S30 Service Procedures

Standard, XP & X4 Models

This manual is not available in hard copy format.

Revision 12-08

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CALIFORNIA PROPOSITION 65 WARNING:
Engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

SAFETY PRECAUTIONS

The following precautions are used throughout this manual as indicated in their description:

WARNING: To warn of hazards or unsafe practices that could result in severe personal injury or death.

CAUTION: To warn of unsafe practices that could result in minor or moderate personal injury.

FOR SAFETY: To identify actions that must be followed for safe operation of equipment.

Do not use the machine other than described in this Operator Manual. The machine is not designed for use on public roads.

The following information signals potentially dangerous conditions to the operator or equipment:

WARNING: Moving belt and fan. Keep away.

WARNING: Machine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

WARNING: Raised hopper may fall. Engage hopper support bar.

WARNING: Lift arm pinch point. Stay clear of hopper lift arms.

WARNING: Burn hazard. Hot surface. Do NOT touch.

WARNING: Accident may occur. Do not operate vacuum or blower wand while driving.

CAUTION: LPG engine will run for a few seconds after key is turned off. Apply parking brake before leaving machine.

FOR SAFETY:

1. Do not operate machine:
   - Unless trained and authorized.
   - Unless operator manual is read and understood.
   - If it is not in proper operating condition.
   - In flammable or explosive areas.
   - In areas with possible falling objects unless equipped with overhead guard.

2. Before starting machine:
   - Check for fuel, oil, and liquid leaks.
   - Keep sparks and open flame away from refueling area.
   - Make sure all safety devices are in place and operate properly.
   - Check brakes and steering for proper operation.
   - Adjust seat and fasten seat belt (if so equipped).

3. When starting machine:
   - Keep foot on brake and directional pedal in neutral.

4. When using machine:
   - Do not pick up burning or smoking debris, such as cigarettes, matches or hot ashes
   - Use brakes to stop machine.
   - Go slow on inclines and slippery surfaces.
   - Use care when reversing machine.
   - Move machine with care when hopper is raised.
   - Make sure adequate clearance is available before raising hopper.
   - Do not carry passengers on machine.
   - Always follow safety and traffic rules.
   - Report machine damage or faulty operation immediately.

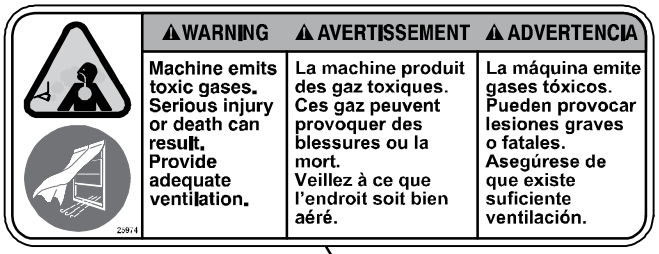
5. Before leaving or servicing machine:
   - Stop on level surface.
   - Set parking brake.
   - Turn off machine and remove key.

6. When servicing machine:
   - Avoid moving parts. Do not wear loose jackets, shirts, or sleeves.
   - Block machine tires before jacking machine up.
   - Jack machine up at designated locations only. Support machine with jack stands.
   - Use hoist or jack that will support the weight of the machine.
   - Wear eye and ear protection when using pressurized air or water.
   - Disconnect battery connections before working on machine.
   - Avoid contact with battery acid.
   - Avoid contact with hot engine coolant.
   - Do not remove cap from radiator when engine is hot.
   - Allow engine to cool.
   - Keep flames and sparks away from fuel system service area. Keep area well ventilated.
   - Use cardboard to locate leaking hydraulic fluid under pressure.
   - Use Tennant supplied or approved replacement parts.

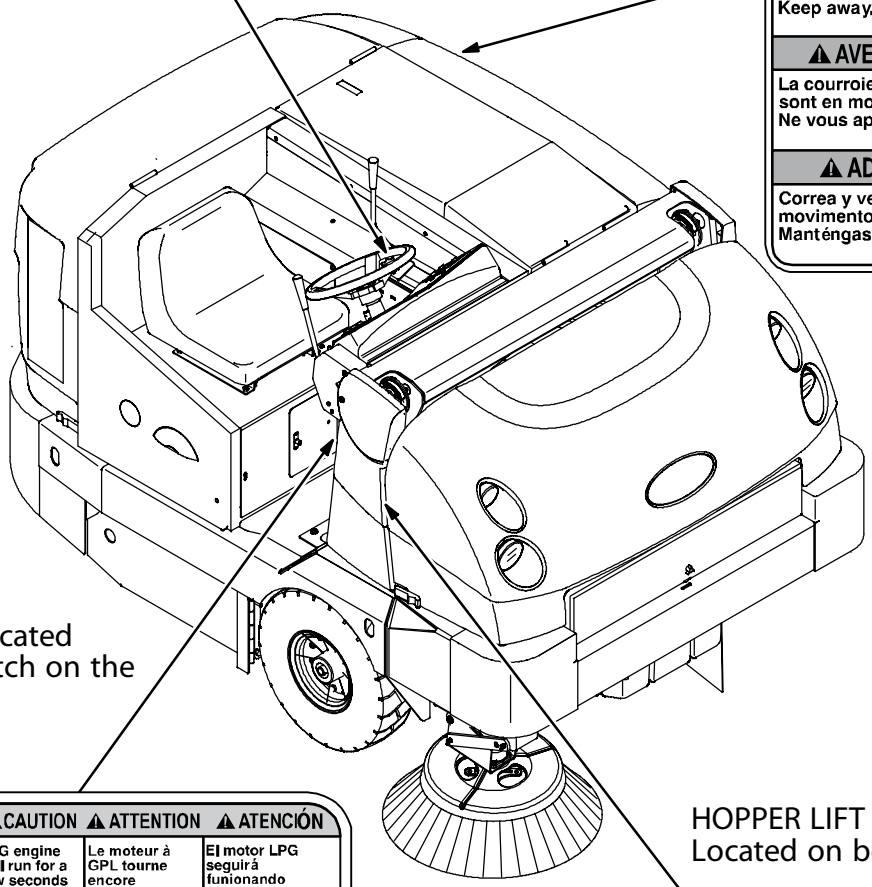
7. When loading/unloading machine onto/off truck or trailer:
   - Turn off machine.
   - Use truck or trailer that will support the weight of the machine.
   - Use winch. Do not drive the machine onto/off the truck or trailer unless the load height is 380 mm (15 in) or less from the ground.
   - Set parking brake after machine is loaded.
   - Block machine tires.
   - Tie machine down to truck or trailer.

The following safety labels are mounted on the machine in the locations indicated. If any label becomes damaged or illegible, install a new label in its place.

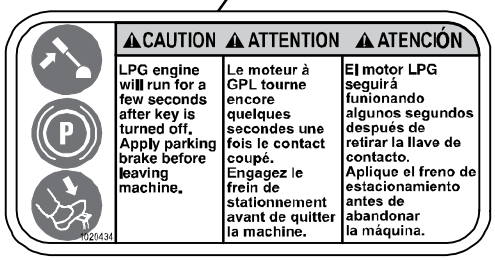
EMISSIONS LABEL – Located on the side of the operator compartment.



FAN AND BELT LABEL – Located on engine belt guard.



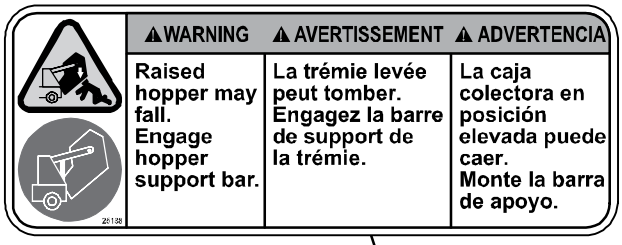
LPG ENGINE LABEL – Located next to the ignition switch on the instrument panel. (LPG machines only)



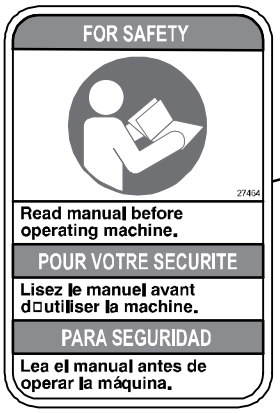
HOPPER LIFT ARMS LABEL – Located on both hopper lift arms.

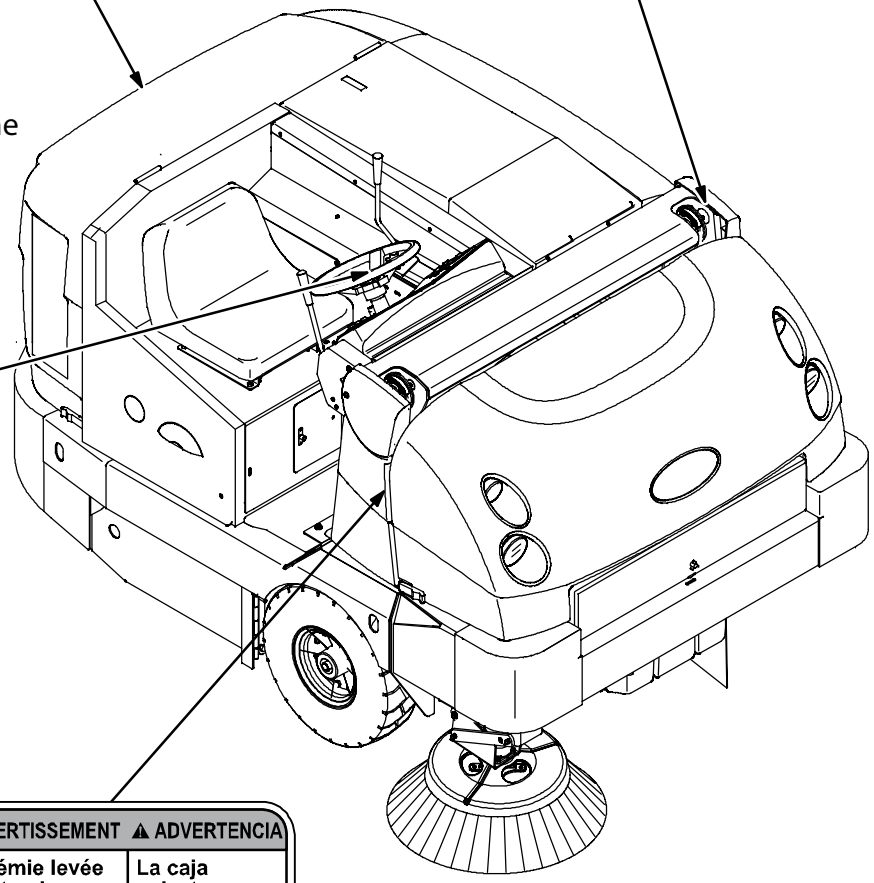
HOT SURFACE LABEL – Located on the exhaust shield.

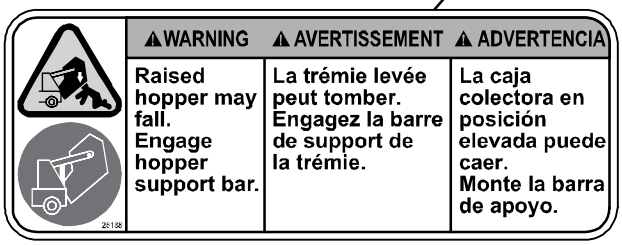
RAISED HOPPER LABEL – Located on the hopper support bar.



FOR SAFETY LABEL – Located on the side of the operator compartment.





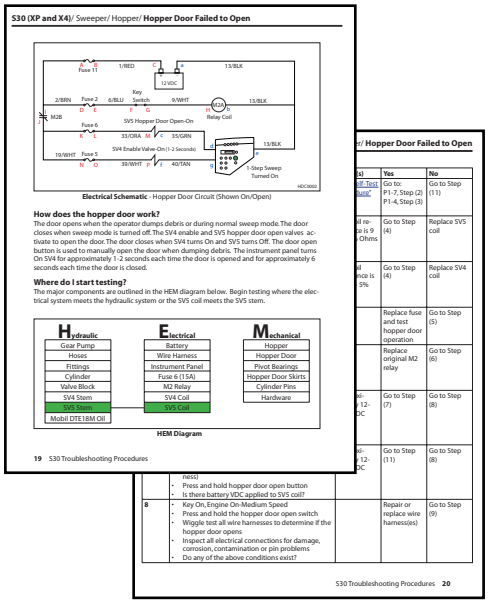


RAISED HOPPER LABEL – Located on the hopper lift arm.

VACUUM / BLOWER WAND LABEL – Located on the optional vacuum or blower wands.

Contents

1 S30 Troubleshooting Procedures



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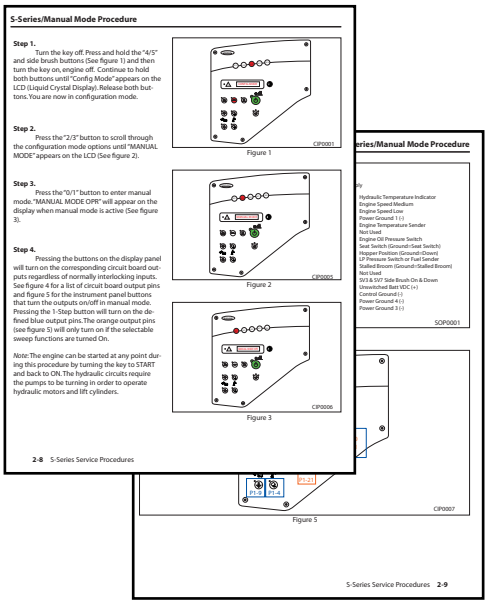
2 S30 Service Procedures


S-Series/Manual Mode Procedure

Step 1.
Turn the key off. Press and hold the "4/5" and side brush buttons (See figure 1) and then turn the key on, engine off. Continue to hold both buttons until "Config Mode" appears on the LCD (Liquid Crystal Display). Release both buttons. You are now in configuration mode.

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "MANUAL MODE" appears on the LCD (See figure 2).

Step 3.
Press the "0/1" button to enter manual mode. "MANUAL MODE OPR" will appear on the display when manual mode is active (See figure 3).

Step 4.
Pressing the buttons on the display panel will turn on the corresponding circuit board outputs regardless of normally interlocking inputs. See figure 4 for a list of circuit board output pins and figure 5 for the instrument panel buttons that turn the outputs on/off in manual mode. Pressing the 1-Step button will turn on the defined blue output pins. The orange output pins (see figure 5) will only turn on if the selectable sweep functions are turned On.

Note: The engine can be started at any point during this procedure by turning the key to START and back to ON. The hydraulic circuits require the pumps to be turning in order to operate hydraulic motors and lift cylinders.

Figure 1
CIP0001

Figure 2
CIP0005

Figure 3
CIP0006

2-8 S-Series Service Procedures

eries/Manual Mode Procedure

Hydraulic Temperature Indicator
Engine Speed Medium
Engine Speed Low
Power Ground 1 (-)
Engine Temperature Sender
Not Used
Engine Oil Pressure Switch
Seat Switch (Ground=Seat Switch)
Hopper Position (Ground=Down)
LP Pressure Switch or Fuel Sender
Stalled Broom (Ground=Stalled Broom)
Not Used
SV3 & SV7 Side Brush On & Down
Unswitched Batt VDC (+)
Control Ground (-)
Power Ground 4 (-)
Power Ground 3 (-)

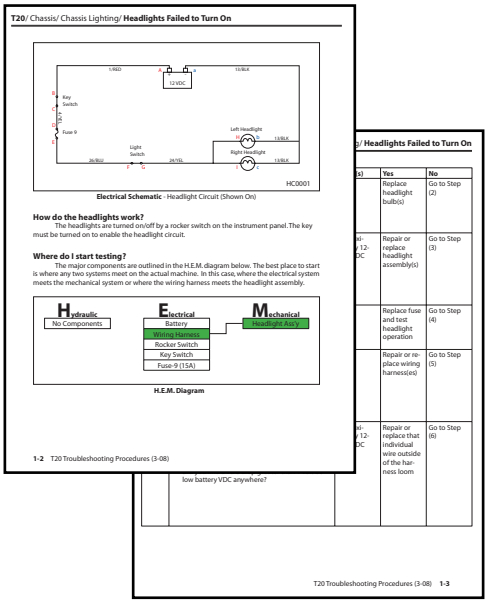
SOP0001

CIP0007

Figure 5

S-Series Service Procedures 2-9

1 S30 Troubleshooting


T20/ Chassis/ Chassis Lighting/ **Headlights Failed to Turn On**

Electrical Schematic - Headlight Circuit (Shown On)

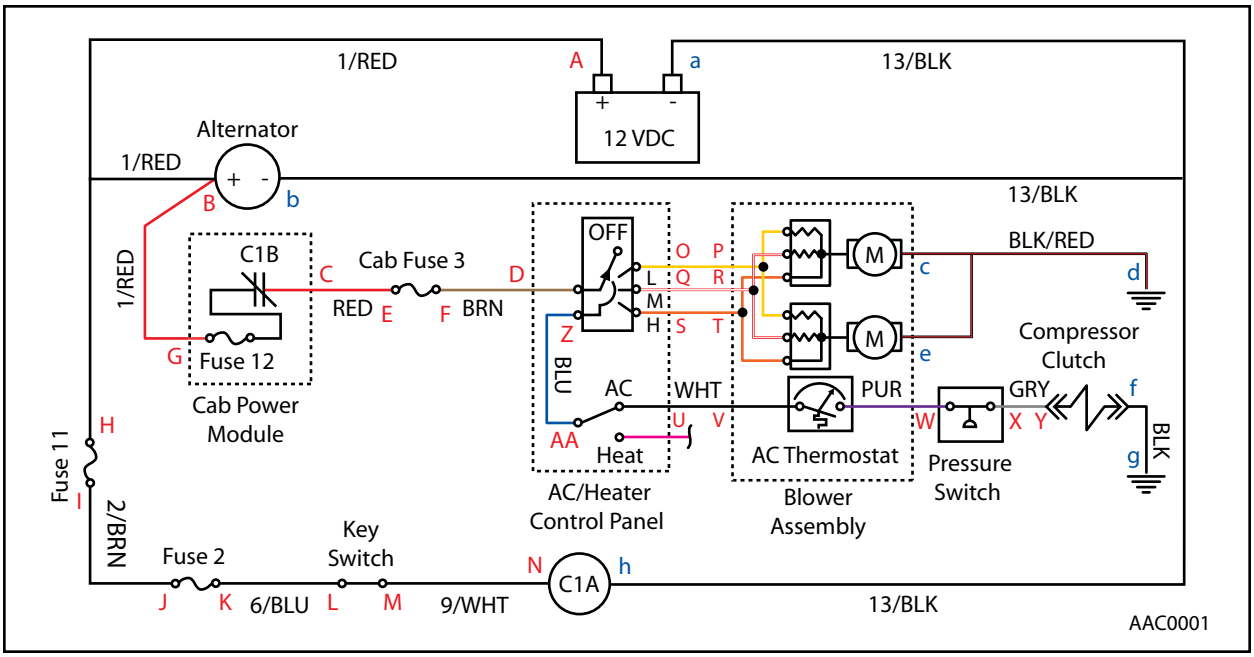
How do the headlights work?
The headlights are turned on/off by a rocker switch on the instrument panel. The key must be turned on to enable the headlight circuit.

Where do I start testing?
The major components are outlined in the H.E.M. diagram below. The best place to start is where any two systems meet on the actual machine. In this case, where the electrical system meets the mechanical system or where the wiring harness meets the headlight assembly.

H.E.M. Diagram

1-2 T20 Troubleshooting Procedures (3-08)

T20 Troubleshooting Procedures (3-08) 1-3



Electrical Schematic - AC Circuit (Shown On)

How does the Air Conditioning work?

The AC system operates on R134a refrigerant. A belt driven compressor pumps compressed refrigerant gas through the condenser where the gas becomes a liquid and dissipates heat. From there, the liquid enters the dryer where contaminates are filtered out. The liquid moves through the expansion valve and into the evaporator where it cools as it expands back into a gas. The blower fan pushes warm outside air through the cold evaporator and into the cab. The system should sustain cab air temperatures 20˚F (11˚C) cooler than the outside air.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing at the blower assembly.

Hydraulic
No Components

Electrical
Cab Wire Harness
Cab Fuse 3
CPM Fuse 12
Cab Power Module
Fan Speed Switch
Thermostat
Pressure Switch
Compressor Clutch
Heat/AC Switch

Mechanical
Compressor
Compressor Belt
Blower Assembly
Condenser Coil
Evaporator Coil
Dryer
Hoses and Fittings
Cab Air Filter

HEM Diagram

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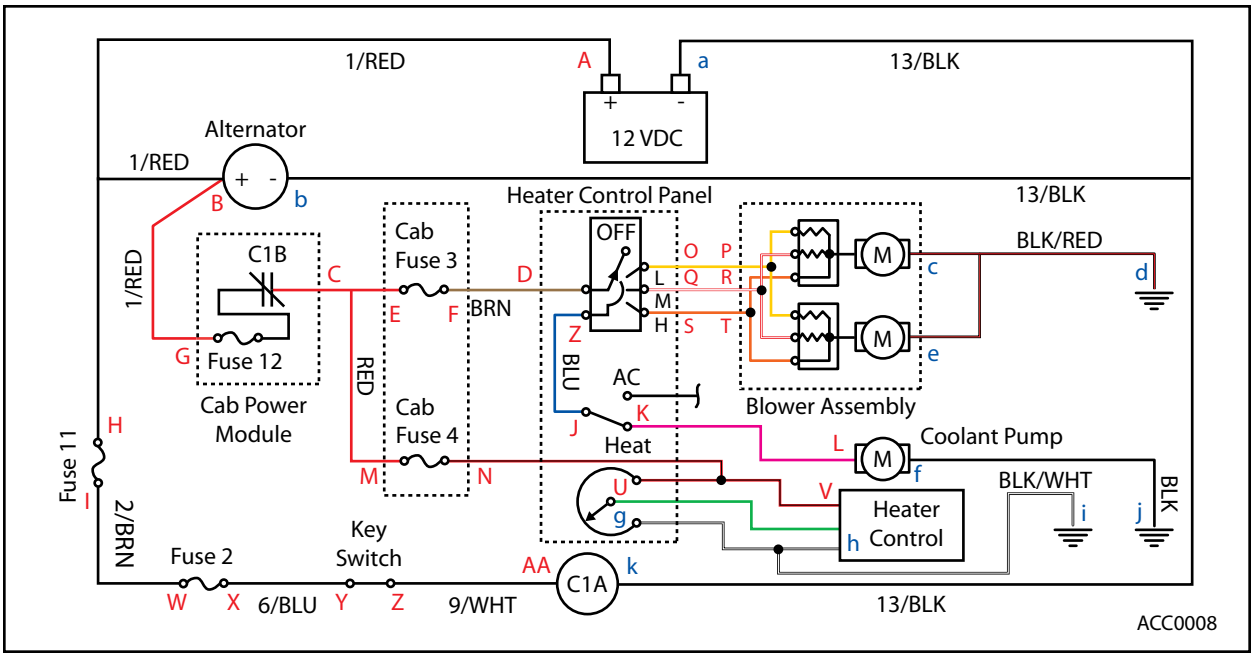
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Air Conditioning rocker switch On • Climate control knob turned to max cool • Fan speed switch On - Low, Med, and High • Does the fan operate in all three level settings?		Go to Step #4	Go to Step #2
2	• Key Off • Verify *Cab* fuse 3 (20A) is not blown. Cab fuses are located behind the overhead access panel in the cab. • Is the fuse blown?		Replace fuse and test AC operation	Go to Step #3
3	• Key Off • Verify CPM (Cab Power Module) fuse 12 (60A) is not blown. This fuse is located above the engine next to the hydraulic reservoir. • Is the fuse blown?		Replace fuse and test AC operation	Go to Step #4
4	• Key Off • Inspect cab air filter for heavy dust accumulation and/or excessive moisture • Do any of the above conditions exist?	Refer to "AC and Heater Box Break-down" in parts manual	Replace cab air filter	Go to Step #5
5	• Key Off • Inspect compressor drive belt tension • Is the compressor drive belt in place and tensioned properly?	Refer to "ENGINE BELT" section in the operator's manual	Go to Step #6	Replace belt and/or set proper belt tension
6	• Key Off • Disconnect electrical connector at the coolant pump (heater) • Key On, Engine On • AC rocker switch On • Climate control knob turned to max cool • Fan speed switch On - High • Does the AC system blow cold air?		Replace AC/ Heat rocker switch in cab	Go to Step #7
7	• Key On, Engine On • AC rocker switch On • Climate control knob turned to max cool • Fan speed switch On - Low, Med, or High • Listen/feel for compressor clutch engagement • Is the compressor clutch engaging?		See "AC System Pressure Testing"	Go to Step #8

Step	Action	Value(s)	Yes	No
8	• Key Off • Disconnect pressure switch on dryer • Insert jumper wire between both wires (harness side) • Key On, Engine On • Fan speed switch On - Low • Activate AC rocker switch momentarily and listen/feel for compressor clutch engagement • Is the compressor clutch engaging?		See "AC System Pressure Testing"	Go to Step #9
9	• Key On, Engine On • AC rocker switch On • Climate control knob turned to max cool • Fan speed switch On - Low, Med, or High • Wiggle test all wire harnesses to determine if AC system blows cold air • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #10
10	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #11
11	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.



Electrical Schematic - Heat Circuit (Shown On)

How does the heater work?

Warm engine coolant is pumped through a heater core where the heat is transferred to incoming fresh air. The heated air enters the cab through overhead vents, causing the cab air temperature to rise. An electric pump is used to circulate engine coolant through the system. A climate control potentiometer (5K Ohm) controls the heater control valve which opens to allow coolant to circulate through the heater core. Engine coolant bypasses the heater core loop when the valve is closed or the climate control knob is set to maximum cool.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing at the blower assembly.

Hydraulic
No Components

Electrical
Cab Wire Harness
Cab Fuse 3
Cab Fuse 4
CPM Fuse 12
Cab Power Module
Fan Speed Switch
Climate Control Pot
Heat/AC Switch

Mechanical
Coolant Pump
Hoses and Fittings
Cab Air Filter
Heater Control Valve
Heater Coil
Blower Assembly

HEM Diagram

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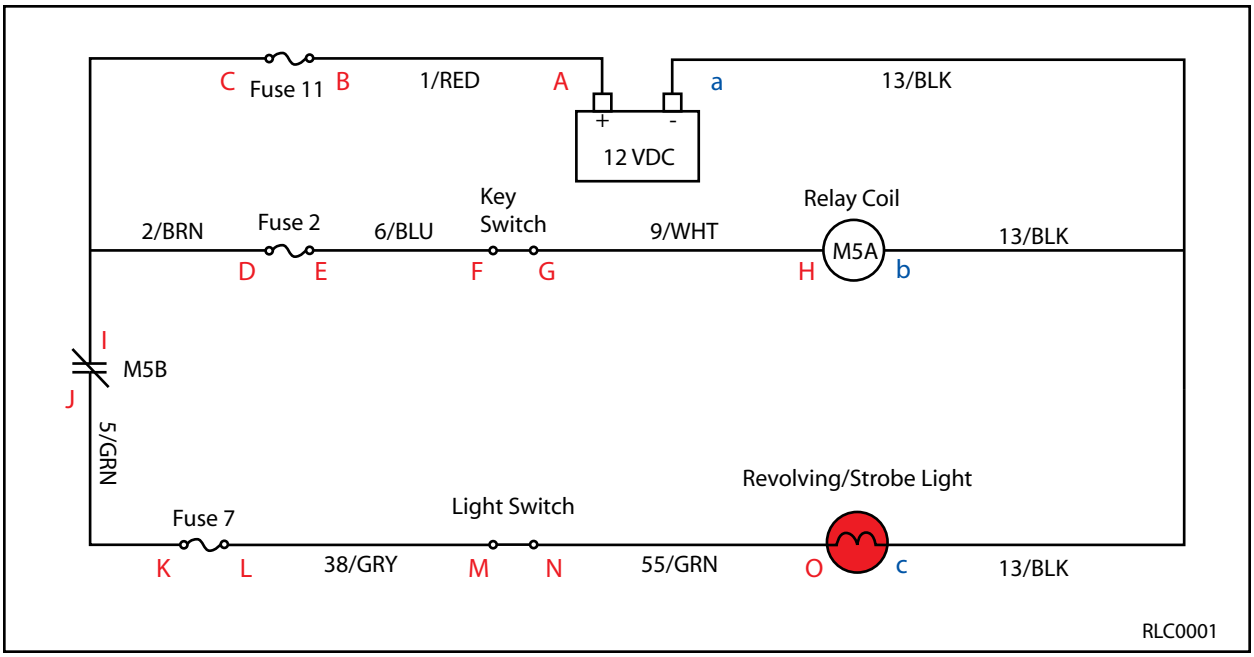
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Heat rocker switch On • Climate control knob turned to max heat • Fan speed switch On - Low, Med, and High • Does the fan operate in all three level settings?		Go to Step #3	Go to Step #2
2	• Key Off • Verify *Cab* fuse 3(20A) is not blown. Cab fuses are located behind the overhead access panel in the cab. • Is the fuse blown?		Replace fuse and test heat operation	Go to Step #3
3	• Key Off • Verify *Cab* fuse 4 (20A) is not blown. Cab fuses are located behind the overhead access panel in the cab. • Is the fuse blown?		Replace fuse and test heat operation	Go to Step #4
4	• Key Off • Verify Cab Power Module fuse 12 (60A) is not blown. CPM is located above the engine next to the hydraulic reservoir. • Is the fuse blown?		Replace fuse and test heat operation	Go to Step #5
5	• Key Off • Inspect cab air filter for heavy dust accumulation and/or excessive moisture • Do any of the above conditions exist?		Replace cab air filter	Go to Step #6
6	• Key On, Engine Off • Fan speed switch On - Low • Heat rocker switch On • Backprobe heater coolant pump electrical connection using DVOM in VDC mode • Is there battery VDC applied to the heater coolant pump?	Approximately 12-14.5 VDC	Go to Step #7	Go to Step #9

Step	Action	Value(s)	Yes	No
7	• Key Off, Engine COOL! • Remove left rear cab access panel • Disconnect coolant hose from heater core (fitting nearest cab) and route into a bucket • Key On, Engine Off • Fan speed switch On - Low • Heat rocker switch On - Momentarily • Does the heater coolant pump dispense coolant into the bucket?		Go to Step #8	Replace heater coolant pump
8	• Key Off, Engine COOL! • See "Heater Control Valve Testing" Procedure • Is the heater control valve operating within specification?	See "Heater Control Valve Testing" procedure	Go to Step #9	Repair or replace heater control valve
9	• Key On, Engine On (warmed to operating temp) • Heat rocker switch On • Climate control knob turned to max heat • Fan speed switch On - Low, Med, or High • Wiggle test all wire harnesses to determine if heater system blows warm air • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #10
10	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.



