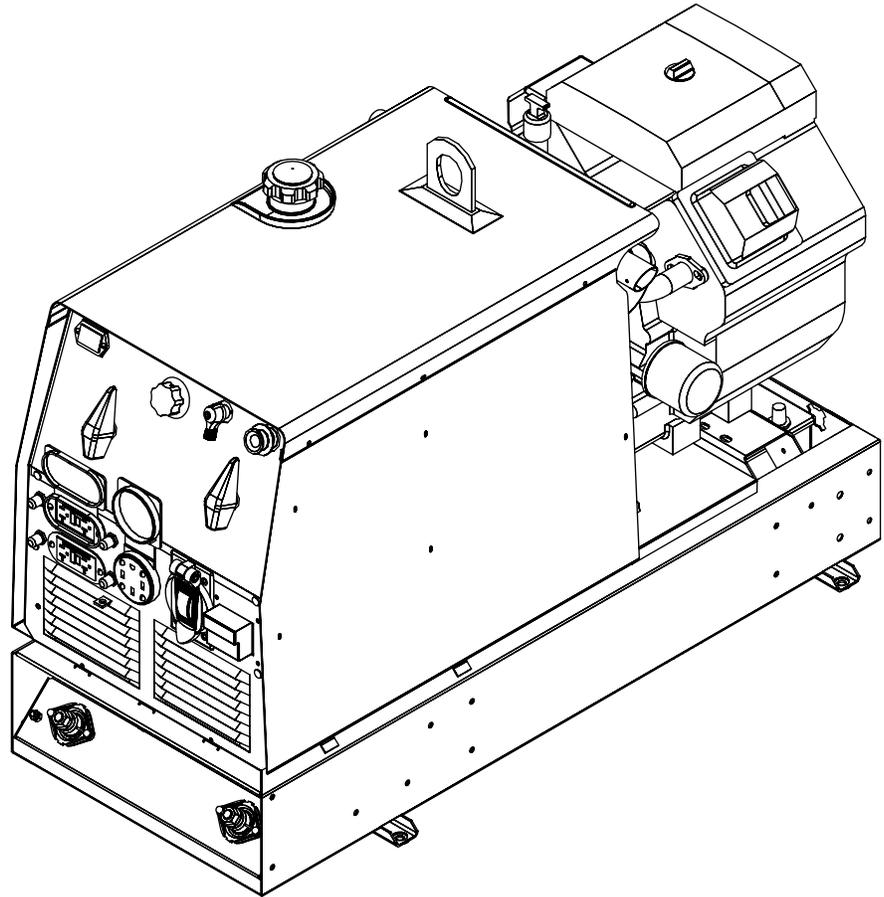


RANGER® 3 Phase

For use with machine code number: **11079 & 11419**

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.



SERVICE MANUAL

LINCOLN®
ELECTRIC

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• World's Leader in Welding and Cutting Products •

• Sales and Service through Subsidiaries and Distributors Worldwide •

Cleveland, Ohio 44117-1199 U.S.A. TEL: 216.481.8100 FAX: 216.486.1751 WEB SITE: www.lincolnelectric.com

⚠ WARNING

⚠ CALIFORNIA PROPOSITION 65 WARNINGS ⚠

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

The Above For Diesel Engines

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

The Above For Gasoline Engines

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 Z87.1 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 with electrodes which require special ventilation such as stainless or hard facing (see instructions on container or MSDS) 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. In confined spaces or in some circumstances, outdoors, a respirator may be required. Additional precautions are also required when welding on galvanized steel.

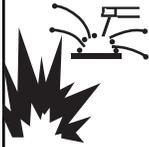
5. b. The operation of welding fume control equipment is affected by various factors including proper use and positioning of the equipment, maintenance of the equipment and the specific welding procedure and application involved. Worker exposure level should be checked upon installation and periodically 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 material safety data sheet (MSDS) and follow your employer’s safety practices. MSDS 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-1, "Precautions for Safe Handling of Compressed Gases in Cylinders," available from the Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202.



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.

PRÉCAUTIONS DE SÛRETÉ

Pour votre propre protection lire et observer toutes les instructions et les précautions de sûreté spécifiques qui paraissent dans ce manuel aussi bien que les précautions de sûreté générales suivantes:

Sûreté Pour Soudage A L'Arc

1. Protégez-vous contre la secousse électrique:
 - a. Les circuits à l'électrode et à la pièce sont sous tension quand la machine à souder est en marche. Eviter toujours tout contact entre les parties sous tension et la peau nue ou les vêtements mouillés. Porter des gants secs et sans trous pour isoler les mains.
 - b. Faire très attention de bien s'isoler de la masse quand on soude dans des endroits humides, ou sur un plancher métallique ou des grilles métalliques, principalement dans les positions assis ou couché pour lesquelles une grande partie du corps peut être en contact avec la masse.
 - c. Maintenir le porte-électrode, la pince de masse, le câble de soudage et la machine à souder en bon et sûr état de fonctionnement.
 - d. Ne jamais plonger le porte-électrode dans l'eau pour le refroidir.
 - e. Ne jamais toucher simultanément les parties sous tension des porte-électrodes connectés à deux machines à souder parce que la tension entre les deux pinces peut être le total de la tension à vide des deux machines.
 - f. Si on utilise la machine à souder comme une source de courant pour soudage semi-automatique, ces précautions pour le porte-électrode s'appliquent aussi au pistolet de soudage.
2. Dans le cas de travail au dessus du niveau du sol, se protéger contre les chutes dans le cas où on reçoit un choc. Ne jamais enrouler le câble-électrode autour de n'importe quelle partie du corps.
3. Un coup d'arc peut être plus sévère qu'un coup de soliel, donc:
 - a. Utiliser un bon masque avec un verre filtrant approprié ainsi qu'un verre blanc afin de se protéger les yeux du rayonnement de l'arc et des projections quand on soude ou quand on regarde l'arc.
 - b. Porter des vêtements convenables afin de protéger la peau de soudeur et des aides contre le rayonnement de l'arc.
 - c. Protéger l'autre personnel travaillant à proximité au soudage à l'aide d'écrans appropriés et non-inflammables.
4. Des gouttes de laitier en fusion sont émises de l'arc de soudage. Se protéger avec des vêtements de protection libres de l'huile, tels que les gants en cuir, chemise épaisse, pantalons sans revers, et chaussures montantes.
5. Toujours porter des lunettes de sécurité dans la zone de soudage. Utiliser des lunettes avec écrans latéraux dans les zones où l'on pique le laitier.

6. Eloigner les matériaux inflammables ou les recouvrir afin de prévenir tout risque d'incendie dû aux étincelles.
7. Quand on ne soude pas, poser la pince à un endroit isolé de la masse. Un court-circuit accidentel peut provoquer un échauffement et un risque d'incendie.
8. S'assurer que la masse est connectée le plus près possible de la zone de travail qu'il est pratique de le faire. Si on place la masse sur la charpente de la construction ou d'autres endroits éloignés de la zone de travail, on augmente le risque de voir passer le courant de soudage par les chaînes de levage, câbles de grue, ou autres circuits. Cela peut provoquer des risques d'incendie ou d'échauffement des chaînes et des câbles jusqu'à ce qu'ils se rompent.
9. Assurer une ventilation suffisante dans la zone de soudage. Ceci est particulièrement important pour le soudage de tôles galvanisées plombées, ou cadmiées ou tout autre métal qui produit des fumées toxiques.
10. Ne pas souder en présence de vapeurs de chlore provenant d'opérations de dégraissage, nettoyage ou pistolage. La chaleur ou les rayons de l'arc peuvent réagir avec les vapeurs du solvant pour produire du phosgène (gas fortement toxique) ou autres produits irritants.
11. Pour obtenir de plus amples renseignements sur la sûreté, voir le code "Code for safety in welding and cutting" CSA Standard W 117.2-1974.

PRÉCAUTIONS DE SÛRETÉ POUR LES MACHINES À SOUDER À TRANSFORMATEUR ET À REDRESSEUR

1. Relier à la terre le châssis du poste conformément au code de l'électricité et aux recommandations du fabricant. Le dispositif de montage ou la pièce à souder doit être branché à une bonne mise à la terre.
2. Autant que possible, l'installation et l'entretien du poste seront effectués par un électricien qualifié.
3. Avant de faire des travaux à l'intérieur de poste, la débrancher à l'interrupteur à la boîte de fusibles.
4. Garder tous les couvercles et dispositifs de sûreté à leur place.

Electromagnetic Compatibility (EMC)

Conformance

Products displaying the CE mark are in conformity with European Community Council Directive of 15 Dec 2004 on the approximation of the laws of the Member States relating to electromagnetic compatibility, 2004/108/EC. It was manufactured in conformity with a national standard that implements a harmonized standard: EN 60974-10 Electromagnetic Compatibility (EMC) Product Standard for Arc Welding Equipment. It is for use with other Lincoln Electric equipment. It is designed for industrial and professional use.

Introduction

All electrical equipment generates small amounts of electromagnetic emission. Electrical emission may be transmitted through power lines or radiated through space, similar to a radio transmitter. When emissions are received by other equipment, electrical interference may result. Electrical emissions may affect many kinds of electrical equipment; other nearby welding equipment, radio and TV reception, numerical controlled machines, telephone systems, computers, etc. Be aware that interference may result and extra precautions may be required when a welding power source is used in a domestic establishment.

Installation and Use

The user is responsible for installing and using the welding equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user of the welding equipment to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing (grounding) the welding circuit, see Note. In other cases it could involve construction of an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

Note: The welding circuit may or may not be earthed for safety reasons according to national codes. Changing the earthing arrangements should only be authorized by a person who is competent to access whether the changes will increase the risk of injury, e.g., by allowing parallel welding current return paths which may damage the earth circuits of other equipment.

Assessment of Area

Before installing welding equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

- a) other supply cables, control cables, signaling and telephone cables; above, below and adjacent to the welding equipment;
- b) radio and television transmitters and receivers;
- c) computer and other control equipment;
- d) safety critical equipment, e.g., guarding of industrial equipment;
- e) the health of the people around, e.g., the use of pacemakers and hearing aids;
- f) equipment used for calibration or measurement
- g) the immunity of other equipment in the environment. The user shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures;
- h) the time of day that welding or other activities are to be carried out.

Electromagnetic Compatibility (EMC)

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

Methods of Reducing Emissions

Mains Supply

Welding equipment should be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed welding equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the welding power source so that good electrical contact is maintained between the conduit and the welding power source enclosure.

Maintenance of the Welding Equipment

The welding equipment should be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the welding equipment is in operation. The welding equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Welding Cables

The welding cables should be kept as short as possible and should be positioned close together, running at or close to floor level.

Equipotential Bonding

Bonding of all metallic components in the welding installation and adjacent to it should be considered. However, metallic components bonded to the work piece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of the Workpiece

Where the workpiece is not bonded to earth for electrical safety, not connected to earth because of its size and position, e.g., ships hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitance, selected according to national regulations.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire welding installation may be considered for special applications.¹

¹ Portions of the preceding text are contained in EN 60974-10: "Electromagnetic Compatibility (EMC) product standard for arc welding equipment."

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TECHNICAL SPECIFICATIONS - RANGER® 3 PHASE (K2337-1 & K2337-2)

INPUT - GASOLINE ENGINE						
Make/Model	Description	Horsepower	Operating Speed (RPM)	Displacement cu. in. (cu.cm.)	Starting System	Capacities
K2337-1 Kohler CH20S	2 cylinder 4 Cycle Air-Cooled Gasoline Engine. Aluminum Alloy with Cast Iron Liners, Electronic Ignition	20 HP @ 3600 RPM	High Idle 3700	38(624) Kohler CH20S	12VDC Battery Electric Start Group 58 Battery (435 cold cranking amps)	Fuel: 9 Gal (34 L) Lubricating Oil: 2.0 Qts. (1.9 L)
K2337-2 Kohler CH23S		23 HP @ 3600 RPM	Full Load 3500 Low Idle 2200	41(674) Kohler CH23S		
RATED OUTPUT @ 104°F (40°C)- WELDER						
Welding Output						
AC Constant Current 225A / 25V / 100%						
DC Constant Current 210A / 25V / 100%						
DC Constant Voltage 200A / 20V / 100%						
RATED OUTPUT @ 104°F (40°C)- GENERATOR						
Auxiliary Power ¹						
11,500 Watts Peak, 10,500 Watts Continuous, 3 Phase 60 Hz AC, 480V 10,500 Watts Peak, 9500 Watts Continuous, Single Phase 60 Hz AC, 120V/240V						
PHYSICAL DIMENSIONS						
HEIGHT	WIDTH		DEPTH		WEIGHT	
30.3 in. 770 mm	19.1 in. 485 mm		42.3 in. 1074 mm		538 lbs. (244kg)	

1. Output rating in watts is equivalent to volt - amperes at unity factor. Output voltage is within +/-10% at all loads up to rated capacity. When welding available auxiliary power will be reduced.

SAFETY PRECAUTIONS

⚠ WARNING

Do not attempt to use this equipment until you have thoroughly read the engine manufacturer's manual supplied with your welder. It includes important safety precautions, detailed engine starting, operating and maintenance instructions, and parts lists.



ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground
- Always wear dry insulating gloves.



ENGINE EXHAUST can kill.

- Use in open, well ventilated areas or vent exhaust outside.



MOVING PARTS can injure.

- Do not operate with doors open or guards off.
- Stop engine before servicing.
- Keep away from moving parts.

See additional warning information at the front of this operator's manual.

MACHINE GROUNDING

Because this portable engine driven welder / generator creates it's own power, it is not necessary to connect it's frame to an earth ground, unless the machine is connected to premises wiring (your home, shop, etc.).

⚠ WARNING

To prevent dangerous electric shock, other equipment to which this engine driven welder supplies power must:

- be grounded to the frame of the welder using a grounded type plug, or be double insulated.

Do not ground the machine to a pipe that carries explosive or combustible material.

When this welder is mounted on a truck or trailer, it's frame must be electrically bonded to the metal frame of the vehicle. Use a #8 or larger copper wire connected between the machine grounding stud and the frame of the vehicle.

Where this engine driven welder is connected to premises wiring such as that in your home or shop, it's frame must be connected to the system earth ground. See further connection instructions in the section entitled "Standby Power Connections", as well as the article on grounding in the latest National Electrical Code and the local code.

In general, if the machine is to be grounded, it should be connected with a #8 or larger copper wire to a solid earth ground such as a metal water pipe going into the ground for at least ten feet and having no insulated joints, or to the metal framework of a building which has been effectively grounded. The National Electrical Code lists a number of alternate means of grounding electrical equipment. A machine grounding stud marked with the symbol \oplus is provided on the front of the welder.

SPARK ARRESTER

Some federal, state, or local laws may require that gasoline engines be equipped with exhaust spark arresters when they are operated in certain locations where unarrested sparks may present a fire hazard. The standard muffler included with this welder does not qualify as a spark arrester. When required by local regulations, the K894-1 spark arrester must be installed and properly maintained.

⚠ CAUTION

An incorrect arrester may lead to damage to the engine or adversely affect performance.

TOWING

The recommended trailer for use with this equipment for road, in-plant and yard towing by a vehicle⁽¹⁾ is Lincoln's K957-1. If the user adapts a non-Lincoln trailer, he must assume responsibility that the method of attachment and usage does not result in a safety hazard nor damage the welding equipment. Some of the factors to be considered are as follows:

1. Design capacity of trailer vs. weight of Lincoln equipment and likely additional attachments.
2. Proper support of, and attachment to, the base of the welding equipment so there will be no undue stress to the framework.

RANGER® 3 PHASE



3. Proper placement of the equipment on the trailer to insure stability side to side and front to back when being moved and when standing by itself while being operated or serviced.

4. Typical conditions of use, i.e., travel speed; roughness of surface on which the trailer will be operated; environmental conditions.

5. Conformance with federal, state and local laws⁽¹⁾

(1) Consult applicable federal, state and local laws regarding specific requirements for use on public highways.

VEHICLE MOUNTING

WARNING

Improperly mounted concentrated loads may cause unstable vehicle handling and tires or other components to fail.

- Only transport this Equipment on serviceable vehicles which are rated and designed for such loads.
- Distribute, balance and secure loads so vehicle is stable under conditions of use.
- Do not exceed maximum rated loads for components such as suspension, axles and tires.
- Mount equipment base to metal bed or frame of vehicle.
- Follow vehicle manufacture's instructions.

PRE-OPERATION SERVICE

CAUTION

READ the engine operating and maintenance instructions supplied with this machine.

WARNING



GASOLINE can cause fire or explosion.

- Stop engine while fueling.
- Do not smoke when fueling.
- Keep sparks and flame away from tank.
- Do not leave unattended while fueling.
- Wipe up spilled fuel and allow fumes to clear before starting engine.
- Do not overfill tank, fuel expansion may cause overflow.

GASOLINE FUEL ONLY

FUEL



Fill the fuel tank with clean, fresh, lead-free gasoline. Observe fuel gauge while filling to prevent overfilling.

WARNING



- Damage to the fuel tank may cause fire or explosion. Do **not** drill holes in or weld to the RANGER® 10,000 or the RANGER® 10,000 PLUS base.

OIL



LUBRICATION SYSTEM CAPACITY (INCLUDING FILTER)

Kohler CH20S / CH23S - 2.0 Quarts (1.9 Liters)

The RANGER® 3 PHASE is shipped with the engine crankcase filled with SAE 10W-30 oil. Check the oil level before starting the engine. If it is not up to the full mark on the dip stick, add oil as required. Make certain that the oil filler cap is tightened securely. Refer to the engine Owner's Manual for specific oil recommendations.

CAUTION

BATTERY CONNECTIONS



Use caution as the electrolyte is a strong acid that can burn skin and damage eyes.

This welder is shipped with the negative battery cable disconnected. Make sure that the Engine Switch is in the "STOP" position and attach the disconnected cable securely to the negative battery terminal before attempting to operate the machine. If the battery is discharged and does not have enough power to start the engine, see the battery charging instructions in the Battery section.

NOTE: This machine is furnished with a wet charged battery; if unused for several months, the battery may require a booster charge. Be careful to charge the battery with the correct polarity.

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WELDING OUTPUT CABLES

With the engine off, connect the electrode and work cables to the studs provided. These connections should be checked periodically and tightened if necessary. Loose connections will result in overheating of the output studs.

When welding at a considerable distance from the welder, be sure you use ample size welding cables. Listed below are copper cable sizes recommended for the rated current and duty cycle. Lengths stipulated are the distance from the welder to work and back to the welder again. Cable sizes are increased for greater lengths primarily for the purpose of minimizing cable voltage drop.

TOTAL COMBINED LENGTH OF ELECTRODE AND WORK CABLES	
	225 Amps 100% Duty Cycle
0-100 Ft.	1 AWG
100-200 Ft.	1 AWG
200-250 Ft.	1/0 AWG

ANGLE OF OPERATION

Internal combustion engines are designed to run in a level condition which is where the optimum performance is achieved. The maximum angle of operation for the engine is 15 degrees from horizontal in any direction. If the engine is to be operated at an angle, provisions must be made for checking and maintaining the oil at the normal (FULL) oil capacity in the crankcase in a level condition.

When operating at an angle, the effective fuel capacity will be slightly less than the specified 9 gallons.

LIFTING

The RANGER® 3 PHASE weighs approximately 575 lbs. with a full tank of gasoline. A lift bail is mounted to the machine and should always be used when lifting the machine.

⚠ WARNING



FALLING EQUIPMENT can cause injury.

- Lift only with equipment of adequate lifting capacity.
- Be sure machine is stable when lifting.
- Do not lift this machine using lift bale if it is equipped with a heavy accessory such as trailer or gas cylinder.
- Do not lift machine if lift bale is damaged.
- Do not operate machine while suspended from lift bale.

HIGH ALTITUDE OPERATION

At higher altitudes, elder output de-rating may be necessary.

For maximum rating, de-rate the welder output 3.5% for every 1000ft. (305m) above 3000ft. (914m).

If operation will consistently be at altitudes above 5,000 ft. (1525m), a carburetor jet designed for high altitudes should be installed. This will result in better fuel economy, cleaner exhaust and longer spark plug life. It will not give increased power. Contact your local authorized engine service shop for high altitude jet kits that are available from the engine manufacturer.

⚠ CAUTION

Do not operate with a high altitude jet installed at altitudes below 5000 ft. This will result in the engine running too lean and result in higher engine operating temperatures which can shorten engine life.

Muffler Relocation

⚠ WARNING

- Shut off welder and allow muffler to cool before touching muffler.

The RANGER® 3 PHASE is shipped with the exhaust coming out on the left side. The exhaust can be changed to the opposite side by removing the two screws that hold the exhaust port cover in place and installing the cover on the opposite side. (Operating the RANGER® 3 Phase machine without the covers in place will result in a higher noise level and no increase in machine output.)

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LOCATION / VENTILATION

The welder should be located to provide an unrestricted flow of clean, cool air to the cooling air inlets and to avoid heated air coming out of the welder recirculating back to the cooling air inlet. Also, locate the welder so that engine exhaust fumes are properly vented to an outside area.

STACKING

RANGER® 3 PHASE machines cannot be stacked.

CONNECTION OF LINCOLN ELECTRIC WIRE FEEDERS

⚠ WARNING

Shut off welder before making any electrical connections.

WIRE FEED (CONSTANT VOLTAGE) CONNECTION OF LN-15 ACROSS-THE-ARC WIRE FEEDER

The LN-15 has an internal contactor and the electrode is not energized until the gun trigger is closed. When the gun trigger is closed the wire will begin to feed and the welding process is started.

Note: LN-15 Control Cable model will not work with the RANGER® 3PHASE.

- Shut the welder off.
- Connect the electrode cable from the LN-15 to the "ELECTRODE" terminal of the welder. Connect the work cable to the "TO WORK" terminal of the welder.
- Set the Polarity switch to the desired polarity, either DC (-) or DC (+).
- Attach the single lead from the front of the LN-15 to work using the spring clip at the end of the lead. This is a control lead to supply current to the wire feeder motor; it does not carry welding current.
- Set the "RANGE" switch to the "WIRE FEED-CV" position
- Place the Engine switch in the "High Idle" position.
- Adjust the wire feed speed at the LN-15 and adjust the welding voltage with the output "CONTROL" at the welder. Output "CONTROL" must be set above 3.

