Vantage™ 520SD

Service Manual - SVM261

Code(s): 12297

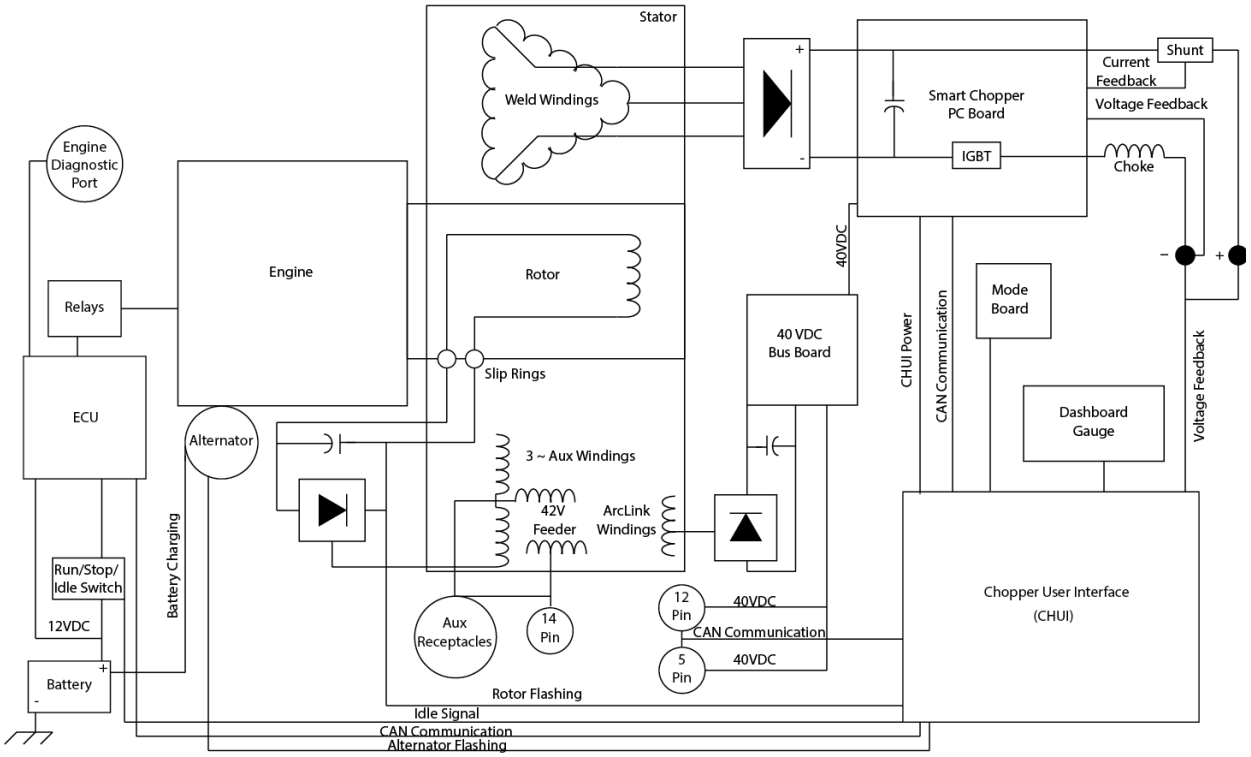
Last update: 7/15/15

Theory of Operation

⚠ WARNING

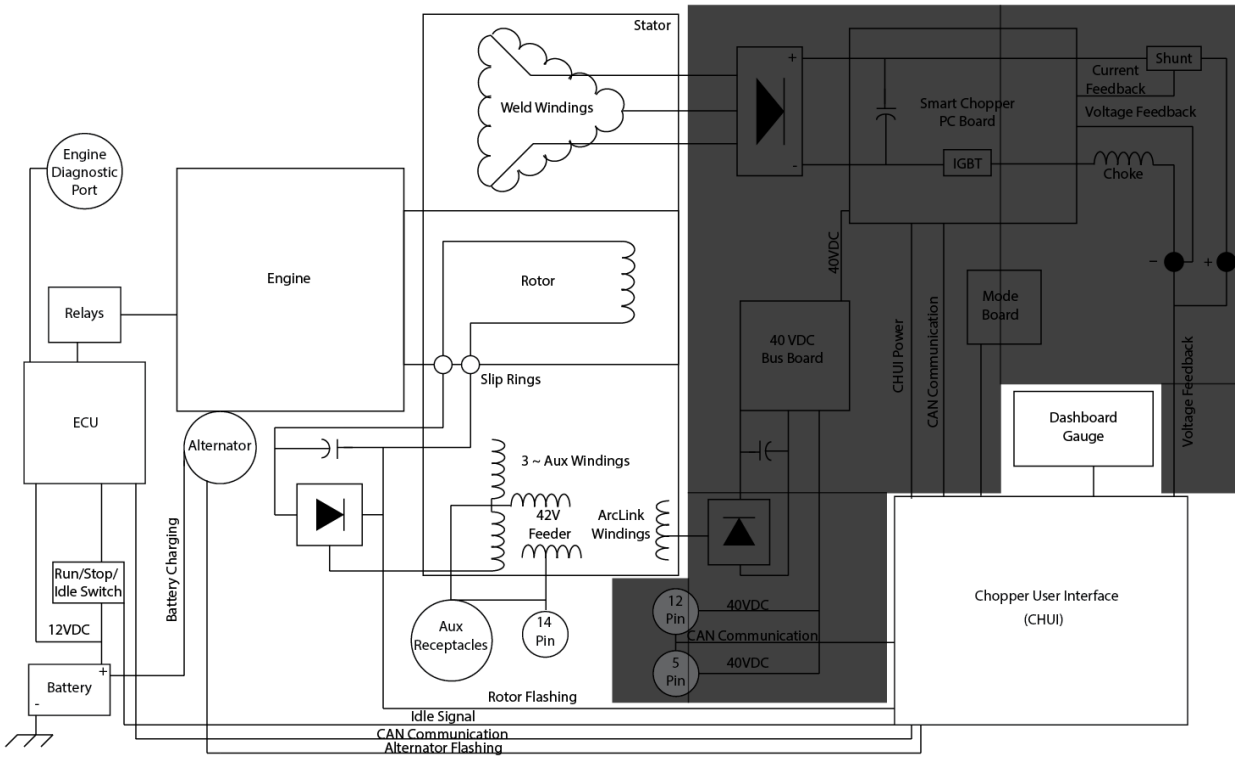
Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

General Description



The Vantage 520SD is a diesel engine driven welding power source capable of producing 520amps at 30VDC at a 60% duty cycle. The engine is coupled to a brush-type AC generator. The welding output is rectified and controlled through Chopper Technology to produce DC current for multiple welding processes. The Vantage 520SD also provides 11kW of single phase and 17kW of three phase power.

Engine, Rotor, Stator, ECU



The 12VDC battery powers the Engine Control Unit which controls all of the engine functions. The ECU communicates with the CHUI board for idle speed.

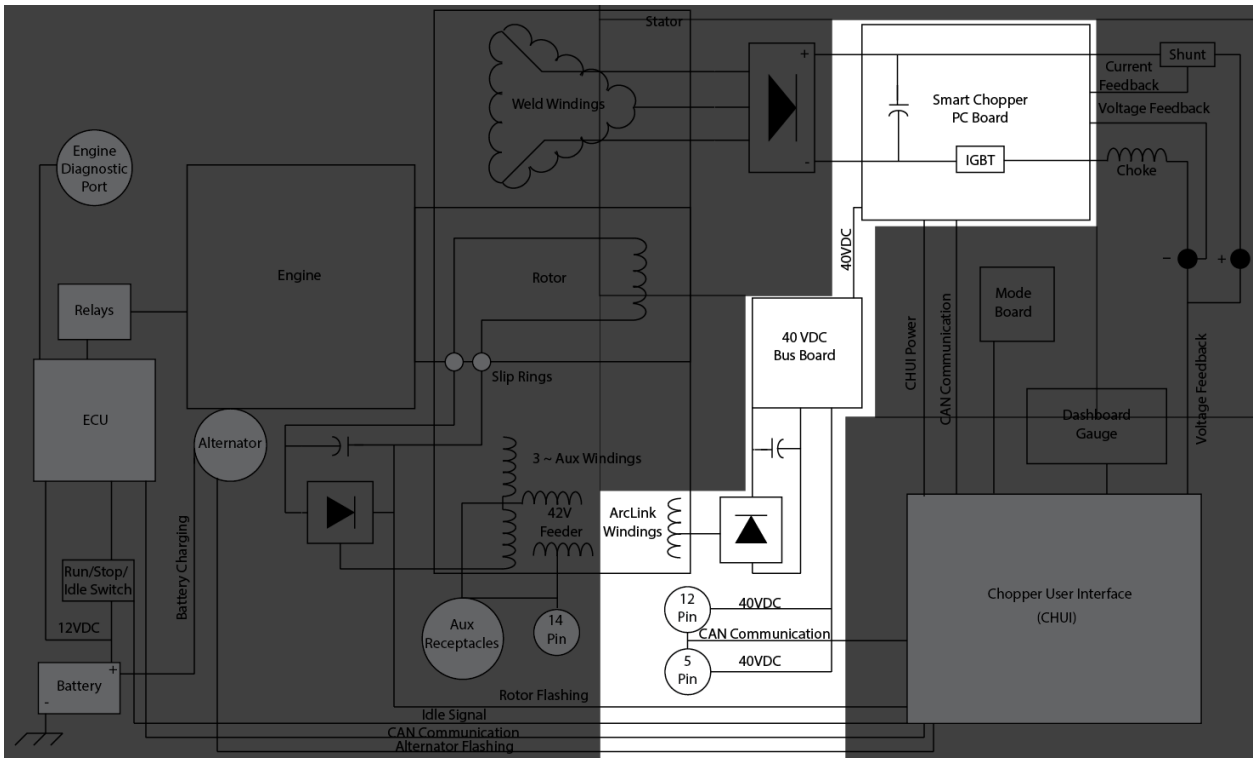
When the engine, which is mechanically coupled to the rotor, starts running, the 12VDC battery voltage is applied to the rotor via the CHUI board. This excitation, or “flashing,” is fed to the rotor field windings through the brushes and slip rings. Once applied a magnetic field is built around the rotor lamination.

The spinning of the rotor induces that field onto the stationary windings of the stator. An excitation winding in the stator provides AC voltage which is rectified, filtered, and fed back into the slip rings. This voltage builds up until the rotor is saturated at 198VDC.

The stator houses four sets of windings:

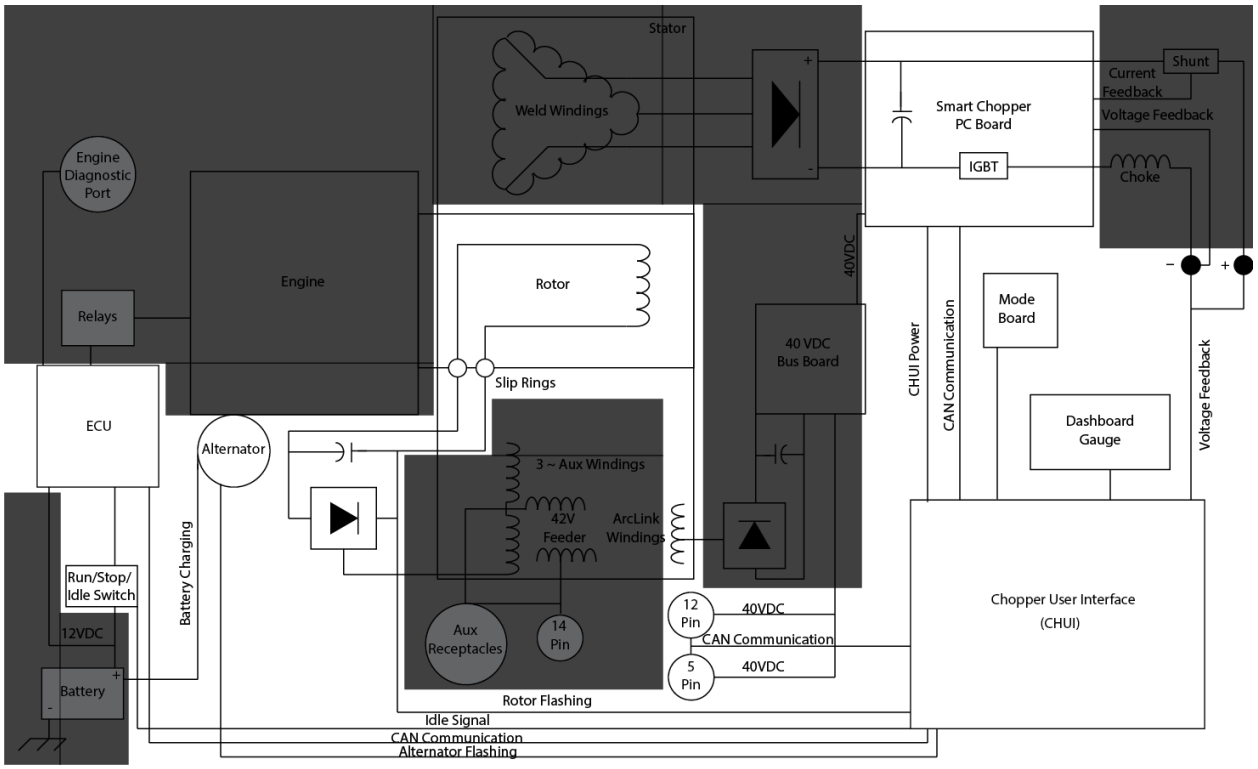
- 3 phase weld windings
- 240VAC 3 phase auxiliary winding (also supplies the 120VAC single phase and excitation
- 42VAC wire feeder power supply
- 42VAC winding for the power board

