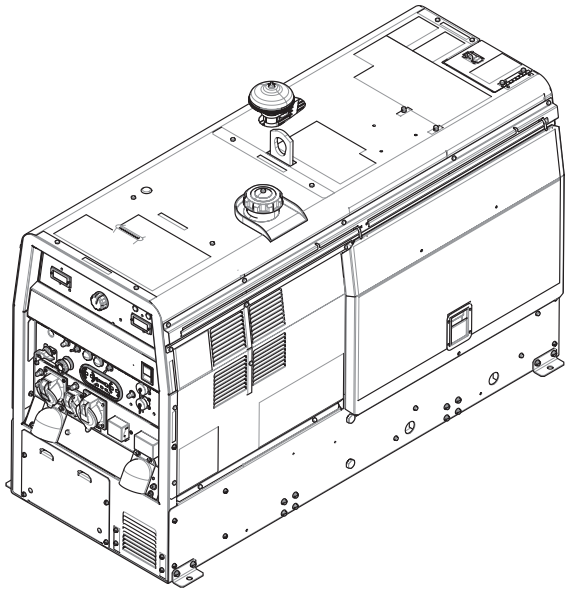
VANTAGE® 410

For use with machines having Code Numbers:

12516, 12635

SERVICE MANUAL



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SVM271 | Issue Date 16-Oct

THE LINCOLN ELECTRIC COMPANY
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THANK YOU FOR SELECTING A QUALITY PRODUCT BY LINCOLN ELECTRIC.

PLEASE EXAMINE CARTON AND EQUIPMENT FOR DAMAGE IMMEDIATELY

When this equipment is shipped, title passes to the purchaser upon receipt by the carrier. Consequently, claims for material damaged in shipment must be made by the purchaser against the transportation company at the time the shipment is received.

SAFETY DEPENDS ON YOU

Lincoln arc welding and cutting equipment is designed and built with safety in mind. However, your overall safety can be increased by proper installation ... and thoughtful operation on your part. **DO NOT INSTALL, OPERATE OR REPAIR THIS EQUIPMENT WITHOUT READING THIS MANUAL AND THE SAFETY PRECAUTIONS CONTAINED THROUGHOUT.** And, most importantly, think before you act and be careful.

⚠ WARNING

This statement appears where the information must be followed exactly to avoid serious personal injury or loss of life.

⚠ CAUTION

This statement appears where the information must be followed to avoid minor personal injury or damage to this equipment.

KEEP YOUR HEAD OUT OF THE FUMES.

DON'T get too close to the arc. Use corrective lenses if necessary to stay a reasonable distance away from the arc.

READ and obey the Safety Data Sheet (SDS) and the warning label that appears on all containers of welding materials.

USE ENOUGH VENTILATION or exhaust at the arc, or both, to keep the fumes and gases from your breathing zone and the general area.

IN A LARGE ROOM OR OUTDOORS, natural ventilation may be adequate if you keep your head out of the fumes (See below).

USE NATURAL DRAFTS or fans to keep the fumes away from your face.

If you develop unusual symptoms, see your supervisor. Perhaps the welding atmosphere and ventilation system should be checked.

WEAR CORRECT EYE, EAR & BODY PROTECTION

PROTECT your eyes and face with welding helmet properly fitted and with proper grade of filter plate (See ANSI Z49.1).

PROTECT your body from welding spatter and arc flash with protective clothing including woolen clothing, flame-proof apron and gloves, leather leggings, and high boots.

PROTECT others from splatter, flash, and glare with protective screens or barriers.

IN SOME AREAS, protection from noise may be appropriate.

BE SURE protective equipment is in good condition.

Also, wear safety glasses in work area **AT ALL TIMES.**

SPECIAL SITUATIONS

DO NOT WELD OR CUT containers or materials which previously had been in contact with hazardous substances unless they are properly cleaned. This is extremely dangerous.

DO NOT WELD OR CUT painted or plated parts unless special precautions with ventilation have been taken. They can release highly toxic fumes or gases.

Additional precautionary measures

PROTECT compressed gas cylinders from excessive heat, mechanical shocks, and arcs; fasten cylinders so they cannot fall.

BE SURE cylinders are never grounded or part of an electrical circuit.

REMOVE all potential fire hazards from welding area.

ALWAYS HAVE FIRE FIGHTING EQUIPMENT READY FOR IMMEDIATE USE AND KNOW HOW TO USE IT.

SECTION A: WARNINGS

CALIFORNIA PROPOSITION 65 WARNINGS

Diesel Engines

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm.

Gasoline Engines

The engine exhaust from this product contains chemicals known to the State of California to cause cancer, birth defects, or other reproductive harm.

ARC WELDING CAN BE HAZARDOUS. PROTECT YOURSELF AND OTHERS FROM POSSIBLE SERIOUS INJURY OR DEATH. KEEP CHILDREN AWAY. PACEMAKER WEARERS SHOULD CONSULT WITH THEIR DOCTOR BEFORE OPERATING.

Read and understand the following safety highlights. For additional safety information, it is strongly recommended that you purchase a copy of "Safety in Welding & Cutting - ANSI Standard Z49.1" from the American Welding Society, P.O. Box 351040, Miami, Florida 33135 or CSA Standard W117.2-1974. A Free copy of "Arc Welding Safety" booklet E205 is available from the Lincoln Electric Company, 22801 St. Clair Avenue, Cleveland, Ohio 44117-1199.

BE SURE THAT ALL INSTALLATION, OPERATION, MAINTENANCE AND REPAIR PROCEDURES ARE PERFORMED ONLY BY QUALIFIED INDIVIDUALS.

FOR ENGINE POWERED EQUIPMENT.

1.a. Turn the engine off before troubleshooting and maintenance work unless the maintenance work requires it to be running.

1.b. Operate engines in open, well-ventilated areas or vent the engine exhaust fumes outdoors.

1.c. Do not add the fuel near an open flame welding arc or when the engine is running. Stop the engine and allow it to cool before refueling to prevent spilled fuel from vaporizing on contact with hot engine parts and igniting. Do not spill fuel when filling tank. If fuel is spilled, wipe it up and do not start engine until fumes have been eliminated.

1.d. Keep all equipment safety guards, covers and devices in position and in good repair. Keep hands, hair, clothing and tools away from V-belts, gears, fans and all other moving parts when starting, operating or repairing equipment.

1.e. In some cases it may be necessary to remove safety guards to perform required maintenance. Remove guards only when necessary and replace them when the maintenance requiring their removal is complete. Always use the greatest care when working near moving parts.

1.f. Do not put your hands near the engine fan. Do not attempt to override the governor or idler by pushing on the throttle control rods while the engine is running.

1.g. To prevent accidentally starting gasoline engines while turning the engine or welding generator during maintenance work, disconnect the spark plug wires, distributor cap or magneto wire as appropriate.

1.h. To avoid scalding, do not remove the radiator pressure cap when the engine is hot.

ELECTRIC AND MAGNETIC FIELDS MAY BE DANGEROUS

2.a. Electric current flowing through any conductor causes localized Electric and Magnetic Fields (EMF). Welding current creates EMF fields around welding cables and welding machines

2.b. EMF fields may interfere with some pacemakers, and welders having a pacemaker should consult their physician before welding.

2.c. Exposure to EMF fields in welding may have other health effects which are now not known.

2.d. All welders should use the following procedures in order to minimize exposure to EMF fields from the welding circuit:

2.d.1. Route the electrode and work cables together - Secure them with tape when possible.

2.d.2. Never coil the electrode lead around your body.

2.d.3. Do not place your body between the electrode and work cables. If the electrode cable is on your right side, the work cable should also be on your right side.

2.d.4. Connect the work cable to the workpiece as close as possible to the area being welded.

2.d.5. Do not work next to welding power source.

ELECTRIC SHOCK CAN KILL.

3.a. The electrode and work (or ground) circuits are electrically “hot” when the welder is on. Do not touch these “hot” parts with your bare skin or wet clothing. Wear dry, hole-free gloves to insulate hands.

3.b. Insulate yourself from work and ground using dry insulation. Make certain the insulation is large enough to cover your full area of physical contact with work and ground.

In addition to the normal safety precautions, if welding must be performed under electrically hazardous conditions (in damp locations or while wearing wet clothing; on metal structures such as floors, gratings or scaffolds; when in cramped positions such as sitting, kneeling or lying, if there is a high risk of unavoidable or accidental contact with the workpiece or ground) use the following equipment:

- Semiautomatic DC Constant Voltage (Wire) Welder.
- DC Manual (Stick) Welder.
- AC Welder with Reduced Voltage Control.

3.c. In semiautomatic or automatic wire welding, the electrode, electrode reel, welding head, nozzle or semiautomatic welding gun are also electrically “hot”.

3.d. Always be sure the work cable makes a good electrical connection with the metal being welded. The connection should be as close as possible to the area being welded.

3.e. Ground the work or metal to be welded to a good electrical (earth) ground.

3.f. Maintain the electrode holder, work clamp, welding cable and welding machine in good, safe operating condition. Replace damaged insulation.

3.g. Never dip the electrode in water for cooling.

3.h. Never simultaneously touch electrically “hot” parts of electrode holders connected to two welders because voltage between the two can be the total of the open circuit voltage of both welders.

3.i. When working above floor level, use a safety belt to protect yourself from a fall should you get a shock.

3.j. Also see Items 6.c. and 8.

ARC RAYS CAN BURN.

4.a. Use a shield with the proper filter and cover plates to protect your eyes from sparks and the rays of the arc when welding or observing open arc welding. Headshield and filter lens should conform to ANSI Z87. I standards.

4.b. Use suitable clothing made from durable flame-resistant material to protect your skin and that of your helpers from the arc rays.

4.c. Protect other nearby personnel with suitable, non-flammable screening and/or warn them not to watch the arc nor expose themselves to the arc rays or to hot spatter or metal.

FUMES AND GASES CAN BE DANGEROUS.

5.a. Welding may produce fumes and gases hazardous to health. Avoid breathing these fumes and gases. When welding, keep your head out of the fume. Use enough ventilation and/or exhaust at the arc to keep fumes and gases away from the breathing zone. **When welding hardfacing (see instructions on container or SDS) or on lead or cadmium plated steel and other metals or coatings which produce highly toxic fumes, keep exposure as low as possible and within applicable OSHA PEL and ACGIH TLV limits using local exhaust or mechanical ventilation unless exposure assessments indicate otherwise. In confined spaces or in some circumstances, outdoors, a respirator may also be required. Additional precautions are also required when welding on galvanized steel.**

5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically thereafter to be certain it is within applicable OSHA PEL and ACGIH TLV limits.

5.c. Do not weld in locations near chlorinated hydrocarbon vapors coming from degreasing, cleaning or spraying operations. The heat and rays of the arc can react with solvent vapors to form phosgene, a highly toxic gas, and other irritating products.

5.d. Shielding gases used for arc welding can displace air and cause injury or death. Always use enough ventilation, especially in confined areas, to insure breathing air is safe.

5.e. Read and understand the manufacturer’s instructions for this equipment and the consumables to be used, including the Safety Data Sheet (SDS) and follow your employer’s safety practices. SDS forms are available from your welding distributor or from the manufacturer.

5.f. Also see item 1.b.

WELDING AND CUTTING SPARKS CAN CAUSE FIRE OR EXPLOSION.

6.a. Remove fire hazards from the welding area. If this is not possible, cover them to prevent the welding sparks from starting a fire. Remember that welding sparks and hot materials from welding can easily go through small cracks and openings to adjacent areas. Avoid welding near hydraulic lines. Have a fire extinguisher readily available.

6.b. Where compressed gases are to be used at the job site, special precautions should be used to prevent hazardous situations. Refer to "Safety in Welding and Cutting" (ANSI Standard Z49.1) and the operating information for the equipment being used.

6.c. When not welding, make certain no part of the electrode circuit is touching the work or ground. Accidental contact can cause overheating and create a fire hazard.

6.d. Do not heat, cut or weld tanks, drums or containers until the proper steps have been taken to insure that such procedures will not cause flammable or toxic vapors from substances inside. They can cause an explosion even though they have been "cleaned". For information, purchase "Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances", AWS F4.1 from the American Welding Society (see address above).

6.e. Vent hollow castings or containers before heating, cutting or welding. They may explode.

6.f. Sparks and spatter are thrown from the welding arc. Wear oil free protective garments such as leather gloves, heavy shirt, cuffless trousers, high shoes and a cap over your hair. Wear ear plugs when welding out of position or in confined places. Always wear safety glasses with side shields when in a welding area.

6.g. Connect the work cable to the work as close to the welding area as practical. Work cables connected to the building framework or other locations away from the welding area increase the possibility of the welding current passing through lifting chains, crane cables or other alternate circuits. This can create fire hazards or overheat lifting chains or cables until they fail.

6.h. Also see item 1.c.

6.I. Read and follow NFPA 51B "Standard for Fire Prevention During Welding, Cutting and Other Hot Work", available from NFPA, 1 Batterymarch Park, PO box 9101, Quincy, MA 022690-9101.

6.j. Do not use a welding power source for pipe thawing.

CYLINDER MAY EXPLODE IF DAMAGED.

7.a. Use only compressed gas cylinders containing the correct shielding gas for the process used and properly operating regulators designed for the gas and pressure used. All hoses, fittings, etc. should be suitable for the application and maintained in good condition.

7.b. Always keep cylinders in an upright position securely chained to an undercarriage or fixed support.

7.c. Cylinders should be located:

- Away from areas where they may be struck or subjected to physical damage.
- A safe distance from arc welding or cutting operations and any other source of heat, sparks, or flame.

7.d. Never allow the electrode, electrode holder or any other electrically "hot" parts to touch a cylinder.

7.e. Keep your head and face away from the cylinder valve outlet when opening the cylinder valve.

7.f. Valve protection caps should always be in place and hand tight except when the cylinder is in use or connected for use.

7.g. Read and follow the instructions on compressed gas cylinders, associated equipment, and CGA publication P-I, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association, 14501 George Carter Way Chantilly, VA 20151.

FOR ELECTRICALLY POWERED EQUIPMENT.

8.a. Turn off input power using the disconnect switch at the fuse box before working on the equipment.

8.b. Install equipment in accordance with the U.S. National Electrical Code, all local codes and the manufacturer's recommendations.

8.c. Ground the equipment in accordance with the U.S. National Electrical Code and the manufacturer's recommendations.

Refer to http://www.lincolnelectric.com/safety for additional safety information.

- MASTER TABLE OF CONTENTS FOR ALL SECTIONS -

FIGURE E.1 BLOCK LOGIC DIAGRAM

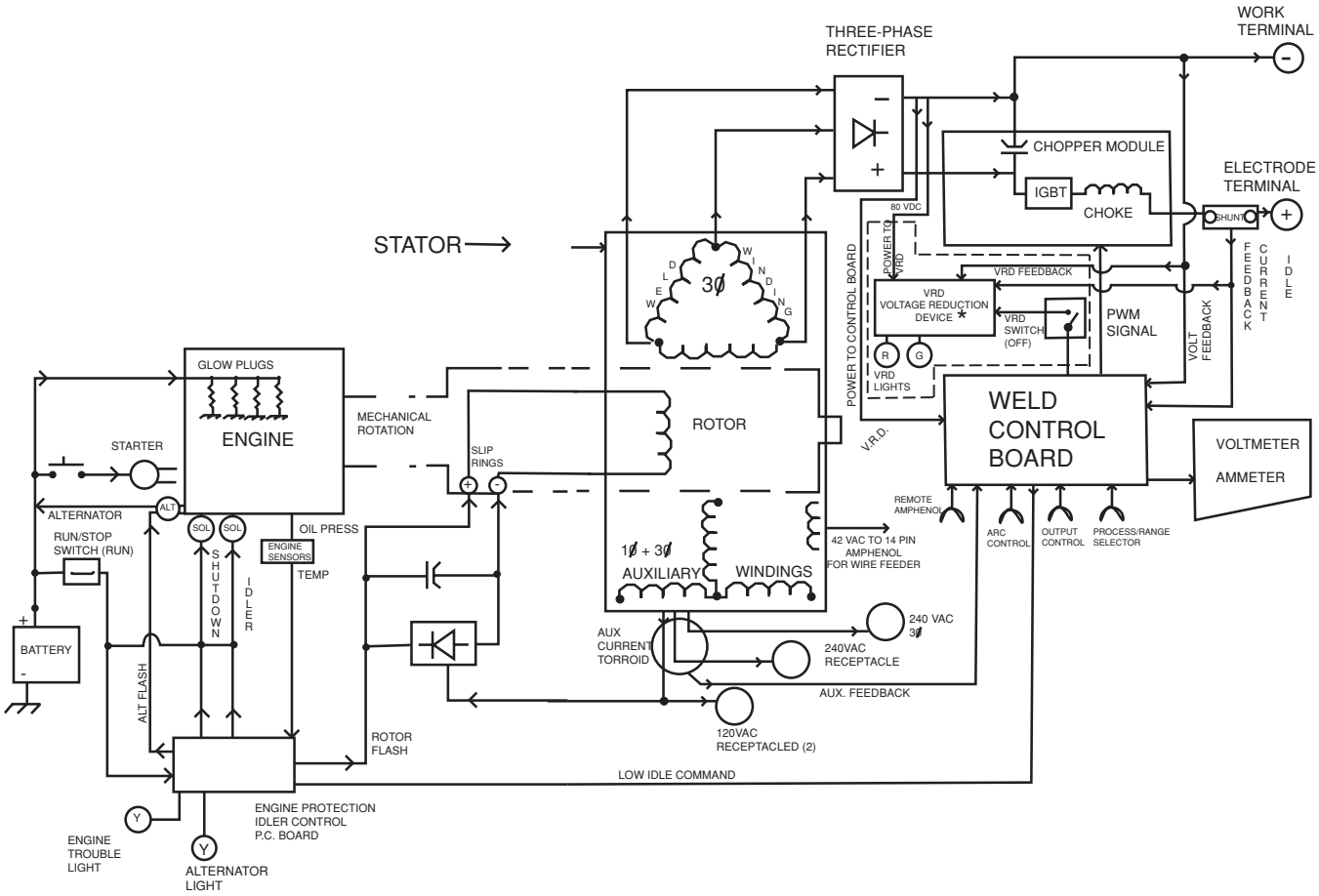
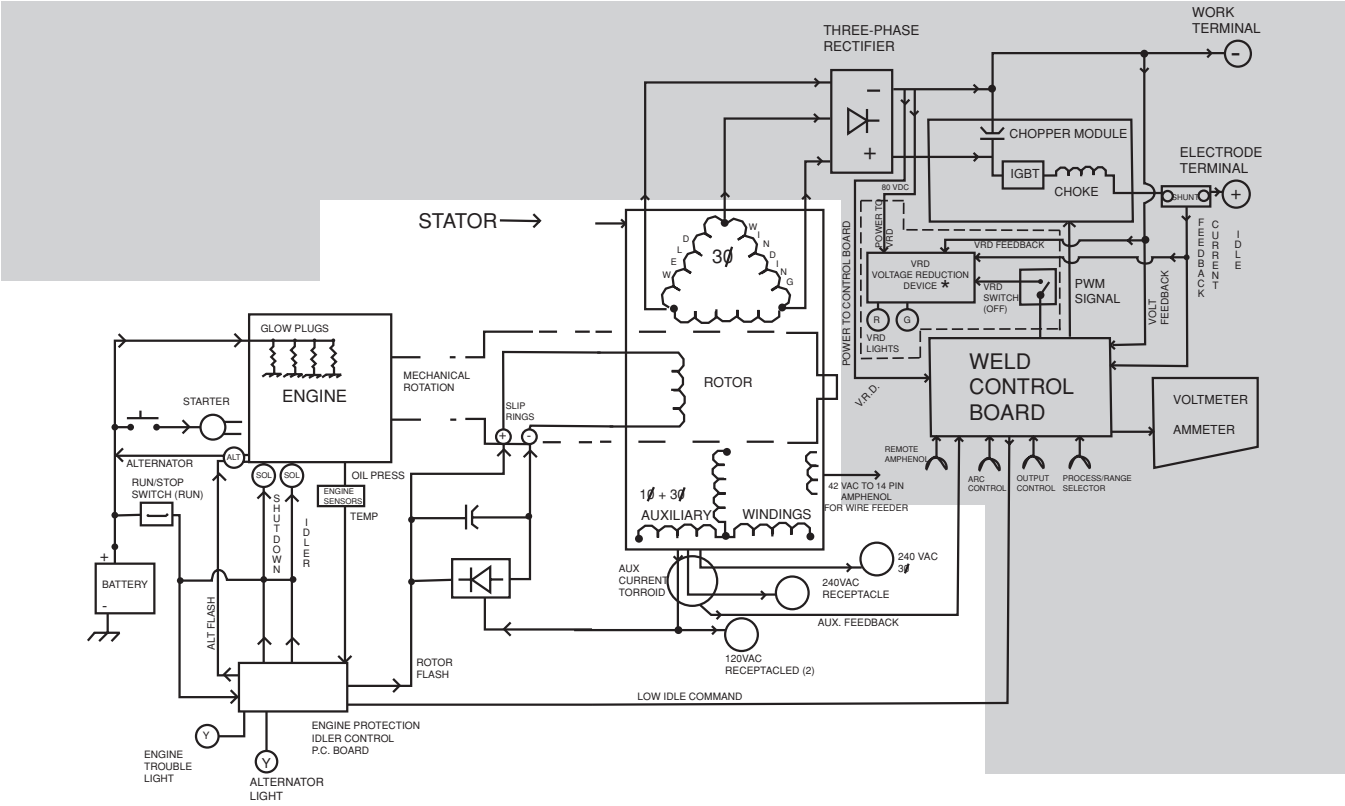


FIGURE E.2 — GENERAL DESCRIPTION, BATTERY, ENGINE, ROTOR, STATOR & ENGINE PROTECTION



GENERAL DESCRIPTION

The Vantage 410 is a diesel engine-driven welding power source capable of producing 350 amps at 28VDC at a 100% duty cycle. The engine is coupled to a brush-type alternating current generator. This AC output is rectified and controlled by ***Chopper Technology*** to produce DC current for multi-purpose welding applications. The Vantage 410 is also capable of producing 10,000 watts of AC auxiliary power at 100% duty cycle and 11,000 watts of three phase 240VAC @ 100% duty cycle.

BATTERY, ENGINE, ROTOR, STATOR & ENGINE PROTECTION

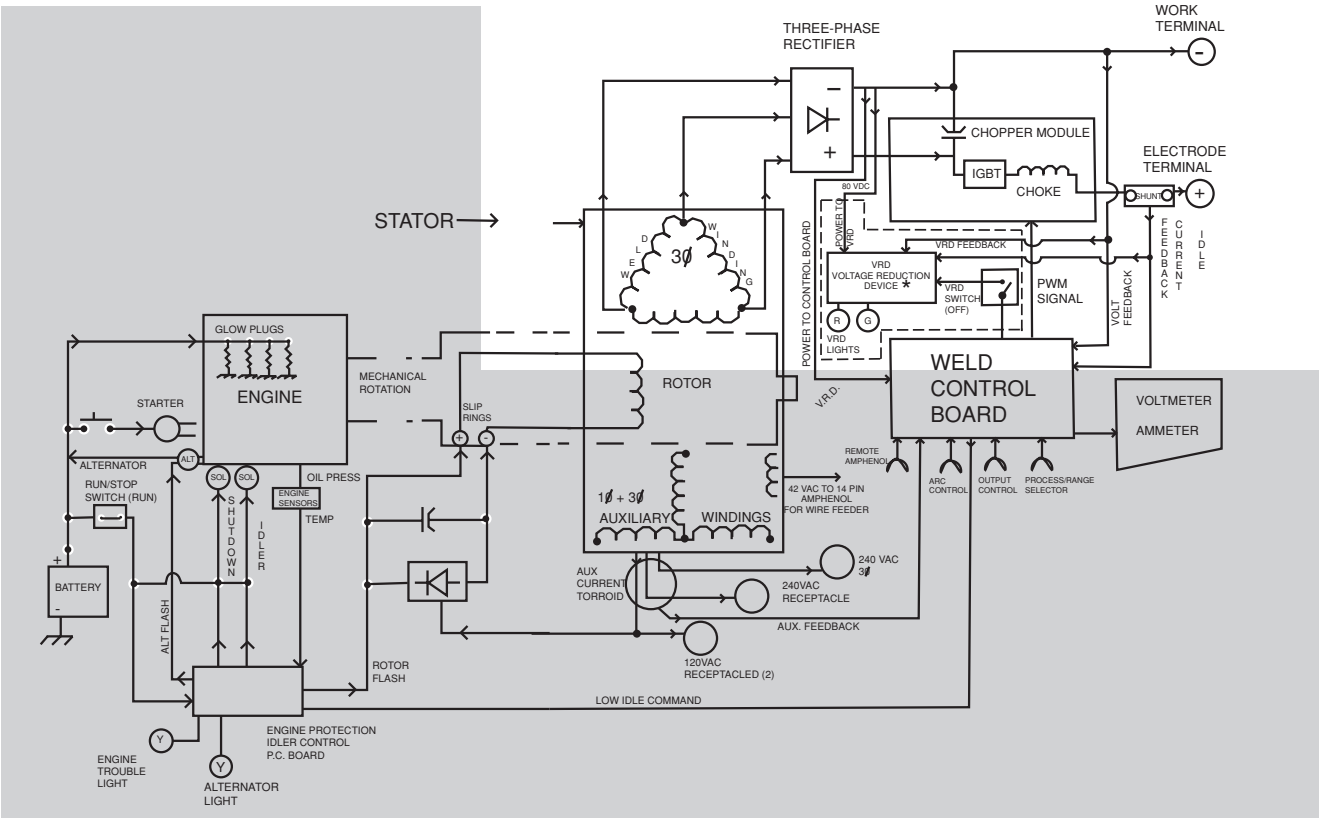
The 12VDC battery powers the engine starter motor and also supplies power to the Engine Protection board and associated circuitry. When the engine, which is mechanically coupled to the rotor, is started and running, the 12 VDC battery voltage is fed through the Engine Protection/Idler P.C. Board to the rotor field coil via a brush and slip ring configuration. Voltage is also supplied to the engine alternator. This excitation or "flashing" voltage magnetizes the rotor lamination. This rotating magnet induces a voltage in the stationary windings of the main alternator stator.

