinder rod from the holding fixture.

15. Place new T-seal and wear 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).

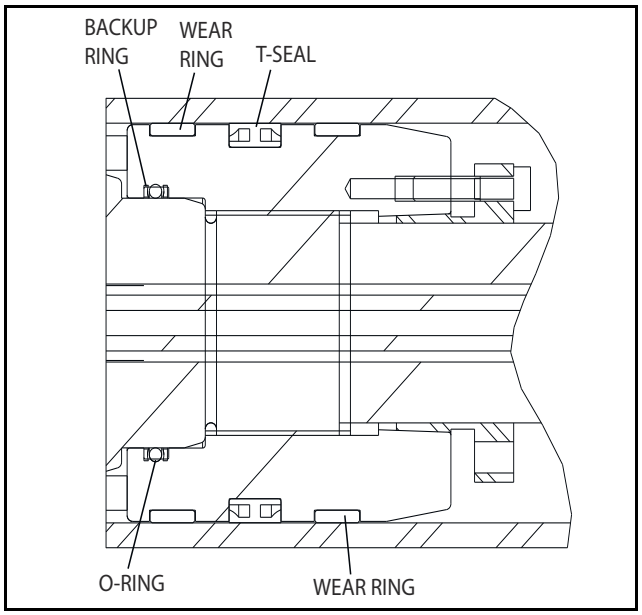


Figure 5-92. Piston Seal Kit Installation

16. Position the cylinder barrel in a suitable holding fixture.

NOTICE

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

17. 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.

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

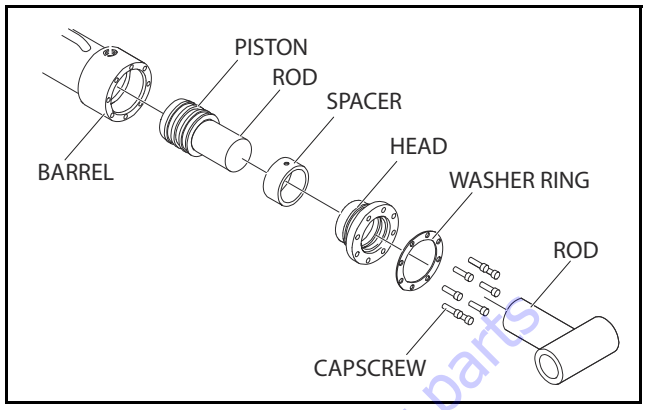
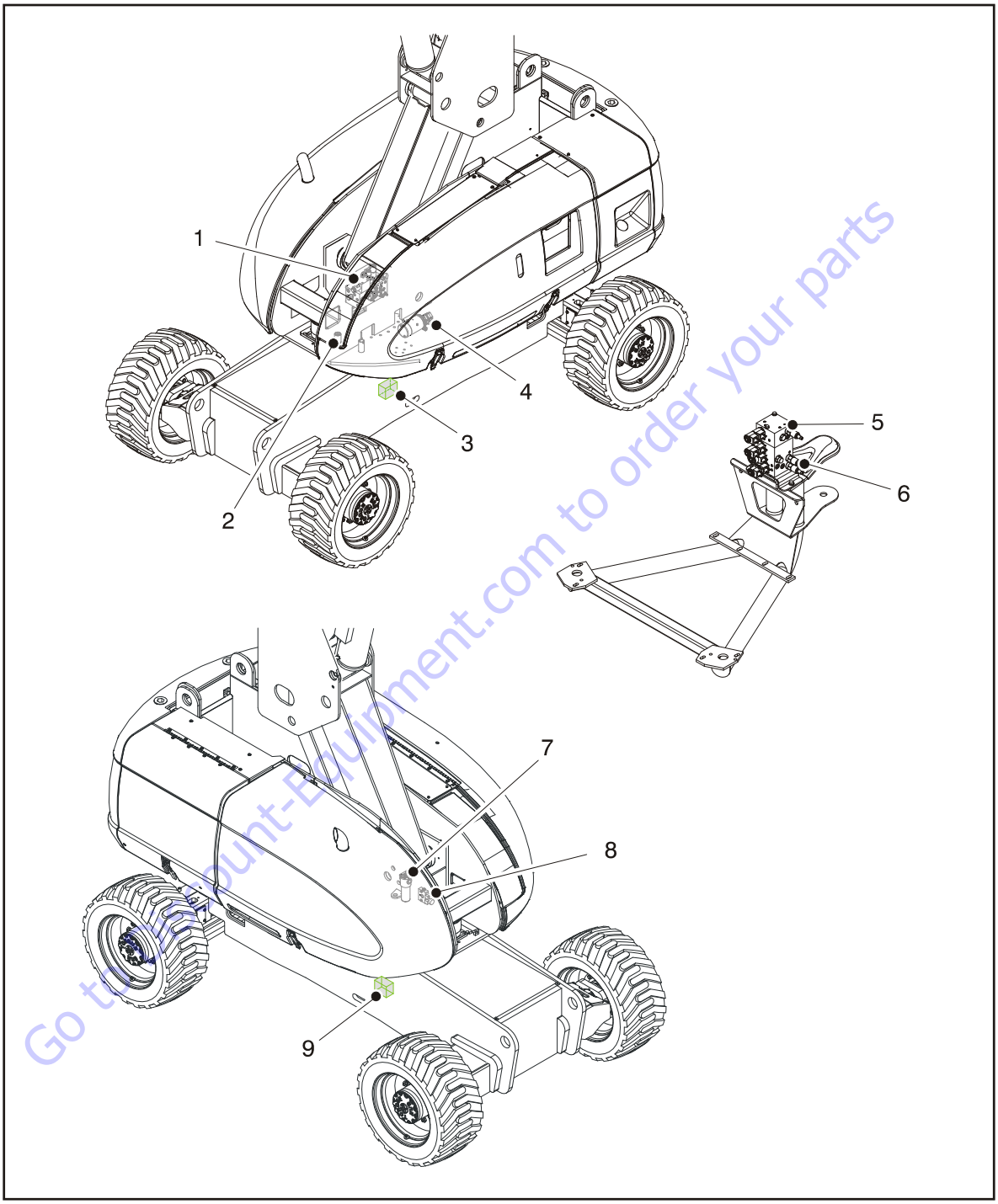


Figure 5-93. Rod Assembly Installation

19. Apply JLG Threadlocker P/N 0100011 to the socket head bolts and secure the cylinder head gland using the washer ring and bolts. Torque bolts to 55 ft.lbs. (75 Nm).

20. After the cylinder has been reassembled, the rod should be pushed all the way in (fully retracted) prior to the re-installation of any holding valve or valves.

21. Install the valve assembly. Torque capscrews to 9 ft.lbs. (12 Nm).



1. Main Valve
2. Platform Valve Filter
3. Dual Flow Divider (4WD)
4. Auxiliary Pump
5. Jib Valve
6. Platform Valve
7. Hydraulic Filter
8. Dual Select Valve
9. Flow Divider (2WD)

Figure 5-94. Control Valve Installation

5.3 PRESSURE SETTING PROCEDURE

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.

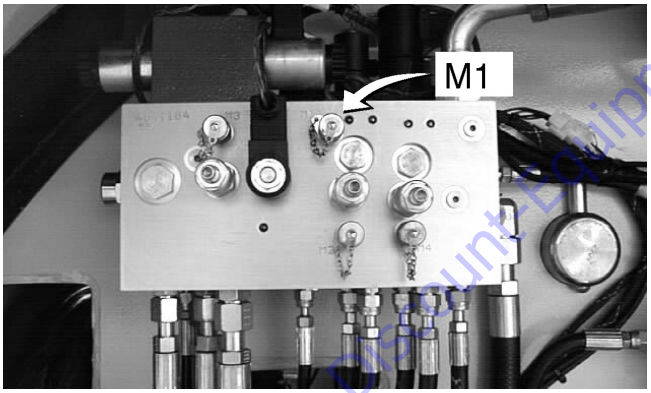
To ensure all pressures are set correctly, the following procedures must be followed in order.

1. All applicable steps in Section 5.4, Start Up Procedures must be followed.
2. Set up of the function pump.
3. Adjustments made at the main valve block.
4. Adjustments made at the platform valve.

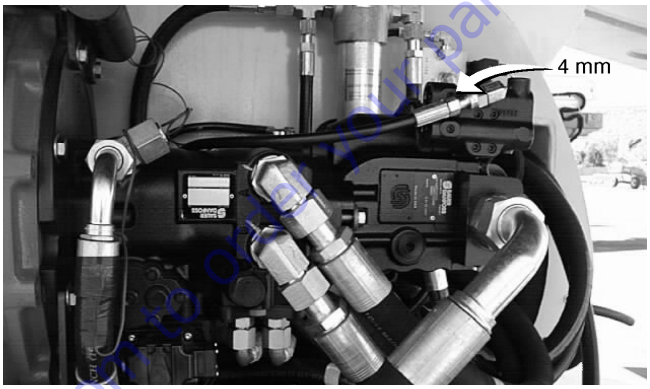
Set Up of the Function Pump

STAND BY PRESSURE OR LOAD SENSE PRESSURE

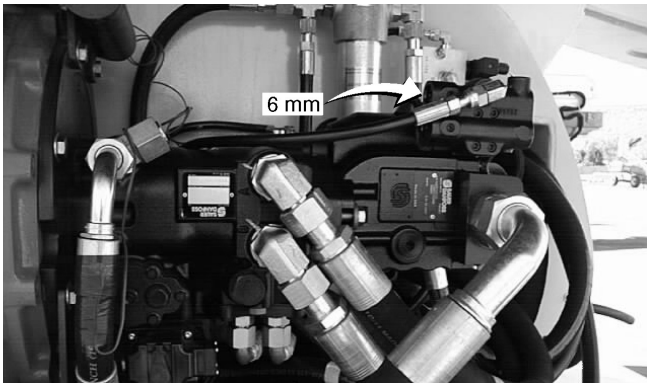
1. Install a low pressure gauge at port "M1" of the main valve block. A low pressure gauge capable of reading 500 psi.



2. Start the engine from the ground control. The gauge should read between 400-440 psi (27.5 to 30 Bar). To make an adjustment to this pressure, go to the engine compartment, locate the function pump.
3. There are (2) adjustments at the top of the pump. They are located on the pump compensator which has (4) bolts mounting it to the pump. The stand by adjustment is at the top. To adjust this, a 4 mm and 6 mm allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine.
   a. First, using the 4 mm wrench, loosen the set screw on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

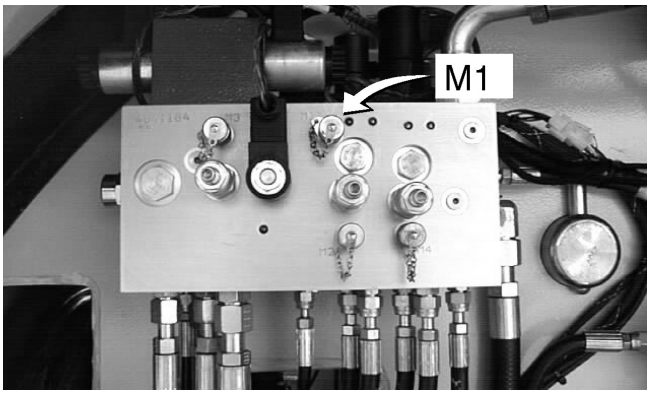


   b. Next, using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. The pressure should read between 400-440 psi (27.5 to 30 Bar).



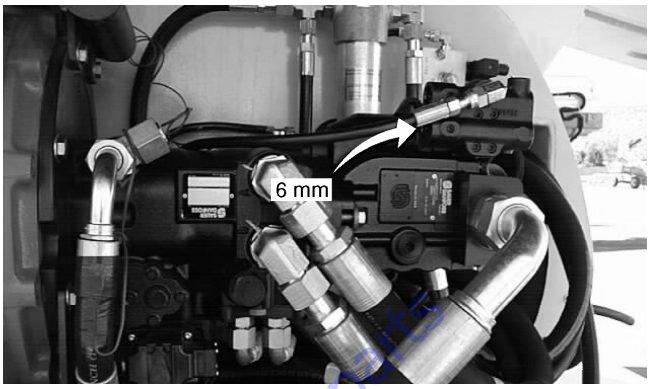
HIGH PRESSURE RELIEF

1. Install a high pressure gauge at the "M1" port of the main valve block.



2. Activate telescope in. The gauge should read 2800 psi.
3. To make an adjustment to this pressure, go back to the engine compartment to the function pump. The high pressure relief adjustment is the lower one of the (2) on the compensator. To adjust this, a 4 mm and 6 mm allen wrench will be needed. The adjustment screw is facing the front of the pump, or toward the engine.
   a. First, using the 4 mm wrench, loosen the set screw on the side of the compensator (facing you) which is in line with the adjustment screw. This is a jam nut screw which holds the main adjustment from turning. Loosen it 1 turn.

   b. Next, using the 6 mm wrench adjust the main adjustment clockwise to increase or counter-clockwise to decrease. This adjustment will be re-set at the end of this procedure to 2500 psi (172 Bar). This is the **maximum** relief pressure for all functions governed by this pump.



Adjustments Made at the Main Valve Block

TELESCOPE OUT

1. Install a high pressure gauge at the "M3" port of the main valve block.
2. Activate Telescope out. The gauge should read 2500 psi (172 Bar).
3. The relief valve is located directly below the M3 port. Turn clockwise to increase, counterclockwise to decrease.

SWING LEFT AND RIGHT

1. Lock the Turn-table lock pin.
2. Install the hi-pressure gauge at M2.
3. Activate swing, the gauge should read 1700 psi (117 Bar).
4. The adjustment cartridge is located right above the M2 port. Turn clockwise to increase, counterclockwise to decrease.

STEER

1. Install a hi-pressure gauge at port M4. Activate steer left or right. The gauge should read 2500 psi (172 Bar).
2. The relief valve is located right above port M4. Turn clockwise to increase, counterclockwise to decrease.

Adjustments Made at the Platform Valve Assembly

NOTE: *When replacing the level up or level down cartridge, the function should be cycled, and then the crack pressure value calibrated.*

PLATFORM LEVEL UP

1. Install a high pressure gauge at port "M1". Activate level up to the end of stroke, you should read 2600 psi (179 Bar).
2. The level up relief valve is located to the right and above port M1. Turn clockwise to increase, counterclockwise to decrease.

PLATFORM LEVEL DOWN

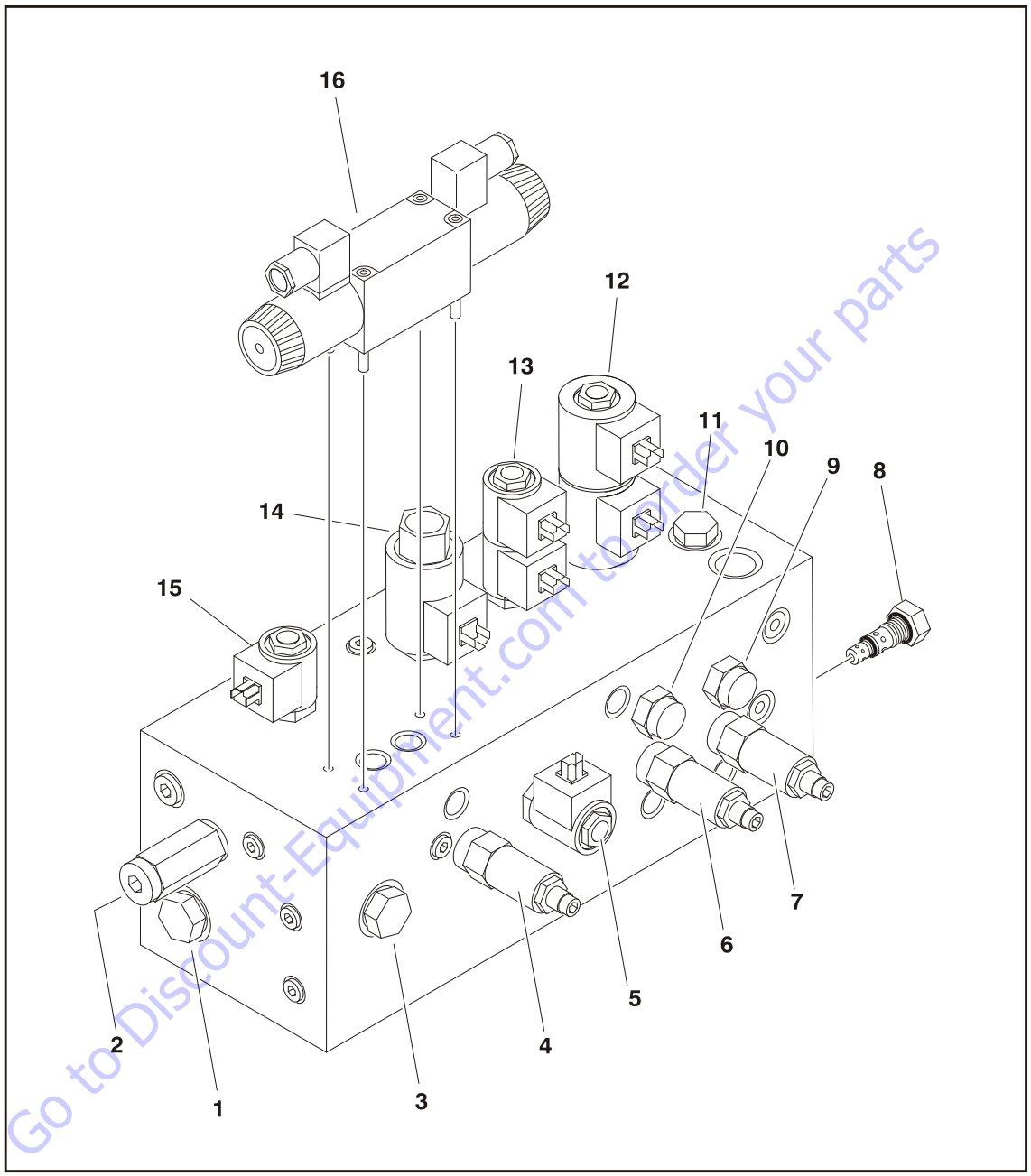
1. Install a high pressure gauge at gauge port "M2", Activate level down to the end of stroke, you should read 1800 psi (124 Bar).
2. The level down relief valve is located to the right and below port M2. Turn clockwise to increase, counterclockwise to decrease.

PLATFORM JIB UP AND DOWN

1. Install a high pressure gauge at port M3. Activate jib up or down, you should read 1700 psi (117.2 Bar).
2. The up relief valve is located above port M3. Turn clockwise to increase, counterclockwise to decrease.

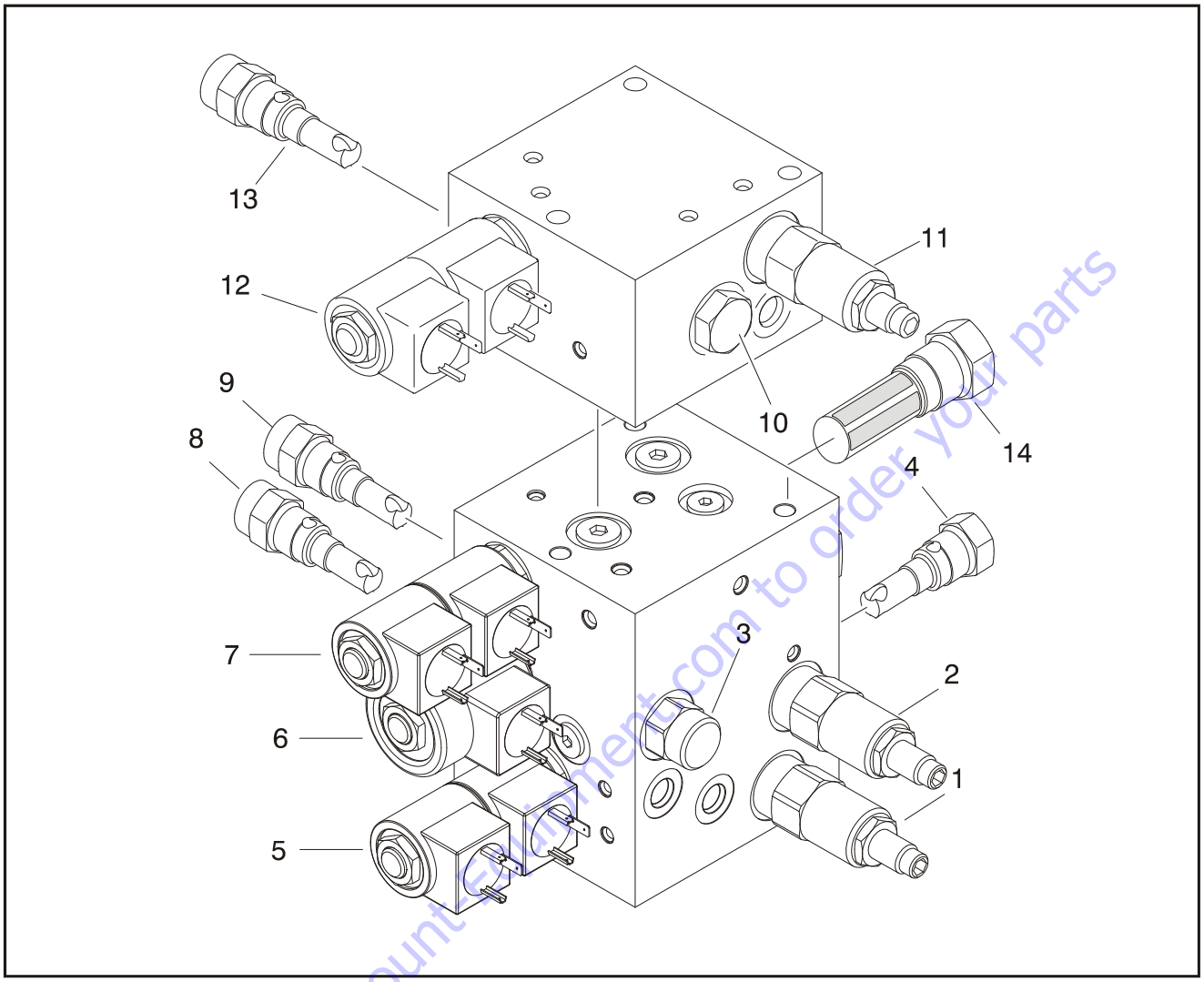
PUMP HI-PRESSURE RELIEF VALVE

Go back to the function pump and reset the hi-pressure from 2800 psi (193 Bar) back to 2500 psi (172 Bar).



1. Check Valve
2. Pilot Valve - Lift
3. Check Valve (100 psi - 6.9 Bar)
4. Tele Out Relief
5. Lift Up Dump
6. Swing Relief
7. Steer Relief
8. Steer Flow Regulator (6 gpm - 22.7 lpm
9. Load Sense - Steer
10. Load Sense - Swing
11. Check Valve (60 psi - 4.1 Bar
12. Steer Control
13. Swing Control
14. Proportional Valve - Tele
15. Main Dump
16. Telescope Control

Figure 5-95. Main Valve Identification



1. Level Down Relief
2. Level Up Relief
3. Flow Regulator (0.5 gpm - 1.9 lpm)
4. Check Valve (25 psi - 1.7 Bar)
5. Platform Level
6. Pressure
7. Rotator
8. Flow Regulator (2 gpm - 7.6 lpm)
9. Flow Regulator (0.2 gpm - 0.75 lpm)
10. Load Sense
11. Jib Relief
12. Jib Control
13. Flow Regulator (2 gpm - 7.6 lpm)
14. Filter

Figure 5-96. Platform Valve Identification

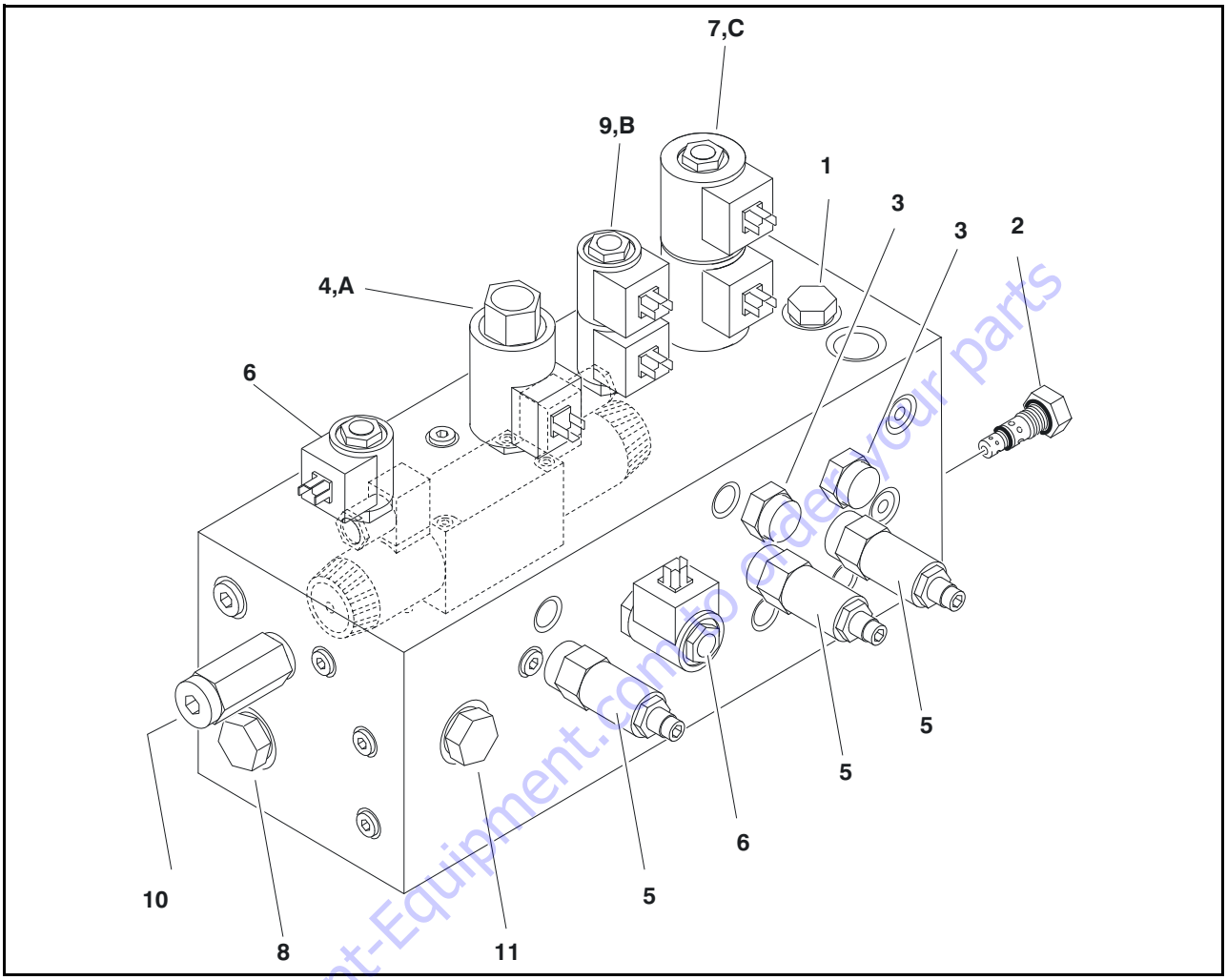


Table 5-1. Cartridge Torque Values

	Ft-Lbs.	Nm
1	18-20	24-27
2	33-37	45-50
3	19-21	26-28
4	50-55	68-75
5	19-21	26-28
6	50-55	68-75
7	24-26	33-35
8	70-80	95-108
9	19-21	26-28
10	50-55	68-75
11	24-26	33-35

Table 5-2. Coil Torque Values

	Ft-Lbs.	Nm
A	5-7	7-9
B	5-7	7-9
C	5-7	7-9

Figure 5-97. Main Valve Cartridge Torque Values

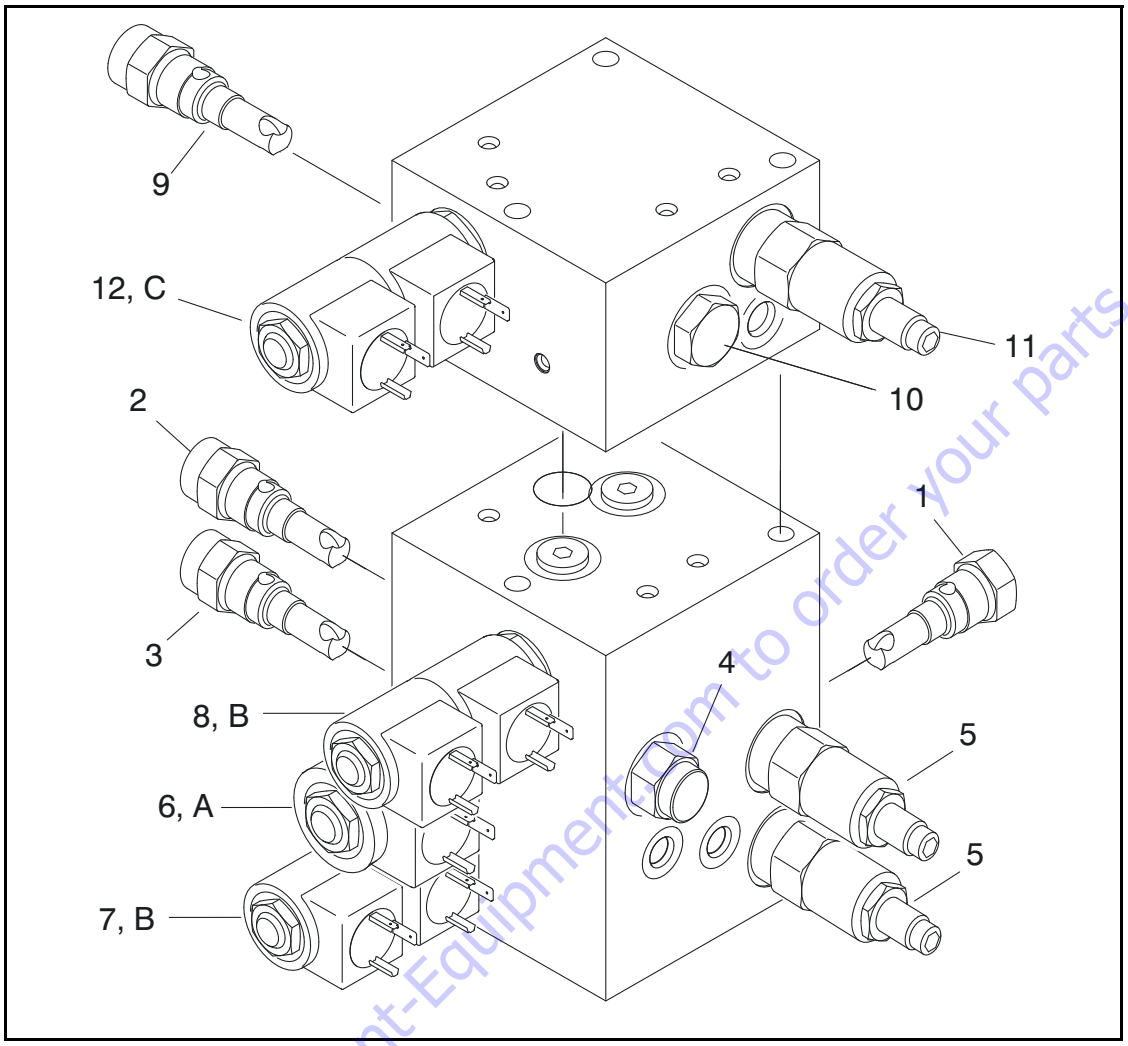


Table 5-3. Cartridge Torque Values

	Ft-Lbs.	Nm
1	20	27
2	20	27
3	20	27
4	20	27
5	20	27
6	25	34
7	20	27
8	20	27
9	20	27
10	20	27

Table 5-3. Cartridge Torque Values

	Ft-Lbs.	Nm
11	20	27
12	20	27

Table 5-4. Coil Torque Values

	Ft-Lbs.	Nm
A	10-12	14-16.8
B	5	7
C	5	7

Figure 5-98. Platform Valve Cartridge Torque Values

5.4 START UP PROCEDURES

Start Up After Overhaul or Replacement of Components

PRE-FILL OF BOTH THE DRIVE AND FUNCTION PUMP

Machine without oil cooler: When filling the oil tank, fill it to the very top of the tank. This will give you enough head pressure from the tank to gravity fill the case on both pumps. The excess oil will be used to fill the cylinders during start up. The top case port on the outside of the drive pump has a ¾" tee fitting. Remove the cap from the end of the tee. You should see oil in 1-2 minutes, tighten up the cap. The drive pump case is done. Next, go the function pump, using a 3/8" allen wrench remove the plug on the inside of the pump next to the turn-table side sheet. When oil flows out of the pump, 2-3 minutes, re-install the plug. Both pumps are pre-filled. Not doing this causes the pumps to start dry, and reduces the efficiency of the pump and can cause premature failure.

Machine with oil cooler: When filling the oil tank, fill it to the very top of the tank. This will help give you enough head pressure from the tank to gravity fill the case on both pumps. The top case port on the outside of the pump has a ¾" tee fitting. Remove the cap from the center of the tee. You should see oil in 1-2 minutes. If not, depending on hose routing, the drive pump may not gravity feed. Oil has to flow through the oil cooler to get to the pump. Hose up an external hand pump to this tee fitting, and give it about (6) pumps after it has started pumping oil. This should be sufficient. Install the cap back onto the tee fitting. The drive pump is done. Next, go the function pump, using a 3/8" allen wrench remove the plug on the inside of the pump next to the turn-table side sheet. When oil flows out of the pump, 2-3 minutes, re-install the plug. Both pumps are pre-filled. Not doing this causes the pumps to start dry, and reduces the efficiency of the pump and can cause premature failure.

PURGING OF THE FUNCTION PUMP SUCTION HOSE.

Large pockets of air get trapped in this line and must be removed at low pressure. Head pressure from the tank is not enough. Here are (3) methods of purging the air from the hose at low pressure.

1. At the main control valve, remove the ¾" hose from port "P1", remove the 1" hose from port "T". Using a 12-16 connector, connect them together. Start the machine and let it run for approx. 10 seconds. Shut off the machine, remove the 12-16 adapter and re-hose.
2. Remove the ¾" hose from port "P1" and hold it into a 5 gallon bucket and start the machine. The air should purge very quickly, (seconds). Shut off the machine and re-hose.
3. Remove the ¾" hose from port "P1", using a #12 male union add approx. 30" of ¾" hose to it. Remove the return filter cap at the top of the tank, lift out the element making sure the canister stays in the tank. Hold the hose end down in the canister and start the machine and let it run approx. 10 seconds. Re-install the filter and re-hose the machine.

NOTE: ***If using a shop vac to create suction on the oil tank while doing maintenance, both steps "1" and "2" will need done.*

NOTE: ***If installing a new drive pump, step "1" will need done.*

NOTE: ***If installing a new function pump, step "1" and "2" will need done.*

NOTE: ***If installing a new function pump and the suction hose is capped without draining a lot of oil out of the hose, which creates a large air void, step "2" will not need to be done.*

NOTE: ***When operating a function such as Lift Up, if the function pump makes a loud noise and the lift up stops and starts, that is a sign of cavitation, air going through the pump at high pressure. This will in a short time destroy the pump and contaminate the entire system. Make sure all suction hoses are tight and free of leaks at the tank and pump. A suction hose does not leak when the engine is running, it will allow air to be drawn into the pump causing cavitation. After the machine is shut down, then you will see a very slow leak.*

