Maintenance Instructions

EASi^2

Model **31**	**Serial No.** **16806 and Up**
PDMM# **0020**	**Date** **09/15/91** **Revised 6/30/93**

Welding Instructions

Before performing any type of electric resistance welding on the truck, note the following: (See NOTE below)

- Turn the key switch off
- Remove the battery
- Remove the Operator's Display (OD)
- Remove the Vehicle Manager (VM)
- Disconnect the 9-pin (JPT2) cable assembly from the Chopper Control Module (CCM)
- Disconnect the 9-pin (JPH2) cable assembly from the H-Bridge Control Assembly (HCM)

NOTE

A new decal, (P/N 411-730), **MUST** be ordered to replace the one destroyed when removing the Operator's Display.

Jacking Truck

Anytime the truck is jacked up for any reason, the service technician should take extra time and caution to ensure that the truck will not tip over or otherwise pose a hazard to himself or others.

The following diagram illustrates the correct jacking points on the truck frame. Whenever the truck is jacked up, there should not be any load on the forks. The forks should be lowered all the way to the lowest possible point. Disconnect the battery and remove the key. Always use solid blocks to support the vehicle. Never rely on jacks or chains to hold the vehicle. Attach a chain to the top of the mast and an overhead hoist to stabilize the mast.

When the truck is jacked up at the rear of the vehicle, it should not be lifted more than two inches (5.0 cm) off the floor. When jacking on the side of the truck, the load wheels should not be lifted off the floor more than one-half inch (1.3 cm).

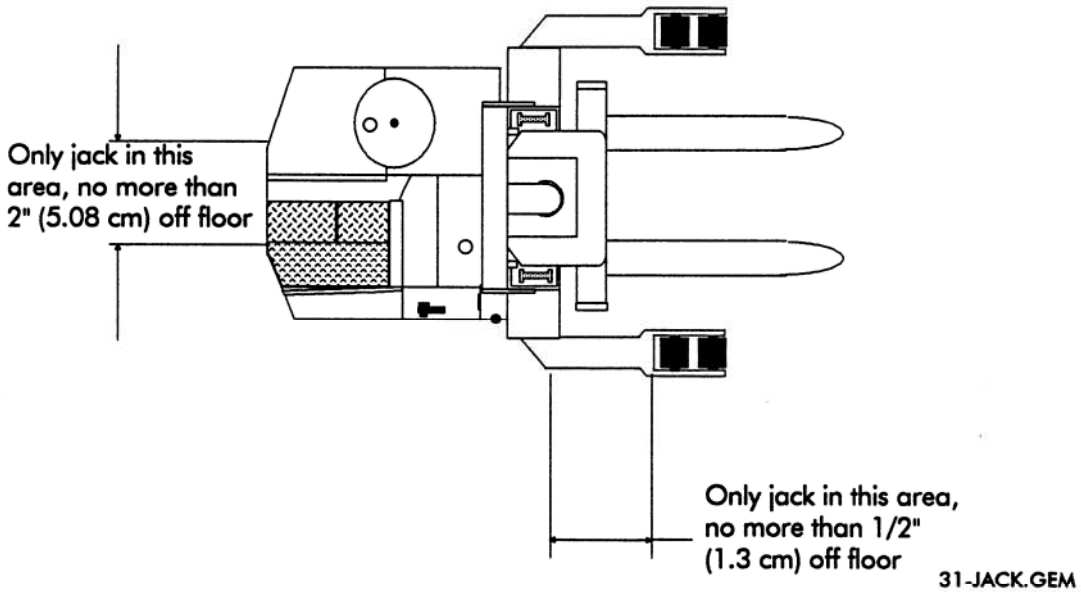


Figure 9 Correct Jacking Locations for the Model 31

Conversion Table

To Convert...	Multiply by...
Inches to Millimeters	25.4
Inches to Centimeters	2.54
Feet to Meters	0.305
Yards to Meters	0.914
Miles to Kilometers	1.609
Millimeters to Inches	0.039
Centimeters to Inches	0.394
Meters to Feet	3.281
Meters to Yards	1.094
Kilometers to Miles	0.621
Square Inches to Square Centimeters	6.452
Square Feet to Square Meters	0.093
Square Yards to Square Meters	0.836
Square Centimeters to Square Inches	0.155
Square Meters to Square Feet	10.155
Square Meters to Square Yards	1.196
Gallons to Liters	3.785
Pounds per Square Inch to Kilo Pascals	6.894
To Convert...	**Perform the following...**
Fahrenheit to Celsius	(°F - 32)÷1.8
Celsius to Fahrenheit	(°C X 1.8) + 32

Figure 11 Conversion Table

Adding Water To Battery

Water must be added to battery cells periodically. Frequency and quantity depend on the water level above the plates and the amount of gassing during charge.

Guidelines

- Use only approved or distilled water.
- Add water after hydrometer and voltmeter readings are taken.
- Add water after charging to minimize overfilling.
- Always have plates entirely covered.
- Keep the outer surfaces of the battery case clean and dry.

Battery History Record

A battery record system is essential because battery failure can cause production slowdowns and increased battery operating costs. A properly supervised record system can detect and call attention to such operating irregularities as:

- Overcharging
- Undercharging
- Over-discharging
- Excessive water consumption
- Excessive dirt and corrosion
- Worn-out batteries
- Excessive current consumption of trucks

Records should be kept for each battery. Your battery supplier should be able to provide maintenance record sheets. Each report should contain:

- Battery number, type, serial number, and service data
- Specific gravity and voltage readings for each cell
- Temperature of the air and electrolyte
- Electrolyte
- Amperes
- Condition of connectors, covers, sealing compound and tray
- General cleanliness
- Number of total cycles
- Average specific gravity drop
- Watering frequency
- User comments and observations

Bleeding Hydraulic System

Bleed the hydraulic system if the system is opened for service/repair or if the load bounces.

1. Elevate forks 2 - 3 inches (50 – 75 MM) off the floor.
2. Turn key OFF. Disconnect battery.
3. Loosen (DO NOT remove) the bleed screw at the top of the back cylinder.
4. When oil starts flowing from the screw hole, tighten the screw.
5. Repeat steps 3 and 4 for the front cylinder
6. Repeat steps 3 and 4 for the side cylinders (trucks with free lift only).
7. Check reservoir level.

Using Maintenance Mode

If you go into and out of Maint several times to resolve a problem, it may save time if the SuperWrd is temporarily changed to a single character or number. The Operator's Display would appear as shown below:

[_ _ _ _ _ _ _ _]

That way, when Program Mode is entered, the password can be entered quickly. **Remember to re-enter the correct SuperWrd when you are done.**

⚠CAUTION

IF THE POWER TRANSISTOR (Q1) GOES BAD IT MAY DESTROY THE CHOPPER CONTROL MODULE (CCM) AND IF THE CHOPPER CONTROL MODULE GOES BAD, IT MAY DESTROY THE POWER TRANSISTOR. THEREFORE, IF THE POWER TRANSISTOR IS FOUND TO BE BAD, TEST THE CHOPPER MODULE BEFORE INSTALLING A NEW POWER TRANSISTOR; LIKEWISE, IF THE CHOPPER CONTROL MODULE IS DEFECTIVE, TEST THE POWER TRANSISTOR BEFORE INSTALLING A NEW CHOPPER CONTROL MODULE.

⚠CAUTION

IF THE H-BRIDGE CONTROL MODULE (HCM) GOES BAD, IT MAY DESTROY THE FIELD WIRING ASSEMBLY (FW) AND IF THE FIELD WIRING ASSEMBLY (FW) GOES BAD IT MAY DESTROY THE H-BRIDGE CONTROL MODULE (HCM). THEREFORE, IF THE HCM IS FOUND TO BE BAD, TEST FW BEFORE INSTALLING A NEW HCM. LIKEWISE, IF FW IS FOUND TO BE DEFECTIVE, TEST THE HCM BEFORE INSTALLING A NEW FIELD WIRING ASSEMBLY.