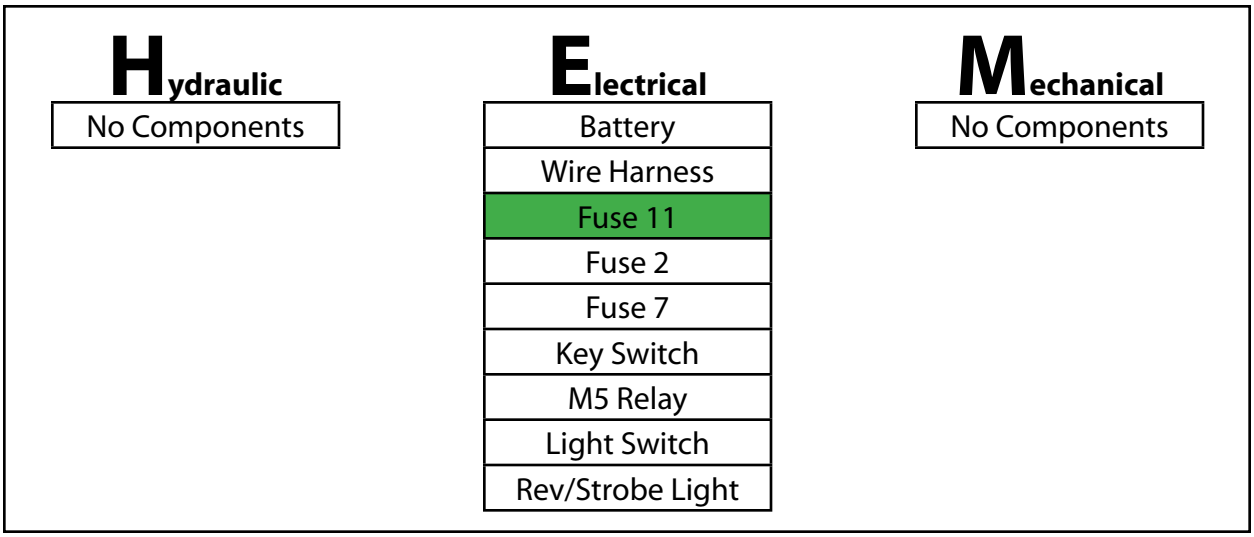
Electrical Schematic - Revolving/Strobe Light Circuit (Shown On)

How does the revolving/strobe light work?

The revolving/strobe light is activated by a rocker switch on the control panel. The ignition key must be On for the M5B relay contacts to close and supply battery voltage through the rocker switch to the light.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing at the fuses.



HEM Diagram

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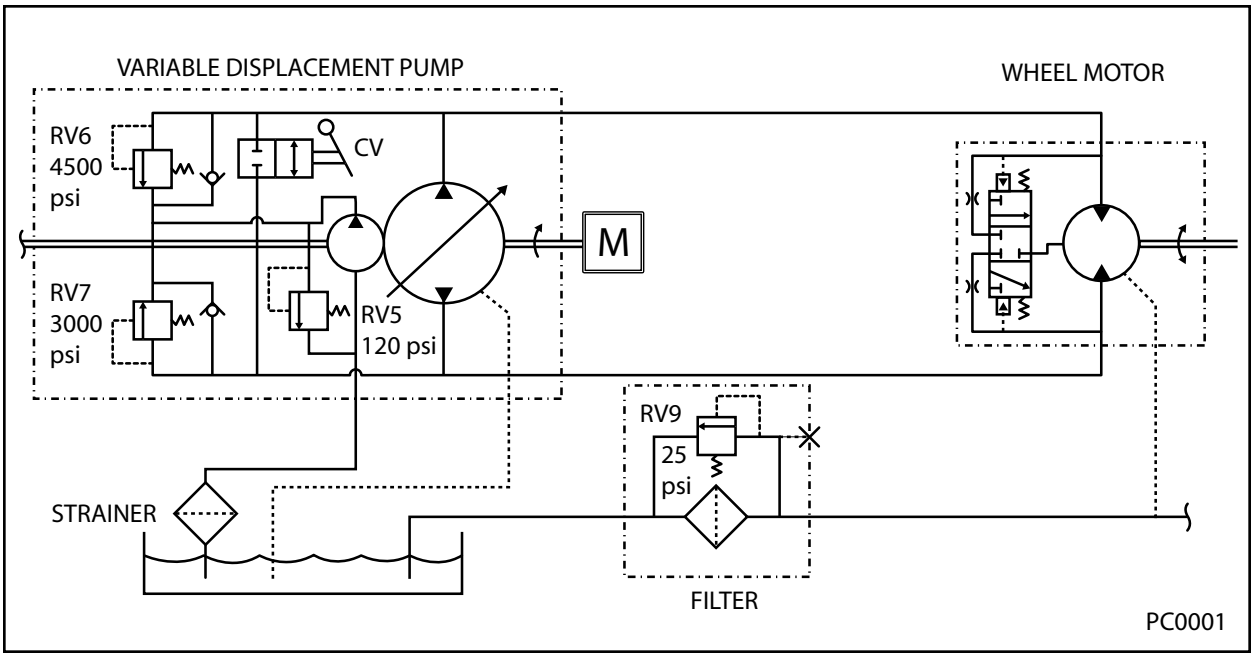
Step	Action	Value(s)	Yes	No
1	• Key Off • Verify fuses 2, 7, and 11 are not blown. Fuses are located in the operator's compartment below the instrument panel • Is a fuse blown?		Replace fuse and test light operation	Go to Step #2
2	• Key Off • Swap M5 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine Off • Revolving/Strobe Light switch On • Does the light turn On?		Replace original M5 relay	Go to Step #3
3	• Key Off • Disconnect light switch from wire harness • Insert a jumper wire between 38/GRY and 55/GRN wires • Key On, Engine Off • Does the light turn On?		Replace light switch	Go to Step #4
4	• Key Off • Reconnect light switch to wire harness • Revolving/Strobe Light switch On • Wiggle test all wire harnesses to determine if light turns On • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #5
5	• Key Off • Revolving/Strobe Light switch On • Backprobe into light assembly connector using DVOM in VDC mode • Is there battery VDC applied to the light?	Approximately 12-14.5 VDC	Replace light assembly	Go to Step #6

Step	Action	Value(s)	Yes	No
6	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #7
7	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.



Hydraulic Schematic - Propel Circuit

How does the propel system work?

A variable displacement piston pump supplies hydraulic fluid to a fixed displacement motor. The pump output increases from zero as the propel pedal moves in either direction. The propel pedal linkage consists of an adjustable cable and a shock absorber that dampens abrupt pedal movement. The machine is designed to climb grades up to 10˚(18% grade) with the hopper full and 14˚(25% grade) with the hopper empty. A full hopper is defined as approximately 1,080 lbs (490 kg)-plastic hopper or 1,200 lbs (544 kg)-steel hopper.

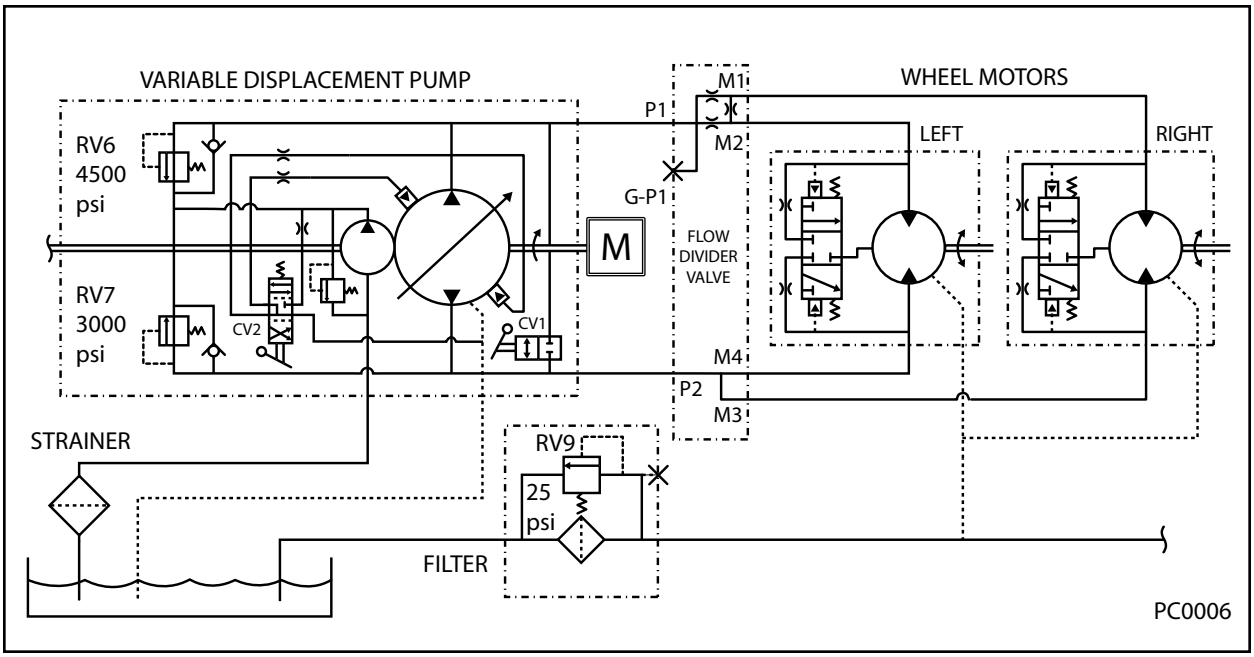
Where do I start testing?

The major components are outlined in the HEM diagram below. Begin by verifying the cause is not engine related.

Hydraulic	**E**lectrical	**M**echanical
Piston Pump	No Components	Hoses and Fittings
Motor		Linkage Shock
Mobil DTE18M Fluid		Pedal and Linkage
Relief Valve 6		Drive Hub
Relief Valve 7		Wheel Assemblies
Filter		Parking Brakes
Hydraulic Reservoir		Operating Brakes

HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key On, Engine On - High Speed • Does the engine maintain 2400 rpm when climbing a ramp?		Go to Step #2	Diagnose base engine or fuel delivery related problem.
2	• Key Off • See "Calculating Ramp Angle" • Is the angle of the ramp greater than 14˚(25% grade)-empty hopper or 10˚(18% grade)-full hopper?	See "Calculating Ramp Angle"	Machine is operating within specification	Go to Step #3
3	• Key Off • See "Propel Hydraulic Circuit Testing (Std and XP)" • Is the propel hydraulic circuit operating within specification?	See "Propel Hydraulic Circuit Testing (Std and XP)	Go to Step #4	See "Propel Hydraulic Circuit Testing (Std and XP) Troubleshooting chart
4	• Key Off • Chock rear drive tire • Refer to "MACHINE JACKING" section of the operator's manual and jack up both front wheels • Release parking brake • Do the front wheels spin freely?	Refer to "MACHINE JACKING" section of the operator's manual	Machine is operating within specification	Inspect brakes and wheel bearings. Perform necessary repairs.



Hydraulic Schematic - Propel Circuit

How does the propel system work?

A variable displacement pump supplies hydraulic fluid through a limited-slip flow divider valve into two fixed displacement motors. The pump output increases from zero as the propel pedal moves in either direction. The propel pedal linkage consists of an adjustable cable and a shock absorber that dampens abrupt pedal movement. The machine is designed to climb grades up to 10˚(18% grade) with hopper full and 14˚(25% grade) with hopper empty. A full hopper is defined as approximately 1,080 lbs (490 kg)-plastic hopper or 1,200 lbs (544 kg)-steel hopper.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin by verifying the cause is not engine related.

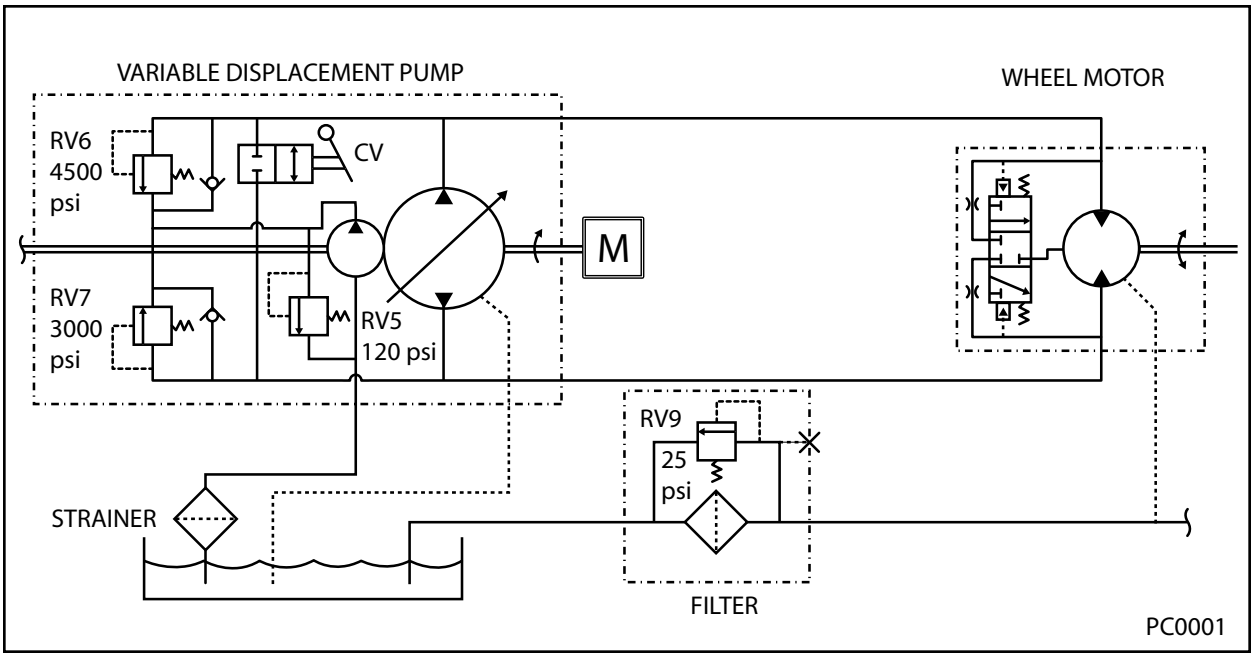
Hydraulic
Piston Pump
Motors
Mobil DTE18M Fluid
Relief Valve 6
Relief Valve 7
Filter
Hydraulic Reservoir
Flow Divider Valve

Electrical
No Components

Mechanical
Hoses and Fittings
Linkage Shock
Pedal and Linkage
Drive Hubs
Wheel Assemblies
Parking Brakes
Operating Brakes

HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key On, Engine On - High Speed • Does the engine maintain 2400 rpm when climbing a ramp?		Go to Step #2	Diagnose base engine or fuel delivery related problem.
2	• Key Off • See "Calculating Ramp Angle" • Is the angle of the ramp greater than 14˚(25% grade)-empty hopper or 10˚(18% grade)-full hopper?	See "Calculating Ramp Angle"	Machine is operating within specification	Go to Step #3
3	• Key Off • See "Propel Hydraulic Circuit Testing (X4)" • Is the propel hydraulic circuit operating within specification?	See "Propel Hydraulic Circuit Testing (X4)	Go to Step #4	See "Propel Hydraulic Circuit Testing (X4) Troubleshooting chart
4	• Key Off • Chock rear drive tires • Refer to "MACHINE JACKING" section of the operator's manual and jack up both front wheels • Release parking brake • Do the front wheels spin freely?	Refer to "MACHINE JACKING" section of the operator's manual	Machine is operating within specification	Inspect brakes and wheel bearings. Perform necessary repairs.



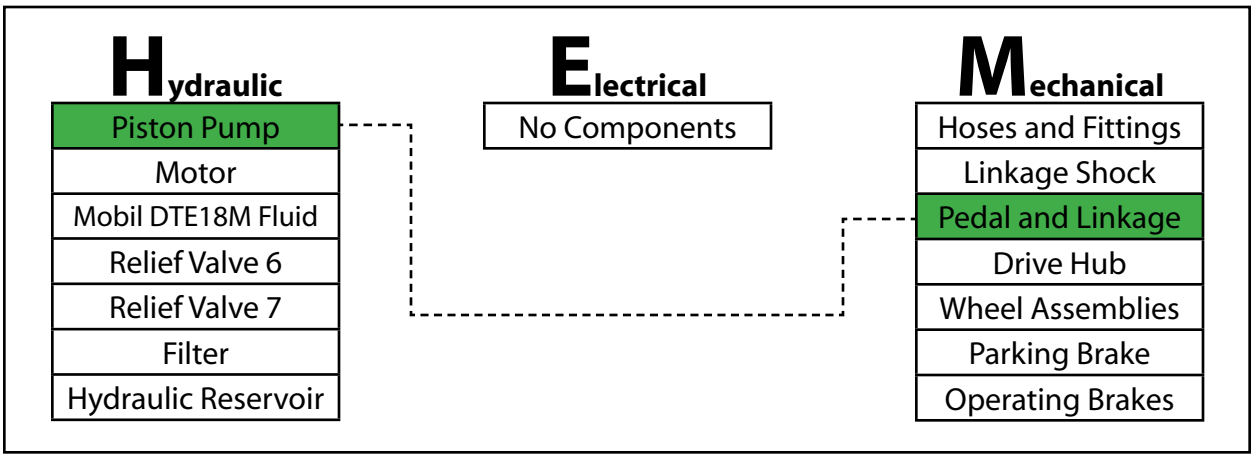
Hydraulic Schematic - Propel Circuit

How does the propel system work?

A variable displacement piston pump supplies hydraulic fluid to a fixed displacement motor. The pump output increases from zero as the propel pedal moves in either direction. The propel pedal linkage consists of an adjustable cable and a shock absorber that dampens abrupt pedal movement.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the hydraulic system meets the mechanical system or the piston pump meets the directional pedal linkage.



HEM Diagram

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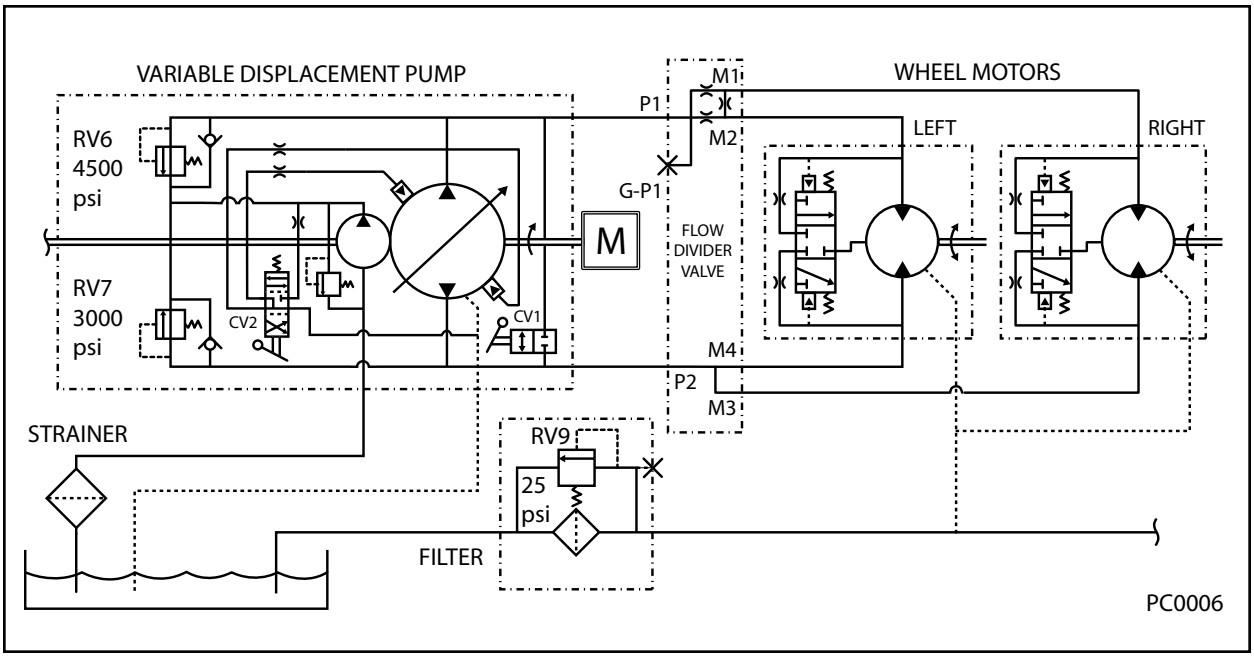
Step	Action	Value(s)	Yes	No
1	• Key Off • Inspect hydraulic fluid level gauge • Is the machine low on hydraulic fluid?		Add fluid and check for leaks	Go to Step #2
2	• Key Off • Observe the pintel arm shaft on the piston pump while pressing the directional pedal in either direction • Does the pintel arm shaft rotate with directional pedal movement?		Go to Step #3	Repair or replace directional pedal linkage components
3	• Key Off • See "Propel Hydraulic Circuit Testing (Std and XP)" • Is the propel hydraulic circuit operating within specification?	See "Propel Hydraulic Circuit Testing (Std and XP)	Go to Step #4	See "Propel Hydraulic Circuit Testing (Std and XP) Troubleshooting chart
4	• Key Off • Chock rear drive tire • Refer to "MACHINE JACKING" section of the operator's manual and jack up both front wheels • Release parking brake • Do the front wheels spin freely?	Refer to "MACHINE JACKING" section of the operator's manual	Machine is operating within specification	Inspect brakes and wheel bearings. Perform necessary repairs.



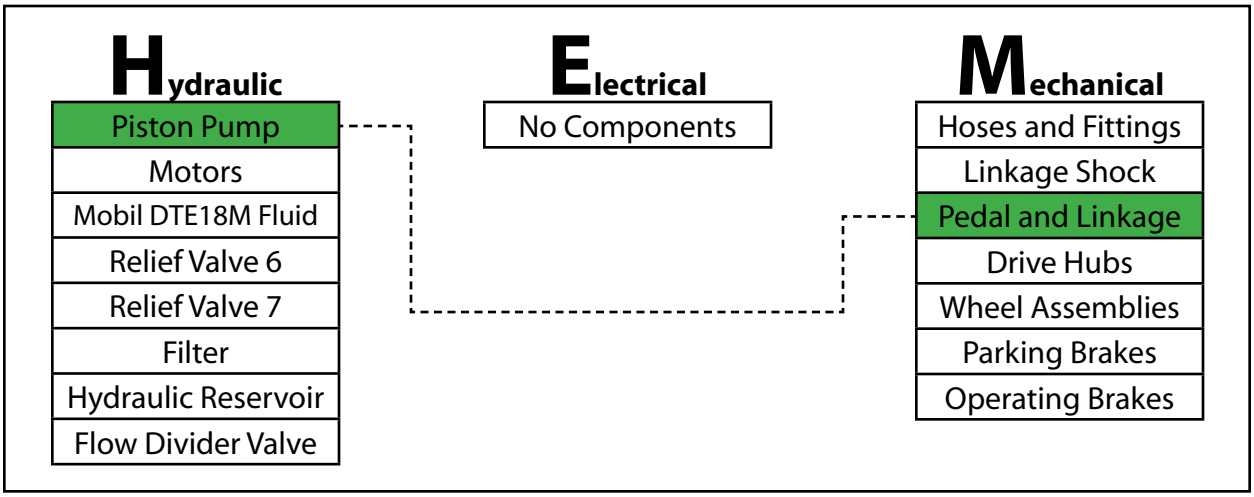
Hydraulic Schematic - Propel Circuit

How does the propel system work?

A variable displacement pump supplies hydraulic fluid through a limited-slip flow divider valve into two fixed displacement motors. The pump output increases from zero as the propel pedal moves in either direction. The propel pedal linkage consists of an adjustable cable and a shock absorber that dampens abrupt pedal movement.

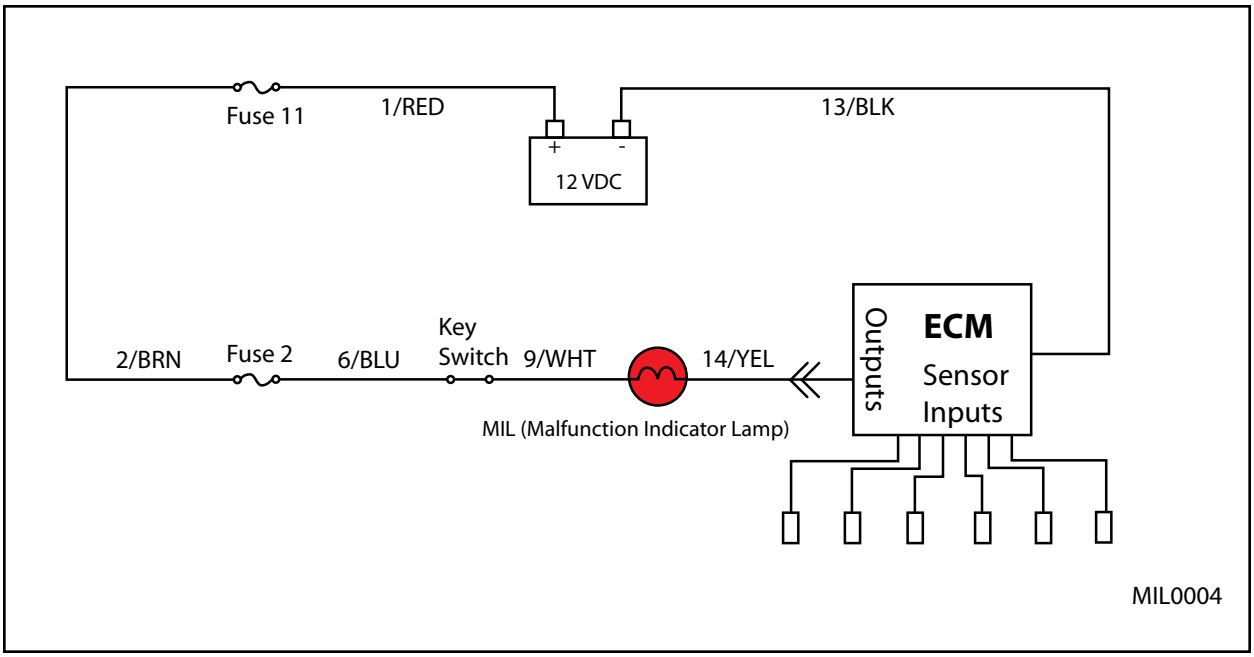
Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the hydraulic system meets the mechanical system or the piston pump meets the directional pedal linkage.



HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key Off • Inspect hydraulic fluid level gauge • Is the machine low on hydraulic fluid?		Add fluid and check for leaks	Go to Step #2
2	• Key Off • Observe the actuator lever on the piston pump while pressing the directional pedal in either direction • Does the actuator lever rotate with directional pedal movement?		Go to Step #3	Repair or replace directional pedal linkage components
3	• Key Off • See "Propel Hydraulic Circuit Testing (X4)" • Is the propel hydraulic circuit operating within specification?	See "Propel Hydraulic Circuit Testing (X4)	Go to Step #4	See "Propel Hydraulic Circuit Testing (X4)
4	• Key Off • Chock rear drive tires • Refer to "MACHINE JACKING" section of the operator's manual and jack up both front wheels • Release parking brake • Do the front wheels spin freely?	Refer to "MACHINE JACKING" section of the operator's manual	Machine is operating within specification	Inspect brakes and wheel bearings. Perform necessary repairs.



Electrical Schematic - MIL Circuit (Shown On)

How does the MIL (Malfunction Indicator Lamp) work?

The malfunction indicator lamp illuminates when the ECM detects an engine control system problem. The ECM activates the MIL by providing a negative to the MIL circuit. There are some basic things to check before pulling DTCs (diagnostic trouble codes). Refer to the *1.6L GM Engine Emission Control Service Manual* for a complete list of DTCs.

Where do I start testing?

The major components are outlined in the HEM diagram below. Check the engine coolant level first and then proceed through the diagnostic chart.

Hydraulic
Pump Load
Mobil DTE18M Oil

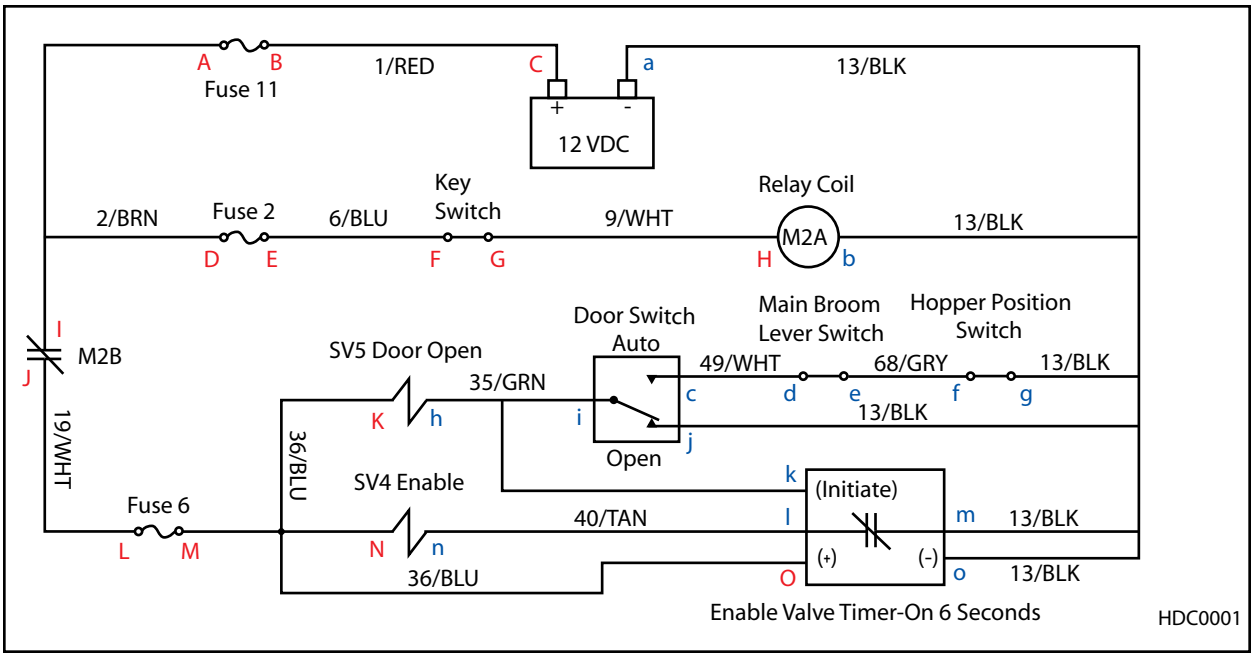
Electrical
Battery
Wire Harness
ECM
Engine Sensors
Diagnostic Port
MIL
Key Switch
Fuse-1 (15A)

Mechanical
Engine Air Intake
1.6L GM Engine
Engine Exhaust
Engine Coolant
Engine Oil
Fuel Delivery

HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key Off, Engine COOL! • Slowly remove radiator cap • Are the radiator and overflow tank filled to the correct levels?	Approximately 2-2.5 Gallon System Capacity	Go to Step #2	Fill with 50/50 water/ anti-freeze
2	• Key Off • Remove engine oil dipstick • Wipe off oil residue • Reinsert engine oil dipstick • Remove engine oil dipstick • Is the engine oil level low?	3.7 quart System Capacity (w/ filter) Use SAE 10W30	Add engine oil to the full mark on the dipstick	Go to Step #3
3	• Key Off • Inspect the LPG fuel tank for "LIQUID" withdrawal markings (Note: Not compatible with "VAPOR") • Inspect the Gasoline fuel tank for fuel contamination (i.e. diesel fuel, hydraulic oil, water, etc) • Do any of the above fuel issues exist?	"LIQUID" LPG tanks only. 87 octane gasoline only (or higher)	Supply correct/clean fuel type and Clear DTCs.	Go to Step #4
4	• Key Off • Inspect the engine air cleaner element • Use compressed air to clean the filter if needed • Reinstall the filter • Key On, Engine On • Does the MIL Turn Off?		Filter was obstructed. Follow maintenance schedule	Go to Step #5
5	• Inspect all engine vacuum hoses for open leaks • Inspect all electrical connectors for pins pushed out (including ECU) corrosion, damaged wires, moisture, etc • Do any of the above conditions exist?		Repair or replace faulty component	Go to Step #6
6	• Key Off • See "Displaying Engine DTCs" service procedure • Record the blinking DTCs • Refer to "*GM 1.6L Engine Emission Control Service Manual*" for troubleshooting procedures • Tier II Manual (CD Version Only) p/n 9003926	See "Displaying Engine DTCs" section of this manual	See "Displaying Engine DTCs" section of this manual	See "Displaying Engine DTCs" section of this manual

Terms:
MIL = Malfunction Indicator Lamp (Check Engine Light)
DTCs = Diagnostic Trouble Codes



Electrical Schematic - Hopper Door Circuit (Shown On/Open)

How does the hopper door work?

The door opens when the operator dumps debris or during normal sweep mode. The hopper door closes when the main broom is turned off. The SV4 enable and SV5 hopper door open valves activate to open the door. The door closes when SV4 turns on and SV5 turns off. The rocker switch has two positions; *auto door* and *open*. The auto door feature automatically opens and closes the door depending on the position of the main brush lever and the hopper position switch. The open position is used to manually open the door when dumping debris. The enable valve timer activates SV4 for 6 seconds each time SV5 is turned On *or* Off.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the electrical system meets the hydraulic system or the SV5 coil meets the SV5 stem.