The stator houses a three-phase weld winding, a 120/240VAC single-phase auxiliary winding, a 3 phase 240VAC winding and a 120/42 volt wire feeder power winding. One side of the 120/240 single phase winding is also used to supply the Field Rectifier and Capacitor which in turn provide a fixed voltage (approx. 160vdc) to the rotor.

The engine alternator supplies charging current for the battery circuit. The Engine Protection Board monitors the engine sensors and will shut the engine off in the event of low oil pressure, engine over temperature or malfunction of the engine's alternator system. The idler solenoid is mechanically connected to the engine's throttle linkage. If no welding or auxiliary current is being drawn from the Vantage 410, the Engine Protection board activates the idler solenoid, which then brings the engine to a low idle state. When output current is sensed, either weld or auxiliary, the Weld Control PC board deactivates the idler solenoid and the engine returns to high RPM.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

FIGURE E.3 — WELD WINDINGS, RECTIFIER, CHOPPER MODULES & FEEDBACK



WELD WINDINGS, RECTIFIER, CHOPPER MODULES AND FEEDBACK

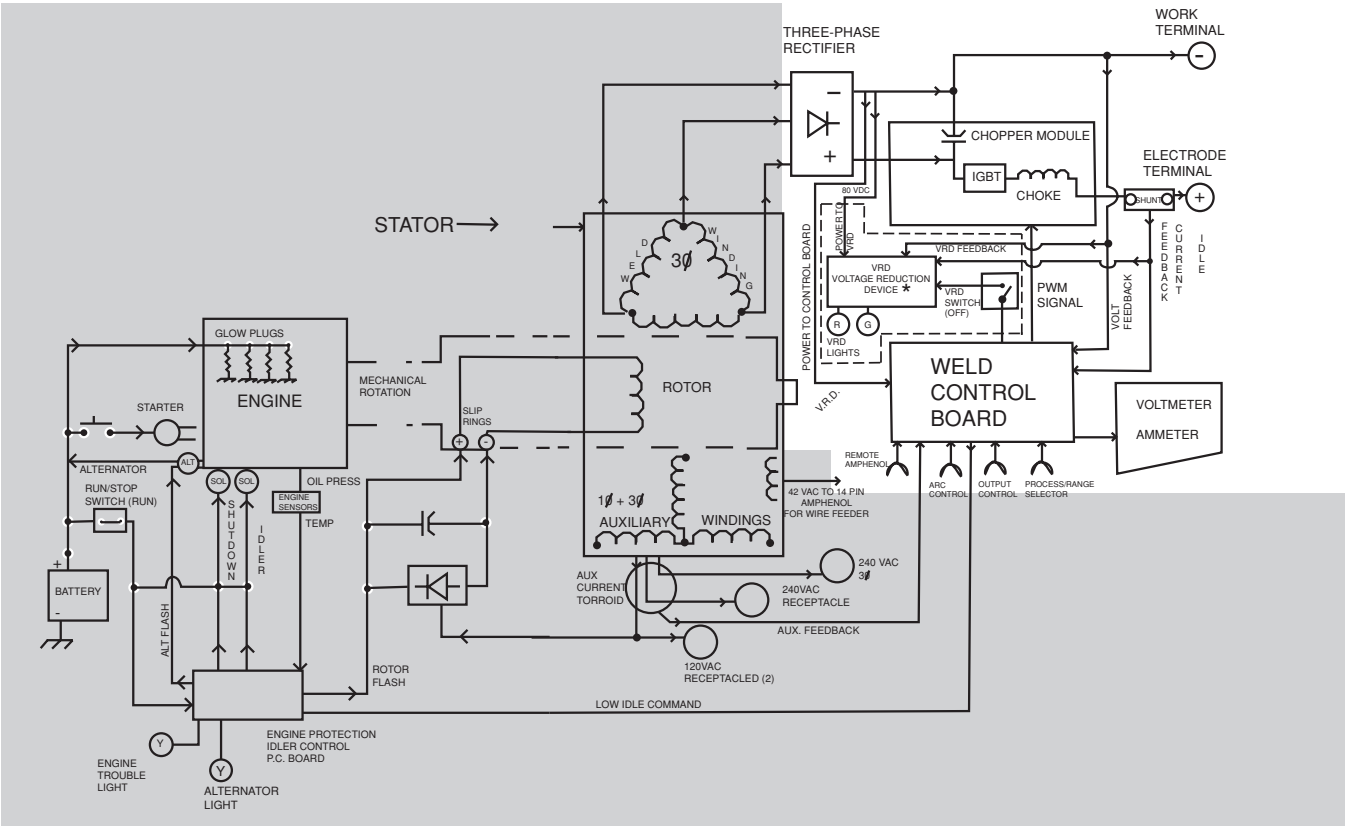
The three-phase stator weld windings are connected to a three-phase rectifier bridge. The resultant DC voltage is applied to four paralleled capacitors incorporated within the chopper module. These capacitors function as filters and also as power supplies for the IGBT's. See ***IGBT Operation*** in this section. The IGBT's act as high-speed switches operating at 20KHZ. These devices are switched on and off by the Weld Control PC board through pulse width modulation circuitry. See ***Pulse Width Modulation*** in this section.

This "chopped" DC output is applied through choke coils and a shunt to the welding output terminals. The choke functions as a current filter to make the chopper output capable of welding. Free-wheeling diodes are incorporated in the power modules to provide a current path for the stored energy in the choke when the IGBTs are turned off. See ***Chopper Technology*** in this section.

Output voltage and current feedback information is fed to the Weld Control PC board. This information is sensed from the output terminal circuits and the shunt.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

FIGURE E.4 — WELD CONTROL BOARD



WELD CONTROL BOARD

The three phase rectifier supplies the welding power through the Chopper Module. It also supplies 80VDC to the Weld Control PC Board. The Weld Control PC Board in turn, develops regulated DC voltages to operate it's circuitry and the IGBT driver circuitry on the Power Module.

The Weld Control PC board monitors the operator controls (arc control, output control and Weld Mode Switch). It compares these commands to the current and voltage feedback information it receives from the shunt and the output terminal circuits. The circuitry on the Weld Control PC board determines how the output should be controlled to optimize welding results and it sends the correct PWM signals to the IGBT driver circuits. The Weld Control PC board also commands the thermal light and the voltmeter and ammeter if installed.

VRD (VOLTAGE REDUCTION DEVICE)

The VRD feature provides additional safety in the CC-Stick mode especially in an environment with a higher risk of electric shock such as wet areas and hot humid sweaty conditions.

The VRD reduces the OCV (Open Circuit Voltage) at the welding output terminals while not welding to less than 13V DC when the resistance of the output circuit is above 200Ω (ohms).

The machine is shipped with the VRD switch in the "Off" position. To turn it "On" or "Off":

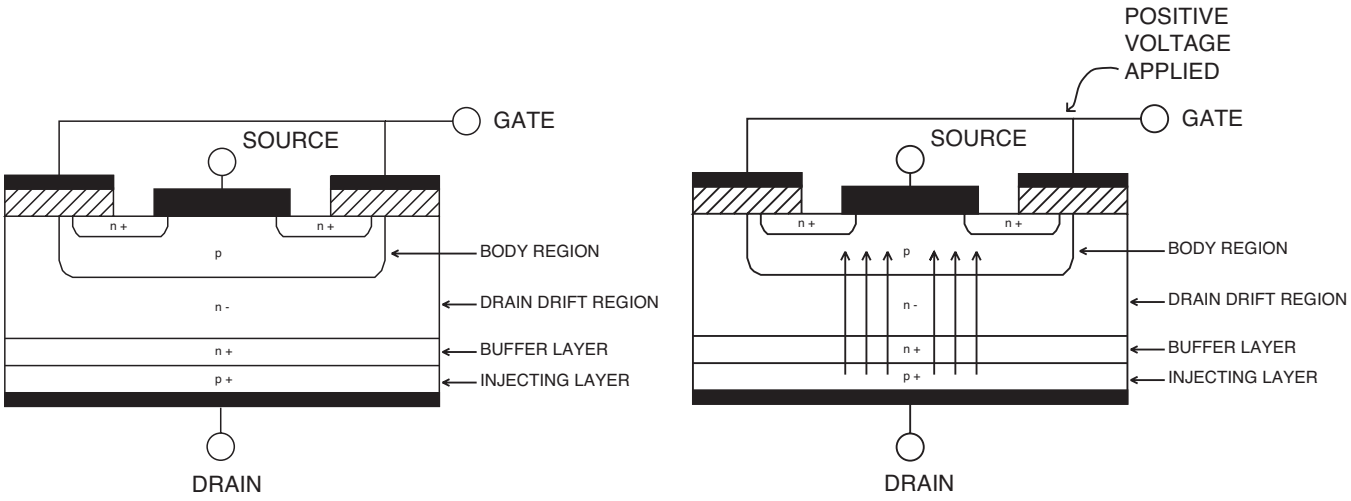
- Turn the engine "Off".
- Disconnect the negative battery cable.
- Lower the control panel by removing 4 front panel screws. (See ***Figure A.1***)
- Place the VRD switch in the "On or "Off" position. (See ***Figure A.1***)

With the VRD switch in the "On" position, the red and green VRD lights are enabled. In the Off position, both lights will be OFF.

These lights monitor the OCV(Open Circuit Voltage) and weld voltage at all times. In the CC-Stick mode when not welding the green light will illuminate indicating that the VRD has reduced the OCV to less than 32V. During welding the red light will illuminate whenever the arc voltage is equal to or greater than 32V. This means that the red and green light may alternate depending on the weld voltage. This is normal operation. See the ***VRD INDICATOR LIGHT*** information in the Operation Section for further details.

NOTE: Unshaded areas of Block Logic Diagram are the subject of discussion

FIGURE E.5 - INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION



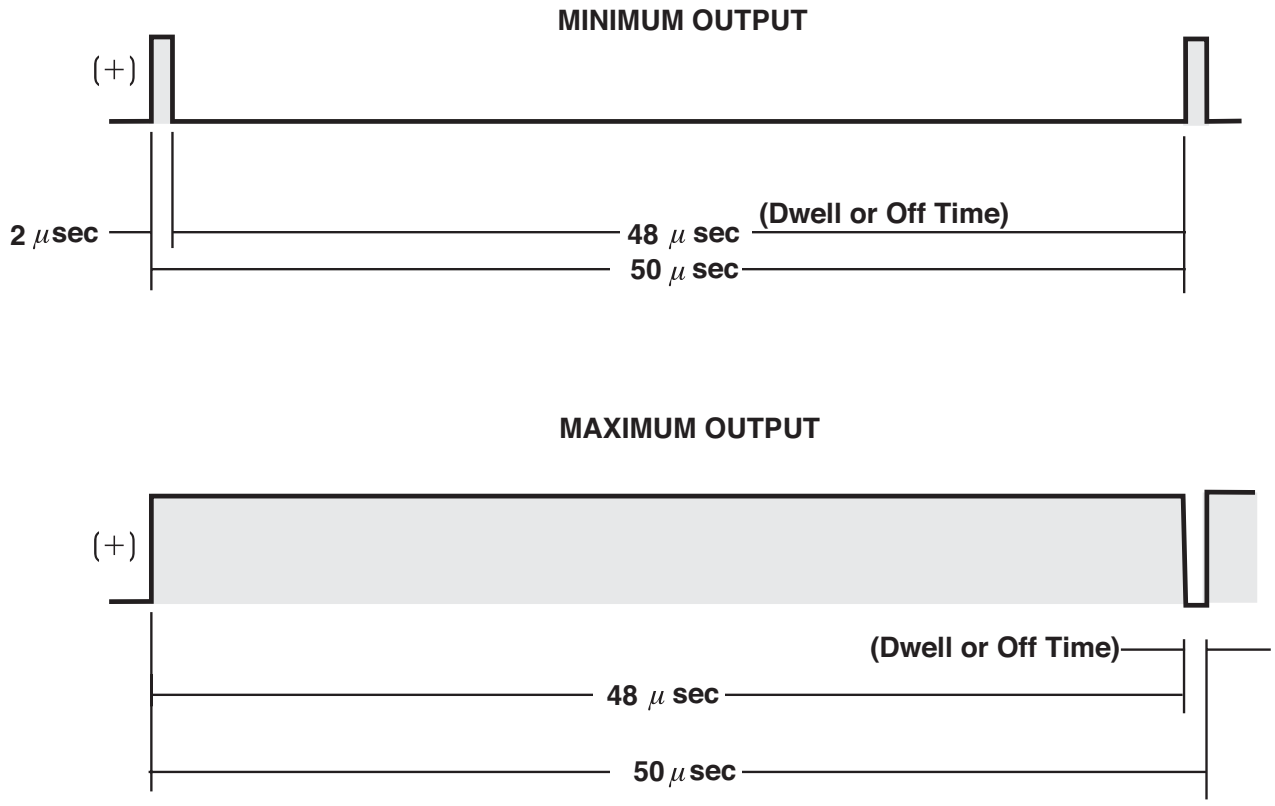
INSULATED GATE BIPOLAR TRANSISTOR (IGBT) OPERATION

An IGBT is a type of transistor. IGBTs are semiconductors well suited for high frequency switching and high current applications.

Drawing A shows an IGBT in a passive mode. There is no gate signal, (zero volts relative to the source) and therefore, no current flow. The drain terminal of the IGBT may be connected to a voltage supply; but since there is no conduction the circuit will not supply current to components connected to the source. The circuit is turned off like a light switch in the OFF position.

Drawing B shows the IGBT in an active mode. When the gate signal, a positive DC voltage relative to the source, is applied to the gate terminal of the IGBT, it is capable of conducting current. A voltage supply connected to the drain terminal will allow the IGBT to conduct and supply current to circuit components coupled to the source. Current will flow through the conducting IGBT to downstream components as long as the positive gate signal is present. This is similar to turning ON a light switch.

FIGURE E.6 - PULSE WIDTH MODULATION



PULSE WIDTH MODULATION

The term PULSE WIDTH MODULATION is used to describe how much time is devoted to conduction in the cycle. Changing the pulse width is known as MODULATION. Pulse Width Modulation (PWM) is the varying of the pulse width over the allowed range of a cycle to affect the output of the machine.

MINIMUM OUTPUT

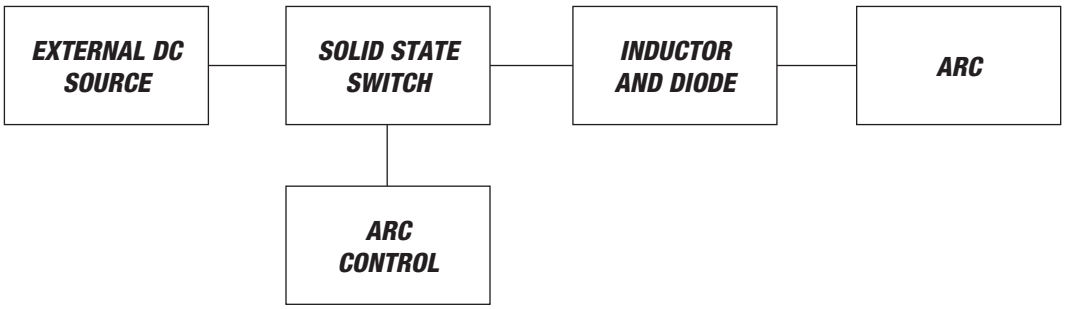
By controlling the duration of the gate signal, the IGBT is turned on and off for different durations during a cycle. The top drawing shows the minimum output signal possible over a 50-microsecond time period. The positive portion of the signal represents one IGBT group conducting for 2 microsecond. The dwell time (off time) is 48 microseconds. Since only 2 microseconds of the 50-microsecond time period is devoted to conducting, the output power is minimized.

MAXIMUM OUTPUT

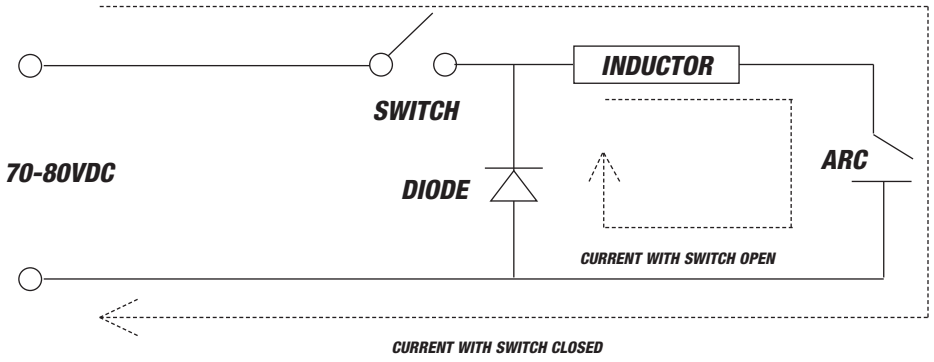
By holding the gate signals on for 48 microseconds and allowing only 2 microseconds of dwell time (off time) during the 50-microsecond cycle, the output is maximized. The darkened area under the top curve can be compared to the area under the bottom curve. The more darkened area under the curve, the more power is present.

CHOPPER TECHNOLOGY FUNDAMENTALS

The new era of welding machines such as the Vantage 410, employ a technology whereby a DC source is turned on and off (chopped up) at high speed, then smoothed through an inductor to control an arc. Hence the name "Chopper." The biggest advantage of chopper technology is the high-speed control of the arc, similar to the inverter machines. A block diagram for this is as follows:



In this system, the engine drives a three-phase alternator, which generates power that is rectified and filtered to produce approximately 85VDC. The current is applied through a solid state switch to an inductor. By turning the switch on and off, current in the inductor and the arc can be controlled. The following diagram depicts the current flow in the system when the switch is open and closed.



When the switch is closed, current is applied through the inductor to the arc. When the switch opens, current stored in the inductor sustains flow in the arc and through the diode. The repetition rate of switch closure is 20Khz, which allows ultra-fast control of the arc. By varying the ratio of on time versus off time of the switch (Duty Cycle), the current applied to the arc is controlled. This is the basis for Chopper Technology: Controlling the switch in such a way as to produce superior welding.

NOTES

TABLE OF CONTENTS - TROUBLESHOOTING AND REPAIR

HOW TO USE TROUBLESHOOTING GUIDE

⚠ WARNING

Service and Repair should only be performed by Lincoln Electric Factory Trained Personnel. Unauthorized repairs performed on this equipment may result in danger to the technician and 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.

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 and 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.

PC BOARD TROUBLESHOOTING PROCEDURES

⚠ WARNING

ELECTRIC SHOCK can kill.

- Have an electrician install and service this equipment. Turn the input power OFF at the fuse box before working on equipment. Do not touch electrically hot parts.

⚠ CAUTION

Sometimes machine failures appear to be due to PC board failures. These problems can sometimes be traced to poor electrical connections. To avoid problems when troubleshooting and replacing PC boards, please use the following procedure:

1. Determine to the best of your technical ability that the PC board is the most likely component causing the failure symptom.
2. Check for loose connections at the PC board to assure that the PC board is properly connected.
3. If the problem persists, replace the suspect PC board using standard practices to avoid static electrical damage and electrical shock. Read the warning inside the static resistant bag and perform the following procedures:

PC board can be damaged by static electricity.

ATTENTION Static-Sensitive Devices Handle only at Static-Safe Workstations

- Remove your body's static charge before opening the static-shielding bag. Wear an anti-static wrist strap. For safety, use a 1 Meg ohm resistive cord connected to a grounded part of the equipment frame.
- If you don't have a wrist strap, touch an un-painted, grounded, part of the equipment frame. Keep touching the frame to prevent static build-up. Be sure not to touch any electrically live parts at the same time.
- Tools which come in contact with the PC board must be either conductive, anti-static or static-dissipative.
- Remove the PC board from the static-shielding bag and place it directly into the equipment. Don't set the PC board on or near paper, plastic or cloth which could have a static charge. If the PC board can't be installed immediately, put it back in the static-shielding bag.
- If the PC board uses protective shorting jumpers, don't remove them until installation is complete.
- If you return a PC board to The Lincoln Electric Company for credit, it must be in the static-shielding bag. This will prevent further damage and allow proper failure analysis.

4. Test the machine to determine if the failure symptom has been corrected by the replacement PC board.

NOTE: It is desirable to have a spare (known good) PC board available for PC board troubleshooting.

NOTE: Allow the machine to heat up so that all electrical components can reach their operating temperature.

5. Remove the replacement PC board and substitute it with the original PC board to recreate the original problem.
   a. If the original problem does not reappear by substituting the original board, then the PC board was not the problem. Continue to look for bad connections in the control wiring harness, junction blocks and terminal strips.
   b. If the original problem is recreated by the substitution of the original board, then the PC board was the problem. Reinstall the replacement PC board and test the machine.
6. Always indicate that this procedure was followed when warranty reports are to be submitted.

NOTE: Following this procedure and writing on the warranty report, "INSTALLED AND SWITCHED PC BOARDS TO VERIFY PROBLEM," will help avoid denial of legitimate PC board warranty claims.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (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.	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***. Check the brushes for wear and proper contact to the rotor slip rings.	Perform the ***Brush and Slip Ring Service Procedure.*** Check for flashing voltage at the slip rings (3-5 Volts DC@.5 amp until generator builds up, then 160 Volts) Perform the ***Flashing Voltage Test***. Perform the ***Rectifier Bridge Test.*** Perform the ***Rotor Voltage Test.*** Perform the ***Stator Voltage Test.***

⚠ 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.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No welding output in any mode. The auxiliary output is normal. The engine operates normally.	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. 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. 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.	Check the Welding Terminals Switch and the associated leads. See ***Wiring Diagram***. Check gate leads #23 and #25 and Weld Control Board power leads #13 and #14 for loose or faulty connections. See ***Wiring Diagram.*** Perform the ***Chopper Module Function Test.*** Perform the ***Stator Voltage Test.*** Perform the ***Output Rectifier Test.*** The weld control board may be faulty.
VRD lights don't light up.	Ensure VRD ON/OFF switch is in the "ON" position. (Factory setting is "OFF"). See the ***VRD Indicator Light*** information in the Operation Section. VRD light may be burned out.	Check connections at the VRD ON/OFF switch. Check the VRD on off switch for proper operation. VRD Display Board may be defective.

⚠ CAUTION

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No auxiliary power at one or more receptacles or at the 14 pin Amphenol. Weld output is normal and the engine operates normally.	Check for loose or faulty connections at the output receptacles or 14 pin amphenol. Check for tripped circuit breaker and/or tripped GFCI receptacles.	Perform the ***Stator Voltage Test.*** Check the wiring between the auxiliary receptacle the and the main stator.
The machine has low welding output and low auxiliary output.	The engine RPM may be low. The brushes may be sticking or poorly seated or the slip rings may be dirty.	The engine high idle speed may be low. Perform the ***Engine Throttle Test (Electronic Idler).*** Full load speed should be about 1800 RPM. Inspect and if necessary service the brushes and slip rings per the ***Brush and Slip Ring Service Procedure.*** Perform the ***Rotor Voltage Test.*** Perform the ***Stator Voltage Test.***
The machine will weld but the welding arc is “COLD”. The engine runs normally and the auxiliary power is normal.	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. Make sure the process does not demand more power than the machine can produce. If the current is correct try increasing the “ARC CONTROL” setting. Check for loose or faulty connections at the weld output terminals and welding cable connections.	The engine RPM may be too low. Perform the ***Engine Throttle Adjustment Test.*** Disconnect all external equipment and perform a “load” test using a resistive load bank and accurate meters. Adjust the load for about 300Amps at 32Volts; Check that the engine speed holds at 1800rpm. If not perform engine maintenance. If the Vantage 410 has meters, make sure that they read the same as the load bank meters. If not, perform the ***Weld Control Feedback Test***.