⚠CAUTION

FOR ANY OF THE TESTS WHERE YOU ARE INSTRUCTED TO DISCONNECT JPT1, JPH1, JPW1 OR JPF5, TURN POWER OFF BEFORE DISCONNECTING EITHER CONNECTOR, THEN RE-ENTER THE TEST. THIS IS VERY IMPORTANT AS FAILURE OF THE CHOPPER MODULE FIELD WIRING ASSEMBLY, H-BRIDGE CONTROL MODULE OR POWER TRANSISTOR IS POSSIBLE IF THE CONNECTOR IS REMOVED AND POWER IS STILL APPLIED.

DISCONNECTING WIRES OR CONNECTORS TO INTEGRATED CIRCUITS WITH POWER ON CAN RESULT IN PREMATURE FAILURE OF THOSE OR OTHER COMPONENTS. ALWAYS TURN POWER OFF BEFORE MAKING OR BREAKING ANY CONNECTIONS.

WHEN REMOVING A CONNECTOR, DO NOT PULL ON THE WIRES TO SEPARATE THE CONNECTION!

⚠ WARNING

WHILE IN MAINTENANCE MODE:

- **THE DRIVE TIRE MUST BE ELEVATED OFF THE FLOOR**
- **ENSURE CONTROLS ARE IN NEUTRAL**
- **THE VEHICLE IS BLOCKED TO PREVENT MOVEMENT AND...**
- **THE CARRIAGE IS LOWERED COMPLETELY TO THE FLOOR.**

FAULT CODES

Code 20

Code Title	Temperature sensor circuits not responding
Reason	The signal from Power Panel temperature sensor (HT) is not correct
System Response	1. Alarm sounds: Yes 2. Operator's Display: CODE 20...Inform Service Personnel 3. PC contactor: Energized 4. VFC Display: 20 5. Speed Limit: 1 mph
How to Clear	The key must be cycled OFF/ON to clear this fault.

Corrective Actions and Checks

Insure the following cables are properly connected:

- JPF4, JPF5 on Power Panel Driver Assembly
- JPT1, JPT2 on CCM
- JPS1 on Vehicle Manager

Run Tests:

- A10 to verify the analog temperature reading.
- I12 to verify the digital temperature limit signal.

Possible causes:

1. Check the cables between:
   - HT sensor and Power Panel Driver Assembly
   - Power Panel Driver Assembly and CCM
   - CCM and Vehicle Manager
2. The HT sensor may be bad.
3. The CCM may be bad.
4. The Power Panel Driver Assembly may be bad.
5. The Distribution Board may be bad.
6. The VFC may be bad.

Code 34

Code Title	Traction motor overheated
Reason	The temperature of the drive motor is hot enough for the Vehicle Manager to prevent travel.
System Response	1. Alarm sounds: Yes 2. Operator's Display: "CODE 34 Drive motor overheated, allow time to cool..." 3. PC contactor: De-energized 4. VFC Display: 34 5. Speed Limit: 0.0 mph
How to Clear	The key must be cycled OFF/ON to clear this fault.

Corrective Actions and Checks

The drive motor temperature circuit may not be functioning correctly:

- Run Test A08 - Traction Motor Temperature Voltage

Possible causes:

1. The drive motor may be overheated...allow to cool.
2. Check cables between:
   - DT sensor and Hydraulic Driver Assembly (HDA)
   - HDA and VFC
3. If the brake is mis-adjusted so that it is too tight, the drive motor will not turn freely. This may cause this code. See "Brake Adjustment" on page 179.
4. The drive motor may be excessively dirty, clean using dry, compressed air (30 psi [206.84 kPa] max.).
5. The DT sensor may be bad.
6. The Distribution Board may be bad.
7. The VFC may be bad.

FAULT CODES

Code 6C

Code Title	Main lift pressure out of range.
Reason	The Vehicle Manager has sensed hydraulic pressure exceeding programmed limits.
System Response	1. Alarm sounds: Yes 2. Operator's Display: "CODE 6C Inform Service Personnel..." 3. PC contactor: Energized 4. VFC Display: 6C 5. Lift Speed Limit: 0.0 fpm
How to Clear	The key must be cycled OFF/ON to clear this fault.

Corrective Actions and Checks

1. Check the pressure sensor.
   - Run Test A13 - Pressure Sensor Voltage

Possible causes:
- Check pressure sensor cable JPN9
- Cable between Hydraulic Driver Assembly and VFC may be bad
- Pressure sensor may be defective
- Hydraulic Driver Assembly may be bad
- VFC may be bad

2. The +12 volt power supply may be bad.
   - Run Test A14 - Power Supply +12 Voltage

Code 87

Code Title	Release throttle to resume operation
Reason	Travel control out of neutral before deadman depressed.
System Response	1. Alarm sounds: Yes 2. Operator's Display: "Release throttle to resume operation...." 3. PC contactor: De-energized 4. VFC Display: 87 5. Speed Limit: 0.0 mph
How to Clear	Return throttle to neutral, then depress the deadman pedal

Corrective Actions and Checks

Depress deadman pedal **before** moving throttle.

Code 88

Code Title	Lift bypass switch activated
Reason	Optional lift limit switch has been actuated
System Response	1. Alarm sounds: Yes 2. Operator's Display: "Depress lift bypass switch to continue lifting..." 3. PC contactor: Energized 4. VFC Display: 88 5. Lift Speed Limit: 0.0 mph
How to Clear	Depress lift bypass switch to continue lifting.

Corrective Actions and Checks

None.

Analog Tests

Test A05 - Lift/Lower Pot Voltage

This test displays the voltage that the VFC reads from the lift/lower pot (VR2).

Related Codes and Tests

Code 81 - Lift/Lower reading out of range.

NOTE:

Learn mode should be run whenever the lift/lower pot is replaced or repaired.

For information on how to use maintenance mode, refer to page 48.

Expected Results

1. The Operator's Display will display the voltage which the Vehicle Manager reads from the lift/lower pot.
2. The test is a success if the voltage displayed is within these limits:

Lift/Lower Control Position	Voltage Displayed
Full lift	0.4 - 1.5
Neutral	2.0 - 3.0
Full lower	4.0 - 4.9

If the voltage reading is outside these limits, then the test is a failure.

Possible causes of test failure:

1. The lift/lower potentiometer may be out of adjustment.
2. The lift/lower pot or wiring between the pot and the Vehicle Manager may be defective.
3. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board and re-run the test.
4. The mechanical portion of the controller may be defective.
5. The VFC may not be functioning properly. Replace with a known good VFC. **After replacing boards, be sure to run Learn Mode BEFORE re-running the test.**

Test A12 - Field Current Sense Voltage

This test displays the voltage which is read from the current sensor "donut" on the HCM.

Related Codes and Tests

Code 25 - Short detected in field circuit.
Code 26 - Open detected in field circuit.
Code 27 - Field current sensor circuits not responding properly.
Code 7E - Field current reading out of range

NOTE:

The current sensor continually monitors the current flowing through Power Transistors TM1 and TM2 in the Field Wiring Assembly (FW). The Vehicle Manager constantly monitors this current, and adjusts its performance accordingly.

The current sensor is dynamically tested for proper operation by SelfTest every time the key is turned on. While monitoring the current sensor, the Vehicle Manager sends a brief pulse of current through transistors TM1 and TM2.

The HCM will automatically limit the maximum current through TM1 and TM2. Whenever the HCM is in current limit, the green LED will be on. It is normal for the HCM to go into current limit, particularly when accelerating. The HCM's current limit threshold is preset at the factory and is not adjustable.

For information on how to use maintenance mode, refer to page 48.

Expected Results

1. The Operator's Display will display the voltage which the Vehicle Manager reads from the current sensor.

System Condition	Voltage Displayed
All cables connected	5.5 - 6.5
JPS2 disconnected	0.0 - 0.5

The test is a success if the voltage is between 5.5 and 6.5 volts. The reading should remain steady, and should not fluctuate by more than 0.02 volts. If this is not observed, then the test is a failure.

Possible causes of test failure:

1. The cable between the HCM and the Vehicle Manager may be loose or defective. Check for continuity.
2. The HCM may be bad. Replace with a known good HCM and re-run this test.
3. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board and re-run the test.
4. The VFC may not be functioning properly. Replace with a known good VFC. **After replacing boards, be sure to run Learn Mode before re-running the test.**

Test I04 - Lift Bypass Switch

This test applies only to vehicles equipped with lift inhibit bypass option.