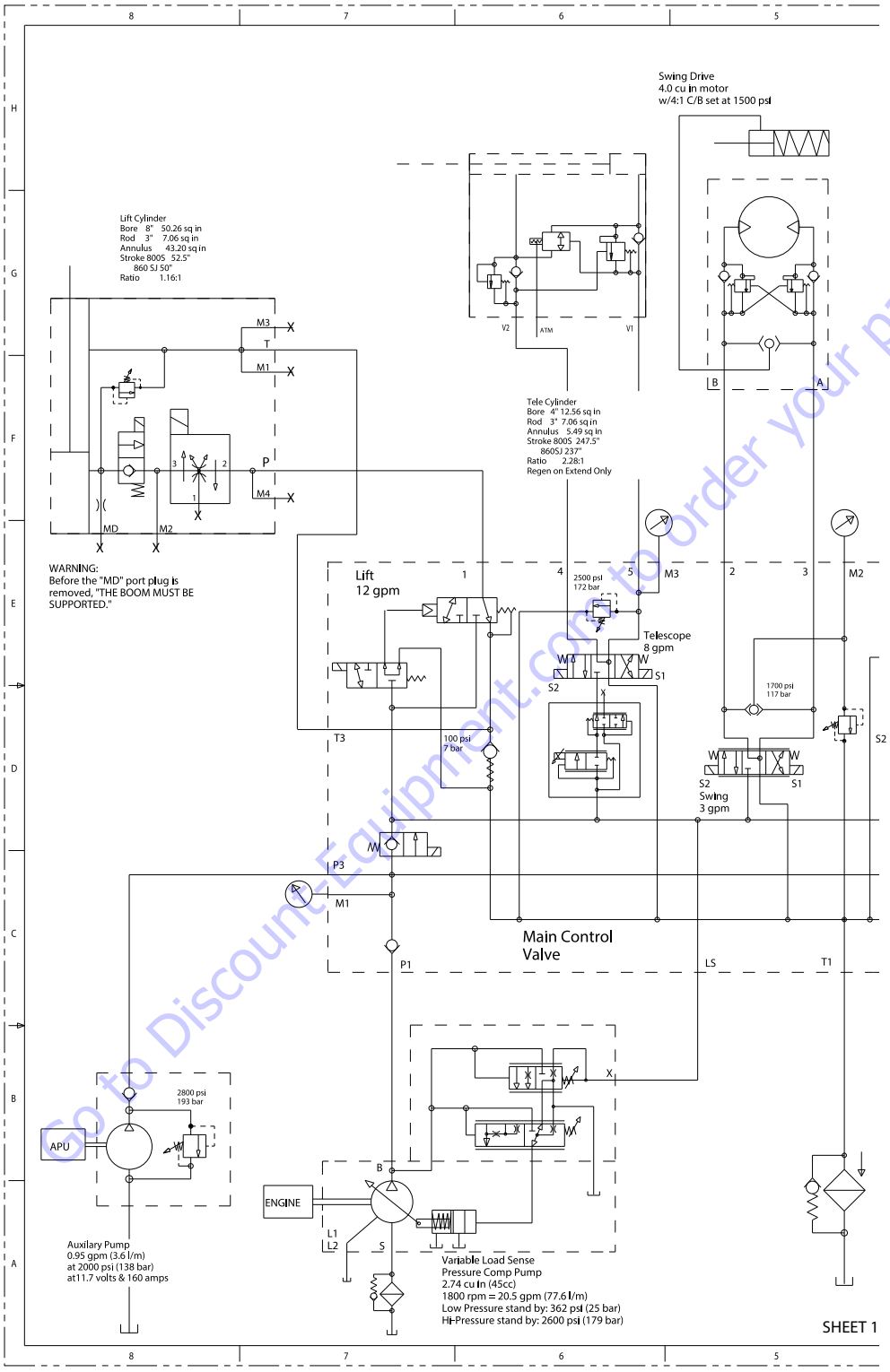


Figure 5-99. Hydraulic Schematic - Sheet 1of 8

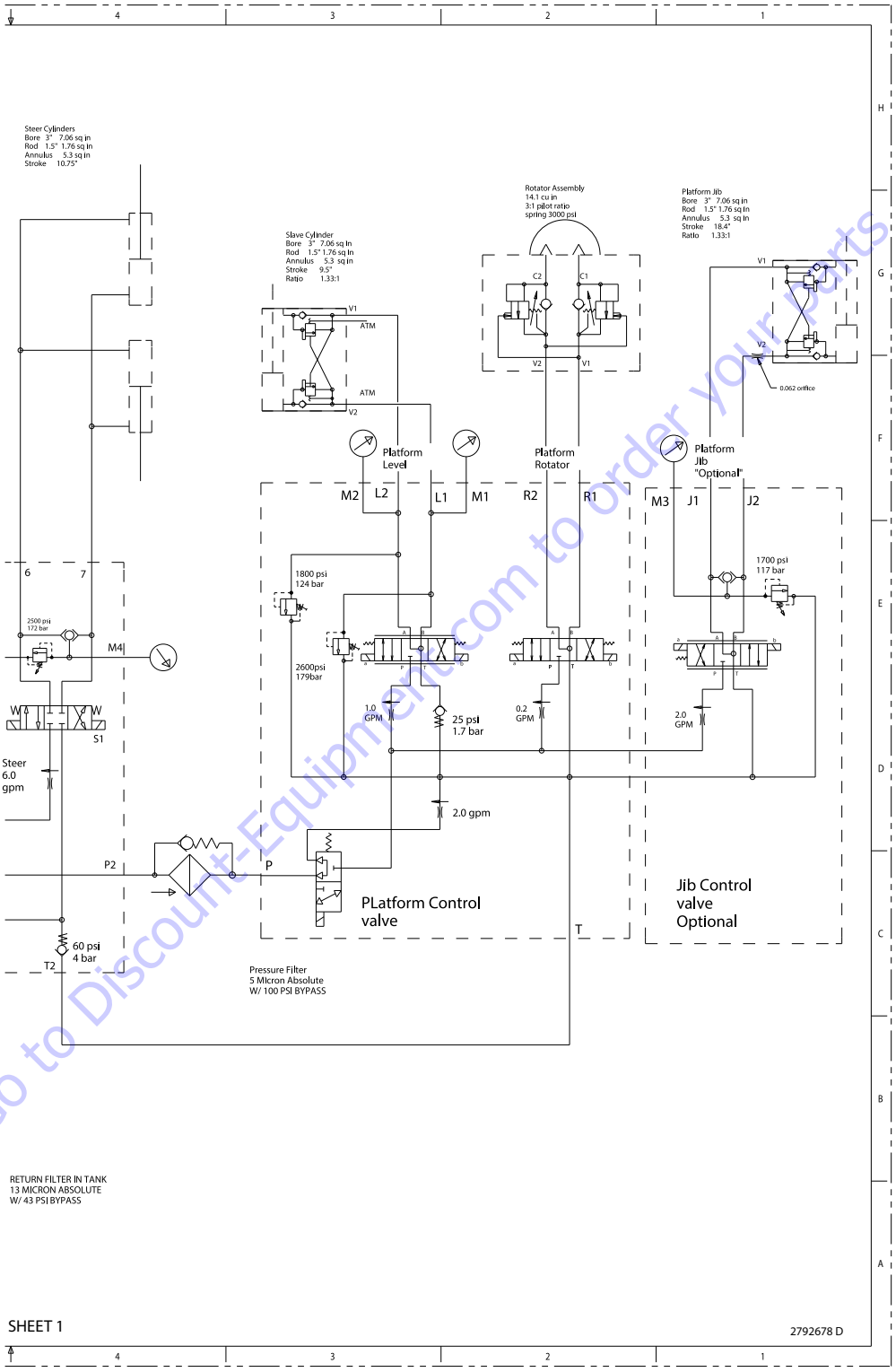


Figure 5-100. Hydraulic Schematic - Sheet 2 of 8

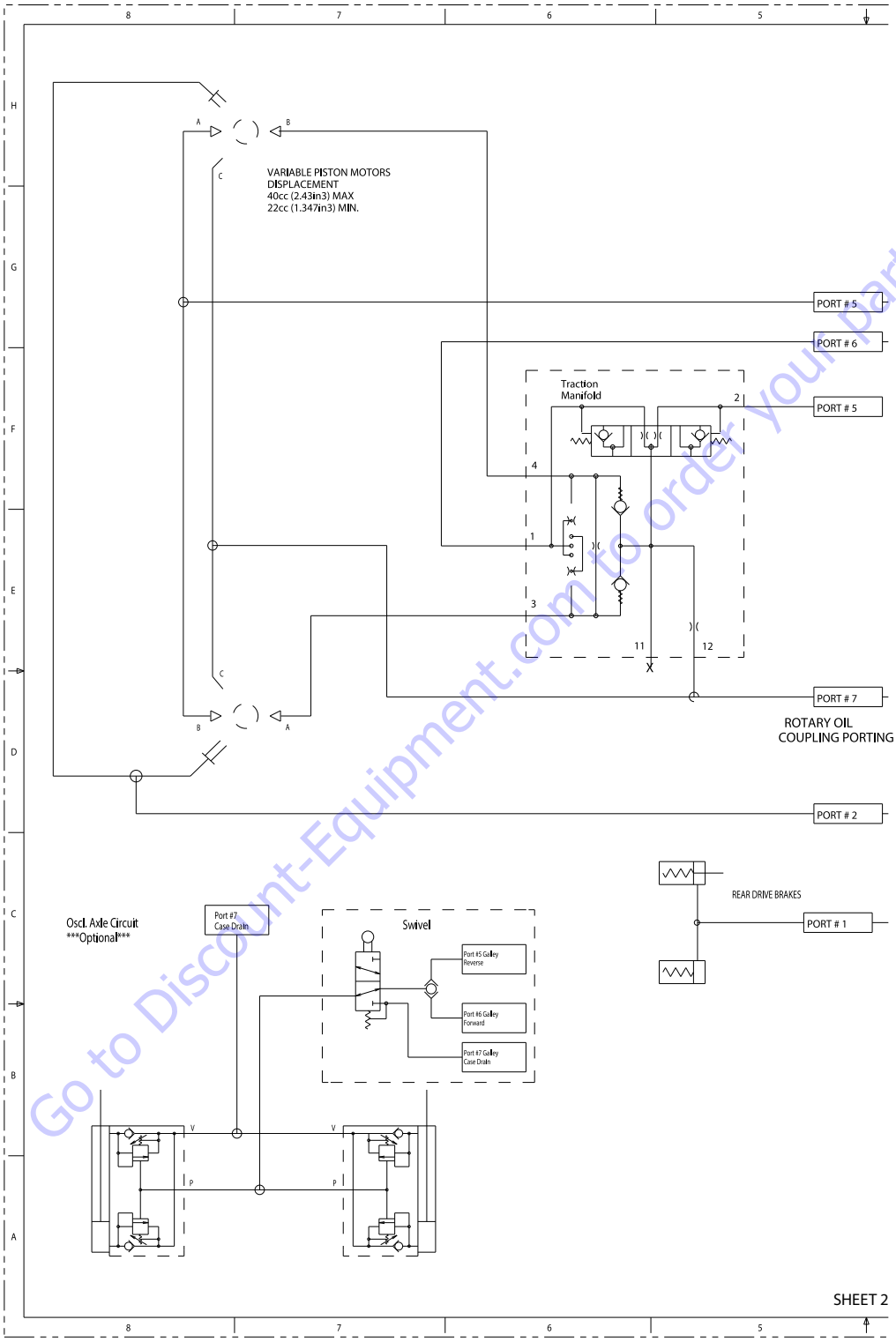


Figure 5-101. Hydraulic Schematic - Sheet 3 of 8

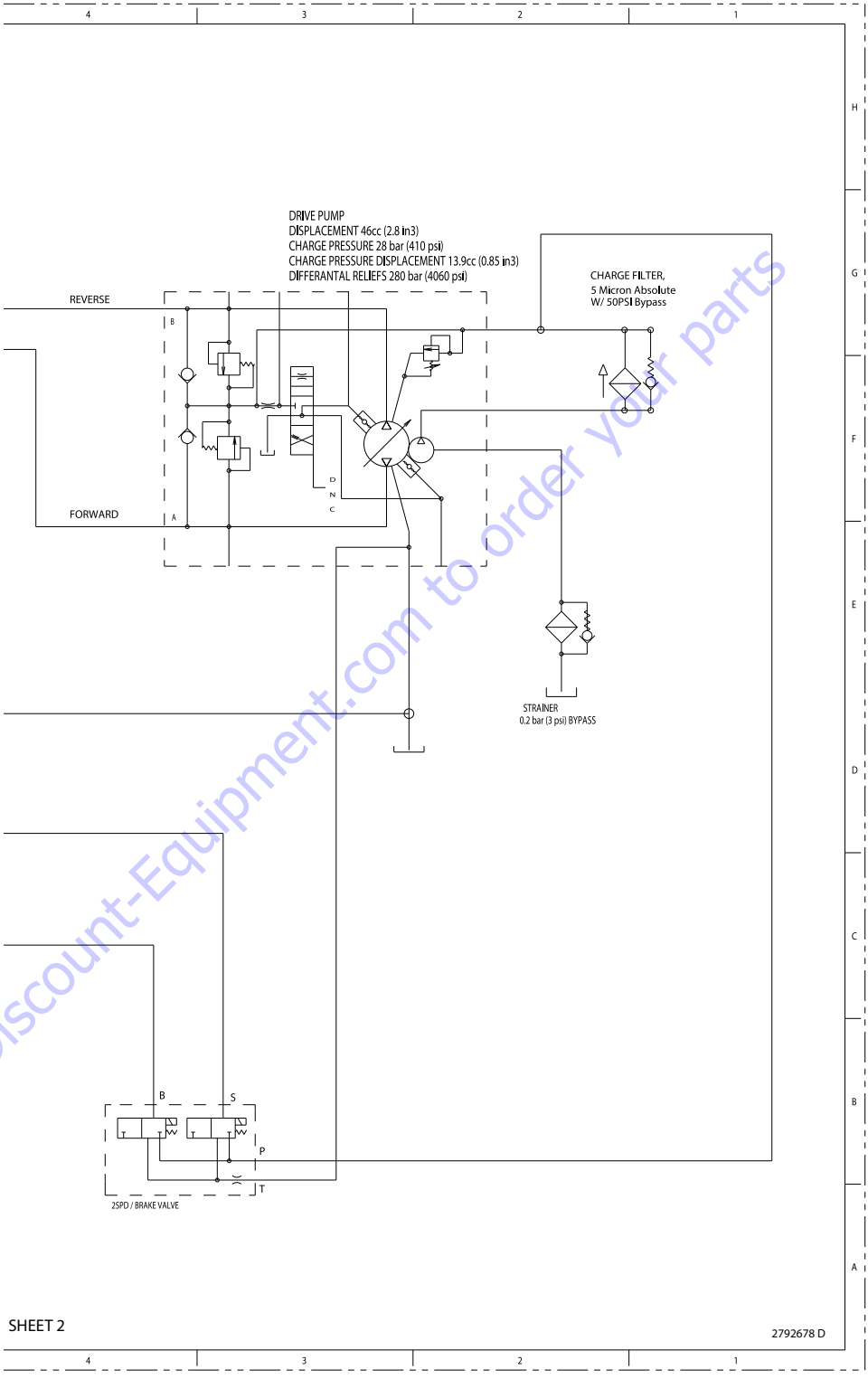


Figure 5-102. Hydraulic Schematic - Sheet 4 of 8

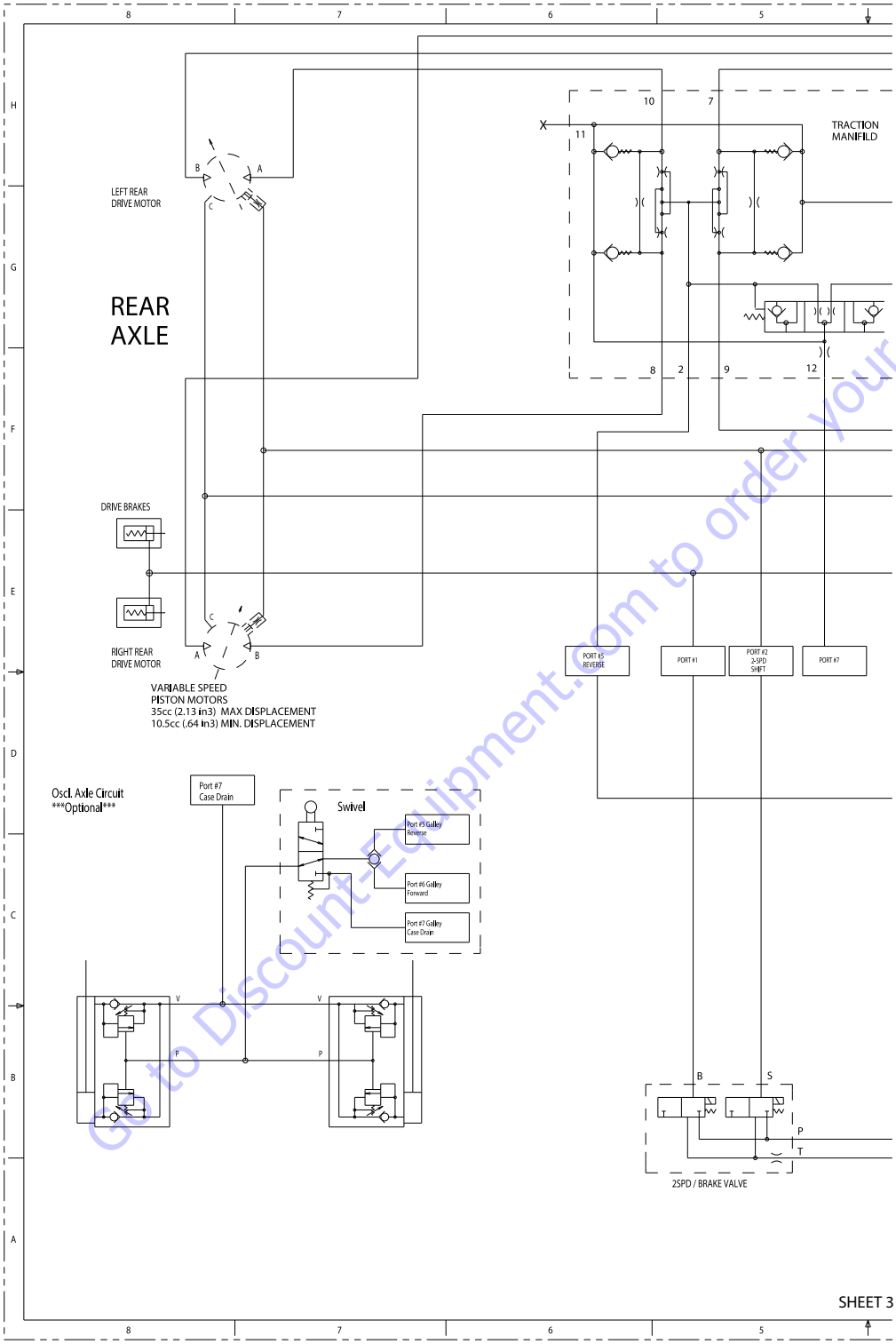


Figure 5-103. Hydraulic Schematic - Sheet 5 of 8

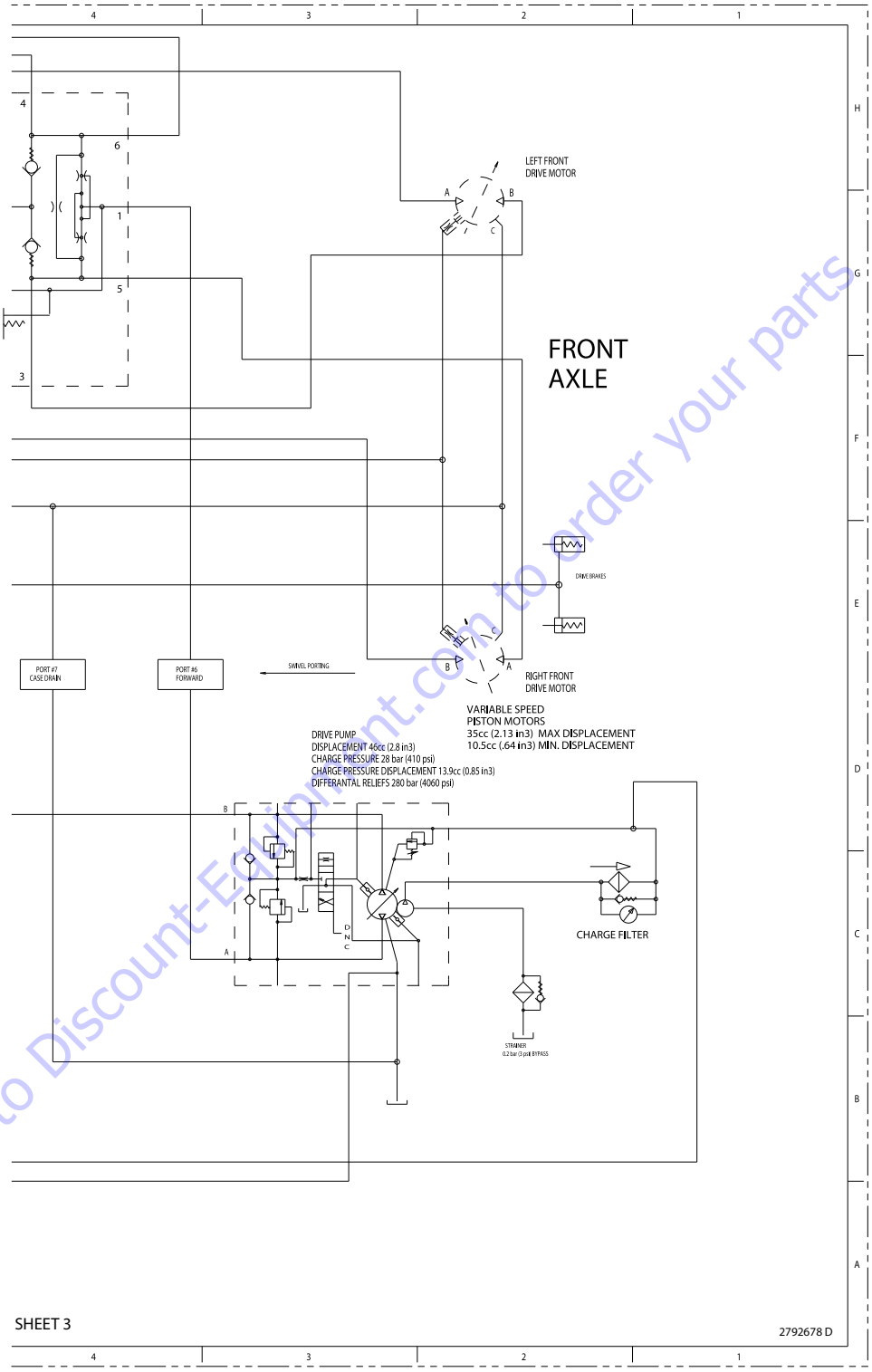


Figure 5-104. Hydraulic Schematic - Sheet 6 of 8

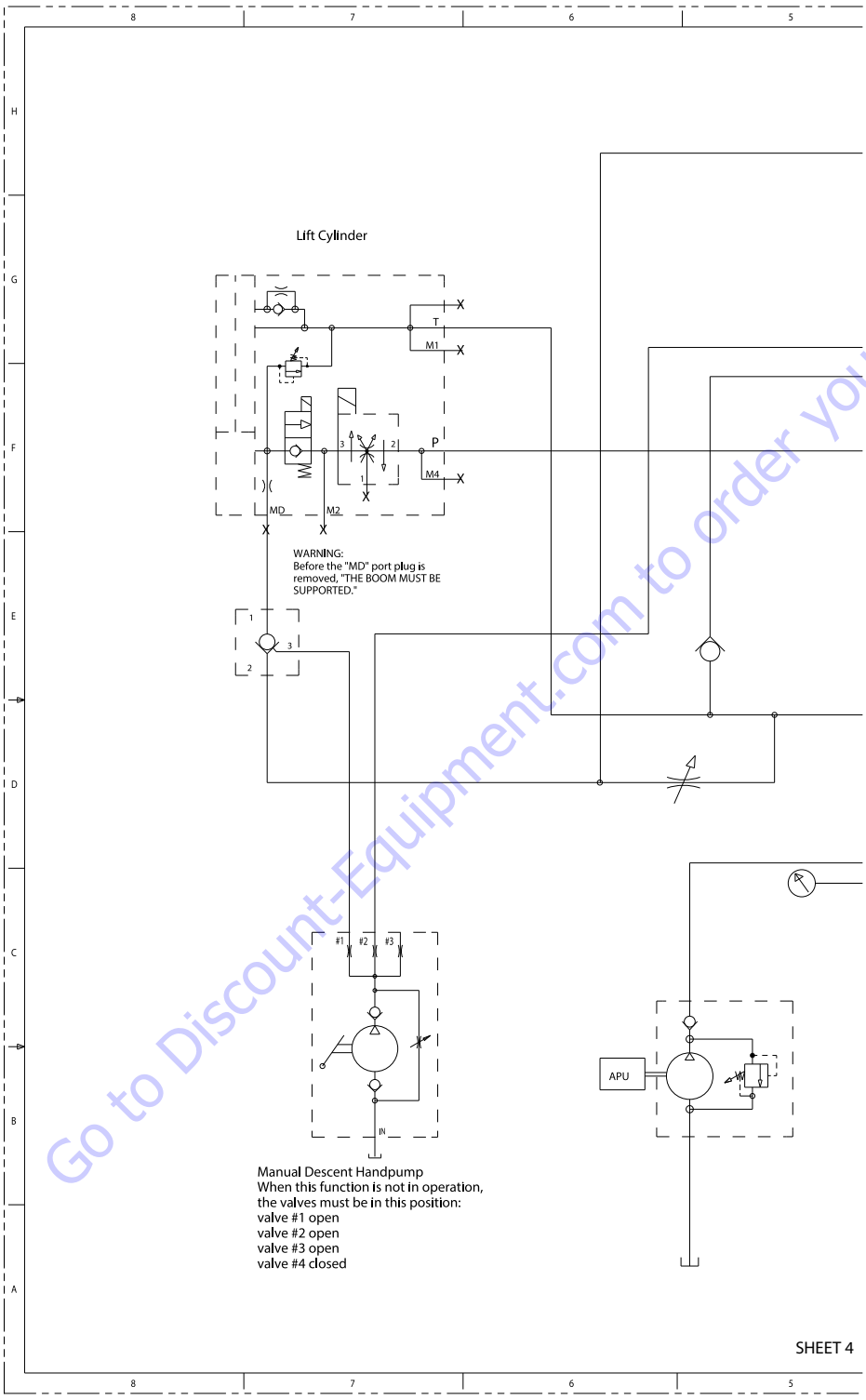


Figure 5-105. Hydraulic Schematic - Sheet 7 of 8

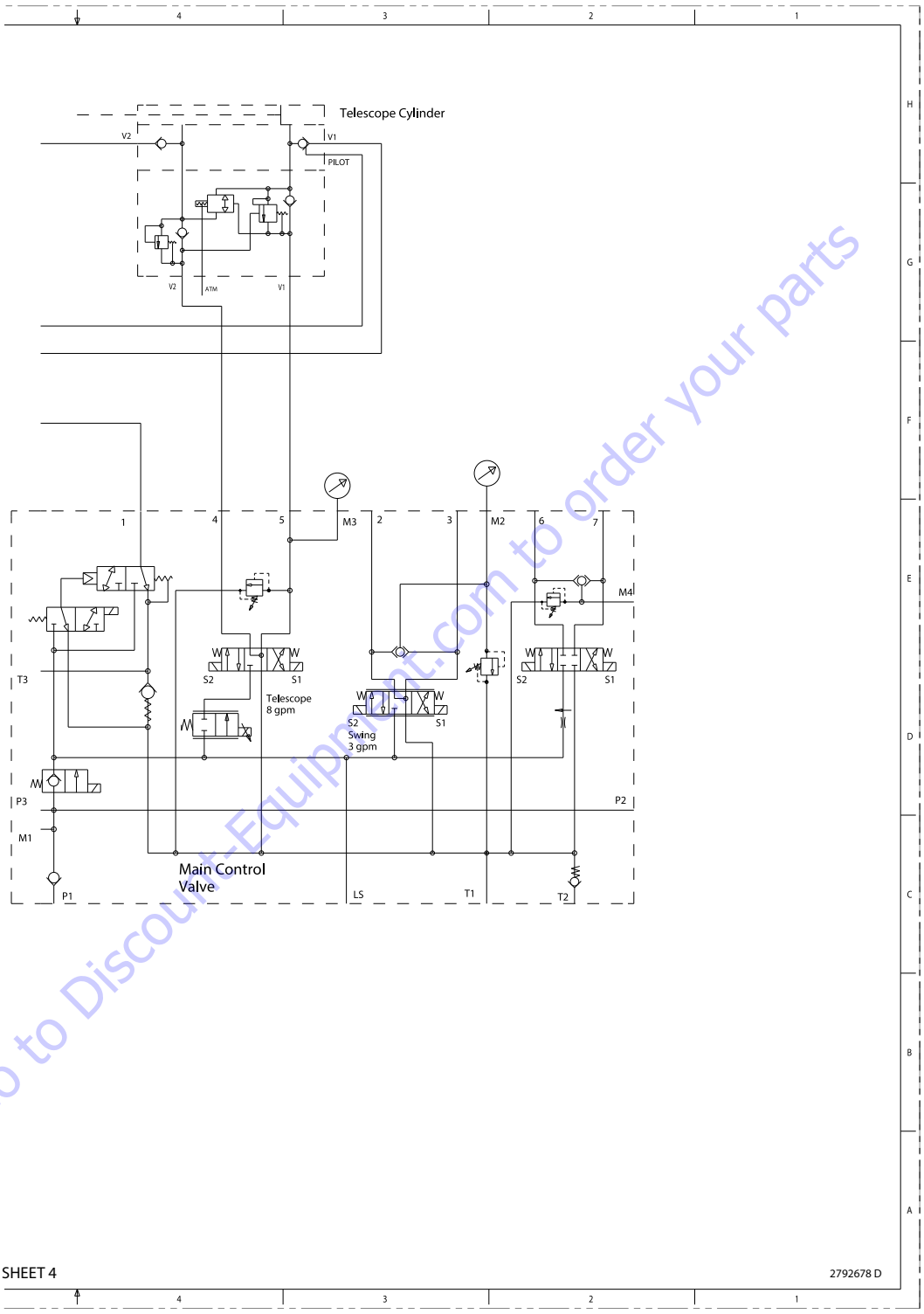
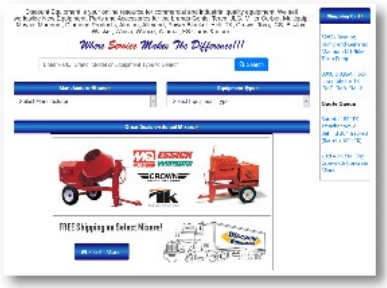


Figure 5-106. Hydraulic Schematic - Sheet 8 of 8

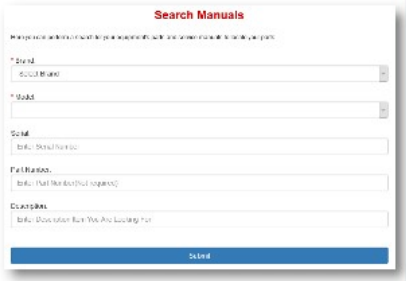
PARTS FINDER

Search Website by Part Number

Discount Equipment



Search Manual Library For Parts Manual & Lookup Part Numbers – Purchase or Request Quote



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We sell worldwide for the brands: Genie, Terex, JLG, MultiQuip, Mikasa, Essick, Whiteman, Mayco, Toro Stone, Diamond Products, Generac Magnum, Airman, Haulotte, Barreto, Power Blanket, Nifty Lift, Atlas Copco, Chicago Pneumatic, Allmand, Miller Curber, Skyjack, Lull, Skytrak, Tsurumi, Husquvarna Target, , Stow, Wacker, Sakai, Mi-T- M, Sullair, Basic, Dynapac, MBW, Weber, Bartell, Bennar Newman, Haulotte, Ditch Runner, Menegotti, Morrison, Contec, Buddy, Crown, Edco, Wyco, Bomag, Laymor, Barreto, EZ Trench, Bil-Jax, F.S. Curtis, Gehl Pavers, Heli, Honda, ICS/PowerGrit, IHI, Partner, Imer, Clipper, MMD, Koshin, Rice, CH&E, General Equipment, ,AMida, Coleman, NAC, Gradall, Square Shooter, Kent, Stanley, Tamco, Toku, Hatz, Kohler, Robin, Wisconsin, Northrock, Oztec, Toker TK, Rol-Air, Small Line, Wanco, Yanmar

SECTION 6. JLG CONTROL SYSTEM

6.1 JLG CONTROL SYSTEM ANALYZER KIT INSTRUCTIONS

Introduction

NOTICE

WHEN INSTALLING A NEW POWER MODULE CONTROLLER ON THE MACHINE, IT WILL BE NECESSARY TO PROGRAM THE CONTROLLER FOR THE PROPER MACHINE CONFIGURATION, INCLUDING OPTIONS.

NOTICE

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 IN. (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 JLG designed Control System is a 12 Volt based control unit installed on the boom lift.

The JLG Control System has reduced the need for exposed terminal strips, diodes and trimpots and provides simplicity in viewing and adjusting the various personality settings for smooth control of: acceleration, deceleration, creep, min speed, and maximum speed for all boom, drive, and steering functions.

The main lift, swing, and drive are controlled by individual joysticks, with steering being controlled by a rocker switch built into the top the drive joystick. To activate Drive, Lift, and Swing simply pull up on the slide lock location on the joystick and move the handle into the direction desired.

The control system will control the voltage output to the valves and pump, as programmed for smooth operation and maximum cycle time. Ground control speeds for all boom functions can also be programmed into the control system.

The JLG Control System controller has a built in LED to indicate any faults. The system stores recent faults which may be accessed for troubleshooting. Optional equipment includes a soft touch system, head and tail lights, and ground alarm. These options may be added later but must be programmed into the control system when installed.

The Control System may be accessed utilizing a custom designed, hand held analyzer (Analyzer Kit, JLG part no. 2901443) which will display two lines of information at a time, by scrolling through the program.

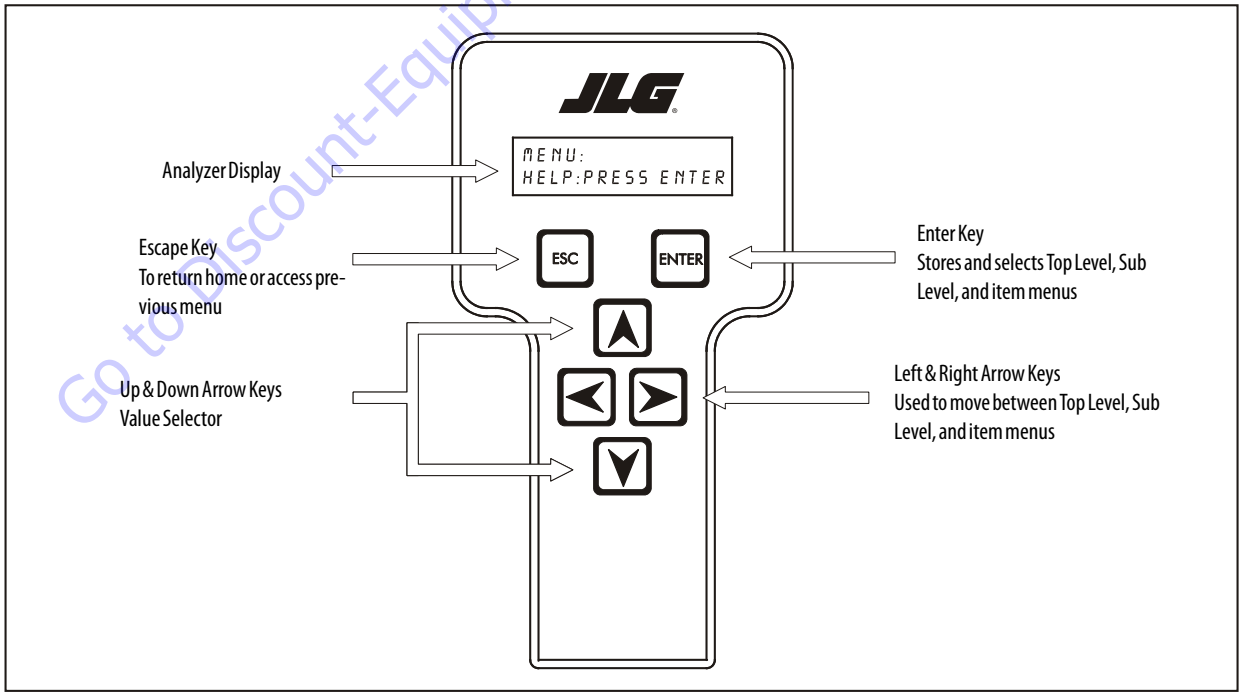


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

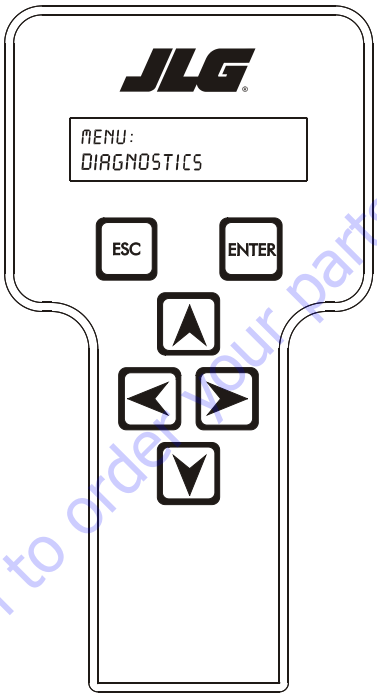
1. Connect one end of the cable, supplied with the analyzer, to the correct four pin connector on the motor control unit; there will be only one connector which correctly fits the cable.
2. Connect the other end of the cable to the analyzer.

NOTE: *The ends of the cable are identical and can be reversed; the cable end can only be inserted one way into the matching connector.*

3. Power up the vehicle by turning the key to the platform or ground position and pulling the emergency stop buttons on; this will power the "SMART System'" and the analyzer.

Using the Analyzer

The analyzer will display the current top level menu item, for example::



MENU:
DIAGNOSTICS

Press LEFT & RIGHT (g, e) to move between menu items; press ENTER to select the displayed menu item.

When a top level menu item is selected, a new set of menu items may be offered; press **LEFT** & **RIGHT** arrows then **ENTER** again to select the required item.

To cancel a selected menu item, press **ESCAPE**; then a different menu item can be chosen.

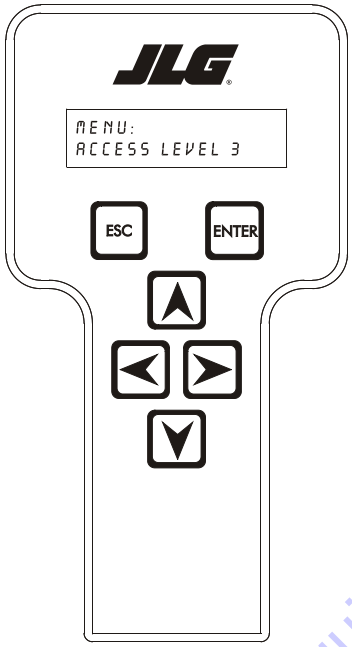
The available menu items will vary depending on the vehicle; check the vehicle manual for more information.

Changing the Access Level of the Hand Held Analyzer

When the analyzer is first connected, its access level ensures that most configurations cannot be changed; this ensures that a setting cannot be accidentally altered.

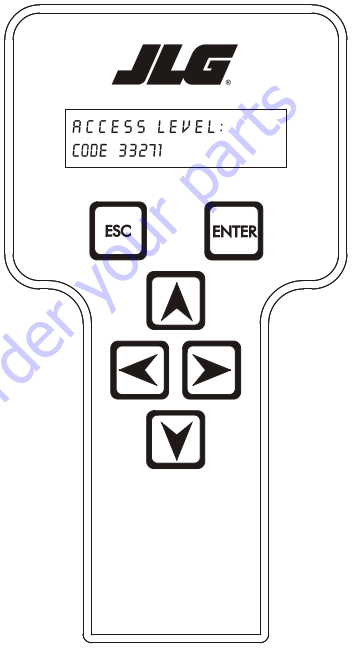
To change the access level, a PASSWORD must be entered; the password must be known.

To enter a password, first find the appropriate top level menu item:



MENU:
ACCESS LEVEL 3

Press **ENTER** ENTER to select the ACCESS LEVEL item; then press **UP** & **DOWN** arrows and **LEFT** & **RIGHT** arrows to enter the correct five digit password:



ACCESS LEVEL:
CODE 33271

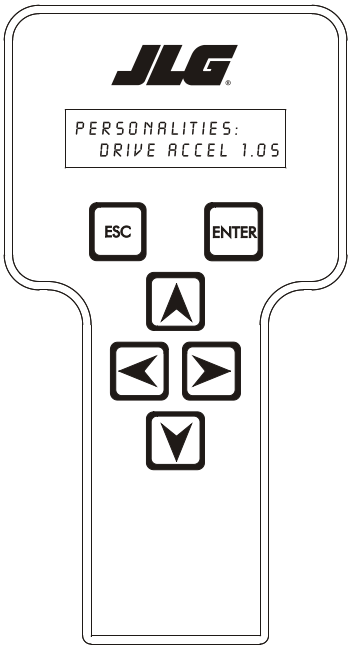
When the correct password is displayed, press **ENTER** ENTER to confirm it; the access level will change to match the password

(If not, press **ENTER** ENTER to check and correct the password).

The correct passwords will vary depending on the vehicle; check the vehicle manual for more information.

Adjusting Configuration Using the Hand Held Analyzer

When a personality item is selected, press **UP** & **DOWN** arrows to adjust its value, for example:



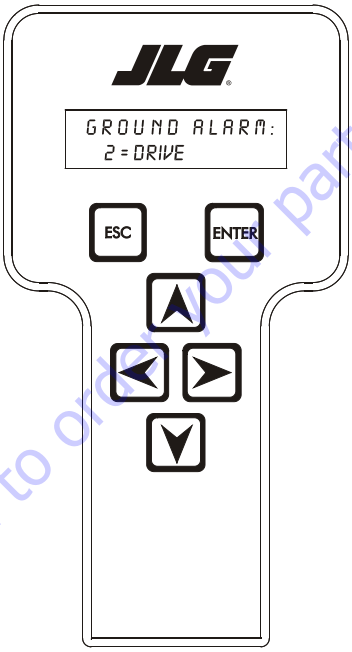
PERSONALITIES:
DRIVE ACCEL 1.0s

There will be a maximum and minimum for the value to ensure safe operation; the value will not increase if **UP** is pressed when at the maximum, or if DOWN is pressed when at the minimum.

If the value does not change when **UP** or **DOWN** is pressed, check the access level.

Machine Setup

When a machine digit item is selected, press **UP** & **DOWN** (e, e) to adjust its value, for example:



GROUND ALARM:
2 = DRIVE

The effect of the machine digit value is displayed along with its value; there will only be certain settings allowed to ensure safe operation.

If the value does not change when **UP** or **DOWN** is pressed, check the access level.

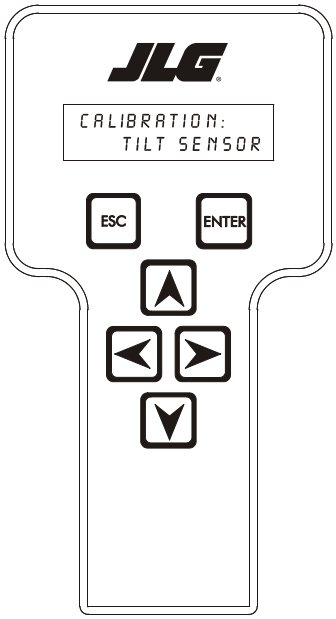
The available personality and machine digit items will vary depending on the vehicle; check the vehicle manual for more information.

Level Vehicle Description

A NEW TILT MODULE WILL ACT AS IF IT IS TILTED ALL OF THE TIME UNTIL THE FOLLOWING PROCEDURE IS PERFORMED.

⚠ WARNING

DO NOT CALIBRATE THE LEVEL SENSOR EXCEPT ON A LEVEL SURFACE.



Place machine in stowed position with the boom between the rear wheels.

To level machine chose:

CALIBRATION:
TILT SENSOR

Press ENTER (ENTER).

When prompted, swing machine 180°

Press ENTER (ENTER).

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
ACCEL	ACCELERATE
ACT	ACTIVE
A/D	ANALOG DIGITAL CONVERTER COUNT
AMB.	AMBIENT
ANG	ANGLE
AUX	AUXILIARY
BCS	BOOM CONTROL SYSTEM
BM	BOOM LENGTH ANGLE MODULE
BLAM	BOOM LENGTH ANGLE MODULE
BR	BROKEN
BSK	BASKET
CAL	CALIBRATION
CL	CLOSED
CM	CHASSIS MODULE
CNTL	CONTROL
CNTRL	CONTROL
C/O	CUT OUT
CONT(S)	CONTRACTOR(S)
COOR	COORDINATED
CRK PT	CRACK POINT
CRP	CREEP
CUT	CUTOUT
CYL	CYLINDER
DECEL	DECELERATE
D	DOWN
DN	DOWN
DWN	DOWN
DEG.	DEGREE
DOS	DRIVE ORIENTATION SYSTEM
DRV	DRIVE
E	ERROR
E&T	ELEVATED & TILTED
ELEV	ELEVATION
ENG	ENGINE
EXT	EXTEND
F	FRONT
FL	FLOW
FNT	FRONT
FOR	FORWARD
FWD	FORWARD
FSW	FOOT SWITCH
FUNC	FUNCTION

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
G	GROUND
GND	GROUND
GRN	GREEN
GM	GROUND MODULE
H	HOURS
HW	HARDWARE
HWFS	HARDWARE FAILSAFE
I	IN or CURRENT
JOY	JOYSTICK
L	LEFT
LB	POUND
LEN	LENGTH
LIM	LIMIT
LT	LEFT
LVL	LEVEL
M	MINUTES
MIN	MINIMUM
MAX	MAXIMUM
M	MAIN
MN	MAIN
NO	NORMALLY OPEN or NO
NC	NORMALLY CLOSED
O	OUT
O/C	OPEN CIRCUIT
OP	OPEN
O/R	OVERRIDE or OUTRIGGER
O//R	OVERRIDE
OSC	OSCILLATING
OVRD	OVERRIDE
P	PLATFORM
P	PRESSURE
PCV	PROPORTIONAL CONTROL VALVE
PLAT	PLATFORM
PLT	PLATFORM
PM	PLATFORM MODULE
POT	POTENTIOMETER
PRES	PRESSURE
PRS	PRESSURE
PT	POINT
R	REAR or RIGHT
REV	REVERSE or REVISION
RET	RETRACT
ROT.	ROTATE

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
RT	RIGHT
S/C	SHORT CIRCUIT
SEL	SELECTOR
SN	SERIAL NUMBER
SPD	SPEED
STOW	STOWED
STOWD	STOWED
SW	SWITCH or SOFTWARE
TELE	TELESCOPE
TEMP	TEMPERATURE
TORQ.	TORQUE
TRN	TRANSPORT
T/T	TURNTABLE
T	TOWER
TURNTBL	TURNTABLE
TWR	TOWER
U	UPPER or UP
V	VOLT
VER	VERSION
VLV	VALVE
WIT	WITNESS
YEL	YELLOW

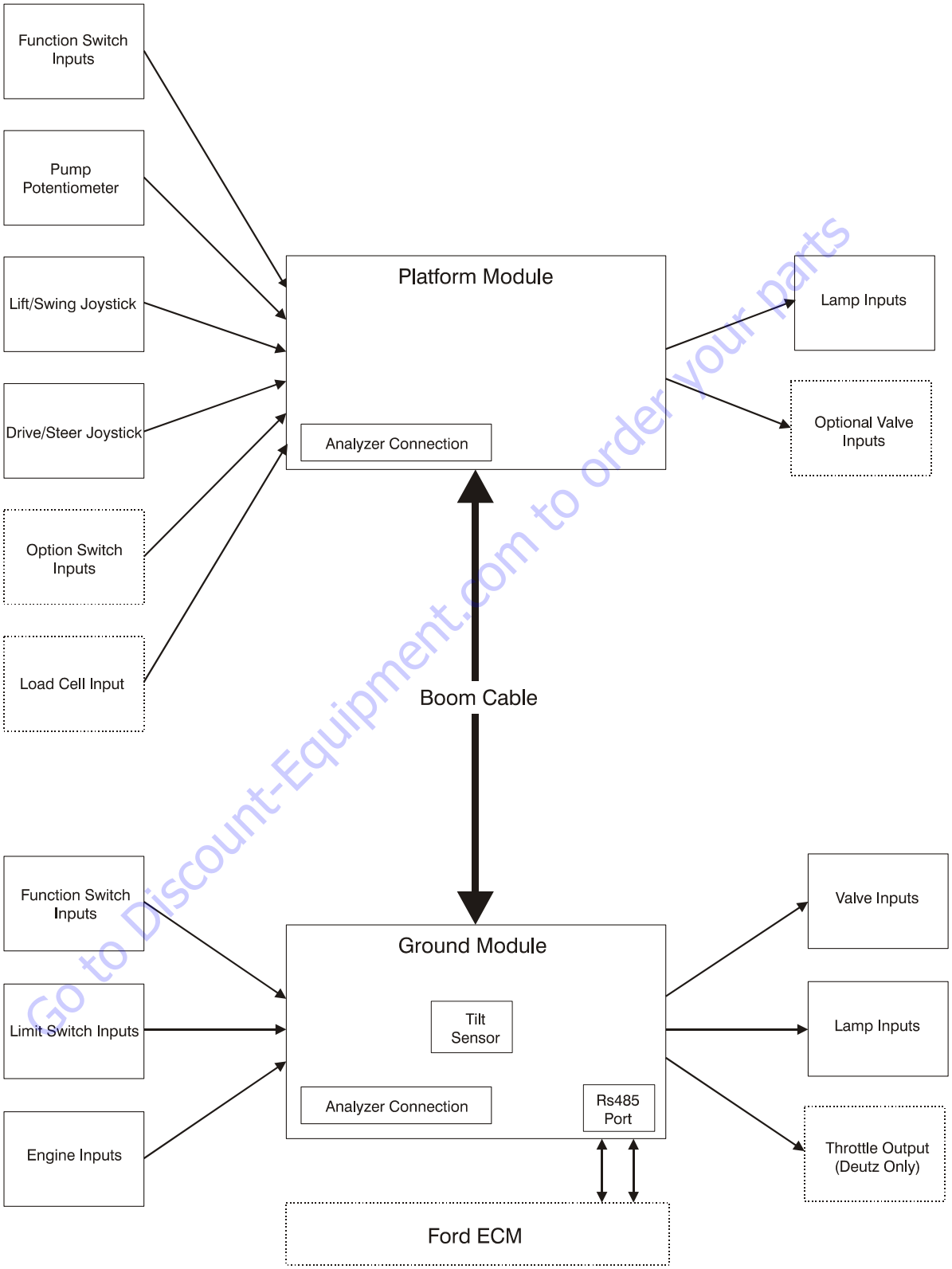


Figure 6-2. ADE Block Diagram

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
MODEL NUMBER: 1	1 2 3 4 5 6 7 8 9 10	400S 450A 510A 600S 600A 600SC 601S 740A 800A 800S	1
MARKET: 2	0 1 2 3 4 5	ANSI USA ANSI EXPORT CSA CE AUSTRALIA JAPAN	0
ENGINE: 3* *Engine selections vary depending on model selection.	1 2 3 4 5 6 7 8 9 10 11	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1) FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1) DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1) DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1) CAT. 3024C: CAT 3024C Diesel (Tier 2) CAT. 3044C: CAT 3044C Diesel (Tier 2) DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2) DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2) FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2) FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2) DEUTZ ECM: Engine Control Module - ECM	11
FLYWHEEL TEETH: 4* *This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0 1	133 TEETH: 133 flywheel teeth. 110 TEETH: 110 flywheel teeth.	1

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
GLOW PLUG: 5	0 1 2	NO GLOW PLUGS: No glow plugs installed. W/O STARTER LOCK: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow. W/ STARTER LOCK: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	1
ENGINE SHUTDOWN: 6	0 1	DISABLED: No engine shutdown. ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 psi.	1
TILT: 7* *Certain market selections will limit tilt options.	1 2 3 4 5	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. *Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.*	1
JIB: 8* *Only visible under certain model selections	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 9* *Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0
SOFT TOUCH: 10* *Only visible under certain model selections.	0 1	NO: No soft touch system installed. YES: Soft touch system installed.	0

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
GEN SET/WELDER: 11	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0
GEN SET CUTOUT: 12* * Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0
H & T LIGHTS: 13	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 14* * Only visible under certain model selections. * Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 15* * Only visible under certain model selections. * Certain market selections will limit load system options or alter default setting.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0
LOAD SENSOR: 16* * Only visible if Load Sensor Menu selection is not 0. * Market selections will limit certain load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1

Table 6-2. Machine Configuration Programming Information Prior to Software Version P5.3

Configuration Digit	Number	Description	Default Number
FUNCTION CUTOUT: 17* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive cutout above elevation. DRIVE CUT E&T: Drive cutout above elevation and tilted.	0
GROUND ALARM: 18* *Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	0
DRIVE: 19* *Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0
TEMPERATURE: 20	0 1	CELSIUS: Celsius unit selection. FAHRENHEIT: Fahrenheit unit selection.	1
LEVELING MODE: 21* *Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0

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Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
MODEL NUMBER: 1	1	400S	1
	2	450A	
	3	510A	
	4	600S	
	5	600A	
	6	600SC	
	7	601S	
	8	740A	
	9	800A	
	10	800S	
MARKET: 2	0	ANSI USA	0
	1	ANSI EXPORT	
	2	CSA	
	3	CE	
	4	AUSTRALIA	
	5	JAPAN	

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
ENGINE: 3* *Engine selections vary depending on model selection.	1	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1)	7
	2	FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1)	
	3	DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1)	
	4	DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1)	
	5	CAT. 3024C: CAT 3024C Diesel (Tier 2)	
	6	CAT. 3044C: CAT 3044C Diesel (Tier 2)	
	7	PERKINS 404C (Tier 2)	
	8	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	9	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	10	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	11	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	12	DEUTZ ECM: Engine Control Module - ECM	
	13	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
FLYWHEEL TEETH: 4* *This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0	133 TEETH: 133 flywheel teeth.	1
	1	110 TEETH: 110 flywheel teeth.	
GLOW PLUG: 5	0	NO GLOW PLUGS: No glow plugs installed.	2
	1	AIR INTAKE: Glow plugs installed in the air intake on the manifold.	
	2	IN-CYLINDER: Glow plugs installed in each cylinder.	
STARTER LOCKOUT: 6	0	DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.	0
	1	ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	
ENGINE SHUTDOWN: 7	0	DISABLED: No engine shutdown.	1
	1	ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.	

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
TILT: 8* *Certain market selections will limit tilt options and alter default setting. Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.	1 2 3 4 5	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up.	1
JIB: 9* *Only visible under certain model selections.	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 10* *Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0
SOFT TOUCH: 11* *Only visible under certain model selections.	0 1	NO: No soft touch system installed. YES: Soft touch system installed.	0
GEN SET/WELDER: 12	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0
GEN SET CUTOUT: 13* *Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
H & T LIGHTS: 14	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 15* *Only visible under certain model selections. *Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 16* *Only visible under certain market selections. *Certain market selections will limit load system options or alter default setting.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0
LOAD SENSOR: 17* *Only visible if Load Sensor Menu selection is not 0 and under certain market selections. *Certain market selections will limit load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1
FUNCTION CUTOUT: 18* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive & steer cutout above elevation. DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	0

Table 6-3. Machine Configuration Programming Information Software Version P5.3 to P6.1

Configuration Label/Digit	Number	Description	Default Number
GROUND ALARM: 19* *Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	3
DRIVE: 20* *Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0
TEMPERATURE: 21* *Certain market selections will alter default setting.	0 1	CELSIUS: Celsius unit selection. FAHRENHEIT: Fahrenheit unit selection.	1
LEVELING MODE: 22* *Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0

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Table 6-4. Machine Configuration Programming Information Software Version P6.1 to Present

Configuration Label/Digit	Number	Description	Default Number
MODEL NUMBER: 1	1	400S	1
	2	450A	
	3	510A	
	4	600S	
	5	600A	
	6	600SC	
	7	601S	
	8	740A	
	9	800A	
	10	800S	
MARKET: 2	0	ANSI USA	0
	1	ANSI EXPORT	
	2	CSA	
	3	CE	
	4	AUSTRALIA	
	5	JAPAN	

Table 6-4. Machine Configuration Programming Information Software Version P6.1 to Present

Configuration Label/Digit	Number	Description	Default Number
ENGINE: 3* *Engine selections vary depending on model selection.	1	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1)	14
	2	FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1)	
	3	DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1)	
	4	DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1)	
	5	CAT. 3024C: CAT 3024C Diesel (Tier 2)	
	6	CAT. 3044C: CAT 3044C Diesel (Tier 2)	
	7	PERKINS 404C (Tier 2)	
	8	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	9	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	10	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	11	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	12	DEUTZ ECM: Engine Control Module - ECM (Tier 2 and Tier 3)	
	13	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
	14	PERKINS ECM	
	15	CAT ECM	
FLYWHEEL TEETH: 4* *This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0	133 TEETH: 133 flywheel teeth.	1
	1	110 TEETH: 110 flywheel teeth.	
GLOW PLUG: 5	0	NO GLOW PLUGS: No glow plugs installed.	2
	1	AIR INTAKE: Glow plugs installed in the air intake on the manifold.	
	2	IN-CYLINDER: Glow plugs installed in each cylinder.	
STARTER LOCKOUT: 6	0	DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.	0
	1	ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	

Table 6-4. Machine Configuration Programming Information Software Version P6.1 to Present

Configuration Label/Digit	Number	Description	Default Number
ENGINE SHUTDOWN: 7	0 1	DISABLED: No engine shutdown. ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.	1
TILT: 8* *Certain market selections will limit tilt options and alter default setting. Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.	1 2 3 4 5	5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up.	1
JIB: 9* *Only visible under certain model selections.	0 1	NO: No jib installed. YES: Jib installed which has up and down movements only.	0
4 WHEEL STEER: 10* *Only visible under certain model selections.	0 1	NO: No four-wheel steer installed. YES: Four-wheel steer installed.	0
SOFT TOUCH: 11* *Only visible under certain model selections.	0 1	NO: No soft touch system installed. YES: Soft touch system installed.	0
GEN SET/WELDER: 12	0 1	NO: No generator installed. BELT DRIVE: Belt driven setup.	0
GEN SET CUTOUT: 13* *Only visible if Gen Set / Welder Menu selection is not 0.	0 1	MOTION ENABLED: Motion enabled when generator is ON. MOTION CUTOUT: Motion cutout in platform mode only.	0

Table 6-4. Machine Configuration Programming Information Software Version P6.1 to Present

Configuration Label/Digit	Number	Description	Default Number
H & T LIGHTS: 14	0 1	NO: No head and tail lights installed. YES: Head and tail lights installed.	0
CABLE SWITCH: 15* *Only visible under certain model selections. *Certain market and model selections will alter the default setting.	0 1	NO: No broken cable switch installed. YES: Broken cable switch installed.	0
LOAD SYSTEM: 16* *Only visible under certain market selections. *Certain market selections will limit load system options or alter default setting.	0 1 2 3 4	NO: No load sensor installed. WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	0
LOAD SENSOR: 17* *Only visible if Load Sensor Menu selection is not 0 and under certain market selections. *Certain market selections will limit load sensor options.	0 1	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. 4 UNDER PLATFORM: Use the EIM for load sensing.	1
FUNCTION CUTOUT: 18* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	0 1 2 3	NO: No drive cutout. BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive & steer cutout above elevation. DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	0

Table 6-4. Machine Configuration Programming Information Software Version P6.1 to Present

Configuration Label/Digit	Number	Description	Default Number
GROUND ALARM: 19* *Certain market selections will alter default setting.	0 1 2 3	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). MOTION: Motion alarm sounds when any function is active (Option).	3
DRIVE: 20* *Only visible under certain model selections.	0 1 2	4WD: Four wheel drive. 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	0
TEMPERATURE: 21* *Certain market selections will alter default setting.	0 1	CELSIUS: Celsius unit selection. FAHRENHEIT: Fahrenheit unit selection.	1
LEVELING MODE: 22* *Only visible on 800S models.	0 1	ALL FUNCTIONS: Platform level with all functions. LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	0
DRIVE CONTROL: 23	0 1 2	NORMAL: Drive coils are energized from the Ground Module. PROPULSION: Drive coils are energized from the Propulsion Module. ENHANCED: Drive coils are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns.	2
CLEARSKY: 24	0 1	NO: Clearsky (telematics) option is disabled. YES: Clearsky (telematics) option is enabled.	0
CRIBBING OPTION: 25	0 1	NO: Cribbing Option is disabled. YES: Cribbing Option is enabled.	0

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Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
NOTE: *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 values.*			
MODEL NUMBER: 1	**1** 2 3 4 5 6 7 8 9 10	**400S** 450A 510A 600S 600A 600SC 601S 740A 800A 800S	**1**
MARKET: 2	**0** 1 2 3 4 5 6	**ANSI USA** ANSI EXPORT CSA CE AUSTRALIA JAPAN GB	**0**

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
ENGINE: 3* *Engine selections vary depending on model selection.	1	FORD EFI GAS: Ford LRG425 EFI Gas (Tier 1)	**14**
	2	FORD EFI D/F: Ford LRG425 EFI dual fuel (Tier 1)	
	3	DEUTZ F4 TIER1: Deutz F4M1011F Diesel (Tier 1)	
	4	DEUTZ F3 TIER1: Deutz F3M1011F Diesel (Tier 1)	
	5	CAT. 3024C: CAT 3024C Diesel (Tier 2)	
	6	CAT. 3044C: CAT 3044C Diesel (Tier 2)	
	7	PERKINS 404C (Tier 2)	
	8	DEUTZ F4 TIER2: Deutz F4M2011 Diesel (Tier 2)	
	9	DEUTZ F3 TIER2: Deutz F3M2011 Diesel (Tier 2)	
	10	FORD GAS TIER2: Ford LRG425 EFI Gas (Tier 2)	
	11	FORD D/F TIER2: Ford LRG425 EFI Dual Fuel (Tier 2)	
	12	DEUTZ ECM: Engine Control Module - ECM (Tier 2 and Tier 3)	
	13	DUAL FUEL ECM: GM/PSI 3.0L Dual Fuel (Tier 2)	
	14	**PERKINS ECM**	
	15	CAT ECM	
	16	DEUTZ EMR4: Deutz Engine Control Module (Tier 4 Final)	
	17	FORD DUAL FUEL	
FLYWHEEL TEETH: 4* *This menu item is only visible if Deutz engine selections 3 or 4 are selected.	0	133 TEETH: 133 flywheel teeth.	**1**
	1	**110 TEETH: 110 flywheel teeth.**	

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
GLOW PLUG: 5	0 1 **2**	NO GLOW PLUGS: No glow plugs installed. AIR INTAKE: Glow plugs installed in the air intake on the manifold. **IN-CYLINDER: Glow plugs installed in each cylinder.**	**2**
STARTER LOCKOUT: 6	**0** 1	**DISABLED: Automatic pre-glow time determined by ambient air temperature; engine start can be attempted at any time during pre-glow.** ENABLED: Automatic pre-glow time determined by ambient air temperature; engine start is NOT permitted until pre-glow is finished.	**0**
FUEL CUTOUT 7 *This menu item is only visible if non dual fuel engines are selected.	**0** 1 2	**RESTART: Engine allowed to be restarted multiple times when very low fuel level is reached.** ONE RESTART: Engine allowed to be restarted once for 2 minutes when very low fuel level is reached. ENGINE STOP: Engine not able to restart when very low fuel level is reached.	**0**
ENGINE SHUTDOWN: 8	0 **1**	DISABLED: No engine shutdown. **ENABLED: Shutdown engine when coolant temperature is greater than 110 deg. C or the oil pressure is less than 8 PSI.**	**1**
TILT: 9* *Certain market selections will limit tilt options and alter default setting. Note: Any of the selections above will light the tilt lamp when a tilted condition occurs and will sound the platform alarm when the machine is also above elevation.	**1** 2 3 4 5 6	**5 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also reduces drive speed to creep.** 4 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also reduces drive speed to creep. 3 DEGREES: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also reduces drive speed to creep. 4 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 3 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up. 5 DEGREES + CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also disallows tower lift up, tower telescope out, drive, main telescope out and main lift up.	**1**

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
JIB: 10* *Only visible under certain model selections.	**0** 1	**NO: No jib installed.** YES: Jib installed which has up and down movements only.	**0**
4 WHEEL STEER: 11* *Only visible under certain model selections.	**0** 1	**NO: No four-wheel steer installed.** YES: Four-wheel steer installed.	**0**
ST TOUCH / SKYGUARD: 12	**0** 1 2 3	**NONE: No soft touch or skyguard system installed.** SOFT TOUCH - Soft touch only installed. SKYGUARD - Skyguard only installed. BOTH (CUTOUT) - Soft touch and Skyguard installed.	**0**
GEN SET/WELDER: 13	**0** 1	**NO: No generator installed.** BELT DRIVE: Belt driven setup.	**0**
GEN SET CUTOUT: 14* *Only visible if Gen Set / Welder Menu selection is not 0.	**0** 1	**MOTION ENABLED: Motion enabled when generator is ON.** MOTION CUTOUT: Motion cutout in platform mode only.	**0**
H & T LIGHTS: 15	**0** 1	**NO: No head and tail lights installed.** YES: Head and tail lights installed.	**0**
CABLE SWITCH: 16* *Only visible under certain model selections. *Certain market and model selections will alter the default setting.	**0** 1	**NO: No broken cable switch installed.** YES: Broken cable switch installed.	**0**