CONNECTION OF THE LN-25 / LN25PRO / LN-25 PRO DUAL

Note: LN-25PRO Dual Control Cable model will not work with the RANGER® 3 PHASEe.

- Shut the welder off.
- Connect the electrode cable from the LN-25 to the "ELECTRODE" terminal of the welder. Connect the work cable to the "TO WORK" terminal of the welder.

- Position the welder "Polarity" switch to the desired polarity, either DC (-) or DC (+).
- Position the "RANGE" switch to the "WIRE FEED" position.
- Attach the single lead from the LN-25 control box to the work using the spring clip on the end of the lead - it carries no welding current.
- Place the engine switch in the "AUTO" position.
- Adjust wire feed speed at the LN-25 and adjust the welding voltage with the output "CONTROL" at the welder.

NOTE: The welding electrode is energized at all times, unless an LN-25 with built-in contactor is used. If the output "CONTROL" is set below "3", the LN-25 contactor may not pull in.

CONNECTION OF K930-2 TIG MODULE TO THE RANGER® 3 PHASE.

The TIG Module is an accessory that provides high frequency and shielding gas control for AC and DC GTAW (TIG) welding. See IM528 supplied with the TIG Module for installation instructions.

NOTE: The TIG Module does not require the use of a high frequency bypass capacitor. However, if any other high frequency equipment is used, a Bypass Capacitor Kit (T12246) must be installed in the RANGER® 3 PHASE.

INSTRUCTIONS

ADDITIONAL SAFETY PRECAUTIONS

Always operate the welder with the roof and case sides in place as this provides maximum protection from moving parts and assures proper cooling air flow.

Read and understand all Safety Precautions before operating this machine. Always follow these and any other safety procedures included in this manual and in the Engine Owner's Manual.

WELDER OPERATION

WELDER OUTPUT

- Maximum Open Circuit Voltage at 3700 RPM is 80 Volts RMS.
- Duty Cycle is the percentage of time the load is being applied in a 10 minute period. For example, a 60% duty cycle represents 6 minutes of load and 4 minutes of no load in a 10 minute period. Duty Cycle for the RANGER® 3 PHASE is 100%.

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Constant Current	225 Amps AC @ 25 Volts 210 Amps DC @ 25 Volts
Constant Voltage	200 Amps DC @ 20 Volts

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AUXILIARY POWER

⚠ CAUTION

Do not connect any plugs that connect to the power receptacles in parallel.

Start the engine and set the "IDLER" control switch to the "High Idle" mode. Set the "CONTROL" to 10. Voltage is now correct at the receptacles for auxiliary power. This must be done before a tripped GFCI receptacle can be reset properly. See the MAINTENANCE section for more detailed information on testing and resetting the GFCI receptacle.

The RANGER® 3 PHASE can provide both three phase and single phase power, up to 11,500 watts of 480 volts AC, three phase 60Hz power for peak use, and up to 10,500 watts of 480 volts AC, three phase 60Hz power for continuous use, up to 10,500 watts of 120/240 volts AC, single phase 60Hz power for peak use, and up to 9,500 watts of 120/240 volt AC, single phase 60Hz power for continuous use. The front of the machine includes four receptacles for connecting the AC power plugs; one 20 amp 480 volt 3 phase NEMA receptacle, one 50 amp 120/240 volt NEMA 14-50R receptacle and two 20 amp 120 volt NEMA 5-20R receptacles. Output voltage is within +/-10% at all loads up to rated capacity. Do not use 3 phase power and single phase power simultaneously. All auxiliary power is protected by circuit breakers.

120/240 VOLT DUAL VOLTAGE RECEPTACLE

The 120/240 volt receptacle can supply up to 40 amps of 240 volt power to a two wire circuit, up to 40 amps of 120 volts power from each side of a three wire circuit (up to 80 amps total). Do not connect the 120 volt circuits in parallel. Current sensing for the automatic idle feature is only in one leg of the three wire circuit as shown in Figure A.1.

FIGURE A.1

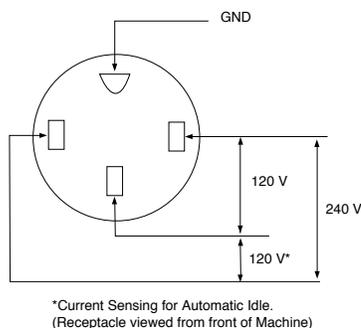
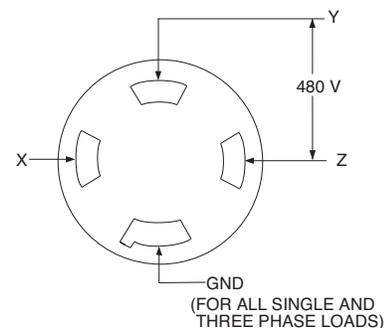


FIGURE A.2



120 V GFCI DUPLEX RECEPTACLES

A GFCI (Ground Fault Circuit Interrupter) electrical receptacle is a device to protect against electric shock should a piece of defective equipment connected to it develop a ground fault. If this situation should occur, the GFCI will trip, removing voltage from the output of the receptacle. If a GFCI receptacle is tripped see the MAINTENANCE section for detailed information on testing and resetting it. A GFCI receptacle should be properly tested at least once every month.

The 120V auxiliary power receptacles should only be used with three wire grounded type plugs or approved double insulated tools with two wire plugs.

The current rating of any plug used with the system must be at least equal to the current load through the associated receptacle.

480 VOLT 3 PHASE RECEPTACLE WITH GROUND

The 480 volt receptacle can supply 12.6 amps of 3 phase power, or up to 15 amps of single phase power. A NEMA L16-20P plug is required to use this receptacle. The ground (GND) connection is connected to the machine frame, it is NOT the neutral of the three phase connection, and should under no circumstances be connected to the neutral of any 3 phase load. Do not connect 480V 3 phase to single phase premises wiring.

If 480 volt single phase load is to be run, the X lead must be one of the leads in the circuit in order for the automatic idle to function. Using a NEMA plug L16-20P, connect either X and Y or X and Z to the receptacle, as well as the machine ground. See Figure A.2.

NOTE: Use of 3-Phase AC power is not recommended while welding.

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All auxiliary power is protected by circuit breakers with the following values:

The 120V has 20 amp circuit breakers for each duplex receptacle. The 240V has 50 amp circuit breakers for each hot lead going to the 240V receptacle.

The 480V 3 phase circuit breaker / switch is a 3 phase, 15 amp circuit breaker.

Ground Wire

Periodically check the ground wire at plugs, power cords and auxiliary loads to ensure that the grounding circuit is intact and connected.

MOTOR STARTING

Most 1.5 hp AC single phase motors can be started if there is no load on the motor or other load connected to the machine, since the full load current rating of a 1.5 hp motor is approximately 20 amperes (10 amperes for 240 volt motors). The motor may be run at full load when plugged into only one side of the duplex receptacle. Larger motors through 2 hp can be run provided the receptacle rating as previously stated is not exceeded. This may necessitate 240V operation only.

The 480 volt 3 phase output of the RANGER® 3 PHASE is capable of running most 480VAC 3 phase motors up to 10HP. A 10HP motor must be started with no load on the motor and no other load connected to the machine, since the full load current of a 10HP 480VAC 3 phase motor is approximately 12.5 amps. Refer to the reconnect phase output to any load, the ground at the 3 phase receptacle is NOT the neutral of 3 phase connection, and should under no circumstance be connected to the neutral of any 3 phase load.

STANDBY POWER CONNECTIONS

The RANGER® 3 PHASE is suitable for temporary, standby, or emergency power using the engine manufacturer's recommended maintenance schedule.

The RANGER® 3 PHASE can be permanently installed as a standby power unit for 240V-3 wire, single phase 40 ampere service.

⚠ WARNING

(Connections must be made by a licensed electrician who can determine how the 120/240V power can be adapted to the particular installation and comply with all applicable electrical codes.) The following information can be used as a guide by the electrician for most applications (refer also to the connection diagram shown in **Figure A.1**).

1. Install a double pole, double throw switch between the power company meter and the premises disconnect.

Switch rating must be the same or greater than the customer's premises disconnect and service over-current protection.

2. Take necessary steps to assure load is limited to the capacity of the RANGER® 3 PHASE by installing a 40 amp 240V double pole circuit breaker. Maximum rated load for the 240V auxiliary is 40 amperes. Loading above 40 amperes will reduce output voltage below the allowable -10% of rated voltage which may damage appliances or other motor-driven equipment.
3. Install a 50 amp 120/240V plug (NEMA type 14-50) to the Double Pole Circuit Breaker using No. 8, 4 conductor cable of the desired length. (The 50 amp 120/240V plug is available in the optional plug kit.)
4. Plug this cable into the 50 amp 120/240V receptacle on the RANGER® 3 PHASE case front.

AUXILIARY POWER WHILE WELDING

Simultaneous welding and power loads are permitted by following Table I. The permissible currents shown assume that current is being drawn from either the 120V or 240V supply (not both at the same time). Also, the "Output Control" is set at "10" for maximum auxiliary power.

Output Selector Setting	Permissible Power Watts (Unity Power Factor)	Permissible Auxiliary Current in Amperes @ 120V *-or- @ 240V	
Max. Stick or Wire Feed Setting	None	0	0
145 Stick Setting	4500	38	23
90 Stick Setting	6500	54**	27
NO WELDING	9500	80**	40

* Each duplex receptacle is limited to 20 amps.

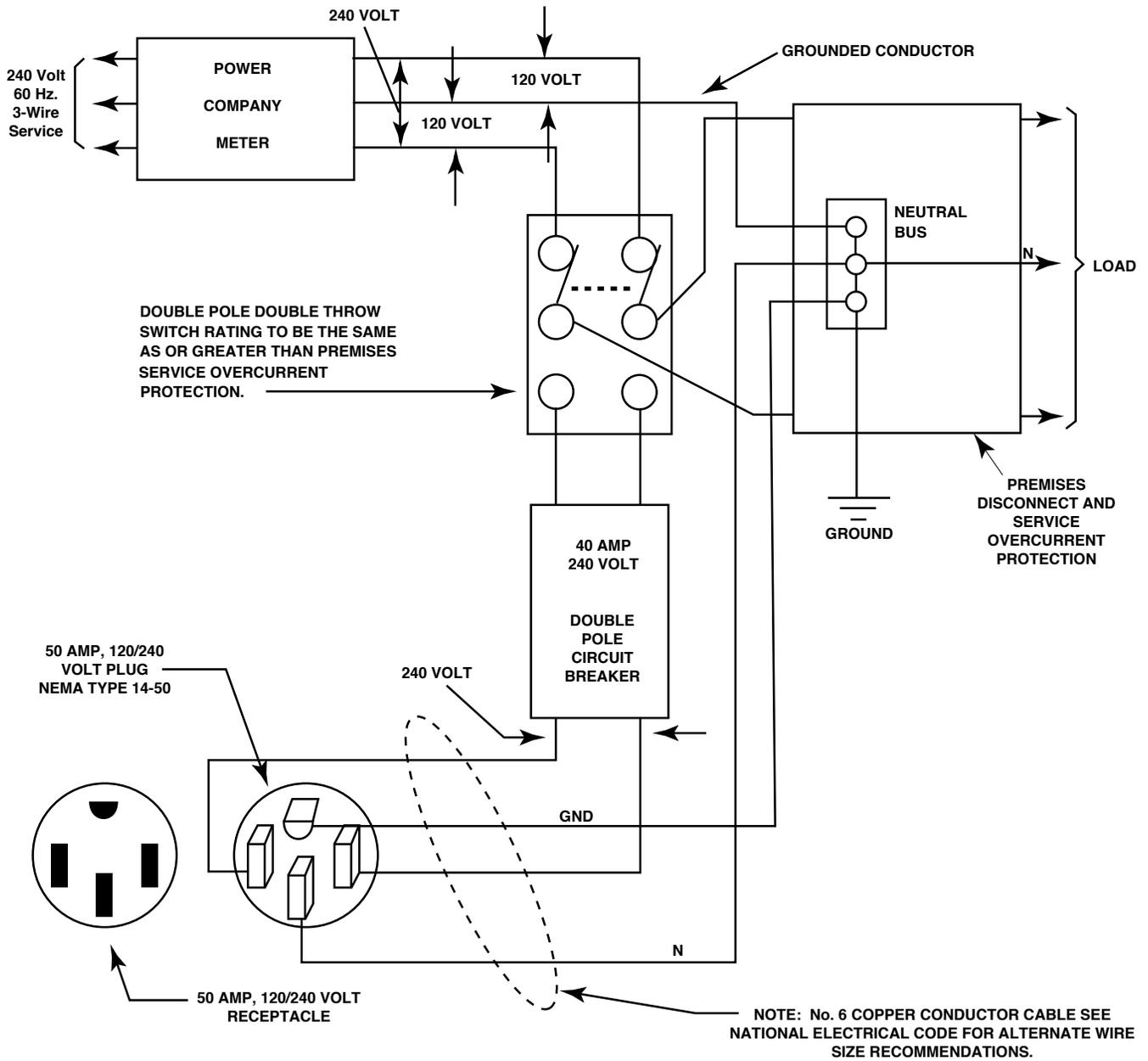
** Not to exceed 40A per 120VAC branch circuit when splitting the 240 VAC output.

*** Use of 3-Phase AC power is not recommended while welding.

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Figure A.3 CONNECTION OF RANGER® 3 PHASE TO PREMISES WIRING



⚠ WARNING

Connection of RANGER® 3 PHASE to premises wiring must be done by a licensed electrician and must comply with the National Electrical Code and all other applicable electrical codes. See the Installation Section for important information about not using the 480V 3 Phase Receptacle for connection to Single Phase Premises Wiring.

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ELECTRICAL DEVICE USE WITH THE RANGER® 3 PHASE

Type	Common Electrical Devices	Possible Concerns
Resistive	Heaters, toasters, incandescent light bulbs, electric range, hot pan, skillet, coffee maker.	NONE
Capacitive	TV sets, radios, microwaves, appliances with electrical control.	Voltage spikes or high voltage regulation can cause the capacitive elements to fail. Surge protection, transient protection, and additional loading is recommended for 100% fail-safe operation. DO NOT RUN THESE DEVICES WITHOUT ADDITIONAL RESISTIVE TYPE LOADS.
Inductive	Single-phase induction motors, drills, well pumps, grinders, small refrigerators, weed and hedge trimmers	These devices require large current inrush for starting. Some synchronous motors may be frequency sensitive to attain maximum output torque, but they SHOULD BE SAFE from any frequency induced failures.
Capacitive/Inductive	Computers, high resolution TV sets, complicated electrical equipment.	An inductive type line conditioner along with transient and surge protection is required, and liabilities still exist. DO NOT USE THESE DEVICES WITH A RANGER® 3 PHASE

The Lincoln Electric Company is not responsible for any damage to electrical components improperly connected to the RANGER® 3 PHASE machine

RANGER® 3 PHASE Extension Cord Length Recommendations

(Use the shortest length extension cord possible sized per the following table.)

Current (Amps)	Voltage (Volts)	Load (Watts)	Maximum Allowable Cord Length in ft. (m) for Conductor Size											
			14 AWG		12 AWG		10 AWG		8 AWG		6 AWG		4 AWG	
15	120	1800	30	(9)	40	(12)	75	(23)	125	(38)	175	(53)	300	(91)
20	120	2400			30	(9)	50	(15)	88	(27)	138	(42)	225	(69)
15	240	3600	60	(18)	75	(23)	150	(46)	225	(69)	350	(107)	600	(183)
20	240	4800			60	(18)	100	(30)	175	(53)	275	(84)	450	(137)
40	240	9500					50	(15)	90	(27)	150	(46)	225	(69)

Conductor size is based on maximum 2.0% voltage drop.

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SAFETY PRECAUTIONS

Do not attempt to use this equipment until you have thoroughly read the engine manufacturer's manual supplied with your welder. It includes important safety precautions, detailed engine starting, operating and maintenance instructions, and parts lists.



ELECTRIC SHOCK can kill.

- Do not touch electrically live parts or electrode with skin or wet clothing.
- Insulate yourself from work and ground
- Always wear dry insulating gloves.

- Always operate the welder with the hinged door closed and the side panels in place.
- Read carefully the Safety Precautions page before operating this machine. Always follow these and any other safety procedures included in this manual and in the Engine Instruction Manual.

GENERAL DESCRIPTION

The RANGER® 3 PHASE is a twin-cylinder, gasoline driven, multiprocess arc welder and AC power generator. It is built in a heavy gauge steel case for durability on the job site.

WELDER CONTROLS - FUNCTION AND OPERATION

ENGINE SWITCH

The engine switch is used to Start the Engine, Select High Idle or Auto Idle while the engine is running, and stop the Engine.

When placed in the "OFF"  position, the ignition circuit is de-energized to shut down the engine.

When held in the "START"  position, the engine starter motor is energized.

When in "HIGH IDLE" () position, the engine will run continuously at high idle.

When in "AUTO IDLE" () position, the engine will run continuously and the idler operates as follows:

- Welding

When the electrode touches the work, the welding arc is initiated and the engine accelerates to full speed.

After welding ceases (and no auxiliary power is being drawn), the engine will return to low idle after approximately 10 to 14 seconds.

- Auxiliary Power

With the engine running at low idle and auxiliary power for lights or tools is drawn (approximately 100-150 watts or greater) from the receptacles, the engine will accelerate to high speed. If no power is being drawn from the receptacles (and not welding) for 10-14 seconds, the idler reduces the engine speed to low idle.

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“ RANGE” SWITCH

The “Range” switch is used to select one of three amperage ranges with generous overlap for Stick/TIG welding, or one Wire Feed welding range.

Process	Range Setting	Current Range
STICK/TIG (constant current) (3 range settings)	90 Max. 145 Max. 210DC/225AC Max.	50 to 90 Amps 70 to 145 Amps 120 to 210 (DC) 225(AC)
WIRE FEED (constant voltage) (one range setting)	15 to 25V	Up to 200 Amps

 CAUTION

Never change the “RANGE” Switch setting while welding. This will damage the switch.

“ CONTROL” DIAL

Provides a fine welding current adjustment within the Range Switch settings in the STICK mode and welding voltage control with the Range switch set in the wire feed mode.

POLARITY SWITCH

Provides three selectable welding polarities:
AC, DC+ & DC-

 CAUTION

Never change the Polarity switch setting while welding. This will damage the switch.

RANGER® 3 PHASE APPROXIMATE FUEL CONSUMPTION

	KOHLER CH20S or CH23S
Low Idle - No Load 2200 RPM	.35 Gallons/Hour (1.34 Liters/Hour)
High Idle - No Load 3700 RPM	.76 Gallons/Hour (2.86 Liters/Hour)
AC CC Weld Output 225 Amps @ 25 Volts	1.23 Gallons/Hour (4.64 Liters/Hour)
DC CC Weld Output 210 Amps @ 25 Volts	1.38 Gallons/Hour (5.21 Liters/Hour)
DC CV Weld Output 200 Amps @ 20 Volts	1.22 Gallons/Hour (4.60 Liters/Hour)
Auxiliary Power Single Phase 9,500 Watts	1.52 Gallons/Hour (5.77 Liters/Hour)
Auxiliary Power 3 Phase 10,500 Watts	1.64Gallons/Hour (6.23 Liters/Hour)

RANGER® 3 PHASE



WELDING PROCESS

For any electrodes the procedures should be kept within the rating of the machine. For electrode information see the appropriate Lincoln publication.

STICK (CONSTANT CURRENT) WELDING

Connect welding cables to the "TO WORK" and "ELECTRODE" studs. Start the engine. Set the "Polarity" switch to the desired polarity. The "RANGE" switch markings indicate the maximum current for that range as well as the typical electrode size for that range. The "OUTPUT" Control provides fine adjustment of the welding current within the select range. For maximum output within a selected range set the "OUTPUT" Control at 10. For minimum output within a selected range set the "OUTPUT" Control at 5. ("OUTPUT" Control settings below 5 may reduce arc stability) For best overall welding performance set the "RANGE" Switch to the lowest setting and the "OUTPUT" Control near the maximum to achieve the desired welding current.

RANGE SETTING	TYPICAL ELECTRODE SIZE	CURRENT RANGE
90 MAX.	3/32	50 TO 90 AMPS
125 MAX.	1/8	70 TO 145 AMPS
210(DC)/225(AC) MAX.	5/32	120 TO 210(DC), 225(AC) AMPS

The RANGER® 3 PHASE can be used with a broad range of AC and DC stick electrodes. See "Welding Tips 1" included with the RANGER 3 PHASE for electrodes within the rating of this unit and recommended welding currents of each.

TIG (CONSTANT CURRENT) WELDING

The K930-[] TIG Module installed on a RANGER 3 PHASE provides high frequency and shielding gas control for AC and DC GTAW (TIG) welding processes. The TIG Module allows full range output control. After flow time is adjustable from 0 to 55 seconds.

When using the RANGER® 3 PHASE for AC TIG welding of aluminum, the following settings and electrodes are recommended:

SETTINGS FOR PURE TUNGSTEN		
TUNGSTEN DIAMETER (in.)	RANGE SWITCH SETTINGS	APPROXIMATE CURRENT RANGE
1/8	90 or 145	80 - 150 Amps
3/32	90 or 145	45 - 130 Amps
1/16	90	40 - 80 Amps

SETTINGS FOR 1% THORIATED TUNGSTEN		
TUNGSTEN DIAMETER (in.)	RANGE SWITCH SETTINGS	APPROXIMATE CURRENT RANGE
1/8	90, 145, or 210	80 - 225 Amps
3/32	90 or 145	50 - 180 Amps
1/16	90 or 145	45 - 120 Amps

The K930-[] TIG Module should be used with the RANGER® 3 PHASE on high idle to maintain satisfactory operation. It can be used in the AUTO position but the delay going to flow idle after welding is ceased will be increased if the AFTER FLOW CONTROL is set above 10 seconds.