Hydraulic	**E**lectrical	**M**echanical
Gear Pump	Battery	Hopper
Hoses	Wire Harness	Hopper Door
Fittings	Rocker Switch	Pivot Bearings
Cylinder	Fuse 6 (15A)	Hopper Door Skirts
Valve Block	M2 Relay	Cylinder Pins
SV4 Stem	SV4 Coil	Hardware
SV5 Stem	SV5 Coil	
Mobil DTE18M Oil	Diode 12	
	Enable Valve Timer	

HEM Diagram

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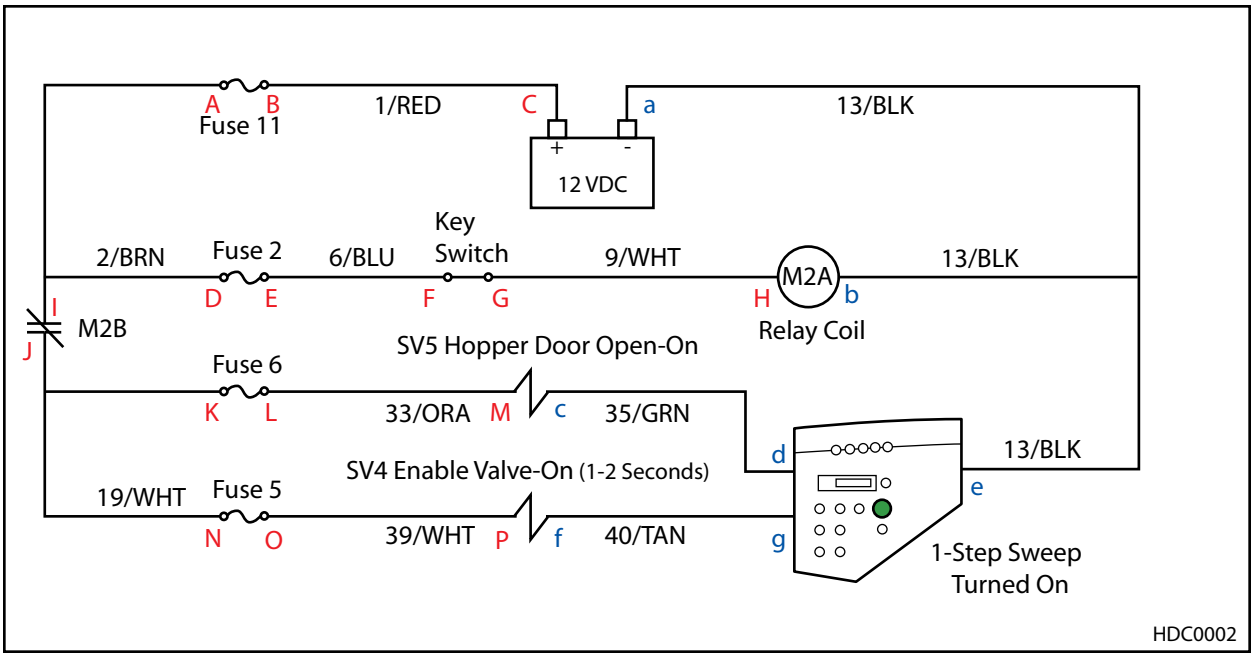
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Hopper door rocker switch in "open" position • Backprobe SV5 coil connection with DVOM in VDC mode (leave SV5 coil connected to wire harness) • Is there battery VDC applied to SV5 coil?	Approximately 12-14.5 VDC	Go to Step #2	Go to Step #5
2	• Key Off • Disconnect SV5 coil from wire harness • Test the resistance of SV5 coil with DVOM in Ohm test mode • Does DVOM display 8.6-9.5 Ohms?	SV5 coil resistance is 9 +/- 5% Ohms	Go to Step #3	Replace SV5 coil
3	• Key On, Engine Off • Backprobe SV4 coil connection with DVOM in VDC mode (leave SV4 coil connected to wire harness) • Hopper door rocker switch in "open" position • Is there battery VDC applied to SV4 coil for approximately 6 seconds after the rocker switch is activated?	Approximately 12-14.5 VDC	Go to Step #4	Go to Step #5
4	• Key Off • Disconnect SV4 coil from wire harness • Test the resistance of SV4 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV5 coil resistance is 7.3 +/- 5% Ohms	Go to Step #12	Replace SV4 coil
5	• Verify fuse 6 is not blown. Fuses and relays are located in the fuse box in the operator's compartment • Is the fuse blown?		Replace fuse and test hopper door operation	Go to Step #6
6	• Key Off • Swap M2 relay with M1 horn relay • Key On, Engine On-Medium Speed • Press the hopper door open switch • Does the hopper door open?		Replace original M2 relay	Go to Step #7

Step	Action	Value(s)	Yes	No
7	• Key Off • Disconnect hopper door rocker switch from wire harness. • Disconnect hopper raise/lower rocker switch from the wire harness. • Swap switch locations • Key On, Engine On-Medium Speed • Press and hold the momentary switch in the hopper door open position • Does the hopper door open?		Replace original hopper door rocker switch	Go to Step #8
8	• Key Off • Reinstall rocker switches to factory positions • Disconnect the 40/Tan and 13/BLK wires from the enable valve timer (enable valve timer located behind instrument panel) • Insert jumper wire between 40/Tan wire and 13/BLK wire • Key On, Engine On-Low Speed • Press the door open switch • Does the hopper door open?		Replace enable valve timer	Go to Step #9
9	• Key On, Engine On-Medium Speed • Press the hopper door open switch • Wiggle test all wire harnesses to determine if the hopper door opens • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #10
10	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
12	• Key Off • Remove SV5 and SV8 coils from valve stems • Swap location of SV5 and SV8 valve stems • Reinstall SV5 and SV8 coils onto valve stems • Key On, Engine On-Low Speed • Press the hopper door open switch • Does the hopper door open?		Replace original SV5 valve stem	Go to Step #13
13	• Key Off • Remove SV4 and SV2 coils from valve stems • Swap location of SV4 and SV2 valve stems • Reinstall SV4 and SV2 coils onto valve stems • Key On, Engine On-Low Speed • Press the hopper door open switch • Does the hopper door open?		Replace original SV4 valve stem	Go to Step #14
14	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline at port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #15	Repair or replace hydraulic gear pump

Step	Action	Value(s)	Yes	No
15	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go to Step #16
16	• Key Off • Remove hydraulic lines from door cylinder and plug hydraulic hoses • Cap both cylinder fitting ports • Remove hydraulic cylinder from machine • Is it possible to extend/retract the cylinder by hand with ports capped?		Replace hydraulic door cylinder	Go to Step #17
17	• Key Off • Remove caps from cylinder • Is it possible to extend/retract the cylinder by hand without ports capped?		Go to Step #18	Replace hydraulic door cylinder
18	• Key Off • Inspect hopper door mechanism for damage • Manually attempt to open hopper door • Does it open?		Go Back to Step #1	Replace hopper door bearings or hopper door component

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



Electrical Schematic - Hopper Door Circuit (Shown On/Open)

How does the hopper door work?

The hopper door opens when dumping debris or during normal sweep mode. The door closes when sweep mode is turned off. The SV4 enable and SV5 hopper door open valves activate simultaneously to open the door. The door closes when SV4 is On and SV5 is Off. The door open button is used to manually open the door when dumping debris. The instrument panel activates SV4 for approximately 1-2 seconds each time the door is opened and for approximately 6 seconds each time the door is closed.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the electrical system meets the hydraulic system or the SV5 coil meets the SV5 stem.

Hydraulic	**E**lectrical	**M**echanical
Gear Pump	Battery	Hopper
Hoses	Wire Harness	Hopper Door
Fittings	Instrument Panel	Pivot Bearings
Cylinder	Fuse 6 (15A)	Hopper Door Skirts
Valve Block	M2 Relay	Cylinder Pins
SV4 Stem	SV4 Coil	Hardware
SV5 Stem	SV5 Coil	
Mobil DTE18M Oil		

HEM Diagram

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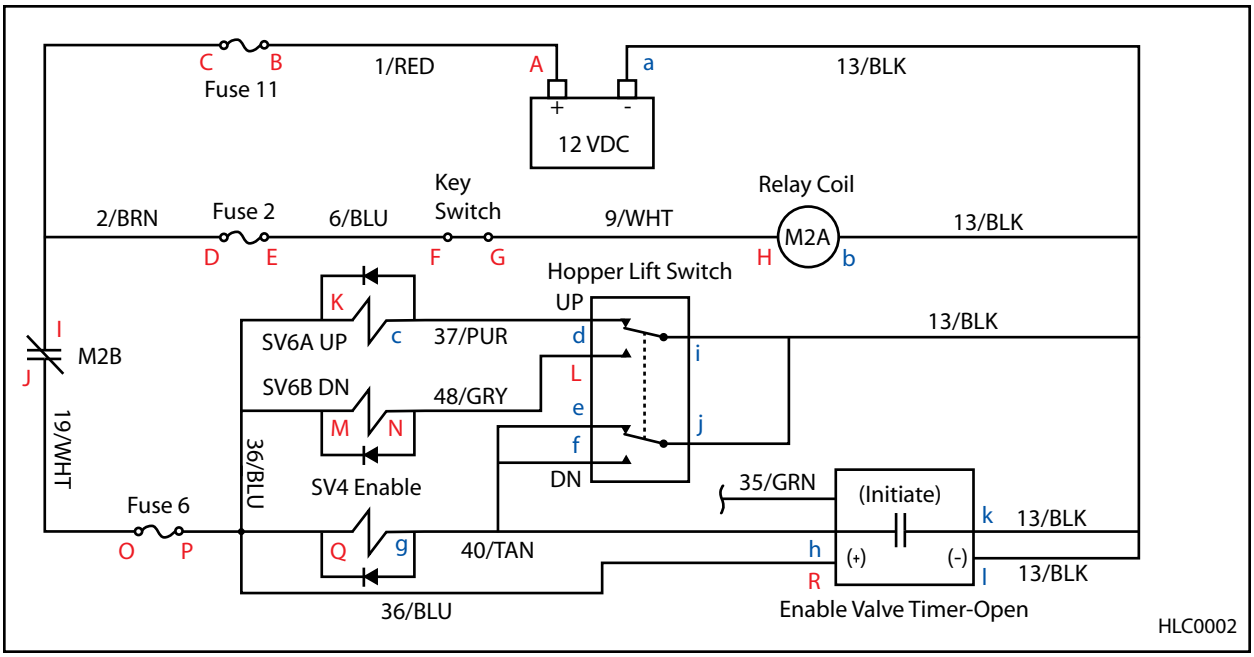
Step	Action	Value(s)	Yes	No
1	• Key Off • See "Self-Test Procedure" • Do circuit board pins "P1-7" or "P1-4" display as "open" or "shorted" on the LCD?	See "Self-Test Procedure"	Go to: P1-7, Step #2 P1-4, Step #3	Go to Step #11
2	• Key Off • Disconnect SV5 coil from wire harness • Test the resistance of SV5 coil with DVOM in Ohm test mode • Does DVOM display 8.6-9.5 Ohms?	SV5 coil resistance is 9 +/- 5% Ohms	Go to Step #4	Replace SV5 coil
3	• Key Off • Disconnect SV4 coil from wire harness • Test the resistance of SV4 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV5 coil resistance is 7.3 +/- 5% Ohms	Go to Step #4	Replace SV4 coil
4	• Verify fuses 5 and 6 are not blown. Fuses and relays are located in the fuse box in the operator's compartment • Is a fuse blown?		Replace fuse and test hopper door operation	Go to Step #5
5	• Key Off • Swap M2 relay with M1 horn relay • Key On, Engine On-Medium Speed • Press and hold hopper door open button • Does the hopper door open?		Replace original M2 relay	Go to Step #6
6	• Key On, Engine Off • Backprobe SV4 coil connection with DVOM in VDC mode (leave SV4 coil connected to wire harness) • Press and hold hopper door open button • Is there battery VDC applied to SV4 coil?	Approximately 12-14.5 VDC	Go to Step #7	Go to Step #8
7	• Key On, Engine Off • Backprobe SV5 coil connection with DVOM in VDC mode (leave SV5 coil connected to wire harness) • Press and hold hopper door open button • Is there battery VDC applied to SV5 coil?	Approximately 12-14.5 VDC	Go to Step #11	Go to Step #8
8	• Key On, Engine On-Medium Speed • Press and hold the hopper door open switch • Wiggle test all wire harnesses to determine if the hopper door opens • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #9

Step	Action	Value(s)	Yes	No
9	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #10
10	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
11	• Key Off • Remove SV5 and SV8 coils from valve stems • Swap location of SV5 and SV8 valve stems • Reinstall SV5 and SV8 coils onto valve stems • Key On, Engine On • Press and hold hopper door open button • Does the hopper door open?		Replace original SV5 valve stem	Go to Step #12
12	• Key Off • Remove SV4 and SV2 coils from valve stems • Swap location of SV4 and SV2 valve stems • Reinstall SV4 and SV2 coils onto valve stems • Key On, Engine On • Press and hold hopper door open button • Does the hopper door open?		Replace original SV4 valve stem	Go to Step #13

Step	Action	Value(s)	Yes	No
13	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline at port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #14	Repair or replace hydraulic gear pump
14	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go to Step #15
15	• Key Off • Remove hydraulic lines from door cylinder and plug hydraulic hoses • Cap both cylinder fitting ports • Remove hydraulic cylinder from machine • Is it possible to extend/retract the cylinder by hand with ports capped?		Replace hydraulic door cylinder	Go to Step #16
16	• Key Off • Remove caps from cylinder • Is it possible to extend/retract the cylinder by hand without ports capped?		Go to Step #17	Replace hydraulic door cylinder
17	• Key Off • Inspect hopper door mechanism for damage • Manually attempt to open hopper door • Does it open?		Go Back to Step #1	Replace hopper door bearings or hopper door component

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
LCD = Liquid Crystal Display
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



Electrical Schematic - Hopper Lift Circuit (Shown On)

How does the hopper lift system work?

The hydraulic lift cylinder is activated by a momentary rocker switch on the control panel. The SV4-enable and SV6A-hopper raise valves energize simultaneously in order to raise the hopper. A gear pump supplies hydraulic fluid to the distribution valve block where SV4 and SV6A direct pressure to the cap end of the lift cylinder circuit, causing the hopper to raise.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the hydraulic system meets the electrical system or the SV4 and SV6A Stems meet the SV4 and SV6A coils.

Hydraulic	**E**lectrical	**M**echanical
Gear Pump	Battery	Bearings
Hoses & Fittings	Wire Harness	Bushings
Relief Valve #3	Rocker Switch	Clevis Pins
Lift Cylinder	Fuse 6 (15A)	Cotter Pins
Valve Block	M2 Relay	Lift Arm Weldment
SV4 Stem	SV4 Coil	
SV6A Stem	SV6A Coil	
Mobil DTE18M Oil		

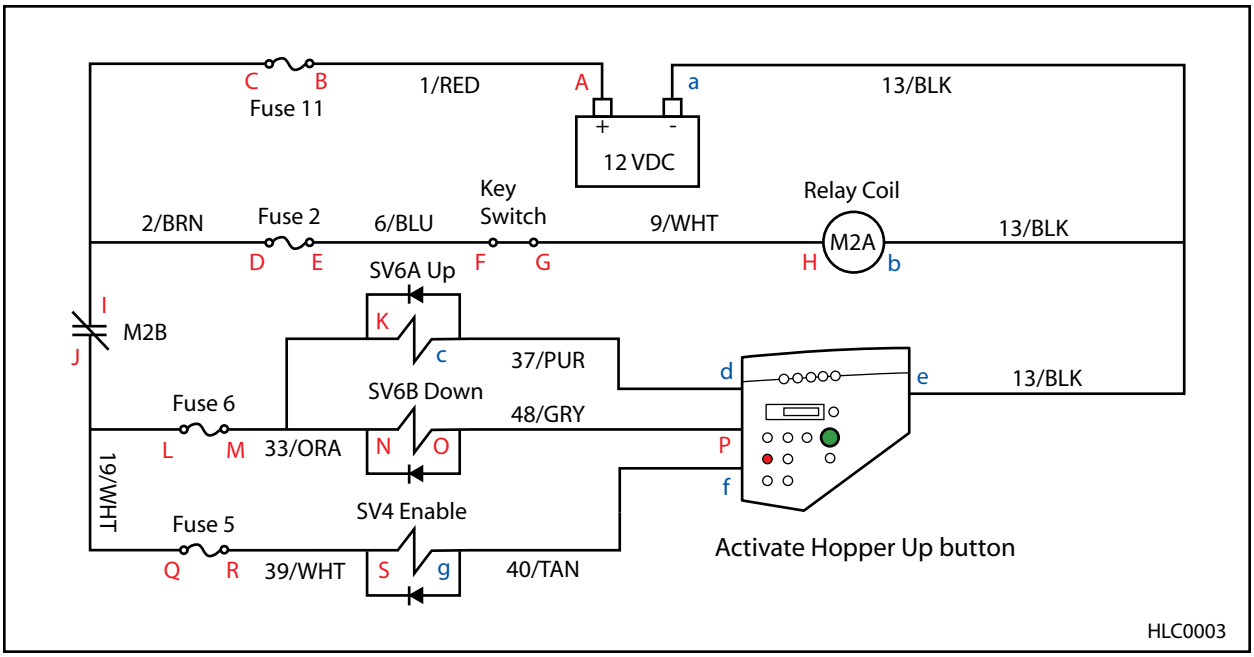
HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Backprobe SV4 and SV6A coil electrical connections using a DVOM in VDC mode • Press and Hold the hopper up switch • Is there battery VDC applied to both these coils?	Approximately 12-14.5 VDC	Go to Step #7	Go to Step #2
2	• Key Off • Verify fuse 6 is not blown. Fuses are located in the operator's compartment below the instrument panel • Is the fuse blown?		Replace fuse and test hopper lift operation	Go to Step #3
3	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On-High Speed • Press the hopper up switch • Does the hopper raise?		Replace original M2 relay	Go to Step #4
4	• Press and hold the hopper up switch • Wiggle test all wire harnesses to determine if hopper raises • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #5
5	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #6
6	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1

Step	Action	Value(s)	Yes	No
7	• Key Off • Disconnect SV6A and SV6B coils from wire harness • Swap location of SV6A and SV6B coils • Reconnect SV6A and SV6B coils to wire harness • Key On, Engine On-High Speed • Press the hopper up switch • Does the hopper raise?		Replace original SV6A coil	Go to Step #8
8	• Key Off • Disconnect SV4 and SV1 coils from wire harness • Swap location of SV4 and SV1 coils • Reconnect SV4 and SV1 coils to wire harness • Key On, Engine On-High Speed • Press the hopper up switch • Does the hopper raise?		Replace original SV4 coil	Go to Step #9
9	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Install hydraulic flow meter tool inline at port P1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speeds	Go to Step #10	Repair or replace hydraulic gear pump
10	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go to Step #11
11	• Key Off • Disconnect and plug hydraulic hoses from lift cylinder • Cap cylinder fitting ports • Remove rod-end clevis pin • Is it possible to extend/retract the cylinder by hand?		Replace hydraulic lift cylinder	Go to Step #12

Step	Action	Value(s)	Yes	No
12	• Key Off • Remove caps from cylinder • Is it possible to extend/retract the cylinder by hand?		Go back to Step #1	Replace hydraulic door cylinder

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



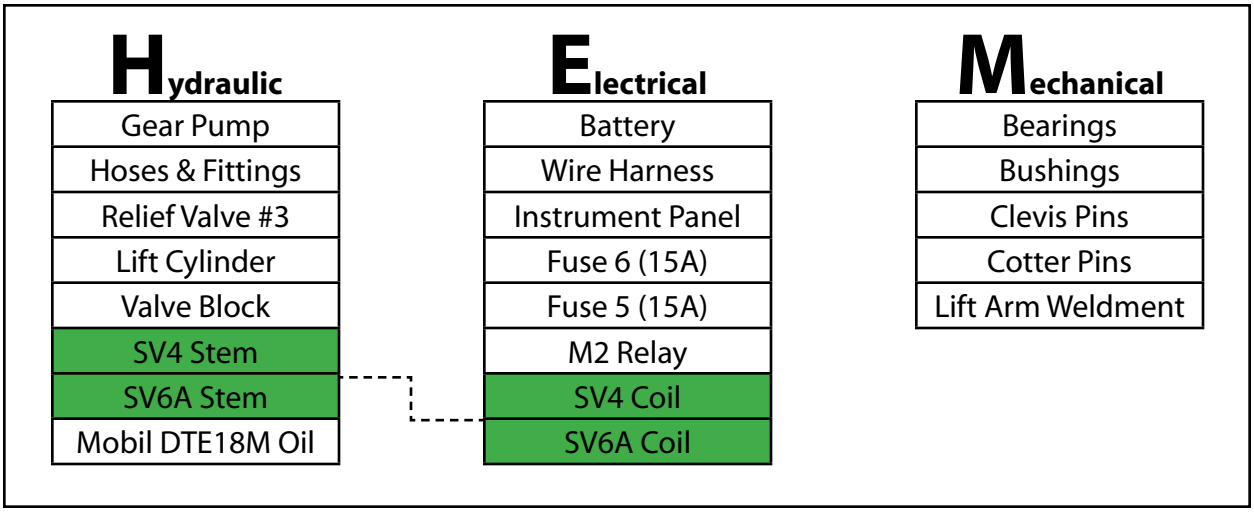
Electrical Schematic - Hopper Lift Circuit (Shown On)

How does the hopper lift system work?

The hydraulic lift cylinder is activated by a momentary button on the instrument panel assembly. The SV4-enable and SV6A-hopper raise valves energize simultaneously in order to raise the hopper. The engine speed increases from low to medium when the hopper up button is activated. A gear pump supplies hydraulic fluid to the distribution valve block where SV4 and SV6A direct pressure to the cap end of the lift cylinder circuit, causing the hopper to raise.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin by conducting a "Self-Test" using the onboard diagnostic feature.



HEM Diagram

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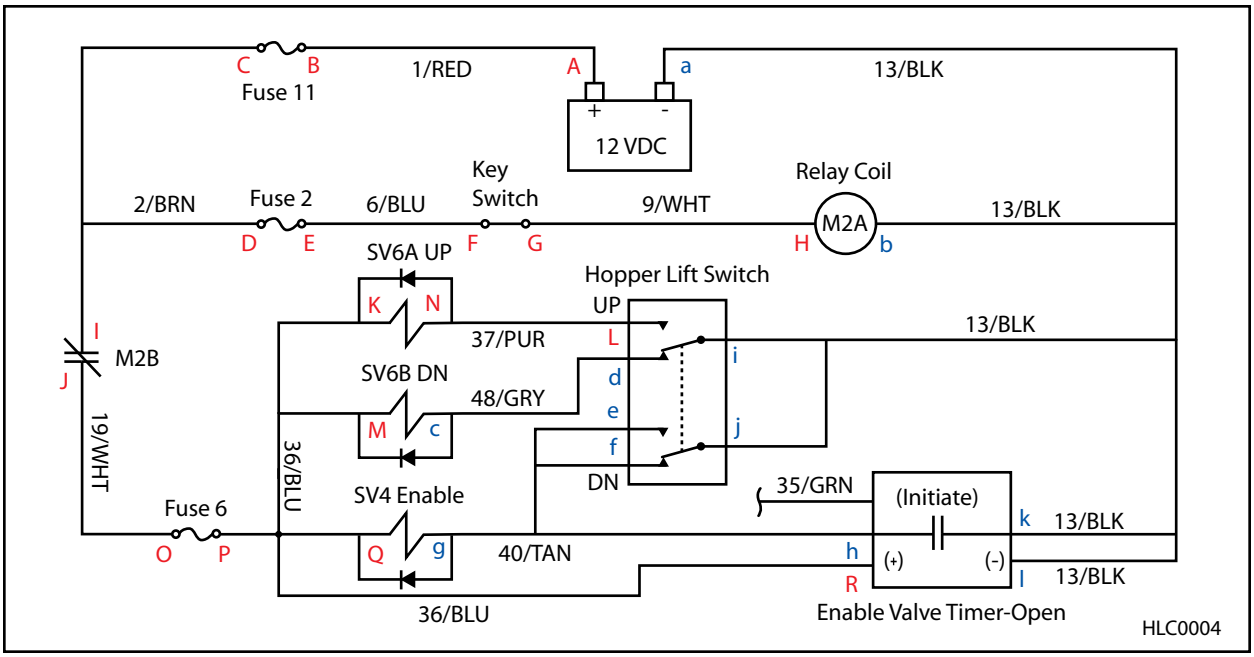
Step	Action	Value(s)	Yes	No
1	• Key Off • See "Self-Test Procedure" • Do circuit board pins "P1-4" or "P1-8" display as "open" or "shorted" on the LCD?	See "Self-Test Procedure"	Go to Step #2	Go to Step # 4
2	• Key Off • Disconnect SV4 coil from the wire harness • Test the resistance of SV4 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV4 coil resistance is 7.3 +/- 5% Ohms	Go to Step #3	Replace SV4 Coil
3	• Key Off • Disconnect SV6A coil from the wire harness • Test the resistance of SV6A coil with DVOM in Ohm test mode • Does DVOM display 8.6-9.5 Ohms?	SV6A coil resistance is 9 +/- 5% Ohms	Go to Step #5	Replace SV6A Coil
4	• Key On, Engine Off • Backprobe SV4 and SV6A coil electrical connections using a DVOM in VDC mode • Press and Hold the hopper up button • Is there battery VDC applied to both these coils?	Approximately 12-14.5 VDC	Go to Step #10	Go to Step #5
5	• Key Off • Verify fuses 5 and 6 are not blown. Fuses are located in the operator's compartment below the instrument panel • Is a fuse blown?		Replace fuse and test hopper lift operation	Go to Step #6

Step	Action	Value(s)	Yes	No
6	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On-High Speed • Press the hopper up button • Does the hopper raise?		Replace original M2 relay	Go to Step #7
7	• Key On, Engine On-High speed • Press and hold the hopper up button • Wiggle test all wire harnesses to determine if hopper raises • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #8
8	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #9
9	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
10	• Key Off • Disconnect SV6A and SV6B coils from wire harness • Swap location of SV6A and SV6B coils • Reconnect SV6A and SV6B coils to wire harness • Key On, Engine On-High Speed • Press the hopper up button • Does the hopper raise?		Replace original SV6A coil	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Key Off • Disconnect SV4 and SV1 coils from wire harness • Swap location of SV4 and SV1 coils • Reconnect SV4 and SV1 coils to wire harness • Key On, Engine On-High Speed • Press the hopper up button • Does the hopper raise?		Replace original SV4 coil	Go to Step #12
12	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Install hydraulic flow meter tool inline at port P1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speed	Go to Step #13	Repair or replace hydraulic gear pump
13	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go to Step #14
14	• Key Off • Disconnect and plug hydraulic hoses from lift cylinder • Cap cylinder fitting ports • Remove rod-end clevis pin • Is it possible to extend/retract the cylinder by hand?		Replace hydraulic lift cylinder	Go to Step #15
15	• Key Off • Remove caps from cylinder • Is it possible to extend/retract the cylinder by hand?		Go back to Step #1	Replace hydraulic lift cylinder

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
LCD = Liquid Crystal Display
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



Electrical Schematic - Hopper Lower Circuit (Shown On)

How does the hopper lift system work?

The hydraulic lift cylinder is activated by a momentary rocker switch on the control panel. The SV4-enable and SV6B-hopper lower valves energize simultaneously in order to lower the hopper. A gear pump supplies hydraulic fluid to the distribution valve block where SV4 and SV6B direct pressure to the rod end of the lift cylinder circuit, causing the hopper to lower. The hopper safety support arm, if engaged, prevents the hopper from lowering in the event of a hydraulic system pressure loss.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the hydraulic system meets the electrical system or the SV4 and SV6B Stems meet the SV4 and SV6B coils.

Hydraulic	**E**lectrical	**M**echanical
Gear Pump	Battery	Bearings
Hoses & Fittings	Wire Harness	Bushings
Relief Valve #3	Rocker Switch	Clevis Pins
Lift Cylinder	Fuse 6 (15A)	Cotter Pins
Valve Block	M2 Relay	Lift Arm Weldment
SV4 Stem	SV4 Coil	
SV6B Stem	SV6B Coil	
Mobil DTE18M Oil		

HEM Diagram

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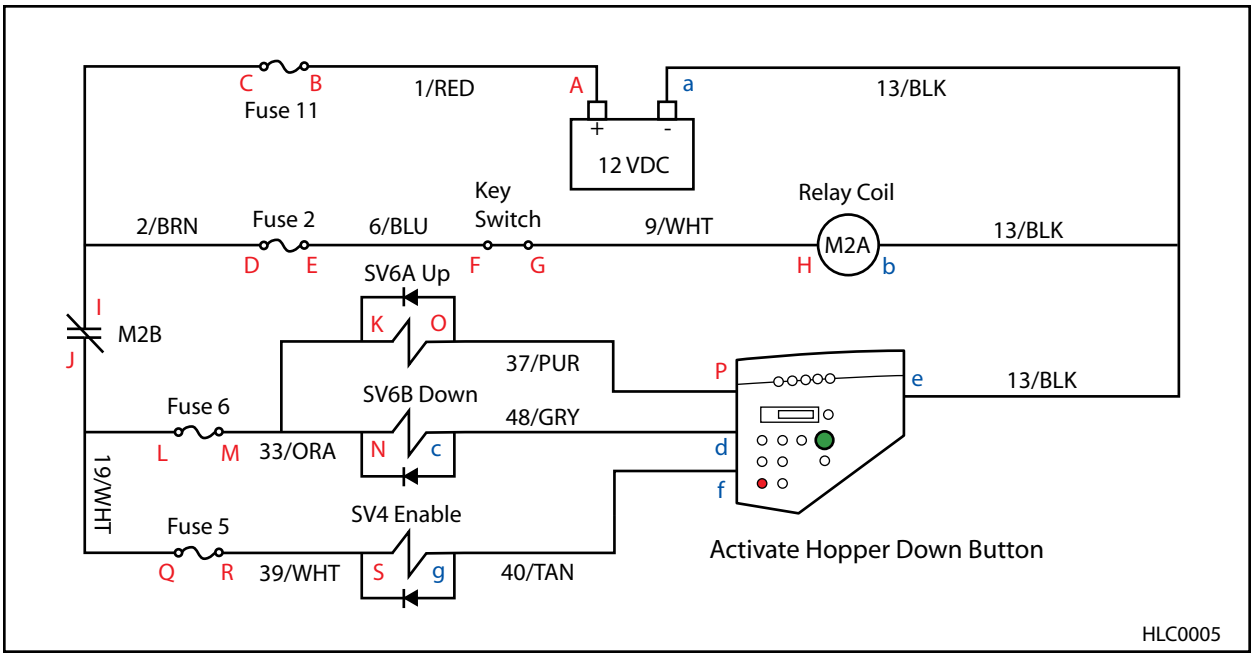
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Backprobe SV4 and SV6B coil electrical connections using a DVOM in VDC mode • Press and Hold the hopper down switch • Is there battery VDC applied to both these coils?	Approximately 12-14.5 VDC	Go to Step #7	Go to Step #2
2	• Key Off • Verify fuse 6 is not blown. Fuses are located in the operator's compartment below the instrument panel • Is the fuse blown?		Replace fuse and test hopper lower operation	Go to Step #3
3	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On-High Speed • Press the hopper down switch • Does the hopper lower?		Replace original M2 relay	Go to Step #4
4	• Key On, Engine On-High speed • Press and hold the hopper down switch • Wiggle test all wire harnesses to determine if hopper lowers • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #5
5	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #6
6	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1

Step	Action	Value(s)	Yes	No
7	• Key Off • Disconnect SV6A and SV6B coils from wire harness • Swap location of SV6A and SV6B coils • Reconnect SV6A and SV6B coils to wire harness • Key On, Engine On-High Speed • Press the hopper down switch • Does the hopper lower?		Replace original SV6B coil	Go to Step #8
8	• Key Off • Disconnect SV4 and SV1 coils from wire harness • Swap location of SV4 and SV1 coils • Reconnect SV4 and SV1 coils to wire harness • Key On, Engine On-High Speed • Press the hopper down switch • Does the hopper lower?		Replace original SV4 coil	Go to Step #9
9	• *Manually lower hopper* • Disengage hopper safety support arm • Key Off • Loosen, DO NOT REMOVE, the hose fitting at port C5 and slowly lower the hopper completely down • Use a drain pan for displaced hydraulic fluid • Is the hopper lowered completely down? **WARNING: Lift arm pinch point. Stay clear of hopper lift arms.**		Go to Step #10	Repeat Step #9
10	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go back to Step #1

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



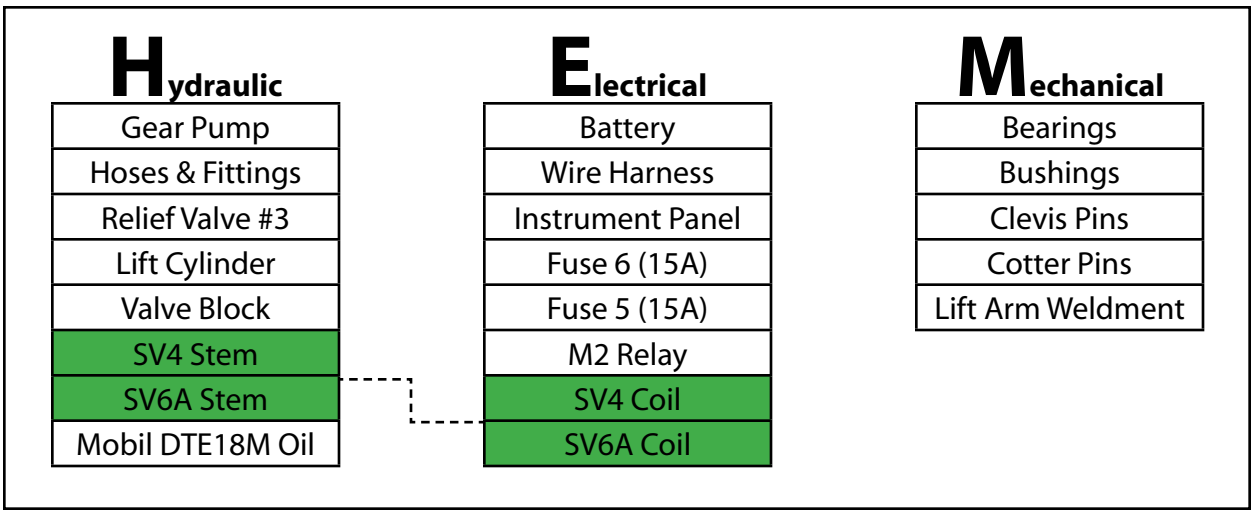
Electrical Schematic - Hopper Lower Circuit (Shown On)

How does the hopper lift system work?