Power Board



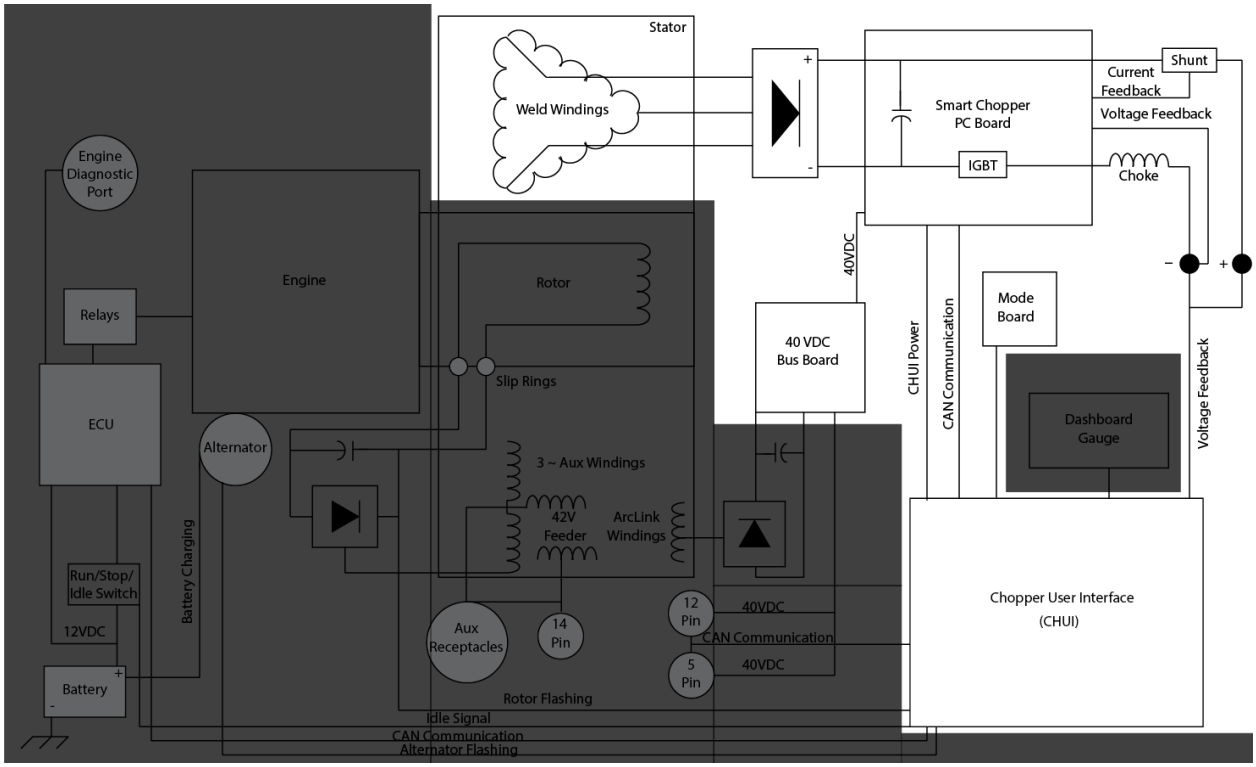
The power board receives approximately 60VDC which is supplied by a dedicated, 42VAC winding in the stator. This is rectified and filtered, then supplied to the power board. This board in turn creates 40VDC supplies for the Smart Chopper board circuitry, as the 5 and 12 pin Amphenol connectors.

CHUI (Chopper User Interface) Board



The CHUI is powered by the DC bus for the weld output. It receives the operator commands and, via Arclink communication, tells the Smart Chopper the desired process and output. It is also responsible for the rotor and battery alternator flashing, and it communicates with the Engine Control Unit for idle purposes.

Weld Windings, Rectifier, Power Module and Feedback



The three phase weld windings feed a three phase rectifier bridge. The resulting DC voltage is filtered by capacitors on the Chopper boards. This is the bus for our weld output and power supply for the Slave Chopper board as well as the Chopper User Interface (CHUI) board. The circuitry on the Master Chopper board is supplied by the Power Board. There are IGBT's on these boards that switch the bus voltage on and off at 20kHz. The IGBT's are controlled by the Smart Chopper board through pulse width modulation, based on settings provided by the CHUI.

This "chopped" DC output is applied through the choke coil and a shunt to the weld output terminals. The choke acts as an inductor, filtering the current, and keeping the arc lit during the IGBT's off cycle.

The current feedback from the shunt is sent to the Master Chopper to control the output.

Troubleshooting

This Troubleshooting Guide is provided to help you locate and repair possible machine malfunctions. Simply follow the three-step procedure listed below.

Step 1. LOCATE PROBLEM (SYMPTOM).

Look under the column labeled “PROBLEM (SYMPTOMS)”. This column describes possible symptoms that the machine may exhibit. Find the listing that best describes the symptom that the machine is exhibiting. Symptoms are grouped into the following categories:

- output problems,
- function problems,
- welding problems,
- engine problems

Step 2. PERFORM EXTERNAL TESTS.

The second column labeled “POSSIBLE AREAS OF MISADJUSTMENT(S)” lists the obvious external possibilities that may contribute to the machine symptom. Perform these tests/checks in the order listed. In general, these tests can be conducted without removing the case wrap-around cover.

Step 3. RECOMMENDED COURSE OF ACTION

The last column labeled “Recommended Course of Action” lists the most likely components that may have failed in your machine. It also specifies the appropriate test procedure to verify that the subject component is either good or bad. If there are a number of possible components, check the components in the order listed to eliminate one possibility at a time until you locate the cause of your problem.

All of the referenced test procedures referred to in the Troubleshooting Guide are described in detail at the end of this chapter. Refer to the Troubleshooting and Repair Table of Contents to locate each specific Test Procedure. All of the specified test points, components, terminal strips, etc. can be found on the referenced electrical wiring diagrams and schematics. Refer to the Electrical Diagrams Section Table of Contents to locate the appropriate diagram.

⚠ CAUTION

If for any reason you do not understand the test procedures or are unable to perform the tests/repairs safely, contact the Lincoln Electric Service Department for technical troubleshooting assistance before you proceed.

Call 1-888-935-3877.

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
Output Problems		
Major mechanical or electrical damage is evident	1. Contact your local Lincoln Authorized Field Service Facility	1. Contact the Lincoln Electric Service Department at 1.888.935.3877
No Welding output or auxiliary power. The Engine operates normally.	1. Check for loose or faulty connections in the auxiliary circuit to the output receptacles, and/or the weld circuit to the output terminals. **SEE WIRING DIAGRAM.** 2. Check the brushes for wear and proper contact to the rotor slip rings.	1. Check the brushes for wear and proper contact to the rotor slip rings 2. Perform the Brush and Slip Ring Service Procedure. Check for flashing voltage at slip rings (3-5 Volts DC@.5 amp until generator builds up, then 160 Volts) See **FLASHING VOLTAGE TEST.** 3. Check Field rectifier and capacitor. **4.** Perform the **ROTOR VOLTAGE TEST.** 5. Perform the **STATOR VOLTAGE TEST.**
No welding output in any mode. The auxiliary output is normal. The engine operates normally.	1. Place the Welding Terminals switch in the "WELD TERMINALS ON" If the problem is solved and there is a control cable, wire feeder, amptrol, or arc start switch connected, the fault may lie in the above attached accessories. 2. If the correct OCV is present at the weld output terminals, check the welding cables, connectors, work clamp, electrode holder, etc. For loose or faulty connections.	1. Check for damaged conductors or faulty connections on the heavy current carrying leads that connect the output studs to the Chopper module and to the Output Rectifier. Also check the shunt and the choke assemblies for damage and faulty connections. 2. Check the Welding Terminals Switch and the associated leads. **SEE WIRING DIAGRAM.** 3. Check the communication leads #284 and #283 and CHUI power leads #13 and #14 for loose or faulty connections. **SEE WIRING DIAGRAM.** 4. Perform the **CHOPPER MODULE FUNCTION TEST.** 5. Perform the **STATOR VOLTAGE TEST**. **6.** Perform the **OUTPUT RECTIFIER TEST.** 7. The Smart Chopper board may be faulty. 8. The CHUI may be faulty.
No output in PIPE or GOUGE MODE. Output's normal in other modes.	1. Make sure VRD ON/OFF toggle switch is in the off position. 2. Faulty CHUI.	1. Check the VRD on off switch for proper function/continuity. 2. See VRD functional description

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
No auxiliary power at one or more receptacles or at the 14 pin Amphenol. Weld output is normal and the engine operates normally.	1. Check for loose or faulty connections at the output receptacles or 14 pin amphenol. 2. Check for tripped circuit breaker and/or tripped GFCI receptacles.	**1. PERFORM THE STATOR VOLTAGE TEST.** 2. Check the wiring between the auxiliary receptacle and the main stator.
The machine has low welding output and low auxiliary output.	1. The engine RPM may be low. 2. The brushes may be sticking, poorly seated or slip rings dirty.	1. The engine high idle speed may be low. CONTACT DEUTZ 2. Inspect and, if necessary, service the brushes and slip rings per the Brush and Slip Ring Service. 3. Perform the **ROTOR VOLTAGE TEST.** 4. Perform the **STATOR VOLTAGE TEST**
Welding Problems		

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
The machine will weld but the welding arc is "COLD". The engine runs normally and the auxiliary power is normal.	1. Make sure the machine is properly set for the electrode and process is being used. Check electrode size, mode switch setting, and amps or voltage setting. If gas is used make sure of correct type and gas flow. 2. Make sure the process does not demand more power than the machine can produce. 3. If the current is correct try increasing the "ARC CONTROL" setting. 4. Check for loose or faulty connections at the weld output terminals and welding cable connections. 5. Check for good connections between the work cable and the work piece. The work cable should be attached to clean metal, as close to the weld area as possible. The work clamp must be in good condition with good spring tension. 6. The weld cables may be too long, or too small diameter causing excessive voltage drop. 7. The weld cables may be coiled, or wrapped around metal racks or reels. This can cause excessive inductance in the weld circuit. Try welding with a short set of adequately sized weld cables	1. The engine RPM may be too low. Perform the. Connect the machine to a resistive load bank. Connect a tachometer, Hz meter or another method to measure engine RPM. Place the mode switch in "CCSTICK, turn the output control to maximum idle switch to "HIGH" terminal switch to "WELD TERMINALS ON". Nothing else attached or plugged into machine (No aux., no control cables). Apply a load with the load bank. Load to 400 Amps, 36 Volts, 100% Duty Cycle. The engine should maintain 1800 RPM. If the engine cannot maintain the RPM make sure there is a supply of clean fresh fuel. Check the fuel filter and the air filter. Replace any filter that is dirty; or damaged. If this doesn't help CONTACT DEUTZ. 2. Compare the volt and amp readings displayed on the machine with that of the load bank. If these are significantly different, perform the **WELD CONTROL FEEDBACK TEST**. 3. If the maximum weld output cannot be obtained even though the front panel displays are reading accurately, check for damaged conductors and lose or damaged connections the large current carrying conductor connect the stator, output rectifier, chopper modules, choke, shunt, and output terminals. See the Wiring Diagram. 4. If all these connections are good perform the **ROTOR VOLTAGE TEST, the STATOR VOLTAGE TEST, and the OUTPUT RECTIFIER TEST.** 5. Perform the **MODE BOARD TEST.** 6. The CHUI may be faulty 7. The Smart Chopper may be faulty

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
The machine welds but it will not maintain a steady output.	1. This condition may be normal in the Downhill Pipe Mode. The downhill pipe mode allows the arc current to increase and decrease slightly as the arc length changes. 2. Check that the electrode is of good quality, dry and free from contamination. Try using some Lincoln Electrode, and setting the machine per Lincoln recommendation. 3. If shielding gas is used, check that the gas and gas flow are correct. Check for damaged, pinched or leaking gas lines. 4. Check for proper work, and electrode leads and connections (size, length, coils, or bad connections). 5. The machine may not be maintaining the correct RPM.	1. If the engine will not maintain the correct load RPM, the engine may need servicing fuel, air, and fuel filters should be checked. If issue persists, CONTACT DEUTZ. 2. Check internal cables and leads that connect the weld winding of the stator, chopper module and the shunt, choke and output terminals. See the wiring diagram. Look for damaged conductors or faulty connections. 3. There may be poor connections in the control wiring at the CHUI, or the SMART CHOPPER board. Pull each plug from the CHUI inspect the terminals in both the plugs and the P.C. Board receptacles. Make sure the connections are clean and the pins are properly seated in the plastic plug housing. Check for loose or damaged pins and faulty crimps. 4. Check for damaged wiring and poor connections in the 13, 14, and the 283 and 284 leads, between the SMART CHOPPER and CHUI. 5. Perform **MODE BOARD TEST.** 6. The Amphenol receptacles may be contaminated or defective. Perform the **REMOTE RECEPTACLE RESISTANCE TEST.** Replace the CHUI or SMART CHOPPER
The weld output cannot be adjusted with the front panel output control knob in one or mode weld modes. The weld output terminals have normal OCV (open circuit voltage). The AC auxiliary power is normal and the engine operated normally	1. Remote control devices override the front output on the low end. Make sure there is nothing plugged into the Amphenol receptacles. Check for dirt or moisture contamination in either the 12 pin or the 14 pin amphenol.	1. Perform the **REMOTE RECEPTACLE RESISTANCE TEST**. 2. The CHUI may be faulty.