WIRE FEED WELDING PROCESSES (CONSTANT VOLTAGE)

The Innershield® electrode recommended for use with the RANGER 3 PHASE is NR®-212-MP. The electrode sizes and welding ranges that can be used with the RANGER® 3 PHASE are shown in the following table:

Diameter (in.)	Wire Speed Range In./Min.	Approximate Current Range
.035	80 - 110	75A to 120A
.045	70 - 130	120A to 170A
.068	40 - 90	125A to 210A

The RANGER® 3 PHASE is recommended for limited "MIG" welding (GMAW - gas metal arc welding). The recommended electrodes are .030" and .035" SuperArc L-50 and L-56. They must be used with a blended shielding gas such as C25 (75% Argon - 25% CO₂). The welding ranges that can be used with the RANGER 3 PHASE are shown in the following table:

Diameter (in.)	Wire Speed Range In./Min.	Approximate Current Range
.030	80 - 110	75A to 120A
.035	70 - 130	120A to 170A

ARC GOUGING

The RANGER® 3 PHASE can be used for limited arc gouging.

Set the Range switch to adjust output current to the desired level for the gouging electrode being used according to the ratings in the following table:

CARBON DIAMETER (in)	CURRENT RANGE (DC, electrode positive)
1/8	30 - 60 Amps
5/32	90 - 150 Amps
3/16	200 - 250 Amps

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SUMMARY OF WELDING PROCESSES

PROCESS	CONTROL CABLE USED	IDLE MODE	ELECTRODE WHEN NOT WELDING	TO START WELDING
STICK	No	AUTO	Hot	Touch electrode to work. Welding starts immediately and engine goes to high idle.
WIRE FEED, LN-25 WITH INTERNAL CONTACTOR	No	AUTO	Cold	Press gun trigger, LN-25 contactor closes. Welding starts immediately and engine goes to high idle. NOTE: Output Control must be set above "3"
TIG, TIG MODULE WITH CONTACTOR KIT WITH CONTACTOR KIT CONTROL CABLE, & ARC START SWITCH	Yes	High	Cold	Press Arc Start Switch contactor closes, welding starts immediately.
WIRE FEED, LN-15 ACROSS the ARC (has internal contactor)	No	Auto	Cold	Press gun trigger. LN-15 contactor closes, Welding starts immediately NOTE: Output Control must be set above "3" on the dial.

STARTING/SHUTDOWN INSTRUCTIONS

STARTING THE ENGINE

⚠ WARNING



- Do not touch electrically live parts of electrode with skin or wet clothing.



- Keep flammable material away.



- Insulate yourself from work and ground. Wear eye, ear, and body protection.



- Keep your head out of the fumes.
- Use ventilation or exhaust to remove fumes from breathing zone.

Be sure all Pre-Operation Maintenance has been performed. Also, read the Engine Owner's Manual before starting for the first time.

Remove all loads connected to the AC power receptacles. Use the choke control as follows:

KOHLER ENGINE - Always pull the choke control out when starting the engine; cold, warm or hot.

Turn the engine switch to the “start”  position and crank the engine until it starts. Release the switch as soon as the engine starts, slowly return the choke control to the full “in” position (choke open), and turn the switch to the Auto Idle ( / ) position. Do not turn the switch to the “start” position while the engine is running because this will cause damage to the ring gear and/or starter motor

After running at high engine speed for 10-14 seconds, the engine will go to low idle. Allow the engine to warm up by letting it run at low idle for a few minutes.

STOPPING THE ENGINE

Remove all welding and auxiliary power loads and allow engine to run at low idle speed for a few minutes to cool the engine.

Stop the engine by placing the Engine switch in the “OFF”  position.

A fuel shut off valve is not required on the RANGER® 3 PHASE because the fuel tank is mounted below the engine.

BREAK-IN PERIOD

It is normal for any engine to use a greater amount of oil until the break-in is accomplished. Check the oil level twice a day during the break-in period (approximately 50 running hours).

IMPORTANT: IN ORDER TO ACCOMPLISH THIS-BREAK-IN, THE UNIT SHOULD BE SUBJECTED TO MODERATE LOADS, WITHIN THE RATING OF THE MACHINE. AVOID LONG IDLE RUNNING PERIODS. REMOVE LOADS AND ALLOW ENGINE TO COOL BEFORE SHUTDOWN.

The engine manufacturer's recommendation for the running time until the first oil change is **5 Hours** .

The oil filter is to be changed at the second oil change. Refer to the Engine Owner's Manual for more information.

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Recommended EquipmentC-3

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OPTIONAL EQUIPMENT (Field Installed)

K957-1 HEAVY DUTY, TWO WHEEL TRAILER FOR SMALL WELDERS - For road, off-road and in-plant and yard towing. (For highway use, consult applicable federal, state and local laws regarding requirements for brakes, lights, fenders, etc.)

Order K957-1 Trailer

K958-1 Ball Hitch

K958-2 Lunette Eye Hitch

K959-2 Fender & Light Kit

K965-1 Cable Storage Rack

K889-2 & -3 TWO-WHEEL UNDERCARRIAGE - For moving by hand. Overall Width 29 in (.74m) Both have pneumatic tires. Puncture proof tires included with K889-3.

K1737-1 FOUR WHEEL ALL-TERRAIN UNDERCARRIAGE - For moving by hand at construction sites. Heavy duty puncture resistant pneumatic tires.

K1770-1 UNDERCARRIAGE (FACTORY) - For moving by hand on a smooth surface. One or two gas cylinders can be mounted on the rear of the undercarriage with the installation of K1745-1 Cylinder Holder(s). Heavy duty puncture resistant pneumatic tires and front caster.

K1745-1 WELDING GAS CYLINDER LPG TANK HOLDER

Holds Welding Gas Cylinder for use on K1770-1 Undercarriage. One or two may be installed on an undercarriage.

K1788-1 ROLL CAGE - Gives added damage protection. Attaches to K1737-1, K1770-1, and K957-1.

K886-1 CANVAS COVER -To protect the RANGER 3 PHASE when not in use. Made from attractive red canvas material which is flame retardant, mildew resistant, and water repellent.

K802R POWER PLUG KIT- provides four 120V plugs rated at 15 amps each and one dual voltage, Full KVA plug rated at 120/240V, 50 amps.

K802N POWER PLUG KIT - Provides four 120V plugs rated at 20 amps each and one dual voltage, full KVA plug rated at 120/240V, 50 amps.

K704 ACCESSORY KIT - Includes 35 ft (10.7m) 2/0 AWG electrode cable, 30 ft. (9.1m) 2/0 AWG work cable, headshield Filterplate, work clamp and electrode holder. 400 Amp. Capacity.

K875 ACCESSORY KIT - Includes 20 ft (6.1m) #6 electrode cable, headshield, filter plate, work clamp, electrode holder and sample pack of mild steel electrodes 150 Amp. Capacity. lug, 15ft. (4.6) #6 work cable

K894-1 SPARK ARRESTER KIT - Includes a heavy gauge steel, approved spark arrester and clamp for easy mounting to muffler exhaust pipe.

K1816-1 FULL KVA ADAPTER KIT - Plugs into the 120/240V NEMA 14-50R receptacle on the case front (which accepts 4-prong plugs) and converts it to a NEMA 6-50R receptacle, (which accepts 3-prong plugs.)

T12153-9 FULL-KVA POWER PLUG - One dual voltage plug rated at 120/240V, 50 amps.

K930-2 TIG MODULE - Provides high frequency and shielding gas control for AC and DC GTAW (TIG) welding applications. Its compact case is designed for easy carrying, complete with a handle. High frequency bypass is built in. Requires K938-1 Contactor Kit, K936-4 Control Cable, and K814 Arc Start Switch.

K938-1 CONTACTOR KIT - For use with TIG Module, Provides a "cold" electrode until the triggering device (Arc Start Switch) is pressed.

K936-4 CONTROL CABLE - Connects TIG Module to RANGER 3 PHASE. (9 Pin to 115V Plug)

K814 ARC START SWITCH - Attaches to the TIG torch for convenient finger control.

K937-45 CONTROL CABLE EXTENSION - Allows TIG Module to be operated at distances up to 200ft. from the power source. Available in 45ft. (13.7m) Sections.

K939-1 DOCKING KIT - For Mounting the K930-2 TIG Module on top of the RANGER 3 PHASE.

RECOMMENDED EQUIPMENT

STICK

K704 Accessory Kit which includes:

- Electrode Holder & Cable
- Work Clamp & Cable
- Headshield

WIRE FEED

LN-25

K449 LN-25 - Includes internal contactor for across the arc operation (no control cable). Provides “cold” electrode until gun trigger is pressed. Includes gas solenoid. Requires Drive Roll Kit and Weld Power Cable.

Magnum Gun and Magnum Gun Connector Kit are required for gas-shielded welding. Innershield Gun is required for gasless welding.

LN-15

K449 LN-15 - Includes internal contactor for across the arc operation (no control cable). Provides “cold” electrode until gun trigger is pressed. Includes gas solenoid. Requires Drive Roll Kit and Weld Power Cable.

Magnum Gun and Magnum Gun Connector Kit are required for gas-shielded welding. Magnum Innershield Gun and wire bushing is required for gasless welding.

TIG

PRO TORCH® TIG Torch

- K1783-9 PTA 26V TIG Torch

Magnum Parts Kit and Argon Gas

- KP509 Parts Kit

K930-2 TIG Module (Requires)

- Requires K938-1 Contactor Kit,
- K936-4 Control Cable, and
- K814 Arc Start Switch

Optional TIG Module Accessory:

- K939-1 Docking Kit
- K937-45 Control Cable Extensions (45ft.)

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SAFETY PRECAUTIONS

⚠ WARNING

Have qualified personnel do the maintenance work. Turn the engine off before working inside the machine. 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.

Do not put your hands near the engine cooling blower fan. If a problem cannot be corrected by following the instructions, take the machine to the nearest Lincoln Field Service Shop.



- ELECTRIC SHOCK can kill.**
- Do not touch electrically live parts or electrode with skin or wet clothing.
 - Insulate yourself from work and ground
 - Always wear dry insulating gloves.



- ENGINE EXHAUST can kill.**
- Use in open, well ventilated areas or vent exhaust outside.



- MOVING PARTS can injure.**
- Do not operate with doors open or guards off.
 - Stop engine before servicing.
 - Keep away from moving parts.

See additional warning information throughout this operator's manual and the Engine manual as well.

Read the Safety Precautions in the front of this manual and the engine instruction manual before working on this machine.

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

ROUTINE MAINTENANCE

- At the end of each day's use, refill the fuel tank to minimize moisture condensation in the tank. Running out of fuel tends to draw dirt into the fuel system. Also, check the crankcase oil level and add oil if indicated.

⚠ CAUTION

Make certain that the oil filler cap is securely tightened after checking or adding oil. If the cap is not tight, oil consumption can increase significantly which may be evidenced by white smoke coming from the exhaust.

- OIL - Maintenance schedule for changing the oil and oil filter after break-in :

	Kohler CH23S
Oil	100 Hrs.
Oil Filter	200 Hrs.

The above schedule is for normal operating conditions. More frequent oil changes are required with dusty, high temperature and other severe operating conditions. Refer to the maintenance section of the Engine Owner's Manual for more information.

NOTE: Engine life will be reduced if the oil and oil filter are not changed according to the manufacturer's recommendation.

ENGINE OIL CHANGE



Drain the oil while the engine is warm to assure rapid and complete draining.

- Remove the oil filler cap and dipstick. Remove the yellow cap from the oil drain valve and attach the flexible drain tube supplied with the machine. Push in and twist the drain valve counterclockwise. Pull the valve out and drain the oil into a suitable container.
- Close the drain valve by pushing in and twisting clockwise. Replace the yellow cap.
- Refill to the upper limit mark on the dipstick with the recommended oil. Tighten the oil filler cap securely.

ENGINE OIL REFILL CAPACITIES

Without oil filter replacement:

- 1.7qt. (1.6 liter)-Kohler

With oil filter replacement:

- 2.0qt. (1.9 liter)-Kohler

Return to Section TOC | Return to Master TOC

Use 4-stroke motor oil that meets or exceeds the requirements for API service classification SG or SH. Always check the API SERVICE label on the oil container to be sure it includes the letters SG or SH.

SAE 10W-30 is recommended for general, all-temperature use, -5 F to 104 F (-20 C to 40 C).

See Engine Owner's Manual for more specific information on oil viscosity recommendations.

Wash your hands with soap and water after handling used oil.

Please dispose of used motor oil in a manner that is compatible with the environment. We suggest you take it in a sealed container to your local service station or recycling center for reclamation.

Do not throw it in the trash, pour it on the ground or down a drain.

OIL FILTER CHANGE

1. Drain the engine oil.
2. Remove the oil filter, and drain the oil into a suitable container. Discard the used oil filter.
3. Clean the filter mounting base, and coat the gasket of the new oil filter with clean engine oil.
4. Screw on the new oil filter by hand, until the gasket contacts the filter mounting base, then use an oil filter socket tool to tighten the filter an additional 1/2 to 7/8 turn.
5. Refill the crankcase with the specified amount of the recommended oil. Reinstall the oil filler cap.
6. Start the engine and check for oil filter leaks.
7. Stop the engine, and check the oil level. If necessary, add oil to the upper limit mark on the dipstick.

AIR CLEANER AND OTHER MAINTENANCE

- Air Cleaner - With normal operating conditions, the maintenance schedule for cleaning and re-oiling the foam pre-filter is every 25 hours and replacement of the air cleaner filter every 100 hours. More frequent servicing is required with dusty operating conditions. Refer to the maintenance section of the Engine Owner's Manual for more information.
- Refer to the maintenance section of the Engine Owner's Manual for other scheduled maintenance ,

- Blow out the machine with low pressure air periodically. In particularly dirty locations, this may be required once a week.
- Output Ranger Selector and Polarity Switches: Switch contacts should not be greased. To keep contacts clean, rotate the switch through its entire range frequently. Good practice is to turn the handle from maximum to minimum setting twice each morning before starting to weld.

GFCI RECEPTACLE TESTING AND RESET-TING PROCEDURE

The GFCI receptacle should be properly tested at least once every month or whenever it is tripped. To properly test and reset the GFCI receptacle:

- If the receptacle has tripped, first carefully remove any load and check it for damage.
- If the equipment has been shut down, it must be restarted.
- The equipment needs to be operating at high idle speed and any necessary adjustments made on the control panel so that the equipment is providing at least 80 volts to the receptacle input terminals.
- The circuit breaker for this receptacle must not be tripped. Reset if necessary.
- Push the "Reset" button located on the GFCI receptacle. This will assure normal GFCI operation.
- Plug a night-light (with an "ON/OFF" switch) or other product (such as a lamp) into the GFCI receptacle and turn the product "ON".
- Push the "Test" button located on the GFCI receptacle. The night-light or other product should go "OFF".
- Push the "Reset" button, again. The light or other product should go "ON" again.

If the light or other product remains "ON" when the "Test" button is pushed, the GFCI is not working properly or has been incorrectly installed (miswired). If your GFCI is not working properly, contact a qualified, certified electrician who can assess the situation, rewire the GFCI if necessary or replace the device.

SLIP RINGS

A slight amount of darkening and wear of the slip rings and brushes is normal. Brushes should be inspected when a general overhaul is necessary. If brushes are to be replaced, clean slip rings with a fine emery paper.

CAUTION

Do not attempt to polish slip rings while engine is running.

WARNING

GASES FROM BATTERY can explode.
 • Keep sparks, flame and cigarettes away from battery.



To prevent EXPLOSION when:
 • **INSTALLING A NEW BATTERY** - disconnect negative cable from old battery first and connect to new battery last.

• **CONNECTING A BATTERY CHARGER** - Remove battery from welder by disconnecting negative cable first, then positive cable and battery clamp. When re-installing, connect negative cable last. Keep well ventilated.



• **USING A BOOSTER** - connect positive lead to battery first then connect negative lead to engine foot.

BATTERY ACID CAN BURN EYES AND SKIN.
 • Wear gloves and eye protection and be careful when working near battery. Follow instructions printed on battery.



BATTERY

1. When replacing, jumping, or otherwise connecting the battery to the battery cables, the proper polarity must be observed. Failure to observe the proper polarity could result in damage to the charging circuit. The positive (+) battery cable has a red terminal cover.
2. If the battery requires charging from an external charger, disconnect the negative battery cable first and then the positive battery cable before attaching the charger leads. Failure to do so can result in damage to the internal charger components. When reconnecting the cables, connect the positive cable first and the negative cable last.

HARDWARE

Both English and Metric fasteners are used in this welder.

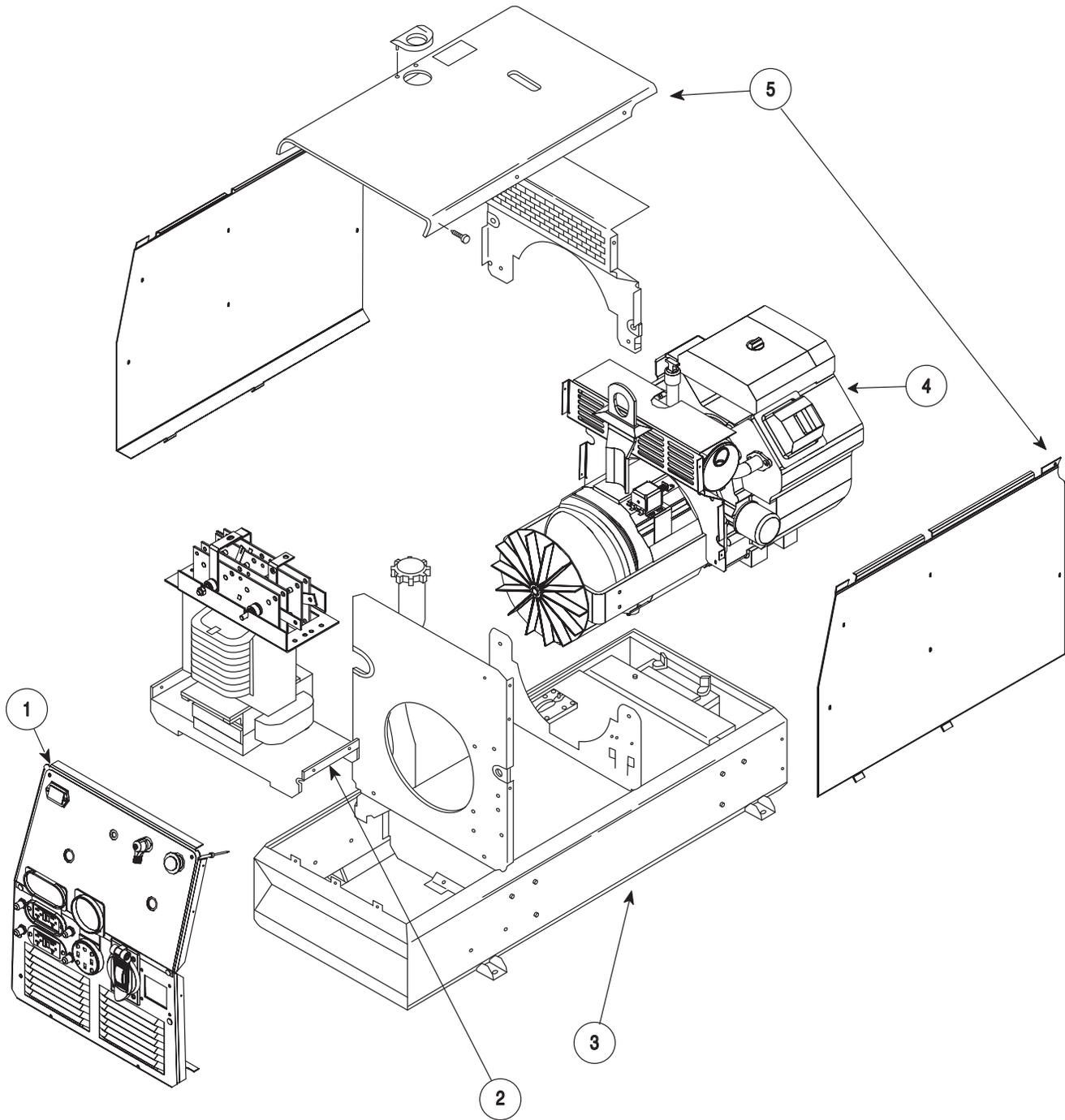
ENGINE MAINTENANCE PARTS

	KOHLER C23S
Oil Filter	KOHLER 12 050 01 FRAM PH8172*
Air Filter Element	KOHLER 47 083 03 FRAM CA79
Air Filter Pre-Cleaner	KOHLER 24 083 02
Fuel Filter	KOHLER 24 050 10
Spark Plugs (Resistor Type)	CHAMPION RC12YC (.030" GAP)

* Oil capacity increases from 2.0 Qts. to 2.1 Qts. when using this filter.

