5.6 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.

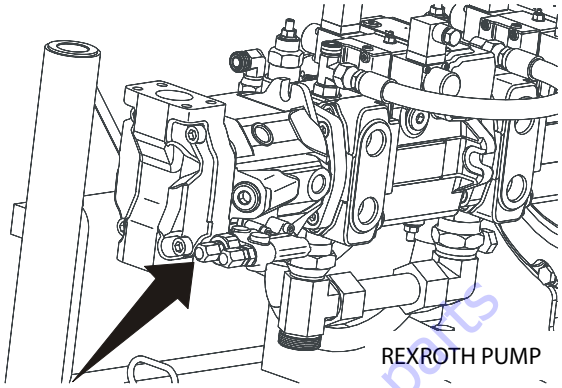
1. All applicable steps in Section 5.12, Drive & Function Pump Start Up Procedures must be followed.
2. Set up of the function pump.
3. Adjustments made at the main valve bank.
4. Adjustments made at the platform valve.
5. Adjustments made at the jib valve.

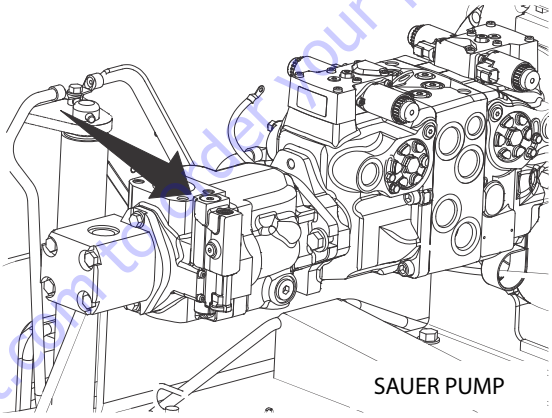
Set Up of the Function Pump

HIGH PRESSURE RELIEF

1. Install a high pressure gauge at the MP port of the main valve block.
2. Using a screwdriver, remove the Din connector from the lift down coil.
3. Activate lift down. The gauge should read 3400 psi (234.4 bar).
4. To make an adjustment to this pressure on a Rexroth pump, go to the engine compartment and locate the function pump which is the back pump. The high pressure relief adjustment is the adjustment closest to the pump. Using a 17 mm wrench, remove the cover nut. Be careful not to lose the o-ring washer inside the cover nut. Loosen the jam nut at the setscrew with the 17 mm wrench. Using a 3 mm allen wrench, adjust clockwise to increase, or counterclockwise to decrease pressure.

   To make an adjustment to this pressure on a Sauer pump, loosen the 4 mm setscrew towards the engine. Using a 6 mm allen wrench, turn clockwise to increase pressure and counterclockwise to decrease pressure.



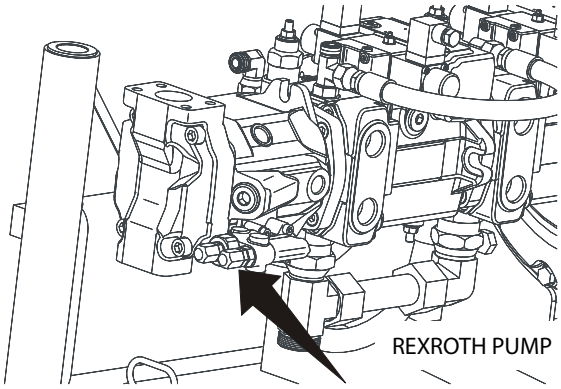


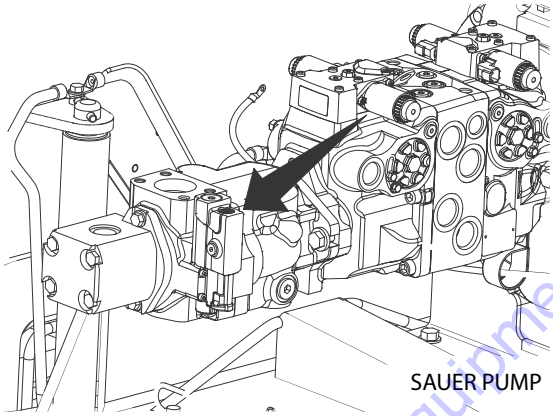
5. After adjusting the pressure, tighten the jam nut and the cover nut if applicable. This is the **maximum** relief pressure for all the functions governed by this pump.

STAND BY PRESSURE OR LOW PRESSURE RELIEF

1. Install a low pressure gauge at port MP of the main valve block capable of accurately reading 300 psi (20.6 bar).
2. Start the engine, the gauge should read 300 psi (20.6 bar).

3. To make an adjustment to this pressure, go to the engine compartment, locate the function pump. The stand by adjustment is the adjustment outside adjustment, closest to the turntable. Use the same tools that were used in the High pressure adjustment procedure.





Adjustments made at the Main Valve Bank

LIFT UP

1. Install a high pressure gauge at the M5 port of the main valve block. Plug and cap the hose on port 5.
2. Activate lift up. The gauge should read 2750 psi (189.6 Bar).
3. The adjustment cartridge is located below the M5 gauge port. Turn clockwise to increase, counterclockwise to decrease pressure.

LIFT DOWN

1. Install a high pressure gauge at the M4 port of the main valve block.
2. Activate lift down to the end of the stroke. The gauge should read 2000 psi (137.9 Bar).
3. The adjustment cartridge is located to the left of the M4 gauge port. Turn clockwise to increase, counterclockwise to decrease pressure.

SWING

NOTE: *Left and right are done with one adjustment.*

1. Install a high pressure gauge at port MS.
2. Lock the turntable pin.
3. Activate swing, the gauge should read 1500 psi (103.4 Bar). The adjustment cartridge is located below the MS gauge port.
4. Turn clockwise to increase, counterclockwise to decrease pressure.

TELESCOPE OUT

1. Install a high pressure gauge at the M8 port of the main valve bank. Plug the telescope out hose either at the valve bank (port #8) or at the inlet of the telescope cylinder (V1).
2. Activate telescope out. The gauge should read 3200 psi (220.6 Bar).
3. The adjustment cartridge is located below the M8 gauge port. Turn clockwise to increase, counterclockwise to decrease pressure.

TELESCOPE IN

1. Install a high pressure gauge at the M7 port of the main valve block. Plug the telescope in hose either at the valve bank (port #7) or at the inlet of the telescope cylinder (V2).
2. Activate Telescope In. The gauge should read 1800 psi (124 Bar).
3. The adjustment cartridge is located to the left of the M7 gauge port. Turn clockwise to increase, counterclockwise to decrease pressure.

Adjustments Made at the Frame Valve Bank

AXLE EXTEND AND RETRACT, FRONT AND REAR

1. To extend the axles, drive the machine back and forth until fully extended. A machine that cannot be driven must be jacked up.
2. On both the front and rear frame valve banks, install a high pressure gauge on ports MA1 for extend and MA2 for retract. The gauge should read 2500 psi (172.3 Bar) in both directions.
3. Turn clockwise to increase, counterclockwise to decrease pressure.

STEERING, FRONT AND REAR

NOTE: *The following procedure requires 2 people to perform. One is needed for verifying / adjusting pressure readings and wheel spindle alignment the other for operating the steer functions and using the Analyzer from the platform.*

The Analyzer is required to perform the pressure check procedure through access of the calibration menu. The calibration menu will allow for extending and retracting the steer cylinders individually, verifying pressures, and proper steer sensor calibration. Verification of the steer sensor calibration will require one of two types of measuring methods; using a square and ruler or using string as explained in Section 6 - JLG Control System. The purpose of these measuring tools is to assure that the wheel spindle is aligned "straight" with the extended axle weldment.

1. Position the machine with both front and rear axles fully extended.
2. Install the Analyzer in the platform control box and scroll menu's to Access Level 2 and insert password (33271) to get into Access Level 1.

3. Scroll to the calibration mode. Once in the calibration mode, press "ENTER" and scroll to steer. Once in the steer calibration mode, the Analyzer is going to ask to calibrate the steer sensors, this is going to allow extending and retracting each steer cylinder individually during this process. The JLG control system will ask to calibrate the left front sensor, the left rear sensor, the right front sensor and finally the right rear sensor in that order. During this calibration mode each individual steer cylinder will be extended and retracted to verify correct pressures with the marked MS (Measure Steer) ports on the steer / axle valve that pertains to that steer cylinder. Refer to the Hydraulic Schematic in Section 7 - Schematics.

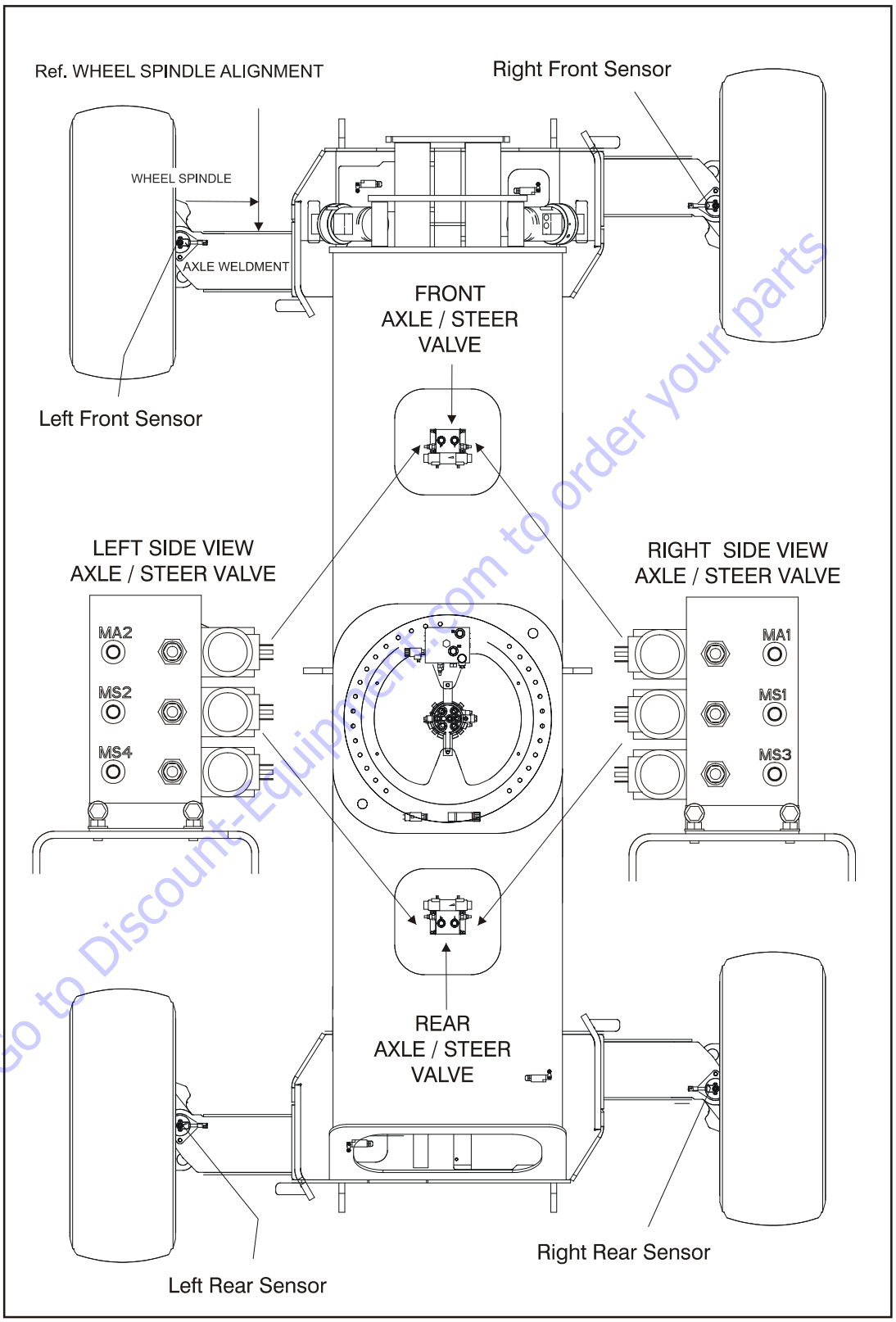
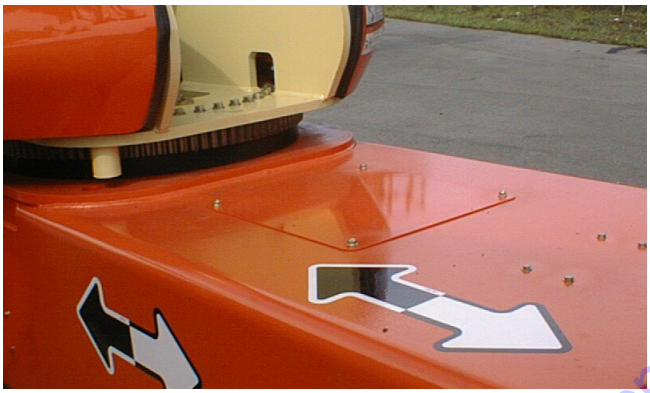
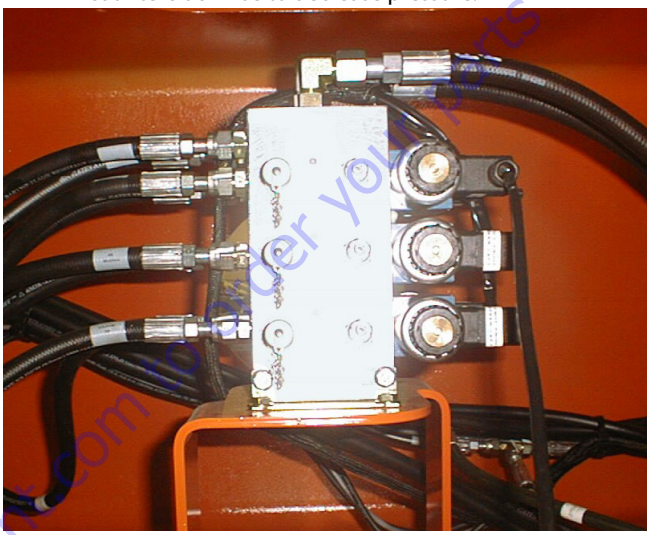


Figure 5-195. Steer Pressure Adjustments

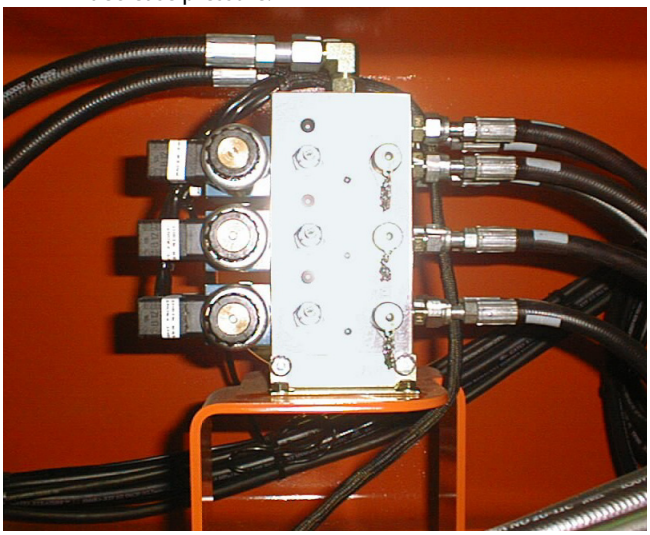
4. Remove the front circular steer/axle access covers at the front of the chassis, and the rear square cover at the top rear of the chassis to gain access to the axle/steer valves.



5. Install a pressure gauge at the front axle/steer valve at MS2 port. This should be located on the left side of the valve closest to the left front wheel spindle. Position the steer switch to activate the left front steer cylinder until the rod is in the fully extended position and hold the switch for a few seconds after the rod has been fully extended. The MS2 port should read 2000 psi (138 Bar). If the pressure is not 2000 psi (138 Bar) adjust relief valve mounted next to the MS2 port, clockwise to increase or counterclockwise to decrease pressure.

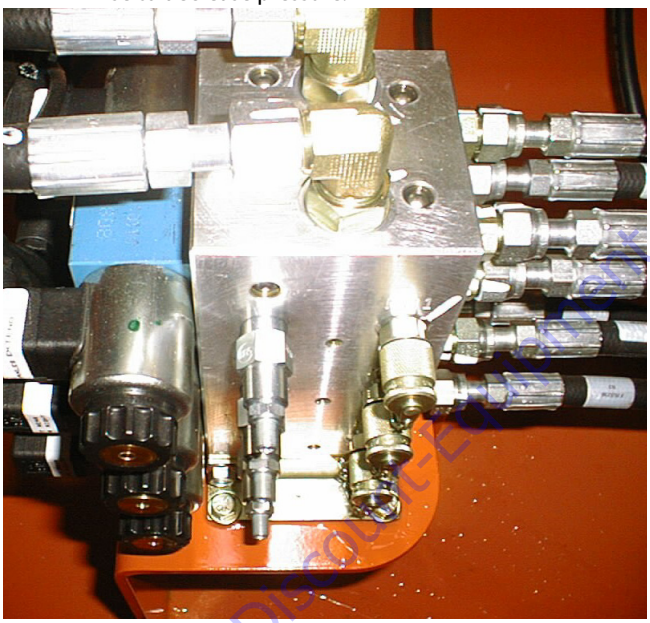


6. Remove the pressure gauge from MS2 port and install on the MS1 port, which is on the right side of the front axle/steer valve, closest to the right front wheel spindle. Position the steer switch to activate the left front steer cylinder until the rod is in the fully retracted position and hold the switch for a few seconds after the rod has stopped. The MS1 port should read 2600 psi (179 Bar). If the pressure is not correct, adjust relief valve next to MS1 port, clockwise to increase or counterclockwise to decrease pressure.

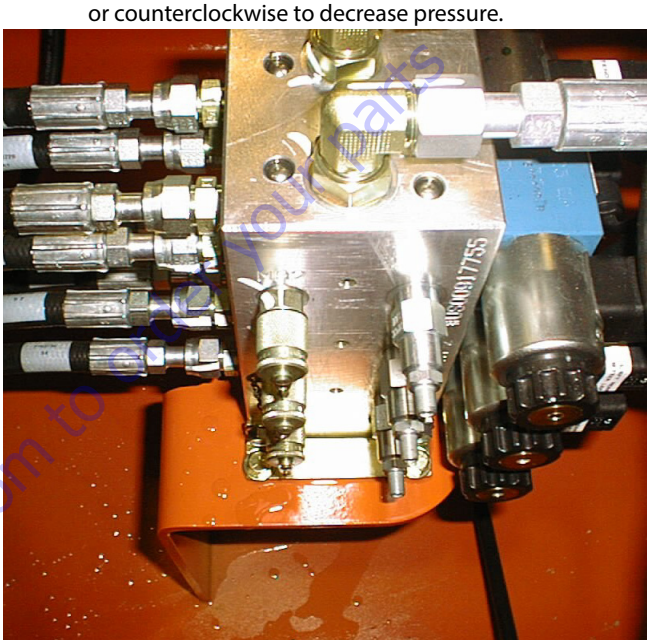


7. This step involves aligning the left front wheel spindle with the axle weldment. Position the left front wheel spindle "straight" using a square and rule or string for proper alignment (Refer to Section 6 - JLG Control System). Once the left front wheel spindle has been properly measured, press "ENTER" on the Analyzer. This is calibrating data to the JLG Control System that the left front steer sensor is centered.

8. Checking the left rear steer cylinder is identical to the procedure for left front steer cylinder, except now we are checking pressures at the rear axle/steer valve location. Install pressure gauge at MS1 port. This should be located on the left side of the valve closest to the left rear wheel spindle. MS1 port should read 2600 psi (179 Bar) when the left rear steer cylinder is activated with the rod in the fully retracted position. If the pressure is not 2600 psi (179 Bar) adjust relief valve mounted next to MS1 port clockwise to increase or counterclockwise to decrease pressure.



9. Remove the gauge from MS1 port and install on MS2 port, which is on the right side of the rear axle/steer valve, closest to the right rear wheel spindle. Position the steer switch to activate the left rear steer cylinder until the rod is in the fully extended position and hold the steer switch for a few seconds after the rod has been fully extended. The MS2 port should read 2000 psi (179 Bar). If the pressure is not correct, adjust the relief valve mounted next to MS2 port clockwise to increase or counterclockwise to decrease pressure.



10. The next step is identical to the left front step mentioned above. Make sure the left rear wheel spindle is straight and press "ENTER" to accept the new calibration settings, now press "ESC" (escape) and scroll to the right front steer calibration step.

11. Checking the right front steer cylinder is identical to the procedure laid out for the left front steer cylinder, except the pressures are now checked at MS3 port of the front axle/steer valve. This should be at the right side of the valve closest to the right front wheel spindle. Install the gauge at MS3 port. Position the steer switch to activate the right front steer cylinder until the rod is in the fully retracted position and hold the steer switch for a few seconds after the rod has been fully retracted. If the pressure is not 2600 psi (179 Bar), adjust the relief valve mounted next to the MS3 port clockwise to increase or counterclockwise to decrease pressure.

12. Remove the gauge from MS3 port and install on MS4 port, which is on the left side of the front axle/steer valve, closest to the left front wheel spindle. Position the steer switch to activate the right front steer cylinder until the rod is in the fully extended position and hold the steer switch for a few seconds after the rod has stopped extending. The MS4 port should read 2000 psi (138 Bar). If the pressure is not correct, adjust relief valve mounted next to the MS4 port clockwise to increase or counterclockwise to decrease pressure.

13. The next step is identical to the left front step mentioned above. Make sure the right front wheel spindle is straight and press "ENTER" to accept the new calibration settings. Scroll over to right rear steer calibration step.

14. Checking the right rear steer cylinder is identical to the procedure laid out for the left rear steer cylinder. Install gauge at MS4 port of the rear axle/steer valve. This should be at the right side of the valve closest to the right rear wheel spindle. Position the steer switch to activate the right rear steer cylinder until the rod is in the fully extended position and hold the steer switch for a few seconds after the rod has stopped extending. The MS4 port should read 2000 psi (138 Bar). If the pressure is not correct, adjust relief valve next to the MS4 port clockwise to increase or counterclockwise to decrease pressure.

15. Remove gauge from MS4 port and install on MS3 port, which is on the left side of the rear axle/steer valve, closest to the left rear wheel spindle. Position the steer switch to activate the right rear steer cylinder until the rod is in the fully retracted position and hold the steer switch for a few seconds after the rod stops retracting. If the pressure is not 2600 psi (179 Bar), adjust the relief valve mounted next to the MS3 port clockwise to increase or counterclockwise to decrease pressure.

16. The next step is identical to the left front step mentioned above, make sure the right rear wheel spindle is straight and press "ENTER" to accept the new calibration settings, now escape out of the calibration menu and remove the Analyzer and pressure gauge.

Adjustments Made at the Platform Valve Bank

PLATFORM LEVEL UP

1. Install a high pressure gauge at the gauge port ML1.
2. Activate level up to the end of stroke, it should read 2500 psi (172.3 Bar).
3. All the relief valves are located on the same face. The level up relief valve is the top. Turn clockwise to increase, counterclockwise to decrease.

PLATFORM LEVEL DOWN

1. Install a high pressure gauge at gauge port ML2.
2. Activate level down to the end of stroke, it should read 2000 psi (138 Bar).
3. The level down relief valve is the second from the top. Turn clockwise to increase, counterclockwise to decrease.

JIB PIN EXTEND

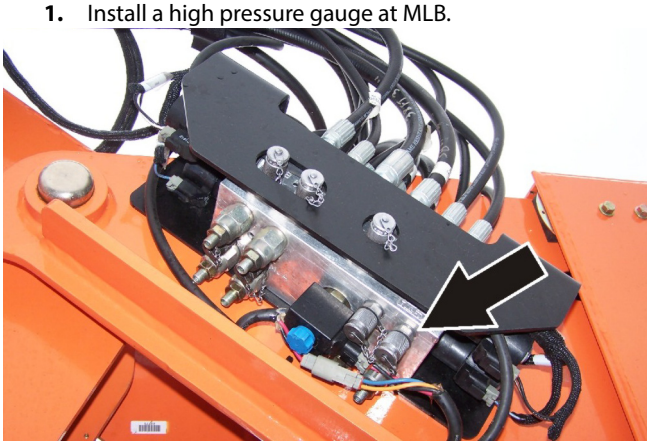
1. Install a high pressure gauge on gauge port MS1.
2. Using the analyzer and set pressures menu, Select jib lock pin extend. This relief valve is the bottom. Turn CW to increase and CCW to decrease pressure.

Adjustments Made at the Jib Valve

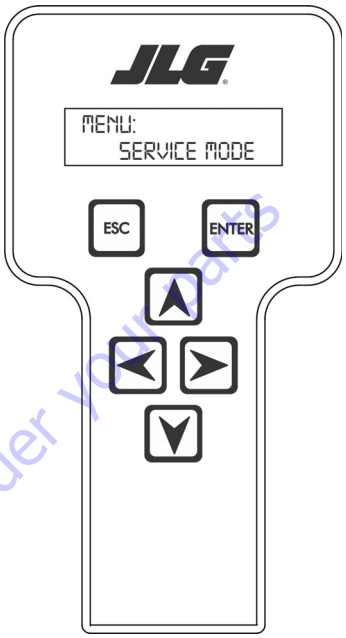
JIB LEVEL UP

NOTE: *To check or adjust the jib level up pressure setting the JLG Analyzer must be used to override the automatic jib level function.*

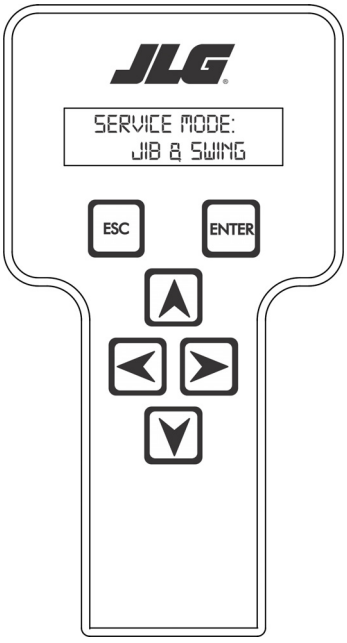
1. Install a high pressure gauge at MLB.

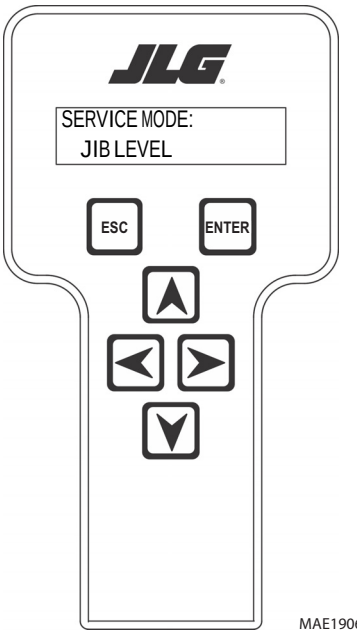


2. Connect the analyzer to the ground control connector.
3. Position the main boom on the boom rest and the jib to horizontal.
4. Using the analyzer, press the RIGHT or LEFT arrow key until ACCESS LEVEL 2 is reached. Press ENTER (ENTER).
5. Using the arrow keys, enter access code 33271 and press ENTER (ENTER).
6. Using the arrow keys scroll until MENU: SERVICE MODE is reached. Press ENTER (ENTER).

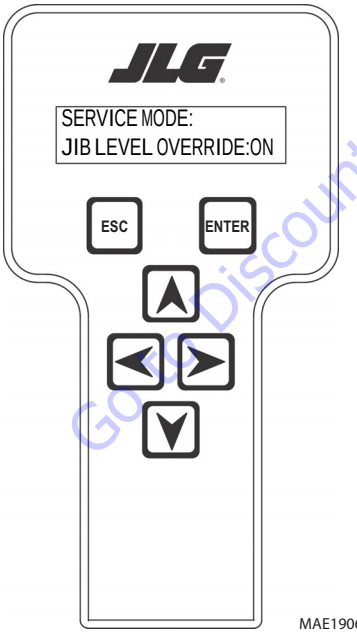


7. Enter code 58237 and Press ENTER (ENTER). The screen should read SERVICE MODE: JIB & SWING AND JIB LEVEL.





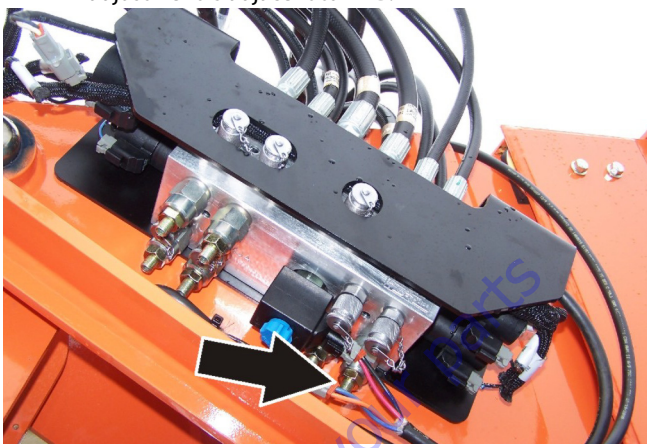
8. Press ENTER (ENTER) again. The screen will read JIB LEVEL OVERRIDE: ON. Use the UP (▲) or DOWN (▼) arrow keys to toggle the override from Off to On.



9. Once turned on, operate the Jib Lift Up function. This will activate the jib level up function.

10. When the function bottoms out, pressure should read 2600 psi.(180bar).

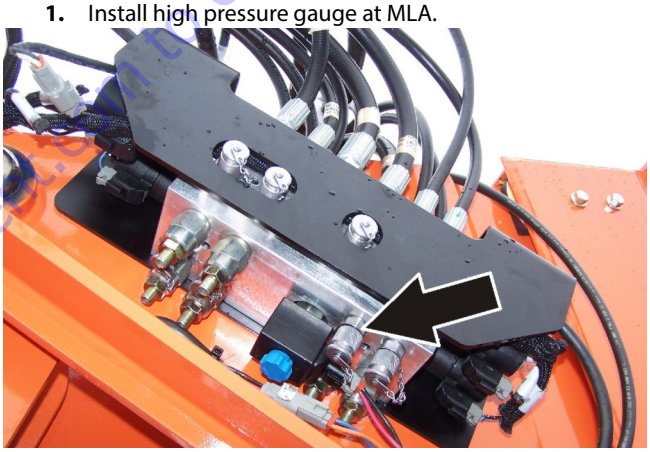
11. If necessary to adjust pressure, CW increases. Jib level up adjustment is adjacent to MLB.



12. Make sure to reset Jib override to off after pressure is set, and cycle machine power.

JIB LEVEL DOWN

1. Install high pressure gauge at MLA.



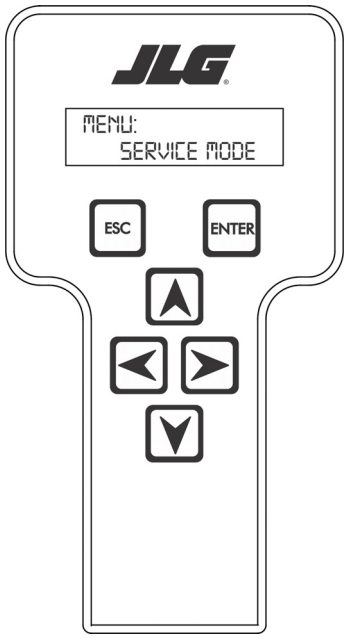
2. Connect the analyzer to the ground control connector.

3. Position the main boom on the boom rest and the jib fully elevated.

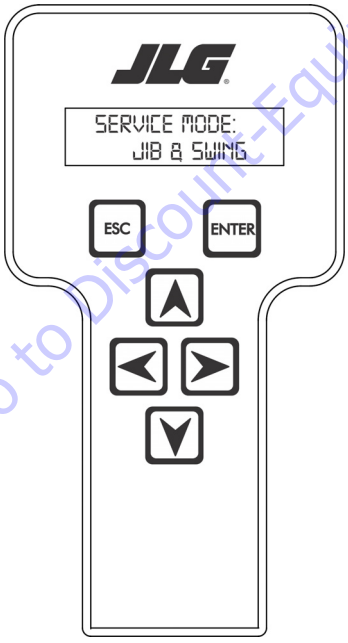
4. Using the analyzer, press the RIGHT (▶) or LEFT (◀) arrow key until ACCESS LEVEL 2 is reached. Press ENTER (ENTER).

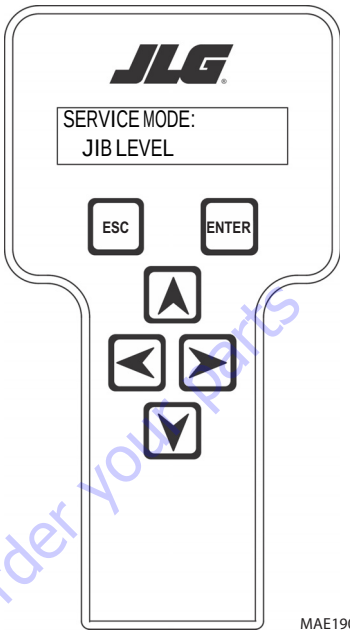
5. Using the arrow keys, enter access code 33271 and press ENTER (ENTER).

6. Using the arrow keys scroll until MENU: SERVICE MODE is reached. Press ENTER (ENTER).



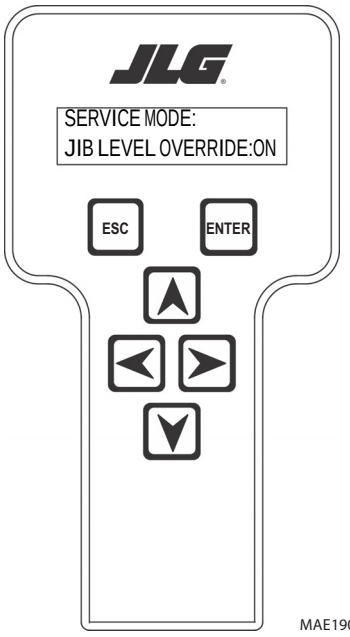
7. Enter code 58237 and Press ENTER (ENTER). The screen should read SERVICE MODE: JIB & SWING AND JIB LEVEL.





MAE19060

8. Press ENTER (ENTER) again. The screen will read JIB LEVEL OVERRIDE: ON. Use the UP or DOWN arrow keys to toggle the override from Off to On.

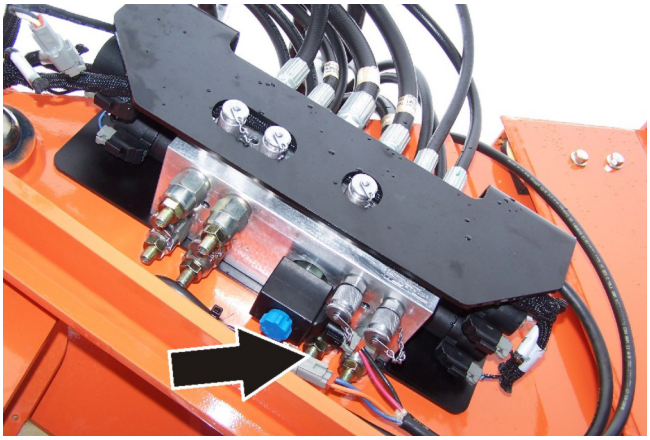


MAE19060

NOTE: *Using this override may set the Jib Leveling System Fault, depending upon how far out of level the jib is moved.*

9. Once turned on, operate the Jib Lift Down function. This will activate the Jib Level Down function.

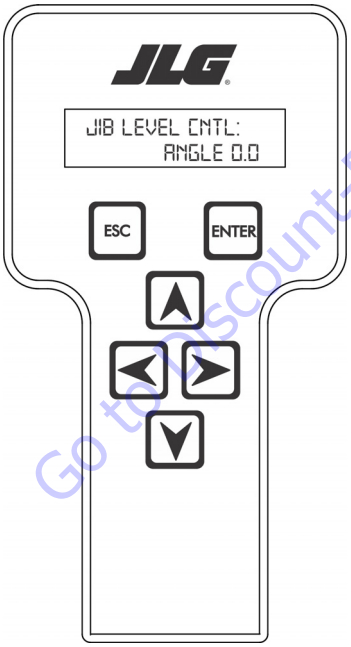
10. When the cylinder is completely retracted, the pressure should be 1500 psi. (104bar). CW increases and CCW decreases setting. Jib level down adjustment is adjacent to MLA.



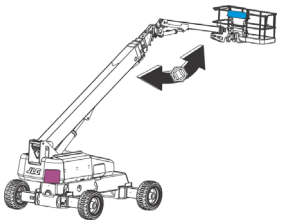
11. To adjust the jib back to level, go into override mode for jib leveling. Turne the override mode to "On" and press the ESCAPE 

key until out of the Service Modes menu.

12. Go to the Diagnostics/Boom Sensors menu. Use the Right arrow key until reaching the "Jib Level CNTL: Angle 0.0" screen.



13. Adjust the jib level using the Jib Lift function switch until the jib level control angle reads zero (0).

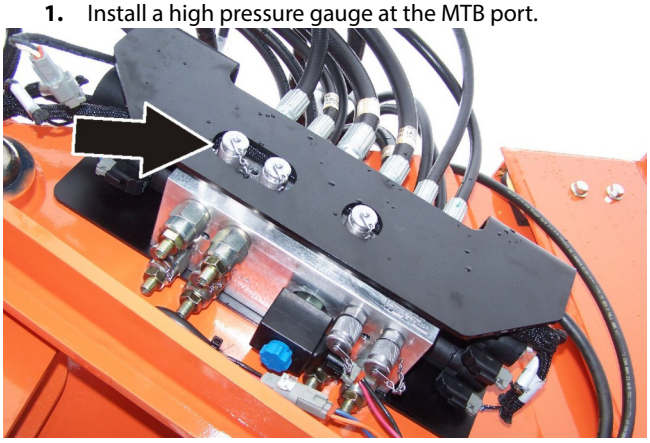


14. After the control angle is set, use the UP  or DOWN  arrow keys to toggle the override from On to Off.

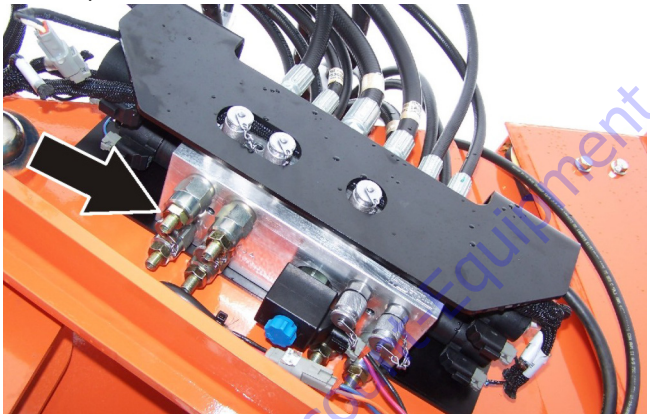
15. Cycle power and operate the main boom to verify jib level is working properly.

JIB TELESCOPE OUT

1. Install a high pressure gauge at the MTB port.

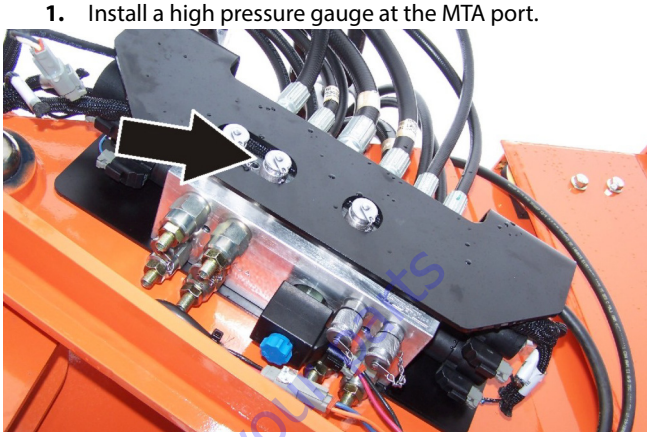


2. Fully extend the jib telescope.
3. Set the Jib Telescope pressure to 2850 psi (196.5 Bar). Turning the adjustment clockwise increases pressure, turning the adjustment counterclockwise decreases pressure.

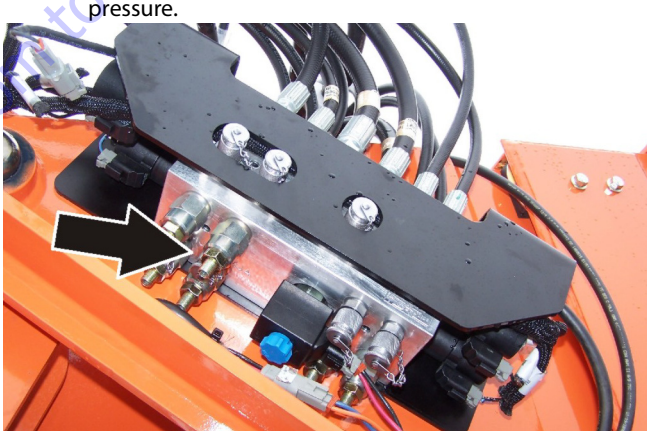


JIB TELESCOPE IN

1. Install a high pressure gauge at the MTA port.

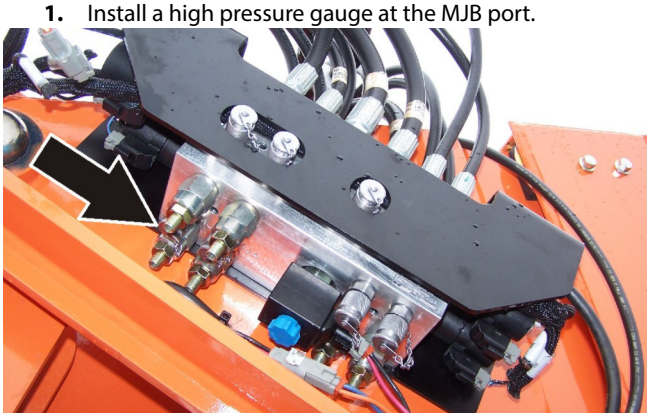


2. Fully retract the jib telescope.
3. Set the Jib Telescope In pressure to 2850 psi (196.5 Bar). Turning the adjustment clockwise increases pressure, turning the adjustment counterclockwise decreases pressure.

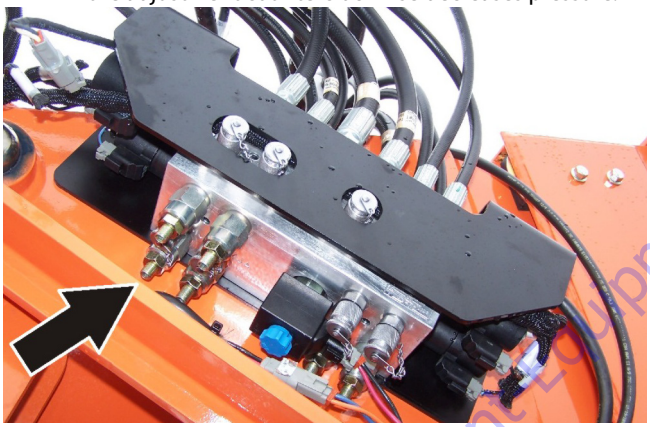


JIB LIFT UP

1. Install a high pressure gauge at the MJB port.

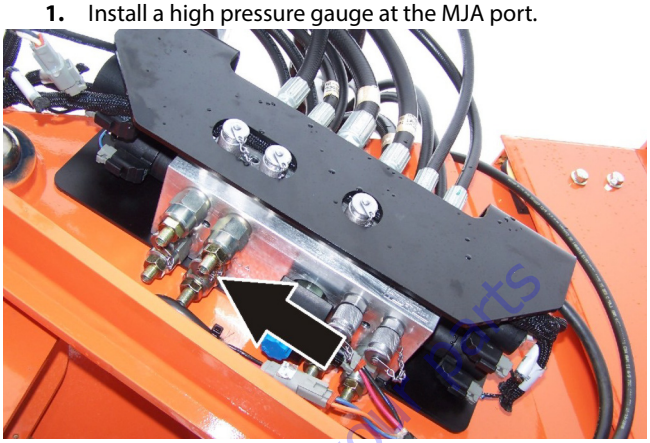


2. Fully extend the jib lift cylinder or cap port JB.
3. Set the Jib Lift Up pressure to 2800 psi (193 Bar). Turning the adjustment clockwise increases pressure, turning the adjustment counterclockwise decreases pressure.

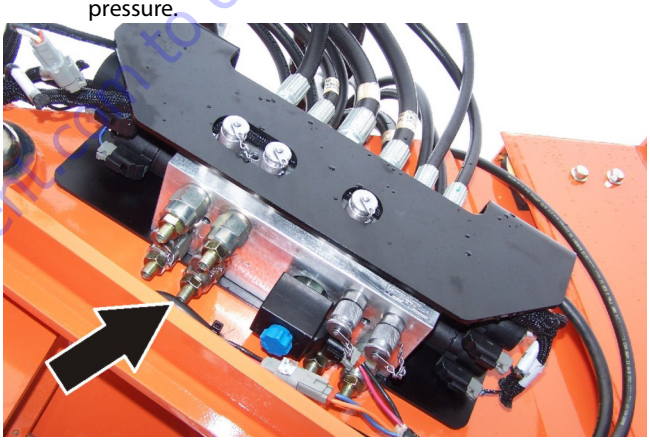


JIB LIFT DOWN

1. Install a high pressure gauge at the MJA port.



2. Fully retract the jib lift cylinder or cap port JB.
3. Set the Jib Lift Down pressure to 1200 psi (82.7 Bar). Turning the adjustment clockwise increases pressure, turning the adjustment counterclockwise decreases pressure.



5.7 DRIVE PUMPS (REXROTH)

Troubleshooting Procedure

To aid in troubleshooting, refer also to the pressure measuring port connections for test gauge installation information as shown on the hydraulic circuit diagram. Procedure assumes proper gauges are installed. (Minimum gauges required: (2) 0-6000 psi, (1) 0-3000 psi & (1) 0-1000 psi [{2} 0-415 bar, {1} 0-210 bar & {1} 0-70 bar]). This procedure was written to aid the troubleshooter in following a logical approach to a hydraulic system fault.

1. Transmission does not propel the machine, diesel engine running properly

a. Is there oil in the reservoir?
No - Fill reservoir
Yes - If yes, proceed to step 1.b

b. Is the pump input shaft connected to the engine flex plate or rear of forward pump?
No - Connect pump input shaft
Yes - If yes, proceed to step 1.c

c. Are the hydraulic hoses and tubing connected in accordance with the hydraulic circuit diagram?
No - Correct the hoses/tubing
Yes - If yes, proceed to step 1.d

d. Is the pump direction of rotation correct? (clockwise as looking at the shaft)
No - Fit pump having the correct direction of rotation
Yes - If yes, proceed to step 1.e

e. Are there O-rings missing from fittings (as example - suction leak), pinched hoses, broken tubing, etc?
No - Proceed to step 1.f
Yes - Repair damage or fault

f. Are the electrical connectors/wiring intact and secure to the pump control solenoids?
No - Repair damage or fault
Yes - If yes, proceed to step 1.g

g. Does the engine "labor" when attempting drive, are the brakes released?
No - Proceed to step 1.h
Yes - Check brake release circuit, measure pressure at port "MP" on Traction Control manifold

h. Are all four wheel drive planetary reduction gearboxes engaged?
No - Engage wheel drive(s)
Yes - If yes, proceed to step 2.a

2. Transmission does not propel the machine, diesel engine running properly - Charge Pump/Relief Valve

a. Is there any charge pressure at port G or indicated by measuring pressure at Ma and Mb?
No - Proceed to step 2.d
Yes - Proceed to step 2.b

b. Is the charge pressure at least 500 psi while running at high engine speed?
No - Proceed to step 2.c
Yes - Proceed to step 3.a

c. Can the charge pressure be raised by removing dirt/debris from charge relief poppet or by adding or removing shims from the charge pressure relief valve mounted in the second pump of the triple?
No - Proceed to step 2.d
Yes - Adjust pressure to 500 psi +50 psi, -0 psi (34.4 bar +3.4 bar, -0 bar)

NOTE: *The propulsion circuit uses a hot oil flushing valve to obtain brake release pressure. The hot oil flushing valve cartridge (#120) is mounted in the Traction Control Manifold. The flushing valve receives its oil from the "left side" wheel drive pump; the middle pump of the triple. With the engine running and propelling the machine forward or reverse, the "hot oil flushing valve" and the brake release pressure must be adjusted to 475 psi, +25 psi, -0 psi (32.7 bar, +1.7 bar, -0 bar), as set by adjusting pressure relief cartridge (#130). The brake release pressure must be 25 psi less than the charge pump pressure. Measure pressure at port "MP" using a 0-1000 psi (0 - 70 bar) pressure gauge.*

d. Is the transmission pumps suction hose pinched shut?
No - Proceed to step 2e
Yes - Repair damaged hose

e. Is the charge pump suction pressure/vacuum within recommended limits? (0.8 bar absolute or 6.3 inches of mercury)
No - Proceed to step 2.f
Yes - Proceed to step 2.g

f. Is the suction strainer inside the reservoir blocked, clogged, restricted?
No - Proceed to step 2.g
Yes - Repair/replace with a clean suction strainer

g. Is the reservoir air breather blocked or restricted?
No - Proceed to step 2.h
Yes - Clean or replace air breather

h. Remove charge pressure relief valve from the middle pump and inspect. Is it damaged?
No - Refit cartridge and proceed to step 2.i
Yes - Clean & inspect cartridge, poppet, springs, seals to determine cause of damage. Repair or fit a new cartridge and return to step 2.a

i. Remove and inspect charge pump assemblies. Are they damaged?
No - Proceed to step 2.j
Yes - Repair and/or replace damaged components and return to step 2.a

j. Is the charge pump installed for the clockwise rotation?
No - Refit charge pump. Return to step 2.a
Yes - With proper charge pressure and transmission still does not operate, proceed to step 3.a

3. Transmission does not propel the machine, diesel engine running properly - Pump Control: (Insure Generator Drive option is not turned "on")

a. Are the electrical connectors & wiring connected properly to the pump control solenoids?
No - Connect a ammeter in series with solenoid wiring. Is a current of 400 mA to 1060 mA being applied. (Current signal varies with joystick position)
Yes - Proceed to step 3.b

b. Are all four of the two-speed motors, mounted in the wheel drive planetary reduction gearboxes, shifted to maximum displacement (high torque - low speed)?
No - Select maximum displacement
Yes - Proceed to step 3.c

c. Actuate the pump control in both directions. Do the pumps stroke? Do they go to full stroke?
No - Refer to the pump service manual and then proceed to step 3.d
Yes - Operate the transmission

d. Remove stroking orifices in X_1 and X_2. Install pressure gauges in X_1 and X_2 (0-500 psi [0 - 35 bar]). Stroke the pump in both directions. Do the pressures at X_1 and X_2 alternate between 30 & 250 psi (2 & 17 bar)?
No - Remove the EP control module & replace it with a new unit. Repeat step 3.c
Yes - Proceed to step 3.e.

e. Is the pressure at port "R", case pressure, less than 15 psi (1 bar) gauge pressure?
No - Correct problem restricting case drain oil flow (oil cooler blockage, pinched hoses, etc.)
Yes - Proceed to step 3.f

f. Stroke pump in both directions, while measuring pressure at Ma & Mb ports of the pump. Does any pressure greater than charge pressure alternate between ports Ma & Mb?
No - Verify that loading the pump will cause system pressure to increase above charge pressure. Proceed to step 3.a
Yes - Proceed to step 3.g

g. Is it possible to adjust high pressure relief valves using 0-6000 psi (0 - 415 bar) gauges to monitor pressure at Ma & Mb? (Refer to relief valve adjustment)
No - Replace high pressure relief valve and return to step 3.c
Yes - Adjust high pressure relief valves to 5000 psi +50 psi, -0 psi (344.7 bar +3.4 bar, -0 bar)

h. Actuate control in both directions. Does transmission operate?
No - Check that minimum displacement stops on the wheel drive motors are adjusted properly, check that the motors stroke between maximum to minimum.
Yes - Operate the transmission

4. Transmission Drive is Sluggish or Erratic

a. Does the "EP" proportional pump control current vary with joystick movement?
No - Rectify the problem - broken wires, electrical connector, open solenoid coil, etc.
Yes - Proceed to step 4.b

b. Are all four (4) brakes fully released?
No - Check brake release pressure and insure each wheel receives correct release pressure.
Yes - Proceed to step 4.c

c. Are the pumps stroking time orifices installed tight and clean?
No - Remove the Plugs in ports X_1 and X_2. Remove orifices with a 3mm allen wrench. Check that orifices are clean & re-install.
Yes - Proceed to step 4.d

d. Is an motor displacement stroking time orifice plugged or is the two-speed shift hose pinched?
Yes - Inspect and clean stroking orifice, check two-speed hose routing

e. Is a flow divider/combiner cartridge stuck in the Traction Control Manifold? Flow divider/combiner cartridge # 111 controls the right side wheels, # 112 controls the left side wheels. Also check to insure bypass orifices #151 (right side) and # 152 (left side are not plugged.

5. Transmission Drives in one direction only

a. Are electrical connections to pump control proportional solenoids correct, intact and without defects?
Yes - Proceed to step 5.b
No - Rectify the problem

b. Check hot oil flushing valve cartridge #120 located in the Traction Control Manifold.
Remove and inspect flushing valve cartridge for stuck spool or damaged cartridge O-ring seals & backup rings.

c. Inspect "Make-Up" check valve cartridges, #190.1-190.4, installed in the Traction Control Manifold. Is a cartridge "stuck" open with debris or is an O-ring failed?
No - Proceed to step 5.d
Yes - Clean/repair or replace Make-Up check cartridge.

d. Swap high pressure relief valves in the transmission. Does the transmission drive in the other direction?
No - Proceed to step 5.e
Yes - Repair/clean/adjust or replace high pressure relief valve on the non-driving side

e. Replace "EP" control module. Does pump operate properly?
No - Replace or repair pump
Yes - Operate the transmission

6. Transmission Drives in Wrong Direction

a. Check to see if electrical connectors or wiring have been swapped on the pump.

b. Check to determine want end of the machine the boom is swung over.

7. Transmission Does Not Find or Hold Neutral

a. Does pump remain in neutral with electrical connectors removed?
No - proceed to step 7.b
Yes - Check electrical system for signal problem

b. With electrical connectors removed and machines wheels jacked off the ground and engine running, momentarily apply 12 volt DC signal (battery voltage) to a pump control solenoid. Does the pump return to neutral after the 12 volt signal is removed?
No - Apply 12 volts to opposite solenoid & recheck.
No - Replace pump control module, repeat step 7.a
Yes - Possibly dirt was dislodged from control module, re-check thoroughly to determine problem has definitely been resolved.

c. Check mechanical centering of the pumps

8. Transmission Drives at a High Noise Level

a. Are the wheel drive planetary reduction gearboxes filled to the correct level and do they have the proper lubricant?
No - Fill gearbox with correct grade of oil to the prescribed level.
Yes - Proceed to step 8.b

b. Is the engine flex plate and drive coupling correctly installed and aligned with the transmission pump?
No - Install flex plate and bell housing per manufacturer's instructions
Yes - proceed to step 8.c

c. Is a rigid item or object contacting the resilient mounted engine/pump assembly?
No - Proceed to step 8.d
Yes - Insure no item is contacting the unit, transmitting air borne noise.

d. Is the suction pressure/vacuum at the charge pumps inlets within recommended limits?
No - Return to step 1.h
Yes - Proceed to step 8.e

e. Is there air in the hydraulic fluid? This may be indicated by foaming or milky colored oil.
No - Proceed to step 8.f
Yes - De-aerate the oil and inspect system for cause of air induction. Check for loose or missing O-rings on face seal connections.

f. Is a wheel drive hydraulic motor operating at excessive speed?
Yes - Check minimum displacement stop screw adjustments on the motors. Should be 0.433" or 11mm above the stop screw lock nut. Is one or more motors "stuck" at minimum displacement, check for plugged/blocked two-speed stroking orifice(s).

9. Transmission Operates at a Higher than Normal Temperature

a. Is the reservoir temperature above 195°F (90.5° C)?
No - 195°F (90.5° C) is the upper limit. If temperature is over 195°F (90.5° C), the oil cooler may need to be cleaned.
Yes - Proceed to step 9.c

b. Are the hydraulic motor(s) stalling (wheels not turning) intermittently?
No - Proceed to step 9.c
Yes - Hydraulic fluid is being heated through system pressure relief valves. Shut down system and rectify the cause of motor stall.

c. Does oil temperature remain above 195°F (90.5° C), after cleaning the oil cooler?
No - Operate transmission. Check oil cooler more often.
Yes - Proceed to step 8.a

10. Transmission Operates at a Higher than Normal Temperature

a. Check for differential temperature across the oil cooler. Is there a temperature difference?
No - Check to determine if the bypass check valve (10 psi [0.7 bar] crack pressure) is stuck open. Check to determine if the oil cooler is restricted internally, causing oil flow to pass across the bypass check valve.
Yes - Proceed to step 8.b

NOTE: *Oil cooler flow is received from the transmission pumps cases, max. continuous pump case pressure is 15 psi gauge pressure. Higher pressure will prematurely damage pump shaft seals*

b. Disconnect pump case drain from oil cooler & check flow rate from charge pumps. Is the flow rate 3.8 GPM (14.4 LPM) with diesel idle speed of 1200 rpm?
No - Refer to charge pump removal & inspection procedure

11. Transmission Pump(s) Do Not Develop Maximum Horsepower (Flow & Pressure)

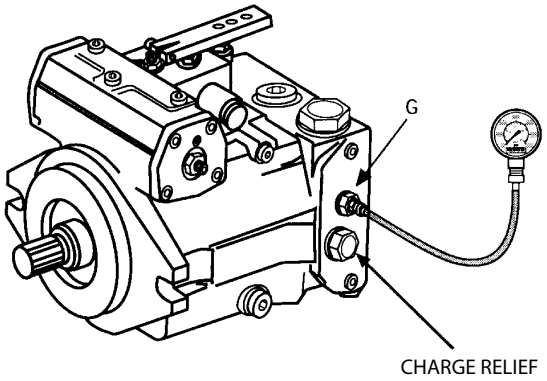
a. Does the charge pump pressure meet specification?
No - Return to step 2.a
Yes - Proceed to step 11.b

b. Does the pump case pressure exceed 15 psi gauge pressure?
No - Proceed to step 11.c
Yes - Check case drain hoses, oil cooler, etc. for pinched or restricted oil flow

c. Are the pump(s) high pressure cross port relief valves adjusted to the required pressure (5000 psi) so they do not bypass prematurely?
No - Inspect/clean/adjust and or replace valve cartridge
Yes - Replace the pump, after blocking the "A" & "B" ports, running the pump and measuring pressure developed at "A" & "B". This must be done to insure that flow & pressure loss in not elsewhere in the system. (motors, swivel coupling, etc.)