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
The arc quality is poor with excessive spatter. The arc heat can be controlled and maintained normally, the auxiliary output is normal and the engine operates normally	1. The ARC CONTROL may be set too high. 2. The output control may be set too high for the electrode being used. 3. Check that the electrode is of good quality, dry and free from contamination. Try using some Lincoln Electrode, and setting the machine per Lincoln's recommendation. 4. If shielding gas is used, check that the gas and gas flow are correct. 5. Check for damaged, pinched, or leaking gas lines. 6. Check for proper work, and electrode leads and connections (size, length, coils, or bad connections).	1. Check that the weld circuit isn't grounded. With the engine off, check the resistance between chassis ground and the weld output terminals. The resistance should be very high, a minimum of 500,000 (500k) Ohms. The weld control system may be grounded or malfunctioning 2. The CHUI may be defective. 3. The SMART CHOPPER may be defective.
The machine welds normally in all modes and the range of weld output seems normal, but one or both of the front panel displays is blank, incorrect welding value, or displays parts of numbers.	1. It is normal for one of the displays to be off when there is no load across the weld output terminals. In "CV" - mode only the "VOLTS" display will be illuminated, in all other modes only the "AMPS" display will be illuminated. 2. When welding both displays should be reading actual welding parameters.	1. The CHUI may be defective
A control cable type feeder does not function when connected to the 14 pin amphenol. Machine operates normally in the "CCSTICK" mode and has normal AC auxiliary output.	1. Make sure the 42V/115V switch is in the proper position for your feeder. 2. Check the circuit breaker CB2 if using a 120VAC wire feeder. 3. Check CB4 if using a 42 VAC wire feeder. Reset breaker if tripped. 4. Check the Amphenol receptacle for damaged, corroded or dirty contact pins. 5. The wire feeder control cable may be defective. 6. The wire feeder may be defective.	1. Use a volt meter to check for the presence of supply voltage at the 14 pin Amphenol receptacle. 120 VAC power is supplied through pins A and J, 42 VAC power is supplied through pins I and K. 2. Perform the **STATOR VOLTAGE TEST.**

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
An Across-the-Arc type wire feeder does not function when connected to the weld output of the machine. The Vantage® operated normally in the CC-STICK mode, and has normal AC auxiliary output.	1. Check that the welding terminals switch is in the "WELD TERMINALS ON" position. 2. Check for poor weld cable connections between the feeder and the welder output terminal, and between the work and the other output terminal. 3. Check that the wire feeder's work sensing lead is properly connected to the work piece and is in good condition. 4. The wire feeder may be defective.	1. Use a voltmeter to check for the presence of about 58 VDC open circuit voltage (OCV) across the output studs of the machine. 2. If there is no OCV, see the troubleshooting sections for "No weld output in any mode".
Engine Problems		
The engine will not crank when the start button is pushed.	1. Check the circuit breaker (CB7). Reset if tripped. 2. Make sure the run/stop switch is in the "RUN" position. 3. Check for loose or faulty battery cable connections. **SEE WIRING DIAGRAM.** 4. The battery may be low or faulty. If the battery will not accept a charge replace it. 5. The starter or starter solenoid may be faulty (have the engine serviced at an authorized engine repair shop).	1. Perform the **ENGINE ALTERNATOR TEST.** 2. There may be a defective component or faulty wiring, causing a current draw when the run/stop switch is in the "stop" position. 3. Check the Run/Stop switch, the glow plug button, the alternator and the starter solenoid. Also check for damaged wiring and insulation. 4. If the engine charging system is operating properly but the battery is not staying charged, the battery is defective and should be replaced.

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
The engine cranks when the start button is pressed but will not start.	1. The battery voltage may be low (normally results in slow cranking speed). The battery should be checked and recharged if it is not producing adequate voltage, and replace if it will not accept a full charge. 2. Make sure the glow plug switch is pressed while pressing the start switch. See the operator's manual, or the operation section of this manual for proper starting procedure 3. Make sure the fuel valve on the fuel sediment filter is in the open position. 4. Check that the machine has an adequate supply of fresh, clean fuel. 5. The fuel filter may be clogged, replace if necessary. 6. Check the oil level.	CONTACT DEUTZ - (800) 241-9886
The engine shuts down shortly after starting.	1. Check for adequate supply of clean fresh fuel. 2. Check fuel and air filters, replace if necessary. 3. Check oil level, add oil as required. Look for oil leakage. 4. Check for loose or faulty battery cable connections.	CONTACT DEUTZ- (800) 241-9886
The engine will not develop full power.	1. The fuel may be old or contaminated. Supply the engine with clean fresh fuel. 2. The fuel filter may be clogged, replace if necessary. 3. The air filter may be clogged, replace if necessary	CONTACT DEUTZ- (800) 241-9886
The engine will not idle down to low RPM. The machine has normal weld and auxiliary output.	1. Make sure the idle switch is in the "AUTO IDLE" position. 2. Make sure there is no external load on the weld terminals or the auxiliary power receptacles.	1. Check for damaged wiring or faulty connections at the run/stop switch and the ECU. 2. CONTACT DEUTZ- (800) 241-9886

Problem (Symptoms)	Possible Areas of Misadjustment(s)	Recommended Course of Action
The engine will not go to high idle when using auxiliary power. Auxiliary power is normal when the idler switch is in the "HIGH" idle position, the automatic idle function works properly when welding.	1. The load on the auxiliary receptacle may be too low. The automatic idle system will not function reliably if the low is less than 100 Watts. 2. The device connected to the auxiliary power may be defective try another device. 3. Make sure the connections to the auxiliary device are tight. 4. Some device are designed to sense for adequate input power. Product of this type may not turn on due to low voltage and frequency of the idling machine. If this happens the current draw will likely be insufficient to activate the automatic idle system.	1. Check that leads #3 and #6 are properly routed through the toroidal current sensor. Each lead must have two turns and must pass through the sensor in the opposite direction. **SEE WIRING DIAGRAM.** The leads should be wrapped tightly and tie wrapped in place. 2. Check the toroidal current sensor for any signs of damage. Check leads #260 and #261 for poor connections and damage to the conductors and insulation between the toroid current sensor and the P33 connector in the CHUI. Measure the resistance of the toroidal current sensor. If the sensor is shorted or open, replace it. 3. The ECU may be defective.
The engine will not go to high idle when striking arc. The automatic idle system functions normally when using auxiliary power. Welding and auxiliary outputs are normal when the idle switch is in the "HIGH IDLE" position.	1. Check that the welding cables are in good working condition and the connections are tight. Make sure the work clamp is attached to clean, bare metal.	1. Check the leads and connections at the SHUNT at the Positive output stud. 2. Check lead 204S and 206S for continuity from the shunt to J20 on the Smart Chopper.

Test Procedures

⚠ WARNING

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If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed.

Call 1-888-935-3877.

CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

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TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the case sheet metal covers.

MATERIALS NEEDED

- 3/8" wrench
- 1/2" wrench

PROCEDURE

1. Turn the engine off.
2. Using the 3/8" wrench, remove the battery cover. Slide the battery out and disconnect the negative battery cable.
3. Unlatch and open the right side service access door. **SEE FIGURE F.1.**
4. Slide the door back 8” to notch in rail. Lift left hinge from track. Slide door forward 2” to notch in rail and lift right hinge from track.
5. Remove access door.
6. With the 1/2” wrench, remove the exhaust pipe rain cap.
7. Remove the fuel tank cap, gasket, and the lift bail cover seal.
8. Remove the screws mounting the roof in place.
9. With the help of an assistant, carefully remove the roof. Replace the fuel cap.
10. With the 3/8” wrench, remove the right case side and the left case side. **SEE FIGURE F.1.**

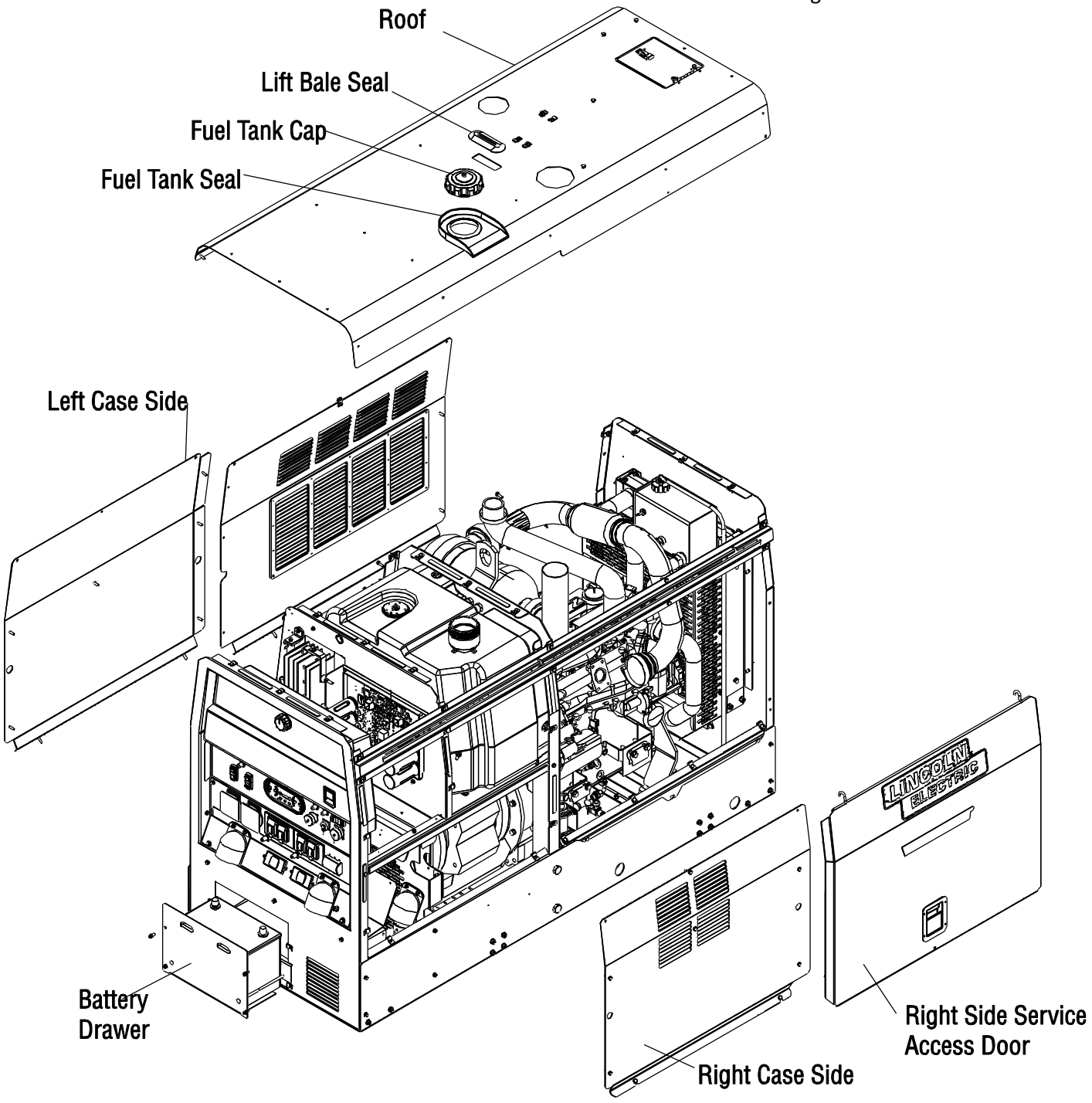

Figure F.1

REPLACEMENT PROCEDURE

1. Install components in reverse order of removal.
2. Be sure components align correctly.
3. Reconnect battery and replace battery door

CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE

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TEST DESCRIPTION

This procedure will insure that the large capacitors in the chopper module have been discharged. This procedure should be performed whenever work is to be attempted on or near the chopper module.

MATERIALS NEEDED

- Miscellaneous hand tools
- Volt/Ohmmeter
- Resistor (25-1000 ohms and 25 watts minimum) Lincoln part #S10404-114 works well for this purpose
- Jumper leads
- Wiring Diagram

⚠ WARNING

ELECTRIC SHOCK can kill.

Do not touch electrically hot parts.

Prior to performing preventative maintenance, perform the following capacitor discharge procedure to avoid electric shock.

DISCHARGE PROCEDURE

1. Turn the engine off.
2. Perform the Case Cover Removal procedure. NOTE: It is necessary to remove the fuel cap in order to take the case cover off the machine. Be sure the fuel cap is ON when discharging the chopper module capacitors.
3. Locate the chopper module and capacitor assembly on the inner machine baffle. **SEE FIGURE F.2** and the Wiring Diagram. **NEVER USE A SHORTING STRAP TO DISCHARGE CAPACITORS**. If the Lincoln recommended resistor, or an equivalent resistor is used, the capacitors can be discharged by holding the resistor with insulated pliers and using the resistor terminals to bridge Chopper Module terminals B1 to B2, and B4 to B5. **DO NOT TOUCH THE TERMINALS OR METAL PARTS OF THE PLIERS WITH YOUR BARE HANDS.** Hold the resistor in place for about 10 seconds. If another type of resistor is used, jumper leads may need to be attached to the resistor. The leads can then be used to connect terminals B1 to B2, and B4 to B5.
4. Using the volt/ohmmeter, check the voltage across B1 and B2, then B4 and B5. It should be zero volts in both cases.