The hydraulic lift cylinder is activated by a momentary button on the instrument panel. Both the SV4-enable and the SV6B-hopper lower valves energize to lower the hopper. The engine speed increases from low to medium when the hopper down button is activated. A gear pump supplies hydraulic fluid to the distribution valve block where SV4 and SV6B direct pressure to the rod end of the lift cylinder circuit, causing the hopper to lower. The hopper safety support arm, if engaged, prevents the hopper from lowering in the event of a hydraulic system pressure loss.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin by conducting a "Self-Test" using the onboard diagnostic feature.



HEM Diagram

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Step	Action	Value(s)	Yes	No
1	• Key Off • See "Self-Test Procedure" • Do circuit board pins "P1-4" or "P1-9" display as "open" or "shorted" on the LCD?	See "Self-Test Procedure"	Go to Step #2	Go to Step # 4
2	• Key Off • Disconnect SV4 coil from the wire harness • Test the resistance of SV4 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV4 coil resistance is 7.3 +/- 5% Ohms	Go to Step #3	Replace SV4 Coil
3	• Key Off • Disconnect SV6B coil from the wire harness • Test the resistance of SV6B coil with DVOM in Ohm test mode • Does DVOM display 8.6-9.5 Ohms?	SV6B coil resistance is 9 +/- 5% Ohms	Go to Step #5	Replace SV6B Coil
4	• Key On, Engine Off • Backprobe SV4 and SV6B coil electrical connections using a DVOM in VDC mode • Press and Hold the hopper down button • Is there battery VDC applied to both these coils?	Approximately 12-14.5 VDC	Go to Step #10	Go to Step #5
5	• Key Off • Verify fuses 5 and 6 are not blown. Fuses are located in the operator's compartment below the instrument panel • Is a fuse blown?		Replace fuse and test hopper lift operation	Go to Step #6
6	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On-High Speed • Press the hopper down button • Does the hopper lower?		Replace original M2 relay	Go to Step #7

Step	Action	Value(s)	Yes	No
7	• Key On, Engine On-High speed • Press and hold the hopper down button • Wiggle test all wire harnesses to determine if hopper lowers • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #8
8	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #9
9	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
10	• Key Off • Disconnect SV6A and SV6B coils from wire harness • Swap location of SV6A and SV6B coils • Reconnect SV6A and SV6B coils to wire harness • Key On, Engine On-High Speed • Press the hopper down button • Does the hopper lower?		Replace original SV6B coil	Go to Step #11
11	• Key Off • Disconnect SV4 and SV1 coils from wire harness • Swap location of SV4 and SV1 coils • Reconnect SV4 and SV1 coils to wire harness • Key On, Engine On-High Speed • Press the hopper down button • Does the hopper lower?		Replace original SV4 coil	Go to Step #12

Step	Action	Value(s)	Yes	No
12	• *Manually lower hopper* • Disengage hopper safety support arm • Key Off • Loosen, DO NOT REMOVE, the hose fitting at port C5 and slowly lower the hopper completely down • Use a drain pan for displaced hydraulic fluid • Is the hopper lowered completely down? **WARNING: Lift arm pinch point. Stay clear of hopper lift arms.**		Go to Step #13	Repeat Step #12
13	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go back to Step #1

DVOM = Digital Volt/Ohm Meter
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Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
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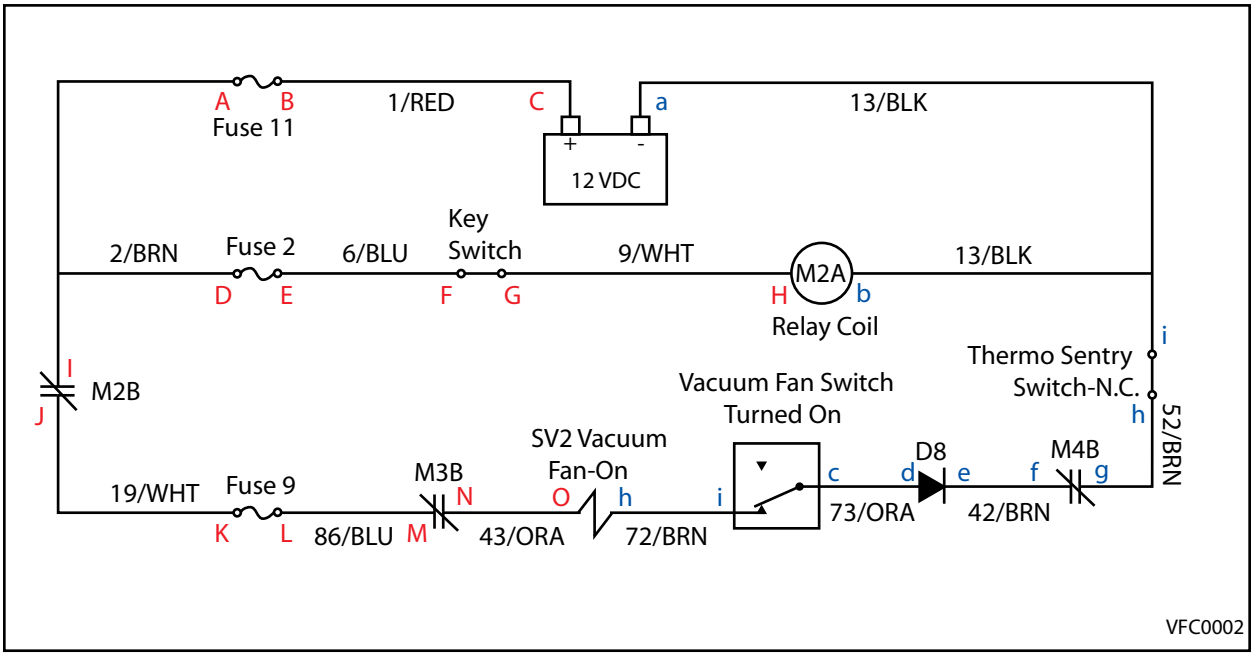


Electrical Schematic - Vacuum Fan Circuit (Shown On/Off)

How does the dust control system work?

The dust control system utilizes a hydraulic vacuum fan motor that pulls air through a cylindrical dust filter. The vacuum fan impeller turns at approximately 5,000 rpm (normal sweeping) and 5,800 rpm (litter sweeping). The dust filter should be shaken periodically to remove heavy dust accumulation. The vacuum fan shuts down if the Thermo-Sentry switch detects a hopper thermal event (i.e. cigarette butt, hot ember, etc).

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing at the dust filter.

Hydraulic
Gear Pump
Hoses
Fittings
Motor
Valve Block
SV2 Stem
Mobil DTE18M Oil

Electrical
Battery
Wire Harness
Rocker Switch
Fuse 9 (15A)
M2,M3, & M4 Relays
SV2 Coil
Thermo-Sentry Switch

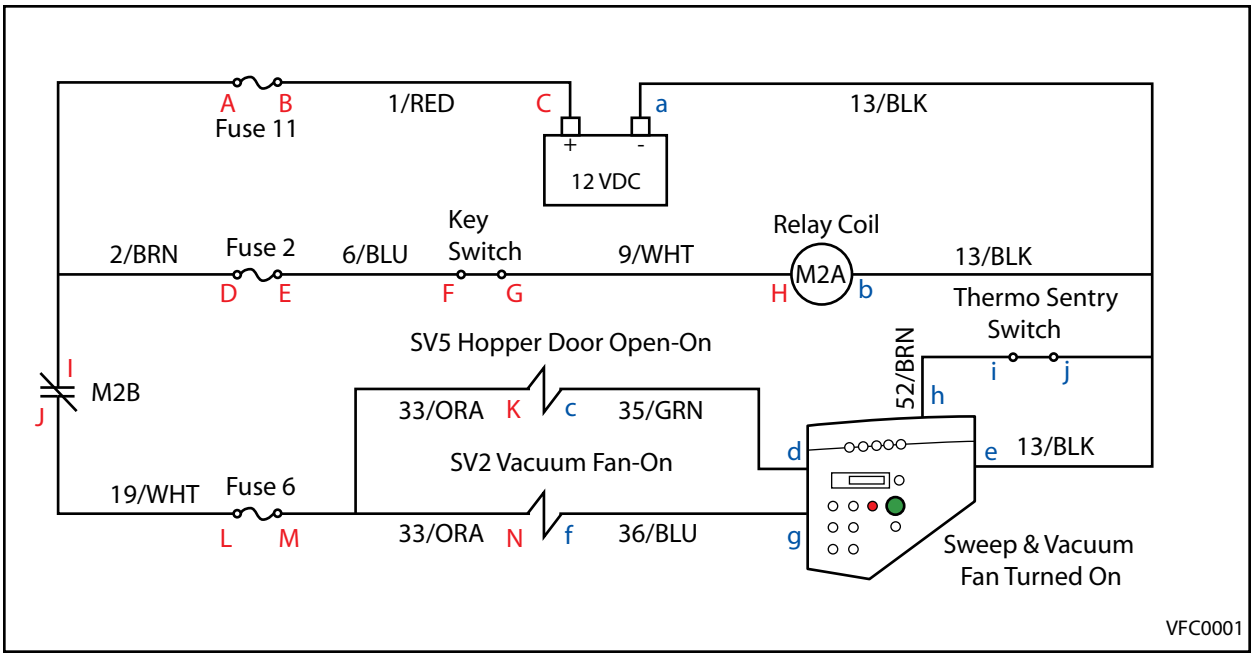
Mechanical
Fan Housing
Impeller
Filter Housing
Hopper Seals
Filter Seal
Shaker System
Dust Filter
Dust Skirts
Hopper & Dust Door

HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key Off • Remove top shaker motor plate to expose the dust filter • Remove dust filter • Is the dust filter obstructed by heavy dust accumulation?		Clean or replace the dust filter.	Go to Step #2
2	• Key Off • Inspect all skirt-to-floor clearances on a flat, level surface • Are all skirt-to-floor clearances between 1/8" and 3/16"?	Skirt-to-floor clearance = 1/8" to 3/16"	Go to Step #3	Repair, replace, or adjust skirting
3	• Key Off • Open the RH or LH main brush door • Measure the remaining main brush bristle length • Are the bristles greater than 2.5 inches?	Replace main brush when bristles are less than 2.5 inches	Go to Step #4	Replace main brush
4	• Reinstall top shaker motor plate • Close main brush access door • Key On, Engine On-Medium Speed • Sweep system turned On • Lower main brush to floor • Is the main brush pattern 2-2.5 inches along the entire length of the main brush? (see "CHECKING THE MAIN BRUSH PATTERN" in operator's manual)	Main brush pattern should be 2-2.5 inches	Go to Step #5	Refer to "ADJUSTING THE MAIN BRUSH TAPER" or "ADJUSTING THE MAIN BRUSH WIDTH" in the operator's manual
5	• Key Off • Raise hopper, engage hopper safety support arm • Apply powder (talc, baking soda, etc) on the hopper contact seals • Key On, Engine On • Lower Hopper and turn Sweep/Vac system On for 2 minutes • Turn Sweep/Vac system Off • Raise hopper, engage hopper safety support arm • Is there any powder missing from the hopper mating seals?		Seals are leaking excessively. Replace seal(s) or adjust hopper component so seals mate properly	Go to Step #6
6	• Key On, Engine On • Hopper Down • Sweep/Vac system On • Is the hopper door fully open?		Go to Step #7	See "Hopper Door Failed to Open"

Step	Action	Value(s)	Yes	No
7	• Key On, Engine On • Sweep/Vac system On • Open main brush access door • Is the main broom sweeping forward on the floor?	RH view = CCW rotation LH view = CW rotation	Go to Step #8	If reversed, swap the inlet/outlet hoses on the hydraulic motor
8	• Key Off • Open main brush access door • Place reflective tape on main brush tube • Key On, Engine On-Medium Speed • Sweep/Vac system On • Use a photo tachometer tool to determine the speed of the main brush • Is the main brush speed greater than 450 rpm @ medium engine speed and greater than 540 rpm @ high engine speed?	Main Broom Speed = 500 rpm +/- 10% @ 2,000 engine rpm, 600 rpm +/- 10% @ 2,400 engine rpm	Go to Step #9	Go to Step #12
9	• Key Off • Remove top shaker motor plate to expose dust filter • Remove dust filter • Key On, Engine On • Sweep/Vac system On • Inspect the vacuum fan impeller rotation • Is the vacuum fan impeller turning *clockwise* from the top view?		Go to Step #10	If reversed, swap the inlet/outlet hoses on the hydraulic motor
10	• Key Off • Place a small piece of reflective tape onto the vacuum fan impeller • Key On, Engine On-Medium Speed • Sweep/Vac system On • Use a photo tachometer tool to determine the speed of the impeller • Is the vacuum fan impeller speed greater than 4,400 rpm @ medium engine speed and greater than 5,200 rpm @ high engine speed?	Fan impeller speeds = 4,880 +/- 10% (2,000 Engine RPM) 5,850 +/- 10% (2,400 Engine RPM)	Go back to Step #1	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Key Off • Disconnect the hydraulic hose from the vacuum fan motor inlet • Insert a hydraulic flow meter tool inline between the hydraulic inlet hose and the fan motor • Key On, Engine On-Medium Speed • Sweep/Vac system On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	Vac fan motor flow rate = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace the vacuum fan motor	Go to Step #13
12	• Key Off • Disconnect the hydraulic hose from the main brush motor inlet • Insert a hydraulic flow meter tool inline at the main brush motor inlet hose • Key On, Engine On-Medium Speed • Sweep/Vac system On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	Main brush motor flow rate = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace the main brush motor	Go to Step #14
13	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline at port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #14	Repair or replace hydraulic gear pump
14	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block etc. • Do any of the above conditions exist?		Replace faulty scrubber valve block component or entire valve block assembly	Go Back to Step #1



Electrical Schematic - Vacuum Fan Circuit (Shown On/Off)

How does the dust control system work?

The dust control system utilizes a hydraulic vacuum fan motor that pulls air through a cylindrical dust filter. The vacuum fan impeller turns at approximately 5,000 rpm (normal sweeping) and 5,800 rpm (litter sweeping). The dust filter should be shaken periodically to remove heavy dust accumulation. The vacuum fan shuts down if the Thermo-Sentry switch detects a hopper thermal event (i.e. cigarette butt, hot ember, etc).

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing at the dust filter.

Hydraulic
Gear Pump
Hoses
Fittings
Motor
Valve Block
SV2 Stem
Mobil DTE18M Oil

Electrical
Battery
Wire Harness
Instrument Panel
Fuse 6 (15A)
M2 Relay
SV2 Coil
Thermo-Sentry Switch

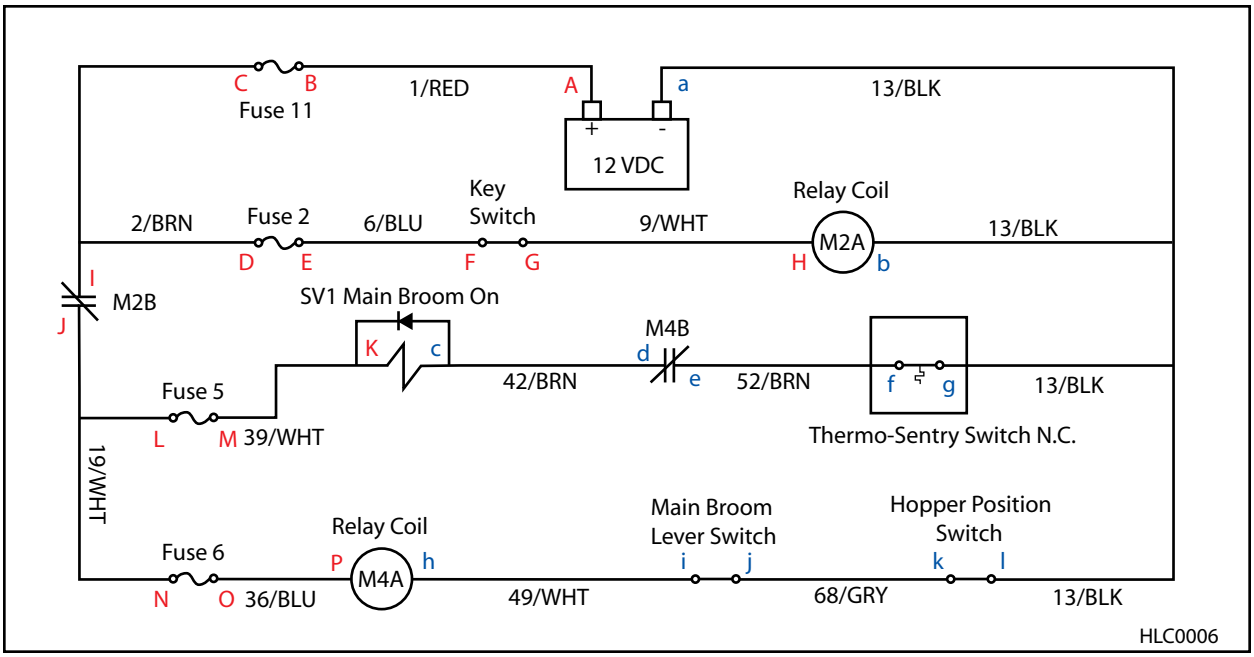
Mechanical
Fan Housing
Impeller
Filter Housing
Hopper Seals
Filter Seal
Shaker System
Dust Filter
Dust Skirts
Hopper & Dust Door

HEM Diagram

Step	Action	Value(s)	Yes	No
1	• Key Off • Remove top shaker motor plate to expose the dust filter • Remove dust filter • Is the dust filter obstructed by heavy dust accumulation?		Clean or replace the dust filter	Go to Step #2
2	• Key Off • Inspect all skirt-to-floor clearances on a flat, level surface • Are all skirt-to-floor clearances between 1/8" and 3/16"?	Skirt-to-floor clearance = 1/8" to 3/16"	Go to Step #3	Repair, replace, or adjust skirting
3	• Key Off • Open the RH or LH main brush door • Measure the remaining main brush bristle length • Are the bristles greater than 2.5 inches?	Replace main brush when bristles are less than 2.5 inches	Go to Step #4	Replace main brush
4	• Reinstall top shaker motor plate • Close main brush access door • Key On, Engine On-Medium Speed • 1-STEP Sweep On • Lower main brush to floor • Is the main brush pattern 2-2.5 inches along the entire length of the main brush? (Refer to "CHECKING THE MAIN BRUSH PATTERN" in Operator's Manual)	Main brush pattern should be 2-2.5 inches	Go to Step #5	Refer to "ADJUSTING THE MAIN BRUSH TAPER" or "ADJUSTING THE MAIN BRUSH WIDTH" in the operator's manual
5	• Key Off • Raise hopper, engage hopper safety support arm • Apply powder (talc, baking soda, etc) on the hopper contact seals • Key On, Engine On • Lower Hopper and turn Sweep/Vac system On for 2 minutes • Turn Sweep/Vac system Off • Raise hopper, engage hopper safety support arm • Is there any powder missing from the hopper mating seals?		Seals are leaking excessively. Replace seal(s) or adjust hopper component so seals mate properly	Go to Step #6
6	• Key On, Engine On • Hopper down • Sweep/Vac system On • Is the hopper door fully open?		Go to Step #7	See "Hopper Door Failed to Open"

Step	Action	Value(s)	Yes	No
7	• Key On, Engine On • Sweep/Vac system On • Open main brush side access door • Is the main broom sweeping forward on the floor?	RH view = CCW rotation LH view = CW rotation	Go to Step #8	If reversed, swap the inlet/outlet hoses on the hydraulic motor
8	• Key Off • Open main brush access door • Place reflective tape on main brush tube • Key On, Engine On-Medium Speed • Sweep/Vac system On • Use a photo tachometer tool to determine the speed of the main brush • Is the main brush speed greater than 450 rpm @ medium engine speed and greater than 540 rpm @ high engine speed?	Main Broom Speed = 500 rpm +/- 10% @ 2,000 engine rpm, 600 rpm +/- 10% @ 2,400 engine rpm	Go to Step #9	Go to Step #12
9	• Key Off • Remove top shaker motor plate to expose the dust filter • Remove dust filter • Key On, Engine On • Sweep/Vac system On • Inspect the vacuum fan impeller rotation • Is the vacuum fan impeller turning *clockwise* from the top view?		Go to Step #10	If reversed, swap the inlet/outlet hoses on the hydraulic motor
10	• Key Off • Place a small piece of reflective tape onto the vacuum fan impeller • Key On, Engine On-Medium Speed • Sweep/Vac system On • Use a photo tachometer tool to determine the speed of the impeller • Is the vacuum fan impeller speed greater than 4,400 rpm @ medium engine speed and greater than 5,200 rpm @ high engine speed?	Fan impeller speeds = 4,880 +/- 10% (2,000 Engine RPM) 5,850 +/- 10% (2,400 Engine RPM)	Go back to Step #1	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Key Off • Disconnect the hydraulic hose from the *vacuum fan* motor inlet • Insert a hydraulic flow meter tool inline between the hydraulic inlet hose and the fan motor • Key On, Engine On-Medium Speed • Sweep/Vac system On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	Vac fan motor flow rate = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace the vacuum fan motor	Go to Step #13
12	• Key Off • Disconnect the hydraulic hose from the *main brush* motor inlet • Insert a hydraulic flow meter tool inline between the hydraulic inlet hose and the main brush motor • Key On, Engine On-Medium Speed • Sweep/Vac system On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	Main brush motor flow rate = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace the main brush motor	Go to Step #14
13	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline at port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #14	Repair or replace hydraulic gear pump
14	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block etc. • Do any of the above conditions exist?		Replace faulty scrubber valve block component and/or entire valve block assembly	Go Back to Step #1



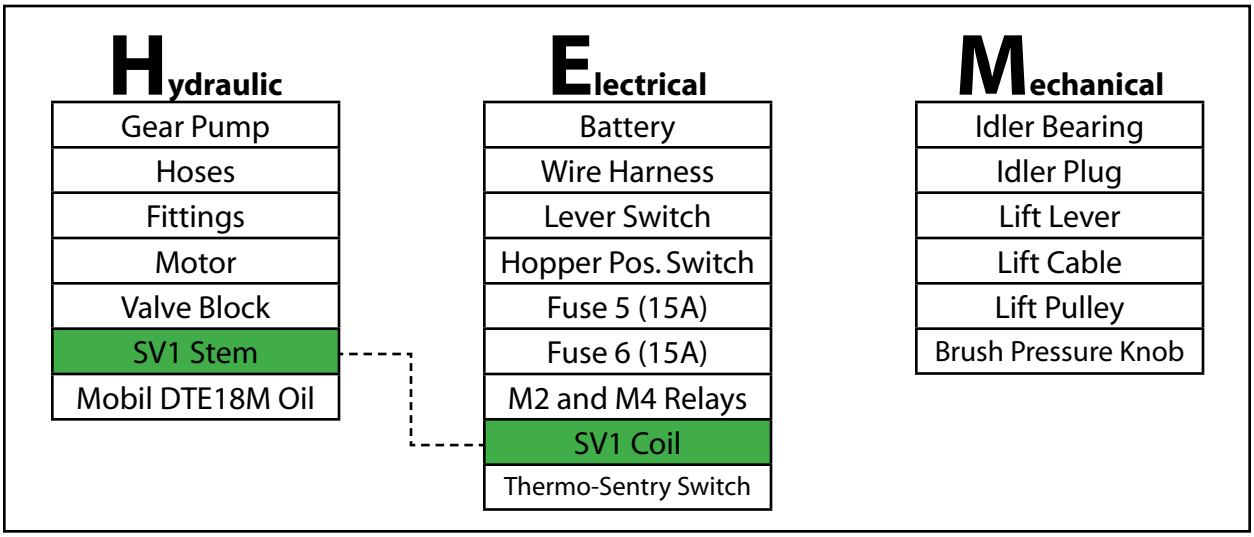
Electrical Schematic - Main Broom Circuit (Shown On)

How does the main broom work?

The main broom is activated when the main brush lever is moved into the down/On position. The lever contacts a switch located below the lintel weldment. This switch and the hopper position switch must be closed for the M4 relay coil to energize. With the M4 relay and Thermo-Sentry contacts closed, the SV1 hydraulic valve energizes and directs hydraulic fluid into the main broom motor, causing the main broom to rotate.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the hydraulic system meets the electrical system or the SV1 Stem meets the SV1 coil.



HEM Diagram

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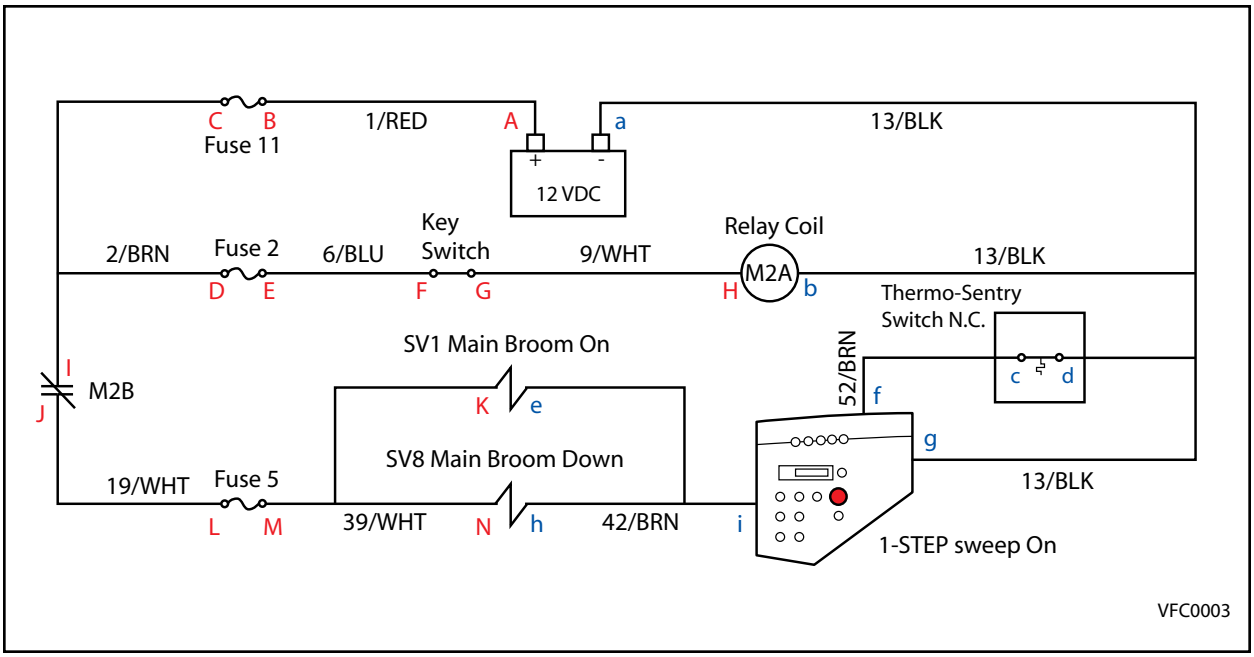
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Backprobe SV1 coil electrical connection using a DVOM in VDC mode • Activate the main brush lever • Is there battery VDC applied to the coil?	Approximately 12-14.5 VDC	Go to Step #11	Go to Step #2
2	• Key Off • Verify fuses 5 and 6 are not blown. Fuses are located in the operator's compartment below the instrument panel • Is a fuse blown?		Replace fuse and test main broom operation	Go to Step #3
3	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On • Activate the main broom lever • Does the main broom turn On?		Replace original M2 relay	Go to Step #4
4	• Key Off • Swap M4 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On • Activate the main broom lever • Does the main broom turn On?		Replace original M4 relay	Go to Step #5
5	• Key Off • Insert jumper wire between 49/WHT and 68/GRY wires at the main broom lever switch • Key On, Engine On • Does the main broom turn On?		Replace or adjust main broom lever switch	Go to Step #6
6	• Key Off • Insert jumper wire between 68/GRY and 13/BLK wires at the hopper position switch • Key On, Engine On • Does the main broom turn On?		Replace or adjust hopper position switch	Go to Step #7
7	• Key Off • Insert jumper wire between 52/BRN and 13/BLK wires at the Thermo-Sentry switch • Key On, Engine On • Does the main broom turn On?		Replace Thermo-Sentry switch	Go to Step #8

Step	Action	Value(s)	Yes	No
8	• Key On, Engine On • Activate the main broom lever • Wiggle test all wire harnesses to determine if main broom turns On • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #9
9	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #10
10	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
11	• Key Off • Disconnect SV1 and SV4 coils from wire harness • Swap location of SV1 and SV4 coils • Reconnect SV1 and SV4 coils to wire harness • Key On, Engine On • Activate the main broom lever • Does the main broom turn On?		Replace original SV1 coil	Go to Step #12
12	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Install hydraulic flow meter tool inline at port P1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speeds	Go to Step #13	Repair or replace hydraulic gear pump

Step	Action	Value(s)	Yes	No
13	• Key Off • Remove flow meter tool and reconnect hydraulic hose to port P1 • Disconnect hydraulic hose from port M1 on valve block • Install hydraulic flow meter tool inline at port M1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speeds	Repair or replace hydraulic main brush motor	Go to Step #14
14	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go back to Step #1

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



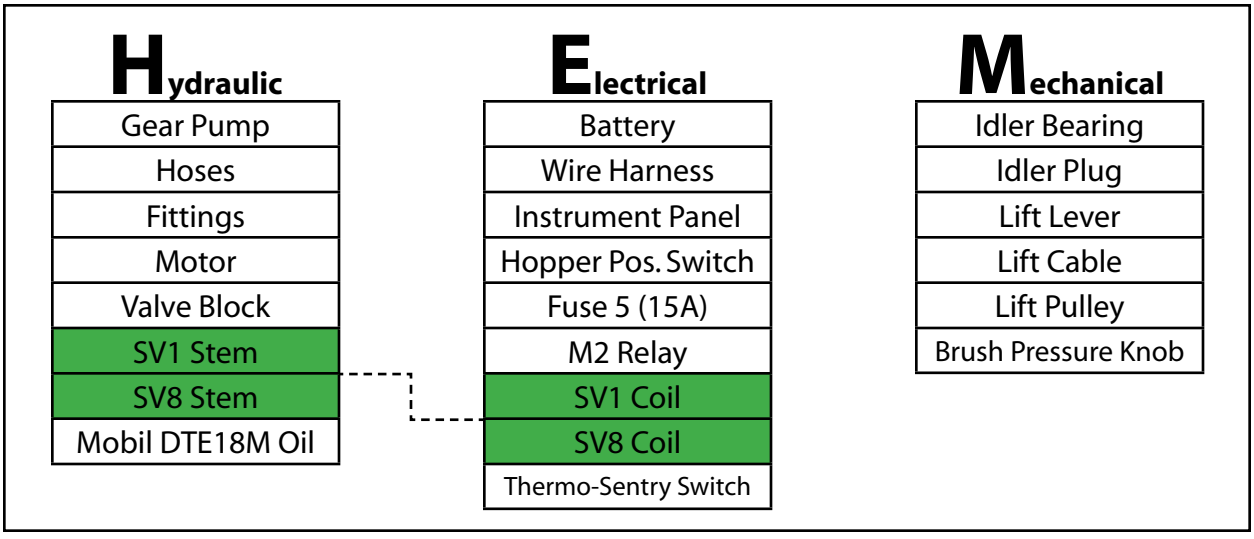
Electrical Schematic - Main Broom Circuit (Shown On)

How does the main broom work?