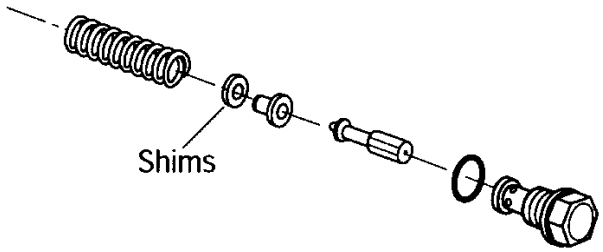
d. Is the diesel engine capable of developing horsepower at design rpm?
Follow recommended troubleshooting procedures to insure the engine is developing full power at specified rpms.

Charge Pressure Relief Valve Adjustment



With a low pressure (0 – 1000 psi [0 - 70 bar]) pressure gauge tee'd into the "G" port or two (2) low pressure gauges installed into "Ma" and "Mb", run pump at engine idle speed. Do not place the pump on stroke – low pressure gauges installed in "Ma" & "Mb" will be damaged! Prior to adjusting pressure, insure charge pressure relief valve is clean of any dirt or debris. The charge pressure relief valve does not wear appreciably over time. If charge pressure was normal and then has decayed, check for other causes of low charge pressure. If pressure is low, remove relief valve and add shim(s). If pressure is high, remove relief valve and take out shim(s).

NOTE: *Shim thickness 1 mm = 56 psi (3.86 bar). Shims are available in 0.3, 0.5, and 1.0 mm thickness.*



Mechanical Centering of Pump

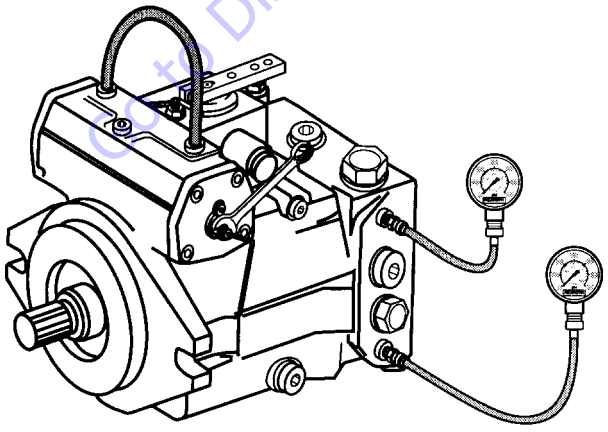
PREPARATION FOR ADJUSTMENT

The control piston has strong centering springs to ensure that once the pump is adjusted for the neutral position it will always return to neutral. If an adjustment is necessary follow the steps listed below.

To ensure there is equal pressure on both sides of the control module during the centering operation, it is necessary to connect the X_1 and X_2 ports together by means of hose or tubing. (No less than a 1/4 inch ID) The port sizes are:

Pump Size	Allen Wrench	Wrench
28	5 mm	17 mm

With pressure gages installed at M_A, and M_B, and with A and B ports blocked (or motor stalled), and with the pump running, loosen the jam nut. Turn the mechanical centering adjusting screw until 1000 psi is read on M_A, or M_B then turn screw opposite direction until 1000 psi is read on other pressure port. Turn the screw back, splitting the distance between the previous two positions. This should be the neutral position. Pressure on M_A, and M_B should be equal.

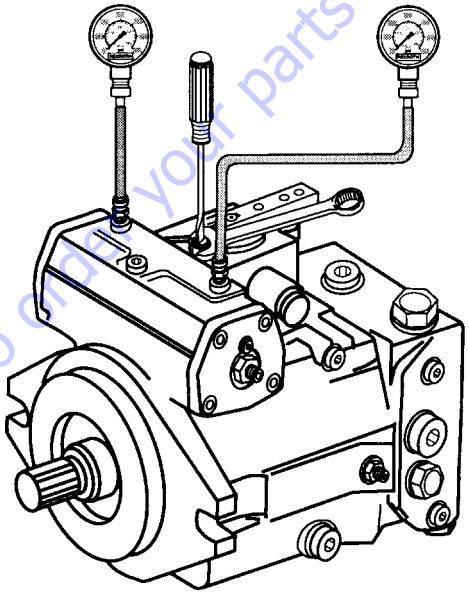


Tighten jam nut, stop the pump drive, remove the hose connecting ports X_1 and X_2.

Hydraulic Centering of Control Modules

PREPARATION FOR ADJUSTMENT

When control modules are exchanged or replaced, it is generally necessary to center the new module. This is done by running the pump with gauges installed at ports X_1, X_2, M_A, and M_B Release the jam nut and turn the adjustment screw on top of the control module valve body.



The adjustment screw is an eccentric, therefore, turning more than 90' in either direction will have no further centering effect, and could cause damage to the eccentric pin.

Pump Size	Tool Required	Wrench
28	Screwdriver	10 mm

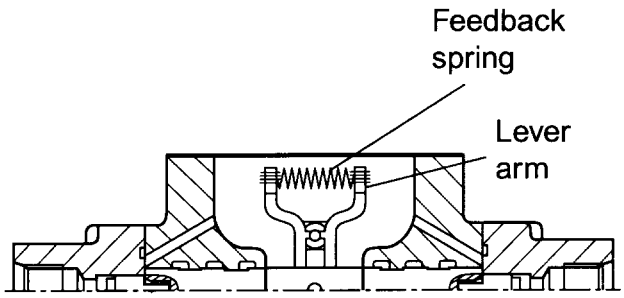
CENTERING THE EP CONTROL MODULE

With no electrical signal to solenoids A and B, (remove both plug-in connectors), the EP control module is correctly adjusted when any or all of the following conditions exist:

1. Approximately, when equal control pressures are obtained at control pressure ports X_1 and X_2.
2. The hydraulic motor does not turn when the brake is released.
3. Charge pressure is registered equally at ports M_A and M_B, when the flow output of the pump is deadheaded against a locked motor or a valve.

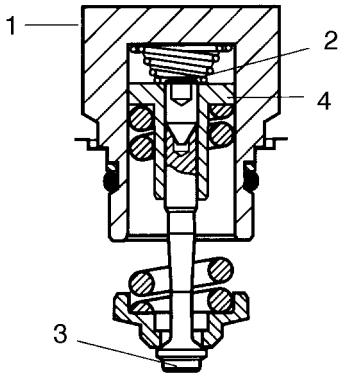
If difficulties are encountered in obtaining neutral position of the HD or EP control modules, check that the ends of the con-

trol spring are correctly located in the grooves near the end of the feedback lever arms.



High Pressure Relief Valve Adjustments

1. Remove relief valve cover from pump (ref. item 1).



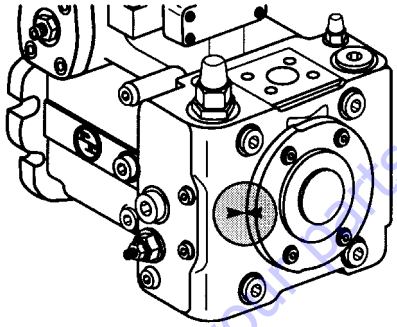
2. Loosen jam screw (ref. item 2).
3. Holding spring loading nut (ref. item 4) rotate valve spindle (ref. item 3). For high range relief valve, one turn equals approximately 630 psi (44 bar). For low range relief valve, one turn equals approximately 377 psi (26 bar).
4. After adjustment is completed torque jam screw (ref. item 4) to 5 ft.lb. (7 Nm).
5. Install relief valve assembly into pump, reinstall cover (ref. item 1) to proper torque.

Table 5-38. Torque Specs for Relief Valves into Port Block

Pump Size	Wrench Size	Torque
28	32 mm	66 ft.lb. (90 Nm)

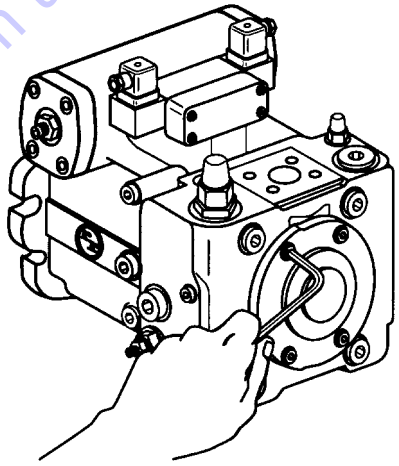
Removal and inspection of charge pump

Before removing cap screws, mark the position of the charge pump housing and separator plate in relation to the port block.



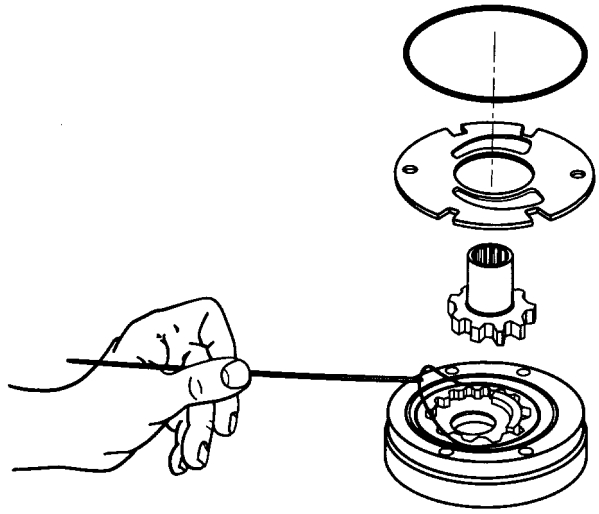
Loosen screws with metric allen wrench.

Pump Size	Allen Wrench
28	8 mm



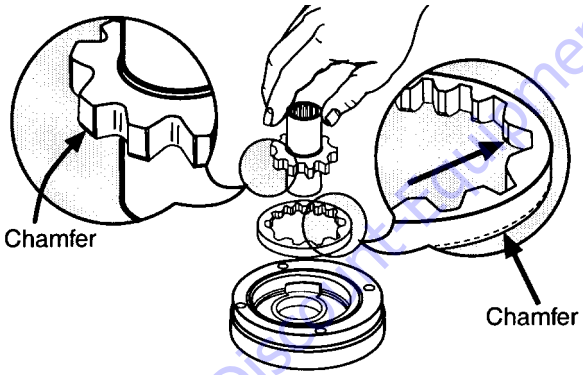
Remove charge pump housing and inspect for wear or damage to gear set and 0-ring seals. Grease 0-rings prior to reas-

sembly. Make sure 0-rings are completely seated in their grooves.



Withdraw pinion shaft and inspect gear teeth and bearing surfaces for abnormal wear.

When reassembling, make sure chamfer (on outer edge of driven gear and drive gear) is installed into housing per illustration.



Torque value for bolts when replacing charge pump.

Pump Size	Torque
28	18 ft.lb. (24 Nm)

NOTE: *If serious wear or damage has occurred to one component, the complete charge pump assembly must be replaced because they are matched components.*

Routine Maintenance

The Variable Displacement Hydrostatic Transmission Pumps are relatively maintenance free. Maintenance work is confined to the system, by way of maintaining hydraulic fluid condition, the "life blood" of the machine. Oil monitoring, changes and filter renewal promote system cleanliness. This will prevent premature breakdown and repairs. Under normal application conditions, the following maintenance intervals are suggested:

1. Renewal of Filter Elements
   - **a.** After commissioning or re-build.
   - **b.** At every 500 operating hours or when filter indicator shows a dirty element.
   - **c.** With the suction strainer, the strainer should be renewed as soon as charge pump inlet pressure is less than -3.2 psi, 6.3"Hg or 0.8 bar absolute.
   - **d.** Only JLG recommended filter elements are to be used. Paper elements cannot be cleaned; use throw-away cartridges.
2. Hydraulic Fluid Change
   - **a.** After 2000 operating hours (1st oil change)
   - **b.** Thereafter, every 2000 operating hours or annually, irrespective of operating hours achieved.
   - **c.** Oil change should be performed with the system in warm running condition. Before re-filling, the reservoir interior should be inspected and cleaned to remove any sludge.
   - **d.** Rags or threaded material must not be used.
   - **e.** This machine has been designed & manufactured to operate on an Exxon-Mobil Oil Co. hydraulic fluid, Mobilfluid #424, Product #52233-4. Consult JLG Industries prior to introducing any other type of fluid to prevent interaction or possible contamination.
   - **f.** The recommended interval between oil changes is based on various factors and should be carried out according to the degree of aging, contamination and water content.

g. Under application conditions with a heavy occurrence of dust or severe temperature fluctuations, the intervals between fluid maintenance should be shortened accordingly.

NOTICE

PRACTICAL EXPERIENCE SHOWS THAT MOST FLUID MAINTENANCE ERRORS OCCUR DURING AN OIL CHANGE DUE TO:

- **USE OF AN UNSUITABLE HYDRAULIC FLUID**
- **USE OF OIL CONTAMINATED DUE TO POOR STORAGE PRACTICES**
- **FAILURE TO CLEAN THE RESERVOIR**
- **INADEQUATE CLEANLINESS WHEN FILLING THE RESERVOIR (DIRTY DRUMS, CONTAINERS, WATER, ETC)**

3. Leakage Inspection

a. After commissioning

b. The complete transmission drive system (pumps, motors, hosing, filters, valves, etc.) should be checked for leakage at regular intervals.

c. Leaking joints & connections must only be tightened when pressureless.

4. Cleanliness Inspection

a. The oil tank breather should be regularly cleaned of dirt and dust to prevent clogging. With each cylinder movement, gallons of oil pumped, an equal amount of air exchange occurs across the reservoir breather. A dirty or clogged breather will affect **all** machine functions!

b. The air/oil cooler surfaces and engine radiator should be cleaned at the same time.

c. If hose connections are disassembled, it is imperative that the utmost care be taken that no foreign bodies infiltrate the oil circuit. Catastrophic component failure may occur.

5. Oil Level Inspection

a. Inspect oil level in the reservoir daily.

b. If "topping off" is required, use only the same Mobilfluid #424, Product #52233-4.

c. Do Not Mix Fluids.

6. Hydraulic Fluid - The "Life Blood" of the Machine

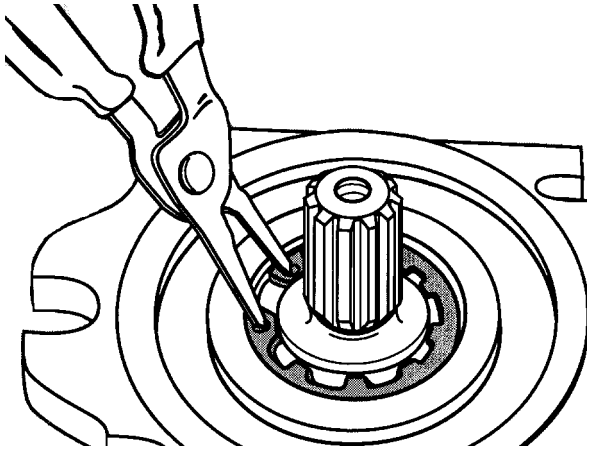
a. The type of hydraulic fluid supplied in the machine from the factory was selected after extensive testing and development. The fluid was selected to perform under "most" applications and conditions. Should this machine be in service for extended time periods at the extremes (hot or cold), JLG should be consulted for assistance in selection of the most suitable fluid type and grade for your application.

b. When operating at temperatures below 0^{o}F, allow a warm-up period, if at all possible, to a temperature of 40^{o}F.

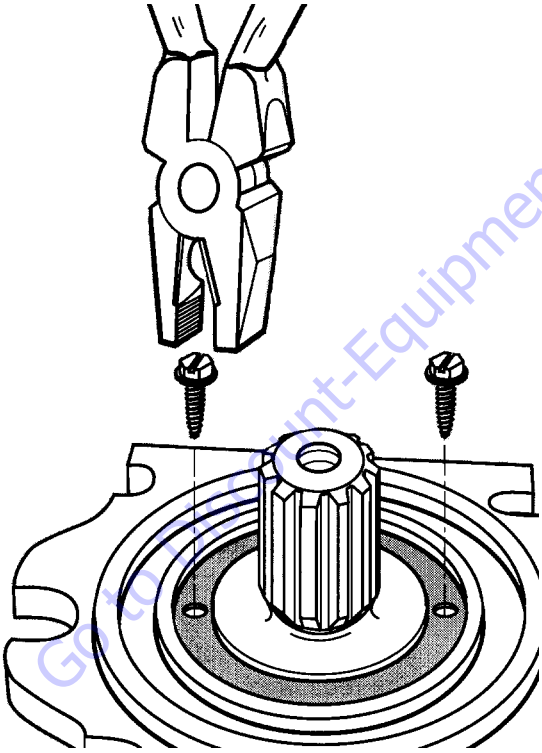
c. When beginning motion of a "cold" machine, operate all functions at reduced speeds until the "cold" oil has circulated out of the drive loop.

Removal and Installation of Shaft Seal

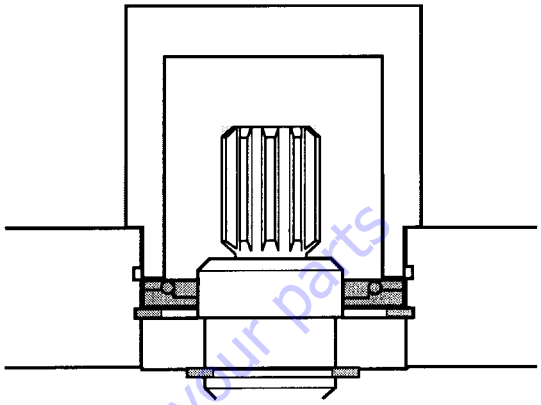
Remove the retaining ring with snap ring pliers.



Screw in sheet metal screw into the holes fitted with rubber. Pull out shaft seal with pliers.



Press in shaft seal with bushing to the stop. Then replace snap ring.



5.8 FUNCTION PUMP (REXROTH)

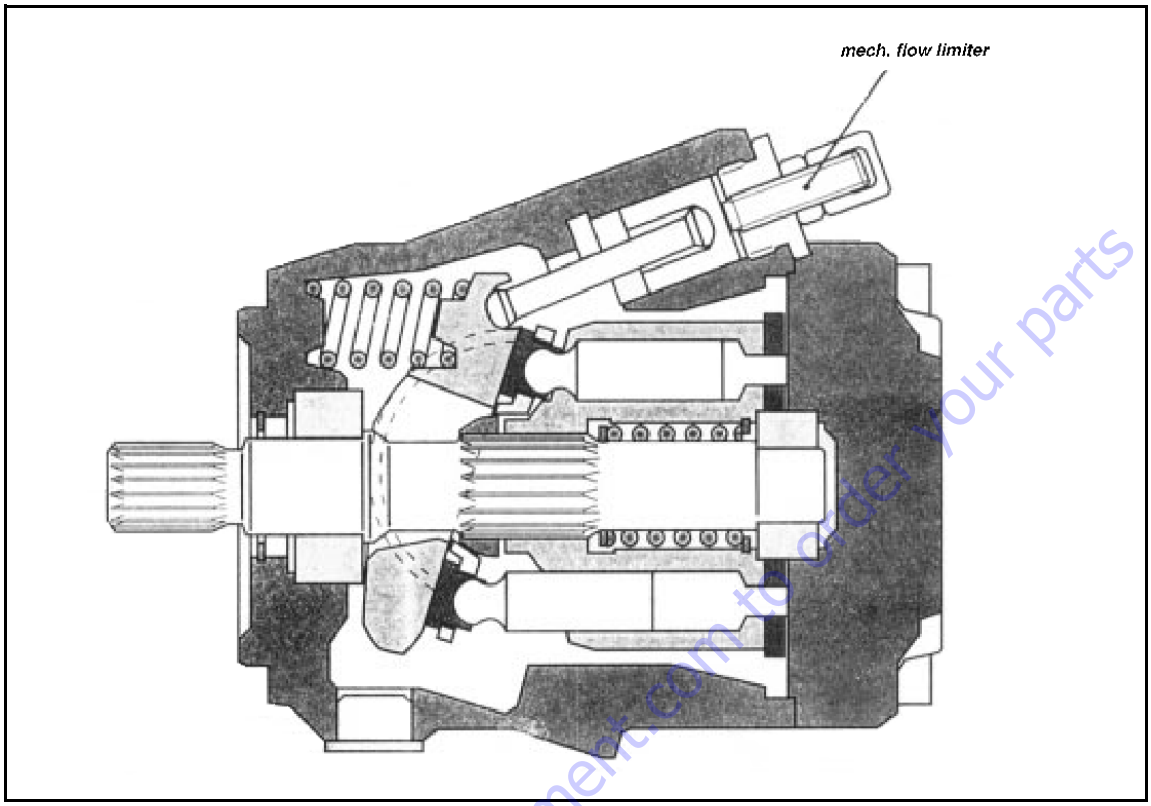
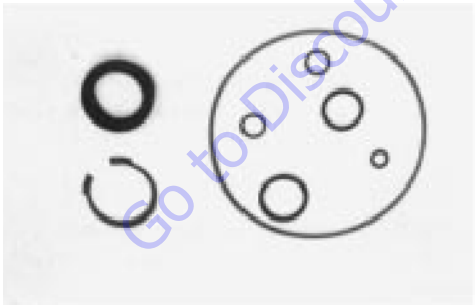


Figure 5-196. Function Pump - Sectional View

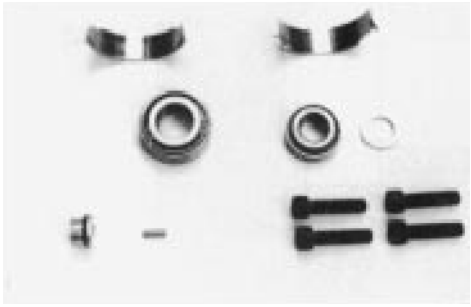
Spare Parts

1. Sealing kit, existing spare parts: shaft sealing ring, o-rings, and a circlip.

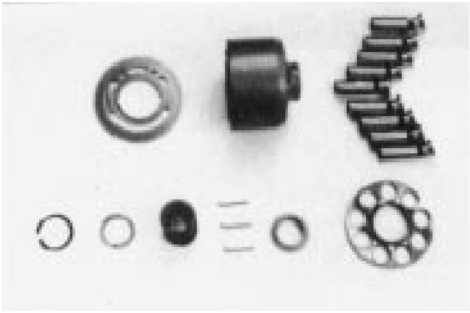


2. Drive Shaft

3. Bearing set, miscellaneous parts.

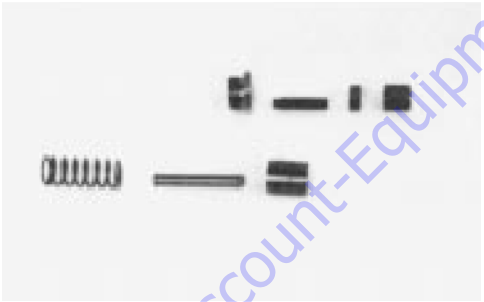


4. Rotary Group complete: 9 pistons, cylinder subassembly, valve plate, retaining plate, and retaining ball.



5. Swash Plate.

6. Parts of the control valve: control piston, piston rod, plug, spring stopper max flow, hex nut, and hex head nut.



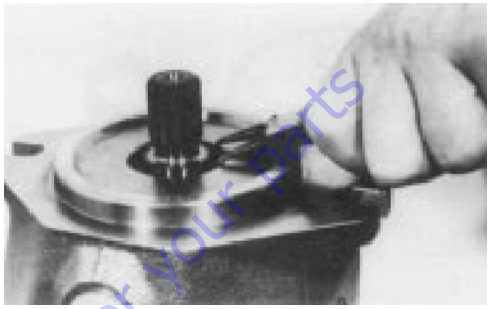
7. DFR pilot valve.

Sealing the Drive Shaft

NOTICE

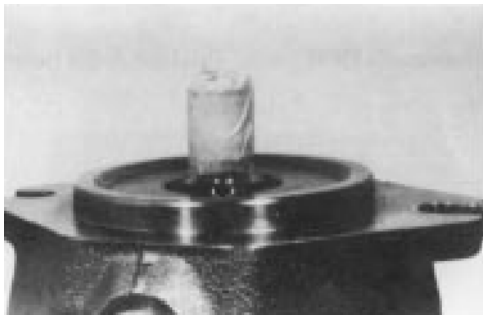
BE VERY CAREFUL SO THE DRIVE SHAFT IS NOT DAMAGED DURING THE REMOVAL OF THE SHAFT SEALING RING.

1. Remove the snap ring.



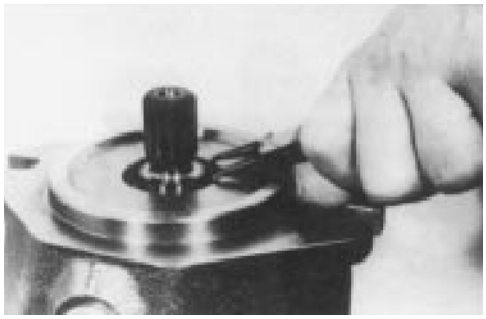
2. Change the shaft seal and check its sliding surface (drive shaft) and housing. Grease the sealing ring.

3. Be careful while you seal the drive shaft. Use an adhesive tape to prevent the shaft splines from damaging the seal.



4. Assemble the sealing ring, fitting tool holds the correct position of the sealing ring in the pump housing.

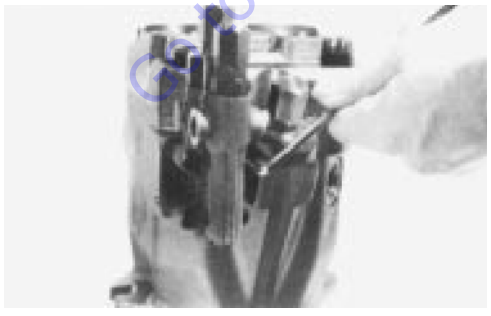
5. Assemble the snap ring.



6. Assemble the snap ring in the correct position.

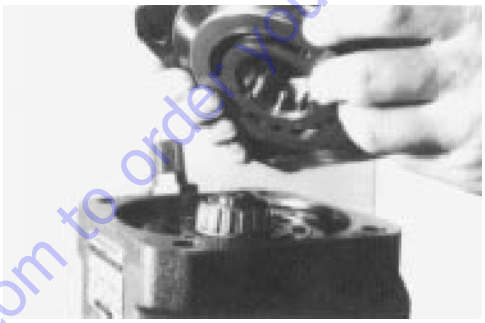
Disassembly and Assembly of the Complete Unit

1. Disassemble the pilot valve.



2. Mark the position of the port plate and remove the socket screw of the port plate.

3. Remove the port plate together with the valve plate (hold the valve plate so the plate can't fall down).

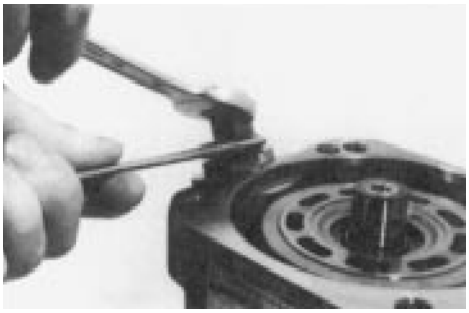


4. Remove the o-ring.

5. Disassemble the taper roller bearing (nearby port plate).

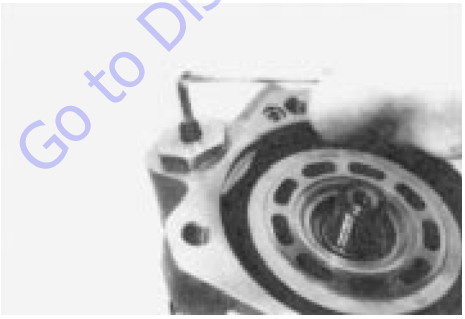
6. Remove the adjustment shim.

7. Unscrew the cap nut and remove it.



8. Loosen the fixing nut of the stopper max flow and disassemble it.

9. Turn in the stopper max flow to get swivel angle zero.



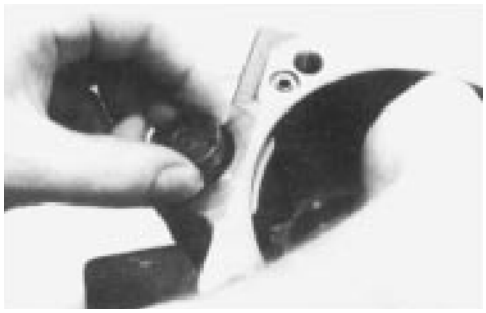
10. Disassemble the rotary group in horizontal position.

11. Disassemble the stopper max flow.

12. Remove the threaded pin.

13. Disassemble the plug.

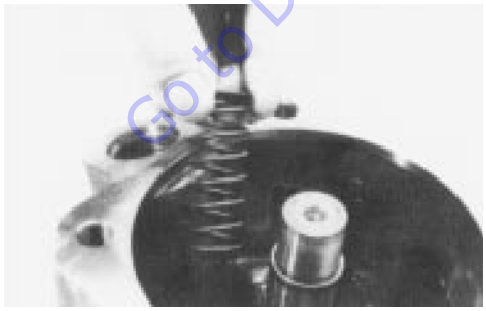
14. Disassemble the control piston while moving the swash plate.



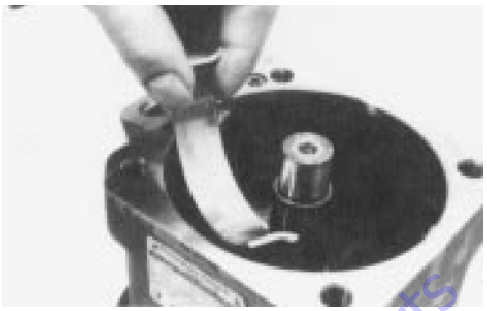
15. The swash plate must be lifted a little bit to disassemble the piston rod.

16. Remove the swash plate.

17. Remove the spring.



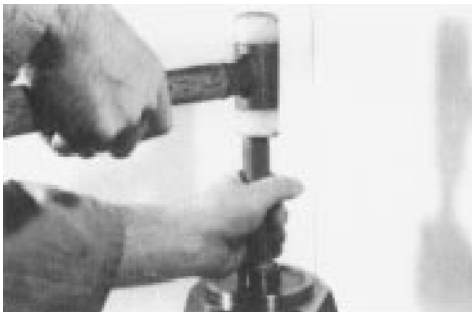
18. Remove both bearing shells.



19. Remove the drive shaft.

20. Disassemble the snap ring.

21. Disassemble the sealing ring.



22. The external front bearing ring is pulled out of the pump housing.

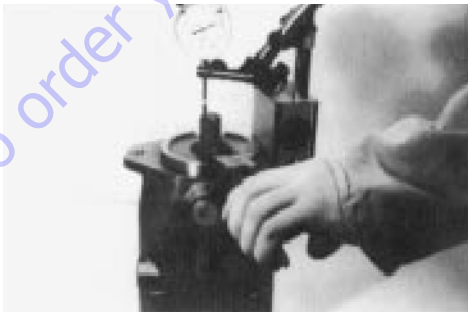
23. Remove the o-ring. Lifting of the valve plate isn't shown.

24. A bearing puller is used to disassemble the external bearing ring of the taper roller bearing inside the port plate. Take care of the surface of the port plate.

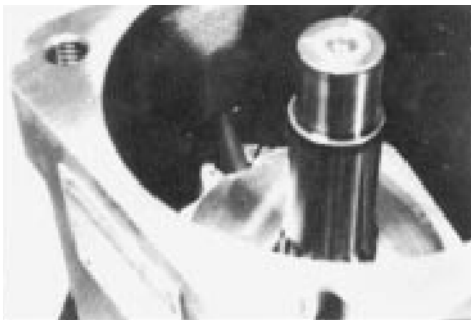
25. The spring has additional pretension while you disassemble the three pressure pins inside the cylinder.

Assembly

1. Measurement of the taper roller bearing pretention.



2. Ensure there is a correct connection of the piston rod and the swash plate.



3. Pumps clockwise driven must have a position of the valve plate 4 degrees out of center in the same direction de-centered like drive direction.

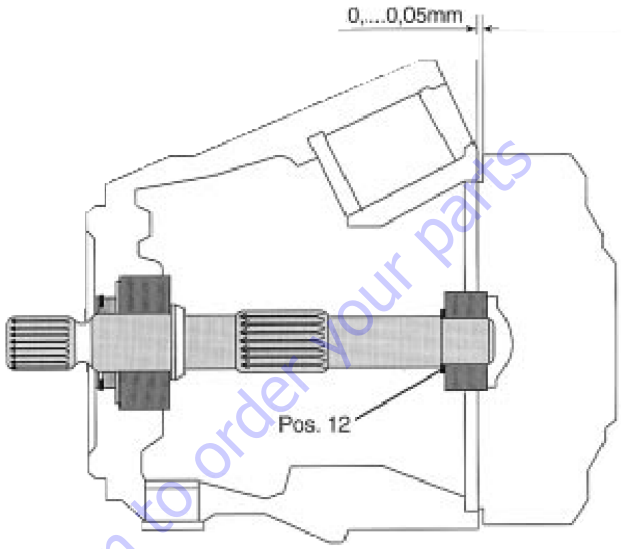
4. Pumps counterclockwise driven must have a position of the valve plate 4 degrees de-centered in the counter-clockwise position.

5. Note the correct position of the drilling that connects high pressure to the control valve. Check control valve drilling position at the pump housing and fit together.

Adjustments

TAPER ROLLER BEARING INITIAL TENSION

Cast Iron pump housing must have initial tension of the bearings: 0 to 0.05 mm.



MECHANICAL FLOW LIMITER

Differential volume if you are rotating the threaded pin - each rotation is approximately 3.1 cm3.

Tightening Torques

For break-off plugs, use Loctite #601.
For all other parts, use JLG Threadlocker PN 0100011.

Table 5-39. Tightening Torques

	M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M24	M30
8.8	2.3	5.0	8.5	21	41	72	115	176	240	350	600	1220
10.9	3.2	7.2	12	29	58	100	165	250	350	490	840	1670
12.9	4.1	8.5	14.5	35	70	121	195	300	410	590	990	2000

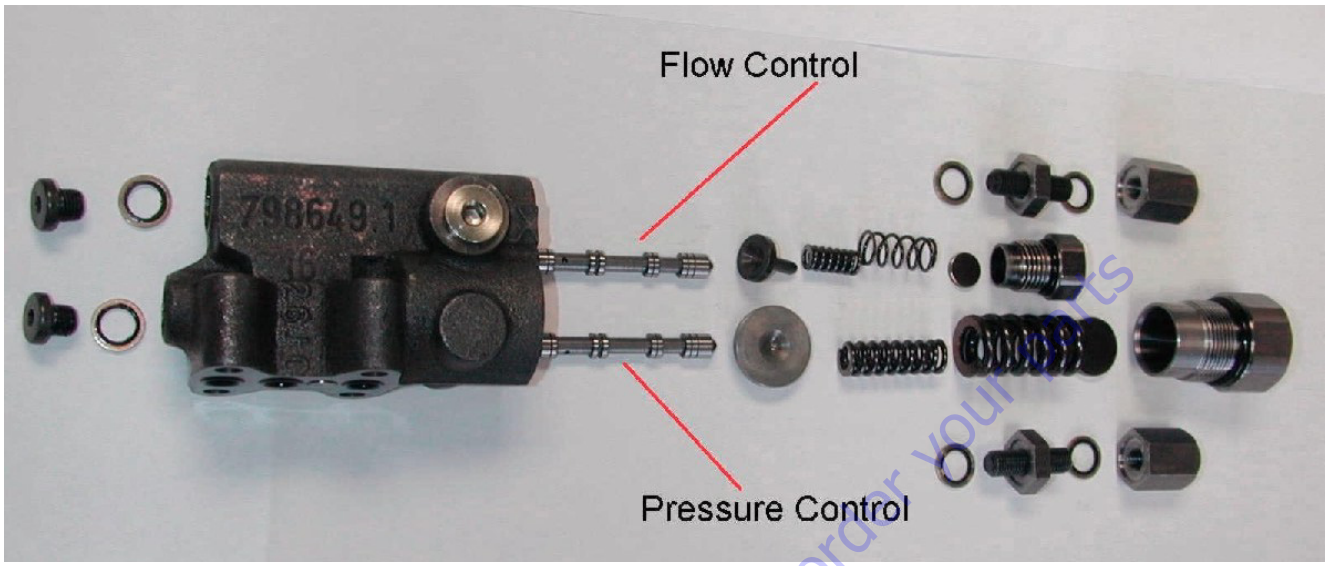


Figure 5-197. Function Pump, Pressure and Flow Control - Sheet 1

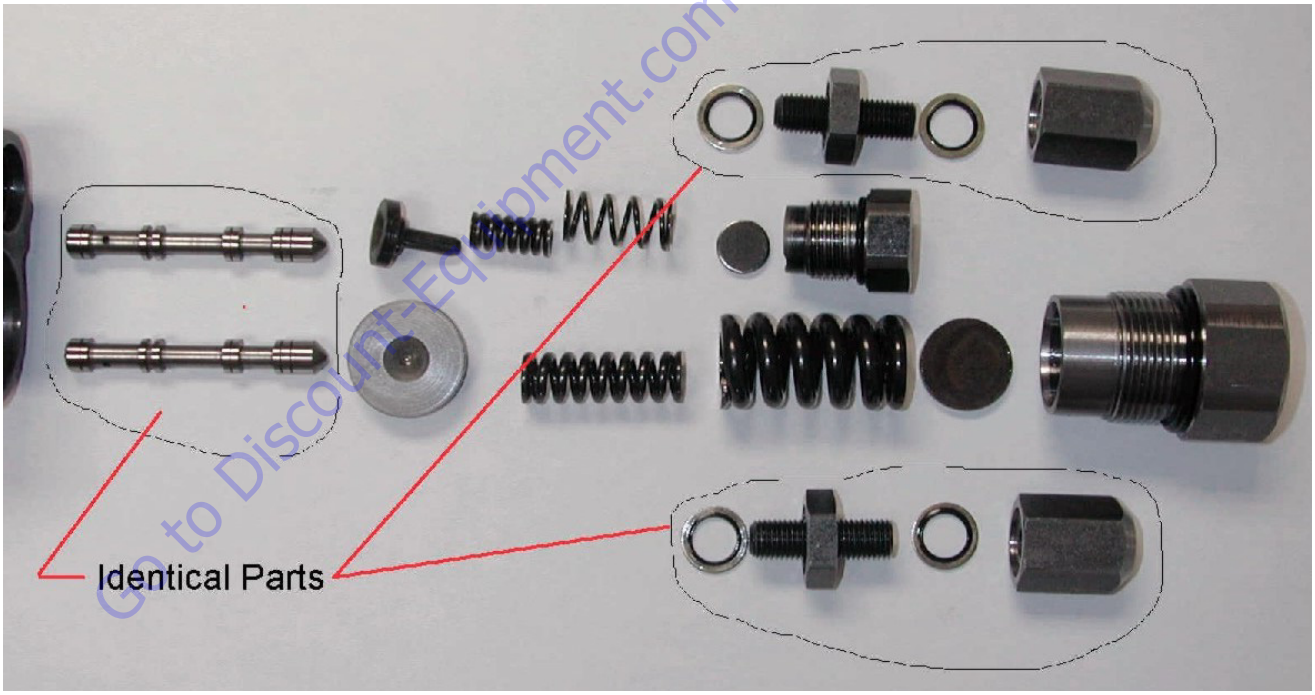


Figure 5-198. Function Pump, Pressure and Flow Control - Sheet 2

Figure 5-199. Function Pump, Pressure and Flow Control - Sheet 3

Pump Control Disassembly For Cleaning

NOTE: If the Function Pump does not perform correctly after following the pre-start start-up procedures, it is possible that a contaminate particle has lodged in the pump control preventing proper operation. The pump control's internal parts are not provided as spare parts due to the close tolerances required between the mating parts. However, the control can be disassembled, cleaned and placed back in service should the only problem prove to be contamination. Disassembly, inspection, cleaning and reassembly MUST BE done in a clean well-illuminated area.

Pump Control removal:

1. Disconnect plug the hose attached to the pump control Port "X".
2. Remove the four (4) socket head cap screws that attach the control to the pump. Insure that the three (3) "0"-rings are also removed with the control.
3. Hydraulic fluid may drip from the pump. Wiping the surface clean and installing some adhesive tape should prevent oil from seeping from the pump control.
4. Work on a clean, lint free area.

NOTE: *The pump control can be equipped with either O-rings or a sealing plate. These components are NOT interchangeable.*

5. Remove the three (3) "0"-rings (Parker # 2-011, Viton 90 shore)
6. Remove both the adjustment hex caps and bonded seal rings. (17 mm wrench)
7. Remove both the adjustment lock nuts and bonded seal rings. (17 mm wrench)
8. Remove both the adjusting screws. (3-mm Allen wrench)
9. Remove the spring cover hex cap for the "outer" flow regulation adjustment this requires a 19-mm wrench.

10. Remove the spring disc.

11. Remove the adjusting springs (two springs, one "nested" inside the other) and spring follower.

12. The flow regulation spool should slide from the control housing, (a magnet should aid in removal). If it does not, remove the hollow hex head plug at the rear of the flow regulation spool and carefully push the spool from the housing - do not scratch/mar the spool's bore.

13. Remove the spring cover hex cap for the "inner" pressure compensation adjustment – this requires a 30-mm wrench.

14. Remove the spring disc.

15. Remove the adjusting springs (two springs, one "nested" inside the other).

16. Remove the spring follower.

17. The pressure compensation spool should slide from the control housing, (a magnet should aid in removal). If it does not, remove the hollow hex head plug at the rear of the flow regulation spool and carefully push the spool from the housing - do not scratch/mar the spool's bore.

18. The spools are identical.

19. Wash the housing and all parts in a clean JLG approved solvent such as non-chlorinated brake cleaner, Stoddard solvent, etc.

20. Blow off all the parts with clean, dry compressed air.

21. Inspect the housing for contamination or plugged orifices. Clean orifices carefully with a dead soft steel wire to insure they are open. Inspect all parts for burrs, scoring, debris, etc.

NOTE: *On the mounting surface of the control housing, between the oil ports is what appears to be a slotted head screw. IT IS NOT A SCREW. This is a bleed orifice, which must be orientated to allow proper control operation. The slot in the head should be oriented to fall in-line with the oil ports, NOT PERPENDICULAR to the oil ports. If the slot is oriented perpendicular to the three ports, the pump pressure will not return from load pressure to stand-by pressure at the end of operating a function! The pump pressure will remain at the last highest pressure generated.)*

22. After all parts are clean and dry, lightly oil a control spool and install in its bore. The spool must slide smoothly and easily within the housing. If it does not, check for contamination. If contamination cannot be found check for "scoring" or "burring" of the control housing. If the spool does not slide smoothly & freely, the control must be replaced with a new unit.

23. Lightly oil and check operation of the second spool. The spools are installed correctly when there "pointed" end faces the spring followers

24. Re-assemble in reverse order.

25. Bench set the pressure adjustments as described in "C. 4" of the Operating Instructions.

NOTE: *The pump control can be equipped with either O-rings or a sealing plate. These components are NOT interchangeable.*

26. Re-install on the Function Pump, insure the "0"-rings are installed properly and tighten the four (4) M6 socket head cap screws to 105 inch pounds.

5.9 DRIVE PUMPS (SAUER)

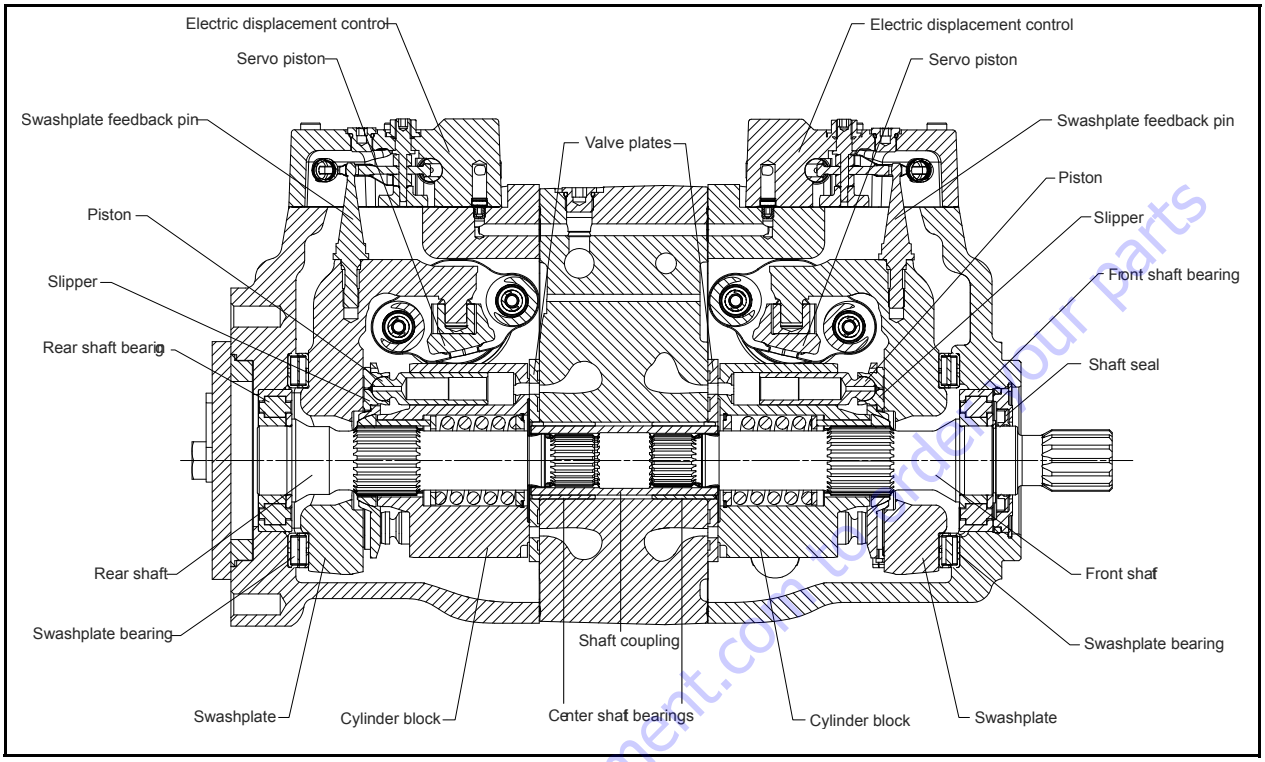


Figure 5-200. Piston Pump Cross Sectional View

Port Locations and Gauge Installation

Table 5-40. Port information

Port identifier	Port size	Wrench size	Reading	Gauge size, bar [psi]
L1, L2, L3	1 1/16-12 UNF 2B	9/16 internal hex	Case drain	10 bar [100 psi]
MA, MB, MC, MD	9/16-18 UNF	1/4 internal hex	System pressure	600 bar [10,000 psi]
M3	9/16-18 UNF 2B	1/4 internal hex	Charge pressure	50 bar [1000 psi]
M4, M5	7/16-20 UNF 2B	3/16 internal hex	Servo pressure	50 bar [1000 psi]
X7	9/16-18 UNF 2B	1/4 internal hex	Brake pressure	50 bar [1000 psi]

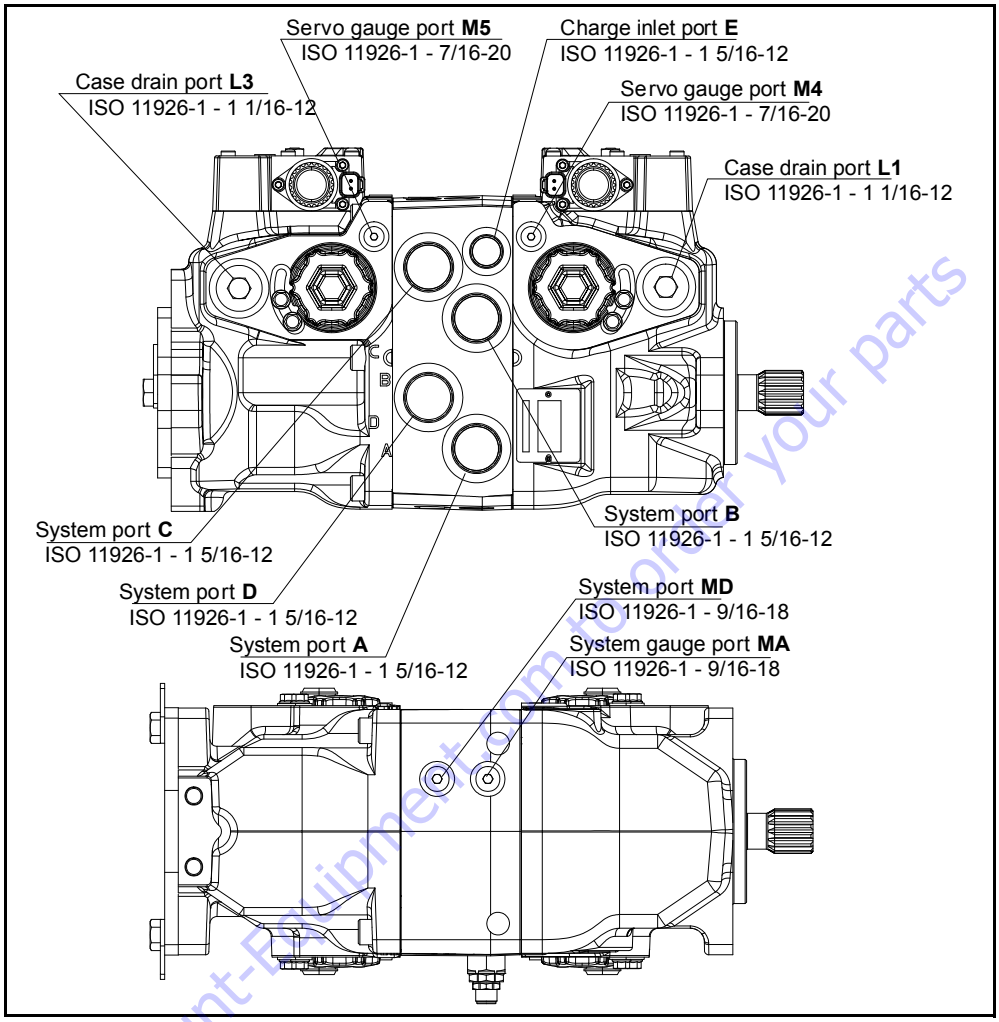


Figure 5-201. Port locations - Sheet 1 of 2

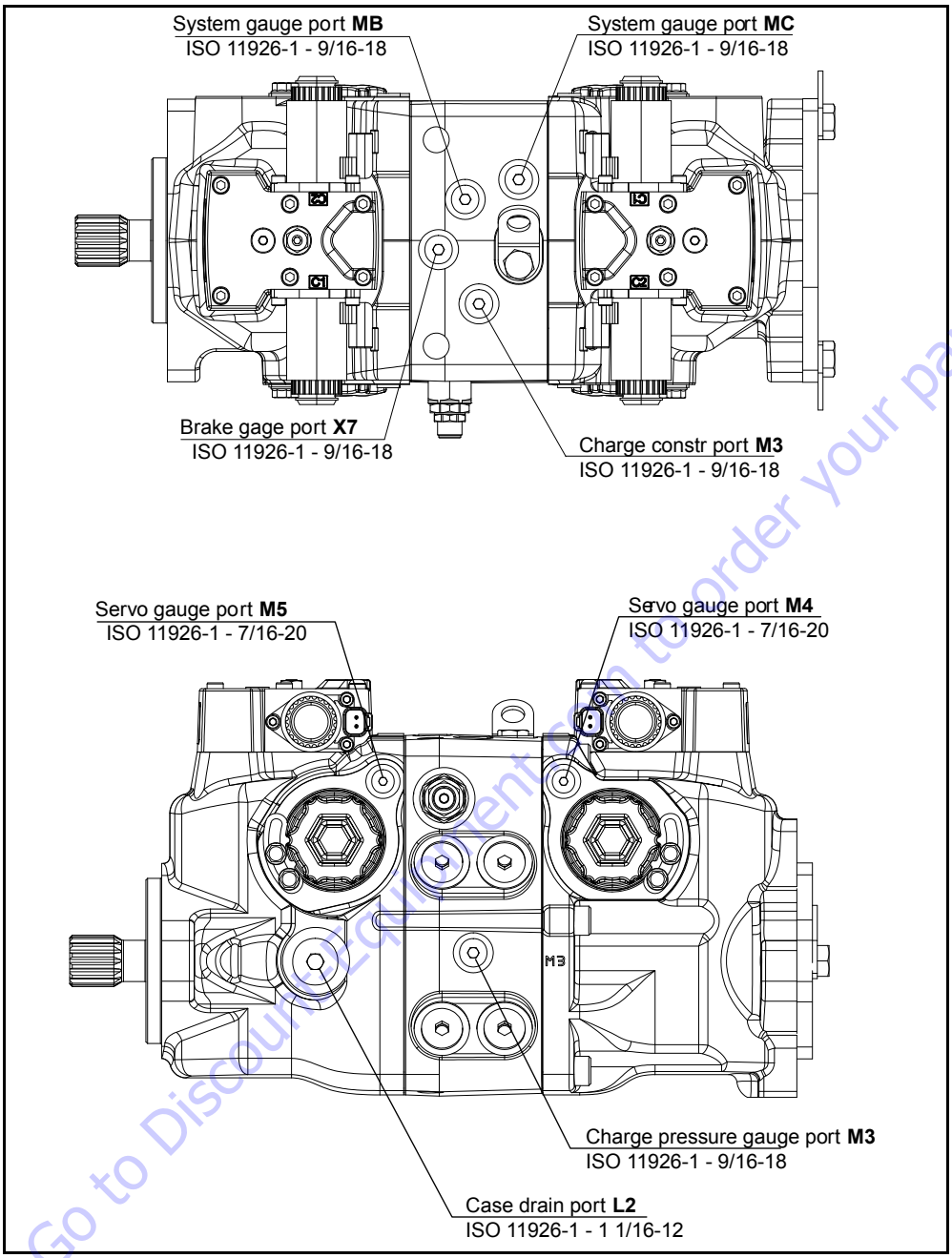


Figure 5-202. Port locations - Sheet 2 of 2

Initial Startup Procedures

Follow this procedure when starting-up a new pump or when restarting a pump that has been removed. Ensure the pump is thoroughly tested on a test stand before installing.

Prior to installing the pump, inspect for damage that may have occurred during shipping.

1. Ensure that the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and free of air leaks.
3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M3.
4. Fill the housing by adding filtered hydraulic fluid to the upper case drain port. If the controls are installed on top, open the construction plugs in the top of the controls to assist in air bleed.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron filler filter. Ensure construction plug is closed after filling is complete.
6. Disconnect the pump from all control input signals.

⚠ CAUTION

AFTER START-UP THE FLUID LEVEL IN THE RESERVOIR MAY DROP DUE TO SYSTEM COMPONENTS FILLING DAMAGE TO HYDRAULIC COMPONENTS MAY OCCUR IF THE FLUID SUPPLY RUNS OUT. ENSURE RESERVOIR REMAINS FULL OF FLUID DURING START-UP.

⚠ CAUTION

AIR ENTRAPMENT IN OIL UNDER HIGH PRESSURE MAY DAMAGE HYDRAULIC COMPONENTS. CHECK CAREFULLY FOR INLET LINE LEAKS.

⚠ CAUTION

DO NOT RUN AT MAXIMUM PRESSURE UNTIL SYSTEM IS FREE OF AIR AND FLUID HAS BEEN THOROUGHLY FILTERED.

7. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
8. When the gauge begins to register charge pressure, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.
9. When adequate charge pressure is established (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
10. Shut the off engine. Connect the pump control signal. Start the engine, checking to be certain the pump remains in neutral. Run the engine at normal operating speed and carefully check for forward and reverse control operation.
11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of the system loop.

NOTE: *Normal charge pressure fluctuation may occur during forward and reverse operation.*

12. Check that the reservoir is full. Remove charge pressure gauge and cap port. The pump is now ready for operation.

Troubleshooting

⚠ CAUTION

HIGH INLET VACUUM CAUSES CAVITATION WHICH CAN DAMAGE INTERNAL PUMP COMPONENTS.

⚠ WARNING

ESCAPING HYDRAULIC FLUID UNDER PRESSURE CAN HAVE SUFFICIENT FORCE TO PENETRATE YOUR SKIN CAUSING SERIOUS INJURY AND/OR INFECTION AND MAY BE HOT ENOUGH TO CAUSE BURNS. RELIEVE PRESSURE IN THE SYSTEM BEFORE REMOVING HOSES, FITTINGS, GAUGES, OR COMPONENTS. SEEK IMMEDIATE MEDICAL ATTENTION IF YOU ARE CUT OR BURNED BY HYDRAULIC FLUID.

⚠ CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM COMPONENTS AND LINES

Table 5-41. Electrical troubleshooting

Item	Description	Action
Control operates pump in one direction only	Control coil failure.	Measure resistance at coil pins. Resistance should be 14.2W (24V) or 3.66W (12V) at 20°C [70°F]. Replace coil.
No pump function	No power to controller.	Restore power to controller.
Erratic pump function	Electrical connection to pump is bad.	Disconnect connection, check wires, reconnect wires.
Erratic or no machine function	External controller malfunction or hydraulic system problem.	Verify external controller problem using spare controller. Replace controller. Check hydraulic system fluid level/pressures/filters/etc. Fix hydraulic system problems.

Table 5-42. Neutral difficult or impossible to find

Item	Description	Action
Input to pump control	Input to control module is operating improperly.	Disconnect input and check to see if pump comes back to neutral. If Yes, input fault, replace/repair external controller. If No, go to next step.
Pump control neutral	Neutral set improperly.	Shunt servo gauge ports M4 and M5 together with external hose and see if pump comes back to neutral. If Yes: control neutral improperly set. If no: balance swashplate (see Mechanical neutral adjustment). If you still cannot set neutral, replace control.

Table 5-43. System operating hot

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid will not meet cooling demands of system.	Fill reservoir to proper level.
Heat exchanger	Heat exchanger not sufficiently cooling the system.	Check air flow and input air temperature for heat exchanger. Clean, repair or replace heat exchanger.
Charge pressure	Low charge pressure will overwork system.	Measure charge pressure. Inspect and adjust or replace charge relief valve. Inspect charge pump. Repair or replace charge pump.
Charge pump inlet vacuum	High inlet vacuum will overwork system. A dirty filter will increase the inlet vacuum. Inadequate line size will restrict flow.	Check charge inlet vacuum. If high, inspect inlet filter and replace as necessary. Check for adequate line size, length or other restrictions.
System relief pressure settings	If the system relief valves are worn, contaminated, or valve settings are too low, the relief valves will be overworked.	Verify settings of high pressure relief valves and replace valves as necessary.
System pressure	Frequent or long term operation over system relief setting will create heat in system.	Measure system pressure. If pressure is too high, reduce loads.

Table 5-44. System will not operate

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid to supply system loop.	Fill reservoir to proper level.
Control orifices	Control orifices are blocked.	Clean control orifices.
Control screens	Control screens are blocked.	Clean or replace control screens.
Charge pressure with pump in neutral	Low charge pressure insufficient to recharge system loop.	Measure charge pressure with the pump in neutral. If pressure is low, go to next step.
Pump charge relief valve	A pump charge relief valve that is leaky, contaminated, or set too low will depressurize the system.	Adjust or replace pump charge relief valve as necessary.
Charge pump inlet filter	A clogged filter will under supply system loop.	Inspect filter and replace if necessary.
Charge pump	A malfunctioning charge pump will provide insufficient charge flow.	Repair or replace the charge pump.
System pressure	Low system pressure does not provide enough power to move load.	Measure system pressure. Continue to next step.
Charge check / HPRVs	Defective charge check / HPRVs cause system pressure to be low.	Repair or replace charge check / HPRVs.
Input to control	Input to control module is operating improperly.	Repair or replace control.
Optional control cutoff valve	Control cutoff valve coil not energized.	Ensure charge pressure to control via port X7. If none, confirm control cutoff valve coil is energized. If still no pressure, repair or replace control cutoff valve.