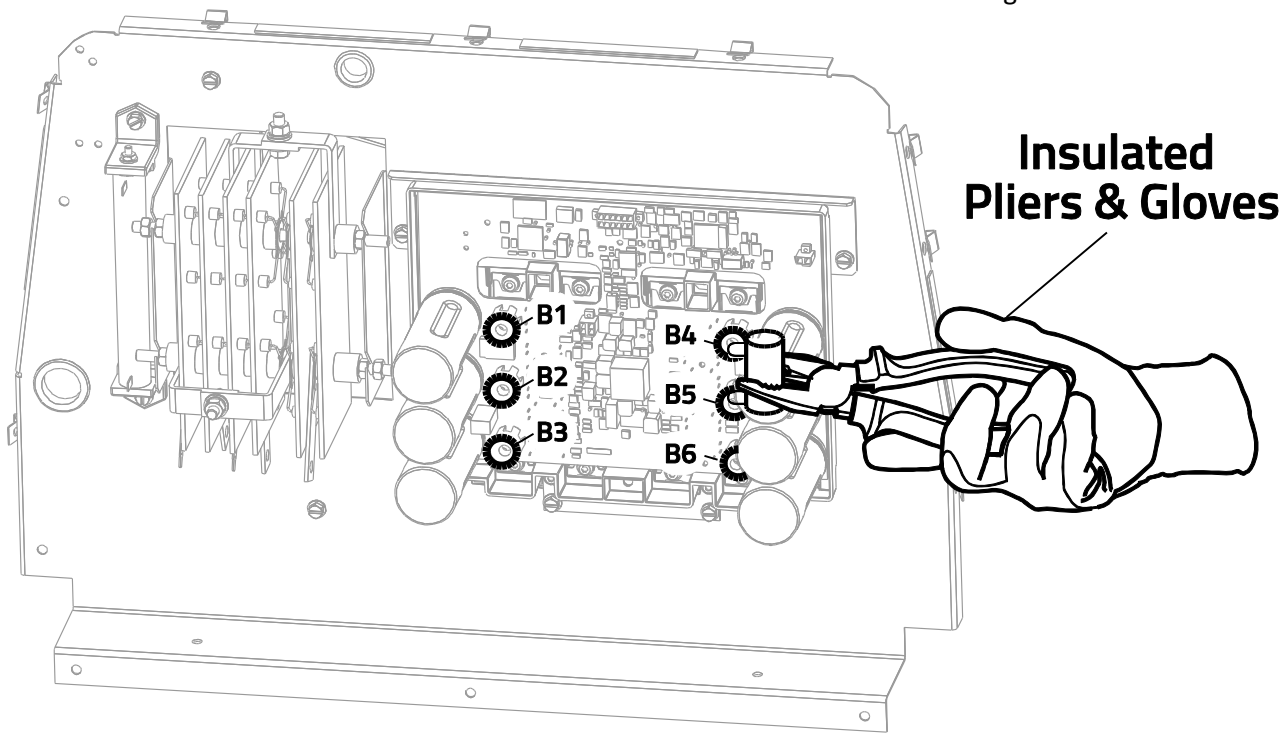

Figure F.2

ENGINE ALTERNATOR TEST

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TEST DESCRIPTION

This test will determine if the engine alternator is properly charging the battery

MATERIALS NEEDED

- Miscellaneous hand tools
- Volt meter
- Wiring Diagram

TEST PROCEDURE

1. Turn the engine off.
2. Open the battery access door and check the voltage at the battery terminals. It should be approximately 12 volts DC.
3. Attach the meter leads to the battery terminals, being careful to position them so they stay clear of moving parts while the engine is running.
4. Place the idle switch in the “HIGH IDLE” position, start the engine, and allow it to run at high idle speed for about 15 to 30 seconds.
5. The meter should read about 13.7 to 14.2 VDC. 6. If the meter reads correctly the engine alternator is producing adequate power to charge the battery and this test is complete.
6. If the voltage is significantly higher than the above values, the alternator is not properly regulating the battery charging voltage and should be replaced. If the voltage reads the same or less than the measurement taken when the engine was not running, proceed with the following tests.
7. Turn off the engine, disconnect the meter from the battery, and open the engine access door on the left side of the machine.
8. Make sure the idle switch is still in the “high” position, start the engine, and allow it to run at high idle speed for about 15 to 30 seconds.
9. Place the negative meter probe on a good chassis ground, or the negative battery terminal. Place the positive meter probe on the battery terminal on the back of the alternator. (Lead #238ALT) **SEE FIGURE F.7**. **SEE WIRING DIAGRAM.**
10. The meter should read about 13.7 to 14.2 VDC.
11. If the meter reads correctly, check the connections between the alternator and the battery. **SEE WIRING DIAGRAM**
12. If the reading is incorrect check from 238ALT to ground. The meter should read >9VDC.

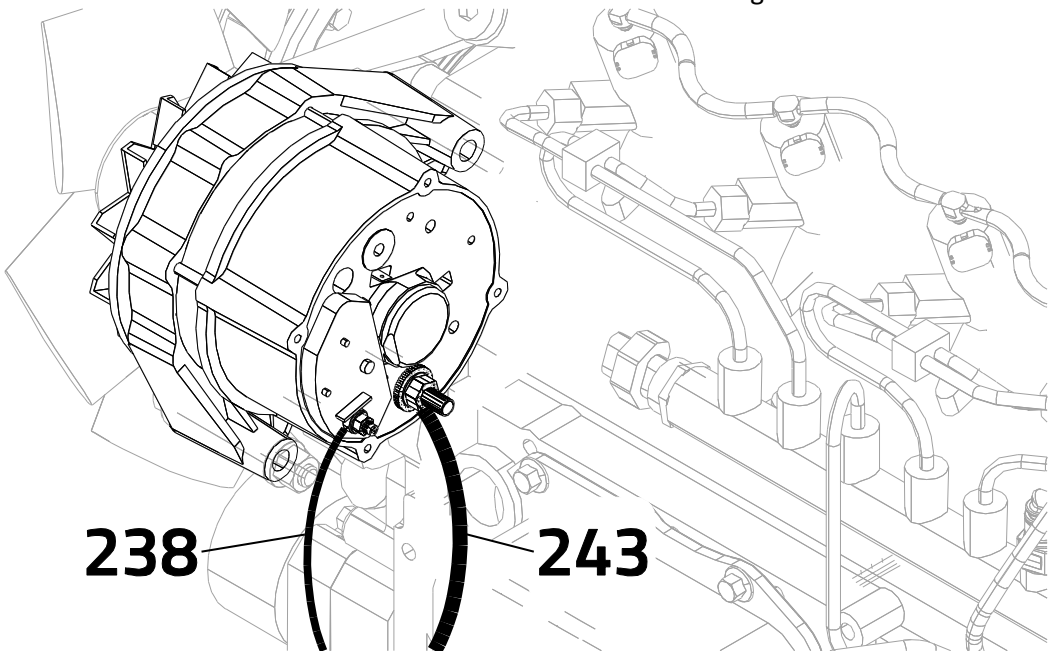

Figure F.7

BRUSH AND SLIP RING SERVICE PROCEDURE

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DESCRIPTION

This procedure provides guidance in testing and maintaining the brush and slip ring system.

MATERIALS NEEDED

- Volt/Ohmmeter
- Miscellaneous hand tools
- 500 or 600 grit emery cloth

TEST PROCEDURE

1. Perform the Case Cover Removal Procedure
2. Examine brushes and slip rings. The slip rings, brush holder, and brushes should be clean and free from oil or grease. The brushes should be making good, continuous contact with the slip rings.
3. The brushes should be of sufficient length and have adequate spring tension. Generally, the brushes should be replaced if either brush has less than 1/4” remaining before it reaches the end of its travel. Spring tension should be sufficient to hold the brushes firmly against the slip rings.
4. The brushes should be removed from the brush holder and examined. The terminals should be clean. The shunt, (braided lead connecting the carbon brush to the terminal) should be in good condition and firmly connected to the carbon brush and to the connection terminal.
5. If the slip rings are discolored, display evidence of excessive sparking, or the brushes have worn prematurely; these may be signs of a grounded or shorted rotor. Perform the rotor resistance test.
6. Check for evidence of sticking brushes. Sticking brushes will normally result in the slip rings being pitted and discolored from excessive arcing. Another sign of sticking brushes is instability or loss of both weld and auxiliary output, but the machine may begin to work properly, for a short time, after being jarred or moved.
7. If there is any evidence that the brushes may have been sticking in the brush holders, a new brush holder and brush assembly should be installed.

Cleaning slip rings:

1. In the event that the slip rings have become dirty, discolored or mildly pitted, it will be necessary to clean them, using very fine, 500 or 600 grit sand paper
2. Perform the Case Cover Replacement Procedure Note: **SEE FIGURE F.8** for general locations.

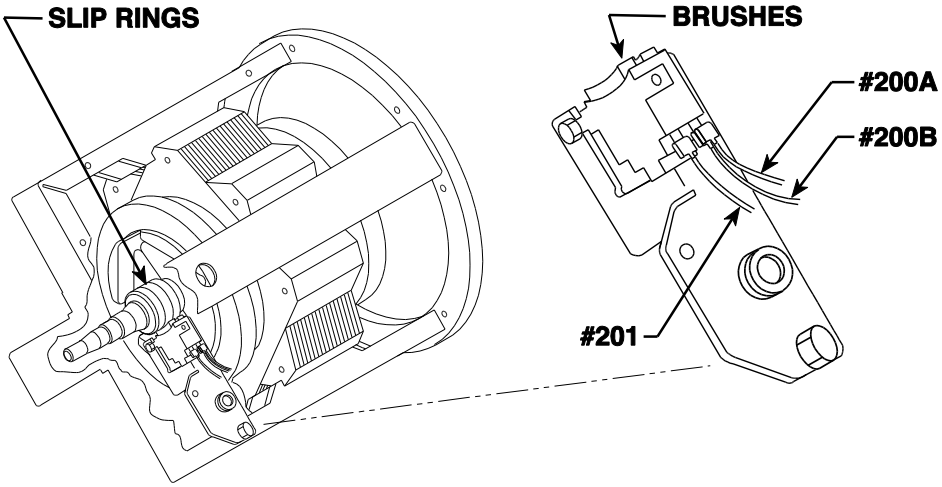


Figure F.8

ROTOR RESISTANCE AND GROUND TEST (STATIC)

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the rotor winding is open, shorted, or grounded.

MATERIALS NEEDED

- Miscellaneous hand tools
- Ohmmeter (Analog type meter required for dynamic resistance test.)
- Wiring Diagram

TEST PROCEDURE

1. Turn the engine off.
2. Perform the Case Cover Removal procedure.
3. Remove the brush holder bracket assembly from the stator tie bar assembly. **SEE FIGURE F.9.** This will electrically isolate the rotor windings.
4. Using the ohmmeter, check the rotor winding resistance across the slip rings. **SEE FIGURE F.9.** Normal resistance is approximately 25 ohm, at 77º F. (25º C.).
5. Measure the resistance to ground. Place one meter probe on either of the slip rings. Place the other probe on any good unpainted chassis ground. The resistance should be very high, at least 500,000 (500k) ohms.
6. If the test does not meet the resistance specifications, then the rotor may be faulty and should be replaced.
7. If this test meets the resistance specifications, continue testing using the **DYNAMIC ROTOR RESISTANCE AND GROUND TEST**.

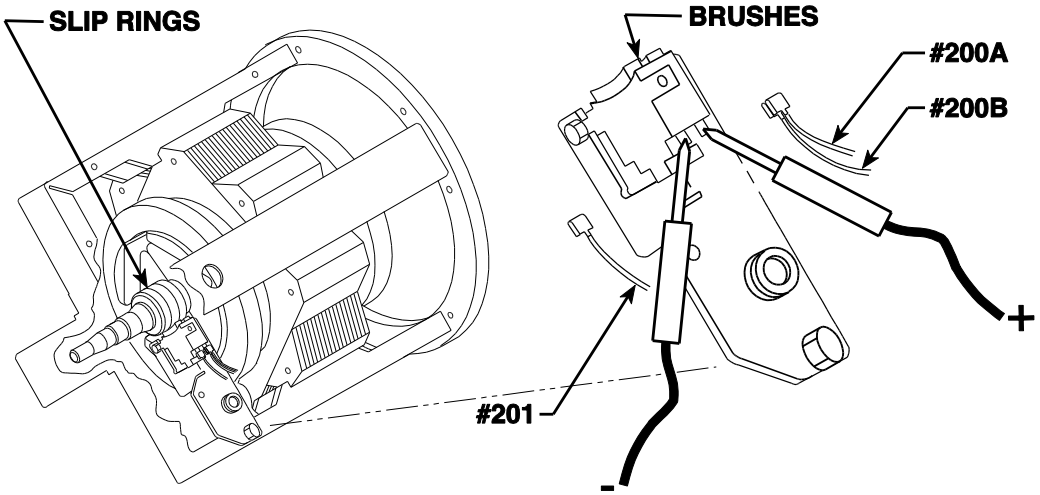


Figure F.9

ROTOR RESISTANCE AND GROUND TEST (DYNAMIC)
(Also referred to as flying resistance test)

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test checks for faults in the rotor winding, while these windings are being stressed by the mechanical forces encountered during normal operation.