⚠ CAUTION

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
The machine will weld but the welding arc is “COLD”. The engine runs normally and the auxiliary power is normal. (continued)	Check for good connections between the work cable and the work piece. The weld cables may be too long or too small diameter causing excessive voltage drop. The weld cables should not 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.	If the maximum weld output cannot be obtained and the front panel displays are reading accurately, check for damaged conductors or loose connections in the large current carrying conductors of the stator, output rectifier, chopper modules, choke, shunt and output terminals. See the ***Wiring Diagram.*** If all these connections are good perform the ***Rotor Voltage Test***, the ***Stator Voltage Test***, the ***Rectifier Bridge Test*** and the ***Chopper Module Resistance Test.*** Perform the ***Control Potentiometer and Mode Switch Resistance Test.*** Perform the ***Remote Receptacle Resistance Test.*** Replace the Control PC Board.

⚠ 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.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine welds but it will not maintain a steady output.	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. 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. If shielding gas is used, check that the gas and gas flow are correct. Check for damaged, pinched or leaking gas lines. Check for proper work and electrode leads and connections (size, length, coils or bad connections).	The machine may not be maintaining the correct RPM. Perform the ***Throttle Adjustment Test.*** If the engine will not maintain the correct load RPM, the engine may be in need of service. Air and fuel filters should be checked. Check large current carrying leads that connect to the stator, chopper module, shunt, choke and output terminals. See the ***Wiring Diagram***. Look for damaged conductors or faulty connections. Check the connections at the Control Board and the Chopper Module. The output control or the arc control potentiometer may be defective or grounded. The mode switch may also be faulty. Perform the ***Potentiometer and Mode Switch Resistance Test.*** The Amphenol receptacles may be contaminated or defective. Perform the ***Remote Receptacle Resistance Test.*** Replace the Weld Control P.C. Board.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The weld output cannot be adjusted with the front panel output control knob in one or more weld modes. The weld output terminals have normal OCV (open circuit voltage). The AC auxiliary power is normal and the engine operates normally.	Remote control devices completely disables the front output in all modes except TOUCH START TIG mode. *Make sure there is nothing plugged into the Amphenol receptacles. Check for dirt or moisture contamination in either 6 pin or the 14 pin amphenol.	Perform the ***Remote Receptacle Resistance Test***. The output control potentiometer may be defective. Perform the ***Control Potentiometer and Mode Switch Resistance Test.*** Check the shunt and associated leads and the voltage feedback leads for loose or faulty connections. See the ***Wiring Diagram***. The Weld Control PC Board may be faulty.
One of the meters is not working properly. The welder works OK in all modes.	Both the “AMPS” and “VOLTS” displays use the same part numbered display unit.	Swap the display board connectors (J4 and J5) on the weld control board (they are both the same), if the good display functions normally in bad display’s place then the Weld Control P.C. Board is OK and only the malfunctioning display needs to be replaced. If the good display malfunctions when plugged into the other connector, then the Weld Control P.C. Board is defective.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
The machine front panel output control is still active when the remote control unit is connected to one of the Front Panel Amphenols.	This condition is normal in the "TOUCH START TIG MODE". *See the operators manual. The remote control unit may be defective. Check the Amphenol receptacles. Look for damage or corroded contact pins in the receptacle and in the plug of the remote control unit.	Check Connector P1 on the Weld Control P.C. Board to see that it is properly seated and the pins in both the plug and the P.C. Board receptacle are in good condition. Check for continuity between the P1 connector and the Amphenol Connectors. See the ***Wiring Diagram***. P1-10 to 6 pin amphenol pin "C" and to 14 pin amphenol pin "G". P1-11 to 6 pin amphenol pin "A" and to 14 pin amphenol pin "E". P1-14 to 6 pin amphenol pin "B" and to 14 pin amphenol pin "F". The Weld Control P.C. Board may be defective.
The machine seems to be locked into the "CC-stick" mode of operation.	Check the position of the WELD MODE selector switch. The switch should positively snap into each mode position and should not feel 'gritty' or get stuck between positions.	Check Connector P7 on the Weld Control P.C. Board to see that it is properly seated and the pins in both the plug and the P.C. Board receptacle are in good condition. Perform the ***Control Potentiometer and Mode Switch Resistance Test.*** The Weld Control P.C. Board may be faulty.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
FUNCTION PROBLEMS		
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.	The ARC CONTROL may be set too high. The output control may be set too high for the electrode being used. 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 recommendations. If shielding gas is used, check that the gas and gas flow are correct. Check for damaged, pinched or leaking gas lines. Check for proper work and electrode leads and connections (size, length, coils or bad connections).	Perform the ***Control Potentiometer and Mode Switch Resistance Test.*** The Weld Control P.C. Board may be faulty.
A control cable type feeder does not function when connected to the 14 pin amphenol. Machine operates normally in the "CC-STICK" mode and has normal AC auxiliary output.	Check the circuit breaker CB1 if using a 120 Volt AC wire feeder. Check CB8 if using a 42 VAC wire feeder. Reset breaker if tripped. Check the amphenol receptacle for damaged, corroded or dirty contact pins. The wire feeder control cable may be defective. The wire feeder may be defective.	Use a volt meter to check for the presence of supply voltage at the 14 pin amphenol receptacle. 120 Volt AC power supplied through pins A and J, 421 VAC power is supplied through pins I and K. Perform the ***Stator Voltage Test.***

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
An Across-the-Arc type wire feeder does not function when connected to the weld output of the machine. The Vantage operates normally in the CC-STICK mode and has normal AC auxiliary output.	Check that the welding terminals switch is in the "WELD TERMINALS ON" position. Check the that WELD MODE switch is in the correct position for the process being used, typically "CV-WIRE" mode. Check for poor weld cable connections between the feeder and the welder output terminal and between the work piece and the other output terminal. Check that the wire feeder's work sensing lead is properly connected to work piece and is in good condition. If there is a reading on the wirefeeder voltmeter, the wire feeder may be defective.	Use a voltmeter to check for the presence of about 58 VDC open circuit voltage (OCV) across the output studs of the machine. If the OCV is low, there may be a problem with the mode switch. Perform the ***Control Potentiometer and Mode Switch Test.*** If there is no OCV, check the WELD TERMINAL Switch and associated wiring. See the ***Wiring Diagram***

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not crank when the start button is pushed.	Check the circuit breaker (CB5). Reset if tripped. Make sure the run/stop switch is in the "RUN" position. Check for loose or faulty battery cable connections. The battery may be low or faulty. If the battery will not accept a charge replace it.	Check the wiring and the connections at the starter motor, glow plug button, CB5 circuit breaker, run/stop switch and the start button. See the ***Wiring Diagram***. Check the chassis ground connections between the engine block and the negative battery terminal. Place the run/stop switch to the "RUN" position. Press the start button, while checking for voltage between a good clean chassis ground connection (-) and lead #231 (+) at the starter solenoid. See the ***Wiring Diagram.*** If battery voltage is present, the starter motor or solenoid may be defective or the engine may be prevented from turning due a mechanical failure.
The battery does not stay charged.	Check for loose, corroded or faulty connections at the battery. Check for loose or damaged alternator drive belt. The battery may be faulty.	Perform the ***Engine Alternator Test.*** There may be a defective component or faulty wiring causing a current draw when the run/stop switch is in the "stop" position Check the Run/Stop switch, the glow plug button, the alternator and the starter solenoid. Also check for damaged wiring and insulation. If the engine charging system is operating properly but the battery is not staying charged, the battery is defective and should be replaced.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine cranks when the start button is pressed but will not start.	The battery voltage may be low (normally results in slow cranking speed). The batter should be checked and recharged if it is not producing adequate voltage and replaced if it will not accept a full charge. Make sure the glow plug button is pressed while pressing the start button. See the operator's manual or the operation section of this manual for proper starting procedure. Make sure the fuel valve on the fuel sediment filter is in the open position. Check that the machine has an adequate supply of fresh, clean fuel.	The fuel filter may be clogged, replace if necessary. Fuel pump may be faulty. Check for fuel flow through filters. Contact local authorized engine service shop. Check oil level. ON/off switch on for more than 60 seconds before starting. The ON/OFF switch will need to be switched off and turned back on again. The fuel solenoid may be faulty or not operating properly. Check lead #233 and #262 and perform the ***Fuel Shutdown Solenoid Test.*** The engine may be in need of mechanical repairs.

⚠ CAUTION

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Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine cranks when the start button is pressed but will not start (continued**).**	Faulty fuel shutdown solenoid (KUBOTA). Check for binding and functionality/ contact authorized Kubota service shop.	Perform the ***Fuel Shutdown Solenoid Test***. The Engine Protection Board may be defective.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine starts but shuts down immediately when the start button is released.	Make sure the glow plug button is pressed while pushing the button. (10 SECONDS MAXIMUM AFTER THE ENGINE STARTS) See the operators manual or the operating section of this manual for proper stating procedure. Check the oil level. Be certain that the engine is not overheated. Check that the machine has an adequate supply of fresh, clean fuel. The fuel filter may be clogged. Replace if necessary. High coolant temperature or low oil pressure (indicator light lit) Check oil and coolant levels to proper level. Check for loose or broken fan belt. Start engine and check for fuel leaks. Faulty oil pressure switch, temperatures switch or other engine component. Faulty Idler protection board.	The shut down fuel solenoid may be faulty or not operating properly. Check lead #233 and #262 and perform the ***Shutdown Solenoid Test***. See the ***Wiring Diagram***. (Kubota). Check for12 volts at the lead #233 when start button is pushed. Check CB5 and lead #231 (KUBOTA). The engine Protection Board may be faulty. Check the Engine Protection Board. The engine may have inadequate oil pressure. Check the Oil and Temperature Sensors.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine shuts down shortly after starting.	Check that the machine has an adequate supply of fresh, clean fuel. Check fuel and air filters, replace if necessary. Check oil level, add oil as required. Look for oil leakage. Check for loose or faulty battery cable connections. High coolant temperature or low oil pressure (indicator light lit) Check oil and coolant levels to proper level. Check for loose or broken fan belt. Start engine and check for leaks. Faulty oil pressure switch, temperatures switch or other engine component. Faulty Idler protection board.	The oil pressure switch or coolant temperature switch may be faulty Check the Oil Pressure Switch and Oil Temperature Switch. Make sure the engine has oil and oil pressure and engine is not overheated. Disconnect lead 234 from Engine Protection PC Board, if the engine continues to run, oil pressure switch or Temperature Switch is faulty. Check the Oil Pressure Switch and Oil Temperature Switch. Check for faulty run/stop switch. Check for poor electrical connections at the run/stop switch and the fuel shutdown solenoid. See ***Wiring Diagram.*** The fuel solenoid may be faulty. ***Perform the Fuel Shutdown Solenoid Test.***

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine shuts down shortly after starting and trips the battery circuit breaker (CB5).	Try resetting the breaker. If it trips again do not attempt to use the machine. **NOTE:** Repeated tripping and resetting of the circuit breaker can damage it or alter its trip point. If the breaker has been tripped and reset many times, it should be replaced once the cause is determined.	Examine the CB5 circuit breaker, run/stop switch, start button, shut-down solenoid, idle solenoid, engine protection board, fuel gauge, fuel sender and all the wiring connecting these components. Look for damaged or out of place wiring that may be in contact with other conductors or chassis ground. See ***Wiring Diagram***. Perform the ***Idler Solenoid Test.*** Perform the ***Fuel Shutdown Solenoid Test.*** The Engine Protection PC Board may be defective.
The engine will not develop full power.	The fuel may be old or contaminated. Supply the engine with clean fresh fuel. The fuel filter may be clogged, replace if necessary. The air filter may be clogged, replace if necessary.	The engine may be in need of adjustment or repair.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not idle down to low RPM. The machine has normal weld and auxiliary output.	Make sure the idle switch is in the "AUTO IDLE" position. Make sure there is no external load on the weld terminals or the auxiliary power receptacles. Check for mechanical restrictions in the idler solenoid linkage. Faulty PC board or idler solenoid (KUBOTA).	Perform the ***Idler Solenoid Test.*** (KUBOTA). Check for damaged wiring or faulty connections at the idle solenoid, the engine protection PC Board, the run/stop switch and the start button. Check for loose or damaged wiring or faulty connections at leads #405, #226, #227 and connections J,P-55-2 and J,P-55-4, (control board, J32-2,B3 and J313-8). See ***Wiring Diagram.*** **KUBOTA:** Set idle switch in the "AUTO" position. Set the mode switch to the "CC-STICK" position. Make sure that no load is applied to either the weld or auxiliary output. Start the machine and allow it to run for about 30 seconds . Manually move the idle solenoid plunger to the idle position. If the solenoid engages and holds in the idle position, the idle pull coil may be bad. If the solenoid does not hold in the low idle position, remove plug J6 from the control PC Board and wait about 30 seconds. If the engine drops to low idle check for damage or buildup of conductive material on or around the bypass filter assembly and the output terminals. See ***Wiring Diagram*** (KUBOTA).

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
The engine will not idle down to low RPM. The machine has normal weld and auxiliary output (continued).		If the engine still does not drop to low idle the Control PC Board is probably defective. Replace it. Check that leads #3 and #6 are properly routed through the toroidal current sensor. See the ***Wiring Diagram***. The leads should be wrapped tightly and tie wrapped in place. 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 J3 connector in the control PC Board. Unplug plug J3 from the control PC Board and check for damaged, dirty or corroded pins. Measure the resistance of toroidal current sensor. Measure between #P-3 and #P-4, the resistance should be 4.1 Ohms. If the sensor is shorted or open replace it. The Weld Control Board may be defective.

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
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.	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. The device connected to the auxiliary power may be defective try another device. Make sure the connections to the auxiliary device are tight. Some devices are designed to sense for adequate input power. Product of this type may not turn on due to low voltage and frequency of the machine at low idle. If this happens the current draw will likely be insufficient to activate the automatic idle system. Devices of this type may require that the Automatic Idle switch be in the "HIGH IDLE" position.	Check that leads #3 and #6 are properly routed through the toroidal current sensor. Each lead must have three turns and must pass through the sensor in the opposite directions. See the ***Wiring Diagram***. The leads should be wrapped tightly and tie wrapped in place. Check the toroidal 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 J3 connector in the control PC Board. Unplug plug J3 from the Control PC Board and check for damaged, dirty or corroded pins. Measure the resistance of toroidal current sensor. Measure between #P-3 and #P-4, the resistance should be 10-14 Ohms. If the sensor is shorted or open replace it. The control board may be defective.

⚠ CAUTION

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PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
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.	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 material.	Check the leads and connections at the SHUNT at the positive output stud. Check lead 204S and 206S for continuity from the shunt to J6-1 and J6-2 on the Weld Control Board. Check the pins and connections at J6. The Weld Control Board may be defective.
The engine will not go to high idle when attempting to strike and arc or when a load is applied to any of the auxiliary power receptacles.	Check that the welding cables and the auxiliary power lead connections are tight.	The Weld Control PC Board may be defective.
The engine goes to low idle, but will not stay at low idle.	Make sure there are no auxiliary loads on either the weld terminals or the auxiliary receptacles. Check that the welding cables and the auxiliary power lead connections are tight and that the insulation is not damaged.	The Idler solenoid linkage may be damaged or out of adjustment. Make sure the solenoid plunger is able to fully ease against the internal stop of the solenoid coil assembly. (KUBOTA) The low idle RPM may be too low. Perform the ***Engine Throttle Adjustment Test*** (KUBOTA). The solenoid hold coil power circuit may be faulty. Check wiring and connections on lead #210A and lead #215. (KUBOTA) The Weld Control PC Board may be defective.

⚠ 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.

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
Engine will not shut off.	Fuel shutdown solenoid not functioning properly. Linkage may be binding. Stop engine by shutting off valve on main fuel filter. Contact authorized local Engine Service Shop (KUBOTA). Fuel shutdown solenoid not functioning properly.	Contact local authorized engine service facility.

⚠ 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.

NOTES

CASE COVER REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by 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

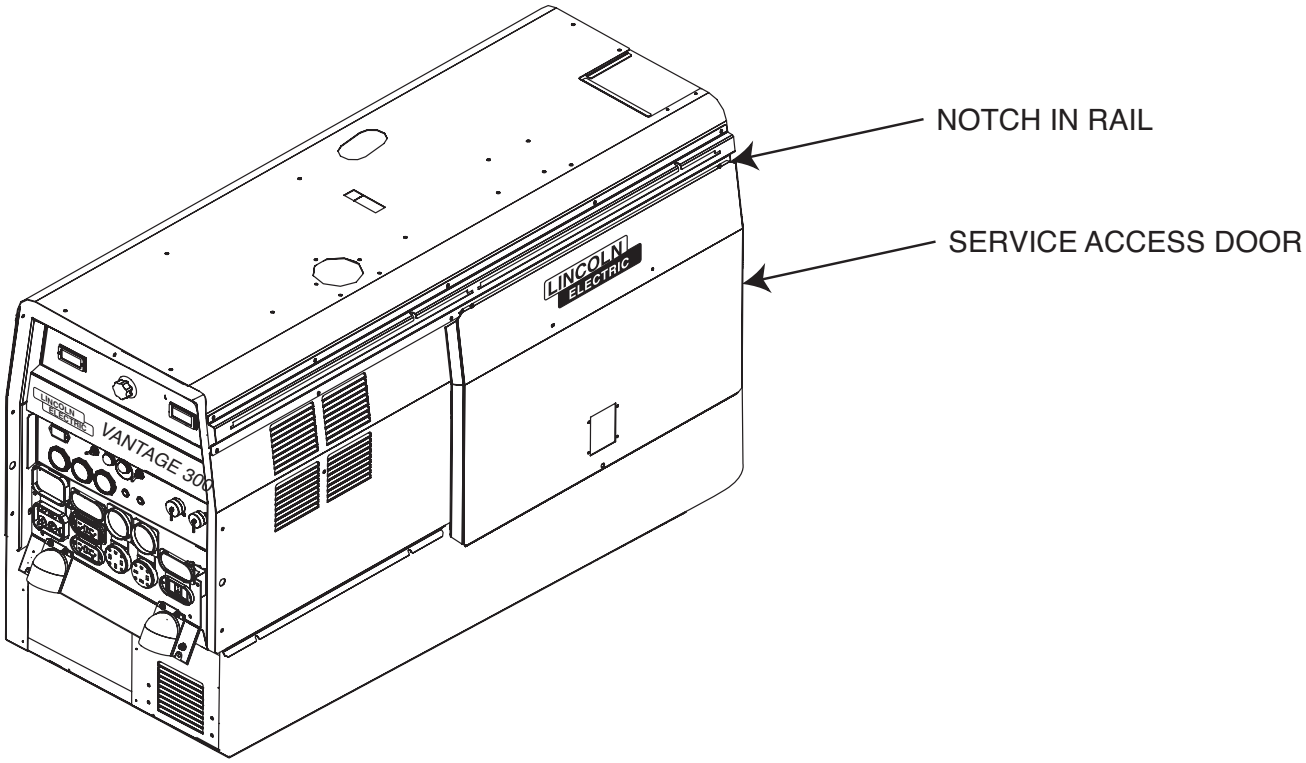
This procedure will aid the technician in the removal and replacement of the Case Sheet Metal Covers.

MATERIALS NEEDED

Miscellaneous Hand Tools
Rubber Mallet

CASE COVER REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.1 – CASE COVER REMOVAL



REMOVAL PROCEDURE

1. Turn the engine off.
2. Unlatch and open the engine service access door.
3. Slide door back approximately 6 inches until right hinge is aligned with slot in roof. Lift straight up. Slide door back until left hinge is aligned with the slot in roof. Lift straight up and remove door.
4. Remove the exhaust pipe extension.
5. Remove the rubber seal from around the lift bail.
6. Remove the sheet metal and machine screws holding the roof in place.
7. Remove the sheet metal screws from the right and left case sides and remove the side panels. Lift the roof slightly, then tilt each side back and lift up to free the bottom tabs from their slots.
8. Lift the case cover off the machine.

NOTE: It is necessary to remove the fuel cap in order to take the cover off of the machine. Screw the cap back on when working on the Vantage 410.

REPLACEMENT PROCEDURE

1. Install the right and left case sides and screw them in place.
2. Remove the fuel cap, then carefully set the case cover in place. Replace the fuel cap and the lift bail cover seal.
3. Install the exhaust pipe extension.
4. Install the side panels
5. Install the door by reversing the procedure described in step 3 of the removal procedure, then slide it fully on to the hinge.
6. Close and latch the door.

CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE

⚠ WARNING

Service and repair should be performed only by 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

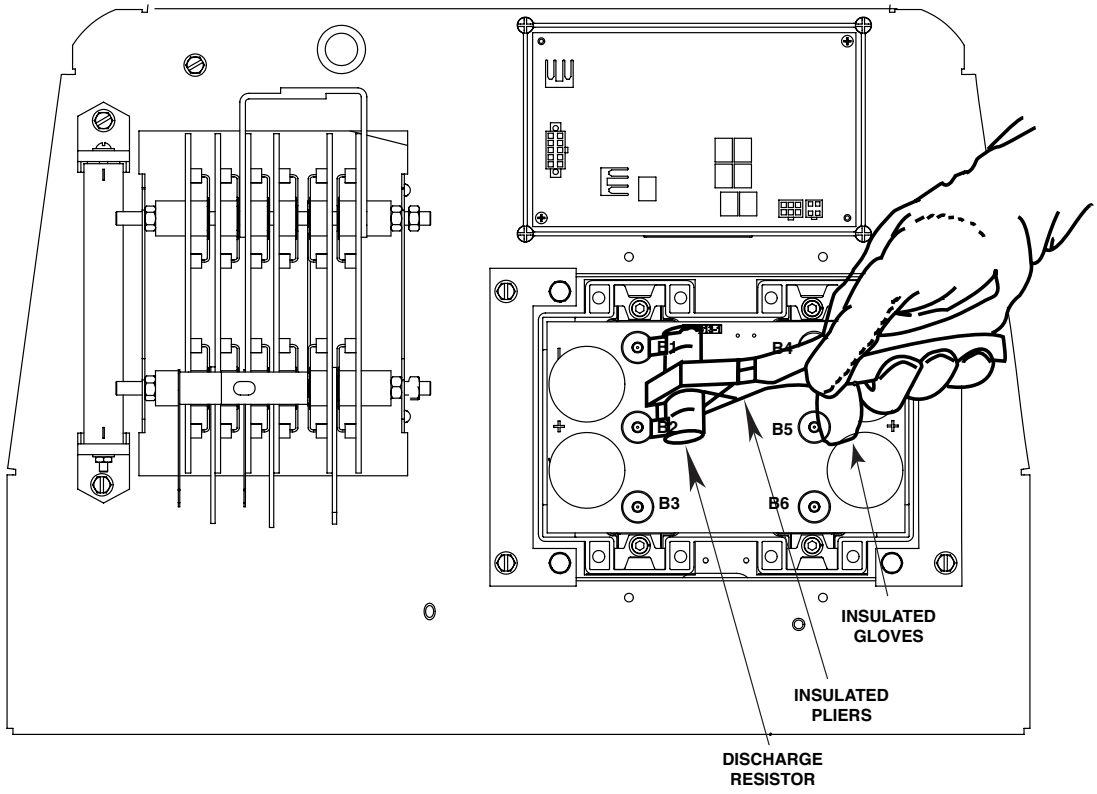
This procedure will ensure that the large Capacitors in the Chopper Module have been discharged. This procedure should be performed whenever work is to be attempted on or near the Chopper Module.

MATERIALS NEEDED

Miscellaneous Hand Tools
Volt/Ohmmeter
Resistor (25-1000 ohms and 25 watts minimum)
Lincoln Part # S01404-114 works well for this purpose
Jumper Leads
Wiring Diagram

CHOPPER MODULE CAPACITOR DISCHARGE PROCEDURE (continued)

FIGURE F.2 – CAPACITOR 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 before 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***.

⚠ WARNING

- Have an electrician install and service this equipment.
- Turn the input power off at the fuse box before working on equipment.
- Do not touch electrically hot parts.

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

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 the resistor from 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. If not, repeat the discharge procedure.