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
LOAD SYSTEM: 17* *Only visible under certain market selections. *Certain market selections will limit load system options or alter default setting. *LOAD SYSTEM will not be visible in CE and defaulted to CUTOUT ALL for machines equipped with MSSO.	**0** 1 2 3 4	**NO: No load sensor installed.** WARN ONLY: Functions in creep, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT PLATFORM: All functions cutout, overload lamp lit, platform alarm beeps (5 sec ON, 2 sec OFF). CUTOUT ALL: All functions cutout, flash overload light (500mS on, 500mS off), platform alarm beeps (5 sec ON, 2 sec OFF). SPECIAL 1: Functions in creep, overload lamp lit, disables main telescope out & main lift up, platform alarm beeps (5 sec ON, 2 sec OFF).	**0**
LOAD SENSOR: 18* *Only visible if Load Sensor Menu selection is not 0 and under certain market selections. *Certain market selections will limit load sensor options.	0 **1**	1 ON ROTATOR: Use the on-board load sensor for all models except those which use the Leveling Platform Module. **4 UNDER PLATFORM: Use the EIM for load sensing.**	**1**
FUNCTION CUTOUT: 19* *Only visible under certain market selections. *Certain market selections will limit function cutout options or alter default setting.	**0** 1 2 3	**NO: No drive cutout.** BOOM CUTOUT: Boom function cutout while driving above elevation. DRIVE CUTOUT: Drive & steer cutout above elevation. DRIVE CUT E&T: Drive & steer cutout above elevation and tilted.	**0**
GROUND ALARM: 20* *Certain market selections will alter default setting.	0 1 2 **3**	NO: No ground alarm installed. DRIVE: Travel alarm sounds when the drive function is active (Option). DESCENT: Descent alarm sounds when lift down is active (Option). **MOTION: Motion alarm sounds when any function is active (Option).**	**3**

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
DRIVE: 21* *Only visible under certain model selections.	**0** 1 2	**4WD: Four wheel drive.** 2WD: Two wheel drive. 2WD W/ 2-SPEED: Two wheel drive with 2-speed valve.	**0**
DISPLAY UNITS: 22* *Certain market selections will alter default setting.	**0** 1	**IMPERIAL: DEG F , PSI, LBS.** METRIC: DEG C, KPA, KGS	**0**
LEVELING MODE: 23* *Only visible on 800S models.	**0** 1	**ALL FUNCTIONS: Platform level with all functions.** LEVEL LIFT/TELESCOPE: Platform level on lift and telescope only.	**0**
DRIVE CONTROL: 24	0 1 2	NORMAL: Drive coils are energized from the Ground Module. PROPULSION: Drive coils are energized from the Propulsion Module. **ENHANCED: Drive coils are energized from the Ground Module and the ground side of the drive coils are brought back to current feedback returns.**	**2**
DRIVE PUMP 25 *Only visible on 600A, 600S, and 800S models.	**0** 1 2 3	**SAUER DANFOSS: Machine equipped with Sauer Danfoss drive pump** EATON: Machine equipped with Eaton drive pump M46 - XXXX: Machine equipped with M46 - XXXX drive pump 830XXXXX: Machine equipped with 830XXXXX: drive pump	**0**
BOOM CONTROL: 26	**0** 1	**NORMAL: Boom function coils are energized from the Ground Module.** ENHANCED: Boom function are energized from the Ground Module and the ground side of the drive coils and brought back to current feedback returns.	**0**
FUNCTION SPEED KNOB 27	**0** 1	**YES: Machine is equipped with Function Speed Knob.** NO: Machine is equipped with Operation Speed Switch.	**0**

Table 6-5. Machine Configuration Programming Information

Configuration Digit	Number	Description	Default Number
CLEARSKY: 28	**0** 1	**NO: Clearsky (telematics) option is disabled.** YES: Clearsky (telematics) option is enabled.	**0**
CRIBBING OPTION: 29	**0** 1	**NO: Cribbing Option is disabled.** YES: Cribbing Option is enabled.	**0**
FUEL TANK SIZE: 30	**0** 1	**31 Gallon Tank** 52 Gallon Tank	**0**
ALARM / HORN: 31	**0** 1	**SEPERATE: Separate alarm and horn.** COMBINED: Combination alarm / horn.	**0**
ALERT / BEACON: 32	**0** 1	**OFF FOR CREEP: Alert beacon will not flash while in Creep.** 20FPS FOR CREEP: Alert beacon will flash at 20FPS while in Creep.	**0**
TEMP CUTOUT: 33	**0** 1	**NO: Temp Cutout is Disabled** YES: Temp Cutout is Enabled	**0**
PLAT LVL OVR CUT: 34	**0** 1	**NO: Platform Level Override will always be functional.** YES: Platform Level Override will only be functional when In Transport.	**0**
WATER IN FUEL SENSOR 35 *This menu item is only visible if Deutz EMR 4 engine is selected. *Only visible under certain market selections.	**0** **1**	**No: Water in Fuel Sensor Disabled.** YES: Water in Fuel Sensor Enabled.	**0**

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Table 6-6. 800S Machine Configuration Programming Settings

800 S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	10	10	10	10	10	10	10
Market	0	1	2	3	4	5	3
Engine	12	12	12	12	12	12	12
Flywheel Teeth	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Glow Plugs	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Starter Lockout	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Fuel Cutout	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Engine Shut-down	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Tilt	1	1	1	X	X	1	X
	2	2	2	X	2	2	X
	3	3	3	X	3	3	X
	4	4	4	4	4	4	4
	5	5	5	5	5	5	5
	6	6	6	X	X	6	X
Jib	0	0	0	0	0	0	0
4 Wheel Steer	0	0	0	0	0	0	0
Soft Touch/ Skyguard	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Gen Set / Welder	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Gen Set Cutout	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Head & Tail-lights	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Cable Break Switch	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Load System	0	0	0	0	0	0	0
	X	1	X	X	X	1	X
	X	2	X	2	2	2	2
	X	3	X	3	X	3	3
	X	4	X	X	X	4	X
Load Sensor	0	0	0	0	0	0	0
	1	1	1	1	1	1	1

Table 6-6. 800S Machine Configuration Programming Settings

800 S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Function Cut-out	0	0	0	0	0	0	0
	X	1	1	1	1	1	1
	2	2	2	X	2	2	2
	X	3	3	X	3	3	3
Ground Alarm	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Drive Type	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Display Units	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Leveling Mode	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Drive Control	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Drive Pump	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Boom Control	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Function Speed Knob	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Clearsky	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Cribbing Option	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Fuel Tank Size	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Alarm / Horn	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Alert Beacon	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
Temp Cutout	X	0	X	0	X	X	0
	X	1	X	1	X	X	1
Plat Lvl Ovr Cut	0	0	0	0	0	0	0
	1	1	1	1	1	1	1

Table 6-6. 800S Machine Configuration Programming Settings

800 S	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Water in Fuel Sensor	X	**0**	X	X	X	X	**0**
	X	1	X	X	X	X	1

BOLD BLUE text indicates the default setting. Plain text indicates another available selection. ***RED ITALIC*** text indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

Table 6-7. 860SJ Machine Configuration Programming Settings

860 SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Model Number	**10**	**10**	**10**	**10**	**10**	**10**	**10**
Market	**0**	**1**	**2**	**3**	**4**	**5**	**3**
Engine	**12**	**12**	**12**	**12**	**12**	**12**	**12**
Flywheel Teeth	0	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**	**1**
Glow Plugs	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Starter Lockout	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Fuel Cutout	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Engine Shut-down	0	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**	**1**
Tilt	**1**	**1**	**1**	X	X	**1**	X
	2	2	2	X	**2**	2	**X**
	3	3	3	X	3	3	X
	4	4	4	**4**	4	4	4
	5	5	5	5	5	5	5
	6	6	6	X	X	6	X
Jib	**1**	**1**	**1**	**1**	**1**	**1**	**1**
4 Wheel Steer	**0**	**0**	**0**	**0**	**0**	**0**	**0**
Soft Touch/ Skyguard	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	3	3	3	3	3	3
Gen Set / Welder	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Gen Set Cutout	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Head & Tail-lights	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1

Table 6-7. 860SJ Machine Configuration Programming Settings

860 SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Cable Break Switch	0	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**	**1**
Load System	**0**	**0**	**0**	0	0	0	0
	X	***1***	X	X	X	**1**	X
	X	2	X	2	**2**	2	**2**
	X	3	X	**3**	X	3	3
	X	4	X	X	X	4	X
Load Sensor	0	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**	**1**
Function Cut-out	**0**	**0**	**0**	0	**0**	**0**	**0**
	X	1	1	**1**	1	1	1
	2	2	2	X	2	2	2
	X	3	3	X	3	3	3
Ground Alarm	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
	3	**3**	**3**	**3**	**3**	**3**	**3**
Drive Type	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
	2	2	2	2	2	2	2
Display Units	**0**	**0**	0	0	0	0	0
	1	1	**1**	**1**	**1**	**1**	**1**
Leveling Mode	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Drive Control	0	0	0	0	0	0	0
	1	1	1	1	1	1	1
	2	**2**	**2**	**2**	**2**	**2**	**2**
Drive Pump	0	0	0	0	0	0	0
	1	**1**	**1**	**1**	**1**	**1**	**1**
	X	X	X	X	X	X	X
	X	X	X	X	X	X	X
Boom Control	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Function Speed Knob	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Clearsky	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Cribbing Option	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Fuel Tank Size	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Alarm / Horn	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1

Table 6-7. 860SJ Machine Configuration Programming Settings

860 SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan	GB
Alert Beacon	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Temp Cutout	X	**0**	X	**0**	X	X	0
	X	1	X	1	X	X	1
Plat Lvl Ovr Cut	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1	1
Water in Fuel Sensor	X	**0**	X	X	X	X	**0**
	X	1	X	X	X	X	1

BOLD BLUE text indicates the default setting. Plain text indicates another available selection. ***RED ITALIC*** text indicates the default when option is factory installed. SHADED CELLS indicate hidden menu or selection.

6.2 MACHINE PERSONALITY SETTINGS AND FUNCTION SPEEDS

NOTE: *Personality settings can be adjusted within the adjustment range in order to achieve optimum machine performance.*

Table 6-8. Machine Personality Settings

FUNCTION	PERSONALITY	RANGE	DEFAULTS-800S	DEFAULTS-860SJ
DRIVE	ACCELeration	0.1 to 5.0 s	2.0	2.0
	DECELeration	0.1 to 3.0 s	2.0	2.0
	FORward MINimum speed	0 to 35%%	4	4
	FORward MAXimum speed	0 to 100%	30	30
	REVerse MINimum speed	0 to 35%	4	4
	REVerse MAXimum speed	0 to 100%	30	30
	ELEVATED MAXimum speed	0 to 50%	20	20
	CREEP MAXimum speed	0 to 50%	20	20
	Engine RPM	800 to 2900	1800	1800
STEER	MAXimum speed	0 to 100%	100	100
	Engine RPM	800 to 2900	1800	1800
MAIN LIFT	ACCELeration	0.1 to 5.0s	2.5	2.5
	DECELeration	0.1 to 3.0s	1.5	1.5
	MINimum UP speed	0 to 60%	15	15
	MAXimum UP speed	0 to 100%	80	80
	CREEP maximum UP speed	0 to 65%	30	30
	MINimum DOWN speed	0 to 60%	15	15
	MAXimum DOWN speed	0 to 100%	80	80
	CREEP maximum DOWN speed	0 to 75%	30	30
	Engine RPM	800 to 2900	1800	1800
TOWER LIFT	ACCELeration	0.1 to 5.0s	N/A	N/A
	DECELeration	0.1 to 3.0s	N/A	N/A
	MINimum UP speed	0 to 60%	N/A	N/A
	MAXimum UP speed	0 to 100%	N/A	N/A
	MINimum DOWN speed	0 to 60%	N/A	N/A
	MAXimum DOWN speed	0 to 100%	N/A	N/A
	Engine RPM	800 to 2900	N/A	N/A
SWING	ACCELeration	0.1 to 5.0s	2.8	2.8
	DECELeration	0.1 to 3.0s	1.7	1.7
	MINimum LEFT speed	0 to 50%	14	14
	MAXimum LEFT speed	0 to 100%	65	65
	CREEP maximum LEFT speed	0 to 65%	43	43
	MINimum RIGHT speed	0 to 50%	14	14
	MAXimum RIGHT speed	0 to 100%	68	68
	CREEP maximum RIGHT speed	0 to 65%	49	49
	Engine RPM	800 to 2900	1800	1800

Table 6-8. Machine Personality Settings

FUNCTION	PERSONALITY	RANGE	DEFAULTS-800S	DEFAULTS-860SJ
MAIN TELESCOPE	ACCELeration	0.1 to 5.0s	3.5	3.5
	DECELeration	0.1 to 3.0s	1.0	1.0
	MINimum IN speed	0 to 65%	24	24
	MAXimum IN speed	0 to 100%	63	63
	MINimum OUT speed	0 to 65%	26	26
	MAXimum OUT speed	0 to 100%	65	65
	Medium Speed	0.01 to 1.00	0.50	0.50
	Engine RPM	800 to 2900	1800	1800
TELESCOPE TOWER	ACCELeration	0.1 to 5.0s	N/A	N/A
	DECELeration	0.1 to 3.0s	N/A	N/A
	MINimum IN speed	0 to 65%	N/A	N/A
	MAXimum IN speed	0 to 100%	N/A	N/A
	MINimum OUT speed	0 to 65%	N/A	N/A
	MAXimum OUT speed	0 to 100%	N/A	N/A
	Engine RPM	800 to 2900	N/A	N/A
PLATFORM LEVEL	ACCELeration	0.1 to 5.0s	0.1	0.1
	DECELeration	0.1 to 3.0s	0.1	0.1
	MINimum UP speed	0 to 65%	48	48
	MAXimum UP speed	0 to 100%	100	100
	MINimum DOWN speed	0 to 65%	48	48
	MAXimum DOWN speed	0 to 100%	100	100
	Medium Speed	0.01 to 1.00	0.10	0.10
	Engine RPM	800 to 2900	1800	1800
PLATFORM ROTATE	ACCELeration	0.1 to 5.0s	0.1	0.1
	DECELeration	0.1 to 3.0s	0.1	0.1
	MINimum LEFT speed	0 to 65%	69	69
	MAXimum LEFT speed	0 to 100%	90	90
	MINimum RIGHT speed	0 to 65%	69	69
	MAXimum RIGHT speed	0 to 100%	90	90
	Medium Speed	0.01 to 1.00	0.30	0.30
	Engine RPM	800 to 2900	1800	1800

Table 6-8. Machine Personality Settings

FUNCTION	PERSONALITY	RANGE	DEFAULTS-800S	DEFAULTS-860SJ
JIB LIFT	Lift ACCELeration	0.1 to 5.0s	N/A	3.3
	Lift DECELeration	0.1 to 3.0s	N/A	0.8
	MINimum UP speed	0 to 65%	N/A	43
	MAXimum UP speed	0 to 100%	N/A	80
	MINimum down	0 to 65%	N/A	40
	MAXimum Down	0 to 100%	N/A	75
	Medium Speed	0.01 to 1.00	N/A	0.60
	Engine RPM	800 to 2900	N/A	1800
GROUND MODE	Tower LIFT UP speed	0 to 100%	N/A	N/A
	Tower LIFT DOWN speed	0 to 100%	N/A	N/A
	Main LIFT UP speed	0 to 100%	63	63
	Main LIFT DOWN speed	0 to 100%	63	63
	SWING speed	0 to 100%	64	64
	Main TELEscope speed	0 to 100%	62	62
	Tower TELEscope speed	0 to 100%	N/A	N/A
	BASKET ROTATE speed	0 to 100%	89	89
	BASKET LEVEL speed	0 to 100%	99	99
	Jib LIFT (UP/DOWN) speed	0 to 100%	N/A	79
	Jib LIFT (LEFT/RIGHT) speed	0 to 100%	N/A	N/A
EXTENDABLE AXLES	REAR Axle Extend	0 to 100%	N/A	N/A
	REAR Axle Retract	0 to 100%	N/A	N/A
	REAR Jack Extend	0 to 100%	N/A	N/A
	REAR Jack Retract	0 to 100%	N/A	N/A
	FRONT Axle Extend	0 to 100%	N/A	N/A
	FRONT Axle Retract	0 to 100%	N/A	N/A
	FRONT Jack Extend	0 to 100%	N/A	N/A
	FRONT Jack Retract	0 to 100%	N/A	N/A
	Engine RPM	800 to 2900	N/A	N/A
Note: Ground Mode speed are automatically limited to being lower than platform speed for a given function.				
				4150384-K

6.3 MACHINE ORIENTATION WHEN DOING SPEED TESTS

Lift: Telescope Retracted. Lift Up, Record Time, Lift Down, Record Time.

Swing: Boom at Full Elevation. Telescope Retracted. Swing the Turntable 360 degrees, Record Time. Swing the Opposite Direction, Record Time.

Telescope: Boom at Full Elevation; Telescope Retracted; Telescope Out, Record Time. Telescope In, Record Time.

Drive (Forward/Reverse): Test should be done on a smooth level surface. Drive Select Switch should be set to High Engine. Results should be recorded for a 200 ft. course. Drive Forward, Record Time. Drive Reverse, Record Time.

Drive (Elevated): Test should be done on a smooth level surface. Drive Select Switch should be set to High Engine. Results should be recorded for a 50 ft. course. Drive Forward, Record Time. Drive Reverse, Record Time.

Platform Rotate: Platform level and completely rotated one direction. Rotate the opposite direction, Record Time. Rotate the other direction, Record Time.

Articulating Jib: Platform level and centered with the boom. Start with the Jib down. Jib Up, Record Time. Jib Down, Record Time.

Test Notes

1. Stop watch should be started with the function, not with the controller or switch.
2. All speed tests are run from the platform. These speeds do not reflect the ground control operation.
3. The platform speed knob control must be at full speed (turned clockwise completely).
4. Function speeds may vary due to cold, thick hydraulic oil. Test should be run with the oil temperature above 100° F (38° C).
5. Some flow control functions may not work with the speed knob clicked into the creep position.

Table 6-9. Function Speeds (In Seconds)

Function	800S	860SJ
Lift Up	59-75	56-73
Lift Down	57-75	56-75
Swing Right & Left*	110-135	110-135
NOTE: *No more than 10% difference between swing left and swing right.*		
Telescope Out	59-65	56-65
Telescope In	45-57	44-60
Platform Rotate Right & Left**	18-30	18-30
NOTE: *No more than 15% difference between rotate left and rotate right.*		
Jib Up	N/A	33-47
Jib Down	N/A	29-39
Drive (Forward)	33-45	33-45
Drive (Reverse)	33-45	33-45
Drive (Elevated)	46-75	46-75

6.4 CANBUS COMMUNICATIONS

CANbus: CAN (Control Area Network) is a two wire differential serial link between the Platform Module, Jib Module, Ground Module, Boom Length Angle Module and the Chassis Module providing bi-directional communications.

Two-wire: One wire (red) is driven high (5v) and the other low (black) (0v) to send a signal; both wires "float" (2.5v) when no signal is being sent.

Differential: Any electrical line noise can affect the high or the low wires but never both, so communications is not corrupted.

Serial Link: Messages are being sent bit by bit along the wires; the high bus speed allow all modules to be constantly updated around 20 times per second. Typical traffic is 300 - 500 messages per second.

A complete CANbus circuit is approximately 60 ohms, which can be verified at the "T" fitting inside the ground station or below the BLAM. Each individual circuit from the modules is approximately 120 ohms.

The GROUND MODULE (UGM) is the master system controller. Most functions are dispatched and coordinated from this module. The PLATFORM MODULE handle sub-tasks. All characterized information (values) are stored into the ground module (i.e., Personalities or Calibrations).

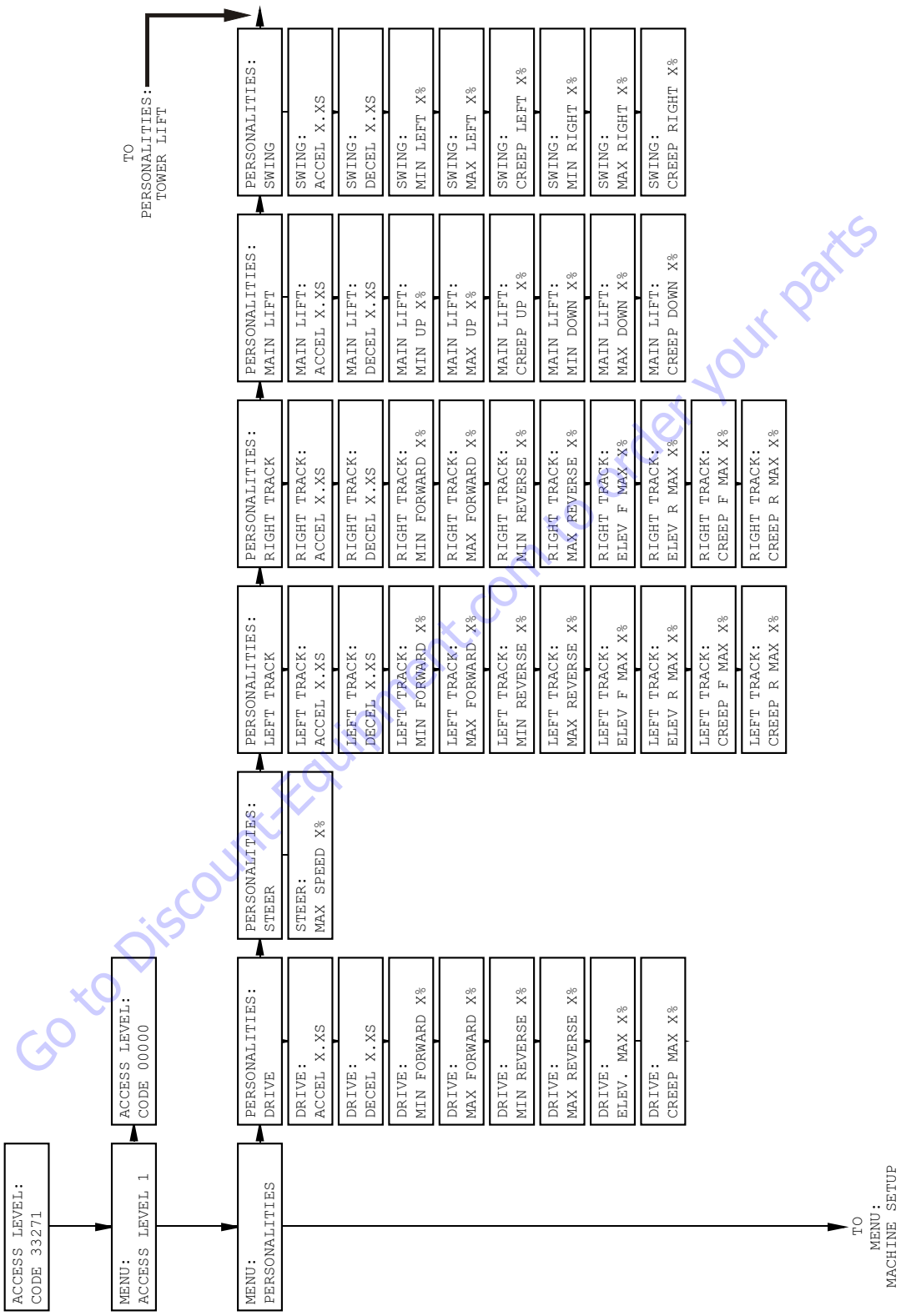
Interlocks: Any device that sends an electrical input. (For an example a limit switch, proximity switch, etc).

Platform Level: The GROUND MODULE stores the default values and handles interlocks. The PLATFORM MODULE reads the sensors mounted on the platform assembly and controls the Level Up / Down valves to maintain setpoint sent from the GROUND MODULE.

Steer: The GROUND MODULE stores crack points and sends desired drive direction, steering mode and axle extend/retract commands. The PLATFORM MODULE reports the steering switch position to the GROUND MODULE.

Drive: The GROUND MODULE stores crack points, sends commands for each drive pump. (Command is computed from drive joystick input, interlocks, wheel angle, etc).

Lift, Tele, & Swing: The GROUND MODULE stores default values and handles interlocks and calibration information. Lift, Telescope and Swing commands are dependent upon interlocks through out the machine. Boom angle, length and swing are controlled by the GROUND MODULE.



NOTE: *Some screens may not be available depending upon machine configuration*

Figure 6-3. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 1 of 4

Figure 6-4. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 2 of 4

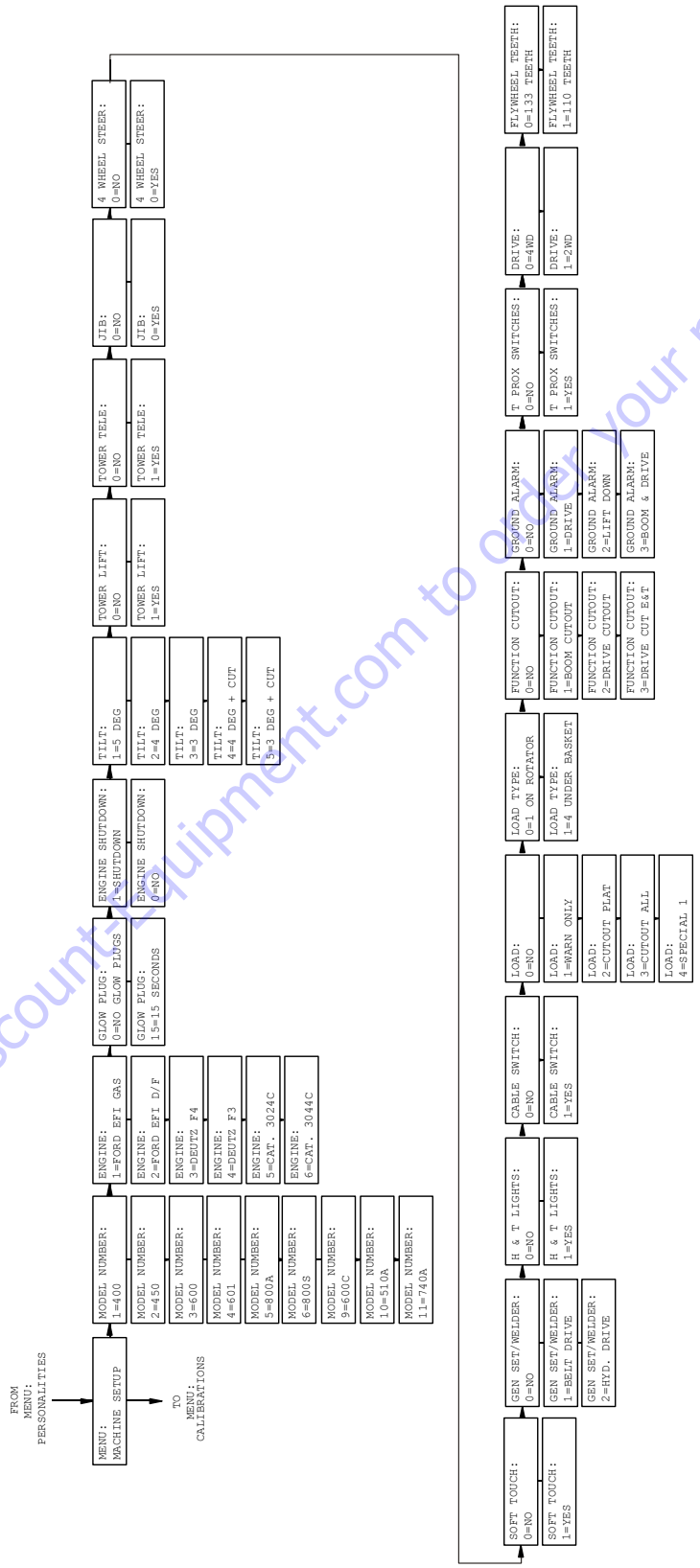
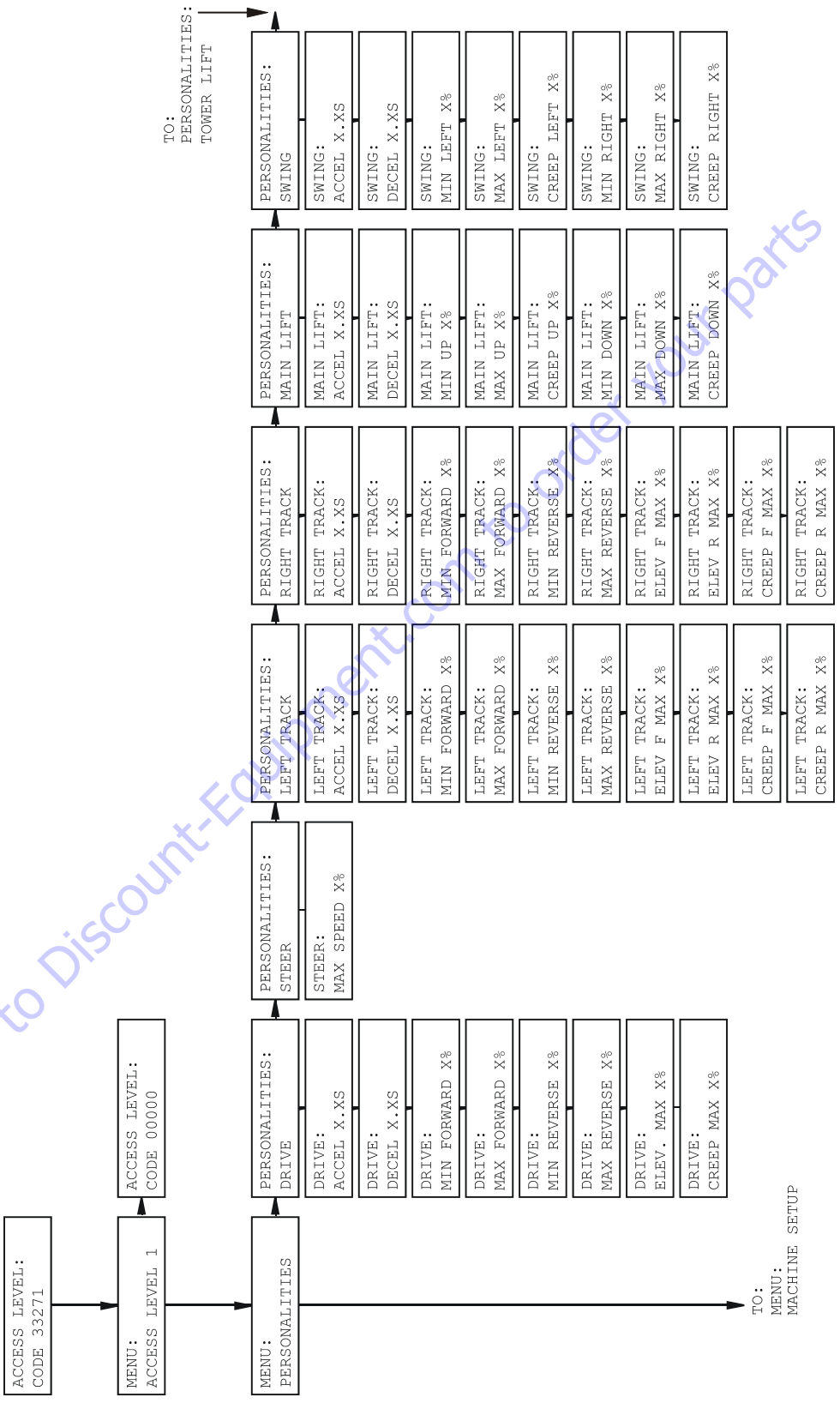


Figure 6-5. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 3 of 4

Figure 6-6. Analyzer Flow Chart, Prior to Version 5.X Software - Sheet 4 of 4



NOTE: *Some screens may not be available depending upon machine configuration.*

Figure 6-7. Analyzer Flow Chart, Version 5.X Software - Sheet 1 of 4

Figure 6-8. Analyzer Flow Chart, Version 5.X Software - Sheet 2 of 4

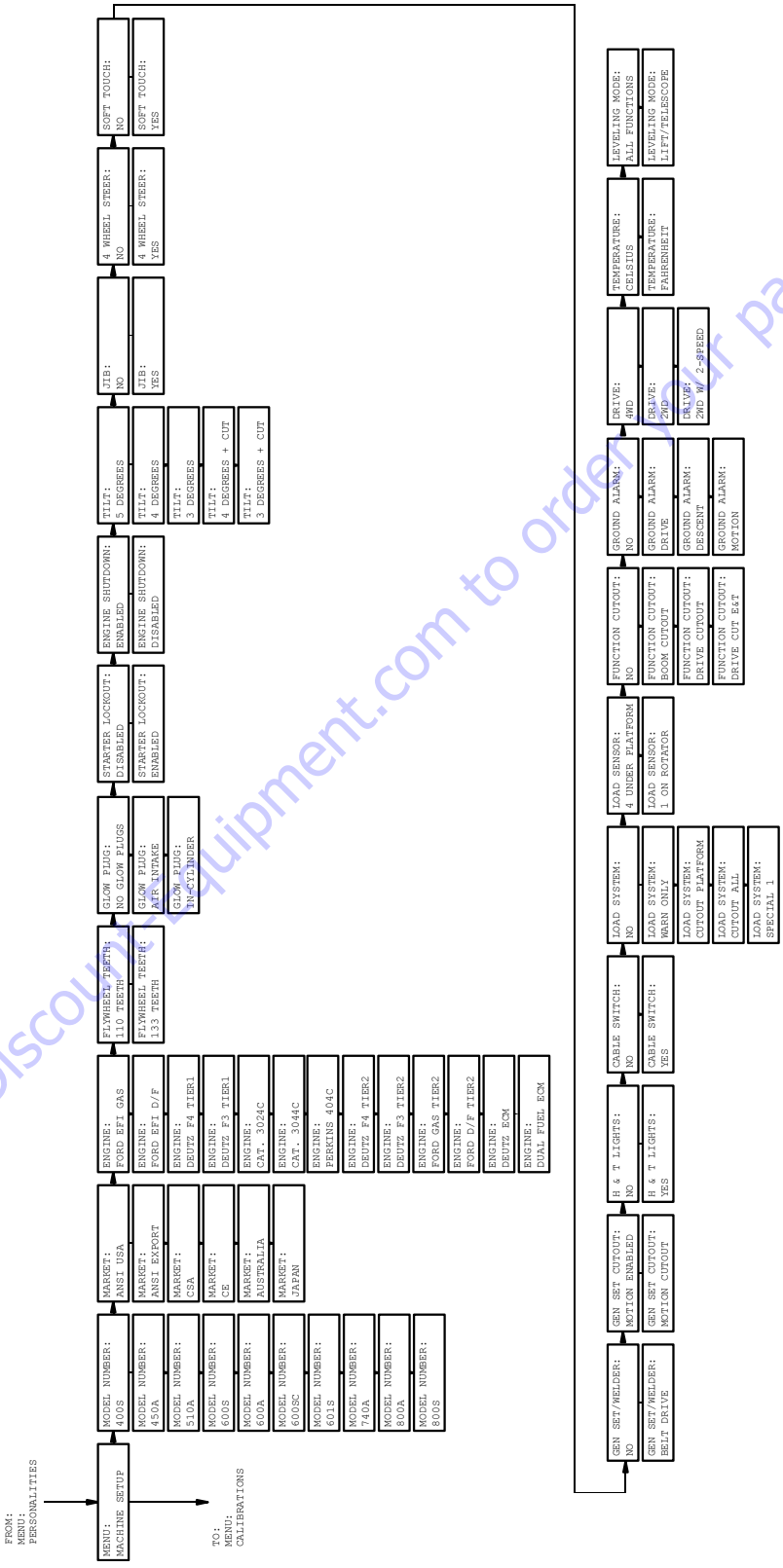


Figure 6-9. Analyzer Flow Chart, Version 5.X Software - Sheet 3 of 4

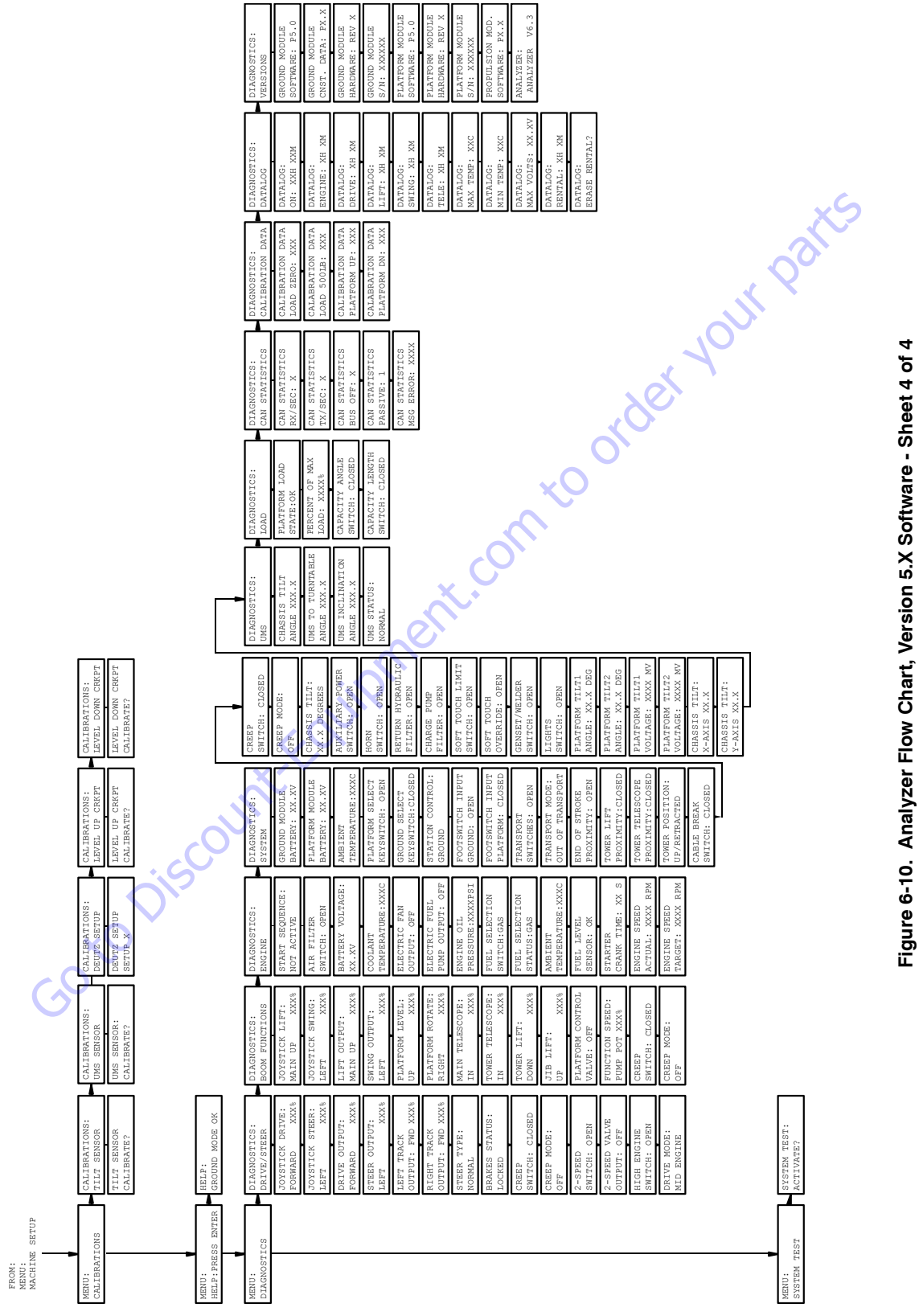


Figure 6-10. Analyzer Flow Chart, Version 5.X Software - Sheet 4 of 4

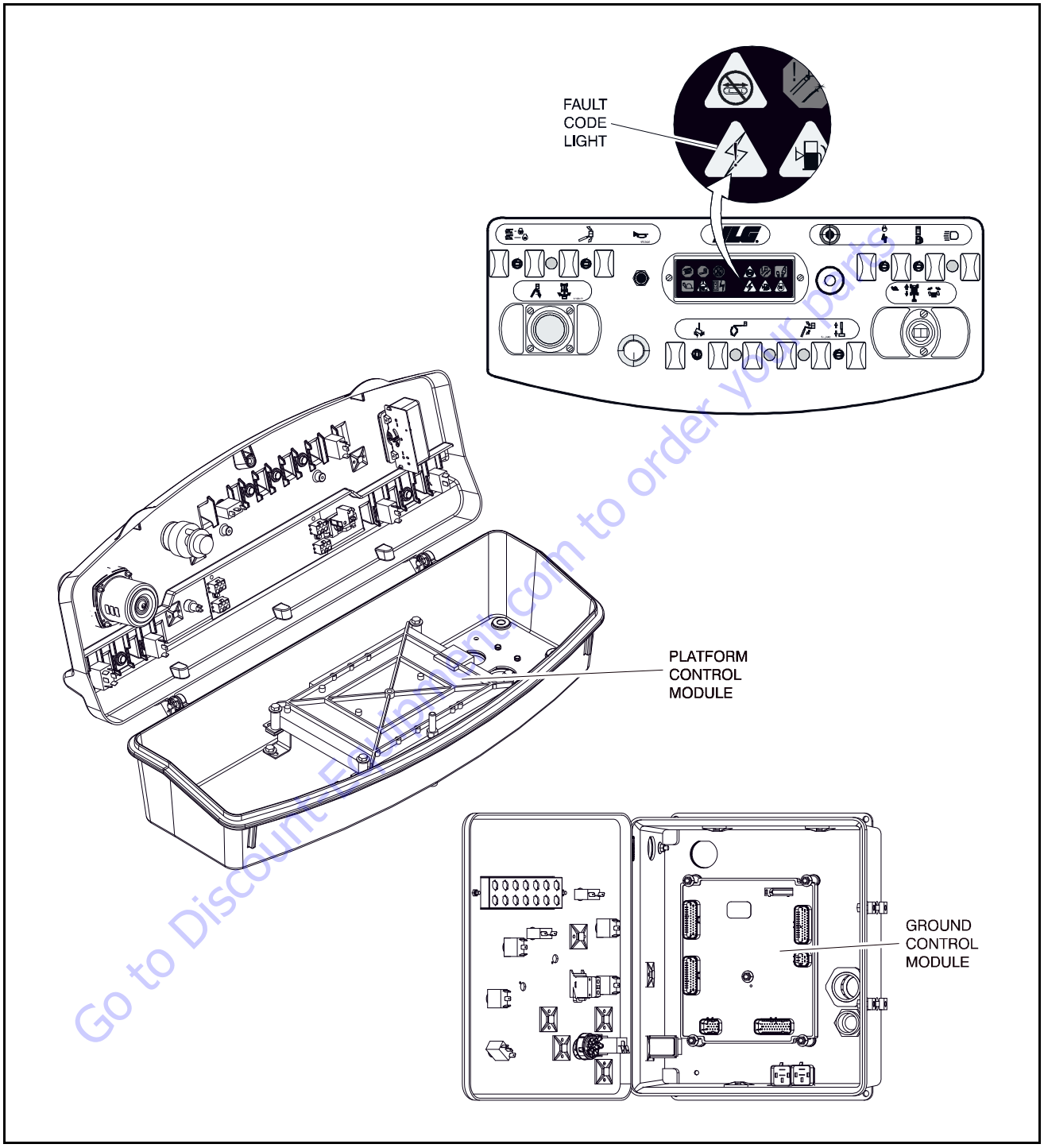
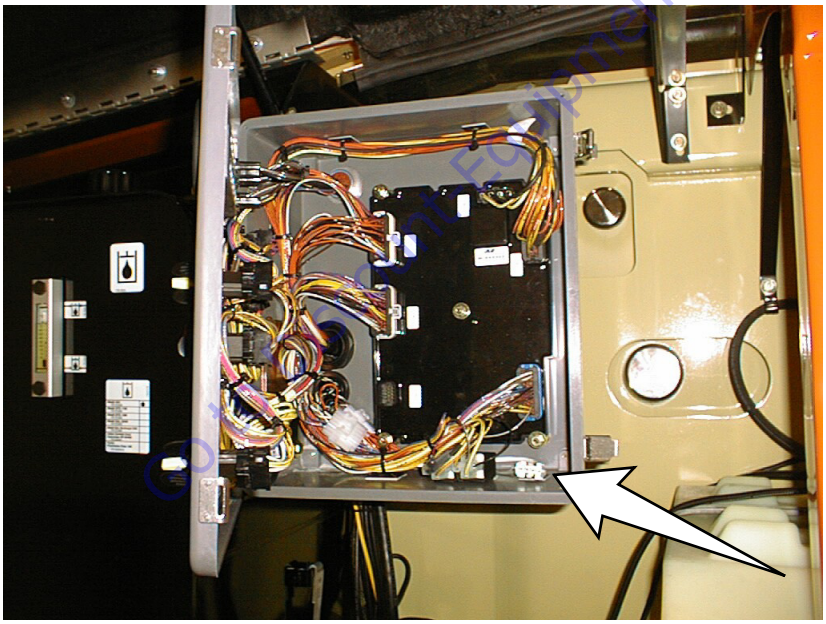


Figure 6-11. Fault Code Light and module Location

PLATFORM CONNECTION



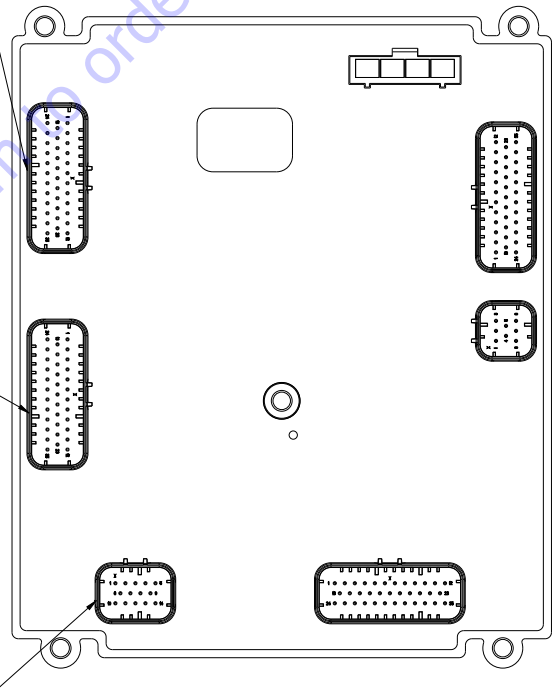
GROUND CONTROL CONNECTION

Figure 6-12. Analyzer Connecting Points

Connector	Pin	Function	Type	
J1 (Natural)	1	ENGINE THROTTLE ACTUATOR	DIGITAL	OUTPUT
	2	LP START ASSIST	DIGITAL	OUTPUT
	3	DRIVE / LEFT TRACK FORWARD COIL	DIGITAL	OUTPUT
	4	GROUND	GROUND	INPUT
	5	GROUND	GROUND	INPUT
	6	DRIVE / LEFT TRACK REVERSE COIL	DIGITAL	OUTPUT
	7	LP LOCK / ELECTRIC FAN DRIVE	DIGITAL	OUTPUT
	8	GROUND	GROUND	INPUT
	9	GROUND	GROUND	INPUT
	10	IGNITION ON RELAY / ALTERNATOR EXCITATION / FUEL ON SOLENOID	DIGITAL	OUTPUT
	11	START SOLENOID	DIGITAL	OUTPUT
	12	ENGAGE GLOW PLUGS	DIGITAL	OUTPUT
	13	APU ENABLE RELAY	DIGITAL	OUTPUT
	14	ENGINE COOLANT TEMPERATURE	ANALOG	INPUT
	15	ENGINE OIL PRESSURE	ANALOG	INPUT
	16	ENGINE SPEED	FREQUENCY	INPUT
	17	GROUND	GROUND	INPUT
	18	GROUND	GROUND	INPUT
	19	GROUND	GROUND	INPUT
	20	2-SPEED VALVE	DIGITAL	OUTPUT
	21	CHARGE PUMP FILTER BY-PASS	DIGITAL	INPUT
	22	GENERATOR ENABLE RELAY	DIGITAL	OUTPUT
	23	BRAKE VALVE	DIGITAL	OUTPUT
	24	NOT CONNECTED	N/C	N/C
	25	RS-485 HIGH	SERIAL	I/O
	26	RS-485 LOW	SERIAL	I/O
	27	GROUND	GROUND	INPUT
	28	ANALYZER POWER	VOLTAGE	OUTPUT
	29	ANALYZER RS-232 RX	SERIAL	INPUT
	30	ANALYZER RS-232 TX	SERIAL	OUTPUT
	31	ANALYZER GROUND	GROUND	INPUT
	32	ALTERNATOR EXCITATION	DIGITAL	OUTPUT
	33	RS-485 GROUND	GROUND	INPUT
	34	AIR FILTER BY-PASS	DIGITAL	INPUT
	35	NOT CONNECTED	DIGITAL	INPUT