MATERIALS NEEDED

- Miscellaneous hand tools
- Ohmmeter Analog type meter required for dynamic resistance test.)
- Wiring Diagram

Note: This test is best performed with a good quality analog type ohmmeter. Many digital meters will not provide stable or accurate Resistance readings while the rotor is spinning.

TEST PROCEDURE

This test requires that the brushes and slip rings are clean, in good condition, and are properly seated.

1. Perform the brush and slip ring service procedure if necessary.
2. Remove leads #200A and #201 from the field capacitor. Securely attach the ohmmeter leads to the lead terminals. Use clips or terminals to attach the leads BEFORE starting the engine. Make sure the leads are not touching any part of the machine.
3. Start the engine and run it at high idle speed. The resistance should read approximately 25Ω at 77ºF (25º C.)
4. Shut off engine, and move one of the ohmmeter leads to a good clean chassis ground.
5. Restart the engine and run it at high idle speed (1860-1890 RPM). The resistance should be very high, at least 500,000 (500k) ohms.
6. If the resistance readings differ significantly from the values indicated, re-check the brushes and the brush spring tension. If the brushes and slip rings are good, replace the rotor.
7. If all testing is finished, perform the Case Cover Replacement procedure.

*NOTE: The resistance of the windings will change with temperature. Higher temperatures will produce higher resistance, and lower temperatures will produce lower resistance.

FLASHING VOLTAGE TEST

(Engine Off)

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test checks the flashing voltage. This is to be done with the ignition switch on, and the engine not running.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Wiring Diagram

TEST PROCEDURE

1. Perform the Case Cover Removal Procedure.
2. Make sure that the battery is fully charged and in good condition, and the battery connections are clean and tight.
3. Place the RUN/STOP switch in the “RUN” position.
4. Place the voltmeter probes on brush terminals.
5. Measure the voltage; it should read about 3VDC.
6. Set the RUN/STOP switch to the “STOP” position.
7. If the meter reading indicates battery voltage, about 12 to 14 VDC, The rotor may be open, or the brushes may be faulty or not making proper contact with the slip rings.
8. Perform the Rotor Resistance Test. Perform the Brush and Slip Ring Service Procedure.
9. If the voltage measures zero or very near zero; this condition could be caused by a poor connection or a defective component in the flashing circuit, or a shorted rotor winding.
10. Perform the Rotor Resistance Test.
11. Refer to the wiring diagram, pull plug P-34 from the CHUl PC board and inspect each terminal. Make sure that all terminals both on the board and in the plug are clean and in good condition, and that the pins are securely crimped to the flex leads. Perform the following additional test.
12. Switch the RUN/STOP switch to the “RUN” position. 14. Use a voltmeter to check for the presents of about 12VDC, battery voltage, at the following location on the CHUI J34-9 (lead 232C) to J34-1 (lead 5K), also J34-15 (lead 200N) to J34-1 (lead 5k).
13. If battery voltage is present at all of the above points; check the top grounding stud on inside left case from and lead #5H, also check leads #200, #200B, R3. Make sure all terminals are crimped tightly to the flex leads and arc free of corrosion.
14. If battery voltage is present at leads #232C, but not present at lead #200N The CHUI is probably defective. Replace.
15. If battery voltage is not present at lead #232C, check wiring per wiring diagram, and check the run/stop switch. Also check the ground PC board chassis ground wire, lead #5K and the stud where it connects to the chassis.
16. Set the RUN/STOP switch to the “STOP” position.
17. If testing is completed, perform the Case Cover Replacement procedure.

ROTOR VOLTAGE TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the rotor winding is operating at normal charge.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Wiring Diagram

TEST PROCEDURE

1. Perform the Case Cover Removal procedure.
2. Hold the voltmeter probes to the brushes. **SEE FIGURE F.10.** See the wiring diagram.
3. Set the RUN/STOP switch to “RUN” and the IDLE switch to “HIGH”. Start the engine and allow the RPM to stabilize for about 15 to 30 seconds. The meter should read 145 to 175 VDC.
4. Set the RUN/STOP switch to “STOP”
5. If the meter reading is normal, this test is complete.
6. If the voltage measures zero or very near zero, the rotor flashing circuit may be faulty or the rotor may be shorted.
7. Perform the Rotor Resistance and Ground Test and the Flashing Voltage Test.
8. If voltage is higher than 175 VDC, the engine RPM may be too high, or there may be voltage intrusion from one of the higher voltage stator windings to the stator exciter winding. Perform Stator Short Circuit and Ground Test.
9. If the voltage is lower than 145, but higher than 120, the engine RPM may be too low, or there may be problems in the windings or other exciter circuit components or connections. Perform the testing described below, under the heading “If the voltage measures about 3 to 5 VDC”
10. If the meter reading indicates battery voltage, about 12 to 14 VDC, the rotor may be open, or the brushes may be faulty or not making proper contact with the slip rings. Perform the Rotor Resistance Test, and Brush and Slip Ring Service Procedure.
11. If the voltage measures about 3 to 5 VDC, the generator is not building-up to normal output even though the flashing circuit appears to be functioning normally. This condition could be caused by one of several failed components or connections. Continue with the following test.
12. Check the field bridge rectifier, and capacitor; also check the wiring and terminals connecting them. See the wiring diagram.
13. Perform the Rotor Resistance Test.
14. Perform the Stator Short Circuit and Ground Test.
15. When the Stator short circuit and ground test has been completed, reconnect leads 6 and 5H to the field bridge rectifier, (D3). All other stator leads should remain disconnected and isolated at this time.
16. Be sure that there are no leads of any kind across any of the stator windings, except the 6A - 5H winding. Examine stator wiring for damage, pinched leads, chafed insulation, etc. If necessary, disconnect and isolate the stator output leads as close to the starter as possible. **SEE WIRING DIAGRAM.**

17. All of these disconnected leads should be insulated, and/or positioned so they cannot come in contact with any other wiring or chassis ground and cannot be damaged by moving parts when the engine is running.
18. Re-start the machine and measure the rotor voltage.
19. If rotor voltage continues to read significantly lower than 120 VDC, the Stator is probably defective and should be replaced.

Note: The field bridge rectifier and field capacitor may appear to function normally when tested independently, but may malfunction when placed under the stress or normal operation. For this reason, It is recommended that the bridge rectifier and the capacitor be replaced with known good components before replacing the stator.

STATOR VOLTAGE TESTS

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if the stator is able to produce correct voltage from of its windings. It will only yield meaning data if the engine high idle speed is correct, (1800 RPM), and approximately 160 VDC is present across the rotor slip rings.

NOTE: The slip ring voltage will most likely be correct if at least one of the AC output voltages is correct.

MATERIALS NEEDED

- Miscellaneous hand tools
- Voltmeter
- Test pins

TEST PROCEDURE

1. Perform the Case Cover Removal procedure.

NOTE: Voltage tests of the 120 and 120/240 VAC receptacles can be performed by placing the meter probes directly into the appropriate connection slots in the front of the receptacles rather than testing at the lead connections described below. If the meter probes are not long enough to make contact with the conductors inside the receptacles, test pins may be used.

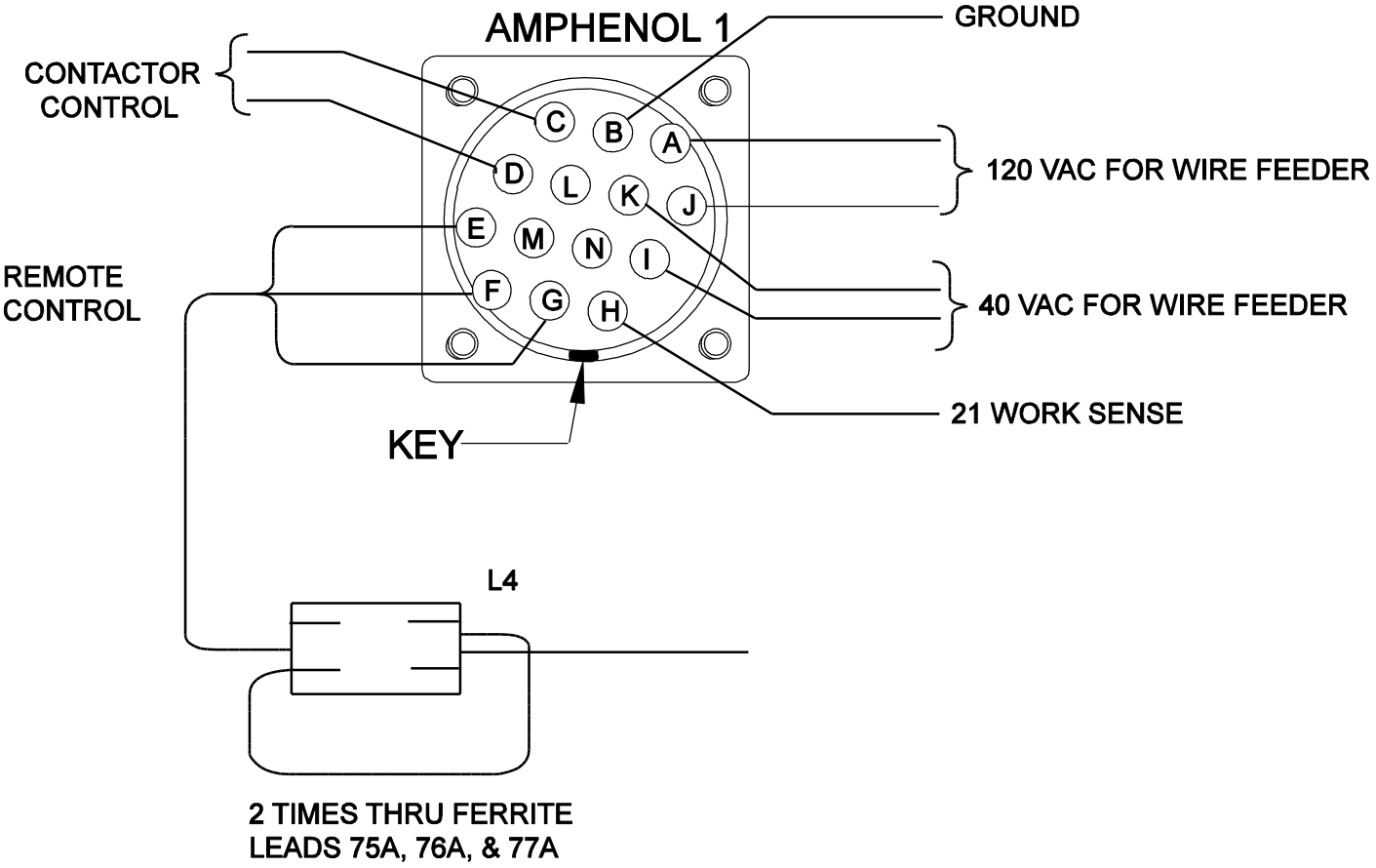


Figure F.11

To test the 120 VAC auxiliary winding:

1. Connect the volt/ohmmeter probes to either 120 VAC receptacle as follows.
2. For the upper receptacle, place the probes directly into receptacle, or connect to leads #3D and #5A. See **FIGURE F.11. SEE WIRING DIAGRAM.** For the lower receptacle, place the probes directly into the receptacle, or connect to leads #6E and 5B. **SEE FIGURE F.11. SEE WIRING DIAGRAM.**
3. Start the engine and run it at high idle (1800 RPM).
4. Check the AC voltage reading. It should read between 115 and 132 VAC.

To test the 240 VAC auxiliary winding:

1. Connect the meter probes to leads #6F and #3E where they connect to the 120/240VAC receptacle, or insert the probes into the 240 VAC connection slots in the front of the receptacle. **SEE FIGURE F.11. SEE WIRING DIAGRAM.**
2. Start the engine and run it at high idle (1800 RPM).
3. Check the AC voltage reading. It should read between 230 and 264 VAC.
4. If these voltage readings are not within the specified limits, check for tripped or defective circuit breakers, loose connections, or broken wires between the test points and the stator windings.
5. If there are no wiring problems, and the circuit breakers are not tripped or defective, the stator is defective and should be replaced.

To test the 42 VAC wire feeder winding:

1. Connect the voltmeter probes to pins “I” (lead 41A) and “K” (lead #42A) of the 14 pin Amphenol. **SEE FIGURE F.11.**
2. Start the engine and run it at high idle (1800 RPM).
3. The AC voltage reading should be between 40 and 50 VAC.
4. If these voltage readings are not within the specified limits, check for a tripped or defective circuit breakers, loose connections, or broken wires between the test points and the stator windings. If there are no wiring problems, and the circuit breakers are not tripped or defective, the stator is defective and should be replaced.

To test the 42VAC Power board supply

1. Remove leads 45 and 46 from the D2 rectifier, **SEE WIRING DIAGRAM**
2. Check for 42VAC across 45 and 46
3. If the voltage readings are not within specified limits, check for broken wires between the test point and the stator.
4. If there are no wiring problems, the stator is defective.