For trucks with lift bypass, this test displays the position of S12 as seen by the Vehicle Manager.

Related codes and Tests

Test I05 - Lift Inhibit Lift Switch

For information on how to use maintenance mode, refer to page 48.

Expected Results

The display will show position of lift bypass switch S12:

Switch S12	Audible Alarm	Operator's Display
Open	Off	Off
Closed	Sounding	On

If this is not observed, then the test is a failure.

Possible causes of test failure:

1. Switch S12 may be defective or wired incorrectly. Check operation of switch and verify wiring connections.
2. The wiring from S12 to JPN13 on the Hydraulic Driver Assembly may be defective.
3. The wiring from the Hydraulic Driver Assembly JPN14-21 to the Vehicle Manager JPS9-21 may be defective. Repair/replace as required.
4. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board, and re-run the test.
5. The VFC board may not be functioning properly. Replace with a known good VFC board. **After replacing boards, be sure to run Learn Mode before re-running the test.**

Test I13 - Armature Current Limit Signal

Using this test, the current limit signal from the CCM can be monitored. A successful test proves that the Vehicle Manager is correctly reading the armature current limit signal.

Related codes and Tests

Code 21 - Short detected in armature circuit
Code 24 - Armature Current Sensing Circuit not responding.
Code 73 - Armature current sensor out of range
Test A11 - Armature Current Sense Voltage

NOTE:

The CCM sends two indications of transistor current to the Vehicle Manager:

- an analog "current sense" signal, and...
- a digital "current limit" signal.

This test allows the current limit signal to be checked.

- See Test A11 - Armature Current Sense Voltage to check current sense signal.

The current limit signal is activated by the CCM whenever the transistor current is exceeded. The green LED on the CCM will be illuminated whenever the current limit signal is active.

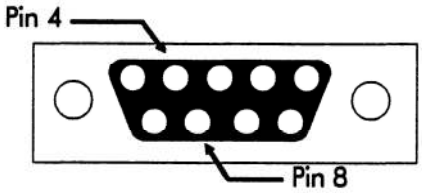
For information on how to use maintenance mode, refer to page 48.

Expected Results

The display should show "NO". If "YES" is displayed, the test is a failure.

Grounding the signal will activate it. To test:

a. Unplug JPT2 from the CCM.
b. Carefully connect a jumper between JPT2-4 and JPT2-8. (See Figure 23.)
Tip: Bend a regular size paper clip and use it as a jumper.
Looking at the end of the cable:



JPT2.GEM

Figure 23 Pinout for JPT2

c. The display should now show "YES". If this is not observed, then the test is a failure.
d. Remove jumper and reconnect cable at JPT2.

Possible causes of test failure:

1. The cable from the CCM may not be properly plugged into the Vehicle Manager at JPS1, or the cable may be bad. Using an ohmmeter, verify continuity of all conductors between JPT2 and JPS1.
2. If the green LED is on when running this test, then the CCM is bad. Replace with a known good unit, and re-run this test.
3. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board, and re-run the test.
4. The VFC board may not be functioning properly. Replace with a known good VFC board. **After replacing boards, be sure to run Learn Mode before re-running the test.**

Test O05 - Toggle Solenoid DIRB

Using this test, DIRB can be turned off and on, verifying its correct operation.

A successful test proves that the wiring and related circuitry in the VFC, Vehicle Manager, Hydraulic Driver Assembly and DIRB coil driver are all functioning correctly. It also proves that DIRB and its harness are electrically functional.

Related Codes and Tests

Test O00 - Toggle the PC Contactor

Procedure

1. Disconnect wire from DIRB.
2. Connect an ammeter in series with DIRB as follows:
   - Positive (+) to DIRB-1 terminal
   - Negative (-) to wire removed from DIRB-1

For information on how to use maintenance mode, refer to page 48.

Expected Results

DIRB Solenoid	Ammeter Reading	Operator's Display
Open	0.5 - 1.0 amp	On
Closed	0.0 - 0.02 amp	Off

If this is not observed, then the test is a failure. Re-connect wire at DIRB-1.

Possible causes of test failure:

1. There may be an open or short in DIRB's coil or associated wiring. Check as follows:
   a. Turn off power.
   b. Unplug JPN1 from the Hydraulic Driver Assembly.
   c. Using an ohmmeter, measure across harness between JPN1-1 and JPN1-9.
   d. If the resistance is less than 10 ohms or more than 75 ohms, then there is a problem in the DIRB coil circuit. Troubleshoot the solenoid coil and its associated wiring.
   e. Reconnect JPN1.
   f. Check for continuity between JPS9-7 on the Vehicle Manager and JPN14-7 on the Hydraulic Driver Assembly.
2. The DIRB coil driver may be bad. Replace it with a known good coil driver and re-run the test. If the test passes, replace the bad coil driver.
3. The Hydraulic Driver Assembly may be defective. Replace with a known good unit and test again.
4. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board, and re-run the test.
5. The VFC board may not be functioning properly. Replace with a known good VFC board. **After replacing boards, be sure to run Learn Mode before re-running the test.**
6. There may be a hydraulic problem in the valve portion of DIRB which is preventing it from operating properly. Investigate and troubleshoot accordingly.

Test O13 - Chopper Control Module Enable Signal

Using this test, proper operation of the Chopper Control Module (CCM) enable signal can be verified.

A successful test proves that the wiring and related circuitry in the VFC, and Distribution Board are all functioning properly.

Related Codes and Tests

Code 21 - Short detected in armature circuit
Code 23 - Open detected in armature circuit
Code 40 - B contactor detected closed when commanded open
Test O14 - Chopper Control Module PWM ramp.

NOTE: This test will toggle the enable signal from the Vehicle Manager on and off. The enable signal "enables" the CCM to pulse the Power Transistor (Q1). If the CCM is not enabled, it can't pass pulses from the Vehicle Manager on to the transistor.

During normal operation, the enable signal is activated whenever the Vehicle Manager is pulsing the Power Transistor (Q1).

This test only checks that the enable signal from the Vehicle Manager is actually arriving at the input to the CCM. *Test O14 - Chopper Control Module PWM* must be run in order to verify that the CCM is correctly enabling its output.

Procedure

1. Disconnect the cable from JPT2, and connect a voltmeter to the cable between JPT2-9 (+ lead) and JPT2-5 (- lead).
   Hint: Use a couple of regular size paper clips to probe the sockets of the cable.

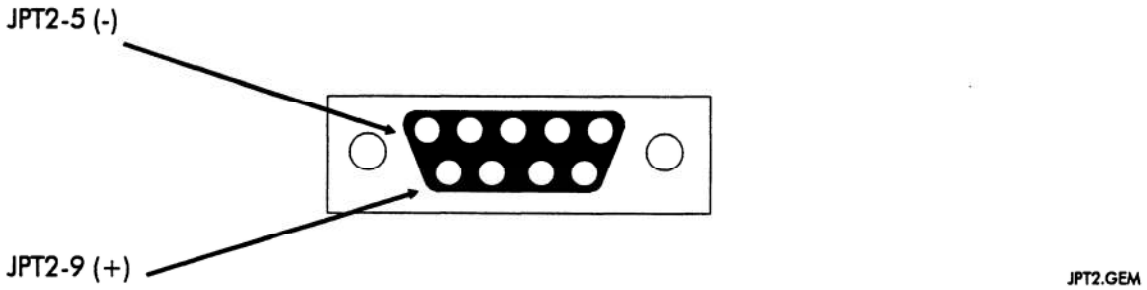


Figure 25 Pinout For JPT2

For information on how to use maintenance mode, refer to page 48.

The voltmeter should display the following:

Display	Voltage
On	10.5 - 12.5 volts
Off	0.0 - 0.5 volts

If this is not observed, then the test is a failure.

(Continued on the next page)

Digital Output Tests

Test O18 - Toggle Horn

Using this test, proper operation of the horn can be verified.

A successful test proves that the horn and its related wiring and circuitry in the VFC, Power Panel Driver Assembly and Distribution Board are functional.