FUEL SHUTDOWN SOLENOID TEST

⚠ WARNING

Service and repair should be performed only by 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

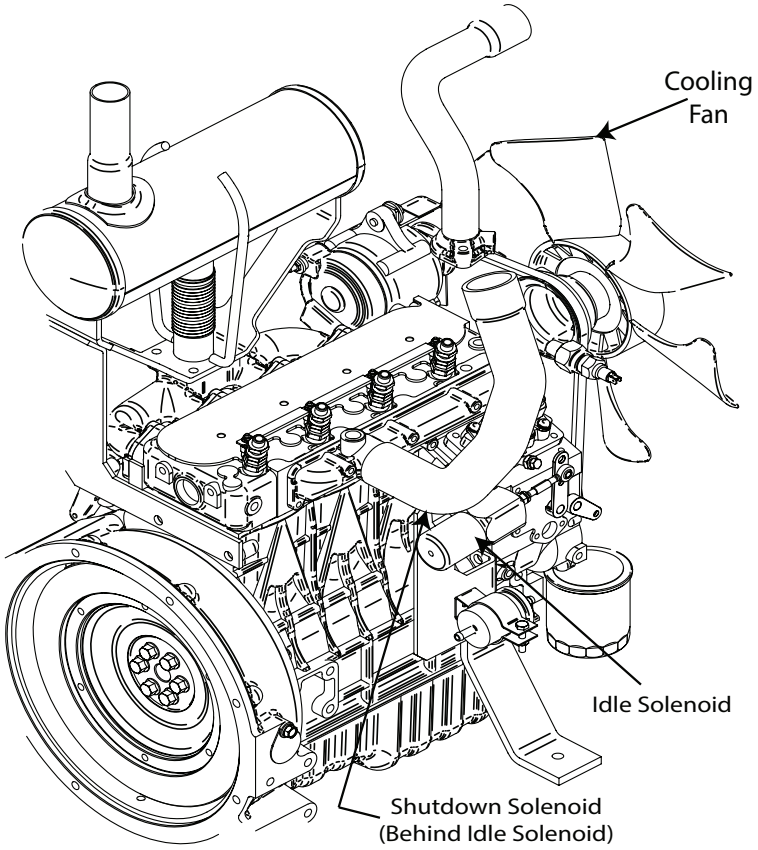
This procedure will determine if the Shutdown Solenoid resistance values are normal and also determine if it will function normally when energized with 12 VDC.

MATERIALS NEEDED

Wiring Diagram
Volt/Ohmmeter
Miscellaneous Hand Tools
12 VDC Power Source (an automotive battery works well)

FUEL SHUTDOWN SOLENOID TEST (continued)

FIGURE F.3 – ENGINE COMPONENTS



KUBOTA

PROCEDURE

1. Turn the engine off.
2. Open the right side engine service access door.
3. Locate the fuel shutdown solenoid, located on side of the engine.
4. Locate and unplug harness connection P54/J 54. Cut any necessary cable ties. See ***Wiring Diagram***.
5. Using the Ohmmeter, check the pull-in coil resistance, (black wire to white wire). The normal resistance is less than 0.2 ohms. Check the hold-in coil resistance, (black wire to red wire). The normal resistance is approximately 11 ohms. Check the Resistance between the black wire and a clean, unpainted chassis ground. The resistance should be very high, 500,000 Ohms or more. If any of the above resistance values are incorrect, the solenoid may be faulty. Replace.
6. Using an external 12VDC supply, apply voltage to the pull-in coil leads, (black-) to (white+). The solenoid should activate. REMOVE THE VOLTAGE immediately to avoid damaging the solenoid.

   Apply 12VDC to the hold coil, leads, (black-) to (red+) While the voltage is applied, manually move the solenoid to the fuel on position. The solenoid plunger should hold this position until the voltage is removed.

   If either coil does not operate as described, check for mechanical restrictions or other problems with the linkage.

   If the linkage is intact and the solenoid does not operate correctly when 12VDC is applied, the solenoid may be defective. Replace.

   Re-connect fuel solenoid and replace any previously removed cable ties.

ENGINE THROTTLE ADJUSTMENT TEST

⚠ WARNING

Service and repair should be performed only by 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

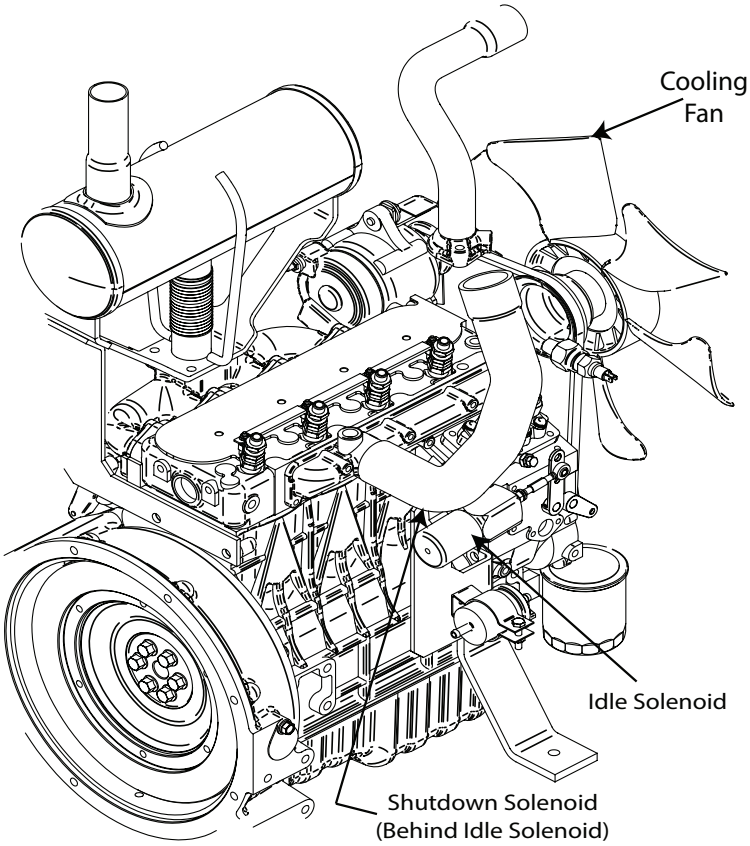
If the machine output is low or high, this test will determine whether the Engine is operating at the correct speed (RPM) during both High and Low idle conditions. You can check RPM using a strobe-tach, a frequency counter or a vibratach. Directions for adjusting the throttle to the correct RPM are given.

MATERIALS NEEDED

Miscellaneous Hand Tools and Metric Wrench Set
High Visibility Marker
Strobe-tach, Frequency Counter or Vibratach

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.4 – FAN LOCATION



KUBOTA

PROCEDURE

Strobe-Tach Method

1. Turn the engine off
2. Remove the right side doors.
3. Place a highly visible mark on the stator cooling fan blade (paint or tape). See Figure F.4.
4. Connect the strobe-tach according to the manufacturer's instructions.
5. Start the engine and place the idle switch in the "HIGH IDLE" position. Make sure that there is no load on the machine.
6. Direct the strobe-tach light at the fan that had been marked earlier and synchronize the light with the rotating mark. See the strobe-tach manufacturer instructions.

   The tach should read between 1860 and 1890 RPM.

7. Move the idle switch to the "AUTO IDLE" position and wait for the idle solenoid to energize and the engine RPM to drop and stabilize at the low idle RPM.
8. Synchronize the strobe-tach to read the low idle RPM (1300-1400 RPM).

   If either of the readings is incorrect, proceed to the ***Throttle Adjustment Procedure.***

ENGINE THROTTLE ADJUSTMENT TEST (continued)

Frequency Counter Method

NOTE: A frequency counter or Digital Multimeter with a Frequency Counter can be used for this test, see the manufacturer instructions for your frequency counter or multimeter.

1. Set your frequency counter per the meter manufacturer instructions, and plug it into one of the 120VAC auxiliary receptacles.
2. Start the engine and place the idle switch in the “HIGH IDLE” position. Make sure that there is no load on the machine.

   The frequency should read between 62.0 and 63.0 Hz.
3. Move the idle switch to the “AUTO IDLE” position and wait for the idle solenoid to energize and the engine RPM to drop and stabilize at the low idle RPM.

   The frequency should read between 43.3 and 46.6 Hz.

   If either of the readings is incorrect, proceed to the ***Throttle Adjustment Procedure***.

NOTE: For the Vantage 410 and any other Lincoln Electric 1800 RPM (4 Pole) machine, engine RPM can be determined by multiplying the frequency, (Hz). By 30. (Example: 30 x 62Hz=1860RPM)

Vibratach Method

A Vibratach is used to measure the vibrations caused by the running engine. It can be positioned anywhere where the engine vibration is reasonably strong. The best results will likely be obtained by opening the top engine cover and placing the Vibratach directly against the top of the engine.

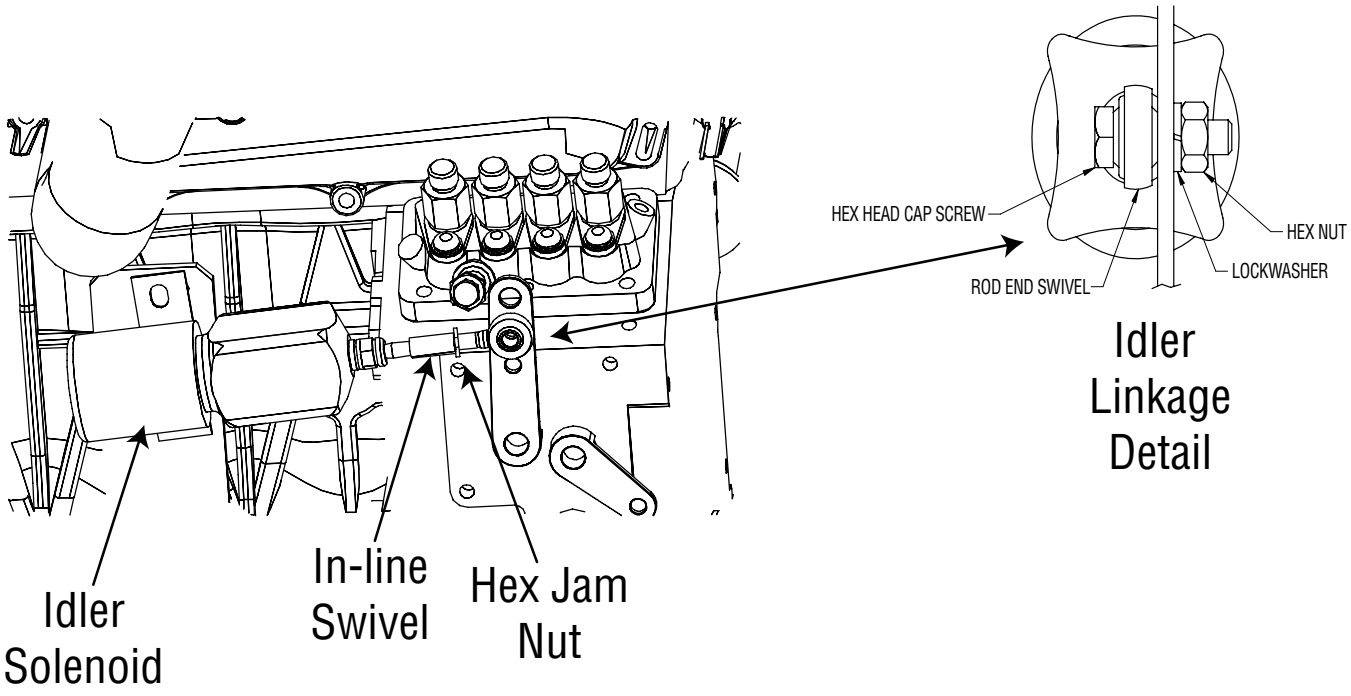
Read and understand the manufacturer’s instructions for the Vibratach.

1. Start the engine and place the idle switch in the “HIGH IDLE” position. Make sure that there is no load on the machine.
2. Position and adjust the Vibratach; it should read between 1860 and 1890 RPM.
3. Move the idle switch to the “AUTO IDLE” position and wait for the idle solenoid to energize and the engine RPM to drop and stabilize at the low idle RPM.
4. Position and adjust the Vibratach; it should read between 1300 and 1400 RPM.

   If either of the readings is incorrect, proceed to the ***Throttle Adjustment Procedure.***

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.5 – IDLE SOLENOID



THROTTLE ADJUSTMENT PROCEDURE

IMPORTANT: Both the high and low idle settings are adjusted at the solenoid. DO NOT ATTEMPT TO ADJUST THE STOP SCREWS ON KUBOTA ENGINE.

1. Check that the linkage attaching the solenoid to the engine speed control lever is properly aligned and in good condition. It is more important that the solenoid linkage be more precisely aligned when in the high speed (de-energized position).
2. Check to be sure the spring located inside the rubber boot is not broken or missing. In the default, (de-energized) position the spring should be holding the solenoid in the high speed position. See ***Figure F.6.***

Low Idle adjustment:

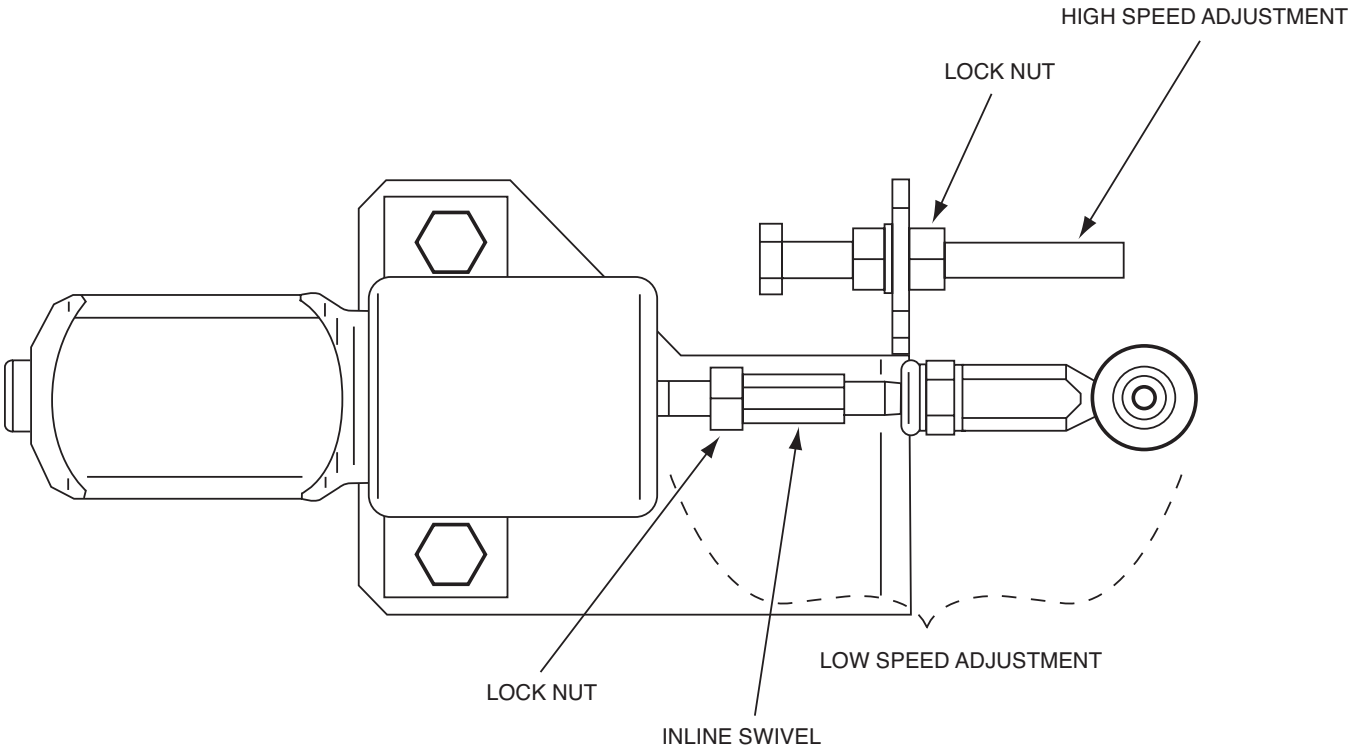
1. With engine running and no load applied to the machine, place the idle switch in the "AUTO IDLE" position. Wait for the idle solenoid to energize and the engine speed to drop and stabilize to low idle RPM.
2. If the low idle RPM requires adjustment, loosen the jam nut that is against the In-line swivel Rotate the In-line swivel until the engine speed has been set to between 1300 and 1400 RPM. Hold the swivel fitting in position while tightening the jam nut against the swivel fitting, See ***Figure F.4.***
3. Re-check the low idle RPM and then proceed to the high idle adjustment.

High idle adjustment:

1. With engine running, place the idle switch in the "HIGH IDLE" position. The solenoid should immediately de-energize, allowing the engine to increase to high idle speed.
2. The High idle RPM is set at the factory and is locked in place to prevent tampering. When the throttle is against the stop the RPM should be between 1860-1890.

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.6 – HIGH IDLE POSITION



NOTES

IDLER SOLENOID TEST

⚠ WARNING

Service and repair should be performed only by 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

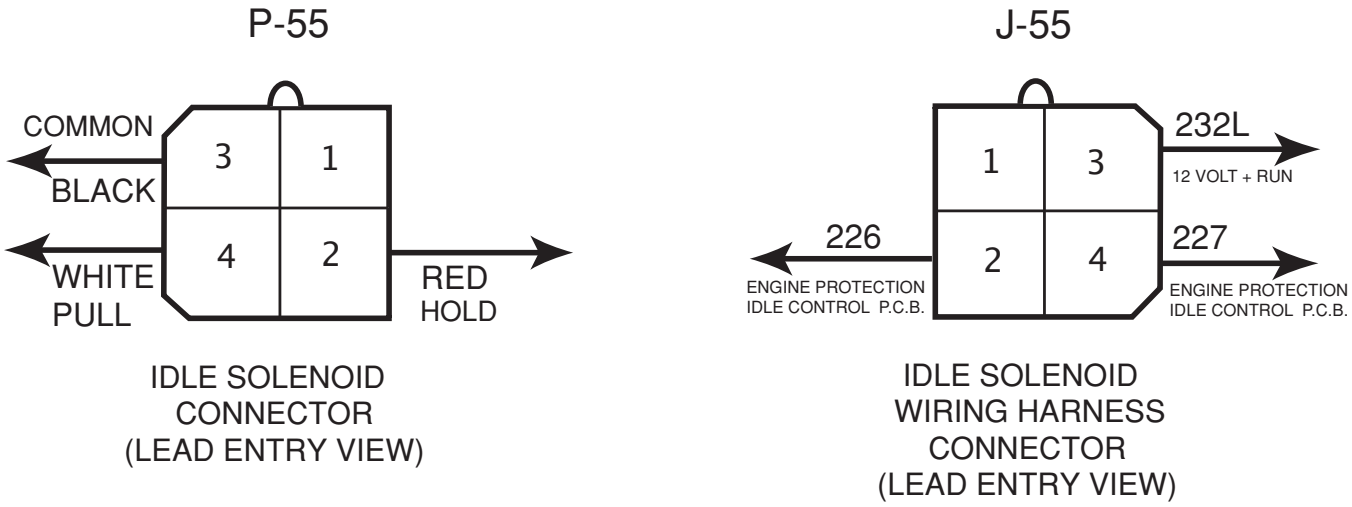
This test will determine if the Idler Solenoid resistance values are normal and also determine if it will function normally when it is energized with 12VDC.

MATERIALS NEEDED

Miscellaneous Hand Tools
External 12VDC supply (30 amps) (automotive battery works well)
Wiring Diagram
Volt/Ohmmeter

IDLER SOLENOID TEST (continued)

FIGURE F.7 – PLUG(S) PIN LOCATION



PROCEDURE

1. Turn the engine off.
2. Open the right side engine service access door.
3. Locate the idler solenoid mounted on the fuel injection pump. (See ***Figure F.3***)
4. Locate and unplug harness connection P55/J 55. Cut any necessary cable ties. See the ***Wiring Diagram.***
5. Using the volt/ohmmeter, check the pull-in coil resistance, pins 3 and 4 (black wire to white wire). The normal resistance is less than 0.2 ohms. Check the hold-in coil resistance, pins 3 and 2 (black wire to red wire). The normal resistance is approximately 11 ohms. Check the resistance between pin 3 (black wire) and a clean, unpainted chassis ground. The resistance should be very high. 500,000 Ohms or more. If any of the above resistance values are incorrect, the solenoid may be faulty. Replace. See Figure F.7.
6. Using the external 12VDC supply, apply 12VDC to the pull-in coil leads at pins 3+ and 4- (black wire to white wire). The solenoid should activate. REMOVE THE VOLTAGE IMMEDIATELY to avoid damage to the unit.

   Apply 12VDC to the hold-in coil at pin #3 (black wire +) and pin #2 (red wire -). While the voltage is applied, manually move the solenoid to the low idle position. The solenoid plunger should hold this position until the voltage is removed. See Figure F.7.
7. If either coil does not operate as described, check for mechanical restrictions or other problems with the linkage.
8. If the linkage is intact and the solenoid does not operate correctly when the 12VDC is applied, the solenoid may be faulty. Replace.
9. Re-connect idle solenoid and replace any previously removed cable ties.

ENGINE ALTERNATOR TEST

⚠ WARNING

Service and repair should be performed only by 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

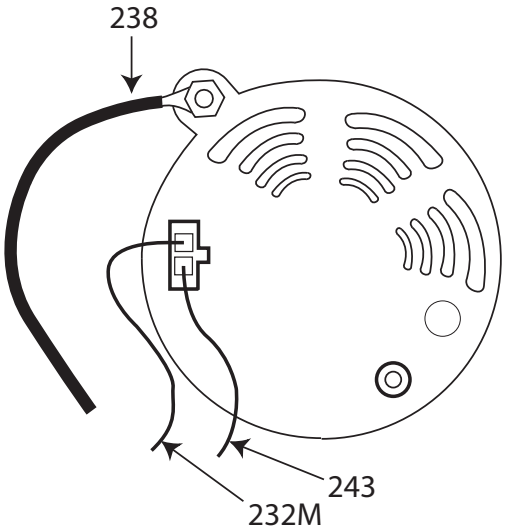
This test will determine if the Engine Alternator is properly charging the Battery.

MATERIALS NEEDED

Miscellaneous Hand Tools
Volt Meter
Wiring Diagram

ENGINE ALTERNATOR TEST (continued)

FIGURE F.8 – LEAD LOCATIONS ON REAR OF ALTERNATOR



PROCEDURE

1. Turn the engine off.
2. Open the engine 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.
7. 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 in Step 2, proceed with the following tests.
8. Turn off the engine, disconnect the meter from the battery and open the engine access door on the left side of the machine.
9. 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.
10. Place the negative meter probe on a good chassis ground or the negative battery terminal. Place the positive meter probe on the ‘battery’ terminal (Lead 238) on the back of the alternator. See Figure F.7 and the ***Wiring Diagram***.
11. The meter should read about 13.7 to 14.2 VDC.
12. Move the positive probe to the IGN terminal on the back of the alternator (Lead 232M). See Figure F.8.
13. The meter should read about 13.7 to 14.2 VDC.
14. If the meter reads correctly, check the connections between the alternator and the battery. See the ***Wiring Diagram***.
15. If the voltage at both of the above test points reads the same or less than the battery voltage measurement in Step 2, the alternator is defective. Repair or replace it.
16. If battery voltage is present at the battery terminal of the alternator, but not at the “IGN” terminal; check the run/stop switch and the wiring connecting the “IGN” terminal to the switch. See Figure F.8.

BRUSH AND SLIP RING SERVICE PROCEDURE

⚠ WARNING

Service and repair should be performed only by 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 provides guidance in testing and maintaining the Brush and Slip Ring system.

MATERIALS NEEDED

Volt/Ohmmeter
Miscellaneous Hand Tools
500 or 600 Grit Sand Paper
180 Grit Sand Paper

BRUSH AND SLIP RING SERVICE PROCEDURE (continued)

PROCEDURE

1. Perform the ***Case Cover Removal Procedure.***
2. Perform the ***Capacitor Discharge Procedure***.
3. Remove the brush holder bracket. See ***Figure F.9.***
4. 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.
5. 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.
6. 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.
7. 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.***
8. Check for evidence of sticking brushes. Sticking brushes will normally result in th slip rings being pitted and discolored from excessive arcing. Another sign of sticking brushes is intermittent instability or loss of both weld and auxiliary output. 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 or a 220 or 320 grit commutator stone.