FIGURE D.1 - MAJOR COMPONENT LOCATION

1. CASEFRONT
2. OUTPUT RECTIFIER ASSEMBLY
3. BASE/UNDERCARRIAGE ASSEMBLY
4. ENGINE/ROTOR/STATOR ASSEMBLY
5. CASE TOP & SIDES



RANGER® 3 PHASE



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Theory of Operation E-1

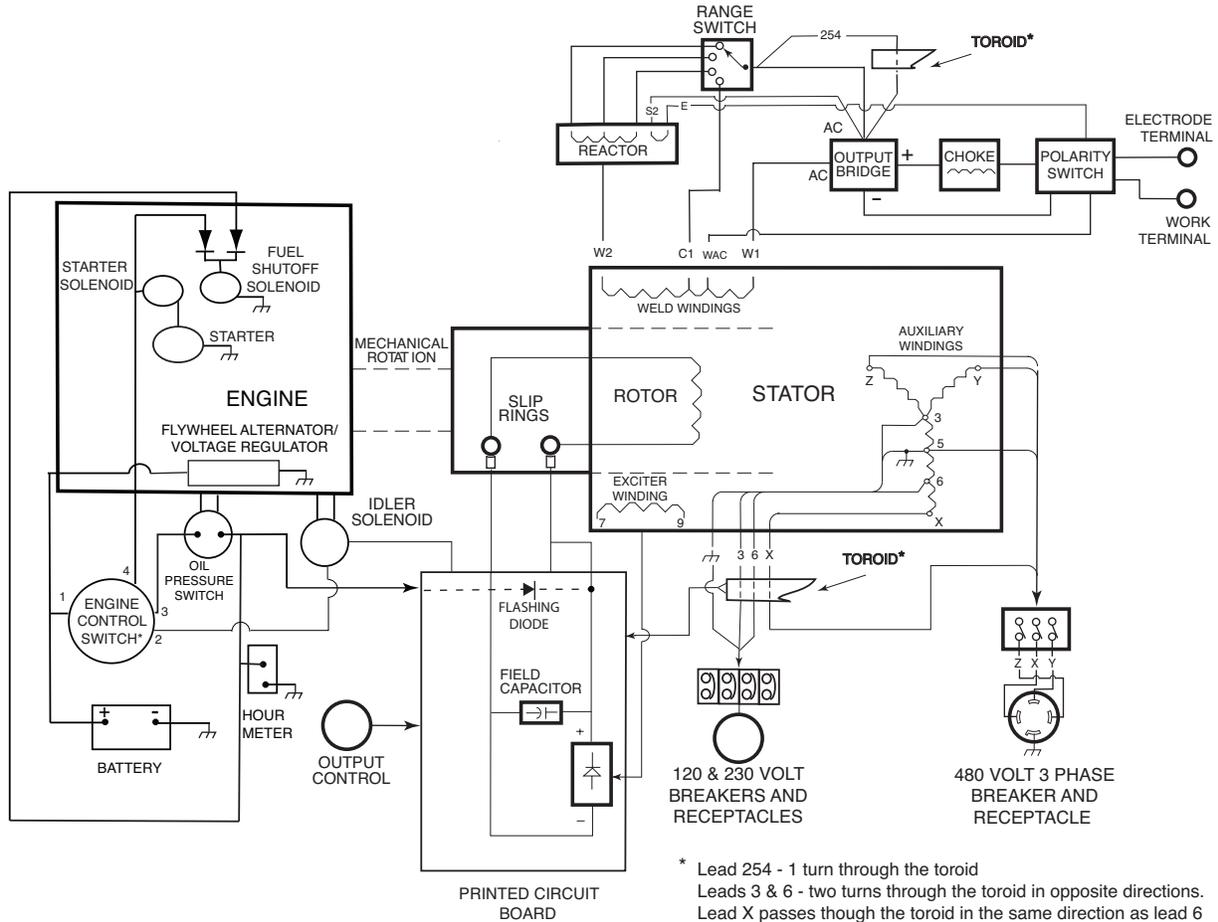
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Engine Components and Operation E-2

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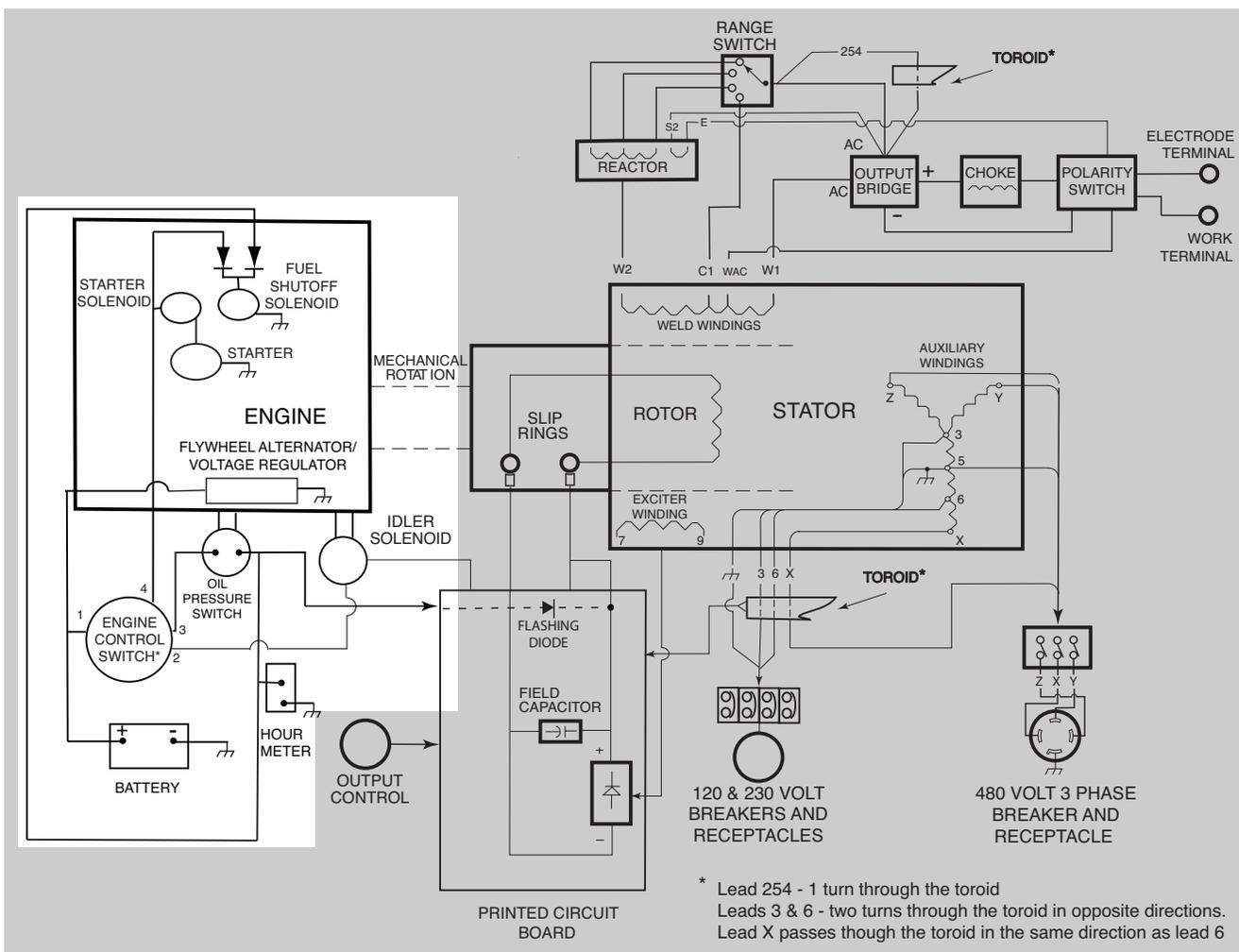
Weld Circuitry E-4

FIGURE E.1 BLOCK DIAGRAM



* Lead 254 - 1 turn through the toroid
 Leads 3 & 6 - two turns through the toroid in opposite directions.
 Lead X passes through the toroid in the same direction as lead 6

FIGURE E.2 - ENGINE COMPONENTS AND OPERATION



GENERAL DESCRIPTION

The RANGER® 3 PHASE is a twin cylinder, gasoline driven, multiprocess arc welder and AC power generator. It is capable of AC or DC Stick (SMAW) or TIG (GTAW) welding and CV Wire welding, either Innershield® or MIG (GMAW). The AC power generator is capable of providing 10,500 Watts continuous, 3 Phase 60 Hz. AC 480 volt power or 9500 Watts continuous, Single Phase 60 Hz. AC 120/240 volt power.

ENGINE COMPONENTS AND OPERATION

The Engine Control Switch is used to start and stop the engine and to select the idle mode (High Idle or Auto Idle). The Fuel Shutoff Solenoid is activated at first by the Engine Control Switch. Then, as oil pressure builds up it is held in by the output of the voltage regulator through the oil pressure switch. If the oil pressure switch opens for any reason, the Fuel Solenoid will release and the engine will shut down.

When the Engine control Switch is released it returns to the High Idle position.

When the switch is placed in the Auto Idle position, after a delay of approximately 10 seconds, the Idler Solenoid will energize and the engine will drop to low speed. Upon striking an arc or drawing of current from any of the Auxiliary Power receptacles, the solenoid will release and the engine will go to the high idle speed. Once the load is removed, and after a 10 second delay, it will return to the low idle condition.

The Hour Meter runs whenever the oil pressure switch is closed to help keep track of running time for maintenance concerns.

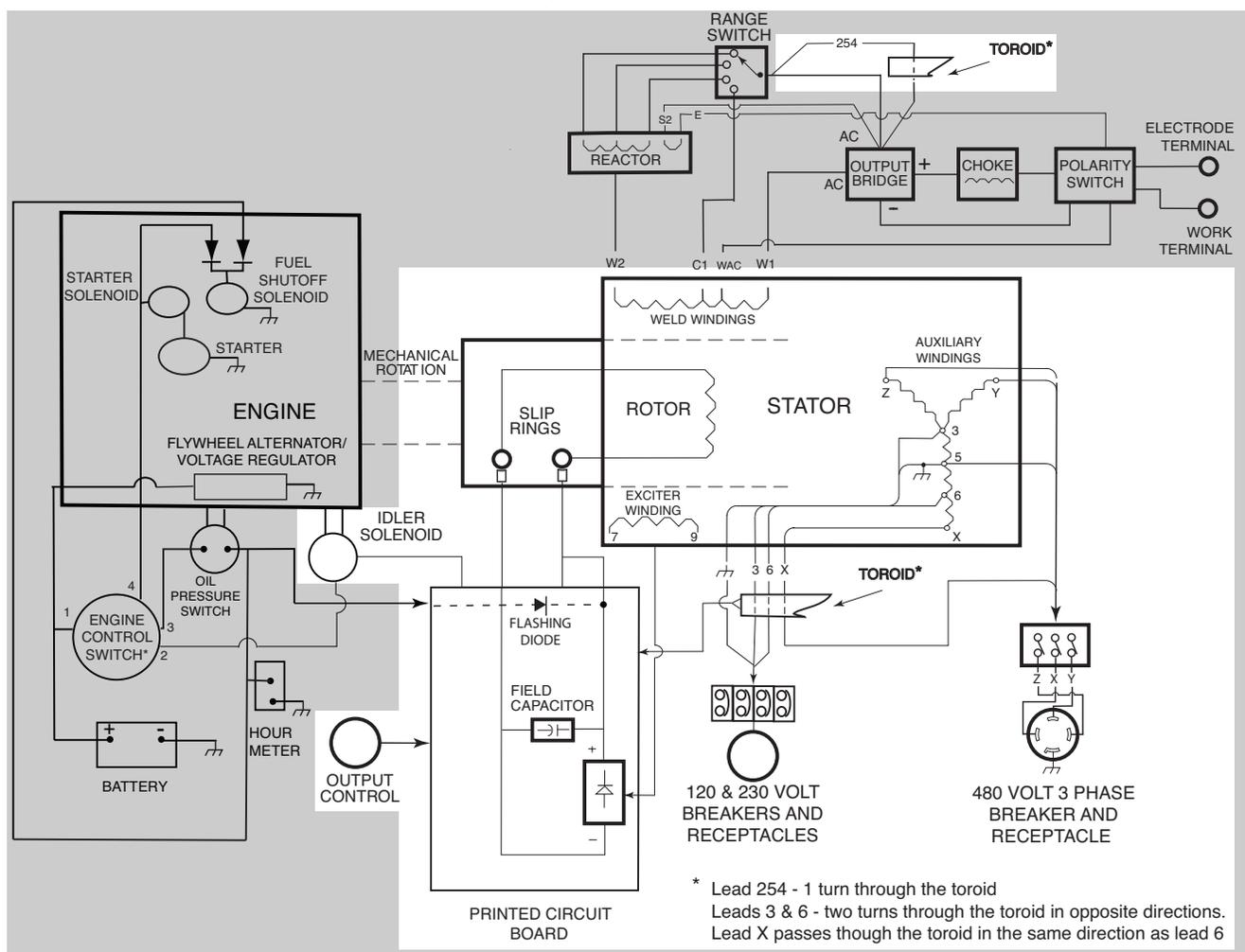
Turning the Engine Control Switch to the 'OFF' Position will shut down the machine.

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

RANGER® 3 PHASE



FIGURE E.2 - ROTOR, STATOR AND CONTROL CIRCUITS



ROTOR, STATOR & CONTROL CIRCUITS

Once the Engine is running and the oil pressure switch closes, 12 VDC is fed to the rotor slip rings by way of the Control PC Board. This “flashing” voltage energizes the rotor and the resulting spinning magnetic field induces power into the windings of the stator. The exciter winding voltage is routed to the Control Board where it is rectified and regulated and fed back to the rotor slip rings. This regulated supply is used to control the voltage output of the welder. A diode on the PC Board is used to isolate the exciter voltage from the engine 12 VDC supply. The Output Control is used to adjust the weld voltage.

The Idler Circuit is also controlled by the Control PC Board. A Toroid is used to sense current draw through either the weld circuit or any of the auxiliary receptacles. When current is sensed, a signal from the Toroid causes the PC Board to release the Idler Solenoid and the engine goes to high speed.

Approximately 10 seconds after the current stops, the board will re-energize the solenoid and pull the engine down to the low idle speed. If the Control Power Switch is in the High Idle position, the signal from the Toroid is ignored.

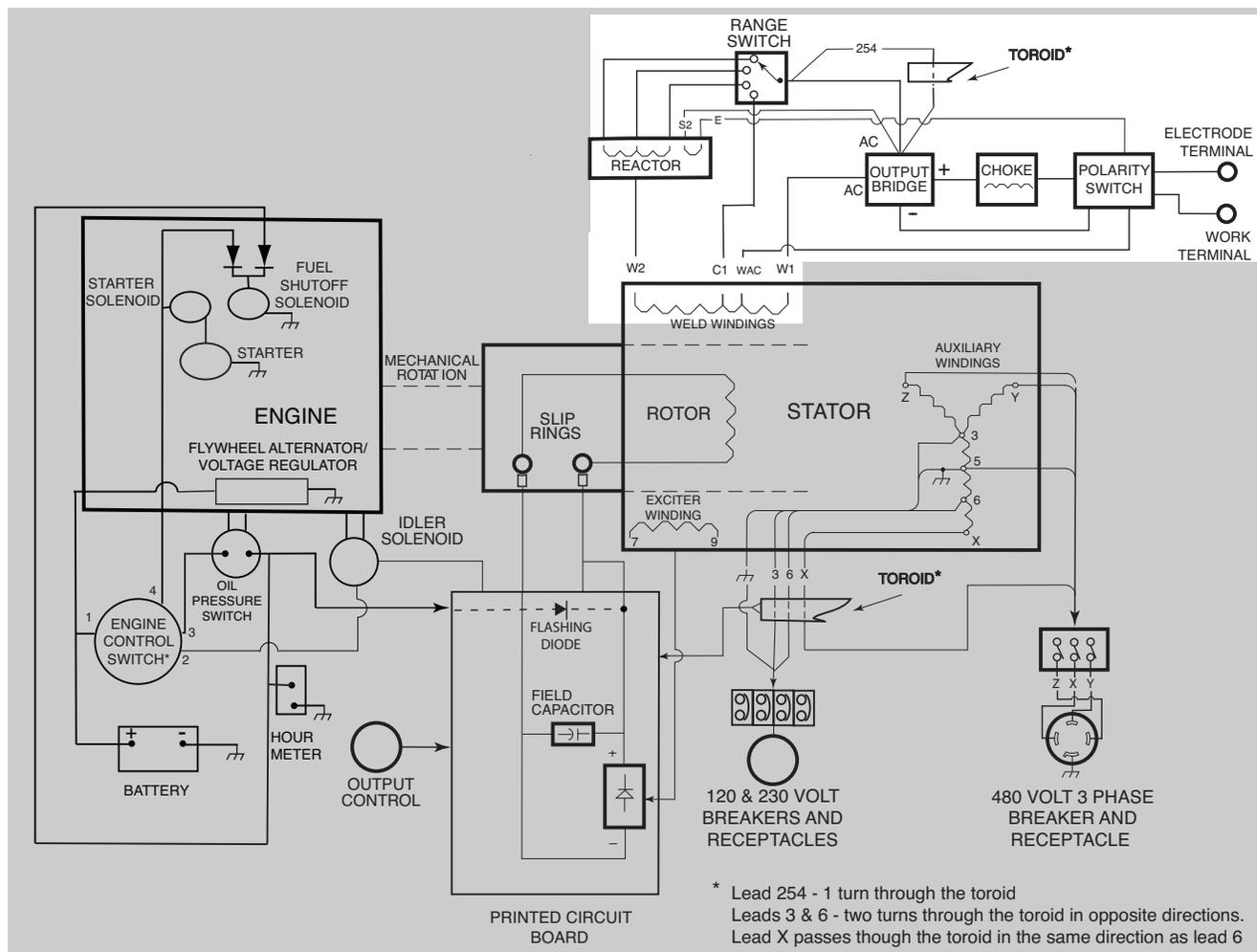
The Weld Winding provides the power for welding. Different portions are used depending on the weld mode selected. The full winding is used for DC welding while a tapped off portion (WAC) is used for AC welding. There is also a tap (C1) used for constant voltage (CV) welding. The Auxiliary Winding is a 3 phase ‘wye’ connected 480 VAC supply. Tapped off of one leg are the 230 VAC single phase and the 120VAC single phase supplies for the various receptacles. Each of the receptacles including the 3 phase receptacle is protected by an appropriately sized Circuit Breaker.

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

RANGER® 3 PHASE

LINCOLN
ELECTRIC

FIGURE E.2 - WELD CIRCUITRY



WELD CIRCUITRY

One end of the Weld Winding is connected to the Output Rectifier and at the other end to the Reactor. There are taps (C1) for constant voltage (CV) welding and (WAC) for AC welding.

The Reactor Winding is tapped winding to provide the three constant current (CC) welding ranges. As current is drawn through the reactor it causes the voltage output of the machine to drop off. This action creates the “drooping” output characteristic that is required for stick and TIG welding. The C1 tap does not go through the reactor so there is very little “droop” as the weld current is increased. It is used to provide the constant voltage (CV) output that is required for wire welding.

The Polarity Switch is used to select the desired weld mode — DC+, DC- or AC. It connects either the AC output or the proper side of the rectified output to the WORK and ELECTRODE terminals.

In AC weld mode, the weld current is routed through another winding in the Reactor (S2 to E) in order to improve weld characteristics.

When DC output is selected, the AC weld current is fed to the Output Rectifier to be converted to DC. The positive output of the rectifier is then routed through the Choke to smooth out the ripple and provide good welding characteristics.

Lead #254 is a sense lead that is connected in parallel to the lead from the Range Switch to the AC side of the rectifier and as a result shares a portion of the weld current. It is routed through the toroid to activate the Idler Circuit when weld current is present.

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

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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, wire feeding problems, and welding 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 Physical or Electrical Damage is Evident.		1. Contact The Lincoln Electric Service Dept. 1-888-935-3877.
No weld output and no auxiliary power. Engine runs normally.	1. Check the brushes for wear and proper contact to the rotor slip rings.	1. Check for the presence of 12 VDC (at the pc board) from lead #224 to frame ground. This is the supply voltage to the board and is present when the engine is running and the S3 switch is in the "HIGH" or "AUTO" position. If the 12VDC is missing check the leads, switches and connections associated with the lead #224. See the Wiring Diagram . 2. Perform the Rotor Voltage Test . 3. If Rotor Voltage Test is normal, then preform the Rotor Resistance Test . 4. If the Rotor Voltage Test is NOT normal, perform the Auxiliary and Field Winding Voltage Test . The Printed Circuit Board may be faulty. Replace

⚠ 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.

RANGER® 3 PHASE



Return to Section TOC

Return to Master TOC

Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No weld output in AC or DC Modes. The auxiliary power (480, 23 & 115VAC) is normal. Engine runs normally.	<ol style="list-style-type: none"> 1. Check the welding cables, clamps and electrode holder for loose or broken connections. 2. Check the open circuit voltage (OCV) at the welder output terminals, engine at high idle (3650 RPM). Normal maximum is 73 to 80VAC. Normal DC maximum is 67 to 72VDC. If the OCV is OK then proceed to Step #2. 	<ol style="list-style-type: none"> 1. Disconnect lead W1 from the Output Bridge (D1) and check for the presence of 80VAC from lead W1 to lead W2 on the main stator winding. See the Wiring Diagram. If the AC voltage is NOT present, the winding in the stator may be faulty. Check the winding for continuity and test to be sure it is NOT grounded to the stator iron. Replace the Sstator if necessary. If the correct AC voltage is present, proceed to step #2. 2. Check the Reactor, Range Switch (S1) and associated wires for loose or faulty connections. Check the reactor winding for continuity and test to be sure it is NOT grounded to the reactor iron. 3. Check the Choke (L1), Polarity Switch (S2) and associated wires for loose or faulty connections. Check the choke winding for continuity and test to be sure it is NOT grounded to the choke iron. 4. Check the weld output terminals and associated wires for loose or faulty connections. 5. Perform the Output Bridge Test.
No DC welding output. AC welding output and auxiliary power is normal.	<ol style="list-style-type: none"> 1. Make sure the Polarity Switch is in the proper position and is "seated" correctly. 2. Make sure the electrode and polarity are correct for the process being used. 	<ol style="list-style-type: none"> 1. Perform the Output Bridge Test. 2. Check the Choke (L1), the Polarity Switch (S2) and associated wires for loose or faulty connections. Check the choke winding for continuity and test to be sure it is NOT grounded the choke iron.

⚠ 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.

RANGER® 3 PHASE



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
OUTPUT PROBLEMS		
No AC welding output. DC welding output and auxiliary power is normal.	<ol style="list-style-type: none"> 1. Make sure the Polarity Switch is in the proper position and is "seated" correctly. 2. Make sure the electrode is correct for the process being used. 3. Make sure the welding cables are not coiled or too long. 	<ol style="list-style-type: none"> 1. Check the operation of the Polarity Switch (S2). Also check the associated wires for loose or faulty connections. See Wiring Diagram. 2. Check for continuity from lead "S2" to lead "E" located in the main stator. See Wiring Diagram.
No constant voltage (CV) welding output. Constant current (CC) and the auxiliary power are operating normally.	<ol style="list-style-type: none"> 1. Make sure the Range Switch (S1) is in the proper position (CV) and "seated" correctly. 2. Make sure the wire feeder is connected correctly. 	<ol style="list-style-type: none"> 1. Check the operation of the Range Switch (S1) and check the associated wires for loose or faulty connections. See Wiring Diagram. 2. Check for continuity from lead C1 to lead W1 located in the main stator. See Wiring 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.