Related Codes and Tests

None.

NOTE: Every time that SelfTest is run during power up, the horn is briefly beeped to indicate that SelfTest completed successfully.

Procedure

1. Connect a voltmeter across H1 at the horn.

For information on how to use maintenance mode, refer to page 48.

Expected Results

Horn	Voltmeter Reading	Operator's Display
Sounding	B+	On
Off	0.0	Off

If this is not observed, then the test is a failure. Remove meter.

Possible causes of test failure:

1. There may be an open in the horn circuit, or the horn may be defective. Check as follows:
   a. Turn off power with the key switch. Leave the battery connected.
   b. Unplug JPN6 from the Hydraulic Driver Assembly.
   c. Attach a ground jumper from TP4 to JPN6-4.
   d. Attach one end of another jumper from JPN6-5. Briefly touch the other end of the jumper to FU5. The horn should sound. If the horn does not sound, then troubleshoot the horn and its associated wiring.
   e. Reconnect JPN6.
2. The horn switch may be defective.
3. Check for continuity between JPS9-6 and JPN14-6.
4. The Hydraulic Driver Assembly may be defective. Replace with a known good unit and perform test again.
5. The Distribution Board may not be functioning properly. Replace with a known good Distribution Board, and re-run the test.
6. The VFC may not be functioning properly. Replace with a known good VFC. **After replacing boards, be sure to run Learn Mode before re-running the test.**

Drive Unit Removal (Cont'd)

12. Remove drive tire.
13. Disconnect steer linkage from drive unit; swing linkage clear.
14. Place temporary support under drive unit or attach a hoist to the tool installed in Step 8.
15. Loosen, then remove the four mounting screws holding the drive unit to the tractor frame.
16. Lower the drive unit to the floor. Tip the drive unit over on its side and remove.

Drive Unit Installation

To install drive unit, reverse removal instructions noting the following:

1. Torque drive unit to tractor frame screws to 150 ft. lbs. (210 Nm).
2. Apply Loctite 242 (990-536) to bolt threads for steer linkage. Torque to 150 ft. lbs. (210 Nm).
3. Use Loctite 242 (990-536) when mounting steer motor.
4. Clean mounting surface of drive motor. Coat mating surfaces using 990-556. Torque mounting screws to 13 ft. lbs. (18.2 Nm).
4. Torque drive tire lug bolts to 130 ft. lbs. (182 Nm).
5. Bleed brake system. Check master cylinder reservoir level.
6. Bleed hydraulic system. Check reservoir level.
7. Refill drive unit using correct type fluid.
8. If you have trouble separating the tool from the drive unit, use the threaded holes in the tool.
9. Test brake for proper operation.

Brake Assembly/ Adjustment

Two brake adjustment procedures are detailed. The first procedure is adjusting the brake without brake adjustment tool 828-003-804. The second procedure is to be followed when using the adjusting tool.

NOTE: Adding or removing shims should only be required if the drive motor or brake assembly is changed.

Without Adjusting Tool

1. Install the snap ring on the lower snap ring groove on the drive motor.
2. Place shim washers on top of the lower snap ring. Use either two of P/N 411-078 (.005" [0.127 MM] thick) or one of P/N 411-079 (.010" [0.254 MM]).
3. Place the brake assembly on the motor shaft. To facilitate adjustment, do not use the Woodruff key at this time.
4. Connect brake line. Bleed the air from the brake lines.
5. While the deadman is depressed, measure the gap between the brake rotor and the bottom plate.
6. When the deadman pedal is depressed, the gap should be between 0.010" and 0.015" (between 0.254 MM and 0.381MM) at both the top and bottom of the rotor.
7. Add or remove shim washers until the proper gap is achieved.
8. When the proper gap is measured, remove brake assembly. Then install Woodruff key on motor shaft. Clean shaft area where rotor is installed on it. Apply Primer T (P/N 990-533) to this area. Sparingly use Loctite 242 (P/N 990-536) to secure the rotor to the shaft.
9. Install brake. Add shim washers to top of rotor until flush with lower surface of snap ring groove. Reinstall upper snap ring, connect brake line (if you had to disconnect it for step 7), and bleed brake.
10. Check gap after final assembly; correct if necessary.
11. Test truck for proper braking action.
12. To change the pressure applied on the brake pads, use spanner wrench (828-900-013). Rotate top of brake counterclockwise to increase stopping distance. Rotate the top of brake clockwise to decrease stopping distance. See NOTE.

NOTE: A hammer or dead-blow mallet may be required to move top ring on brake assembly

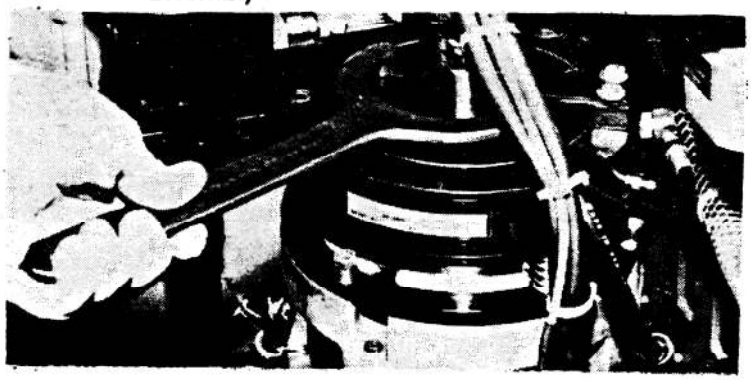


Figure 41 Adjusting Stromag Brake

Brake Assembly
Service - Stromag
(Cont'd)

5. Remove the two O-Rings.

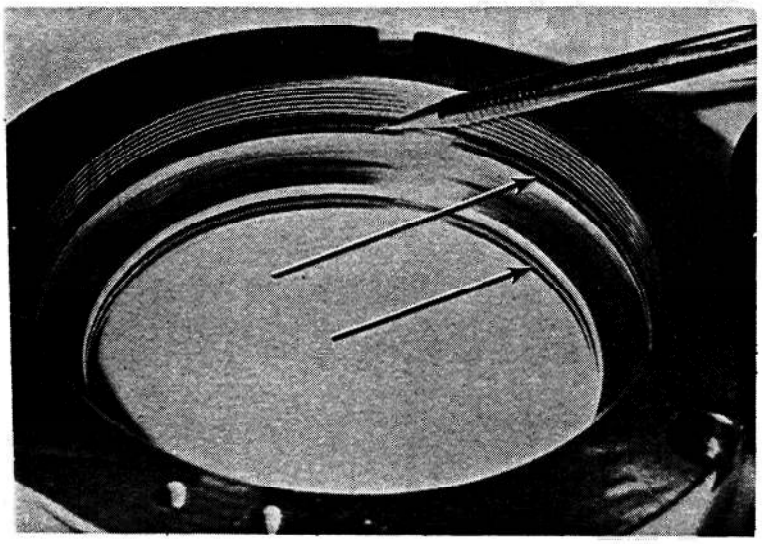


Figure 53 O-ring Location

6. Thoroughly clean and inspect individual components for damage or nicks which may cause leakage.
7. Refer to page 190 for reassembly instructions.

Theory of Operation

1. Pressure for steering is supplied by the auxiliary system. The steering system has priority over all other auxiliary functions.
2. Pressurized hydraulic fluid from the auxiliary pump flows to the steering orbitrol.
3. Turning the steering wheel, directs oil to one side of the steer motor. Turning the steering wheel in the opposite direction directs fluid to the other side of the steer motor.
4. Maximum hydraulic pressure in the steering system is limited by the auxiliary relief valve. The auxiliary relief is located on the auxiliary pump. Auxiliary relief pressure is set at 1600 psi (11,031.6 kPa).