The main broom is activated by the 1-STEP button on the instrument panel. The instrument panel controls the SV1-Main Broom On and SV8-Main Broom Down electrical circuits. When battery voltage is applied to the SV1 and SV8 coils, the valve stems shift and direct hydraulic fluid into the main broom motor and the hydraulic lift cylinder, causing the main broom to rotate and lower.

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin by conducting a "Self-Test" using the onboard diagnostic feature.



HEM Diagram

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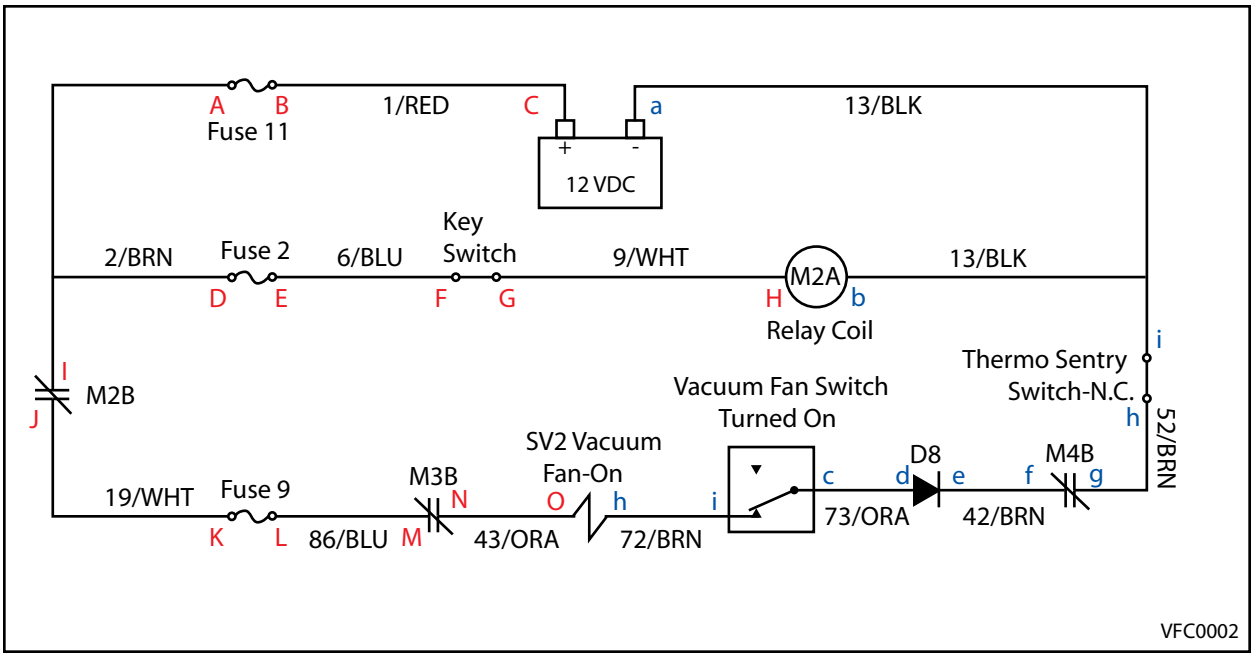
Step	Action	Value(s)	Yes	No
1	• Key Off • See "Self-Test Procedure" • Does circuit board pin "P1-5" display as "open" or "shorted" on the LCD?	See "Self-Test Procedure"	Go to Step #2	Go to Step # 4
2	• Key Off • Disconnect SV1 coil from the wire harness • Test the resistance of SV1 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV1 coil resistance is 7.3 +/- 5% Ohms	Go to Step #3	Replace SV1 Coil
3	• Key Off • Disconnect SV8 coil from the wire harness • Test the resistance of SV8 coil with DVOM in Ohm test mode • Does DVOM display 8.6-9.5 Ohms?	SV8 coil resistance is 9 +/- 5% Ohms	Go to Step #5	Replace SV8 Coil
4	• Key On, Engine Off • Backprobe SV1 and SV8 coil electrical connections using a DVOM in VDC mode • Activate the 1-STEP sweep button • Is there battery VDC applied to both these coils?	Approximately 12-14.5 VDC	Go to Step #10	Go to Step #5
5	• Key Off • Verify fuse 5 is not blown. Fuses are located in the operator's compartment below the instrument panel • Is the fuse blown?		Replace fuse and test main broom operation	Go to Step #6
6	• Key Off • Swap M2 relay with M1 horn relay. Relays are located in the operator's compartment below the instrument panel. • Key On, Engine On • Activate the 1-STEP sweep button • Does the main broom turn On?		Replace original M2 relay	Go to Step #7

Step	Action	Value(s)	Yes	No
7	• Key On, Engine On • Activate the 1-STEP sweep button • Wiggle test all wire harnesses to determine if main broom turns On • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #8
8	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #9
9	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
10	• Key Off • Disconnect SV8 and SV5 coils from wire harness • Swap location of SV8 and SV5 coils • Reconnect SV8 and SV5 coils to wire harness • Key On, Engine On • Activate the 1-STEP sweep button • Does the main broom turn On?		Replace original SV8 coil	Go to Step #11
11	• Key Off • Disconnect SV1 and SV4 coils from wire harness • Swap location of SV1 and SV4 coils • Reconnect SV1 and SV4 coils to wire harness • Key On, Engine On • Activate the 1-STEP sweep button • Does the main broom turn On?		Replace original SV1 coil	Go to Step #12

Step	Action	Value(s)	Yes	No
12	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Install hydraulic flow meter tool inline at port P1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speeds	Go to Step #13	Repair or replace hydraulic gear pump
13	• Key Off • Remove flow meter tool and reconnect hydraulic hose to port P1 • Disconnect hydraulic hose from port M1 on valve block • Install hydraulic flow meter tool inline at port M1 • Key On, Engine On-High Speed • Does the flow meter tool read at least 6.5 GPM on high engine speed?	1st section gear pump output = 7.2 GPM +/- 10% @ high engine speeds	Repair or replace hydraulic main brush motor	Go to Step #14
14	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go back to Step #1

DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
LCD = Liquid Crystal Display
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



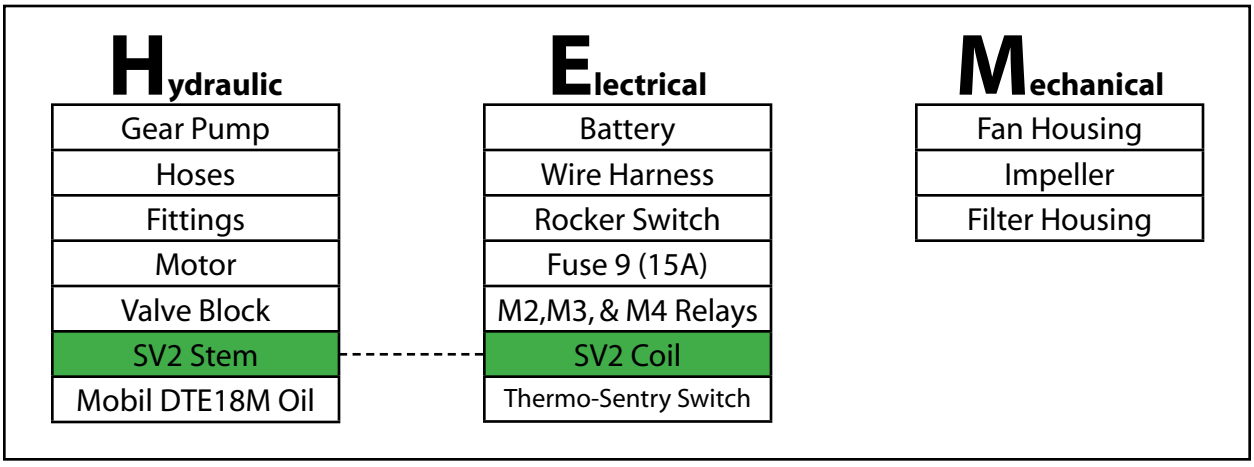
Electrical Schematic - Vacuum Fan Circuit (Shown On)

How does the vacuum fan work?

The dust control system utilizes a hydraulic vacuum fan motor that pulls air through a cylindrical dust filter. The vacuum fan impeller turns at approximately 5,000 rpm (normal sweeping) and 5,800 rpm (litter sweeping). The vacuum fan is activated by a rocker switch located on the control panel. The hopper must be completely lowered and the main broom must be activated in order to enable the vacuum fan electrical circuit. The vacuum fan turns Off if the Thermo-Sentry switch opens or detects a hopper thermal event (i.e. cigarette butt, hot ember, etc).

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the electrical system meets the hydraulic system or the SV2 coil meets the SV2 stem.



HEM Diagram

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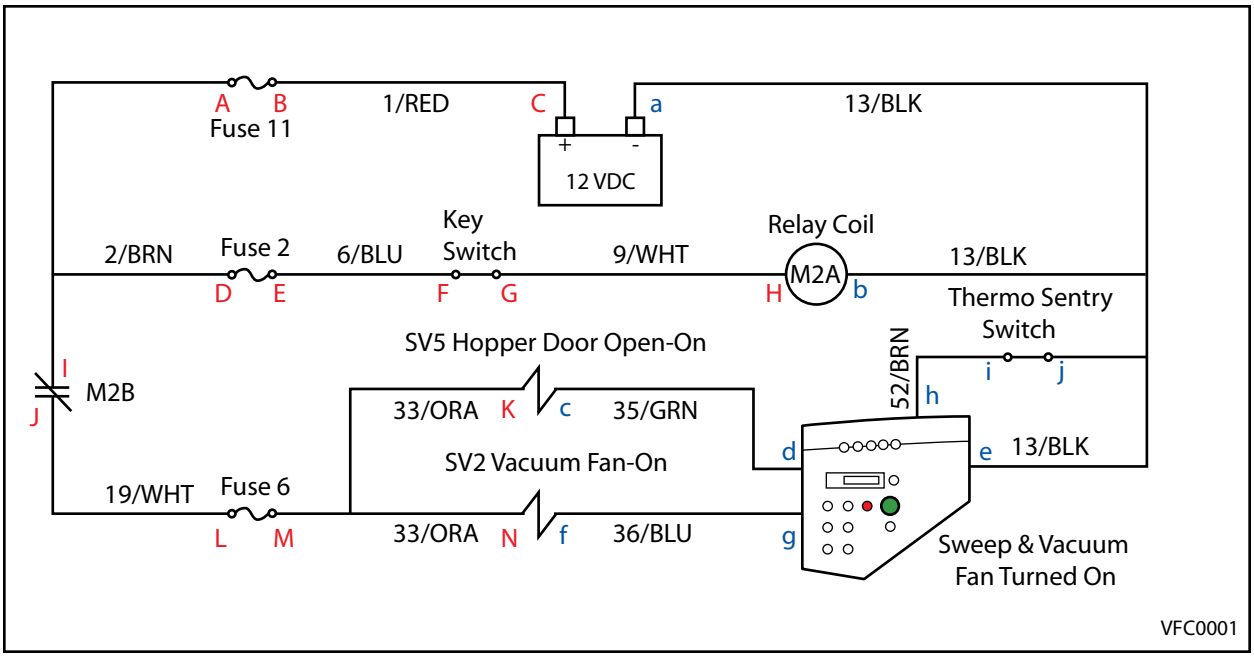
Step	Action	Value(s)	Yes	No
1	• Key On, Engine Off • Sweep/Vac Fan Turned On • Backprobe SV2 coil connection with DVOM in VDC mode (leave SV2 coil connected to wire harness) • Is there battery VDC applied to SV2 coil?	Approximately 12-14.5 VDC	Go to Step #2	Go to Step #3
2	• Key Off • Disconnect SV2 coil from wire harness • Test the resistance of SV2 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV2 coil resistance is 7.3 +/- 5% Ohms	Go to Step #12	Replace SV2 coil
3	• Verify fuse 9 is not blown. Fuses and relays are located in the fuse box in the operator's compartment • Is the fuse blown?		Replace fuse and test vacuum fan operation	Go to Step #4
4	• Key Off • Swap M2 relay with M1 horn relay • Key On, Engine On-Medium Speed • Main brush On • Press the vacuum fan on switch • Does the vacuum fan turn On?		Replace original M2 relay	Go to Step #5
5	• Key Off • Swap M3 relay with M1 horn relay • Key On, Engine On-Medium Speed • Main Brush On • Press the vacuum fan on switch • Does the vacuum fan turn On?		Replace original M3 relay	Go to Step #6
6	• Key Off • Swap M4 relay with M1 horn relay • Key On, Engine On-Medium Speed • Main Brush On • Press the vacuum fan On switch • Does the vacuum fan turn On?		Replace original M4 relay	Go to Step #7

Step	Action	Value(s)	Yes	No
7	• Key Off • Disconnect 52/BRN and 13/BLK wires from Thermo-Sentry switch in front of hopper • Insert a jumper wire between 52/BRN and 13/BLK wires • Key On, Engine On-Medium Speed • Main Brush On • Press the vacuum fan On switch • Does the vacuum fan turn On?		Replace hopper Thermo-Sentry switch	Go to Step #8
8	• Key Off • Disconnect vacuum fan rocker switch from wire harness. • Disconnect hopper raise/lower rocker switch from the wire harness. • Swap locations of switches • Key On, Engine On-Medium Speed • Main Brush On • Press and hold the momentary switch in the On position • Does the vacuum fan turn On?		Replace original vacuum fan rocker switch	Go to Step #9
9	• Reinstall rocker switches to factory positions • Key On, Engine On-Medium Speed • Main brush On • Press the vacuum fan On switch • Wiggle test all wire harnesses to determine if the vacuum fan turns On • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #10
10	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
12	• Key Off • Disconnect SV2 and SV4 coils from wire harness • Swap location of SV2 and SV4 coils • Reconnect SV2 and SV4 coils to wire harness • Key On, Engine On-Low Speed • Main Brush On • Press the vacuum fan On switch • Does the vacuum fan turn On?		Replace original SV2 valve stem	Go to Step #13
13	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline at port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #14	Repair or replace hydraulic gear pump

Step	Action	Value(s)	Yes	No
14	• Key Off • Disconnect the hydraulic hose from vacuum fan motor inlet • Insert hydraulic flow meter tool inline at vacuum fan motor inlet • Key On, Engine On-Medium Speed • Main brush On • Vacuum fan switch On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace vacuum fan motor	Go to Step #15
15	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go Back to Step #1

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute



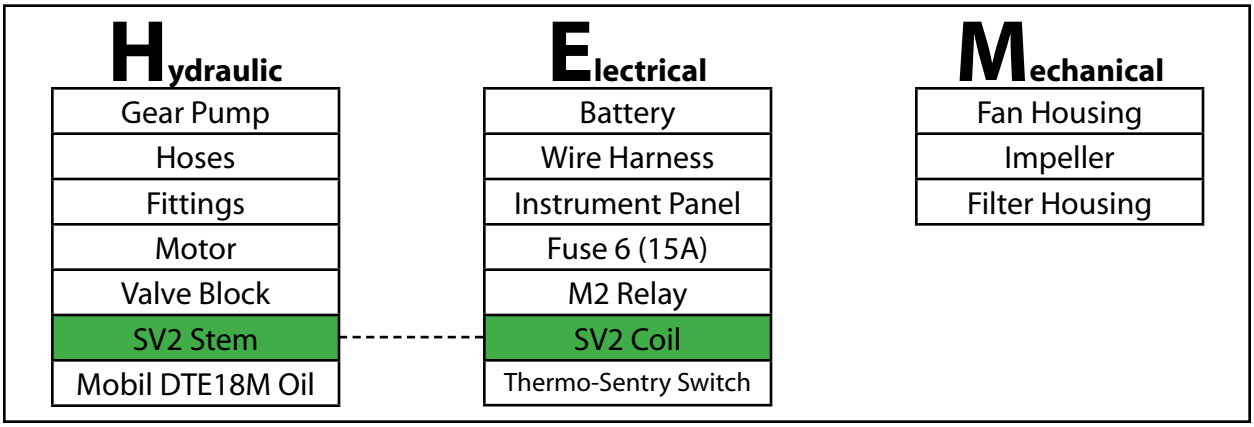
Electrical Schematic - Vacuum Fan Circuit (Shown On)

How does the vacuum fan work?

The dust control system utilizes a hydraulic vacuum fan motor that pulls air through a cylindrical dust filter. The vacuum fan impeller turns at approximately 5,000 rpm (normal sweeping) and 5,800 rpm (litter sweeping). SV2 energizes when the 1-STEP Sweep and vacuum fan buttons are activated. The vacuum fan turns Off if the Thermo-Sentry switch detects a hopper thermal event (i.e. cigarette butt, hot ember, etc).

Where do I start testing?

The major components are outlined in the HEM diagram below. Begin testing where the electrical system meets the hydraulic system or the SV2 coil meets the SV2 stem.



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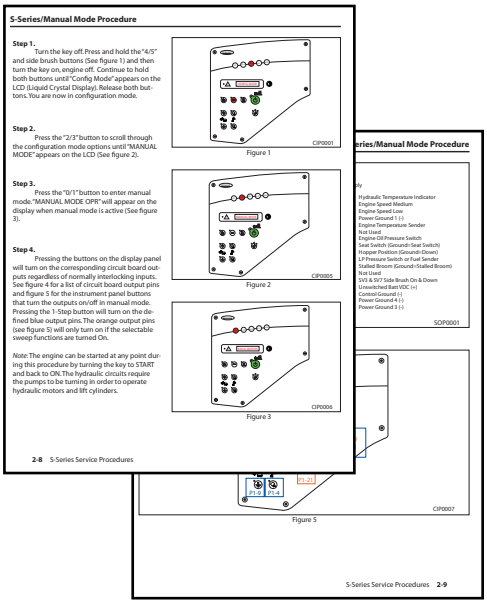
Step	Action	Value(s)	Yes	No
1	• Key Off • See "Self-Test Procedure" • Does circuit board pin "P1-10" display as "open" or "shorted" on the LCD?	See "Self-Test Procedure"	Go to Step #2	Go to Step #8
2	• Key Off • Disconnect SV2 coil from wire harness • Test the resistance of SV2 coil with DVOM in Ohm test mode • Does DVOM display 6.9-7.7 Ohms?	SV2 coil resistance is 7.3 +/- 5% Ohms	Go to Step #3	Replace SV2 coil
3	• Verify fuse 6 is not blown. Fuses and relays are located in the fuse box in the operator's compartment • Is the fuse blown?		Replace fuse and test vacuum fan operation	Go to Step #4
4	• Key Off • Swap M2 relay with M1 horn relay • Key On, Engine On-Medium Speed • 1-STEP Sweep On • Vacuum fan On • Does the vacuum fan turn On?		Replace original M2 relay	Go to Step #5
5	• Key On, Engine On-Medium Speed • 1-STEP Sweep On • Wiggle test all wire harnesses to determine if the vacuum fan turns On • Inspect all electrical connections for damage, corrosion, contamination or pin problems • Do any of the above conditions exist?		Repair or replace wire harness(es)	Go to Step #6
6	• Place one DVOM probe on battery (-) • Place other DVOM probe on each UPPERCASE red alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go to Step #7

Step	Action	Value(s)	Yes	No
7	• Place one DVOM probe on battery (+) • Place other DVOM probe on each lowercase blue alpha point as shown on the electrical schematic (see previous page) • Backprobe each test point. All components must remain connected during this test. • Is there any point where the voltage is more than 1 volt below battery voltage?	Approximately 12-14.5 VDC (See "Alpha Point Voltage Drop Testing" Procedure)	Repair or replace the wire segment outside of the harness loom	Go back to Step #1
8	• Key Off • Disconnect SV2 and SV4 coils from wire harness • Swap location of SV2 and SV4 coils • Reconnect SV2 and SV4 coils to wire harness • Key On, Engine On-Low Speed • 1-STEP Sweep On • Vacuum fan On • Does the vacuum fan turn On?		Replace original SV2 valve coil	Go to Step #9
9	• Key Off • Disconnect the hydraulic hose from port P1 on valve block • Insert hydraulic flow meter tool inline between port P1 and the hydraulic hose that connects to port P1 • Key On, Engine On-Medium Speed • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Go to Step #10	Repair or replace hydraulic gear pump
10	• Key Off • Disconnect the hydraulic hose from vacuum fan motor inlet • Insert hydraulic flow meter tool inline between motor inlet hose and motor • Key On, Engine On-Medium Speed • Main brush On • Vacuum Fan LED On • Does the flow meter tool read greater than 5.4 GPM on medium engine speed and greater than 6.5 GPM on high engine speed?	1st section gear pump output = 6 GPM and 7.2 GPM +/- 10% @ medium and high engine speeds	Repair or replace vacuum fan motor	Go to Step #11

Step	Action	Value(s)	Yes	No
11	• Key Off • Remove all valve stems, relief valves, orifices, and check valves from valve block and inspect for missing O-rings, damage, metal shavings, cracked block, etc. • Do any of the above conditions exist?		Replace faulty valve block component or entire valve block assembly	Go Back to Step #1

Terms:
DVOM = Digital Volt/Ohm Meter
VDC = DC Voltage
LCD = Liquid Crystal Display
LED = Light Emitting Diodes
Backprobe = To probe along the wire into the back of a connector without opening the connection. The DVOM probe must contact the terminal inside the connector body when this is done.
GPM = Gallons per Minute

2 S30 Service Procedures


S-Series/Manual Mode Procedure

Step 1.
Turn the key off. Press and hold the "4/5" and side brush buttons (See figure 1) and then turn the key on, engine off. Continue to hold both buttons until "Config Mode" appears on the LCD (Liquid Crystal Display). Release both buttons. You are now in configuration mode.

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "MANUAL MODE" appears on the LCD (See figure 2).

Step 3.
Press the "0/1" button to enter manual mode. "MANUAL MODE OPR" will appear on the display when manual mode is active (See figure 3).

Step 4.
Pressing the buttons on the display panel will turn on the corresponding circuit board outputs regardless of normally interlocking inputs. See figure 4 for a list of circuit board output pins and figure 5 for the instrument panel buttons that turn the outputs on/off in manual mode. Pressing the 1-Step button will turn on the defined blue output pins. The orange output pins (see figure 5) will only turn on if the selectable sweep functions are turned On.

Note: The engine can be started at any point during this procedure by turning the key to START and back to ON. The hydraulic circuits require the pumps to be turning in order to operate hydraulic motors and lift cylinders.

Figure 1
CIP0001

Figure 2
CIP0005

Figure 3
CIP0006

2-8 S-Series Service Procedures

eries/Manual Mode Procedure

Hydraulic Temperature Indicator
Engine Speed Medium
Engine Speed Low
Power Ground 1 (-)
Engine Temperature Sender
Not Used
Engine Oil Pressure Switch
Seat Switch (Ground=Seat Switch)
Hopper Position (Ground=Down)
LP Pressure Switch or Fuel Sender
Stalled Broom (Ground=Stalled Broom)
Not Used
5V1 & 5V7 Side Brush On & Down
Unswitched Batt VDC (+)
Control Ground (-)
Power Ground 4 (-)
Power Ground 3 (-)

SOP0001

Figure 5
CIP0007

S-Series Service Procedures 2-9

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key On, Engine Off. Place the DVOM (Digital Volt Ohm Meter) probes on the battery positive and negative terminals in VDC mode (See figure 1).

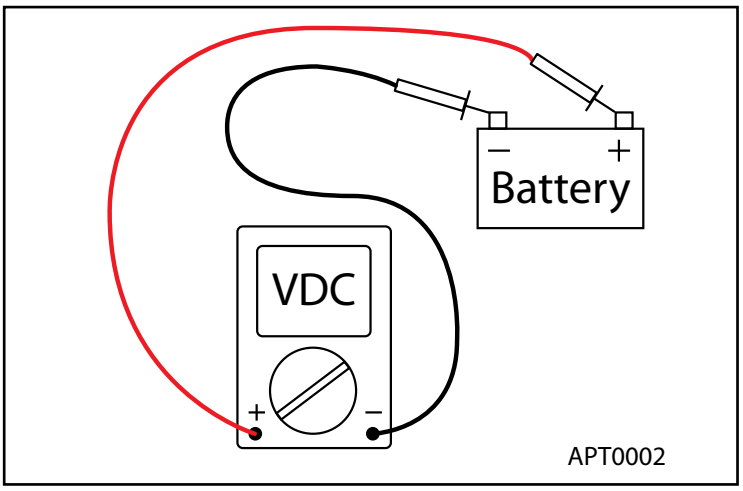


Figure 1

Step 2.
Print a copy of the "Alpha Point Voltage Drop Testing Worksheet" (See figure 4). Record the battery voltage value as displayed on DVOM into the "Battery Voltage" box of the "Alpha Point Voltage Drop Testing worksheet" (See figure 2).

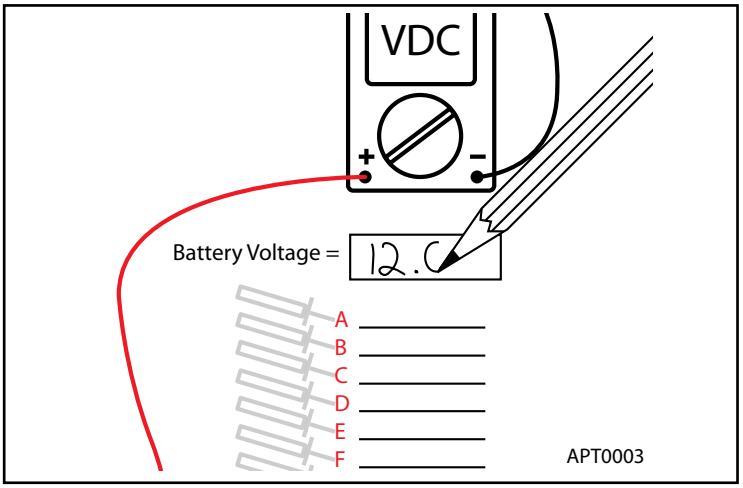


Figure 2

Step 3.
Fill in all of the alpha point test values on the worksheet (See figure 3). The alpha point test locations are shown on the individual electrical schematics in the troubleshooting section. The electrical schematics identify control conditions, wire numbers/colors, and components.

After completing the worksheet, look for any alpha test point value that is more than 1 volt below battery voltage. For example, if the actual battery voltage is 12.6, look for a number that is less than 11.6 volts. If there is an excessive voltage drop, repair or replace the wire segment as needed.

Note: When repairing damaged wires, use solder, shrink tubing, and the same size/type wire.

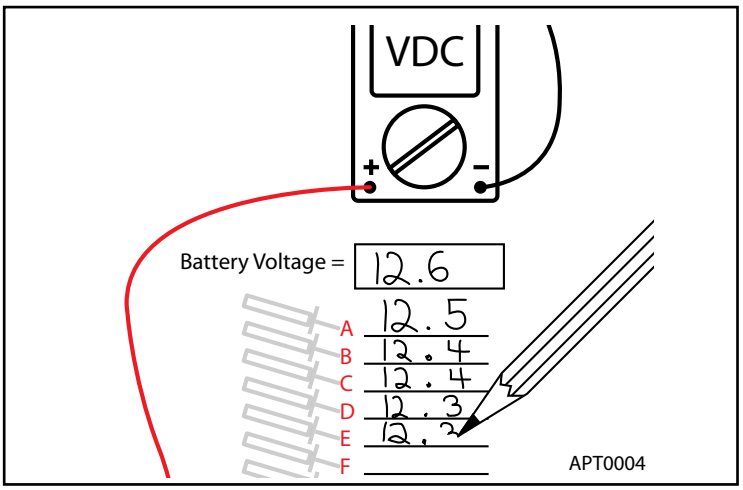
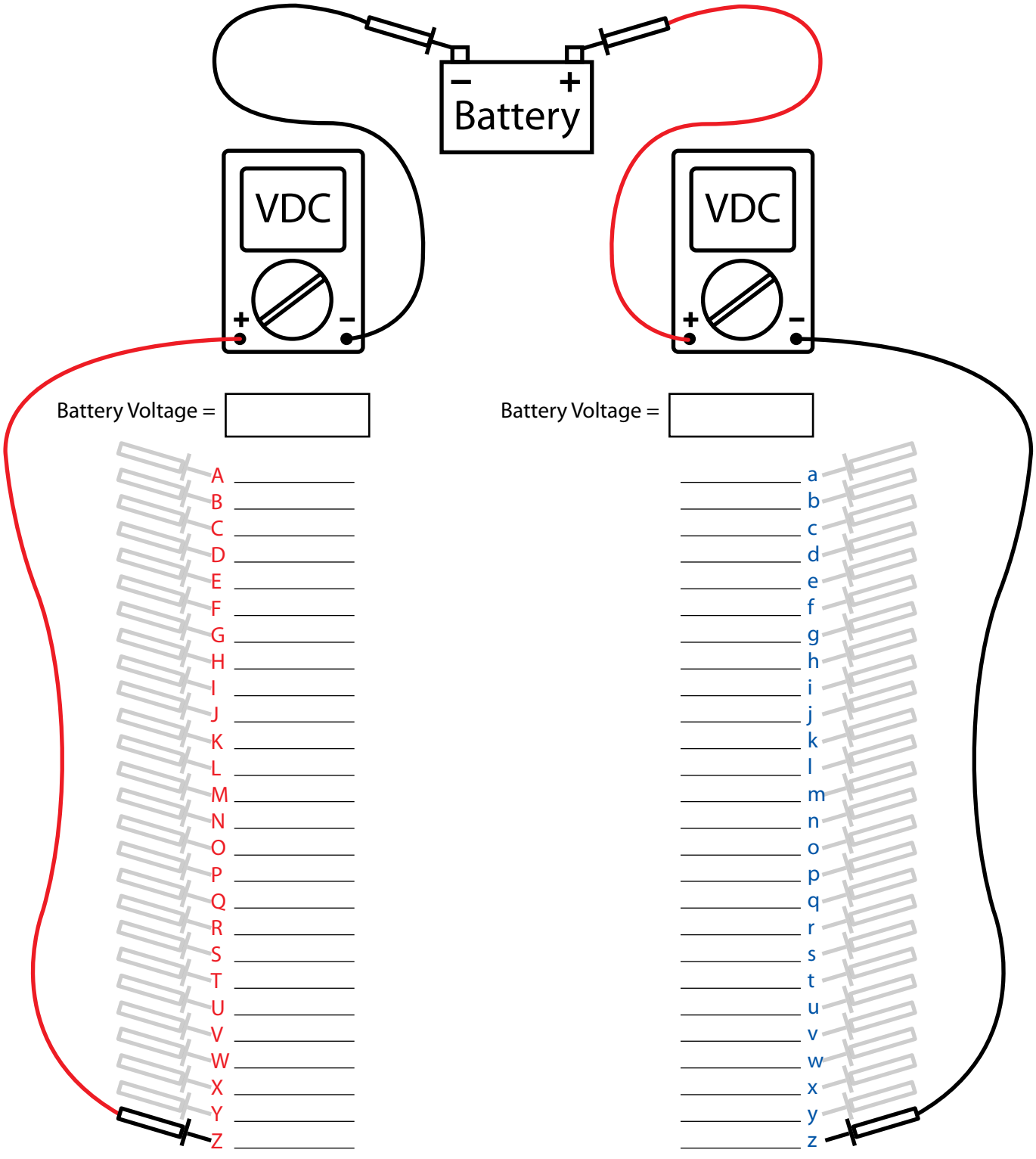


Figure 3

Alpha Point Voltage Drop Testing Worksheet



Is there any point where the voltage is more than 1 volt below battery voltage?