RANGER® 3 PHASE



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
ENGINE PROBLEMS		
<p>Engine will not go to high idle when attempting to weld or when the auxiliary power is loaded. Welding output and auxiliary power output is normal when Idler Switch is in the "HIGH" position.</p>	<ol style="list-style-type: none"> 1. Automatic idler may not function if the auxiliary power is loaded to less than 100 Watts. 	<ol style="list-style-type: none"> 1. Check that the leads are correctly wrapped through the Toroid. See Wiring Diagram. 2. Perform the Toroid Test. 3. The Printed Circuit Board may be faulty. Replace.
<p>Engine will not go to high idle when attempting to weld. Welding output is normal when Idler Switch is in "HIGH" position. Automatic idle function works properly when the auxiliary power is loaded.</p>	<ol style="list-style-type: none"> 1. Make sure the welding cables and connections are tight. 	<ol style="list-style-type: none"> 1. Check for broken or faulty connections in the sensing lead (#254). Make sure the connections are tight at the Output Rectifier and the Polarity Switch. See the Wiring Diagram. 2. Make sure the #254 lead is wrapped properly through the Toroid. See the Wiring 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.

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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		
<p>Engine will not idle down to low speed. Machine has normal weld output and auxiliary power.</p>	<ol style="list-style-type: none"> 1. Make sure the Engine Control Switch (S3) is in the "AUTO" position. 2. Make sure there is NOT an external load on the weld terminals or the auxiliary power receptacles. 	<ol style="list-style-type: none"> 1. With the Engine Control Switch in the "AUTO" position, check for the presence of 12VDC at leads #213 to #215 located at the Idler Solenoid. If 12VDC is present and the Idler Solenoid is not activating, then the solenoid may be faulty or there is a mechanical restriction preventing it from functioning. 2. If there is NOT 12VDC at leads #213 to #215, then test for 12VDC from lead #213 to ground (lead #5). See Wiring Diagram. If 12VDC is present, then check lead #215 for continuity (zero ohms) from the Idler Solenoid to the Printed Circuit Board plug 3J1. If lead #215 is OK, then the Printed Circuit Board may be faulty. Replace 3. If there is NOT 12VDC from lead #213 to ground (lead #5), then check the Engine Control Switch (S3) for proper operation and associated wires for loose or faulty connections. See the Wiring Diagram.
<p>Engine will not crank or cranks very slow.</p>	<ol style="list-style-type: none"> 1. Check for loose or faulty battery cable connections. 2. The battery may be faulty. 3. Check the ammeter to see if the battery is charging. If not, the charging circuit may be defective. 	<ol style="list-style-type: none"> 1. If the battery is replaced or tests good, then the charging circuit may be faulty. Perform the Charging Circuit Test. 2. The starter motor or starter solenoid may be faulty. 3. The Engine may be hard to crank due to a mechanical failure in the engine.

⚠ 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.

RANGER® 3 PHASE



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 shuts off.	<ol style="list-style-type: none"> 1. The Engine may be low on or out of fuel. 2. The Oil level may be low. Check and fill to proper level. 3. The fuel filter may be clogged. 	<ol style="list-style-type: none"> 1. The oil pressure switch may be faulty. Replace if necessary. 2. The fuel shut off solenoid may be faulty (Kohler Engines only).
Engine does not develop full power.	<ol style="list-style-type: none"> 1. The fuel filter may be clogged. Replace if necessary. 2. The air filter may be clogged. Replace if necessary. 3. The spark plug(s) may be faulty. Replace if necessary. 	<ol style="list-style-type: none"> 1. Due to wear, the engine may be in need of repair.
Engine tries to start when S3 is in start position, then shuts off when switched to run.	<ol style="list-style-type: none"> 1. Oil pressure switch may be faulty. 2. Fuel Shutoff Solenoid Diodes may be open. 	<ol style="list-style-type: none"> 1. Check Oil Switch should show continuity when running/open when off Switch. Replace oil pressure switch if necessary. 2. Check engine diodes in engine wiring harness. Replace if necessary (Engine Mfg. Part).
Engine will not start with S3 in start position, but then tries to start or does start when S3 is switched to run position.	<ol style="list-style-type: none"> 1. Engine shutdown solenoid diodes may be open. 2. Start switch (S3) may be faulty. 	<ol style="list-style-type: none"> 1. Check Engine diodes in engine wiring harness. Replace if necessary (Engine Mfg. Part). 2. Check start switch (S3). Replace if necessary.
Engine will not shut off when S3 is placed "OFF" position.	<ol style="list-style-type: none"> 1. Fuel shutoff solenoid may be faulty or stuck open. 2. Start switch (S3) may be faulty. 	<ol style="list-style-type: none"> 1. Feel solenoid for clicking open or closed. Replace if necessary. 2. Check start switch (S3). Replace if necessary.
Engine continues to crank when S3 is switched to "RUN" position.	<ol style="list-style-type: none"> 1. Engine shutdown solenoid diodes may be shorted. 	<ol style="list-style-type: none"> 1. Check diodes. Replace Engine Diodes (Engine Mfg. Part) if necessary.

⚠ CAUTION

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RANGER® 3 PHASE



Observe Safety Guidelines detailed in the beginning of this manual.

PROBLEMS (SYMPTOMS)	POSSIBLE AREAS OF MISADJUSTMENT(S)	RECOMMENDED COURSE OF ACTION
WELDING PROBLEMS		
<p>The welding arc is "cold." Engine runs normally (3700 RPM no load). Auxiliary power is functioning normally.</p>	<ol style="list-style-type: none"> 1. Check for loose or faulty connections at the weld output terminals and welding cable connections. 2. The welding cable may be too long or coiled, causing an excessive voltage drop. 	<ol style="list-style-type: none"> 1. Check for the correct open circuit voltage (OCV) at the welder output terminals. See the Machine Diagram. If the correct voltage is present at the output terminals, then check for loose connections on the heavy current carrying leads inside the RANGER® 8. See Wiring Diagram. 2. If the OCV is low at the welder output terminals, perform The Engine Throttle Adjustment Test. 3. Perform the Output Rectifier Bridge Test. 4. Check for shorted or grounded windings in the reactor and also in the main stator. See Wiring Diagram.
<p>Welding output is low with little or no control. Auxiliary output is also low.</p>	<ol style="list-style-type: none"> 1. Check the brushes for wear and proper contact to the rotor slip rings. 	<ol style="list-style-type: none"> 1. Make up a jumper to connect the Field Test Point (FTP1) on the PC Board to lead 219. The connection can be made at the board (J1,Pin5), or at the Negative Exciter Brush. See Figure F.4 and/or the Wiring Diagram. If the output comes up to full strength, the Control Board is probably defective. Replace. 2. Perform the Rotor Voltage Test. 3. If Rotor Voltage Test is normal, then perform the Rotor Resistance Test. 4. If the Rotor Voltage Test is NOT normal, perform the Auxiliary and Field Winding Voltage Test. The Printed Circuit Board may be faulty. Replace

⚠ 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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ROTOR VOLTAGE TEST 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

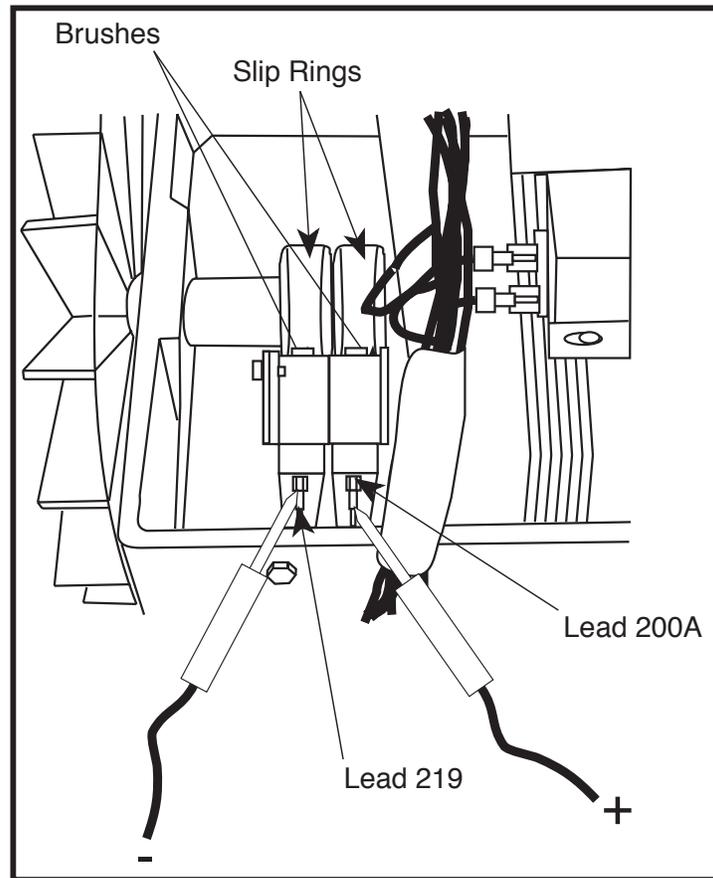
This test will determine if the correct DC voltage is being applied to the rotor at maximum engine speed (3700 RPM). This information will aid the technician in determining if the generator field is operating properly.

MATERIALS NEEDED

Volt/Ohmmeter
Misc. Hand Tools
Wiring Diagram

ROTOR VOLTAGE TEST (continued)

FIGURE F.1 – SLIP RINGS AND BRUSHES



TEST PROCEDURE

- Using a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
- Remove the rubber gasket (cover seal) from the lift bail.
- Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
- Remove the case top, **then reinstall the fuel cap.**
- With the 5/16" nut driver or socket, remove the 5 screws holding the right case side.
- Remove the right case side by lifting up and out.
- Set the volt/ohmmeter to the DC volts position.
- Connect the positive meter probe to the brush nearest the rotor lamination (lead 200A). See Figure F.1 for location.
- Connect the negative meter probe to the other brush (lead 219).
- Start the engine and run it at high idle. Set the output control to the MAXIMUM position (position 10).]
- Check the voltage reading on the voltmeter. It should read between 32 and 45 VDC.
- If the voltage reading is low or not present, the generator field is not functioning properly. Perform the **Rotor Resistance Test**.
- If the voltage reading is normal, the field circuit is functioning properly. Install the right case side with the 5 sheet metal screws. Remove the fuel cap; install the case top and tighten the 6 sheet metal screws. Install the rubber gasket over the lift bail and reinstall the fuel cap.

ROTOR 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

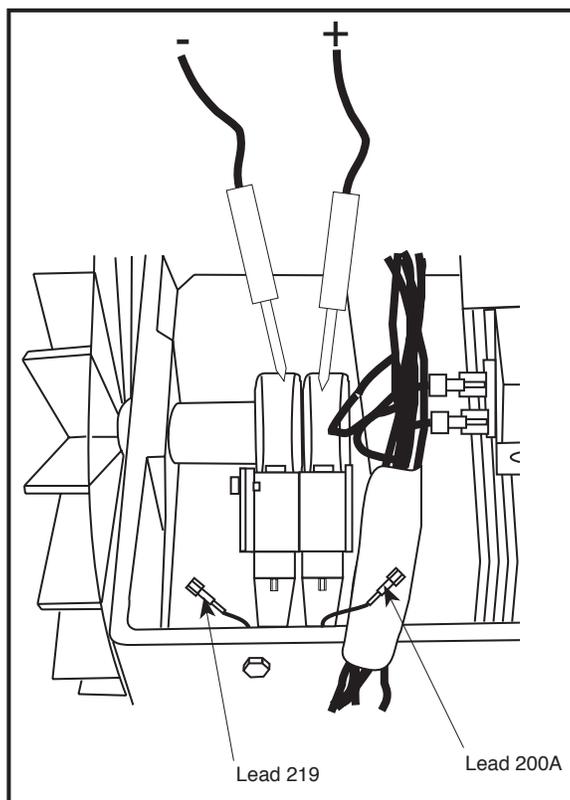
This test will determine if there is a shorted winding in the rotor or if the rotor is grounded.

MATERIALS NEEDED

- Volt/Ohmmeter
- Misc. Hand Tools
- Wiring Diagram

ROTOR RESISTANCE TEST *(continued)*

FIGURE F.2 – SLIP RINGS



TEST PROCEDURE

1. With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bail.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then replace the fuel cap.**
5. Remove the 5 screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Conduct the test with the gasoline engine OFF.
8. Remove the spark plug wires to prevent accidental engine kickback or starting.
9. Isolate the rotor electrically by removing the generator brush leads (#219 & #200). Refer to Figure F.2 as you perform the remaining steps.
12. Measure the resistance across the rotor slip rings.
 - A. Set the ohmmeter on the low scale (X1).
 - B. Check the resistance across the slip rings. It should read approximately 5 ohms.
13. Measure the resistance to ground.
 - A. Set the ohmmeter on the high scale (X100,000).
 - B. Place one probe on either of the slip rings. Place the other probe on any good, unpainted ground. The machine ground stud works well.
 - C. Check the resistance. It should read very high, at least 0.5 megohm (500,000 ohms).

If the test does not meet the resistance specifications, then the rotor may be faulty. Replace the rotor.

If the test does meet the resistance specifications, the rotor is okay.
14. Connect lead 200A to the positive brush, which is the one nearest the rotor lamination. Connect lead 219 to the negative brush.
15. Reinstall the case side, case top, fuel cap, lift bail gasket and spark plug wires.

AUXILIARY AND FIELD WINDING 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

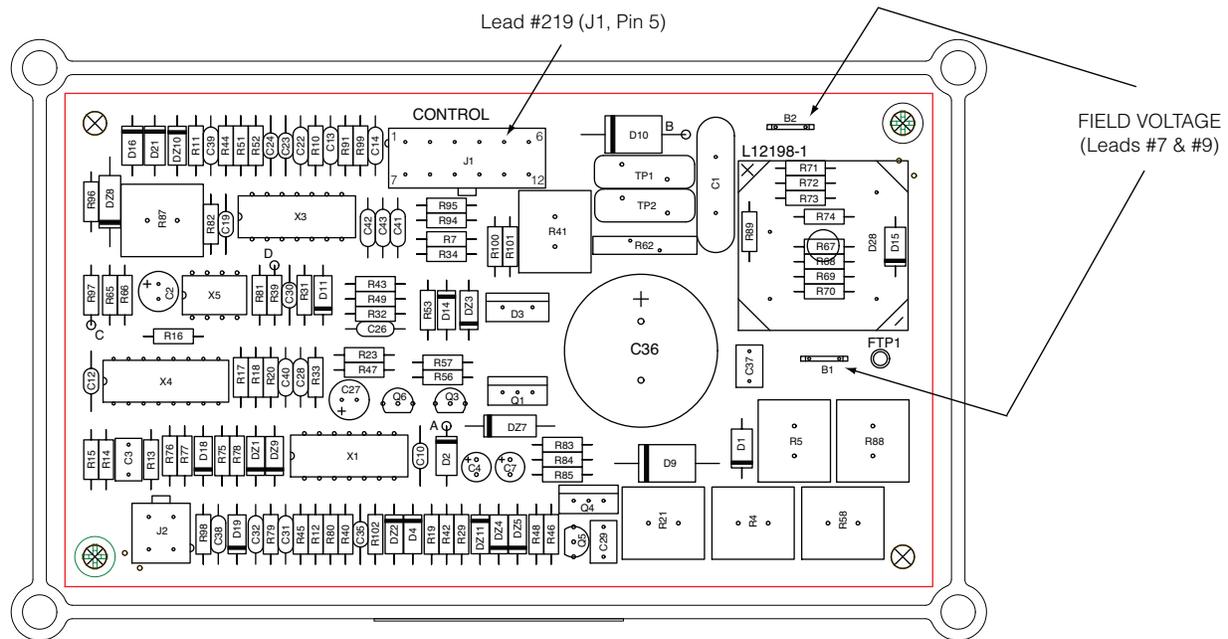
This test will determine if the correct AC voltages are being generated from the stator windings.

MATERIALS NEEDED

Volt/Ohmmeter
Misc. Hand Tools
Wiring Diagram

AUXILIARY AND FIELD WINDING TEST (continued)

FIGURE F.4 – CONTROL PC BOARD



FIELD WINDING

1. Remove the fuel cap and lift bail rubber gasket. With a 5/16" nut driver or socket, remove the case top and left side; **then reinstall the fuel cap.**
2. Connect the volt/ohmmeter probes to leads #7 and #9 where they connect to the Control P.C. Board.
3. Start the engine and run it at high idle (3700 RPM).
4. Set the output control to the maximum position (position 10).
5. Check the AC voltage reading. It should be between 41 and 45 VAC.

If any one or more of the readings are missing or not within specifications, then check for loose or broken wires between the test points and the stator windings. See the Wiring Diagram. Make sure the windings are NOT grounded internally to the stator iron. If the leads are intact, then the stator may be faulty. Replace the stator.

If the voltage readings are within specifications, then the windings are good and functioning properly.

6. Reinstall the case side, case top, fuel cap, and lift bail gasket

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RANGER® 3 PHASE



OUTPUT 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 troubleshooting assistance before you proceed. Call 1-888-935-3877.

TEST DESCRIPTION

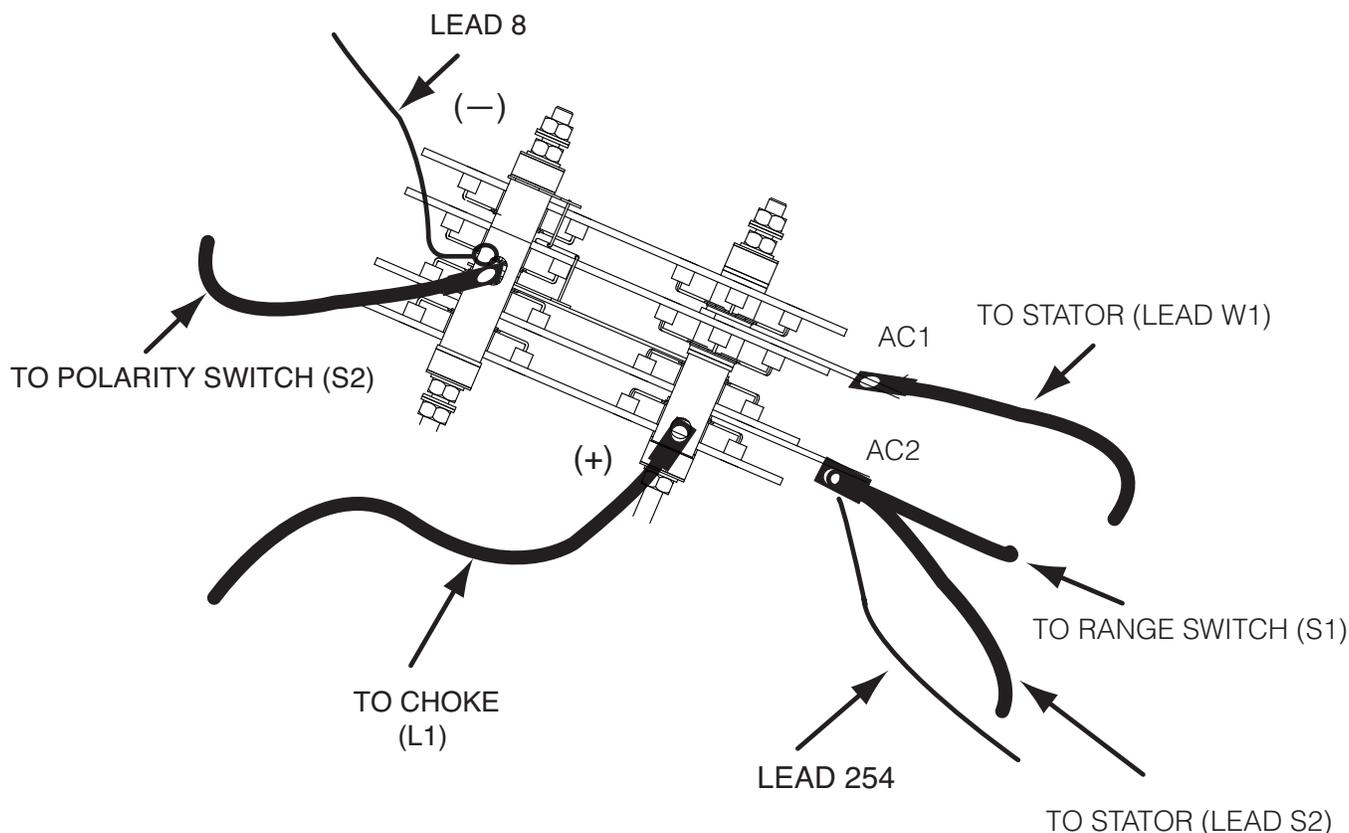
This test will determine if there are faulty diodes in the Output Rectifier Bridge.

MATERIALS NEEDED

- Volt/Ohmmeter (Analog Meter Preferred)
- Misc. Hand Tools
- Wiring Diagram

OUTPUT RECTIFIER BRIDGE TEST (continued)

FIGURE F.5 – OUTPUT RECTIFIER



TEST PROCEDURE

- Remove the spark plug wires to prevent accidental engine kickback or starting.
- With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
- Remove the rubber gasket (cover seal) from the lift bail.
- Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
- Remove the case top, **then replace the fuel cap.**
- Remove the 5 screws holding the right case side.
- Remove the right case side by lifting up and out.
- Conduct the test with the gasoline engine OFF.
- Locate the Output Rectifier Bridge behind the machine case front.
- Put the Polarity Switch in the **AC Mode**.
- Unplug the 12 pin connector (J1) from the Control Board.
- Use an Ohmter (analog meter preferred) to test the Output Rectifier per the following chart:

+ Meter Lead	- Meter Lead	Meter Reading
AC 1	+	LOW < 100Ω
+	AC 1	HIGH >1MΩ
AC 2	+	LOW < 100Ω
+	AC 2	HIGH >1MΩ
AC 1	-	HIGH >1MΩ
-	AC 1	LOW < 100Ω
AC 2	-	HIGH >1MΩ
-	AC 2	LOW < 100Ω

NOTE: Meter readings may vary depending on the type of meter. Typically, all "LOW" readings and all "HIGH" readings should be similar.