SEATING BRUSHES:

1. If brushes have been replaced, repositioned or are not making full contact with the slip rings, it may be necessary to re-seat them. This can be done by placing a strip of 180 grit sandpaper between the slip rings and the brushes, with the abrasive side against the brushes. Pull the sandpaper strip around the circumference of the slip rings in the direction of rotor rotation only. Repeat this procedure until the surface of each brush is in full contact with its matching slip ring.
2. Use a low pressure compressed air to thoroughly blow the carbon, commutator stone and/or sandpaper dust from the machine before operating.
3. Replace the brush holder bracket and perform the ***Case Cover Replacement Procedure.***

ROTOR RESISTANCE AND GROUND TEST (STATIC)

⚠ WARNING

Service and repair should be performed only by 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

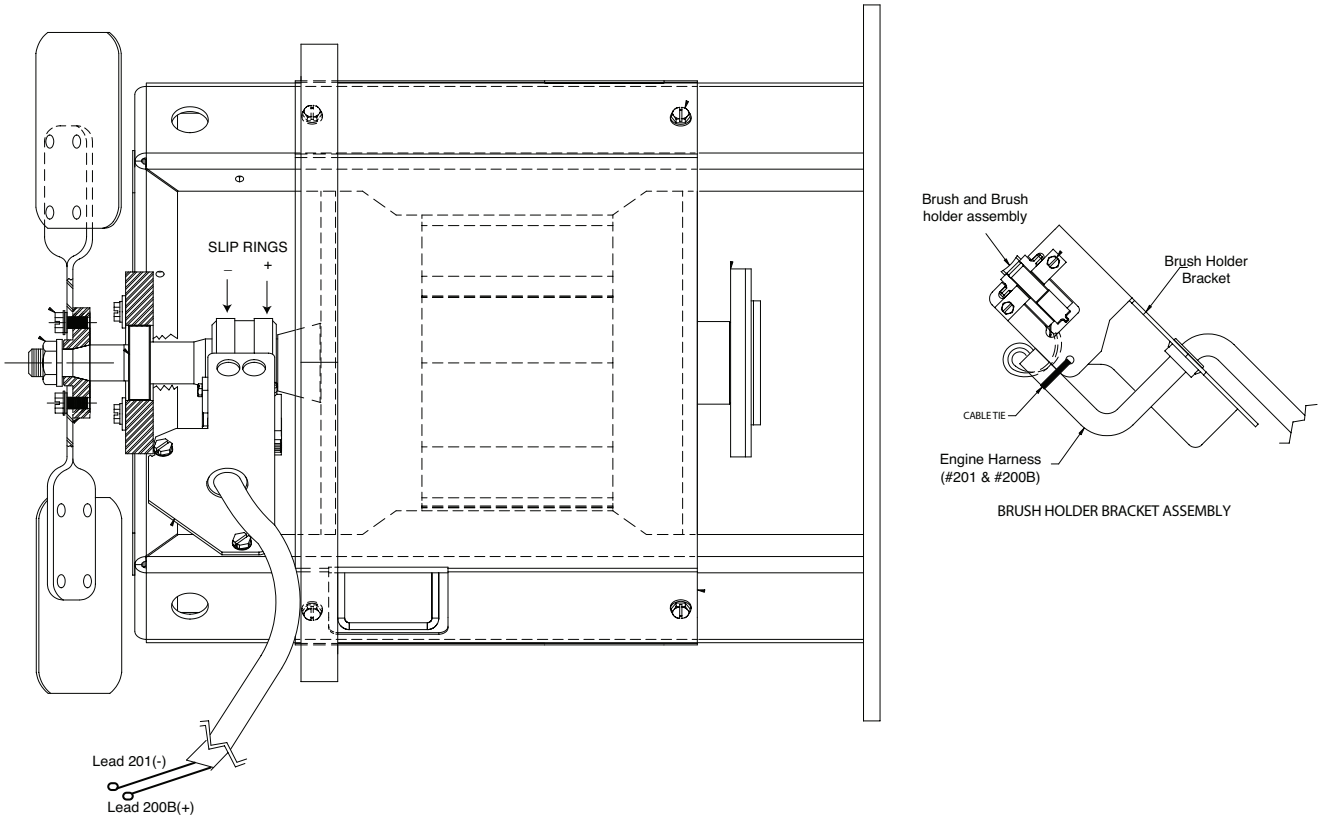
This test will determine if the Rotor Winding is open, shorted or grounded.

MATERIALS NEEDED

Miscellaneous Hand Tools
Ohmmeter Analog type meter required for dynamic resistance test.)
Wiring Diagram

ROTOR RESISTANCE AND GROUND TEST (STATIC) (continued)

FIGURE F.9 – ROTOR BRUSH LEADS



PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal Procedure.***
3. Perform the ***Capacitor Discharge Procedure***.
4. Disconnect leads #201 and #200B from the field Capacitor located on the right side of the Stator Fan Shroud. This will electrically isolate the rotor windings.
5. Using the ohmmeter, check the resistance from lead 201 to 200B. It should read approximately 25 ohms. See Figure F.9.
6. If reading is incorrect, remove the brush holder bracket and measure directly across the slip rings. If reading is correct, check the brushes and the leads. If reading is still incorrect, the rotor is defective.
7. Measure the resistance to ground from either of the slip rings to any good unpainted chassis ground. The resistance should be very high, at least 500,000 ohms (500k).
8. If the test does not meet the resistance specifications, then the rotor is grounded and should be cleaned or replaced.
9. If this test meets the resistance specifications, continue testing using the ***Dynamic Rotor Resistance and Ground Test.***
10. Re-connect the 202 and 200B leads to the Field Capacitor. Be sure to connect them to the proper polarity terminals.

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

⚠ WARNING

Service and repair should be performed only by 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 for faults in the Rotor Winding, while these windings are being stressed by the mechanical forces encountered during normal operation.

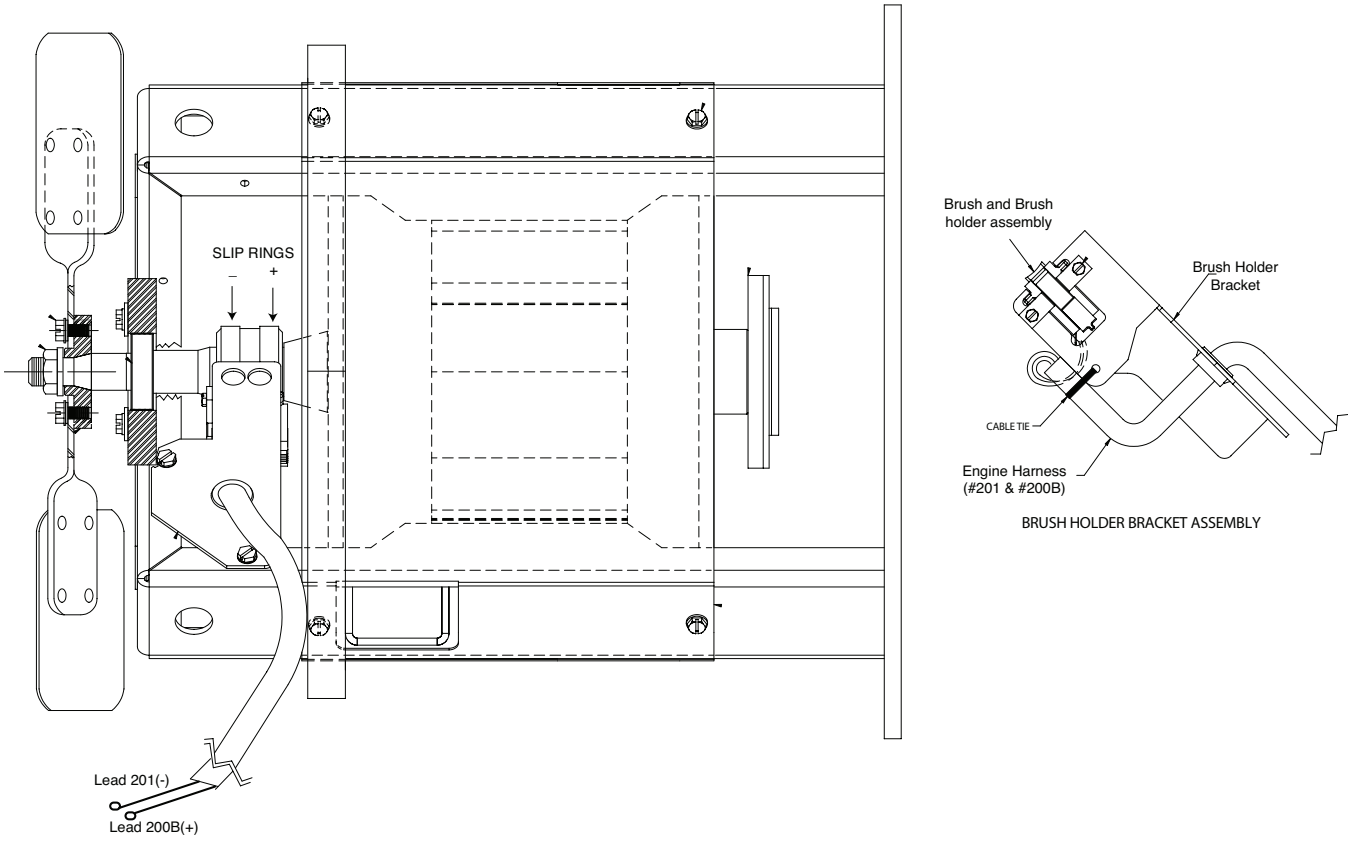
MATERIALS NEEDED

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.

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

FIGURE F.10 – BRUSH HOLDER BRACKET AND SLIP RINGS



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. Disconnect leads #201 and #200B from the field Capacitor and connect an ohmmeter across the two leads and insulate the connections. See Figure F.10.
3. Start the engine and run it at high idle speed (1860-1890 RPM). The resistance should read approximately 25 ohms.
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, reconnect the leads to the Field Capacitor and 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.

ROTOR VOLTAGE TEST

⚠ WARNING

Service and repair should be performed only by 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 trouble-shooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

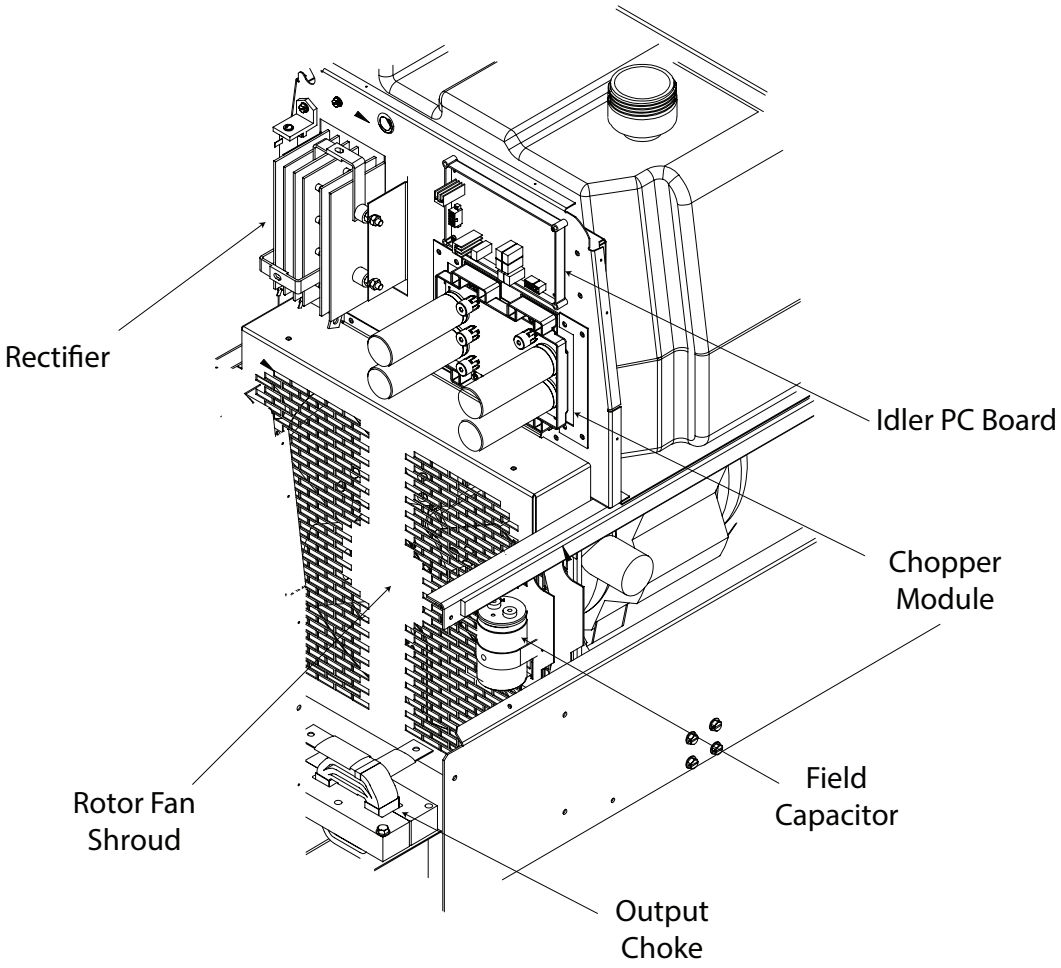
This test will determine if the Rotor Winding is operating at normal charge.

MATERIALS NEEDED

Miscellaneous Hand Tools
Voltmeter
Wiring Diagram

ROTOR VOLTAGE TEST (continued)

FIGURE F.11 – TEST COMPONENT LOCATIONS



PROCEDURE

1. Perform the ***Case Cover Removal Procedure.***
2. Connect the voltmeter probes to the field Capacitor terminals (201 & 200B). See Figure F.11. 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 145-175 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, the leads may be open or the rotor may be shorted.
7. Perform the ***Rotor Resistance and Ground Test*** and the ***Rotor 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 the ***Engine Throttle Adjustment Test*** and the ***Stator Short Circuit and Ground Test***.
9. **If the voltage is lower than 145**, the engine RPM may be too low or there may be problems in the windings or other exciter circuit components or connections. Perform the ***Engine Throttle Adjustment Test*** and then perform the testing described in Step 11.

ROTOR VOLTAGE TEST (continued)

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 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 #5 & #6A leads. Examine stator wiring for damage, pinched leads, chafed insulation, etc. If necessary, disconnect and isolate the stator output leads as close to the stator as possible. See the ***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 of 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.

NOTES

FLASHING VOLTAGE TEST
(Engine Not Running)

⚠ WARNING

Service and repair should be performed only by 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 with the engine stopped, by simulating a running condition.

MATERIALS NEEDED

Miscellaneous Hand Tools
Voltmeter
Wiring Diagram

FLASHING VOLTAGE TEST (Engine Not Running) (continued)

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. Remove leads 234 and 235 from the oil pressure switch; see the ***Wiring Diagram***. Insulate or position the leads so they cannot come in contact with chassis ground or any other wiring.

NOTE: The Oil Pressure Switch is on the Left Side of the Engine Disconnecting the leads simulates a running engine.

4. Place the RUN/STOP switch in the "RUN" position. (The engine protection light should remain off)
5. Connect the voltmeter probes to the terminals of the Field Capacitor.

   If the meter reads normal voltage of 3 to 5 VDC, this test is complete.

6. Measure the voltage; it should read about 3 to 5 VDC.
7. Set the RUN/STOP switch to the "STOP" position and perform the ***Case Cover Replacement Procedure***.
8. 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.
9. Perform the ***Rotor Resistance Test***. Perform the ***Brush and Slip Ring Service Procedure***.
10. 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 or grounded rotor winding.
11. Perform the ***Rotor Resistance Test***.
12. Refer to the ***Wiring Diagram***, pull plug J33 from the Engine Protection/Idle 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.
13. 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 locations on the Engine Protection/Idle PC board.

    (-) Lead 5 (B1) to (+) Lead 232 (J31-1)

    (-) Lead 5 (B1) to (+) Lead 232F (J31-2)

    (-) Lead 5 (B1) to (+) Lead 232 (J33-5)

    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 and make sure all terminals are crimped tightly to the flex leads and are free of corrosion.

15. If battery voltage is present at leads 232, 232F, but not present at lead 200, the PC board is probably defective. Replace.
16. If battery voltage is present at lead 232, but not present at leads 232F or 200 check the engine protection wiring and wiring diagram.
17. If battery voltage is not present at lead 232, 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.
18. Set the RUN/STOP switch to the "STOP" position.
19. Re-connect leads 234 and 235 to the oil pressure switch.
20. If testing is completed, perform the ***Case Cover Replacement Procedure.***

STATOR VOLTAGE TEST

⚠ WARNING

Service and repair should be performed only by 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

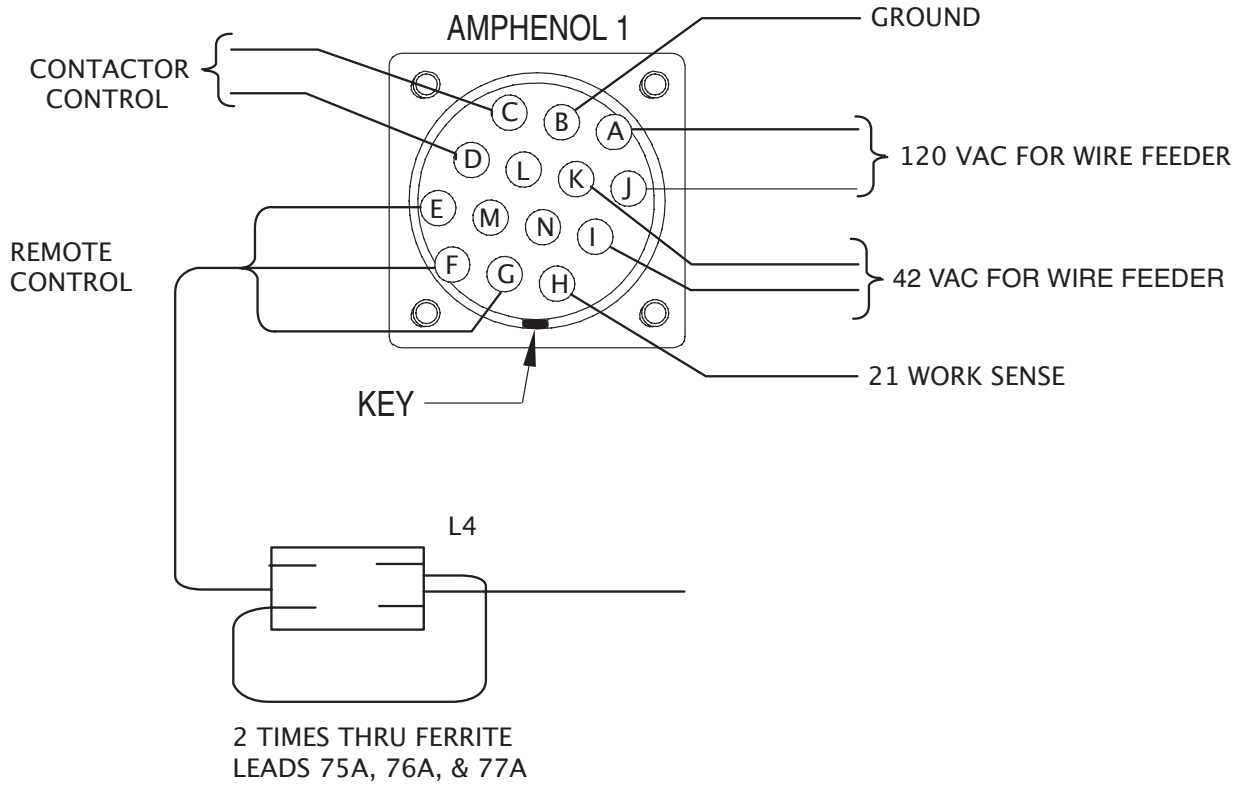
This test will determine if the Stator is able to produce correct voltage from of its Windings. It will only yield meaning data if the engine high idle speed is correct (1860 to 1890 RPM) and approximately 160 VDC is present across the Rotor Slip Rings.

MATERIALS NEEDED

Miscellaneous Hand Tools
Voltmeter
Test Pins

STATOR VOLTAGE TEST (continued)

FIGURE F.12 – RECEPTACLE LEAD LOCATIONS



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.

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 D and A. See Figure F.12. See ***Wiring Diagram.***

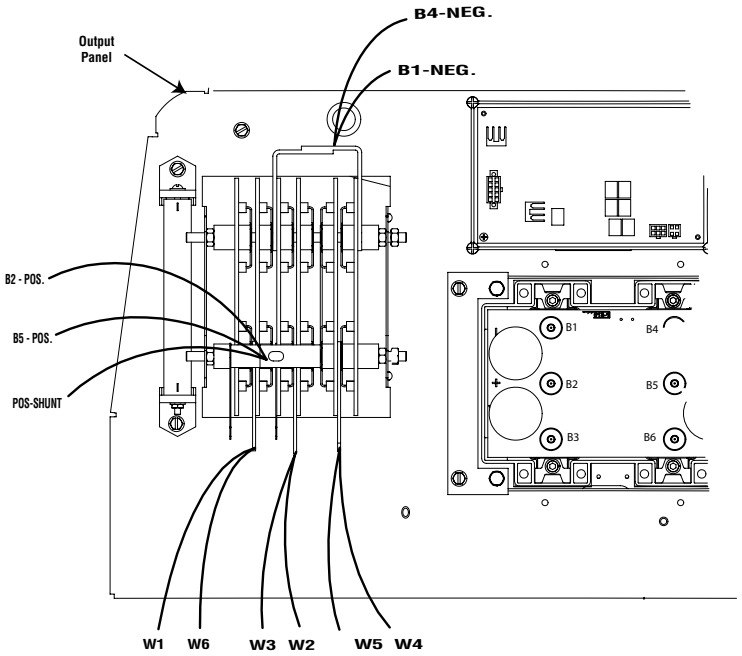
   For the lower receptacle, place the probes directly into the receptacle or connect to leads E and B. See Figure F.12. See ***Wiring Diagram.***
3. Start the engine and run it at high idle (1860-1890 RPM).
4. Check the AC voltage reading. It should read between 115 and 132 VAC.

To test the 240 VAC auxiliary winding:

1. Connect the meter probes to leads F and E 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.12. See ***Wiring Diagram.***
2. Start the engine and run it at high idle (1860-1890 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. If there are no wiring problems and the circuit breakers are not tripped or defective, the stator is defective and should be replaced.

STATOR VOLTAGE TEST (continued)

FIGURE F.13 – RECTIFIER BRIDGE DETAIL



To test the 120 VAC wire feeder supply:

NOTE: The wire feeder AC voltage supply tests require that the meter probes be inserted into the Amphenol connection cavities. Be careful not to damage or expand the terminals when inserting the probes.

NOTE: The 120 VAC power supplied to the 14 pin Amphenol connector originates from the same winding that supplies the 120 VAC receptacles. If the machine has previously passed 120VAC auxiliary winding test, this test indicates problems in connections between the Amphenol and the stator winding.

1. Connect the voltmeter probes to pins “A” (lead #32) and “J” (lead #31) of the 14 pin Amphenol. See ***Figure F.12*** and ***Wiring Diagram.***
2. Start the engine and run it at high idle (1860 to 1890 RPM).
3. The AC voltage reading should be between 115 and 132 VAC If this voltage is not within specifications, check for a tripped or defective circuit breaker, faulty connections or broken wires between the test points and the stator windings. See ***Wiring Diagram.***

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.12***.
2. Start the engine and run it at high idle (1860 to 1890 RPM).
3. The AC voltage reading should be between 40 and 50 VAC. If this voltage is 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 OK, the stator is defective and should be replaced.

To test the three-phase weld winding:

1. Locate weld winding leads W1, W2 and W3 where they connect to the three-phase output bridge rectifier. See Figure F.13**.** See ***Wiring Diagram.***
2. Start the engine and run it at high idle (1860 to 1890 RPM).
3. Check for about 60 to 65 VAC from leads W1 to W2, W2 to W3 and W1 to W3.
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.

NOTES

STATOR SHORT CIRCUIT & GROUND TEST

⚠ WARNING

Service and repair should be performed only by 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 poor electrical connections or defective or grounded windings within the Stator.

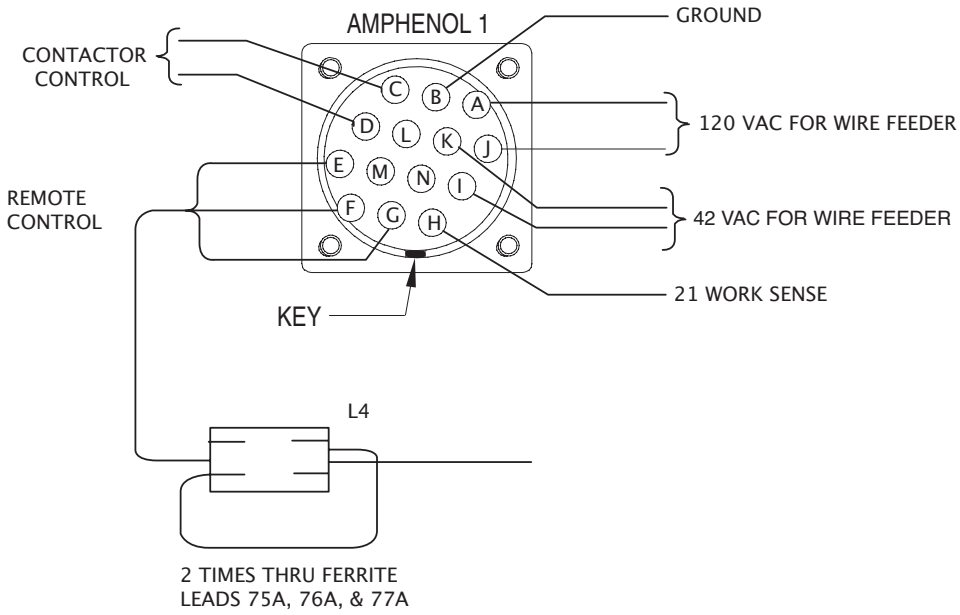
This test should be performed if flashing voltage is present at the Rotor Slip Rings, Rotor resistance, Field Bridge Rectifier, Field Capacitor and all associated wiring are proven to be good, but the Stator output voltage fails to build-up to normal levels or is too high in one or more, but not all of the Windings.