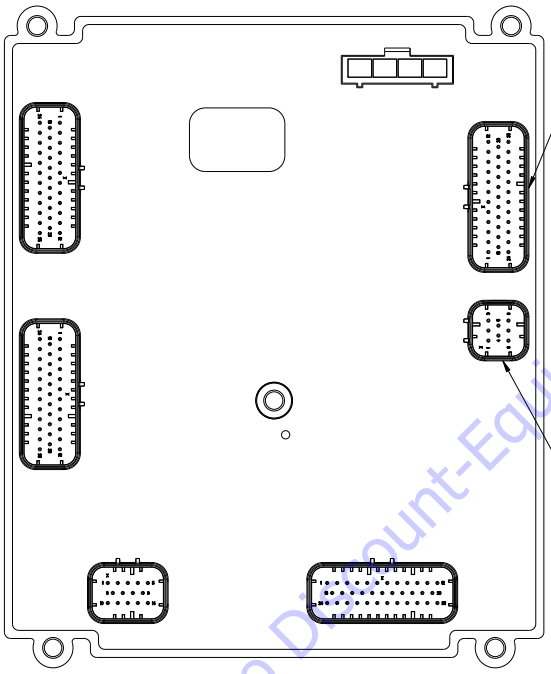
Connector	Pin	Function	Type	
J2 (Gray)	1	STEER DUMP VALVE	DIGITAL	OUTPUT
	2	HORN OUTPUT	DIGITAL	OUTPUT
	3	TOWER TELESCOPE IN SOLENOID	DIGITAL	OUTPUT
	4	MAIN TELESCOPE IN SOLENOID	DIGITAL	OUTPUT
	5	PLATFORM LEVEL UP SOLENOID	DIGITAL	OUTPUT
	6	GROUND	GROUND	INPUT
	7	PLATFORM LEVEL DOWN SOLENOID	DIGITAL	OUTPUT
	8	RIGHT TRACK REVERSE COIL	DIGITAL	OUTPUT
	9	NOT ALLOCATED	DIGITAL	OUTPUT
	10	PLATFORM ROTATE LEFT SOLENOID	DIGITAL	OUTPUT
	11	MAIN LIFT UP SOLENOID	DIGITAL	OUTPUT
	12	JIB UP SOLENOID	DIGITAL	OUTPUT
	13	MAIN DUMP VALVE	DIGITAL	OUTPUT
	14	GROUND	GROUND	INPUT
	15	TOWER TELESCOPE OUT SOLENOID	DIGITAL	OUTPUT
	16	MAIN TELESCOPE OUT SOLENOID	DIGITAL	OUTPUT
	17	GROUND	GROUND	INPUT
	18	GROUND	GROUND	INPUT
	19	RIGHT TRACK FORWARD COIL	DIGITAL	OUTPUT
	20	NOT ALLOCATED	DIGITAL	OUTPUT
	21	PLATFORM ROTATE RIGHT SOLENOID	DIGITAL	OUTPUT
	22	MAIN LIFT DOWN SOLENOID	DIGITAL	OUTPUT
	23	JIB DOWN SOLENOID	DIGITAL	OUTPUT
	24	RETURN FILTER BY-PASS	DIGITAL	INPUT
	25	FUEL LEVEL SENSOR	ANALOG	INPUT
	26	HEAD / TAIL LIGHT ENABLE RELAY	DIGITAL	OUTPUT
	27	ALARM OUTPUT	DIGITAL	OUTPUT
	28	GROUND	GROUND	INPUT
	29	GROUND	GROUND	INPUT
	30	GROUND	GROUND	INPUT
	31	FLOW CONTROL VALVE	DIGITAL	OUTPUT
	32	TOWER LIFT DOWN SOLENOID	DIGITAL	OUTPUT
	33	TOWER LIFT UP SOLENOID	DIGITAL	OUTPUT
	34	SWING LEFT SOLENOID	DIGITAL	OUTPUT
	35	SWING RIGHT SOLENOID	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J3 (Black)	1	DRIVE / LEFT TRACK CURRENT FEEDBACK	GROUND	INPUT
	2	RIGHT TRACK CURRENT FEEDBACK	GROUND	INPUT
	3	GROUND	GROUND	INPUT
	4	SWING CURRENT FEEDBACK	GROUND	INPUT
	5	NOT CONNECTED	GROUND	INPUT
	6	FLOW CONTROL CURRENT FEEDBACK	GROUND	INPUT
	7	BATTERY VOLTAGE	VBAT	OUTPUT
	8	UMS ANGLE SENSOR	DIGITAL	INPUT
	9	CRIBBING ENGAGE SWITCH	DIGITAL	INPUT
	10	NOT CONNECTED	DIGITAL	INPUT
	11	CONFIGURATION #1	DIGITAL	INPUT
	12	NOT CONNECTED	VOLTAGE	OUTPUT
	13	NOT CONNECTED	ANALOG	INPUT
	14	LIFT CURRENT FEEDBACK	GROUND	INPUT



1001103667 V

Figure 6-13. Ground Control Module - Sheet 1 of 3



Connector	Pin	Function	Type	
J7 (Black)	1	PLATFORM EMS	DIGITAL	INPUT
	2	PLATFORM MODE	DIGITAL	INPUT
	3	GROUND MODE	DIGITAL	INPUT
	4	CAPACITY ANGLE SWITCH	ANALOG	INPUT
	5	+5 VOLTS	VOLTAGE	OUTPUT
	6	CAN1 TERMINATOR	TERM	I/O
	7	CAPACITY LENGTH SWITCH	ANALOG	INPUT
	8	NOT CONNECTED	ANALOG	INPUT
	9	GROUND	GROUND	INPUT
	10	GROUND	GROUND	INPUT
	11	IN/OUT OF TRANSPORT SWITCHES	DIGITAL	INPUT
	12	BROKEN CABLE SWITCH	DIGITAL	INPUT
	13	CAN1 HIGH	SERIAL	I/O
	14	GROUND MODE POWER TO PLATFORM	DIGITAL	INPUT
	15	FOOTSWITCH	DIGITAL	INPUT
	16	+5 VOLTS	VOLTAGE	OUTPUT
	17	CAN1 TERMINATOR	TERM	I/O
	18	CAN1 SHEILD	GROUND	INPUT
	19	GROUND	GROUND	INPUT
	20	NOT CONNECTED	ANALOG	INPUT
	21	TOWER TELESCOPE PROXIMITY (800A ONLY)/DRIVE ORIENTATION SWITCH	DIGITAL	INPUT
	22	TOWER LIFT PROXIMITY (800A ONLY)	DIGITAL	INPUT
	23	GROUND FUNCTION ENABLE AVAILABLE	DIGITAL	INPUT
	24	CAN1 LOW	SERIAL	I/O
	25	GROUND	GROUND	INPUT
	26	+5 VOLTS	VOLTAGE	OUTPUT
	27	+5 VOLTS	VOLTAGE	OUTPUT
	28	GROUND	GROUND	INPUT
	29	BATTERY VOLTAGE	VBAT	OUTPUT
	30	BATTERY VOLTAGE	VBAT	OUTPUT
	31	BATTERY VOLTAGE	VBAT	OUTPUT
	32	BATTERY VOLTAGE	VBAT	OUTPUT
	33	BATTERY VOLTAGE	VBAT	OUTPUT
	34	BATTERY VOLTAGE (PROPULSION MODULE)	VBAT	OUTPUT
	35	BOOM ANGLE PROXIMITY SWITCH (800S ONLY)/DRIVE ORIENTATION SWITCH	DIGITAL	INPUT

Connector	Pin	Function	Type	
J12 (Black)	1	NOT CONNECTED	FREQUENCY	INPUT
	2	NOT CONNECTED	FREQUENCY	INPUT
	3	CAN2 HIGH (TELEMATICS)	SERIAL	I/O
	4	CAN2 LOW (TELEMATICS)	SERIAL	I/O
	5	CAN2 SHIELD (TELEMATICS)	GROUND	INPUT
	6	CAN2 TERMINATOR	TERM	I/O
	7	CAN2 TERMINATOR	TERM	I/O
	8	MSSO	DIGITAL	INPUT

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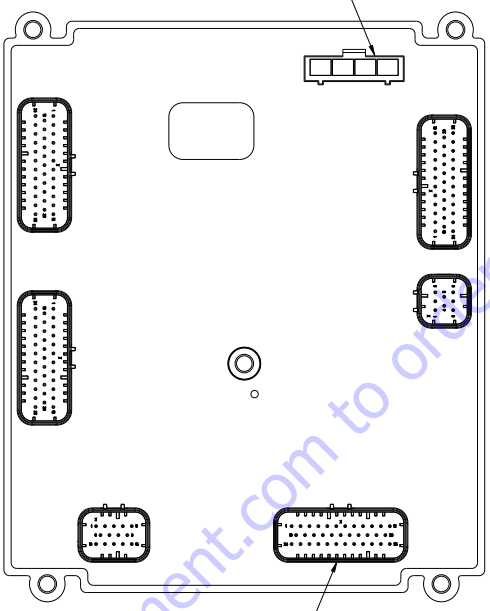
Figure 6-14. Ground Control Module - Sheet 2 of 3

Connector	Pin	Function	Type	
J8 (Black)	1	MODULE GROUND	GROUND	OUTPUT
	2	MODULE POWER	VBAT	INPUT
	3	GROUND TO PLATFORM MODULE	GROUND	INPUT
	4	POWER TO PLATFORM MODULE	VBAT	OUTPUT



Connector	Pin	Function	Type	
J4 (Blue)	1	CRIBBING ENGAGED INDICATOR	DIGITAL	OUTPUT
	2	500 LB CAPACITY LAMP	DIGITAL	OUTPUT
	3	GLOWPLUG INDICATOR	DIGITAL	OUTPUT
	4	ENGINE START	DIGITAL	INPUT
	5	PLATFORM LEVEL DOWN	DIGITAL	INPUT
	6	PLATFORM ROTATE LEFT	DIGITAL	INPUT
	7	MAIN TELESCOPE IN	DIGITAL	INPUT
	8	JIB DOWN	DIGITAL	INPUT
	9	JIB LEFT	DIGITAL	INPUT
	10	TOWER LIFT UP	DIGITAL	INPUT
	11	TOWER TELESCOPE IN	DIGITAL	INPUT
	12	HOURMETER	DIGITAL	OUTPUT
	13	RETURN FILTER BY-PASS LAMP	DIGITAL	OUTPUT
	14	PLATFORM OVERLOADED INDICATOR	DIGITAL	OUTPUT
	15	BOOM MALFUNCTION INDICATOR	DIGITAL	OUTPUT
	16	AUXILIARY POWER / FUNCTION ENABLE	DIGITAL	INPUT
	17	PLATFORM LEVEL UP	DIGITAL	INPUT
	18	PLATFORM ROTATE RIGHT	DIGITAL	INPUT
	19	JIB UP	DIGITAL	INPUT
	20	JIB RIGHT	DIGITAL	INPUT
	21	TOWER LIFT DOWN	DIGITAL	INPUT
	22	TOWER TELESCOPE OUT	DIGITAL	INPUT
	23	MAIN LIFT UP	DIGITAL	INPUT
	24	BATTERY VOLTAGE	VBAT	OUTPUT
	25	BATTERY VOLTAGE - (GROUND ENABLE PRESENT)	VBAT	OUTPUT
	26	BATTERY LOW / NOT CHARGING INDICATOR	DIGITAL	OUTPUT
	27	CHARGE PUMP FILTER BY-PASS LAMP	DIGITAL	OUTPUT
	28	ENGINE HIGH COOLANT TEMPERATURE INDICATOR	DIGITAL	OUTPUT
	29	ENGINE LOW OIL PRESSURE INDICATOR	DIGITAL	OUTPUT
	30	MAIN TELESCOPE OUT	DIGITAL	INPUT
	31	GROUND	GROUND	INPUT
	32	GROUND	GROUND	INPUT
	33	MAIN LIFT DOWN	DIGITAL	INPUT
	34	SWING LEFT	DIGITAL	INPUT
	35	SWING RIGHT	DIGITAL	INPUT

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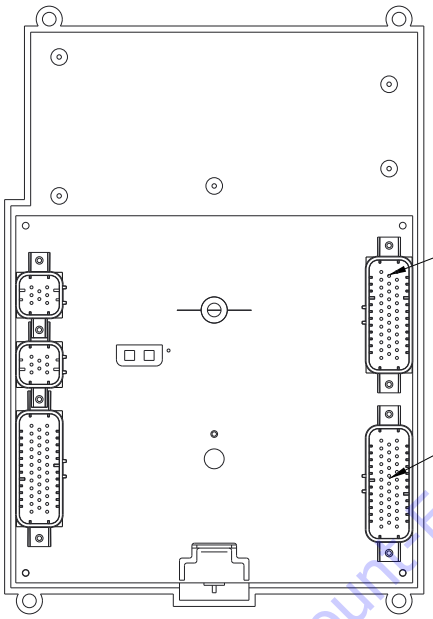
Figure 6-15. Ground Control Module - Sheet 3 of 3



CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J2 BLUE	1	UNALLOCATED	HS DIGITAL INPUT
	2	UNALLOCATED	HS DIGITAL INPUT
	3	BATTERY VOLTAGE	BATTERY VOLTAGE
	4	DRIVE ORIENTATION SYSTEM OVERRIDE SWITCH	HS DIGITAL INPUT
	5	PLATFORM STOWED	HS DIGITAL INPUT
	6	CHASSIS TILTED INDICATOR	LAMP OUTPUT
	7	FUNCTION ENABLE INDICATOR	LAMP OUTPUT
	8	VEHICLE SYSTEM DISTRESS INDICATOR	LAMP OUTPUT
	9	CREEP SPEED INDICATOR	LAMP OUTPUT
	10	BROKEN CABLE INDICATOR	LAMP OUTPUT
	11	PLATFORM OVERLOADED INDICATOR	LAMP OUTPUT
	12	500 LB CAPACITY INDICATOR	LAMP OUTPUT
	13	1000 LB CAPACITY INDICATOR	LAMP OUTPUT
	14	DRIVE ORIENTATION SYSTEM INDICATOR	LAMP OUTPUT
	15	GENERATOR ON INDICATOR	LAMP OUTPUT
	16	SOFT TOUCH TRIGGERED INDICATOR	LAMP OUTPUT
	17	GLOW PLUG ENGAGED INDICATOR	LAMP OUTPUT
	18	LAMP RETURN	GROUND
	19	UNALLOCATED	LAMP OUTPUT
	20	UPRIGHT TILTED INDICATOR	LAMP OUTPUT
	21	LOW FUEL INDICATOR	LAMP OUTPUT
	22	1/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	23	3/4 FUEL LEVEL INDICATOR	LAMP OUTPUT
	24	1/2 FUEL LEVEL INDICATOR	LAMP OUTPUT
	25	FUEL LEVEL INDICATORS RETURN	GROUND
	26	ANALYZER POWER	ANALYZER POWER
	27	ANALYZER GROUND	ANALYZER GROUND
	28	ANALYZER RX	ANALYZER RX
	29	ANALYZER TX	ANALYZER TX
	30	SPARE PIN	LAMP OUTPUT
	31	SPARE PIN	DIGITAL OUTPUT
	32	BATTERY VOLTAGE	BATTERY VOLTAGE
	33	BATTERY VOLTAGE	BATTERY VOLTAGE
	34	SWITCH POWER	BATTERY VOLTAGE
	35	FULL FUEL LEVEL INDICATOR	LAMP OUTPUT

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J1 NATURAL	1	TOWER LIFT UP	HS DIGITAL INPUT
	2	TOWER LIFT DOWN	HS DIGITAL INPUT
	3	TOWER TELESCOPE IN	HS DIGITAL INPUT
	4	TOWER TELESCOPE OUT	HS DIGITAL INPUT
	5	MAIN TELESCOPE IN	HS DIGITAL INPUT
	6	MAIN TELESCOPE OUT	HS DIGITAL INPUT
	7	PLATFORM ROTATE RIGHT	HS DIGITAL INPUT
	8	PLATFORM ROTATE LEFT	HS DIGITAL INPUT
	9	PLATFORM LEVEL UP	HS DIGITAL INPUT
	10	PLATFORM LEVEL DOWN	HS DIGITAL INPUT
	11	JIB UP	HS DIGITAL INPUT
	12	JIB DOWN	HS DIGITAL INPUT
	13	SPEED PUMP POTENTIOMETER GROUND	GROUND
	14	ENGINE START	HS DIGITAL INPUT
	15	AUXILIARY POWER	HS DIGITAL INPUT
	16	CRAB STEER SELECT	HS DIGITAL INPUT
	17	COORDINATED STEER SELECT	HS DIGITAL INPUT
	18	SWITCH POWER	BATTERY VOLTAGE
	19	JIB 1000LB ENABLE	HS DIGITAL INPUT
	20	EIM PLATFORM OVERLOAD	HS DIGITAL INPUT
	21	500/1000 LB. CAPACITY SELECT	HS DIGITAL INPUT
	22	DRIVE ORIENTATION SYSTEM FEATURE ENABLE	HS DIGITAL INPUT
	23	SPARE PIN	HS DIGITAL INPUT
	24	SPARE PIN	HS DIGITAL INPUT
	25	LEVEL SENSOR 1 SIGNAL	HS DIGITAL INPUT
	26	LEVEL SENSOR 2 SIGNAL	HS DIGITAL INPUT
	27	TWO SPEED VALVE (HIGH ENGINE)	HS DIGITAL INPUT
	28	TORQUE MODE	HS DIGITAL INPUT
	29	SOFT TOUCH OVERRIDE	HS DIGITAL INPUT
	30	HEAD/TAIL LIGHT	HS DIGITAL INPUT
	31	HORN	HS DIGITAL INPUT
	32	CREEP MODE	HS DIGITAL INPUT
	33	DUAL-FUEL SELECT	HS DIGITAL INPUT
	34	SPEED PUMP POTENTIOMETER REFERENCE VOLTAGE	+7 REFERENCE VOLTAGE
	35	SPEED PUMP POTENTIOMETER	ANALOG INPUT

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Figure 6-16. Platform Control Module - Sheet 1 of 2

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J8	1	MODULE GROUND	GROUND
	2	MODULE POWER	BATTERY VOLTAGE

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J5 NATURAL	1	LIFT / SWING JOYSTICK SUPPLY VOLTAGE	SUPPLY VOLTAGE
	2	LIFT CENTER TAP	ANALOG INPUT
	3	LIFT SIGNAL	ANALOG INPUT
	4	SWING SIGNAL	ANALOG INPUT
	5	SWING CENTER TAP	ANALOG INPUT
	6	NOT CONNECTED	ANALOG INPUT
	7	LIFT / SWING JOYSTICK RETURN	GROUND
	8	SPARE PIN	BLANK

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J6 BLACK	1	DRIVE / STEER JOYSTICK SUPPLY VOLTAGE	SUPPLY VOLTAGE
	2	DRIVE CENTER TAP	ANALOG INPUT
	3	DRIVE SIGNAL	ANALOG INPUT
	4	STEER SIGNAL	ANALOG INPUT
	5	STEER LEFT	ANALOG INPUT
	6	STEER RIGHT	ANALOG INPUT
	7	DRIVE / STEER JOYSTICK RETURN	GROUND
	8	SPARE PIN	BLANK

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J7 BLACK	1	GROUND MODE	GROUND MODE
	2	PLATFORM EMS	PLATFORM EMS
	3	PLATFORM EMS TO GROUND MODULE	PLATFORM MODE
	4	FOOTSWITCH (FUNCTION ENABLE SWITCH) POWER	BATTERY VOLTAGE
	5	PLATFORM ROTATE LEFT	ME DIGITAL OUTPUT
	6	PLATFORM ROTATE RIGHT	ME DIGITAL OUTPUT
	7	SOFT TOUCH LIMIT SWITCH POWER	BATTERY VOLTAGE
	8	FOOTSWITCH SIGNAL	DIGITAL INPUT
	9	GENERATOR ON SIGNAL	DIGITAL INPUT
	10	+7 REFERENCE VOLTAGE	+7 REFERENCE VOLTAGE
	11	SPARE PIN	+5V REFERENCE VOLTAGE
	12	SPARE PIN	+5V REFERENCE VOLTAGE
	13	SPARE PIN	ANALOG INPUT
	14	GROUND RETURN	GROUND
	15	PLATFORM LEVEL UP	HS DIGITAL OUTPUT
	16	PLATFORM LEVEL DOWN	HS DIGITAL OUTPUT
	17	JIB BLOCK LIMIT SWITCH	HS DIGITAL INPUT
	18	SOFT TOUCH LIMIT SWITCH	HS DIGITAL INPUT
	19	PLATFORM ALARM	LAMP OUTPUT
	20	ALARM RETURN	GROUND
	21	SPARE PIN	GROUND
	22	SPARE PIN	GROUND
	23	SPARE PIN	ANALOG INPUT
	24	SPARE PIN	DIGITAL OUTPUT
	25	JIB UP	ME DIGITAL OUTPUT
	26	JIB DOWN	ME DIGITAL OUTPUT
	27	JIB RIGHT	ME DIGITAL OUTPUT
	28	JIB LEFT	ME DIGITAL OUTPUT
	29	GROUND RETURN	GROUND
	30	CAN LOW	CAN LOW
	31	CAN HIGH	CAN HIGH
	32	CAN SHIELD	CAN SHIELD
	33	SPARE PIN	GROUND
	34	SPARE PIN	GROUND
	35	SPARE PIN	ANALOG INPUT

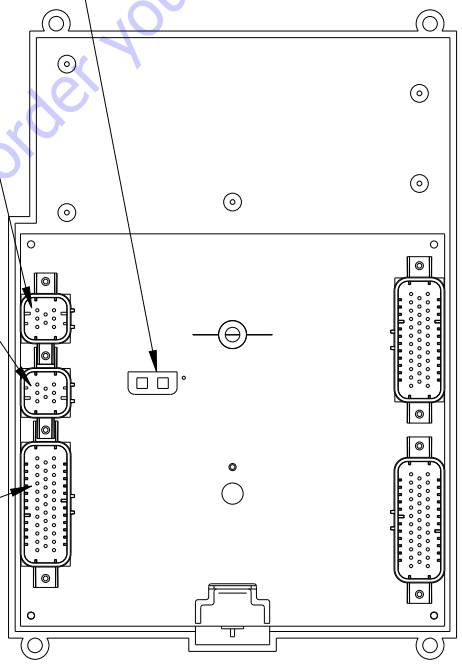

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Figure 6-17. Platform Control Module - Sheet 2 of 2

Analyzer Diagnostics Menu Structure

In the following structure descriptions, an intended item is selected by pressing ENTER; pressing **ESC** steps back to the next outer level. The **LEFT**/**RIGHT** arrow keys move between items in the same level. The **UP** / **DOWN** arrow keys alter a value if allowed.

Table 6-10. ADJUSTMENTS - Personality Descriptions

DRIVE	
ACCEL	Displays/adjusts drive acceleration
DECEL	Displays/adjusts drive deceleration
MIN FORWARD	Displays/adjusts minimum forward drive speed
MAX FORWARD	Displays/adjusts maximum forward drive speed
MIN REVERSE	Displays/adjusts minimum reverse drive speed
MAX REVERSE	Displays/adjusts maximum reverse drive speed
ELEVATED MAX	Displays/adjusts maximum drive speed NOTE: used when elevation cutout switches are limiting maximum speed
CREEP MAX	Displays/adjusts maximum drive speed NOTE: used when creep switch on pump pot is active
STEER MAX	Displays/adjusts the maximum steer speed
LIFT	
ACCEL	Displays/adjusts upper lift acceleration
DECEL	Displays/adjusts upper lift deceleration
MIN UP	Displays/adjusts minimum upper lift up speed
MAX UP	Displays/adjusts maximum upper lift up speed
CREEP UP	Displays/adjusts maximum upper lift up speed NOTE: used when creep switch on pump pot is active
MIN DOWN	Displays/adjusts minimum upper lift down speed
MAX DOWN	Displays/adjusts maximum upper lift down speed
CREEP DOWN	Displays/adjusts maximum upper lift down speed NOTE: used when creep switch on pump pot is active
SWING	
ACCEL	Displays/adjusts swing acceleration
DECEL	Displays/adjusts swing deceleration
MIN LEFT	Displays/adjusts minimum swing left speed
MAX LEFT	Displays/adjusts maximum swing left speed

Table 6-10. ADJUSTMENTS - Personality Descriptions

CREEP LEFT	Displays/adjusts maximum swing left speed NOTE: used when creep switch on pump pot is active
MIN RIGHT	Displays/adjusts minimum swing right speed
MAX RIGHT	Displays/adjusts maximum swing right speed
CREEP RIGHT	Displays/adjusts maximum swing right speed NOTE: used when creep switch on pump pot is active
MAIN TELESCOPE	
ACCEL	Displays/adjusts telescope acceleration
DECEL	Displays/adjusts telescope deceleration
MIN IN	Displays/adjusts minimum telescope in speed
MAX IN	Displays/adjusts maximum telescope in speed
MIN OUT	Displays/adjusts minimum telescope out speed
MAX OUT	Displays/adjusts maximum telescope out speed
BASKET LEVEL	
ACCEL	Displays/adjusts basket level acceleration
DECEL	Displays/adjusts basket level deceleration
MIN UP	Displays/adjusts minimum basket level up speed
MAX UP	Displays/adjusts maximum basket level up speed
MIN DOWN	Displays/adjusts minimum basket level down speed
MAX DOWN	Displays/adjusts maximum basket level down speed
BASKET ROTATE	
ACCEL	Displays/adjusts basket rotate acceleration
DECEL	Displays/adjusts basket rotate deceleration
MIN LEFT	Displays/adjusts minimum basket rotate left speed
MAX LEFT	Displays/adjusts maximum basket rotate left speed
MIN RIGHT	Displays/adjusts minimum basket rotate right speed
MAX RIGHT	Displays/adjusts maximum basket rotate right speed
JIB LIFT	Not displayed if JIB = NO
ACCEL	Displays/adjusts jib acceleration
DECEL	Displays/adjusts jib deceleration
MIN UP	Displays/adjusts minimum jib up speed
MAX UP	Displays/adjusts maximum jib up speed
MIN DOWN	Displays/adjusts minimum jib down speed

Table 6-10. ADJUSTMENTS - Personality Descriptions

MAX DOWN	Displays/adjusts maximum jib down speed
MIN LEFT	Displays/adjusts minimum jib left speed
MAX LEFT	Displays/adjusts maximum jib left speed
MIN RIGHT	Displays/adjusts minimum jib right speed
MAX RIGHT	Displays/adjusts maximum jib right speed
STEER	
MAX SPEED	Displays/adjusts maximum steer speed, which applies when vehicle speed is at minimum
GROUND MODE	
LIFT UP	Displays/adjusts fixed lift up speed
LIFT DOWN	Displays/adjusts fixed lift down speed
SWING	Displays/adjusts fixed swing speed
TELE	Displays/adjusts fixed telescope speed
BASKETLEVEL	Displays/adjusts fixed basket level speed
BASKETROTATE	Displays/adjusts fixed basket rotate speed
JIB (U/D)	Displays/adjusts jib lift speed Not displayed if JIB = NO
JIB (L/R)	Displays/adjusts jib swing speed Not displayed if JIB = NO

Table 6-11. Diagnostic Menu Descriptions

DRIVE	
DRIVE FOR . . .	Displays drive joystick direction & demand
STEER . . .	Displays steer switch direction & demand NOTE: steer demand is inversely proportional to vehicle speed
BRAKES . . .	Displays brake control system status
CREEP . . .	Displays pump pot creep switch status
TWO SPEED...	Displays two speed switch status
2 SPEED MODE	Displays status of two speed valve
HIGH ENGINE	Displays high engine switch status
BOOM	
U LIFT UP . . .	Displays lift joystick direction & demand
SWING LEFT . . .	Displays swing joystick direction & demand
LEVEL UP . . .	Displays basket level switch direction & demand NOTE: demand is controlled by the pump pot
ROT. LEFT . . .	Displays basket rotate switch direction & demand NOTE: demand is controlled by the pump pot
U TELE IN . . .	Displays telescope switch direction & demand NOTE: demand is controlled by the pump pot
JIB UP . . .	Displays jib lift switch direction & demand NOTE: demand is controlled by the pump pot Not displayed if JIB = NO
JIB LEFT . . .	Displays jib swing switch direction & demand NOTE: demand is controlled by the pump pot Not displayed if JIB = NO
PUMP POT . . .	Displays pump pot demand
ENGINE	
START . . .	Displays start switch status
AIR FILTER . . .	Displays air filter status
BATTERY . . .	Displays measured battery voltage
COOLANT . . .	Displays coolant temperature
OIL PRS . . .	Displays oil pressure status
FUEL SELECT . . .	Displays selected fuel (Dual Fuel only)
FUEL LEVEL . . .	Displays fuel level status
RPM	Displays Engine RPM
GM BATTERY	Displays battery voltage at ground module

Table 6-11. Diagnostic Menu Descriptions

PM BATTERY . . .	Displays battery voltage at platform module
TEMP...	Displays ground module temperature
ELEV. CUTOUT . . .	Displays elevation cutout switch status
FUNC. CUTOUT . . .	Displays function cutout switch status
CREEP. . .	Displays creep switch status
TILT . . .	Displays measured vehicle tilt
AUX POWER . . .	Displays status of auxiliary power switch
HORN . . .	Displays status of horn switch
R FILTER . . .	Displays status of return filter switch
C FILTER . . .	Displays status of charge pump filter
LOAD LENGTH . . .	Displays length switch status
ANGLE . . .	Displays angle switch status
LOAD . . .	Displays load sensor value NOTE: Not displayed if load = 0.
DATALOG	
ON . . .	Displays total controller on (EMS) time
ENGINE . . .	Displays engine run time
DRIVE . . .	Displays total controller drive operation time
LIFT . . .	Displays total controller lift operation time
SWING . . .	Displays total controller swing operation time
TELE . . .	Displays total controller tele operation time
MAX.TEMP . . .	Displays maximum measured heatsink temp.
MIN.TEMP . . .	Displays minimum measured heatsink temp.
MAX.VOLTS . . .	Displays maximum measured battery voltage
RENTAL . . .	Displays total controller operation time NOTE: can be reset
ERASE RENTAL	Not available at password level 2
YES:ENTER, NO:ESC	ENTER resets rental datalog time to zero
VERSIONS	
GROUND . . .	Displays ground module software version
PLATFORM . . .	Displays platform module software version
ANALYSER . . .	Displays Analyzer software version

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
001	00	1	EVERYTHING OK	The normal help message in Platform Mode.	No response required for this DTC.
002	00	2	GROUND MODE OK	The normal help message in Platform Mode.	No response required for this DTC.
0010	00	10	RUNNING AT CUTBACK - OUT OF TRANSPORT POSITION	Drive speed is limited to "ELEVATED MAX" while the vehicle is out of transport position.The normal help message in Ground Mode.	Response described in Drive Modes section.
000	**00**	**0**	**<<< HELP COMMENT >>>**		
0011	00	11	FSW OPEN (Foot switch open)	A drive / boom function was selected with the Footswitch open.	The UGM shall not Enable the Machine.
0012	00	12	RUNNING AT CREEP - CREEP SWITCH OPEN	All functions at creep while the Creep Switch is open.	The UGM shall limit the machine to Creep speed.
0013	00	13	RUNNING AT CREEP - TILTED AND ABOVE ELEVATION	All functions at creep while the Platform is elevated and the Chassis is tilted.	
0014	00	14	CHASSIS TILT SENSOR OUT OF RANGE	The Chassis is tilted > 19 degrees for more then 4 seconds.	Not reported during power-up.
0015	00	15	LOAD SENSOR READING UNDER WEIGHT	The Load Sensing System indicates > 20% under calibrated zero point.	
0031	00	31	FUEL LEVEL LOW - ENGINE SHUTDOWN	Engine Shutdown has occurred due to Fuel Level = EMPTY condition.	Response described in Fuel Shutdown section.
0035	00	35	APU ACTIVE	Auxiliary Power/Emergency Descent Mode is active.	Response described in Auxiliary Power/Emergency Descent Mode section.
0039	00	39	SKYGUARD ACTIVE - FUNCTIONS CUTOUT	Response described in Auxiliary Power/ Emergency Descent Mode section.	Response described in SkyGuard section.
0040	00	40	RUNNING AT CREEP - CREEP SWITCH CLOSED	All Function speeds are limited to creep because the creep switch is closed.	
210	**21**	**0**	**<<< POWER-UP >>>**		
211	21	1	POWER CYCLE	The normal help message is issued at each power cycle.	
212	21	2	KEYSWITCH FAULTY	Both Platform and Ground modes are selected simultaneously.	The UGM shall assume a station selection of Ground.
213	21	3	FSW FAULTY	Both Footswitches are closed for more then one second.	The UGM shall not Enable the Machine.
220	**22**	**0**	**<<< PLATFORM CONTROLS >>>**		
227	22	7	STEER SWITCHES FAULTY	Both Steer Left and Steer Right inputs are closed simultaneously.	The UGM shall prohibit Steer; The UGM shall limit Drive to Creep The Steer Left switch input = Low; The Steer Right switch input = Low; Steer and full Drive speed permitted after controls are initialized.
2211	22	11	FSW INTERLOCK TRIPPED	The Footswitch was closed for more then seven seconds.	Can be reported during power- up.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
2212	22	12	DRIVE LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	A drive function was selected with Foot-switch open.	Can be reported during power- up.
2213	22	13	STEER LOCKED - SELECTED BEFORE FOOTSWITCH	A steer function was selected with Foot-switch open.	The UGM shall not Enable the Machine.
2214	22	14	DRIVE/STEER LOCKED - JOYSTICK MOVED BEFORE ENABLE	Drive/Steer was selected before Enable switch activated.	
2216	22	16	D/S JOY. OUT OF RANGE HIGH	The D/S Joystick reference voltage is > 8.1V.	Resistive joysticks. If the reference voltage is > 7.7V then the reference voltage is out of tolerance of a short to battery has occurred.
2217	22	17	D/S JOY. CENTER TAP BAD	The D/S Joystick center tap voltage is < 3.08V or > 3.83V.	Resistive joysticks. - There is a +/-.1V range. around these values due to resistor tolerances.
2219	22	19	L/S JOY. OUT OF RANGE HIGH	The L/S Joystick reference voltage is > 8.1V.	Resistive joysticks. - If the reference voltage is > 7.7V then the reference voltage is out of tolerance of a short to battery has occurred.
2220	22	20	L/S JOY. CENTER TAP BAD	The L/S Joystick center tap voltage is < 3.08V or > 3.83V.	Resistive joysticks. - There is a +/- .1V range. around these values due to resistor tolerances.
2221	22	21	LIFT/SWING LOCKED - JOYSTICK MOVED BEFORE FOOTSWITCH	A lift / swing function was selected with Footswitch open.	If triggered by the Lift and/or Swing joystick not being in the neutral position at Startup, the UGM shall pro-hibit Lift and Swing. If triggered by Lift and/or Swing joystick is not in the neutral position when Foot-switch becomes active or while DTC 2212, 2213 or 2223 is active, the UGM shall not Enable the Machine.
2222	22	22	WAITING FOR FSW TO BE OPEN	The Footswitch was closed during Platform selection.	Can be reported during power- up.
2223	22	23	FUNCTION SWITCHES LOCKED - SELECTED BEFORE ENABLE	A boom function was selected with Foot-switch open.	The UGM shall not Enable the Machine.
2224	22	24	FOOTSWITCH SELECTED BEFORE START	The Footswitch was closed during engine start.	The UGM shall prohibit Engine Start.
2269	22	69	FUNCTION PROBLEM - HIGH SPEED & CREEP ACTIVE TOGETHER		

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
234	23	4	FUNCTION SWITCHES FAULTY - CHECK DIAGNOSTICS/BOOM	A boom function has both directions selected together.	Disable whichever boom functions whose boom control inputs are triggering the fault. If Engine Start/Aux at fault, disable Engine Start but permit Auxiliary Power/ Emergency Descent.
235	23	5	FUNCTION SWITCHES LOCKED - SELECTED BEFORE AUX POWER	A boom function was selected before aux power.	
236	23	6	FUNCTION SWITCHES LOCKED - SELECTED BEFORE START SWITCH	A boom function was selected before engine start.	
237	23	7	START SWITCH LOCKED - SELECTED BEFORE KEYSWITCH	The Start Switch was closed during power-up.	The UGM shall prohibit Engine Start.
23163	23	163	FUNCTION PROBLEM - MSSO PERMANENTLY SELECTED	The MSSO switch input = Low at Startup.	No response required for this DTC Power Cycled.
240	**24**	**0**	**<<< OTHER CONTROLS >>>**		
241	24	1	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE LOW	MACHINE SETUP > TEMP CUTOUT = YES; Ambient Temperature sensor reading - 50C.	The UGM shall set Low Temperature Cutout state = Faulty If the Machine is in Platform Mode and if the Boom is Above Elevation; The UGM shall suspend motion; If the Machine is in Ground Mode; No response required for this DTC.
242	24	2	AMBIENT TEMPERATURE SENSOR - OUT OF RANGE HIGH	Ambient Temperature sensor reading ≥ 85C.	Check Ambient Temperature sensor reading < 85C.
250	**25**	**0**	**<<< FUNCTION PREVENTED >>>**		
259	25	9	MODEL CHANGED - HYDRAULICS SUSPENDED - CYCLE EMS	The model selection has been changed.	Disable all machine and engine functions (i.e., command engine shutdown and do not permit start).
2513	25	13	GENERATOR MOTION CUTOUT ACTIVE	Driving is not possible while the vehicle generator is running AND is configured to prevent drive.	The UGM shall not Enable the Machine.
2514	25	14	BOOM PREVENTED - DRIVE SELECTED	Boom functions are not possible while the vehicle is being driven AND is configured to not allow simultaneous drive & boom operation.	The UGM shall prohibit all boom functions.
2516	25	16	DRIVE PREVENTED - ABOVE ELEVATION	Driving is not possible while Boom functions are selected AND is configured to not allow simultaneous drive & boom operation.	The UGM shall prohibit Drive and Steer.
2517	25	17	DRIVE PREVENTED - TILTED & ABOVE ELEVATION	Driving is not possible while the vehicle is tilted and above elevation AND is configured to prevent drive while tilted and above elevation.	The UGM shall prohibit Drive and Steer.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
2518	25	18	DRIVE PREVENTED - BOOM SELECTED	MACHINE SETUP > FUNCTION CUTOUT = BOOM CUTOUT The boom is Above Elevation Any boom function is already active The operator attempts to activate Drive or Steer.	The UGM shall prohibit Drive and Steer.
2519	25	19	DRIVE PREVENTED - TILTED & EXTENDED OR HIGH ANGLE	Drive Selected while tilted and extended and tilt is configured to cutout drive.	
2520	25	20	FUNCTIONS LOCKED OUT - CONSTANT DATA VERSION IMPROPER		
2530	25	30	UMS SENSOR FORWARD LIMIT REACHED	The Upright angle relative to the turntable is less than -4.0 degree.	
2531	25	31	UMS SENSOR OUT OF USABLE RANGE	Both the turntable tilt sensor and the UMS sensor read greater then +/-10 degree in the same direction.	
2532	25	32	UMS SENSOR BACKWARD LIMIT REACHED	The Upright angle relative to the turntable is greater than +2.5 degree.	
2563	25	63	SKYGUARD SWITCH - DISAGREEMENT	MACHINE SETUP > SKYGUARD = YES; Machine is in Platform Mode; [(SkyGuard input #1 Platform Module J7-18) ≠ (SkyGuard input #2 Platform Module J1-23)] > 160ms	Response detailed in Sky-Guard section.
2568	25	68	TEMPERATURE CUTOUT ACTIVE - AMBIENT TEMPERATURE TOO LOW	Low Temperature Cutout = Active	If the Boom is Above Elevation; The UGM shall suspend motion; The UGM shall limit the machine to Creep speed after controls initialized If the Machine is in Platform Mode and if the Boom is not Above Elevation.
2576	25	76	PLATFORM LEVEL PREVENTED - ABOVE ELEVATION	Platform Level Override Cutout = Enabled; The Platform Level Up or Down switch input = High; Footswitch is active.	The UGM shall suspend Platform Level Up and Down commands; The UGM shall prohibit Platform Level Up and Down
2577	25	77	DRIVE PREVENTED - START BATTERY CONNECTED	Start battery is connected	Check the battery.
330	**33**	**0**	**<<< GROUND OUTPUT DRIVER >>>**		
331	33	1	BRAKE - SHORT TO BATTERY	There is a Short to Battery to the Brake Valve.	Check Harness for damage.
332	33	2	BRAKE - OPEN CIRCUIT	There is an Open Circuit to the Brake Valve.	Check Harness for damage.
3311	33	11	GROUND ALARM - SHORT TO BATTERY	There is a Short to Battery to the Ground Alarm.	Ground Alarm equipped vehicles only.
3336	33	36	ALTERNATOR POWER - SHORT TO GROUND	There is a Short to Ground to the Alternator/ECM.	Check Harness for damage.
3340	33	40	AUX POWER - SHORT TO GROUND	There is a Short to Ground to the Auxiliary Power Pump Relay.	Check Harness for damage.
3341	33	41	AUX POWER - OPEN CIRCUIT	There is an Open Circuit to the Auxiliary Power Pump Relay.	Check Harness for damage.
3342	33	42	AUX POWER - SHORT TO BATTERY	There is a Short to Battery to the Auxiliary Power Pump Relay.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
3346	33	46	ELECTRIC FAN - SHORT TO GROUND	There is a short to ground to the Electric Fan.	Check Harness for damage.
3347	33	47	ELECTRIC FAN - OPEN CIRCUIT	There is an Open Circuit to the Electric Fan.	Check Harness for damage.
3348	33	48	ELECTRIC FAN - SHORT TO BATTERY	There is a Short to Battery to the Electric Pump.	Check Harness for damage.
3349	33	49	ELECTRIC PUMP - SHORT TO GROUND	There is a Short to Ground to the Pump Relay.	Check Harness for damage.
3350	33	50	ELECTRIC PUMP - OPEN CIRCUIT	There is an Open Circuit to the Pump Relay.	Check Harness for damage.
3351	33	51	ELECTRIC PUMP - SHORT TO BATTERY	There is a Short to Battery to the Pump Relay.	Check Harness for damage.
3352	33	52	LP LOCK - SHORT TO GROUND	There is an Open Circuit to the LP Lock.	Check Harness for damage.
3353	33	53	LP LOCK - OPEN CIRCUIT	There is an Open Circuit to the LP Lock.	Check Harness for damage.
3354	33	54	LP LOCK - SHORT TO BATTERY	There is a short to Battery to the LP Lock.	Check Harness for damage.
3355	33	55	LP START ASSIST - SHORT TO GROUND	There is a short to ground to the LP Start Assist.	Check Harness for damage.
3356	33	56	LP START ASSIST - OPEN CIRCUIT	There is an Open Circuit to the LP Start Assist.	Check Harness for damage.
3357	33	57	LP START ASSIST - SHORT TO BATTERY	There is a short to battery to the LP Start Assist.	Check Harness for damage.
3358	33	58	MAIN DUMP VALVE - SHORT TO GROUND	There is a Short to Ground to the Main Dump Valve.	Check Harness for damage.
3359	33	59	MAIN DUMP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Main Dump Valve.	Check Harness for damage.
3360	33	60	MAIN DUMP VALVE - SHORT TO BATTERY	There is a Short to Battery to the Main Dump Valve.	Check Harness for damage.
3361	33	61	BRAKE - SHORT TO GROUND	There is a Short to Ground to the Brake Valve.	Check Harness for damage.
3362	33	62	START SOLENOID - SHORT TO GROUND	There is a Short to Ground to the Start Relay.	Check Harness for damage.
3363	33	63	START SOLENOID - OPEN CIRCUIT	There is an Open Circuit to the Start Relay.	Check Harness for damage.
3364	33	64	START SOLENOID - SHORT TO BATTERY	There is a Short to Battery to the Start Relay.	Check Harness for damage.
3365	33	65	STEER DUMP VALVE - SHORT TO GROUND	There is a Short to Ground to the Steer Dump Valve.	Check Harness for damage.
3366	33	66	STEER DUMP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Steer Dump Valve.	Check Harness for damage.
3367	33	67	STEER DUMP VALVE - SHORT TO BATTERY	There is a Short to Battery to the Steer Dump Valve.	Check Harness for damage.
3368	33	68	TWO SPEED VALVE - SHORT TO GROUND	There is a Short to Ground to the Two Speed Valve.	Check Harness for damage.
3369	33	69	TWO SPEED VALVE - OPEN CIRCUIT	There is an Open Circuit to the Two Speed Valve.	Check Harness for damage.
3370	33	70	TWO SPEED VALVE - SHORT TO BATTERY	There is a Short to Battery to the Two Speed Valve.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
3371	33	71	GROUND ALARM - SHORT TO GROUND	There is a Short to Ground to the Ground Alarm.	Check Harness for damage.
3372	33	72	GROUND ALARM - OPEN CIRCUIT	There is an Open Circuit to the Ground Alarm.	Check Harness for damage.
3373	33	73	GEN SET/WELDER - SHORT TO GROUND	There is a Short to Ground to the Generator Relay.	Check Harness for damage.
3374	33	74	GEN SET/WELDER - OPEN CIRCUIT	There is an Open Circuit to the Generator Relay.	Check Harness for damage.
3375	33	75	GEN SET/WELDER - SHORT TO BATTERY	There is a Short to Battery to the Generator Relay.	Check Harness for damage.
3376	33	76	HEAD TAIL LIGHT - SHORT TO GROUND	There is a Short to Ground to the Head Light Relay.	Check Harness for damage.
3377	33	77	HEAD TAIL LIGHT - OPEN CIRCUIT	There is an Open Circuit to the Head Light Relay.	Check Harness for damage.
3378	33	78	HEAD TAIL LIGHT - SHORT TO BATTERY	There is a Short to Battery to the Head Light Relay.	Check Harness for damage.
3379	33	79	HOUR METER - SHORT TO GROUND	There is a Short to Ground to the Hour Meter.	Check Harness for damage.
3382	33	82	PLATFORM LEVEL UP VALVE - SHORT TO GROUND	There is a Short to Ground to the Platform Level Up Valve	Check Harness for damage.
3383	33	83	PLATFORM LEVEL UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Level Up Valve.	Check Harness for damage.
3384	33	84	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	There is a Short to Battery to the Platform Level Up Valve	Check Harness for damage.
3388	33	88	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	There is a Short to Ground to the Platform Level Down Valve	Check Harness for damage.
3389	33	89	PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Level Down Valve.	Check Harness for damage.
3390	33	90	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	There is a Short to Battery to the Platform Level Down Valve	Check Harness for damage.
3394	33	94	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	There is a Short to Ground to the Platform Rotate Left Valve.	Check Harness for damage.
3395	33	95	PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Rotate Left Valve.	Check Harness for damage.
3396	33	96	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	There is a Short to Battery to the Platform Rotate Left Valve.	Check Harness for damage.
3397	33	97	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	There is a Short to Ground to the Platform Rotate Right Valve.	Check Harness for damage.
3398	33	98	PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Rotate Right Valve.	Check Harness for damage.
3399	33	99	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	There is a Short to Battery to the Platform Rotate Right Valve.	Check Harness for damage.
33100	33	100	JIB LIFT UP VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Lift Up Valve.	Check Harness for damage.
33101	33	101	JIB LIFT UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Lift Up Valve.	Check Harness for damage.
33102	33	102	JIB LIFT UP VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Lift Up Valve.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
33103	33	103	JIB LIFT DOWN VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Lift Down Valve.	Check Harness for damage.
33104	33	104	JIB LIFT DOWN VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Lift Down Valve.	Check Harness for damage.
33105	33	105	JIB LIFT DOWN VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Lift Down Valve.	Check Harness for damage.
33106	33	106	TOWER LIFT UP VALVE - SHORT TO GROUND	There is a Short to Ground to the Tower Lift Up Valve.	Check Harness for damage.
33107	33	107	TOWER LIFT UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Tower Lift Up Valve.	Check Harness for damage.
33108	33	108	TOWER LIFT UP VALVE - SHORT TO BATTERY	There is a Short to Battery to the Tower Lift Up Valve.	Check Harness for damage.
33109	33	109	TOWER LIFT DOWN VALVE - SHORT TO GROUND	There is a Short to Ground to the Tower Lift Down Valve.	Check Harness for damage.
33110	33	110	TOWER LIFT DOWN VALVE - OPEN CIRCUIT	There is an Open Circuit to the Tower Lift Down Valve.	Check Harness for damage.
33111	33	111	TOWER LIFT DOWN VALVE - SHORT TO BATTERY	There is a Short to Battery to the Tower Lift Down Valve.	Check Harness for damage.
33112	33	112	TOWER TELESCOPE IN VALVE - SHORT TO GROUND	There is a Short to Ground to the Tower Telescope In Valve.	Check Harness for damage.
33113	33	113	TOWER TELESCOPE IN VALVE - OPEN CIRCUIT	There is an Open Circuit to the Tower Telescope In Valve.	Check Harness for damage.
33114	33	114	TOWER TELESCOPE IN VALVE - SHORT TO BATTERY	There is a Short to Battery to the Tower Telescope In Valve.	Check Harness for damage.
33115	33	115	TOWER TELESCOPE OUT VALVE - SHORT TO GROUND	There is a Short to Ground to the Tower Telescope Out Valve.	Check Harness for damage.
33116	33	116	TOWER TELESCOPE OUT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Tower Telescope Out Valve.	Check Harness for damage.
33117	33	117	TOWER TELESCOPE OUT VALVE - SHORT TO BATTERY	There is a Short to Battery to the Tower Telescope Out Valve.	Check Harness for damage.
33118	33	118	SWING RIGHT VALVE - SHORT TO GROUND	There is a Short to Ground to the Swing Right Valve.	Check Harness for damage.
33119	33	119	SWING RIGHT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Swing Right Valve.	Check Harness for damage.
33120	33	120	TELESCOPE IN VALVE - SHORT TO BATTERY	There is a Short to Battery to the Main Telescope In Valve.	Check Harness for damage.
33121	33	121	SWING RIGHT VALVE - SHORT TO BATTERY	There is a Short to Battery to the Swing Right Valve.	Check Harness for damage.
33122	33	122	SWING LEFT VALVE - SHORT TO GROUND	There is a Short to Ground to the Swing Left Valve.	Check Harness for damage.
33123	33	123	TELESCOPE OUT VALVE - SHORT TO BATTERY	There is a Short to Battery to the Main Telescope Out Valve.	Check Harness for damage.
33130	33	130	THROTTLE ACTUATOR - SHORT TO GROUND	There is a Short to Ground to the Throttle Actuator.	Check Harness for damage.
33131	33	131	THROTTLE ACTUATOR - OPEN CIRCUIT	There is an Open Circuit to the Throttle Actuator.	Check Harness for damage.
33132	33	132	THROTTLE ACTUATOR - SHORT TO BATTERY	There is a Short to Battery to the Throttle Actuator.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
33170	33	170	LIFT DOWN VALVE - OPEN CIRCUIT	There is a Short to Ground to the Lift Down Valve.	Check Harness for damage.
33171	33	171	LIFT DOWN VALVE - SHORT TO BATTERY	There is an Open Circuit to the Lift Down Valve.	Check Harness for damage.
33172	33	172	LIFT DOWN VALVE - SHORT TO GROUND	There is a Short to Battery to the Lift Down Valve.	Check Harness for damage.
33175	33	175	JIB ROTATE LEFT VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Rotate Left Valve.	Check Harness for damage.
33176	33	176	JIB ROTATE LEFT VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Rotate Left Valve.	Check Harness for damage.
33177	33	177	JIB ROTATE LEFT VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Rotate Left Valve.	Check Harness for damage.
33178	33	178	JIB ROTATE RIGHT VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Rotate Right Valve.	Check Harness for damage.
33179	33	179	JIB ROTATE RIGHT VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Rotate Right Valve.	Check Harness for damage.
33180	33	180	JIB ROTATE RIGHT VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Rotate Right Valve.	Check Harness for damage.
33182	33	182	LIFT VALVES - SHORT TO BATTERY	There is a Short to Battery to the Lift Valves.	Check Harness for damage.
33186	33	186	TELESCOPE OUT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Main Telescope Out Valve.	Check Harness for damage.
33188	33	188	TELESCOPE OUT VALVE - SHORT TO GROUND	There is a Short to Ground to the Main Telescope Out Valve.	Check Harness for damage.
33189	33	189	TELESCOPE IN VALVE - OPEN CIRCUIT	There is an Open Circuit to the Main Telescope In Valve.	Check Harness for damage.
33190	33	190	TELESCOPE IN VALVE - SHORT TO GROUND	There is a Short to Ground to the Main Telescope In Valve.	Check Harness for damage.
33207	33	207	HORN - OPEN CIRCUIT	There is an Open Circuit to the Horn.	Check Harness for damage.
33208	33	208	HORN - SHORT TO BATTERY	There is a Short to Battery to the Horn.	Check Harness for damage.
33209	33	209	HORN - SHORT TO GROUND	There is a Short to Ground to the Horn.	Check Harness for damage.
33279	33	279	GLOWPLUG - OPEN CIRCUIT	There is an Open Circuit to the Glow Plugs.	Check Harness for damage.
33280	33	280	GLOWPLUG - SHORT TO BATTERY	There is a Short to Battery to the Glow Plugs.	Check Harness for damage.
33281	33	281	GLOWPLUG - SHORT TO GROUND	There is a Short to Ground to the Glow Plugs.	Check Harness for damage.
33287	33	287	LIFT - CURRENT FEEDBACK READING TOO LOW	The Engine State = ENGINE RUNNING; The UGM commanded current > 250mA; The difference between the commanded current and the measured feedback current > [the larger of (125mA) or (15% of the commanded function Max)] for longer than 1 second.	The UGM shall suspend Lift Up and Down command and revert to Open Loop Current control for Lift; The UGM shall limit Lift Up and Down to Creep speed after controls initialized.
33295	33	295	SWING LEFT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Swing Left Valve.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
33306	33	306	SWING LEFT VALVE - SHORT TO BATTERY	There is short to Battery to the Swing Left Valve.	Check Harness for damage.
33314	33	314	FLOW CONTROL VALVE - OPEN CIRCUIT	There is an Open Circuit to the Flow Control Valve.	Check Harness for damage.
33315	33	315	FLOW CONTROL VALVE - SHORT TO BATTERY	There is short to Battery to the Flow Control Valve	Check Harness for damage.
33316	33	316	FLOW CONTROL VALVE - SHORT TO GROUND	There is short to Ground to the Flow Control Valve	Check Harness for damage.
33317	33	317	DRIVE FORWARD VALVE - OPEN CIRCUIT	There is an Open Circuit to the Drive Forward Valve.	Check Harness for damage.
33318	33	318	DRIVE FORWARD VALVE - SHORT TO BATTER	There is short to Battery to the Drive Forward Valve.	Check Harness for damage.
33319	33	319	DRIVE FORWARD VALVE - SHORT TO GROUND	There is short to Ground to the Drive Forward Valve.	Check Harness for damage.
33320	33	320	DRIVE REVERSE VALVE - OPEN CIRCUIT	There is an Open Circuit to the Drive Reverse Valve.	Check Harness for damage.
33321	33	321	DRIVE REVERSE VALVE - SHORT TO BATTERY	There is a short to Battery to the Drive Reverse Valve.	Check Harness for damage.
33322	33	322	DRIVE REVERSE VALVE - SHORT TO GROUND	There is a short to Ground to the Drive Reverse Valve.	Check Harness for damage.
33323	33	323	LIFT UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Lift Up Valve.	Check Harness for damage.
33324	33	324	LIFT UP VALVE - SHORT TO BATTERY	There is a short to Battery to the Lift Up Valve.	Check Harness for damage.
33325	33	325	LIFT UP VALVE - SHORT TO GROUND	There is a Short to Ground to the Lift Up Valve.	Check Harness for damage.
33331	33	331	DRIVE - CURRENT FEEDBACK READING TOO LOW	The Engine State = ENGINE RUNNING; The UGM commanded current > 250mA; The difference between the commanded current and the measured feedback current > [the larger of (125mA) or (15% of the commanded function Max)] for longer than 1 second.	The UGM shall suspend Drive Forward and Reverse command and revert to Open Current loop control for Drive; The UGM shall limit Drive Forward and Reverse to Creep speed after controls initialized.
33410	33	410	DRIVE - CURRENT FEEDBACK READING LOST	Measured feedback current < 225mA while PWM output > 40% for a period of 100ms.	The UGM shall suspend Drive Forward and Reverse command and revert to Open Current loop control for Drive; The UGM shall limit Drive Forward and Reverse to Creep speed after controls initialized.
33412	33	412	SWING VALVES - SHORT TO BATTERY	There is a short to Battery to the Swing Valves.	Check Harness for damage.
33414	33	414	SWING - CURRENT FEEDBACK READING TOO LOW	Current feedback into controller is below threshold value.	Check wiring and coil.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
33415	33	415	FLOW CONTROL VALVE - CURRENT FEEDBACK READING TOO LOW	The Engine State = ENGINE RUNNING; The UGM commanded current > 250mA; The difference between the commanded current and the measured feedback current > [the larger of (125mA) or (15% of the commanded function Max)] for longer than 1 second .	The UGM shall suspend Flow Control and revert to Open Current loop control for Flow Control.
33417	33	417	LIFT - CURRENT FEEDBACK READING LOST	Measured feedback current < 225mA while PWM output > 40% for a period of 100ms.	The UGM shall suspend Lift Up and Down command and revert to Open Loop Current control for Lift; The UGM shall limit Lift Up and Down to Creep speed after controls initialized.
33418	33	418	SWING - CURRENT FEEDBACK READING LOST	Current feedback into controller not detected.	Check wiring and coil.
33419	33	419	FLOW CONTROL VALVE - CURRENT FEEDBACK READING LOST	Measured feedback current < 225mA while PWM output >40% for a period of 100ms.	The UGM shall suspend Flow Control and revert to Open Current loop control for Flow Control.
33488	33	488	SWING FLOW CONTROL VALVE - SHORT TO GROUND	There is a short to the Ground to the Swing Flow Control Valve.	Check Harness for damage.
33575	33	575	ECM PULL DOWN RESISTOR - OPEN CIRCUIT	There is an Open Circuit to the ECM Pull Down Resistor.	Check Harness for damage.
340	**34**	**0**	**<<< PLATFORM OUTPUT DRIVER >>>**		
341	34	1	PLATFORM LEVEL UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Level Up Valve.	Check Harness for damage.
342	34	2	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY	There is a Short to Battery to the Platform Level Up Valve.	Check Harness for damage.
343	34	3	PLATFORM LEVEL UP VALVE - SHORT TO GROUND	There is a Short to Ground to the Platform Level Up Valve.	Check Harness for damage.
344	34	4	PLATFORM LEVEL UP VALVE - SHORT TO BATTERY OR OPEN CIRCUIT	There is a Short to Battery or an Open Circuit to the Platform Level Up Valve.	Check Harness for damage.
345	34	5	PLATFORM LEVEL DOWN VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Level Down Valve.	Check Harness for damage.
346	34	6	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY	There is a short to Battery to the Platform Level Down Valve.	Check Harness for damage.
347	34	7	PLATFORM LEVEL DOWN VALVE - SHORT TO GROUND	There is a short to the Ground to the Platform Level Down Valve.	Check Harness for damage.
348	34	8	PLATFORM LEVEL DOWN VALVE - SHORT TO BATTERY OR OPEN CIRCUIT	There is a Short to Battery or an Open Circuit to the Platform Level Down Valve.	Check Harness for damage.
349	34	9	PLATFORM ROTATE LEFT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Rotate Left Valve.	Check Harness for damage.
3410	34	10	PLATFORM ROTATE LEFT VALVE - SHORT TO BATTERY	There is a short to Battery to the Platform Rotate Left Valve.	Check Harness for damage.
3411	34	11	PLATFORM ROTATE LEFT VALVE - SHORT TO GROUND	There is a short to Ground to the Platform Rotate Left Valve.	Check Harness for damage.
3412	34	12	PLATFORM ROTATE RIGHT VALVE - OPEN CIRCUIT	There is an Open Circuit to the Platform Rotate Right Valve.	Check Harness for damage.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
3413	34	13	PLATFORM ROTATE RIGHT VALVE - SHORT TO BATTERY	There is a short to Battery to the Platform Rotate Right Valve.	Check Harness for damage.
3414	34	14	PLATFORM ROTATE RIGHT VALVE - SHORT TO GROUND	There is a short to Ground to the Platform Rotate Right Valve.	Check Harness for damage.
3415	34	15	JIB LIFT UP VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Lift Up Valve.	Check Harness for damage.
3416	34	16	JIB LIFT UP VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Lift Up Valve.	Check Harness for damage.
3417	34	17	JIB LIFT UP VALVE - SHORT TO GROUND	There is a short to Ground to the JIB Lift Up Valve.	Check Harness for damage.
3418	34	18	JIB LIFT DOWN VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Lift Down Valve.	Check Harness for damage.
3419	34	19	JIB LIFT DOWN VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Lift Down Valve.	Check Harness for damage.
3420	34	20	JIB LIFT DOWN VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Lift Down Valve.	Check Harness for damage.
3421	34	21	JIB ROTATE LEFT VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Rotate Left Valve.	Check Harness for damage.
3422	34	22	JIB ROTATE LEFT VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Rotate Left Valve.	Check Harness for damage.
3423	34	23	JIB ROTATE LEFT VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Rotate Left Valve.	Check Harness for damage.
3424	34	24	JIB ROTATE RIGHT VALVE - OPEN CIRCUIT	There is an Open Circuit to the JIB Rotate Right Valve.	Check Harness for damage.
3425	34	25	JIB ROTATE RIGHT VALVE - SHORT TO BATTERY	There is a Short to Battery to the JIB Rotate Right Valve.	Check Harness for damage.
3426	34	26	JIB ROTATE RIGHT VALVE - SHORT TO GROUND	There is a Short to Ground to the JIB Rotate Right Valve.	Check Harness for damage.
430	**43**	**0**	**<<< ENGINE >>>**		
431	43	1	FUEL SENSOR - SHORT TO BATTERY OR OPEN CIRCUIT	The Fuel Sensor reading is > 4.3V.	Energize fuel sensor per System Indicators
432	43	2	FUEL SENSOR - SHORT TO GROUND	The Fuel Sensor reading is < 0.2V.	Energize fuel sensor per System Indicators
433	43	3	OIL PRESSURE - SHORT TO BATTERY	The Oil Pressure Sensor reading is > 6.6V.	Deutz engine only.
434	43	4	OIL PRESSURE - SHORT TO GROUND	The Oil Pressure Sensor reading is < 0.1V for more then 5 seconds.	Deutz engine only. - Not reported during engine start.
435	43	5	COOLANT TEMPERATURE - SHORT TO GROUND	The Coolant Temperature Sensor reading is < 0.1V.	Deutz engine only.
436	43	6	FORD FAULT CODE ##	All ford fault codes except 63 are simply passed through from the Ford ECM. They only occur if a Ford Engine is selected in the machine configuration digits. Can be reported during power-up sequence.	