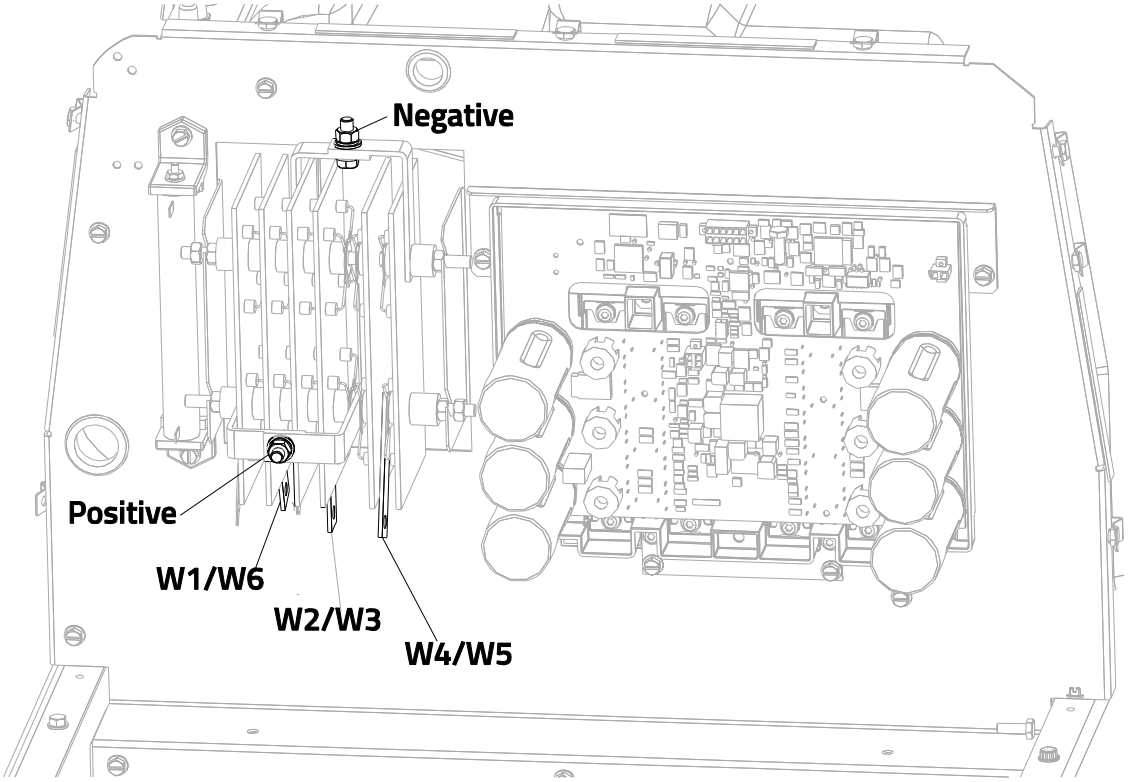


Figure F.12

To test the three-phase weld winding:

1. Locate weld winding leads W1/W6, W2/W3, and W4/W5 where they connect to the three-phase output bridge rectifier. **SEE FIGURE F.12**. **SEE WIRING DIAGRAM.**
2. Start the engine and run it at high idle (1800 RPM).
3. Check for about 60 to 65 VAC from leads W1/W6 to W2/W3, W2/W3 to W4/W5, and W4/W5 to W1/W6.
4. If these voltage readings are not within the specified limits, check for loose connections or broken wires between the test points and the stator windings. If there are no wiring problems, the stator is defective and should be replaced.

* These values are maximum for a cold machine.

STATOR SHORT CIRCUIT & GROUND TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will determine if there are undesirable electrical connections between the stator windings and chassis ground, or between individual windings within the stator. This test should be performed if flashing voltage is present at the rotor slip rings, Rotor resistance, field bridge rectifier, field capacitor and all associated wiring are proven to be good, but the stator output voltage fails to build-up to normal levels, or is too high in one or more, but not all, of the windings.

MATERIALS NEEDED

- Miscellaneous hand tools
- Ohm meter

TEST PROCEDURE

1) Perform **CASE COVER REMOVAL PROCEDURE**.
2) Perform **CAPACITOR DISCHARGE PROCEDURE**.
3) Unplug anything that may be connected to the auxiliary receptacles or the 14 pin amphenol.
4) Disconnect and isolate GND-5 lead from the bottom ground screw inside the left case front, and #5A from the neutral stud. See control Inner-Connection diagram. **SEE FIGURE F.13.**

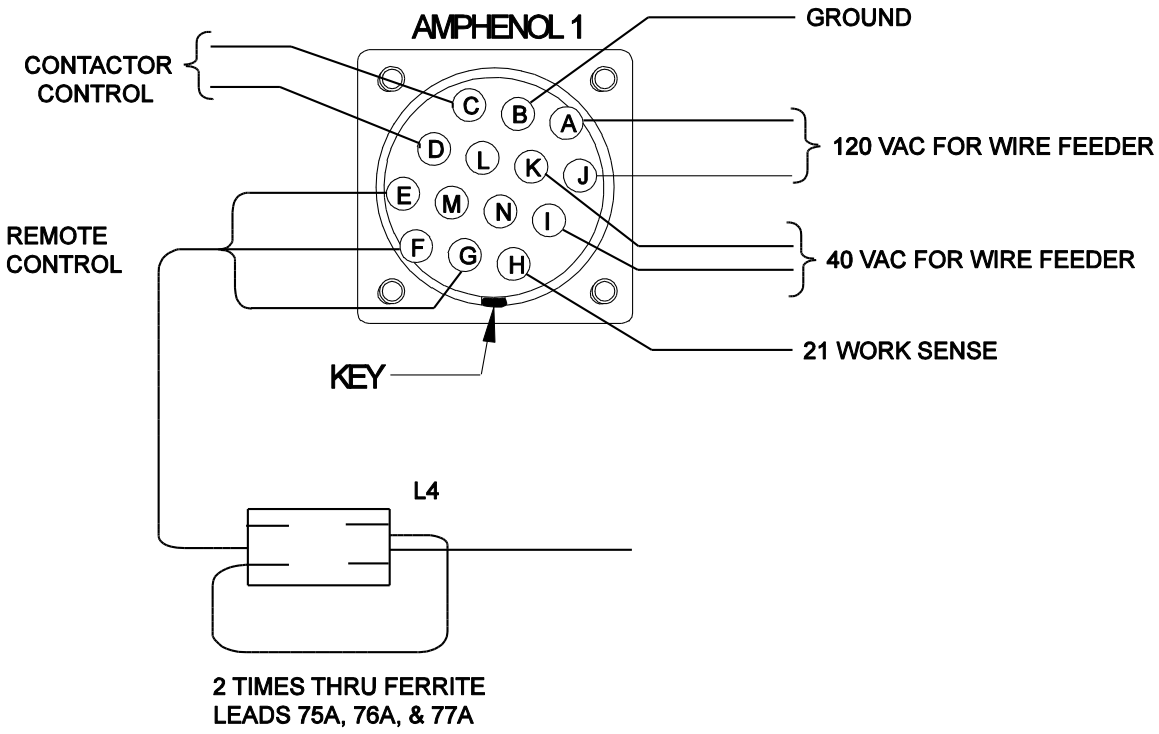


Figure F.13

5) Disconnect the #5H and #6 leads from the field bridge rectifier. **SEE WIRING DIAGRAM.**
6) Using an ohmmeter, check the resistance between chassis ground and each of the following points; Resistance should read very high, 500,000 (500K) ohms minimum.
    a. Lead #6 to Chassis Ground
    b. Lead W1/W6 to Chassis Ground
    c. Lead 42 to Chassis Ground
    d. Lead 45 to Chassis Ground
    e. Lead W1/W6 to Lead #6
    f. Lead W1/W6 to Lead 42
    g. Lead W1/W6 to Lead 45
    h. Lead 42 to Lead 45
    i. Lead 42 to Lead #6
    j. Lead 45 to Lead#6

If any of the above readings is less than 500,000 (500k) ohms, check for damaged, contaminated, or shorted wiring or components between the test points and the stator winding. If necessary, disconnect and isolate the stator leads as close to the stator winding as possible. **SEE WIRING DIAGRAM.** If the low resistance is determined to be between the windings within the stator, the stator is defective and should be replaced*.

NOTE: The field bridge rectifier and field capacitor may appear to function normally when tested independently. But may malfunction when placed under the stress of normal operation. For this reason, it is recommended that the bridge rectifier and capacitor be replaced with known good components before replacing the stator.

OUTPUT RECTIFIER BRIDGE TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

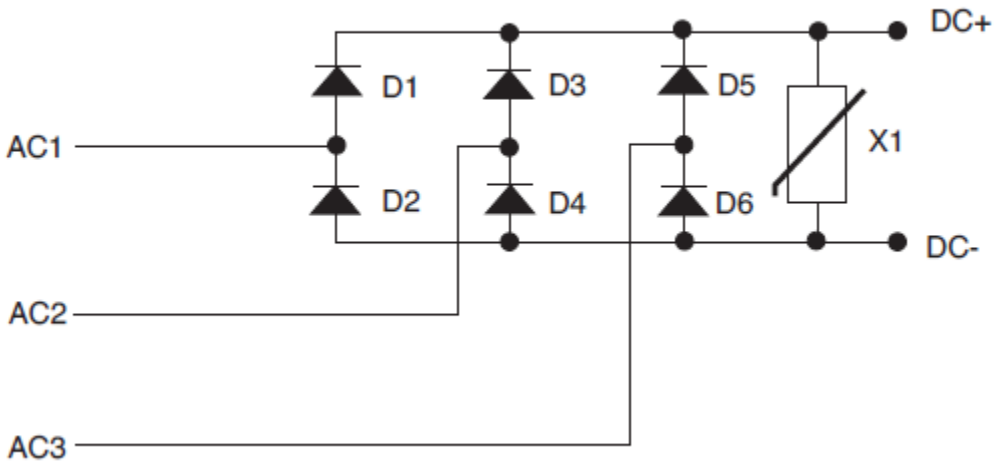
TEST DESCRIPTION

This test will determine if the rectifier is grounded, or if there are any failed diode groups.

NOTE: This test will not be able to detect individual open diodes within a group.

MATERIALS NEEDED

- Miscellaneous hand tools
- Diode tester (For testing diodes)
- Ohm meter (any type for ground test)



TEST PROCEDURE

1. Turn the engine off.
2. Perform the **CASE COVER REMOVAL PROCEDURE.**
3. Perform the **CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE**.

Electrically isolate the three-phase input terminals of the output bridge rectifier as follows:

- Mark leads W1/W6, W2/W3, and W4/W6 so they can be properly reconnected after the test is complete.
- Remove these leads and position them so they do not come in contact with any part of the rectifier.
- **SEE FIGURE F.15. SEE WIRING DIAGRAM.**

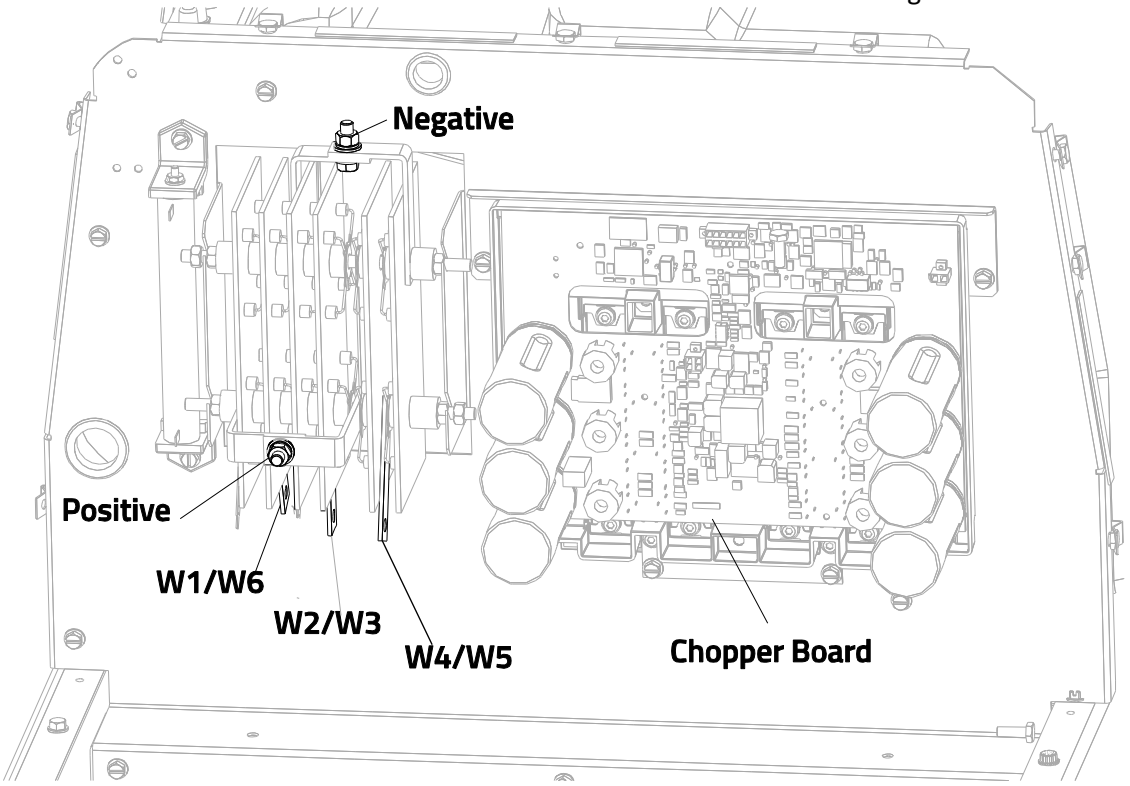


Figure F-15

Electrically isolate the DC output terminals of the rectifier:

1. Mark the leads connected to the positive and negative terminals of the output bridge rectifier to assure that they can be reconnected properly.
2. Check for grounds by placing one of the ohm meter probes on a clean, unpainted metal surface of the machine. Touch the other probe to each of the five rectifier terminals. The resistance to chassis ground from each terminal should be very high, 500,000 (500K) ohms minimum. If the resistance reading is less than specified, the rectifier is grounded and should be replaced.
3. If using diode checker or a multimeter with diode check functionality, read and understand the instructions that accompany your test equipment...
4. Test all of the diode groups per the *Table F.1.*

Table F.1

Test Point	+ Meter Lead	- Meter Lead	Measured Value	Component Tested
1.)	Terminal AC1	Positive Terminal	~.45VDC	Output Rectifier
2.)	Terminal AC2	Positive Terminal	~.45VDC	
3.)	Terminal AC3	Positive Terminal	~.45VDC	
4.)	Negative Terminal	Terminal AC1	~.45VDC	
5.)	Negative Terminal	Terminal AC2	~.45VDC	
6.)	Negative Terminal	Terminal AC3	~.45VDC	

CHOPPER MODULE FUNCTION TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will help determine if the chopper module is functioning properly, and receiving the correct input from the output rectifier and Power Board This test can only provide meaningful results if the machine is producing normal AC auxiliary output.