Table 5-45. System noise or vibration

Item	Description	Action
Reservoir oil level	Low oil level leads to cavitation.	Fill reservoir.
Aeration of the oil/pump inlet vacuum	Air in system decreases efficiency of units and controls. Air in system is indicated by excessive noise in pump, foaming in oil, and hot oil.	Find location where air is entering into the system and repair. Check that inlet line is not restricted and is proper size.
Cold oil	If oil is cold, it may be too viscous for proper function and pump cavitates.	Allow the oil to warm up to its normal operating temperature with engine at idle speed.
Pump inlet vacuum	High inlet vacuum causes noise/cavitation.	Check that inlet line is not restricted and is proper size. Check filter and bypass switch.
Shaft couplings	A loose input shaft to prime mover coupling will cause excessive noise.	Replace loose shaft coupling.
Shaft alignment	Misaligned input and prime mover shafts create noise.	Correct misalignment.
Charge/system relief valves	Unusual noise may indicate sticking valves. Possible contamination.	Clean/replace valves and test pump. May be a normal condition.

Table 5-46. Sluggish system response

Item	Description	Action
Oil level in reservoir	Low oil level will cause sluggish response.	Fill reservoir.
Charge check / HPRVs	Incorrect pressure settings will affect system reaction time.	Replace charge check / HPRVs.
Low prime mover speed	Low engine speed will reduce system performance.	Adjust engine speed.
Charge and control pressures	Incorrect pressures will affect system performance.	Measure and adjust charge and control pressures.
Air in system	Air in system will produce sluggish system response.	Fill tank to proper level. Cycle system slowly for several minutes to remove air from system.
Contaminated control orifices	Control orifices are plugged.	Clean control orifices.
Contaminated control screens	Control screens are plugged.	Clean or replace control screens.
Pump inlet vacuum	Inlet vacuum is too high resulting in reduced system pressure.	Measure charge inlet vacuum. Inspect line for proper sizing. Replace filter. Confirm proper bypass operation.

Adjustments

⚠ CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS AND VOID YOUR WARRANTY. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND REINSTALLING SYSTEM LINES

1. Thoroughly clean the outside of the pump.
2. If removing the pump, tag each hydraulic line. When you disconnect hydraulic lines, cap them and plug each open port to prevent contamination.
3. Ensure the surrounding area is clean and free of contaminants like dirt and grime.
4. Inspect the system for contamination.
5. Check the hydraulic fluid for signs of contamination: oil discoloration, foam in the oil, sludge, or metal particles.
6. If there are signs of contamination in the hydraulic fluid, replace all filters and drain the hydraulic system. Flush the lines and refill the reservoir with the correct filtered hydraulic fluid.
7. Before reinstalling the pump, test for leaks.

CHARGE PRESSURE RELIEF VALVE.

1. Install a 50 bar [1000 psi] pressure gauge in charge pressure gauge port M3. Install a 10 bar [100 psi] gauge at case pressure port L1, L2, or L3. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.
2. The table below shows the acceptable pump charge pressure range for some nominal charge relief valve settings (refer to model code located on serial number plate). These pressures assume 1800 min-1 (rpm) pump speed and a reservoir temperature of 50°C [120°F], and are referenced to case pressure.

NOTE: *Listed pressures assume a pump speed of 1800 min-1 (rpm) and charge flow of 26.5 l/min [7 US gal/min]. At higher pump speeds or higher charge flows the charge pressure will rise over the rated setting.*

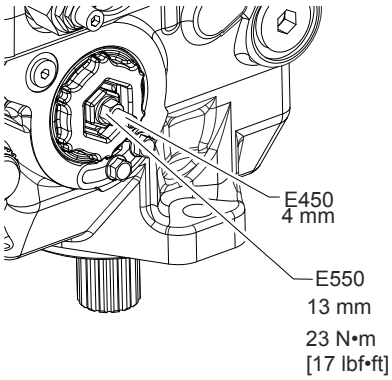
3. Loosen the locknut and rotate the adjusting screw clockwise to increase the setting; counterclockwise to decrease it. Subtract the case pressure reading to compute the actual charge pressure.

NOTE: *Pressure change per turn is dependent on charge flow entering pump.*

4. While holding the adjusting screw, torque locknut to 12 Nm [9 lbft].
5. When you achieve the desired charge pressure setting, remove the gauges and plug the ports.

DISPLACEMENT LIMITER ADJUSTMENT

1. Mark servo cylinder location in case it rotates during displacement limiter adjustment.
2. Loosen the locknut (E550).



3. Rotate the adjusting screw (E450) based on the following table. Rotating the adjusting screw clockwise decreases the maximum displacement of the pump while rotating the adjusting screw counterclockwise increases the maximum displacement.

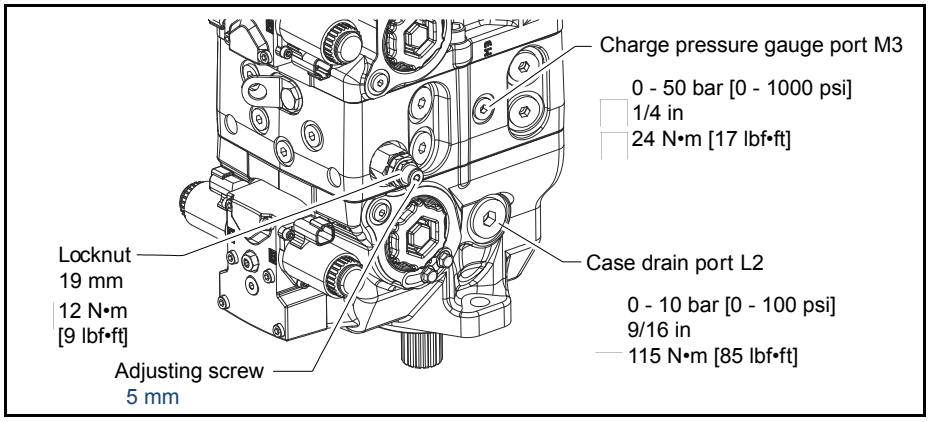


Figure 5-203. Charge Pressure Adjustment

4. After establishing the desired maximum displacement setting, hold adjusting screw in place and tighten the locknut. Torque to 23 Nm [17 lbft]. C

⚠ CAUTION

BE SURE SERVO CYLINDER DOES NOT ROTATE WHEN DISPLACEMENT LIMITER LOCKNUT (E550) IS TORQUED.

5. One turn of the adjusting screw will change the maximum displacement approximately as follows.

Table 5-47. Displacement Limiter Adjustment Data

Displacement	Locknut wrench size and torque	Adjusting screw size	Approximate displacement change per revolution of adjusting screw
45	13 mm 23 Nm [17 lbft]	4 mm internal hex	5.1 cc / turn

CONTROL NEUTRAL ADJUSTMENT

All functions of the Electric Displacement Control (EDC) are preset at the factory. Adjust the pump to neutral with the pump running on a test stand or on the vehicle/machine with the prime mover operating. If adjustment fails to give satisfactory results, you may need to replace the control or coils.

1. Install a 50 bar [1000 psi] gauge in each of the two servo gauge ports (M4 and M5). Disconnect the external control input (electrical connections) from the control. Start the prime mover and operate at normal speed.

2. Use a 4mm internal hex wrench to hold the neutral adjusting screw stationary while loosening the locknut with a 13mm wrench.

3. Observe pressure gauges. If necessary, turn adjusting screw to reduce any pressure differential.

NOTE: *Adjustment of the EDC is very sensitive. Be sure to hold the hex wrench steady while loosening the locknut. Total adjustment is less than 120 degrees.*

4. Rotate the neutral adjusting screw clockwise until the pressure increases on the gauge. Note the angular position of the wrench. Then rotate the neutral adjusting screw counterclockwise until the pressure increases by an equal amount on the other gauge. Again note the angular position of the wrench.

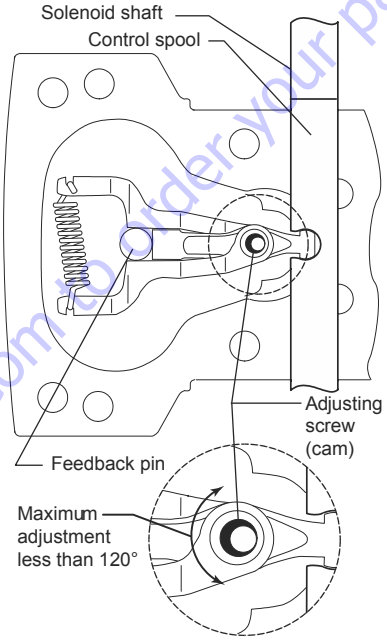


Illustration shows how eccentric cam on adjusting screw rotates to adjust neutral.

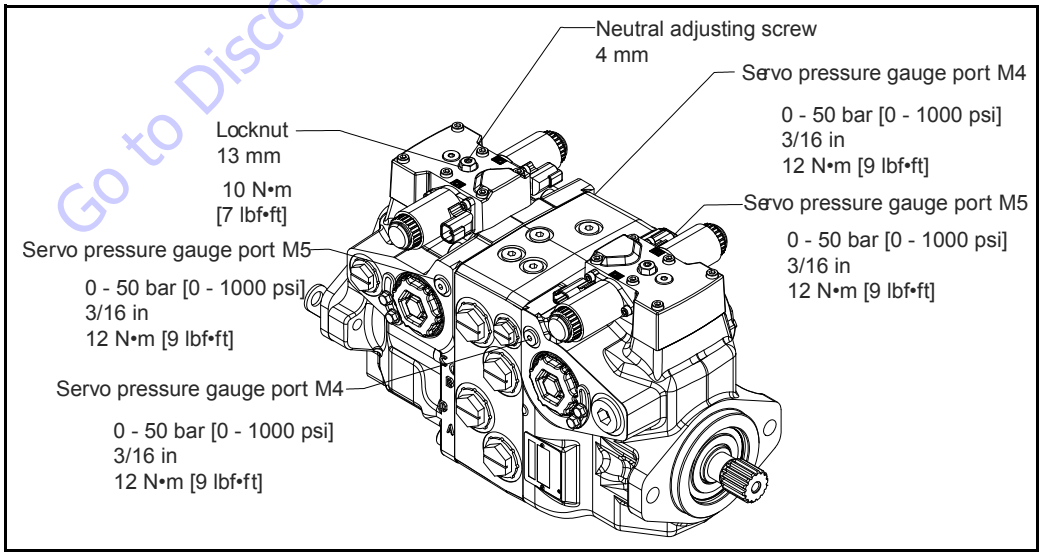


Figure 5-204. Control Neutral Adjustment

5. Rotate the neutral adjusting screw clockwise half the distance between the wrench positions noted above. The gauges should read the same pressure, indicating that the control is in its neutral position.

6. Hold the neutral adjusting screw stationary and tighten the lock nut. Torque to 10.Nm [7 lbft]. Do not over torque the nut.

7. When the neutral position is set, stop the prime mover, remove the gauges, and install the gauge port plugs. Reconnect the external control input.

NOTE: *A small pressure differential of 1.5 bar [22 psi] or less is acceptable. Zero differential is usually not possible.*

MECHANICAL NEUTRAL ADJUSTMENT

Mechanical neutral is set with the pump running at 1800 min (rpm). To set neutral, you must stroke the pump in each direction.

This procedure details setting neutral for the entire pump, one side at a time. The procedure is the same for each side of each pump so you will need to repeat it four times to set mechanical neutral for both the front and rear sections. Alternate M4/M5 and MA/MB to zero out forward and reverse directions of the front unit, then move the gauges to M4/M5 of the rear unit and MC/MD (system gauge ports for the rear unit). Refer to the drawing that follows to identify all ports. The front and rear sections are basically mirror images of each other. The control solenoids C1 and C2 are marked on each control.

While performing this adjustment, you monitor the following pressures.:

- Servo pressure at M4 and M5
- System pressure at MA and MB or MC and MD
- Pressure differential between M4 and M5 (optional)
- Pressure differential between A and B or C and D (optional)

PUMP SETUP

1. Attach a 50 bar [1000 psi] gauge to each servo pressure port M4 and M5.

2. Attach a 600 bar [10 000 psi] gauge to each system pressure port (MA and MB for front pump, MC and MD for rear pump).

3. Remove servo cylinder locking screws (E350) and plates (E300) from both sides of the pump.

4. Disconnect the control solenoids from the vehicle wiring harness.

5. If using a PWM signal to set mechanical neutral, connect the control solenoids C1 and C2 to the signal source. Ensure the source supplies no current to the solenoids until required in the following procedure.

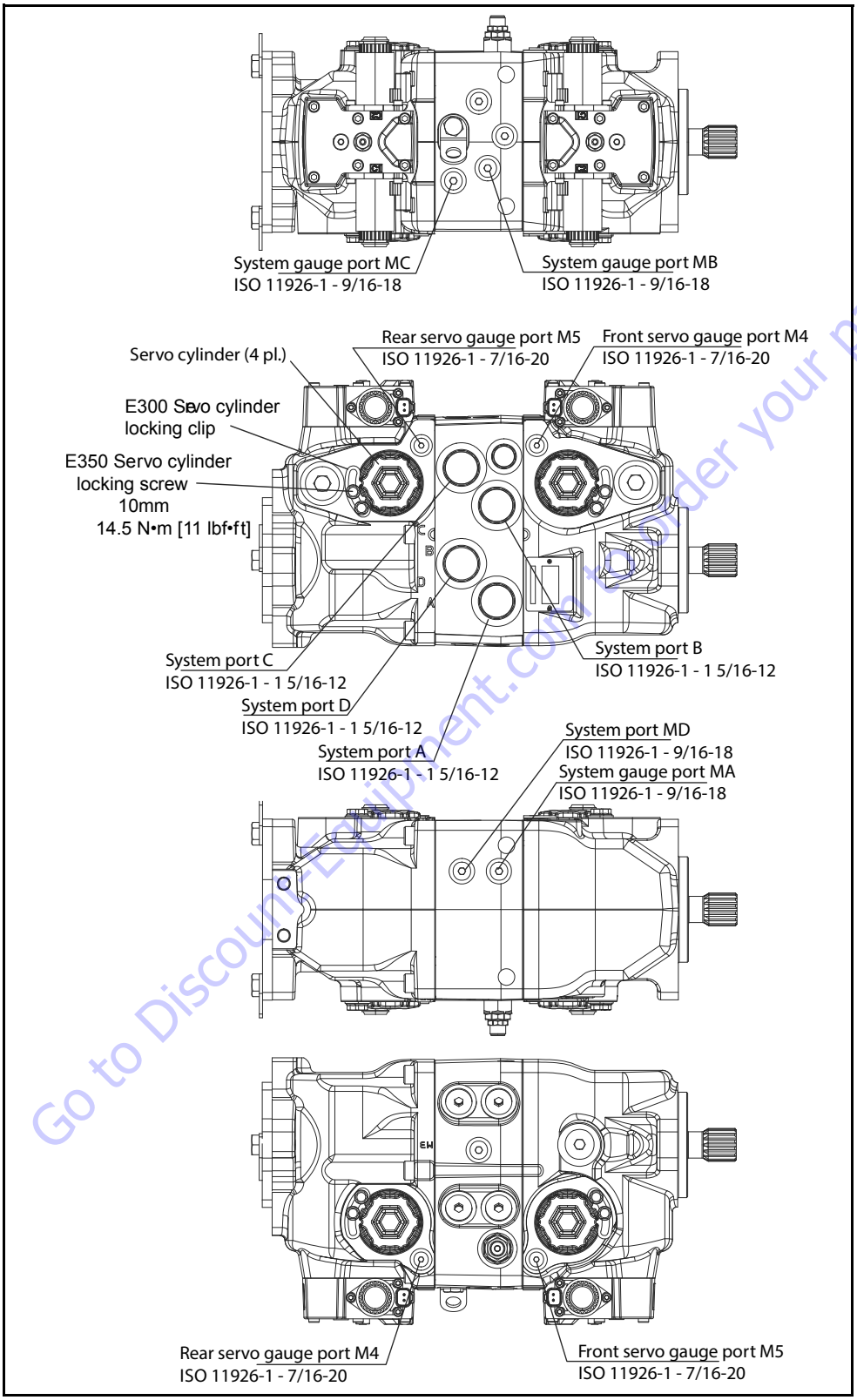


Figure 5-205. Servo and System Pressure Gauge Port Locations

SERVO ADJUSTMENT

6. Run prime mover at 1800 min (rpm).

7. If using a PWM signal, ensure the signal is off. Check the servo pressure gauges. Ensure the differential between M4 and M5 is less than 1.5 bar [22 psi].

8. Using a 3/4 in deep socket, unthread both servo cylinders 2-3 turns. This step ensures the servo cylinders have no contact with the servo piston.

9. Stroke the pump by turning the control eccentric screw (or supplying current to solenoid C1) until the servo pressure at port M4 is 1 to 2 bar [14 -29 psi] greater than at port M5 and the system pressure gauges indicate displacement. Pressure should be greater at port MA for clockwise rotation, or MB for counterclockwise rotation. This also indicates the servo piston is in contact with the servo cylinder on side M5.

10. Slowly thread the servo cylinder on the M5 side in until the system pressure differential starts to decrease. Maintain servo pressure differential between 1-2 bar [14-29 psi] during this step. Continue turning the servo cylinder in until the system pressure differential (between ports MA/MB or MC/MD) is less than 1.5 bar [22 psi]. This procedure sets the servo and swashplate to mechanical neutral on the M5 side.

11. To complete setting neutral, repeat steps 1-5 but stroke the pump in the opposite direction by turning the eccentric screw in the opposite direction, or by supplying current to solenoid C2. Reverse gauge locations (M4 for M5, MB for MA etc.) from those stated above since the pump is now stroking the other direction.

12. Set neutral for the rear pump by repeating steps 1-6 on the rear pump. Remember that the rear pump is a mirror image of the front pump and therefore the locations of the servo gauge ports (M4/M5) and the control solenoids (C1/C2) are opposite.

13. Remove all gauges and replace gauge port plugs.

Removing The Pump

Before working on the pump, thoroughly clean the outside. If the pump has an auxiliary pump attached, remove both pumps as a single unit. Tag and cap all hydraulic lines as you disconnect them, and plug all open ports to ensure that dirt and contamination do not get into the system.

⚠ CAUTION

CONTAMINATION CAN DAMAGE INTERNAL COMPONENTS. TAKE PRECAUTIONS TO ENSURE SYSTEM CLEANLINESS WHEN REMOVING AND INSTALLING SYSTEM LINES.

1. Thoroughly clean all dirt and grime from the outside of the pump.
2. Tag, disconnect, and cap each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

NOTE: *Be careful, do not damage solenoids and electrical connections when using straps or chains to support the pump.*

Inspection

1. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
2. Inspect the system for contamination.
3. Look at the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or metal particles.

Replacement

1. Before replacing the pump, replace all filters and drain the hydraulic system. Flush the system lines and fill the reservoir with the correct, filtered hydraulic fluid.
2. Fill the pump with clean, filtered hydraulic fluid.
3. Attach the pump to the prime mover. Torque mounting screws according to the manufacturers recommendation.
4. Replace all hydraulic lines. Ensure the charge inlet line is filled with fluid.

Electric Control Module

REMOVAL

Refer to exploded diagram, next page.

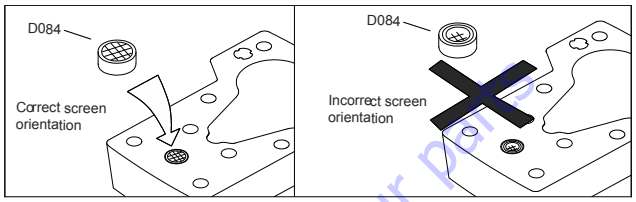
1. Using a 5 mm internal hex wrench, remove the six cap screws (D250).
2. Remove the control module and gasket (D150). Discard the gasket.
3. If necessary, remove orifices (F100) using a 3 mm internal hex wrench. Tag and number them for reinstallation.
4. Inspection
5. Inspect the machined surfaces on the control and top of the pump. If you find any nicks or scratches, replace the component.

NOTE: *Remove plug on top of control to ensure the swashplate feedback pin is properly positioned in the center of the control module when installing control.*

REASSEMBLY

NOTE: *Ensure you install dowel pins (D300) in housing before installing control.*

1. Install a new gasket (D150).
2. If you removed screen (D084), install a new one. Install with the mesh facing outward.



3. If previously removed, install orifices (F100) using a 3 mm internal hex wrench. Torque to 2.5 Nm [1.8 lbft].
4. Install the control module and six cap screws (D250).
5. Using a 5 mm internal hex wrench, torque the cap screws (D250) to 13.5 Nm [10.lbft].

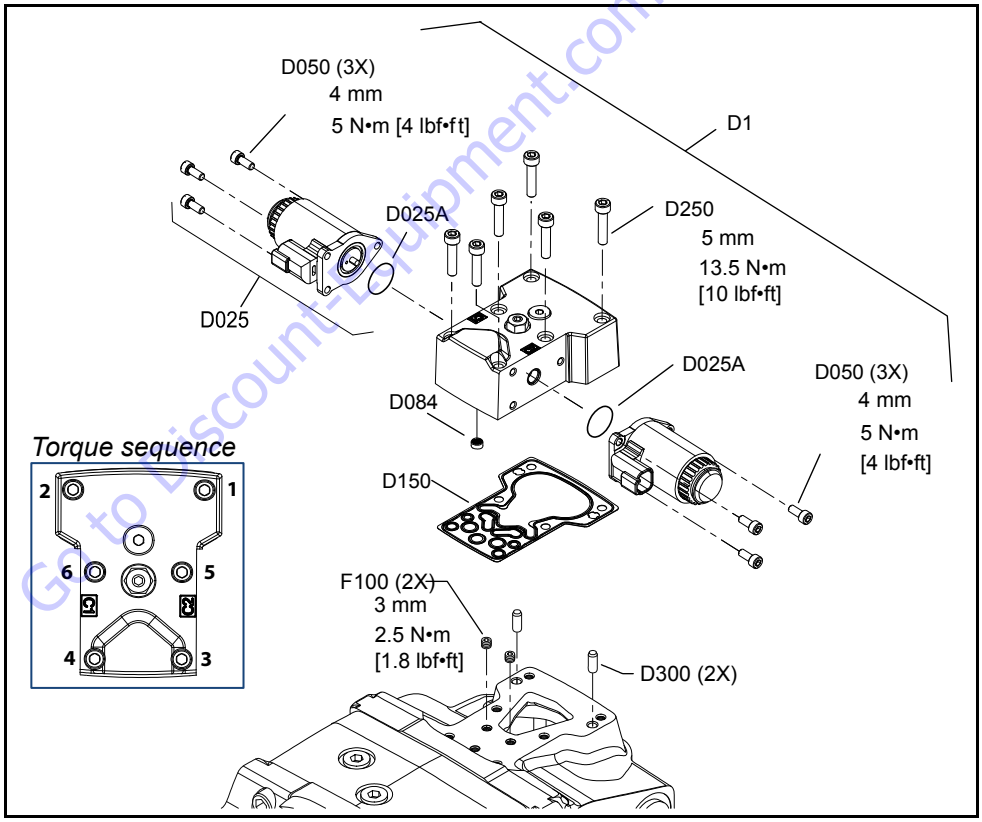


Figure 5-206. Control Module And Solenoid Removal/installation

CONTROL SOLENOIDS REMOVAL

1. Disconnect electrical connection and remove the three cap screws (D050) using a 4.mm internal hex wrench.
2. Remove the solenoid (D025) and O-ring (D025A). Discard the O-ring.
3. If necessary, remove the coil using a 12 point 26 mm socket.

CONTROL SOLENOIDS INSPECTION

1. Inspect the machined surface on the control. If you find any nicks or scratches, replace the component.

CONTROL SOLENOIDS REASSEMBLY

1. Lubricate new O-ring (D025A) using petroleum jelly and install.
2. Install solenoid with three cap screws (D050) using a 4 mm internal hex wrench. Torque screws to 5 Nm [4 lbft].
3. Install coil using a 12 point 26 mm socket. Torque coil nut to 5 Nm [3.7 lbft].
4. Reconnect electrical connections and test the pump for proper operation.

Shaft, Seal, and Bearing

The front pump input shaft assembly is serviceable without disassembling the pump, the rear shaft is not. Orient the pump on the work surface so the shaft is pointing to the side.

REMOVAL

1. Unwind the spiral ring (J300) from the housing to release the shaft/seal/bearing subassembly.
2. Pry on the lip of the seal carrier (J275) to remove it from the pump. Remove the seal carrier. Remove and discard O-ring (J260). Press the seal (J250) out of the carrier and discard.
3. Pull the shaft (J100) with bearing (J150) out of the pump. If necessary, tap lightly on the shaft to dislodge it from the cylinder block. C

⚠ CAUTION

DO NOT DAMAGE THE HOUSING BORE, SHAFT OR BEARING WHEN REMOVING THE SHAFT AND BEARING.

4. Remove the retaining ring (J200) using retaining ring pliers. Press the bearing off the shaft.

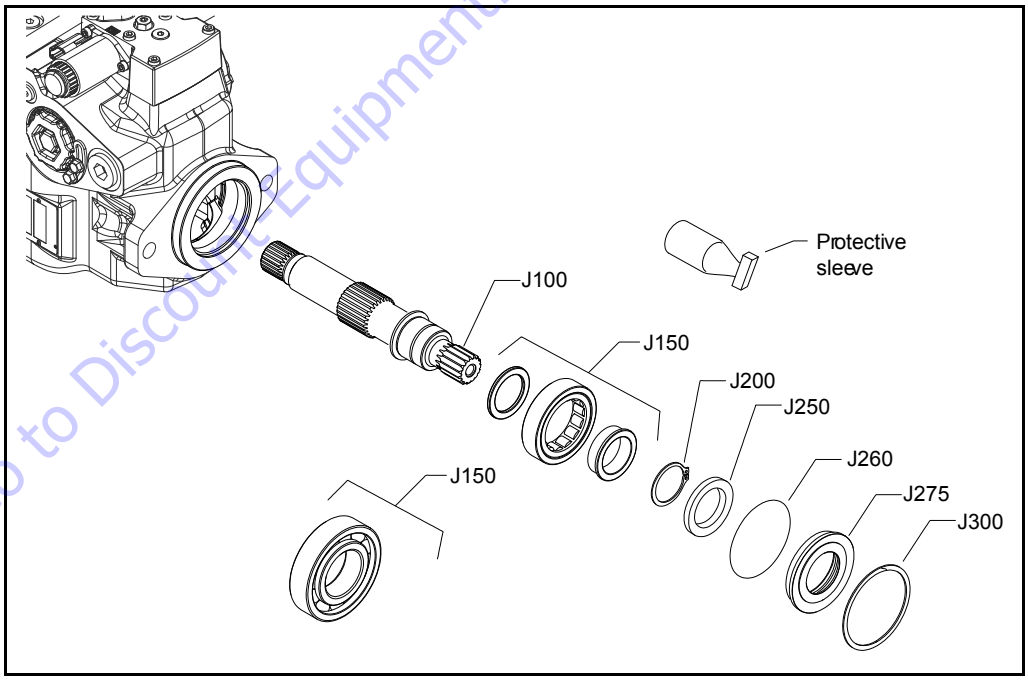


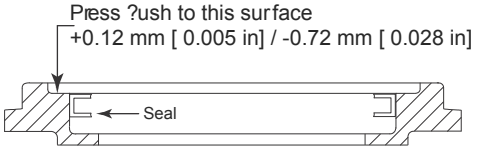
Figure 5-207. Shaft Assembly

INSPECTION

1. Inspect the shaft journals for wear, scratching, and pits. Check the splines for fretting; replace if damaged. Rotate the bearing, if it does not rotate smoothly, replace it.

REASSEMBLY

1. Press the bearing (J150) onto the shaft (J100) and replace the retaining ring (J200). Ensure the retaining ring diameter is less than 38.84 mm [1.53.in] when installed on the shaft.
2. Install the shaft/bearing assembly into the pump.
3. Lubricate and install a new O-ring (J260) onto seal carrier (J275). Press a new seal (J250) into the seal carrier. Press the seal until it is flush within +0.12mm [0.005 in] or -0.72 mm [0.0028 in] of the inside lip of the carrier: see illustration.



4. Cover the shaft with a protective sleeve while installing the seal carrier. Hand press the seal carrier into the housing. Ensure the seal carrier clears the spiral ring groove in the housing. Remove the protective sleeve.
5. Wind the spiral ring into the housing. Ensure the inside diameter of the spiral ring is greater than 68 mm [2.677 in] after installation.

Charge Pump

Position pump with front shaft pointing downward. Attach securely to a proper work stand. If an auxiliary pump is attached, remove auxiliary pump before servicing charge pump.

REMOVAL

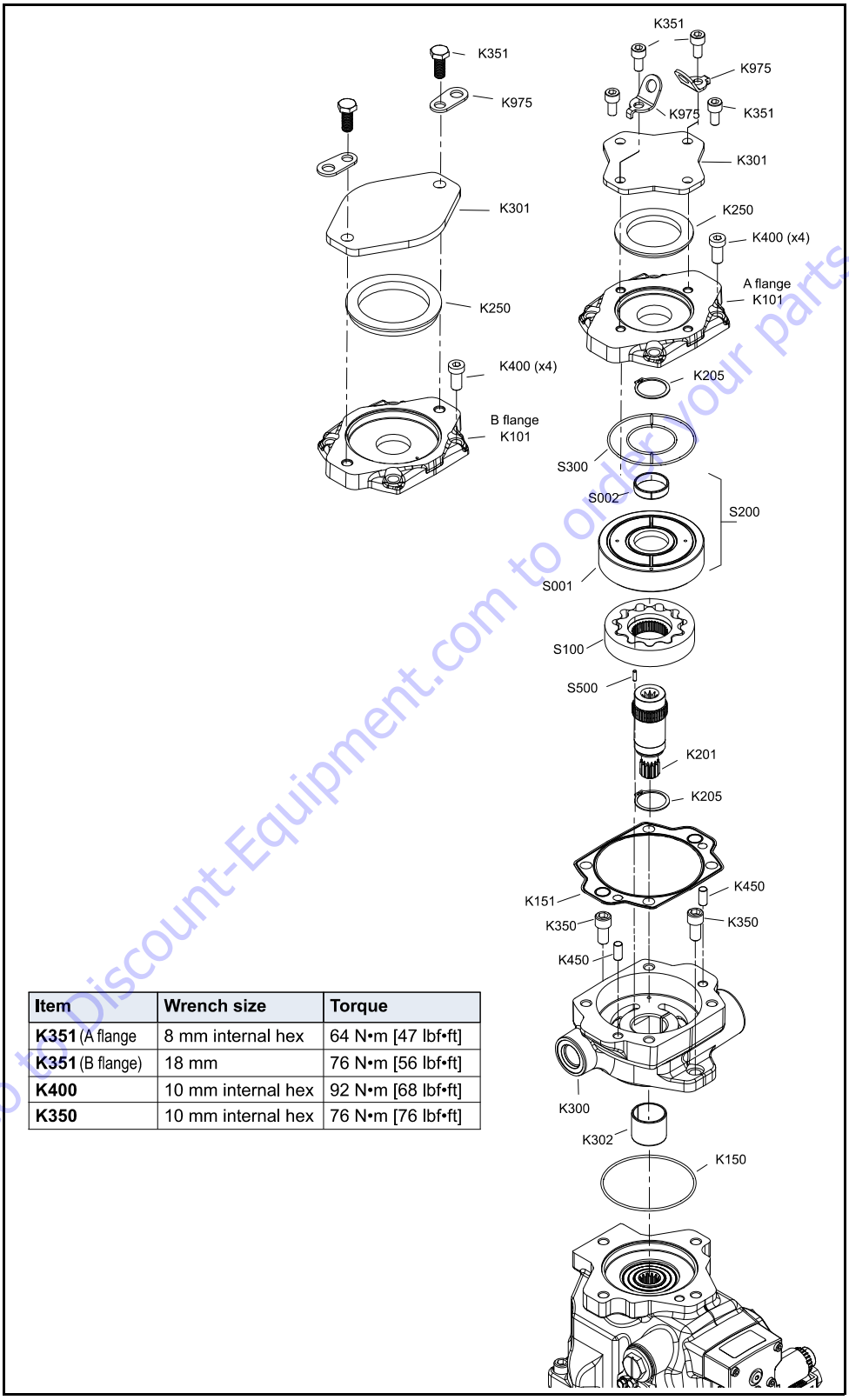
1. Remove screws (K351), and hangers (K975).
2. Remove running cover (K301). Remove and discard seal ring (K250).
3. Using a 10 mm internal hex, remove screws (K400). Remove cover (K101).
4. Remove charge pump assembly with shaft.

NOTE: *Note position of alignment pin (S500) in housing. Alignment pin position will change for clockwise or counter-clockwise rotation.*

5. Remove and discard seal (S300).
6. Using a snap ring pliers, remove two clips (K205).
7. Remove geroter cover (S200). Remove geroter assembly (S100).
8. Remove and discard gasket (K151). Remove alignment pins (K450).
9. If it is necessary to remove housing (K300), use a 10 mm internal hex to remove screws (K350).
10. Remove housing (K300).
11. Remove and discard seal (K150).

INSPECTION

1. Inspect all machined surfaces. If you find any nicks or scratches, replace the component.
2. Inspect geroter and cover for wear or damage. If wear or damage is found, replace geroter kit.
3. Inspect shaft for wear or damage. If found, replace shaft.
4. Inspect journal bearings in aux pad and housing. If worn or damaged, replace journal bearings or aux pad or housing assembly.

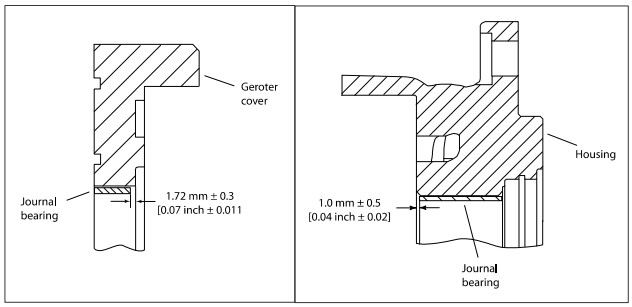


Item	Wrench size	Torque
K351 (A flange	8 mm internal hex	64 N•m [47 lbf•ft]
K351 (B flange)	18 mm	76 N•m [56 lbf•ft]
K400	10 mm internal hex	92 N•m [68 lbf•ft]
K350	10 mm internal hex	76 N•m [76 lbf•ft]

Figure 5-208. Charge Pump

REPLACING CHARGE PUMP JOURNAL BEARINGS

Use a suitable press to remove and replace the journal bearings. Refer to the drawings below for installation dimensions.



ASSEMBLY

1. Lubricate and install new seal (K150).
2. Install housing (K300). Install screws (K350). Using a 10 mm internal hex, torque screws per listing in table.
3. Install alignment pins (K450). Install new gasket (K151).
4. Lubricate and reassemble charge pump assembly [shaft (K201), pin (S500), geroter (S100), cover (S200), two clips (K205)].
5. Install charge pump assembly into housing in original position.
6. Lubricate and install seal (S300).
7. Install aux pad (K101).
8. Using a 10 mm internal hex, install screws (K400). Torque screws per listing in table.
9. Lubricate and install seal (K250). Install running cover (K301).
10. Install screws (K351) and brackets (K975). Torque screws per listing in the table.

Charge Check / HPRV

The high pressure relief and charge check valve assembly may be removed for cleaning and replacement of the O-rings. These valves are factory set and are not field adjustable. Refer to the pump model code for the factory setting when ordering replacements.

REMOVAL

1. Using an 8 mm internal hex wrench, remove the valve seat plugs (K007).
2. Carefully lift the valve (H002) and spring (H003) assemblies from the center section using a magnet.

INSPECTION

1. Inspect the valves and mating seats in the valve seat plugs (K007) for damage or foreign material.

REASSEMBLY

1. Lubricate and install new O-rings (K008, K010) and backup ring (K009) on valve seat plug (K007).
2. Verify that the conical springs (H003) are properly retained on the check relief valves (H002). Install the valve assemblies into the center section. Ensure each valve assembly moves freely in its bore.
3. Install the valve seat plugs into the center section and torque to 80 Nm [59.lbft].
4. Operate machine through full range of controls to ensure proper operation. Check for leaks.

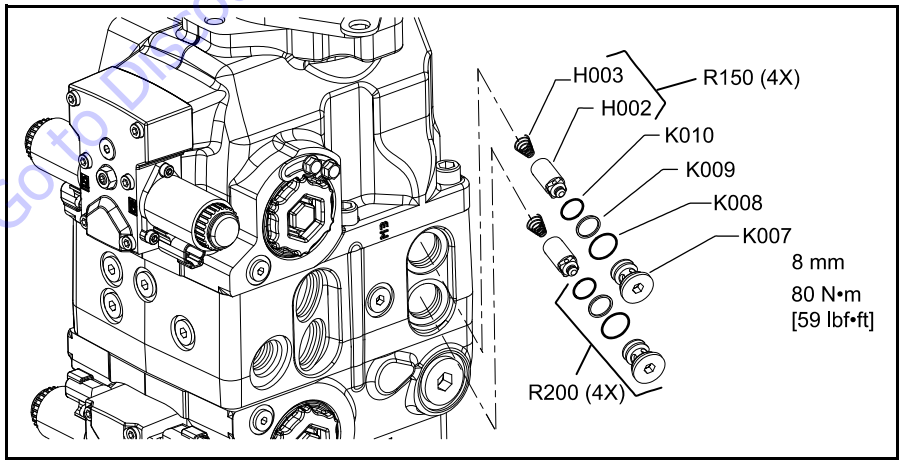


Figure 5-209. Charge Check / HPRV

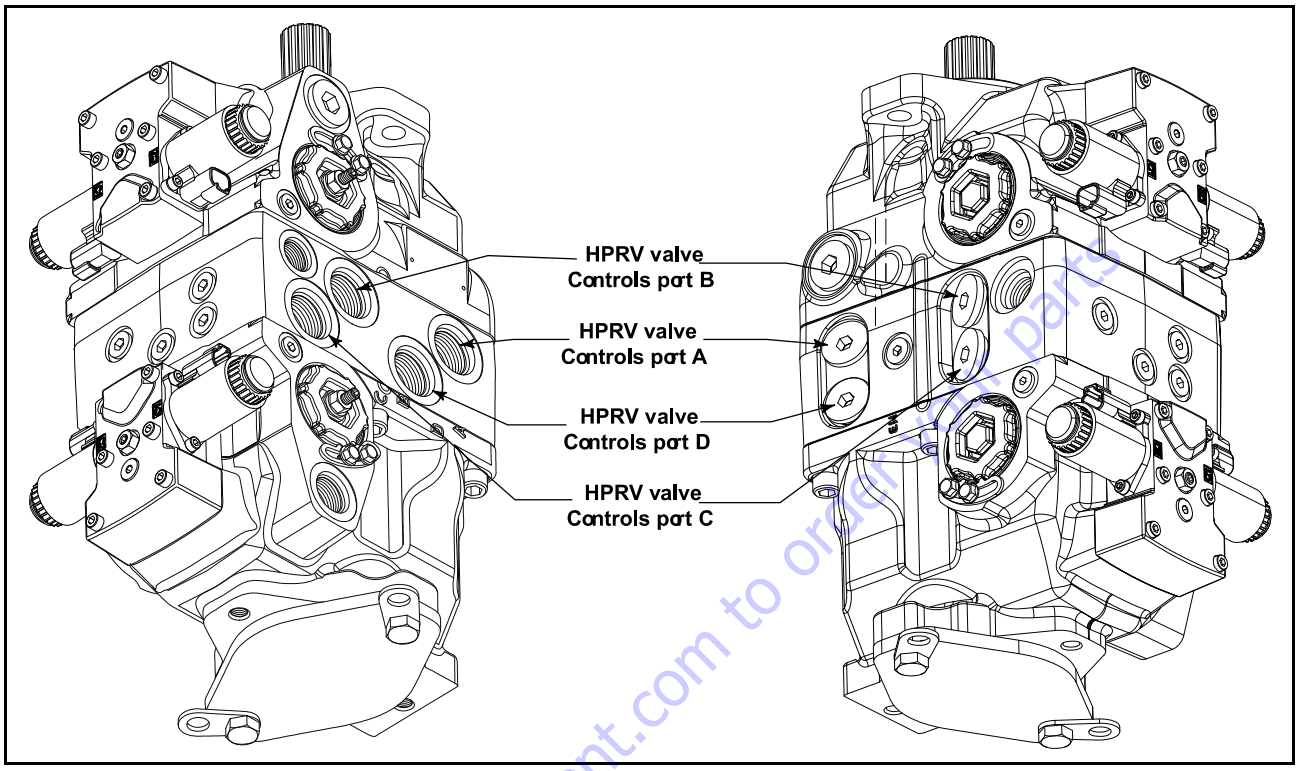


Figure 5-210. Charge Check / HPRV

Charge Pressure Relief Valve

Replace the charge pressure relief valve (V10-1) or (V10-2) as a complete unit. Do not attempt to repair the internal components of the valve.

REMOVAL

1. Using a 27 mm (V10-1) or a 1 in (V10-2) wrench, remove the charge pressure relief valve. Discard the O-rings (V10A).

INSPECTION

1. Inspect the sealing surfaces of the pump and charge pressure relief valve for nicks or scratches, replace components as necessary.

REASSEMBLY

1. Lubricate and install new O-rings (V10A).
2. Install the charge pressure relief valve (V10). Torque to 52 Nm [38 lbft].
3. Operate vehicle/machine through full range of controls to ensure proper operation.

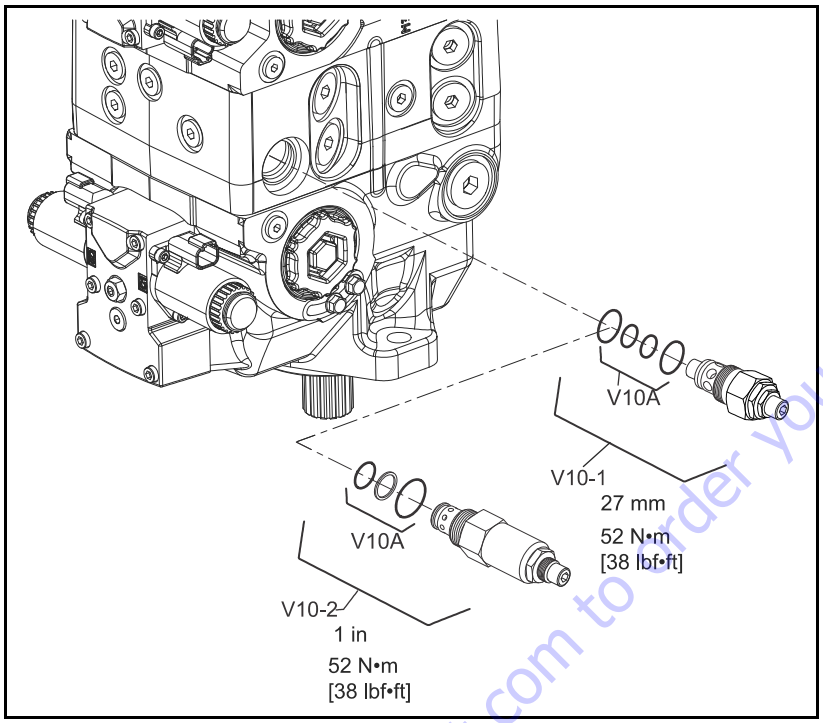


Figure 5-211. Charge Pressure Relief Valve

Control Cutoff Valve

Replace the control cutoff valve as a complete unit. Do not attempt to repair the internal components of the valve.

REMOVAL

1. Disconnect the coil from the vehicle/machine wire harness.
2. Using a 24 mm hex wrench, remove the control cutoff valve coil nut (G30). Remove the coil (G20).
3. Use a 1 1/16 in hex wrench to remove the control cutoff valve (G10). Remove and discard the O-rings and backup rings (G10A).

INSPECTION

1. Inspect the sealing surfaces of the pump and control cutoff valve for nicks or scratches. Replace components as necessary.

REASSEMBLY

1. Lubricate and install new O-rings (G10A) onto the valve.
2. Install the control cutoff valve (G10). Torque to 46 Nm [34 lbft]. Slide the coil (G20) onto the valve.
3. Install the coil nut (G30). Torque to 9 Nm [7.lbft]. Do not overtorque.
4. Operate vehicle/machine through full range of controls to ensure proper operation

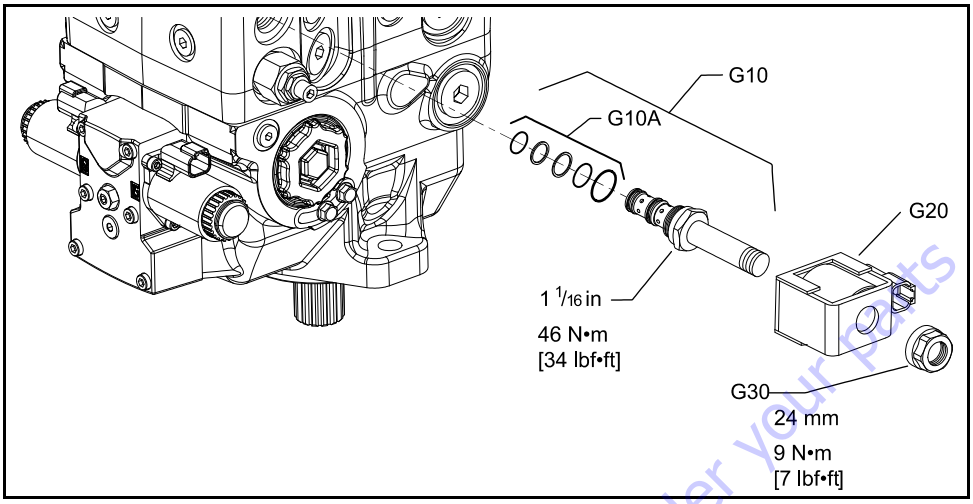


Figure 5-212. Control Cutoff Valve

Table 5-48. Fastener Size and Torque Chart

Item	Fastener	Wrench size	Torque
D015	Neutral adjust screw	4 mm internal hex	NA
D050	Control coil mounting screw	4 mm internal hex	8 Nm [5.9 lbft]
D060	Neutral adjust locking nut	13 mm hex	10 Nm [7 lbft]
D200	Swash plate feedback pin (not shown)	13 mm hex	25 Nm [18.4 lbft]
D250	Electric control mounting screw	5 mm internal hex	13 Nm [9.5 lbft]
E350	Servo cylinder locking screw	10 mm hex	14.5 Nm [11 lbft]
G10	Control cutoff valve	1 1/16 in hex	45 Nm [33 lbft]
G10B	Control cutoff valve coil nut	24 mm hex	9 Nm [7 lbft]
K007	Charge check / HPRV	8 mm internal hex	80 Nm [60 lbft]
K350	A pad cover mounting screw	17 mm hex	70 Nm [52 lbft]
	B pad cover mounting screw	8 mm hex	111 Nm [82 lbft]
V10-1	Charge relief valve	27 mm hex	52 Nm [38 lbft]
V10-2	Charge relief valve	1 in hex	52 Nm [38 lbft]

Table 5-49. Plug Size and Torque Chart

Item	O-ring plug	Wrench size	Torque
B015	7/16 - 20	3/16 internal hex	20 Nm [15 lbft]
B020	1-1/16 - 12	9/16 internal hex	48 Nm [35 lbft]
D065	7/16 - 20	3/16 internal hex	12 Nm [9 lbft]
G250	9/16 - 18	1/4 internal hex (hardened plug)	45 Nm [33 lbft]

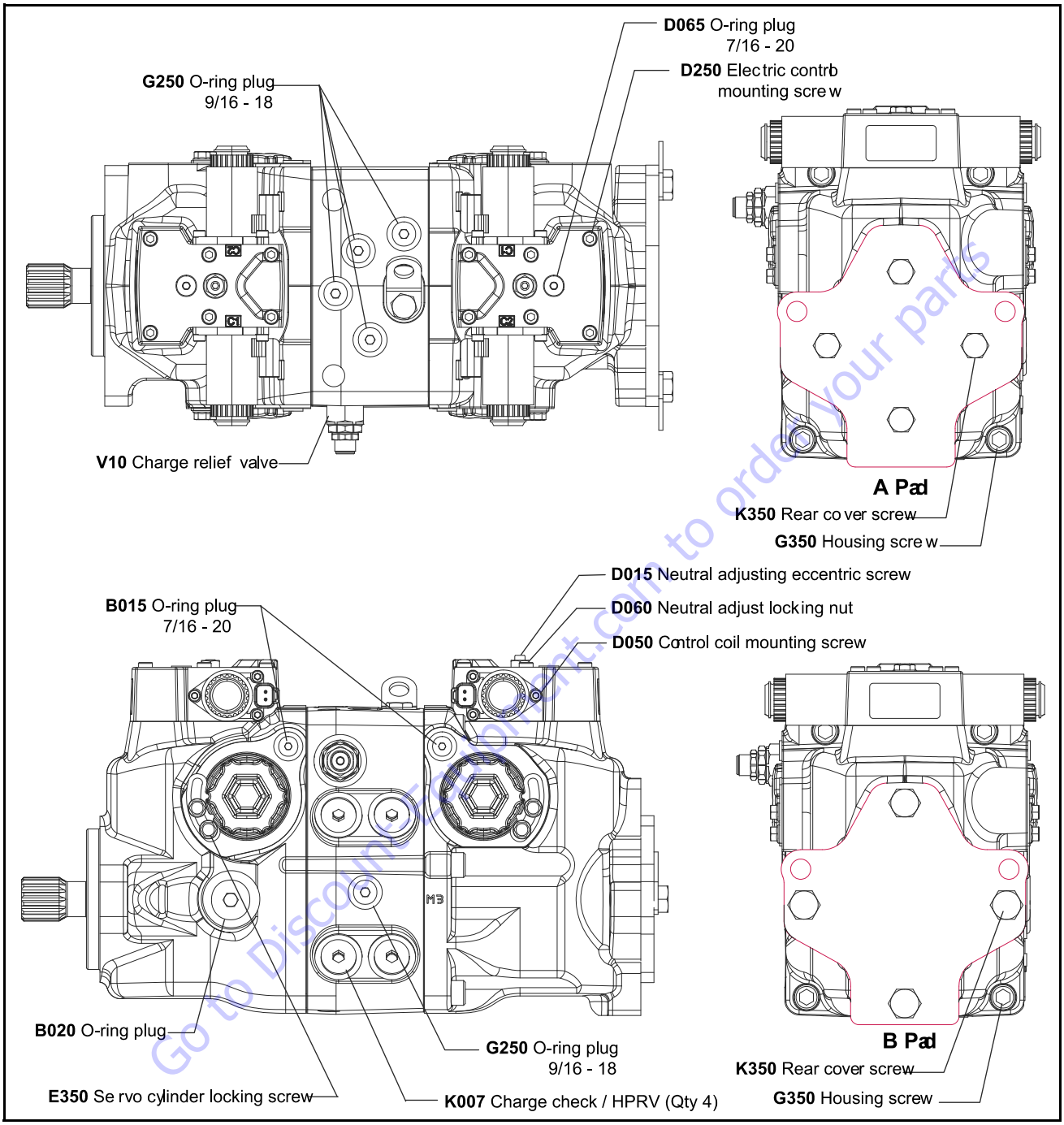
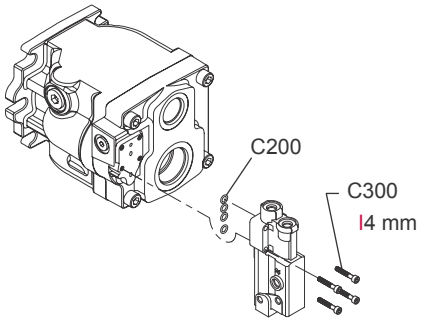


Figure 5-213. Fastener and Plug Locations

5.10 FUNCTION PUMP (SAUER)

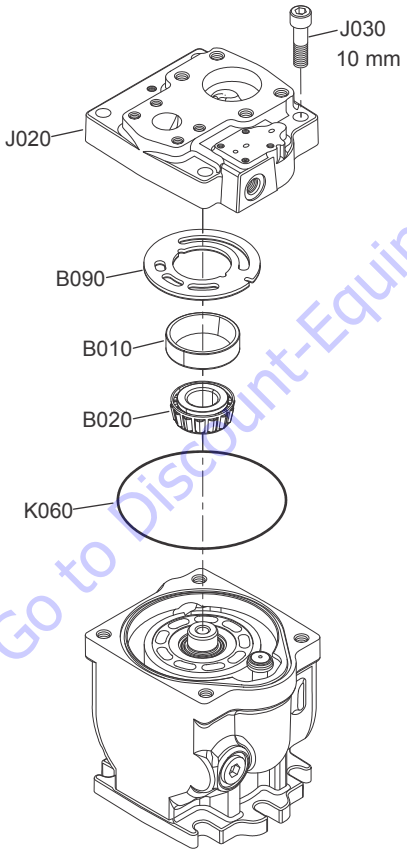
Disassembly

1. Remove the control from the endcap by removing the 4 control bolts (C300), using a 4 mm internal hex wrench.



2. Remove and discard the 4 O-rings (C200).

3. Remove the 4 endcap screws (J030) using a 10 mm internal hex wrench.



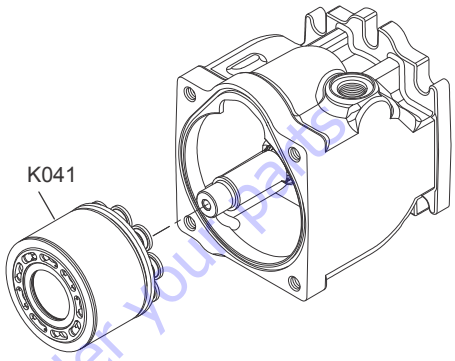
4. Carefully remove the endcap (J020). Prevent the valve (B090) plate from falling off.

5. Place the endcap and valve plate in a clean area, protecting them from contamination.

6. Remove the bearing cup (B010), bearing cone (B020) and housing O-ring (K060). Discard the O-ring.

7. Tilt the housing on its side to allow fluid to drain.

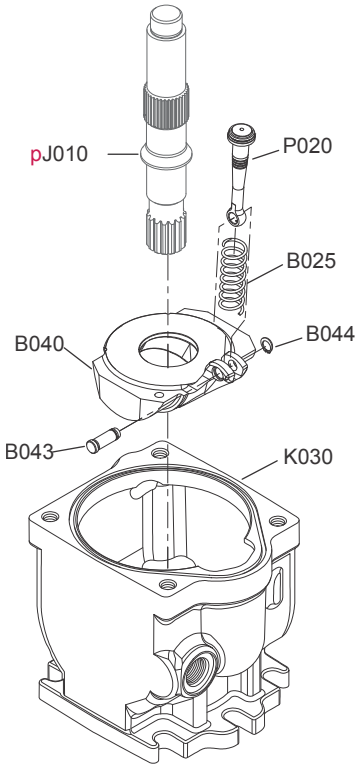
8. Remove the cylinder block kit while holding onto the front shaft.



9. Set cylinder block on a clean dry surface.

10. Rotate pump back to a position so that the shaft is pointing down.

11. Pull the shaft (J010) from the shaft seal.

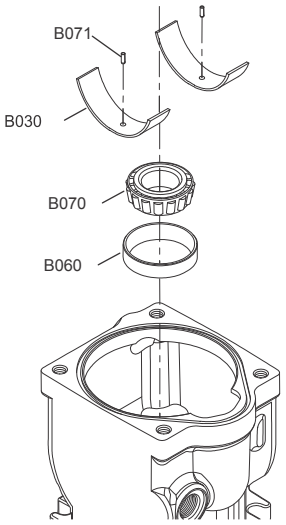


12. Compress the bias spring (B025) and rotate the servo piston assembly (P020) towards the swashplate (B040).

13. Lift the swashplate/servo piston assembly up at an angle and remove it from the housing.

14. Remove the servo piston (P020) and bias spring (B025) from the swashplate by removing the clevis pin (B043) and snap ring (B044). Discard the snap ring.

15. Pull to remove the front tapered roller bearing cup (B060) and cone (B070).



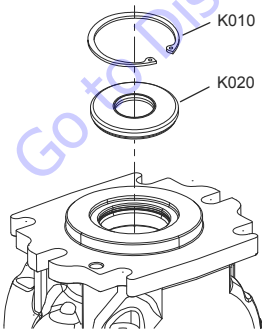
16. Examine the cradle bearings (B030) to determine if they need replacement.

NOTE: *Removing the pins (B071) will likely damage the cradle bearings, so make sure you have replacement bearings before you remove them.*

17. If cradle bearings need replacing, remove the 2 pins (B071) holding the cradle bearings, and then remove the cradle bearings. Note the location and orientation of the bearings for re-installation.

18. Orient the housing with the flange facing up.

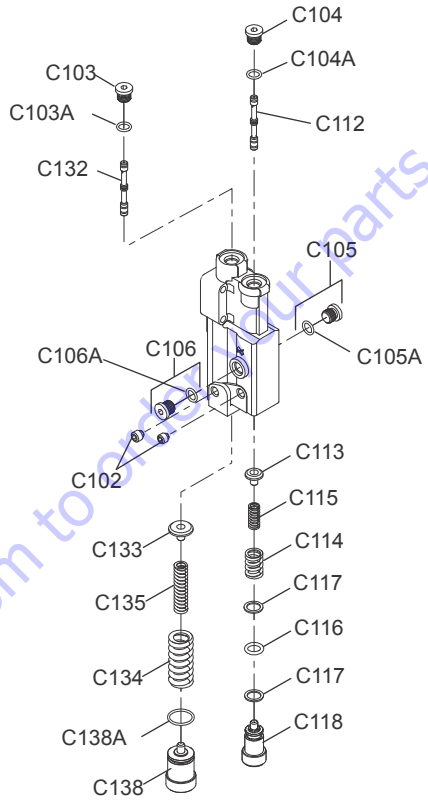
19. Using snap-ring pliers, remove the snap ring (K010).



20. Carefully pry out the shaft seal (K020).

If you are unable to pull the shaft seal out, try to push the seal out by going through the inside of the housing.

21. Remove the 4 plugs (C103, C104, C105, C106) and their O-rings (C103A, C104A, C105A, C106A). Discard the O-rings. Remove the 2 set screws (C102). Remove the spools (C112, C132). Note which bore each spool came out of. Also note the orientation of each spool for reinsertion. There may be differences in reinserting into the same bore.