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
437	43	7	ENGINE TROUBLE CODE	Displays engine SPN FMI code.	Report and log in Help If [(MACHINE SETUP > DEUTZ EMR2) or (MACHINE SETUP > DEUTZ EMR4) and SPN:FMI = 535:7], prohibit engine cranking.
438	43	8	HIGH ENGINE TEMP	(Ford engine only) The engine temperature is > 117 C. (Deutz engine only) The engine temperature is > 130 C.	Ford / Deutz engine only.
439	43	9	AIR FILTER BYPASSED	The Air Filter is clogged.	Check Airfilter for clogging
4310	43	10	NO ALTERNATOR OUTPUT	Battery voltage is < 11.5 volts for more then 15 seconds after engine start.	Activate the No Charge indicator J4-26 per System Indicators.
4311	43	11	LOW OIL PRESSURE	(Ford engine only) The ECM has reported a low oil pressure fault. (Deutz engine only) Oil pressure is < 8 PSI for more then 10 seconds after engine start.	Ford / Deutz engine only.
4312	43	12	485 COMMUNICATIONS LOST	This fault only occurs with a Ford Engine. It occures when no response are received from the ECM for 2.5 seconds. Can be reported during power-up sequence.	
4313	43	13	THROTTLE ACTUATOR FAILURE	The engine RPM is > XXX for more then XX seconds.	
4314	43	14	WRONG ENGINE SELECTED - ECM DETECTED	A ECM was detected with a non- ECM type engine selected.	
4322	43	22	LOSS OF ENGINE SPEED SENSOR	The engine RPM sensor indicates 0 RPM AND the Oil Pressure Sensor indicates > 8 PSI for three seconds.	Diesel engine only.
4323	43	23	SPEED SENSOR READING INVALID SPEED	The engine RPM sensor indicates > 4000 RPM.	Diesel engine only.
4331	43	31	SOOT LOAD WARNING - LOW	SPN/FMI 3719 / 16 3703 / 31	Check Engine.
4332	43	32	SOOT LOAD WARNING - HIGH	SPN/FMI 3719 / 0 3714 / 31	Check Engine.
4333	43	33	SOOT LOAD WARNING - SEVERE	SPN/FMI 3715 / 31	Check Engine.
4334	43	34	ENGINE COOLANT - LOW LEVEL	MACHINE SETUP > ENGINE = DEUTZ EMR4; ECM transmits a J1939 DM1 message for an engine coolant low level fault (SPN:FMI 111:1) on CAN2 or uses the J1939 Transport Protocol every one second to send this information if multiple engine faults exist.	MACHINE SETUP > ENGINE SHUTDOWN = ENABLED then shutdown the engine; Activate High Engine Temperature indicator J4-28.
440	**44**	**0**	**<<< BATTERY SUPPLY >>>**		
441	44	1	BATTERY VOLTAGE TOO LOW - SYSTEM SHUTDOWN	Battery voltage is < 9V.	
442	44	2	BATTERY VOLTAGE TOO HIGH - SYSTEM SHUTDOWN	Battery voltage is > 16V.	
445	44	5	BATTERY VOLTAGE LOW	Battery voltage is < 11V for more then 5 seconds.	

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
660	**66**	**0**	**<<< COMMUNICATION >>>**		
662	66	2	CANBUS FAILURE - PLATFORM MODULE	Platform Module CAN communication lost.	
664	66	4	CANBUS FAILURE - ACCESSORY MODULE	The accessory module is not receiving CAN messages. This is probably due to wiring problem.	Check the Wiring.
666	66	6	CANBUS FAILURE - ENGINE CONTROLLER	Engine Control Module CAN	ECM equipped engine only.
6620	66	20	CANBUS FAILURE - UMS SENSOR	communication lost.	
6622	66	22	CANBUS FAILURE - TCU MODULE	Machine Setup/ Telematics = YES, No device heartbeat for 30 sec	
6623	66	23	CANBUS FAILURE - GATEWAY MODULE	Machine Setup/ Telematics = YES, No device heartbeat for 30 sec	
6629	66	29	CANBUS FAILURE - TELEMATICS CANBUS LOADING TOO HIGH		
6657	66	57	CANBUS FAILURE - TEMPERATURE SENSOR	MACHINE SETUP > TEMP CUTOUT = YES; UGM does not receive any CAN messages from the Ambient Temperature sensor in 250ms	The UGM shall set Low Temperature Cutout state = Faulty If the Machine is in Platform Mode and if the Boom is Above Elevation; The UGM shall suspend motion; The UGM shall limit the machine to Creep speed after controls initialized If the Machine is in Platform Mode and if the Boom is not Above Elevation.
671	67	1	ACCESSORY FAULT		
680	**68**	**0**	**<<< TELEMATICS >>>**		
681	68	1	REMOTE CONTRACT MANAGEMENT OVERRIDE - ALL FUNCTIONS IN CREEP		
810	**81**	**0**	**<<< TILT SENSOR >>>**		
813	81	3	CHASSIS TILT SENSOR NOT CALIBRATED	The Chassis Tilt Sensor has not been calibrated.	
815	81	5	CHASSIS TILT SENSOR DISAGREEMENT		
816	81	6	UMS SENSOR NOT CALIBRATED	The Control System detects a sensor out of range condition or a not calibrated fault with UMS angle sensor	
817	81	7	UMS SENSOR FAULT	The system detects that the UMS sensor frequency outside the 100Hz+/- 5Hz range or the duty cycle is outside 50% +/- 21% Range.	
820	**82**	**0**	**<<< PLATFORM LOAD SENSE >>>**		
825	82	5	LSS HAS NOT BEEN CALIBRATED	The Load Sensing System Module has not been calibrated.	UGM to set Platform Load State = Overloaded.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
826	82	6	RUNNING AT CREEP - PLATFORM OVERLOADED	All functions at creep, the Load Sensing System indicates the Platform is overloaded AND is configured to warn only while the Platform is overloaded.	
827	82	7	DRIVE & BOOM PREVENTED - PLATFORM OVERLOADED	Driving and boom functions are not possible while the Load Sensing System indicates the Platform is overloaded AND is configured to prevent drive and boom functions while the Platform is overloaded.	
828	82	8	LIFT UP & TELE OUT PREVENTED - PLATFORM OVERLOADED	Lift up and telescope out are not possible while the Load Sensing System indicates the Platform is overloaded AND is configured to prevent Lift up and telescope out while the Platform is overloaded.	
8639	86	39	FRONT LEFT STEER VALVE - OPEN CIRCUIT	There is an open circuit to the Front Left Steer Valve	Check Harness for damage.
8640	86	40	FRONT LEFT STEER VALVE - SHORT TO BATTERY	There is a short to Battery to the Front Left Steer Valve	Check Harness for damage.
8641	86	41	FRONT LEFT STEER VALVE - SHORT TO GROUND	There is a short to Ground to the Front Left Steer Valve	Check Harness for damage.
8642	86	42	FRONT RIGHT STEER VALVE - OPEN CIRCUIT	There is an open circuit to the Front Right Steer Valve	Check Harness for damage.
8643	86	43	FRONT RIGHT STEER VALVE - SHORT TO BATTERY	There is a short to Battery to the Front Right Steer Valve	Check Harness for damage.
8644	86	44	FRONT RIGHT STEER VALVE - SHORT TO GROUND	There is a short to Ground to the Front Right Steer Valve	Check Harness for damage.
8645	86	45	REAR LEFT STEER VALVE - OPEN CIRCUIT	There is an open circuit to the Rear Left Steer Valve	Check Harness for damage.
8646	86	46	REAR LEFT STEER VALVE - SHORT TO BATTERY	There is a short to Battery to the Rear Left Steer Valve	Check Harness for damage.
8647	86	47	REAR LEFT STEER VALVE - SHORT TO GROUND	There is a short to Ground to the Rear Left Steer Valve	Check Harness for damage.
8648	86	48	REAR RIGHT STEER VALVE - OPEN CIRCUIT	There is an open circuit to the Rear Right Steer Valve	Check Harness for damage.
8649	86	49	REAR RIGHT STEER VALVE - SHORT TO BATTERY	There is a short to Battery to the Rear Right Steer Valve	Check Harness for damage.
8650	86	50	REAR RIGHT STEER VALVE - SHORT TO GROUND	There is a short to Ground to the Rear Right Steer Valve	Check Harness for damage.
871	87	1	RETURN FILTER BYPASSED	Hydraulic Return Filter Clogged	Check Hydraulic Return Filter.
872	87	2	CHARGE PUMP FILTER BYPASSED	Charge Pump Filter Clogged	Check Charge Pump Filter.
873	87	3	MACHINE SAFETY SYSTEM OVERRIDE OCCURRED	MSSO = Active	Response described in MSSO Influence on Machine Operation section.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
998	99	8	EEPROM FAILURE - CHECK ALL SETTINGS	The Ground Module has reported an EEPROM failure.	Disable all machine and engine functions (i.e., command engine shutdown and do not permit start); reset the section of EEPROM where the failure occurred to defaults.
9910	99	10	FUNCTIONS LOCKED OUT - PLATFORM MODULE SOFTWARE VERSION IMPROPER	The Platform Module software version is not compatible with the rest of the system.	Activate the platform alarm continuously Creep mode is active If Platform Mode is active, disable all Drive, Steer, and Boom functions and do not permit Machine Enable.
9914	99	14	PLATFORM MODULE SOFTWARE UPDATE REQUIRED	The Platform Module software requires an update.	
9915	99	15	CHASSIS TILT SENSOR NOT GAIN CALIBRATED	The Chassis Tilt Sensor gain calibration has been lost.	
9916	99	16	CHASSIS TILT SENSOR GAIN OUT OF RANGE	The Chassis Tilt Sensor gain calibration has become corrupted.	
9919	99	19	GROUND SENSOR REF VOLTAGE OUT OF RANGE	The Ground Module has reported that its sensor reference voltage is outside acceptable range.	Not reported during power-up.
9920	99	20	PLATFORM SENSOR REF VOLTAGE OUT OF RANGE	The Platform Module has reported that its sensor reference voltage is outside acceptable range.	Not reported during power-up.
9921	99	21	GROUND MODULE FAILURE - HIGH SIDE DRIVER CUTOUT FAULTY	The Ground Module has reported that its high side driver cutout failed.	
9922	99	22	PLATFORM MODULE FAILURE - HWFS CODE 1	The Platform Module has reported that the V(Low) FET has failed.	
9923	99	23	GROUND MODULE FAILURE - HWFS CODE 1	The Ground Module has reported that the V(Low) FET has failed.	
9924	99	24	FUNCTIONS LOCKED OUT - MACHINE NOT CONFIGURED	The machine is powered up and no model has been selected yet in the MACHINE SETUP menu.	Display ??? or NO MODEL at Analyzer MACHINE SETUP menu MACHINE SETUP->MODEL NUMBER Do not report any other faults Disable all machine and engine functions (i.e., command engine shutdown and do not permit start).
9944	99	44	CURRENT FEEDBACK GAINS OUT OF RANGE	The factory set current feedback gains are out of range.	A gain of 1 is used for the factory gain(s) that was out of range; all functions shall be placed in Creep mode.

Table 6-12. Diagnostic Trouble Code Chart (DTC)

DTC	Flash Code	Sequence	Fault Message	Fault Description	Check
9945	99	45	CURRENT FEEDBACK CALIBRATION CHECKSUM INCORRECT	The factory set current feedback checksum is not correct.	
9979	99	79	FUNCTIONS LOCKED OUT - GROUND MODULE SOFTWARE VERSION IMPROPER	Temporary fault for the telematics project. The model needs to be a 600S or 1350S if not this fault will be generated and Platform controls will be prevented. This fault was to ensure that the software will only work for these two models.	Disable all machine and engine functions (i.e., command engine shutdown and do not permit start).

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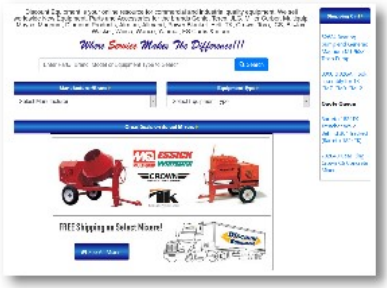

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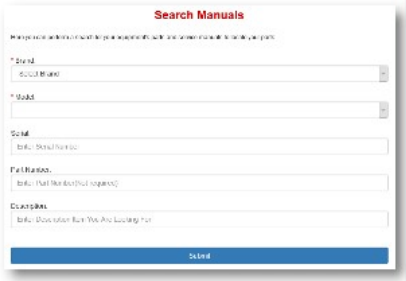

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SECTION 7. BASIC ELECTRICAL INFORMATION & SCHEMATICS

7.1 GENERAL

This section contains basic electrical information and 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.

NOTE: *Some of the procedures/connectors shown in this section may not be applicable to all models.*

7.2 MULTIMETER BASICS

A wide variety of multimeters or Volt Ohm Meters (VOM) can be used for troubleshooting your equipment. This section shows diagrams of a common, digital VOM configured for several different circuit measurements. Instructions for your VOM may vary. Please consult the meter operator's manual for more information.

Grounding

"Grounding the meter" means to take the black lead (which is connected to the COM (common) or negative port) and touch it to a good path to the negative side of the Voltage source.

Backprobing

To "backprobe" means to take the measurement by accessing a connector's contact on the same side as the wires, the back of the connector. Readings can be done while maintaining circuit continuity this way. If the connector is the sealed type, great care must be taken to avoid damaging the seal around the wire. It is best to use probes or probe tips specifically designed for this technique, especially on sealed connectors. Whenever possible insert probes into the side of the connector such that the test also checks both terminals of the connection. It is possible to inspect a connection within a closed connector by backprobing both sides of a connector terminal and measuring resistance. Do this after giving each wire a gentle pull to ensure the wires are still attached to the contact and contacts are seated in the connector.

Min/Max

Use of the "Min/Max" recording feature of some meters can help when taking measurements of intermittent conditions while alone. For example, you can read the Voltage applied to a solenoid when it is only operational while a switch, far from the solenoid and meter, is held down.

Polarity

Getting a negative Voltage or current reading when expecting a positive reading frequently means the leads are reversed. Check what reading is expected, the location of the signal and that the leads are connected to the device under test correctly. Also check that the lead on the "COM" port goes to the Ground or negative side of the signal and the lead on the other port goes to the positive side of the signal.

Scale

M = Mega = 1,000,000 * (Displayed Number)

k = kilo = 1,000 * (Displayed Number)

m = milli = (Displayed Number) / 1,000

µ = micro = (Displayed Number) / 1,000,000

Example: 1.2 kW = 1200 W
Example: 50 mA = 0.05 A

Voltage Measurement

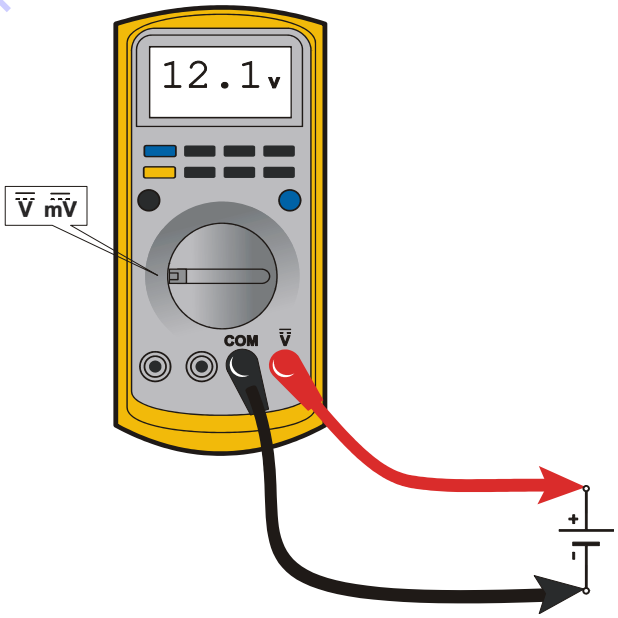


Figure 7-1. Voltage Measurement (DC)

- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual)
- Use firm contact with meter leads

Resistance Measurement

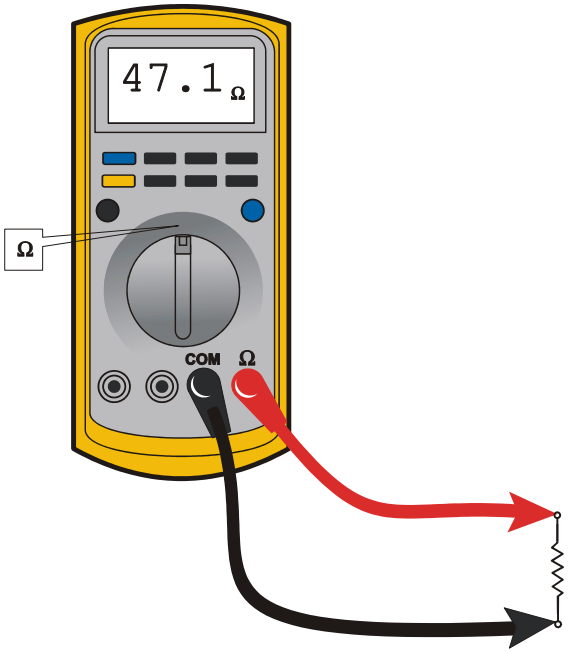


Figure 7-2. Resistance Measurement

- First test meter and leads by touching leads together. Resistance should read a short circuit (very low resistance).
- Circuit power must be turned OFF before testing resistance.
- Disconnect component from circuit before testing.
- If meter is not auto ranging, set it to the correct range (See multimeter's operation manual).
- Use firm contact with meter leads.

Continuity Measurement

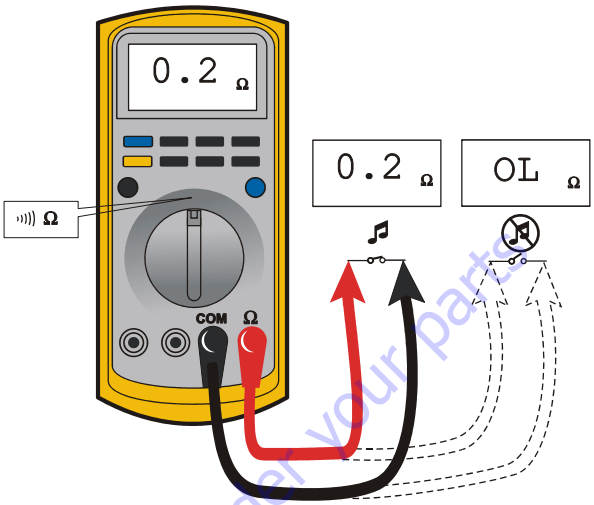


Figure 7-3. Continuity Measurement

- Some meters require a separate button press to enable audible continuity testing.
- Circuit power must be turned OFF before testing continuity.
- Disconnect component from circuit before testing.
- Use firm contact with meter leads.
- First test meter and leads by touching leads together. Meter should produce an audible alarm, indicating continuity.

Current Measurement

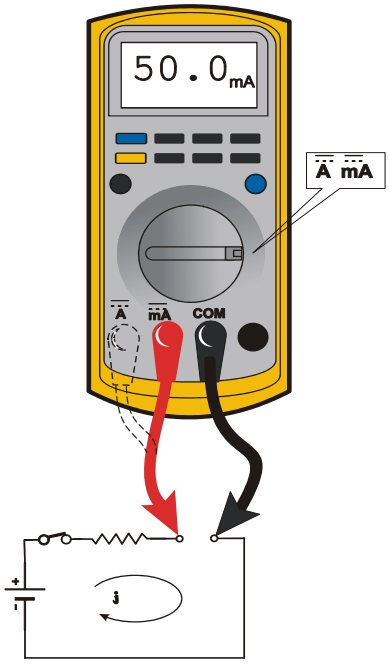


Figure 7-4. Current Measurement (DC)

- Set up the meter for the expected current range.
- Be sure to connect the meter leads to the correct jacks for the current range you have selected.
- If meter is not auto ranging, set it to the correct range (See multi meter's operation manual).
- Use firm contact with meter leads.

7.3 CHECKING SWITCHES

Basic Check

The following check determines if the switch is functioning properly, not the circuit in which the switch is placed. A switch is functioning properly when there is continuity between the correct terminals or contacts only when selected.

1. De-energize the circuit.
2. Isolate the switch from the rest of the circuit if possible. If not possible, keep in mind it may affect readings.
3. Access the terminals to the switch.
4. If the switch has two terminals:
   a. Measure resistance across the terminals.
   b. Change the switch position.
   c. Measure resistance again with the leads in the same positions. If the meter was reading short, it should read an open. If the meter was reading open it should read short.
5. If the switch has more than two terminals, consult the schematic or switch diagram to determine what terminals will be connected. The test is similar to testing a switch with two terminals.
   a. Place one meter lead on the common contact and the other on a different contact in the same circuit.
   b. Cycle through all positions of the switch. The meter should read short only when the switch connects the two terminals and open otherwise.
   c. If the switch has more than one common contact repeat the process for that circuit.

Limit Switches

Limit switches are used to control movement or indicate position. Mechanical limit switches are just like manually operated switches except that the moving object operates the switch. These switches can be tested the same way as a standard switch by manually operating the sensing arm.

Another type of limit switch used by JLG is the inductive proximity switch, also referred to as a "prox switch". Inductive proximity switches are actuated only by ferrous metal (metal that contains Iron, such as steel) near the switch. They do not require contact, and must be energized to actuate. These types of switches can be used to detect boom or platform position, for example. These switches have a sensing face where the switch can detect ferrous metal close to it. To find the sensing face, take note how the switch is mounted and how the mechanisms meet the switch. Test this type of switch as follows:

1. Remove prox switch from its mount.
2. Reconnect harness if it was disconnected for step a, and turn on machine.
3. Hold switch away from metal and observe switch state in the control system diagnostics using the Analyzer. See vehicle or control system documentation on how to do this.
4. Place sensing face of switch on the object to be sensed by the switch. If that is not available, use a piece of ferrous metal physically similar to it. The switch state in the control system diagnostics should change.
5. When reinstalling or replacing switch be sure to follow mounting instructions and properly set the gap between the switch and object sensed.

Automatic Switches

If the switch is actuated automatically, by temperature or pressure for example, find a way to manually actuate the switch to test it. Do this either by applying heat or pressure, for example, to the switch. These switches may need to be energized to actuate.

1. Connect instrumentation to monitor and/or control the parameter the switch is measuring.
2. Observe switch state in control system with the Analyzer. See vehicle or control system documentation on how to do this.
3. Operate system such that the switch actuates. This could be going over a certain pressure or temperature, for example. The state indicated in the control system should change.

Switch Wiring - Low Side, High Side

When controlling a load, a switch can be wired between the positive side of the power source and the load. This switch is called a "high side" switch. The switch supplies the power to the load. When a switch is wired between the negative side of the power source and the load, it is a "low side" switch. The switch provides the ground to the load.

A low side switch will allow voltage to be present on the load. No power is applied because the switch is stopping current flow. This voltage can be seen if the measurement is taken with one test lead on the load and the other on the battery negative side or grounded to the vehicle. What is actually being measured is the voltage drop across the switch. This could mislead a technician into thinking the load is receiving power but not operating. To produce an accurate picture of power or voltage applied to the load, measure voltage across the load's power terminals. Also, the technician can measure the voltage at both power terminals with respect to battery ground. The difference between those two measurements is the voltage applied to the load.

7.4 APPLYING SILICONE DIELECTRIC COMPOUND TO ELECTRICAL CONNECTIONS

NOTE: *This section is not applicable for battery terminals.*

NOTICE

JLG P/N 0100048 DIELECTRIC GREASE (NOVAGARD G661) IS THE ONLY MATERIAL APPROVED FOR USE AS A DIELECTRIC GREASE.

NOTE: *Do NOT apply dielectric grease to the following connections:*

- Main Boom Rotary sensor connections (on Celesco Sensor),
- LSS Modules connections,
- Deutz EMR 2 ECM connection.

Silicone Dielectric Compound must be used on all electrical connections except for those mentioned above for the following reasons:

- To prevent oxidation at the mechanical joint between male and female pins.
- To prevent electrical malfunction caused by low level conductivity between pins when wet.

Use the following procedure to apply Silicone Dielectric Compound to the electrical connectors. This procedure applies to all plug connections not enclosed in a box. Silicone grease should not be applied to connectors with external seals.

1. To prevent oxidation, silicone grease must be packed completely around male and female pins on the inside of the connector prior to assembly. This is most easily achieved by using a syringe.

NOTE: *Over a period of time, oxidation increases electrical resistance at the connection, eventually causing circuit failure.*

2. To prevent shorting, silicone grease must be packed around each wire where they enter the outside of the connector housing. Also, silicone grease must be applied at the joint where the male and female connectors come together. Any other joints (around strain reliefs, etc.) where water could enter the connector should also be sealed.

NOTE: *This condition is especially common when machines are pressure washed since the washing solution is much more conductive than water.*

3. Anderson connectors for the battery boxes and battery chargers should have silicone grease applied to the contacts only.

NOTE: *Curing-type sealants might also be used to prevent shorting and would be less messy, but would make future pin removal more difficult.*

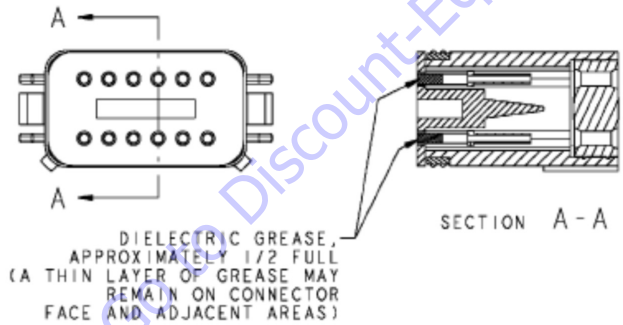
When applied to electrical connections, dielectric grease helps to prevent corrosion of electrical contacts and improper conductivity between contacts from moisture intrusion. Open and sealed connectors benefit from the application of dielectric grease.

Dielectric grease shall be applied to all electrical connectors at the time of connection (except those noted under Exclusions).

Installation of Dielectric Grease

Before following these instructions, refer to excluded connector types (See Exclusions below).

1. Use dielectric grease in a tube for larger connection points or apply with a syringe for small connectors.
2. Apply dielectric grease to the female contact (fill it approximately ½ full; see example below)
3. Leave a thin layer of dielectric grease on the face of the connector
4. Assemble the connector system immediately to prevent moisture ingress or dust contamination
5. Pierce one of the unused wire seals prior to assembly if the connector system tends to trap air (i.e. AMP Seal) and then install a seal plug.



Deutsch HD, DT, DTM, DRC Series

The Deutsch connector system is commonly used for harsh environment interconnect. Follow the installation instructions.

AWP Seal

The AMP Seal connector system is used on the Control ADE Platform and Ground Modules.

Apply dielectric grease to the female contact. If trapped air prevents the connector from latching, pierce one of the unused wire seals. After assembly, install a seal plug (JLG #4460905) in that location to prevent moisture ingress.

Note that seal plugs may be installed by the wire harness manufacturer if an unused wire seal becomes compromised (wire inserted in the wrong cavity during assembly and then corrected).

Figure 7-5. Application to Female Contacts

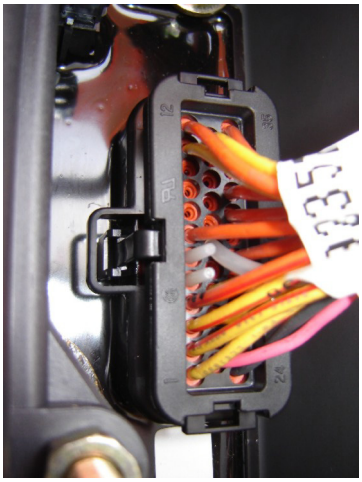
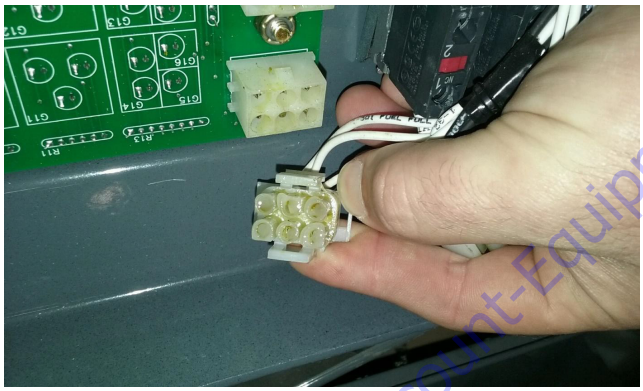


Figure 7-6. Use of Seal Plugs

AMP Mate-N-Lok

This connector system is widely used inside enclosures for general-purpose interconnect. Follow the installation instructions.



DIN Connectors

This connector is typically used on hydraulic valves. Follow the installation instructions.

Exclusions

A limited number of connectors do not benefit from dielectric grease, or may be permanently damaged by application. Dielectric grease may not be required in properly sealed enclosures.

BRAD HARRISON / PHOENIX CONTACT M12

The connector uses gold contact material to resist corrosion and an o-ring seal for moisture integrity. If dielectric grease is mistakenly applied to this connector system, the low-force contacts cannot displace the grease to achieve electrical contact. Once contaminated, there is no practical way to remove the dielectric grease (replacement of female contacts required). The JLG Load Sensing System and 1250AJP Rotary Angle Sensors are examples of components with the M12 connector system.

AMP JUNIOR TIMER

This type of connector uses back-seals for moisture integrity. However, the low-force contacts cannot displace dielectric grease and create electrical contact. It is possible to use solvents (i.e. contact cleaner or mineral spirits) for the removal of improperly applied dielectric grease. The EMR2 engine control module from Deutz employs this connector system (for example).

7.5 AMP CONNECTOR

Assembly

Check to be sure the wedge lock is in the open, or as-shipped, position (See Figure 7-7.). Proceed as follows:

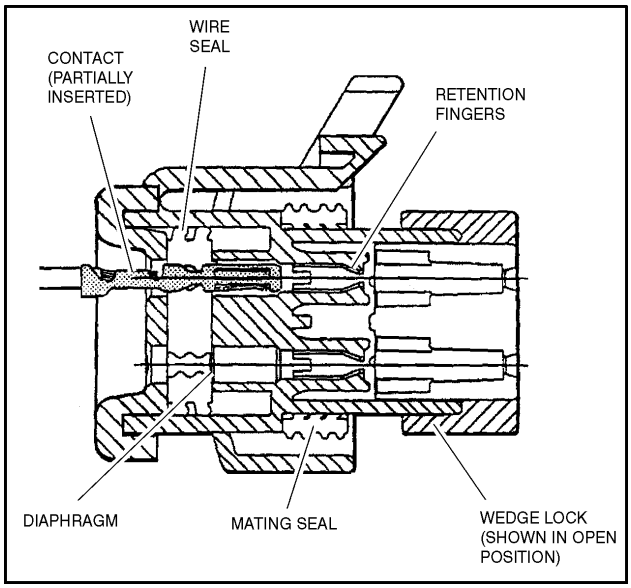


Figure 7-7. Connector Assembly Figure 1

1. To insert a contact, push it straight into the appropriate circuit cavity as far as it will go (See Figure 7-9.).
2. Pull back on the contact wire with a force of 1 or 2 lbs. to be sure the retention fingers are holding the contact (See Figure 7-9.).

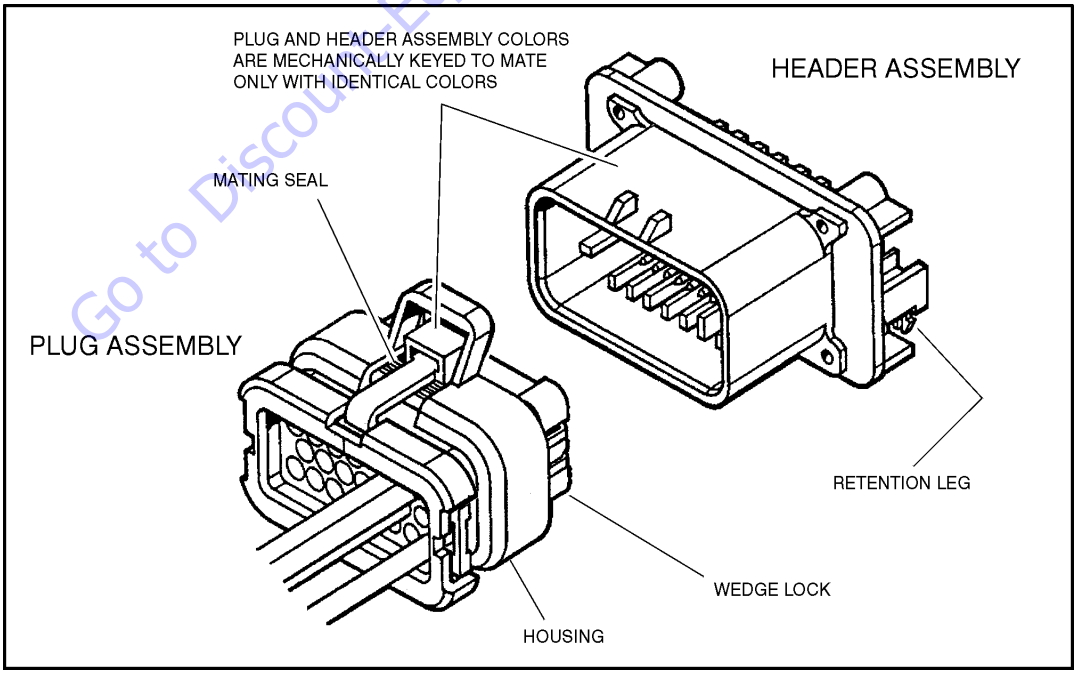


Figure 7-8. AMP Connector

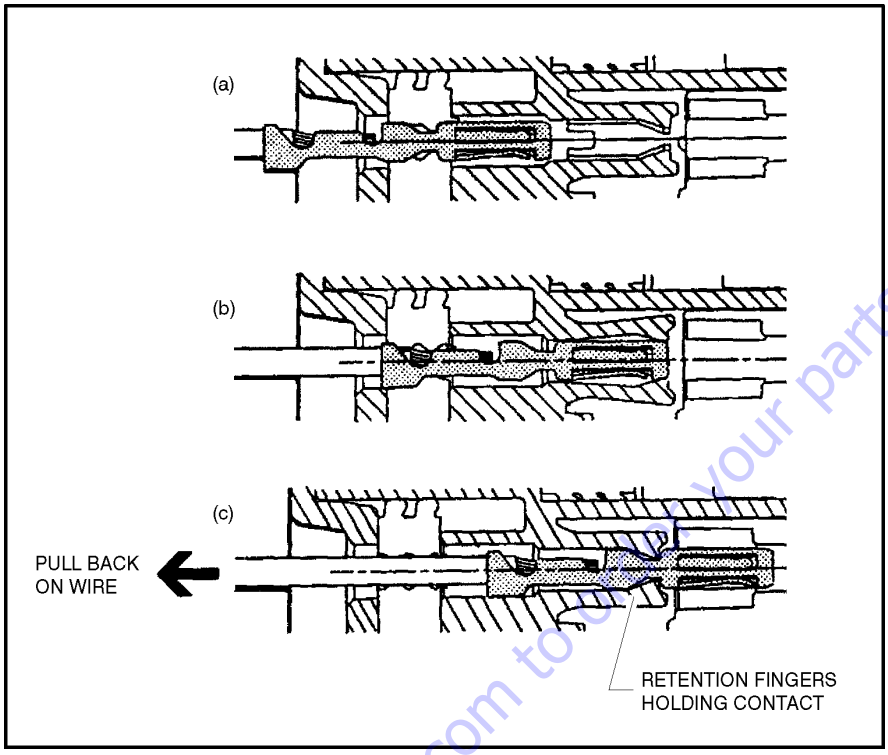


Figure 7-9. Connector Assembly Figure 2

3. After all required contacts have been inserted, the wedge lock must be closed to its locked position. Release the locking latches by squeezing them inward (See Figure 7-10.).

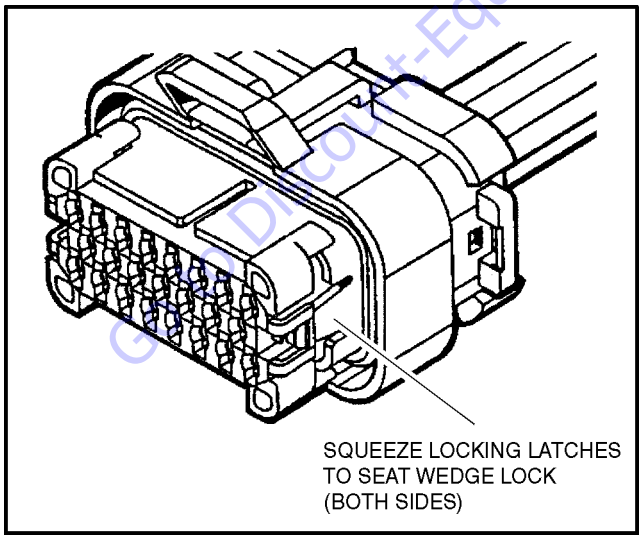


Figure 7-10. Connector Assembly Figure 3

4. Slide the wedge lock into the housing until it is flush with the housing (See Figure 7-11.).

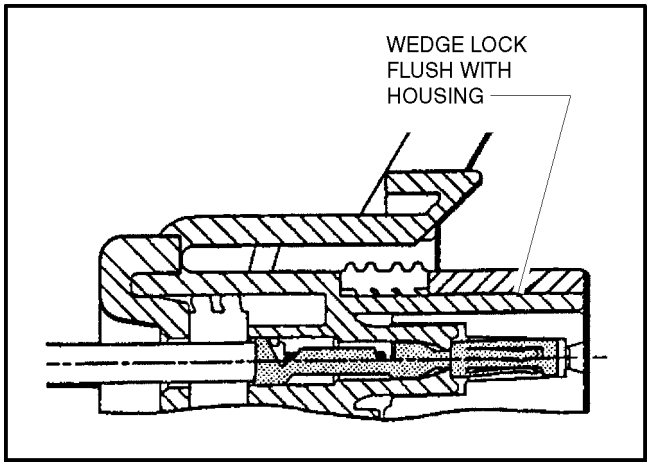


Figure 7-11. Connector Assembly Figure 4

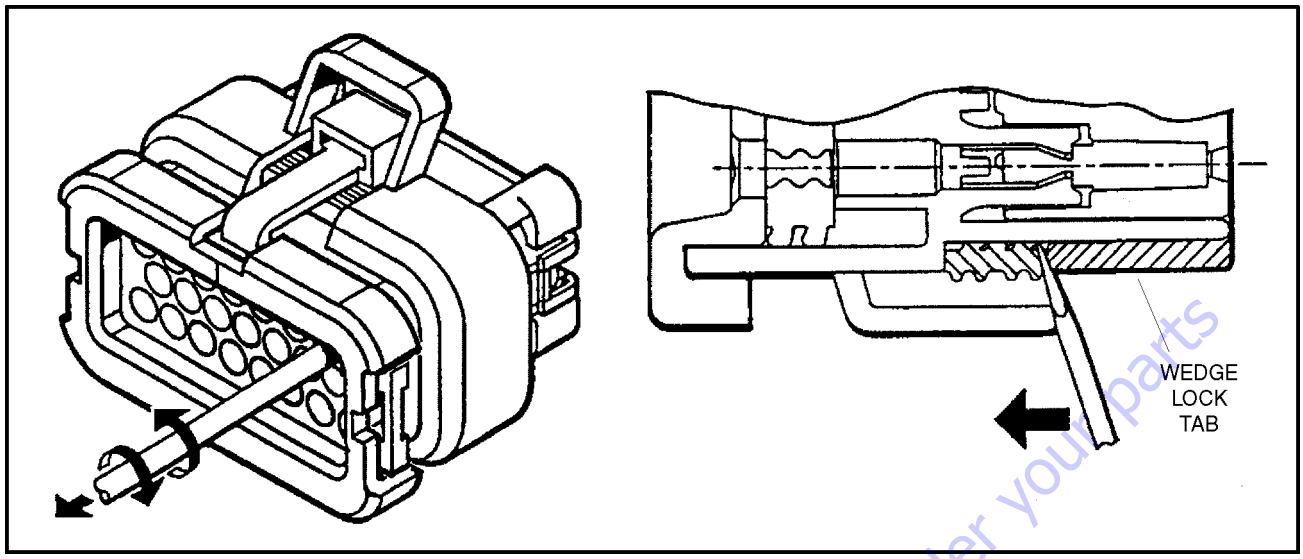


Figure 7-12. Connector Disassembly

Disassembly

1. Insert a 4.8 mm (3/16") wide screwdriver blade between the mating seal and one of the red wedge lock tabs.
2. Pry open the wedge lock to the open position.
3. While rotating the wire back and forth over a half turn (1/4 turn in each direction), gently pull the wire until the contact is removed.