MATERIALS NEEDED

Miscellaneous Hand Tools
Ohmmeter

STATOR SHORT CIRCUIT & GROUND TEST (continued)

FIGURE F.14 – WELD CONTROL BOARD



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-E lead from the bottom ground screw inside the left case front. See ***Wiring Diagram.***
5. Disconnect the 5 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) Ωohms minimum.
   1) Pin 1 at the 14 pin amphenol and the #5 lead that had been disconnected from the ground screw (this checks for a connection between the wire feed winding and the auxiliary winding).
   2) Pin 1 of the 14 pin amphenol and lead #7 or #9. (This checks for a connection between the wire feed winding and the exciter winding.)
   3) Pin 1 of the 14 pin amphenol an lead W1, W2 or W3 (This checks for a connection between the wire feed winding and the weld winding).
   4) Lead #5 and lead #7 or #9 (this checks for a connection between the auxiliary winding and the weld winding). See ***Wiring Diagram***.
   5) Lead #5 and lead W1, W2 or W3. (This checks for a connection the auxiliary winding and the weld winding). See ***Wiring Diagram***.
   6) Lead #7 or #9 and lead W1, W2 or W3. (This checks for a connection between the exciter winding and the weld winding). See ***Wiring Diagram***.

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.

RECTIFIER BRIDGE TEST

⚠ WARNING

Service and repair should be performed only by 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 trouble-shooting 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.

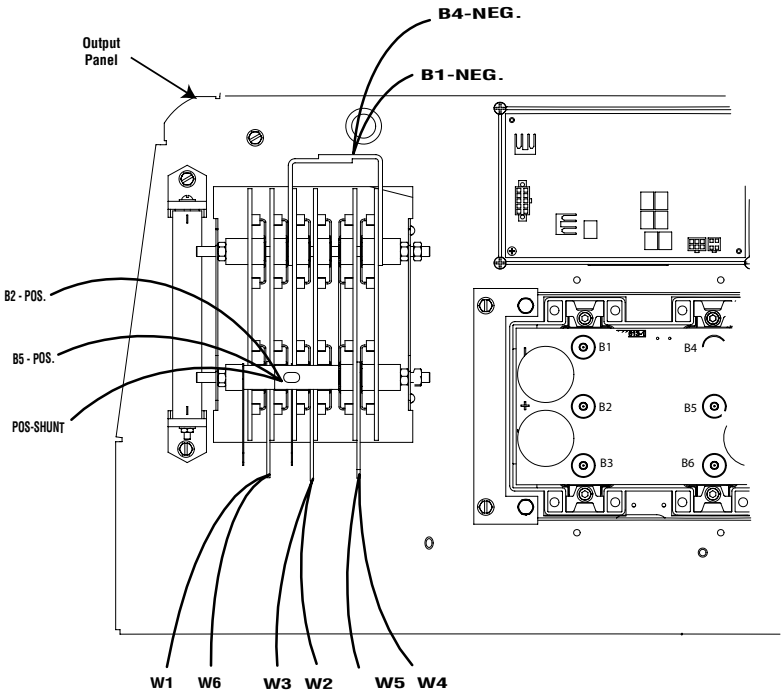
NOTE: This test will not be able to detect individual open Diodes within a group.

MATERIALS NEEDED

Miscellaneous Hand Tools
Analog Ohmmeter or Diode Tester (For Testing Diodes)
Ohmmeter (any type for ground test)

RECTIFIER BRIDGE TEST (continued)

FIGURE F.15 – RECTIFIER LEADS



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:

4. Mark leads W1, W2 and W3 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 and ***Wiring Diagram***.

   Electrically isolate the DC output terminals of the rectifier:

5. Mark the leads connected to the positive and negative terminals of the output bridge rectifier to assure that they can be reconnected properly. See Figure F.15.
6. Remove the three leads from the positive terminal of the Rectifier and the two leads from the negative terminal. Position these leads so they do not come to contact with any part of the rectifier. See Figure F.15. See the ***Wiring Diagram.***
7. 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.
8. If using diode checker or a multimeter with diode check functionality, read and understand the instructions that accompany your test equipment.
9. If using an analog ohmmeter, the forward bias test will indicate low resistance and the reverse bias test will indicate high resistance. Precise ohm values for this test will vary depending on the test equipment used.

NOTE: A digital Ohmmeter is not recommended for this test. While it may indicate a shorted or open device, typical digital meter does not provide enough voltage or current flow to reliably test the diodes used in this rectifier.

10. Test all of the diode groups per the ***Table F.1.***
11. Reconnect all leads.
12. Perform the ***Case Cover Replacement Procedure***.

RECTIFIER BRIDGE TEST (continued)

TABLE F.1 – DIODE TEST TABLE

Rectifier Terminal Connections	Test Instrument		
	(+) Lead	**(-) Lead**	**Diode Bias and Expected Test Result**
	W1	DC(+)	FORWARD BIAS (Low Resistance)
	W2	DC(+)	FORWARD BIAS (Low Resistance)
	W3	DC(+)	FORWARD BIAS (Low Resistance)
	DC(-)	W1	FORWARD BIAS (Low Resistance)
	DC(-)	W2	FORWARD BIAS (Low Resistance)
	DC(-)	W3	FORWARD BIAS (Low Resistance)
	W1	DC(-)	REVERSE BIAS (High Resistance)
	W2	DC(-)	REVERSE BIAS (High Resistance)
	W3	DC(-)	REVERSE BIAS (High Resistance)
	DC(+)	W1	REVERSE BIAS (High Resistance)
	DC(+)	W2	REVERSE BIAS (High Resistance)
	DC(+)	W3	REVERSE BIAS (High Resistance)

NOTES

CHOPPER MODULE FUNCTION TEST

⚠ WARNING

Service and repair should be performed only by 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 trouble-shooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

This test will help determine if the Chopper Module is functioning properly and receiving the correct input from the Output Rectifier and Control PC Board.

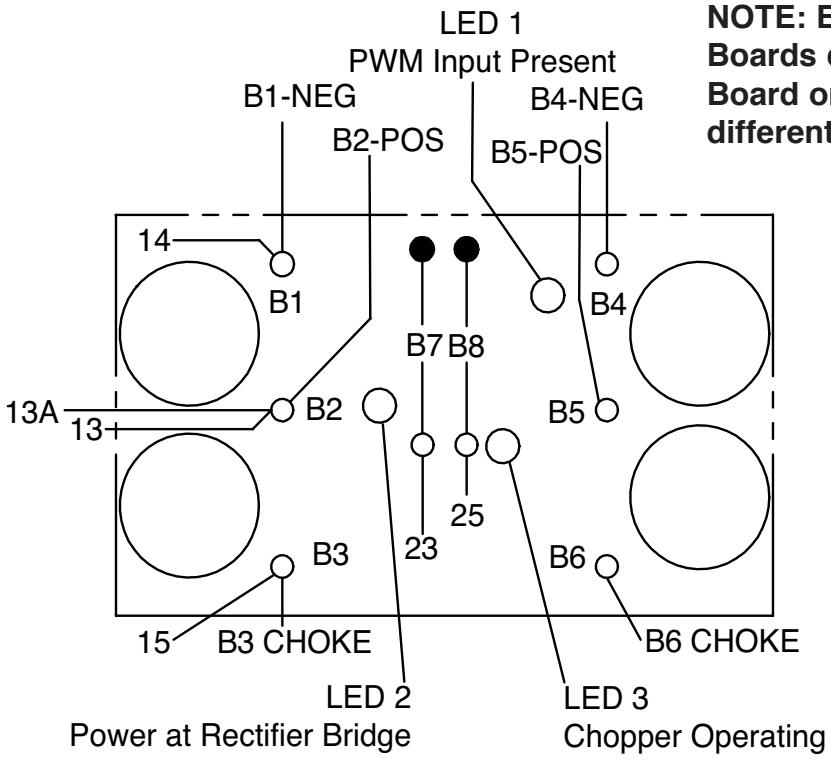
This test can only provide meaningful results if the machine is producing normal AC auxiliary output.

MATERIALS NEEDED

Miscellaneous Hand Tools
Digital Multimeter
Frequency counter or digital multi-meter with frequency counter function.
Wiring Diagram

CHOPPER MODULE FUNCTION TEST (continued)

FIGURE F.16 – CHOPPER MODULE CONNECTIONS



NOTE: Early design P C Boards did not have LED's. Board orientation may be different than what is shown.

PROCEDURE

1. Perform the ***Case Cover Removal Procedure***.
2. Make sure that there is nothing plugged into either of the Amphenol receptacles.
3. Place idle switch in the "HIGH" position.
4. Place the mode switch in the "CC-STICK" position.
5. Place the Welding Terminal switch in the "REMOTELY CONTROLLED" position.
6. Start the engine and allow it to stabilize at high idle RPM.
7. Check for 80 to 100 VDC at terminals B1- to B2+ and B4- to B5+ of the chopper module. See ***Wiring Diagram*** and Figure F.16.
8. 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.16. See the ***Wiring Diagram***. Perform the ***Stator Voltage Tests*** and the ***Rectifier Bridge Test***.
9. 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 leads #23 and #25 from the chopper module PC board. If voltage is still present, the copper module is shorted and should be replaced.
10. If the voltage drops to 0 VDC after the #23 and #25 leads have been disconnected, the control PC board is driving the chopper module when it should not be doing so. Reconnect the #23 and #25 leads and perform the ***Weld Control Board Gate Signal Test***.
11. Reconnect leads #23 and #25 and place the Welding Terminal switch in the "WELD TERMINALS ON" position.
12. 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***.

CHOPPER MODULE FUNCTION TEST (continued)

13. 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, on leads W7, W8, W9 and W10. Also check the shunt, the choke and the connections at the back of the output terminals. See the ***Wiring Diagram***.
14. 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. See the Control Inner-Connection diagram. Also check for damaged conductors or faulty connections at leads #302 and #302. See ***Wiring Diagram***.
15. If the voltage at terminals B2+ to B3- and B5+ to B6- of the chopper module is very low or not present, use the frequency counter to check for the presents of a 20 kHZ PWM signal between leads #23 +and #25-, where they connect to the chopper module PC board.
16. If the 20 kHz signal is present, the chopper module is defective. Replace.
17. If the 20 kHz signal is not present, perform the ***Weld Control Board Gate Signal Test***.
18. If the weld control board is producing a PWM gate signal, check the #23 and #25 leads for damaged conductors and faulty connections between the control PC board and the chopper module.
19. If testing is complete, Perform the ***Case Cover Replacement Procedure***.

TERMINAL	LEADS
B4	Heavy Lead B4-NEG
B5	Heavy Lead B5-POS
B6	Heavy Lead B6-Choke
B1	Heavy Lead B1-NEG Small Lead 14
B2	Heavy Lead B2-POS Small Leads 13 &13A
B3	Heavy Lead B#-Choke Small Lead #5

NOTES

CHOPPER MODULE RESISTANCE TEST

⚠ WARNING

Service and repair should be performed only by 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 help determine if the Chopper Module is shorted. This test can only detect some problems in the "Power" section of the Module. Problems in some other PC board components may not be detected.

MATERIALS NEEDED

Miscellaneous Hand Tools
Digital Ohmmeter
Wiring Diagram

NOTE: Different digital meters may give results that vary significantly from the readings listed. Readings that are similar in the table should be similar with the meter being used.

CHOPPER MODULE RESISTANCE TEST (continued)

PROCEDURE

1. Perform the ***Case Cover Removal Procedure***.
2. Perform the ***Capacitor Discharge Procedure***.
3. Check that all of the leads connected to the chopper module terminals are clearly marked to facilitate reassembly. Remove all of the leads from the chopper module and position them so they do not make electrical contact with any part of the module. See ***Wiring Diagram.***`
4. Use a digital Ohmmeter to test the module per Table F.2.
5. Reconnect all leads.
6. The chopper module screw connection should be lightened to 50-60 inch-pounds.
7. Perform the ***Case Cover Replacement Procedure.***

TABLE F.2 - DIODE TEST TABLE

Chopper Terminal Connections	OHMMETER		OHMMETER READING
	(+) Lead	(-) Lead	Diode Bias and Expected Test Result
	B5	B6	6K to 9K
	B6	B5	6K to 9K
	B4	B5	200k or higher
	B5	B4	400k or higher
	B4	B6	200k or higher
	B6	B4	400k or higher
	B2	B3	6K to 9K
	B3	B2	6K to 9K
	B4	B2	200k or higher
	B2	B4	400k or higher
	B4	B3	200k or higher
	B3	B4	400k or higher

WELD CONTROL BOARD PWM GATE SIGNAL TEST

⚠ WARNING

Service and repair should be performed only by 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 Weld Control PC Board is able to produce the PWM (Pulse Width Modulated) gate signal needed to control the IGBTs (Insulated Gate Bipolar Transistor) on the Chopper Module. This test will also verify that the Control PC Board can turn the PWM gate signal on and off properly.

MATERIALS NEEDED

Digital Multimeter
Frequency counter or digital Multi-meter with frequency counter function
Wiring Diagram

WELD CONTROL BOARD PWM GATE SIGNAL TEST (continued)

PROCEDURE

1. Perform the ***Case Cover Removal Procedure***.
2. Unplug any device that may be attached to either the 6 pin or the 14 pin Amphenol receptacles.
3. Place the idle switch in the “HIGH IDLE” position.
4. Place the mode switch in the “CC-STICK” position.
5. Place the Weld terminals switch in the “WELD TERMINALS ON” position.
6. Start the engine and let it run and stabilize at high idle RPM.
7. Locate plug J3 on the control PC board. See the ***Wiring Diagram***.
8. Use the frequency counter to test for 20kHz PWM gate signal between leads #23+ (J3-10) and #25- (J3-9).
9. If the 20KHz gate signal is present, place the weld terminals switch in the ”REMOTELY CONTROLLED” position. The gate signal should turn off.
10. If the 20 KHz gate signal responds as described above, this test is complete.
11. If there is no 20 KHz gate signal, test for the presents of 80 to 100 VDC, at leads 13+ (J3-8) to 14- (J3-16) of the weld control PC board.
12. If voltage is very low or not present, check leads #13 and #14 for faulty or damaged wiring or connections between the control PC board and the chopper module.
13. Test for 80 to 100 VDC at the terminals where the #13 and #14 leads connect to the chopper module. See the ***Wiring Diagram***. If there is no voltage at the chopper module, perform the ***Chopper Module Function Test***.
14. If the 80 to 100 VDC supply voltage is present at the weld control PC board, but there is no PWM gate signal, check the voltage between leads #2+ (P1-4) and #4 (P1-3).

    The voltage should be about 0 VDC.
15. If about 5 VDC is detected, the welding terminal control circuit is open. Check for damaged leads for faulty connections at leads #2 and #4; also check for a defective welding terminal switch. See the ***Wiring Diagram***.
16. If the PWM signal remains after the welding terminal switch has been placed in the “REMOTELY CONTROLLED” position, check the voltage between leads #2+ (P1-4) and #4- (P1-3) at the control PC board.
17. If the voltage reads 0 or very near 0, Check for damaged insulation at leads #2 and #4, also check for a shorted welding terminal switch or damaged or contaminated Amphenol receptacle. See the ***Wiring Diagram***.
18. If the above wiring and components are undamaged and functioning properly, the control PC board is defective and should be replaced.
19. If the voltage reads about 5 VDC and the PWM signal remains, the control PC board is defective and should be replaced.
20. Perform the ***Case Cover Replacement Procedure***.

WELD CONTROL FEEDBACK TEST

⚠ WARNING

Service and repair should be performed only by 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 Weld Control PC Board is receiving accurate current and voltage feedback from the Weld Circuit.

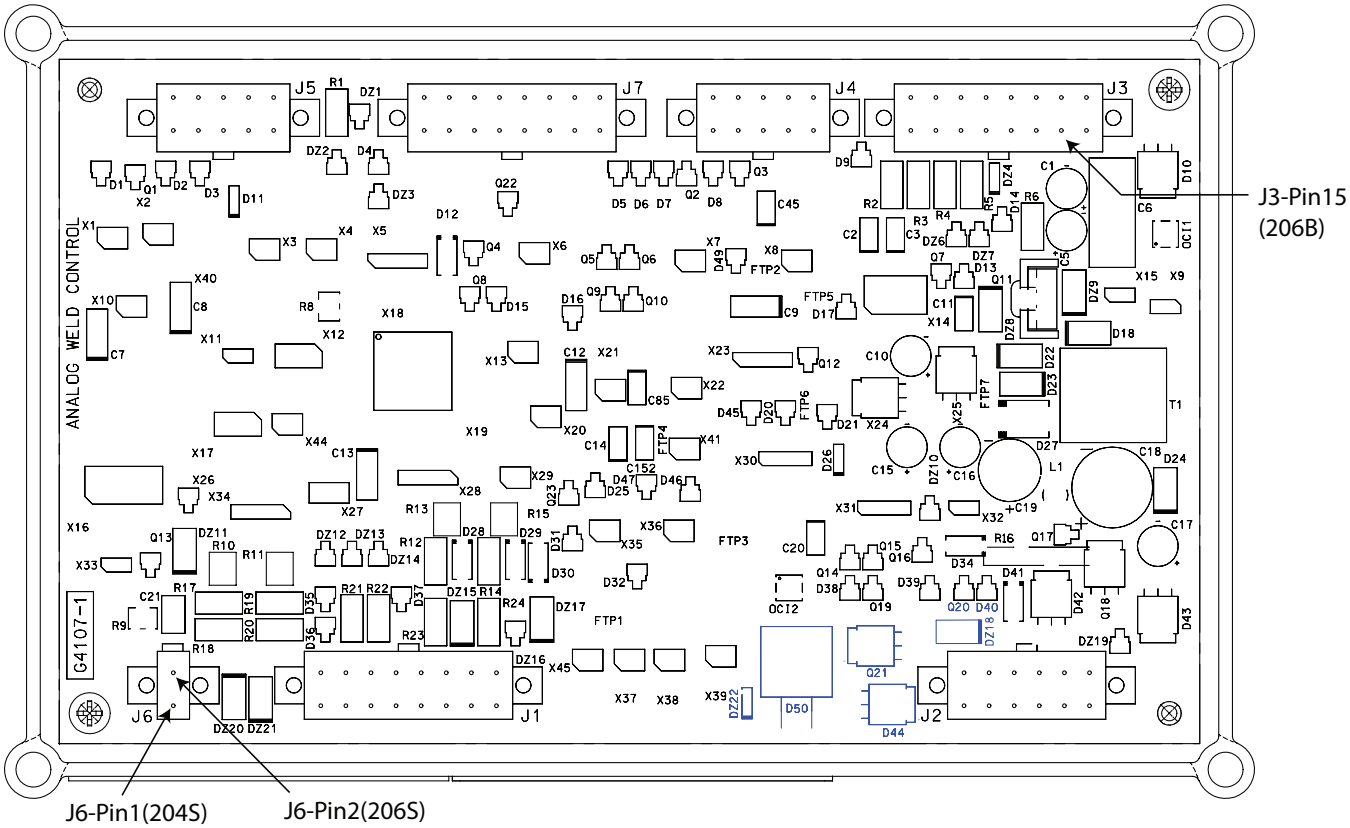
This test will only yield usable information if the machine is producing some weld output.

MATERIALS NEEDED

Digital Multimeter 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

WELD CONTROL FEEDBACK TEST (continued)

FIGURE F.17 – CONTROL PC BOARD



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.

NOTE: If the optional Weld Meter Kit is not installed, proceed to Step 10.

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. Remove the load from the weld terminals and turn off the engine. (The load bank and ammeter can remain connected).

WELD CONTROL FEEDBACK TEST (continued)

PROCEDURE

11. Perform the ***Case Cover Removal Procedure***.
12. Locate plugs J3 and J6 on the control PC board. See ***Figure F.18.*** 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+ (J6-1) and lead #208B- (J3-15) at the Control 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+ (J6-2) and lead 204S- (J6-1). 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.

    The shunt used in this machine will produce 50 millivolts at a load of 400 amps or 8 amps per millivolt.

    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.
19. 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.
20. Perform the ***Case Cover Replacement Procedure***.

NOTES

CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST

⚠ WARNING

Service and repair should be performed only by 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

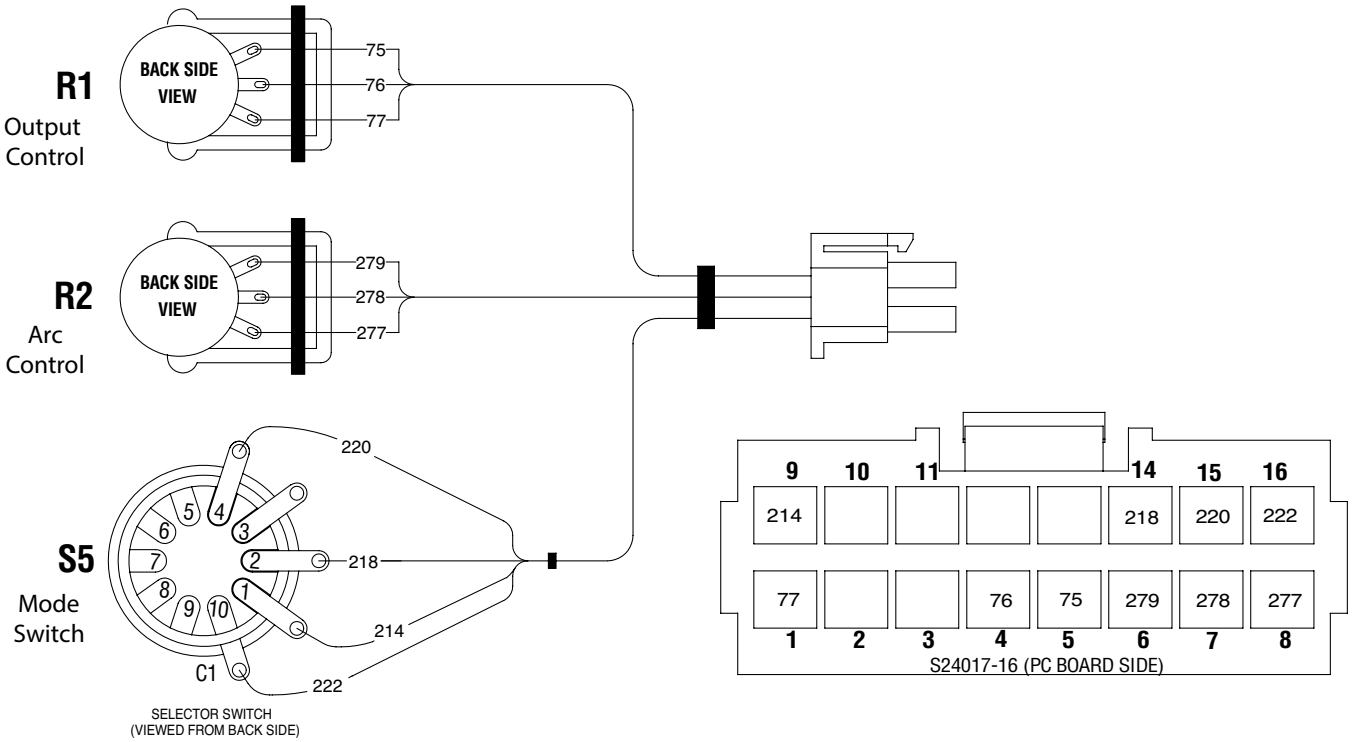
This test will check the Output Control Potentiometer, Arc Control Potentiometer, Mode Switch and associated wiring for damage, proper operation, tracking and grounds.

MATERIALS NEEDED

Digital Ohmmeter
Wiring Diagram

CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST (continued)

FIGURE F.18 – POTENTIOMETER AND SWITCH ASSEMBLY



PROCEDURE

1. Turn the engine off.
2. Perform the ***Case Cover Removal Procedure***.
3. Unplug J7 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. J7 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 J7 and a good clean chassis ground connection. Be very careful that the connection pins in J7 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 resistance tests per ***Table F.3.***
9. If the resistance readings are not as specified in the table, replace the potentiometer and mode switch plug and lead assembly or replace the defective component. See ***Wiring Diagram.***
10. If testing is complete, plug J7 back into the control PC board and perform the ***Case Cover Replacement Procedure***.