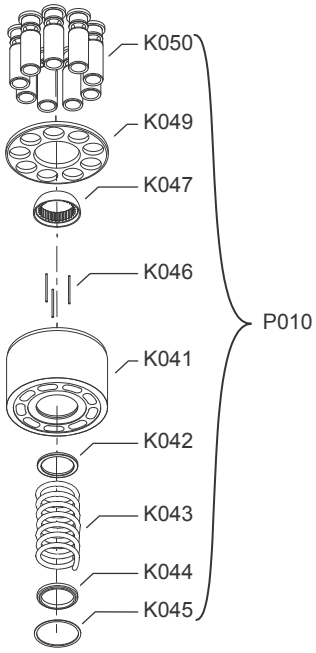


22. Remove the adjusting screw (C138) and the O-ring (C138A). Discard the O-ring. Remove the springs (C134, C135) and spring guide (C133).

23. Remove the adjusting screw (C118), O-ring (C116) and 2 backup rings (C117). Discard the O-ring and backup rings. Remove the springs (C114, C115) and spring guide (C113).

24. Pull to remove the slipper retainer (K049) with the pistons (K050) from the cylinder kit.

NOTE: *The pistons are not selectively fitted, however units with high hourly usage may develop wear patterns. Number the pistons and bores for reassembly if they are to be reused.*



25. Remove the ball guide (K047).

26. Remove the 3 pins (K046).

NOTE: *Most repairs do not require block spring removal. Perform this procedure only if you suspect problems with the block spring.*

27. Turn the block over. Using a press, apply pressure on the block spring washer (K044) to compress the block spring (K043). Compress the spring enough to safely remove the spiral retaining ring (K045). While maintaining pressure, unwind the spiral retaining ring. Carefully release the pressure and remove the outer block spring washer, block spring, and inner block spring washer (K042) from the cylinder block.

⚠ WARNING

RISK OF PERSONAL INJURY: COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90.LBF]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO REMOVE. THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING.RING IS REMOVED.

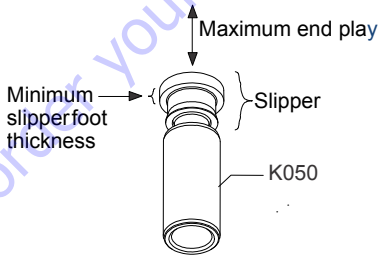
Inspection

After disassembly, wash all parts (including the end-cap and housing) thoroughly with clean solvent and allow to air dry. Blow out oil passages in the housing and endcap with compressed air. Conduct inspection in a clean area and keep all parts free from contamination. Clean and dry parts again after any rework or resurfacing.

PISTONS AND SLIPPERS

Inspect the pistons for damage and discoloration. Discolored pistons may indicate excessive heat; do not reuse.

Inspect the running surface of the slippers. Replace any piston assemblies with scored or excessively rounded slipper edges. Measure the slipper foot thickness. Replace any piston assemblies with excessively worn slippers. Check the slipper axial end-play. Replace any piston assemblies with excessive end-play.

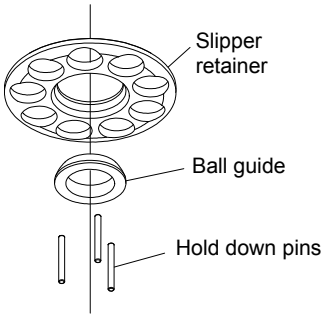


Minimum slipper foot thickness and maximum axial end-play are given in the table below.

J Frame	
Slipper foot thickness	3.23 mm [0.127 in]
Piston/slipper end play	0.05 mm [0.002 in]

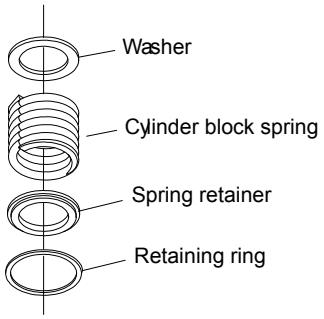
BALL GUIDE, SLIPPER RETAINER, AND HOLD-DOWN PINS

The ball guide should be free of nicks and scratches, and should not be excessively scored. Examine for discoloration that may indicate excessive heat or lack of lubrication. The slipper retainer should be flat, and slippers should fit in the retainer with minimal side play. Place the hold-down pins on a flat surface and roll them to make sure they are straight. Discard and replace any damaged parts.



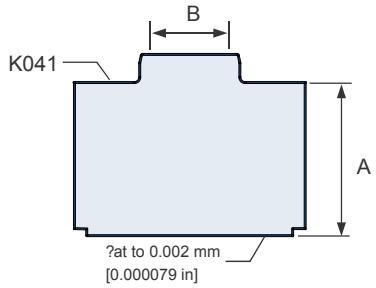
BLOCK SPRING, AND WASHERS

If cylinder kit was fully dissembled, visual inspection of the cylinder block, spring, and washers should indicate minimal wear. Replace if cracks or other damage is present.



CYLINDER BLOCK

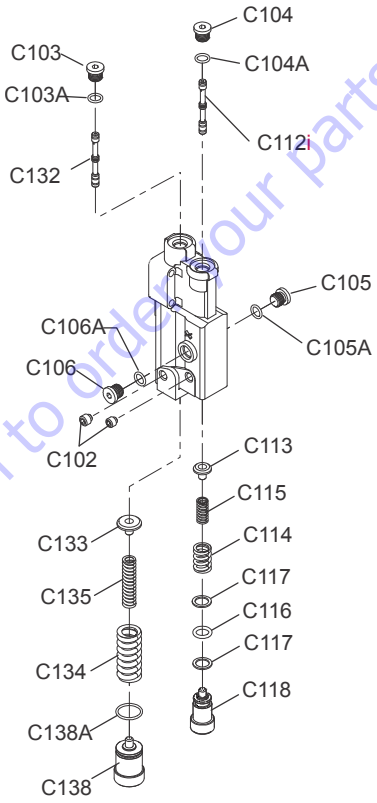
Examine the running face of the cylinder block. The surface should be smooth and free of nicks and burrs. Ensure that no scratches or grooves exist; these may drastically reduce output flow.



J Frame	45-60 cc	65-75 cc
Minimum cylinder block height (A)	62.25 mm [2.45 in]	
Maximum block bore diameter (B)	19.8 mm [0.785 in]	21.57 mm [0.85 in]

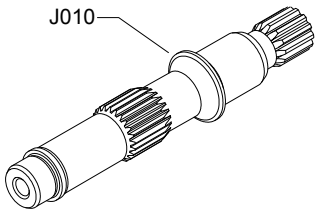
CONTROL

Carefully examine the plug(s) for signs of wear. Also check the small tip of the plug(s) for heavy wear and replace if necessary. Inspect each spool's springs to make sure they are intact. Check the inside and outside surfaces of the springs for wear and replace if necessary. Check the spool's outside diameter for scratches and / or burrs. Clean and coat all spools, bores, and seals with a light coating of hydraulic oil.



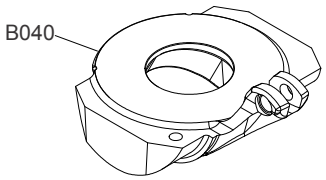
INPUT SHAFT

Check to see that the shaft (J010) and its splines are straight and free of damage or heavy wear. Inspect the shaft surface where it meets the shaft seal. Replace the shaft if a groove exists at the sealing land surface that may let dirt into or hydraulic fluid out of the unit. Clean the sealing area with a nonabrasive material if necessary. Lubricate the shaft with a light coat of hydraulic fluid.



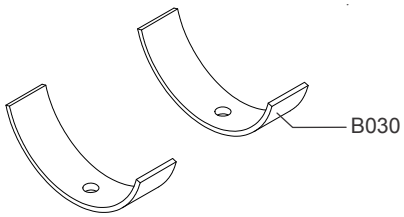
SWASHPLATE

Carefully inspect each surface of the swashplate for wear. All swashplate surfaces should be smooth. Inspect the swashplate's slipper running surface for damage and brass transfer. Excessive brass transfer from slippers may indicate that the slippers should be replaced. Finally, check the swashplate bearing journal for scratches. Replace swashplate if necessary.



JOURNAL BEARINGS

Inspect the journal bearings for damage or excessive wear. Replace journal bearings if scratched, warped, or excessively worn. The polymer wear layer must be smooth and intact.

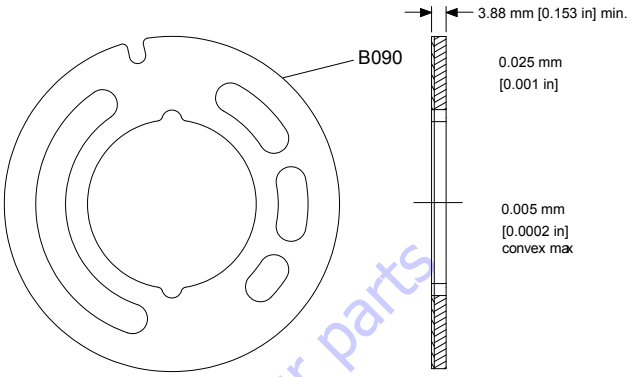


VALVE PLATE

Inspect the valve plate for scratches and grooves. Check the plate for evidence of any cavitation along the running face of the valve plate. If pitting from cavitation exists, replace the valve plate. Check for excess wear on the brass running face. If any discoloration or burn marks are observed, replace the valve plate.

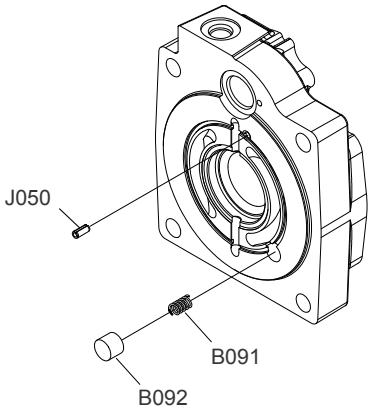
Run a fingernail or pencil tip across the diameter of the sealing land surface (see illustration). No deep or outstanding grooves should be felt, as these may decrease pump flow. Lap or replace if grooves or nicks are present. Inspect the mating surfaces of the endcap and valve plate for any possible contamination; even a few thousandths of an inch may affect pump operation.

Measure the thickness of the valve plate. Ensure that valve plate parallelism is equal to or less than 0.025 mm [0.001 in]. Appearance should be flat and smooth on both the running face and the bottom surface. The valve plate should be flat to 0.005 mm [0.0002.in] convex. A magnetic particle inspection is recommended to detect cracks. The valve plate must be replaced if any cracks exist.



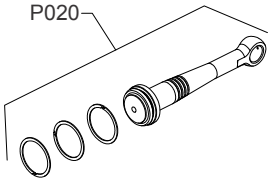
ENDCAP

Inspect the endcap. Remove the check valve (B092) to expose the spring (B091). Check and record orientation of the timing pin (J050) The split in the timing pin should be facing into or out of the slot in the valve plate. Inspect the check valve for wear on its sealing face and replace if necessary. Make sure the spring is undamaged. Replace any components if excess wear is present.



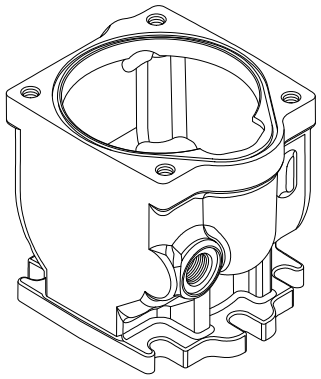
SERVO PISTON

Check the servo piston assembly (P020) for any obvious wear or damage. Check the corresponding endcap bore for galling or excessive wear. Discard the piston if damaged. Replace the servo piston-rings.



HOUSING

Inspect the housing to ensure that it is clean and free of foreign material. Inspect the swashplate bearing surfaces, and endcap mating surfaces.

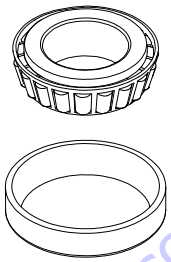


SHAFT BEARING KITS

The tapered roller bearing kit consists of a cup and cone. Make sure the cup and cone are free of excessive wear or contamination. Rotate the bearings to check for smoothness. If a contaminated bearing is suspected, clean with a solvent and lubricate with hydraulic fluid.

NOTE: *Replace the bearing if the problem is not remedied by cleaning.*

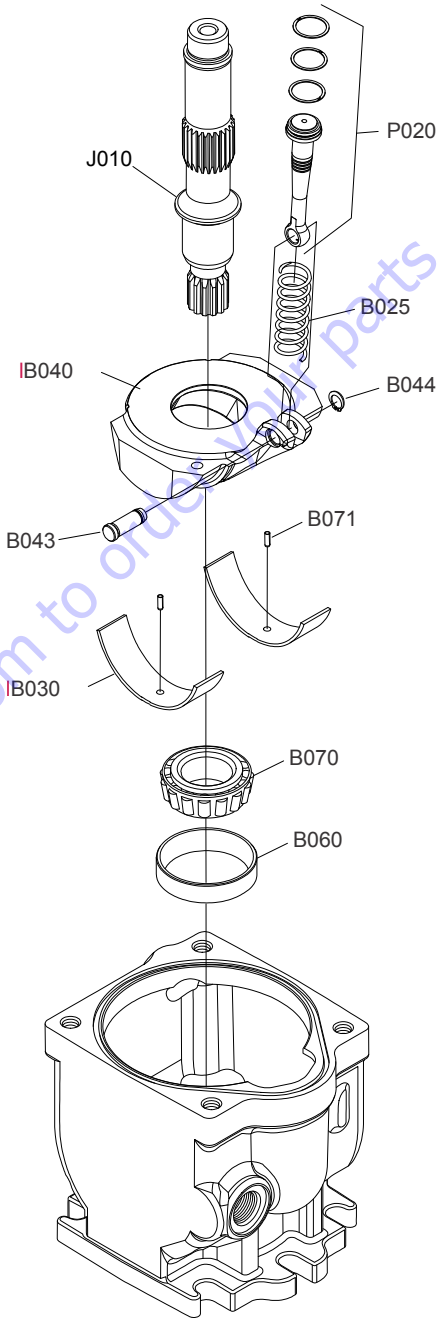
Inspect for uneven wear. If abnormal wear is found, replace the bearing kit.



Assembly

1. Coat the journal bearings (B030) with hydraulic fluid and install them into the pump housing. Punch in retaining pins (B071) a minimum of 0.5 mm [0.002 in] below the bearing surface.

NOTE: *If journal bearings are reused, reinstall them in their original orientation and position.*



2. Reinstall shaft bearing cup (B060) and cone (B070). Before replacing the bias spring (B025), coat the curved surface of the swashplate with hydraulic fluid.

3. Reinstall the swashplate/servo piston/bias spring assembly in its original orientation in the housing. Rotate the servo piston perpendicular to the swashplate, and at the same time compress the bias spring to fit into housing pocket. Lubricate all sides of the servo piston and its respective bore liberally with hydraulic oil. Also, lubricate the flat face of the swashplate to prevent premature wear during start-up.

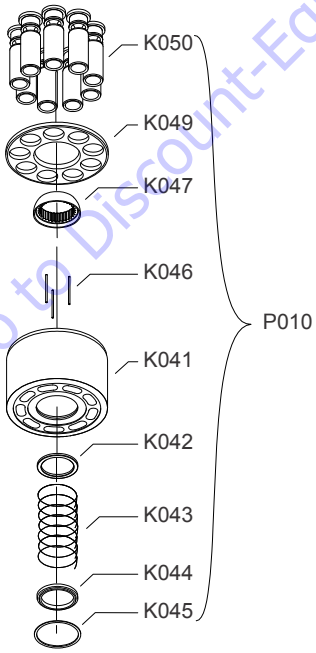
4. Insert the input shaft (J010) through the bearing into the housing. You may need to push on the servo piston to rotate the swashplate in order to put the shaft in properly.

5. Coat all parts with hydraulic fluid prior to reassembly.

⚠ WARNING

COMPRESSING THE BLOCK SPRING REQUIRES ABOUT 350 TO 400 N [80 TO 90 LBF]. USE A PRESS SUFFICIENT TO MAINTAIN THIS FORCE WITH REASONABLE EFFORT. ENSURE THE SPRING IS SECURE BEFORE ATTEMPTING TO INSTALL.THE SPIRAL RETAINING RING. RELEASE THE PRESSURE SLOWLY AFTER THE RETAINING RING IS INSTALLED.

6. Install the inner block spring washer (K042), block spring (K043), and outer washer (K044) into the cylinder block. Using a press, compress the block spring enough to expose the retaining ring groove. Wind the spiral retaining ring (K045) into the groove in the cylinder block.

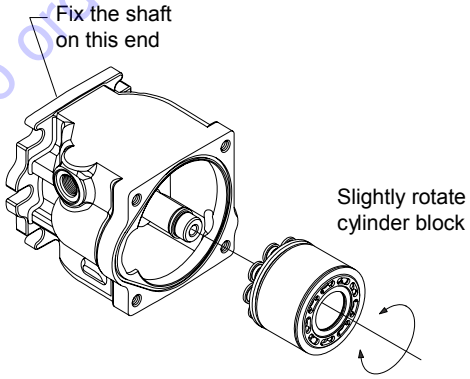


7. Turn the block over and install the hold-down pins (K046), and ball guide (K047) to the cylinder block.

8. Install the pistons (K050) to the slipper retainer (K049). Install the piston/retainer assembly into the cylinder block. Ensure the concave surface of the retainer seats on the ball guide. If you're reusing the pistons, install them to the original block bores. Lubricate the pistons, slippers, retainer, and ball guide before assembly. Set the cylinder kit aside on a clean surface until needed.

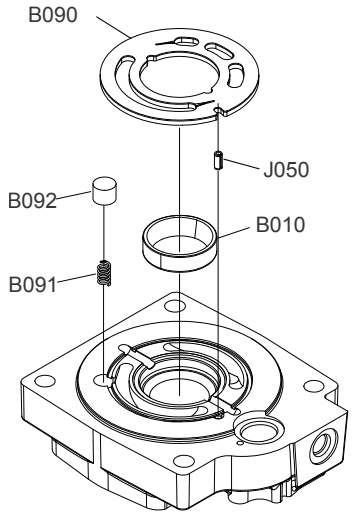
NOTE: *Be sure to install the slipper retainer so it mates correctly with the ball guide (concave side of the slipper retainer against the convex side of the ball guide).*

9. Set the pump on its side. Secure the end of the shaft with one hand and keep it horizontal. Insert the cylinder kit onto the shaft. While holding the shaft still, slightly rotate the cylinder block kit to help start the shaft splines over the ball guide and align it with the block splines. When the cylinder block kit slides completely over the shaft splines, reposition the unit with the flange facing downward.



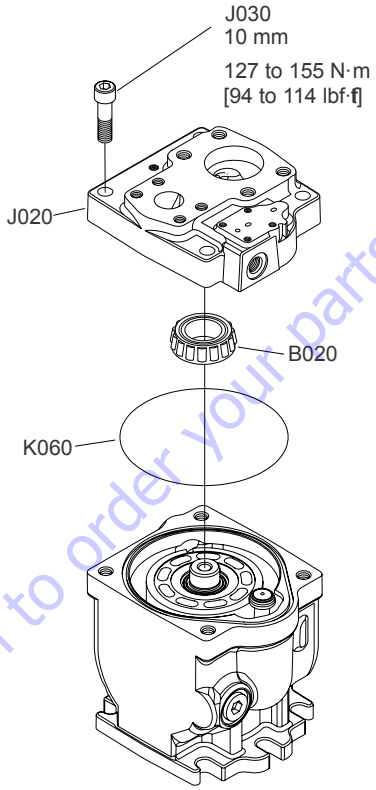
10. Clean the valve plate (B090) and endcap. Install the timing pin (J050) in the endcap and verify that it is properly oriented with the split facing into or out of the slot in the valve plate. The timing pin should be installed to 3.61 ? 0.25.mm [0.14.?.0.01 in] above the valve plate surface. Apply a liberal amount of assembly grease to the backside of the valve plate surface to hold it in position.

Install the valve plate over the timing pin, check valve (B092), and bearing cup (B010).

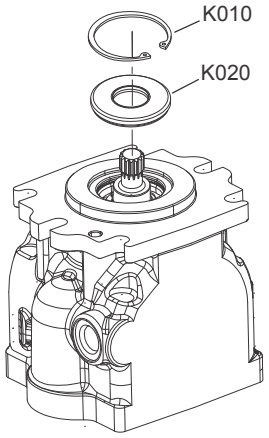


NOTE: *To insure proper pump operation, it is extremely important to ensure that there is no contamination between the end-cap and valve plate.*

11. Install the bearing cone (B020) onto the shaft. Using assembly grease to hold the seal (K060), install the end-cap to the housing. Ensure that seals remain properly seated and are not pinched during assembly. With a 10 mm internal hex wrench, install and torque endcap screws at 127 to 155 Nm [94.to.114.lbft], using the criss cross pattern. Retorque the first screw to ensure proper torque retention.

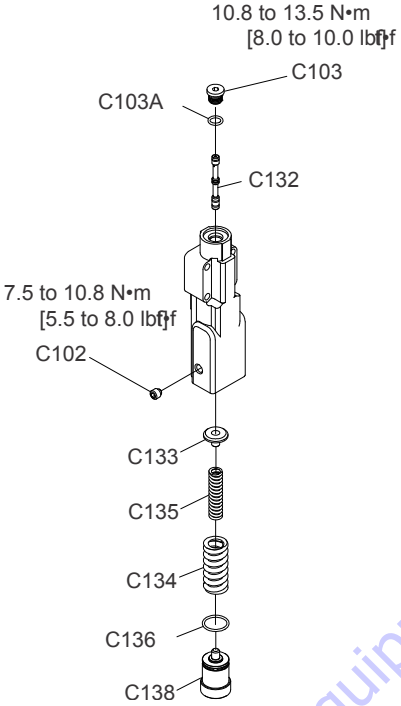


12. Lubricate the lip of the new shaft seal (K020) with clean hydraulic fluid. Place a protective sleeve over the shaft end to prevent damage to the seal during installation. Keeping the seal perpendicular to the shaft, press the new seal into the housing just far enough to clear the retaining ring groove. Install seal with the cupped side toward the shaft bearing. Do not damage the seal during installation. Using the appropriate snap ring pliers,install the seal retaining ring (K010). Remove the installation sleeve.

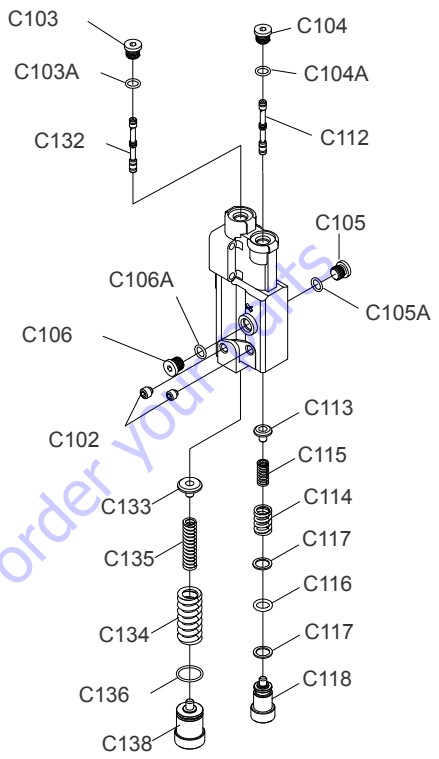


13. Clean all control parts and cover with a light coating of hydraulic fluid prior to reassembly.

14. Install the spherical end of the PC spool (C132) into the PC bore (refer to illustration). Install the PC plug (C103) using a new O-ring (C103A). Torque at 10.8 to 13.5 Nm [8.to.10.lbft]. Place the two PC springs (C134, C135) onto the PC spring guide (C133) and install into the PC bore. Place a new O-ring onto the PC plug and install it so that it sits one turn below the surface of the control housing. Install and tighten set screw (C102) at 7.5 to 10.8 Nm [5.5 to 8.0 lbft] to retain the adjusting plug.

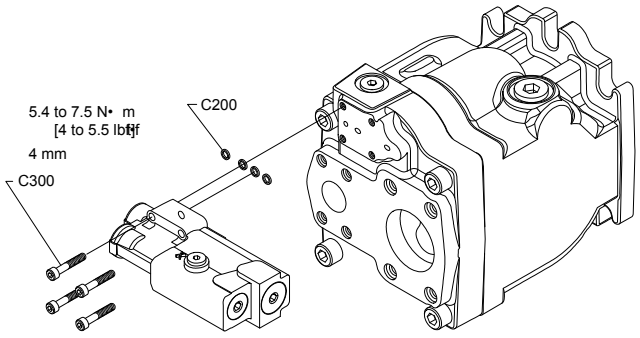


15. Hold the control in a horizontal position. Install the spherical end of the LS spool (C112) into the LS bore (see illustration). Using a new O-ring, install the LS plug (C104), torque at 10.8 to 13.5 Nm [8 to 10 lbft]. Place the 2 LS springs (C114, C115) onto the LS spring guide (C113) and install into the LS bore. Place a new O-ring (C116) and back-up rings (C117) onto the LS adjustment screw (C118). Install the LS plug assembly so that it sits one turn below the surface of the control housing. Install and tighten set screw (C102) at 7.5 to 10.8 Nm [5.5.to 8.0 lbft]. Also, install the plugs (C105, C106) with new O-rings. Torque the plugs at 10.8 to 13.5 Nm [8 to 10 lbft].



NOTE: *PC and LS spools need to be adjusted to proper setting according to tag nomenclature.*

16. Using petroleum jelly to retain them, install 4 new seal rings (C200) in the recesses on the control housing. Install the control assembly onto the endcap using the 4 screws (C300). Torque at 5.4 to 7.5 Nm [4.0 to 5.5 lbft] using a criss cross pattern and retorque the first screw to ensure proper torque retention.



5.11 GEAR PUMP (SAUER)

Disassembly

Prior to proceeding it may be necessary to prepare some subassemblies separately.

The details for preparing each subassembly are given in the following section.

Also, some general recommendations are given below.

CLEANLINESS
Cleanliness is a primary factor for reliable pump performance. Wash the outside of the pump thoroughly before disassembly and all pieces prior to assembly. Cleaning parts with clean shop solvent and air drying is usually adequate.

LUBRICATION OF MOVING PARTS
During assembly, it is imperative to provide lubrication with clean hydraulic oil to all the running parts of the pump.

It is also necessary to coat the seals with grease. The absence of lubrication during assembly can cause the unit to seize after a few minutes of running.

CARE OF SURFACE TREATMENT
Be careful when handling all the internal surfaces, especially bearings, gears, and body faces. Do not touch or score them with metal tools or cutting edges.

MARKING THE PARTS
Mark the parts before completely disassembling a pump. The marks allow components to be reassembled in the same relative position. This action should be applied to the body, bearings, and gears. Scribing, bluing, or using a felt tip pen to mark the outside of the body on the inlet side is suggested to indicate the relative position of the front flange and the rear cover to the body. Mark the bearing blocks also on the inlet side and the gears position relative to each other. DO NOT scribe internal surfaces.

PROCEDURE

1. Clamp the unit.

   Clamp the unit in a vice from the flange side.

   Make sure the vice jaws are clean and have smooth surfaces to prevent damage to the pump.

NOTE: *Clamping the pump on the body is not recommended because serious damage to the surfaces, on which the ports are located, may occur.*

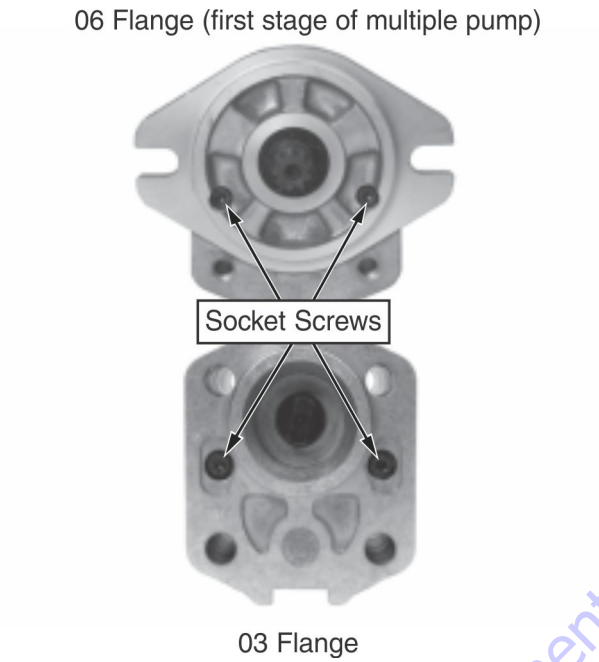
2. Remove capscrews. (Except Units with 03 Flange).

   Use a 17 mm socket wrench and loosen the four capscrews on the cover. Next completely unscrew the capscrews and remove them.

   Inspect the threads of the capscrews for damage.

3. Remove socket head capscrews. (03 Flange or Multiple Pump Stages Only).

Using a 4 mm internal hex wrench, loosen and remove the two small socket screws placed in the center of the cover. Repeat the same operation for the corresponding screws on the rear flange.



4. Remove front flange.

Place the pump on the table and slowly remove the front flange.

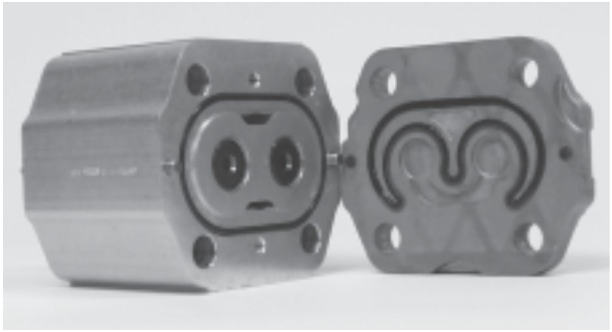
Be careful not to damage the shaft seal when removing the flange. Avoid contact of the shaft seal lips with key-way edges (in tapered and parallel shafts) or splined shaft teeth.

Inspect the front flange and seal area.

Clean with shop solvent, dry, and set aside.

5. Remove rear cover.

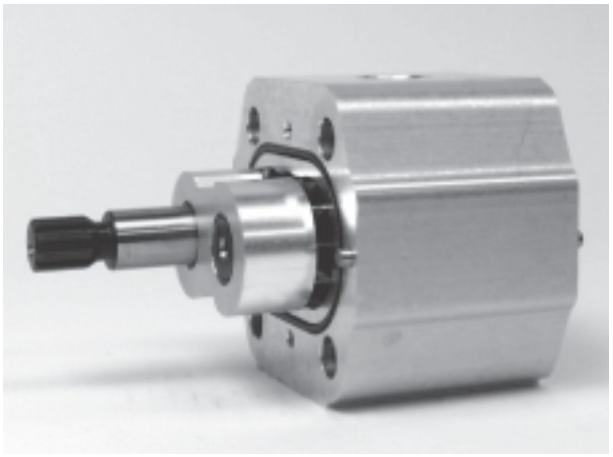
Remover rear cover. Clean with shop solvent, dry, and set aside. Visually inspect rear cover and seal area.



6. Remove bearing blocks and gears.

Place the pump on its side and carefully remove the bearing block and gear set. To accomplish this, hold the pump body and push with your fingers on the rear bearing block.

Mark the relative positions of the gear mesh (drive gear tooth to idler gear tooth) and the bearing blocks to the body so they can be reas?sembled in the same position.

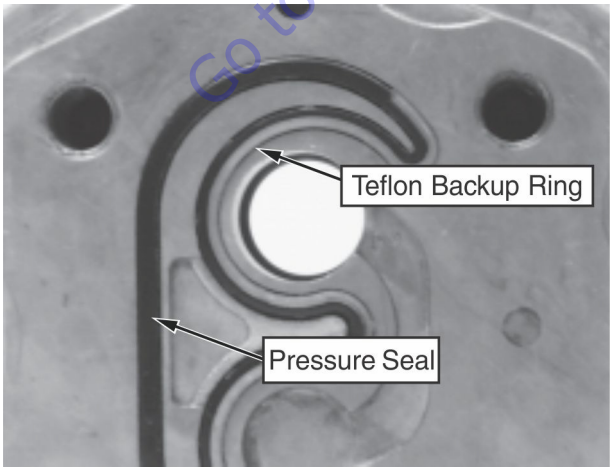


7. Remove pressure seals.

Check the seal quality. Replacement is recommended whenever there are burrs, evidence of extrusion, or marks caused by overheating. If the seals need to be replaced, carefully remove them from the flange cover, beginning with the backup ring and then the pressure seal.

Do not use tools with sharp edges to remove the seals, as damage to the cover can result.

After removal, dispose of damaged seals.

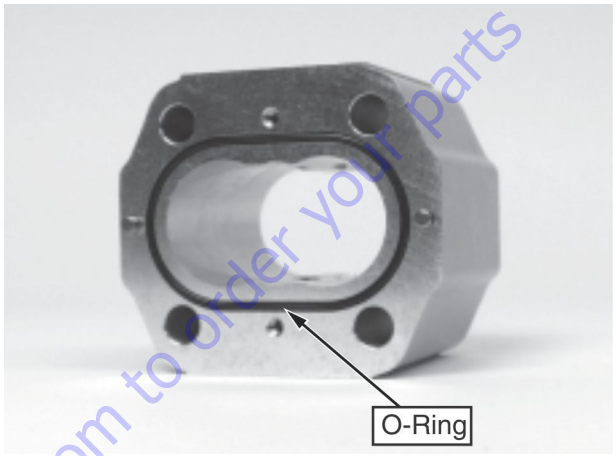


8. Remove Outer O-Ring Seal

Check the quality of this seal. If necessary, replace it. Follow the same removal recommenda?tions given in step 7.

After removal, discard the damaged seal.

Do not use tools with sharp edges to remove the seals, as damage to the cover can result.



9. Remove the snap ring.

Place the flange on the work surface. Using internal snap ring pliers, remove the snap ring.

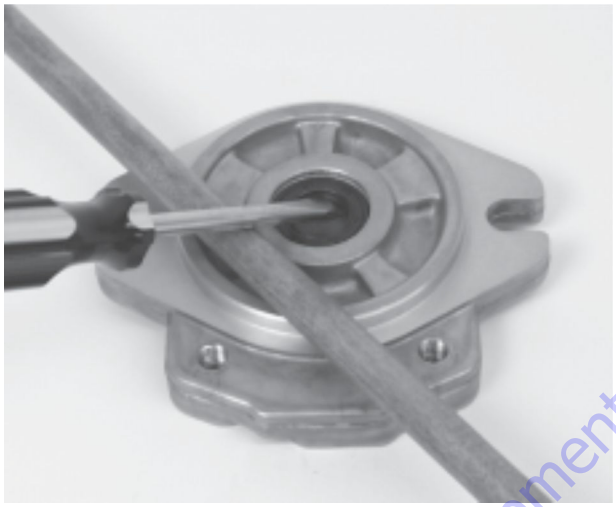
10. Remove the shaft seal.

Check the shaft seal quality and remove if necessary.

To remove, pry the bottom of the shaft seal and force it out while rotating the flange to lift it out evenly.

Do not use the flange pilot to gain leverage, damage may result. Use a plastic rod or wooden dowel as a fulcrum.

After removal, dispose of damaged seal.



Assembly

1. Prepare the seals.

Have the entire seal kit available.

Lightly coat all seals with seal grease. The grease is needed to adhere the seals to their grooves.

Do not install dry seals.

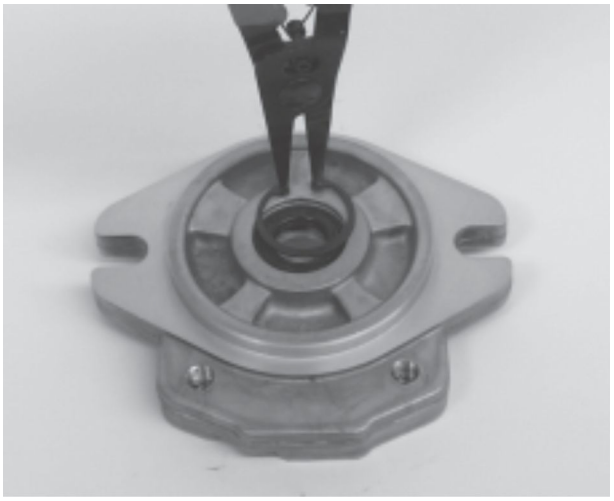
2. Install shaft seal into front flange.

Prepare the flange and shaft seal by lightly lubricating with grease.

Seat the seal in the flange by hand. Then, using the shaft seal installation tool, press the seal until the tool stops on the flange. This will insure the seal is inserted to the proper depth.

3. Install snap ring.

Install the snap ring using internal snap ring pliers. Ensure the snap ring fits securely in its groove. This is necessary to retain the shaft seal.

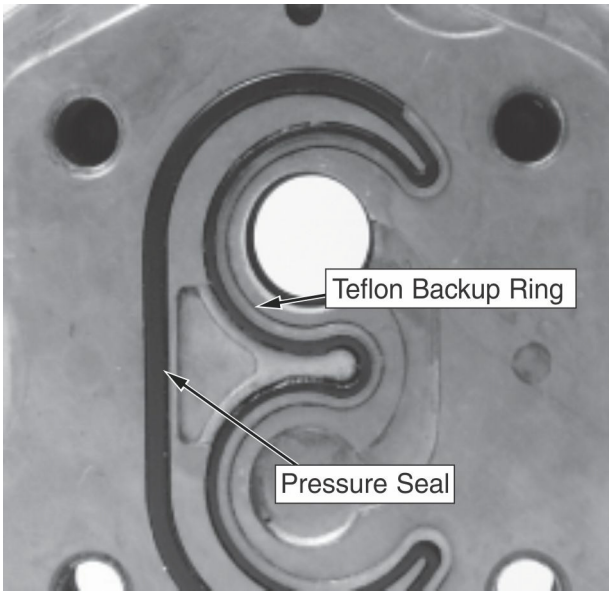


4. Install pressure seals.

   Prepare the pressure seals by lightly lubricating them with grease.

   Install pressure seals into the grooves on the front flange and rear cover. Then install the teflon backup ring.

   Ensure that the seals are located in the grooves, as shown.



5. Prepare the body.

   Clean the body.

   Inspect the internal and mating surfaces. Ensure the surfaces are free of burrs and scratches. Check both the bearing block mating surface and the cut-in path. The cut-in path should be no deeper than 0.1 mm (0.004 in).

6. Install outer seal.

   Prepare the outer seal by lightly lubricating with grease.

   Install outer seals in the grooves on both sides of the body.

7. Prepare the gears.

⚠ CAUTION

THE GEAR SURFACES ARE SUPER-FINISHED. RESIDUE ON HANDS AND FINGERS MAY BE CORROSIVE TO THIS SURFACE. DO NOT TOUCH.

Carefully clean the two gears. If the gears are new, wash them with shop solvent to remove any anticorrosive grease on the surfaces.

Inspect the journals and the flat faces on the top and bottom of the gears. Ensure these surfaces are free from burrs or scratches. If scratches or burrs are found, clean them with a flat stone and/or very fine emery paper. Rewash the gears after this operation.

8. Prepare the bearing blocks.

Clean the two bearing blocks.

Inspect the flat surfaces of the bearing blocks for burrs or scratches on the edges. If necessary, remove burrs with very fine emery paper. Then rewash the bearings.

Inspect the DU bushings for wear. There should be no bronze showing.

Using clean hydraulic oil, lubricate the internal and external surfaces of the bearing blocks.

9. Assemble the bearing blocks and gears.

Lubricate the journals and the gear faces.

Assemble the bearing blocks and gears. Ensure that the recessed bearing faces are installed adjacent to the gear faces. Align all assembly marks made during disassembly. Ensure the front and rear bearing blocks occupy the same location with respect to the housing as before disassembly. Ensure that the relative position of the gear mesh is maintained as before disassembly. Misalignment of the gear teeth may increase operating noise.

10. Install the gear block assembly.

Install the bearing block and gear assembly into the body cavity. Align the assembly marks to ensure that the gear block assembly is installed with the same orientation as before disassembly.

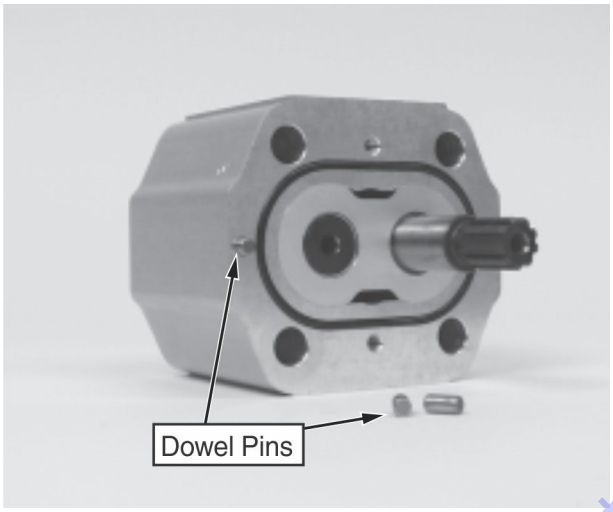
11. Clean the mating surfaces.

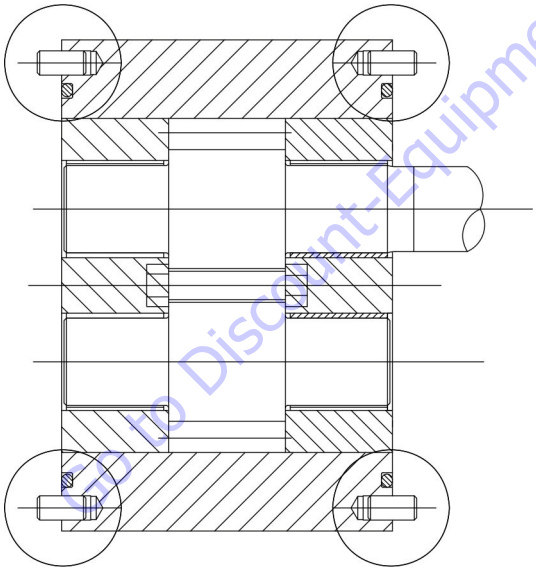
Remove any excess lubrication and grease from the mating surfaces of the pump body. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

12. Install the dowel pins.

Install four 5 mm dowel pins into the proper cavities on both sides of the body (refer to the illustration). Swab the pins with assembly grease or petroleum jelly to retain them during assembly.

Do not install dowel pins to the rear cover or flange, as one of them may drop inside the pump during assembly.





13. Clean the mating surfaces.

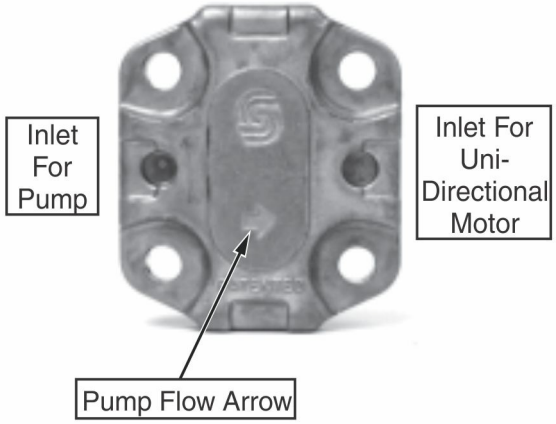
Remove any excess lubrication and grease from the mating surfaces of the front flange and rear cover. Ensure that these surfaces are dry and free of contamination before moving on to the next step.

Ensure the pressure seals are seated properly after this operation.

14. Install Rear Cover.

Mount the cover on the body. Ensure the arrow on the back is oriented properly. The arrow should be In the same direction as the flow.

Ensure that all the pressure seals stay in place during this operation.



15. Prepare pump for front flange assembly.

Place the pump with the rear cover downwards.

Ensure that the assembly marks on the bearing block / body are properly aligned.

16. Install the front flange.

Install a protective sleeve over the shaft. The sleeve is used to protect the shaft seal from damage by the shaft splines / keyway during front flange assembly.

Install the flange onto the body, then remove the protective sleeve.

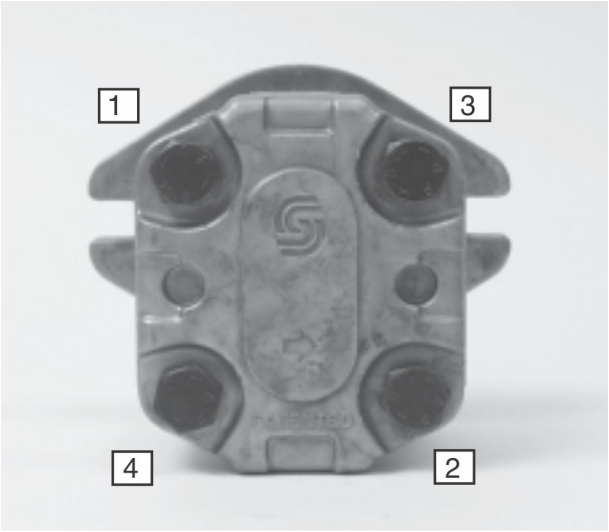
Ensure that the seals remain seated in their grooves during this operation.

17. Torque sequence.

When assembling units with 01 flange and short coupled tandems, wash the capscrews and apply JLG Threadloacker PN 0100011 or equivalent thread lock compound to the threads before assembly.

Install capscrews. While observing the torque sequence shown, pre tighten the capscrews. Then, using a torque wrench, tighten them to the proper torque.

Torque 44-54 Nm (32-40 ft.lbs.).



18. Install socket head capscrews. (03 flange and first stage of multiple).

Using a 4 mm internal hex wrench, install the socket head capscrews to the front flange and rear cover.

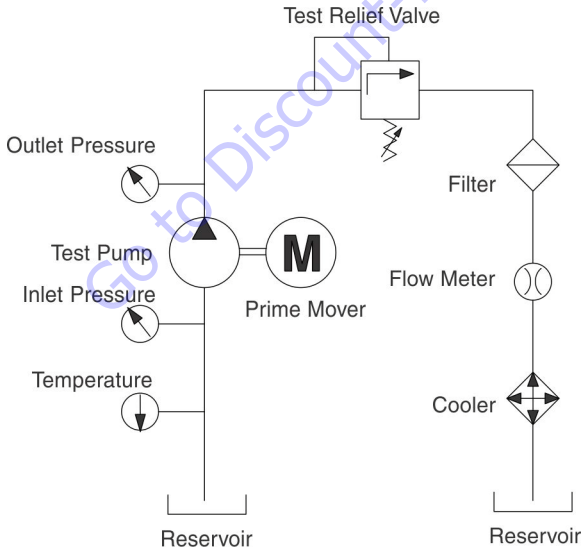
Torque 2.5-3.4 Nm (22-30 ft.lbs.).

If used, install new o-ring to flange pilot.

19. Testing

After pump has been disassembled and reassembled, it is suggested that the pump be run in and tested on an appropriate test stand. This is done to verify the volumetric efficiency and the integrity of the unit.

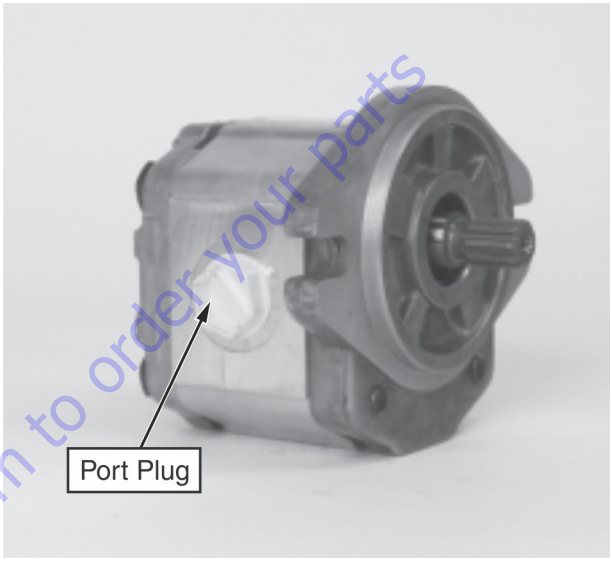
Test specifications and procedure are given in Testing the Pump.



20. Prepare the unit for shipment or storage.

Clean the exterior of the pump and install the following:

- **a.** Port Plugs
- **b.** Key (CI and CO shafts)
- **c.** Shaft protective cap (CI and CO shafts)
- **d.** Nut and washer (CO shaft)



Trouble Shooting

Table 5-50. Troubleshooting

Low or No Flow From Gear Pump		
Item	Description	Action
1. Check oil level in reservoir.	Description Insufficient oil to supply gear pump.	Fill reservoir to proper level.
2. Check input spline condition.	Input shaft broken or stripped.	Repair or replace gear pump.
3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start.	Clogged suction filter or inlet screen.	Replace filter or clean suction screen.
4. Check condition of gear faces and bearing blocks.	Scored bearing block and gear faces will reduce pump efficiency.	Repair or replace gear pump.
5. Check bushings.	Overpressure of gear pump will cause idler gear bushing to fail.	Repair or replace gear pump.
Excessive Noise		
Item	Description	Action
1. Check oil level in reservoir.	Excessive air will cause cavitation sound.	Fill reservoir to proper level .
2. Check inlet line for leaks.	Excessive air will cause cavitation sound.	Repair inlet line.
3. Check pressure at pump inlet. Recommended inlet pressure: 0.8 to 3.0 bar absolute. 0.6 Minimum at cold start.	Lower than normal inlet pressure causes excessive pump noise.	Return inlet pressure to recommended levels.
External Leakage		
Item	Description	Action
1. Check for pinched o-rings or backup ring seal.	Pinched seal will allow leakage.	Replace pinched seal.
2. Check pressure seals.	Damage to pressure seals is typically caused by reduced stack-up in the pump assembly. This may be due to under-torqued assembly fasteners, or more commonly is attributed to excessive wear on the bearing blocks. Reduced stack-up will affect seal efficiency possibly to the point of seal extrusion.	Inspect condition of bearing blocks. If they are found to be worn, repair or replace the pump. If bearing blocks are not worn, replace pressure seals and re-torque pump assembly fasteners.

5.12 DRIVE & FUNCTION PUMP START UP PROCEDURES

Start-Up Procedure

The Boom Lift utilizes a Triple Combination Pump coupled to the Deutz diesel engine. The pumps are connected in-line to each other as follows:

1. The front hydrostatic transmission pump, or drive pump, is coupled directly to the diesel engine and provides oil flow to operate the machine's right side wheels.
2. The middle hydrostatic transmission pump, or drive pump, is coupled to the back of the front pump and provides oil flow to operate the machine's left side wheels.
3. The third or rear pump is the function pump. It is coupled to the back of the middle pump and provides oil flow to operate the boom, axle, steer and platform functions.

The transmission pumps share some common connections. Each pumps charge oil suction ports are connected by steel tubing, the charge pumps discharge oil flows are connected and flow to a common charge pump inline oil filter, cleaned & filtered oil flows back to the transmission pumps "G" ports. The pumps case drain ports are connected (T1 & T2), oil flow from the middle pumps T1 port also provides flows to the oil cooler. The charge pumps oil pressure is regulated by a single boost oil pressure relief valve installed in the middle pump. The front pump has an orifice cartridge (0.047" diameter) installed in place of a charge oil pressure relief cartridge. This insures that only one valve controls charge pressure & provides an amount of charge oil flow to the front pump's case to insure flushing & removal of hot oil.

Each pump has its own separate electrical proportional directional control valve to control oil flow and direction. The signals or command values to each pump are similar except when steering. During steering and propel of the machine the pump supplying oil to the "inside turning radius" has a command less than the pump supplying oil flow to the "outside turning radius" pump.

"Posi-Traction" control, front to rear on a given side of the machine, is accomplished by a flow divider/combiner cartridge installed in the Traction Control Manifold. There is a flow divider/combiner for each side. Each flow divider/combiner also has a "bleed orifice" to limit the amount of flow splitting or combining.

The middle transmission pump also supplies oil to a hot oil flushing valve cartridge, #120, in the Traction Control Manifold. This cartridge provides a means to obtain brake release oil pressure. The brake release pressure is controlled by a pressure relief valve cartridge # 130 and a solenoid operated brake release directional control cartridge, #170, also located in the Traction Control Manifold. This is important to note as the brake release oil pressure must be set 25 psi (1.7 bar) below the boost oil pressure relief valve. If the brake release pressure is set too low, brake drag and pump control will be affected. If set too high, damage to the wheel drive parking brakes could result. Prior to start, connect appropriate pressure gauges to the unit.

FOR THE START-UP OF NEW OR OVERHAULED INSTALLATIONS:

1. Insure all electrical checks have been performed & the machine is set up correctly with the JLG Analyzer.
2. Insure the machine has all four wheels jacked & blocked off the ground per JLG procedures.
3. Insure the triple pump assembly is installed and connected correctly per the hydraulic circuit diagram.
4. Disconnect the electrical connector from the diesel's throttle actuator, to prevent engine start.
5. Crank the engine until charge pressure reaches 50 psi or more.
6. Re-connect throttle actuator electrical connector and start engine. Allow engine to run at idle speed only for at least 5 minutes. This will allow the hydrostatic system to filled.
7. Listen for any abnormal noises.
8. Check for oil leaks.
9. Check charge pressure (500 psi +50psi, - 0 psi [34.4 bar +3.4 bar, - 0 bar]). Pressure can be measured a pump ports Ma & Mb or by "teeing" into the inlet for the charge oil filter. Charge pressure is checked with the joystick in neutral. A 0-1000 psi (0-70 bar) pressure gauge must be used. (If pressure gauges were installed in Ma & Mb to check charge pressure, disconnect the gauges installed in Ma & Mb, as they will be damaged if loop pressure rises above 1000 psi [34.4 bar].)

10. Operate the drive system in the "turtle mode", forward and reverse.

11. De-aerate the system by bleeding fluid from the Ma & Mb ports.

12. Switch the drive mode speed control from "turtle" to "rabbit". Gradually increase drive speed forward & reverse, still with no load - wheels off the ground.

13. With the joystick in neutral, check for creep in neutral. If evident, most likely dirt is present in the proportional pump control, an incorrect electrical signal is present on the pump's electrical control(s) or the control was not centered properly when overhauled. See service manual for centering instructions.

14. Check that the controls are connected so that the transmissions operate in the correct direction related to control input.

15. Continue to monitor all pressure gauges & correct any irregularities.

16. Remove the brake coil (leaving the electrical connection intact) from the brake release solenoid cartridge located on the Traction Manifold. This disables the machine's ability to release the brakes! Stroke the transmission pumps slightly (less than 20%) and check the setting of the high pressure cross port relief valves. Setting should be 5000 psi +50 psi, - 0 psi (344.7 bar +3.4 bar, -0 bar). Install 0-6000 psi (0 - 415 bar) gauges on Pump ports Ma & Mb.

17. Check oil level & temperature.

18. Remove and inspect charge pressure oil filter, replace with new element.

19. Operate the transmission under no load conditions for about 15 minutes to stabilize the temperature and remove any residual air from the fluid.