NOTE: *The wedge lock should never be removed from the housing for insertion or removal of the contacts.*

Wedge Lock

The wedge lock has slotted openings in the forward, or mating end. These slots accommodate circuit testing in the field, by using a flat probe such as a pocket knife. DO NOT use a sharp point such as an ice pick.

Service - Voltage Reading

⚠ CAUTION

DO NOT PIERCE WIRE INSULATION TO TAKE VOLTAGE READINGS.

It has been common practice in electrical troubleshooting to probe wires by piercing the insulation with a sharp point. This practice should be discouraged when dealing with the AMPSEAL plug assembly, or any other sealed connector system. The resulting pinholes in the insulation will allow moisture to invade the system by traveling along the wire strands. This nullifies the effectiveness of the connector seals and could result in system failure.

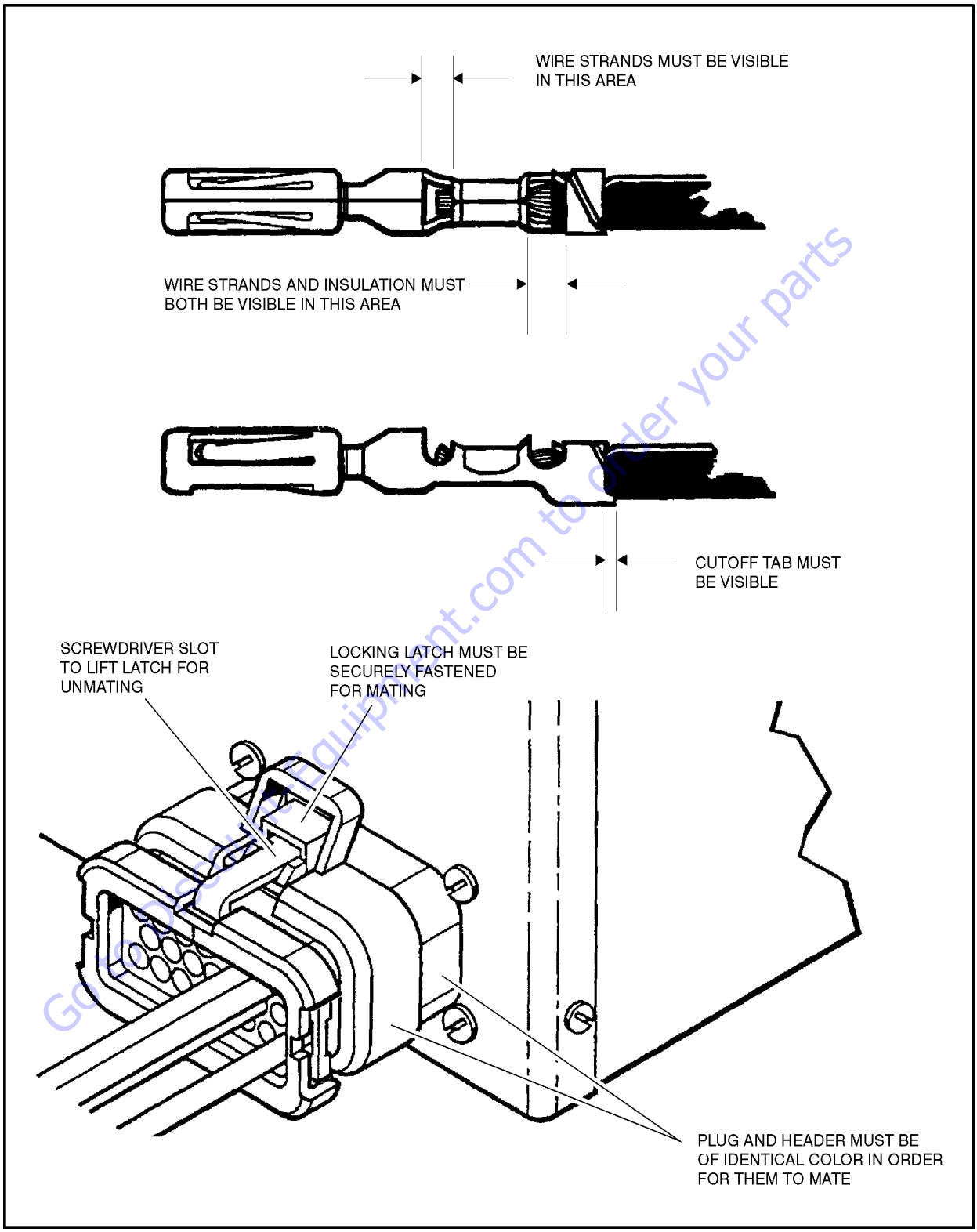


Figure 7-13. Connector Installation

7.6 DEUTSCH CONNECTORS

DT/DTP Series Assembly

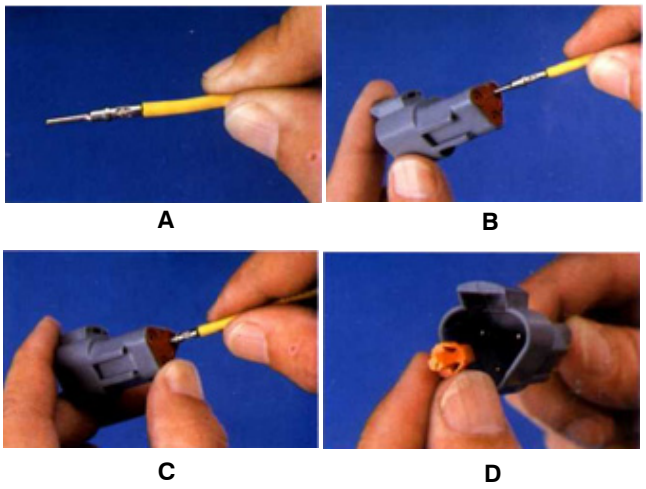


Figure 7-14. DT/DTP Contact Installation

1. Grasp crimped contact about 25mm behind the contact barrel.
2. Hold connector with rear grommet facing you.
3. Push contact straight into connector grommet until a click is felt. A slight tug will confirm that it is properly locked in place.
4. Once all contacts are in place, insert wedgelock with arrow pointing toward exterior locking mechanism. The wedgelock will snap into place. Rectangular wedges are not oriented. Thy may go in either way.

NOTE: *The receptacle is shown - use the same procedure for plug.*

DT/DTP Series Disassembly

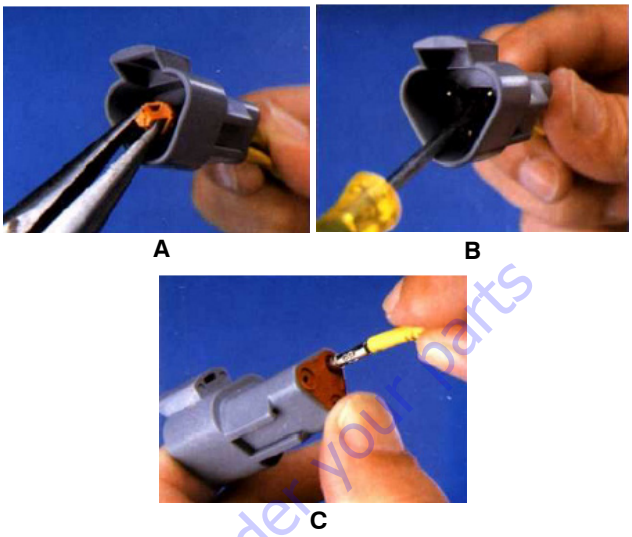


Figure 7-15. DT/DTP Contact Removal

5. Remove wedgelock using needle nose pliers or a hook shaped wire to pull wedge straight out.
6. To remove the contacts, gently pull wire backwards, while at the same time releasing the locking finger by moving it away from the contact with a screwdriver.
7. Hold the rear seal in place, as removing the contact may displace the seal.

HD30/HDP20 Series Assembly

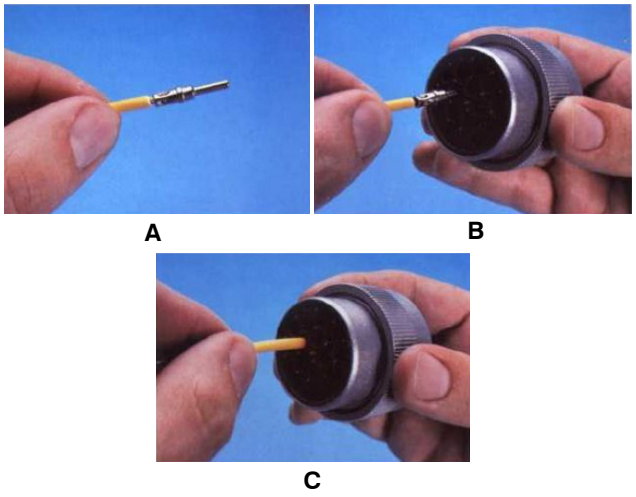


Figure 7-16. HD/HDP Contact Installation

8. Grasp contact about 25mm behind the contact crimp barrel.
9. Hold connector with rear grommet facing you.
10. Push contact straight into connector grommet until a positive stop is felt. A slight tug will confirm that it is properly locked in place.

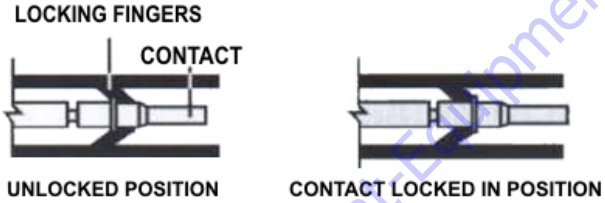


Figure 7-17. HD/HDP Locking Contacts Into Position

NOTE: *For unused wire cavities, insert sealing plugs for full environmental sealing*

HD30/HDP20 Series Disassembly

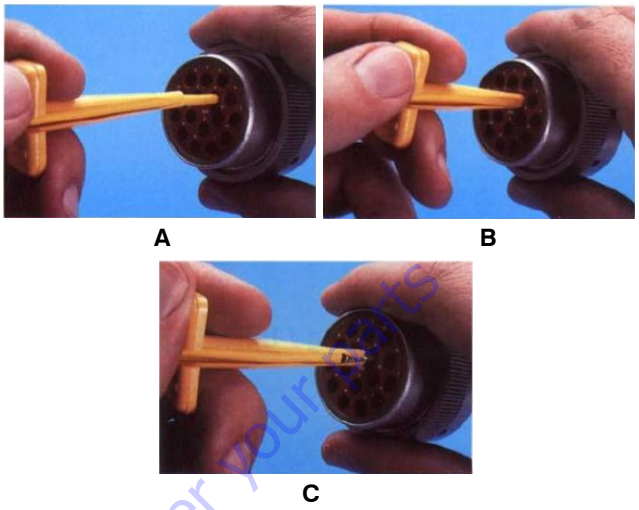


Figure 7-18. HD/HDP Contact Removal

11. With rear insert toward you, snap appropriate size extractor tool over the wire of contact to be removed.
12. Slide tool along into the insert cavity until it engages contact and resistance is felt.
13. Pull contact-wire assembly out of connector.

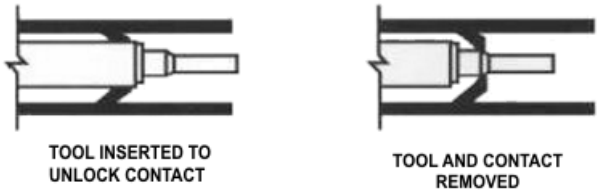


Figure 7-19. HD/HDP Unlocking Contacts

NOTE: *Do Not twist or insert tool at an angle.*

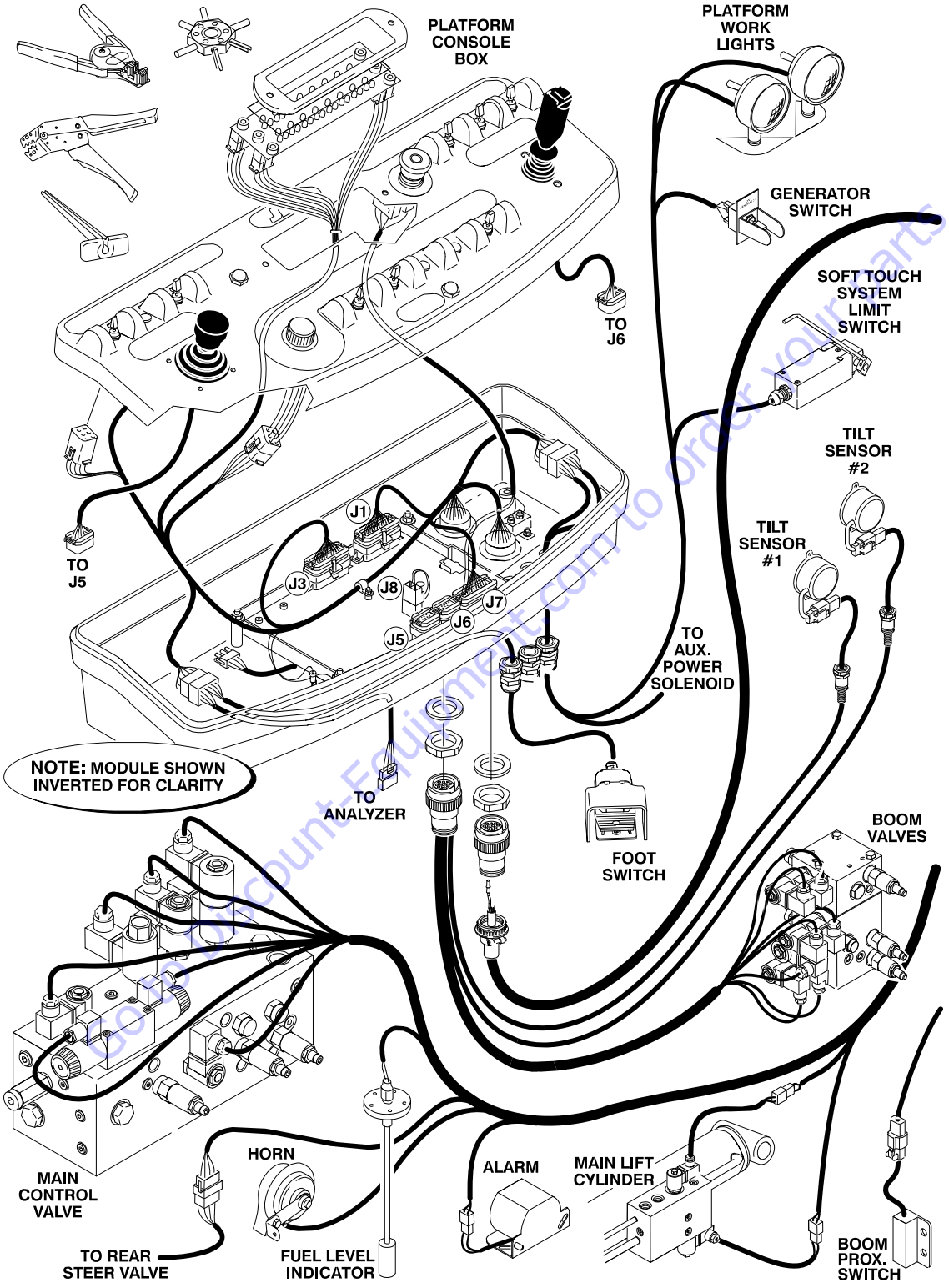


Figure 7-20. Electrical Components Installation (WITHOUT UGM) (Prior to SN 0300085332) - Sheet 1 of 2

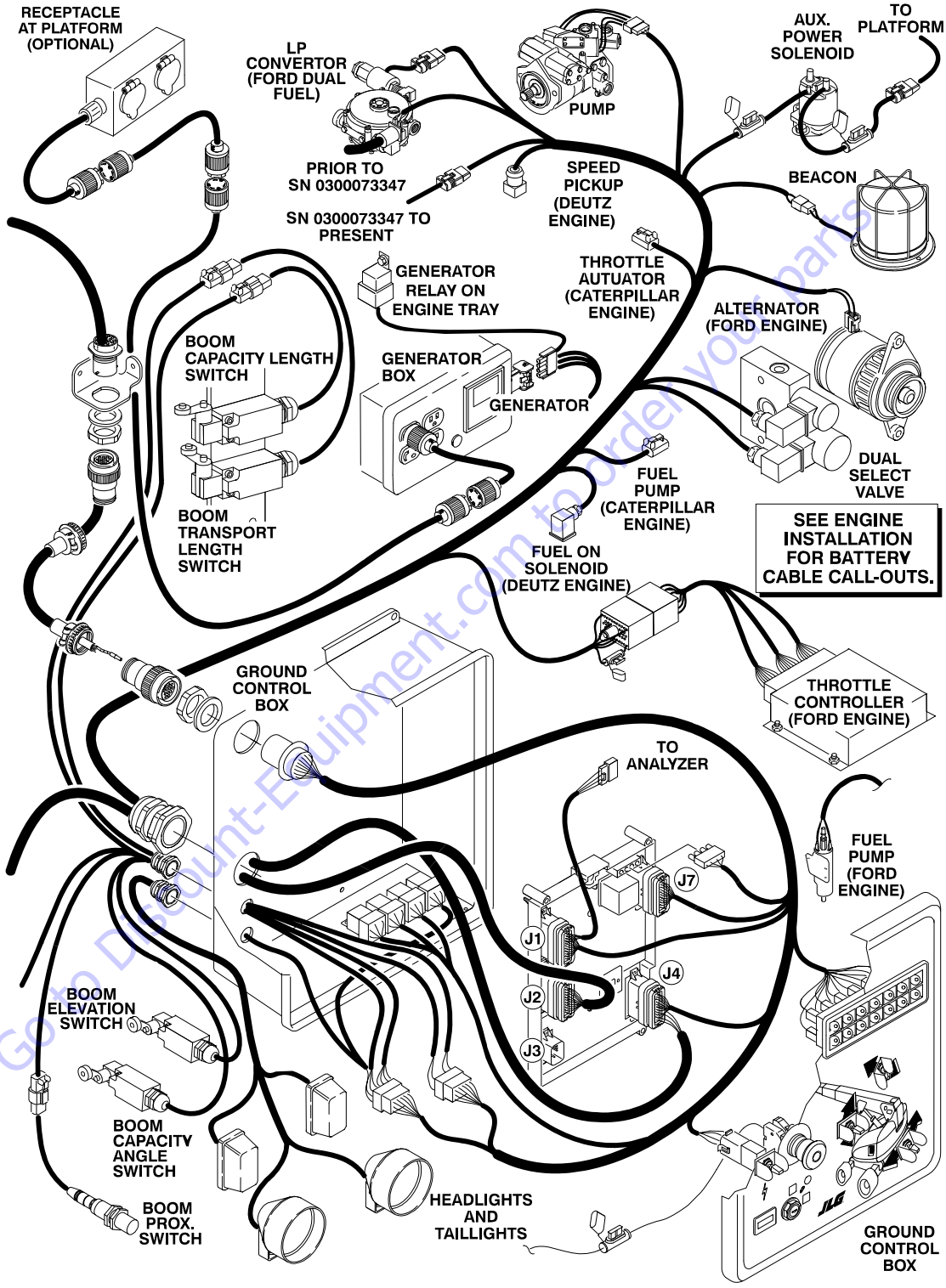


Figure 7-21. Electrical Components Installation (WITHOUT UGM) (Prior to SN 0300085332) - Sheet 2 of 2

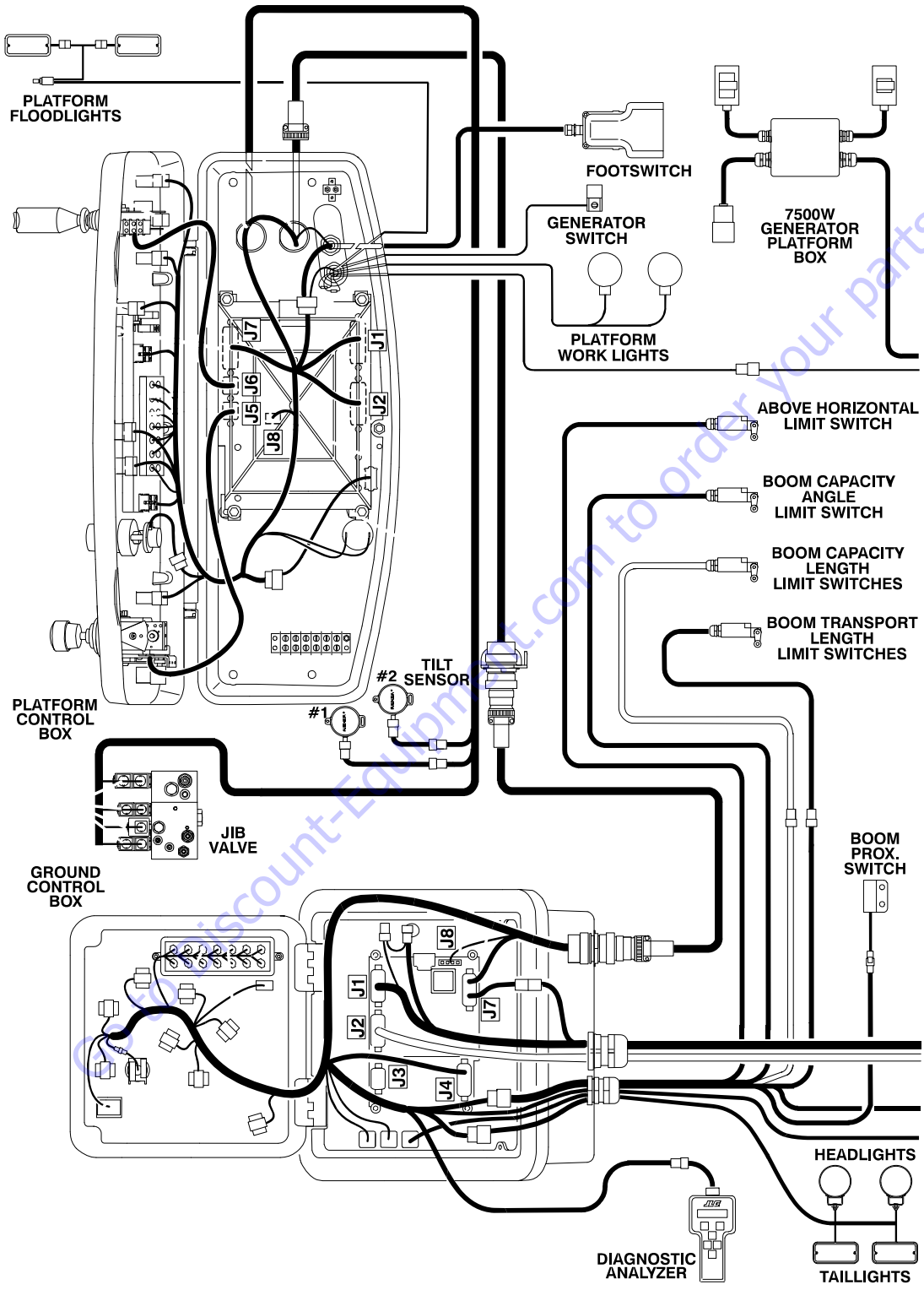


Figure 7-22. Electrical Components Installation (WITHOUT UGM) (SN 0300085332 through 0300140000) - Sheet 1 of 2

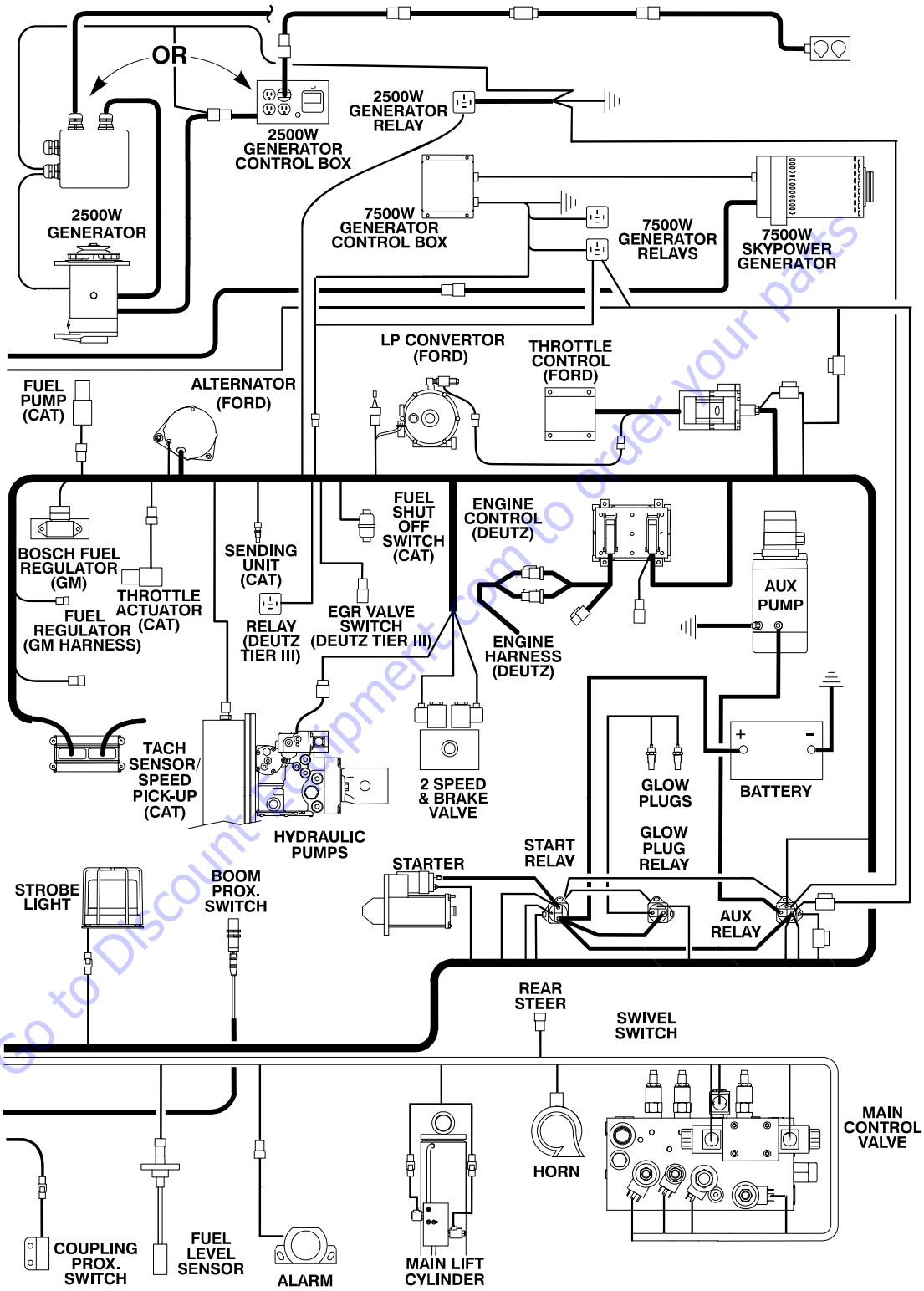
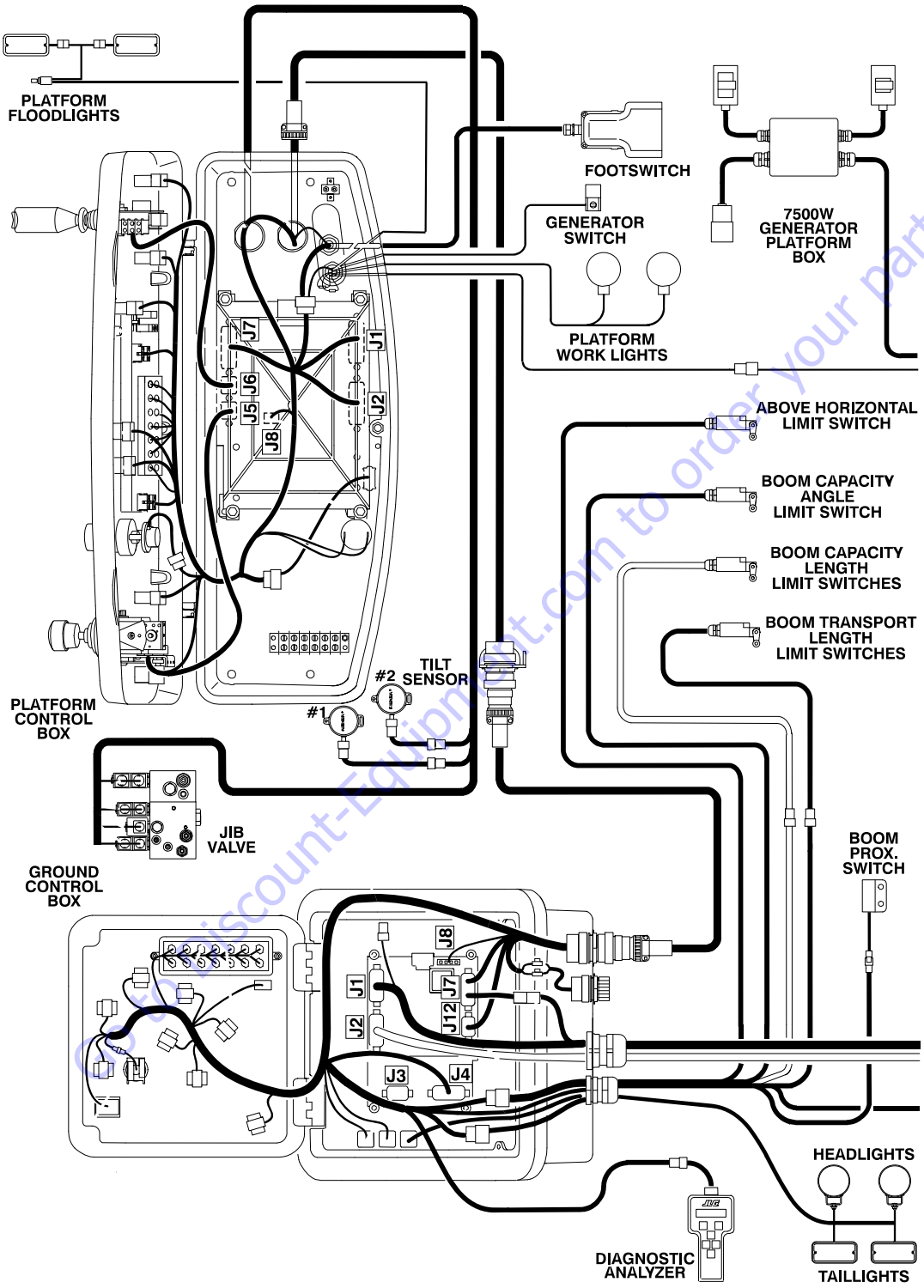


Figure 7-23. Electrical Components Installation (WITHOUT UGM) (SN 0300085332 through 0300140000) - Sheet 2 of 2



Electrical Components Installation (WITH UGM) (Prior to SN 0300140000) - Sheet 1 of 2

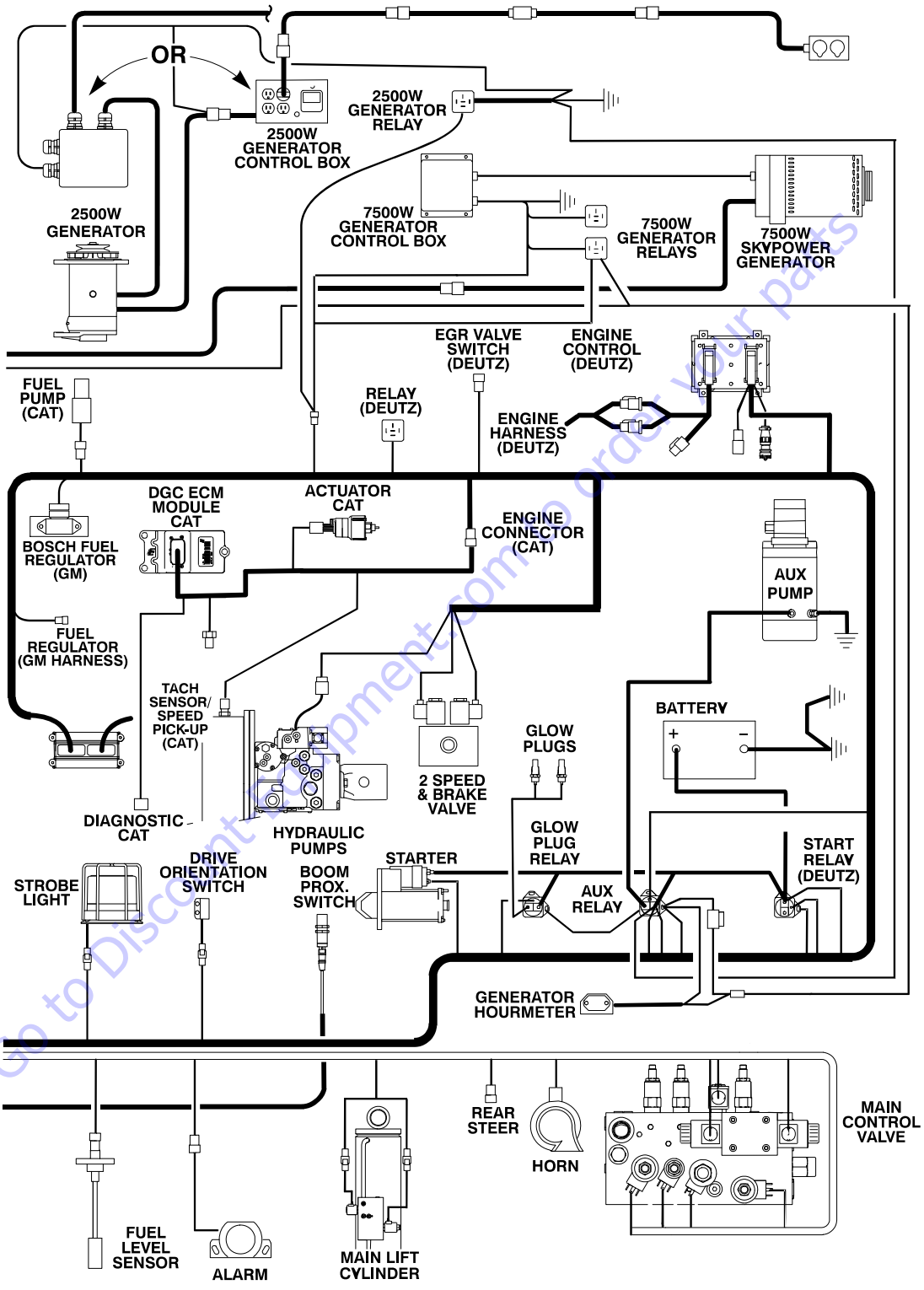


Figure 7-24. Electrical Components Installation (WITH UGM) (Prior to SN 0300140000) - Sheet 2 of 2

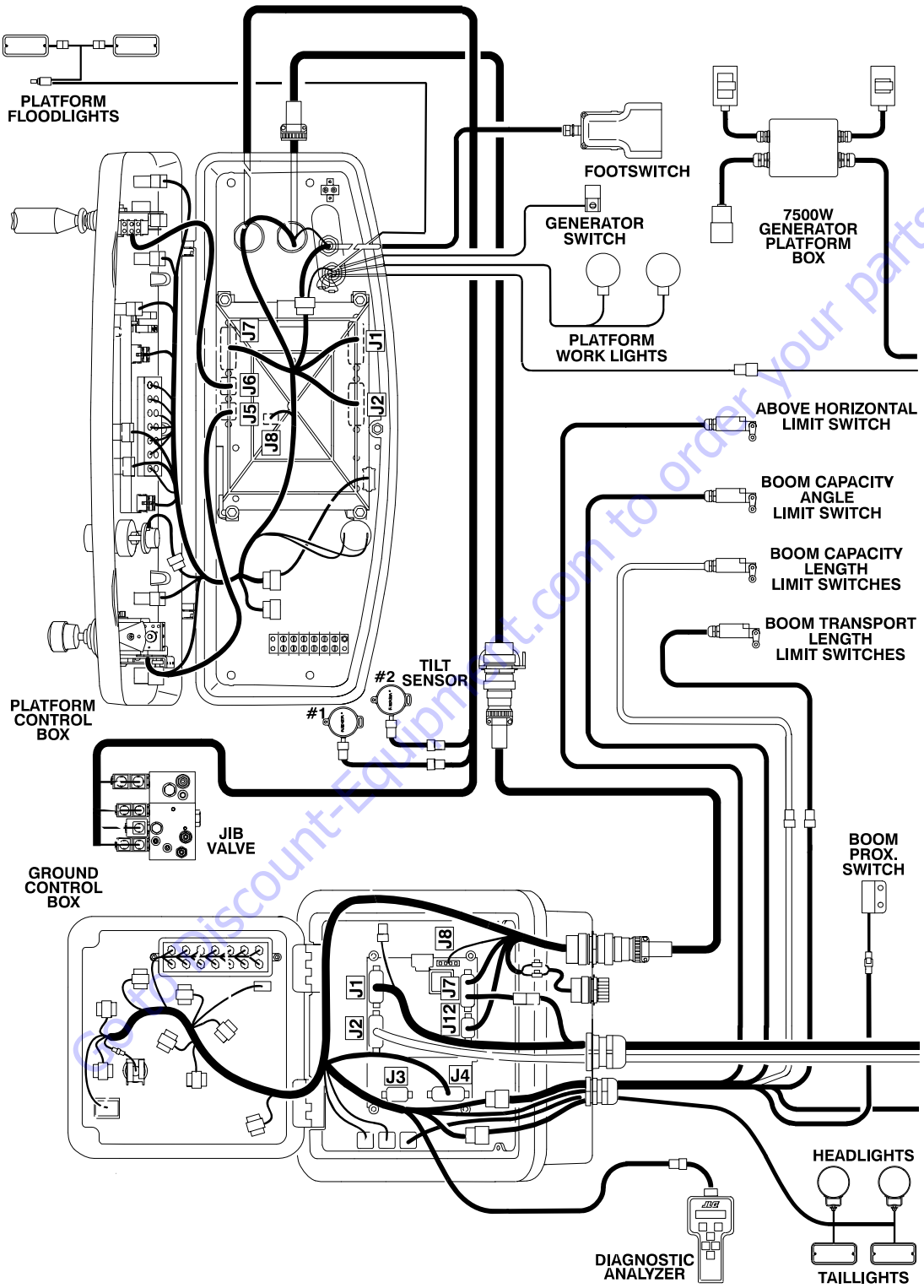


Figure 7-25. Electrical Components Installation (WITH UGM) (SN 0300140000 through 0300182743 and SN B300000100 through B300001091) - Sheet 1 of 2

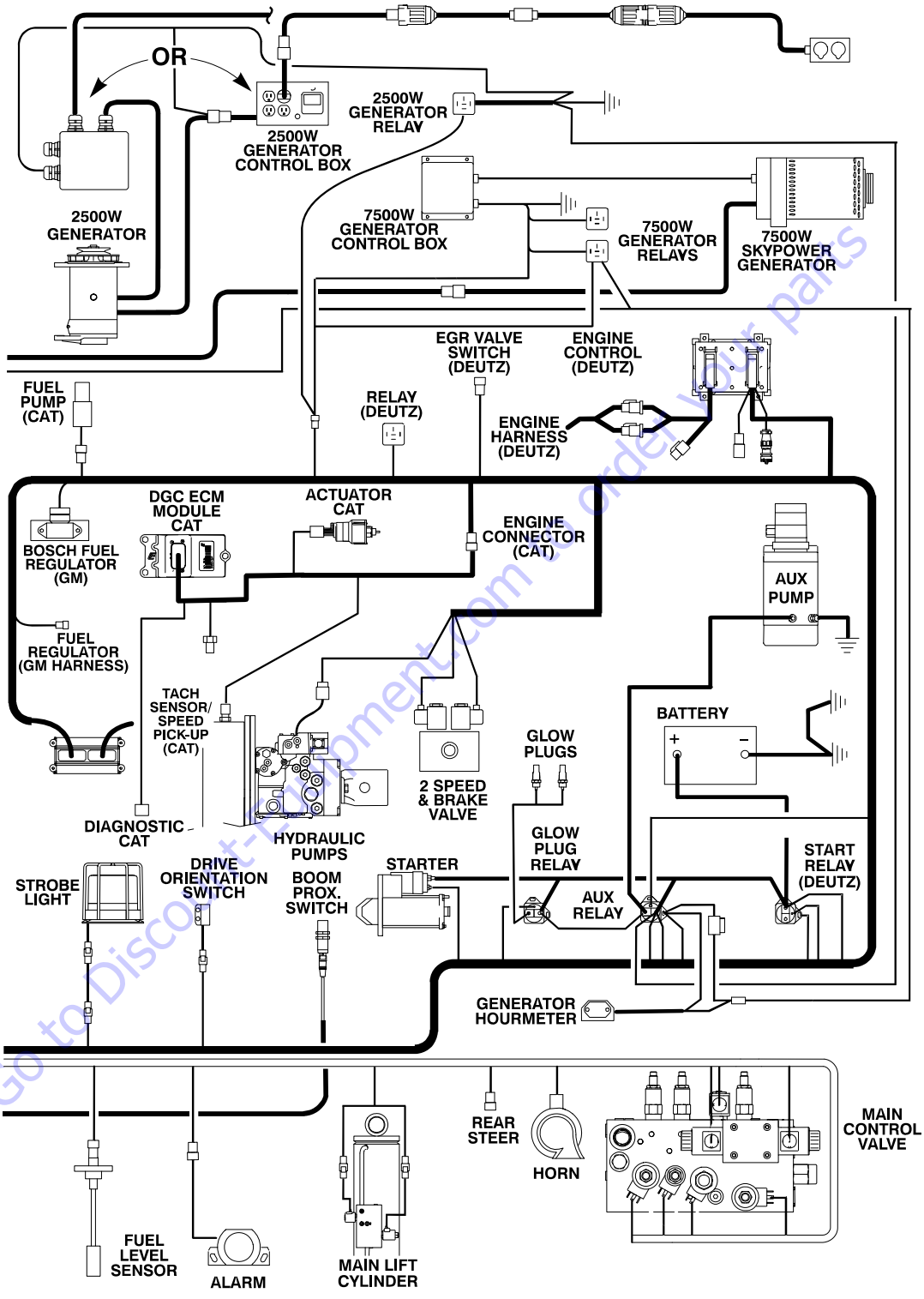


Figure 7-26. Electrical Components Installation (WITH UGM) (SN 0300140000 through 0300182743 and SN B300000100 through B300001091) - Sheet 2 of 2