CONTROL POTENTIOMETER AND MODE SWITCH RESISTANCE TEST (continued)

TABLE F.3

POT/MODE SWITCH RESISTANCE TEST		
MODE SWITCH SETTING	**OHMMETER CONNECTION**	**OHMMETER READING**
CC-STICK	P7-9 (#214) TO P7-14 (#218)	500K or Higher
CC-STICK	P7-9 (#214) TO P7-15 (#220)	500K or Higher
CC-STICK	P7-9 (#214) TO P7-16 (#222)	500K or Higher
CC-STICK	P7-14 (#218) TO P7-15 (#220)	500K or Higher
CC-STICK	P7-14 (#218) TO P7-16 (#222)	500K or Higher
CC-STICK	P7-15 (#220) TO P7-16 (#222)	500K or Higher
TOUCH START TIG	P7-15 (#220) TO P7-16 (#222)	0*
DOWNHILL PIPE	P7-14 (#218) TO P7-16 (#222)	0*
CV-WIRE	P7-9 (#214) TO P7-16 (#222)	*
N/A	P7-5 (#75) TO P7-1 (#77)	about 10K
N/A	P7-1 (#77) TO P7-4 (#76)	Ohms values should sweep smoothly from 10K to 0 when ARC CONTROL is turned from Min. to Max.
N/A	P7-6 (#279) TO P7-8 (#277)	about 10K
N/A	P7-8 (#277) TO P7-7 (#278)	Ohms values should sweep smoothly from 10K to 0 when ARC CONTROL is turned from Min. to Max.

* Resistance should be very low, The Ohmmeter should read about the same value as one would get by touching the two meter probes together.

NOTES

REMOTE RECEPTACLE RESISTANCE TEST

⚠ WARNING

Service and repair should be performed only by 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 trouble-shooting assistance before you proceed. Call 1-888-935-3877.

TEST 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.

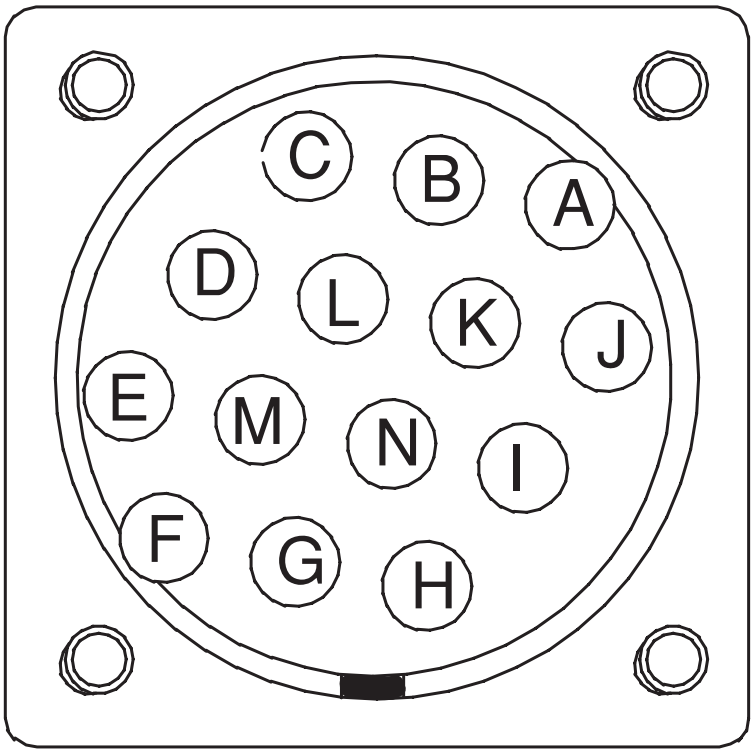
MATERIALS NEEDED

Ohm Meter
Wiring Diagram

REMOTE RECEPTACLE RESISTANCE TEST (continued)

FIGURE F.19 – AMPHENOL RECEPTACLES

AMPHENOL 1



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 J1 from the control PC board, see Control Inner-Connection Diagram. 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 J1 plug so it can not 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 J1 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 ***Wiring Diagram***. Repair any faulty connections or replace the switch if necessary.
9. Plug J1 back into the Control PC board.
10. Perform the ***Case Cover Replacement Procedure***.

REMOTE RECEPTACLE RESISTANCE TEST (continued)

TABLE - F.4

AMPHENOL RESISTANCE TEST		
WELDING TERMINAL SWITCH SETTING	**OHMMETER CONNECTION**	**OHMMETER READING**
N/A	PIN “G” (#75B) to PIN “A” (#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” (#32)	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)	0*

*Resistance should be very low. The Ohmmeter should read about the same value as one would get by touching the two meter probes together.

NOTES

RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed only by 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

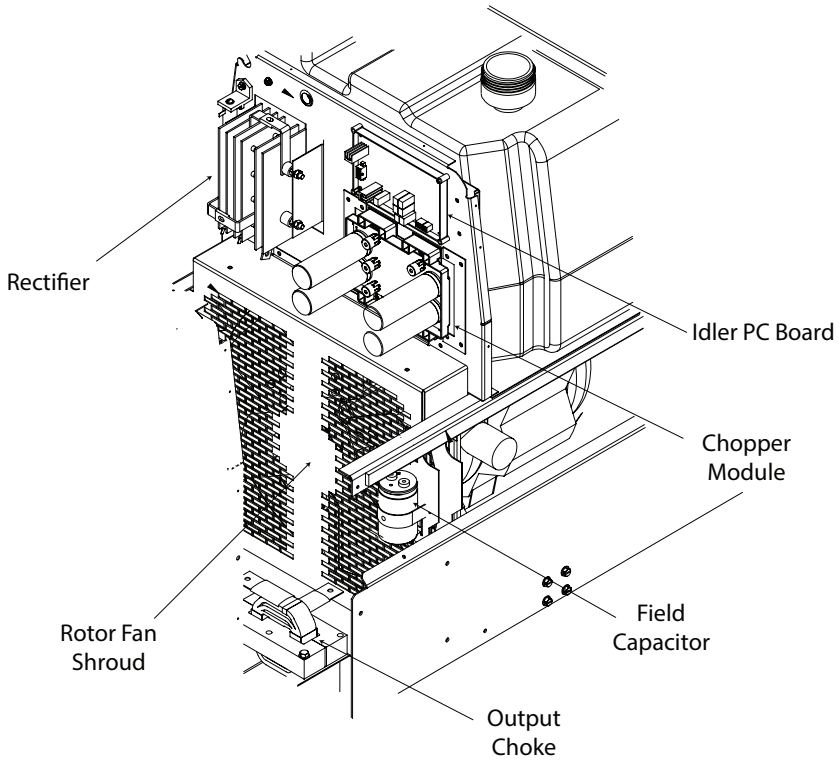
The following procedure will aid the technician in removing and replacing the Output Rectifier Bridge and the Choke in the Vantage 410.

MATERIALS NEEDED

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

RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT (continued)

FIGURE F.20 – RECTIFIER AND CHOKE LOCATION



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.

RECTIFIER BRIDGE AND CHOKE REMOVAL AND REPLACEMENT (continued)

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 they 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.

NOTES

CHOPPER MODULE REMOVAL AND REPLACEMENT

⚠ WARNING

Service and repair should be performed only by 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.

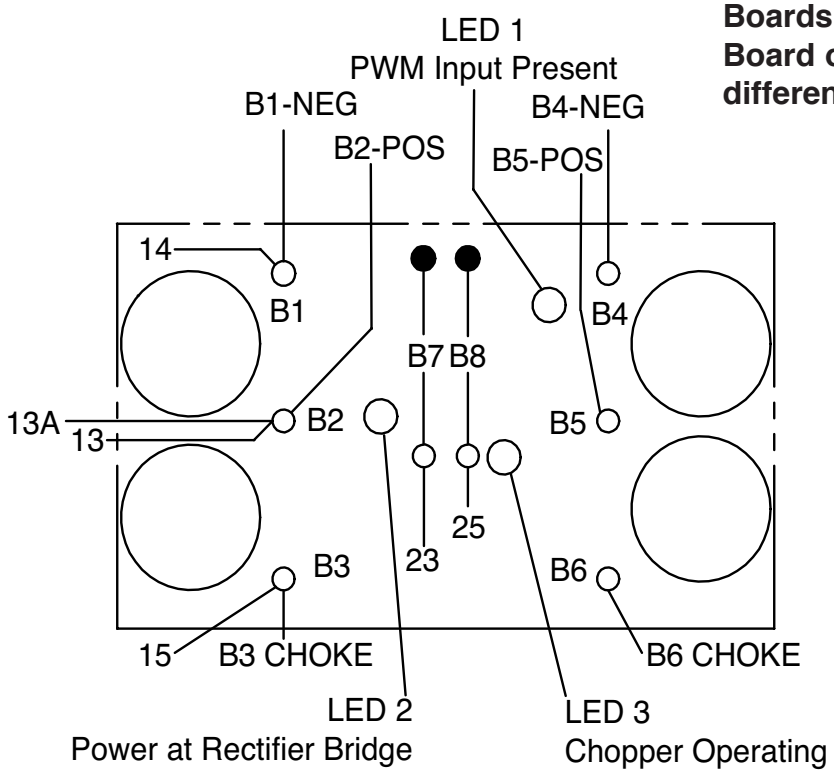
MATERIALS NEEDED

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

CHOPPER MODULE REMOVAL AND REPLACEMENT (continued)

FIGURE F.21 – CHOPPER MODULE CONNECTIONS

NOTE: Early design P C Boards did not have LED's. Board orientation may be different than what is shown.



PROCEDURE

Removal

1. Turn the engine off.
2. Perform the ***Case Cover Removal Procedure***.
3. Perform the ***Chopper Module Capacitor Discharge Procedure***.
4. Disconnect leads 23 and 25 from leads B7 and B8 at the in-line connections.
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 three screws holding the power module assembly to its brackets on the vertical baffle. Remove the plastic strip with the top two screws. Be sure to support the Chopper Module as you remove the last screw.
7. Remove the Chopper Module assembly from the machine.

CHOPPER MODULE REMOVAL AND REPLACEMENT (continued)

Replacement

1. Mount the heat sink to the brackets on the vertical baffle with the three 3/8" screws. Mount the plastic strip with the top two screws.
2. Connect leads 23 and 25 to leads B7 and B8 at the in-line couplers.
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, small lead, 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.***

TERMINAL	LEADS
B4	Heavy Lead W11 Small Lead 14
B5	Heavy Lead W5 Small Lead 13
B6	Heavy Lead W8
B1	Heavy Lead W6
B2	Heavy Lead W4 Small Lead 301
B3	Heavy Lead W9 Small Lead 302

NOTES

ROTOR REMOVAL AND REPLACEMENT PROCEDURE

⚠ WARNING

Service and repair should be performed only by 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.

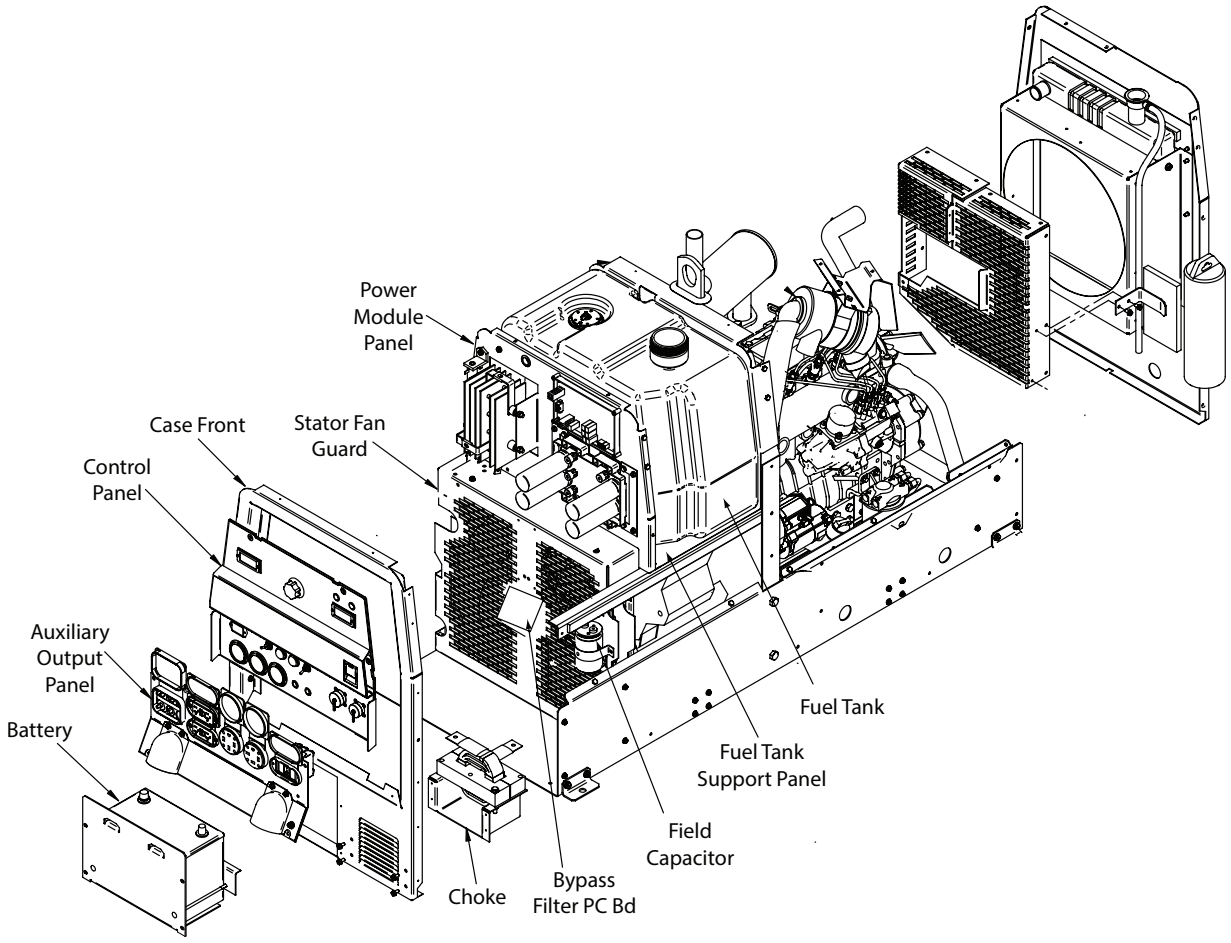
MATERIALS NEEDED

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.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.22 – FUEL TANK REMOVAL



MACHINE DISASSEMBLY PROCEDURE

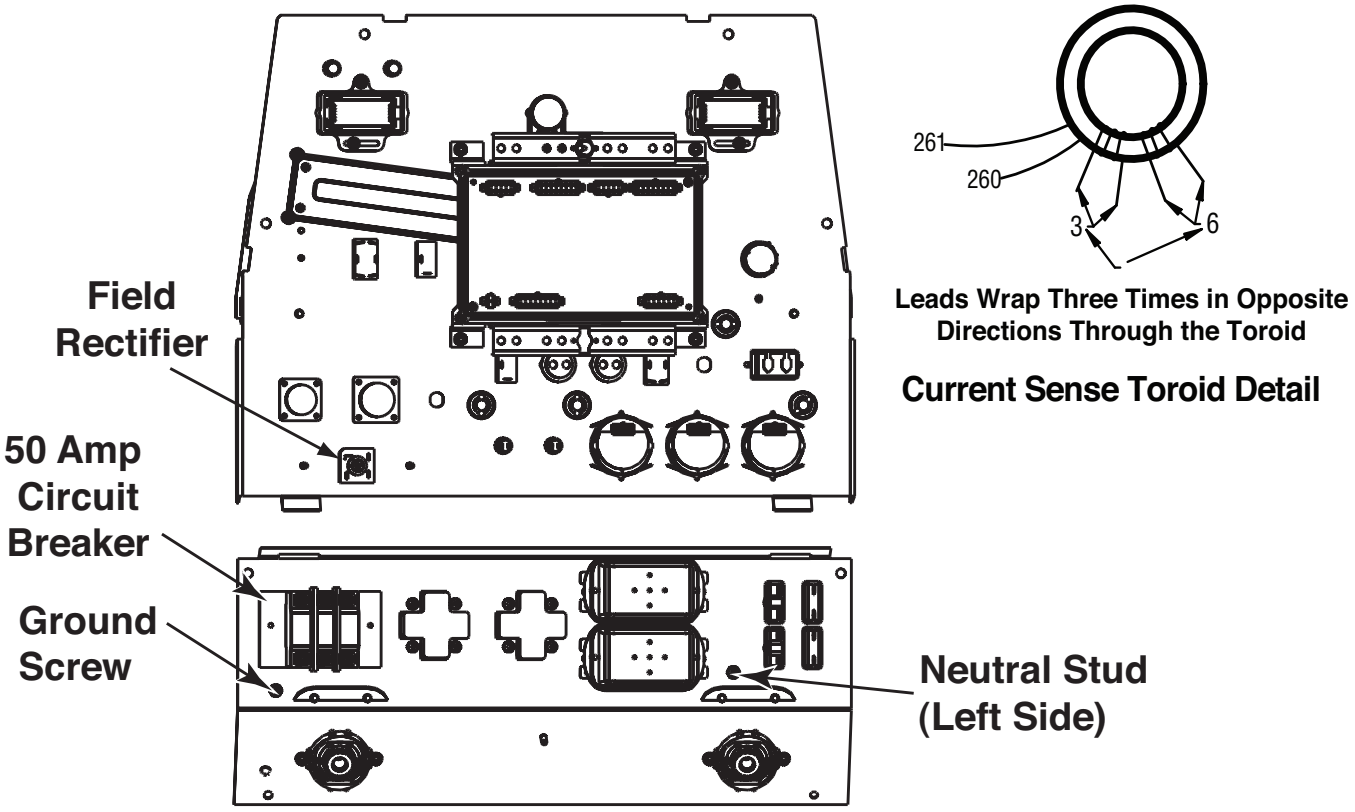
1. Perform the ***Case Cover Removal Procedure.***
2. Remove the battery.
3. Perform the ***Capacitor Discharge Procedure.***
4. Drain the Fuel Tank. Close the shut-off valve on the Fuel Filter and disconnect and plug the fuel line (Kubota).
5. Remove and plug the upper fuel line.

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 leads 23 and 25 and the leads from the B1, B2, B3 and B6 terminals of the Chopper Module. Note the position of the leads and placement of the hardware.
11. Disconnect leads 5S, 227, 217 and the Molex connectors from the Idler/Engine Shutdown PC Board.
12. Remove leads 13A and 15 from the R4 resistor.
13. Un-bolt (4 places) and remove the Power Module Panel and the Fuel tank support panel.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.23



DISASSEMBLY PROCEDURE (CONT.)

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***.

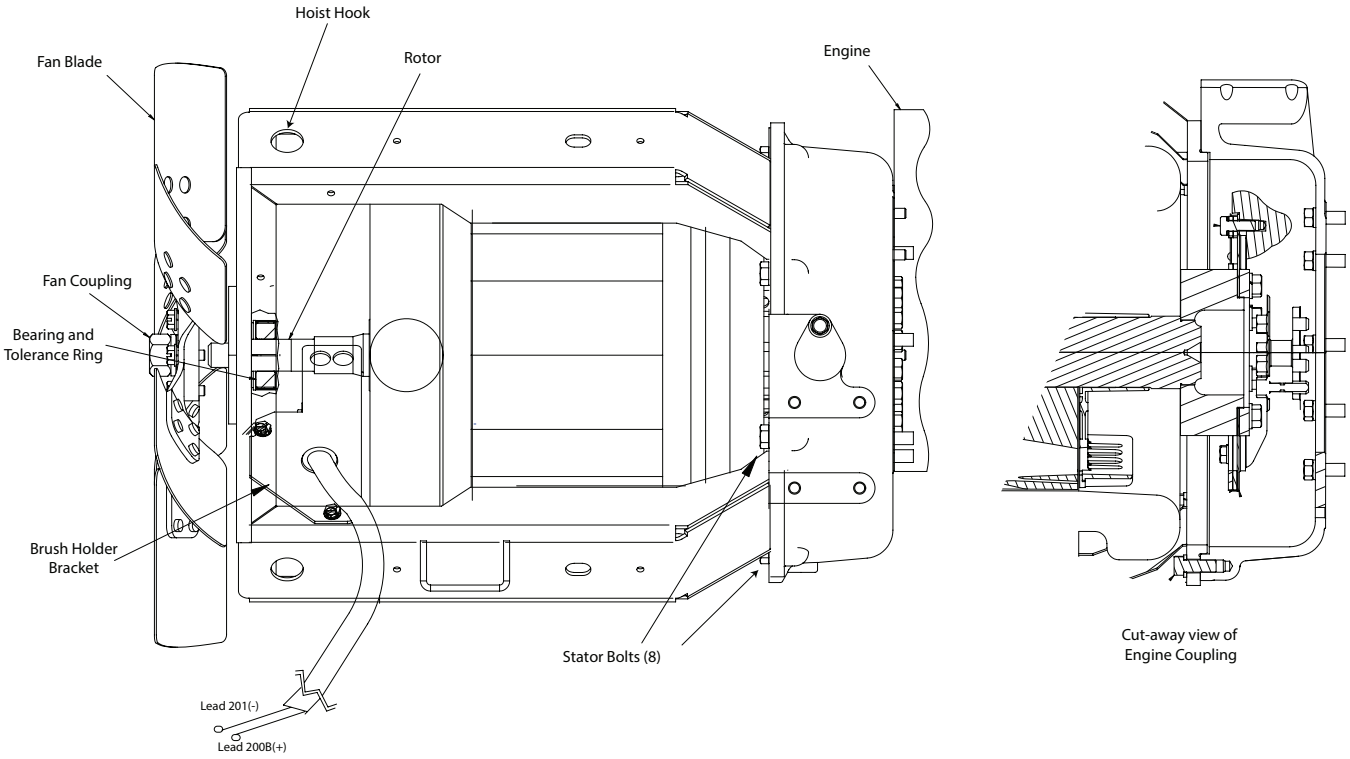
16. Disconnect lead 5 from the ground stud and lead 5A from the Neutral Stud on the Auxiliary Power Panel.
17. Disconnect leads 6A, 201 and 200B from the Field Rectifier.
18. Separate the in-line connections (206C and 208C) from the Bypass Filter PC Board that is mounted on the Stator Fan Shroud. See ***Figure F.22.***
19. Disconnect the Green grounding lead from the Bypass Filter PC Board.

NOTE: On older codes, the Bypass Filter PC Board is mounted on the Auxiliary Power Panel and does not have to be disconnected.

20. Disconnect the upper lead from the Choke.
21. Remove the left side fuel tank support rail.
22. 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.
23. Unbolt and slide the Stator Fan Guard out the front of the machine.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.24 – STATOR REMOVAL



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.
4. Remove the two bolts holding the stator to the shock mounts.
5. Loosen the two engine mounting bolts.
6. 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.
7. Put a block under the engine for support and remove those two lower bolts.

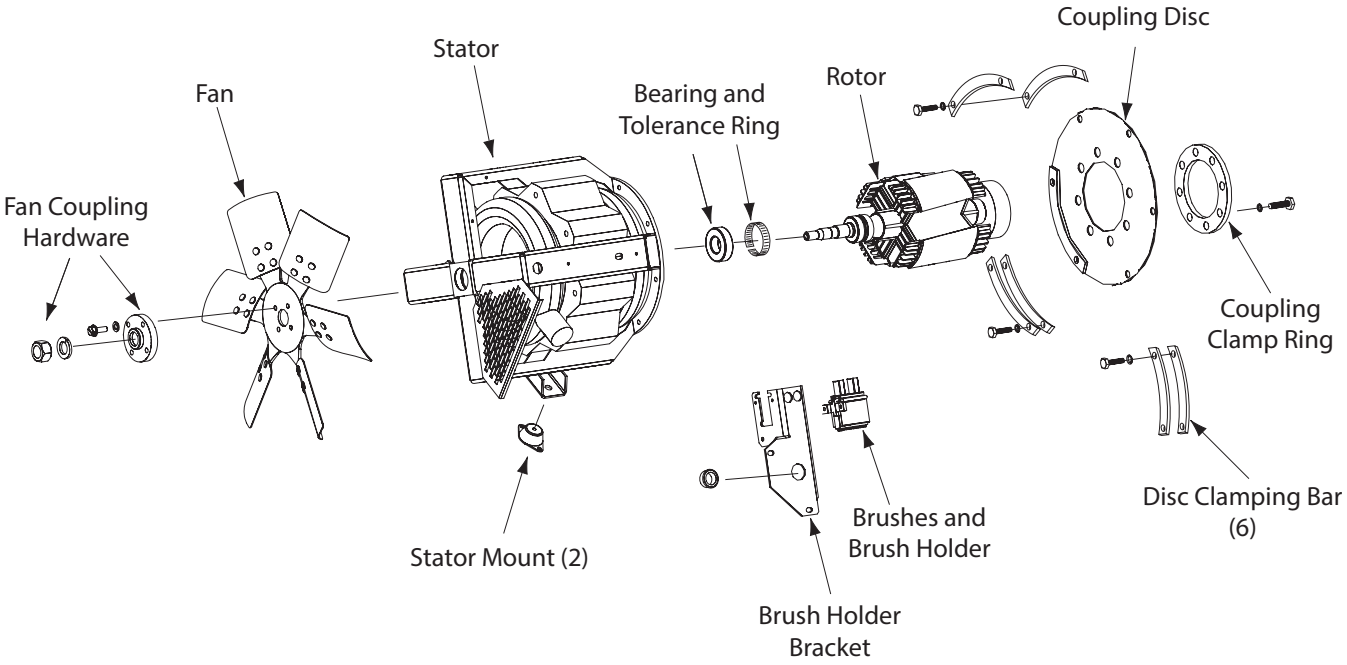
NOTE: When lifting the stator, be certain not to lift far enough to damage the cooling fan or the radiator.