If any of the readings are not correct, disconnect the leads at those terminals and re-test. If still not correct, replace the Output Rectifier.

If the readings are now correct, check the leads that were disconnected for shorts or grounds.

TOROID 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

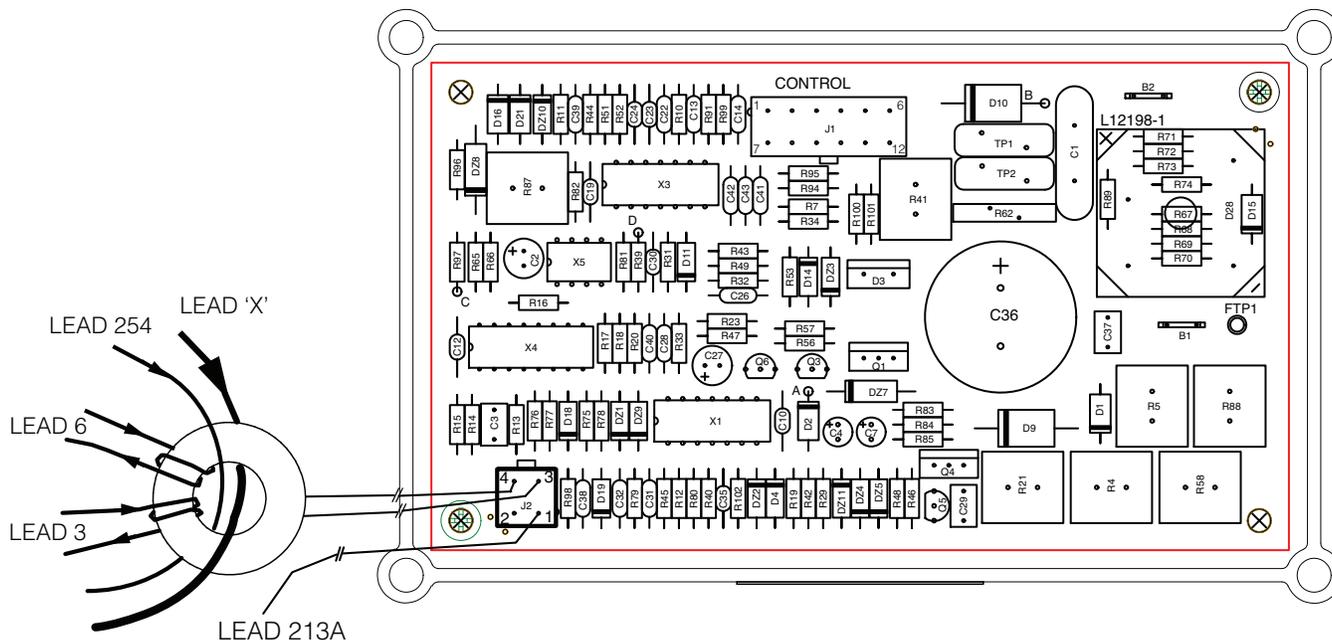
This procedure will aid the technician in determining whether the current sensing toroid is functioning properly

MATERIALS NEEDED

Volt/Ohmmeter
Misc. Hand Tools
Wiring Diagram

TOROID TEST (continued)

FIGURE F.6 – TOROID ASSEMBLY



TEST PROCEDURE

1. With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bail.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then replace the fuel cap.**
5. Remove the screws holding the right case side.
6. Remove the right case side by lifting up and out.
7. Start the engine and set it to AUTO and wait for it to drop to low idle (2400 rpm).
8. Plug a trouble light with a 100 watt bulb into one of the 120VAC receptacles.

The machine should go to High Idle.

If it does not, measure the voltage across the toroid leads (260 and 261) at pins 3 and 4 of J2. See Figure F.6. It should be approximately 2.8VAC.

If the voltage is correct, the Control Board may be defective.

If the voltage is not correct, the toroid may be defective.

9. Shut the engine OFF.

NOTE: If the Toroid needs to be replaced, pay close attention to the direction that the various leads are routed through it. See the **Wiring Diagram** for exact instructions.

CHARGING CIRCUIT 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

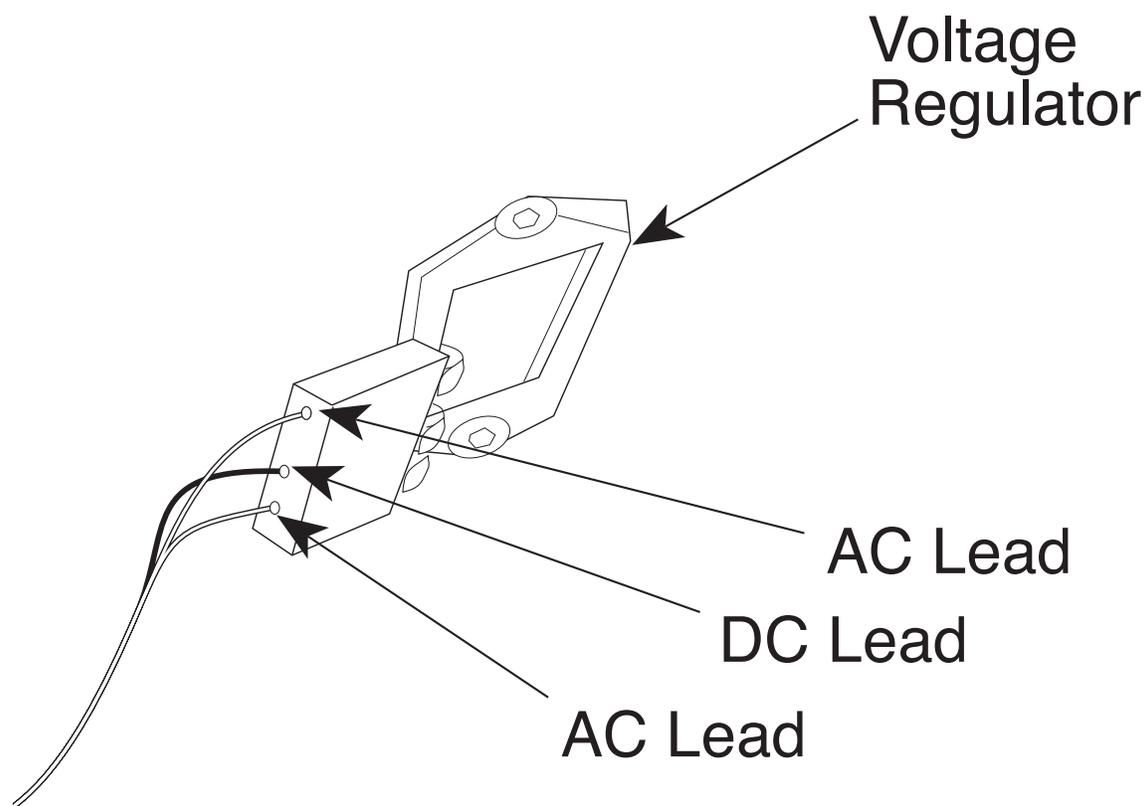
This test will determine if the Flywheel Alternator, Regulator, and associated circuitry are functioning properly.

MATERIALS NEEDED

- Volt/Ohmmeter
- Misc. Hand Tools
- Wiring Diagram

CHARGING CIRCUIT TEST (continued)

FIGURE F.1 – DOOR REMOVAL



TEST PROCEDURE

1. Start the engine and run it at high idle (3650 RPM).
2. Set the voltmeter for AC volts and place one meter probe on each of the two outside leads that attach to the engine voltage regulator. See Figure F.5 for location. Check for 42-52 VAC at the voltage regulator.
3. If the AC voltage is low or not present, the engine flywheel alternator may be faulty. This is an engine problem; consult your local engine repair facility.
4. If the voltage reading is correct, then check the output of the voltage regulator to determine the charging voltage for the battery. Run the engine at high idle (3650 RPM). Set the voltmeter for DC volts and place the Positive meter probe on the middle lead and the Negative probe on the green ground wire connected to the voltage regulator. See Figure F.5.. The meter should read 13-15 VDC.
5. If the DC voltage reading is incorrect or not present, the voltage regulator may be faulty. Replace the entire voltage regulator module.
6. If the DC voltage reading is correct, check the associated wiring and circuitry. See the **Wiring Diagram**.

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

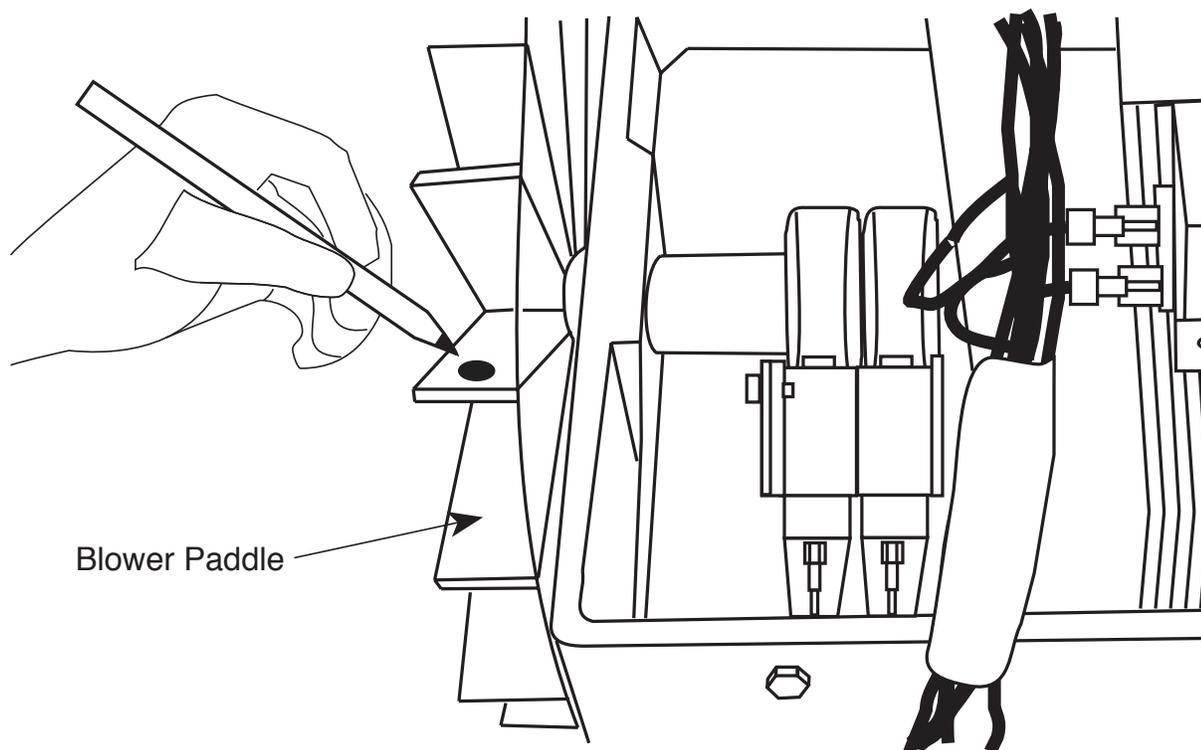
If the machine output is low, this test will determine whether the gasoline engine is operating at the correct speed (RPM) during both HIGH and LOW idle conditions. Directions for adjusting the throttle to the correct RPM are given.

MATERIALS NEEDED

Misc. Hand Tools
Strobe-tach, frequency counter, oscilloscope, or vibratach
Black or red marking pencil

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.6 – BLOWER PADDLE MARKED FOR STROBE-TACH METHOD



TEST PROCEDURE

This test can be conducted by any one of four methods.

Strobe-tach Method:

1. With the 5/16" nut driver, remove the 6 sheet metal screws from the case top.
2. Remove the rubber gasket (cover seal) from the lift bail.
3. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
4. Remove the case top, **then replace the fuel cap.**
5. Conduct this marking procedure with the gasoline engine OFF.
6. Remove the spark plug wires to prevent accidental engine kickback or starting.
7. With the black or red marking pencil, place a mark on one of the blower paddles. See Figure F.6 for location.
8. Connect the strobe-tach according the manufacturer's instructions.
9. Reconnect the spark plug wires and start the engine. Direct the strobe-tach light on the blower paddle and synchronize it to the rotating mark.
10. With the machine at HIGH IDLE the tach should read between 3700 and 3750 RPM.
With the machine at LOW IDLE the tach should read between 2150 and 2400 RPM.
11. If either of the readings is incorrect, adjust the throttle as follows:
Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See Figure F.8 for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the tach reads between 3700 and 3750 RPM.
Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLE switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.8 for location of the adjustment nut. Adjust the nut until the tach reads between 2150 and 2400 RPM.

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.7
HIGH IDLE ADJUSTMENT NUT

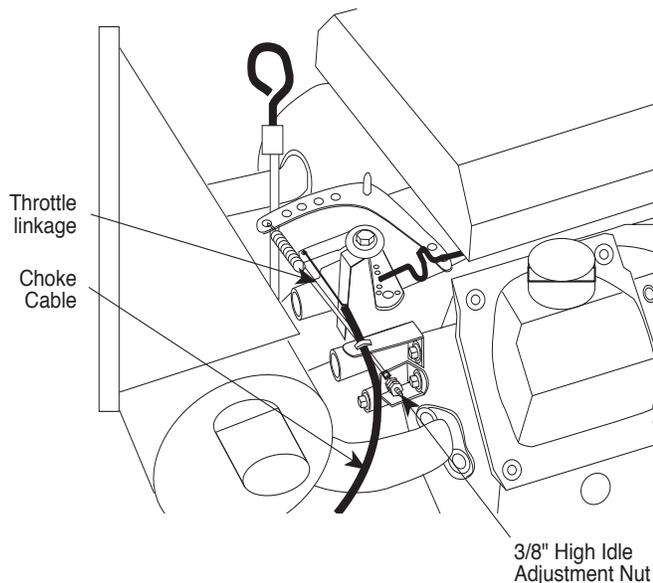
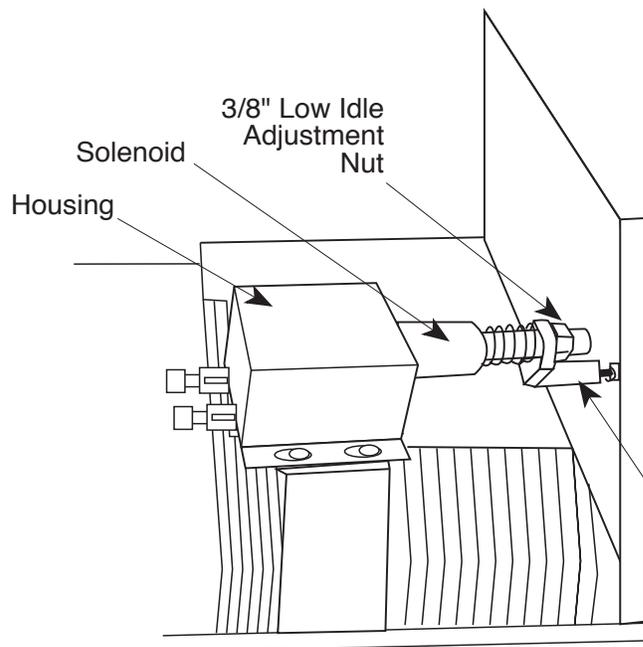


FIGURE F.8
LOW IDLE ADJUSTMENT NUT



Frequency Counter Method

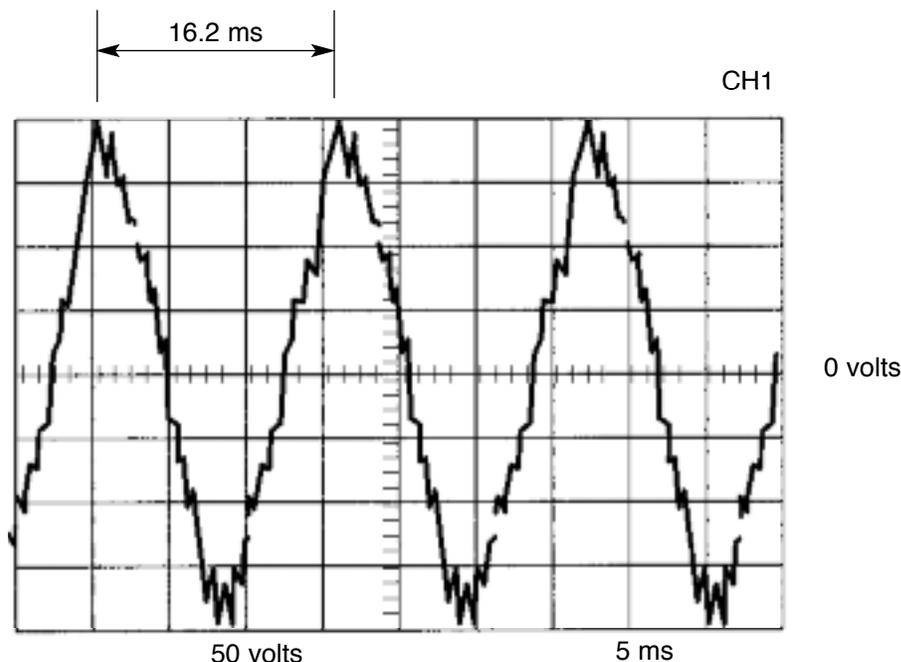
1. Plug the frequency counter into one of the 115 VAC auxiliary receptacles.
2. Start the engine and check the frequency counter. At HIGH IDLE (3700 RPM), the counter should read 60.8 to 62.5 Hz. At LOW IDLE (2200 RPM), the counter should read 38.3 to 41.6 Hz. Note that these are median measurements; hertz readings may vary slightly above or below.
3. If either of the readings is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See Figure F.7 for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the frequency reads between 60.8 and 62.5 Hz.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See Figure F.8 for location of the adjustment nut. Adjust the nut until the frequency reads between 38.3 and 41.6 Hz.

ENGINE THROTTLE ADJUSTMENT TEST (continued)

FIGURE F.9 - 115VAC SUPPLY WAVEFORM (HIGH IDLE- NO LOAD)

**Oscilloscope Method:**

1. Connect the oscilloscope to the 115 VAC receptacle, according to the manufacturer's instructions. At 3700 RPM, the waveform should exhibit a period of 16.2 milliseconds. At 2400 RPM, the waveform should exhibit a period of 25.0 milliseconds. Refer to NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115 VAC SUPPLY) HIGH IDLE – NO LOAD in this section of the manual.
2. If either waveform periods is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See **Figure F.8** for location of the adjustment nut. Adjust the speed until the period is 16.2 milliseconds.

Adjust LOW IDLE: First make sure there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See **Figure F.8** for location of the adjustment nut. Adjust the speed until the period is 27.3 milliseconds.

Vibratach Method:

1. Place the vibratach as close to the engine as possible. With the machine case top removed, the top of the air cleaner is the best location.
2. Start the engine and observe the whip handle of the vibratach. At HIGH IDLE (3700 RPM), the whip handle should exhibit maximum oscillation. At LOW IDLE (2400 RPM), the whip handle should exhibit minimum oscillation.

Note that these are median measurements; vibratach readings may vary slightly above or below:

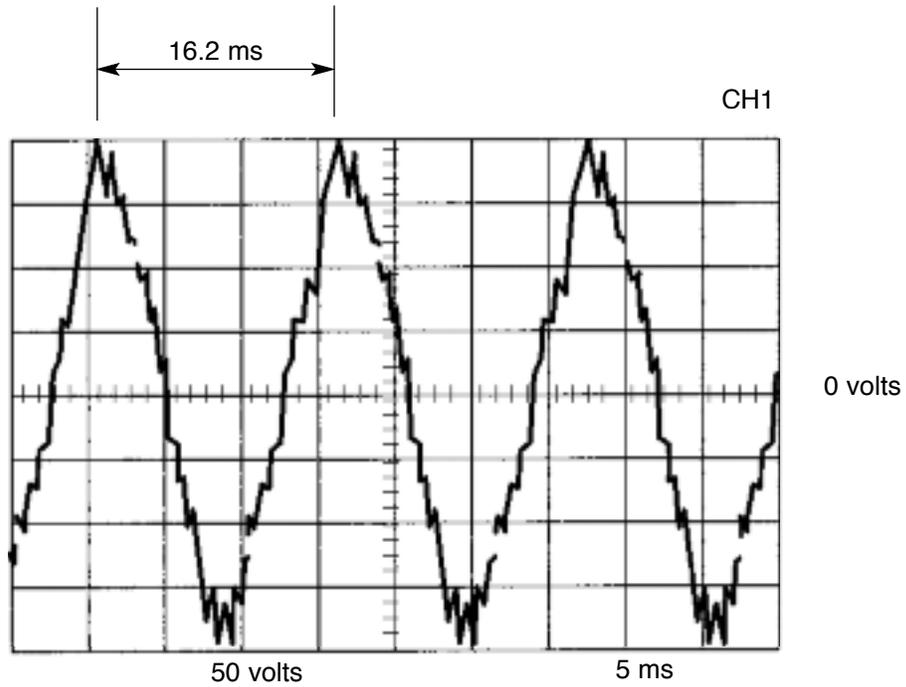
3. If either of the vibratach indications is incorrect, adjust the throttle as follows:

Adjust HIGH IDLE: Use the 3/8" wrench to turn the spring-loaded adjustment nut. See **Figure F.8** for location of the adjustment nut. Turn the nut clockwise to increase HIGH IDLE speed. Adjust the speed until the vibratach whip handle exhibits maximum oscillation at 3700 to 3750 RPM.

Adjust LOW IDLE: First make sure that there is no load on the machine. Set the IDLER switch to AUTO and wait for the engine to change to low idle speed. Use the 3/8" wrench to adjust the solenoid nut, which changes the amount of throw in the throttle lever arm. See **Figure F.8** for location of the adjustment nut. Adjust the speed until the vibratach whip handle exhibits minimum oscillation at 2150 to 2400 RPM.