7.7 ELECTRICAL SCHEMATICS

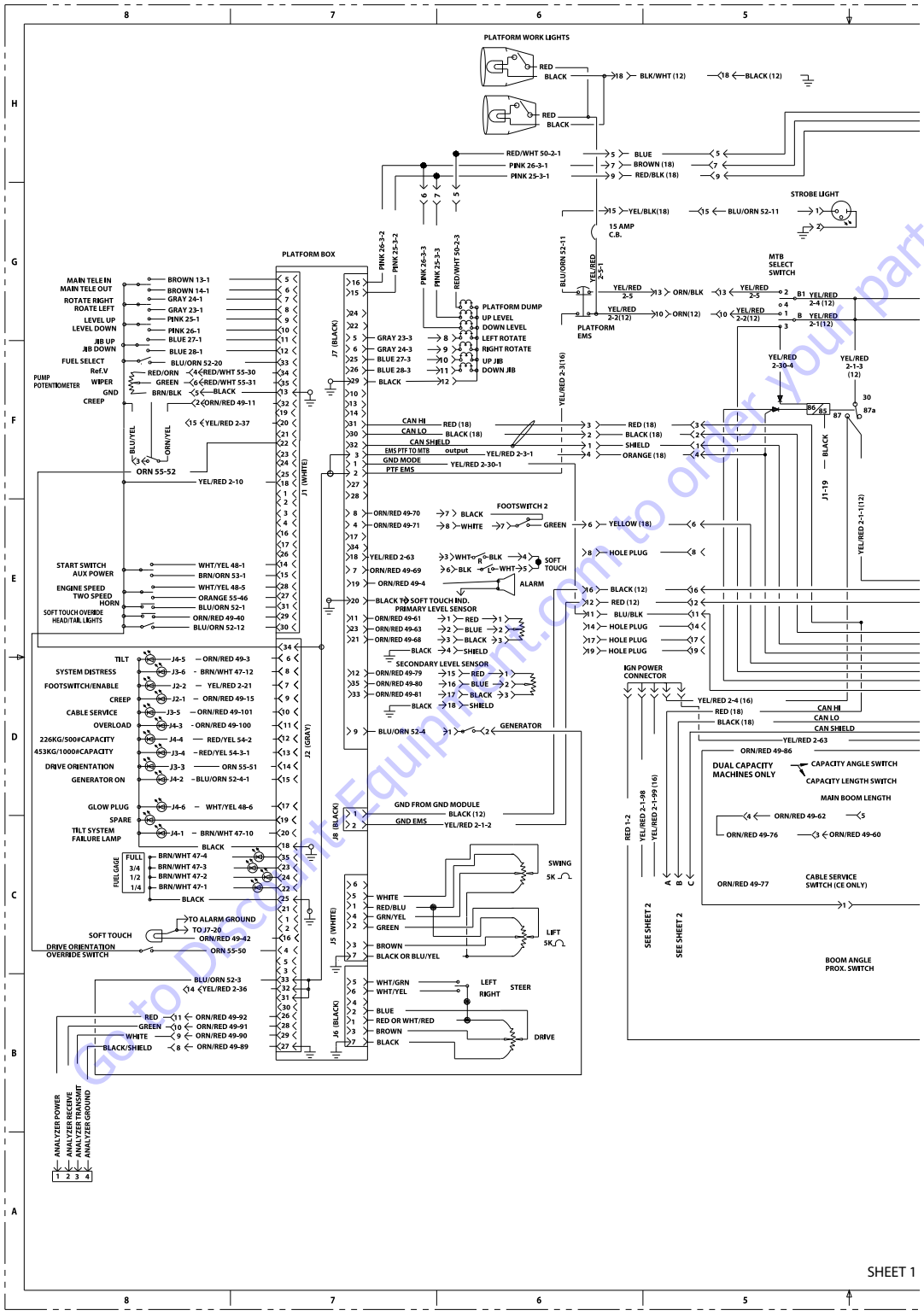


Figure 7-27. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 1 of 6

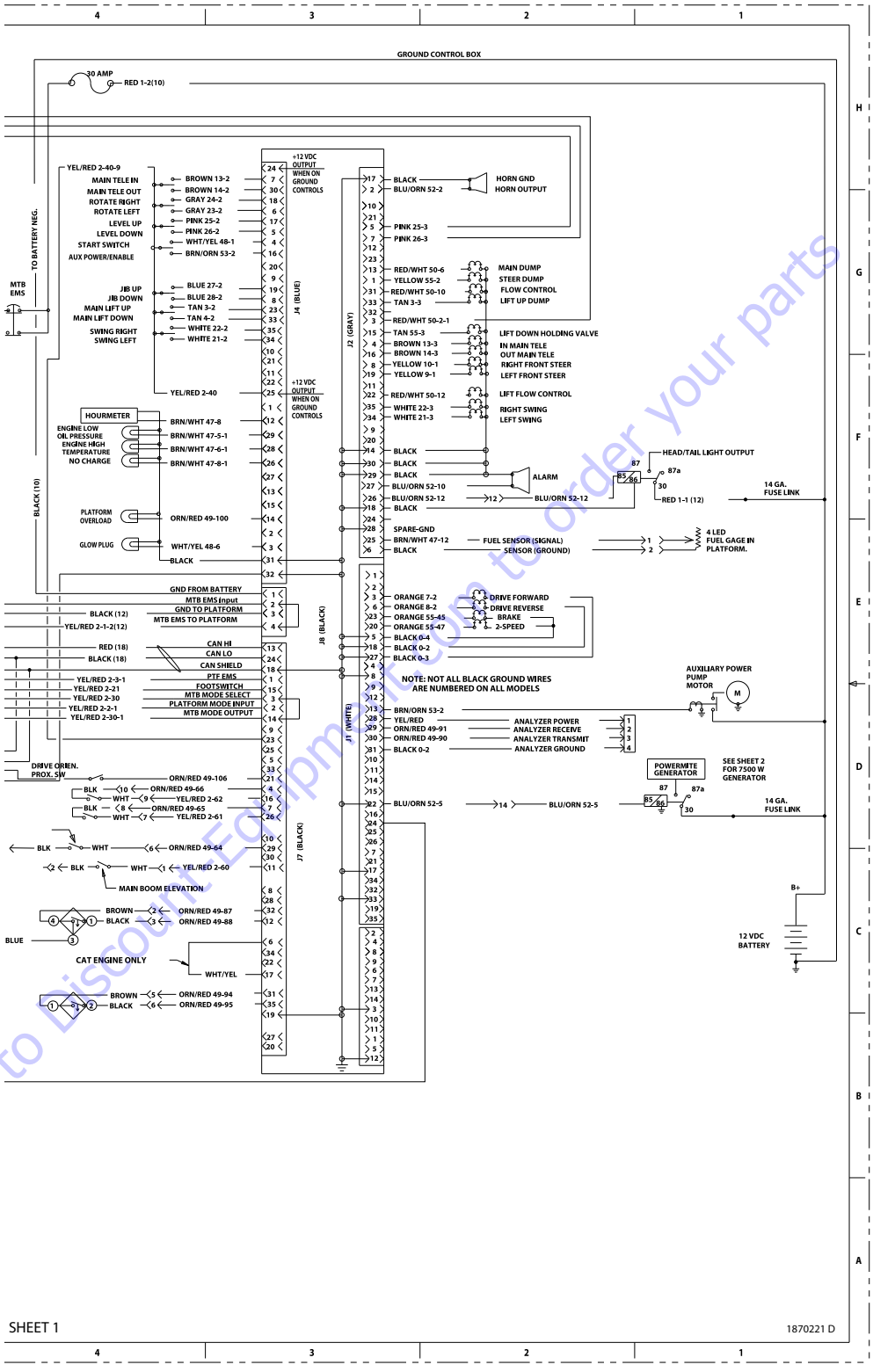


Figure 7-28. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 2 of 6

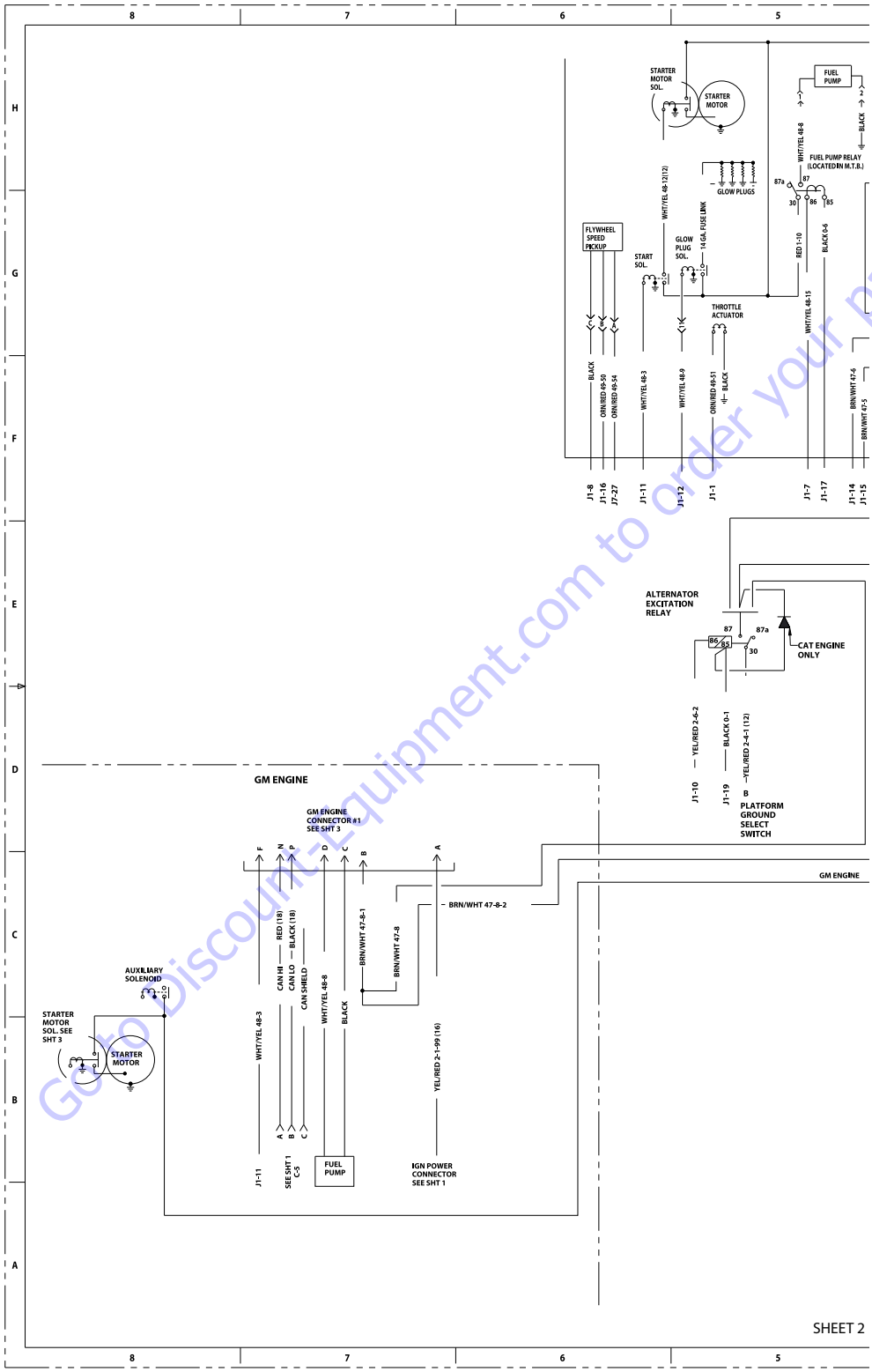


Figure 7-29. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 3 of 6

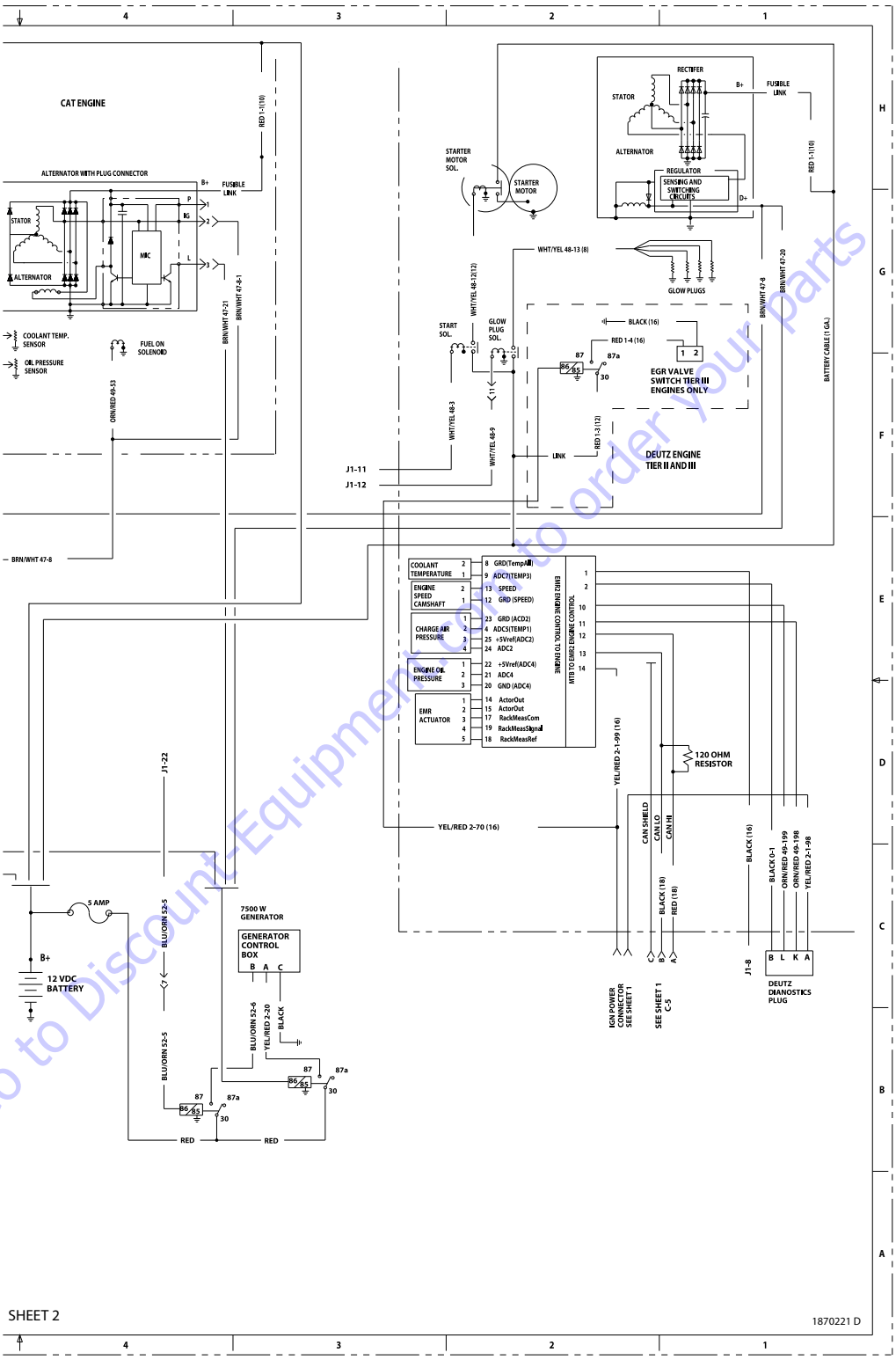


Figure 7-30. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 4 of 6

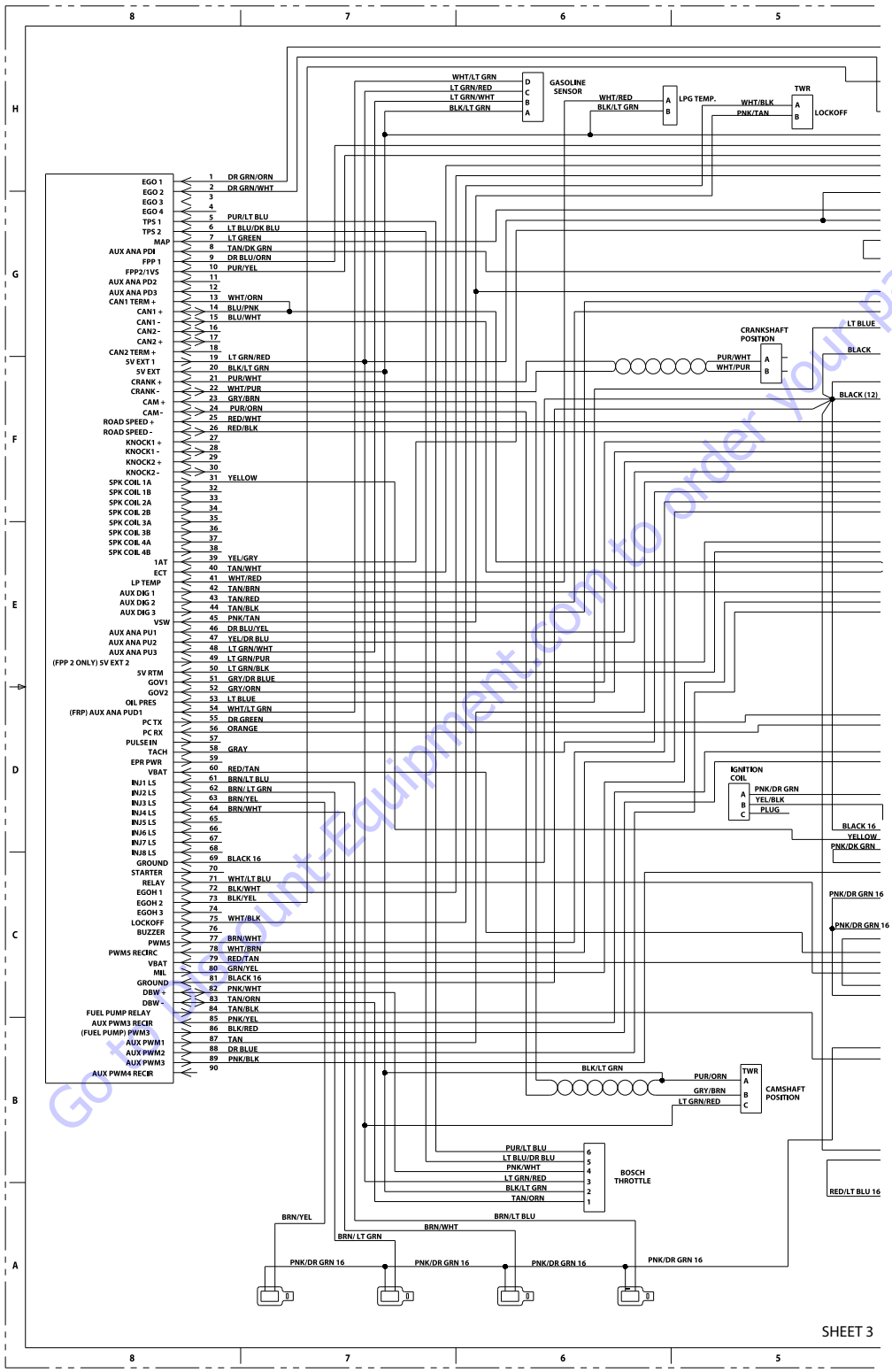


Figure 7-31. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 5 of 6

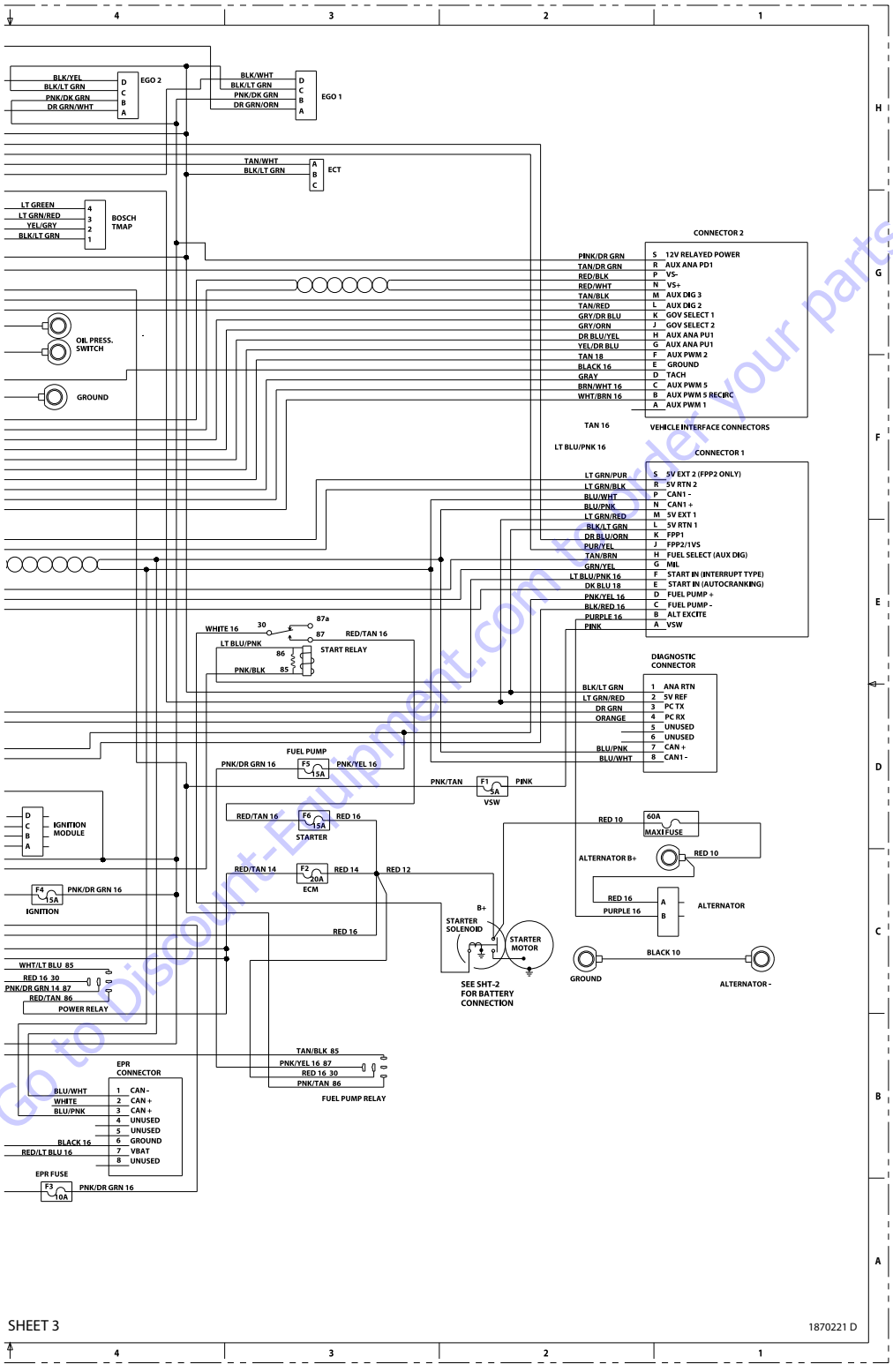


Figure 7-32. Electrical Schematics Caterpillar, Deutz EMR2 and GM (Prior to SN 0300139080) - Sheet 6 of 6

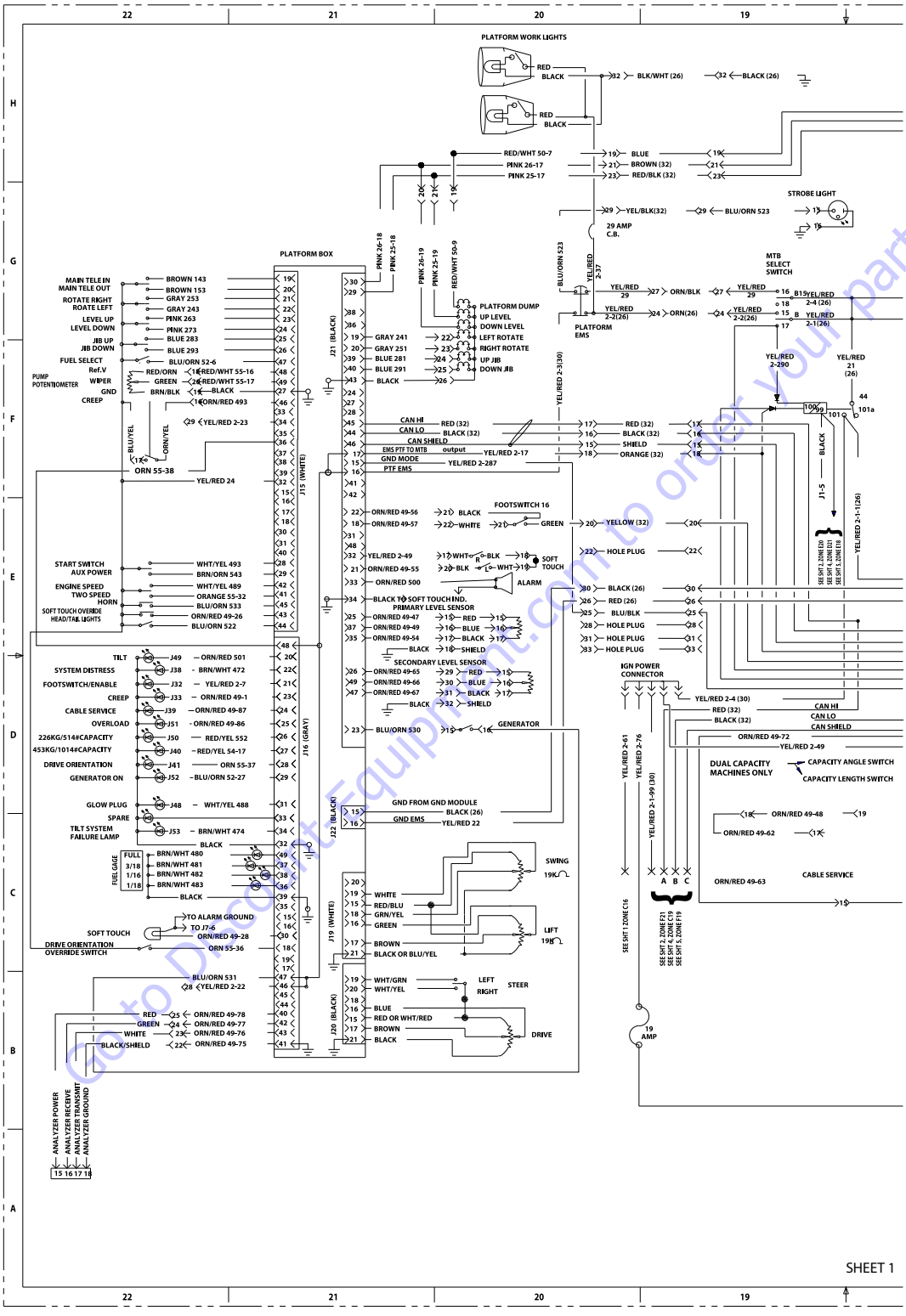


Figure 7-33. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639)- Sheet 1 of 10

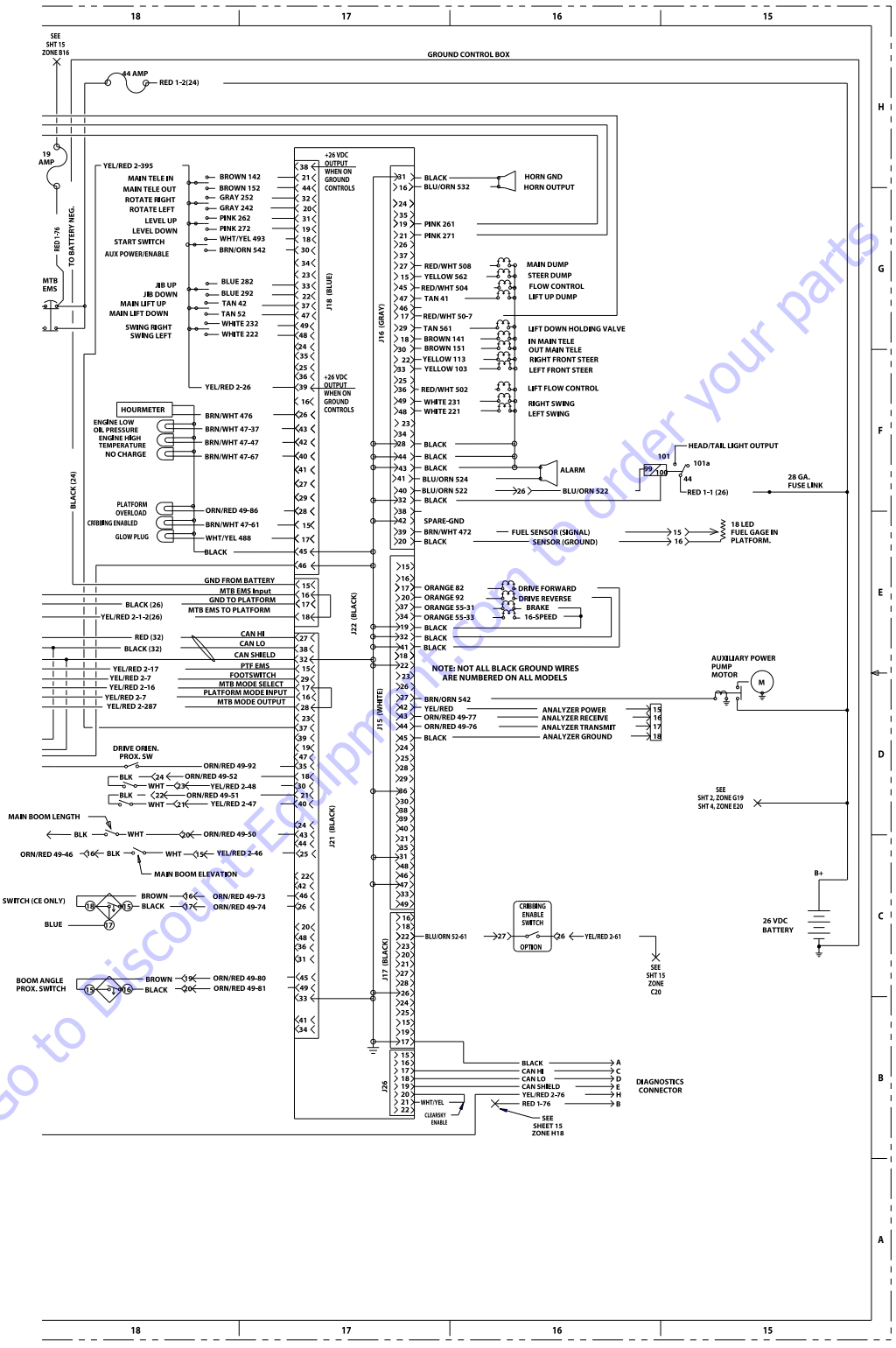


Figure 7-34. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 2 of 10

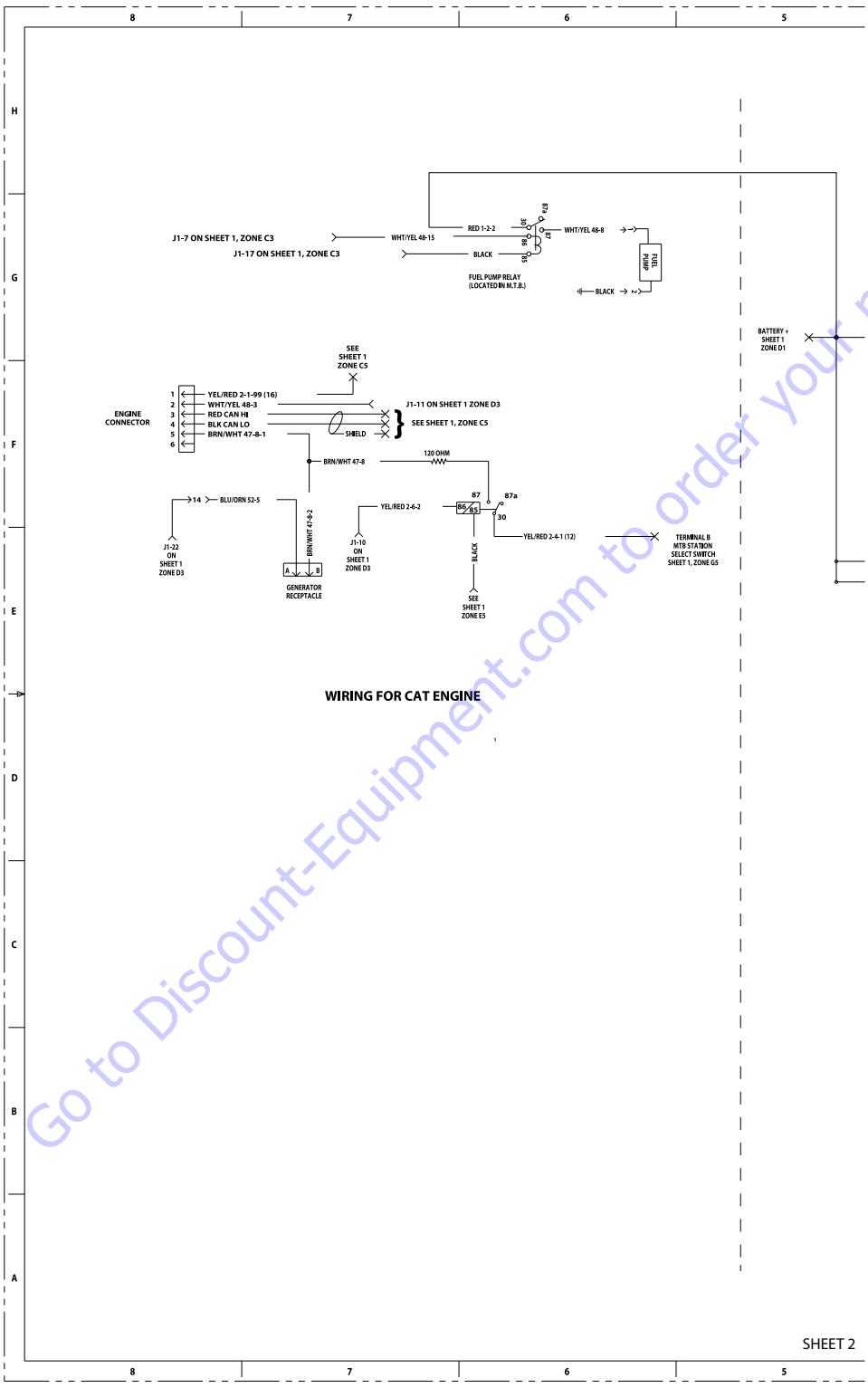
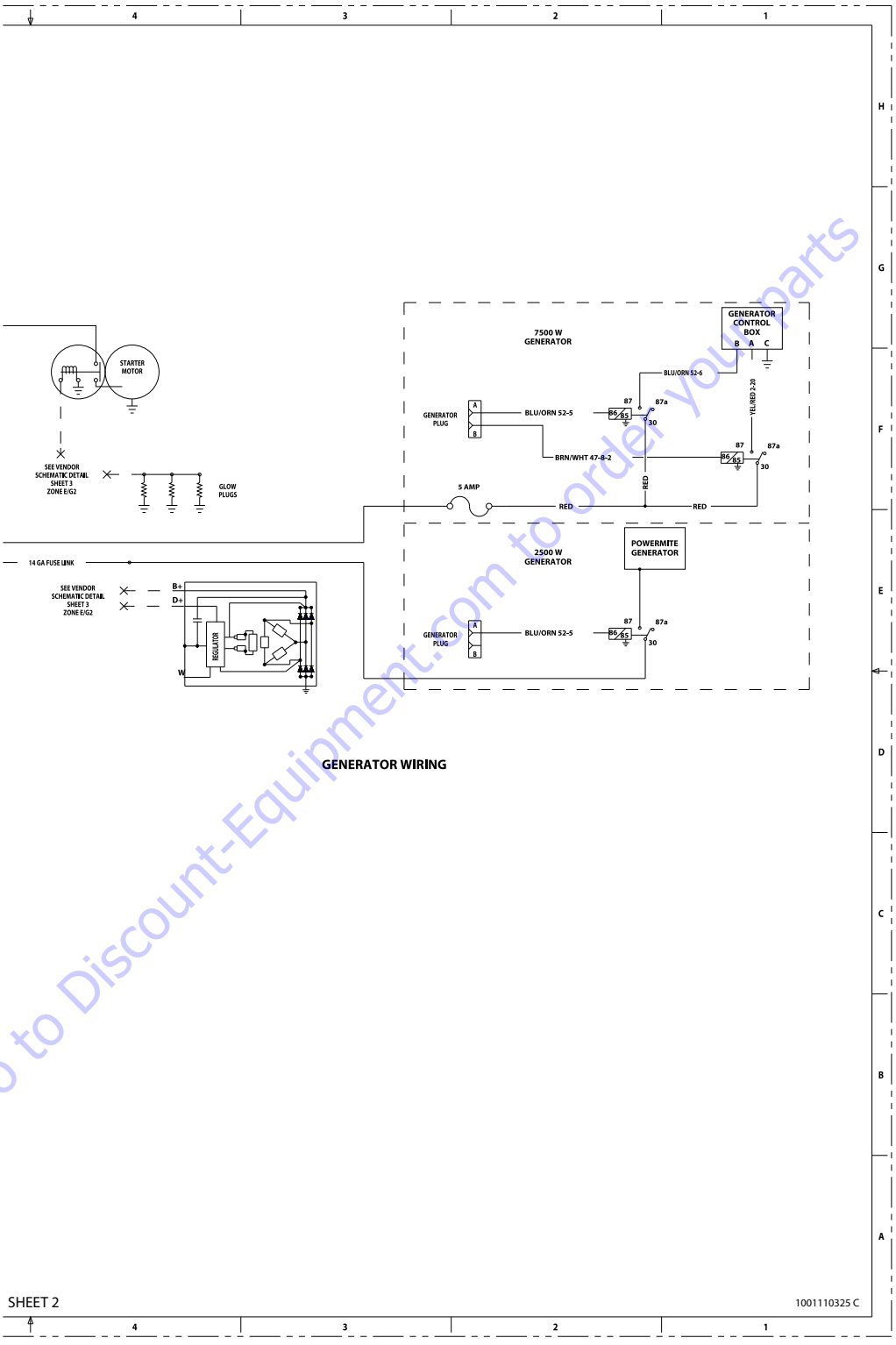


Figure 7-35. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 3 of 10



GENERATOR WIRING

Figure 7-36. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 4 of 10

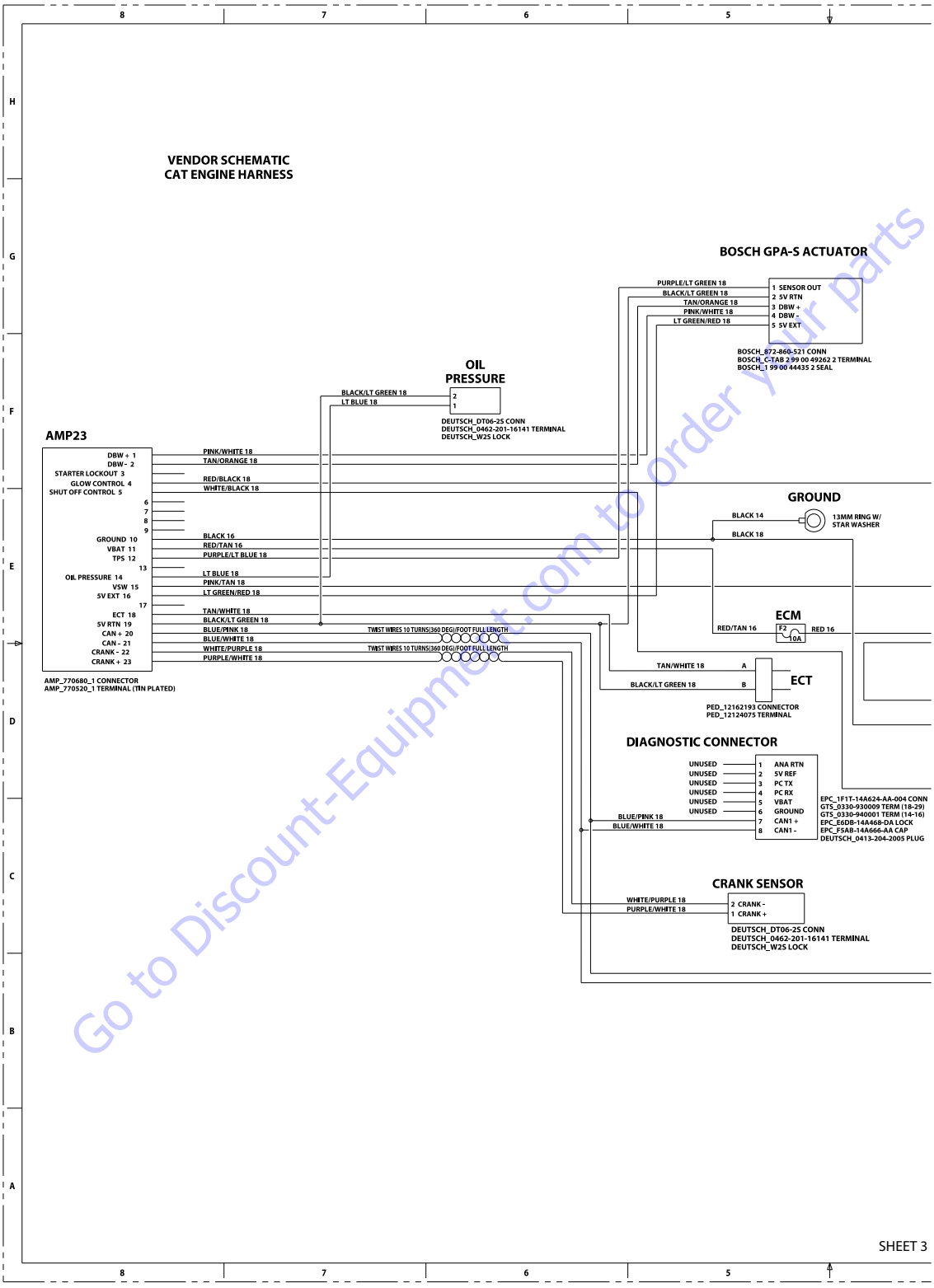


Figure 7-37. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 5 of 10

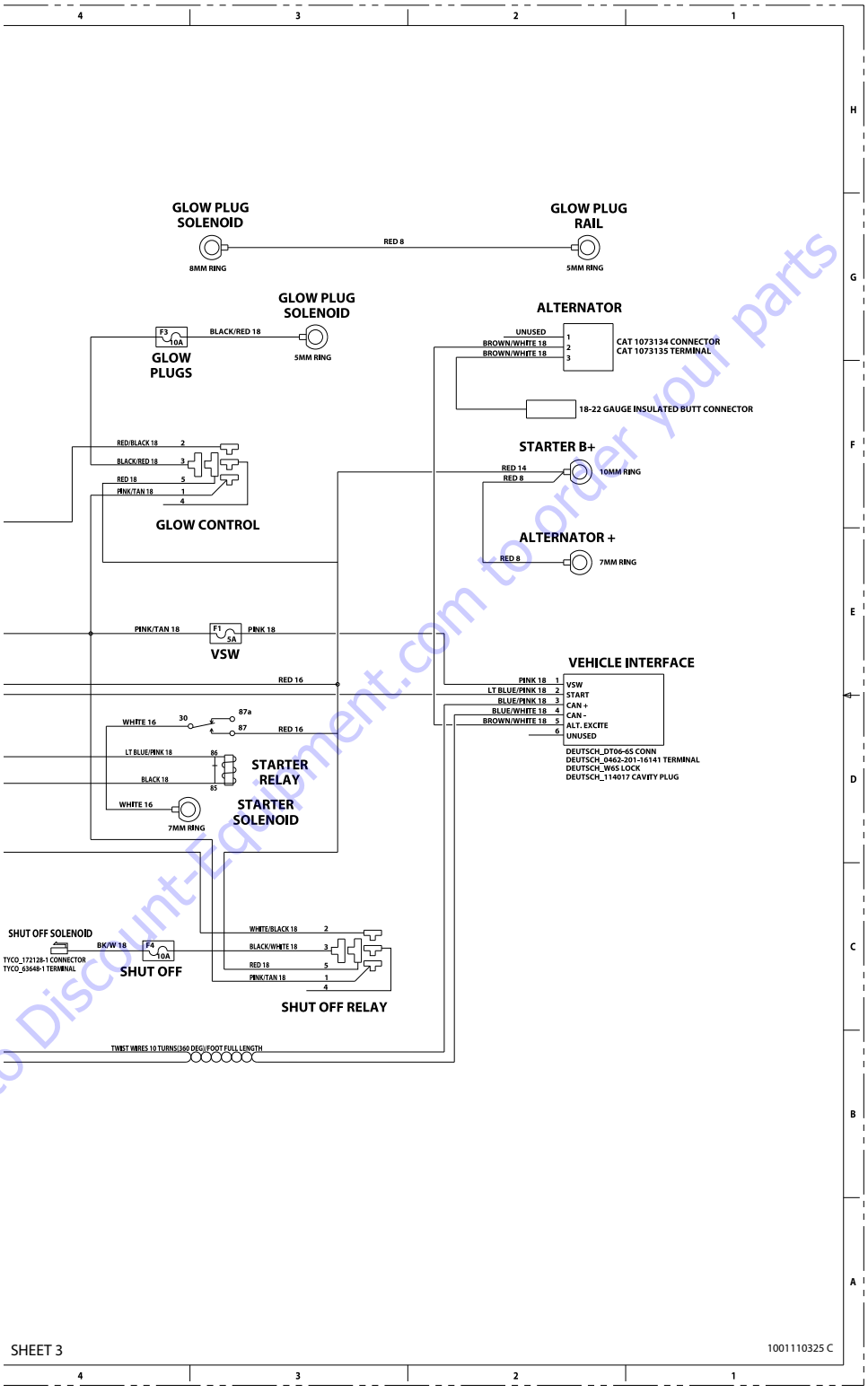


Figure 7-38. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 6 of 10

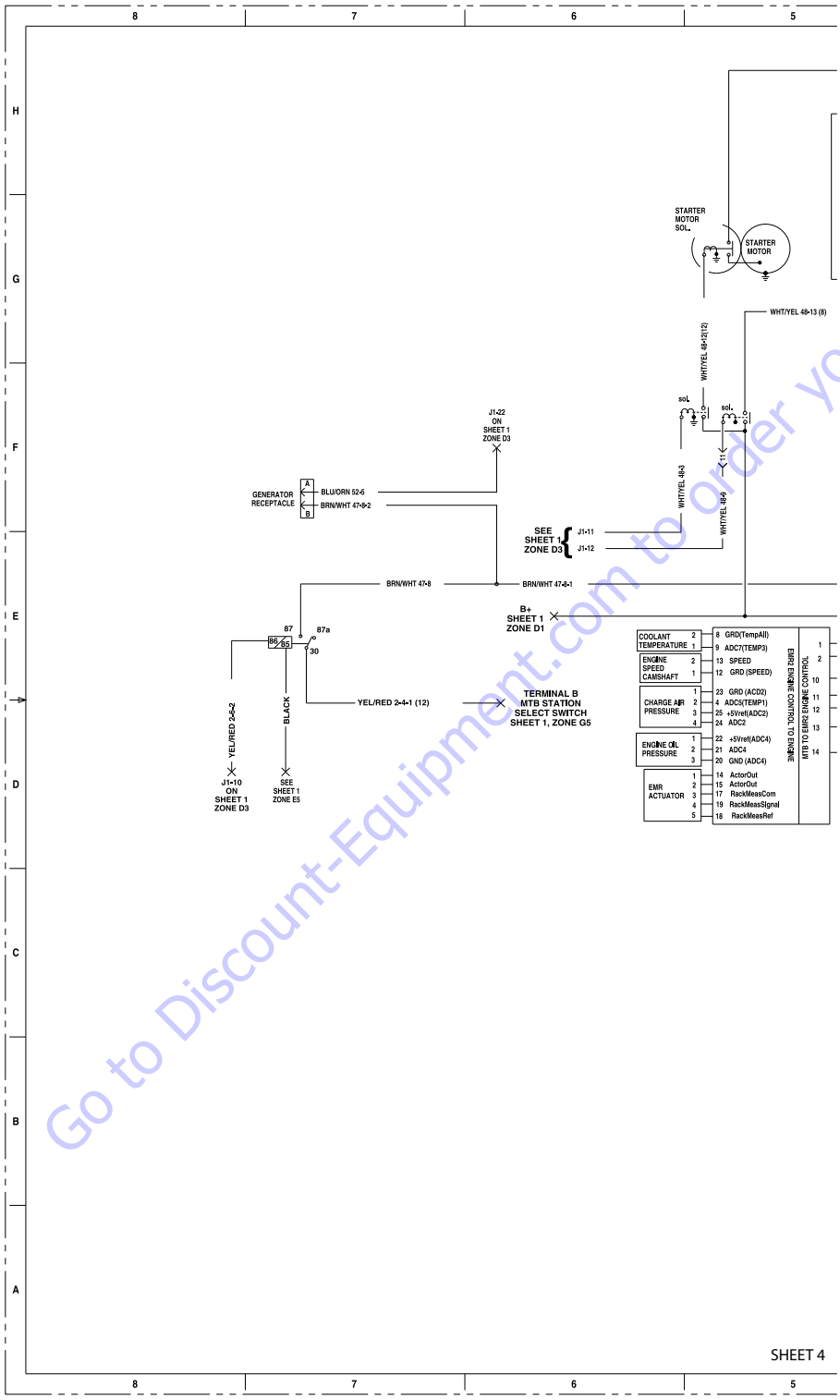


Figure 7-39. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 7 of 10

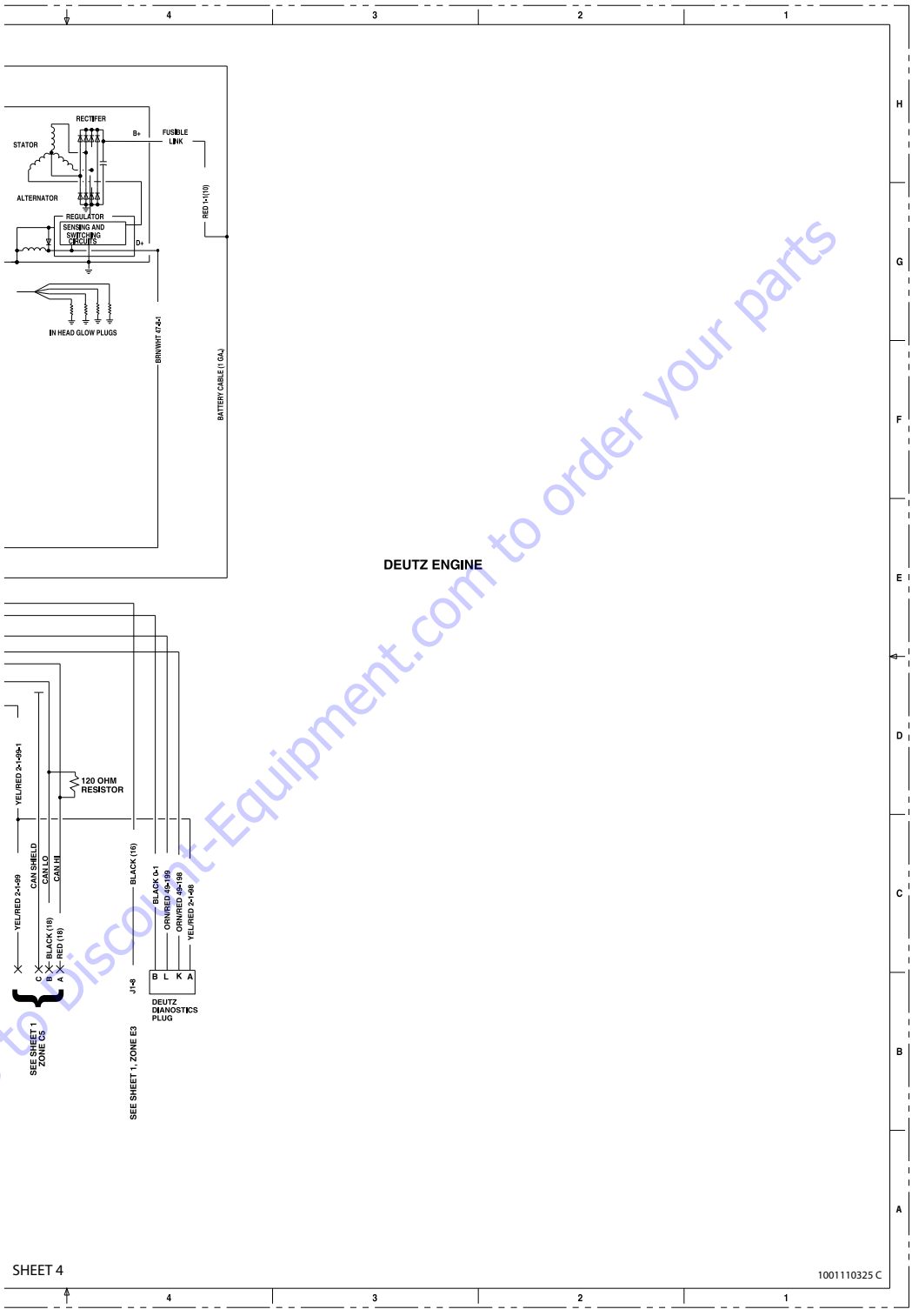


Figure 7-40. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 8 of 10

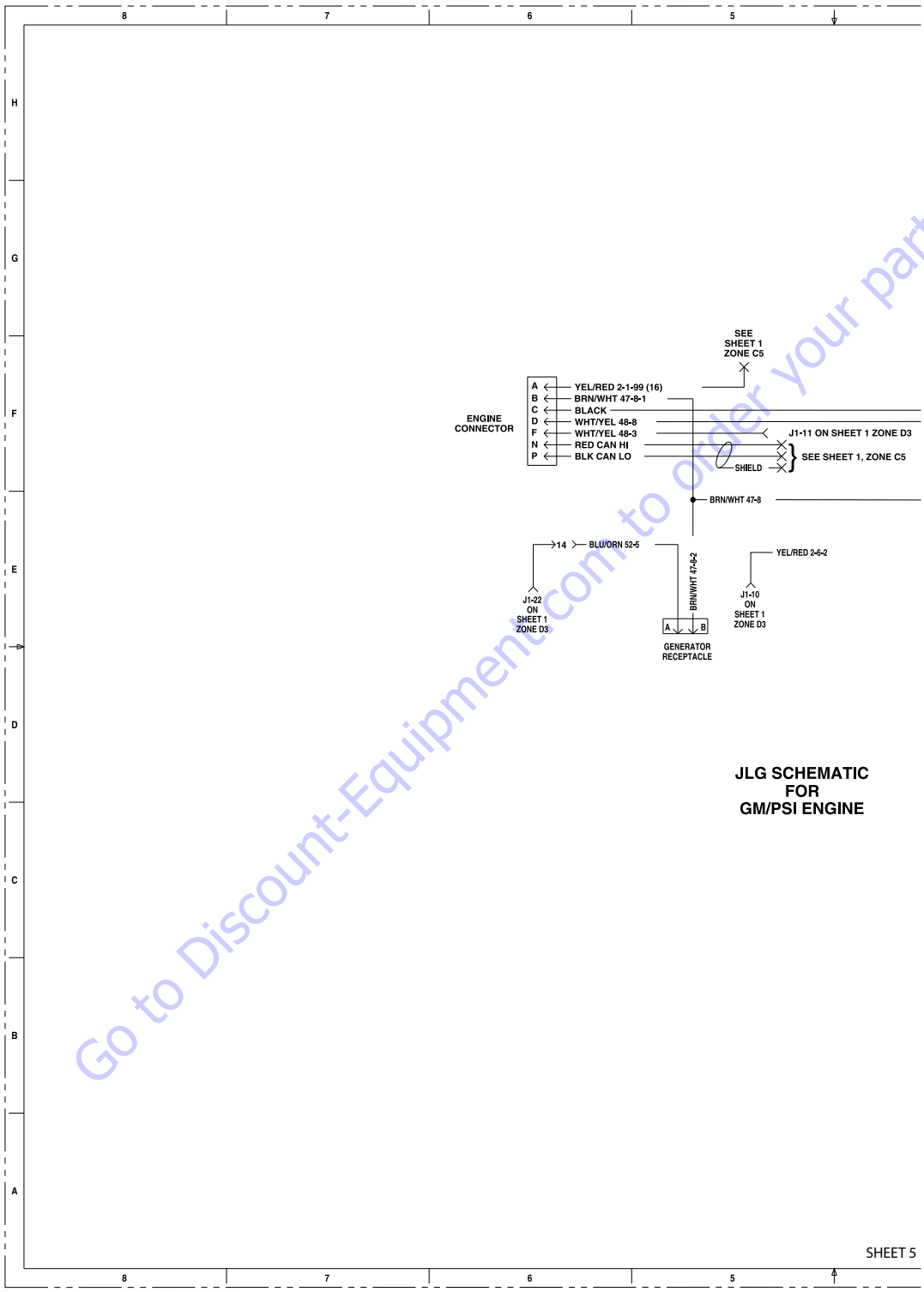


Figure 7-41. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 9 of 10

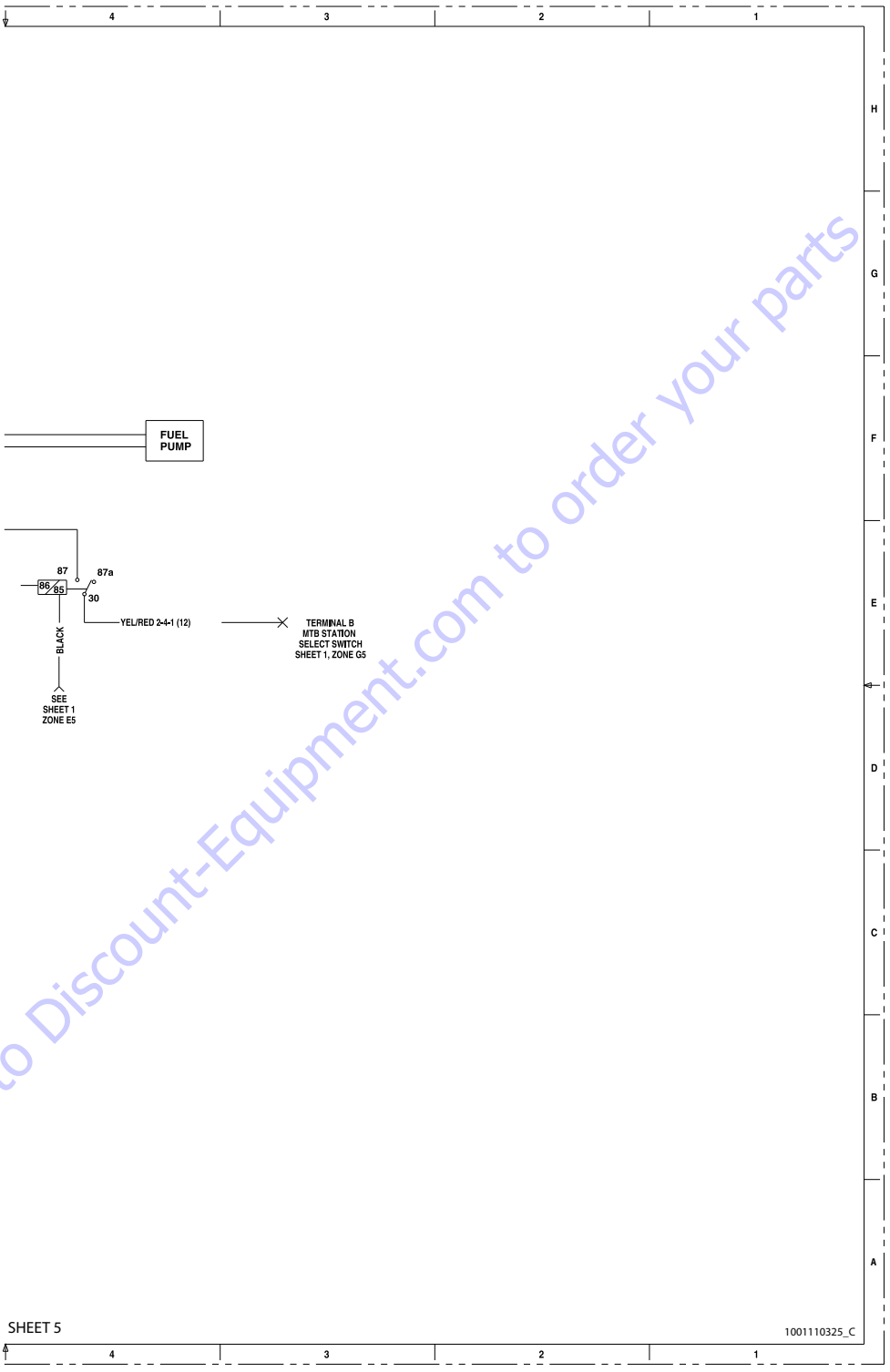


Figure 7-42. Electrical Schematics Caterpillar, Deutz EMR2 and GM (SN 0300139080 through 0300161729 and SN B300000100 through B300000639) - Sheet 10 of 10