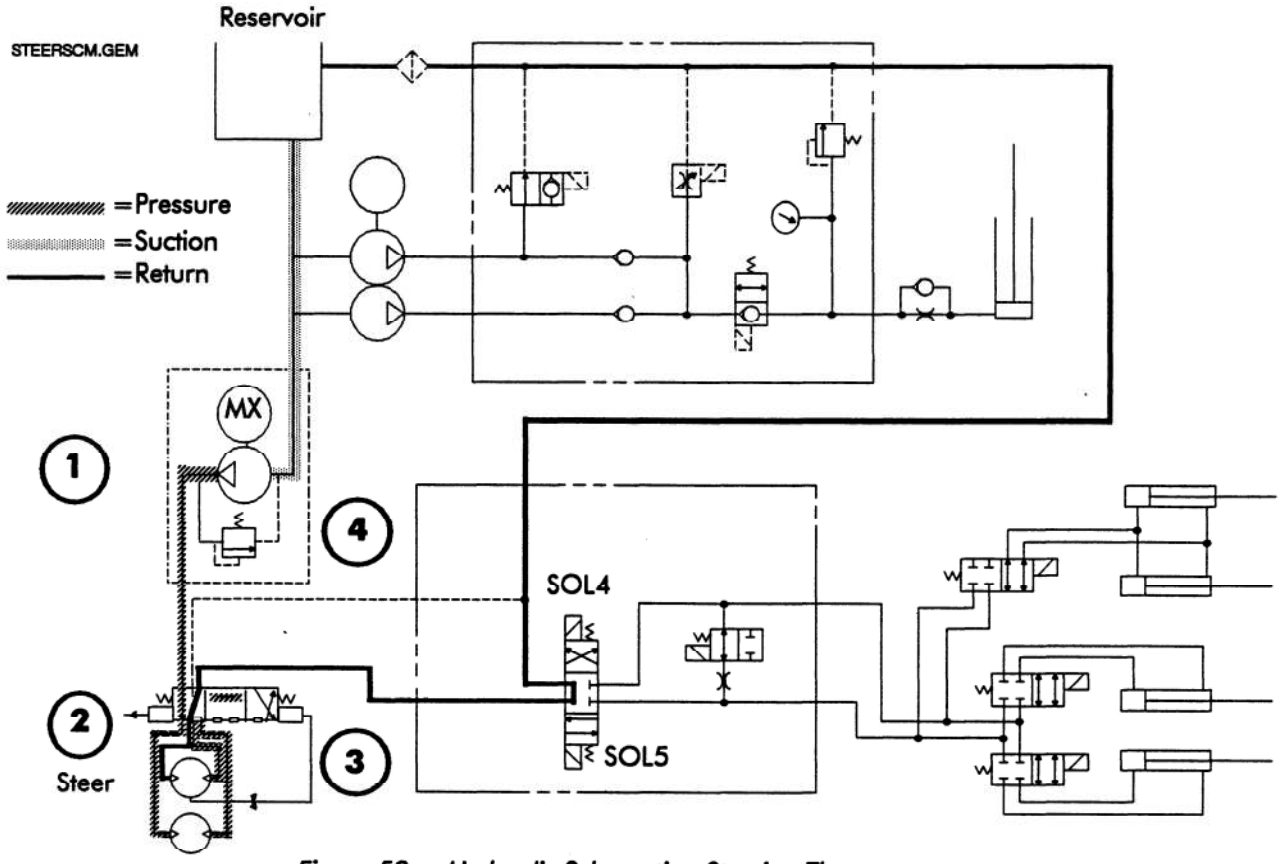


Figure 59 Hydraulic Schematic - Steering Theory

Equalization Chain Adjustment (TT)

The equalization chains on the three stage (TT) masts must be adjusted properly to prevent the possibility of stretched hoses and electrical cables.

Depending on the mast configuration, the equalization chains will be located either between the outer telescopic and the main frame **OR** on the tractor-side of the mast uprights. Determine which mast configuration is used on the truck, then follow the appropriate procedure.

⚠CAUTION

WITH BOTH EQUALIZATION CHAINS SLACK, NOTE THE RELATIONSHIP BETWEEN THE TOP OF THE MAST MAIN FRAME AND THE TELESCOPIC FRAME SECTIONS. UNDER NO CIRCUMSTANCES SHOULD THE EQUALIZATION CHAINS BE ADJUSTED SO THE INNER TELESCOPIC IS RAISED ABOVE THE POSITION NOTED BEFORE STARTING THE ADJUSTMENT PROCEDURE.

All Mast Configurations

1. The equalization chains are properly adjusted if the inner telescopic contacts the mechanical stops on the outer telescopic JUST BEFORE the outer telescopic contacts the mechanical stops on the main frame.
2. The adjusters are located near the top of the main frame, either between the mast main frame and the outer telescopic OR on the tractor-side of the mast. To adjust the equalization chains, turn the chain anchor locknut until the outer telescopic starts to move, then loosen the nut one-half turn. Repeat this step for the other side.
3. Check the adjustment by elevating the carriage (if required) so that 4 – 5 feet (1.2 – 1.5 m) of the equalization chains are visible. Using your fingers, apply pressure on each chain. Determine if the pressure is approximately the same on both sides. If there is a significant difference between the two sides, repeat this procedure on the chain that has the lower tension. See NOTE.

NOTE: Make only minor adjustments to ensure that the chains are not overtightened. Make adjustments equally to both sides. Always recheck chain tension after any adjustments are made to either or both equalization chains.

NOTE:
This figure shows the location of the equalization chains on a mast with 8-inch thick uprights. These chains are located in back of the uprights on masts with a 9-inch thick upright

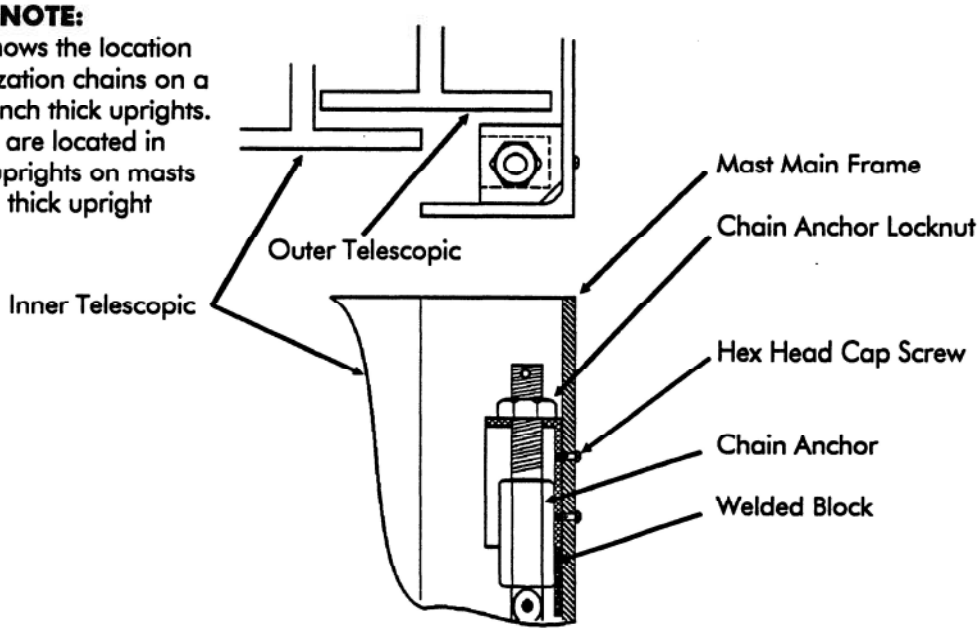
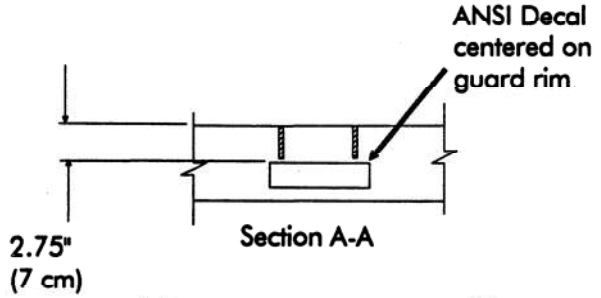
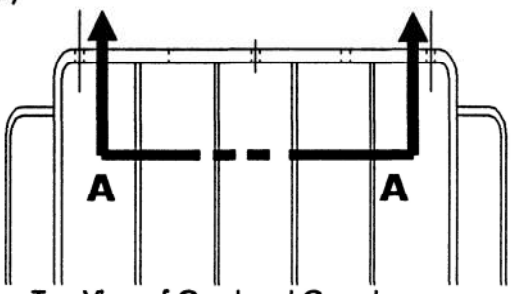