MATERIALS NEEDED

- Miscellaneous hand tools
- Digital Multi-meter
- Wiring diagram

TEST PROCEDURE

1. Perform the Case Cover Removal Procedure.
2. Perform the Chopper Module Discharge Procedure.
3. Make sure that there is nothing plugged into either of the Amphenol receptacles.
4. Place idle switch in the “HIGH” position.
5. Place the mode switch in the “CC-STICK” position.
6. Place the Welding Terminal switch in the “REMOTELY CONTROLLED” position.
7. Start the engine and allow it to stabilize at high idle RPM.
8. Check for 80 to 100 VDC at terminals B1- to B2+ and B4- to B5+ of the chopper module. **SEE WIRING DIAGRAM** and **FIGURE 16.**

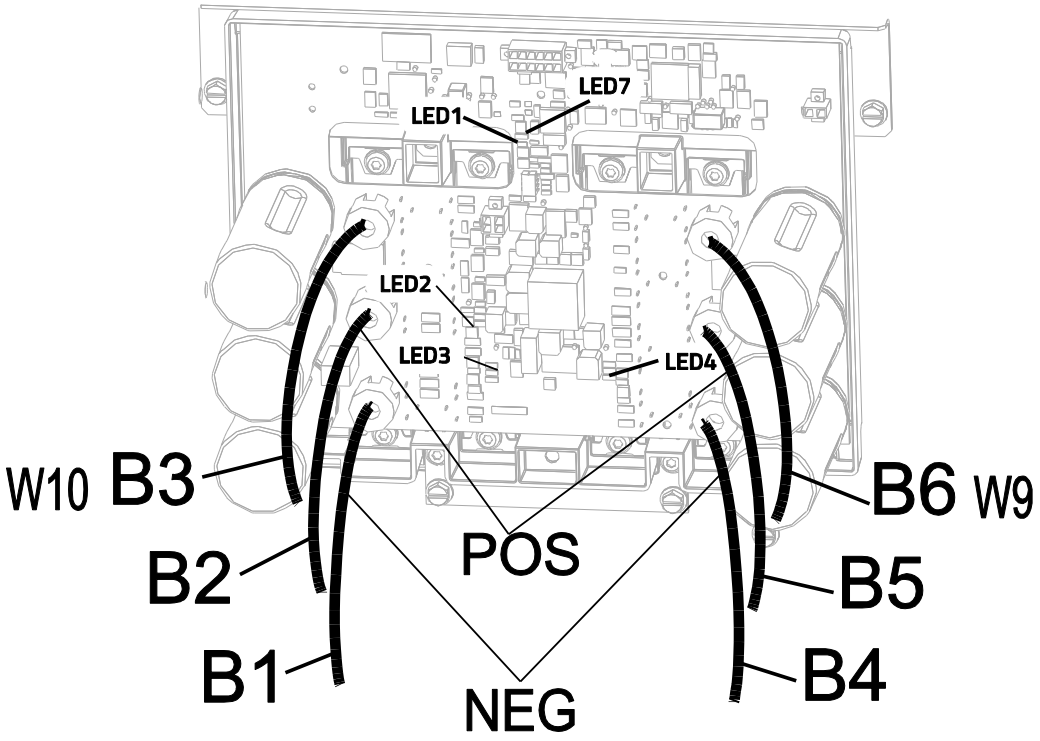


Figure F.16

9. If the correct DC voltage is not present at terminals B1- to B2+ and B4- to B5+, check for damaged conductors or faulty connections between the chopper module, the output rectifier, and the stator weld winding. **SEE FIGURE F.17. SEE THE WIRING DIAGRAM. PERFORM THE STATOR VOLTAGE TESTS, AND THE OUTPUT RECTIFIER TEST.** Check for 40VDC at lead 51C (J22-2) and lead 52C (J22-3)
10. If the correct voltage is present at terminals B1- to B2+ and B4- to B5+ of the chopper module, check for DC voltage at the chopper module terminals B2+ to B3-, and B5+ to B6-, If significant voltage is present, disconnect J21 from the Smart chopper PC board. If voltage is still present, the chopper module is shorted and should be replaced.
11. If the voltage drops to 0 VDC after J21 has been disconnected, CHUI PC board may be faulty
12. Reconnect J21 and place the Welding Terminal switch in the “WELD TERMINALS ON” position.
13. Check for about 58 VDC between Chopper Module Terminals B2+ to B3-, and B5+ to B6 and between the welder output terminals. **SEE FIGURE F.16. SEE THE WIRING DIAGRAM.**
14. If about 58 VDC is present at chopper module terminals B2+ to B3-, and B5+ to B6-, but not at the output terminals, there is a problem between the chopper module and one of the output terminals. Check for damaged conductors or faulty connections, The POS and CHOKE leads. Also check the shunt, the choke, and the connections at the back of the output terminals. See the wiring diagram.
15. If the voltage at terminals B2+ to B3-, and B5+ to B6- of the Chopper module is significantly higher than 58 VDC, check for an open R4 load resistor.
16. If the voltage at terminals B2+ to B3-, and B5+ to B6- of the chopper module is very low, or not present, The Smart Chopper or CHUI may be defective.

SMART CHOPPER FEEDBACK TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will determine if the Smart Chopper PC board is receiving accurate current and voltage feedback from the weld circuit. This test will only yield usable information if the machine is producing some weld output.

MATERIALS NEEDED

- Digital Multi-meter suitable for accurate readings in both the millivolt and normal weld voltage ranges.
- Resistive load bank
- Ammeter, suitable for accurate readings of normal welding current. (Often built into the load bank.
- Wiring diagram

TEST PROCEDURE

1. Place the idle switch in the “HIGH IDLE” position.
2. Place the mode switch in the “CC-STICK” position.
3. Place the weld terminals switch in the “WELD TERMINALS ON” position.
4. Make sure that nothing is plugged into either Amphenol receptacle.
5. Connect the resistive load bank and the ammeter to the weld output terminals per the equipment manufacturer’s instructions; also connect the voltmeter probes across the weld output terminals.
6. Start the machine and, apply a load of about 200 Amps, as shown on the external ammeter. If the machine will not produce 200 amps, apply as much load as you can.
7. Compare the readings shown on the external ammeter and voltmeter to the amps and volts displayed on the front panel of the machine.
8. If the readings shown on the front panel displays are about the same or very close to the reading on the external meters, the feedback is probably good, and this test is complete.
9. If the readings differ significantly, continue with this procedure
10. Turn off the engine and release the load from the weld terminals. (The load bank and ammeter should remain connected, but the load should be released.)
11. Perform the Case Cover Removal Procedure.
12. Locate plugs P20 and P22 on the Smart Chopper PC board. **SEE FIGURE #1.** Remove the plugs and check for dirt, corrosion, damaged, expanded, or incorrectly positioned terminals. Repair or replace wiring components as needed and reconnect the plugs to the control board.
13. Restart the machine and apply a load across the weld terminals that measures about 200 amps. If the machine will not produce 200 amps of current, apply as much load as you can.
14. Using the voltmeter, measure and note the DC voltage at the weld output terminals.
15. Check the voltage between leads #204S+ (P20-1) and lead #208B- (P22-6) at the Smart Chopper PC board Molex plugs. The voltage should be the same as was measured at the weld terminals.
16. If the voltage readings are different, check the wiring and connections between the welding terminals and the control PC board. See the wiring diagram.

17. Connect the millivolt meter probes between lead #206S+ (P20-2) and lead 204S- (P20-1). **SEE WIRING DIAGRAM.** If the machine is currently producing 200 amps the millivolt meter should read about 25 millivolts.
18. If the machine cannot produce 200 amps of weld current, the correct millivolt signal will need to be calculated by dividing the reading displayed on the external ammeter by 8. See the following explanation.
19. The shunt used in this machine will produce 50 millivolts at a load of 400 amps, or 8 amps per millivolt.
20. To calculate the correct millivolt signal for a given load, you divide the number of amps displayed on the ammeter by 8. Example: If your ammeter reads 75, (75/8 = 9.4) If the shunt is working correctly, and the wiring between the shunt and the control PC board is in good condition, the meter connected at the control PC board should be reading about 9.4 millivolts.
21. If the millivolt reading is incorrect, check the wiring between the shunt and the control PC board for damage, grounds, and faulty connections. If the wiring is good, the shunt and lead assembly is faulty and should be replaced.
22. Perform the Case Cover Replacement Procedure.

MODE BOARD TEST

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

This test will check the mode board, arc control and associated wiring for damage, proper operation, tracking, and grounds.

MATERIALS NEEDED

- Digital Ohmmeter
- Wiring Diagram

TEST PROCEDURE

1. Turn the engine off
2. Perform the Case cover Removal Procedure.
3. Unplug P32 from control board, see control Inner-connection diagram, and visually check the plug and attached wiring for damage, corrosion, improperly seated or damaged contact pins. P32 will remain unplugged for following test.
4. Set the mode switch in the “CC-Stick” position.
5. Test the resistance between each of the leads in P32 and a good clean chassis ground connection. Be very careful that the connection pins in P32 are not damaged or spread out.
6. The resistance should be very high. A reading of 500,000 (500k) ohms or higher is acceptable.
7. If the resistance is lower than 500k Ohms, replace the potentiometer and mode switch plug and lead assembly, or replace the defective component within the assembly. **SEE WIRING DIAGRAM.**
8. Perform the following voltage check

(NEG = + STUD)

MODE	
CV	2V
PIPE	0V
CC	3.5V
GOUGE	6.5V
TIG	8V
ARCLINK	9V

9. If testing is complete, plug P32 back into the control PC board and perform the

REMOTE RECEPTACLE RESISTANCE TEST

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DESCRIPTION

This test will help determine if there is a problem with the remote receptacle control wiring, relating to electrical tracking between other control conductors, power conductors, or ground. This test also checks the function of the weld terminal switch.

MATERIALS NEEDED

- Ohm Meter
- Wiring Diagram

TEST PROCEDURE

1. Turn the machine off.
2. Perform the Case Cover Removal Procedure.
3. Make sure that there are no devices of any kind plugged into either Amphenol receptacles.
4. Remove Molex plug P33 from the CHUI PC board, Examine the Molex plug and the receptacle on the control PC board for dirt, corrosion, damaged or out-of-position pins. Repair or replace any damaged components. Position the P33 plug so it cannot make electrical contact with any other conductor or chassis ground.
5. Perform the following resistance tests shown in the following table. Be very careful not to damage or spread any of the connection pins in the Amphenol receptacle. See Table F.4.
6. If the measured resistance does not meet values specified, check for damage, dirt or moisture contamination in the Amphenol receptacles and the P33 Molex plug. Check for damaged or grounded wiring.
7. If the resistance values are found to be too low, due to contaminated electrical components in the Amphenol harness assembly. Try removing the contamination and drying the components completely. If the resistance values are still too low, replace the Amphenol harness assembly.
8. If the values are incorrect for the last two tests in the table, (Pin C to Pin D) check the welding terminal switch and the wiring connected to that switch. See the wiring diagram. Repair any faulty connections or replace the switch if necessary.
9. Plug P33 back into the Control Pc board.
10. Perform the Case Cover Replacement Procedure.