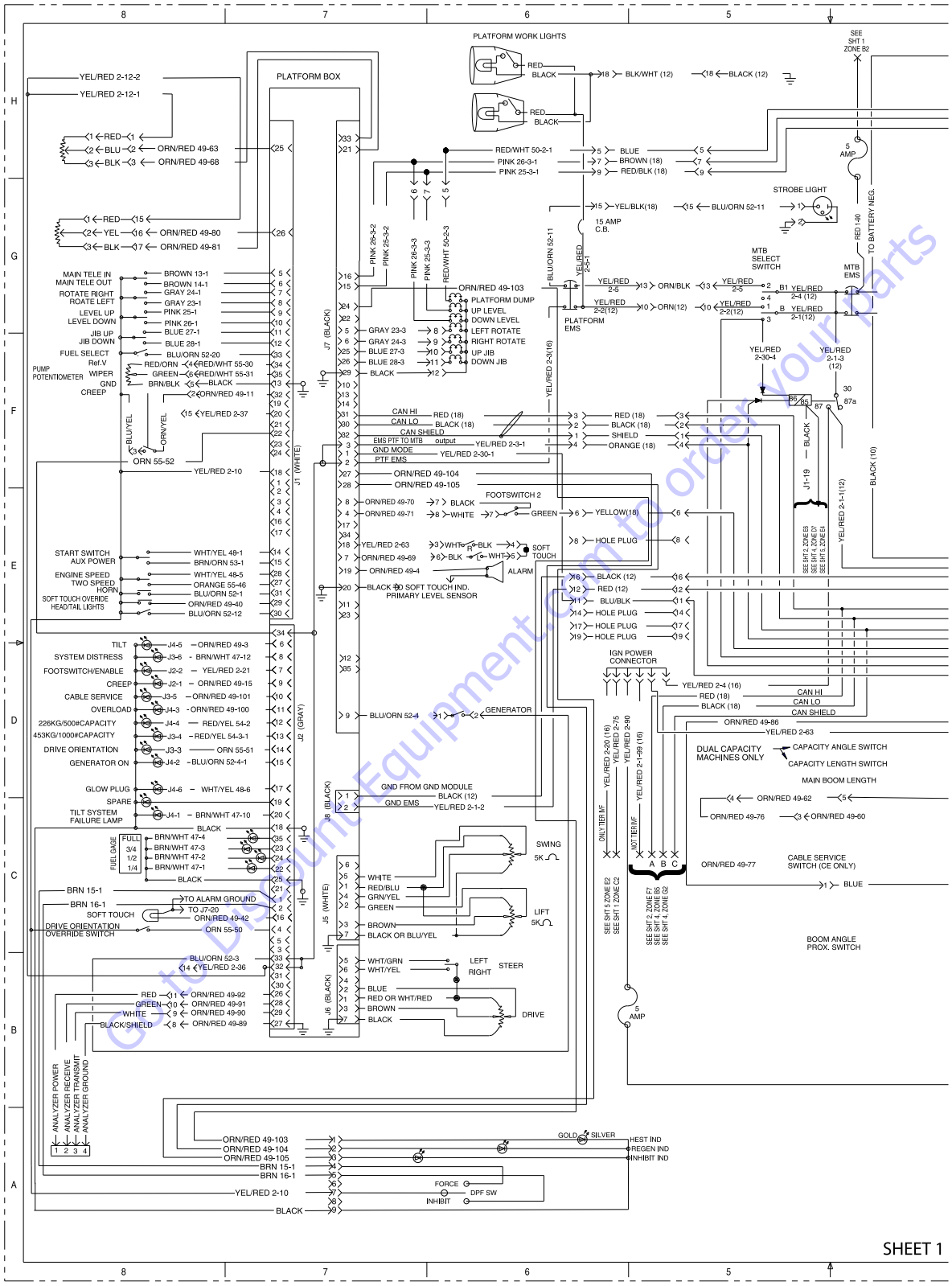


Figure 7-43. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091) - Sheet 1 of 10

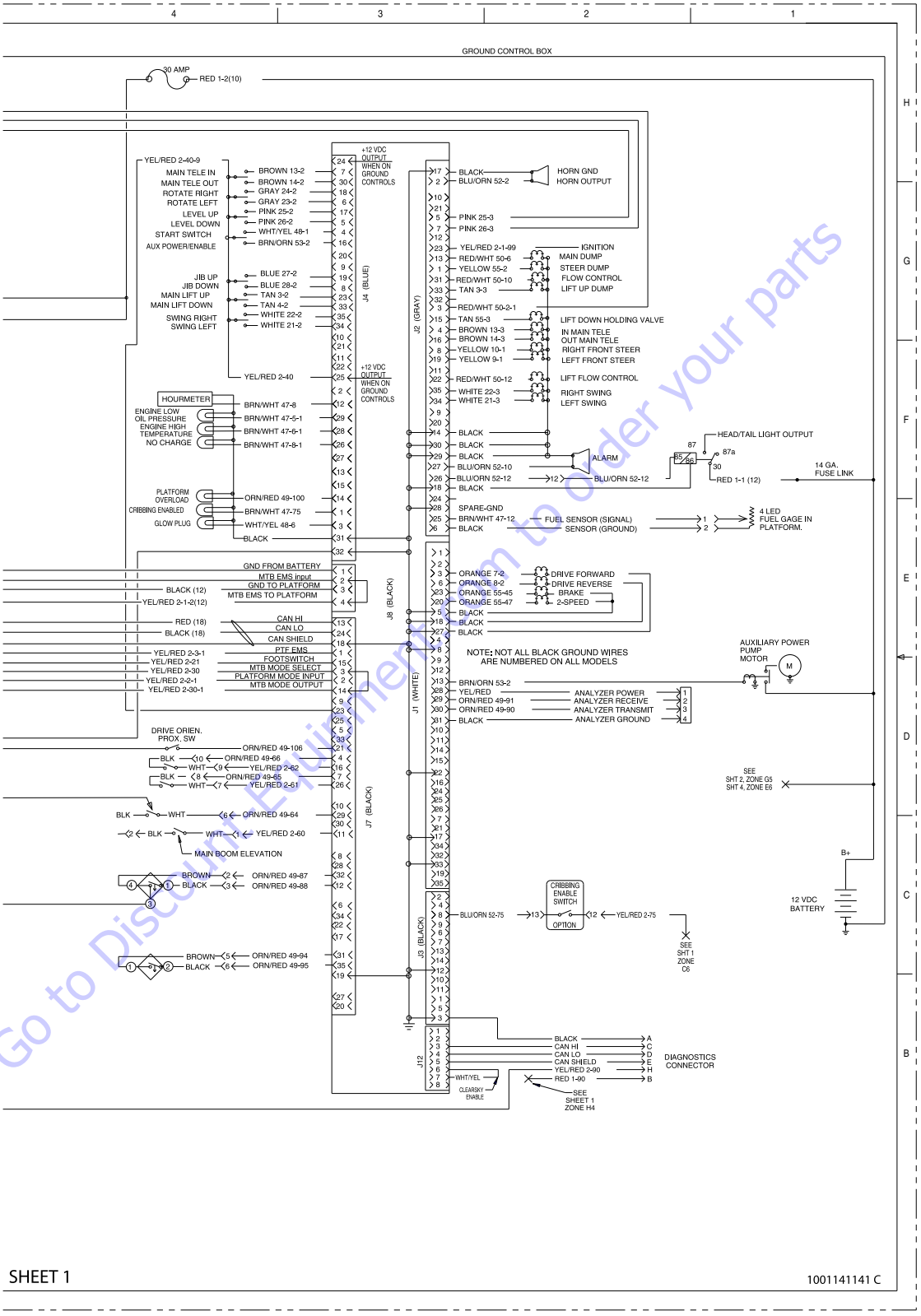


Figure 7-44. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 2 of 10

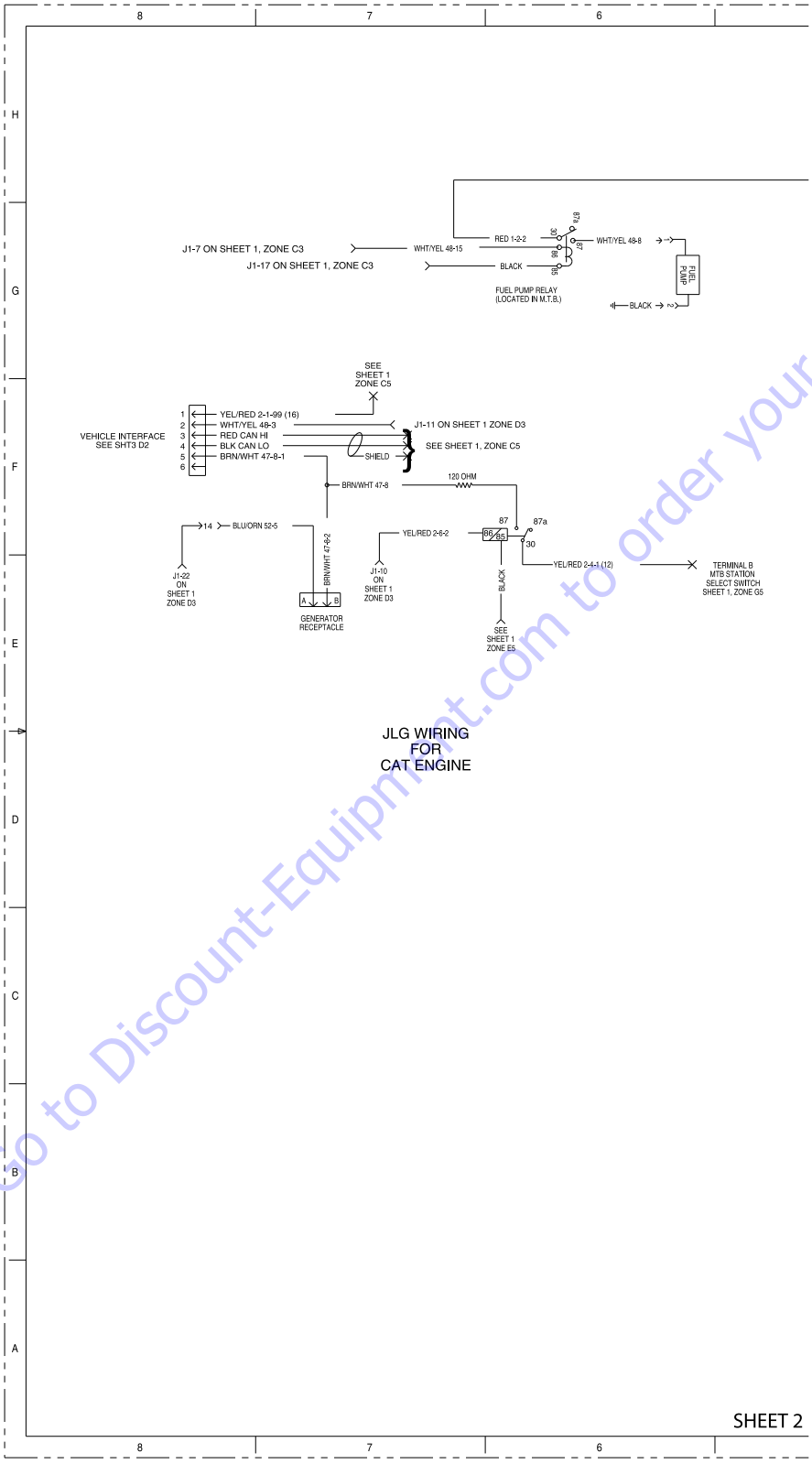


Figure 7-45. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 3 of 10

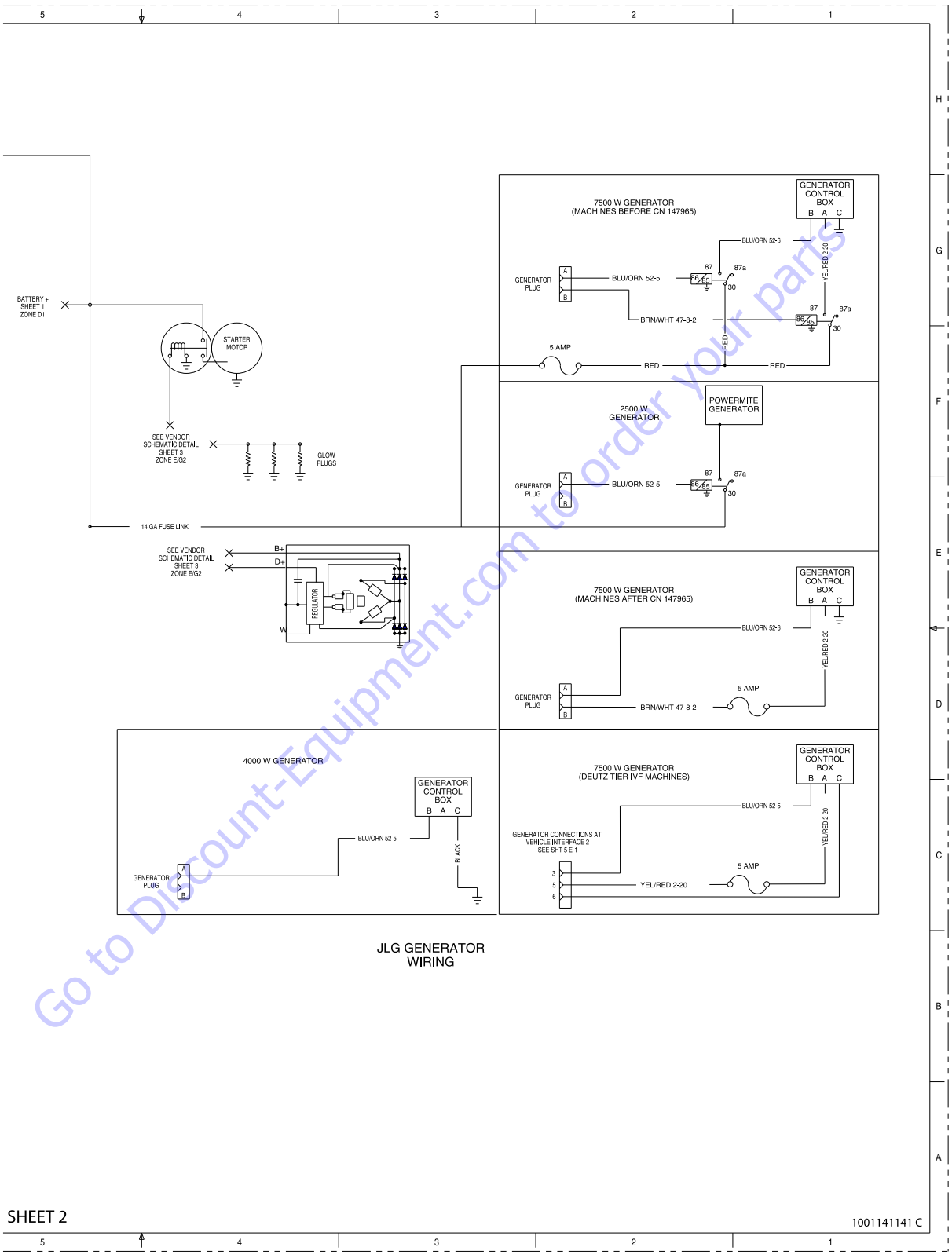


Figure 7-46. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 4 of 10

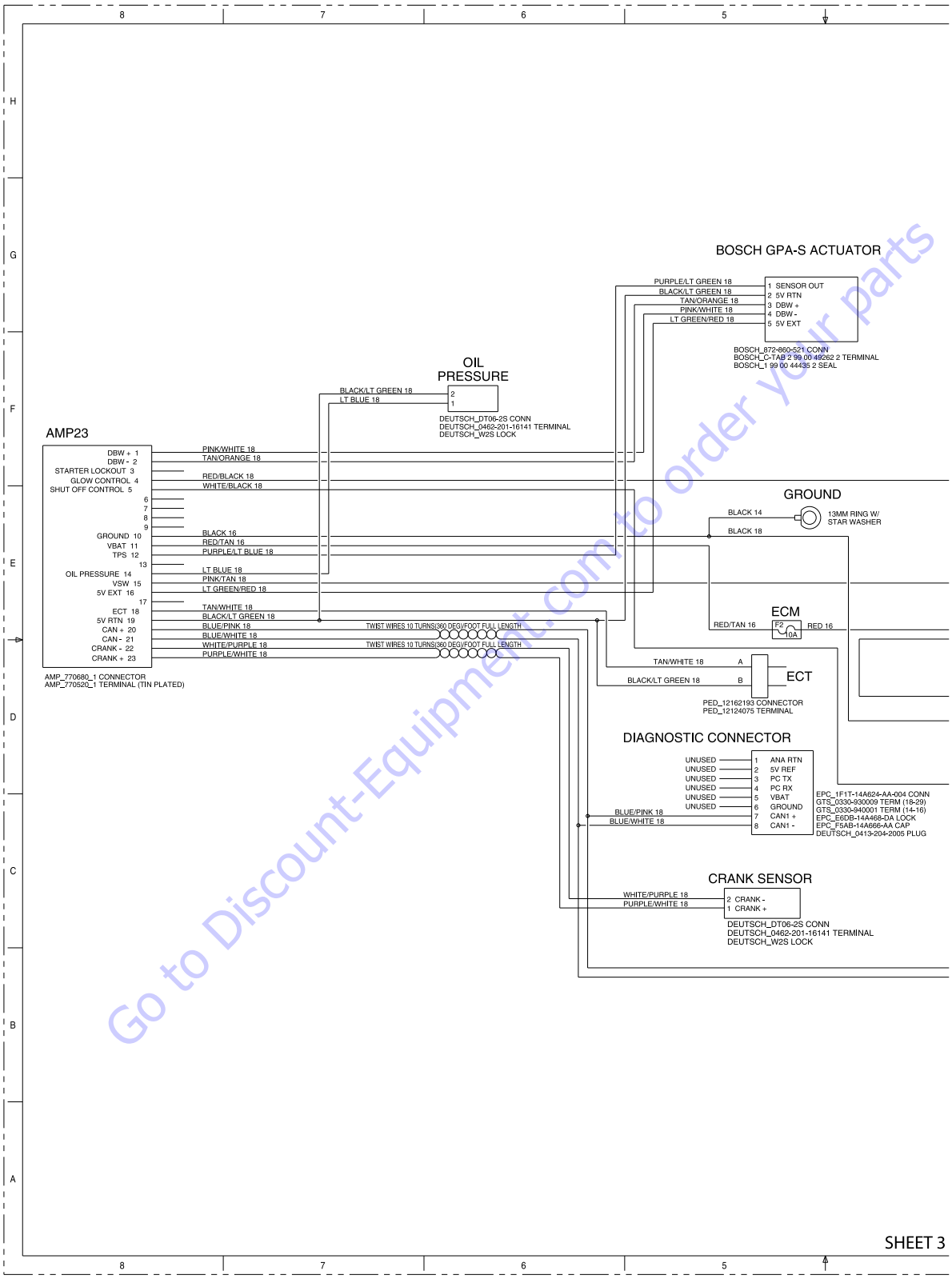


Figure 7-47. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 5 of 10

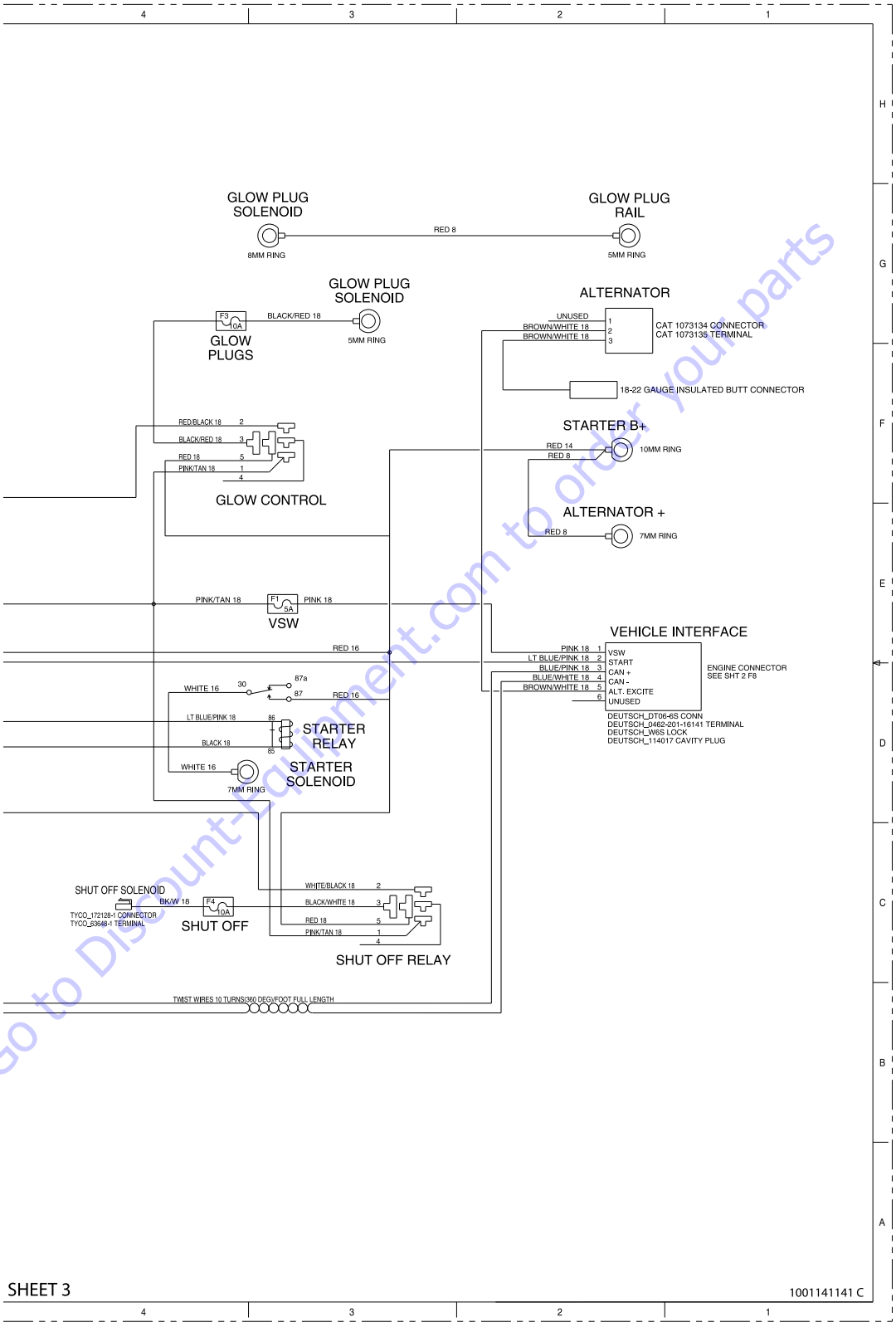


Figure 7-48. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 6 of 10

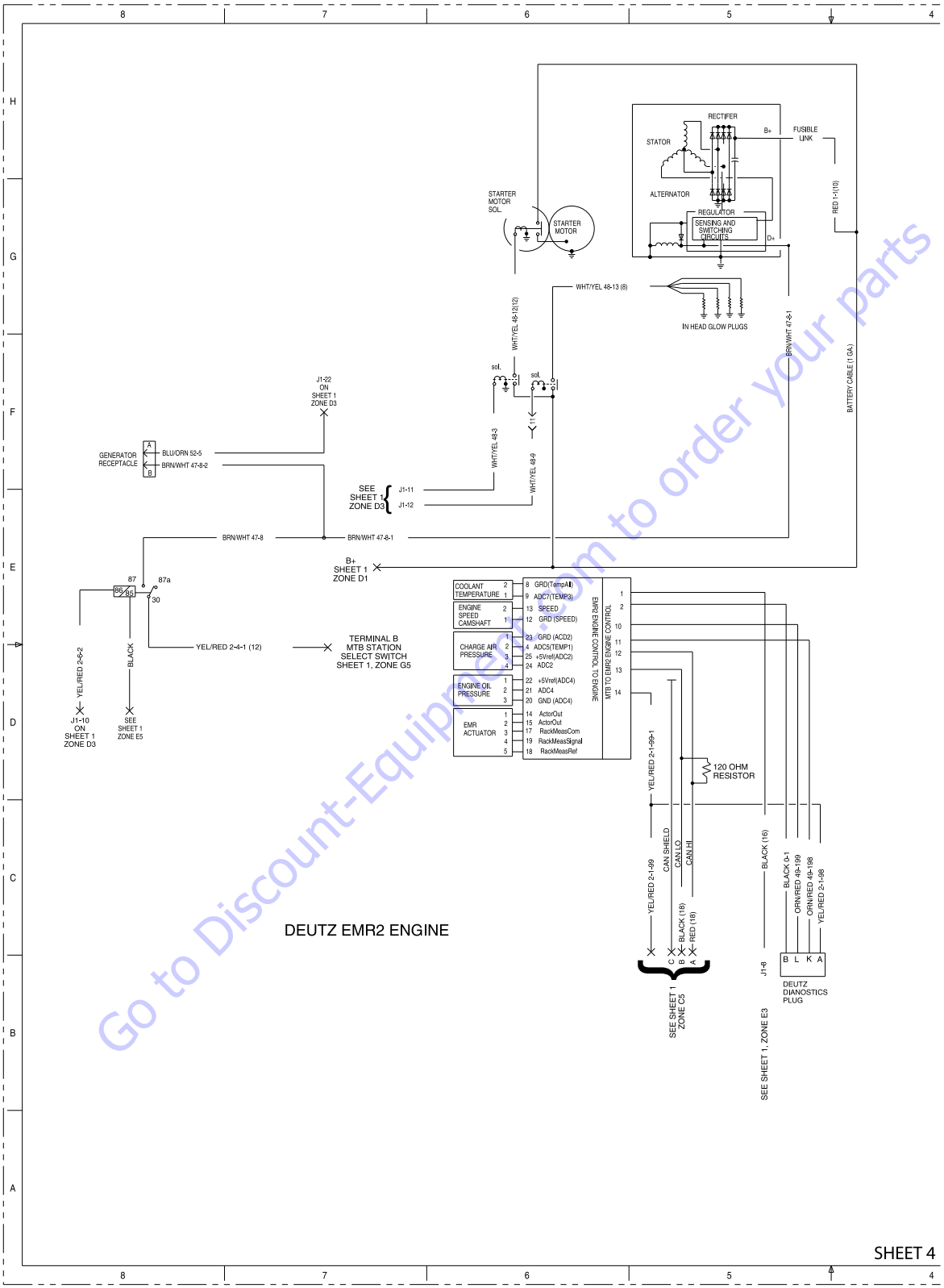


Figure 7-49. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 7 of 10

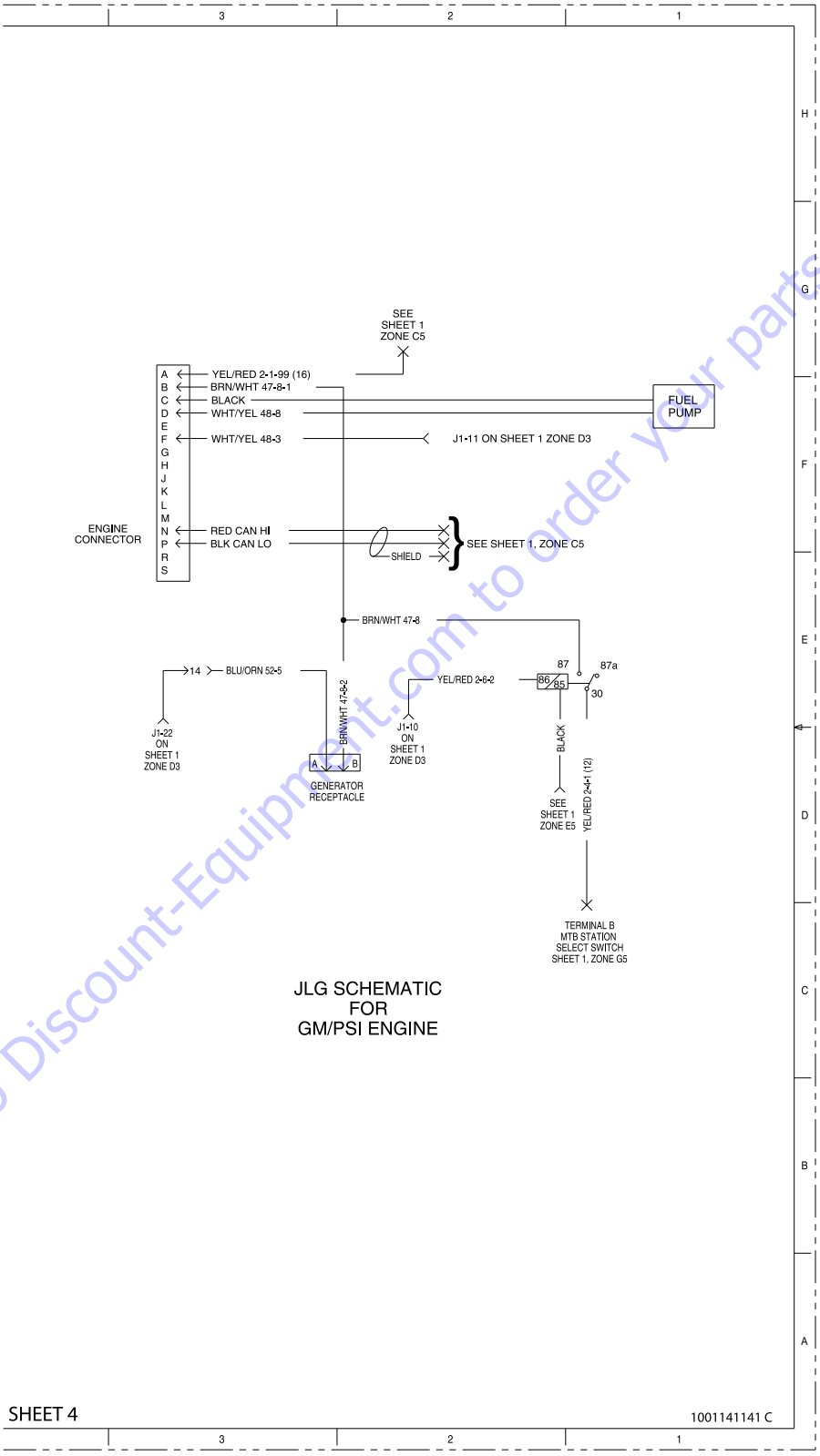


Figure 7-50. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 8 of 10

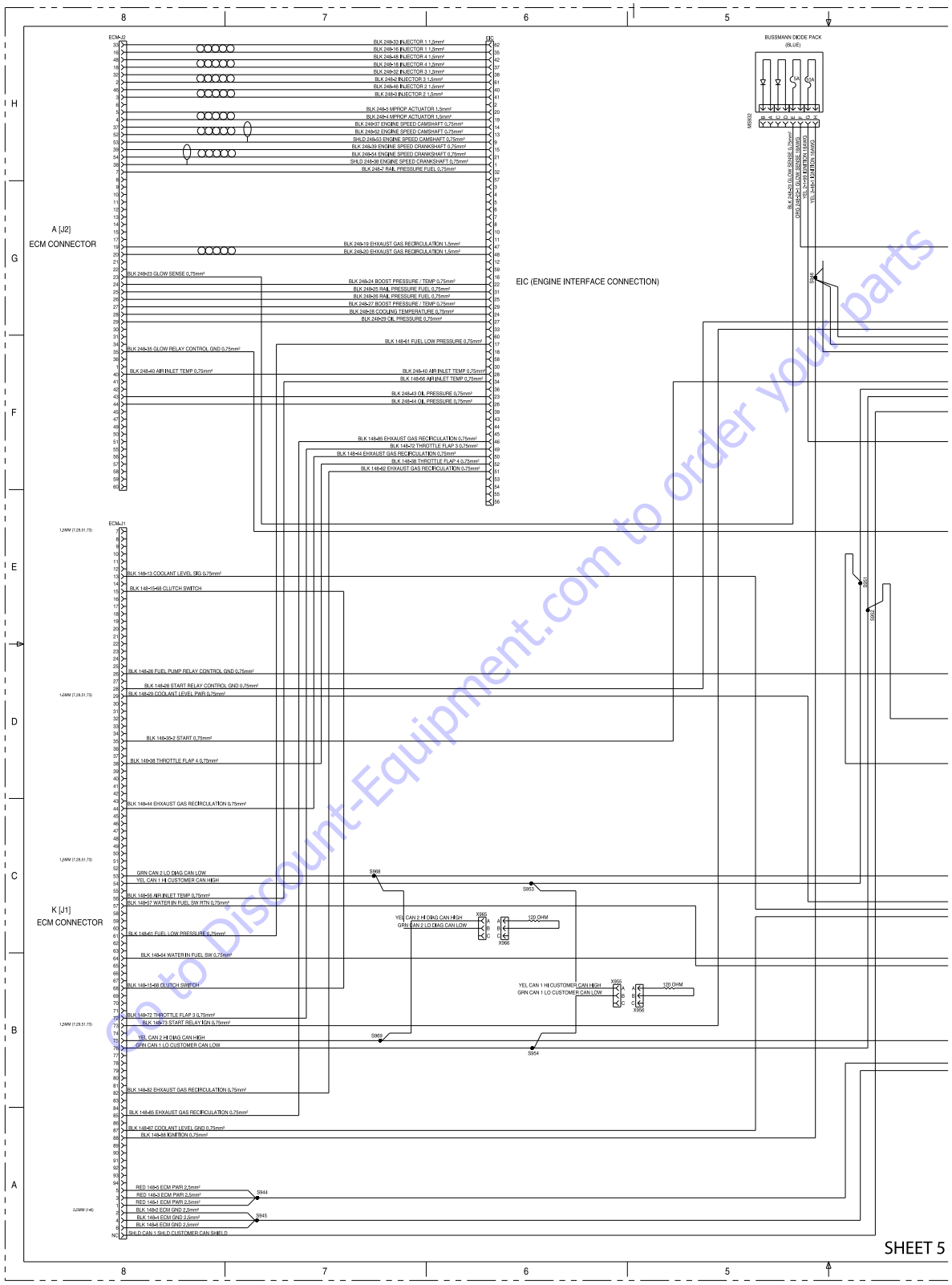


Figure 7-51. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 9 of 10

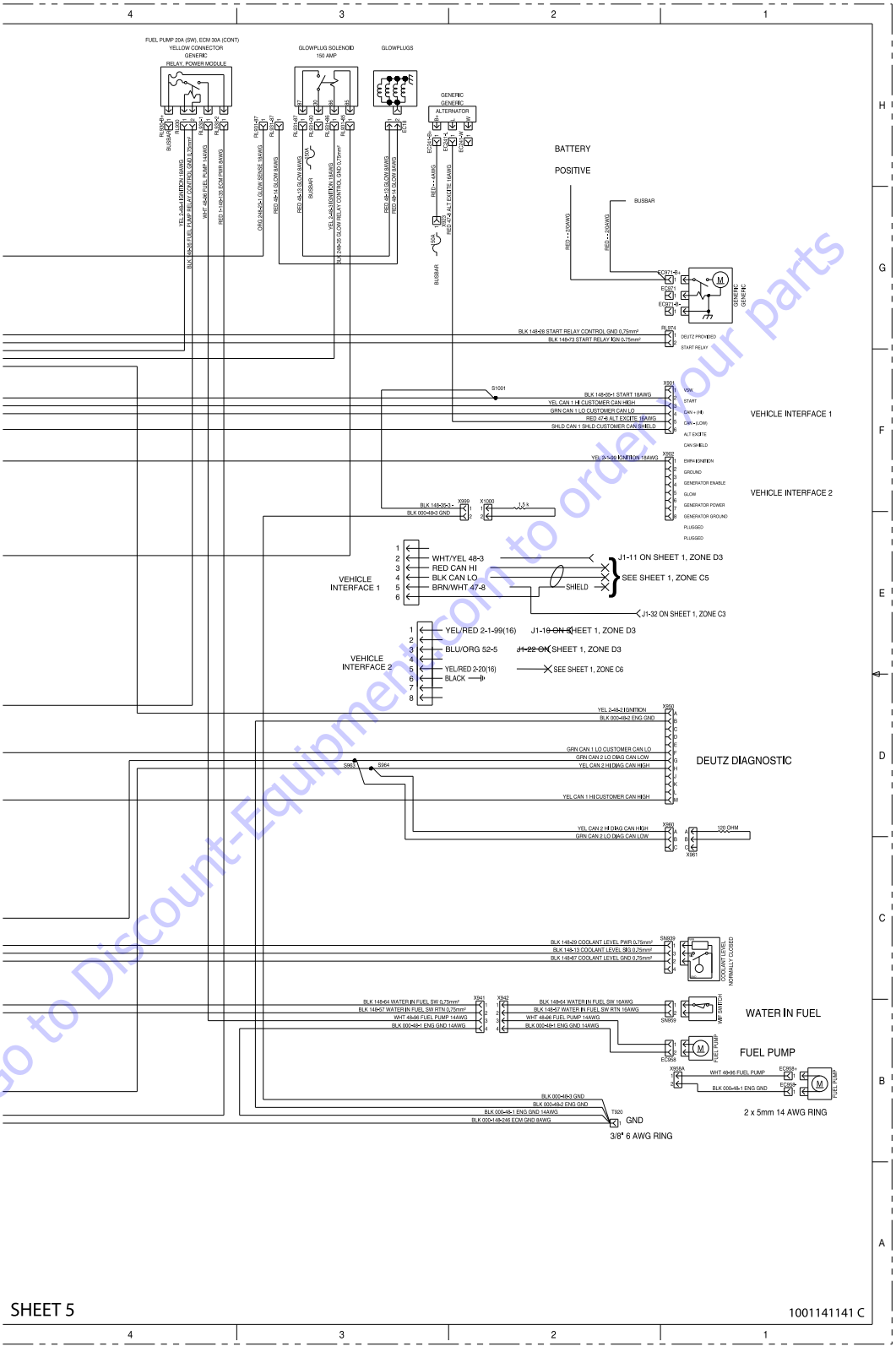


Figure 7-52. Electrical Schematic (SN 0300161730 through 0300182743 and B300000640 through B300001091)- Sheet 10 of 10

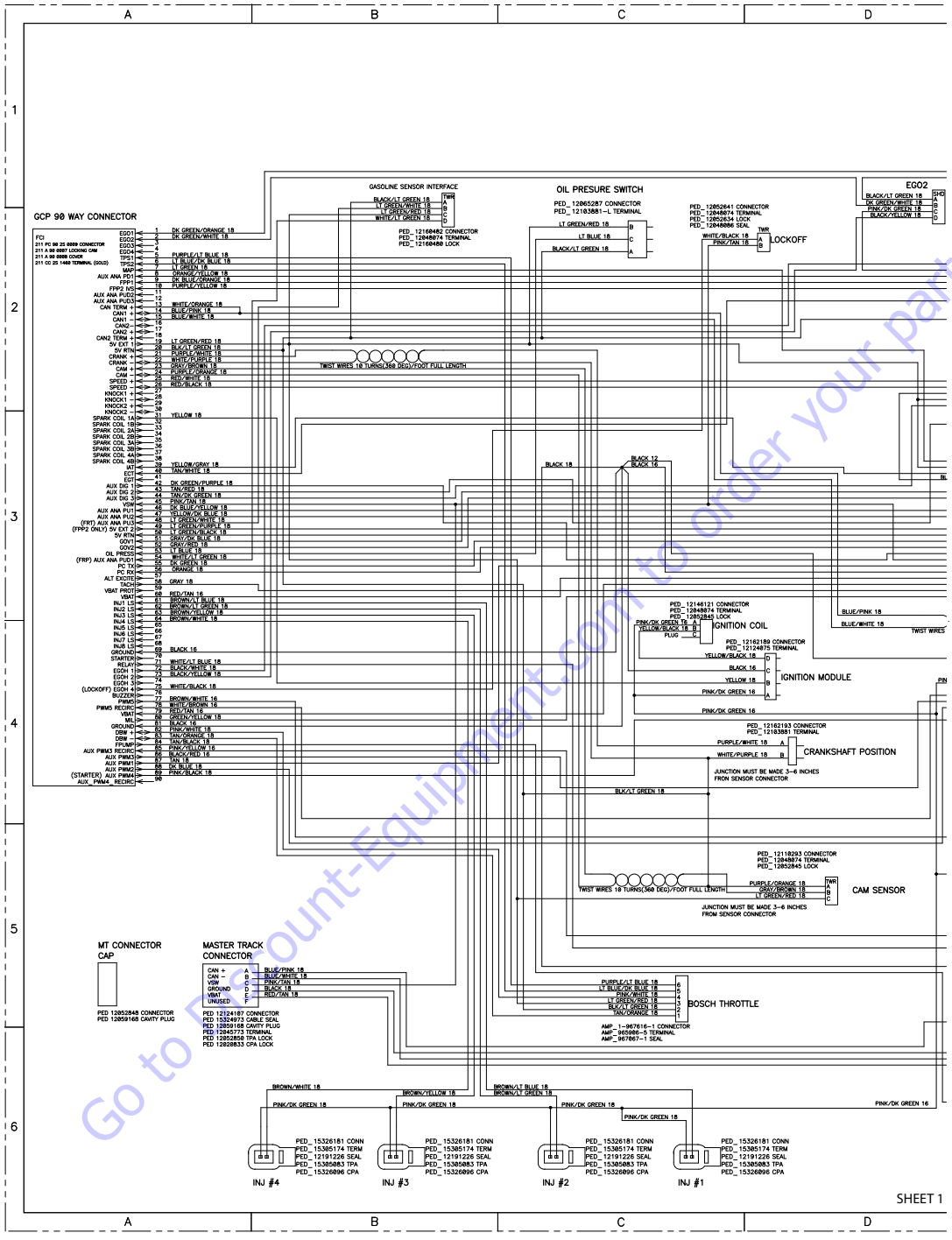


Figure 7-53. Electrical Schematic GM - Sheet 1 of 2

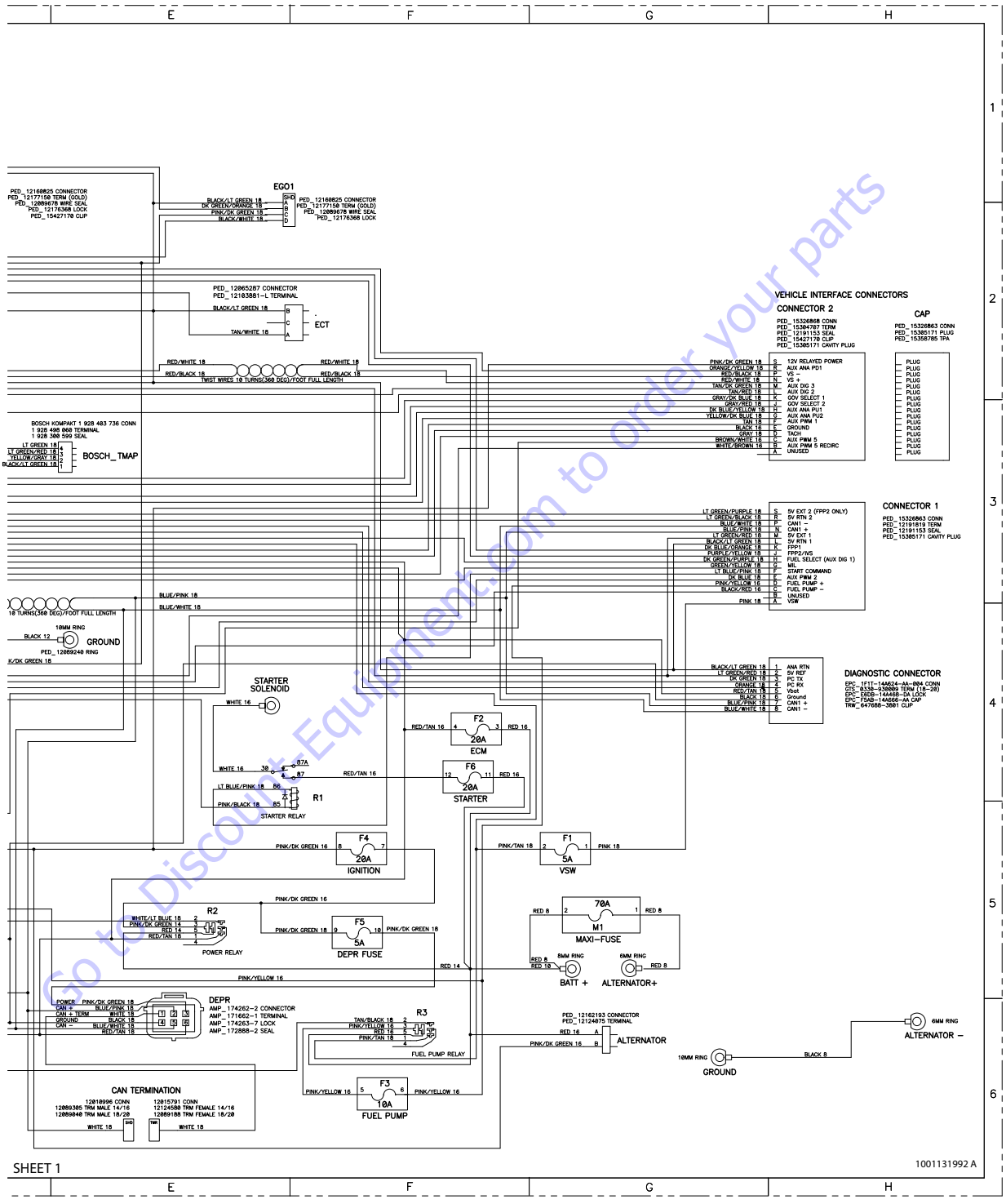


Figure 7-54. Electrical Schematic GM - Sheet 2 of 2

PROPOSITION 65 WARNING

- **Battery posts, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and reproductive harm.**
- **Batteries also contain other chemicals known to the State of California to cause cancer.**
- **Wash hands after handling.**

⚠ WARNING: ⚠

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

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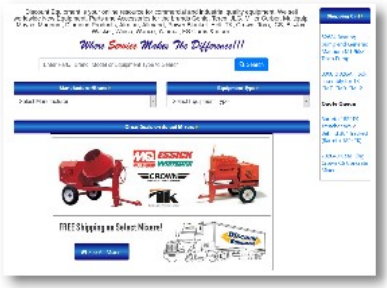

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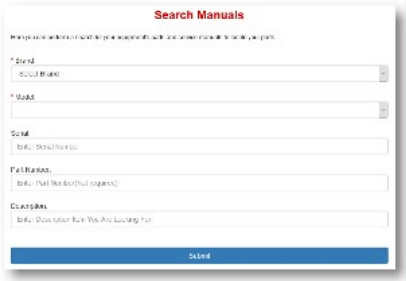

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