NORMAL OPEN CIRCUIT VOLTAGE WAVEFORM (115 VAC SUPPLY)

HIGH IDLE – NO LOAD – OUTPUT CONTROL AT MAXIMUM



This is the typical AC 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 115 VAC receptacle.

SCOPE SETTINGS

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

Return to Section TOC

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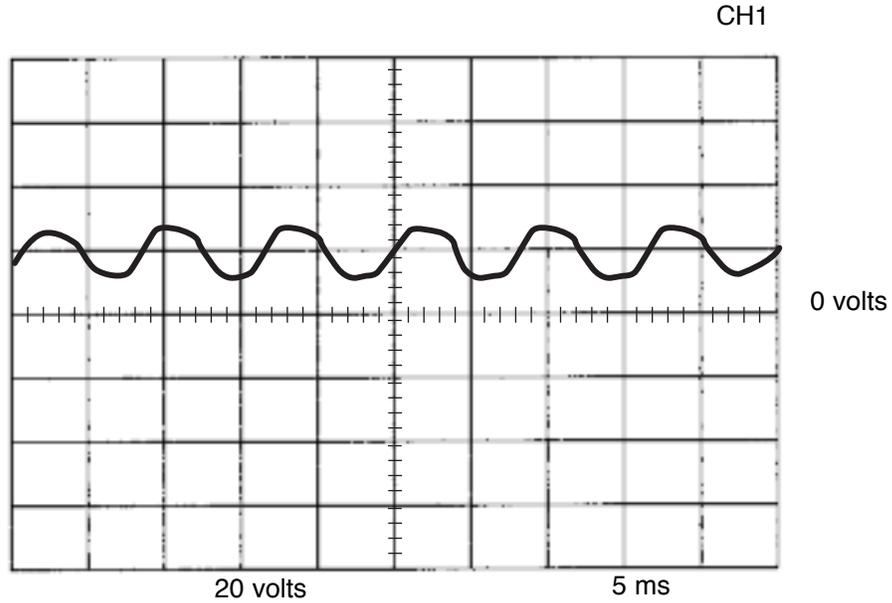
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TYPICAL DC WELD OUTPUT WAVEFORM (CV MODE) MACHINE LOADED



MACHINE LOADED TO 200 AMPS AT 20 VDC

This is the typical CV output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time. The machine was loaded with a resistance grid bank.

Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

RANGER® 3 PHASE



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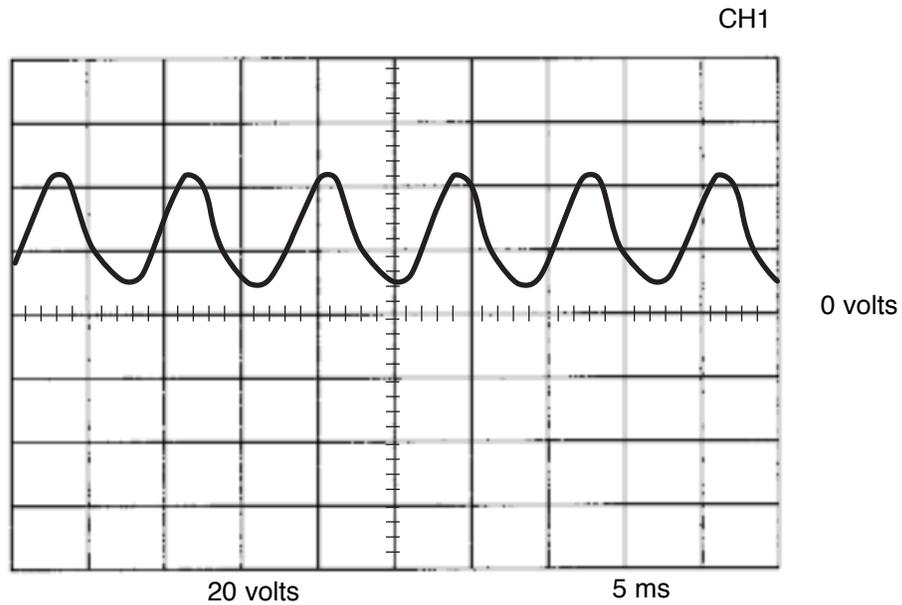
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TYPICAL DC WELD OUTPUT WAVEFORM (CC MODE) MACHINE LOADED



MACHINE LOADED TO 200 AMPS AT 26 VDC

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 5 milliseconds in time. The machine was loaded with a resistance grid bank.

Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

RANGER® 3 PHASE

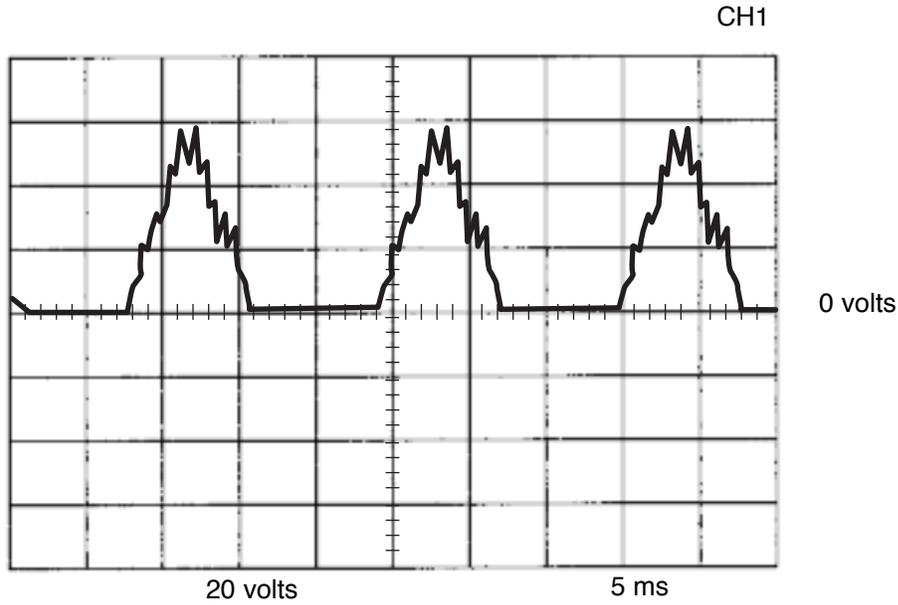


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ABNORMAL OPEN CIRCUIT WELD VOLTAGE WAVEFORM (CV MODE)

HIGH IDLE - NO LOAD - OUTPUT CONTROL AT MAXIMUM ONE OUTPUT DIODE NOT FUNCTIONING



This is NOT the typical CV output voltage waveform. One output diode is not functioning. Note the “gap” in the waveform. One output diode was disconnected to simulate an open or non-functioning output diode. Each vertical division represents 20 volts and each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div.....	20V/Div.
Horizontal Sweep.....	5 ms/Div.
Coupling.....	DC
Trigger.....	Internal

RANGER® 3 PHASE

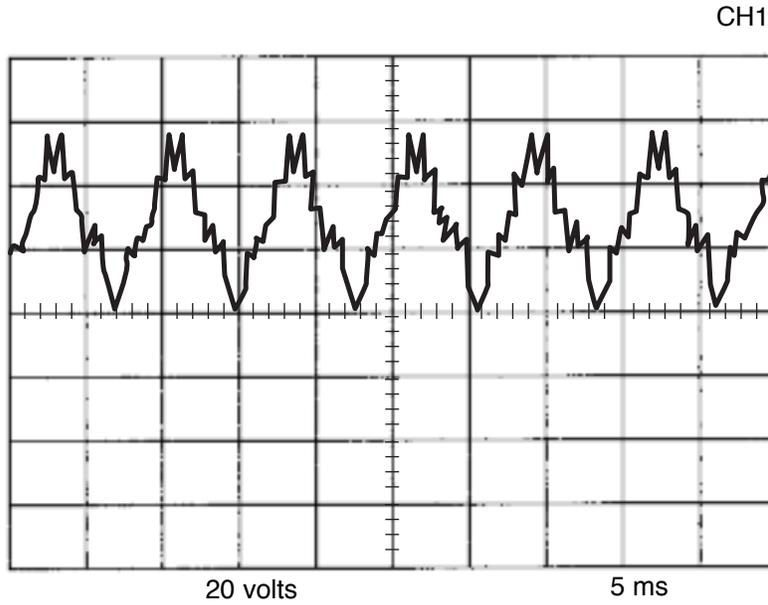


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NORMAL OPEN CIRCUIT WELD VOLTAGE WAVEFORM (CV MODE)

HIGH IDLE - NO LOAD - OUTPUT CONTROL AT MAXIMUM



This is the typical CV output voltage generated from a properly operating machine. Note that each vertical division represents 20 volts and that each horizontal division represents 5 milliseconds in time.

Note: Scope probes connected at machine 115VAC receptacle.

SCOPE SETTINGS

Volts/Div	20V/Div.
Horizontal Sweep	5 ms/Div.
Coupling	DC
Trigger	Internal

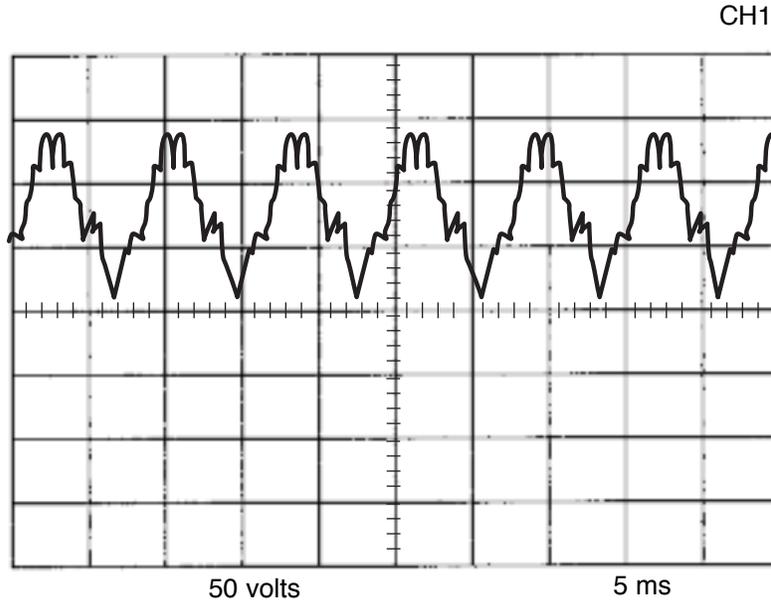
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NORMAL OPEN CIRCUIT DC WELD VOLTAGE WAVEFORM (CC MODE)
HIGH IDLE - NO LOAD - OUTPUT CONTROL AT MAXIMUM



This is the typical DC 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 115VAC receptacle.

SCOPE SETTINGS

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

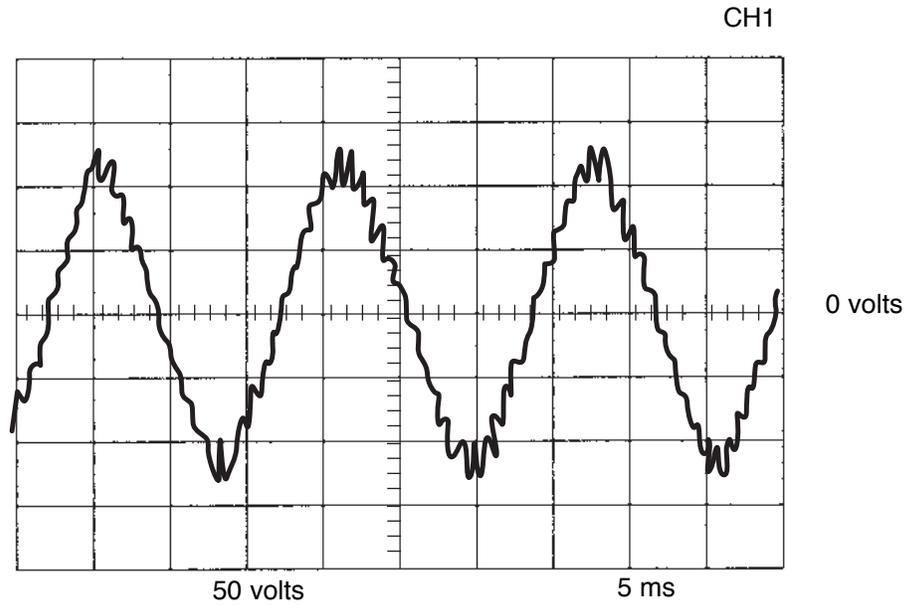
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NORMAL OPEN CIRCUIT AC WELD VOLTAGE WAVEFORM
HIGH IDLE - NO LOAD - OUTPUT CONTROL AT MAXIMUM



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 115VAC receptacle.

SCOPE SETTINGS

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

RANGER® 3 PHASE



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RANGER® 3 PHASE



BRUSH 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

The following procedure will aid the technician in accessing the generator brushes for maintenance or replacement.

MATERIALS NEEDED

Misc. Hand Tools

Return to Section TOC

Return to Master TOC

BRUSH REMOVAL AND REPLACEMENT PROCEDURE (continued)

PROCEDURE

1. Remove the spark plug wires.
2. With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, then reinstall the fuel cap.
6. With the 5/16" nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. With the needle nose pliers, gently remove the blue and the red wires from the brushes. **See Figure F.9.**
9. With a 7/16" wrench or socket, remove the brush holder assembly bracket from the stator frame.
10. With a 5/16" open end wrench, remove the two screws that secure the brush holder assembly to the bracket. Slide the brush holder assembly out of the bracket.
11. To change the brushes, use a flat head screw driver to pop off the plastic retainer on the back of the brush holder assembly.
12. Remove the old brushes and insert the new ones. One corner of the terminal clip is beveled so that the brush can go in only one way.
13. Snap the plastic retainer back onto the brush holder. The brushes may need some repositioning; wiggle them slightly to help them seat properly on the slip rings.
14. To reinstall the brush holder, depress the spring-loaded brushes into the holder and slip a suitable non-metallic, fairly stiff retainer through the slots at the top and bottom of the holder. A cable tie works well, and will hold the brushes up so that you can easily install the holder.
15. Slide the brush holder assembly back into the bracket and, with the 5/16" open end wrench, install the two screws that hold it in place.
16. With the 7/16" wrench, install the brush holder assembly bracket to the stator frame.
17. Slowly remove the non-metallic retainer from the brush holder and let the brushes snap back against the slip rings.
18. With the needle nose pliers, connect the red and the black wires to the appropriate terminals on the brushes. The red wire is inboard.
19. Check the wire connections for clearance and tightness.
20. Reinstall the case side, fuel cap, lift bail gasket, case top, and spark plug wires.

SLIP RINGS

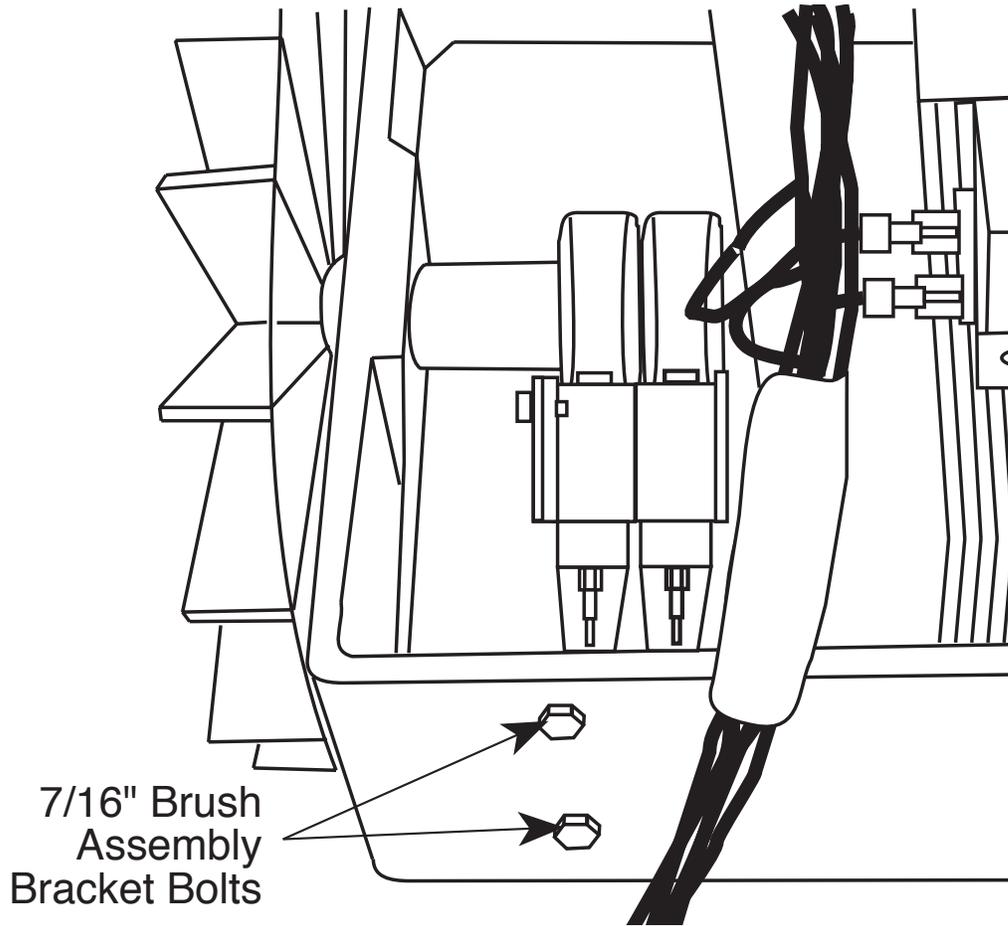
A slight amount of darkening and wear of the slip rings and brushes is normal. Brushes should be inspected when a general overhaul is necessary. If brushes are to be replaced, clean slip rings with a fine emery paper.

CAUTION

Do not attempt to polish slip rings while engine is running.

BRUSH REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.9 – BRUSH HOLDER MOUNTING BOLTS



7/16" Brush
Assembly
Bracket Bolts

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PRINTED CIRCUIT BOARD 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

The following procedure will aid the technician in removing the printed circuit board for maintenance or replacement.

MATERIALS NEEDED

Misc. Hand Tools
Wiring Diagram

Return to Section TOC

Return to Section TOC

Return to Section TOC

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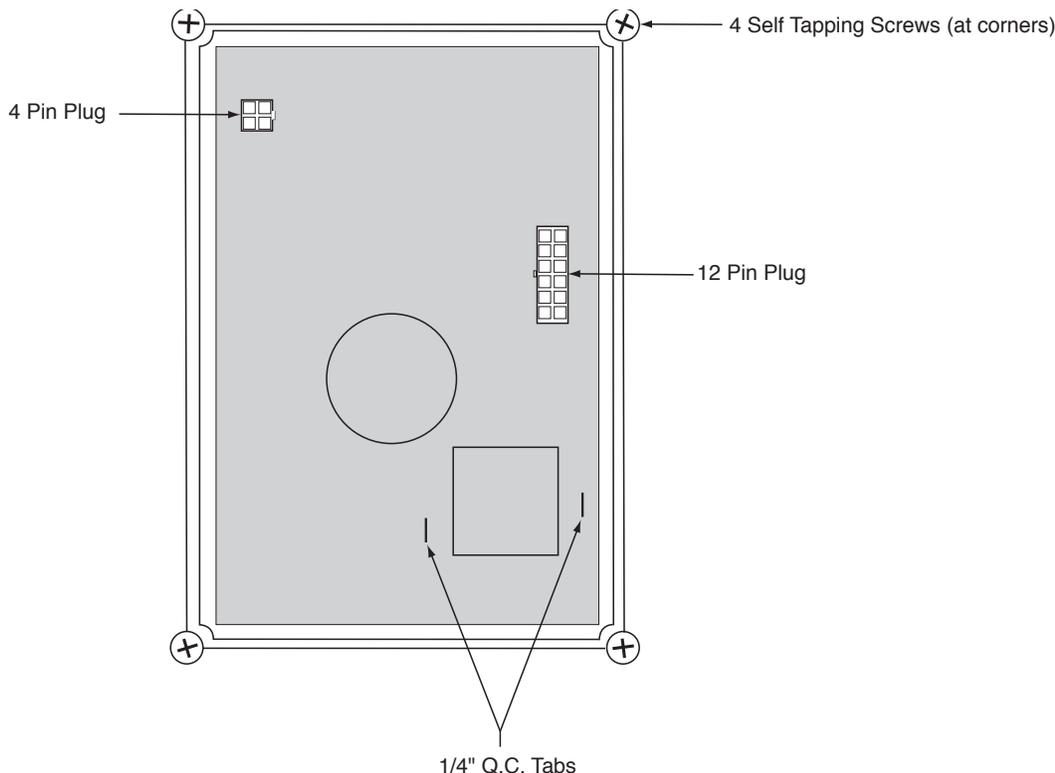
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PRINTED CIRCUIT BOARD REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.10 – DOOR REMOVAL



PROCEDURE

Before starting the following procedure, refer to the topic “PC Board Troubleshooting Procedures” at the beginning of this section.

1. Remove the engine spark plug wires.
2. With a 5/16” nut driver or socket, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. With the 5/16” nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. Remove the 12-pin and 4 pin molex plugs from the Printed circuit board.
9. Remove leads 7 and 9 from two 1/4” Q.C. connectors from the board.
10. With a 1/4” phillips head screw driver, remove four self tapping screws holding the printed circuit board to the panel.

⚠ CAUTION

Be sure to follow the recommended static-free methods for handling printed circuit boards. Failure to do so can result in permanent damage to the equipment.

11. Replace the old printed circuit board with a new one.
12. Replace 4 self tapping screws previously removed.
13. Connect the two Molex plugs and the 7 and 9 leads to P.C. Board.
14. Replace any cable ties that were cut during the removal procedure.
15. Reinstall the case side, fuel cap, lift bail gasket, case top, and spark plug wires.

RANGER® 3 PHASE



OUTPUT RECTIFIER BRIDGE 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

The following procedure will aid the technician in removing the output rectifier bridge for maintenance or replacement.