AMPHENOL RESISTANCE TEST		
WELDING TERMINAL SWITCH SETTING	**OHMMETER CONNECTION**	**OHMMETER READING**
N/A	PIN "G" (#75B) to PIN "Å" (#32)	500K or Higher
N/A	PIN "G" (#75B) to PIN "B" (GND-A)	500K or Higher
N/A	PIN "G" (#75B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "E" (#77B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "F" (#76B)	500K or Higher
N/A	PIN "G" (#75B) to PIN "H" (#21)	500K or Higher
N/A	PIN "G" (#75B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "G" (#75B) to PIN "J" (#31)	500K or Higher
N/A	PIN "G" (#75B) to PIN "K" (#42A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "A" (#42)	500K or Higher
N/A	PIN "F" (#76B) to PIN "B" (GND-A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "E" (#77B)	500K or Higher
N/A	PIN "F" (#76B) to PIN "H" (21)	500K or Higher
N/A	PIN "F" (#76B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "F" (#76B) to PIN "J" (#31)	500K or Higher
N/A	PIN "F" (#76B) to PIN "K" (#42A)	500K or Higher
N/A	PIN "E" (#77B) to PIN "A" (#32)	500K or Higher
N/A	PIN "E" (#77B) to PIN "B" (GND-2)	500K or Higher
N/A	PIN "E" (#77B) to PIN "C" (#2B)	500K or Higher
N/A	PIN "E" (#77B) to PIN "D" (#4B)	500K or Higher
N/A	PIN "E" (#77B) to PIN "H" (#21)	500K or Higher
N/A	PIN "E" (#77B) to PIN "I" (#41A)	500K or Higher
N/A	PIN "E" (#77B) to PIN "J" (#31)	500K or Higher
N/A	PIN "E" (#77B) to PIN "K" (42A)	500K or Higher
REMOTELY CONTROLLED	PIN "C" (#2B) to PIN "D" (#4B)	500K or Higher
WELD TERMINALS ON	PIN "C" (#2B) to PIN "D" (#4B)	*

OUTPUT RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

DESCRIPTION

The following procedure will aid the technician in removing and replacing the output rectifier bridge and the choke in the Vantage® 520SD.

MATERIALS NEEDED

- Miscellaneous hand tools
- Electrical joint compound (Penetrox)

PROCEDURE

1. Turn the engine off.
2. Remove negative battery cable.
3. Perform the Case Cover Removal procedure.
4. Perform the Chopper Module Capacitor Discharge procedure.
5. Remove the screws holding the case front to the base of the machine.
6. Remove all plugs and leads from the weld control and pull coil PC boards. Be sure to mark the leads and plugs so they can be properly re-connected. See the Wiring Diagram.
7. Remove the screws holding the diode bridge and the capacitor to the center baffle assembly, allowing these components to remain attached to the case front wiring.
8. Remove any additional wiring and cable ties as needed. Carefully mark leads for accurate re-connection.
9. Swing the case front to the side to permit access to the Output Rectifier and Choke. Removing the Rectifier
10. Remove the heavy leads from the Rectifier. Carefully mark the leads for accurate re-connection, and also note the order and position of multiple lead connections.
11. Remove the nuts and lock washers holding the Rectifier to the mounting bracket. You will need to reach through the large access holes on either side of the rectifier to reach these nuts.
12. Remove the Rectifier from the machine.

Removing the Output Choke

1. Remove the heavy leads from the choke. Carefully mark the leads for accurate re-connection, and also note the order and position of the leads in multiple lead connections.
2. Remove the two bolts and washers holding the choke to the mounting bracket in the machine base. Note that the bolts are in the right front and left rear corners of the choke.
3. Carefully remove the choke.

Replacing the Output Choke

1. Place the choke into the machine so that the three mounting holes in the choke line up with the holes in the mounting bracket.
2. Insert the three long bolts through the choke and the mounting bracket. Place a lock washer and nut on the end of each bolt and tighten.
3. Reconnect the choke leads. Position the leads, bolts, washers, and nuts exactly as they had been originally connected. Tighten the connection securely.

Replacing the Rectifier

1. Place the Rectifier into the machine so that its mounting studs fit into the holes in the bracket. Place a lock washer and a nut on each stud and tighten.
2. Apply a thin film of Penetrox heat sink compound (Lincoln Part T12837-1) between the surfaces of the “W” leads and the Output Rectifier. Reconnect the Rectifier, positioning the leads, bolts, washers, and nuts exactly as hey had been originally connected. Tighten all of the connections securely. See the Wiring Diagram.
3. Swing the case front back into position.
4. Attach the case front to the machine base with four screws.
5. Mount the D4 diode bridge and the capacitor to the center baffle assembly. **SEE FIGURE F.20.**
6. Reconnect all of the leads and plugs that were disconnected during the removal procedure, and replace any cable ties that were removed

CHOPPER MODULE REMOVAL AND REPLACEMENT

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of the Chopper Module Assembly. NOTE: The Chopper Module assembly is removed and replaced as a unit. It contains no serviceable parts.

MATERIALS NEEDED

- Miscellaneous Hand Tools
- Penetrox Heat Sink Compound (Lincoln Part T12837-1)

PROCEDURE

Removal

1. Turn the engine off.
2. Perform the Case Cover Removal Procedure.
3. Perform the Chopper Module Capacitor Discharge Procedure.
4. Disconnect the three Molex plugs from the board.
5. Using the 7/16” socket wrench, remove the following leads. Label the leads before removal. Cut cable ties as needed. Note placement order of the leads and fasteners: bolt, lock washer, flat washer, small lead, heavy lead.
6. Using a 3/8” socket wrench, remove the four screws holding the power module assembly to its brackets on the vertical baffle.
7. Remove the Chopper Module assembly from the machine.

Replacement

1. Mount the heat sink to the brackets on the vertical baffle with the three 3/8” screws.
2. Connect the three Mmolex plugs.
3. Using a 7/16” wrench, attach the heavy leads and small leads per the chart below. Note placement order of the leads and fasteners: screw, lock washer, flat washer, heavy lead. Apply a thin coating of Penetrox heat sink compound (Lincoln Part T12837-1) to the mating surfaces (but not the threads). Tighten the fasteners to between 50-60 in-lbs.
4. Replace any cable ties cut at disassembly.
5. When procedures are complete, Perform the Case Cover Replacement Procedure.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This procedure will aid the technician in the removal and replacement of Rotor.

MATERIALS NEEDED

- Misc. Hand Tools
- Torque Wrenches (up to 120 ft/lb)
- Hoist

NOTE: This is a complicated procedure. Read through the instructions before proceeding. Pay particular attention to the placement and sequence of leads and hardware as they are disconnected and/or removed to facilitate proper re-assembly

MACHINE DISASSEMBLY PROCEDURE

1. Perform the Case Cover Removal Procedure.
2. Remove the battery.
3. Perform the Capacitor Discharge Procedure.
4. Drain the Fuel Tank. Close the shut-off valve on the Fuel Filter and disconnect and plug the fuel line.
5. Remove and plug the upper fuel line. NOTE: Cut tie wraps as necessary in the following steps. Be sure to replace them after the new parts are installed and machine is re-assembled.
6. Disconnect leads 5J and 229 from the Fuel Level Sender at the top of the fuel tank and pull the harness thru the Power Module Panel grommet.
7. Remove the Fuel Tank.
8. Remove the bolts holding the Control Panel in place and lower the panel to provide easier access to the connections in the following steps
9. Disconnect the Stator Leads (W1 thru W6) and the POS.-Shunt lead from the Rectifier. **SEE FIGURE F.13.**
10. Disconnect the Molex plugs and the leads from the B3 and B6 terminals of the Smart Chopper Module. Note the position of the leads and placement of the hardware.
13. Un-bolt (4 places) and remove the Power Module Panel and the Fuel tank support panel
14. Disconnect the stator auxiliary winding leads 3.4 and 6 from the 3 phase circuit breaker.
15. Remove leads 3 and 6 from the toroid, noting the direction that they are wound. **SEE FIGURE F.22.** NOTE: Leads 3,4 and 6 are routed differently depending on Code Number. See the appropriate Wiring Diagram.
16. Disconnect lead 5 from the ground stud and lead 5A from the Neutral Stud on the Auxiliary Power Panel.
17. Disconnect leads 6A, 201 and 200B from the Field Rectifier.
18. Separate the in-line connections (206C and 208C) from the Bypass Filter PC Board that is mounted on the Stator Fan Shroud. **SEE FIGURE F.22.** 19. Disconnect the Green grounding lead from the Bypass Filter PC Board.
20. Remove the left side fuel tank support rail.
21. Unbolt the front panel from the base and the right side support rail and carefully fold it back towards the left side of the machine.
22. Unbolt and slide the Stator Fan Guard out the front of the machine.

STATOR REMOVAL PROCEDURE

1. Remove the brush holder bracket assembly
2. Remove the 3/4-10 hex nut and lockwasher from the end of the rotor shaft and remove the fan blade assembly.
3. Remove the two bolts holding the stator to the shock mounts.
4. Loosen the two engine mounting bolts.
5. Using a hoist and a sling or two hooks in the two large holes of the stator, lift the entire assembly far enough to gain access to the bottom two stator bolts. **SEE FIGURE F.24.**
6. Put a block under the engine for support and remove those two lower bolts. NOTE: When lifting the stator, be certain not to lift far enough to damage the cooling fan or the radiator.
7. Lower the stator and loosen the remaining six stator bolts.
8. Reposition the hoist to provide full support to the stator. Remove the bolts and carefully slide the stator off of the rotor. NOTE: Whenever the Stator or Rotor is replaced it is advisable to replace both the Bearing and the Tolerance Ring.

ROTOR REMOVAL PROCEDURE

1. Perform the Stator Removal Procedure.
2. Use a hoist and sling to support the rotor
3. Remove the bolts holding the Disc Clamping bars to the flywheel. **SEE FIGURE F.25.**
4. If the rotor is to be replaced, remove the Coupling Clamping Ring and the Coupling Disc so they can be installed on the new rotor. NOTE: Whenever the Stator or Rotor is replaced it is advisable to replace both the Bearing and the Tolerance Ring.

ROTOR REPLACEMENT PROCEDURE

1. Install the Bearing on to the rotor shaft.
2. Install the Coupling Disc and the Coupling Clamp Ring to the engine end of the Rotor using the hex head cap screws and washers from the old rotor. Tighten the bolts in an alternating fashion. IMPORTANT: The burr on the Clamping Ring is to face away from the Coupling Disc. The Burr on the Coupling Disc is to face the Rotor.
3. Install the bearing on the new rotor. NOTE: Whenever the Stator or Rotor is replaced it is advisable to replace both the Bearing and the Tolerance Ring.
4. Using a sling, position the rotor into the flywheel. Make sure it is located fully into and flush against the counterbore of the flywheel.
5. Use the clamping bars with the hex head cap screws and washers that were removed in the Rotor Removal Procedure to mount the rotor assembly to the flywheel of the engine. Tighten the bolts in an alternating fashion.

STATOR REPLACEMENT PROCEDURE

1. Apply a light coating of grease to the I.D. of the Tolerance Ring and install the tolerance ring into the bearing seat of the stator.
2. Using a hoist, slide the Stator over the rotor, making sure that the bearing lines up into the bearing seat. NOTE: The heavy Stator leads should be on the left and the Auxiliary stator leads on the right when looking at the bearing end of the stator.
3. Line up the holes in the Stator with those in the engine bell housing and insert the bolts and washers that were removed in the Stator Removal Procedure. Tighten the bolts in an alternating fashion. 4. Check the air gap between the Stator and the Rotor using a .010 feeler gage. Make sure that the gage is parallel to the rotor shaft and that it has clearance for the full length of the rotor lamination. Check the clearance in 4 places, 90° apart.
4. Replace the fan and hub assembly and lock them in place with the 3/4”nut and lockwasher. Torque the nut to a minimum of 100 in-lb.

RE-ASSEMBLY PROCEDURE

1. Slide the Stator Fan Guard into place and fasten it to the base.
2. Install the left side rail and carefully swing the front panel back into place and fasten it to the base.
3. Install the fuel tank support panel and the Power Module Panel.
4. Install the Fuel Tank.
5. Install the Brush Holder Bracket assembly.
6. Reconnect the leads that were disconnected in steps 6 thru 20 of the Machine Disassembly Procedure. Route the leads as nearly as possible to their original positions. Replace the leads on the Chopper Module exactly as they were with the heavy lead closest to the PC Board. See the Chopper Module Removal Procedure. Torque the Chopper connections to 50-60 - in-lbs. Wrap stator leads 3 and 6 through the toroid three times in opposite directions. **SEE FIGURE F.23.** Replace any tie-wraps that were cut during disassembly.
7. Perform the Case Cover Replacement Procedure.

RETEST AFTER REPAIR

Service and repair should be performed by only Lincoln Electric factory trained personnel. Unauthorized repairs performed on this equipment may result in danger to the technician or machine operator and will invalidate your factory warranty. For your safety and to avoid electrical shock, please observe all safety notes and precautions detailed throughout this manual. If for any reason you do not understand the test procedures or are unable to perform the test/repairs safely, contact the Lincoln Electric Service Department for electrical troubleshooting assistance before you proceed. Call 1-888-935-3877.

Retest a machine:

- If it is rejected under test for any reason that requires you to remove any mechanical part which could affect the machine's electrical characteristics. OR
- If you repair or replace any electrical components.

Engine Speed

Mode	No Load RPM	Loaded Rpm
Low Idle	1500	N/A
High Idle	1800	1800

Welder Output

Welder Output	Output	Open Circuit Volt	Load Volt	Load Amps
CC - Stick	Maximum	55-60	36-38	400

Auxiliary Output

240 Volt Receptacle			120 Volt Receptacle		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
230-264	216-252	50	115-132	108-126	20

42V Feeder Power

Open Circuit Voltage	Load Volts	Load Amps
40-50	38-48	8.5