APT0001

Figure 4

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key Off. Locate the diagnostic communication port (DCP) connector on the engine harness.

The Tier II DCP connector is located next to the valve cover on top of the engine (see figure 1). The DCP connector is an 8 terminal white connector. Remove the plastic dust cap to expose the terminals.

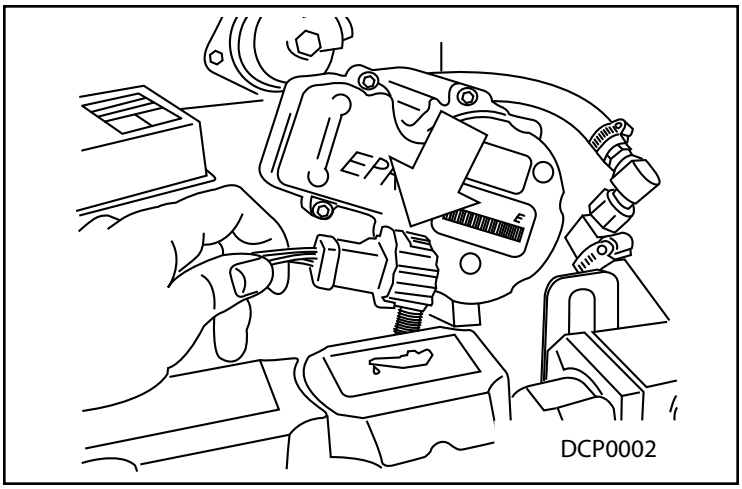


Figure 1

Step 2.
Insert a jumper wire between terminals "1" and "4" on the Tier II DCP connector (see figure 2).

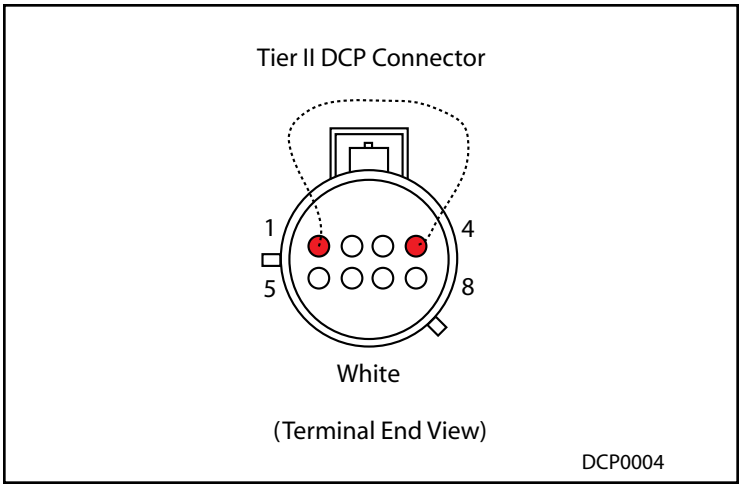


Figure 2

Step 3.
Turn the key On, engine Off and observe the MIL (Malfunction Indicator Lamp) on the instrument panel (See figure 3). Tier II engines blink (3) 3 or 4 digit codes beginning with 1654. The 1654 code indicates ECM diagnostic routines are functioning properly. Any codes present in addition to 1654 are actual DTCs that require further investigation. Write down all DTCs before clearing DTCs.

Note: DTCs will blink the MIL On/Off. For example, (one blink) short pause (six successive blinks) short pause (five successive blinks) short pause (4 successive blinks) long pause, indicates a "1654."

Note: To clear historic DTCs: Tier II systems Can only be cleared using the E-controls DST (Diagnostic Scan Tool).

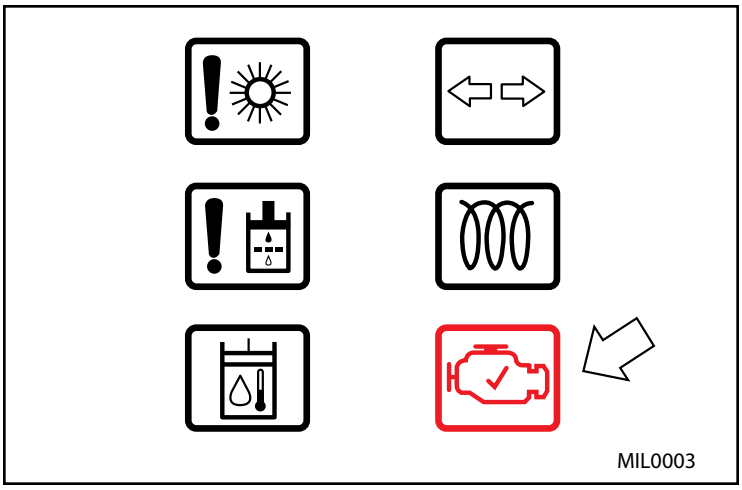


Figure 3

Step 4.
Find all Tier II DTC's in figure 4. For in-depth DTC troubleshooting procedures, refer to the *GM 1.6L Engine Emission Control Service Manual*.

Note: Tier II GM 1.6L *Engine Emission Control Service Manual* (CD-ROM Version Only) p/n 9003926

Tier II Diagnostic Trouble Codes (DTCs)

16-Crank Not Synced @ Start
91-Fuel Pressure Sensor VDC Low
92-Fuel Pressure Sensor VDC High
107-MAP VDC Low
108-BP High Pressure
111-IAT Higher Than Expected 1
112-IAT Low VDC-SPN/FMI
113-IAT High VDC-SPN/FMI
116-ECT Higher Than Expected 1
117-ECT Low VDC-SPN/FMI
118-ECT High VDC-SPN/FMI
121-TPS 1 Lower Than TPS 2
122-TPS 1 Signal Low VDC
123-TPS 1 Signal High VDC
127-IAT Higher Than Expected 2
129-BP Low Pressure
134-EGO 1 Open/Inactive
154-EGO 2 Open/Inactive
171-Adaptive Learn High (Gasoline)
172-Adaptive Learn Low (Gasoline)
182-Gasoline Temperature VDC Low
183-Gasoline Temperature VDC High
187-LPG Fuel Temp VDC Low
188-LPG Fuel Temp VDC High
217-ECT Higher Than Expected 2
219-Max Govern Speed Override
221-TPS 1 Higher Than TPS 2
222-TPS 2 Signal VDC Low
223-TPS 2 Signal VDC High
336-Crank Sync Noise
337-Crank Loss
420-Gasoline Catalyst Monitor
524-Oil Pressure Low
562-System VDC Low
563-System VDC High
601-Flash Checksum Invalid
604-RAM Failure
606-COP Failure
642-External 5 VDC Reference Low
643-External 5 VDC Reference High
685-Power Relay On
686-Power Relay Shorted
687-Power Relay Short To Power
1111-Fuel Rev Limit
1112-Spark Rev Limit
1151-Closed Loop Multiplier High LPG
1152-Closed Loop Multiplier Low LPG
1155-Closed Loop Multiplier High Gas
1156-Closed Loop Multiplier Low Gas
1161-Adaptive Learn High LPG
1162-Adaptive Learn Low LPG
1165-LPG Catalyst Monitor
1171-LPG Pressure Higher Than Expected
1172-LPG Pressure Lower Than Expected
1173-EPR Comm Lost
1174-EPR VDC Supply High
1175-EPR VDC Supply Low
1176-EPR Internal Actuator Fault
1177-EPR Internal Circuitry Fault
1178-EPR Internal Comm Fault
1612-RTI 1 Loss
1613-RTI 2 Loss
1614-RTI 3 Loss
1615-A/D Loss
1616-Invalid Interrupt
1626-CAN Tx Failure
1627-CAN Rx Failure
1628-CAN Address Conflict Failure
2111-Unable to Reach Lower TPS
2112-Unable to Reach Higher TPS
2229-BP High Pressure

DTC0002

Figure 4

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key Off. Press and hold the "4/5" and side brush buttons (see figure 1) and then turn the key On, engine Off. Continue to hold both buttons until "Config Mode" appears on the LCD (Liquid Crystal Display). Release both buttons.

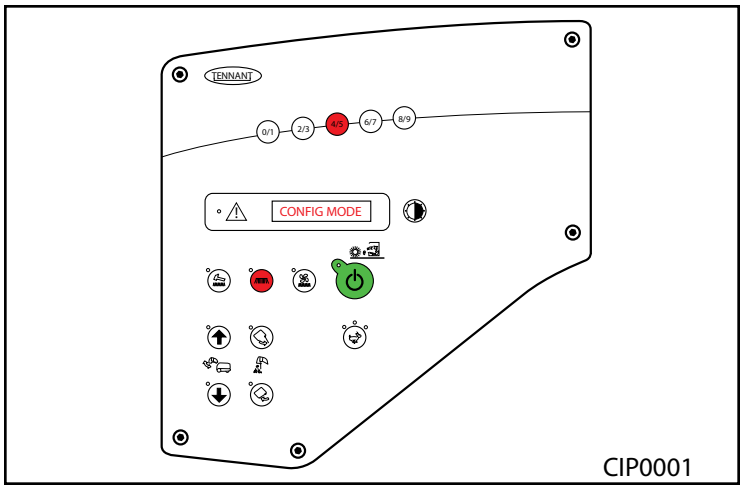


Figure 1

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "INPUT MODE" appears on the LCD (see figure 2).

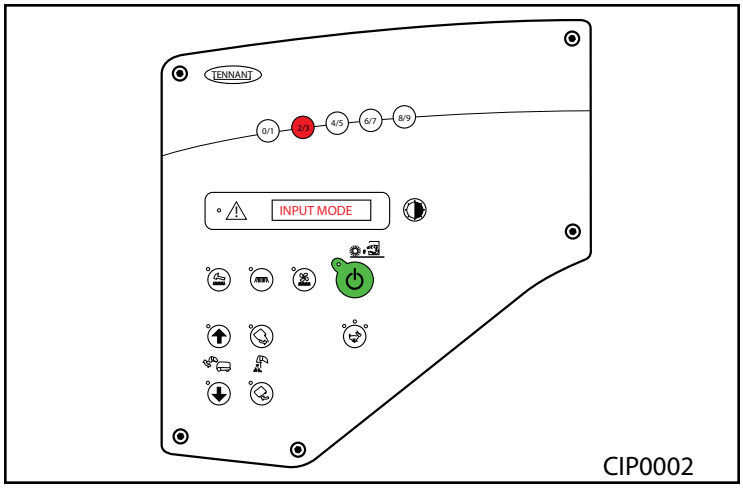


Figure 2

Step 3.
Press the "0/1" button to enter input mode. "INPUT MODE OPR" will appear on the display (see figure 3).

Step 4.
The purpose of input mode is to use instrument panel LEDs as visual indicators of switch and sensor input conditions.

Figure 4 identifies circuit board input pins. Not all inputs listed activate LEDs. See figure 5 for corresponding LEDs on the instrument panel assembly.

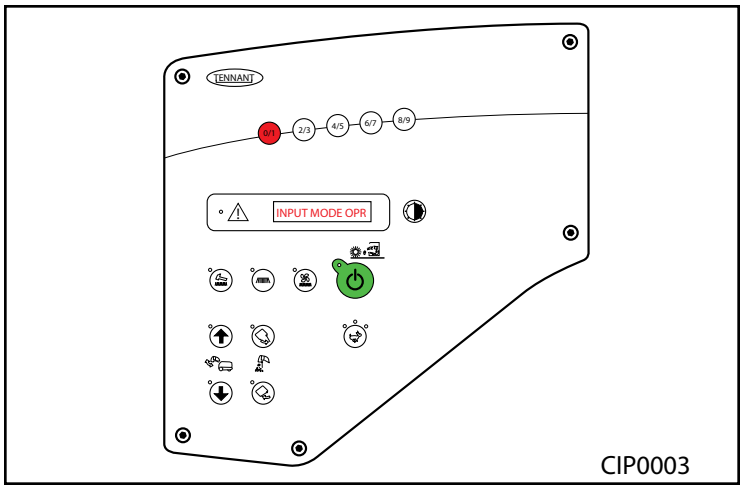


Figure 3

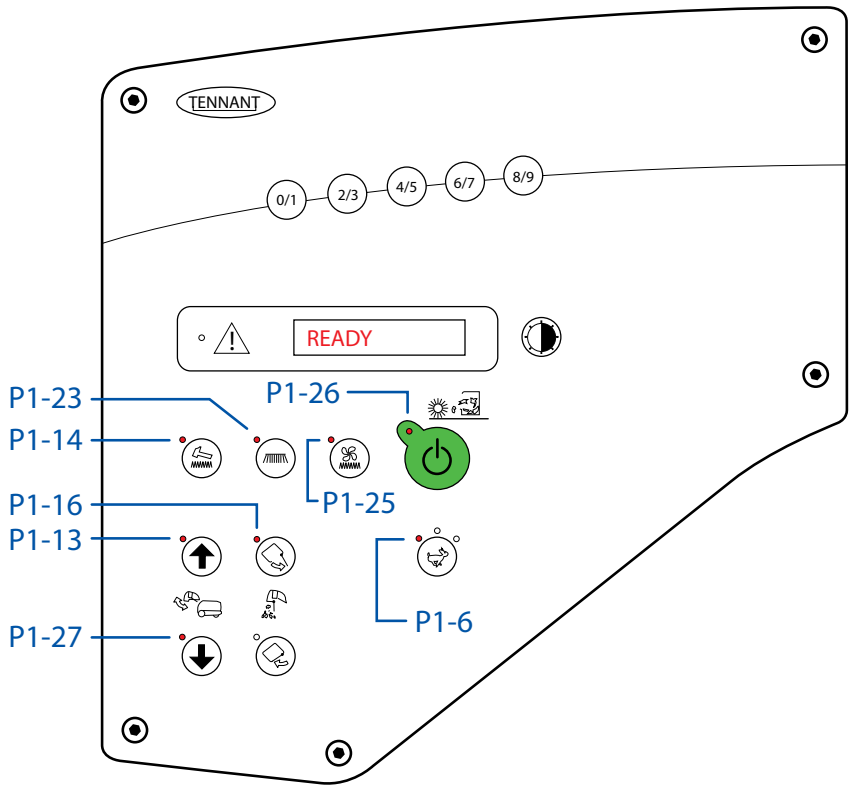
S30 Controller Pins

■ = Inputs ■ = Outputs ■ = Power Supply

P1-1	Chassis Ground (-)	P1-19	Hydraulic Temperature Indicator
P1-2	Switched Batt VDC (+)	P1-20	Engine Speed Medium
P1-3	Switched Batt VDC (+)	P1-21	Engine Speed Low
P1-4	SV4 Enable Valve	P1-22	Power Ground 1 (-)
P1-5	SV1 & SV8 Main Brush On & Down	P1-23	Engine Temperature Sender
P1-6	Hydraulic Oil Temperature	P1-24	Not Used
P1-7	SV5 Hopper Door Open	P1-25	Engine Oil Pressure Switch
P1-8	SV6A Hopper Up	P1-26	Seat Switch (Ground=Seat Switch Disabled)
P1-9	SV6B Hopper Down	P1-27	Hopper Position (Ground=Down)
P1-10	SV2 Vacuum Fan	P1-28	LP Pressure Switch or Fuel Sender
P1-11	M3 Shaker Relay	P1-29	Stalled Broom (Ground=Stalled Broom)
P1-12	Not Used	P1-30	Not Used
P1-13	Hopper Thermo Sentry	P1-31	SV3 & SV7 Side Brush On & Down
P1-14	Clogged Dust Filter (Ground=Clogged)	P1-32	Unswitched Batt VDC (+)
P1-15	Hydraulic High Pressure Switch	P1-33	Control Ground (-)
P1-16	Alternator Charge Indicator	P1-34	Power Ground 4 (-)
P1-17	Not Used	P1-35	Power Ground 3 (-)
P1-18	Not Used		

SOP0001

Figure 4



CIP0004

Figure 5

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key off. Press and hold the "4/5" and side brush buttons (See figure 1) and then turn the key on, engine off. Continue to hold both buttons until "Config Mode" appears on the LCD (Liquid Crystal Display). Release both buttons.

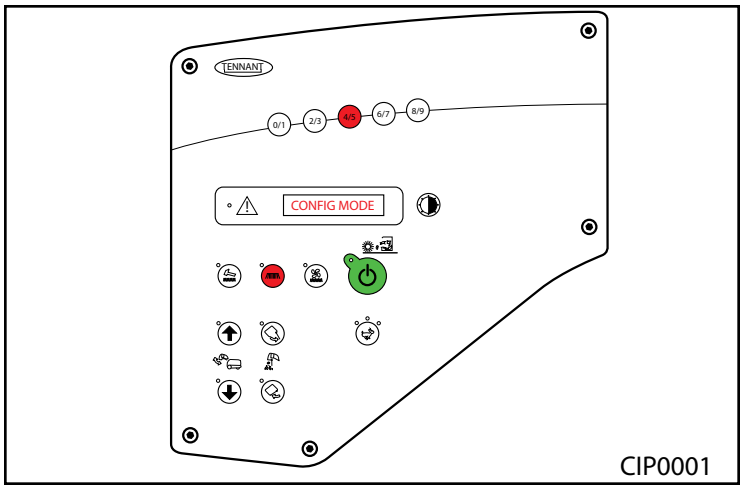


Figure 1

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "LED BRIGHTNESS" appears on the LCD (See figure 2).

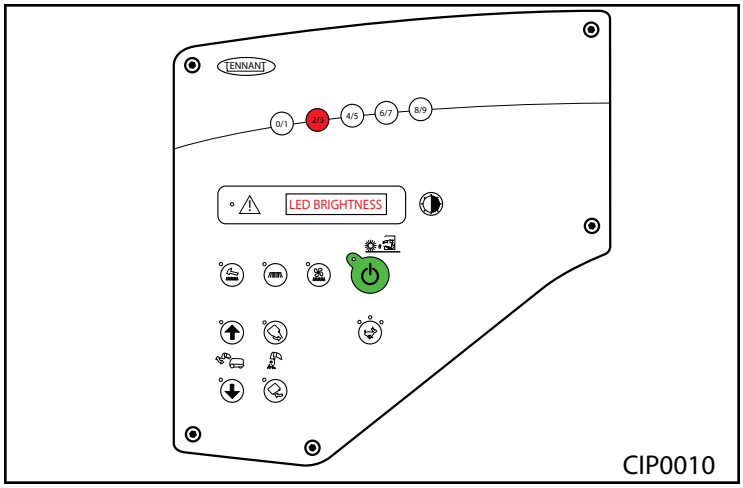


Figure 2

Step 3.
Press the "0/1" button to enter "LED BRIGHTNESS" mode. "LED BRIGHTNESS" will remain on the LCD (See figure 3).

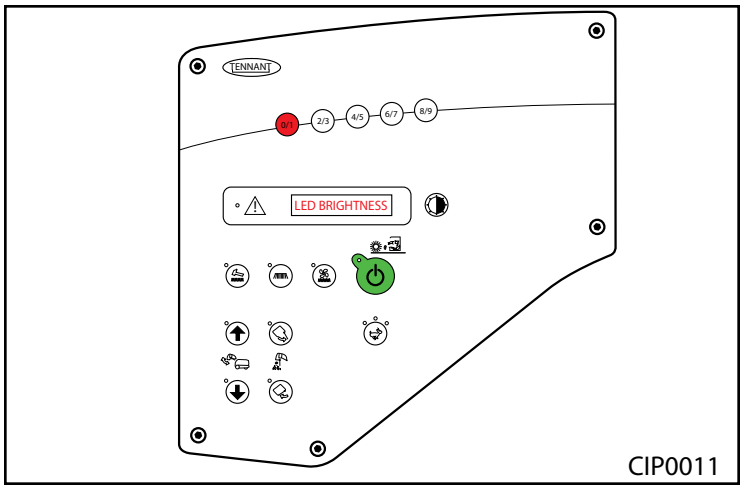


Figure 3

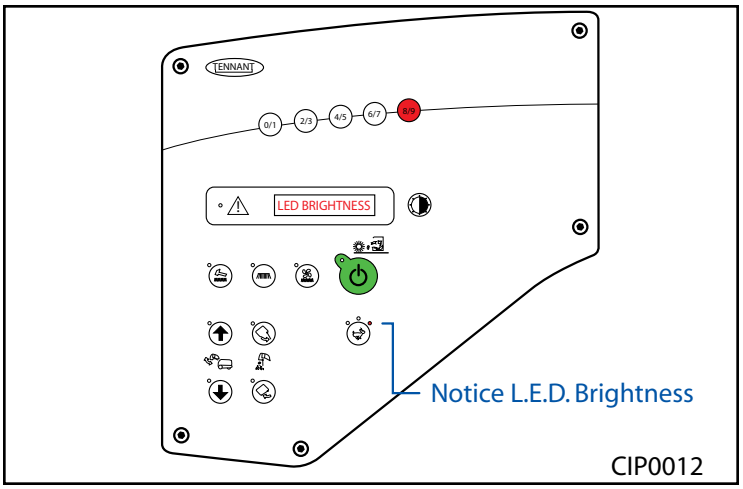


Figure 4

Step 4.
Press and hold the "8/9" button once to make the engine high speed LED brighter. Press and hold the "8/9" button a second time to make the engine high speed LED dimmer. Turn the key off to save the setting.

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key off. Press and hold the "4/5" and side brush buttons (see figure 1) and then turn the key on, engine off. Continue to hold both buttons until "Config Mode" appears on the LCD (Liquid Crystal Display). Release both buttons.

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "MANUAL MODE" appears on the LCD (See figure 2).

Step 3.
Press the "0/1" button to enter manual mode. "MANUAL MODE OPR" will appear on the display (see figure 3).

Step 4.
Pressing the buttons on the display panel will activate the corresponding circuit board outputs regardless of normally interlocking inputs. See figure 4 for a list of circuit board output pins and figure 5 for the instrument panel buttons that control those outputs in manual mode. Pressing the 1-STEP button will activate the defined blue output pins. The orange output pins turn On only if the other non 1-STEP buttons are activated.

Note: The engine can be started at any point during this procedure by turning the key to START and back to On. Any hydraulic circuits need the engine On to operate.

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

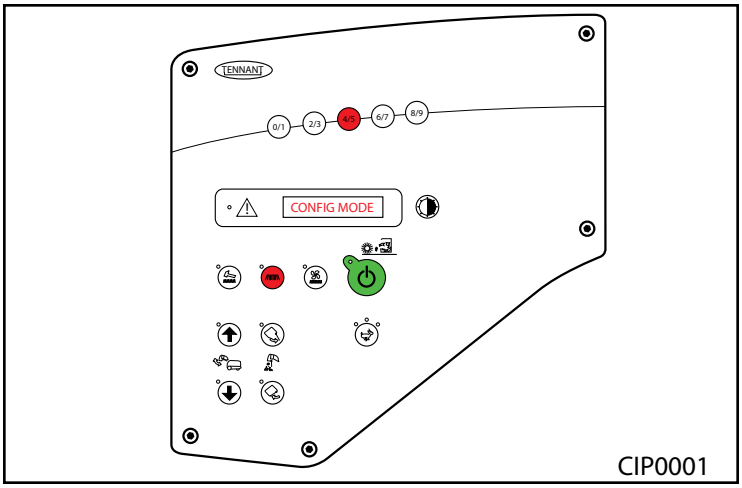


Figure 1

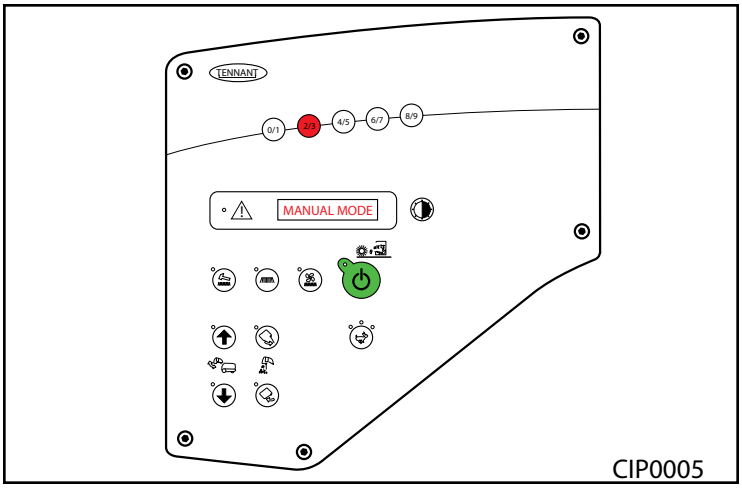


Figure 2

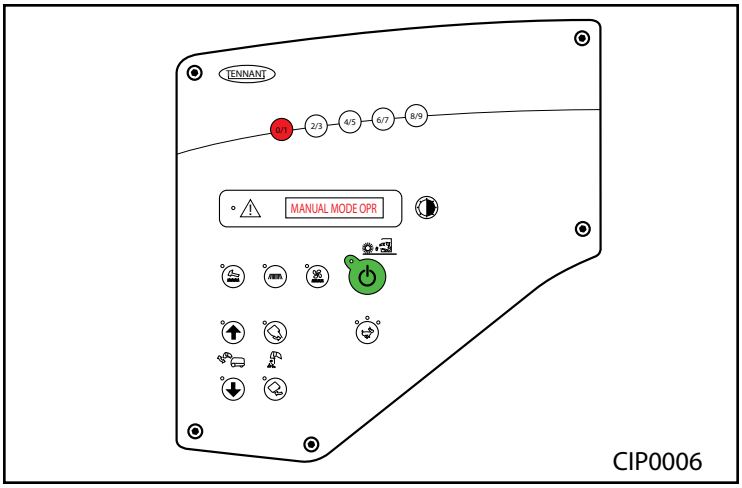


Figure 3

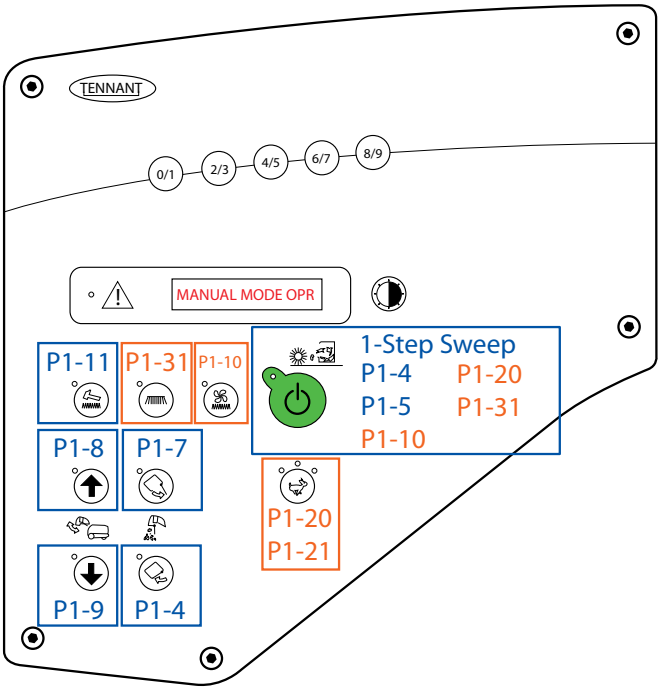
S30 Controller Pins

= Inputs = Outputs = Power Supply

P1-1	Chassis Ground (-)	
P1-2	Switched Batt VDC (+)	
P1-3	Switched Batt VDC (+)	
P1-4	SV4 Enable Valve	
P1-5	SV1 & SV8 Main Brush On & Down	
P1-6	Hydraulic Oil Temperature	
P1-7	SV5 Hopper Door Open	
P1-8	SV6A Hopper Up	
P1-9	SV6B Hopper Down	
P1-10	SV2 Vacuum Fan	
P1-11	M3 Shaker Relay	
P1-12	Not Used	
P1-13	Hopper Thermo Sentry	
P1-14	Clogged Dust Filter (Ground=Clogged)	
P1-15	Hydraulic High Pressure Switch	
P1-16	Alternator Charge Indicator	
P1-17	Not Used	
P1-18	Not Used	
P1-19	Hydraulic Temperature Indicator	
P1-20	Engine Speed Medium	
P1-21	Engine Speed Low	
P1-22	Power Ground 1 (-)	
P1-23	Engine Temperature Sender	
P1-24	Not Used	
P1-25	Engine Oil Pressure Switch	
P1-26	Seat Switch (Ground=Seat Switch Disabled)	
P1-27	Hopper Position (Ground=Down)	
P1-28	LP Pressure Switch or Fuel Sender	
P1-29	Stalled Broom (Ground=Stalled Broom)	
P1-30	Not Used	
P1-31	SV3 & SV7 Side Brush On & Down	
P1-32	Unswitched Batt VDC (+)	
P1-33	Control Ground (-)	
P1-34	Power Ground 4 (-)	
P1-35	Power Ground 3 (-)	

SOP0001

Figure 4



CIP0007

Figure 5

S30/ Propel Cable Adjustment Procedure

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

FOR SAFETY: When servicing machine, block machine tires before jacking machine up. Jack machine up at designated locations only. Support machines with jack stands.

Step 1.
Turn the key off and set parking brake. Jack the rear of the machine up and place on two jack stands (see figure 1). Be sure the rear wheel is off the ground.

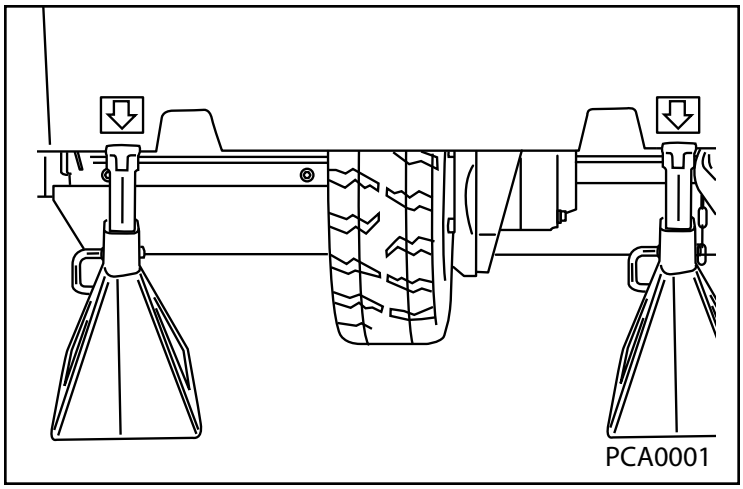


Figure 1

Step 2.
Turn the key On, engine On. Raise the hopper completely up and engage hopper safety support arm (see figure 2). Turn the key Off.