8. Lower the stator and loosen the remaining six stator bolts.
9. 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 AND REPLACEMENT PROCEDURE (continued)

FIGURE F.25 - ROTOR REMOVAL



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.

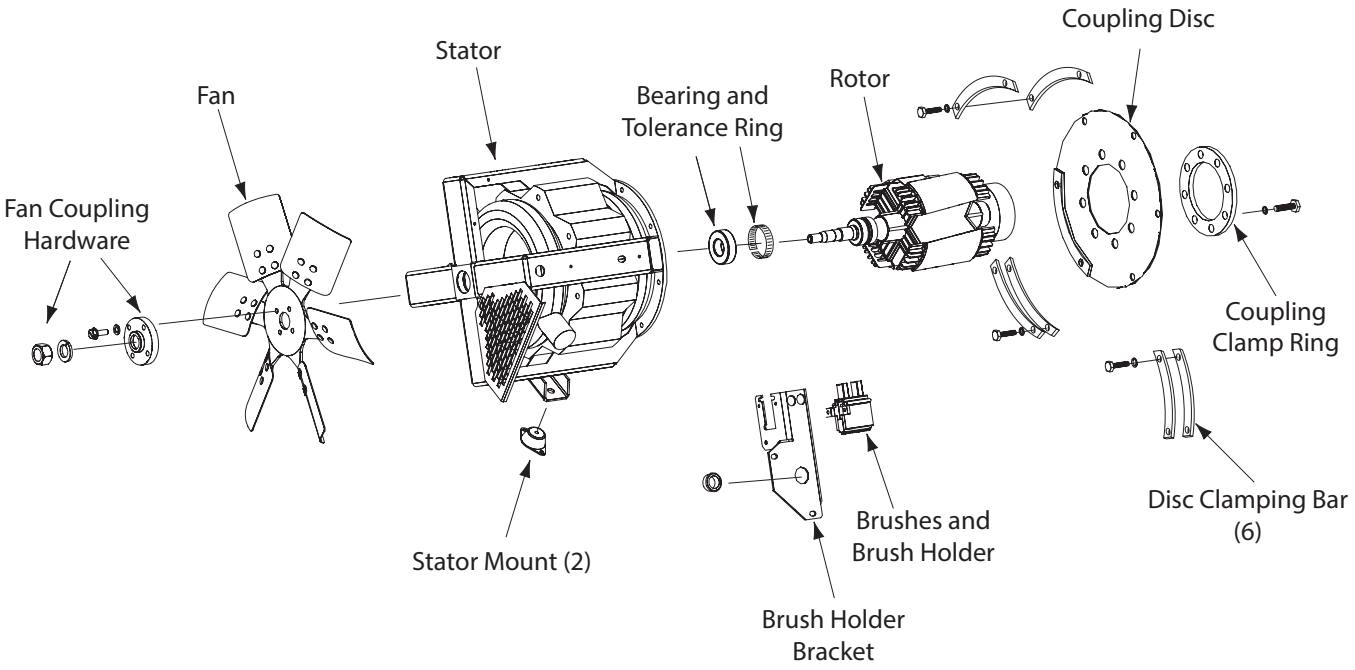
NOTE: Depending on the machine Code Number, there will be 6 (Kubota) clamping bars. See Figure F.25.

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 REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.26 ROTOR REPLACEMENT



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.

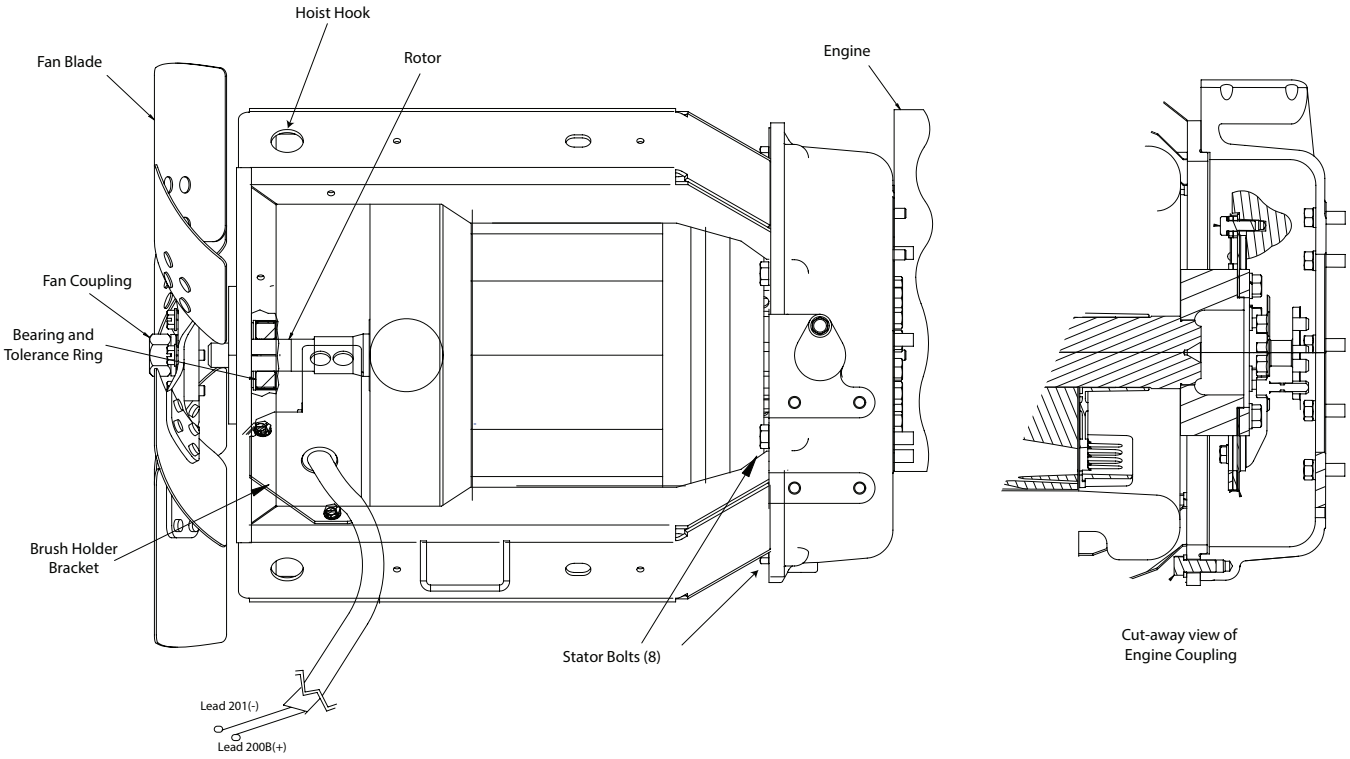
3. Install the bearing on the new rotor.

NOTE: Whenever the Stator or Rotor is replaced it is advisable to replace both the Bearing and the Tolerance Ring.

3. Using a sling, position the rotor into the flywheel. Make sure it is located fully into and flush against the counterbore of the flywheel.
4. 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.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.27 – STATOR REPLACEMENT



STATOR REPLACEMENT PROCEDURE

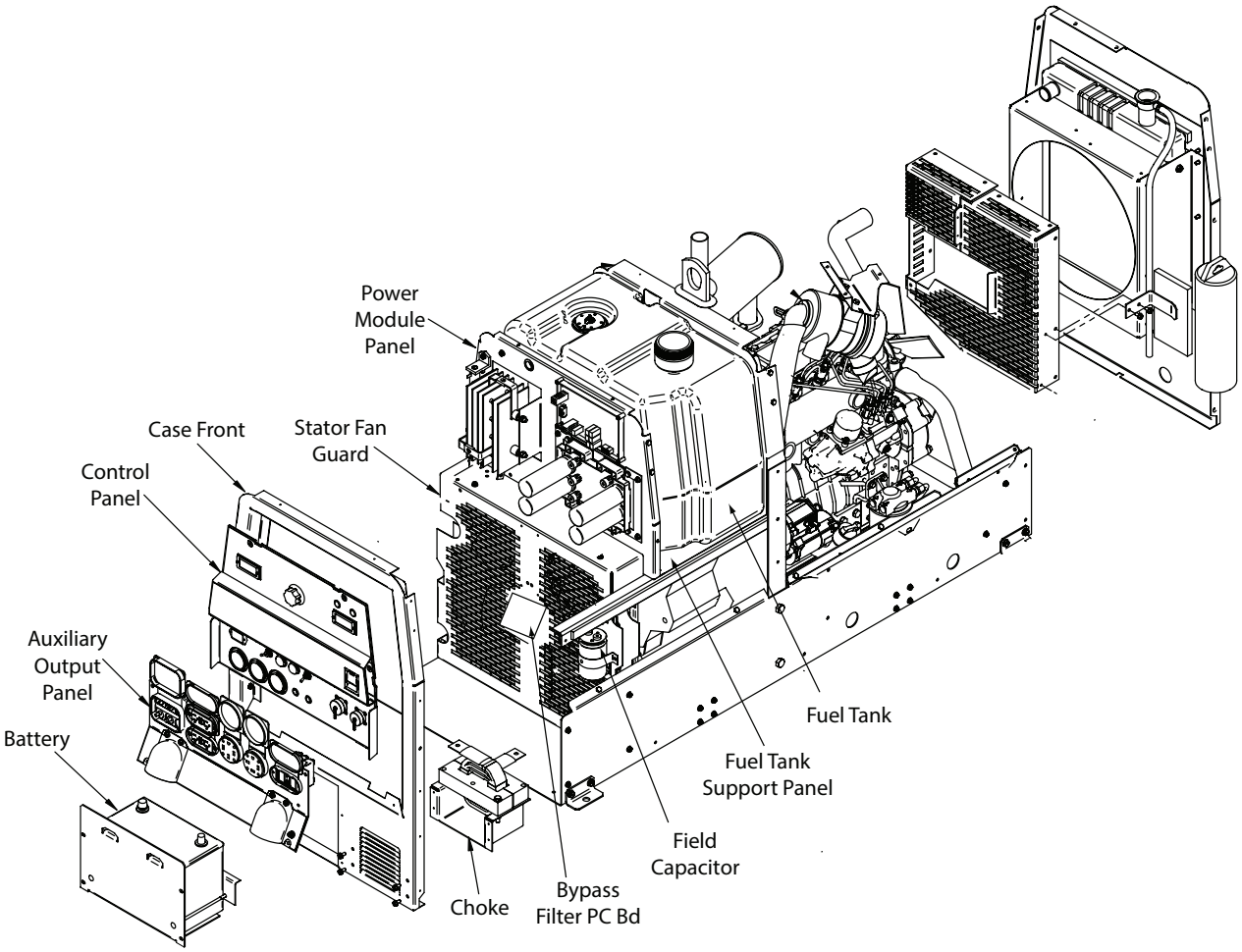
1. Apply a light coating of grease to the I.D. of the Tolerance Ring and install the tolerance ring into the bearing seat of the stator.
2. Using a hoist, slide the Stator over the rotor, making sure that the bearing lines up into the bearing seat.

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.
5. 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.

ROTOR REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.28 – MACHINE REASSEMBLY



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.
5. 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.

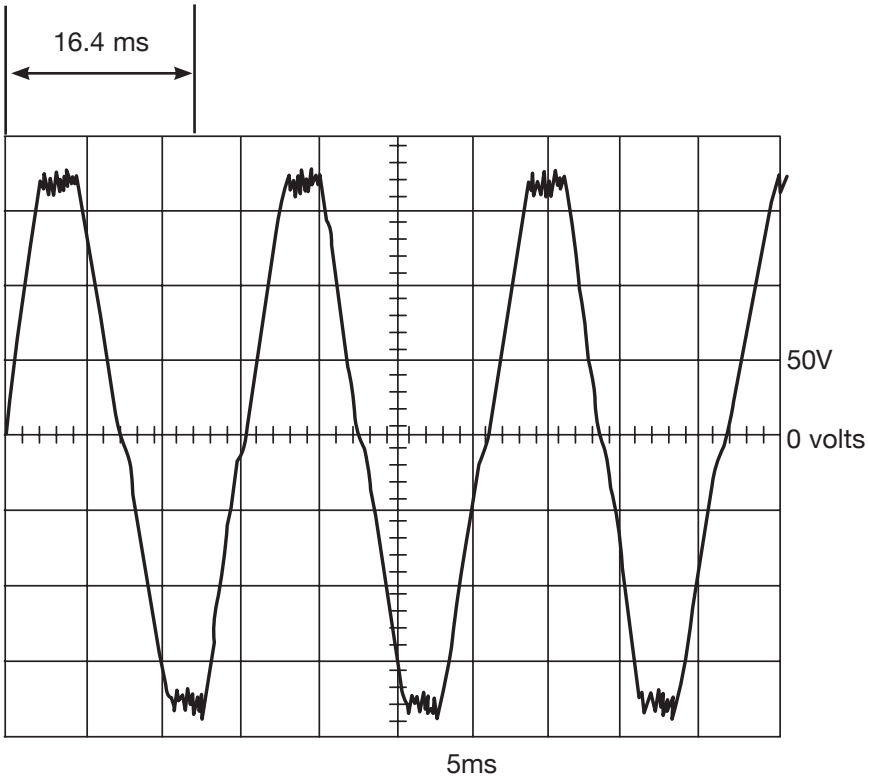
   Wrap stator leads 3 and 6 through the toroid three times in opposite directions. See ***Figure F.23.***

   Replace any tie-wraps that were cut during disassembly.

6. Perform the ***Case Cover Replacement Procedure.***

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115VAC SUPPLY)

HIGH IDLE – NO LOAD



This is the typical auxiliary output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

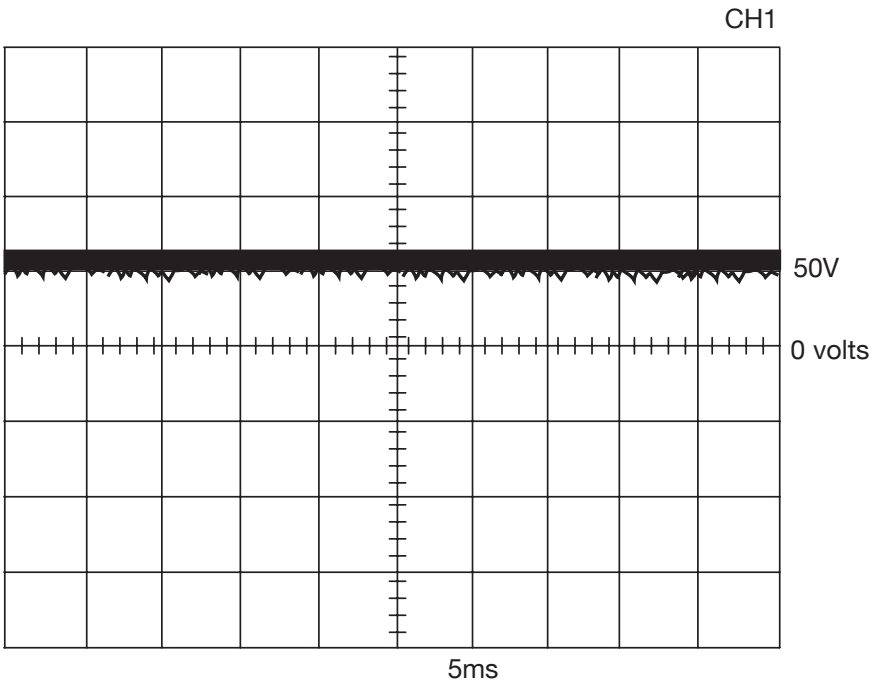
NOTE: Scope probes connected at machine 120VAC receptacle.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115VAC SUPPLY)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

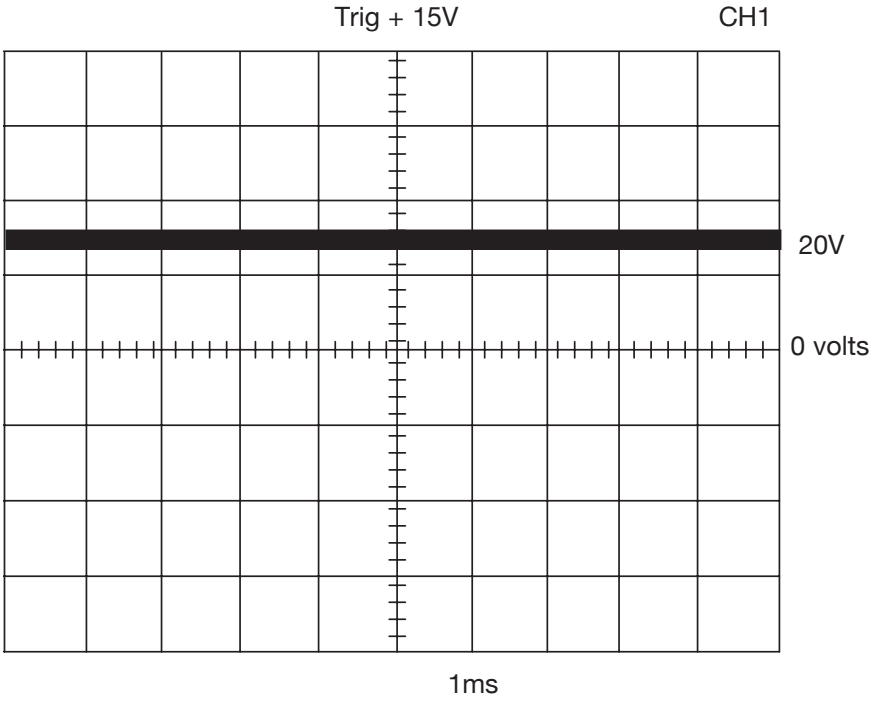
NOTE: Scope probes connected at weld output terminal.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115VAC SUPPLY)

MACHINE LOADED TO 300 AMPS AT 27 VOLTS



This is the typical DC output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 300 amps at 27 volts.

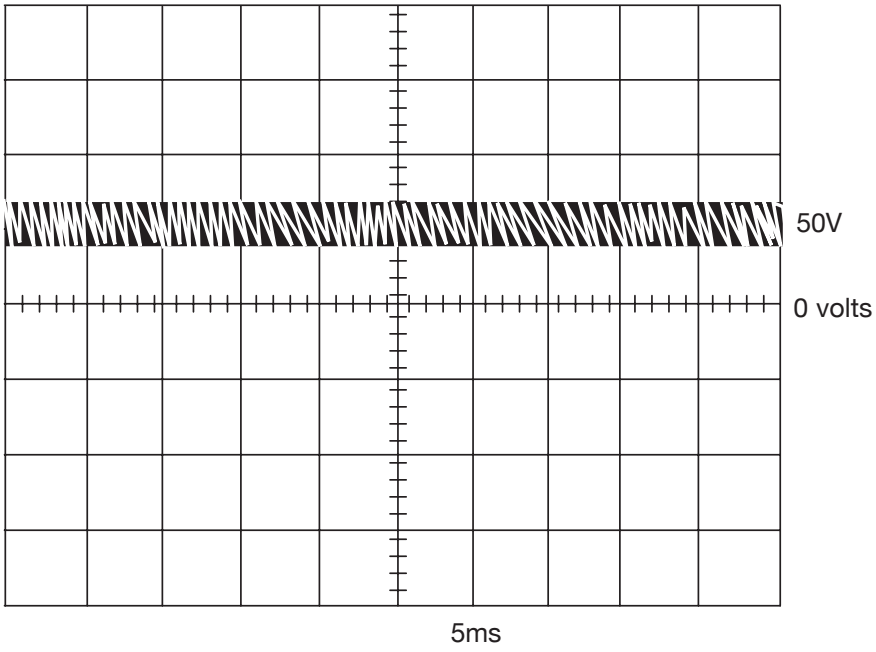
NOTE: Scope probes connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	1 ms/Div.
Coupling	DC
Trigger	Internal

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (WIRE CV TAP)

MAX CONTROL POT - HIGH IDLE - NO LOAD



This is the typical DC open circuit output voltage generated from a properly operating machine. Note that each vertical division represents 50 volts and that each horizontal division represents 5 milliseconds in time.

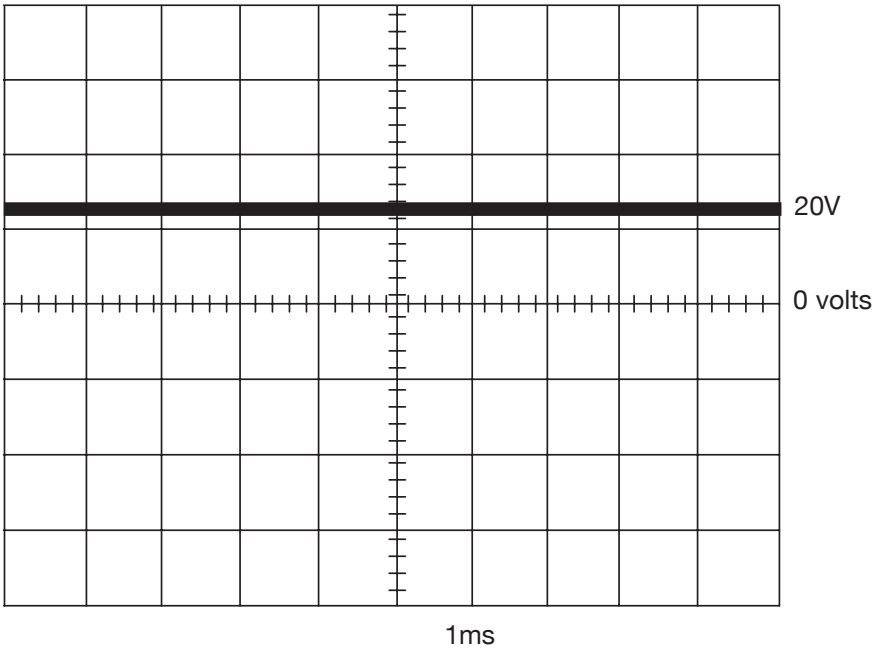
NOTE: Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	50V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

NORMAL CIRCUIT VOLTAGE WAVEFORM (WIRE CV)

MACHINE LOADED TO 300 AMPS AT 28 VOLTS



This is the typical DC voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 1 millisecond in time.

The machine was loaded with a resistance grid bank to 300 amps at 28 volts.

NOTE**:** Scope probes are connected at weld output terminals.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	1 ms/Div.
Coupling	DC
Trigger	Internal

RETEST AFTER REPAIR

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 OUTPUT

Mode	No Load RPM	Load RPM
Low Idle	1300 - 1400	N/A
High Idle	1860 - 1890	1800

WELDER DC (STICK) OUTPUT (ARC control @ -10)

Mode Selector Switch	Output Control	Open Circuit Volts	Load Volts	Load Amps
Stick (CC)	Maximum	55-60	36-38	400

WELDER CV (WIRE) OUTPUT (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
CV	Maximum	55-60	36-38	290-310
CV	Minimum	55-60	17-19	220

TOUCH START TIG (ARC Control @ +10)

Mode Selector Switch	Output Control	Open Circuit Voltage	Load Volts	Load Amps
TIG	Maximum	10-15	18-22	240-260
TIG	Minimum	10-15	Short Circuit	18-28

AUXILIARY POWER OUTPUT

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

* Upper limit reflects cold machine, voltage will be below 132/264 for machine at normal operating temperature.

42 VOLT WIRE FEEDER POWER

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

TABLE OF CONTENTS - DIAGRAM SECTION

*** NOTE:** Many PC Board Assemblies are now totally encapsulated, surface mounted and or multi-layered and are therefore considered to be unserviceable. Assembly drawings of these boards are no longer provided.