Figure 71 Adjusting Equalization Chain

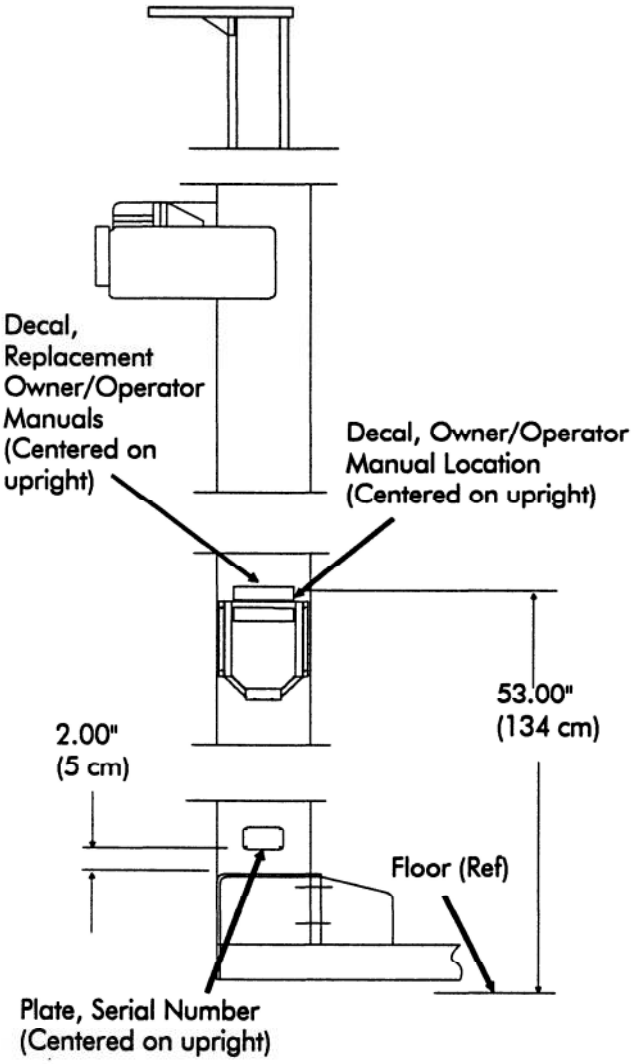
Decal Information

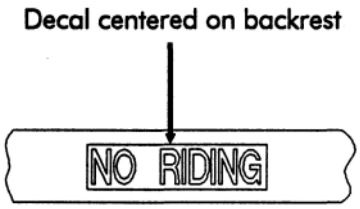
The Figures below and on the next page show the correct position of Decals on the mast.



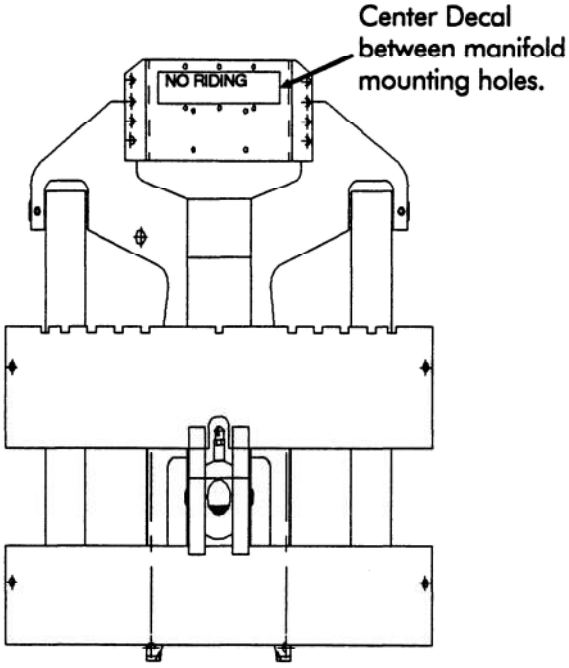


Top View of Overhead Guard





Top View of Load Backrest



Front View of Fork Carriage

Remote Lift/Lower (Optional)

Optional remote lift/lower controls located on the fork carriage, allow an operator to raise or lower the forks while the operator is positioned at the remote platform. For this discussion, remote lift is explained. Refer to Figures 90 through 92.

1. The key switch (S1) is moved to the remote position. See NOTE.

NOTE: With the key switch in the remote position, all travel and auxiliary functions are disabled.

2. Remote lift is activated by depressing both S16 and S17 at the same time.
3. The input line has a resistor (R3) which drops the input voltage to slightly less than battery potential. This supplies a voltage sense input into the hydraulic driver assembly at TS19-2.
4. The Vehicle Manager (JPS9-25) senses the input and sends a signal to the Hydraulic Driver Assembly at JPN14-19, positioning the proportional lift/lower solenoid to the configured position.
5. The Vehicle Manager also provides ground for the pump (P) contactor at JPF2-1. The pump contactor is energized and the pump contactor tips close causing the lift pump motor to start.
6. If the remote EPO button is depressed, the Lift contactor and PC contactor are de-energized.

NOTE: On cold storage trucks with a remote station, terminals on the remote EPO will have a silicone compound (P/N 990-592) applied to them.

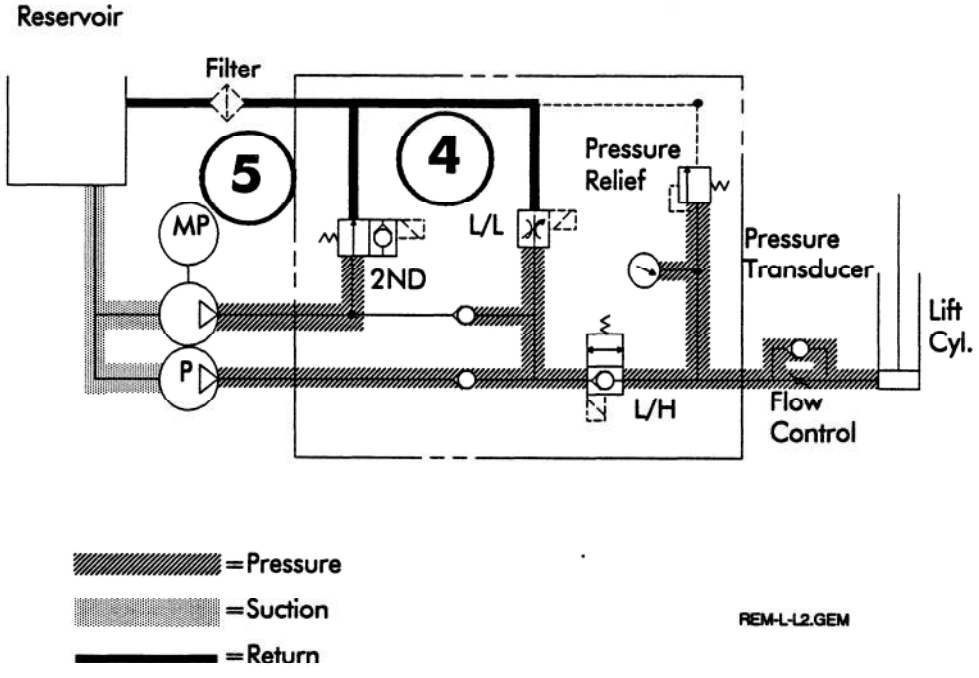


Figure 90 Hydraulic Schematic - Remote Lift/Lower (Optional)

NOTE:
This schematic is for Theory of Operation only. Refer to the electrical schematics at the back of this manual when troubleshooting or performing maintenance.