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

WARNING: Raised hopper may fall. Engage hopper support pin.

WARNING: Lift arm pinch point. Stay clear of hopper lift arms.

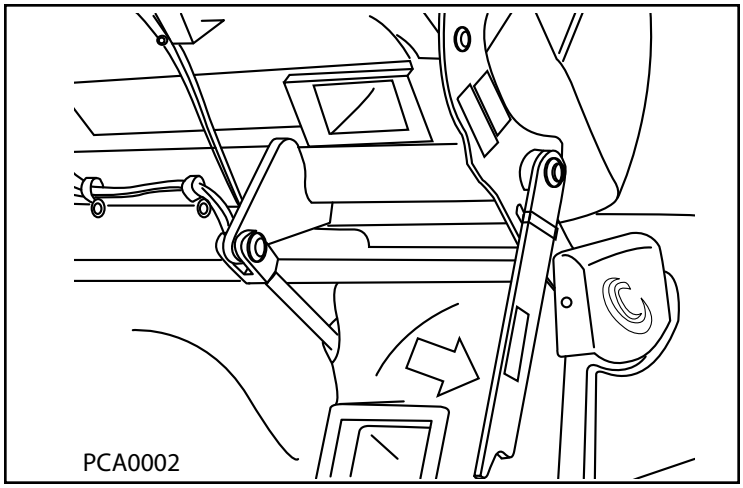


Figure 2

Step 3. (New cable installation only!)
Skip this step if adjusting an existing propel cable! The initial cable settings are shown in figure 3. Both rod-ends and cable mounting locations are identified.

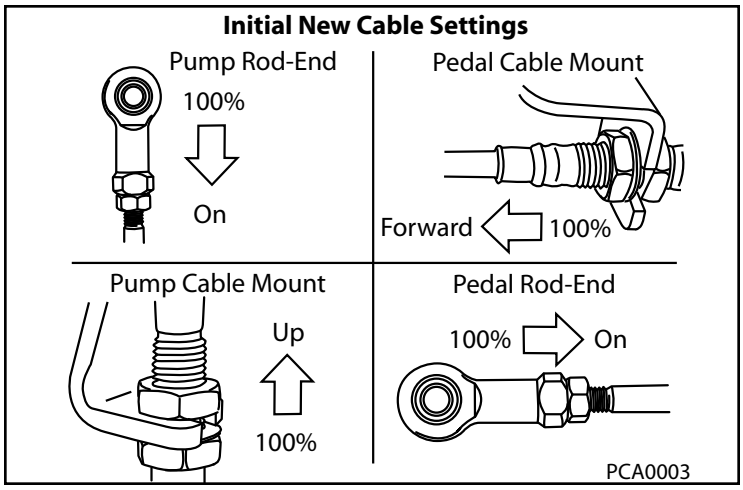


Figure 3

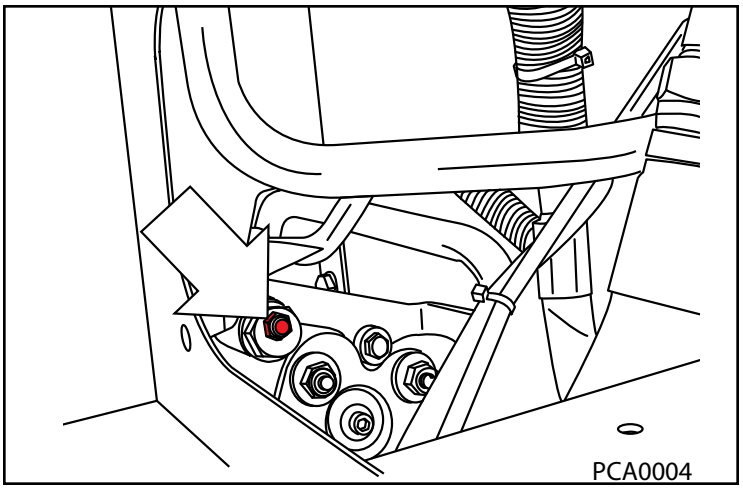


Figure 4

Step 4.
Remove the 4 nuts fastening the operator's seat to the seat plate. Remove the seat and set aside. Remove the 4 access panel bolts on LH side of operator's compartment (next to seat) and set access panel aside.

Loosen the locking nut on the propel creep adjustment cam. (see figure 4).

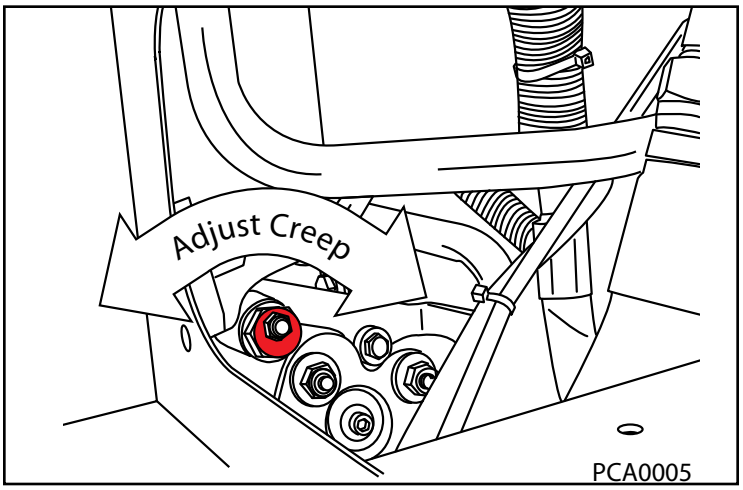


Figure 5

Step 5.
Start the engine and rotate the cam clockwise or counter-clockwise until the rear wheel stops turning (pedal in the neutral position). Tighten the locking nut on the propel creep adjustment cam (see figure 4).

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

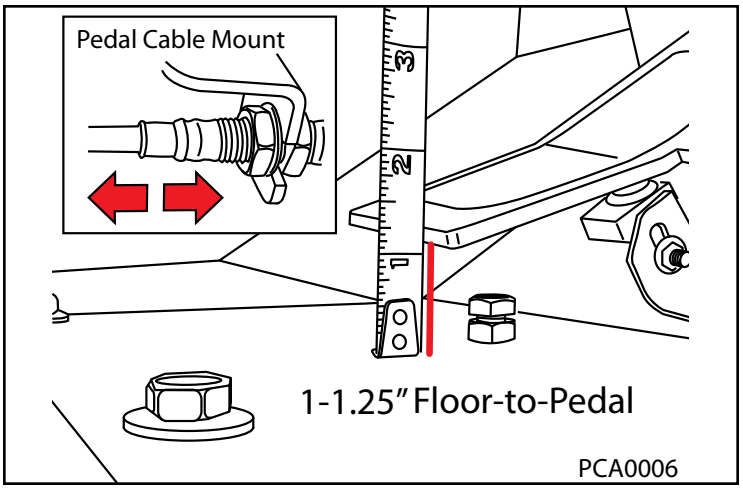


Figure 6

Step 6.
Loosen the front pedal cable mounting nuts (see figure 6) and adjust the front cable mount so the lower end of the propel pedal is 1-1.25 inches from the floor of the operator's compartment (see figure 6). Tighten the front cable mounting nuts.

Step 7.
Place a piece of reflective tape on the side of the rear drive tire (see figure 8). A photo tachometer is required to test the speed of the rear drive tire.

Start the engine and activate the sweep system for approximately 5-10 minutes to allow the hydraulic fluid to reach operating temperature.

Press the propel pedal down in the reverse direction until it touches the reverse stop bolt. Adjust the stop bolt (see figure 7) so the maximum reverse speed is *3 mph* or *54-60 rpm* on the rear drive wheel. Use the photo tachometer to measure the rear tire speed (see figure 8). Tighten the adjustment bolt when the specified speed is achieved.

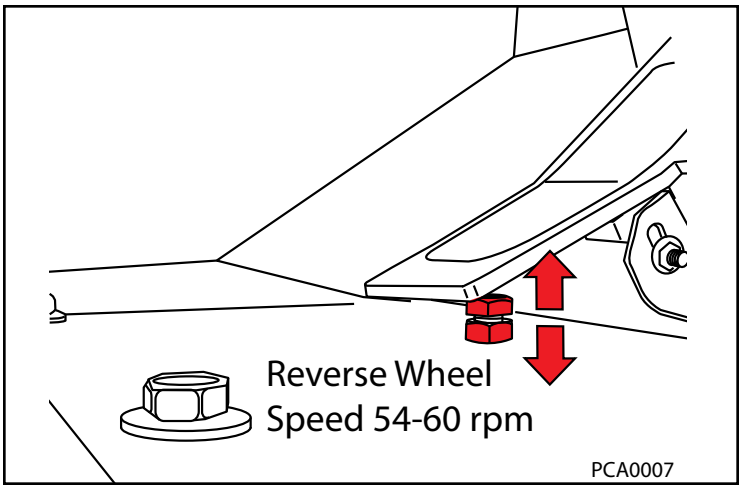


Figure 7

TOOLS:
- Photo Tachometer-Item #163931
- Available at www.northerntool.com

Step 8.
The hopper raised-forward speed adjustment can now be made. *The maximum hopper raised-forward speed is 3 mph or 54-60 rpm* on the rear drive wheel. Press the propel pedal completely forward (hopper raised) and test the rear wheel speed using a photo tachometer.

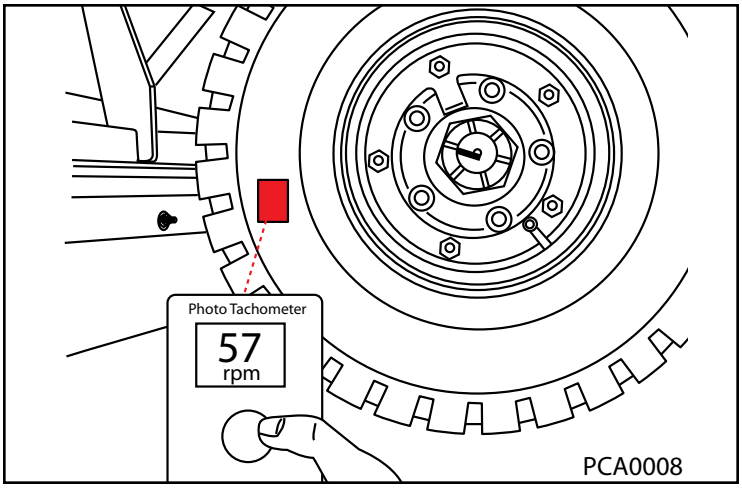


Figure 8

Step 9.
To adjust the hopper raised-forward speed, loosen the hopper push/pull cable (*not the propel cable*) mounting nuts (see figure 9). Increase the cable length to decrease hopper raised-forward speed and decrease the cable length to increase hopper raised-forward speed. *The maximum hopper raised-forward speed is 3 mph or 54-60 rpm.* Use a photo tachometer to check the speed (see figure 8). Tighten the push/pull cable mounting nuts when the specified speed is achieved.

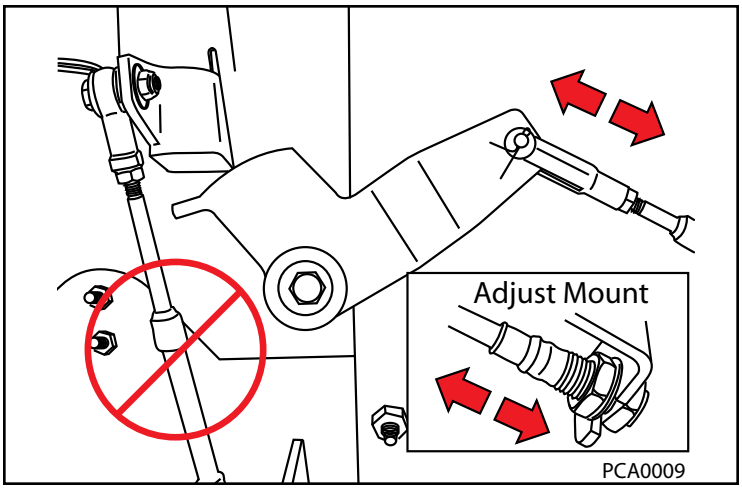


Figure 9

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key Off. Install a flow meter and pressure gauge tool in the propel circuit at the rear drive motor. The flow meter must be connected to the large hose nearest the case drain line (see figure 1).

Note: Be sure the flow meter/pressure gauge tool is rated for at least 4500 psi (310 bar).

TOOLS:
- Flow Meter (5000 psi, 30 GPM)-Item #2048
- Pressure Gauge (0-5000 psi)-Item #53821
- Available at www.northerntool.com

Step 2.
Start the engine-Low speed and release the parking brake. Slowly move the machine until the front bumper contacts a rubber loading dock bumper or equivalent immovable fixture (see figure 2). Be sure the rubber bumper pad aligns with the S30 metal bumper surface. Set the parking brake.

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

Step 3.
Select High engine speed. Press the propel pedal *completely* forward and observe the hydraulic flow and pressure gauges (see figure 3). Record the test values.

SPECIFICATIONS:
- Forward Relief Valve-4500 psi (310 bar)
- Reverse Relief Valve-3000 psi (207 bar)
- Pump Output Maximum-12.9 GPM (49 LPM) *@ 2400 engine RPM and 100% efficiency*

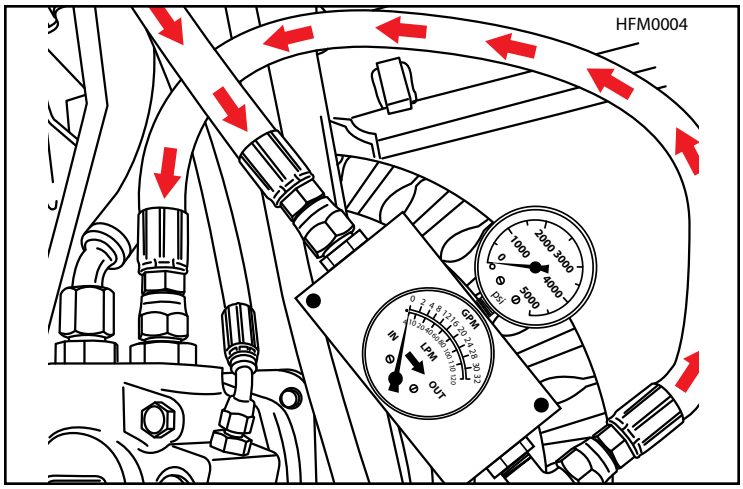


Figure 1

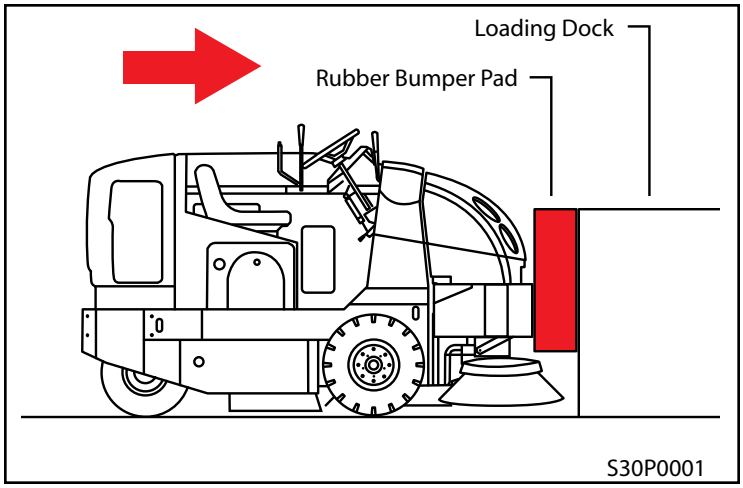


Figure 2

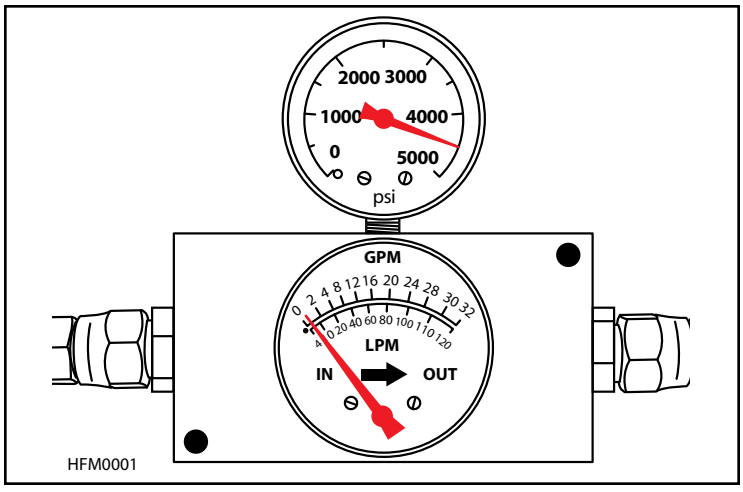


Figure 3

Step 4.
Use the chart below to troubleshoot flow/pressure related problems.

Flow/Pressure Gauge Related Troubleshooting

Operating Flow/Pressure	Possible Cause	Correction
High Flow/Low Pressure *High Flow = Greater than 10 GPM (38 LPM)* *Low Pressure = Less than 4000 psi (276 bar)*	Excessive fluid bypass/leakage in propel *motor*	Repair or Replace propel *motor*
	Mechanical shaft failure inside propel motor (i.e. broken shaft, stripped spline, etc)	Repair or Replace propel *motor*
	Drive hub key sheared	Replace drive hub key
	Wheel is spinning inside tire	Replace wheel/tire assembly
	Incorrect Hydraulic Fluid - Viscosity too low/thin	Change fluid
Low Flow/High Pressure *Low Flow = Less than 2 GPM (7.6 LPM)* *High Pressure = Greater than 4000 psi (276 bar)*	Normal operation - Pump relief valve opens and little or no flow/bypass through the propel motor	No action necessary
Low Flow/Low Pressure *Low Flow = Less than 2 GPM (7.6 LPM)* *Low Pressure = Less than 4000 psi (276 bar)*	Excessive fluid bypass/leakage in propel *pump*	Repair or Replace propel *pump*
	Propel pump pintel arm not rotating when operator activates directional pedal	Repair or Replace directional pedal linkage See "Propel Cable Adjustment Procedure"
	Low hydraulic fluid level in reservoir	Add fluid and inspect for leaks
	Hydraulic reservoir suction strainer obstruction	Replace reservoir suction strainer and identify source of fluid contamination

Figure 4

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key Off. Install a flow meter and pressure gauge tool into the propel circuit between the uppper servo pump port fitting and port P1 of the flow divider valve. (see figure 1). The flow direction must be from the pump to the flow divider valve.

Note: Be sure the flow meter/pressure gauge tool is rated for at least 4500 psi (310 bar).

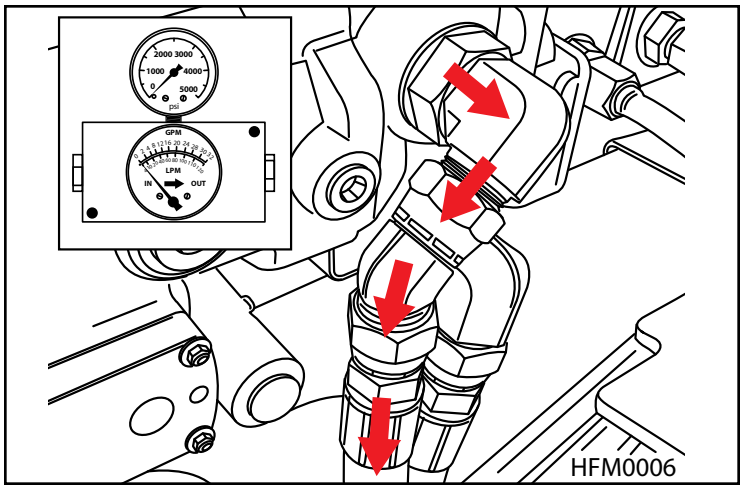


Figure 1

TOOLS:
- Flow Meter (5000 psi, 30 GPM)-Item #2048
- Pressure Gauge (0-5000 psi)-Item #53821
- Available at www.northerntool.com

Step 2.
Start the engine-Low speed and release the parking brake. Slowly move the machine until the front bumper contacts a rubber loading dock bumper or equivalent immovable fixture (see figure 2). Be sure the rubber bumper pad aligns with the S30 metal bumper surface. Set the parking brake.

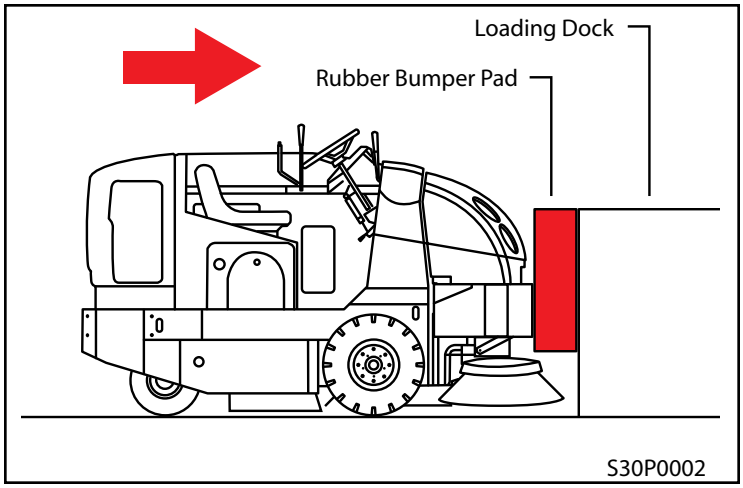


Figure 2

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

Step 3.
Select High engine speed. Press the propel pedal *completely* forward and observe the hydraulic flow and pressure gauges (see figure 3). Record the test values.

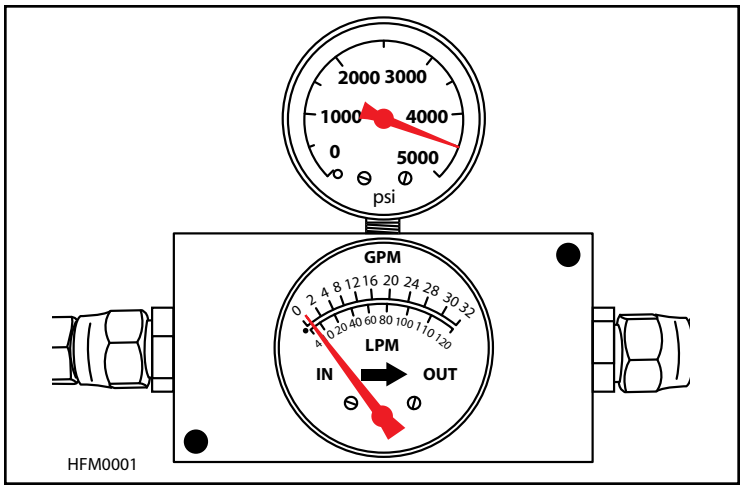


Figure 3

SPECIFICATIONS:
- Forward Relief Valve-4500 psi (310 bar)
- Reverse Relief Valve-3000 psi (207 bar)
- Pump Output Maximum-25.8 GPM (98 LPM) *@ 2400 engine RPM and 100% efficiency*

Step 4.
Use the chart below to troubleshoot flow/pressure related problems.

Flow/Pressure Gauge Related Troubleshooting

Operating Flow/Pressure	Possible Cause	Correction
High Flow/Low Pressure *High Flow = Greater than 22 GPM (83 LPM)* *Low Pressure = Less than 4000 psi (276 bar)*	Excessive fluid bypass/leakage in a propel *motor*	Repair or Replace a propel *motor*
	Excessive fluid bypass/leakage in flow divider valve	Repair or Replace flow divider valve
	Mechanical shaft failure inside propel motor (i.e. broken shaft, stripped spline, etc)	Repair or Replace a propel *motor*
	Drive hub key sheared	Replace drive hub key
	Wheel is spinning inside tire	Replace wheel/tire assembly
	Incorrect Hydraulic Fluid - Viscosity too low/thin	Change fluid
Low Flow/High Pressure *Low Flow = Less than 2 GPM (7.6 LPM)* *High Pressure = Greater than 4000 psi (276 bar)*	Normal operation - Pump relief valve opens and little or no flow/bypass through the propel motor	No action necessary
	Flow divider valve stuck or obstructed	Repair or Replace flow divider valve
Low Flow/Low Pressure *Low Flow = Less than 2 GPM (7.6 LPM)* *Low Pressure = Less than 4000 psi (276 bar)*	Excessive fluid bypass/leakage in propel *pump*	Repair or Replace propel *pump*
	Propel pump pintel arm not rotating when operator activates directional pedal	Repair or Replace directional pedal linkage
	Low hydraulic fluid level in reservoir	Add fluid and inspect for leaks
	Hydraulic reservoir suction strainer obstruction	Replace reservoir suction strainer and identify source of fluid contamination

Figure 4

Step 1.
A ramp is a right triangle with a rise, run, and hypotenuse (see figure 1). This calculator tool uses trigonometric functions to provide a chart of ramp angles and grades based on a single rise measurement.

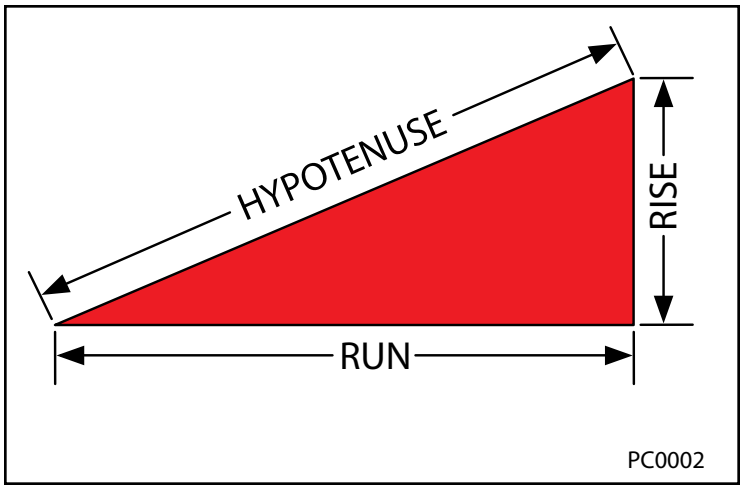


Figure 1

Step 2.
Measure 2 ft (60.96 cm) from the start of the ramp and draw a line (see figure 2).

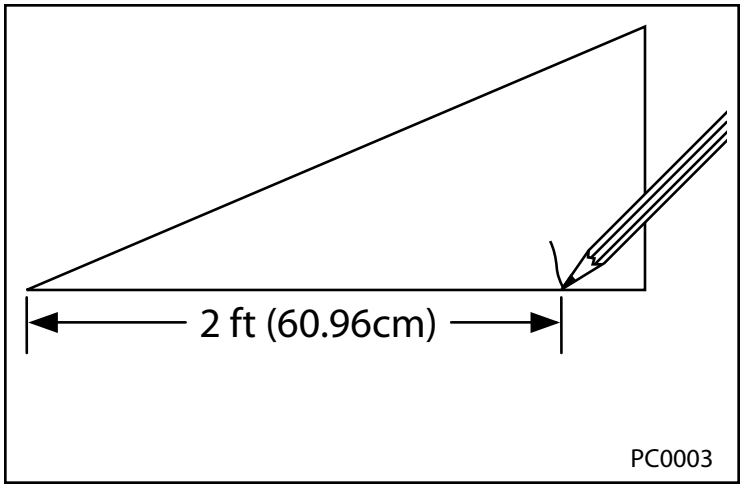


Figure 2

Step 3.
Measure the vertical distance between the drawn line and the ramp deck surface. The measurement must be made straight up and down (see figure 3).

Note: Using a plumb bob tool will ensure the vertical measurement is straight up and down.

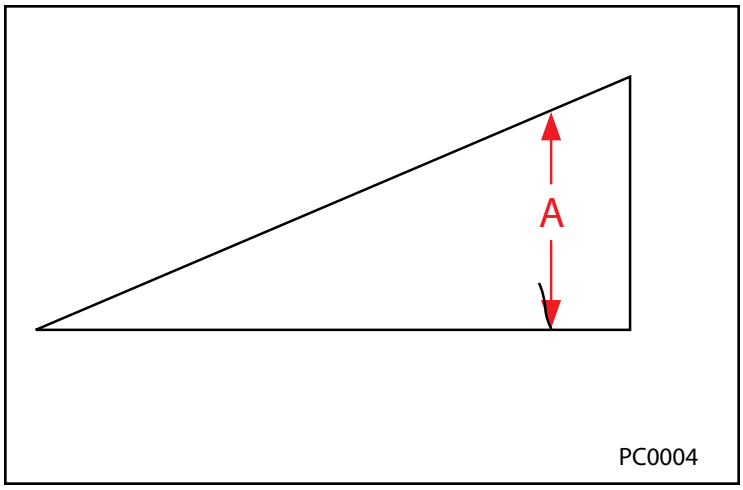


Figure 3

S30 RAMP ANGLE CALCULATOR

Rise = A and Run = 24 in(60.96 cm)

A = in (cm)	% Grade	˚Angle	
6.00 (15.24)	25.0%	14.04˚	Hopper Empty
5.75 (14.61)	24.0%	13.47˚	
5.50 (13.97)	22.9%	12.91˚	
5.25 (13.34)	21.9%	12.34˚	
5.00 (12.70)	20.8%	11.77˚	
4.75 (12.07)	19.8%	11.20˚	
4.50 (11.43)	18.8%	10.62˚	
4.25 (10.80)	17.7%	10.04˚	Hopper Full
4.00 (10.16)	16.7%	9.46˚	
3.75 (9.53)	15.6%	8.88˚	
3.50 (8.89)	14.6%	8.30˚	
3.25 (8.23)	13.5%	7.71˚	
3.00 (7.62)	12.5%	7.13˚	
2.75 (6.99)	11.5%	6.54˚	
2.50 (6.35)	10.4%	5.95˚	
2.25 (5.72)	9.4%	5.36˚	
2.00 (5.08)	8.3%	4.76˚	
1.75 (4.45)	7.3%	4.17˚	
1.50 (3.81)	6.3%	3.58˚	
1.25 (3.18)	5.2%	2.98˚	
1.00 (2.54)	4.2%	2.39˚	
0.75 (1.91)	3.1%	1.79˚	
0.50 (1.27)	2.1%	1.19˚	
0.25 (0.64)	1.0%	0.60˚	
0.00 (0.00)	0%	0.00˚	

PC0005

Figure 4

Step 4.

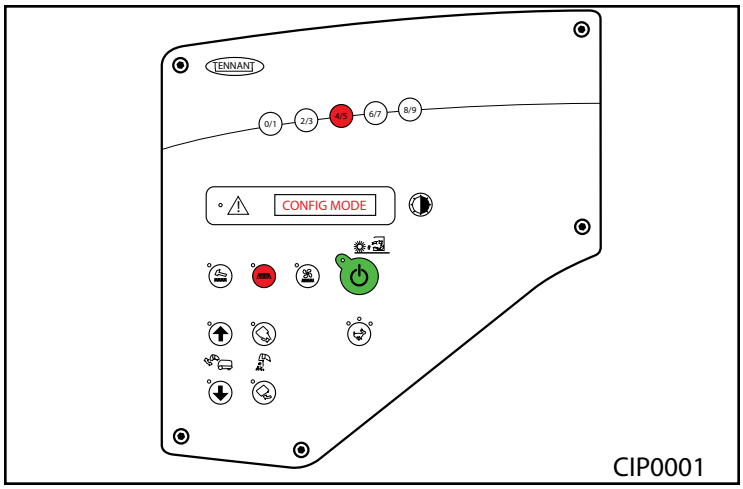
Use the chart in figure 4 to calculate the angle of the ramp. Please note the maximum ramp angles for hopper full and hopper empty.