20. Set the machine back on the ground. Operate the transmissions under full and normal conditions.

21. Erratic operation may indicate there is still air trapped in the system. By working the pump controls forward and reverse the remaining air can be eliminated. The system is free of air when all functions can be operated smoothly and when the oil in the reservoir is no longer aerated. (Usually less than one hour of operation)

NOTE: *If the transmissions do not perform correctly after following the pre-start & start-up procedures, refer to the relevant sections of the trouble-shooting procedures.*

This Page Left Blank Intentionally

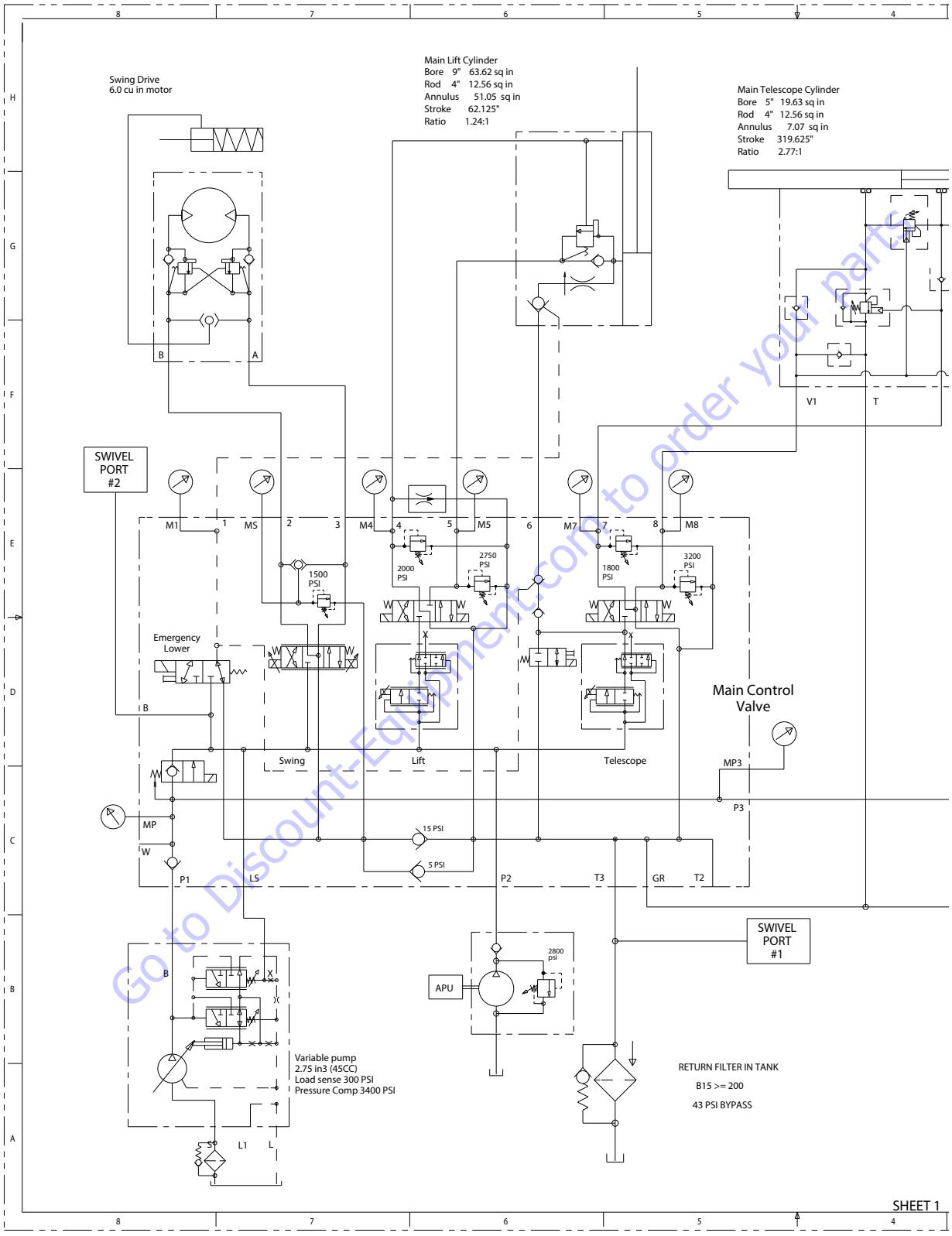


Figure 5-214. Hydraulic Schematic - Sheet 1 of 10

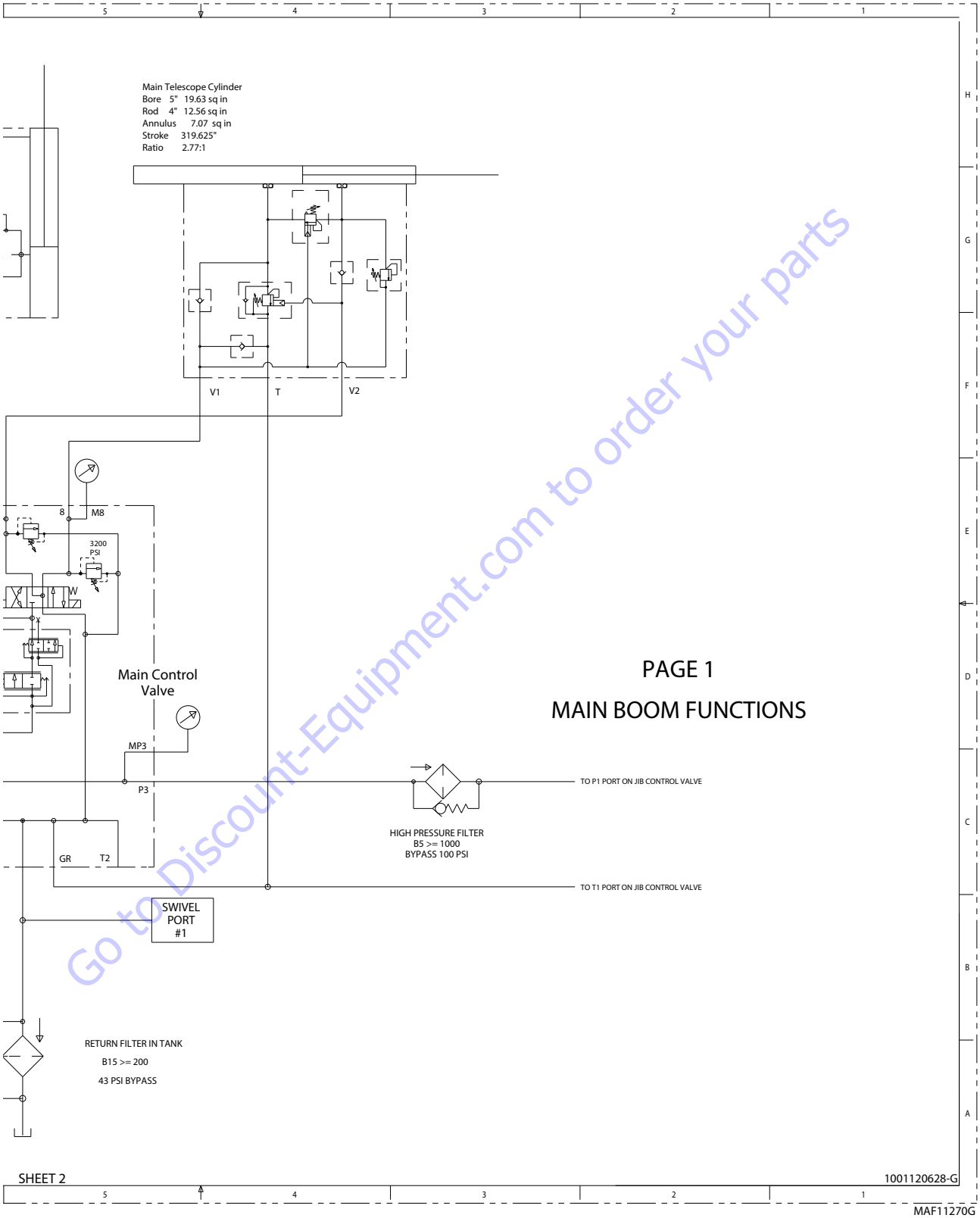


Figure 5-215. Hydraulic Schematic - Sheet 2 of 10

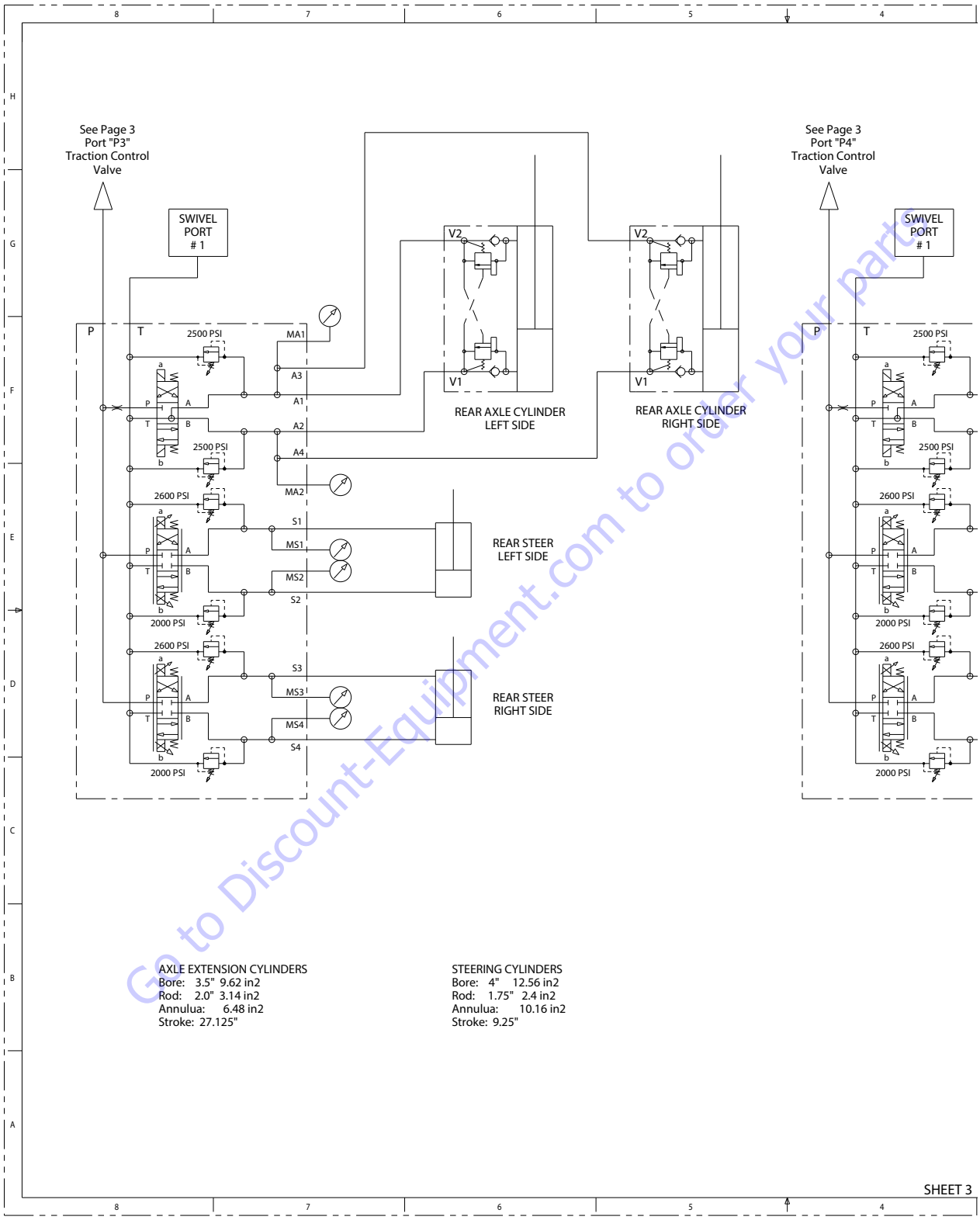


Figure 5-216. Hydraulic Schematic - Sheet 3 of 10

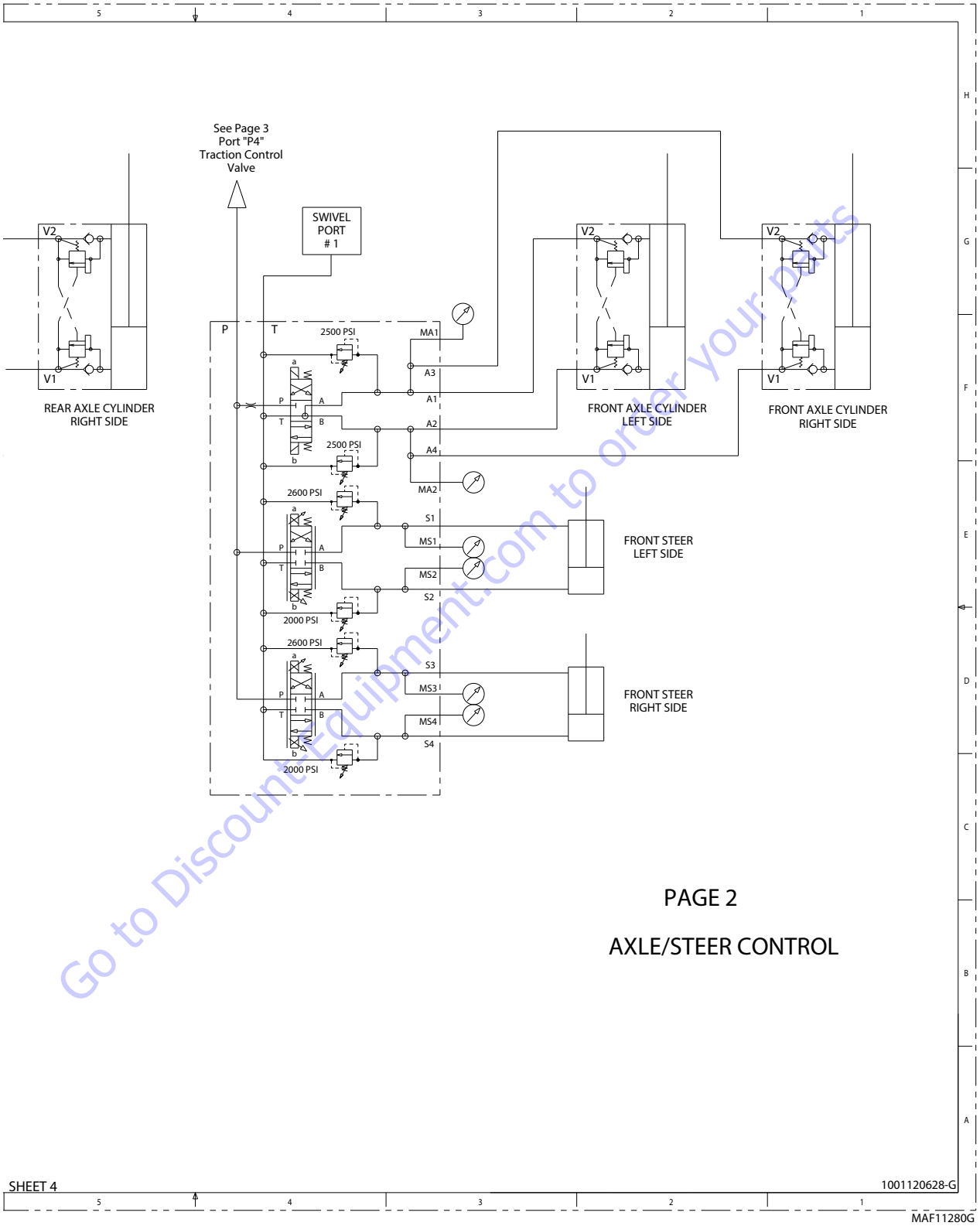


Figure 5-217. Hydraulic Schematic - Sheet 4 of 10

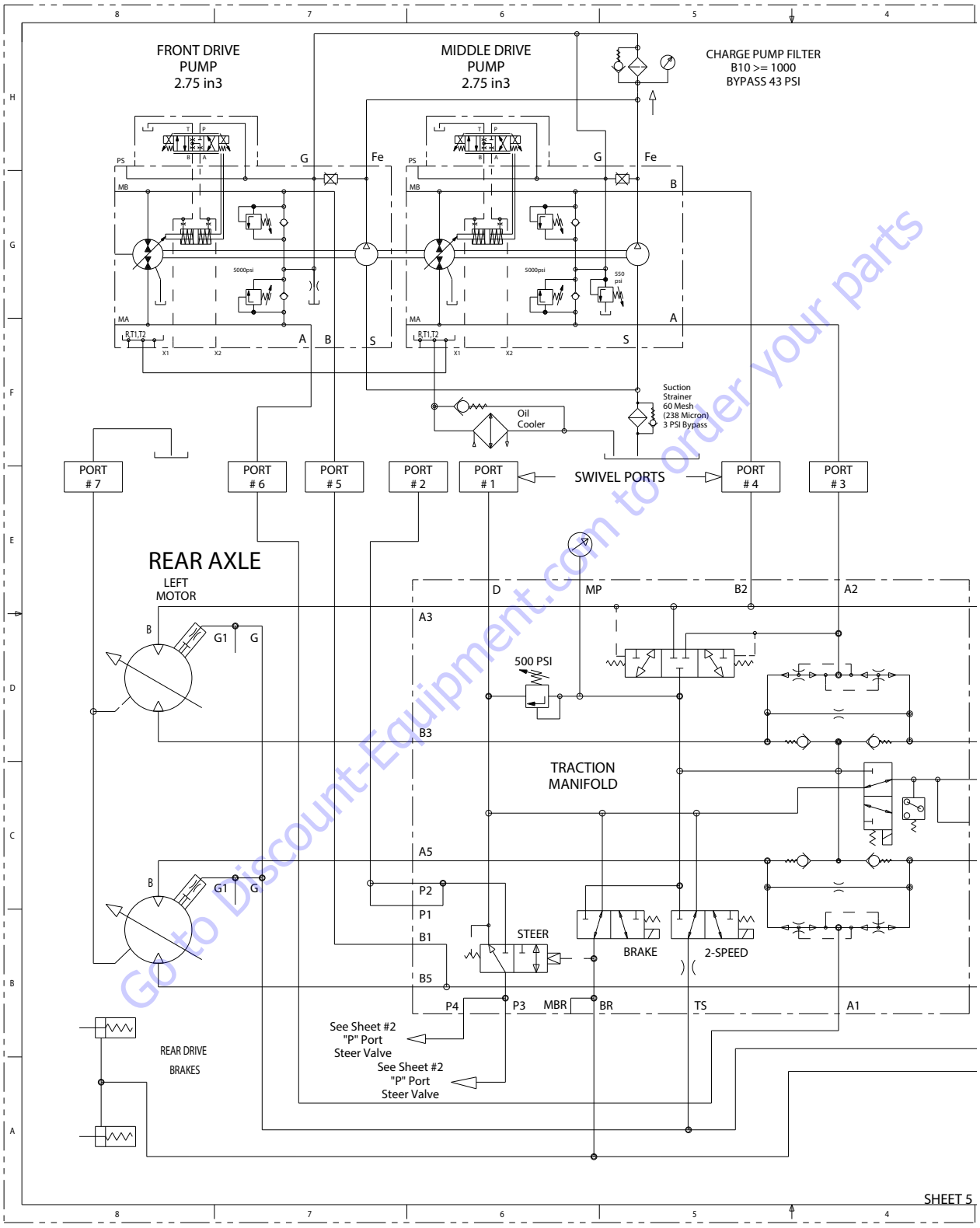


Figure 5-218. Hydraulic Schematic - Sheet 5 of 10

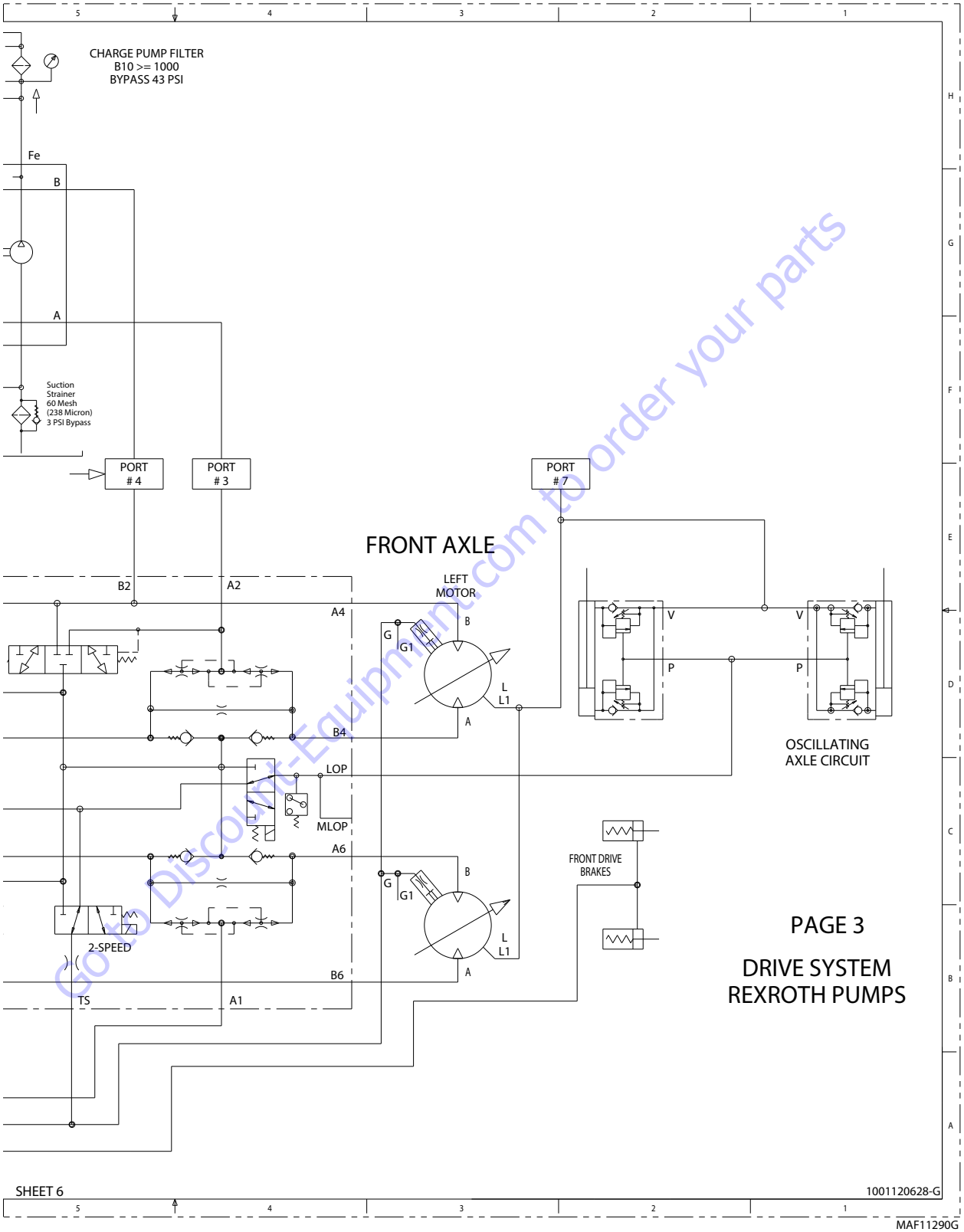


Figure 5-219. Hydraulic Schematic - Sheet 6 of 10

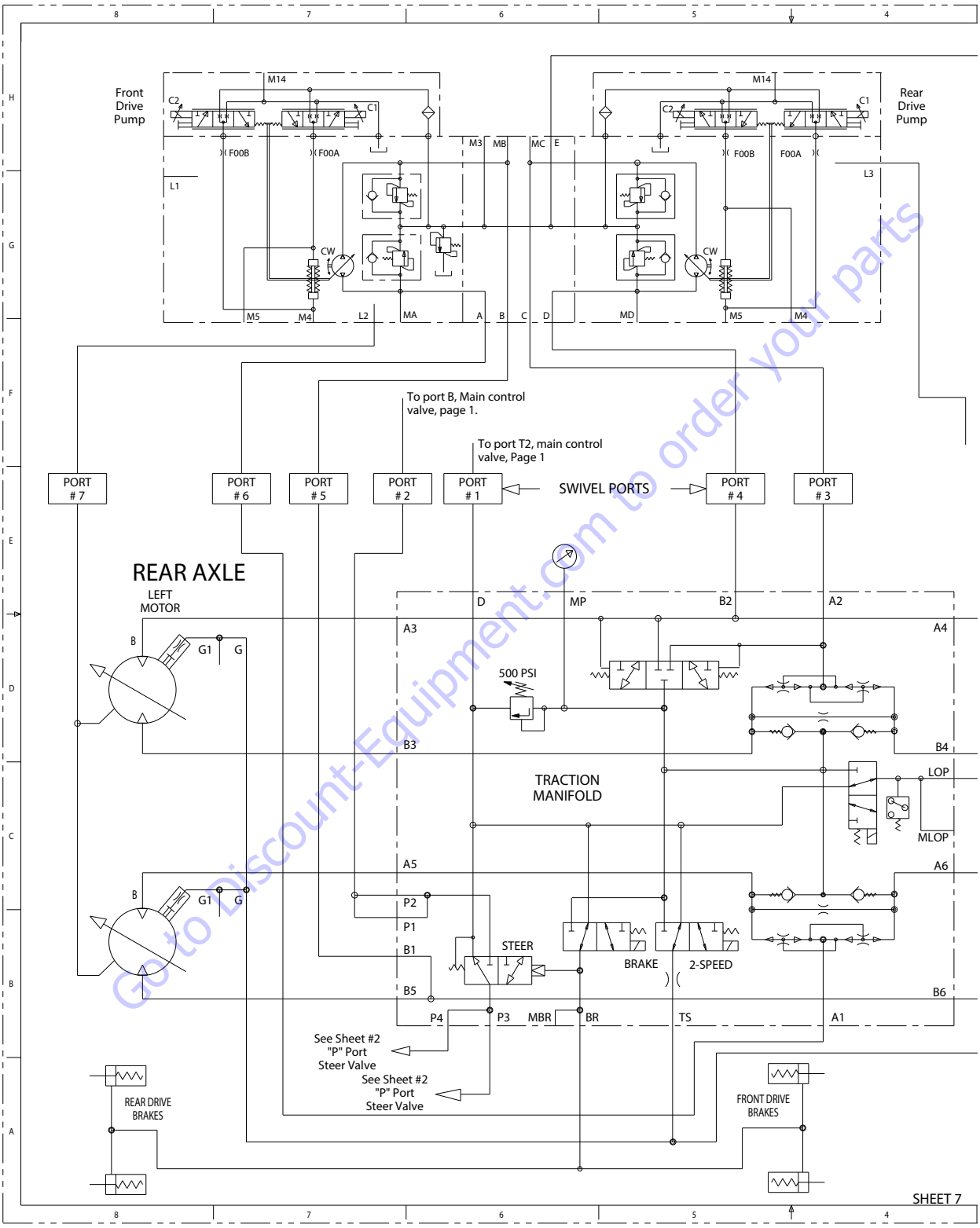


Figure 5-220. Hydraulic Schematic - Sheet 7 of 10

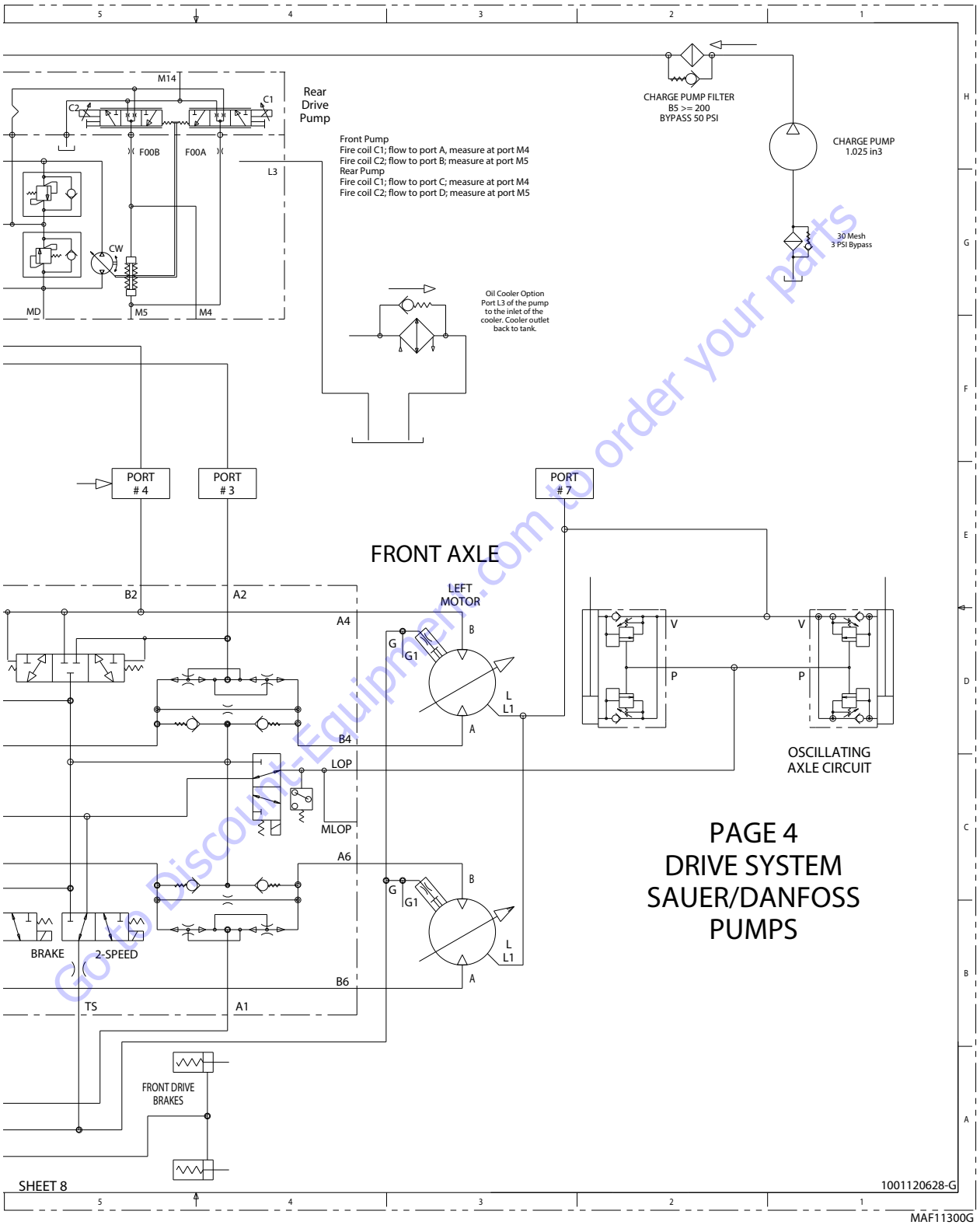


Figure 5-221. Hydraulic Schematic - Sheet 8 of 10

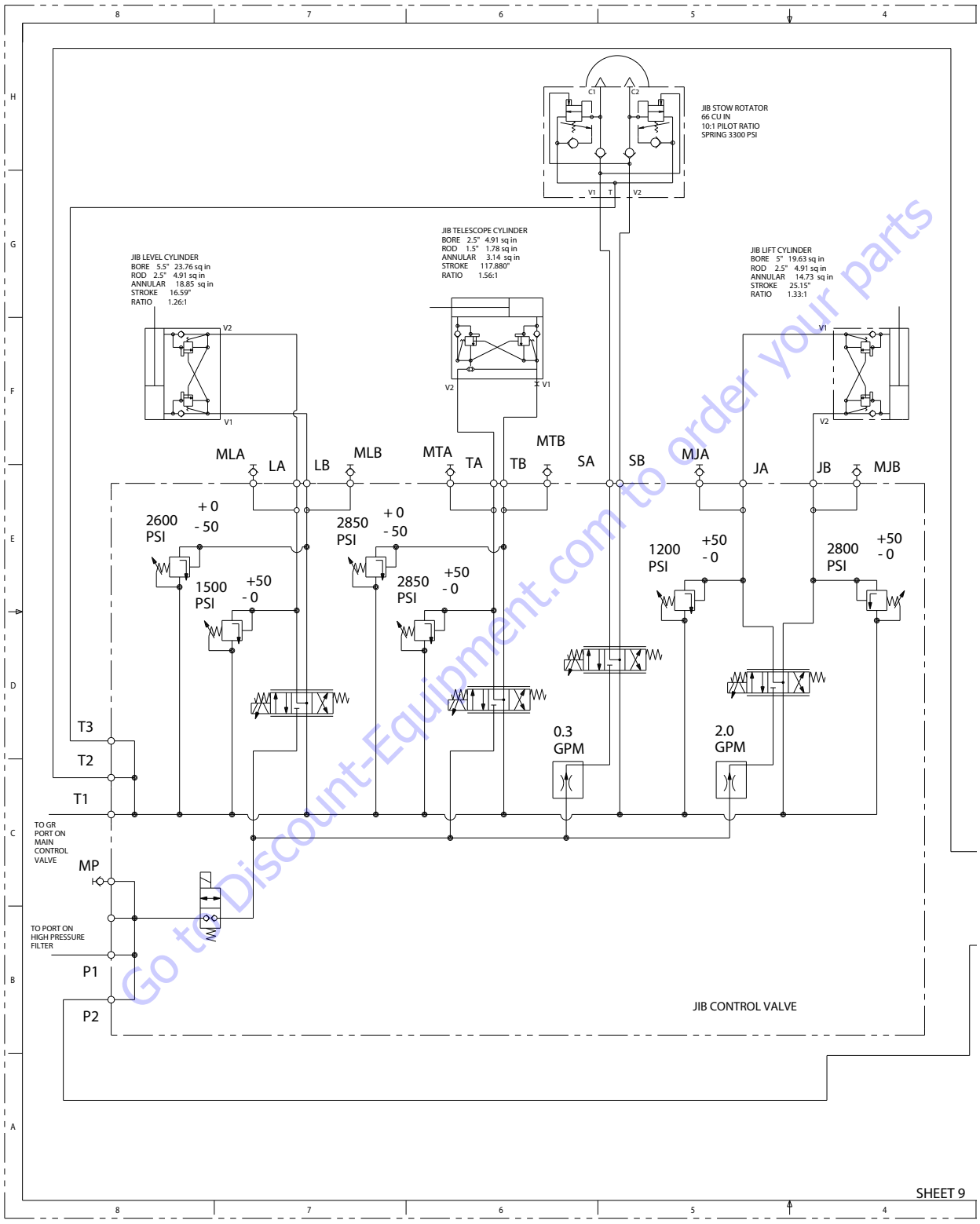


Figure 5-222. Hydraulic Schematic - Sheet 9 of 10

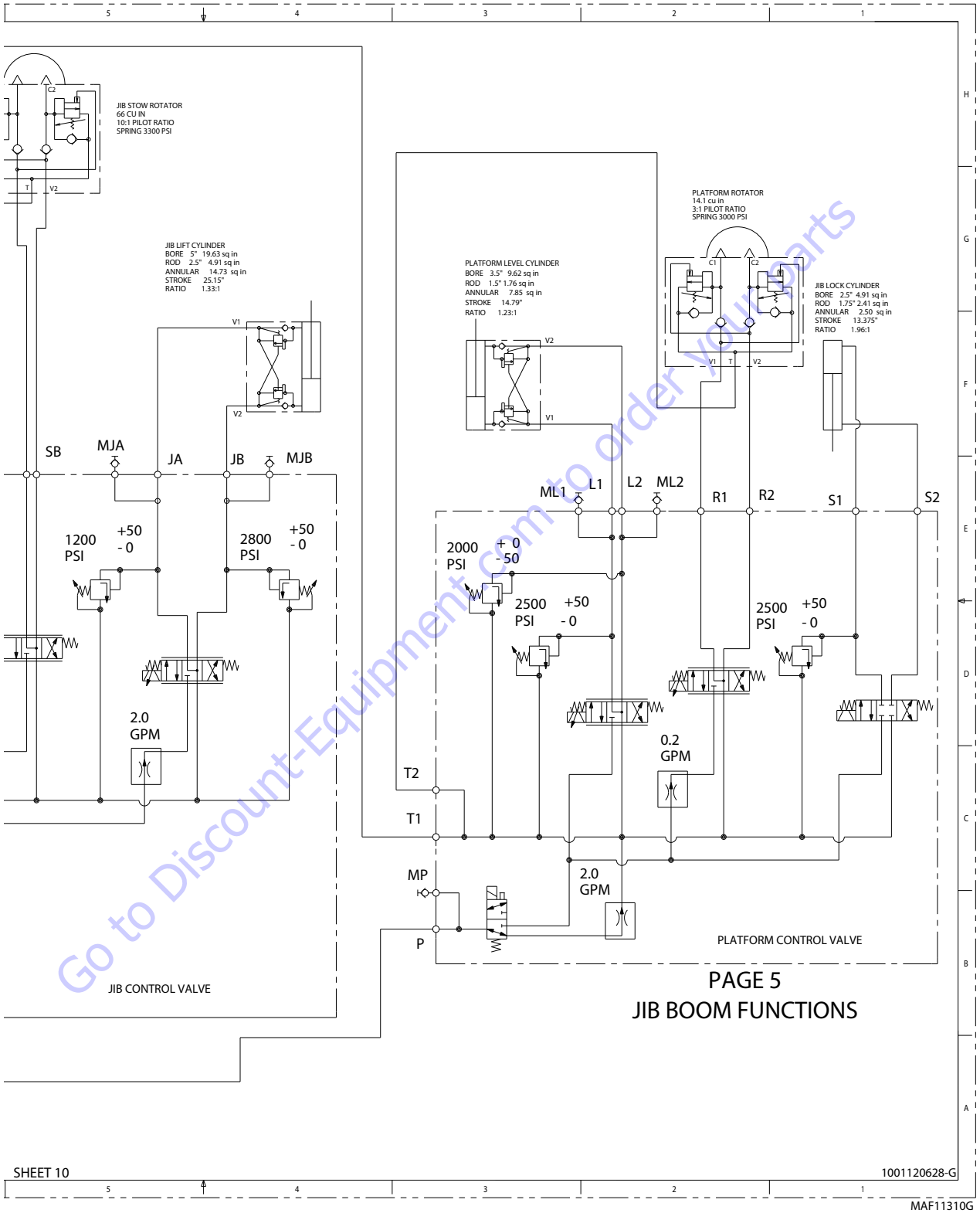
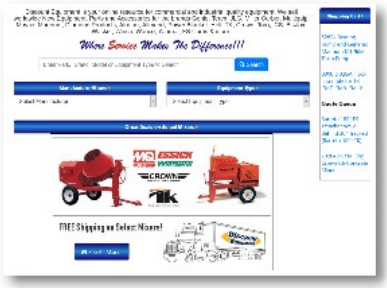


Figure 5-223. Hydraulic Schematic - Sheet 10 of 10

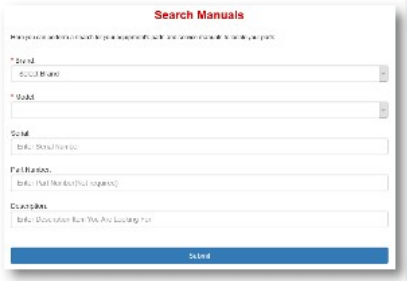
PARTS FINDER

Search Website by Part Number

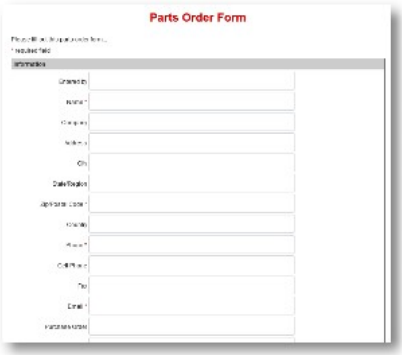
Discount Equipment



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



Can't Find Part or Manual? Request Help by Manufacturer, Model & Description



Discount-Equipment.com is your online resource for quality parts & equipment.
Florida: 561-964-4949 Outside Florida TOLL FREE: 877-690-3101

Need parts?

Click on this link: http://www.discount-equipment.com/category/5443-parts/ and choose one of the options to help get the right parts and equipment you are looking for. Please have the machine model and serial number available in order to help us get you the correct parts. If you don't find the part on the website or on once of the online manuals, please fill out the request form and one of our experienced staff members will get back to you with a quote for the right part that your machine needs.

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 INCHES (30.5 CM) AWAY FROM THESE COMPONENTS. IF ELECTRICAL/ELECTRONIC COMPONENTS ARE SPRAYED, SPRAYING MUST NOT BE DIRECT AND BE FOR BRIEF TIME PERIODS TO AVOID HEAVY SATURATION.

The 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 max.-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.

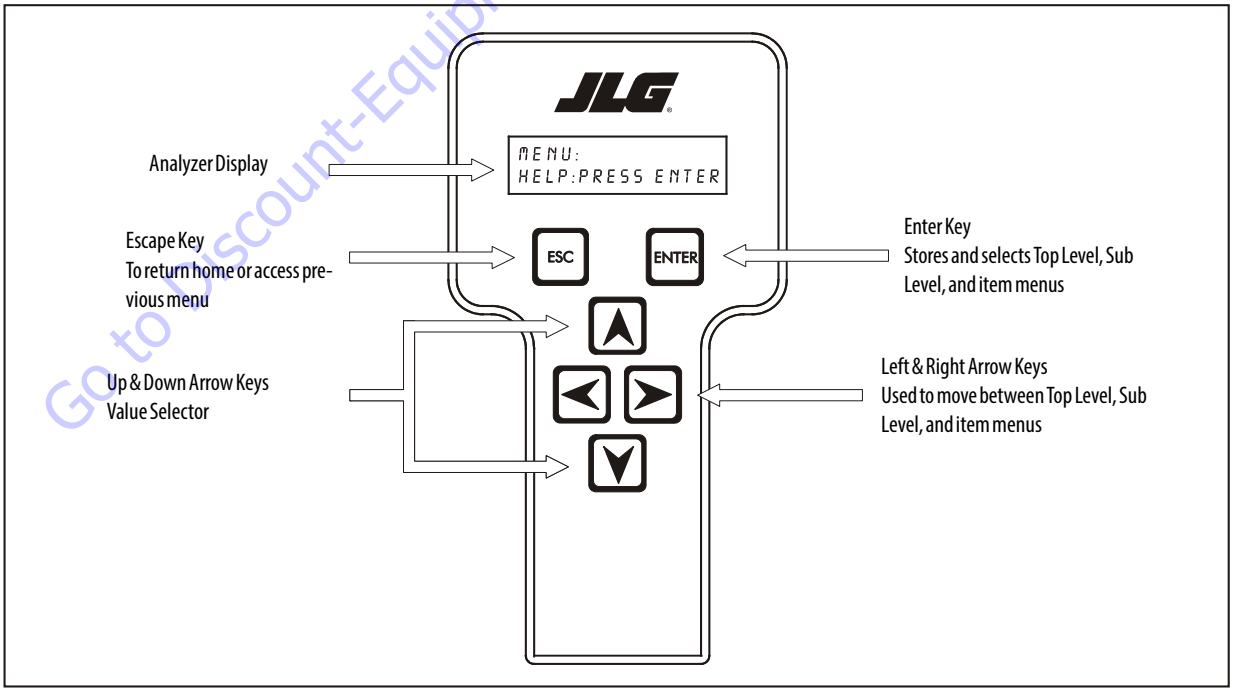


Figure 6-1. Hand Held Analyzer

To Connect the JLG Control System Analyzer

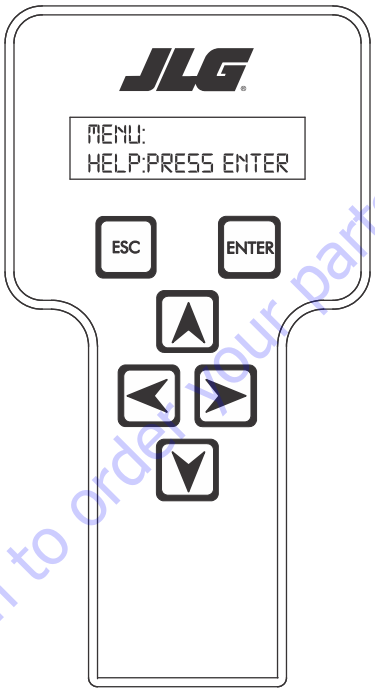
1. Connect the four pin end of the cable supplied with the analyzer, to the motor controller module located in the platform box or at the power module and connect the remaining end of the cable to the analyzer.

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

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

Using the Analyzer

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



HELP:
PRESS ENTER

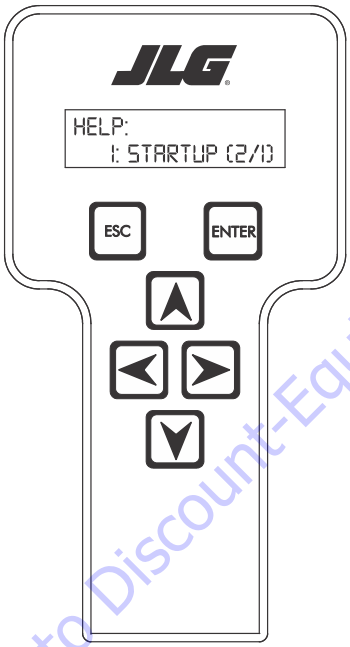
At this point, using the RIGHT  and LEFT  arrow keys, you can move between the top level menu items. To select a displayed menu item, press ENTER  . To cancel a selected menu item, press Escape  ; then you will be able to scroll using the right and left arrow keys to select a different menu item.

The top level menus are as follows:

HELP
DIAGNOSTICS
ACTIVATE TEST
ACCESS LEVEL
PERSONALITIES
MACHINE SETUP
LEVEL VEHICLE (level 1 only)
CALIBRATIONS (view only)

If you press **ENTER** ENTER, at the **HELP: PRESS ENTER** display, and a fault is present, the analyzer display will scroll the fault across the screen. If there was no fault detected, the display will read: **HELP: EVERYTHING OK.** If powered up at the ground station, the display will read: **GROUND OK.**

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



LOGGED HELP
1: STARTUP (2/1)

At this point, the analyzer will display the last fault the system has seen, if any are present. You may scroll through the fault logs to view what the last 25 faults were. Use the right and left arrow keys to scroll through the fault logs. To return to the beginning, press **ESCAPE** ESC two times. **STARTUP (2/1)** indicates a power up.

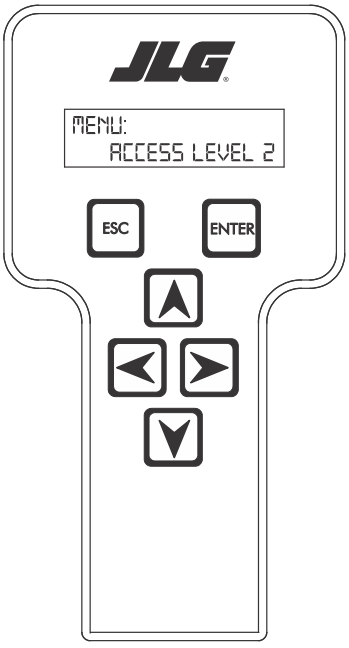
When a top level menu is selected, a new set of menu items may be offered: for example:

DRIVE
BOOM
SYSTEM
DATALOG
VERSIONS

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

Changing the Access Level of the Hand Held Analyzer

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



ACCESS LEVEL:
CODE 00000

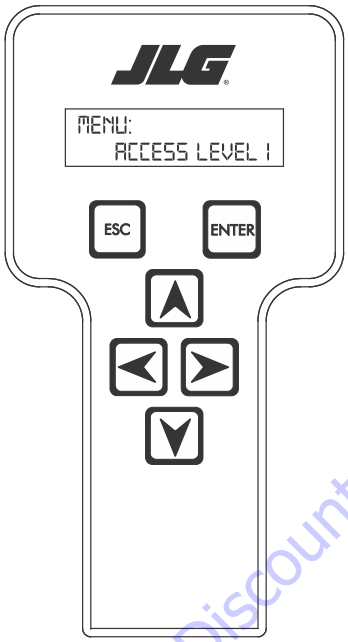
Press **ENTER** to select the **ACCESS LEVEL** menu.

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

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

Use the **UP** or **DOWN** arrow key to enter the second digit of the password which is 33271.

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

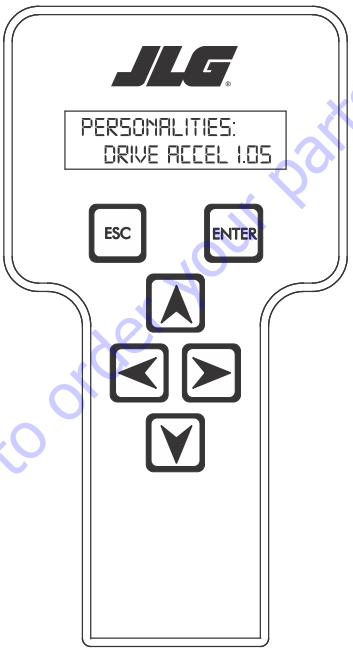


MENU:
ACCESS LEVEL 1

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

Adjusting Parameters Using the Hand Held Analyzer

Once you have gained access to level 1, and a personality item is selected, press the **UP** or **DOWN** arrow keys to adjust its value, for example:

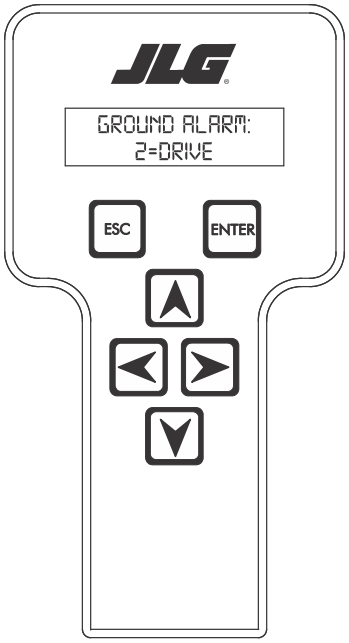


DRIVE:
ACCEL 1.5s

There will be a minimum and maximum for the value to ensure efficient operation. The Value will not increase if the **UP** arrow is pressed when at the maximum value nor will the value decrease if the **DOWN** arrow is pressed and the value is at the minimum value for any particular personality. If the value does not change when pressing the up and down arrows, check the access level to ensure you are at access level 1.

Machine Setup

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



GROUND ALARM:
2 = DRIVE

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

When selection the machine model to match the size of the machine, the personality settings will all default to the factory recommended setting.

NOTE: *Refer to Personality Ranges/Defaults for the recommended factory settings.*

NOTE: *Password 33271 will give you access to level 1, which will permit you to change all machine personality settings.*

There is a setting that JLG strongly recommends that you do not change. This setting is so noted below:

ELEVATION CUTBACK

⚠ WARNING

CHANGING THIS SETTING MAY ADVERSELY AFFECT THE PERFORMANCE OF YOUR MACHINE.

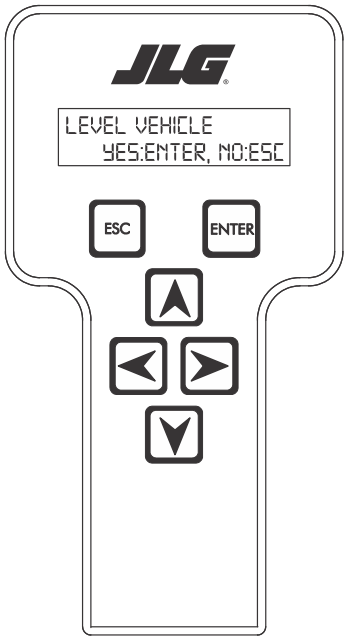
NOTICE

ITS IS A GOOD PRACTICE TO AVOID PRESSURE-WASHING ELECTRICAL/ELECTRONIC COMPONENTS. SHOULD PRESSURE-WASHING BE UTILIZED TO WASH AREAS CONTAINING ELECTRICAL/ELECTRONIC COMPONENTS, JLG INDUSTRIES INC. RECOMMENDS A MAXIMUM PRESSURE OF 750 PSI (52 BAR) AT A MINIMUM DISTANCE OF 12 INCHES (30.5CM) 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.

Level Vehicle Description

⚠ WARNING

DO NOT LEVEL VEHICLE EXCEPT ON A LEVEL SURFACE.



LEVEL VEHICLE
YES:ENTER, NO:ESC

Not available at password level 2 ENTER confirms that vehicle is currently level, and zeroes the tilt sensor measurements

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
G	GROUND

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
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
RT	RIGHT

Table 6-1. Analyzer Abbreviations

ABBREVIATION	MEANING
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

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

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	0 **1** 2	No Model **1500SJ** 1850SJ	**1**
ENVELOPE HEIGHT: 2	**0** 1	**1500SJ: 150' MAX** 1850SJ: 185' MAX	**0**
Note: The default settings (bold) will vary depending on the model selection with selection # 0 being the initial default setting.			
MARKET: 3	**0** 1 2 3 4 5	**ANSI USA** ANSI EXPORT CSA CE AUSTRALIA JAPAN	**0**
ENGINE: 4	1 2 **3** 4 5 **6**	DEUTZ F4 TIER1: Deutz BF4M1011 Diesel (Tier 1) DEUTZ F4 TIER2: Deutz BF4M2011 Diesel (Tier 2) **DEUTZ ECM: Engine Control Module** CAT Engine DEUTZ ECM T4i: Engine Control Module (Tier 4 Interim) **DEUTZ ECM: T4F: Engine Control Module (Tier 4 Final)**	**3(1500SJ)** **6(1850SJ)**
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**

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

Configuration 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**
FUEL CUTOUT: 8*	**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**
* This menu item is only visible if non-dual fuel engines are selected.			
TILT: 9*	**1** 2 3 4 5 6	**5 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 5 degrees and above elevation; also cuts out drive.** 4 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 4 degrees and above elevation; also cuts out drive. 3 DEGREES + DRV CUT: Reduces the maximum speed of all boom functions to creep when tilted more than 3 degrees and above elevation; also cuts out drive. 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**
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.			
* Certain market selections will alter default setting.			
JIB: 10	0 1 **2**	NO: No Jib installed. YES: Jib installed. **SIDESWING: Jib with Sideswing installed.**	**2**
4WS: 11	0 **1**	NO: 2WS mode enabled. **YES: 4WS mode enabled.**	**1**

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

Configuration Digit	Number	Description	Default Number
DRIVE: 12	0 **1**	2WD drive mode enabled. **4WD drive mode enabled.**	**1**
SOFT TOUCH/SKYGUARD: 13	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.	**2**
GEN SET/WELDER: 14	0 **1** 2	NO: No generator installed. **BELT DRIVE: Belt driven setup.** HYDRAULIC DRIVE: Hydraulic driven setup.	**1**
GEN SET CUTOUT: 15*	**0** 1	**MOTION ENABLED: Motion enabled when generator is ON.** MOTION CUTOUT: Motion cutout in platform mode only.	**0**
* Only visible if Gen Set / Welder Menu selection is not 0.			
H & T LIGHTS: 16	**0** 1	**NO: No head and tail lights installed.** YES: Head and tail lights installed.	**0**
LOAD SYSTEM: 17*	**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**
* Only visible under certain market selections.			
* Certain market selections will limit load system options or alter default setting.			
LOAD TYPE: 18	0 **1**	NO CAN LSS: Non CAN based LSS installed. **CAN LSS: CAN based LSS installed.**	**1**

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

Configuration Digit	Number	Description	Default Number
FUNCTION CUTOUT: 19*	**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**
* Only visible under certain market selections.			
* Certain market selections will limit function cutout options or alter default setting.			
GROUND ALARM: 20*	**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**
* Certain market selections will alter default setting.			
FLYWHEEL TEETH: 21*	**0** 1 2	**110 TEETH: Engine speed is calculated using 110 flywheel teeth.** 133 TEETH: Engine speed is calculated using 133 teeth. 112 TEETH: Engine speed is calculated using 112 teeth.	**0**
* Certain market selections will alter default setting.			
OSCILLATING AXLE: 22	0 **1**	NO: No oscillating axle system installed. **YES: Oscillating axle system installed.**	**1**
Note: The default settings (bold) will vary depending on the model selection with selection #0 being the initial default setting.			
DISPLAY UNTIS: 23*	0 **1**	METRIC: units selection (Deg. C, KPA, Kg). **IMPERIAL: units selection (Deg. F, PSI, Lbs).**	**1**
* Certain market selections will alter default setting.			
LEVELING MODE: 24	0 **1**	LIFT: Platform leveling during lift only. **ALL: Platform leveling during all functions.**	**1**
CLEARSKY: 25	**0** 1	**NO: ClearSky Telematics system not installed.** YES: ClearSky Telematics system installed.	**0**

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

Configuration Digit	Number	Description	Default Number
FUEL TANK: 26	**0** 1 2	**52 Gallon Fuel Tank** 31 Gallon Fuel Tank 45 Gallon Fuel Tank	**0**
ALERT BEACON: 27	**0** 1	**OFF FOR CREEP** 20FPS FOR CREEP	**0**
LANGUAGE: 28	**0** 1 2 3 4 5 6 7 8 9 10	**ENGLISH** SPANISH EURO PORTUGUESE BRAZILIAN PORTUGUESE FRENCH GERMAN DUTCH ITALIAN SIMPLIFIED CHINESE JAPANESE KOREAN	**0**
TEMP CUTOUT: 29*	**0** 1	**NO: No temperature cutout.** YES: Temperature cutout enabled.	**0**
* Certain market selections will alter default setting.			
PLAT LVL OVR CUT: 30	**0** 1	**NO: No platform cutout.** YES: Platform cutout enabled.	**0**
CRIBBING: 31*	**0** 1	**NO: Cribbing is not installed.** YES: Cribbing is installed.	**0**
* Certain market selections will alter default setting.			
WATER IN FUEL SENSOR: 32	**0** 1	**NO: Water in Fuel Sensor Option not installed.** YES: Water in Fuel Sensor Option installed.	**0**

Table 6-2. Machine Configuration Programming Information (Software Version P7.29)

Configuration Digit	Number	Description	Default Number
ALARM/HORN: 33	**0** 1	**COMBINED: The White Noise Alarm Option is not installed.** SEPARATE: The White Noise Alarm Option is installed.	**0**

1001128802-H

Table 6-3. Machine Configuration Programming Settings (Software Version P7.29)

1500SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Model Number	1	1	1	1	1	1
Envelope Height	0	0	0	0	0	0
Market	0	1	2	3	4	5
Engine	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	6	6	6	6	6	6
Glow Plug	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
Starter Lockout	0	0	0	0	0	0
	1	1	1	1	1	1
Engine Shutdown	0	0	0	0	0	0
	1	1	1	1	1	1
Fuel Cutout	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
Chasis Tilt	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
Jib	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
4 Wheel Steer	0	0	0	0	0	0
	1	1	1	1	1	1
Drive Type	0	0	0	0	0	0
	1	1	1	1	1	1
Soft Touch/SkyGuard	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
Gen Set / Welder	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2

Table 6-3. Machine Configuration Programming Settings (Software Version P7.29)

1500SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Gen Set Cutout	0	0	0	0	0	0
	1	1	1	1	1	1
Head & Taillights	0	0	0	0	0	0
	1	1	1	1	1	1
Load System	0	0	0	0	0	0
	X	1	X	2	2	1
	X	2	X	2	2	2
	X	3	X	3	3	3
	X	4	X	X	4	4
Load Type	0	0	0	0	0	0
	1	1	1	1	1	1
Function Cutout	X	0	0	1	0	0
	X	1	1	X	1	1
	X	2	2	X	2	2
	3	3	3	X	3	3
Ground Alarm	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
Flywheel Teeth	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
Oscillating Axle	0	0	0	0	0	0
	1	1	1	1	1	1
Display Units	0	0	0	0	0	0
	1	1	1	1	1	1
Leveling Mode	0	0	0	0	0	0
	1	1	1	1	1	1
ClearSky	0	0	0	0	0	0
	1	1	1	1	1	1
Fuel Tank	0	0	0	0	0	0
	1	1	1	1	1	1
	2	2	2	2	2	2
Alert Beacon	0	0	0	0	0	0
	1	1	1	1	1	1

Table 6-3. Machine Configuration Programming Settings (Software Version P7.29)

1500SJ	ANSI USA	ANSI Export	CSA	CE	Australia	Japan
Language	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
	2	2	2	2	2	2
	3	3	3	3	3	3
	4	4	4	4	4	4
	5	5	5	5	5	5
	6	6	6	6	6	6
	7	7	7	7	7	7
	8	8	8	8	8	8
	9	9	9	9	9	9
	10	10	10	10	10	10
Platform Cutout	**0**	**0**	**0**	**0**	**0**	**0**
	1	1	1	1	1	1
Temp Cutout	X	**0**	X	**0**	X	X
	X	1	X	1	X	X
Cribbing	0	0	0	X	X	0
	1	**1**	**1**	X	X	**1**
Water in Fuel Sensor	X	**0**	X	X	X	X
	X	1	X	X	X	X
Alarm/Horn	X	X	X	X	X	X
	X	X	X	X	X	X

BOLD TEXT indicates the default setting. Plain text indicates another available selection. ***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 6-4. Machine Personality Settings and Function Speeds

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION	RANGE	DEFAULT VALUES	TIME RANGE (SEC)
DRIVE:	ACCEL X.Xs	Displays/adjusts drive acceleration	0.1 to 5.0 sec	2	
	DECEL X.Xs	Displays/adjusts drive deceleration	0.1 to 3.0 sec	1.3	
	MIN forward XX%	Displays/adjusts minimum forward drive speed	0 to 35%	1	
	MAX forward XXX%	Displays/adjusts maximum forward drive speed	0 to 100%	100	44-48 (see orientation)
	MIN reverse XX%	Displays/adjusts minimum reverse drive speed	0 to 35%	1	
	MAX reverse XXX%	Displays/adjusts maximum reverse drive speed	0 to 100%	100	
	ELEV. MAX XX%	Displays/adjusts maximum drive speed	0 to 50%	25	93-104 (see orientation)
		NOTE: used when elevation cutout switches are limiting maximum speed			
	CREEP MAX XX%	Displays/adjusts maximum drive speed	0 to 50%	35	79-87 (see orientation)
		NOTE: used when creep switch on pump pot is active			
STEER:	MAX SPEED XXX%	Displays/adjusts maximum steer speed.	0 to 100%	100	

Table 6-4. Machine Personality Settings and Function Speeds

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION	RANGE	DEFAULT VALUES	TIME RANGE (SEC)
MAIN LIFT:	ACCEL X.Xs	Displays/adjusts main lift acceleration	0.1 to 5.0 sec	1	
	DECEL X.Xs	Displays/adjusts main lift deceleration	0.1 to 3.0 sec	1	
	MIN UP XX%	Displays/adjusts minimum main lift up speed	0 to 60%	20	
	MAX UP XX%	Displays/adjusts maximum main lift up speed	0 to 100%	60	80-120 (see orientation)
	CREEP UP XX%	Displays/adjusts maximum main lift up speed	0 to 65%	50	
		NOTE: used when creep switch on pump pot is active			
	MIN DOWN XX%	Displays/adjusts minimum main lift down speed	0 to 60%	10	
	MAX DOWN XXX%	Displays/adjusts maximum main lift down speed	0 to 100%	60	85-110 (see orientation)
	CREEP DOWN XX%	Displays/adjusts maximum main lift down speed	0 to 75%	45	
		NOTE: used when creep switch on pump pot is active			
SWING:	ACCEL X.Xs	Displays/adjusts swing acceleration	0.1 to 5.0 sec	2	
	DECEL X.Xs	Displays/adjusts swing deceleration	0.1 to 3.0 sec	1.5	
	MIN LEFT XX%	Displays/adjusts minimum swing left speed	0 to 50%	40	
	MAX LEFT XXX%	Displays/adjusts maximum swing left speed	0 to 100%	65	110-130 (see orientation)
	CREEP LEFT XX%	Displays/adjusts maximum swing left speed	0 to 65%	52	
		NOTE: used when creep switch on pump pot is active			
	MIN RIGHT XX%	Displays/adjusts minimum swing right speed	0 to 50%	40	
	MAX RIGHT XXX%	Displays/adjusts maximum swing right speed	0 to 100%	60	110-130 (see orientation)
	CREEP RIGHT XX%	Displays/adjusts maximum swing right speed	0 to 65%	47	
		NOTE: used when creep switch on pump pot is active			
MAIN TELESCOPE:	ACCEL X.Xs	Displays/adjusts main telescope acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts main telescope deceleration	0.1 to 3.0 sec	1	
	MIN IN XX%	Displays/adjusts minimum main telescope in speed. Same as Creep speed	0 to 65%	15	
	MAX IN XXX%	Displays/adjusts maximum main telescope in speed	0 to 100%	65	30-45 (see orientation)
	MIN OUT XX%	Displays/adjusts minimum main telescope out speed. Same as Creep speed	0 to 65%	10	
	MAX OUT XXX%	Displays/adjusts maximum main telescope out speed	0 to 100%	60	40-60 (see orientation)

Table 6-4. Machine Personality Settings and Function Speeds

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION	RANGE	DEFAULT VALUES	TIME RANGE (SEC)
PLATFORM LEVEL:	ACCEL X.Xs	Displays/adjusts basket level acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts basket level deceleration	0.1 to 3.0 sec	0.5	
	MIN UP XX%	Displays/adjusts minimum basket level up speed. Same as Creep speed	0 to 65%	55	
	MAX UP XXX%	Displays/adjusts maximum basket level up speed	0 to 100%	70	
	MIN DOWN XX%	Displays/adjusts minimum basket level down speed. Same as Creep speed	0 to 65%	50	
	MAX DOWN XXX%	Displays/adjusts maximum basket level down speed	0 to 100%	70	
PLATFORM ROTATE:	ACCEL X.Xs	Displays/adjusts basket rotate acceleration	0.1 to 5.0 sec	1	
	DECEL X.Xs	Displays/adjusts basket rotate deceleration	0.1 to 3.0 sec	0.5	
	MIN LEFT XX%	Displays/adjusts minimum basket rotate left speed. Same as Creep speed	0 to 100%	60	
	MAX LEFT XXX%	Displays/adjusts maximum basket rotate left speed	0 to 100%	60	24-30 (180°)
	MIN RIGHT XX%	Displays/adjusts minimum basket rotate right speed. Same as Creep speed	0 to 100%	60	
	MAX RIGHT XXX%	Displays/adjusts maximum basket rotate right speed	0 to 100%	60	24-30 (180°)

Table 6-4. Machine Personality Settings and Function Speeds

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION	RANGE	DEFAULT VALUES	TIME RANGE (SEC)
JIB LIFT:	ACCEL X.Xs	Displays/adjusts jib lift acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts jib lift deceleration	0.1 to 3.0 sec	1	
	MIN UP XX%	Displays/adjusts minimum jib up speed. Same as Creep speed	0 to 65%	65	
	MAX UP XXX%	Displays/adjusts maximum jib up speed	0 to 100%	85	70-120
	MIN DOWN XX%	Displays/adjusts minimum jib down speed. Same as Creep speed	0 to 65%	60	
	MAX DOWN XXX%	Displays/adjusts maximum jib down speed	0 to 100%	85	65-100
JIB SWING:	ACCEL X.Xs	Displays/adjusts jib swing acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts jib swing deceleration	0.1 to 3.0 sec	0.5	
	MIN LEFT XX%	Displays/adjusts minimum jib left speed. Same as Creep speed	0 to 65%	48	
	MAX LEFT XXX%	Displays/adjusts maximum jib left speed	0 to 100%	70	60-68 (180°)
	MIN RIGHT XX%	Displays/adjusts minimum jib right speed. Same as Creep speed	0 to 65%	55	
	MAX RIGHT XXX%	Displays/adjusts maximum jib right speed	0 to 100%	70	60-68 (180°)
JIB TELESCOPE:	ACCEL X.Xs	Displays/adjusts jib tele acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts jib tele deceleration	0.1 to 3.0 sec	1	
	MIN IN XX%	Displays/adjusts minimum jib tele in speed. Same as Creep speed	0 to 65%	45	
	MAX IN XXX%	Displays/adjusts maximum jib tele in speed	0 to 100%	70	20-35(see orientation)
	MIN OUT XX%	Displays/adjusts minimum jib right speed. Same as Creep speed	0 to 65%	40	
	MAX OUT XXX%	Displays/adjusts maximum jib right speed	0 to 100%	70	15-25 (see orientation)

Table 6-4. Machine Personality Settings and Function Speeds

SUBMENU (DISPLAYED ON ANALYZER 1ST LINE)	PARAMETER (DISPLAYED ON ANALYZER 2ND LINE)	DESCRIPTION	RANGE	DEFAULT VALUES	TIME RANGE (SEC)
JIB LEVEL:	ACCEL X.Xs	Displays/adjusts jib level acceleration	0.1 to 5.0 sec	1.5	
	DECEL X.Xs	Displays/adjusts jib level deceleration	0.1 to 3.0 sec	0.5	
	MIN UP XX%	Displays/adjusts minimum jib level up speed. Same as Creep speed	0 to 65%	60	
	MAX UP XXX%	Displays/adjusts maximum jib level up speed	0 to 100%	100	
	MIN DOWN XX%	Displays/adjusts minimum jib level down speed. Same as Creep speed	0 to 65%	60	
	MAX DOWN XXX%	Displays/adjusts maximum jib level down speed	0 to 100%	100	
GROUND MODE:	M. LIFT UP XXX%	Displays/adjusts fixed main lift up speed	0 to 100%	60	
	M. lift DN XXX%	Displays/adjusts main lift down speed	0 to 100%	60	
	SWING XXX%	Displays/adjusts fixed swing speed	0 to 100%	60	
	PLATFORM LVL XXX%	Displays/adjusts fixed basket level speed	0 to 100%	75	
	PLATFORM ROT XXX%	Displays/adjusts fixed basket rotate speed	0 to 100%	75	
	MAIN TELE XXX%	Displays/adjusts fixed main telescope speed	0 to 100%	60	
	JIB (U/D) XXX%	Displays/adjusts jib lift speed	0 to 100%	80	
		Not displayed if JIB = 0			
	JIB (L/R) XXX%	Displays/adjusts jib swing speed	0 to 100%	80	
		Displayed if JIB = 2			
	JIB TELE XXX%	Displays/adjusts jib tele speed	0 to 100%	80	
	JIB LEVEL XXX%	Displays/adjusts jib level speed	0 to 100%	100	
GEN SET/WELDER:	Engine XXXX RPM	Control generator/welder RPM. Not displayed if GEN SET/WELDER = 0	1200-2800	1800	

1001128803-F

6.3 MACHINE ORIENTATION WHEN SETTING FUNCTION SPEEDS

LIFT UP, from platform control, lowest elevation up to maximum elevation, boom retracted, jib retracted.