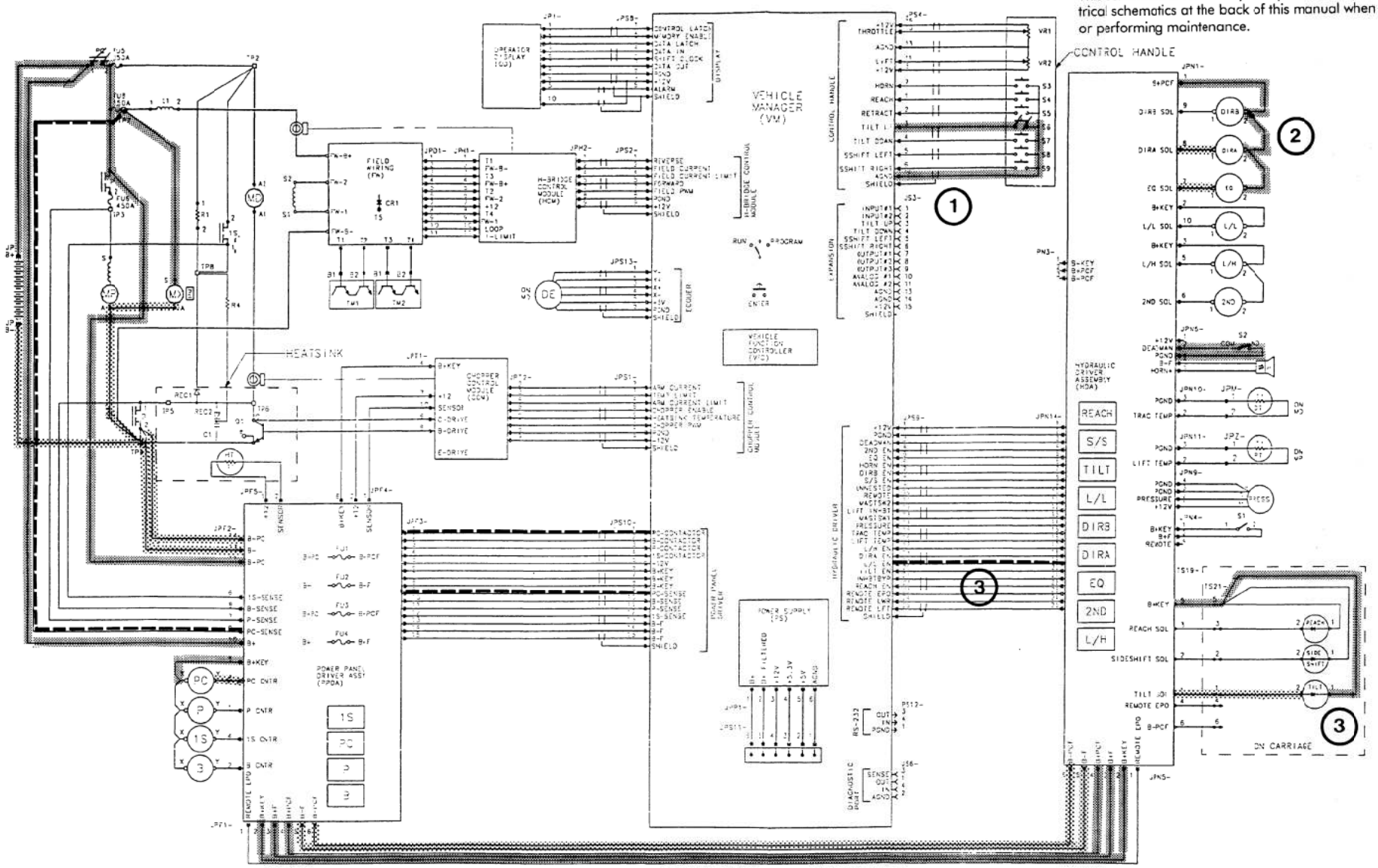


Figure 101 Electrical Schematic - Fork Tilt

Turning Key Switch (S1) ON - Before SelfTest

During initial power-up, the Vehicle Manager performs a SelfTest of all inputs and outputs. SelfTest takes approximately 8 seconds. During SelfTest, contactor coils and circuits controlled by the Vehicle Manager are momentarily activated and sensor leads are checked for correct voltage signals. If a problem is detected, the Vehicle Manager will prevent truck operation and a fault code for the detected malfunction will be displayed on the Vehicle Manager and the Operator Display.

NOTE: All the following are with respect to (WRT) TP4 (-). (Refer to Figure 109.)

1. Turning key switch S1 on supplies battery potential from S1-2 to JPN4-1 on the Hydraulic Driver Assembly.
2. Battery potential is at the following points on the Hydraulic Driver Assembly.
   - JPN1-3 to JPN1-6 (2ND Solenoid)
   - JPN1-2 to JPN1-10 (Lift/Lower Solenoid)
   - JPN1-3 to JPN1-5 (Load Holding Solenoid)
   - JPN5-2 to JPF1-2 on the Power Panel Driver Assembly
3. Battery potential is at the following points on the Power Panel Driver Assembly:
   - JPF2-5 through the PC contactor coil to JPF2-3
   - JPF2-5 through the P contactor coil to JPF2-1
   - JPF2-5 through the 1S contactor coil to JPF2-4
   - JPF2-5 through the B contactor coil to JPF2-2
   - JPF4-6 to JPT1-4 on the Chopper Control Module (CCM)
4. B+ from JPF3-6, JPF3-7, and JPF3-8 on the Power Panel Driver Assembly goes to the Vehicle Manager at JPS10-6, JPS10-7, and JPS10-8 respectively.
5. The Vehicle Manager power supply receives battery potential (JPP1-1) and produces the following voltages:
   - +5 volts,
   - +5.3 volts and...
   - +12 volts
6. +5 volts is now at:
   - JPS13-5 to the drive motor encoder
7. +5.3 volts is at JPP1-4 of the Vehicle Manager Power Supply to JPS11-3 on the Vehicle Manager.
8. +12 volts can be found at:
   - JPS8-9 on the Vehicle Manager to JPI-9 on the Operator's Display
   - JPS2-9 on the Vehicle Manager to JPH2-9 on the HCM
   - JPS1-9 on the Vehicle Manager to JPT2-9 on the CCM
   - JPS10-5 on the Vehicle Manager to JPF3-5 on the PPDA
   - JPS4-15 on the Vehicle Manager to the throttle potentiometer, VR1
   - JPS4-8 on the Vehicle Manager to the lift/lower potentiometer, VR2
   - JPS3-15 on the Vehicle Manager
   - JPS9-1 on the Vehicle Manager to JPN14-1 on the HDA
   - JPN9-1 of the Hydraulic Driver Assembly to the positive side of the hydraulic pressure sensor (PRESS)
   - JPF5-1 on the Hydraulic Driver Assembly, activating the temperature sensor on the Power Panel

Contactor Coils

The coil drivers allow the use of 24 volt contactor coils even though this is a 36 volt truck. This is accomplished by the Vehicle Manager determining the voltage of the battery and pulsing the appropriate contactor coil to a level that does not exceed 24 volts.

For a 24 volt truck, the contactor coils would not need to be pulsed, therefore the coil (when energized) will be on all the time. But since this is a 36 volt truck, the coil (when energized) is pulsed at a rate of 66% ON and 34% OFF, (36 volts X .66 = 24 volts).

In Figure 114, three separate test points are shown, with the resulting readings, that would be found in both energized and de-energized states.