SPECIFICATIONS:

- Max Climb Angle-Hopper Full 10˚(18%)
- Max Climb Angle-Hopper Empty 14˚(25%)
- Hopper Capacity (Plastic)-1080 lbs (490 kg)
- Hopper Capacity (Steel)-1200 lbs (545 kg)

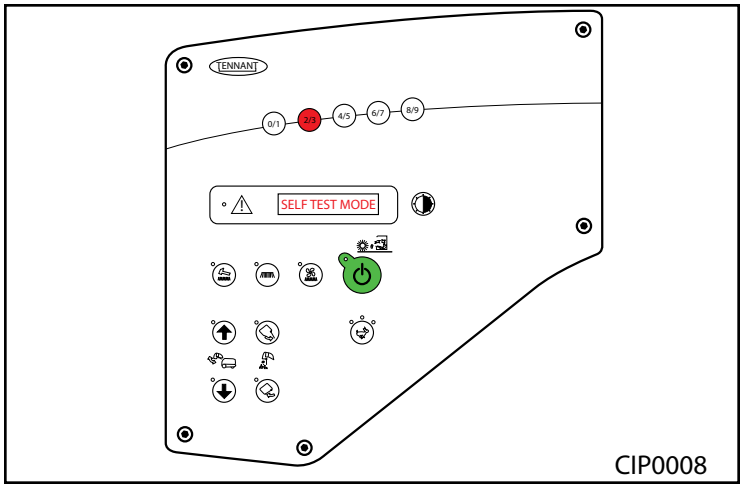
FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key off. Press and hold the "4/5" and side brush buttons (see figure 1) and then turn the key on, engine off. Continue to hold both buttons until "CONFIG MODE" appears on the LCD (Liquid Crystal Display). Release both buttons. You are now in configuration mode.



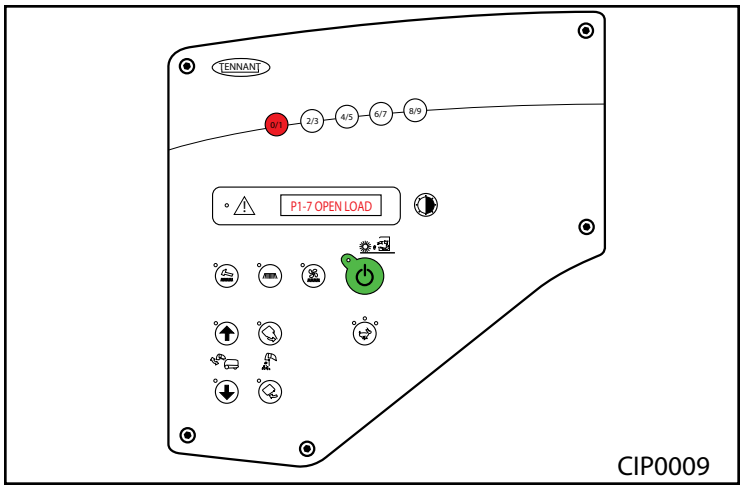
CIP0001

Step 2.
Press the "2/3" button to scroll through the configuration mode options until "SELF TEST" appears on the LCD (see figure 2).



CIP0008

Step 3.
Press the "0/1" button to start the self test (see figure 3). The instrument panel assembly will automatically test each output circuit for an open or short. The LCD will display all open or shorted circuits using the Px-xx format. The Px-xx format indicates the connector number (P1 and then the circuit board pin (01 thru 35).



CIP0009

S30 Controller Pins

= Inputs = Outputs = Power Supply

P1-1	Chassis Ground (-)
P1-2	Switched Batt VDC (+)
P1-3	Switched Batt VDC (+)
P1-4	SV4 Enable Valve
P1-5	SV1 & SV8 Main Brush On & Down
P1-6	Hydraulic Oil Temperature
P1-7	SV5 Hopper Door Open
P1-8	SV6A Hopper Up
P1-9	SV6B Hopper Down
P1-10	SV2 Vacuum Fan
P1-11	M3 Shaker Relay
P1-12	Not Used
P1-13	Hopper Thermo Sentry
P1-14	Clogged Dust Filter (Ground=Clogged)
P1-15	Hydraulic High Pressure Switch
P1-16	Alternator Charge Indicator
P1-17	Not Used
P1-18	Not Used
P1-19	Hydraulic Temperature Indicator
P1-20	Engine Speed Medium
P1-21	Engine Speed Low
P1-22	Power Ground 1 (-)
P1-23	Engine Temperature Sender
P1-24	Not Used
P1-25	Engine Oil Pressure Switch
P1-26	Seat Switch (Ground=Seat Switch Disabled)
P1-27	Hopper Position (Ground=Down)
P1-28	LP Pressure Switch or Fuel Sender
P1-29	Stalled Broom (Ground=Stalled Broom)
P1-30	Not Used
P1-31	SV3 & SV7 Side Brush On & Down
P1-32	Unswitched Batt VDC (+)
P1-33	Control Ground (-)
P1-34	Power Ground 4 (-)
P1-35	Power Ground 3 (-)

SOP0002

Figure 4

Step 4.
The LCD will display "Done" if no circuit board outputs are open or shorted. Use the "S30 Controller Pins" listing (see figure 4) to cross-reference open or shorted circuits.

Note: Circuits identified as "open" are not necessarily faulty. Some optional circuits may not be used and will display as "open."

Note: Circuits that are identified as "Shorted" have zero resistance to ground. The self test will not detect *partially* shorted loads. An ohm test is the best way to identify partially shorted relays, hydraulic coils, water valves, or contactors.

FOR SAFETY: All diagnosis, service or repairs to the refrigeration system of automotive air conditioning systems should only be performed by a Certified Refrigeration Technician, and should follow procedures for refrigerant recovery and recycling , using only certified equipment, as provided in local, state, and federal laws, requirements and provisions. No part of this program should be construed to recommend any service procedure contrary to those laws or provisions.

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key Off. Locate the R-134a port fittings on top of the compressor and remove dust caps (see figure 1).

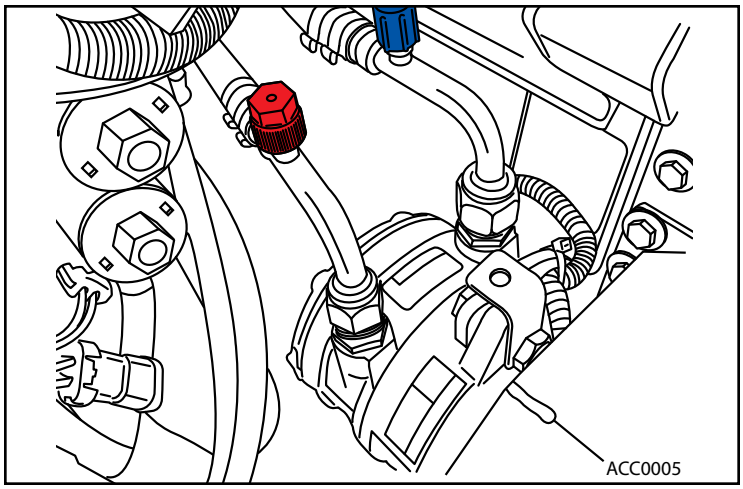


Figure 1

Step 2.
Note: Be sure both manifold valves are closed before connecting manifold gauge set to compressor port fittings.

Connect manifold gauges to the compressor port fittings (see figure 2). The high side gauge range should be 0-500 psi (3.5 MPa) and the low side gauge range should be 0-150 psi (1.0 MPa) clockwise and 0-30 in Hg (76 cm Hg) counter-clockwise.

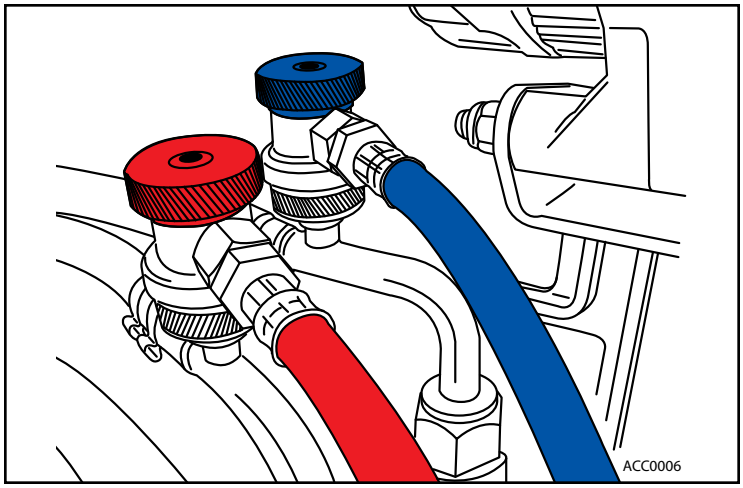


Figure 2

Step 3.
Static Pressure-A system that has been setting (engine off) should read equal high side and low side pressures. Figure 3 shows an example test done at approximately 70˚F (22˚C). Both gauges read approximately 71 psi (0.5 MPa). Refer to figure 4 for specific temperature/pressure values.

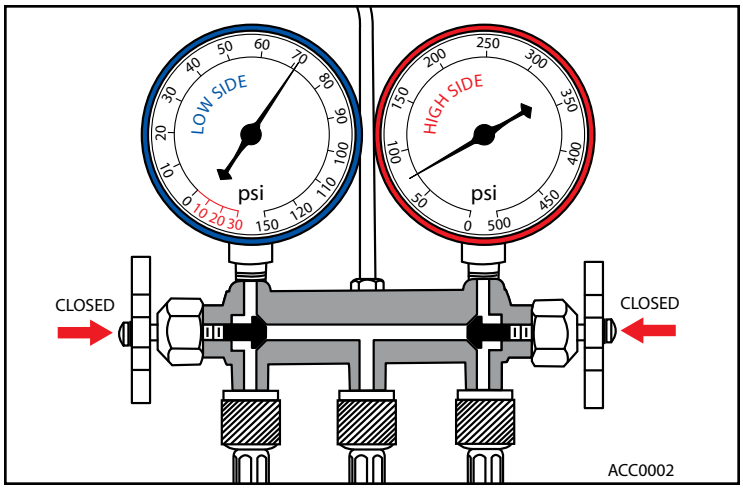


Figure 3

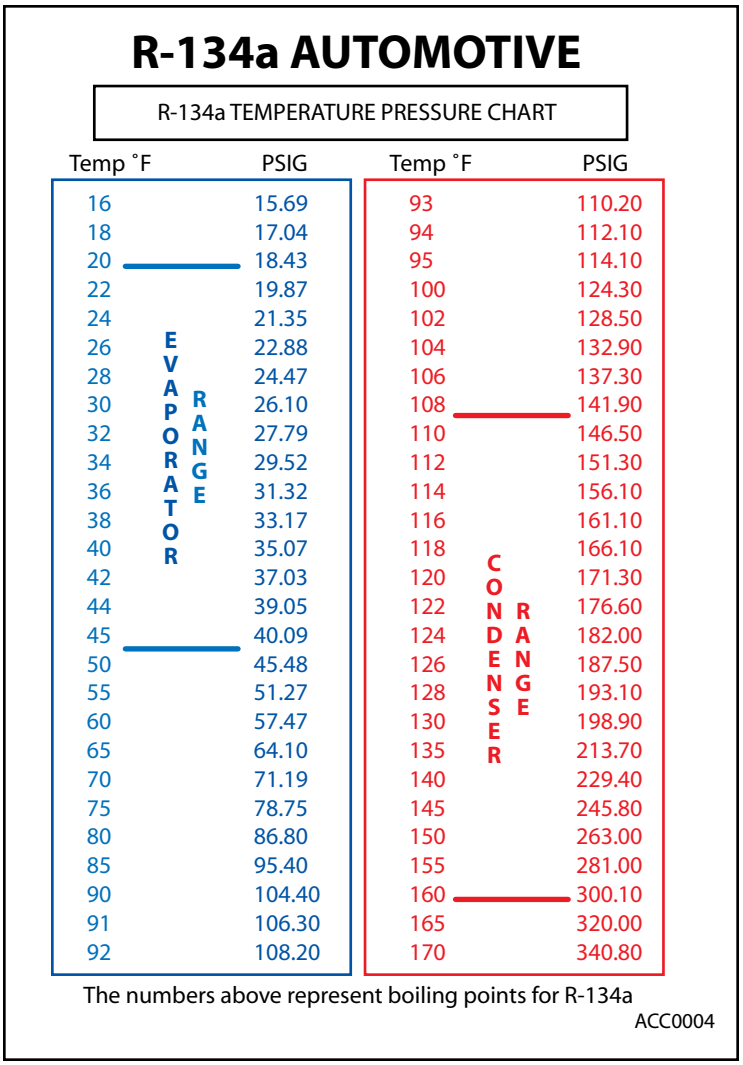


Figure 4

Step 4.
Start the engine and select high engine speed. Activate the AC system and adjust the climate control knob to max cool. Normal compressor suction and discharge pressures at outside air temperatures of 70-75˚F (21-24˚C) and at High engine speed are listed below. See chart in figure 6 if the values are outside of the specified range.

SPECIFICATIONS:

- R-134a Refrigerant Capacity: 1 lb (0.45 kg)
- Low Side Pressure: 10-15psi (0.07-0.10 MPa)
- High Side Pressure: 140-150 psi (0.97-1.03 MPa)
- Compressor Oil Type: ZXL 100 PG
- Compressor Oil Capacity: 150-170 ml

WARNING: Engine emits toxic gases. Serious injury or death can result. Provide adequate ventilation.

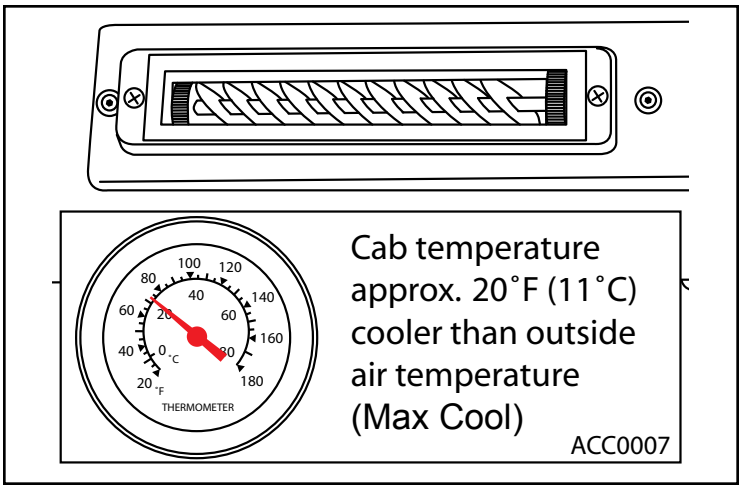


Figure 5

Step 5.
Test the cab temperature using a thermometer. The system should maintain cab air temperatures that are approximately 20˚F (11˚C) cooler than outside air temperatures.

Step 6.
Use the chart below to troubleshoot pressure related problems.

Manifold Pressure Gauge Related Troubleshooting

Operating Pressures	Trouble Symptom	Possible Cause	Correction
Low Side - Too High *Note: If both high and low side pressures are too high, refer to "High Pressure Side too high" first*	The thermostat switch opens before the outlet air temperature is sufficiently low.	Faulty thermostat	Replace thermostat
	The high and low side gauge pressures equalize immediately when the compressor clutch is off-engine on	Defective compressor seal or low compression	Replace compressor
	Low side hose/pipe is frosted	Poor expansion valve temperature sensor contact	Clean the sensor contact against the low-pressure pipe
	Same as above	The expansion valve opens too far	Replace expansion valve
Low Side - Too Low	Static pressure too low	Insufficient refrigerant	Check for leaks
	Considerable temperature difference between inlet and outlet sides, or the receiver/dryer is frosted	Clogged receiver/dryer	Replace receiver/dryer
	The expansion valve's inlet side is frosted	Clogged expansion valve	Replace expansion valve
	The expansion valve's outlet side is chilled, and low pressure gauge indicates low pressure	Expansion valve temperature sensor gas leak (damaged capillary tube, etc)	Clean or replace expansion valve
	When the piping is clogged or blocked, the low-pressure gauge reading will decrease, or a negative reading may be shown. A frost spot may be present at the point of restriction	Clogged or blocked piping	Clean or replace piping
	The evaporator is frozen	Defective thermostat	Replace thermostat
High Side - Too High	Dirty or clogged condenser fins. Cooling fan does not operate correctly	Poor condenser cooling	Clean coil and/or repair fan
	Static pressure too high	Excessive refrigerant	Recover, recycle, evacuate and recharge system
	Pressure is high on both high and low sides	Air in the system	Check for leaks
High Side - Too Low	Static pressure too low	Insufficient refrigerant	Check for leaks

Figure 6

FOR SAFETY: Before servicing machine, stop on level surface and set parking brake.

Step 1.
Turn the key off. The engine must be COOL before following this procedure! Disconnect the electrical connector from the heater control valve (see figure 1). The heater control valve is located below the hydraulic valve block on the left side of the machine.

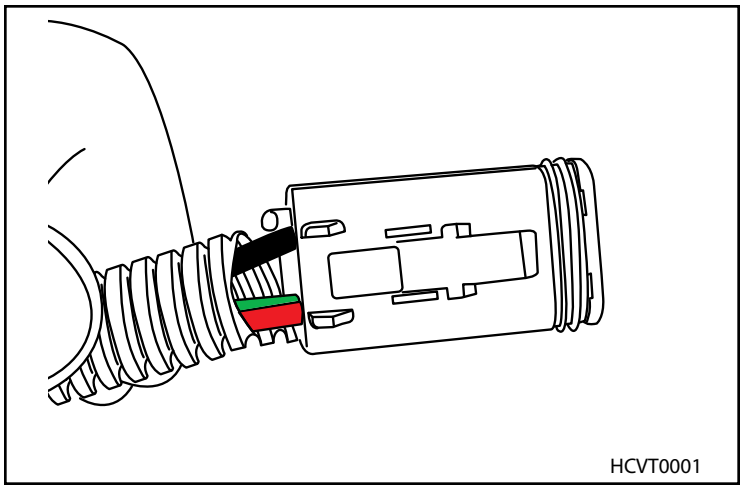


Figure 1

Step 2.
Backbrobe between the GREEN and BLACK wires using a DVOM in VDC mode (see figure 2).

Note: Be sure the probes are contacting the conductive terminals inside the connector body.

Tip: Insert paper clips if meter probes are too short or if probe diameter is too large to reach terminals.

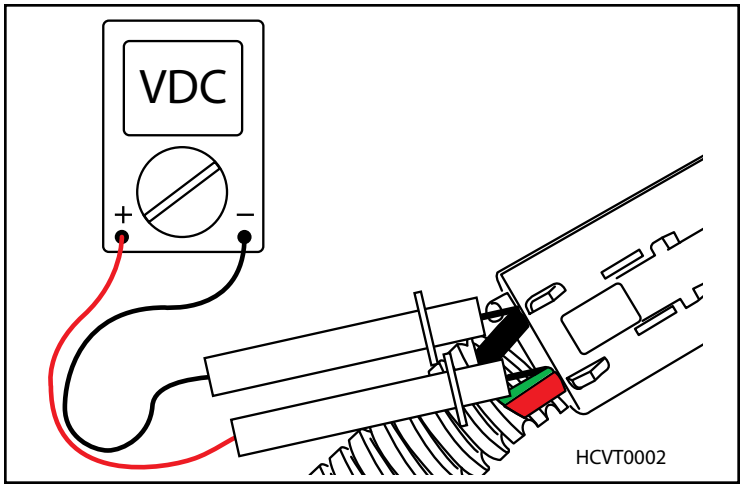


Figure 2

Step 3.
Turn the key On, engine Off. Rotate the climate control knob in the cab while observing the DVOM display.

SPECIFICATION:
- 100% Heat (Clockwise) = 0 to 1 VDC
- 100% Cool (Counter Clockwise) = Batt VDC
- Variable Range (Heat to Cool) = 0 to Batt VDC

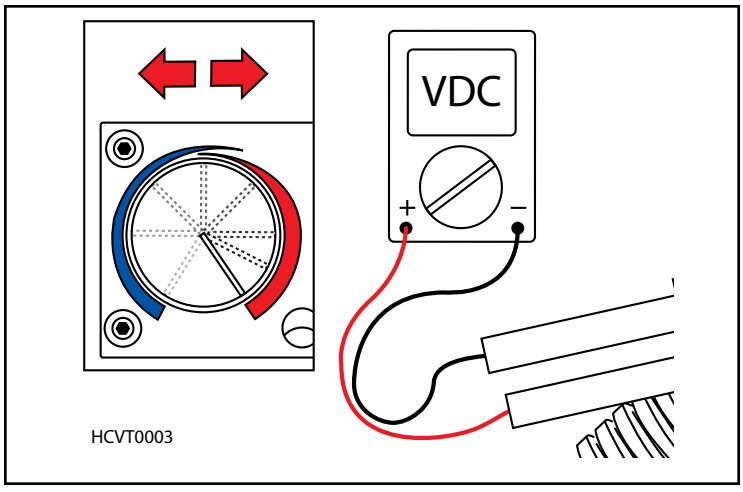


Figure 3

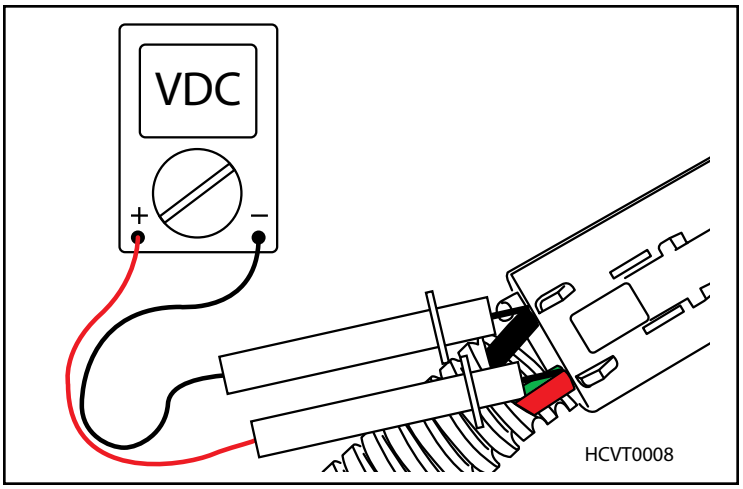


Figure 4

Step 4.
Backbrobe between the GREEN and RED wires using a DVOM in VDC mode (see figure 4).

Note: Be sure the probes are contacting the conductive terminals inside the connector body.

SPECIFICATION:
- Key On = Batt VDC

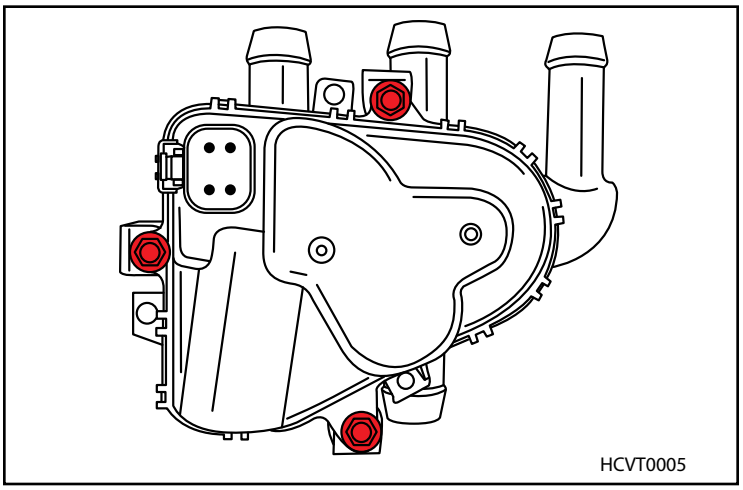


Figure 5

Step 5.
Disconnect coolant hoses from heater control valve and remove heater control valve from machine. Remove the 3 sheet metal screws holding the actuator to the valve body (see figure 5).

Step 6.
Rotate the white valve stem (see figure 6) in either direction. It should turn approximately 1/4 turn. Check for an obstruction inside the valve body.

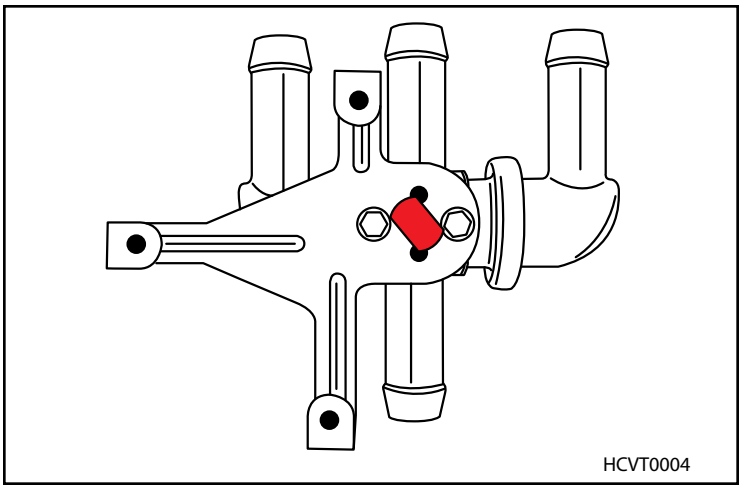


Figure 6

Step 7.
Reinstall the actuator onto the valve body and tighten the 3 sheet metal screws (see figure 5).

Step 8.
Connect jumper wires to the heater control valve pins as shown in figure 7. This should rotate the valve as shown or the heat Off position (if not already there). Blow air through the ports to confirm proper porting.

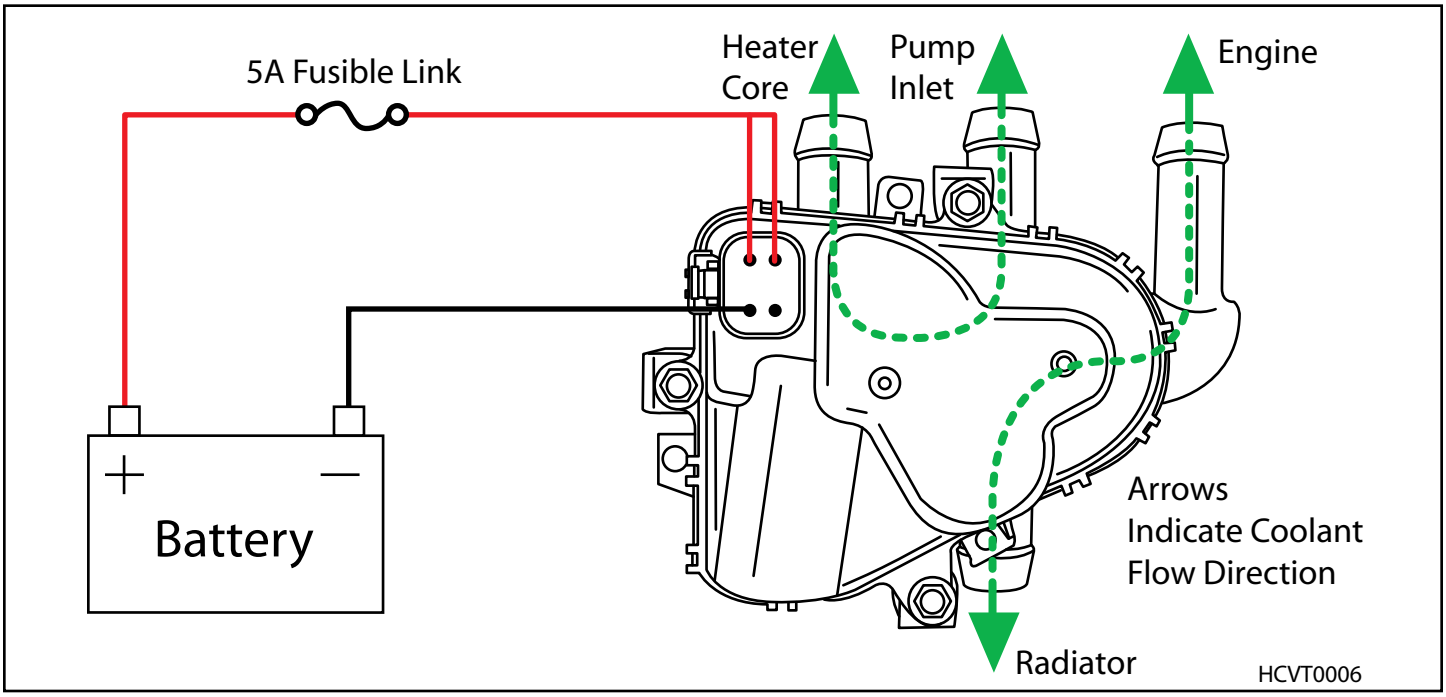


Figure 7

Step 9.
Connect jumper wires to the heater control valve pins as shown in figure 8. This should rotate the valve as shown or the heat On position. Blow air through the ports to confirm proper porting. Replace the heater control valve if not operating within specification.

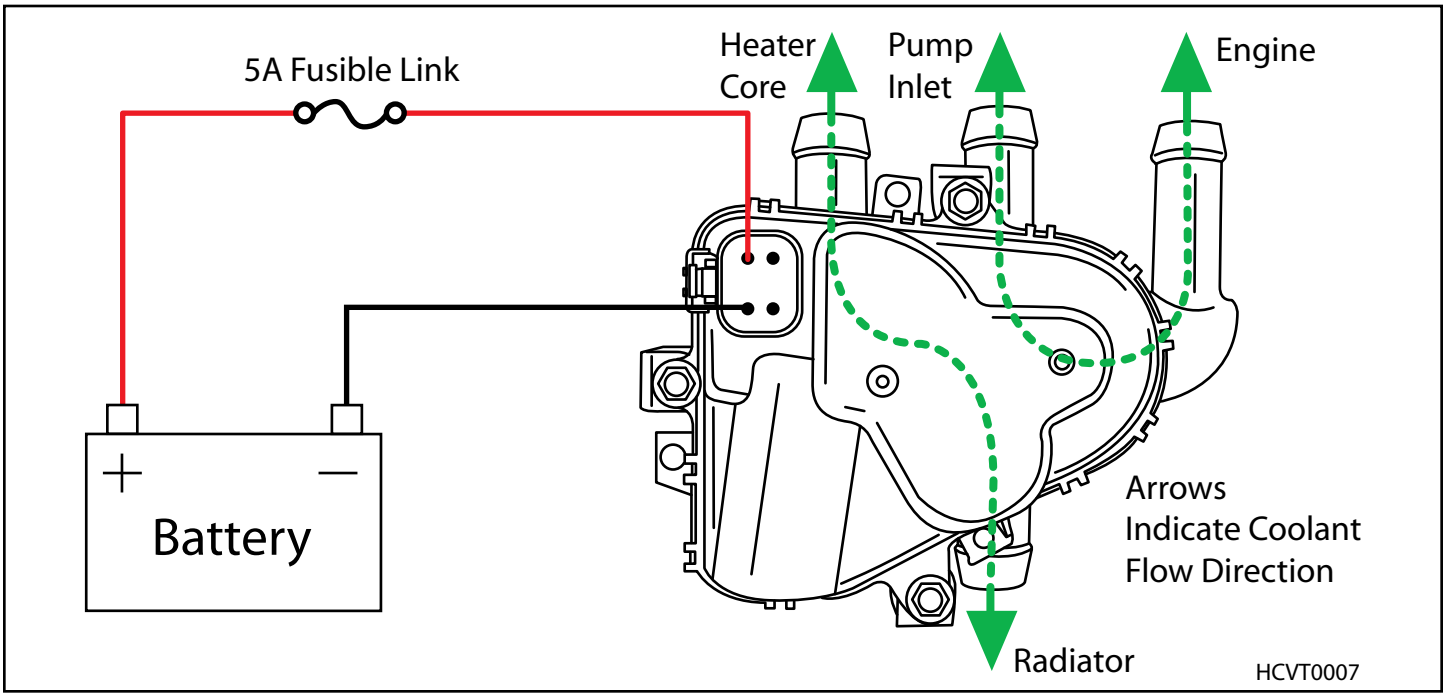


Figure 8