LIFT DOWN, from platform control, maximum elevation down to minimum elevation, boom retracted, jib retracted.

JIB LIFT UP, from platform control, lowest jib elevation up to maximum jib elevation, boom retracted, jib retracted.

JIB LIFT DOWN, from platform control, maximum jib elevation down to minimum jib elevation, boom retracted, jib retracted.

SWING RIGHT(Max),360 Degrees, from platform control, boom approximately 45° elevation, boom retracted, jib retracted.

SWING LEFT (Max), 360 Degrees, from platform control, boom approximately 45° elevation, boom retracted, jib retracted.

TELESCOPE OUT, from platform control, boom @ 20 degrees, 500 lb. capacity selected.

TELESCOPE IN, from platform control, boom @20 degrees, 500 lb. capacity selected.

JIB TELESCOPE IN, from platform control, boom horizontal, jib horizontal, 500 lb. capacity selected.

JIB TELESCOPE OUT, from platform control, boom horizontal, jib horizontal, 500 lb. capacity selected.

DRIVE FORWARD (Max), high speed - low torque setting, drive 200 ft. front wheels to front wheels. Timed after machine has obtained maximum speed.

DRIVE REVERSE (Max), high speed - low torque setting, drive 200 ft. front wheels to front wheels. Timed after machine has obtained maximum speed.

DRIVE FORWARD (Creep Max), high torque - low speed setting, platform speed knob at full creep

DRIVE REVERSE (Creep Max), high torque - low speed setting, platform speed knob at full creep

DRIVE FORWARD (Elevated Max - Boom Beyond Transport), high speed - low torque setting, platform speed knob out of creep, Lift boom above transport, drive forward 50 ft.

DRIVE REVERSE (Elevated Max - Boom Beyond Transport), high speed - low torque setting, platform speed knob out of creep, Lift boom above transport, drive backward 50 ft.

Test Notes

1. Personality settings can be adjusted anywhere within the adjustment range in order to achieve optimum machine performance.
2. Stop watch should start when the function is activated, not with the controller or switch.
3. Unless noted, function speeds should be measured from platform.
4. Platform speed knob must be at full speed (fully clockwise).
5. All test should be done with the oil temp above 100° F (38° C).

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, all other system modules (PLATFORM, JIB, BLAM, CHASSIS) 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, sends desired drive direction, sends steering mode and sends axle extend / retract commands. The PLATFORM MODULE reports the steering switch position to the GROUND MODULE. The CHASSIS MODULE modulates each steer left / right valve to maintain commanded wheel position.

Drive: The GROUND MODULE stores crack points, sends commands for each drive pump to the BLAM. (Command is computed from drive joystick input, interlocks, wheel angle, etc). BLAM maintains proper current for the drive pumps by modulating PWM outputs.

Lift, Tele, & Swing: The GROUND MODULE stores default values, 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. The BLAM monitors and communicates (CANbus) to the GROUND MODULE boom angle and boom length via two angle sensors, a length sensor and a load moment pin.

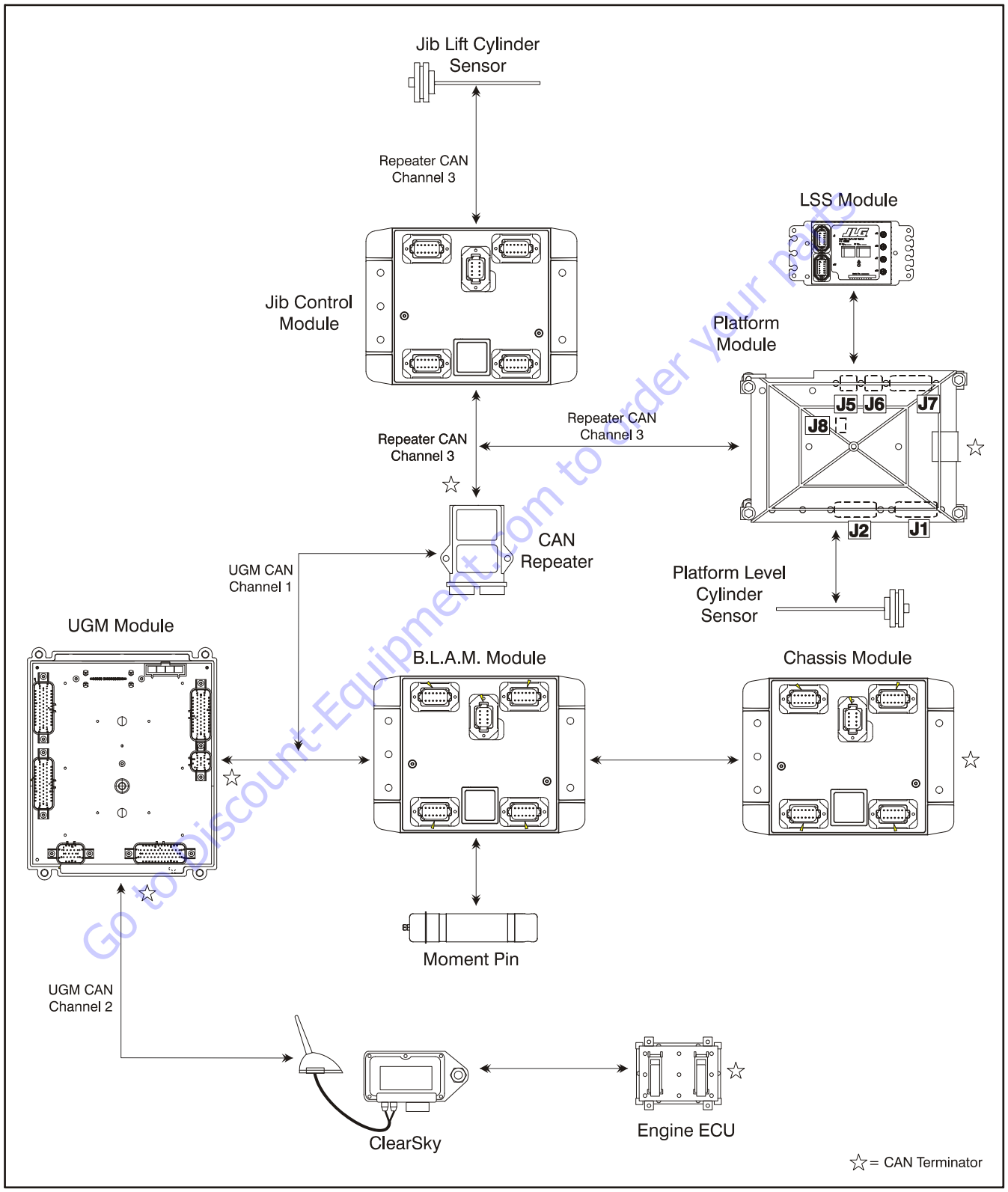


Figure 6-2. Control System Block Diagram

6.5 CALIBRATION INSTRUCTIONS

This machine incorporates a variety of sensors and a high degree of function interaction. For safety and proper machine functionality, the calibration procedures must be repeated for any control module replacement, system calibration related fault, or removal or replacement of any sensors, valves, coils, motors, or pumps.

The chart below lists the calibrations required and potential reasons for re-calibration. All calibration procedures are menu driven through the use of the standard analyzer. With the exception of steering calibration, no external tools are required to complete the calibration procedures.

The user is prompted to exercise the machine in a specific order to use the machines physical properties to consistently establish sensor response and the interaction of valves, pumps, and motors. Steering calibration also uses the analyzer and is performed on one side of the machine at a time requiring the use of a string or other means to determine when the tires are in line with each other. Calibrations are accessed by connecting the analyzer into the control system inside the main terminal box or on the bottom of the platform control box.

Table 6-5. Calibration Instructions

Calibration Procedure	Reasons for Re-calibration
Steering Calibration	Ground module replacement Chassis module replacement Steer sensor removal or replacement Persistent wheel misalignment
Drive Calibration	Ground module replacement BLAM module replacement Drive pump/coil replacement Drive pulls to one side Drive lugs engine Poor slow speed control
Platform Leveling Calibration	Ground module replacement Platform module replacement Platform level sensor removal or replacement Platform level sensor calibration fault
Platform Level Crack Point Calibration	Platform module replacement Ground module replacement Platform level valve/coil replacement Erratic platform leveling
Jib Level Crack Point Calibration	Ground Module replacement Jib Control Module replacement Jib Level Sensor replacement Jib Level valve/coil replacement Erratic jib leveling

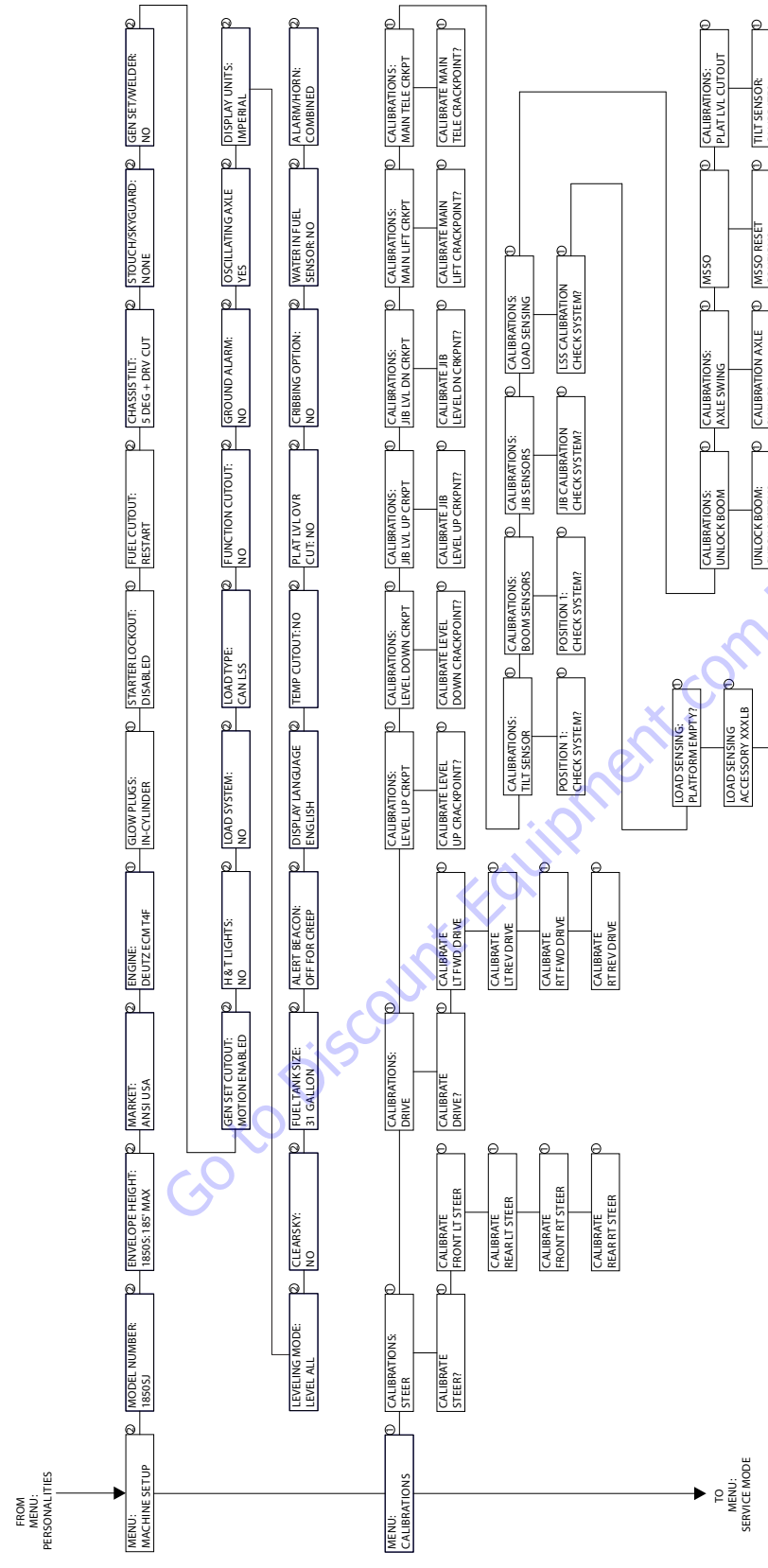
Table 6-5. Calibration Instructions

Lift Crack Point Calibration	Ground module replacement Lift proportional valve/coil replacement Erratic controlled arc operation Erratic controlled boom angle operation
Telescope Crack Point Calibration	Ground module replacement Telescope proportional valve replacement Erratic controlled arc operation Erratic controlled boom angle operation
Jib Level Crack Point Calibration	Jib Control Module replacement Jib level proportional valve replacement
Chassis Tilt Calibration	Ground module removal or replacement Main terminal box removal or replacement Tilt indication inaccuracy
Boom Sensors Calibration	Ground module removal or replacement BLAM module removal or replacement Boom angle sensor removal or replacement Boom length sensor removal or replacement Moment pin removal or replacement Main Boom angle sensor calibration fault Main Boom length sensor calibration fault Moment pin fault Failed BCS functional check Boom control system inaccuracies
Jib Sensor Calibration	Ground module removal or replacement Replacement of any Jib sensor Replacement of the Jib Control Module
Platform Load Control Calibration	LSS module replacement Load cell removal or replacement Load control inaccuracy

1001119511-P
MAF09890P

Figure 6-3. Analyzer Flow Chart - Sheet 1 of 5 (Software Version P7.29)

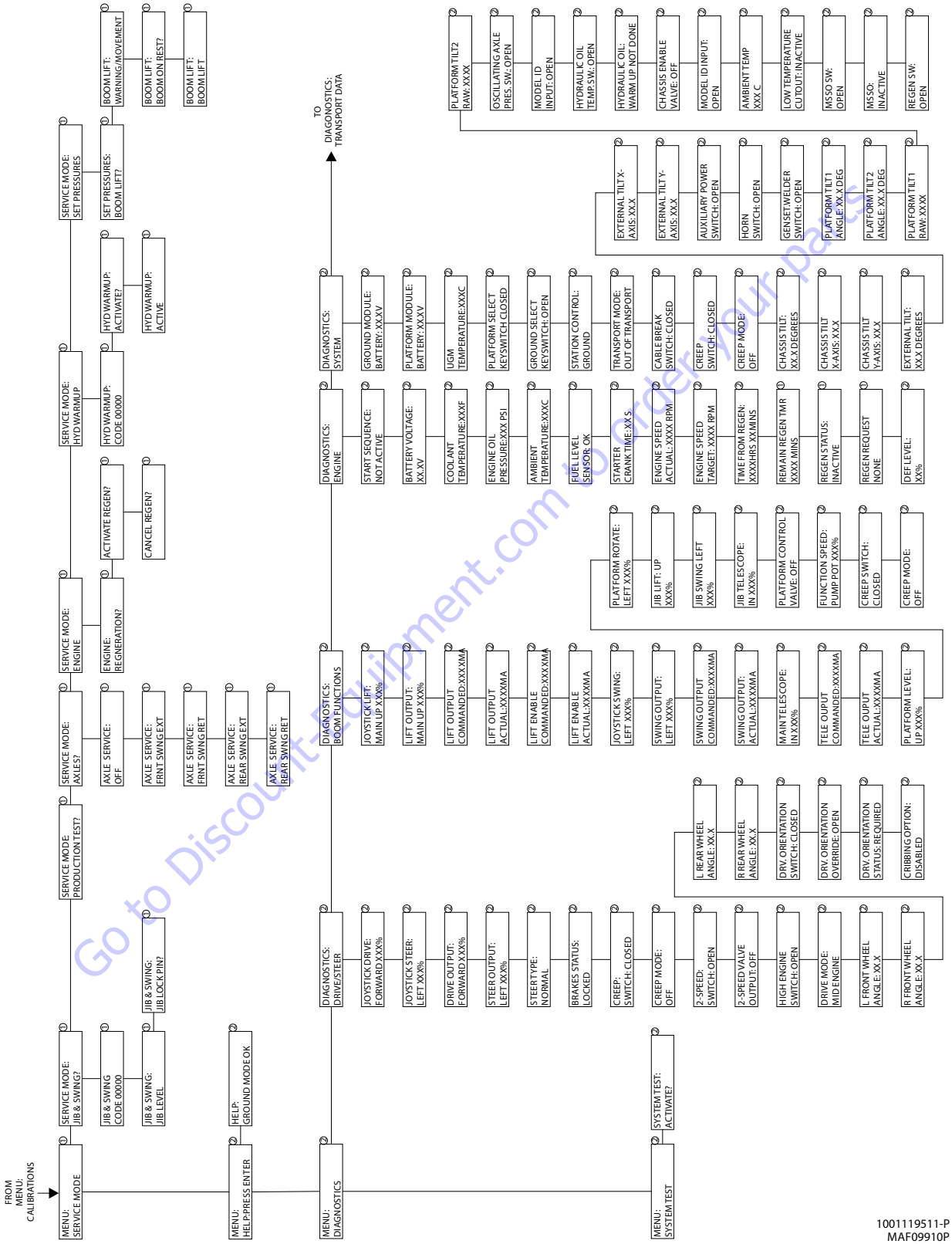
NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-4. Analyzer Flow Chart - Sheet 2 of 5 (Software Version P7.29)

1001119511-P
MAF09900P

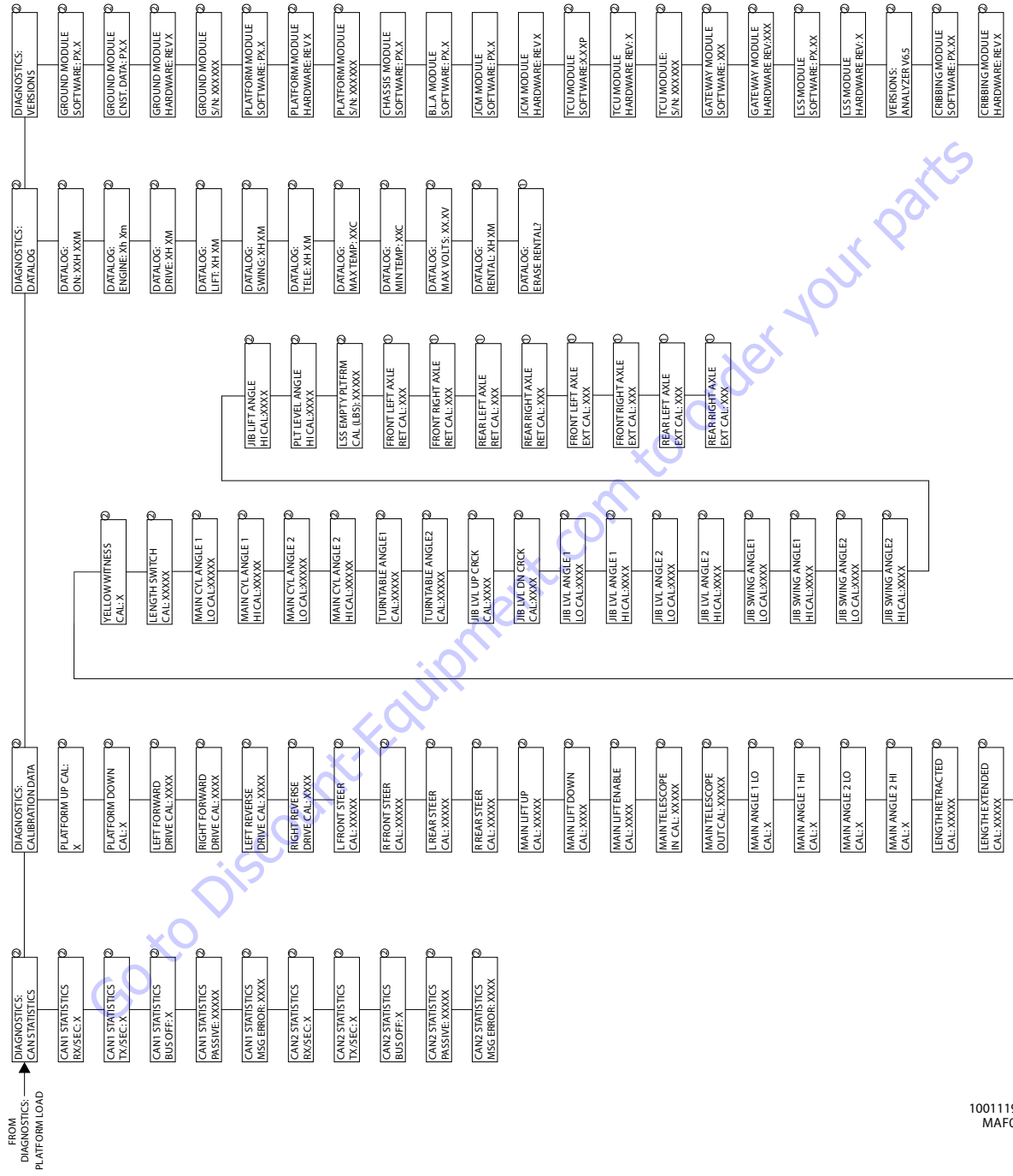


NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-5. Analyzer Flow Chart - Sheet 3 of 5 (Software VersionP 7.29)

NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-6. Analyzer Flow Chart - Sheet 4 of 5 (Software Version P7.29)



NOTE: *The layout shown includes all possible analyzer screens. Please note that some screens may not be available depending upon machine configuration.*

Figure 6-7. Analyzer Flow Chart - Sheet 5 of 5 (Software Version P7.29)

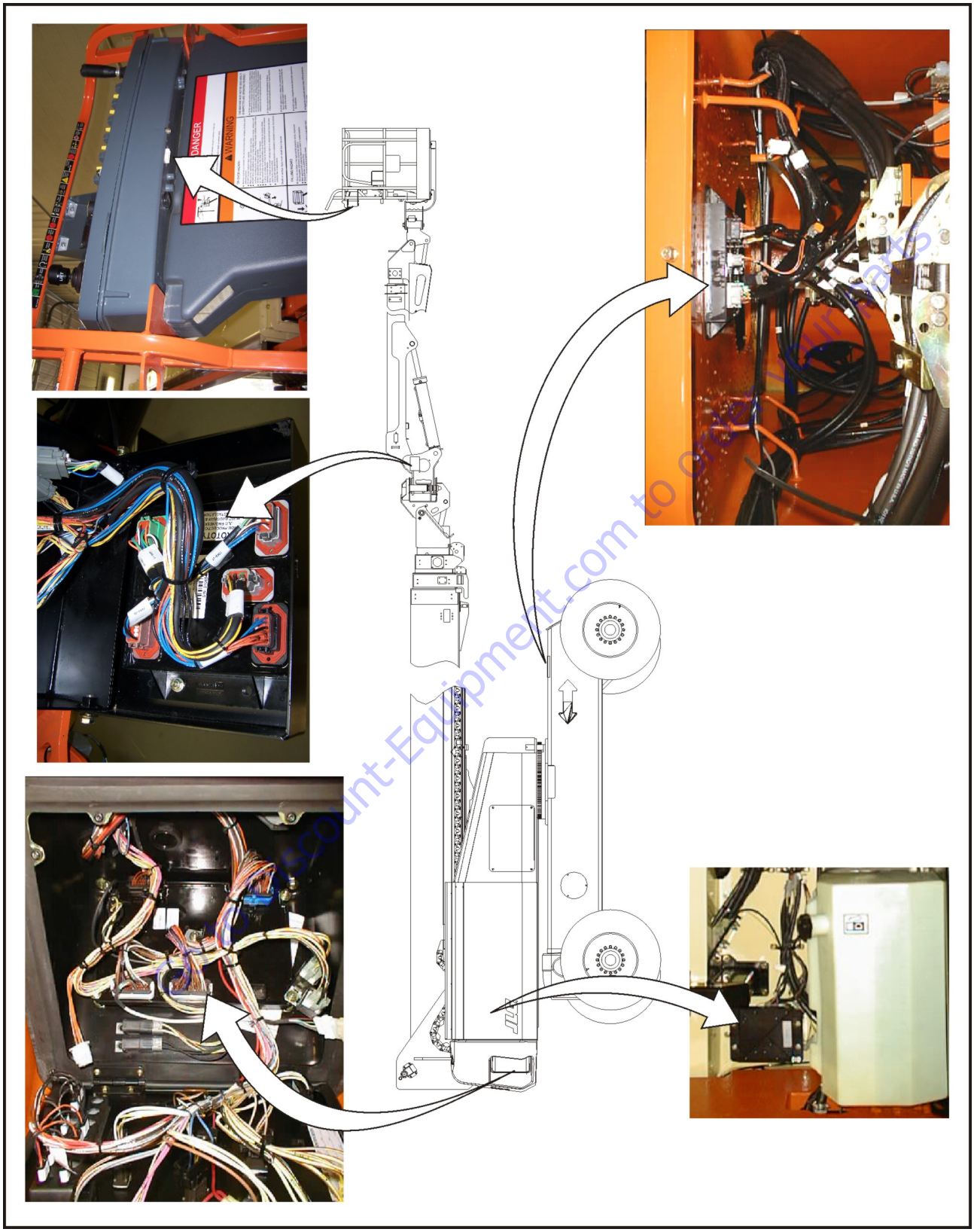


Figure 6-8. Control Module Location

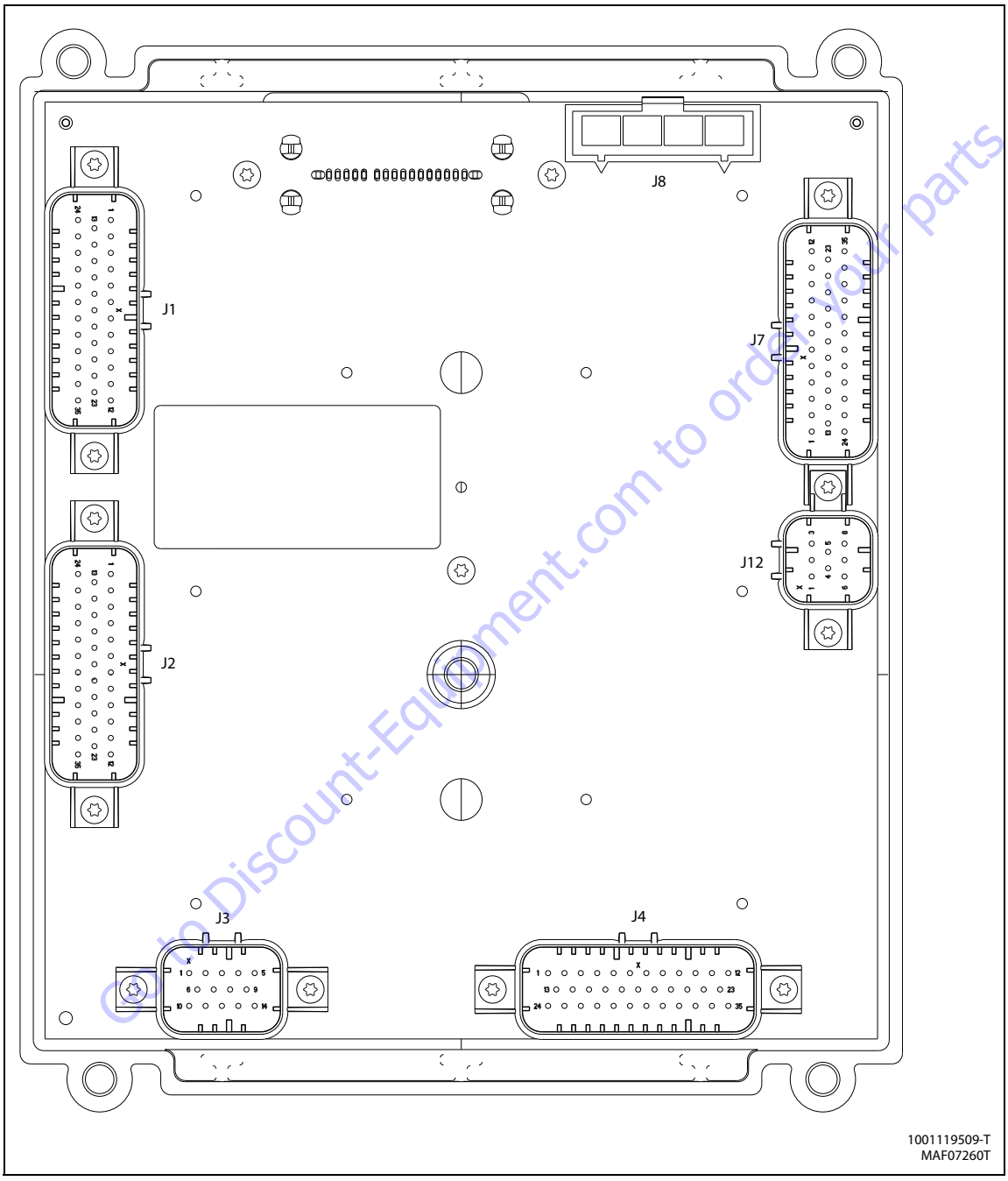


Figure 6-9. Ground Control Module

Connector	Pin	Function	Type	
J1 (Natural)	1	THROTTLE ACTUATOR (DIESEL ONLY)	DIGITAL	OUTPUT
	2	SPARE (LP NOT USED)	DIGITAL	OUTPUT
	3	TOWER BOOM LIFT POWER	DIGITAL	OUTPUT
	4	GROUND	GROUND	INPUT
	5	GROUND	GROUND	INPUT
	6	TOWER TELESCOPE ENABLE	DIGITAL	OUTPUT
	7	SPARE (LP NOT USED)	DIGITAL	OUTPUT
	8	GROUND	GROUND	INPUT
	9	GROUND	GROUND	INPUT
	10	IGNITION ON RELAY	DIGITAL	OUTPUT
	11	START SOLENOID (DIESEL ONLY)	DIGITAL	OUTPUT
	12	GLOW PLUG (DIESEL ONLY OPTION)	DIGITAL	OUTPUT
	13	AUXILIARY POWER	DIGITAL	OUTPUT
	14	COOLANT TEMP (DIESEL ONLY)	ANALOG	INPUT
	15	OIL PRESSURE (DIESEL ONLY)	ANALOG	INPUT
	16	FLYWHEEL SPEED PICKUP (DIESEL ONLY)	FREQUENCY	INPUT
	17	GROUND	GROUND	INPUT
	18	SPARE GROUND	GROUND	INPUT
	19	SPARE GROUND	GROUND	INPUT
	20	TWO SPEED	DIGITAL	OUTPUT
	21	MAIN LIFT PILOT PRESSURE SWITCH	DIGITAL	INPUT
	22	GENERATOR/WELDER (OPTION)	DIGITAL	OUTPUT
	23	PARKING BRAKE	DIGITAL	OUTPUT
	24	CONSTANT BATTERY	N/C	N/C
	25	RS-485 HI	SERIAL	I/O
	26	RS-485 LO	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	GROUND SHIELD	GROUND	INPUT
	34	SPARE	DIGITAL	INPUT
	35	HYDRAULIC OIL TEMPERATURE SWITCH	DIGITAL	INPUT

Connector	Pin	Function	Type	
J2 (Gray)	1	MAIN LIFT PILOT	DIGITAL	OUTPUT
	2	HORN	DIGITAL	OUTPUT
	3	PLATFORM CONTROL VALVE	DIGITAL	OUTPUT
	4	UPPER TELESCOPE IN	DIGITAL	OUTPUT
	5	BASKET LEVEL UP OVERRIDE	DIGITAL	OUTPUT
	6	GROUND	GROUND	INPUT
	7	BASKET LEVEL DOWN OVERRIDE	DIGITAL	OUTPUT
	8	TOWER TELESCOPE POWER	DIGITAL	OUTPUT
	9	TELESCOPE FLOW CONTROL	DIGITAL	OUTPUT
	10	LIFT PILOT	DIGITAL	OUTPUT
	11	UPPER LIFT UP	DIGITAL	OUTPUT
	12	LIFT DOWN AUXILIARY	DIGITAL	OUTPUT
	13	MAIN DUMP	DIGITAL	OUTPUT
	14	GROUND	GROUND	INPUT
	15	NOT CONNECTEDRS232 BACKUP COMM. ENABLE	DIGITAL	OUTPUT
	16	UPPER TELESCOPE OUT	DIGITAL	OUTPUT
	17	GROUND	GROUND	INPUT
	18	SPARE PIN	GROUND	INPUT
	19	LIFT FLOW CONTROL	DIGITAL	OUTPUT
	20	SPARE OUTPUT	DIGITAL	OUTPUT
	21	MAIN BOOM ANGLE SENSOR #2 POWER	DIGITAL	OUTPUT
	22	UPPER LIFT DOWN	DIGITAL	OUTPUT
	23	MAIN BOOM LIFT ENABLE	DIGITAL	OUTPUT
	24	TOWER CYLINDER TYPE	DIGITAL	INPUT
	25	FUEL SENSOR	ANALOG	INPUT
	26	HEAD/TAIL LIGHT	DIGITAL	OUTPUT
	27	ALARM	DIGITAL	OUTPUT
	28	SPARE PIN	GROUND	INPUT
	29	GROUND	GROUND	INPUT
	30	GROUND	GROUND	INPUT
	31	PVG ENABLE	DIGITAL	OUTPUT
	32	TOWER BOOM TELESCOPE PILOT	DIGITAL	OUTPUT
	33	TOWER BOOM LIFT ENABLE	DIGITAL	OUTPUT
	34	SWING LEFT	DIGITAL	OUTPUT
	35	SWING RIGHT	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J8 (Black)	1	GROUND FROM BATTERY	GROUND	OUTPUT
	2	GROUND EMS	VBAT	INPUT
	3	GROUND TO PLATFORM	GROUND	INPUT
	4	GROUND EMS OUT TO PLATFORM	VBAT	OUTPUT

Connector	Pin	Function	Type	
J12 (Black)	1	FREQUENCY INPUT 2	FREQUENCY	INPUT
	2	FREQUENCY INPUT 2 RETURN	FREQUENCY	INPUT
	3	CAN 2 H	SERIAL	I/O
	4	CAN 2 L	SERIAL	I/O
	5	CAN 2 SHIELD	GROUND	INPUT
	6	CAN 2 TERMINATOR	TERM	I/O
	7	CAN 2 TERMINATOR	TERM	I/O
	8	SPARE LS DIGITAL INPUT	DIGITAL	INPUT

Connector	Pin	Function	Type	
J3 (Black)	1	SPARE VAVLE RETURN 1	GROUND	INPUT
	2	SPARE VAVLE RETURN 2	GROUND	INPUT
	3	GROUND	GROUND	INPUT
	4	SPARE VAVLE RETURN 4	GROUND	INPUT
	5	SPARE VAVLE RETURN 5	GROUND	INPUT
	6	SPARE VAVLE RETURN 6	GROUND	INPUT
	7	VBAT	VBAT	OUTPUT
	8	SPARE HS DIGITAL IN (FREQ. CAPABLE)	DIGITAL	INPUT
	9	ALTERNATOR EXCITATION INPUT	DIGITAL	INPUT
	10	SPARE HS SWITCH INPUT (MODEL INPUT FOR 1100S)	DIGITAL	INPUT
	11	SPARE LS DIGITAL INPUT	DIGITAL	INPUT
	12	ANALOG REF. VOLTAGE	VOLTAGE	OUTPUT
	13	SPARE ANALOG INPUT 8	ANALOG	INPUT
	14	SPARE VALVE RETURN 3	GROUND	INPUT

Connector	Pin	Function	Type	
J4 (Blue)	1	AXLES SET LAMP	DIGITAL	OUTPUT
	2	500# CAPACITY LAMP	DIGITAL	OUTPUT
	3	BOOM CONTROL SYSTEM LAMP	DIGITAL	OUTPUT
	4	START SWITCH	DIGITAL	INPUT
	5	BASKET LEVEL DOWN	DIGITAL	INPUT
	6	BASKET LEVEL DOWN	DIGITAL	INPUT
	7	UPPER TELESCOPE IN	DIGITAL	INPUT
	8	JIB DOWN	DIGITAL	INPUT
	9	JIB LEFT	DIGITAL	INPUT
	10	TOWER UP	DIGITAL	INPUT
	11	MAIN TOWER TRANSPORT ANGLE OPEN	DIGITAL	INPUT
	12	HOUR METER	DIGITAL	OUTPUT
	13	BCS CALIBRATED LAMP	DIGITAL	OUTPUT
	14	OVERLOAD LAMP	DIGITAL	OUTPUT
	15	SPARE	DIGITAL	OUTPUT
	16	AUXILIARY POWER	DIGITAL	INPUT
	17	BASKET LEVEL UP	DIGITAL	INPUT
	18	BASKET ROTATE RIGHT	DIGITAL	INPUT
	19	JIB UP	DIGITAL	INPUT
	20	JIB RIGHT	DIGITAL	INPUT
	21	TOWER DOWN	DIGITAL	INPUT
	22	MAIN BOOM TRANSPORT ANGLE CLOSED	DIGITAL	INPUT
	23	UPPER LIFT UP	DIGITAL	INPUT
	24	VBAT	VBAT	OUTPUT
	25	VBAT	VBAT	OUTPUT
	26	NO CHARGE LAMP	DIGITAL	OUTPUT
	27	1000# CAPACITY LAMP	DIGITAL	OUTPUT
	28	ENGINE HIGH TEMPERATURE LENGTH'	DIGITAL	OUTPUT
	29	ENGINE LOW OIL PRESSURE LAMP	DIGITAL	OUTPUT
	30	UPPER TELESCOPE OUT	DIGITAL	INPUT
	31	GROUND	GROUND	INPUT
	32	SPARE PIN	GROUND	INPUT
	33	UPPER LIFT DOWN	DIGITAL	INPUT
	34	SWING LEFT	DIGITAL	INPUT
	35	SWING RIGHT	DIGITAL	INPUT

Connector	Pin	Function	Type	
J7 (Black)	1	PLATFORM EMS	DIGITAL	INPUT
	2	PLATFORM MODE	DIGITAL	INPUT
	3	GROUND MODE	DIGITAL	INPUT
	4	TOWER CYLINDER PRESSURE	ANALOG	INPUT
	5	REFERENCE VOLTAGE	VOLTAGE	OUTPUT
	6	CAN TERMINATION	TERM	I/O
	7	SPARE	ANALOG	INPUT
	8	SPARE ANALOG INPUT 2	ANALOG	INPUT
	9	GROUND	GROUND	INPUT
	10	GROUND	GROUND	INPUT
	11	BOOM RETRACTED CLOSED	DIGITAL	INPUT
	12	BROKEN CABLE SWITCH	DIGITAL	IPUT
	13	CAN HI	SERIAL	I/O
	14	GROUND MODE OUT TO PLATFORM	DIGITAL	INPUT
	15	FOOTSWITCH ENGAGE	DIGITAL	INPUT
	16	REFERENCE VOLTAGE	VOLTAGE	OUTPUT
	17	CAN TERMINATION	TERM	I/O
	18	CAN SHEILD	GROUND	INPUT
	19	SPARE PIN	GROUND	INPUT
	20	SPARE ANALOG INPUT 1	ANALOG	INPUT
	21	PUSH TO TEST	DIGITAL	INPUT
	22	TOWER BOOM TRANSPORT ANGLE	DIGITAL	INPUT
	23	GROUND CONTROL ENABLE	DIGITAL	INPUT
	24	CAN LO	SERIAL	I/O
	25	GROUND	GROUND	INPUT
	26	REFERENCE VOLTAGE	VOLTAGE	OUTPUT
	27	REFERENCE VOLTAGE	VOLTAGE	OUTPUT
	28	GROUND (RESERVED FOR CRIBBING OPTION)	GROUND	INPUT
	29	VBAT	VBAT	OUTPUT
	30	VBAT	VBAT	OUTPUT
	31	VBAT	VBAT	OUTPUT
	32	VBAT	VBAT	OUTPUT
	33	VBAT (RESERVED FOR CRIBBING OPTION)	VBAT	OUTPUT
	34	CLEARSKY POWER (VBAT)	VBAT	OUTPUT
	35	BOOM RETRACT OPEN	DIGITAL	INPUT

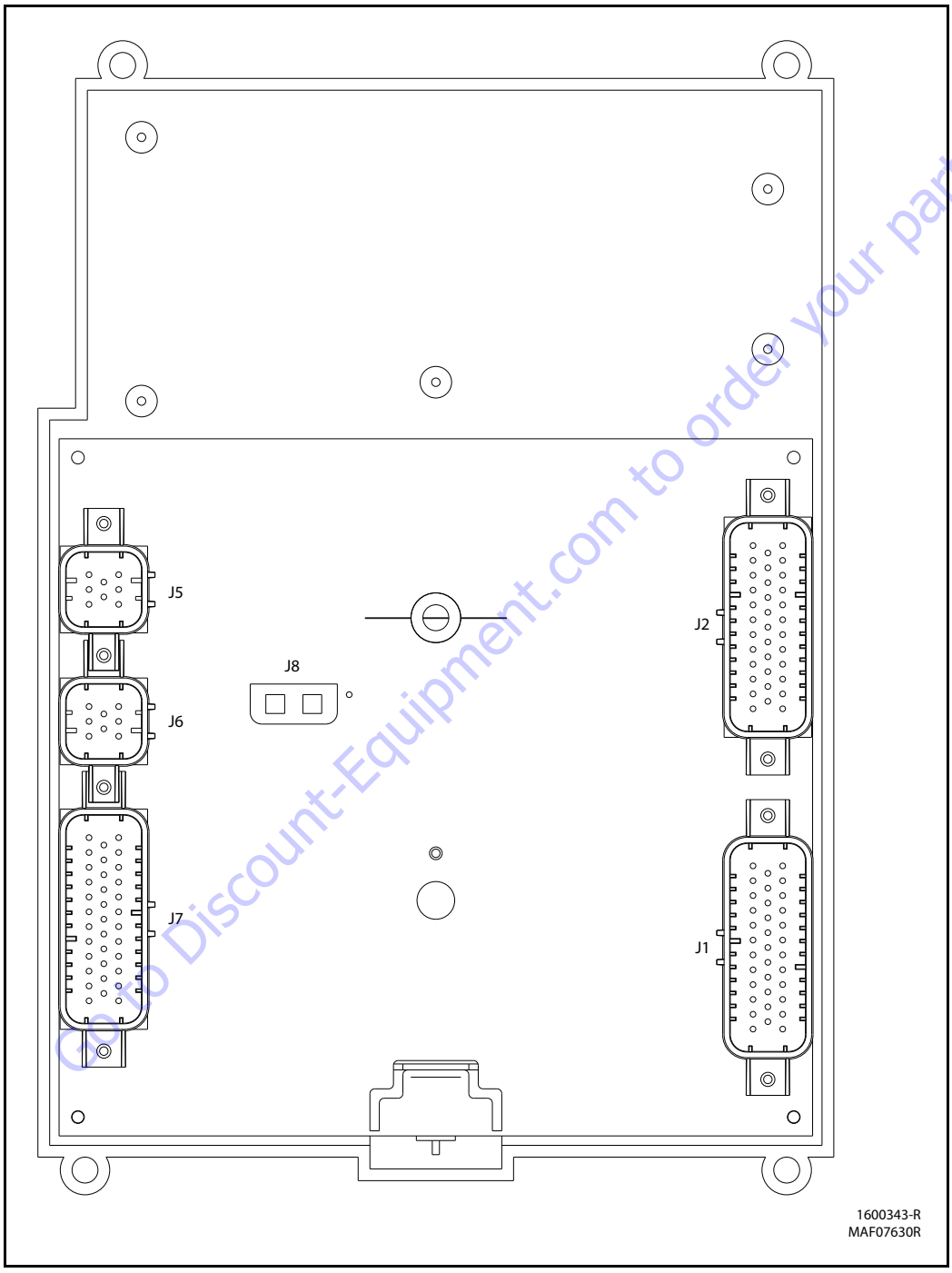


Figure 6-10. Platform Control Module

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

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
J8	1	MODULE GROUND	GROUND
	2	MODULE POWER	BATTERY VOLTAGE

CONNECTOR	PIN	ASSIGNMENT	FUNCTION
J2 (BLUE)	1	SPARE PIN	HS DIGITAL INPUT
	2	SPARE PIN	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	SPARE PIN	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
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	GRPOUND
	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

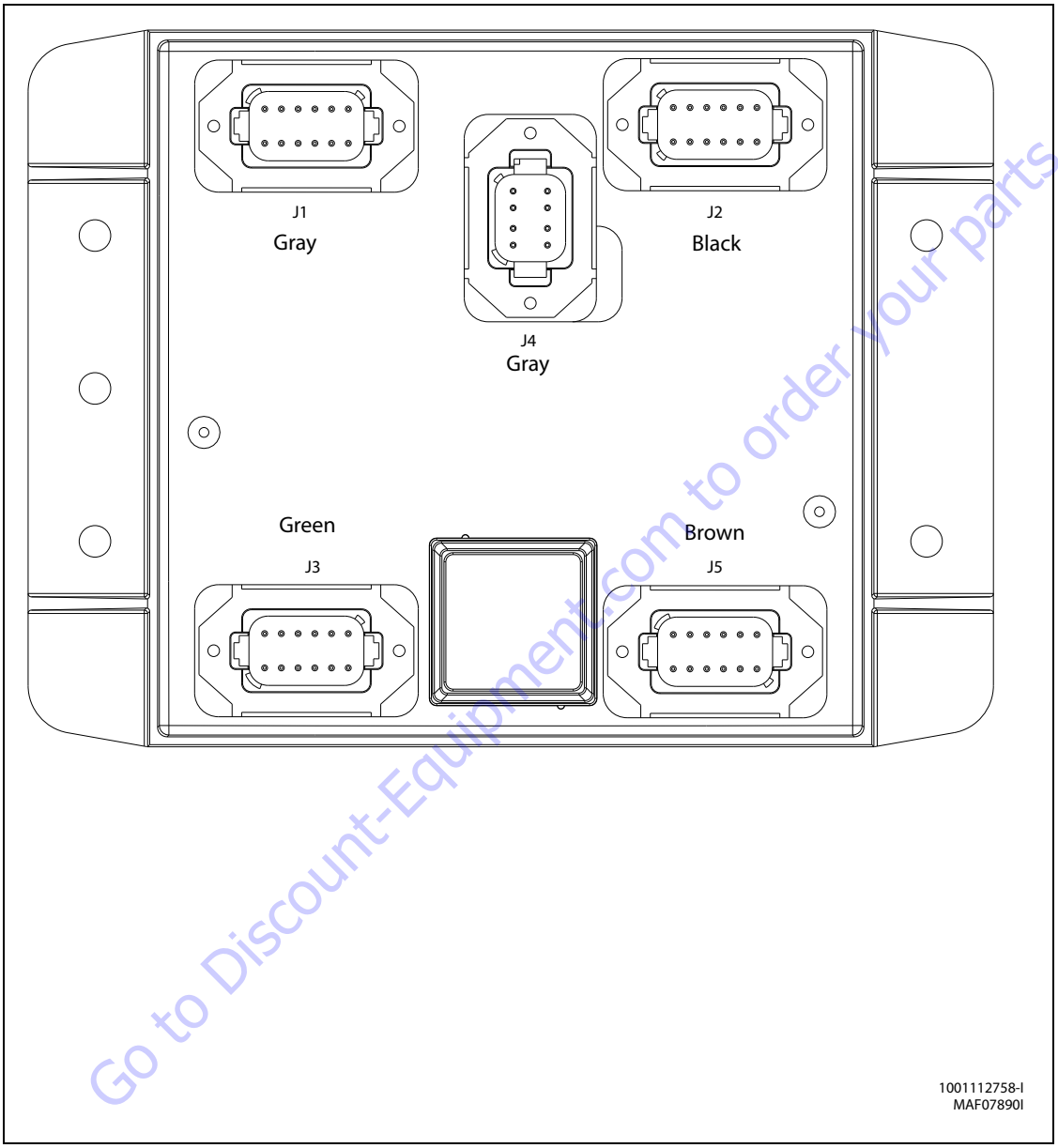


Figure 6-11. Chasis Control Module

Connector	Pin	Function	Type	
J1 (Gray)	1	POWER FEED THRU TO J2-1	POWER	I/O
	2	POWER FEED THRU TO J2-2	POWER	I/O
	3	SIGNAL FEED THRU TO J2-4	DIGITAL	I/O
	4	MASTER GROUND CONNECT	POWER	INPUT
	5	MASTER IGNITION CONNECT	POWER	INPUT
	6	CANBUS HIGH	SERIAL	I/O
	7	CANBUS LOW	SERIAL	I/O
	8	CANBUS SHIELD	SERIAL	I/O
	9	CANBUS TERMINATOR	SERIAL	I/O
	10	CANBUS TERMINATOR	SERIAL	I/O
	11	IGNITION	POWER	OUTPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J5 (Brown)	1	RIGHT FRONT STEER RIGHT	DIGITAL	OUTPUT
	2	RIGHT FRONT STEER LEFT	DIGITAL	OUTPUT
	3	LEFT FRONT STEER RIGHT	DIGITAL	OUTPUT
	4	LEFT FRONT STEER LEFT	DIGITAL	OUTPUT
	5	RIGHT REAR STEER RIGHT	DIGITAL	OUTPUT
	6	RIGHT REAR STEER LEFT	DIGITAL	OUTPUT
	7	LEFT REAR STEER RIGHT	DIGITAL	OUTPUT
	8	LEFT REAR STEER LEFT	DIGITAL	OUTPUT
	9	IGNITION	POWER	OUTPUT
	10	RS232 RECEIVE	SERIAL	INPUT
	11	RS232 TRANSMIT	SERIAL	OUTPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J2 (Black)	1	POWER FEED THRU TO J1-1	POWER	I/O
	2	POWER FEED THRU TO J1-2	POWER	I/O
	3	GROUND	POWER	OUTPUT
	4	FRONT AXLES LIMIT SWITCH	DIGITAL	INPUT
	5	REAR AXLES LIMIT SWITCH	DIGITAL	INPUT
	6	DRIVE ORIENTATION SWITCH	DIGITAL	INPUT
	7	OSCILLATING AXLE PRES SW	DIGITAL	INPUT
	8	TURNTABLE ANGLE SENSOR #1	DIGITAL	INPUT
	9	TURNTABLE ANGLE SENSOR #2	DIGITAL	INPUT
	10	SPARE ANALOG	ANALOG	INPUT
	11	FRONT/REAR AXLE EXTEND	DIGITAL	OUTPUT
	12	FRONT/REAR AXLE RETRACT	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J3 (Green)	1	+5V ANALOG REFERENCE	POWER	OUTPUT
	2	FRONT RIGHT STEER ANGLE	ANALOG	INPUT
	3	GROUND	POWER	OUTPUT
	4	+5V ANALOG REFERENCE	POWER	OUTPUT
	5	FRONT LEFT STEER ANGLE	ANALOG	INPUT
	6	GROUND	POWER	OUTPUT
	7	+5V ANALOG REFERENCE	POWER	OUTPUT
	8	REAR RIGHT STEER ANGLE	ANALOG	INPUT
	9	GROUND	POWER	OUTPUT
	10	+5V ANALOG REFERENCE	POWER	OUTPUT
	11	REAR LEFT STEER ANGLE	ANALOG	INPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J4 (Gray)	1	IGNITION	POWER	OUTPUT
	2	GROUND	POWER	OUTPUT
	3	CANBUS HIGH	POWER	I/O
	4	CANBUS LOW	SERIAL	I/O
	5	CANBUS SHIELD	SERIAL	INPUT
	6	BOOTSTRAP MODE	POWER	INPUT
	7	IGNITION	DIGITAL	OUTPUT
	8	GROUND	POWER	OUTPUT