	Voltage Reading (Contactor Coil Not Energized)		Voltage Reading (Contactor Coil Energized)	
Test Case	**24V Battery**	**36V Battery**	**24V Battery**	**36V Battery**
1	24	36	24	36
2	0	0	24	24
3	24	36	0 (approx.)	12

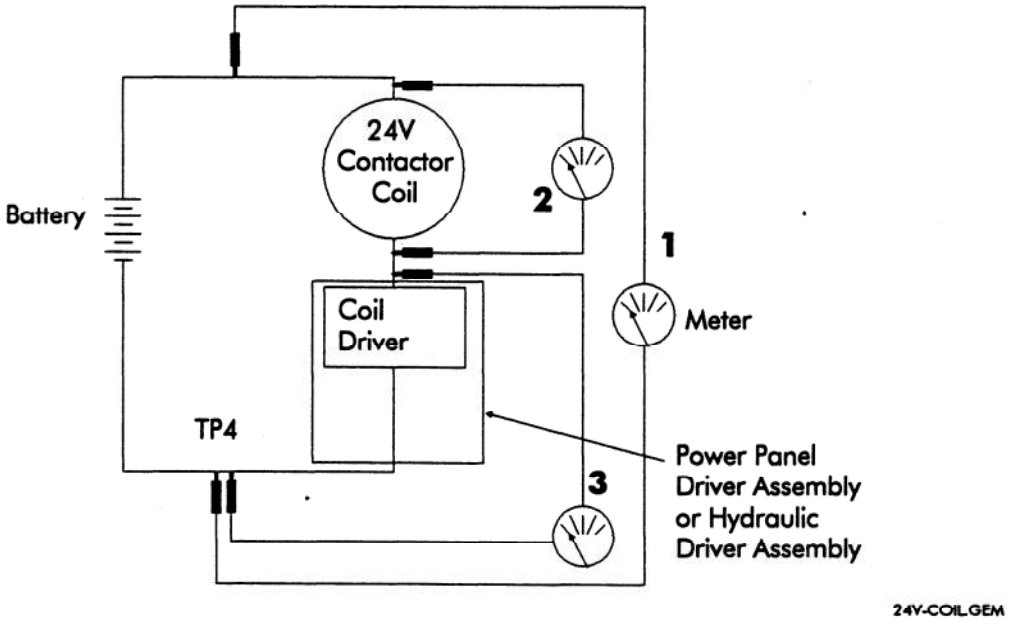
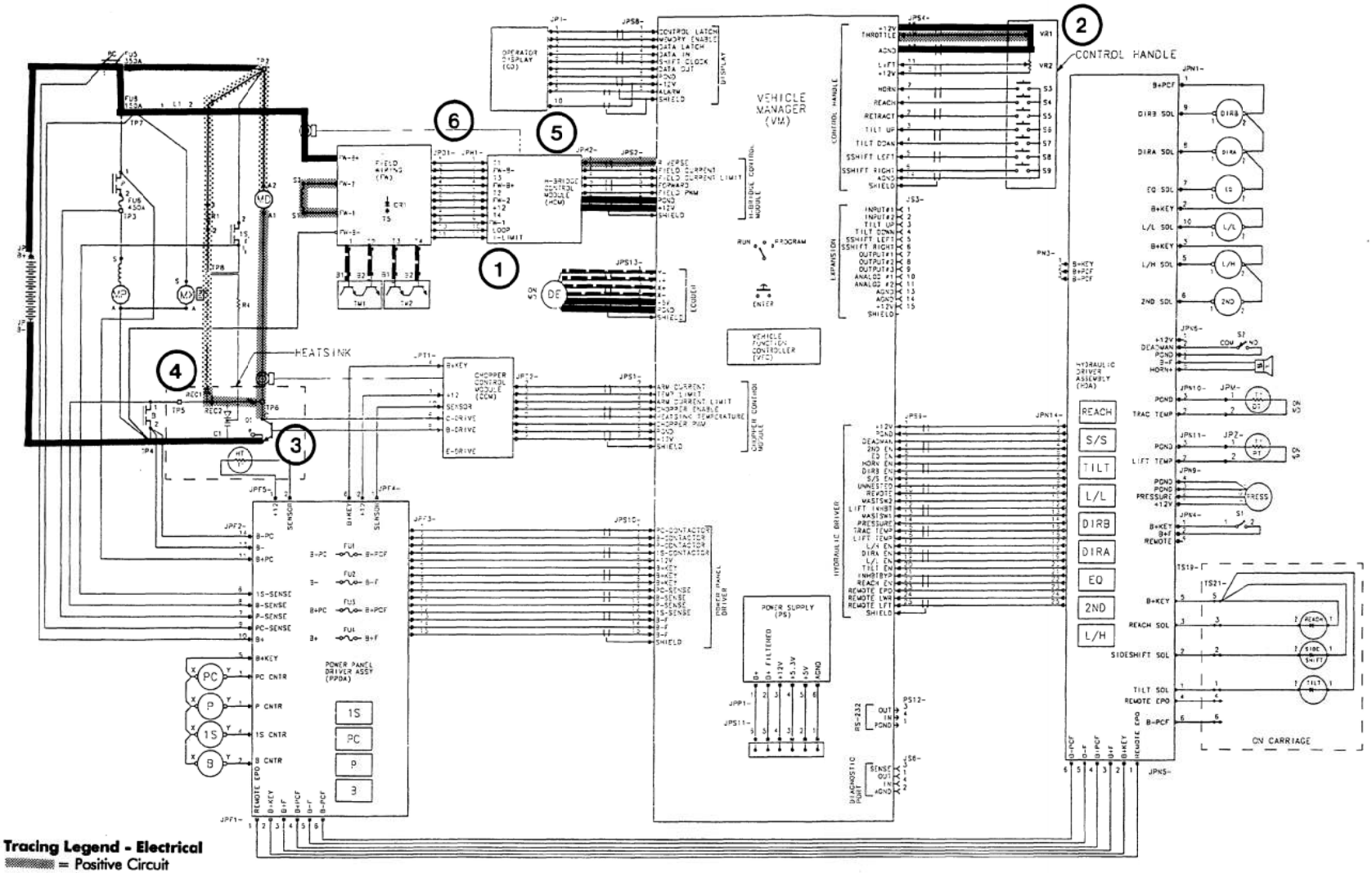


Figure 114 Voltage Readings for 24 Volt Contactor Coil



Tracing Legend - Electrical

= Positive Circuit

= Negative Circuit

= Circuit Traced Earlier

= Detect/Signal Lines

NOTE:
This schematic is for Theory of Operation only. Refer to the electrical schematics at the back of this manual when troubleshooting or performing maintenance.

Figure 122 Schematic - Plugging

Wiring - General

Save time and trouble – look for simple causes first.

- Visually inspect all wiring in all components for:
  - broken wiring and shorted conditions (especially close to metal edges or surfaces)
  - loose connections
  - loose or broken terminals
  - damaged terminal blocks or strips.
- Use an ohmmeter to check wiring continuity.
- Repair or replace the wiring wherever a problem exists.

⚠CAUTION DISCONNECT THE BATTERY WHEN CHECKING ELECTRICAL CIRCUITS WITH AN OHMMETER. BATTERY CURRENT CAN DAMAGE THE OHMMETER.

If a truck problem cannot be located in the wiring or a short-to-frame test, trouble-shoot in accordance with the following procedure:

1. Determine exactly which operation(s) the truck is failing to perform.
2. To accomplish this, it is often advisable to jack up and block the truck so the drive wheel is off the floor. Be sure the mast is supported by a suitable hoist so the truck does not tip over.

⚠ WARNING USE EXTREME CARE WHENEVER THE TRUCK IS JACKED UP FOR ANY REASON. NEVER BLOCK THE TRUCK BETWEEN THE TELESCOPIC AND THE FLOOR. USE A SUITABLE HOIST TO STABILIZE THE MAST. KEEP HANDS AND FEET CLEAR FROM BENEATH VEHICLE WHILE JACKING. USE JACK STANDS OR SOLID BLOCKS TO SUPPORT TRUCK - DO NOT RELY ON JACKS. REFER TO PAGE 9.

3. Operate all the truck's functions slowly, observing during which sequence the truck malfunctions.
4. Perform the checks in the appropriate Flow Diagram.

Wiring Harness

Truck problems are often caused by defects in the wiring. When truck problems exist, use the following procedure to check out the wiring harness:

1. Visually inspect problem areas for:
   - Loose connections
   - Faulty terminals
   - Broken wires
   - Worn insulation
2. Check for continuity in the wiring harness using an ohmmeter and referring to the Electrical Schematic on page 294.

Truck Completely Inoperative, 2-digit Display Lit, But No Valid Code

No Lift/Travel OK
Selftest OK

Open Vehicle Manager.

Replace the VFC. OK? — NO — Replace Distribution Board.

During Powerup, Operator's Display Shows - "Deadman?"

Are you standing on deadman pedal? — YES — Release deadman pedal.

NO

Run Test 100 and troubleshoot accordingly.

Speed Limited with No Code

If the speed of the truck is limited with no speed limit or fault code shown, check mast switches S10 and/or S11 and associated wiring.