MATERIALS NEEDED

Misc. Hand Tools
Dow Corning 340
Wiring Diagram

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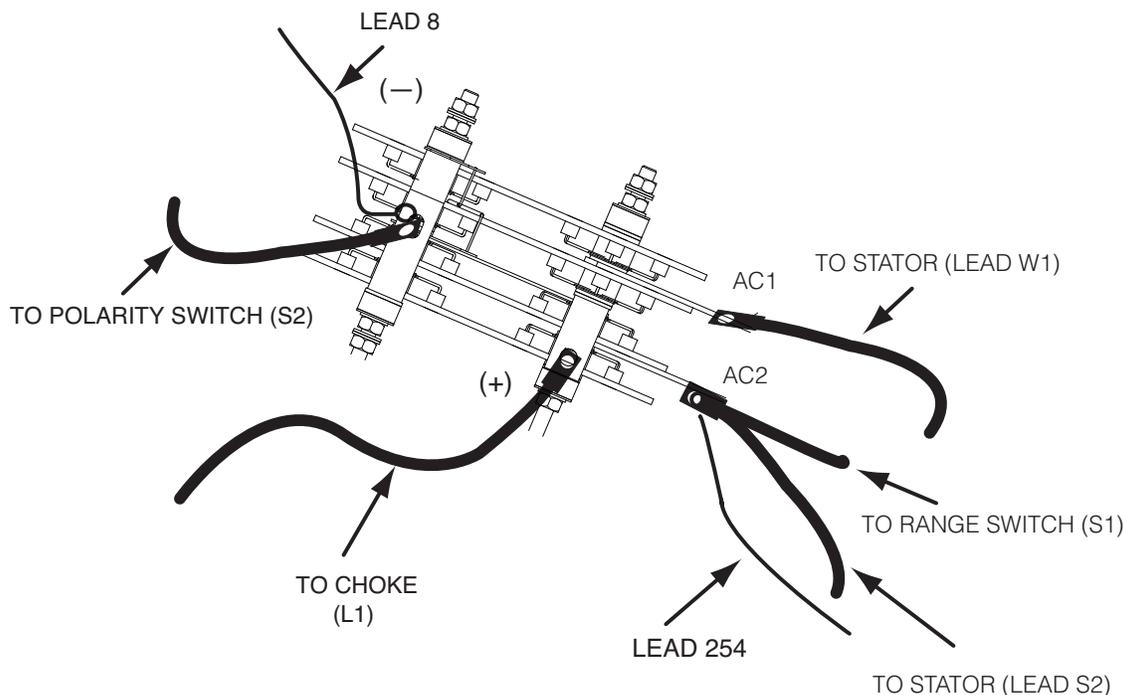
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OUTPUT RECTIFIER BRIDGE REMOVAL AND REPLACEMENT PROCEDURE (continued)

FIGURE F.11 – OUTPUT RECTIFIER



PROCEDURE

1. Remove the engine spark plug wires.
2. With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
3. Remove the rubber gasket (cover seal) from the lift bail.
4. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
5. Remove the case top, **then reinstall the fuel cap.**
6. With the 5/16" nut driver, remove the 5 screws holding the right case side.
7. Remove the right case side by lifting up and out.
8. Disconnect the leads from the four terminals of the rectifier. Note the lead placement and hardware positioning for reassembly.
9. Loosen the three (3) mounting nuts that hold the rectifier assembly to the mounting bracket.
10. Remove the rectifier assembly from the bracket.
11. Install the replacement rectifier assembly.
12. Re-connect the leads removed in Step 8.

Clean rectifier connection areas with a "very fine" abrasive to provide a shiny surface.

Use a thin film of heat sink compound (Dow Corning 340) between the leads and the rectifier connection points.

Place the leads and hardware exactly as found on original installation and tighten securely.

NOTE: The mounting nuts are metric (M8) hardware. Use the proper wrench or an adjustable wrench to avoid damaging the nuts.

Do not loosen the nuts closest to the heat sinks. They are factory set to a specific torque.

ENGINE/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

The following procedure will aid the technician in removing the engine and/or rotor for maintenance or replacement of either component.

MATERIALS NEEDED

Lincoln Electric Rotor Removal Kit (S20788)

Required to remove rotor from Engine

Misc. Hand Tools

Impact Wrench

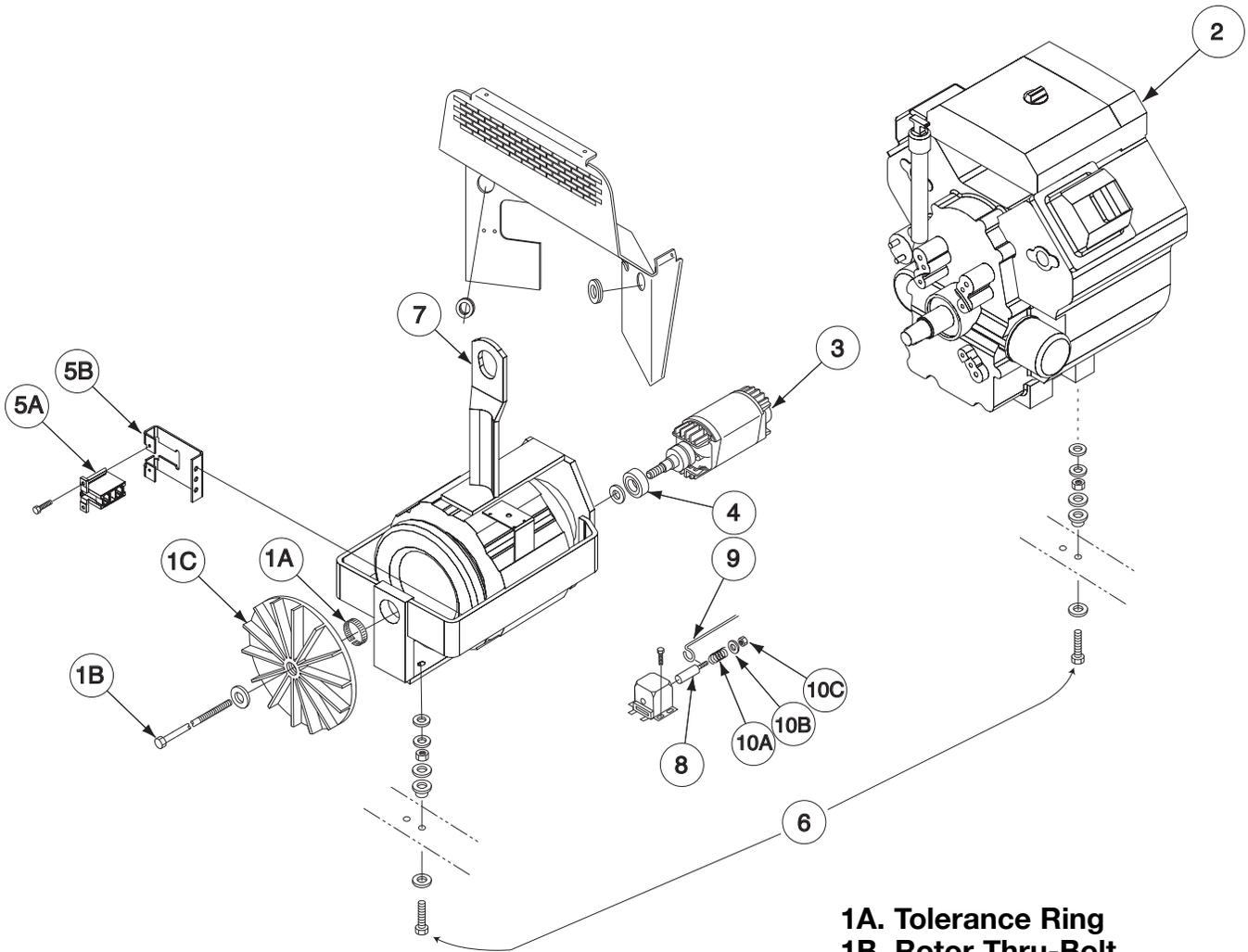
Torque Wrench (ft. lbs)

.017 Feeler Gauge

Wiring Diagram

ENGINE/ROTOR REMOVAL AND REPLACEMENT PROCEDURE (cont.)

FIGURE F.12 – ENGINE/ROTOR COMPONENT LOCATIONS



- 1A. Tolerance Ring
- 1B. Rotor Thru-Bolt
- 1C. Blower Fan
- 2. Kohler Engine
- 3. Rotor
- 4. Rotor Shaft Bearing
- 5A. Brush Bracket
- 5B. Brush Holder
- 6. Engine/Stator Mtg. Bolts
- 7. Lift Bale/Stator
- 8. Idler Plunger
- 9. Pull Wire
- 10A. Idle Spring
- 10B. Idle Washer
- 10C. Adjustment Nut

RANGER® 3 PHASE



ENGINE/ROTOR REMOVAL AND REPLACEMENT PROCEDURE (cont.)

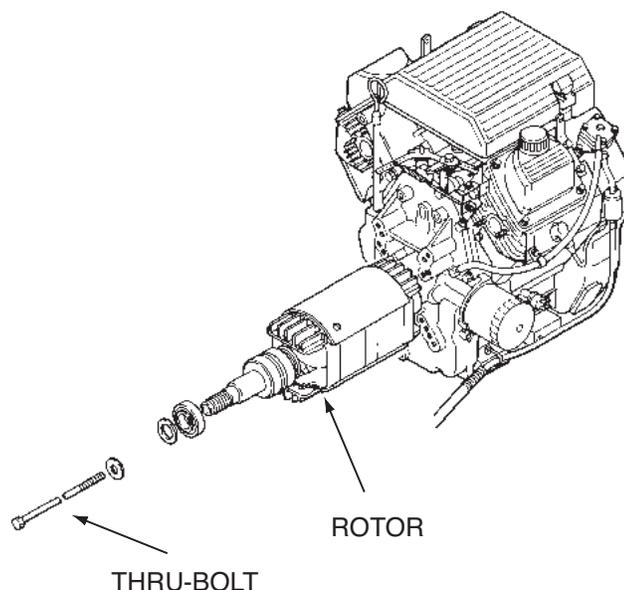
PROCEDURE

1. Refer to **Figure F.12** for component locations.
2. Remove the engine spark plug wires.
3. With a 5/16" nut driver or socket, remove the 6 sheet metal screws from the case top.
4. Remove the rubber gasket (cover seal) from the lift bail.
5. Remove the fuel cap. The rubber gasket for the fill tube will come off with the case top.
6. Remove the case top, the reinstall the fuel cap.
7. Remove the 5 screws holding the right case side and the 5 screws holding the left case side.
8. Remove the case sides by lifting up and out.
9. With a 3/8" wrench or socket, remove the battery cover.
10. Disconnect the negative battery cable, then the positive battery cable. **BE SURE TO DISCONNECT THE NEGATIVE BATTERY CABLE FIRST.** Remove the battery and set it aside.
11. With a diagonal cutters, cut the cable ties around the leads from the starter solenoid and disconnect the leads. Remove lead 209A from the harness bundle.
12. Disconnect the large black plug in front of the fuel tank spout.
13. With a 3/8" wrench, remove the cowling covers at the rear on the stator, both sides of the machine.
14. With a 3/8" wrench, remove the two screws that hold the vertical fan baffle in place. Slide the baffle forward toward the rectifier bridge heat sink assembly.
15. Hold the rotor shaft with locking pliers and unscrew the blower fan. **Turn the fan counterclockwise.** You do not need to remove the fan from the machine, but be sure it is completely unscrewed from the rotor shaft
16. With a 1/4" nut driver, disconnect the engine choke cable from the engine. Mark the location of the retainer for reassembly. The other end can remain connected.
17. Disconnect the idle linkage by unsnapping the plastic clip at the engine end of the idler rod. Snap the clip back onto the rod to avoid losing it; remove the rod for reassembly.
18. Disconnect the fuel line from the fuel tank. Plug the hose and also plug the connection at the fuel tank to prevent the escape of gasoline fumes.
19. Cut the cable ties and remove leads 224C and 210 from the oil pressure switch.
20. With a 9/16" wrench, remove the ground lead from the right engine foot mounting bolt.
21. With a 7/16" wrench, remove the brush holder bracket and leads #219 & 200A from the stator frame.
22. Support the engine with a chain hoist. Lift bails are provided on the top of the engine for this purpose.
23. With the 9/16" wrench, remove the right and left engine foot mounting bolts.
24. With the 9/16" wrench, remove the four bolts that hold the stator to the engine. There is one lock washer per bolt.
25. With the chain hoist, unweight the engine gently. Use a pry bar to carefully pry between the engine and the stator frame in order to unseat the bearing on the end of the rotor shaft. Separate the engine and rotor from the stator frame, supporting the rotor by hand to prevent damage to the rotor core.
26. Move the engine and rotor assembly to a bench. The engine is off balance with the rotor still attached; therefore, support the end of the rotor with a suitably sized block before unhooking the chain hoist.

NOTE: If the Stator needs to be replaced, it can be disconnected and removed/replaced at this point. Then move on to the **Reassembly Procedure**.

ENGINE/ROTOR REMOVAL AND REPLACEMENT PROCEDURE (cont.)

FIGURE F.13 - ENGINE AND ROTOR REMOVED FROM STATOR



ROTOR REMOVAL PROCEDURE

1. To remove the rotor, double check that the engine spark plug wires are disconnected. You will be turning the rotor during this procedure, and this could accidentally cause engine kickback.
 2. With an impact wrench, remove the rotor thru-bolt. See Figure F.13. If an impact wrench is not available, use a 5/8" box wrench or socket. Hold the rotor with one hand and shock the wrench with a mallet to loosen the thru-bolt. The thru-bolt has a star washer and lock washer, beveled to conform to the rotor shaft. Pull out the thru-bolt.
 3. Install the appropriate long thru-bolt (two are provided) supplied with Lincoln Electric Rotor Removal Kit S20788. The slot head must face out. Screw in the bolt with the slot head screw driver until the bolt bottoms out on the engine crankshaft, about 3/4".
 4. Turning it **counterclockwise**, screw in the left-hand thread rotor removal tool from the kit into the rotor shaft. Support the rotor with one hand and tighten the tool to approximately 50 ft lbs with the torque or impact wrench.
 5. If the rotor does not pop off, tighten the rotor removal tool an additional 5 ft lbs. Hold the rotor with one hand until the rotor pops off the engine crankshaft.
- HINT: If the rotor does not pop off, hit the end of the rotor removal tool with a hammer.
6. Slide the rotor the rest of the way off the crankshaft. Be careful not to lose the washer that fits between the blower fan and the rotor.

ENGINE/ROTOR REMOVAL AND REPLACEMENT PROCEDURE (cont.)

REASSEMBLY PROCEDURE

NOTE: Lincoln Electric recommends that a new bearing be installed when you replace the rotor and blower assembly.

1. Clean the tapered engine crankshaft. Slide the rotor onto the shaft.
2. Insert the rotor thru-bolt, and with the torque wrench tighten the bolt to 50 ft lbs.
3. Support the engine/rotor assembly with the chain hoist. Fit the rotor into the stator frame, being careful not to damage the rotor core against the stator. The bearing will seat into its race about half way.
4. Insert the four bolts and lock washers that hold the engine to the stator. With the 9/16" wrench, draw the bolts up evenly in order to seat the bearing properly. Tighten to 22 ft-lb. moving diagonally from bolt to bolt.
5. Check the rotor-stator air gap with the .017 feeler gauge. The measurement is taken at the blower end of the rotor before the fan is reinstalled. Turn the rotor with a pair of locking pliers as necessary so that the rotor "iron" is up to take the measurement. (The rotor has two flat sides, which are not measured for air gap.) Slide in the gauge. Then rotate the shaft 180 degrees and measure again. If the gauge does not clear, loosen the four engine/stator bolts; retighten the bolts and recheck the air gap. Repeat until the proper .017 minimum air gap is achieved.
6. Fasten the ground lead to the right engine mounting bolt and install both bolts.
7. Install the brush holder bracket back into the stator frame. See the **Brush Removal and Replacement Procedure** in this section of the manual.
8. Attach leads to the oil pressure switch refer to wiring diagram. Replace any cut cable ties.
9. Unplug the fuel tank connection and fuel hose and connect them.
10. Connect the idle linkage to the idler rod. Snap the plastic clip back into place.
11. Connect the engine choke cable at the position marked during disassembly.
12. Screw the blower fan back onto the end of the rotor shaft. Be sure the washer is in place and hand tighten the fan only.
13. Reposition the vertical fan baffle and secure it with the two screws.
14. Install the two cowling covers at the rear of the stator.
15. Connect the black plug in front of the fuel tank fill spout.
16. Connect the leads to the starter solenoid and replace any cable ties cut during disassembly.
17. Install the battery. Connect the positive battery cable, then the negative battery cable. **BE SURE TO CONNECT THE POSITIVE BATTERY CABLE FIRST.**
18. Replace the battery cover.
19. Reinstall the case side, fuel cap, lift bail gasket, and case top. Connect the spark plug wires.
20. See the **Retest after Repair Procedure**, the following topic in this section of the manual.

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	2200-2400	NA
High Idle	3700-3750	3100-3750

WELDER DC OUTPUT¹

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Maximum	65 - 72	21 - 26.5	205 - 240

WELDER AC OUTPUT¹

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Maximum	73 - 80	25 - 32	225 - 275

WELDER CV OUTPUT¹

Output Control	Range Switch	Open Circuit Volts	Load Volts	Load Amps
Maximum	Wire Feed CV	29 - 33	19 - 23	200 - 220

AUXILIARY POWER RECEPTACLE OUTPUT¹

230 Volt Receptacle			115 Volt Receptacle ²		
Open Circuit Voltage	Load Volts	Load Amps	Open Circuit Voltage	Load Volts	Load Amps
246 - 264	216 - 250	34 - 41.5	123- 132	115 - 130	17.5 - 21

FIELD AMPS AND VOLTS

Slip Ring Volts	Field Amps
32.0 - 45.0 VDC	6.5 - 7.5 VDC

¹ OUTPUT CONTROL set at MAXIMUM (position 10).

² Output values of each receptacle can vary within the range shown but must be within 2 volts of each other.

Electrical Diagrams **G-1**

 Wiring Diagram Complete Machine (M20315) G-2

 Schematic – Complete Machine (L12259) G-3

 Schematic – Control PC Board (L12197-1) G-4

*** 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.

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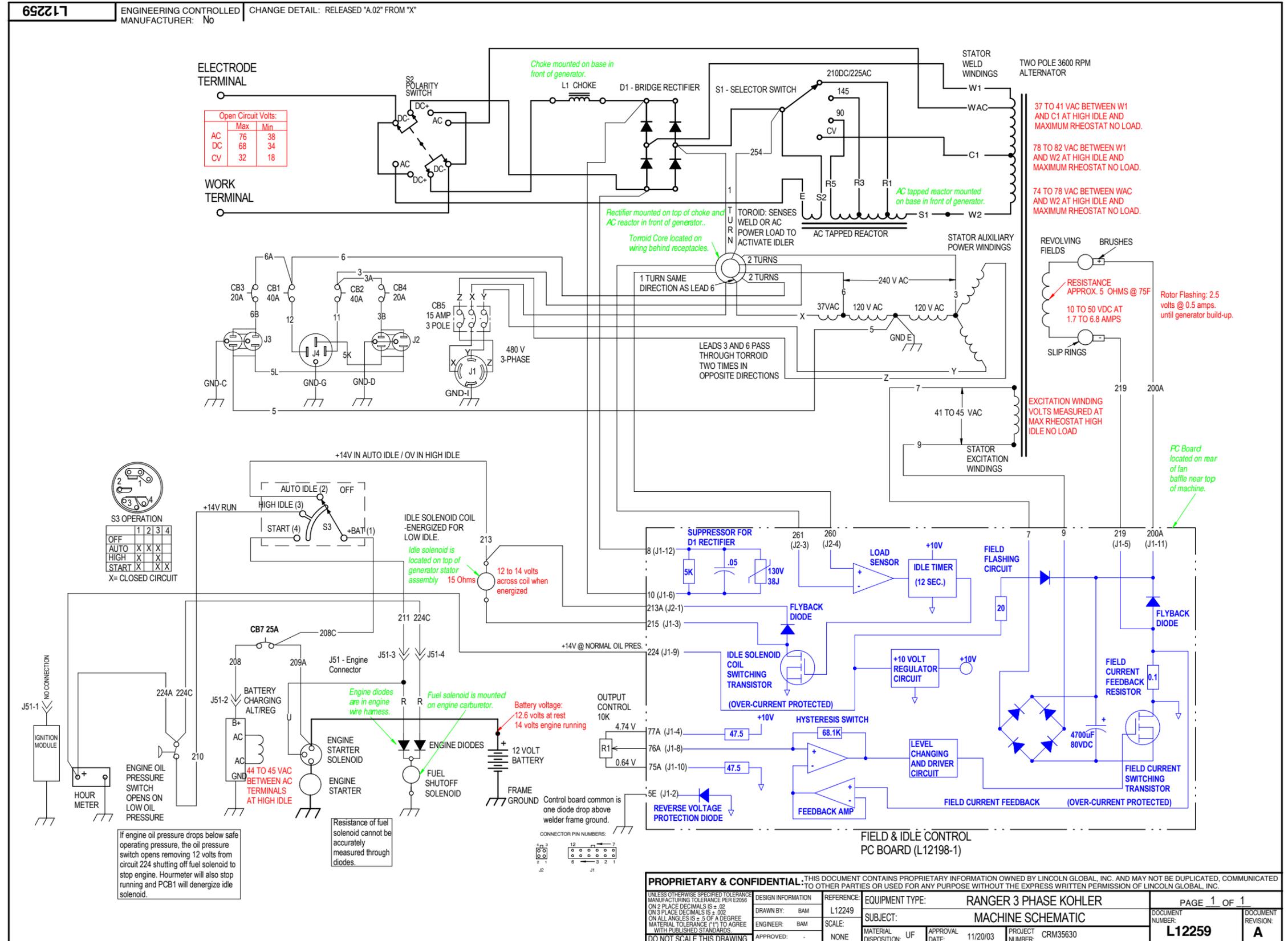
SCHEMATIC - COMPLETE MACHINE - L12259

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NOTE: This diagram is for reference only. It may not be accurate for all machines covered by this manual.