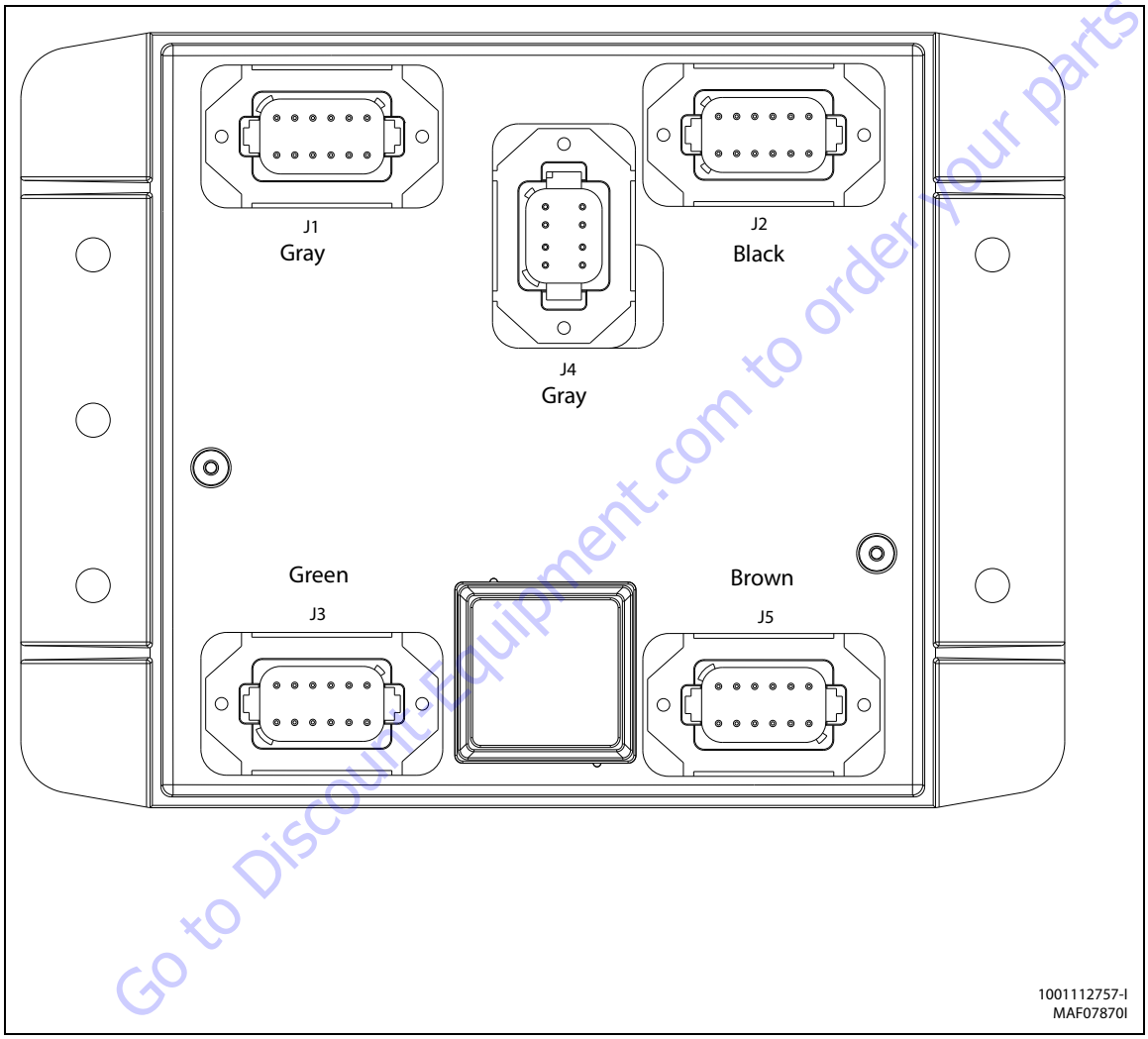


Figure 6-12. BLAM Control Module (SN 030020900 through 0300248621)

Connector	Pin	Function	Type	
J1 (Gray)	1	POWER FEED THRU TO J2-1	POWER	I/O
	2	POWER FEED THRU TO J2-2	POWER	I/O
	3	SIGNAL FEED THRU TO J2-4	DIGITAL	INPUT
	4	MASTER GROUND CONNECT	POWER	INPUT
	5	MASTER IGNITION CONNECT	POWER	INPUT
	6	CANBUS HIGH	SERIAL	I/O
	7	CANBUS LOW	SERIAL	I/O
	8	CANBUS SHIELD	SERIAL	I/O
	9	CANBUS TERMINATOR	SERIAL	I/O
	10	CANBUS TERMINATOR	SERIAL	I/O
	11	IGNITION	POWER	OUTPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J2 (Black)	1	POWER FEED THRU TO J1-1	POWER	I/O
	2	POWER FEED THRU TO J1-2	POWER	I/O
	3	GROUND	POWER	OUTPUT
	4	SPARE INPUT	DIGITAL	INPUT
	5	SPARE INPUT	DIGITAL	INPUT
	6	SPARE INPUT	DIGITAL	INPUT
	7	SPARE INPUT	DIGITAL	INPUT
	8	MAIN BOOM ANG 1 (GRAVITY)	DIGITAL	INPUT
	9	MAIN BOOM ANG 2 (GRAVITY)	DIGITAL	INPUT
	10	SPARE ANALOG	ANALOG	INPUT
	11	RIGHT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	12	RIGHT DRIVE PUMP REVERSE	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J4 (Gray)	1	IGNITION	POWER	OUTPUT
	2	GROUND	POWER	OUTPUT
	3	CANBUS HIGH	SERIAL	I/O
	4	CANBUS LOW	SERIAL	I/O
	5	CANBUS SHIELD	POWER	INPUT
	6	BOOTSTRAP MODE	DIGITAL	INPUT
	7	IGNITION	POWER	OUTPUT
	8	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J3 (Green)	1	+5V ANALOG REFERENCE	POWER	OUTPUT
	2	REF VOLTAGE FROM J3-1	ANALOG	INPUT
	3	GROUND	POWER	OUTPUT
	4	+5V ANALOG REFERENCE	POWER	OUTPUT
	5	MAIN CYL ANGLE #1(ABSOLUTE)	ANALOG	INPUT
	6	GROUND	POWER	OUTPUT
	7	+5V ANALOG REFERENCE	POWER	OUTPUT
	8	BOOM LENGTH SENSOR	ANALOG	INPUT
	9	GROUND	POWER	OUTPUT
	10	+5V ANALOG REFERENCE	POWER	OUTPUT
	11	MAIN CYL ANGLE #2(ABSOLUTE)	ANALOG	INPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J5 (Brown)	1	LEFT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	2	LEFT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	3	OSCILLATING AXLES	DIGITAL	OUTPUT
	4	SPARE OUTPUT - D005	DIGITAL	OUTPUT
	5	SPARE OUTPUT - D006	DIGITAL	OUTPUT
	6	SPARE OUTPUT - D007	DIGITAL	OUTPUT
	7	SPARE OUTPUT - D008	DIGITAL	OUTPUT
	8	SPARE OUTPUT - D009	DIGITAL	OUTPUT
	9	IGNITION	POWER	OUTPUT
	10	RS232 RECEIVE	SERIAL	INPUT
	11	RS232 TRANSMIT	SERIAL	OUTPUT
	12	GROUND	POWER	OUTPUT

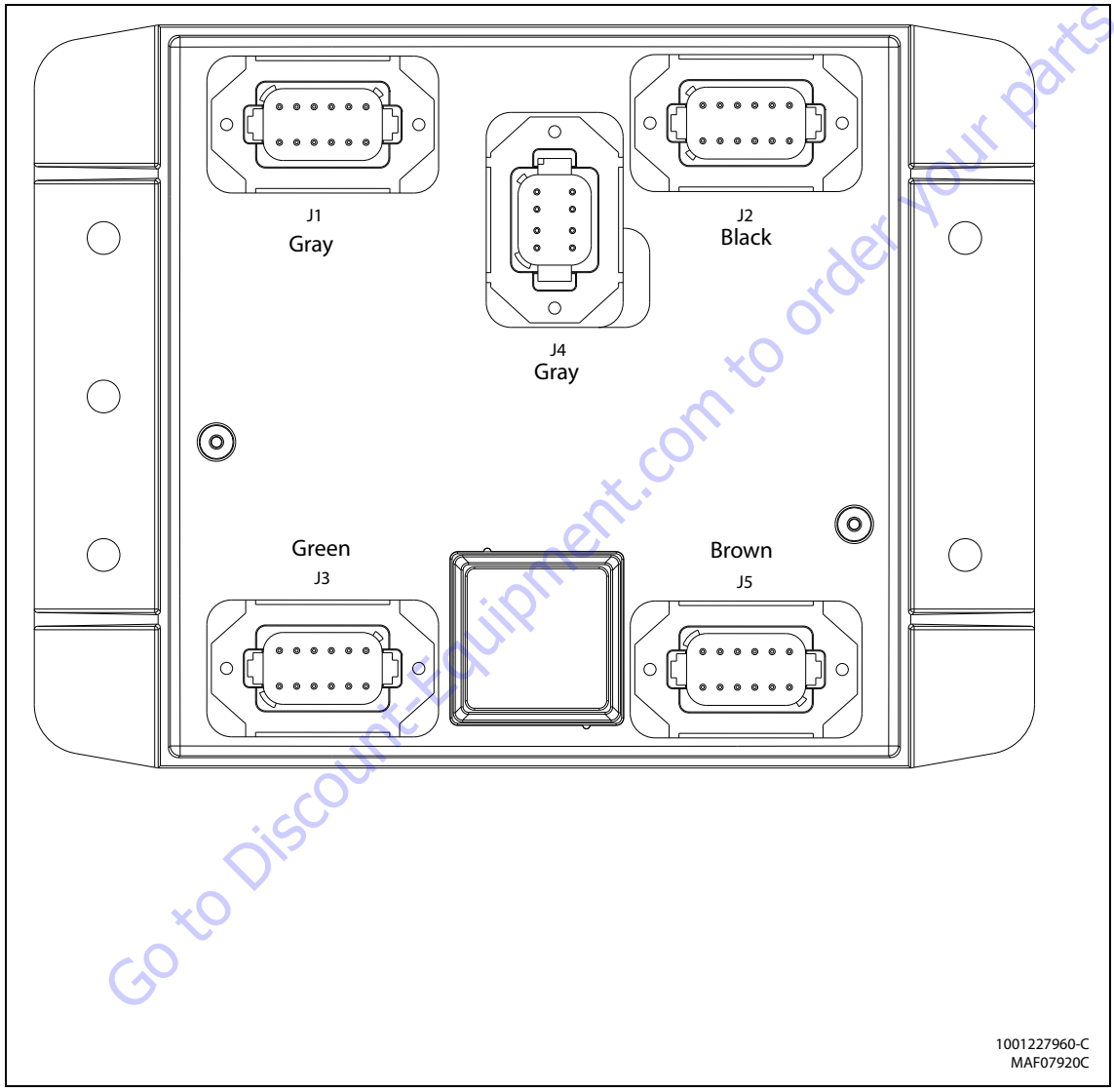


Figure 6-13. BLAM Control Module (SN 0300248622 to Present)

Connector	Pin	Function	Type	
J1 (Gray)	1	POWER FEED THRU TO J2-1	POWER	I/O
	2	POWER FEED THRU TO J2-2	POWER	I/O
	3	SIGNAL FEED THRU TO J2-4	DIGITAL	INPUT
	4	MASTER GROUND CONNECT	POWER	INPUT
	5	MASTER IGNITION CONNECT	POWER	INPUT
	6	CANBUS HIGH	SERIAL	I/O
	7	CANBUS LOW	SERIAL	I/O
	8	CANBUS SHIELD	SERIAL	I/O
	9	CANBUS TERMINATOR	SERIAL	I/O
	10	CANBUS TERMINATOR	SERIAL	I/O
	11	IGNITION	POWER	OUTPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J2 (Black)	1	POWER FEED THRU TO J1-1	POWER	I/O
	2	POWER FEED THRU TO J1-2	POWER	I/O
	3	GROUND	POWER	OUTPUT
	4	SPARE INPUT	DIGITAL	INPUT
	5	SPARE INPUT	DIGITAL	INPUT
	6	SPARE INPUT	DIGITAL	INPUT
	7	SPARE INPUT	DIGITAL	INPUT
	8	MAIN BOOM ANG 1 (GRAVITY)	DIGITAL	INPUT
	9	MAIN BOOM ANG 2 (GRAVITY)	DIGITAL	INPUT
	10	SPARE ANALOG	ANALOG	INPUT
	11	RIGHT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	12	RIGHT DRIVE PUMP REVERSE	DIGITAL	OUTPUT

Connector	Pin	Function	Type	
J3 (Green)	1	+5V ANALOG REFERENCE	POWER	OUTPUT
	2	REF VOLTAGE FROM J3-1	ANALOG	INPUT
	3	GROUND	POWER	OUTPUT
	4	+5V ANALOG REFERENCE	POWER	OUTPUT
	5	MAIN CYL ANGLE #1(ABSOLUTE)	ANALOG	INPUT
	6	GROUND	POWER	OUTPUT
	7	+5V ANALOG REFERENCE	POWER	OUTPUT
	8	BOOM LENGTH SENSOR	ANALOG	INPUT
	9	GROUND	POWER	OUTPUT
	10	+5V ANALOG REFERENCE	POWER	OUTPUT
	11	MAIN CYL ANGLE #2(ABSOLUTE)	ANALOG	INPUT
	12	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J4 (Gray)	1	IGNITION	POWER	OUTPUT
	2	GROUND	POWER	OUTPUT
	3	CANBUS HIGH	SERIAL	I/O
	4	CANBUS LOW	SERIAL	I/O
	5	CANBUS SHIELD	POWER	INPUT
	6	BOOTSTRAP MODE	DIGITAL	INPUT
	7	IGNITION	POWER	OUTPUT
	8	GROUND	POWER	OUTPUT

Connector	Pin	Function	Type	
J5 (Brown)	1	LEFT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	2	LEFT DRIVE PUMP FORWARD	DIGITAL	OUTPUT
	3	OSCILLATING AXLES	DIGITAL	OUTPUT
	4	SPARE OUTPUT - D005	DIGITAL	OUTPUT
	5	SPARE OUTPUT - D006	DIGITAL	OUTPUT
	6	SPARE OUTPUT - D007	DIGITAL	OUTPUT
	7	SPARE OUTPUT - D008	DIGITAL	OUTPUT
	8	SPARE OUTPUT - D009	DIGITAL	OUTPUT
	9	IGNITION	DIGITAL	OUTPUT
	10	RS232 RECEIVE	SERIAL	INPUT
	11	RS232 TRANSMIT	SERIAL	OUTPUT
	12	GROUND	POWER	OUTPUT

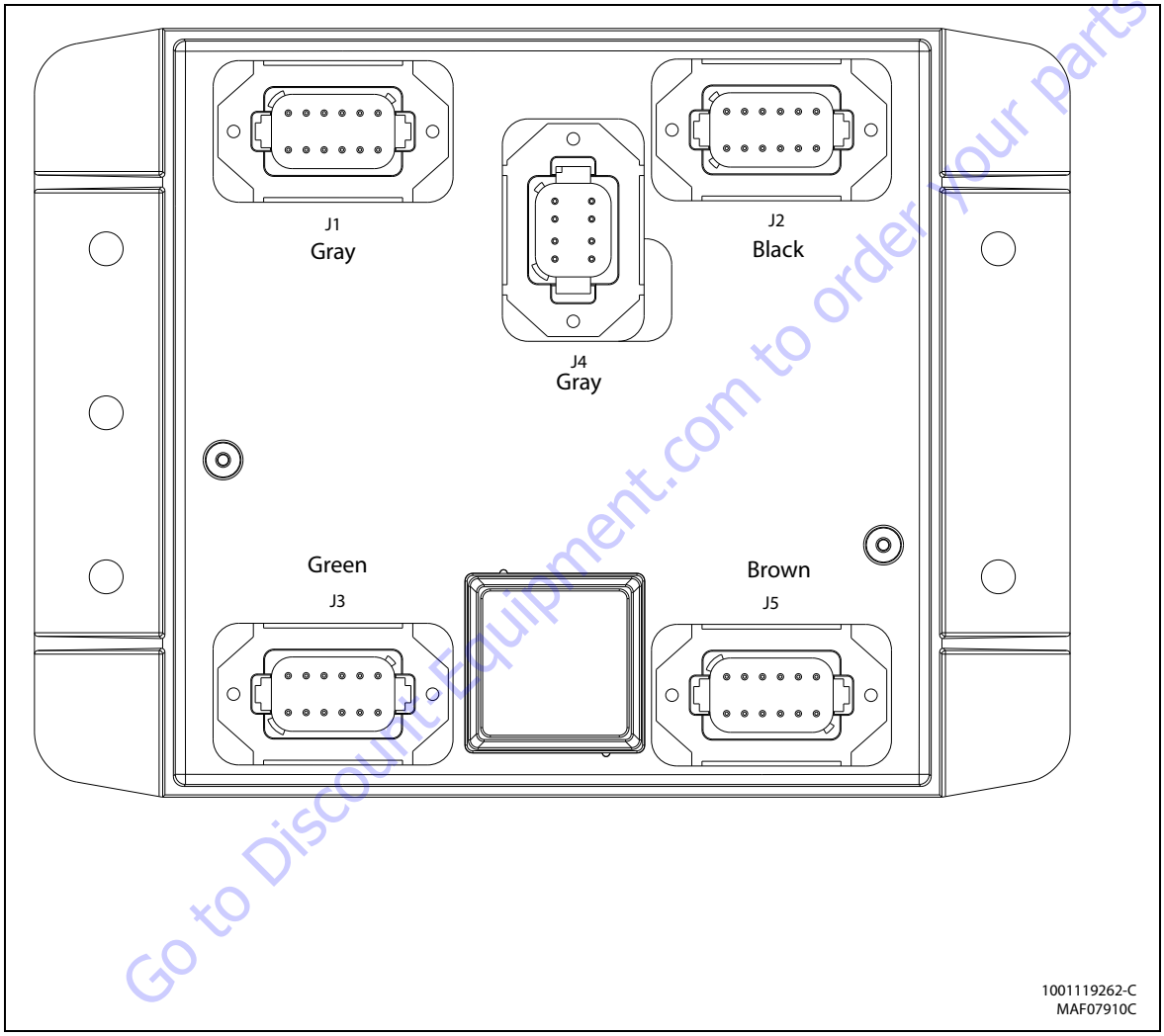


Figure 6-14. Jib Control Module

Connector	Pin	Function	Type	
J1 (Gray)	1	Power Feed Thru to J2-1	Power	I/O
	2	Power Feed Thru to J2-2	Power	I/O
	3	Signal Feed Thru to J2-4	Digital	Input
	4	Master Ground Connect	Power	Input
	5	Master Ignition Connect	Power	Input
	6	CANbus High	Serial	I/O
	7	CANbus Low	Serial	I/O
	8	CANbus Shield	Serial	I/O
	9	CANbus Terminator	Serial	I/O
	10	CANbus Terminator	Serial	I/O
	11	Ignition	Power	Output
	12	Ground	Power	Output

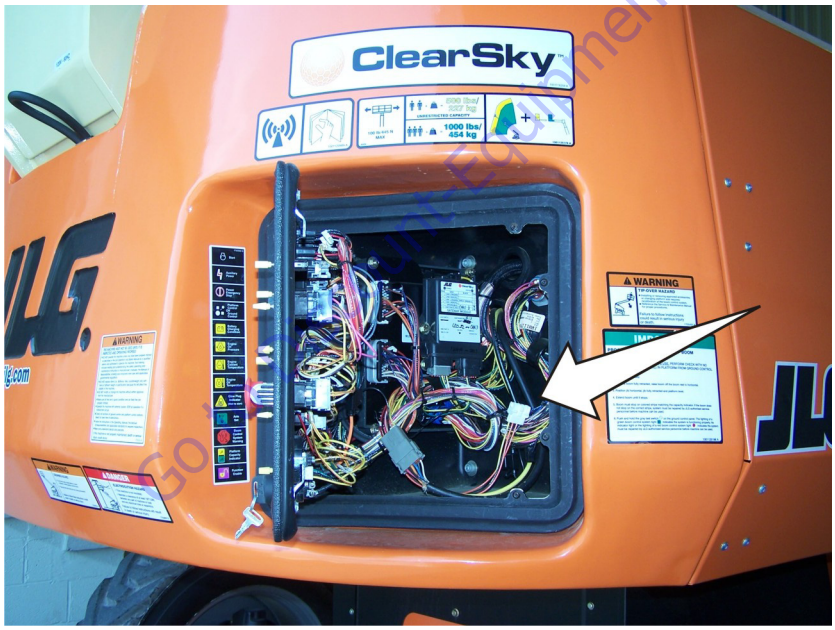
Connector	Pin	Function	Type	
J2 (Black)	1	Power Feed Thru to J1-1	Power	I/O
	2	Power Feed Thru to J1-2	Power	I/O
	3	Ground	Power	Output
	4	Lock Pin NO Contact	Digital	Input
	5	Lock Pin NC Contact	Digital	Input
	6	Jib Transport #1 NO Contact	Digital	Input
	7	Jib Transport #1 NC Contact	Digital	Input
	8	Spare Input	Digital	Input
	9	Spare Input	Digital	Input
	10	Spare Analog Input	Analog	Input
	11	Jib Level Up	Digital	Output
	12	Jib Level Down	Digital	Output

Connector	Pin	Function	Type	
J3 (Green)	1	+5V Analog Reference	Power	Output
	2	Jib Level Angle #1	Analog	Input
	3	Ground	Power	Output
	4	+5V Analog Reference	Power	Output
	5	Jib level Angle #2	Analog	Input
	6	Ground	Power	Output
	7	+5V Analog Reference	Power	Output
	8	Jib Swing Angle #1	Analog	Input
	9	Ground	Power	Output
	10	+5V Analog Reference	Power	Output
	11	Jib Swing Angle #2	Analog	Input
	12	Ground	Power	Output

Connector	Pin	Function	Type	
J4 (Gray)	1	Ignition	Power	Output
	2	Ground	Power	Output
	3	CANbus High	Serial	I/O
	4	CANbus Low	Serial	I/O
	5	CANbus Shield	Power	Input
	6	Bootstrap Mode	Digital	Input
	7	Ignition	Power	Output
	8	Ground	Power	Output

Connector	Pin	Function	Type	
J5 (Brown)	1	Jib Lift Up	Digital	Output
	2	Jib Lift Down	Digital	Output
	3	Jib Swing Right	Digital	Output
	4	Jib Swing Left	Digital	Output
	5	Jib Telescope In	Digital	Output
	6	Jib Telescope Out	Digital	Output
	7	Spare Output	Digital	Output
	8	Spare Output	Digital	Output
	9	Ignition	Power	Output
	10	RS232 Receive	Serial	Input
	11	RS232 Transmit	Serial	Output
	12	Ground	Power	Output

PLATFORM CONNECTION



GROUND CONTROL CONNECTION

Figure 6-15. Analyzer Connecting Points

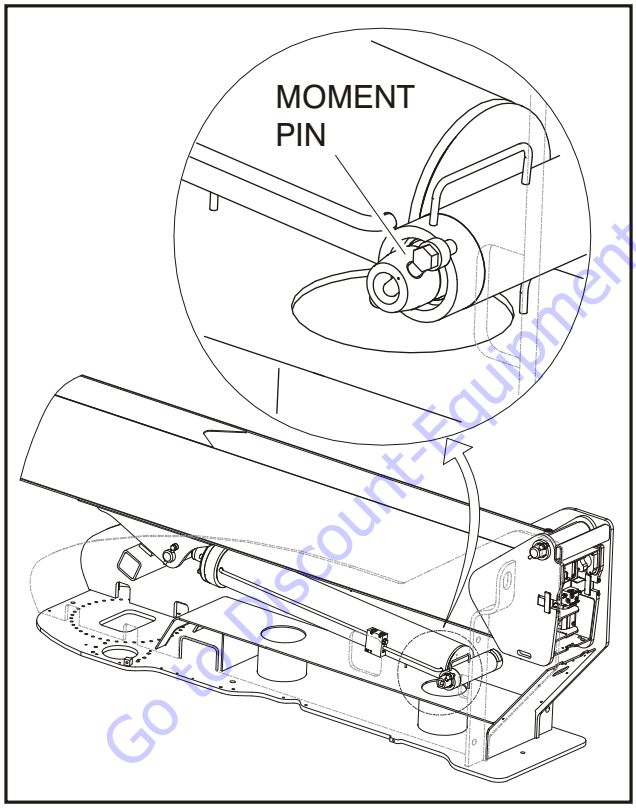
6.6 CONTROL SYSTEM BOOM SENSORS

NOTE: *Note: The machine is defined as being in transport mode if:*

Axles are retracted.
Main boom lift is below elevation angle.
Main boom telescope is fully retracted.
Jib boom telescope is fully retracted.
Jib boom locked inline with the main boom via the jib lock pin.
Turntable swung so that the main boom is between the rear wheels.

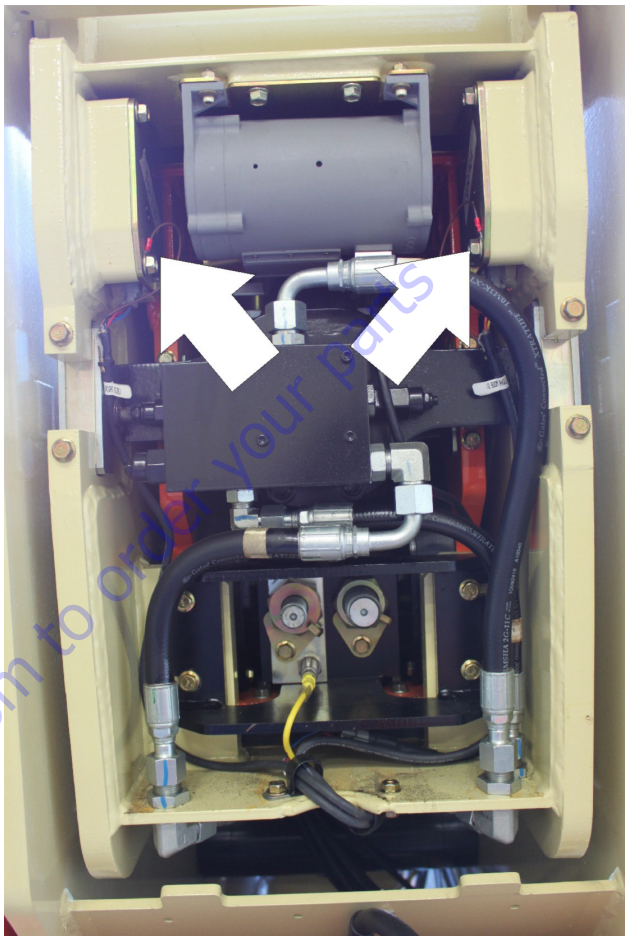
The Boom Control System (BCS) uses a number of sensors to measure the position of the boom. The sensors used to determine main boom and jib boom position are shown in Figure 6-16., Control System Boom Sensors.

Sensor #1 -Moment Pin



The Main Lift Cylinder is attached to the Turntable with a Moment pin. This pin is fixed to the Turntable so as to allow measurement of the force exerted by the cylinder regardless of the cylinder orientation.

Sensor #2 - Main Boom Angle Sensors



These sensors measure Main Boom angle in reference to gravity. They are located in the rear of the Base Boom and mounted such that they generate opposing signals with respect to boom movement.

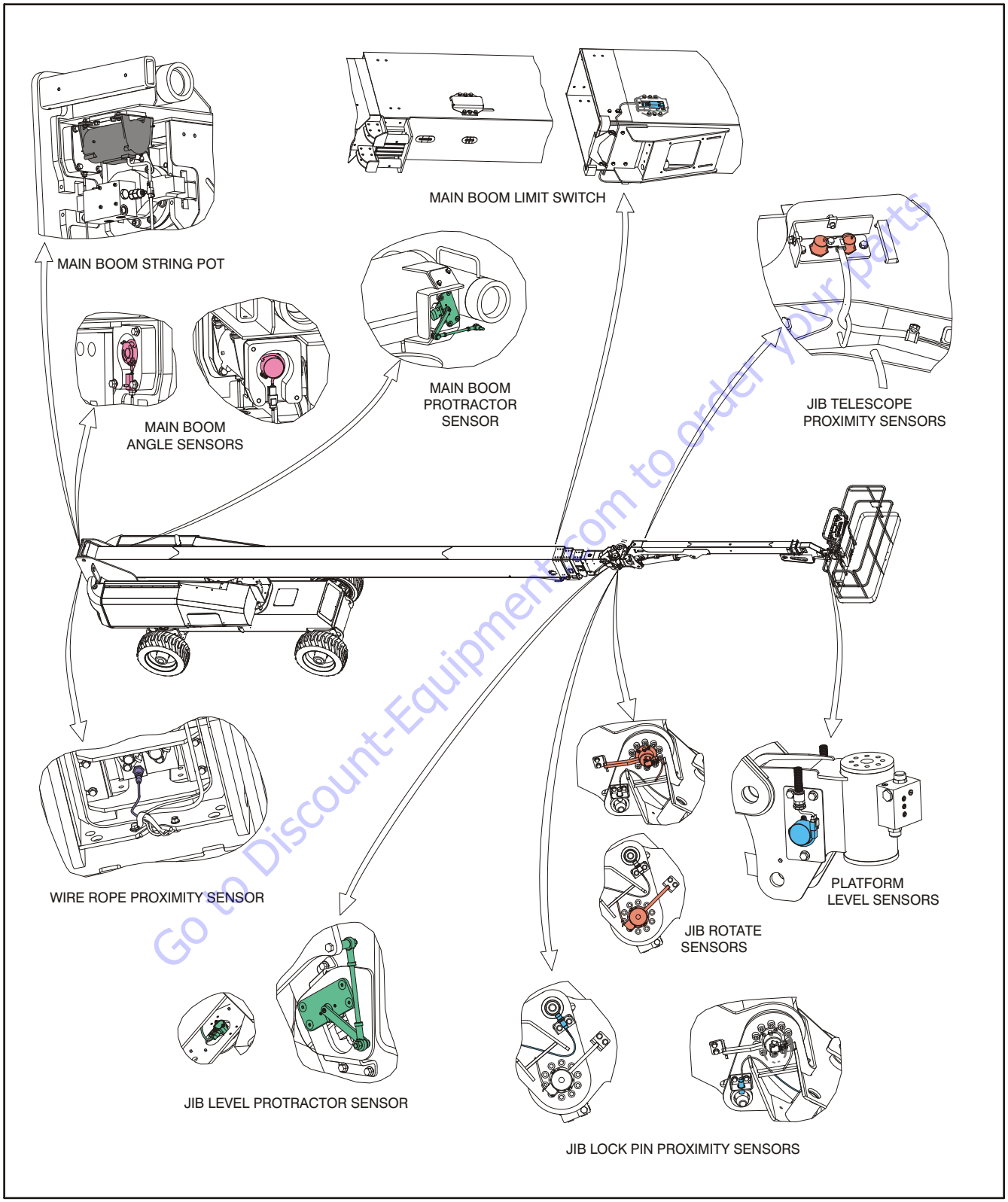
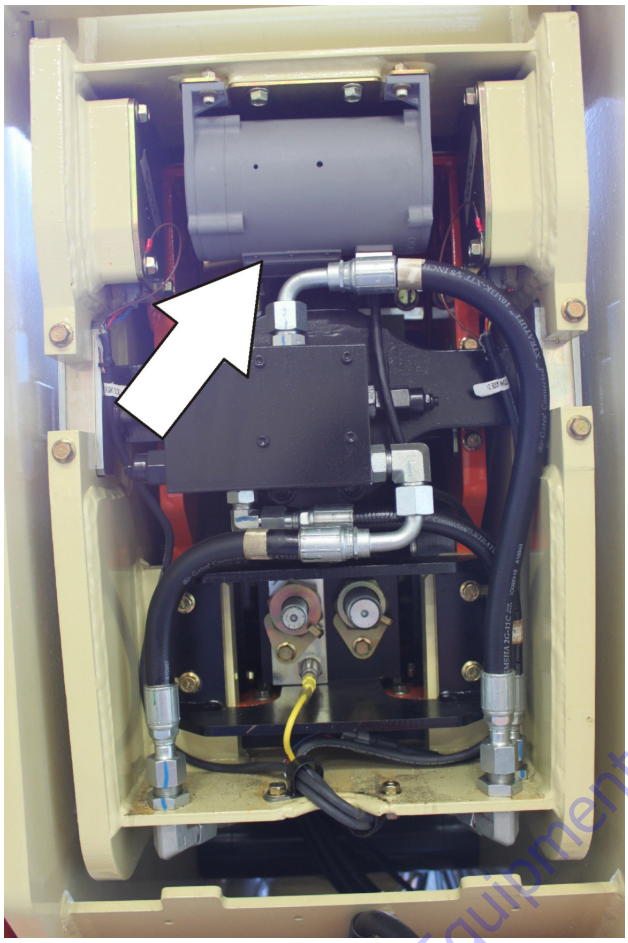


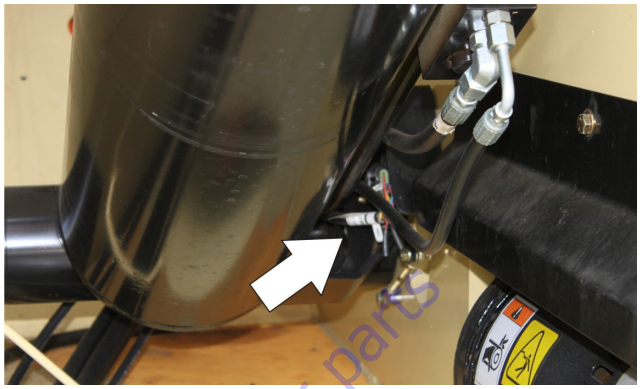
Figure 6-16. Control System Boom Sensors

Sensor #3 - Main Boom Length Sensor



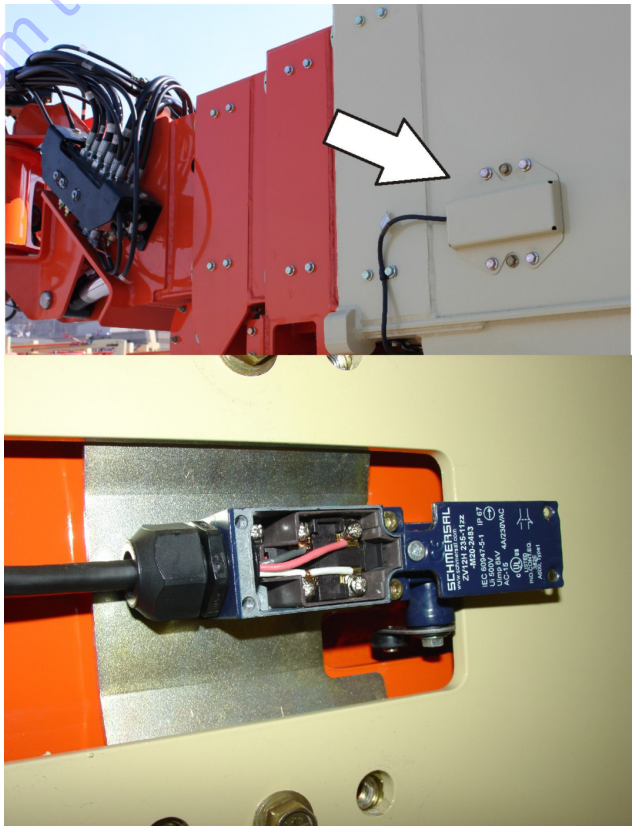
This sensor is used to measure total length of the Main Boom. It is located in the rear of the Base Boom and consists of a wire rope attached to a rotating drum.

Sensor #4 - Main Boom Cylinder Angle Sensor



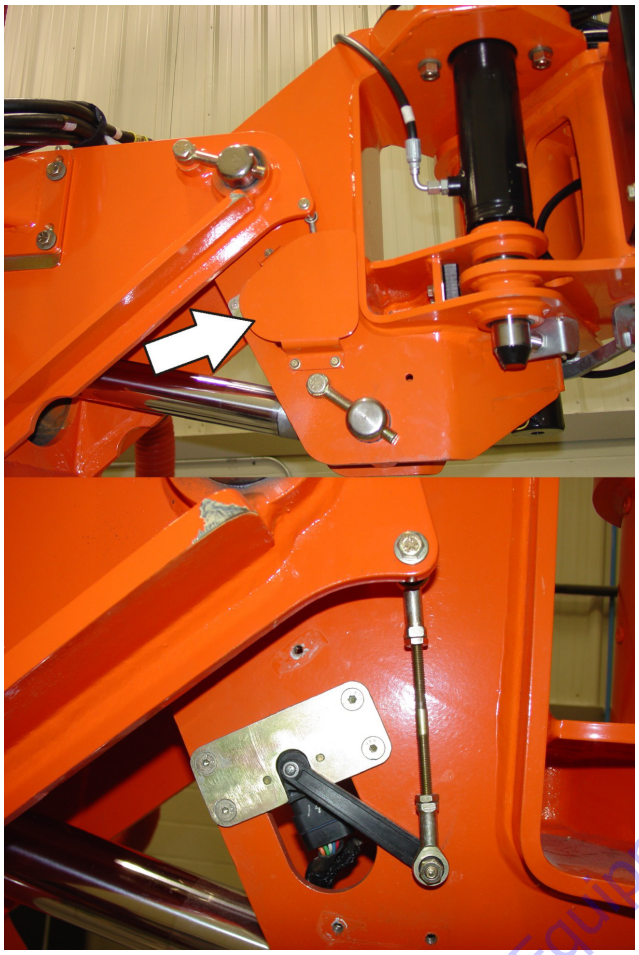
This sensor's function is to measure Main Boom angle relative to the Turntable. A rotary type sensor is mounted to the Turntable and attached to the Main Lift cylinder of the base boom. It is a dual output sensor in a single mechanical body with electrically opposing signals.

Sensor #5 - Main Boom Transport Length Switch



This switch is used to indicate the Main Boom is in the retracted position for transport. This sensor is a mechanical limit switch.

Sensor #6 - Jib Level Angle Sensor

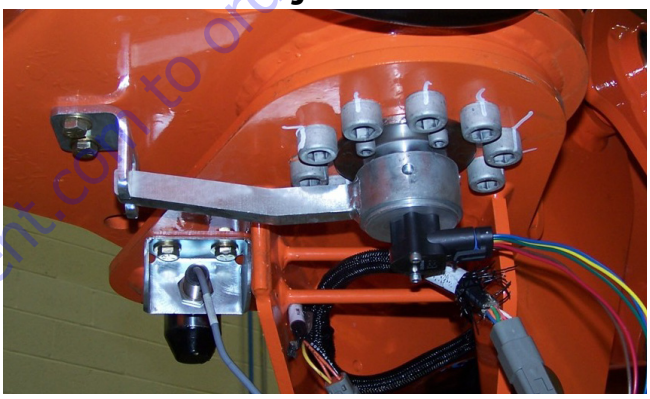


This sensor is used to measure Jib Level angle relative to the Main Boom. A rotary type sensor is mounted between the Main Boom Fly nose and the Jib Pivot weldment. It is a dual output sensor in a single mechanical body with electrically opposing signals.

Sensor #7 - Jib Lock Pin Switch with both normally open and normally closed outputs

This sensor is used to indicate the Jib Lock Pin is fully engaged. This is a proximity switch mounted to the Jib Pivot weldment.

Sensor #8 - Jib Stow Angle Sensor



This sensor is used to measure Jib swing angle. This is a rotary sensor mounted to the underside of the Jib Pivot weldment. It is a dual output sensor in a single mechanical body with electrically opposing signals.

Sensor #9 - Jib Lift Angle Sensor

This sensor's function is to measure the Jib angle relative to the Main Boom Pivot weldment. A linear position sensor is located inside the Jib lift cylinder to measure cylinder stroke.

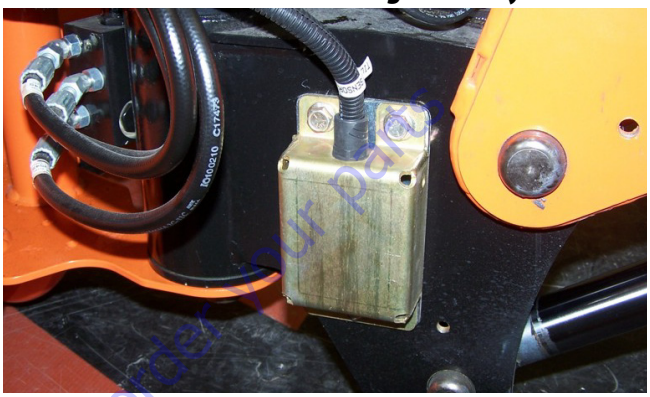
Sensor #10 - Dual Capacity / Jib Transport Length Switches

These switches are located on the Jib Base Boom and are used to measure transport position and 1000# length limit. These are proximity switches mounted such that they generate opposing signals.

Sensor #11 - Platform Level Cylinder Angle Sensor

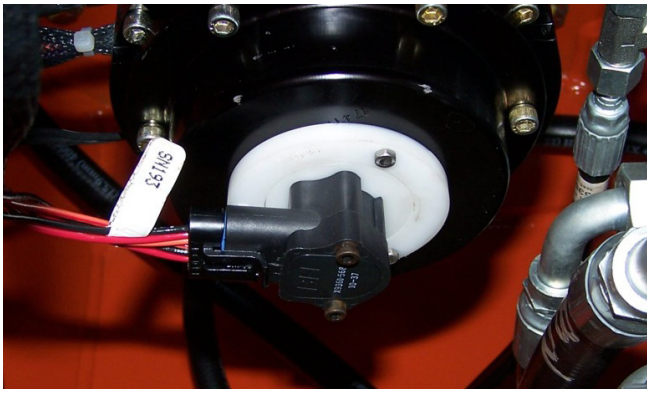
This sensor is used to measure Platform angle relative to the Jib. A linear position sensor is located inside the Platform Level cylinder to measure cylinder stroke.

Sensor #12 - Platform Level Angle Gravity Sensors



These sensors are located on the Platform Support and are used to measure platform angle with respect to gravity. They are mounted such that they generate opposing signals.

Sensor #13 - Turntable Swing Angle



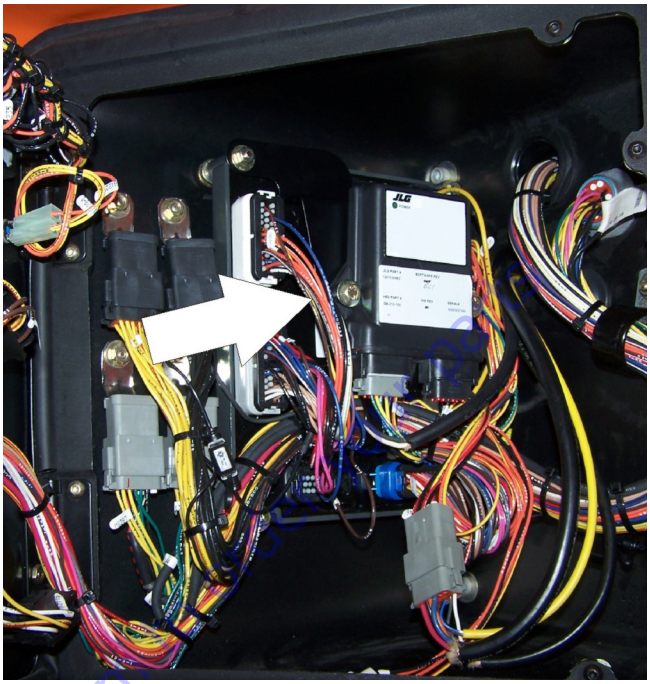
This sensor is used to determine turntable swing angle. It is used for turntable swing control when the boom is in transport position (Axles Retracted). It is a dual output sensor in a single mechanical body with electrically opposing signals.

6.7 JIB CONTROL MODULE

See Figure 6-14., Jib Control Module.

The Jib Control Module is mounted at the end of the main boom to aid in control of Jib Lift, Jib Level, Jib Telescope, and Jib Swing functions and also to process the information transmitted by the Jib Level angle sensor, the Jib Rotate angle sensor, and the Jib lock pin sensing proximity switch.

6.8 CAN GATEWAY



The CAN gateway is located in the ground control box. To decrease overall bus loading, the CAN gateway module divides the CANbus so that the platform module, the jib control module, the LSS (if equipped), and the in cylinder length sensors are on gateway CAN bus 2 and the ground module, the BLAM, the moment pin, and the chassis module are on gateway CANbus 1. The CAN gateway is transparent to the control system and passes all messages from one CANbus to the other.

6.9 SYSTEM TEST

The Control System Incorporates a built-in system test to check the system components and functions. To use this function, use the following procedures.

Test from the Platform

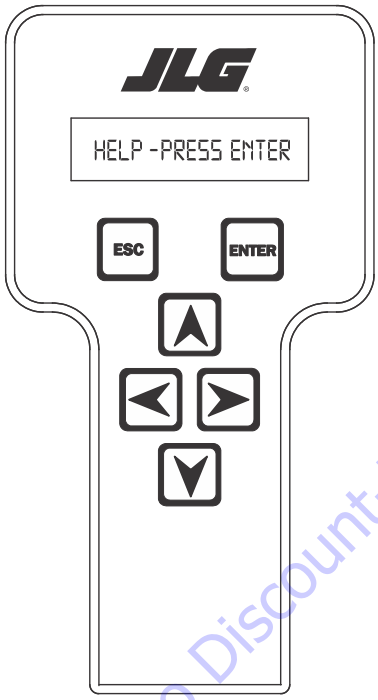
1. Position the Platform/Ground select switch to the Platform position.

2. Plug the analyzer into the connector at the base of the platform control box.

3. Before proceeding, ensure that the switches on the platform console are in the following positions:
   a. Drive speed switch is in the Middle position. (Turtle Icon)
   b. 4WS switch is in the Middle position. (2WS mode)
   c. Capacity select switch in the 1000 lb. (450 kg) mode.
   d. Function speed potentiometer out of creep mode switch.
   e. Generator (if equipped) switched to the off position.
   f. Head and Tail lights (if equipped) switched to the off position.

4. Pull out the Emergency Stop switch and Start the engine.

5. The analyzer screen should read:



6. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.

7. Follow the flow path in Figure 6-17., System Test Flow Chart - Platform Tests and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

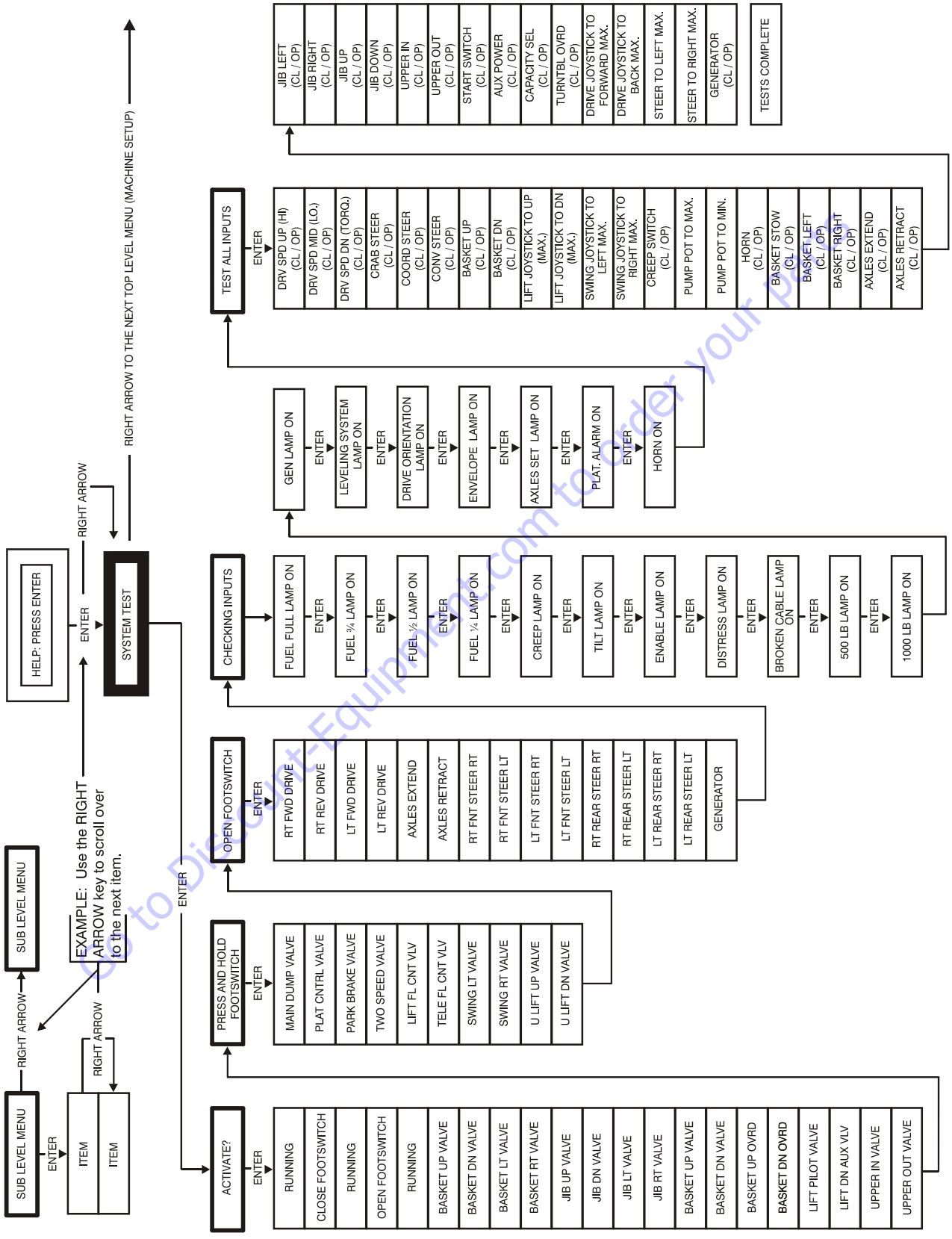


Figure 6-17. System Test Flow Chart - Platform Tests

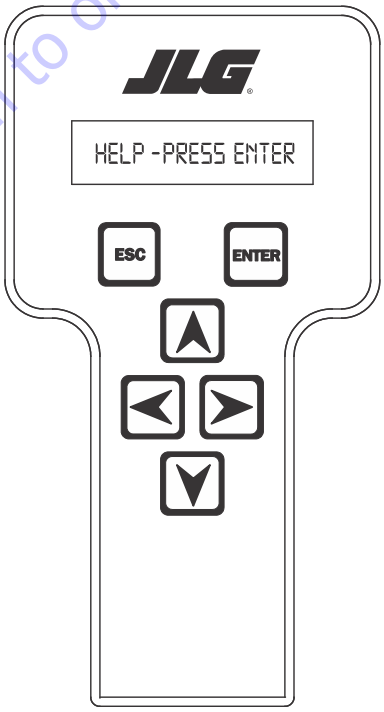
Test from the Ground Station

1. Position the Platform/Ground select switch to the Ground position.

2. Plug the analyzer into the connector inside the Ground control box.

3. Pull out the Emergency Stop switch. and Start the engine.

4. The analyzer screen should read:



5. Use the arrow button to reach SYSTEM TEST. Hit Enter. The analyzer will prompt you asking if you want to activate the system test; hit Enter again to activate.

6. Follow the flow path in Figure 6-18., System Test Flow Chart - Ground Station Tests and go through the component tests. Hit the ESC key during any part of the test to return to the main menu without completing all tests or wait until all tests are complete. During the TEST ALL INPUTS sequence, the analyzer allows control switches to be operated and shows if they are closed (CL) or open (OP).

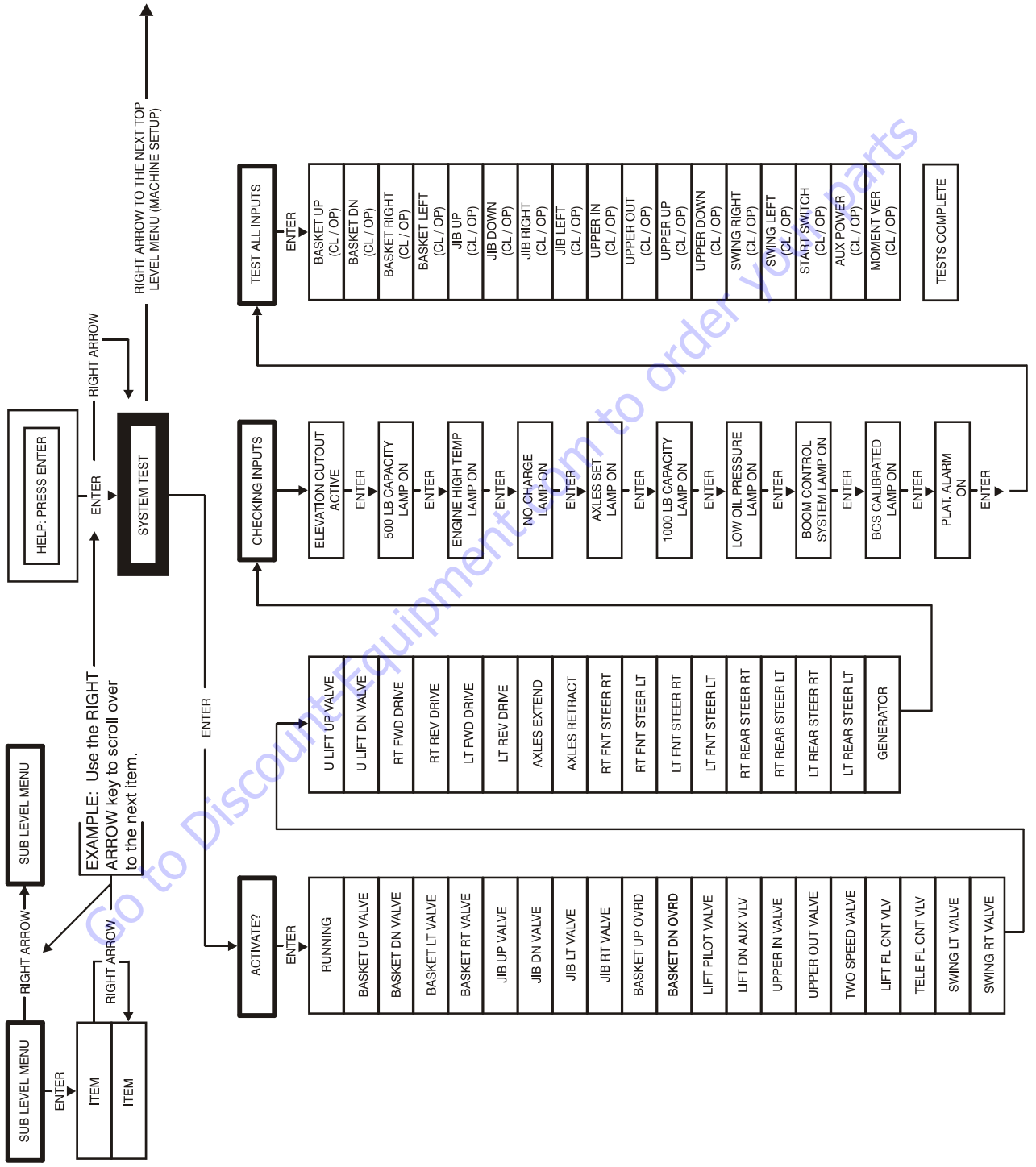


Figure 6-18. System Test Flow Chart - Ground Station Tests

Table 6-6. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
RUNNING		Initial display when system test is run; certain "critical" checks are made. Problems that can be reported include below messages.
	ONLY 1 ANALYZER!	Do not connect two Analyzers while running the system test.
	BATTERY TOO LOW	The system test cannot run with battery voltage below minimum (9 V).
	BATTERY TOO HIGH	The system test cannot run with battery voltage above maximum. (16 V).
	CHECK CAN WIRING	The system test cannot run in platform mode unless data is being received from the platform and ground modules. The system test cannot run in ground mode unless data is being received from the platform module.
	CHECK SPEED	There is an open- or short- circuit in the speed encoder wiring. Check speed encoder.
	BAD GROUND MODULE	An internal problem was detected in the ground module.
	HIGH TILT ANGLE	The vehicle is very tilted (19.3°), or the tilt sensor has been damaged. Check tilt sensor.
	HOT ENGINE	The engine temperature exceeds 100°C. This is only a warning.
	BAD I/O PORTS	The controller detected a problem with its internal circuits at switch on. If other problems are also detected, the controller may need replacing.
	SUSPECT EEPROM	The controller detected a problem with its EEPROM stored personality settings at switch on. Check and, if necessary correct, all personality settings.
	OPEN FSW	In platform mode, the footswitch must be open at the start of the test.
	CLOSE FSW	In platform mode, the footswitch must be closed when this message is displayed; the footswitch MUST BE KEPT CLOSED during the valve & contactor tests.
	BAD FSW	The two footswitch signals are not changing together, probably because one is open-circuit. One footswitch signal ("FSW1") is routed to the power module, the other ("FSW2") is routed to the platform module. Check footswitch and wiring.
TESTING VALVES		Indicates that the valve test is beginning. Each valve is alternately energized and de-energized; checks are made for open- and short- circuit valve coils. NOTE: In platform mode, the footswitch must be closed. NOTE: Tower lift valves are not tested if TOWER LIFT=NO. Tower telescope valves are not tested if TOWER TELE=NO. Jib valves are not tested if JIB = NO. Extendable axle valves are not tested if EXT AXLES=NO. Four wheel steer valves are not tested if 4WS=NO. NOTE: Left/right jib valves are not tested unless JIB = SIDESWING. Problems that can be reported include below messages.
	CANT TEST VALVES	There is a wiring problem, which prevents the valve test from functioning correctly. Check valve wiring. Check ground alarm & hour meter wiring.
	XXXXXXX S/C	The named valve is drawing too much current so is presumed to be short-circuited. Check valve wiring.
	XXXXXXX O/C	The named valve is drawing too little current so is presumed to be open-circuit. Check valve wiring.

Table 6-6. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
CHECKING INPUTS		Indicates that the inputs test is beginning. Every input is checked to ensure that it is in its "normal" position; function switches should be open, cutout switches should be closed, joysticks should be in neutral. In platform mode any non-neutral platform switch or joystick is reported; any active cutouts are reported. In ground mode any non-neutral ground switches is reported; any active cutouts are reported. NOTE: Switches, which are not in use (due to the settings of machine digits), are not checked. NOTE: The pump pot is checked only for a wire-off condition; it can be at any demand from creep to maximum. Problems that can be reported include below messages.
	CHECK XXXXXXX	The named switch is not in its "normal" position. Check switch & wiring.
	CHECK XXXXXXX JOY	The named joystick appears to be faulty. Check joystick.
TESTING LAMPS		Indicates that the lamps test is beginning. Each lamp is energized in turn; a prompt asks for confirmation that the lamp is lit. ENTER must be pressed or clicked to continue the test. NOTE: Lamps, which are not in use (due to the settings of machine digits), are not checked. NOTE: Platform Lamps are only tested in platform mode. NOTE: The GM overload lamp and 500# capacity lamp are not tested. NOTE: Head and tail lamps are tested in both platform and ground mode if enabled by a machine digit.
TESTING ALARMS		Indicates that the alarms test is beginning. Each alarm is energized in turn; a prompt asks for confirmation that the alarm is sounding. ENTER must be pressed or clicked to continue the test. NOTE: The platform alarm and the horn are only tested in platform mode. NOTE: The ground alarm is not tested if GROUND ALARM = NO.

Table 6-6. System Test Messages

Message Displayed on Analyzer	Message Displayed on Analyzer	Description
TEST ALL INPUTS?		Prompts whether to check every operator input. If ESC is pressed or clicked, the system test ends. If ENTER is pressed or clicked, each operator input is prompted for in turn. In platform mode every platform switch and joystick is tested. In ground mode every ground switch is tested. NOTE: Tower lift switches are not tested if TOWER LIFT=NO. Tower telescope switches are not tested if TOWER TELE=NO. Jib switches are not tested if JIB = NO. Extendable axle switches are not tested if EXT AXLES=NO. Four wheel steer switches are not tested if 4WS=NO. NOTE: Left/right jib switches are not tested unless JIB = SIDESWING. Prompts displayed during the operator input test below messages.
	CLOSE XXXXXXX	The named switch should be closed.
	OPEN XXXXXXX	The named switch should be opened.
	XXXXXXX XXXXXXX TO MAX	The named joystick should be pushed to its full extent in the named direction.
	XXXXXXX XXXXXXX TO MIN	The named joystick should be returned to neutral from the named direction.
	PUMP POT TO MAX	The pump pot should be turned to maximum.
	PUMP POT TO MIN	The pump pot should be turned to minimum.
	MULTIPLE CLOSURE	More than one operator input is closed; if only one has been operated, there could be a short between two inputs.
TESTS COMPLETE		Indicates that the system test is complete. Any problems reported should have been noted and should now be rectified. Press ESC/CANCEL to return to the RUN SYSTEM TEST Analyzer menu.

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
DRIVE:			
	DRIVE	FOR/REV XXX%	Displays drive joystick direction & demand
	STEER	RIGHT/LEFT XXX%	Displays steer switch direction & demand
	4WS	NORMAL/COOR/CRAB	Displays status of four wheel steer input (Displayed if 4WS = 1)
	BRAKES	LOCKED/RELEASED	Displays brake control system status
	CREEP	ACTIVE/NOT ACTIVE	Displays pump pot creep switch status
	CRP MODE	ACTIVE/NOT ACT	Displays creep mode status
	QPRX1	ACTIVE/NOT ACTIVE	Displays status of Q-Prox sensor in drive joystick (Displayed if JOYSTICK TYPE = 1)
	QPRX2	ACTIVE/NOT ACTIVE	Displays status of Q-Prox sensor in drive joystick (Displayed if JOYSTICK TYPE = 1)
	TWO SPEED	OP/CL	Displays status of two speed switch input if selected model has two speed.
	2 speed mode	ON/OFF	Displays status of two speed valve if selected model has two speed
	high engine	OP/CL	Displays status of high engine switch
	LT F ANG	XX.X	Displays status of left front steer angle (Displayed if MODEL NUMBER = 7 or 8)
	RT F ANG	XX.X	Displays status of right front steer angle (Displayed if MODEL NUMBER = 7 or 8)
	LT R ANG	XX.X	Displays status of left rear steer angle (Displayed if MODEL NUMBER = 7 or 8)
	RT R ANG	XX.X	Displays status of right rear steer angle (Displayed if MODEL NUMBER = 7 or 8)
	DOS LIM sw	OP/CL	Displays status of Drive Orientation System limit switch. (Displayed if MODEL NUMBER = 7 or 8)
	DOS O/R sw	OP/CL	Displays status of Drive Orientation Limit System override switch. (Displayed if MODEL NUMBER = 7 or 8)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
BOOM:			
	U LIFT	UP/DOWN XXX%	Displays main lift joystick direction & demand
	SWING	RIGHT/LEFT XXX%	Displays swing joystick direction & demand
	QPRX1	ACTIVE/NOT ACTIVE	Displays status of Q-Prox sensor in lift/swing joystick (Displayed if JOYSTICK TYPE = 1)
	QPRX2	ACTIVE/NOT ACTIVE	Displays status of Q-Prox sensor in lift/swing joystick (Displayed if JOYSTICK TYPE = 1)
	LEVEL	UP/DOWN XXX%	Displays basket level switch direction & demand. NOTE: demand is controlled by the pump pot
	ROT.	RIGHT/LEFT XXX%	Displays basket rotate switch direction & demand. NOTE: demand is controlled by the pump pot
	U TELE	IN/OUT XXX%	Displays main telescope switch direction & demand. NOTE: demand is controlled by the pump pot
	T TELE	IN/OUT XXX%	Displays tower telescope switch direction & demand. NOTE: demand is controlled by the pump pot Not displayed if TOWER TELE=NO (machine digit = 0)
	T LIFT	UP/DOWN XXX%	Displays tower lift switch direction & demand. NOTE: demand is controlled by the pump pot Not displayed if TOWER LIFT=NO (machine digit = 0)
	JIB	UP/DOWN XXX%	Displays jib lift switch direction & demand. NOTE: demand is controlled by the pump pot Not displayed if JIB = NO (machine digit = 0)
	JIB	RIGHT/LEFT XXX%	Displays jib swing switch direction & demand. NOTE: demand is controlled by the pump pot Displayed if JIB = SIDESWING (machine digit = 2)
	JIB INLINE	OP/CL	Displays status of jib inline limit switch. Displayed on models equipped with the Jib Stow System
	JIB LIMIT	OP/CL	Displays status of jib right limit switch. Displayed on models equipped with the Jib Stow System
	JIB LIM OVRD	OP/CL	Displays status of jib limit override switch. Displayed on models equipped with the Jib Stow System
	PCV	ON/OFF	Displays status of Platform Control Valve. Displayed on models equipped with Electronic Platform Leveling.
	PUMP POT	XXX%	Displays pump pot demand. Not displayed if MODEL = 601 (machine digit = 4)
	CREEP	ACTIVE/NOT ACTIVE	Displays pump pot creep switch status
	CRP MODE	ACTIVE/NOT ACT	Displays creep mode status

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
ENGINE:			
	START	ACTIVE/NOT ACTIVE	Displays status of the engine start circuit
	AIR FILTER	OP/CL	Displays measured status of air filter by-pass switch. (Not displayed if MODEL NUMBER = 7 or 8)
	BATTERY	XX.XV	Displays measured battery voltage
	COOLANT	XXXC	Displays measured coolant temperature
	OIL PRS	LOW / OK or XXPSI	Displays measured oil pressure
	FUEL SELECT	GAS/LP	Displays status of fuel select switch. (Displayed if MODEL NUMBER = 2)
	AMB. TEMP	XXXC	Displays measured ambient air temperature
	FUEL LEVEL	¼ / ½ / ¾ / FULL or LOW / OK	Displays measured fuel level
	XXXX rpm		Engine RPM

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
SYSTEM:			
	GM BATTERY	XX.XV	Ground module battery voltage
	PM BATTERY	XX.XV	Platform module battery voltage
	AMB. TEMP	XXXC	Ambient temperature
	FSW1	OP/CL	Displays footswitch status. NOTE: FSW1 is wired to the ground module.
	FSW2	OP/CL	Displays footswitch status. NOTE: FSW2 is wired to the platform module.
	ABOVE ELEV.	OP/CL/YESNO	Displays above elevation cutout switch status or above angle status
	LEN SW 1	OP/CL	Displays status of boom length retracted limit switch (Displayed if MODEL NUMBER = 7 or 8)
	LEN SW 2	OP/CL	Displays status of boom length retracted limit switch (Displayed if MODEL NUMBER = 7 or 8)
	RETRACTED	YES/NO	Displays status of boom length retracted (Displayed if MODEL NUMBER = 7 or 8)
	TRANSPORT	YES/NO	Displays status of transport position
	U LIFT CUTOUT	OP/CL	Displays status of boom length retracted limit switch (Displayed if MODEL NUMBER = 6)
	T LIFT PROX	OP/CL	Displays status of tower lift proximity switch (Displayed if TOWER PROX SWITCHES = 1)
	T TELE PROX	OP/CL	Displays status of tower telescope proximity switch (Displayed if TOWER PROX SWITCHES = 1)
	BR CABLE CUT.	OP/CL	Displays status of broken cable switch (Displayed if BROKEN CABLE SWITCH = 1)
	CREEP	ACTIVE/NOT ACTIVE	Displays pump pot creep switch status. Not displayed if MODEL = 601 (machine digit = 4)
	CRP MODE	ACTIVE/NOT ACT	Displays creep mode status
	SUPER CREEP	ON/OFF	Displays super creep mode status (Displayed if MODEL NUMBER = 7 or 8)
	TILT	XX.X DEG	Displays measured vehicle tilt. (Displayed if internal tilt sensor is configured)
	LO TILTED -	NO/YES	Displays status of lo tilt input. (Displayed if external tilt sensor is configured)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	HI TILTED -	NO/YES	Displays status of hi tilt input. (Displayed if external tilt sensor is configured)
	AUX POWER	OP/CL	Displays the status of the auxiliary power switch input
	HORN	OP/CL	Displays the status of the horn input
	R FILTER	OP/CL	Displays the status of the return hydraulic filter by-pass switch. Displayed ONLY if MODEL = 600 (Configuration digit = 3)
	C FILTER	OP/CL	Displays measured status of charge pump filter bypass switch. Displayed ONLY if MODEL = 600 (Configuration digit = 3)
	JIB BLOCK	OP/CL	Displays jib block limit switch status. Not displayed if associated configuration digit = 0
	BASKET STOWD	YES/NO	Displays status of basket stowed mode. (Displayed if MODEL NUMBER = 7 or 8)
	SOFT LIMIT	OP/CL	Displays status of soft touch limit switch. Not displayed if associated configuration digit = 0
	SOFT O/R	OP/CL	Displays status of soft touch override switch. Not displayed if associated configuration digit = 0
	GEN SET/WELDER	OP/CL	Displays generator/welder switch input status. Not displayed if associated configuration digit = 0
	LIGHTS	OP/CL	Displays head and tail light switch input status. Not displayed if associated configuration digit = 0
	BSK TILT1	XX.X	Displays indicated platform tilt angle. Displayed on models equipped with Electronic Platform Leveling.
	BSK TILT2	XX.X	Displays indicated platform tilt angle. Displayed on models equipped with Electronic Platform Leveling.
	AXLE RET SW	OP/CL	Displays status of axle extension user switches. (Displayed if MODEL NUMBER = 7 or 8)
	AXLE EXT SW	OP/CL	Displays status of axle retraction user switches. (Displayed if MODEL NUMBER = 7 or 8)
	AXLE LIM SW	RET/EXT	Displays status of axle extension limit switches. (Displayed if MODEL NUMBER = 7 or 8)
	DOS LIM SW	OP/CL	Displays status of Drive Orientation System Limit Switch. (Displayed if MODEL NUMBER = 7 or 8)
	DOS O/R SW	OP/CL	Displays status of Drive Orientation System Override switch. (Displayed if MODEL NUMBER = 7 or 8)
	CAPACITY SW	500/1000	Displays status of capacity selection switch. (Displayed if MODEL NUMBER = 7 or 8)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
	OSC AXLE P SW	OP/CL	Displays status of oscillating axle pressure switch. (Displayed if OSCILLATING AXLE = 1)
	SKY WELDER	YES/NO	Displays the status of Sky Welder selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY CUTTER	YES/NO	Displays the status of Sky Cutter selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY GLAZIER	YES/NO	Displays the status of Sky Glazier selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY BRIGHT	YES/NO	Displays the status of Sky Bright selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	PIPE RACKS	YES/NO	Displays the status of Pipe Racks selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	CAMERA MOUNT	YES/NO	Displays the status of Camera Mount selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
LOAD:			Not displayed if LOAD=NO, LENGTH=NO, and ANGLE=NO (machine digits = 0)
	LENGTH	OP/CL	Displays measured length, NOTE: Not displayed if MODEL NUMBER = 7 or 8
	ANGLE	OP/CL	Displays measured angle, NOTE: Not displayed if MODEL NUMBER = 7 or 8
	WEIGHT	XXXX%	Percentage of maximum calibrated weight on the platform. An uncalibrated load cell will read 1000% Displayed if LOAD is not 0 and LOAD TYPE is 0.
		OK/OVERLOADED	Displayed if LOAD is not 0 and LOAD TYPE is 1.

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
MOMENT:			Displayed if MODEL NUMBER = 7 or 8
	(LB-IN) ACTUAL	XXXXXXXX	Displays current moment value
	(LB-IN) OVER	XXXXXXXX	Displays current over moment setpoint.
	(LB-IN) UNDER	XXXXXXXX	Displays current under moment setpoint.
	CAL PT UNDER	XXXXXXXX	Displays the under moment value recorded during boom sensor calibration.
	CAL PT WIT YEL	XXXXXXXX	Displays the yellow witness mark moment value recorded during boom sensor calibration.
	CAL PT WIT GRN	XXXXXXXX	Displays the green witness mark moment value recorded during boom sensor calibration.
	CYL PIN RATIO	X.XXX	Displays the current cylinder moment pin ratio of X and Y forces.
	PIN E FLAGS	0xXXXX	Displays the current error flag status of the cylinder moment pin.
	SKY WELDER	YES/NO	Displays the status of Sky Welder selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY CUTTER	YES/NO	Displays the status of Sky Cutter selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY GLAZIER	YES/NO	Displays the status of Sky Glazier selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	SKY BRIGHT	YES/NO	Displays the status of Sky Bright selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	PIPE RACKS	YES/NO	Displays the status of Pipe Racks selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)
	CAMERA MOUNT	YES/NO	Displays the status of Camera Mount selected during boom sensor calibration. (Displayed if MODEL NUMBER = 7 or 8)

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
ENVELOPE:			Displayed if MODEL NUMBER = 7 or 8
	LENGTH	XXXX.X	Displays the current indicated boom length in inches.
	ANGLE 1	XX.X	Displays the current indicated boom angle 1 in degrees.
	ANGLE 2	XX.X	Displays the current indicated boom angle 2 in degrees.
	A/D LNGTH	XXXXX	Displays the current indicated boom length in A/D counts.
	A/D ANG1	XXXXX	Displays the current indicated boom angle 1 in A/D counts or raw angle if calibrated.
	A/D ANG2	XXXXX	Displays the current indicated boom angle 2 in A/D counts or raw angel if calibrated.
CAN STATISTICS:			CAN Statistics as detected by the Ground Module
	RX/SEC	XXX	Displays the number of received messages per second
	TX/SEC	XXX	Displays the number of transmitted messages per second
	BUS OFF	XX	Displays the number of bus off occurrences
	PASSIVE	XX	Displays the number of bus passive occurrences

Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
CALIBRATION DATA			
	BASKET UP	XXX	Displays the basket up calibration point
	BASKET DOWN	XXX	Displays the basket down calibration point
	L FWD DRIVE	XXX	Displays the left forward drive calibration point
	R FWD DRIVE	XXX	Displays the right forward drive calibration point
	L REV DRIVE	XXX	Displays the left reverse drive calibration point
	R REV DRIVE	XXX	Displays the right reverse drive calibration point
	F LT STEER	XXX	Displays the forward left steer calibration point
	F RT STEER	XXX	Displays the forward right steer calibration point
	R LT STEER	XXX	Displays the reverse left steer calibration point
	R RT STEER	XXX	Displays the reverse right steer calibration point
	U LIFT UP	XXX	Displays the main lift up calibration point
	U LIFT DOWN	XXX	Displays the main lift down calibration point
	U TELE IN	XXX	Displays the main telescope in calibration point
	U TELE OUT	XXX	Displays the main telescope out calibration point
	BM ANG 1 LO	XXX	Displays the boom angle 1 low calibration point
	BM ANG 1 HI	XXX	Displays the boom angle 1 high calibration point
	BM ANG 2 LO	XXX	Displays the boom angle 2 low calibration point
	BM ANG 2 HI	XXX	Displays the boom angle 2 high calibration point
	LEN RETRACT	XXX	Displays the length sensor retracted calibration point
	LEN EXTEND	XXXXX	Displays the length sensor extended calibration point
	LEN WIT	XXXXX	Displays the witness mark calibration point
	LEN SWITCH	XXXX	Displays the length switch calibration point

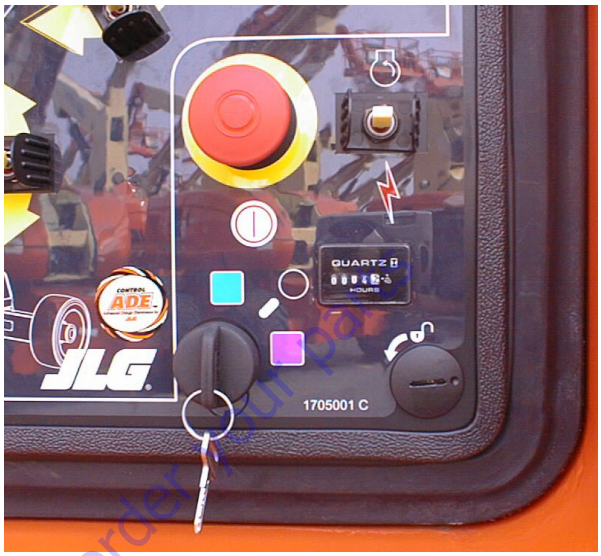
Table 6-7. Machine Diagnostics Parameters

Diagnostics Submenu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
DATALOG:			
	ON	XXXXhXXm	Displays total controller on (EMS) time
	ENGINE	XXXXhXXm	Display engine run time
	DRIVE	XXXXhXXm	Displays total controller drive operation time
	LIFT	XXXXhXXm	Displays total controller lift operation time
	SWING	XXXXhXXm	Displays total controller swing operation time
	TELE	XXXXhXXm	Displays total controller telescope operation time
	MAX TEMP	XXC	Displays maximum measured ambient temp.
	MIN TEMP	XXC	Displays minimum measured ambient temp.
	MAX VOLTS	XX.XV	Displays maximum measured battery voltage
	RENTAL	XXXXhXXm	Displays total controller operation time. NOTE: can be reset
	ERASE RENTAL?		Not available at OPERATOR ACCESS. ENTER resets rental data log time to zero.
VERSIONS:			
	GM SW	PX.X	Displays ground module software version
	GM HW REV	XXXX	Displays ground module hardware revision
	GM SN	XXXXXX	Displays ground module serial number
	PM SW	PX.X	Displays platform module software version
	PM HW REV	XXXX	Displays platform module hardware revision
	PM SN	XXXXXX	Displays platform module serial number
	CM SW	PX.X	Displays chassis module software version
	BM SW	PX.X	Displays BLAM module software version
	CPIN SW		Displayed if cylinder moment load pin transmits software version.
	CPIN SN		Displayed if cylinder moment load pin transmits serial number.
	ANALYZER	VX.XXXX	Displays Analyzer software version

6.10 CALIBRATING STEER

When calibrating steering, each individual wheel must be calibrated in order to make the tire and wheel parallel with the frame. Two methods to help ensure proper calibration are the use of a carpenter's square to square the spindle to the axle or aligning the two wheels on one side using a stretched string.

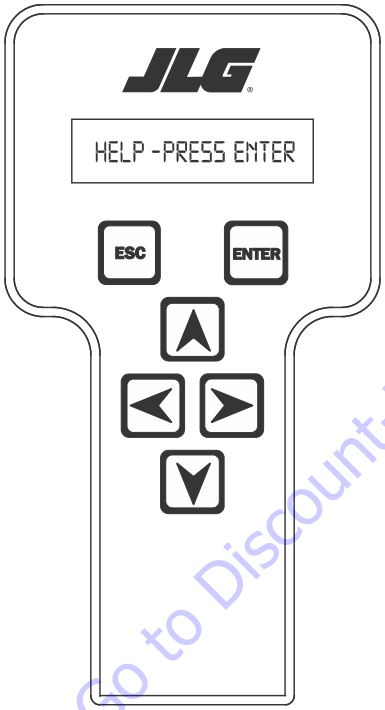
1. Position the Platform/Ground select switch to the Platform position.



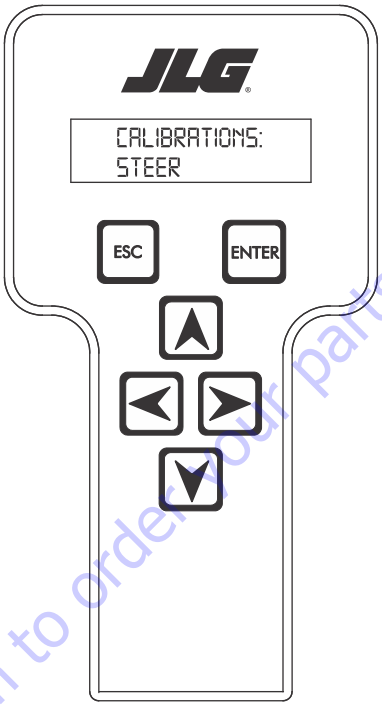
2. Plug the analyzer into the connector at the base of the platform control box.

3. Pull out the Emergency Stop switch and Start the engine.

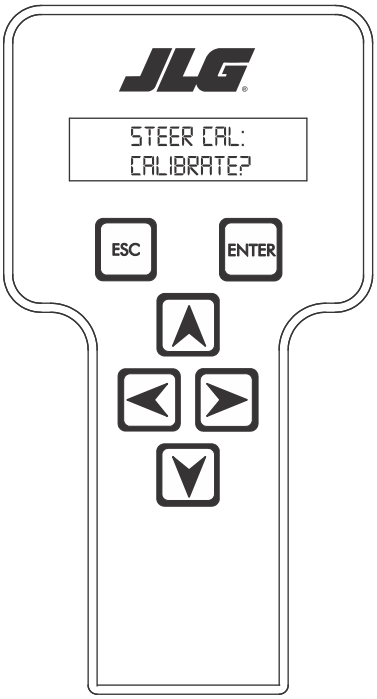
4. The analyzer screen should read:



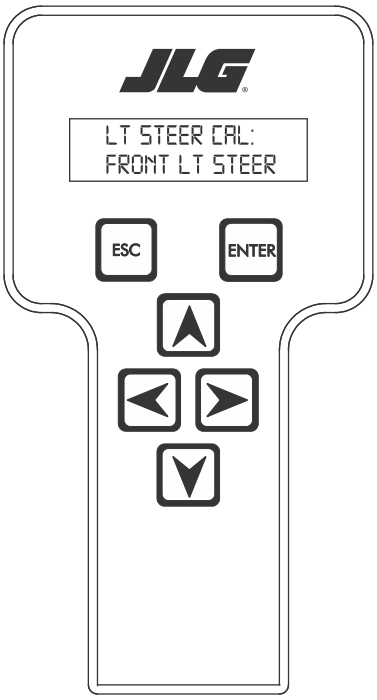
5. Use the arrow button to reach OPERATOR ACCESS. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.
8. Use the arrow keys to reach Steer. The screen will read:



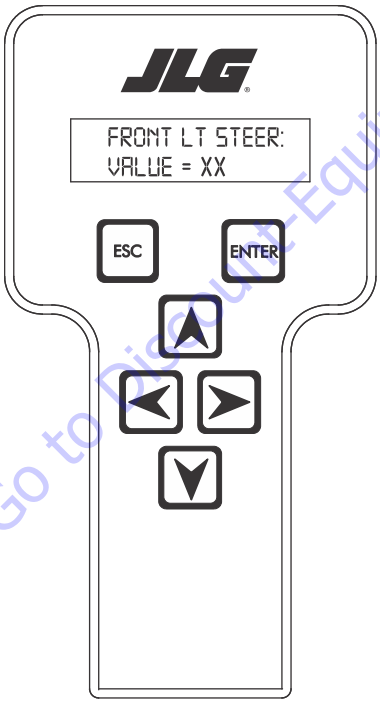
9. Hit Enter. The screen will read:



10. Hit Enter. The screen will read:

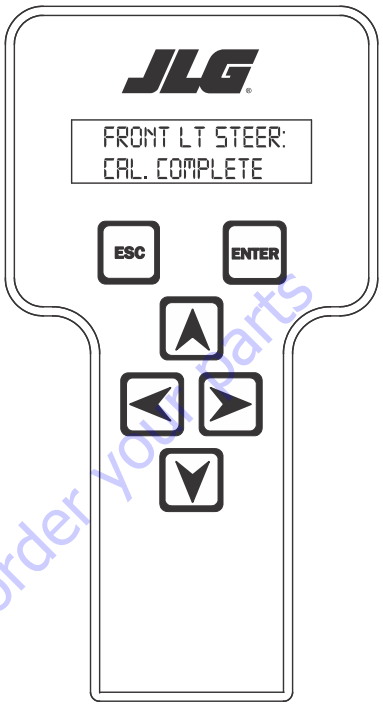


11. Hit Enter again. The screen will read:



12. Activate the steer control until the tire and wheel are straight in relationship with the chassis, then leave off the control. The display will read FRT LEFT = and show the numeric calibration value for that wheel.

13. Hit Enter. The screen will read:



14. Repeat steps 10 thru 12 for left rear steer.

15. Left Rear Steer Calibration will be followed by Right Forward Steer Calibration which will be followed by Right Rear Steer Calibration.

16. After completing all the Steer Calibrations, hit ESC twice to go back to CALIBRATIONS.

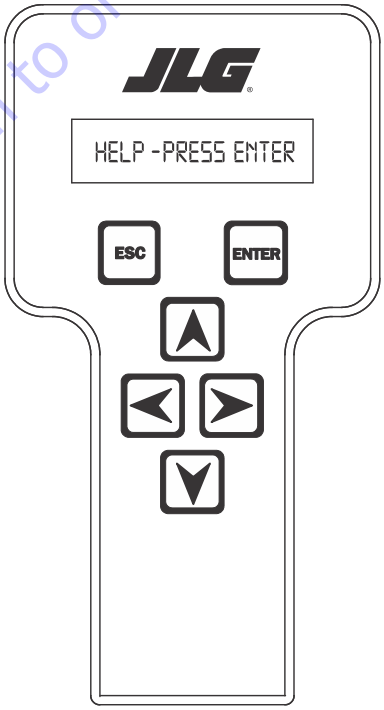
6.11 CALIBRATING DRIVE

1. Position the Platform/Ground select switch to the Platform position.

2. Plug the analyzer into the connector at the base of the platform control box.

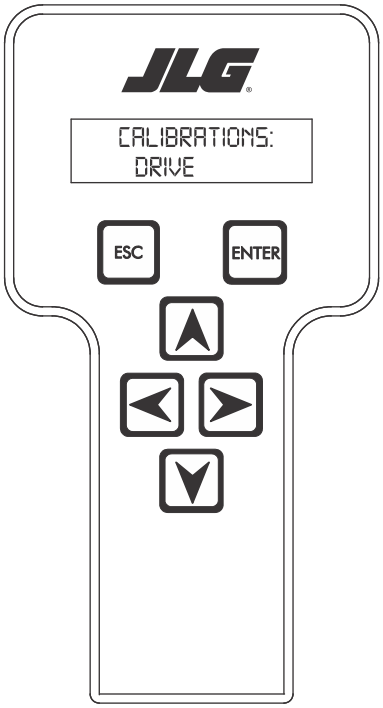
3. Pull out the Emergency Stop switch and Start the engine.

4. The analyzer screen should read:

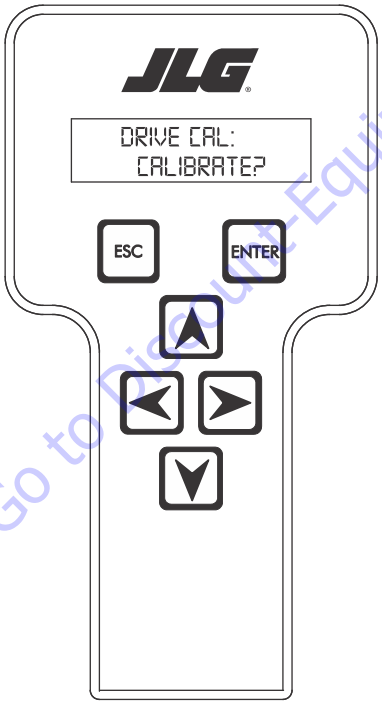


5. Use the arrow button to reach OPERATOR ACCESS. Hit Enter.
6. Enter the Access Code, 33271.
7. Use the right Arrow key to reach CALIBRATIONS. Hit Enter.

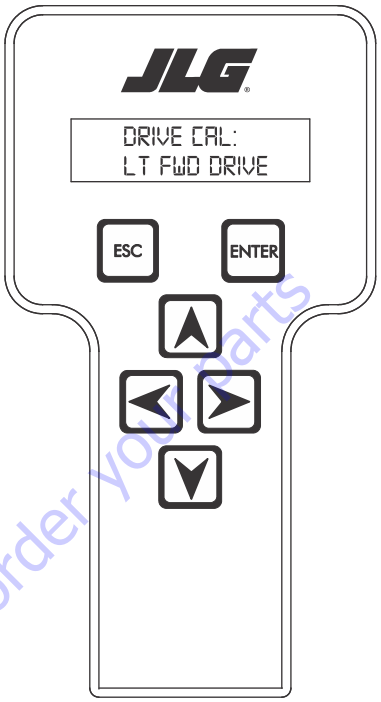
8. Use the arrow keys to reach DRIVE.



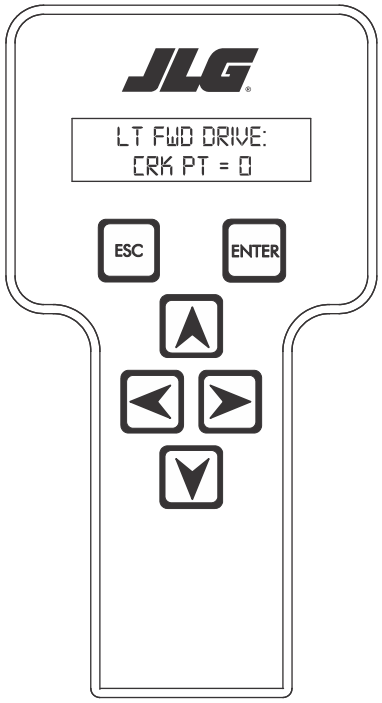
9. Hit Enter. The screen will read:



10. Hit Enter again. The screen will read:

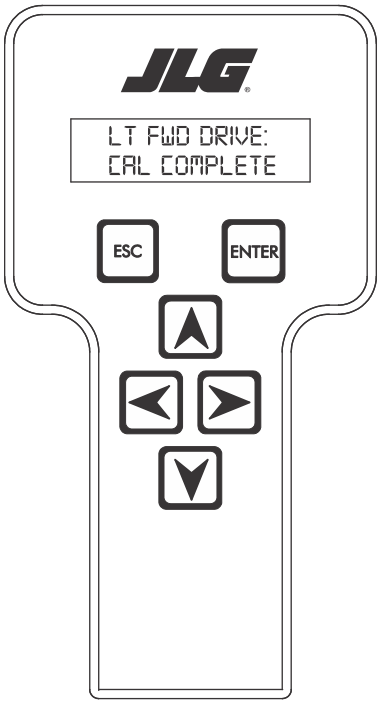


11. Hit Enter again. The screen will read:

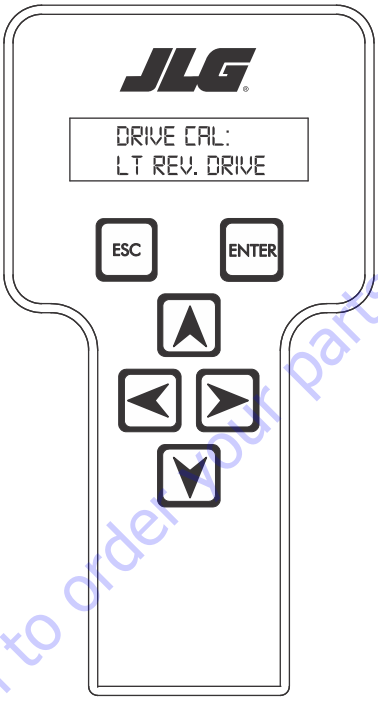


12. Activate the Drive Joystick forward full stroke until the machine just begins to move, then leave off the joystick immediately. The display will read CRK PT = and show the numeric crack point value.

13. Hit Enter. The number displayed will be the value that the crack point is set to. The screen will show:



14. Hit Enter. The screen will read:



15. Repeat steps 10 thru 12 for left reverse drive.

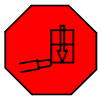
16. Left Reverse Drive Calibration will be followed by Right Forward Drive Calibration which will be followed by Right Reverse Calibration.

17. After completing all the Drive Calibrations, hit ESC twice to go back to CALIBRATIONS.

6.12 LSS SYSTEM

The JLG-designed Load Sensing System (LSS) measures platform load via a sensor mounted in the platform support structure. If the actual platform load exceeds the selected Rated Load, the following will occur:

1. The Overload Visual Warning Indicator will flash at the selected control position (platform or ground).



2. The Platform and Ground Alarms will sound 5 seconds On, and 2 seconds Off.
3. All normal movement will be prevented from the platform control position (optional - ground control functions may be prevented).
4. Further movement is permitted by:
   - **a.** Removing the excess platform load until actual platform load is less than Rated Load.
   - **b.** Operation of the overriding emergency system (Auxiliary Power Unit).
   - **c.** By an authorized person at the ground control position (optional - ground control functions may be prevented).

NOTICE

THE LOAD SENSING SYSTEM MUST BE CALIBRATED WHEN ONE OR MORE OF THE FOLLOWING CONDITIONS OCCUR:

- **a.** LSS Sensor removal or replacement
- **b.** Addition or removal of certain platform mounted accessories. (Refer to Calibration)
- **c.** Platform is removed, replaced, repaired or shows evidence of impact.

NOTICE

THE LOAD SENSING SYSTEM REQUIRES PERIODIC FUNCTION VERIFICATION NOT TO EXCEED 6 MONTHS FROM PREVIOUS VERIFICATION. REFER TO TESTING & EVALUATION.

All calibration procedures are menu driven through the use of a JLG Analyzer.

Diagnostic Menu

The Diagnostic Menu is another troubleshooting tool for the Load Sensing System. Sensor and status information is presented in real-time for the technician. Several sub-menus exist to organize the data.

To access the Diagnostic Menu, use the LEFT and RIGHT Arrow keys to select DIAGNOSTICS from the Top Level Menu. Press the ENTER key to view the menu.

Press the LEFT and RIGHT Arrow keys to view the displays and select the various sub-menus. To access a sub-menu, press the ENTER key. Once in a sub-menu, press the LEFT and RIGHT Arrow keys to view the various displays (just like a Top Level menu). To exit a sub-menu, press the ESC key.

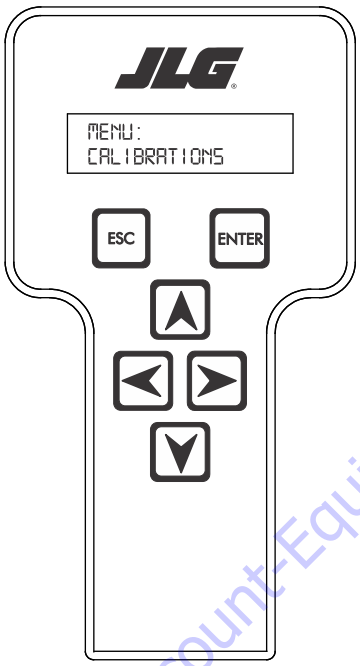
Table 6-8, Diagnostic Menu Descriptions details the structure of the Diagnostic Menu, and describes the meaning of each piece of information presented.

Table 6-8. Diagnostic Menu Descriptions

Diagnostics Menu (Displayed on Analyzer 1st Line)	Parameter (Displayed on Analyzer 2nd Line)	Parameter Value (Displayed on Analyzer 2nd Line)	Description
PLATFORM LOAD	STATE:	OK / OVERLOAD	LSS Status.
PLATFORM LOAD	ACTUAL:	XXX.X KG	Calibrated weight of the platform. ??? if Platform Load is Unhealthy**.
PLATFORM LOAD (service*)	GROSS:	XXX.X KG	Gross weight of the platform. ??? if both Cells are Unhealthy**.
PLATFORM LOAD (service*)	OFFSET 1:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	OFFSET 2:	XXX.X KG	Stored offset weight of Cell 1. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	ACCESSORY	XXX.X KG	Stored accessory weight. ??? if LSS is not calibrated.
PLATFORM LOAD (service*)	UNRESTRICT	XXX.X KG	UGM will set Unrestricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RESTRICT	XXX.X KG	UGM will set Restricted Rated Load as defined by Machine Configuration.
PLATFORM LOAD (service*)	RAW 1:	XXX.X KG	Gross value from Cell 1. ??? if Unhealthy**.
PLATFORM LOAD (service*)	RAW 2:	XXX.X KG	Gross value from Cell 2. ??? if Unhealthy**.
* Indicates only visible in service view mode ** Typically indicates a DTC is active			

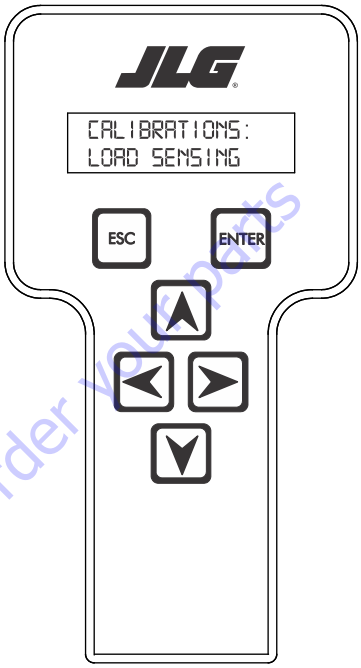
Calibration Procedure

1. Remove everything from the platform, except permanently fixed JLG Accessories, to allow the Load Sensing System to record its' weight during calibration. This includes all tools, debris, and customer-installed devices.
2. Plug the JLG Analyzer into the Machine at the Ground Station and enter Service Access Password 33271.
3. The platform should be approximately level for calibration. Level the platform from ground control (if necessary) to within +/- 5°.
4. To access the Calibration Menu, use the LEFT and RIGHT Arrow keys to select CALIBRATION from the Top Level Menu. The screen will read:

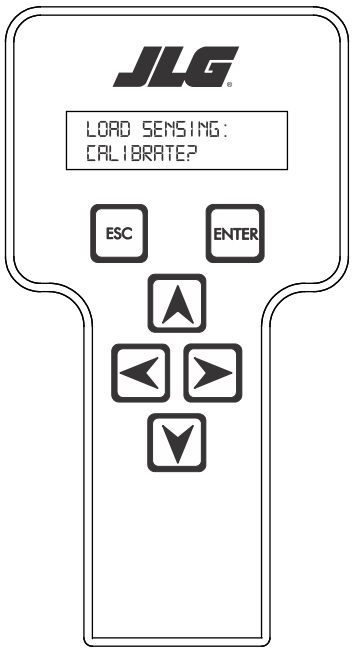


NOTE: *The Calibration Menu is not available in OPERATOR ACCESS.*

5. Press the ENTER key ENTER to view the menu. Upon entry to the Calibration Menu, the JLG Control System will link to the Analyzer and the screen will read:



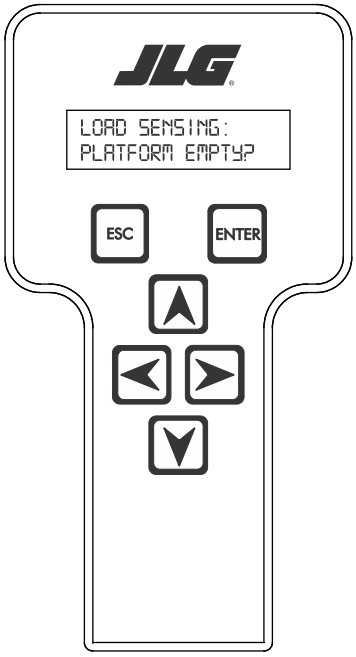
6. Press Enter ENTER. The Screen will read:



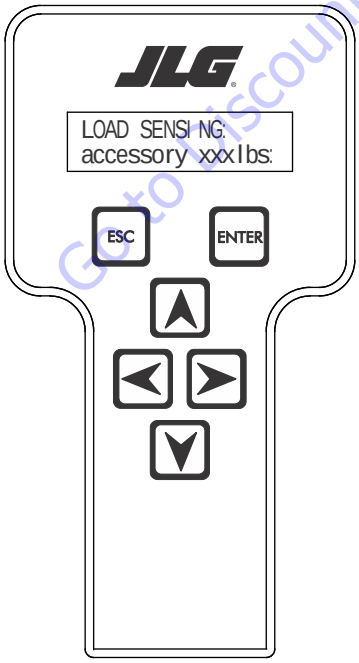
NOTE: *Calibration will auto fail if LSS DTC's are active (443, 444, 4479, 4480, 663, 821, 822, 823, 824, 8218, 8222 -> 8238, 991, 992, 993, 994 or 99285).*

Pressing the ESC key [ESC] after starting calibration and before calibration is complete will display the CAL FAILED message. This will not disturb the prior calibration information.

7. Press ENTER [ENTER]. The analyzer screen will read:



8. If the platform is empty, press ENTER [ENTER]. The screen will read:



NOTE: *Accessory weight will reset to 0 lbs. each time the machine is re-calibrated and will need to be re-entered.*

NOTE: *The Accessory weight will be temporarily stored in the Control System until calibration has been completed successfully.*

Refer to Table 6-9, Accessory Weights. Use the up and down analyzer keys to enter the accessory weight(s) (in lbs). When all the accessory weights are entered, press ENTER [ENTER]. The screen will read:

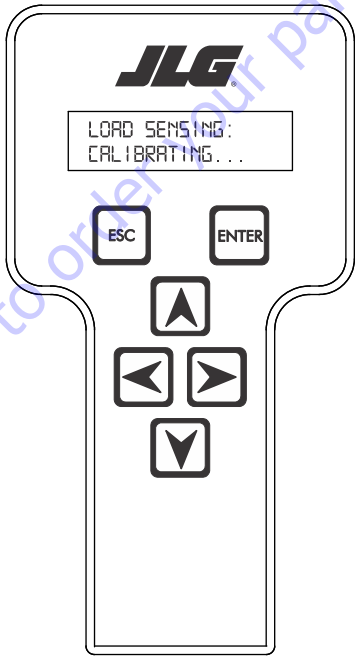


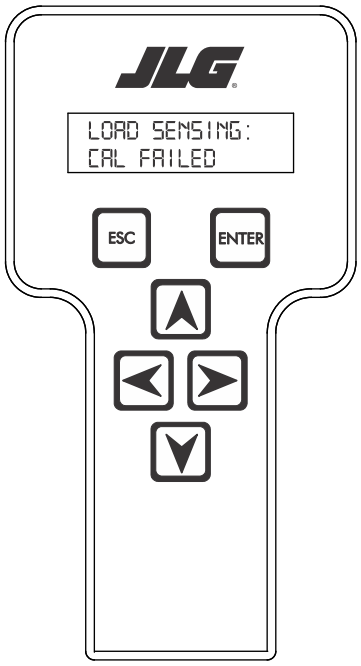
Table 6-9. Accessory Weights

Accessory	Weight
SkyWelder (stick welder)	70 lb (32 kg)
SkyWelder Prep	Prep only = 15 lb (7 kg) Full install = 70 lb (32 kg)
SkyCutter (plasma cutter)	70 lb (32 kg)
SkCutter / SkyWelder Combo	140 lb (64 kg)
Fire Extinguisher	45 lb (20 kg)
Overhead SoftTouch	80 lb (36 kg)
Work Surface	20 lb (9 kg)

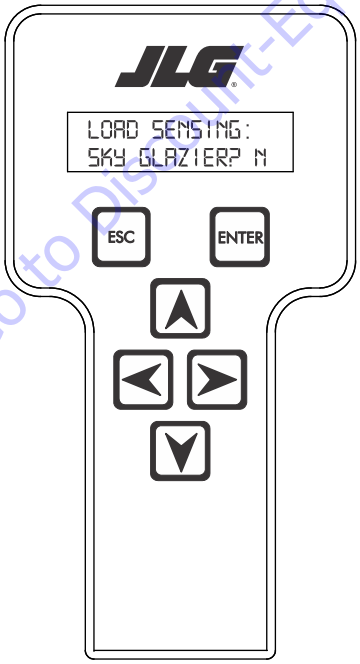
NOTE: *Not all Accessories are available on every JLG model. Some Accessory combinations are prohibited due to excessive weight and/or load restriction. If any installed JLG Accessories are labeled with weight decals but are not listed in the table above, include their weight when entering the ACC WEIGHT value.*

9. The control system will calculate the load cell readings and ensure it is greater than 130 lbs. (59 kg), but less than 575 lbs.(261 kg).

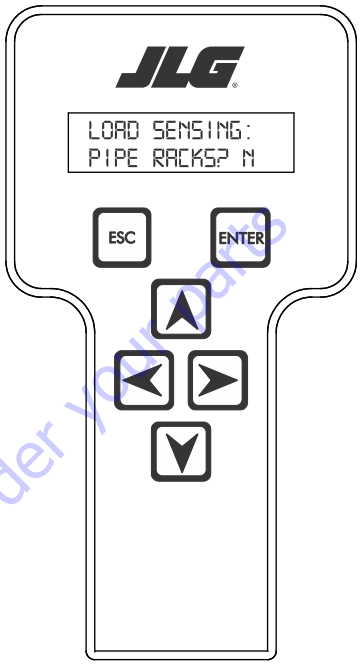
If the platform weight is not within the allowed range, the calibration attempt will be unsuccessful and the Analyzer will show the following:



10. Press ENTER (ENTER). The control system will ask for installed accessories. The screen will show the following:



11. Use the analyzer keys to select N for no or Y for yes. Press ENTER (ENTER). The screen will read:



12. Use the analyzer keys to select N for no or Y for yes. Press ENTER (ENTER). The control system will default to an estimate of unrestricted capacity, which can be adjusted if necessary. Refer to Table 6-10, SkyGlazier Capacity Reductions and Table 6-11, Pipe Rack Capacity Reductions.

The screen will read:

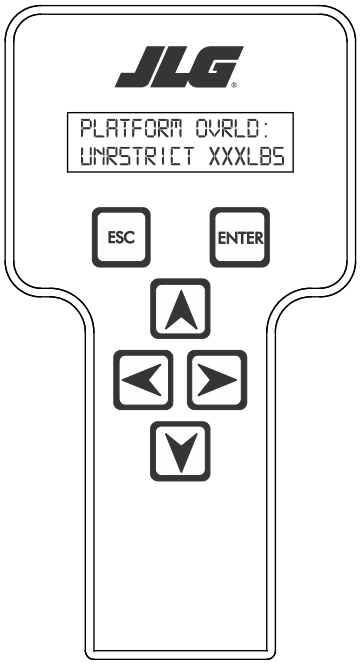


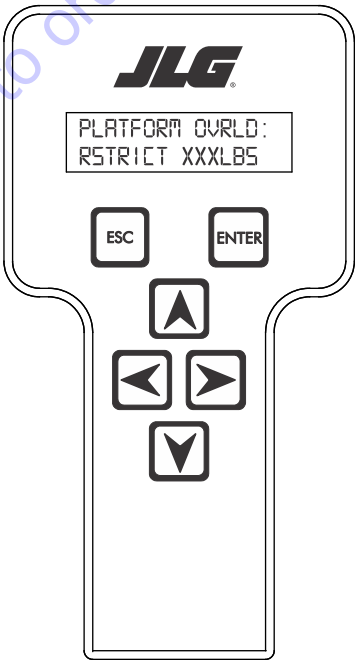
Table 6-10. SkyGlazier Capacity Reductions

Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	400 lb (181 kg)	n/a
600 lb (272 kg)	400 lb (181 kg)	n/a
750 lb (340 kg)	n/a	590 lb (268 kg)
1000 lb (454 kg)	n/a	750 lb (340 kg)
Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.		

Table 6-11. Pipe Rack Capacity Reductions

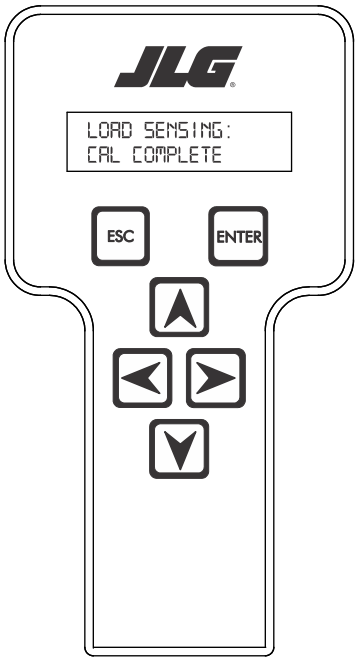
Capacity	PLATFORM OVRLD	PLATFORM OVRLD RESTRICT
500 lb (227 kg)	400 lb (181 kg)	n/a
550 lb (250 kg)	450 lb (204 kg)	n/a
600 lb (272 kg)	500 lb (227 kg)	n/a
750 lb (340 kg)	n/a	650 lb (295 kg)
1000 lb (454 kg)	n/a	900 lb (408 kg)
Note: If both SkyGlazier and Pipe Racks are configured, capacity will be the lower of the two values.		

13. Press ENTER (ENTER). The following screen will be displayed for restricted capacity, which can be adjusted if necessary. Refer to Table 6-10, SkyGlazier Capacity Reductions and Table 6-11, Pipe Rack Capacity Reductions.



14. Press ENTER 

. If calibration is successful, the screen will read:



Testing & Evaluation

Refer to Troubleshooting if the Load Sensing System fails to meet these guidelines.

1. Connect the JLG Analyzer.
2. Level the Platform. The platform should be approximately level for analysis, or the guidelines below will not be applicable. Level the platform from Ground Control (if necessary) to within ±5 degrees.
3. Observe the Empty Platform Weight. Proceed to the DIAGNOSTICS, PLTLOAD sub-menu and observe the measured platform load. All tools, debris, and customer-installed devices shall be removed during evaluation. Ideally, the PLTLOAD should be zero but can vary ±15lbs (± 7kg). Further, the reading should be stable and should not vary by more than ±2lbs (±1kg) (unless there is heavy influence from wind or vibration).
4. Use the Technician's Weight to Evaluate. The technician should enter the platform and record the PLTLOAD reading while standing in the center of the platform.
5. Confirm Control System Warnings and Interlocks. Using the keyswitch, select Platform Mode and power-up. Start the vehicle's engine and ensure that all controls are functional and the Load Sensing System's Overload Visual and Audible Warnings are not active. Simulate an Overload by unplugging the Shear Beam Load Cell. The Overload Visual Warning should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, and 2 seconds Off. With the engine running, all control should be prevented. Cycle the Platform EMS to stop the engine and then power-up again. The Overload Visual and Audible Warning should continue. Confirm that controls are responsive when using the Auxiliary Power Unit for emergency movement. Reconnect the Load Cell. The Overload Visual and Audible Warnings should cease and normal control function should return. Switch the vehicle's keyswitch to Ground Mode and repeat the above procedure. The Overload Visual Warning at the Ground Controls should flash, and the Audible Warning (at Platform and Ground) should sound for 5 seconds On, 2 seconds Off. However, the controls should remain functional when using the engine and the Auxiliary Power Unit (if the Control System's MACHINE SETUP, LOAD is set to "2=CUTOUT PLT". If set to "3=CUTOUT ALL", then Ground Controls will be prevented when using the engine as in the platform).
6. Confirm Control System Capacity Indication (optional for vehicles with Dual Capacity Ratings). For vehicles equipped with a Capacity Select switch on the Platform Console Box, it is necessary to examine an additional interface between the Load Sensing System and the Control System. Using the keyswitch, select Platform Mode and power-up. If necessary, put the boom in the transport position (completely stowed) and center the Jib Plus (if equipped). Place the Capacity Select switch in the unrestricted position and ensure that the proper indicator illuminates on the Platform Console Box. Plug the JLG Analyzer into the Analyzer connection and proceed to the DIAGNOSTICS, SYSTEM submenu. Ensure that the CAPACITY displays indicate OFF. Place the Capacity Select switch in the unrestricted position (if so equipped) and ensure that the proper indicator illuminates on the Platform Console Box (but does not flash). For vehicles with unrestricted capacity, ensure that the unrestricted CAPACITY display indicates ON but the restricted CAPACITY indicates OFF. For vehicles with restricted capacity, ensure that the unrestricted CAPACITY display indicates OFF but the restricted CAPACITY indicates ON.
7. Confirm Load Sensing System Performance with Calibrated Weights. Operate the vehicle from Ground Control and place the boom in the transport position (fully stowed) for safety. Plug the JLG Analyzer into the control system connection and proceed to the DIAGNOSTICS, PLTLOAD display. Place 500lbs (230kg) in the platform and ensure that PLTLOAD is with ±5% of the actual weight. For Dual Capacity vehicles, do the same for the alternate capacity (unrestricted or restricted).

Troubleshooting

The following tables are furnished to provide possible resolutions for common difficulties. Difficulties are classified as General, Calibration, Measurement Performance, and Host System Functionality.

Table 6-12. LSS Troubleshooting Chart

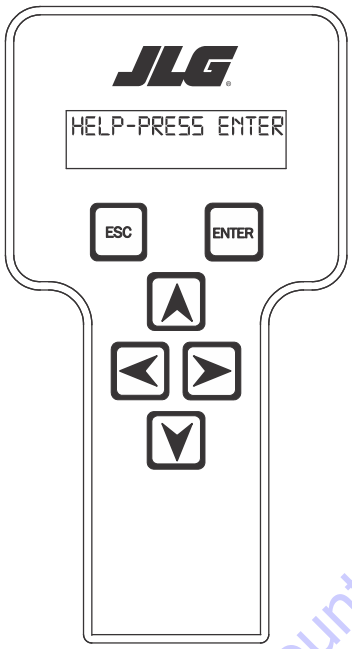
Difficulty	Possible Resolution
Empty Platform Weight (DIAGNOSTICS, PLATFORM LOAD) is not within ±15lbs (±7kg) of zero. or Platform Load readings (DIAGNOTICS, PLTLOAD) are unstable by more than ±2lbs (±1kg) (without the influence of vibration or wind). or There are large variations in Platform Load (DIAGNOSTICS, PLTLOAD) based on the location of the load. Tolerance to variations is 20lbs for an evaluation using the technician's weight, and ±5% of Rated Load when using calibrated weights.	The LSS System is unable to properly measure the platform weight. 1. The Load Cell is not properly plugged into the LSS Harness. It is possible poor electrical contact is made. 2. Wiring leading to the Load Cell is damaged. Carefully inspect sensor wiring where it passes through cable clamps for signs of damage. Inspect wiring where damage to the channel is apparent. 3. The Load Cell was not assembled properly during installation. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable. It is often helpful to apply slight downward pressure above the sensor and observe that its output increases (increasing force measurement; decreasing means the sensor is mounted upside-down). 4. The Load Cell is contaminated by debris or moisture. Examine the sensor's reading using the JLG Analyzer. Proceed to the DIAGNOSTICS, CELL, LOAD displays and determine if the readings are reasonable and stable (not changing by more than ±2lbs (±1kg) (without the influence of vibration or wind). Lack of measurement stability is a key indication of contamination. Unplug the connector and inspect for dirt or moisture. Look carefully into the female connector on the sensor's cordset for evidence of contamination. Debris should be brushed away with a soft bristle brush (do not introduce any cleaners as they will leave conductive residue). Moisture should be allowed to evaporate or accelerated with a heat-gun (use low heat and be carefully to not melt connector materials). Moisture intrusion into the molded portion of the connector (capillary action into the wire bundle) or the Shear Beam Load Cell itself will require replacement of the sensor. 5. The Load Cell has been mechanically damaged. If the Load Cell is physically deformed or has damage to the cover it should be replaced immediately. It is also possible to have invisible mechanical damage resulting from an extreme overload (>6000lbs [>2722kg]).
The Visual and Audible Overload Warnings fail to sound when platform is loaded beyond Rated Load, or when simulated by unplugging the Load Cell. Controls remain functional at Platform and Ground Control positions.	The Control System is failing to regard the overload signal from the LSS System, or the signal is shorted. 1. The Load Sensing System must be enabled within the Control System. Plug the JLG Analyzer into the Control System, enter the Access Level 1 password (33271), and examine the MACHINE SETUP, LOAD sub-menu. The selection "2=CUTOUT PLT" should be displayed (platform controls prevented during overload, ground controls remain operational). In country- or customer-specific circumstance, the selection "3=CUTOUT ALL" is used (platform and ground controls prevented during overload).
The Ground Audible Warning fails to sound, but the Platform Audible Warning sounds properly.	The Ground Alarm is missing or improperly installed. Verify that the device is mounted. Verify wiring from the Main Terminal Box and Ground Module.
Controls remain functional at the Ground Control position during an overload, or when simulated by unplugging the Load Cell. The Controls at the Platform Control position are prevented when using the engine, but not when using the Auxiliary Power Unit.	The JLG Control System is configured to prevent platform controls only in the event of overload. Alternately, the Host Control System can be configured to prevent ground and platform controls for country- or customer-specific circumstances. Using the JLG Analyzer, enter the Access Level 1 password (33271). Proceed to the MACHINE SETUP, LOAD sub-menu. Set this parameter to "2=CUTOUT PLT" to prevent platform controls in the event of overload. Set this parameter to "3=CUTOUT ALL" to prevent platform and ground controls in the event of overload.

6.13 RESETTING THE MSSO SYSTEM

1. Use the following procedure to reset the MSSO system.
2. Position the Platform/Ground select switch to the desired position.
3. Plug the analyzer into the connector coming from the ground control module or from the platform console.

NOTE: *If performing the procedure from the platform console, the Emergency Stop switch on the ground console must also be pulled out.*

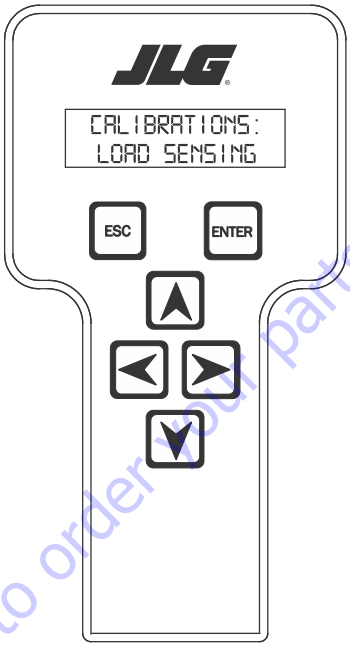
4. Pull out the Emergency Stop switch.
5. The analyzer screen should read:



6. Use the arrow button to reach OPERATOR ACCESS. Press Enter 

.
7. Enter the Access Code, 33271.
8. Use the right Arrow key to reach MENU: CALIBRATIONS. Press Enter 

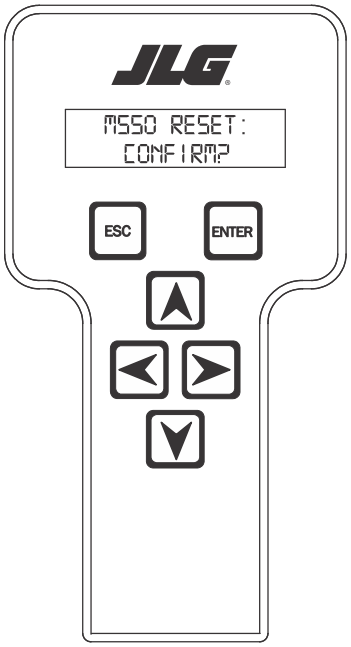
.
9. Use the arrow keys to reach the LOAD SENSING menu. The screen should read:



10. Press ENTER 

.
11. Use the Down  arrow to reach MSSO RESET.

12. Press Enter (ENTER). The screen will read:



13. Press Enter (ENTER). The JLG Control System will reset an active 873 DTC and the MSSO System will be reset. Press Escape (ESC) to return to the CALIBRATIONS menu.